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Cyclone tracking in the Mediterranean region using a multi-variable ensemble technique

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Several methods exist for objective cyclone identification and tracking, however, there is no commonly accepted optimal method. The methods differ in their basic approaches (e.g., Eulerian or Lagrangian), in the selection of variables and other elements. This high level of complexity causes uncertainty of the results if using only one particular method.
In our work we selected the Lagrangian approach to analyse mid-latitude cyclones in the Mediterranean region. Both uni- and bivariate methods were applied using several different variables. Instead of the difficult decision to identify the one and only ideal method using a specific meteorological variable, reasonable variants were all analysed at once forming an ensemble. Moreover, this multi-variable ensemble can be used to assess the uncertainty originating from the selection of a specific variable. The applied uni- or bivariate methods identify extremes in one or two meteorological fields, respectively. One of the fields is selected among three commonly used variables, namely, mean sea level pressure (MSLP), geopotential height at 1000 hPa and at 850 hPa isobaric level. In case of bivariate methods, the second field is always the relative vorticity field at 850 hPa isobaric level. Thus, the multi-variable ensemble contains six members resulting in six different cyclone time series.
For this cyclone identification the required meteorological fields are derived for the Mediterranean region (covering the area of 29.25°-55.5°N, 11.25°W-42.75°E) from the ERA Interim reanalysis at 0.75° horizontal resolution using the 1981-2010 period.
The outcomes of the six different cyclone tracking methods are analysed together. The numbers of cyclones are evaluated on seasonal and annual scales. Cyclone track and genesis density distributions as well, as significant trend coefficients are mapped for the whole Mediterranean domain.