Surface radiation budget over China

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The radiation budget at the surface is crucial for determining the evapotranspiration and calculation with numerical hydrological models. Here we introduce two surface radiative budget estimates that were obtained independently. One is with satellite data, and the other is using routine meteorological observations. Comparisons between these two datasets were made at several stations, and room for improvement of both methods was suggested.

1. Surface radiative flux estimated by satellite measurements

We adopt a method developed by NASA Langley Research Center as using satellite data. This is called LPSA (Langley Parameterization for Shortwave Approximation) (Gupta et al. 1999). LPSA uses cloud information such as the cloud optical depth, cloud top height, cloud amount and so on) from ISCCP (International Satellite Cloud Climatology) and meteorological parameters like water vapor amount and temperature profiles, and then determines the surface radiative flux empirically. Figure 1 illustrates examples of the monthly-mean surface shortwave radiative flux (hereafter referred to as S(Langley) for January, April, July and October in 1994. We find substantial difference between four panels due to accompanying seasonal changes of the solar incidence, wind pattern and cloud system. This dataset is prepared from July 1983 to October 1995.

2. Surface radiative flux estimated by routine meteorological observation

The surface radiation calculated by routine meteorological observations (hereafter referred to as S(N)) is formulated using the sunshine duration measured by sunshine recorders for all sky cases (clear and cloudy). Coefficients of Jordan sunshine recorders take the surface air pressure into account (Kondo 1994). S(N) is parameterized by the precipitable water and surface air pressure for clear sky cases. As the atmospheric turbidity, results of Robinson (1966) were assumed. Figure 2 shows the time-series of S(N) in Beijing from 1983 to 1995 which is the same period as that of S(Langley). Although values seem to have a decreasing trend generally, we need to perform detailed analyses on the long-term changes of the humidity and cloud properties. This dataset is prepared for more than 30 years, from 1970 to the present in China (Xu et al. 2004).

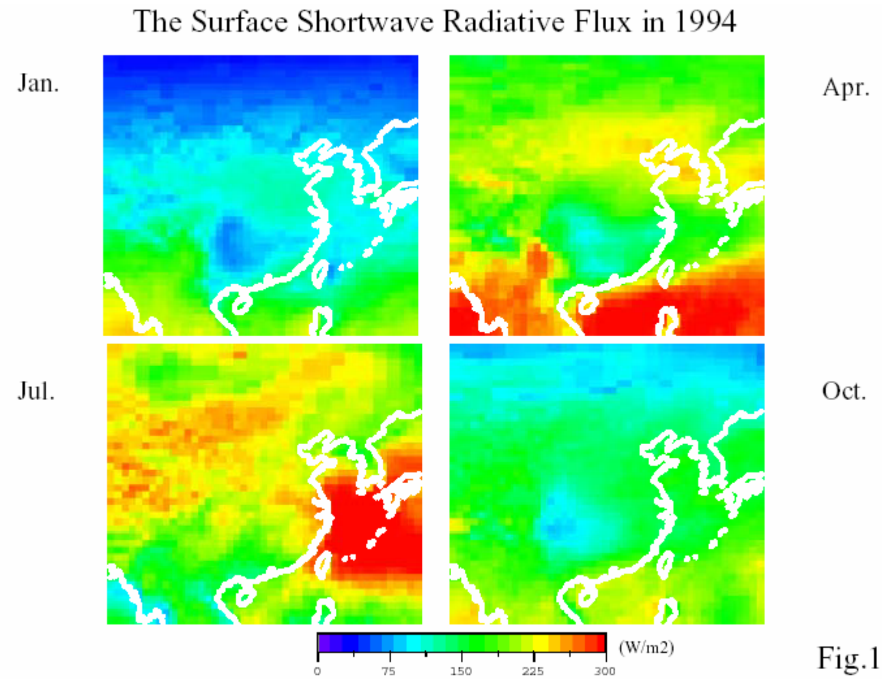

Fig.1 Monthly-mean downward shortwave radiative fluxes at the surface over China for January, April, July and October in 1994.

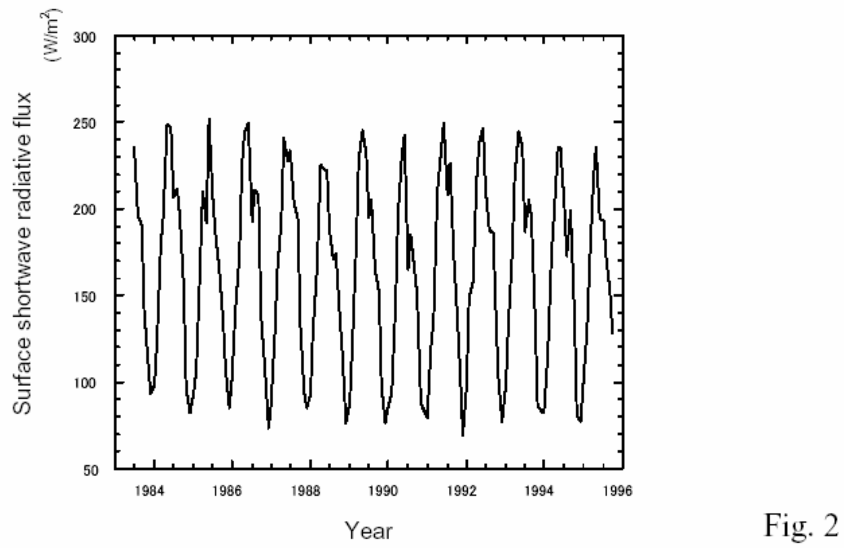

Fig.2 Time-series of S(N) in Beijing from 1983 to 1995.

3. Comparisons of the two datasets at several stations and the geographical features

We made a comparison between the two datasets. Figures 3 presents time series of Beijing, Hailar and Lhasa cases, respectively. S(Langley) is systematically larger for Beijing case, and both methods are almost the same for Hailar case, and S(N) is larger on the whole for Lhasa case. Figure 4 shows a map of the observation points with results of the comparison. From this figure, we find following geographical features, that is, S(Langley) is larger in big cities like Beijing and Shanghai, and both methods are almost the same in moderately-sized cities such as Hailar, and S(N) is larger in the west area near the Tibetan plateau. These features suggest room for improvement of both methods such as validity of the assumption about aerosol properties of big cities in estimating S(N) and topographical treatment of the west area in estimating S(Langley).

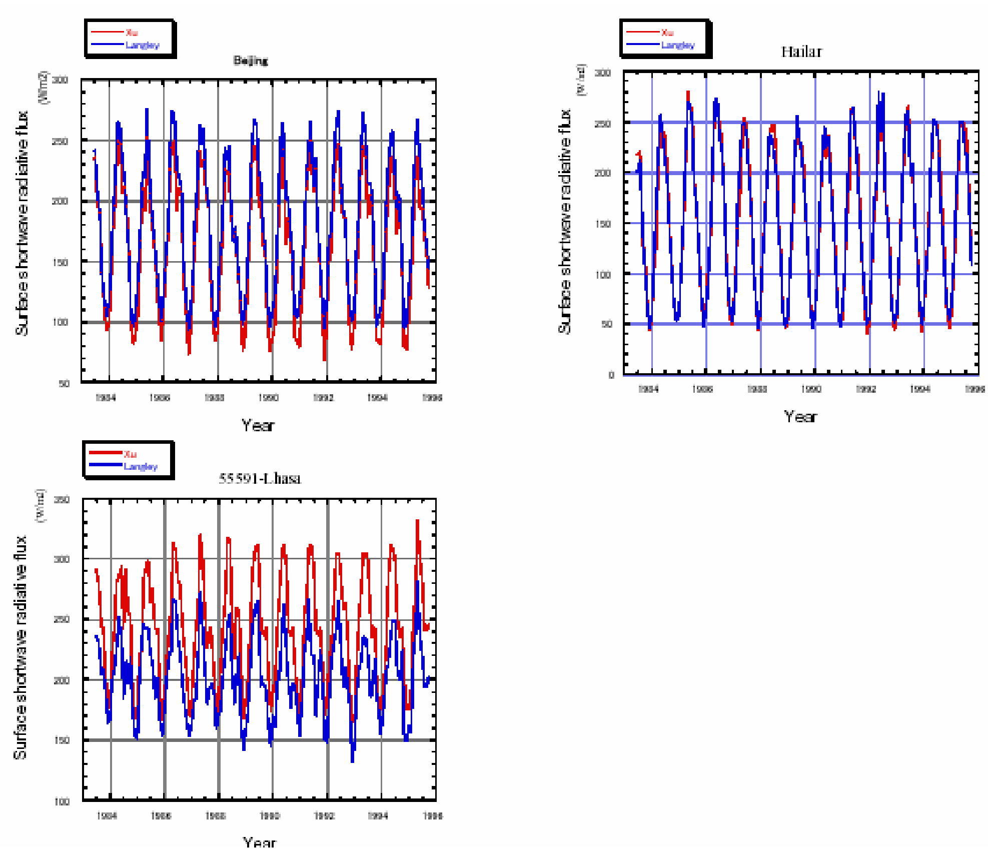

Fig.3

Fig.3 Time-series of the comparisons between S(N) and S(Langley) from 1983 to 1995 for Beijing, Hailar and Lhasa.

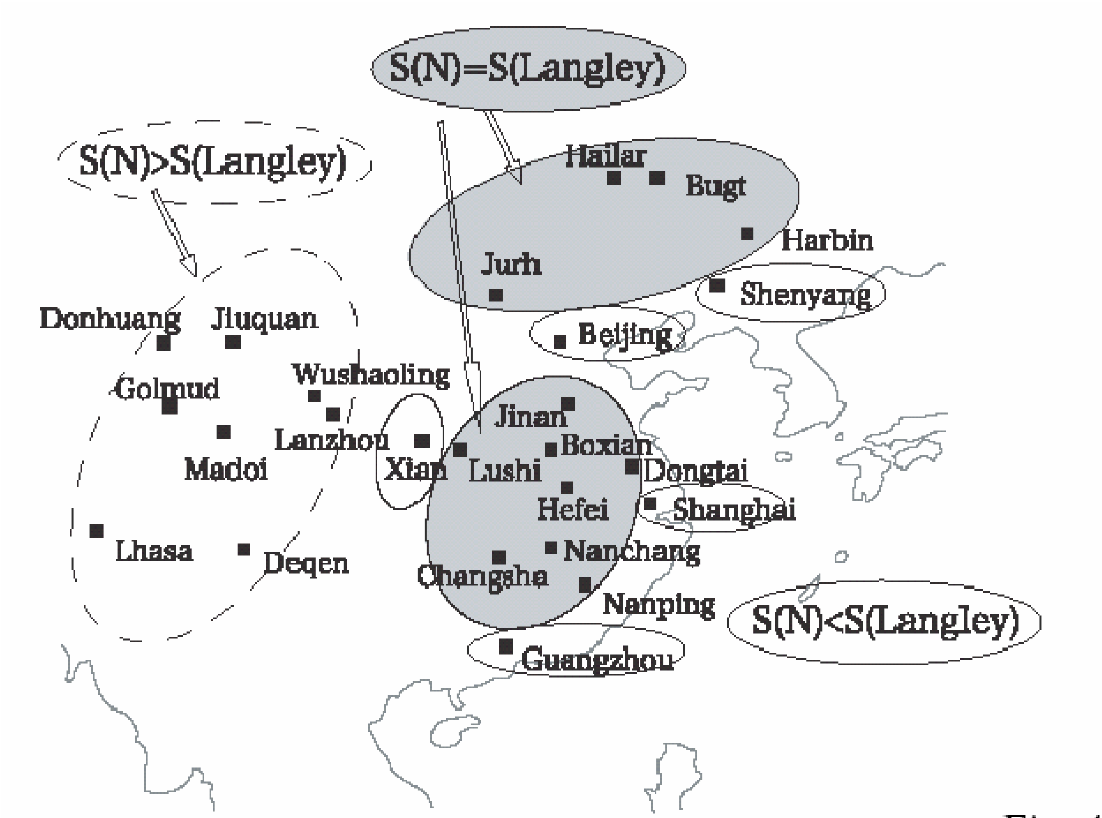

Fig.4 Geographical features of the comparison between S(N) and S(Langley)

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