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Climatology of severe convective storm environments from ERA-interim

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1. Introduction

Creating reasonably accurate climatologies of severe convective storms is challenging. They are relatively small-scale events and rare at any particular location. Their reporting is contingent on the presence of an observer or an observation system available at their location. Reporting processes and population biases are concerns for report-based climatologies (Doswell and Burgess 1988; Brooks and Doswell 2001, 2002; Verbout et al. 2006; Doswell 2007).

There is a significant similarity between distribution of observed severe convective storms and storm environmental parameters (e.g., Brooks et al. 2003; Romero et al. 2007; Gensini and Ashley 2011). This paper introduces a climatology of severe convective storm environments for a domain covering Europe, Middle East and North Africa for the 35-year period of 1979–2014 from ERA-interim (Dee et al. 2011). Section 2 presents data and methods for this climatology. Selected storm-related environmental parameters are also designated in this section. Current results are given in Section 3, as well as http://web.itu.edu.tr/~tanriovers/. Finally, Section 4 concludes this paper.

2. Data and Methods

To establish the climatology of severe convective environments for the 35-y period, ECMWF Era-Interim data interpolated on a limited area domain under a Lambert conformal map projection. Era-Interim data has 0.75° horizontal grid spacing (approximately 80 km), 28 vertical levels, consisting of 1 surface level and 27 pressure levels from 1000 hPa to 100 hPa and available with 6 hours interval (00 UTC, 06 UTC, 12 UTC, 18 UTC) since 1979.

Specifically, the climatology consists of surface-based convective available potential energy (SBCAPE), mixed-layer (lowest 500 m) convective available potential energy (MLCAPE), most unstable convective available potential energy (MUCAPE), surface-based convective inhibition energy (SBCIN), mixed-layer (lowest 500 m) convective inhibition energy (MLCIN), most unstable convective inhibition energy (MUCIN), surface-based lifting condensation level (SBLCL), mixed-layer (lowest 500 m) lifting condensation level (MLLCL), 0–6-km wind shear, 0–3-km wind shear, 0–1-km wind shear, and mid-tropospheric (700–500-hPa) lapse rate (LR7050). These parameters were calculated on each grid point of the domain for whole period for 12 UTC. After calculation of these environmental parameters, averages for each month were calculated for each year and then for long-term. For CAPE calculations, a fortran code by George Bryan is wrapped into NCL (NCAR 2015), with mixed layer depth modification to 500 m (The code is available at http://www2.mmm.ucar.edu/people/bryan/Code/getcape.F). For shear calculations, horizontal wind components at specific height levels are calculated with linear interpolation between the pressure levels above and below the level.

3. Results

Long-term monthly means show that, in the cold season, there is only small amount of SBCAPE over the Mediterranean Sea and Atlantic Ocean, whereas there is no SBCAPE over Europe, Turkey and Arabian Peninsula in general. Abundant SBCAPE is available over the ITCZ region and Red Sea, even in the cold season. In early spring, SBCAPE becomes much more widespread around the Mediterranean coasts, southern Europe and interior Turkey. Highest European average SBCAPE values occur on June, July and August over Iberian Peninsula, Italy and Balkans. Maximum average SBCAPE values exceed only 100 J kg^{-1} over some regions of the Scandinavian Peninsula and UK and 200 J kg^{-1} around the Baltic coasts. With the strengthening of the jet stream during winter, the highest average 0–6-km wind shear values occur beneath the jet regions. Overlapping of ingredients seems most probable during spring over a zonal belt including southern Europe, northern Africa and Turkey. Another finding is large 0–1-km wind shear values over the Arabian Sea and Somalia from June to September, related to the Somalia low-level jet. This region is notable considering the extreme SBCAPE values available at that time of the year together with these large wind-shear values.

4. Conclusions

Convective storm related environmental parameters, namely SBCAPE, MLCAPE, MUCAPE, SBCIN, MLCIN, MUCIN, SBLCL, MLLCL, 0–6-km wind shear, 0–3-km wind shear, 0–1-km wind shear and LR7050 were calculated on each grid point of a domain covering Europe, Middle East and North Africa for 1979–2014 from ERA-interim 12 UTC data. Long-term monthly mean maps have been created and are available at http://web.itu.edu.tr/~tanriovers/. Statistical analysis is still continuing. Calculations of the number of days with SBCAPE over particular thresholds are in progress. An enquiry into the variability of the ranges for each parameter is also planned.

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