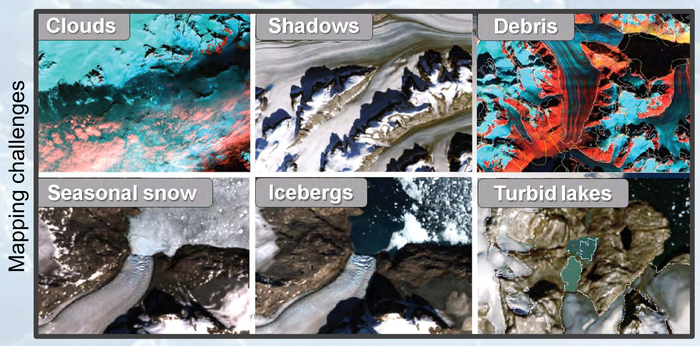
The first complete glacier inventory for entire Greenland

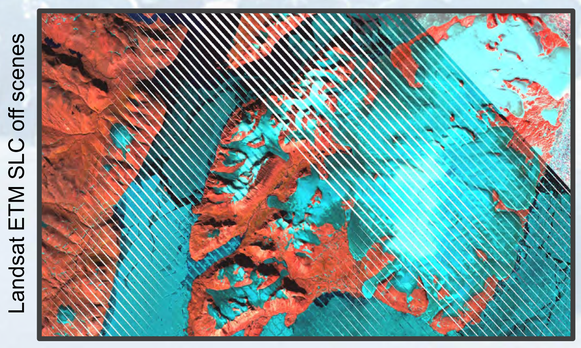
Philipp Rastner[1], Tobias Bolch[1,2], Nico Mölg[1], Horst Machguth[1,3], Frank Paul[1]
[1]Department of Geography, University of Zuerich, Switzerland
[2]Institute for Cartography, Technische Universität Dresden, Germany
[3]Marine Geology and Glaciology, Geological Survey of D. and Gl. – GEUS, København, Denmark

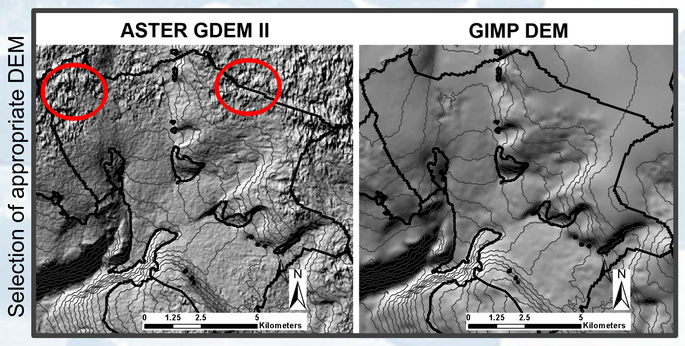
1. Abstract

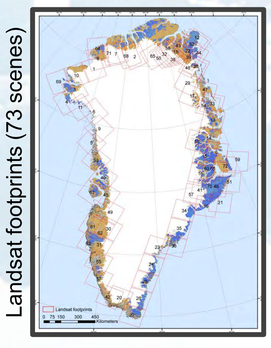
Meltwater from glaciers and icecaps (GIC) is a significant contributor to global sea-level rise, but estimates are uncertain due to incomplete information about glacier location and size, as well as large uncertainties in future climate evolution. The GIC on Greenland were one of the regions with largely lacking information. Within the EU FP7 project ice2sea and the ESA project Glaciers_cci we created a detailed inventory of all GIC on Greenland using Landsat TM/ETM+ imagery, the DEM-, and parts of the outlines from the Greenland ice mapping project (GIMP) in the very far north . A major challenge in this regard is the application of a consistent strategy to separate the local GIC from the ice sheet. For this purpose we have defined different levels of connectivity (CL). Considering only GIC larger than 0.05 km², all CL0 and CL1 GIC amount to 18'426 entities with a total area of about ***89'273 ±2767 km²***. Including also CL2 to the local GIC adds 1855 entities and ***40'710 ±1262 km²*** (the total is then ***129'983 ±4029 km²***). The area of the ice sheet is ***1'719'207 km²*** in the former and ***1'678'500 km²*** in the latter case. The entire ice-covered area on Greenland is thus ***1'808'480*** **km²**.

2. Challenges



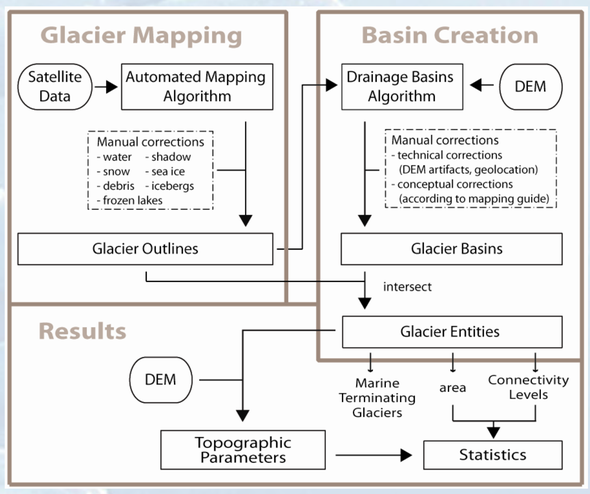






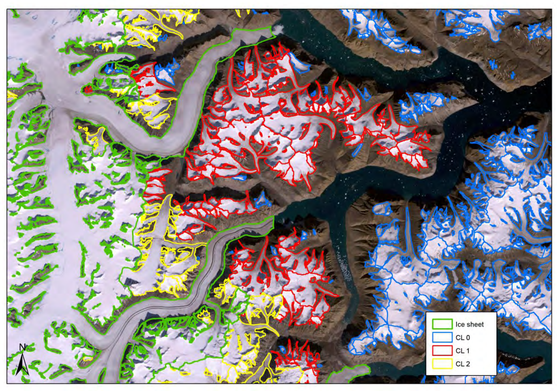
3. Methods

3.1 Workflow



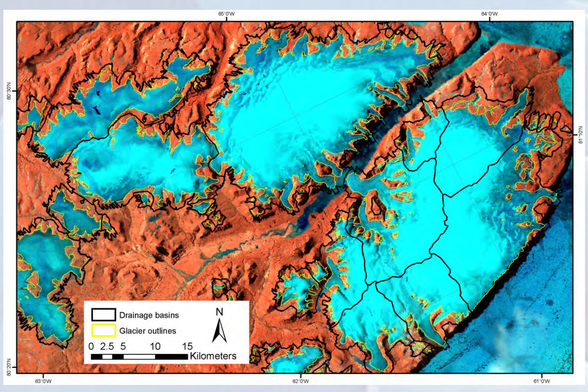
3.2 Assignments of connectivity levels to local GIC:

-**CL0:** no connection
-**CL1:** weak connection (clearly separable by drainage divides in the accumulation region, not connected or only in contact in the ablation region)
-**CL2:** strong connection (difficult to separate in the accumulation region or joint flow in the ablation region)

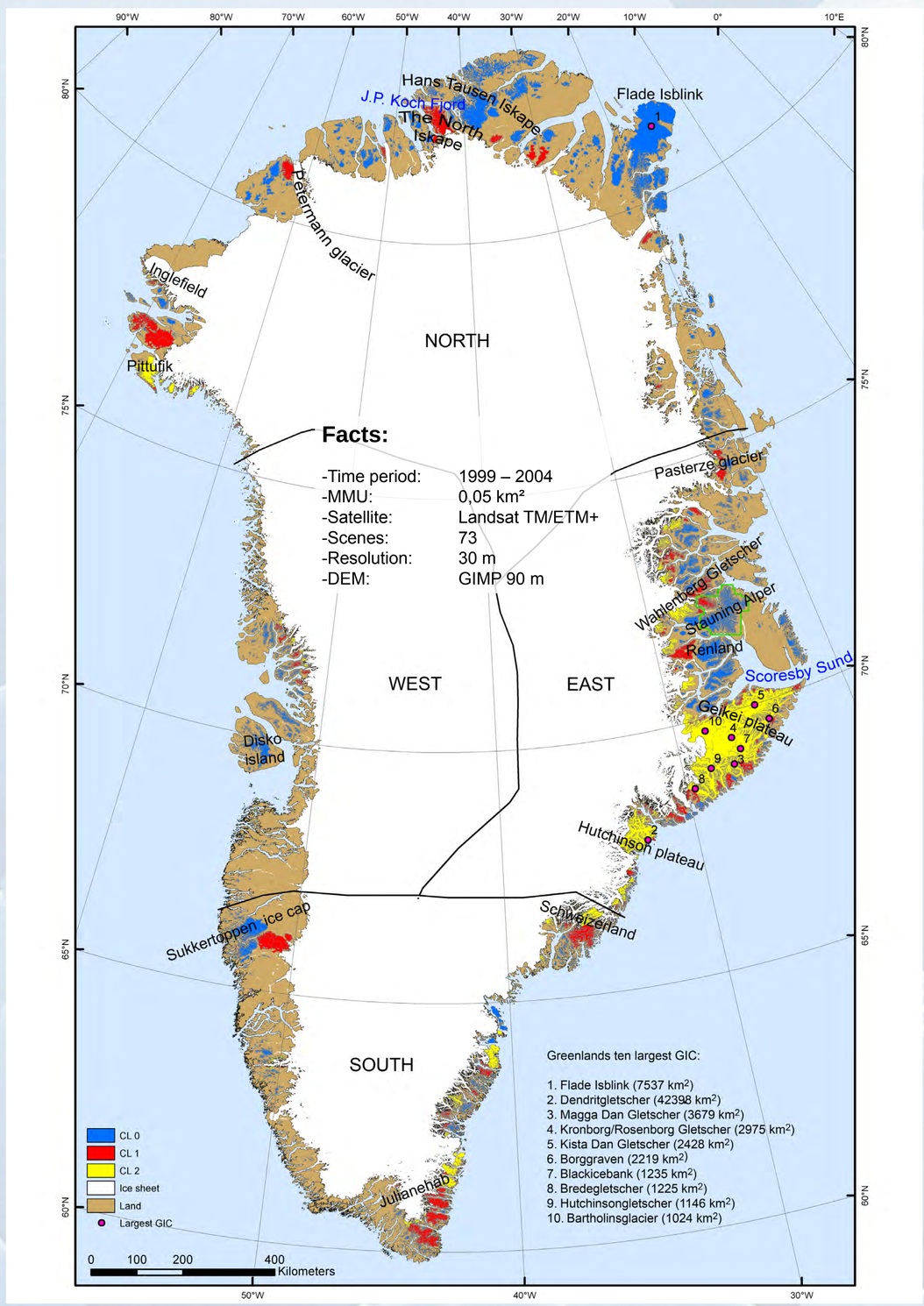


3.3 GIC separation rules:

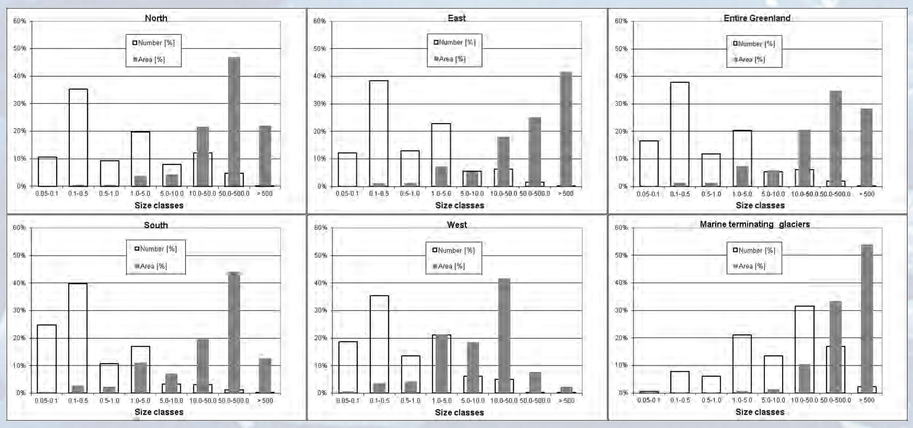
-**GIC rule I:** Divide an ice cap only when it has prominent outlet glaciers and at least some topographic variability in the accumulation area.
-**GIC rule II**: If one outlet glacier is separated, the entire icecap has to be divided into entities.
-**GIC rule III:** For ice caps and glacierized mountain flanks, the smallest number of entities should be assigned, only considering the most prominent topographic divides.



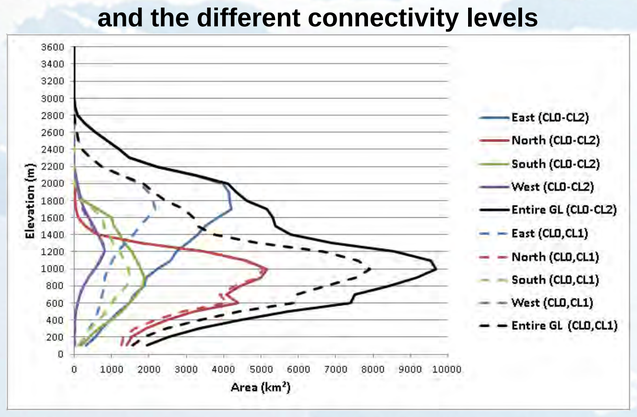
4. Results



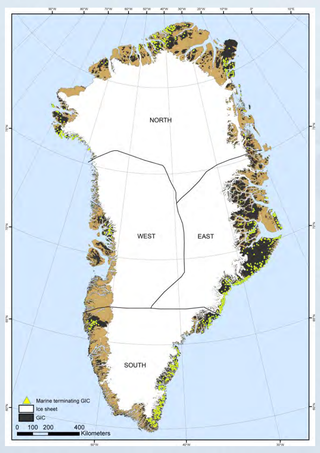
4.1 Number of glaciers and area covered per size class and per region



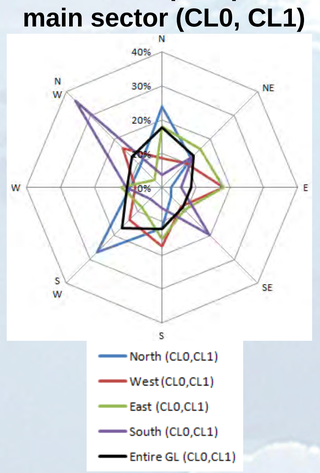
4.2 Area-elevation distribution for all sectors and the different connectivity levels



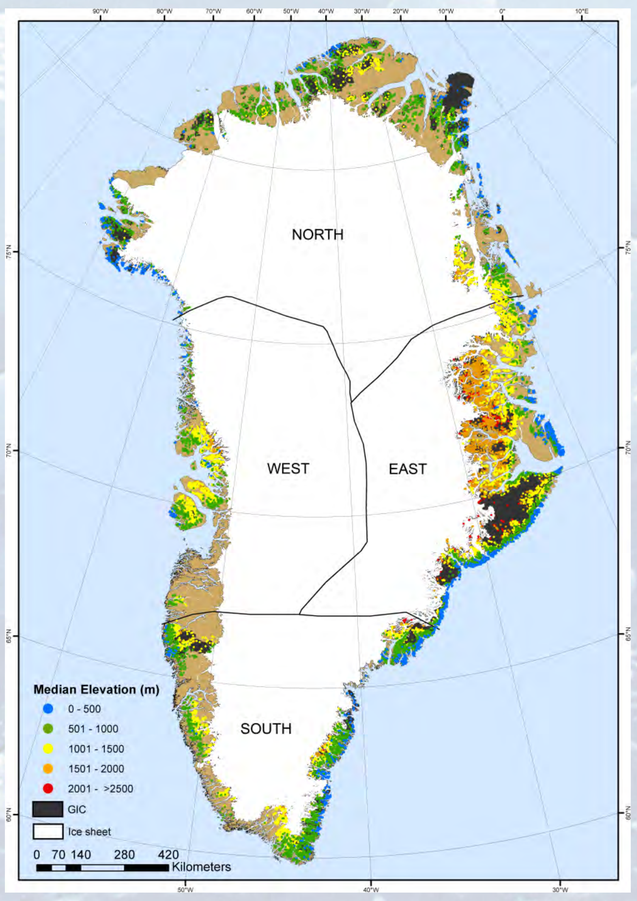
4.3 Identified marine terminating glaciers



4.4 Area distribution versus aspect per main sector (CL0, CL1)



4.5 Color coded median-elevation



www. glaciers-cci.org
www. ice2sea.eu

Contact: philipp.rastner@geo.uzh.ch

Estimating the future contribution of continental ice to sea-level rise.
A programme of research funded by the European Union Framework 7 Programme. 2009 – 2013