STMAS/LAPS for Convective Weather Analysis and Short-range Forecast

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Outline:

- Current status of STMAS for storm/gust front detection;
- A multigrid data assimilation (STMAS/LAPS): multiscale, spatial/temporal and dynamically consistent analysis for improving short-range forecasts;
- Future developments;

Status of STMAS Surface Analysis for Storm/Gust Front Detection

Space and Time Multiscale Analysis System (STMAS) is a 4-DVAR generalization of LAPS and modified LAPS is running at terminal scale for FAA for wind analysis.

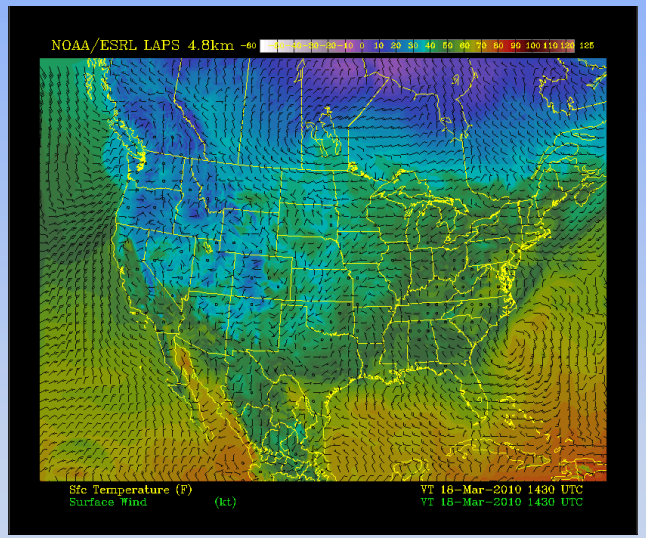
STMAS real time runs with 15 minute latency due to the observation data:

- STMAS surface analysis is running in real time over CONUS with 5-km resolution and 15-minute analysis cycle. It is so efficient that it runs on a single processor desktop;
- Real time 5-minute cycle run of STMAS assimilating 5-minute ASOS data also on single processor.

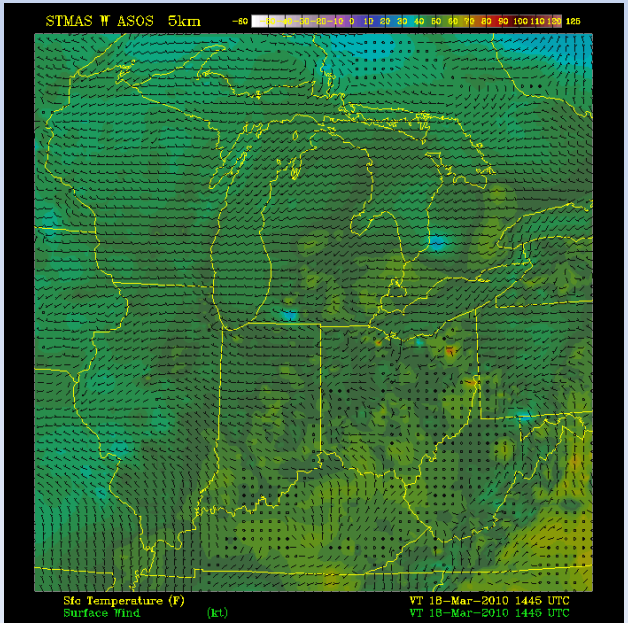
STMAS surface analysis with 5 minute latency:

- Modernizing the surface analysis with (MPI/SMS) and targeting at

2-km resolution;
5-minute cycle;
over CONUS domain;
assimilating 1-minute ASOS;
using HRRR as background.



CONUS 15-min cycle



5-min ASOS, 5-min cycle

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STMAS/LAPS multiscale and well-balanced analysis for nowcasts/short-range forecasts

Why STMAS 4DVAR for short-range forecast:

- A multigrid variational analysis with model constraints provides spatial and temporal consistent analysis;
- LAPS hot-start analysis shows good forecast impact and will be ported to STMAS variational analysis;
- Improve the assimilation of radar radial wind and reflectivity in a multiscale manner;

(Publications: 3 published journal papers and one under review.)

Our goal is to investigate next generation data assimilation system,

- *reducing initial shock to improve short-range forecasts;*
- *0.5-1 km resolution analysis and forecast with half hour cycle-time;*
- *Assimilation of high spatial density and high frequency of observations (e.g., radar, satellite, 1-minute ASOS).*

Eventually, this technique can be transferred to the current system, e.g. HRRR and be HRRR surface component with 5-minute cycle capability.

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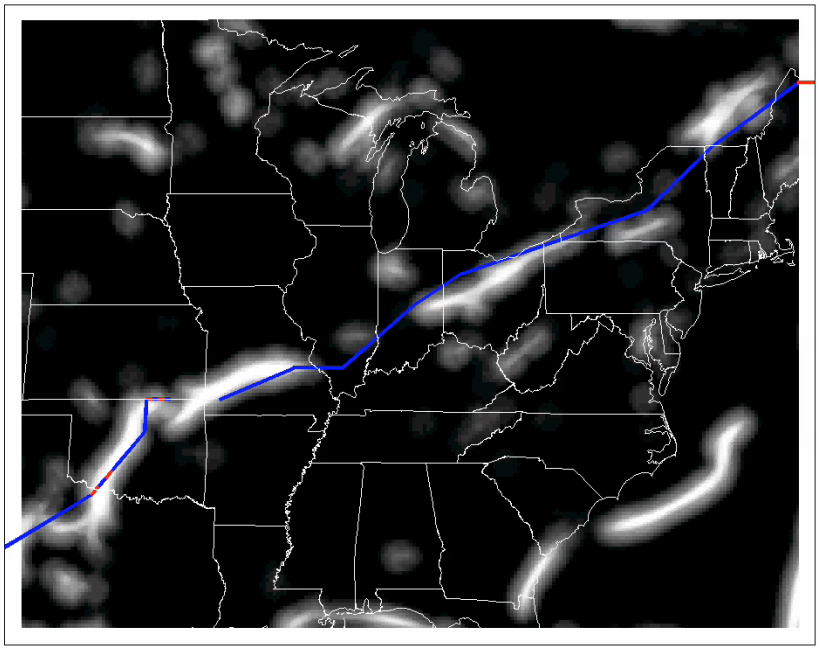


Automated Surface Front Detection and NWS HPC Frontal Analysis

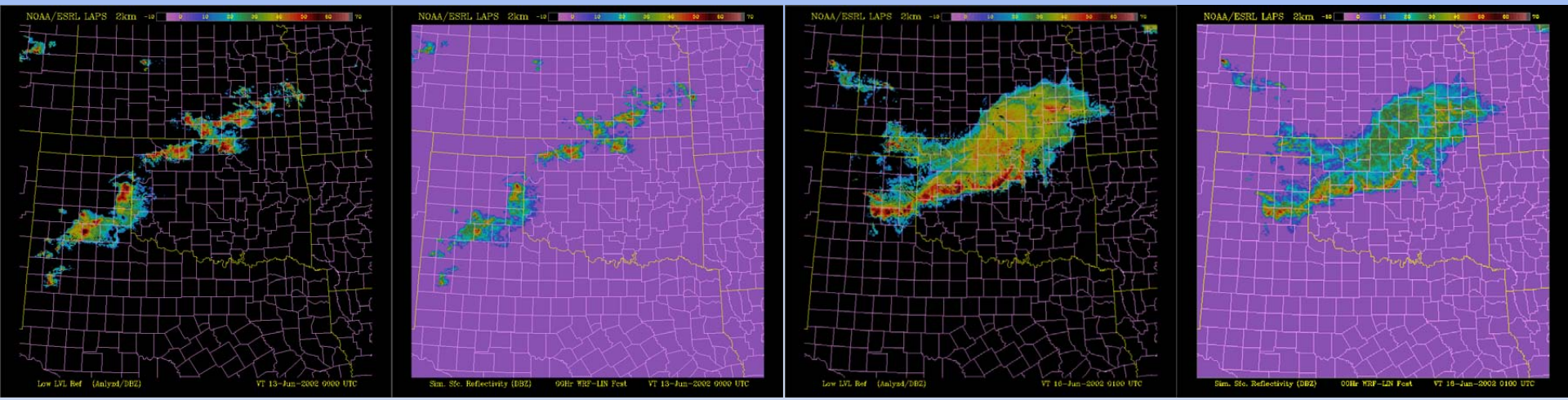
By MIT/LL using STMAS surface analysis
In the LSI boundary detection algorithm

Examples of LAPS/STMAS analysis impact

LAPS hot-start & WRF-ARW Forecast (2km with Lin Micro-physics): IHOP cases

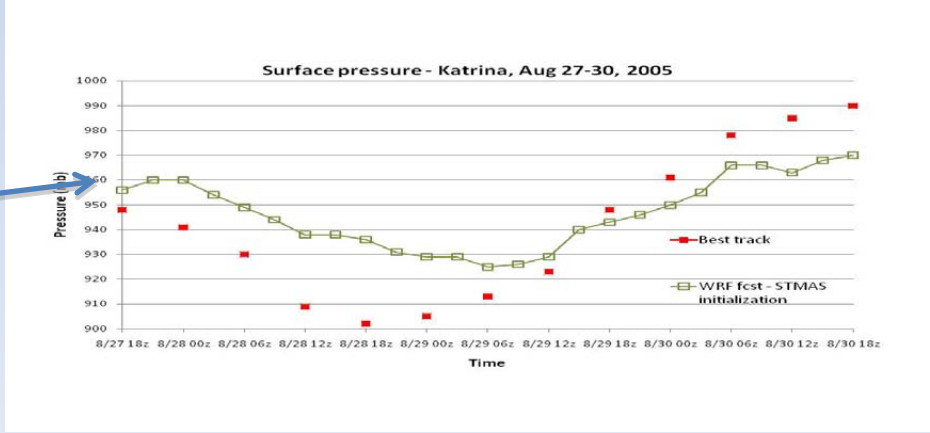
LAPS Forecast: Jun. 13, 2002

LAPS Forecast: Jun. 16, 2002



(Steve Albers and Isidora will talk these cases in more details at their presentations

Little shock to WRF-ARW by a STMAS 4D analysis without a model constraint: 3 mb increase on pressure field.



Future Developments

- Cycling LAPS/STMAS analysis and forecast at terminal scales (0.5-1 km) and 15-min to half hour cycle;
- Parallelization of STMAS for 5-minute cycle 2-km resolution STMAS surface analysis over whole CONUS with 1-minute ASOS data;
- Incorporation of fine scale topography and land-water information into STMAS analysis;
- Verification of short-range forecasts and systematic inter-comparison to other DA schemes;
- Improved radar forward operator in STMAS for better use of reflectivity and radial wind;
- Porting CRTM LAPS/STMAS for improving cloud analysis using satellite data;
- Model constraint for STMAS to improve short-range forecast;
- Incorporating the analysis into GSI and for HRRR.