# Assisting the Design of the Arctic Observational Network by Quantitative Network Design (WP1, WP2, and WP4)

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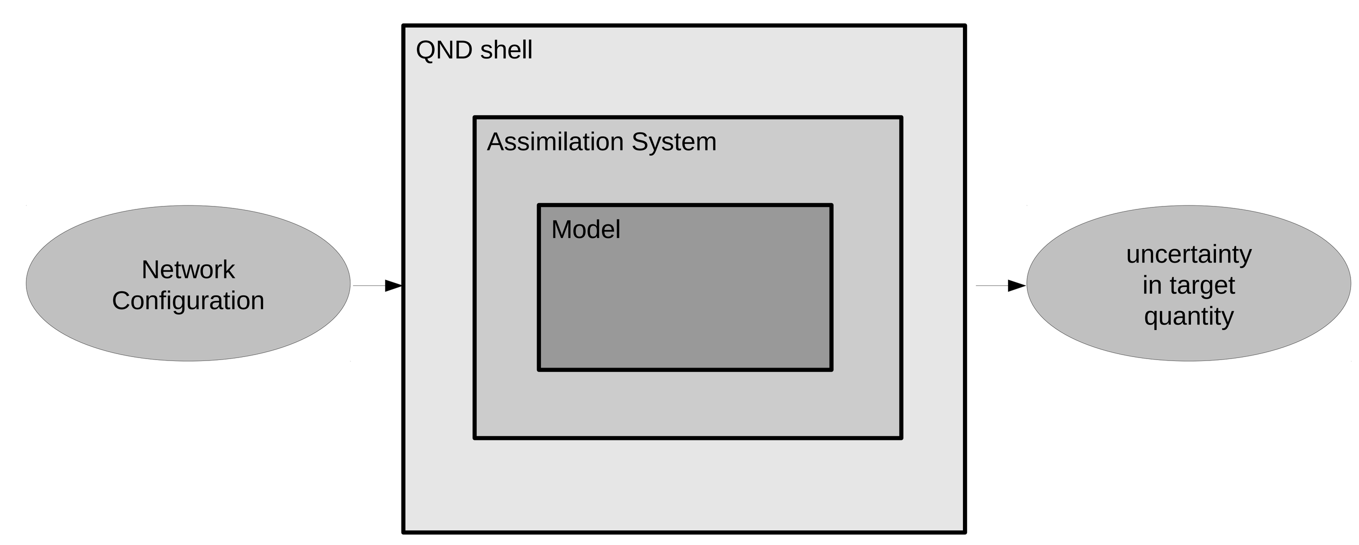
It is not clear how to best configure an observational network for the Arctic. The 'best' network will certainly depend on the question we want to answer. A typical question could be to reduce the uncertainty in a patricular target variable, such as ice thickness averaged over a given domain and a given period, which may well be in the future. Quantitative Network Design (QND) is a methodology that can help to devise a sampling strategy and assist observationalists in the planning of the campaigns or space agencies in the planning of their missions. We have established a prototype of a QND system for the Arctic and show sample applications. All results are very preliminary and need to be confirmed by a more mature version of the QND system

## METHOD:

Our QND system (Kaminski and Rayner, 2009; Kaminski et al., 2012) consists of multiple levels:

- In the core there is a model of the coupled Arctic ocean sea-ice system (NAOSIM, Kauker et al., 2003)
- The second layer is an advanced assimilation system around the model (NAOSIMDAS, Kauker et al., 2010).
- A QND shell that allows to evaluate potential networks within NAOSIMDAS in terms of the uncertainty reduction (relative to uncertainty from prior information, i.e. without observations) they provide on selected target quantities

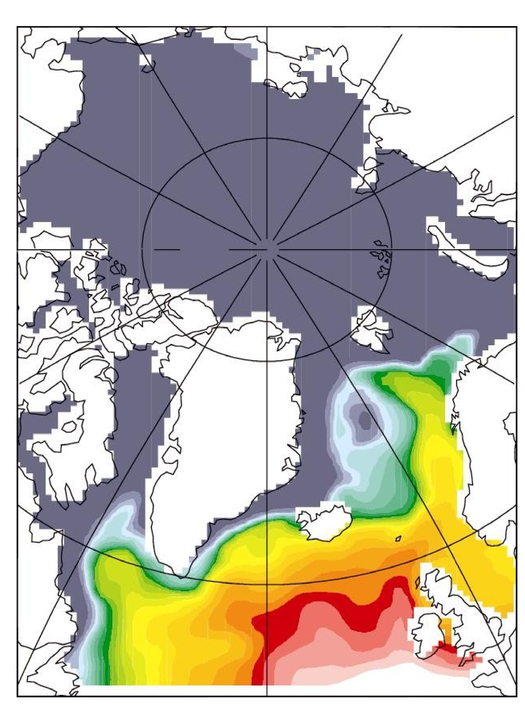



## Prototype:

A prototype is ready and will be extended step by step

- covers Arctic and North Sea (>54 N), see Figure
- coarse 2 x 2 resolution
- short control vector:

1) initial temperature ocean
2) 2-meter atmospheric temperature
3) surface wind stress, x direction
4) kappa_m (constant in ocean model)
5) kappa_h (constant in ocean model)
6) pstar (constant in ice model)
7) h0 (constant in ice model)



Available Data Streams:

- a: ice concentration
- h: ice thickness
- hsn: snow thickness

All data streams available

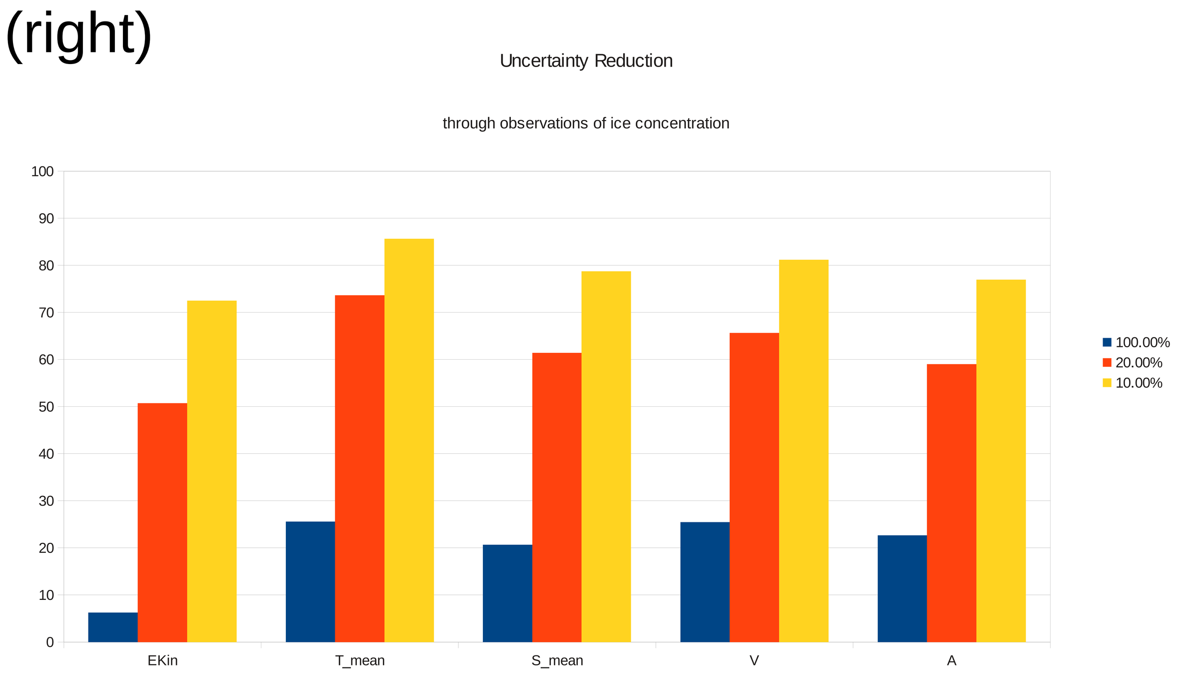
- over each model grid cell
- for each day in January
- with variable data uncertainty

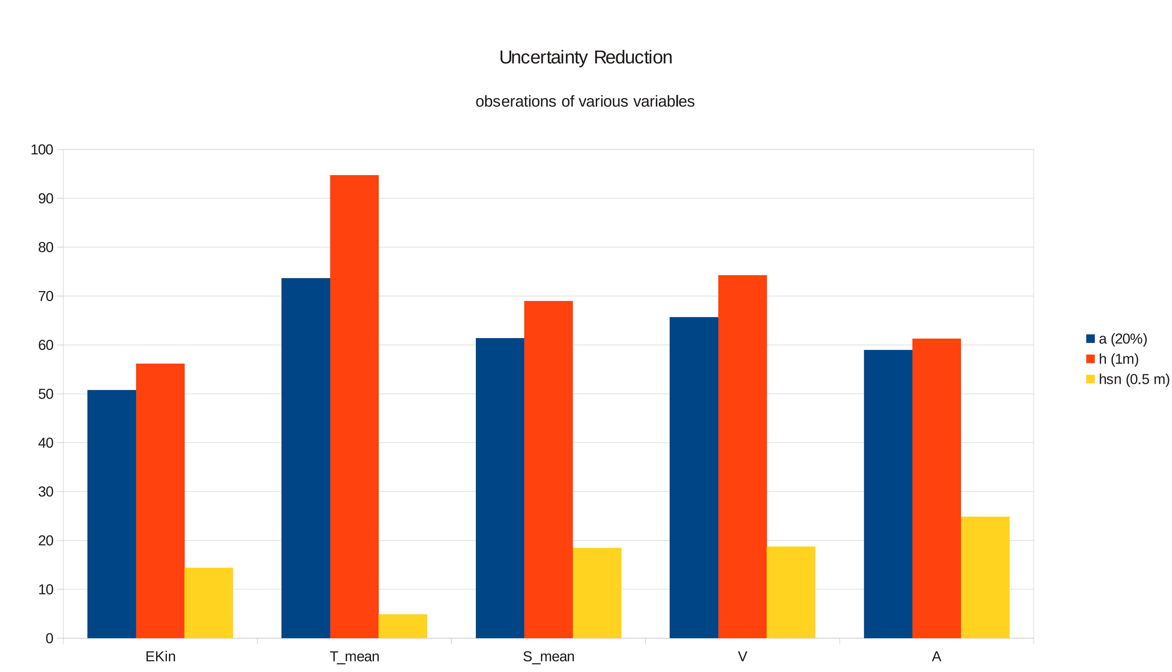
Available Target Quantities (January 2010 average):

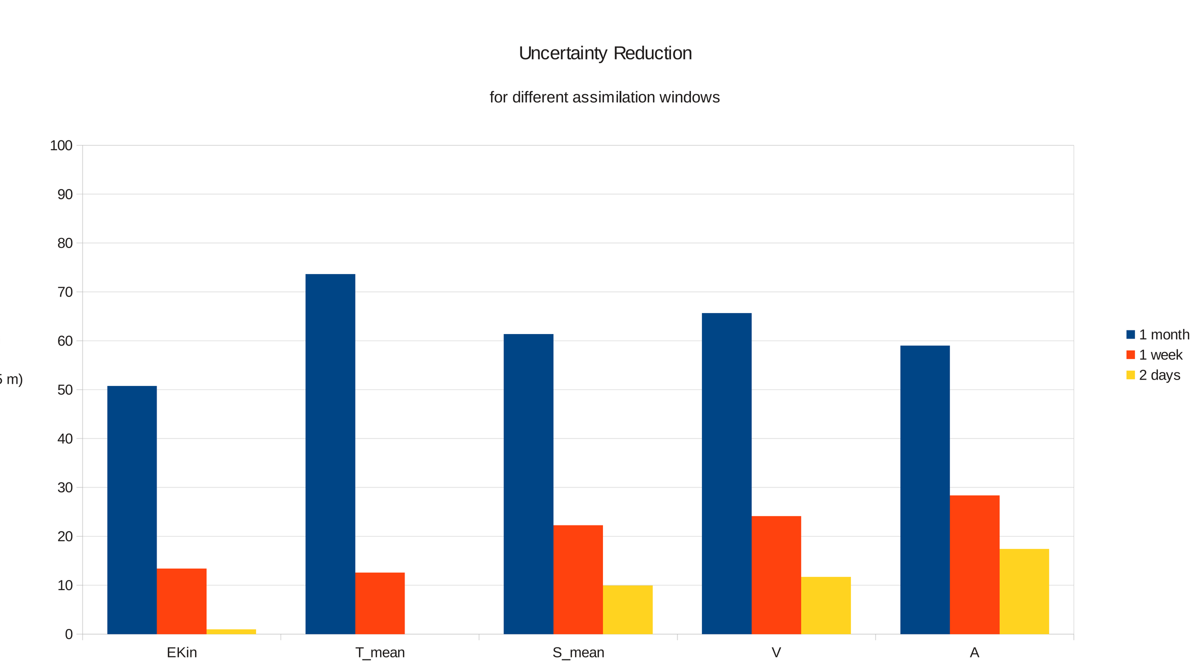
- Ekin: average ocean Kinetic Energy
- T_mean: mean ocean temperature
- S_mean: mean ocean salinity
- V : integrated ice volume
- A : integrated ice area

## Impact of Satellite Products:

Assuming an observation over any model grid cell. Impact on data uncertainty (left) of h, of observed variable (middle), length of sampling (right)

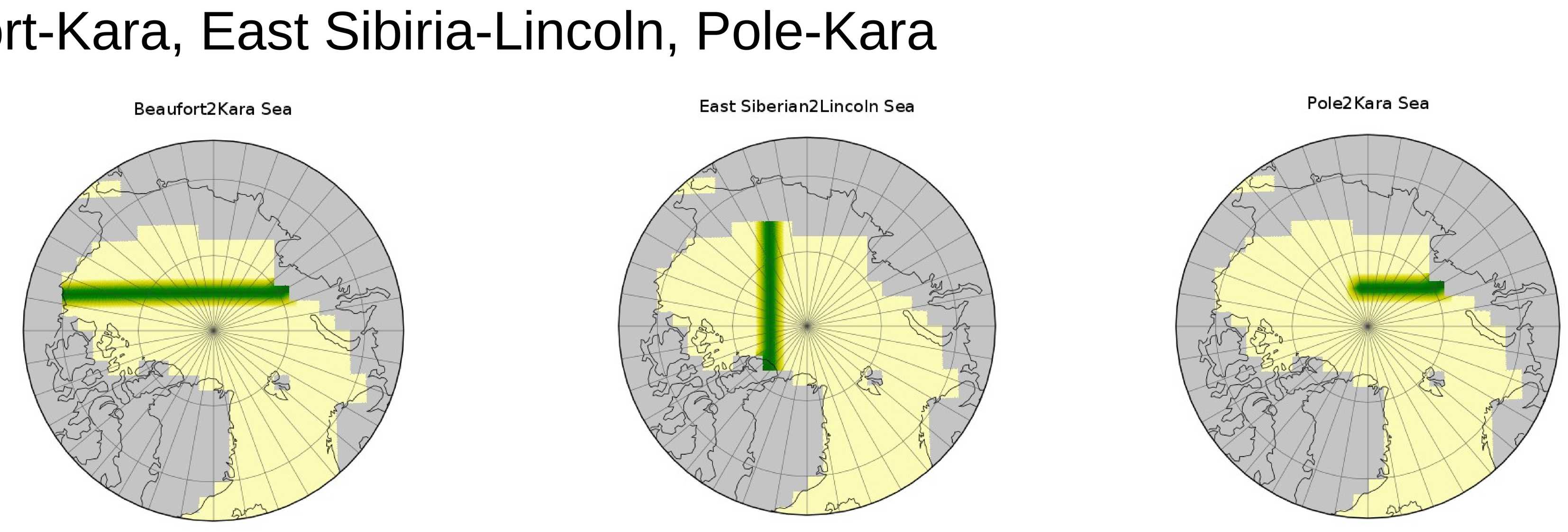


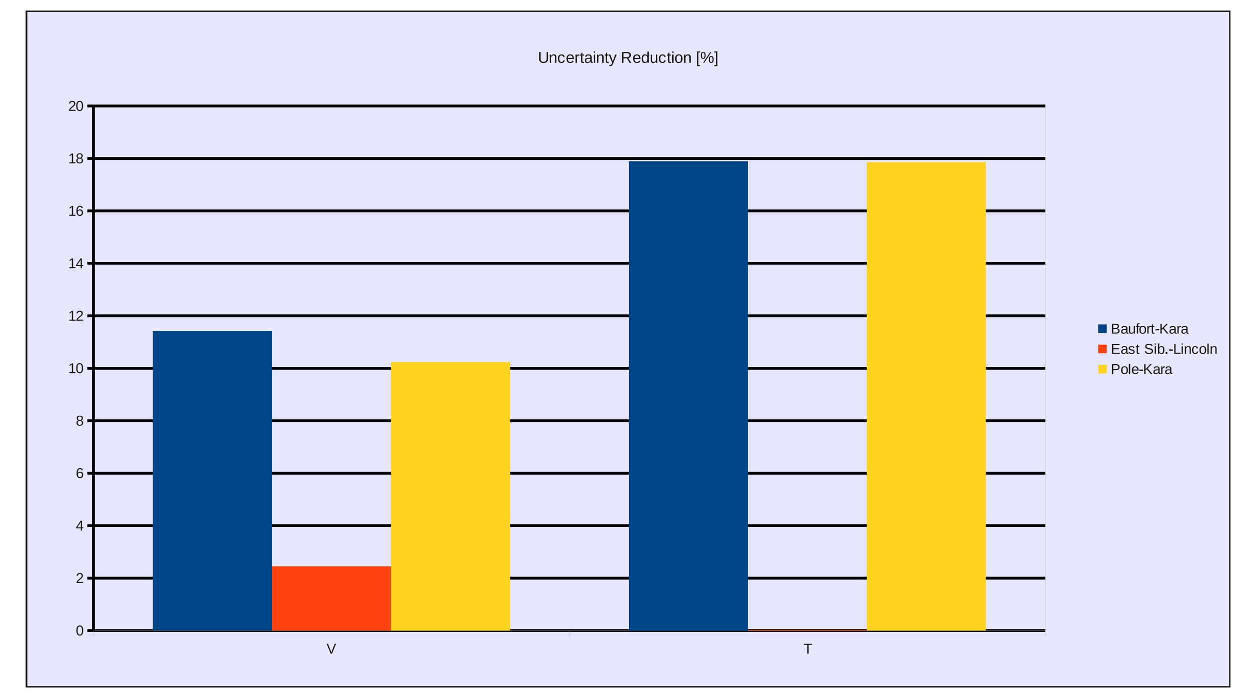




## Impact of airborne observations

Sampling of h and hsn at sections defined in the Figure below (from left to right) Beaufort-Kara, East Sibiria-Lincoln, Pole-Kara

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