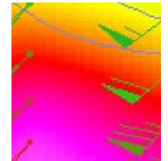
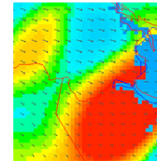
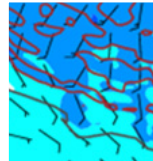


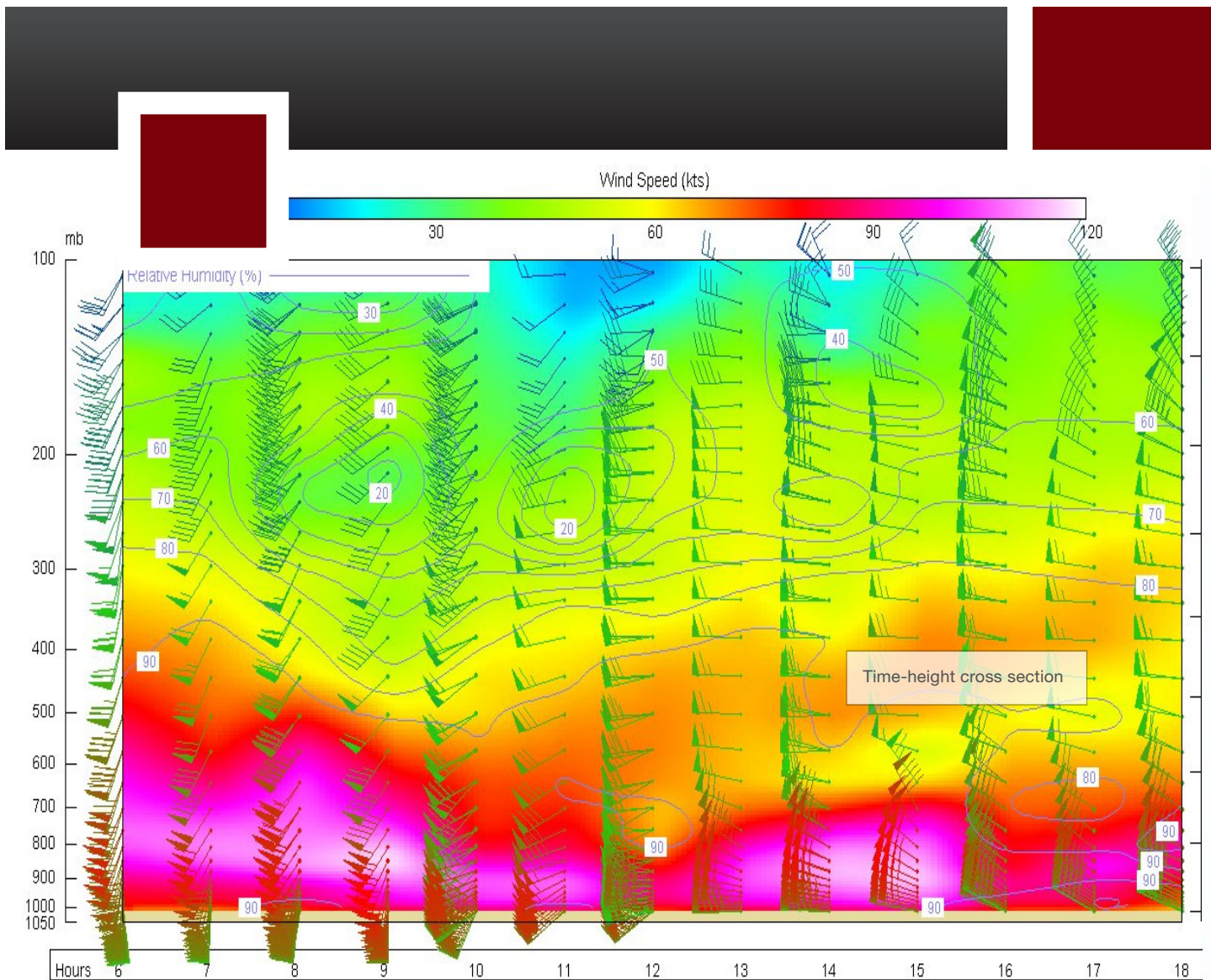


Mesoscale Analysis and Prediction  
Support System (MAPSS)

Weather Solutions for Global  
Governments and Organizations



MAPSS



## Mesoscale Analysis and Prediction Support System (MAPSS)

WDT offers a complete operational mesoscale NWP system that can be fully integrated into meteorological operations centers: The Mesoscale Analysis and Prediction Support System (MAPSS). MAPSS features the following components and capabilities:

### Weather Research and Forecasting (WRF) Mesoscale Modeling System.

MAPSS fully integrates the latest available version (currently 3.2) of the Advanced Research WRF (ARW) dynamic model and the WRF Pre-processing System (WPS).

### WDT's Customized PostWRF Application

WDT has developed a comprehensive application for post-processing the raw WRF output into parameters and formats that are applicable to operational meteorologists. PostWRF performs all necessary vertical interpolation and grid destaggering while applying a plethora of diagnostic algorithms, outputting the results into World Meteorological Organization (WMO) GRIB Edition 2 format for easy integration into a wide variety of meteorological display applications.

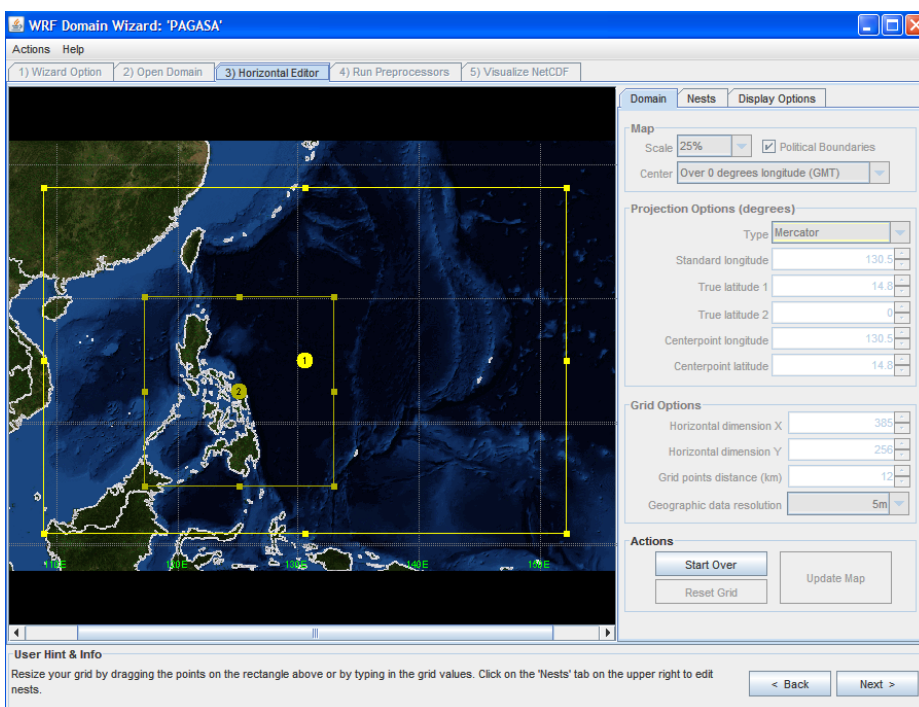
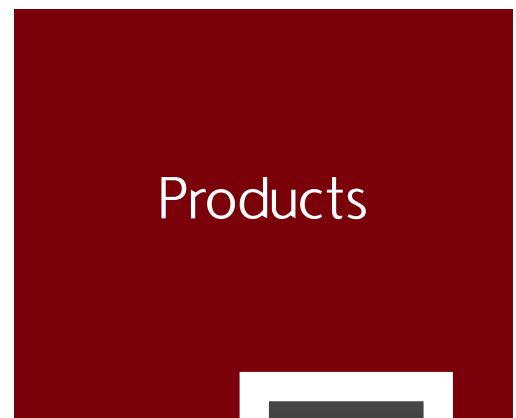
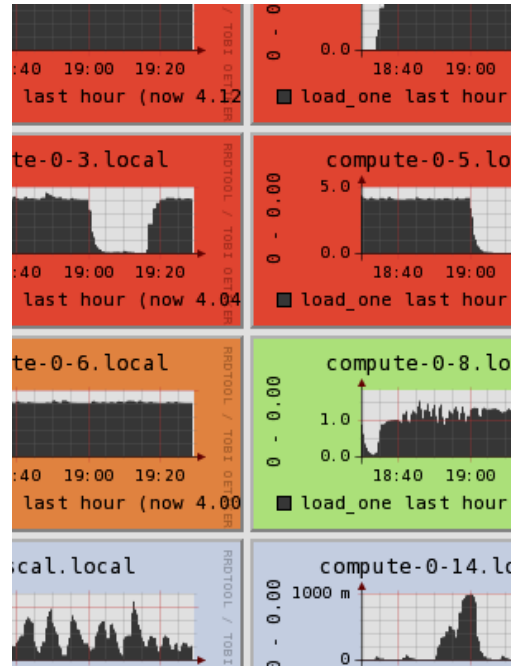
### Advanced Data Assimilation.

Whereas mesoscale models are often simply "nested" within larger scale regional or global models, MAPSS incorporates various data assimilation techniques that improve the accuracy of the forecast while reducing model "spin-up" time for producing precipitation processes. At the heart of this is Four Dimensional Data Assimilation (FDDA). FDDA is coupled with an advanced three-dimensional analysis system, which can be one of two supported systems: The Local Analysis and Prediction System (LAPS) developed and maintained by the Global Systems Division of the NOAA Earth Systems Research Lab, or the WRF Variational Analysis (WRF-Var) package supported by NCAR.

# WRF Management Portal

WDT has developed a web-based management portal that allows meteorological operations staff to monitor and manage the system without any specialized knowledge of WRF or the operating system. This optional component provides user-friendly interfaces to provide the following capabilities:

- Easy management of multiple WRF nested grids
- Includes the Java-based WRF Domain Wizard for creating and modifying domains.
- Scheduling of routine model runs, including start times, forecast length, and computing resources
- Scheduling and monitoring of forecasts
- View automated product images in PNG format via a user-friendly web page. Products are generated using WDT-develop NCAR Command Language (NCL) scripts.
- Download GRIB data to your local system directly from the system for viewing in other meteorological display systems.
- Consolidated system reference information via hyperlinks



## Products

## Contact

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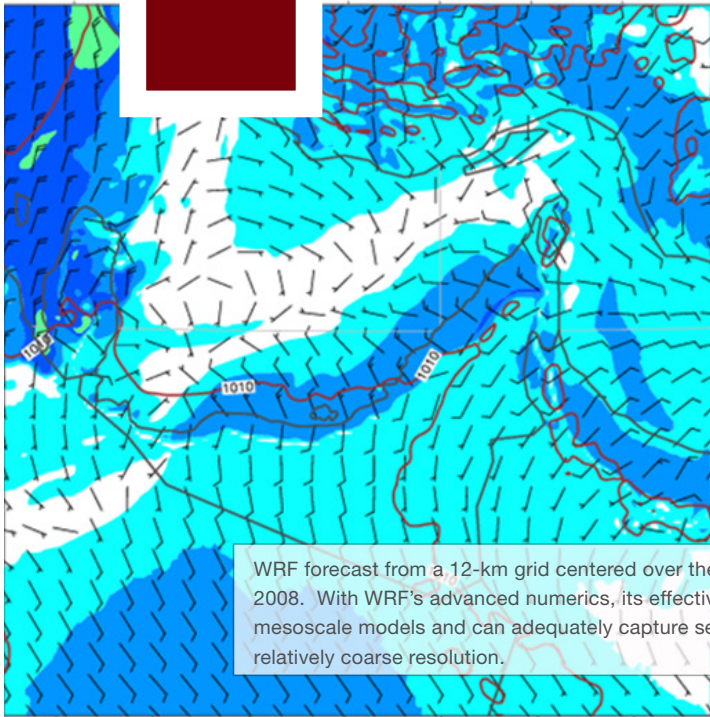
E: [bshaw@wdtinc.com](mailto:bshaw@wdtinc.com)

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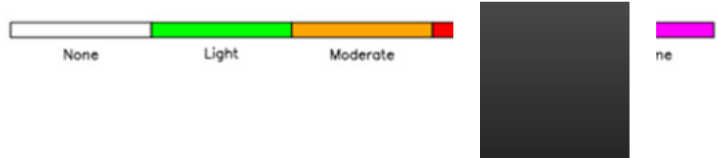
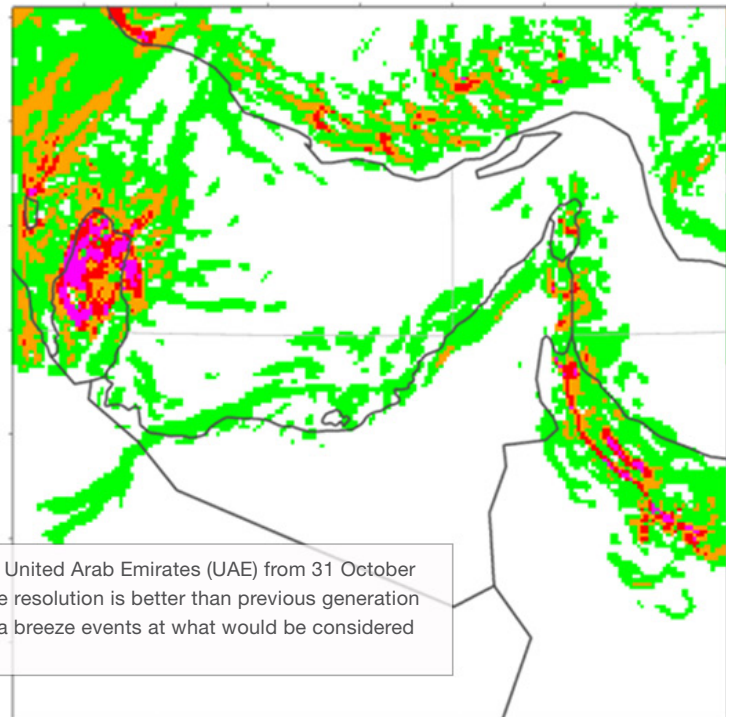
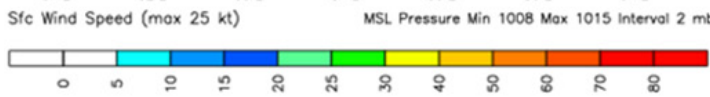
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WRF forecast from a 12-km grid centered over the United Arab Emirates (UAE) from 31 October 2008. With WRF's advanced numerics, its effective resolution is better than previous generation mesoscale models and can adequately capture sea breeze events at what would be considered relatively coarse resolution.



## WDT's NWP Experience and Capabilities

WDT has a team of NWP experts with decades of combined experience developing and/or using various NWP systems for operational weather forecasting applications, ranging from the global scale to the microscale. WRF is the primary mesoscale NWP system used by WDT for the past few years. Currently, WDT produces over 300 different WRF forecast simulations per day in its world class Oklahoma City data center, with output being provided in standard WMO formats to a variety of customers as well as being used to improve a host of other meteorological products and services.

### MAPSS Details

MAPSS is built around the WRF model, which represents leading edge technology in the field of NWP. The WRF model is now the primary regional forecast model in the U. S., and is being used by many other operational and research institutions around the world. The numerical methods used within WRF are significantly improved both in accuracy and efficiency compared to previous mesoscale models such as MM5, ARPS, and RAMS.

Although the WRF model is scientifically advanced and its open source nature ensures community use and contributions, it does not include the necessary components to allow users to easily configure it for robust and efficient operations. MAPSS provides a software wrapper around the key components of WRF to ensure reliable execution, monitoring, and data delivery.

# MAPSS Features:

## Flexible configuration

Flexible configuration. The grid spacing, temporal output frequency, update frequency, output products, etc. are all configurable, allowing a system to be tailored directly to the needs of the client. The configuration options are only limited by computational and scientific applicability constraints.

## Scalable Architecture

MAPSS is typically implemented on Linux cluster systems built from commodity off-the-shelf servers, which allows redundancy and easy scalability for future growth and/or technology refresh.

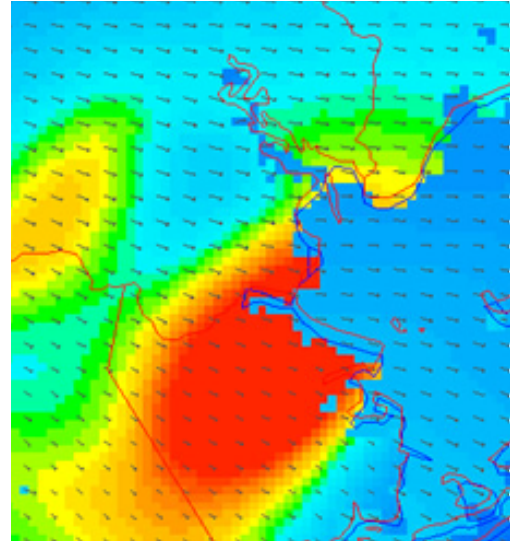
## User Friendly WRF Management Portal

The WRF Management Portal is a web-based interface for managing the WRF domain(s), run schedule, system status, etc. without the need for specialized knowledge.

## Unique Data Assimilation

Unique data assimilation. MAPSS includes support for multiple data assimilation schemes that can be used individually or combined to provide a powerful capability to leverage multiple types of observations. Most operational centers only use variational analysis or similar techniques, and many do not perform any extra data assimilation for their regional models, relying only on the global model that it is nested within for data assimilation by proxy. WDT currently supports three data assimilation options within MAPSS:

- **Four Dimensional Data Assimilation (FDDA)** using observation and/or grid-based Newtonian relaxation (“nudging”). This method is most useful for assimilating platforms that provide basic meteorological state variables at high temporal resolution.
- **WRF-Var Three-Dimensional Variational (3DVAR) Analysis Package.** A variational analysis package has been developed by the WRF community, and WDT has experience implementing this procedure in operations (e.g., Dubai International Airport). The strength of the 3DVAR technique is its ability to use non-traditional observations, through the use of forward models that convert model state variables into quantities directly observed by the observation platform (e.g., radiances, reflectivity, etc.).
- **Local Analysis and Prediction System (LAPS) Analysis System.** Developed and maintained by the Global Systems Division of the NOAA Earth Systems Research Laboratory, LAPS has been extensively used as a tool for initializing mesoscale models, and WDT can accommodate LAPS-based initialization within MAPSS.



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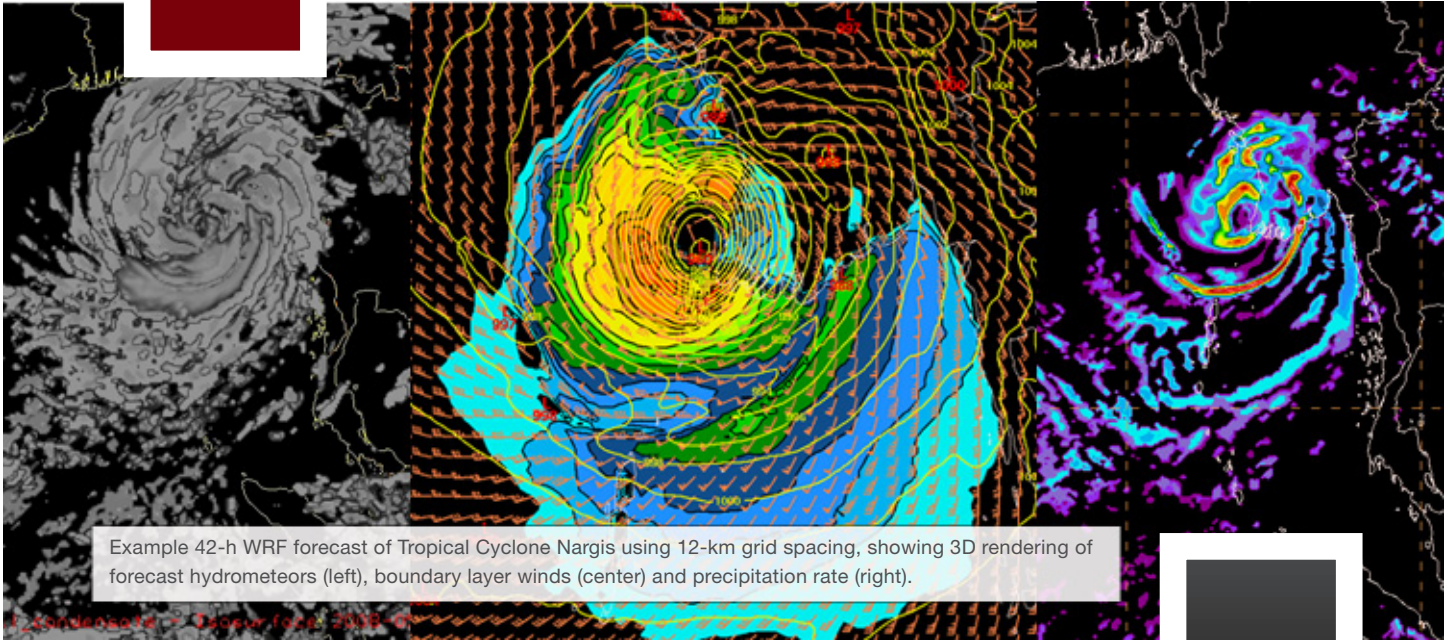
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## Output Products

Data products from the system are produced in WMO GRIB-2 format. To minimize latency, WDT's MAPSS utilizes concurrent post-processing, such that products become available as the model progresses forward in time rather than waiting for the entire forecast run to complete. Additionally, the system includes automated graphical product generation in PNG format, suitable for basic web page viewing, and the WRF Management Portal includes a viewer to display these images.

The WDT PostWRF program performs grid destaggering, vertical interpolation, and diagnostic computations to produce the following set of output products in GRIB-2 format:

### Surface products

- Temperature
- Dew Point Temperature
- Relative humidity
- Specific Humidity
- Horizontal wind components
- CAPE/CIN (surface-based, most unstable parcel)
- Lifted Index
- Pressure (surface and MSLP)
- Visibility
- Precipitation accumulation (1, 3, 6, 12, 24 hr & forecast total)
- Conditional precipitation type
- Categorical precipitation type
- Radar reflectivity
- Lightning flash density
- Cloud cover (total, low, middle, and high)

### Products on standard pressure levels

- Geopotential height
- Horizontal wind components
- Temperature
- Relative humidity
- Vertical velocity
- Absolute vorticity

### Aviation products

- Aircraft Turbulence (multiple flight levels and or layers), based on Ellrod-Knapp kinematic formulation
- Aircraft Icing (multiple flight levels), based on VVICE developed at the U.S. Aviation Weather Center
- Ceiling
- Visibility
- Cloud type
- Maximum 0-2km Low-Level Wind Shear

WDT can develop additional products within PostWRF as necessary.

## WRFControl Package

The WRFControl package is the heart of the MAPSS, providing end-to-end task management with fault tolerance, automated e-mail alerting, resource allocation, and job monitoring and logging.

## Management Portal

The MAPSS Management Portal provides WRF system management and monitoring all via the convenience of a user-friendly internal web page, allowing the operations staff to manage various aspects of the system without any specialized knowledge. The Portal allows creation, modification, and deletion of WRF domains, routine scheduling of the forecasts, monitoring system and run status, and viewing of basic graphical products generated by the MAPSS automatic plotting capability.

## Flexibility via the Management Portal

MAPSS provides the user an ability to customize the WRF domain and schedule as often as necessary according to operational needs. The range of configuration possibilities is only limited by computational resources and scientific applicability of the WRF model.

## Expandability

MAPSS is expandable in both system architecture and capability. Because it runs on a Linux cluster built from commodity hardware, hardware upgrades can be done incrementally and at lower cost. In terms of capabilities, WDT offers various “add-on” capabilities that can be seamlessly coupled with MAPSS.

## Fully Integrated, Turn-Key Operations

WDT provides all required engineering services to deliver a complete system that is ready for full operations in a minimum amount of time with maximum operational reliability.



Portal

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# Weather Decision Technologies

WDT is a leader in providing value-added weather content, geo-mapping solutions and mobile alerting applications to our customers. We count as clients most of the United States' leading weather services and interactive media outlets, as well as governmental, industrial and military weather customers from all over the world. Founded in 2000, WDT has been awarded Inc. 500 and Inc. 5000 status five times after experiencing 80 percent annual growth during its first four years and continued rapid growth in the past few years.

WDT has its roots in transferring technology from Federal and University Meteorological Research Organizations and operationalizing that technology to provide value-added content to its partners. As an example, we have licensed state-of-the-science technologies from the National Severe Storms Laboratory, MIT Lincoln Laboratories, the Oklahoma Climatological Survey, the University of Oklahoma and McGill University, among others, providing superior weather prediction capabilities to companies with weather sensitive end consumers.

WEATHER DECISION TECHNOLOGIES, INC.



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