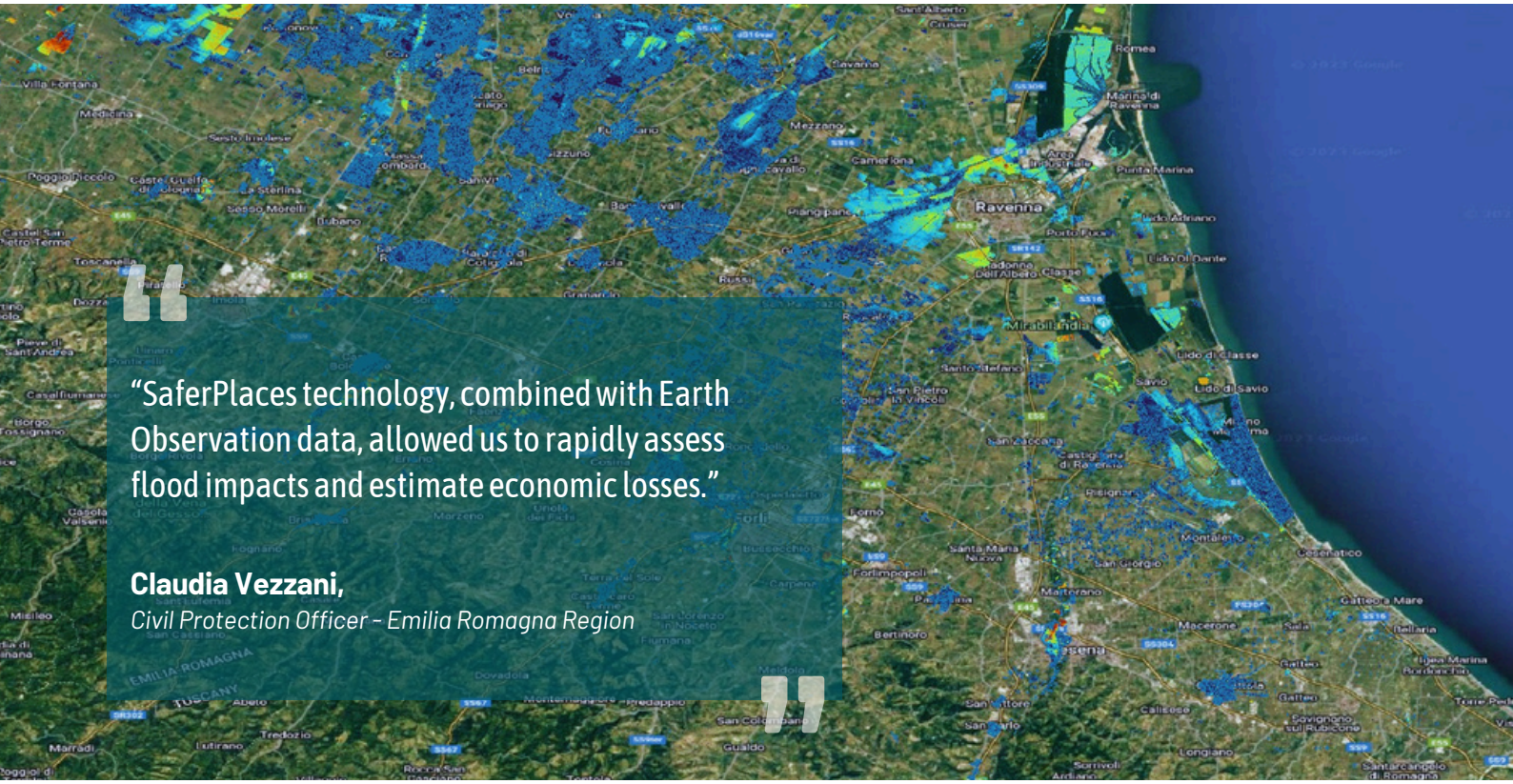
PROGRAMME OF THE EUROPEAN UNION

co-founded with esa

COPERNICUS4REGIONS 2025

SATELLITE-BASED FLOOD MAPPING IN EMILIA-ROMAGNA

Stefano Bagli, Paolo Mazzoli, Francesca Renzi
GECOsistema | Italy



> "SaferPlaces technology, combined with Earth Observation data, allowed us to rapidly assess flood impacts and estimate economic losses."
>
> **Claudia Vezzani,**
> *Civil Protection Officer - Emilia Romagna Region*

Emilia-Romagna Region Flood Map | SaferPlaces

In May 2023, the Emilia-Romagna region in Italy was struck by catastrophic floods, causing an estimated €8.8 billion in damages. During the emergency and recovery phases, the Civil Protection of Emilia-Romagna used SaferPlaces, an ESA InCubed-funded platform, to rapidly generate satellite-based flood extent and water depth maps.
By integrating Copernicus Earth Observation data with AI-enabled analytics, SaferPlaces supported emergency response operations and accelerated economic damage assessment, enabling faster and more robust requests for recovery funding at national and European level.

THE CHALLENGE

Between 16 and 18 May 2023, Emilia-Romagna experienced an unprecedented hydrometeorological event. In just 36 hours, the region received rainfall equivalent to six months of precipitation, overwhelming 23 rivers, triggering more than 400 landslides, and inundating extensive urban and agricultural areas.

Over 35,000 people were displaced, critical infrastructure was severely damaged, and more than 100 municipalities were affected.
The scale, speed, and spatial complexity of the event exposed a critical challenge: how to rapidly obtain reliable, spatially detailed flood information to support emergency management, damage quantification, and recovery planning.

THE SPACE SOLUTIONS

The Civil Protection Agency of Emilia-Romagna used SaferPlaces as an operational decision-support platform during emergency response and post-event assessment phases.

At the core of the solution is SaferSat, a SaferPlaces operational module for rapid and reliable flood mapping using Copernicus Sentinel-1 SAR data. SaferSat is based on a neural-network flood segmentation model developed to detect flood-induced changes in radar backscatter under all-weather and day-and-night conditions.

SaferSat automatically compares pre- and post-event Sentinel-1 acquisitions to identify flooded areas while filtering noise, permanent water bodies, and radar artefacts. This AI-based segmentation improves the accuracy and speed of flood extent detection compared to traditional threshold-based approaches, particularly in complex urban and vegetated environments.

SaferSat outputs are integrated with Copernicus Sentinel-2 optical imagery, COSMO-SkyMed, Planet, and SPOT satellite data, together with high-resolution terrain models, to generate flood extent and water-depth maps at building scale.

By comparison with Copernicus Emergency Management Service (CEMS) products, a high level of agreement was observed, confirming the robustness of the SaferSat AI-based flood segmentation and the added value of integrating Copernicus Earth Observation data with AI-driven analytics for operational decisions

.

Emilia-Romagna Flood | SaferPlaces dashboard

THEMATIC AREA
Civil Protection

REGION OF APPLICATION
Emilia-Romagna

SENTINEL MISSION USED
S1, S2

COPERNICUS SERVICE USED
CEMS

THE BENEFITS AND THE BENEFICIARIES

The satellite-based flood maps generated by SaferPlaces provided the Civil Protection Agency of Emilia-Romagna with timely, spatially detailed information to support both emergency management and recovery planning. High-resolution flood extent and water-depth maps enabled rapid quantification of impacts in some of the most affected municipalities, including Faenza, Cesena, Forlì, and Conselice.

These products supported the estimation of economic losses, accelerating the preparation of official documentation required for recovery funding requests to national and European authorities. The availability of consistent, objective flood impact data reduced uncertainty and improved coordination between regional authorities and local administrations.

Local municipalities benefited from precise, building-scale information to prioritise reconstruction activities and plan infrastructure repairs. In addition, regional planners and insurance companies gained access to reliable damage assessments to support compensation mechanisms and resilience strategies.

Ultimately, citizens and businesses affected by the floods benefited from faster recovery processes and improved transparency in damage evaluation, while public authorities strengthened their capacity to prepare for and respond to future flood events using Copernicus-based Earth Observation intelligence.

	TIER 1 SERVICE PROVIDER	TIER 2 PRIMARY USER	TIER 3 SECONDARY USER	TIER 4 END USER BENEFICIARIES
SERVICES AND BENEFITS	SaferPlaces (using Copernicus Sentinel-1, Sentinel-2, CosmoSky-Med, Planet, SPOT)	Emilia-Romagna Civil Protection (utilizing flood extent and depth maps for emergency response)	Local municipalities and infrastructure agencies (using damage assessments for recovery planning)	Regional authorities, insurance companies, and residents affected by the floods
BENEFICIARIES	SaferPlaces powered by GECOsistema srl (Italy)	Civil Protection Agency of Emilia-Romagna	Municipalities of Faenza, Cesena, Forlì, Conselice	Residents, businesses, and government agencies coordinating recovery efforts

EU POLICY / DIRECTIVE

INSPIRE Directive

TYPE OF SERVICE PROVIDER

Commercial Service

TYPE OF FUNDING SOURCE

ESA

USAGE MATURITY LEVEL

5

A FUTURE WITH COPERNICUS

Building on this experience, SaferPlaces is expanding its Copernicus-based services beyond post-event mapping toward anticipatory flood risk intelligence. Future developments will leverage:

- Sentinel-1 Next Generation (NG) for higher temporal frequency,
- Sentinel-2 continuity missions
- Copernicus Climate Change Service (C3S)

The goal is to provide near real-time flood forecasting, impact estimation, and climate resilience analytics that can be activated globally and for any area of interest, supporting Civil Protection authorities before, during, and after flood events.

DID YOU KNOW?

The May 2023 floods in Emilia-Romagna were the worst in decades, affecting more than 100 municipalities and causing economic losses comparable to the largest flood disasters in recent European history.

Acknowledgements

This project was made possible through collaboration between SaferPlaces, ESA InCubed, the Civil Protection of Emilia-Romagna, and local municipalities.

Contacts

Stefano Bagli | stefano.bagli@gecosistema.com
Paolo Mazzoli | paolo.mazzoli@gecosistema.com
Francesca Renzi | francesca.renzi@gecosistema.com

ABOUT COPERNICUS4REGIONS

This user story is part of the Copernicus4Regions collection, which is managed by NEREUS under an assignment from ESA. The views expressed in the Copernicus User Stories are those of the Authors and can in no way be taken to reflect the official opinion of the European Space Agency or of the European Commission. Copernicus4Regions is funded by the European Union, in collaboration with NEREUS. Paging, printing and distribution funded by the European Space Agency. Graphical design by the ESA EO Graphics Bureau.