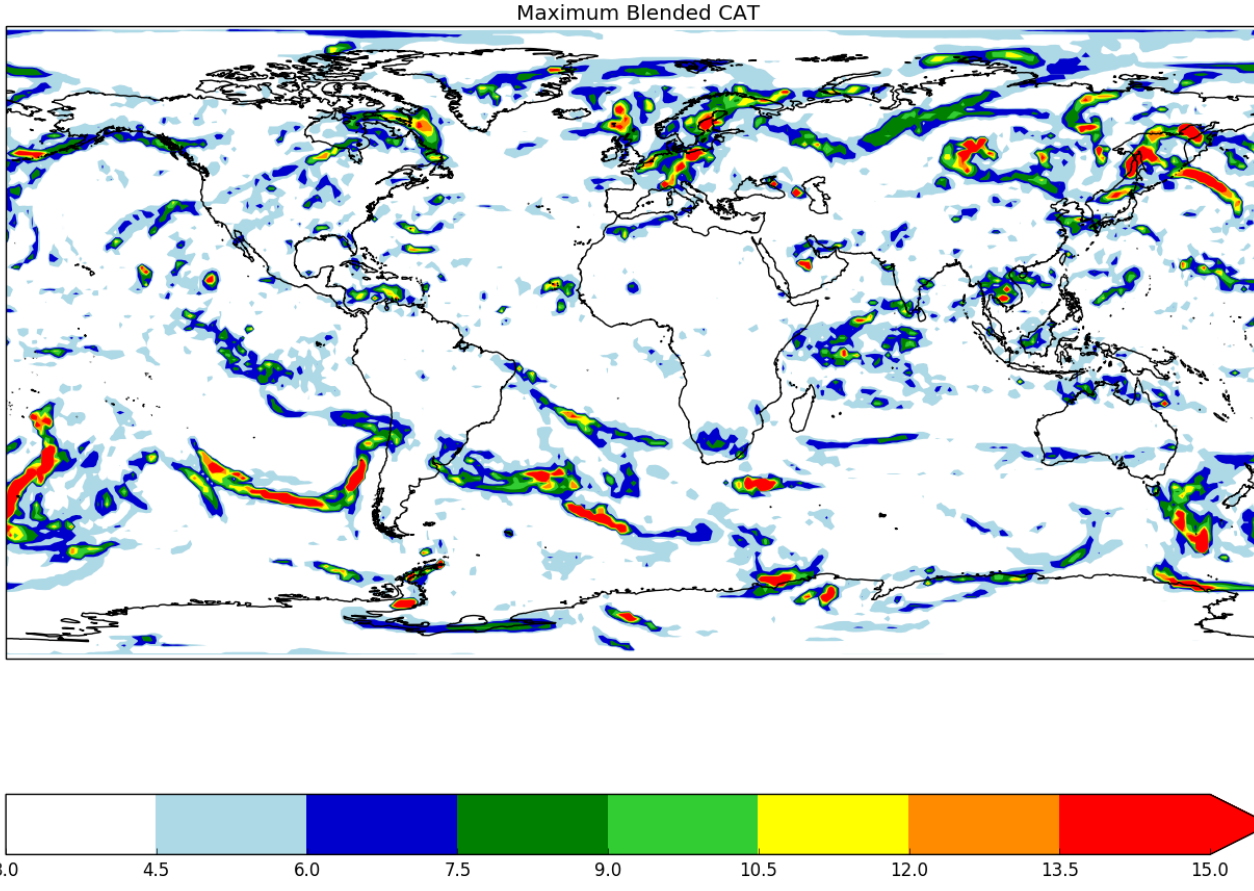
Turbulence Impact Mitigation Workshop 3

Next Generation World Area Forecast System Turbulence Forecasts

Presented by Claire Bartholomew, WAFC London and Matt Strahan, WAFC Washington

Current WAFS Turbulence Product

- Two provider states, WAFC London and WAFC Washington
- Max and a mean turbulence “potential”
- 1.25 degree horizontal resolution grid. T+6 to T+36 3 hour time steps



WAFS Improvement Schedule

2020

- Turbulence Severity (EDR)
- Horizontal resolution increased to 0.25 degrees

2022

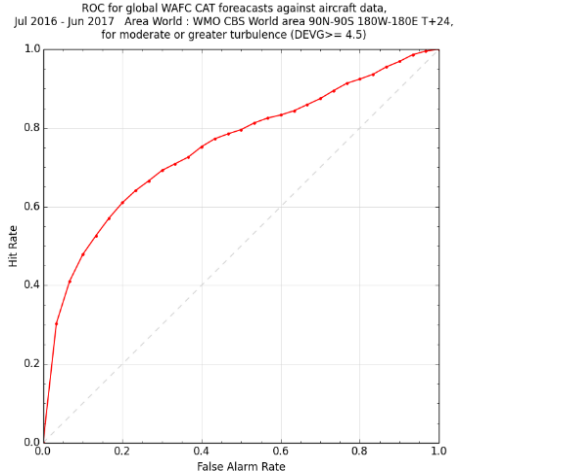
- Temporal resolution T+6 to T+24 in 1 hour increments
- Temporal resolution T+27 to T+48 in 3 hour increments

2024

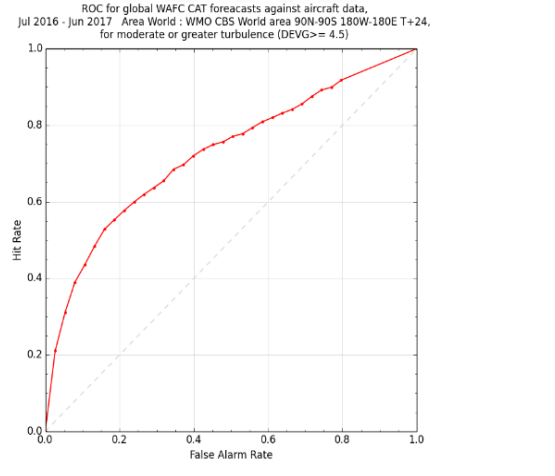
- Probabilistic Severity (EDR)

ROC Plots of GTG vs current WAFS

WAFS



GTG



- GTG fractionally higher but this is lower resolution ensemble data (control).
- Next trial (underway) uses (~10km) global deterministic data

Turbulence Climatology: AIM

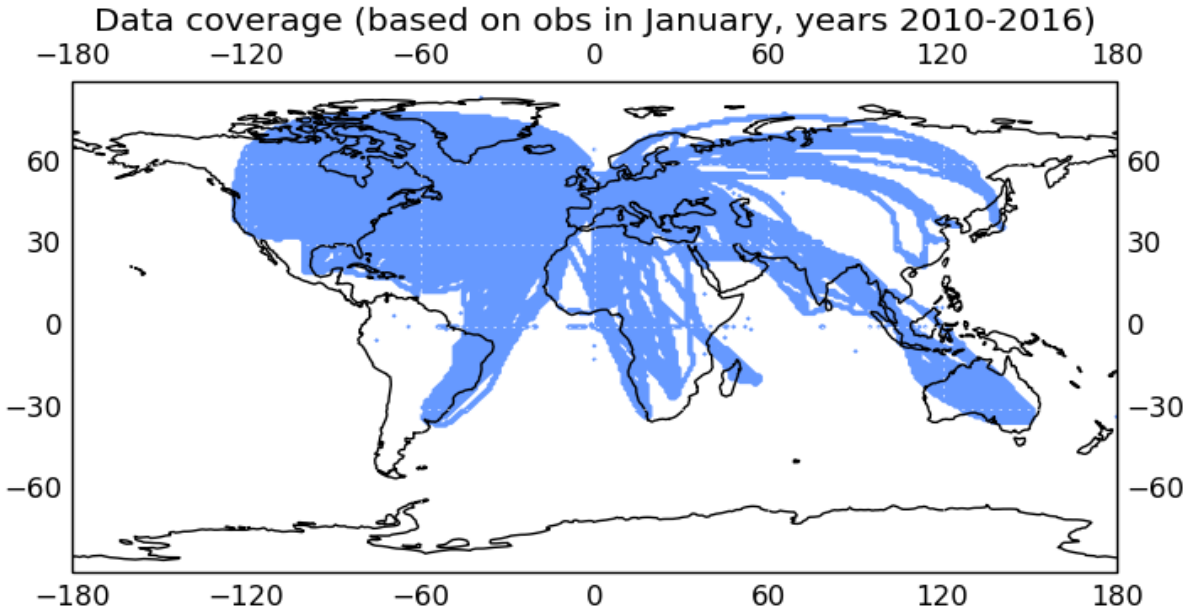
- To generate MOG turbulence climatology using database of automated aircraft observations
- To attempt identification of turbulence events generated by convection and mountain waves, and start to build a climatology of these

Study will ultimately aim:

- To identify areas where MOG turbulence is more likely, for use in the aviation community
- To provide a basis for future studies of turbulence
- To aid future development of turbulence indicators

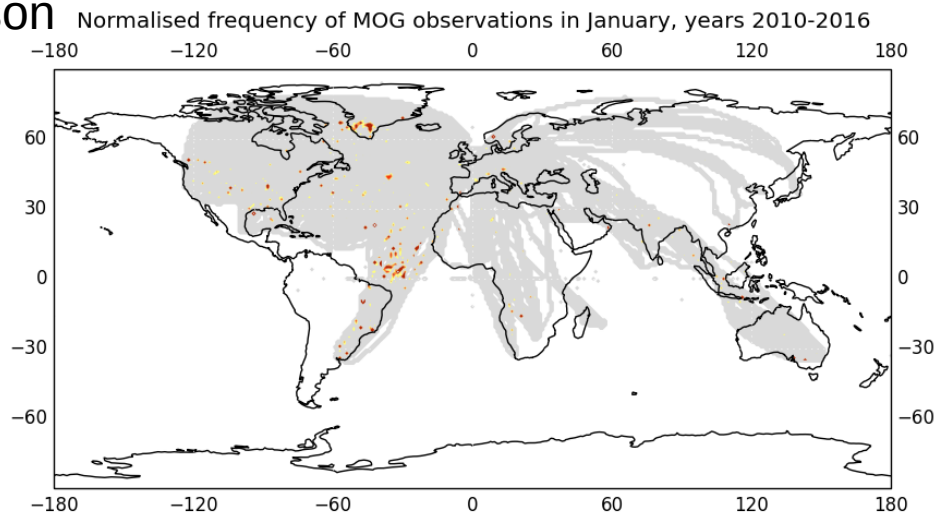
Aircraft observational data used

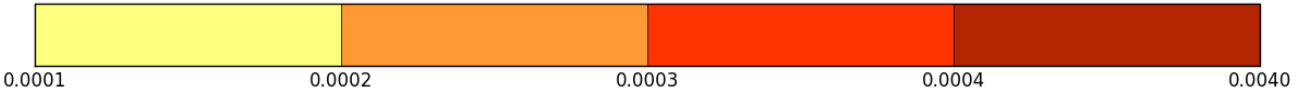
- Archive of automated aircraft measurements
  - Global Aircraft Data Set (GADS) – aircraft observations
  - ~13 years worth of data available, but need to re-quality control the data for use. Currently 7 years of data has been re-qc'ed
  - Data includes vertical acceleration, from which DEVG is calculated
  - Main area of coverage indicated below:



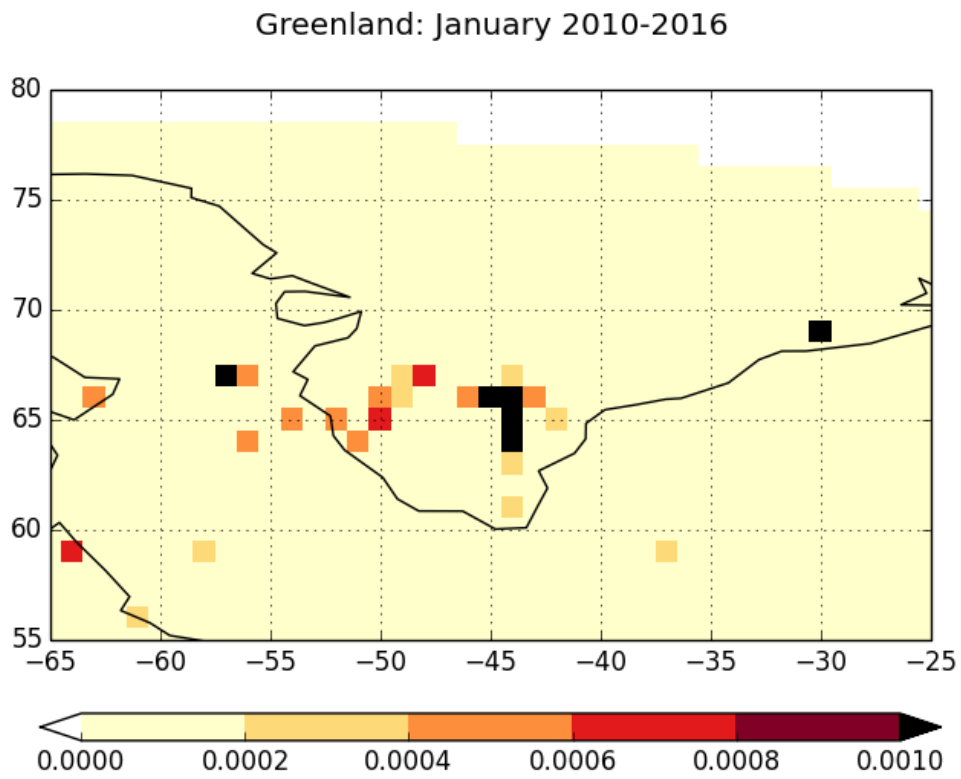
Percentage of Turbulence Obs that are Moderate or Greater (MOG)

- Calculation of (total number of MOG obs)/(total number of obs) in a 1º x 1º grid square
- For each month and season for 7 years
- Initial results for January 2010-2016:

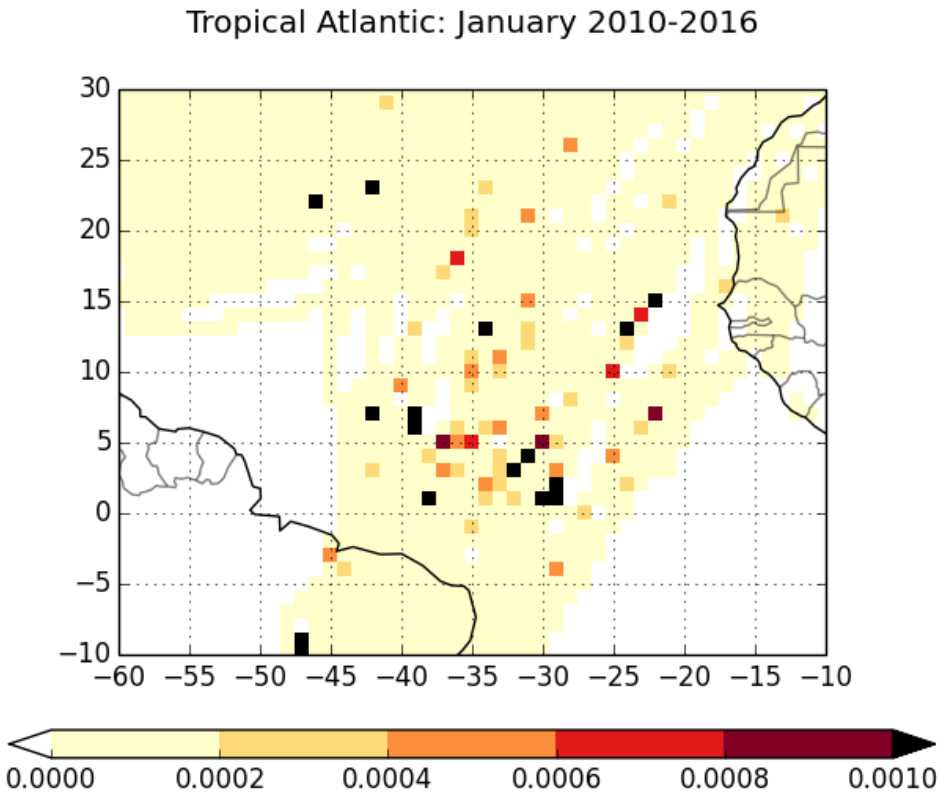




Turbulence Hotspots - Greenland



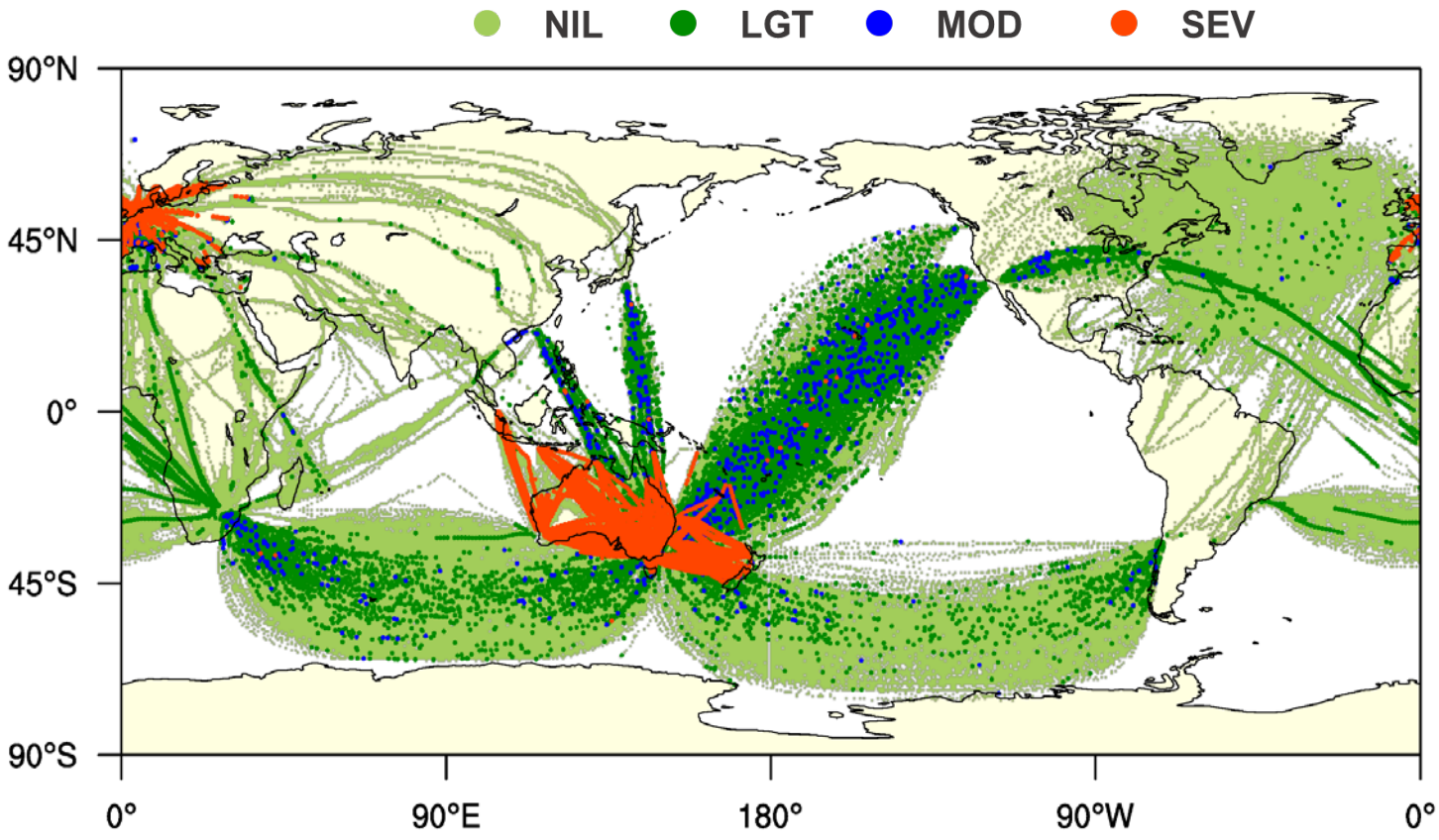
Turbulence Hotspots -Tropical Atlantic



Next Steps

- Combining with other airlines data
- Using to verify WAFS turbulence diagnostic
- Further QC of more recent aircraft observations

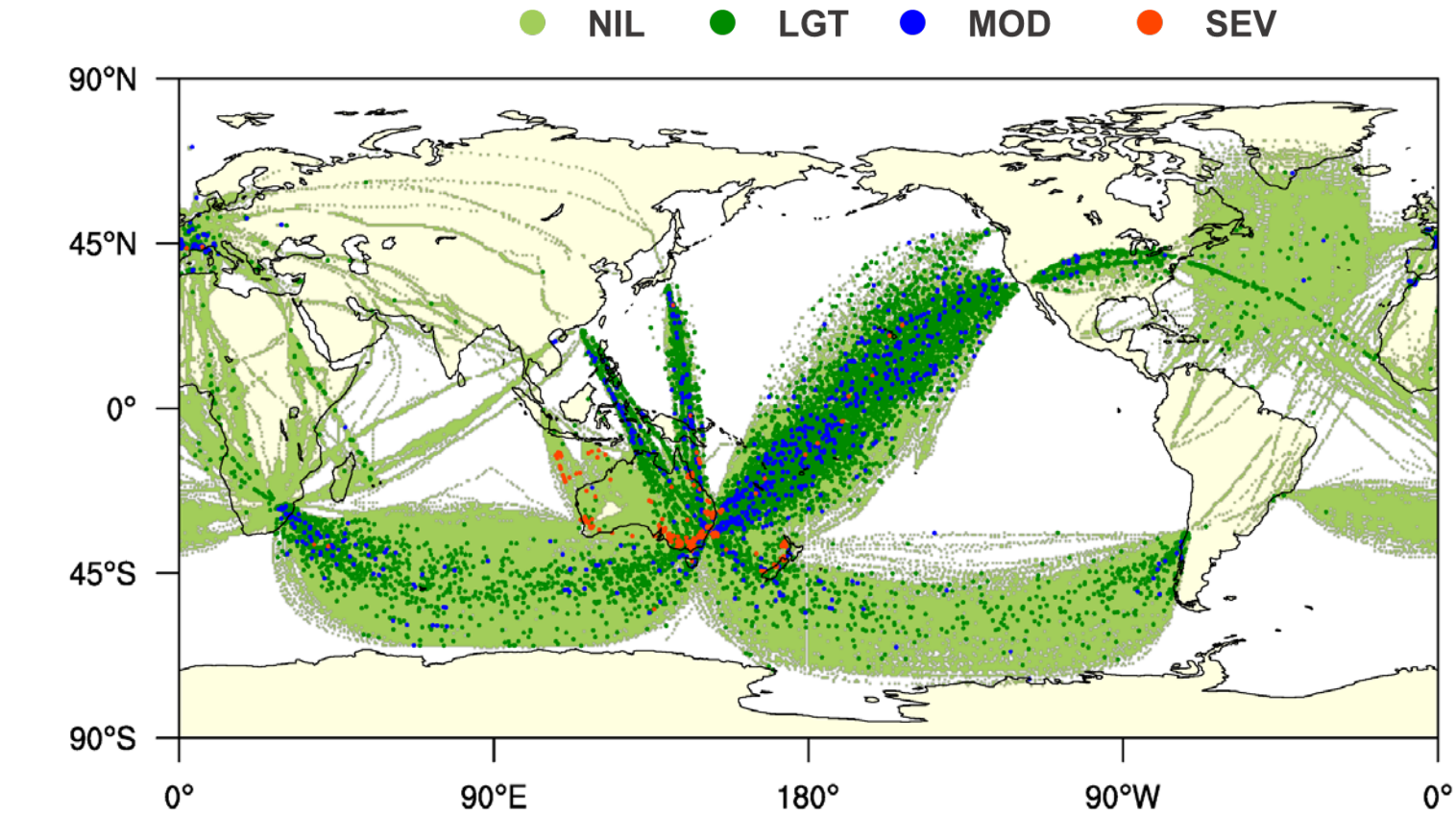
Issues on quality of AMDAR data



- Includes below FL280
- Includes “bad” aircraft
- Problems with positioning
- Spurious severe reports

Credit:
Soo-Hyun Kim
Yonsei University

After Quality Control



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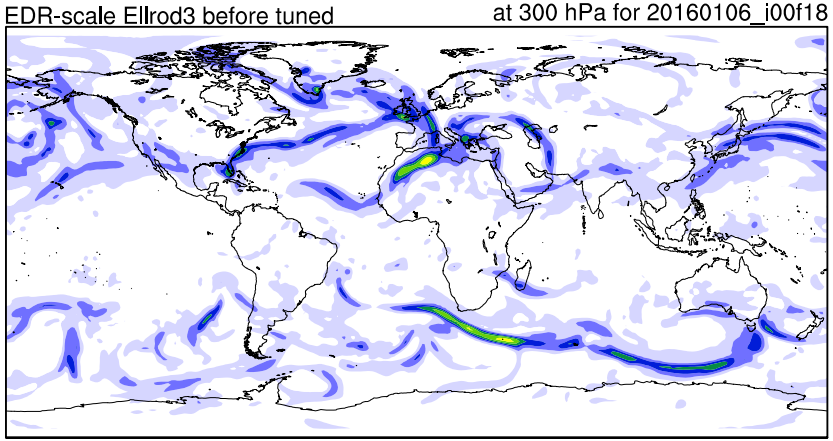
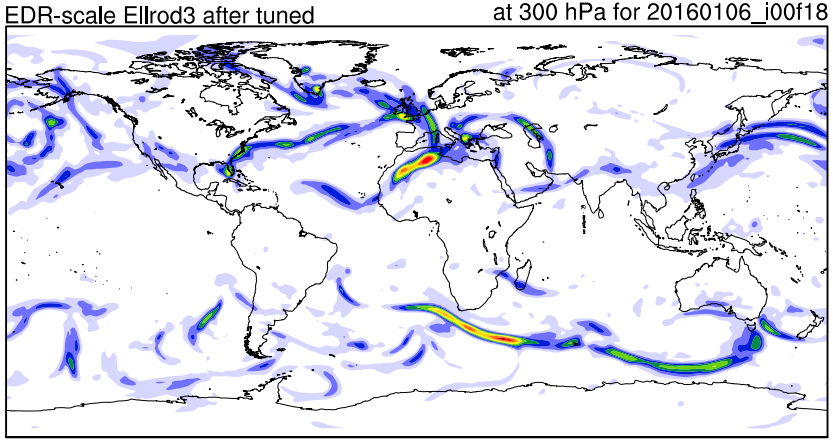
Importance of the EDR tuning

Ellrod3

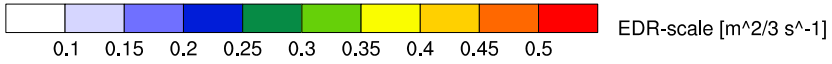


Uncalibrated

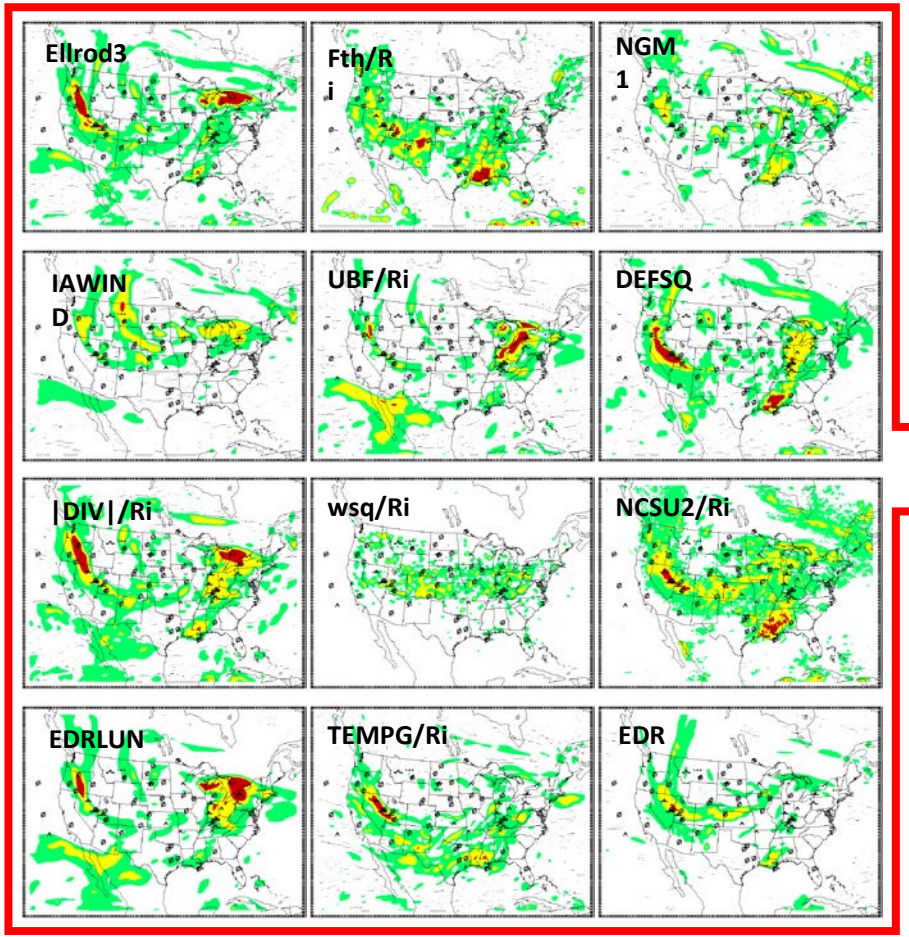
Ellrod3



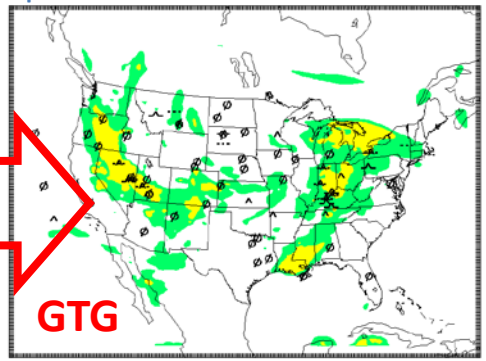
Calibrated



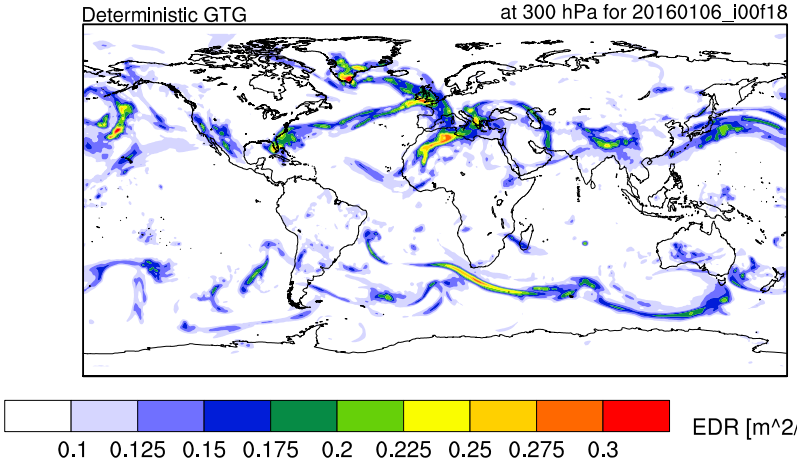
GTG combination



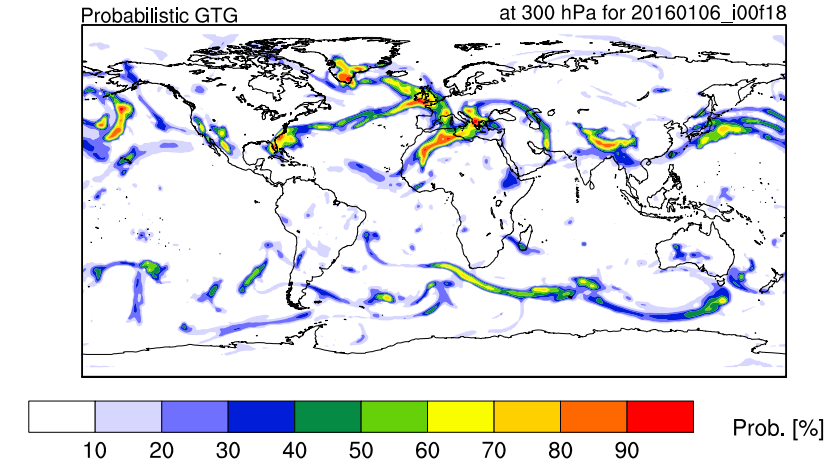
* Probabilistic GTG: the percentage of CAT and MWT diagnostics exceeding a certain threshold at given grid points.



Deterministic vs Probabilistic



- Deterministic GTG
- Ensemble mean of EDR
- 15 CAT and 15 MWT
- Max EDR (CAT, MWT)



- The Best Probabilistic GTG
- Frequency (%):

The number of CAT and MWT exceeding **0.14 EDR** value / 15 CAT, 15 MWT at given grid points

- Max Prob. (CAT, MWT)

** Definition: A chance of having 10's km size eddy at the given grid box or area

Next Steps for Global Turbulence

- Improve data collection and quality control
- Improve algorithm tuning and verification
- Create global turbulence database
- Define and explain probabilistic turbulence forecasts