Adaptive Observation Strategies for Advanced Weather Prediction

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Over the past 40 years, there have been significant improvements in weather forecasting. These improvements are primarily due to (1) improved model physics and increased numerical grid resolution made possible by ever-increasing computational power, and (2) improved model initialization made possible by the use of satellite-derived remotely sensed data. In spite of these improvements, however, we are still not able to consistently and accurately forecast some of the most complex nonlinear diabatic mesoscale phenomena – particularly out beyond 3 days. These phenomena include: propagating mesoscale convective complexes, tropical cyclones, and intense extratropical squall lines and rainbands (i.e., phenomena which develop over very fine spatial scales of motion and temporal periods and are dependent on convection for their existence). Poor observations of convection, boundary layer dynamics, and the larger scale pre-convective environment are often the cause of these substandard simulations, and thus require improved observational data density and numerical forecast grid resolution.

The problem with uniform increases in both observational data density and numerical forecast grid resolution is that, quite often, great volumes of the atmosphere are relatively uniform; hence, the increased density results in a great deal of redundant data. For example, numerous samples of the bulk of the same air mass are not as valuable at the same number of observations accurately describing the location of the front between air masses. This proposal explores dynamic data assimilation strategies that identify *critical* data necessary to improve forecast accuracy, and hence reserves as much computational power as possible for model physics.

This proposal looks at data assimilation strategies that focus on critical, rather than typical, data. We will use a weather forecasting system based on a dynamically adapting grid to create a synthetic/optimally sampled data set and then look at the forecast accuracy of simulations performed with critical data inclusion / denial.