10TH ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

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ESA Earth Observation, Science for Society & Forests Espen Volden, Frank Martin Seifert & other colleagues

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ESA
 Earth Observation programs and satellite missions
 EO Science for Society and Forests
 Opportunities for Young Scientists

The European Space Agency

22

Member

States

ace Agency

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Over 80 satellites developed, tested, and operated since 1975

> 2020 Budget 6.68 billion = 12 per European

for peaceful purposes

THE EUROPEAN SPACE AG

esa

ESA Membership

22 Member States

Italy

Spain

Austria **Belgium** Luxembourg **Czech Republic Netherlands** Denmark Norway Estonia Poland Finland Portugal Romania France Germany Greece Sweden Hungary Switzerland Ireland **United Kingdom**

Cooperation Agreements

7 other European States & Canada of which 3 Associated Members including **SLOVENIA**



ESA ESRIN Establishment

Activities

- Earth Observation
- Vega Launcher
- Corporate Informatics
- ESA Security Office
- Contracts, Personnel
- Site Management
- Communication

50.000 visitors868 personnelper yearon the site

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ESA Directorate of EOP

ESA EO Vision:



Taking the Pulse of our Planet



ESA-Developed Earth Observation Satellites

2015

16 in operation 38 under development 14 under preparation



BIOMASS Mission

Payload Orbit

Satellite Consortium

InstrumerLaunch date2023Lifetime5.5 years

Measure of forest biomass and height (200 m. pixel resolution) **P-Band radar** SSO, alt: 666 km; LTAN: 6h00 1250 Kg Prime: ADS-UK, Instrument: ADS-DE





FLEX Mission

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Swath Payload

Orbit

Satellite Consortium

Launch date Lifetime Study & monitoring of fluorescence signal linked to vegetation stress; pixel 300m.

150 km

FLORIS, 2 channels spectrometers (O₂ lines) SSO Alt: 814 km; LTDN: 10h00

470 Kg Prime: TAS Instrument: Leonardo 2024

3.5 years





Copernicus

Copernicus Dashboard



> 405.000
registered users
= tip of the iceberg





full, free & open data policy 8 Copernicus Sentinels flyingS1S2S3S4S5PS5S6Image: Signed state stat

Copernicus Sentinel Data Policy



Sentinel data are available:

Free, Full and Open*
 Over very long term
 Systematically, Operationally

EUROPEAN COMMISSION Directorate-General for Internal Market, Industry, Entrepreneurship and States Copernicus and Defence for Societal Challenges and Growth Legal notice on the use of Copernicus Sentinel Data and Service Information The access and use of Copernicus Sentinel Data and Service Information is regulated under EU Jaw, ¹ In particular, the Jaw provides that users shall have a free, full and open access to Copernicus Sentinel Data² and Service Information without any express or moded warranty, including as regards quality and suitability for any purpose.³ EU law grants free access to Copernicus Sentinel Data and Service Information for the purpose of the following use in so far as it is lawfult. (c) communication to the public. (c) communication to the public. (d) adaptation, modification and combination with other data and information: (e) and publication of public (e) (e) (e) (e) any combination of points (a) to (d). EU law allows for specific limitations of access and use in the rare cases of security by using Sentinel Data or Service Information the user acknowledges that these wand that the mean removance to your claims for. Jy using Sentinel Data or Service Information the user acknowledges that these ionalitions are applicable to him/her and that the user renounces to any claims for Annanae ansinet the Forenaes Union and the providers of the soil Date and conditions are applicable to him/her and that the user renounces to any claims for damages against the European Union and the providers of the said Data and Information. The scope of this waiver encompasses my dispute, including contrast and torts claims, that might be filed in court, in arbitration or in any other form of Information. The scope of this waiver encompasses any dispute, including contracts and torts claims, that might be filed in court, in arbitration or in any other form of dispute settlement Where the user communicates to the public or distributes Copernicus Sentinel Data and Service information, he/she shall inform the recipients of the source of that Data and Information by using the following notice's: (1) 'Copernicus Sentinel data [Year]' for Sentinel data; and/or Copenicus Service information [Year] for Copenicus Service Where the Copernicus Seminel Data and Service Information have been adapted or

Regulation (EU) No 377/2014 and Commission Delegated Regulation (EU) No 317/2014 and see in particular Art's and 90 of Resultance Data Policy, ESA/PB.EO(2013)00 1159/2013 are an particular Art's of Regulation 1159/2013 ee an particular Art. 7 of Regulation 1159/2013.

* ESA Sentinel Data Policy (Sep 2013) and EU Delegated Act on Copernicus Data and Information Policy (Dec 2013)

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Copernicus Sentinel Satellites





Sentinel 1 (A/B/C/D) **SAR Imaging**

All weather, day/night applications, interferometry



Sentinel 2 (A/B/C/D) Multispectral Imaging

Land applications: urban, forest, agriculture, ... Continuity of Landsat, SPOT



Sentinel 3 (A/B/C/D) Ocean & Global Land Monitoring

Wide-swath ocean colour, vegetation, sea/land surface temperature, altimetry



Sentinel 4 (A/B) **Geostationary Atmospheric**

Atmospheric composition monitoring, pollution; instrument on MTG satellites



Sentinel 5 (MF/B/C) & Precursor **Low-Orbit Atmospheric**

Atmospheric composition monitoring; instrument on MetOp-SG satellites



Sentinel 6 Jason CS (A/B)

Altimetry reference mission

Copernicus: Sentinel Expansion Missions



CO2M - Anthropogenic CO₂ Monitoring



Causes of Climate Change

LST – Land Surface Temperature Mission



Agriculture & Urban Management

CRISTAL – Polar Ice & Snow Topography



Effects of Climate Change **CHIME – Hyperspectral Imaging Mission**



Food Security, Soil, Minerals, Biodiversity

CIMR – Passive Microwave Radiometer



Sea: Surface Temp. & Ice Concentration

ROSE-L – L-band SAR Mission



Vegetation & Ground Motion & Moisture

Why forests?



Livelihood for indigenous people

Food and medicine

Carbon sink

Income from timber and non-timber products

Biodiversity of plants and animals

Flood control and tsunami mitigation

Clean drinking water and air

Influence rainfall patterns

Recreation and tourism

Fuel wood and charcoal

> **Erosion control and landslide prevention**

EO and Policy Sector related to Forestry



- Attributes of EO: global, transparent, independent, timely
- Supporting of policies, in particular for
 - o policy analysis,
 - o monitoring and
 - o compliance purposes
- Collect and translate policy needs into technical requirements for EO products and services
- Ensure the delivery of concrete solutions or applications meeting the policy needs



Green Deal, Forest Strategy, Farm to Fork, Biodiversity Strategy, Bioeconomy Strategy, FLEGT, ...



Local Deforestation Rondonia, Brazil Sentinel 2 5 June 2019

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Ecosystem Destruction



Kalimantan, Indonesia Summer 2015 Sentinel-2A

Drought

Western Europe (after) 25 July 2018 Copernicus Sentinel-3

 HRL
 TreeCover Density

 Tree Cover Density

 All Non Tree Areas

 1 - 20 %

 21 - 40 %

 41 - 60 %

 61 - 80 %

 81 - 100 %

 Unclassifiable

 Outside Area

Rony Hoverswerda European Commission

elonia Gora Leszno

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European Environment Agency (EEA) | Esri, HERE...

Dernicus Emergency Management Service: Wildfires

EMSR540: Fire in Western Attica, Greece

Event Time (UTC): 2021-08-16 09:29 Event Time (LOC): 2021-08-16 09:29 Event Type: Wildfire (Forest fire) Activation Time (UTC): 2021-08-17 07:03 Activation Status: Closed

Affected Countries/Territories: Hellenic Republic

Service Output: 5 products (7 maps) First Estimate: 1 products (1 maps) Delineation: 2 products (2 maps) Grading: 2 products (4 maps)Authorised User: Greece General secretariat for Civil protection - Directorate for Emergency Planning and Response

https://emergency.copernicus.eu/mapping/1 22 ist-of-components/EMSR540 THE EUROPEAN SPACE AGENCY

Mapping of harmful broadleaved shrubs in forest regeneration areas based on Sentinel-2 data

- Production: VTT
- Customer: Finnish Forest Centre
- Impact: Operational use planned
- Article: <u>Space helps forests</u> regenerate

Image (left): detail - shrub abundance on two forest regeneration areas with stand borders

https://f-tep.com/

Forest management -Forest variable estimation

• Stem volume per species

Red = Broadleaved

Blue = Pine

Green = Spruce

Bark Beetle – Suspicious Areas

- Sentinel-2 scene from 28
 September 2018
- Military training area Allentsteig
- Classification: RED = Suspicion for nests of bark beetles, Status: September 2018

Carbon Assessment – Growing Stock Volume

Legend	
No data (<i>e.g.</i> clouds)	
Water	
Non-tree cover	
≤ 50 m³/ha	
51-100 m³/ha	
101-150 m³/ha	
151-200 m³/ha	
201-250 m³/ha	
251-300 m³/ha	
> 300 m³/ha	

© AssessCarbon – ESA Open Call project led by VTT

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Land use following tropical deforestation

De Sy et al., 2019, Tropical deforestation drivers and associated carbon emission factors derived from remote sensing data, ERL

WAGENINGEN UNIVERSITY & RESEARCH Radar Alerts for Detecting Deforestation

Sentinel-1-based weekly forest disturbance alerts at 10 m resolution for humid tropics in 31 countries (RADD alerts)

Paper: https://iopscience.iop.org/article/10.1088/1748-9326/abd0a8 RADD alert app: https://gena.users.earthengine.app/view/raddal ert (also available on WRI's Global Forest Watch)

Selective logging pattern in Central African Republic Sentinel-1-based weekly alerts, period Jan. 2019 – Dec. 2020 http://radd-alert.wur.nl

S-2 time series to track clear cutting/deforestation

S-1 for Science Amazonas : Reducing uncertainties in terrestrial carbon sources and sinks

1. Develop, test and validate a Multitemporal forest Change Detection (MCD) algorithm for Sentinel-1 IW SLC time series 2. Quantify carbon loss and gain from Land Use/Land Cover Changes in the Amazonas based on the MCD algorithm output 3. Perform a contextual scientific analysis and interpretation of the carbon gain/loss accounting for stressors (e.g. droughts or fires)

CCI BIOMASS

- New maps 2010, 2017 & 2018
- 2020 map in progress for COP26
- Consistency: a decade of change

GF®I Global Forest Observations Initiative

- International collaboration to:
 - foster sustained availability of satellite and ground observation in support of national forest information systems
 - support countries in the use of observations for their national forest information systems

EO applications in forestry

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- Sustainable forest management
- Illegal logging
- Forest health
- Insect infestation
- Storm damage
- Forest certification
- Forest fires & burned area
- Forest restoration
- Biomass and -energy
- Carbon accounting
- Sustainable supply chains
- Climate change mitigation REDD+

→ THE EUROPEAN SPACE AGENCY

CCI BIOMASS - AGB, 2017 [Mg/ha]

Platforms – Bring the People to the Data!

One-stop shop for forestry remote sensing services for the academic, public and commercial sectors.

System for Earth Observation, Data Access, Processing and Analysis for Land Monitoring

Part of the geospatial tools OpenForis at FAO

http://sepal.io

SNAP cumulative download by month and OS (2015/06/15 – 2021/08/31)

SNAP download exceeded 835[°]000 from June 2015 until today

Living Planet Fellowship

Supporting young scientists to undertake cutting-edge research in EO, Earth System Science or Climate Research

Co-funded 2-year post-doctoral full-time projects proposed by new scientists through their Host Organisation

https://eo4society.esa.int/con fellowship/

LIVING PLANET FELLOWSHIP

EOP-SD

17/09/2021

The Earth System Science Hub A new collaborative model based on 3 pillars...

Focus on major community goals

Grand science challenges, DTE, Green Deal...

Open Science & digital platforms

New research infrastructure and ITC capabilities New mechanisms to engage with scientists

Based on

Networking &

Partnerships

Supporting young talented post-doctoral researches in MSs to address specific science challenges with a period of at least one year as a visiting scientists in the ScienceHub

In September 2021 a final go/no-go decision will be taken depending on the COVID-19 situation

living planet symposium BONN 23-27 May 2022

Sustainability

TAKING THE PULSE OF OUR PLANET FROM SPACE

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2022 Living Planet Symposium

23-27 May 2022, World Conference Center Bonn

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EO and AI for Forestry

https://landtraining2021.esa.int

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European Space Agency

Thanks for your attention!

https://eo4society.esa.int

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