

Day 1

Background Federal Briefings

USGCRP discussion [Notes from Mariotti's]

- Ram: Missing feedback loop from implementation back to USGCRP planning?
- Gary: A feedback from this group could be very useful.
- Gary: The human impact of prediction or projection is where the real interest is - that's why we need to start incorporating it.
- Hendrik: consistent with the NWS weather ready nation, from user requirement all the way to decision support.
- Anjuli: a charge for this group, are we covering all bases for modeling for the Nation? Are the various modeling centers taking on different parts of the problem?
- Bill LP: importance of this group is to try to influence priorities and provide feedback.
- Bill L.: if we are not able to influence priorities (non-Feds cannot provide advice) why are we here?
- Bill LP: models are tools. Need to use the right tool for the right application. We need diversity in the models - there is value in MME - but we (NWS) rely on others to develop the system - we cannot support all.
- Tsengdar: NAS report: do we have investment to sustain all we want to do or whether we need to narrow it down. Have a forum to discuss coordination/collaboration so we don't stretch out too thin?
- Ram: a lot of emphasis on predictability/prediction - there should be an emphasis on science and modeling - an important set of activities that need to be sustained.
- Discussions reveal different definitions of seamless.
- Brian - NCAR's Yellowstone is comparable to NOAA's R&D compute. NASA is leading the exploration of mic intel cores. DOE has the best skin in the game. Collaboration between NOAA and DOE was an allocation on Titan. Titan has allowed exploration of mixed gpu systems. DOE has an order of magnitude growth in compute and this will eventually help deployment agencies getting better compute. Software development to optimize code is important to ensure the codes are suitable for the architecture. Also there needs to be interactions with those that develop compilers.

HPC and software

HPC discussion [Mariotti's notes]:

- Ram what is NOAA's experience with the integrated systems? NOAA and DOE can collaborate on dynamical core and tracer transport.
- David C.: need for analysis is not addressed - are there plans for server side analytics? GFDL is now getting the data back from Oakridge - what are the strategies for dealing with lots of data and moving it around? Inline processing should be the future and data download should not be the metrics for success of a model database.

- Bader: there is a consortium for open source compilers including Fortran, there is a community that needs this type of work so that the compilers adapt and are efficient on new architectures.
- Tsegdar: cost for NCAR to port the codes on new machine is 70 FTE years. What is the strategy? If we decreased the number of codes we would be better off.
- Binkley: this community should reach out to other communities that have gone through this (e.g. the weapons community). Should there be a WG to look at this across the modeling centers? Is there efficiency here? Is there a role for ESPC?
- Hendrik: how to re-train the people to work with the new software and systems? We cannot wait, we need to start moving towards that now.
- Ram: how is the European community dealing with this?
- Bill: they have one code.

Model integration frameworks for IAV and IAM efforts [Notes from Archambault]:

- Interagency coordinating group has been formed under IGIM
- Gary Geernaert is vice chair
- Has established objectives and foci
- Two key areas:
 - Drought
 - infrastructure vulnerabilities
- What are the tools and capabilities needed?
- Multi-model frameworks and flexible couples are key
- Uncertainty characterization
- Sensitivity studies
- Identified desirable characteristics of the framework
- Use PNNL's PRIMA – an illustrative example
- Robust IAM soft coupled to climate
- ACME/IESM as hard coupled IAM-ESM for use with IAVs
- Three communities: ESM, IAM, IAV
- High resolution is a critical need
- Characterizing uncertainties all along the way (including with RCPs) is important
Understanding changes in extremes is high priority

Bill L: how do you handle uncertainties with a system this complex?

Bob: socio-economic models – human behaviors add even more uncertainty; ideas is less of a predictive system than a way to improve insight

Ruby: will there be a way for operational centers to plug in with their models?

Bob: That's the idea

IAAs Discussion [Notes from Mariotti]:

- Framework for IAAs is being developed including multi-model and flexible coupling. 2 focus topics are droughts and concentrated infrastructure.
- Bill LP: how do you deal with uncertainties? For socio-economics metrics and verification are different. It involves human decision making/behaviors.
- JF Lamarque: what is the effort to go full circle on particular sectors?
- Ruby: do you envision this being a framework where even the operational centers can plug in? Can this favor multi-center collaboration?
- Anjali: are the IAVs/IAM going to be evaluated back in time?
- Gary: this is for scenario simulation (5 years out or more) not for predictions.
- Gavin: but in practice these systems are being used differently e.g. to estimate the social cost of carbon. There should be clear guidance regarding predictive capability and use.

Modeling center updates [Notes from Archambault]:

GFDL - Ram

- Two different model configurations in preparation for CMIP6
- Comparison of new AMIP (AM4g7) vs. CMIP5 AMIPs
 - some good, some bad
 - CM4: ENSO spectrum is not as good as best model, but is better in other ways

Two approaches to weather-climate prediction:

- 1) brute force, ultra-high-res, global “cloud-resolving” approach
- 2) regional approach (nesting) within global approach

- FLOR: coupled atmos-ocean model for seasonal prediction that came out of Sandy Supplemental funds
- HiFLOR – simulates Cat 4-5 TCs as a global model
- Can capture observed distribution of TC intensity

Priorities:

- Hydrologic cycle – interaction between climate, land use and urban changes
- Processes in climate models
- “Grand challenge” topics
 - CPO-21 aftermath (?) – adaptation and mitigation
 - Carbon and other BGC cycles
 - Air and water quality
 - Carbon: wetlands, permafrost, leaks, blue carbon (human destruction of Carbon holdings in land -- mangroves -- more green/brown than blue)
 - Arctic: ESM with prognostic ecosystems

Bill: has running high-res climate models for seasonal prediction been beneficial or a distraction?

Ram: running climate models on short time scale reveals biases; very useful

ACME - Dave Bader

- 50 FTEs working on ACME
- “Why do we need another model?”
 - It’s not the model – the model is a means to an end. DOE has specific needs that ACME will address
- Have performed baseline runs for sea ice
- Have a 5-yr roadmap
- coupled system training is ongoing
- Major experiments start in summer
- Maintaining state of the art infrastructure will be a challenge
 - High res: 25 km atmos, 1/10 degree ocean, 1/10 degree ocean
 - Low res: 1 degree atmos and ocean
- Will run the DECK experiments, but not CMIP
- Physics and dynamics for CICE have been decoupled separately for its implementation to MPAS – a question of governance
- Some question about how community (NWS) can work with DOE on CICE (co-design vs. governance)

NASA GMAO - Steve Pawson

- Global mesoscale modeling
- GEOS-5 reanalysis – MERRA-2 – towards Earth System Reanalysis
- Lots of modeling partnerships
 - NASA MAP projects – projects with NCAR, DoE
- Will GMAO use GEOS-5 to do CMIP6? - possibly

GMAO - Randy Koster

SMAP work

NCAR CESM - J-F Lamarque

Update on CESM2

- Idea of CMIP analysis platform
- New NCAR service to address the CMIP big data storage and analysis problems
- Impacts on human systems – combining climate and demography projections
- CESM grand challenges
 - Avoided impacts (different RCPs)
 - High-resolution, scale-aware parameterization
 - Biogeochemical cycles and process representation
 - Cloud aerosol interactions
 - Whole atmosphere coupling
- CIME infrastructure

- Bill L: how is CIME infrastructure working out? Interoperability can be a challenge for working with community (speaking from experience with ESMF)
- Dave Bader: some delays initially, but fine
- Can ESMF be within CIME infrastructure? Yes..not there yet

GISS ModelE - Gavin Schmidt

- Working to improve CMIP5 model (GISS-ES.1)
 - QBOs, MJOs, mesoscale ocean parameterizations
 - testing next-generation models – GISS-E3, GISS-E4
- Better MJO through tweaking convection scheme
- Good improvements on secondary variables like aerosols
- Also improved resolution (atmos, ocean)
- GISS Ocean 2 (GO2) model

EMC - Hendrik Tolman

- Unified doesn't mean one model – as few as possible
- Tentative layout:
 - Extend present day ensemble out to week 3-4 (from day 16)
- 35-km resolution, coupling (ocean, ice, ?), increased ensemble size, DA, from week range?) → consistent with Hamill work?
- Present status:
 - Extend range of GEFS without stepping down resolution
- Could be uncoupled baseline: IOC, but coupling preferred
- Key science questions:
 - Predictability; what to focus on for products
 - Advanced coupling
 - Physics suitable for severe weather outlook – this is the target verification, not just 500Z AC
- Will stop running 45-day CFS
- NGGPS/UGCM and NEMS/ESMF
- Coupled DA proof of concept
- Need an integrated coupled modeling and DA approach
- Wind and wave errors – strong cross correlations
- Building a demonstration system at end of the year to do joint development work on
- 6 way coupled system
- NCEP – Coupled Hybrid DA and Forecast System
- Individual DAs for individual components, but then include cross correlations
- 100% HPC exercise → compute needs
- Goal is to understand requirements for each system, not to make each system work within pre allocated compute
- Also does exercise for all of NOAA –operations having enough at the expense of research is not helpful
- Includes reanalysis/reforecast
- Fully supported ensembles

- at year time scale
- at 40 days
- out to a week
- days – hourly updating

Discussion and highlights of outstanding issues:

Discussion of coupling, software infrastructure

- MOM6 and SIS2 are tightly coupled for specific reason
- If computational paradigm for how to solve problem is well defined, then you can move forward with computational architecture, etc.
- Historically, models start independently without coupling
 - Same modeling decisions would not be made if starting from scratch now
 - But also, the choice is often based on what is easiest
- Discussion of coordination of software architecture – how will each agency approach architecture?
- USGCRP priorities
 - NCEP not directly responsive to them
 - But all the modeling centers are working in broad areas of importance
 - The goal is that agencies map some activities against that of USGCRP
- Ram: USGCRP should emphasize fundamental aspects – DA, chemical processes, etc. → need dedicated attacks on those topics (as opposed to focus on phenomena)
- HPC, architecture changes
 - these are huge issues that should be elevated through USGCRP
 - how does the community prepare for the changes?
 - A long term plan to transition to a new architecture would be helpful to elevate
- Not enough to invest in new architecture, but need to invest in infrastructure for it