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Some considerations for constructing global spectral OLR climatology from the FORUM mission: radiance-to-flux conversion and spatial gap filling

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Broadband outgoing longwave radiation (OLR) has been a critical quantity to monitor for a variety of studies such as energy budget, climate change, as well as climate model evaluation. A well-known challenge in the use of broadband OLR in climate studies is that the compensating biases to different spectral bands can lead to a seemingly good result but for the wrong reasons. From this perspective, spectrally resolved OLR has its advantage as it can directly reveal the decomposition of OLR in each spectral band and can, at the same time, be related to temperature, humidity, and clouds in the different part of the atmosphere.

This study addresses two questions closely related to the FORUM mission design and for the feasibility of deriving global spectral OLR climatology from the FORUM mission.
1. What is the uncertainty estimation for such radiance-to-flux inversion for FORUM observations, for spectral OLR as well as for broadband OLR?
2. Given the 100-km sampling interval of the FORUM mission, how to produce meaningful climatology of spectral OLR that is useful for radiation budget and model evaluation studies?

We carry out an observing system simulation experiment to answer the above questions. First, we have produced 15 years of synthetic nadir-view radiances over the entire globe from the 6-hourly ERA-interim reanalysis and then sampled such synthetic data sets in a pattern similar to the proposed FORUM sampling pattern. Then we performed spectral flux estimations based on the synthetic FORUM observations and compared with the accurate spectral flux climatology averaged over the 6-hourly full datasets. We also explore whether the spatial gap-filling technique can be used to improve the estimation of climatology (monthly, seasonal, and annual-mean) from the 15-km field of views of FORUM observation for every 100 km intervals.