An example of the observed heat, water, and CO_2 fluxes at Yucheng Station in 2002 is shown in Figure 12. Clearly, marked CO_2 absorption and H_2O evapotranspiration occurred during the crop growth season.

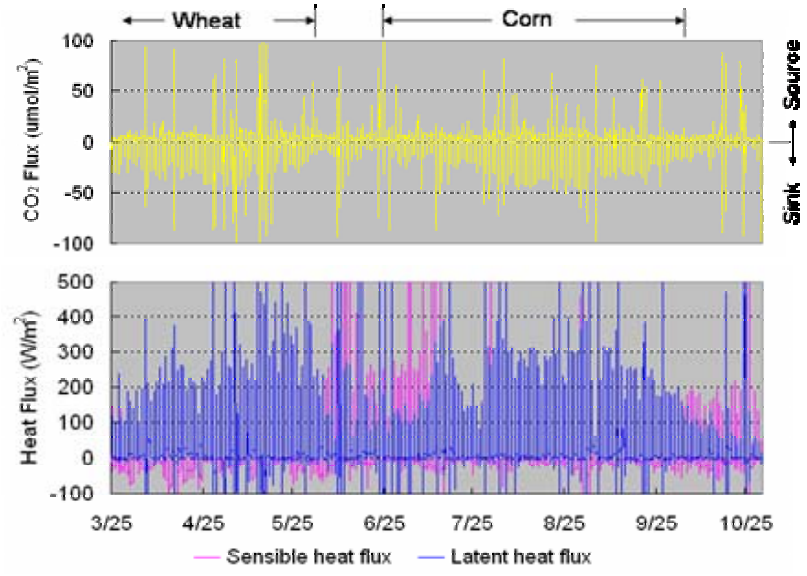

Figure 12 CO_2 sinks and crop evapotranspiration observed at the Yucheng, China, validation site in 2002

2.4.4 Development of an integrated catchment management model that combines a MODIS-based ecosystem model and a DSSAT (Decision Support System for Agro-technology Transfer) model

Soil moisture plays the most important role in the soil–vegetation–atmosphere continuum. However, it is one of the factors most difficult to estimate at a regional scale because of the heterogeneity of land surface characteristics. As most studies determining soil moisture address observational data analysis and biophysical mechanism modeling at one site or on a micro-scale, up-scaling to a regional or macro-scale is very difficult. Satellite data provide great potential for solving this problem, and accordingly an observation scheme has been designed at Haibei Ecological Station, in China (Fig. 13).

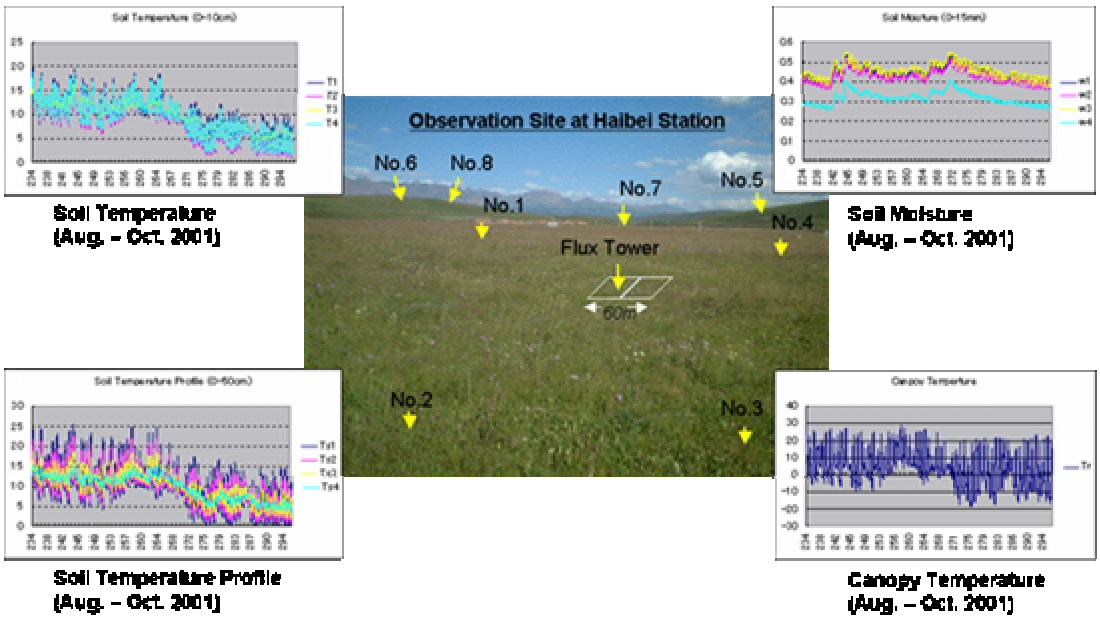

Figure 13 Observation scheme set up at Haibei Station, China

Further, integrated models that simulate ecological functions have been developed for use in decision-support systems for sustainable development, biophysical processes, and human interactions (Fig. 14). For example, (1) a MODIS-based ecosystem model has been developed to simulate water, heat, and carbon cycles, sediment transport, and agricultural production; and (2) A sophisticated DSSAT model has been used to simulate agricultural production. Simulations show that, through scientific irrigation scheduling, water use efficiency (WUE) can be greatly improved and water resources can be saved with no effect on wheat yield. Further, the drawdown of groundwater can be effectively controlled by adoption of new irrigation technology. These findings were derived from the following simulation.

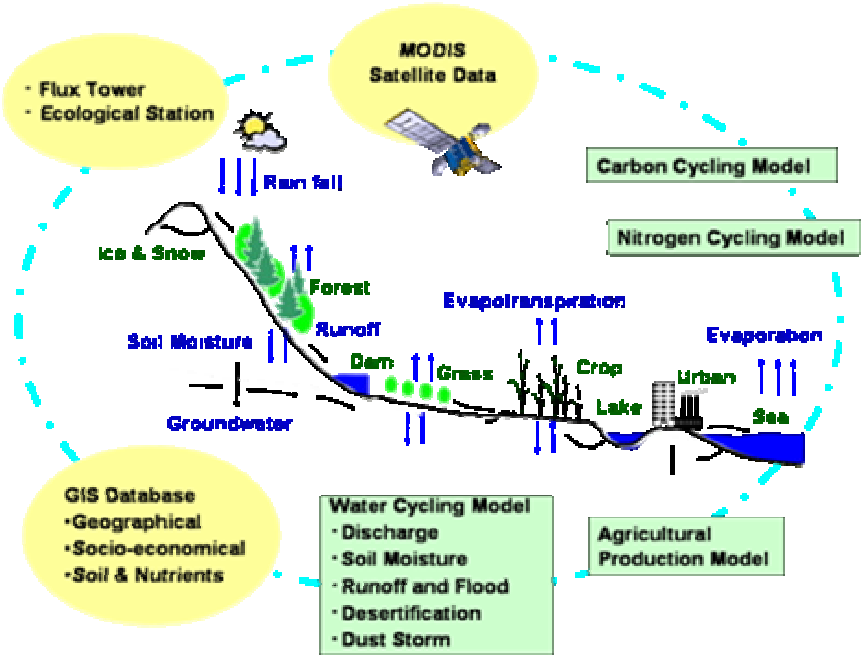

Figure 14 Structure of the integrated catchment management model

A simulation was applied to wheat production on the North China Plain, one of the largest bases of crop production in China. The widely distributed irrigation networks rely on the use of groundwater, and this has caused a rapid decline in the water table in the region. Figure 15 (left side) shows the average water table fluctuation observed in 22 wells during 1974–2001 in Gaocheng County, which indicates that the groundwater level dropped 19.7 m in a 28-year period. Groundwater drawdown takes place mainly in March–June, which coincides with the wheat-growing season (Fig. 15, right side). Sustainable development of agriculture in this area is facing huge challenges. In such areas, it is very important for us to find out the best irrigation scheme to decrease the amount of water used for irrigation. Our strategy is to produce the highest or near-highest yield with the smallest amount of irrigation water through the improvement of WUE.