Precipitation Data Availability over the East Mediterranean and Their Preliminary Analysis

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1. Introduction

Yatagai (2002, 2003) used ECMWF reanalyses to estimate the hydrological balance and its variability over semi-arid regions of Eurasia, including Turkey, as part of ICCAP. Section 2 of this brief paper describes recent climate changes over the ICCAP region using analyses of meteorological data, especially gauge precipitation data. Section 3 outlines future plans.

2. Preliminary reports of recent precipitation changes over the Eastern Mediterranean

2.1 Datasets archived by NOAA

Daily meteorological reports worldwide are reported over the Global Telecommunication System (GTS) network to facilitate daily weather forecasts. The present study used freely available datasets to investigate recent precipitation trends in the Eastern Mediterranean.

Precipitation data from 1977 to 2000 were analyzed using three different global daily precipitation datasets. Data archived by NOAA from 1977 to 1991 are summarized in a Global Daily Summary CD-ROM. Precipitation data from 1992 and 1993 were provided by Dr. Xie (NOAA/CPC). Finally, surface meteorological data from 1994 and later were obtained from NOAA/NCDC (http://lwf.ncdc.noaa.gov/oa/climate/climatedata.html#DAILY).

2.2 Stations available from 1977 to 2000

Data availability varies from station to station. Figure 1 shows the stations listed in all three datasets described above. There are 769 stations between longitudes 20 and 50 degrees east and latitudes 20 and 50 degrees north, but only 325 (lower panel of Figure 1) have records for more than 12 of the 24 years from 1977 to 2000.

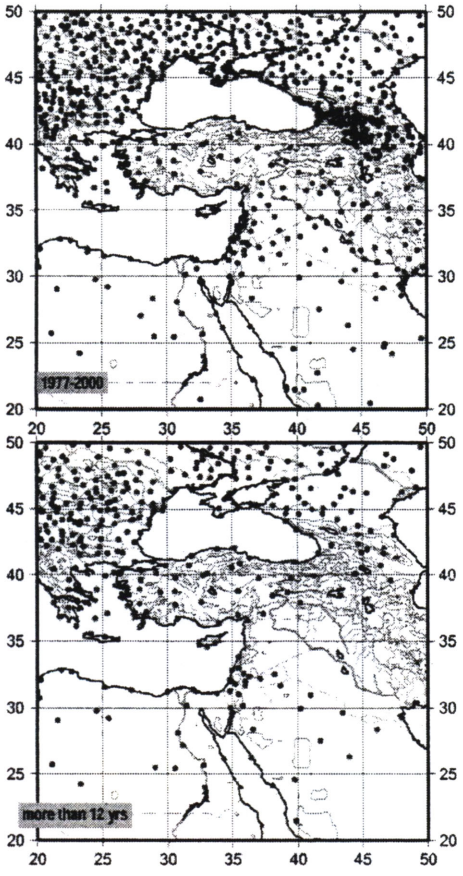

Fig. 1 Stations in the eastern Mediterranean that are listed in all three datasets (upper). Stations that reported for more than 12 years between 1977 and 2000 are shown in the bottom panel.

2.3 Seasonal precipitation trends from 1987 to 2000

Figure 2 shows the linear trend of monthly precipitation for January, April, July, and October. Only those stations having a data record longer than 12 years are included. The rainfall season in the Eastern Mediterranean is the winter; the dry season is the summer. Mean precipitation (1979-1993) data from the CPC merged analysis of precipitation (Xie and Arkin, 1997) for the four months are also displayed in Fig. 3 for reference.

It is evident from Figure 2 that January precipitation is decreasing at most stations. Precipitation in April and July is increasing over most of Turkey, except near the Black Sea, while precipitation in October is increasing over central and northern Turkey. Turkes (1996) investigated precipitation trends over Turkey from 1930 to 1993, and noted that area-averaged annual rainfall decreased slightly over all of Turkey and adjacent regions of the Black and Mediterranean Seas. However, none of the rainfall trends were statistically significant.

The present study uses a shorter and more recent time series that contains many missing fields. It is therefore very difficult to compare the present results with Turkes (1996). However, the decrease in January (rainy season) precipitation and its affect in decreasing the annual precipitation (not shown) are consistent with the results in Turkes (1996).

Decreases in precipitation have occurred in January, April, and October over Israel, where water shortages have recently been reported (e.g., the decreasing water level of Lake Galilee). It would therefore be worthwhile to investigate hydrological variability in the Eastern Mediterranean in terms of both global change and local human activity.

2.4 Stations of Turkish Meteorological Agency

As noted in Section 2.2, data are often missing from the fields used in this study. For example, 111 stations are listed in Turkey, but only 49 have data coverage exceeding 50% for the period 1994-2000. More than 1000 stations record precipitation (Fig. 4 upper panel) according to the Turkish Meteorological Agency. Of these, about 80 have been observing precipitation since before 1930 (Fig. 4 middle panel). Collection and investigation of such long-term precipitation data are important for the ICCAP, which seeks to investigate the impact of global warming or of climate change in the Eastern Mediterranean. In addition to the Turkish stations, the ECMWF 40-year reanalysis (ERA40) dataset (1957-2002) can be used for climate change research. Turkey has 222 stations that overlap the ERA40 dataset (Fig. 4 lower panel). Such dense datasets are important not only in assessing current climate change but also for use in statistical downscale methods for general circulation model (GCM) output.

3. Future Plans

Three further steps are planned. First, interannual variability of the hydrological budget in the ICCAP regions will be investigated using ECMWF 40-year reanalysis (ERA40). Second, local precipitation changes associated with large-scale climate change will be investigated using precipitation data obtained from the Turkish Meteorological Agency. A statistical downscale technique will be applied to the ICCAP region using these data and Meteorological Research Institute (MRI) GCM output. Finally, the drought monitoring system in the United States (Svoboda et al., 2002) will be studied with an eye to considering its application to ICCAP studies of drought information related to global warming.

4. References

Svoboda et al. (2002) The drought monitor, BAMS, 83, 1181-1190.

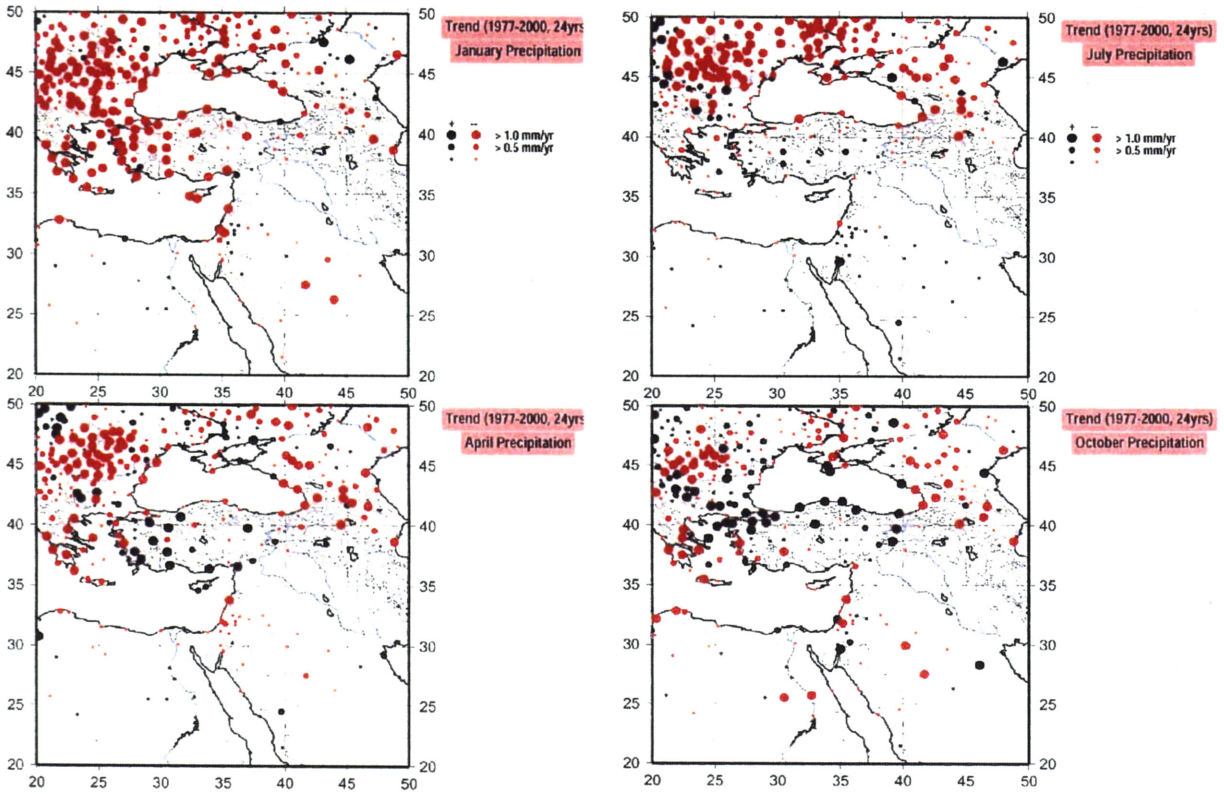

Fig. 2 Linear trends in monthly precipitation from 1977 to 2000. Upper left: January, Lower left: April, Upper right: July, and Lower right: October. Black shows increases and red shows decreases.

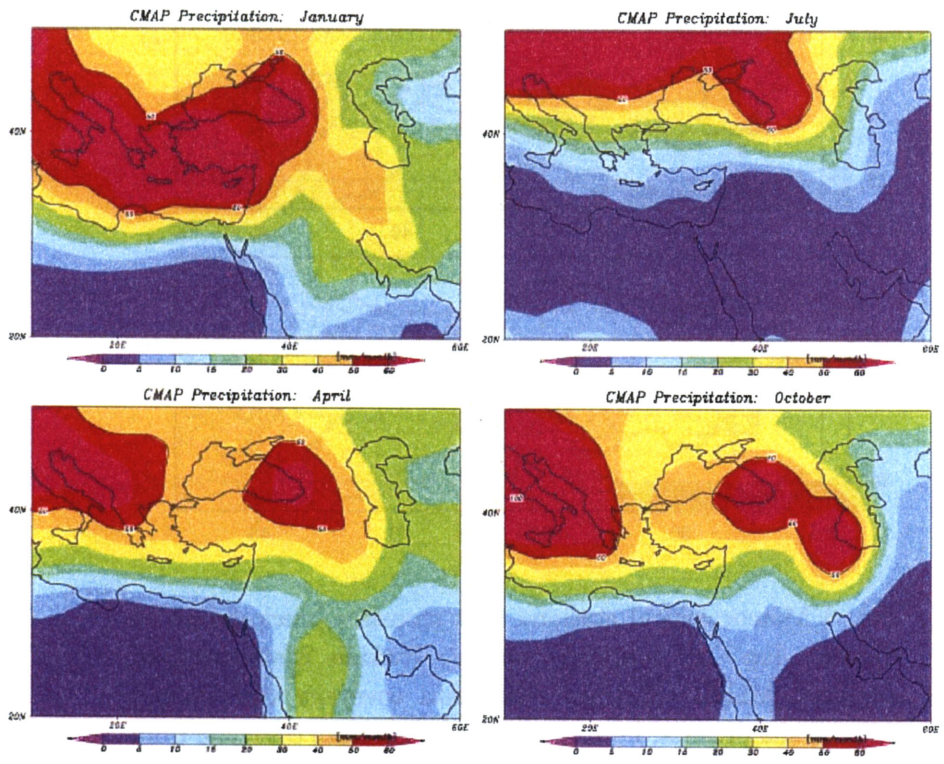

Fig. 3 Mean monthly (January, April, July and October) CMAP precipitation (1979-1993).

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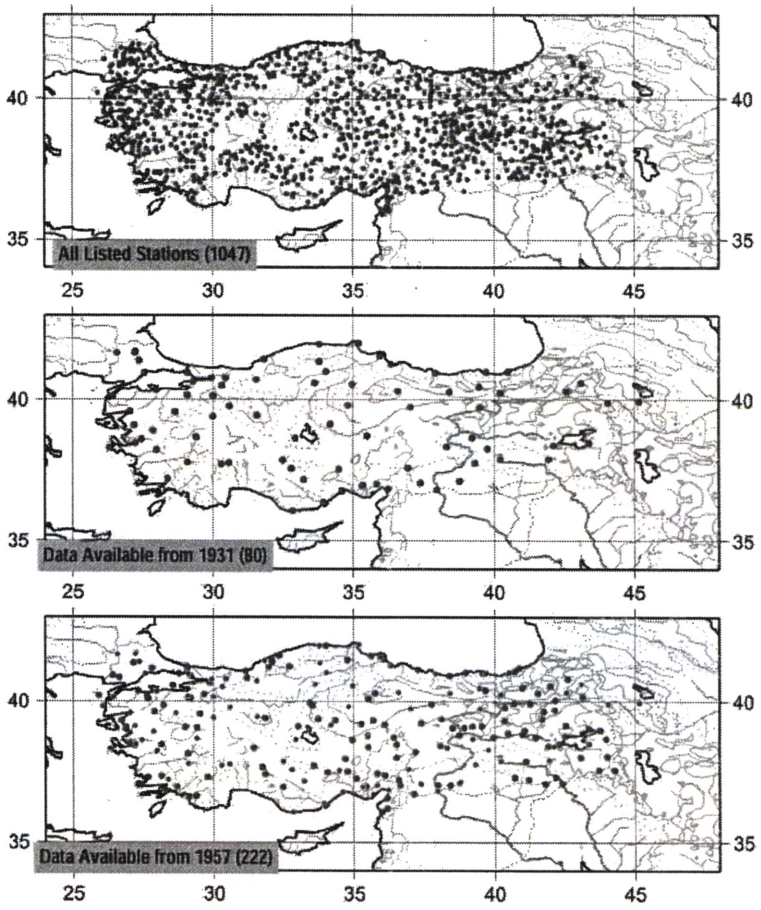

Fig. 4 Meteorological stations that measure precipitation in Turkey. Top: All stations (source: Turkish Meteorological Agency). Middle: Stations with data coverage from before 1931 to the present. Bottom: Stations with data coverage from before 1957 to the present.