

Next Generation Global Prediction System Progress: Transition to Operations

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NGGPS

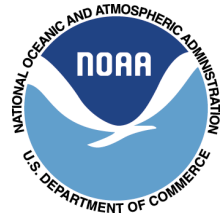
Over-arching Objective



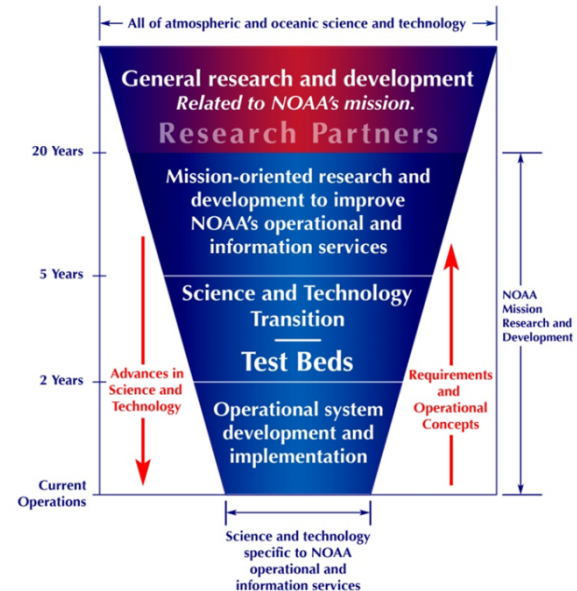
- Design, develop, and implement the Next Generation Global Prediction System (NGGPS)
- Extend Weather Forecast to 30 days
 - Atmosphere, Ocean, Ice, Land, Waves, Aerosol
 - Fully coupled using NEMS/ESMF
- Fully utilize evolving HPC capabilities
- 5-year Community Effort



Over-arching Strategy

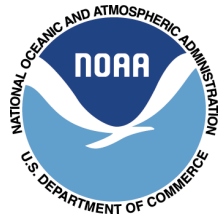


- Implement coupled system
 - ESMF/NEMS Based
 - Prototype by Sep 30, 2015
- Develop components as community code
 - Atmosphere (Core and Physics), Aerosols
 - Ocean
 - Ice
 - Waves
 - Land
 - Atmospheric Data Assimilation
- Migrate from current operational modeling suite to an over-arching integrated coupled system
 - Annual (as needed) upgrades to existing components
 - Global domain with convective scale nesting to support severe weather
- Review/upgrade software architecture as appropriate for next generation HPC





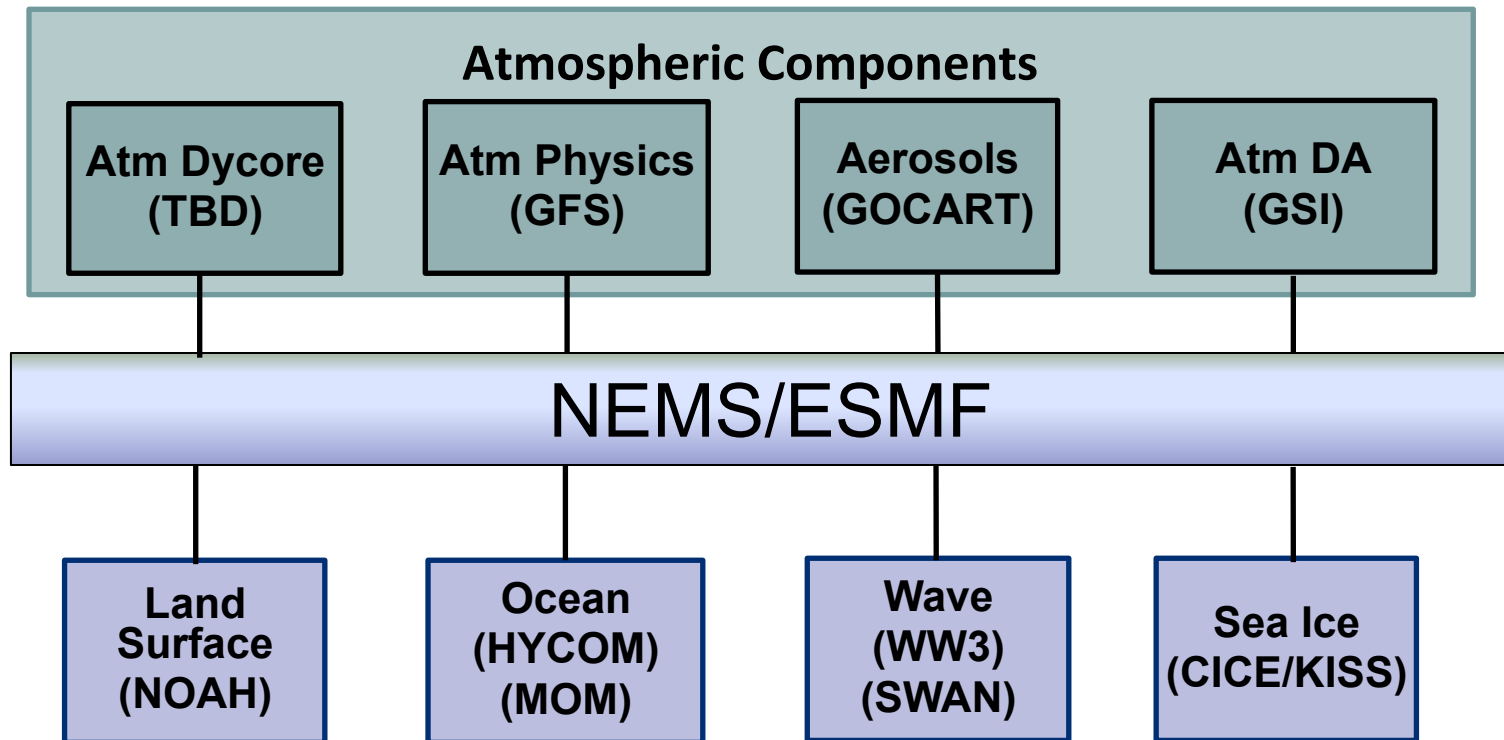
Initial Activities and Objectives



- Define Next Generation Global Prediction System
 - Characteristics, components and performance
- Develop project Implementation Plan
 - Including 5-yr Physics Development Plan – Community Physics Workshop
- **Conduct Atmospheric Model Dynamic Core Evaluation**
- Accelerate NEMS – Develop Prototype Coupled System
- Augment ocean, land, sea ice, wave, aerosol component development
- Upgrade EMC infrastructure to support community participation
- Initiate Test Bed Activities
- Broaden Community Participation
 - Conducted external and internal Announcements of Opportunity; ~\$6M for approved activities from universities, internal weather test beds and labs



NGGPS Planned Components





Implementation Plan - Development Teams

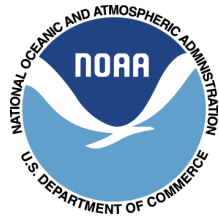


- Atmospheric Prediction - Dynamics
- Atmospheric Prediction – Physics
- Data Assimilation
- Ocean Prediction (includes waves and sea ice)
- Land Prediction
- Hurricanes and Tropical Storms
- Nested Subsystem for Storm-scale, Fire Weather and Severe Convective Weather Prediction
- Ensemble Development
- Post-Processing
- Testing/Testbeds
- Infrastructure
- HPC Configuration

Includes participation across NOAA line offices/laboratories, Navy, NASA, UCAR and coordination with the High Impact Weather Prediction Project and the National Earth System Prediction Capability program



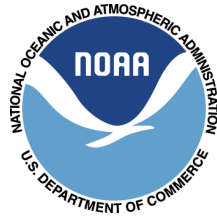
Physics Development Team



- Overall physics parameterization objective:
 - Develop/transition accurate and efficient representations of atmospheric physical processes
 - Spanning spatial scales from cloud and convective permitting resolutions (~ 1 km) to climate applications (~ 100 km)
- Draft short term goals include:
 - Assess current state-of-the-science of physical parameterizations and aerosol predictions along with potential impact on NWP
 - Finalize a 5-Year Technical Plan



Physical Parameterization 5-Year Technical Plan



- Follow-on meeting Thursday to review draft plan
 - Expected areas of research are:
 - Radiation
 - Turbulent transport and surface interactions
 - Cloud and precipitation estimation/prediction
 - Orographic and non-orographic drag
 - Prediction of natural and anthropogenic aerosols
 - Atmospheric composition/trace gas prediction
 - Development also planned in NEMS infrastructure and an interoperable physics driver



Why a New Operational Dynamic Core




- Current GFS approaching end-of-life
 - Needs to be non-hydrostatic
 - Multiple one or two- way nests for convectively driven severe weather
 - Spectral models have inherent limitations with regard to computing scalability
- Next Generation computing paradigm will require scaling across potentially 100,000's processors or more
- As part of NGGPS effort, will evaluate, select and implement the follow-on core for the next several decades
- Parallel efforts initiated at UKMO and ECMWF



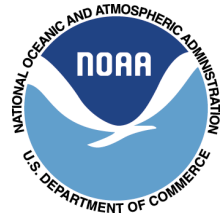
Dynamic Core Evaluation Workshop



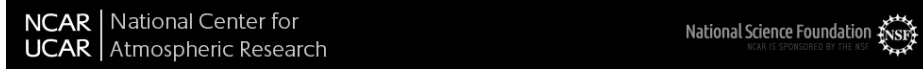
- Held Aug 5-6, 2014 at NCWCP in College Park, MD
- Defined a set of evaluation criteria for selection of a next generation operational non-hydrostatic atmospheric dynamic core
- Test protocol developed for each criterion for evaluation
- Leveraging and integrating the ongoing work with the High-Impact Weather Prediction Project (HIWPP) dynamic core inter-comparison study 
- Goal for evaluation is provide a recommendation to NCEP/NWS Directors by spring 2016
 - Technical
 - Business



Dynamic Core Evaluation Participants



- MPAS (NCAR) – Unstructured grid with C-grid discretization



- FV3 (GFDL) – Cubed sphere, finite-volume



- NIM (ESRL) – Non-hydrostatic Icosahedral Model



- NEPTUNE (Navy) – Flexible grid with adaptive mesh Refinement



- NMM-B (EMC) – Finite difference, cartesian grid, global extension of regional model



- GSM-NH (EMC) – Non-hydrostatic extension of Semi-Lagrangian Global Spectral Model



NGGPS Dynamic Core Testing



Phase 1 of Testing:

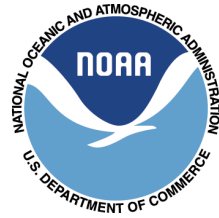
- Incorporation of HIWPP testing
- Computational performance and scalability testing by Advanced Computing Evaluation Committee
- Report of test results by late spring 2015
- Recommendation of which dynamic cores proceed to next round

Phase 2 of Testing (proposed):

- Porting to NEMS/ESMF infrastructure and establish interface with GFS physics
- Meteorological/Computational Performance benchmarking tests with GFS physics
- Assessment of potential for future optimization
- Evaluation of variable resolution/nesting capability
- Evaluation of conservative properties
- Final report of dynamic core evaluations by March 2016..., including business case and technical assessments
- Decision/Selection – Spring 2016



NGGPS Dynamic Core Testing Status



Phase 1 Testing

- Level 1 computational performance testing on schedule – final report 30 April 2015
- Report on HIWPP non-hydrostatic dynamical core tests delivered
- Dycore Test Group to be formed to evaluate results and follow-on test plan

Phase 2 Testing

- Finalizing Phase 2 test criteria
- Leveraging U. of Wisconsin knowledge on conservation testing
- Target date for delivery of GFS physics and prototype driver interface is June 2015
 - NUOPC Physics Interoperability leading design effort for driver interface



Summary

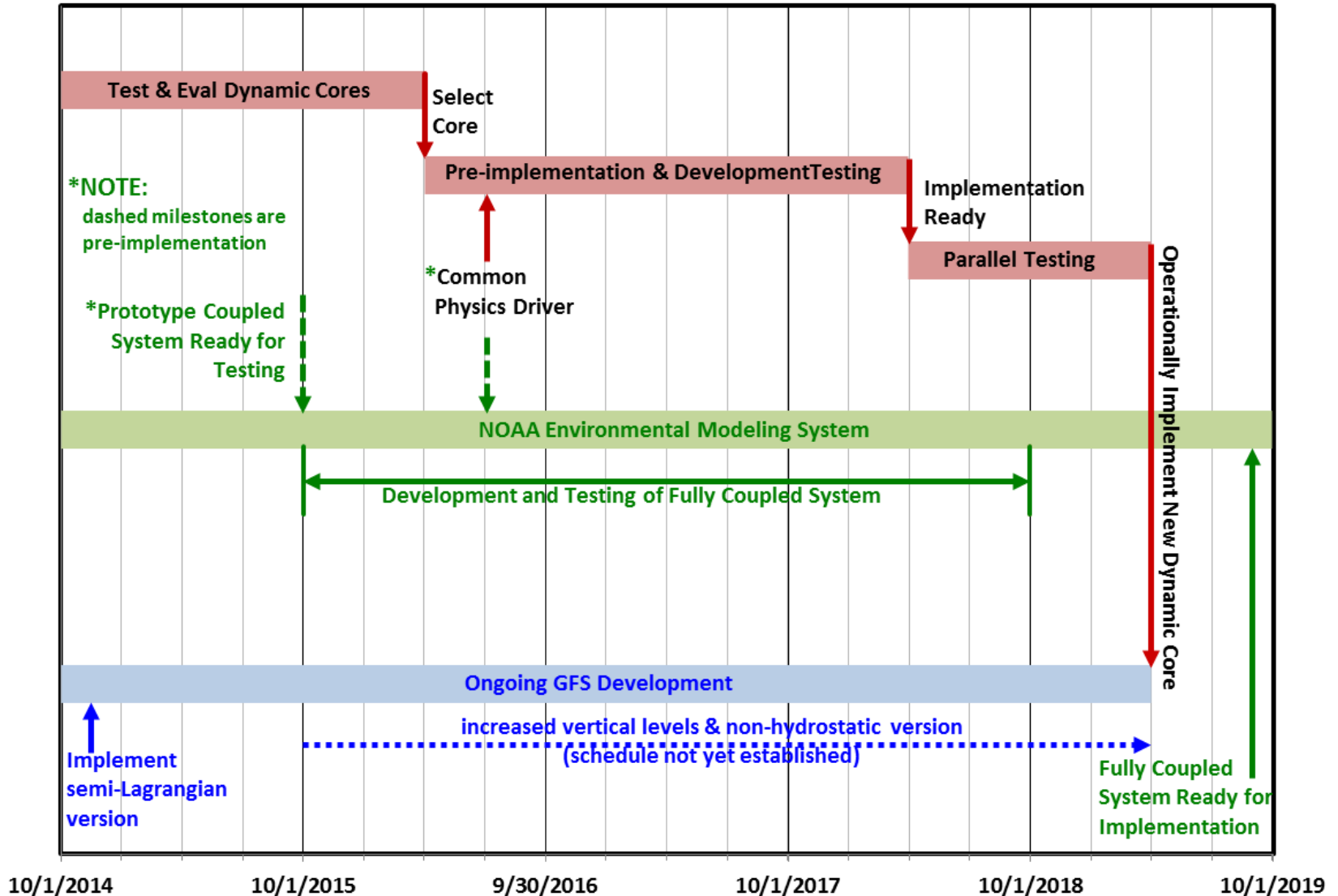


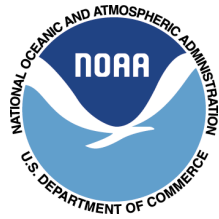
- NGGPS Implementation Plan and Dynamic Core Test Plan drafted
- Moving ahead with Development Team planning
 - Physics Workshop Jan 27-29, 2015 at NOAA NCWCP
- Coordinating proposal driven scientific development by universities, federal labs, and testbeds
- Dynamic core testing underway with final decision anticipated spring 2016
- Further dynamic core development and parallel testing required after selection with operational implementation planned by April 2019
- Future focus on development of model components as community code

Goal is to design, develop, and implement the Next Generation Global Prediction System and maintain world-class forecast capability



Potential NGGPS Implementation





Questions?

NGGPS Website:

<http://www.nws.noaa.gov/ost/nggps>

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