A PROMPT INDEX FOR SEA STORM HAZARDS

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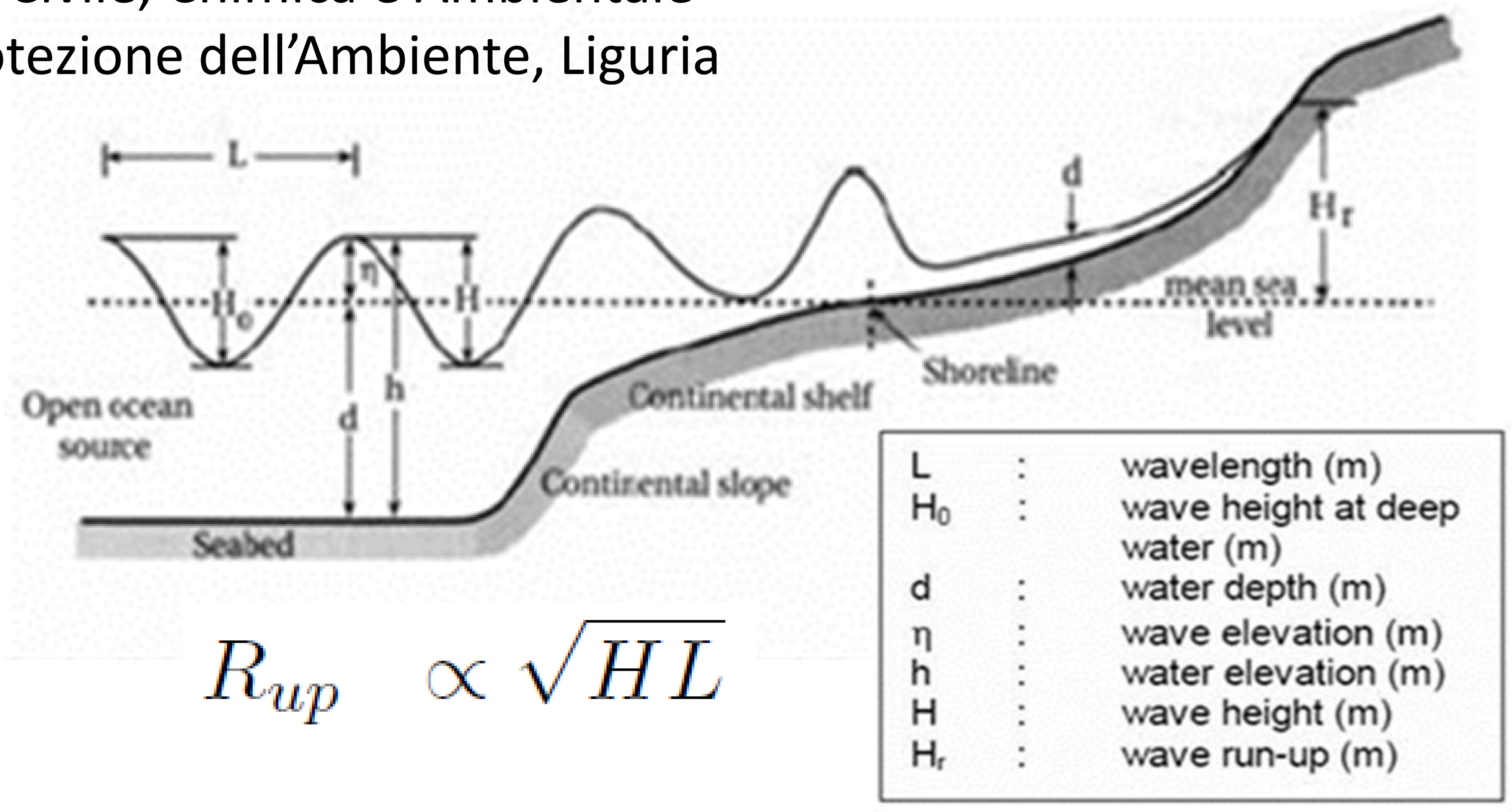
Abstract A quick and prompt procedure for coastal risk assessment during sea storms in the Northern Thyrrenian Sea is presented. Assessment of hazards for goods and people is evaluated on the basis of the potential run-up of sea waves along the coastline and on the basis of the persistence of storm conditions through the estimate of wave energy over a defined time window. The procedure has been developed fulfilling two main operating conditions: first it needs to have zero computational costs (i.e. no additional CPU time for the hazard index forecast computation) and secondly it should give clear and easily interpretable information to forecasters on duty who needs to issue official weather alerts. Validation and calibration of the hazard index (*HI*) has been performed through historical observations and data for different significant wave storms occurred in the Northern Thyrrenian basin.



$$R_{up} \propto \sqrt{HL}$$

Methods The level of hazard associated to the sea state has been expressed taking into account two different aspect of sea waves storms. The first one is related to the possible run-up over the emerged beach (proportional to the square root of wave height and wave length; Stockdon et al., 2006), while the second contribution is related to the persistency of storm conditions. This kind of effect has been taken into account through the estimate of the energy content *E* of the sea storm. Hence the hazard index *HI* results to be proportional to the former contributions, weighed between them with a linear expression.

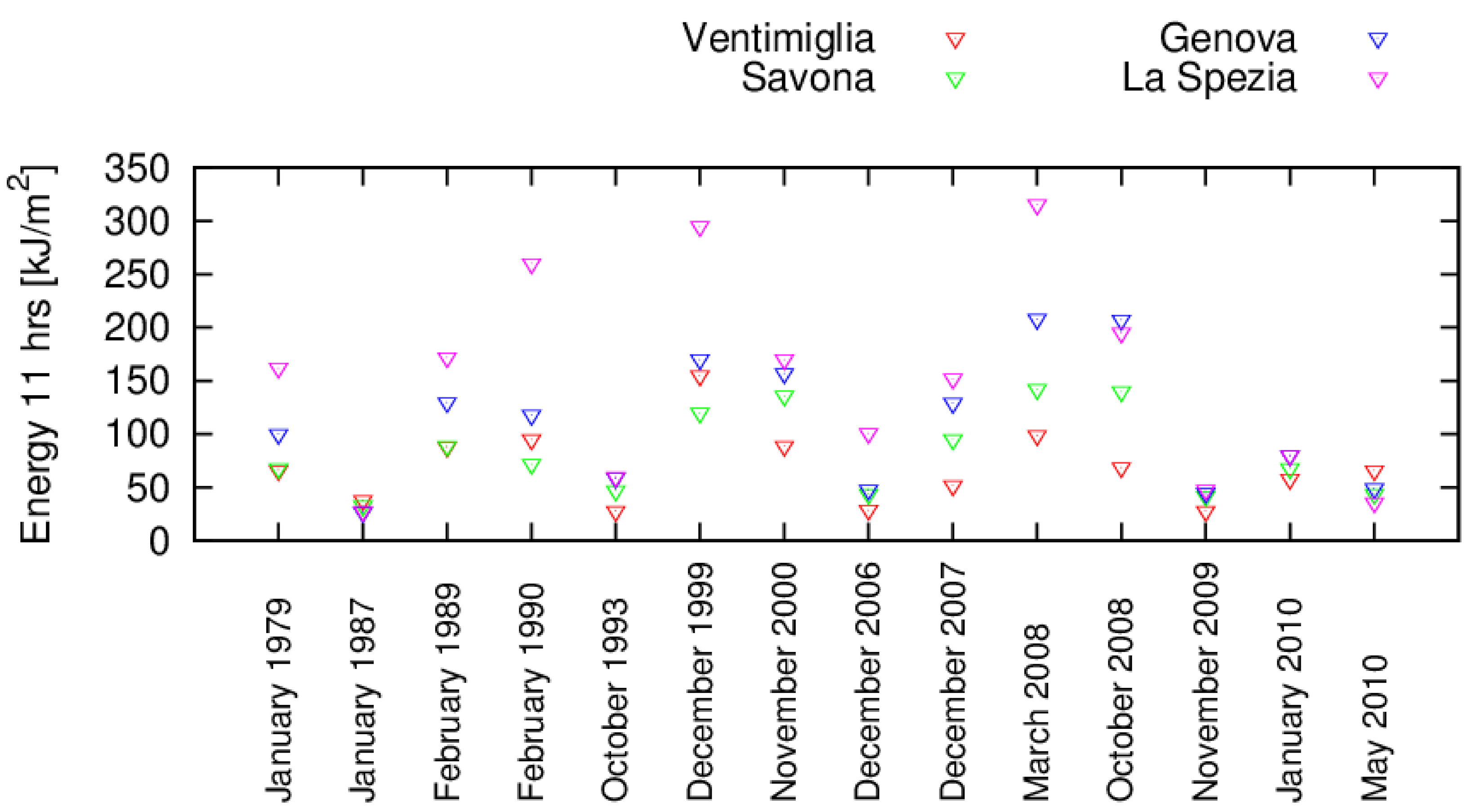
$$HI \propto \left(\sqrt{H\,L}, E\right)$$

$$HI = HI_w\,X + (1 - X)\,HI_E$$

The contribution related to the persistency of wave conditions (HI_E) has been evaluated through the computation of the energy content over a defined time window (we adopted three different time windows equals to 3, 5 and 11 hours)

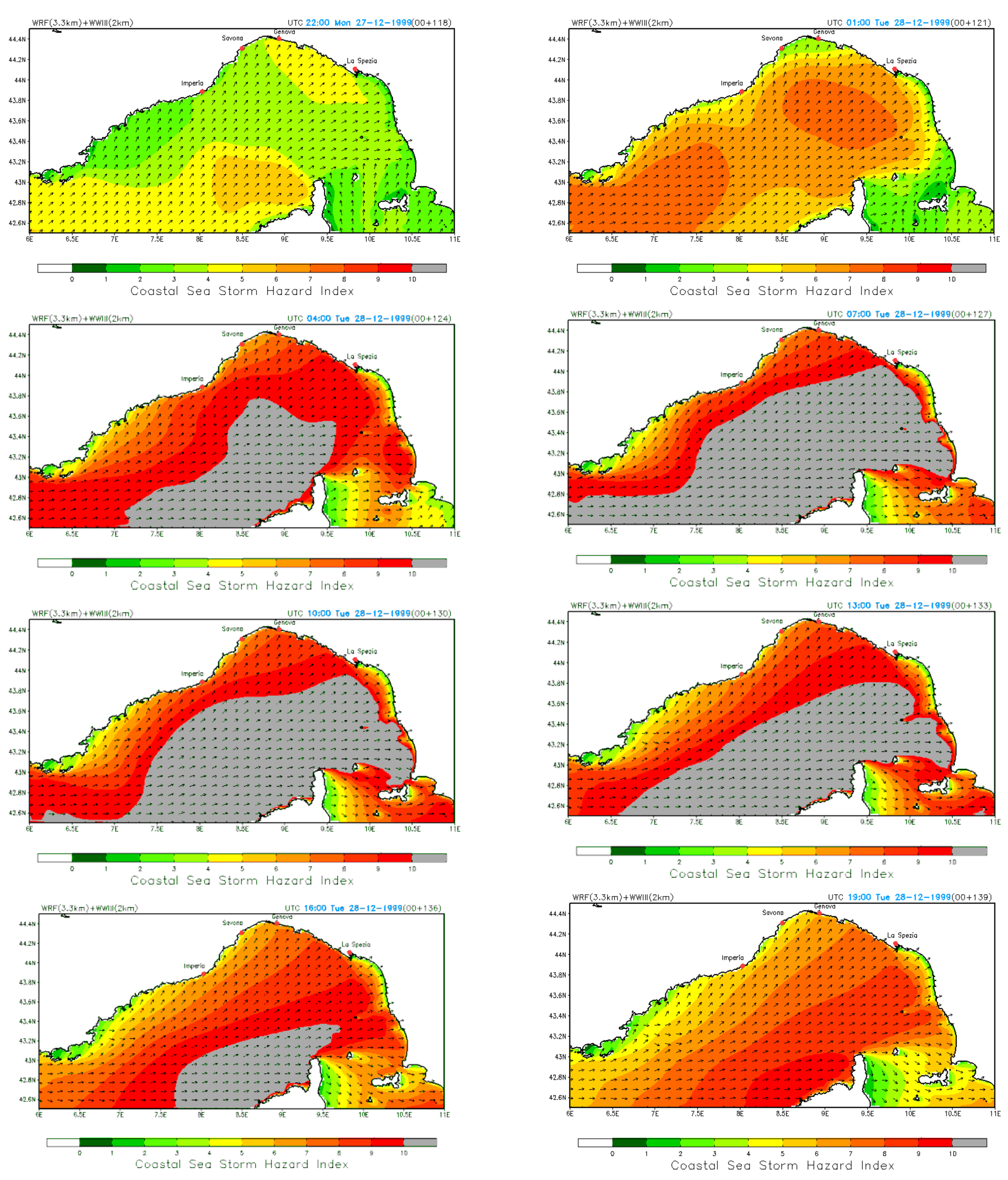
$$HI_w = \sqrt{H\,L}\frac{10}{\sqrt{H_{max}\,L_{max}}}$$

$$HI_E = 10\left(1 - \frac{E_{max} - E}{E_{max}}\right)$$



Values of H_{max}, L_{max}, E_{max} and X have been estimated and calibrated through a detailed comparison between model results and historical records of significant storms in the Northern Thyrrenian Sea

28 December 1999 Storm



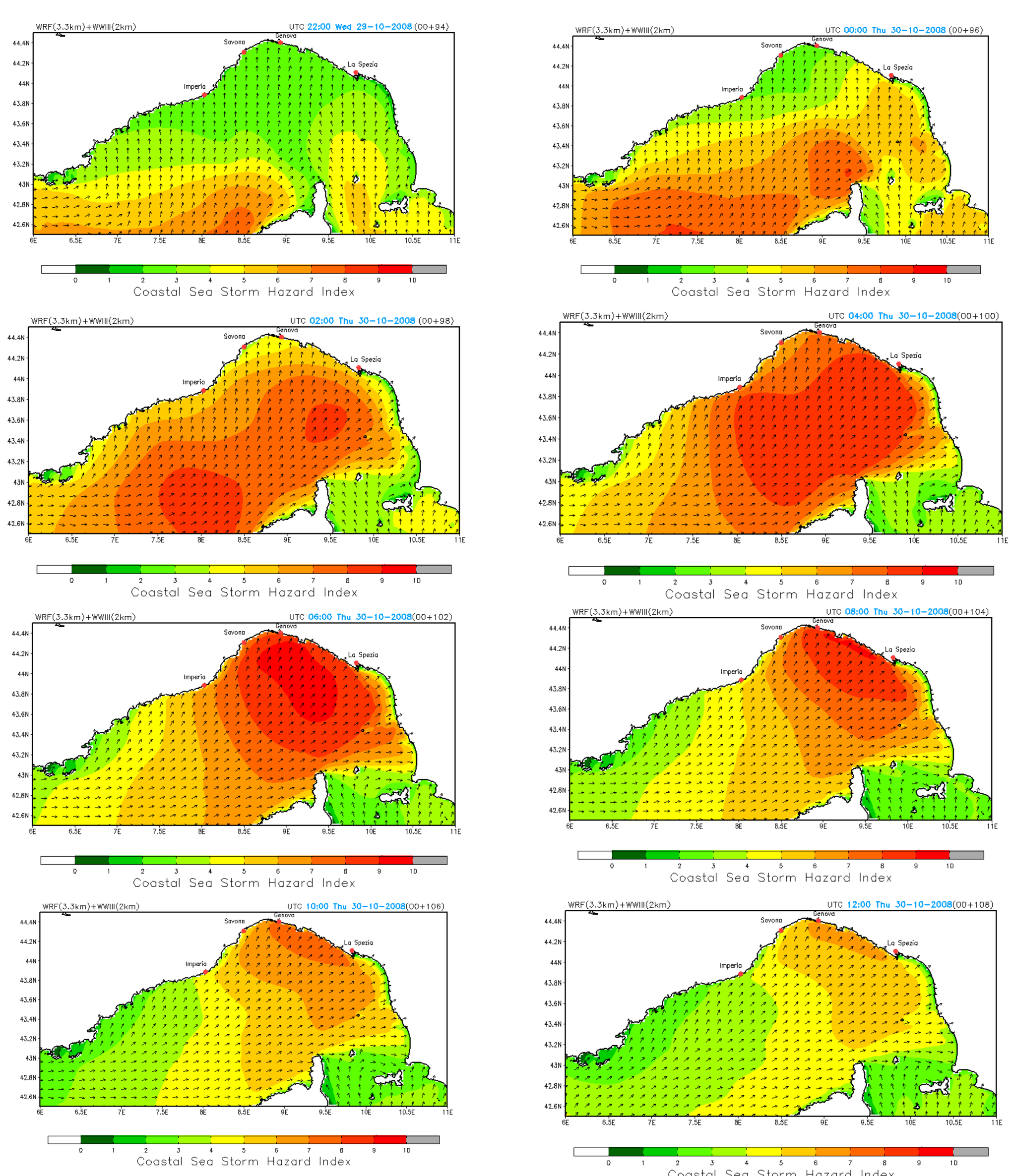
The storm of 28 December 1999 has been caused by the occurrence of the bigger storm "Lothar" in the northern Europe. A strong gradient in the western Mediterranean was present just on the day of 27 December (with rough sea conditions, H_s=3 m and period=7 s registered by the buoy Coté d'Azur). Strong south-westerly strong winds occurred with a fetch at least a hundred miles involving a consequent rapid increase in the waves of the Gulf up to very rough sea conditions in west coast of Liguria (H_s=4.5 m and T_p=9 sec registered by the buoys Coté d'Azur) and storms more intense on the Western Ligurian coast.

The biggest harms have been recorded especially in the eastern part of the Ligurian coast with the major damages and losses comprised between Sestri Levante and La Spezia. Hazard Index reveals how the biggest values are reported especially in the eastern Ligurian coast with the bigger intensity in the area to the east of Promontory of Portofino in good agreement with the damages records.

The present work is dedicated to the memory of Stefano Gallino, colleague and friend

HI Forecast @5 days

30 October 2008 Storm



The sea storm was created by at o short fetch of Libeccio (of about 100 miles) for a period of 18-24 hours (from 12 UTC on the day before), characterized by strong south-westerly flow near the central part of the Gulf of Genoa. Waves reached up to 7-8 meters as measured from the La Spezia RON buoy. SSW winds of 90 km/h (50 knots) were recorded and waves of about 7-8 meters on the coast of Genoa where estimated by photos of waves.

The biggest damages have been reported only in the area concerning Genoa and its neighborhood: the airport has been closed due to the overtopping of waves through the breakwater, an offshore platform employed for the discharge of crude oil in front of the airport breakwater has been damaged and up to today is still non operative, the fast ferry GNV Fantastic almost overturned during the maneuver of approach into Genoa harbor. Along the eastern coast of Genoa province different damages to coastal structures and infrastructures have been reported. Out from Genoa province there have been no records of damages or losses related to the sea storm. Hazard Index is able to predict the concentration of risk and hence damages in the Genoa Province, presenting moderate values for the rest of the coast.