

ESA and EUMETSAT on a par with NASA and NOAA

Hartmut Graßl

Max Planck Institute for Meteorology, Hamburg

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A Look Back

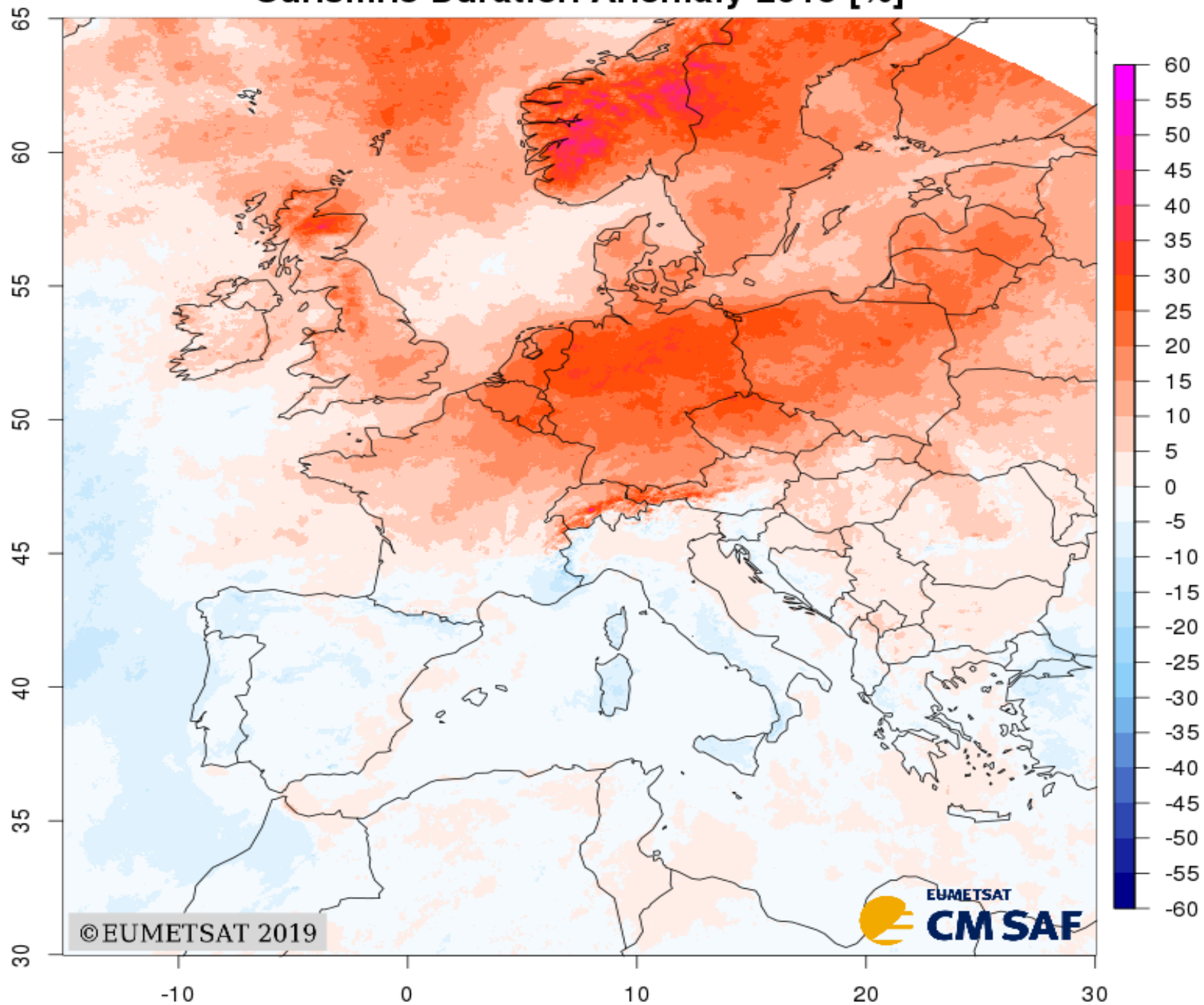
When EUMETSAT started the satellite application facilities, among them CM-SAF, it woke up some European meteorological services from „Dornröschenschlaf“ (longlasting sleep or sleeping beauty), certainly valid for Deutscher Wetterdienst.

Earth Observation from Space

It took a very long time (starting in the early 1960ies) for the democratically governed Europe to remarkably contribute to Earth Observation from Space in comparison to the USA where mostly NASA set the stage and NOAA followed.

The main reason was the reluctance to create a powerful European space agency besides the mostly weak national agencies (similar to the development in the aviation sector). Multilateral approaches are nearly always better.

Sunshine Duration Anomaly 2018 [%]



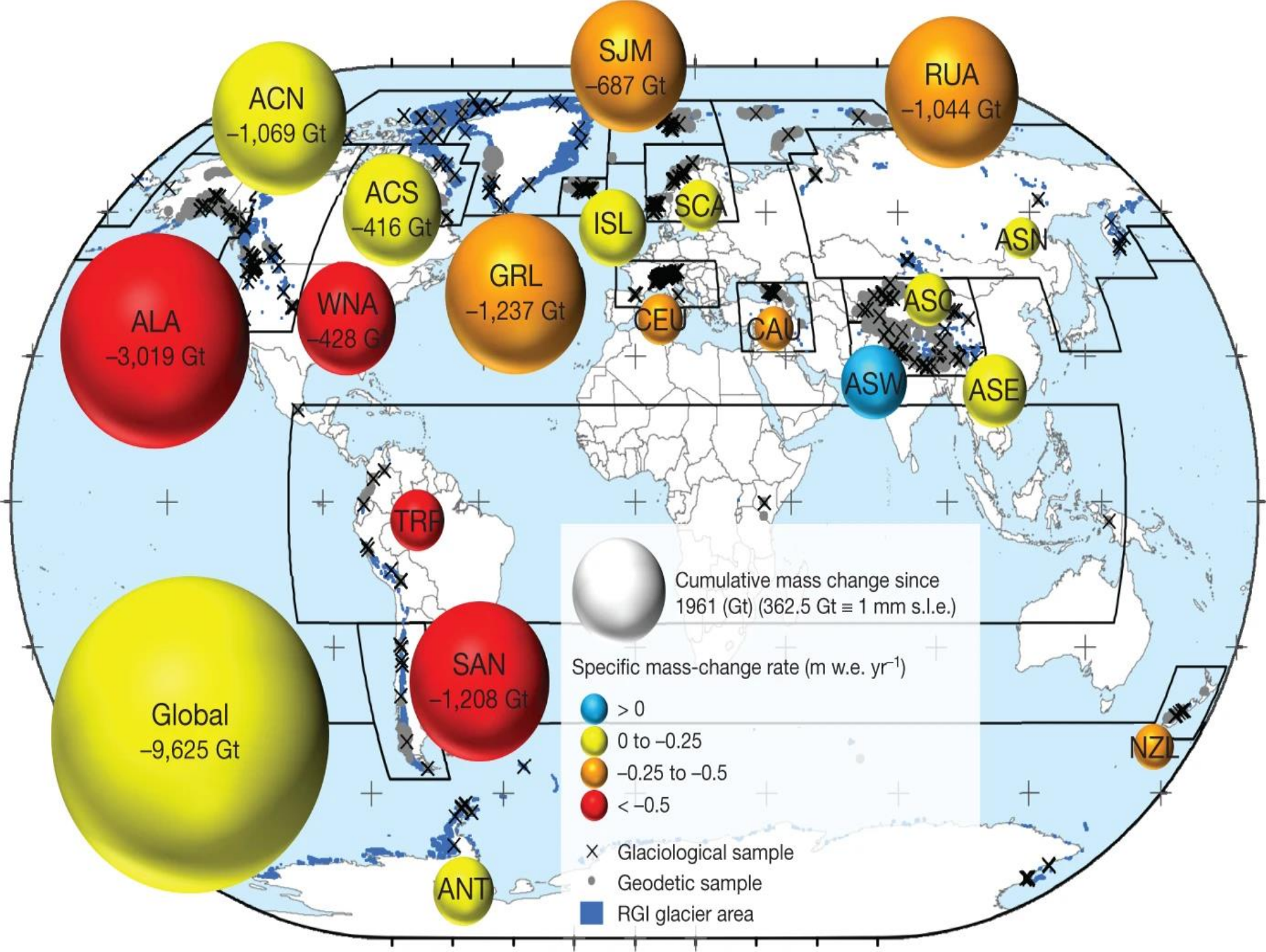
From ESA's Website

Swarm helps pinpoint new magnetic north for smartphones

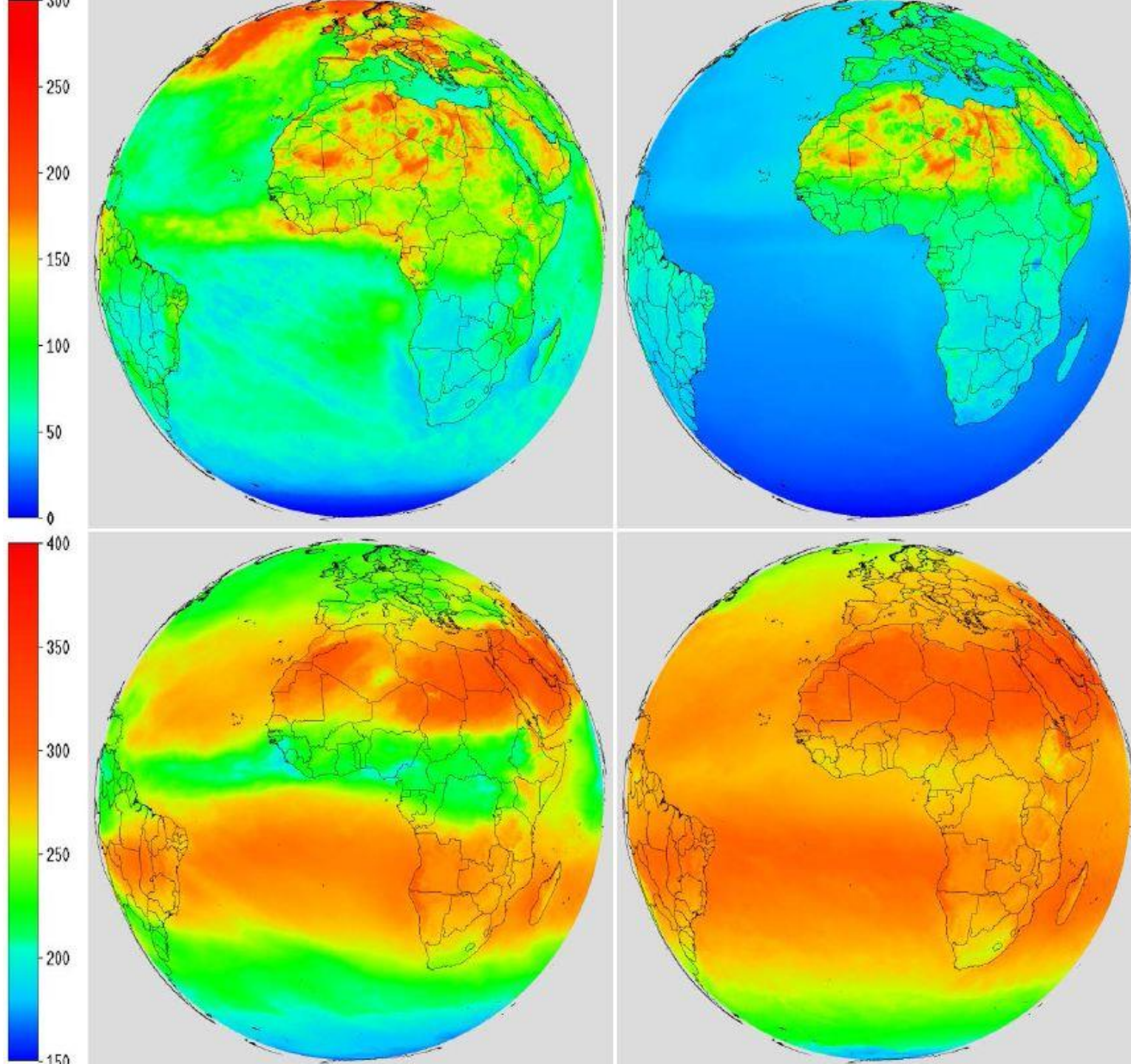
08 February 2019

Since 1831 we have known that the magnetic north is constantly on the move. However, its tendency to slowly roam has stepped up pace recently – so much so that the World Magnetic Model has had to be updated urgently with the pole's new location, vital for navigation on smartphones, for example. [ESA's magnetic field Swarm mission](#) has been key for this update.

Geological evidence shows that every few hundred thousand years or so it even flips, so that north becomes south.

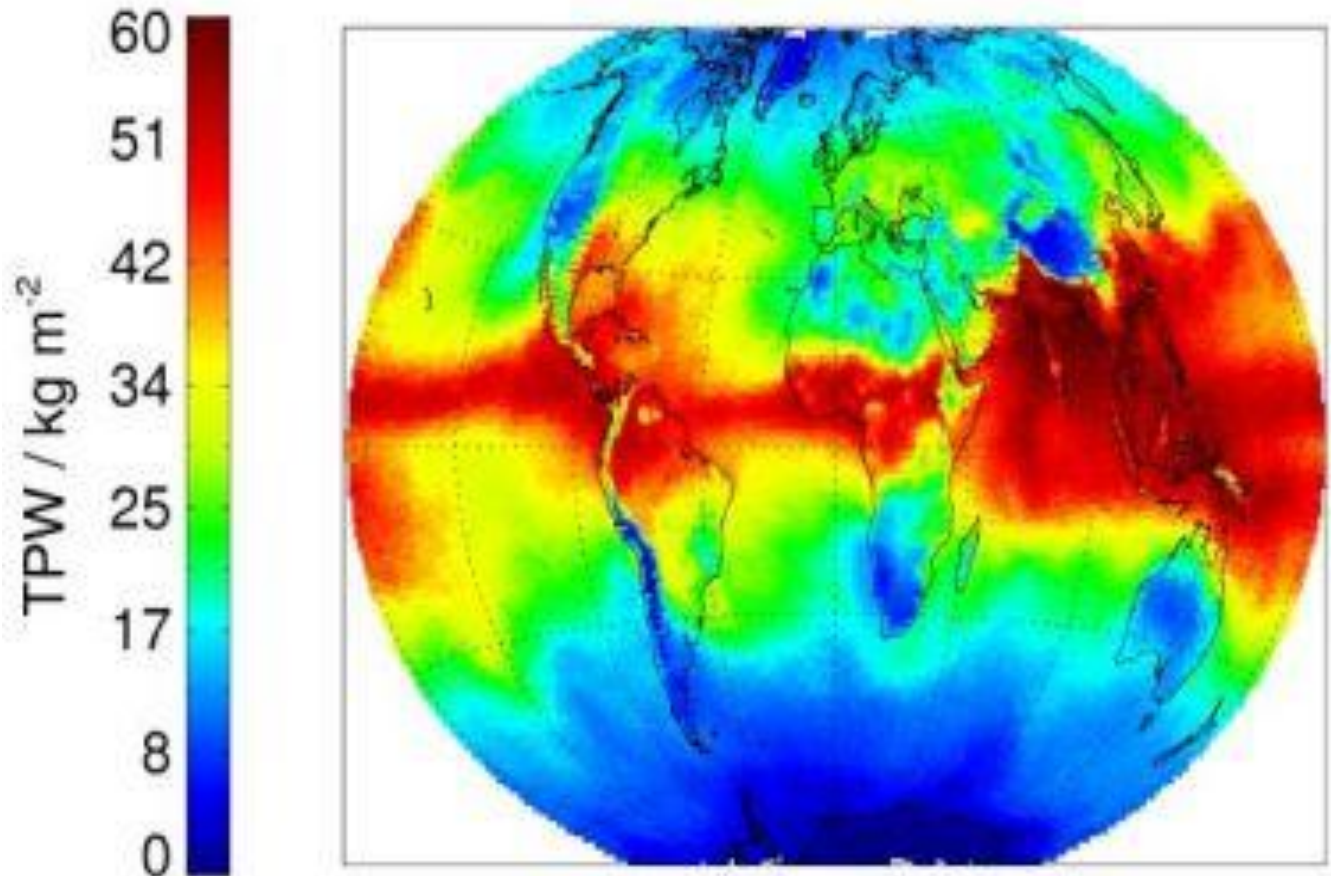


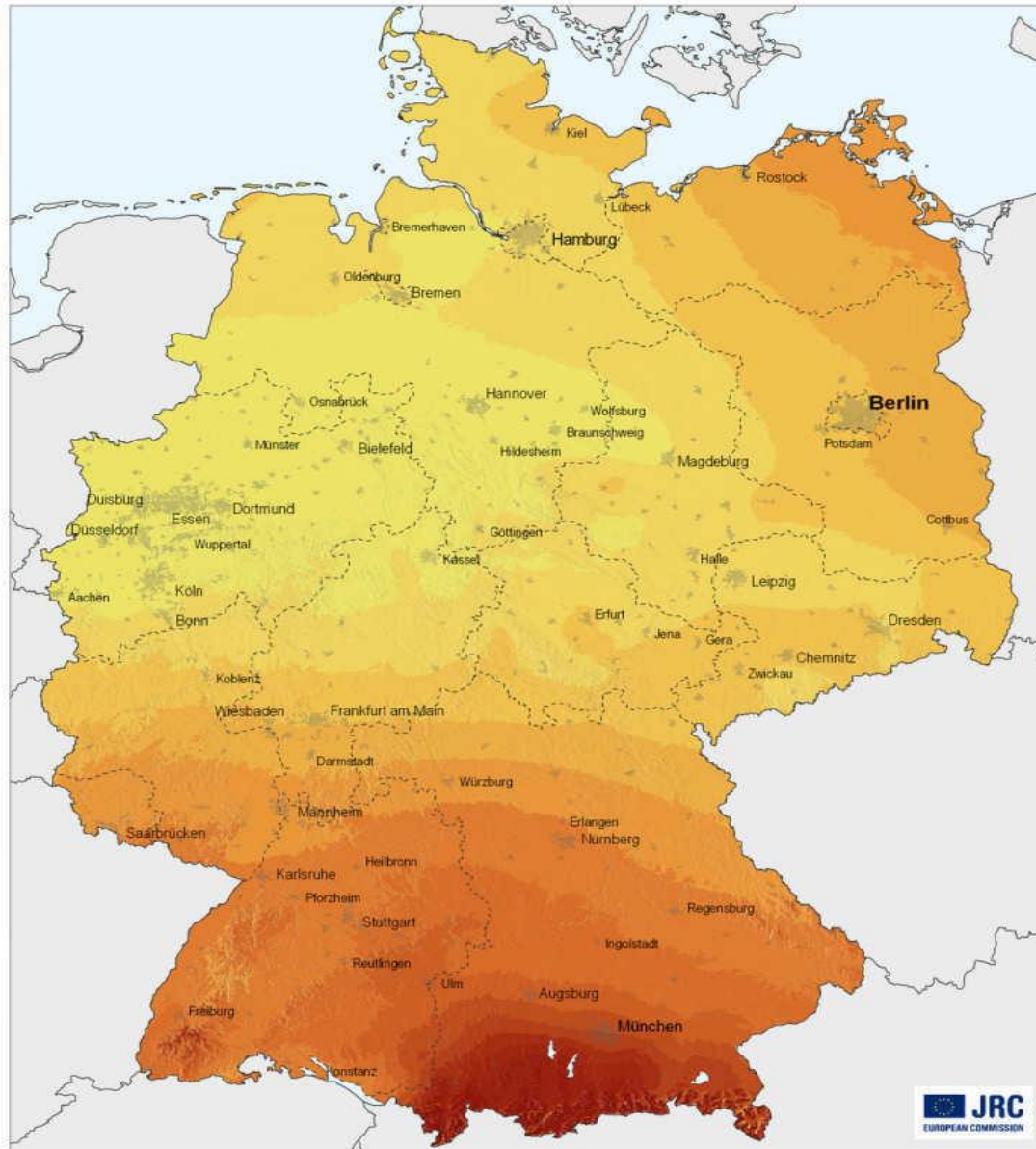
Monthly mean TRS (top) and TET (bottom) fluxes for June 2010 in W/m^2 . The right images provide the corresponding "clear sky" fluxes (i.e. only those fluxes, where clear sky is observed).



An optimal estimation technique (Li et al., 2000) is applied to data from the Advanced TIROS Operational Vertical Sounder (ATOVS) on board NOAA and MetOp satellites to retrieve humidity and temperature profiles and total column water vapour products (HSH, HLW, and HTW).

**A CM-SAF
product
merging
EUMETSAT
and NOAA
data**





Yearly sum of global irradiation [kWh/m^2]

< 1100 1150 1200 1250 1300 1350 1400 >

< 825 863 900 938 975 1013 1050 >

Yearly electricity generated by 1kW_{peak} system with performance ratio 0.75 [$\text{kWh}/\text{kW}_{\text{peak}}$]

Authors: M. Suri, T. Cebeauer, T. Huld, E. D. Dunlop
PVGIS © European Communities, 2001-2008
<http://re.jrc.ec.europa.eu/pvgis/>

0 25 50 100 km

A service derived from CMSAF data

Das Fotovoltaikpotenzial in Deutschland bei optimal geneigten Solarzellen; in kWh/m^2 pro Jahr

The yearly photovoltaic potential in Gemany at optimized inclination of the cells in kWh/m^2 .

ESA's Earth Observation Missions

Aeolus	Earth Explorer Core Mission; commissioning phase
Sentinel-5P	Gap filler
Sentinel-3	First satellite mainly for ocean applications
Sentinel-2	First satellites mainly for land surface changes;
Sentinel-1	First satellites for SAR-C-Band applications
Swarm	Earth Explorer Opportunity Mission
Proba-V	Prolongation of SPOT-V until 2020
CryoSat 2	Earth Explorer Opportunity Mission
SMOS	Earth Explorer Opportunity Mission
GOCE	Earth Explorer Opportunity Mission
Envisat	Largest Environmental Satellite in history
Proba-1	Minisatellite technology demonstration mission
ERS 1/2	First ESA EO missions

EarthCARE

EarthCARE will advance our understanding of the role that clouds and aerosols play in reflecting incident solar radiation back into space and trapping infrared radiation emitted from the Earth's surface.

The mission will employ high-performance lidar and radar technology that has never been flown in space before.

EarthCARE will deliver unprecedented datasets to allow scientists to study the relationship of clouds, aerosols and radiation at accuracy levels that will significantly improve our understanding of these highly variable parameters.

Mission details:

Launch Date: 2021

Duration: It has a design lifetime of three years, including a six-month commissioning phase.

The scientific objectives of the mission are:

- To observe vertical profiles of natural and anthropogenic aerosols on a global scale, their radiative properties and interaction with clouds***
- To observe vertical distributions of atmospheric liquid water and ice on a global scale, their transport by clouds and their radiative impact***
- To observe cloud distribution, cloud-precipitation interactions and the characteristics of vertical motions within clouds***
- To retrieve **profiles of atmospheric radiative heating and cooling** through the combination of the retrieved aerosol and cloud properties***

Biomass

The Earth Explorer **Biomass** will provide global maps of the amount of carbon stored in the world's forests and how this changes over time, mainly through absorbing carbon dioxide, which is released from burning fossil fuels.

Biomass will also provide essential support to UN treaties on the reduction of emissions from deforestation and forest degradation.

Due for launch in 2021, the satellite will carry the first **P-band synthetic aperture radar**, able to deliver accurate maps of tropical, temperate and boreal forest biomass. The global mass of trees is not obtainable by ground measurement techniques. The five-year mission will witness at least eight growth cycles in the world's forests.

FLEX

*The Earth Explorer mission, named Fluorescence Explorer (**FLEX**) will map vegetation fluorescence to quantify photosynthetic activity.*

The conversion of atmospheric carbon dioxide and sunlight into energy-rich carbohydrates through photosynthesis is one of the most fundamental processes on Earth – and one on which we all depend.

*Information from **FLEX** will improve our understanding of the way carbon moves between plants and the atmosphere and how photosynthesis affects the carbon and water cycles.*

*In addition, information from **FLEX** will lead to better insight into plant health and stress. This is of particular relevance since the growing global population is placing increasing demands on the production of food and animal feed.*

*At the moment, photosynthetic activity cannot be measured from space, but **FLEX's** novel sensor will observe this faint glow.*

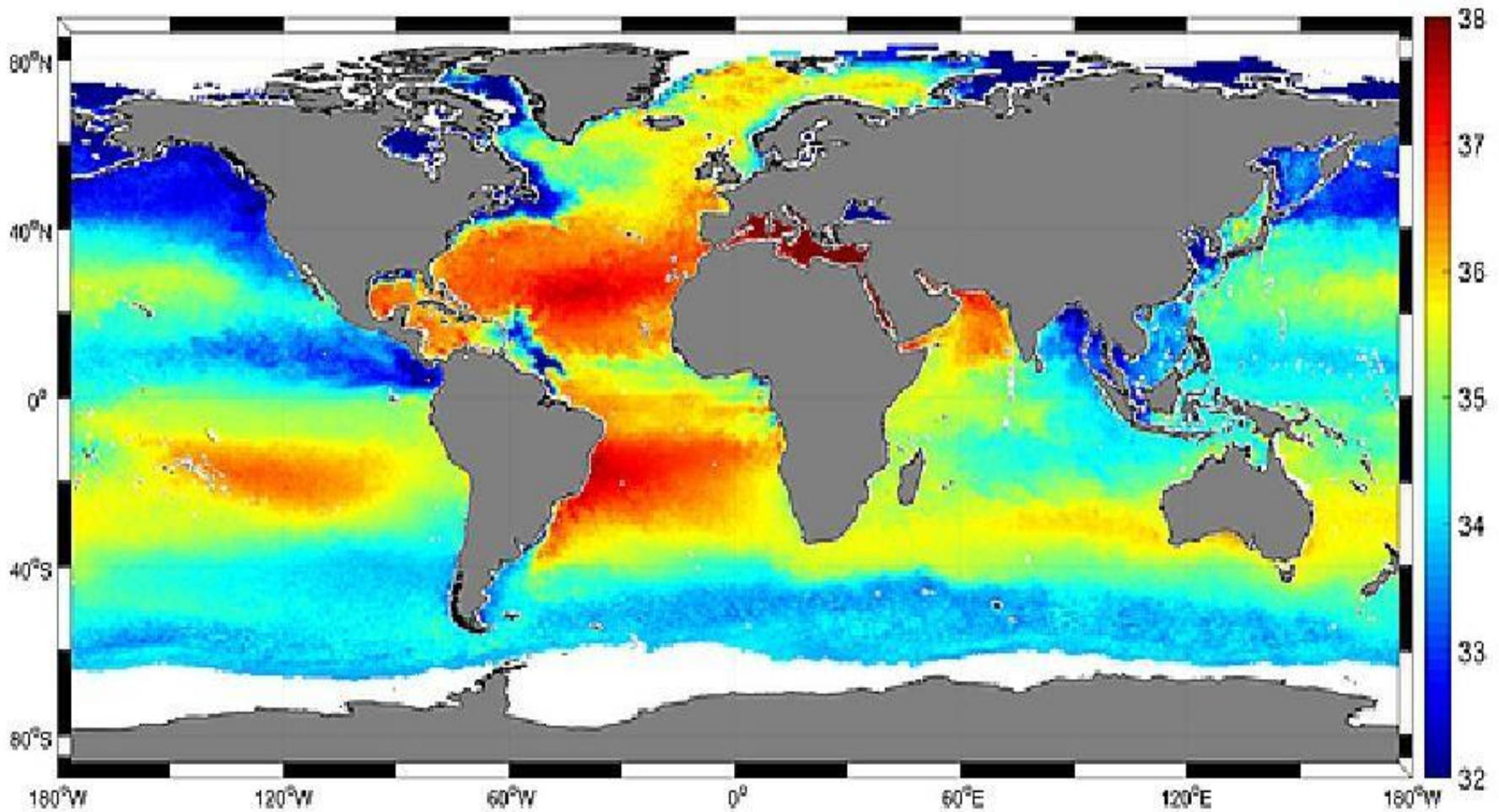
*The **FLEX** satellite will orbit in tandem with one of the Copernicus Sentinel-3 satellites, taking advantage of its optical and thermal sensors to provide an integrated package of measurements.*

Planned launch date: 2022

NASA's Achievements

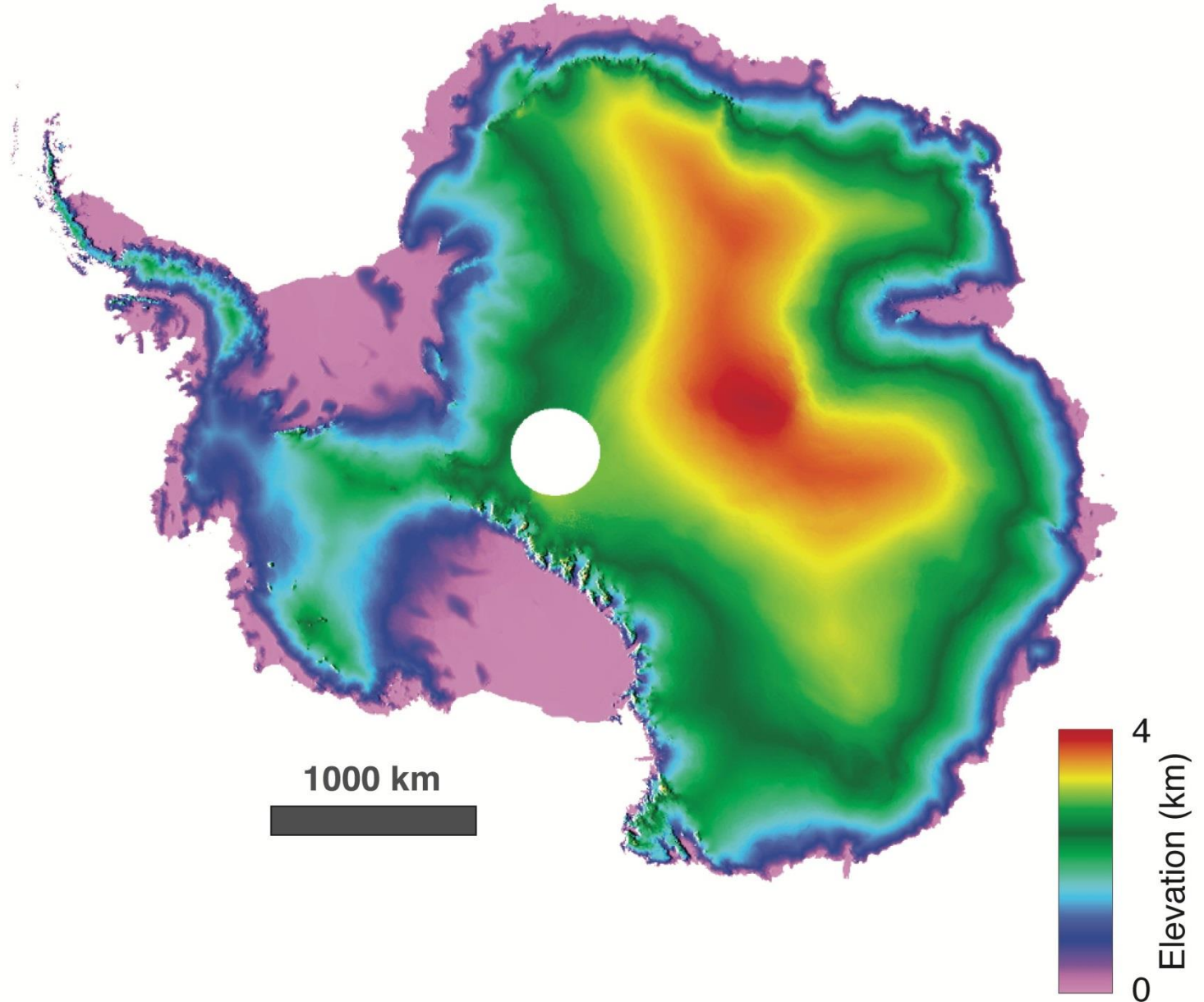
47 completed missions, 31 active, 24 future missions



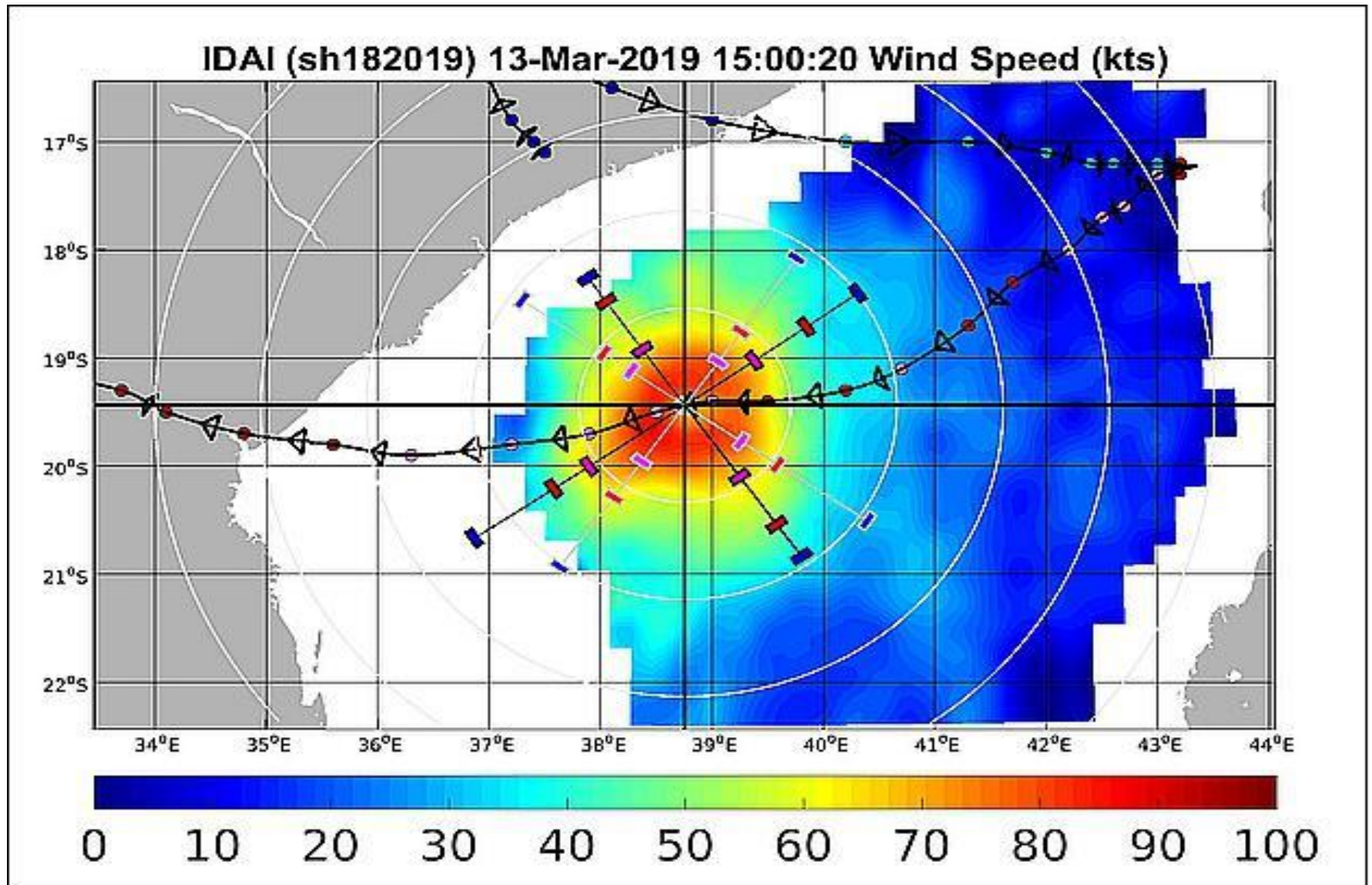


The most precise sea-surface salinity global dataset to date. Spanning nine years, the dataset is based on observations from the three satellite missions that measure sea-surface salinity from space - SMOS, SMAP and Aquarius (image credit: ESA-CCI)

Cryosat-2 - Most detailed topography of Antarctica



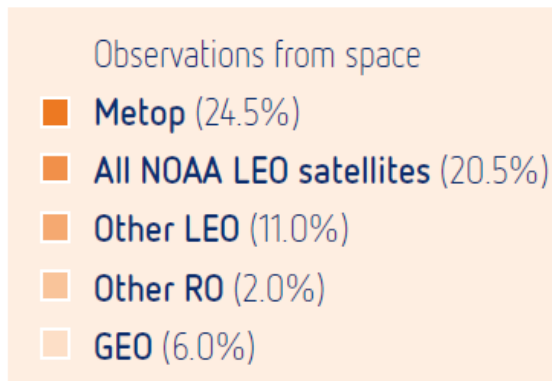
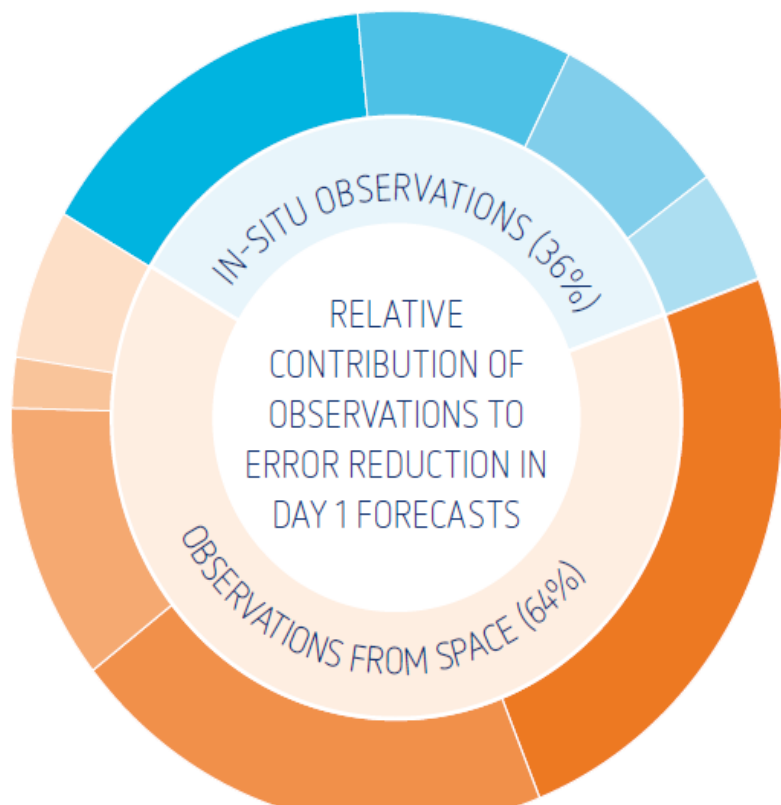
More precise surface wind speed measurements inside hurricanes



Why do European institutions give the best weather forecasts on global scale?

- Firstly, because we have a multilateral forecasting centre, the **ECMWF**, (jointly financed by most European meteorological services);***
- Whose constitution asks for 25 percent of the budget to be reserved for research;***
- Which leads to the best general circulation model of the atmosphere;***
- Secondly because we have **EUMETSAT**, again jointly financed by many European meteorological services, deploying in space leading geostationary and polar orbiting satellites;***
- Allowing **ECMWF** to assimilate many satellite observations into the global starting fields for the forecasts, thereby using the most sophisticated assimilation schemes;***
- Hence Europe and other regions save many billion EUROS per year by investing a few .***

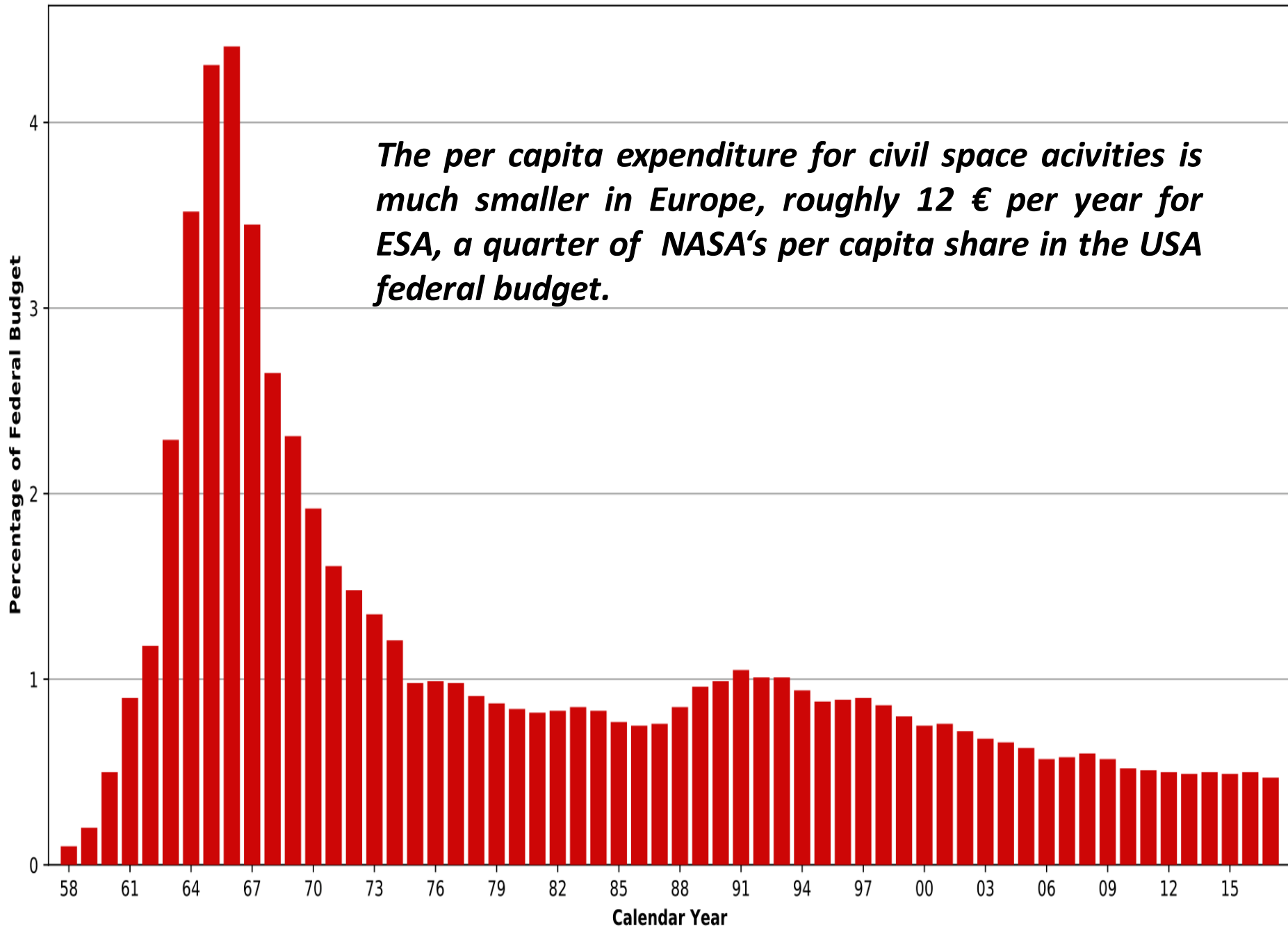
(NOAA is not the leader in this service to the citizens)



Another structural advantage for Europe

The European Space Agency - as a very experienced satellite mission selector, supervisor of construction by industry, with a technology centre supporting industry, also for developing launchers - supervises the construction of European Operational Meteorological Satellites selected by EUMETSAT

NASA Budget as a Percentage of Federal Budget



The per capita expenditure for civil space activities is much smaller in Europe, roughly 12 € per year for ESA, a quarter of NASA's per capita share in the USA federal budget.

Protection of Property & Infrastructure (avoided costs)

- Forecast information integrated into warning/civil protection systems limits economic losses due to *floods and storms*
 - Floods in Europe cost on average €4Bn/year
 - Storms in Europe cost on average €2.6Bn/year
- Based on published information, likely annual benefit of forecast information in limiting EU losses due to *floods and storms* is €2.75Bn
- Publications suggest that *forecasts of other severe phenomena* (risk of forest fires, snow, heat-waves, cold spells, etc.) *bring altogether benefits in the same order as for floods and storms*
- Likely aggregate benefit is €5.5Bn/year

What to do?

- ***Keep the proper mix between research missions and operational ones (EUMETSAT+ ESA+EU)***
- ***Better advertisement of the EO achievements to foster financial support in order to enhance the well-being in Europe and elsewhere (EUMETSAT and ESA are key foreign aid institutions)***
- ***Continue cooperation with other space agencies***