A NEW GPU-ENABLED MODTRAN THERMAL MODEL FOR THE PLUME TRACKER VOLCANIC EMISSION ANALYSIS TOOLKIT

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Summary

quantification Real-time of volcanic gaseous and particulate releases is important for (1) recognizing rapid increases in SO_2 gaseous emissions which may signal an impending eruption; (2) characterizing ash clouds to enable safe and efficient commercial aviation; and (3)



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quantifying the impact of volcanic aerosols on climate forcing. JPL has developed state-of-theart algorithms, embedded in their analyst-driven Plume Tracker (PT) toolkit, for performing SO₂, NH_3 , and CH_4 retrievals from remotely sensed thermal-infrared (TIR) multi-spectral imagery. While PT provides accurate results, it typically requires extensive analyst time. MODTRAN atmospheric and local plume thermal radiance calculations are a major bottleneck in this Spectral Sciences, Inc. (SSI) in processing. collaboration with JPL is porting these slow TIR algorithms onto massively parallel, relatively inexpensive and commercially-available GPUs. Specifically, SSI is developing a GPU implementation of the band model Voigt in-band transmittance algorithm. These calculations were decomposed into 3 functions, individually implemented as GPU kernels, and tested for accuracy and performance relative to the CPU code. Speedup factors of 14 to $30 \times$ were realized for individual processing components on an NVIDIA GeForce GTX 295 graphics card with no loss of accuracy. Due to the separate host (CPU) and device (GPU) memory spaces, a redesign of the MODTRAN architecture was required to ensure efficient data transfer between host and device, and to facilitate high parallel throughput. Currently, we are incorporating the separate GPU kernels into a single function for calculating the Voigt in-band transmittance, for later integration into the re-architectured MODTRAN6 code. Our overall objective is a 100-fold increase in the computational speed, obtained by combining the GPU processing with Plume retrieval efficient Tracker more algorithms. Since the Plume Tracker runs on Windows-based platforms, the GPU-enhanced MODTRAN6 will be packaged as a DLL. We do however anticipate that the accelerated option will be made available to the general community through the MODTRAN6 API (Application Programming Interface).

In-band Voigt Transmittance Components

- - Remaining CPU computations are the current bottleneck
 - In particular, the re-architecturing of MODTRAN to set up the GPU calculations is slow.