# WDT's Use of LAPS for Operational Numerical Weather Prediction Systems

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Weather Decision Technologies, Inc.

# WDT Overview

- 1999 spin-off from NSSL and OU
- Headquartered on OU Research Campus with an additional office in Atlanta
- Currently 70 employees with about half having MS and PhD degrees
- Specializing in "research-to-operations"
- Global content and technology leader in weather industry
- Increasing growth in media and consumer industries with iMap® products

# WDT Customers and Partners

Google
msn weather
FOX
FOX TELEVISION STATIONS, I
abc
SOUTHERN COMPANY
PG&E
CNN
Discovery CHANNEL
THE E.W. SCRIPPS COMPANY
TRIBUNE
Chesapeake ENERGY
LCRA
GRIFFIN COMMUNICATIONS, L.L.C.
Meredith BROADCASTING GROUP
CITADEL BROADCASTING CORPORATION
WorldNow
Vestas
OG&E
The Weather Channel
weather.com
WeatherBug
AccuWeather.com
meteorlogix
MIS Maritime Information Systems
PELMOREX MEDIA INC.
IPS MeteoStar
JEPPESEN
ForeFlight Mobile Preflight Intelligence
aen Emergency Communications System
BONNIER THE BONNIER GROUP
hydroOne
Dubai Airports
weatherTAP.com
BaseVelocity

# History of NWP at WDT

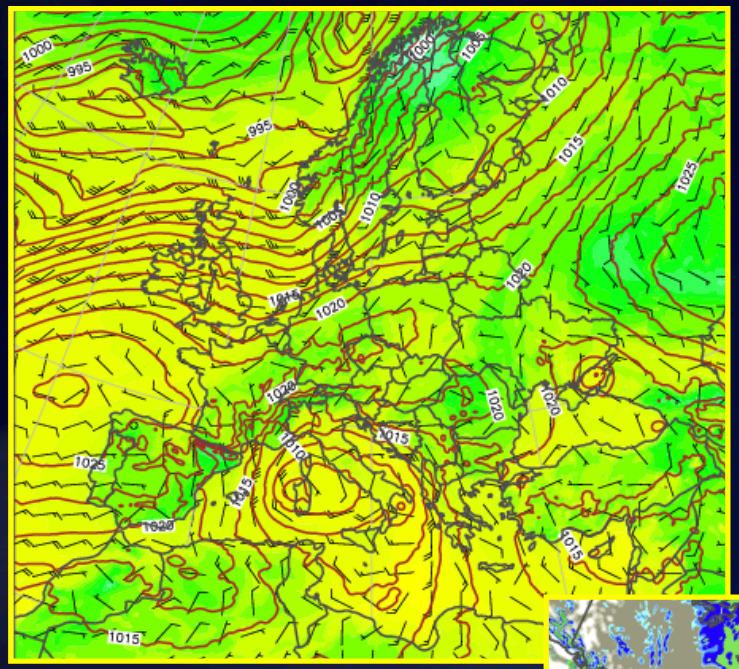
- ARPS and ADAS (2000-2004)
- Migrated to WRF+ADAS in 2004
  - MetroCast system for television stations
  - Gridded data services for aviation clients
  - First international WRF system (Paraguay)
- "Early GFS" with GDAS System (2003-2005)
- WRF v2.2 (2007) with WRF-Var and FDDA. Eliminated ARPS-to-WRF and WRF-to-ARPS converssion
  - Dubai International Airport system delivery
  - High-resolution professional and marine services
  - US Army Future Combat Systems
- WRF v3.0 in 2009 with FDDA, dropped WRF-Var
- WRF v3.1 in 2010, added LAPS support
  - Philippines (PAGASA) System Delivery

# WDT's Operational System

- Heterogeneous Cluster
  - 9 Intel Xeon Blades
  - 17 AMD 2x Dual Core
  - 10 AMD 2x Quad Core
  - 16 Intel 2x Quad Core
  - InfiniBand Interconnect
- Nearly 250 runs/day
  - 1-km to 13-km resolution
  - Various initialization combinations
  - Various physics configurations
  - 3 different WRF releases

Perimeter Technology Center
- Hardened facility in OKC
- Redundant power
- Redundant networking
- Advanced security
- 99.999% uptime
- WDT is FAA QICP-certified

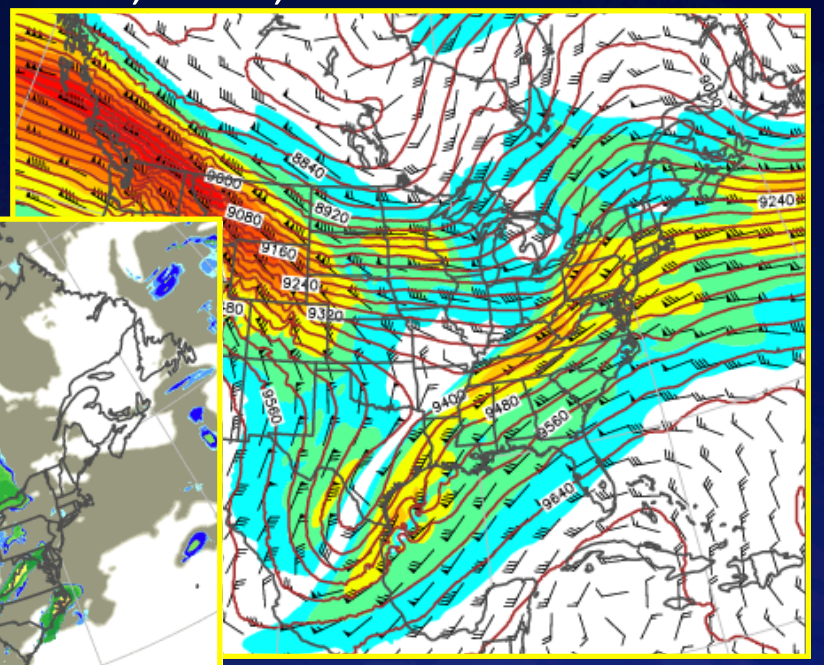
# Operational WRF System



*European 12 km*

## *Data Assimilation*

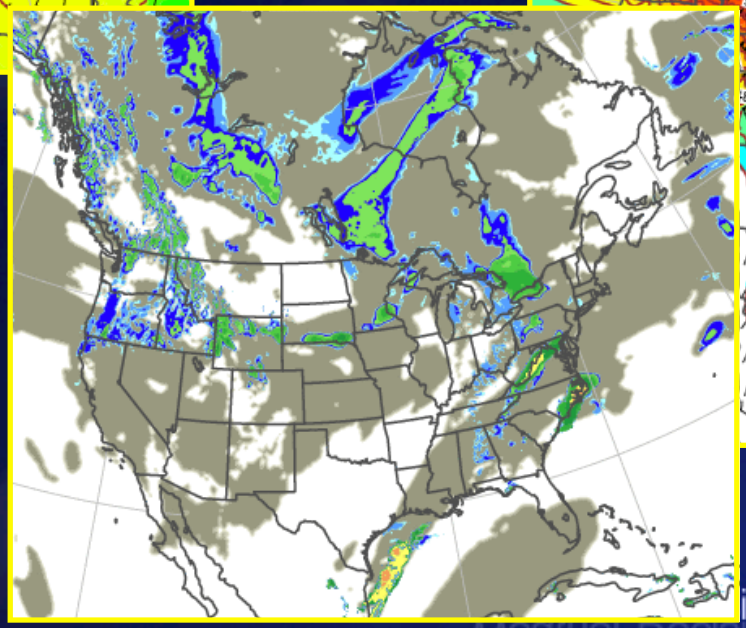
- NAM/GFS for first guess and BC
- NOAAPort and MADIS Obs
- WDT Radar Mosaics
- Geostationary Imagery
- FDDA, 3DVAR, ADAS, LAPS



*N. American 11 km*

## *Post Processing*

- Custom Algorithms
- GRIB-2 Data Feeds
- Point Data
- MET Verification



*Hourly 10 km*

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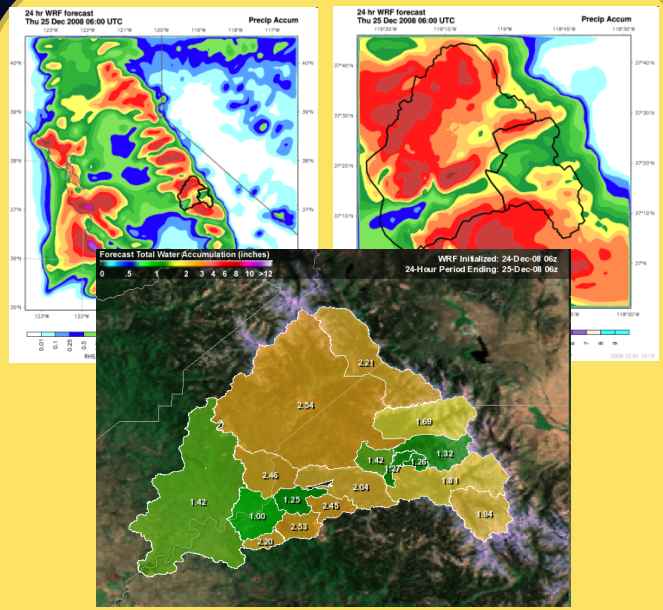
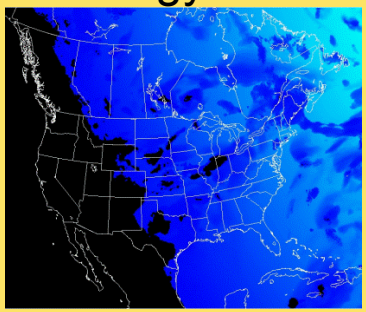
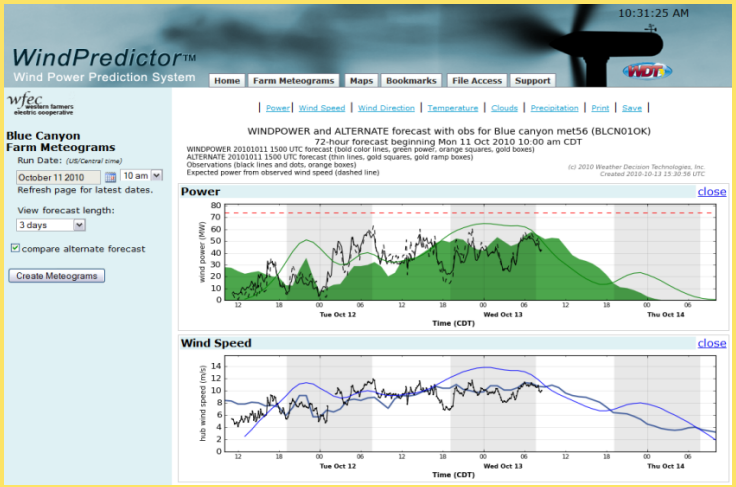
# WDT NWP Applications

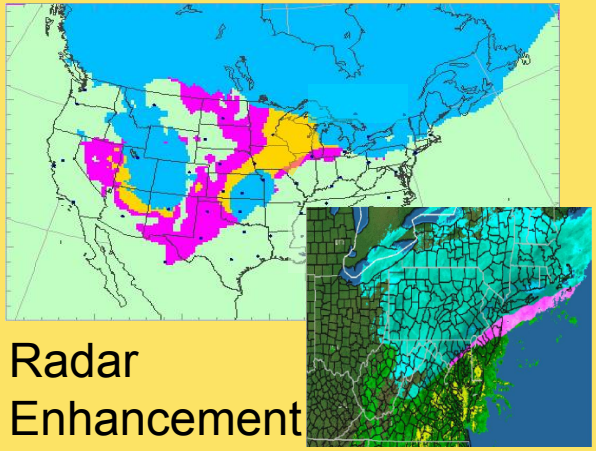



Hydromet

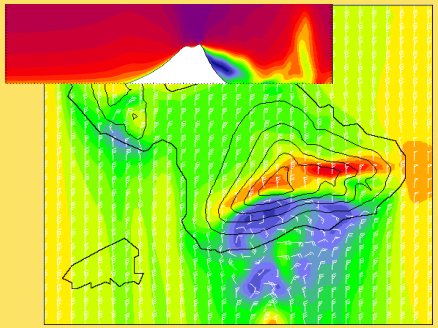
Renewable Energy



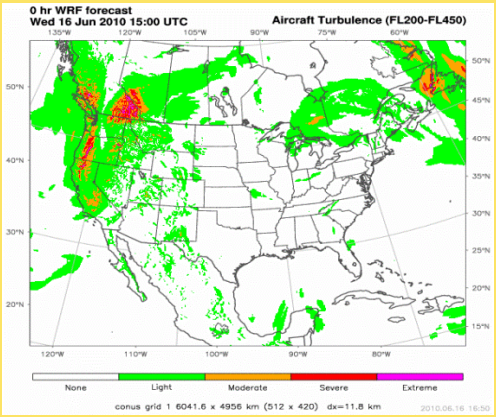


Radar Enhancement



Wind Eng.




Transportation

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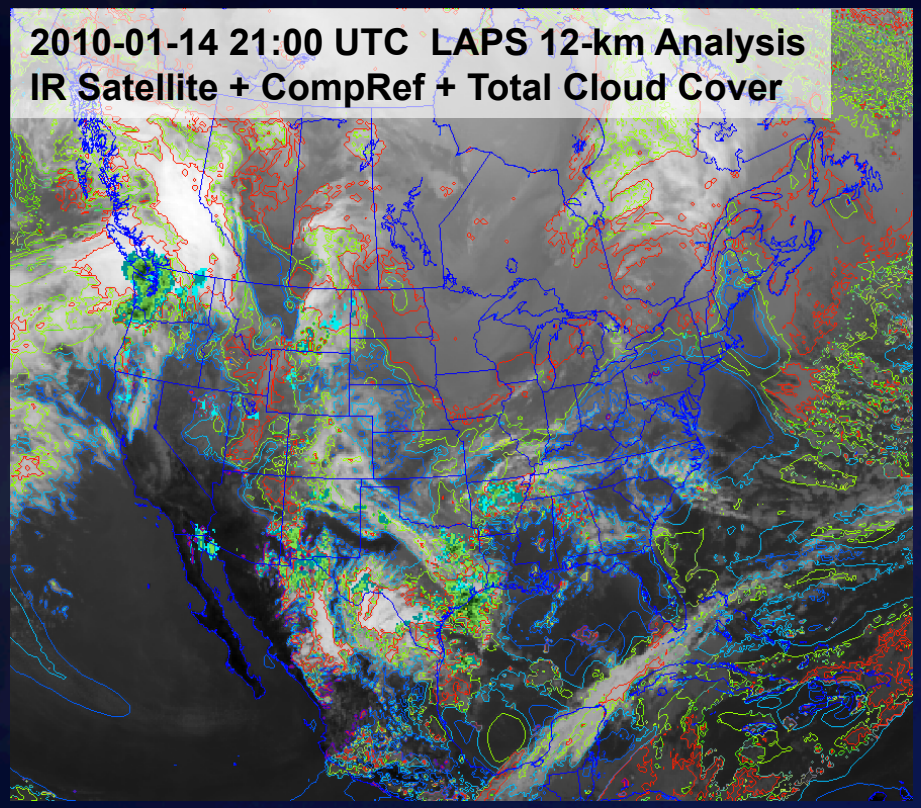
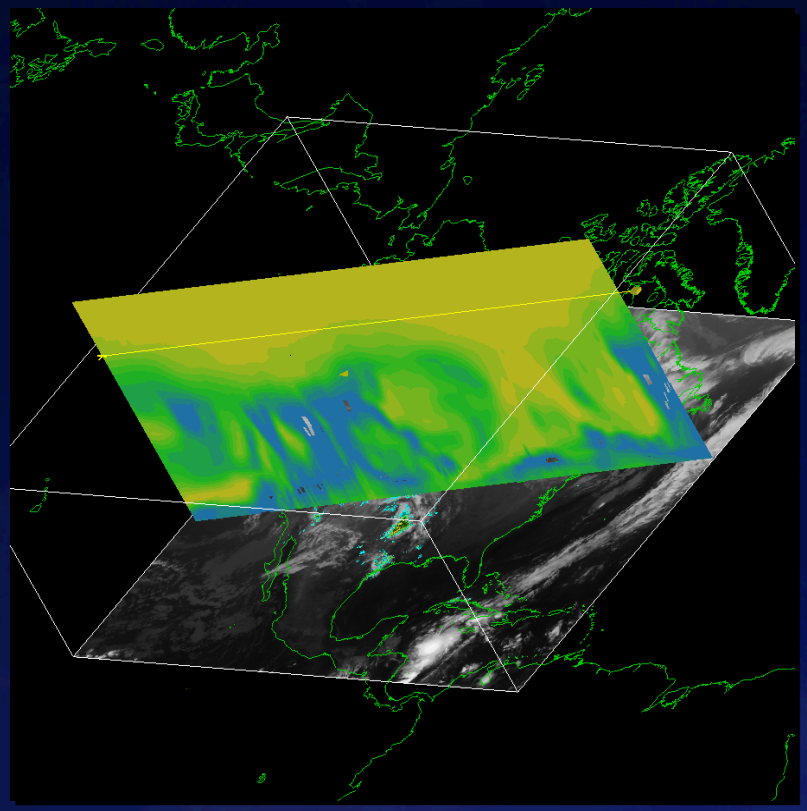
# WDT Operational LAPS Implementation



## Full LAPS implementation

- WDT McIDAS-NetCDF Mosaic to LAPS-LVD
- WDT 3D WDSS-II Radar Mosaic to LAPS-VRZ Converter
- MADIS Ingest (RAOBs, GOES CDW, Profilers, Surface METAR/Mesonet)
- Various utility scripts
- Subversion Code Repository

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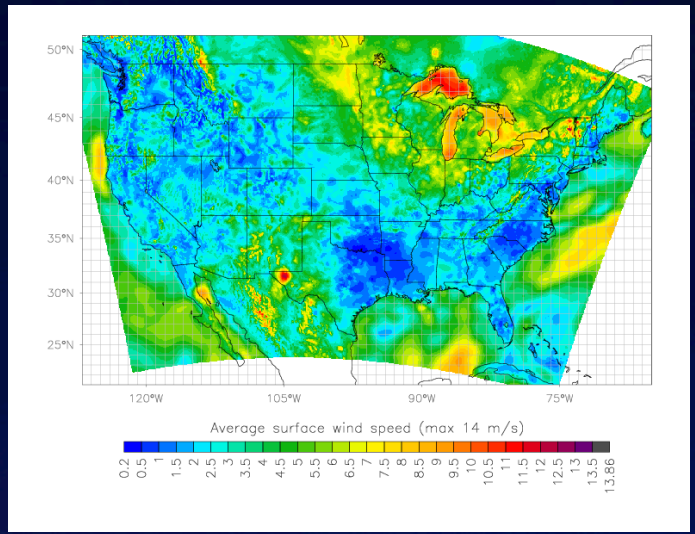
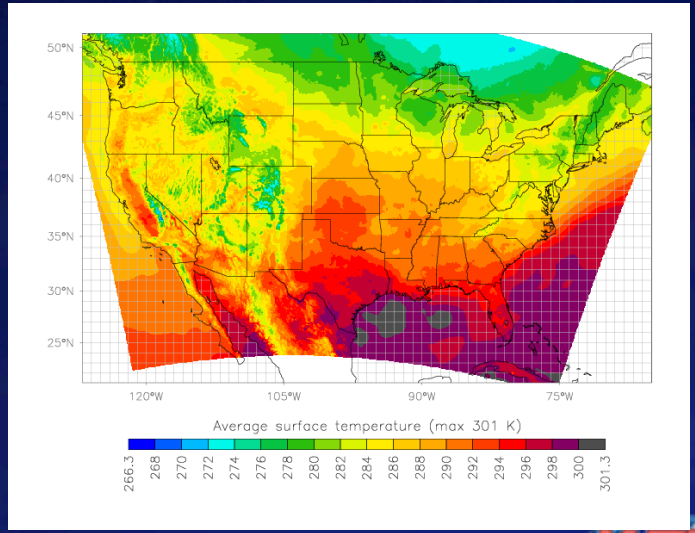
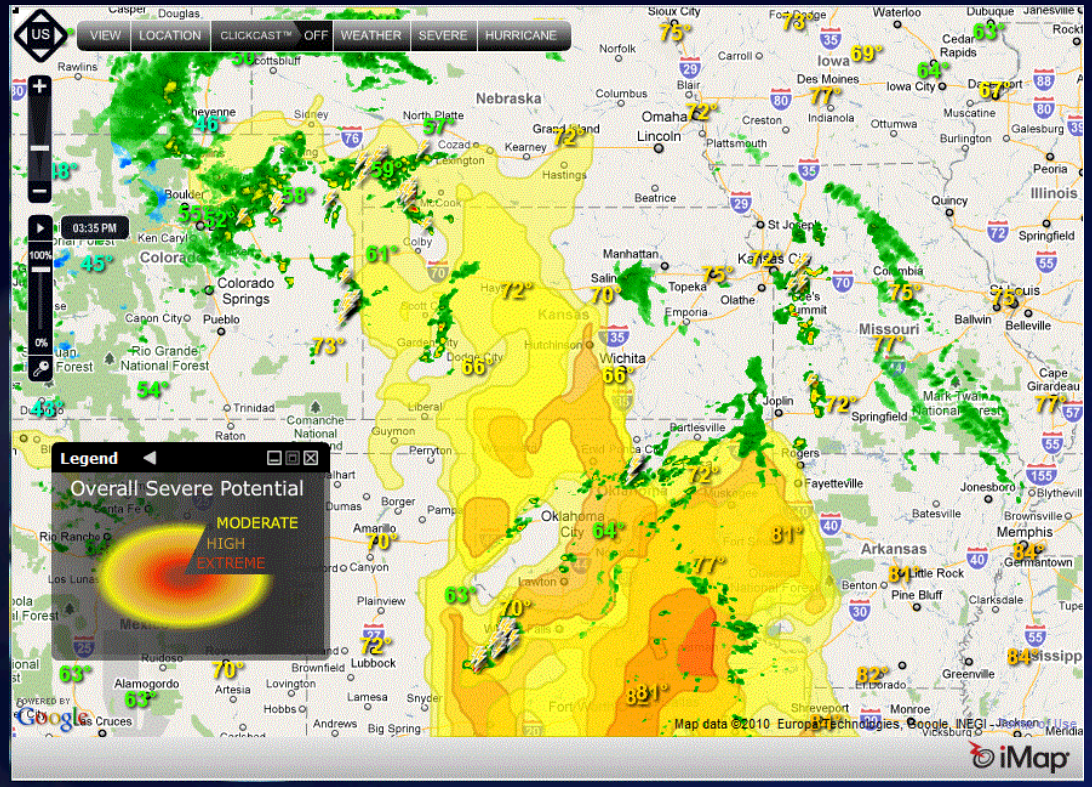
# Other WDT LAPS Applications

## Professional Services Content




## Interactive Media Content

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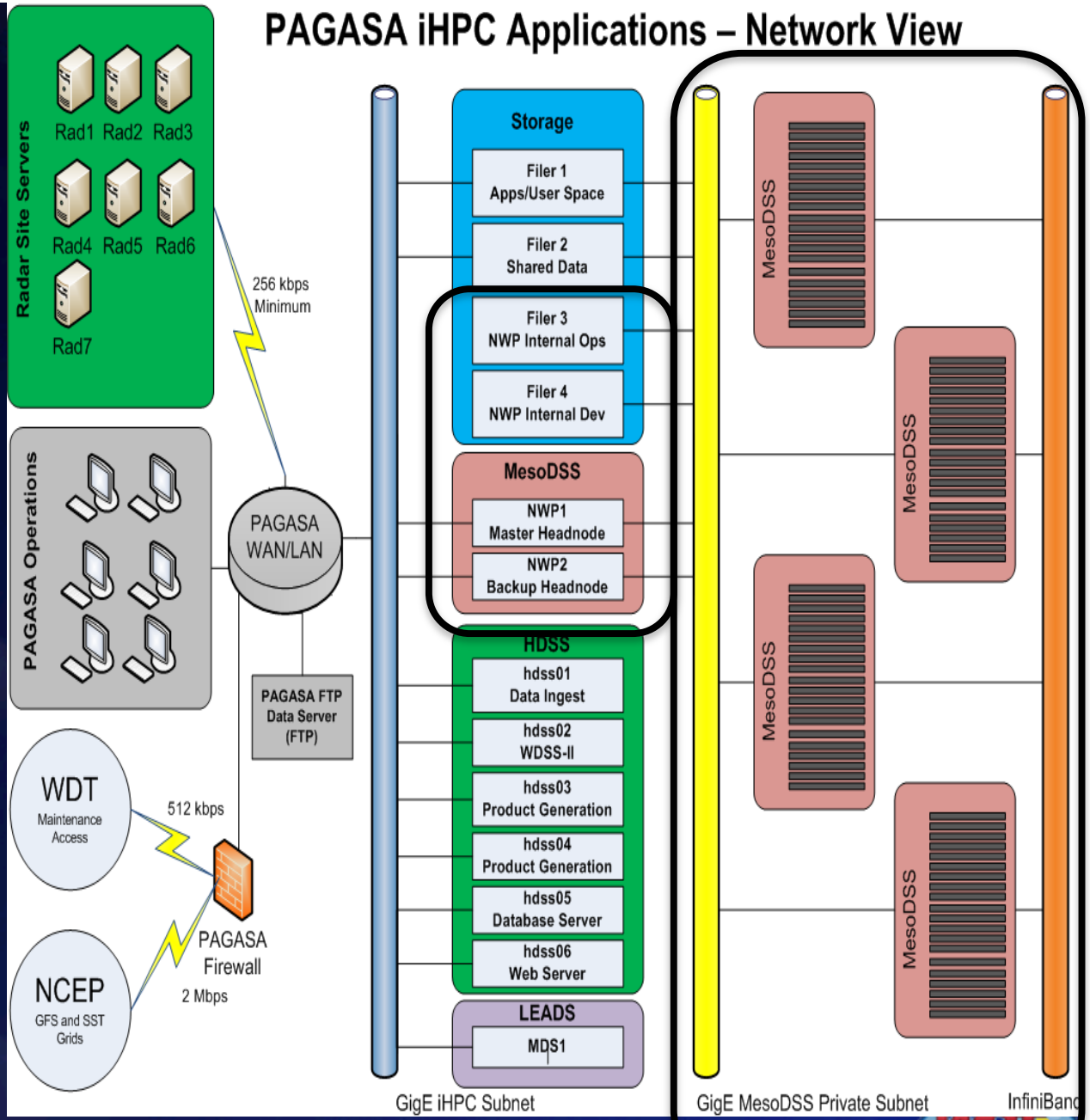
# PAGASA Project

- Research-to-Operations making a difference internationally!
- WDT providing:
  - Hydromet Decision Support System
    - Ingest, QC, and mosaic of 7 radar sites
    - Suite of nowcasting algorithms for QPE, etc.
  - Mesoscale Forecast Decision Support System
    - WRF
    - Data Assimilation with LAPS, FDDA, and DFI
  - IPS MeteoStar LEADS Display

- Provisioned with SGE Queues
  - 26 Operational Nodes
  - 52 R&D Nodes
- Private subnet
  - Compute nodes
  - Two dedicated NAS devices
- InfiniBand for MPI traffic
- Input
  - NCEP GFS*
  - LEADS
    - Satellite Images
    - WMO Obs
  - HDSS Radar Mosaics
- Output
  - GRIB for LEADS
  - GRIB for HDSS

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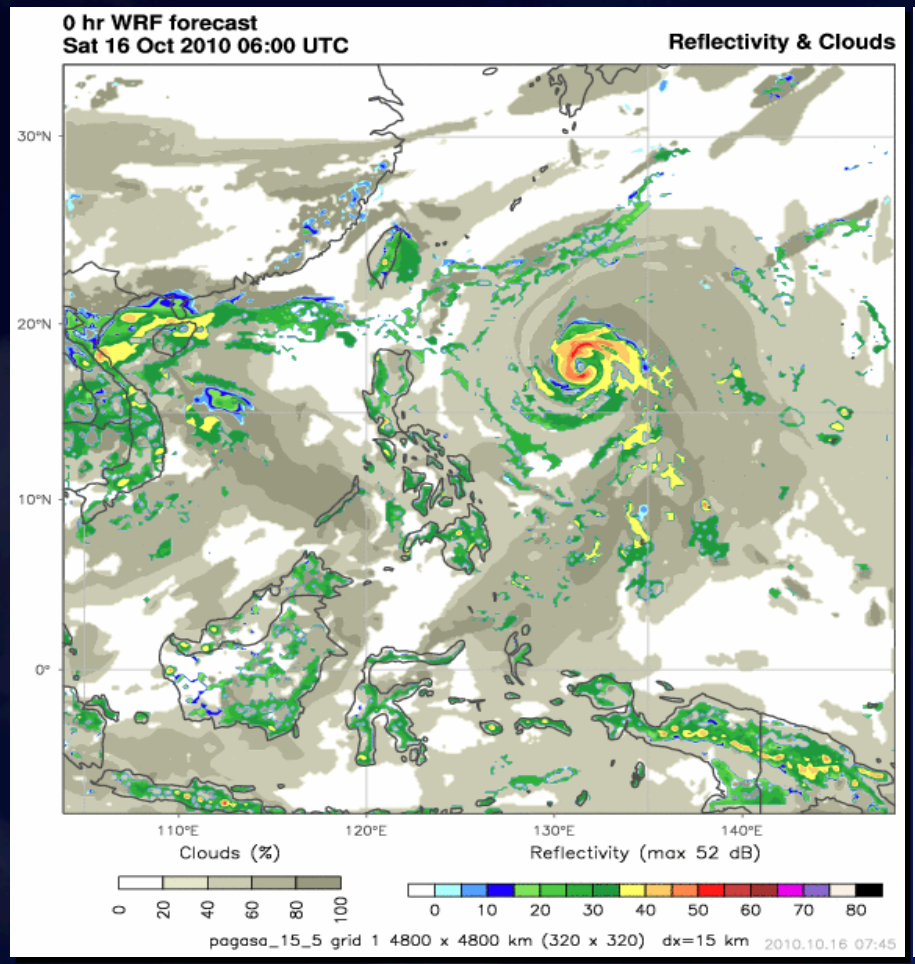
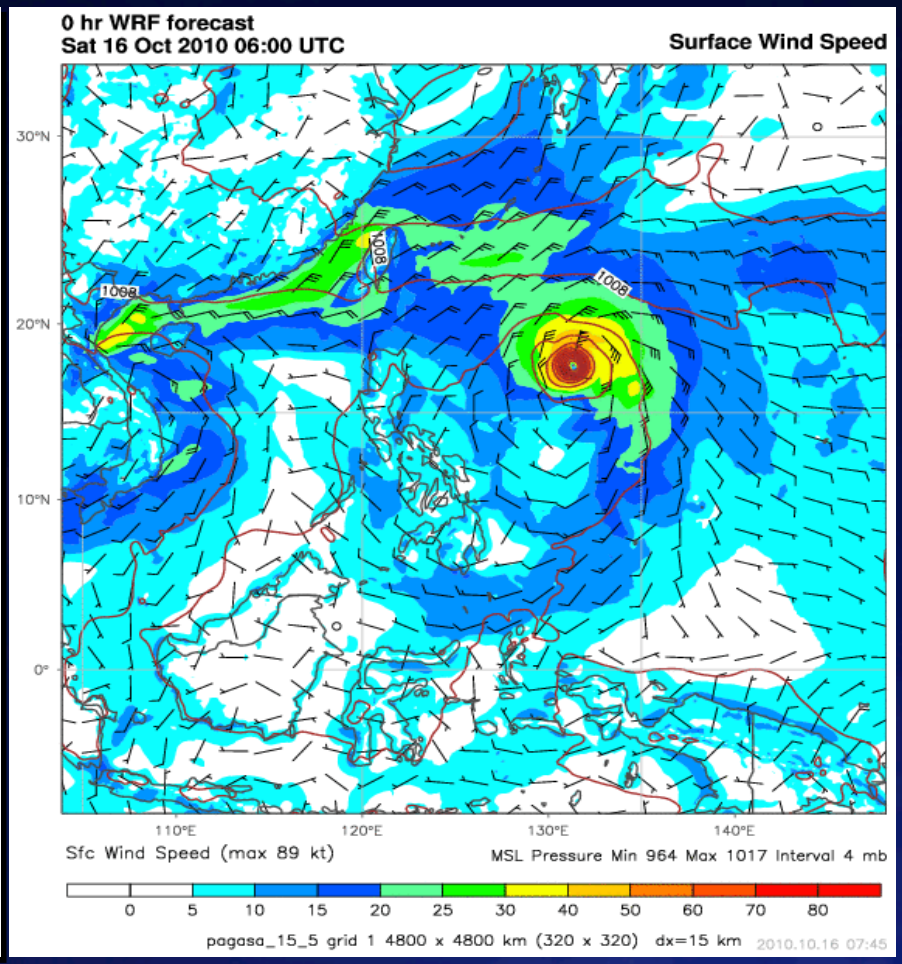
*Minimum required data to allow forecast production

# Typhoon Megi Simulations

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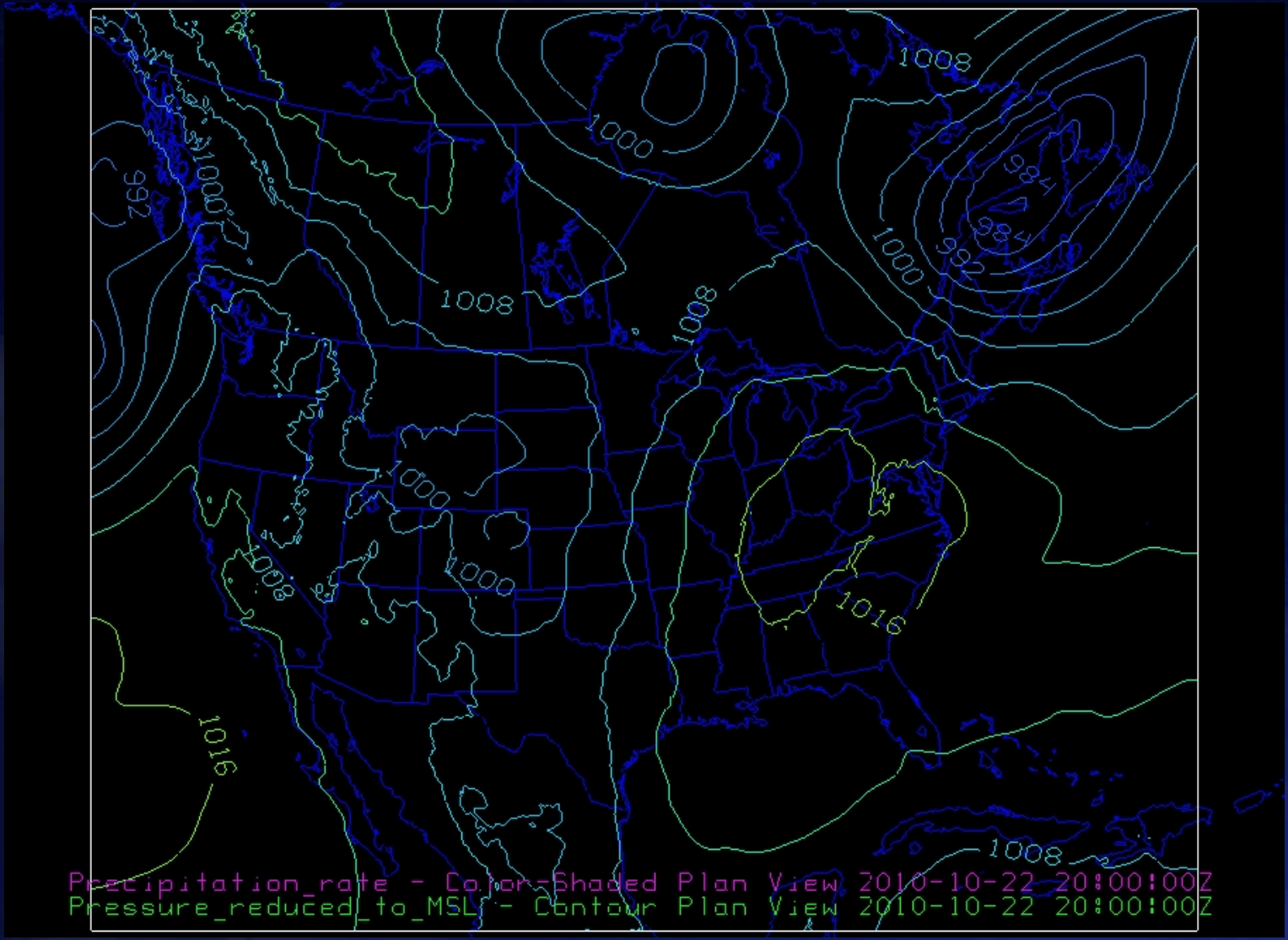
# WDT's LAPS Items of Interest

- LAPS vertical resolution when running balance package
- Imbalances in early hours
  - Primarily seems to affect wind and pressure
  - Affects first 6-9 hours for CONUS domains
- Moisture bias?
- Future of LAPS and STMAS

# MSLP and Precip Rate




Length: 2h:15m at 15-m interval

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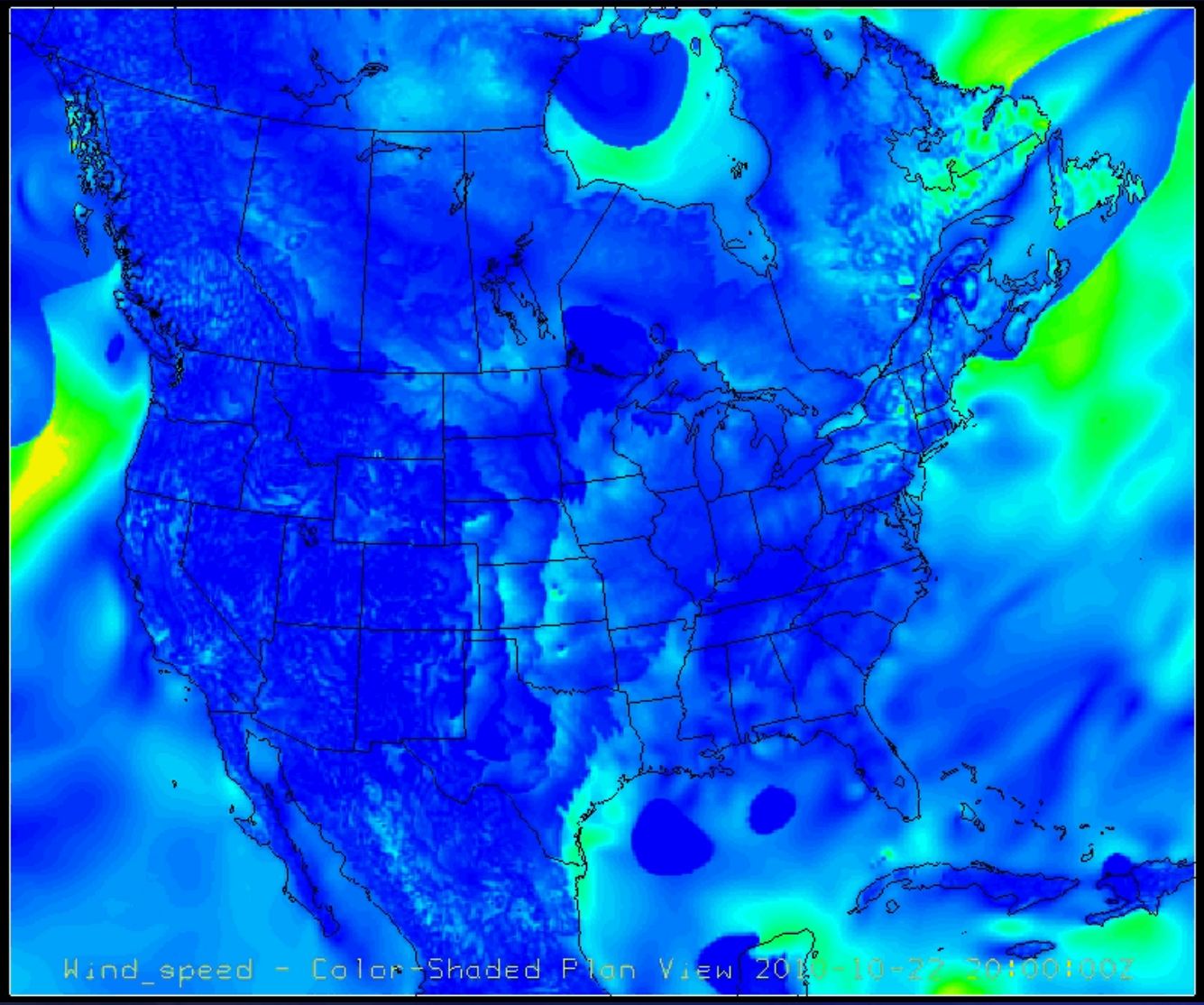
# 10-m Wind Speed




Length: 2h:15m at 15-m interval

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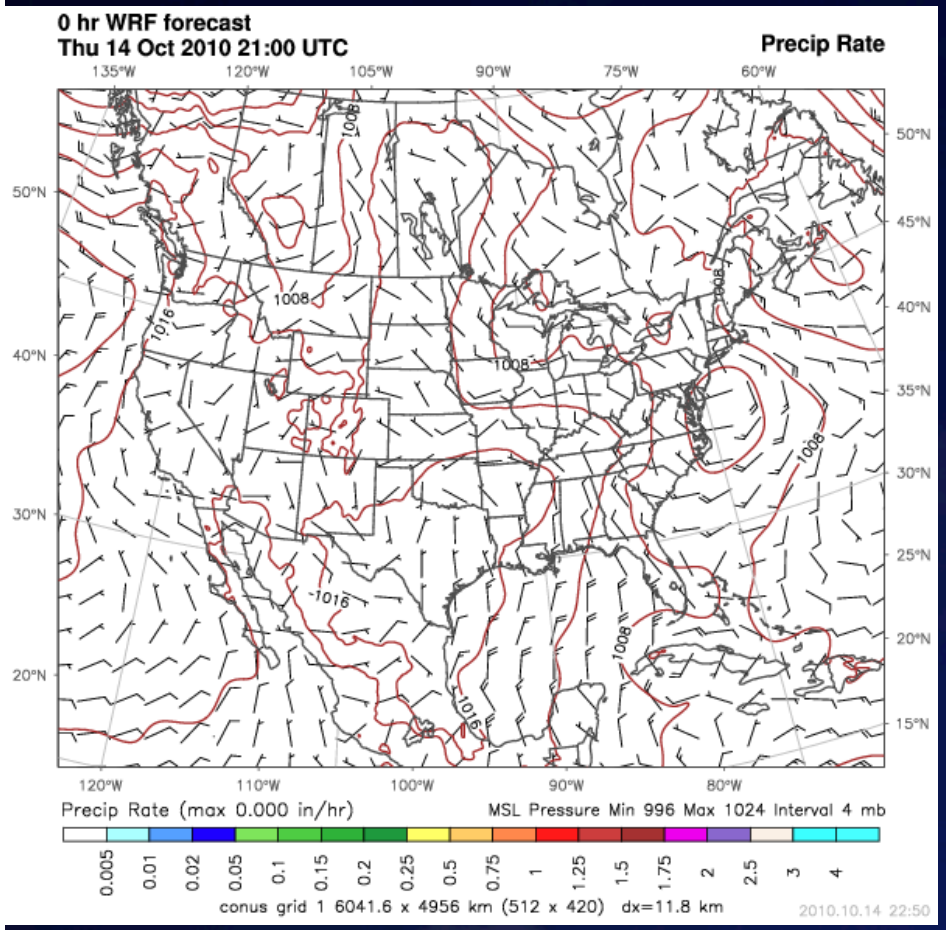
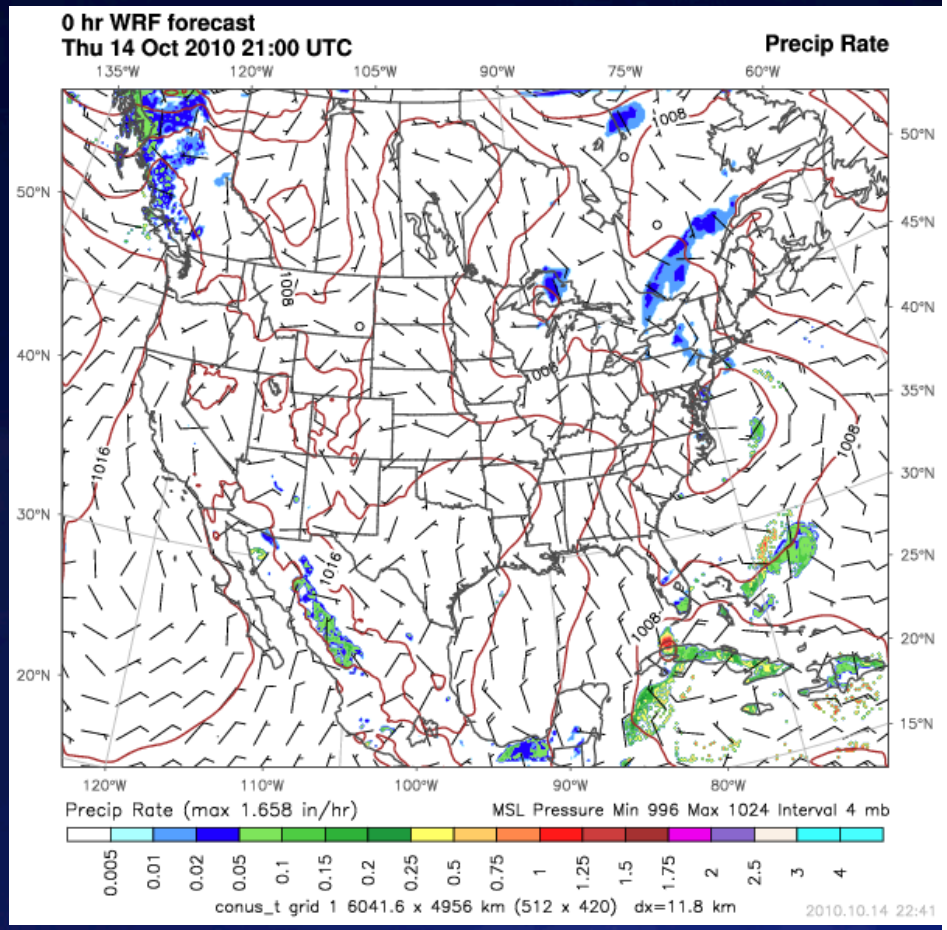
# GFS vs. LAPS+DFI Initialization




GFS Cold Start




LAPS Hot Start + 30 minute DFI

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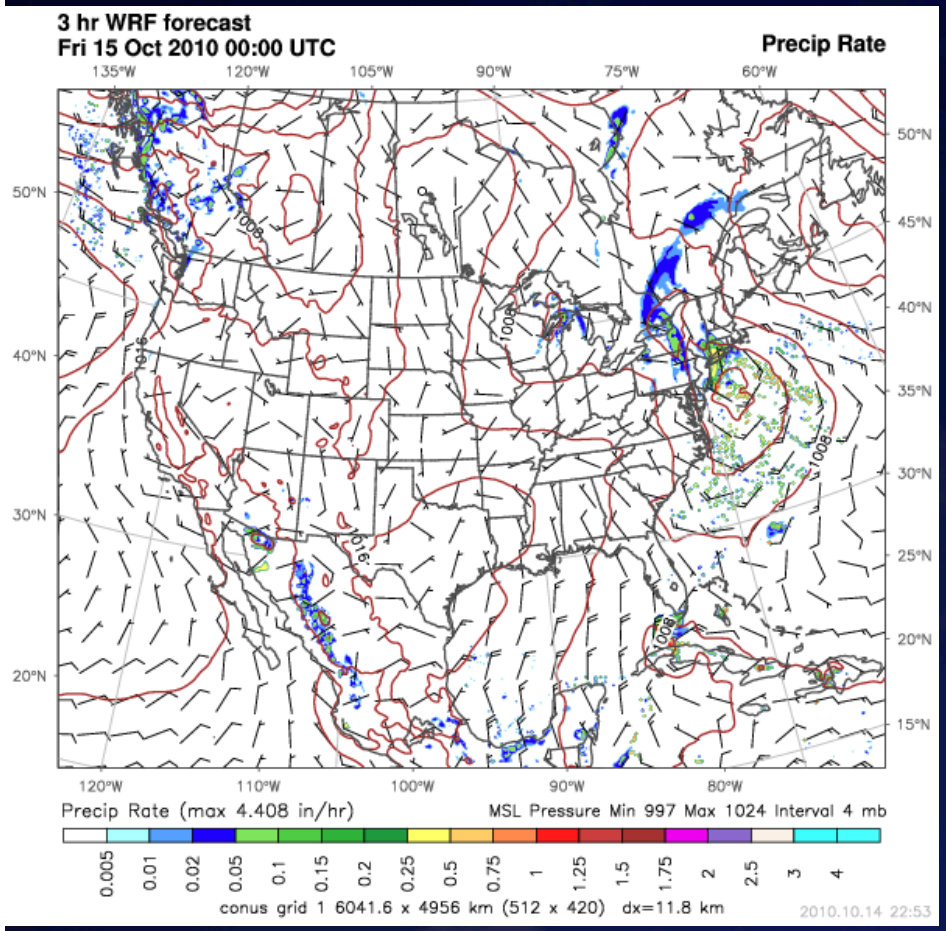
# GFS vs. LAPS+DFI Initialization

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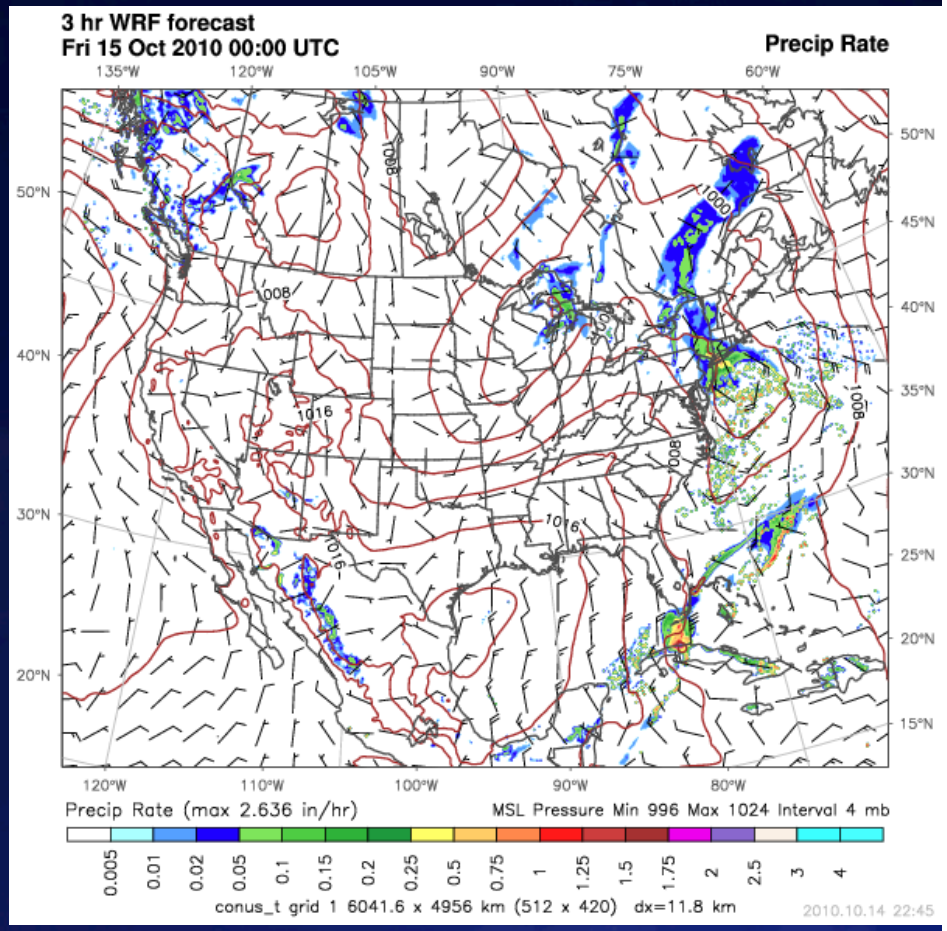


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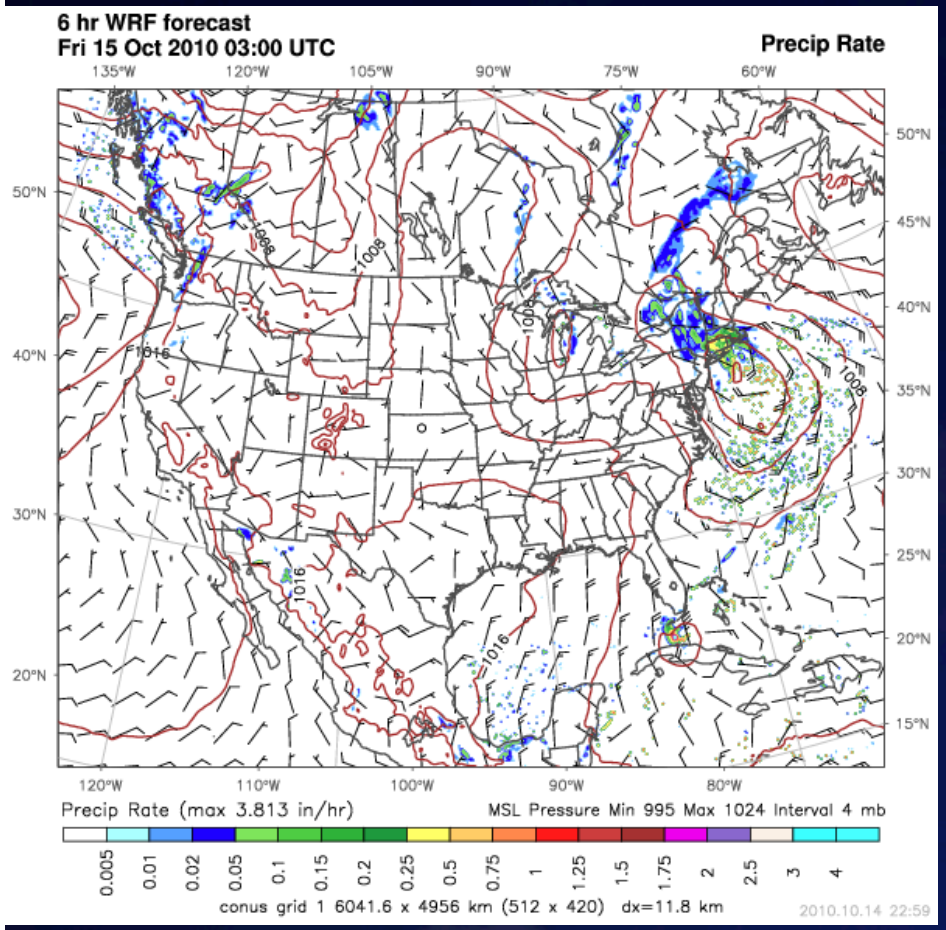
# GFS vs. LAPS+DFI Initialization

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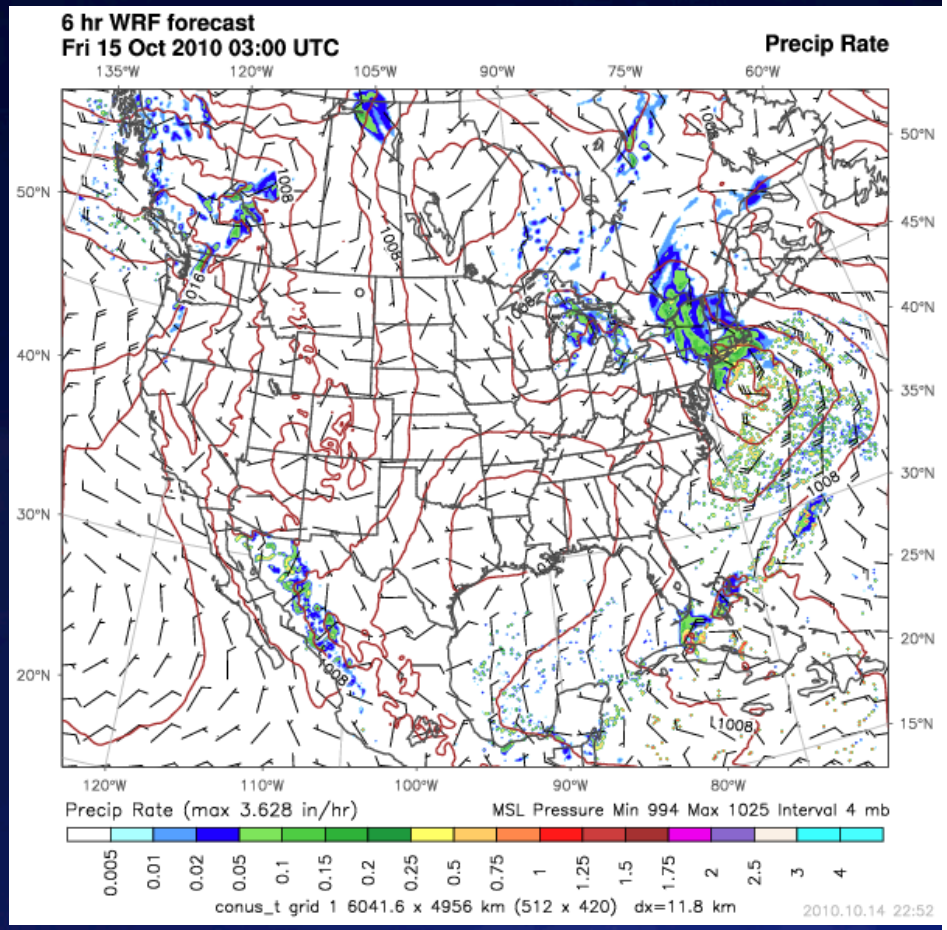


LAPS Hot Start + 30 minute DFI

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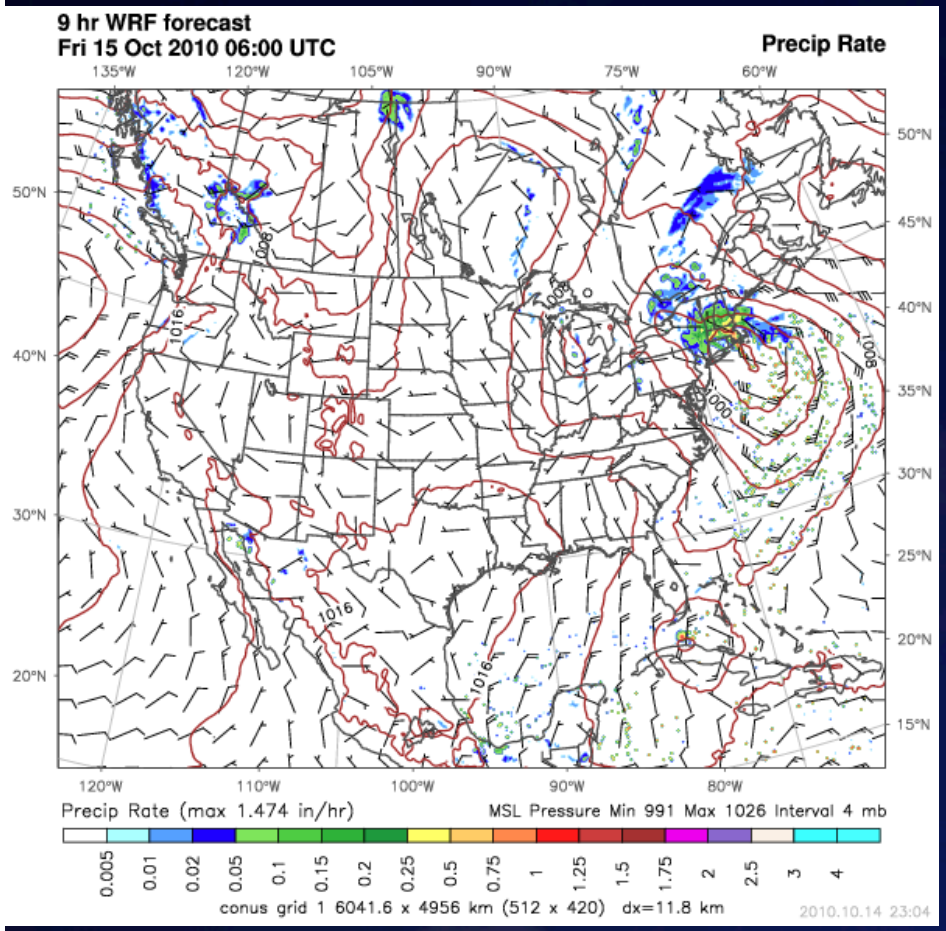
# GFS vs. LAPS+GSI Initialization

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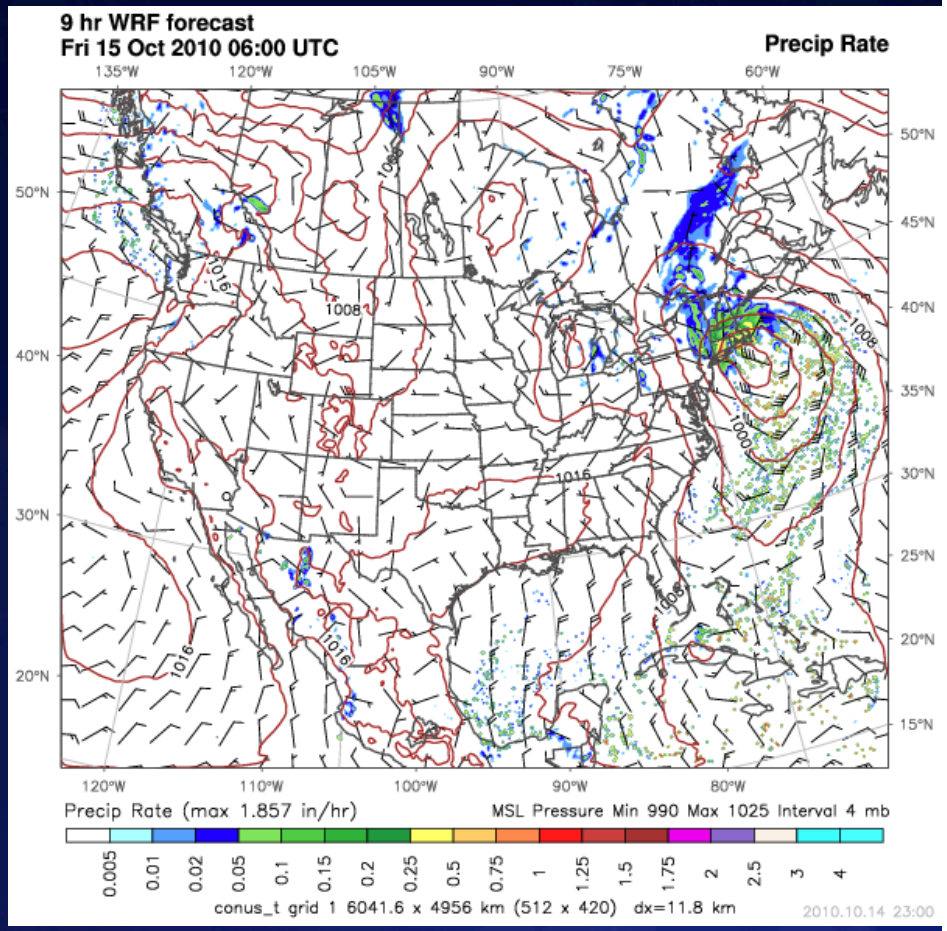


LAPS Hot Start + 30 minute DFI

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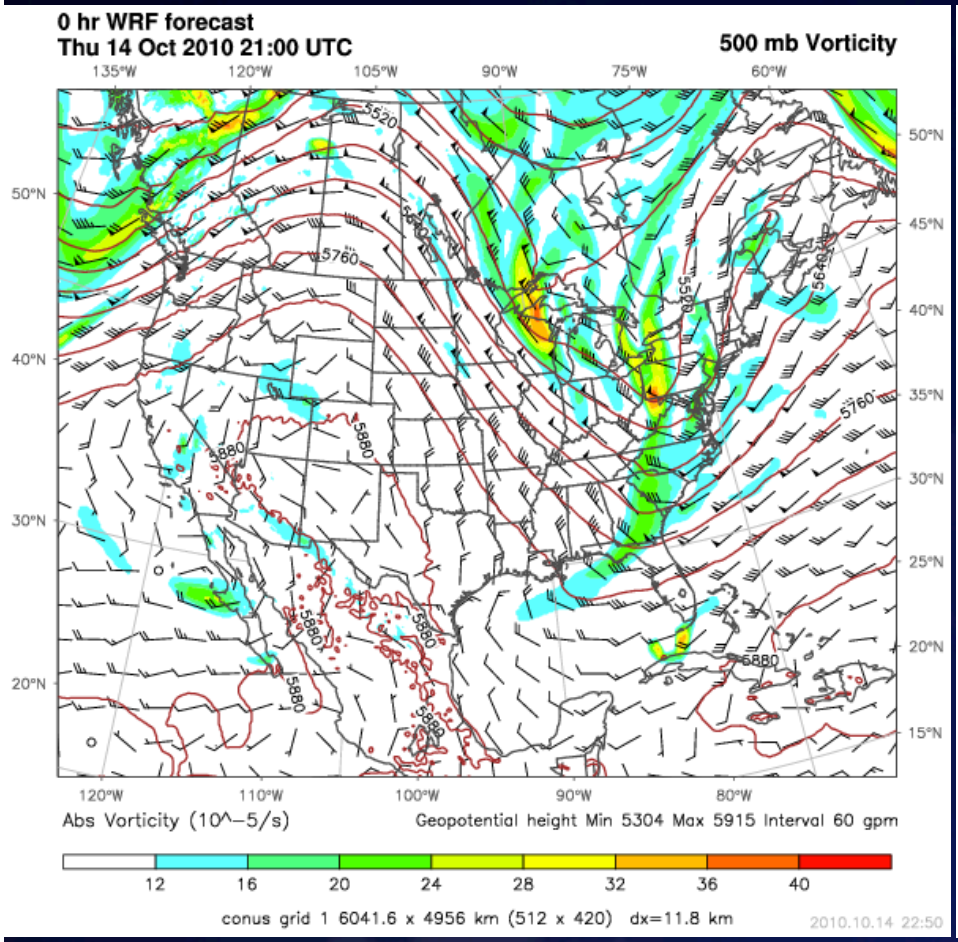
# Initial 500 mb Chart

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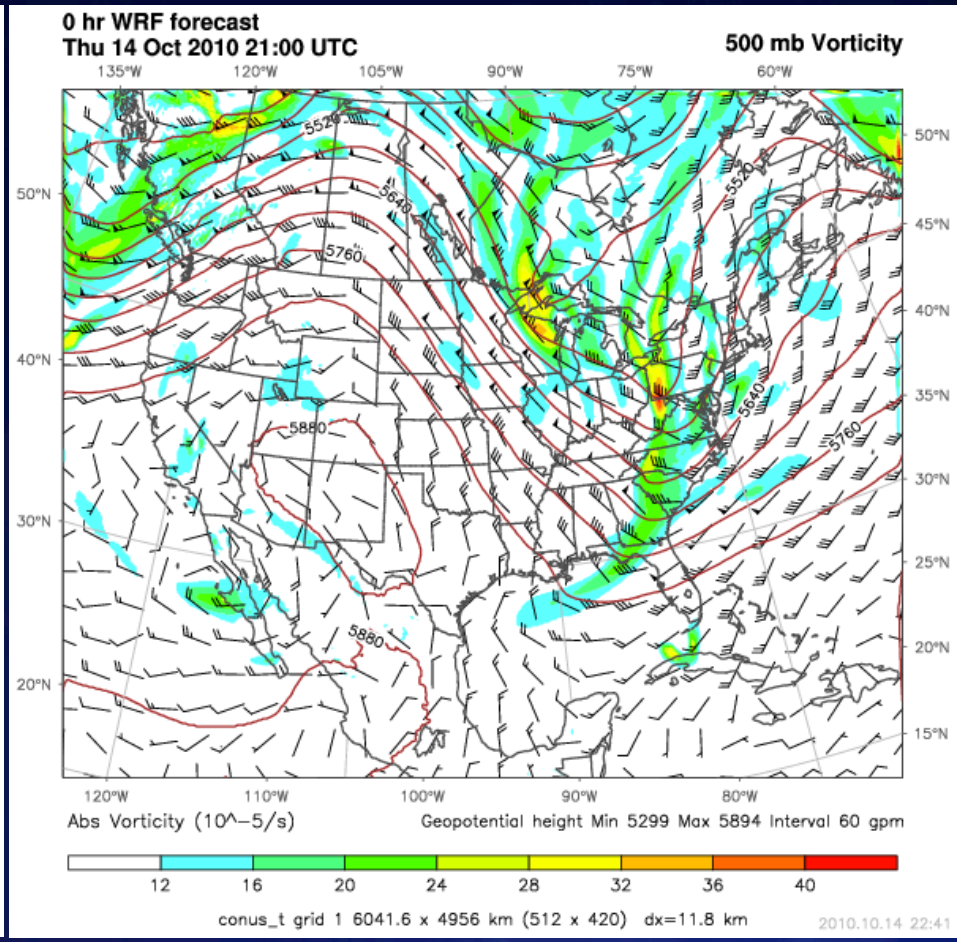
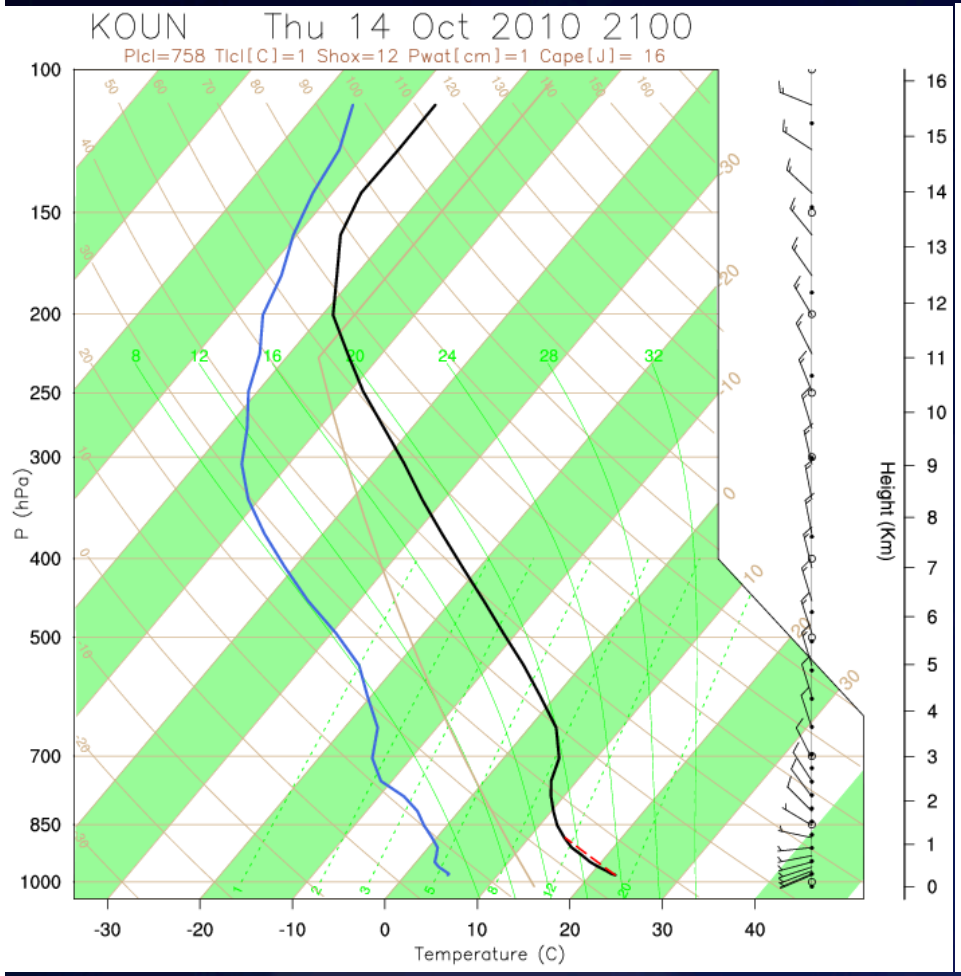
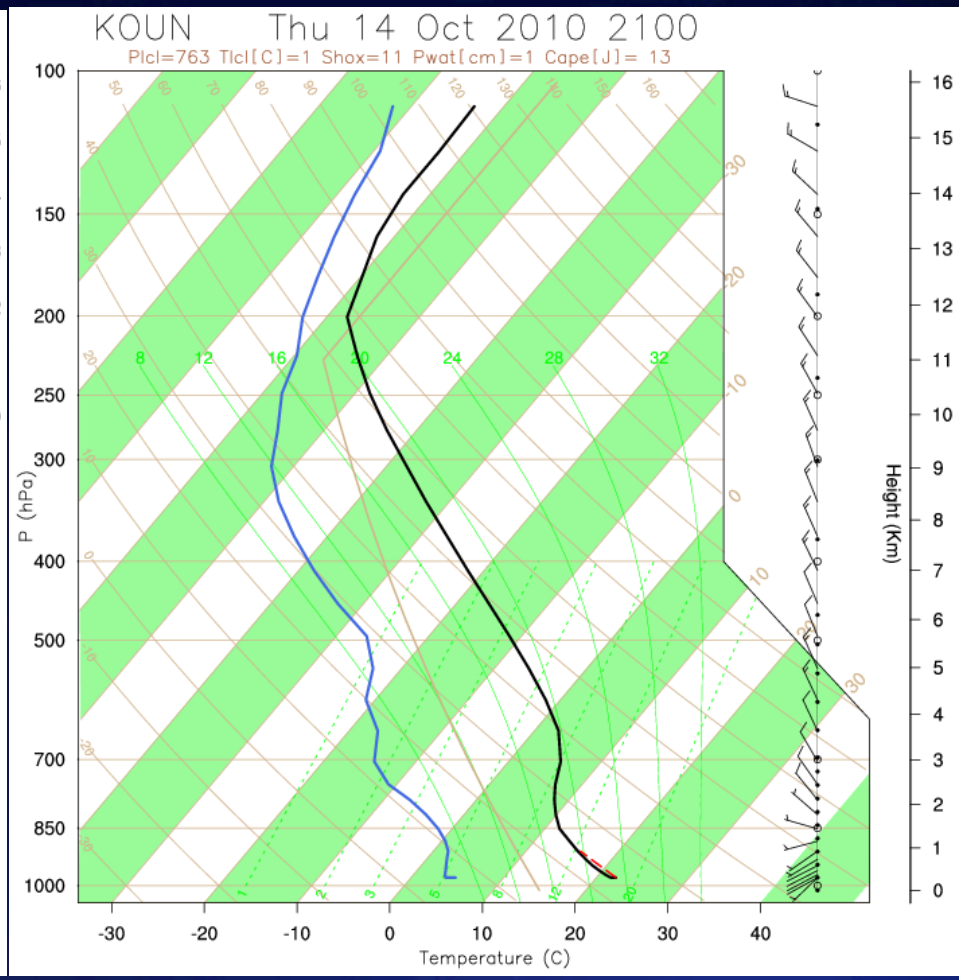



LAPS Hot Start + 30 minute DFI

# KOUN Sounding at Initial Time




GFS Cold Start

LAPS Hot Start + 30 minute DFI

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# Summary

- LAPS has replaced WRF-Var as WDT's preferred analysis system for model initialization
  - Globally applicable
  - Model independent
  - Robust data ingest, including unique capability to use geostationary satellite imagery
  - Familiarity and "straightforwardness"
- Research at NOAA/ESRL is helping developing countries through the private sector
- WDT looks forward to future collaboration with ESRL/GSD and other LAPS users