Nadir Correction of AIRS Radiances

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The present generation of space borne hyper-spectral infrared sounders like Atmospheric Infrared Sounder (AIRS), Infrared Atmospheric Sounding Interferometer and Cross-track Infrared Scanner enable terrestrial radiometric measurements to achieve well beyond what their predecessors can in terms of spectral resolution. With several one-dimensional retrieval packages (e.g. IMAPP and UKMO SAF 1D-Var package) freely available, one immediate benefit these data bring for some Numerical Weather Prediction (NWP) centers is the possibility of assimilating high quality vertical temperature and moisture profiles retrieved from the observed radiances in NWP. This is very useful for forecasting weather over the Maritime Continent where in-situ weather sensors are sparse.

However, radiometric measurements from these cross-track scanners suffers from "limb effects" whereby the intensity of the observed radiance at a given frequency changes due to the increase of atmospheric optical path with increasing with scan angle. Limb effects contributes to about 4K to 11K differences in the mean observed brightness temperature between the nadir and the extreme scan angle for AIRS over equatorial Indian Ocean and western Pacific Ocean. For many AIRS channels, the standard deviation of brightness temperature also deviates increasingly away from the nadir position. Correcting the limb effect on the radiance measurements is an important first step preceding the retrieval of the atmospheric variables.

A statistical method is presented here that potentially can correct for the limb effect in off-nadir AIRS channel radiances, using the channel radiance itself and principal components of the other channel radiances to account for the multi-collinearity. A method of selecting an optimal set of predictors is proposed and demonstrated for one and two principal component predictors. Validation results with a subset of AIRS channels in the spectral region 649 cm^{-1} – 2664 cm^{-1} is discussed.

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