NMME Update and Next Steps

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What is NMME?

NMME (National Multi-Model Ensemble) is an unprecedented MME system to improve intra-seasonal to interannual (ISI) operational predictions based on the leading US and Canada climate models.

NMME Phase-I: An experimental system initiated as a Climate Test Bed (CTB) research project supported by CPO/MAPP in FY11.

NMME Phase-II: An **improved** experimental system as a FY12-FY13 MAPP/CTB research project with additional support from NSF, DOE and NASA.

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North-American

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Current NMME Forecast Providers

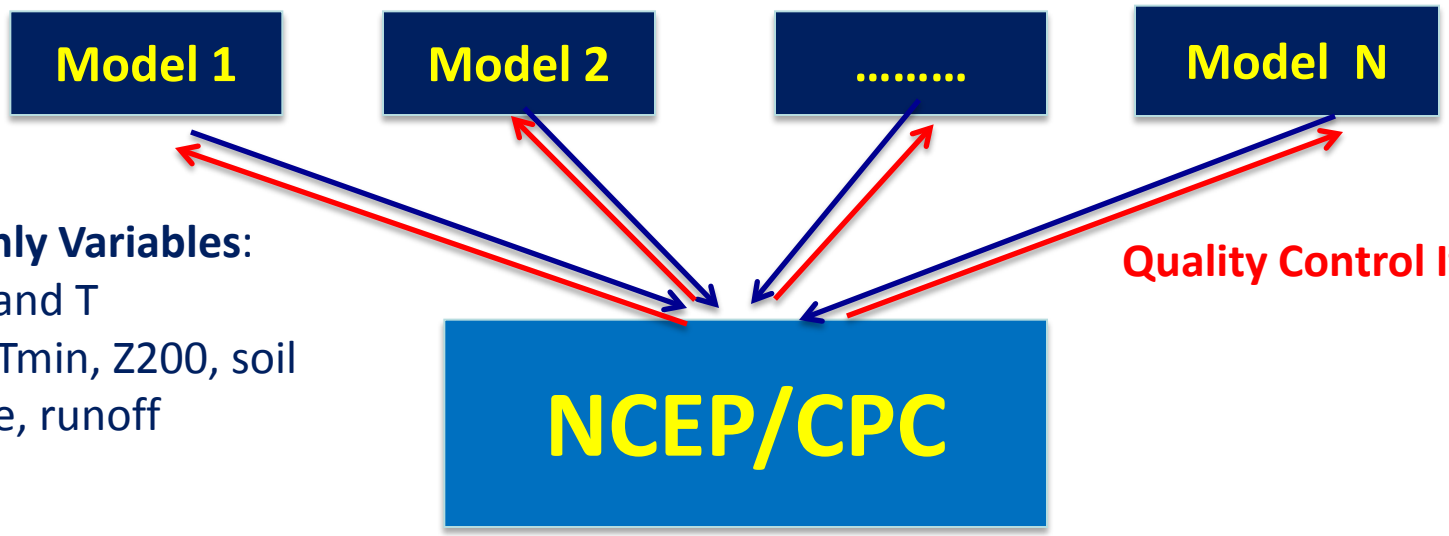
Model	Hindcast Period	No. of Member	Arrangement of Members	Lead (months)	Model Resolution: Atmosphere	Model Resolution: Ocean	Reference
NCEP-CFSv2	1982-2010	24(20)	4 members (0,6,12,18Z) every 5th day	0-9	T126L64	MOM4 L40 0.25 deg Eq	Saha et al. (2010)
GFDL-CM2.1	1982-2010	10	All 1st of the month 0Z	0-11	2x2.5deg L24	MOM4 L50 0.30 deg Eq	Delworth et al. (2006)
CMC1-CanCM3	1981-2010	10	All 1st of the month 0Z	0-11	CanAM3 T63L31	CanOM4 L40 0.94 deg Eq	Merryfield et al. (2012)
CMC2-CanCM4	1981-2010	10	All 1st of the month 0Z	0-11	CanAM4 T63L35	CanOM4 L40 0.94 deg Eq	Merryfield et al. (2012)
NCAR-CCSM3.0	1982-2010	6	All 1st of the month	0-11	T85L26	POP L40 0.3 deg Eq	Kirtman and Min (2009)
NASA-GEOS5	1981-2010	11	4 members every 5th days; 7 members on the last day of the previous month	0-9	1x1.25deg L72	MOM4 L40 1/4 deg at Eq	Rienecker et al. (2008)

* This slide is by courtesy of Huug Vandendool, Qin Zhang, and Emily Becker.

NMME Real-time Forecast Process

The NMME-I system is currently real-time but not operational

Each center generates hindcasts and forecasts in-house.
Monthly hindcasts/real-time forecasts at CPC by the 8th of month.



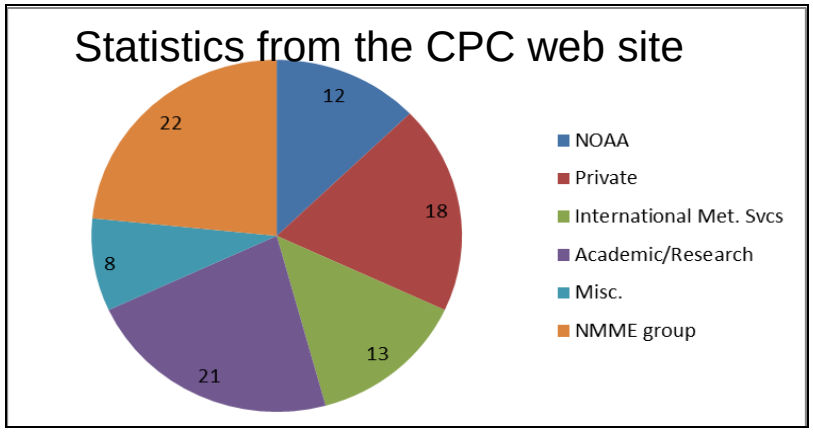
8 Monthly Variables:
- SST, P and T
- Tmax, Tmin, Z200, soil moisture, runoff

NCEP/CPC performs consolidation, develops forecast products, and does verification

NMME Data Available to Users

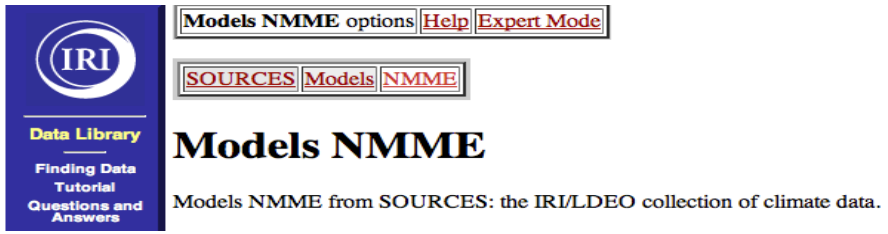
NMME is the only system with a **strict protocol** that openly provides real-time climate forecasts and hindcasts for research and applications

Realtime forecasts from CPC website



Phase-I Reforecast data in IRI website

Monthly Mean of 30 year reforecast:
P, T, SST, Z200, Tmax, Tmin
Soil Moisture, Runoff

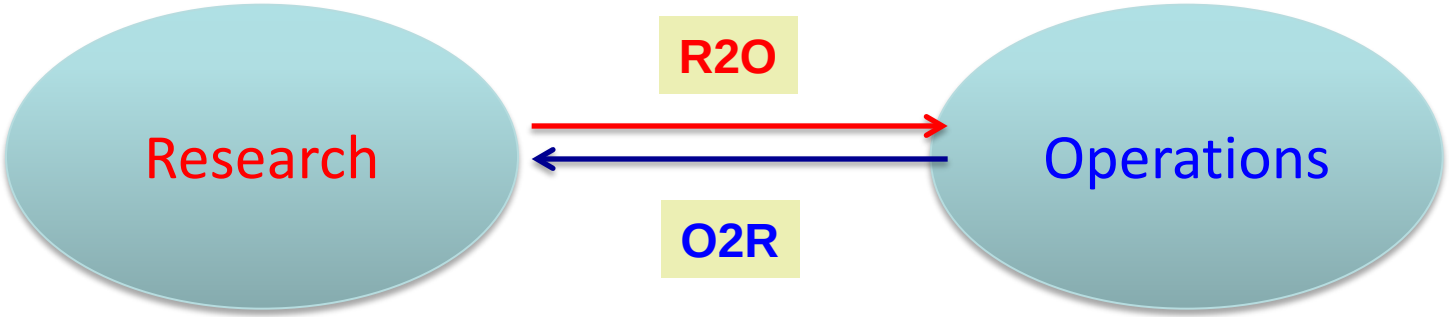


Phase-II Reforecast data in NCAR will be available in July 2014

- Complete monthly Mean of 30 year reforecast
- Daily reforecast data of selected variables
- The Phase-II data will be enhanced and easier to access using Sandy Supplemental Fund

NMME Integrates Research and Operations

- **Improved operational ISI prediction capabilities leveraging US investments in model development and expertise in a distributed way**



- **Openly distributed hindcast and real-time data**
- **Model diagnosis and evaluations in operational setting**
- **Drives climate predictability and prediction research**

Steps towards NMME beyond 2014

- **The support for the current NMME project will end in July 2014.**

- **A white paper on "Operationalize NMME" was developed**

- A draft **"Vision and 5-Year Plan for NMME" document** is under development by CTB, NMME team, CPO, NWS, ESPC, as to:
  - How the current NMME seasonal system should evolve to contribute to ISI climate **research** and **operational prediction** capabilities
  - How NMME can contribute to missions of, and be supported by those agencies
  - How to manage NMME an an interagency platform

- This plan serves **to initiate dialogue among interested agencies**

Vision and 5-Year Plan for NMME

- Needs for NMME
- Vision
- Objectives and major tasks
- Milestones, products and timelines
- Metrics
- Resources
- Management strategy
- Risks and challenges

Needs for Sustained and Enhanced NMME

- Continuously **support operations** for NCEP and other operational agencies and users beyond July 2014;

- Provide an integrated research and operational platform to **drive and support research**;

- **Enhance** the current NMME seasonal forecast system to meet more operational and user requirements, e.g.,
  - Sub-seasonal forecast capability
  - High-impact weather and climate extremes
  - Arctic Region

Vision for Long-Term NMME

- The NMME core strength is the **integration between the operational and research community.**
  - The integration is the key driver for new understanding of ISI climate predictability and prediction skills

- **A distributed operational NMME system**
  - All participating modeling centers generate **model reforecasts** on their own and provide **real-time forecasts** to NCEP following NCEP's operational launch schedule, e.g., EUROSIP; NAEFS; Experimental NMME
  - The greatest **benefit** of a distributed system is leveraging the efforts (HPC, and human power) of each modeling center in i) maintaining/improving models, and ii) generating reforecasts.

How Can a Distributed NMME System Meet the Operational Requirements?

- The operational NMME will be a **product-based** system. Its performance will be measured based on delivery of the product rather than individual models.
- Inclusion of **models from operational centers** will ensure delivery of timely, reliable products.
- Inclusion of **models from non-operational centers** is important for NOAA and ESPC operations to take advantage of model advances in the research community.
- **Agreements** between participating organizations (both operational and non-operational) and **sustained resources** are required to ensure operational execution of NMME forecasts.

NMME Near-Term Objectives and Tasks

- **Bring the experimental system to full operation by August 2014**.

- **Improve the NMME prediction system and products**
  - Add new or upgraded models
  - Expand the scope of the system, e.g., sub-seasonal forecast capability, seasonal hurricane forecast system.
  - Evaluate and optimize the system
  - Develop NMME-based application products.

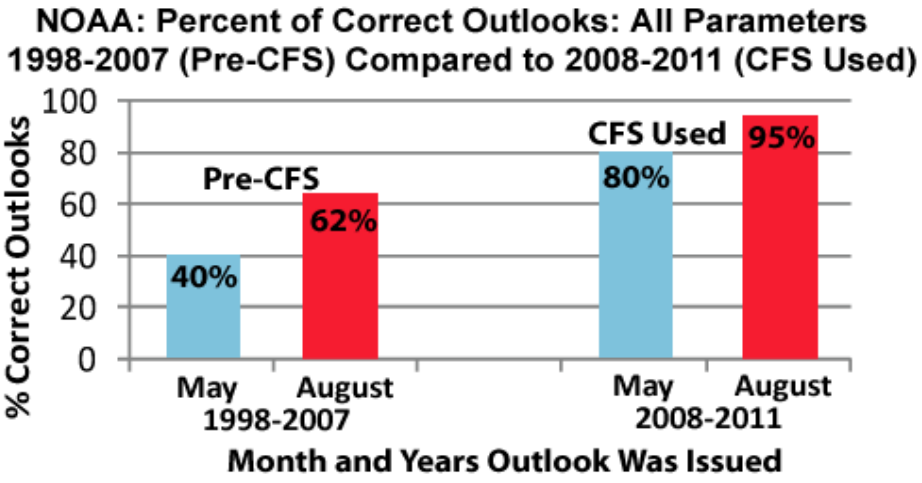
- **Continuously support the research and user communities**
  - Archive and disseminate the NMME data
  - Provide an operational platform for predictability studies and model diagnosis and evaluations at ISI time scales

Key Resource Requirements

- **Human resources to sustain the operational NMME system supporting**
  - Non-operational modeling center efforts
  - CPC's real-time forecast operations: in particular, additional resources for future intra-seasonal forecasts
- **Sustained funding for the research to enhance the NMME system**
- **High Performance Computing (HPC)**
  - Mainly leverage participating modeling center
- **Data Archive, access and management**

Potential New Funding Opportunities for NMME

NMME Expansion in HIWPP (High Impact Weather Prediction Project) from Sandy Supplemental Fund: To evaluate and establish the prediction capability of hurricane and other high impact weather extremes out to several months by leveraging and enhancing the existing NMME system and data.



MAPP-CTB FY14 call for proposals to advance NOAA operational prediction systems.

NMME Assessment in Arctic Region with funding from BOEM (Bureau of Ocean Energy Management) and BSEE (Bureau of Safety and Environmental Enforcement): To evaluate the performance of the current and future NMME systems and to compare models in Arctic Region.

Summery

- **Great progress in the NMME project since 2011**
  - real-time monthly/seasonal forecasts contributing to CPC's operations
  - testing sub-seasonal forecast protocol
  - NMME data is openly accessible
  - benefits participating modeling centers and research
  - potential new funding on NMME applications from and for users

- **NMME is currently funded as a MAPP-CTB research project which will end in July 2014.**

- **Urgent need for a plan and resources to sustain and enhance NMME beyond 2014**
  - A draft "Vision and 5-Year Plan for NMME" is under review
  - Next step is to engage interested agencies to refine the plan and to get support.