



# The NCEP Production Suite

## Current status and future evolution

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# A Hierarchy of Plans

## 1. UMC

- Unified Modeling Committee: High-level NOAA Unified Modeling Overview
- **Horizon:** 5-10 Years
- **Scope:** NOAA

Online <sup>1</sup>

## 2. Vision

- A Strategic Vision for the US National Environmental Modeling Enterprise
- **Horizon:** 5-10 Years
- **Scope:** US Environmental Modeling Enterprise (Federal focus, integrated with Academia)

## 3. Roadmap

- Roadmap for the Production Suite at NCEP
- **Horizon:** 5-10 Years
- **Scope:** NCEP Production Suite (Unified Forecast System)

## 4. SIP

- Strategic Implementation Plan
- **Horizon:** 0-3 Years
- **Scope:** NCEP Production Suite (Unified Forecast System)

NGGPS '+'

- (1) A broad “strategy document” from the NOAA Unified Modeling Committee (UMC; under the auspices of the NOAA Research Council); spans the entirety of the NOAA modeling enterprise, inclusive of bio-geo-chemical, social and physical.
- (2) The NWS and OAR are developing a Strategic Vision Document looking out 10 years and bridging US Environmental Modeling Enterprise with the higher level NOAA UMC effort.
- (3) Also emanating from an NWS-OAR partnership, is a Roadmap document that lays out how we can move the NCEP Production Suite towards the vision described in the Vision Document.
- (4) At a practical level, the Strategic Implementation Plan (SIP), describes NOAA’s concrete steps over the next 3 years to build the Next Generation Global Prediction System based on the Unified Forecast System, beginning with numerical weather prediction across scales and in partnership with with the community (all stakeholders).

\* [ftp://ftp.library.noaa.gov/noaa\\_documents.lib/NOAA\\_UMTF/UMTF\\_overview\\_2017.pdf](ftp://ftp.library.noaa.gov/noaa_documents.lib/NOAA_UMTF/UMTF_overview_2017.pdf)

# Strategic Vision: Key Elements

Focus on products supporting mission requirements

Unified modeling and data assimilation

- Coupled, ensemble based, reforecast and reanalysis
- Including pre- and postprocessing, calibration, verification validation

Focus on community modeling

- Operations **and** research

Evidence-driven decisions

- Same standards for all who contribute

Transparent and robust governance

- Service requirements
- Technical requirements / solutions
- Prioritization

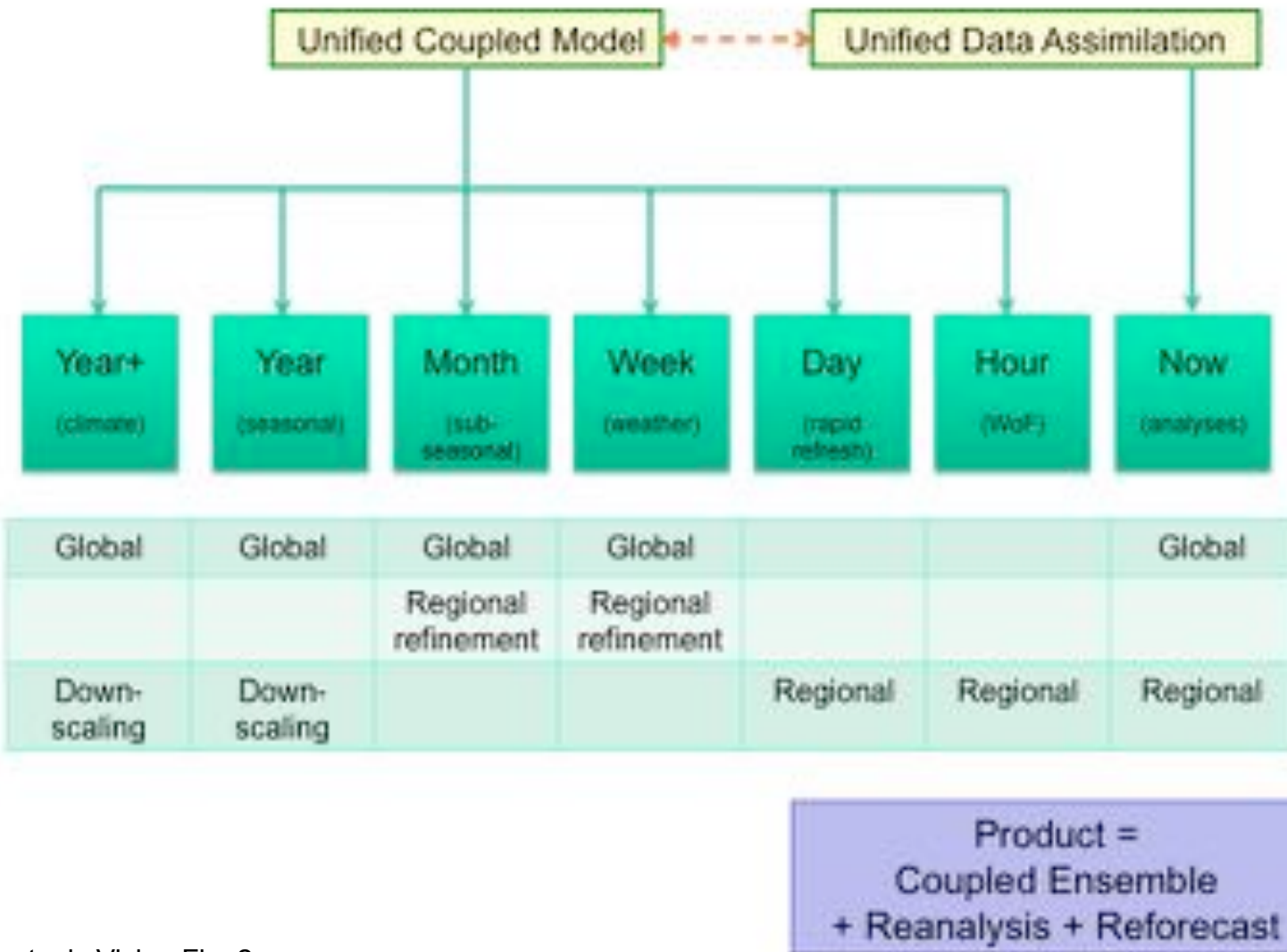
See SIP for community governance



Courtesy Louis Uccellini

Strategic Vision Fig. 1

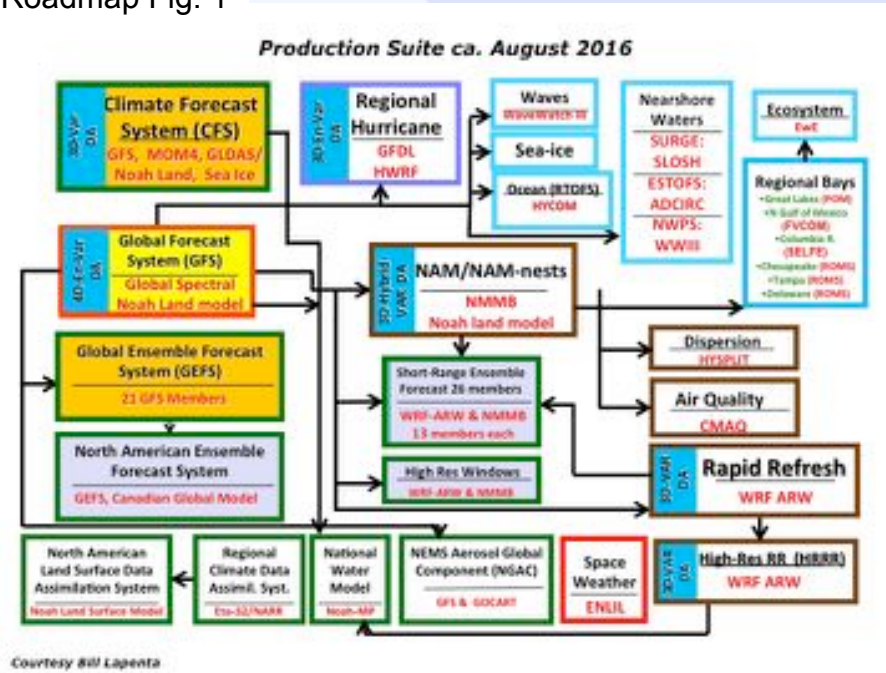
# Strategic Vision: Temporal Domains



Strategic Vision Fig. 2

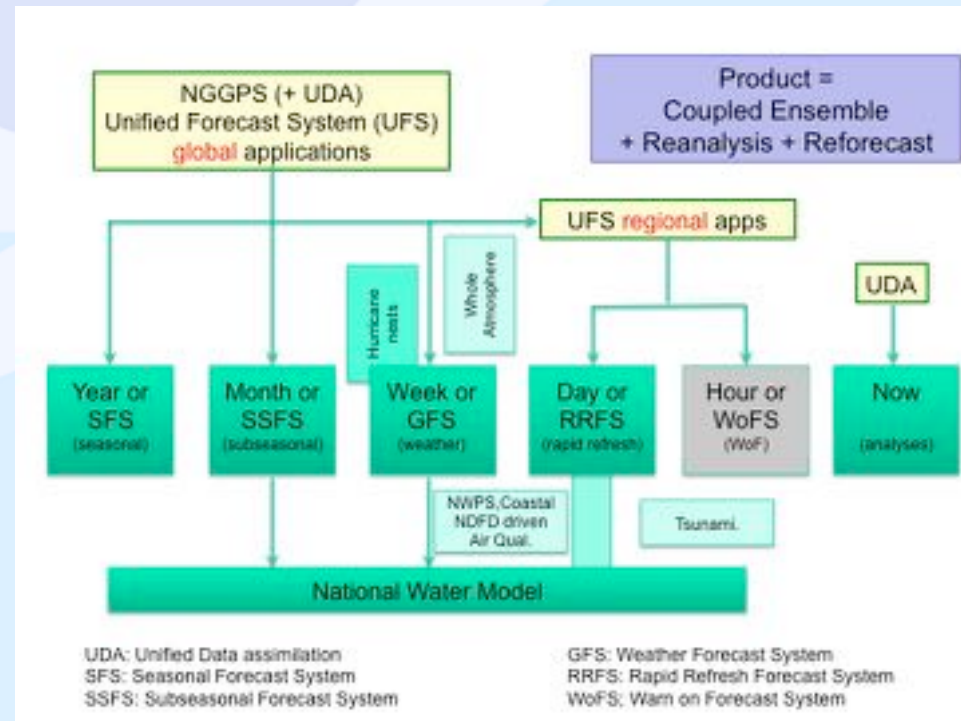
# Roadmap: Big Picture

Roadmap Fig. 1



*Starting from the quilt of models and products created by the implementing solutions rather than addressing requirements ....*

*... we will move to a product based system that covers all present elements of the productions suite in a more systematic and efficient way*



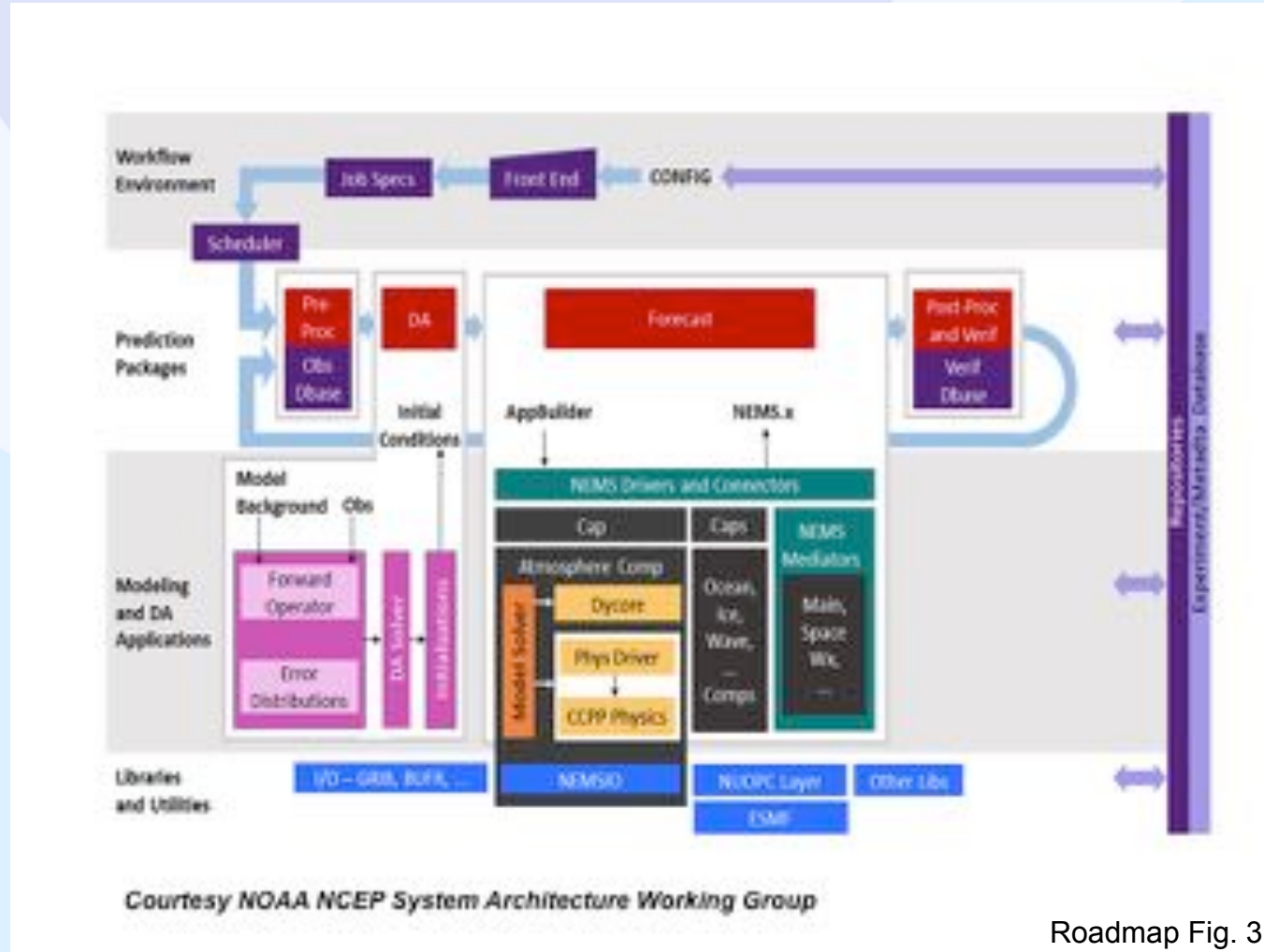
Roadmap Fig. 2

# Roadmap: Architecture

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

Consistent with  
broader NOAA  
(UMTF) and US  
vision (National  
ESPC)

FV3, CCPP, CICE,  
MOM6 (?), WW3,  
GOCART, WRF-  
Hydro, .....



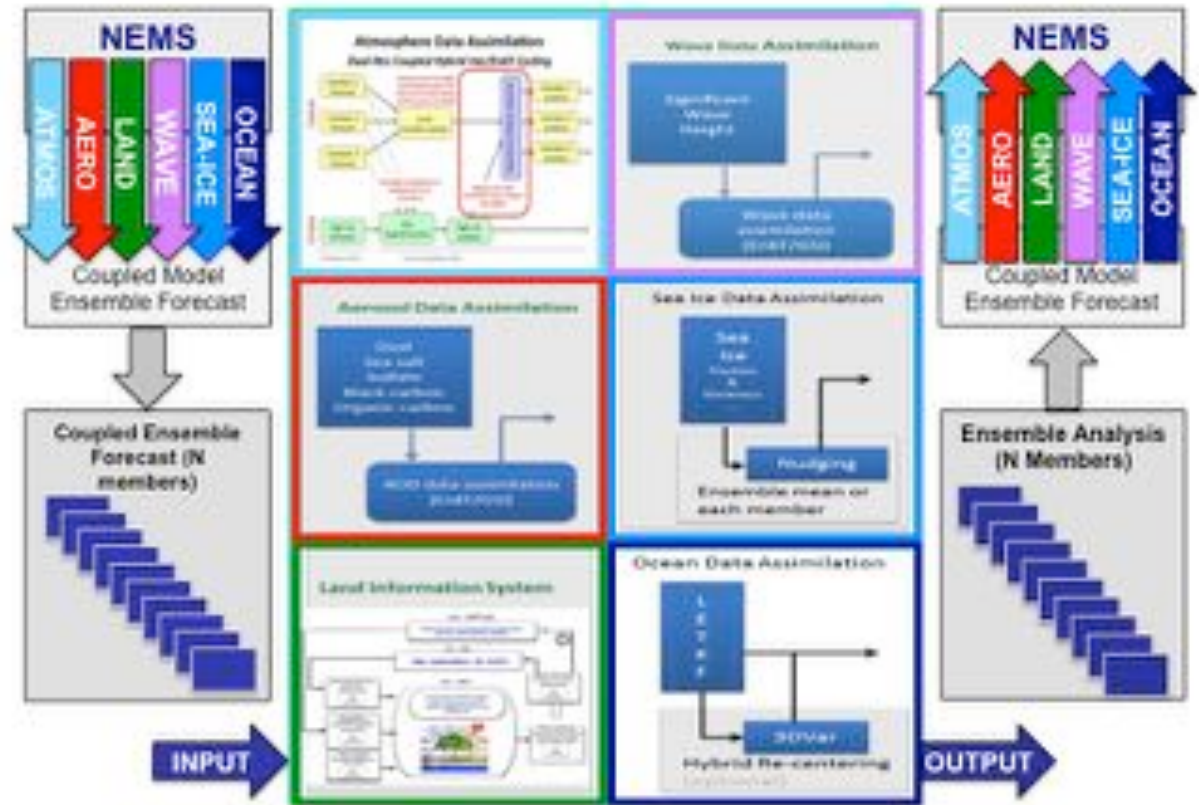
Roadmap Fig. 3

# Roadmap: Fully Coupled

Moving to coupled  
Data Assimilation

Range of work  
going from weakly  
to strongly coupled  
Data Assimilation

Commitment to go  
there, not mature  
enough for hard  
commitment



Courtesy Suru Saha

Roadmap Fig. 4

# Roadmap: 5 year “end state”

## Focus on transition to Unified System

Roadmap Table 2

Element	Cadence	Range	Resol.	Ens.	Update	RR
<b>SFS</b>	7 d	9-15 mo	50 km (g)	28	4 y	1979-present
<b>SSFS</b>	24 h	35-45 d	35 km (g)	31	2 y	20-25 y
<b>GFS</b>	6 h	7-10 d	13 km (g)	26	1 y	3 y
<b>RRFS</b>	1 h	18 h	3 km (r)	<b>26</b>	<b>1 y</b>	<b>TBD</b>
	6-12 h	30 h				
	6-12 h	60 h				
<b>WoFS</b>	<b>5-15 min</b>	<b>2-4h</b>	<b>1 km (r)</b>	<b>26</b>	<b>1 y</b>	<b>TBD</b>
<b>Analyses</b>						
<b>Trad.</b>	6-24 h	---	Var. (g)	---	6 mo	N/A
<b>RUA</b>	<b>15 min</b>	---	<b>TBD (r)</b>	---	<b>6 mo</b>	

(g) Global  
(r) regional  
**Red:** uncharted territory

SFS= Seasonal Forecast System  
 SSFS= Sub-Seasonal (Outlook) Forecast System  
 GFS= Global Forecast System  
 RRFS= Rapid Refresh Forecast System  
 WoFS = “Warn on Forecast” System

Changing use of WCOSS  
 Needing ~ 37 PFlop machine



# Roadmap: 10 year “best system”

Focus on becoming best in the world

Roadmap Table 4

Element	Cadence	Range	Resol.	Ens.	Update	RR
<b>S3FS</b>	7 d	12 mo	15 km (g)	200	TBD	1979-present
	24 h	45 d		100		
<b>GFS</b>	1? - 6 h	7-10 d	5 km (g)	50	1 y	3 y
<b>RRFS</b>	1 h	24 h	1.5 km (r)	50	1 y	TBD
	3 h	48 h				
	6 h	72 h				
<b>WoFS</b>	5 min	2h	0.5 km (r)	50	1 y	TBD
<b>Analyses</b>						
<b>Trad.</b>	6-24 h	---	Var. (g)	---	1 y	N/A
<b>RUA</b>	5 min	---	TBD (r)	---		

SFS= Seasonal Forecast System  
 SSFS= Sub-Seasonal (Outlook) Forecast System  
 GFS= Global Forecast System  
 RRFS= Rapid Refresh Forecast System  
 WoFS = “Warn on Forecast” System

SFS / SSFS use single model  
 Needing ~ 730 PFlop machine

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

Next Generation Global Prediction System

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

# SIP 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
- 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
- End product (in final coordination) will be SIP version 1.0, a 3-year plan (FY 2018-2020)

Long term: SIP to be rolling 3-year plan to be updated annually

# SIP Working Groups

## Governance

- Decision making, roles/responsibilities, advisory boards, org. alignment, etc.

## Communications and Outreach

- Common messaging strategy

## Convective Allowing Models (CAMs)

- Intermediate steps to CAM ensembles, Warn on Forecast; test/eval w/community

## System Architecture

- NEMS evolution; community approach

## Infrastructure

- Standards/doc; CM; code repository; etc.
- Role of testbeds; regression testing; etc.

## Verification & Validation (V&V)

- V&V of ops forecasts vs. R&D testing/eval
- Unified/standard tools and data formats

*New WG or addition*

Augmentation of existing NGGPS group

## Dynamics and Nesting

- FV3 transition on global wx/S2S/climate
- Nests for hurricanes (moving?)

## Model Physics

- Common Comm. Physics Pkg (CCPP); stochastic, scale-aware physics

## Data Assimilation

- NOAA, NASA integ. w/FV3; coupled DA
- Joint Effort for DA Integration (JEDI)

## Ensembles

- Strategy across scales; model uncertainty

## Post-Processing

- Comm. PP infrastructure; std formats/tools

## Component Model groups

- Marine models + *NOS coastal/bay models*
- Aerosols and Atmospheric Composition
- Land Sfc Models (LSMs) + *hydrology (OWP)*

# SIP Governance Planning

The SIP Governance WG drafted a *Governance Model for Unified Forecast System for NCEP's Production Suite*

- Model for a NOAA-community partnership to provide a state-of-the-art modeling system for use in NCEP's Production Suite
- Proposed governance structure consists of a Steering Committee and a set of Working Groups
  - Steering Committee is charged by and reports to an Executive Oversight Board

Proposed Governance document is in final coordination

Once approved the governance needs to be chartered by the organizations and the sponsors that will be committed to a community-based approach with the goal of providing end-to-end modeling capacity bridging research and operations

# SIP Governance WG Membership

*Whit Anderson (NOAA/GFDL) \*\**

Tom Auligne (JCSDA)

Rusty Benson (NOAA/GFDL)

Ligia Bernardet (NOAA/ESRL)

Patrick Burke (NOAA/NOS)

Jesse Carman (NOAA/OAR)

Brian Colle (Stonybrook Univ.)

Chris Davis (NCAR/MMM)

*Mike Farrar (NWS/NCEP) \*\**

Gary Lackmann (NC St. Univ)

*Steven Pawson (NASA/GMAO) \*\**

David McCarren (US Navy)

*Ricky Rood (Univ. of Michigan) \*\**

Vijay Tallapragada (NWS/NCEP)

Fred Toepfer (NWS/OSTI)

*Mariana Vertenstein (NCAR/CGD) \*\**

*Co-Chair \*\**

# SIP UFS Communication & Outreach Plan

The SIP Communications and Outreach Working Group drafted a plan that is aligned with the main SIP

Four major goals drive this communication plan:

- GOAL 1: Establish, maintain, monitor, and assess a range of channels that promote multidirectional communication and convey content related to the UFS
- GOAL 2: Establish guidelines and processes that result in improvements in content quality and consistency
- GOAL 3: Promote and enable collaborative development and integrated decision making through open access to information and resources
- GOAL 4: Create and sustain an identity through branding for the UFS, working through and with NOAA Communications and other parallel offices in partner organizations

Outreach will be guided by the implemented governance structure and follow-on guidance

# SIP / NGGPS Summary and Next Steps

NGGPS has provided a foundation to build upon to unite the ops and R&D communities with a next-generation National unified forecast system

Expect to finalize the SIP and associated Governance document and Communications/Outreach Plan by end of CY17

SIP plans and teams will be integrated with NGGPS moving forward

- Planning late January or February 2018 NGGPS/SIP program meeting with SIP (*now NGGPS/SIP*) WG Co-Chairs to move finalized SIP planning forward
- Expect unified planning moving forward (NGGPS/SIP plans, EMC 3-Year Implementation Plan, and Strategic Plan/Roadmap)

NOAA already moving to replace legacy models (e.g., Global Spectral Model) with new FV3-based NGGPS modeling system; migration underway!

NCEP/EMC taking concrete steps to evolve to unified modeling paradigm

***NOAA and partners are working with broad community to build towards a National unified modeling system across time/space scales***



# NGGPS UFS: Vision for Community

Mission of Community: Improve environmental modeling forecast capability unified across time and space for both research and operations

- Develop the next generation of scientists
- Conduct research for improved scientific understanding and innovation
- Engage with community to improve transition of research to operations
- Build the world's best operational capability

The community will be guided by:

- Shared goals, objectives and “ownership” with transparent governance
- Inclusive and collaborative development, testing and evaluation
- Balance of operational, research and end-user needs and priorities
- Scientific capability and credibility
- Strong partnership between research and operations

*Unprecedented opportunity to develop and advance a world-class unified modeling system for the Nation!*

# SIP Vision for Community

## Engage community on several layers for varying roles:

- **Researchers, Users, Stakeholders:** Conducts research and testing on publicly available model baseline; long-term science contributions; builds next-gen STEM workforce
- **Trusted Super-users:** Select R&D users that test/evaluate prototype models under development by core development partners prior to baselining and public release
- **Core Development partners:** Orgs actively involved in development of next-gen operational unified modeling system. Orgs include:
  - NOAA ops, R&D and program offices; NCAR; NASA/GMAO; Navy/NRL; JCSDA
- **Operations:** Centers that own/operate operational version of unified modeling system.
  - For NOAA, this equates to the NCEP Production Suite

Thank you