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Interactive mapping of volcanic emissions with high-performance radiative transfer modeling tools

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The estimation of plume composition from radiance measurements is based on the use of radiative transfer (RT) modeling to fit the observed radiance spectra. In the thermal infrared (TIR), we must account for the temperature, emissivity, and elevation of the surface beneath the plume, plume altitude and thickness, and local atmospheric temperature and humidity. Our knowledge of these parameters is never perfect, and interactive mapping allows us to evaluate the impact of these uncertainties on our estimates of plume composition.

To facilitate this interactive mapping, the Jet Propulsion Laboratory (JPL) and Spectral Sciences, Inc. (SSI) are developing a new class of mapping tools based on the implementation of RT modeling on graphics processor (GPU) hardware. We will achieve a 100-fold increase in processing speed, relative to conventional CPU-based processing, and thus enable fully-interactive estimation and visualization of plume composition. The heritage for our new tools is based on the Plume Tracker toolkit, developed at JPL, and MODTRAN RT model, developed by SSI. Plume Tracker integrates retrieval procedures, interactive visualization tools, and an interface to a customized version of MODTRAN under a single graphics user interface (GUI). Our new tools will incorporate new adaptations of MODTRAN to optimize modeling of the radiative properties of chemical and aerosol clouds.

This presentation will include a review of the foundations of plume mapping in the TIR and examples of the application of Plume Tracker to ASTER, MODIS, and AIRS data. We will focus on our current efforts to validate the Plume Tracker retrievals for ASTER data acquired over the Turrialba and Kilauea Volcanoes in Costa Rica and Hawaii, respectively. Finally, we will discuss the application of our tools to data from new and future instruments, such as the airborne Hyperspectral Thermal Emission Spectrometer and TIR data from the upcoming Hyperspectral and Infrared Imager mission.