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Statistical evaluation of a mesoscale data assimilation system over Greece

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Numerical weather prediction is considered as an initial/boundary value problem: given an estimate of the present state of the atmosphere (initial conditions), and appropriate surface and lateral boundary conditions, an atmospheric model is able to simulate the future state of the atmosphere. Therefore, the more accurate the estimate of the initial conditions, the better the quality of the forecasts. Advanced data assimilation systems have been developed in order to construct analysis fields on high spatial and temporal resolution and minimize the initialization errors in atmospheric modelling. Such systems combine coarse gridded data (as background fields) with regional surface and upper air observations for producing real-time objective analyses.
Local Analysis and Prediction System (LAPS) is a mesoscale meteorological data assimilation tool that utilizes a suite of observations (e.g. surface meteorological stations, radar, satellite, soundings, and aircraft) to generate a spatially distributed, time-evolving, three-dimensional representation of atmospheric patterns and processes. LAPS can be used standalone as an advanced nowcasting system and it can also serve as a procedure to initialize local-to-mesoscale limited area atmospheric models.
In this study a number of independent observations were employed in order to assess the LAPS analysis performance during two consecutive years (1 January 2008-31 December 2009). The system is operated at the Hellenic Centre for Marine Research and it has been appropriately configured to provide the initial conditions to the mesoscale atmospheric model of the POSEIDON system. LAPS surface state variables such as mean sea level pressure, wind speed, relative humidity and temperature were evaluated against independent surface observations provided by a dense network of surface stations operated by the National Observatory of Athens over Greece. A quality control procedure has been applied to remove erroneous measurements, based on checking the physical range of each parameter being verified, the allowable rate of change in time and the stationarity. The evaluation methodology was based on the point-to-point comparison between the LAPS-generated variables and the independent surface observations that were not assimilated in LAPS. For this purpose a new developed statistical package has been implemented to identify the nature and the spatiotemporal variability of the systematic and stochastic errors in LAPS analyses.