Flux observation at the irrigated farmland in North China Plain

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This paper presents some of outcomes from NCP(North China Plain) N38º project. This is a synthetic project concerning whole hydrological processes including evapotranspiration, subsurface water, water contamination, mountain hydrology, and so on. Flux is an important part of NCP N38º project.

Three flux stations are disposed along N38º line, and fluxes have been measured continuously from 1998. The results from Luancheng Agro-Ecosystem Station are presented here. Experimental site is large field of winter wheat and summer maize. Wheat is seeded in a field on around October and harvested on next June. Maize season is from June to September.

Some selected results are explained below:

1) Comparison between lysimeter method and bowen ratio energy balance technique(BREB)

Seasonal trend of evapotranspiration in 1999 wheat season was measured by different methods. Both methods gave consistent results and proved the accuracy of the BREB. The results gave a typical seasonal pattern of evapotranspiration from wheat field.

2) Diurnal and seasonal changes in heat budget in 1999

Diurnal changes in heat budget in 1999 wheat season were shown in the paper. The ratio of latent heat(LE) to net radiation(Rn) was gradually increased accompanied by the growth of wheat. The changing trend of LE/Rn in the growing season was clear from DOY100 to DOY120, and it was proportional to the changes in LAI(Leaf Area Index) .

3) Influence of irrigation

The amount of irrigation is compatible with the precipitation in this area. The relationship between available energy and evaporation ratio(EF=LE/(LE+H)) explains the effect of irrigation to heat budget. In wet case, EF approached unity. On the other hand, EF fell below unity in the dry case. Irrigation certainly affects the heat budget on the field.

4) Relationship between evapotranspiration and crop conductance

Seasonal changes in ET and crop conductance, daily precipitation, and average soil moisture to the depth of 60cm were shown . There were little changes at the early irrigation, however, ET showed sharp increase after final irrigation at DOY138. The crop conductance was in the decreasing tendency just before the irrigation, and wheat was in the stressed condition. ET was controlled by the low soil moisture, however, the irrigation promoted the transpiration.

5) Diurnal and seasonal variations in stomatal resistance/conductance

Diurnal patterns of stomatal conductance in well-watered(W) and rain-fed(R) experimental field were compared. There was little difference in the early morning, however, stomatal conductance in rain-fed field became very low compared with that of well-watered field. The stomatal conductance at the well-watered field showed its maximum at around 10 a.m., and the gradually decreased to the evening minimum.

The seasonal trend in stomatal resistance showed U-shaped change. Stomatal resistance was high in pre-jointing and post-milking stage, and low after jointing stage.

6) Relationship between stomatal resistance and soil moisture

Evapotranspiration is controlled by the soil moisture especially in the semi-arid region. Although the maximum conductances were different in growing stages, stomatal conductance decreased linearly with decreasing ESW(ESW=(Sa-Sw)/(Sf-Sw), where Sa, Sw, and Sf are soil moisture content, welting point, field capacity, respectively) when ESW fell below 0.5. This means the possibility to model control of soil moisture to evapotranspiration.

7) Seasonal variations in spectral reflectance and vegetation index

The seasonal trend of NDVI(Normalized Difference Vegetation Index) by albedo meter and PAR(Photosynthetically Active Radiation) sensor were obtained, and its time changes accompanied by the growth of wheat and maize were clearly recorded. The time series of NDVI by NOAA/AVHRR at Luancheng station were also extracted. The trends were strongly related to the change in evapotranspiration.