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METEOROLOGISKA INSTITUTET
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Aviation products from EU ERA4CS DustClim project

InDust event User Workshop on Dust products for Aviation

Budapest, Hungary, 17-18 Mar 2020

1.4.2020

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EU ERA4CS DustClim

DUST storms assessment for the development of user-oriented CLIMate services in Northern Africa, Middle East and Europe (2017–2020) provides high-resolution baseline and trend information on sand and dust storms over Europe, Northern Africa, and the Middle East, and develops dust-related climate services tailored to aviation, solar energy, air quality.

The project is a collaboration between BSC (Spain, coordinator), FMI (Finland), AEMET (Spain), CNR-DTA (Italy), and CNRS-LISA (France). Funding: European Commission through the JPI Climate ERA4CS initiative.

Objective

Understand the impacts of operating in risky environments

Environmental threats to operations, reported by scientific, regulatory and technical literature as well as by operational requirements, based on end-user input, in the aviation sector.

Sand and dust storms (SDS) entail short- and long-term operational threats for aviation. The risks include substantial disruptions of activities and operations, safety, and economic losses.

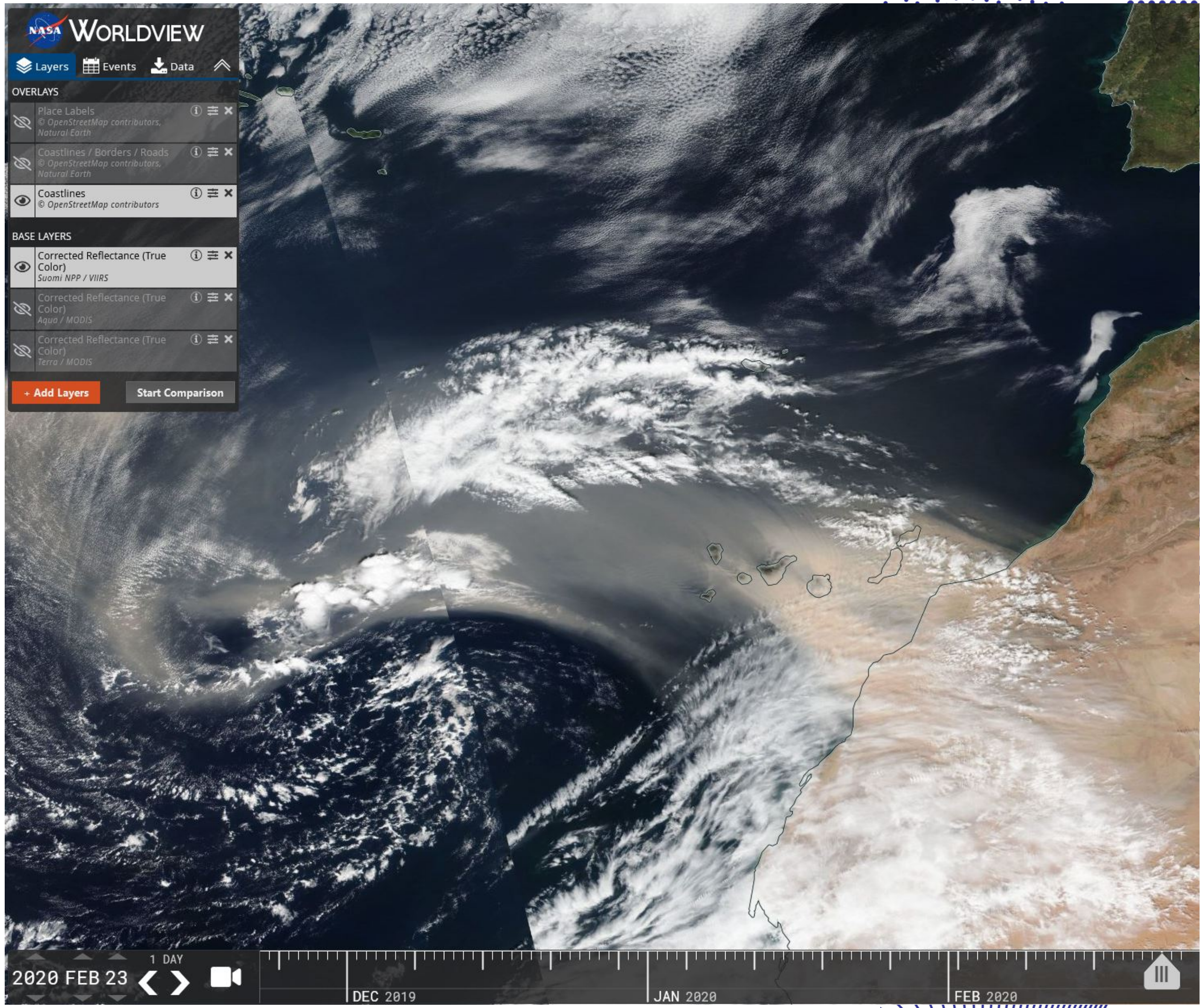
Our approach is to develop purpose-specific products that help the aviation industry in understanding and reducing SDS-related risks. We further plans to develop them into dynamic map service hosted by the WMO SDS-WAS.

Example: Spain 2/2020

Visibility: SDS caused cancellations and various other diruptions in February 2020. Two airports in Tenerife and one in Canary Islands were closed.

Aircraft & Engine exposure: Geographically extensive phenomenon, with also long-term implications for maintainance (cost, scheduling) and safety.

Capture form YLE newsvideo 23.2.2020



1. Exposure

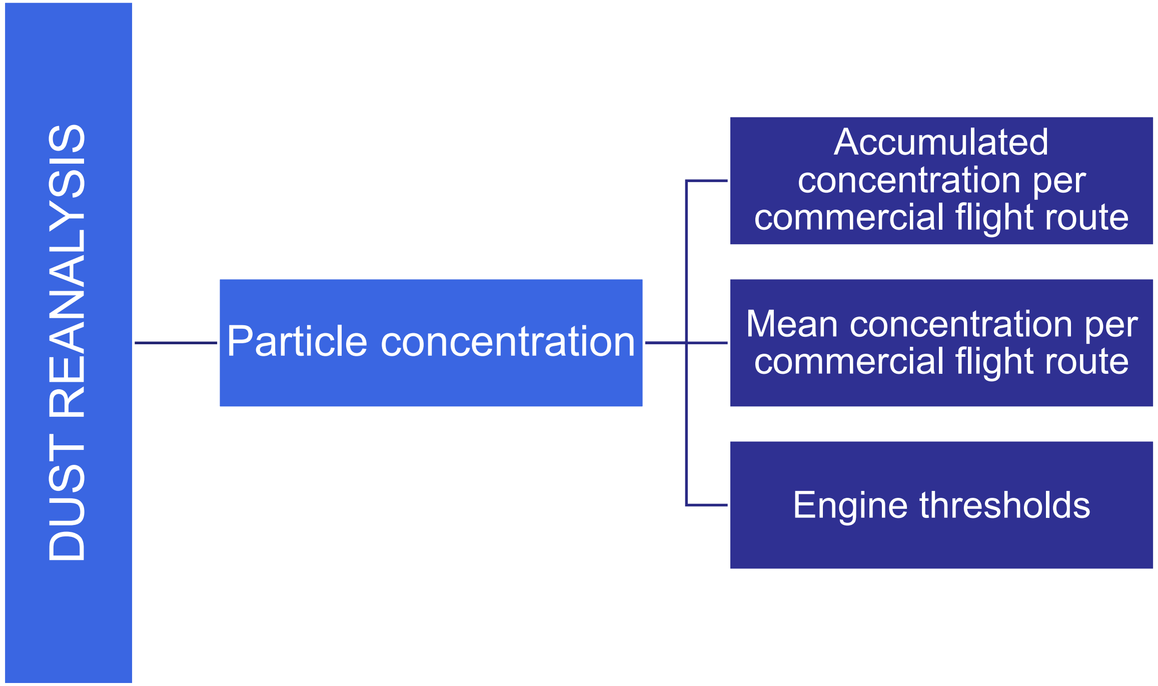
Particle exposure products

We address exposure effects during flight routes through products that indicate

(a) Accumulation of exposure per flight route for approx. 66 000 routes

(b) Mean (average) exposure per flight route for approx. 66 000 routes

(c) Translation of (a) and (b) into engine-specific thresholds



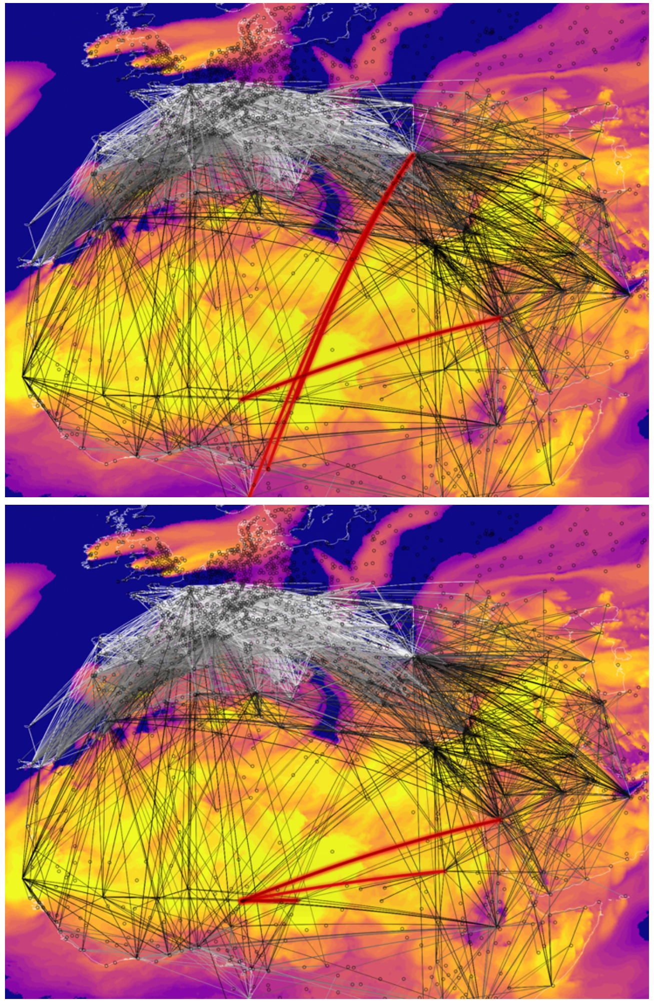
14 WAFC Flight Levels

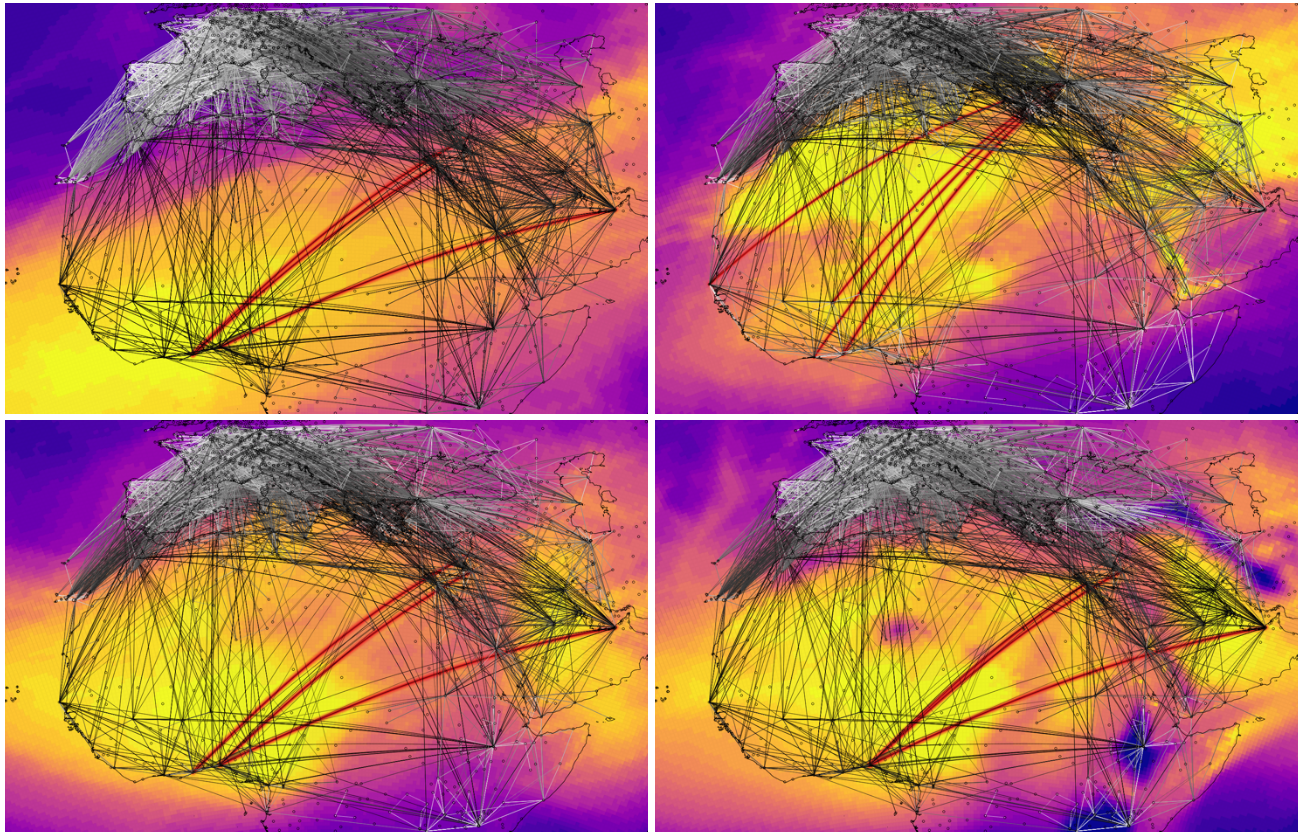
hPa	Flight Level	Critical flight stages
1000	FL000 (ground)	take off, landing, taxying
975	FL010	min. alt. for light aircraft
850	FL050	initial climb/min WAFS/WAFC
750	FL080	
700	FL100	decent
600	FL140	climb
500	FL180	
400	FL240	climb/initial decent
350	FL270	
300	FL300	
250	FL340	
175	FL410	cruise
150	FL450	
100	FL530	max WAFS/WAFC

ICAO (International Civil Aviation Organization) (2018), Gridded Data Precise Pressure Levels, METPWGMOG/7/IP/15

Exposure during flight routes

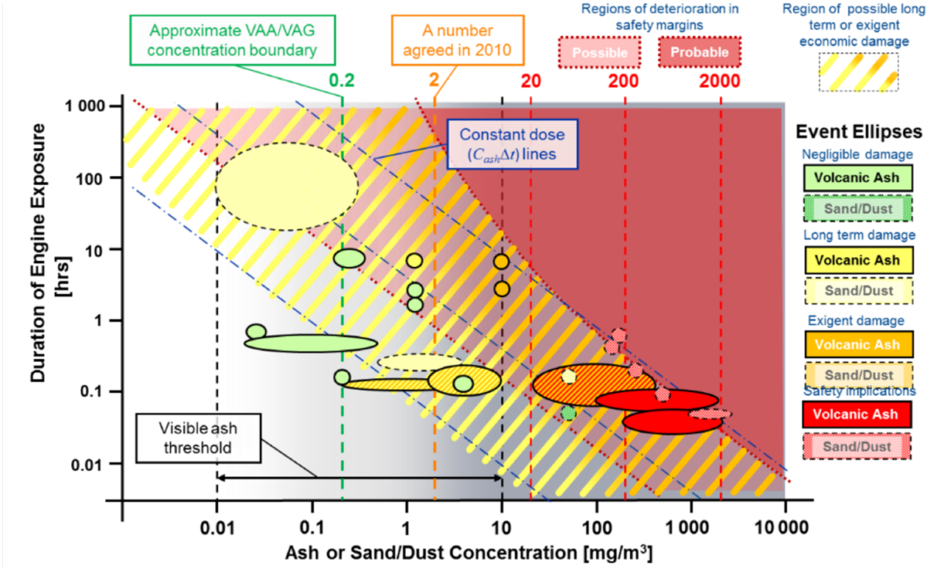
Example of accumulated particle exposure (top) and average per-grid-cell particle exposure (bottom).





Examples of accumulated maximum particle exposure per flight route; from top left clockwise: WAFC pressure level 1, 4, 7, 10. The routes with the four highest maximum concentrations are highlighted in red.

Exposure: Engine thresholds



Clarkson R, Simpson H (2017), Maximising Airspace Use During Volcanic Eruptions: Matching Engine Durability against Ash Cloud Occurrence, NATO STO AVT-272 Specialists Meeting on "Impact of Volcanic Ash Clouds on Military Operations" Volume: 1.

If statistics or assumptions are available about the average duration and/or speed of each flight route, the thresholds provided by **Clarkson & Simpson (2017)** can be applied to the particle exposure products so that a more precise risk categorization of flight routes can be produced.

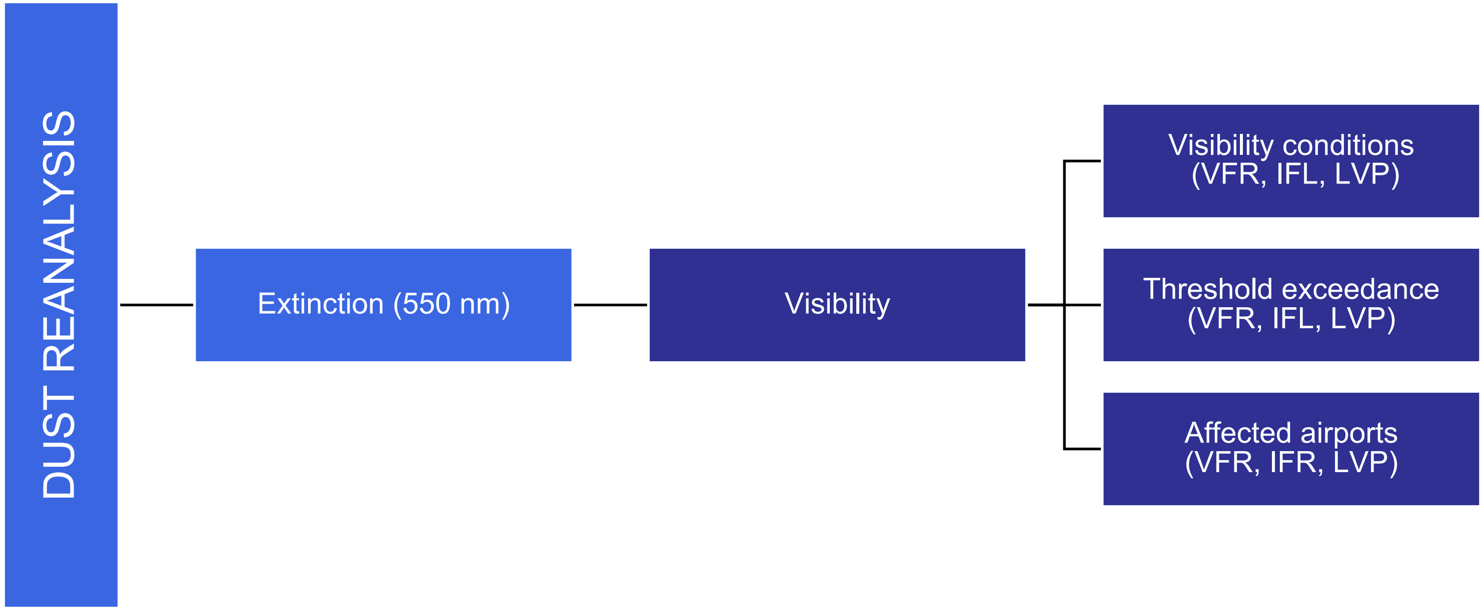
2. Visibility

Visibility products

We address visibility effects through products that indicate

(a) exceedances of IFR, VFR, and low-visibility procedures (LVP) thresholds for 14 flight levels and various temporal aggregations

(b) implications for airport closures according to their current instrument approach capacity >> Affected airports from low visibility conditions due to their ILS/CAT instrumentation.

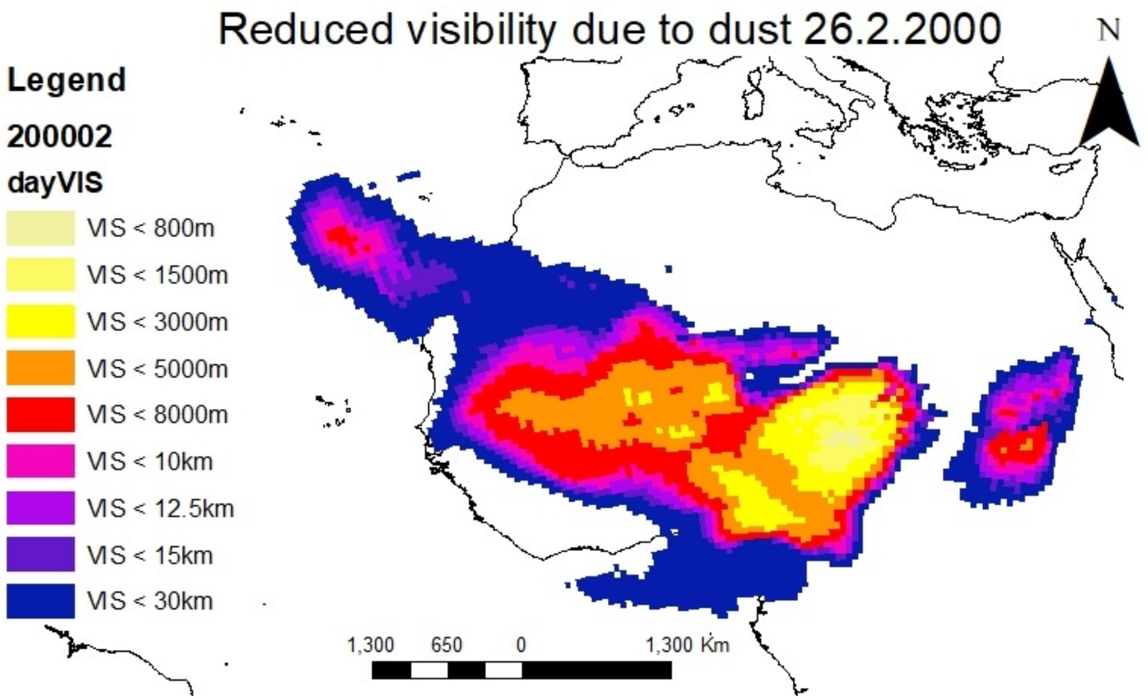


VFR/IFR/LVP thresholds

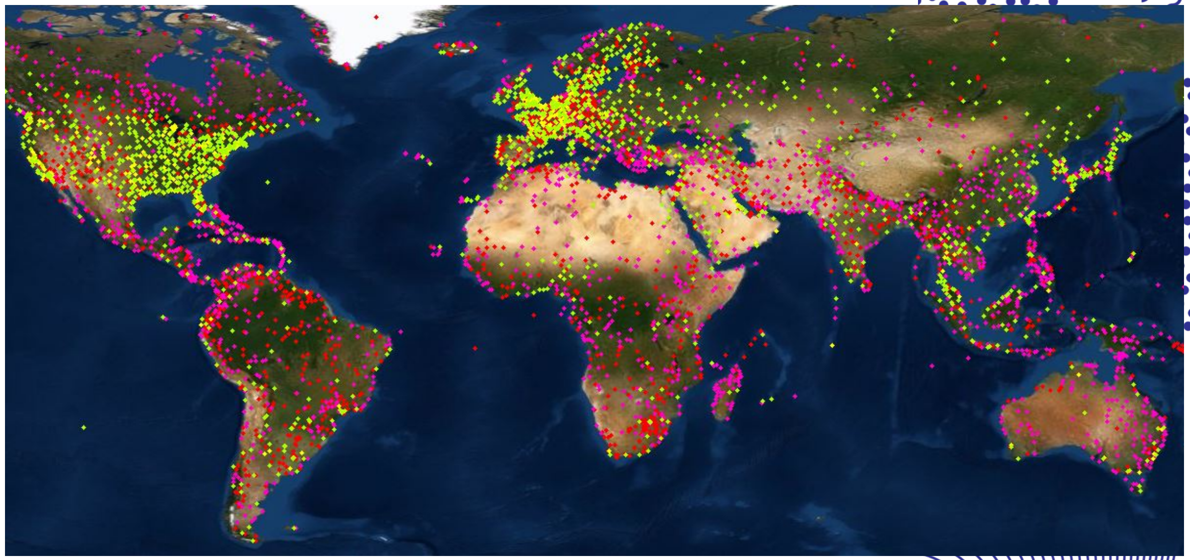
Visibility threshold (meters)	Limit/Range	Procedure
Visual Flight Rules (VFR)		
10000+	over	
10000	below	
8000	below	
5000	below	
3000	below	
1500	below	
Instrument Flight Rules (IFR) according to ICAO/FAA thresholds		
800+	over	CAT I
800–350	between	CAT II
350–200	between	CAT III A
200–50	between	CAT III B
50–0	between	CAT III C
Low Visibility Procedures (LVP)		
550	below	Restricted ground operations
end-user specified values	below	Restricted ground operations

Visibility: Threshold exceedances & implications per ILS/CAT capability

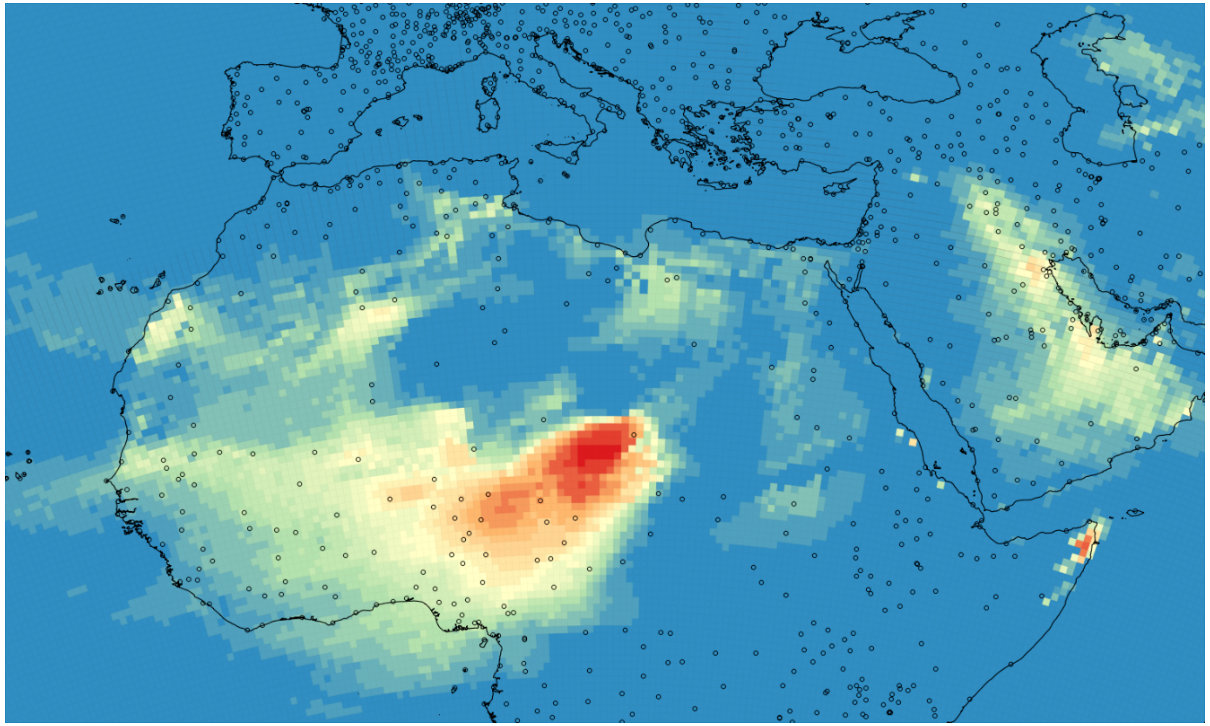
- PM10 concentrations over approximately 100-150 µg/m3 reduce visibility to below 10 km.
- Concentrations over approximately 450-650 µg/m3 (depending on the model that is used to derive visibility from particle concentration) reduce visibility to zero.



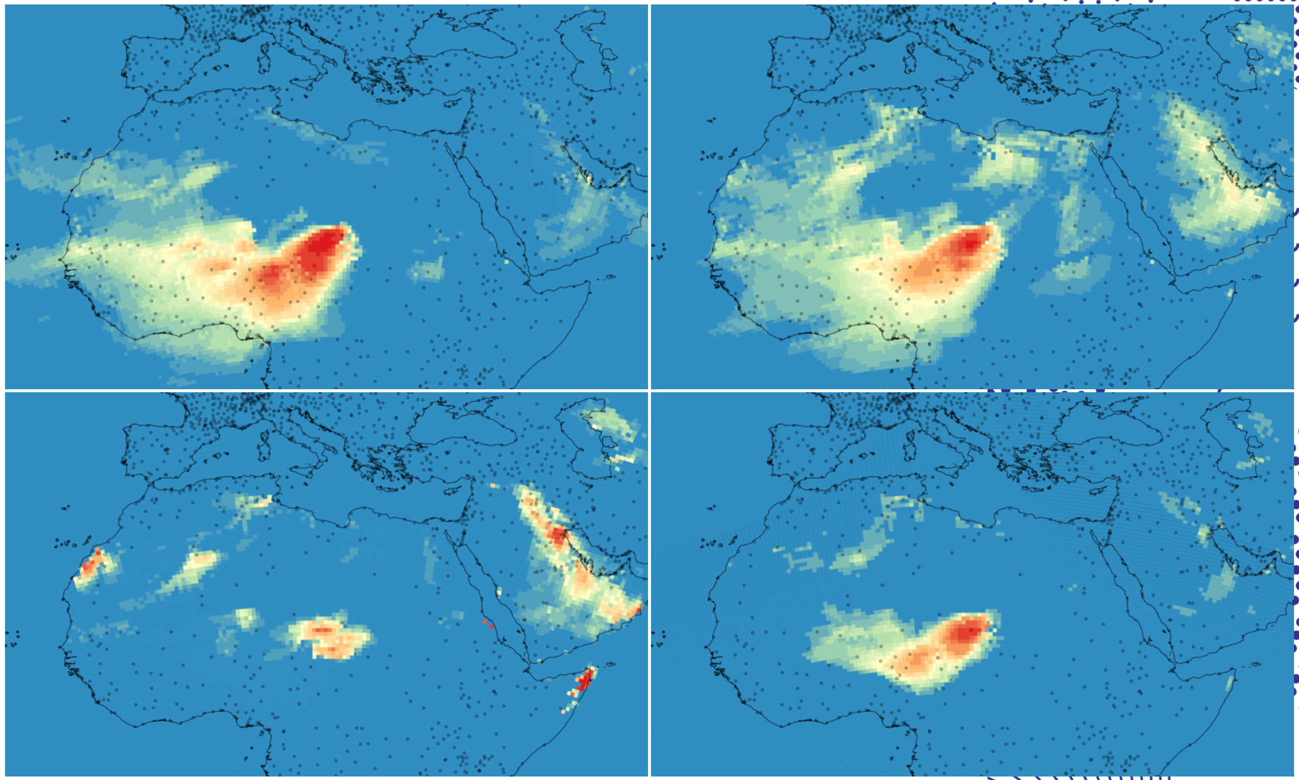
Classification of airports per their ILS/CAT capability



Visibility: Frequency of threshold exceedance



Exceedances of the 8000 m VFR category, total for the test climatology period (Jan 2000–Jul 2003)



Number of exceedances for the 8000 m VFR category, seasonal totals for the test climatology period (2000/1–2003/7). Top left clockwise: DJF, MAM, JJA, SON.

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Thank you!

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