

climate change initiative

RIVER DISCHARGE

Science objectives and goals



river
discharge
cci



User Workshop
Météo-France, Toulouse
03-04 June 2024



AGENDA



Monday 03-Jun

Start	End	Duration	Title	Speaker
9:00:00	9:30:00	0:30:00	Welcome coffee	
9:30:00	9:50:00	0:20:00	Science objectives and consortium presentation	A. Andral
9:50:00	10:10:00	0:20:00	Introduction from ESA	C. Albergel
10:10:00	10:20:00	0:10:00	User Requirements	S.Biancamaria
10:20:00	10:30:00	0:10:00	Selected basins and locations	L. Gal
10:30:00	11:00:00	0:30:00	Altimetry Water Surface Elevation	S. Biancamaria
11:00:00	11:30:00	0:30:00	Break	
11:30:00	12:30:00	1:00:00	Altimetry-based river discharge	L. Gal
12:30:00	14:00:00	1:30:00	Lunch	
14:00:00	14:45:00	0:45:00	Multispectral images-based river discharge	P. Filippucci and D. Sahoo
14:45:00	15:30:00	0:45:00	Combined satellite-based river discharge	A. Tarpanelli
15:30:00	15:50:00	0:20:00	Break	
15:50:00	16:35:00	0:45:00	River discharge products benchmark and validation	M. Vayre and L. Gal
16:35:00	16:45:00	0:10:00	Climate assessment	Elena
16:45:00	17:00:00	0:15:00	Wrap-up	All

Tuesday 04-Jun

Start	End	Duration	Title	Speaker
9:00:00	9:30:00	0:30:00	Welcome coffee	
9:30:00	10:00:00	0:30:00	Use case: river discharge product assimilation	S.Munier and V.Pedinotti
10:00:00	11:00:00	1:00:00	Feedbacks from users on products and user requirements	All
11:00:00	11:20:00	0:20:00	Break	
11:20:00	11:40:00	0:20:00	River Discharge Roadmap	S. Biancamaria
11:40:00	12:25:00	0:45:00	Discussion on roadmap	All
12:25:00	12:45:00	0:20:00	Conclusion of the workshop	S. Biancamaria
12:45:00	13:45:00	1:00:00	Lunch and end of the workshop	





Science objectives

- If “only” 0.0002% of water on earth is stored in the river network (Gleick, 1996), it corresponds to the main water exchange from land to the ocean with 36,000 km³/y (Milliman and Farnsworth, 2013)
- Climate change affects water cycle
- ➔ Long-time series of river discharges needed to better assess its impact on continents, for adaptation of human societies, and the impact on the oceans

- internationally available in situ gage networks are very heterogeneous both in space and time.
- Northern hemisphere (mainly US and western Europe) = streams are strongly anthropized and water cycle variations at such locations do not directly reflect CC consequences

- ➔ Use of global information given by EO satellites to preserve and improve our capacity to observe and infer CC impacts on continental freshwater



Science objectives



- Target = GCOS requirements on river-related ECVs

PRODUCT	DEFINITION	FREQUENCY	RESOLUTION	REQUIRED MEASUREMENT UNCERTAINTY	STABILITY	STANDARDS/ REFERENCES
River Discharge	Volume of water flowing through a river (or channel) cross-section per unit time	Daily	Per river	10 % (relative)		ISO/TC 113: WMO (2010) WMO (2008a) WMO (2009)
Water Level	Elevation of the free-water surface of a body of water relative to a datum level	Daily	100m	10 cm	1 cm/yr	ISO/TC 113: WMO (2010) WMO (2008a) WMO (2009)
Flow Velocity	Vector indicating the speed and direction, at a point, of a moving liquid	Few times per year for station calibration	Per river	10 % (relative)		ISO/TC 113: WMO (2010) WMO (2008a) WMO (2009)
Cross-Section	Section perpendicular to the main direction of flow bounded by the free surface and wetted perimeter of the stream or channel (ISO 772)	Few times per year for station calibration	Per river	10 % (relative)		ISO/TC 113: WMO (2010) WMO (2008a) WMO (2009)

→ First analysis on the feasibility to derive long term (at least over twenty years) river discharge time series at selected locations, over 15 basins, using remote sensing observations and ancillary data, as a proof-of-concept of the feasibility of CCI river discharge ECV products



Science objectives

- River discharge from Earth Observation
 - There is currently no satellite instrument measuring river discharge
 - Use of EO linked with river discharge to indirectly estimate discharge, using for example, parametrization or numerical models and ancillary data.



Aqua satellite with MODIS (credits: NASA)

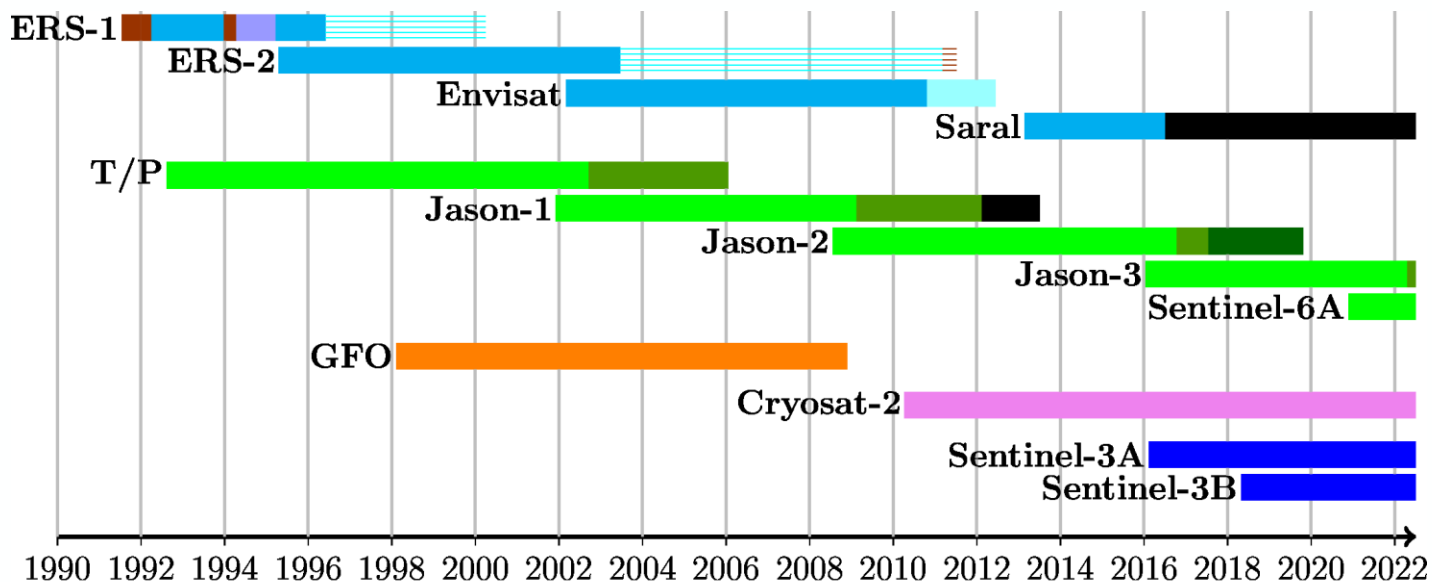


Jason-2 alti. mission (credits: CNES/Mira production)



Science objectives

- Altimetry = provides water surface elevation at virtual stations
 - the longest timeseries since 1990
 - BUT not on the same orbit, uncertainties and observation capabilities, gaps in the data



Colors = orbit repeat periods : 3 d, 10 d (tandem phase), 17 d, 27 d, 30 d, 35 d, 168 d, ~1 year, 369 d, drifting

From Biancamaria, 2020. Colors correspond to missions' orbits repeat periods. After June 1996, ERS-1 is in back-up mode and no measurements are recorded and from Mid-2003, altimeter onboard ERS-2 stopped working. That's why the boxplot patterns for these two missions after these dates are changed to show the absence of measurements

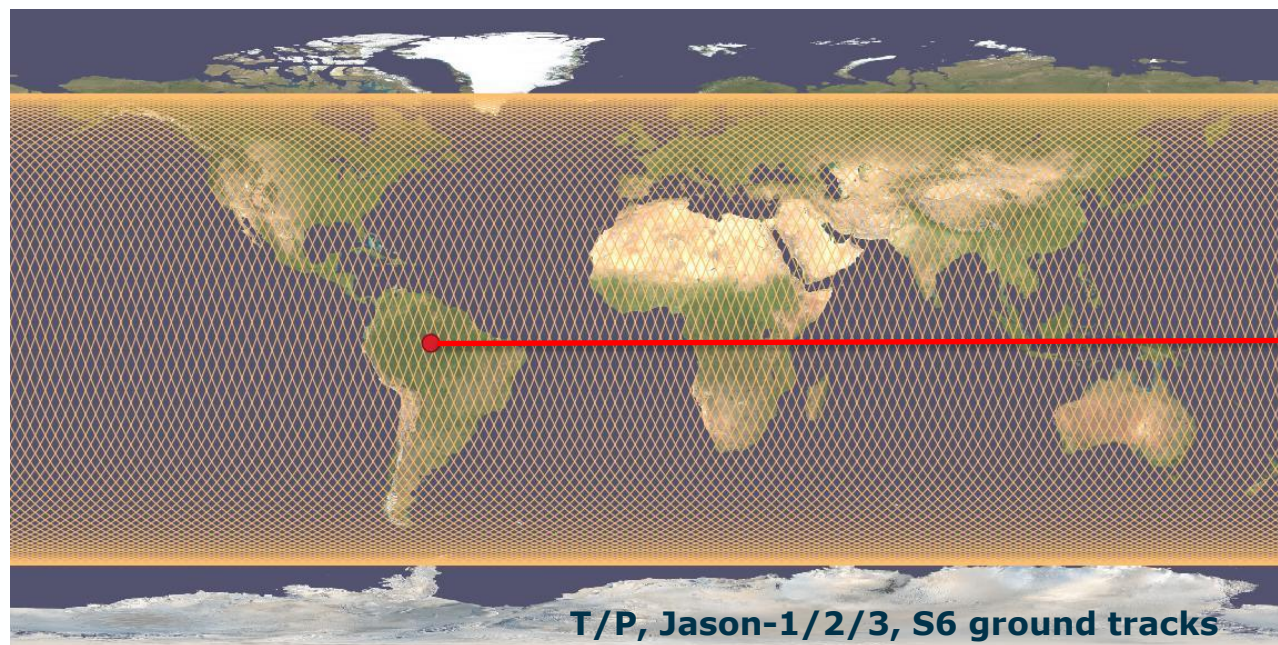
☀ Altimetry missions considered: ERS-1/-2, Envisat, Saral, Topex-Poseidon, Jason-1/-2/-3, Sentinel-6A, Sentinel-3A/B



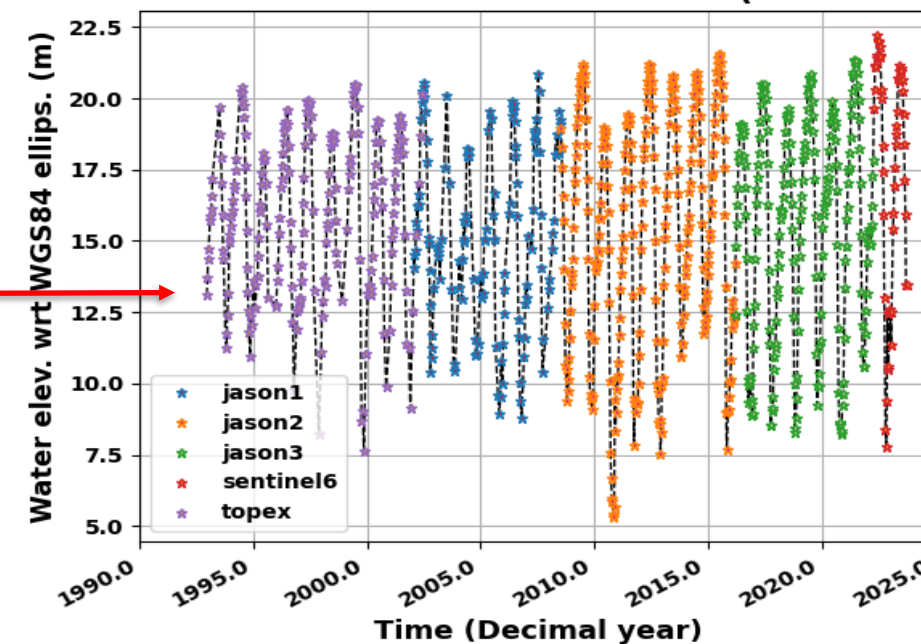
Science objectives



- Long-term time series of water surface elevation
 - Merge of virtual stations to increase temporal sampling
 - Biases correction between satellite altimetry
- ➔ Critical analysis of their capability to feed climate services



SOLIMOES RIVER NEAR MANACAPURU (AMAZON BASIN)





Science objectives

- River discharge estimation
 - From **Altimetry**: 3 methods based on data availability
 - stage-discharge rating curve, parametrized with a power relationship between these two quantities
 - simulated river discharges along with radar altimetry water elevation to compute rating curves
 - When no temporal overlap between in-situ or simulated discharge and water surface elevation data : assumption on the rating curve (valid and stable across the various time periods covered by the two datasets)
 - From **multispectral images** (sub-daily temporal resolution): differences between the passive response of the reflectance signal from the soil and from the water are used to identify a change in the land area near the river channel that is shown to be strongly correlated with river discharge
 - **Multi-mission** river discharge = take benefit of altimetry and multispectral
- Focus on validation + uncertainties of the dataset
- Algorithm round robin to objectively assess the generation (and evaluation) of long time series of river discharge



Science objectives



- Use case: river discharge estimation by assimilation in models.
 - generate and evaluate long term discharge time series within the entire river network of the selected basins, based on the assimilation of satellite products (WSE and/or discharge) into large scale river routing models.

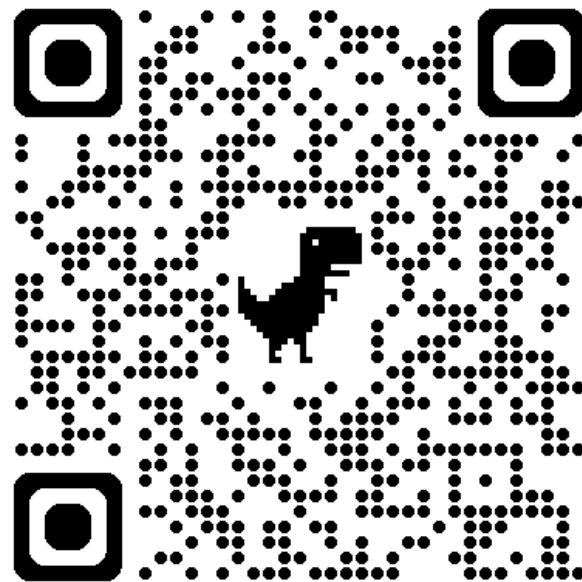


Science objectives



- All documents and news about the project are available here :

<https://climate.esa.int/fr/projects/river-discharge/>





Consortium



- Project Management – altimetry & round robin = CLS
- Science Lead – Altimetry, User requirement, User workshop = CNRS-LEGOS
- CNR-IRPI = river discharge from multispectral images and merge of altimetry and multispectral
- Hydromatters = altimetry, river discharge with altimetry and validation
- EOLA = altimetry and river discharge in arctic basins and climate assessment
- CNRS-CNRM = large-scale model and user workshop
- MAGELLIUM = large-scale model.

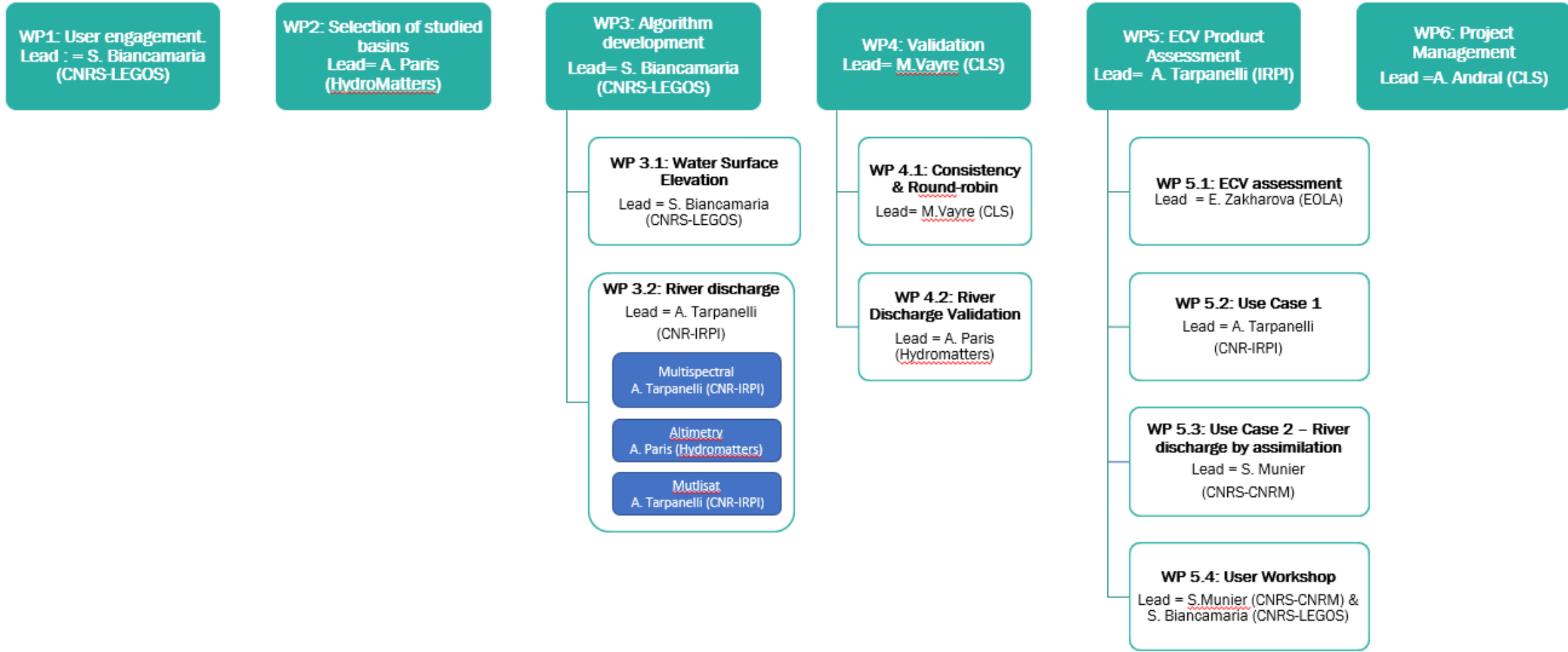


Hydromatters
Prendre la mesure de l'eau From space to society



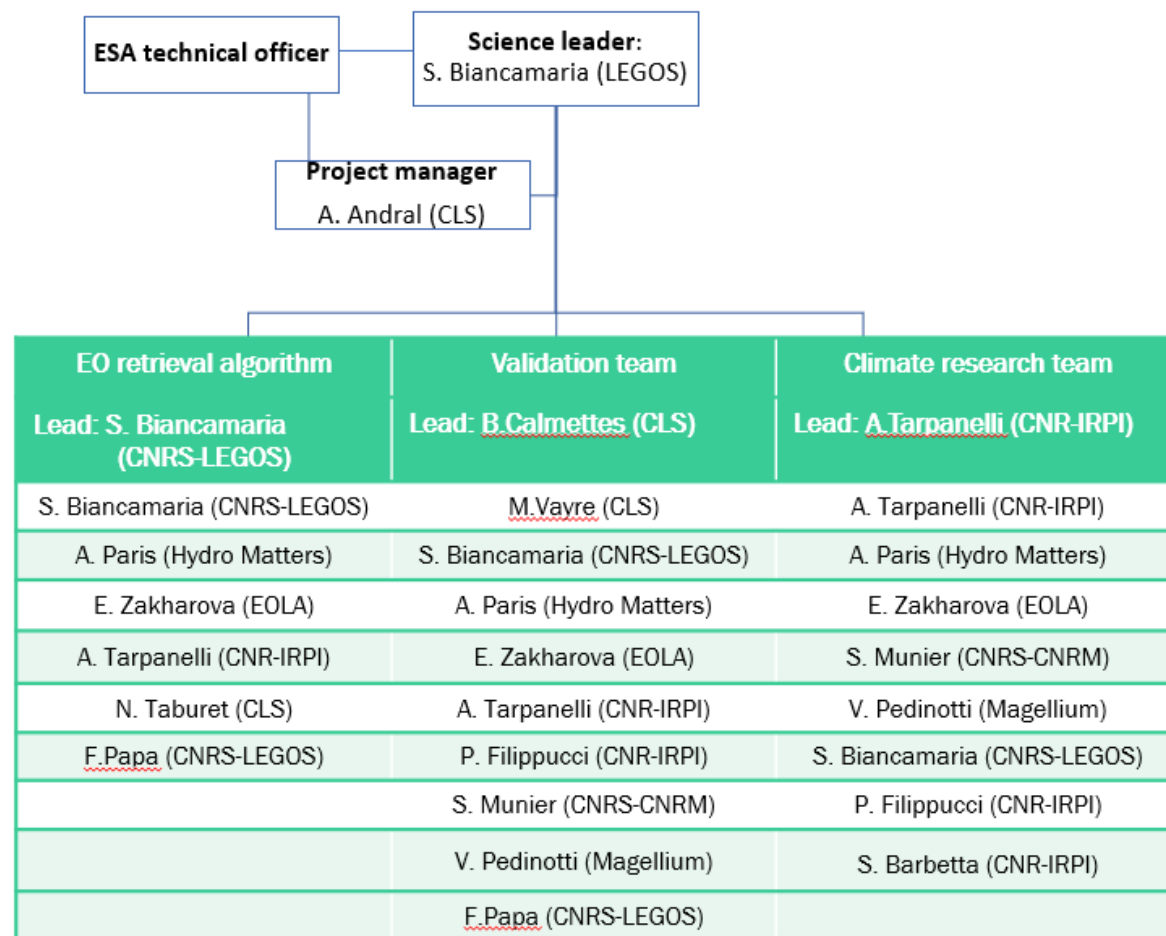


WP breakdown Structure



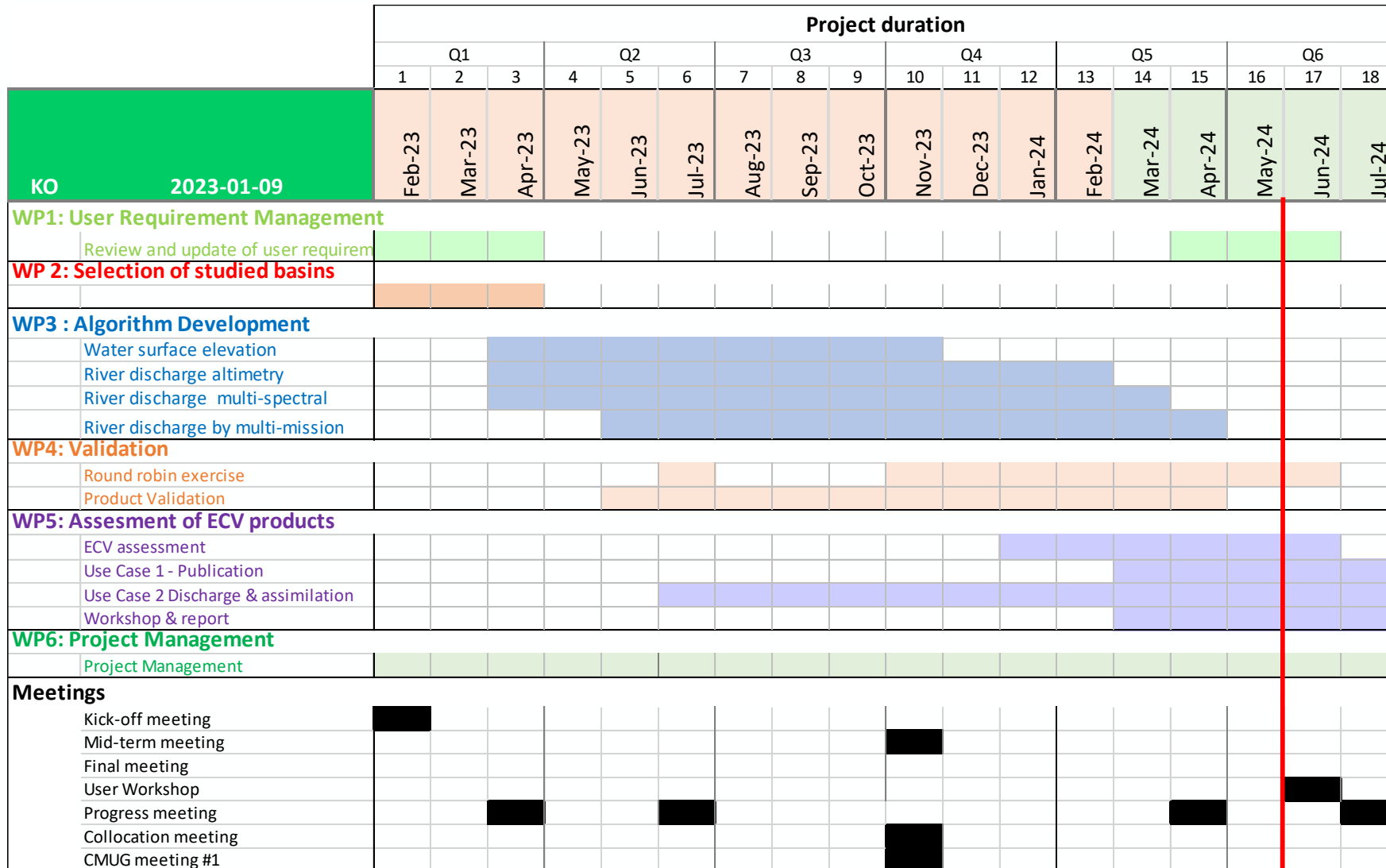


Organisation





Project planning





river discharge cci

climate.esa.int/projects/river-discharge

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