An Analysis of Energy and Water Balance through Routine Meteorological Datain the Yellow River (Huanghe River) Valley

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A model with its input data derived from routine meteorological data has been used for estimating heat and water balance in China including the Yellow River (Huanghe River) Valley. Soil-water transportation through vapor and liquid phases under the ground surface has been considered in the model. Calculated results have been verified by the observed heat fluxes, soil-water observation results, and observed surface temperatures (Kondo and Xu 1997, Xu and Haginoya 2001). Daily and seasonal variations show good or reasonable agreements between the calculated and observed results.

Solar and longwave radiations, latent and sensible heat fluxes, surface temperatures, evaporation, corrected precipitation, soil-water contents, etc., can be output by the model. For example, we estimated that from northwest to southeast in the Yellow River (Huanghe River) Valley, annual solar radiation flux (estimated from sunshine duration.) changes from 220 Wm^{-2} to 140 Wm^{-2}. Annual effective longwave radiation flux (estimated from solar radiation flux, air temperature, and air humidity) has a range from 80 Wm^{-2} to 50 Wm^{-2}.

On the other hand, climatic variation over Eastern Asia including the Yellow River (Huanghe River) Valley, were analyzed using meteorological data for 32 points in the period 1971 to 2000. Changes in heat and water balances were examined using potential evaporation. Climate zones in Eastern Asia identified by the wetness index matched well with the distribution of vegetation.

At a station in semi-arid region such as Lanzhou, the sensible heat flux is found to be considerably greater than the latent-heat flux during the dry season. Both fluxes, however, have comparable magnitudes during the rainy season. The annual mean value of the soil-water content increases with depth, and the rate of increase grows larger as the amount of annual precipitation increases. But for an arid station, the profile of annual mean value of soil-water content does not increase with depth and the soil-water evaporated from the soil surface during the day and came back to the soil surface at night. At a station having a snowfall during the winter, the ground-surface temperature begins to rise just after the disappearance of the snow cover. Consequently, the sensible and latent heat fluxes increase abruptly from negative values to positive values. Soil-water content becomes abundant due to the melted snow.

It is found that the annual amount of evaporation depends on the annual amount of precipitation. That is, in the arid region, it is proportional to the annual amount of precipitation. On the other hand, in the humid region, it tends to have a limited upper value, determined as functions of the potential evaporation and soil or vegetation types. In arid and semi-arid regions, a greater portion of precipitation from rain events is lost to evaporation within a few days after rainfall, so water resources become scarce. For a region having a snow cover during the winter, however, a considerable amount of melted water formed in the spring, resulting in a remarkable contribution to water resources.

Reference

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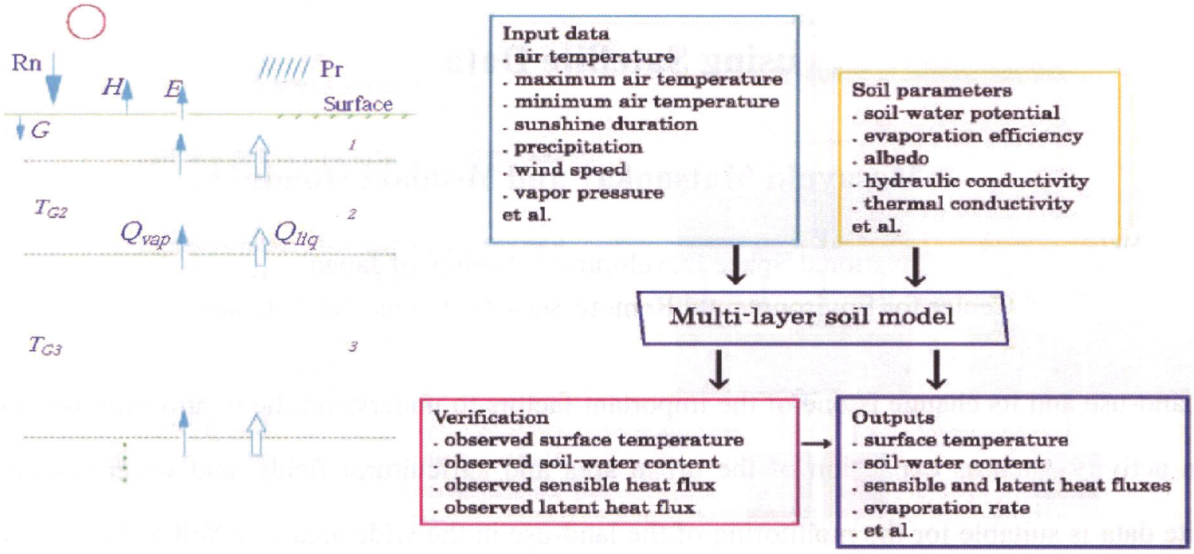

Fig.1. Outline of the soil model.

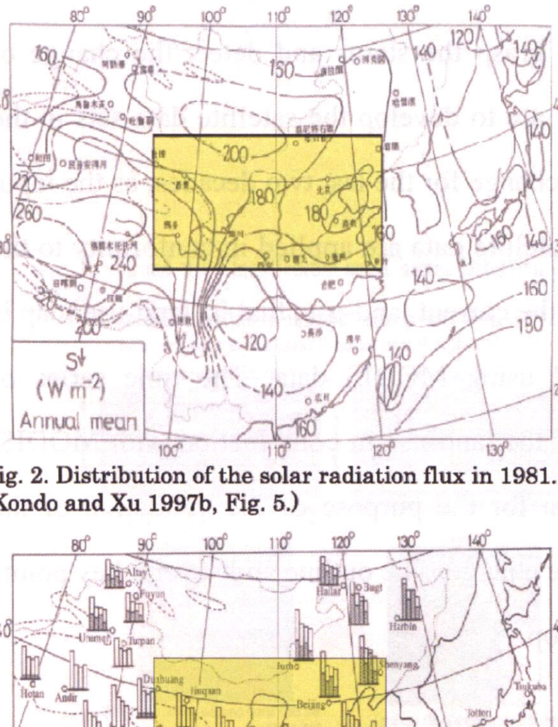

Fig. 2. Distribution of the solar radiation flux in 1981. (Kondo and Xu 1997b, Fig. 5.)

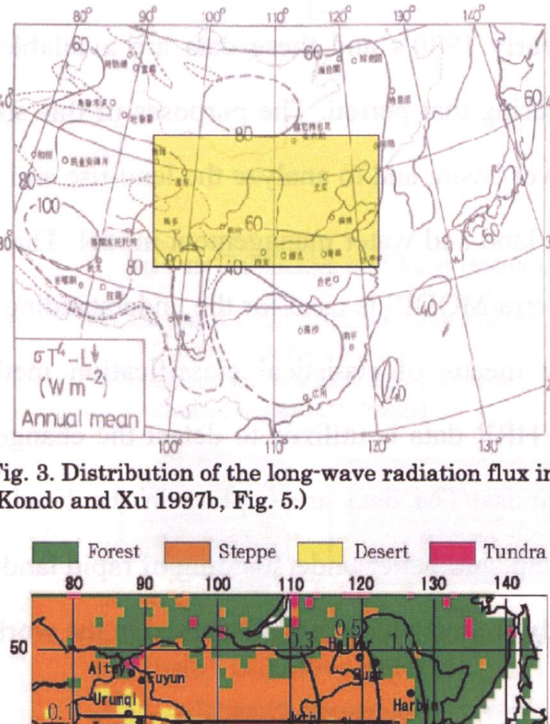

Fig. 3. Distribution of the long-wave radiation flux in 1981. (Kondo and Xu 1997b, Fig. 5.)

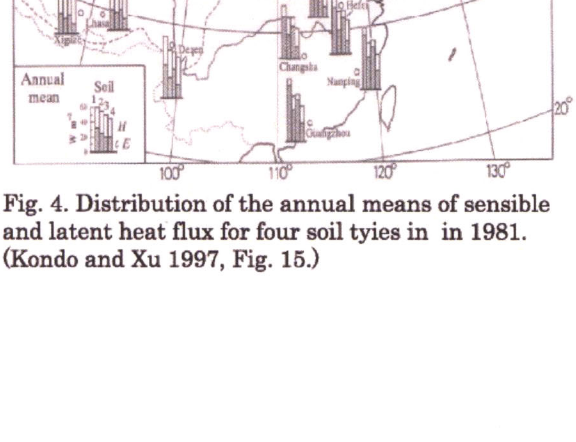

Fig. 4. Distribution of the annual means of sensible and latent heat flux for four soil tyies in in 1981. (Kondo and Xu 1997, Fig. 15.)

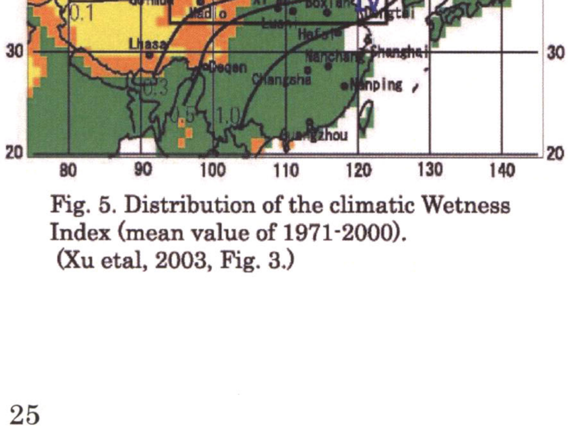

Fig. 5. Distribution of the climatic Wetness Index (mean value of 1971-2000). (Xu etal, 2003, Fig. 3.)