Overview of EUMETSAT Satellite Programmes

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EUMETSAT

Some Highlights of 2012

- **Successful launch of MSG-3 (Meteosat-10) from Kourou on 5 June 2012**
- **Successful launch of Metop-B on 17 September 2012 from Baikonur**
- **Meteosat Third Generation Programme is making good progress (it is a two-satellite system with four instruments)**
- **EPS-Second Generation (follow-on to Metop series): Preparatory Program has been agreed by EUMETSAT Member States**

Current Polar-orbiting satellites: EUMETSAT Polar System

Europe's first series of polar-orbiting meteorological satellites

3 Metop satellite for at least 14 years of operations (mid morning orbit)

Metop-A launched in 2006

Metop-B launched in 2012

Metop-C launch planned early 2018

Part of Initial Joint Polar System shared with NOAA

Missions and Payload

- Imagery (VIS, IR), sounding (IR, MW, UV, GPS occultation), radar (Ascat)
- direct broadcasting and data collection capabilities

Applications

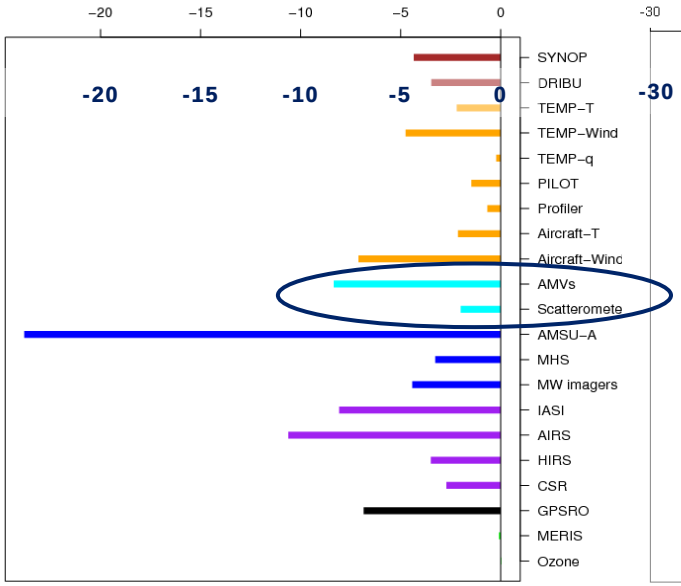
- Numerical Weather Prediction and Nowcasting at high latitudes
- Marine meteorology and oceanography
- Air quality, atmospheric chemistry

Products from Meteosat:

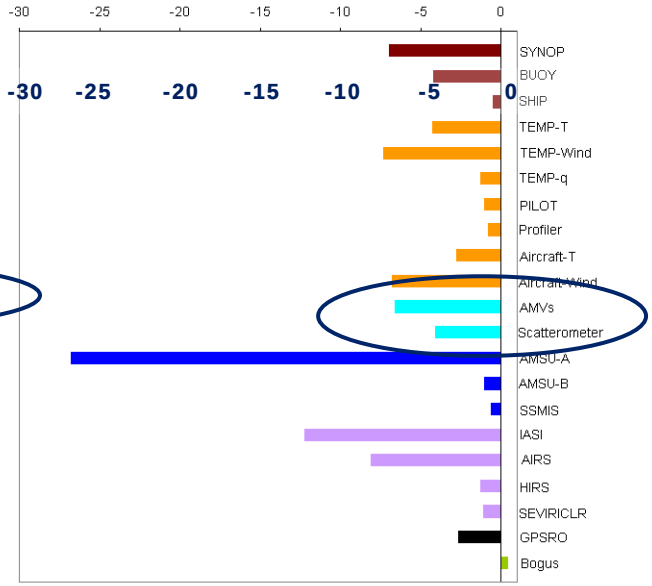
Atmospheric Motion Vectors (AMVs) have been improved

Note: AMVs have high positive impact on NWP

- **AMV impact intercomparison study (two seasons):**
  - **Participating NWP Centers: DWD, ECMWF, JMA, KMA, Meteo-France, NRL, UKMO**
- **Forecast Sensitivity to Observations (FSO) => estimates contribution of each observation to reduction of forecast error (over 24-hour)**
  - **Error reduction at NWP centers in good agreement: AMV: 7-11%; Scatterometers: 3-5%**

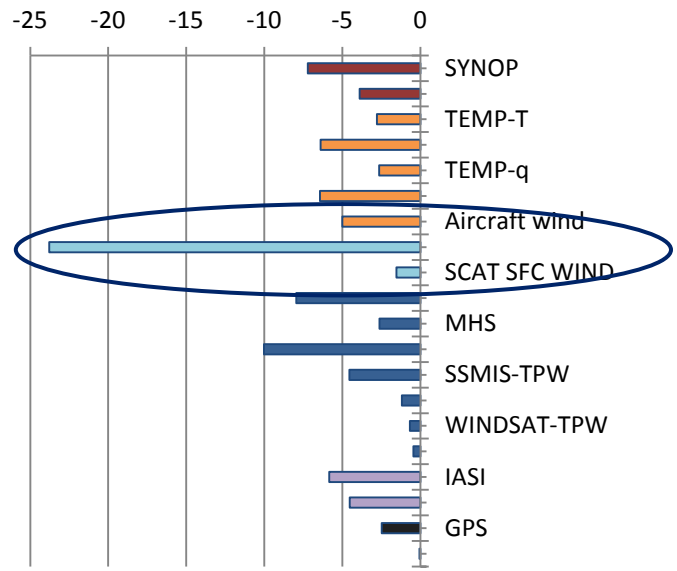


ECMWF



Met Office

(*J. Daniels et al., 2012*)



NRL

EUMETSAT

Improving Satellite Atmospheric Motion Vectors (Winds) with future Geostationary Imagers

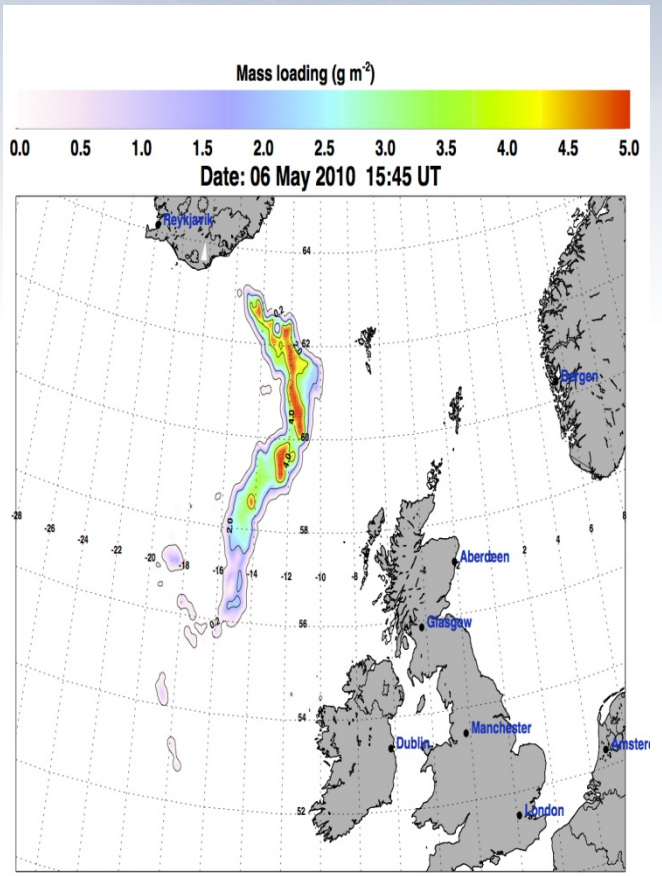
- **Development of AMVs has been coordinated for some 20 years through the International Winds Working Group of CGMS (Coordination Group for Meteorological Satellites)**

- **This coordinated development and sharing of progress has led to improved impact on NWP and more consistent characteristics of AMV products**

- **High potential with future imagers in geostationary orbit:**
  - Future imagers *(Himawari-8/9 AHI, FY-4 AGRI, GOES-R ABI, MTG FCI, Geo-KOMPSAT-2, ….)*
  - Common methods for height assignment of tracers (clouds) using various multi-channel approaches (water-vapor intercept method, CO2-slicing, ...)
  - Higher spatial and temporal resolution opens the way toward high-density winds for nowcasting applications

Example of volcanic ash retrieval from Meteosat-9

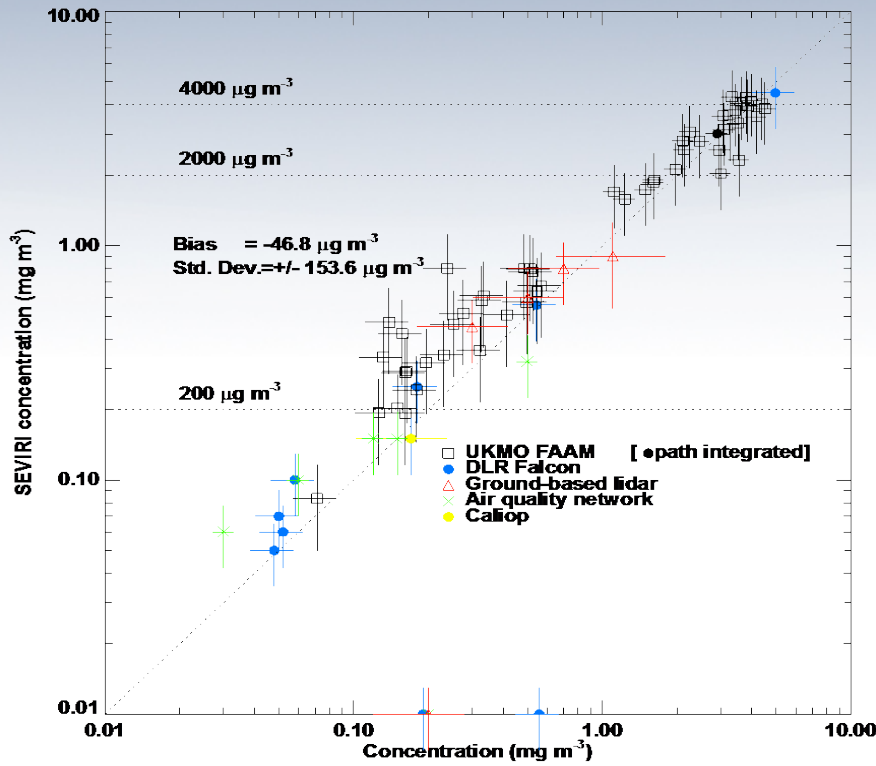
=> will be improved with future imagers



Ash massloading determined from SEVIRI (only split-window used!)

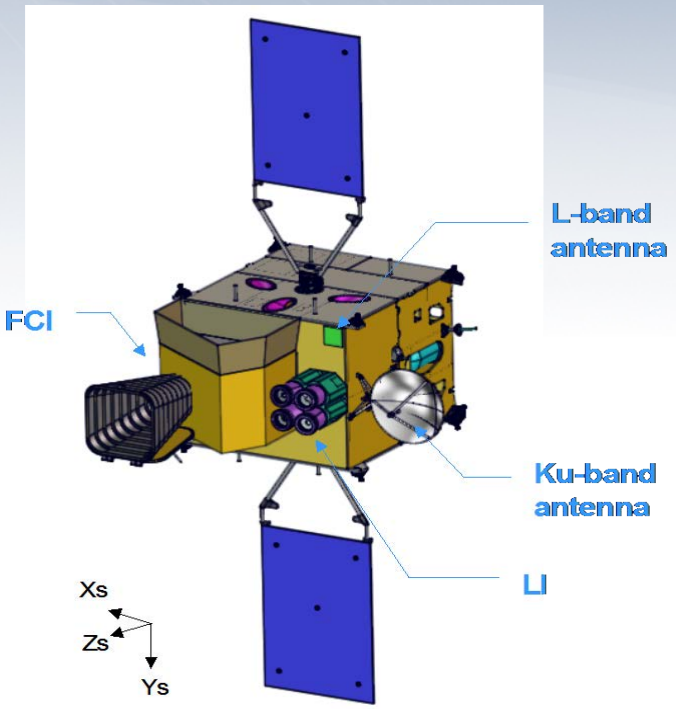
Eyjafjallajökull eruption on 6 May, 2010 at 15:45 UT

(F. Prata, 2012)



Validation of satellite-based SEVIRI ash concentrations against independent measurements from 5 different sources (F. Prata, 2012)

Meteosat Third Generation (MTG) In-Orbit Configuration
=> An imaging and a sounding satellite



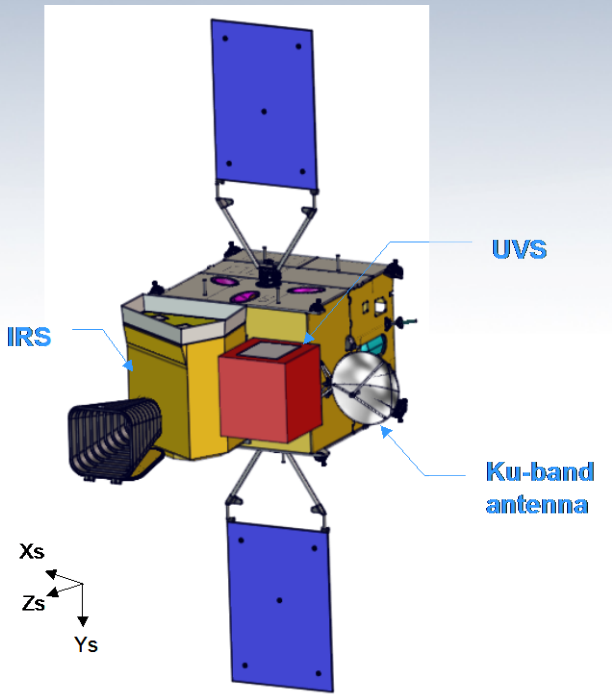
Payload of MTG-I:

- **Flexible Combined Imager (FCI)**
- **Lightning Imager (LI)**
- Data Collection System (DCS) and Search and Rescue (GEOSAR)

Payload of MTG-S:

- **Infrared Sounder (IRS)**
- **Ultra-violet, Visible and Near Infrared Sounder (UVN).**

(UVN is provided as GMES Sentinel 4 Instruments)



MTG: Joint development by ESA and EUMETSAT

- ESA develops the **MTG-I**mager and **MTG-S**ounder proto-flight satellites
- EUMETSAT procures recurrent MTG satellites with ESA as a procurement agent
- EUMETSAT:
  - operates the Meteosat satellites
  - delivers data and products (e.g. for use in Nowcasting and Numerical Weather Prediction)
  - Reprocesses data and products for climate applications and services

- Note: Also includes operations of **Satellite Application Facilities** (SAF) => i.e. a **broad user and developer community** is directly embedded within the MTG Programme

- Launch of first Imaging Satellite **MTG-I** in 2018

MTG Provides a Total of Five Missions:

- **Flexible Combined Imager (FCI):** Full Disk Scan Service (FCI-FDSS), global scales (Full Disk) , RC = 10 min, with 16 channels at spatial resolution of 1 km (8 solar channels) and 2 km (8 thermal channels)

- FCI - Rapid Scan Service (FCI-RSS), local scales (1/4th of Full Disk): RC = 2.5 min; 4 channels at high spatial resolution 0.5 km (2 solar channels), and 1.0 km (2 thermal channels)

- **Infrared Sounder (IRS):** global scale - Full Disk Soundings: RC = 15 min per 1/4th of Full Disk with a 6 h repeat sequence, European zone every 30 minutes, spatial resolution of 4 km, hyperspectral soundings at 0.625 cm^{-1} spectral sampling
  two bands: Long-Wave-IR (LWIR: 700 – 1210 cm^{-1} ~ 820 spectral samples)
  Mid-Wave-IR (MWIR: 1600 – 2175 cm^{-1} ~ 920 spectral samples)

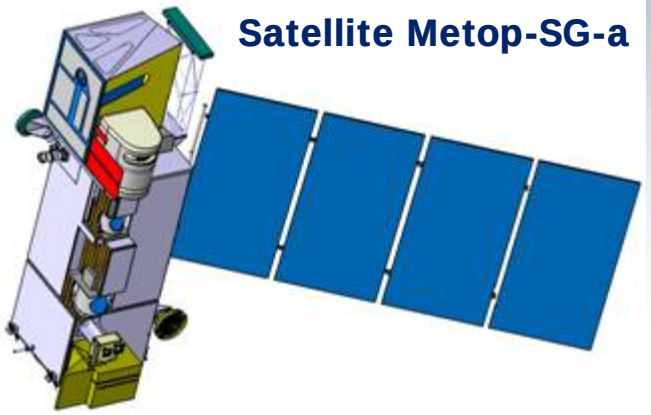
- **Lightning Imager (LI):** continuously observing 80% of Full Disk; integration Time~1.5ms; detection/mapping of Intra-Cloud and Cloud-Ground strokes at ~10km spatial resolution DE=90% (night) and DE=40% (overhead sun)

- **Ultra-violet Visible Near-Infrared Sounder (UVN):** GMES Sentinel 4 instruments provided by ESA

EPS-SG in-orbit configuration

NOTE: Preparatory Program approved by EUMETSAT Council

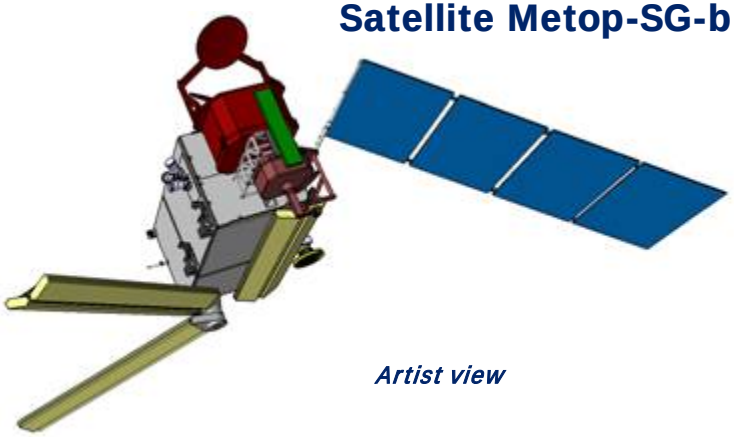
Satellite Metop-SG-a



Artist view

Satellite-a Payload	METimage IASI-NG MWS 3MI Sentinel-5 RO
Dry mass	~ 3250 kg
Launch mass	~ 3661 kg
Power	~ 2.3 kW
P/L data rate	~ 54 Mb/s

Satellite Metop-SG-b



Artist view

Satellite-b Payload	SCA MWI ICI ARGOS-4 RO
Dry mass	~ 2928 kg
Launch mass	~ 3339 kg
Power	~ 2.0 kW
P/L data rate	~ 6.3 Mb/s

EPS-SG space segment

Two-Satellite Configuration

Overall lifetime

21 years

Earliest launch date (first satellite)

end 2020

Orbit

Metop orbit @ 09:30 LTDN

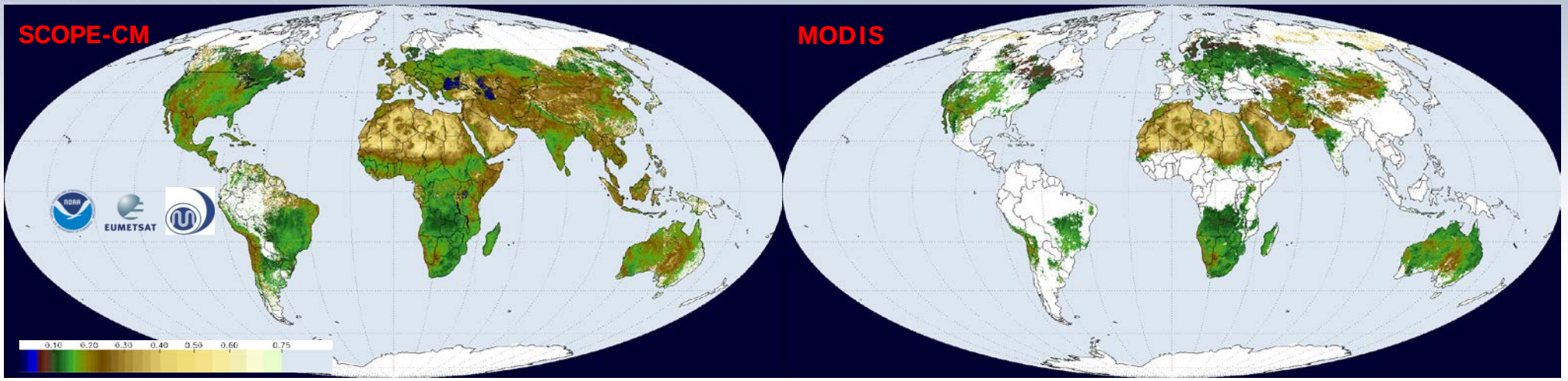
Phasing of Sat-a and Sat-b is **180°**

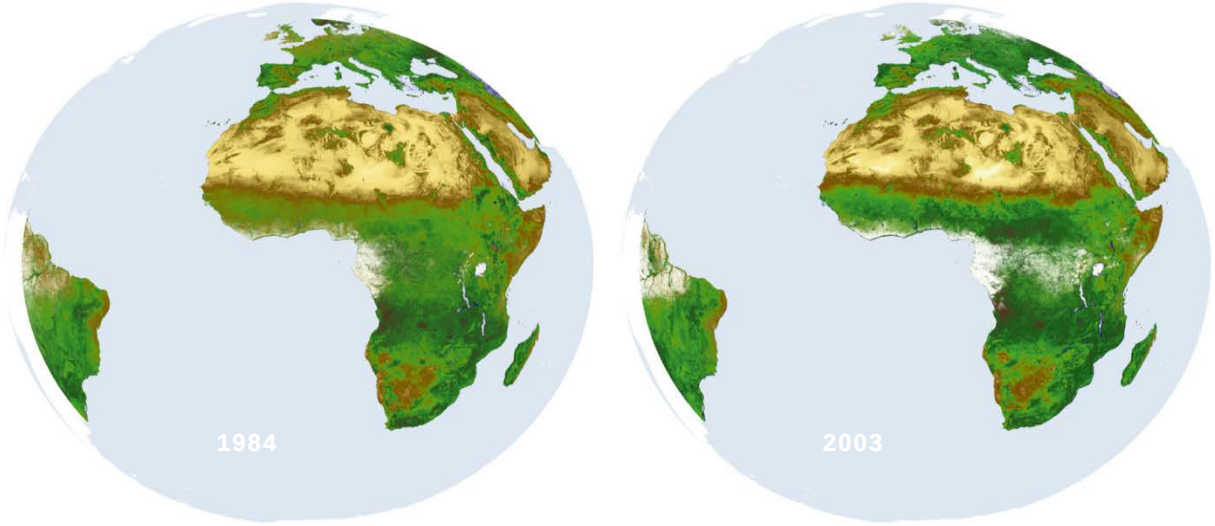
EPS-SG Observation Missions

Mission	Instrument	Applications Benefitting
Hyper-spectral Infrared Sounding	IASI-NG	NWP, NWC, Air Quality, CM
Visible/Infra-red Imaging	METimage	NWC, NWP, CM, Hydrology, Oceanography
Microwave Sounding	MWS	NWP, NWC, CM
Radio Occultation Sounding	RO	NWP, CM
Nadir viewing UV/VIS/NIR/SWIR Sounding	Sentinel 5	Ozone-UV, Air Quality, CM, Composition-Climate interactions
Multi-viewing, -channel, -polarisation Imaging	3MI	Air Quality, CM, NWC
Scatterometry	SCA	NWP, NWC, Oceanography, Hydrology
Microwave Imaging	MWI	NWP, NWC, Hydrology, CM, Oceanography
Ice Cloud Imaging	ICI	NWP, NWC, Hydrology, CM

NWP: Numerical Weather Prediction; NWC: Nowcasting; CM: Climate Monitoring

Climate Monitoring:
Example: Surface Albedo from geostationary satellites –
Contribution to SCOPE-CM





- **Algorithm successfully exported to and implemented at three space agencies;**
- **Results jointly published in BAMS;**
- **Efficient product validation performed by independent scientists in Europe;**
- **Coordinated Reprocessing in SCOPE-CM Phase-2 envisioned.**

Concluding Remarks (1)

- MSG-3 satellite will become operational in early 2013 and named Meteosat-10; MSG-4 launch in early 2015 with in-orbit storage
- Metop-B will become operational in the 2nd quarter of 2013
- Dual-mission operation of Metop-A and Metop-B
- Antarctic Data Aquisition (ADA) Service provided on average 12.3 passes per day from McMurdo
- ADA will support Metop-B
- Indian Ocean Data Coverage (IODC): Council agreed to extend the MTP Programme (Meteosat-7) for a further period of 3 years (2014-2016) at 57.5° E over the Indian Ocean. Nominal longitude and attitude control; but no orbit inclination manoeuvres

Concluding Remarks (2)

- Operational products => various improvements throughout 2012; examples shown: AMVs (winds from geo) and volcanic ash monitoring
- Climate products => reprocessing or new processing ongoing, example shown: Surface albedo from geostationary satellites (coordinated with other satellite operators within SCOPE-CM)
- Data from Suomi NPP are being disseminated via EUMETCast and GTS (CrIS, ATMS and VIIRS)
- NEW Programs:

a) *Meteosat Third Generation (MTG): good progress; first launch in 2018*

b) *EPS-Second Generation (i.e. Metop follow-on): Preparatory Program approved by Council*