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Development and evaluation of a scheme to identify cold fronts in the Mediterranean region on a climatological basis

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Cold fronts in the Mediterranean are significant components of weather and climate being frequently associated with intense weather phenomena. Climatological studies focusing on the Mediterranean fronts are relatively few and based on subjective approaches. Since the Mediterranean Sea is a closed basin with complex topography, the fronts exhibit smaller spatial and time scales, and often a complicated evolution regarding their kinematic and thermodynamic features from their formation until their dissipation, as compared to the fronts over oceans.

The objective of this study is to present an algorithm for the identification of cold frontal systems in the Mediterranean basin and to evaluate the results against operational charts and satellite images for specific high impact cases. The basis of this algorithm is the University of Melbourne state-of-the-art frontal tracking scheme FTS (Simmonds et al. 2012), modified appropriately to adapt to the distinct characteristics of the Mediterranean.

Using the ERA-Interim wind data, the wind velocity changes at the surface are studied at time intervals of 6 hours. A front is identified if an adequate wind shift from the southwest to the northwest is observed. In particular, the following criteria are employed to identify a front: (a) the zonal component u is positive (from the west) both at t and t+6h, (b) the meridional wind component v changes sign from positive to negative (i.e. from the south to the north), (c) the magnitude of change in the v component (δv) is above a specific threshold, or both the direction shift of the wind ($\delta\phi$) and the magnitude of the total wind |U| are above specific thresholds. Sensitivity tests are performed employing combination of the above mentioned criteria.

The results show that the algorithm performs better when the criteria of $\delta\phi$ and |U| are combined with specific threshold values revealing interesting frontal features. It is suggested that additional criteria referring to vertical temperature gradient should be incorporated in the algorithm in order to improve its efficiency in capturing Mediterranean cold fronts.

Simmonds, I., K. Keay, and J.A.T. Bye, 2012: Identification and climatology of southern hemisphere mobile fronts in a modern reanalysis. J. Climate, 25, 1945-1962