

Calculation of Radiative Flux with the GOES Derived Cloud Data and Validation with SURFRAD Observations

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Abstract

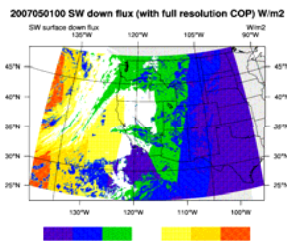
Radiative flux is one of the most important forcings used in land surface model which decides the model simulation of soil moisture, soil temperature etc. In this study the GOES derived Cloud Optical Property (COP) product was used in the four-stream radiative transfer code (Fu-Liou) to calculate the radiative flux. The model simulation results were validated with the SURFRAD measurements. We also compared the four-stream model simulation results with the current AFWA operational model-AGRMET radiative flux. The results indicated that using Four-stream radiative transfer model with the COP data the accuracy of radiative forcing estimation (especially the SW forcing) in cloudy conditions can be improved.

Datasets

1 COP data –the cloud microphysical properties (cloud effective radius, cloud temperature and cloud height etc.) was derived from the GOES observations by AER. In this study, cloud effective radius, cloud temperature and cloud height was used in the model calculation. The cloud temperature is used to classify the cloud particle phase and cloud height is used to determine the cloud levels in the model.

2 SURFRAD flux observations - the Surface Radiation Budget Network (SURFRAD) has seven stations operating in climatologically diverse regions. SURFRAD SW and LW measurements were used in this study.

3 AGRMET flux simulation - the AGRMET model uses the empirical methods developed by Shapiro and Idso to calculated the shortwave and longwave radiative fluxes.



Fu-liou model calculated Shortwave radiative flux with the GOES-west derived COP data



SURFRAD validation sites

Model description

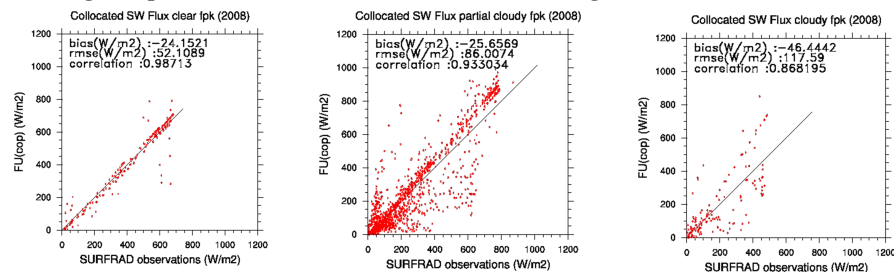
The four-stream radiative transfer model Fu-Liou code is an plane-parallel radiative transfer model which provides 2 and 4 stream radiative transfer solver (Fu et al. 1993, 1996). This model also used the delta-Eddington approximation which enable the model to calculate more accurate and efficiently. Here listed the major characteristics of the model:

| Number of Bands | SW | 6 |
|----------------------------|---|--|
| | LW | 12 |
| Parameterized Cloud Optics | Extinction, Single Scatter Albedo, Asymmetry Parameter Simple Henyey-Greenstein Phase Function even for Ice clouds | |
| Cloud parameterization | Water Clouds | Stephens(1978) eight cloud cases particle size distributions |
| | Ice cloud | Hexagonal Crystals, Effective Size D_e , Geometric ray tracing $\alpha > 30$ & Mie Ice refractive index from Warren(1984) Ice Particle Distributions Heymsfield (1975), FIRE(1986), Heymsfield&Platt(1984). |

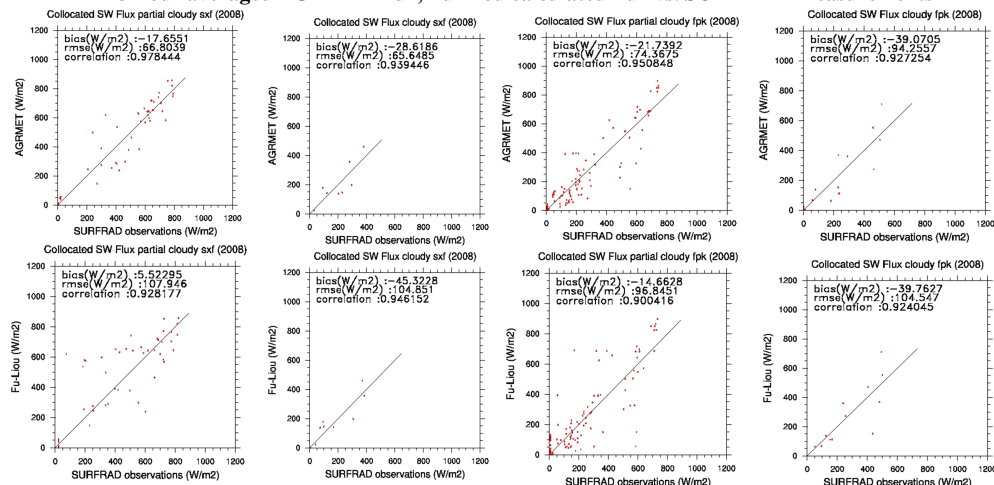
Results and Discussion

The statistic results indicated that SW radiative flux in the cloudy sky conditions can be accurately calculated using four-stream radiative transfer model and the COP data. Which can be incorporated into the land surface model to improve the forcing calculation and further more to improve the land surface property calculation. In our current study with the high temporal resolution COP data we get good statistics results. But in this study a lot of data is missing (only fraction of 200807-200812 data was used) and we only made a simple linearly average to get the 3 hourly mean therefore the 3-hourly averaged flux is just comparable with the AGRMET results. Further study with more COP data is necessary to improve the radiative flux calculation.

High temporal resolution radiative flux calculation using Fu-Liou model with COP data



3-hour averaged AGRMET flux, Fu-Liou calculated flux vs. SURFRAD Measurements



References:

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