International Workshop on Coupled Modeling of Polar Environments
Held 4-5 June, 2016 at the Byrd Polar and Climate Research Center
The Ohio State University, Columbus, Ohio

MEETING NOTES: Final 14 July, 2016

Session 1 Notes

General Strategy
- Various opinions exist on which models and couplers should be used for a polar coupled model, but our **goal is to develop a single model framework for this task (COAWST/MCT or CPL7?)**
- Model options?
    - Polar WRF – most likely for the atmosphere
    - Budgell or CICE – sea ice
    - ROMS (many threads exist – not part of a publically available release)- ocean model
    - SWAN, WAVEWATCH III- wave models
- Coupling Strategy?
    - MCT, ESMF, MetROMS-MCT-CICE approach?
- Idea is to utilize the strategy that yield productive results in a timely fashion
- Funding is minimal while model development is time consuming/computationally intense – path of least resistance?
- On short time scales, ice sheet model may not be necessary
- Physics are important

Ice sheets and Modeling
- Should ice sheet modeling be part of the polar regional model?
- Discussion on the different timescales: week to month on the ice sheet model timescale
- Strategies involving running ice sheet model for a month, then ocean model, then restarting – why not develop the coupler (maybe already exist) to be able to handle this?
- What about fast ice, grounding line retreat?
    - Rapid in Amundsen Sea sector, slow in the Ross Sea sector
- Need to minimize the shock between ice shelf change and ocean impacts; gradually introduce changes to the geometry of the ice shelves/sheets
- Gravity wave impacts
- How/do we deal with icebergs and calving? Moving them around vs. impacts?

Operational Concerns
- How can this project serve the operational community?
- Predictive sea-ice
- Seasonal prediction is challenging
- Fast ice, bergs
- High resolution modeling currently out 39 hours in AMPS with fixed sea ice

- A few-day predictions with prognostic sea ice will help all operational transportation efforts
- Budgell handles fast ice? Some work done.
- RASM sea-ice forecasting for Arctic example of how it can be done
  - Amy Solomon: GFS lateral boundaries with WRF/CLM in RASM through coupler
  - Mark Seefeldt shared website of sea ice forecasts and information: http://www.esrl.noaa.gov/psd/forecasts/seaice/
- Norwegian effort - MetROMS
- Sea ice charting, NICE (NSIDC) – near real-time satellite sea ice used in AMPS, Global Ocean Forecast System (GOFS) – resolution matters
- Can sea ice modeling help force AMPS?
  - E.g., fluxes over sensitive areas, rapid polynya development
  - Answer should be yes – need to move beyond static sea ice
  - Can we use this to make a compelling argument for increased funding on the operational/forecasting side?

Other benefits
- Results from coupled output can help advise various countries mission planning, e.g. ice breakers over the course of the next 20 years – right now using what is available from CMIP5
- Once a coupled model is running, seasonal/real-time predictions of sea ice, etc. become more viable
- National programs are vulnerable due to increased traffic; one would think that the safety and efficiency issues would be more than compelling to increase funding

Engaging SOCOM
- More focused on biogeochemistry, designed to address CO_2 sequestration
- But they are building observing capacity – Argo floats (again, mostly for biogeochem)
- Scope is broader/global but may be worth engaging in the future
- GFDL conducting modeling (ice shelf, etc.) but not for Antarctica
- Use the scientific ideas of SOCOM to sell the need for coupled polar model

Other Thoughts
- All of this is compelling argument for regional modeling systems (certain areas, embedded grids, aerosols, etc.)
- Antarctica is international, should be a way to motivate a multinational funding effort to build capacity (many compelling reasons – flights, cruises, climate, operational)

Session 2: Open Discussion

- There is a clear need for coupled modeling.
- What is the immediate action and feasibility for funding?
- Where do we want to be in 5 or 10 years?
- Need flexibility – no exclusion of models just based on convenience

- Ice sheet model needs to be included
- Consortium in Europe for the Arctic - Can we be engaged with this group?
  - Grassroots effort or European Climate Research Alliance (collaborative)
  - Find the topics, arching connections, find and funding, Arctic climate stability and change, extreme events, sea level and climate change, changes in the hydrological cycle
  - WMO – YOPP
  - This brings up the question: do we need a more formal structure vs informal? Formal means everybody is on the same page.
- For COAWST: Need an intercomparison test bed? - different models using dedicated observing platforms
  - Can this idea be sold to program managers?
  - If we had plentiful resources we could try this approach.
- Need to increase visibility – draw attention and support from the various funding through YOPP, Southern Ocean groups, SCAR, etc.
- EOS short article? – Yes, good idea
- Multiple small groups with small amount of money (CLIVAR, SCAR) – can provide meeting support, travel, publication charges
- Need short- and long-term goals
- Shared resources – complex, no single group can do this, need to be more collaborative
- Leverage different opportunities and sustain research
- From modeling development viewpoint:
  - Need better documentation of results
  - Need benchmarking test cases
  - Devise idealized polar environment to aid the modeling development - cheaper but takes a big effort
  - Create documented test cases - increase the knowledge base and user friendly aspects of a coupled model
- What systems are out there?
  - Literature review type exercises
  - There are more groups working on this than we know about
  - A lot of repetition – need to avoid this
  - Understand the landscape – there is a lot of Arctic things, but what about Southern Ocean?
- Many Ocean models (ROMS, NEMO, HYCOM)
  - Preference is up to the user in terms of level of comfort and development
  - Changing to a different model will take a long time
  - Therefore, continued development of ROMS seems the best idea
  - Be mindful of additional developments to be able to adapt to changes in the modeling environment
  - First step is a usable coupled model
  - Have generally underestimated the challenges of performing this exercise
- First priority: Working model with good results
- Balance model development to model research
  - Model running vs publishable results is a big gap
  - Need to think about sensitivity and physics

- o Need time must document and report
- o Document, publish, and share vision
- o Sea ice model down the road
- Two immediate problems: Communication between WRF and sea ice and weights interpolation using SCRIPT (important because WRF is a computer intensive)
- Benchmarking: Developing idealized coupled model applications – need to think about it
  - o ROMS has one developed case – shelf slope with uniform shelf break with trough
  - o Might be best to present regional results, e.g., certain people present results in Prydz bay, etc.
  - o Seasonal ice change, ice shelf basal melt (year to year variability),
  - o Are there general results that all models are going to get? Volume transport through Drake Passage?
  - o Use satellites to compare seasonal patterns of sea ice.
  - o Use this strategy to gain a larger body of results of any modeling – compare different results, utilize observations to analyze the model results
- Idealized word vs real world – can be expensive to try real cases (should be highly specified)
  - o What does a coupled idealized simulation look like?
    - ▪ Doesn't matter – just need to produce a solution that you can match to model output?
  - o Is there an example for the atmosphere? – Analytical solution in the offshore direction, Terra Nova Bay turbulent heat fluxes
- Abu Dhabi
  - o ROMS with CICE in COAWST
  - o Trying to couple CICE and pass through MCT
  - o Entraining the MetROMS approach into COAWST
  - o Also add an ice sheet model once this works
  - o Funding through the university – Center for Sea Level Change – don't have to generate proposals
  - o Have new computer system with great computational resources

Proposals
- Funding still a challenge in US
- WRF development funding is not present, very difficult to get funded - it's a community driven effort; less funding from outside; NCAR has gone to half soft money

ODU
- Developing whatever ocean products they can
- Short term funding- short bursts of development
- Just 2 members and a grad student – small program and tough to perform model development, done on the side of other projects
- Benefits from all of the international efforts
- Budgell model works, usable; but if a better model comes along, it can be used
  - o e.g., ice rheology and physics
- Need a sea ice expert at the table!
  - o Parameters need to be changed - need an expert to help tune the parameters

Longevity of the COAWST effort?
- Branch or separate activity with focus on shallow water sediments and estuaries, but there is a large community around it
- COAWST and ROMS could recombine – similar motives
- If we develop a Polar COAWST, would it find a home?
- COAWST is not likely to go away
- Every two years, COAWST workshop – helpful but not enough
- Stay at WHOI? Help increase the visibility of USGS
- More people that use COAWST – more questions – need more staff
- Has critical mass now, but it's always a big effort – similar to WRF
- Questions on COAWST often get sent to ROMS or WRF so they need the support from one of these development groups
- COAWST should be available to support both ROMS and WRF – difficult for a single user to use out of the box
- How do we solve this problem? Bug reports? Questions on running? WRF has multiple staff to help with questions. ROMS and COAWST don't have this.
- Mechanism for timely response is not in place – volunteer basis in ROMS
- NCAR's background in COAWST: John Warner worked on his own to combine WRF with ROMS, SWAN – comes back periodically to work with NCAR folks
- Started with grad student in WHOI – 2.5 years for Joe Dunbar
- NCSU is more beta users for COAWST and designing experiments; hurricanes, winter storm air-sea interactions, sediment transport
- The polar version is a very new idea; talked to John and he is receptive to Polar COAWST

Significant interest in Polar COAWST?
- General agreement for near term
- Antarctic COAWST – this is not built for the Arctic; sea ice model is not good for the Arctic
- CICE then?

ACTION ITEMS
- Abu Dhabi – Working on CICE
- NCSU and OSU – Working on getting a fully capable coupled model
    - Sensitivity benchmarking cases
    - ROMS with Budgell looks good
    - Need a reasonable representation of clouds with impact on sea ice cover
    - Very sensitive to the radiative clouds
    - Cumulative radiative feedback
    - Benchmark on a big domain looking at basic variables (sea ice patterns, seasonal cycles, timing of sea ice, extent)
    - Have to solve the grid coupling; SCRIP – try the new version what may be new is John Warner's code to use SCRIP
    - Relax the atmospheric resolution to 30 km

- o For ocean - sea ice at 10 or 5 km doesn't make much difference. Just need a broad scale representation right now
- Ben Galton-Fenzi - Try to unify Polar ROMS
  - o Ice shelf code needs to be updated to use Ben's code (with ROMS 3.7)
  - o GSW runs with tides and wave propagation
- Formal structure?
  - o Need to see how it goes before it becomes formal
  - o Should remain this way for now, too immature to bring a formal structure
  - o Need results before we have a consortium (down the road idea)
- Would you consider using the coupled system on Prydz Bay in a few months – circumpolar grid to a regional area? A next step? A Ross Sea – polynyas etc.
- Could have an ensemble of regional set ups
  - o Can be ported to other regional areas – existing regional model set up; circulation and observations present; informed decision on the grid boundaries
- Scott Carpentier – Bureau of Met./Australia would welcome some opportunity to assess the operations using some results from these benchmarking – provide the link to the Australian operations near Prydz Bay
- AMPS may have some resources available – changing sea ice cover is desirable
  - o Cooperation after Polar COAWST is shaken down
- Need a sharable code repository
  - o When do the various efforts become merged?
  - o John Warner is willing to act as a repository for the code at USGS – need details
- Polar COAWST in Hobart ROMS Asia-Pacific meeting in October, 2016
  - o 1 day sidebar – yes…timescale is perfect