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Linked Environments for Atmospheric Discovery (LEAD): A Cyberinfrastructure for Mesoscale Meteorology Research and Education

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Linked Environments for Atmospheric Discovery (LEAD), a 5-year National Science Foundation funded a Large Information Technology Research (ITR) grant, has the following overarching goals:

To democratize the availability of advanced weather technologies for research and education, lowering the barrier to entry, empowering application in a grid context, increasing the realism of how technologies are applied, and facilitating rapid understanding, experiment design, and execution.

To improve our understanding of and ability to detect, analyze, and predict mesoscale atmospheric phenomena by interacting with weather in a dynamically adaptive manner.

To that end, LEAD is creating an integrated, scalable framework in which meteorological analysis tools, forecast models, and data repositories can operate as dynamically adaptive, on-demand, grid-enabled systems that a) change configuration rapidly and automatically in response to weather; b) respond to decision-driven inputs from users; c) initiate other processes automatically; and d) steer remote observing technologies to optimize data collection for the problem at hand. The initial application domain for LEAD is thunderstorms and related severe weather forecasting on scales ranging from

a few kilometers to over a thousand kilometer.

Within this context, LEAD is developing capabilities a) to allow models and other atmospheric tools to respond dynamically to their own output, to observations, and to user inputs so as to operate as effectively as possible in any given situation; b) to allow models and other atmospheric tools to dynamically task adaptive observing systems, with an emphasis on Doppler radars, to provide data when and where needed based upon the application, user or situation at hand; and c) appropriate adaptive capabilities within supporting IT infrastructures. Containing virtually all elements of modern cyberinfrastructure – from adaptive sensors and high-performance computing and networking to huge data sets, human decision making and complex virtual organizations – LEAD functionality also has been integrated with the TeraGrid as a successful TeraGrid Science Gateway project and continues to serve as an *avant-garde* system for the meteorological and computer science communities.

We describe in this presentation the concepts, architecture, implementation, and use of LEAD systems in education and research, the underpinning of which is a series of interconnected, heterogeneous virtual IT "Grid environments" designed to provide a complete framework for mesoscale meteorology research and education. Ultimately, the LEAD environments will enable researchers, educators, and students to run atmospheric models and other tools in a much more on-demand setting than is now possible.