Outgoing Longwave Radiation and Its Diurnal Variation from Combined FY3D and FY4A

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Introduction

The outgoing longwave radiation (OLR) is a crucial parameter for studying many areas in the atmospheric science, including the investigations of the cloud/water vapor/radiative interaction processes, climate variability, and for climate change monitoring and numerical model evaluation and diagnostics, etc. The OLR has continued being observed or estimated from Fengyun meteorological satellites, including solar orbit satellites (such as FY3D/MERSI) and geostationary satellites (such as FY4A/AGRI).

The advantage of solar orbiting satellites is global coverage. Thus it is difficult to reflect the diurnal variation of OLR for twice observations a day. While geostationary satellites are observed 24 times a day, which can accurately describe the diurnal variation of OLR. But its coverage is limited. Therefore, the development of OLR fusion products combined with solar orbit satellite and geostationary satellite, can improve product accuracy without losing coverage advantage. In this study, we use OLR from FY4A and FY3D to build a fusion OLR product to correct the diurnal variation of OLR, and get good results.

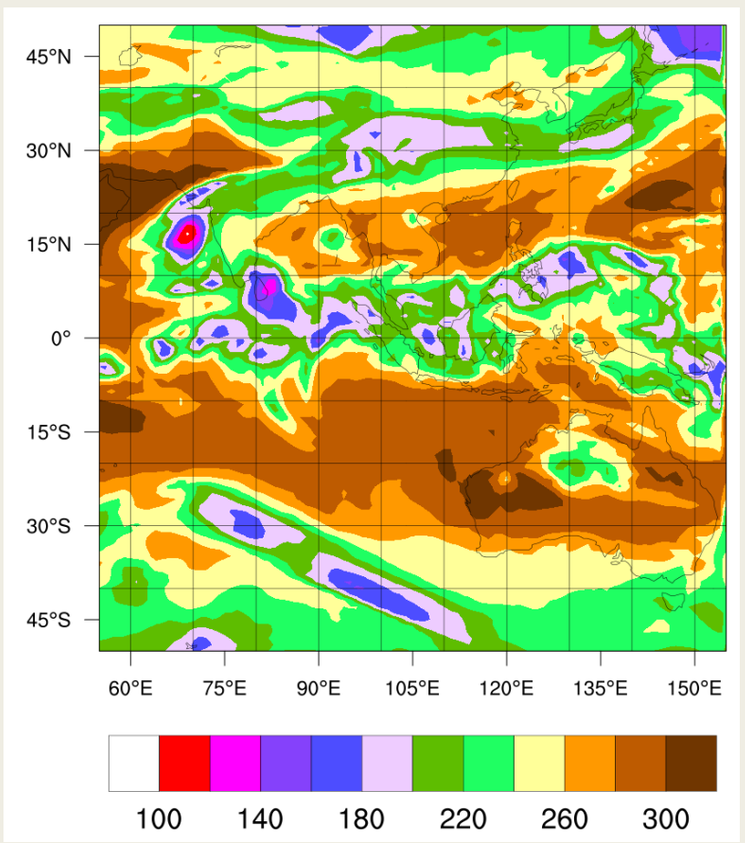
Method

The data merging strategy of HIRS OLR CDR to deal with the problem of diurnal variation was used here. To be specific, a blending procedure is devised to merge FY3D/FY4A OLR data for the daily OLR determination. Since the FY3D/MERSI OLR retrieval has higher precision and is considered as the absolute radiometric reference, the FY4A OLR is adjusted towards the FY3D OLR within a processing unit termed “7-day boxcar” on the grid-by-grid basis (CDR Program Document Number: CDRP-ATBD-0526).

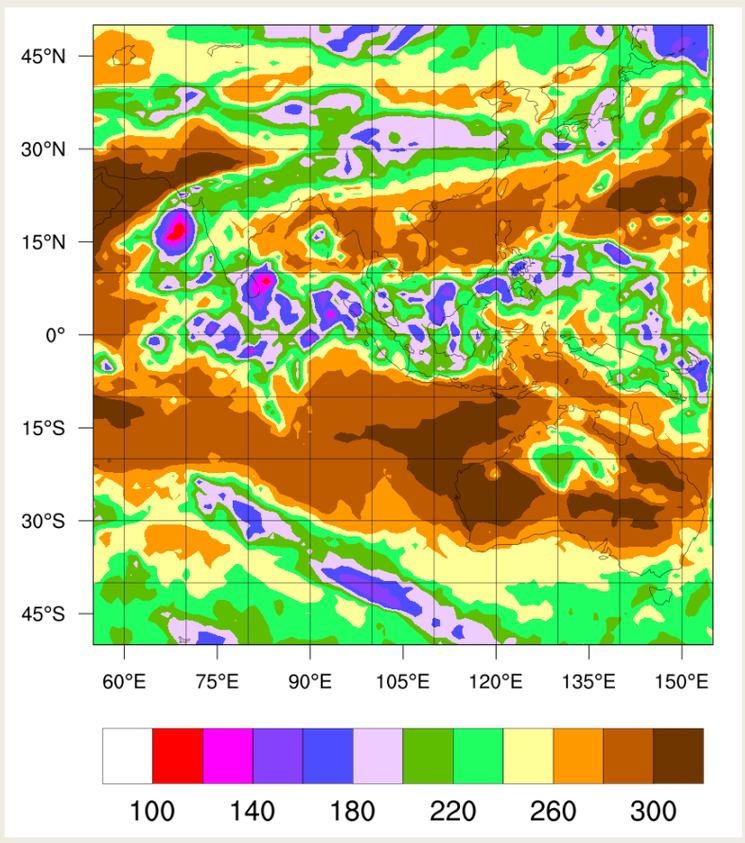
Result and Validation

FY3D/FY4A OLR on Oct. 26, 2019 was tested on this method. And HIRS OLR CDR was used as verification source. The result showed that merged OLR plots more fine structure compared with FY3D OLR. The RMSE is 10.47W/m2 for merged OLR, which is higher than FY3D OLR and lower than FY4A OLR. But the correlation coefficient is comparable to FY4A OLR.

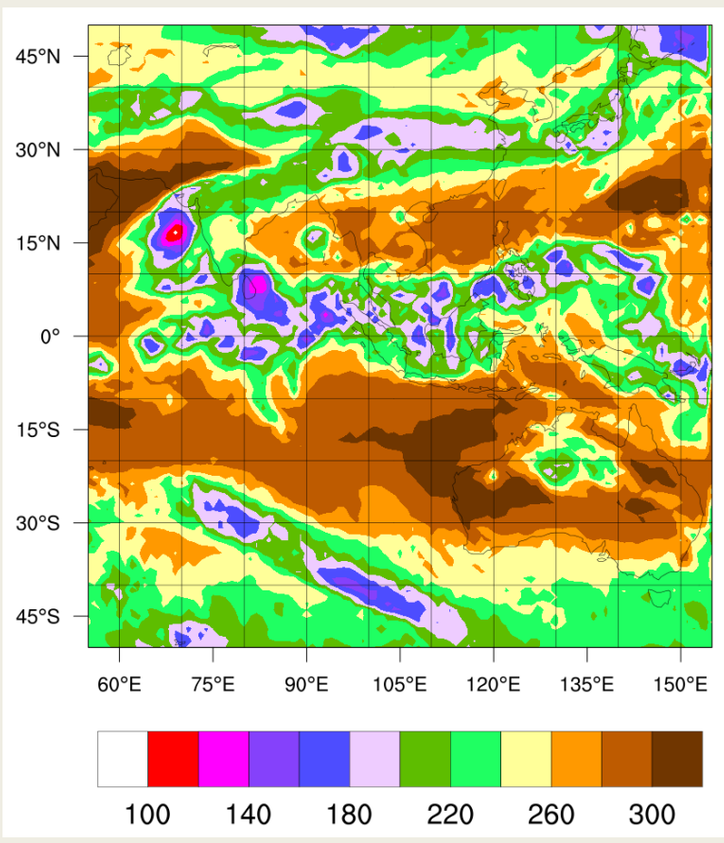
This method can effectively solve the problem of diurnal variation of polar-orbiting satellites. But the coverage of FY4A is limited. In the future, we will consider the FY-polar-orbiting satellite daily variations correction using more geosynchronous satellite data sets.



FY3D daily mean OLR 2019/10/26
RMSE:14.70W/m2 R:0.93 Bias:2.95W/m2



FY4A daily mean OLR 2019/10/26
RMSE:7.92W/m2 R:0.98 Bias:3.92W/m2



Merged OLR 2019/10/26
RMSE:10.47W/m2 R:0.97 Bias:2.97W/m2

References

Climate Data Record (CDR) Program, Climate Algorithm Theoretical Basis Document (C-ATBD), Outgoing Longwave Radiation (OLR)-Daily CDR Program. CDRP-ATBD-0526, Configuration Item Number: 01B-21,Revision 1/June 1, 2014, DSR Number: DSR-661.

Lee, H. T., Gruber, A., Ellingson, R. G., Laszlo, I. (2007). Development of the HIRS outgoing longwave radiation climate dataset. Journal of Atmospheric and Oceanic Technology, 24(12), 2029–2047.