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Validation of a high-resolution precipitation database (CHIRPS) over Cyprus for a 30-year period

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ABSTRACT

A study for a 30-year period (1981–2010) for a new precipitation database is performed over the island of Cyprus. Climate Hazards Group Infrared Precipitation with Station data (CHIRPS) is a more than 30-year quasi-global rainfall dataset, spanning 50°S–50°N (and all longitudes). Starting in 1981 to near-present, CHIRPS incorporates 0.05° resolution satellite imagery with *in situ* station data to create gridded rainfall time series. In this study, CHIRPS database is firstly compared to other precipitation databases over the Mediterranean basin. In the following, this study focuses over Cyprus, where a dense and reliable network of rain gauges is available. CHIRPS data are compared for the first time with *in situ* measurements in this area, for the aforementioned 30-year period. Monthly and annual comparisons are presented for each of the 0.05 × 0.05 degree cells overlaying the island of Cyprus. Results showed good correlation between CHIRPS values and recorded precipitation, although an overestimation of the *in situ* rainfall data has been noted during the last decade.

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1. Introduction

Climate Hazards Group Infrared Precipitation with Station data (CHIRPS) is a new land-only climatic database of precipitation, made available since early 2014; it encompasses three diverse types of information: global climatologies, satellite estimates and *in situ* observations. More specifically, this database incorporates monthly precipitation climatology CHPClim (Climate Hazards Group Precipitation Climatology), quasi-global geostationary thermal infrared satellite observations, Tropical Rainfall Measuring Mission's (TRMM) 3B42 product, atmospheric model rainfall fields from NOAA CFS (Climate Forecast System), and precipitation observations from various sources, including national or regional Meteorological Services (Funk et al., 2013). Nevertheless, the key difference of this database with all other existing precipitation databases is the high-resolution of the available data, since the inherent 0.05-degree resolution is a rather unique threshold; the majority of the available global precipitation datasets have a resolution of 0.5° or lower (Tapiador et al., 2012), while a mere few of them, like TRMM's 3B43 (Huffman et al., 2007) and E-OBS (Haylock et al., 2008) have a 0.25-degree resolution.

To date, studies based on CHIRPS data are limited in the literature and those existing are mainly focused on Africa. For example, Shukla et al. (2014) used CHIRPS data for the primary growing and rainy season (March–April–May) to evaluate soil moisture forecasts generated by a seasonal drought forecast system on the equatorial East Africa (*i.e.*, southeastern Ethiopia, northern Kenya and southern Ethiopia). In their study for mapping population vulnerability to climate change in Africa, López-Carr et al. (2014) used CHIRPS' standardized precipitation index time series for Africa with regard to the main growing season. Also, in a study focusing on Eastern Africa, Funk et al. (2013) showed an almost identical precipitation average for CHIRPS and GPCC (Global Precipitation Climatology Centre) datasets, regarding springtime (March–May). On that count, the present study performs for the first time validation of the CHIRPS dataset in the area of the Mediterranean basin, especially using a detailed rain-gauge network.

Section 2 presents a climatology of CHIRPS database over the Mediterranean, together with a brief comparative assessment of this database with other sources of precipitation data. Section 3 focuses over Cyprus, making use of the extensive network of rain gauges of the island. Conclusions are presented in Section 4.

2. CHIRPS Climatology

2.1. CHIRPS data climatology over the Mediterranean

The spatial distribution of the data gives a very detailed representation of precipitation climatology in the Mediterranean basin in which elevation effects along with latitude and longitude have been taken into consideration (Funk et al., 2013). This is obvious looking both at the annual average map (Fig. 1) and the seasonal maps (Fig. 2), where the characteristics of rainfall climatology for the area surrounding the Mediterranean Sea can be observed.

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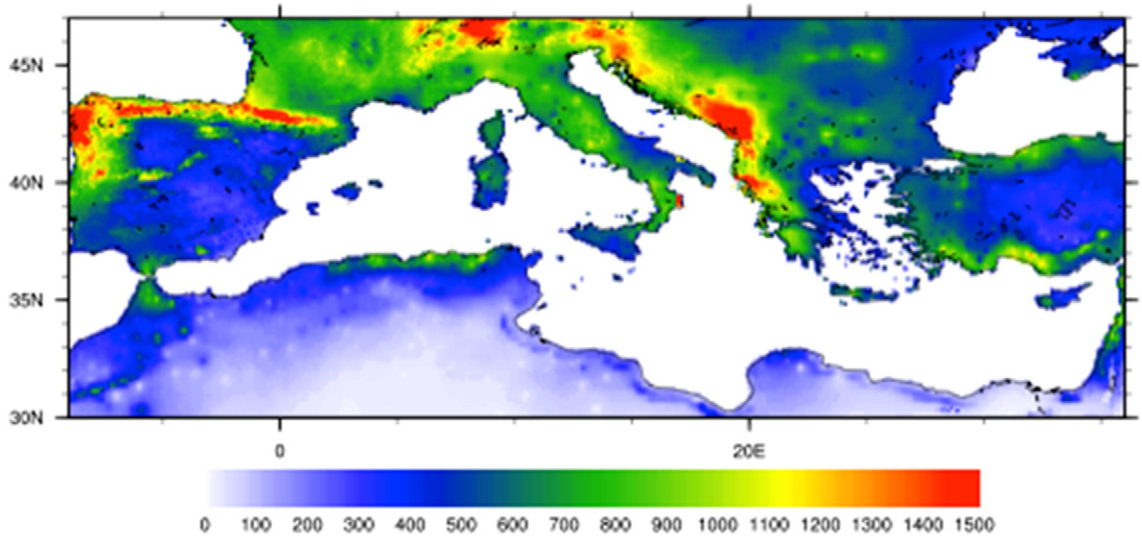

Fig. 1. Spatial distribution of CHIRPS data over land areas surrounding the Mediterranean. Mean annual values (mm/year) for a 30 year period (1981–2010).

On the one hand, by looking at the map with the annual mean (see Fig. 1), one can see the high precipitation values positioned over the mountainous areas of the Alps and the Pyrenees and also over the coastal areas of the Balkan Peninsula. On the other hand, in the seasonal mean (mm/month) maps (see Fig. 2), contrasting differences between winter and summer can be observed. Summer (Fig. 2c) is topographically influenced, since the seasonal values are higher in the mountainous regions of the Alps mainly, and also the Pyrenees in the west and the Carpathians in the east. On the contrary, winter values (Fig. 2a) are higher near the coasts of the Balkans, highlighting the influence of the warmer sea and its temperature contrast with the cooler land surface. Spring (Fig. 2b) has a "mixed" portrayal, with high values both over mountainous areas and coastal zones, while autumn seems to be more like winter than like summer, with the higher values being observed primarily over coastal areas; however, high values are also observed over some mountainous regions.

2.2. Comparison between CHIRPS and other datasets

CHIRPS data are compared with two different datasets over the Mediterranean basin: TRMM's 3B43 product and E-OBS precipitation data, both provided at a spatial resolution of $0.25 \times 0.25°$.

Level 3 TRMM 3B43 data, also called TRMM Multi-satellite Precipitation Analysis (TMPA) products, have a spatial coverage that is quasi-global. This is the first rain product, combining TRMM precipitation radar (PR) and TRMM microwave imager (TMI) rain rates to calibrate rain estimates from other microwave and infrared measurements

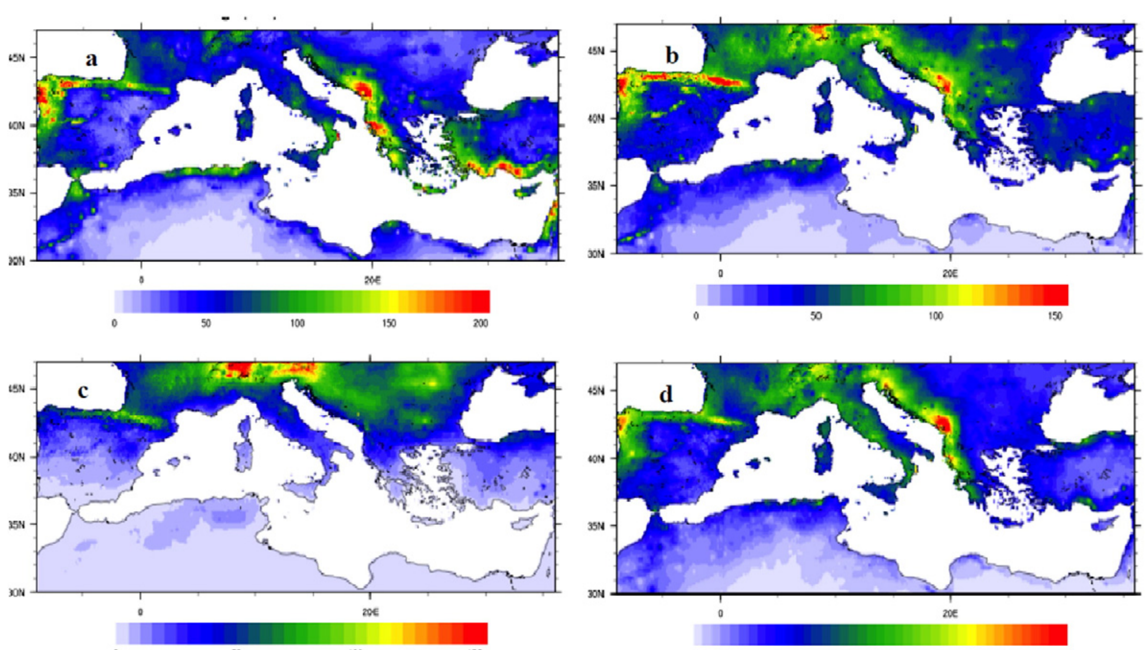

Fig. 2. Seasonal average values (mm/month) for CHIRPS data: a) December–January–February, b) March–April–May, c) June–July–August, d) September–October–November.

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