Effect of irrigation on summertime low-level cloud in Cukurova plain

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1. Introduction

Fujiwara (2005) presents the following features of low-level cloud in Cukurova plain, Turkey by the analysis of satellite image and the radio sonde data. (1) The low-level cloud, which entirely covers over the plain even though the arid climate, appears once per 3 days in summertime. (2) The appearance frequency is significant higher than surrounding area. (3)The low-level cloud is formed upper part of mixing layer where located in 800 to 1500 m up by the thermal convection. The cloud seems to be related with the large-scale irrigation, although the mechanism has been unidentified yet.

This study aims to reproduce the cloud by a Regional Climate Model (RCM), and discuss with the relationship between human activities and its effect to the climate in arid area.

2. Numerical experiments

Terrestrial Environment Research Center modified version of Regional Atmospheric modeling System (TERC-RAMS) is utilized. The RCM has the two-way nesting, the finer domain covers all over the Cukurova plain by 62 x 62 grid system with 1.7 km grid spacing in longitude and latitude. Initial and boundary forcing data is obtained by the radio sonde at 00 UTC 27, July 2002 on Adana, provided by University of Wyoming.

Following four numerical experiments are carried out; (1) DRY-run, in which the relative soil moisture is set to 25 percent (quite dry), corresponding to the control run; (2) WET-run, in which the realistic soil moisture is set to 62.5percent; (3) IRG14, which has 1.4 times soil moisture in the irrigated area (non-irrigated area set as well as DRY-run); (4) IRG18-run, which is same as IRG14-run but has 1.8 times soil moisture.

3. Result

Low level clouds are simulated by the RCM, it appears DRY-run and WET-run both. It distributed along the coast side accompanying with the entering sea breeze in both runs, among the mountainous area and the eastern side of Seyhan dam in WET-run. The amount of vetical integrated cloud water in IRG14 and IRG18 are greater than that in DRY-run and less than that in WET-run as the obedient response to the soil moisture setting. The spatial pattern of cloud water (Fig. 1) is correspondents to that of cloud obtained by the satellite image (Fig. 2) in the mountainous area and west part of the plain excepting for the central and southwestern part.

In DRY-run, the deep convection appears over the plain dispersedly (Fig. 3a) whereas the convection are comparatively shallow and sporadically in IRG-runs (Fig. 3b, c). Deep and dispersed convection prevents the downwelling wind reaching to the surface. Otherwise the comparatively shallow and sporadically convection arises the downwelling wind to the surface in the plain, it suppresses the occurrence of the cloud.

4. Conclusion

As the result, the increase of soil moisture in irrigated area causes the decrease of sensible heat flux accompanying with the increase of latent heat flux, and enhances the subsidence through the enlargement of

thermal contrast between irrigated area and surrounding. Totally, the increase of soil moisture in irrigated area suppresses the cloud formation in this study

Reference

Fijiwara, T., 2005: Influence of Large-scale Irrigation on Low-level Clouds over Cukurova Plain in Turkey, Master thesis of Graduate School of Life and Environmental Sciences, University of Tsukuba.

Yuyama, T., 2006: Effect of Large-scale Irrigation on Climate in Arid-area and Its Mechanism in Cukurova Plain, Master thesis of Master's Program in Environmental Sciences, University of Tsukuba.

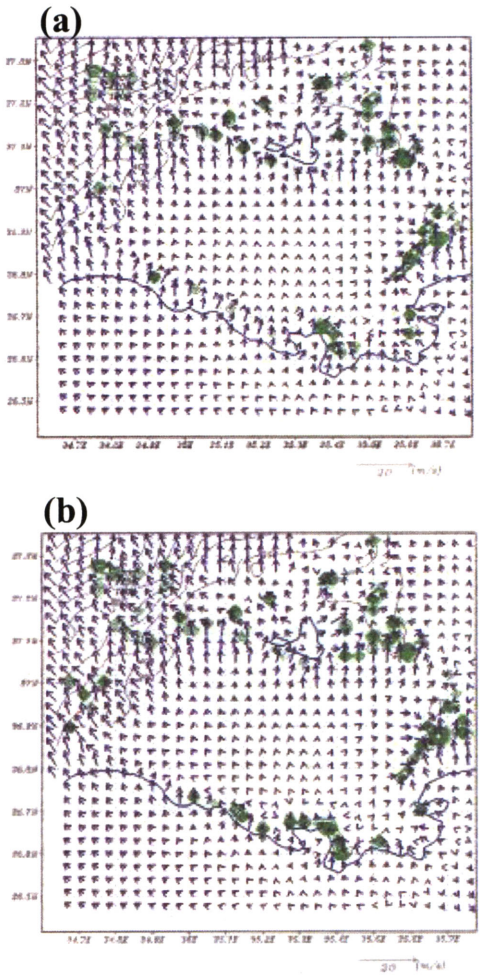

Figure 1. Reproduced vertical integrated cloud water and wind filed by RCM in IRG14-run (a) and IRG18-run (b). Green contour shows vertical integrated cloud water.

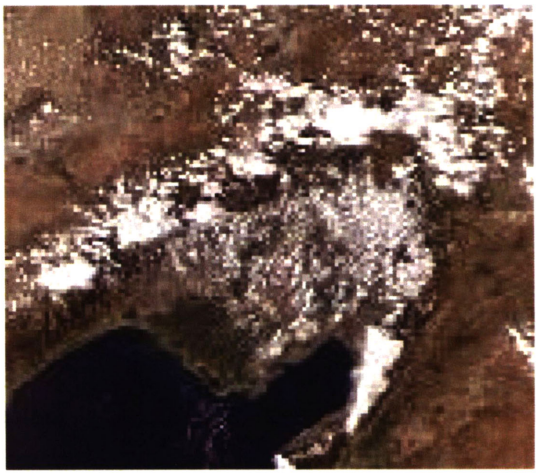

Figure 2. Observed cloud distribution obtained from Aqua/MODIS at 10:50 UTC in 27, July 2002

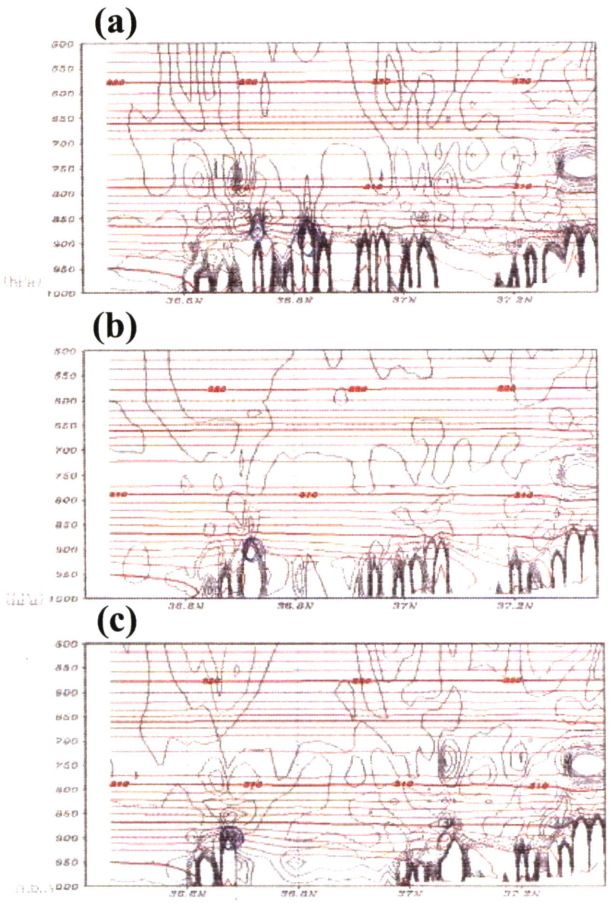

Figure 3. Latitude-pressure cross section on 34.24E at 12:00 UTC in DRY-run (a), at 11:50 in IRG14-run (b) and IRG18-run (c). Red line shows potential temperature, black solid line shows upwelling wind and black dotted line shows downwelling wind. Blue contour shows cloud water.