Time-Varying Flow Analysis and Visualization for Climate Science

### Scalable Computation of Field Lines and Surfaces
The starting point of all flow analysis is particle advection.

#### Streamlines and Pathlines
Particle trajectories are connected into curves.

- **Strong Scaling Performance**
  - Strong scaling performance time shows 3x improvement over previously published results.
  - Teleconnections can be derived from correlations in source and destination of field lines.

#### Stream Surfaces
Field lines are connected into surfaces.

- Stream surface computations can cause severe load imbalance. Our work-stealing algorithm had < 5% imbalance at scale.

### LaRangian Coherent Structures
The divergence in pathlines can segment flow structures.

#### Scalable Computation of Deterministic FTLE
The Finite-Time Lyapunov Exponent (FTLE) is computed from pathlines seeded at each time step.

### Information Theoretic Feature Detection
Data distribution statistics can also classify features.

#### Time Activity Curves
Temporal summarization helps scientists understand underlying time series in climate models.

### Time Histograms
Time histograms computed at block levels can serve as visual signatures of a feature’s behavior over space and time.

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