Breakout groups:

Today’s emphasis: The present status, challenges and opportunities for improved predictions, building from today’s presentations, i.e., identify high-priority issues

Tomorrow’s discussion will focus much more heavily on actions

Start with a service perspective, i.e., services as a driver; let NOAA services have a first voice.

Ola Persson (OAR), Wayne Weeks (NWS), and Hal Ritchie (EC):

Start from Services:

What are primary prediction challenges for services now? What are the critical variables or fields?

• Public not being aware of some of the products being out there – outreach needed; some communities may not have an “emergency manager;” some of the folks in these communities may not be native English speakers, may not have a computer at home, may not even be literate. They want and need input as to what’s happening, where’s flooding, etc., too.
• Villages work on VHF and ham radio – no equivalent to WX Radio Sea ice prediction is dependent on wind, wave height – if you improve one, you improve others
• Top challenge – getting good wx prediction
• What are forecast variables or events for which there is a large demand, i.e., break-up of land-fast ice
• Need to know wind, waves, how much rain/snow to produce flooding, storm surge
• River melt and flooding
• Fire weather forecasting
• Sea ice prediction is dependent on wind, wave height – if you improve one, you improve others. Overall goals to support communities, safety in navigation
• Coastal erosion and storm systems – open water led to long fetches
  o Complex
  o Evacuation of communities?

• Of the services we provide now, what are the ones has the lowest reliability, forecast busts, etc?
• Models have coarse resolution, poor measuring of Bering Sea inflow
• Freezing spray, Snow cover, Fog
• Coupling to the ice, Dynamics, wind forcing, air-ocean temperatures, etc.

• Mixing scheme not correctly implemented – changes to heat content before, during, and after storm

• Understanding upper structure

• Reliability of products? Yes and No. Forecast verification is “burr” in saddle, i.e., vessel icing model, no verification, no observations. Sea ice model/sea ice drift – 20 years of verification.

• Is there a similar call to predict polar low within 6 hours?

What advances in predictions are most needed to address these challenges (lead times, spatial resolution, etc.)?

• Improved lead times (three-fold improvement)
• Improve vertical and horizontal resolution – for aviation and nearshore
• Improvements in model physics

What new prediction products are likely to be required between now and 2020?

• Prediction of ice-free season (onset and end, breakup, and length) – for oil exploration
• Passability of the Northwest and Northeast Passages – teach users about probabilistic forecasts

What are the drivers and where is the demand for new products coming from?

• Arctic communities, oil exploration, aviation, renewable energy, minerals, marine, tourism, fisheries, ice road viability

Consider modeling next:

What are the primary challenges for model predictions in the Arctic now?

• Wave, ice, and tides/interactions and dynamic processes need to be implemented into model
• Lots of unknowns about where to make improvements – need validation/testing of various components of models, i.e., in atmosphere, forcing over sea ice, do we know if forcing is correct? Atmospheric radiation due to clouds – impacts on net surface flux? There are case studies we can do; there are some improvements to buoys, putting wind measurements.
• Winds
• Ice drift
• Need to examine and verification coupled systems; flux corrections between the atmosphere and ocean
• #1 challenge -- Validation and observations!!!!!!!!!! How can we get remote based obs that match model forecasts that are well linked to sensible forecasts? Alaska is not going to get $40 million for an obs network!

What is required to address these challenges (improved representation of key processes, data assimilation, higher horizontal or vertical resolution, etc.)?

• Yes to everything in paren
• Vertical mixing in ocean and atmosphere
• Handling of leads in land-fast ice
• Higher resolution models for both atmosphere and ocean
• Representation of clouds and radiative impacts

What advances in observations or process understanding would likely have the largest impacts on improving predictions of the Arctic coupled system?

• RAOBs over the Arctic
• Arctic COSMIC
• Flying Global Hawk 3 times a week

Processes and Observations:

What are the major gaps in process understanding in the Arctic?
• For coastal regions, anchoring process in land-fast ice
• ** Dynamics and thermodynamic processes air-ice-wave-sea-tides interaction
• Processes in marginal ice zone we don’t really understand
• ** Impact of river input into Arctic Ocean
• Impact of heat advected through Bering Strait and from Atlantic Ocean
• E-P
• ** Clouds and radiative impact
• ** Ice concentration
• ** Snow depth – hugely affects albedo
• SST in marginal ice zone
• ** Aerosol forcing
• Ice-ocean-snow albedo feedback process in the coupled ice-ocean model – melt pond
• ** We don’t know how any one of these things affect the skill of our forecasts

** “Major”

What are observations needed to improve this understanding and steps that would accelerate transfer of this knowledge into prediction model improvements?
• Density of surface obs and remote sensing obs
• Dropsondes from Global Hawk over water
• Field campaigns for validation data and studies on these processes
• Novel instrumentation for improved observation over the Arctic Ocean – UAS, AUV, NTM
• Measurement and parameterization of melt ponds – UAV

What are the major gaps in Arctic observations limiting predictions?
• Funding
• People
• Autonomous Insitu Sensing
• International agreements for instrument deployment and data sharing
• Interagency data sharing
• Referred to obs above
• Common access, easy navigability, documentation of data collected

What steps can NOAA take between now and 2020 to help optimize the observing system?
• An Act of Congress – funding, authority (mandate)
• Common access, easy navigability, documentation of data collected – an offline NOAA group to discuss
• Encourage improvement of models in the processes defined above
• Encourage filling the observational gaps defined above