Strategic Implementation Plan (SIP) for a Community-based Unified Modeling System: *Overview and Introduction*

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Outline

- Three-pronged Planning approach to enable change
  - 1) Strategic plan/vision, 2) Roadmap, 3) Strategic Implementation Plan
- Strategic Implementation Plan (SIP)
  - Basic Approach
  - Vision for Community
  - Working Group structure
  - Schedule
- NOAA/NWS evolutionary changes
  - Upcoming NWS/NCEP global model transitions towards unified system
  - Environmental Model Center (EMC) strategic changes
- Summary and Next Steps

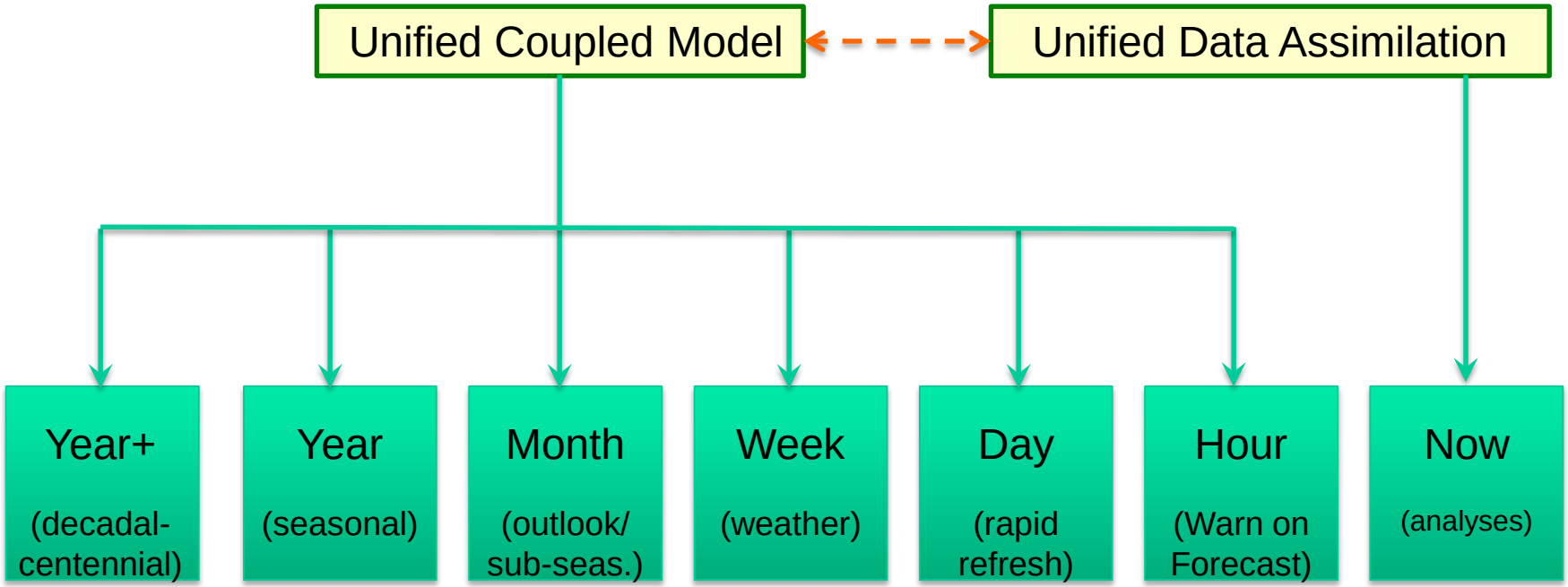
Strategic Planning Approach for Unified Modeling

- Traditional approach would begin with long term vision codified in mature ***Strategic Plan***, followed by ***Implementation Plan*** that lays out implementation details needed to execute the vision
- For challenges associated with unified modeling across spatial and temporal scales, a mature Strategic Plan is a long-term process
  - If we were to wait for a mature Strategic Plan before any implementation activities, many months or years would be lost towards the end goal
- Therefore we are taking a concurrent, parallel planning approach
  - **High-level/broad Strategic Plan** co-led by NWS/OSTI & OAR/OWAQ
    - High-level Strategic Plan + accompanying detailed Roadmap document
  - **Short-term (0-3 years) Strategic Implementation Plan (SIP)** combines implementation activities with near-term strategic actions
    - Led by NWS/NCEP/EMC (Mike Farrar) with NOAA and external partners

Strategic Vision
Key Elements

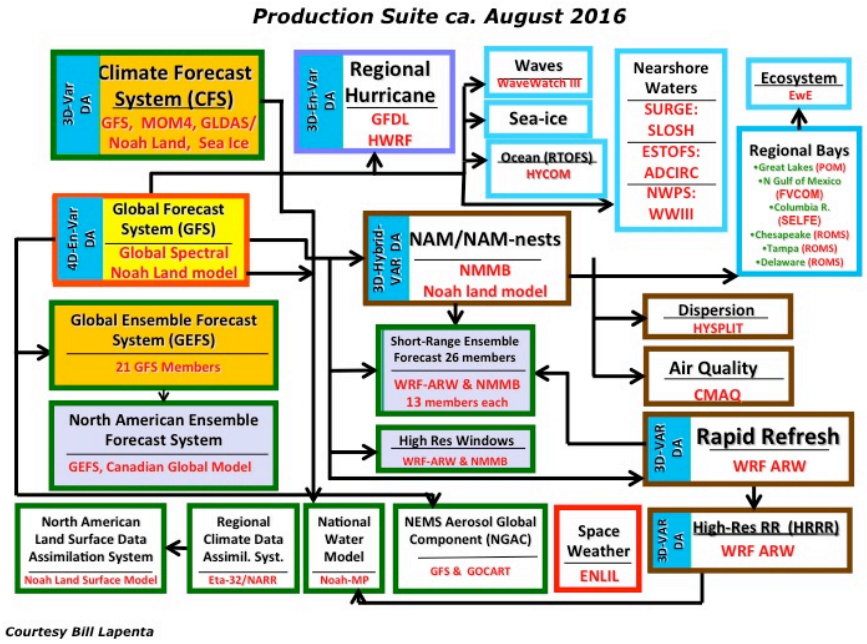
- Focus on ***products*** supporting mission requirements
- ***Unified*** modeling and data assimilation
  - Coupled, ensemble-based, reforecast and reanalysis
  - Including pre- and postprocessing, calibration, verification validation
- Focus on ***community*** modeling
  - Flexible architecture and infrastructure to meet needs of Ops and R&D
- ***Evidence-driven*** decisions
- Consistent ***standards*** for all who contribute
- Transparent and robust ***governance***

Strategic Vision
Temporal Domains



Global	Global	Global	Global			Global
		Regional refinement	Regional refinement			
Down-scaling	Down-scaling			Regional	Regional	Regional

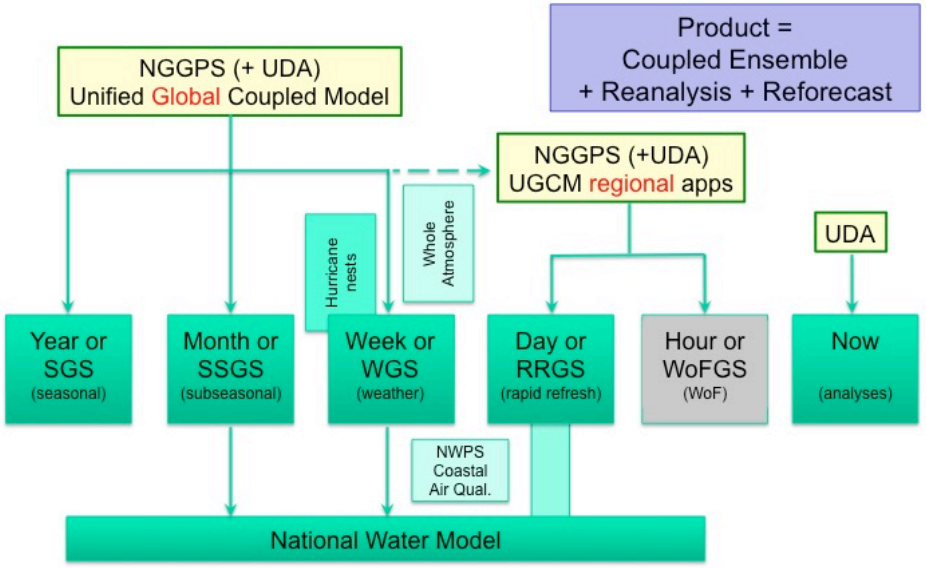
Roadmap



Courtesy Bill Lapenta

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



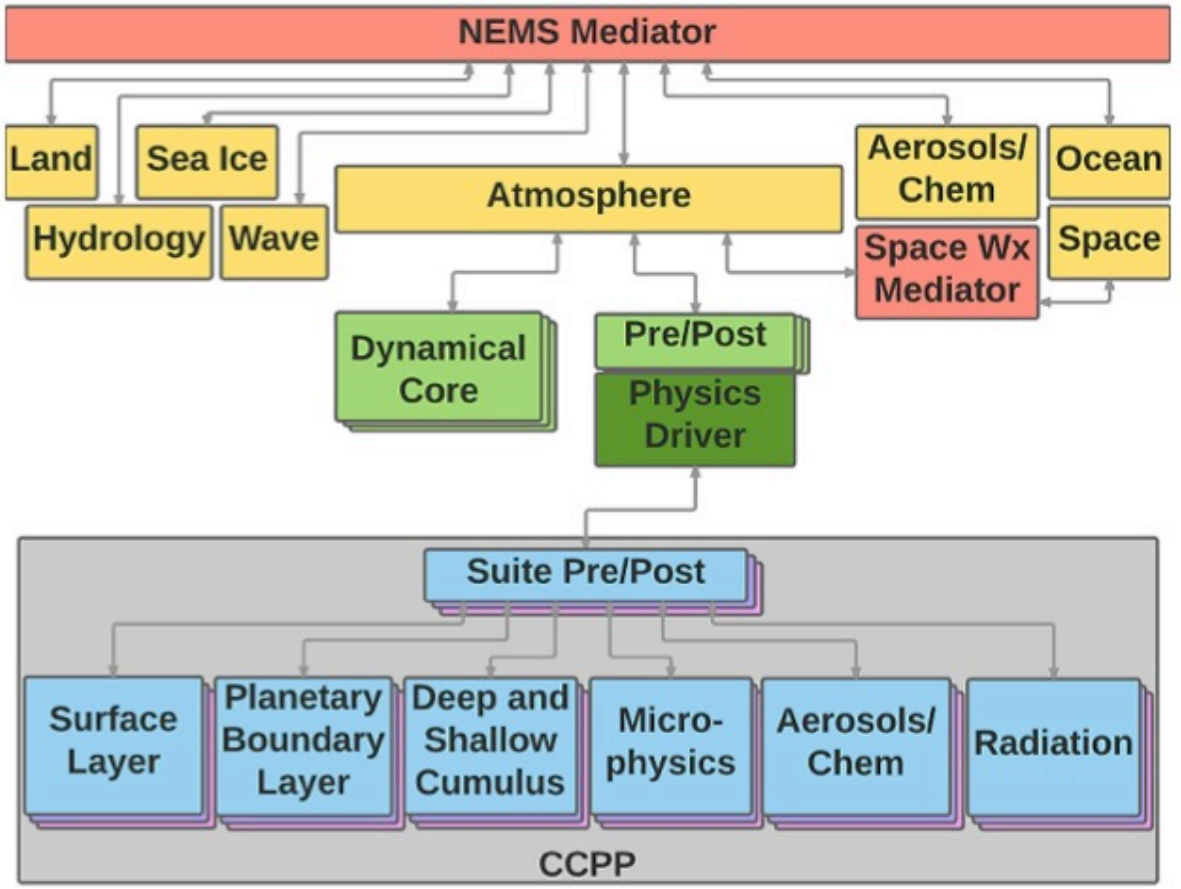
UDA: Unified Data assimilation
SGS: Seasonal Guidance System
SSGS: SubseasonalGuidance System

WGS: Weather Guidance System
RRGS: Rapid Refresh Guidance System
WoFGS; WoF Guidance System

Roadmap

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

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



Courtesy Developmental Testbed Center

Strategic Implementation Plan (SIP) for Unified Modeling

- 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
  - Next Generation Global Prediction System (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
  - Bring together *broader community*, first as invited WG members, followed by *public workshop* (College Park, MD; April 2017)
    - Second workshop/planning meeting targeted for late summer 2017
  - ***End product 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 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

Strategic Implementation Plan (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
- 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)*

- *New WG or addition* - Augmentation of existing NGGPS group

Strategic Implementation Plan (SIP)
Schedule

- Nov 2016: First SIP Planning Meeting (Boulder, CO)
- Dec 2016: Establish Working Group membership and co-chairs
- Jan 2017: Brief approach at AMS Town Hall Meeting (Seattle, WA)
- Apr 2017: Community Workshop (College Park, MD)
  - WGs brief initial findings; solicit community input
- ~ Late summer 2017: Meeting to draft SIP v1.0 (location TBD)
  - Incorporate Community and SIP WG inputs into SIP v 1.0 (FY 2018-2020)
  - SIP v 1.0 will be initial, "living" document; once mature, update annually
- Potential for forums at upcoming major conferences
  - AGU (Dec 11-15, 2017; New Orleans)
  - AMS (Jan 7-11, 2018; Austin TX)
  - *Any others? Seeking additional ideas from the community…*

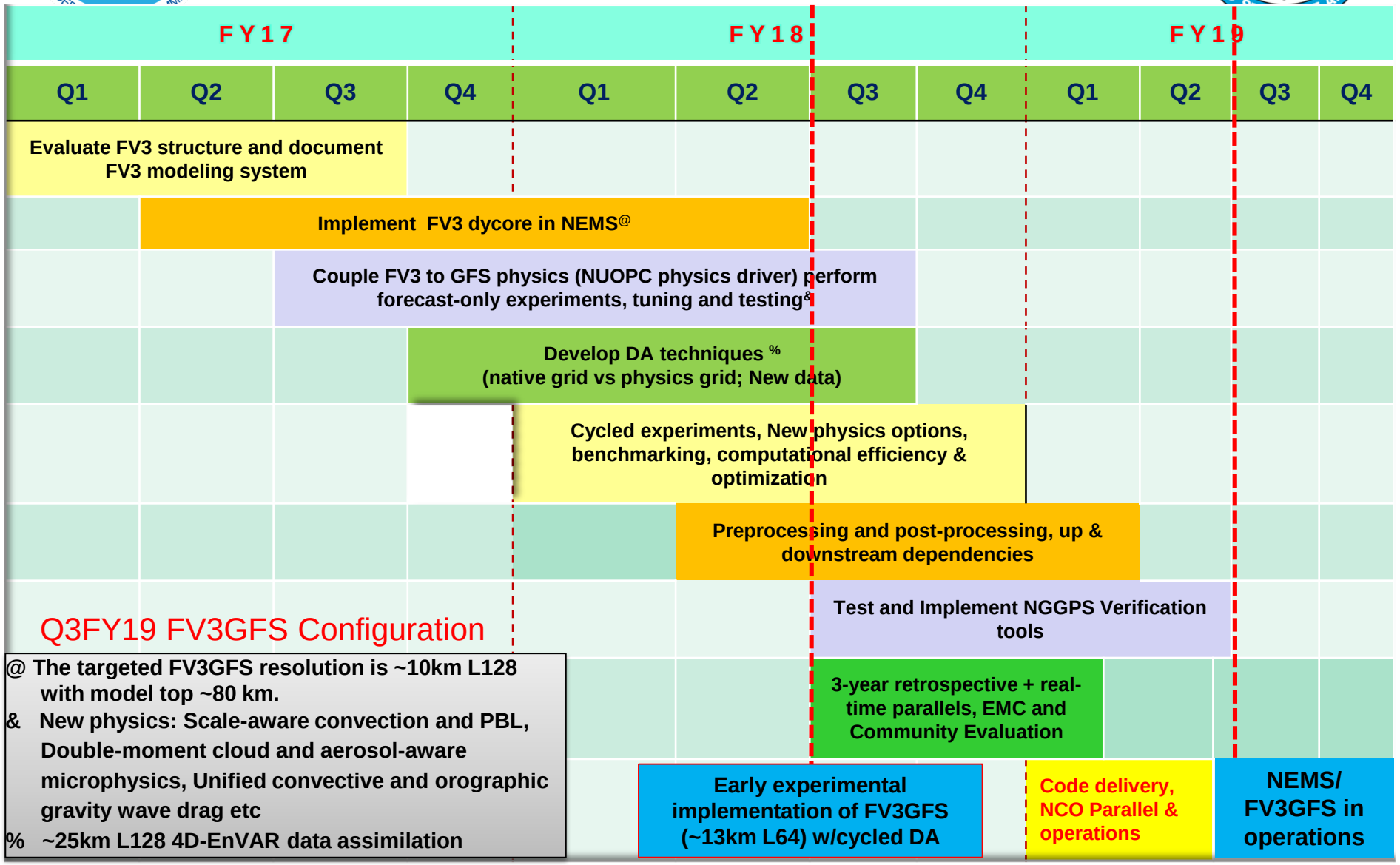
NOAA/NWS Evolutionary Changes

- Evolution of current operational modeling systems
  - Global Forecast System (GFS) >> ***weather***
    - ***NGGPS: Transition legacy GFS/GSM to GFS/Fv3***
  - Global Ensemble Forecast System (GEFS) >> ***Sub-seasonal system***
  - Climate Forecast System (CFS) >> ***Seasonal system***
- Evolution of the Environmental Modeling Center (EMC)

FV3-GFS
Development/Implementation Plan

- After Q3FY17 NEMS/GSM implementation (last spectral model upgrade), *all resources are diverted to FV3 implementation task*
- Benchmark FV3GFS with fully cycled DA to match or exceed the skill of operational GFS
- Experimental early (parallel) implementation of FV3GFS in Q2FY18
- Simultaneous development and testing of advanced physics and higher resolution for FV3GFS
- First official implementation of FV3GFS in Q2FY19

Implementation Plan of FV3GFS (FY17-FY19)



Q3FY19 FV3GFS Configuration

@ The targeted FV3GFS resolution is ~10km L128 with model top ~80 km.

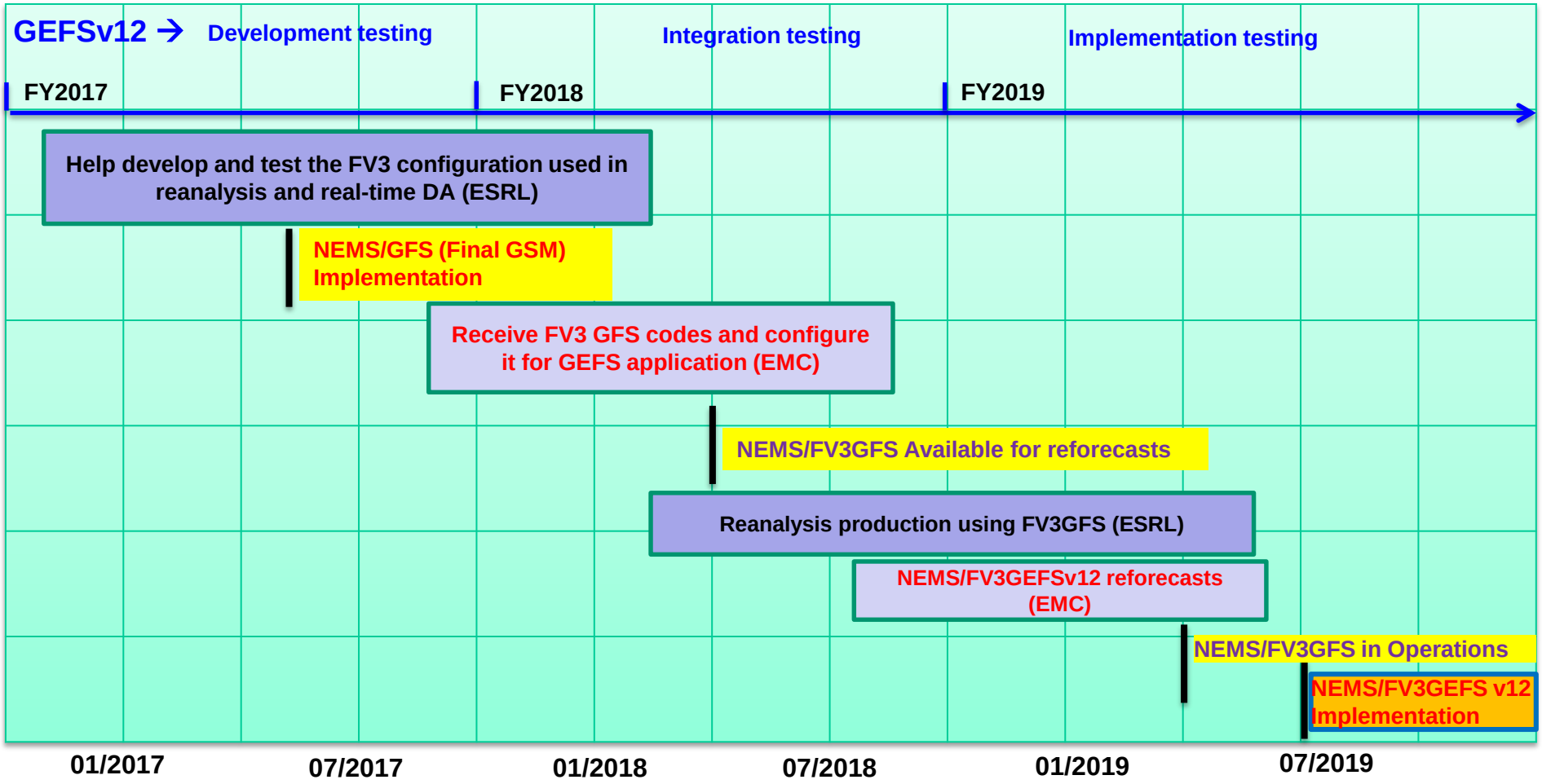
& New physics: Scale-aware convection and PBL, Double-moment cloud and aerosol-aware microphysics, Unified convective and orographic gravity wave drag etc

% ~25km L128 4D-EnVAR data assimilation

GEFS Implementation Plans
Implications of Changes

- GEFS v12 implementation will use FV3 dycore, in close coordination with the FV3 deterministic GFS development
- GEFS v12 implementation will be consistent with EMC's global modeling strategies of unified system
- Reanalysis production is performed with FV3 system, not the obsolete spectral dycore
- ESRL reanalysis team participates in bringing FV3-based assimilation system online more quickly and testing an FV3-based GEFS,
  - *Reduces risk of delays with FV3GFS implementation*

Proposed Plan for FV3-based GEFS v12 *(sub-seasonal ensemble system)* with reanalysis and reforecast



Proposed changes: **1) Start producing FV3-based reanalysis for GEFS v12 in ~Q1 FY18, using the configuration of FV3GFS. 2) Reforecasts will commence soon after starting the reanalysis, uncoupled*, with 2-tier SST approach, and will include extension to 35 days**

CFS Development Plans
Status quo vs. alternative

- Climate Forecast System (CFS) = ***Seasonal*** forecast model
- EMC's current/official development path follows sequential FV3 development starting with GFS (under NGGPS)
  - GFS (FY19) > GEF/Sub-seasonal (FY20+ > CFS/Seasonal (FY22?)
- Several areas of overlap exist between future GFDL climate models and NCEP/EMC's seasonal model
  - GFDL's current HiFLOR climate model runs with old version of FV3 and MOM4 ocean model
  - CM4, next-gen GFDL model, plans to use latest FV3 and MOM6
  - Since this is consistent with EMC's plans for FV3-based CFS, EMC and GFDL are now ***exploring joint development***

Environmental Modeling Center (EMC) Strategic Changes

How is EMC evolving to meet new challenges?

- Incorporate Project Management (PM) principles into model development
  - PM training for all federal employees and contractor team/area leads
  - Quarterly PM Reviews for all EMC development and implementation projects
- Shift model development resources from legacy models to FV3
  - Next NAM and GFS (GSM) implementation will be the last, then freeze development
  - GFDL and EMC working early prototype parallel runs for FV3-GFS: already underway!
  - EMC model developers shifting focus to development in FV3 framework
- EMC reorganization
  - Old org structure (separate Global, Meso, and Marine Branches) built around legacy architecture of independent models; ***reorganize around unified modeling system***
  - Consolidate science in single ***Modeling & DA branch***: all work together inside unified framework; break down old global vs. meso stovepipes
  - New ***Verification, Post-Processing, and Production Generation branch***: consolidate resources for efficiency and consistency; verification independent from development
  - New ***Systems Engineering and Implementation branch***: consolidate resources for efficiency and consistency; greater focus on NEMS and community systems arch

Summary and Next Steps

- NGGPS provides golden opportunity; foundation to build upon to unite the ops and R&D communities with a next-generation National unified modeling system
- Strategic planning organized around 3-pronged approach
  - Strategic Plan: Broad, high-level strategic vision
  - Roadmap: More detailed evolution over 5-10 year time frame
  - Strategic Implementation Plan (SIP): Short-term (2-3 years) to move toward vision
    - Detailed planning broken down into Working Groups, now underway
- Community workshop (April 2017) to begin building SIP strategy/approach
- 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
  - *PM principles; Reorg around unified system; freeze legacy models, working on FV3*

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