ESA contribution to CEOP objectives

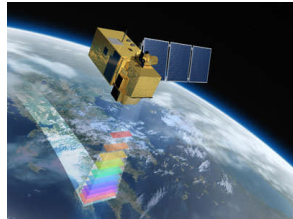## Einar-Arne Herland

ESA data provision to CEOP

- agreement on data provision to CEOP was made in March 2007 (Category 1 proposal #3801)

- the CEOP proposal does not require observations that have to be planned

- data allocation includes several thousands of scenes from both radar and optical sensors

- access information was provided to CEOP on 5 April 2007

- the ESA EO Help and Order Desk is the interface for all issues regarding data access

- large amounts of data are available on the web for free download

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GMES dedicated missions: Sentinels

Sentinel 1 – SAR imaging

All weather, day/night applications, interferometry

2011

Sentinel 2 – Multispectral imaging

Land applications: urban, forest, agriculture, etc
Continuity of Landsat, SPOT data

2012

Sentinel 3 – Ocean and global land monitoring

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

2012

Sentinel 4 – Geostationary atmospheric

Atmospheric composition monitoring, trans-boundary
pollution

2017+

Sentinel 5 – Low-orbit atmospheric
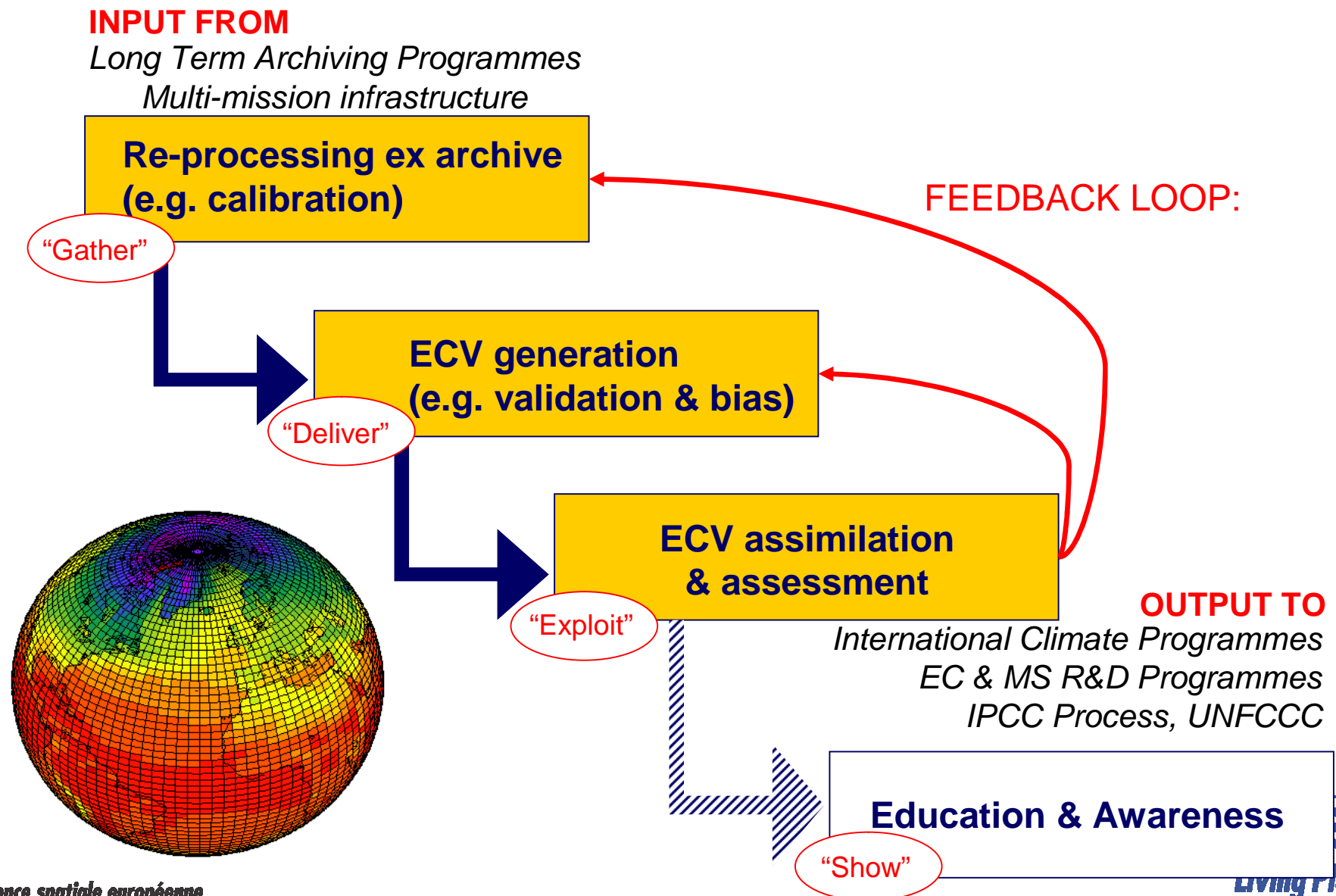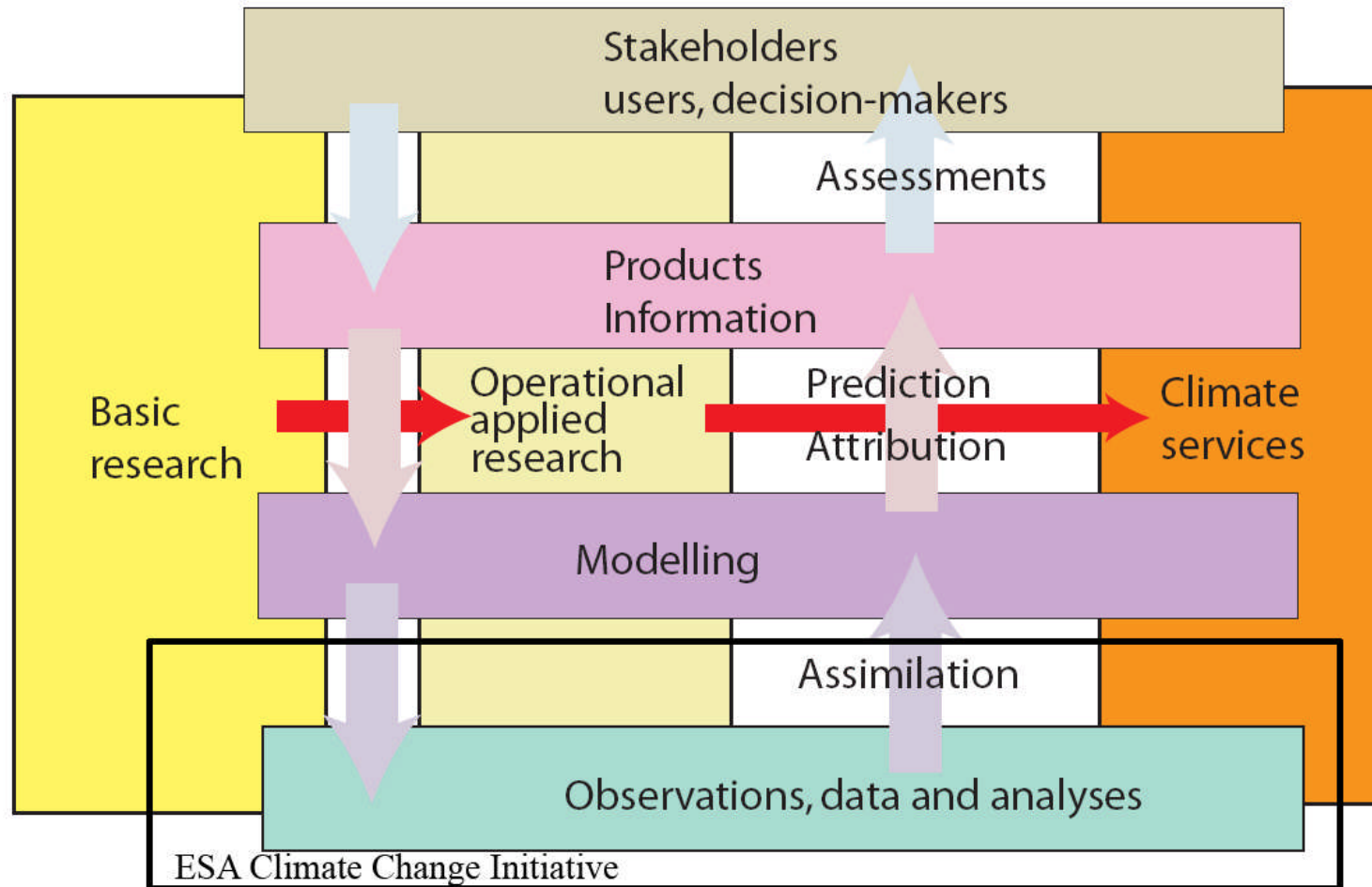
Atmospheric composition monitoring

2019+

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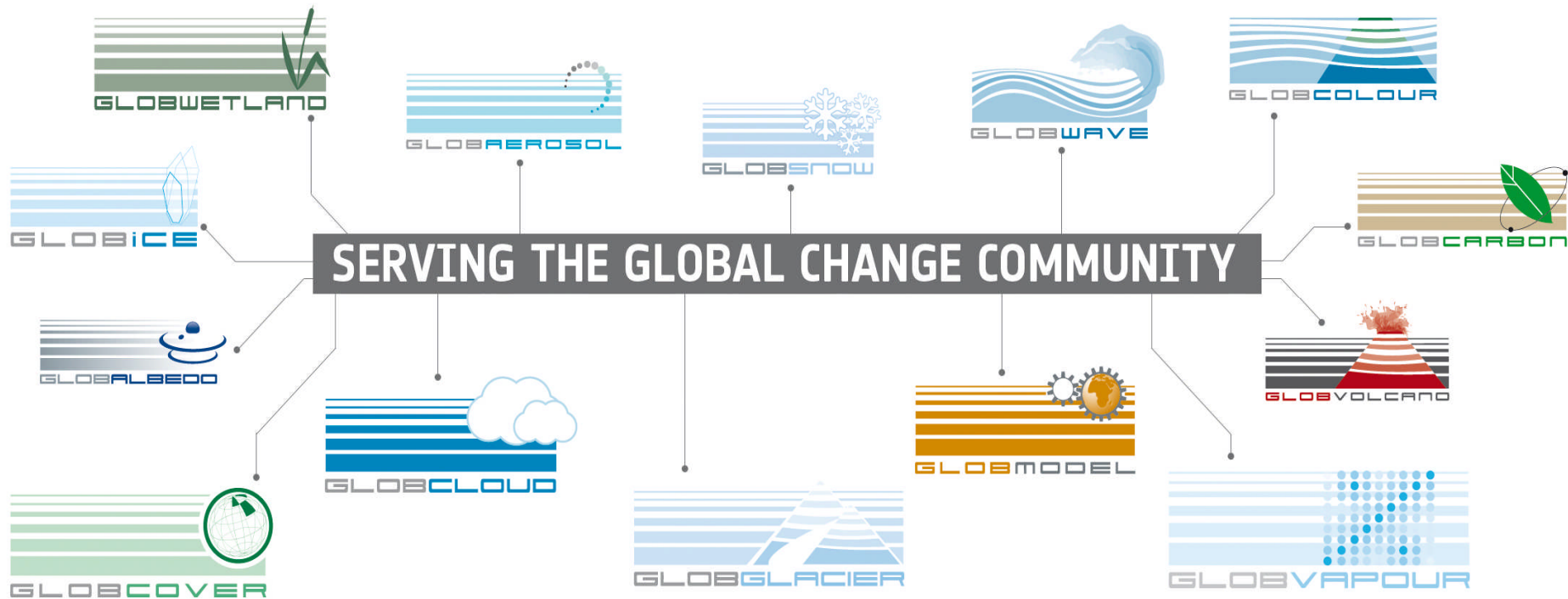
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Sensor Comparision	+Δ
S1 C-band SAR / Envisat ASAR	• Inclusion of strip mode with 5m resolution (e.g. for disaster req.) • IWS Interferometric Wide Swath in dual-pol- 250km – 5x20m (instead of 5x20m 100km swath), system will mainly be operated in IWS • Increased revisit for repeat pass interferometry (6days based on 2 sat) • Better accuracy: 1dB instead of 1.5 – 3.5 dB (3 sigma level)
S2 MSI / SPOT-4 HRV	• Much larger swath: 290km instead of 117km (60km + 60km) • Increased revisit: 5days instead of 27 days global coverage • Superspectral design instead of multispectral design (13 bands instead of 4 bands) • Additional bands in the red edge with high rpectral resolution • Dedicated atmos. correction bands
S3 OLCI / Envisat MERIS	• Sun-glint free design • Slightly larger swath (1270km instead of 1150km) • Higher revisit (1 day instead of 3 days) • 6 new bands in the VNIR (21 bands instead of 15 bands)
S3 SLST / Envisat AATSR	• Total overlap with OLCI (750km nadir – 1675km backwards) • Higher revisit (1 day instead of 3 days) • Increased spatial resolution for VIS bands (500m instead of 1km) • 9 bands instead of 7 bands, additional 2 new TIR bands under discussion
S3 SRAL / Envisat RA-2	• dual band acquisition, Ku-band, for height estimate and C-band, for ionopheric correction, • a SAR mode with the prime interest to discriminate sea/ice transitions, sea/land transitions in a coastal area or inland water areas. It will allow measuring the topography over all types of surfaces such as sea, coastal areas, sea ice, ice sheets, ice margins, in-land waters with higher coverage and increased accuracy.

3nd annual meeting of CEOP, Melbourne, Australia, 19-21 Aug 2009

ESA Initiative on Climate Change

The climate information system
(*from K. Trenberth: Observational needs for climate prediction and adaptation, WMO Bulletin 57(1), January 2008*) and the position of the ESA climate change initiative within it.

GlobSeries projects (DUE)

SERVING THE GLOBAL CHANGE COMMUNITY

GLOBWETLAND · GLOBAEROSOL · GLOBSNOW · GLOBWAVE · GLOBCOLOUR · GLOBiCE · GLOBCARBON · GLOBALBEDO · GLOBVOLCANO · GLOBCLOUD · GLOBMODEL · GLOBCOVER · GLOBGLACIER · GLOBVAPOUR

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ECV Maturity (Science & Methods)

Mature → **Research**

Scale: 6 — 5 — 4 — 3 — 2 — 1

OCEANIC
- Sea Level
- Sea State
- Sea Ice
- SST
- Ocean Colour
- Salinity

TERRESTRIAL
- Land Cover
- Snow Cover
- Glaciers Ice Caps
- LAI FAPAR
- Fire Disturb.
- Albedo
- Lake Levels
- Soil moisture
- Biomass

ATMOSPHERE
- Ozone (total)
- Cloud prop. (coverage)
- Aerosol Prop.
- GHG
- Upper wind speed

Sea Level ECV
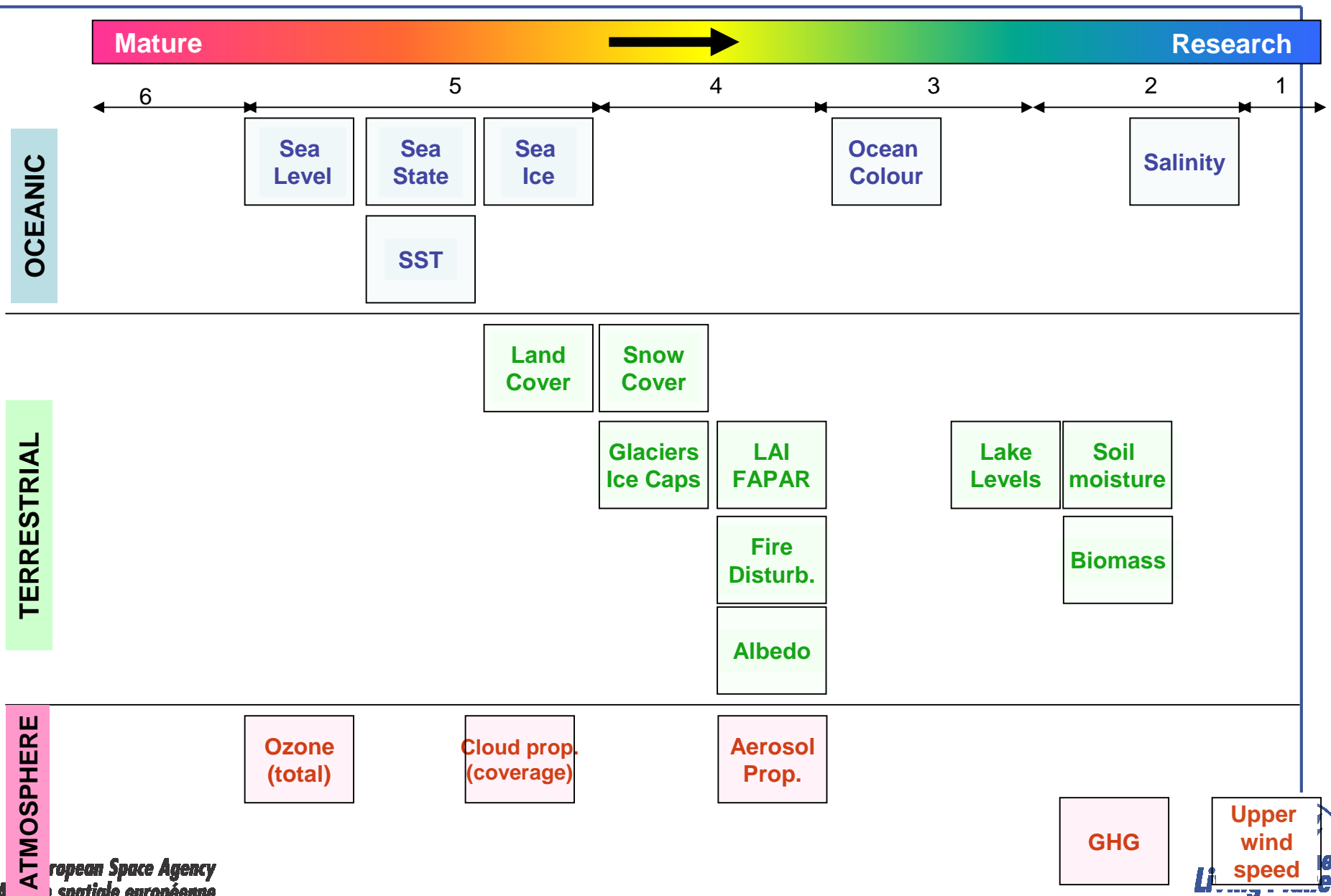
Data

Instrument	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ESA																									
ERS-1		██	██	██	██	██	██	██	██																
ERS-2					██	██	██	██	██	██	██	██	██	██	██	██	██								
ENVISAT												██	██	██	██	██	██	██	██	██	██	██	██		
CryoSat-2																				██	██	██			
Sentinel-3																						██	██	██	██
Europe																									
Topex/Poseidon		██	██	██	██	██	██	██	██	██	██	██	██	██											
Jason 1-3												██	██	██	██	██	██	██	██	██	██	██	██	██	██
World																									
Geosat-FO										██	██	██	██	██	██	██	██								
GFO-2																							██	██	██

Projects

DUACS ████████████████████

RADS ████████████████████

1992-2009 ██████████████
All RA missions

- ▇ Duration
- [2000] Time series

1991   1995   2002   2009   2012   2015

Users

DUACS-AVISO User Numbers: >500

Key Users: Sea-Level Science community, ECMWF, Marine Core Service/MyOcean/ MFSPP, USNAVY, Blue-Ocean (AUS)

RADS User Numbers: >500

Key Users: Delft U, Sea-Level Science Community

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Sea Level ECV

GCOS Requirements for Sea Level:

GCOS Requirement		Current Status
• Accuracy: • Spatial resolution: • Temporal resolution: • Stability:	1 cm Horizontal: 25 km Daily 0.5 mm/decade	2 cm Horizontal: 25 km Weekly 10 mm/decade (1 mm/yr)

Requirements for Sea Level:

- **FCDR generation**
  - Evolution in the processing algorithms and chains
  - ERS-1, ERS-2 and ENVISAT data re-processed to level 2 in ENVISAT format
- **Algorithm issues**
  - ERS-1, ERS-2 based on outdated processing algorithms developed in the 1980s
  - ENVISAT auxiliary data outdated
  - Algorithm improvement required, both instrumental and geophysical.
  - Need multi-mission homogeneity in all fields of the vertical datum equation. The reprocessing shall be designed in cooperation with CNES
  - Application of consistent cross-calibration and validation protocols (across all RA missions).
  - Development of assimilation of products in climate models.
- **Linked Projects**
  - DUACS-AVISO (CNES/PODAAC-NASA)
  - RADS (Delft University)

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Activity schedule for an ECV

Activity No.		Cycle No.	Start	Prep	Lasts	End	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Gather	1	2	0	4	17																								
		2	18		4	21																								
		3	22		4	25																								
2	UpgradeL 1B	1	2	0	3	4																								
		2	8	0	3	10																								
		3	14		3	16																								
2	Reprocess L1B	1	5	0	3	7																								
		2	11		3	13																								
		3	17		3	19																								
3	Product Specification	1	13	0	4	16																								
		2	18		4	21																								
		3	23		4	26																								
5	Algo Development	1	15	0	4	18																								
		2	19		4	22																								
		3	23		4	26																								
		4	27		8	34																								
4	ECV Sys Development	1	17	0	4	20																								
		2	21		4	24																								
		3	25		4	28																								
4	ECV Re(gener ation)	1	21	0	4	24																								
		2	25		4	28																								
		3	29		4	32																								
4	ECV Validation	1	22	0	4	25																								
		2	26		4	29																								
		3	30		4	33																								
5	Assimilate & Feedback	0	4	0	8	23																								
		1	24	0	4	27																								
		2	28		4	31																								
		3	32		4	35																								

3 re-processing cycles in 6 years
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- **Systematically track changes in climate system & forcings**
  - e.g. trends in ECVs

- **Assess consistency across related ECVs**
  - e.g. sea-level, ice melting, SST

- **Analyse global data products (e.g. re-analysis data sets)**

- **Provide assessment feedback:**
  - error analyses, anomalies, inconsistencies

- **Test sensitivity of models to new data**
  - e.g. Observing System Experiments

- **Confront model output with observations**
  - to validate model simulation

- **Assimilate data into models to constrain simulations**

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Web-based user access
- access, visualise, share, compare ECV data products

Observation operators
- for users to confront climate model outputs v observations.

Data Assimilation platform
- providing access to a hierarchy of assimilation tools
  from Kalman Filter to variational methods
- existing assimilation infrastructure (e.g. ECMWF)
- accelerate integration of ECV data sets into models.

Interface
- to distributed computing & modelling resources
- for data sensitivity tests (e.g. OSEs & OSSEs).