The National Earth System Prediction Capability (National ESPC)
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What is National ESPC?

• An integrated National Capability meeting the U.S. Federal need for Earth System Prediction for the provision of operational products and services
  – For the protection of life and property in the US
  – For the economic development, aviation, maritime, shipping, agriculture of the US
  – National defense and homeland security (World Wide)
  – Strategic decision making

• Includes:
  – Near term, medium range and extended range weather (< 90 days)
  – Seasonal and inter-annual climate (90 Days+)
  – Sub-decadal to decadal

• Leverages existing and planned Agency operational capabilities, and research and development programs and projects

• Work within mission of each agency, to further a national goal towards which each agency contributes

[Strong need Identified for Inter-Agency Coordination]

Effort is broadly consistent with WMO’s S2S Prediction Plan and various national reports.
Building a National ESPC

• Develop and implement a common or coordinated prediction technology through
  – An affiliation of existing Programs, Projects, Laboratories, Centers

• Cooperative effort of the participating federal environmental research and environmental operational guidance agencies
  – Multiple offices and laboratories within each agency
  – Application of significant internal & external research and development funding

• Focus on meeting needs of user community through existing and planned agency operational numerical prediction capabilities through coordinated R&D and Operations

Coordination of Existing and Planned Agency Capabilities
Where we are

• Operational Global Weather Ensemble
  – 63 member, multi-model, > 80 variables, out to 16 days, with skill at 11+ days, at 1 degree resolution - going to ½ degree, adding variables, will do extended runs to 32 days

• Operational Multi-model Ensemble for Sub-seasonal and Seasonal Prediction

• Earth System Modeling Framework - Common Model Architecture

• In-place Coordinating Structure – Project Office
  – Executive Steering Group
  – Multiple committees - agencies regularly interacting to solve problems in a common way.
Bridging the Gap

• Research agencies: work within mission expertise to improve skill
• Operational agencies: exploit the research for skill improvements
• Need strategic-level coordination of issues

To extend weather skill past traditional weather scales:
  – Fully coupled air-ocean-land-ice modeling systems needed
  – Multi-model ensembles
  – Improved data assimilation techniques, particularly for ocean-land-ice

To improve climate model skill at subseasonal scales:
  – Data assimilation, reanalysis/reforecast
  – Process representation

Needed across time scale:
  • Improved HPC utilization, incl. advanced architectures
  • Common model architectures
  • Multi-model ensemble management
  • Uncertainty depiction; metrics suited for longer time scales
  • Product creation
Mission Needs

The National ESPC collected Agency missions needs across timeframes in order to know where to look for skill.

• Examples
  – Severe weather and high-impact events/potential
  – Temperature, precipitation, pressure, etc. (extremes)
  – Pollen forecast outlook
  – Sub-surface freeze/thaw patterns
  – Ocean current speed/direction
  – Stream flow, soil moisture, and deficit and runoff
  – Snow density and presence of ice layers

• Feedback from Agencies
  – Air Force - NOAA
  – EPA - NPS
  – FHWA - USDA
  – Navy
Mission Needs
The National Earth System Prediction Capability (ESPC) is a collaboration between the National Oceanic and Atmospheric Administration (NOAA), U.S. Navy, U.S. Air Force, Dept. of Energy (DOE), National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF).
Backup Slides
Agency Roles and Responsibilities

**NOAA**
- **Operations:** US, territories, Weather: land, coastal oceans, fisheries
- **Climate:** global atmosphere, oceans, land, cryosphere, stratosphere

**DoD (Navy/AF)**
- **Operations:** Global tactical and strategic support
- **Weather:** Ship, aircraft, installation, deployment support
- **Ocean:** surface to bottom globally
- **Land:** trafficability
- **Near-space:** communications

**DoE**
- **Research:** Climate modeling to determine impacts, possible mitigation of climate change. Requires integrated air, ocean, land, ice and biogeochemical capabilities

**NSF**
- **Researcher-driven research on topics geophysical sciences communities** Recent NSCI has permitted addressing new HPC architectures, data assimilation problems

**NASA**
- **Climate modeling for climate sensitivity**
- **Data assimilation research for satellite data parameterization.**
HIGH

LOW

FORECAST CONFIDENCE

3 days 1 week 2 weeks 1 month 3 months 1 year 10 years 30 years

AVIATION PLANNING

Issuue aviation weather

EMERGENCY MANAGEMENT

Plan evacuations & sorties

Inform situational awareness

AGRICULTURE

Plan hospital management

Plan pest management

Plan for demand spikes and loads

Plan water allocation during drought

ENERGY

Anticipate renewable energy availability

Schedule planting

Managing future markets

WATER RESOURCES

Manage river levels

Plan/conduct Navy ship sorties

Plan humanitarin assistance

DEFENSE

Tropical cyclone preparations for commercial shipping

SHIP Routing, prepositioning

Plan Arctic commerical shipping

MARITIME PLANNING

Designate global ship routing

Arctic Availability/Access

Inform situational awareness

Plan FE MA evacuations

Issue weather watches & warnings

Irrigate, apply nutrients, manage pests

Schedule planting

Plan pest management

Plan hospital management

Plan for demand spikes and loads

Managing future markets

Plan water allocation during drought

Plan humanitarian assistance

Design/construct port infrastructure, ship acquisition

Climate Driven Training; scenarios, diplomacy, infrastructure, acquisitions/development

Strategic business planning

Infrastrcuture and business planning

Design/Develop Infrastructure

Plan Arctic commerical shipping
Unified Roadmap

• Notional display of time coverage, agency plans over different parts of the timescale
• High-level: focus on common/bridging initiatives, rather than repeating individual model upgrade plans
National ESPC Roadmap: Synoptic (0-16 days)

**NWS**
- GFS
- FV3-GFS
- NextGen?

**USN**
- NAVGEM
- Coupled NAVGEM/HyCOM
- NUOPC ensemble
- NEPTUNE?

**USAF**
- GALWEM
- NextGen?

**Timeline:**
- FY17
- FY18
- FY19
- FY20
- FY21
- FY22
- FY23
- FY24

**Ensemble Resolution:**
- 0.5° ensemble
- 25° ensemble

**Other Models:**
- Common physics driver
- Feb ESG
National ESPC Roadmap: Seasonal (1-12 months)

North American Multi-Model Ensemble (NMME)

NOAA
- CFSvX
- FLOR
- FV3CFS/MOMx

NASA
- GEOS-5

NSF
- CCSM4

DOE

ECCC
- CanCM3
- CanCM4

FY17 FY18 FY19 FY20 FY21 FY22 FY23 FY24

DRAFT
National ESPC Roadmap: Decadal (1-30 years)

- **NOAA** (GFDL/CMx)
- **NASA** (GMAO/GEOS-5)
- **NSF** (NCAR/CCSMx)
- **DOE** (BER/ACME)
- **ECC** (Can CMx)

**Potential Climate Systems; existing runs produced for IPCC and others**

**Workshop(s) to Define ESPC Extended Range Operations**
* See notes

**Proposed for ESG Discussion**

- **Product development and testing**
- **Operational**

**Inter-Agency Agreement to provide an operational or “decision support” product**

- **FY17**
- **FY18**
- **FY19**
- **FY20**
- **FY21**
- **FY22**
- **FY23**
- **FY24**