



Observational Data – the fuel of Global NWP

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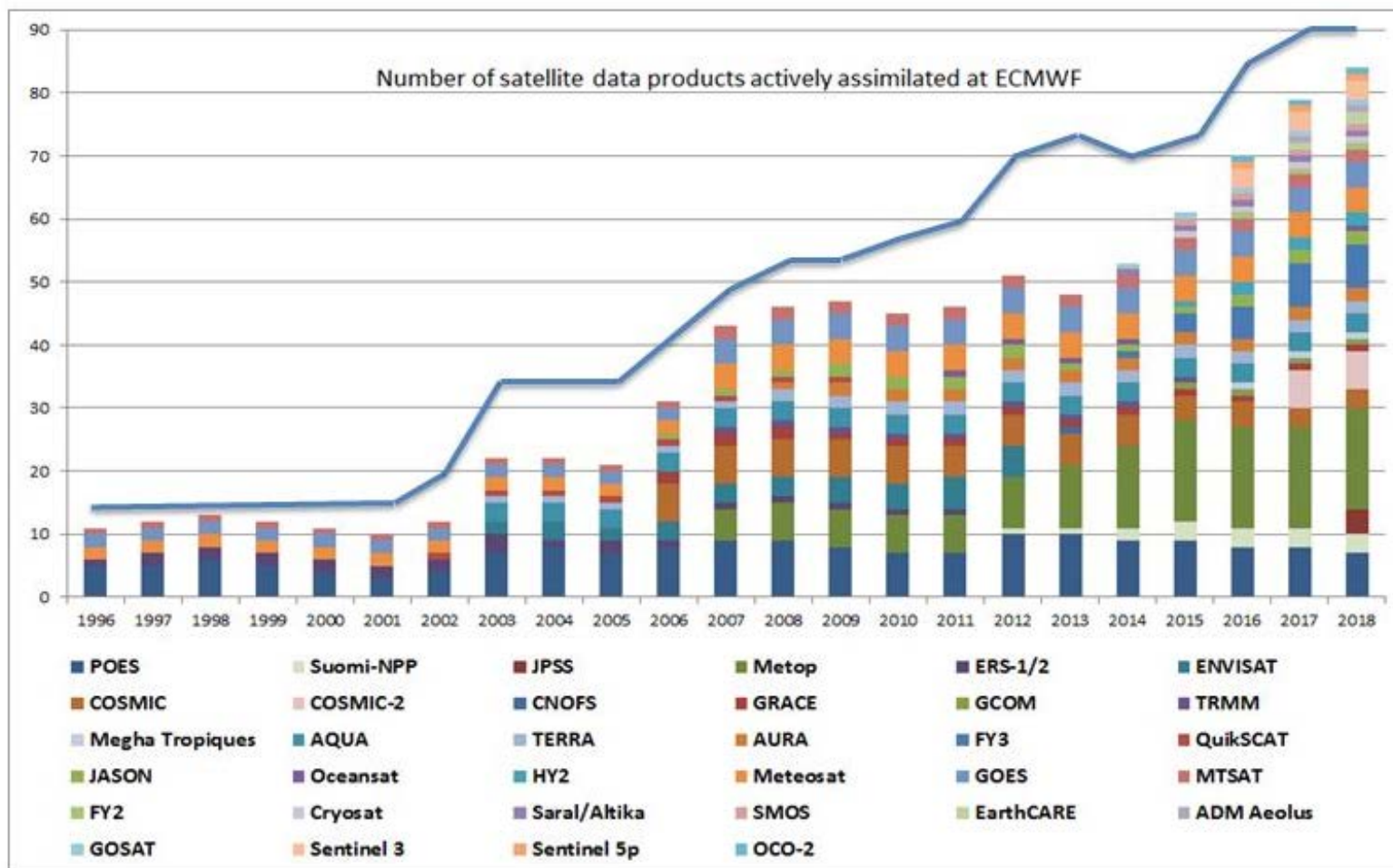
Chair WMO/CBS IPET-OSDE (Observing System Design and Evolution)

Soon – Copernicus Unit of the European Commission, Brussels, Belgium.

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Explosion in Satellite Observations

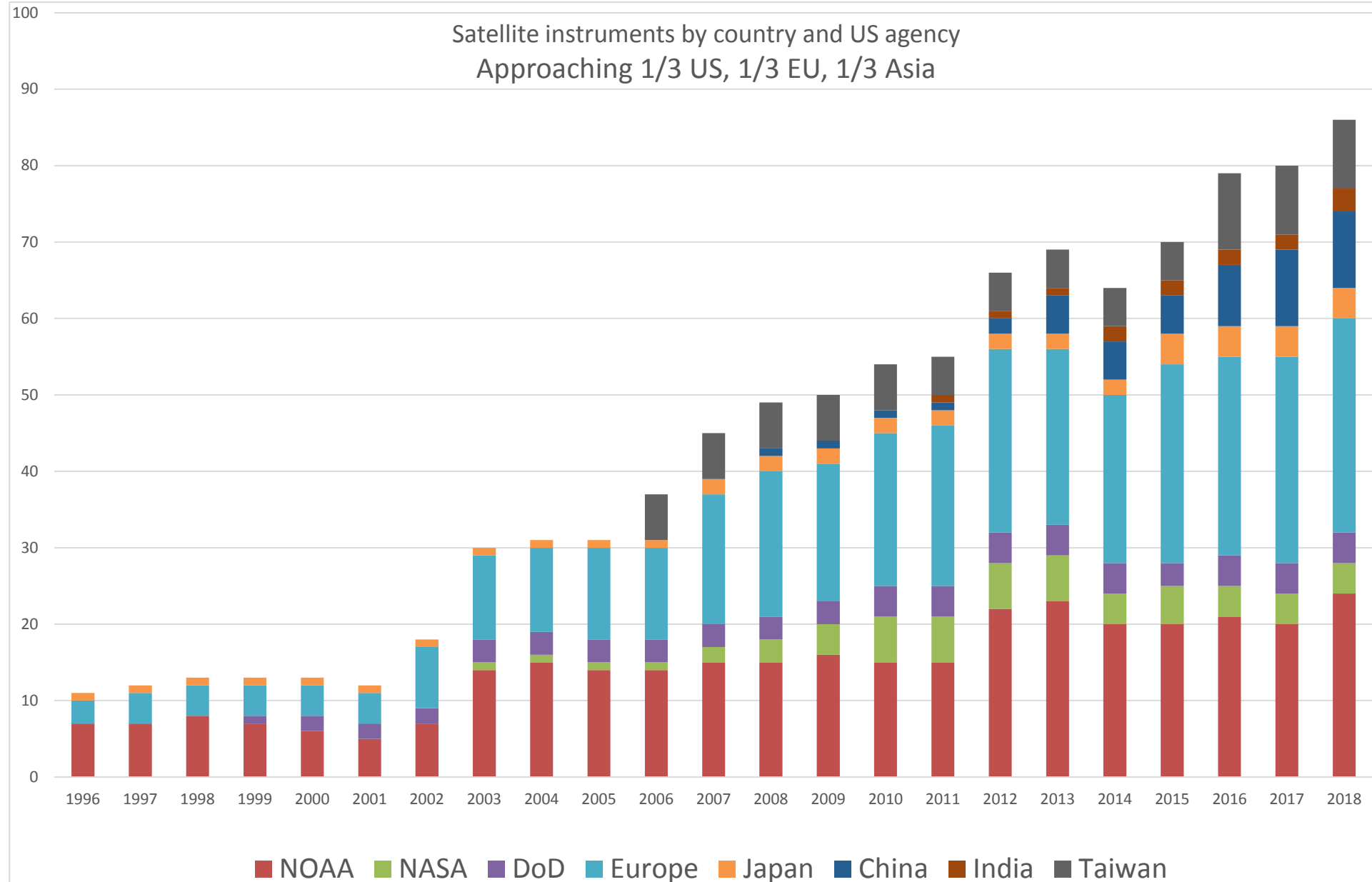


EPS-SG
MTG
FY4

2019-2025

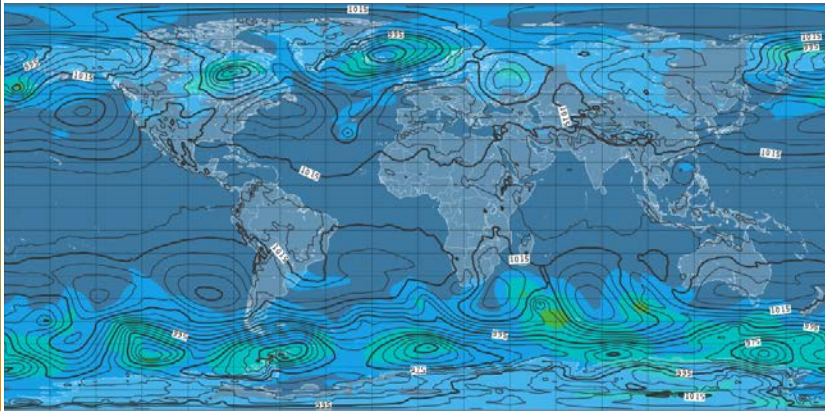
— Number of satellite products operationally monitored

Satellite instruments by country and US agency
Approaching 1/3 US, 1/3 EU, 1/3 Asia



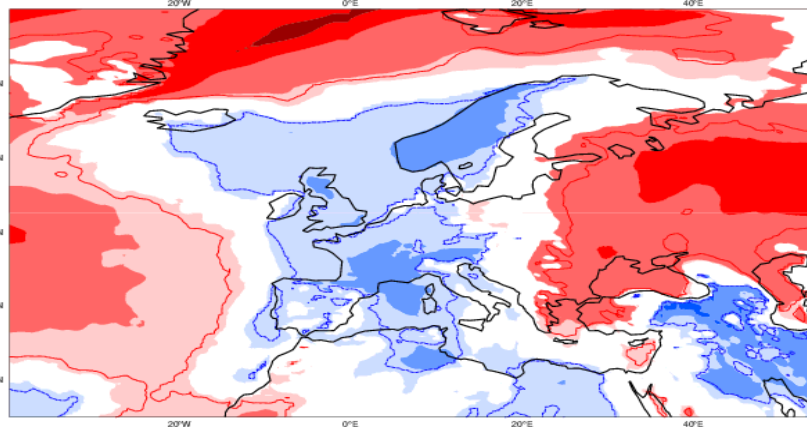
NWP Deliverables: Global NWP at all time ranges

Medium range prediction



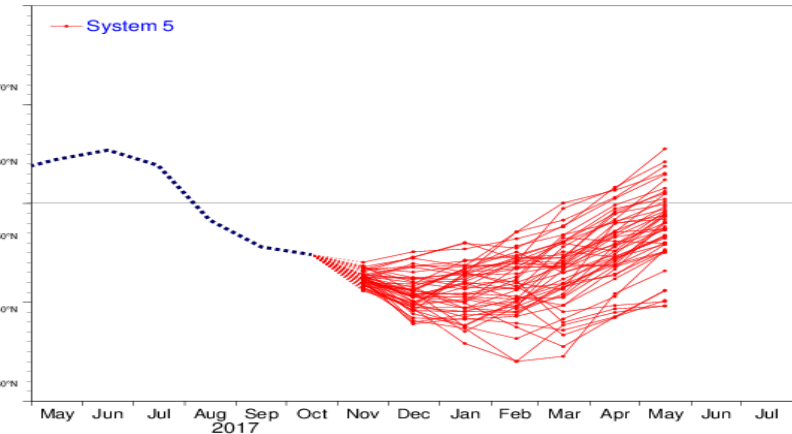
High resolution mean sea level pressure and ensemble spread

Monthly forecasts



Weekly anomaly – 2m temperature over Europe (3-10 Dec)

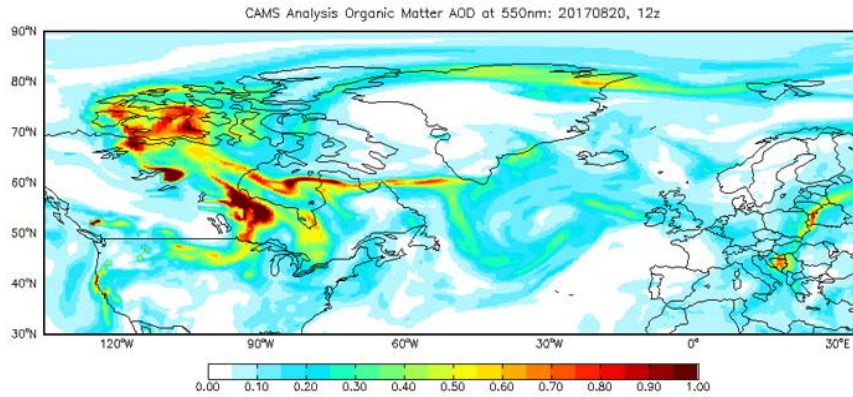
Long range prediction



El Nino 3.4 SST anomaly plume – 1 November 2017

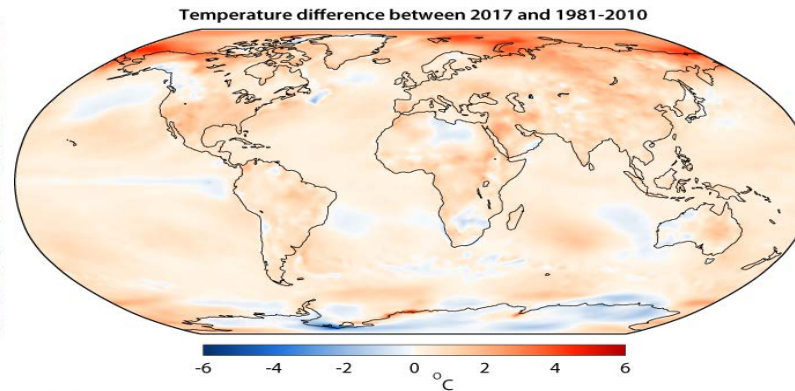
NWP Deliverables: Environmental information

Atmosphere Monitoring Service



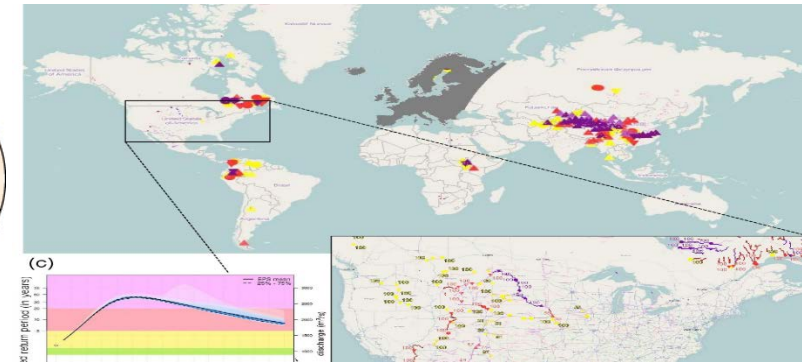
CAMS analysis organic matter AOD
(fire emissions)

Climate Change Service



Reanalysis monitoring
changes in global surface air
temperature

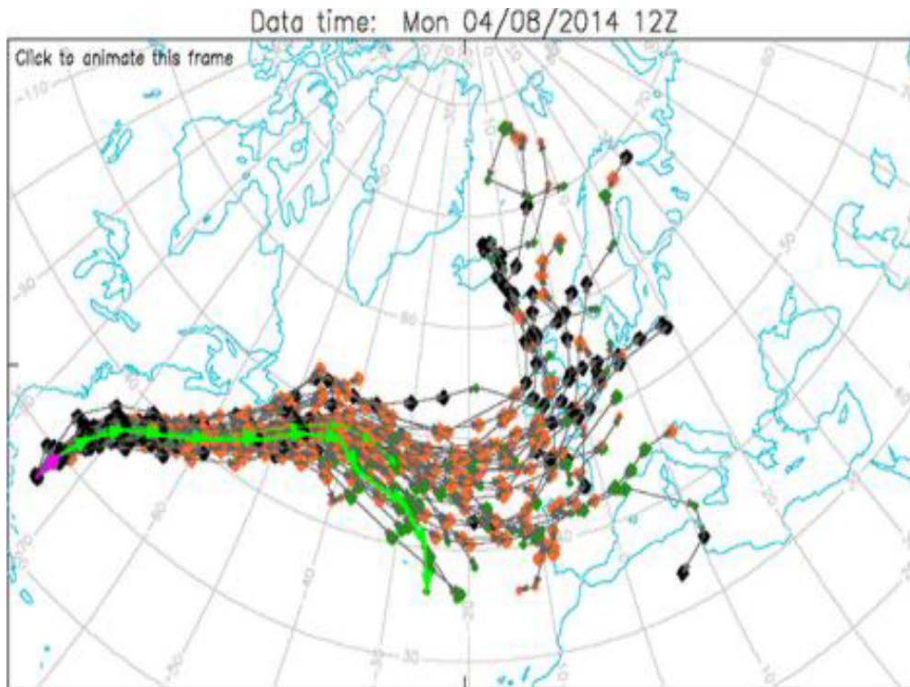
Emergency management Service Flood and Fire forecasting



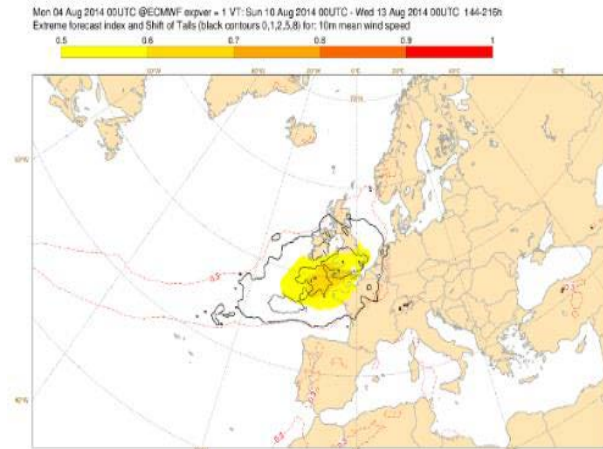
Main GloFAS interface

The challenge – improved forecast ensembles

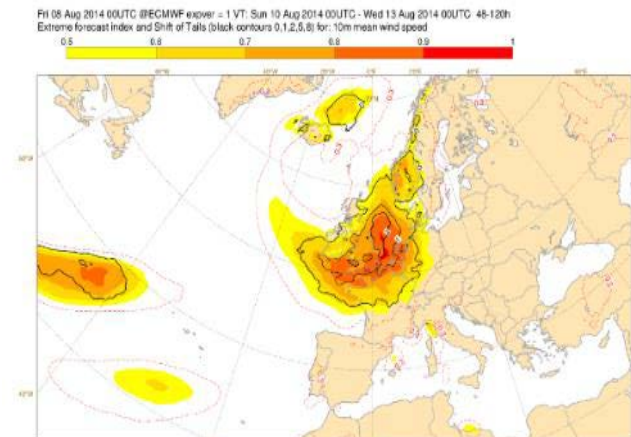
Severe weather: Hurricane Bertha



The difficulty: Sharp ensembles two weeks ahead

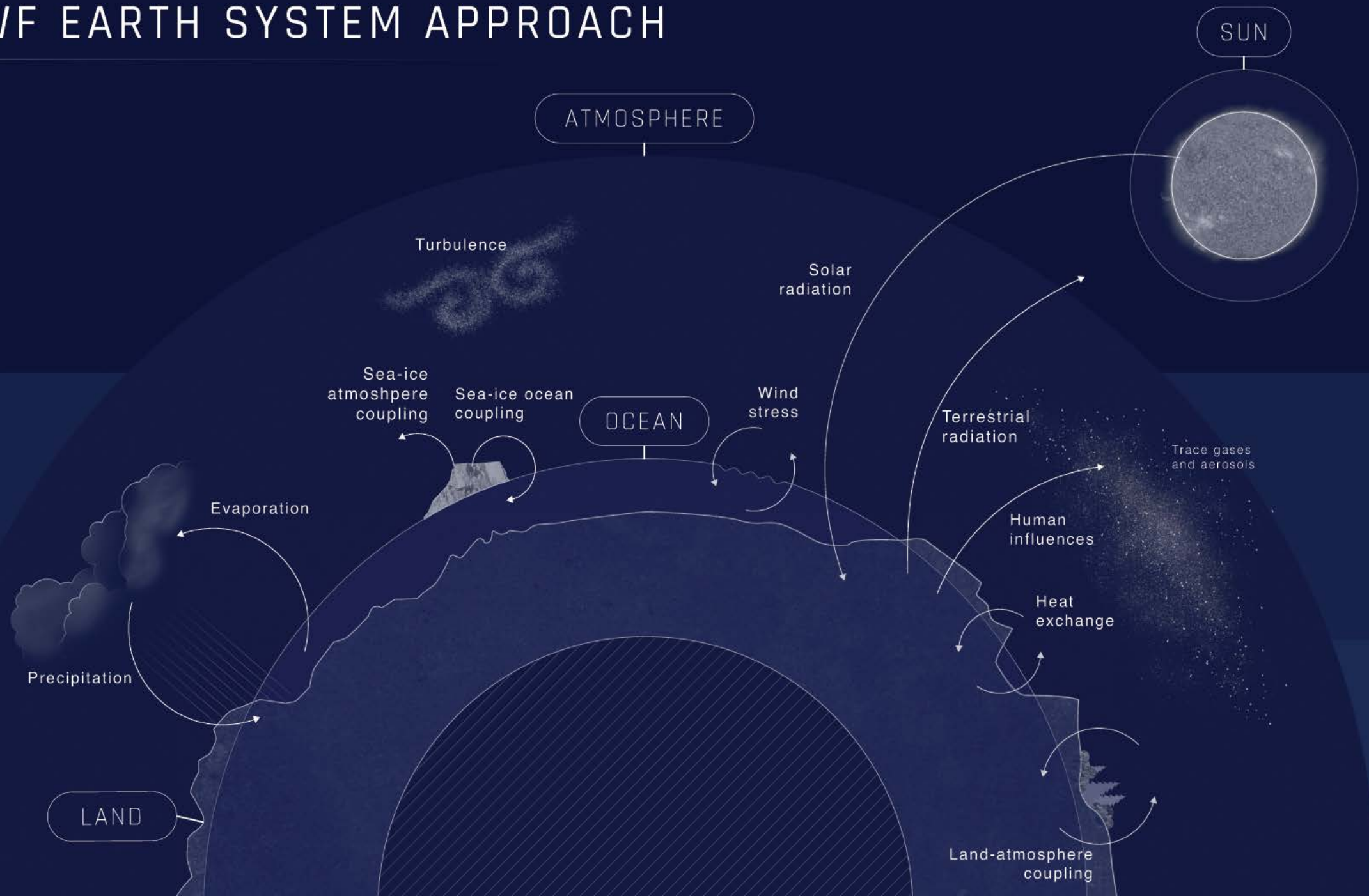


6-9 days

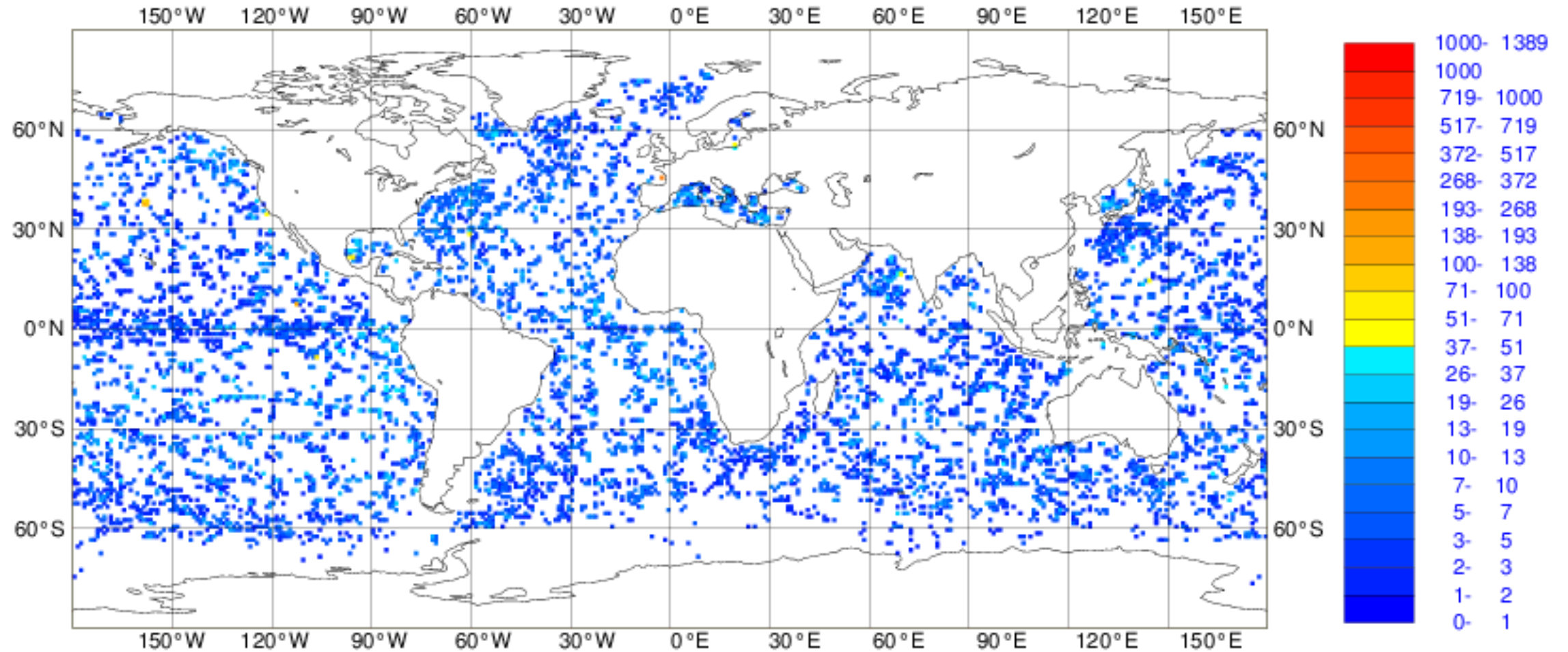


2-5 days

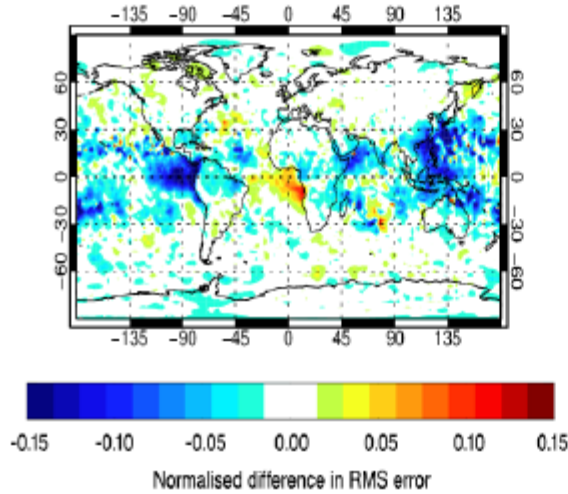
ECMWF EARTH SYSTEM APPROACH



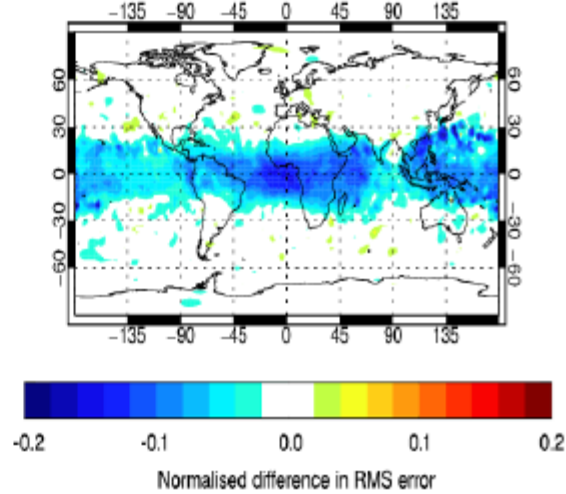
ARGO – ocean temperature profiles



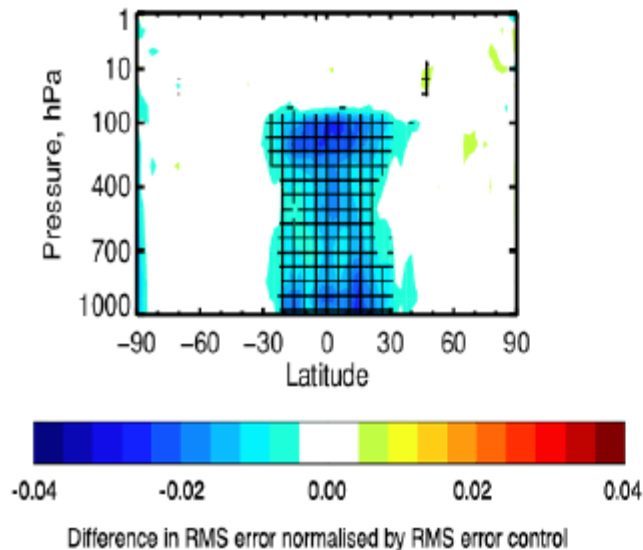
Mean Sea Level Pressure
Improvement from Ocean coupling



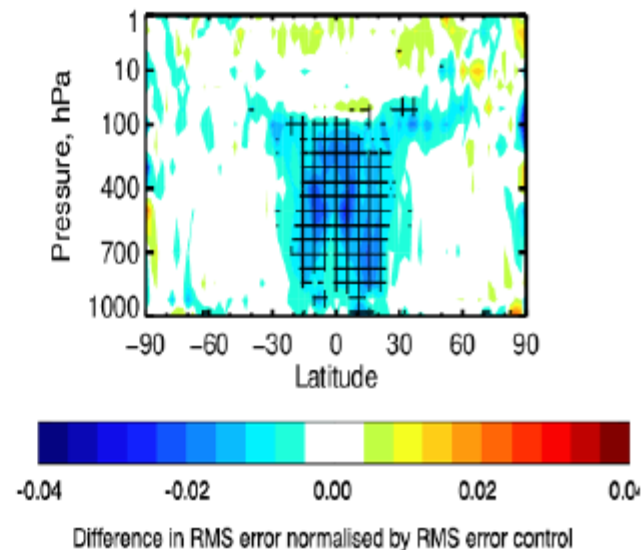
500 hPa Geopotential Height
Improvement from Ocean coupling



Winds improvement
from Ocean coupling



Relative Humidity
improvement from Ocean coupling



Coupling with the ocean improves the weather forecast scores.

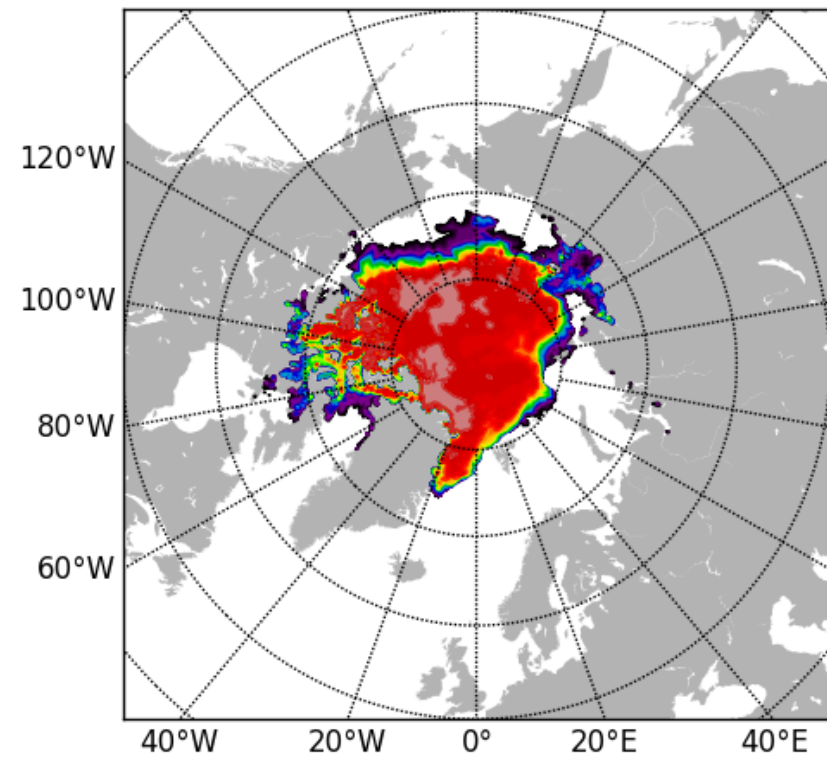
RMSE reduction (blue) in Day+5 weather forecast by coupling to the ocean in the tropics

Large benefit across the tropics. Some degradation in Gulf of Guinea. Need observational studies to understand why

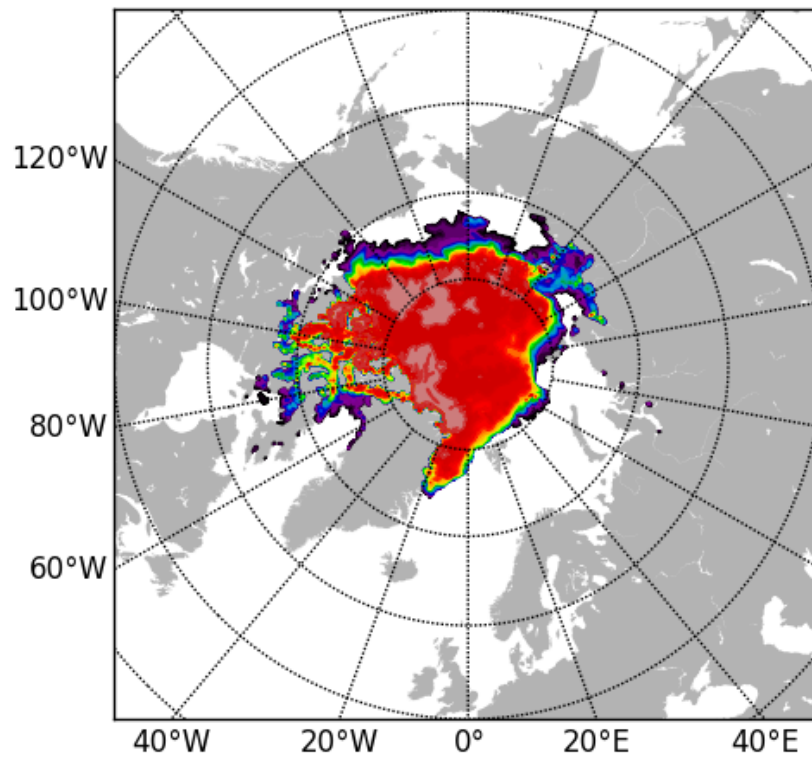
Courtesy of Kristian Mogensen

Sea ice concentration

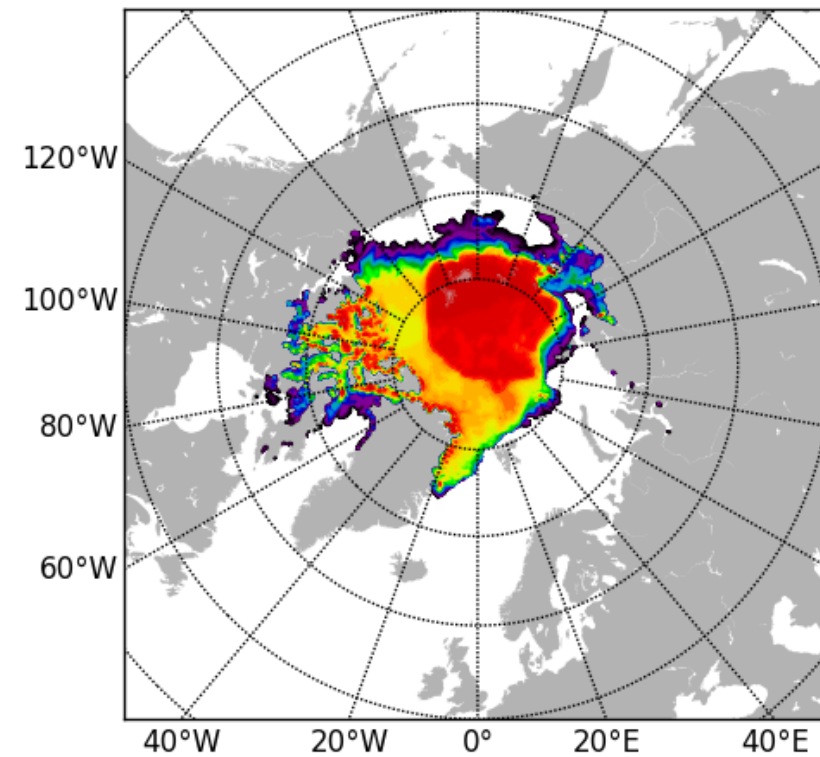
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20161017



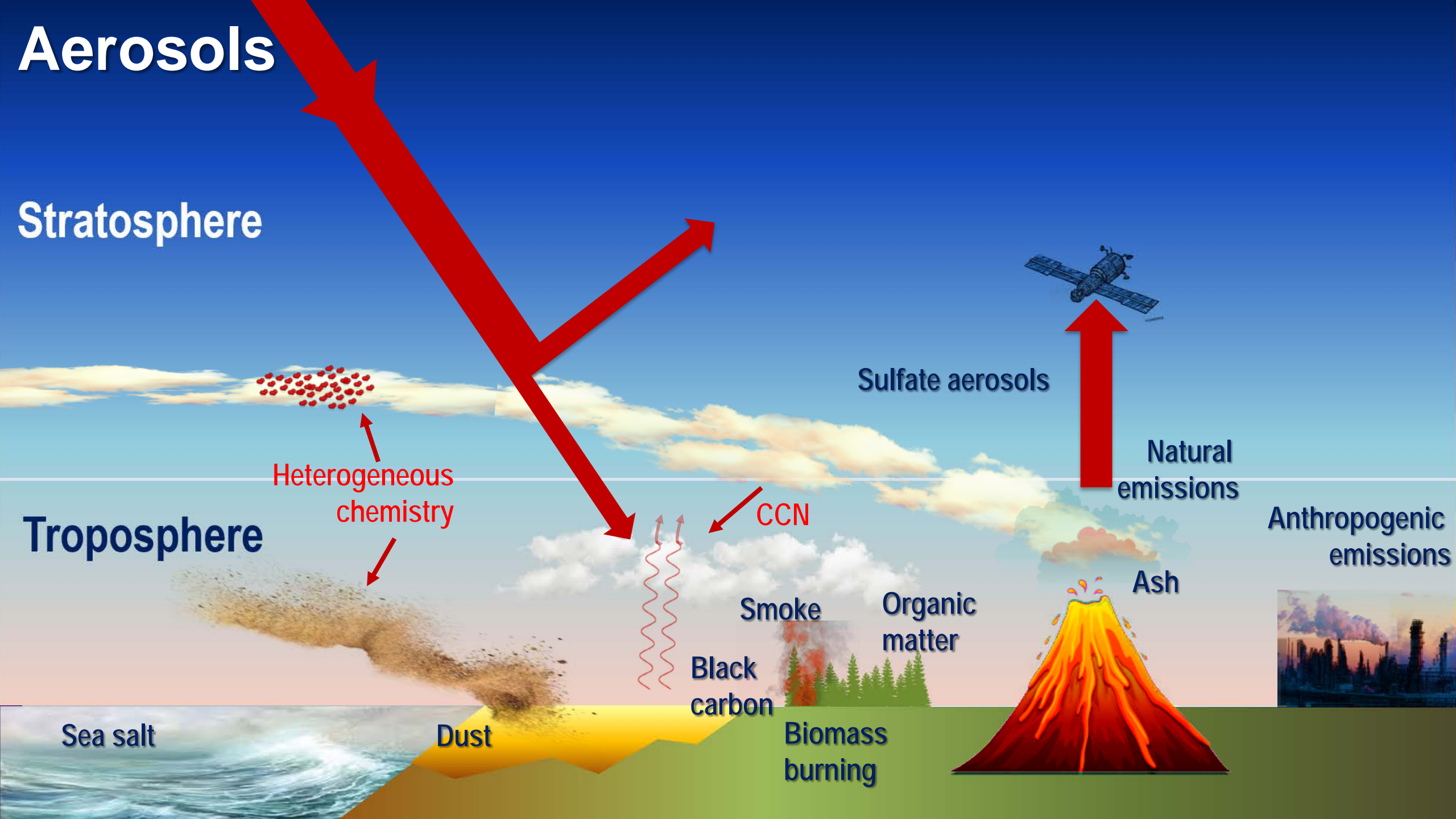
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Aerosols

Stratosphere

Troposphere



Heterogeneous chemistry

Sulfate aerosols

Natural emissions

Anthropogenic emissions

Sea salt

Dust

Black carbon

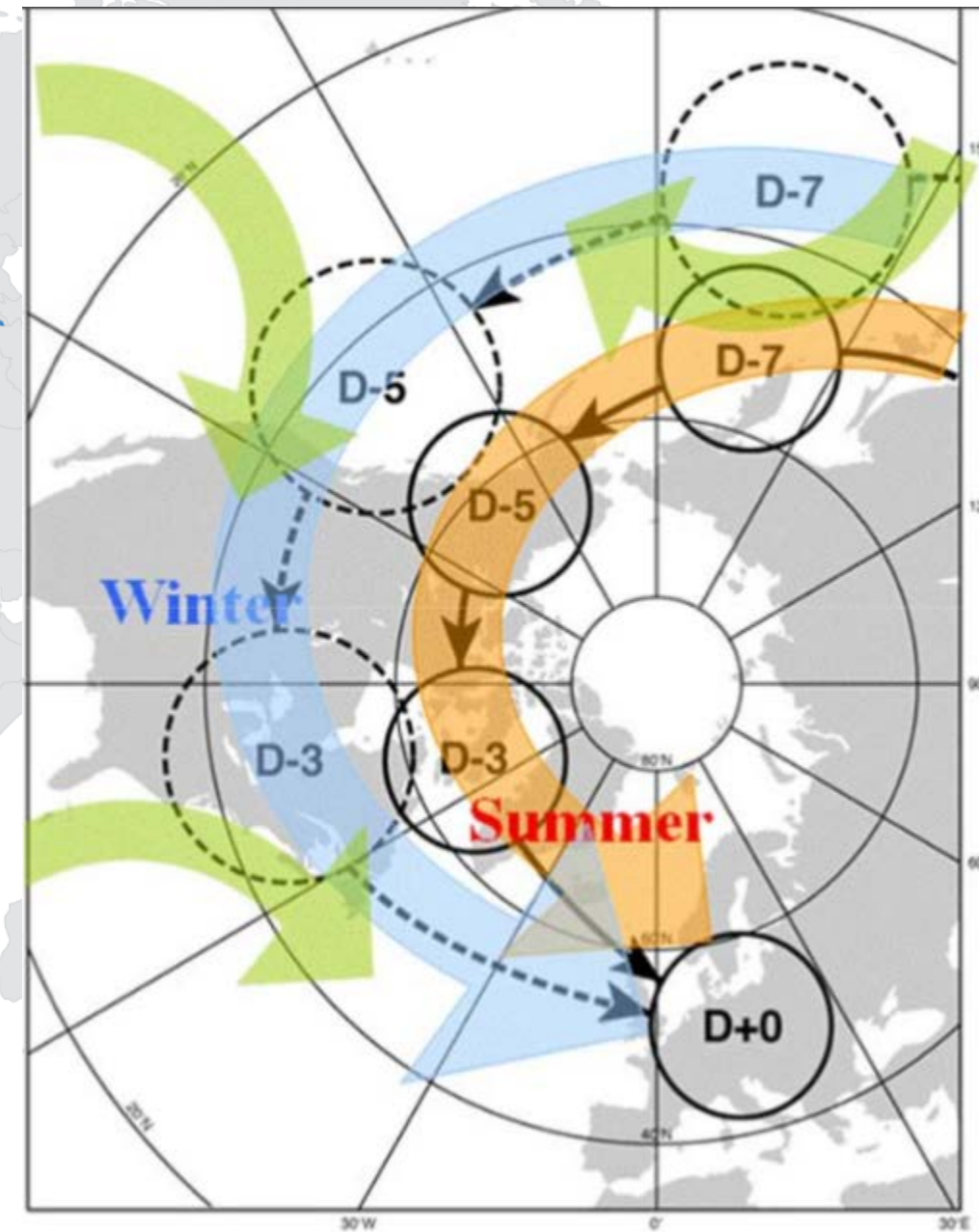
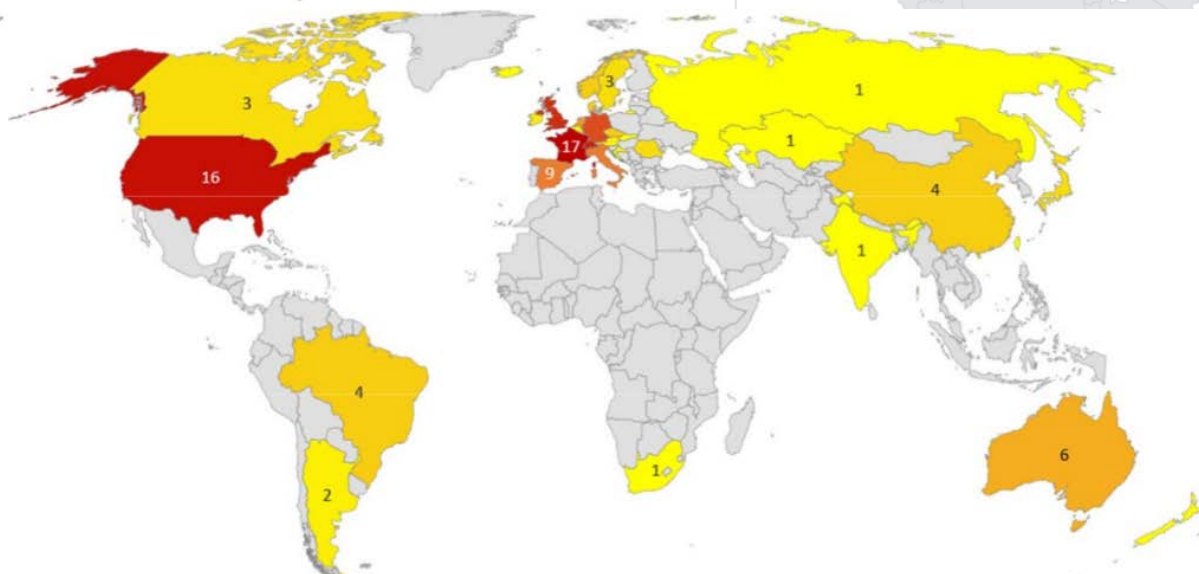
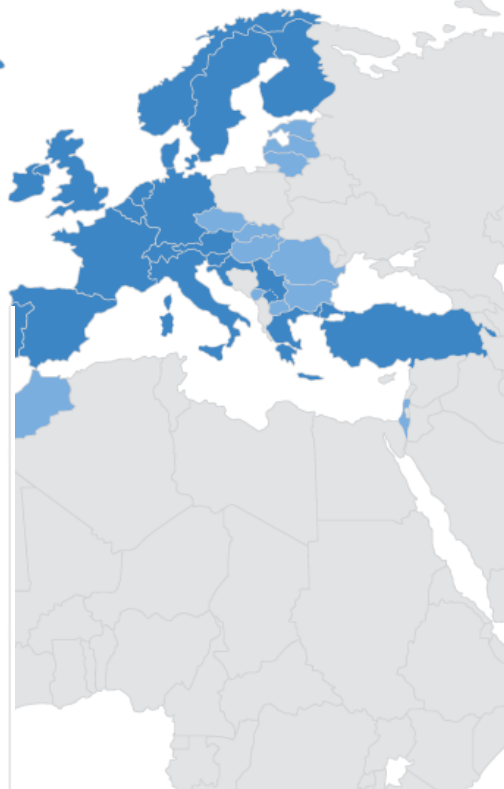
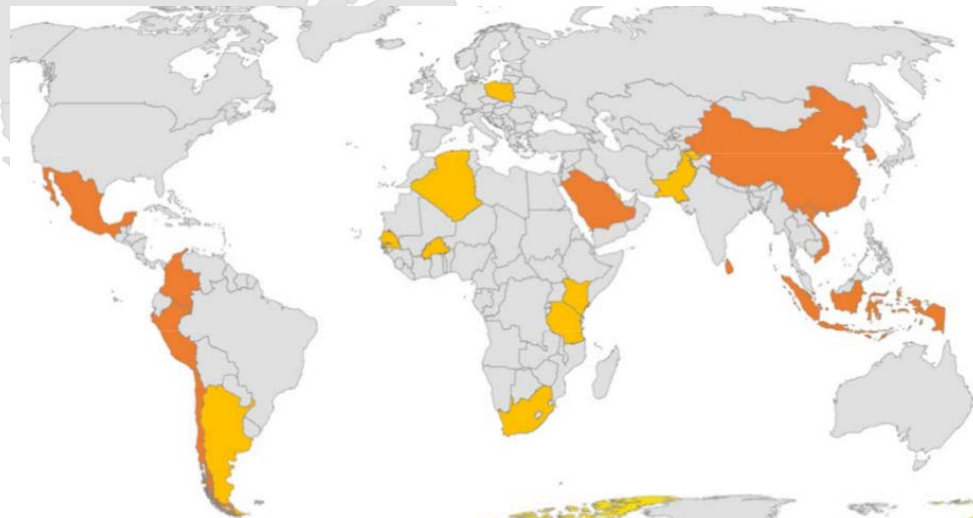
Smoke

Biomass burning

Organic matter

Ash

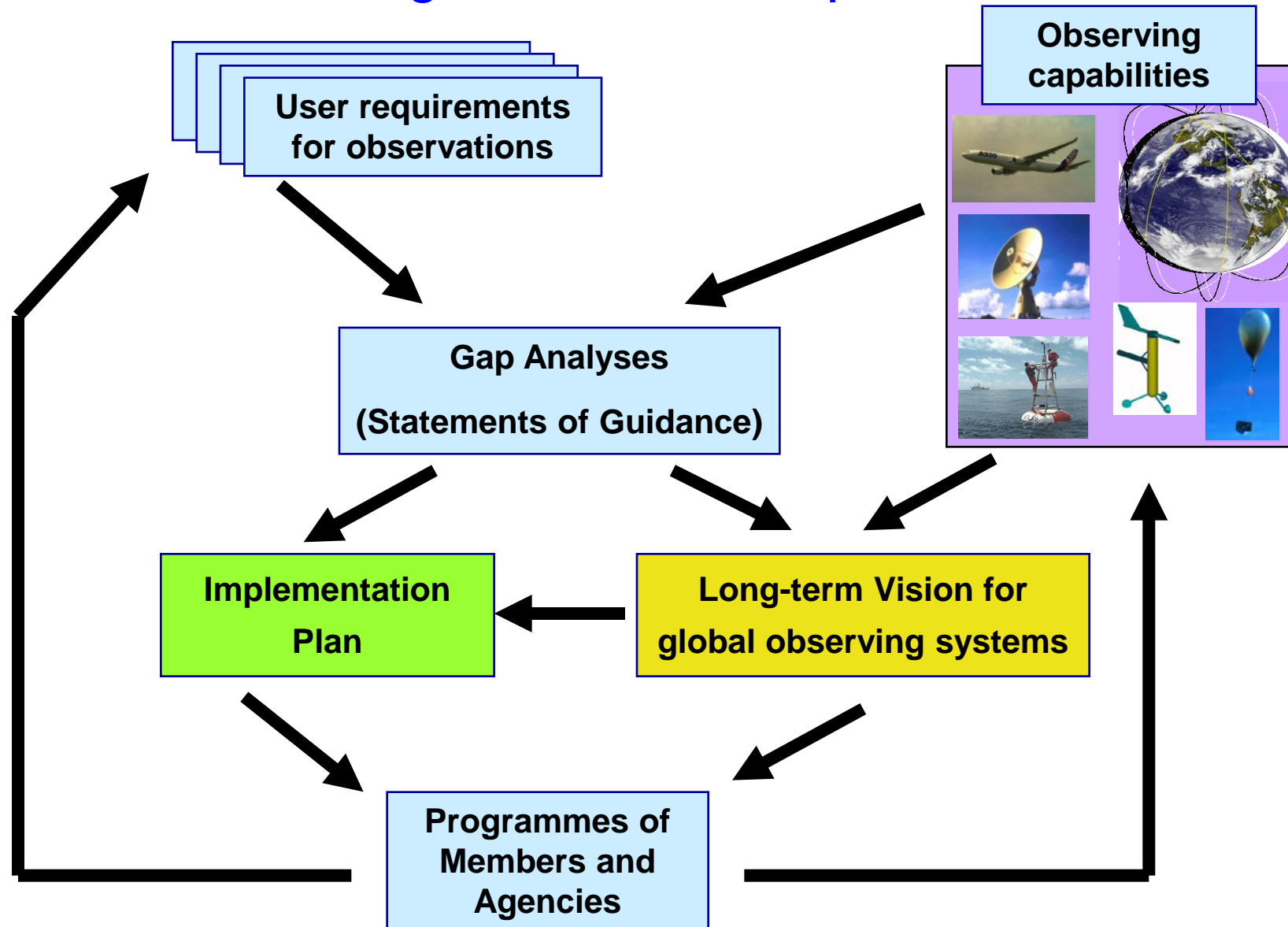
ECMWF's role is to address the critical and most difficult research problems in medium-range NWP that no one country could tackle on its own



The WIGOS RRR process: Rolling Review of Requirements



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RRR process: Application Areas

Global NWP

High-resolution NWP

Nowcasting

Sub-seasonal to Longer-range Forecasting

Aeronautical Meteorology

Forecasting Atmospheric Composition

Monitoring Atmospheric Composition

Atmospheric Composition info → services in urban and populated areas

Ocean Applications (JCOMM)

Agricultural Meteorology

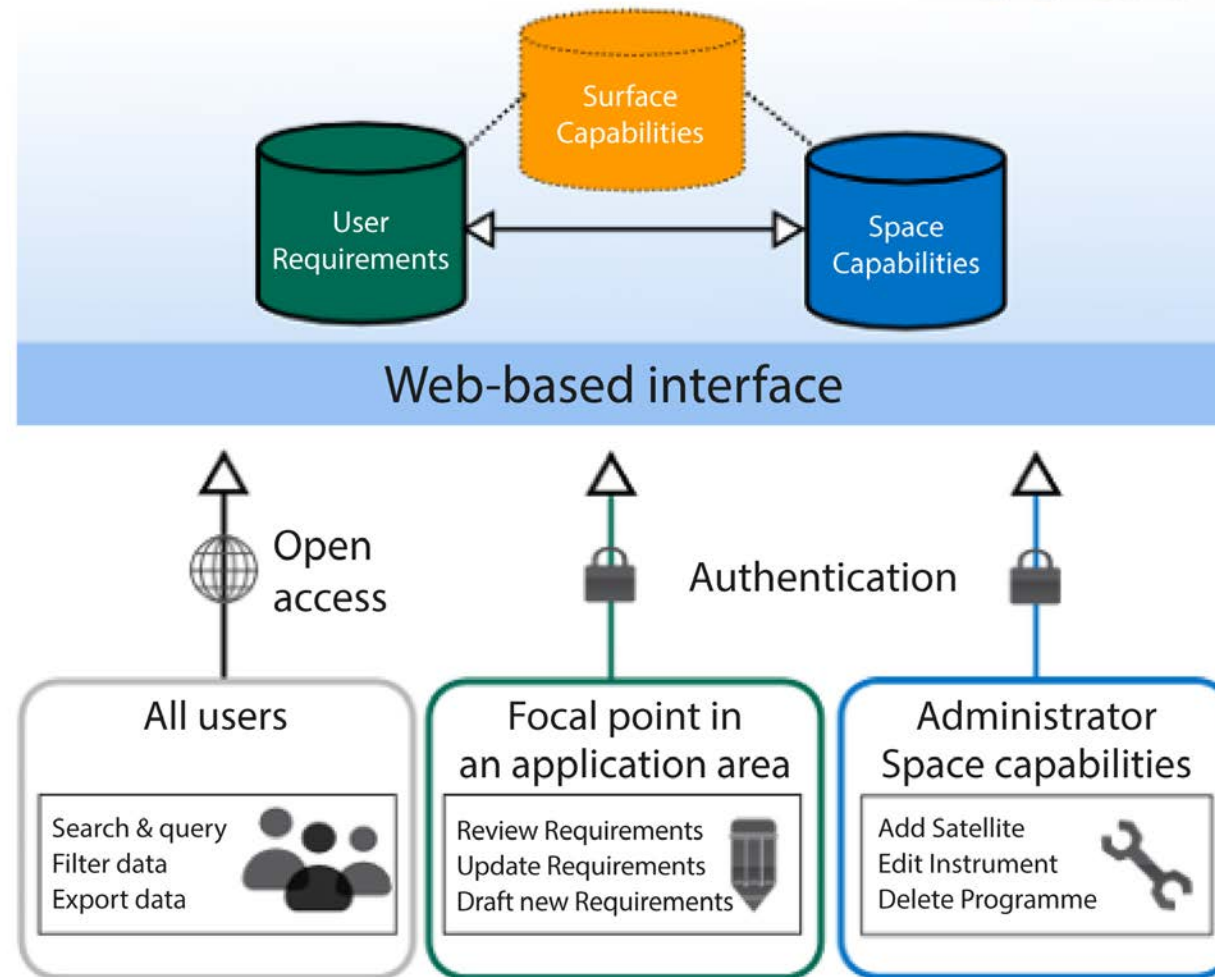
Hydrology

Climate Monitoring (GCOS)

Climate Science

Space Weather

OSCAR



To conclude

The success of Global NWP and Climate Monitoring in future depends on global exchange of observations

- GBON for the WMO Congress June 2019 and EC 2020

GRUAN key contributions

- Improved characterization of radiosonde data
- A reference for bias correction of satellite and in situ data