Graphical Turbulence Guidance
&
Area Forecast Transition

Aviation Weather Center
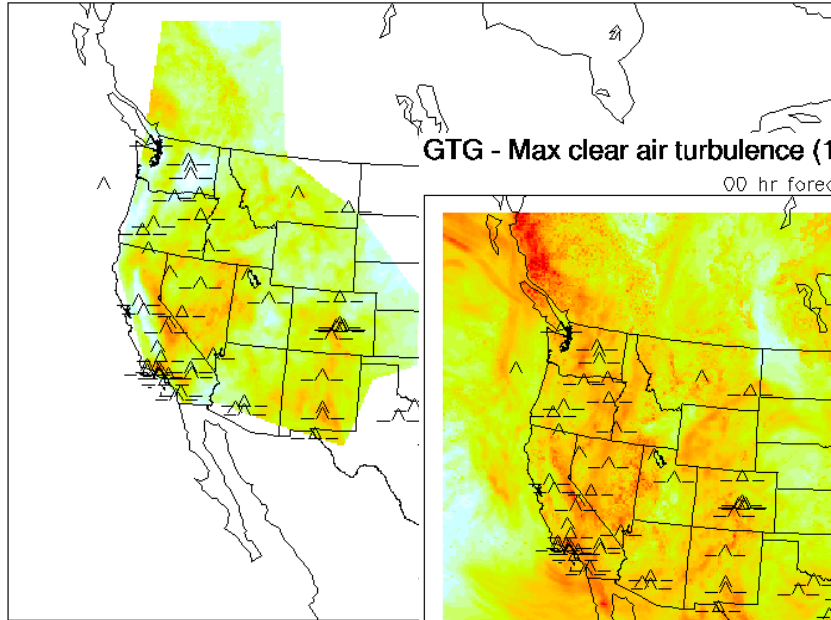
Mike Bettwy

GTG Version 3

Major Upgrades

- All diagnostics mapped to Eddy Dissipation Rate
  - ADDS now displays EDR values
- CAT diagnostic extended down to 1000 feet MSL & forecast hours 15 and 18
- New Mountain Wave diagnostic
  - CAT diagnostics combined with low level winds and terrain characteristics
- Hosted on NCEP Central Operation's (NCO) Weather and Climate Operational Supercomputing System (WCOSS)
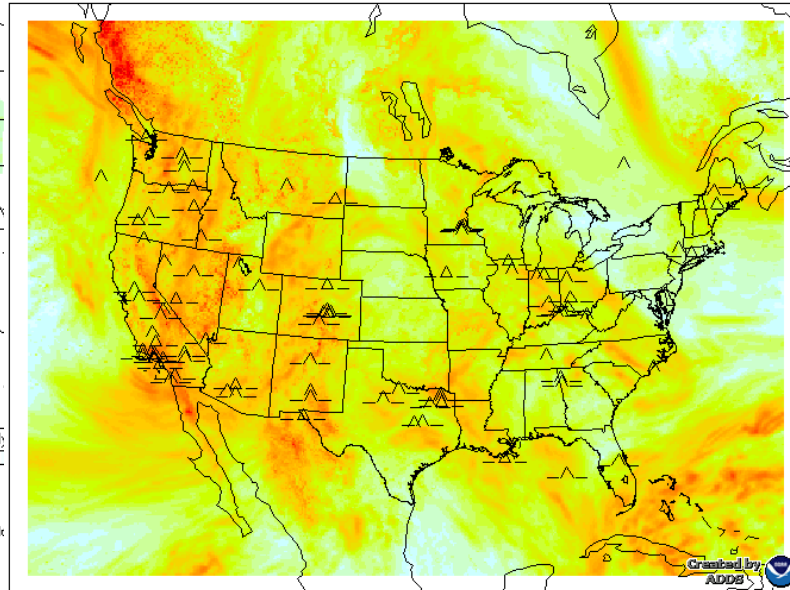
GTG - Max mountain wave (1000 ft. MSL to FL500)

00 hr forecast valid 1700 UTC Mon 16 Nov 2015

GTG - Max clear air turbulence (1000 ft. MSL to FL500)

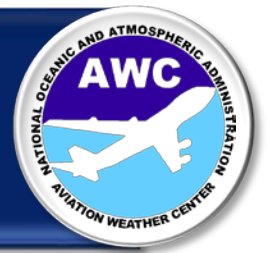00 hr forecast valid 1700 UTC Mon 16 Nov 2015

Calculates CAT and MWT diagnostics

Paired down choice of diagnostics (reduce diagnostic redundancy)

Statically weighted for all forecast hours

Improved method of converting diagnostics to EDR (with aircraft type discrimination – light/mod/heavy)

3

GTG Version 3: CAT

- Reduced diagnostics
  - Focus on unique features
  - Example: Using only a single variant of the Ellrod index
- Vertical levels expanded
  - 010-FL100
  - Explicit calculations to account for boundary layer

GTG - Max clear air turbulence (1000 ft. MSL to FL500)

00 hr forecast valid 1700 UTC Mon 16 Nov 2015

Created by ADDS

Eddy Dissipation Rate (EDR)

| Lgt | Mod | Sev | IE |
10 20 30 40 50 60 70 80 90
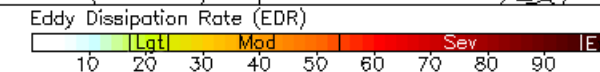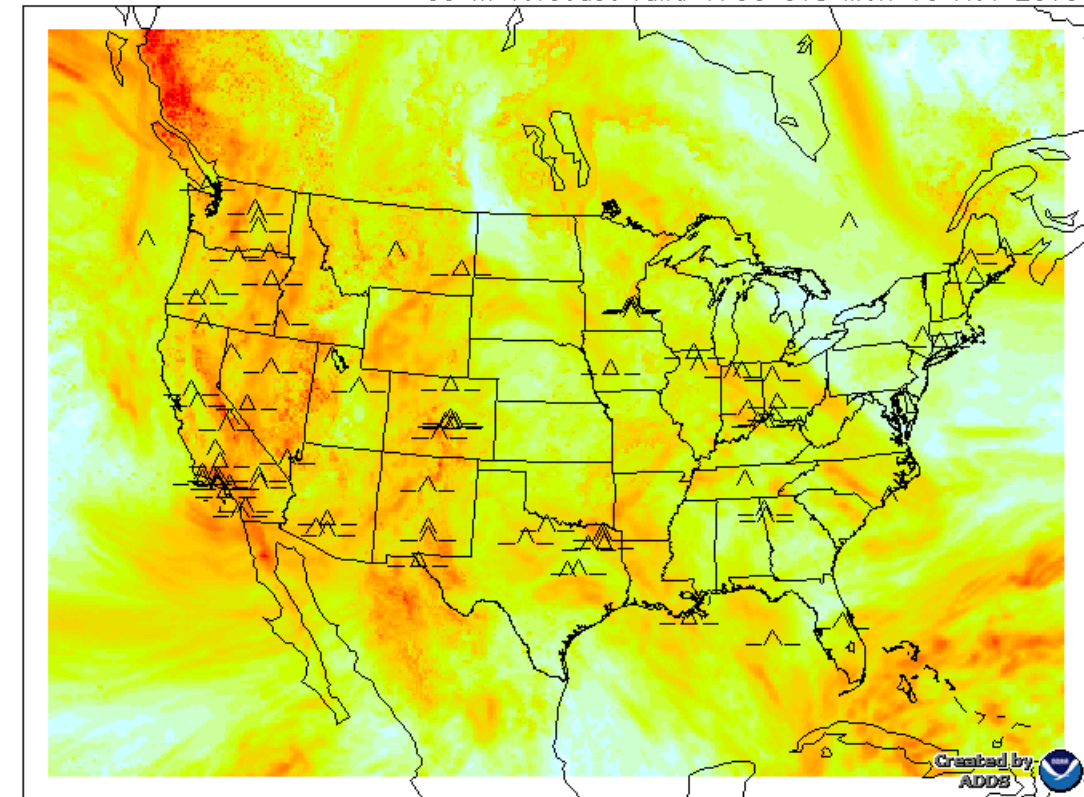
Turb PIREP Symbols
Ø Smooth   ∧ Light   ∧ Moderate   ∧ Severe
_ _ Smooth-Light   ∧ Light-Moderate   ∧ Moderate-Severe   ∧ Extreme
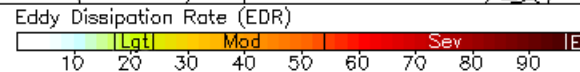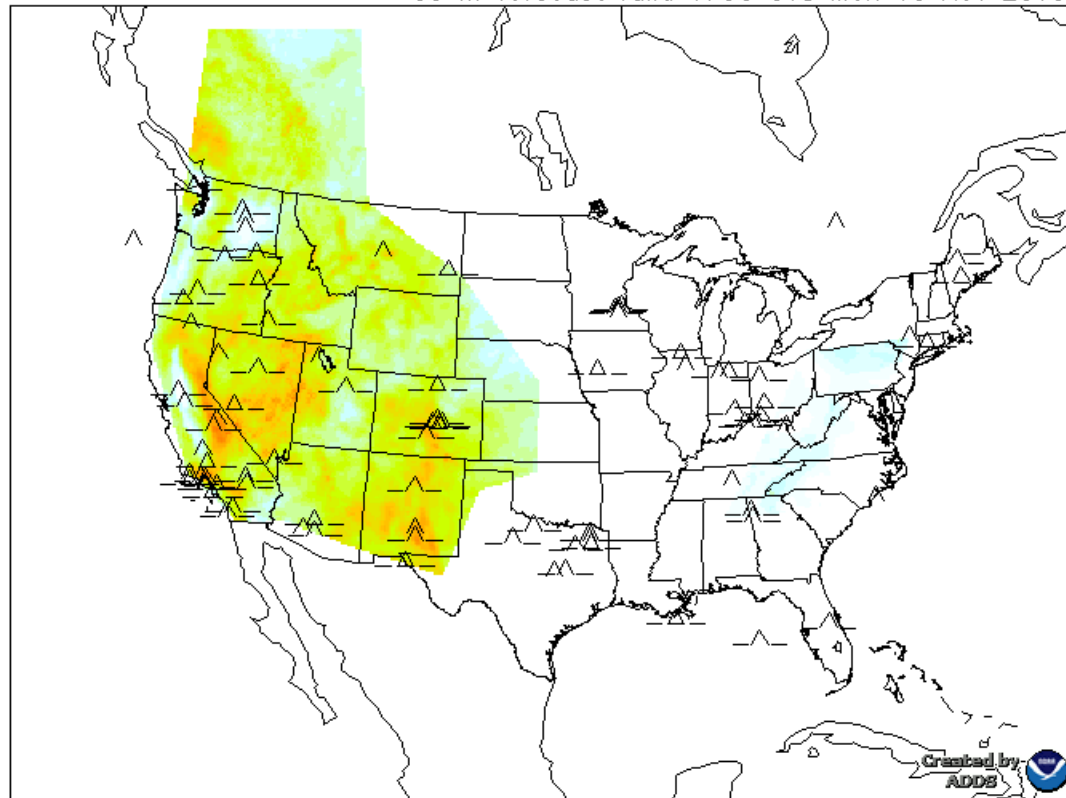
GTG Version 3: Mountain Wave

GTG - Max mountain wave (1000 ft. MSL to FL500)

00 hr forecast valid 1700 UTC Mon 16 Nov 2015

Eddy Dissipation Rate (EDR)

Turb PIREP Symbols
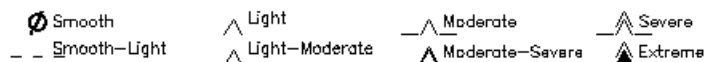
- Limited domain to focus over regions with more terrain influence

- Modified clear-air diagnostics with terrain features
  - Interpolated to MSL as well

Version 3 vs. Version 2.5

- FAA AWRP tasked NOAA/ESRL/Quality Assessment group to evaluate the performance of GTG3

- Primary findings include:
    - GTG3 improved event discrimination
    - GTG3 improved performance at higher EDR thresholds
    - Mountain wave addition does not degrade performance

- Safety Risk Assessment performed by the FAA

GTG Performance

FAA Safety Risk Assessment

- Comprised of FAA standards, requirements, and representatives from multiple airline user groups (Commercial and GA)

- GTG not for tactical use, does not impact the NAS

- User risks identified limited to pilots who might misinterpret the output

- Acceptance of QA results

GTG Version 2 vs. Version 3

GTG2 - Maximum turbulence intensity (10000 ft. MSL to FL450)
Valid 2100 UTC Thu 08 Oct 2015 — 02-hr forecast from 1900 UTC 08 Oct

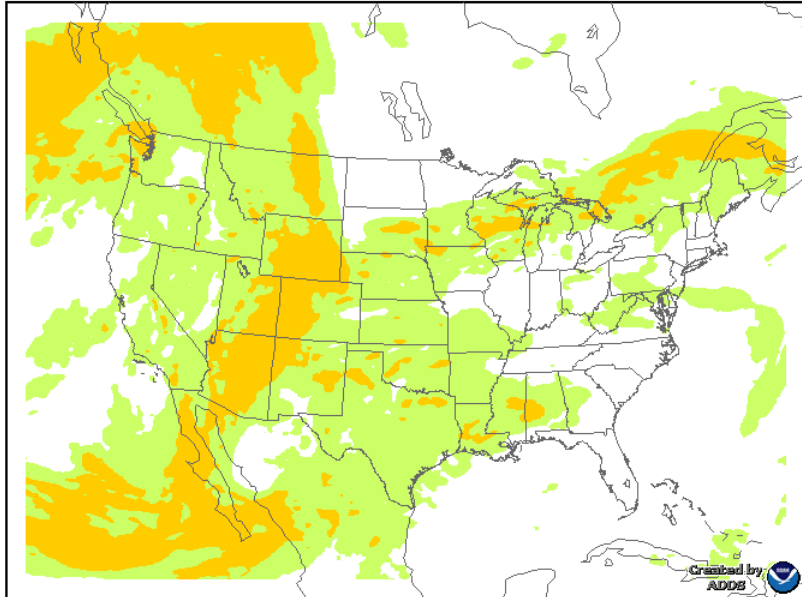GTG - Max clear air turbulence (1000 ft. MSL to FL500)
02 hr forecast valid 2100 UTC Thu 08 Oct 2015

GTG - Max mountain wave (1000 ft. MSL to FL500)
02 hr forecast valid 2100 UTC Thu 08 Oct 2015

Categorical display based on thresholds

v2.5: 2-hr forecast valid 21Z 10/8/15
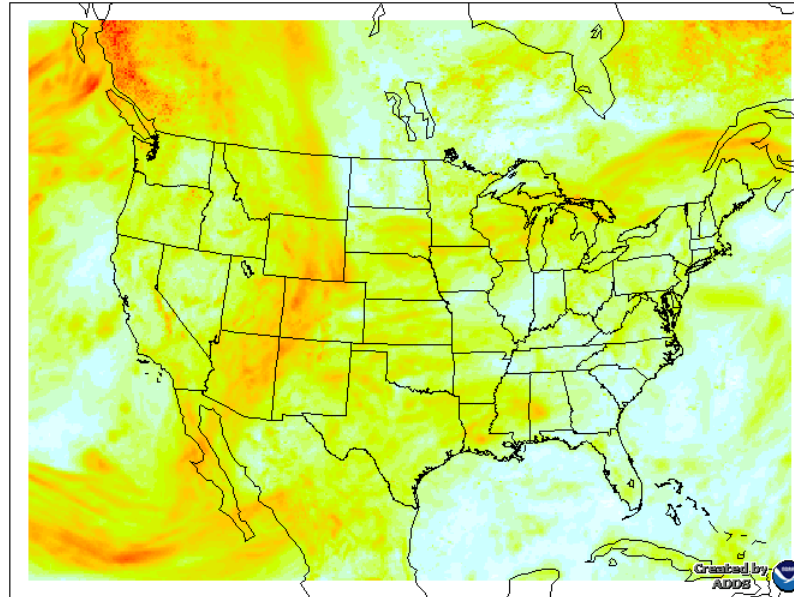
Combined (Max of CAT, MTW) in units of EDR

v3.0: 2-hr forecast valid 21Z 10/8/15
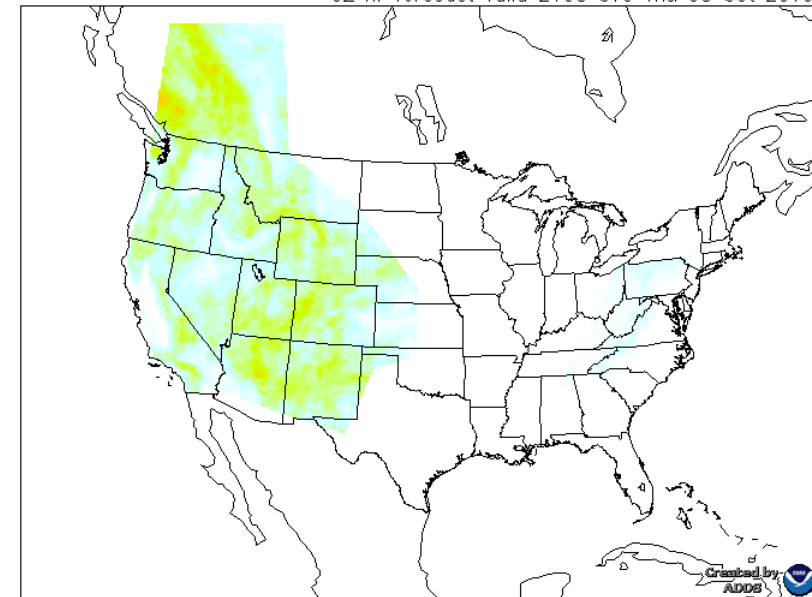
MTW forecast domains in units of EDR

v3.0: 2-hr forecast valid 21Z 10/8/15

GTG Summary

- **GTG operational NWS product (since 2002)**

- **Primary enhancements: expansion of diagnostics below 10kft MSL; explicit Mountain Wave diagnostic, addressing the need to discriminate source of turbulence as well as intensity**

- **Secondary enhancements: optimized EDR conversions; transition to national computing platform (WCOSS), improving performance**

Transition to Graphical Forecasts for Aviation

Aviation Weather Center

Mike Bettwy

Area Forecasts (FA)

Current FA:

- Manually-generated text products (no graphical components)

- Forecasts VFR clouds and weather over 16 vast geographical areas:
  CONUS (6), Hawaii (1), Alaska (7),
  Gulf of Mexico (1), Caribbean (1)

- Issued 3-4x daily, valid 18hrs (12hr + 6hr categorical outlook)

- Character-limited

- Unchanged since the early 1990s (variations date back to 1930s)

```
FAUS45 KKCI 132045
FA5W
SLCC FA 132045
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 141500
CLDS/WX VALID UNTIL 140900...OTLK VALID 140900-141500
ID MT WY NV UT CO AZ NM
.
SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.
TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HGTS DENOTED BY AGL OR CIG.
.
SYNOPSIS...ALF...MOD WLY FLOW WL CONT FM THE PAC NW INTO THE NRN
RCKYS. LGT-MOD WSWLY FLOW PREVAILS FM NRN BAJA TO SRN NM. LGT
FLOW WL CONR RMNDR.
SFC...MOD-STG WLY GRAD WNDS WL CONT FM NRN ID THRU CNTRL MT. LRG
HI PRES RDG EXTDS FM NRN CA THRU THE GRT BASIN INTO THE CNTRL
RCKYS WL LTL CHG EXP.
.
ID
NRN...BKN050-060 OVC120 TOPS FL220. SCT -SHRA. OTLK...MVFR CIG
SHRA.
CNTRL MTNS...
NRN SXNS...BKN090-100 BKN140 TOPS FL200. WDLY SCT -SHRA.
OTLK...VFR.
SRN SXNS...SCT120-140 SCT-BKN CI. OTLK...VFR.
SWRN...SCT120 SCT CI. OTLK...VFR.
SERN...
FAR NERN SXNS...BKN090 TOPS 110. OTLK...VFR.
RMNDR...SCT-BKNSCT CI. OCNL SCT140. OTLK...VFR.
.
MT
CONTDVD WWD...BKN060-080 OVC120 TOPS FL220. WDLY SCT -SHRA.
OTLK...MVFR CIG SHRA NRN SXNS..VFR SRN SXNS.
SWRN MTNS...SCT-BKN090-100 TOPS 120. OTLK...VFR.
ERN SLOPES OF CONTDVD...BKN CI. WND WLY G45KT. OTLK...VFR WND.
CNTRL...SCT130 BKN CI. WND WLY G35KT. OTLK...VFR WND.
ERN...SCT-BKN CI. OTLK...VFR.
.
WY
NWRN MTNS...SCT-BKN100 TOPS 130 SCT-BKN CI. OTLK...VFR.
N CNTRL-NERN SXNS...SCT-BKN CI. OTLK...VFR.
SRN SXNS...SKC OR SCT CI. OTLK...VFR.
.
NV UT
NRN  SKC OR SCT CI. OTLK  VER
```

Graphical Forecasts for Aviation (GFA)

Observations	Radar	Satellite
PIREPs	C&V/Flight Category	TAFs
Thunderstorms	Clouds (layers)	Precipitation
Icing	Turbulence	Winds
NWS Warnings	AIRMETs	SIGMETs

Forecasts to 18 hours (CONUS)

Modern graphical layout: Open Layers Display with more details and higher resolution

More timely and consistent with other NWS products

Graphical Forecasts for Aviation (GFA)

Prototype in development at:

http://new.aviationweather.gov/areafcst
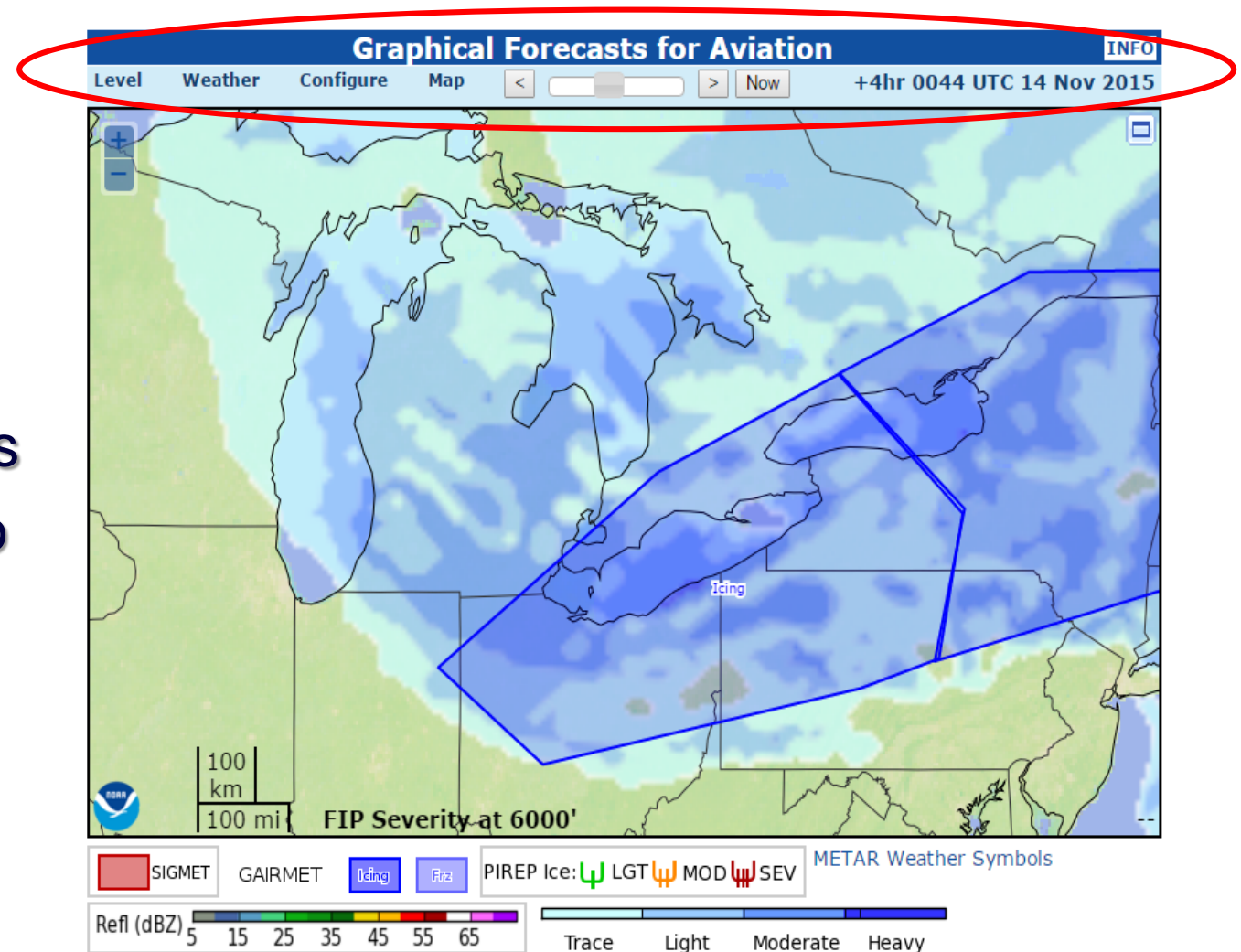
Interface allows users to:

- View data at hourly time increments
- Manipulate level of interest (SFC to FL450 or MAX composite)
- Map configurations & overlays
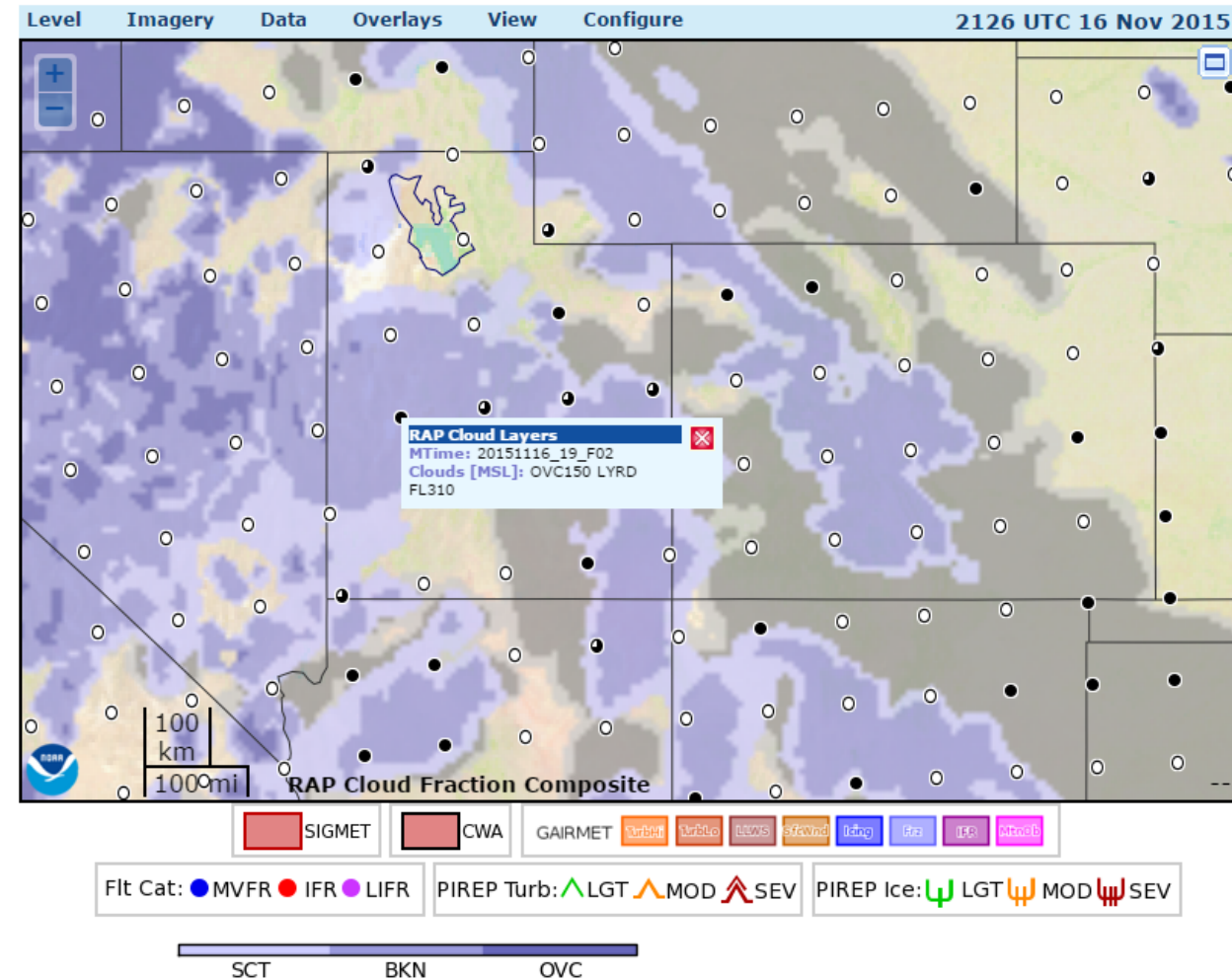- Utilize slider controls and legends

GFA: Clouds

Users have expressed the most concern over the availability of cloud information (bases, layers and tops)

- Combination Cloud Fraction (RAP 13km)
  - Total Cloud Fraction: Gray Scale (FEW/SCT/BKN/OVC)
  - Maximum Cloud Fraction BLW FL180: Color (FEW/SCT/BKN/OVC)

- Click/Mouseover for specifics
  - Works at non-station locations
  - Example: 12Z FEW025 SCT050 BKN100 (TOP250|LYRD250)

Level   Imagery   Data   Overlays   View   Configure   2126 UTC 16 Nov 2015

RAP Cloud Layers
MTime: 20151116_19_F02
Clouds [MSL]: OVC150 LYRD
FL310

100 km
1000 mi
RAP Cloud Fraction Composite

SIGMET   CWA   GAIRMET Turb-Hi Turb-Lo LLWS Sfcwnd Icing Frz IFR Mtnob

Flt Cat: ●MVFR ●IFR ●LIFR   PIREP Turb:∧LGT∧MOD∧SEV   PIREP Ice:Ѱ LGT Ѱ MOD Ѱ SEV

SCT   BKN   OVC

GFA Data Sources

RAP13:

- Clouds
- Winds Aloft

CIP/FIP:

- Icing

GTG:

- Turbulence

NDFD:

- Surface Winds
- Forecast Thunderstorms
- Future Precip/Weather

Gust (kt)

Surface Wind Gusts (kt)
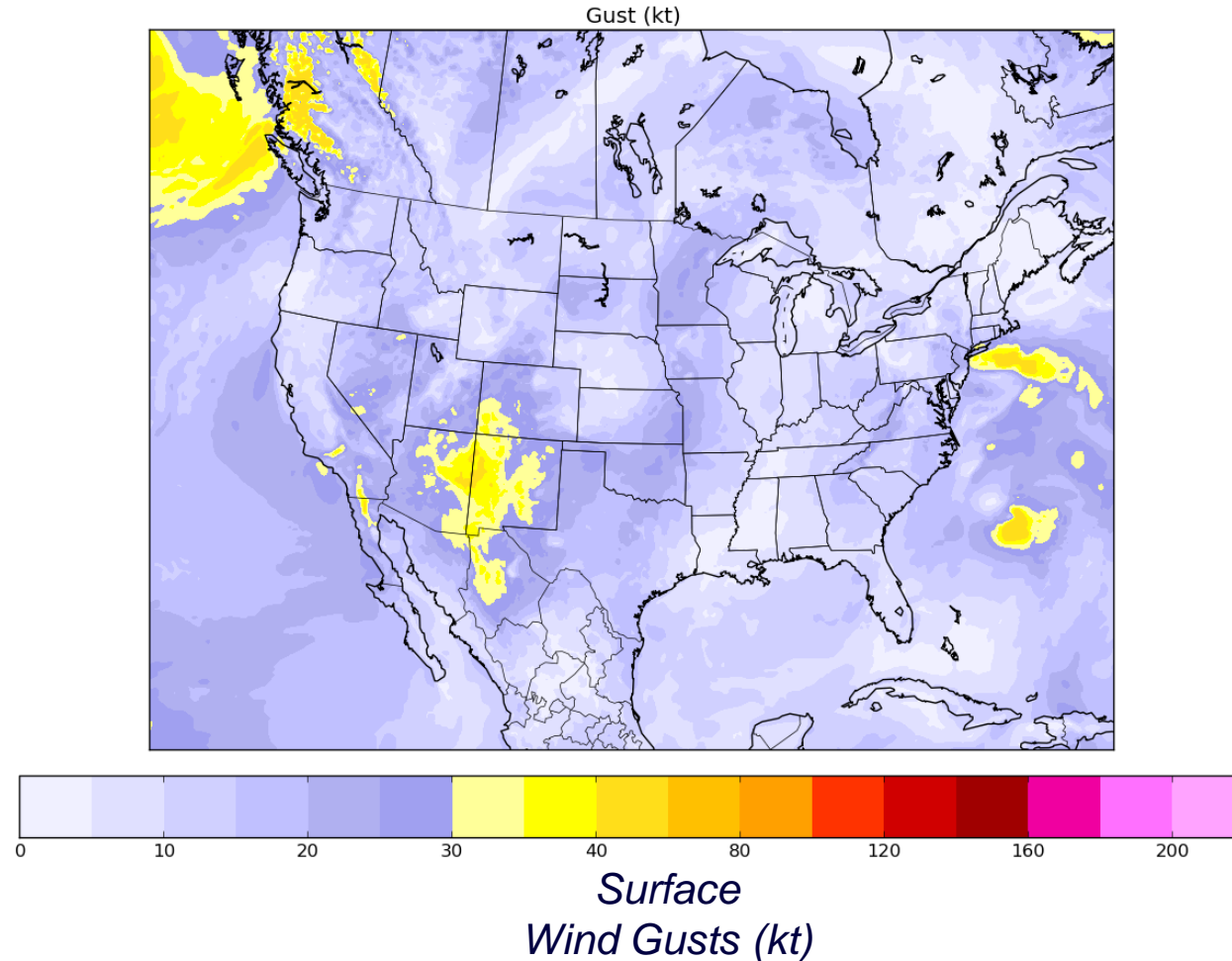
GFA Status Update

- Under development, initial Web work to be completed by late December

- Will provide greater detail with finer time scales and areal depictions

- Increased utility and relevance in era of digital products

- Allow forecasters to maximize operational benefit (more time for AIRMETs, SIGMETs, distribution of PIREPs, decision support activities)

GFA Status Update

- Testing will include collaboration with partners and primary users

- Monthly Technical Exchange Meetings and other activities

- Will build upon and utilize weather elements contained in other products, including:
  - Significant Weather (SIGWX) Charts
  - Surface Weather Analyses & Prog Charts
  - Aviation Forecast Discussions
  - Terminal Aerodrome Forecasts (TAFs)
  - Airmen's Meteorological Information (AIRMETs)
  - National Digital Forecast Database (NDFD)

GFA Sample Data
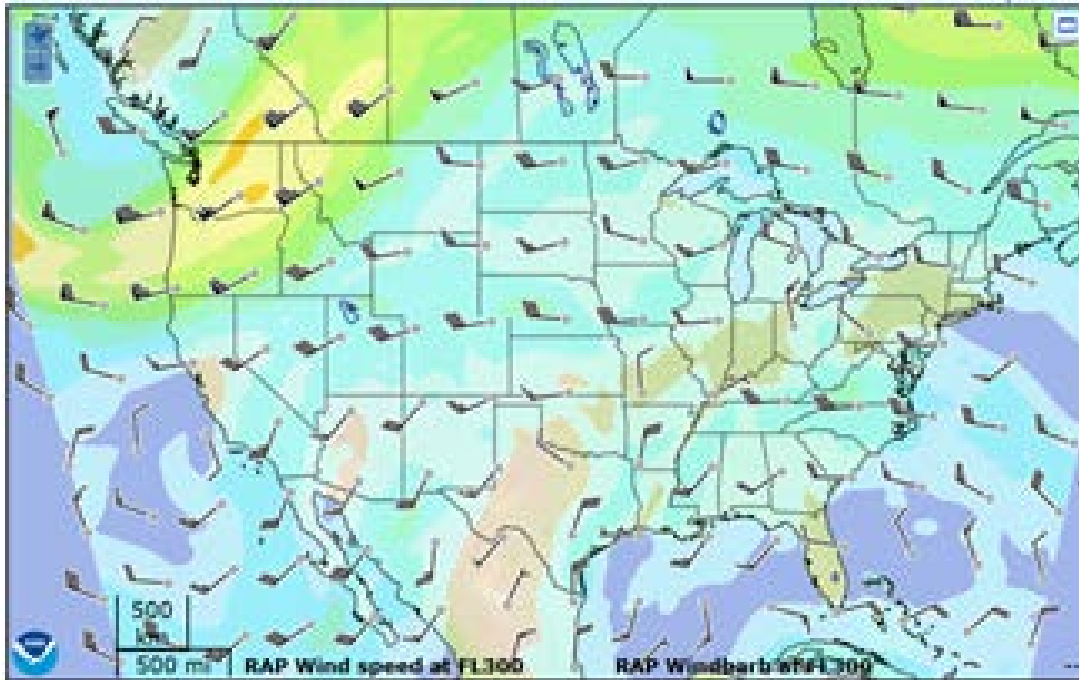
Wind data at FL300
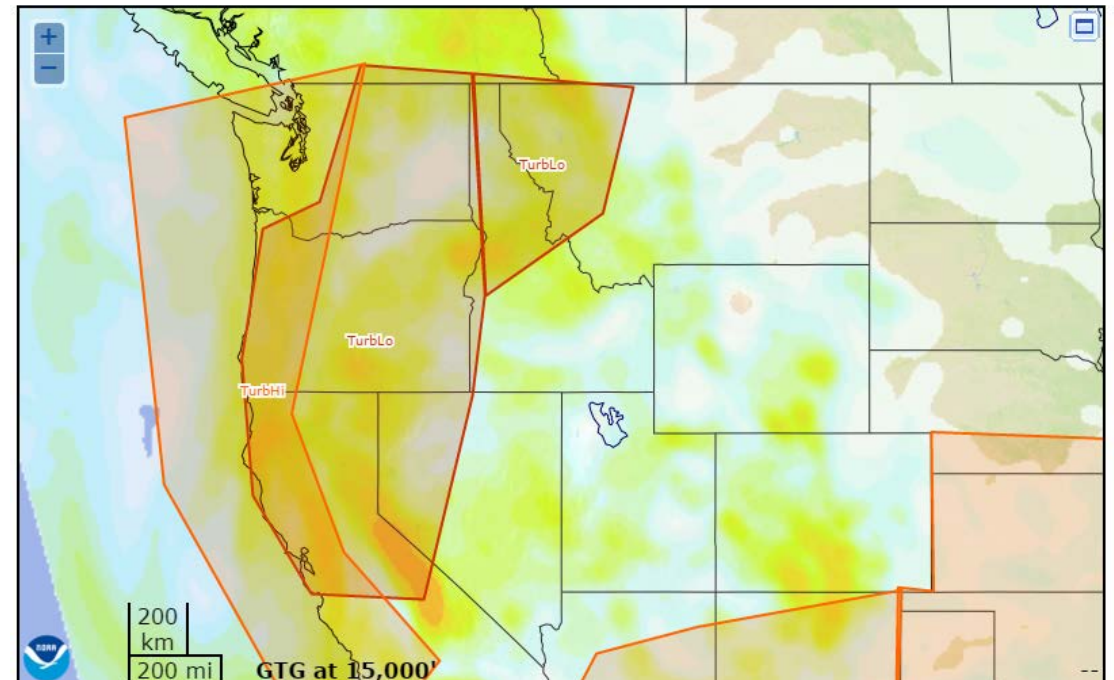
GTG and Turbulence AIRMETS

Graphical FA Challenges

- 15-day archive capability (under development)
- Internet access at Flight Service Stations
  - Partners need a way to regenerate the images and graphics for use within their systems and networks
  - Flight Service providers must be able to access equivalent information through NOAAPORT (concerns with some NDFD data)
- Route of flight capability
- Delivery methods (SBN and NOAAPORT)
- Provide equivalent information that is readily available on ADDS

GFA Summary

- **Text Area Forecasts will continue to be produced for at least 3 months after the new GFA product is officially available (mid-2016)**

- **Modern graphical layout for improved dissemination of weather information to decision-makers in a timely fashion**

- **GFA will consist of current FA elements along with additional information on a single portal**

- **Builds upon existing NWS products and data (including NDFD, RAP13, GTG, CIP/FIP)**

- **Data will also be readily available on current platforms (i.e., NOAAPORT)**