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Synergistic Severe Weather Monitoring over the Greek Seas

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Throughout the year, but especially during the summer/fall months, marine thunderstorms appear on a frequent basis with devastating results over near-by coastal areas as well as on small-to-medium sized marine traffic. Their main differentiation from severe weather of continental origin is a) the pronounced influence from differential heating (sea/land transition) usually enhanced by complex coastlines, b) the diurnal character of local low level circulation (e.g. sea breeze, coastally trapped winds etc.) that potentially attributes to the storm evolution a unique local character c) the sporadic "ground" related observations, all facts contributing to their challenging numerical nowcasting.
The close collaboration between the Hellenic Center for Marine Research (HCMR), the National Hellenic Meteorological Service (HNMS), the National Observatory of Athens (NOA) and the Universities of Athens and Ioannina has envisioned a bottom-up research initiative, comprising of a) synergistic real-time ground and space based observations of direct or proxy convective/severe weather parameters b) customized numerical models that allow
The main components of the featured monitoring network are highlighted as follows:
The HNMS ground observational network comprising of more than 30 coastal sites of continuous monitoring of key meteorological parameters. The network has archived data since
Eight Doppler C-band weather radars (of which 2 with polarimetric capabilities and noise ratio -32db) maintained and operated by the HNMS, covering the western Aegean and eastern Ionian Seas. The radar network has become operational since mid-2008 and since then it has observed several types of intense marine thunderstorms (e.g. from organized mesoscale, to local convective cells, water spouts and tornadic events).
The NOA owns a high-resolution mobile X-band polarimetric weather radar (XPOL) and a 2D-video disdrometer (2DVD). The XPOL is permanent deployed at NOA's site on the Penteli's hill 500 meters above the sea and 35 km northeast from the HCMR. The 2DVD has been installed at the HCMR's roof since 2007 and it is used as the ground validation of the XPOL.
Five X-band wave radars maintained and operated by HCMR. Their operational use varies from 0.5 to 5 nautical miles away from the coast. The retrieved parameters among others include maximum and significant wave height, direction. Based on the same algorithm, surface wind magnitude and direction can be also retrieved.
HCMR has deployed two Passive Acoustic Listeners (PAL), at two Poseidon Buoys. The sensor comprising of a sensitive omni-directional hydrophone, a microprocessor and a battery pack. Experimental research on the PAL includes surface wind and precipitation retrieval directly over areas where the PAL is moored. The distinct advantage that PAL offers is the continuous measurements where any type of observation is absent.
The Lightning Detection Network maintained and operated by HNMS since early 2008. Both cloud and cloud-to-ground lightning discharges are recorded at an approximate 95% detection efficiency over a 250 m accuracy (tech specifications). The network consists of 8 VLF-VHF receivers covering the entire Greek peninsula and surrounding waters. Ongoing collaboration with HCMR is based on the evaluation of the network synergistically with satellite information in terms of the early convective initiation and nowcasting.
The Poseidon Buoy network has been maintained and operated by HCMR since late 1999. The only buoy network monitoring oceanographic and meteorological parameters over the eastern Mediterranean comprising of (presently) 10 buoys. In addition, the Poseidon forecasting system incorporates models of ocean circulation, waves and weather numerical forecasting. Besides the 10 years of archived data, the Poseidon database has been employed in latent/sensible heat fluxes re-analysis estimation specifically customized for the Greek Seas.
An open-ended (user input) database (operational since 2009) archiving extreme events are feeding an extensive database (more than 100 years) of tornados, waterspouts, funnel clouds and dust devils, maintained and operated by the University of Athens (Laboratory of Climatology and Atmospheric Environment). Additional tasks targeting such phenomena are also investigated via satellite remote sensing and hi-resolution numerical simulations in order to establish an early warning system for atmospheric natural hazards.