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Using IASI to Simulate the Total Spectrum of Outgoing Longwave Radiances

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A new method of deriving high-resolution top-of-atmosphere spectral radiances in 10181 bands over the whole outgoing longwave spectrum of the Earth, is presented. Theoretically derived correlations between channels measured by the Infrared Atmospheric Sounding Interfermeter (IASI) on the MetOp-A satellite and unobserved wavenumbers are used to estimate far infrared radiances at 0.5 cm-1 intervals between 25.25 - 644.75 cm-1 (the far infrared), and additionally between 2760 - 3000 cm-1. The spectrum is validated by comparing the Integrated Nadir Longwave Radiance (INLR) product (spanning the whole 25.25 - 3000 cm-1 range) with the corresponding broadband measurements from the Clouds and the Earth's Radiant Energy System (CERES) instrument on the Terra and Aqua satellites at points of simultaneous nadir overpass, revealing mean differences of 0.3 Wm-2sr-1 (0.5% relative difference). This is well within the uncertainties associated with the measurements made by either instrument, however, with a noticeable contrast of the biases when separating nighttime and daytime scenes. In the absence of an operational spaceborne instrument that isolates the far infrared this product provides a useful proxy for such measurements, within the limits of the regression model it is based on, which is shown to have very low root mean squared errors. The new high resolution spectrum is presented for global mean clear and all skies where the far infrared is shown to contribute 44% and 47% to the total INLR respectively, consistent with previous estimates. In terms of the spectral longwave cloud effect (CINLR), the far infrared contributes 19% and in some subtropical instances appears to be negative, results that would go un-observed with a traditional broadband analysis.