Barrow workshop
29 Apr – 31 May 2015

Observers-Modelers Observations-Models

Same struggle?

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Université catholique de Louvain

IC3R

Blending observers and modelers

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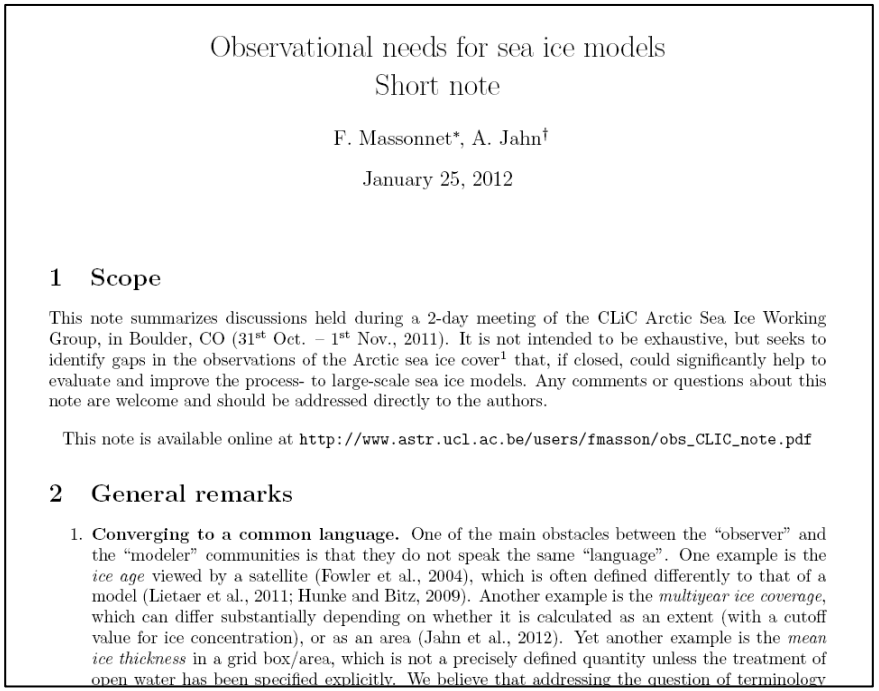


Observational needs for sea ice models
Short note

F. Massonnet*, A. Jahn†

January 25, 2012

1 Scope

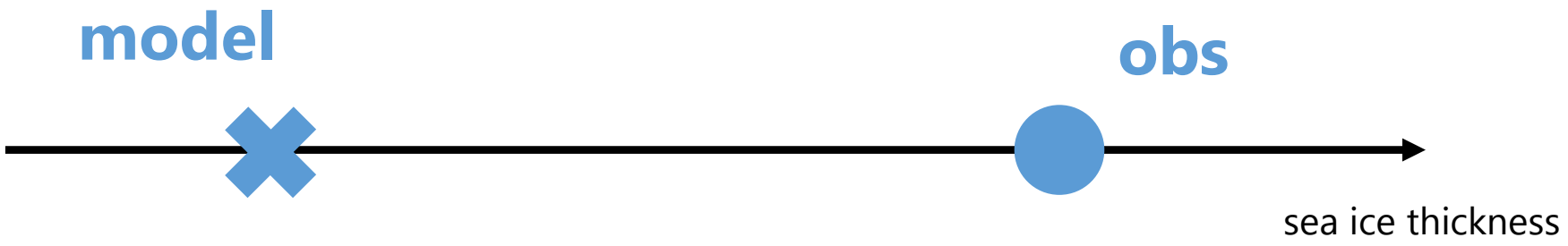
This note summarizes discussions held during a 2-day meeting of the CLiC Arctic Sea Ice Working Group, in Boulder, CO (31st Oct. – 1st Nov., 2011). It is not intended to be exhaustive, but seeks to identify gaps in the observations of the Arctic sea ice cover[1] that, if closed, could significantly help to evaluate and improve the process- to large-scale sea ice models. Any comments or questions about this note are welcome and should be addressed directly to the authors.

This note is available online at `http://www.astr.ucl.ac.be/users/fmasson/obs_CLIC_note.pdf`

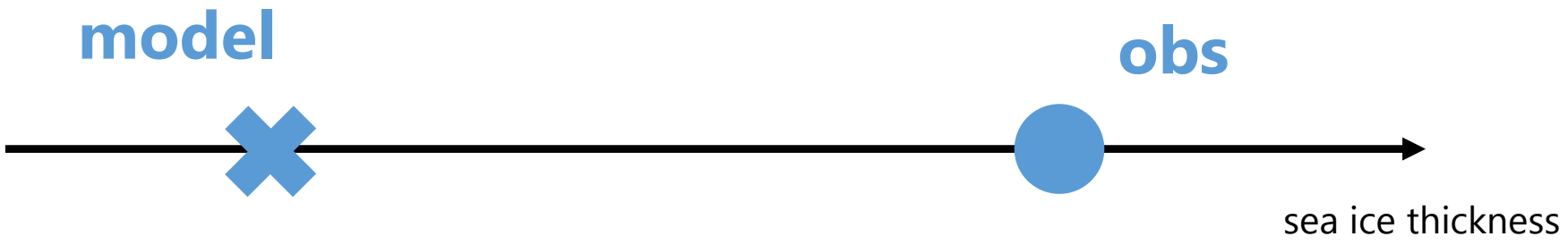
2 General remarks

1. **Converging to a common language.** One of the main obstacles between the "observer" and the "modeler" communities is that they do not speak the same "language". One example is the *ice age* viewed by a satellite (Fowler et al., 2004), which is often defined differently to that of a model (Lietaer et al., 2011; Hunke and Bitz, 2009). Another example is the *multiyear ice coverage*, which can differ substantially depending on whether it is calculated as an extent (with a cutoff value for ice concentration), or as an area (Jahn et al., 2012). Yet another example is the *mean ice thickness* in a grid box/area, which is not a precisely defined quantity unless the treatment of open water has been specified explicitly. We believe that addressing the question of terminology

Document issued after CliC Arctic Sea Ice Working Group meeting, Boulder, Nov. 2011


model
obs
sea ice thickness

Let’s list all the reasons why a model result and an observation could be different

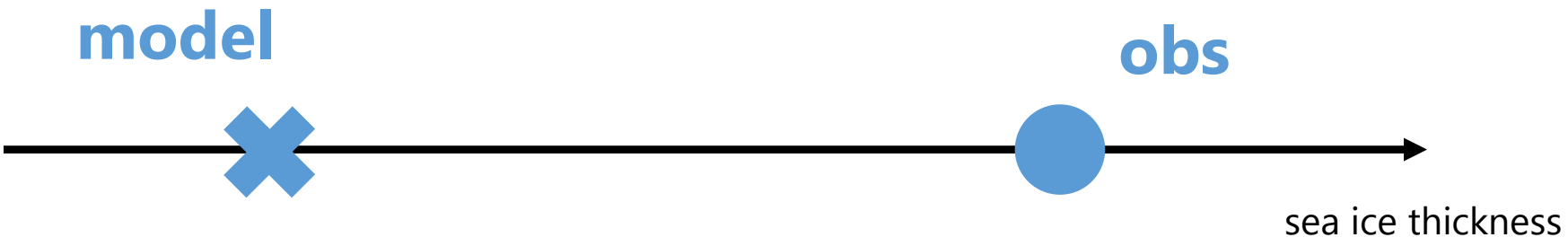


Let's list all the reasons why a model result and an observation could be different

1. The model is truly wrong

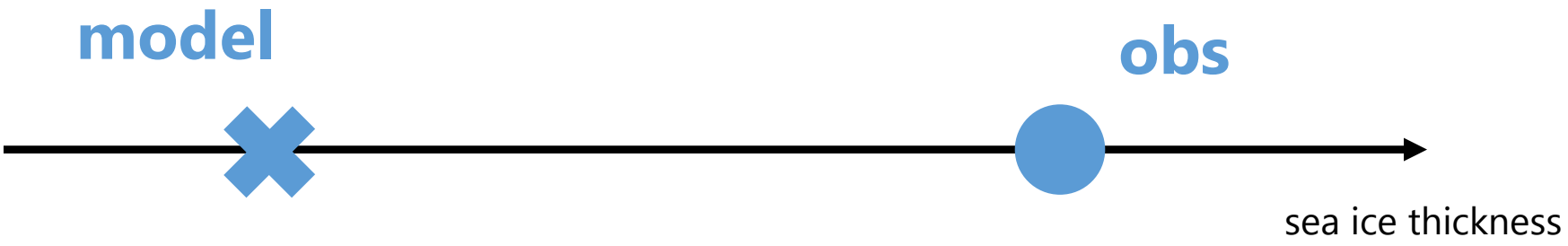
   Parameterizations induce biases, forcing is not correct

   Note: we never *validate* models. Sometimes, we are just not able to discard them (cf. Dirk Notz)



Let's list all the reasons why a model result and an observation could be different

1. The model is truly wrong
2. Variables are not defined consistently
   - Grid-cell average sea ice thickness versus in situ
   - Sampling issues in time and space (e.g., ASPeCT ship data)
   - Averaging and scaling issues (3-day ice displacement ≠ Sum of hourly displacements over three days)

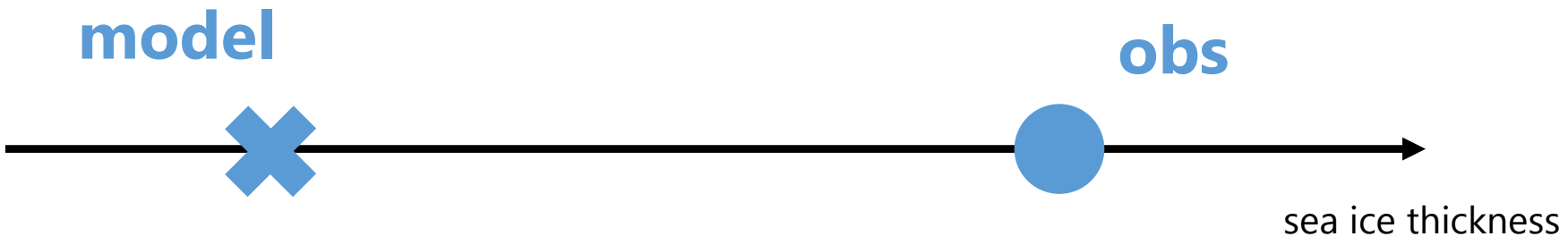


Let's list all the reasons why a model result and an observation could be different

1. The model is truly wrong
2. Variables are not defined consistently
3. Important assumptions are not necessarily verified

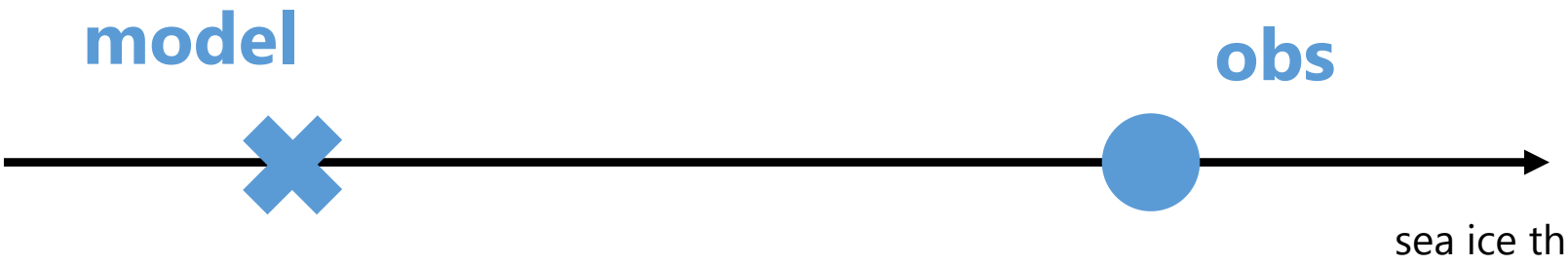
- Hydrostatic assumption: sea ice thickness retrieved from freeboard. Snow load and density are often assumed constant!

- Melt ponds are viewed as open water in some retrieval algorithms for sea ice concentration



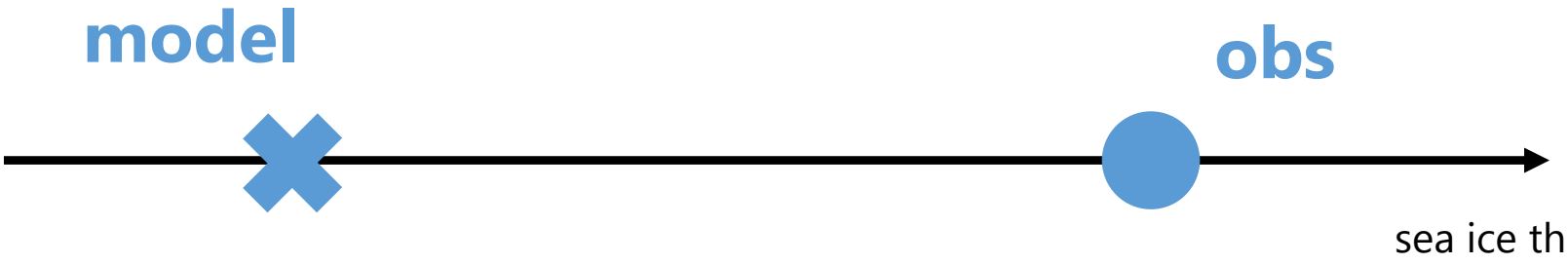
Let's list all the reasons why a model result and an observation could be different

1. The model is truly wrong
2. Variables are not defined consistently
3. Important assumptions are not necessarily verified
4. Observations have uncertainties (rarely reported though).
   - Instrumental error
   - Imprecision of algorithm.



Let's list all the reasons why a model result and an observation could be different

1. The model is truly wrong
2. Variables are not defined consistently
3. Important assumptions are not necessarily verified
4. Observations have uncertainties (rarely reported though).
5. The model is just not expected to reproduce this observation
    - Presence of internal variability. Now also for OGCMs!
    - Members, members, members.



Blending observers and modelers

- To avoid language issues: glossary?
- Standardize sea ice output (e.g. CMIP6), obs (e.g. ASPeCT)
- Read the god-damned meta-data!

Blending observations and models

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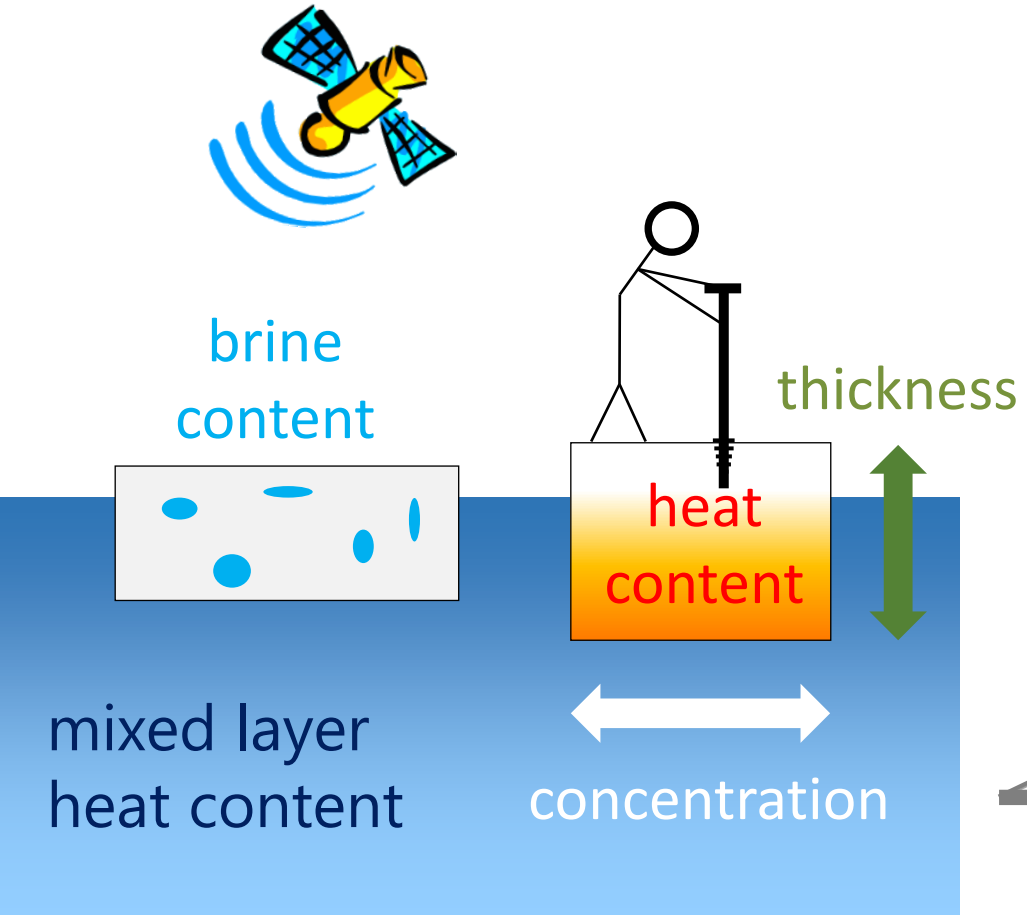
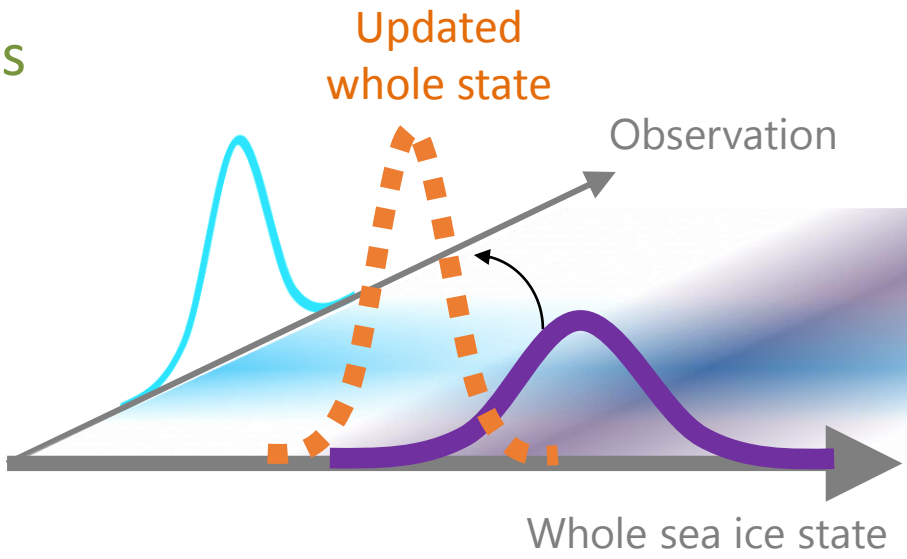
Data assimilation consists in optimally updating the whole sea ice state, given incomplete observations

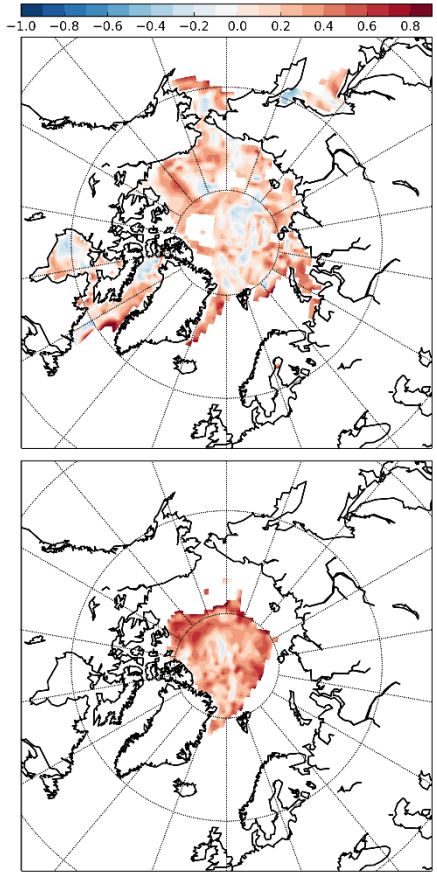




1. Run an *ensemble* of simulations and shake your model as much as you can

2. Look at relationships between « observables » and « non-observables »

Correlation (ice conc., snow thick.)



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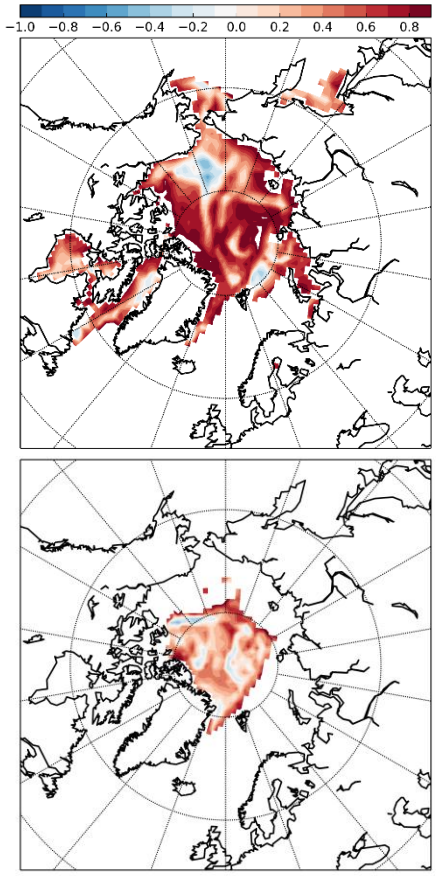

26th March 2012

27th September 2012

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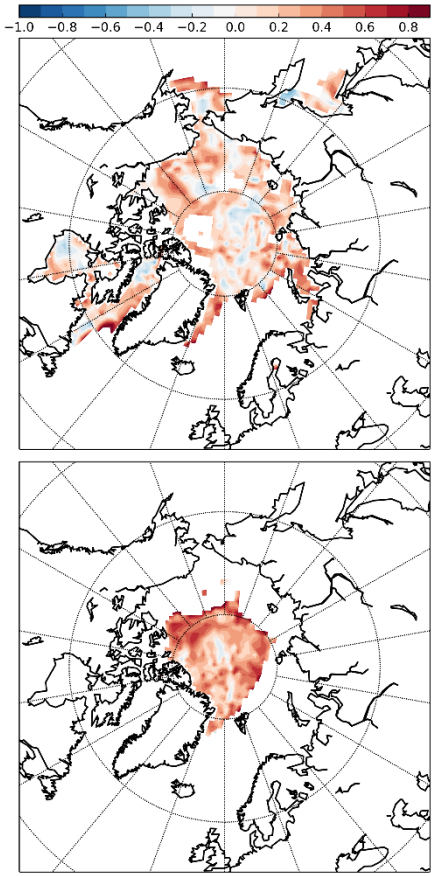

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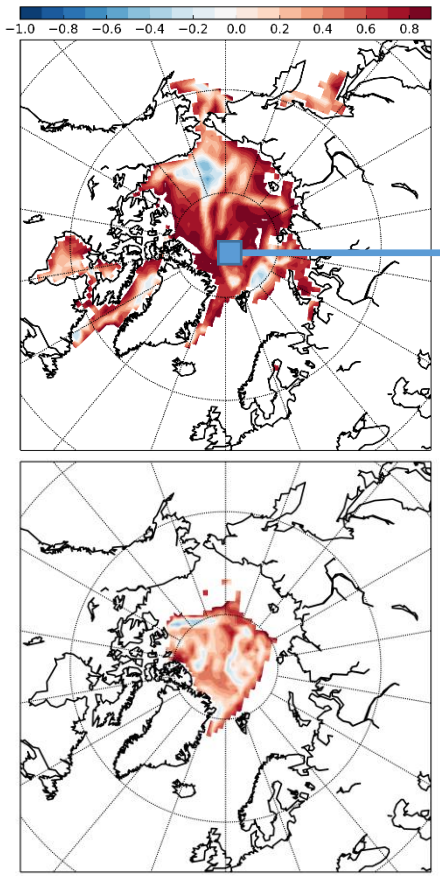
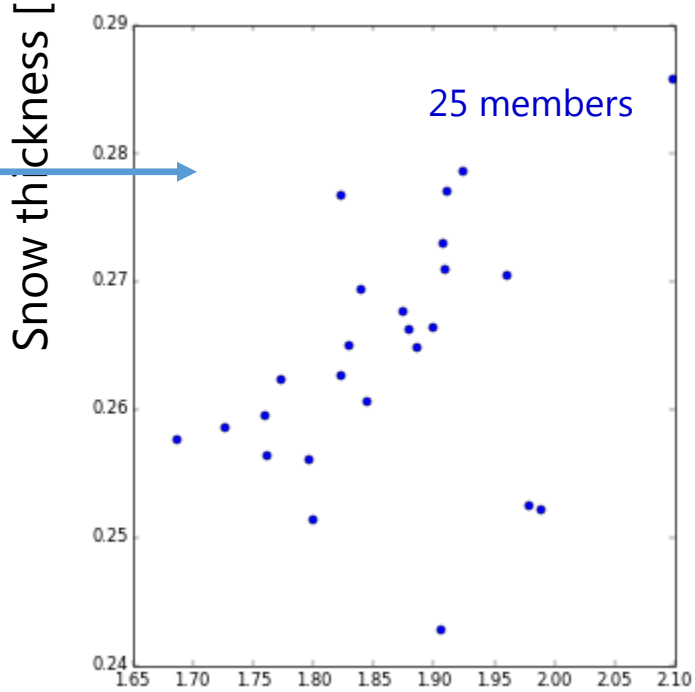


3. Update the *non-observable* (e.g. snow), given information on an observable (e.g. sea ice)



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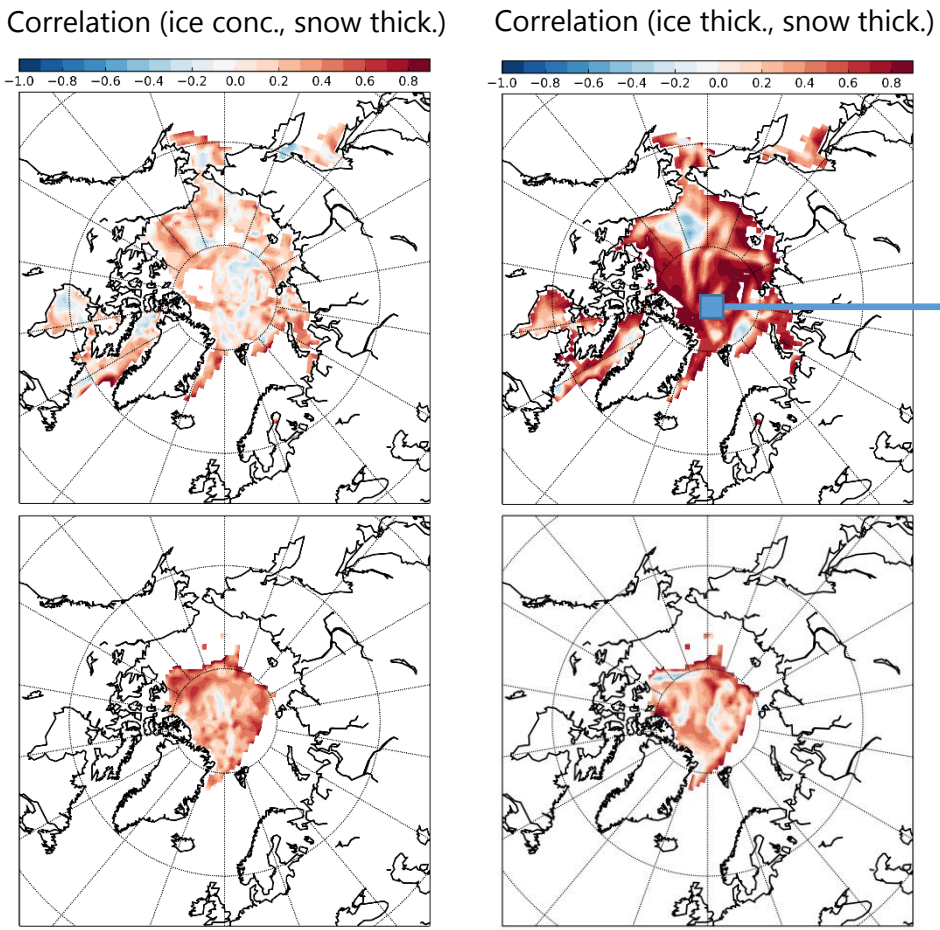

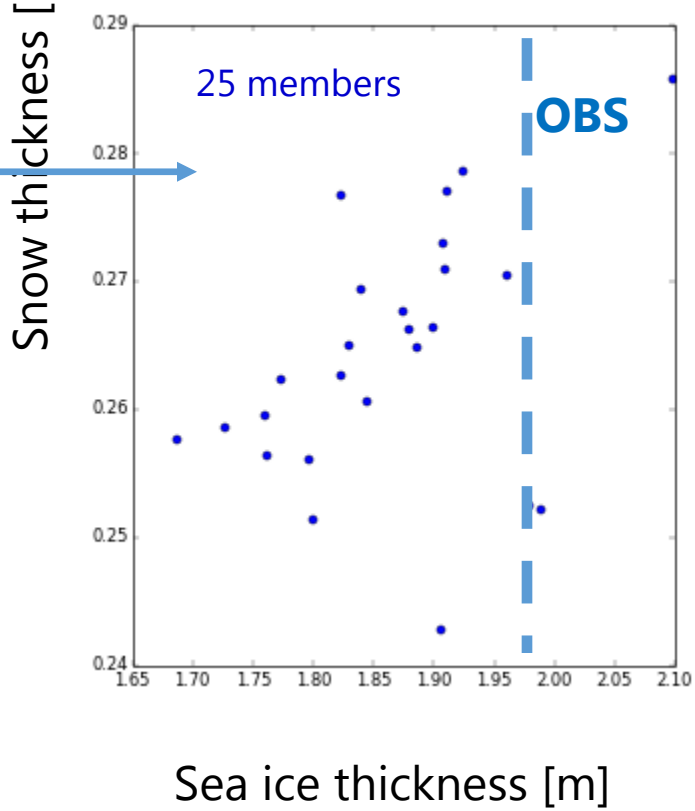

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Blending observations and models

- An ensemble allows to understand relationships among different variables
- More generally, a model can guide observations
- Data assimilation updates the whole model given incomplete observations

Thank you!

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