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Variability of the moisture sources around the Mediterranean Basin during 1980-2000

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Understanding of the hydrological cycle and its development over time is one of the most important topics for the climatologist during the last decades. The hydrological cycle can essentially be summarised to be the evaporation of moisture in one location, offset by precipitation elsewhere. The rate of evaporation exceeds the rate of precipitation over the oceans, which are therefore a net source of moisture; this moisture is then transported to the land masses, which are a net sink for moisture, where precipitation exceeds evapotranspiration. It is now commonly accepted that the precipitation that falls in a region has one of the following origins: 1) moisture already in the atmosphere, 2) moisture transported into the region from remote sources by wind (advection) or, 3) recycling, local evaporation from the earth's surface.
The aim of this study is to identify the variations in sources of moisture for different areas around the Mediterranean basin along the period from 1980 to 2000.
In order to determine the origin of moisture, we used the Lagrangian particle dispersion model FLEXPART. This model used global data from the meteorological reanalysis of the European Centre for Medium-Range Weather Forecasts on model levels (ERA-40) to track different meteorological parameters for the entire atmosphere along individual trajectories. We are interested in atmospheric moisture, so we used the specific humidity interpolated to the position in the trajectory at given points in time.
The method can track (E-P) from a region forward or backward in time along the trajectories choosing particles appropriate for finding sinks or sources of moisture and precipitation. The origin of air-masses residing within the atmosphere over 8 different continental regions surrounding the Mediterranean Basin (trying to cover the maximum area around the sea) was tracked. The analyzed areas for backward trajectories are: the Iberian Peninsula, France, the Italian Peninsula, the Balcanic Peninsula, Eastern Mediterranean, Western Africa, Central Africa and Eastern Africa. We also traced (E-P) forwards trajectories over 3 areas over the Mediterranean Sea, these areas were selected based on the climatological atmospheric moisture flux divergence. As previous works using only a 5-year period the method determine how the Mediterranean Sea can affect the surrounding areas and also remote regions. In general, that the North Atlantic basin and the western Mediterranean Sea are the main moisture source regions affecting the western target regions, Iberian Peninsula, France and Western North Africa. The eastern target regions are affected by each surrounding sea areas (recycling). In central Mediterranean regions both type of sources of moisture (remote and recycling) are important. It is remarkable the role of the subtropical and tropical North Atlantic Ocean source of moisture (extending from the Gulf of Mexico to Africa) in the western and central regions.
The Lagrangian diagnostic can be applied to other data set as the re-analysis of the ECMWF with a higher time covering, around 40 years. The use of around 20 years of data is particularly important for studying interannual variability of moisture transport and the influence of the large-scale climate modes that affect the Mediterranean region, for instance the NAO. This topic constitutes one of the fundamental understandings for the future to know with more detail the hydrological cycle of the Mediterranean Sea.