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Precipitation in the Mediterranean basin as seen from the 2000-2010 TRMM-3B42-v6 database

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This work presents a detailed analysis of 11 yrs of the version 6 of the TRMM-3B42 multi-sensor precipitation product (3-h and 0.25° resolution) from March 2000 to February 2011 over the whole Mediterranean basin and surrounding areas including the Black Sea (25°N-50°N, 10°W-43°E). We first discuss some issues in the data set regarding spatial and temporal discontinuities in coastal areas, and further illustrate a critical underestimation of light rains at latitudes higher than 36-37° that somewhat improves from 2007 on and is associated to the absence of coverage by the Precipitation Radar. North of the radar field of view, it seems that the marine coastal band is subject to a significant under detection of precipitation, whereas, on the opposite, the terrestrial coastal band south of 35°N in North Africa and the Near East shows unrealistic over detection of precipitation. We then evaluate the product against rain gauges with a focus on the western Mediterranean basin and the Adriatic. Our reference rain gauge data set includes about 1 million daily rain reports from more than 260 Mediterranean surface stations from Croatia, France, Italy, Malta, Spain (including 2 stations on the northern coast of Africa) and Tunisia, and from 9 additional non-Mediterranean stations from a flat region in France. It includes stations from almost 20 small Mediterranean islands. The comparison shows a significant correlation between TRMM-3B42v6 and rain gauges but with an overall tendency to underestimation. The average ratio of daily rates between surface stations and TRMM product is $\sim$0.63 with significant regional variations, Corsica showing the poorest results and Spain the best. Over the Mediterranean stations considered, the average rate of success on the occurrence of precipitation ($\sim$0.75) is enhanced by the high proportion of dry days in the Mediterranean climate ($\sim$4 over 5 on average in the rain gauge data set) and drops off when only days with precipitation recorded at surface stations are considered. Averaging fallout at monthly and annual time scales somewhat improves the comparison to rain gauges. We find that results are better in summer and likely more generally in unstable conditions, as illustrated by a subset of data composed of days with high African dust load over the basin. Using a few TRMM pixels that cover 3 or even 5 surface stations, we further illustrate how the small scale heterogeneity of precipitation is a limitation in the comparison between the integrated view of precipitation from space and the local surface measurements. Finally we integrate the variability of the rainfall geographical distribution at seasonal and annual scales over 5 sub-basins (western and eastern Mediterranean, Adriatic, Aegean, and Black Sea). An increasing trend in annual precipitation in the Mediterranean basin is observed over the decade that is also found at the global scale and appears related to the improving performance of the product with time regarding the detection of light rains, especially over Europe and the Mediterranean. Finally we compare the TRMM-3B42v6 precipitation budget over the basin with comparable budgets from ERA-Interim, HOAPS and CMAP data sets.