

4th Carbon from Space Workshop



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25/10/2022

The Terrestrial Carbon Cycle – Perspectives on the Contribution of ESA Earth Observation

Worldwide Urgent Priorities



ipcc
INTERGOVERNMENTAL PANEL ON climate change

Climate Change 2021

The Physical Science Basis

Summary for Policymakers

WORLD ECONOMIC FORUM

The Global Risks Report 2022

17th Edition

INSIGHT REPORT

EUROPEAN STATE OF THE CLIMATE

SUMMARY 2021

WGI

PROGRAMME OF THE EUROPEAN UNION

copernicus

supported by **ECMWF**

Climate Change

ipbes ipcc

BIODIVERSITY AND CLIMATE CHANGE

WORKSHOP REPORT

IPBES-IPCC CO-SPONSORED WORKSHOP

ipcc

ipbes

SUSTAINABLE DEVELOPMENT GOALS

1 NO POVERTY

2 ZERO HUNGER

3 GOOD HEALTH AND WELL-BEING

4 QUALITY EDUCATION

5 GENDER EQUALITY

6 CLEAN WATER AND SANITATION

7 AFFORDABLE AND CLEAN ENERGY

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

14 LIFE BELOW WATER

15 LIFE ON LAND

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

17 PARTNERSHIPS FOR THE GOALS



EO Supports Global and European Actions



Sustainable
Development

UN SDGs

Climate Change

UNFCCC

Climate Change

*SPACE CLIMATE
OBSERVATORY*

The **European Green Deal** - Benefitting strongly from ESA Earth Observation capabilities, both now and in the future

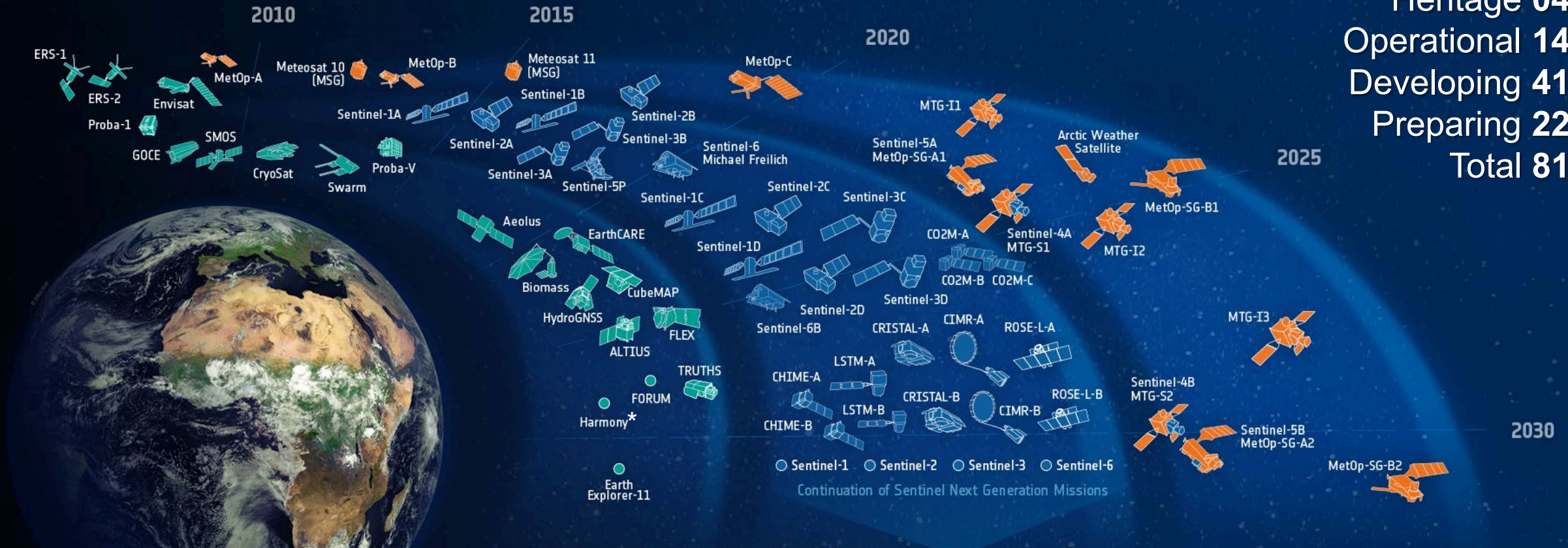
The **Sendai Framework** - Mitigating environmental threats to society and strengthen Global Resilience through novelty



ESA Develops world-class EO systems with European and global partners to address Scientific & Societal challenges



Satellites
Heritage 04
Operational 14
Developing 41
Preparing 22
Total 81



*Pending final mission selection

Science

Copernicus

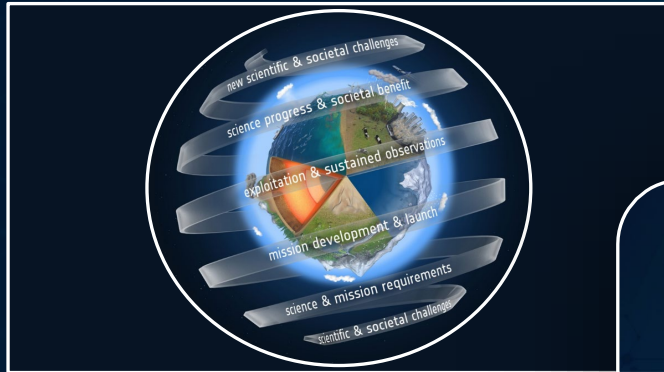
Meteorology



FutureEO - ESA's core Earth Observation R&D programme since 2000



Earth Science, Preparation of EO future and World-class EO Research Missions



Foundations and Concepts



Research Missions



Mission Management



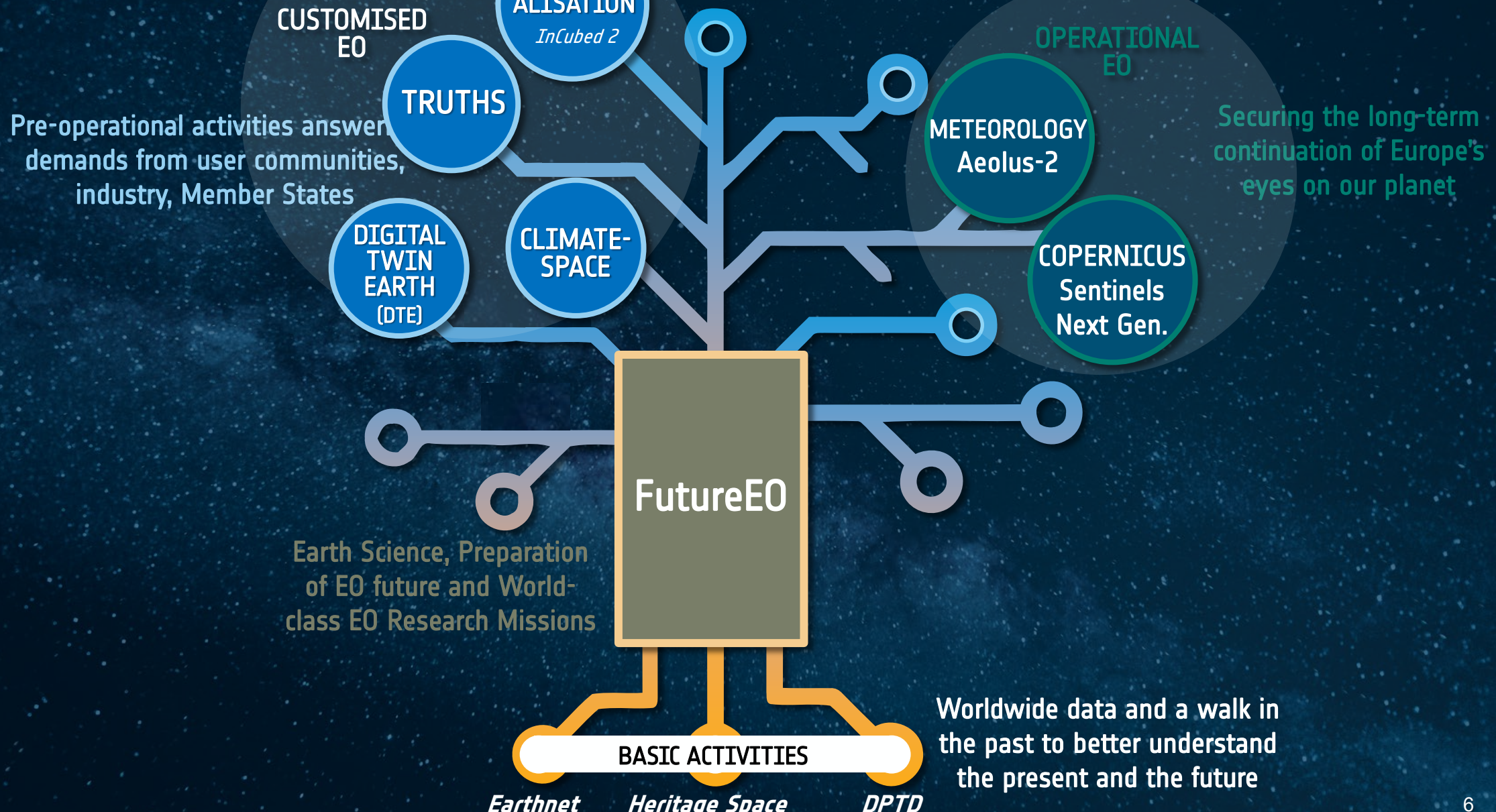
Earth Science for Society

The only ESA (EO) optional programme bringing together all Member States

The Earth Observation locomotive at the Next Ministerial (CM22)



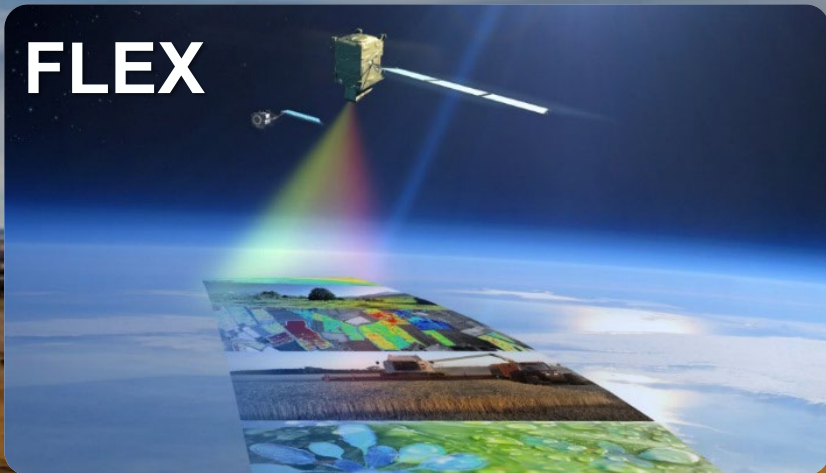
EO at CM22...



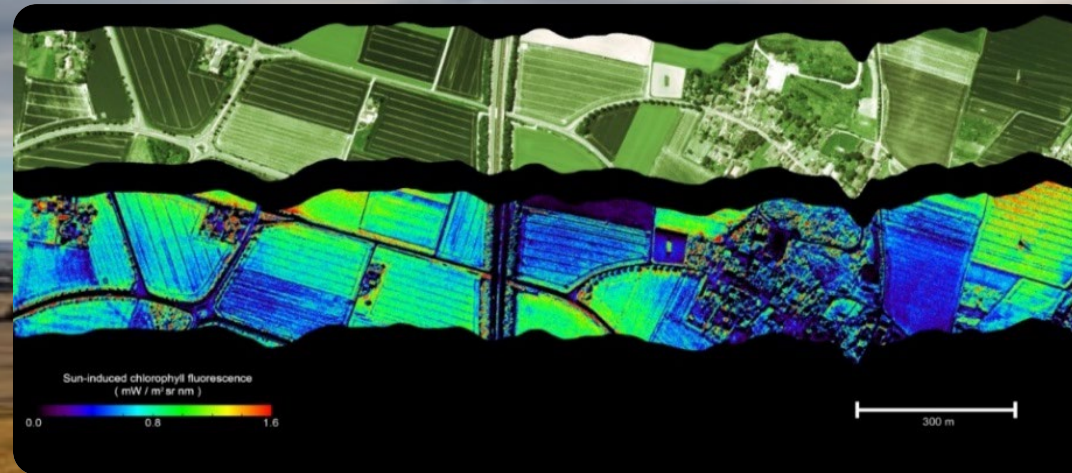
Research EO missions for terrestrial carbon



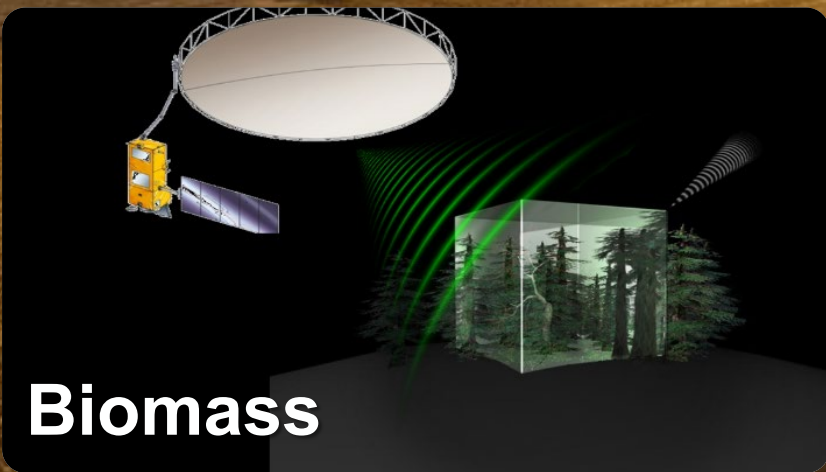
FLEX



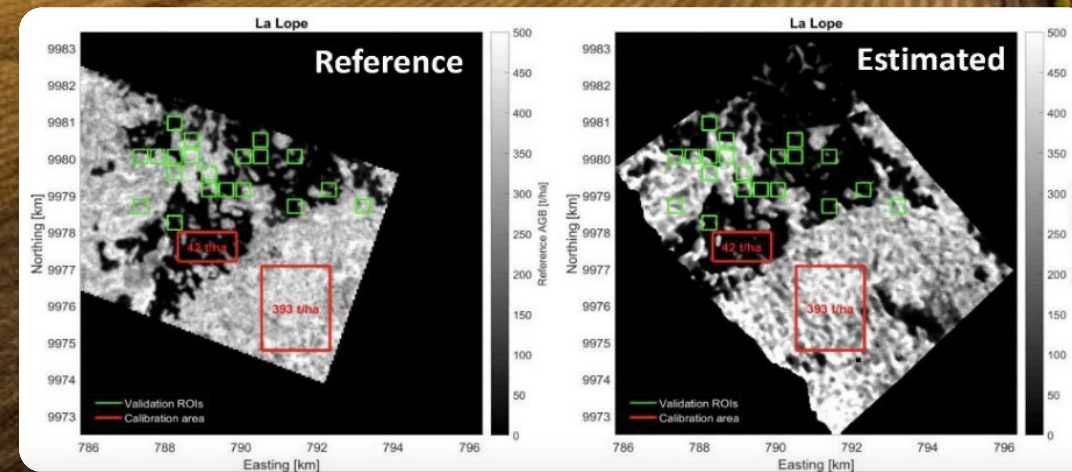
Solar Induced Fluorescence

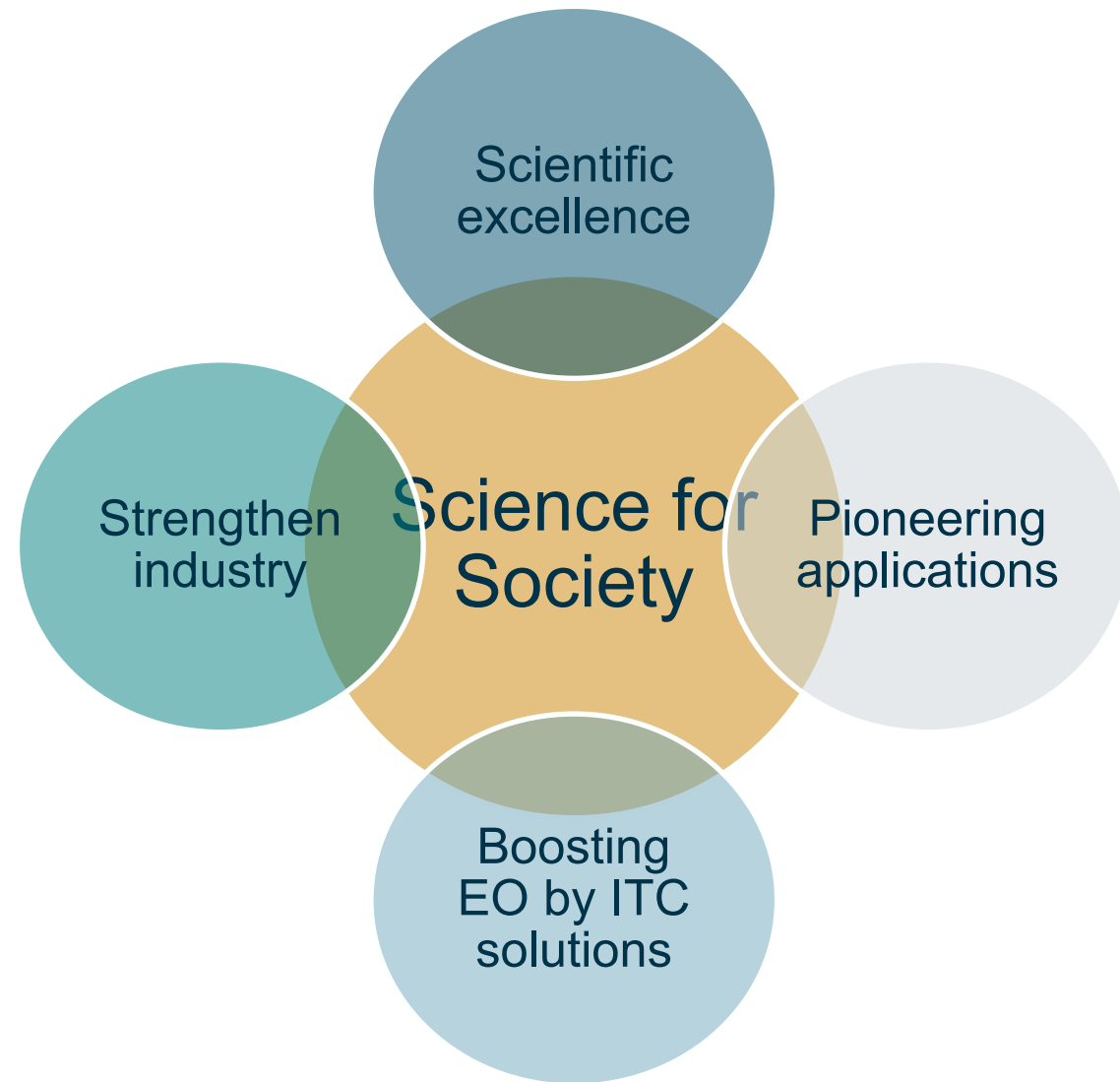


Biomass



Above ground biomass estimates from P-Band SAR



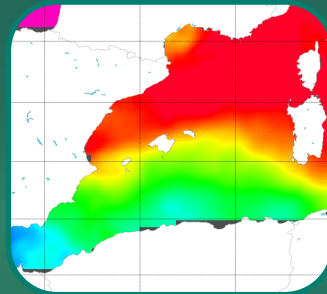


- **Deliver scientific excellence** in EO, maximizing the scientific impact of European EO capabilities and advancing our fundamental understanding of the Earth and system in close collaboration with EC.
- **Pioneer innovative and reliable Earth Observation applications** to support international policies on the environment and sustainable development.
- **Strengthen European EO industry** competitiveness through new technologies, stimulating innovative approaches to open new market opportunities.
- **Making full leverage of ICT advances** ensuring competitive R&D cycle generating information EO-derived information in an agile and rapid innovation process.
- **Maximising the impact of existing EO** capacity (EE, Sentinels, National Missions) and preparing for a fast exploitation of the next Sentinel missions

We foster scientific excellence and maximise the scientific impacts of ESA missions in terms of new methods, novel products and breakthroughs in Earth System Science



Engaging the community



New methods & products



Advancing Earth System Science



Scientific Campaigns



Training and Education



Open Science Tools/Virtual Labs



Networking & collaboration

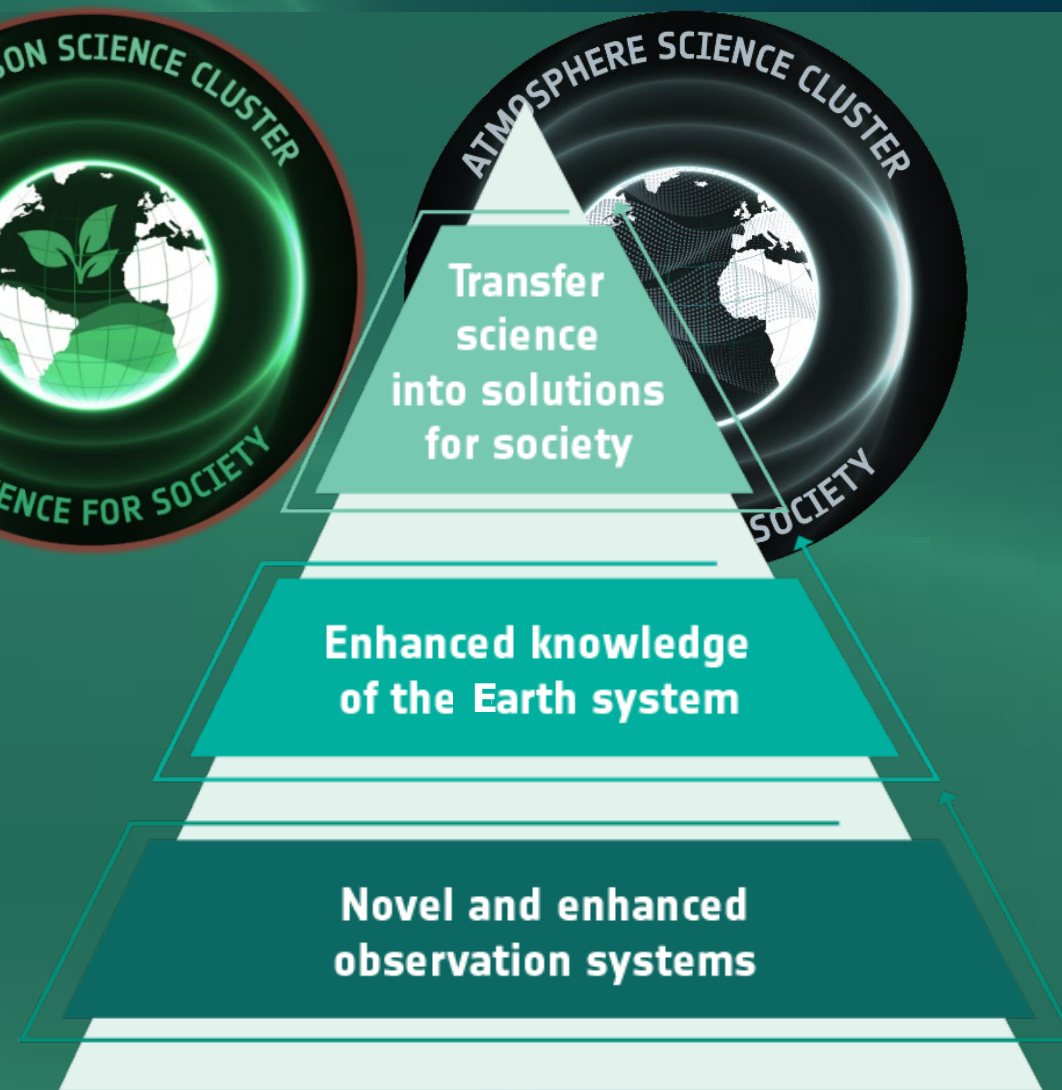


Transfer to future missions



Science Clusters:

- *Promote collaborative research across projects and teams (also non ESA projects) towards common and more ambitious goals;*
- *Promote a coordinated approach to science, through networking and partnerships;*



ESA Carbon Science Cluster Themes



Interfaces to Ocean and Cryosphere

*Permafrost
Blue Carbon*



Vegetation State and Processes

*Carbon Stocks
(Biomass)*



*Vegetation
Processes*

*Model-data
Interfaces*

*Analysis
Tools*

*Open Science
Tools
Platforms*

*Land Use and
Emissions*

*Land Use,
Land Use
Change,
Agriculture*



*Dynamics and
Disturbance*

*Disturbance,
Extremes and
Vegetation
Dynamics*



ESA Carbon Science Cluster Projects



The land projects from the CCI are also a resource

Interfaces to Ocean and Cryosphere

Cryobiolinks
AMPAC-net



Analysis Tools

DTE – Forest
Earth System Data
Lab (ESDL)
DeepESDL

Land Use and Emissions

Photoproxy
Multi-Flex
WorldCover



Vegetation State and Processes

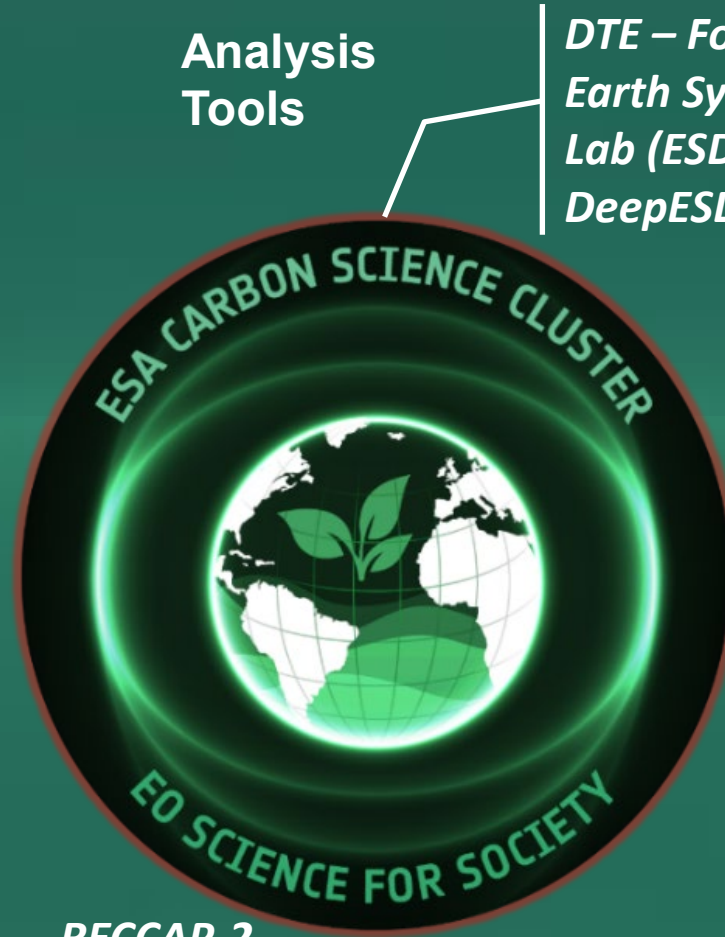
Albiom
Biomascap
Forest Carbon
Monitoring
Terra-P
Sen4GPP
TROPOSIF
SMOS+ Vegetation
PMVOS



RECCAP-2
Vad3emecum
IMITATE
Land Carbon Constellation

Dynamics and Disturbance

SHRED
S14Amazonas
Sense4Fire
SeasFire
Hi-Five

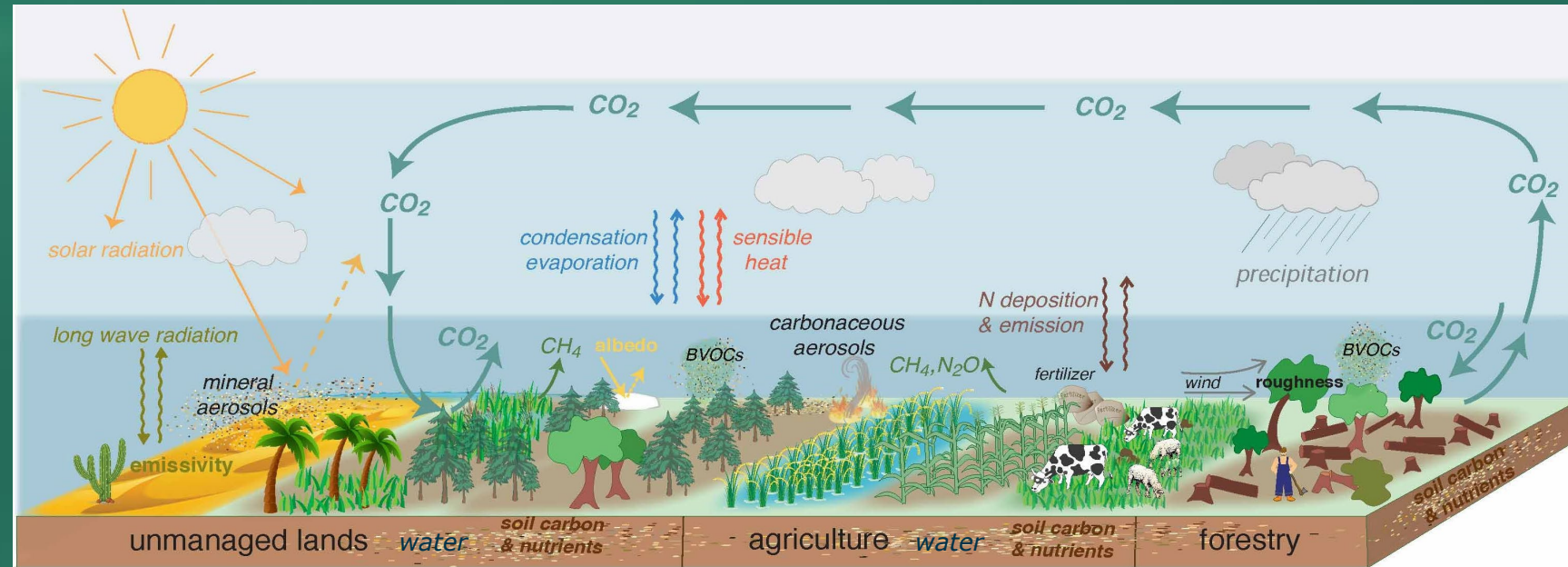


An unprecedented opportunity for a community effort



In the coming few years EO will provide an unique capability to advanced towards a complete dynamic reconstruction of the terrestrial carbon cycle at unprecedented scales in space and time...

Synergistic observations from Sentinels 1, 2, 3, S5P, FLEX, BIOMASS... together with missions from our international partners will open a new potential to better characterise the terrestrial carbon cycle from space



We will not do this alone....



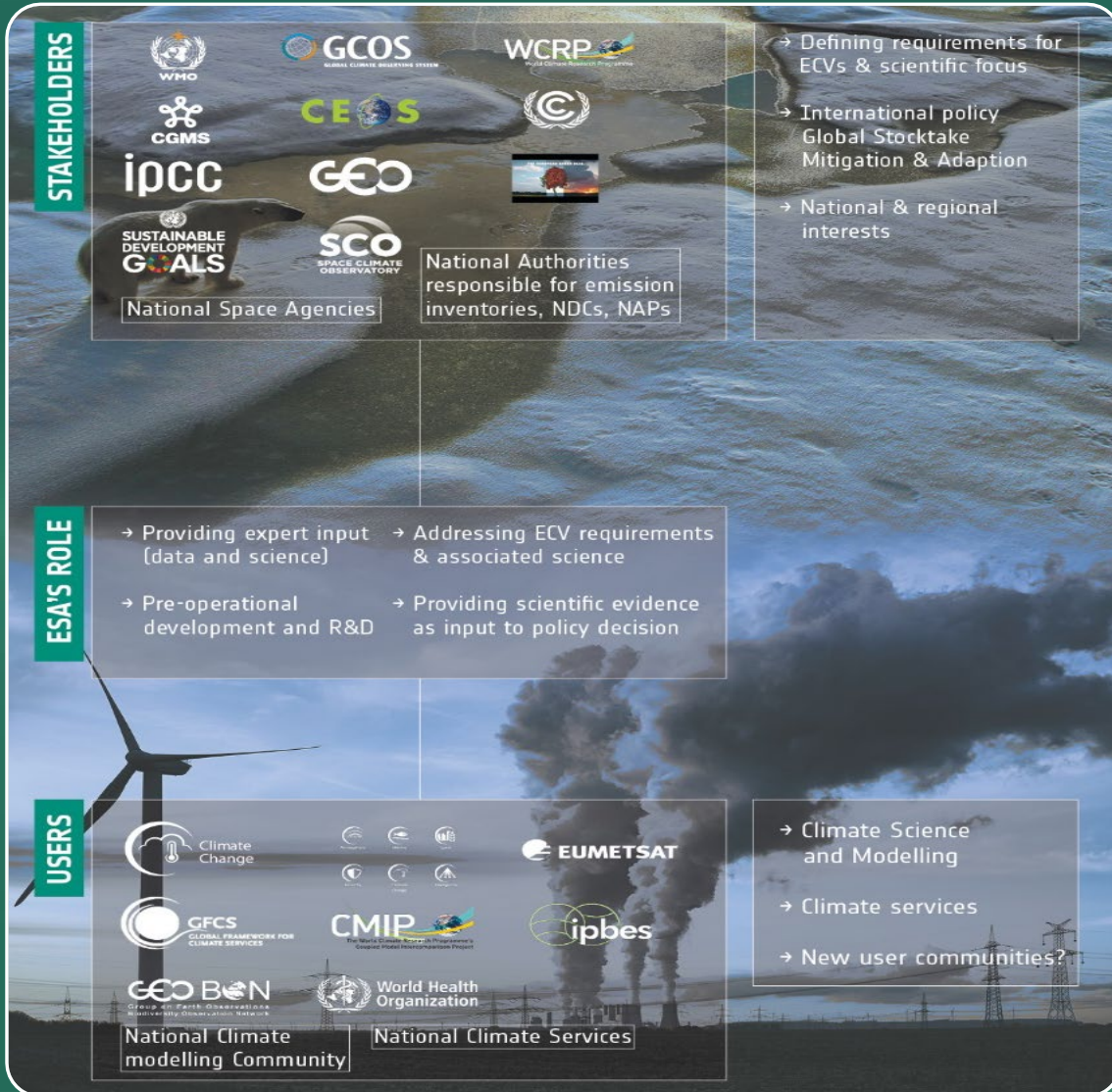
“... to jointly advance Earth system science and its contribution to respond to the global challenges that society is facing in the onset of this century”



The European Commission's Deputy Director General for Research and Innovation, Patrick Child and ESA's Director of Earth Observation Programmes, Josef Aschbacher at the signing ceremony, January 2020.

See talk by Franz Immler for further details





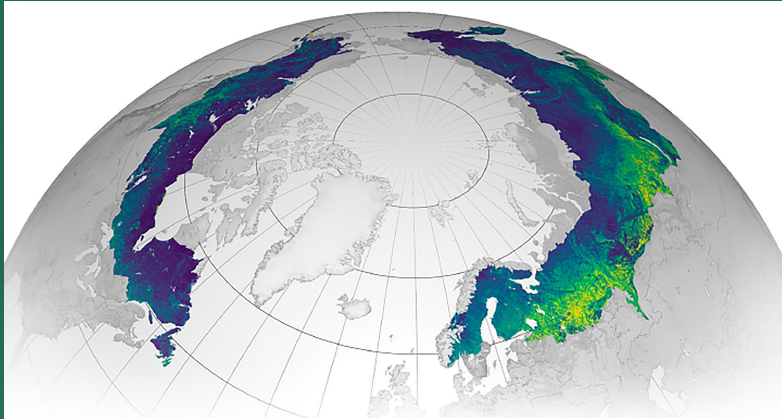
THE INTERNATIONAL CLIMATE NETWORK

Policy drivers

- UNFCCC Paris Agreement/ IPCC
- 2030 Agenda for Sustainable Development
- Sendai Framework for Disaster Risk Reduction 2015–2030
- EU's Green Deal
- UN conventions: biodiversity & ecosystems
- Requirements from various stakeholders of the international climate network, in particular GCOS

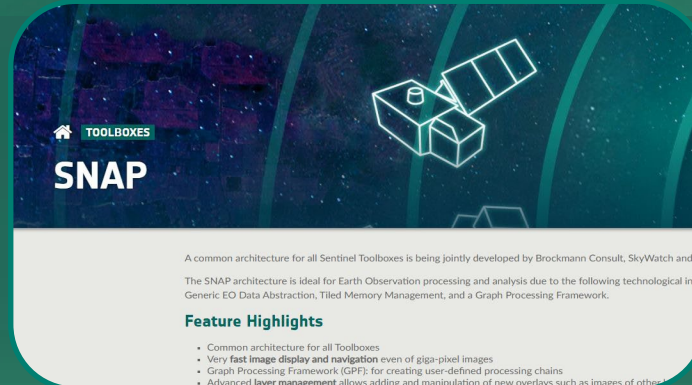
Focus on collaboration, complementarity and synergy

Community tools and open science

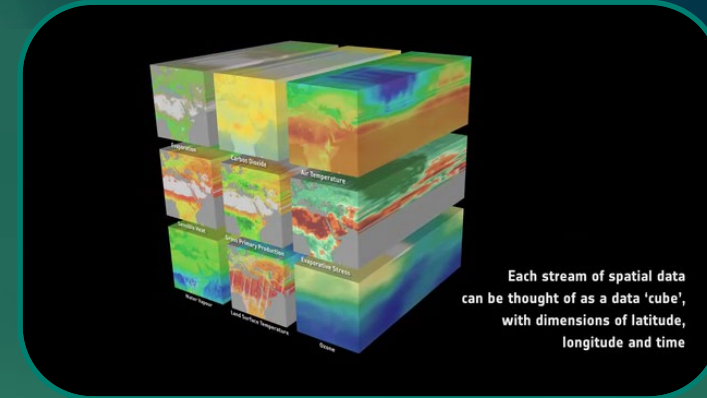


MAAP

Virtual open and collaborative environment built in collaboration between ESA and NASA



SNAP: Community multi-mission toolbox

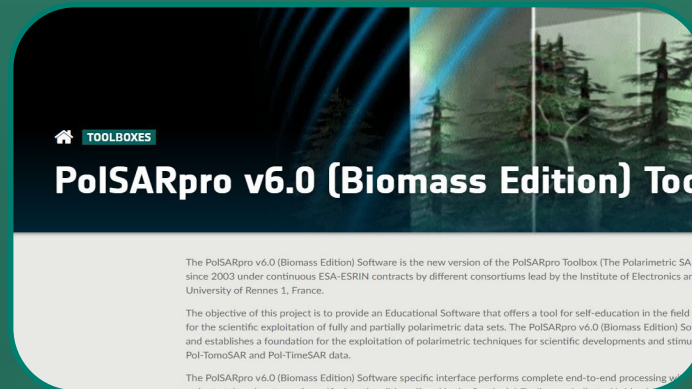


Each stream of spatial data can be thought of as a data 'cube', with dimensions of latitude, longitude and time

Developing collaborative research platforms e.g. DeepESDL, EDC, NoR...



scimaap.net



PoISARpro BIO: Polarimetric tool including dedicated tools for BIOMASS

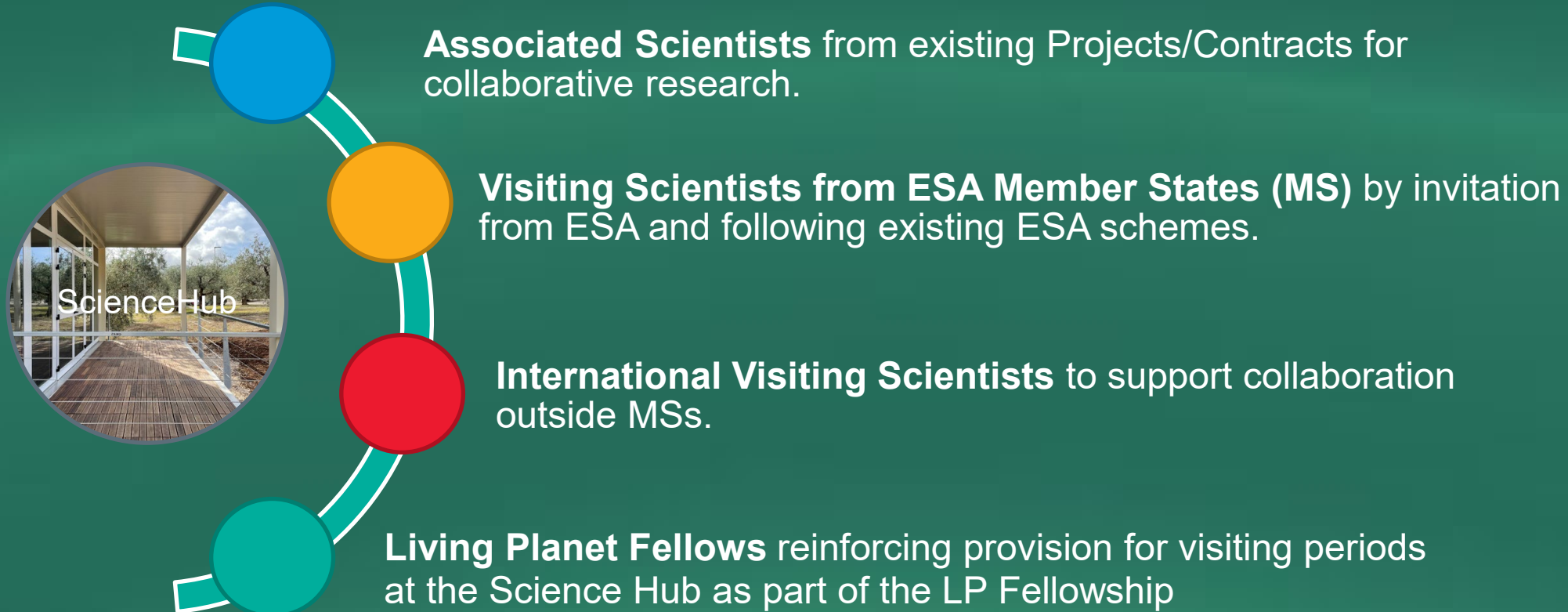


Open Data Science Catalogue

Science Hub – Open for business



A new science facility in ESA (ESRI) to boost the scientific output of ESA and its engagement with the scientific community



Through the different projects and activities funded today by ESA (e.g., Carbon Science Cluster) and others we are already defining some building blocks for a Next Generation Assessment of Terrestrial Carbon but need the community to help us

How can we structure our activities to exploit the unique set of complementary missions and sensors (together with in-situ observations, enhanced models), emerging technologies e.g. DTE and collaborations e.g. ESSI, AMPAC, RECCAP-2 to significantly advance the way we observe and assess the terrestrial carbon cycle?