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Auto-correcting for atmospherical effects in thermal hyperspectral measurements

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Correct estimation of soil and vegetation thermal emissivity's has been of huge importance in remote sensing studies. Field measurements of the leaf/soil and canopy emissivity can lead to estimations of water content. Consequently several studies have been performed with the objective of identifying the spectral behavior of the emissivity. However such measurements provide additional challenges before any retrieval can successfully be performed. While in laboratory the influence of the atmospheric conditions can be controlled in field experiments this cannot be done. In most cases such atmospheric correction however requires detailed knowledge of the atmospheric constituents at the time of the measurements. The objective of this research was to create an auto-atmospherically correct thermal hyperspectral emissivity measurements for retrieving canopy water content.

For this hyperspectral thermal measurements were obtained during ESAs REFLEX campaign in 2012 using a MIDAC FTIR radiometer. MODTRAN simulations were used to construct a simple quadratic radiative transfer model that couples atmospheric transmissivities to the different gas constituents. This model was afterwards used to estimate the concentrations of H20 (g) and CO_2 (g). The radiative measurements were afterwards corrected for these gas absorptions. Finally a temperature emissivity separation was applied to estimate the emissivities of the different land surface components.

Gas concentrations were validated against measurements of a LICOR 7500 taken in parallel to the MIDAC measurements. It is observed that in general the relative errors are around 25% of the LICOR measurements, which are in the same range as the instrumental errors of the eddy-covariance system (15-30%).

The correction of the absorption features proved however more difficult and resulted in overestimations of the correction-terms; 1) because spectral collocation of the simulations with the observations proved troublesome, and 2 because some of the errors occur from trying to correct observations inside deep absorption features ($0.1<\tau<0.3$).