The Current EUMETSAT Polar System (EPS)

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The EUMETSAT Polar System

➢The EUMETSAT Polar System (EPS) is Europe's contribution to the global satellite observing system from low Earth orbit. From an altitude of about 817 km in sun-synchronous orbit (9:30 LST desc. node), the Metop satellites provide key imaging and atmospheric sounding data e.g. temperature and humidity, wind speed. Metop instruments provide also information on the atmospheric composition and chemistry, with unprecedented accuracy and resolution.

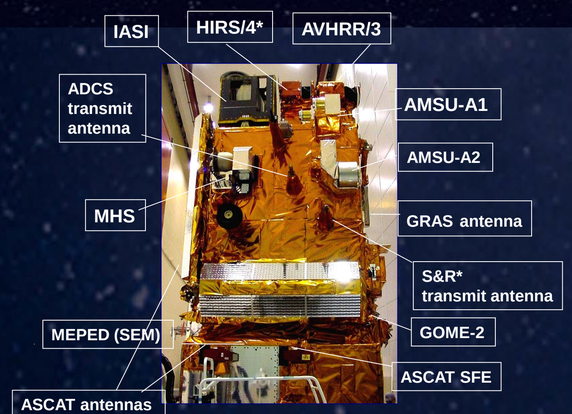
EPS data also contribute to oceanography, environmental sciences and Earth system research.

The Space Segment

Space Segment: Metop Satellites, developed jointly with the European Space Agency (ESA), Centre National d'Etudes Spatiales (CNES), and the US National Oceanic and Atmospheric Administration (NOAA).

Eight meteorological instruments:
- IASI (Infrared Atmospheric Sounding Interferometer) (CNES)
- HIRS/4 (High Resolution Infrared Radiation Sounder) (NOAA/NASA)
- AVHRR/3 (Advanced Very High Resolution Radiometer) (NOAA/NASA)
- AMSU-A (Advanced Microwave Sounding Unit-A) (NOAA/NASA)
- MHS (Microwave Humidity Sounder) (EUM)
- ASCAT (Advanced Scatterometer) (ESA)
- GOME-2 (Global Ozone Monitoring Experiment-2) (ESA)
- GRAS (GNSS (Global Navigation Satellite System) Radio Occultation Atmospheric Sounder) (ESA)

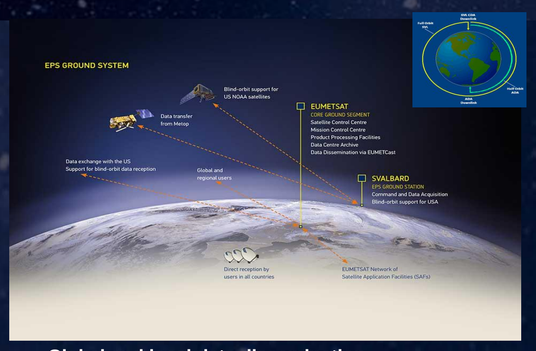
The Instruments



- ADCS – Advanced data Collection System
- SEM – Space Environment Monitor
- SAR – Search and Rescue

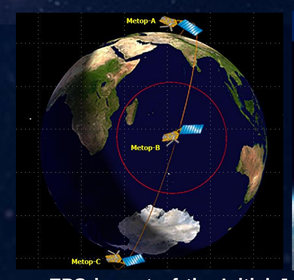
*HIRS/4 and SARR/SARP not on Metop-C

The Ground Segment and Services



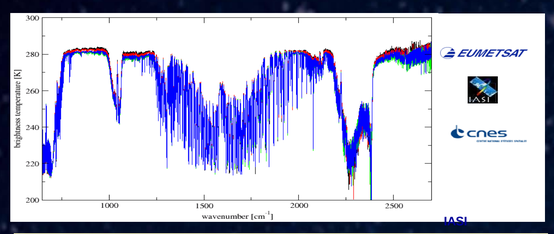
- Global and local data dissemination
- Archiving of products
- Central (EUMETSAT HQ) and decentral (Satellite Application Facilities (SAF)) Ground segment components

Continuity over 20+ years (2006 – 2027+)

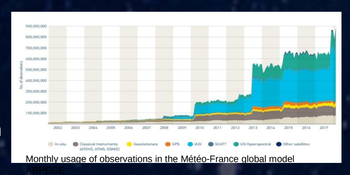


- EPS is part of the Initial Joint Polar System (IJPS) with the US
- Currently three Metop satellites in orbit after launch of Metop-C (7 November 2018) (Metop-A 19 October 2006, Metop-B 17 September 2012)
- Services far beyond lifetime (5 years nominally) provide continuity and long data series
- Metop-A drifting, end of life about end 2021/(?22)

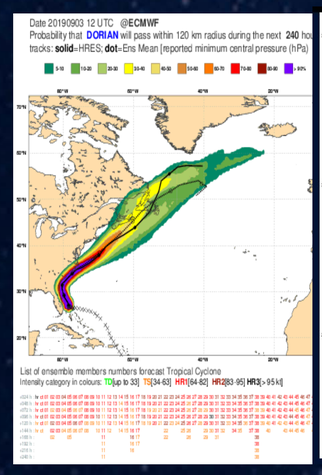
Main mission: Support Operational Meteorology

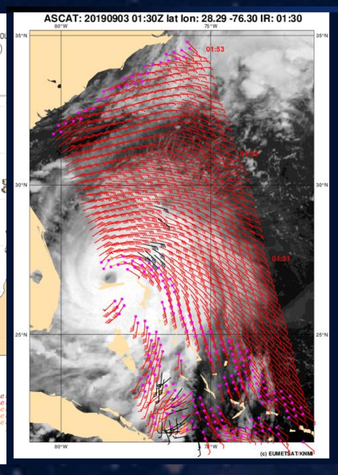


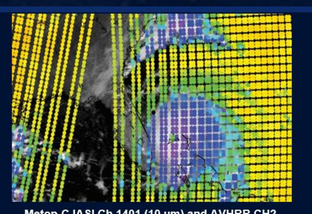
Global three dimensional information on temperature and humidity at high vertical resolution
- IASI
- AMSU-A
- MHS
- GRAS



Satellite based observations are the main contributors to global NWP (Source: Météo-France)

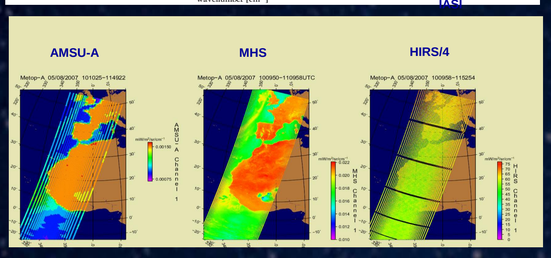




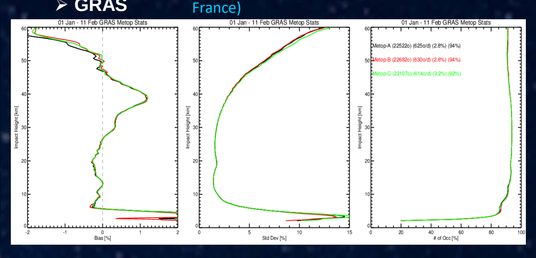


Metop-C IASI Ch 1401 (10 µm) and AVHRR CH2
02 Sep 2019

AVHRR Metop-C AVHRR RGB Ch221
01 Sep 2019

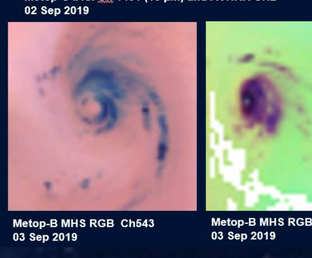


Assimilation of Global Data into Global Numerical Weather Prediction



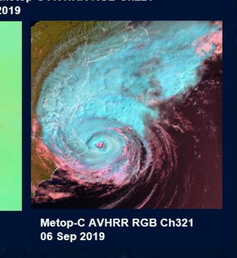
Already in Metop-C commissioning strong consistency was demonstrated between the three GRAS instruments on the three Metop Satellites.

Good measurements allow forecasting of extreme events like Hurricane Dorian in Septmber 2019 (Tracking plot Courtesy ECMWF, 2019, ASCAT plot courtesy OSI SAF (KNMI))



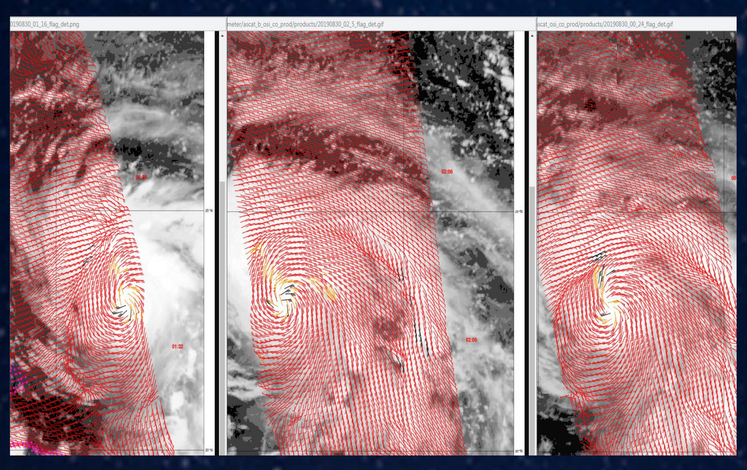
Metop-B MHS RGB Ch543
03 Sep 2019

Metop-B MHS RGB Ch123
03 Sep 2019

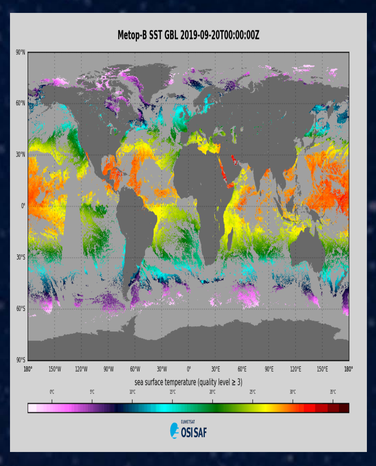


Metop-C AVHRR RGB Ch321
06 Sep 2019

Marine Applications with EPS



Hurricane Dorian seen by three ASCAT instruments on the 30 August 2019, 00:50 to 2:05 UTC.
Courtesy Ad Stoffelen, Ocean and Sea Ice Satellite Application Facility (KNMI)



Global Sea Surface Temperatures derived from Metop-B 20 September 2019, Courtesy Ocean and Sea Ice Satellite Application Facility

EPS/METOP marine products have a large impact

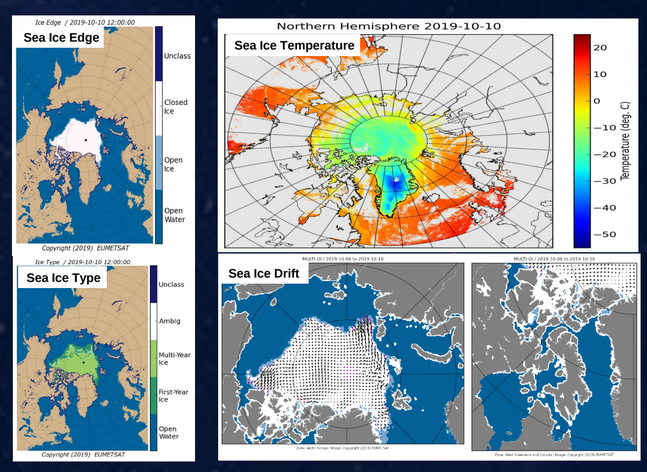
➢ They bring significant information on the ocean/atmosphere interface in meteorological and oceanographic models

➢They serve many marine end-users:

➢Ocean Science: study the Ocean, its mechanisms and variability (all space and time scales)

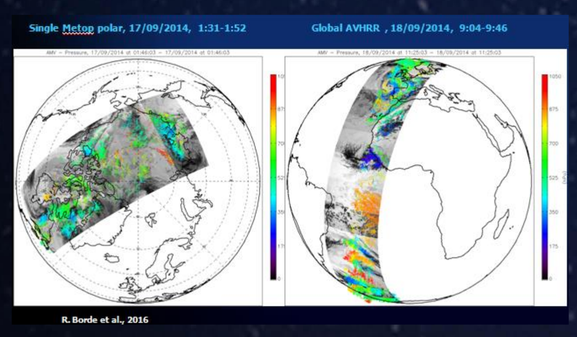
➢Climate science: study the Ocean as a main regulator of the climate system

➢Marine people: they evolve in this environment (marine, fishing, navigation, oil and gas industry…)



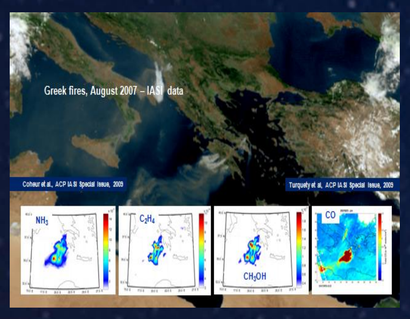
Sea Ice Products 10 Oct 2019 (Ocean and Sea Ice Satellite Application Facility)

EPS/Metop AVHRR/3 AMV

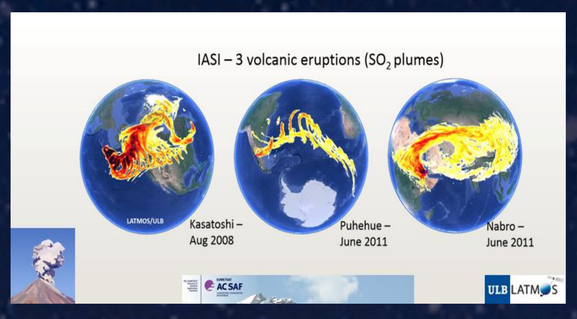


Global and Polar Atmospheric Motion Vectors (AMV) from single and multiple AVHRR/3 Imagery

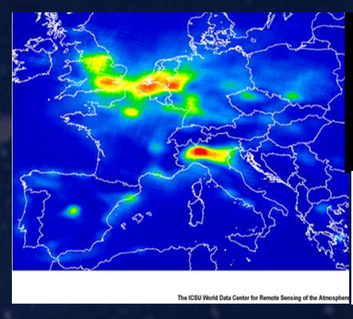
EPS/Metop Atmospheric Composition



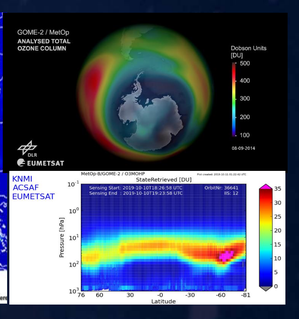
Beyond expectations: Trace gases resulting from Forest fires 2007, ULB /LATMOS 2008



Volcanic Ash Monitoring with IASI (Atmospheric Composition Satellite Application Facility (AC SAF))



Total amount of nitrogen dioxide (NO_2) in the atmosphere above Europe derived from one year of data from the GOME-2 instrument on Metop-A (March 2007 - February 2008. (AC SAF)

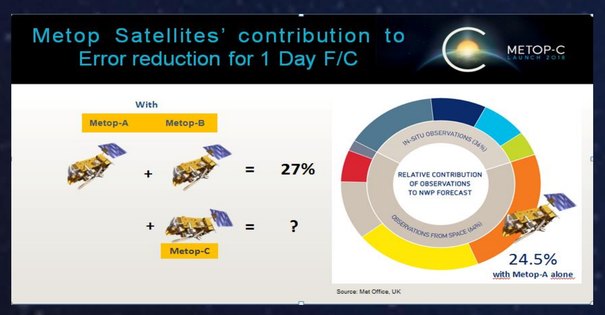


Ozone Monitoring, 10 Oct. 2019:
Total Column (top, Source: AC SAF (DLR)) and Profile (bottom, Source: AC SAF (KNMI))

EPS/Metop Contribution to Climate Monitoring

Courtesy of GCOS, 2018	Atmosphere	Terrestrial	Ocean
Energy & Temperature	Surface Radiation Budget, Earth Radiation Budget, Surface Temperature, Upper Air Temperature, Surface and Upper Air Wind Speed	Albedo, *Latent and Sensible Heat fluxes*, Land Surface Temperature	Ocean Surface Heat Flux, Sea Surface Temperature, Subsurface Temperature
Other Physical Properties	Surface Wind, Upper Air Wind, Pressure, Lightning, Aerosol Properties		Surface Currents, Subsurface Currents, Ocean Surface Stress, Sea State, Transient Tracers
Carbon Cycle and other GHGs	Carbon Dioxide, Methane, Other long-lived GHG, Ozone, Precursors for Aerosol and Ozone	Soil Carbon, Above-ground Biomass	Inorganic Carbon, Nitrous Oxide
Hydrosphere	Precipitation, Cloud Properties, Water Vapour (Surface), Water Vapour (Upper Air), Surface Temperature	Soil Moisture, River Discharge, Lakes, Groundwater	Sea Surface Salinity, Subsurface Salinity, Sea Level, Sea Surface Temperature
Snow & Ice		Glaciers, Ice Sheets and ice shelves, Permafrost, Snow	Sea Ice
Biosphere		Land Cover, Leaf Area Index (LAI), Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), Fire	Plankton, Oxygen, Nutrients, Ocean Colour, Marine Habitat Properties
Human Use of Natural Resources		Water Use, Greenhouse Gases (GHG) Fluxes	Marine Habitat Properties

EPS/Metop Benefit: Forecast Error Reduction



Under Development: EUMETSAT Polar System Second Generation Continuity for 20+ further years: 2022– 2042+

- Major improvements to all EPS observation missions
  - Infrared and microwave sounding
  - Optical imagery (METImage, developed by DLR)
  - Scatterometer
  - Radio occultation
- New imagery missions:
  - 3MI: first operational imaging polarimeter
  - MWI: microwave imagery of precipitation
  - ICI: Ice Cloud Imagery

RDK 19