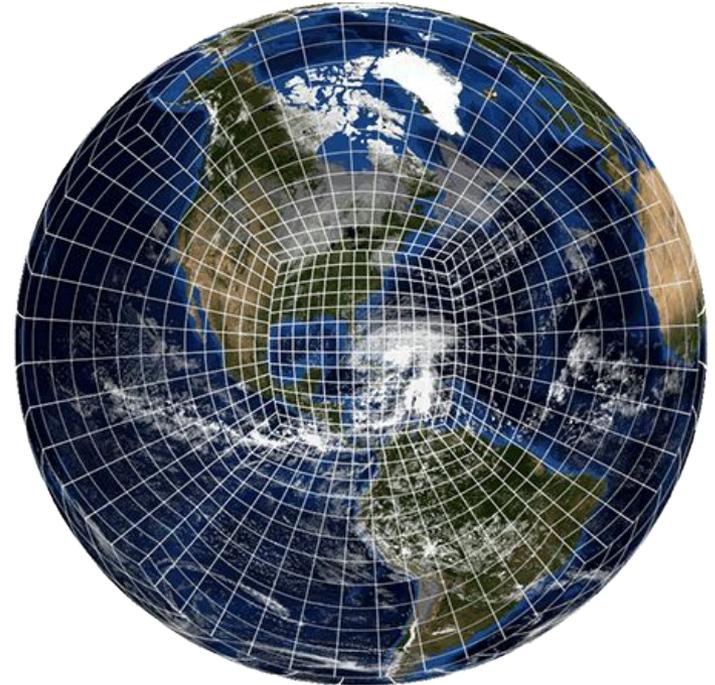




# NOAA's Unified Forecast System

## Strategic Implementation Plan (SIP)



Coordination Meeting for UFS SIP Annual Update

Ming Ji and Fred Toepfer  
August 1, 2018



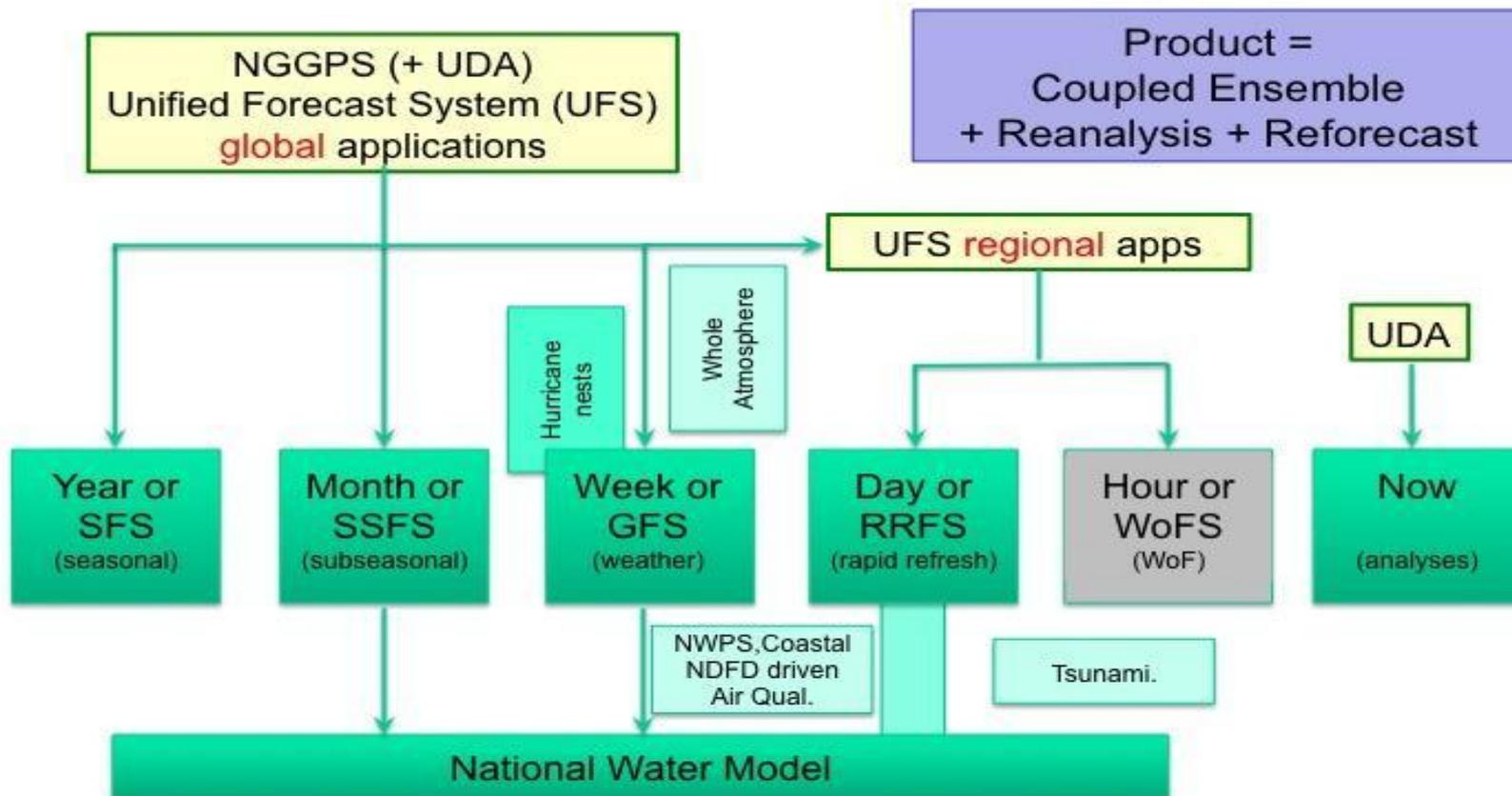
# Highlights since January



- 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



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

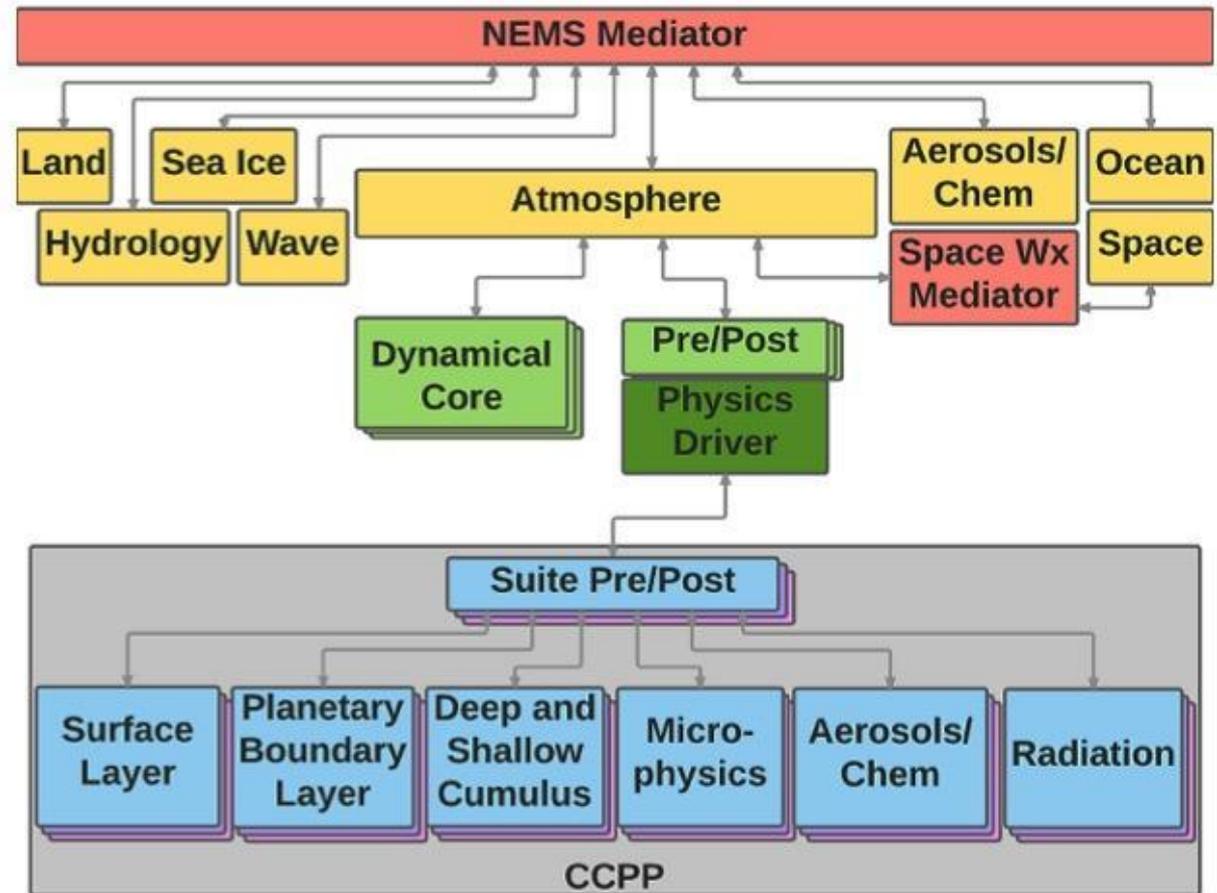


# Unified Forecast System for Operational Earth System Prediction (2018)



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

*Consistent with broader community (CESM) and US National ESPC*





# Unified Forecast System Governance



Partners: e.g.  
NASA GEOS 5,  
JCSDA, NCAR,...

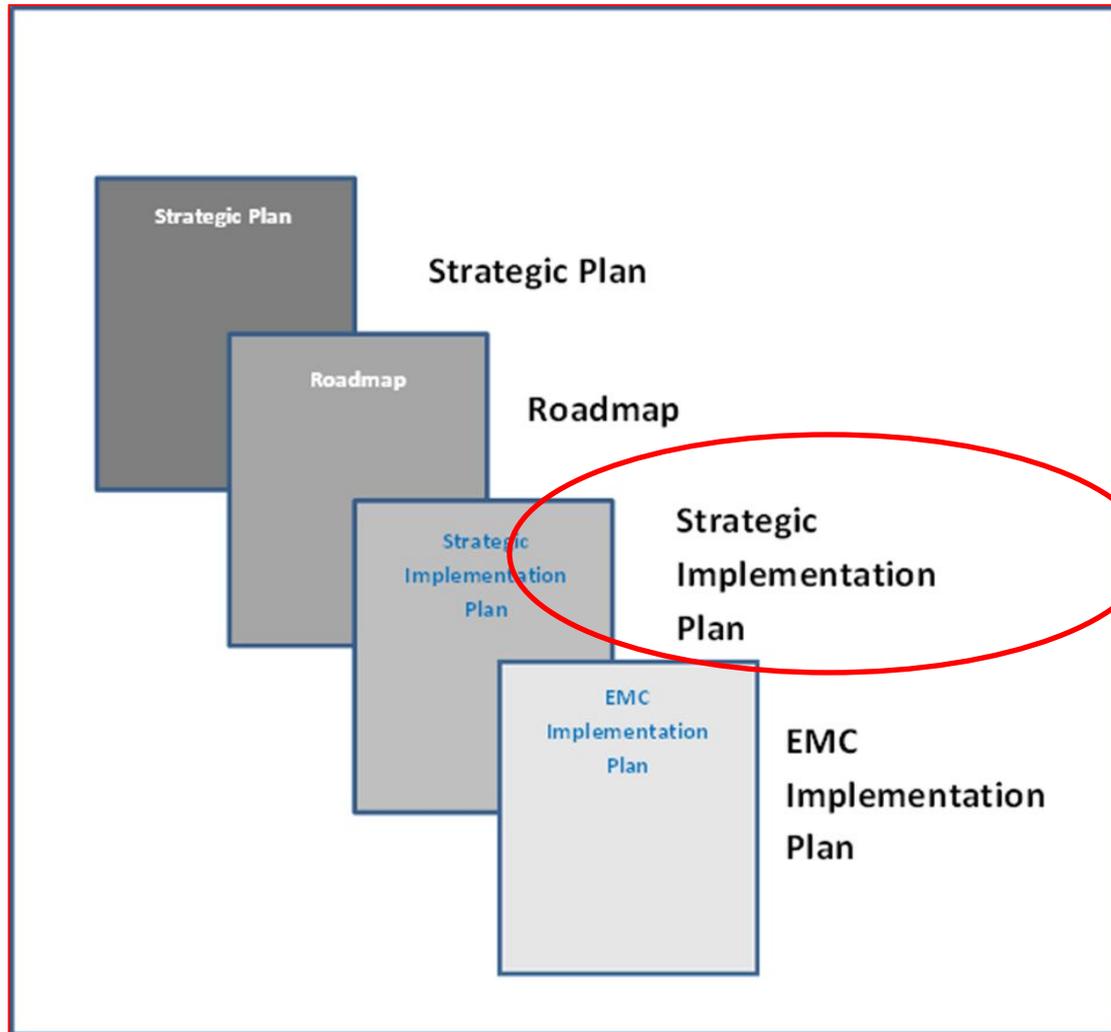
NCEP Production Suite  
Implementation  
and  
Operations

UFS Research  
and  
Development

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).

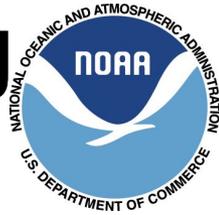


# NOAA – UFS Planning Documents Hierarchy





# 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.



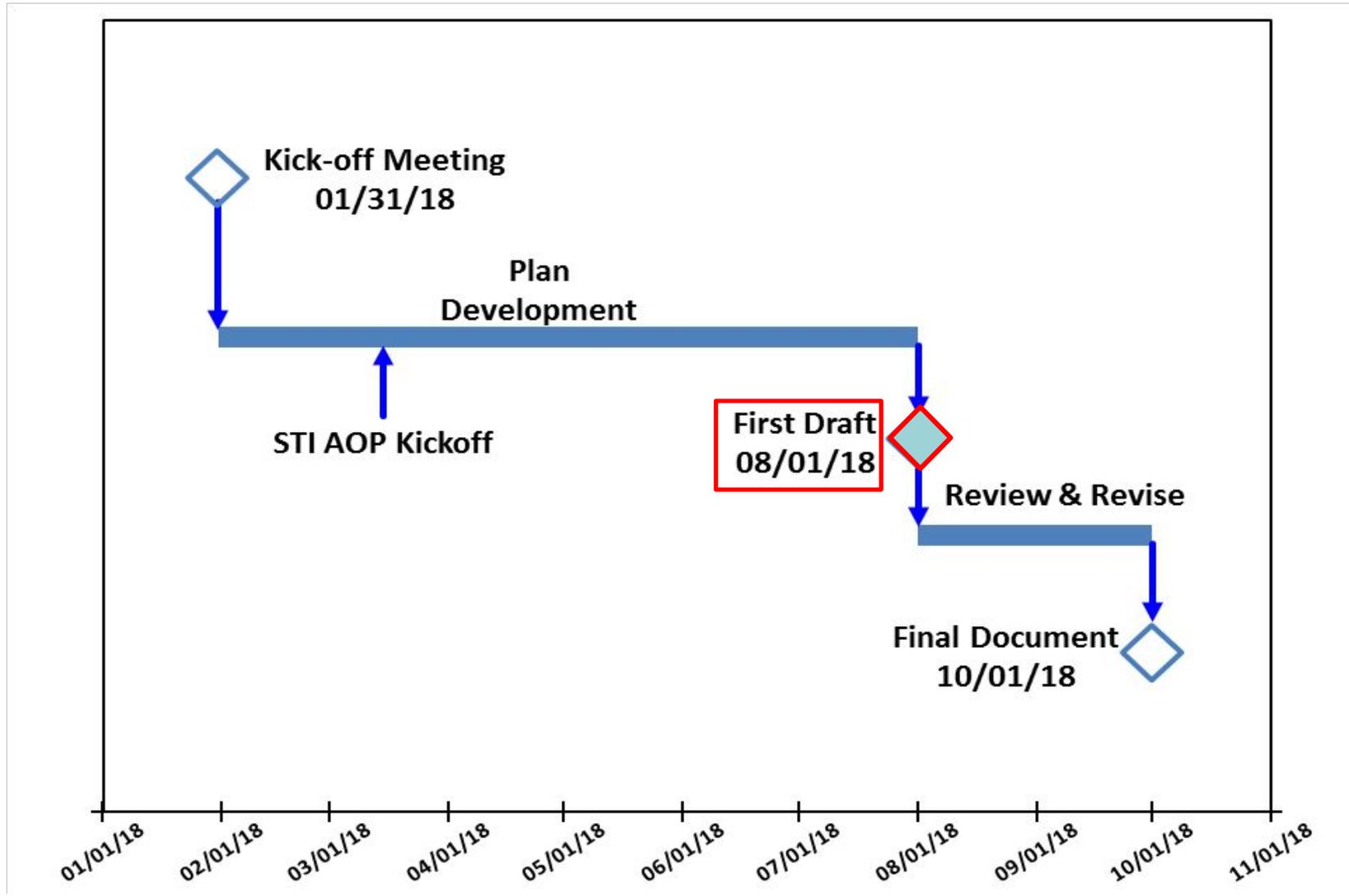
# SIP Annual Planning Cycle



- 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





# 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)



# 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](http://www.weather.gov/sti/stimodeling_nggps)**

**Strategic Implementation Plan**

**[https://www.weather.gov/sti/stimodeling\\_nggps\\_implementation](https://www.weather.gov/sti/stimodeling_nggps_implementation)**

**Information on Grants:**

**<http://www.weather.gov/sti/stigrants>**



# Back-Up



# NGGPS Goals and Objectives<sup>1</sup>



- 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**

<sup>1</sup>From NWS Budget Initiative proposal to OMB



# FV3-GFS near-term plans



Version 1.1 January 2018		Implementation Plan for FV3-GFS (FY2017-2020)																% complete
FV3GFS		FY17				FY18				FY19				FY20				
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
FV3 Documentation	Evaluate, prepare and document FV3 dycore for GFS																	80%
FV3 Dycore in NEMS	Implement FV3 dycore in NEMS@																	100%
FV3 Dycore with GFS Physics	Couple FV3 to GFS physics (NUOPC physics driver) perform forecast-only experiments, tuning and testing																	90%
Preliminary GSI/EnKF DA for FV3	Develop DA techniques and use new data																	90%
Cycled FV3GFS* experiments (real-time parallels)	Cycled experiments, benchmarking, efficiency and optimization																	20%
	Real-time parallel FV3GFS forecasts to the field																	0%
Advanced Physics&	Couple FV3 to Advanced physics (NUOPC physics driver) perform forecast-only experiments, tuning and testing&																	30%
Post Processing	Adapt post-processing & downstream to FV3 Dycore																	50%
Verification	Test & evaluate using Global MET transition to Operation																	0%
Pre-implementation T&E for FV3GFS@&%	3-year retrospective + real-time parallels, EMC and Community Evaluation																	0%
Transition to semi-operation*	FV3GFS Experimental*																	0%
Transition to operation@&%	NCO Parallel FV3GFS in Operation @&%																	0%
Advancement of FV3GFS	Further advancements of FV3GFS with inputs from NGGPS and community contributions & Global-Meso unification (Unified Model Development)																	0%

\* Q3FY18 FV3GFS will be very similar to operational GFS being implemented in May 2017  
 @ Q3FY19 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

**VIRTUAL LAB**  
WHERE GREAT IDEAS BECOME OPERATIONAL REALITY

FV3GFS Home

FV3GFS Version 0 Release

Announcing the Version 0 Release of the FV3GFS!

NOAA users and external partners with NWS Virtual Lab access can view the release information, as well as other developmental details, in the FV3GFS Community.

**NGGPS and FV3 Dynamic Core:**

NOAA GFDL's Finite Volume Cubed Sphere (FV3) dynamical core was selected for the new NGGPS atmospheric model. FV3 dynamical core implementation includes incorporating FV3 into NEMS, and developing advanced physics and data assimilation techniques to match or exceed the skill of operational Global Forecast System (GFS). In addition, NWS is working with federal partners, universities, and the community to create a fully accessible community model.

NGGPS FV3-based Unified Modeling System will be a community guided system. Additional information can be found on the [Community Participation](#) page.

[Click here to view a 2016 FV3 Workshop presentation by the GFDL FV3 team.](#)

Documentation of FV3 Dynamic Core is available through various documents listed below.

FV3	A brief overview of the FV3 dynamical core	General description that is part of FV3 Documentation.
FV3	A class of the van Leer-type Transport Schemes and its Application to the Moisture Transport in a General Circulation Model	Scientific Journal Article that is part of FV3 Documentation.
FV3	A Control-Volume Model of the Compressible Euler Equations with a Vertical Lagrangian Coordinate	Scientific Journal Article that is part of FV3 Documentation.
FV3	A finite-volume integration method for computing pressure gradient force in general vertical coordinate	Scientific Journal Article that is part of FV3 Documentation.
FV3	An explicit flux-form semi-Lagrangian shallow-water model on the sphere	Scientific Journal Article that is part of FV3 Documentation.
FV3	A Two-Way Nested Global-Regional Dynamical Core on the Cubed-Sphere Grid	Scientific Journal Article that is part of FV3 Documentation.

**How to access the FV3GFS Version 0 Release**

**NON-NOAA USERS**

Users outside of NOAA will need to obtain a VLab External Partner Account. To get an external partner account please fill out the [FV3GFS External Partner Request Form](#)

**NOAA USERS AND EXTERNAL PARTNERS**

**FV3GFS VLab community.**

NOAA users and external partners with VLab access: 1) click "Sign In" on top right of this page, 2) once signed in click on "All Available Communities" in the "My Communities" portlet on the left side, 3) scroll down the list to find the "FV3GFS" community and 4) click "Join" next to the community. Then navigate to the community home page through your "My Communities" list at the top or by this link:

<https://vlab.ncep.noaa.gov/group/fv3gfs/>

**FV3GFS Redmine & Git repository:**  
(access requested through form in FV3GFS VLab community)

<https://vlab.ncep.noaa.gov/redmine/projects/comfv3>

**EMC SVN repository:**  
(users with pre-established access to EMC SVN server)

<https://svnemc.ncep.noaa.gov/trac/nems/>

Documents and Media Display

Release Version 0 Documents

Last Updated 5/15/17 5:22 PM | Subfolders | Documents

- 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

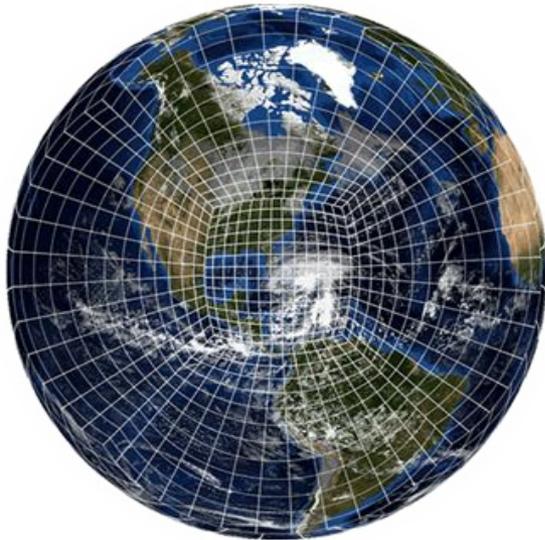


# FV3 for Convection Allowing Models



## Completed

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



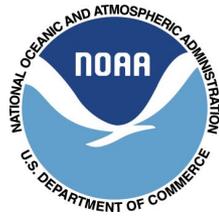
## Near-term Milestones

- 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



# GMTB CCPP schedule



- **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



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