NOAA’s Unified Forecast System

Strategic Implementation Plan (SIP)

Coordination Meeting for UFS SIP Annual Update

Ming Ji and Fred Toepfer
August 1, 2018
Highlights since January

• FY2019 NGGPS/SIP Kick-off
• Unified Forecast System Steering Committee Established
• CCPP Version 1.0 Released to the Community
• Hurricane Supplemental Planning Meeting – April 2018
• Global FV3 released to the community
• NCAR-NOAA MOA negotiated – signatures immanent
Unified Forecast System
NWS Operational Applications

NGGPS (+ UDA)
Unified Forecast System (UFS) global applications

Product = Coupled Ensemble + Reanalysis + Reforecast

UFS regional apps

Year or SFS (seasonal)
Month or SSFS (subseasonal)
Week or GFS (weather)
Day or RRFS (rapid refresh)
Hour or WoFS (WoF)
Now (analyses)

UDA

National Water Model

UDA: Unified Data assimilation
SFS: Seasonal Forecast System
SSFS: Subseasonal Forecast System
GFS: Weather Forecast System
RRFS: Rapid Refresh Forecast System
WoFS: Warn on Forecast System
Unified Forecast System for Operational Earth System Prediction (2018)

ESMF/NUOPC/NEMS architecture enables unified global and regional coupled modeling and DA

Consistent with broader community (CESM) and US National ESPC

Courtesy Developmental Testbed Center
Governance functions at the interface of the NCEP Production Suite, the broader UFS and the broader research and development community. What is being governed is: a community-based, unified, coupled modeling system suitable for application in NCEP’s Production Suite (UFS).
Approach for Unified Modeling Planning

• A concurrent, parallel planning approach
  – High-level/broad Strategic Plan
    • High-level Strategic Plan + accompanying detailed Roadmap document
  – Short-term (0 to ~2-3 years) Strategic Implementation Plan (SIP) combines implementation activities with near-term strategic actions
    • Led by NWS/NCEP/EMC with NOAA and external partners
SIP Goals and Objectives for Unified Model

• Common Goal: Single integrated plan that coordinates activities of NOAA + external partners in common goal of building a national unified modeling system across temporal and spatial scales
  – NGGPS: foundation to build upon
  – Expand to include other STI development programs and EMC development efforts
  – Activities include R&D, testing/eval, V&V, R2O, shared infrastructure, etc.

• Approach for SIP development:
  – Began with existing core R&D partners to organize in functional area Working Groups (WGs) responsible for drafting respective functional SIP components
  – Add/Revise functional Working Groups and Scope as needed.
• UFS Strategic Implementation Plan - a rolling 3-year plan, updated annually
  – FY18 – 20 (initial cycle) published in November 2017
  – FY19 – 21 to be published October 2018
  – FY20 – 22 initial kick-off planned for Feb 2019
    – Planned to be published in Oct 2019
2018 SIP Update Timeline

- Kick-off Meeting: 01/31/18
- Plan Development
- STI AOP Kickoff: 08/01/18
- First Draft: 08/01/18
- Review & Revise
- Final Document: 10/01/18
SIP Working Groups

- Communications and Outreach
  - Common messaging strategy
- Convective Allowing Models (CAMs)
  - Intermediate steps to CAM ensembles, Warn on Forecast; test/evaluate with community
- System Architecture
  - NEMS evolution; community approach
- Infrastructure
  - Standards/doc; CM; code repository; etc.
- Testing and Testbeds
  - Role of testbeds; regression testing; etc.
- Verification & Validation (V&V)
  - V&V of ops forecasts vs. R&D testing/evaluate; unified/standard tools and data formats
- Dynamics and Nesting
  - FV3 transition on global wx/S2S/climate; moving nests for hurricanes
- Model Physics
  - Common Comm. Physics Package (CCPP); stochastic, scale-aware physics
- Data Assimilation
  - DA Science Strategy, FV3 integ. between NOAA, NASA; Joint Effort for DA Integ. (JEDI); coupled DA
- Ensembles
  - Strategy across scales; model uncertainty
- Post-Processing
  - Comm. PP infrastructure; std formats/tools
- Component Model sub-groups
  - Marine models + NOS coastal/bay models
  - Aerosols and Atmospheric Composition
  - Land Sfc Models (LSMs) + hydrology (OWP)

UFS-SC/TOB: Decision making, roles/responsibilities, advisory boards, org. alignment
How STI and OWAQ Use SIP

• Establish Funding Priorities
• Make Funding Determinations
• Use for Hurricane Supplemental Planning
  – Begin with SIP Modeling Research and Development Activities
  – Accelerate as appropriate!
  – Augment as appropriate!
UFS Next Steps

• Implement FV3 dynamical core (Global, CAM, Hurricane Analysis and Forecasting System (HAFS), Supplemental Augment)
• Accelerate evolution of model physics (Supplemental augment)
• Advance overall data assimilation capability (supplemental augment for JEDI, Dropouts, Science Strategy!)
• Modernize Infrastructure (NCAR MOA, Supplemental Augment)
• Foster a community model environment, with GMTB, JCSDA, and community involved governance (FV3 (Global & CAM) and CCPP public releases); incorporate OWAQ funded activities into SIP.
Meeting Objectives

Objective:

• To present the status of current SIP Working Group activities, and facilitate discussion and coordination among SIP working groups to finalize updates needed to draft the FY19-FY21 SIP document

  • Groups will present progress and successes, and address issues and dependencies requiring resolution

  • Updates on special topics - Hurricane Supplemental, HPC resources

  • Discussion on special topics - Unified Forecast System Governance, Community Engagement,

  • Focused sessions in specific areas – Global Model suites, CAM, and Data Assimilation

• Begin to align with OWAQ funded activities and incorporate into SIP!
Questions?

STI Modeling Program Website:
http://www.weather.gov/sti/stimodeling

Information NGGPS:
http://www.weather.gov/sti/stimodeling_nggps

Strategic Implementation Plan
https://www.weather.gov/sti/stimodeling_nggps_implementation

Information on Grants:
http://www.weather.gov/sti/stigrants
Back-Up
NGGPS Goals and Objectives

• Design/Develop/Implement NGGPS global atmospheric prediction model
  - Non-hydrostatic scalable dynamics
• Improve data assimilation and physics
• Position NWS for next generation high performance computing
• Engage community in model/components development
• Reduce implementation time
• Increase effectiveness of product distribution
  - Post-processing, assessments, and display

World’s Best Global Forecast Guidance

¹From NWS Budget Initiative proposal to OMB
# FV3-GFS near-term plans

**Version 1.1**  
January 2018

<table>
<thead>
<tr>
<th>Implementation Plan for FV3-GFS (FY2017-2020)</th>
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<tr>
<td>FY17</td>
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<td>Q1</td>
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<th><strong>FV3GFS</strong></th>
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<td>FV3 Documentation</td>
<td>Evaluate, prepare and document FV3 dycore for GFS</td>
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<td>FV3 Dycore with GFS Physics</td>
<td>Couple FV3 to GFS physics (NUOPC physics driver) perform forecast-only experiments, tuning and testing</td>
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<td>Preliminary SGI/EnlEn DA for FV3</td>
<td>Develop DA techniques and use new data</td>
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<td>Cycled FV3GFS* experiments (real-time paral)</td>
<td>Cycled experiments, benchmarking, efficiency and optimization</td>
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<td>Advanced Physics&amp;</td>
<td>Couple FV3 to Advanced physics (NUOPC physics driver) perform forecast-only experiments, tuning and testing&amp;</td>
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<td>Post Processing</td>
<td>Adapt post-processing &amp; downstream to FV3 Dycore</td>
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<td>Verification</td>
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<td>Pre-implementation T&amp;E for FV3GFS@&amp;%</td>
<td>3-year retrospective + real-time paral, EML and Community Evaluation</td>
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<td>Transition to semi-operation*</td>
<td>FV3GFS Experimental*</td>
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<td>Advancement of FV3GFS</td>
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* Q3FY18 FV3GFS will be very similar to operational GFS being implemented in May 2017  
* FY3FY19 FV3GFS target resolution is ~10km grid with 127 layers; extends up to 80 km  
* Advanced physics: Scale-aware convection, SHOC PBL, Double-moment microphysics, Unified convective and orographic gravity wave drag etc  
* DA system with higher resolution consistent with the model and using 4d-Hybrid EnVAR
FV3-GFS Release Schedule

• **FV3-GFS Release v0**
  - released in **May 2017**
  - Access by request (core developers and trusted users)
  - Limited capability: forecast only experiment on WCOSS, Theia and Jet

• **FV3-GFS Release v1**
  - planned for **March 2018**
  - Core developers and trusted users to get access through **Vlab/Git**
  - Public release through **github.com**
  - Full capability; including Data Assimilation and Post-Processing
  - Instructions and documentation at NCEP Vlab FV3-GFS community page

  - Access FV3-GFS Project on VLab https://vlab.ncep.noaa.gov/web/fv3gfs
  - Code repositories set up on VLab GIT
  - Community Wiki page, Forums and Developers Pages on VLab
FV3 for Convection Allowing Models

Completed
- Q3FY17: Initial concept ensemble test case with FV3 nesting on a stretched cube (manually run)

Near-term Milestones
- Q1FY18: More testing with global FV3 with a 3 km CONUS nest on a stretched cube including ensemble display tools
- Q1FY18: Develop a standalone regional FV3 capability
- Q3FY18: Static nests running in standalone regional FV3
- Q4FY18: Integration/testing of advanced physics in nested FV3
- Q2FY19: Compare pure FV3-based HREF with multi-model HREF

CAPS was funded by NGGPS to enhance/evaluate FV3 at CAM (~3km) resolution during the HWT Spring Experiment
  - Enhancement included implementation of Thompson microphysics and several PBL schemes
  - Evaluation demonstrated results comparable to WRF
• **CCPP v1 release (Mar 2018):** FY17 GFS Suite in CCPP + SCM. Target audience: public release.

• **CCPP Demo capability (Apr 2018):** FY17 GFS Suite in CCPP + latest FV3-GFS at top of trunk (with modifications to build system, run scripts etc. to work with CCPP). Target audience: developers and trusted collaborators.

• **CCPP v2 release (Q3 FY18):** FY17 GFS Suite in CCPP + FV3 v1. Target audience public. Use FV3-GFS Beta Physics configuration (replace Zhao-Carr with GFDL MP; and other changes to GFS physics as needed).
## Unified Forecast System

### Technical Oversight Board

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<tr>
<th>ORGANIZATION / POSITION</th>
<th>PRIMARY</th>
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<tr>
<td>Board Members</td>
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<tr>
<td>NWS/STI</td>
<td>Ming Ji <em>(Co-Chair)</em></td>
<td>Hendrik Tolman</td>
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<td>OAR/OWAQ/WX</td>
<td>John Cortinas <em>(Co-Chair)</em></td>
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<td>NWS/NCEP</td>
<td>Bill Lapenta</td>
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<td>NWS/EMC</td>
<td>Brian Gross</td>
<td>Vijay Tallapragada</td>
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<td>NWS/SWPC</td>
<td>Brent Gordon</td>
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<td>OAR/ESRL</td>
<td>Kevin Kelleher/Robin Webb</td>
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<td>OAR/GFDL</td>
<td>V. Ramaswamy</td>
<td>Whit Anderson</td>
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<td>OAR/AOML</td>
<td>Robert Atlas</td>
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<td>OAR/ARL</td>
<td>Ariel Stein</td>
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<td>OAR/GLERL</td>
<td>Deborah Lee</td>
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<td>OAR/NSSL</td>
<td>Stephen Koch</td>
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<td>OAR/CPO</td>
<td>Wayne Higgins</td>
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<td>NOS/CSDL</td>
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<td>NASA</td>
<td>Steven Pawson/Tsengdar Lee</td>
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<td>NCAR/RAL</td>
<td>Scott Swerdlin/Louisa Nance</td>
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<td>NCAR/MMM</td>
<td>Chris Davis</td>
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<td>NCAR/CGD</td>
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<td>OWP</td>
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<td>NAVY/NRL Stennis</td>
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