AN INCREASE OF EARLY RAINS IN SOUTHERN ISRAEL FOLLOWING LAND-USE CHANGE?

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Abstract. The October rains (at the onset of the rainy season that extends to April) in southern Israel have steeply increased in the last quarter century relative to the prior two decades. A less pronounced, but appreciable, increase is noted for the rest of the rainy season. This apparent reversal of desertification is attributed here to land use changes. Afforestation, increased cultivation and limitations on grazing after the establishment of the State of Israel resulted in an increased vegetation cover over the inherently high-albedo soils in this region (an area of $\sim 10^4\,km^2$). The changes are shown in a July 1985 Landsat image of the area.

The increase in precipitation is specifically attributed to intensification of the dynamical processes of convection and advection resulting from plant-induced enhancement of the *daytime* sensible heat flux from the generally dry surface. This enhancement results both from the reduced surface albedo and the reduced soil heat flux (reduced day-to-night heat storage in the soil) in October when insolation is strong. Stronger daytime convection can lead to penetration of the inversions capping the planetary boundary layer (which are weaker in October than in summer) while strengthened advection (sea breeze) can provide moist air from the warm Mediterranean Sea. This suggested mechanism is consistent with previous studies showing that the autumn rains in southern Israel exhibit convective mesoscale characteristics and occur predominantly in the daytime. However, other causes, such as a shift in the synoptic-scale circulation, cannot be ruled out at this stage.

1. Introduction and Background

The fluxes of sensible and latent heat from the surface to the atmosphere can have important bearing on the amounts and patterns of rainfall. A small natural heat source can significantly enhance local rainfall, as observed in the tropics by Malkus (1963). Well-known is the significant enhancement (by some 15%) of the rain amounts downwind of St. Louis, MO (Huff *et al.*, 1971; Ching, 1985). Similar local effects of urbanization have been reported for the central Coastal Plain of Israel (Goldreich, 1987). The influence of surface heat flux on local precipitation derives first from the effects of heating on the thickness of the planetary boundary layer (PBL) and vertical circulations within it (Berkofsky, 1977). However, the presence of differential surface forcing at the mesoscale appears to be a very important element (Anthes, 1984). Differential boundary-layer development leads to mesoscale circulations which provide the organization often required for the development of precipitating clouds. For example, sea breeze circulations often occur in coastal locations and may result in enhancement of cloudiness and precipitation at inland locations close to the coast.

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