Finanziato dall'Unione europea
NextGenerationEU

Ministero dell'Università e della Ricerca

Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA

ICSC
Centro Nazionale di Ricerca in HPC, Big Data and Quantum Computing

ICSC
Centro Nazionale di Ricerca in HPC, Big Data and Quantum Computing

The HaMMon Project:
A Journey through Management Approach and Technical Progress

Antonio Tirri

Spoke 3 Annual meeting

08/05/2024

HAzard **M**apping and vulnerability **MON**itoring

- Provide an operational contribution for characterisation of risks related to extreme natural events
- Develop tools that can be used in different application areas
- Promote collaboration between research organisations and the Italian industrial system

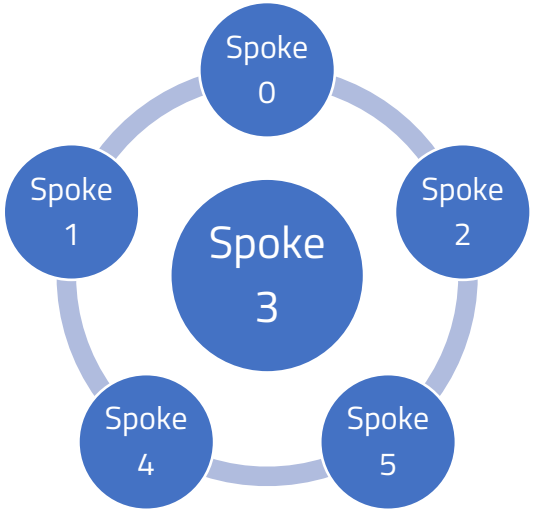
Climate change trends are leading to an increase in **extreme events**, with significant impacts on the economy and on people's quality of life.

The **2023 flood event in Emilia-Romagna** affected 30 per cent of the population and almost a third of agricultural land. Damage was estimated at **8.8 billion euro**. **Flooding in Tuscany in 2023** caused damage estimated at around **€1.9bn**.

The **hailstorms in northern Italy in July 2023**, the highest losses ever recorded by SwissRe for a single SCS event in Europe, are estimated to have caused losses of **USD 5.5 billion**.

HAzard **M**apping and vulnerability **MON**itoring

ICSC Centro Nazionale di Ricerca in HPC, Big Data and Quantum Computing



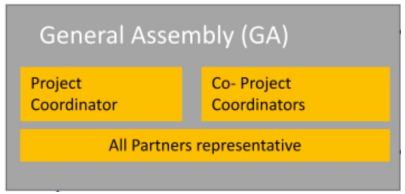
HaMMon

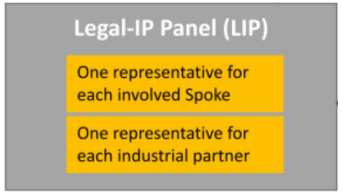
- Post-event analysis — WP2
- Seasonal forecasts and weather generator — WP3
- Building features extraction from images — WP4
- Vulnerability curves for earthquakes and landslides — WP5
- Technological infrastructure to run and deploy the applications — WP1

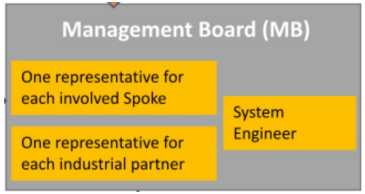
WP0: Management

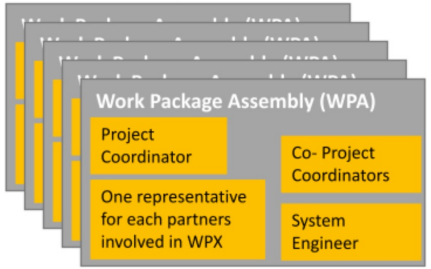
People

Project coordinator (PI): Antonio Tirri – Leithà
Industrial Co-PI: Antonio Ballarin - Sogei
Research Co-PI: Fabio Vitello – INAF
System Engineer (SE): Costantino Cafaro – Leithà









Main activities in WP0

- Kick-off, 19/10/2023
- Monthly meetings for each WP
- WP Leader meetings
- ICSC Milestone Reporting
- Planning MGMT Meeting

Main activities in WP0

- Kick-off, 19/10/2023
- Monthly meetings for each WP
- WP Leader meetings
- ICSC Milestone Reporting
- Planning MGMT Meeting

Milestone	Ref period	Research plan	Research Report
M7	Sep 23 – Feb 24	X	X
M8	Mar 24 – Jun 24	X	Partial
M9	Jul 24 – Oct 24	X	-
M10	Nov 24 – Aug 25	X	-

WP1: Technological infrastructure to run and deploy the applications – WP Leader: UniTO

Objective: Creation and configuration of a Kubernetes cluster and a set of services such as data archive, cloud storage, workflow management as well as test, dev and prod environments, with a high-performance approach.

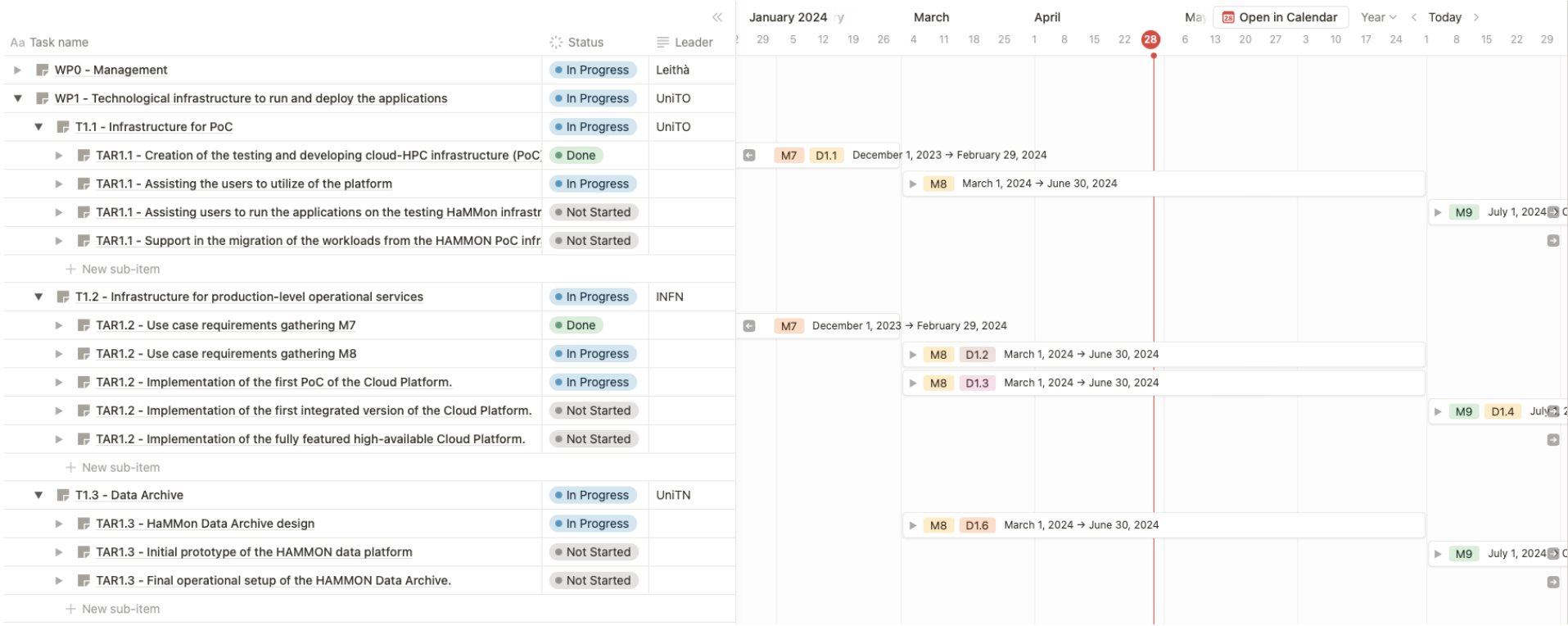
Involved partners:

Task:

- T1.1: Infrastructure for PoC (**Leader: UniTo**; Contributors: INAF, UnipolSai-Leithà)
- T1.2: Infrastructure for production-level operational Services (**INFN**; UnipoSai-Leithà, ENEA, UniTo)
- T1.3: Data Archive (**UniTN**; Unipolsai-Leithà, INFN)

Deliverables and milestones:

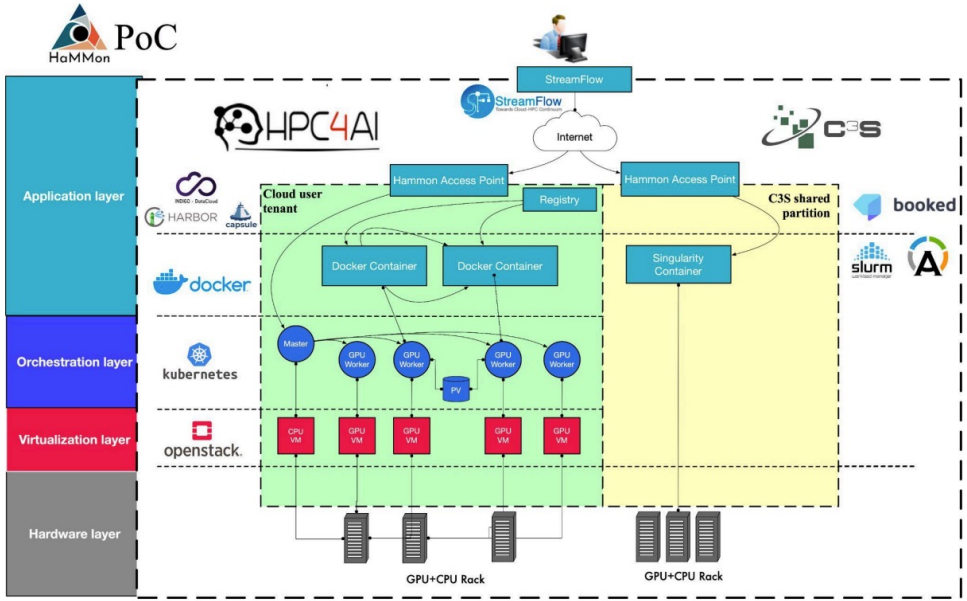
- D1.1 PoC level infrastructure (M8 – UniTO)
- D1.2 Use case requirements gathering (M8 - INFN)
- D1.3 Implementation of the first PoC of the Cloud Platform (M8 – INFN)
- D1.4 Implementation of the first integrated version of the Cloud Platform (M9 – INFN)
- D1.5 Implementation of the fully featured high-available Cloud Platform (M10 – INFN)
- D1.6 HaMMon Data Archive design (M8 –UNITN)
- D1.7 Final operational setup of the HaMMon Data Archive (M10 – UNITN)


Aa Task name
Status
Leader
January 2024
March
April
May
Open in Calendar
Year
Today
WP0 - Management
In Progress
Leithà
WP1 - Technological infrastructure to run and deploy the applications
In Progress
UniTO
T1.1 - Infrastructure for PoC
In Progress
UniTO
TAR1.1 - Creation of the testing and developing cloud-HPC infrastructure (PoC
Done
M7 D1.1 December 1, 2023 → February 29, 2024
TAR1.1 - Assisting the users to utilize of the platform
In Progress
M8 March 1, 2024 → June 30, 2024
TAR1.1 - Assisting users to run the applications on the testing HaMMon infrastr
Not Started
M9 July 1, 2024
TAR1.1 - Support in the migration of the workloads from the HAMMON PoC infr
Not Started
New sub-item
T1.2 - Infrastructure for production-level operational services
In Progress
INFN
TAR1.2 - Use case requirements gathering M7
Done
M7 December 1, 2023 → February 29, 2024
TAR1.2 - Use case requirements gathering M8
In Progress
M8 D1.2 March 1, 2024 → June 30, 2024
TAR1.2 - Implementation of the first PoC of the Cloud Platform.
In Progress
M8 D1.3 March 1, 2024 → June 30, 2024
TAR1.2 - Implementation of the first integrated version of the Cloud Platform.
Not Started
M9 D1.4
TAR1.2 - Implementation of the fully featured high-available Cloud Platform.
Not Started
New sub-item
T1.3 - Data Archive
In Progress
UniTN
TAR1.3 - HaMMon Data Archive design
In Progress
M8 D1.6 March 1, 2024 → June 30, 2024
TAR1.3 - Initial prototype of the HAMMON data platform
Not Started
M9 July 1, 2024
TAR1.3 - Final operational setup of the HAMMON Data Archive.
Not Started
New sub-item

Main activities in WP1

- Kubernetes cloud infrastructure coupled with a HPC partition
- Kubernetes cluster based on OpenStack infrastructure provided by UniTo

ID	Descrizione
vCPU	320
RAM	512 GB
STORAGE FAST	1.5TB
STORAGE WORK	30TB
GPU	6 T4
NETWORK	2 IP public



WP2: Post-event analysis – WP Leader: INAF

Objective:

- Improve damage assessment, claims processing and time needed for on-site inspections after a natural disaster
- Collecting requirements for the remote inspection of areas damaged by natural disasters
- Development of algorithms to identify and classify objects and features within 3D models and 2D images.

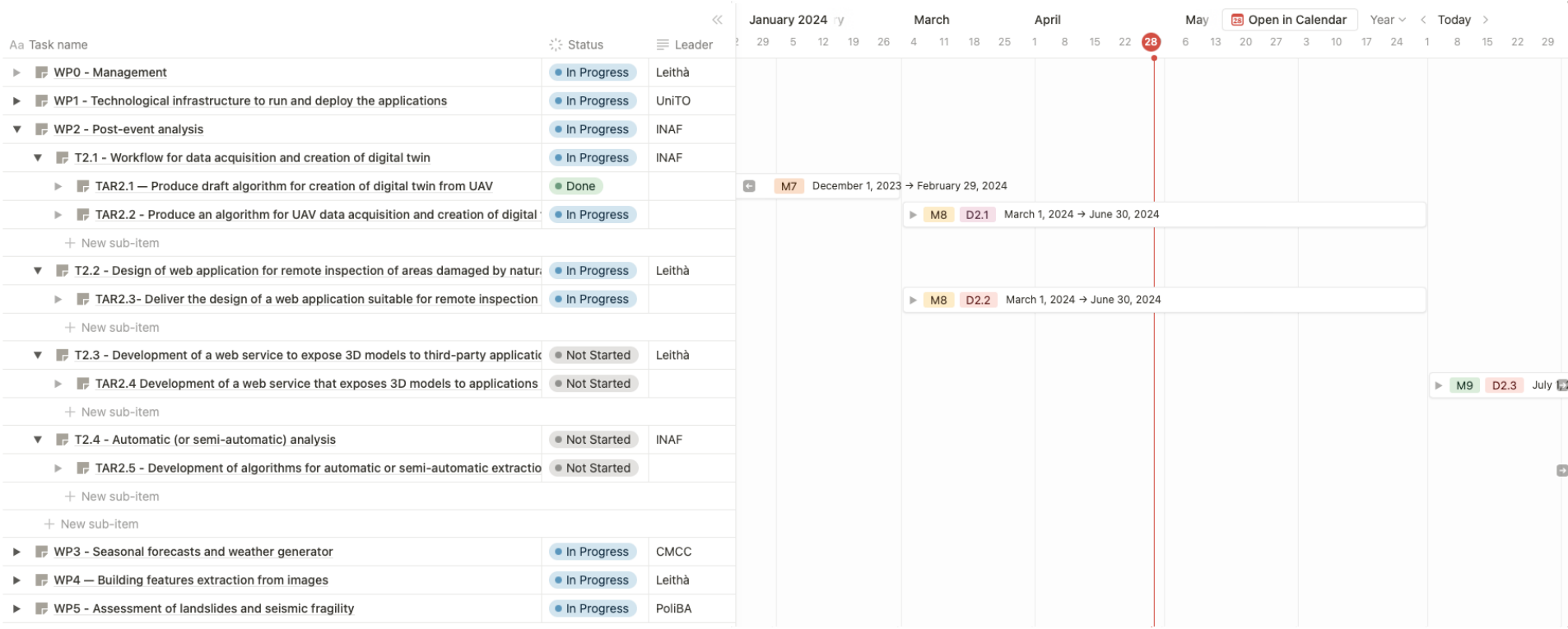
Involved partners: Leithà, ENEA, sogei, INAF, Università del Salento, INFN

Description of work:

- T2.1: Workflow for data acquisition and creation of digital twin (**Leader: INAF**, Contributors: Leithà, Sogei, ENEA)
- T2.2: Design of web application for remote inspection of areas damaged by natural disasters (**Leithà**; INAF, Sogei)
- T2.3: Development of a web service to expose 3D models to third-party applications (**Leithà;** INAF, Sogei)
- T2.4: Automatic (or semi-automatic) analysis (**INAF**; Leithà, Sogei, UniSalento)

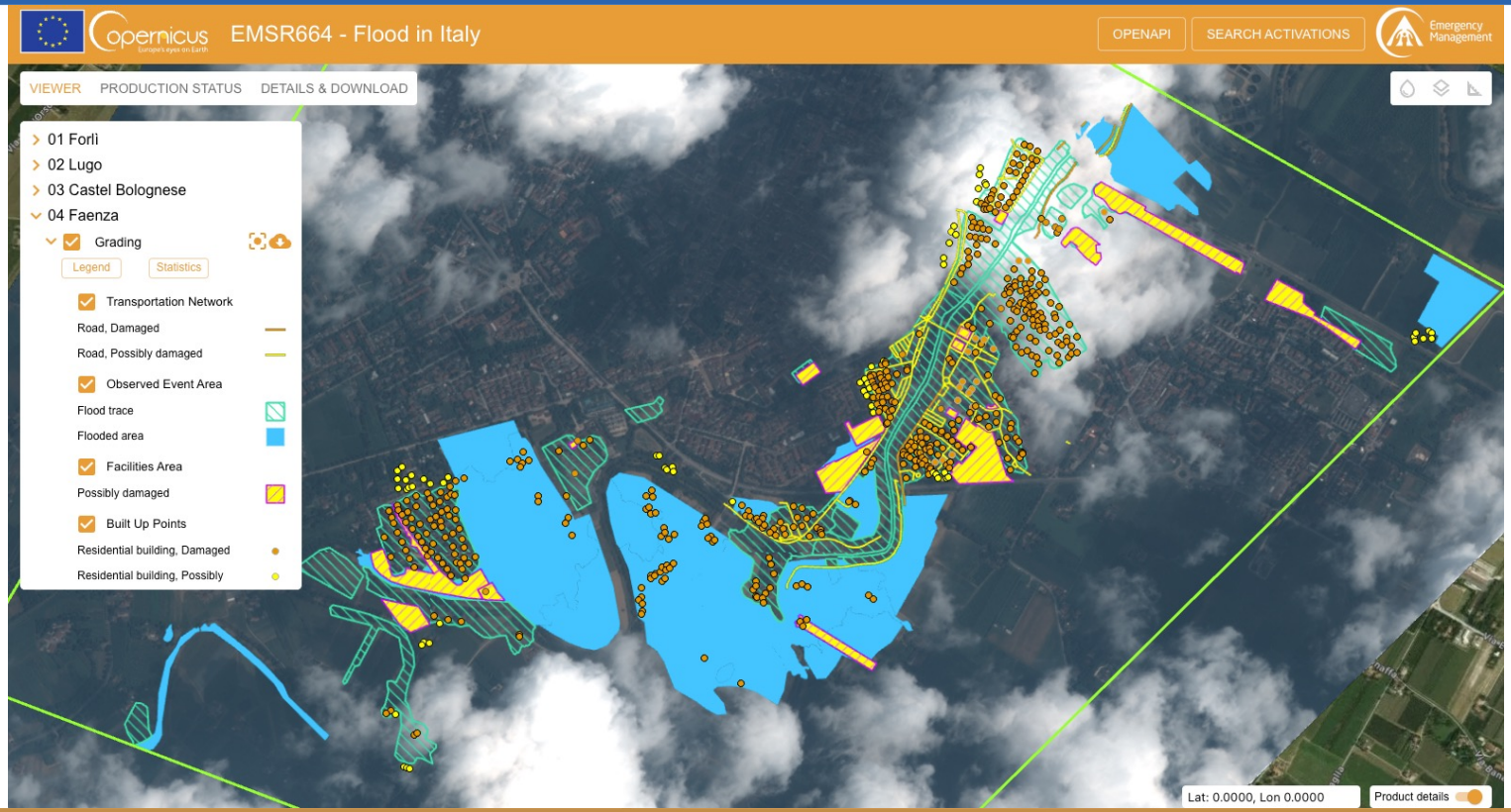
Deliverables and milestones:

- D2.1 Produce an algorithm for UAV data acquisition and creation of digital twin (M8 – INAF).
- D2.2 Deliver the design of a web application suitable for remote inspection in the aftermath of extreme vents (M8 – Leithà).
- D2.3 Deliver the web service for claim adjusters (M9 –Leithà).
- D2.4 Produce an algorithm for automatic or semi-automatic information extraction from digital twin (M10 – INAF).

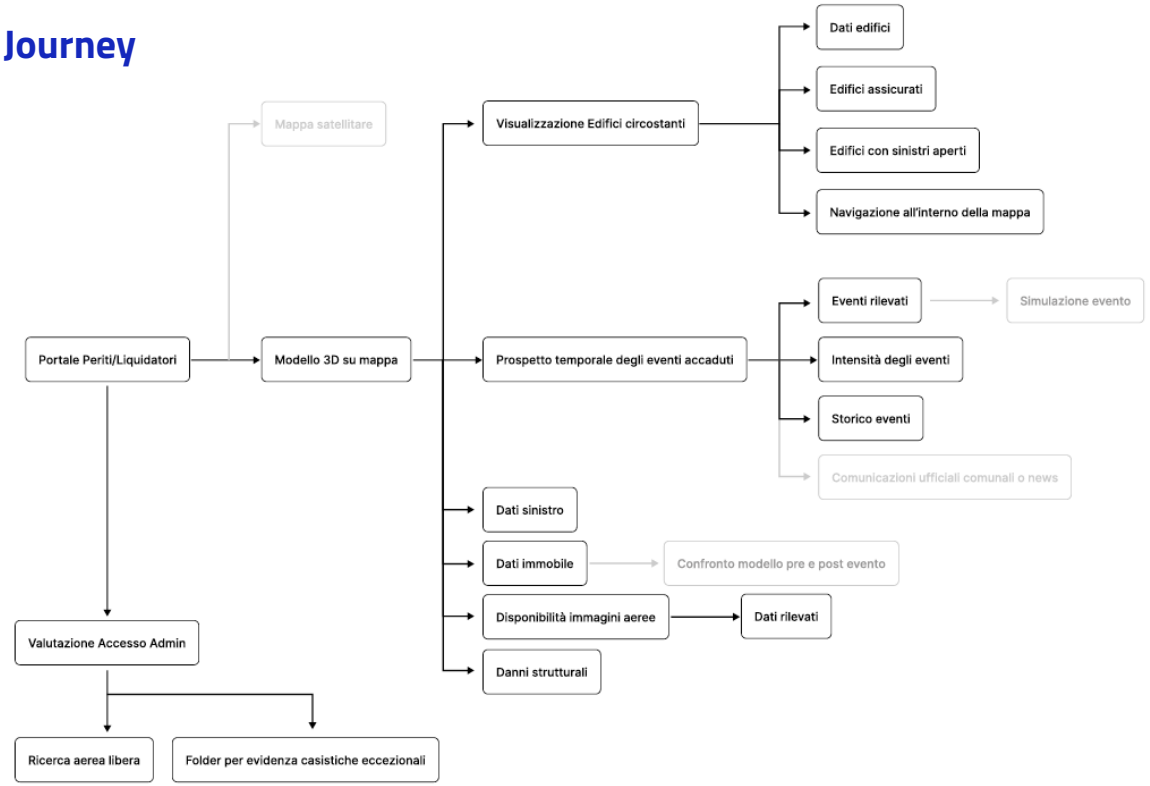

January 2024
March
April
May
Open in Calendar
Year
Today
Aa Task name
Status
Leader
WP0 - Management
In Progress
Leithà
WP1 - Technological infrastructure to run and deploy the applications
In Progress
UniTO
WP2 - Post-event analysis
In Progress
INAF
T2.1 - Workflow for data acquisition and creation of digital twin
In Progress
INAF
TAR2.1 — Produce draft algorithm for creation of digital twin from UAV
Done
M7 December 1, 2023 → February 29, 2024
TAR2.2 - Produce an algorithm for UAV data acquisition and creation of digital
In Progress
M8 D2.1 March 1, 2024 → June 30, 2024
New sub-item
T2.2 - Design of web application for remote inspection of areas damaged by natur
In Progress
Leithà
TAR2.3- Deliver the design of a web application suitable for remote inspection
In Progress
M8 D2.2 March 1, 2024 → June 30, 2024
New sub-item
T2.3 - Development of a web service to expose 3D models to third-party applicatic
Not Started
Leithà
TAR2.4 Development of a web service that exposes 3D models to applications
Not Started
M9 D2.3 July
New sub-item
T2.4 - Automatic (or semi-automatic) analysis
Not Started
INAF
TAR2.5 - Development of algorithms for automatic or semi-automatic extractio
Not Started
New sub-item
New sub-item
WP3 - Seasonal forecasts and weather generator
In Progress
CMCC
WP4 — Building features extraction from images
In Progress
Leithà
WP5 - Assessment of landslides and seismic fragility
In Progress
PoliBA

Main activities in WP2

1. Identification of target area
2. Development of the workflow to produce a high-resolution 3D tiled model with centimeter accuracy.
3. Esploring solution to deploy 3D Models using web services
4. Identification of the main functionalities for for a web application to be used by claims adjusters


Copernicus
EMSR664 - Flood in Italy
OPENAPI
SEARCH ACTIVATIONS
Emergency Management
VIEWER
PRODUCTION STATUS
DETAILS & DOWNLOAD
01 Forlì
02 Lugo
03 Castel Bolognese
04 Faenza
Grading
Legend
Statistics
Transportation Network
Road, Damaged
Road, Possibly damaged
Observed Event Area
Flood trace
Flooded area
Facilities Area
Possibly damaged
Built Up Points
Residential building, Damaged
Residential building, Possibly
Lat: 0.0000, Lon 0.0000
Product details

HaMMon – WebAPP Journey



WP3: Seasonal forecasts and weather generator – WP Leader: CMCC

Objective:

- Developing a system for seasonal forecasting for the hazard assessment of extreme events
- Creation of a weather generator tool for the characterization of climate change risks.

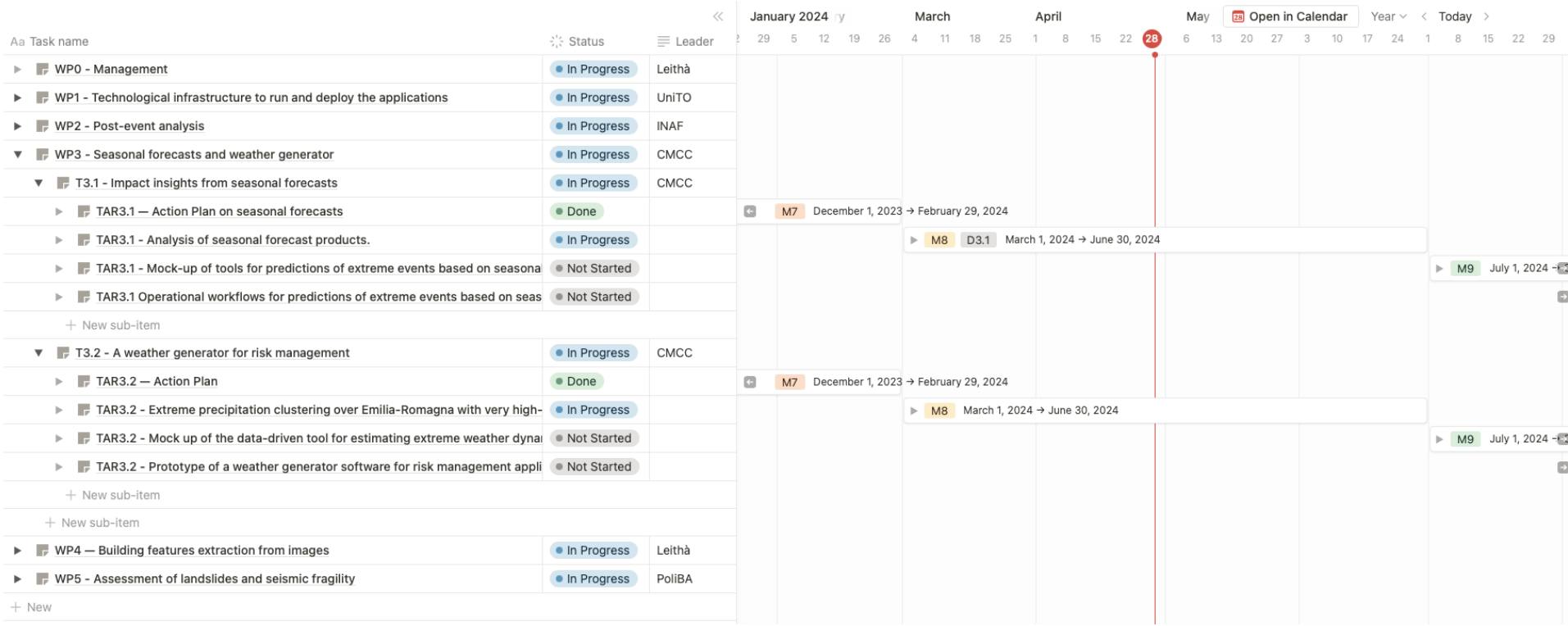
Involved partners:

Description of work:

- T3.1 Impact insights from seasonal forecasts (**Leader: CMCC**; Contributors: FBK, Leithà, ENEA, Sogei)
- T3.2 A weather generator for risk management (**CMCC**; FBK, Leithà)

Deliverables and milestones:

- D3.1 Analysis of seasonal forecast products (M8 – CMCC)
- D3.2 Derivation of an operational workflow for predictions of extreme events based on seasonal forecasts (M10 – CMCC)
- D3.3 CMCC - Prototype of a weather generator software for risk management applications (M10 – CMCC)



Task name	Status	Leader
WP0 - Management	In Progress	Leithà
WP1 - Technological infrastructure to run and deploy the applications	In Progress	UniTO
WP2 - Post-event analysis	In Progress	INAF
WP3 - Seasonal forecasts and weather generator	In Progress	CMCC
T3.1 - Impact insights from seasonal forecasts	In Progress	CMCC
TAR3.1 — Action Plan on seasonal forecasts	Done	
TAR3.1 - Analysis of seasonal forecast products.	In Progress	
TAR3.1 - Mock-up of tools for predictions of extreme events based on seasonal	Not Started	
TAR3.1 Operational workflows for predictions of extreme events based on seas	Not Started	
New sub-item		
T3.2 - A weather generator for risk management	In Progress	CMCC
TAR3.2 — Action Plan	Done	
TAR3.2 - Extreme precipitation clustering over Emilia-Romagna with very high-	In Progress	
TAR3.2 - Mock up of the data-driven tool for estimating extreme weather dynai	Not Started	
TAR3.2 - Prototype of a weather generator software for risk management appli	Not Started	
New sub-item		
New sub-item		
WP4 — Building features extraction from images	In Progress	Leithà
WP5 - Assessment of landslides and seismic fragility	In Progress	PoliBA
New		

Main activities in WP3

1. State of the art of the simulation chains currently adopted for seasonal forecasts: pros and cons, strengths and weaknesses, how the outputs of such modelling chains are currently used, where to find and how to process the data.
2. Identification and characterization of extreme events in Emilia-Romagna: extreme precipitation clustering with very high-resolution downscaling from reanalysis.

WP4: Building features – WP Leader: Leithà

Objective:

- Mapping the main characteristics of the built environment in Italy
- Development of algorithms for the classification of the built environment using multiple data sources
- Development of vulnerability curves for a set of hazards by using abovementioned building features

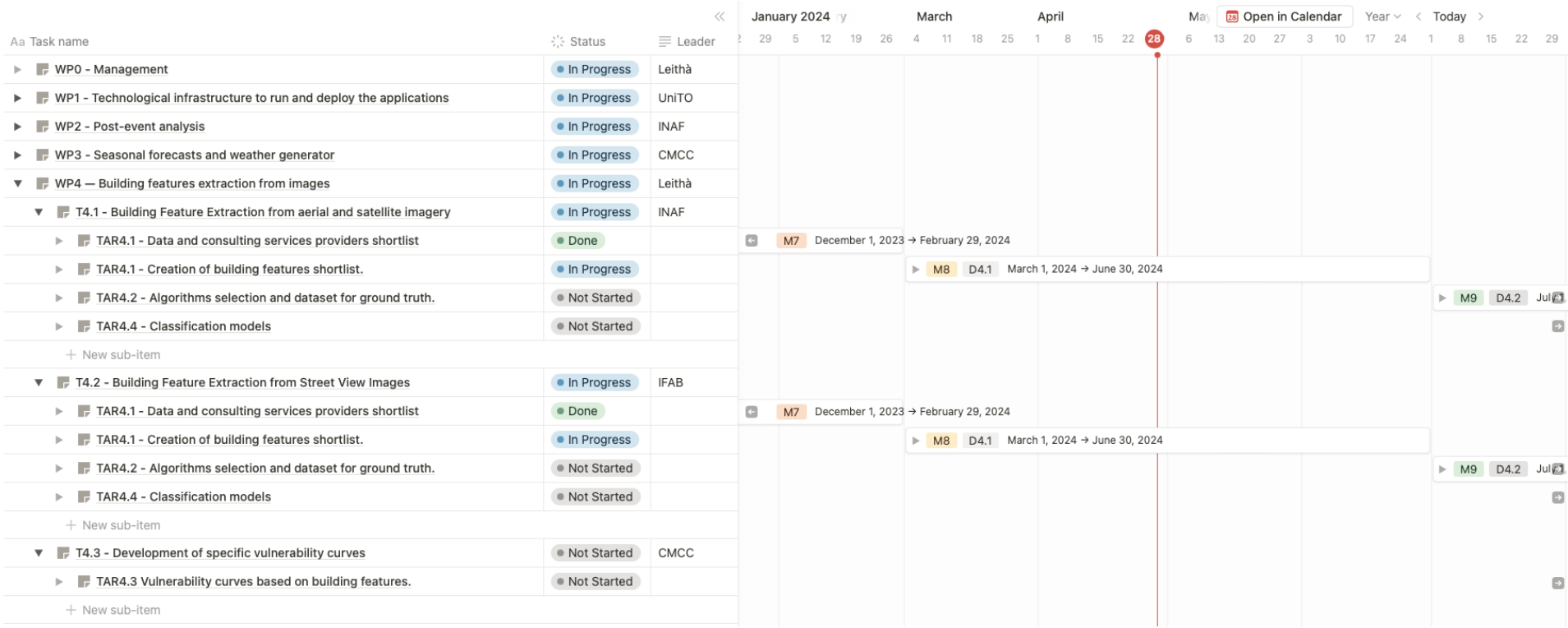
Involved partners:

Description of work:

- T4.1 - Building Feature Extraction from aerial and satellite imagery (**Leader: Leithà**; Contributors: INAF, UniBA)
- T4.2 - Building Feature Extraction from Street View Images (**Leithà**; PoliBa, UniBa)
- T4.3 - Development of specific vulnerability curves (**CMCC**, Contributors: PoliBa, ENEA, Leithà, IREA)

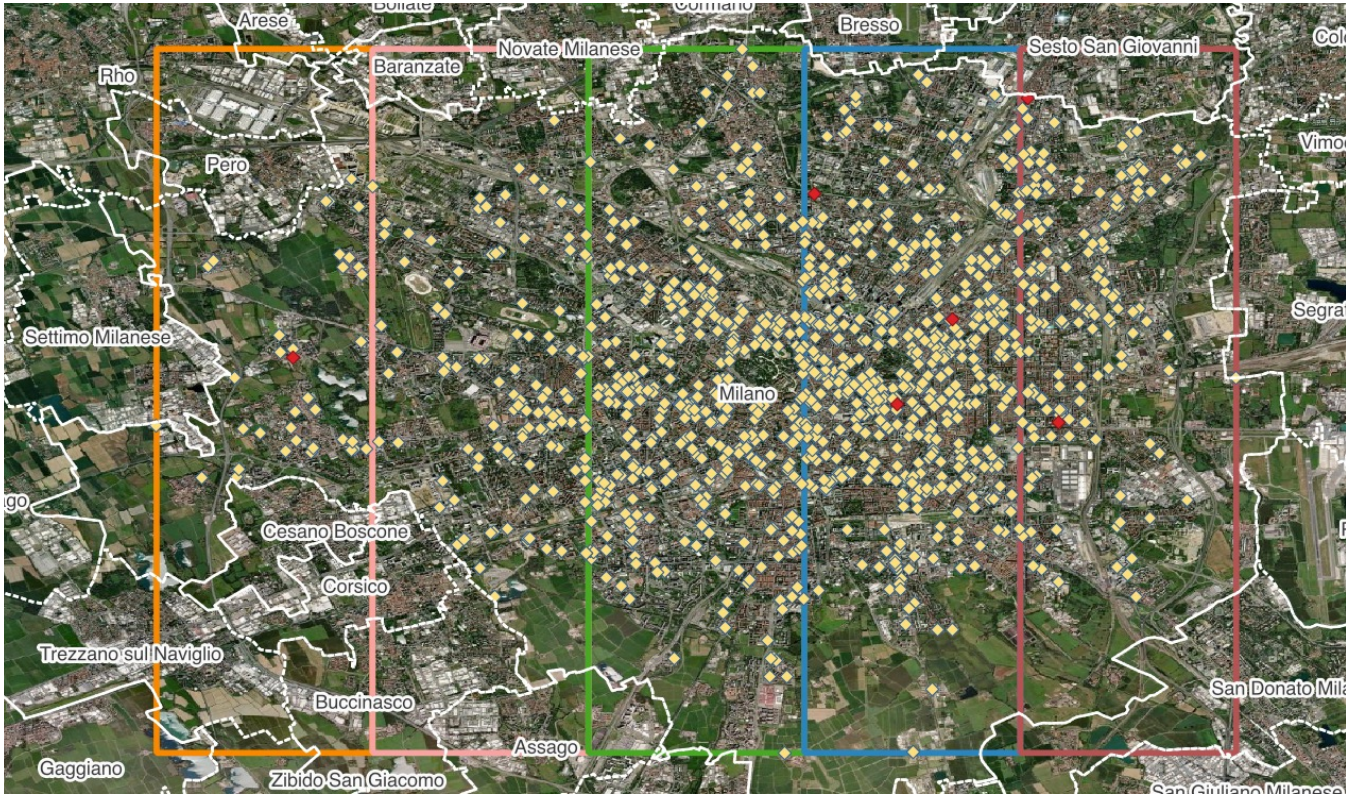
Deliverables and milestones:

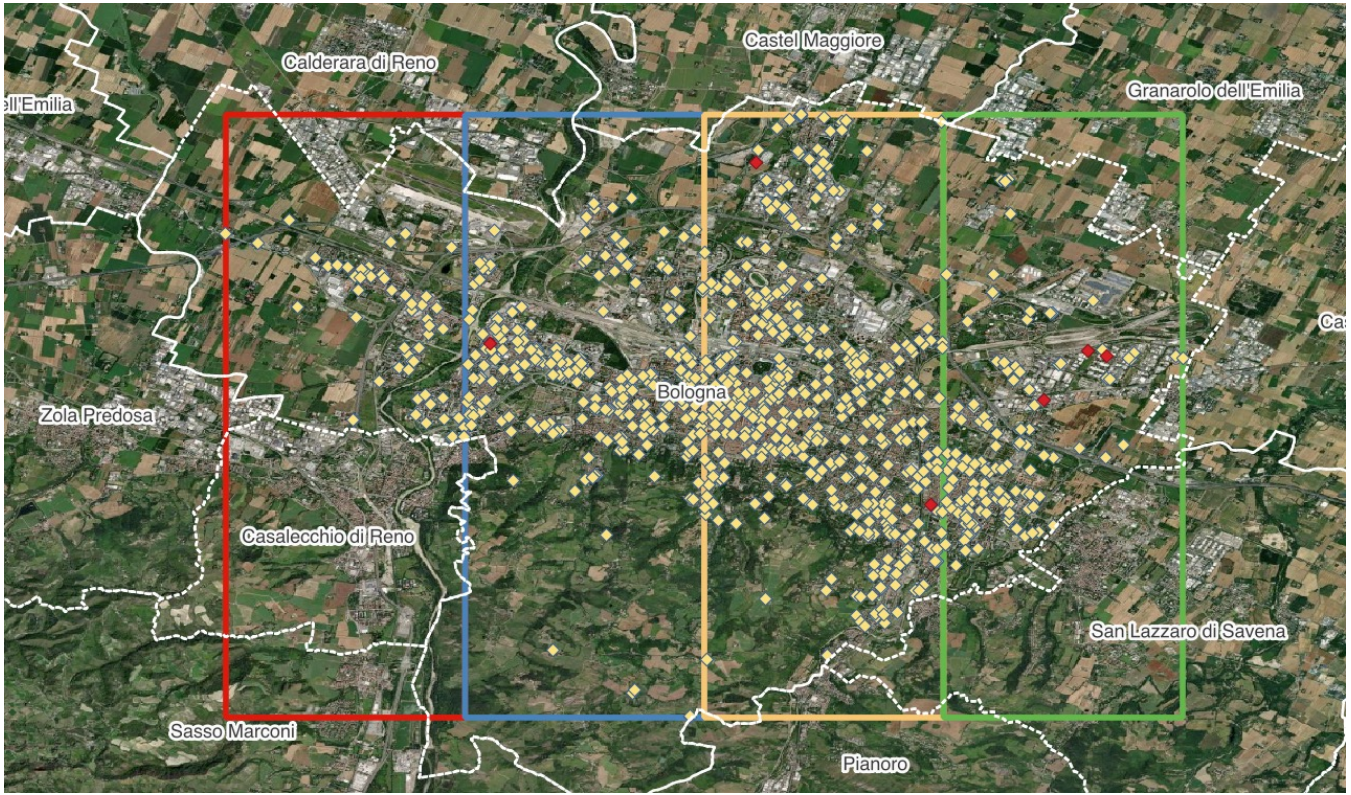
- D4.1 Data provider shortlist and building features to monitor (M8 – Leithà)
- D4.2 Algorithm selection and dataset for ground truth (M9 – Leithà)
- D4.3 Vulnerability curves for seismic and flood risk (M10 – CMCC)
- D4.4 Classification models (M10 – Leithà)


Open in Calendar
Year
Today
January 2024
March
April
May
Aa Task name
Status
Leader
WP0 - Management — In Progress — Leithà
WP1 - Technological infrastructure to run and deploy the applications — In Progress — UniTO
WP2 - Post-event analysis — In Progress — INAF
WP3 - Seasonal forecasts and weather generator — In Progress — CMCC
WP4 — Building features extraction from images — In Progress — Leithà
T4.1 - Building Feature Extraction from aerial and satellite imagery — In Progress — INAF
TAR4.1 - Data and consulting services providers shortlist — Done
M7 December 1, 2023 → February 29, 2024
TAR4.1 - Creation of building features shortlist. — In Progress
M8 D4.1 March 1, 2024 → June 30, 2024
TAR4.2 - Algorithms selection and dataset for ground truth. — Not Started
M9 D4.2
TAR4.4 - Classification models — Not Started
New sub-item
T4.2 - Building Feature Extraction from Street View Images — In Progress — IFAB
TAR4.1 - Data and consulting services providers shortlist — Done
M7 December 1, 2023 → February 29, 2024
TAR4.1 - Creation of building features shortlist. — In Progress
M8 D4.1 March 1, 2024 → June 30, 2024
TAR4.2 - Algorithms selection and dataset for ground truth. — Not Started
M9 D4.2
TAR4.4 - Classification models — Not Started
New sub-item
T4.3 - Development of specific vulnerability curves — Not Started — CMCC
TAR4.3 Vulnerability curves based on building features. — Not Started
New sub-item

Main activities in WP4

- Activation of UP42 services for ICSC
- Setup of image tagging service and contract
- Target identification
- Scouting of Street view data providers
- Building feature list
- Usage of radar (Cosmo SkyMed) data for vulnerability assessment


Arese
Novate Milanese
Bresso
Sesto San Giovanni
Rho
Baranzate
Pero
Settimo Milanese
Milano
Cesano Boscone
Corsico
Trezzano sul Naviglio
Buccinasco
Assago
Gaggiano
Zibido San Giacomo


Calderara di Reno
Castel Maggiore
Granarolo dell'Emilia
Bologna
Zola Predosa
Casalecchio di Reno
San Lazzaro di Savena
Sasso Marconi
Pianoro

Recognition of photovoltaic cells

- Recognition of photovoltaic cells in aerial images with Convolutional Neural Networks (CNNs)
- Object detection with YOLOv5 models
  - F1 score 0.86
  - 86.7M parameters
  - Trained on public datasets
- Image segmentation

WP 5: Vulnerability curves – WP Leader: PoliBA

Objective:

- Provide vulnerability assessment criteria for damage induced on structures by slow-moving landslides
- Assess future evolution of risk related to slow-moving landslides due to evolving climate

Involved partners:

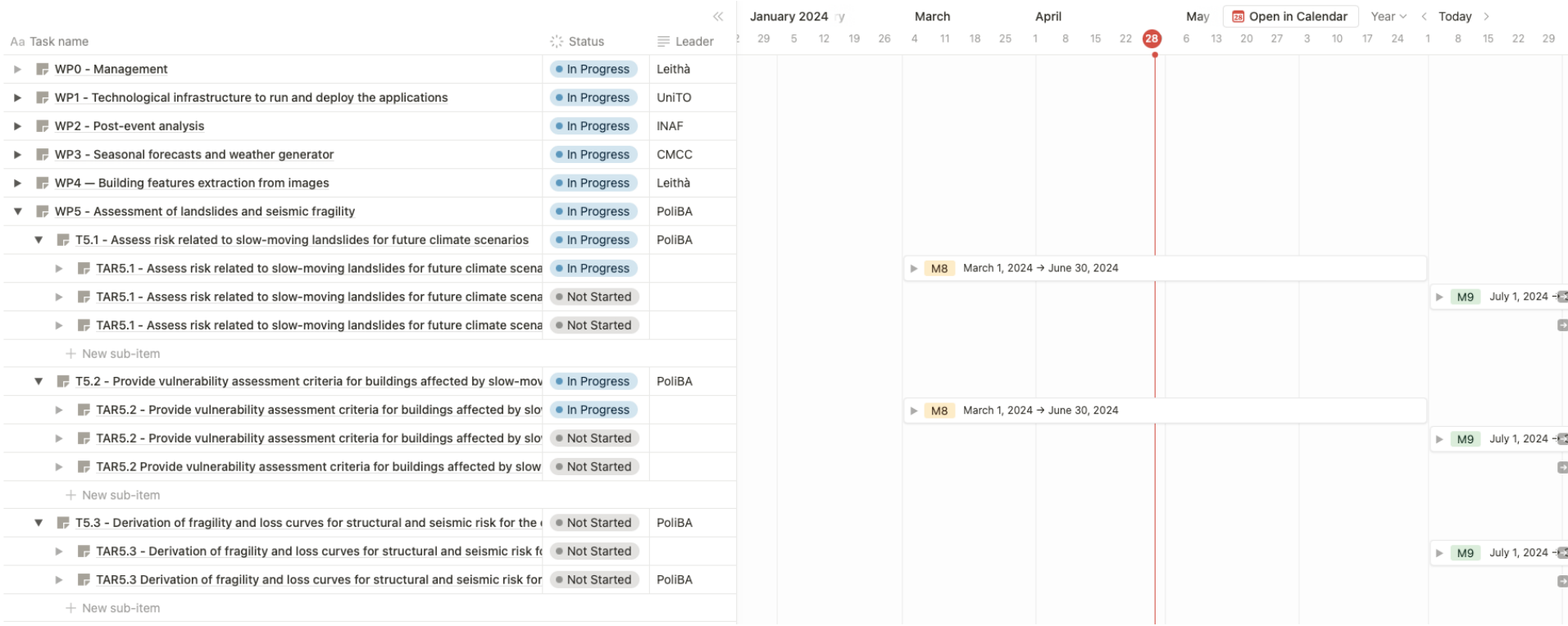
Leithà sogei SAPIENZA UNIVERSITÀ DI ROMA

Description of work:

- T5.1 - Assess risk related to slow-moving landslides for future climate scenarios (**Leader: PoliBA**; Contributors: Leithà, Sogei, UniRoma1)
- T5.2 - Provide vulnerability assessment criteria for buildings affected by slow-moving landslides (**PoliBa**, Leithà, Sogei, UniRoma1, UnivAq)
- T5.3 - Derivation of fragility and loss curves for structural and seismic risk for the existing residential building stock (**PoliBA**; Leithà, Sogei, UniRoma1, UnivAq)

Deliverables and milestones:

- D5.1 Sample numerical models of slopes affected by slow-moving landslides, endowed with guidelines for construction and initialization of the model, as well as for the application of weather-related boundary conditions. Results of analyses carried out using future climate scenarios (M10 - PoliBA)
- D5.2 Landslide-related damage charts for prototype cases (M10 – PoliBA)
- D 5.3 Fragility and loss curves for specific building typologies for structural and seismic risk. M10 – PoliBA)



Task name	Status	Leader
WP0 - Management	In Progress	Leithà
WP1 - Technological infrastructure to run and deploy the applications	In Progress	UniTO
WP2 - Post-event analysis	In Progress	INAF
WP3 - Seasonal forecasts and weather generator	In Progress	CMCC
WP4 — Building features extraction from images	In Progress	Leithà
WP5 - Assessment of landslides and seismic fragility	In Progress	PoliBA
T5.1 - Assess risk related to slow-moving landslides for future climate scenarios	In Progress	PoliBA
TAR5.1 - Assess risk related to slow-moving landslides for future climate scena	In Progress	
TAR5.1 - Assess risk related to slow-moving landslides for future climate scena	Not Started	
TAR5.1 - Assess risk related to slow-moving landslides for future climate scena	Not Started	
New sub-item		
T5.2 - Provide vulnerability assessment criteria for buildings affected by slow-mov	In Progress	PoliBA
TAR5.2 - Provide vulnerability assessment criteria for buildings affected by slo	In Progress	
TAR5.2 - Provide vulnerability assessment criteria for buildings affected by slo	Not Started	
TAR5.2 Provide vulnerability assessment criteria for buildings affected by slow	Not Started	
New sub-item		
T5.3 - Derivation of fragility and loss curves for structural and seismic risk for the	Not Started	PoliBA
TAR5.3 - Derivation of fragility and loss curves for structural and seismic risk fo	Not Started	
TAR5.3 Derivation of fragility and loss curves for structural and seismic risk for	Not Started	PoliBA
New sub-item		

Main activities in WP5

1. Definition of target area
2. Review of models for simulation of slow landslides in target area to be defined jointly with Unipol
3. Review and improvement of the results of surveys of landslide-related damage in the pilot area

Thank you

antonio.tirri@leitha.eu