Analysis of the water vapor field and synoptic characteristics in relation to regional variation of precipitation in Israel

S. Malka, A. Zangvil

Ben Gurion University, Beer Sheva, Israel.

Major rain days over Israel were investigated with the aim of finding connections between synoptic systems and humidity field to the spatial rainfall distribution and for identifying the sources of moisture for the major rain days (MRDs). Gridded NASA reanalysis data at 18 pressure levels with a resolution of 2^0 latitude by 2.5^0 longitude, for the Mediterranean Sea and vicinity, March 1985 to November 1993, have been used. In addition we used rainfall measurements from 11 stations over Israel. The country from the North to Mitzpe Ramon has been sub-divided into three parts, North (a), Center (b) and South (c). The MRDs over the country were grouped as the following: a: Total number of MRDs recorded at any station. (480 days); b: MRDs only in the North; c: MRDs only in Center; d: MRDs only in South; e: MRDs simultaneously in the 3 regions.

In order to isolate the physical processes causing rain in different parts of the country, we used for each of the above lists a test kit containing composite synoptic charts, moisture flux charts and vertical moisture flux profiles over Israel. Full water vapor budgets have been computed in our region for the first time in 3 atmospheric boxes of equal area, 3.1 x 10^5 km^2 each. The first, central box is right over Israel; the second to the west and the third to the east of Israel.

It was found that averaged over the 3 seasons MRDs only in the North are associated with an upper trough whose axis extends from the northern Black Sea to Southwest Turkey, then south-southwest to Alexandria. MRDs in central Israel are associated with a trough axis from the Sea of Azov to Ankara, then south to the Nile delta. For MRDs only in the South the trough axis extends from the eastern black Sea south westward to Alania in southern Turkey, then to the Nile Delta.

In winter the water vapor budget for MRDs in the North is characterized by strong inflows of moisture into the western Box, about 32 mm/day, compared to situations of rainfall only in the Center or South with 17 mm/day. In MRDs only in the South the ratio between the moisture flux from the north to that from the west is 0.74 compared with a 0.10 ratio for rain only in the North. This is an example to the ”Rain Switch” preventing rain in the South with westerly winds, opening up and allowing rain in the South when the wind is northwesterly. Also, in spring and fall the ratio between flux from the south to the flux from the west reaches 0.63 – pointing at the importance of

southerly non-Mediterranean moisture sources.

We found marked differences in the recycling ratio (expressing the ratio water vapor from local evaporative sources to moisture coming into the box from outside) between the values calculated for the three boxes. Since the recycling ratio is low even in the western box, it may be concluded that moisture evaporating from the EM Basin is not an important factor for rainfall in Israel – contrary to common wisdom among Israeli meteorologists.