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Anomalies in the surface water and energy balance: An application to the analysis of European droughts

E. Dutra (1), P. Viterbo (1,2), P. M. A. Miranda (1)

(1) CGUL, IDL, University of Lisbon(endutra@gmail.com), (2) Instituto de Meteorologia, Lisbon

ERA-40 precipitation, downwelling radiation and near-surface meteorology were used to force the land-surface model TESSEL for the period 1958-2001 over Europe. Monthly averaged hydrological and radiative surface fluxes were used to investigate some aspects of the surface water and energy balance anomalies, and their relations with drought during this period. Anomalies were studied for four different indicators: i) accumulated precipitation; ii) ratio of evaporation over precipitation minus runoff; iii) evaporative fraction; and iv) total depth soil moisture. Drought summers were defined when at least twenty percent of Europe was under a certain threshold. The thresholds chosen led to the identification of at least ten drought summers for each anomaly indicator. The combination of indicators led to the identification of four drought summers present in the four analyzed anomalies: 1959, 1976, 1990 and 1994. The thresholds were established empirically; however, the minimum spatial coverage requirement and coherency in the identified summers indicate a robust classification. Drought summers were characterized by the affected area and spatial extension; the variety of indicators illustrates hydrological, meteorological and agricultural aspects of drought. Preceding seasons to each dry summer were also analyzed to assess the temporal evolution and possible precursors of summer anomalies. Various atmospherics variables were analyzed for each drought summer, allowing the characterization the predominant patterns of large-scale circulation associated with the surface water and energy balance anomalies.

A better understanding of past droughts mechanisms and characteristics is a key factor in assessing future impacts of climate change.