



# An Automated Decision and Control System for Numerical Weather Prediction Research and Education: Results from a Recent Experiment

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## Abstract

During the 2005 spring severe weather season, the CAPS forecast system was used to provide real time storm-scale forecasts, one of several storm-scale numerical predictions from participating prediction centers, covering the eastern 2/3rds of the US to the participants in the 2005 Storm Prediction Center (SPC) Spring Severe Weather Experiment. The SPC Spring Program is designed to further the training of the severe weather forecasters, researchers and students in terms of thunderstorm prediction via numerical modeling output and to further our understanding of numerically simulated severe weather. In addition, the experiment exercises the computing and networking infrastructures required for large-scale remote parallel computing. This poster contrasts the CAPS automated forecast system and the proposed LEAD forecast and research control system and presents preliminary results from the 2005 Spring Program and identifies areas for future fault tolerance research.

## Research Objectives

- Assess the workflow and fault characteristics of the CAPS forecast software for use in the design of the LEAD Portal and workflow components
- Assess the performance and reliability of the network and parallel computer resources, data storage and archive systems associated with the real time weather prediction environment
- Provide the key functional requirements for building a discovery environment for meteorologists to study several types of high-impact mesoscale weather including severe storms and hazardous winter weather
- Archive high-resolution (2-km grid horizontal grid spacing) storm-scale forecasts over an extended period (two months)

## CAPS Forecast System

The CAPS real time forecast system, containing 40,000+ lines of PERL code, was developed over the past 10 years to enable real time data assimilation and numerical weather prediction for use in education, research and private industry. Key features of the system include:

- Automated forecasts and analyses initiated from a single Perl script (user supplied or scheduled execution)
- Performs daily forecasts and nested forecasts with 27, 9, and 3km grid spacing to 84 hours.
- Automated web site generation presents forecasts products and animations of simulated weather features and atmospheric quantities
- Automated file transfers and remote job submission

### •Key functionality:

1. Data collection and pre-processing from data sources
2. Prepare application input files and batch scripts for submission on a remote supercomputer
3. Data transfer to the supercomputer site
4. Job submission (batch script)
5. Forecast monitoring and file handling on the supercomputer
6. Post-processing, generate graphical output for web pages and analysis
7. Data transfer back to end users or web site location
8. Disk clean up and data archive

### •Human intervention is required/suggested for the following steps:

1. Building the preprocessing, analysis, forecast, and post processing template input files and batch job configurations
2. Develop software to monitor the forecast system and notify the system manager if major problem exists
3. Data transfers
4. Disk clean up and archive, checking files prior to removal
5. Fault handling (minimal fault tolerance capability exists)

## Current Limitations to the CAPS Forecast System

- A minimum of 1 week of support required per new instance of a real-time system configuration/operations
- No grid services or security usage
- 100% human created script development
- Specialized Perl programming language training required
- No data mining capabilities
- Minimal automated job monitoring
- Requires preconfigured data sub-system
- Requires preconfigured resources
- Programming required to add/modify dynamically adaptive capabilities

## CAPS Forecast System and Proposed LEAD Portal Functionality

Function	Current CAPS System	LEAD Portal
Meta data catalog and data resources	No	MyLEAD, meta data catalog, THREADS catalog
Grid services including secure job submission and file transfer and batch scheduling	No	Yes
Automated job submission	Yes, to pre-specified resources	Yes, to any grid available resource
Job configuration and reconfiguration requirements	Script editing, Unix shell environment	Experiment builder, web browser/based environment
Error handling	Limited, script generated	Performance monitoring and error handling services
Ensemble	Yes, script edit	Yes, ensemble service
Data mining and discovery	No	Yes, ADaM data mining service
Visualization	Limited, 2-d plots and animations direct to web pages	IDV service + 2-D and 3-D visualization services

## CAPS Real Time Forecast System Key Steps

