National Unified Operational Prediction Capability

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7 May 2011
Background

NUOPC is an integration of ongoing efforts coordinated by a Tri-Agency management organization.

- **2005** - Tri-Agency established a goal of complementary operational NWP
- **2006** - Reviewed opportunities and alternatives; selected coordinated Global NWP as initial focus area
- **2007** - Developed initial concepts and project plan for NUOPC
  - Initial dialog with Stakeholders, March 2007
  - Phase I approved by Tri-Agency principals group (DoC US for Ocean and Atmospheres, AF/A3O-W, and Navy N84)
- **2008**
  - Jan 22: Executive Steering Group (ESG) appointed Project Manager, approved ESG Charter for signature and authorized further resolution of “Stretch Goals” for IOC-1
  - Follow-up dialog with Stakeholders, April 2008
  - Three Interim Committees established; chairs appointed, membership selected, first meetings conducted in August 2008
  - Executing Phase I
- **2009** – ESG approved moving to Phase II
Original Near-Term Objectives

- Implement a management structure including committees
- Establish interoperable infrastructure standards and common model architecture
- Establish a common research and development agenda based on common requirements
- Create a development test center structure to encourage and support rapid transition of outside research
- Pursue the North American Ensemble Forecast System ensemble (NAEFS) effort as a precursor to a unified ensemble effort
- Pursue initial agency stretch goals
Recent Accomplishments

- IOC-1 of NOAA-Navy National Unified Ensemble (NUE) – Jan 2011
- NUOPC Interoperability Standards in ESMF Release 5.1
- Socializing of R&D Requirements
- Progress on Common Model Architecture
- NUOPC User Workshop
Unified Ensemble Operations

- Management Agreement codified in a proposed Annex to existing Data Acquisition, Processing, and Exchange (DAPE) MOA
  - Draft Annex deals with *joint* multi-model ensemble operations and management
  - Draft Annex reviewed with COPC at November meeting
  - COPC suggests signing at ESG level
- Next step – Submit final draft for Agency review and approval by ESG
Common Metrics Proposal

- Need controlled comparison (i.e. model vs model)
- Common verification:
  - Eight parameters measured at 6-hr intervals
  - Broad verification over N/S hemispheres
  - Defined observation set, **UK Meteorological Office analysis**, and World Wide Merged Cloud Analysis used for verification
  - Appropriate statistical methods employed (RMSE, Brier Score, CRPS, Ensemble Mean/Spread)
- Metrics sent to centers for implementation
- Each agency to develop implementation plan
  - Regular status reporting
Common Model Architecture

- Implementing agreed-to standards into NUOPC Layer
- Component and Coupler Templates
  - Prototype code available
- Common guidance on Model Metadata
- NUOPC Compliance Checker
- Examples and use guidance available.
CMA Projects

NUOPC Plans

The National Unified Operational Prediction Capability (NUOPC) is a strategic initiative to fundamentally advance the weather prediction modeling systems used by the National Weather Service, Air Force and Navy meteorologists, mission planners, and decision makers.

Pilot Project Design Documents

- NUOPC Layer: Coupled Atmosphere and Ocean Model Design Document (Download MS Word Document)
- NUOPC Layer: Single Column Model Design Document (Download MS Word Document)

General Guidance and Architectural Documents

- NUOPC Layer: Guidance Document on Component and Coupler Templates (Download MS Word Document)
- Final Report on the Interim Committee on Common Model Architecture, June 18, 2009 (Download MS Word Document)

Guidance Documents for Conventions

- NUOPC Layer: Guidance Document on Model Metadata (Download MS Word Document)

Reference Manuals

These may be absorbed into the ESMF documentation.

- NUOPC Layer: ESMF Compliance Checker - ESMF v5.1.0 (Download MS Word Document)
- NUOPC Layer Reference (v. 05/03/2011) (Download PDF)
"I would like to congratulate Gerhard and CSC committee for doing a great job in developing a wonderful NUOPC tool for the community. I was able to use this NUOPC tool to achieve the following goals.

1. Was able to use NUOPC prototype to drive NOGAPS and HYCOM individually to ensure that each model can run under NUOPC correctly. This proves that NUOPC prototype is flexible enough to be used as a single model driver.

2. Was able to use NUOPC prototype to drive NOGAPS and HYCOM parallely to ensure that both model can run together under NUOPC.

3. Was able to use NUOPC prototype to drive NOGAPS and HYCOM using NUOPC coupling connector.

4. Was able to adopt NOGAPS-HYCOM regrid function under NUOPC coupling connector. To have this flexibility under NUOPC is a huge plus. NUOPC prototype definitely has a very smart design to deal with this issue. Excellent work.

In summary, I believe that NUOPC prototype is a valuable tool with a great potential."

---  James Chaing - NRL Monterey
Operational Modeling Systems Using (or will use) ESMF in some form

- Global Forecast System (GFS)
- Global Ensemble Forecast System (GEFS)
- North American Mesoscale Model (NMM)
- Finite Element Icosahedral Model (FIM)
- NOAA Environmental Modeling System (NEMS)
- Global Assimilation of Ionospheric Measurements (HAF-GAIM)
- Weather Research and Forecasting Model (WRF)
- Land Information System (LIS)
- Naval Operational Global Atmospheric Prediction System (NOGAPS)
- Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS)
- Navy Coastal Ocean Model (NCOM)
- Hybrid Coordinate Ocean Model (HYCOM)
- Wave Watch 3 (WW3)
- Community Ice Code (CICE)
- Ensemble Forecast System (EFS)
- Simulating Waves Near Shore (SWAN)
- Advanced Circulation Model (ADCIRC)
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<tr>
<th><strong>Tri-Agency Stretch Goals</strong></th>
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<td><strong>Air Force</strong></td>
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<td><strong>Goal:</strong></td>
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<tr>
<td>Develop capability to produce operationally significant ceiling and visibility probability forecast products leveraging AF Wx Ensemble Prediction System</td>
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<tr>
<td><strong>Progress:</strong></td>
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<td>- Achieved operational deterministic GFS and WRF-based Diagnostic Cloud Fcst products.</td>
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<td>- IOC-1 will enable GFS &amp; NOGAPS ensemble members delivery in timely manner &amp; in useable format.</td>
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<td><strong>NOAA</strong></td>
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<td><strong>Goal:</strong></td>
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<td>Deliver 6-14 day probabilistic hurricane track and intensity guidance</td>
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<td><strong>Progress:</strong></td>
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<td>- 20 mbr low resolution GFS (~60 km) ensemble using an EnKF DA system showed a 20% improvement over the higher resolution operational GFS using GSI DA at the longer lead times</td>
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<td>- Stream 1.5 runs experimental available to forecasters in real-time (AHW at 1 km and the experimental GFDL at 7.5 km)</td>
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FY 2011

- **Continue Implementation of the National Unified Ensemble (NUE) System**
  - Establish management
  - Development of Post-Processing Toolkit
  - Resolve IOC-2 post-processing framework

- **NUOPC/ESMF Model Architecture**
  - Continue incorporation of NUOPC standards in ESMF
    - Including Coupling conventions
  - Begin Single Column Model (SCM) effort
  - Initiate Future Model Architecture Work

- **Continue community outreach activities**
  - e.g., Conduct User Workshop for ensemble use in forecasting

- **Define formal Earth System Prediction Capability linkage**
NUOPC Next Steps
Where is Progress Achievable, Beneficial, Cost Effective?

• This Workshop
  • User Products to make better use of probabilistic information

• NUOPC conduct workshops to expand/codify areas where there is ongoing complementary effort:
  • Data Assimilation – Maintain and expand JCSDA mission
  • Global Atmosphere – Pursue ESPC, CMA
  • Ocean – Pursue agreements on HYCOM
  • Waves – Pursue agreements on Wave Watch III
  • Tropical Cyclone Prediction – Pursue joint ensemble capability

• Explore options where no progress to date:
  • Data Quality Control, Land, Aerosols, Sea Ice, Riverine, Ionosphere, Space, Solar
QUESTIONS?
End State Attributes

• The most capable prediction system that meets all Tri-agency mission requirements.

• A system that assures full operational backup among agencies.

• A system that takes advantage of core capabilities and investment of each agency, both in development and operations.

• A system that doesn’t pose risk to individual agency mission responsibilities.

• A system that provides increased capability and accelerates the adoption of new capability for each agency without unduly increasing demand for agency resources.
Ensemble User Workshop

- 31 May to 2 June, Seattle, NOAA Sand Pt

**Workshop Goals:**
- Address issues from R&D workshop
- Improve operational ensemble products
- Steer new product development to user needs, preferences
- Foster user-developer teams for continuous product improvement

- Approximately 50 – 60 attendees
  - NOAA WFOs, AWC, EMC, ESRL, MDL
  - Navy FWCs, JTWC, FNMOC, NAVO, NRL
  - USAF AFWA
  - NCAR DET/DTC
  - Universities – UW, UAz, SU, Delft