

The European Space Agency Earth Observation Programme

Yan Soldo (ESA)

Training Workshop on Use and Management of Radio Spectrum for Meteorology 3-4 March 2025, Singapore

ESA UNCLASSIFIED – For ESA Official Use Only



ESA Membership



THE EUROPEAN SPACE AGENCY

+

Đ

<u>.</u>

-

23 Member States

Austria Belgium Czech Republic Denmark Estonia Finland France Germany Greece Hungary Ireland Italy

Luxembourg Netherlands Norway Poland Portugal Romania Spain Slovenia Sweden Switzerland United Kingdom

3 Associate Members Slovakia, Latvia, Lithuania

Cooperation Agreements 4 other European States + Canada



EOP Activities at ESRIN, ESTEC, ECSAT Spending 30% of ESA 2024 Budget • Cesa

Satellite Design & Development

Missions Management

Cal/Val & Data Distribution



ESA's Earth Observation Missions





Heritage **08** 2010 2015 **Operational 16** 2020 ERS-1 Meteosat 11 Meteosat 10 / MetOp-B [MSG] Developing 40 MetOp-Centinel-1B ERS-2 Envisat MTG-I1 Sentinel-2E Preparing 22 Proba-1 🍊 Arctic Weather SMOS Sentinel-3B Satellite Sentinel-2A Sentinel-6 Sentinel-4A GOCE Total 86 lichael Freilich 2025 MTG-S1 Proba-V Sentinel-3A Swarm Sentinel-5P Sentinel-2C Sentinel-30 Sentinel-10 EarthCARE C02M-A MetOp-SG-B Sentinel-1D Sentinel-5A MetOp-SG-A1 MTG-I2 CO2M-B CO2M-C Phisat-2 World-class Earth **Biomass CIMR-A** Sentinel-6B ROSE-L-A CRISTAL-A **Observation systems** ALTIUS LSTM-A CHIME-A ROSE-L-B CRISTAL-B developed with FORUM CIMR-B I STM-B Aeolus-2A MTG-I3 Harmony CHIME-B 2030 TRUTHS European and global ന MAGIC Sentinel-6 Sentinel Earth Explorer-11 partners to address Sentinel-5B Sentinel-4B MTG-S2 MetOp-SG-A2 MetOp-SG-B2 Earth Explorer-12 scientific & societal challenges Science Meteorology Copernicus eesa EUMETSAT

Earth Explorers

Pioneering Scientific and Technical Excellence





Copernicus Space Evolution

SENTINELS (First generation)

CIMR LSTM CHIME

CO2M

ROSE-L

CRISTAI

EXPANSION

A

NEXT GENERATION

Sentinel-1 NG

Sentinel-2 NG

Sentinel-3 NG

Sentinel-6 NG

Meteorological Missions





Satellites to be Launched in 2025





Scientific Impact of ESA EO Missions







Mapping & Pinpointing Greenhouse Gases: Example Methane Leaks • CESA

Sentinel-3

ALGERIA Sentinel-5P

> Methane observed by Copernicus Sentinel-5P

Hassi Messaoud

> Methane anomaly 4 January 2020, 18:51 UTC

by Copernicus

Sentinel-3

Methane anomaly 4 January 2020, 9:55 UTC **Sentinel-2**

0.5 km

- by Copernicus Sentinel-2

Methane anomaly 4 January 2020, 10:22 UTC

Deforestation Alerts with Sentinel-1



http://radd-alert.wur.nl

Reiche et al.(2021), ERL

RAdar for Detecting Deforestation Alerts (RADD) based on dense Sentinel-1 time series

> RADD Alerts Jan. 2020 – Mar. 2024 Brazil – State of Parà medium scale forest clearing



EO's Vantage Point Provides A View on the Full Magnitude of Changes in Both Space and Time



Spectrum use for Earth observation

TT&C:

- S-band (approx. 2 GHz): ALL ESA missions
- Possible future use of X-band (7 GHz)
- WRC-31 Preliminary AI on Ka-band (23 GHz)

Payload data downlink (PDD):

- X-band (approx. 8 GHz): Main band today (link with WRC-27 AI 1.7)
- Ka-band (approx. 26 GHz): Increasingly used
- WRC-31 Preliminary AI on Q/V band

ESA EO missions using X- and Ka-band for PDD





Spectrum use for Earth observation (sensors)



Sensors:

- Various active/passive sensors using different frequency bands
- Increasing number of bands observed (twice as many now wrt 10 years ago)
 - Better understanding of Earth, but more RFI issues



Takeaways



- Earth observation satellites enable a variety of applications
- ESA plans to increase its EO capabilities (more missions, more frequency bands, ...)
- Data of EO satellites has a large user base.
- Protecting the frequency bands used by EO satellites is beneficial not only for the operators, but also for all the users of that data.
- Several WRC-27 AIs are threatening bands used by EO satellites.



Questions?

yan.soldo@esa.int



•

۲

+