



METEOROLOGY PANEL



# World Area Forecast System (WAFS) gridded data upgrade

March 2024





## WAFS CHANGES COMING IN WITH AMENDMENT 82 TO ANNEX 3 ....

WAFS gridded data will get a large upgrade:

- Many more vertical levels
- More timesteps
- Wind, temperature, relative humidity, geopotential height at 0.25 degree resolution

All changes relate to Amendment 82 to ICAO Annex 3, due for implementation in November 2025.

*Note: these proposed changes were part of the ICAO Air Navigation Commission consultation State letter SL 2023.1 and were originally expected to form part of Amendment 81 in November 2024. The changes have now been delayed by 1 year, and the Amendment number changed.*



WAFC London and Washington have already introduced these new data sets!

The new data sets will only be available on the new SADIS API (and WAFC Washington operated twin system, the WIFS API)

- The 1.25 Hazard data sets (cumulonimbus, CAT and icing) were retired from SADIS on 24<sup>th</sup> January 2024. They stopped being an ICAO requirement in November 2020.

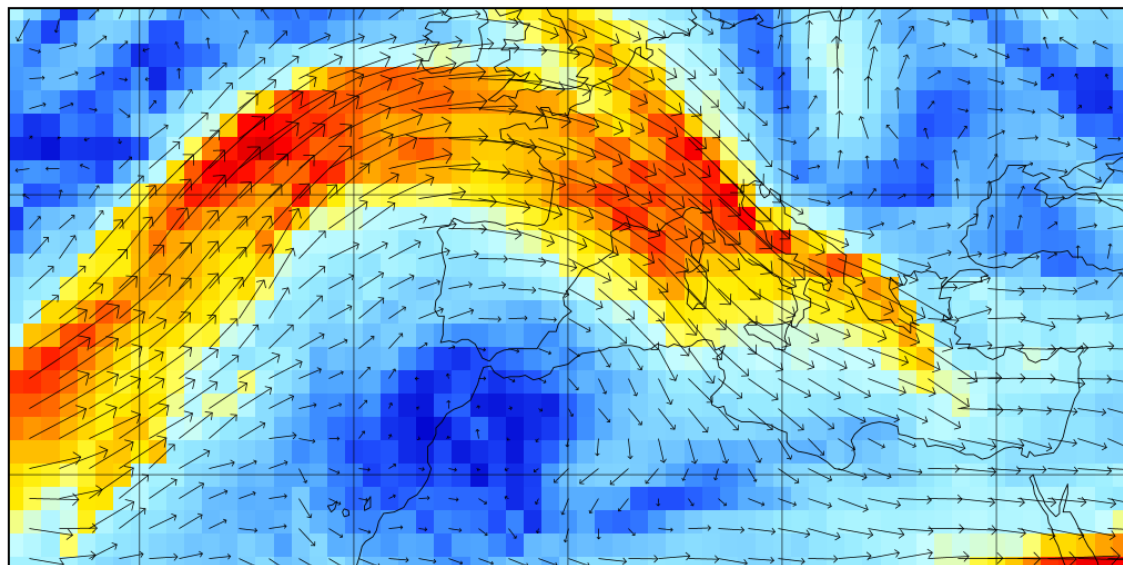




# WAFS GRIDDED DATA CHANGES – INCREASED HORIZONTAL RESOLUTION

*1.25 degree resolution*

wind vector @ FL300 (300hPa)



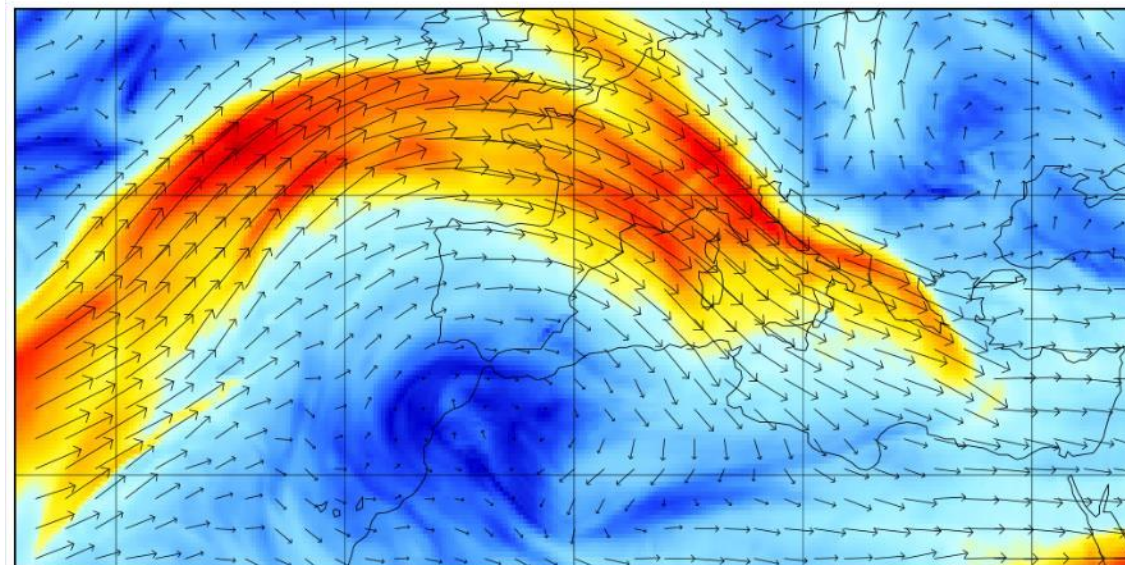
$\text{Sqrt}[(\text{u-component of wind @ Isobaric surface})^2 + (\text{v-component of wind @ Isobaric surface})^2]$



Data Min = 1.3, Max = 109.0

*0.25 degree resolution*

wind vector @ FL300 (300.9hPa)



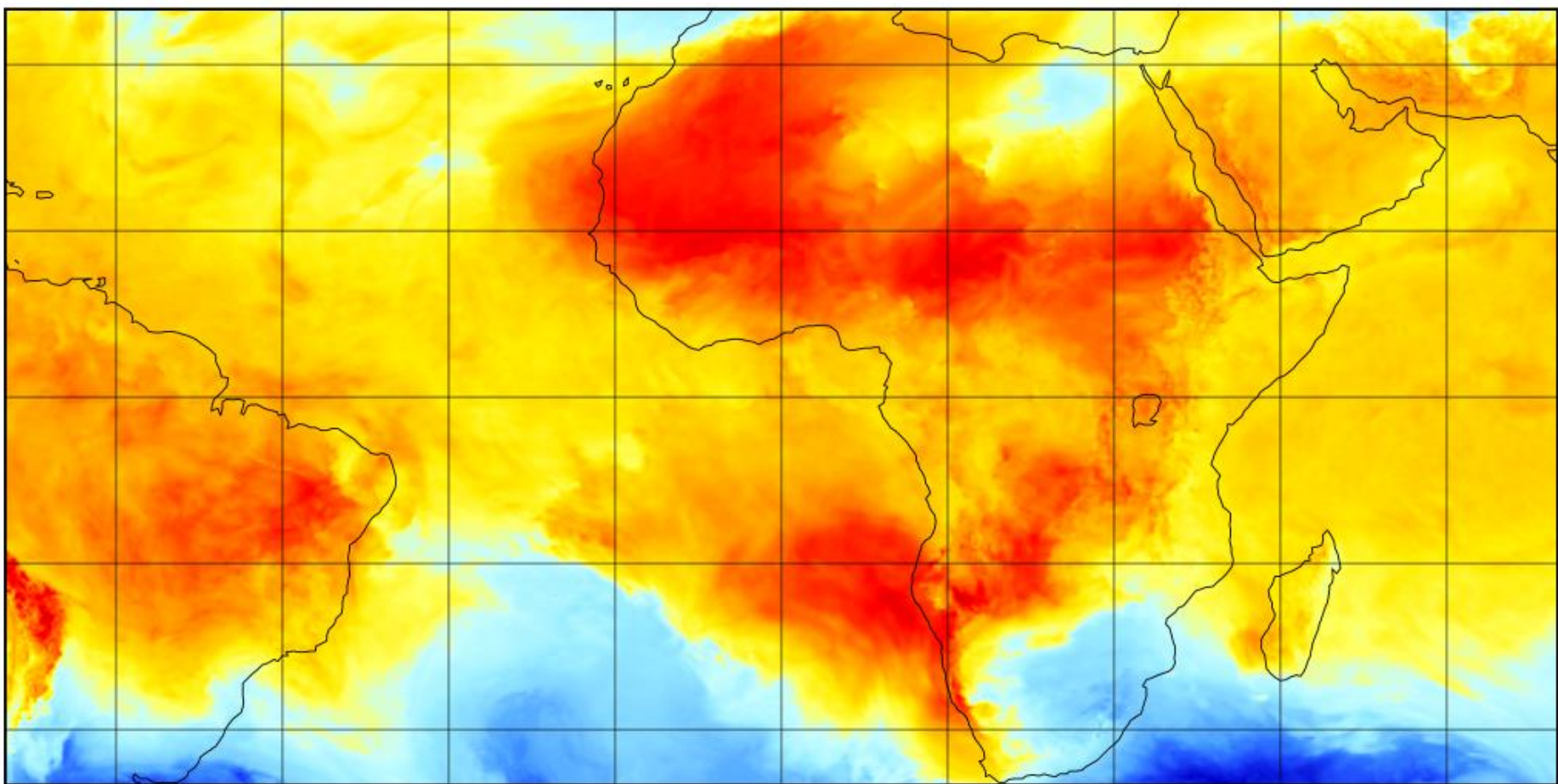
$\text{Sqrt}[(\text{u-component of wind @ Isobaric surface})^2 + (\text{v-component of wind @ Isobaric surface})^2]$



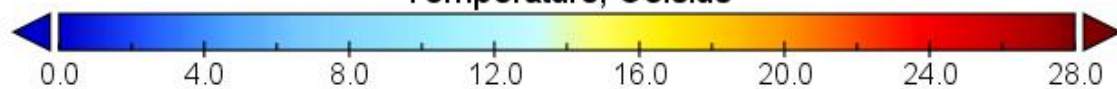
Data Min = 0.0, Max = 113.2



Temperature @FL050



Temperature, Celsius





# WAFS GRIDDED DATA – INCREASED LEVELS

Flight Level	ICAO Standard Atmosphere pressure level (hPa)	Geopotential Altitude	Wind	Temperature	Turbulence Severity	Icing Severity	Humidity
FL050	843.1	X	X	X		X	X
FL060	812.0	X	X	X		X	X
FL070	781.9	X	X	X		X	X
FL080	752.6	X	X	X		X	X
FL090	724.3	X	X	X		X	X
FL100	696.8	X	X	X	X	X	X
FL110	670.2	X	X	X	X	X	X
FL120	644.4	X	X	X	X	X	X
FL130	619.4	X	X	X	X	X	X
FL140	595.2	X	X	X	X	X	X
FL150	571.8	X	X	X	X	X	X
FL160	549.2	X	X	X	X	X	X
FL170	527.2	X	X	X	X	X	X
FL180	506.0	X	X	X	X	X	X
FL190	485.5	X	X	X	X	X	
FL200	465.6	X	X	X	X	X	
FL210	446.5	X	X	X	X	X	
FL220	427.9	X	X	X	X	X	
FL230	410.0	X	X	X	X	X	
FL240	392.7	X	X	X	X	X	
FL250	376.0	X	X	X	X	X	
FL260	359.9	X	X	X	X	X	
FL270	344.3	X	X	X	X	X	
FL280	329.3	X	X	X	X	X	
FL290	314.9	X	X	X	X	X	
FL300	300.9	X	X	X	X	X	
FL310	287.4	X	X	X	X		
FL320	274.5	X	X	X	X		
FL330	262.0	X	X	X	X		
FL340	250.0	X	X	X	X		
FL350	238.4	X	X	X	X		
FL360	227.3	X	X	X	X		
FL370	216.6	X	X	X	X		
FL380	206.5	X	X	X	X		

FL390	39000	X	196.8	X	X	X		
FL400	40000	X	187.5	X	X	X		
FL410	41000	X	178.7	X	X	X		
FL420	42000	X	170.4	X	X	X		
FL430	43000	X	162.4	X	X	X		
FL440	44000	X	154.7	X	X	X		
FL450	45000	X	147.5	X	X	X		
FL460	46000	X	140.6	X	X			
FL470	47000	X	134.0	X	X			
FL480	48000	X	127.7	X	X			
FL490	49000	X	121.7	X	X			
FL500	50000	X	116.0	X	X			
FL510	51000	X	110.5	X	X			
FL520	52000	X	105.3	X	X			
FL530	53000	X	100.4	X	X			
FL540	54000	X	95.7	X	X			
FL550	55000	X	91.2	X	X			
FL560	56000	X	87.0	X	X			
FL570	57000	X	82.8	X	X			
FL580	58000	X	79.0	X	X			
FL590	59000	X	75.2	X	X			
FL600	60000	X	71.7	X	X			

Data shown in blue is what is currently available.

Note: Data will be produced for exact pressure levels e.g. 392.7hPa for FL240 instead of the current 400hPa



## WAFS GRIDDED DATA – INCREASED TIMESTEPS

<i>Upper-air grid point forecasts</i>	<i>1-hourly intervals</i>	<i>3-hourly intervals</i>	<i>6-hourly intervals</i>
Wind (56), temperature (56), geopotential altitude (56)	6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23 and 24 hours*	27, 30, 33, 36, 39, 42, 45 and 48 hours*	54, 60, 66, 72, 78, 84, 90, 96, 102, 108, 114 and 120 hours*  Note data from 72hours onward will only be produced for two of the four daily model runs.
Flight level and temperature of tropopause			
Direction, speed and flight level of maximum wind			
Humidity (14)			
Cumulonimbus extent, base and top	6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23 and 24 hours*	27, 30, 33, 36, 39, 42, 45 and 48 hours*	Not provided
Icing (26)			
Turbulence (36)			

*\*after the time (0000, 0600, 1200 and 1800 UTC) of the synoptic data on which the forecasts were based.*

*The number in blue shows the number of vertical levels that will be available.*



## WAFS GRIDDED DATA

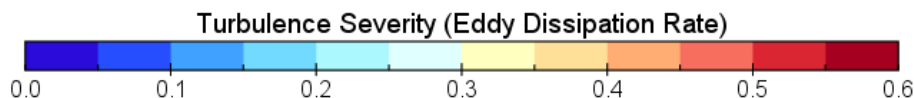
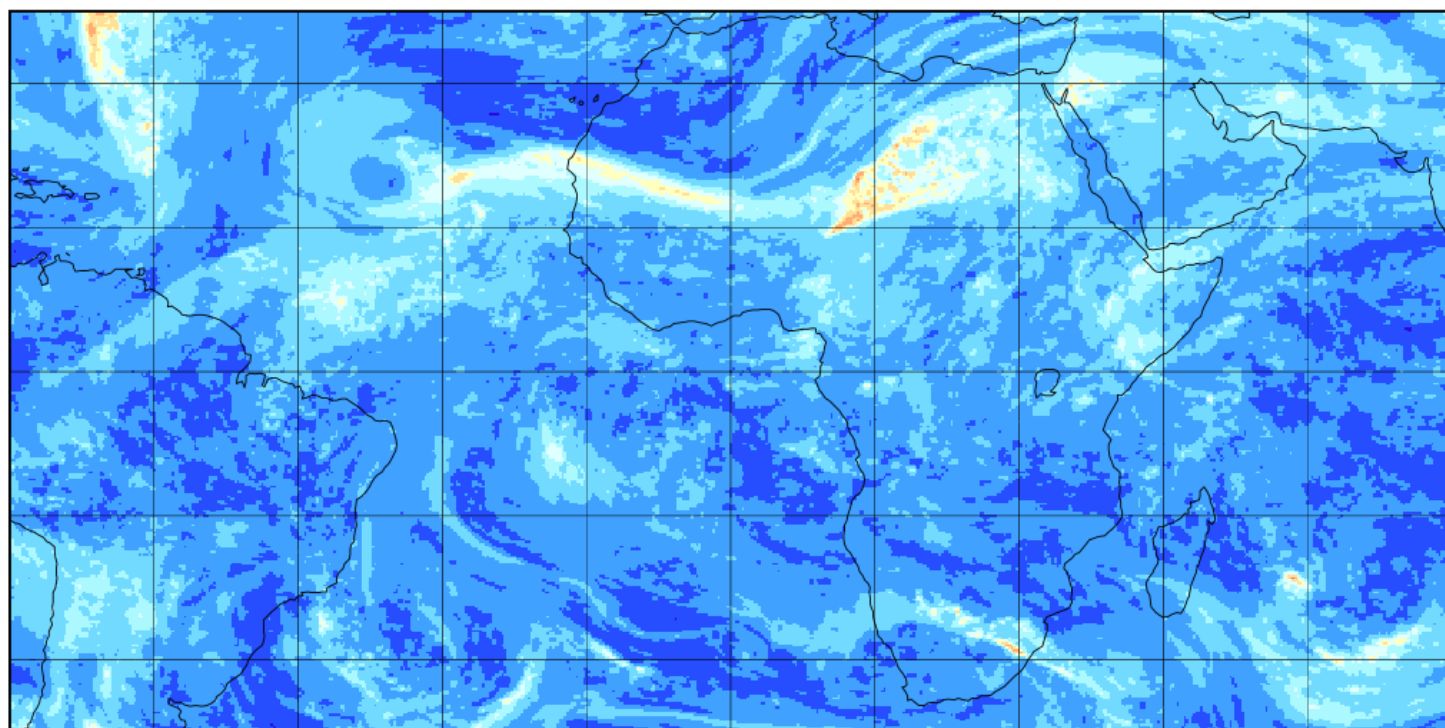
- The new data will all be provided at 0.25 degree resolution.
- The 1.25 degree wind, temperature, relative humidity, and tropopause and geopotential height data will continue to be provided for the levels and timesteps produced now (T+6 to T+36 at 3 hourly intervals)
- The way the data is distributed is also being updated.





## WAFS HAZARD DATA SETS – TURBULENCE SEVERITY

Eddy dissipation parameter FL300 (300.9hPa)

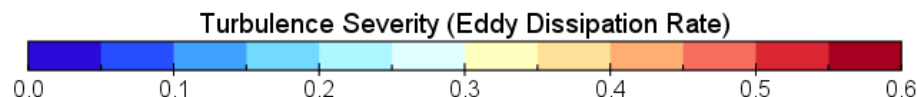
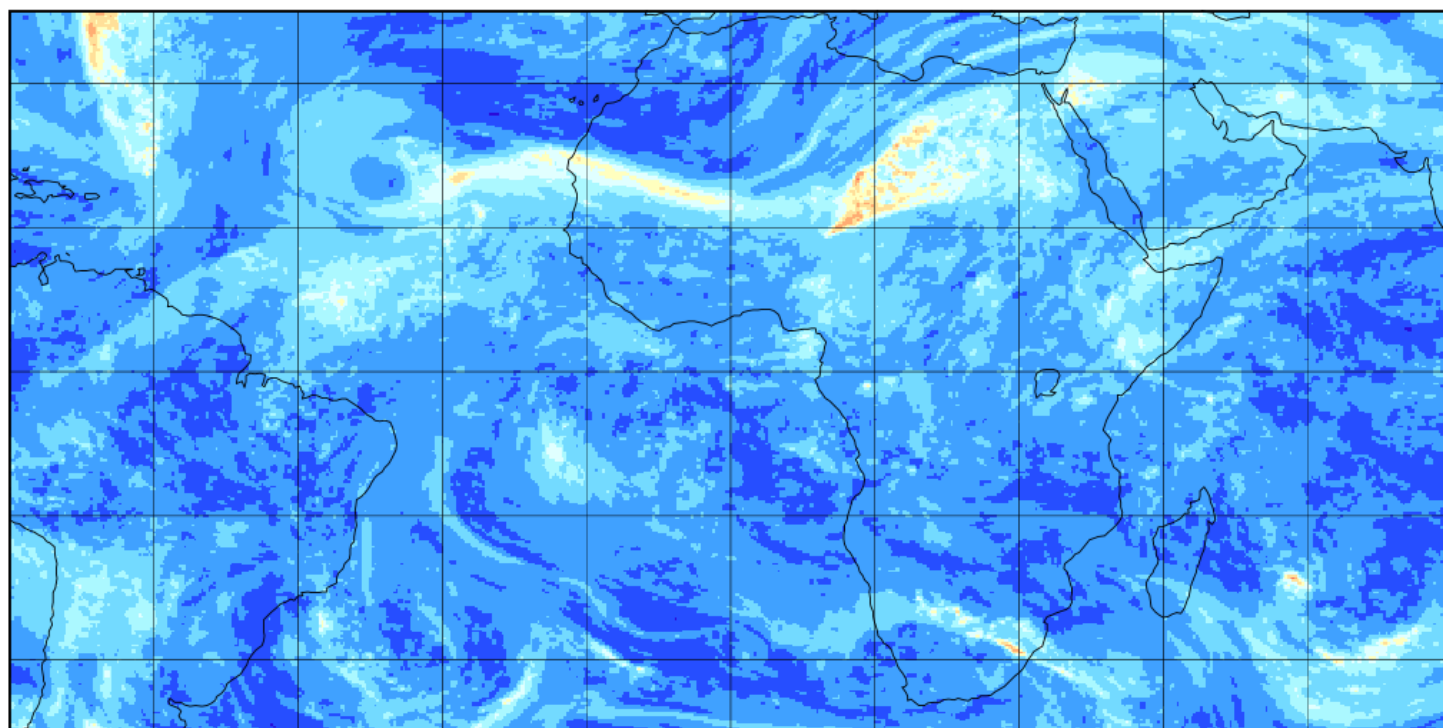


- Turbulence Severity provides a forecast in terms of an “Eddy Dissipation Rate”.
- Eddy Dissipation Rate is an objective, aircraft-independent, universal measure of turbulence based on the rate at which energy dissipates in the atmosphere. EDR is the official ICAO and WMO atmospheric turbulence intensity metric and will have values that range between 0 and 1.
- When the atmosphere is dissipating energy quickly (i.e the EDR is large), atmospheric turbulence levels are high.”
- The effect of a particular EDR value on an aircraft will depend on the size (weight) of the aircraft.



## WAFS HAZARD DATA SETS – TURBULENCE SEVERITY

Eddy dissipation parameter FL300 (300.9hPa)



ICAO Annex 3 - Meteorological Service for International Air Navigation, Appendix 4 has the following information:

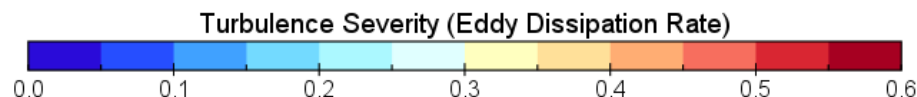
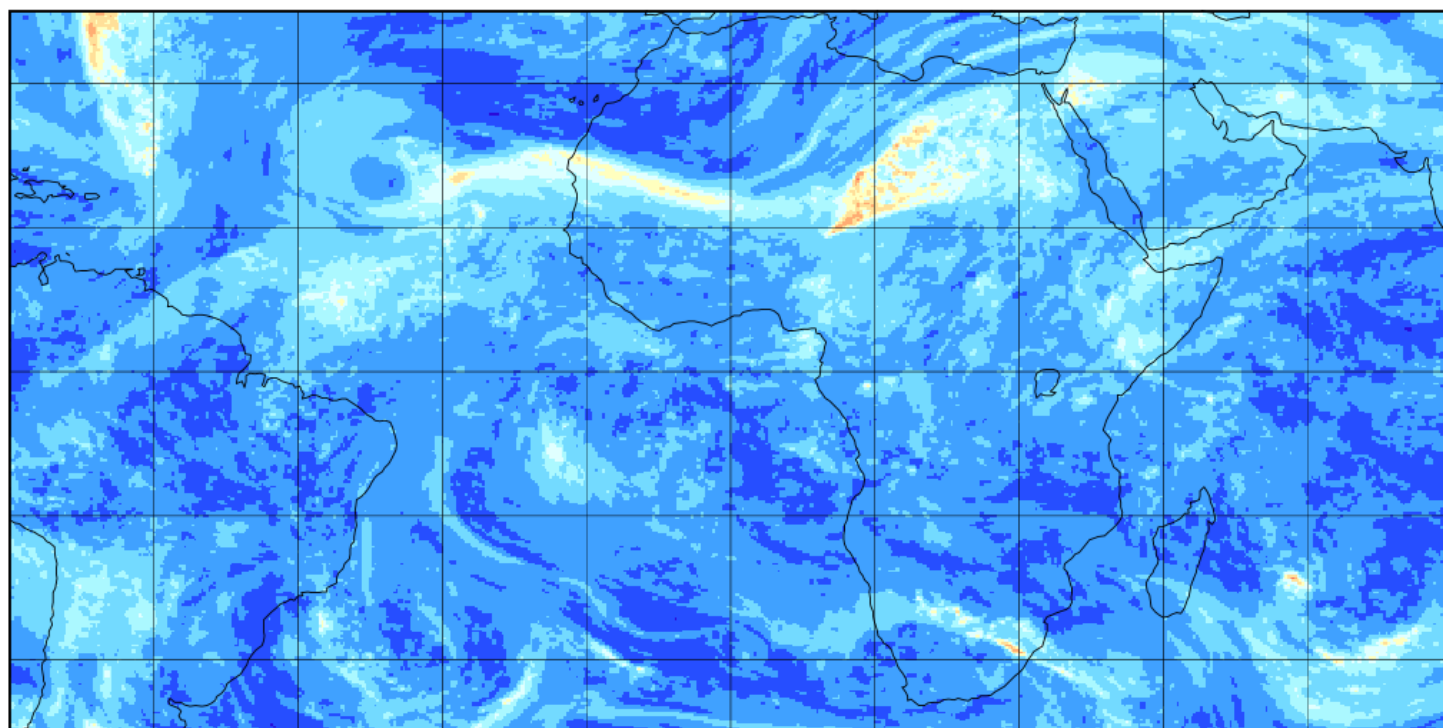
Turbulence shall be considered (*for a medium sized transport aircraft under typical en-route conditions (i.e. altitude, airspeed and weight)*):

- a) Severe when the peak value of EDR equals or exceeds 0.45;
- b) moderate when the peak value is equal to or above 0.20 and below 0.45;
- c) Light when the peak value is above 0.10 and below 0.20; and
- d) nil when the peak value is below or equal to 0.10.



## WAFS HAZARD DATA SETS – TURBULENCE SEVERITY

Eddy dissipation parameter FL300 (300.9hPa)



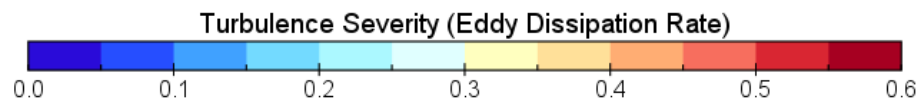
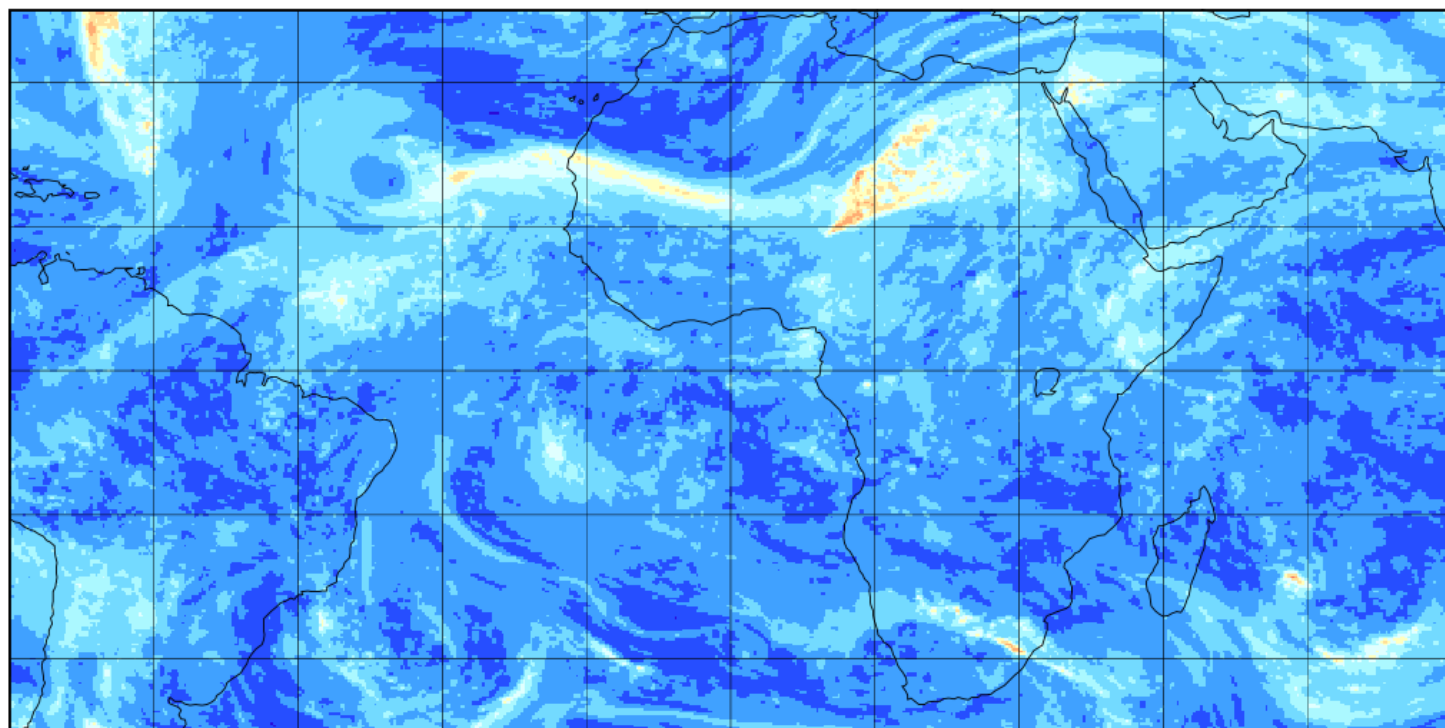
Thresholds haven't been determined for other aircraft sizes. For a "heavy" sized aircraft (e.g. B777/787 or A330/A350) to experience severe turbulence it is likely that an EDR value higher than 0.45 would be required.

[https://en.wikipedia.org/wiki/List\\_of\\_ailiners\\_by\\_maximum\\_takeoff\\_weight](https://en.wikipedia.org/wiki/List_of_ailiners_by_maximum_takeoff_weight)



## WAFS HAZARD DATA SETS – TURBULENCE SEVERITY

Eddy dissipation parameter FL300 (300.9hPa)



You could choose to only display turbulence that is at moderate or severe intensities.

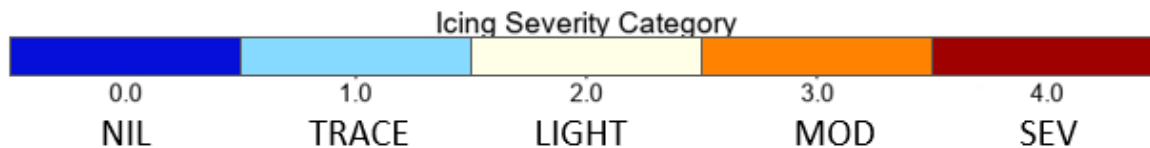
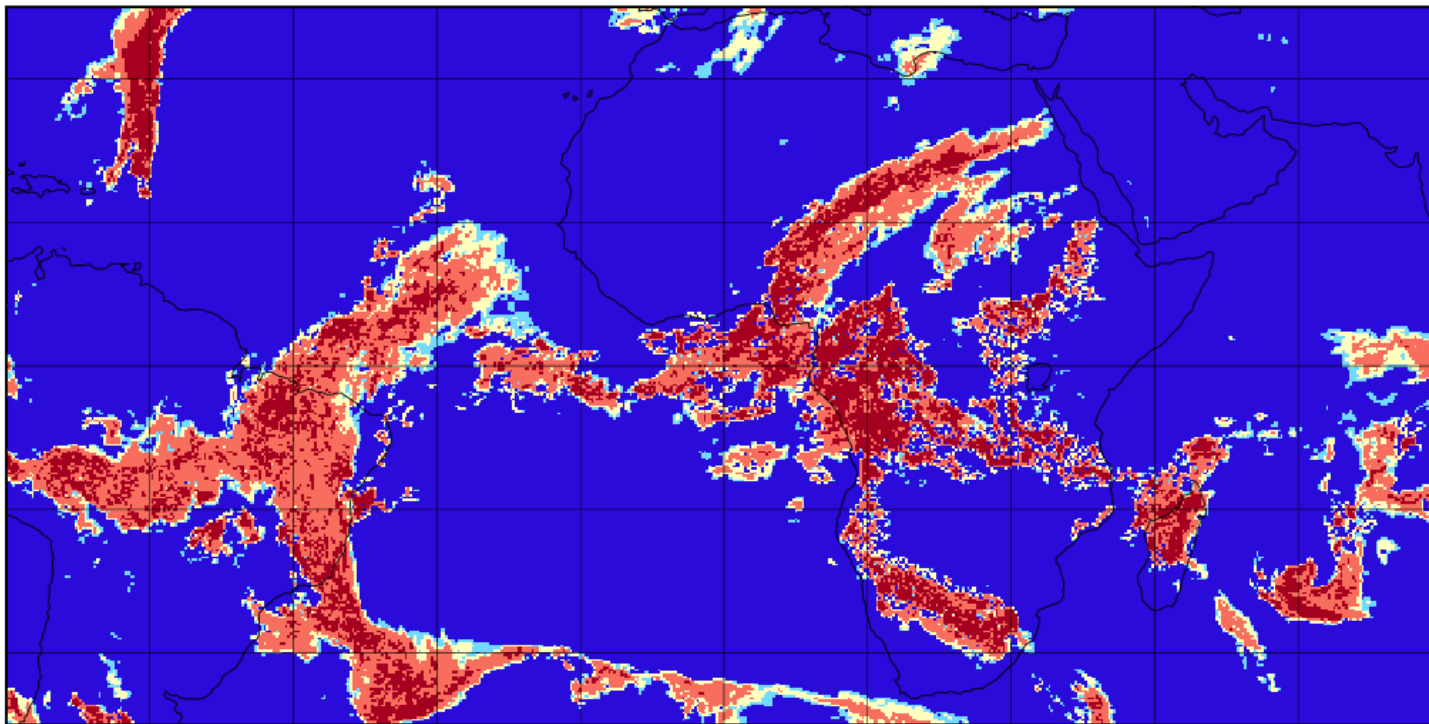
The Turbulence severity field forecasts both Clear Air Turbulence (CAT) and orographic turbulence.





## WAFS HAZARD DATA SETS – ICING SEVERITY

Icing Severity FL180 (506.0hPa)



The Icing severity field gives a categorical assessment of icing severity.

The categories relate to an icing intensity

0 = NIL

1 = TRACE

2 = LIGHT

3 = MODERATE

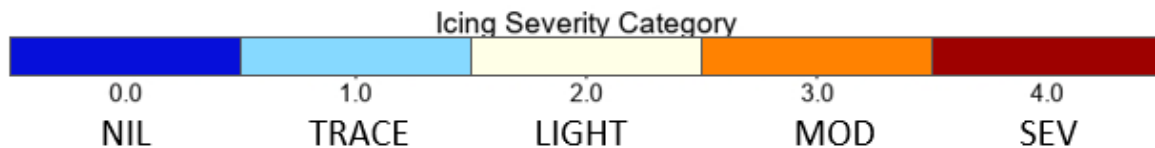
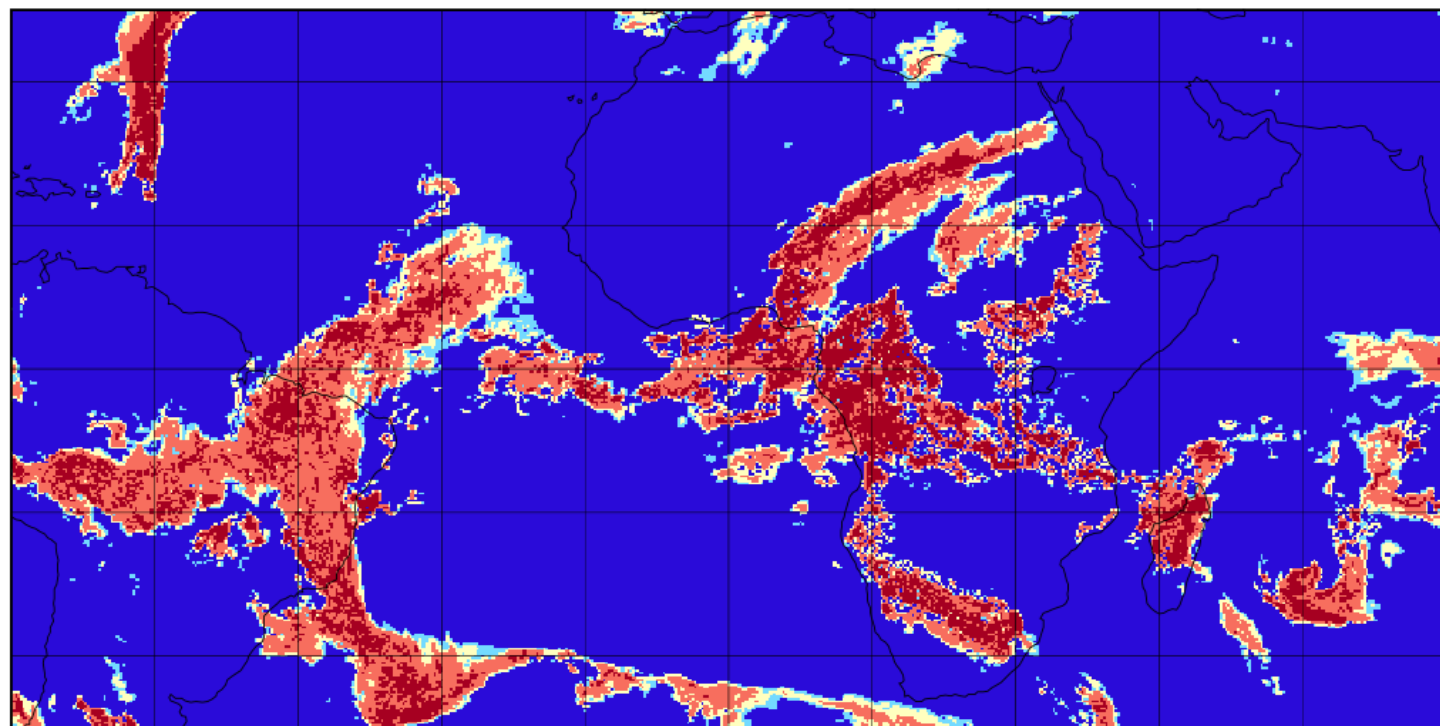
4 = SEVERE

It has been calibrated through verification using various aircraft observations (including PIREPS) to create a statistically weighted combination of meteorological variables.



## WAFS HAZARD DATA SETS – ICING SEVERITY

Icing Severity FL180 (506.0hPa)

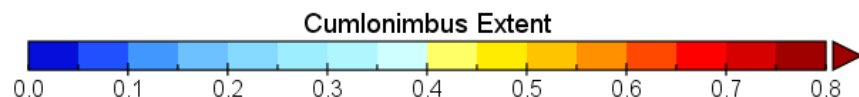
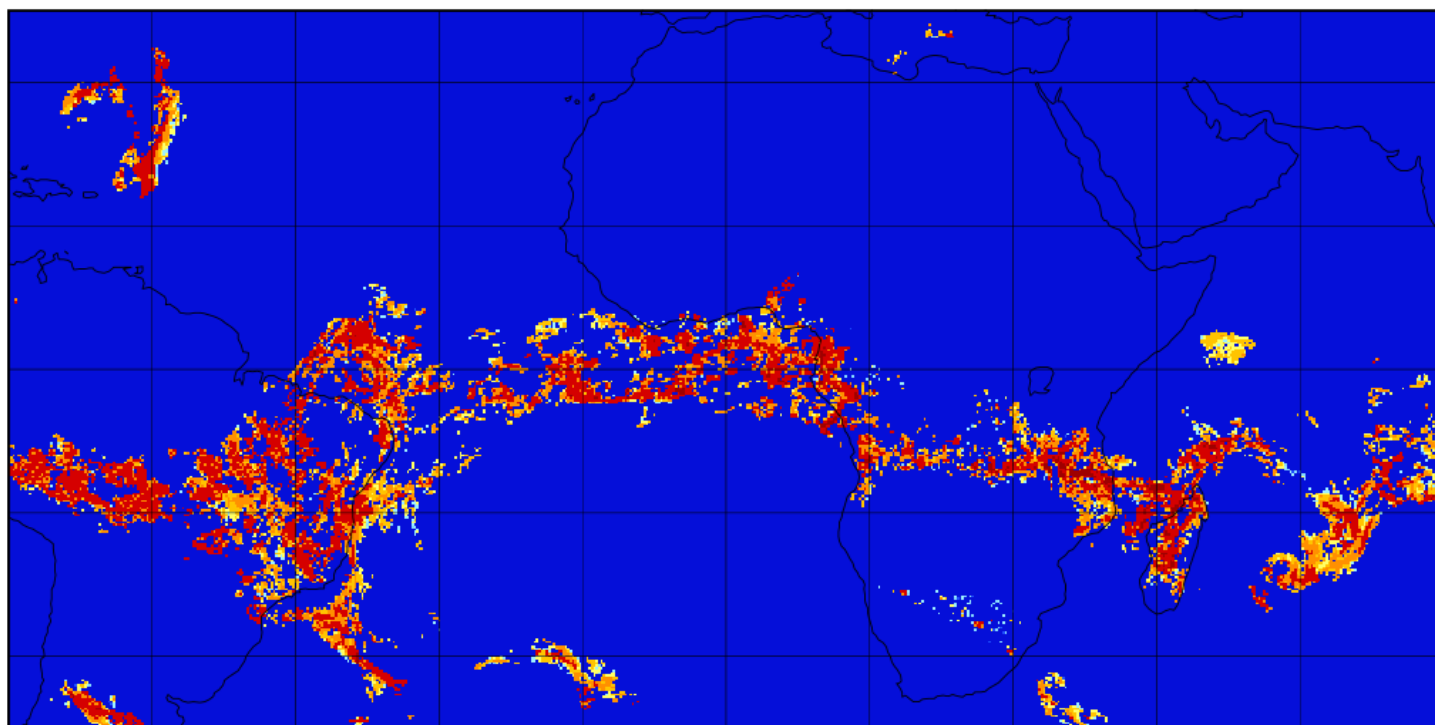


Icing occurring in frontal systems and icing from convection are both forecast.



## WAFS HAZARD DATA SETS – CUMULONIMBUS

Horizontal extent of cumulonimbus (CB)



For cumulonimbus extent the higher values indicate where clouds are likely to be more concentrated.

Please don't use the value shown literally

0.8 doesn't mean 80% of the area is covered or 80% probability of there being a CB

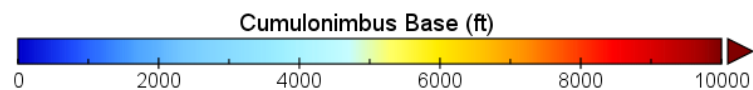
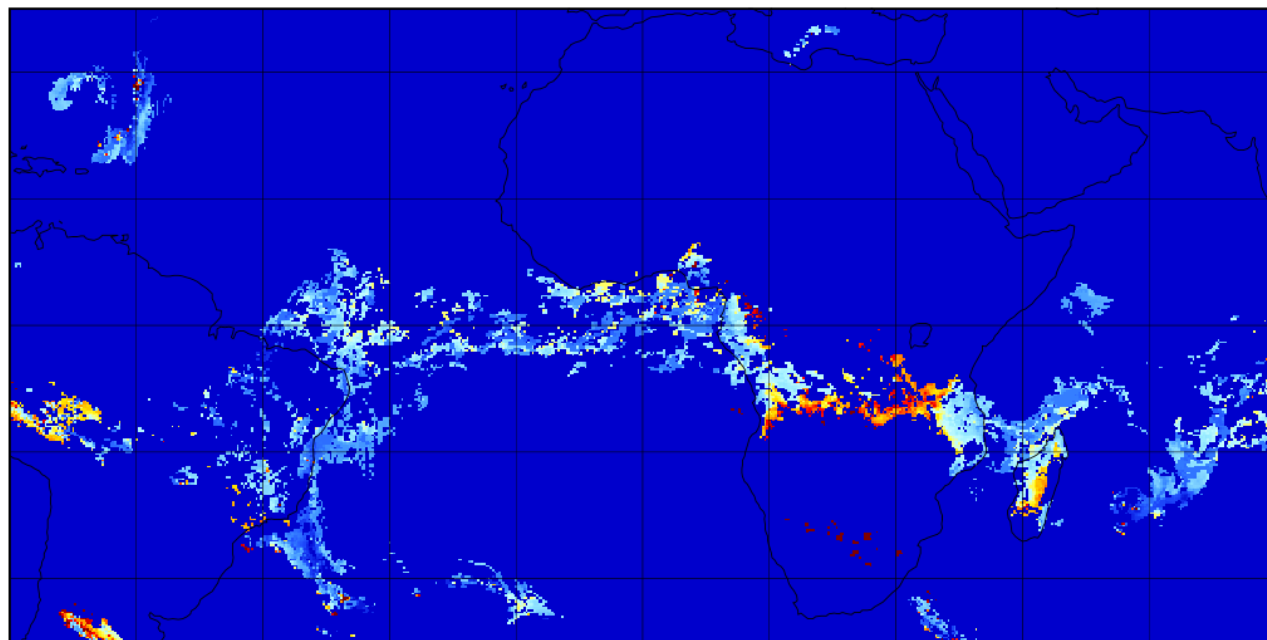


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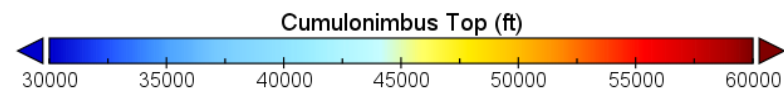
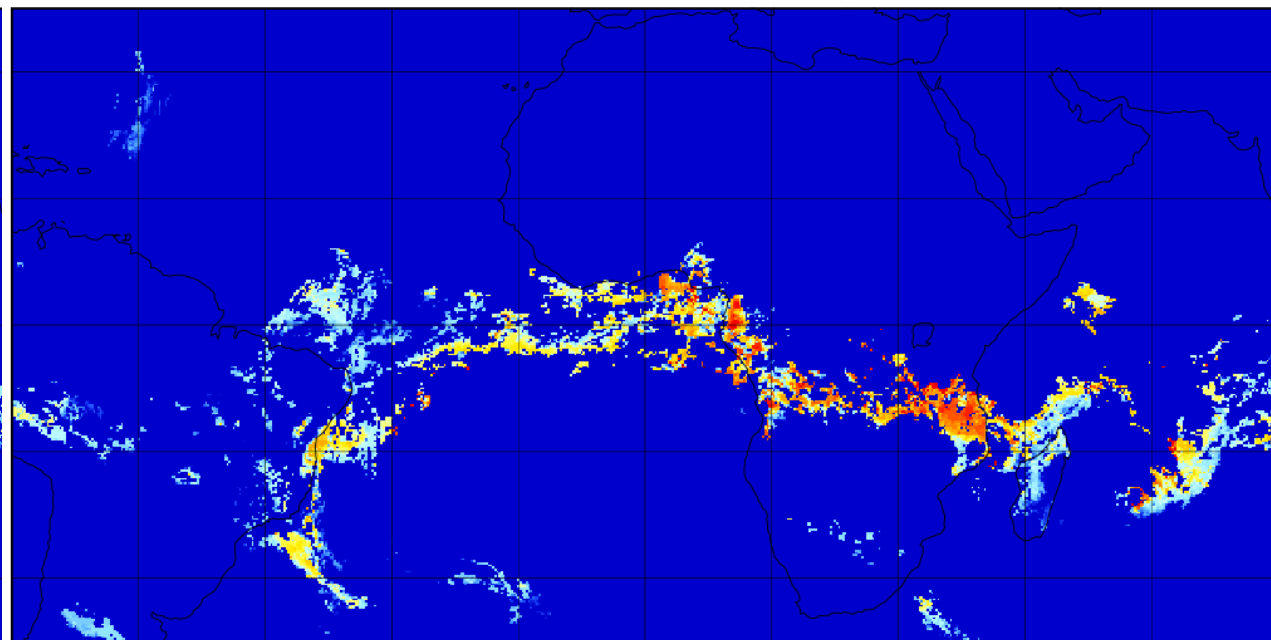


## WAFS HAZARD DATA SETS – CUMULONIMBUS

Cumulonimbus (CB) base



Cumulonimbus (CB) top







## TIMELINES – WAFS GRIDDED DATA

### March 2023

- WAFS gridded data upgrade
- SADIS and WIFS API's available to access new gridded data sets

### November 2027

- Introduction of probabilistic WAFS forecasts (hazards), made available through the SADIS and WIFS API's



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## PROBABILISTIC WAFS DATA SETS

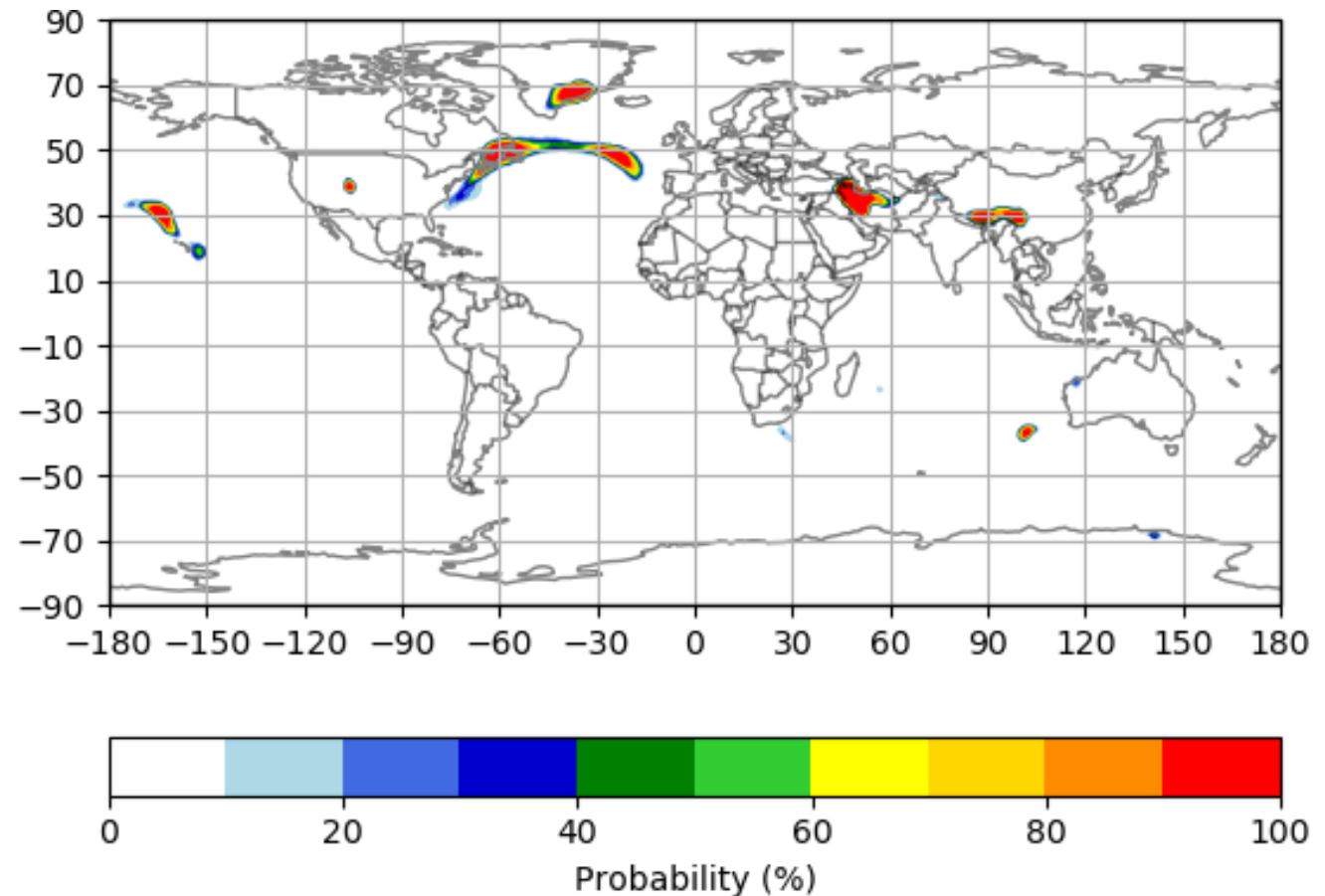
The WAFCs plan to introduce probabilistic hazard gridded data sets in November 2027, before making them operational in November 2028



## PROBABILISTIC TURBULENCE

....the probability that the Turbulence Severity (which is an Eddy Dissipation Rate) will exceed certain thresholds at a particular flight level

Probability of the turbulence EDR exceeding 0.20

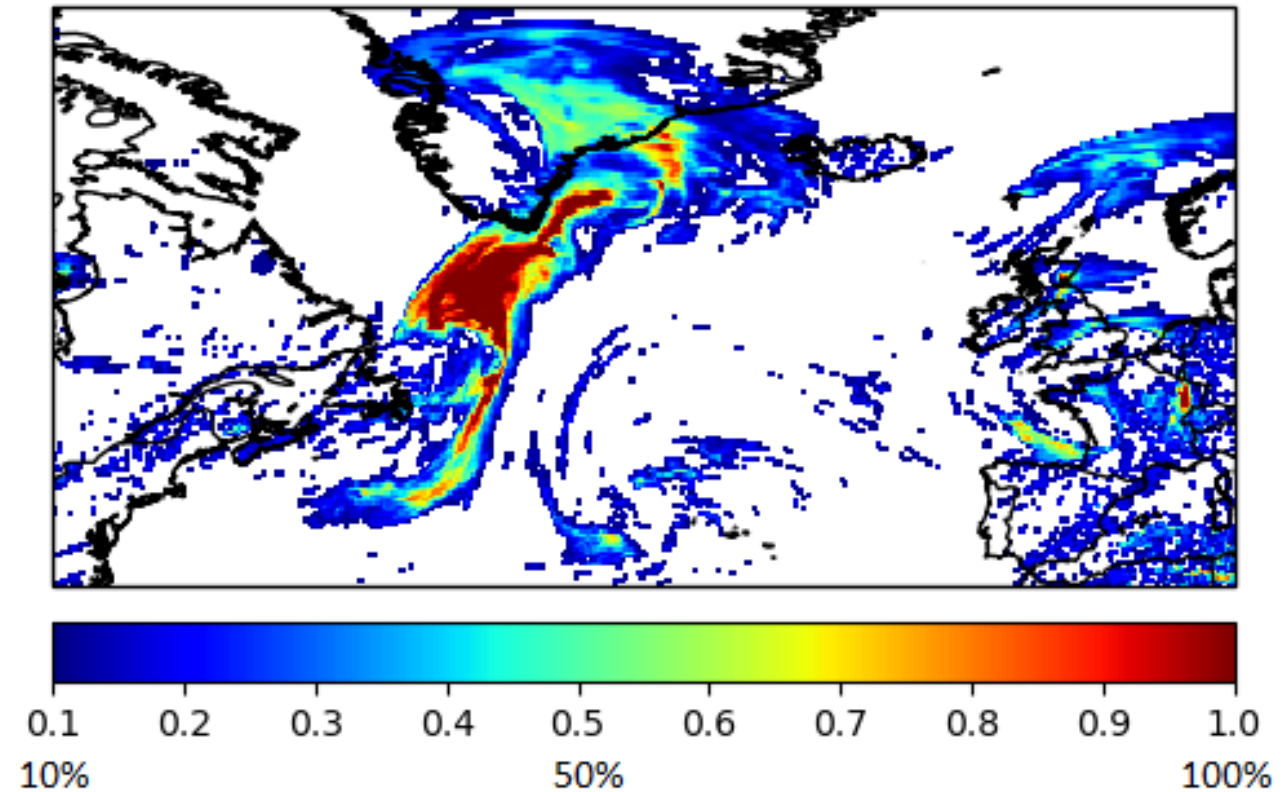




## PROBABILISTIC ICING

....the probability that the Icing Severity will be MOD or greater in intensity at a particular flight level

Probability of moderate or greater icing severity







## PROBABILISTIC CUMULONIMBUS

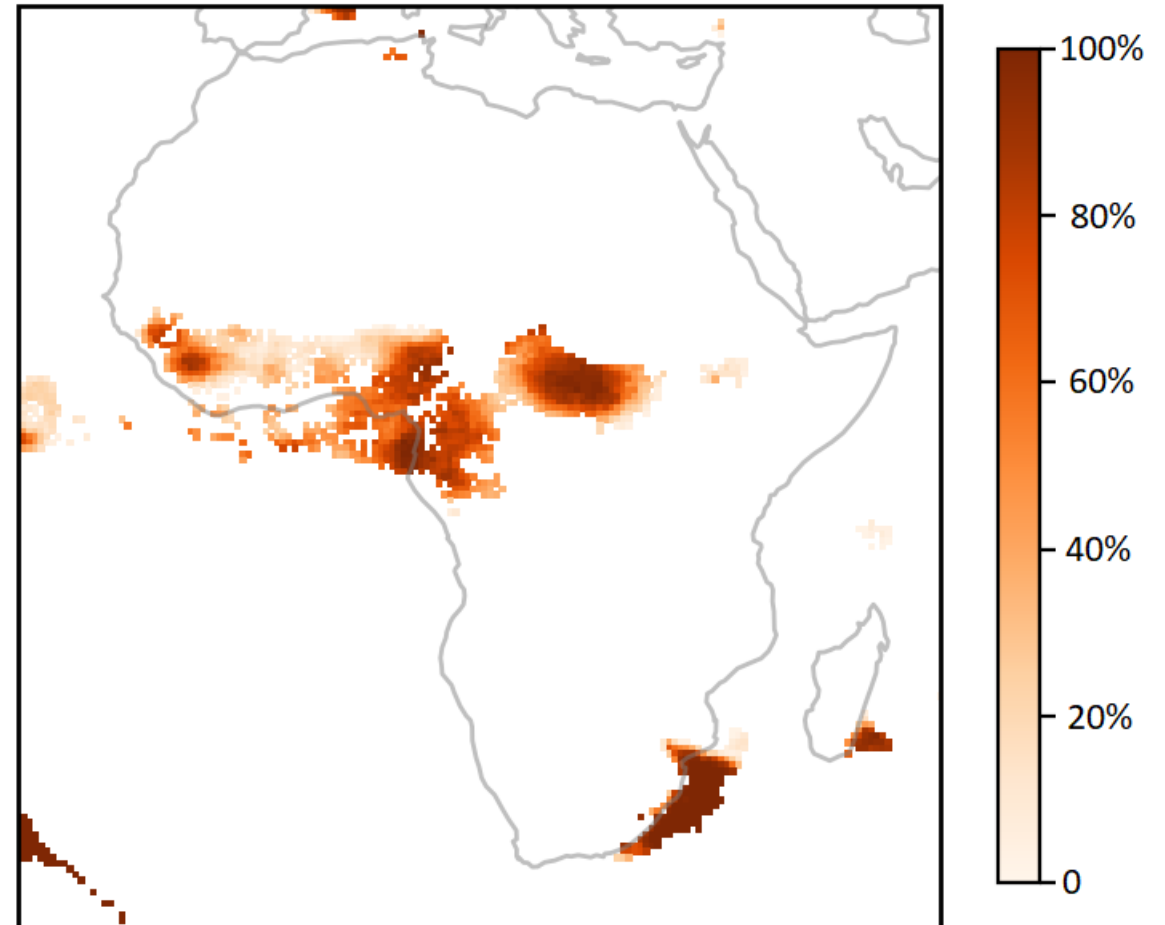
...the probability that the height of the cumulonimbus tops will exceed a certain height level

Expected levels :

FL300, FL350 and FL400

We may also provide the probability of any cumulonimbus clouds

Probability of CB exceeding 35,000ft





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Thank you for listening.