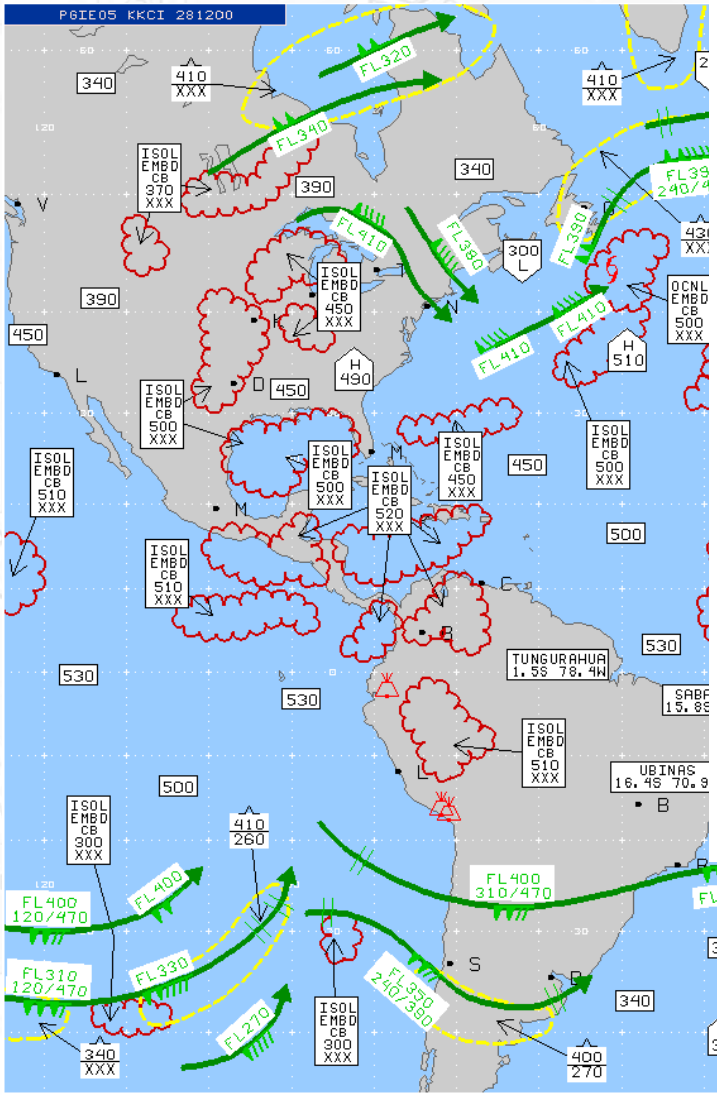
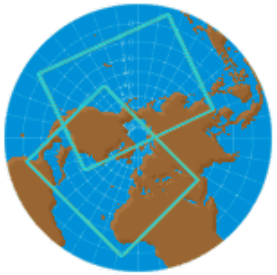
World Area Forecast System

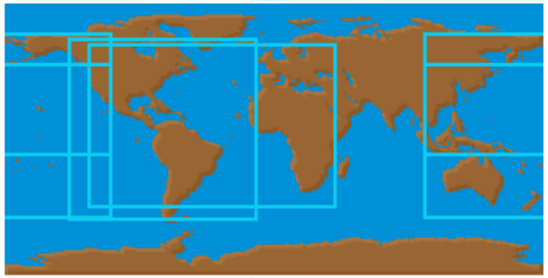
- Created in 1984 to consolidate Significant Weather Chart production.
- Wind/Temp/Rh/Height grids began in 1990s
- Hazard grids for Cb, Turbulence and Icing approved by ICAO in 2013.

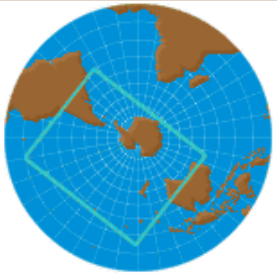
WAFS Current Products

Significant Weather Charts









High Level FL240-630 (Latest: 06Z updated at 1252Z)

Click on the region for a larger view, hover to see extent

North Polar Stereographic

- ICAO Area H — Color | B&W
- ICAO Area I — Color | B&W

Central Mercator

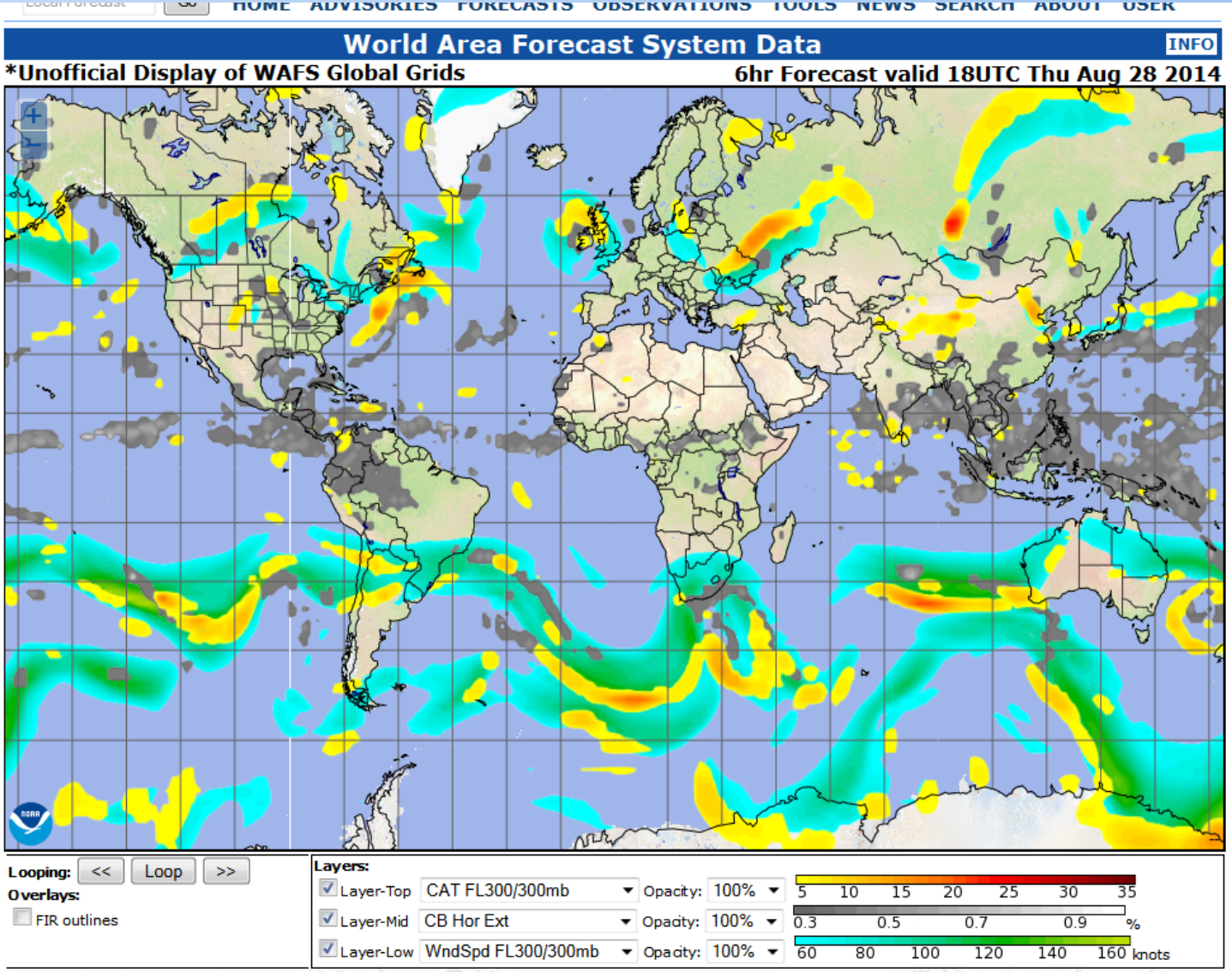
- ICAO Area A — Color | B&W
- ICAO Area B1 — Color | B&W
- ICAO Area F — Color | B&W
- ICAO Area M — Color | B&W

South Polar Stereographic

- ICAO Area J — Color | B&W

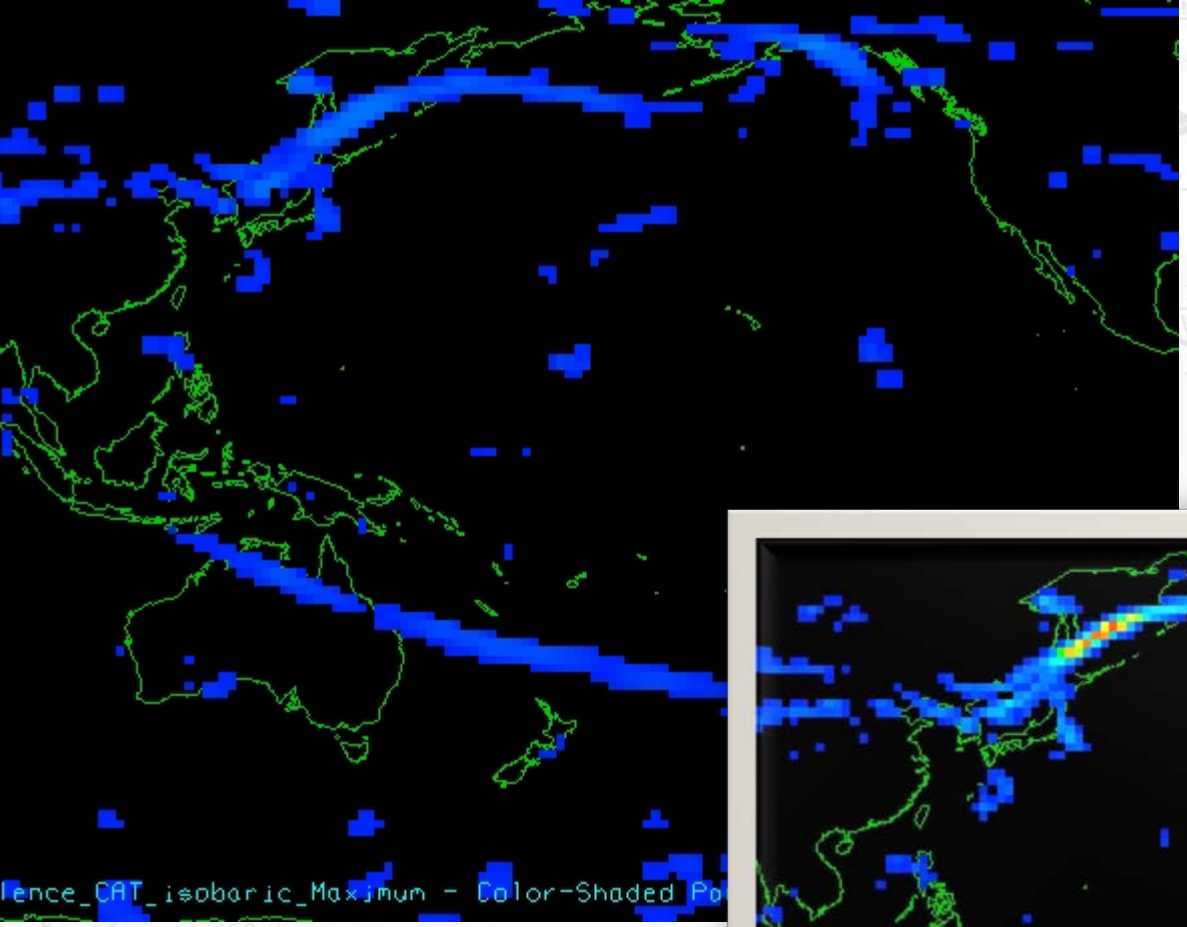
WAFS Current Products

Global 1.25 Degree Grids



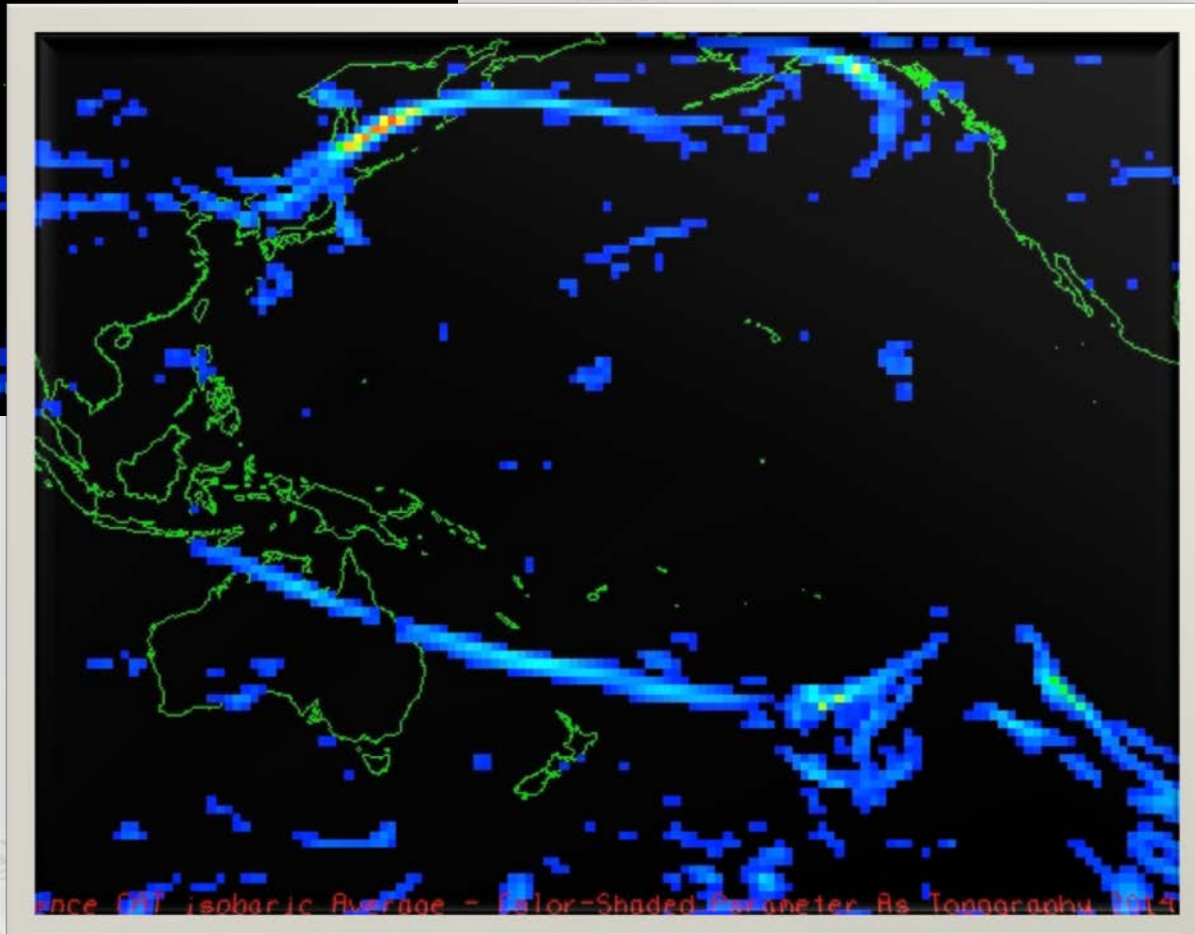
Limits of Current WAFS Turbulence Grid

- Only provides uncalibrated turbulence potential.
- Output of blend with UK is simple:
  - Max
  - Mean
- No indication of severity.
- 1.25 degree resolution.



CAT Mean

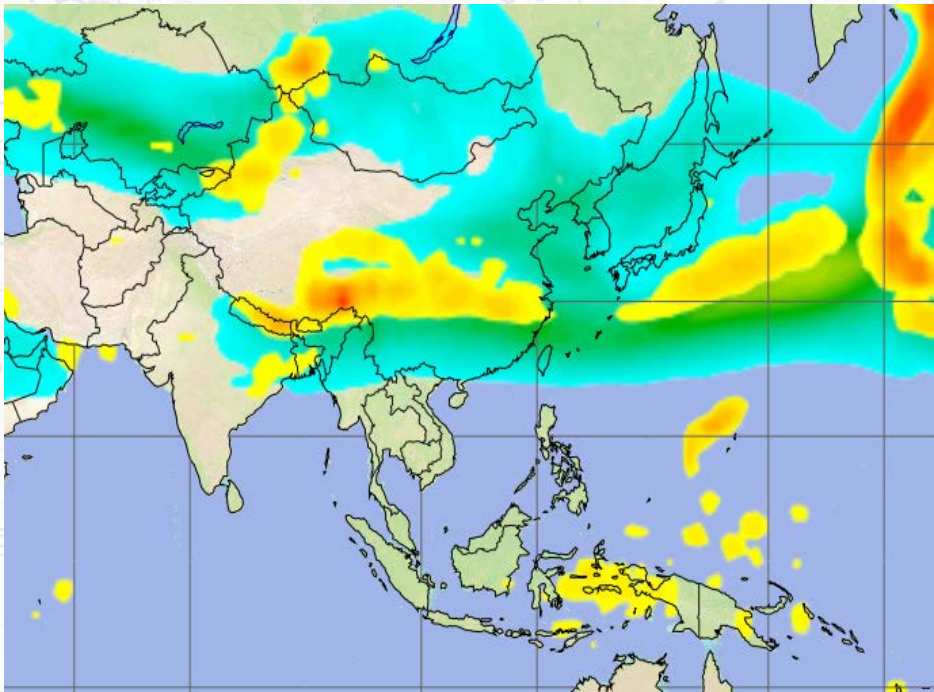
CAT Max



WAFS Roadmap

accepted by joint WMO/ICAO MET Division meeting

- Based on Discussions at Joint IATA/WAFC Meeting in Feb, 2013 and again in Feb 2014.
- Probability of Exceeding Severity Thresholds for Aviation Hazards.
- Increased Resolution.
- Three Step Plan that Follows Aviation System Block Upgrade (ASBU) Plan.



ASBU 0 – today thru 2018

- Implement improved turbulence algorithms, including the replacement of turbulence potential with turbulence severity (i.e. eddy dissipation rate (EDR))
- Implement improved icing algorithms, including the replacement of icing potential with icing severity
- Global and regional verification of WAFS forecasts by utilizing data provided by States and user organizations

ASBU 1 2018 thru 2023

- Implement cumulonimbus cloud ensemble based prediction system
- Implement turbulence type forecasts (e.g. convection, jet-stream shear, terrain) utilizing
- Implement finer grid resolution for WAFS data
- Implement calibrated probabilistic forecasts for icing, turbulence and cumulonimbus cloud
- Provide partial datasets of meteorological information suitable for integration into flight planning, flight management and air traffic management (ATM) decision support systems for en-route weather
- Implement significant weather forecasts (SIGWX) in XML/GML format as a replacement to SIGWX in BUFR format
- Make available WAFS data via the System Wide Information Management (SWIM)

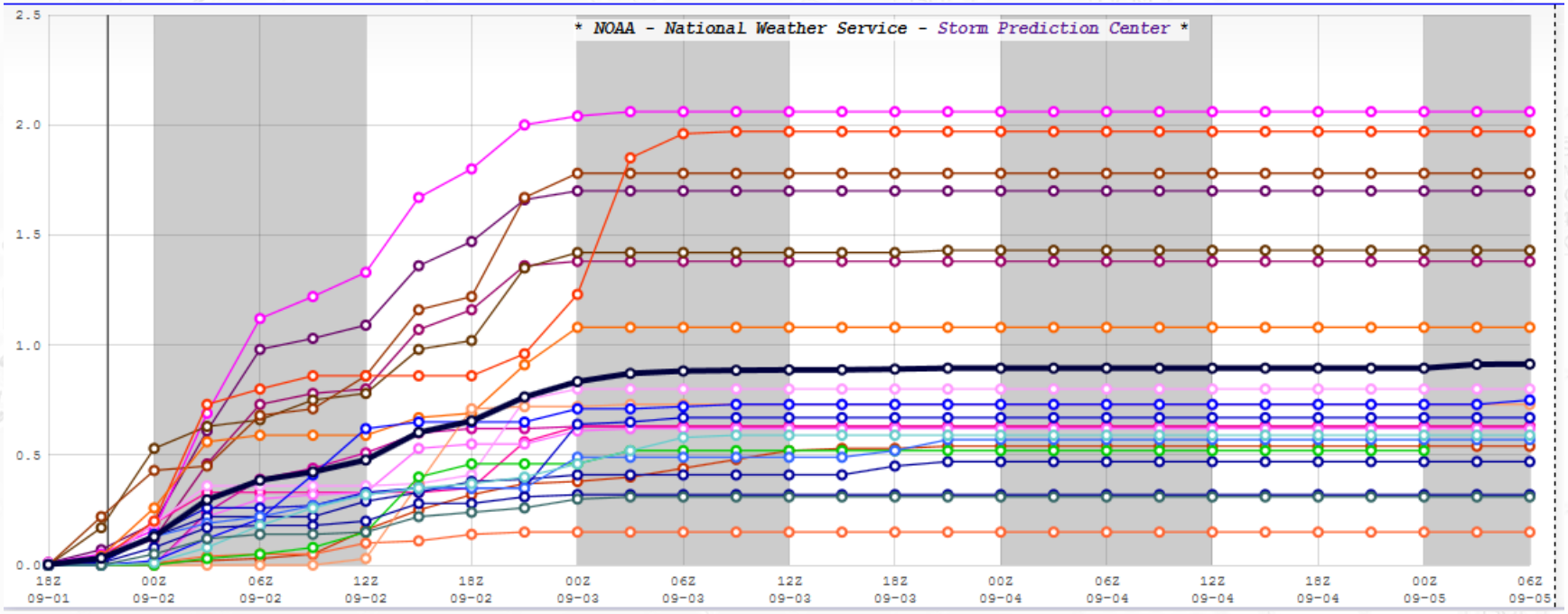
ASBU 3 2028+
note there is no ASBU 2 for MET

- Fully integrated multi-member/multi-State global ensemble hazard forecasts
- Implementation of high spatial and temporal resolution models resulting in improved representations of meteorological information
- Provide full dataset of meteorological information covering en-route weather suitable for integration into flight planning for en-route operations, flight management and air traffic management (ATM) decision support systems
- Fully automated gridded and significant weather forecast (SIGWX) output
- Full implementation of system wide information management (SWIM) for access to WAFS data
- Retirement of legacy WAFS products and dissemination systems

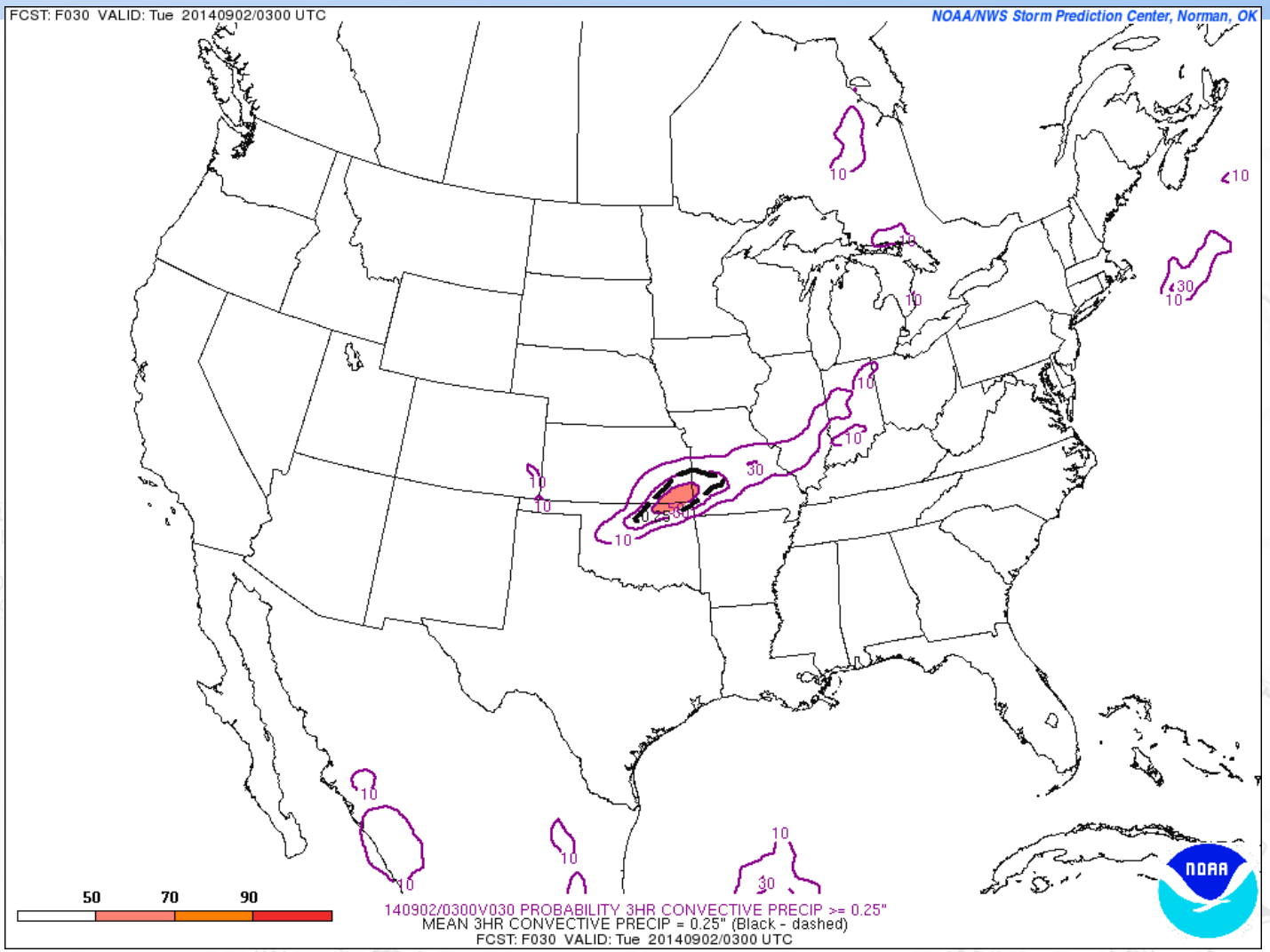
Probability

- Created by multi-center ensemble
  - Calibrated against observations, not blended.
  - Initially limited to U.S. and U.K. global ensembles.
  - Could incorporate grids from other states.
- User selectable severity thresholds

SREF Total Precip in NE Oklahoma



SREF Prob 3hr precip > 0.25”



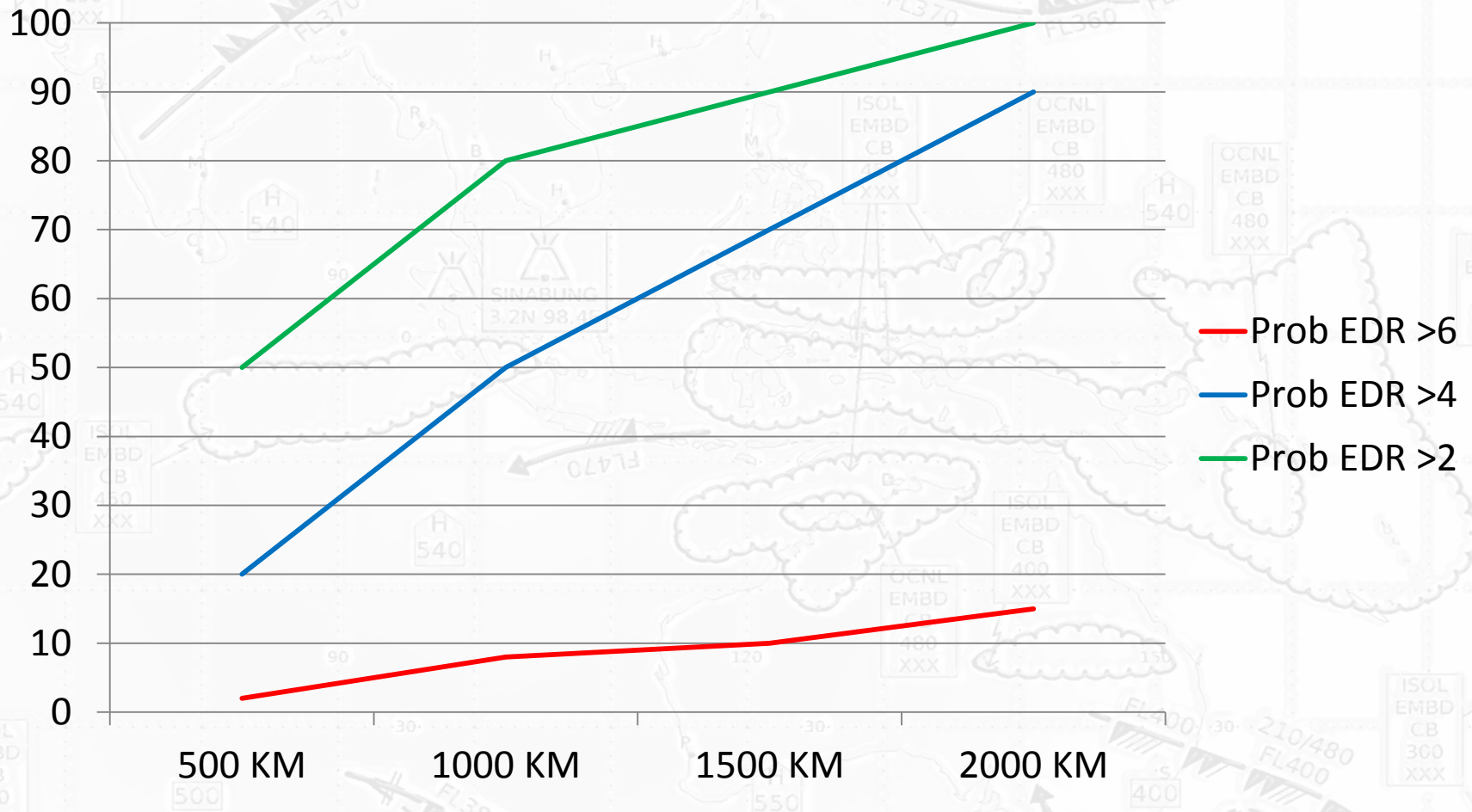
Ensemble Pro/Con

- Pro
  - Diversity in models and initialization
  - Good at locating area of hazard
  - Ensemble spread provides valuable information about range of possibilities
  - Smarter way of blending multiple models

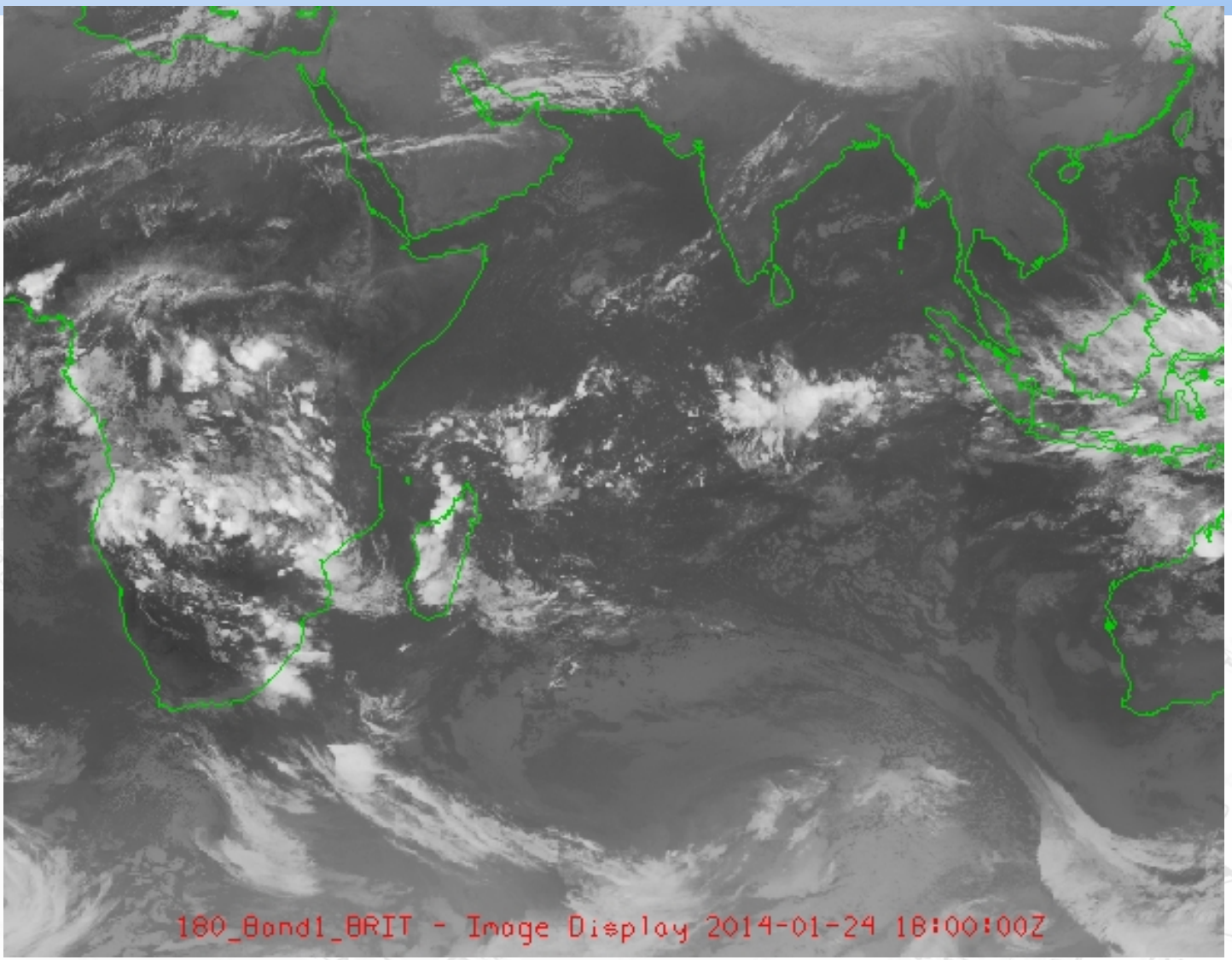
Ensemble Pro/Con

- Con
  - Computationally expensive
  - Requires more data exchange
    - Maybe just exchange probabilities
  - Requires verification data to tune
    - As does any method of producing probabilities
    - Can use reforecasting to tune
  - Max and Min values can get washed out
    - Can use probability matched mean to restore extremes

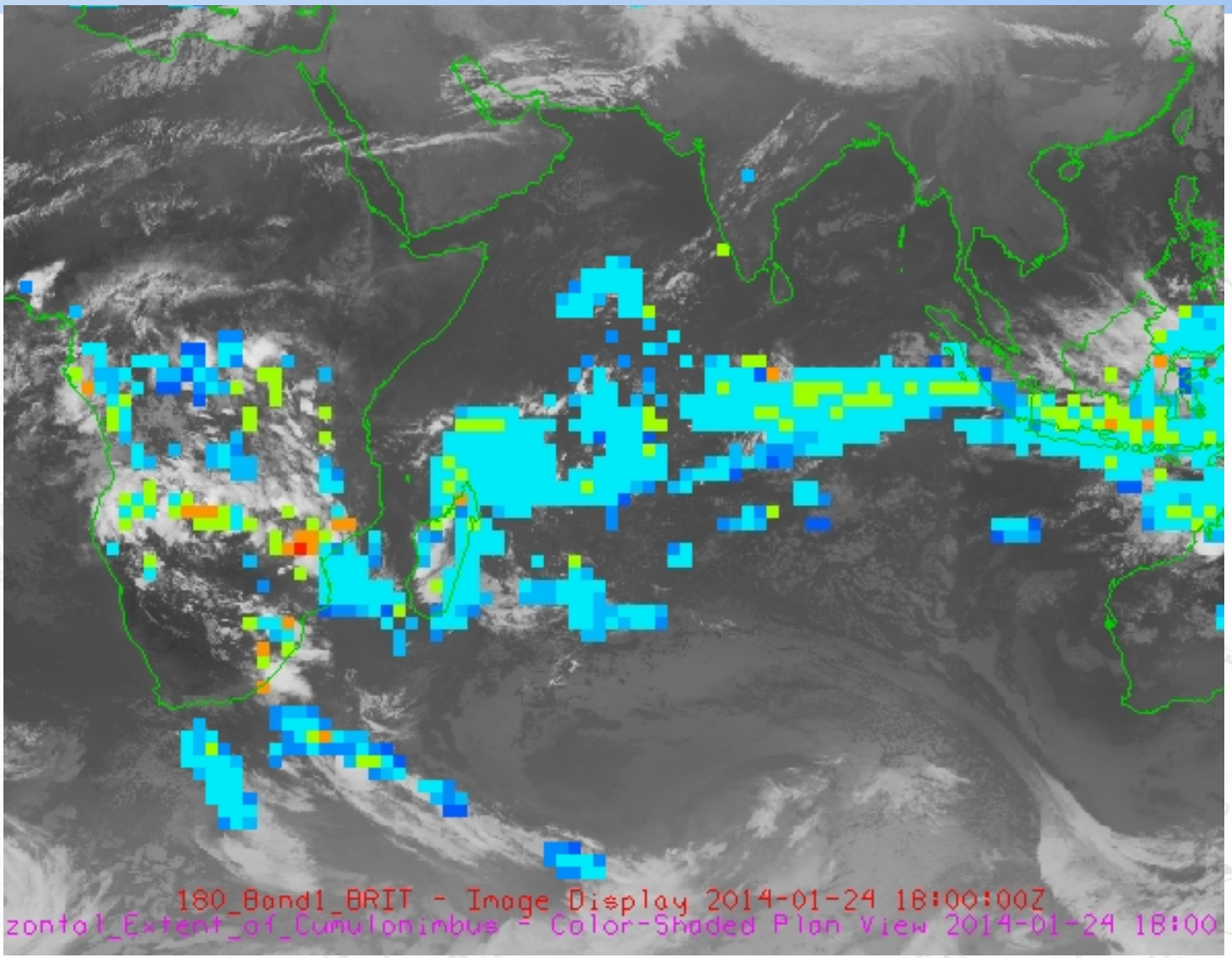
Cumulative Probability Along Flight Path



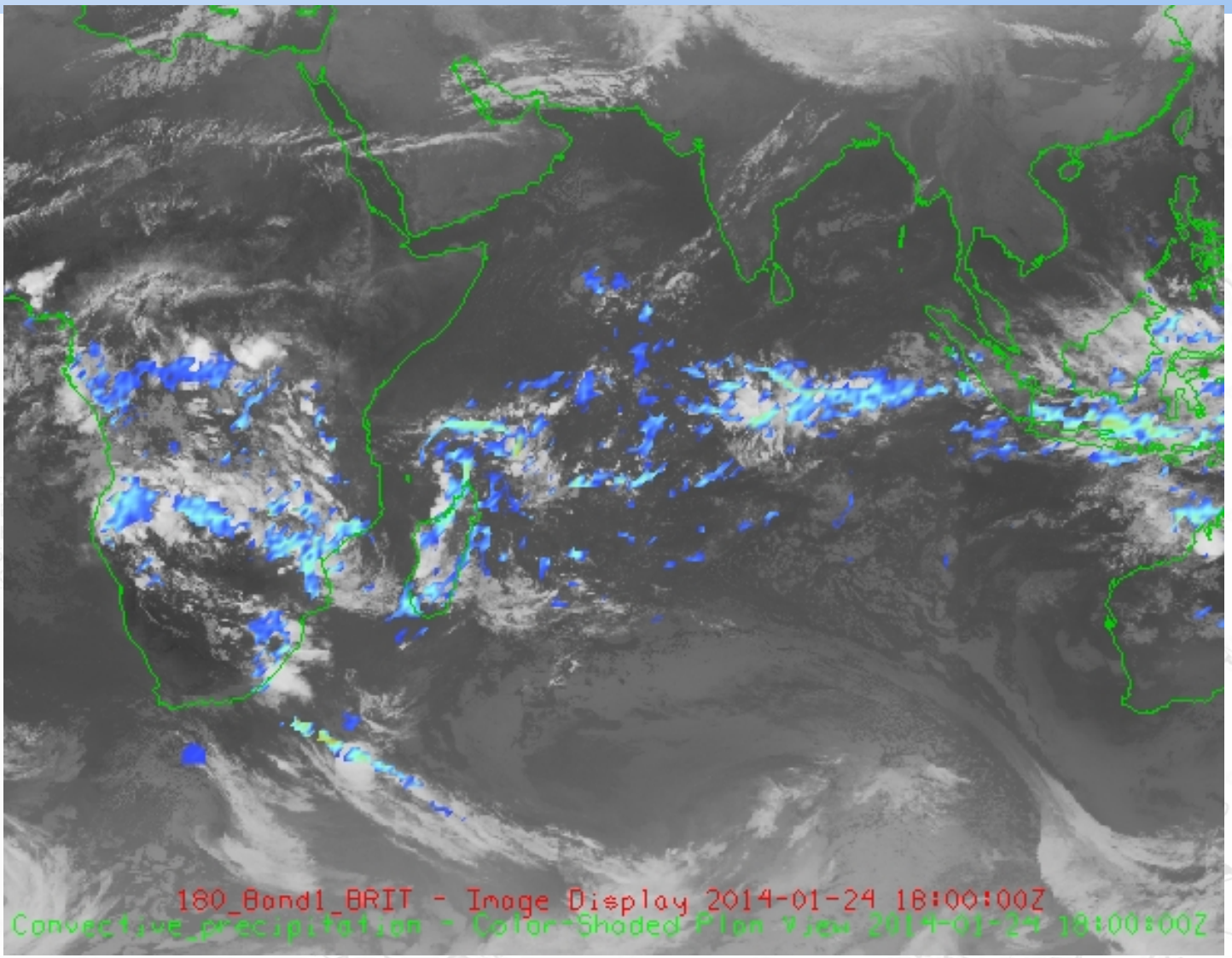
Benefits of Higher Resolution



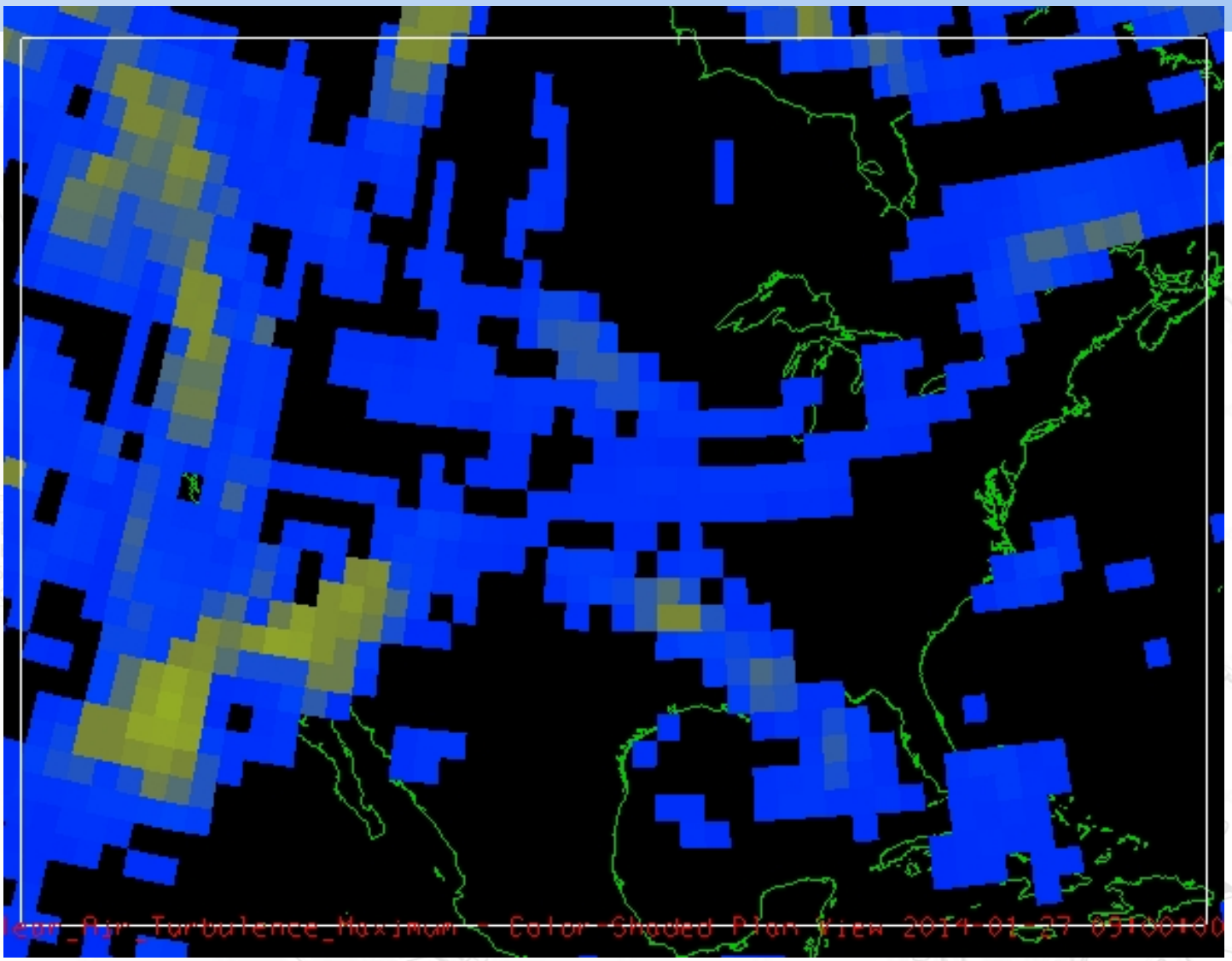
Current WAFS 1.25 Degree Cb Grid



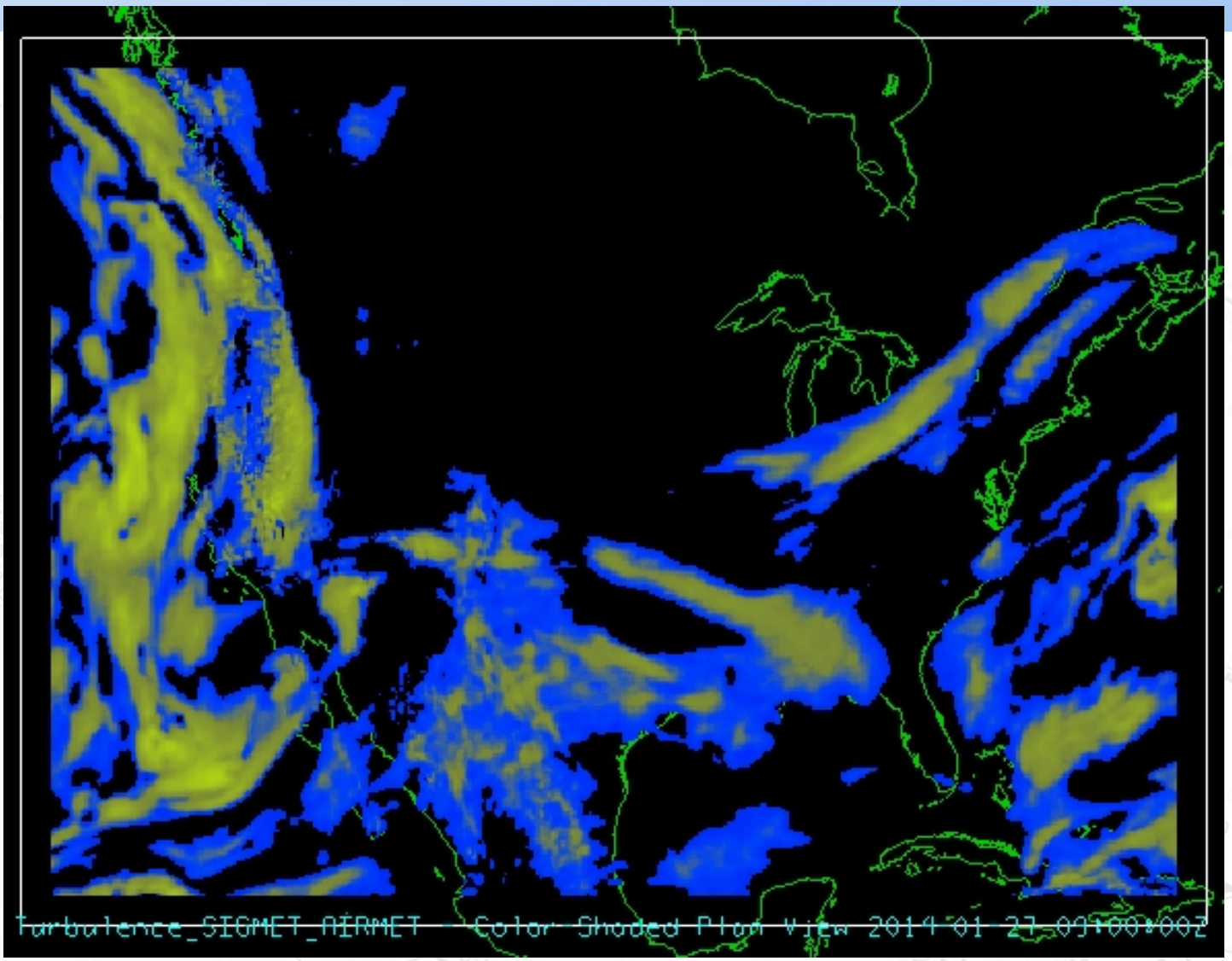
0.5 Degree Cb Grid



WAFS 1.25 Degree Max Turbulence



0.12 Degree Turbulence (from GTG)



Costs of Higher Resolution

- File Size Increases
  - 0.5 degree is 23 percent larger
  - 0.12 degree is xx percent larger
- Can be Mitigated by
  - Keeping the lower resolution data available.
  - Allowing selective downloading

Selective Downloading

You may select some or all levels and variables. The selections below represent common choices which may or may not be relevant to the files that you have selected. For example choosing RH (relative humidity) would be pointless in file of sea-surface temperatures. In addition, not all possibilities are allowed. For example, suppose you only want the virtual temperature at the tropopause at 01Z. In this case you'd have to transfer the entire file.

For GRIB-2 data only.

Select the levels desired:

all 1 mb 2 mb 3 mb 5 mb 7 mb 10 mb 20 mb 30 mb 50 mb 70 mb 100 mb 125 mb 150 mb 175 mb 200 mb 225 mb 250 mb 275 mb
300 mb 325 mb 350 mb 375 mb 400 mb 425 mb 450 mb 475 mb 500 mb 525 mb 550 mb 575 mb 600 mb 625 mb 650 mb 675 mb 700 mb 725 mb
750 mb 775 mb 800 mb 825 mb 850 mb 875 mb 900 mb 925 mb 950 mb 975 mb 1000 mb 0-0.1 m below ground 0.1-0.4 m below ground 0.4-1 m below ground
1-2 m below ground surface 2 m above ground 10 m above ground 80 m above ground 100 m above ground mean sea level 305 m above mean sea level 457 m above mean sea level
610 m above mean sea level 914 m above mean sea level 4572 m above mean sea level 1829 m above mean sea level 2743 m above mean sea level 3658 m above mean sea level 30-0 mb above ground
180-0 mb above ground 255-0 mb above ground 0C isotherm 60-30 mb above ground 90-60 mb above ground 120-90 mb above ground 150-120 mb above ground 180-150 mb above ground
3000-0 m above ground 6000-0 m above ground entire atmosphere (considered as a single layer) 0.33-1 sigma layer 0.44-1 sigma layer 0.72-0.94 sigma layer 0.44-0.72 sigma layer
0.995 sigma level PV=5e-07 (Km^2/kg/s) surface PV=-5e-07 (Km^2/kg/s) surface PV=2e-06 (Km^2/kg/s) surface PV=-2e-06 (Km^2/kg/s) surface PV=1e-06 (Km^2/kg/s) surface
PV=-1e-06 (Km^2/kg/s) surface PV=1.5e-06 (Km^2/kg/s) surface PV=-1.5e-06 (Km^2/kg/s) surface middle cloud layer high cloud layer low cloud bottom level
middle cloud bottom level high cloud bottom level low cloud top level low cloud top level middle cloud top level high cloud top level
convective cloud layer boundary layer cloud layer top of atmosphere highest tropospheric freezing level

Convective Precip

Select the variables desired:

all 4LFTX 5WAVA 5WAVH ABSV ACPCP ALBDO APCP CAPE CDUVB CFRZR CICEP CIN CLWMR CNWAT CPRAT CRAIN CSNOW
CWAT CWORK DLWRF DSWRF DUVB FLDCP GFLUX GPA GUST HGT HINDEX HLCY HPBL ICAHT ICEC ICETK LAND LFTX
LHTFL MSLET O3MR PEVPR PLPL POT PRATE PRES PRMSL PWAT RH SHTFL SNOD SOILL SOILW SPFH SUNSD TCDC TMAX
TMIN TMP TOZNE U-GWD UFLX UGRD ULWRF USTM USWRF V-GWD VFLX VGRD VRATE VSTM VVEL VWSH WATR WEASD
WILT

Extract Subregion

File transfer times can be reduced by only transferring a subregion. You can use this section to extract a geographic subsection from a most GRIB files. Use negative numbers for south and west.

make subregion left longitude 0 right longitude -180
top latitude 90 bottom latitude 0

Above Selections Return This URL to Use for Scripts =

http://nomads.ncep.noaa.gov/cgi-bin/filter_gfs_hd.pl?file=gfs.t00z.mastergrb2f09&lev_surface=on&var_ACPCP=on&subregion=&leftlon=0&rightlon=-180&toplat=90&bottomlat=0&dir=%2Fgfs.2014012700%2Fmaster

Future Thoughts

- What if the WAFS Global Ensemble included grids from all qualified providers?
- What if the WAFS Global Ensemble was available at multiple resolutions?
- Could the WAFS Global Ensemble become the world's digital weather data source?
  - Seamless
  - Because it is calibrated against observations, it would provide the best data available, regardless of the original source.