00:00:00.000 --> 00:00:19.900
Flowe, Tammy (FAA)
I'm I'm Fortunately our guests, our keynote speaker is not here yet, so I'm gonna pause. This let's see if there's any questions right now before we get started and then hopefully our keynote is supposed to be on in 5 minutes. So hopefully we will be able to start that at that time, so is there are there any questions?

00:00:20.890 --> 00:00:23.420
Flowe, Tammy (FAA)
I'm gonna let Steve monitor the chat room here.

00:00:28.410 --> 00:00:30.860
Flowe, Tammy (FAA)
Tammy do you want to turn your?

00:00:30.820 --> 00:00:39.100
Matt Fronzak
Your camera on when you're speaking so that we can see you as should all the other speakers please. I I should thank you. And so here I am.

00:00:39.360 --> 00:00:40.170
Flowe, Tammy (FAA)
I'm I'm here.

00:00:41.580 --> 00:00:47.330
Flowe, Tammy (FAA)
Yes, thank you. Thanks Matt UM Yeah, uhm whenever the speakers are giving your presentation.

00:00:48.720 --> 00:00:53.130
Flowe, Tammy (FAA)
Please turn your camera on if you're directing your own uh.

00:00:54.350 --> 00:01:00.460
Flowe, Tammy (FAA)
Show your own slides that's fine. Just let us know what you would like this to do, if you haven't already told us thank you.

00:02:11.910 --> 00:02:13.860
Bob Sharman (Guest)
OK so I just heard from our keynote.

00:02:13.850 --> 00:02:20.050
Flowe, Tammy (FAA)
Speaker Mister Bradford, he cannot make it until 11:00 o'clock so we're going to press ahead with the agenda.

00:02:20.870 --> 00:02:25.820
Flowe, Tammy (FAA)
Uh my boss take it over and we will just fit Steven at 11:00 o'clock in 2 hours from now.

00:02:29.150 --> 00:02:31.570
Flowe, Tammy (FAA)
Yeah, hi. I'm Bob German, then I'll be moderating.

00:02:32.310 --> 00:02:55.850
Bob Sharman (Guest)
Today's session our first speaker is Matt Strahan from aviation weather center in Kansas City and he'll be giving us some information about a KO requirements. He's been working for the last for quite awhile now and so he has a good handle on what the requirements are that are coming down the line for turbulence observations and forecasting.

00:02:56.790 --> 00:02:57.680
Bob Sharman (Guest)
So Matt Go ahead.

00:03:01.300 --> 00:03:02.010
Bob Sharman (Guest)
Wow, wow.

00:03:01.910 --> 00:03:07.270
Matt Strahan (Guest)
I was hoping to reverse my speaker or my talk while the keynote speaker talk now.

00:03:08.500 --> 00:03:10.770
Matt Strahan (Guest)
OK, I think I can pull this off.

00:03:11.560 --> 00:03:12.250
Matt Strahan (Guest)
Uhm.

00:03:13.370 --> 00:03:14.990
Matt Strahan (Guest)
Let me share my screen.

00:03:28.390 --> 00:03:29.870
Matt Strahan (Guest)
Hopefully this you see.

00:03:30.980 --> 00:03:31.920
Matt Strahan (Guest)
A slide.

00:03:32.640 --> 00:03:33.160
Matt Strahan (Guest)
Now.

00:03:35.180 --> 00:03:37.420
Matt Strahan (Guest)
We got it met and you're in presentation mode, thank you.

00:03:37.820 --> 00:03:39.170
Matt Fronzak
Good deal OK.

00:03:40.690 --> 00:03:50.730
Matt Strahan (Guest)
So my name is Matt Strahan and work for the invitation weather center in Kansas City. And, yes, I've been I've been doing. The laughs work for quite awhile since 2010.

00:03:51.500 --> 00:04:06.680
Matt Strahan (Guest)
Uh so this talk will go over what's coming and what's recently happened in the last World, and I have a lot of user feedback. I'm hoping together so go ahead and type anything comments questions in the chat and I'll try to get to it.

00:04:07.730 --> 00:04:14.000
Matt Strahan (Guest)
Other things, I want to cover is just an overview of laughs. Whether the upcoming improvements to apps.

00:04:14.670 --> 00:04:20.620
Matt Strahan (Guest)
How alleviation industry can maximize those improvements and then get a a call for feedback?

00:04:21.390 --> 00:04:22.970
Matt Strahan (Guest)
Uh whereas laughs.

00:04:23.030 --> 00:04:34.330
Matt Strahan (Guest)
Come grab started when they combined all the regional centers graphs ease into 2 Afcis Website, London lasting Washington.

00:04:35.060 --> 00:04:35.750
Matt Strahan (Guest)
And.

00:04:36.500 --> 00:04:47.200
Matt Strahan (Guest)
They did global significant weather charts for quite some time and then they started doing a grid forecast for wind and temperature and RH for flight planning and then they added.

00:04:48.370 --> 00:04:53.950
Matt Strahan (Guest)
Our agent, I'm sorry I turbulence. I see and thunderstorms that became official in 2013.

00:04:54.710 --> 00:05:15.500
Matt Strahan (Guest)
And we disseminate all the above on whiffs and say this then we back each other up so the bottom left is a picture of the old style significant weather chart in the bottom right is the newest. Yfc turbulence and CB grids and their time match so if you go back and look at the seal.

00:05:16.240 --> 00:05:18.300
Matt Strahan (Guest)
You'll notice how well they do or don't do.

00:05:18.350 --> 00:05:37.420
Matt Strahan (Guest)
Do they do a nice job of resolving find turbulence features in a way that's better than the significant weather charts. One thing that's better about it is, you can get these grids and 3 hour time steps, whereas the West is the old significant weather charts only available from T plus 24.

00:05:38.290 --> 00:05:43.810
Matt Strahan (Guest)
So you get quite a bit better, temporal resolution and better spatial resolution.

00:05:45.890 --> 00:06:13.160
Matt Strahan (Guest)
What are you people doing with this one and this is an old slide but one of the best things people are doing is put into computers. The grids go in and you can determine when you want to deviate from your window optimal route to have the best efficiency and you know the blue line on this screen is the wind optimal route and the other lines or the the the possible deviations.

00:06:13.850 --> 00:06:24.420
Matt Strahan (Guest)
And Yeah, the idea is sustained wind optimal get the tail end as long as possible without having to deviate too far when you finally get to the turbulence that's an orange.

00:06:25.210 --> 00:06:39.000
Matt Strahan (Guest)
And if you pick the right spot, which is over Colorado and the middle. Graphic you only adds about 6 minutes as opposed to 16 or 18 minutes. If you do it, too early or too late.

00:06:39.850 --> 00:07:10.480
Matt Strahan (Guest)
So that's the kind of thing people are starting to do with with the WAF. Swindon hazard grids and you know if you save 1012 minutes on every flight that adds up over over time to be quite a bit of savings and there are studies out there. the UK Commission that depending on how you count those savings if it's just fuel or you start, adding in climate costs. You know you're into the trillions of dollars certainly billions of dollars.

00:07:10.540 --> 00:07:15.250
Matt Strahan (Guest)
In savings globally just running the new improvements of laughs grids.

00:07:16.610 --> 00:07:34.280
Matt Strahan (Guest)
And what are the improvements were they just updated the hazard grids to move from one and a quarter to quarter degree but more importantly, we go from a very simple potential of the hazard to a now a severity of the hazard.

00:07:35.190 --> 00:07:36.640
Matt Strahan (Guest)
For turbulence and icing.

00:07:37.540 --> 00:07:43.410
Matt Strahan (Guest)
So that was a big update that happened in late 2020 early 2021.

00:07:44.040 --> 00:07:56.860
Matt Strahan (Guest)
Next big update is 2023 when we move the wind and temp and RH to quarter degree and they had extra time steps and extra vertical levels to support trajectory based operations.

00:07:57.910 --> 00:08:15.000
Matt Strahan (Guest)
And then we also increase the resolution of the turbulence, I since the beat grids as well. And then the next big. Update is to where they want to talk about and get user feedback, which is probabilistic turbulence ICN CB.

00:08:15.910 --> 00:08:19.940
Matt Strahan (Guest)
And that happens in November 2026.

00:08:20.590 --> 00:08:27.100
Matt Strahan (Guest)
Along the way we get to update the city weather charts by automating them.

00:08:27.860 --> 00:08:34.870
Matt Strahan (Guest)
And making match the grids make them available in 3 hour time steps and.

00:08:36.580 --> 00:08:56.190
Matt Strahan (Guest)
That'll let people loop through the Sigma other charts and and then the the USA and UK charts, will match not just the grids that match each other as well because our grids match each other so it's a great improvement in inconsistency coming in November 2023.

00:08:57.980 --> 00:09:07.380
Matt Strahan (Guest)
So where does it hold stuff look like healed stuff is turbulence and air mats and sigmets and airmets for turbulence.

00:09:08.140 --> 00:09:16.750
Matt Strahan (Guest)
And you can see. Now there's maybe still some role for the forecaster and defining rural areas to focus on with turbulent segments.

00:09:17.450 --> 00:09:30.350
Matt Strahan (Guest)
But you can get on the top right or real fill, especially if you loop that and put it in motion for how the turbulence looks and evolves and I think that's going to be a real nice help for decision making.

00:09:31.410 --> 00:09:35.370
Matt Strahan (Guest)
When that when people start using that and that's available right now.

00:09:37.600 --> 00:09:40.320
Matt Strahan (Guest)
Uh so probabilistic.

00:09:41.060 --> 00:09:50.840
Matt Strahan (Guest)
Uh we're we're developing the ability to discern the probability of exceeding discrete turbulence levels made the R 0.2, 2.4.

00:09:51.540 --> 00:09:55.350
Matt Strahan (Guest)
Of course, we can't do this for every level 'cause the file size we get huge.

00:09:56.170 --> 00:10:17.260
Matt Strahan (Guest)
We can also relate 3rd most probability to Climatology and I believe that appears from the UK as talk on that coming up and we can offset provided deterministic single value forecast or we could combine deterministic and probabilistic into a risk based forecast now show you some examples of only talking about.

00:10:20.490 --> 00:10:25.600
Matt Strahan (Guest)
The thing about it, though, is it's interesting when you play with the The Witch.

00:10:26.550 --> 00:10:34.160
Matt Strahan (Guest)
Which come IVR value? Should you look at in the forecast to avoid monitor greater turbulence?

00:10:34.950 --> 00:10:42.140
Matt Strahan (Guest)
And depending on the study. You might get a different answer, but in this particular study you get a more reliable answered with the?

00:10:42.990 --> 00:10:45.320
Matt Strahan (Guest)
The kind of orangish red.

00:10:45.990 --> 00:10:47.350
Matt Strahan (Guest)
0.14.

00:10:47.400 --> 00:11:12.830
Matt Strahan (Guest)
Or, a line which is corresponds to the 0.148 dissipation rate, which gets you closest to the middle. Diagonal line for the on this reliability plot where if you were absolutely perfect on the reliability. Whenever you forecast 60% probability of something happened. If it actually happens 60% of the time and I would fault directly online.

00:11:13.460 --> 00:11:16.970
Matt Strahan (Guest)
So the red line is closest to.

00:11:17.650 --> 00:11:25.160
Matt Strahan (Guest)
That diagonal line so it's just being most reliable, which is interesting if you want to do a point.

00:11:26.030 --> 00:11:51.380
Matt Strahan (Guest)
You wanna avoid 0.22 ers or greater than maybe the thing you want to look for? Is 0.14 and that's the kind of thing that we can tease out. We had very good turbulence observations, we could help users better use. The forecast and tune. The forecast so you didn't have to do this. But right now, it seems to be the best answer, which is kind of interesting and different studies do different show a little different.

00:11:52.070 --> 00:12:03.020
Matt Strahan (Guest)
Uh answer, but I kinda wanna make the point that we need the observations to be able to to better use the forecast and to improve the forecast.

00:12:04.580 --> 00:12:20.610
Matt Strahan (Guest)
Uhm no other thing we're looking at doing committed climatology and this is at tornado forecast that the US does today and the top graphic that got 10%. Max there over Kentucky and Indiana.

00:12:21.300 --> 00:12:27.850
Matt Strahan (Guest)
And that compares to a very low probability climatologically in that area.

00:12:28.700 --> 00:12:31.330
Matt Strahan (Guest)
And, which is actually less than 1%.

00:12:32.180 --> 00:12:41.480
Matt Strahan (Guest)
So you know 10% doesn't sound very high, but if you relate that to normal. It's actually quite high so.

00:12:42.430 --> 00:12:58.400
Matt Strahan (Guest)
We can use these ratios sorry vantage with something else like turbulence, which is a very low frequency event. Lobe and normal their normal probability or run into turbulence is quite low, thankfully or probably wouldn't be fine.

00:12:59.060 --> 00:13:06.110
Matt Strahan (Guest)
So maybe we can highlight areas by comparing the probability of bird goes to the normal probability.

00:13:07.360 --> 00:13:09.880
Matt Strahan (Guest)
And what might that look like this is dumb.

00:13:11.230 --> 00:13:17.660
Matt Strahan (Guest)
Probability of precip over 25 millimeters out in the desert you get that much rain. It's a real problem.

00:13:18.310 --> 00:13:22.410
Matt Strahan (Guest)
Out there in California 's Sierra in the desert.

00:13:23.230 --> 00:13:29.750
Matt Strahan (Guest)
And the normal probability of journalists, yeah, is quite low.

00:13:30.760 --> 00:13:37.820
Matt Strahan (Guest)
So that if you compare that to the forecast probability, which is also quite low less than 1%.

00:13:38.510 --> 00:13:47.540
Matt Strahan (Guest)
Uh you actually end up to today. You have a forecast that tells you today's forecast of heavy rain is 100 times more likely than normal.

00:13:48.670 --> 00:14:02.690
Matt Strahan (Guest)
And you can do that, if you have a good climatology of heavy rain, which they do. We don't yet have that for turbulence. But I've always thought this would be a good way to highlight probabilistic turbulence forecast.

00:14:04.690 --> 00:14:06.390
Matt Strahan (Guest)
Not severe risk index.

00:14:08.640 --> 00:14:12.590
Matt Strahan (Guest)
I think peers may have talked about this as well at 1:00 point.

00:14:13.220 --> 00:14:26.630
Matt Strahan (Guest)
Uhm but this is you have a deterministic forecasts on the X axis and probabilistic or likelihood on the Y axis and you can see that if you have a high.

00:14:27.460 --> 00:14:35.400
Matt Strahan (Guest)
Uh deterministic edr and high likelihood you'd be in the top right and I would give your wrist index of 9 as compared to.

00:14:36.330 --> 00:14:48.940
Matt Strahan (Guest)
Low deterministic low low likelihood on the bottom left, which gives you at risk index of wine and you can combine those together all the numbers on this chart and produce go risk category.

00:14:50.070 --> 00:14:58.540
Matt Strahan (Guest)
And some users are are quite happy just to have that and so that's something else where we're looking at doing.

00:14:59.320 --> 00:15:04.860
Matt Strahan (Guest)
And it seems to actually get pretty good response from from users when we show it.

00:15:07.770 --> 00:15:13.820
Matt Strahan (Guest)
All of this is determined is dependent on industry, helping this out.

00:15:14.520 --> 00:15:16.770
Matt Strahan (Guest)
At the bottom left graphic.

00:15:17.570 --> 00:15:24.260
Matt Strahan (Guest)
Is what we currently get in Armatus system for observations? I believe this is?

00:15:25.560 --> 00:15:29.600
Matt Strahan (Guest)
Brandon Pettigrew did this work and I think it's just a month of observations.

00:15:30.370 --> 00:15:37.880
Matt Strahan (Guest)
And that compares to the bottom right, which is the iota turbulence aware operations, which are way more global.

00:15:38.730 --> 00:16:08.340
Matt Strahan (Guest)
Out of the blue is I believe negative turbulence in the orange and yellow rose or or moderate or greater. Maybe I have that backwards. But the point is that if we had this data, we could really give you a lot more information. We can tune this stuff into our forecasts regionally and seasonally and maybe even by time of day. Normally, the seat belt sign goes off, and climb out it.

00:16:08.400 --> 00:16:10.720
Matt Strahan (Guest)
About 2000 feet but.

00:16:11.530 --> 00:16:27.220
Matt Strahan (Guest)
If we were tuning this by time of day, we might be able to give you a better forecast that said, today over Denver. You gotta keep the leg out until 12:00, 1000 feet don't have people up in about take it a little higher because there is afternoon thermals. I've over Denver.

00:16:28.150 --> 00:16:34.500
Matt Strahan (Guest)
That's that's the kind of thing that if we had the ability to tune our forecast we might be able to do.

00:16:36.910 --> 00:16:38.280
Matt Strahan (Guest)
And this is the importance of.

00:16:38.890 --> 00:16:41.040
Matt Strahan (Guest)
Tip tuning in our forecast yeah.

00:16:41.750 --> 00:16:52.640
Matt Strahan (Guest)
Top top left or top graphic rather is missing. Its uncalibrated and it's missing. Some of the peaks and in turbulence that the bottom calibrated graphic can show.

00:16:53.930 --> 00:17:00.790
Matt Strahan (Guest)
So there seems to be quite a bit of value of tuning against observations.

00:17:02.430 --> 00:17:04.450
Matt Strahan (Guest)
This I think is my final slide.

00:17:05.580 --> 00:17:08.470
Matt Strahan (Guest)
And on unless it's kind of net.

00:17:09.240 --> 00:17:15.890
Matt Strahan (Guest)
We we start going to hourly data 1000 foot interval in the vertical and quarter green horizontal.

00:17:16.810 --> 00:17:21.920
Matt Strahan (Guest)
We start giving you risk indexes and maybe probabilities of exceeding different thresholds.

00:17:22.920 --> 00:17:27.790
Matt Strahan (Guest)
File sizes can get huge So what we've done so far is to divide the world up.

00:17:28.560 --> 00:17:36.460
Matt Strahan (Guest)
So if you don't have to take it take the whole world you can just take preset areas and I've got a graphic that shows what they look like?

00:17:37.560 --> 00:17:44.200
Matt Strahan (Guest)
So if you're not operating under to Australia. You don't take the Australia tile as as I call them.

00:17:45.550 --> 00:17:46.240
Matt Strahan (Guest)
Uhm.

00:17:46.910 --> 00:17:59.000
Matt Strahan (Guest)
And then there's another question as we move into to the swim world. You should be able to download corridors and trajectory 's of data for your particular flight.

00:17:59.990 --> 00:18:03.320
Matt Strahan (Guest)
And we kind of wonder if that's worth doing.

00:18:04.210 --> 00:18:21.020
Matt Strahan (Guest)
Users can make many corridors in trajectories themselves to increase at areas, you download the area once and printer computer and you can make all the all the trajectories that you want. But you might not want to invest in making your own trajectory 's and corridors.

00:18:22.570 --> 00:18:23.840
Matt Strahan (Guest)
But I kind of wonder.

00:18:24.570 --> 00:18:31.380
Matt Strahan (Guest)
If you can use a trajectory, maybe you can make your own and software is using it. Maybe it can actually make them.

00:18:32.000 --> 00:18:33.170
Matt Strahan (Guest)
And I say that because.

00:18:33.920 --> 00:18:48.050
Matt Strahan (Guest)
You might prefer to do it yourself to be reliant on on us to do it for you and if you're gonna do it yourself. It's very expensive for us to invest in and do it for you so maybe I'd like I'd kind of like to know if it's worth.

00:18:48.670 --> 00:18:55.740
Matt Strahan (Guest)
I spend the money to do develop to develop and maintain the capability of delivering it kept delivering those.

00:18:57.140 --> 00:19:03.390
Matt Strahan (Guest)
And that was the last slide, so I can just throw it open to comments and questions.

00:19:04.680 --> 00:19:06.720
Matt Strahan (Guest)
And I'll start current screening list.

00:19:08.380 --> 00:19:11.090
Matt Strahan (Guest)
Somebody has something like that thanks man.

00:19:11.400 --> 00:19:13.050
Matt Strahan (Guest)
Steve everyone here I'm gonna monitor.

00:19:12.900 --> 00:19:27.080
Steve Abelman
Or the chat as Tim pointed out earlier so one question that came in from Randy Bass. Matt are you able to translate those time savings due to better laughs. Wind data into monetary and or emission savings for airlines.

00:19:29.000 --> 00:19:30.180
Steve Abelman
There was a time we did.

00:19:30.040 --> 00:19:33.020
Matt Strahan (Guest)
Did that pretty pretty simply we just?

00:19:34.320 --> 00:19:50.290
Matt Strahan (Guest)
Looked at how much fuel per member that average commercial debt burns and what fuel costs was at the time and then you kind of can add that app overriding flights. You think you're going to have. But yes that's that's what we did. And it was a significant number of I don't have it.

00:19:51.650 --> 00:19:52.560
Matt Strahan (Guest)
I don't have it handy.

00:19:54.460 --> 00:19:56.590
Matt Strahan (Guest)
K. Thank you, UM.

00:19:56.760 --> 00:20:08.570
Steve Abelman
Bob Babb Jen Matt do you think the future in the future that users can supply their own Geo subsets versus using the preset regions thinking about the grid filters that the end of NWS provides.

00:20:10.020 --> 00:20:11.870
Steve Abelman
Oh, that's a good question.

00:20:12.300 --> 00:20:15.670
Matt Strahan (Guest)
Yeah, there's like nomads, the NWSS where you can.

00:20:16.720 --> 00:20:20.490
Matt Strahan (Guest)
Create your own Polygon and and get your own aerial subset.

00:20:21.120 --> 00:20:25.930
Matt Strahan (Guest)
And that is something we're also we have the capability to do it.

00:20:27.030 --> 00:20:33.440
Matt Strahan (Guest)
That may be coming in next in the inner update their lives. I know the UK is planning to do that for status.

00:20:37.400 --> 00:20:39.480
Matt Strahan (Guest)
OK, I don't see any other.

00:20:39.580 --> 00:20:41.000
Steve Abelman
Questions at this time.

00:20:42.040 --> 00:20:42.400
Steve Abelman
Ah.

00:20:44.530 --> 00:20:46.780
Steve Abelman
Uh yeah, I actually.

00:20:46.660 --> 00:20:55.740
Bob Sharman (Guest)
Man, I have one question in previous workshops. We've had specially pilots out there that say they don't want probability.

00:20:56.410 --> 00:21:12.220
Bob Sharman (Guest)
They want deterministic forecast period. Can I go there or not, and I'm just wondering if you're seeing a shift in the user attitude to accept probabilistic forecasts more than they have been in the past.

00:21:13.920 --> 00:21:15.020
Bob Sharman (Guest)
I think the pilots.

00:21:15.010 --> 00:21:18.320
Matt Strahan (Guest)
Or are there some plastic?

00:21:19.330 --> 00:21:25.200
Matt Strahan (Guest)
Maybe I don't like that word but that's that uses a very simplistic use can we go there or not.

00:21:26.130 --> 00:21:30.940
Matt Strahan (Guest)
But when your flight planning and then you want to do a cost benefit analysis.

00:21:31.850 --> 00:21:34.520
Matt Strahan (Guest)
Yeah, if I if I take this deviation.

00:21:35.510 --> 00:21:49.280
Matt Strahan (Guest)
He was gonna cost me some money versus how much it hit how much it costs me to to go in you know hit the hazard and how many times should I deviate? How many times, I hit the hazard and that's what probabilistic helps you do.

00:21:49.950 --> 00:22:03.280
Matt Strahan (Guest)
And I think that's something the airlines want you hear that from my out if they're they're driving the probabilistic requirement, not the pilots. They want to be able to do that cost benefit analysis of avoiding turbulence.

00:22:05.020 --> 00:22:06.480
Matt Strahan (Guest)
So it sounds like if.

00:22:07.350 --> 00:22:10.730
Bob Sharman (Guest)
They had access to this risk analysis that you showed.

00:22:11.570 --> 00:22:15.460
Bob Sharman (Guest)
Uh that would satisfy them right because it gives them one number.

00:22:18.260 --> 00:22:18.850
Bob Sharman (Guest)
Well.

00:22:19.350 --> 00:22:19.820
Matt Strahan (Guest)
Alright.

00:22:21.430 --> 00:22:24.250
Matt Strahan (Guest)
I think that it does that.

00:22:24.300 --> 00:22:24.520
Matt Strahan (Guest)
Like.

00:22:25.720 --> 00:22:30.680
Matt Strahan (Guest)
I think they will make their own risk analysis because they have different mission types.

00:22:31.460 --> 00:22:43.910
Matt Strahan (Guest)
You know different airlines are very careful about turbulence more careful than others are about avoiding it box haulers. You know, we know they don't have they have a much higher threshold?

00:22:44.530 --> 00:22:46.500
Matt Strahan (Guest)
Not turbulence so.

00:22:47.680 --> 00:22:49.230
Matt Strahan (Guest)
I think you want to make your own.

00:22:49.960 --> 00:22:51.070
Matt Strahan (Guest)
Risk index.

00:22:51.830 --> 00:22:53.450
Matt Strahan (Guest)
So I think you want the full.

00:22:54.270 --> 00:22:56.820
Matt Strahan (Guest)
Full probabilities and fold terministic.

00:22:57.580 --> 00:23:04.820
Matt Strahan (Guest)
But maybe there's a market for this risk index as well for people who don't know they just want a simple easy answer.

00:23:07.700 --> 00:23:08.670
Matt Strahan (Guest)
OK, thank you.

00:23:11.950 --> 00:23:13.420
Matt Strahan (Guest)
So I guess we'll move on to the.

00:23:13.300 --> 00:23:20.880
Bob Sharman (Guest)
The next speaker who is Dean Locket from the wmo he's the scientific officer there and.

00:23:22.040 --> 00:23:27.890
Bob Sharman (Guest)
They had a little while ago talked about data sharing and I guess a Dean will talk about data sharing as well.

00:23:28.480 --> 00:23:28.850
Bob Sharman (Guest)
Eat.

00:23:31.870 --> 00:23:33.300
Bob Sharman (Guest)
Yes, thanks Bob,

00:23:33.560 --> 00:23:56.630
Dean Lockett
I'm hoping you can hear me OK. I'll share my screen in a in a moment but just wanted to say thank you for having me today. I'm I'm Dean Locket. I work for the world. Meteorological organization and I coordinate the aircraft based observations program. But today, I'm talking on a fairly high level topic data policy more generally.

00:23:56.690 --> 00:24:03.250
Dean Lockett
Yeah, at at the at the global level, so let me just share my screen.

00:24:09.350 --> 00:24:12.480
Dean Lockett
So hopefully now you're you're you're seeing my screen.

00:24:12.530 --> 00:24:15.760
Dean Lockett
In my content today is dumb.

00:24:16.770 --> 00:24:27.960
Dean Lockett
It's about the need for the international sharing and of of the earth system monitoring data. So it's it's quite a broad data set we're talking about.

00:24:29.180 --> 00:24:36.340
Dean Lockett
Uh and as you might be aware. I'm sure people have heard of W Moe's Resolution 40, which is the.

00:24:36.390 --> 00:25:04.940
Dean Lockett
The UM is the resolution W my put in place to support its data sharing policy among its members, particularly in support of whether for weather monitoring but you'll see that it's become a little broader under this new policy and then I'll I'll just finish by talking a little bit about aircraft based observations and the likely impact that this policy might have.

00:25:07.000 --> 00:25:24.070
Dean Lockett
So one of course, uh when one of the the the drivers for for the the updating and the review of this data policy is is of course, climate change. There's a number of other factors. Of course, but we'd put this up, up there.

00:25:24.120 --> 00:25:27.860
Dean Lockett
Yeah, and you know as one of the the key drivers.

00:25:27.910 --> 00:25:51.280
Dean Lockett
So we're seeing an increase in the frequency of extreme weather events, and of course. This is bringing about concerns about populations that are are living in high risk areas and the impacts on things like food security and migration and of course. We had the the Paris agreement. I think we all know that.

00:25:51.340 --> 00:26:07.920
Dean Lockett
Dumb you know, we're headed for for climate change pretty much no matter what we do. From here and so under the Paris agreement. There's been a move towards adaptation and mitigation as well as trying to of course, you know.

00:26:08.560 --> 00:26:17.110
Dean Lockett
To bring about the required change to to put A to put a stop or or to reduce climate change more generally in under global warming.

00:26:19.880 --> 00:26:24.520
Dean Lockett
So you know if we want to be able to undertake this.

00:26:24.590 --> 00:26:34.570
Dean Lockett
And this role of you know being able to provide information in support of these these data or risk reduction.

00:26:35.320 --> 00:27:04.330
Dean Lockett
Uhm elements the managing mitigation and risk associated with climate change, then we need to support the whole of of this value change to be able to sort this value chain to be able to get us to the point where we can make effective decisions and take action relating to the impacts of climate change and as it does the with whether it all starts with observations of course, so.

00:27:05.130 --> 00:27:15.380
Dean Lockett
You know, we, we have 2 of course, look at the requirements for observations and ensure these observations are made and then in supporting.

00:27:16.560 --> 00:27:45.400
Dean Lockett
Uh whether to start with, but of course, climate that, there's no boundaries when it can comes to comes to a prediction of weather and climate. So we need to have international exchange of observations and that has become even more critical. More recently as with the advent of numerical weather prediction and particularly global numeric numerical weather prediction, which really forms the basis of for all.

00:27:46.050 --> 00:27:47.400
Dean Lockett
You know all of our.

00:27:48.470 --> 00:28:07.860
Dean Lockett
Forecast warnings and products that support not only weather forecasting that now support climate services and it's that process that that whole value chain that we're we're looking to drive to be able to provide the informations that that's necessary at at the end of this chain.

00:28:11.720 --> 00:28:12.350
Dean Lockett
Sorry.

00:28:13.770 --> 00:28:37.640
Dean Lockett
In terms of developing this data policy of course, we know that there's a bit of a well. There's a major political approach that has to be taken and and we have to understand to be able to convince members to to undertake this exchange of data what the requirements really are, for for these observations, maybe wants to be.

00:28:38.280 --> 00:29:09.720
Dean Lockett
Uhm you know spending resources and and and making observations when the requirements are there

so we need to go through a process of of finding out the requirements for observations and then there's a process of outreach and advocacy. We're calling it here. So we need to convince members that these observations are necessary. The resources need to be applied and then that they will commit to sharing them and that that is what does?

00:29:10.080 --> 00:29:18.270
Dean Lockett
WS dollar policy is it's a commitment of UB W as member states to to undertake this. This data sharing.

00:29:19.680 --> 00:29:35.120
Dean Lockett
And that that gets put into effect in our regulatory material. If you're familiar with wmo OK. Of course, we, we had our regulations, which which basically define what our members will do and how they will support this data policy.

00:29:36.830 --> 00:29:54.300
Dean Lockett
And then the 5th ingredient that we talk about here is really associated with cat capacity development. So we can have the the regulations and the agreement to to to make observations and and provide them internationally. But the end of at the end of the day.

00:29:54.890 --> 00:30:05.230
Dean Lockett
Uh and members and particularly those you know, those most disadvantaged and the ability to be able to do this to be able to make it a truly global.

00:30:05.810 --> 00:30:06.430
Dean Lockett
Uhm.

00:30:06.480 --> 00:30:08.010
Dean Lockett
In a meeting.

00:30:08.490 --> 00:30:29.000
Dean Lockett
Have a global observing system that they need support in terms of capacity development and and of course, finances so WMO is supporting and promoting this. This new item called the systematic observation finance facility. This off as we call it, which which we hope will drive.

00:30:29.050 --> 00:30:36.900
Dean Lockett
Uhm the availability of resources to support the expansion of these observing systems and observing programs.

00:30:39.150 --> 00:31:07.920
Dean Lockett
So Umm there's several key planks of course in bringing about this vision that W has we actually have

this WMO data policy in place, but of course, there's there's other things that need to be done to assure that we, we build this observing system that can support the the the requirements for both weather and climate so most recently WMO membership has.

00:31:08.190 --> 00:31:24.500
Dean Lockett
The approved what's known as the the Geo bond. The global basic observing network, which the software support and that is the observing system that basically supports our global NWP systems.

00:31:25.730 --> 00:31:38.010
Dean Lockett
And then the second item that the second major development. The wmo is undertaking currently is the building of a new information system that can support the?

00:31:38.060 --> 00:31:55.340
Dean Lockett
Uhm the complete communications. That's required to to make observations of available. So we call this. WMO Information System 2 and of course, that will be very different to our global telecommunications system, which was a basically a broadcast system you can understand with.

00:31:55.390 --> 00:32:04.780
Dean Lockett
Done with the invent of bigger volumes of data. We need a we need a different communication system that can cope with this these volumes of data.

00:32:06.130 --> 00:32:22.760
Dean Lockett
And then of course, they help our global numerical weather prediction system that is at adapting as well. To to this earth system approach. The coupling of the different domains to truly give us a acclimate weather prediction system.

00:32:23.840 --> 00:32:27.730
Dean Lockett
And then finally at the bottom there, we have this capacity building.

00:32:27.790 --> 00:32:43.050
Dean Lockett
The component that W math course, it's a a core component of what WMR does so one of the examples of that is the climate risk in early early warning system cruise that is being developed by W.

00:32:45.070 --> 00:33:11.480
Dean Lockett
So this new WW move data policy. These are the major aspects so the aim here is to to be able to cover or to provide a dollar policy that the cuts across all the various disciplines and domains and and goes beyond just just weather forecasting weather prediction. You were talking about a a whole of earth monitoring system and and prediction system as well.

00:33:12.780 --> 00:33:43.490
Dean Lockett
The the policy itself has has changed resolution 40 used to be a a standalone policy. That members signed up to its been developed now so that the the resolution is incorporated into our our technical regulations so that so that it can be easily updated by just updating the relevant component and and changing the requirements, there Whilst, the policy itself.

00:33:43.540 --> 00:33:44.540
Dean Lockett
Remains intact.

00:33:46.210 --> 00:33:46.760
Dean Lockett
Uhm.

00:33:47.630 --> 00:34:17.420
Dean Lockett
One thing that certainly changed his definitions had become a little more precise are. I think our old policy wasn't always well understood and people had different interpretations of what free and unrestricted meant so that's been better defined and importantly here and I think it's one of the the major components of this update is that it's not just NMHS that are contributing to this data policy W members our country States and so.

00:34:17.980 --> 00:34:34.270
Dean Lockett
This means that the under this policy it. It goes beyond the Met Services. So we expect data data sharing under this policy from a range of different agencies and from from a number of different domains.

00:34:35.480 --> 00:34:45.750
Dean Lockett
We still have our basically our mandatory and non mandatory aspects of this policy. We call them the shelves and the Shoulds.

00:34:46.340 --> 00:34:53.500
Dean Lockett
And they still remain in place so we have certain data that are that are basically mandatory.

00:34:53.550 --> 00:35:03.940
Dean Lockett
Uh we highly critical to the forecast system and then we have the others that are you know, we, we, we, we would prefer that members.

00:35:04.400 --> 00:35:06.810
Dean Lockett
Uh we share these daughter if they can.

00:35:09.640 --> 00:35:20.440
Dean Lockett

OK went through it goes through the policy, but if you you can see at the end, there and and if you know W mode at all well. You'll understand that usually it takes a long time to do anything and.

00:35:21.080 --> 00:35:49.710
Dean Lockett
We we W may really started looking at this revision of this policy that date dates back to 95 after it's or during its Congress in 2019 and the go ahead was given to do that and and so there's been a a range of activities, including conferences, and various pathways through our constituent bodies to arrive at the point where in October. The 2021 this. This new data policy has actually been approved.

00:35:52.820 --> 00:36:22.700
Dean Lockett
So this is a very quick comparison of of the Old Resolution 40 dated 1995 with what we have now so as I mentioned it was aimed at provision of weather data only previously under Resolution 40. The aim here is to to be able to cover the monitoring of the The The whole of the earth system so cuts across weather climate and Hydrology. We still have these 2 main categories of data.

00:36:22.920 --> 00:36:27.330
Dean Lockett
We used to turn them essentially and additional now their core and recommended.

00:36:28.250 --> 00:36:34.260
Dean Lockett
Uhm previously as as I mentioned this policy was a standalone item where.

00:36:34.830 --> 00:36:52.450
Dean Lockett
The daughter required to be shared or agreed to be shared was was formulated in an annex to the resolution. Now it's integrated into the to the wider technical regulations of of wmo so as mentioned, it's easily updated.

00:36:52.500 --> 00:36:55.150
Dean Lockett
And as necessary.

00:36:56.510 --> 00:37:26.740
Dean Lockett
There's some notion of free and unrestricted has been strengthened by I think really WM of course, promotes the the free and unrestricted sharing of of of data and support of its core activities and so basically it it. It means what you would expect that there's data. That's that is expected to be shared under this policy is provided free of charge and there are essentially no restrictions on it.

00:37:26.810 --> 00:37:27.580
Dean Lockett
And it's used.

00:37:29.800 --> 00:37:50.960
Dean Lockett

And yeah, and as previously mentioned basically resolution 40 was a was an agreement between Sean W members, but basically we understood that to mean meteorological agencies and services but now this truly is a you know a global data policy that cuts across all the various.

00:37:51.010 --> 00:37:56.260
Dean Lockett
Some sectors, which includes private in academia as well.

00:37:58.750 --> 00:38:14.300
Dean Lockett
So what does this brain under unrestricted mean by definition definition here it means available for use reuse and sharing without charge and with no conditions on use so that's basically it, it, it, it's publicly available.

00:38:15.830 --> 00:38:21.900
Dean Lockett
And there's a range of reasons why this is important, particularly when we moved to this whole of earth system monitoring.

00:38:22.490 --> 00:38:28.490
Dean Lockett
Uhm unrestricted to to access to a range of data sources will be will be critical.

00:38:29.260 --> 00:38:43.750
Dean Lockett
Uh but it's been demonstrated that you know the maximum benefit to all members is provided when these data are exchanged in these ways as soon as we start to introduce restrictions there becomes confusion and of course.

00:38:43.800 --> 00:38:52.720
Dean Lockett
Uh you're not everyone is able to use the data that provides the best outcome in terms of the products and services that are provided.

00:38:54.030 --> 00:38:55.410
Dean Lockett
And Additionally.

00:38:56.560 --> 00:39:17.820
Dean Lockett
As well as data being shared what's happening or expected to happen is that there will be the the emergence of the the sharing of global NWP output as a as a as a shared item and that's clearly a a. A requirement because it does underpin so many aspects of the of the.

00:39:17.870 --> 00:39:25.920
Dean Lockett
The you know this forecast in monitoring system and and the resulting products and services that come out of it.

00:39:27.520 --> 00:39:52.130
Dean Lockett
And then we had the other sectors and of course to to develop a policy that cuts across the the research operational communities and then across to the private sectors it to to have to have the range of agreements that that underpin a data sharing arrangement really is, is not able to be contemplated really so free and under restricted basically makes the most sense.

00:39:54.790 --> 00:40:04.500
Dean Lockett
So then we come to of course, the all important benefits and and what does WMA see coming out of this so of course, the policy means that?

00:40:05.590 --> 00:40:32.090
Dean Lockett
We moved to sharing the the the system. The data that's required for the the earth system monitoring and prediction that we, we, we see becoming a part of of wmo activities and and and into the climate domain and of course, with this we'll we'll see a dramatic increase in the essential data. That's required to support these these systems being available.

00:40:32.630 --> 00:40:40.150
Dean Lockett
Uhm and that in turn will lead to significantly improved access to 2.

00:40:40.540 --> 00:40:45.400
Dean Lockett
Uh to to better products and predictions from our applications.

00:40:46.280 --> 00:40:55.300
Dean Lockett
And in particular, this will be available to developing countries. Both the data and and and the products from NWP that's a key component of this policy.

00:40:56.250 --> 00:41:19.500
Dean Lockett
Uhm a broader application at this data policy. Of course means that incorporates not only the government public sector. But that can support the involvement of the private sector and this is certainly in in the interests of you know of a number of areas, including the providers themselves.

00:41:20.850 --> 00:41:31.080
Dean Lockett
This policy as I mentioned will be future proof. So changes will be able to be easily implemented it can be expanded and extended in the future as as required.

00:41:31.680 --> 00:41:41.780
Dean Lockett
The important thing is that the benefit is that they met services maintain this role as the key providers of critical weather and climate information.

00:41:45.320 --> 00:41:52.210
Dean Lockett
So I I mentioned I die quickly talk about aircraft based observations at the area of interest here and.

00:41:53.090 --> 00:41:55.740
Dean Lockett
Uh my particular area of interest of course.

00:41:55.800 --> 00:42:09.330
Dean Lockett
So and of course, some you know aircraft based observations come from the private sector. We call them. 3rd party data sources and you know this is always been a difficult aspect too.

00:42:09.390 --> 00:42:26.530
Dean Lockett
Umm I guess to to find a business case for and you know, we've struggled that with that in the Amber Program. But I think we've been been quite successful. Really, the the the the data that is produced under the aircraft based observations basically are.

00:42:27.230 --> 00:42:41.920
Dean Lockett
Uh they are they freely shared of course, it costs money to produce data but you know. We certainly have conditions and so I I think it's true to say we've never really been comfortable with the notion that aircraft based observations.

00:42:42.490 --> 00:43:04.380
Dean Lockett
Like uh those produced under WMD programs should be classified as essential data because in fact, there really are conditions imposed on the use of these data as is as is well known in the US. Some you know in other parts where the other parts of the globe, where the program is is built upon a partnership and.

00:43:05.740 --> 00:43:15.210
Dean Lockett
And then more recently W moves formed a collaborative arrangement where they are to call it the WMR to collaborative vendor program.

00:43:15.860 --> 00:43:47.370
Dean Lockett
And and that has its own data policy, which has been negotiated with the with Archer and and and the partner. Airlines and based on that policy, which we've put in place just recently. We you know, we understand that there are restrictions that have to be put in place and and this really dictates that aircraft based observations, particularly at the current time cannot really be core data. They they they basically will become part of this recommended data set in the future, which I think is appropriate and.

00:43:47.860 --> 00:43:53.990
Dean Lockett

You know, hopefully things might change become a little different in the future but that's where we're at currently.

00:43:55.290 --> 00:44:20.980
Dean Lockett
And then when it comes to turbulence daughter part of our negotiations with I had worked with Archer have incorporated turbulence data and many will be aware that I arteries recently developed their turbulence aware program aiming to expand the availability of turbulence information and and to make it available for use by its its member airlines in in operations and.

00:44:21.970 --> 00:44:40.090
Dean Lockett
Do we we, we've used recently come to terms with Archer and and there's an understanding that that basically these these these won't be shared under W most data policy. There will be a different data policy that will come into effect for the sharing of turbulence data, particularly from turbulence aware.

00:44:44.540 --> 00:45:14.120
Dean Lockett
I don't think I'll need to to to go through the the summary. I basically provided you with the the background. On on the data policy and the benefits will come from that, but ultimately of course, there's this new data policy that ultimately the aim is to make these data available to the application areas that require them so that the the services in support of you know, saving lives and protecting livelihoods that can be.

00:45:14.520 --> 00:45:18.760
Dean Lockett
Can be better brought into effect and managed internationally?

00:45:19.790 --> 00:45:28.680
Dean Lockett
So I'll leave it, there thank you. I I think they believe there is a video but I'll leave it to others to decide whether we have time to play that or not thank you.

00:45:29.730 --> 00:45:33.480
Dean Lockett
OK, Steve we probably have time for just one.

00:45:33.940 --> 00:45:36.600
Bob Sharman (Guest)
OK, OK, they're they're actually you did A.

00:45:36.470 --> 00:45:58.610
Steve Abelman
Bill nice job date of answering some of the questions along the way with with slides. I think that you produced a really quickly, so there was questions on free and unrestricted. I think he answered from Tammy proprietary value. I think you there was a question from a TS? Can you elaborate more on the aspects of proprietary value access for a fee versus public benefit of sharing data freely?

00:46:00.390 --> 00:46:01.340
Steve Abelman
Yeah, well.

00:46:01.800 --> 00:46:36.230
Dean Lockett
I I guess that's that's what's being acknowledged under this data policy that when we want to bring in the private sector here, we have to acknowledge that are that there are restrictions that will be imposed. But you know they they can't be couched under this core area. They they need to be handled under this recommended and and these data sets, where we understand that there will be restrictions and and This is why the the development of W Moe's information system version 2 is important because it will be able to.

00:46:36.740 --> 00:46:46.020
Dean Lockett
Support the requirements, there are imposed on on making these data available by you know, 3rd parties from the private sector.

00:46:48.630 --> 00:46:50.700
Dean Lockett
Hey Bob do we have time for one more? Do we need to move on.

00:46:51.300 --> 00:46:53.140
Steve Abelman
I think we should move on, I think we're a little bit.

00:46:53.010 --> 00:46:54.240
Bob Sharman (Guest)
Behind OK.

00:46:55.830 --> 00:46:56.210
Bob Sharman (Guest)
Thanks.

00:46:56.090 --> 00:46:58.510
Dean Lockett
Jerry much thank you Dean.

00:47:00.530 --> 00:47:02.190
Dean Lockett
So we're going to go on to.

00:47:02.100 --> 00:47:04.020
Bob Sharman (Guest)
The next talk, which is.

00:47:04.780 --> 00:47:09.730
Bob Sharman (Guest)
Looks like it's A tag team of 3 people. Pierce Buchanan Debbie Terp and Phil Gil.

00:47:10.810 --> 00:47:11.520
Bob Sharman (Guest)
Ah.

00:47:12.620 --> 00:47:16.950
Bob Sharman (Guest)
Pierce will be talking about uh aviation turbulence at the Met Office.

00:47:17.760 --> 00:47:30.510
Bob Sharman (Guest)
Debbie will talk about a global turbulence climatology. She's been working on and Phil will talk about turn off verification. So are you starting peers, except the right order.

00:47:31.310 --> 00:47:33.460
Bob Sharman (Guest)
Yes, that's right thanks Bob can you hear?

00:47:33.350 --> 00:47:35.150
Buchanan, Piers
Maybe OK yes.

00:47:35.750 --> 00:47:40.300
Buchanan, Piers
Perfect I'm yeah, so exactly as you said. We're presenting as a trio.

00:47:42.080 --> 00:47:59.540
Buchanan, Piers
I will just briefly outline the general background why we work on global aviation turbulence at the Met Office. I'm peers. I I run. The aviation applications science team here at the Met Office? What you worry about various hazards, including turbulence.

00:48:00.470 --> 00:48:30.740
Buchanan, Piers
Uhm a lot of the backgrounds master hand is covered so yeah, we're we're the sort of UK. Part of the world area forecast system where WAF see London providing the sort of UK. Half of the forecasts. It's worth noting as ever that the forecasts are produced by forecasters. There's sig weather charts currently in the process of being automated and also by gridded model output for hazards and wind and temperature and as Matt alluded to those various.

00:48:30.900 --> 00:48:47.060
Buchanan, Piers
Major upgrades happening to the service right now, so it's a combination of of making the community. Yourselves aware that some things have changed and also that some things are going to change and we're in the process of sort of eliciting feedback on that.

00:48:47.990 --> 00:49:17.030
Buchanan, Piers
So it it terms of hazards improvements, so as Matt said. We have recently upgraded the turbulence to

be 0.25 degree resolution and also in terms of severity in 2023. We're going to be adding extra time steps and levels and as we push towards 2026. We're going to be looking at producing a prototype probabilistic turbulence forecast in real time.

00:49:19.220 --> 00:49:28.150
Buchanan, Piers
So what does the capability look like? Well, if you look at the left hand plot here that was the sort of 1.25 degree wafs.

00:49:29.450 --> 00:49:45.710
Buchanan, Piers
A cat forecast so that's elrod potential and a bit of mountain wave potential as well. So it's a you know sort of relatively unsophisticated the middle panel? Where is the deterministic edr?

00:49:45.760 --> 00:49:50.140
Buchanan, Piers
Our forecast so that's actually based here as well.

00:49:50.190 --> 00:49:51.590
Buchanan, Piers
Not seeing it hide.

00:49:51.470 --> 00:49:58.210
Bob Sharman (Guest)
It's Bob I'm not seeing the slide you're talking about on my screen so everybody else.

00:49:58.820 --> 00:50:00.170
Bob Sharman (Guest)
No, it's not in France.

00:50:01.320 --> 00:50:03.820
Matt Strahan (Guest)
So we not have we not got turbulence past.

00:50:03.770 --> 00:50:07.820
Buchanan, Piers
Present and future no just your lead in slide.

00:50:08.220 --> 00:50:09.820
Bob Sharman (Guest)
Uh apology.

00:50:09.710 --> 00:50:12.860
Buchanan, Piers
Is I think there's a button?

00:50:12.770 --> 00:50:16.330
Andreas Dörnbrack (Gast)
They're very can click forward Bob on a bottom of the.

00:50:17.450 --> 00:50:20.950
Andreas Dörnbrack (Gast)
So at least at my screen you can click forward.

00:50:22.330 --> 00:50:24.030
Andreas Dörnbrack (Gast)
Yeah, that's I think that's what you.

00:50:23.890 --> 00:50:25.230
Bob Sharman (Guest)
You were talking about peers.

00:50:25.880 --> 00:50:27.990
Bob Sharman (Guest)
Yeah, how are we now we have?

00:50:27.900 --> 00:50:36.470
Buchanan, Piers
Did we see turbulence past? Present and future? Yes yes so excellent apologies? Yes. It's some? I'm trying to do it all on one screen here.

00:50:37.600 --> 00:51:06.800
Buchanan, Piers
Right so yes, as I was saying the left hand plot is this sort of potential representation outwards and booted mountain wave the middle plot is the GTG algorithm to produce Cdr based on several different potentials. Sorry it predictors. Plus, the UM. The calibration code kindly provided by colleagues at Wesley Washington RN car and then on the right hand plot.

00:51:06.850 --> 00:51:27.910
Buchanan, Piers
Yeah, as we look towards the future. This is the probabilistic. Edr forecast so as Matt said earlier. You could potentially have a a hazard sort of type matrix representation in this case. We're looking at those sort of probability of moderate or greater edr value being exceeded.

00:51:28.940 --> 00:52:00.370
Buchanan, Piers
So last slide from me, so as we look towards probabilistic wifes what we're really trying to do is just look at things in terms of useful usable and used so useful is it something that the forecasts are the user understands and wants usable does it integrate with current decision making processes does it integrate with the other products that the user is currently using and used does it run reliably does it produce a product at the appropriate time for the user to make a decision?

00:52:00.800 --> 00:52:26.450
Buchanan, Piers
And then sort of segueing into the sort of things that Debbie talking about does it give the user better outcome than than with what they currently use so there was a loss of importance in our team here at the Met Office around understanding the performance of of the various sort of prototypes. We're working on so without further ado, our hand over to Debbie to talk about turbulence climatology.

00:52:30.710 --> 00:52:32.410
Buchanan, Piers
OK so if you move on.

00:52:32.320 --> 00:52:48.900
Turp, Debi
To the title slide turbans climatology right, thanks peers and hello. Everyone I'm Debbie Turk from the aviation applications group at the Met Office and I'm going to describe the turbulence climatology. We've been we've been working on over the last few years.

00:52:49.950 --> 00:52:51.400
Turp, Debi
Moving on to the next slide.

00:52:53.360 --> 00:53:03.430
Turp, Debi
And the climatology covers the period from January 2008 to March 2020 and was constructed using 2 sets of aircraft turbulence observations.

00:53:04.220 --> 00:53:16.420
Turp, Debi
To the first set was the global aircraft data set or kids data, which is provided by a Northern European airline and it contains measurements of vertical acceleration, which we converted to a measure of turban severity.

00:53:17.500 --> 00:53:23.230
Turp, Debi
Uh measurements are taken every 4 seconds, which gives a comprehensive coverage along the flight routes.

00:53:24.140 --> 00:53:27.990
Turp, Debi
The Climatology uses over 12 years of this God 's data.

00:53:29.710 --> 00:53:37.350
Turp, Debi
The second set was the Delta Airways data set and this was originally provided by Bob Sharman and more recently downloaded from the made this website.

00:53:38.130 --> 00:53:42.920
Turp, Debi
It contains measurements of Eddy Dissipation rate, which we convert into turbines severity.

00:53:44.080 --> 00:53:51.430
Turp, Debi
Measurements from this data set and much more sporadic rather recording is continuous. There is about one report per minute.

00:53:52.040 --> 00:53:56.070
Turp, Debi
Despite this, the data improves the coverage over the US and the North Atlantic.

00:53:56.770 --> 00:53:59.900
Turp, Debi
The Climatology is he's 11 years of this data.

00:54:01.600 --> 00:54:12.910
Turp, Debi
So the climatology only contains observations from the from cruise level. That's above about 28,000 feet and of moderate or greater turbulence as this is of greatest interest to the aviation community.

00:54:14.390 --> 00:54:18.380
Turp, Debi
So the plot on the right there shows coverage of the observational data.

00:54:19.040 --> 00:54:21.180
Turp, Debi
Uh shown by the Gray shaded area.

00:54:22.080 --> 00:54:26.950
Turp, Debi
Coverage is good over the North Atlantic and Europe and sparse over the Southern Hemisphere.

00:54:27.870 --> 00:54:34.280
Turp, Debi
Some regions aren't covered at all for example, Alaska, most of the Pacific parts of Asia and South America.

00:54:35.560 --> 00:54:49.390
Turp, Debi
God status East in February 2021, partly as a result of the pandemic and we also need data sets of a wider coverage of the Southern Hemisphere and Pacific to extend the climatology and enable its use in these regions.

00:54:50.060 --> 00:54:54.600
Turp, Debi
And to do this we hope to obtain access to the IR to tournaments aware database.

00:54:56.450 --> 00:54:57.980
Turp, Debi
So moving on to the next slide.

00:55:00.420 --> 00:55:05.130
Turp, Debi
The climatology provides up database of or turbulence observations from the 2 sources.

00:55:05.830 --> 00:55:13.660
Turp, Debi
2 methods of analyzing the data. I used firstly. These observations were plotted individually as shown in the left hand plot.

00:55:14.370 --> 00:55:20.540
Turp, Debi
Here, the the blue dots are the cats observations and the brand dots are the Delta Airways presently observations.

00:55:21.170 --> 00:55:23.820
Turp, Debi
And this is the result for the month of December.

00:55:25.470 --> 00:55:38.700
Turp, Debi
Then Secondly the fraction of observations were at that were actually of moderate or greater turbulence were calculated for each degree by degree grid square for each month and the corresponding result for December is shown on the right.

00:55:40.450 --> 00:55:48.940
Turp, Debi
This shows that there was a maximum reported turbulence in the tropical Atlantic over the eastern North Atlantic and southern tip of Greenland at this time of year.

00:55:50.050 --> 00:55:58.840
Turp, Debi
These plots can be used to assess mean forecast for turbulence for a particular calendar month as a sanity check that the forecast model is producing the expected results.

00:56:03.920 --> 00:56:05.910
Turp, Debi
OK moving on to the next slide.

00:56:06.470 --> 00:56:17.900
Turp, Debi
This slide shows some of the main features of the Climatology and these were investigated further using significant weather charts satellite and lightning data to determine the likely cause of the turbulence.

00:56:18.830 --> 00:56:28.540
Turp, Debi
As expected, the turbulence was generally observed over the North Atlantic, especially in the colder months of the year and this is Windshear turbulence connected to their jet stream?

00:56:29.770 --> 00:56:38.320
Turp, Debi
Tablets also occurred over the southern tip of Greenland, particularly in the winter months due to mountain wave turbulence and also Windshear turbulence, resulting from the jet stream?

00:56:39.170 --> 00:56:50.460
Turp, Debi
Jet uh tablets also occurred over Southwest Asia between February and April and significant weather charts suggested this maybe Windshear tablets connected with the subtropical jet.

00:56:51.230 --> 00:56:55.390
Turp, Debi
This may also cause some of the turbulence over southeast Brazil along with convection.

00:56:56.360 --> 00:57:06.230
Turp, Debi
There was a maximum in reported turbans over the Bay of Bengal from June to September and this is likely to be convicted turbulence connected with the Asian monsoon.

00:57:07.120 --> 00:57:12.670
Turp, Debi
Similarly, the maximum over Indonesia and then tropical Atlantic is likely to be convective turbulence.

00:57:17.290 --> 00:57:18.670
Turp, Debi
Moving on to the next slide.

00:57:19.590 --> 00:57:23.180
Turp, Debi
The Climatology in certain regions was investigated further.

00:57:24.380 --> 00:57:37.130
Turp, Debi
For example, the climatology of turbulence over Greenland was investigated by comparing turbulent events to the correspondence and not chart and satellite data to determine whether there's any mountain wave activity.

00:57:38.530 --> 00:57:48.220
Turp, Debi
To do this we looked for low level flow from the southeastern quadrant in the synoptic charts. Following Lena tells findings that mountain wave activity frequently occurs in this situation.

00:57:49.420 --> 00:57:56.070
Turp, Debi
The corresponding satellite imagery was examined for mountain wave signatures such as a tear in the cloud cover as shown here.

00:58:01.830 --> 00:58:12.350
Turp, Debi
So if you move on to the next slide that the average number of days in each month when turbulence reports coincided with mounting wave activity was then determined and is shown here.

00:58:13.050 --> 00:58:19.020
Turp, Debi
Generally, there was mounting wave activity on over to 75% of days went urban 's was reported.

00:58:20.160 --> 00:58:32.670
Turp, Debi
Therefore, most tablet ports over green and I likely to be at least partly caused by mounting wave activity. There is mounting wave activity in all months of the year are there. There are more frequent in the colder months as expected.

00:58:33.510 --> 00:58:45.000
Turp, Debi
These results are similar to the pattern reported in Lane ET al 2009 who also found most turbulent reports occurred between November and February with a minimum of reports in June, July and August.

00:58:45.950 --> 00:58:52.500
Turp, Debi
This annual pattern of turbulence can be compared with the predicted pattern of mountain wave turbulence as part of forecast verification.

00:58:56.680 --> 00:59:09.010
Turp, Debi
So moving on to the last last slide up in summary, then and the climatology gives us a picture of turbulence in various locations around the Globe and identifies areas, particularly prone to turbulence.

00:59:09.730 --> 00:59:18.340
Turp, Debi
This can then be used as a tool in forecast verification for example, to sanity check forecasts and to direct further research.

00:59:19.070 --> 00:59:25.560
Turp, Debi
Finally, new sources of observations are needed to extend the climatology into regions. Not currently covered in into the future.

00:59:26.250 --> 00:59:30.140
Turp, Debi
Now I hand over to Phil who would talk more about the verification of our forecasts.

00:59:35.970 --> 00:59:37.070
Turp, Debi
OK, thank you Debbie.

00:59:37.840 --> 00:59:38.590
Turp, Debi
Uh me too.

00:59:38.490 --> 00:59:52.150
Gill, Philip

My name is Philip GAIL and I managed the operational verification team at the Met Office. Then I'm just going to take you through a couple of recent bit of turbulence verification that we've been working on so if I could have the next slide, please.

00:59:53.740 --> 01:00:11.210
Gill, Philip
So first of all we're going to have a look at the new quarter degree resolution wifes turbulence forecasts and then we'll have a quick look at some of the sig weather guidance products as he's trying to Automate. The production of the sick weather charts, so if we can go on to the next one please.

01:00:12.460 --> 01:00:14.060
Gill, Philip
So with the high resolution.

01:00:14.870 --> 01:00:24.370
Gill, Philip
Uh we've carried out some verification, UM over a period between October and December 2020.

01:00:25.260 --> 01:00:55.430
Gill, Philip
And we've compared the quarter of a degree resolution forecast. That's using the GTG scheme against the operational turbulence forecast which that one over the quarter degree and that just uses a single elrod predictor together with some mountain wave and so we've looked at first of all the Roc curve on the top left. This is a way of looking at the skill of the forecast at discriminating between air turbulence event and when turbulence.

01:00:55.470 --> 01:01:01.150
Gill, Philip
Doesn't occur and basically you're looking for the curved be towards the top left hand corner?

01:01:02.360 --> 01:01:04.390
Gill, Philip
So, in this case, the green line.

01:01:05.040 --> 01:01:34.630
Gill, Philip
Uh, which is showing much greater area under it, than the red line so the green line corresponds to the quarter of a degree GTG so that clearly has a lot more skill than the one in a quarter operational single predictor forecast and then in the middle there. We've got a what we call a relative economic value plot. So this is looking at various cost loss ratios for a user and looking at this sort of relative.

01:01:34.680 --> 01:02:00.370
Gill, Philip
Value you could obtain this is quite a nice measure to use and and we can sort of compare in this sort of cost loss economic way so again. The higher the curve, the better, so in this case, the green curve is always higher than the red curve showing that the quarter of a degree resolution forecast has more value or whatever. The users cost loss ratio so there's still really very positive.

01:02:02.050 --> 01:02:16.490
Gill, Philip
One thing we do have to remember is that 2020 was a very unusual year and as you can see in the bottom left plot comparing their 2020 with the year before, is that there were far fewer lights so a degree of caution. I think is needed.

01:02:17.720 --> 01:02:22.250
Gill, Philip
But it's very encouraging I think, to see that the the advantages of GTG.

01:02:22.300 --> 01:02:22.480
Gill, Philip
See.

01:02:23.540 --> 01:02:38.780
Gill, Philip
I I think probably most of the advantages between these 2 plots are probably coming from the GTG rather than just the higher resolution itself and perhaps some more studies are needed to actually be able to work out exactly where the benefits coming from.

01:02:39.690 --> 01:02:40.880
Gill, Philip
Next slide please.

01:02:42.360 --> 01:03:11.530
Gill, Philip
Uh so into the sick weather guidance plots so on the left. This is sort of shows. An example of how these can be produced so the top plot is a manually producing weather chart. So it's produced by forecasters drawing objects onto a chart and these are produced by both West C, London and buffs. Obviously Washington so they're produced separately and as Matt was saying earlier on.

01:03:12.430 --> 01:03:14.890
Gill, Philip
By by the use of an automated sig weather.

01:03:16.220 --> 01:03:32.950
Gill, Philip
Products it would eventually be possible to make these 2 consistent and the bottom plot shows the automated version so these show not just the turbulence, which is in yellow on these charts, but also various other hazards, such as CBI Synjet Strawboard.

01:03:34.640 --> 01:03:47.650
Gill, Philip
And these automated ones are based on the West gridded forecasts, so once we're able to use. These then we'll get consistency between the gridded products and the graphical products and between the 2 centers.

01:03:48.310 --> 01:03:49.560
Gill, Philip
And the next slide, please.

01:03:51.440 --> 01:04:05.410
Gill, Philip
So again we got 2 ways of comparing them. We got rock curves looking at the scale on the top left and the relative economic value plots on the right and actually there's not much in it. Between these 3 so they are very close.

01:04:06.100 --> 01:04:25.760
Gill, Philip
And so we've got some in red we got wife, see London and in blue. I see Washington who are very close on those plots and then the automated product is in green so actually it's it's very, very sort of reasonable. I think there are some differences by area, which we haven't shown here, but they are there?

01:04:27.430 --> 01:04:32.400
Gill, Philip
I would say if anything, there's perhaps slightly high false alarm rates from the automated product.

01:04:33.150 --> 01:04:41.710
Gill, Philip
Uhm but since then. Some works being done to enhance that if we go on to the next slide will have a look at the the latest version.

01:04:42.440 --> 01:04:49.160
Gill, Philip
Uh so actually now we're seeing the green run the automated one getting considerably higher skill and value.

01:04:50.250 --> 01:04:54.520
Gill, Philip
Compared to the manually produced chance so again this is very encouraging.

01:04:55.300 --> 01:05:07.640
Gill, Philip
Uh I think we, we do have to be very cautious here because we are only looking at, I think 2 or 3 months. In this comparison, so it's sort of work in progress to verify this over a longer period.

01:05:08.290 --> 01:05:24.640
Gill, Philip
Uhm again, I would say if anything, we could probably look at doing some calibration to the automated one bring those false alarm rates down a bit in line with the UM manual sick weather charts. And I'm pretty sure you'd still see a benefit in terms of increased hit rate there.

01:05:25.500 --> 01:05:27.670
Gill, Philip
For can move on to the next slide, please.

01:05:28.760 --> 01:05:46.230
Gill, Philip
So then just to sum up really, and I think we've seen here that certainly the quarter of degree. D GTG shows significant improvements over the current operational forecast and that's been produced since I think December 2020 in parallel.

01:05:46.890 --> 01:06:03.140
Gill, Philip
Uhm perhaps on also question here for users to think about how do you actually use this gridded data if you are simply interpolating to the aircraft track from the quarter degree grid? It is possible. You may not realize the full benefits from the higher resolution.

01:06:03.710 --> 01:06:34.000
Gill, Philip
Uh I'm perhaps some further postprocessing could bring in surrounding grid points, which I think would probably give you increased skill and it's something we could certainly look at internally and would be an interesting study and then finally it's Debbie and peers, said our turbulence observations against observations finished at the end of February. So we are looking at alternatives and we certainly looking forward to using the IR to turbulence aware database.

01:06:34.300 --> 01:06:35.360
Gill, Philip
They got access to that.

01:06:36.070 --> 01:06:39.980
Gill, Philip
And I think that's the last slide so any questions.

01:06:41.450 --> 01:06:41.830
Gill, Philip
Yes.

01:06:42.920 --> 01:06:43.830
Gill, Philip
Thank all of you.

01:06:44.820 --> 01:06:47.820
Bob Sharman (Guest)
Uh peers Debbie hand and Phil.

01:06:48.510 --> 01:06:54.940
Bob Sharman (Guest)
Uh excellent talk uh do we have any questions. Steve yeah we? Do we have several a couple questions.

01:06:54.880 --> 01:07:07.340
Steve Abelman
Debbie for you on climatology first of all from Matt Delta when you convert DDR 2 turbulence, severity is the conversion fleet specific or fleet agnostic.

01:07:08.250 --> 01:07:10.100
Steve Abelman
OK, so I used the.

01:07:10.040 --> 01:07:30.230
Turp, Debi
Definitions that are they user end car, which I got from Bob Sharman, which, if I number. Rightly is more 0.154 light turbulence and nought 0.224 model or greater turbulence. I'm not sure if that's fleet specific or leaked agnostic.

01:07:30.940 --> 01:07:33.440
Turp, Debi
Well, that's based on a medium sized aircraft.

01:07:33.370 --> 01:07:40.640
Bob Sharman (Guest)
It's like 737, so for 777 or 747, those thresholds are probably a little higher.

01:07:42.460 --> 01:07:44.380
Bob Sharman (Guest)
OK, another question on climatology.

01:07:44.520 --> 01:07:49.820
Steve Abelman
Have you done your over year comparisons over any regions like the North Atlantic, where there is good coverage.

01:07:50.720 --> 01:07:52.670
Steve Abelman
That's a good question no, I haven't.

01:07:52.860 --> 01:07:53.440
Turp, Debi
Uh my though.

01:07:53.490 --> 01:08:03.800
Turp, Debi
So I did look quite a lot at Screenland and the variation there. And, yes, some months were particularly relevant, and some weren't. But I didn't look at it in any detail.

01:08:05.730 --> 01:08:07.910
Turp, Debi
And then there's a thank you. There's one final question.

01:08:07.760 --> 01:08:33.550
Steve Abelman
Chin Debbie because of the noisiness of the data and and uh. I'll stop here. Matt makes a good point to there's a couple of unknown user questions or I would give the name of the folks who are doing it. But so it Maps, suggesting please put your name and we can give you a reply. But because of the noisiness of the data turbulence Climatology Fields can look very different depending on the choice of grilled resolution and smoothing methodology. Can you talk about the choices you made in this regard?

01:08:34.570 --> 01:08:35.850
Steve Abelman
That's a good question as well.

01:08:36.180 --> 01:08:56.070
Turp, Debi
And I used one degree by one degree. I think just because it was simple. I can't really remember now it's a long time ago, but I also started looking at nought 0.25 by North 0.25 degree oven to fit with the new resolution at the right size for costs. But I didn't get time to do a thorough analysis of it.

01:08:56.730 --> 01:09:02.280
Turp, Debi
I also looked at the individual observations themselves partly to address that issue.

01:09:04.980 --> 01:09:06.620
Turp, Debi
OK, that seems to be all the question.

01:09:06.480 --> 01:09:18.640
Steve Abelman
Genzyme I'm gonna reiterate another thing Matt has posted the the slides will be available and correct me. If I'm wrong, Tammy or Bob or matte but the slides will be available at the end of this presentation to review.

01:09:20.220 --> 01:09:21.720
Steve Abelman
Yeah, I'm not sure how quickly.

01:09:22.540 --> 01:09:22.900
Flowe, Tammy (FAA)
OK.

01:09:24.200 --> 01:09:35.500
Flowe, Tammy (FAA)
They they will be made a part of the minutes as well. You know the the list of attendees in that email addresses. So yeah, I just can't guarantee it's gonna be tomorrow. That's all.

01:09:38.050 --> 01:09:40.020
Flowe, Tammy (FAA)
Alright so I guess it's time for A.

01:09:39.920 --> 01:09:45.970
Bob Sharman (Guest)
Quick break 10 minute break it's on the schedule right now, yeah, so, so, so close.

01:09:45.940 --> 01:09:53.720
Flowe, Tammy (FAA)
Please deep Bradford has said he will be on at 11:00, so let's just kind of plan that in there, if we could Bob.

01:09:54.680 --> 01:09:55.350
Flowe, Tammy (FAA)
I'm not sure.

01:09:56.250 --> 01:09:57.570
Flowe, Tammy (FAA)
OK great thanks.

01:09:59.780 --> 01:10:00.190
Flowe, Tammy (FAA)
OK.

01:10:00.680 --> 01:10:02.120
Bob Sharman (Guest)
Come back in 10 minutes.

01:18:20.740 --> 01:18:21.140
Bob Sharman (Guest)
So yeah,

01:19:55.990 --> 01:20:01.660
Bob Sharman (Guest)
will I see that's about a 10 minute break? Do you want to start now or do you wanna wait a few more minutes.

01:20:09.210 --> 01:20:10.540
Bob Sharman (Guest)
Sorry I was on mute.

01:20:11.610 --> 01:20:12.130
Flowe, Tammy (FAA)
I think.

01:20:13.280 --> 01:20:20.560
Flowe, Tammy (FAA)
This virtual stuff is challenging so I think we should get going, 'cause Yeah, OK so this will be a 20 minute timer.

01:20:20.430 --> 01:20:22.070
Bob Sharman (Guest)
Like including questions.

01:20:22.710 --> 01:20:25.110
Bob Sharman (Guest)
So that won't quite be 11:00 o'clock.

01:20:26.980 --> 01:20:28.650
Bob Sharman (Guest)
Well then we could give it another 5 minutes.

01:20:28.540 --> 01:20:31.170
Flowe, Tammy (FAA)
'cause I think people are still coming back from the break.

01:20:33.000 --> 01:20:42.350
Flowe, Tammy (FAA)
Yeah, let's give it another 5 minutes and then we'll start and then if Steve if Steve isn't here will just start the next talk. I don't. I don't know what else to do so I know OK.

01:20:43.070 --> 01:20:44.290
Bob Sharman (Guest)
Alright Thanks Bob,

01:20:44.930 --> 01:20:48.910
Flowe, Tammy (FAA)
Flexibility that's what my husband keeps telling me gotta be flexible.

01:20:51.130 --> 01:20:52.510
Flowe, Tammy (FAA)
You tell him that back.

01:20:55.150 --> 01:20:56.610
Bob Sharman (Guest)
uh yeah, I do.

01:20:59.490 --> 01:21:02.250
Flowe, Tammy (FAA)
This would be so much easier if we were in person right.

01:21:03.110 --> 01:21:03.990
Flowe, Tammy (FAA)
It's so much worse.

01:21:03.880 --> 01:21:06.290
Bob Sharman (Guest)
Enjoyable to yeah, I agree.

01:21:07.300 --> 01:21:11.040
Flowe, Tammy (FAA)
This is very, very disappointing.

01:21:12.630 --> 01:21:18.330
Flowe, Tammy (FAA)
Right so that talks are really good. I'm really. I'm I'm getting a lot out of the talks, so I I think.

01:21:18.650 --> 01:21:20.140
Flowe, Tammy (FAA)
We think they have all been right.

01:21:20.010 --> 01:21:21.460
Bob Sharman (Guest)
OK, good so far, yeah.

01:22:19.480 --> 01:22:21.380
Bob Sharman (Guest)
Tell Steve able men are you on.

01:22:26.830 --> 01:22:33.780
Flowe, Tammy (FAA)
OK, he's post office break, yeah, we need him on to monitor the chat. It's doing a good job doing a good Steve is that you.

01:22:38.800 --> 01:22:41.010
Flowe, Tammy (FAA)
No, that was Bob and this is Matt.

01:22:41.460 --> 01:22:45.960
Matt Fronzak
I mean, if you want to get going. I'll monitor until Steve comes back, I'm sure he's he's?

01:22:47.310 --> 01:22:49.040
Matt Fronzak
Yeah, we're trying to we're trying to model.

01:22:48.890 --> 01:22:53.560
Flowe, Tammy (FAA)
Under the time because Steve Bradford told me he'd be available at 11:00.

01:22:54.590 --> 01:23:03.810
Flowe, Tammy (FAA)
So we're trying to make sure that we're at a good breaking point at 11:00. So Bob we probably can get going, 'cause Well, you know if nothing else will have a couple extra questions that we can answer.

01:23:11.630 --> 01:23:20.560
Bob Sharman (Guest)

OK, I guess we're ready to get started again come in our next talk would be by Olivia Jeroen and Pierre Chris Bell from Mineo, France.

01:23:21.400 --> 01:23:27.430
Bob Sharman (Guest)
It's the use of the Arpege ensemble forecast model to derive.

01:23:28.190 --> 01:23:29.830
Bob Sharman (Guest)
Uh aeronautical turbulence.

01:23:30.850 --> 01:23:36.310
Bob Sharman (Guest)
So Olivier you want to take it away, yeah, I remember.

01:23:37.410 --> 01:23:40.000
Olivier Jaron (MF) (Invité)
I'm sharing my screen first.

01:23:47.290 --> 01:23:48.140
Olivier Jaron (MF) (Invité)
K.

01:23:50.120 --> 01:23:51.010
Olivier Jaron (MF) (Invité)
We see you.

01:23:52.130 --> 01:23:52.990
Bob Sharman (Guest)
OK.

01:23:55.490 --> 01:23:57.650
Olivier Jaron (MF) (Invité)
Do you see my yes?

01:23:57.990 --> 01:23:59.930
Olivier Jaron (MF) (Invité)
Translation very good.

01:24:00.720 --> 01:24:13.250
Olivier Jaron (MF) (Invité)
OK, thank you so I'm starting I'm a revision one with the purchase period. We are working at Metro, France, French National.

01:24:14.530 --> 01:24:15.620
Olivier Jaron (MF) (Invité)
With our service.

01:24:16.570 --> 01:24:22.280
Olivier Jaron (MF) (Invité)
And today we talk about the use of ensemble to forecast.

01:24:22.330 --> 01:24:24.080
Olivier Jaron (MF) (Invité)
Uh turbulence.

01:24:25.520 --> 01:24:28.430
Olivier Jaron (MF) (Invité)
Without somebody not seeing anything on your side.

01:24:28.320 --> 01:24:29.400
Bob Sharman (Guest)
Green right now.

01:24:30.660 --> 01:24:38.050
Bob Sharman (Guest)
You see nothing. No, you had it up earlier, but maybe I don't know something happened when presentation mode or.

01:24:38.610 --> 01:24:40.280
Bob Sharman (Guest)
OK and now

01:24:40.930 --> 01:24:43.570
Olivier Jaron (MF) (Invité)
Now I see it, but it's not in presentation.

01:24:43.480 --> 01:24:44.030
Bob Sharman (Guest)
mode.

01:24:45.540 --> 01:24:46.170
Bob Sharman (Guest)
Yes.

01:25:00.640 --> 01:25:02.770
Olivier Jaron (MF) (Invité)
So olyvia teams can be.

01:25:02.640 --> 01:25:11.060
Matt Fronzak
Really fussy when you go to presentation mode about which screen it's on and which one you've selected to to show and I think that's what happened there.

01:25:11.920 --> 01:25:14.810
Matt Fronzak
Yes, yeah, you could just show it like.

01:25:14.780 --> 01:25:17.200
Bob Sharman (Guest)
This this will be alright yeah, I'm just.

01:25:18.260 --> 01:25:20.150
Olivier Jaron (MF) (Invité)
I I have changed the.

01:25:20.200 --> 01:25:22.640
Olivier Jaron (MF) (Invité)
A shared mode.

01:25:23.220 --> 01:25:28.260
Olivier Jaron (MF) (Invité)
Uh is it better like that, or not, it looks the same.

01:25:28.930 --> 01:25:30.270
Bob Sharman (Guest)
So so, so OK so.

01:25:31.060 --> 01:25:34.200
Olivier Jaron (MF) (Invité)
I'm I will present like that.

01:25:36.070 --> 01:25:36.570
Olivier Jaron (MF) (Invité)
I.

01:25:40.280 --> 01:25:43.030
Olivier Jaron (MF) (Invité)
OK. Sorry I'm trying to

01:25:43.090 --> 01:25:46.910
Olivier Jaron (MF) (Invité)
well, this is yeah, this is screen OK.

01:25:50.040 --> 01:25:51.880
Olivier Jaron (MF) (Invité)
It's a beautiful picture incidentally.

01:25:53.100 --> 01:25:53.570
Bob Sharman (Guest)
Thanks.

01:25:55.680 --> 01:26:02.310
Olivier Jaron (MF) (Invité)
Uhm it's great waves in with a strap to communities or auto commute. I don't know.

01:26:03.380 --> 01:26:08.980
Olivier Jaron (MF) (Invité)
OK so uh I'm moving to the plan, UM.

01:26:09.840 --> 01:26:35.550
Olivier Jaron (MF) (Invité)
First, I will present you then somebody forecast of turbulence without pairs, then I'm I present uh try to forecast convective connection and used the turbulence and finally I present an improvement for tke representations that he's a PhD work.

01:26:36.760 --> 01:26:44.110
Olivier Jaron (MF) (Invité)
So let's talk about should you seem how we compute idiot diagnostic on our global model.

01:26:44.160 --> 01:26:56.420
Olivier Jaron (MF) (Invité)
Yeah, didn't tell Ministik name, Apache so as we can see in before with previous presentation. We also use a GTG method.

01:26:57.230 --> 01:26:59.330
Olivier Jaron (MF) (Invité)
Uhm for that we

01:26:59.390 --> 01:27:09.430
Olivier Jaron (MF) (Invité)
we combine individual diagnostics compute under directly on the model going to get the best resolution of it.

01:27:10.190 --> 01:27:15.890
Olivier Jaron (MF) (Invité)
Uh it is a spherical geometry grind and.

01:27:16.820 --> 01:27:23.970
Olivier Jaron (MF) (Invité)
And the for each individual diagnostic we, we map them into your unit using a climatology.

01:27:25.090 --> 01:27:32.150
Olivier Jaron (MF) (Invité)
And Outputs on high frequency and high resolution described on the slide.

01:27:33.260 --> 01:28:02.830
Olivier Jaron (MF) (Invité)
And on the table in the table on the bottom we can read different combination of individual diagnostic for different flavors and the associate area under curves scores for moderate or greater turbulence observation. So we use 2. The media database to to compute climatology and scores so let's move on.

01:28:03.170 --> 01:28:03.940
Olivier Jaron (MF) (Invité)
To the next slide.

01:28:03.990 --> 01:28:09.060
Olivier Jaron (MF) (Invité)
I'd uh why using ensemble forecast to Jack knows.

01:28:09.240 --> 01:28:09.500
Olivier Jaron (MF) (Invité)
Then.

01:28:10.590 --> 01:28:16.590
Olivier Jaron (MF) (Invité)
Forecast turbulence uh first when we try to improve turbulence forecast skills.

01:28:17.500 --> 01:28:36.140
Olivier Jaron (MF) (Invité)
Then we would like to access confidence in the forecast and we are thinking about other application like now casting by selecting the best scenario based on the last Test available observations if we can if we have.

01:28:37.390 --> 01:29:06.560
Olivier Jaron (MF) (Invité)
And then we are thinking about to provide a better connection. CIT connection forecast with his ensemble. So our configuration for Apache ensemble is the one control member plus 34 perturbated members, so from each these members, we compute Eddie on the fly.

01:29:06.730 --> 01:29:17.500
Olivier Jaron (MF) (Invité)
With the the Apache post processing software name. The full post so we are very close to the to the war files.

01:29:18.390 --> 01:29:31.390
Olivier Jaron (MF) (Invité)
Uh once we have compute this uh India D. Uh we compute statistics with a pile workflow and HPC in Pete and so this.

01:29:31.550 --> 01:29:40.050
Olivier Jaron (MF) (Invité)
Uh static seat statistics will be available for our forecasters on users in early 2022.

01:29:43.060 --> 01:29:47.500
Olivier Jaron (MF) (Invité)
Down here is the evaluation of the ensemble.

01:29:48.300 --> 01:29:53.840
Olivier Jaron (MF) (Invité)
To predict the CIT under mounting raised with this ID so.

01:29:54.870 --> 01:30:16.960
Olivier Jaron (MF) (Invité)
Something important to notice here is that for this 2 DA and symbol as a lower resolution than the

deterministic model. So we had to Recompute Climatology or selected diagnostics and then we use the same combination of individual diagnostics than for the deterministic model.

01:30:17.840 --> 01:30:31.890
Olivier Jaron (MF) (Invité)
But uh in early 22. Uh ensemble will have the same resolutions and deterministic model. So on this plot. Uh we you can see the Roc curve of A.

01:30:33.000 --> 01:30:35.380
Olivier Jaron (MF) (Invité)
Different different.

01:30:36.870 --> 01:30:48.390
Olivier Jaron (MF) (Invité)
Diagnostics the blue lines. I I'm trying to see if I can do zoom. No, I can OK sorry for the OK great.

01:30:49.790 --> 01:31:18.870
Olivier Jaron (MF) (Invité)
OK, that's a zoom of the road curves as the blue lines are the control member. The Red Lines is deterministic model. Soum you can see that with a better resolution. You have a better kids better lightweight at with the false alarm rate constant so the red dashed.

01:31:18.910 --> 01:31:21.180
Olivier Jaron (MF) (Invité)
Blue line that scare blue line.

01:31:22.220 --> 01:31:34.880
Olivier Jaron (MF) (Invité)
And even if ensemble as a lower resolution that the deterministic model in where we have a better weather better height weight, so the the benefit is clear here.

01:31:35.460 --> 01:31:36.960
Olivier Jaron (MF) (Invité)
Uh fuzzy and symbol.

01:31:38.990 --> 01:31:41.230
Olivier Jaron (MF) (Invité)
OK, UM.

01:31:43.110 --> 01:31:46.330
Olivier Jaron (MF) (Invité)
I reduce my screen OK.

01:31:47.830 --> 01:31:48.620
Olivier Jaron (MF) (Invité)
Great.

01:31:52.780 --> 01:31:54.150
Olivier Jaron (MF) (Invité)
OK, so.

01:31:55.570 --> 01:31:56.850
Olivier Jaron (MF) (Invité)
Now, an example.

01:31:57.620 --> 01:32:27.180
Olivier Jaron (MF) (Invité)
Uh and example of dispersion of idea Andy compute among Ensembl at only 6 hour only times so you can see in the Black Circle. Some moderate to severe observation to the souls of Westerly jet that is not seen by the control number, but the number. The member number 3 can see this observation.

01:32:30.880 --> 01:32:42.950
Olivier Jaron (MF) (Invité)
We will also provide statistics to our forecasters to help them to synthesize the information from the ensemble and to draw up a scenario.

01:32:43.800 --> 01:32:53.680
Olivier Jaron (MF) (Invité)
On the right on the left side of the slide you can see some Contacts from yes for for example.

01:32:54.450 --> 01:33:04.660
Olivier Jaron (MF) (Invité)
And on the right side you can see the probability to overcome a moderate or severe threshold turbulence.

01:33:07.880 --> 01:33:08.920
Olivier Jaron (MF) (Invité)
So OK but

01:33:09.950 --> 01:33:41.390
Olivier Jaron (MF) (Invité)
as we have said before some end users want a single value for probabilistic forecast. So we developed 2. UM another project, specifically for air traffic controllers so we cross the idea ensemble forecast, with air traffic control sector by using a risk matrix to give a single value.

01:33:41.440 --> 01:33:42.230
Olivier Jaron (MF) (Invité)
Uhm.

01:33:42.950 --> 01:33:47.810
Olivier Jaron (MF) (Invité)
To to describe turbulence into a specific control sectors.

01:33:50.760 --> 01:34:11.110
Olivier Jaron (MF) (Invité)

OK, now uh sofa I have shown you some rocks that work pretty well and I will. I will show you around that didn't so it's conviction in collective induced turbulence forecast so we, we have.

01:34:12.590 --> 01:34:23.780
Olivier Jaron (MF) (Invité)
Tested 6 new diagnostics compute only with the deterministic model. You have details on the tab in the table on the right.

01:34:25.170 --> 01:34:40.660
Olivier Jaron (MF) (Invité)
So for this particular job we use observation who which are filtered by their distance to a convicted felon. We use our algorithms that detect thunderstorm with.

01:34:40.740 --> 01:34:43.250
Olivier Jaron (MF) (Invité)
Uh infrared imagery.

01:34:44.660 --> 01:35:03.060
Olivier Jaron (MF) (Invité)
And you can see on the on this plot the Wizards. Uh in particularly you can see that all the 6 diagnostics for CIT are very close to the diagonal so that's uh indicate.

01:35:04.190 --> 01:35:25.900
Olivier Jaron (MF) (Invité)
That we have no skill at all to predict city with this diagnostics, so we, we think that the scores are sensible to uncertainty linked to the deterministic convection forecast and we plan to to to use ensemble forecast to improve this course.

01:35:29.140 --> 01:35:36.870
Olivier Jaron (MF) (Invité)
So to complete my presentation, I will talk about a improvement, or tiki.

01:35:36.940 --> 01:35:52.570
Olivier Jaron (MF) (Invité)
A representation in the model so it's a work of literature and I think is connected if you have question about his job. You can ask in those chat and you will be able to answer you.

01:35:53.920 --> 01:36:13.340
Olivier Jaron (MF) (Invité)
So Leo is trying to improve physical parameterization scheme for turbulence in our model to do that. He is truly a case study where moderate reports have been reported over Belgium.

01:36:13.960 --> 01:36:21.720
Olivier Jaron (MF) (Invité)
Uhm due to a jet streak into a Ridge it is a black square on the map.

01:36:23.270 --> 01:36:51.840
Olivier Jaron (MF) (Invité)
And they will use these the 3 Nested models our operational one named a room over Europe. West

Europe, another one called Midway Nash. Our research model and a large scale model. Miscellaneous 2, but at very high resolution of 260 meter so at yes, larger diskaid allowed to serve.

01:36:51.890 --> 01:37:13.660
Olivier Jaron (MF) (Invité)
Internal gravity wave linked to to this jet and the results of the this model is used as a reference to compute tikki tikki. Isaurian idea to compare with the result of a parametrization scheme from customer coarser mesh model.

01:37:14.570 --> 01:37:22.180
Olivier Jaron (MF) (Invité)
You have an example of this high resolution modernization for this case over Belgium.

01:37:23.350 --> 01:37:28.740
Olivier Jaron (MF) (Invité)
Offer this, this is the vertical velocity close to the tropopause.

01:37:29.510 --> 01:37:34.680
Olivier Jaron (MF) (Invité)
And we can see uh the gravity wave pattern.

01:37:38.030 --> 01:37:42.330
Olivier Jaron (MF) (Invité)
OK and the 2 so the the.

01:37:43.180 --> 01:38:09.490
Olivier Jaron (MF) (Invité)
The first thing to do is to to to get the value of idea over this area. So to do that. Leo is computing. The Spectra or vertical velocity and we can see on the red curve that describes the energy close to the tropopause. A peak of energy due to the Jet Street and far lower scale.

01:38:10.590 --> 01:38:13.580
Olivier Jaron (MF) (Invité)
How is the inner shell at Windscale we have?

01:38:13.910 --> 01:38:15.290
Olivier Jaron (MF) (Invité)
Uh.

01:38:16.070 --> 01:38:18.040
Olivier Jaron (MF) (Invité)
It it well known behavior.

01:38:18.690 --> 01:38:27.430
Olivier Jaron (MF) (Invité)
And with the so the energy for a slope that and then using an equation.

01:38:27.560 --> 01:38:38.410
Olivier Jaron (MF) (Invité)

Uhm provided for example, by Sherman. We can uh retrived need an EDM value and compare them to come.

01:38:39.550 --> 01:38:49.330
Olivier Jaron (MF) (Invité)
To the parametrization scheme of custom mesh model OK, thank you. Uh I hope.

01:38:50.960 --> 01:39:01.130
Olivier Jaron (MF) (Invité)
I hope the the last 15 minutes where more pleasant than the end of this flight during a landing at Madeira Airport. Thank you.

01:39:05.480 --> 01:39:06.720
Olivier Jaron (MF) (Invité)
OK, thank you.

01:39:07.010 --> 01:39:08.610
Bob Sharman (Guest)
Yeah, I'm still looking at this picture.

01:39:10.600 --> 01:39:11.170
Bob Sharman (Guest)
Uhm.

01:39:11.930 --> 01:39:16.220
Bob Sharman (Guest)
Steve are there any questions I don't see any questions in the chat at this time.

01:39:16.630 --> 01:39:18.240
Steve Abelman
OK, well, I I they haven't.

01:39:18.110 --> 01:39:21.920
Bob Sharman (Guest)
A couple UM Olivier, one is.

01:39:23.710 --> 01:39:35.960
Bob Sharman (Guest)
When you talked about this, it diagnostic? How do you define sit? Is it in cloud or in cloud and close to cloud or is it out of cloud?

01:39:38.160 --> 01:39:40.510
Bob Sharman (Guest)
Uh you mean to select observation.

01:39:40.660 --> 01:39:47.630
Olivier Jaron (MF) (Invité)
We are to to build the The Diagnostics to build the diagnostic service.

01:39:47.730 --> 01:39:55.450
Bob Sharman (Guest)
Diagnostics trying to capture turbulence in the cloud or outside the cloud or in my mind.

01:39:55.680 --> 01:40:03.530
Olivier Jaron (MF) (Invité)
'cause the outside the cloud because we we use a Cape to find the cells.

01:40:04.220 --> 01:40:10.810
Olivier Jaron (MF) (Invité)
Into the in the model and then we the idea is to catch.

01:40:11.430 --> 01:40:12.660
Olivier Jaron (MF) (Invité)
Uh turbulence.

01:40:13.890 --> 01:40:20.410
Olivier Jaron (MF) (Invité)
Gravity turbulence and used a by you, using vertical wind Shear.

01:40:21.590 --> 01:40:22.140
Olivier Jaron (MF) (Invité)
OK.

01:40:22.970 --> 01:40:34.360
Bob Sharman (Guest)
And another question is on your last slide where you're talking about the possibly new tke algorithm UM.

01:40:35.740 --> 01:40:40.610
Bob Sharman (Guest)
Do you have any observations of edr to compare these 2?

01:40:41.500 --> 01:40:46.090
Bob Sharman (Guest)
Or are you just using the high resolution model as truth.

01:40:47.030 --> 01:40:49.300
Bob Sharman (Guest)
No, we are using a idea.

01:40:49.250 --> 01:40:50.980
Olivier Jaron (MF) (Invité)
Form a modest database.

01:40:53.270 --> 01:40:55.080
Olivier Jaron (MF) (Invité)
OK, 2 to find.

01:40:55.190 --> 01:40:57.890
Olivier Jaron (MF) (Invité)
The the first thing was to find.

01:40:58.030 --> 01:40:59.430
Olivier Jaron (MF) (Invité)
Uh OK.

01:40:59.720 --> 01:41:17.040
Olivier Jaron (MF) (Invité)
A great case study uh I mean, uh uh jets related case study for no no more time waves or sieti only uh on a jet case study.

01:41:18.120 --> 01:41:21.750
Olivier Jaron (MF) (Invité)
Jets trick yeah, there may be inside.

01:41:21.790 --> 01:41:29.900
Bob Sharman (Guest)
Chewy are available over France for some period of time. We we would have to look. I don't know if that would be.

01:41:30.490 --> 01:41:32.000
Bob Sharman (Guest)
Useful to you, or not.

01:41:33.160 --> 01:41:34.710
Bob Sharman (Guest)
Uh.

01:41:34.820 --> 01:41:36.220
Olivier Jaron (MF) (Invité)
Yes yes.

01:41:37.610 --> 01:41:43.040
Olivier Jaron (MF) (Invité)
Yes, I think I'm we, we didn't look after the data database.

01:41:43.680 --> 01:41:44.820
Olivier Jaron (MF) (Invité)
Uh-huh OK.

01:41:46.700 --> 01:41:49.110
Olivier Jaron (MF) (Invité)
Bob I did get one question from Debbie Colas.

01:41:49.020 --> 01:41:57.480
Steve Abelman

Ski jump on the ATC tool did ATC used the turbulence stated increase spacing between aircraft or make any other changes.

01:42:00.520 --> 01:42:02.280
Steve Abelman
Uh for this uh.

01:42:02.170 --> 01:42:10.090
Olivier Jaron (MF) (Invité)
Uh predict uh ATC I think user turbulence forecast too.

01:42:11.300 --> 01:42:34.190
Olivier Jaron (MF) (Invité)
To avoid that many flights ask to change their level at the same times and the to get to to to get on the 2 avoid air traffic controllers too busy so if they know that an area will be very turbulent, they can come.

01:42:35.090 --> 01:42:45.220
Olivier Jaron (MF) (Invité)
Umm put several controllers on the same position to be able to answer pilots request to change level.

01:42:48.260 --> 01:42:49.850
Olivier Jaron (MF) (Invité)
OK thanks and there's there's one more.

01:42:49.720 --> 01:42:58.420
Steve Abelman
Or from John Williams did you look at? How many members of the ensemble were needed to give good results? How many ensemble members would be ideal.

01:42:59.410 --> 01:43:01.050
Steve Abelman
No, we don't know we don't.

01:43:00.930 --> 01:43:02.390
Olivier Jaron (MF) (Invité)
To use all the members.

01:43:04.500 --> 01:43:06.470
Olivier Jaron (MF) (Invité)
We we, we didn't look too.

01:43:07.110 --> 01:43:16.460
Olivier Jaron (MF) (Invité)
Uh this how many how many members is A is enough to improve skin.

01:43:18.640 --> 01:43:20.340
Olivier Jaron (MF) (Invité)
OK and there's one follow up from Deb.

01:43:20.200 --> 01:43:26.080
Steve Abelman
Become was this information shared with the users the airlines and so they could plan around the turbulence.

01:43:27.720 --> 01:43:28.740
Steve Abelman
So we I didn't.

01:43:29.830 --> 01:43:33.220
Olivier Jaron (MF) (Invité)
Understand so uh W follows up on her.

01:43:33.250 --> 01:43:40.620
Steve Abelman
Easy question with was this shared with airline users if so did they plan around the turbulence.

01:43:43.390 --> 01:43:45.550
Steve Abelman
Hi I'm so we can you can you?

01:43:45.450 --> 01:43:46.950
Olivier Jaron (MF) (Invité)
Keeping the foot doesn't once again.

01:43:48.010 --> 01:43:51.640
Olivier Jaron (MF) (Invité)
I'm not sure to understand OK, Debbie is asked.

01:43:51.540 --> 01:44:01.020
Steve Abelman
Getting up was the information shared with airlines and if it was did they try to plan around the forecast turbulence.

01:44:04.580 --> 01:44:05.500
Steve Abelman
Hello.

01:44:06.580 --> 01:44:07.880
Steve Abelman
OK, I can answer it.

01:44:07.870 --> 01:44:08.790
Pierre Crispel (Météo-France) (Invité)
So carefully.

01:44:10.470 --> 01:44:14.560
Pierre Crispel (Météo-France) (Invité)
You have to equip with which you prefer or you have the question in the chat.

01:44:15.220 --> 01:44:17.020
Pierre Crispel (Météo-France) (Invité)
Yes, yes, but I have to.

01:44:17.130 --> 01:44:19.090
Olivier Jaron (MF) (Invité)
Quit took it the the chat.

01:44:19.140 --> 01:44:21.820
Olivier Jaron (MF) (Invité)
There's a lot more at this time.

01:44:21.930 --> 01:44:26.950
Pierre Crispel (Météo-France) (Invité)
The ATC tool is not it's it is not given to airlines so.

01:44:30.300 --> 01:44:33.130
Pierre Crispel (Météo-France) (Invité)
OK thanks for our lines, we

01:44:33.010 --> 01:44:39.970
Olivier Jaron (MF) (Invité)
We will provide the risk matrix value from a The The Risk Matrix.

01:44:44.020 --> 01:44:45.710
Olivier Jaron (MF) (Invité)
OK, that's all the questions I see here Bob.

01:44:46.250 --> 01:44:48.390
Steve Abelman
OK very good thank you.

01:44:48.270 --> 01:44:50.270
Bob Sharman (Guest)
Well, this is Tammy so.

01:44:50.480 --> 01:45:00.500
Flowe, Tammy (FAA)
start confirmation that Steve Bradford will be on at 11:00. So we have about a 5 minute break do. We wanna we? I don't think we have enough time to start another talk?

01:45:01.630 --> 01:45:03.520
Flowe, Tammy (FAA)
No, not for 5 minutes, so maybe.

01:45:03.390 --> 01:45:09.550
Bob Sharman (Guest)
It would take another 5 minute break, yeah, and then we will convene it at 11:00 and.

01:45:09.470 --> 01:45:11.360
Flowe, Tammy (FAA)
And hopefully Steve will be on then.

01:45:12.310 --> 01:45:13.360
Flowe, Tammy (FAA)
OK sounds good.

01:45:14.270 --> 01:45:15.840
Flowe, Tammy (FAA)
See you back in 5 minutes.

01:45:20.520 --> 01:45:22.180
Flowe, Tammy (FAA)
Can you hear me like summer?

01:45:23.230 --> 01:45:23.800
Ulrich.Schumann
Yes.

01:45:24.460 --> 01:45:26.070
Ulrich.Schumann
And since you have time.

01:45:26.770 --> 01:45:27.280
Ulrich.Schumann
Yeah.

01:45:28.600 --> 01:45:39.600
Ulrich.Schumann
I wonder how in the model, the dissipation rate is computed. I think I think it's computed as a function of kinetic energy and divided by a thread length scale.

01:45:40.250 --> 01:45:42.040
Ulrich.Schumann
How do you determine that link scale?

01:45:48.200 --> 01:45:49.730
Ulrich.Schumann
Olivia that was for you.

01:45:53.320 --> 01:45:54.680
Bob Sharman (Guest)
Say that again. Sorry.

01:45:56.120 --> 01:45:57.300
Olivier Jaron (MF) (Invité)
I was living.

01:45:58.000 --> 01:46:00.430
Olivier Jaron (MF) (Invité)
Should I repeat yeah, it is?

01:46:01.260 --> 01:46:02.990
Olivier Jaron (MF) (Invité)
Yeah, I see.

01:46:03.070 --> 01:46:11.640
Ulrich.Schumann
From modeling to tablet kinetic energy and so you have a source from the sheer and you and you have a sync from dissipation rate is that right.

01:46:14.100 --> 01:46:14.980
Ulrich.Schumann
Uh.

01:46:16.570 --> 01:46:18.340
Olivier Jaron (MF) (Invité)
No, I'm not sure to understand.

01:46:19.380 --> 01:46:23.910
Olivier Jaron (MF) (Invité)
Can can you repeat once again please OK the question is I wanted to?

01:46:23.810 --> 01:46:35.090
Ulrich.Schumann
Know how you modeled dissipation rate as a function of kinetic energy. Yes, and do you have a length scale in that and how do you turn that exactly and and that's the?

01:46:35.010 --> 01:46:41.430
Olivier Jaron (MF) (Invité)
This is the core of the PhD student in fact, uh you're you are right you.

01:46:41.560 --> 01:46:42.010
Olivier Jaron (MF) (Invité)
Umm.

01:46:43.450 --> 01:46:48.480
Olivier Jaron (MF) (Invité)
India is a function of TKE and the UM.

01:46:49.540 --> 01:47:08.960
Olivier Jaron (MF) (Invité)
How do you say UM the link scale is a landscape thing and uh the purpose of the PhD work is to improve this and then scale in Peter in particular, really uh in stable condition.

01:47:09.550 --> 01:47:09.950
Olivier Jaron (MF) (Invité)
Ah.

01:47:10.590 --> 01:47:17.770
Olivier Jaron (MF) (Invité)
Uh after I'd seen her to large scale stable condition like just trick.

01:47:18.420 --> 01:47:20.550
Olivier Jaron (MF) (Invité)
Yeah, that's a very demanding that's a very good.

01:47:20.490 --> 01:47:37.710
Ulrich.Schumann
Morning, job, I understand that this link scale is quite well defined. If you're strong turbulence. But as soon as you have as you have a stable stratified situation. The length scale is very ill defined in any length scales wrong, so exactly and that's that's that's why you?

01:47:37.730 --> 01:47:49.530
Olivier Jaron (MF) (Invité)
And in many global models. We have quite poor skills about tke our idea to to forecast the.

01:47:50.210 --> 01:47:50.730
Olivier Jaron (MF) (Invité)
C. 8.

01:47:50.780 --> 01:47:53.050
Olivier Jaron (MF) (Invité)
Yeah, yeah turbulence.

01:47:53.810 --> 01:47:58.660
Olivier Jaron (MF) (Invité)
Because today is a oftenly very low.

01:47:59.390 --> 01:48:03.160
Olivier Jaron (MF) (Invité)
Yeah, OK, yeah idea in fact, perhaps even setting.

01:48:03.090 --> 01:48:08.600
Ulrich.Schumann
Dissipation rate to zero might be a better approach than just approximating it.

01:48:09.540 --> 01:48:10.230
Ulrich.Schumann
Yeah, OK.

01:48:12.050 --> 01:48:17.630
Ulrich.Schumann
Thank you. Thank you just put some time. Thank you for your question so, so alright this is bad.

01:48:18.510 --> 01:48:22.200
Bob Sharman (Guest)
Your presentation are you sharing that with Andreas and Peter.

01:48:22.710 --> 01:48:23.900
Bob Sharman (Guest)
Yeah, Andreas will start.

01:48:24.600 --> 01:48:25.150
Bob Sharman (Guest)
OK.

01:48:25.970 --> 01:48:28.370
Bob Sharman (Guest)
And it can be centrally is presented in.

01:48:28.240 --> 01:48:28.550
Ulrich.Schumann
Big.

01:48:29.470 --> 01:48:33.260
Ulrich.Schumann
What is your advice should be should be asked you to present the slides or should we do it?

01:48:34.430 --> 01:48:36.380
Ulrich.Schumann
I think it's probably better for you.

01:48:36.270 --> 01:48:39.980
Bob Sharman (Guest)
So if you do it, OK undressed Starbucks starts. Yeah.

01:48:40.570 --> 01:48:44.200
Ulrich.Schumann
And then he will continue with just keep continuing the slide.

01:48:45.230 --> 01:48:51.590
Ulrich.Schumann
The action and and then take over again at it OK. Maybe I can just try to share my.

01:48:51.470 --> 01:48:52.980
Andreas Dörnbrack (Gast)
Screen is it possible Bob.

01:48:54.210 --> 01:48:54.710
Andreas Dörnbrack (Gast)
Uh.

01:48:55.510 --> 01:48:57.190
Andreas Dörnbrack (Gast)
Is it Matt is it possible?

01:48:58.690 --> 01:48:59.600
Bob Sharman (Guest)
Absolutely.

01:49:01.030 --> 01:49:05.780
Matt Fronzak
I mean, just for a check, yeah go forward Andre.

01:49:12.080 --> 01:49:12.830
Olivier Jaron (MF) (Invité)
Turn.

01:49:17.270 --> 01:49:18.230
Olivier Jaron (MF) (Invité)
Hey Bob,

01:49:19.150 --> 01:49:25.040
Flowe, Tammy (FAA)
I I see that Steve Bradford has joined us so let's give it one more minute and then let's start.

01:49:26.030 --> 01:49:27.100
Flowe, Tammy (FAA)
OK, this looks good.

01:49:27.790 --> 01:49:29.920
Bob Sharman (Guest)
Rings we had your we have.

01:49:29.820 --> 01:49:37.140
Matt Fronzak
Your slide you wanna see if you can go into presentation mode and still be able to control it. So I'm in the presentation mode and I.

01:49:37.030 --> 01:49:38.690
Andreas Dörnbrack (Gast)
can go forward like this right?

01:49:39.810 --> 01:49:42.150
Andreas Dörnbrack (Gast)
Uh it's not showing up on presentation mode.

01:49:42.020 --> 01:49:43.840
Matt Fronzak
In our side, it's showing up in the.

01:49:45.050 --> 01:49:46.820
Matt Fronzak
With the with the the.

01:49:48.260 --> 01:49:50.060
Matt Fronzak
Yeah, guys, but we're going to do.

01:49:50.060 --> 01:49:53.240
Flowe, Tammy (FAA)
We're gonna do the keynote at 11:00 right.

01:49:53.920 --> 01:49:56.300
Flowe, Tammy (FAA)
OK, cool, so then they can keep going for a few minutes.

01:49:56.160 --> 01:49:57.250
Bradford, Steve (FAA)
It's uh I'm interested.

01:49:57.310 --> 01:49:59.330
Bradford, Steve (FAA)
Right we run a runner breaks Steve so I.

01:49:59.200 --> 01:50:02.440
Flowe, Tammy (FAA)
I think we're good thanks. We just testing from slides.

01:50:03.980 --> 01:50:05.430
Bob Sharman (Guest)
Well, it's it's usually at the top.

01:50:05.310 --> 01:50:12.470
Bradford, Steve (FAA)
About the top there's usually switch switch switch presentation at the top of your.

01:50:15.060 --> 01:50:17.360
Bradford, Steve (FAA)
Well, it's OK, I mean, the slides are big enough.

01:50:17.430 --> 01:50:23.700
Bob Sharman (Guest)
That we could see it that way. If we can't do presentation mode, but you could do you could figure it out? It's you guys?

01:50:23.560 --> 01:50:25.300
Bradford, Steve (FAA)
Their scientists you can figure it out.

01:50:26.920 --> 01:50:28.150
Bradford, Steve (FAA)
That's one thing.

01:50:29.410 --> 01:50:31.830
Bob Sharman (Guest)
Hey look at book Neil mathematician could figure this out.

01:50:31.720 --> 01:50:34.320
Bradford, Steve (FAA)
But you scientists can certainly figure this out.

01:50:35.560 --> 01:50:37.210
Bradford, Steve (FAA)
I forecast that you could do this.

01:50:38.500 --> 01:50:39.790
Bradford, Steve (FAA)
There you go you know how.

01:50:39.680 --> 01:50:40.820
Bob Sharman (Guest)
Good forecasts are.

01:50:43.700 --> 01:50:44.690
Bob Sharman (Guest)
Wondering about

01:50:44.830 --> 01:50:47.780
Bob Sharman (Guest)
or do you want me to tell you about the first next Gen?

01:50:48.750 --> 01:50:51.940
Bradford, Steve (FAA)
Budget so can, we can, we get started here.

01:50:52.030 --> 01:50:56.590
Flowe, Tammy (FAA)
Bob yes go. No, you're you're running the show not me.

01:50:57.300 --> 01:50:58.930
Flowe, Tammy (FAA)
Yeah, I thought you were gonna come.

01:50:58.860 --> 01:51:00.960
Bob Sharman (Guest)
Oh yeah, OK.

01:51:00.850 --> 01:51:12.630
Flowe, Tammy (FAA)

So we have our our keynote this morning. Is that Steve Bradford. He's the chief scientific and technical advisor for architecture and next Gen development at the FAA.

01:51:12.680 --> 01:51:16.020
Flowe, Tammy (FAA)
Hey, I'm I'm reading right from your your.

01:51:16.560 --> 01:51:19.240
Flowe, Tammy (FAA)
So don't don't read anymore. I just I'm so embarrassed.

01:51:19.110 --> 01:51:22.230
Bradford, Steve (FAA)
First don't read anymore, OK well.

01:51:22.270 --> 01:51:41.800
Flowe, Tammy (FAA)
Where I I do appreciate you taking the time out of your schedule to talk to us a little bit about what you see as you know the future of of you know the FAA and where we're going and especially in the area of turbulence, so this is we've got over 200 people registered for this car.

01:51:42.130 --> 01:51:50.400
Flowe, Tammy (FAA)
No well, I don't think we have 200 on right now, but there is a lot of interest in this so in this so, so let me tell you.

01:51:51.350 --> 01:51:56.850
Bradford, Steve (FAA)
Tammy called me, this morning. Let me tell you what, I was doing which is really related is dumb.

01:51:58.670 --> 01:52:08.060
Bradford, Steve (FAA)
I'm I'm on I'm the chair of the Global Air Navigation Plan Study Group, which is the I Cal group that overseas the global air navigation planned.

01:52:09.120 --> 01:52:17.850
Bradford, Steve (FAA)
And dumb unfortunately when they put in the invitation. It ends up being just the ribbon at the top of my calendar.

01:52:18.730 --> 01:52:30.670
Bradford, Steve (FAA)
So you know it was like, at 5:30. This half hour block even though it was several hours in somehow with Tammy originally asked me I said sure no problem and then turns out that because I'm the chair I'm in this meeting.

01:52:32.610 --> 01:52:41.530
Bradford, Steve (FAA)

I don't know how many of you know the I Cal Global Air Navigation plan. But we have a major section in there called aim at which is where all the plans for.

01:52:42.260 --> 01:52:46.450
Bradford, Steve (FAA)
The future of Aviation Meteorology are supposed to be.

01:52:47.520 --> 01:52:50.470
Bradford, Steve (FAA)
Coming out of the Met Panel and how.

01:52:51.720 --> 01:52:56.220
Bradford, Steve (FAA)
It holds the the states in the MSP should look at met for the next.

01:52:58.440 --> 01:53:03.070
Bradford, Steve (FAA)
But at this point, it for the next 15 years we go in 6 year blocks 'cause we line up with the.

01:53:03.700 --> 01:53:07.500
Bradford, Steve (FAA)
The major every other Assembly, but so I was doing.

01:53:08.800 --> 01:53:13.720
Bradford, Steve (FAA)
I gods work, which includes met this morning. That's my excuse that and I'm really old so.

01:53:14.710 --> 01:53:20.220
Bradford, Steve (FAA)
I've been around forever, but anyway, so let's talk a little bit about where the FAA is going.

01:53:22.010 --> 01:53:27.280
Bradford, Steve (FAA)
If you can read my background, you'll see. It says charting aviations future living in an infant centric mass.

01:53:29.590 --> 01:53:34.200
Bradford, Steve (FAA)
We really embrace that idea when we put together next Gen.

01:53:35.160 --> 01:53:39.810
Bradford, Steve (FAA)
And the first budget in 2007, 2008 going out for.

01:53:41.080 --> 01:53:43.100
Bradford, Steve (FAA)
Basically, we plan to 15 years.

01:53:43.840 --> 01:53:53.800
Bradford, Steve (FAA)

Uh our idea of communications with the with the aircraft was over a cars. You know data.com was the wave of the future.

01:53:54.670 --> 01:53:55.260
Bradford, Steve (FAA)
Uh.

01:53:55.880 --> 01:53:56.780
Bradford, Steve (FAA)
We still

01:53:57.910 --> 01:54:07.730
Bradford, Steve (FAA)
he had pilots dragging around Jefferson charts and giant carry on luggage and so that's not that long ago.

01:54:09.190 --> 01:54:13.480
Bradford, Steve (FAA)
And then suddenly, we've entered this whole information age where.

01:54:14.190 --> 01:54:24.180
Bradford, Steve (FAA)
Everything is becoming connected, including the aircraft is becoming very, very connected and So what is that doing for us and what have we? What have we implemented?

01:54:24.250 --> 01:54:26.370
Bradford, Steve (FAA)
Come and how can we?

01:54:26.980 --> 01:54:31.580
Bradford, Steve (FAA)
Advance the state of meteorology using this info centric world so.

01:54:32.230 --> 01:54:32.800
Bradford, Steve (FAA)
Uh.

01:54:35.580 --> 01:54:39.870
Bradford, Steve (FAA)
One of the things we've been investigating and turbulences ever since.

01:54:40.660 --> 01:54:48.490
Bradford, Steve (FAA)
2008 turbulence has been part in turbulence Maps and turbulence has been part of our plans.

01:54:49.220 --> 01:54:58.290
Bradford, Steve (FAA)
I will tell you that, UM forecasting when we would get turbulence Maps to the general aviation and the commercial pilots is probably is.

01:54:59.450 --> 01:55:01.220
Bradford, Steve (FAA)
It's not that they're gonna forecast.

01:55:02.530 --> 01:55:05.910
Bradford, Steve (FAA)
But then on the other hand, when I put together the original budget.

01:55:06.540 --> 01:55:11.490
Bradford, Steve (FAA)
Uh Rick Heuwinkel was still around and he came in with his budget request.

01:55:13.060 --> 01:55:29.830
Bradford, Steve (FAA)
And it's it was 30 to $50,000,000.00 in for 5 years and I'm going well, which isn't he says. Well, it's 30 to $50,000,000.00. I I had to remind him that budgets are not weather forecast so that's where we're at.

01:55:31.390 --> 01:55:37.900
Bradford, Steve (FAA)
But Tammy is promised me a turbulence Maps for a long time, but I think part of the problem is been.

01:55:39.630 --> 01:55:56.970
Bradford, Steve (FAA)
The availability of good data lots of data and we're still working on that, so I'm sure we're going to cover this week. Some of the some of our efforts to try to extract turbulence out of a DSB messages using the vertical vector.

01:55:58.710 --> 01:56:00.630
Bradford, Steve (FAA)
On the other hand, UM.

01:56:02.050 --> 01:56:14.710
Bradford, Steve (FAA)
We also have been doing some very interesting things with connected aircraft where just this last year. In fact, we just won an award in at the world ATM in Madrid for this.

01:56:15.610 --> 01:56:17.290
Bradford, Steve (FAA)
We basically showed how.

01:56:18.950 --> 01:56:49.960
Bradford, Steve (FAA)
Over Airborne Internet or connected aircraft we could negotiate we could get information from the flight deck down link it to 2 of our automation. We could negotiate with the pilots in the AOC 's over iPad slash surfaces. We could then come up with a new route of flight, and we could basically push that route of flight, securely to the second page of the FMS. The one thing we didn't do is execute that that clearance because that's

01:56:50.490 --> 01:56:57.670
Bradford, Steve (FAA)
that was this was a trial mode and we have an approved the safety of that, but then leads you to wonder begin to wonder.

01:56:58.460 --> 01:56:59.070
Bradford, Steve (FAA)
Uhm.

01:57:00.020 --> 01:57:02.020
Bradford, Steve (FAA)
How are we gonna exploit?

01:57:02.960 --> 01:57:12.250
Bradford, Steve (FAA)
The connected aircraft how are we going to exploit this info centric world where everything that can be connected will be connected and part of that issue I think is.

01:57:13.880 --> 01:57:21.090
Bradford, Steve (FAA)
Why am I trying to extract exactly what's going on with turbulence from the ATSB vertical?

01:57:21.960 --> 01:57:38.630
Bradford, Steve (FAA)
The velocity vector when I now have to try to figure out whether they're banking ET cetera ET cetera. Why can't I get that information directly from the from the aircraft like can't we have this richer. Fuller view of life so that's one thing I'd seems to me that over the next 15 years.

01:57:39.700 --> 01:58:03.780
Bradford, Steve (FAA)
As we push this connected aircraft. We need to get our our pilots to participate airlines that participate. More and more and direct information not using the expense of acreage linked or not using trying to drive it from a 3rd from another source, but really connected and I was going through your agenda and the other thing I've I find very interesting.

01:58:05.470 --> 01:58:06.200
Bradford, Steve (FAA)
Is that?

01:58:08.630 --> 01:58:27.240
Bradford, Steve (FAA)
What are the role of global models versus local models especially when you get to turbulence at low altitudes? Do I need a global model or can I use information that's coming from my individual vehicles with whether it's a or or or small uas to actually forecast.

01:58:28.460 --> 01:58:42.590
Bradford, Steve (FAA)

But forecast nowcast real time what the turbulences is in a regime and an area in how can I push that those calculations and that that mapping to the edge and that should be available to us with them.

01:58:43.510 --> 01:58:52.660
Bradford, Steve (FAA)
With especially at the lowest altitudes with the cellular networks that 5 G. The ability to push things to the edge, we seen in ground transportation.

01:58:53.550 --> 01:58:58.480
Bradford, Steve (FAA)
Uh edge computing why, why don't we see more and more of that at the?

01:58:59.610 --> 01:59:01.120
Bradford, Steve (FAA)
At the uh.

01:59:01.910 --> 01:59:08.930
Bradford, Steve (FAA)
For turbulence at low altitudes do. I really need a global model or do I need a combination of global and edge modeling.

01:59:10.630 --> 01:59:17.920
Bradford, Steve (FAA)
And then finally and this is one of my is going way too fast. I apologize but following this is one of my.

01:59:20.540 --> 01:59:22.630
Bradford, Steve (FAA)
Particular interests is.

01:59:23.450 --> 01:59:27.060
Bradford, Steve (FAA)
Tribulus for a long time has been the the domain of the pie Rep.

01:59:28.100 --> 01:59:35.950
Bradford, Steve (FAA)
And I'm trying to figure out with my team our team. What is the what is the modern pirap?

01:59:38.090 --> 01:59:40.440
Bradford, Steve (FAA)
How do I get that information?

01:59:42.230 --> 01:59:44.500
Bradford, Steve (FAA)
Without actually having to have it voiced.

01:59:45.240 --> 01:59:46.710
Bradford, Steve (FAA)
Uh what is our goal.

01:59:48.120 --> 01:59:49.030
Bradford, Steve (FAA)
And dumb.

01:59:50.950 --> 02:00:01.530
Bradford, Steve (FAA)
Because as we know one. One pilots interpretation of turbulence is different than the next pilots. It all depends on the size of your aircraft your weight.

02:00:02.130 --> 02:00:04.290
Bradford, Steve (FAA)
Uh your tolerance.

02:00:06.100 --> 02:00:07.230
Bradford, Steve (FAA)
And a

02:00:08.250 --> 02:00:26.760
Bradford, Steve (FAA)
Whether it's boxes or people So what is the role of the modern of what is the role of Pireps in this modern info centric world and those are the kind of things that I think from the turbos perspective. I'm really interested in I. I have really pushed the DSB.

02:00:28.120 --> 02:00:36.750
Bradford, Steve (FAA)
Because I wasn't sure that I could get the connected aircraft working as well as we are getting it working but should I push the ADF be sure that pushed both.

02:00:37.310 --> 02:00:39.690
Bradford, Steve (FAA)
Uh should we

02:00:41.590 --> 02:00:47.620
Bradford, Steve (FAA)
should we consider good citizenship, sharing of information from the flight deck over the connected aircraft.

02:00:48.230 --> 02:00:56.990
Bradford, Steve (FAA)
Uh is that part of our best equipped best served going forward. If you share the information. I'll let you do certain things, I don't know, but

02:00:58.910 --> 02:01:02.660
Bradford, Steve (FAA)
I think a new worlds opening up for us, we spent.

02:01:03.660 --> 02:01:10.010
Bradford, Steve (FAA)

Several years trying to figure out how to use the old technology. Now it's time to figure out how to use our new technology.

02:01:10.830 --> 02:01:18.620
Bradford, Steve (FAA)
Tammy I'm I apologize. I'll take any questions. Anybody has them or I'll let you get back to real science.

02:01:19.810 --> 02:01:21.880
Bradford, Steve (FAA)
No thank you Steve that that.

02:01:22.260 --> 02:01:41.260
Flowe, Tammy (FAA)
You you hit on a couple of points that I think are very, very important. One is the you know the modern pie Rep thing. I think the the days of the pilots calling down say, Oh, we're kind of bouncing the coffee cups around you know what we can do better than that now and I think that we need to focus on that.

02:01:41.690 --> 02:02:05.810
Flowe, Tammy (FAA)
Uhm sharing of info is really important, and and and we had a presentation earlier from Dean Locket of the world. Meteorological organization talking about their new resolution 40 and data sharing policies and so I think that's something that we need to really take a hard look at from from a US carrier standpoint.

02:02:07.480 --> 02:02:16.510
Flowe, Tammy (FAA)
Yeah, I I'll I'll turn it over to Steve Adelman. Here, who's monitoring our chat and see if we have any questions, so Steve well, I just wanted to say hi Mister able.

02:02:17.100 --> 02:02:19.050
Bradford, Steve (FAA)
Hello Mister, Bradford how are you it's been awhile?

02:02:19.670 --> 02:02:26.400
Steve Abelman
Uh actually Steve to my amazement. There are no questions on the chat room right now. I'm getting a few I'm not surprised.

02:02:28.200 --> 02:02:29.270
Bradford, Steve (FAA)
No no no.

02:02:30.340 --> 02:02:33.470
Steve Abelman
We do have some time for some questions if anybody wants to.

02:02:34.220 --> 02:02:36.450
Steve Abelman
To move things along I think uh?

02:02:37.560 --> 02:02:45.290
Steve Abelman
Let me see I think there might be one from John Williams. At IBM, who asked what is the role of the private sector in modernizing aviation?

02:02:45.870 --> 02:02:50.860
Steve Abelman
Could industry FAA partnerships help accelerate transition of research to operations?

02:02:51.550 --> 02:02:53.980
Steve Abelman
I so I absolutely.

02:02:53.860 --> 02:02:56.460
Bradford, Steve (FAA)
We believe that we need to get to come.

02:02:57.520 --> 02:02:58.510
Bradford, Steve (FAA)
Especially.

02:02:59.440 --> 02:03:09.200
Bradford, Steve (FAA)
In our non traditional areas, the places we don't do so well. But whether I absolutely think that the public, private partnership is really, really important and.

02:03:09.260 --> 02:03:09.620
Bradford, Steve (FAA)
Uh.

02:03:11.680 --> 02:03:22.570
Bradford, Steve (FAA)
Yeah, Bill Bill Bob and his guys working are really trying to figure out what is performance? How do we describe the performance of of of weather and weather forecasting and weather?

02:03:23.420 --> 02:03:24.390
Bradford, Steve (FAA)
As opposed to.

02:03:26.900 --> 02:03:36.010
Bradford, Steve (FAA)
Being technology, centric, which is what we live our performances right now and so I absolutely think that we can move faster. I also think that.

02:03:38.750 --> 02:03:39.940
Bradford, Steve (FAA)
I also think that.

02:03:42.100 --> 02:03:44.450
Bradford, Steve (FAA)
Do we actually have to come.

02:03:45.410 --> 02:03:46.440
Bradford, Steve (FAA)
Do we actually have to?

02:03:47.530 --> 02:04:07.700
Bradford, Steve (FAA)
Compute everything or can, we share share that compute computational power, especially especially for this for the Urban Air. Mobility 's in the hour passes. I I don't think that the FAA wants to be the OR the National Weather Service and be the source of real information.

02:04:08.360 --> 02:04:08.950
Bradford, Steve (FAA)
Uhm.

02:04:10.360 --> 02:04:13.720
Bradford, Steve (FAA)
I see lots of questions about airlines being reluctant.

02:04:13.780 --> 02:04:14.440
Bradford, Steve (FAA)
Uh.

02:04:16.070 --> 02:04:28.810
Bradford, Steve (FAA)
It's a It's a good question. I've always wondered about why they're reluctant to share their their their sensed information where Pirates is supposed to be a community responsibility.

02:04:29.460 --> 02:04:35.230
Bradford, Steve (FAA)
Uhm encouraged but the actual data seems to be more.

02:04:36.930 --> 02:04:38.120
Bradford, Steve (FAA)
Held close.

02:04:38.900 --> 02:04:39.410
Bradford, Steve (FAA)
Uhm.

02:04:40.600 --> 02:04:47.290
Bradford, Steve (FAA)
I think that if you want to fully participate in in trajectory based operations to answer the one question you really want to get.

02:04:47.350 --> 02:04:59.070
Bradford, Steve (FAA)
Uh that we should probably make the cost of entry use you sharing but not only your your trajectory intent. But the conditions that you see around you is from a weather intents, so that we can get a full picture.

02:04:59.910 --> 02:05:01.120
Bradford, Steve (FAA)
When we do the planning.

02:05:02.780 --> 02:05:03.230
Bradford, Steve (FAA)
You know.

02:05:04.420 --> 02:05:31.310
Bradford, Steve (FAA)
Part of the problem with trajectory based operations today is that even though you can fork you can do a nice trajectory based on what you know about the airspace. You really don't know about what's how it's evolving ahead of you and so the sharing that information with each other and actually improve your forecast reduced the buffers and probably make our space much more efficient. So I think sharing of the information also does a lot for our sustainability goal?

02:05:34.240 --> 02:05:35.890
Bradford, Steve (FAA)
So we did have a question Uh Matthias.

02:05:36.310 --> 02:05:44.750
Steve Abelman
Has a question TS diner for men car? What are the hurdles for getting a best equipped best served approach implemented it could greatly accelerate modernization?

02:05:45.950 --> 02:05:47.050
Steve Abelman
I think that their heart.

02:05:46.910 --> 02:05:47.740
Bradford, Steve (FAA)
Both are.

02:05:49.140 --> 02:05:49.850
Bradford, Steve (FAA)
Ah.

02:05:51.640 --> 02:05:54.920
Bradford, Steve (FAA)
Put the hurdles really are just a.

02:05:55.840 --> 02:05:57.450
Bradford, Steve (FAA)
What what do you get in return?

02:05:59.490 --> 02:06:04.900
Bradford, Steve (FAA)
And if it's you know if if it's focused on the airport and the runway. It gets really difficult.

02:06:05.960 --> 02:06:10.990
Bradford, Steve (FAA)
But if it's focused on how you can participate in certain operations.

02:06:12.100 --> 02:06:13.780
Bradford, Steve (FAA)
Uh in the en route.

02:06:14.390 --> 02:06:28.890
Bradford, Steve (FAA)
I think that we can, we can reach that hurdle pretty pretty readily. You know, we do, do a lot of best equipped best served but it's usually very binary, you know if you if you don't have cat too. You can't land a cat too. If you don't have cat 3. You can't win and get 3.

02:06:30.380 --> 02:06:31.350
Bradford, Steve (FAA)
Or if you

02:06:32.630 --> 02:06:36.520
Bradford, Steve (FAA)
but I I think that there are opportunities for.

02:06:39.850 --> 02:06:50.340
Bradford, Steve (FAA)
Forgetting too uh it's in root operations where if you share the information. We could probably say that you can participate in more trajectory based operations and we

02:06:51.650 --> 02:06:55.440
Bradford, Steve (FAA)
we can do this by providing advantage. I mean, most people.

02:06:56.650 --> 02:06:59.590
Bradford, Steve (FAA)
We have analogiesifyoulook@data.com?

02:07:00.890 --> 02:07:05.050
Bradford, Steve (FAA)
Uh the pre departure clearance, which has got nothing to do with turbulence, but anyways.

02:07:05.120 --> 02:07:05.480
Bradford, Steve (FAA)
Right.

02:07:06.960 --> 02:07:12.350
Bradford, Steve (FAA)
You know uh we let people who can get the The The New.

02:07:13.100 --> 02:07:32.380
Bradford, Steve (FAA)
Uh departure clearances over Datacom get to go the head of the line because the controller can just push push push while he's talking to the ones who can't and they just naturally get to the head of the line. I think we can show preference to those who share information if we're trying to do better trajectory.

02:07:33.450 --> 02:07:35.460
Bradford, Steve (FAA)
Negotiations so I would say.

02:07:36.050 --> 02:07:42.080
Bradford, Steve (FAA)
I would couple it with not just the weather information, but your intent information to make things a little bit.

02:07:43.270 --> 02:07:43.920
Bradford, Steve (FAA)
Easier.

02:07:46.240 --> 02:07:47.580
Bradford, Steve (FAA)
K thanks it now one of.

02:07:47.450 --> 02:08:04.090
Steve Abelman
Their question here, I see when you mentioned in a in A and this is actually quite quite a topic of conversation. The next couple days when you mentioned the need for modern pireps or you specifically thinking of edr observations? How much do you think ERS could meet miss or? How do you think edr 's could meet this need?

02:08:05.700 --> 02:08:06.790
Steve Abelman
Well, so I don't know.

02:08:07.760 --> 02:08:08.460
Bradford, Steve (FAA)
I don't know well.

02:08:09.590 --> 02:08:11.020
Bradford, Steve (FAA)
How am I getting the ERS?

02:08:14.230 --> 02:08:18.770
Bradford, Steve (FAA)
It might it might yeah, my getting it from a limited set of participants or they all providing it to me.

02:08:19.210 --> 02:08:21.250
Bradford, Steve (FAA)
Well, that's that's a very good question.

02:08:22.440 --> 02:08:25.030
Flowe, Tammy (FAA)
So if if if if I'm still doing it with the living.

02:08:24.910 --> 02:08:31.230
Bradford, Steve (FAA)
Help set up participants. I'm I'm not sure that you have the coverage that you would like to get it.

02:08:31.880 --> 02:08:33.930
Bradford, Steve (FAA)
It all altitudes, but if if.

02:08:35.520 --> 02:08:38.610
Bradford, Steve (FAA)
If we actually can figure out how to get more participants using?

02:08:39.450 --> 02:08:43.370
Bradford, Steve (FAA)
Uh other communications paths and on board.

02:08:44.290 --> 02:08:50.990
Bradford, Steve (FAA)
Equip each other than your your traditional avionics. I think yeah, I think edr could.

02:08:51.550 --> 02:08:52.810
Bradford, Steve (FAA)
Could replace

02:08:53.420 --> 02:08:57.690
Bradford, Steve (FAA)
uhm that is if you guys? Give me the?

02:08:58.340 --> 02:08:59.000
Bradford, Steve (FAA)
Then.

02:08:59.680 --> 02:09:01.210
Bradford, Steve (FAA)
The translation from Edr.

02:09:01.260 --> 02:09:11.810
Bradford, Steve (FAA)
Are based on the weight of the aircraft that's receiving it to? What will it be experienced by aircraft of other different weights as I remember this is the problem with DDR?

02:09:13.130 --> 02:09:26.140
Bradford, Steve (FAA)
Or as I say when I threw the food the 3 heavier back and forth to Heathrow, a few times. I think I felt turbulence. Once in the North Atlantic, which is not the normal sensation of the North Atlantic.

02:09:29.520 --> 02:09:30.860
Bradford, Steve (FAA)
Yeah, I'm absolutely.

02:09:30.750 --> 02:09:33.980
Flowe, Tammy (FAA)
Steve but it's certainly something that we're looking at.

02:09:35.610 --> 02:09:37.980
Flowe, Tammy (FAA)
But I really think the more observations.

02:09:37.860 --> 02:09:56.580
Bradford, Steve (FAA)
We get the more comfortable will be will be with is is my edr map sufficient for me to really hit publish it as a tribulus map based on the class of aircraft and the type of operation, which has always been our goal take? How can I take the state of the atmosphere turn it into something that could be?

02:09:57.190 --> 02:10:05.480
Bradford, Steve (FAA)
Measured against a trajectory, which would be based on both class and type of operation so I can issue either.

02:10:05.540 --> 02:10:09.180
Bradford, Steve (FAA)
Uhm better planning or alerting let's say.

02:10:13.160 --> 02:10:14.160
Bradford, Steve (FAA)
Wait, we're putting it.

02:10:15.850 --> 02:10:16.790
Bradford, Steve (FAA)
No, that's

02:10:17.340 --> 02:10:26.460
Flowe, Tammy (FAA)
You hit the nail on the head. There absolutely and you know based on the NTSB report that came out recently so we're going to be looking at a lot of these things.

02:10:27.530 --> 02:10:29.590
Flowe, Tammy (FAA)
I always read that I I I.

02:10:29.820 --> 02:10:39.430
Bradford, Steve (FAA)
so I listened in a little bit when you were looking at your slides about clear air turbulence. I always remember the one time, we all got dragged over to OMB where we show that you know.

02:10:40.110 --> 02:10:55.340
Bradford, Steve (FAA)
Edr from the aircraft preceding the aircraft hit the clear outage rebalance didn't show any the aircraft behind. It didn't show any but the one aircraft got a big upset so clearly. It's not it can't solve all of our problems, but it's.

02:10:57.410 --> 02:10:59.560
Bradford, Steve (FAA)
You're right, but we can, we can work at it.

02:11:00.180 --> 02:11:00.630
Flowe, Tammy (FAA)
Yep.

02:11:02.390 --> 02:11:03.860
Flowe, Tammy (FAA)
And there was Steve there is one final.

02:11:03.860 --> 02:11:27.040
Steve Abelman
Airline response from Tim Miner, who just pointed out from American you just pointed out that you know, he may not want to publicize the fact that he flew through moderate or greater turbulence to keep it in the public domain and that is part of the challenge of of commercial airlines when with litigations and everything else. That's going on. It's it's going to be. It's been one of the challenges community has faced for a long time, so we have to figure that out.

02:11:27.110 --> 02:11:28.530
Bradford, Steve (FAA)
We also have to figure out whether.

02:11:31.790 --> 02:11:32.260
Bradford, Steve (FAA)
So.

02:11:34.470 --> 02:11:37.790
Bradford, Steve (FAA)
I I think we can get around that, if we work at it right.

02:11:40.580 --> 02:11:42.430
Andreas Dörnbrack (Gast)
We share lots of information where we don't need.

02:11:42.310 --> 02:11:43.430
Bradford, Steve (FAA)
Make it public domain.

02:11:44.560 --> 02:11:46.430
Bradford, Steve (FAA)
Right and so infoshare is like.

02:11:46.300 --> 02:11:48.760
Flowe, Tammy (FAA)
Like I'm I'm really a good.

02:11:49.640 --> 02:11:54.410
Flowe, Tammy (FAA)
Paradigm for us to work on right right so does it so is it is it going?

02:11:54.420 --> 02:11:57.840
Bradford, Steve (FAA)
Where is it going encrypted is it is it?

02:12:00.440 --> 02:12:04.350
Bradford, Steve (FAA)
Do you attribute it is that the way we put it as you build your Maps?

02:12:06.630 --> 02:12:08.780
Bradford, Steve (FAA)
I think those are all things we have to consider.

02:12:10.830 --> 02:12:12.420
Bradford, Steve (FAA)
Yeah, absolutely I mean?

02:12:12.680 --> 02:12:15.800
Flowe, Tammy (FAA)
It and in the end, it comes down to a safety thing.

02:12:19.360 --> 02:12:21.810
Flowe, Tammy (FAA)
Hey Bob how we doing on time here, we need.

02:12:21.860 --> 02:12:23.030
Steve Abelman
I think it's time for me to leave.

02:12:24.410 --> 02:12:26.950
Steve Abelman
Thank thank you Steve I appreciate you.

02:12:26.830 --> 02:12:30.930
Flowe, Tammy (FAA)
Do you like taking the time I apologize profusely?

02:12:31.150 --> 02:12:32.250
Bradford, Steve (FAA)
No, it's OK.

02:12:32.950 --> 02:12:35.650
Flowe, Tammy (FAA)
We're flexible we can do it so.

02:12:36.660 --> 02:12:39.110
Flowe, Tammy (FAA)
Well, you should have forecasted I'd be late that's all I got.

02:12:40.400 --> 02:12:41.130
Bradford, Steve (FAA)
Well, I I'm.

02:12:41.010 --> 02:12:42.190
Flowe, Tammy (FAA)
Remember that for next time.

02:12:43.460 --> 02:12:46.190
Flowe, Tammy (FAA)
Thank you so much OK, bye bye.

02:12:52.440 --> 02:12:53.160
Bradford, Steve (FAA)
OK Bob,

02:12:53.750 --> 02:12:56.180
Flowe, Tammy (FAA)
OK, I think we're ready for our.

02:12:56.050 --> 02:13:08.460
Bob Sharman (Guest)
Our next talk is by Professor Paul Williams. At the University of Reading, UK and he's gonna talk about something I think we're all very interested in and that is.

02:13:10.010 --> 02:13:14.860
Bob Sharman (Guest)
The effect of climate change on clear air turbulence, so Paul.

02:13:15.480 --> 02:13:17.630
Bob Sharman (Guest)
Hi Bob thanks everyone.

02:13:18.430 --> 02:13:19.550
Bob Sharman (Guest)
And just let me figure.

02:13:19.420 --> 02:13:20.240
Paul Williams
Route how to

02:13:22.440 --> 02:13:26.140
Paul Williams
how to get this right share. I want to share.

02:13:27.410 --> 02:13:30.800
Paul Williams
A window I think PowerPoint slideshow.

02:13:33.010 --> 02:13:35.980
Paul Williams
How's that looking good presentation mode?

02:13:36.950 --> 02:13:38.320
Paul Williams
Yep, great.

02:13:39.910 --> 02:13:58.130
Paul Williams
Uh I just want to do that, so you can see my pointer. I hope as well. Yes, yes, thanks a lot. Bob and feed current Ami for continuing to organize what I think it's become one of my favorite workshops and I. I really appreciate the combination of basic science and operational impacts.

02:13:59.470 --> 02:14:17.490
Paul Williams
So, please continue organizing it in future if you can and I'm very much on the basic science side of things and I'm a University academic trained in physics and now working in Meteorology, but the operational impacts of turbulence on aviation uh why or why I do what I do.

02:14:18.960 --> 02:14:34.330
Paul Williams
So, in this talk, I'll cover something I've talked about. In previous incarnations of this workshop climate change. But I'm also going to show you some new work that we've not yet published so in fact, you're the first people to see it work on climate variability.

02:14:35.340 --> 02:14:43.420
Paul Williams
Come out as a specifically I'll talk about El Nino and La Nina events and their consequences for clear air turbulence as well.

02:14:45.830 --> 02:14:51.720
Paul Williams
Just making a note of the time so I got 50 minutes and he just stop stop talking at 22:00 all right.

02:14:53.530 --> 02:14:59.120
Paul Williams
So let's start with a quick 101 on the basics of cat as they pertain to this talk.

02:14:59.930 --> 02:15:10.510
Paul Williams
And we've known for several decades from an observation from observational evidence that there's a clear link between vertical wind shear instabilities and clear air turbulence.

02:15:13.330 --> 02:15:21.030
Paul Williams
And the second point is that we also know that the vertical wind shear varies in strength a lot overtime at any given location.

02:15:21.870 --> 02:15:30.880
Paul Williams
So that could be for example, variations from one year to the next so No 2 years are the same because of internal climatic oscillations.

02:15:31.700 --> 02:15:37.460
Paul Williams
Like how Nina or the North Atlantic oscillation or any of a number of other named oscillations.

02:15:38.630 --> 02:15:43.680
Paul Williams
Ah, but the wind shear is varying on longer timescales 2, decades because of climate change.

02:15:44.600 --> 02:16:13.750
Paul Williams
Ask a stick I guess the intrinsic difference between these 2 modes of variability is that the year to year. Variations are are cyclic. They flipped from positive to negative to positive from El Nino to La Nina El Nino and back again, whereas the the longer time scale. Climate change driven variability is only going in One Direction and not coming back to its starting place in general. When we look over a period of time will be seeing a combination of these 2.

02:16:15.420 --> 02:16:23.530
Paul Williams
So just putting these 2 points together if cat is associated with vertical wind shear and vertical wind shear varies in time that gives us the?

02:16:24.490 --> 02:16:28.790
Paul Williams
The potential for a new source of variability in class in cat.

02:16:29.800 --> 02:16:36.900
Paul Williams
And and so that line of argument and that logic is going to be the focus of my talk can, we learn something about cat.

02:16:37.960 --> 02:16:42.040
Paul Williams
From the changes in vertical wind shear on different time scales.

02:16:43.400 --> 02:16:45.420
Paul Williams
Just to emphasize those points graphically.

02:16:45.980 --> 02:17:15.900
Paul Williams
And we know that the atmosphere is what meteorologists call stratified so it's pretty dense negate the ground level and the air gets thinner and less dense the further up. We go that stratification and it inhibits the production of turbulence. That's basically because it costs more energy to move some dense fluid up against gravity than the energy that you would get back from moving light fluid back down to fill its space and replace it so vertical motions don't happen spontaneously.

02:17:16.190 --> 02:17:18.970
Paul Williams
In a stratified fluid they require a source of Energy.

02:17:19.920 --> 02:17:24.130
Paul Williams
And a good source of energy is is the winds and specifically Windshear.

02:17:25.600 --> 02:17:39.480
Paul Williams
So that's what is is driving cat and we get instability called the Kelvin Helmholtz instability in fluid dynamics if the wind. Shear is stronger than the stratification as measured by a non dimensional parameter called the Richardson number.

02:17:41.530 --> 02:18:06.580
Paul Williams
So if the Windshear is strong enough little perturbations in the flow can grow exponentially and eventually overturn and break generating clear air turbulence. So here's a numerical simulation of that process. In a simple flow with 2 layers. Black fluid being the denser fluid on the bottom and white fluid being being the lighter fluid on top so this is what we fly through when we fly through cat.

02:18:07.430 --> 02:18:08.770
Paul Williams
Doesn't look much fun does it?

02:18:12.170 --> 02:18:24.310
Paul Williams
So I'll start with talking about climate variability and I'll come back to climate change in the second part of my talk and it was actually reading one of Bob 's papers coauthored with Jamie Wolf. There was the inspiration here.

02:18:25.330 --> 02:18:33.430
Paul Williams
What they did in that paper is analyzed pilot reports over a 12 year period from 1994 to 2005?

02:18:34.000 --> 02:18:50.070
Paul Williams
These are pilot reports over the US between flight level 180 and 600 monthly averaged counts per day number of encounters with moderate or greater is shown here severe or greater and the total number of encounters.

02:18:51.490 --> 02:18:59.390
Paul Williams
So there's a clear seasonal cycle here. That's interesting it peaks in winter bottoms out in summer, perhaps because of of.

02:19:00.980 --> 02:19:03.320
Paul Williams
Convective turbulence in winter storms or maybe.

02:19:03.650 --> 02:19:04.080
Paul Williams
And.

02:19:04.450 --> 02:19:14.760
Paul Williams
And there's a stronger jet stream, generating more clear air turbulence. These are of course, not, pireps specifically for cat, but Pireps in in general, for any source of turbulence.

02:19:16.100 --> 02:19:34.500
Paul Williams
So this intra annual variability within a year but what's more interesting to me for this talk is the Inter annual variability from one year to the next you can see it goes up and down quite a lot in. In in many winters. There will be 200 to 250 encounters a day but in some winters over 300.

02:19:35.950 --> 02:20:04.870
Paul Williams
Specifically, in this winter here over 300 encounters a day and I love. This There's a footnote in the paper, which I have copied and I've copied that from a screenshot as pointed out by an anonymous

reviewer. It may be more than a coincidence that 1998 the year of this peak was one of the strongest done in years on record, and that may be expected to lead to stronger jet streams and more turbulence. So it was literally reading this paper of barbs and and this footnote.

02:20:05.880 --> 02:20:12.570
Paul Williams
Which is just mentioned in passing that has been the inspiration for the research I'll show you the new research in the next few slides.

02:20:13.200 --> 02:20:17.290
Paul Williams
So do read Bob 's papers a great source of inspiration or find.

02:20:18.800 --> 02:20:19.250
Paul Williams
Uhm.

02:20:19.820 --> 02:20:33.480
Paul Williams
I think you I guess you all know about El Nino and but here's a a quick introduction to it in case you don't this is actually called the El Nino, Southern Oscillation in full and it's lost relation. That's centered in the tropical Pacific Ocean.

02:20:34.000 --> 02:20:40.700
Paul Williams
Uh in en El Nino phase the tropical Pacific warms up and these winds weaken.

02:20:41.860 --> 02:20:50.810
Paul Williams
And when we go back into la Nina conditions. The wind strengthened so stronger flight cruising level winds in La Nina and weaker and they'll Nina.

02:20:52.510 --> 02:21:08.680
Paul Williams
But as well as these impacts on what are called the Walker circulation in the tropics they're also known impacts of El Nino and La Nina. The cold sister of the warm El Nino. They're also impacts on the jet streams. In the mid latitudes as well so it is plausible that.

02:21:09.330 --> 02:21:14.550
Paul Williams
This oscillation, natural climate oscillation could be driving changes in clear air turbulence.

02:21:16.120 --> 02:21:18.090
Paul Williams
And having a little dig through the data.

02:21:18.670 --> 02:21:35.860
Paul Williams
Looking back over 30 years worth of data at El Nino events. Typical El Nino events on the left and La

Nina on the right. I'm showing here. The flight cruising flight cruising level. Wind speed anomalies. I think I'm on that. Yes, at 2:00, 100 hecto pascals so about 40,000 feet.

02:21:37.200 --> 02:21:46.860
Paul Williams
So indeed well there's when there's an El Nino. The flight cruising level winds in the tropical Pacific are up to 10 meters a second weaker than normal.

02:21:47.940 --> 02:21:55.520
Paul Williams
And 6789 meters per second stronger during La Nina. Let's just consistent with what I was showing that's these winds changing up here.

02:21:57.370 --> 02:22:06.160
Paul Williams
But also during our ninyo the jet stream over the over the US and in the Northeast Pacific, is up to 10 meters a second stronger than normal.

02:22:07.690 --> 02:22:27.620
Paul Williams
And and and correspondingly weaker during a la Nina so this is entirely consistent with the footnote in Bob and jamies paper? It is it is possible that the reason for the spike in pilots encountering turbulence in 199798, was due to El Nino, but this is plotting wind speed, which is.

02:22:29.080 --> 02:22:34.900
Paul Williams
Well, it's a a useful proxy for cat, but it's not really what we're interested in what we really want is the sheer.

02:22:35.890 --> 02:22:40.420
Paul Williams
So that's what we've calculated here and this work was done by a student of mine Rachel Chaney.

02:22:42.860 --> 02:22:59.910
Paul Williams
And I if I just flipped backwards and forwards so this is the wind speed in meters per second. The anomalous wind speed and this is the same for the sheer in meters per second per 100 hectopascals so for every 100 hectare. Pascal vertical change in altitude. This is the change in wind speed that results.

02:23:00.940 --> 02:23:11.610
Paul Williams
And again, I'll Nina on the left and La Nina on the right and to a good first approximation. These patterns are the same which just confirms the link really between Shia and speed.

02:23:15.820 --> 02:23:41.520
Paul Williams
And so just looking in detail then let's focus on the the Northeast Pacific and the the US. It's quite a strong signal in an El Nino year. The sheer increases by 5 meters per second per 100 hectopascal and the

opposite during La Nina. It's a 5 meter per second reduction, so the difference between El Nino and La Nina is 10 meters per second per 100 hectopascals, which is quite large.

02:23:43.430 --> 02:23:56.300
Paul Williams
And a sheer of 10 meters per second per 100 hectopascals means that the wind, it 200. Hectopascals or 40,000 feet is 10 meters. A second faster than the wind at 3:00, 100 hectopascals or 30,000 feet.

02:23:57.480 --> 02:24:05.180
Paul Williams
I mean, just to analyze that a little bit further what we've done here is a scatter plot of every winter over a 4 decade period.

02:24:07.350 --> 02:24:08.430
Paul Williams
And we've plotted.

02:24:09.170 --> 02:24:15.550
Paul Williams
The wind shear averaged over the US and Mexico and that's the box we've used.

02:24:16.630 --> 02:24:20.740
Paul Williams
Every winter so every Blue Cross in this diagram is one winter.

02:24:22.040 --> 02:24:45.050
Paul Williams
And on the X axis. I've gotten a metric of of the of of El Nino conditions. It's the sea surface temperature anomaly in the central tropical Pacific when it's positive then we haven't al Nino event and when it's negative. It's La Nina and there's a clear relationship here between the wind shear and the and and whether El Nino is is our Nino or la Nina.

02:24:46.840 --> 02:25:18.190
Paul Williams
And the slope here is nought 0.5 roughly the units are meters per second per 100 hectopascals per degree. Celsius so that tells you that each one degree. Celsius increase in the sea surface. Temperatures in the tropical Pacific incruse increases the flight cruising level. Windshear over the US by about half a meter per second per 100 hectopascals and just look at the range from a from a strong la Nina event. We have about 4 units of sheer but for a strong El Nino we have about 6.

02:25:18.470 --> 02:25:42.260
Paul Williams
So that's a 50% stronger wind shear between these 2 extremes of this natural climatic oscillation. We've done. Similar analysis for different parts of the Globe Southeast Asia. Here showing an even more sensitive relationship of North 0.8 compared to North 0.5 over here. A very statistically significant and just clearly obvious by I kind of a link.

02:25:43.630 --> 02:25:45.870
Paul Williams
Same for Australia and we've actually looked at.

02:25:47.130 --> 02:26:12.760
Paul Williams
8 different geographic regions, and found significant relationships soon most of them apart from Europe, where there's no significant finding here. No difference between linear and Arlene Yo the Windshear at flight cruising levels over Europe doesn't depend on NA Nina or El Nino conditions. We're just too far away in Europe from the tropical Pacific Ocean for for there to be any meaningful effect.

02:26:15.130 --> 02:26:18.410
Paul Williams
Then come on now in my final couple of minutes to climate change.

02:26:18.850 --> 02:26:19.390
Paul Williams
And.

02:26:20.430 --> 02:26:23.020
Paul Williams
So just briefly to explain the mechanism here.

02:26:24.130 --> 02:26:37.800
Paul Williams
For why I expect climate change to be increasing clear air turbulence and the reason here. We are over the Atlantic by the way. The reason we have jet streams is the tropical parts of the planet are very warm the polar regions are very cold.

02:26:38.630 --> 02:26:40.200
Paul Williams
So there's a temperature difference.

02:26:40.780 --> 02:26:47.470
Paul Williams
And that means there's a density difference. And that means there's a pressure difference and North South pressure difference.

02:26:48.060 --> 02:26:52.790
Paul Williams
And that drives a flow because fluids flow from high pressure to low pressure.

02:26:53.740 --> 02:27:15.870
Paul Williams
And the final ingredient here is that there's something called the Coriolis force because we're on a rotating planet. So the flow that tries to go North. South gets blown and ends up going East West and that's why we have the jet streams. It's ultimately because of the North. South temperature difference

between the warm tropics and the cold polls now? What climate change is doing to this picture is it's warming, the tropics.

02:27:16.560 --> 02:27:23.830
Paul Williams
A lot more than opposing in fact, it's cooling the pose here. We are at 2:00, 150 hectopascals so that's about 35,000 feet.

02:27:25.090 --> 02:27:25.830
Paul Williams
And actually.

02:27:26.630 --> 02:27:38.050
Paul Williams
Although people don't talk about this a lot CO 2 has a cooling effect in the lower stratosphere, which is where we are here for well understood reasons, but it has a warming effect in the troposphere and the upper troposphere.

02:27:38.880 --> 02:27:47.350
Paul Williams
I mean that's so it actually there's an amplified warming here to do with lapse rate feedback switch, I can take a question on if anyone is really interested anyway. The point is.

02:27:48.000 --> 02:27:52.180
Paul Williams
The North South temperature difference is getting stronger because of climate change.

02:27:52.980 --> 02:27:56.460
Paul Williams
We see that in satellite observations, we understand physically why.

02:27:58.130 --> 02:28:27.920
Paul Williams
And from a relationship called the firmer wind balance. That means that we should be having more wind shear because the North. South temperature gradient is proportional to the amount of wind shear, which is the most important equation in atmospheric dynamics. Thermal wind balance, so more temperature gradient, driving a stronger shear in the jet stream, and we absolutely see that too. In satellite observations going back to the 1970s, using 3 different datasets here in the 3 different colors.

02:28:28.430 --> 02:28:34.910
Paul Williams
We absolutely see that over the 40 years since I was born basically in the late 70s that's quite sobering.

02:28:35.840 --> 02:28:43.040
Paul Williams
There's been a 15% increase in the amount of wind shear in the North Atlantic at 35,000 feet.

02:28:44.110 --> 02:28:56.960
Paul Williams

And so this is not a climate model result. This is observations in the real climate system over the past 4 decades and entirely consistent with the changes in the temperature that are resulting from C oh 2.

02:28:57.640 --> 02:29:02.750
Paul Williams
So this is a really well understood robust rigorous finding.

02:29:03.910 --> 02:29:16.380
Paul Williams
And it's going to continue into the future, according to a new study that came out just a few weeks ago now using climate models because of course. We don't have satellite observations of the future but this is calculating the amount of wind Shear.

02:29:17.390 --> 02:29:24.470
Paul Williams
Towards the end of this century over the next 85 years from 2015, I guess was the start date.

02:29:25.790 --> 02:29:33.010
Paul Williams
And we see up to 29% more sheer as this effect about stronger temperature gradients continues.

02:29:34.270 --> 02:29:53.130
Paul Williams
What does that mean for cat? Well, I've been calculating that again using atmospheric model simulations calculating turbulence diagnostics here is T one L rods variant. One of L rods turbulence index because the cat is of course, subgrid scale in an atmospheric model so we have to diagnose it.

02:29:54.630 --> 02:30:04.090
Paul Williams
From the resolved flow and we can ask the question. If we turn up. the C 0:02 in the model and watch the jet stream, become more sheared as it has in the real world.

02:30:04.930 --> 02:30:27.150
Paul Williams
Uh we can analyze the statistics of these patches of turbulence is there any evidence that they get stronger and more frequent and they're absolutely is here is a a histogram showing the distribution of the strength of the turbulence as diagnosed by this index in control conditions and increase SEO 2 conditions in yellow and red.

02:30:27.950 --> 02:30:35.470
Paul Williams
And we do, indeed get a lot more proper probability, shifting to the right hand tail of this distribution and that's where all of the significant cat is.

02:30:36.600 --> 02:30:44.070
Paul Williams
And then we repeated those calculations with a an ensemble of different cat diagnostics. That's what the different colors are here.

02:30:45.240 --> 02:30:49.970
Paul Williams
And this is all in the North Atlantic at about 40,000 feet in winter.

02:30:51.540 --> 02:31:04.670
Paul Williams
And done separate calculations for lights all the way through to severe turbulence and we see increases of 59% on average in light, although there is some spread 59% as the average across the basket of diagnostics.

02:31:05.450 --> 02:31:14.760
Paul Williams
All the way up to 149% increase so halfway between a doubling and trebling of the amount of cat in the North Atlantic, but with a lot of spread.

02:31:15.940 --> 02:31:21.900
Paul Williams
Because severe turbulence is so rare and there's this There's this kind of signal to noise issue going on here.

02:31:23.200 --> 02:31:25.120
Paul Williams
Which is why there's more spread for severe?

02:31:26.630 --> 02:31:42.320
Paul Williams
And and we've not just done that for the North Atlantic in winter but for every season every part of the world different flight cruising levels different climate models and we always get the same result. So here's a picture for example, showing by the period 2050 to 2080.

02:31:43.310 --> 02:31:46.210
Paul Williams
The change in the amount of cat this is moderate cat.

02:31:46.830 --> 02:32:00.040
Paul Williams
In a commonly used climate change scenario and we see as you can see in the jet stream, regions, which are the parts that are becoming more sheared for very well understood and non controversial reasons, we see.

02:32:00.650 --> 02:32:08.680
Paul Williams
You know 23, 400%, maybe look very locally 500% increases in the frequency of occurrence of of cat.

02:32:10.530 --> 02:32:15.500
Paul Williams
Nash I've talked about climate variability hourly neo affecting Windshear.

02:32:16.560 --> 02:32:46.590
Paul Williams
I'm I have a question for the audience actually just to be a bit different than normally. I mean, I hope you have questions for me, too, but I suppose we could tell you because I'm suggesting here that there's a new source of seasonal predictability for cat coming from El Nino. We can predict our ninyo. Several months in advance, with very high skill for example. Today we're in la. Nina conditions and we're very likely to remain in La Nina for December, January and February if not further ahead is this of any use.

02:32:46.640 --> 02:33:02.410
Paul Williams
To you if you're in the airline sector. If we could tell you 4 months ahead. There's gonna be 30% more cats. Over the USA for the next 4 months? Is is that actionable information that would affect your operations. I'm really curious to know so I'd value your thoughts.

02:33:03.530 --> 02:33:14.540
Paul Williams
And then I went on to talk about climate change jet stream is already 15% more sheer than when satellites began observing it. We understand why and we expect a lot more cat to result in the coming decades.

02:33:15.680 --> 02:33:20.970
Paul Williams
That's it do get in touch if you have any questions and if there's time, Bob I'll be happy to take some now.

02:33:22.240 --> 02:33:24.130
Paul Williams
So thank you. Paul this is Tammy.

02:33:23.990 --> 02:33:25.830
Flowe, Tammy (FAA)
And that was Tommy thank you.

02:33:26.090 --> 02:33:38.140
Flowe, Tammy (FAA)
That was fascinating talk no no no no. I'm I'm I'm very that was very interesting and I would love to hear from the airline representatives in the audience. You know whether they think this would be actionable.

02:33:39.510 --> 02:33:39.980
Flowe, Tammy (FAA)
Me too.

02:33:42.290 --> 02:33:44.340
Paul Williams
But in the meantime, we have a lot of quest.

02:33:44.220 --> 02:33:47.850
Bob Sharman (Guest)
Questions I see so Steve do you have a?

02:33:50.400 --> 02:33:52.560
Bob Sharman (Guest)
List of priority questions.

02:33:53.400 --> 02:33:55.360
Bob Sharman (Guest)
Yeah, let's yeah, let's start.

02:33:55.390 --> 02:34:00.370
Steve Abelman
How much time do we have Bob I may be about 5 minutes?

02:34:00.480 --> 02:34:02.580
Bob Sharman (Guest)
OK, so, so let let's try it out.

02:34:02.480 --> 02:34:22.720
Steve Abelman
Product group, I'm here so uhm was the rate of pilot reporting consistent across time in other words, number of pireps per flight or per hour. I noticed that when you're when you're going year to year are you? Are you trying to rate that down to a number of of of flight hours or is it just purely number of results.

02:34:23.780 --> 02:34:25.520
Steve Abelman
Can I deflect that question to Bob?

02:34:25.760 --> 02:34:27.880
Paul Williams
Well, I was just gonna say, Yeah sounds like.

02:34:27.930 --> 02:34:30.400
Bob Sharman (Guest)
My question and my answer is I don't know.

02:34:32.260 --> 02:34:51.030
Bob Sharman (Guest)
We were going to look at that and never got around to it. That is look at what the traffic flow was for those different years compared to the pilot reports but really. I don't see any reason why there would be a tremendous variability in the number of aircraft that are up there between year to year so.

02:34:51.890 --> 02:34:52.250
Bob Sharman (Guest)
Ah.

02:34:52.850 --> 02:34:56.770
Bob Sharman (Guest)
I would assume that it's pretty constant, although slowly growing of course.

02:34:57.380 --> 02:34:58.550
Bob Sharman (Guest)
OK, OK.

02:34:59.120 --> 02:35:03.350
Steve Abelman
I'm gonna kind of zip through these as quick as I can Matt Fronzak.

02:35:03.400 --> 02:35:13.870
Steve Abelman
Got Uh, I read the flight cruising level anomaly slide. What depth of column did the 10 meter per second 100 millibar apply to flight level 300 to 400.

02:35:16.010 --> 02:35:16.710
Steve Abelman
And.

02:35:18.820 --> 02:35:20.370
Steve Abelman
Sorry. Could you repeat the question again.

02:35:20.330 --> 02:35:24.870
Paul Williams
Sorry about that I'm just trying to multitask and I think I caught the end of it, but I didn't catch this start?

02:35:26.250 --> 02:35:27.600
Paul Williams
Matt do you wanna do you wanna?

02:35:27.480 --> 02:35:28.490
Steve Abelman
Uh read it.

02:35:29.890 --> 02:35:31.400
Steve Abelman
Sure, so uh.

02:35:31.460 --> 02:35:51.770
Matt Fronzak
So Paul I was wondering on the slide in which you showed and and calculated a a vertical wind shear anomalies? What depth of column did that apply to so it was, it was, it from the ground to final 400 or was it from 300400. Where was it?

02:35:52.520 --> 02:35:53.950
Matt Fronzak
Uh it no it wasn't from the ground.

02:35:53.820 --> 02:36:01.290
Paul Williams
And thanks for the question good good question. I should have clarified should have explained it was just a local shear in in in.

02:36:02.220 --> 02:36:12.820
Paul Williams
Somewhere I think be taken between 203 100. Hectopascals so some kind of large scale shear between about 30,000 feet and 40,000 feet something like that.

02:36:13.480 --> 02:36:16.060
Paul Williams
So it was basically at cruise flight level.

02:36:16.430 --> 02:36:16.830
Matt Fronzak
Yes.

02:36:16.890 --> 02:36:18.630
Matt Fronzak
I don't know you apply to yeah.

02:36:21.560 --> 02:36:23.970
Matt Fronzak
OK let me see we've got some.

02:36:24.000 --> 02:36:38.750
Steve Abelman
Answers for you, that maybe we can hold those kind of collect those and send those to you, a little later. Uh let's see from Donna like the NTSB. What about increased resolution and measurement of upper level wind during the period versus any major changes due to climate change.

02:36:41.170 --> 02:36:42.440
Steve Abelman
I'm sorry, it cut out again.

02:36:42.330 --> 02:36:46.250
Paul Williams
A little bit would you mind repeating it please sure what about?

02:36:46.280 --> 02:36:56.560
Steve Abelman
Increase resolution and measurement of upper level winds during the period versus any major changes due to climate change OK, so changes systematic changes long.

02:36:56.480 --> 02:36:59.870
Paul Williams
In short term systematic changes in the in the resolution of the.

02:37:00.540 --> 02:37:11.410
Paul Williams
If the model, I guess or the OR the OR the satellite observations improvements in the satellite observations and so the the OK, the plots. I showed you of the 15% increase in Shear.

02:37:12.220 --> 02:37:33.780
Paul Williams
Over 4 decades, so everything was controlled over that 4 decade period. So it was a consistent model with a consistent resolution. So they what they do to do those calculate those data as they fix everything to control for all of the everything that they can control for apart from real changes in the atmosphere, so that that was a real that was a real change.

02:37:35.640 --> 02:37:37.050
Paul Williams
OK, UM.

02:37:37.250 --> 02:37:47.380
Steve Abelman
From from Orrick Shuman Hyppa Uh as you know cat depends on sure and on sheer and vertical heat fluxes? How do you know that sheer is the dominant effect?

02:37:49.670 --> 02:37:50.250
Steve Abelman
As opposed to.

02:37:50.140 --> 02:37:56.060
Paul Williams
Vertical heat fluxes uhm well, I don't accept that UM.

02:37:57.330 --> 02:38:03.420
Paul Williams
I suppose I'm calling here on the on the operational cat forecasts such as GTG which use which use.

02:38:04.120 --> 02:38:14.020
Paul Williams
I don't think there's any indexing GTG that uses a vertical heat flux to diagnose cat. Maybe that maybe there should be. I mean, the 2 are related. Of course I mean uh?

02:38:14.680 --> 02:38:17.130
Paul Williams
If there's a vertical heat flux that will change the sheer.

02:38:17.930 --> 02:38:31.230
Paul Williams
So I guess we're just hoping when we diagnose cat operationally and Bob might want to come in if he

has a comment as well. But then the sheer seems to do a good job, not perfect of course at like nosing cat.

02:38:35.350 --> 02:38:38.010
Paul Williams
Well, Richardson number is in a lot of the diagram.

02:38:37.890 --> 02:38:45.030
Bob Sharman (Guest)
Gnostics, too, so it partially accommodates that right, the stratification is is that that.

02:38:44.910 --> 02:38:45.860
Paul Williams
That's right? Yeah.

02:38:47.480 --> 02:38:50.080
Paul Williams
OK, there was a question from Judith the.

02:38:50.310 --> 02:38:59.780
Steve Abelman
Uh I'm gonna say your last name wrong, rife any flight level. Any data for flight levels above 40,000 feet for the corporate and private aircraft side of things.

02:39:00.420 --> 02:39:02.260
Steve Abelman
Wow, that's a good question, Hi Judy.

02:39:02.170 --> 02:39:03.210
Paul Williams
Thanks for your question.

02:39:05.660 --> 02:39:06.770
Paul Williams
I don't know I think the.

02:39:06.820 --> 02:39:14.590
Paul Williams
Umm from the Wolf in shaman paper. I think they did include pireps up to. I'm just going back to my slides.

02:39:15.490 --> 02:39:16.900
Paul Williams
They did go up to come.

02:39:18.940 --> 02:39:27.460
Paul Williams
60,000 feet but I don't know how what people I would guess the proportion in between 40 1060, 1000, would be pretty low.

02:39:28.560 --> 02:39:29.450
Paul Williams
That's correct.

02:39:31.210 --> 02:39:33.590
Paul Williams
Yeah, these days, there are a lot of UM.

02:39:33.540 --> 02:39:41.180
Bob Sharman (Guest)
Private jets that are flying around 45,000 feet so there's probably more data higher up than it used to be.

02:39:44.110 --> 02:39:45.700
Bob Sharman (Guest)
OK, it seems like.

02:39:45.590 --> 02:39:51.730
Steve Abelman
Like the most well know there's still a couple more questions, so Bob? What do you think I I think we're?

02:39:51.720 --> 02:39:56.670
Bob Sharman (Guest)
Blind as it is, and maybe we should one so, so I would just point out for you.

02:39:56.800 --> 02:40:08.070
Steve Abelman
Well, there, there there's a lot of a lot of answers on not a lot. But some answers to your questions that I'm I'm sure we could collect and get to you as feedback so that's great to see. I'll I'll take a look I can see that.

02:40:07.950 --> 02:40:12.470
Paul Williams
I'm in the chat so that's that's really useful. Many thanks everyone. Thank you. Thank you pal.

02:40:13.440 --> 02:40:14.090
Paul Williams
Interesting.

02:40:13.990 --> 02:40:14.500
Bob Sharman (Guest)
Tuck.

02:40:15.940 --> 02:40:25.450
Bob Sharman (Guest)
So now we'll move on to a talk given by some DLR people. Ulrich seen when Andreas Dornbracht and Peter Bechtold.

02:40:26.190 --> 02:40:41.910
Bob Sharman (Guest)
Uh comparing aircraft observations to cat indices and in fact, they've changed the title slightly to measurements of high altitude turbulence from research aircraft. In comparison with cat indices as predicted by ECMWF 's.

02:40:42.500 --> 02:40:48.650
Bob Sharman (Guest)
Integrated forecast system so I guess we're gonna start with Andreas and go ahead.

02:40:49.740 --> 02:40:51.430
Bob Sharman (Guest)
Sing spoke I hope you see.

02:40:51.460 --> 02:40:53.590
Andreas Dörnbrack (Gast)
So first slide and can hear me.

02:40:53.650 --> 02:41:23.210
Andreas Dörnbrack (Gast)
We do wonderful so this actually is study as you already said, which is a close collaboration between Peter Bechtold. All Shuman and myself and we use the opportunity of a quick research aircraft campaign in South America actually to analyze turbulence data and just to give you a first visual impression about what is behind this aircraft campaign. It was called South Texas Southern Hemispheric transport to dynamics and chemistry mission?

02:41:23.920 --> 02:41:56.390
Andreas Dörnbrack (Gast)
Many institutions from Germany, where involved in this campaign Harlow was one of the main airborne platforms evaluating trace gases and different species and also turbulence will see wonderful nose boom peeking out of the aircraft them and there's a little overview paper by Microsoft or director actually on the campaign there. Just highlighting some of their results just to give you an impression about the physical sceneries or we were based.

02:41:56.460 --> 02:42:00.260
Andreas Dörnbrack (Gast)
It's this campaign in Rio Gonna, which is in the early offseason.

02:42:00.940 --> 02:42:02.840
Andreas Dörnbrack (Gast)
I only see the.

02:42:03.040 --> 02:42:03.490
Andreas Dörnbrack (Gast)
Don't.

02:42:03.410 --> 02:42:05.710
Ulrich.Schumann
Slide overview, I don't have a full screen.

02:42:07.800 --> 02:42:09.470
Ulrich.Schumann
Right you're not in presentation.

02:42:09.370 --> 02:42:12.560
Bob Sharman (Guest)
Mode Andreas actually I'm a prison.

02:42:12.450 --> 02:42:14.560
Andreas Dörnbrack (Gast)
Patient mood was about this.

02:42:16.310 --> 02:42:17.530
Andreas Dörnbrack (Gast)
No no it is.

02:42:17.520 --> 02:42:17.860
Ulrich.Schumann
Not.

02:42:19.820 --> 02:42:20.480
Ulrich.Schumann
Uhm.

02:42:20.860 --> 02:42:23.400
Andreas Dörnbrack (Gast)
But I understood him So what about this.

02:42:25.460 --> 02:42:27.080
Andreas Dörnbrack (Gast)
That's not good no.

02:42:28.670 --> 02:42:30.780
Andreas Dörnbrack (Gast)
Well, just go back to the way you had it.

02:42:30.650 --> 02:42:32.180
Bob Sharman (Guest)
But it's we can follow it.

02:42:33.850 --> 02:42:35.870
Bob Sharman (Guest)
I have no idea so I just press.

02:42:35.780 --> 02:42:41.430
Andreas Dörnbrack (Gast)
F 5 is just presentation mode and on my screen. I see the full screen so I don't know.

02:42:43.390 --> 02:42:45.900
Andreas Dörnbrack (Gast)
What to do right now? I'm not seeing anything?

02:42:46.160 --> 02:42:47.250
Bob Sharman (Guest)
Except Aldridge.

02:42:51.940 --> 02:42:53.610
Bob Sharman (Guest)
Yeah, well so.

02:42:53.900 --> 02:42:56.120
Andreas Dörnbrack (Gast)
Future work home desktop things done.

02:43:01.410 --> 02:43:03.180
Andreas Dörnbrack (Gast)
Matt do you have a suggestion?

02:43:05.440 --> 02:43:07.190
Bob Sharman (Guest)
Uh I believe I have.

02:43:07.090 --> 02:43:13.210
Matt Fronzak
The deck and if you'd like me to share from my end. I'm happy to do that. Oh, we've we've got it perfect.

02:43:13.140 --> 02:43:13.850
Bob Sharman (Guest)
OK, good.

02:43:14.890 --> 02:43:15.400
Bob Sharman (Guest)
Wow.

02:43:16.500 --> 02:43:17.140
Bob Sharman (Guest)
So what?

02:43:17.970 --> 02:43:18.180
Bob Sharman (Guest)
No.

02:43:19.600 --> 02:43:21.700
Bob Sharman (Guest)
No, it's better, yeah, this looks good.

02:43:22.380 --> 02:43:24.510
Bob Sharman (Guest)
So that's the full screen now, yeah, yeah.

02:43:26.740 --> 02:43:32.530
Andreas Dörnbrack (Gast)
OK, I was here just explaining that we were based in Rio Grande, which is in the.

02:43:33.470 --> 02:43:54.050
Andreas Dörnbrack (Gast)
Leo see any mountains and we had another station in California, where we did some glider measurements bust. But just to show you the area of BC high peaks of the any mountains and all the research flights were actually done in this area and we also had these transfer flights to Germany, which will be part of the presentation.

02:43:55.060 --> 02:44:11.830
Andreas Dörnbrack (Gast)
And just to give you an impression about some nice guys there or Lago Argentino and their collaborators. So we have lots of different wave patterns. Here you also see the indications of small scale instabilities like these may be pattern here, which finally leads into turbulence.

02:44:12.630 --> 02:44:13.230
Andreas Dörnbrack (Gast)
And.

02:44:14.490 --> 02:44:45.160
Andreas Dörnbrack (Gast)
Coming through the research flight here in blue on the left hand side you see all the research flights, which were which were conducted during this campaign so you see we were actually starting here from Germany and they will transfer flights over the Atlantic down 2 bonus iOS and then down to Rio Grande and from there. There were many, many different flights and one of the characteristics of these flights is actually that these flights in contrast to former research aircraft campaigns.

02:44:45.690 --> 02:45:04.600
Andreas Dörnbrack (Gast)
Not directly aligned with the wind or against servants, so severe kind of random and this is actually shown here in the red right panel plot where you have here. The hollow flight directions are heading actually ends of interaction where you see that only a subset of all the flights were directly.

02:45:05.290 --> 02:45:14.390
Andreas Dörnbrack (Gast)
Pointing into the wind or against event so there kind of randomly flying there due to different constraints. We had on the instruments on the aircraft.

02:45:15.440 --> 02:45:16.390
Andreas Dörnbrack (Gast)
From this.

02:45:17.140 --> 02:45:31.270
Andreas Dörnbrack (Gast)
Flights we actually selected 188 straight and level decks, which means these are all the legs, which had no attitude and no directional change and all together, these are more than 100,000 kilometers, which is about.

02:45:32.120 --> 02:45:37.470
Andreas Dörnbrack (Gast)
2 and a half times the circumference of Sierra so that's a really large.

02:45:38.050 --> 02:45:42.540
Andreas Dörnbrack (Gast)
Data set and one of the purposes of this truck is actually to show you that these.

02:45:43.160 --> 02:46:13.530
Andreas Dörnbrack (Gast)
Data can be used actually to evaluate the edit dissipation rate, and also then to compare and that's the second goal of such papers and also to compare with prediction of Cifs Model. So we have 10 hearts data, which are standard output of the Bahamas system. Bahamas is a measurement system of so far gone for 123 flight hours and we have also 100 hats data, which is available for a subset of about 20 hours.

02:46:13.990 --> 02:46:44.410
Andreas Dörnbrack (Gast)
And most of the flights you can see us see this here on these penalty on the side where actually conducted at flight levels, which are higher than 10 kilometers, so mostly in the upper troposphere lower stratosphere and that's also represented by the brunt visor frequency Calculator along the flight track so these are ifs data, which are interpolated in space and time to the position of the aircraft.

02:46:44.460 --> 02:47:00.590
Andreas Dörnbrack (Gast)
On the left hand side you see that there's a peak in the probability density function, which is around the expected value for the stratosphere, 0.02 and there's a little peek here. Also in the troposphere is or most of the flights were actually in the lower stratosphere.

02:47:01.620 --> 02:47:21.670
Andreas Dörnbrack (Gast)
An interesting parameter SV already heard in the talk by Paul Williams is sheer and also the shears actually and just it's really interesting that most of the shear values are below 0.01 per second. This means actually we have their met conditions whereas a sheer is.

02:47:22.460 --> 02:47:29.520
Andreas Dörnbrack (Gast)

In the majority of the flights rather low large shear effects, which are larger than this value are actually very rare.

02:47:31.870 --> 02:47:33.650
Patrick Vrancken (DLR) (Gast)
And now we have come to see.

02:47:33.690 --> 02:47:38.350
Andreas Dörnbrack (Gast)
Regulation of the application rate, and I hand over to order through map for this.

02:47:39.450 --> 02:47:39.860
Andreas Dörnbrack (Gast)
OK.

02:47:42.300 --> 02:47:42.870
Patrick Vrancken (DLR) (Gast)
Nice.

02:47:43.700 --> 02:47:44.870
Patrick Vrancken (DLR) (Gast)
It's important.

02:47:46.020 --> 02:47:47.230
Ulrich.Schumann
But I continue.

02:47:49.200 --> 02:47:50.650
Patrick Vrancken (DLR) (Gast)
I hope you understand me.

02:47:52.300 --> 02:47:54.280
Patrick Vrancken (DLR) (Gast)
So the first thing which?

02:47:54.150 --> 02:48:11.150
Ulrich.Schumann
No one knows about these data was whether the Spectra of the horizontal winds and the vertical wins. Where are similar in South correct to? What we found in the previous experiments nordics over the North Atlantic and deep wave in the area around New Zealand.

02:48:11.700 --> 02:48:12.270
Ulrich.Schumann
The.

02:48:13.380 --> 02:48:13.920
Ulrich.Schumann
Yeah.

02:48:15.320 --> 02:48:20.020
Ulrich.Schumann
Experiments and you see here from a paper, which I published 2 years ago.

02:48:20.470 --> 02:48:30.650
Ulrich.Schumann
The 2 plots office part of the horizontal drilling spectrum in black and the words within spectral in green and a model spectrum in red.

02:48:30.930 --> 02:48:32.690
Ulrich.Schumann
Yeah, right.

02:48:33.770 --> 02:48:35.640
Patrick Vrancken (DLR) (Gast)
And you also see model Spec.

02:48:35.510 --> 02:48:42.630
Ulrich.Schumann
The court is in Astral Gauge Limpach Spectrum, which has a -5 thought partner -3 part and very.

02:48:43.720 --> 02:48:54.950
Ulrich.Schumann
Long wavelengths and it has we have here. The Kolmogorov Spectrum, which is adjusted to the dissipation rate of on which is the average dissipate right from this campaign.

02:48:55.610 --> 02:49:26.940
Ulrich.Schumann
And we see that the red and the the green curves are quite similar. Both show a flat behavior of vertical velocity variance over a wide range of scales for all scales below about 10 kilometer and then it transitioned to a -5 search range, which we would expect at least for moderately high dissipation rate. These have been solid curves. The dashed curves are for low dissipation rates. I split this set of data and in 2/2, 1/2 for high dissipation rate.

02:49:26.990 --> 02:49:57.170
Ulrich.Schumann
In 1/2 without dissipation rate, and you see the low dissipation rate. Spectra have a steeper gradient here. But you also see that the red and the green curves are close in the sense here. If you would show the center deviations of the measurements. They are small, but they are in the same order as it differences. We see here and so we see that the model was able to describe the nadis was as it was also able to describe the deep breath results, which had sort of a peak here.

02:49:57.300 --> 02:50:06.030
Ulrich.Schumann
Over at the windber variants around 10 kilometers, possibly because of mountain gravity waves because there are many flights over the.

02:50:07.600 --> 02:50:13.950
Ulrich.Schumann
Muselet so this is one we started and that is now the next plus plot trails, please go ahead.

02:50:14.430 --> 02:50:20.100
Ulrich.Schumann
Yeah, so this is the same for South strike in the lower panel and you'll see for South Korea.

02:50:21.410 --> 02:50:46.680
Ulrich.Schumann
It's very similar to what we have seen for deep vein, it again has a small peek at it immediate very flings. Vertical velocity variance. They even beans and green and the red curve is perhaps not so ideal as it was in the other cases, but still successful featuring so we can say that we have good measurements, which covers 3 experts campaigns similarly.

02:50:48.590 --> 02:50:49.040
Ulrich.Schumann
Yeah.

02:50:50.090 --> 02:50:50.540
Patrick Vrancken (DLR) (Gast)
K.

02:50:50.770 --> 02:50:51.240
Patrick Vrancken (DLR) (Gast)
The order.

02:50:51.290 --> 02:50:51.610
Patrick Vrancken (DLR) (Gast)
So yeah,

02:50:53.650 --> 02:50:55.320
Patrick Vrancken (DLR) (Gast)
so this is the basis.

02:50:55.190 --> 02:51:07.350
Ulrich.Schumann
Yes, and now we start to look at the smallest scales and the next plot shows you the dissipation rates, which the spectrum, which we live in the frequency range now as a function of frequency.

02:51:08.470 --> 02:51:10.700
Ulrich.Schumann
Turn have spectrum spectrum.

02:51:12.270 --> 02:51:14.630
Ulrich.Schumann
Cities in flight direction of either.

02:51:15.760 --> 02:51:16.680
Ulrich.Schumann
This is awesome.

02:51:17.030 --> 02:51:17.670
Ulrich.Schumann
Direction.

02:51:17.780 --> 02:51:41.490
Ulrich.Schumann
I can tell you the particle below city for high dissipation rates full curves and for low dissipation rates dashed curves and the -5 3rd line here in it, and you see the 10 Hertz. Spectra is 100. Hertz Spectra under his status. Spectra are very similar up to about 4. Hertz has plenty of so these in these ranges boasts was I started to write.

02:51:41.540 --> 02:51:42.690
Ulrich.Schumann
So our patients.

02:51:44.610 --> 02:51:46.410
Ulrich.Schumann
I think somebody.

02:51:46.800 --> 02:51:48.850
Ulrich.Schumann
It's hard to ask question I asked.

02:51:50.840 --> 02:51:52.860
Patrick Vrancken (DLR) (Gast)
There's somebody talking around.

02:51:53.100 --> 02:51:55.000
Ulrich.Schumann
Yeah, can somebody.

02:51:54.870 --> 02:51:57.210
Bob Sharman (Guest)
Mute that who's ever talking.

02:51:57.910 --> 02:51:58.880
Bob Sharman (Guest)
I think it's bad.

02:52:00.310 --> 02:52:02.170
Matt Strahan (Guest)
Now it's gone so you see.

02:52:02.050 --> 02:52:30.890
Ulrich.Schumann

Here, a peak invariants at low dissipation rates, which obviously comes from the nose boom oscillations of the aircraft at 20:00. Hertz you see that at low dissipation rates. You don't see that at Heights or you see it less at higher dissipation rates. You also see a divergent of the horizontal wind in a long stream and transverses stream so that these are data are no longer reliable measurements are certainly also experimented problems contributed to this.

02:52:31.870 --> 02:52:43.880
Ulrich.Schumann
Differences so that is the reason why we only analyze the data between 0.0 0.4. Hertz and 4 Hertz. This is what we think that the data are consistent and reliable.

02:52:44.710 --> 02:53:16.260
Ulrich.Schumann
So we it fit the clinical spectrum as you have no it's traditionally with these parameters in order to get from the vertical. Wind spectrum the the variance from the, The Dissipation from vertical velocity. So we should keep in mind that the inertial range. Spectrum occurs rarely because in most cases, the resolution is not small compared to the positive scale. Those middle scale depends on the dissipation rate.

02:53:16.310 --> 02:53:30.460
Ulrich.Schumann
In spite ification most of the atmosphere is very stable stratified. You would have very little turbulence in those areas and these are the dominant cases cases with strong turbulence our air next weeks.

02:53:32.320 --> 02:53:59.420
Ulrich.Schumann
Next slide handlers now this just summarizes the method. I don't want to read it in detail so this then shows comparisons of turn hats and 100. Hertz data that this was just to allow you to check how we do it. I just mentioned that we compare the method with Brown bag at higher than their Bob Simon was involved in a restaurant. But we so we get the same numerical results from dissipation rates for the same measurements.

02:54:00.120 --> 02:54:30.120
Ulrich.Schumann
This is a plot of 100. Hertz data against 10. Hertz data and what you see for you, it stops at about a participation rate of 10 to the -7 meters squared per second cubed whereas for W. It goes down to 10 to the -9 or even 10 to the -10 meters squared per second cubed and you also see the slope of the spectrum. It's not always at -5 3rd it varies Richards is wide point it varies strongly.

02:54:30.170 --> 02:54:32.640
Ulrich.Schumann
Of a wide range, which is partly due to.

02:54:32.690 --> 02:55:02.720
Ulrich.Schumann
Will not equilibrium Spectra they are transient states where either you have a tablet burst in the high frequency range can be stronger or you have very stable stable satisfied situations. Then the slope can

be steeper. So this is to be kept in mind. We rarely have the -5 3rd Slovenia ideal sense. But we do see that the vertical velocity variance from 100. Hertz and turn hurts comes out quite well correlated.

02:55:02.770 --> 02:55:08.740
Ulrich.Schumann
Down to 10 to the -8 or 10 to the -9 meters squared per second cubed next please.

02:55:10.360 --> 02:55:39.700
Ulrich.Schumann
The next plot shows the PDFs I hope it's yeah here. We see so it's basically the same data for the long stream and across stream and vertical velocity and the slope and we see the PDS are not symmetric actually that is also found in previous studies here from show newly others in danger. They show very similar. PDFs of dissipation rates derived from a long wind long iteration velocity measurements.

02:55:39.880 --> 02:56:09.050
Ulrich.Schumann
So we these measurements are limited by noise in true airspeed. Let us not so much. The case for the translator on satellite velocity and the vertical velocity seems to be the best parameter to be used to derive dissipation rates down to quite low dissipation rates. We always fight to get the low dissipation reside. I know I Bashan wants to know more about the height turbulence cases and you see here that we reach up to about moderate.

02:56:09.830 --> 02:56:18.100
Ulrich.Schumann
Turbulent situations this tempters -2 as maximum in meters squared per second cubed dissipation rate.

02:56:18.830 --> 02:56:19.620
Ulrich.Schumann
Next, please.

02:56:22.140 --> 02:56:52.400
Ulrich.Schumann
Yeah, this shows is a comparison of the 3 plots and it shows as a linear scales and it shows the logarithm scales and you see that we have rarely moderate turbulence. We had never found. On that on those campaigns moderate to severe turbulence light to moderate was also there, but these turbulent cases are rare. They are here for 99% of the Flyers. It's very common with light or in lesson light flights you have dissipation rates.

02:56:52.470 --> 02:56:56.080
Ulrich.Schumann
Which in aircraft would hardly realize as being turbulent?

02:56:56.660 --> 02:57:01.410
Ulrich.Schumann
Yeah, that's the input which we have, I think the next plot. It goes on to undress.

02:57:02.090 --> 02:57:02.490
Ulrich.Schumann
But.

02:57:05.560 --> 02:57:05.900
Ulrich.Schumann
Yeah.

02:57:06.860 --> 02:57:07.680
Ulrich.Schumann
Take over please.

02:57:12.010 --> 02:57:12.570
Ulrich.Schumann
And yes,

02:57:15.370 --> 02:57:16.060
Ulrich.Schumann
you don't.

02:57:17.320 --> 02:57:18.700
Ulrich.Schumann
Yeah, you're not you're muted.

02:57:20.960 --> 02:57:21.640
Ulrich.Schumann
You're muted.

02:57:27.020 --> 02:57:28.650
Jung-Hoon Kim (Seoul National Univ., South Korea) (Guest)
OK, no no in here.

02:57:29.080 --> 02:57:34.080
Andreas Dörnbrack (Gast)
Yeah, UM is it still to see yes, no no.

02:57:34.100 --> 02:57:35.800
Ulrich.Schumann
Obviously Yes No.

02:57:38.420 --> 02:57:40.160
Ulrich.Schumann
OK, this actually works.

02:57:40.090 --> 02:57:42.650
Andreas Dörnbrack (Gast)
Which uh already started 2 years ago?

02:57:43.540 --> 02:58:13.640
Andreas Dörnbrack (Gast)

When Uh Martina Bomberger visited ECM WFNZ installed or implemented actually different indices into the IFS for experimental purposes. And there was actually a set of 3 different parameters to use one was the arrow at T, one index. The other one is actually is the subgrid scale contribution from the drag by breaking convectively generated gravity waves and in order to calculate the Eddy Dissipation.

02:58:14.000 --> 02:58:37.690
Andreas Dörnbrack (Gast)
Should be from this non orthographic gravity waves scheme? Which assumes a classy uniform. Departure spectrum for the gravity waves globally say normalized this with vertically integrated convective heating between 500 hectopascal and the cloud tops. That's an idea actually which was implemented and also introduced by Peter Bechtold, so next.

02:58:39.520 --> 02:59:10.320
Andreas Dörnbrack (Gast)
Predictor of clear air turbulence was actually easy Turbo total turbulent dissipation, which was derived from the physical tendencies for horizontal momentum, which include actually contributions from the vertical diffusion scheme due to turbulent mixing or graphic wave track and or graphic blocking NC convective momentum. Transport actually these 3 indices where then combined in the How to say kind of dog approach that.

02:59:10.370 --> 02:59:17.670
Andreas Dörnbrack (Gast)
We have sent an index, which has been calibrated these cut 12 index, which is the.

02:59:17.720 --> 02:59:47.290
Andreas Dörnbrack (Gast)
The uh average between this cut one index and they cut 2 index, which combines the arrow at Index and the gravity wave drag NZ gravity wave drag and CTC patient so this was actually possible to run and to verify and to adjust and calibrate this cut index for the already mentioned made this data set and this described actually in these 2, contributions by Peter Bechtold 's there from the technical memorandum and also from the.

02:59:47.770 --> 03:00:05.160
Andreas Dörnbrack (Gast)
Uh most recent ECMWF newsletter due to operational constraints actually ECMWF decided only to UC cut 2 index for operational forecasts and this something we used also for the comparison of our observed.

03:00:05.800 --> 03:00:25.290
Andreas Dörnbrack (Gast)
Eddy dissipation rates from this holster campaign versus prediction of Cifs and how did we do this so we have the computed edr values from the IFS runs every hour so every hour? We have an output for all the flight days in September, October November 2019.

03:00:26.230 --> 03:00:32.900
Andreas Dörnbrack (Gast)
Additionally, actually Peter did run also 15 ensemble members, which were initialized different.

03:00:33.880 --> 03:00:40.260
Andreas Dörnbrack (Gast)
Differently and this takes into consideration that these turbulence events are really rare events and that.

03:00:40.880 --> 03:01:11.070
Andreas Dörnbrack (Gast)
The other way hurts us doing several talks that the probabilistic approach is actually the most appropriate approach to increase the skill score of Sicut forecast and then we interpolated all these outputs on the lat long positions of C Harlow observations or so not in time. But just on in space and we compared the observed DDR values with Cifs values in a time window, plus -50 minutes, which is approximately.

03:01:11.210 --> 03:01:16.270
Andreas Dörnbrack (Gast)
The timestamp of Cifs in order to get all the observations.

03:01:16.880 --> 03:01:25.750
Andreas Dörnbrack (Gast)
The assigned or associated with the predictions of Cifs and they also have to deviate less than 160 meters in altitude.

03:01:26.890 --> 03:01:41.480
Andreas Dörnbrack (Gast)
This actually reduces the data by 1/5 at by by one first and the results look like this, if you plot here. The modeled vertical dissipation rate Epsilon W.

03:01:42.280 --> 03:01:57.810
Andreas Dörnbrack (Gast)
Uh against the observed or vice versa, as we see, there is a nice correlation between the observed edit dissipation rates versus modeled dissipation rate. So we have a correlation coefficients are averages about 3/4.

03:01:58.560 --> 03:02:21.120
Andreas Dörnbrack (Gast)
So, your 0.74 and if you just sync OK, Richards numbers. One of the criteria. We usually use in order to predict shear instabilities and we also plots the observed dissipation rates against the inverse of Sir Richard 's number so actually against the sheer VCs as a correlation, but this correlation is very weak.

03:02:22.380 --> 03:02:28.240
Andreas Dörnbrack (Gast)
What you did send this to plot the same PDF 's actually as shown before bio like shuman?

03:02:28.940 --> 03:02:59.040
Andreas Dörnbrack (Gast)
For Epsilon you which is see a long flight component and the vertical components or we're just concentrating here on the red curve, which is C curve, which should be used against all these 15 different ensemble members, which are these Gray lines here and the ensemble mean we see that there's a nice coincidence. Actually, of these 2 curves for the larger dissipation values, so for values,

which are greater than 10 to the -4 and we also see is in this different plot, which takes into account that we have now.

03:02:59.080 --> 03:03:08.320
Andreas Dörnbrack (Gast)
Edr, which is a cubic root of Epsilon so we see that the red curve and the observed curve, which is.

03:03:08.450 --> 03:03:34.900
Andreas Dörnbrack (Gast)
The other recognize you observed one and the blue curve is actually easy on someone mean save closely. Follow actually for moderate and lighter turbulence or do you also see is that the predictions of Cifs actually predict higher turbulence events? Which were not observed actually by the aircraft so there's actually maybe an overproduction of turbulence due to this scheme here.

03:03:36.670 --> 03:04:07.080
Andreas Dörnbrack (Gast)
I already mentioned it said. We also used the ensemble capabilities of the ECMWF and this table shows the correlation of these different indices actually for the evaluation of seeing calibrated cut index by Peter Basch taught that we see that the correlation between the ensemble forecast here for certain period is much higher than for the deterministic forecast and we did the same for the soundtrack Halo data.

03:04:07.410 --> 03:04:38.600
Andreas Dörnbrack (Gast)
If you see that the young someone menidi are from Cifs Rosa Cdr from the along when component is in the same order of magnitude like this one and gets higher for the vertical then components. This means actually there's a stronger correlation between the observations of sub vertical wind and the derived Epsilon compared to EU component and there's another parameter, which is called the continuous ranked probability score, which should be small actually very small and you see if you compare this.

03:04:38.910 --> 03:04:47.450
Andreas Dörnbrack (Gast)
We see calibrated Index Patricio, 0.029 that actually for the South straight data we get a much higher.

03:04:48.030 --> 03:05:03.490
Andreas Dörnbrack (Gast)
A CR PS value actually from the IFS then compared to the aircraft observations, which actually gives confidence sets it on on summer prediction. Having higher skill score compared to the different for the deterministic forecast.

03:05:04.750 --> 03:05:21.150
Andreas Dörnbrack (Gast)
Just to summarize so we lined up some of our conclusions. We haven't extensive data set which many straight legs. And we have conditions in the atmosphere, which go from zero to moderate turbulence. It's Aminev Inspector of South Strike.

03:05:21.200 --> 03:05:23.130
Andreas Dörnbrack (Gast)
Uh are different.

03:05:23.760 --> 03:05:51.740
Andreas Dörnbrack (Gast)
2. The results from depression addicts because we have their rather strong vertical shear for some cases and mostly also we have stronger vertical wind due to gravity. Waves C 10 and 100, 100. Hertz data are fully consistent and there's always human already mentioned we have to be careful that we still not resolve source meat of scales. Yeah, for dissipation rates, which are large as intent was -4.

03:05:53.150 --> 03:06:01.680
Andreas Dörnbrack (Gast)
We have seen that the Epsilon 4 W is actually smaller than the Epsilon for the along and crosslink components and we have.

03:06:02.320 --> 03:06:16.130
Andreas Dörnbrack (Gast)
Results is actually 2 the UN isotropic nature of turbulence and also because we have some measurement issues, which best represent actually is EW component for calculating Z Epsilon.

03:06:17.500 --> 03:06:20.090
Andreas Dörnbrack (Gast)
It's already said the atmosphere is.

03:06:20.730 --> 03:06:31.150
Andreas Dörnbrack (Gast)
It's these flat levels V through actually mostly very smooth and very coms or 99.9% of the atmosphere is close to zero turbulent dissipation.

03:06:32.030 --> 03:06:53.540
Andreas Dörnbrack (Gast)
End Quote I didn't show. I also correlate it actually is it dissipation rates with some atmospheric parameters and what I found is actually that the most strongest correlation as the enhanced values of dissipation rate are actually associated with stronger shield, which suggests that actually she resume generate of turbulence during these flights.

03:06:54.460 --> 03:07:04.270
Andreas Dörnbrack (Gast)
Can somebody agrees better with the observed Epsilon WNBC observed Epsilon you and we get higher scale scores for the only prediction system.

03:07:06.150 --> 03:07:23.330
Andreas Dörnbrack (Gast)
What do you found is also that siv escalation with the research aircraft data and other statistical measures actually compareable or even slightly better than the comparison within normal. This data set which was used previously by Peter based or 2 calibrate sicut indices.

03:07:24.360 --> 03:07:53.580
Andreas Dörnbrack (Gast)
And what is really interesting that the eyvaz predictions are much better than a simple correlation with C inverse officer. Richardson numbers so he derived Epsilon values are and available and valid measure for the clear turbulence and that's and data set which will be available for research communities and we were happy if people would use. It actually also to compare with their own prediction from different numerical result prediction Centers for instance, with seeing GGG from.

03:07:54.270 --> 03:08:03.510
Andreas Dörnbrack (Gast)
So you you came at office offer meet your phones. Yeah, that's all and thank you for your attention and just another picture about so beautiful Sky over Argentina.

03:08:08.900 --> 03:08:11.420
Andreas Dörnbrack (Gast)
Yes, thank you Andreas and Ulrich.

03:08:11.340 --> 03:08:18.180
Bob Sharman (Guest)
For very interesting talk, I don't know if we have any questions in the chat room. I don't see anybody.

03:08:19.200 --> 03:08:21.050
Bob Sharman (Guest)
Well, I just have one quick question.

03:08:21.100 --> 03:08:27.930
Bob Sharman (Guest)
Uhm did you look at or plan to look at the transfer legs?

03:08:29.960 --> 03:08:31.110
Bob Sharman (Guest)
So yes.

03:08:31.560 --> 03:08:37.650
Ulrich.Schumann
Yeah, the transfer legs, I included the already included in the data set or they are included OK.

03:08:37.550 --> 03:08:38.090
Bob Sharman (Guest)
Yes.

03:08:40.170 --> 03:08:47.870
Bob Sharman (Guest)
Ah, what, if you did them separately, not much different OK. Details Yes, but not dramatic.

03:08:48.540 --> 03:08:48.990
Ulrich.Schumann
OK.

03:08:50.810 --> 03:08:52.800
Ulrich.Schumann
Interesting well, I think we're.

03:08:52.710 --> 03:08:56.120
Bob Sharman (Guest)
Running a little behind so we should move on to the next topic.

03:08:57.560 --> 03:09:15.530
Bob Sharman (Guest)
Which is uh Julia Pierson from in car and she will update us on the turbulence no caste system GTG in that we've been developing and has been running in a semi operational mode for the last couple of years, so Julia.

03:09:17.680 --> 03:09:18.490
Bob Sharman (Guest)
Thank you Bob,

03:09:20.930 --> 03:09:22.980
Bob Sharman (Guest)
can you can you see my screen?

03:09:26.390 --> 03:09:28.160
Julia Pearson (Guest)
Yes, but not in presentation.

03:09:28.060 --> 03:09:28.680
Matt Fronzak
Imodium.

03:09:29.480 --> 03:09:29.890
Matt Fronzak
OK.

03:09:31.910 --> 03:09:35.180
Matt Fronzak
How's that perfect right?

03:09:37.090 --> 03:09:37.620
Matt Fronzak
OK.

03:09:40.190 --> 03:09:42.300
Matt Fronzak
So the graphical turbulence guidance.

03:09:42.160 --> 03:09:43.260
Julia Pearson (Guest)
Is now cast?

03:09:43.960 --> 03:10:14.880
Julia Pearson (Guest)
Uh was developed as a tactical turbulence product and its goal is to help dispatchers and pilots make short term routing and operational decisions in order to avoid turbulence hazards and thus enhance safety in the national airspace system so in this talk. I'm going to describe now. I'm going to go over the current semi operational version of the algorithm GTG and 1.0. I'm going to describe the data inputs that go into GTA.

03:10:15.270 --> 03:10:23.150
Julia Pearson (Guest)
One and also show a few case studies to illustrate its current capability and then after that, I will describe.

03:10:23.710 --> 03:10:41.610
Julia Pearson (Guest)
Uh the next version of the algorithm that's under development and car version 2.0 and show some case studies that highlight the benefit of adding new input datas, including lightning, and higher resolution data inputs and then I'll summarize.

03:10:44.090 --> 03:10:46.800
Julia Pearson (Guest)
So the graphical turbulence guidance now casts.

03:10:47.770 --> 03:10:59.660
Julia Pearson (Guest)
Algorithm provides a 3 dimensional short term now casts of turbulence. In energy dissipation rate, and this is an atmospheric aircraft independent measure of turbulence.

03:11:00.350 --> 03:11:17.280
Julia Pearson (Guest)
The output of Gnna, now cast is the same as the domain and it is has vertical levels that are pertinent to aviation, which is every 1000 feet in flight levels above 18,000 feet.

03:11:18.350 --> 03:11:43.100
Julia Pearson (Guest)
GT Jan has a rapid update rate of 15 minutes and the real key of the algorithm is that it uses a short term, GTG forecasts and then ingest recent turbulence observation and then nudges. The forecast to be in line with those turbulence observations in order to give the most accurate snapshot of the current turbulent conditions in the Nas.

03:11:44.090 --> 03:12:14.780
Julia Pearson (Guest)
And then I also want to mention that the GTGN. One is running semi operationally at end car and real time. Output is available via an LDM data feed and I've highlighted in blue here. The inputs of the GTG and one system so as you can see GTG 3 feeds into the algorithm and then the airborne observations that are included are in situ. Edr reports and pilot reports or Pirates and then we get convective information.

03:12:14.840 --> 03:12:37.150
Julia Pearson (Guest)
From the next red or end car turbulence detection algorithm and then future versions. Like I said version 2 will include lightning turbulence and information and surface wind speed and Gus and then we also have potential future inputs of satellite based data and a DSB edr.

03:12:39.130 --> 03:12:55.360
Julia Pearson (Guest)
So I know a lot of people have mentioned GTG I still included a quick overview. It's just that it's a turbulence forecast based on numerical weather prediction models. GTG 3 is currently operational and it's running on the rap model over the continental US.

03:12:56.070 --> 03:13:02.560
Julia Pearson (Guest)
But underdevelopment GTG 4 will run on the higher resolution her or Rufus 3 kilometer model.

03:13:03.300 --> 03:13:15.250
Julia Pearson (Guest)
GTG also provides 3 dimensional forecasts and DDR and the we are using the konis domain version with the 1000 foot vertical levels.

03:13:16.170 --> 03:13:20.340
Julia Pearson (Guest)
So GTG 3 is initialized every hour and it has outputs.

03:13:21.270 --> 03:13:32.880
Julia Pearson (Guest)
Forecast similar to numerical weather prediction models, but forg we use a one or 2 hour forecast who's valid time is closest to the current update time.

03:13:33.690 --> 03:13:44.240
Julia Pearson (Guest)
And Lastly as many of you know, GTG calculates and in Sambol of turbulence diagnostics that are converted to ER and then combined to create the forecasted edr grid.

03:13:46.240 --> 03:13:46.750
Julia Pearson (Guest)
So then it.

03:13:46.600 --> 03:13:48.400
Andreas Dörnbrack (Gast)
In terms of the airborne.

03:13:48.570 --> 03:14:18.690
Julia Pearson (Guest)
Observations that we end put so there's Pilar reports and in situ. Edr reports so pireps are subjective aircraft. Dependent pilots assessment of the level of turbulence that they're experiencing null too. Extreme and we turn that pirap intensity. We convert that to edr using a parabolic equation based on

the type of reporting aircraft and we get approximately 500 and some of these on average per day and I've included just a graphic of the.

03:14:18.740 --> 03:14:25.950
Julia Pearson (Guest)
Different UM pirate symbols and you can see in this image here. I'm showing a few moderate to severe reports.

03:14:27.410 --> 03:14:46.180
Julia Pearson (Guest)
Then in situ Edr reports those these are automated aircraft independent measures of turbulence and so there's an algorithm which is deployed on the acms box on of several commercial aircraft, and this algorithm calculates peak and mean edr every minute of flight.

03:14:47.050 --> 03:15:16.960
Julia Pearson (Guest)
And these reports include very precise time and position information more so than pilot reports and we get a lot more of them per day. Approximately 35,000 on average. And just for reference. I wanted to say that moderate or greater turbulence is approximately a point to edr for a medium or say a Boeing 737 sized aircraft and so whenever I show edr reports anything from.

03:15:17.010 --> 03:15:28.880
Julia Pearson (Guest)
In the null category will be dots, but then higher up values will be open circles color coded to the to the same color scale shown in my figures.

03:15:31.060 --> 03:16:01.300
Julia Pearson (Guest)
So the next we have the ANTDA this algorithm is a radar based algorithm that measures edr from spectrum with estimates and the key for NDA is that it only measures turbulence where sufficient wind tracing reflectors exist, which is in clouds and storms. I've included a vertical cross section of the NTDAYDR versus reflectivity for comparison, just to show that.

03:16:01.660 --> 03:16:11.070
Julia Pearson (Guest)
Uh increase DDR isn't necessarily the same as where increased reflectivity. You can see, there's elevated edr above the the score.

03:16:12.710 --> 03:16:26.770
Julia Pearson (Guest)
ANTA is a high resolution product. It's native grid is 2 kilometer and then it's in the in the horizontal and then in the vertical. It's every 3000 feet over the Konus and it updates every 5 minutes.

03:16:27.470 --> 03:16:58.140
Julia Pearson (Guest)
So the benefits of NDA is that it can measure turbulence remotely in particular, convectively in twos turbulence. Its spatial and temporal coverage are far exceed the Pireps and in situ. ER and the measurements are root independent. However, there are some limitations were obviously limited to

where we have radar coverage and also there's sparse sampling in the western US of of of the atmosphere by the radar network.

03:16:58.250 --> 03:17:03.340
Julia Pearson (Guest)
So I I've included this image here showing the maximum number.

03:17:04.060 --> 03:17:15.910
Julia Pearson (Guest)
Of radars that could sample a given cell so you can see, there's pretty good coverage in the eastern US. But like I said it's sparse in the West and then the purple color is showing where we have no coverage.

03:17:19.330 --> 03:17:21.290
Andreas Dörnbrack (Gast)
So next I'm just going to show an exam.

03:17:21.120 --> 03:17:50.560
Julia Pearson (Guest)
Example of Guduan and the different components that make it up so in the upper left. I have GTG 3. It's a 2 hour forecast valid at 16:00 UTC and then I've also included NTD a valid from 1555 and Pirates in in situ. We used the previous hours worth of observations so from 15 to 16 UTC and once we combine all of these.

03:17:50.920 --> 03:18:20.260
Julia Pearson (Guest)
We get the resultant GTG an update on the right valid at 16:00 UTC enough. I overlay some verification observations, which in this case will always be the observations over the next 15 minutes during the algorithms. Valid time from 16 to 1615. You can see the dog was able to capture some of these moderate reports because of GTG but then also this moderate poured and some of these in situ reports.

03:18:21.490 --> 03:18:27.000
Julia Pearson (Guest)
Due to the inclusion of of the convectively induced component of from NTDA.

03:18:29.420 --> 03:18:45.200
Julia Pearson (Guest)
Next I have another operational case study analysis from February of this past year. I'm showing here 3 different GTG and updates all at flight level 370 from 1645 to 1715.

03:18:46.400 --> 03:18:46.960
Julia Pearson (Guest)
Uh.

03:18:47.640 --> 03:19:10.760
Julia Pearson (Guest)
These these examples show GTG and forecast moderate or greater turbulence in areas where we see moderate or greater. Pirates here and also down in Louisiana. Here you can see some in situ. Edr reports that match up with the GTGN and then there's also a few moderate in city reports in Tennessee here.

03:19:11.910 --> 03:19:32.720
Julia Pearson (Guest)
And you can also see that there's quite a bit of null reports. These dots surrounding the this area of moderates so these examples. Show dog has skill and correctly identifying narrow regions of moderate or greater greater turbulence as well as adjacent areas of null turbulence.

03:19:35.030 --> 03:20:02.970
Julia Pearson (Guest)
So moving on to GTG and 2 under development. We have found in our research that lightning characteristics correlate within cloud turbulence and that as lightning frequency increases. So does the edr intensity and while NTDS currently there are main contributor of in cloud convectively induced turbulence. We said that like we mentioned earlier, the we are limited by the radar coverage.

03:20:03.630 --> 03:20:24.040
Julia Pearson (Guest)
But lightning observations are available over the continental US to fill in where MTA has sparse coverage, but also lightning will be available is available over oceans and globally, which will allow for GT GN with convectively induced turbulence observations overexpanded domains in the future.

03:20:25.330 --> 03:20:38.620
Julia Pearson (Guest)
I've included a quick example here so on the left. Jan one and then on the right GT GN with lightning and you can see that the Lightning edition of lightning data alerts too.

03:20:39.390 --> 03:20:58.090
Julia Pearson (Guest)
Uh some moderate turbulence in Wyoming and North Western Colorado that was missing in the GTGN. One version and you can see that there was even a few moderate and Situee are reports that ended up.

03:20:58.140 --> 03:21:05.830
Julia Pearson (Guest)
Uh experiencing turbulence where the dog with lightning would have warned moderate turbulence.

03:21:07.890 --> 03:21:31.330
Julia Pearson (Guest)
Another quick example showing of the addition of lightning data so I've highlighted this area in this Oval here and you can see from the image on the bottom that we are just outside of the radar coverage. This purple area means no coverage and so you can see that the GT GN with lightning.

03:21:32.020 --> 03:21:40.310
Julia Pearson (Guest)
Would alert to this area of moderate turbulence here kind of extend down? What you see?

03:21:40.360 --> 03:21:52.850
Julia Pearson (Guest)
BANGTGN one and as you can see here there was also a moderate in situ. Edr report that verified that yes, there was still moderate turbulence in that region.

03:21:55.310 --> 03:22:20.440
Julia Pearson (Guest)
Next uh GTG and 2 is going to be utilizing higher resolution inputs, so specifically GTG and 2 will be using short term, GTG 4 forecasts. That'll be on either the her. Rufus models and this will be a have a 3 kilometre grid spacing allowing for more detail in the turbulence features and less volume of moderate or greater turbulence forecast.

03:22:21.350 --> 03:22:27.400
Julia Pearson (Guest)
Just to note, I also want to mention that GG 4 will also include a convectively induced turbulence forecast.

03:22:28.180 --> 03:22:58.470
Julia Pearson (Guest)
Or planning GTG and 2 will still be on the konis domain similar to GTGN one and NTDA being on the higher resolution domain 3 kilometer, which is closer to its native 2 kilometre domain will result in more precise in cloud turbulence input into GTGN and I've included jug on the rap versus GT GN on the her down here at the bottom and you can see that there's definitely more detail and less.

03:22:58.910 --> 03:23:03.220
Julia Pearson (Guest)
Volume of moderate or greater turbulence in the GTG and on the her.

03:23:05.600 --> 03:23:16.050
Julia Pearson (Guest)
So, in summary the graphical turbulence guidance now cast is a tactical turbulence avoidance aid for aviation developed underfunding front provided by the FAA.

03:23:16.100 --> 03:23:35.110
Julia Pearson (Guest)
Hey GTGN is a 3 dimensional product that identifies turbulent layers. In the atmosphere on flight levels pertinent to aviation users. It has rapid updates and ingest real time observations that provide an immediate feedback to aviation users on the state of the atmosphere.

03:23:36.460 --> 03:23:46.160
Julia Pearson (Guest)
The real time case studies have shown that GTGN is able to pinpoint specific regions of moderate or greater turbulence and adjacent areas of null turbulence.

03:23:47.510 --> 03:24:02.830
Julia Pearson (Guest)
The first version of the algorithm 1.0 has undergone the FAA STRP and SRM processes and it's output is available on a semi operational basis through LDM feed from end car.

03:24:04.870 --> 03:24:27.450
Julia Pearson (Guest)
Currently we are developing a version 2.0, which will include lightning data and higher resolution inputs and then Lastly. I just want to mention that the NTSB did recently published recommendations to

operationalize turbulence. Now casts such as GTGN and GT GN is planned to be transitioned to no end sub for operations.

03:24:28.960 --> 03:24:30.450
Julia Pearson (Guest)
And thank you. That's all I have.

03:24:34.220 --> 03:24:35.780
Julia Pearson (Guest)
Thank you Julia that was a good.

03:24:35.650 --> 03:24:44.690
Bob Sharman (Guest)
A Doc UM interesting and something interesting. I see we have a lot of questions. So Steve can you pick 2 or 3 of them?

03:24:44.850 --> 03:24:46.920
Bob Sharman (Guest)
Sure, we have a couple questions on.

03:24:46.830 --> 03:24:56.350
Steve Abelman
On uh from mad at Delta. What is required for you to ingest other sources of in situ turbulence observations in the now cast?

03:24:59.450 --> 03:25:00.340
Steve Abelman
Uh.

03:25:00.910 --> 03:25:06.190
Julia Pearson (Guest)
What is required to to ingest more observations?

03:25:07.260 --> 03:25:13.200
Julia Pearson (Guest)
I mean, I guess they just need to be available to us, UM that's really the main thing.

03:25:16.350 --> 03:25:16.990
Julia Pearson (Guest)
I don't.

03:25:18.360 --> 03:25:20.680
Julia Pearson (Guest)
Yeah, I think it's long as the observation is.

03:25:20.560 --> 03:25:24.100
Bob Sharman (Guest)
There's an edr observation, it's fairly easy to implement.

03:25:25.060 --> 03:25:25.650
Bob Sharman (Guest)
Right.

03:25:26.310 --> 03:25:27.580
Bob Sharman (Guest)
OK, we have 2.

03:25:27.640 --> 03:25:35.730
Steve Abelman
Questions on GTGN is a 3 D product by understand lightning to be 2 D. How do you incorporate?

03:25:36.860 --> 03:25:40.550
Steve Abelman
The difference between the 2 merged the 2 yeah, so.

03:25:40.910 --> 03:26:00.500
Julia Pearson (Guest)
So there are lining algorithm algorithm was based on statistics, So what we ended up doing was we looked at the 3 dimensional. UM NTD a mostly NTA, but also some in situ. Empire up information in the column and then matched that with.

03:26:01.350 --> 03:26:06.860
Julia Pearson (Guest)
The number of lightning strikes and so we looked at how.

03:26:08.890 --> 03:26:09.380
Julia Pearson (Guest)
I'm sorry.

03:26:09.270 --> 03:26:11.030
Andreas Dörnbrack (Gast)
From getting into the weeds but how.

03:26:11.400 --> 03:26:35.040
Julia Pearson (Guest)
Uhm the turbulence varied within that vertical column and then statistically derived a relationship so that we apply kind of a of of an influence to the GTG forecast based on the number of lightning strikes that we have at that location in the vertical based on this statistical relationship that we came up with.

03:26:37.080 --> 03:26:38.750
Julia Pearson (Guest)
OK thanks.

03:26:38.710 --> 03:26:41.490
Steve Abelman
Uhm what source of lightning data is used.

03:26:42.800 --> 03:26:43.840
Steve Abelman
So currently.

03:26:43.710 --> 03:26:53.250
Julia Pearson (Guest)
We we've trained on using the Earth Networks Lightning, but we are working on looking at a using GLM in the future.

03:26:55.360 --> 03:26:56.900
Julia Pearson (Guest)
Skype from Tim.

03:26:56.900 --> 03:27:11.960
Steve Abelman
In American given that there are many flight attendants suffering injuries injuries in the 10 to 20,000 foot altitude. Is there any plan to add that range starting at 18:00, 1000 feet as a significant safety issue for us in the airline world, so dog.

03:27:12.040 --> 03:27:25.970
Julia Pearson (Guest)
Actually goes all the way down to the surface and it's at 1000 foot levels from the surface up to 18,000 feet. It's just the the output is on flight levels above that so it's not.

03:27:26.030 --> 03:27:38.830
Julia Pearson (Guest)
Uh we just set you know it's on uh. Not exactly 1000 feet above the ground. That makes sense. So is so it is a product that goes all the way down to the surface.

03:27:40.780 --> 03:27:42.470
Julia Pearson (Guest)
OK thanks I'll

03:27:42.370 --> 03:27:56.660
Steve Abelman
I'll show you my face. 'cause some Steve guys right writing a question for you. Julia how are you by the way anyway have you considered I'm asking have you considered blocking out some of the turbulence forecasts that completely overlay. A solid line of weather in areas where?

03:27:57.280 --> 03:28:08.770
Steve Abelman
Pilots and dispatchers are avoiding anyway, I've noticed a couple of the GTM forecast get really cluttered when there's a whole lot of convective weather going on it, you know at the scales that you're looking so have you given that any consideration?

03:28:10.720 --> 03:28:11.850
Steve Abelman
You know, I haven't.

03:28:11.750 --> 03:28:16.980
Julia Pearson (Guest)
Uh I haven't thought about blocking out certain regions entirely.

03:28:18.670 --> 03:28:26.230
Julia Pearson (Guest)
So that's interesting I mean, it would be interesting to get feedback from users. If that would be something that they would be interested in and if that would be helpful.

03:28:27.900 --> 03:28:30.140
Julia Pearson (Guest)
And also Steve if you see a case like that.

03:28:30.030 --> 03:28:32.250
Bob Sharman (Guest)
Let us know and we'll take a look at it.

03:28:33.760 --> 03:28:36.170
Bob Sharman (Guest)
Yeah, Bob I don't look as many cases they used to these.

03:28:36.090 --> 03:28:37.550
Steve Abelman
Dates OK will do.

03:28:39.030 --> 03:28:42.380
Steve Abelman
Uh OK let's see UM.

03:28:43.330 --> 03:28:56.800
Steve Abelman
It's OK, I think we got that in principle can one accept other sources of turbulence information. As long as he can relate them to edr since GT GN is expressed in EDR values and it gets going back to.

03:28:57.370 --> 03:29:00.480
Steve Abelman
A little bit back to Matt 's question and to Pireps.

03:29:02.580 --> 03:29:04.410
Steve Abelman
I mean, yeah in theory, we can.

03:29:04.830 --> 03:29:17.880
Julia Pearson (Guest)
We can input other sources that are in Edr. Of course, we'd wanna look at that and evaluate evaluate any new sources of data before we put it in and figure out how to put it in.

03:29:21.710 --> 03:29:23.620
Andreas Dörnbrack (Gast)
OK come from?

03:29:23.640 --> 03:29:36.220
Steve Abelman
OBGYN so GGG one gridded datasets are only available by a LDM feed. Yes, would GT Jan gridded data set data sets be available for research purposes and not operational use.

03:29:38.840 --> 03:29:40.010
Steve Abelman
Yeah, so.

03:29:39.910 --> 03:29:40.830
Julia Pearson (Guest)
Uhm.

03:29:42.120 --> 03:29:51.030
Julia Pearson (Guest)
The data is currently available and it is available via the LDM fee just have to sign a licensing agreement with any car, UM.

03:29:52.420 --> 03:30:00.440
Julia Pearson (Guest)
So I I don't believe our licensing agreement has anything restricting the use so I believe that you could use it for research use.

03:30:03.360 --> 03:30:03.720
Andreas Dörnbrack (Gast)
OK.

03:30:04.590 --> 03:30:06.360
Andreas Dörnbrack (Gast)
I think I've covered.

03:30:06.870 --> 03:30:08.680
Steve Abelman
Did you do to do that? I think that's it?

03:30:09.500 --> 03:30:10.870
Steve Abelman
Pick up covered them all.

03:30:14.150 --> 03:30:16.180
Steve Abelman
OK, well, I guess that ends.

03:30:16.390 --> 03:30:25.400
Bob Sharman (Guest)

Session one except for some open discussion later and right now on the agenda. We have uh a break schedule a 10 minute break.

03:30:27.180 --> 03:30:30.030
Bob Sharman (Guest)
Are we OK to take the break or do you want to go forward Tammy?

03:30:38.390 --> 03:30:39.780
Andreas Dörnbrack (Gast)
OK, executive decision.

03:30:39.700 --> 03:30:41.110
Bob Sharman (Guest)
I'll take a 10 minute break.

03:31:22.940 --> 03:31:24.190
Bob Sharman (Guest)
Tell me 15.

03:31:35.290 --> 03:31:39.990
Bob Sharman (Guest)
Hey Bob Yeah, this is Matt in light of the fact that we have.

03:31:39.950 --> 03:31:49.180
Matt Fronzak
Quite a few European guests and it's getting late in their day there. I wonder if if we, we maybe should should focus on getting out on time.

03:31:50.560 --> 03:31:51.160
Matt Fronzak
Ah.

03:31:51.840 --> 03:31:52.320
Matt Fronzak
Yeah, we?

03:31:52.190 --> 03:31:54.180
Bob Sharman (Guest)
We can, we can pick it up now.

03:31:55.790 --> 03:32:03.220
Bob Sharman (Guest)
We gave a let's see we've got like 2 minute break so far. We could give it another 3 minutes and then pick it up.

03:32:03.720 --> 03:32:05.860
Bob Sharman (Guest)
Yeah, I I just I I saw on input from.

03:32:05.750 --> 03:32:11.110
Matt Fronzak
And Olivier, who I I suspect is he replied from that perspective.

03:32:12.080 --> 03:32:13.850
Matt Fronzak
Yeah, I know it's getting late.

03:32:13.790 --> 03:32:14.350
Bob Sharman (Guest)
There.

03:32:17.640 --> 03:32:20.950
Bob Sharman (Guest)
OK, well, let's just go another couple of minutes, UM.

03:32:21.850 --> 03:32:23.030
Bob Sharman (Guest)
And then we'll pick up the.

03:32:23.080 --> 03:32:23.470
Bob Sharman (Guest)
Yeah.

03:32:25.580 --> 03:32:27.060
Bob Sharman (Guest)
The open discussion.

03:32:33.700 --> 03:32:34.740
Olivier Jaron (MF) (Invité)
Bah Bah.

03:32:35.630 --> 03:32:37.510
Olivier Jaron (MF) (Invité)
Bob yeah, there is Ella.

03:32:39.930 --> 03:32:40.740
Bob Sharman (Guest)
No, I know.

03:32:41.190 --> 03:32:42.180
Bob Sharman (Guest)
200.

03:32:45.660 --> 03:32:46.650
Ulrich.Schumann
They may

03:32:46.860 --> 03:32:47.340
Ulrich.Schumann
so.

03:32:48.630 --> 03:32:49.260
Ulrich.Schumann
See here.

03:32:50.580 --> 03:32:51.030
Olivier Jaron (MF) (Invité)
Wow.

03:32:51.910 --> 03:32:52.390
Olivier Jaron (MF) (Invité)
Yeah.

03:32:53.630 --> 03:32:54.850
Olivier Jaron (MF) (Invité)
You album.

03:32:55.730 --> 03:32:58.080
Olivier Jaron (MF) (Invité)
Just after I met him.

03:33:00.070 --> 03:33:00.910
Olivier Jaron (MF) (Invité)
Yes.

03:33:01.880 --> 03:33:03.480
Olivier Jaron (MF) (Invité)
How old is she 3?

03:33:05.600 --> 03:33:09.570
Bob Sharman (Guest)
How how many years old? How many how many?

03:33:09.610 --> 03:33:10.000
Bob Sharman (Guest)
Yeah, so.

03:33:10.760 --> 03:33:11.700
Olivier Jaron (MF) (Invité)
2 years and a half.

03:33:12.380 --> 03:33:13.010
Olivier Jaron (MF) (Invité)
OK.

03:33:14.350 --> 03:33:15.370
Olivier Jaron (MF) (Invité)
Does not need me?

03:33:16.010 --> 03:33:16.530
Olivier Jaron (MF) (Invité)
Check it out.

03:33:17.020 --> 03:33:17.630
Olivier Jaron (MF) (Invité)
Dinner.

03:33:18.650 --> 03:33:19.230
Olivier Jaron (MF) (Invité)
It's OK.

03:33:22.100 --> 03:33:22.520
Olivier Jaron (MF) (Invité)
Wait.

03:33:23.380 --> 03:33:23.930
Olivier Jaron (MF) (Invité)
We did that.

03:33:27.220 --> 03:33:27.870
paola imazio (Invitado)
Ella.

03:33:28.560 --> 03:33:30.030
paola imazio (Invitado)
Tina what's this.

03:33:35.210 --> 03:33:36.820
Olivier Jaron (MF) (Invité)
Did you want to know what?

03:33:43.100 --> 03:33:43.820
Olivier Jaron (MF) (Invité)
No no.

03:33:44.940 --> 03:33:46.360
Olivier Jaron (MF) (Invité)
My my thought.

03:33:47.640 --> 03:33:48.210
paola imazio (Invitado)
I like rice?

03:33:48.840 --> 03:33:49.250
paola imazio (Invitado)
Ah.

03:33:52.900 --> 03:33:53.370
paola imazio (Invitado)
We meet.

03:33:53.430 --> 03:33:54.140
Olivier Jaron (MF) (Invité)
During the Monday.

03:33:56.030 --> 03:33:56.470
Olivier Jaron (MF) (Invité)
Yeah.

03:33:56.990 --> 03:33:59.690
Olivier Jaron (MF) (Invité)
2 South Clap Come on come on.

03:34:00.770 --> 03:34:02.190
Olivier Jaron (MF) (Invité)
Or should I bid Paola.

03:34:02.950 --> 03:34:03.560
paola imazio (Invitado)
Uh-huh.

03:34:05.510 --> 03:34:06.140
paola imazio (Invitado)
Folder.

03:34:10.240 --> 03:34:10.870
paola imazio (Invitado)
This is offline.

03:34:12.240 --> 03:34:12.590
paola imazio (Invitado)
Cool.

03:34:13.680 --> 03:34:14.430
Olivier Jaron (MF) (Invité)
Liquid.

03:34:14.930 --> 03:34:16.700
paola imazio (Invitado)
It's 2250.

03:34:16.620 --> 03:34:18.710
Olivier Jaron (MF) (Invité)
6 young radical don't.

03:34:18.960 --> 03:34:19.260
Olivier Jaron (MF) (Invité)
Hey.

03:34:19.310 --> 03:34:19.920
Olivier Jaron (MF) (Invité)
Did you feel?

03:34:22.440 --> 03:34:22.710
Olivier Jaron (MF) (Invité)
Yeah.

03:34:24.180 --> 03:34:24.920
Olivier Jaron (MF) (Invité)
Oh yeah.

03:34:24.980 --> 03:34:25.220
Olivier Jaron (MF) (Invité)
Yeah.

03:34:25.550 --> 03:34:25.810
Olivier Jaron (MF) (Invité)
Bob.

03:34:25.860 --> 03:34:27.730
Olivier Jaron (MF) (Invité)
We don't know right now.

03:34:28.880 --> 03:34:33.550
Ulrich.Schumann
Post live in Boulder, right now, what about you know.

03:34:34.090 --> 03:34:39.440
Bob Sharman (Guest)
Covid Here is really taking off, it's gotten much worse in the last few weeks.

03:34:40.300 --> 03:34:43.890
Bob Sharman (Guest)
And I I really don't know why.

03:34:44.710 --> 03:34:49.040
Bob Sharman (Guest)
Because at least in Boulder County, there's still a mask mandate.

03:34:50.140 --> 03:34:58.610
Bob Sharman (Guest)
Uh yet the cases keep going up. There is in the state of Colorado, there's only 100 ICU beds available.

03:34:59.920 --> 03:35:01.790
Bob Sharman (Guest)
So yeah, it's

03:35:02.600 --> 03:35:07.140
Bob Sharman (Guest)
I don't know right now, we're having a surge, Yeah, same same here.

03:35:07.490 --> 03:35:08.720
Ulrich.Schumann
You are OK.

03:35:09.440 --> 03:35:10.630
Ulrich.Schumann
But it can be very and.

03:35:12.520 --> 03:35:14.370
Ulrich.Schumann
Uh do you do they know? Why?

03:35:16.430 --> 03:35:17.320
Ulrich.Schumann
They it didn't.

03:35:18.490 --> 03:35:22.710
Ulrich.Schumann
But vaccinate or there are too many people who don't accept it.

03:35:23.470 --> 03:35:25.610
Ulrich.Schumann
Yeah, that's part of the problem here.

03:35:25.490 --> 03:35:30.660
Bob Sharman (Guest)
But in the County we do have an 80% vaccination rate.

03:35:31.530 --> 03:35:34.120
Bob Sharman (Guest)
Well, I'm surprised we're having this much trouble.

03:35:35.340 --> 03:35:37.680
Bob Sharman (Guest)
What is the problem of the non vaginal?

03:35:37.570 --> 03:35:42.800
Ulrich.Schumann
Stated price yes for sure, yeah, more than 80%.

03:35:42.680 --> 03:35:46.310
Bob Sharman (Guest)
Other people that are hospitalized are unvaccinated.

03:35:48.620 --> 03:35:49.770
Bob Sharman (Guest)
So it's still not that good.

03:35:49.790 --> 03:35:51.480
Ulrich.Schumann
And to visit Boulder again.

03:35:53.120 --> 03:35:53.910
Ulrich.Schumann
Yeah, probably.

03:35:53.790 --> 03:35:54.460
Bob Sharman (Guest)
Came out right.

03:35:55.710 --> 03:36:02.450
Bob Sharman (Guest)
I see I don't know if it's better than where you are or not, but it's it's not very good right now? Yeah.

03:36:03.260 --> 03:36:05.830
Bob Sharman (Guest)
So Bob how many speakers do we have left 'cause we're?

03:36:05.850 --> 03:36:08.000
Flowe, Tammy (FAA)
Then there were speakers, so it's it's OK.

03:36:07.880 --> 03:36:12.820
Bob Sharman (Guest)
Open discussion next OK alright good 'cause we got about 2 minutes now.

03:36:13.640 --> 03:36:16.140
Bob Sharman (Guest)
Yeah, why don't we start I mean Steve there there?

03:36:15.990 --> 03:36:18.500
Flowe, Tammy (FAA)
Or anything outstanding in the in the chat room.

03:36:24.080 --> 03:36:25.460
Patrick Vrancken (DLR) (Gast)
No, I'm talking on mute button.

03:36:26.600 --> 03:36:29.730
Steve Abelman
No there's not nothing that I've seen.

03:36:29.810 --> 03:36:30.270
Steve Abelman
Uhm.

03:36:31.080 --> 03:36:32.180
Steve Abelman
Don't miss.

03:36:35.130 --> 03:36:35.360
Steve Abelman
Yeah.

03:36:35.210 --> 03:36:37.300
Patrick Vrancken (DLR) (Gast)
Yeah, more more just some of the feed.

03:36:37.170 --> 03:36:47.320
Steve Abelman
Back to Paul but I think he's able to read that on on the chat room. I think we've covered everything I guess if I missed the question if you want to pipe up.

03:36:49.160 --> 03:36:50.170
Steve Abelman
Now I guess maybe?

03:36:50.950 --> 03:36:52.490
Steve Abelman
Well, so I mean, one pause.

03:36:52.390 --> 03:36:58.690
Bob Sharman (Guest)
This building is people could think about this put it in the chat room later and we could pick them up for discussion.

03:36:59.370 --> 03:37:00.980
Bob Sharman (Guest)
One of the next 2 days.

03:37:05.620 --> 03:37:10.920
Flowe, Tammy (FAA)
Yeah, I I think that's a great idea. I mean, I I I think that we have the capability to.

03:37:11.700 --> 03:37:14.110
Flowe, Tammy (FAA)
Save the chat.

03:37:14.940 --> 03:37:30.540
Flowe, Tammy (FAA)
I mean, I can I I'll defer to Matt here. But I'm pretty sure we have the capability to save that at and if we didn't meet anybody question, we can certainly pick it up with the minutes. I guess we could have a little section maybe.

03:37:31.150 --> 03:37:35.460
Flowe, Tammy (FAA)
Ah responses to the questions I don't know I'm I'm I'm thinking out loud here.

03:37:36.340 --> 03:37:38.980
Flowe, Tammy (FAA)
I did I did get ping that I missed once from.

03:37:38.900 --> 03:37:48.340
Steve Abelman
From my Rick I'm really sorry buddy from my old buddy. Rick Curtis, who asked any estimate on when GTG and will transition fully to put a fully operational.

03:37:49.210 --> 03:37:49.640
Steve Abelman
No.

03:37:50.720 --> 03:37:53.820
Flowe, Tammy (FAA)
Rec rec man it's like ask the hardest question.

03:37:56.470 --> 03:37:59.760
Flowe, Tammy (FAA)
So so Rick I'm I'm gonna take that one up so.

03:38:01.300 --> 03:38:15.040
Flowe, Tammy (FAA)
As you know the NTSB report, which we're going to get a report on on Wednesday as part of this workshop, but that was one of the recommendations they made was to operationalize GT GN?

03:38:16.380 --> 03:38:30.900
Flowe, Tammy (FAA)
As you know the FAA is funding the running of GT GN at end car right now and anybody that wants access to it. Just has to sign a licensing agreement so it's there's no cost associated with that.

03:38:31.470 --> 03:38:36.120
Flowe, Tammy (FAA)
Uhm so anybody can get that information that once that grid information.

03:38:38.530 --> 03:38:43.270
Flowe, Tammy (FAA)
You know, we, we I won't tell you that we have been working with.

03:38:44.610 --> 03:38:49.850
Flowe, Tammy (FAA)
The National Weather Service to try to move this product into operations.

03:38:49.920 --> 03:39:02.600
Flowe, Tammy (FAA)
Uhm originally there was like a 2 year time frame, but then the NTSB report came out which is kind of put a little sense of urgency a little little fire under all of our buds right now.

03:39:03.120 --> 03:39:03.780
Flowe, Tammy (FAA)
Uhm.

03:39:04.400 --> 03:39:06.810
Flowe, Tammy (FAA)
So I'm hopeful.

03:39:07.450 --> 03:39:15.620
Flowe, Tammy (FAA)
That we're gonna see this operational within the next couple years. You know, and that sounds like a long time, but you know how things work.

03:39:16.190 --> 03:39:16.730
Flowe, Tammy (FAA)
Uhm.

03:39:17.320 --> 03:39:24.580
Flowe, Tammy (FAA)
Yeah, I I will I I I can say, though, you know with assurance that this is getting the attention it needs?

03:39:25.320 --> 03:39:33.220
Flowe, Tammy (FAA)
Uhm to move it into operations, so I don't know if that answers your question it probably doesn't make you feel good, but that's the best answer I can give you right now.

03:39:35.650 --> 03:39:37.970
Flowe, Tammy (FAA)
So I don't I I don't know if Rick 's online or not.

03:39:39.930 --> 03:39:41.970
Flowe, Tammy (FAA)
I'm on Tammy I appreciate that.

03:39:41.920 --> 03:39:45.560
Rick Curtis
Ah, what about the dog and 2.

03:39:46.600 --> 03:39:48.950
Rick Curtis
Right so I I think what we're.

03:39:48.950 --> 03:39:51.250
Flowe, Tammy (FAA)
Planning on doing is actually.

03:39:52.450 --> 03:40:10.640
Flowe, Tammy (FAA)
Transitioning the GT Gen 2 product over which is going to be Rufus based they are RFS rather than the one that's running right now at end car, but you know again a lot of that Rufus stuff is dependent upon.

03:40:11.800 --> 03:40:21.870
Flowe, Tammy (FAA)
You know how quickly National Weather Service can get that running over there and and you know, we're making progress. We're making progress. We have some of the information we need to.

03:40:22.090 --> 03:40:32.650
Flowe, Tammy (FAA)
Uhm transition GTG not just GTG enburg 4, which is going to be very fast paced and have set up as part of it as well.

03:40:32.700 --> 03:40:39.380
Flowe, Tammy (FAA)
Well, yeah, I I know I realized that my answer really doesn't answer your question.

03:40:41.030 --> 03:40:46.640
Flowe, Tammy (FAA)
But you know, I I I feel confident I feel optimistic that we're making progress.

03:40:48.390 --> 03:40:54.800
Flowe, Tammy (FAA)
And and I I I hate to say it but it's probably gonna be a couple of years, but you know, we're we're doing the best weekend.

03:40:56.870 --> 03:41:06.250
Flowe, Tammy (FAA)
No and and and you know, and this goes back to the question that we had earlier you know at what point do we want to start discussing?

03:41:07.360 --> 03:41:17.820
Flowe, Tammy (FAA)
Not utilizing the National Weather services are out to operationalizing things and maybe throwing it over to industry and I think that's a discussion that we need to have.

03:41:20.630 --> 03:41:24.790
Flowe, Tammy (FAA)
And that's just Tammy talking so that's not the FAA talking that's Tammy talking.

03:41:26.970 --> 03:41:28.590
Flowe, Tammy (FAA)
Yeah, sure this is Rick again.

03:41:29.260 --> 03:41:59.510
Rick Curtis
Appreciate it and the important thing is, is to help set expectations. I'd rather see you just say. Hey it's going to be a couple years than to say. Hey it's going to be around the corner around the corner and you know that corner never comes so that that's that's appreciated and the second thing is, is I just want to. Thank you for putting that out. At least on a non operational if you fully operational basis and getting that available to the industry so.

03:41:59.770 --> 03:42:10.020
Rick Curtis
I know that was that was done and that isn't always done and it was done in this case, and I. I appreciate that, yeah, and I you know, I want folks.

03:42:09.900 --> 03:42:33.670
Flowe, Tammy (FAA)
Must realize that it's out there and and you can access the data now so if if there are people who want this data, it, you know just contact in car because they're the ones that are you know, we're FA is funding them to run this product and and we want it out there. We want people to be using it right now 'cause that helps us justify you know.

03:42:33.890 --> 03:42:34.270
Flowe, Tammy (FAA)
Ah.

03:42:35.360 --> 03:42:37.790
Flowe, Tammy (FAA)
Then the transition to operations.

03:42:39.670 --> 03:42:41.350
Flowe, Tammy (FAA)
There were a couple questions about the.

03:42:41.220 --> 03:42:58.430
Steve Abelman
The meaning of operationalize that that may have been answered in the chat, but I think the the the meaning the operationalized. We're talking about here is this the operations that somebody is actually running it and maintaining it and National Weather Service is the logical candidate there correct me if I missed anything there Tammy.

03:42:59.480 --> 03:43:01.710
Steve Abelman
I I mean that that's that's the.

03:43:01.560 --> 03:43:02.480
Flowe, Tammy (FAA)
The assumption.

03:43:04.160 --> 03:43:08.280
Flowe, Tammy (FAA)
I'm not saying that that's that's always gonna be the way it's gonna be.

03:43:08.950 --> 03:43:15.040
Flowe, Tammy (FAA)
That's why I'm doing out there, they said that we may need to talk about some alternative solutions here.

03:43:17.420 --> 03:43:19.830
Flowe, Tammy (FAA)
So that's just again that's Tammy talking.

03:43:24.160 --> 03:43:25.770
Flowe, Tammy (FAA)
OK, I see a hand up.

03:43:25.830 --> 03:43:27.720
Steve Abelman
I think if you could quickly write it.

03:43:28.880 --> 03:43:32.380
Steve Abelman
Write it in chat that might be easier. I don't hand uh playing might.

03:43:33.140 --> 03:43:36.690
Steve Abelman
Start open Pandora's box as you said Bob I think so.

03:43:46.000 --> 03:43:48.160
Bob Sharman (Guest)
Matthias I'll let you speak that if you'd like to go.

03:43:48.720 --> 03:43:49.990
Steve Abelman
That's probably a good one.

03:43:53.900 --> 03:43:55.210
Steve Abelman
Well, it's it's a?

03:43:55.090 --> 03:44:14.790
Matthias Steiner (Guest)
Simple comment based on you know the discussion. We had before, in terms of accessing bug and it's a simple as reaching out to either ripka dialing Bob Sharman or or me for that matter, too, happy happy to to pick up contact information and.

03:44:15.240 --> 03:44:35.150
Matthias Steiner (Guest)
Uh take it from there, but in principle, you can't access the cheat ichien and a license agreement that there is no cost involved. It's really a protection for us that we can't help be held liable in case something is not right with the product that we are sharing with you. That's all there is to it. Thank you.

03:44:38.640 --> 03:44:40.790
Matthias Steiner (Guest)
Here's a comment question that might be relevant.

03:44:40.670 --> 03:44:44.980
Steve Abelman
And for some of the discussion later in in the.

03:44:46.050 --> 03:44:50.990
Steve Abelman
In in the workshop and that is what does all the way to the surface mean for urban areas?

03:44:53.870 --> 03:44:54.760
Steve Abelman
I guess so.

03:44:54.800 --> 03:45:00.600
Bob Sharman (Guest)
Take that I mean, we run off of NWP model output so.

03:45:01.920 --> 03:45:02.800
Bob Sharman (Guest)
You know the

03:45:03.440 --> 03:45:09.420
Bob Sharman (Guest)
the resolution is not sufficient to model buildings and building effects so.

03:45:11.520 --> 03:45:29.260
Bob Sharman (Guest)
You know it's basically based on whatever the NWP model resolves which is not a lot in urban areas, so that is actually a work area that needs to be addressed in the next few years I think we'll talk more about that on in my talk on Wednesday.

03:45:30.440 --> 03:45:32.180
Bob Sharman (Guest)
Yeah, so I think that this.

03:45:32.420 --> 03:45:42.880
Flowe, Tammy (FAA)
I think that this is an area that we need to explore farther up as part of you know are are moving forward in turbulence research I.

03:45:43.590 --> 03:45:56.440
Flowe, Tammy (FAA)
I mean materials you can jump in here, but I mean, I. I really think that this is something that we need to spend a little more of our resources looking at in the future.

03:45:59.000 --> 03:45:59.530
Flowe, Tammy (FAA)
Episode.

03:45:59.390 --> 03:46:30.990
Matthias Steiner (Guest)
Local attorney and and and also I warn you may have seen some of the work that we are doing and you will see some discussion about that. Tomorrow, too, as part of the presentations. It's really. When you think in terms of a per pixel, which is the highest resolved operational. America weather prediction model. We run in by the Weather Service in the US that has a 3 kilometre grid resolution so if you think in terms of what's going on?

03:46:31.040 --> 03:47:01.350
Matthias Steiner (Guest)
In a downtown area whether that's Dallas or LA or some other place New York. I mean, this is all sub grid scale. This is not resolved by by the numerical weather prediction model, so clearly. If we start thinking about low altitude. Advanced air mobility operations like uas or Umm. We need something better to understand what the wind and turbulence hazards are at those levels.

03:47:01.400 --> 03:47:02.430
Matthias Steiner (Guest)
In those areas.

03:47:06.960 --> 03:47:08.470
Matthias Steiner (Guest)
Thank you Matias and.

03:47:09.200 --> 03:47:10.150
Clark, Ivan O. (LARC-D319)
Hi Bob Sherman.

03:47:10.920 --> 03:47:17.950
Clark, Ivan O. (LARC-D319)
Uh this is Ivan Clark I. I do want to compliment. Matias on the work that he and his group are doing in this area.

03:47:18.770 --> 03:47:19.580
Clark, Ivan O. (LARC-D319)
And a

03:47:20.630 --> 03:47:31.100
Clark, Ivan O. (LARC-D319)
Oh, I was just sort of wondering the feel, and and it's been answered now about what to the surface means when you have a heat island or something so thank you right.

03:47:32.290 --> 03:47:32.970
Clark, Ivan O. (LARC-D319)
Right now, it's

03:47:32.900 --> 03:47:36.120
Bob Sharman (Guest)
Just what the large scale models can resolve.

03:47:39.950 --> 03:47:46.820
Julia Pearson (Guest)
There's also observations blended in right to the now cast that impact the low levels as well.

03:47:54.520 --> 03:47:56.290
Bob Sharman (Guest)
There's this would trade razor.

03:47:56.190 --> 03:48:17.100
Matthias Steiner (Guest)
Whole other discussion about observations at low altitudes. If all these uus and you aim for hickles that we are envisioning to fly around will carry meteorological sensors in shared that data this will be wonderful to get more coverage in the boundary layer. Thank you. There's a lot of big ifs in there.

03:48:18.320 --> 03:48:18.890
Bob Sharman (Guest)
Yes.

03:48:19.980 --> 03:48:21.850
Bob Sharman (Guest)
Well, I I mean, I think I can see it.

03:48:21.710 --> 03:48:24.790
Flowe, Tammy (FAA)
is having a whole 3 day conference just on uas stuff.

03:48:26.400 --> 03:48:26.990
Flowe, Tammy (FAA)
Uhm.

03:48:27.850 --> 03:48:28.530
Flowe, Tammy (FAA)
You know.

03:48:30.660 --> 03:48:32.010
Flowe, Tammy (FAA)
I don't know I'm just throwing that out there.

03:48:33.200 --> 03:48:40.410
Flowe, Tammy (FAA)
I can I can definitely see questions that could lead us down several days worth of conversations?

03:48:44.480 --> 03:48:46.190
Flowe, Tammy (FAA)
Right I think in the near term.

03:48:46.070 --> 03:48:51.020
Bob Sharman (Guest)
Now we'll be forced to do some sort of a parameterisation of urban effects.

03:48:52.210 --> 03:48:53.990
Bob Sharman (Guest)
That somehow translates to.

03:48:54.050 --> 03:49:03.530
Bob Sharman (Guest)
Uh and Hans turbulence, I'm not sure how to do that. Yet there are people that are working on urban parameterisations and maybe we can use some of that work.

03:49:04.900 --> 03:49:17.230
Bob Sharman (Guest)
Longer term of course, we can start moving towards at least building resolving models in selected cities can't do it over the whole globe, but for selected cities, we might be able to do something.

03:49:20.390 --> 03:49:21.270
Bob Sharman (Guest)
MP aware.

03:49:21.150 --> 03:49:27.580
Matthias Steiner (Guest)
There, if you start doing that that sort of meter resolution. You are looking at an awful lot of data.

03:49:29.640 --> 03:49:31.350
Matthias Steiner (Guest)
Well, yeah, and then the process.

03:49:31.230 --> 03:49:39.430
Flowe, Tammy (FAA)

To seeing you know power that's going to be required to do this kind of stuff I mean, I. I don't think we're capable of that right now.

03:49:42.650 --> 03:49:44.070
Flowe, Tammy (FAA)
We're getting there Tammy.

03:49:45.910 --> 03:49:47.120
Matthias Steiner (Guest)
I went one can.

03:49:47.030 --> 03:49:47.560
Flowe, Tammy (FAA)
Hope.

03:49:57.250 --> 03:49:59.380
Bob Sharman (Guest)
Pretty much finished now for today.

03:50:03.880 --> 03:50:06.320
Bob Sharman (Guest)
I I think I miss anybody.

03:50:06.200 --> 03:50:13.280
Flowe, Tammy (FAA)
Has any extra questions. I don't know Matt? Are you seeing anything on your end? No, I I did want to pass along to every.

03:50:13.150 --> 03:50:44.560
Matt Fronzak
Everybody was hung in there with us that that yes, the chat is saved and will be cleaned up and made available after the meeting on a TBD location and that's part of the work that we have to do after the meeting, Tammy and Bob and Ann Vika and and as well. The recording itself, so for folks who ask questions about that. I I think it is certainly our intention to to make this available. We just have to figure out exactly where.

03:50:45.760 --> 03:50:47.770
Matt Fronzak
Yes, yes, I agree with that.

03:50:47.930 --> 03:50:48.320
Flowe, Tammy (FAA)
Uh-huh.

03:50:50.960 --> 03:50:59.230
Flowe, Tammy (FAA)
Alright Bob I think so. Tomorrow is our late day from the US standpoint, so we're going to.

03:50:59.530 --> 03:51:06.580
Flowe, Tammy (FAA)
Uh we give our Asian colleagues of an opportunity to not have to get up in the middle of the night.

03:51:07.620 --> 03:51:37.940
Flowe, Tammy (FAA)
So we will uh reconvene again tomorrow evening if anybody still needs the dial in information. I assume that everybody is on the line. Now got the dial in information that it is a different call in information for tomorrow. If you need it. Please let me or Bob or Beacon. Oh, and and will take care of. You guys, but yeah, I'm good. I'm good. This has been a wonderful session, and I I appreciate everybody.

03:51:38.400 --> 03:51:42.030
Flowe, Tammy (FAA)
Who darling thank you so much right and I would just like to add?

03:51:41.890 --> 03:51:45.670
Bob Sharman (Guest)
That all the presentations were excellent today and very informative.

03:51:46.830 --> 03:51:49.100
Bob Sharman (Guest)
Absolutely yeah, it was very, very.

03:51:48.960 --> 03:51:49.660
Flowe, Tammy (FAA)
Informative.

03:51:52.180 --> 03:51:53.330
Flowe, Tammy (FAA)
OK, we'll see you all tomorrow.

03:51:53.380 --> 03:51:53.750
Flowe, Tammy (FAA)
Work.

03:51:56.190 --> 03:52:01.210
Flowe, Tammy (FAA)
Alright, thank you. Everybody thank you. Goodnight goodnight to my European friends.

03:52:01.270 --> 03:52:01.440
Flowe, Tammy (FAA)
Yes.

03:52:03.590 --> 03:52:06.180
Flowe, Tammy (FAA)
Make sure it's been very informative. Thank you from the MTA.

03:52:06.070 --> 03:52:06.850
Eick Donald
Miss beside

03:52:08.020 --> 03:52:09.190
Eick Donald
thank you thanks.

03:52:09.090 --> 03:52:10.200
Greg Meymaris (Guest)
You very much.

03:52:10.490 --> 03:52:11.100
Olivier Jaron (MF) (Invité)
Bye. Bye.

03:52:11.790 --> 03:52:12.700
Olivier Jaron (MF) (Invité)
Thank you.