Ensuring spatial and temporal consistencies for the time series of the Copernicus Land Monitoring Pan-European HRLs

Christophe Sannier, Sophie Villerot, Alexandre Pennec, Alice Lhernould, Clémence Kenner, Antoine Masse
SIRS - CLS Group, 27 rue du Carrousel, 59650 Villeneuve d'Ascq, France

Horizon 2020
www.ecolass.eu

ECoLaSS – Evolution of Copernicus Land Services based on Sentinel data

ECoLaSS: a Horizon 2020 project

- **Duration:**
  Jan 2017– Dec 2019 (3 years)
- **Location:**
  European & African sites (→ towards global Service)
- **Team:**
  GAF (Coordinator), SIRS, Joanneum Research, UCL, DLR

ECoLaSS will develop several prototypes of new or enhanced Copernicus Land Services of the Continental and the Global Component, which will make full use of high data volume processing of dense time series of SAR and Optical Sentinel (and other) EO data. These prototypes shall be suggested to EC and the relevant decision-makers for qualifying as candidates for operational integration into the future Copernicus Land Monitoring Service from 2020 onwards.
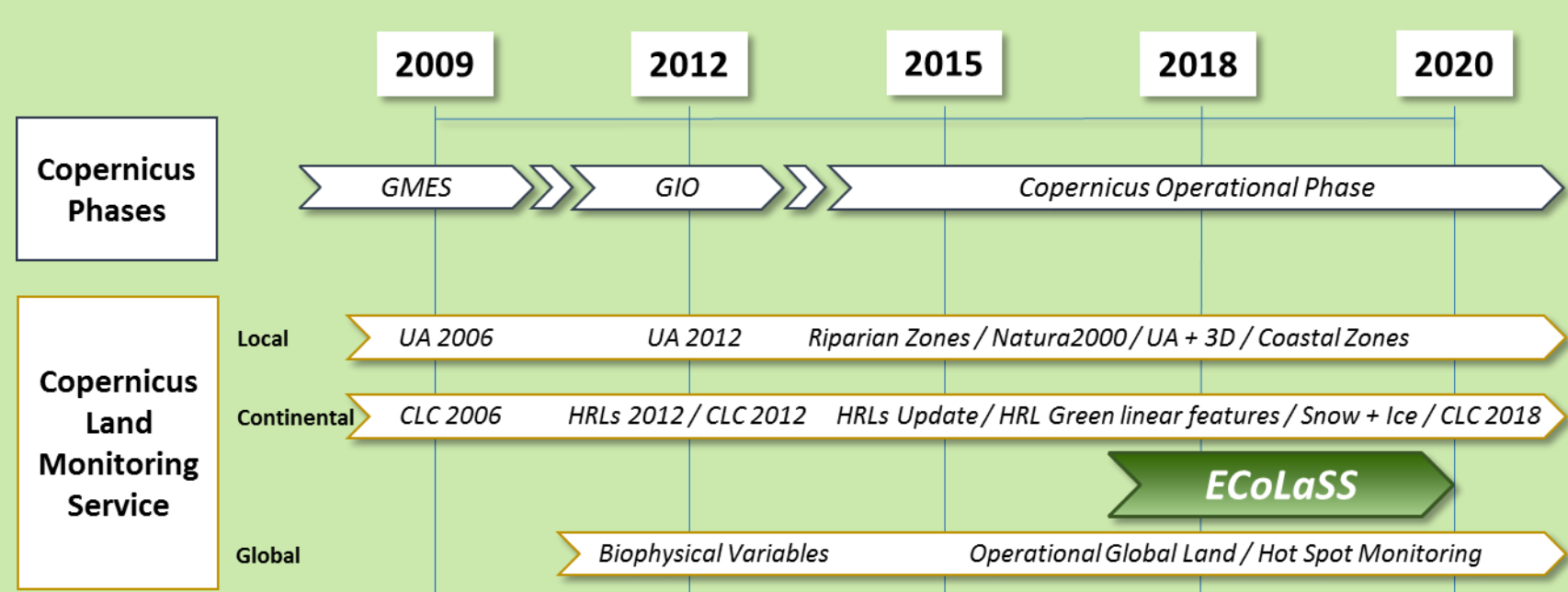
KEY OBJECTIVES: DEVELOPMENT OF...

- **Innovative Methods** based on high volume data processing of Sentinel (Optical and SAR) time series to improve existing and develop novel products and services for the pan-European and Global Copernicus Land Components.
- **Prototypes** for improved and novel next-generation operational Copernicus Land Services, which are demonstrated in large prototype sites of biogeographical diversity.
- an **Operationalization Framework** including benchmarking of prototypes in view of their innovation potential and technical excellence for operational service implementation into Copernicus Land Services from 2020 onwards.
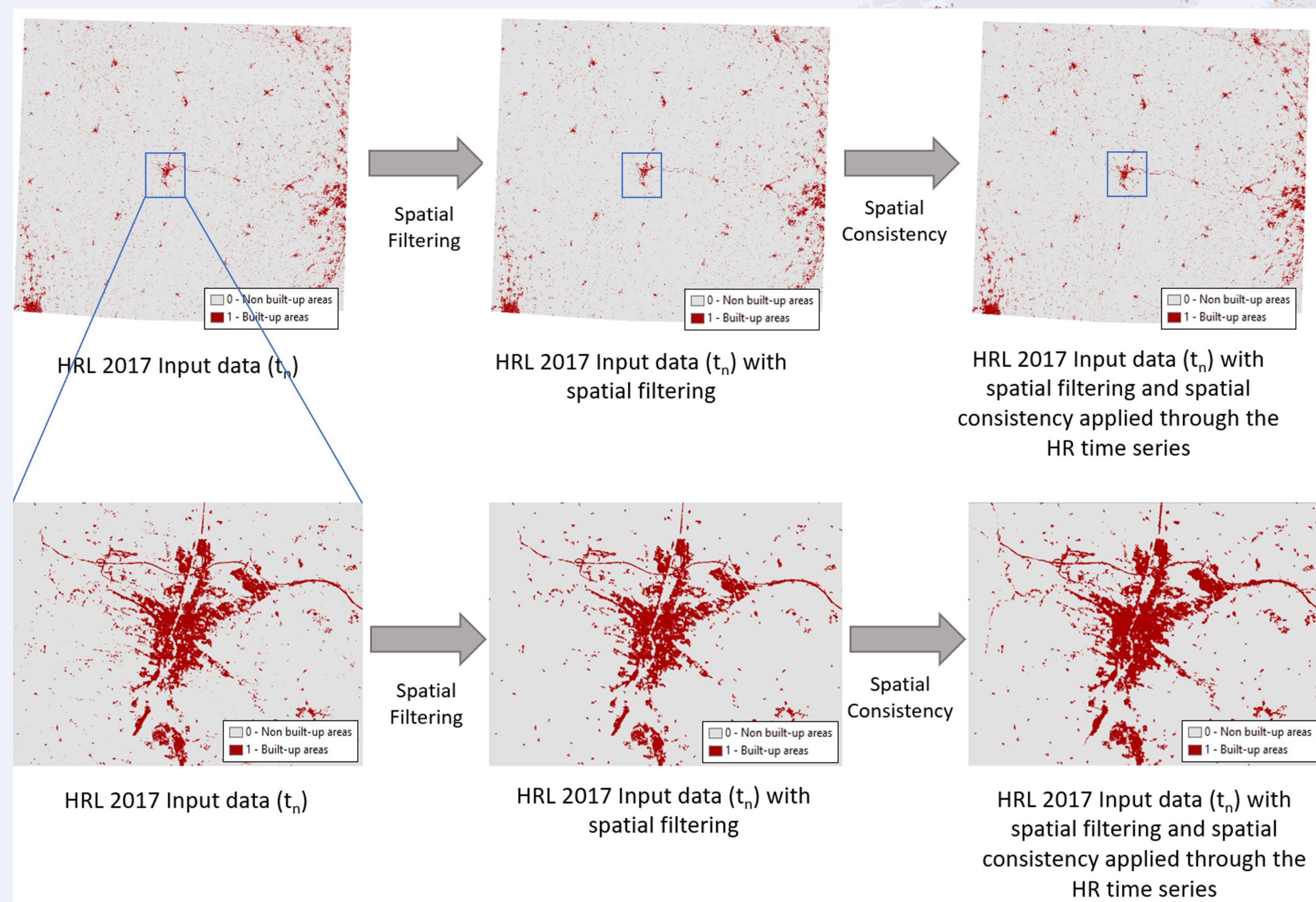
BACKGROUND

Copernicus: European Earth Observation (EO) programme headed by the European Commission (EC) in partnership with the European Space Agency (ESA). Six operational Copernicus services on the earth's main sub-systems (i.e. Land, Atmosphere, Oceans) and on cross-cutting processes (i.e., Climate Change, Emergency and Security).
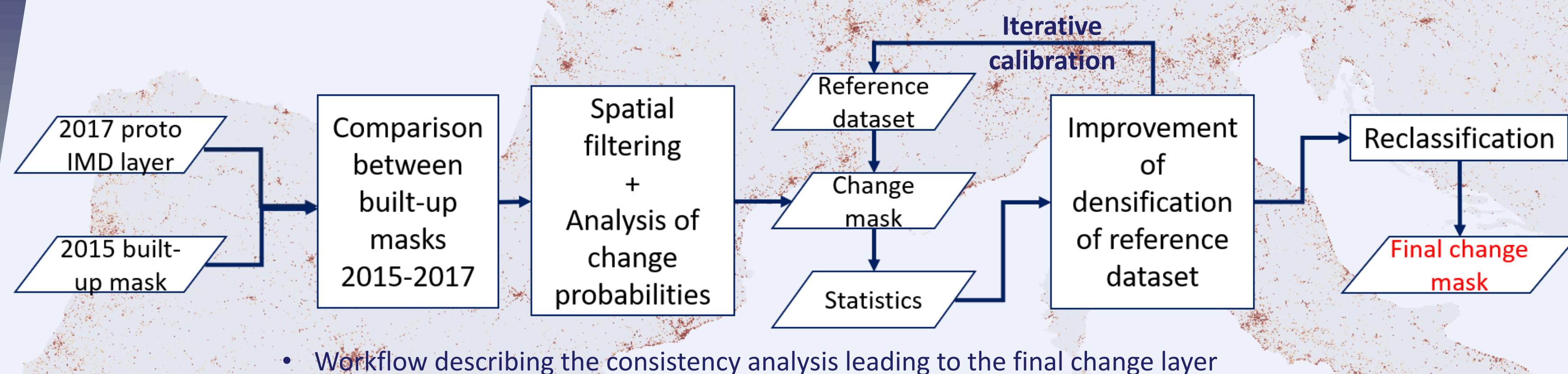
Copernicus Land Monitoring Service: provides EO-based spatial information related to bio-geophysical variables, Land Cover/Land Use characteristics & their changes over time. The related services are reflected in a Global, pan-European (Continental), Local and an In-situ Component. The Service is increasingly based on **Sentinel Data** from ESA.
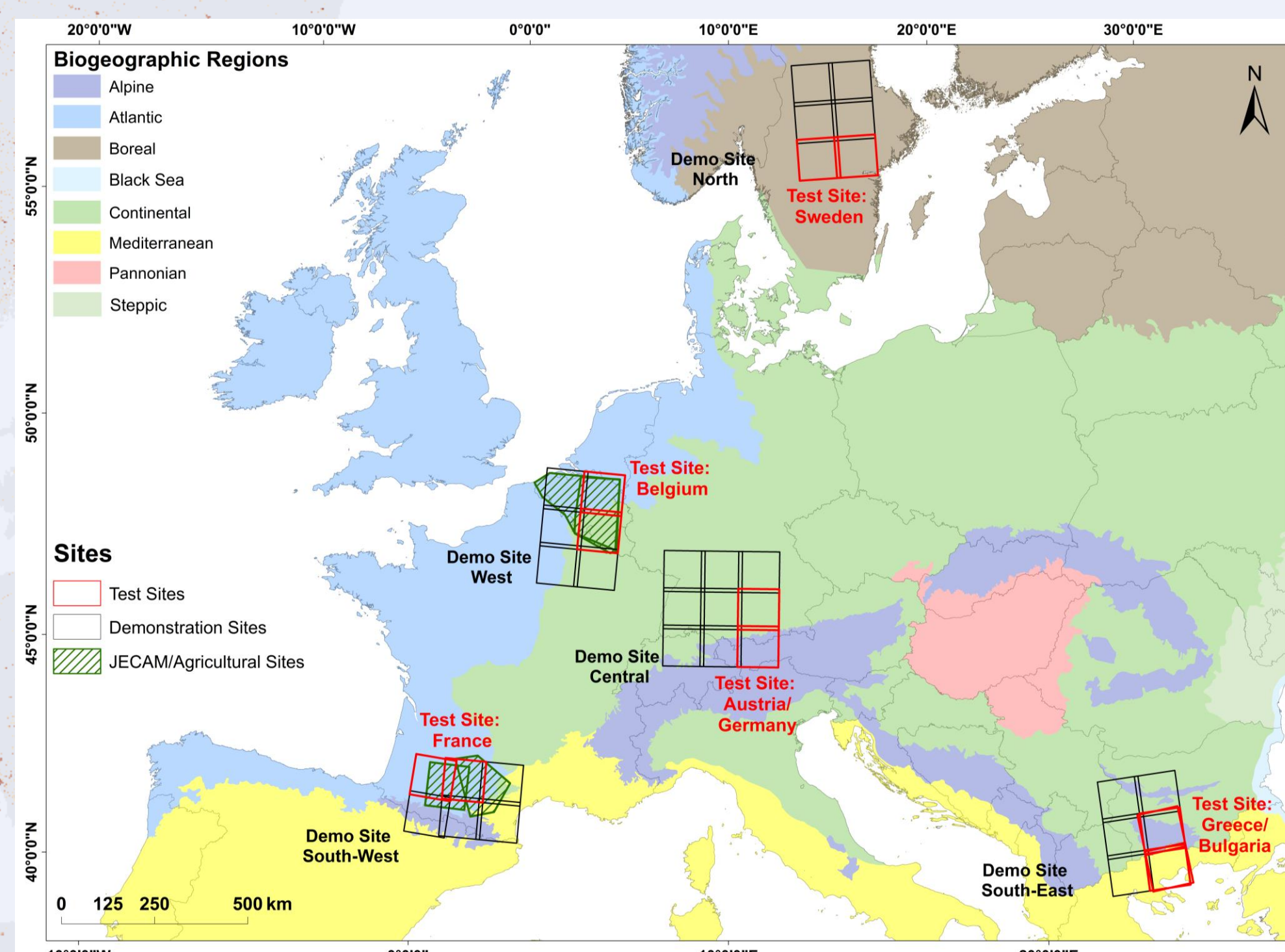
TEST & PROTOTYPE SITES: THE IMPERVIOUSNESS (IMP) LAYERS EXAMPLE

HRL 2017 Input data (t_n)

Spatial Filtering

HRL 2017 Input data (t_n) with spatial filtering

Spatial Consistency

HRL 2017 Input data (t_n) with spatial filtering and spatial consistency applied through the HR time series

HRL 2017 Input data (t_n)

Spatial Filtering

HRL 2017 Input data (t_n) with spatial filtering

Spatial Consistency

HRL 2017 Input data (t_n) with spatial filtering and spatial consistency applied through the HR time series

- **Five selected prototype sites** (60 up to 90.000 km²) cover most important environmental zones of Europe and different EEA-39 member states.
- **Test sites** within prototype sites
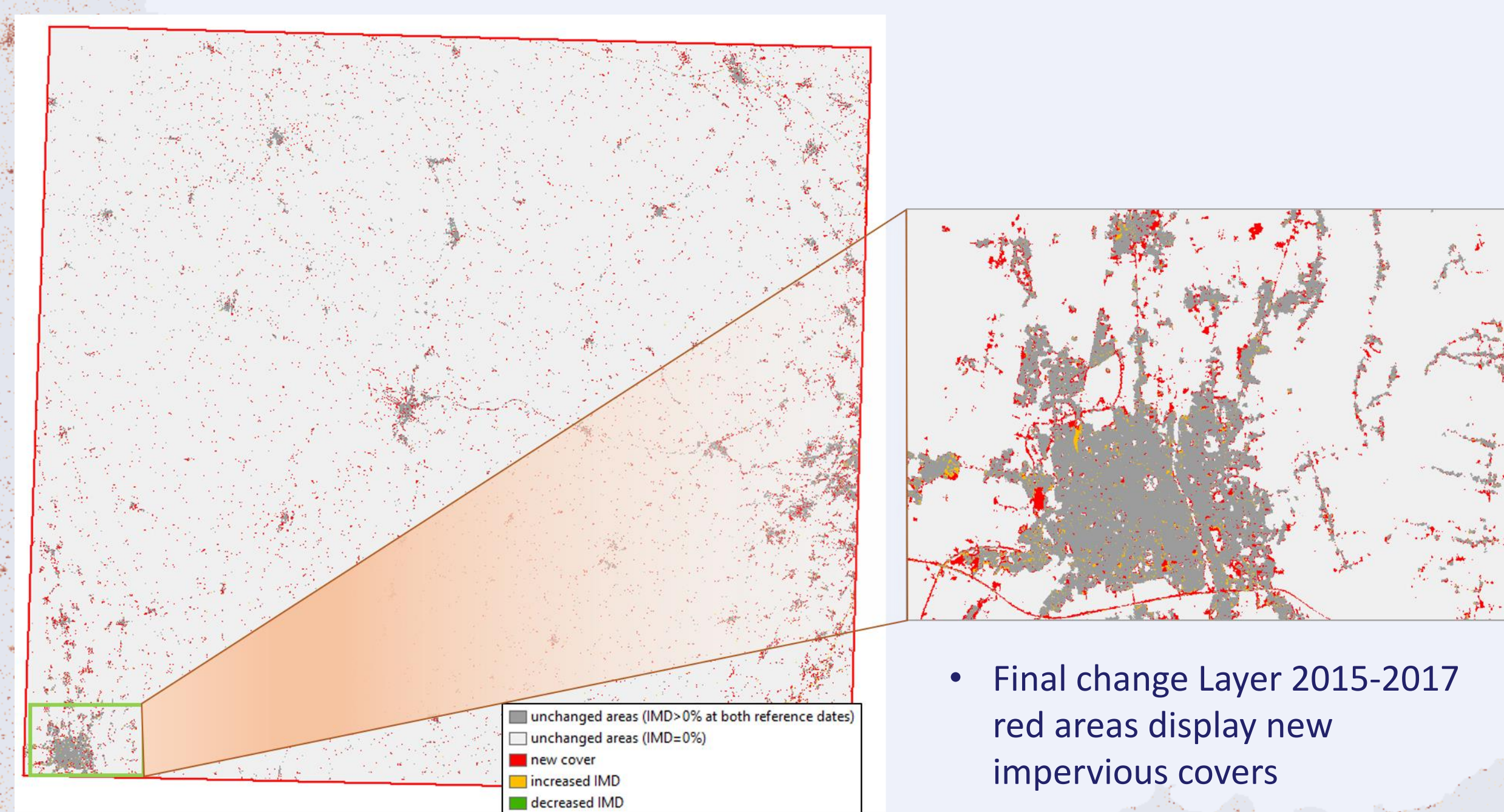- **JECAM sites:** specific in-situ data

Through ECoLaSS, demonstration has been made of the added values of both Sentinel datasets, from S-1 (A and B) and S-2 (A and B) to orient the production toward a yearly release, all the while maintaining the integrity of HRL time series based on heterogeneous datasets coming from multiple sensors and tackling the increase volume of data, using temporal metrics in time-efficient automated algorithms.

- **Final change Layer 2015-2017** red areas display new impervious covers

2017 proto IMD layer / **2015 built-up mask** → **Comparison between built-up masks 2015-2017** → **Spatial filtering + Analysis of change probabilities** → **Reference dataset** / **Change mask** / **Statistics** → **Improvement of densification of reference dataset** (Iterative calibration) → **Reclassification** → **Final change mask**

- Workflow describing the consistency analysis leading to the final change layer

New challenges are expected to be the focus of the 2018 production for the HRLs, such as the creation of a building footprint mask, that could be used as a future "backbone", opening new potential tools ensuring the spatial consistency of the time series, as well as in the second phase of the H2020ECoLaSS project, where new prototypes and their robustness for operational roll-out will be tested.

ACCURACY

Prototype Layer IMP 2017 based on Sentinel

Sensor	User Accuracy	Producer Accuracy
Sentinel-1	70.59%	88.89%
Sentinel-2	72.41%	77.78%
Fusion of both classification	74.19%	85.19%

Change Layer 2015-2017

Total Change Areas	Statistic of the 1st calibration	Statistics of 2nd calibration
New built-up 2017	9%	9.64%
Omission: undetected built-up in 2015	58%	76.65%
Commission: false detection of built-up in 2017	33%	13.71%

References:

Lefebvre, A., Sannier, C., and Corpetti, T., "Monitoring Ur-ban Areas with Sentinel-2A Data: Application to the Up-date of the Copernicus High Resolution Layer Impervious-ness Degree", Remote Sensing, Volume 8, pp. 1-21, 2016, doi:https://doi.org/10.3390/rs8070606.

Moser, L., Probeck, M., Ramminger, G., Sannier, C., DescleB., Schardt, M., Gallaun, H., Deutscher, J., Defourny, P., BlaesX., Klein, I., Keil, M., Hirner, A., and Esch, T. "Sentinel-based Evolution of Copernicus Land Services on Continentaland Global Scale", 2017, see: https://www.ecolass.eu/

www.ecolass.eu
ecolass.info@gaf.de