Overview of implementation/pathway: *Transition to operations at EMC*

What works and what does not work

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Overview

- Some background on operational computing.
- Driving forces for NCEP.
- The operational business model.
- The strategic view in the business model.
- UCACN Model Advisory Committee (UMAC).

Public-private partnership

The US is unique in that weather forecasting is treated as a public-private partnership with close interactions between

- National Weather Service.
- Other government entities.
  - In NOAA, NASA, DoD, ….
- Commercial weather companies.
- Including and integrated in the media.

- 2003 report from Committee on Partnerships in Weather and Climate Services, Committee on Geophysical and Environmental Data, National Research Council:
  - Fair Weather: Effective Partnerships in Weather and Climate Services.

Google: Fair weather report

Impact on operations:

- From Fair Weather report and last NCEP strategic plan:
  - Emphasis on timeliness and reliability.
  - Accuracy only at the third place.

- NOAA / NWS / NCEP does this better than any other organization in the world.
  - 99.9% on time delivery of products.
  - Products go to the public as soon as we produce them.

  - Example HRRR transition from ESRL to NCEP.
    - Immediate 99.9% reliability.
    - 45 min faster delivery of products.

UCAN report and NCEP Strategic plan

- EMC modeling directions:
  - Toward unified modeling:
    - Simplify Production Suite.
  - But ….. also add more:
    - New elements in the environmental modeling suite.
    - Reforecast for postprocessing of model results.
  - Be more nimble, faster model improvements.
  - But …… changes require much work on post-processing side, so change less often …..

Business model

Traditionally two types of implementations:

- Forklift upgrades (brand new model) :
  - Historically 5+ year process with need for maintaining old and new models side-by-side.
    - Examples: first WW3 model, GFDL-HWRF transition, ….
- Incremental improvement of existing systems:
  - Typically one significant upgrade per year (target).
  - Can be done with existing support for model, no second effort needed.
  - Up to order of magnitude cheaper than forklift upgrade.

- For price of forklift upgrade we can do 5 to 10 incremental upgrades
  - More efficient for majority of upgrades!

New business model

Moving to community modeling:

- Operations and research work on the same codes:
  - Open-source style environment, but …
  - operations needs to retain some control over codes to assure continued robustness and reliability of codes.
  - R2O and O2R are tightly joined in this concept, focus of NCEP of making ALL operational codes available with the proper support to make community modeling possible.
  - Concept proven within NWS particularly with the CRTM, WAVEWATCH III and HWRF.
    - GSI, GOCART, Noah, MOM, HYCOM, …….
  - Large part of our codes are community codes, but needs work for flagship models (NEMS, GFS, NMMB).
  - Code management a challenge, and not (yet ?) unified.

New business model

But this does not mean we will take any community model …

- Small number of models for each application, with a well defined business model, strategic plan:
  - NMMB and WRF-ARW,
  - WAVEWATCH III and SWAN,
  - MOM and HYCOM, ….
  - Similar approach at NOS for coastal ocean models.

- Focus first on incremental upgrades with the community of accepted operational community models.
- Strategic planning essential for address if and when community models need to be added, replaced or retired.
  - This will still be a much more expensive business model and therefore needs to be addressed carefully and strategically.

Essential elements for effective community model development

- Work on common source base (R2O2R) in a designated code repository with:
  - Each developer updating with “trunk” code versions regularly (monthly).
    - Keeps al development work relevant for operations.
  - Each developer maintaining code in their own branch in the central repository.
    - Early access of operations to development.
  - End-to-end testing of development, not just “science cases”.
    - Done by “team”, full T2O projects rather than fundamental research.

Strategic approach: UMAC

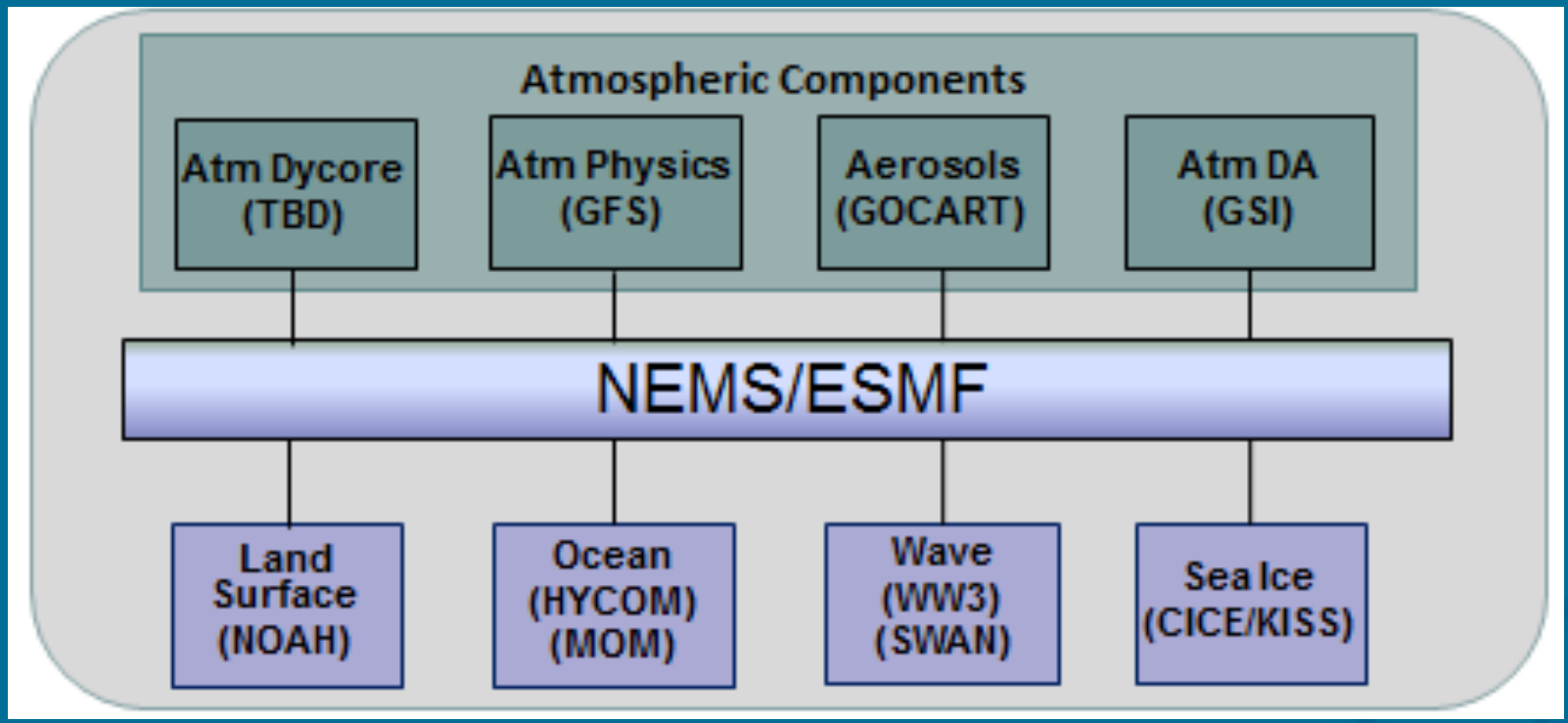
- UCACN Model Advisory Board
  - Review production suite
    - Strategic level.
    - Team from academia.
    - Stakeholders (including contributors) to be heard, but not on the panel itself.
- Global unification ?
  - Following slides on global are tentative ….
  - Next Generation Global Prediction System (NGGPS).
- High Resolution Rapid Refresh and ensembles.
- Everything in between

- Essential point of reference for NCEP

Software architecture considerations play an important role in the new business model.

- Modular code design based on NEMS.
  - ESMF, NUOPC.
- Dealing with component models in coupled modeling approach as “plug and play”.
- Separating dynamic core from physics in weather models.
- Modular unified postprocessing etc.
  - What used to be a full forklift model upgrade can now be much less intrusive, leveraging modular NEMS features.
  - NGGPS dynamic core upgrade can now tentatively be a core upgrade in NEMS, rather than building an entire new modeling suite.
    - Targeting five year project.
    - Upgrade of GFS rather than running old and new side-by-side for many years.

NGGPS and NEMS / ESMF



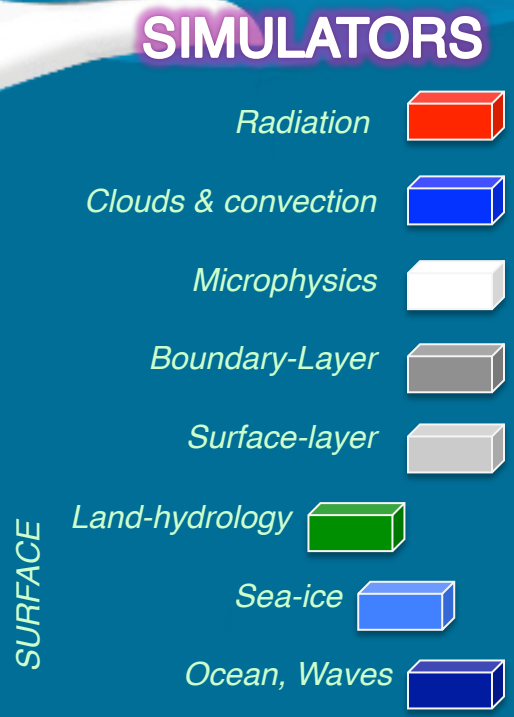
Modular modeling, using ESMF to modularize elements in fully coupled unified global model

(*+ ionosphere , ecosystems , ……*)

Research needs to fit into strategy

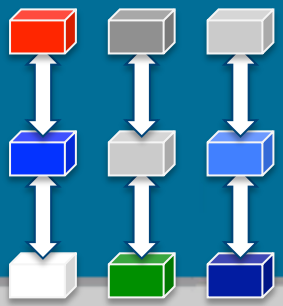
Model Parameterization Testbed

Model Development Heirarchy: Simple-to-More Complex

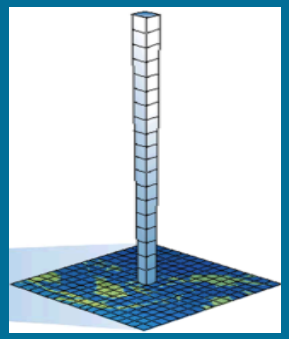


- Simulators: test submodel parameterizations at process level, e.g. radiation-only, land-only, etc.
- Testbed data sets to develop, drive & validate submodels using: observations, model, idealized cases, *with "benchmarks" before adopting changes*.
- Submodel interactions, *with benchmarks*.
- Full columns, *with benchmarks*.
- Limited-area/3-D (e.g. convection), *w/ benchmarks*.
- Regional & global NWP & seasonal climate, *with benchmarks.*
- **More efficient** model development, community engagement, R2O/O2R & computer usage.

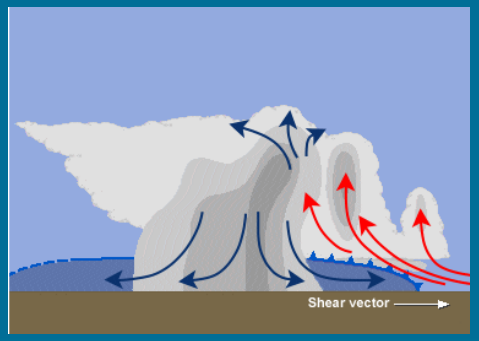
Interaction tests



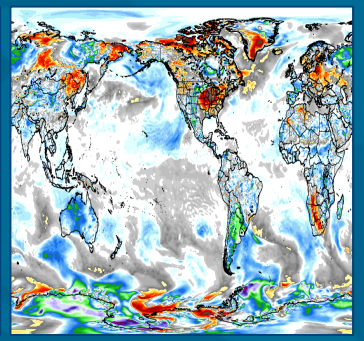
Column tests



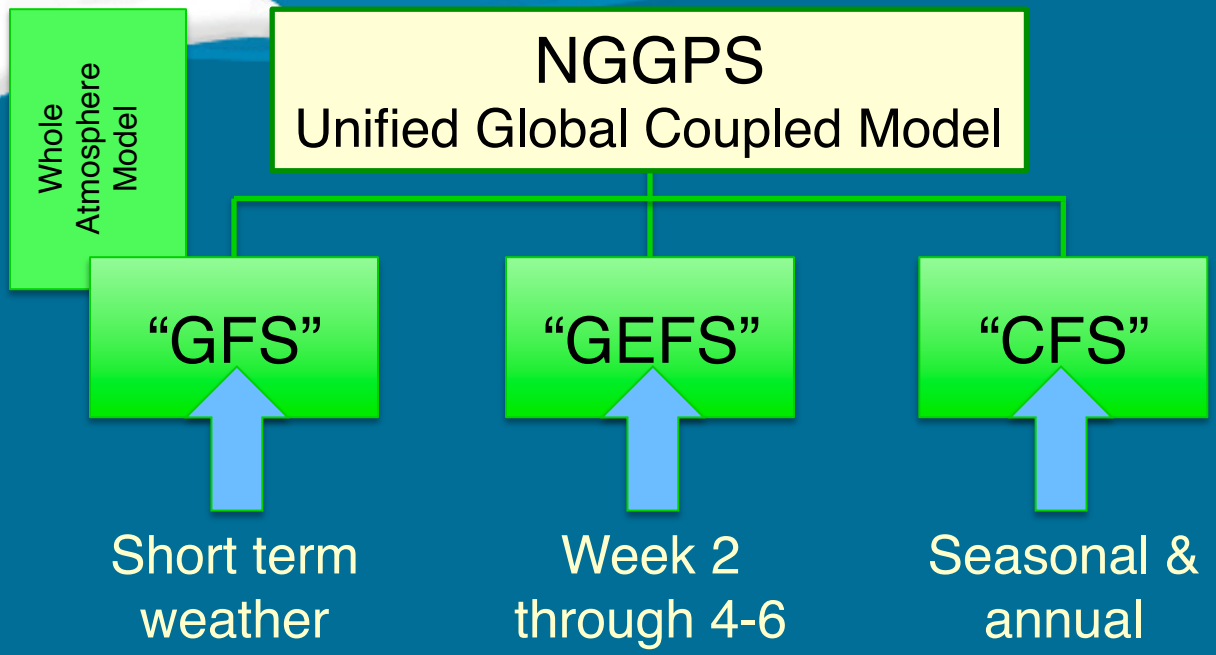
Limited-area



Regional & Global



Unified Global Model



Application
=
Ensemble
+
Reanalysis
+
Reforecast

1 y	2 y	4 y	**Update cycle**
3 y	20-25 y	1979 - present	**Reanalysis**
6h	6-24h	???	**cycling**
WCOSS	WCOSS	WCOSS ?	**where**

Research needs to fit into strategy


Thank You!