Report on IFPS Science Steering Team (ISST) Activities

DOH/RDM Science Workshop

Silver Spring, MD
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Office of Science and Technology

Outline of Presentation

- Brief background on ISST

  - members

  - history and charter

  - priorities and activities

- DGEX (Downscaled GFS with Eta eXtension)

- Analysis of Record

ISST Charter

- **Vision --** The IFPS Science Steering Team facilitates an efficient and effective process that allows the NWS to identify, collect, prioritize, and propose focused solutions and recommended courses of action to IFPS science issues. Recognized as a primary conduit between IFP operations and NWS Headquarters, this team of field experts serves to better ensure scientific and technological integrity in the digital forecast process.

- **Roles and Responsibilities**
  - Collect and take ownership of IFPS science issues
  - Define/refine these issues
  - Explore alternatives for solving these issues
  - Recommend proper courses of action

IFPS Science Steering Team

- Brad Colman (WR) – Lead
- Kevin Schrab (OST) – Facilitator
- Mark Jackson (WR)
- Greg Mann (CR)
- Dave Sharp (SR)
- Steve Keighton (ER)
- Eric Stevens (AR)
- Bill Ward (PR)
- Pete Manousos (HPC)

ISST Accomplishments over past year

- Identified opportunity to fill SBN "transmission gaps" with transmission of Eta surface and BL fields

- Conceived, developed, and championed the Downscaled GFS with Eta Extension (DGEX)

- Worked with MDL on their efforts to develop COOP MOS (now in GFE; number of MOS sites increased by a factor of 3) and gridded MOS

- Provided scientific critique and feedback into the 10-506 directive process and NVIWT verification plan design

- Investigated and prioritized a spectrum of downscaling possibilities and reported to S&T Committee

- Input to DSPO Action Teams

Current ISST Roadmap

- Prioritized list of action topics:
  - Analysis of Record
  - Digital services forecast process (science critical issues)
  - Verification
  - Climatology
  - Downscaling (long-term solutions)
  - Review of 10-506 (preliminary review to DSPO and OCWWS by July)
  - Uncertainty and probabilistic information

DGEX (Downscaled GFS with Eta eXtension)

- Brings forecasters some immediate relief in generating medium-range grids

  - GFS grids currently distributed are too coarse in vertical and horizontal resolution to provide an acceptable first guess – especially in areas of complex terrain

- Produces objective, physically-consistent downscaled model guidance through 192 hours (days 4 to 8)

- Distributed grid set focuses on optimal downscaling to NDFD-matching resolution

- Baseline SmartInit scripts designed to mitigate ISC issues

Brief DGEX description

- 12-km Eta used as downscaling model (WRF in future)
- Analogous to Downscaling GFS Since GFS Synoptic Scale Should Dominate Eta Solution in Its Interior
- GFS LBCs; 78-174 hr uses 3-hr LBCs; 174-192 hr uses 6-hr LBCs
- Start DGEX at 78 hr for adjustment (84 hr first time available)
- Provides 12-km data every 6 hours to 192 hours
- Operational cycle times – run twice per day per grid
  - 06Z and 18Z (00Z and 12Z GFS LBCs) for CONUS
    - Available ~10Z (06Z run) and ~22Z (18Z run)
  - 12Z and 00Z (06Z and 18Z GFS LBCs) for OCONUS
  - Accommodates 18Z, day 8 grids timeliness deadline
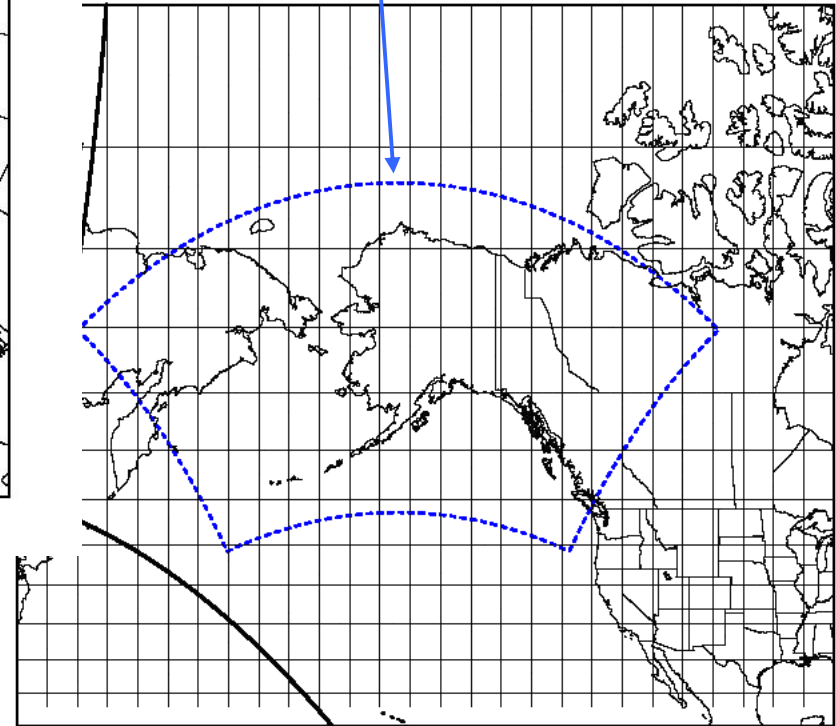
DGEX – Domains
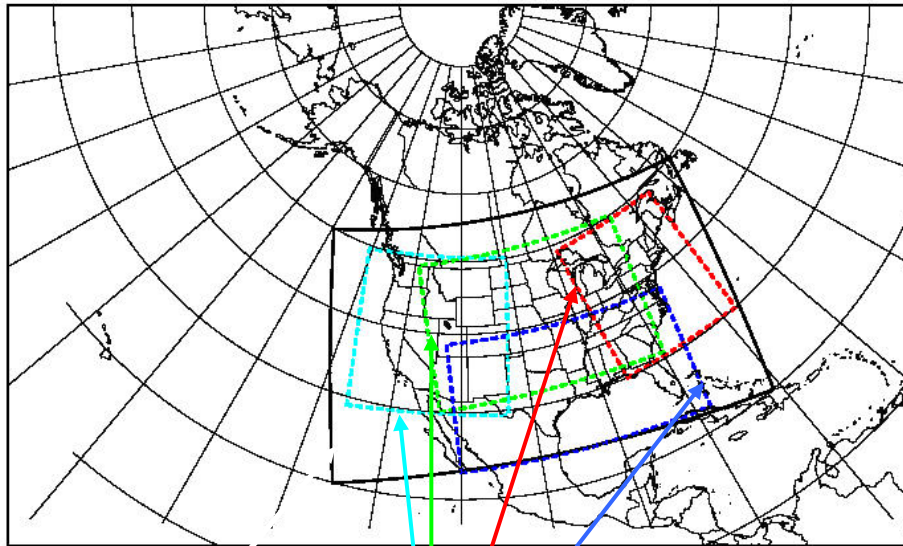
Dashed = Eta output grids for 5-day extension

CONUS Domain

Regional Distribution Tiles

Alaska Region Domain

Regional subsets only used during evaluation period (Regional WAN distribution).

Final distribution will be on grid #185 with GRIB2 compression via new AWIPS SBN.

DGEX Parameters

- Pressure at Surface
- Pressure at MSL
- T at 6 Levels: 2m, 0-30mb,30-60mb,60-90mb,90-120mb,120-150mb,150-180mb
- RH at 6 Levels: 2m,0-30mb,30-60mb,60-90mb,90-120mb,120-150mb,150-180mb
- Uwind at 6 Levels: 10m,0-30mb,30-60mb,60-90mb,90-120mb,120-150mb,150-180mb
- Vwind at 6 Levels: 10m,0-30mb,30-60mb,60-90mb,90-120mb,120-150mb,150-180mb
- Total Precip at Surface
- Total Cloud Cover
- Max Temperature at 2meter
- Min Temperature at 2meter
- Terrain height
- Synoptic Parameters (for Assessment of Model Synoptics):
  - 1000 mb - Height
  - 850 mb - Height Temperature Relative Humidity Wind
  - 700 mb - Height Temperature Relative Humidity Wind Omega
  - 500 mb - Height Temperature Relative Humidity Wind
  - 250 mb - Height Wind
  - Lifted Index (Surface Based)
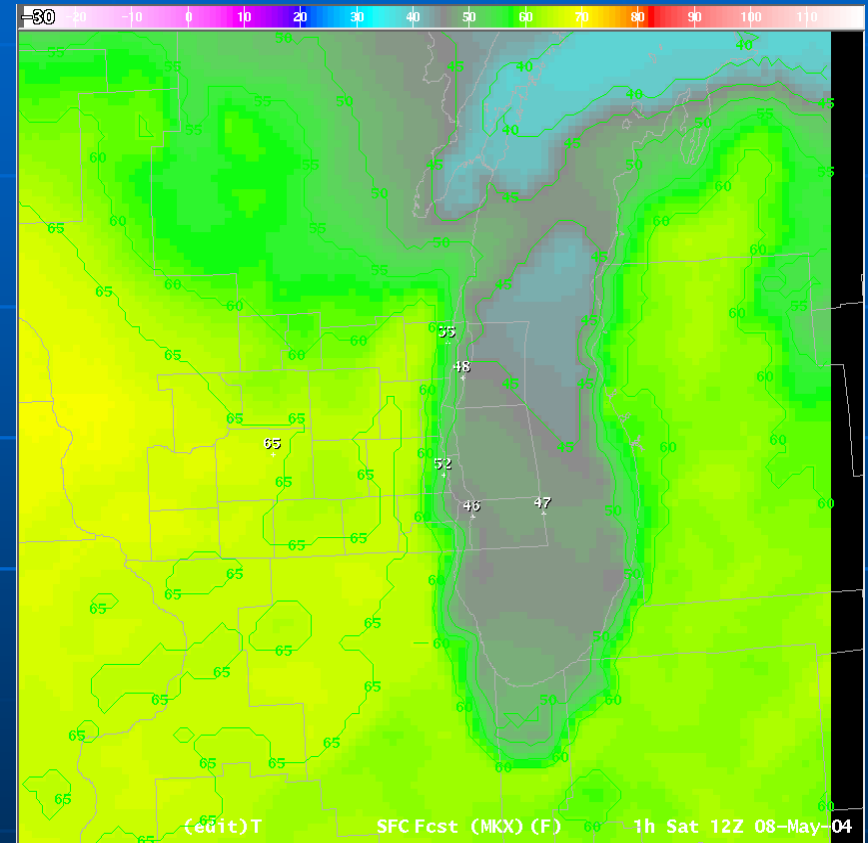
LaCrosse Example – Dan Baumgardt
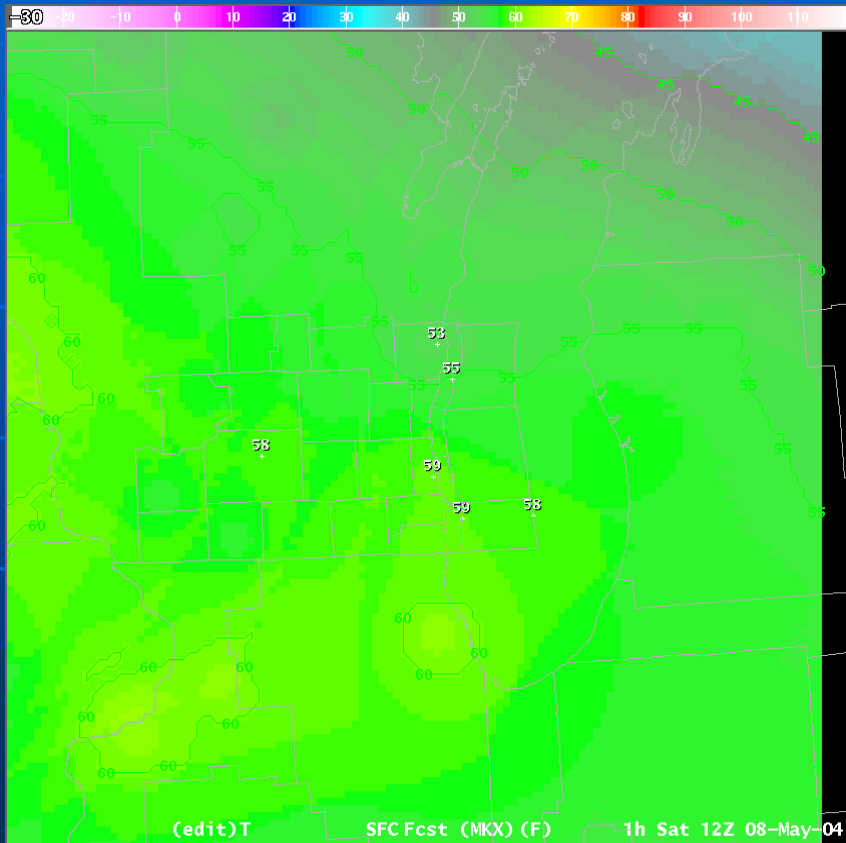

SNOW WATER EQUIV OPS12 VALID 12Z 22 MAR 2004
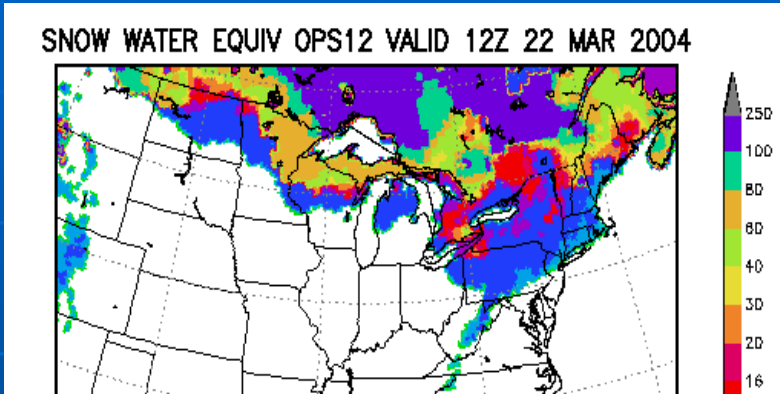
• Eta Snow Cover Reflected in the Day 4 MaxT Grid
• Verified Temps in Blue
• DGEX Very Useful to Modify Forecast MaxT
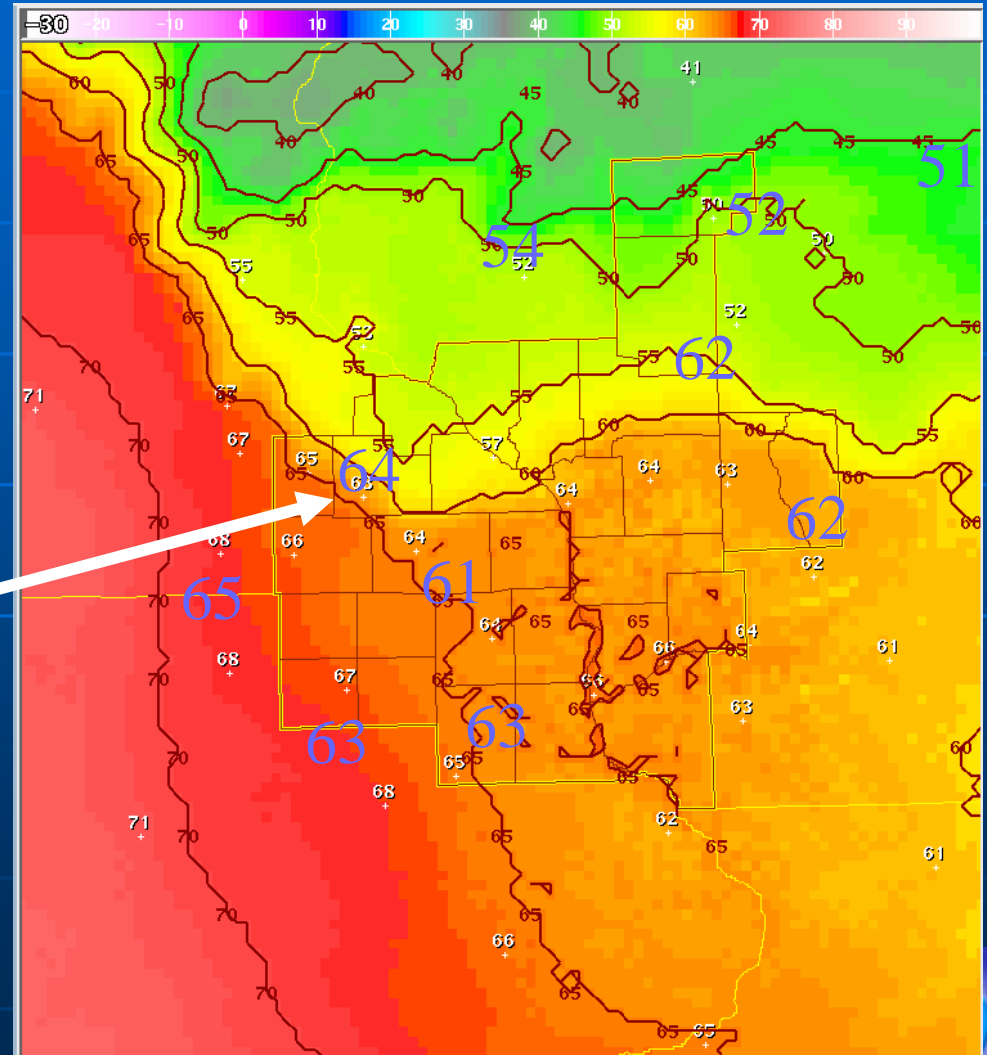
Milwaukee Example – John Eise
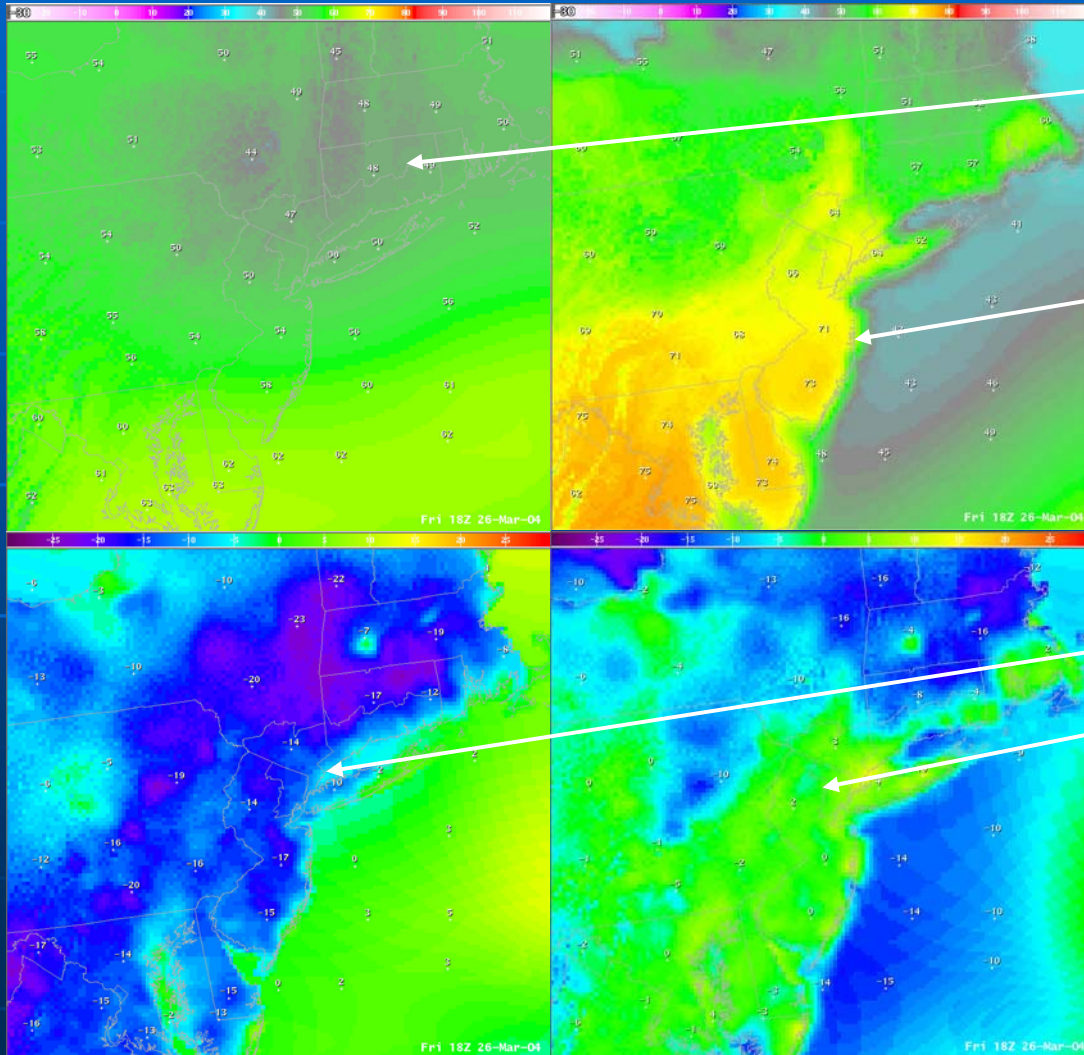
Day 6 Forecasts

ADJMRF: COOP and MRF MOS   Raw DGEX Surface T

ER Example – Dave Novak

- 90 hr GFS Forecast Verifying 18Z March 26
- 90 hr DGEX Forecast Verifying 18Z March 26
- LAPS Used as "Ground Truth"
- GFS Forecast Error
- DGEX Forecast Error
- DGEX Significantly Reduces the Error

DGEX Scientific Assessment

- EMC objective verification

- HPC subjective forecaster feedback

- Field Evaluation: March 15 – April 20, 2004

  - 10 WFOs participated

    - WR offices (Spokane, Boise, and Pendleton)

  - Survey form provided subjective feedback

DGEX Assessment Summary

Special considerations

- Occasional, significant differences occur between DGEX and GFS
  - Still, EMC objective verification shows DGEX and forcing GFS of equal skill
  - Requires training and increased forecaster experience to build confidence
- Run-to-run variability impacts usefulness of DGEX (model flip-flop)
  - Underscores current imbalance between forecast resolution and forecast uncertainty (argument to apply ensemble guidance on DGEX background field?; other ways to include uncertainty?)
  - A synoptic-scale GFS issue, not a DGEX issue
- Forecaster workload did not show an overall decrease
  - Expected for any new model, especially given impact of assessment activities
  - Should be reduced when all WFOs have DGEX, and when consistent methodologies for populating grids are developed

Operational DGEX

- Still planned for OB3.2 (later this month)

- GFE SmartInits will be updated (Tim Barker WFO MSO)

- Can also be used as background field to apply MatchMOS (see Dave Novak's (ER) page)

  http://www.werh.noaa.gov/SSD/smarttools/newdata/newdata.htm

- Details (e.g., available fields) on ISST page

  http://www.nws.noaa.gov/ost/ifps_sst/

A National Weather Service Success Story

- ISST and EMC (Geoff Dimego) early partners

- OS&T and NCEP management recognized importance

- Regions supported effort

- EMC, NCO, TOC, and others critical

- A few key individuals:

  - Eric Rogers (EMC), Brent Gordon (NCO), Kirby Cook (WR/SSD), Tim Barker (WFO Boise), and Jay Smith (WFO Fairbanks)

Other New Model Data

- Eta12 Sfc fields thru 84 hrs (since Feb)

- "Full" Eta12, thru 84hrs, 4x/day (OB3.2)

- More GFS levels, thru 240hrs, 4x/day (OB3.2)

- "Full" set of GFS fields on grid 211, thru 240hrs, 4x/day (OB4)

- For details on these RCs, see ISST page

Analysis of Record (AOR)

- A gridded analysis of base state and sensible weather parameters

- Rapid refresh – nominally hourly frequency

- Done in real-time with possible second "archive" AOR after all data assets are received

- Retrospective (using 25 year regional re-analysis just completed at EMC)

Analysis of Record

- ISST has identified this as our number one priority

- Immediate goal: Determine operational requirements, science and R&D issues that need to be addressed, potential roadblocks, and strategy for implementation. <u>Need to get this on a fast track</u>!

Analysis of Record

NWS motivation:

- Real-time seamless verification
- Provide forecasters useful feedback
- Give forecasters a way to assess the initialization and performance of NWP models
- Serves as input to the GFE for use in short-term forecasts
- Contributes to the ongoing development of a gridded climatology
- Building block for new MOS applications
- Hydrology applications

Analysis of Record

Community motivation:

- Mesoscale model development and verification
- Transportation management
- Emergency management and response
- Hindcast testing of data assimilation schemes
- Private sector requirements
- Homeland defense
- Regional climate studies
- Etc.

- Considerations:
  - Be at the same resolution (both spatial and temporal) as the forecast grids
  - Incorporate data from all sources: RAWS, COOP, satellite, radar
  - Be as independent from the NWP models as possible

- Potential directions:
  - A collaborative effort will likely be needed between the NWS, ERL, and universities.
  - Opportunities for outsourcing should be explored
  - External peer-review process will be beneficial
  - A long-term effort is required. Work should begin now, as it will likely be some time before results are available.

EMC's AOR Concept

- Can't just apply 2-D analysis (variational or otherwise) to surface data - we might have 10,000's of mesonet/surface obs, **B U T** we have millions of AOR grid points

- Need a 3-D forecast model to obtain temporally consistent solution dictated among observed data, terrain & lower boundary forcing and synoptic forcing

- Propose to apply tried & true NCEP 4-D data assimilation technique of forecast-analysis cycle at high resolution (~2 km) with cost cutting measures to make feasible in production

EMC's AOR Concept

- NCEP's 4DDA will (like the EDAS) use
    - Full complexity of NOAH Land-Surface Model
    - Assimilation of observed precipitation data to ensure lower-boundary states are optimal
- NCEP will use WRF-NMM as assimilating model to efficiently include
    - Nonhydrostatic effects in the dynamics
    - Terrain following coordinate (hybrid sigma-pressure replaces step-mountain eta)
    - Nudging (not in any of NCEP current models)

EMC's AOR Concept

- AOR's emphasis is on sensible weather elements

- Focus AOR on surface & sensible weather where we have majority of mesoscale observations

- To save cost, reduce vertical resolution away from surface (run with 20-30 levels instead of current 60 levels)

- To compensate for less vertical, nudge prediction away from sfc to an existing solution provided by operational North American Mesoscale run (currently 12 km Eta but 10 km WRF-NMM by late FY2005)

Analysis of Record Summit

- This is a community problem
  - Mesoscale research and NWP, dispersion modeling, regional climate, etc.
- USWRP and OS&T sponsoring a workshop, Boulder, CO, 29-30 June
- John Horel and ISST organizing it
- Geoff Dimego, EMC, playing critical role
- Goal: Implementation plan with community endorsement (John Horel)

Critical Questions

(1) What can be learned from the literature and applications of existing methodologies as far as benefits and limitations of a particular approach that may be advocated for an analysis of record?

(2) What are the critical issues that must be faced in order to successfully develop a quality analysis of record at spatial scales of 2.5-5 km every hour?

(3) Are there some aspects of an analysis of record effort that are more straightforward to accomplish than others, i.e., specific variables (temperature vs. precipitation), real-time analyses vs. retrospective analyses?

(4) To what extent will the analysis of record be constrained by limitations of the existing and future observational data base vs. that available in the past? What observational data sets do you view to be most critical?

(5) To what extent will the analysis of record be constrained by limitations of an underlying model? Sensitivity to boundary layer parameterizations, soil moisture, clouds, etc.?

(6) What are appropriate measures to assess the skill of an analysis of record on these spatial and temporal scales?

(7) What are the resource implications of a particular method?

AMS 1st National Weather and Climate Enterprise Partnership Summit

- Follows from NRC report "*Fair Weather, Effective Partnerships in Weather and Climate Services*."

- Part of AMS effort to serve as a neutral host

- 27/28 July 2004, Dallas-Fort Worth

- "Developing a National Mesoscale Observing Network: Fundamental Questions."

- Targets the process necessary to achieve a National mesoscale network