

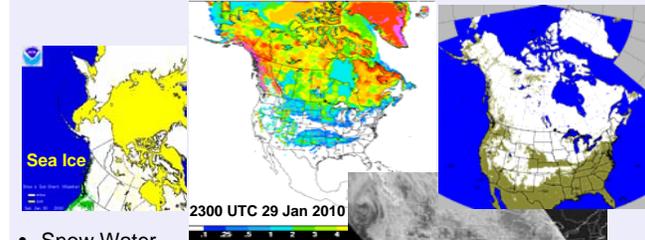
# Parameterization of Land-Surface Processes in the Rapid Update Cycle (RUC) and Rapid Refresh (RR)

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RUC Land Surface Model development - response to GSD mission "to provide NOAA and the nation with observing, prediction... systems that deliver environmental products ranging from local to global predictions of short-range, high impact weather and air quality events to longer-term intra-seasonal climate forecasts"

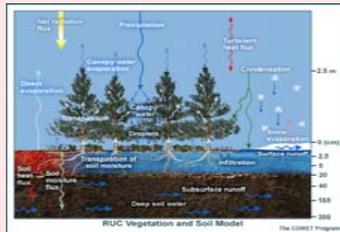
- RUC LSM implemented in:
  - Operational RUC in 1998
  - Weather Research and Forecasting (WRF) modeling system in 2002, used in WRF by non-ESRL researchers
  - Rapid Refresh (RR) system using Advanced Research WRF (ARW) dynamic solver over North America domain with vast areas of Arctic sea ice
- RUC LSM planned for testing in FIM

Snow Water Equivalent Cycled in RR verified against NESDIS Automated Snow Mapping System and Visible Satellite Image



- Snow Water Equivalent depends on 1-h RR precipitation forecast and RUC LSM snow melting algorithm
- Removal of snow when clear disagreement with NESDIS product

## RUC Land Surface Model (RUC LSM)



- more accurate lower boundary for aviation/severe weather predictions in RUC
- 13-year long record of surface grids provided to GCIP/GAPP community for climate studies

Cycling of soil moisture, soil temperature, snow cover and depth, skin temperature in RUC 1h cycle since 1997

## Land Surface Model Validation



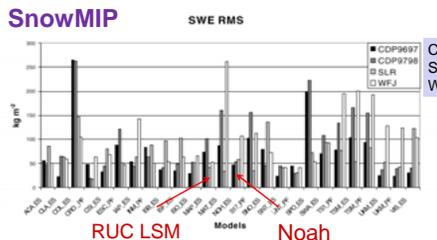
- Project for the Intercomparison of Land-Surface Parameterization Schemes (PILPS), coordinated by Global Land Atmosphere System Study (GLASS)

- 21 models participated (including RUC LSM, Noah)

Goal – controlled comparisons of LSMs and snow models of different complexity

- Snow Models Intercomparison Project (SnowMIP and SnowMIP2), coordinated by International Commission on Snow and Ice

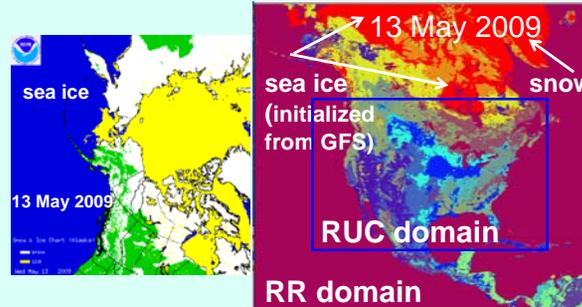
- 27 models participated (including RUC LSM, Noah)



Col de Porte, France  
Sleepers River, Vermont  
Weissfluhjoch, Switzerland

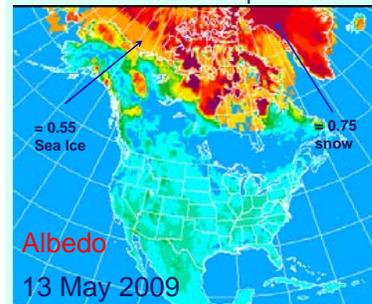
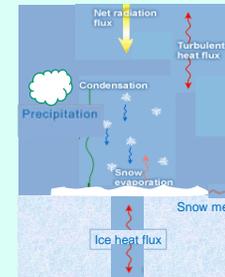
Figure 1 - RMS of the simulated SWE for each model on the different sites (PF indicates that the model has run with a prescribed soil flux, ES that the exchanges between the soil and the snowpack have been explicitly simulated). SWE – snow water equivalent

## Land Use Types in Rapid Refresh (RR)



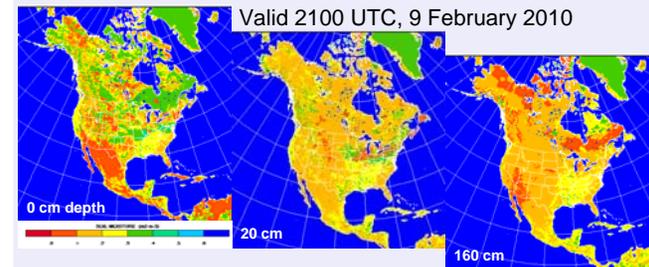
## New Sea Ice/Snow Treatment in RUC LSM

- Solution of surface energy budget and heat diffusion equation in ice
- No melting, drifting or building new sea ice
- Option of fractional sea ice
- Snow accumulation on the sea ice surface
- Snow/ice albedo is a function of snow/ice surface temperature



Snow/sea ice albedo is reduced when:  
 T snow/ice > 10°C  
 h (snow height) < 10cm  
 - "patchy" snow, albedo averaged between snow-covered and snow-free areas

## Soil Moisture Climatology in RR System



Soil moisture evolution in RR system is driven by 1-h precipitation forecast and RUC LSM performance

Consistent with GSD Science and Technology Objectives to "develop and improve local-to-global weather... prediction models" future work includes:

- Refinements of physics parameterization in RUC LSM
- Assimilation of satellite/in-situ data for snow depth, soil moisture, skin temperature
- Improvements in hydrometeor initialization for better 1-h precipitation (radar data assimilation, cloud analysis ...)
- Collaboration with scientific community and providing availability to new developments in RUC LSM