Space and Time Multiscale Analysis System (STMAS)

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Introduction

STMAS is a next generation data assimilation system designed to improve forecasts and analysis and meets NOAA goals:

"*Improving tornado warning lead-time accuracy via multiple radar data assimilation and storm scale numerical model*", "*Doubling the hurricane intensity forecast skill via developing data assimilation*"

(Quote from NOAA-OAR 5 Year Plan 2005-2010)

STMAS is Designed to Improve EnKF/4DVAR

It uses a multigrid technique combining the advantages of EnKF and 4DVAR and reducing their limitations.

- Limited ensembles (EnKF): STMAS applies EnKF at its finest multigrid level.
- Nonlinearity (EnKF): Over each multigrid level, STMAS solves the nonlinear variational problem.
- Inaccurate error covariance (4DVAR): At coarser grids, STMAS retrieves long waves from the observation network. Accurate covariance and Gaussian error distribution are not necessary.
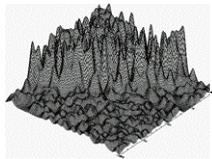
(a)   **(b)**

Observation Sites   *Truth*
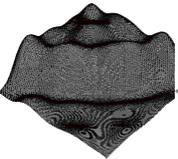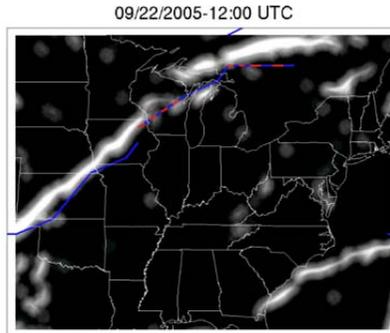

Standard   *3DVAR*   *STMAS*

STMAS Surface Analysis

With NOAA and FAA support, we started to develop the STMAS Surface Analysis System for the FAA Aviation Weather Research Project to use for storm boundary detection in 2004.

"STMAS has become an important component in the CoSPA system."

(Quote from AWRP ConvWx Program Plan)

09/22/2005-12:00 UTC

Automated Surface Front Detection and NWS HPC Frontal Analysis

Blue/Red curves are the HPC frontal analysis

STMAS is designed to analyze high frequency surface data, such as ASOS with 5 to 15 minute reports, in high resolution of 5km (now target at 2km).

A multigrid technique**,** is **extremely efficient**. *For example, for a 5-km analysis of 10 state variables over the CONUS domain, it takes* **4 minutes** *by a* **single 3.2GHz desktop computer.**

STMAS now has more users:

- MIT for storm boundary detection;
- CWB, Taiwan for surface reanalysis;
- MDL and WFOs for nowcasting;
- NMDIS, China for ocean SST reanalysis;
- NCAR for wind energy applications. …

STMAS 3D/4D Analysis

STMAS 3/4D analysis prototype has been developed with NOAA/FAA/CWB supports and an international effort. The current system is capable of analyzing all *in-situ* observation data, radar radial wind and SFMR data. STMAS analysis has been started testing initialization of WRF forecast for hurricanes and even a tornado case study.

Surface pressure - Katrina, Aug 27-30, 2005
Good: it did not shock the model
Improvement need for RI

Above: *Hurricane forecast - it increased the central pressure by only 3 mb and STMAS did not shock the NWP model*

Windsor Tornado Touchdown Location
Observation   *Forecast*
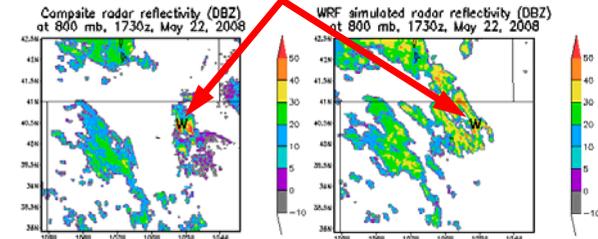
"W" indicates the location of Windsor, Colorado

Future

A multiscale analysis targeting improvement of forecasts with all data source and model constraints. An evaluation of STMAS comparing to NWS operational systems after completing basic development. Use of the STMAS or portion of STMAS to improve NWS operational data assimilation in the future.