EARS-NWC SERVICE: NRT NOWCASTING PRODUCTS ON EUMETCAST

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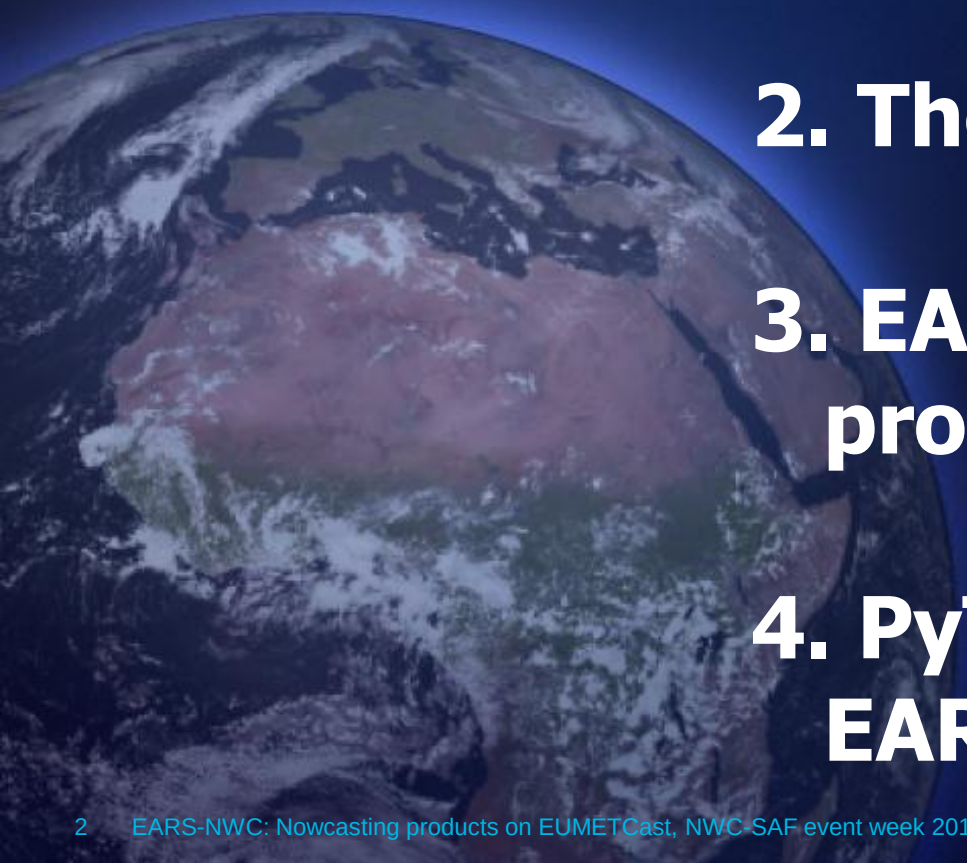
OVERVIEW



1. EUMETSAT data distribution mechanisms
2. The EARS service
3. EARS-NWC , Nowcasting products in NRT
4. PyTROLL: Make use of EARS-NWC

EUMETSAT is an intergovernmental organisation with 27 Member and four Cooperating States

Member States

AUSTRIA
BELGIUM
CROATIA
CZECH REPUBLIC
DENMARK
ESTONIA
FINLAND
FRANCE
GERMANY
GREECE
HUNGARY
IRELAND
ITALY
LATVIA
LUXEMBOURG
NETHERLANDS
NORWAY
POLAND
PORTUGAL
ROMANIA
SLOVENIA
SPAIN
SWEDEN
TURKEY
UNITED KINGDOM

Cooperating States

BULGARIA
ICELAND
LITHUANIA
SERBIA

Where do you live?

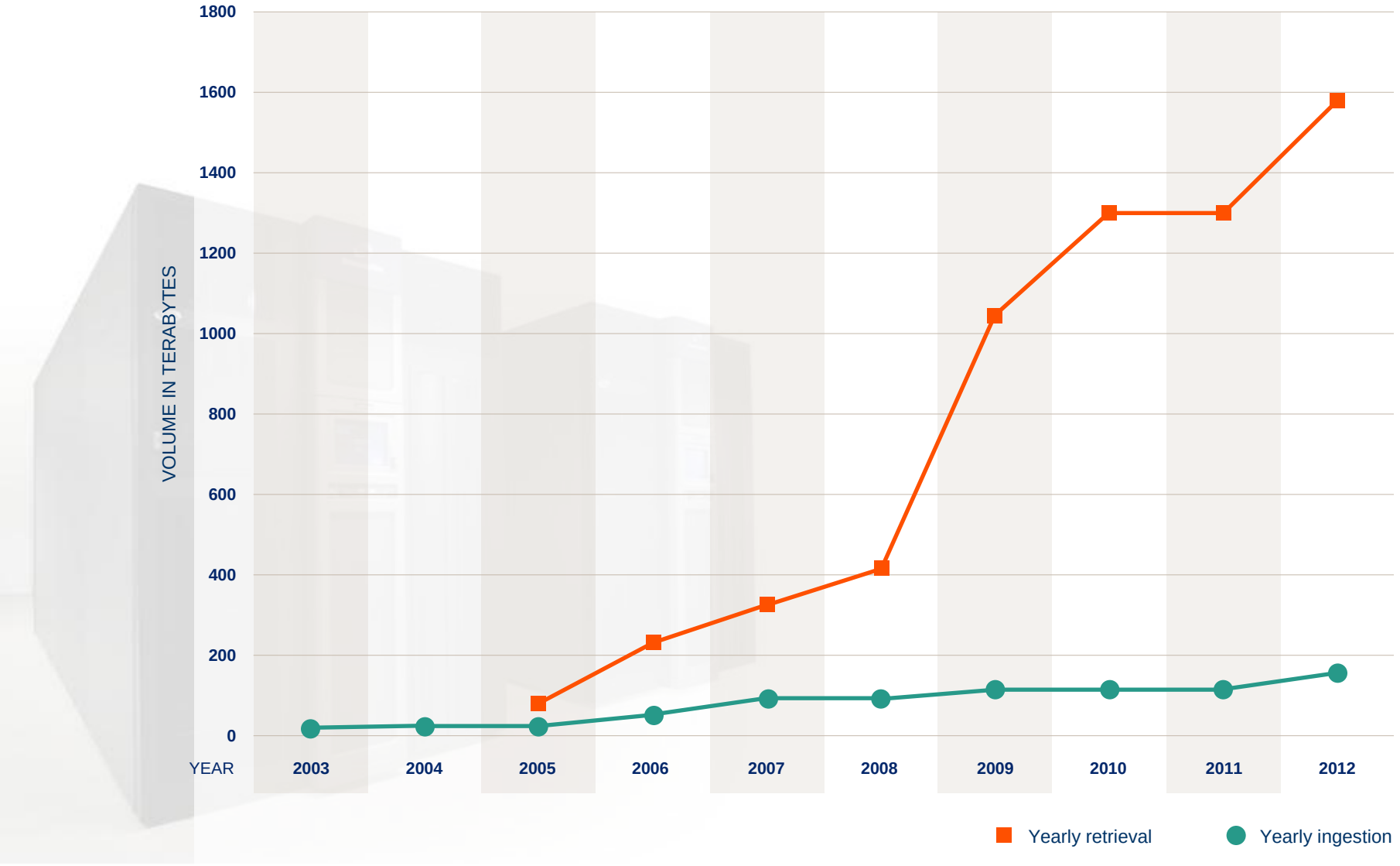
EUMETSAT headquarters

DATA ACCESS 1 (ARCHIVE)

EUMETSAT Data Centre

- Archive dating back to 1981
- Over 530 Terabytes stored
- 1.4 Petabytes retrieved annually
- Raw and reprocessed data, centrally and decentrally produced
- Networked with Satellite Application Facilities (SAFs)
- Access online via Product Navigator

EUMETSAT Data Centre



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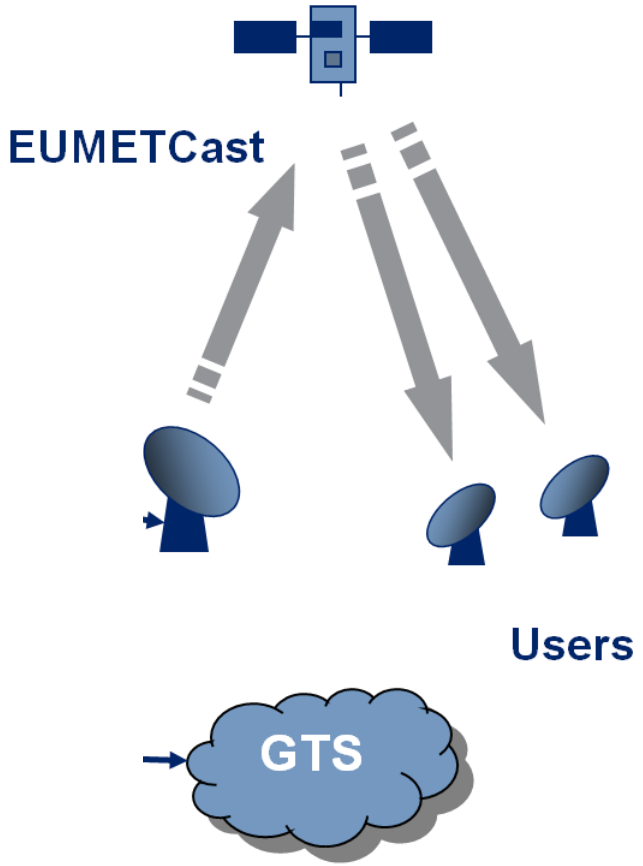
DATA ACCESS 2 (EUMETCAST)

Distribution Channels for EUMETSAT Services

EUMETCast

- Digital Video Broadcast via Satellite (DVB-S)
- Around 3000 Users in Europe (Ku-Band)
- Simple and Affordable Reception Stations
- Current Data Rate 20 Mb/s
- Carries all data of Meteosat, Metop and Jason-2 as well as many third party data sets



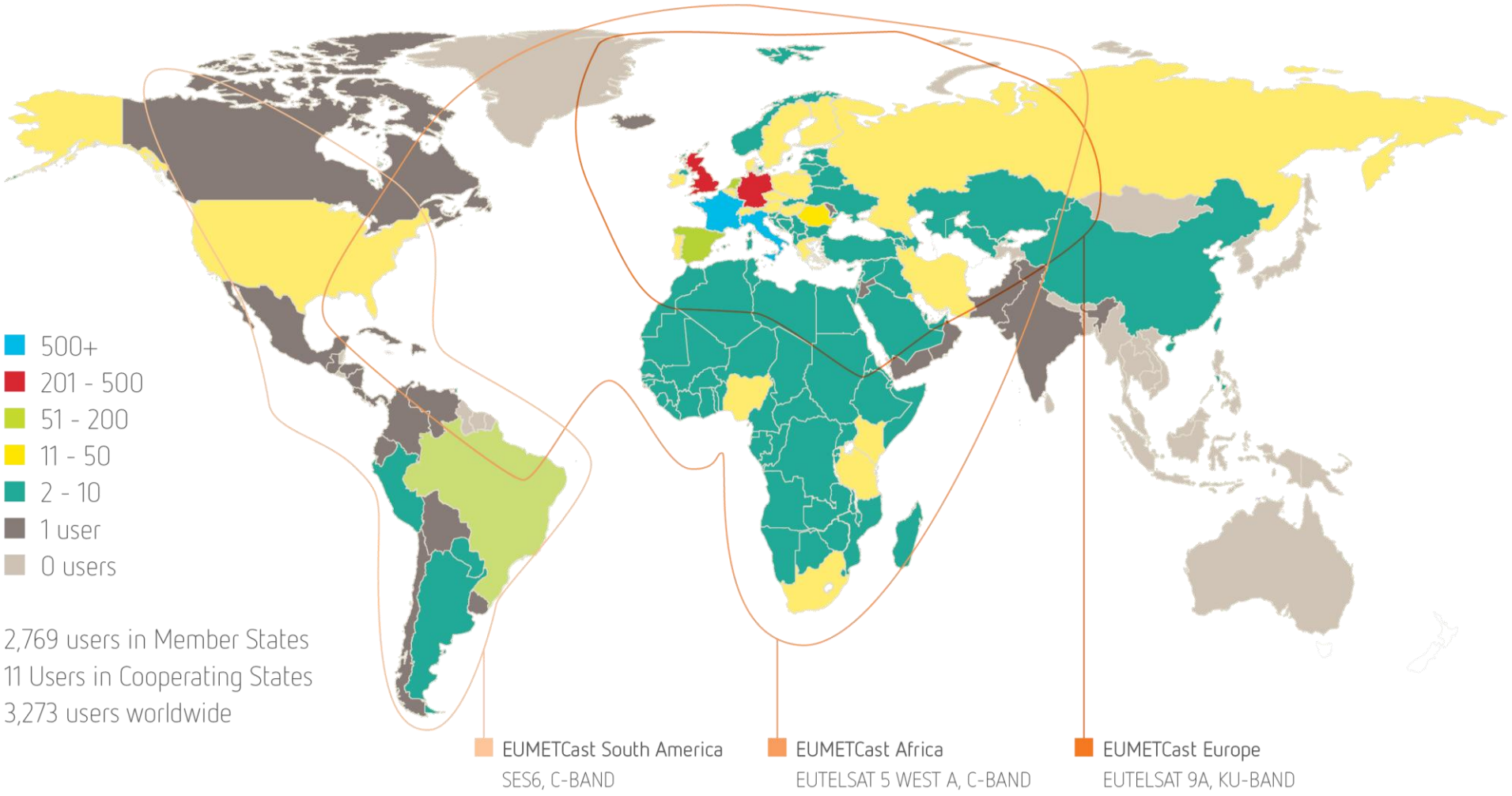
Global Telecommunication System (GTS)

- Established by the World Meteorological Organization (WMO)
- EUMETSAT distributes selected data sets on GTS, including Sounder Data

EUMETCast data dissemination

- EUMETSAT's primary dissemination mechanism for the near real-time delivery.
- Disseminates satellite data and products generated by the EUMETSAT Application Ground Segment and a range of **third-party products**.
- Multi-service dissemination system based on standard Digital Video Broadcast (DVB) technology.
- Uses commercial telecommunication geostationary satellites to multicast files directly to the user community.
- EUMETSAT's contribution to GEONETCast.

Delivering to users worldwide



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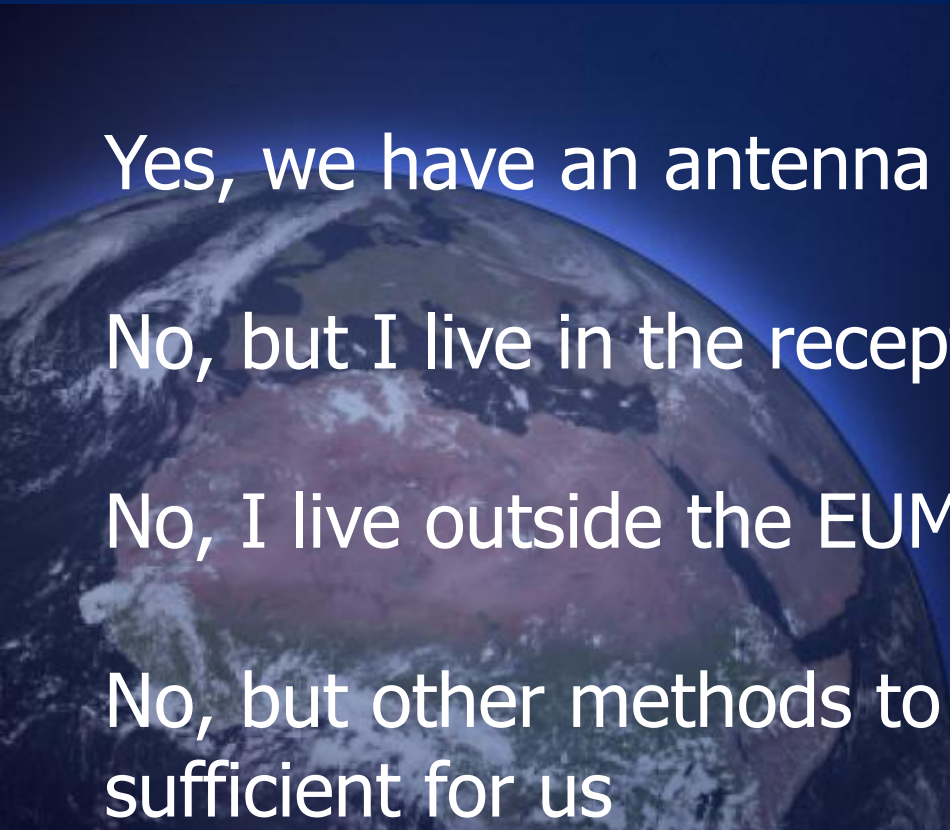
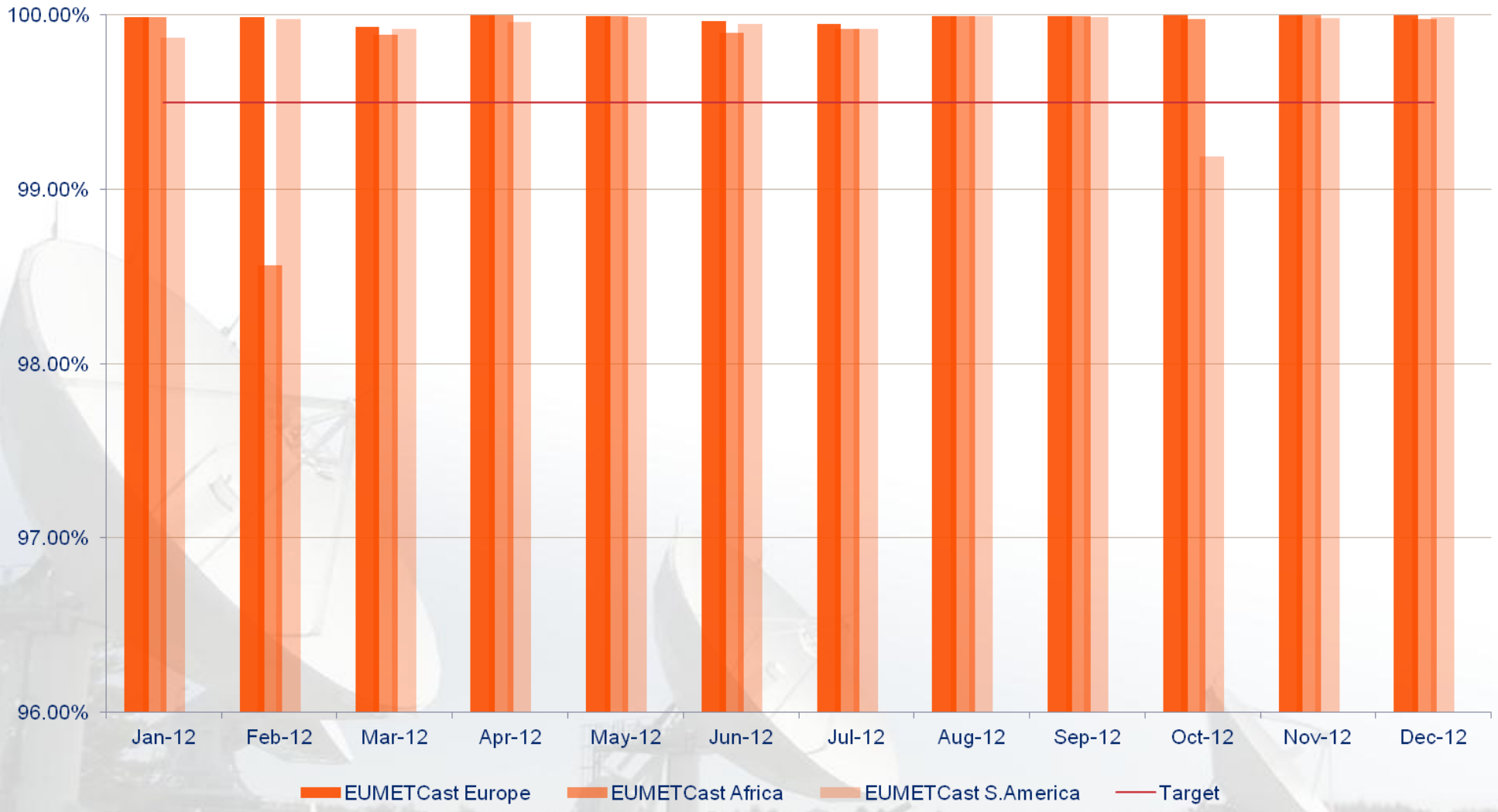
Question: Do you have access to EUMETCast data ?



- Yes, we have an antenna ☐
- No, but I live in the reception area ☐
- No, I live outside the EUMETCast reception range ☐
- No, but other methods to get satellite data are sufficient for us ☐

EUMETCast availability 2012



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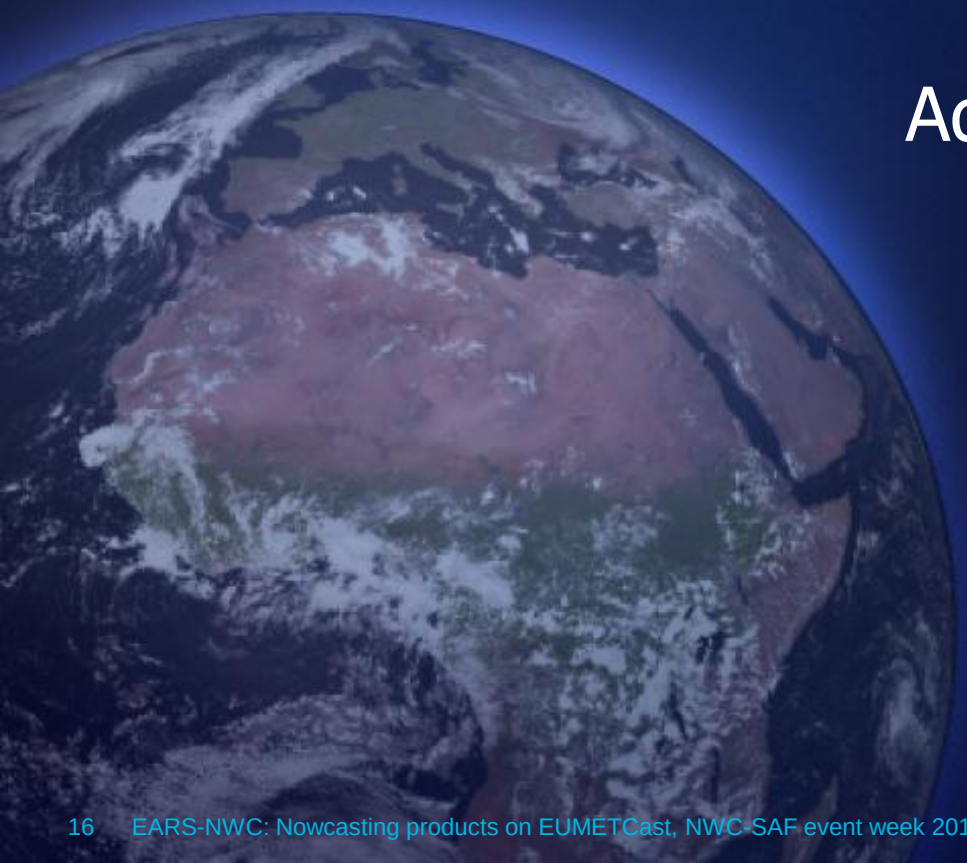
EUMETCast antennas in:

East-Africa and Iceland

The EUMETSAT Advanced Retransmission Service (EARS)

Question on EARS:



Do you know the EUMETSAT Advanced Retransmission service (EARS) ?

Yes ☐

No ☐

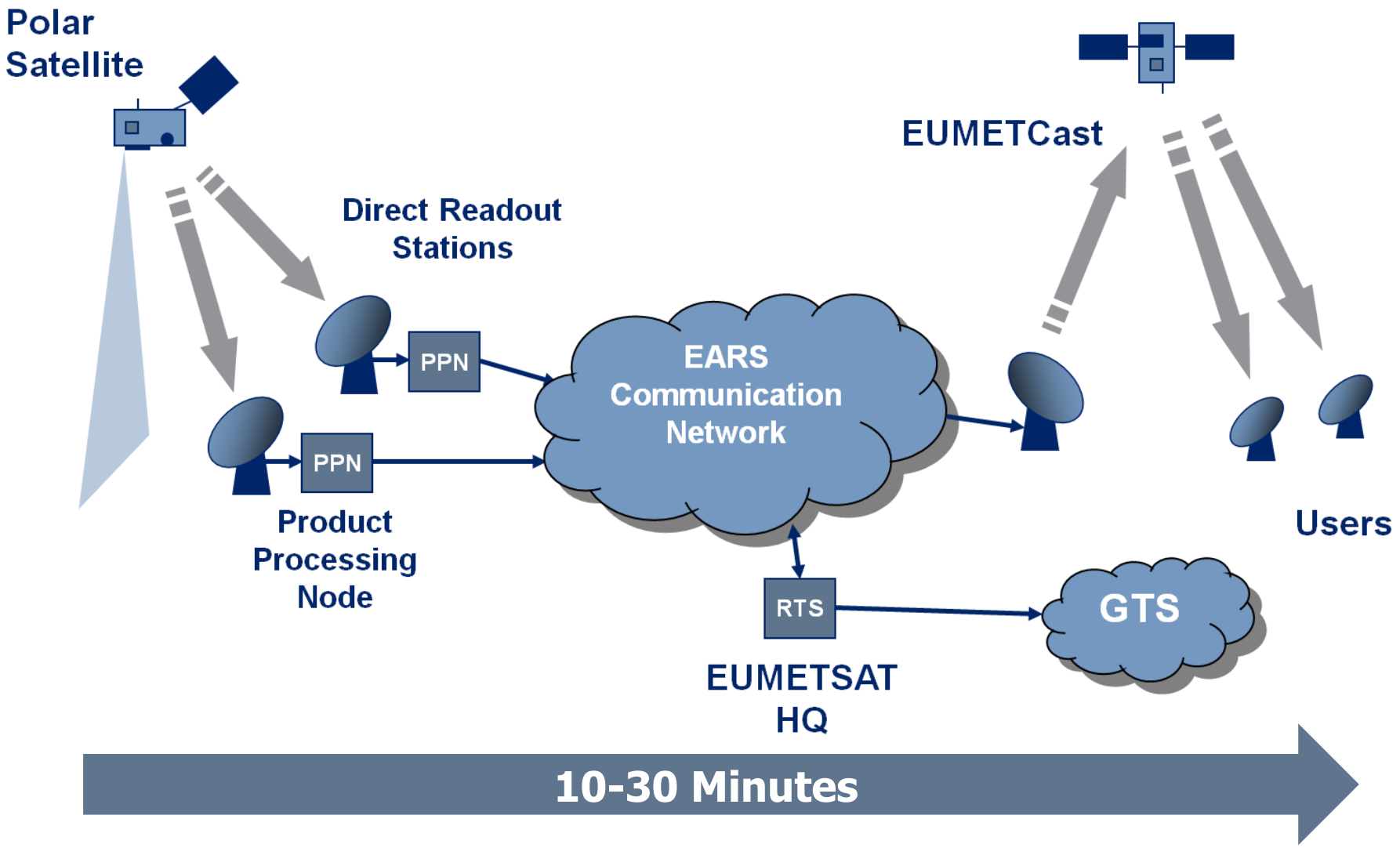
EUMETSAT Advanced Retransmission Service (EARS)
Objective and Principle

- **EARS Objective**
- To provide Users with high timeliness regional data from Polar Orbiting Meteorological Satellites in support of Numerical Weather Prediction (NWP) and Nowcasting (NWC).

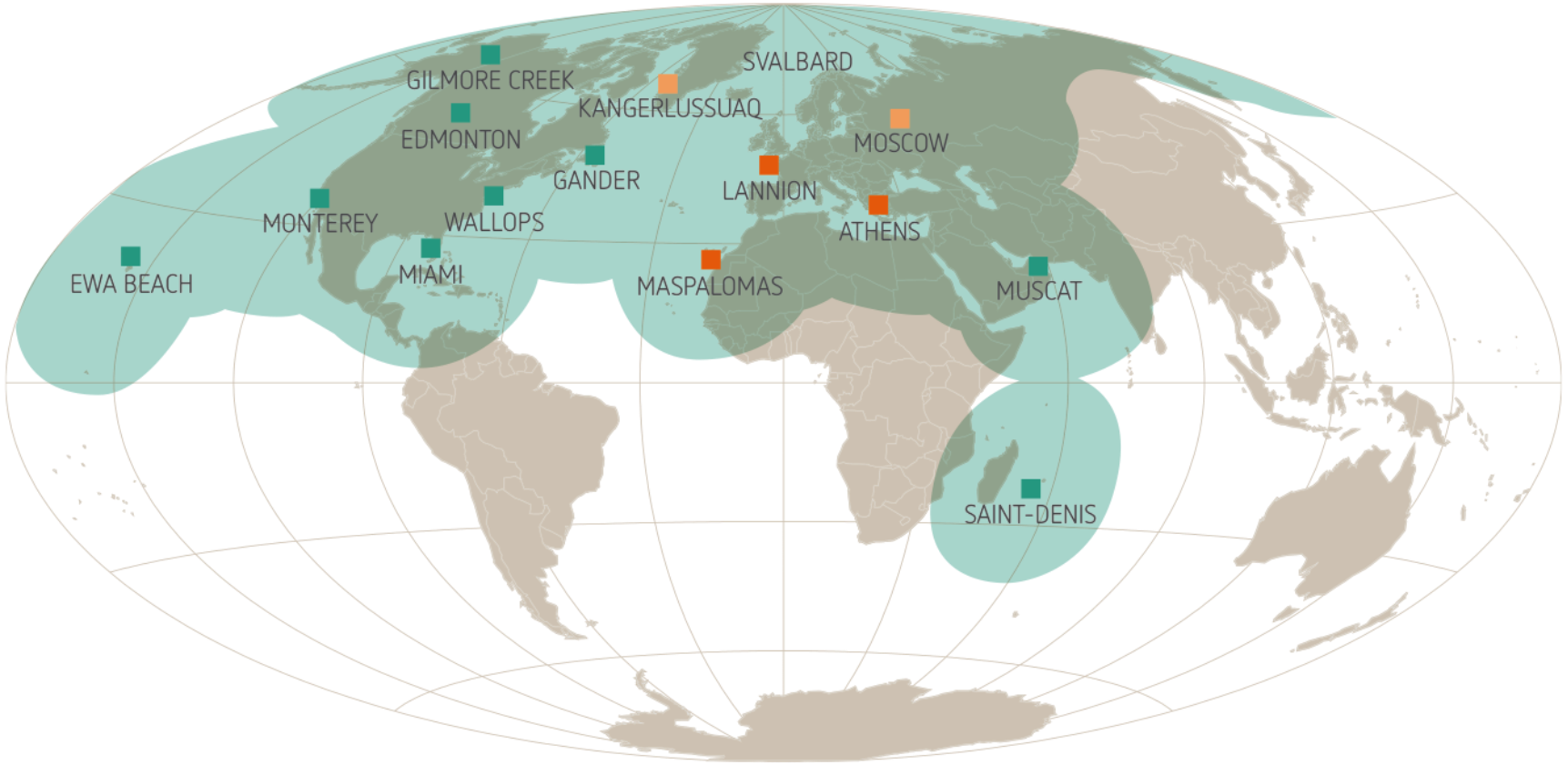
- **EARS Principle**

Achieved through a regional network of Direct Readout ground stations collecting, processing and retransmitting data to Users in near real time.

Regional Data Services: EARS – System Overview



Network of EARS* stations and coverage

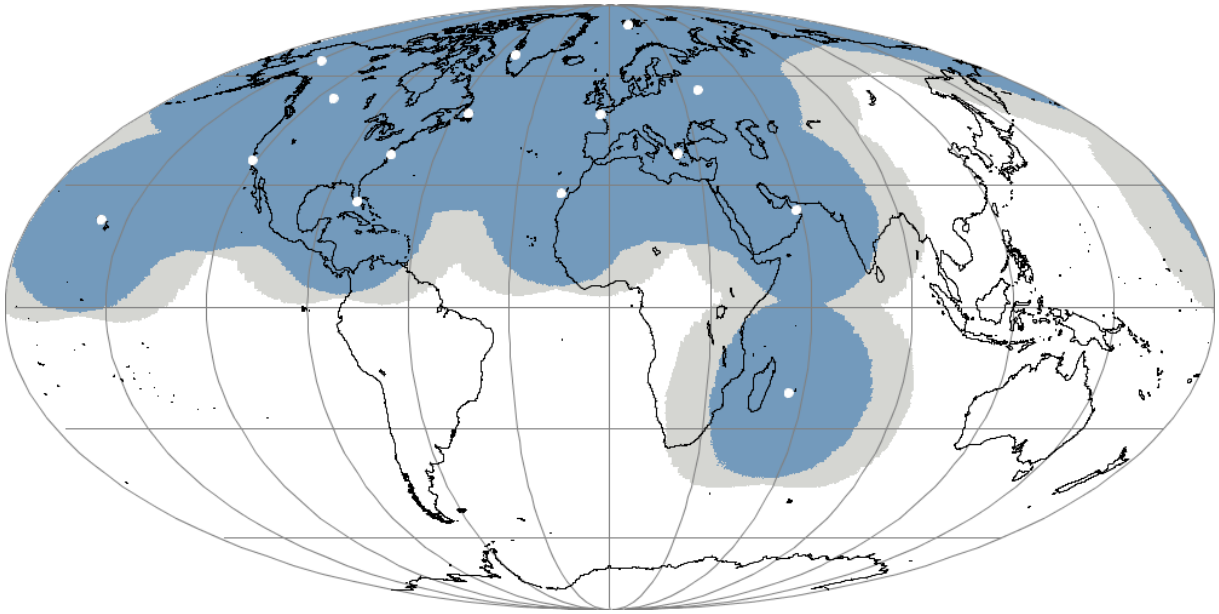


* EUMETSAT Advanced Retransmission Service

EUMETSAT

EARS –Operational Services

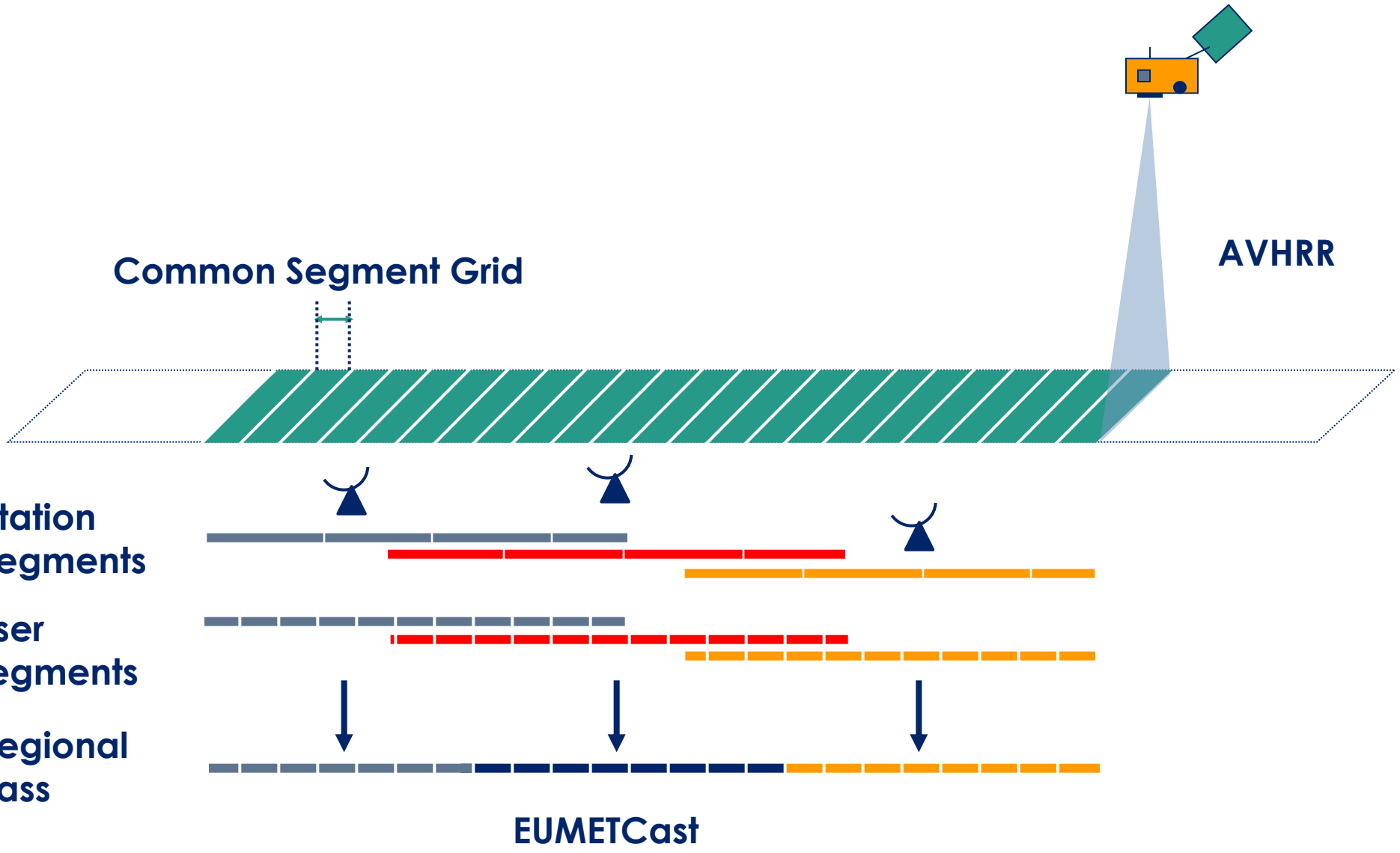
Services	
EARS-ATOVS	L1
EARS-ASCAT	L2 Winds
EARS-AVHRR	L0
EARS-IASI	L1C
EARS-NWC	L2 Clouds
EARS-CrIS	SDR
EARS-ATMS	SDR
EARS-VIIRS (2014)	SDR



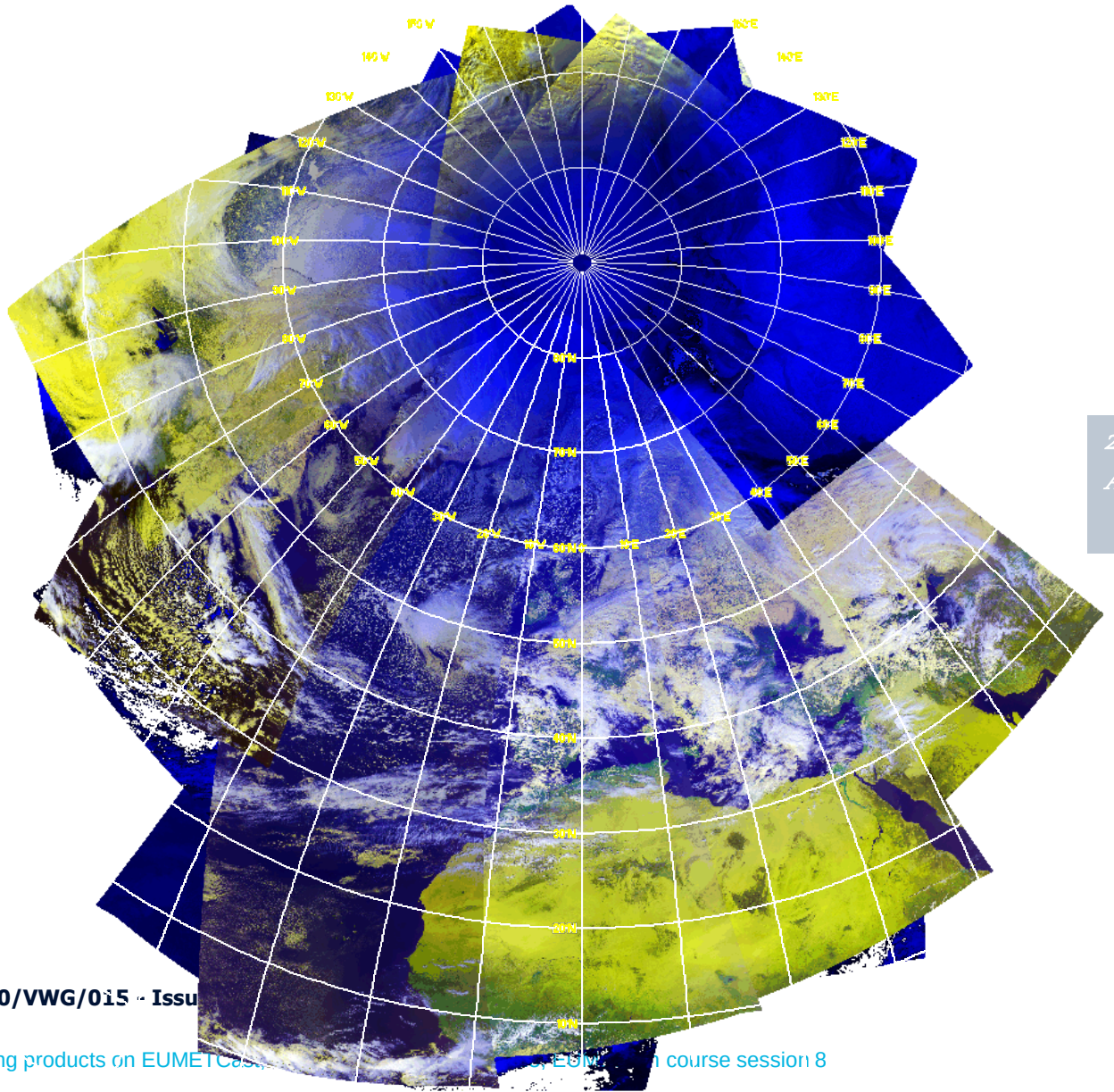
Satellites: NOAA POES
Metop
Suomi-NPP

Not all services have the same coverage !

EARS AVHRR and EARS NWC



EARS-AVHRR: Afternoon orbit coverage



22 February 2010 EARS - AVHRR NOAA 19

The EARS-NWC service

Description of the nowcasting product service as part of the EARS network

Products	Cloud Mask, Cloud Type, Cloud Top Height/Temperature (including semi-transparency correction)
Coverage	EARS data from Kangerlussuag, Svalbard, Lannion, and Moscow
Processing mode	Swath processing
Resolution	Full AVHRR pixel resolution
Latency	30 min
Satellites	IJPS satellites (currently Metop-B and NOAA-19)
File format	PPS (HDF-5)
Geo-location	not corrected by landmarks, reduced to tie-points
Archiving	EUMETSAT UMARF

EARS-NWC service description

- **Data Segmentation**:
  - Each segment contains one minute of observations.
  - Duplicate segments are removed.

The NWC-SAF PPS package used for EARS-NWC

- The Nowcasting and Very Short Range Forecasting Satellite Application Facility (NWC-SAF) is responsible of the development and maintenance of the Polar Platform System (PPS) package.

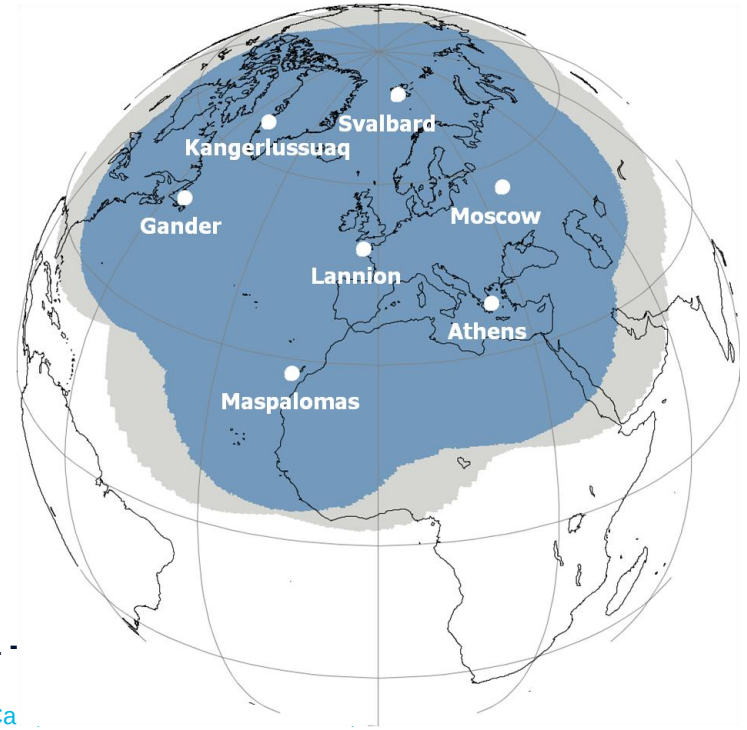
- This package provides four products:
  - AVHRR Cloud Mask (CMa);
  - AVHRR Cloud Type (CTy);
  - AVHRR Cloud Top Temperature & height (CTTH);
  - AVHRR and AMSU/MHS Precipitating Clouds (PC).

- More information on the PPS package can be found on the SAFNWC webpage, http://www.nwcsaf.org.

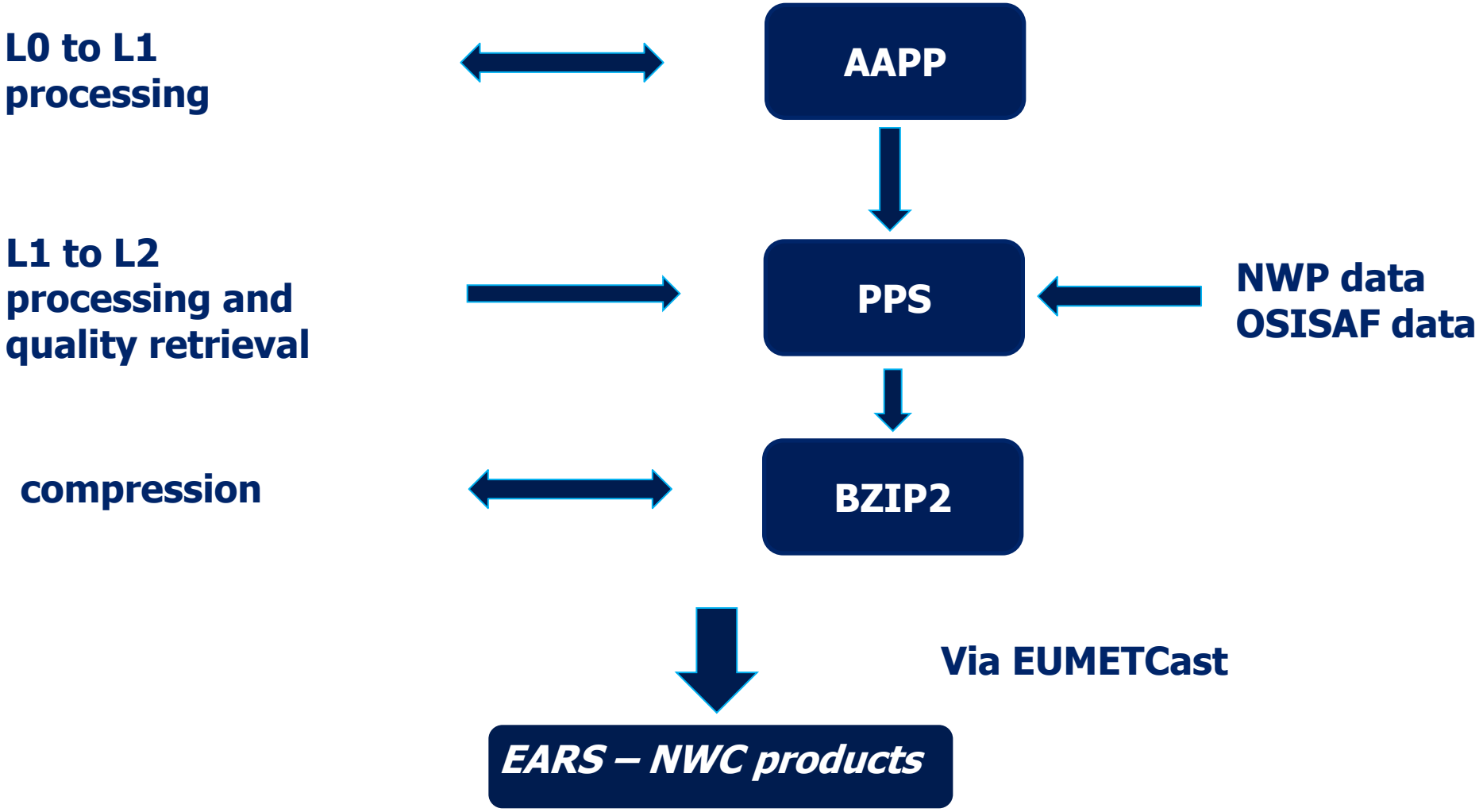
EARS-NWC: Coverage

- **Satellites**: one operational satellite in the Morning Orbit and one operational satellite in the Afternoon Orbit. Currently Metop-A and NOAA-19.

- **Area**: All stations involved in EARS-AVHRR, namely Athens, Maspalomas, Lannion, Kangerlussuaq, Svalbard, Moscow and Gander.

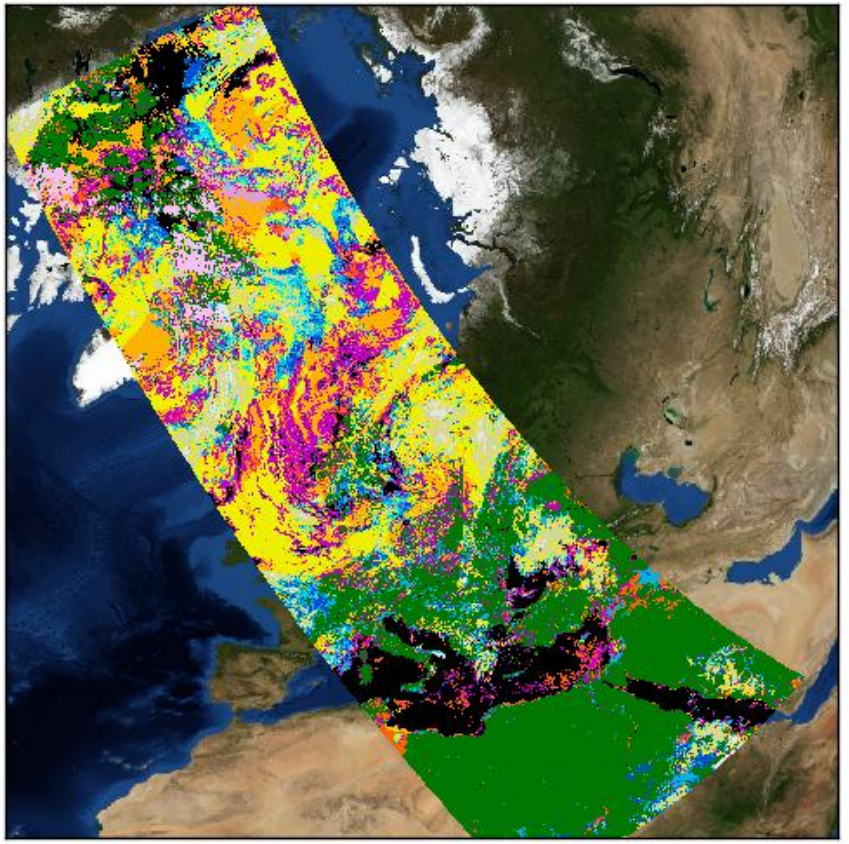


EARS – NWC Data Flow

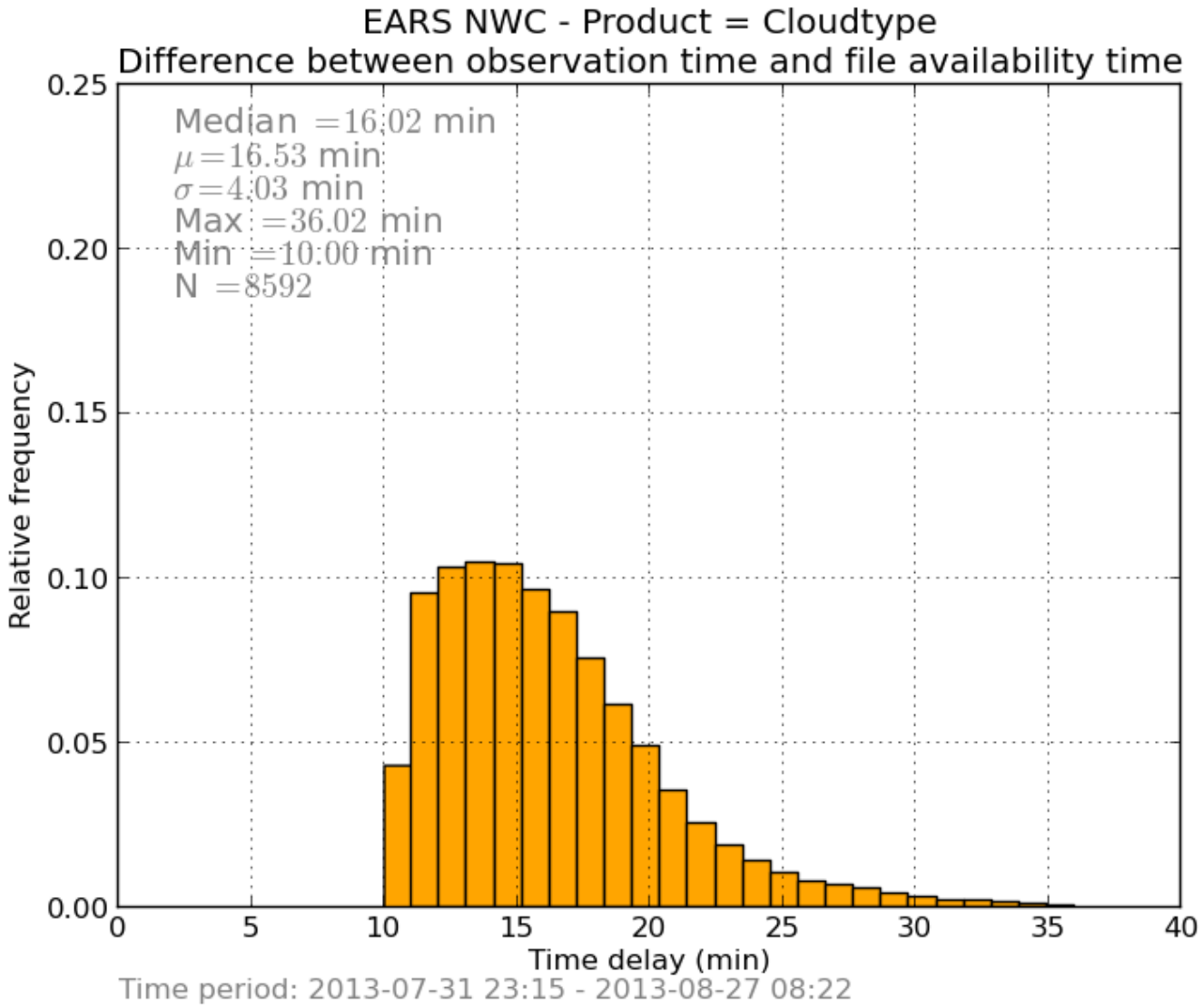


EARS-NWC parameters

- **Cloud Mask**
  + processing and testflags
- **Cloud Type**
  + processing flags
- **CTTH**
- height
- temperature
- pressure
  + processing flags



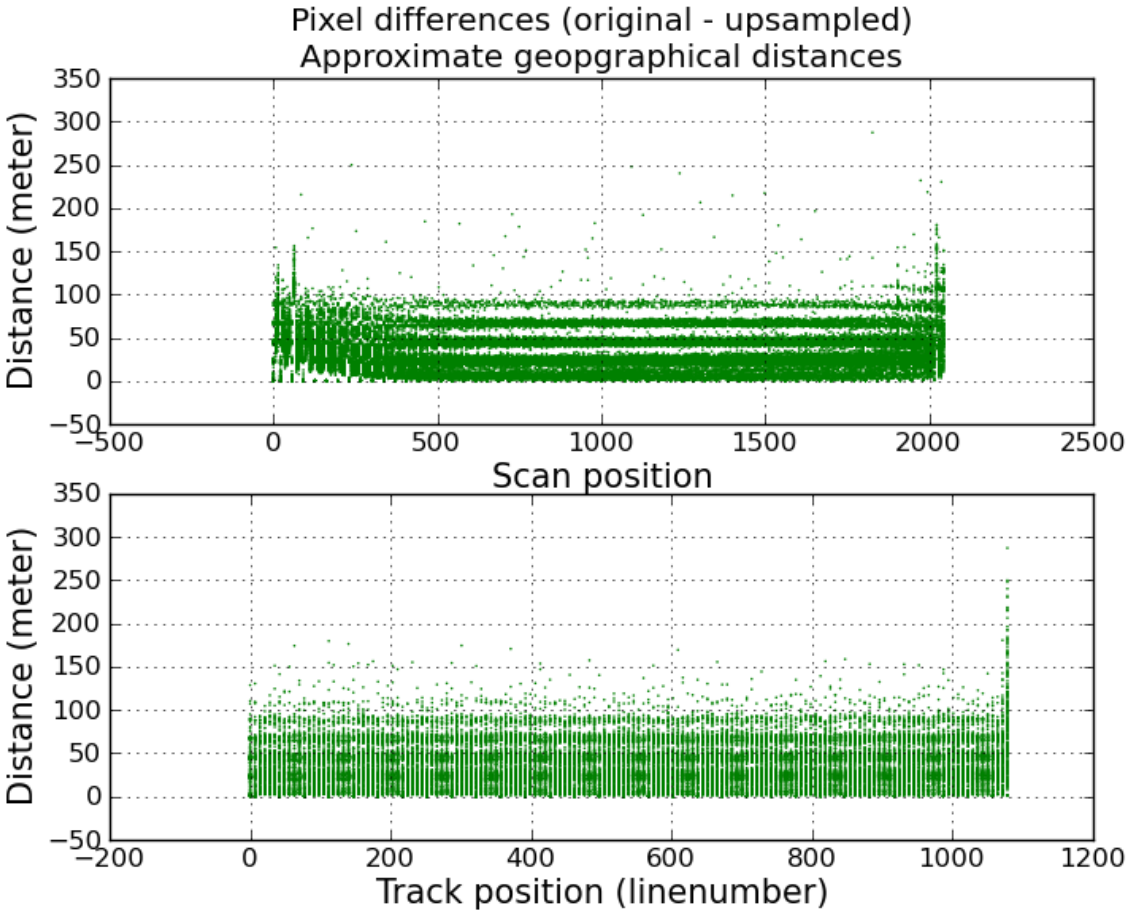
Achieved timeliness



EARS-NWC geolocation

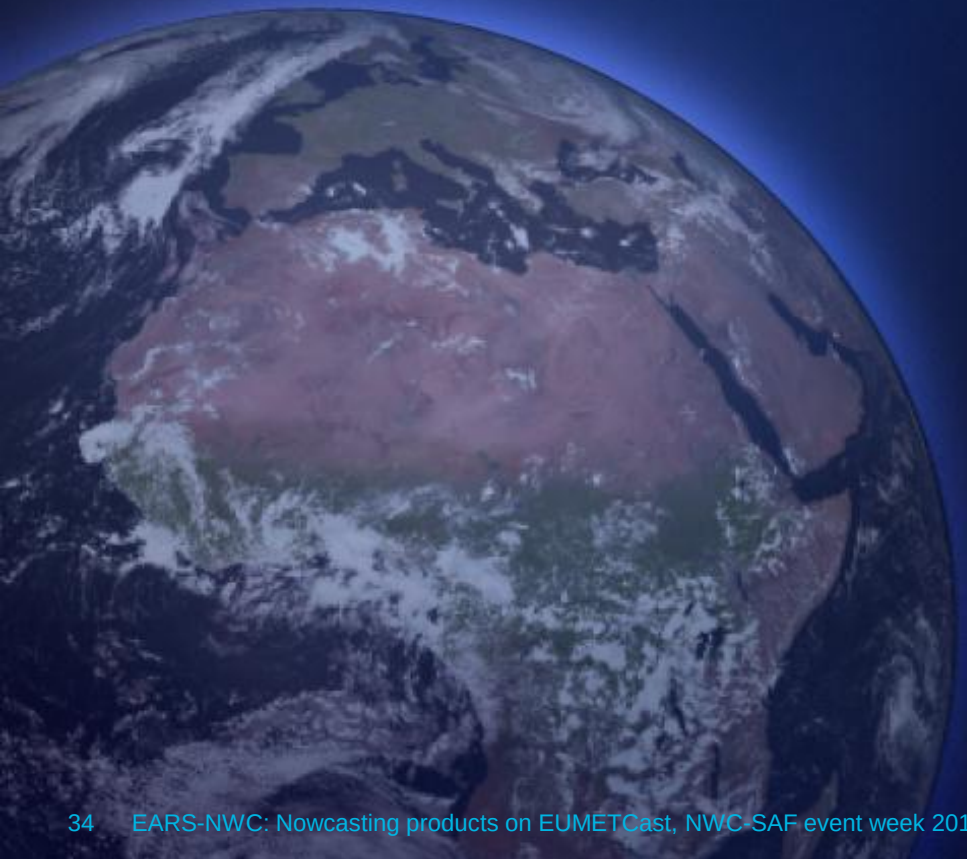
- Geo-referencing is achieved using the most recent TLE orbital parameters and the AAPP processing package
- No post-processing using landmarks to improve geolocation accuracy is applied.
- Longitudes and latitudes on a tie-point grid (every fifth pixel and line) are appended to each product
- Accuracy after reconstruction of full geolocation information is within a fraction of an AVHRR footprint

Achieved geolocation accuracy with Tie-Points



Geolocation accuracy after reconstruction for a Metop-A 3 minute scene over the North pole
Tiepoint res = 5x5
Mean deviation = 35m
STDV = 24m

Monitoring EARS-NWC



Product validation and monitoring

Based on a joint activity between EUMETSAT CAF and NWC-SAF (SMHI)

EUMETSAT CAF:

- **Real-time monitoring** of timeliness and product availability
- **Sanity check**s of each product per granule by monitoring product summary statistics (to become operational Q1/2014)

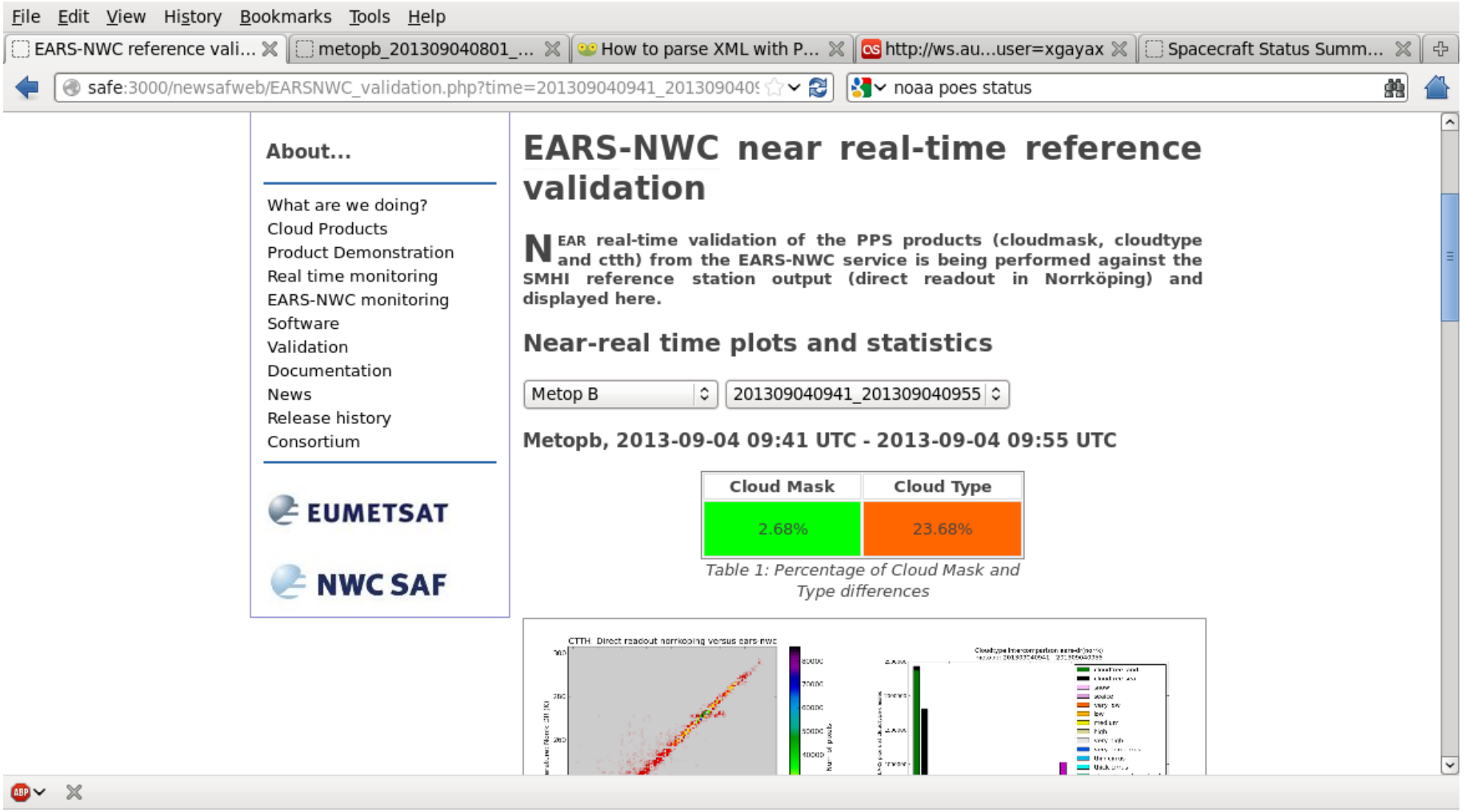
Product validation and monitoring

Based on a joint activity between EUMETSAT CAF and NWC-SAF (SMHI)

SMHI:

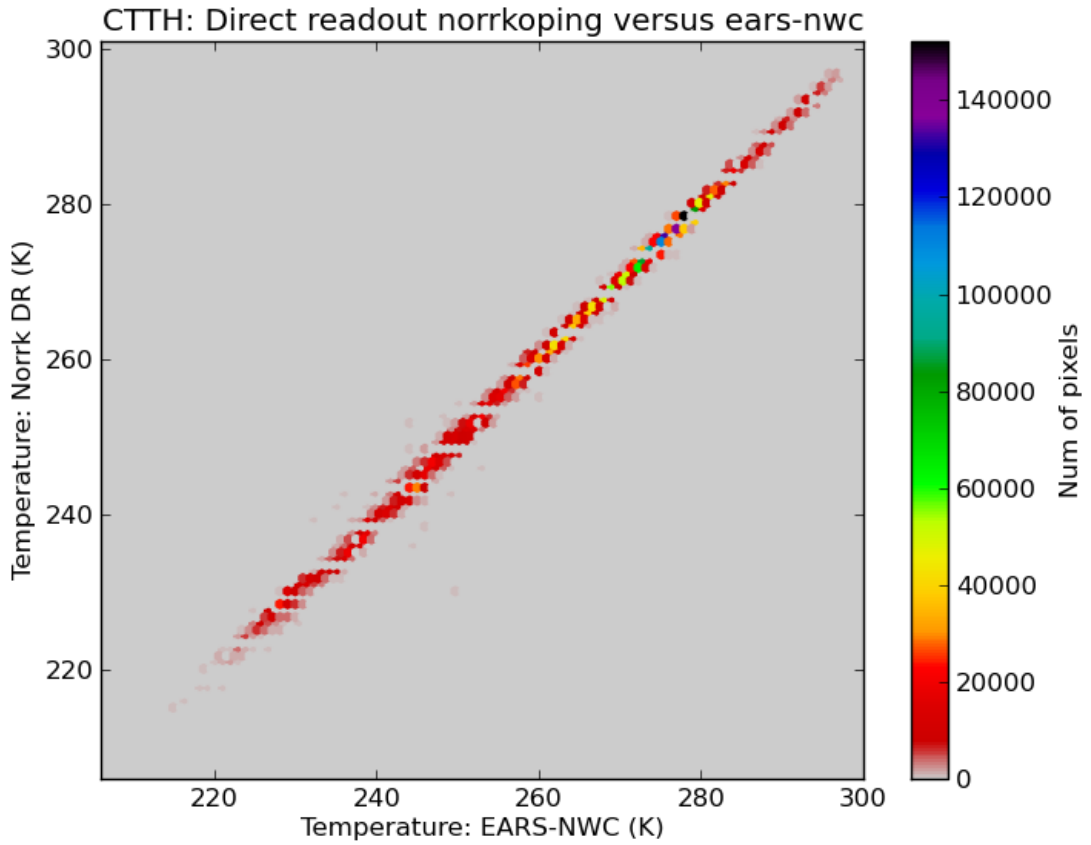
- Near real-time cross validation using reference PPS production at SMHI (using DR data from Norrköping)

EARS-NWC reference validation

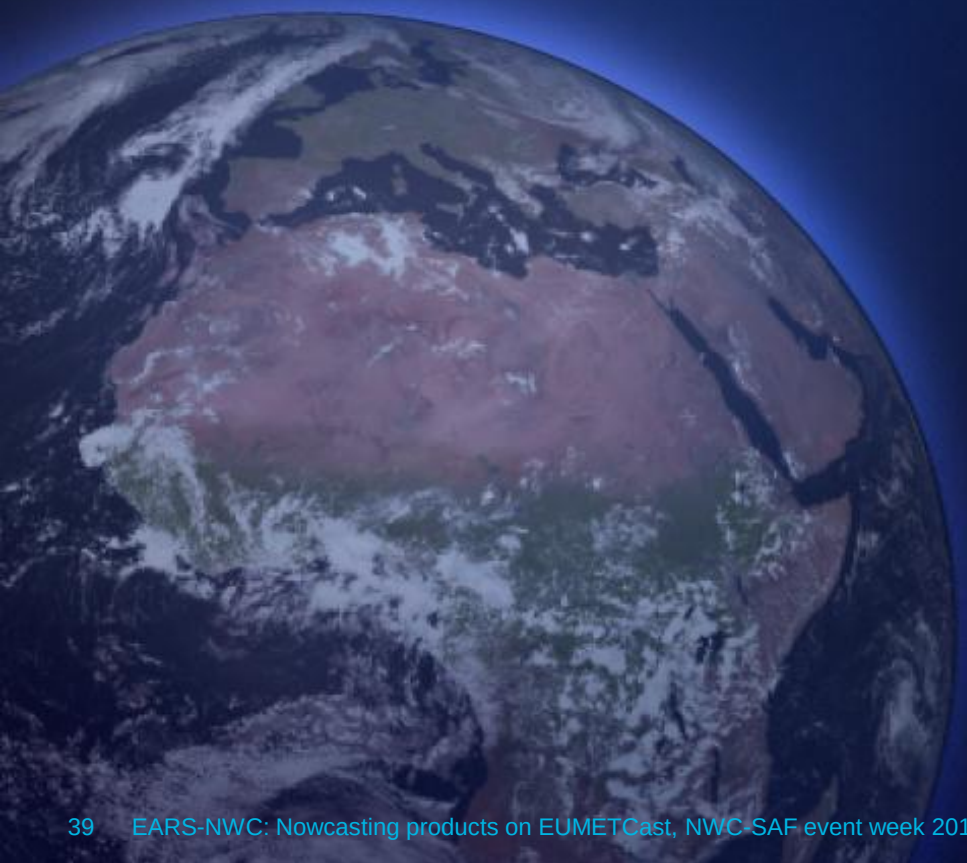


NRT cross-reference validation accessible through NWC-SAF webpage

Example of Cross validation – graphics:
Cloud Top Temperature correlation



User tools: PyTROLL



SMHI

PyTROLL

What is PyTROLL

- Pytroll project is a collaboration on weather satellite data processing between DMI and SMHI.
- Its objective is provide different free and open source python modules for the reading, interpretation, and writing of weather satellite data.
- The provided python packages are designed to be used both in R&D environments and in 24/7 operational production.

Using PyTROLL for EARS-NWC

- Read the product
- Up-sample the geolocation
- Concatenate the granules
- Geo-reference (project) the data
- Use the data

...for assembling granules and project data see the EARS-NWC quickstart at http://pytroll.org

Summary

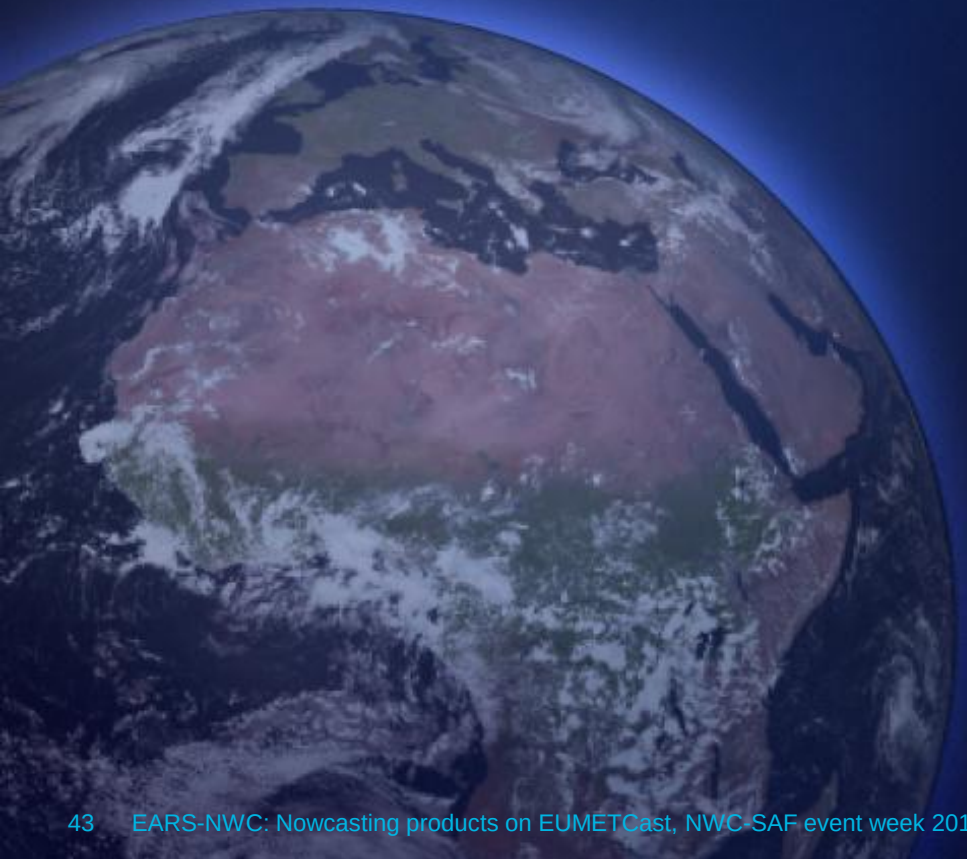
- Cloud parameters on AVHRR 1-minute granules are available via EUMETCast with a timeliness suitable for Nowcasting

- Coverage excellent for use over Europe and the North Atlantic

- Metop-B and NOAA-19 only

- Easy usage (read, assemble, project, display) via open source tools

RESERVE SLIDES



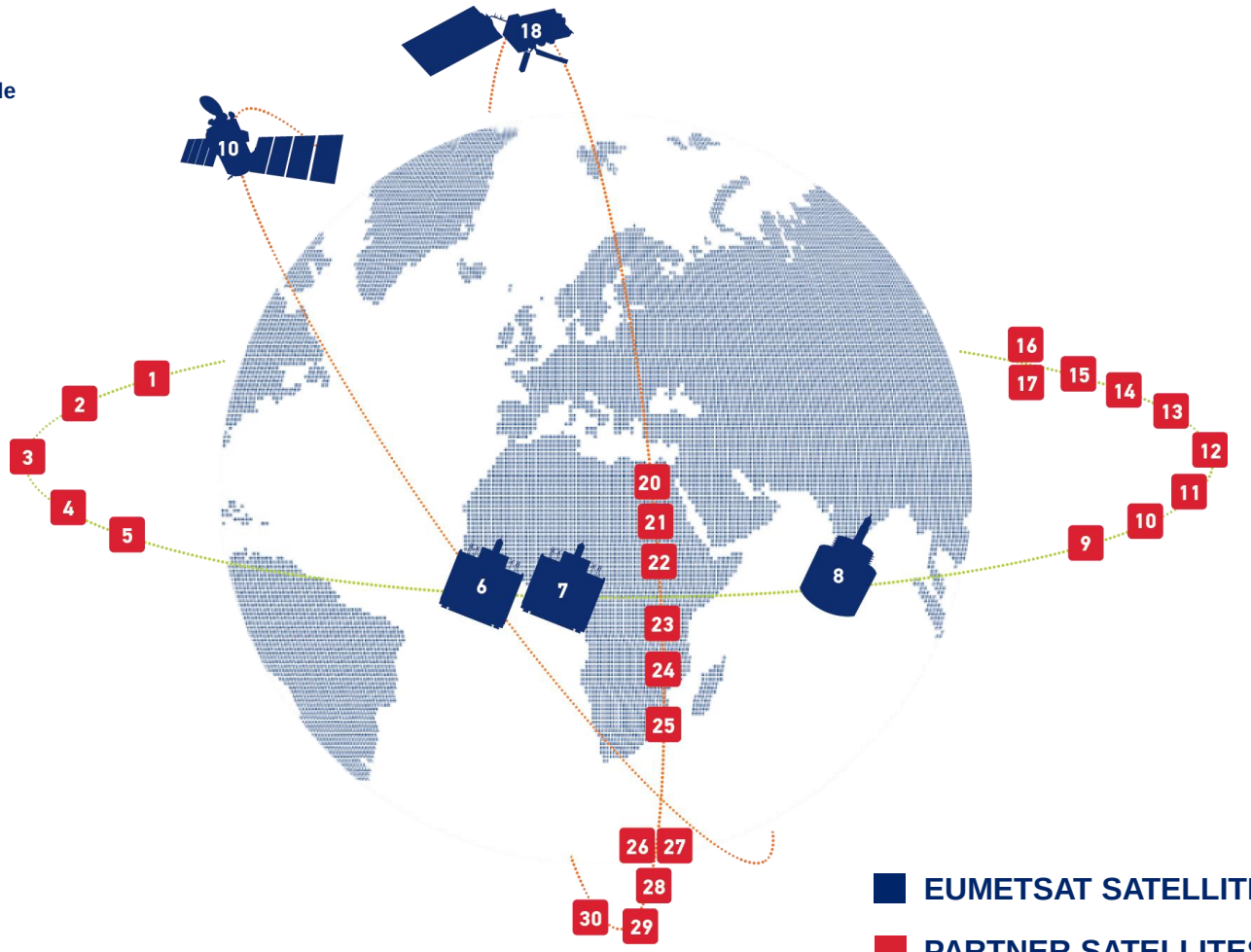
Global meteorological satellite system

GEOSTATIONARY

- 1-5 GOES-11, -12, -13, -14, -15 (USA)
- 6 METEOSAT-9 (EUMETSAT) 0°Longitude
- 7 METEOSAT-8 (EUMETSAT) 9.5°E
- 8 METEOSAT-7 (EUMETSAT) 57.5°E
- 9 ELECTRO-L N1 (RUSSIA)
- 10 KALPANA-1 (INDIA)
- 11 FY-2D (CHINA)
- 12 INSAT-3A (INDIA)
- 13 FY-2E (CHINA)
- 14 FY-2C (CHINA)
- 15 COMS-1 (SOUTH KOREA)
- 16 MTSAT-1R (JAPAN)
- 17 MTSAT-2 (JAPAN)

LOW EARTH ORBIT

- 18 METOP-A (EUMETSAT)
- 19 JASON-2 (USA, EUROPE)
- 20-24 NOAA-15, -16, -17, -18, -19 (USA)
- 25 FY-1D (CHINA)
- 26 FY-3A (CHINA)
- 27 FY-3B (CHINA)
- 28-29 OCEANSAT-1, -2 (INDIA)
- 30 METEOR-M N1 (RUSSIA)



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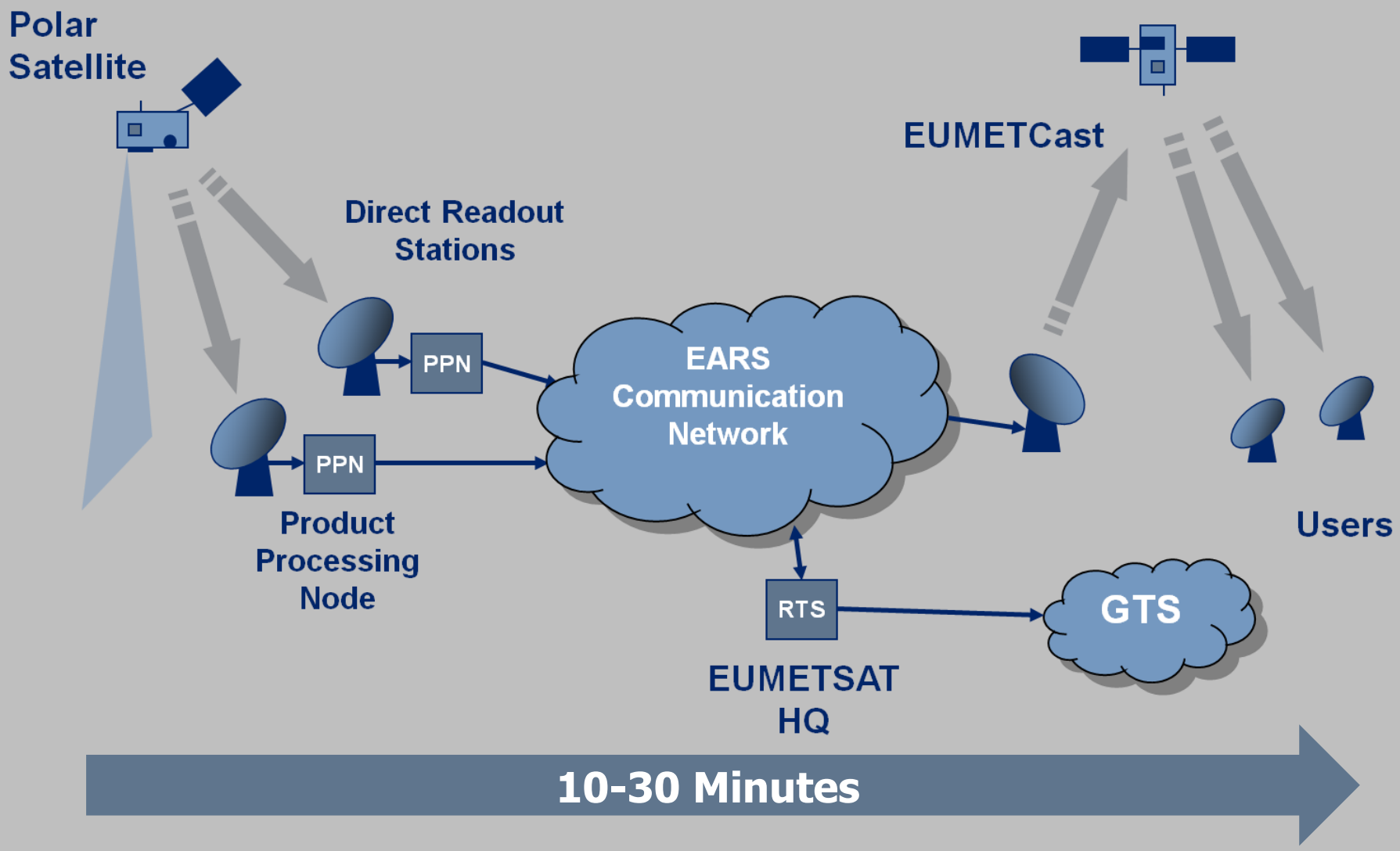
EARS – System Overview



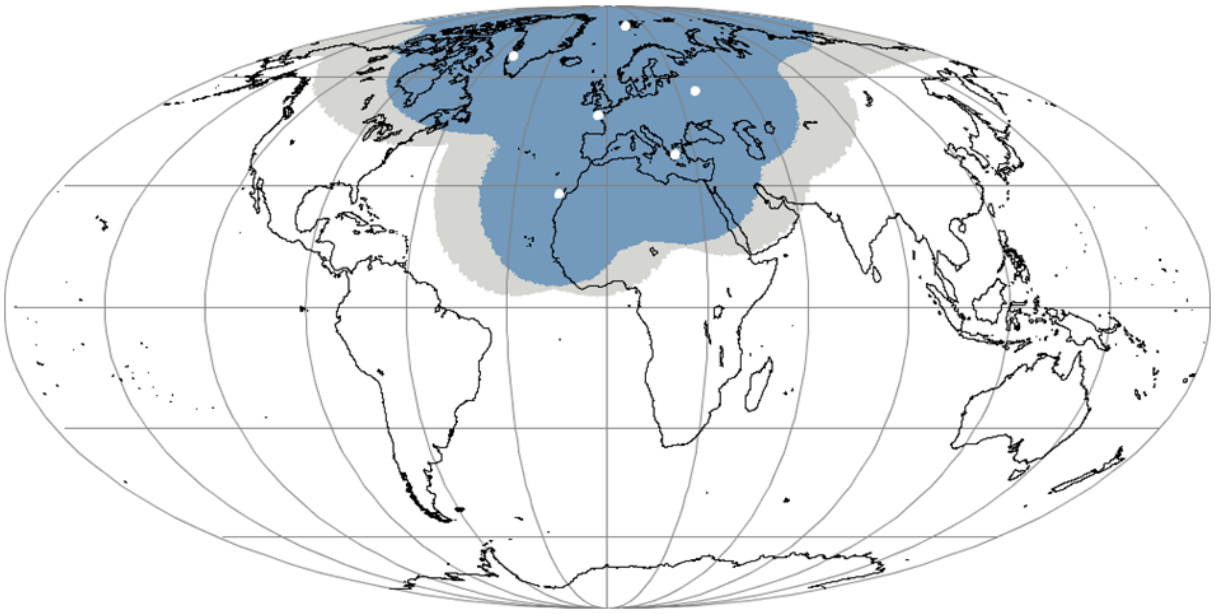
EARS – Suomi NPP Services

Suomi-NPP regional services are the first regional 3rd party services.

The feasibility of regional FY-3 services are under investigation

Services	
EARS-ATMS	SDR (L1c)
EARS-CrIS	SDR (L1c)
EARS-VIIRS	SDR (L1c)

Initial EARS NPP Coverage



EARS-AVHRR Status

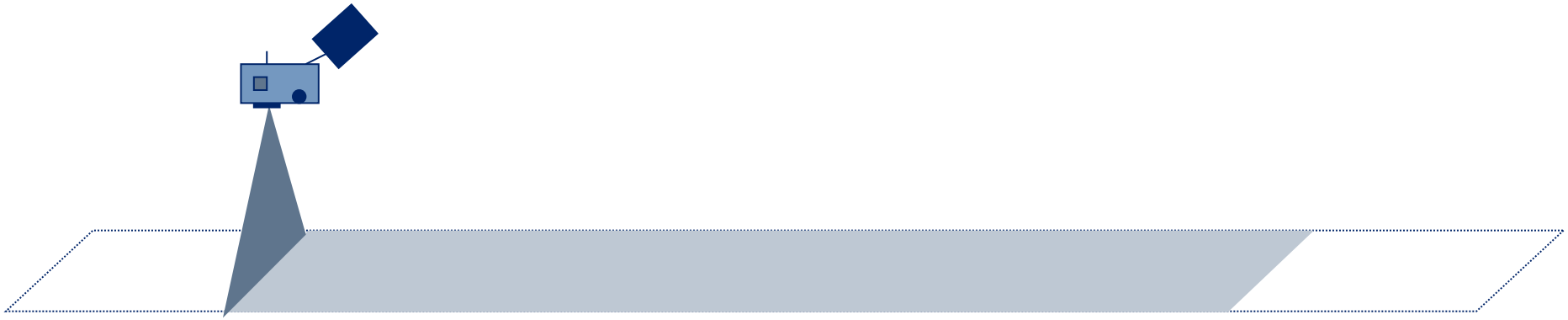
Station	Status
Moscow	NOAA and Metop service operational.
Athens	NOAA and Metop service operational.
Kangerlussuaq	NOAA service operational.
Gander	NOAA service operational.
Lannion	NOAA and Metop service operational.
Maspalomas	NOAA and Metop service operational.
Svalbard	NOAA and Metop (FDES) service operational.

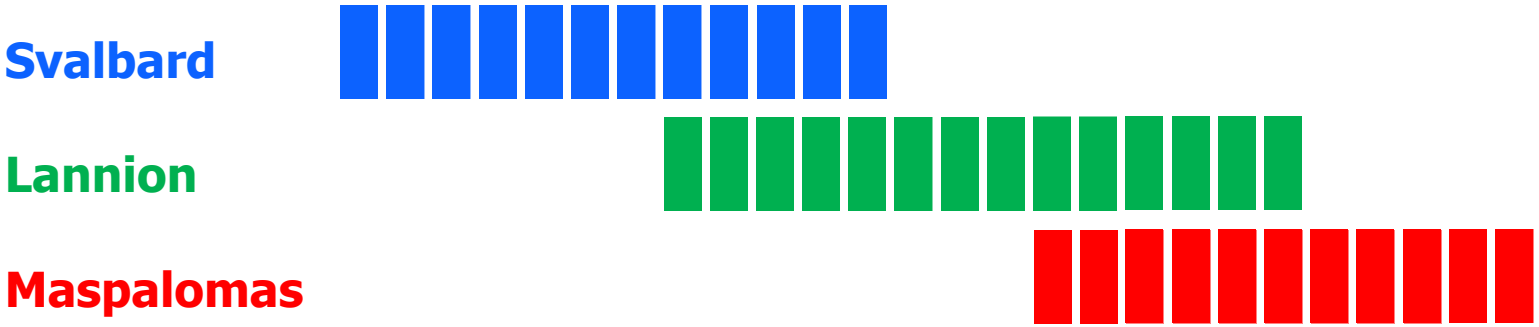
EUMETSAT VIIRS HDF5 Product Format

Original VIIRS SDR HDF5		EUMETSAT VIIRS HDF5
• Radiances • Brightness Temperatures • Reflectances	→	• Radiances • Coefficients for converting to Brightness Temperatures and Reflectances
• Geolocation and Angles for each Pixel	→	• Geolocation and Angles on Tiepoint Grid

Expected Deviation in Reconstructed Product
- Better than 10m in geolocation and 0.01 degree in Angles
- Better than .....

Data Segmentation and Selection
Applied for EARS-AVHRR and EARS-VIIRS





EUMETCast User Station

Timeliness 10 Minutes