



D.2.1.1

Analysis of flood hazard in Ravenna



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Executive Summary

This report summarizes the work for Activity 2.1 of the Interreg Italy-Croatia STRENGTH project, and specifically the aspects of the project aimed at enhancing coastal flood risk assessment in the Emilia-Romagna region. Using the LISFLOOD-FP physics-based hydrodynamic model, the study simulates coastal inundation scenarios for the Ravenna province by integrating datasets of Total Water Level (TWL) from the Po River District Authority (ADBPO) developed in 2012 and updated in 2023 in the context of the requirements for the EU Flood Directive.

The primary objectives were i) to compare physics-based simulations with existing regional flood maps, ii) to identify specific coastal sectors highly susceptible to flooding, and iii) to provide a series of refined flood maps and a transparent, reproducible workflow to assist local authorities in selecting the most effective mitigation strategies.

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1. Introduction

This report summarizes the work carried out for Activity 2.1, developed within the Interreg Italy-Croatia STRENGTH project, aiming at the improvement of coastal flood risk assessment and mitigation in the municipality of Ravenna. It focuses on applying a physics-based approach to simulate coastal inundation scenarios to obtain flood maps which will be used later in the project for exposure and potential damage assessment.

Within this project's activity, the modelling methodology draws on and extends approaches developed in prior Pan European research projects (e.g., ECFAS; Le Gal et al., 2023) and subsequent local scale studies (Cabrita et al., 2024), adapting them to the datasets and requirements of STRENGTH. The model used for the simulations is LISFLOOD-FP, a well-established validated hydrodynamic model used to simulate and calculate flood extensions. Synthetic extreme scenarios based on datasets provided by the Po River Authority (Autorità di Bacino Distrettuale del Fiume Po - ADBPO) were modelled. Two datasets of Total Water Level (TWL) estimations were considered according to the versions of the work performed by the Authority for the application of the EU Flood Directive: i) the 2012 TWL values, and ii) the 2023 values for 2% and 3% coastal slopes, corrected applying a +0.35 m to the original dataset to shift all estimations to the local geoid (see in 3.1 for details).

In the 2012 Flood Directive maps, scenarios were provided for return periods of 1, 10, and 100 years (ADBPO, 2012). In 2020, regional inundation maps were produced using a GIS-based "bathtub" method with return periods of 10, 100, and 100+ years (ADBPO, 2020). In 2023, updated TWL values for different coastal slopes (2% and 3%) were calculated by Duo et al. (2024), providing refined input data for extreme event simulation in the region.

The goals of this work are:

- To compare the flood maps produced via LISFLOOD-FP with the current regional maps and to clarify methodological implications;
- To provide maps of the different flood scenarios defined over the years, enabling authorities to select and apply the most appropriate approach for their needs;
- To identify coastal sectors where hydraulic connectivity, land cover, or topography increases vulnerability to inland flood propagation;
- To deliver a transparent, reproducible workflow (scripts and inputs) aligned with STRENGTH's objectives.



2. Data acquisition

The Digital Terrain Model (DTM) used for the analyses are the DTM RER 2022 and the DTM RER 2023/24 provided by the Emilia-Romagna Region. The DTMs have a resolution of 0.5 m and were produced after airborne Lidar flight carried out in the period 2022 - 2024. The 2022 dataset includes northern part of the area from Casalborgsetti; the 2023/24 one includes the area south of Casalborgsetti. Both DTMs were resampled to 5 m to reduce computational cost (Table 1). Adjustments and editing of the DTMs were made to account for the presence of buildings and walls near the coastline, which were otherwise not adequately represented at this resolution and, due to the nature of the source data, were absent in the original file. These elements were considered essential for accurately simulating the protective role of coastal infrastructures. The reconstruction of walls and buildings was carried out by observing the temporally closest aerial photographs available from the portal of the Regione Emilia-Romagna, such as the 2022 orthophotos and comparing the project's DTM with the values of the DSM RER 2019, which maintains the original values of the surface, thus buildings elevation. The elevation attributed to the pixel was adapted depending on the type of structure to reproduce. For example, if there was a large building, a high elevation value was adopted (e.g. 4 m); if a low wall was present, the value observed from the DSM was adopted. However, it is important to consider that this editing was carried out only after a few tests performed using the hydraulic model, which allowed to identify floodpaths that were acting as corridors for the flooding. Therefore, the DTM was modified only where the location of the floodpaths would have been influenced by the absence of these structures, not in all available areas of the Ravenna Province. Furthermore, since the pixels were 5 x 5 m, it was necessary to leave "openings" between walls or other structures when certain areas presented gates or other paths that would allow the water to flood within the urban areas. However, it is important to note that in certain cases, buildings were not "recreated" since water could flow at their base, thus they did not act as an obstacle to the water movement.

Land Use and Land Cover (LU/LC) data were used to classify coastal typologies (urban, port, forest, beach, rocky shore, etc.). Following the approach in Le Gal et al. (2023), coastal segments were coded based on LU/LC classes, associating each typology with a Manning's roughness coefficient. Given that the current classification of land-use is based on the Emilia-Romagna dataset, whereas the original classification in Le Gal et al. (2023) used Copernicus LU/LC data, the classification table was adapted accordingly. The land-use classes can be converted into bedfriction classes by applying Chow (1959) and



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Papaioannou et al.'s. (2018) work, where the area's land cover classes were associated with a specific Manning coefficient ($0.013 \text{ s m}^{-1/3}$ for urban and transport infrastructures areas; $0.1 \text{ s m}^{-1/3}$ for Coniferous and Broadleaved forest; $0.04 \text{ s m}^{-1/3}$ for grassland; $0.03 \text{ s m}^{-1/3}$ for permanent crops). The DTMs and LU/LC are available from the Geoportal of Regione Emilia-Romagna (Table 1).

To reduce computational complexity, the province of Ravenna was divided into eight sectors, which extends from 2 to 5.8 km (Figure 2). The boundaries of these sectors were defined by natural and artificial barriers, such as inlets and cross-shore structures, while the inland limit was set along national roads. For each sector, the shoreline was manually extracted, following the lowest elevations available in the DTMs (about 0.3 m above m.s.l.). The coordinates were referred to RDN2008 / UTM 32N and to the vertical datum Genova 1942.

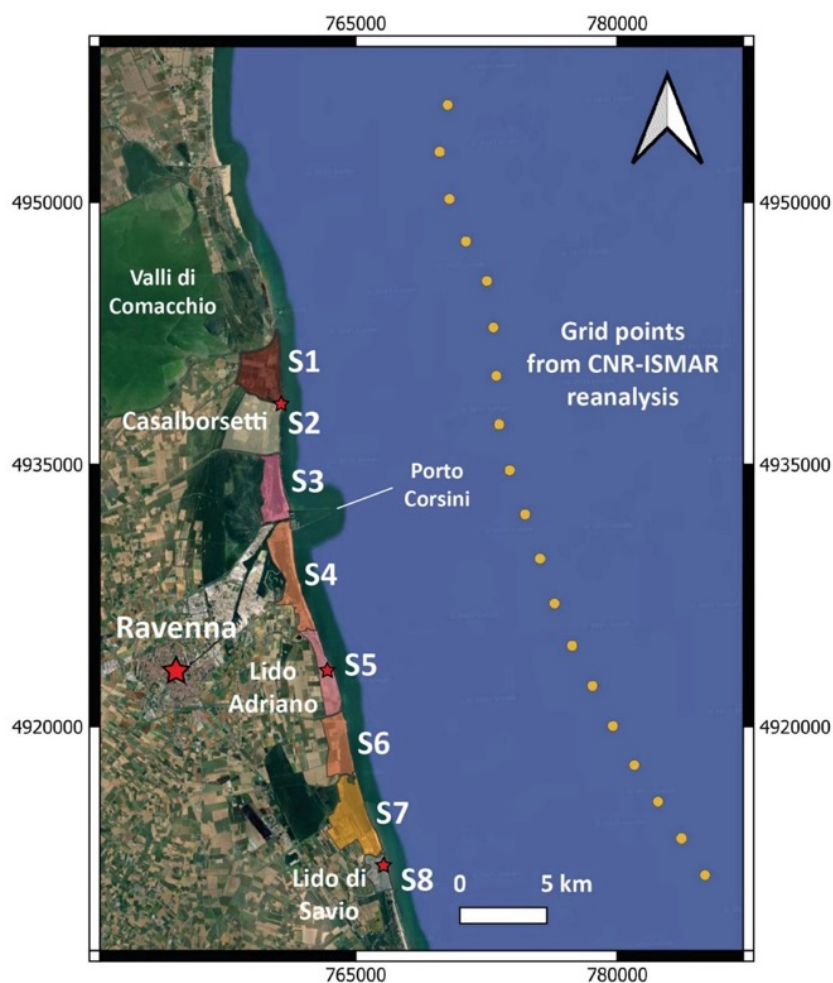


Figure 1 – Study area and Sectors used for flood modelling.



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Table 1 – Metadata and sources used in the LISFLOOD-FP modelling framework (DTMs and Land Use and Land Cover).

Type	Source	Scale	Coordinate System	Link
DTM (2022) - 0.5 m resolution	Geoportal e RER	1:1000	RDN 2008 / UTM 32 [EPSG: 7791]	https://metasfera.regione.emilia-romagna.it/ricerca_metadato?uui_d=r_emiro:2022-07-04T145317
DTM (2023/24) - 0.5 m resolution		1:1000		https://metasfera.regione.emilia-romagna.it/ricerca_metadato?uui_d=r_emiro:2024-01-31T143925
Land Use and Land Cover 2020 - 2023 Edition		/		https://geoportale.regione.emilia-romagna.it/catalogo/dati-cartografici/pianificazione-e-catasto/uso-del-suolo/layer-14

3. Modelling methodology

3.1. Scenario implementation

The storm data that allowed to estimate the Total Water Levels (TWL) used in the model were produced by the University of Ferrara within the “Quadri Conoscitivi Ambito Costiero Accordo MARE” (Protocollo nr. 00003355 Registro Generale ADBPO) project using a re- of the wave and water level characteristics provided by CNR-ISMAR (<https://zenodo.org/records/10683078>). This dataset is a validated sea level and wave hindcast for the Northern Adriatic Sea that contains a 27-year hindcast (1994-2020) generated using the unstructured hydrodynamic model SHYFEM (<https://github.com/SHYFEM-model/shyfem>) and the spectral wave model WAVEWATCH III (<https://polar.ncep.noaa.gov/waves/wavewatch>). The numerical simulations were forced by



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ERA5 meteorological (mean sea level pressure and climate-corrected wind) fields (Benetazzo et al., 2022; <https://doi.org/10.3390/w14101590>).

Based on these datasets, previous work performed by the University of Ferrara for the Regional Po Authority (Autorità di Bacino Distrettuale del Fiume Po - ADBPO) allowed to define extreme Total Water Level (TWL) scenarios and associated return periods for coastal flooding. Two of the original datasets were used in the framework of this STRENGTH project activity: i) a dataset originally produced in 2012 for the very first application of the EU Flood Directive, which provides parameters for events with return periods of 1, 10, and 100 years (ADBPO, 2012), and ii) a second dataset produced in 2023, which includes updated TWL values for different coastal slopes calculated by Duo et al. (2024), providing refined input data for extreme event simulation in the region. Specifically, the dataset of 2023 was calculated based on the extreme values extracted from a static combination (i.e. without dynamic run-up) of water levels that include Mean Sea Levels (MSL), High Tides, Residual and Setup, hereby referred as **sTU values**. In this dataset, the scenarios of low, medium, and high frequency were calculated considering a range of return periods, rather than specific ones, dividing them into bins of 1-15, 50-100, 150-500 return periods. These TWLs were calculated applying 2% and 3% coastal slopes for the estimation of wave set-up (Duo et al., 2024; Table 2).

Based on the findings of Cabrita et al. 2024 in a case study on Lido di Volano, a dissipative beach of the Ferrara coastline, the sTU combination was shown to produce the most realistic TWL estimates, compared to the other combination of parameters (Figure 2), therefore it was selected for use in this study. The sTU values for each scenario (i.e. High, Medium, Low frequency) were used as inputs for the LISFLOOD-FP simulations. The scenarios are listed in table 3, based on the ADBPO datasets.



TWL scenarios: methods comparison

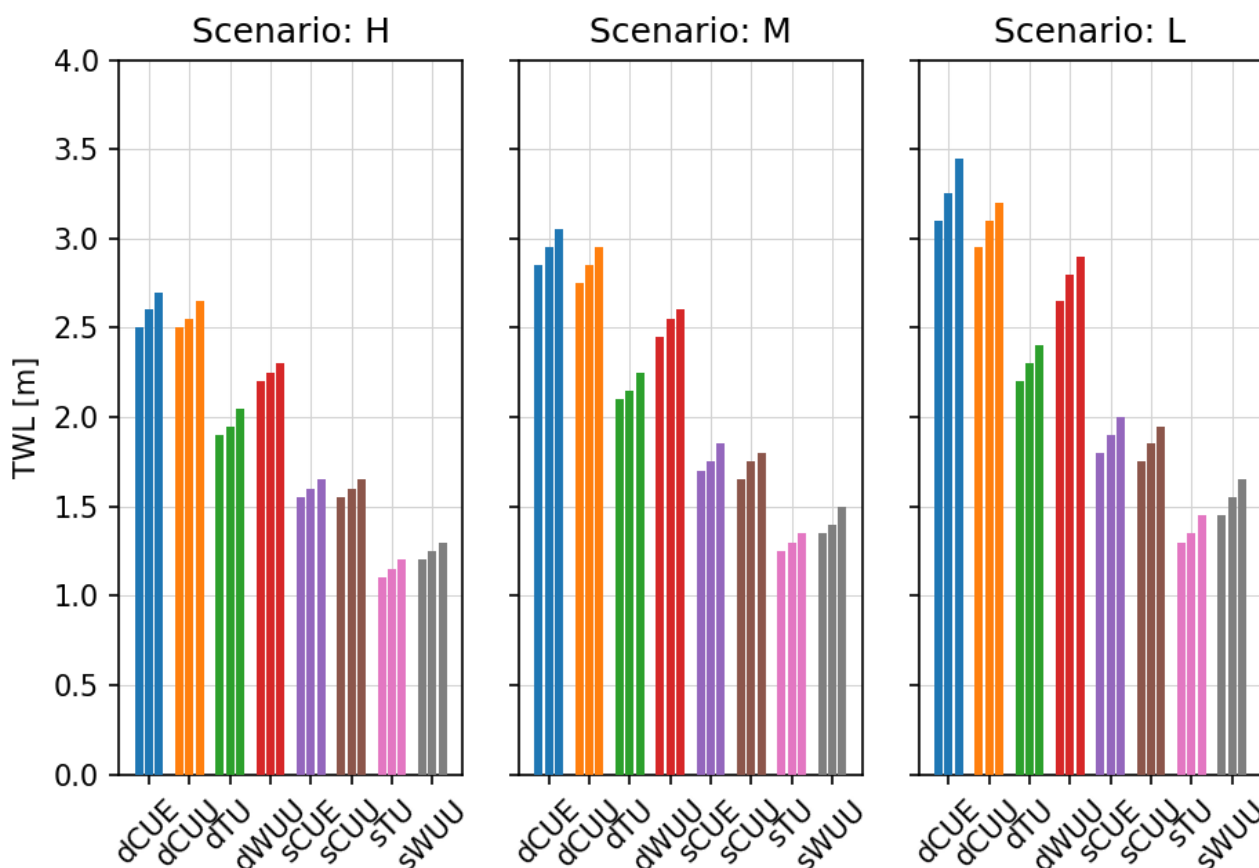


Figure 2 - Comparison of Total Water Level (TWL) values from the ADBPO 2023 dataset for high (H), medium (M), and low (L) scenarios across different calculation methods. Values shown represent the mean TWL for the sTU method (selected for use in this study), along with other available methods for reference. Previous work by Cabrita et al. (2024) for Lido di Volano found the sTU method to provide the most realistic representation for that location.

To notice that a correction of +0.35 m was applied to the whole dataset, since it was empirically determined this is the offset between the local vertical datum of the hindcast and the Italian vertical datum (Genova 1942). This offset was estimated by comparing the local tide gauge data (Porto Garibaldi, 44°40'36.0"N 12°14'58.0"E) to the model's values. For dates prior to 2016, an offset of +0.1231 m was applied, as indicated on the regional authority's website (<https://www.arpae.it/it/temi-ambientali/mare/dati-e-indicatori/rete-di-monitoraggio-meteo-marina>). The maps produced in this work are then compared with the



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regional inundation maps of 2020 (In_CoastFlood on the Regione Emilia-Romagna official website) produced using a GIS-based “bathtub” method with return periods of 10, 100, and 100+ years (ADBPO, 2020).

Table 2 – Metadata and Input datasets and sources used in the LISFLOOD-FP modelling framework (TWL dataset).

Type	Source	Link
TWL (elevation correction)	Porto Garibaldi - Tide Gauge	https://simc.arpae.it/dext3r/
TWL - ADBPO 2012	Reports	https://pianoalluvioni.adbpo.it/wp-content/uploads/2014/06/Allegato_6_4_RER-Costa.pdf
TWL - ADBPO 2023 - sTU (2% and 3 % of slope)	Duo et al. 2024 + 0.35 m	https://zenodo.org/records/11126671



Table 3 - Summary of the TWL values used for each scenario and return period. The original values of 2023 are corrected adding 0.35 m, to change the local zero of the model to the mean sea level.

Scenario Defined	Return Period (years)	Value (m) - No Slope info	Value (m) - 3% Slope	Value (m) - 2% Slope
TWL - ADBPO 2012	1	1.30	-	
	10	1.49		
	100	1.73		
TWL - sTU - ADBPO 2023 (corrected)	1-25	-	1.48	1.42
	50-100		1.61	1.55
	150-500		1.7	1.63

3.2. Triangular storms

Extreme scenarios were modelled as triangular-shaped storms (i.e. synthetic storms), following the methodology described in Cabrita et al. (2024). A synthetic storm is a simulation of water level changes during a storm event. It is represented by a gradual increase of water level in time from a starting value above MSL up to a chosen TWL maximum, followed by a symmetric decrease from the TWL to the starting level (Figure 3).



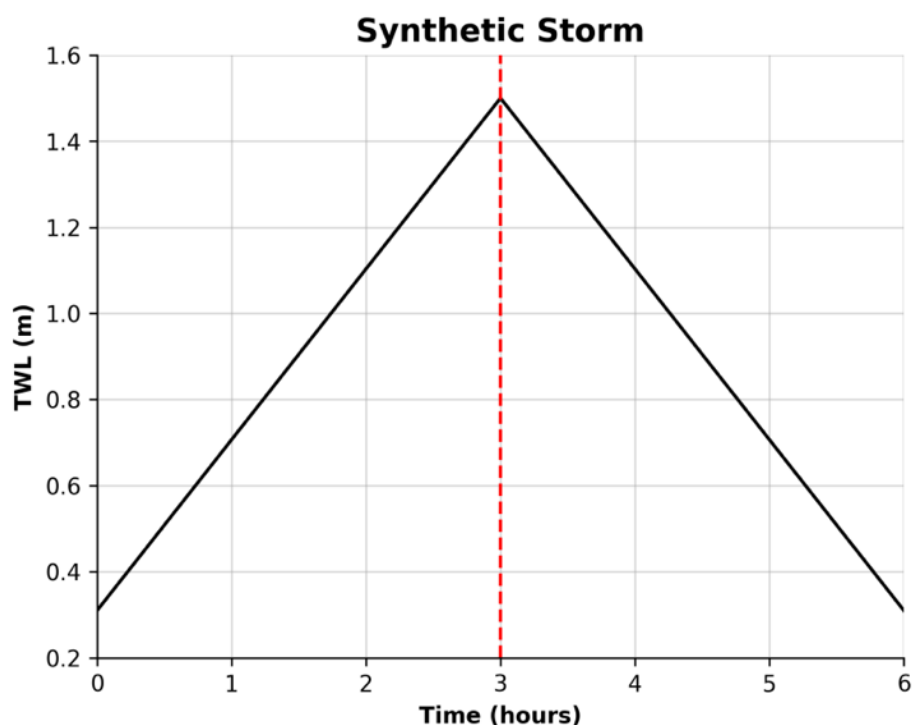


Figure 3. An example of a triangular-shaped storm used in this work. In the case of this work, the start and end values correspond to 0.3 m, which is the mean value of the tide time series obtained from pyTides2 (from Cabrita et al., 2024).

This approach can simplify mathematically the variation of TWL and can represent storm events. However, it is known to have limitations in reproducing complex coastal events (Duo et al., 2020). In fact, the water level during a storm does not change gradually and constantly in time but rather increases and decreases rapidly, alternating phases of flooding and non-flooding conditions. The storm duration chosen for this work was 6 hours for all return periods.

These synthetic storms begin and end at 0.3 m TWL, with a peak corresponding to the maximum TWL for each return period scenario. The ADBPO 2023 values were referenced to a 20 m water depth, consistent with the approach in Cabrita et al. (2024) and the data provided in Duo et al. (2024). This was indeed the innermost grid point in the dataset of waves and water levels produced by the reanalysis described above. Simulations were run for both 3% and 2% coastal slopes for estimations of wave set-up. Defining regional or local slope values more precisely could further improve dataset applications in future work.



Model outputs were saved at hourly intervals, and a fixed initial timestep of 10 seconds was applied. Surface roughness was represented using spatially variable Manning's coefficients derived from LU/LC Regione Emilia-Romagna classifications (see Section 2.1). A uniform infiltration rate of 1×10^{-6} m/s was applied across the domain, following the approach of Le Gal et al. (2023). Boundary conditions were imposed both temporally and spatially, the latter defined along the coastal contour line at approximately 0.3 m elevation. The model was executed with hazard and composite outputs enabled, and adaptive timestep control was disabled to ensure consistency and comparability across simulations.

4. Results

For each of the 8 sectors, flood maps were produced and provided in raster format (res.max) representing the maximum extension of the flood, for a total of 9 combinations, which include 3 return periods for the 2012 dataset and 6 for the 2023 dataset. A total of 72 products is available in the repository of the project. Data representing the sector's extension are provided as well in shapefile format. An example of the results from both dataset can be examined in figure 4. More inundation maps and inundated area values for each Sector and scenario are provided in Annex A (Table A1 and examples from 2023 TWL values with 3% slope are shown in Figures A1–A7), allowing direct visual comparison with the regional maps obtained with the GIS-based method (In_CoastFlood) in 2020.

It is important to note that only the 10-year and 100-year return periods from the 2012 ADBPO dataset can be compared with the In_CoastFlood maps, referred in the original nomenclature as P3 and P2 scenarios, respectively. P1 refers to the 100+ years return period; therefore, it is comparable with the dataset of 2023, which includes 150-500 return period storms, but not the 2012. However, the 2012 scenarios presented the highest TWL values among the datasets considered (1.73 m of TWL), representing the most conservative (extreme) predictions.

The comparison between the maps based on the dataset of 2012 and 2023 needs to be taken with caution since a direct comparison is not possible; 2012 scenarios are defined for return periods of 1, 10, and 100 years, whereas 2025 scenarios are grouped as 1–25, 50–100, and 150–500 years (see Figures 4 and A1–A7). However, a qualitative comparison still provides useful insight into how updated TWL estimates influence flood model outputs.



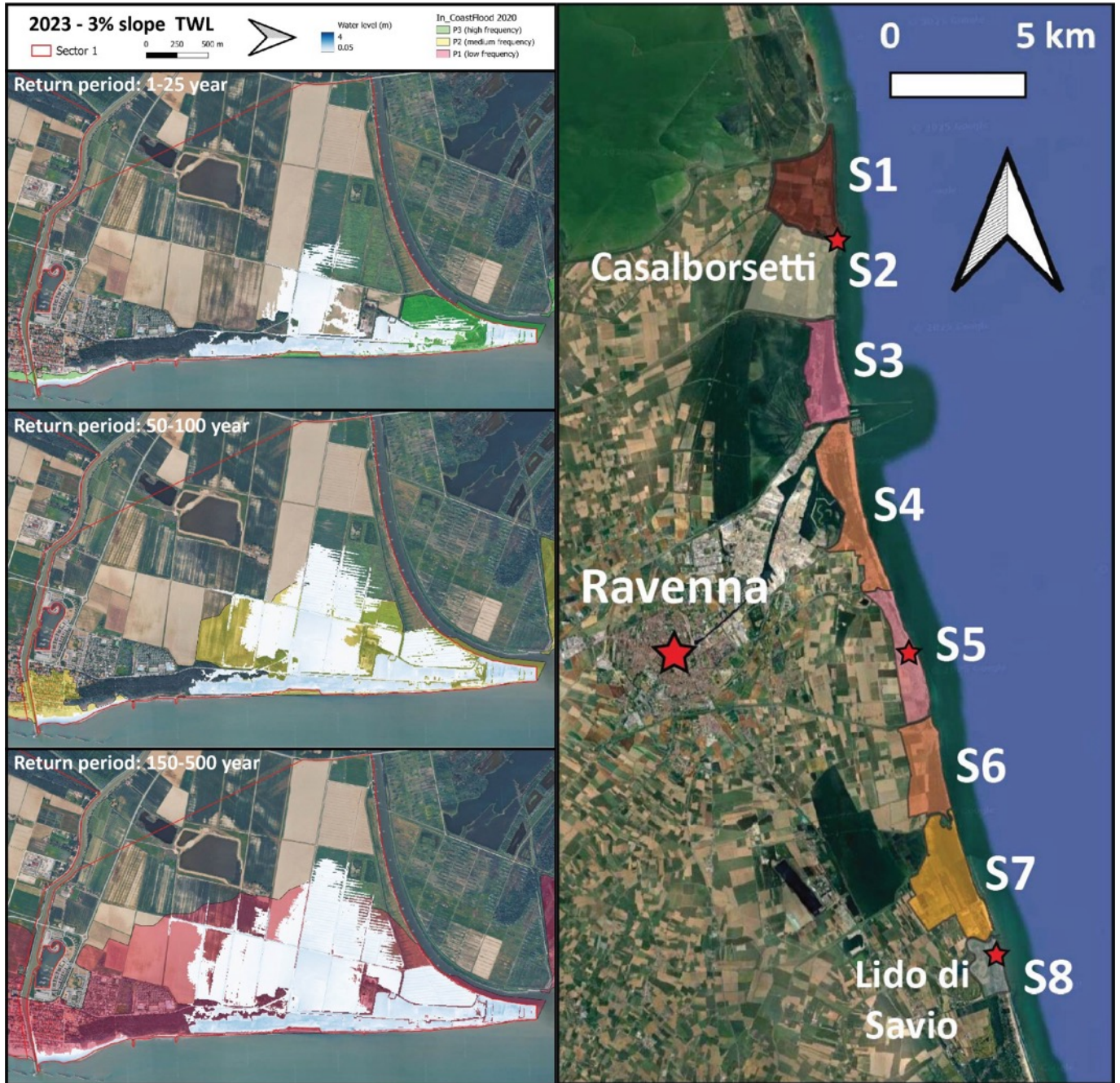


Figure 4 - Flood map of Sector 1 using the ADBPO 2023 scenarios with 3% slope.



5. Discussion

5.1. Flood extension

Before comparing the official regional maps of ADBPO and those developed in this study, it is important to note that the official maps were produced according to the three probability scenarios defined within the Floods Directive: i) high probability events (P3), typically associated with return periods of about 20–50 years; ii) medium probability events (P2), generally corresponding to return periods of about 100–200 years; and iii) low probability events (P1), representing rare events with return periods typically exceeding 200 years. These probability classes do not correspond directly to the return periods used to generate the scenarios in this study.

The In_CoastFlood maps tend to cover a larger extent compared to the LISFLOOD-FP results. Opposite conditions are found only in a few areas, mainly in Sectors 1 and partially in 3 (Figures 4 and A3). Sector 1 is characterised by natural landscapes, consisting of flat areas, such as agricultural fields, therefore with no sudden changes in slope. This condition can be easily represented by both methods (model vs bathtub), in fact the maps obtained with LISFLOOD-FP and the bathtub method cover similar areas. In the case of the northern side of Sector 3, the limit between the forest and the beach is never surpassed in both maps, probably due to the sufficient elevations of the area that does not allow the water to enter inland.

However, larger differences are visible in urbanised areas, where the In_CoastFlood maps consistently overestimated inundation compared to the LISFLOOD-FP maps. This difference is expected, since the In_CoastFlood maps do not consider physical processes such as surface roughness, drainage, and infiltration. LISFLOOD-FP calculates flooding based on the interconnectivity of areas with similar or lower elevation. In short, only areas with lower elevation and connected to portions where water is flowing can be inundated. Furthermore, if the water level is not sufficiently high to overcome the structure's elevation, water cannot flow further.

The most interesting aspect of the analysis is the identification of flood pathways, e.g. areas where water easily overcomes the elevation threshold of the structures, entering inland. Some urban areas, such as Sectors 4, 5, 7, and 8 (Figures A3, A4, A6, and A7), present clear pathways that allow storm events to largely extend the flooded area. The results show how



the variation of TWL highly affects the flood extension variation, probably due to the presence of urbanised corridors, low-friction zones, or direct hydrological connections with coastal areas. In the case of the 2012 dataset, when water is able to enter inland, in several cases its propagation reaches the maximum extension of the In_CoastFlood, therefore suggesting that water extension calculated by LISFLOOD-FP could reach similar extension of the regional flood maps, but only if the TWL can overcome the elevation threshold of the structures that prevent water to flood inland.

5.2. Limitations

It is important to consider the limitations of LISFLOOD-FP and how the model's parameters influence the flood extension. The TWL is the value that affects the flood pathways the most. In fact, flooding occurs only if the TWL overcomes pixel elevation in the coastal portions where high-rise elements may be present (e.g. dunes, walls, or other protection structures). However, the chosen duration of 6 hours for the synthetic storm implies some limitations and inaccuracies to consider. As the return period of the event increases, the duration should increase as well. Therefore, real storms with return periods of 10 years or higher should last for longer time spans, reaching 10, 20, or more hours. The TWL during a real storm does not usually surpass the threshold to flood continuously in time, which is one of the assumptions when using triangular synthetic events. The water level generally changes over time during the event not in a linear way, overcoming but also decreasing in time, leading to an alternation of flooding and non-flooding conditions. A triangular storm instead increases gradually until it reaches the maximum TWL established and decreases gradually as well. The threshold overpass is continuous, leading to a constant overflowing of the land that is not realistic. The 6 hours duration was chosen due to this strong limitation of LISFLOOD-FP, to avoid an overestimation of the flooded areas. Future analysis could consider using different durations to observe and estimate different flood extensions and possibilities.

Another important difference between a flood estimated by LISFLOOD-FP and a real case scenario is that LISFLOOD-FP does not consider the wave run-up. The run-up discontinuously increases the TWL in time, influencing the threshold overcoming and consequently the flood extension. Finally, it is important to mention that LISFLOOD-FP do not consider the effects of breakwaters or other structures offshore. In real storm events, structures can change the effects of run-up and, therefore, the TWL and flooding extension. To do so, a wave propagation across the structures would be needed using a 3-d model, largely increasing the workload which was out of the scope of the current project.



6. Conclusions

This study focuses on the production of coastal flood maps for the Ravenna Province (Emilia-Romagna, Italy) using physically based numerical modelling tools (LISFLOOD-FP) for coastal flood risk assessment. Synthetic scenarios based on ADBPO datasets for TWL (i.e. 2012 and 2023 datasets with 2 and 3% slope) allowed the production of a total of 9 combinations of flood maps, which represent 1, 10, and 100 return period storm events for the 2012 dataset, and 1-25, 50-100, and 150-500 return period storm event for 2023 for 2 and 3% slope. The Ravenna Province was divided into 8 Sectors, leading to the production of a total of 72 raster files (res.max) that can be found in the repository of the project. These flood maps were then compared with the GIS-based “bathtub” regional flood maps developed by ADBPO in 2020. The results indicate that the Flood Directive regional maps tend to overestimate inundation extents, particularly in urban areas where land cover, infrastructure, and micro-topography significantly influence flood propagation. In natural landscapes, the two methods produced similar flood extension, due to flat areas and similar water propagation. However, the greatest differences are found in urban areas, mostly due to the inability of the TWL to overcome the structures. Only where the flood paths are found, water could reach similar extensions to the regional flood maps of 2020.

The modelling framework developed here is reproducible, transparent, and adaptable to future applications, including climate change projections and real-time forecasting, using the maps in a look-up mode as done in the ECFAS project by Le Gal et al. (2023). It also identifies priority areas for intervention in the Ravenna province—specifically Sectors 4, 5, 7, and 8—based on hydraulic connectivity and vulnerability to inland flood propagation.

The outputs of this work directly support STRENGTH’s objective of providing decision-ready tools for coastal flood risk management in Emilia-Romagna.

All corresponding inundation maps and inundated area data are provided in the annexes for transparency and reproducibility. Annex A presents flood maps for the TWL calculated for 2023 with 3% slope. Annex B lists all simulation runs with their corresponding scenario definitions and parameters.



7. Recommendations and Future Work

Based on the obtained results and the developed modelling framework, the following recommendations are proposed to further enhance coastal flood risk assessment in the Emilia-Romagna region:

1. Coupling LISFLOOD-FP with a numerical model such as XBeach to represent barrier overtopping, run-up, and wave setup, particularly for areas fronted by coastal defences, to improve flood map's reliability.
2. It is important to consider that these are modelled scenarios. It is fundamental to validate simulated inundation extents using independent datasets such as satellite imagery, UAV surveys, or civil protection reports. While the November 2022 event was validated for Lido di Volano in Cabrita et al. (2024), local validation in Ravenna is essential to assess LISFLOOD-FP's performance under site-specific conditions.
3. To expand the modelling framework, it would be important to include river flood inputs and assess compound risk scenarios combining coastal and fluvial/pluvial sources. Future applications should also incorporate port areas, which were excluded here due to their complex hydrodynamics.
4. This study does not take into account future changes in Total Water Level conditions. Therefore, it is suggested to consider new scenarios based on sea-level rise projections and changes in extreme event statistics, in line with climate change scenarios for the region.
5. The spatial resolution of DTM inputs may be changed and increased in densely urbanised or narrow flood pathways to capture fine-scale infrastructure such as streets, drainage systems, and small protective barriers.
6. The breach of defensive structures is a type of condition that it is not covered in this study. It would be useful to make tests to evaluate flood extensions in these types of scenarios.



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9. Annex A — Inundation Results and Flood Maps

Annex A presents the complete set of flood maps and inundated area values for all simulated scenarios of 2012 and 2025. The results are organised by Sector (S1–S8) and by scenario, allowing direct visual and quantitative comparison between LISFLOOD-FP outputs and the regional In_CoastFlood flood maps.

Table A1 summarises the total inundated area for each Sector and scenario. The maps presented in this annex are numbered A1–A7 and refers to the inundation maps calculated based on the most updated values (TWL of 2023). The other maps developed based on the TWL of 2012 can be found in the repository.

Table A1 – Inundation area per Sector (m²) for ADBPO 2012 and 2025 scenarios based on TWL levels

Sector	ADBPO 2012			ADBPO 2025		
	H	M	L	H	M	L
1	425025	792000	1931525	516375	829575	1214000
2	57250	63050	70650	62825	67150	69150
3	137575	236000	313575	219275	270175	298750
4	198500	315300	765700	291350	490625	675975
5	175100	213800	303300	204275	232975	277800
6	129400	163650	247425	159975	197250	222350
7	179100	225025	333425	222450	255400	306475
8	61600	67300	170025	66100	100225	144675





Figure A1 - Flood map of Sector 2 using the ADBPO 2023 scenarios.



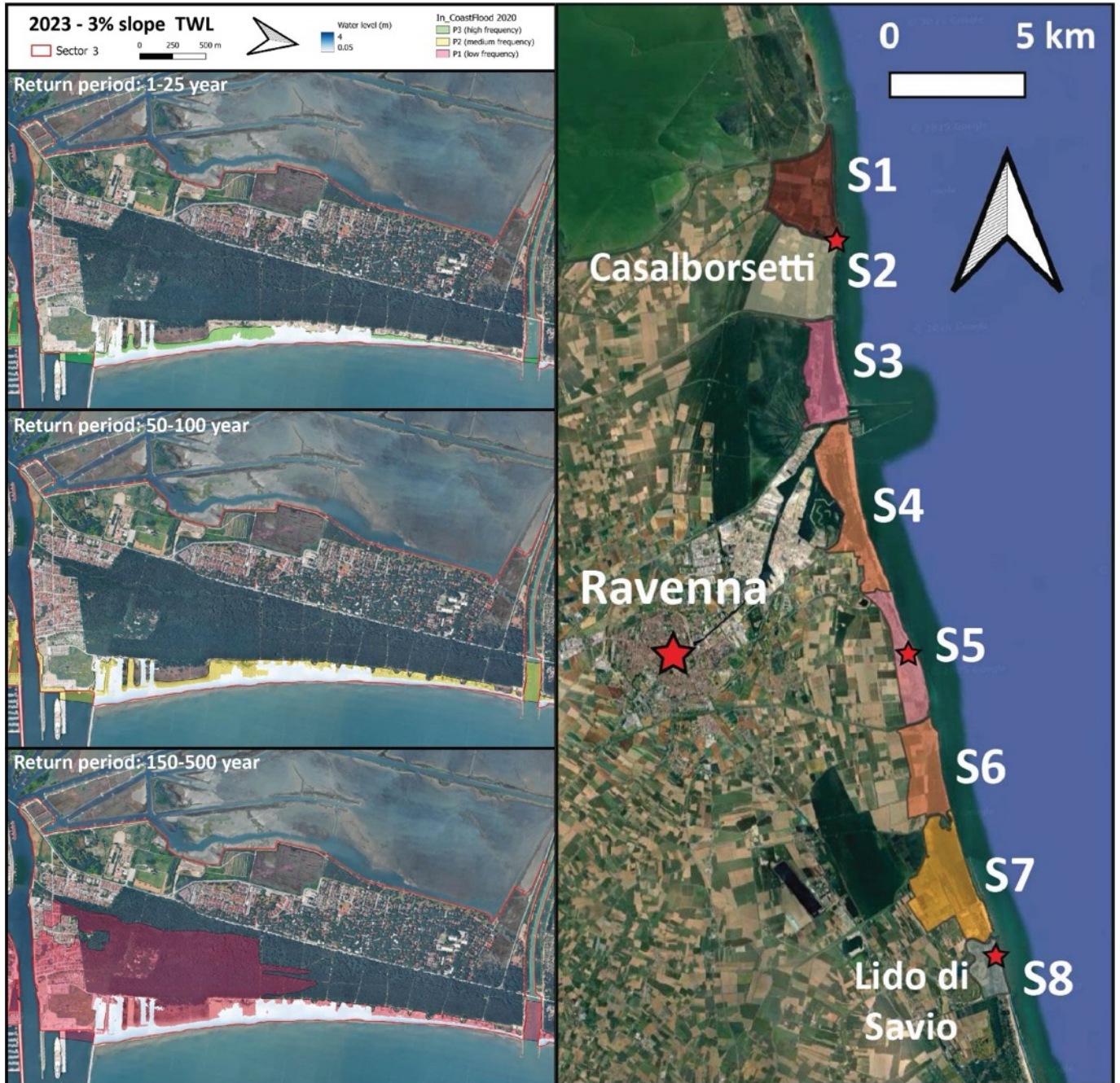


Figure A2 - Flood map of Sector 3 using the ADBPO 2023 scenarios.

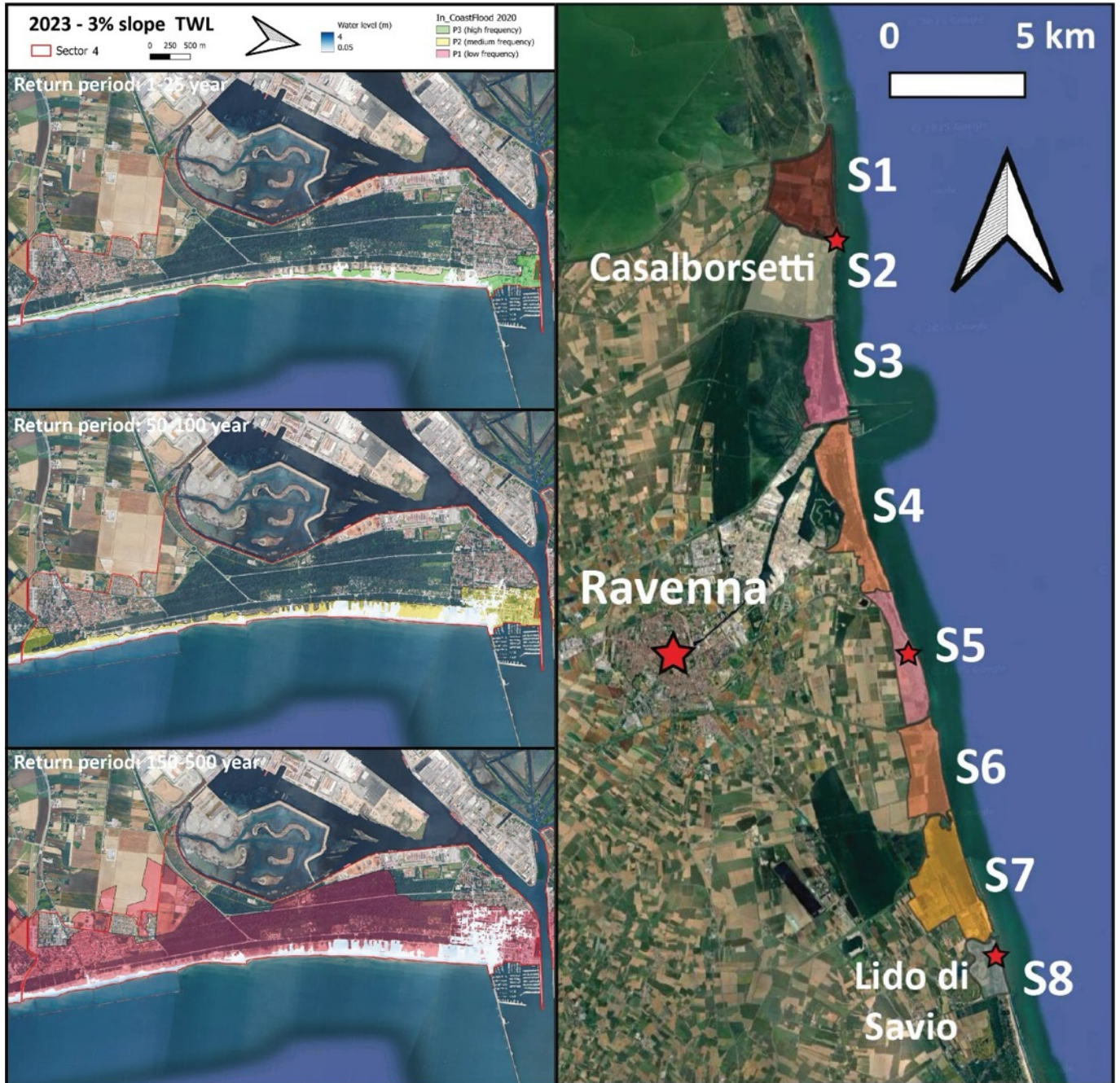


Figure A3 - Flood map of Sector 4 using the ADBPO 2023 scenarios.

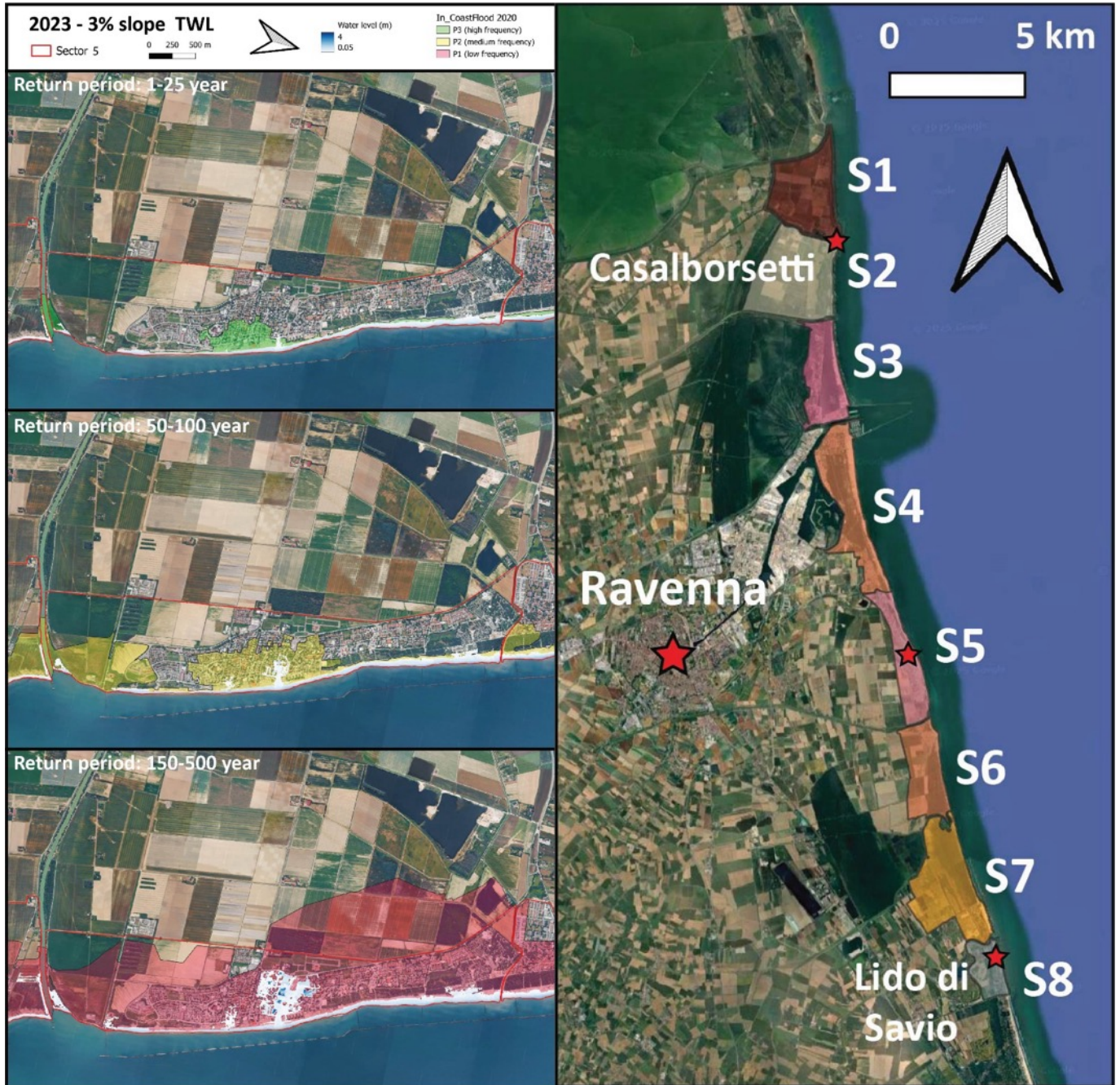


Figure A4 - Flood map of Sector 5 using the ADBPO 2023 scenarios.



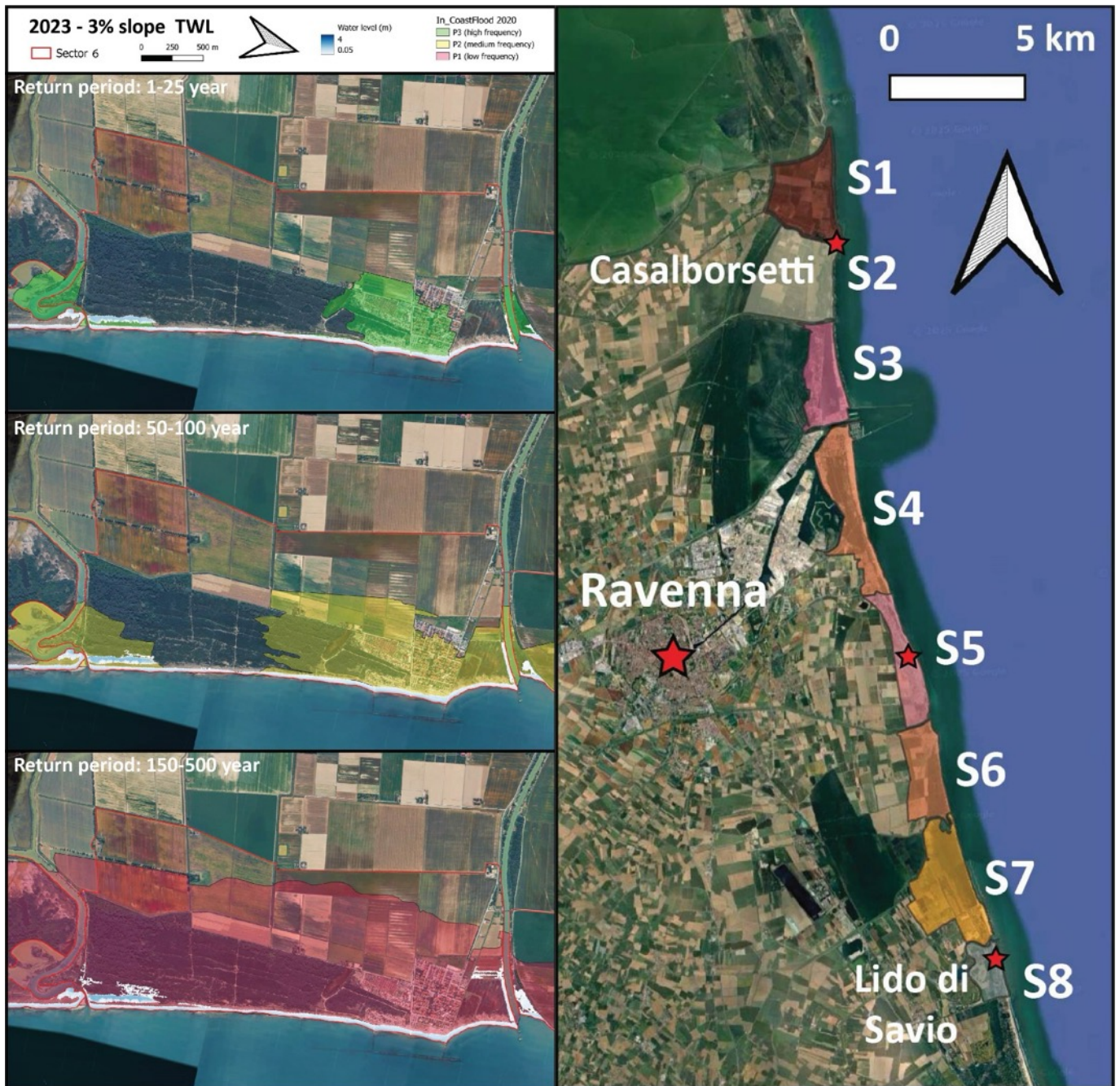


Figure A5 - Flood map of Sector 6 using the ADBPO 2023 scenarios.



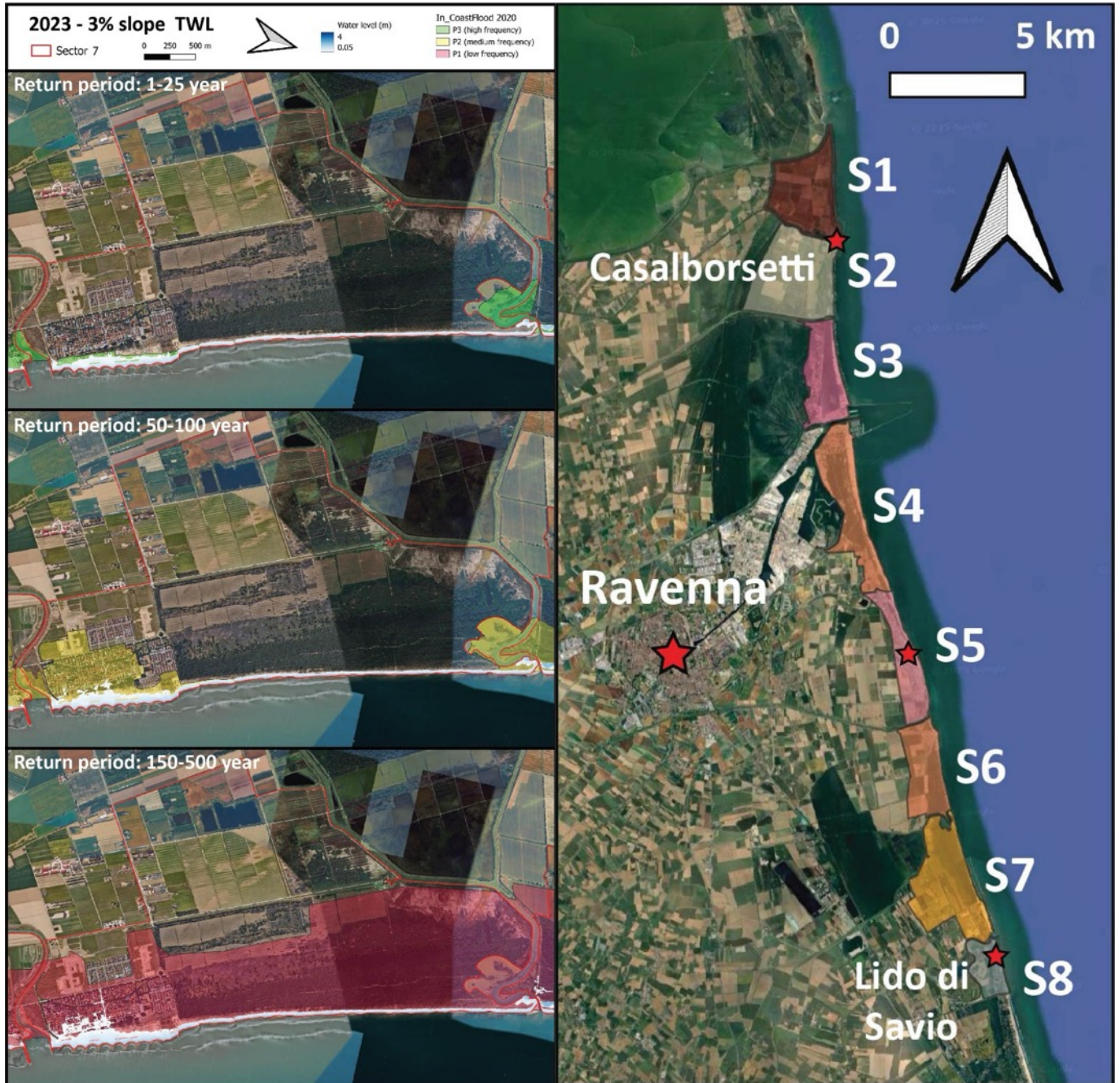


Figure A6 - Flood map of Sector 7 using the ADBPO 2023 scenarios.

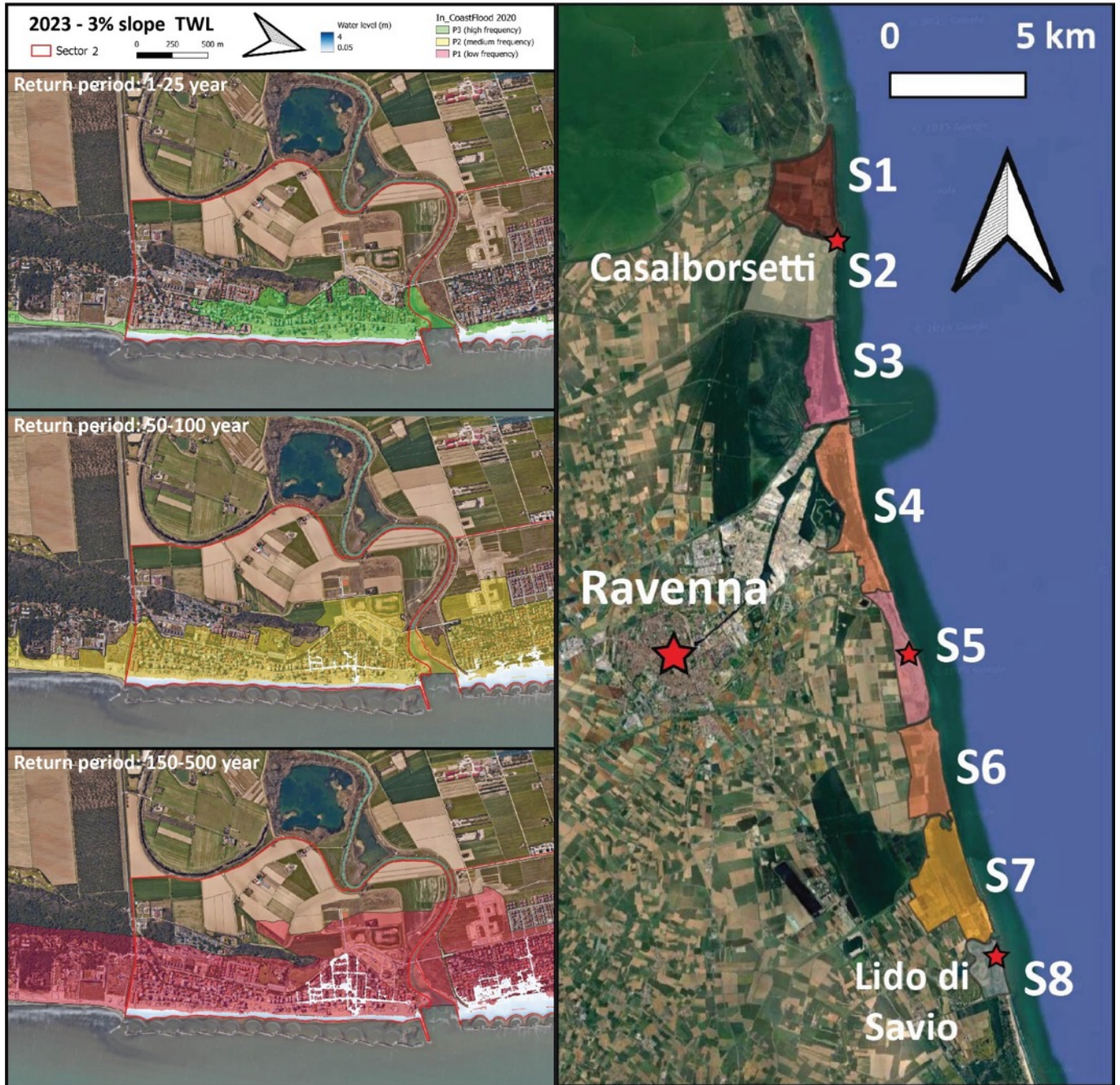


Figure A7 - Flood map of Sector 8 using the ADBPO 2023 scenarios.



10. Annex B — Run Catalogue and Scenario Parameters

Annex B lists all LISFLOOD-FP simulation runs carried out for this study, including the run number, associated scenario, TWL value, and slope assumption. This run catalogue is intended to facilitate cross-referencing between the numerical results, the maps presented in Annex A. It also serves as a reference for any future replication, modification, or extension of the simulations presented in this report.

Table B1 - The table lists all runs conducted for this study, including run number, associated scenario, return period range, TWL value, slope assumption (if applied), and source of data.

Run ID	Scenario	Slope (%)	TWL Peak (m)	Data Source
1003	T1 Scenario Regione		1.30	ADBPO 2012 - https://pianoalluvioni.adbpo.it/wp-content/uploads/2014/06/Allegato_6_4_RER-Costa.pdf
1005	T10 Scenario Regione		1.49	
1007	T100 Scenario Regione		1.73	
1016	TSU1 Scenario ADBPO	3.0	1.48	ADBPO 2023 (corrected) - https://zenodo.org/records/11126671



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1018	TSU10 Scenario ADBPO		1.61	
1020	TSU100 Scenario ADBPO		1.7	
1028	TSU1 Scenario ADBPO	2.0	1.42	
1030	TSU10 Scenario ADBPO		1.55	
1032	TSU100 Scenario ADBPO		1.63	

