International Civil Aviation Organization (ICAO) Turbulence Requirements for the World Area Forecast System (WAFS)

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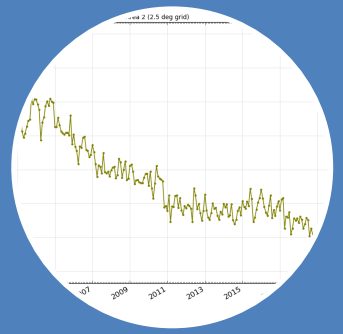
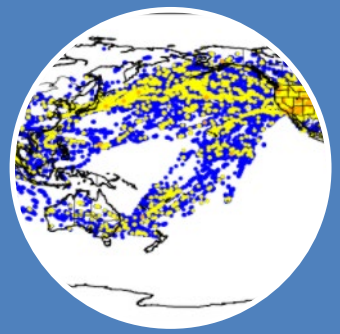
Topics

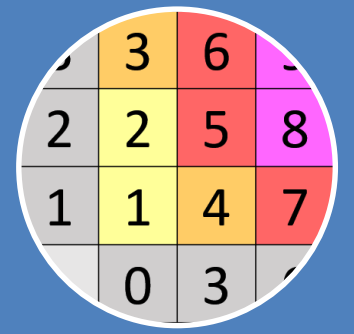


WAFS Overview

What are the upcoming improvements?



How can the aviation industry help maximize those improvements?

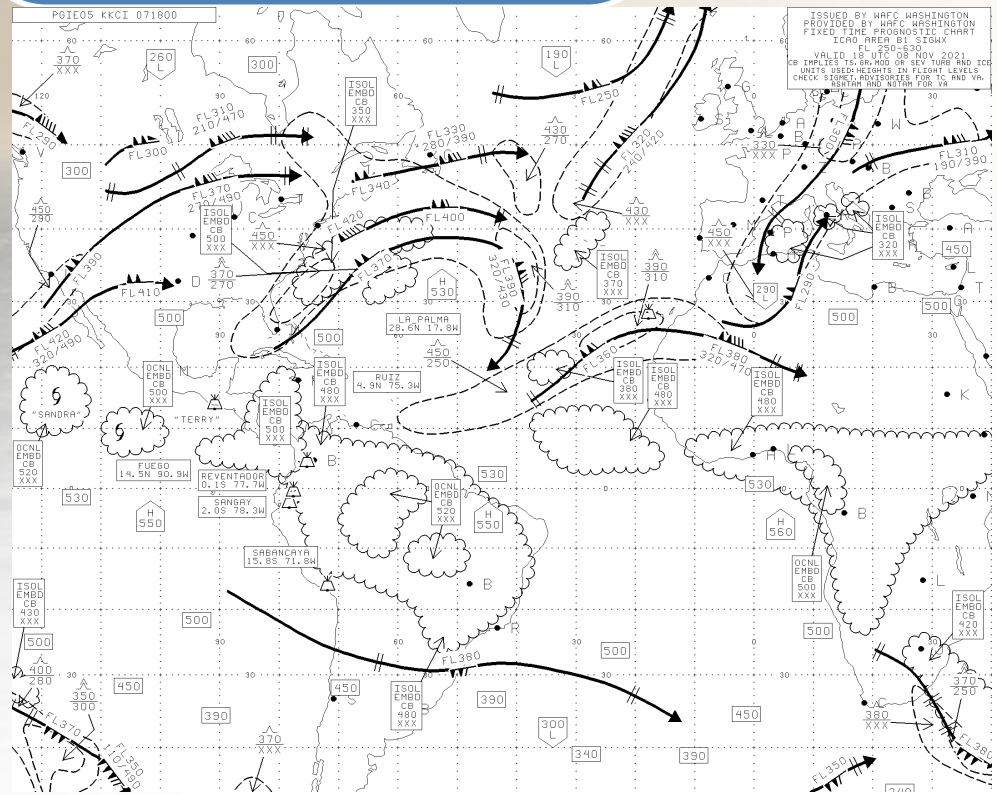


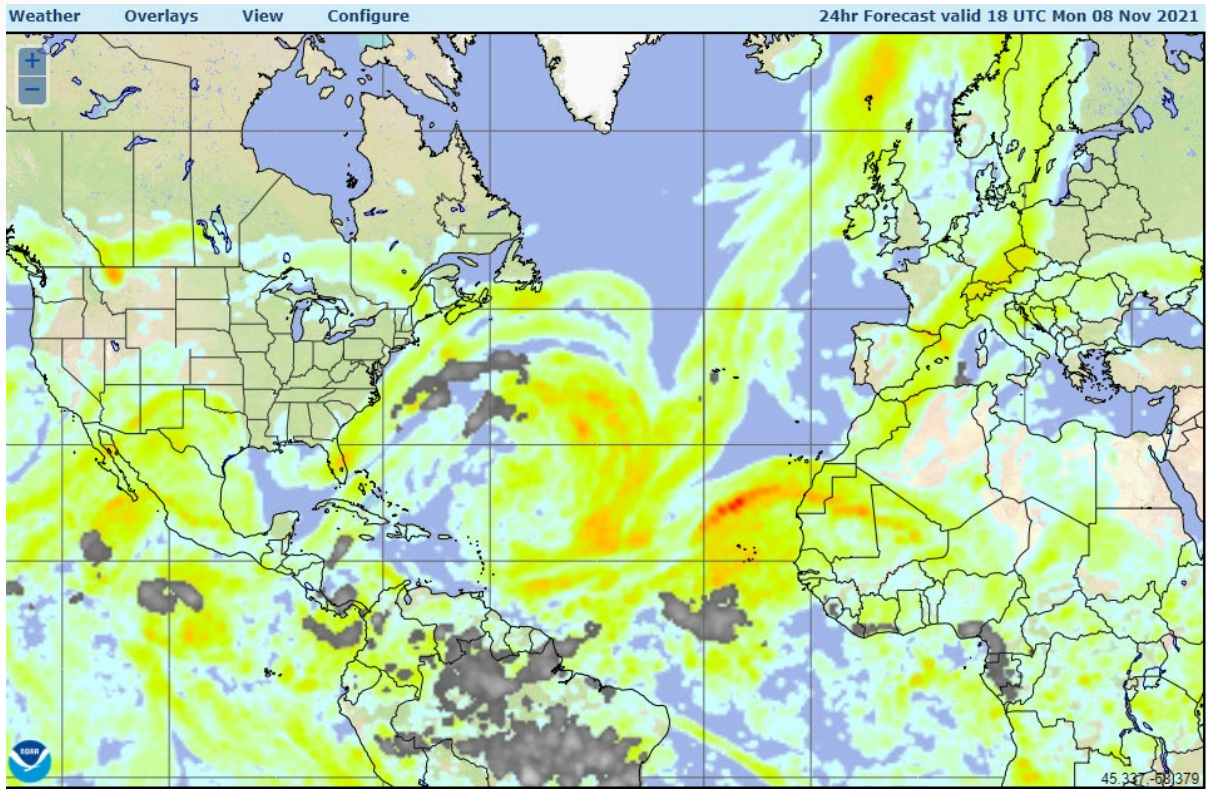
Call for feedback on improvements

What is WAFS?

Comprised of World Area Forecast Center (WAFC) London and Washington, the two centers:

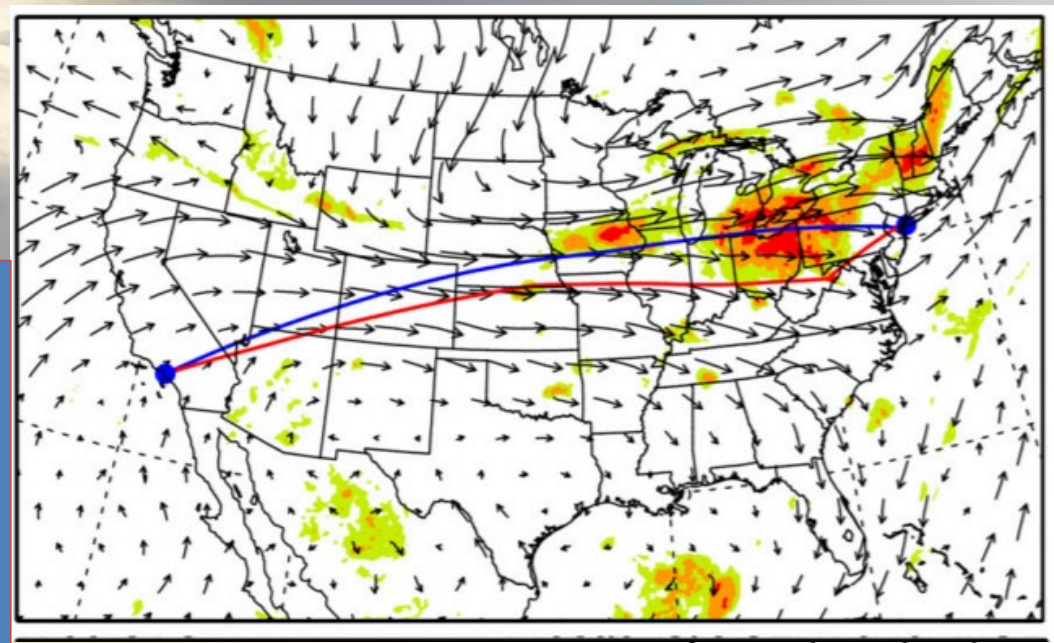
- Produce global Significant Weather Charts valid at T+24 hours
- Provide global gridded forecasts of wind/temp/RH/turbulence/ icing/thunderstorms valid at T+06 to T+36 hours in 3 hr steps.
- Disseminate the above on WIFS and SADIS
- Back each other up in case one center cannot provide service



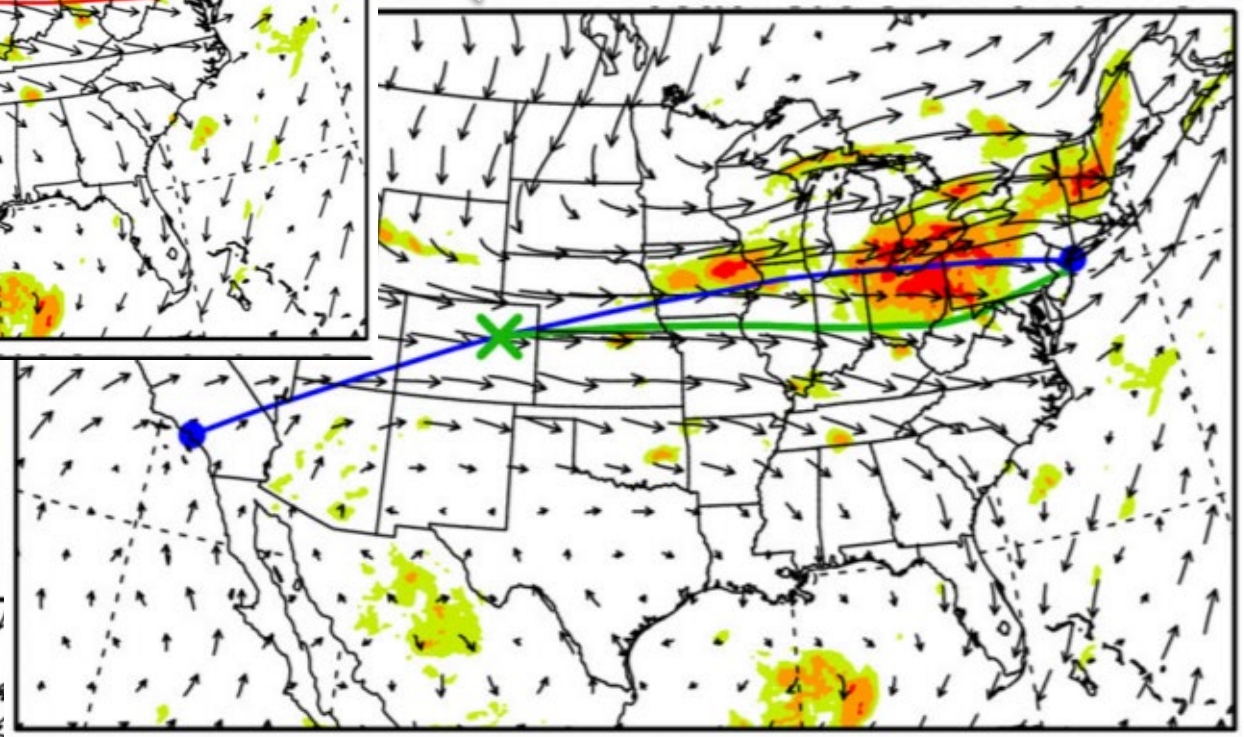


Benefit of WAFS Winds and Turbulence

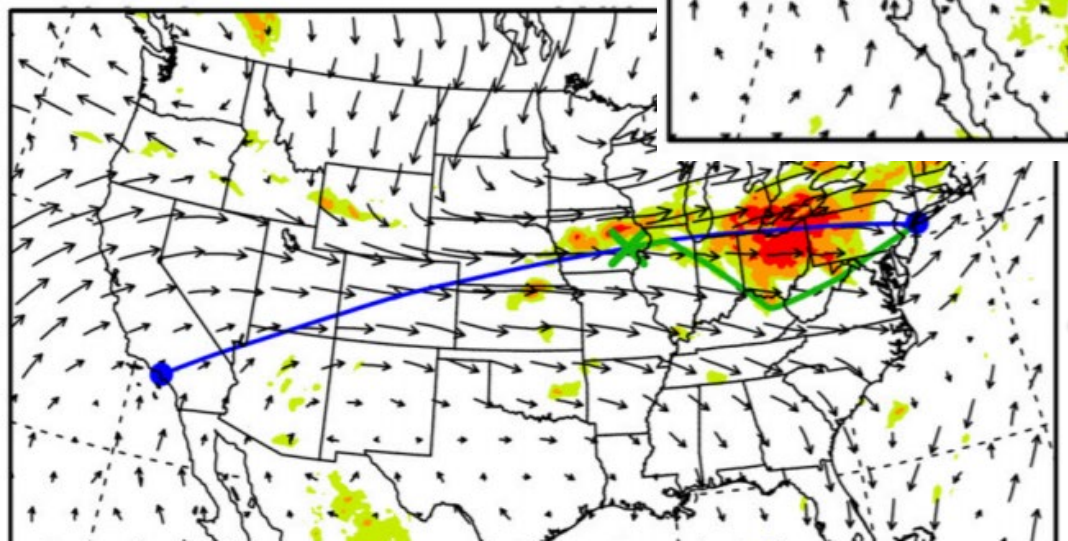
When to Deviate from Wind Optimal Route to Avoid Turbulence



16 Extra Minutes

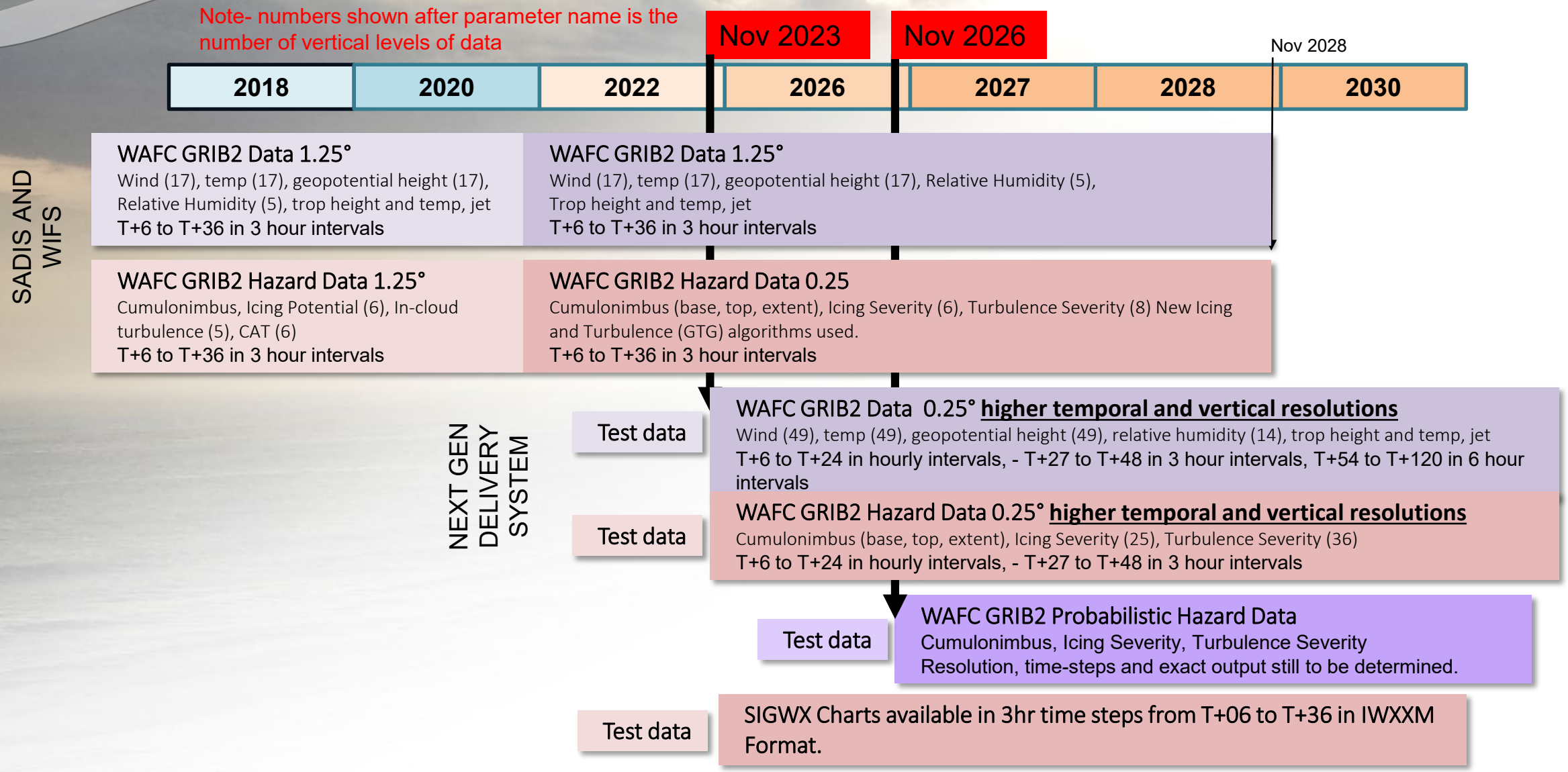


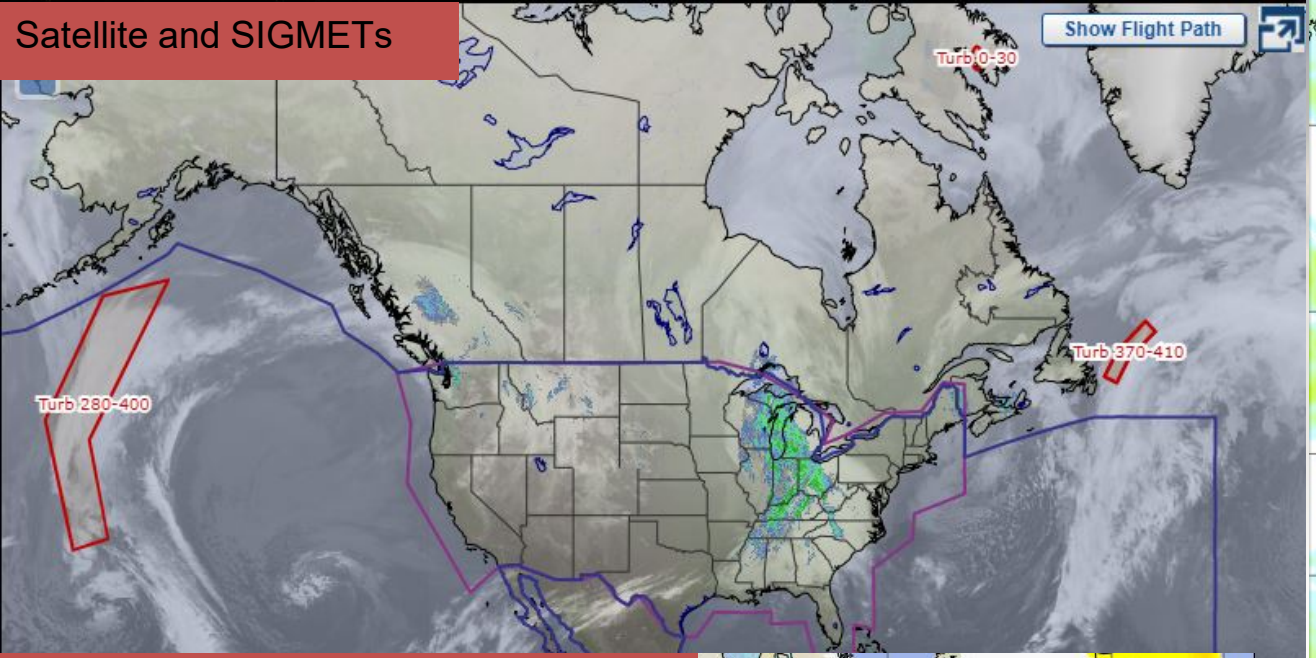
6 Extra Minutes

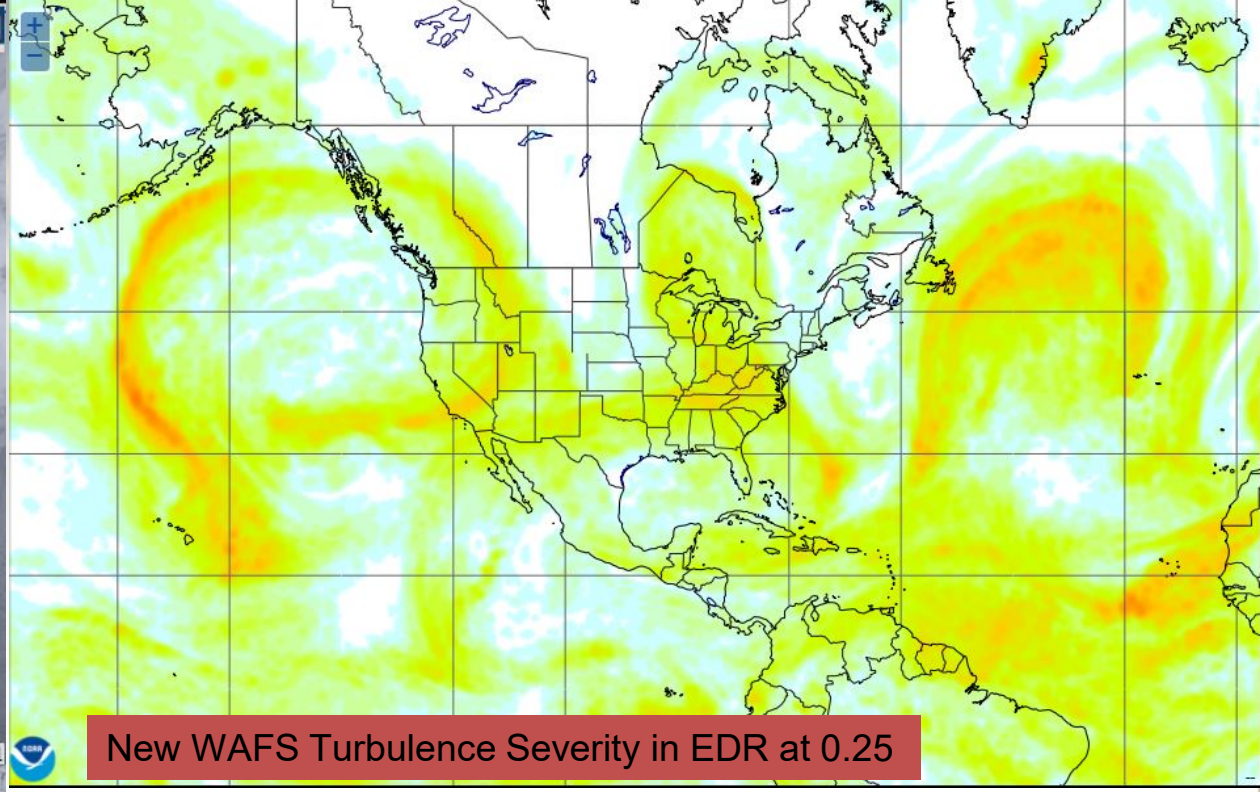


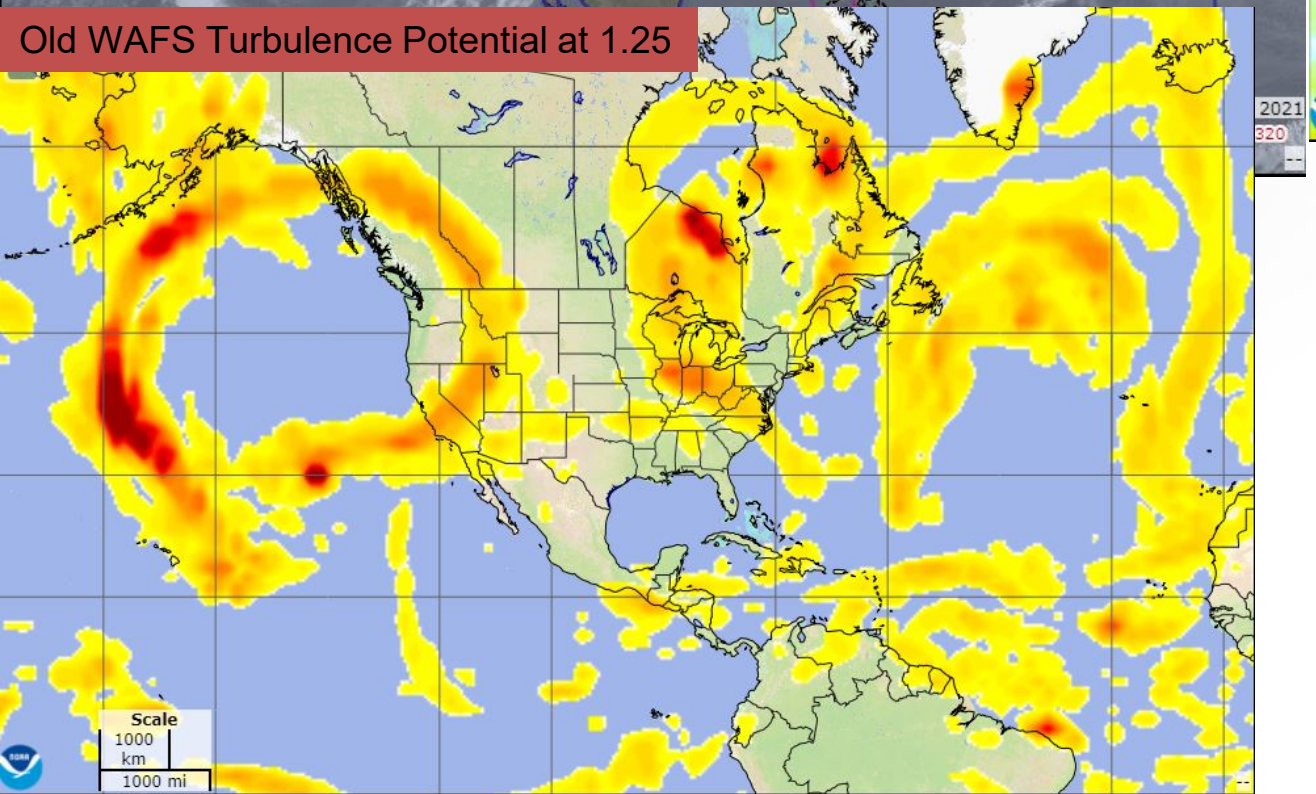
18 Extra Minutes

WAFS Improvement Schedule




Satellite and SIGMETs
Show Flight Path
Turb 10-30
Turb 370-410
Turb 280-400


New WAFS Turbulence Severity in EDR at 0.25


Old WAFS Turbulence Potential at 1.25
2021
320
Scale
1000 km
1000 mi

Feedback Needed on Probabilistic Forecasts

We will have the ability to discern the probability of exceeding discrete turbulence severity levels, such as EDR of 0.22 or 0.4.

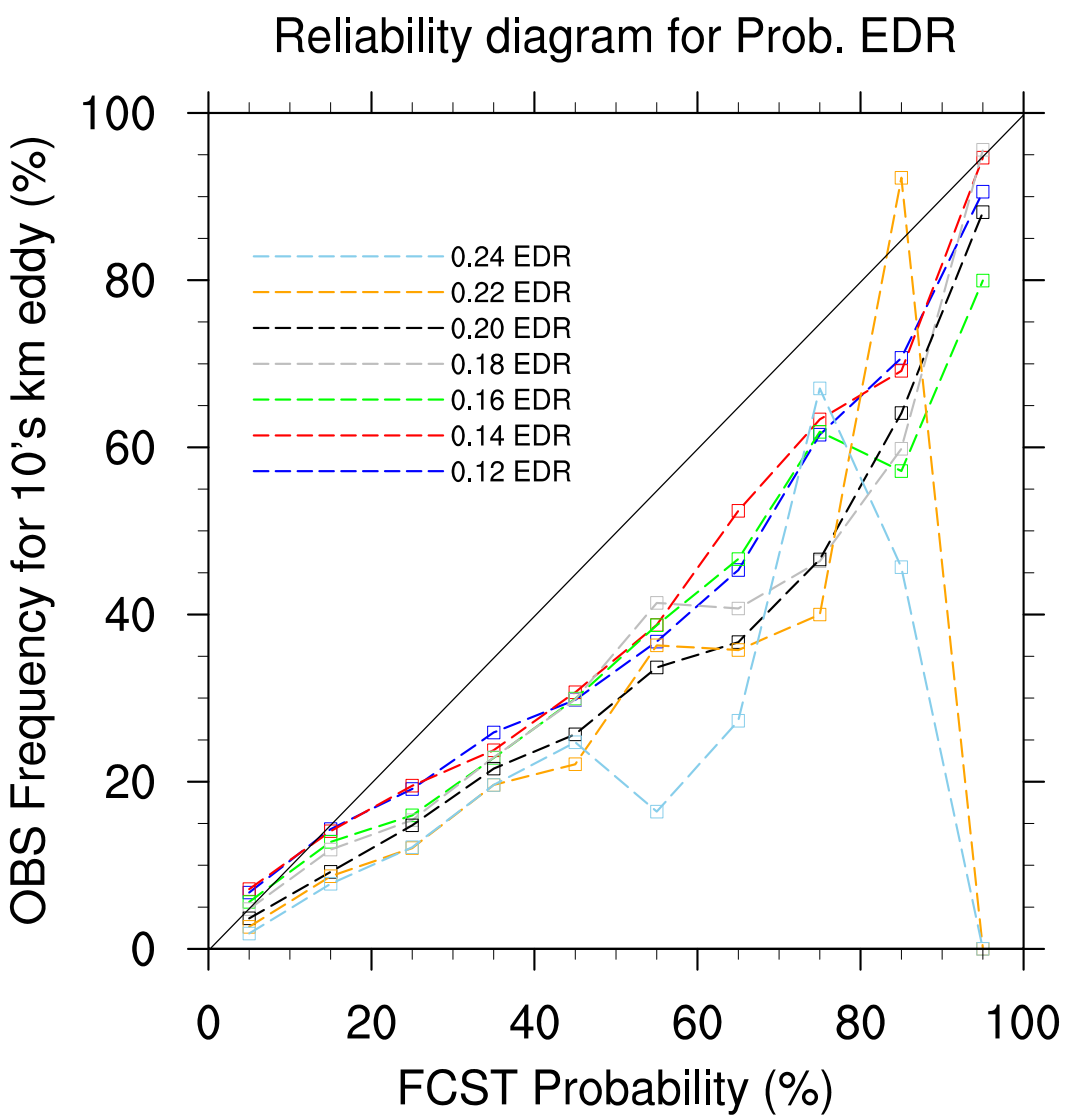
- Keep in mind that additional levels increase file size

We can relate turbulence probability to turbulence climatology.

We can also provide a deterministic (single value) forecast.

Or, we could combine the deterministic and probabilistic into a risk based forecast.

Which forecast EDR probability is most reliable when you are trying to find Moderate or Greater (MOG) >0.22 turbulence? Answer = 0.14

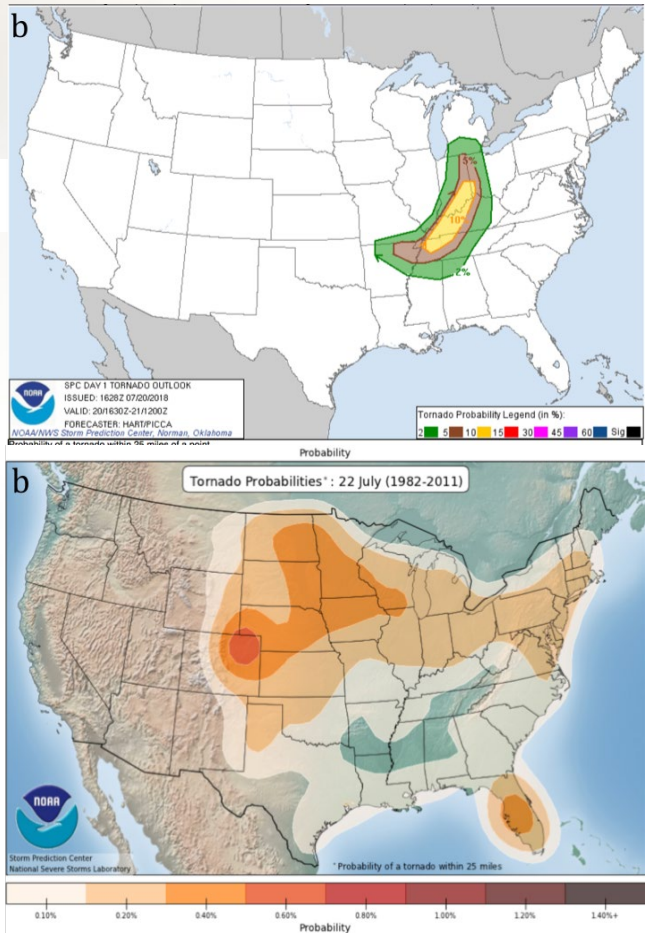


Credit Dr. Jung-Hoon Kim

Probabilistic forecasts of rare events

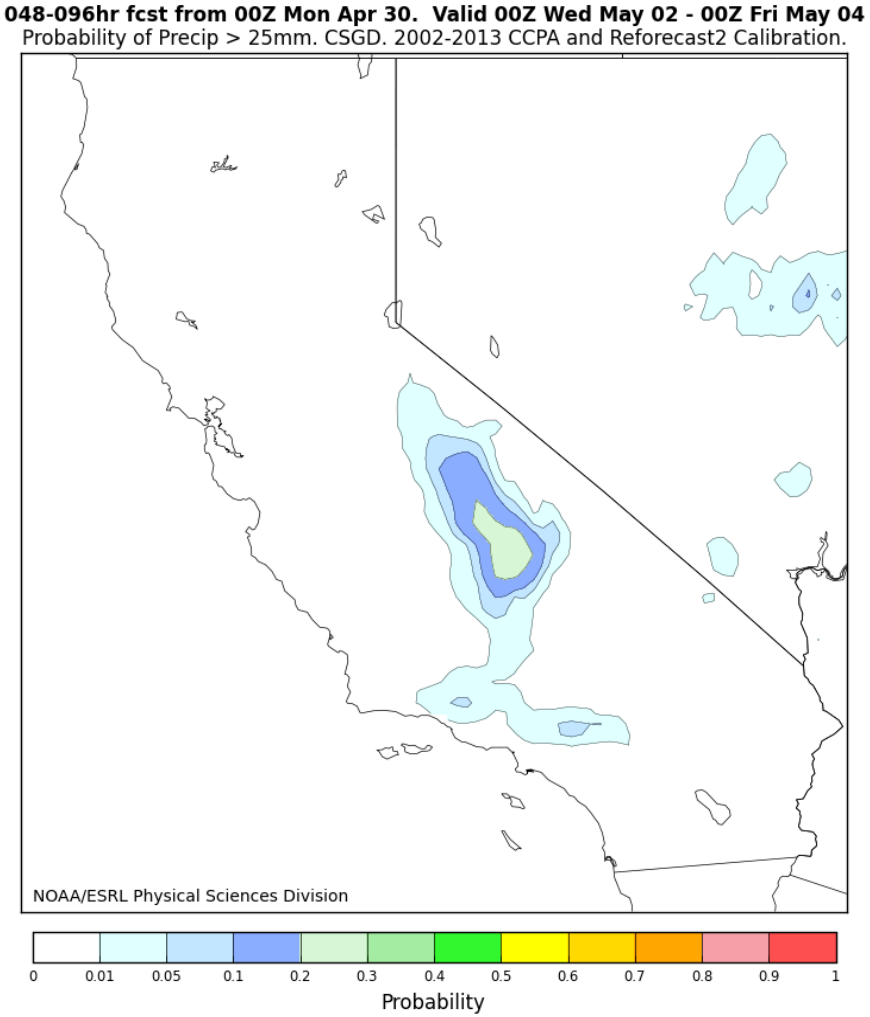
- Turbulence not the only rare weather phenomenon
- Tornado forecasts regularly feature low probabilities (here, up to 10%)
- But those low probablilities are many times larger than the climatological frequencies (≤ 0.4%)

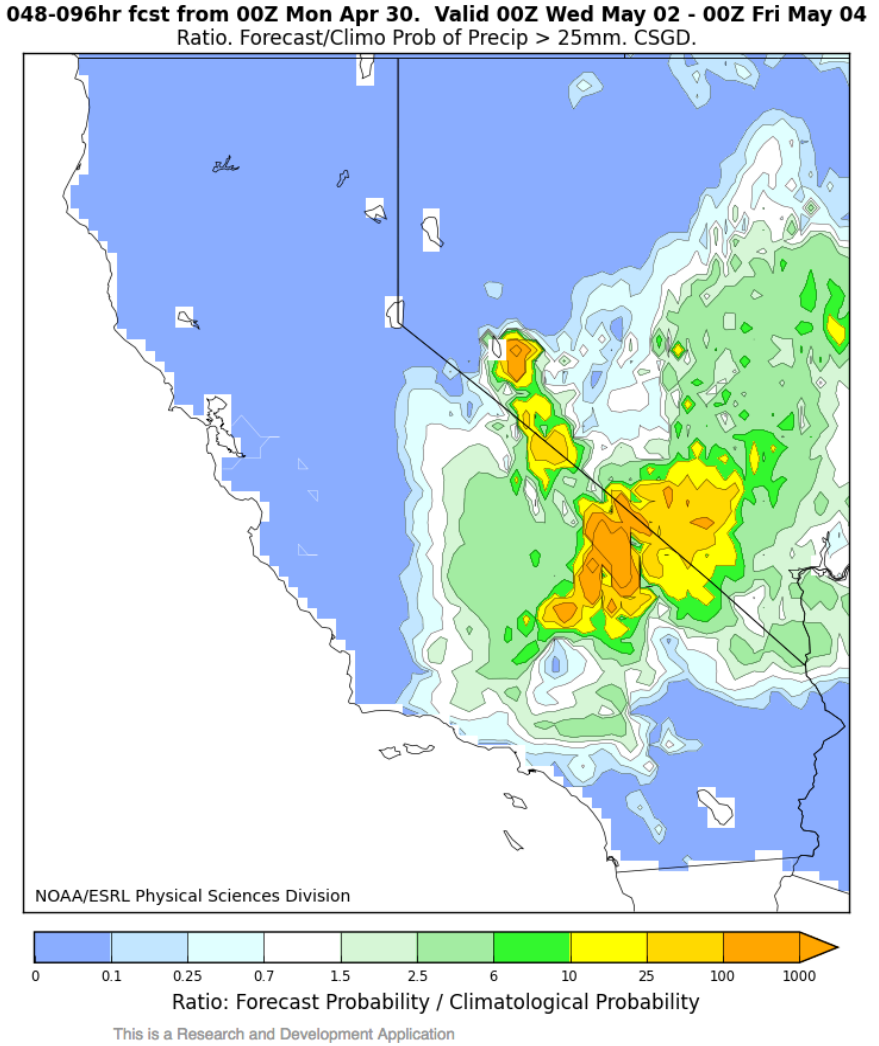
1. Probabilities for particular forecasts can be many times larger than climo likelihoods
2. We can use these ratios to our advantage



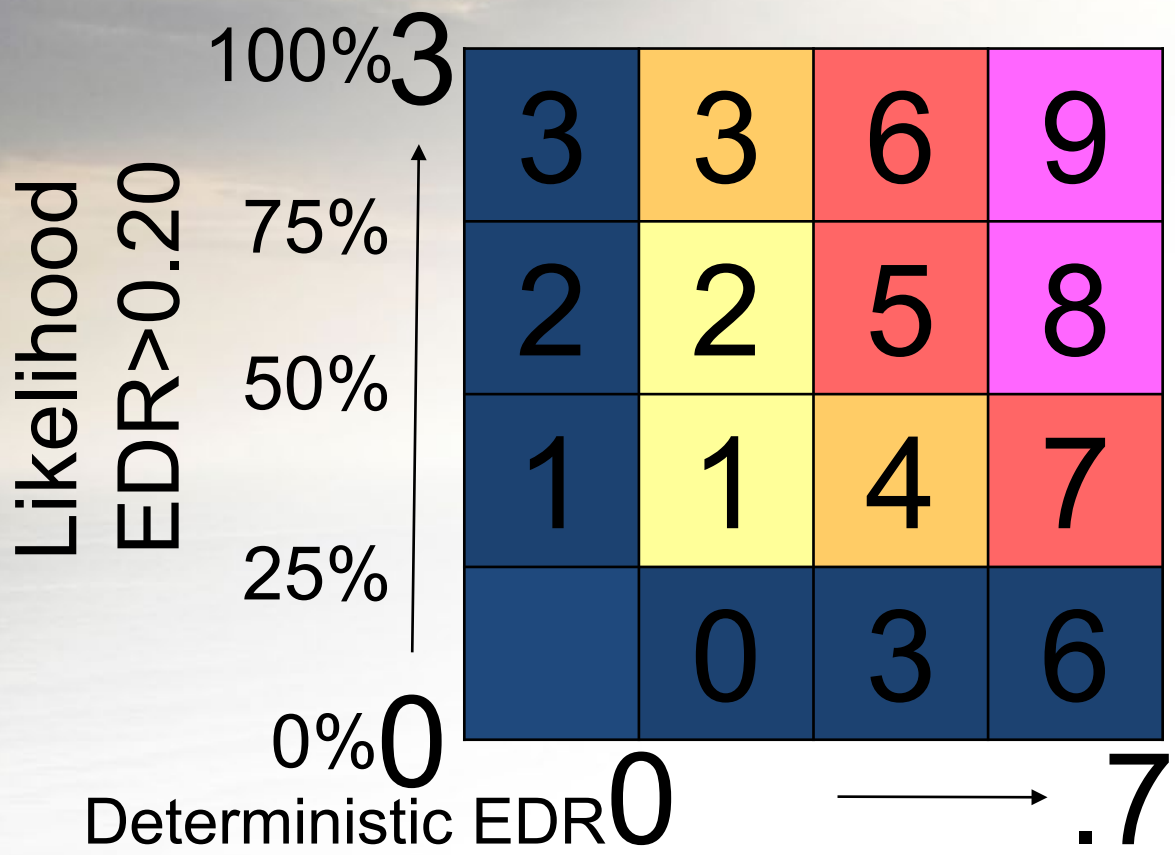
Probabilistic forecasts of rare events

- Example from PSD reforecast project
- Forecast probabilities < 1% become forecast ratios > 100
- "100 times more likely" than normal has a very different feel than "a 0.2% chance"





Turbulence Risk Index



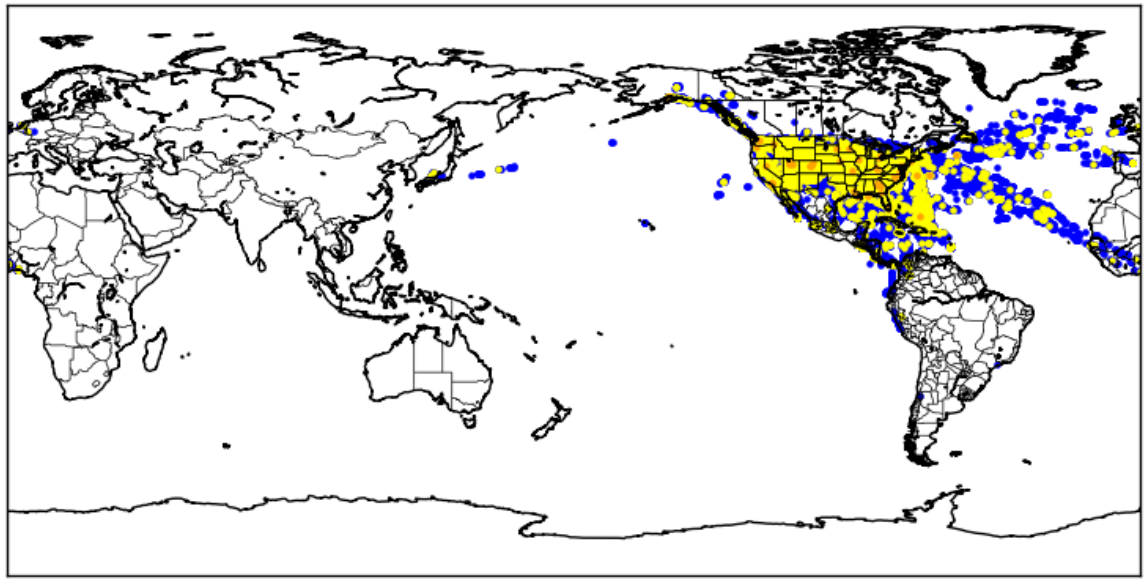
Risk Categories

Slight	Low	Medium	High
1-3	3-7	7-9	9-10

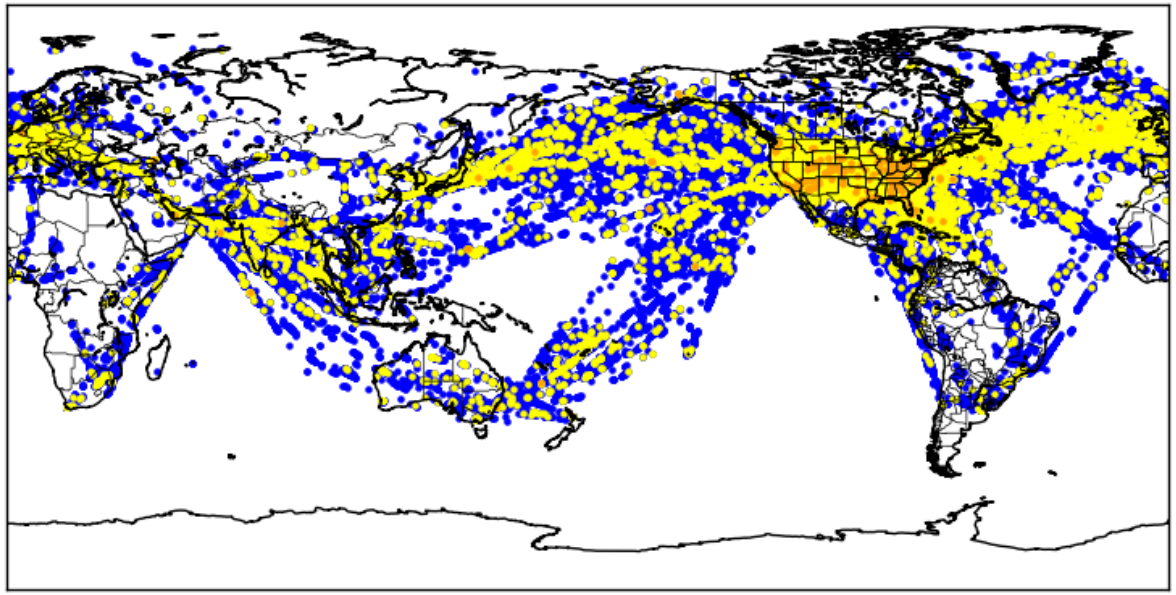
How Can Industry Help? Share Data!

The WAFCs will tune our forecasts regionally and seasonally, maybe even by time of day. What if we could tell you to keep the seatbelts signs on to 12,000 feet (vs 10,000ft normally) this afternoon on Denver approach/departure?

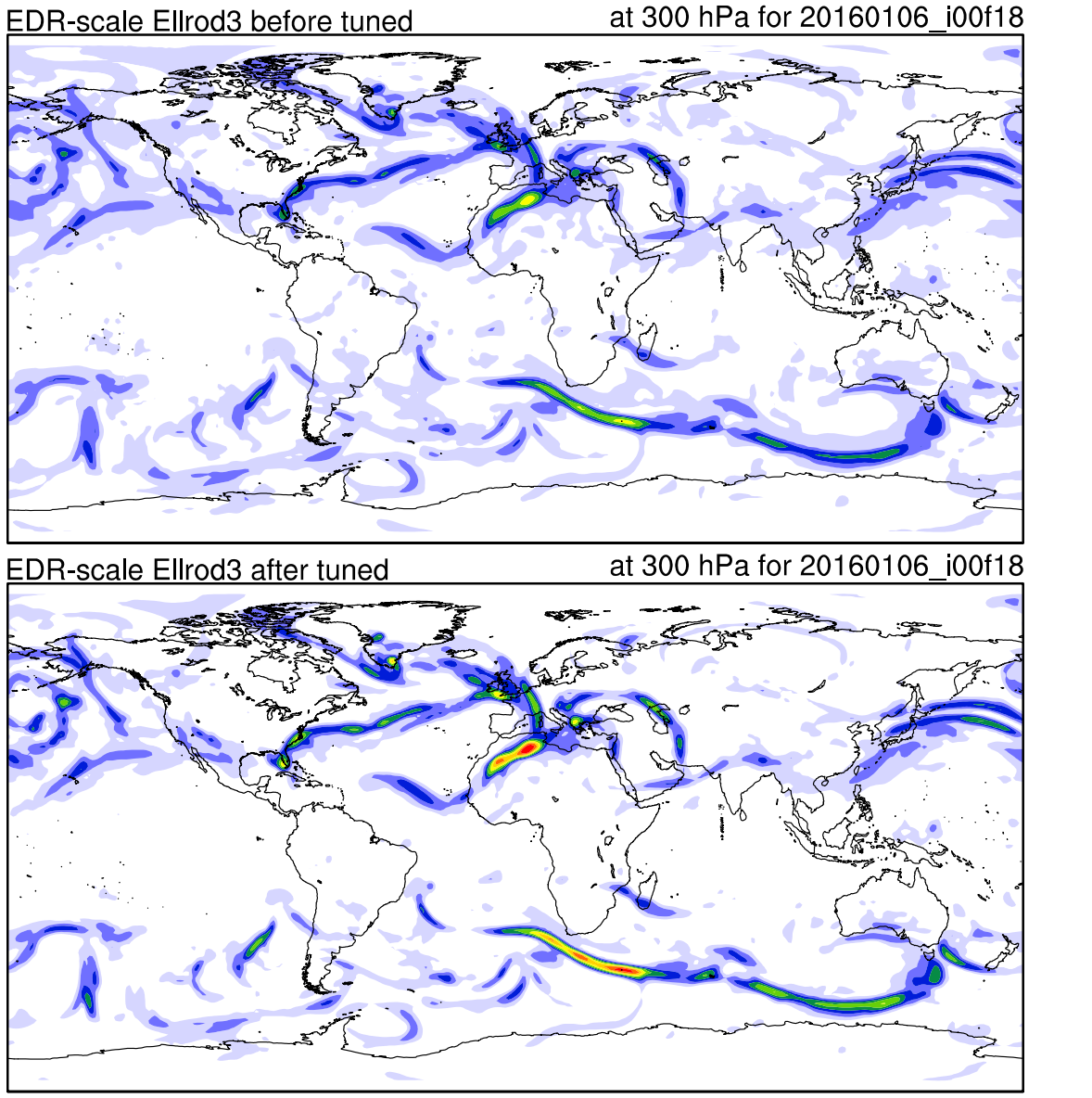
MADIS EDR All Alts, All Times



IATA EDR All Alts, All Times



Importance of the EDR tuning

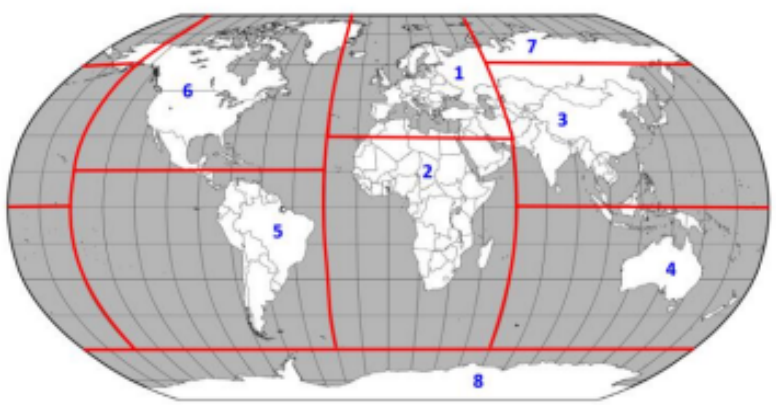


Uncalibrated

Calibrated

Dissemination Thoughts

- File sizes get very large
  - Hourly data
  - 1000 feet vertical
  - 0.25 degree horizontal.



Region 1	30W-60E, 30N-90N
Region 2	30W-60E, 60S-30N
Region 3	60E-150W, 0-60N
Region 4	60E-150W, 60S-0
Region 5	150W-30W, 15N-90N
Region 6	150W-30W, 60S-15N
Region 7	60E-150W, 60N-90N
Region 8	180W-180E, 90S-60S

Figure 1, Pre-set map areas

- Corridor/Trajectory vs pre-set map areas
  - Users can make many corridors/trajectories from pre-set areas
  - Users might not want to invest in making their own corridors/trajectories
    - On the other hand, if you can use a corridor/trajectory, you can probably make your own