Nowcast Modeling

Research Objective

- Provide the Warfighter with precise, localized, and actionable environmental information/predictions with confidence estimates.
- Improve microscale (2-2000 m, minutes) & mesoscale (2-200 km, minutes to hours) modeling capabilities in Army relevant settings.
- Exploit increasing, but often non-traditional, sensor data to inform environmental state and evolution.
- Estimate and express uncertainty due to model errors and incomplete initial and boundary conditions.

Challenges

- Requires near real time performance from the models relying on limited capabilities of tactical computers.
- Assimilation of observations in high-resolution simulations – availability, methods, processes.
- Forecasting mesoscale to microscale – e.g., terra incognita gap, using non-turbulent mesoscale as boundary conditions for turbulent microscale.
- Representing chaotic turbulent flows in forest, urban, and mountainous terrain.

ARL Facilities and Capabilities Available to Support Collaborative Research

- High Performance Computing capabilities for model development, testing, validation, and transition.
- Microscale Atmospheric Boundary Layer Environment (ABLE) model prototype codes developed using both Lattice Boltzmann (ABLE-LBM) and vortex filament (ABLE-VFM) methods.
- Numerical modeling framework developed to manage source code complexity & increase development efficiency.
- Coordinated triple-LIDAR algorithm developed for detection of turbulent flow over mountainous terrain. This algorithm is very useful for model validation.

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- Expertise on parallel/massive parallel computing including GPU and distributed computing.
- Expertise in novel observing and assimilation techniques effective for high-resolution, thermally impacted simulations.
- Expertise in uncertainty quantification (forward propagation problem, inverse problem, etc).
- Phenomenological expertise on atmospheric turbulence modeling, complex microscale flows over mountains and in urban environments.
- Laboratory capabilities (wind tunnel, water channel) for idealized fluid flow tests to evaluate the microscale numerical model.

List of Related Publications: