Italian Research and development Initiative for Spaceborne river monitoring (IRIS) in the framework of the ASI-ISPRA project "Habitat Mapping"

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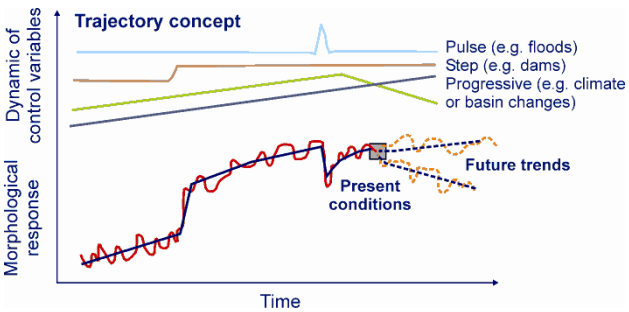
Workshop "AMBER meets IRIS", 24 September 2018, Milan, Italy

Italian hydromorphological framework: IDRAIM

State of the art / User requirements

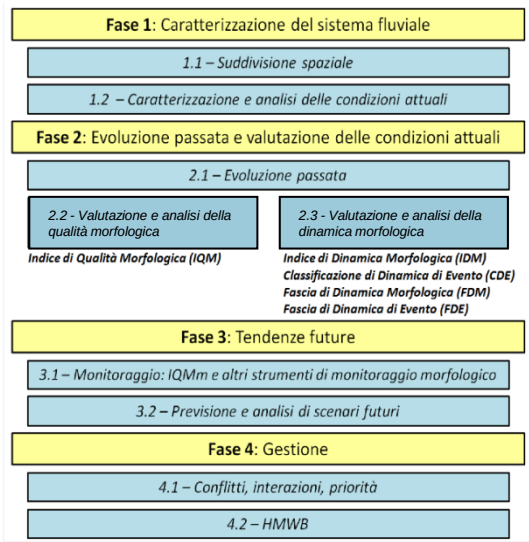
- National activity: Regional and local Authorithies responsible of the hymo monitoring, ISPRA and MATTM
- EU Commission activity: WG ECOSTAT (co-lead IT) & WG Floods of the *Common Implementation Strategy* for WFD and FD + Ad Hoc Task Group on Hydromorphology (co-lead IT)
- New European Standard on hymo – WG CEN
- EU project REFORM: review tool Hymo based on remote sensing data
- Research and scientific studies



Operational framework

- IDRAIM-stream hydromorphological evaluation, analysis and monitoring system, developped by ISPRA and Italian Universities
  - Morphological Quality Index (MQI)
- SUM–The Geomorphic Unit survey and classification System
- e-MesoHABSIM for modeling and evaluating river habitat integrity
- Specialized training by ISPRA

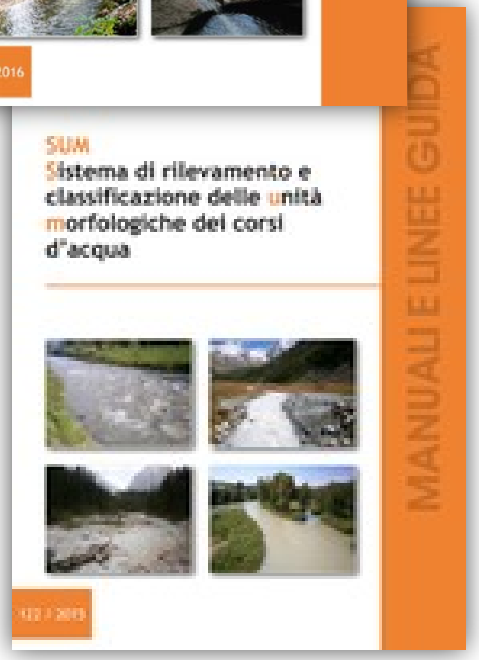
IDRAIM



New oper. tools and indicators based on Copernicus data

- Habitat Mapping project:
  - Developping operational tools and indicators for hymo monitoring based on Copernicus Sentinel 1 and 2 data in the framework of IDRAIM to support regional and local Authorities
- Testing the operational tools and indicators on four river basins

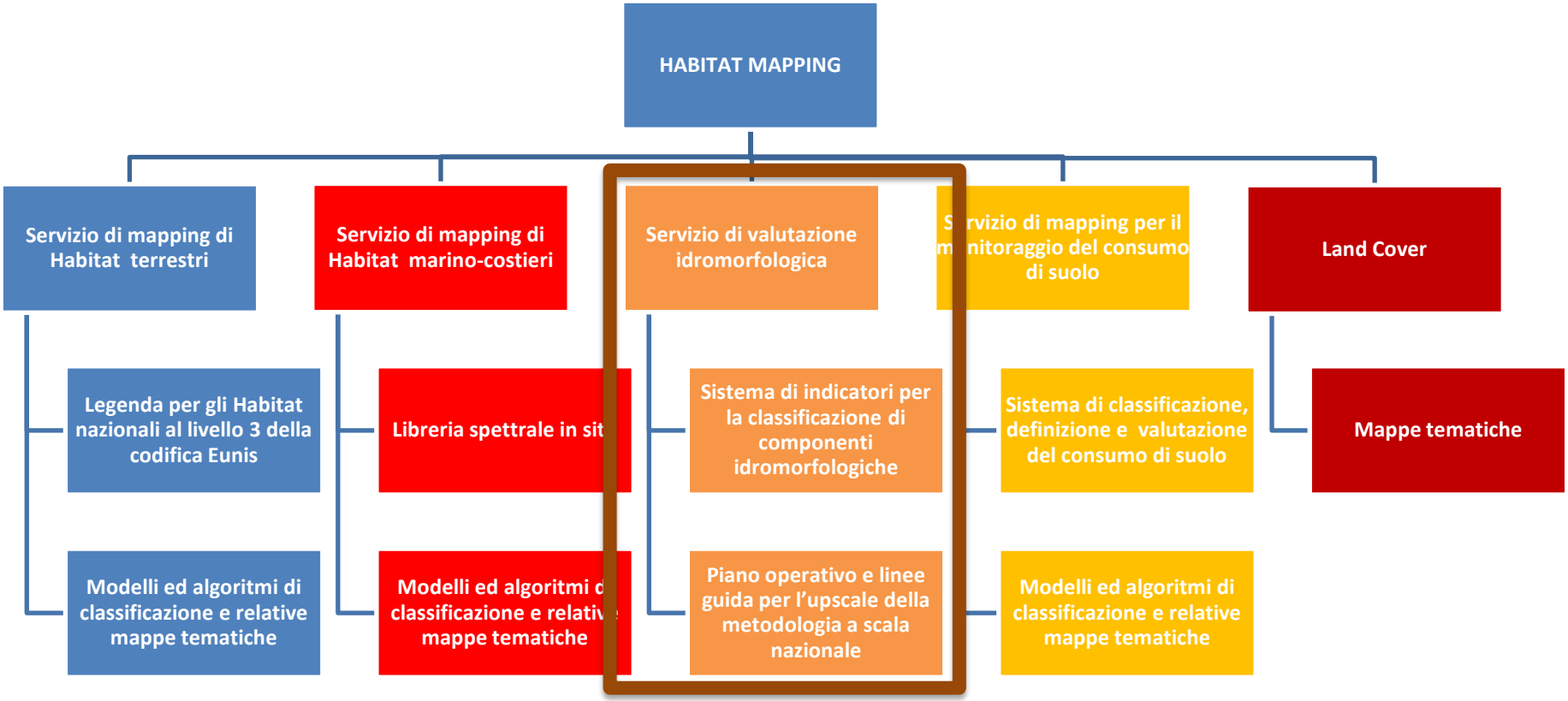
Italian hydromorphological framework: IDRAIM



- **IDRAIM** is a comprehensive methodological framework developped by ISPRA and Universities of Florence, Padoa, and Bozen to support **integrated management of geomorphological river processes**.
- It accounts for the specific Italian context and the EU Directives, namely the **WFD 2000/60/EC** and **FD 2007/60/EC**, explicitly including consideration of fluvial hazard (**FD**).
- A system for the **classification and survey of geomorphic units**, named **GUS**, part of the IDRAIM framework, is used to identify, characterize and analyse the assemblage of geomorphic units within a given reach.
- The **e-MesoHABSIM** system is used for modeling and evaluating river habitat integrity.

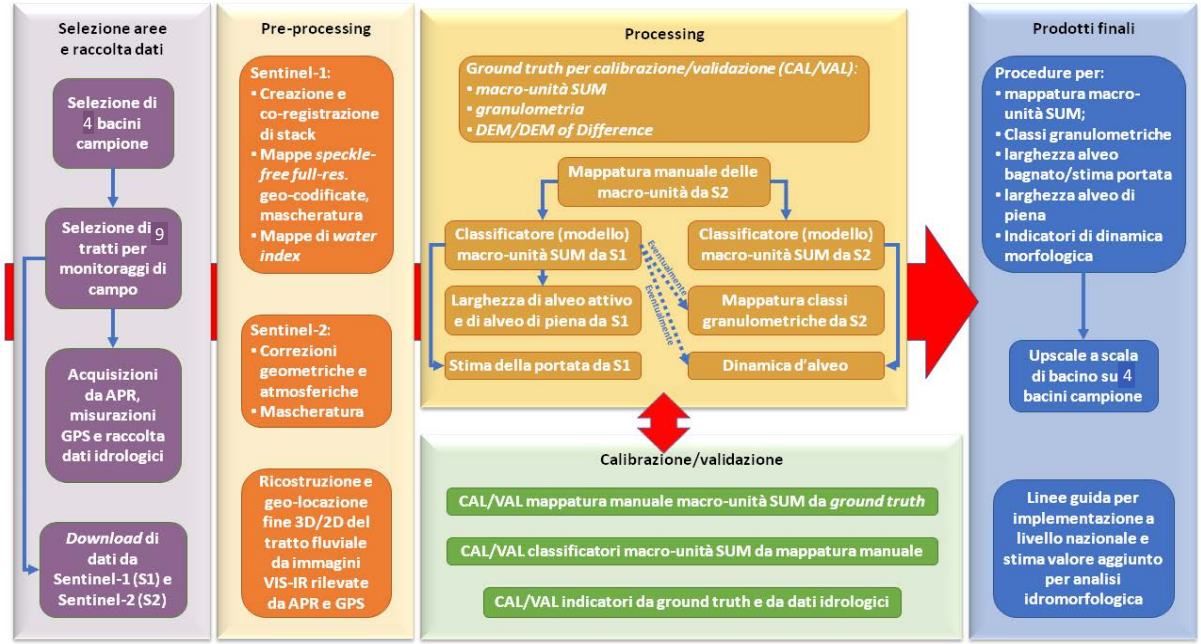
ASI-ISPRA project "HABITAT MAPPING"

Scientific coordinated by Prof. A. Taramelli (IUSS Pavia & ISPRA)



Developing multi-scale HYMO monitoring tools for medium-large river systems based on Copernicus Sentinel 1 and Sentinel 2 data

Modello concettuale per le attività di sviluppo degli strumenti applicativi basati su dati Copernicus Sentinel 1 e 2



INPUT

Collecting data from:

- In-situ stream gauges
- GPS instruments
- Drone (UAV)
- Copernicus Sentinels

→ **almost completed**

METHODOLOGY

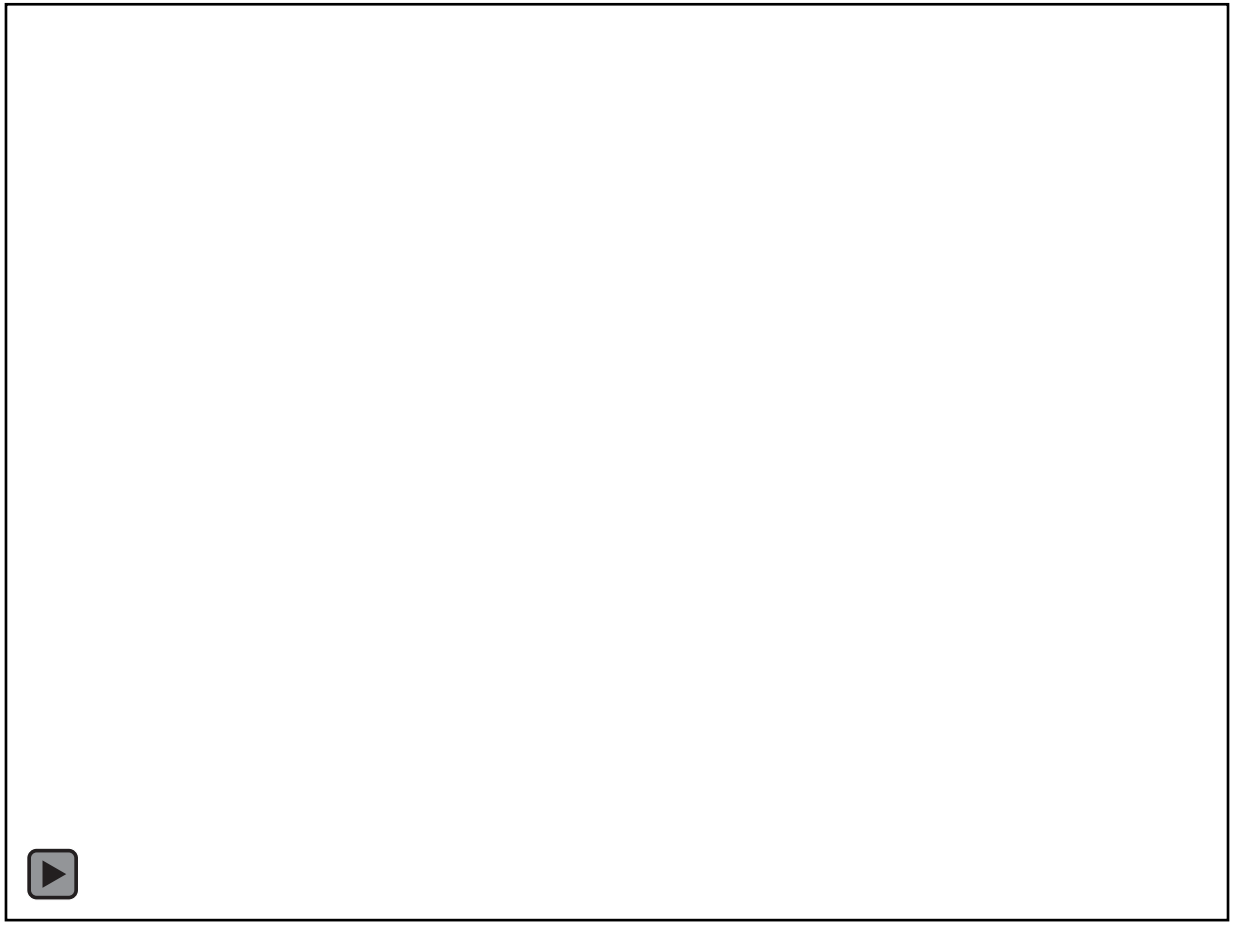
Developing (semi-) automatic tools to classify Sentinel images, using in-situ data and drone images for calibration and validation

OUTCOMES

- Hymo maps & indicators over test sites
- Guidelines to extend the methodology

Bacini campione

- ❑ **Po/Sesia** (3 tratti fluviali) – Distretto Idrografico Padano
- ❑ **Tevere/Paglia** (3 tratti) – Distretto Idrografico Appennino Centrale
- ❑ **Bonamico** (2 tratti) – Distretto Idrografico Appennino Meridionale
- ❑ **Tagliamento** (1 tratto) – Distretto Idrografico Alpi Orientali

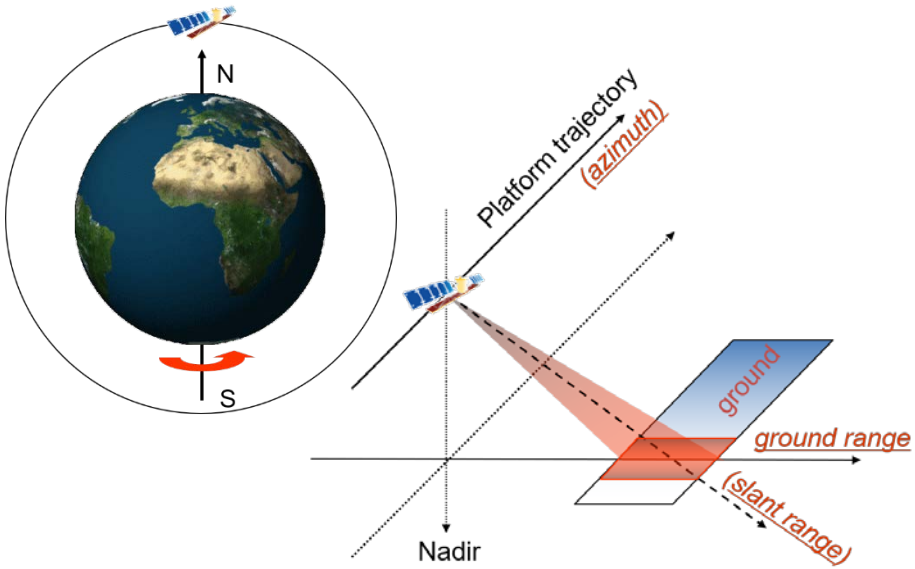


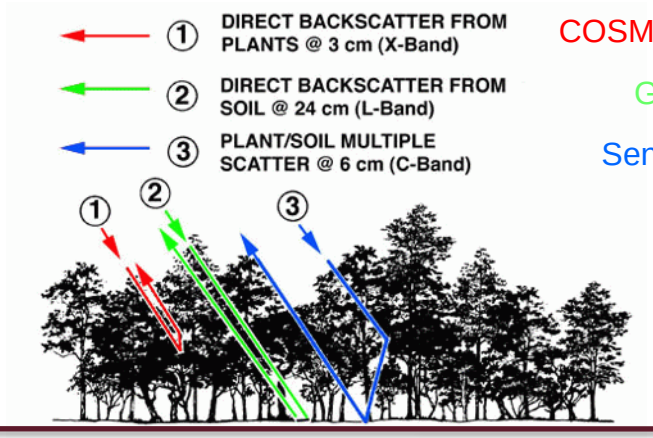
Unmanned Aircraft Systems and traditional field techniques (e.g. RTK-GPS) are used to survey local river features, e.g., topography, sediment size, vegetation, morphological habitats, to provide ground truth.

SENTINEL 1: radar (SAR) C-Band

Pixel 20 x 5 m

Frequency of acquisition: 6 days





COSMO-SkyMed

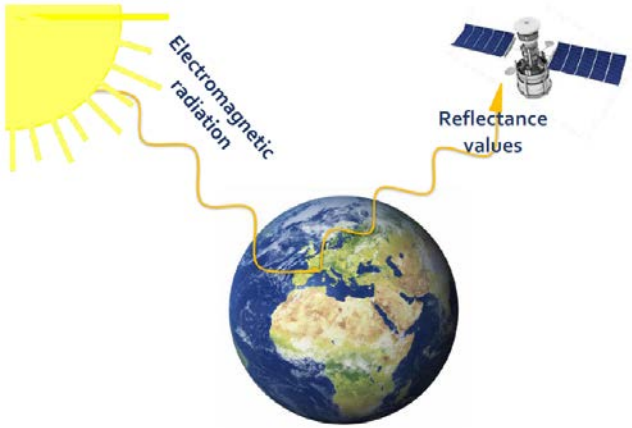
GPS

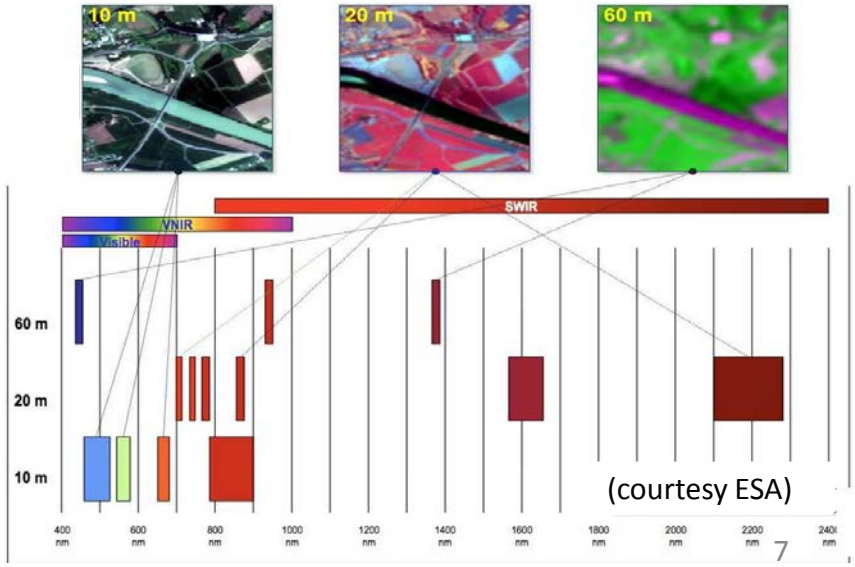
Sentinel 1

SENTINEL 2: Multispectral optical

Pixel 10x10 or 20x20

Frequency of acquisition: 5 days

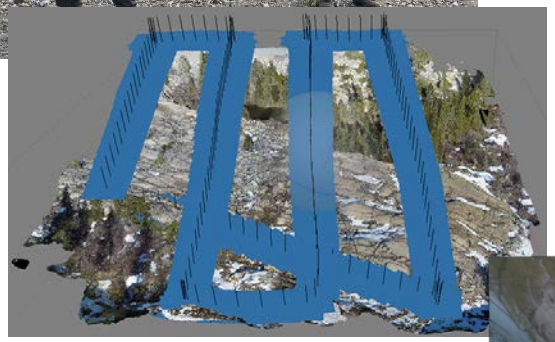


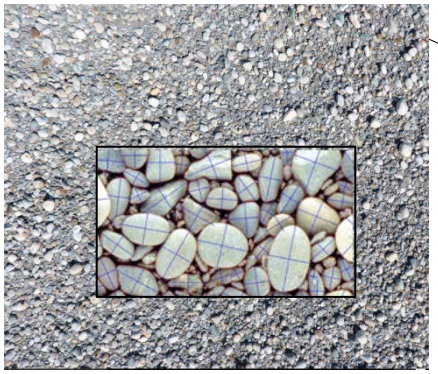


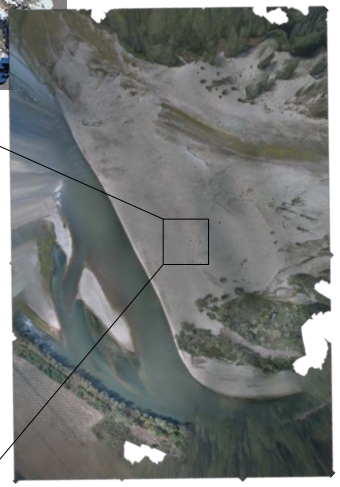
(courtesy ESA)

FIELD DATA

Very high resolution remote sensing data (UAV)





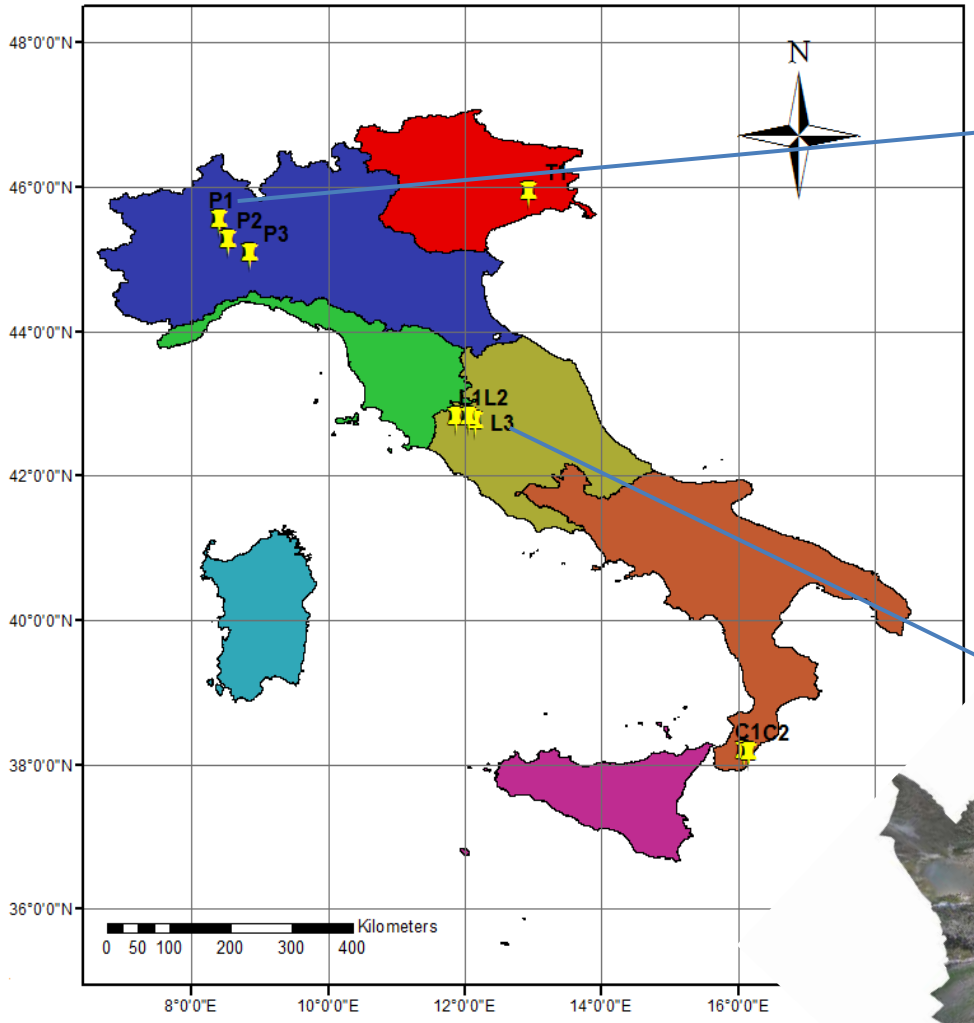


Ground truth to calibrate and validate satellite data

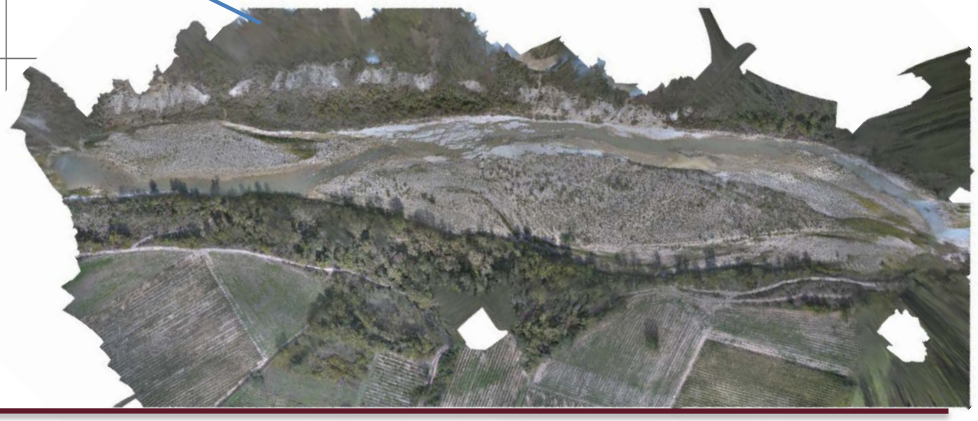
Very high resolution Topographic data (GPS)

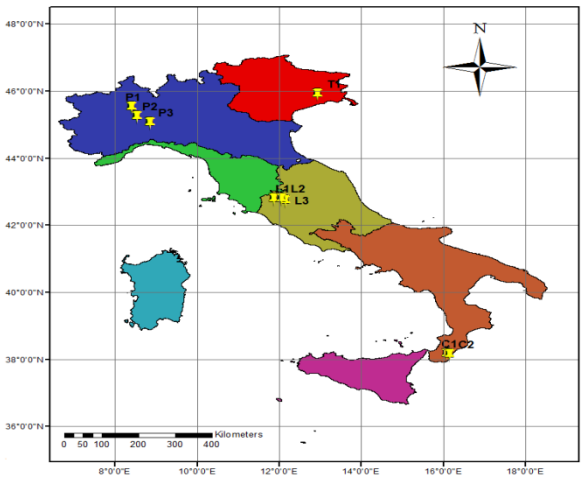
sUAS pre-processing

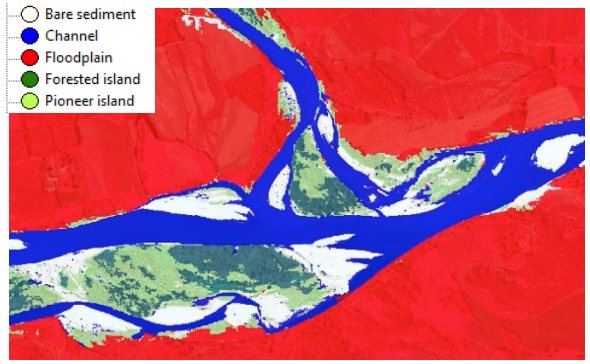
ORTOPHOTOS



PhotoScan
3D Modeling and Mapping





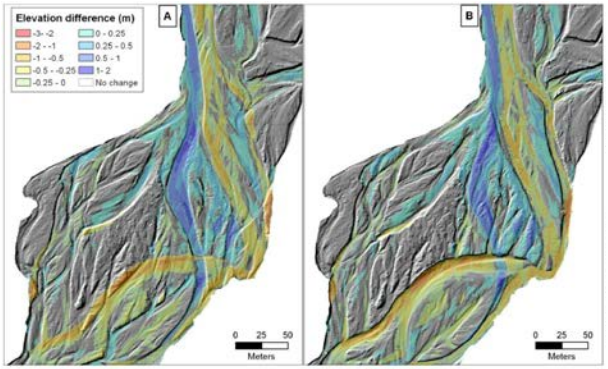


Habitat mapping

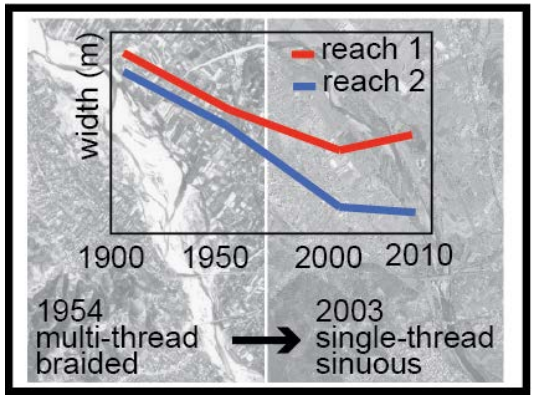
Sediment size classes

Hydromorphological indicators from satellite remote sensing

Water extraction



Indicators of processes

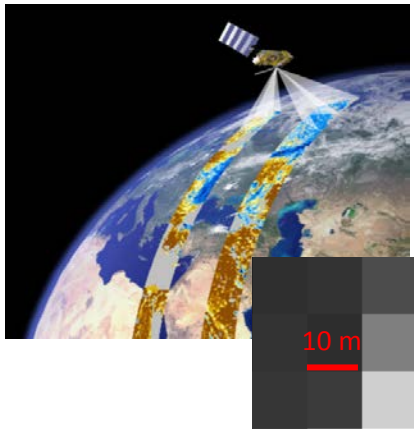


Overall grain size mapping: S2

Grain size estimation

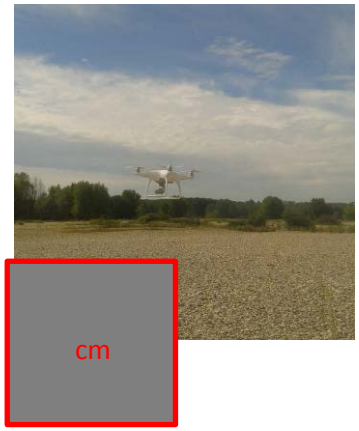
Multispectral satellite data with high repeat time

Indirect measurement
→ Reflectance values



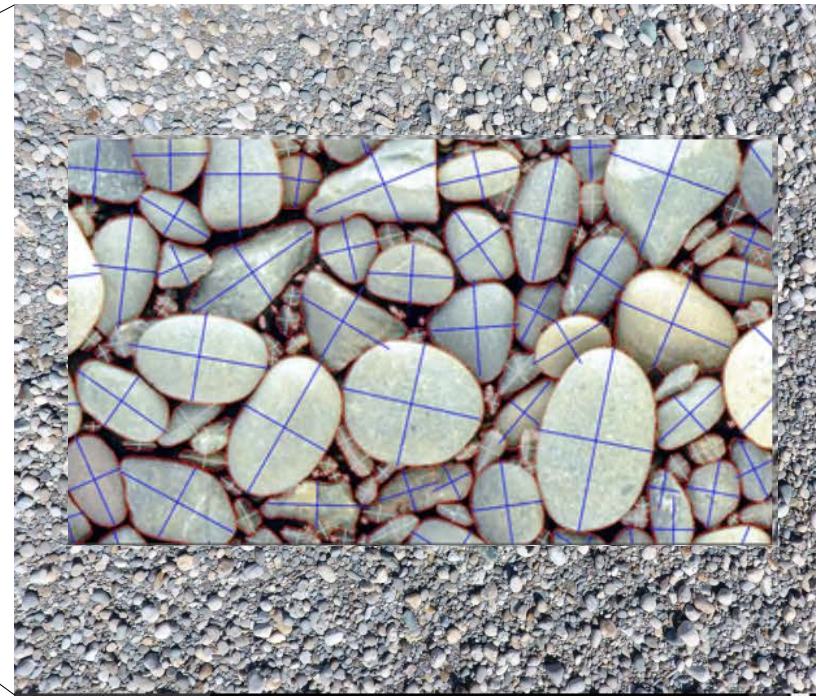
Marchetti et al. (in prep.)

Grain size measurement



Low coast technology for calibration (sUAS)

Direct measurement
→ Photosieving technique
→ Grain size percentiles

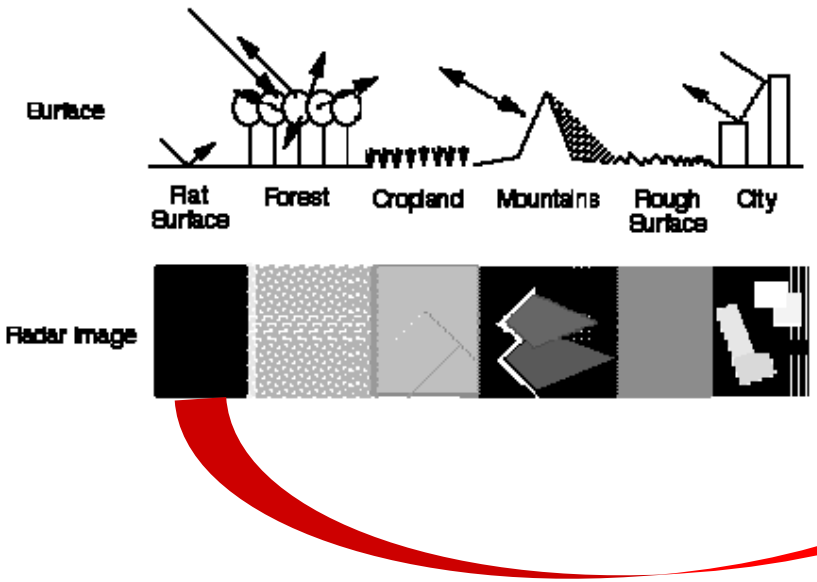


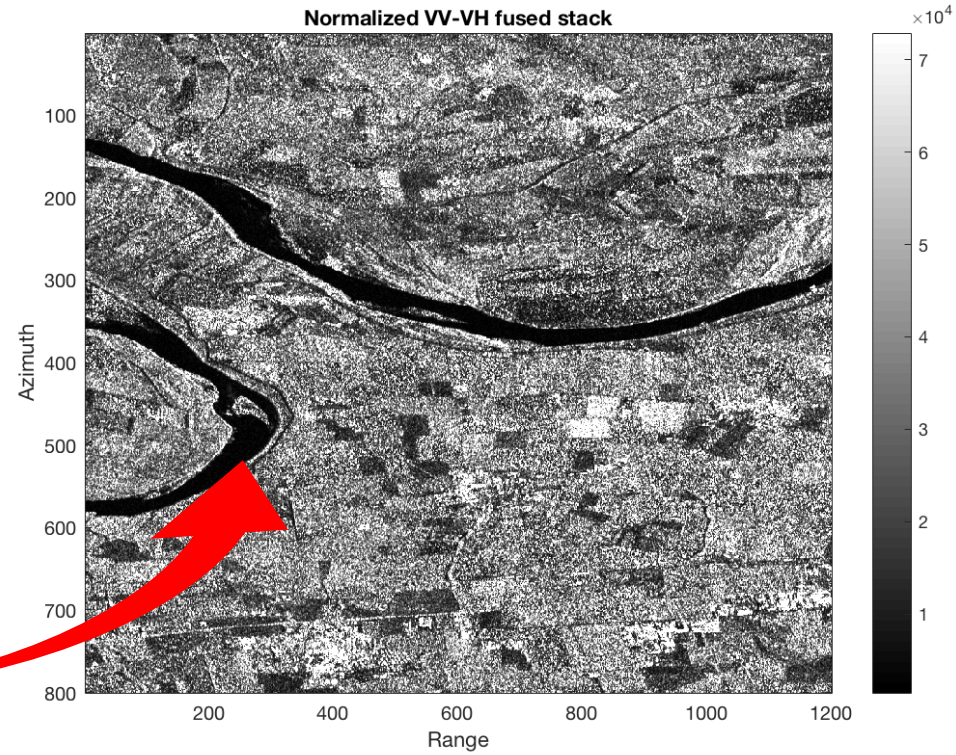
Carbonneau, Bizzi, Marchetti, 2017 (ESPL)

Water index: S1

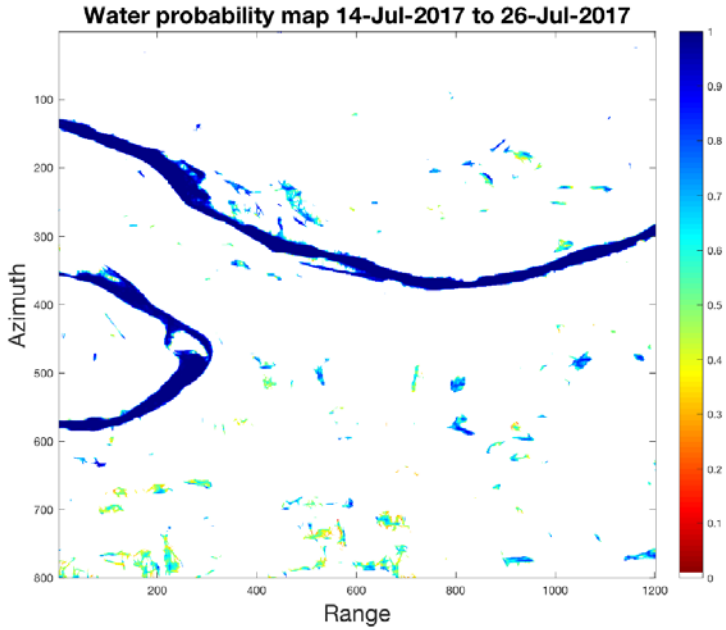
The intensity of a SAR image is strongly influenced by the terrain structure and **roughness**

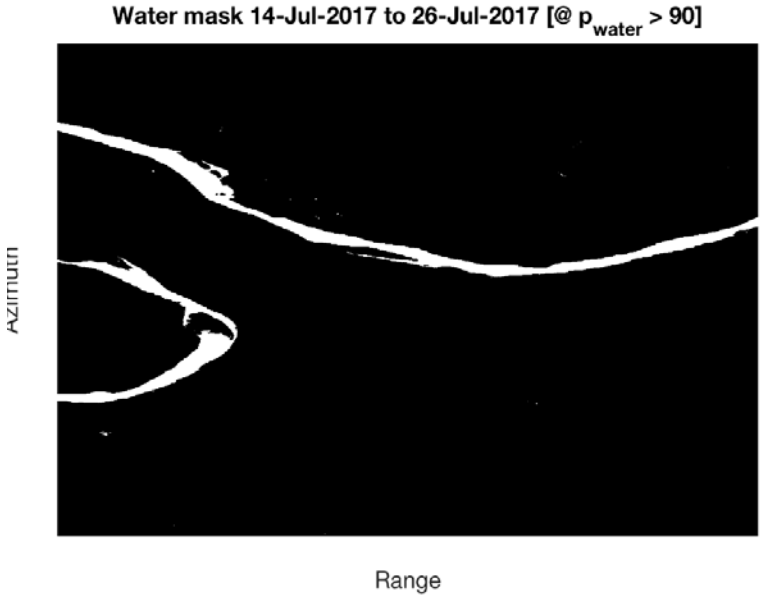
Water = no backscatter





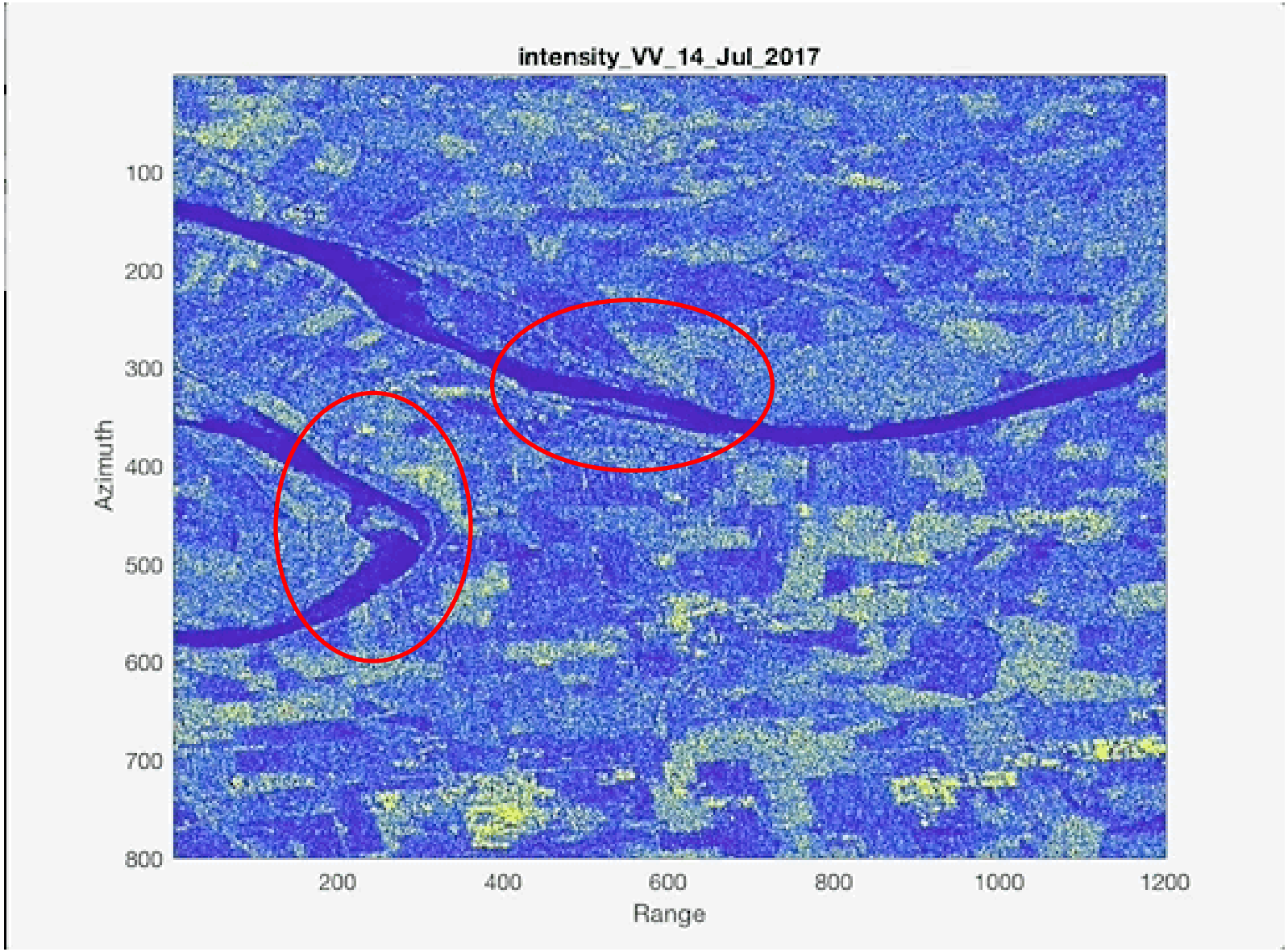
Water index: water probability map



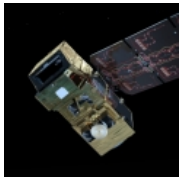


Asaro et al., 2017 (submitted IS.Rivers 2018)

Application: water discharge estimation



Habitat mapping: S2



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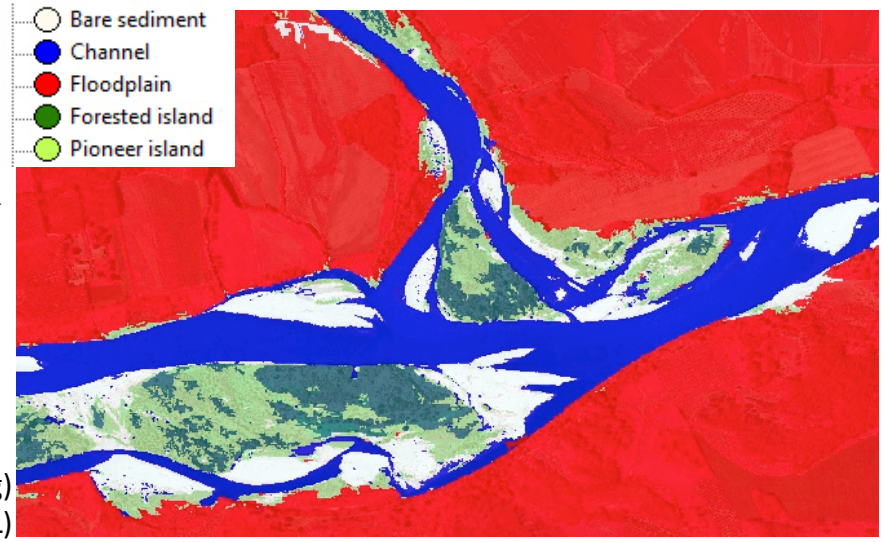
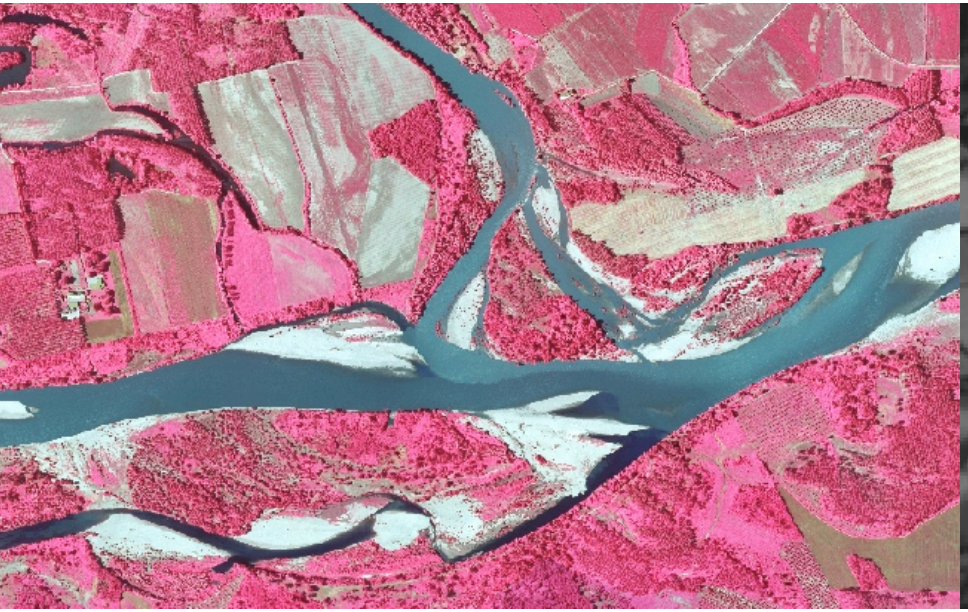


River features: Geomorphic units

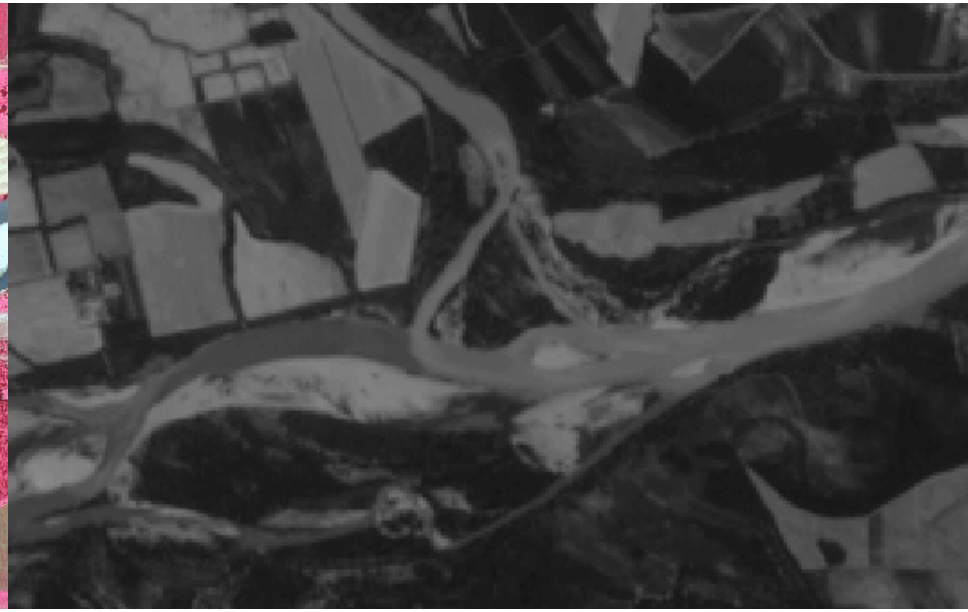
Demarchi et al., 2016 (Remote Sensing)
Demarchi et al., 2016 (ESPL)

PO/Dora Baltea Junction

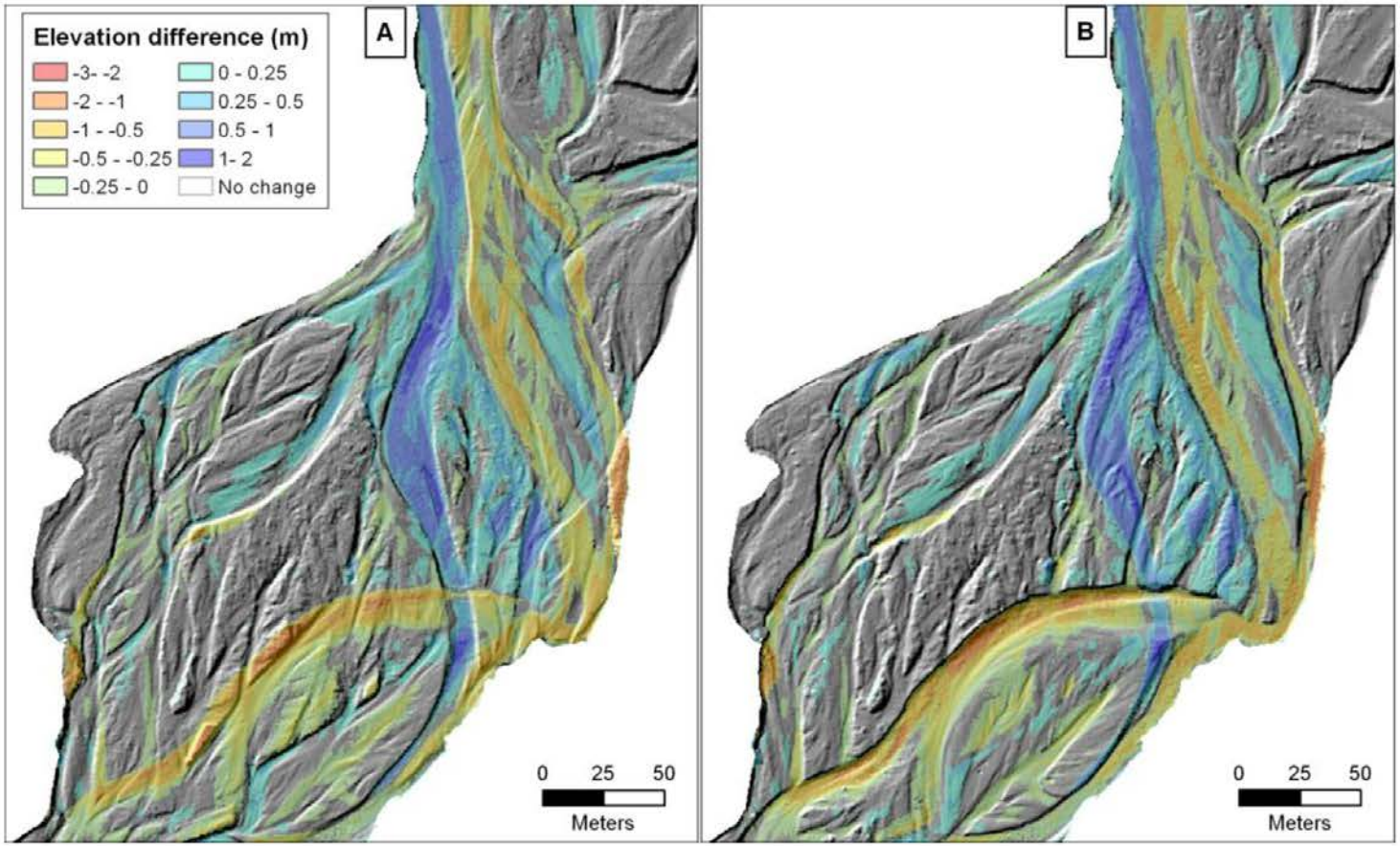
Aerial photo - NIR 40 cm



Sentinel 2 - Band 04 Red 10 m



Application: Habitat and processes mapping



(DoD on 2008 (A) and 2010 (B) DEMs ; Tacon, 2015)

DEM of Difference

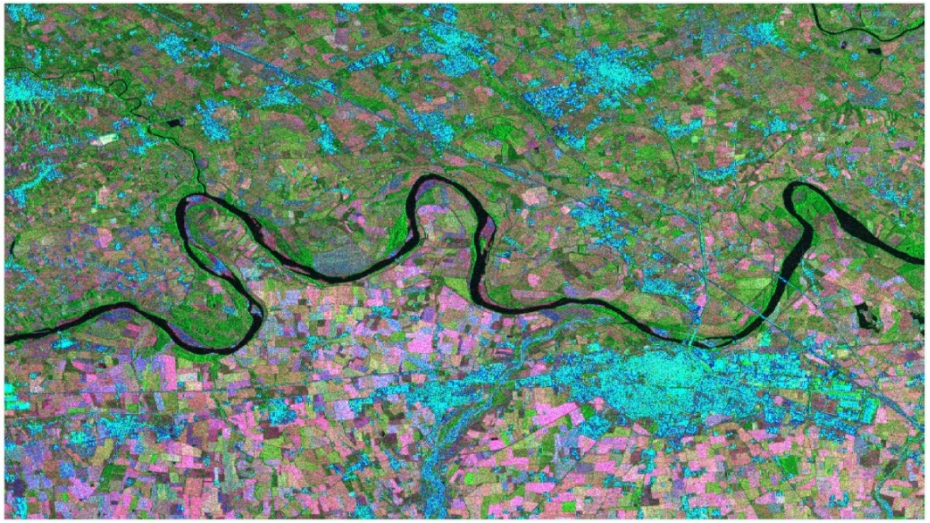
Sediment budget, river morphodynamics, etc.

Mapping river indicators towards processes monitoring…

Monitoring of the evolutionary trajectories of indicators through time, by combining:

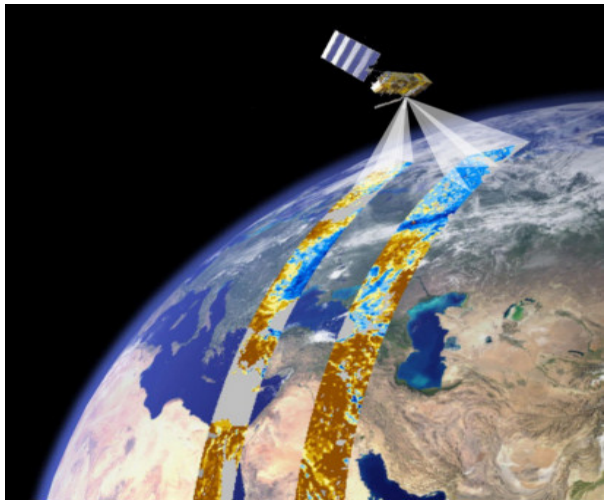
- ❑ the high temporal frequency of Copernicus Sentinel 1 and 2 data
- ❑ repeated field survey (GPS and drone) to built high resolution topographic data (DoD)

➔ Understand river and floodplain hymo processes at large scale

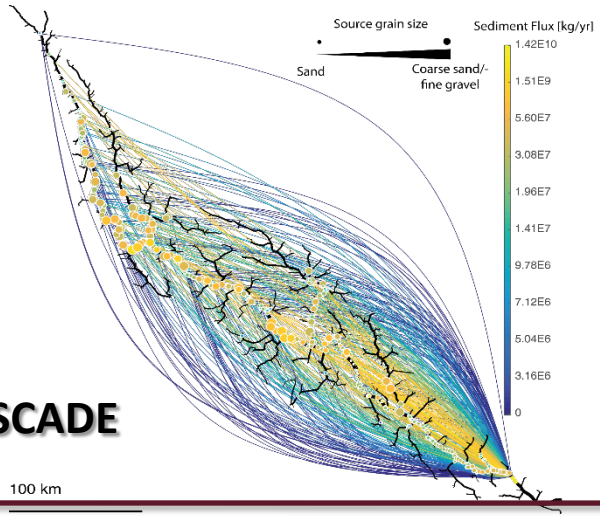


…and modeling at global scale

Low cost global river processes mapping, monitoring and modeling



Multiscale RS for calibration and validation of network-scale models of new generation



CASCADE

Thanks for your kind attention!

IRIS

Italian Research and development Initiative for Spaceborne river monitoring

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IRIS projecthttps://www.researchgate.net/project/Italian-Research-and-development-Intiative-for-Spaceborne-river-monitoring-IRIS