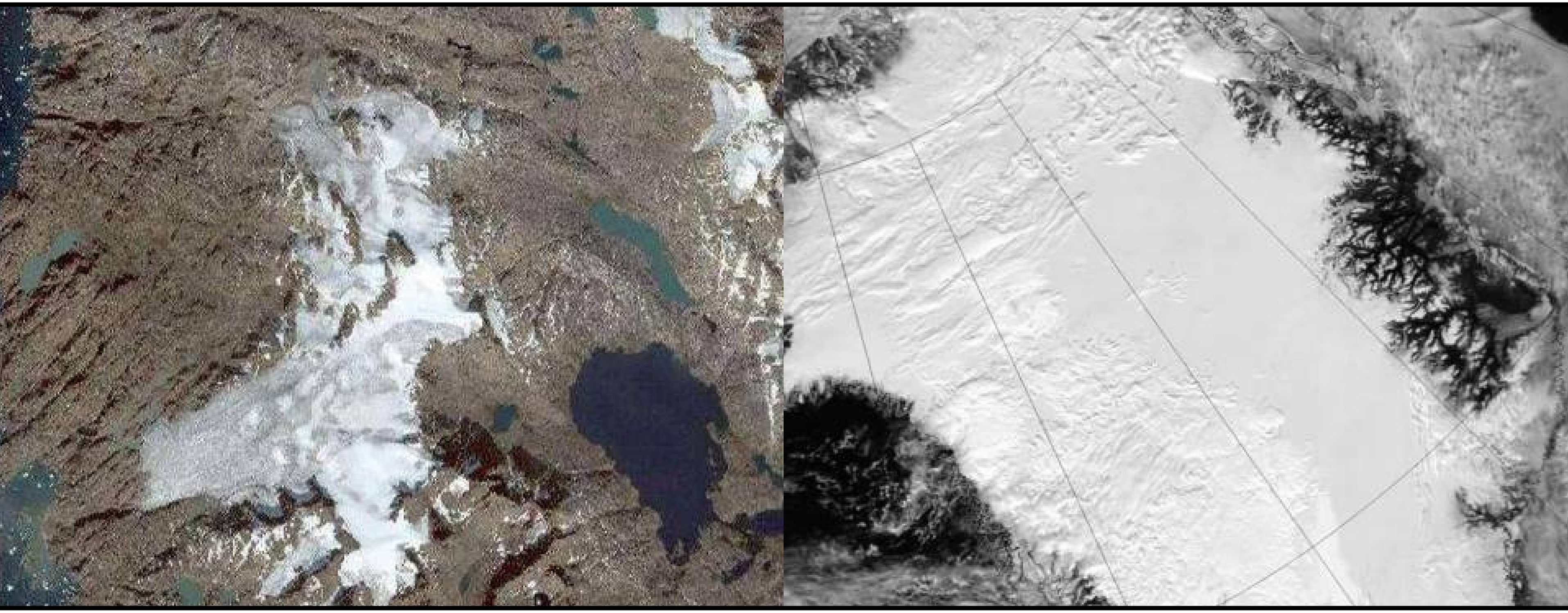
Simulated runoff from a Peripheral Glacier and Greenland Ice Sheet



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Colorado State University

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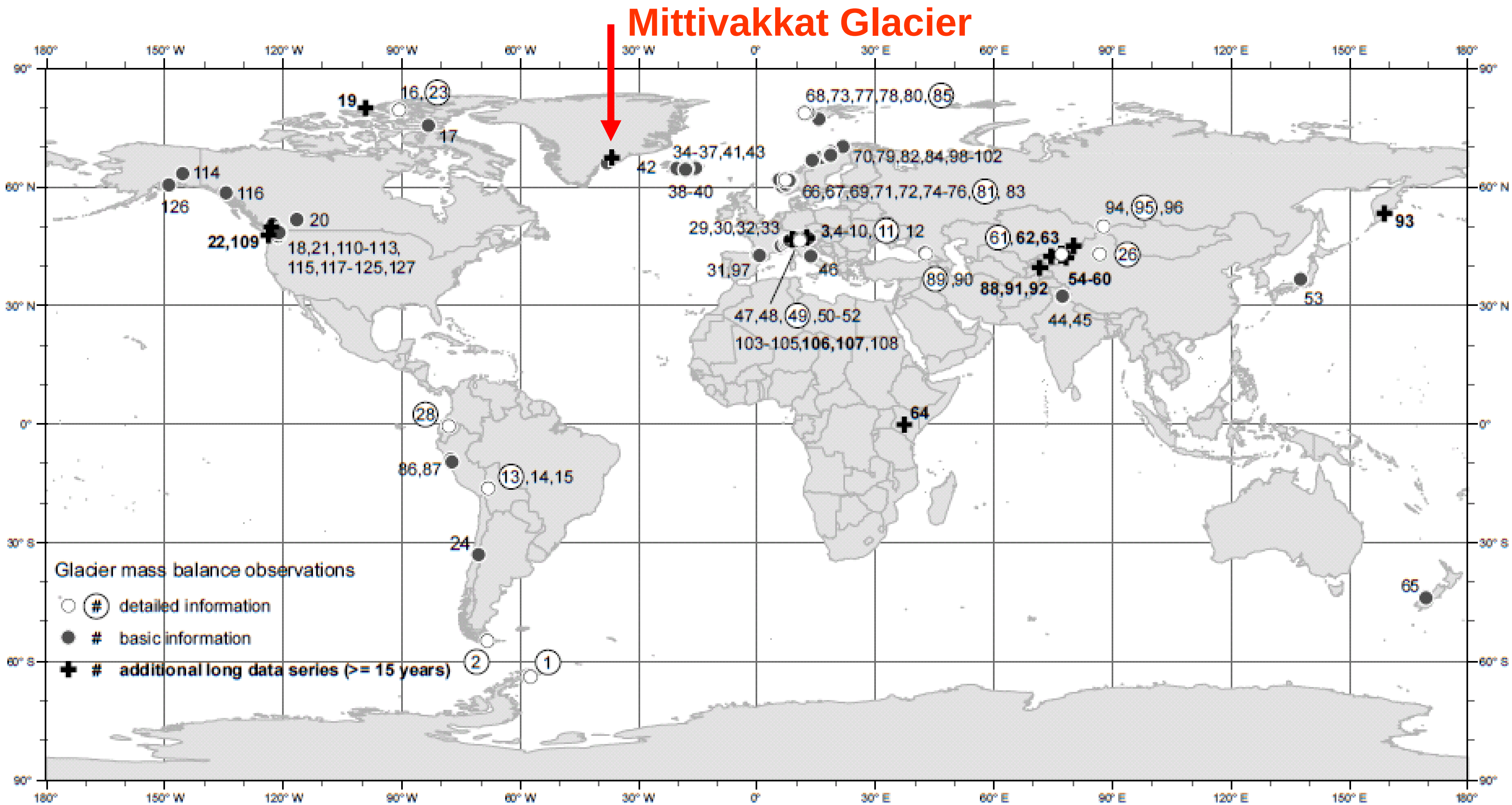
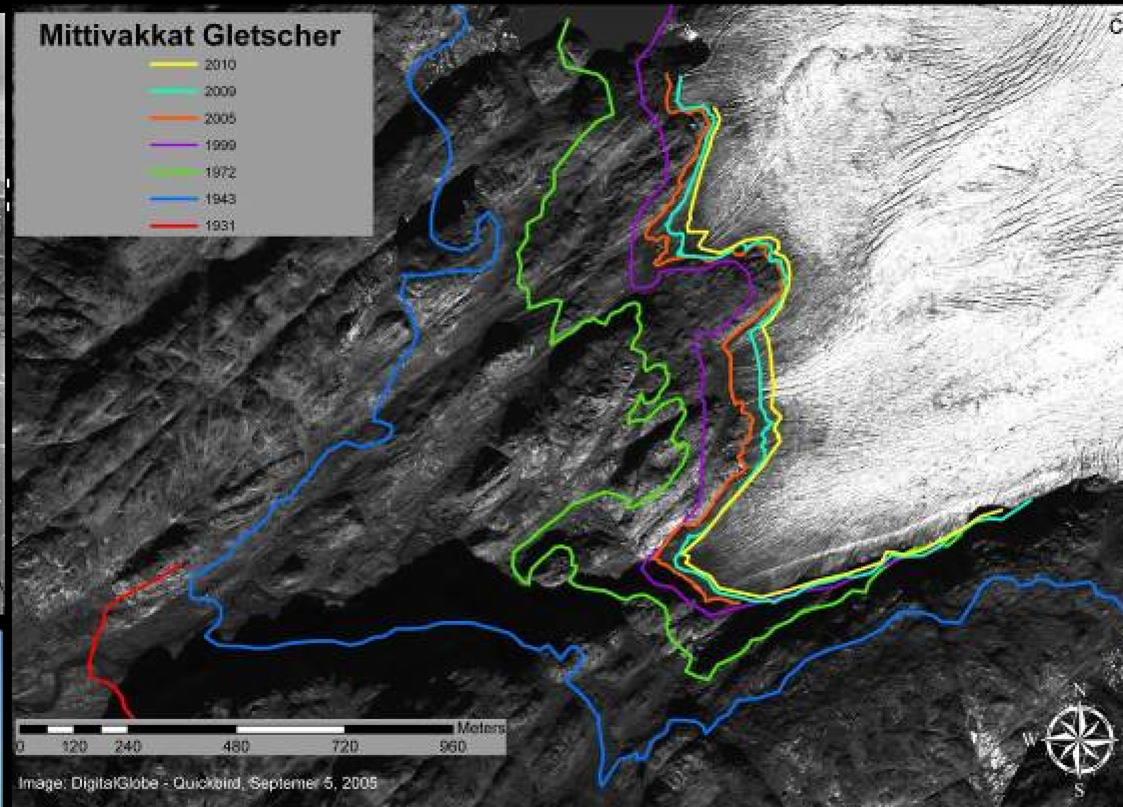
Locations of local glaciers with mass balance observations:



Source: World Glacier Monitoring Service 2009

Local glacier mass loss (Mittivakkat Glacier):

Source: B. Hasholt, University of Copenhagen.



Source: Mernild et al. review

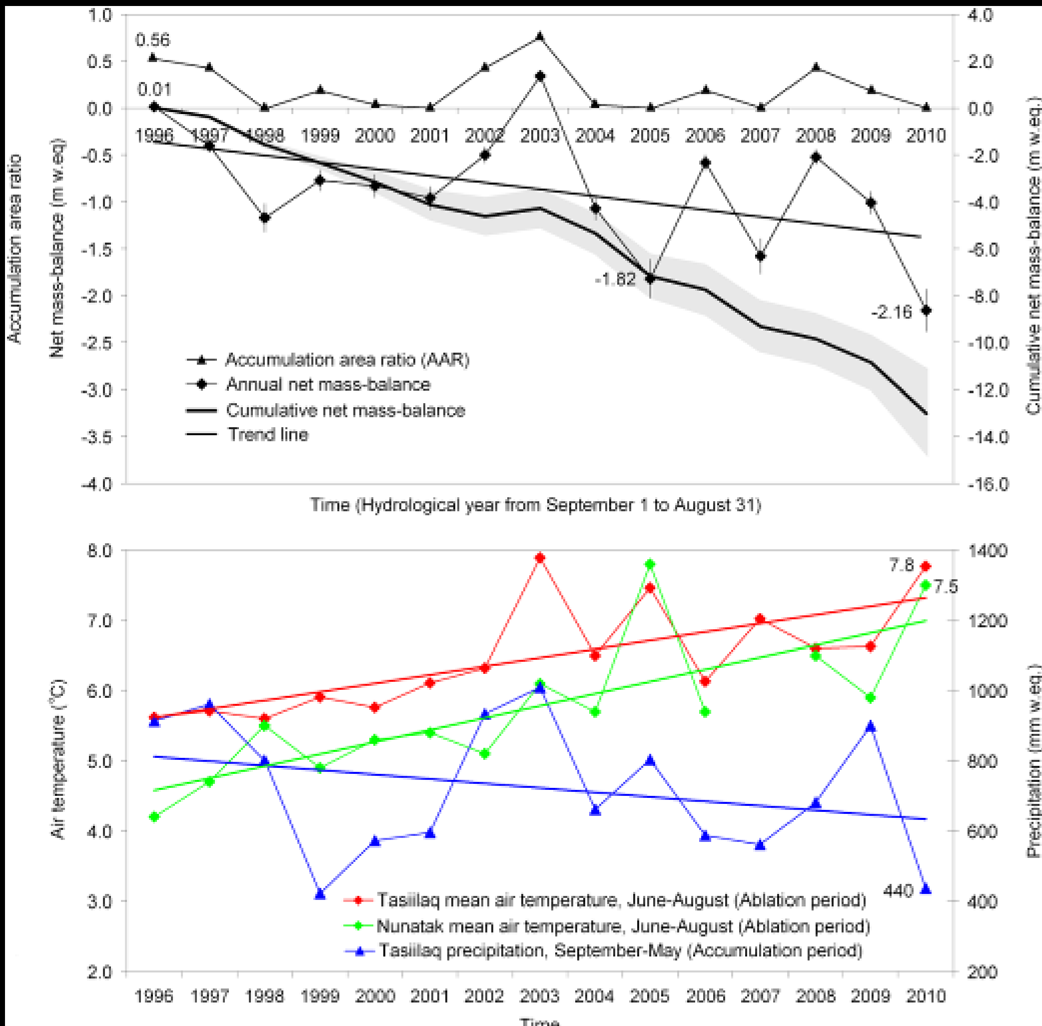
The only local glacier in Greenland where long-term observations of both surface mass balance and glacier front fluctuations are available: since 1931, the glacier terminus has retreated by about 1300 m.

Average retreat ~16 m yr^{-1}; in 2009/10 ~30 m

2009/10 average terminus melt rate 4.5 to 5.2 m, twice the average value of approximately 2.5 m.

Local glacier runoff observation (Mittivakkat Glacier):

Local glacier mass loss (Mittivakkat Glacier):



Source: Mernild *et al.* review

In 13 of the last 15 years, the MG had a negative surface mass balance,

Greatest annual mass loss in 2009/10 of 2.16 m w.eq.

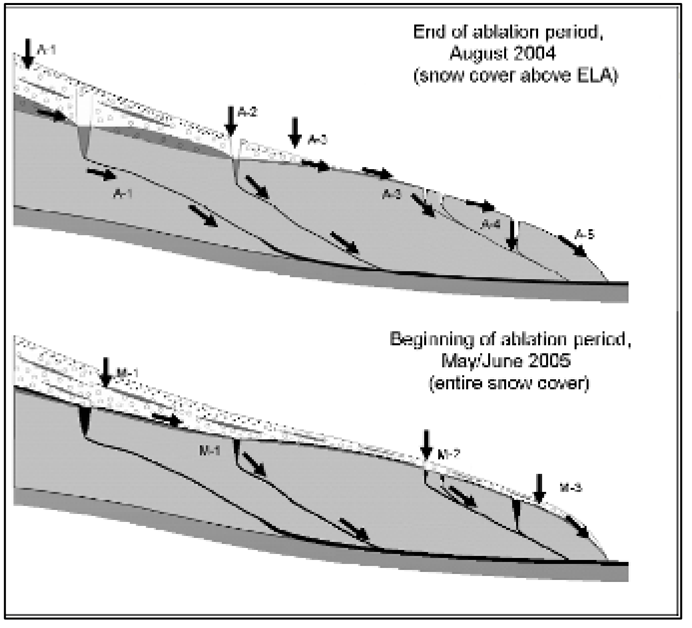
Since 1995 the MG is significantly out of equilibrium and will likely lose approximately 60% of its area and 70% of its volume, even in the absence of further climate change.

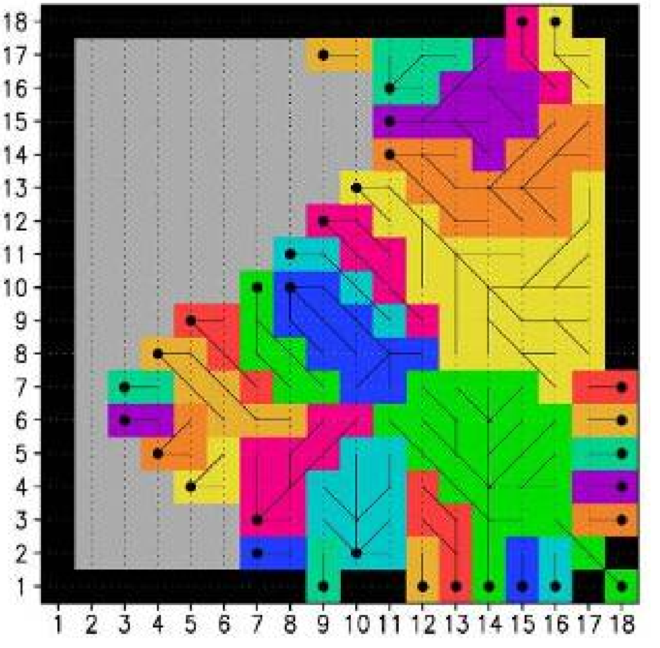
Bahr *et al.* (2009): Global average, glaciers and ice caps must lose at least 27% of their volume (the equivalent of an 18-cm rise in global average sea level) to return to equilibrium.

(a_r=AAR/AAR_0, where $p_s=a_r-1$ and $p_v=a_r^g-1$, where p_s is the fractional area change, p_v is the fractional volume change, and g=1.36 is an empirical constant

MG is representative of many hundreds of local glaciers found in East Greenland outside the Greenland Ice Sheet, and these observations quantitatively document the general retreat of local glaciers in Southeast Greenland under ongoing climate warming.

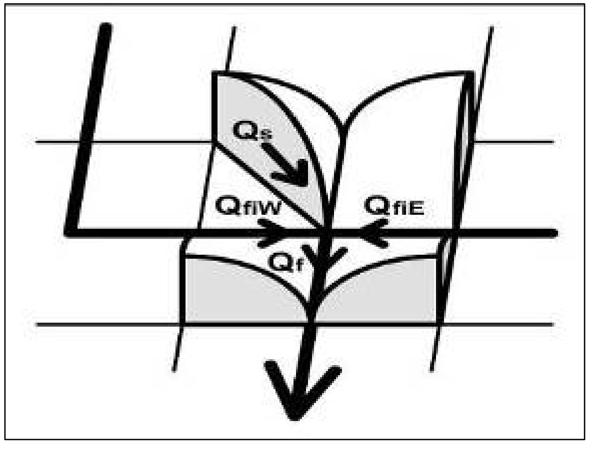
Runoff simulations, IceHydro



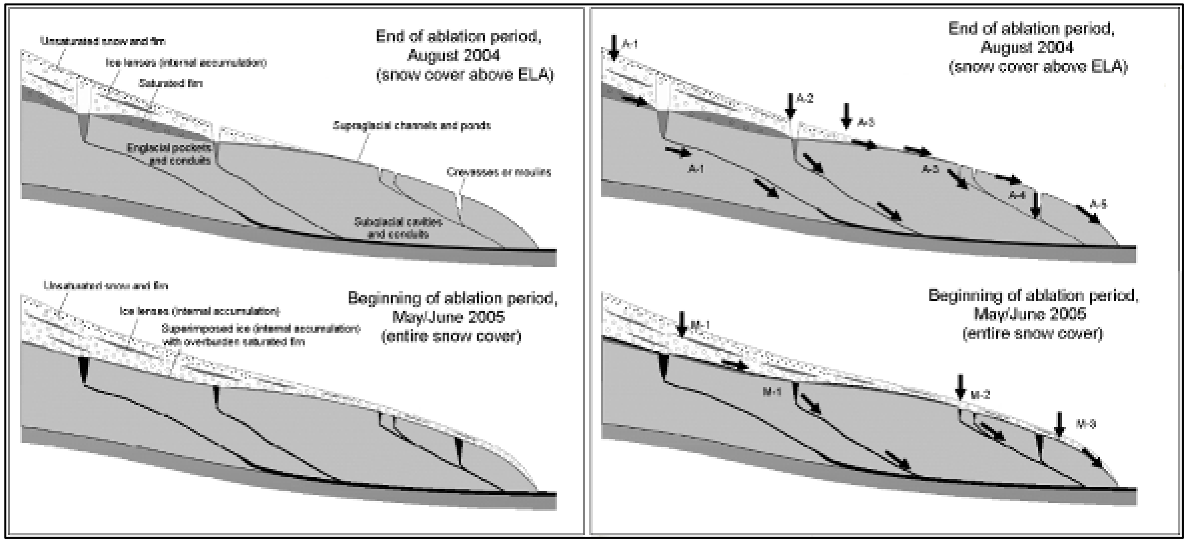


IceHydro assumes there are two runoff components within each model grid cell:
- a slow-response runoff (snow/firn), and
- a fast-response runoff (glacier ice).

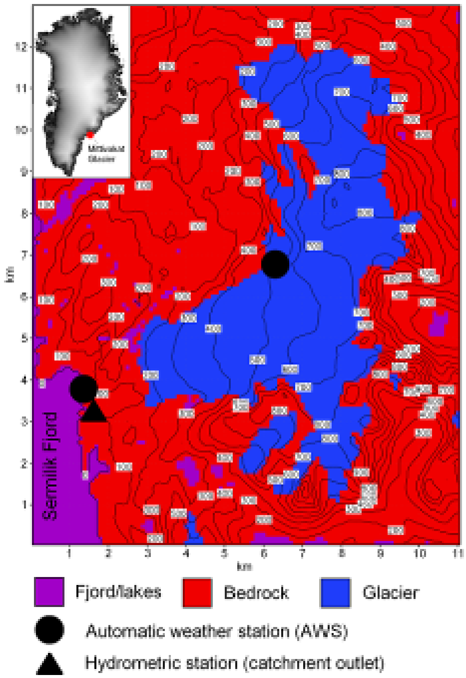
Each of these runoff components have different time scales associated with them.

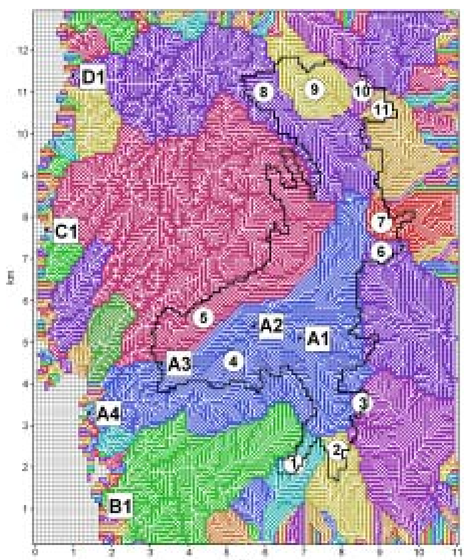


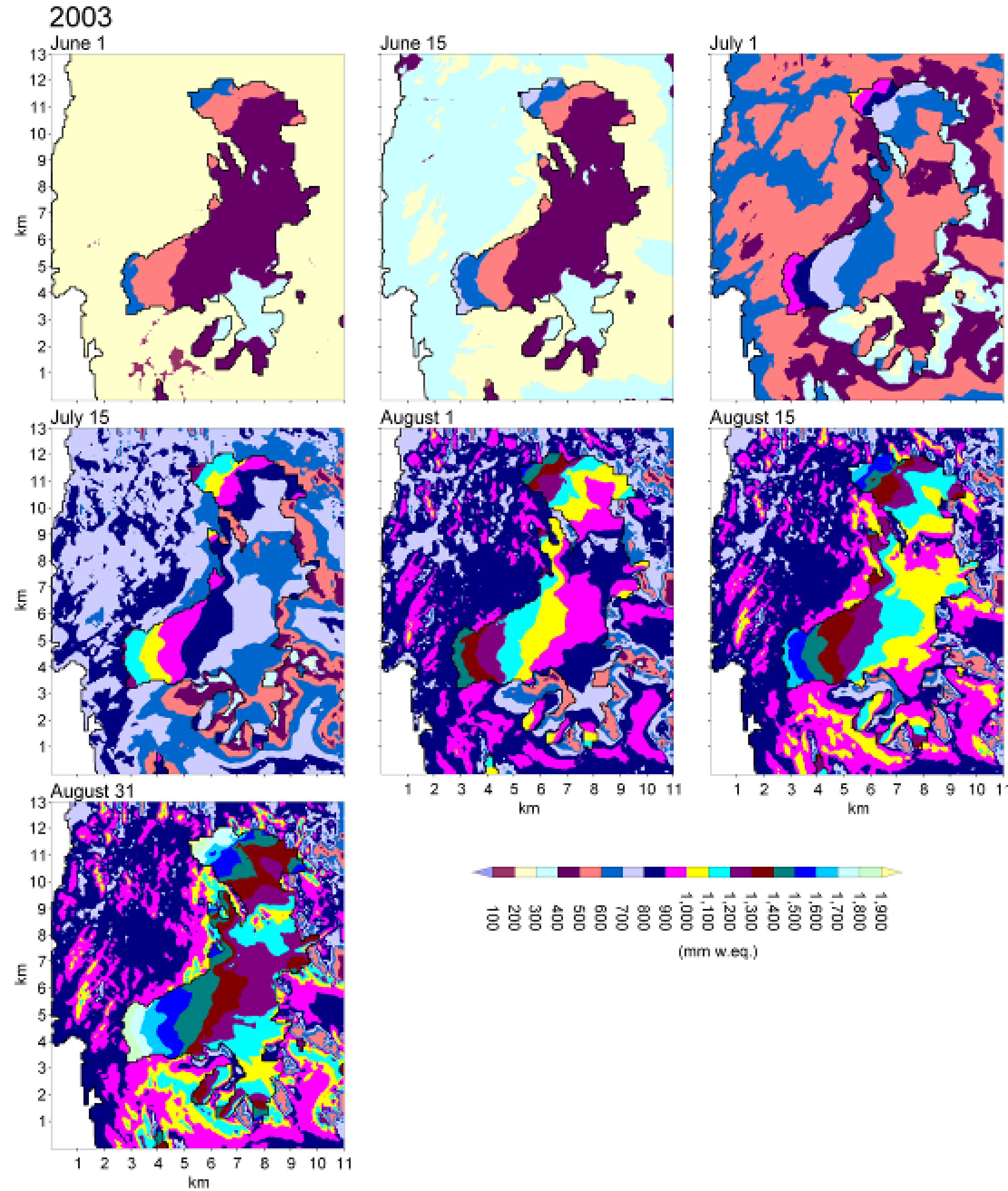
Runoff simulations, IceHydro (estimating flow velocity)



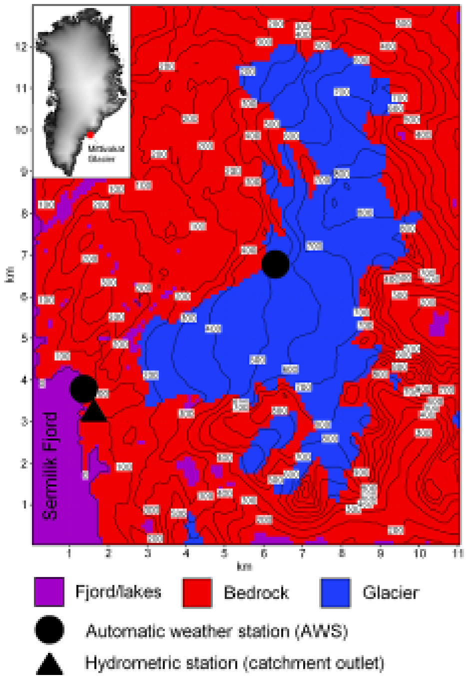
Runoff from glaciated and non-glaciated areas, peripheral to the ice sheet

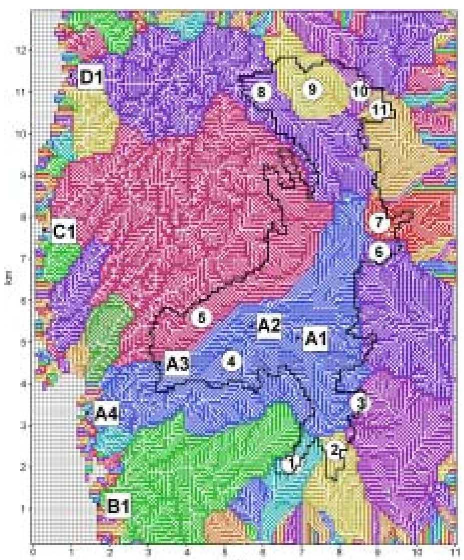


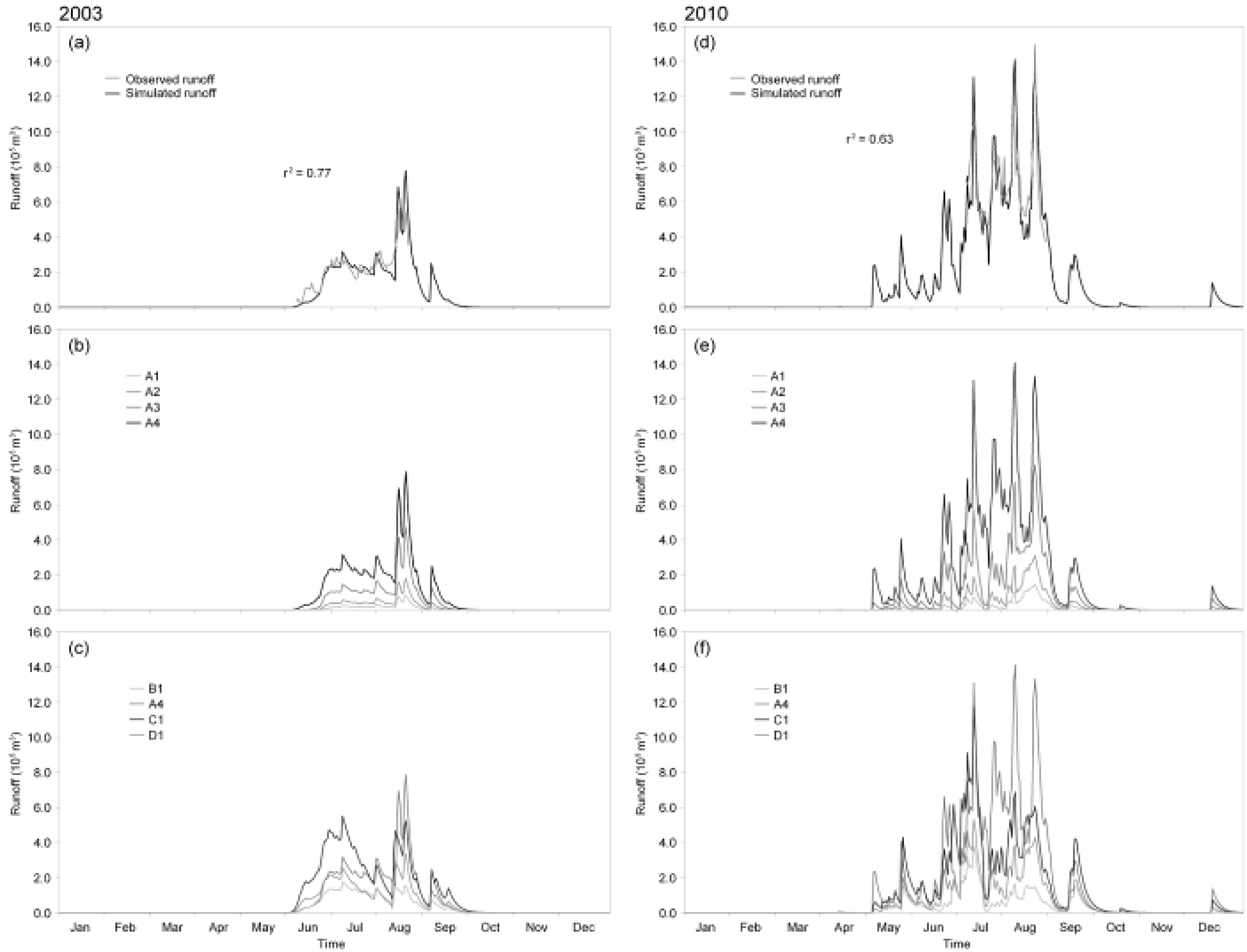




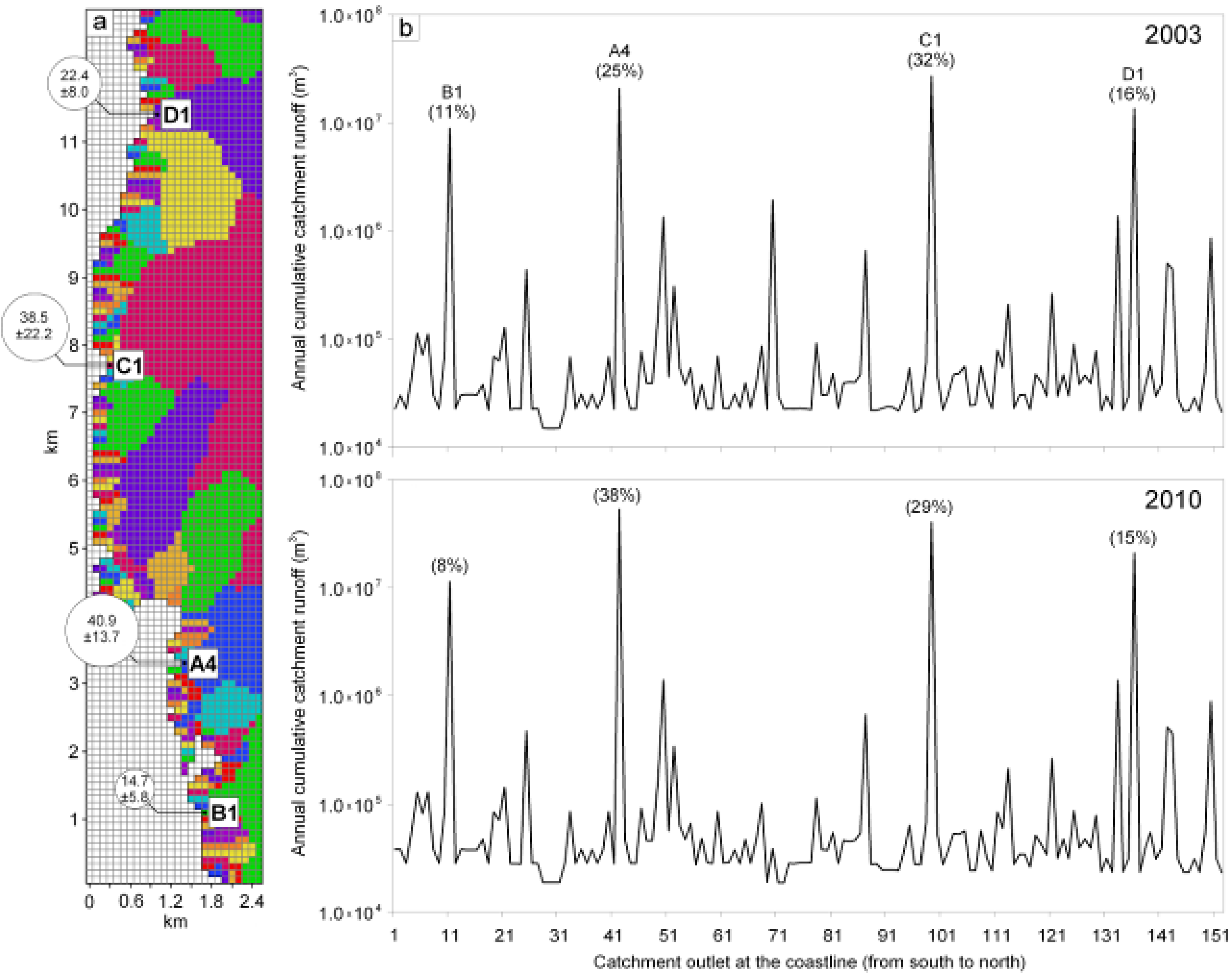
Runoff from glaciated and non-glaciated areas, peripheral to the ice sheet

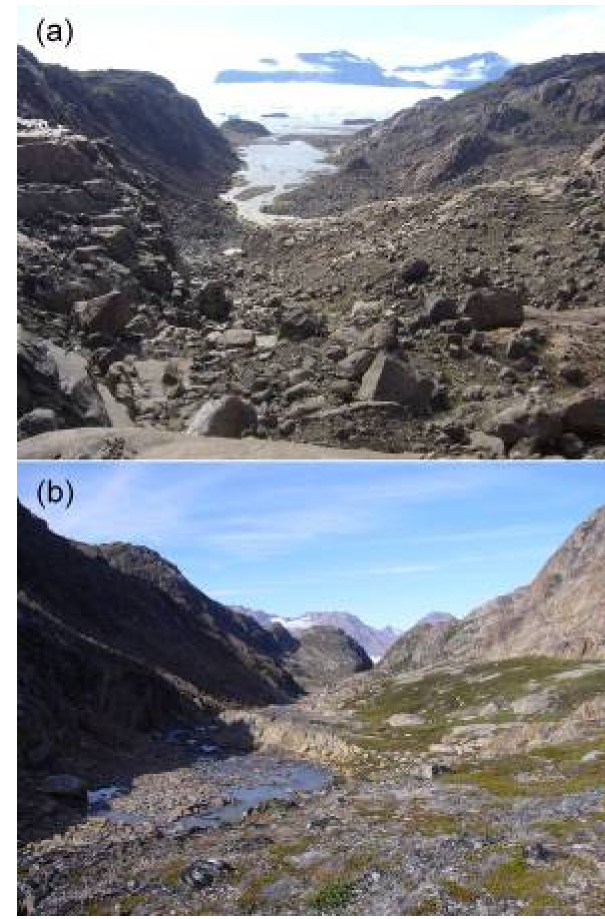




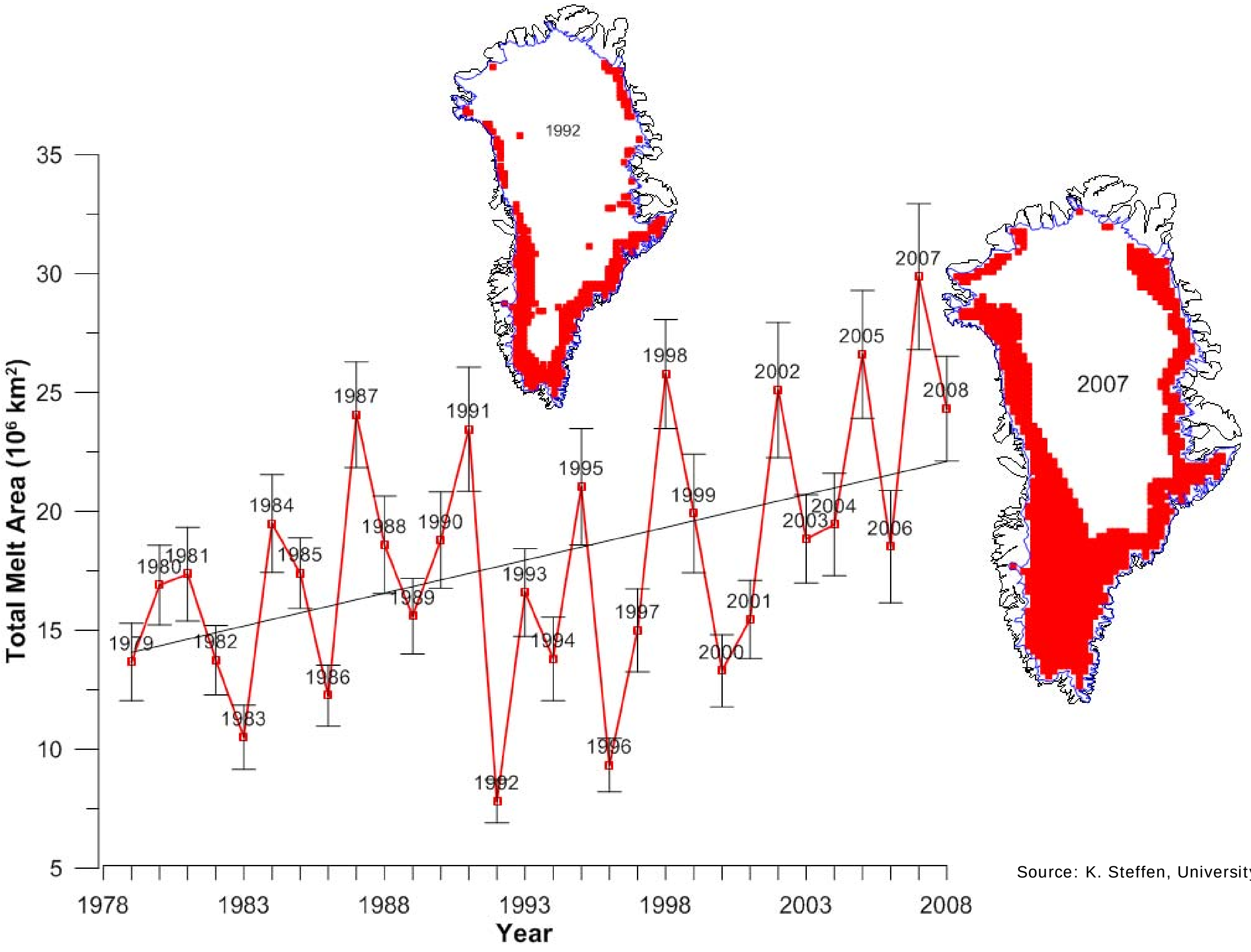


Runoff from glaciated and non-glaciated areas, peripheral to the ice sheet



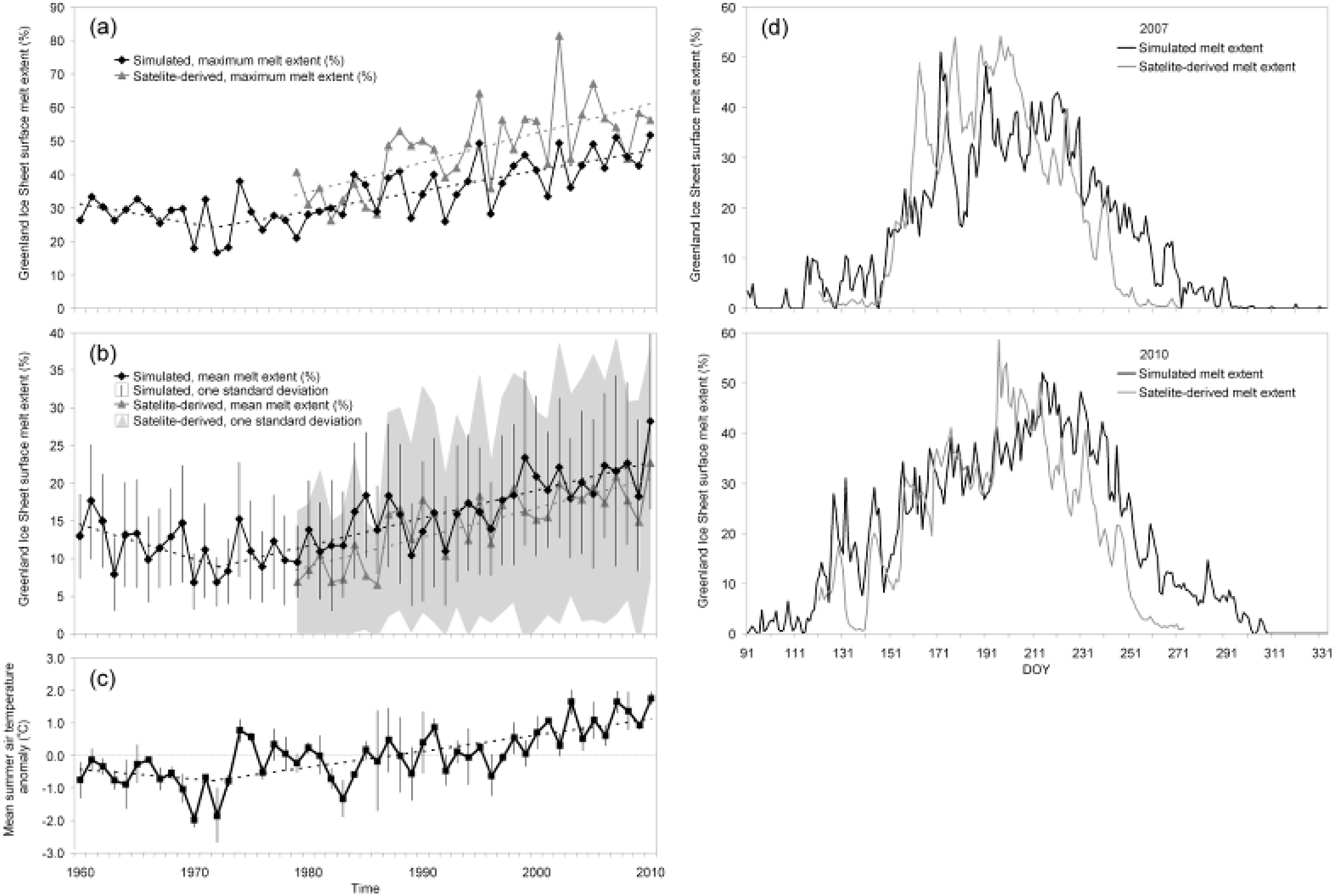


Satellite-derived GrIS surface melt extent, 1979-2008



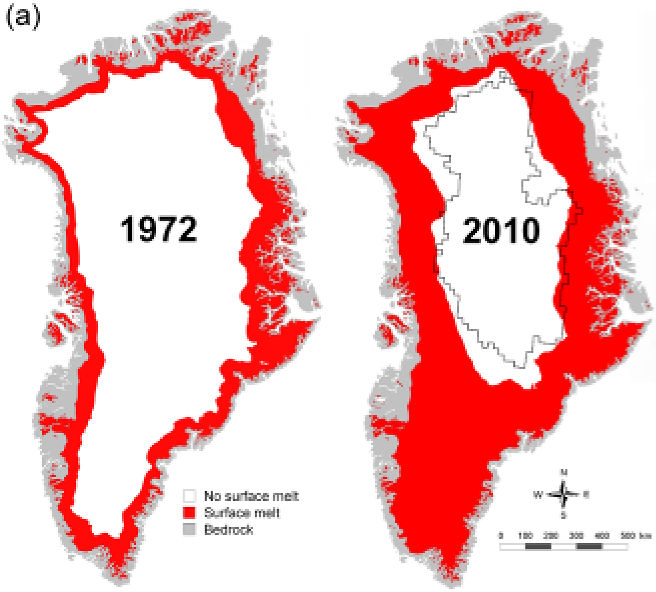
Source: K. Steffen, University of Colorado.

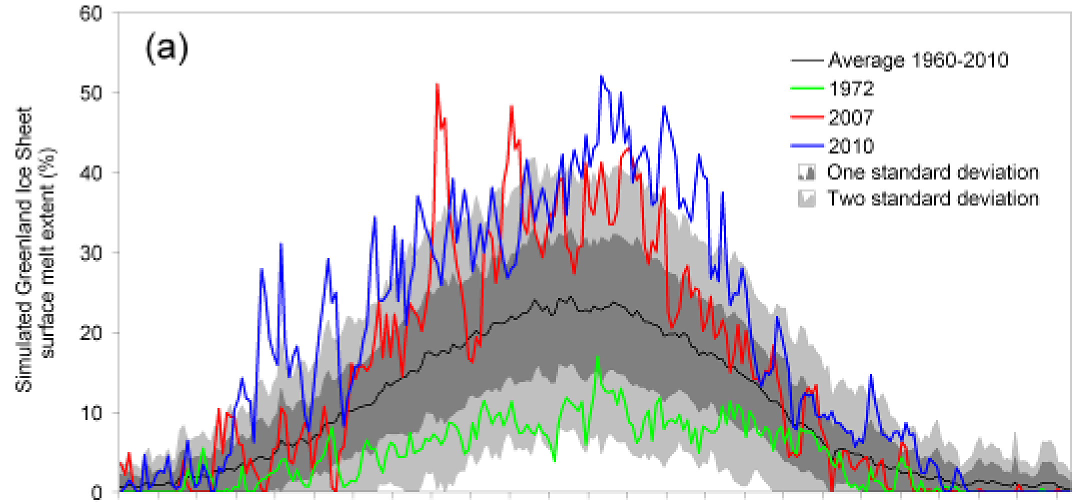
Simulated GrIS surface melt extent and summer mean temperature

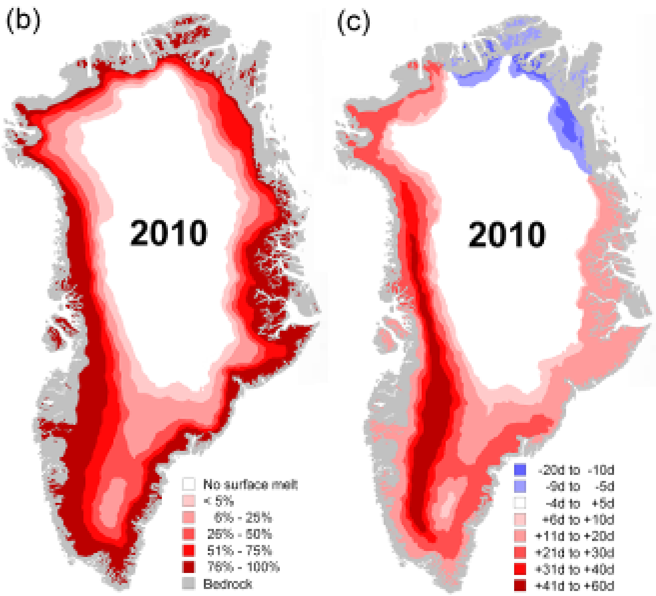


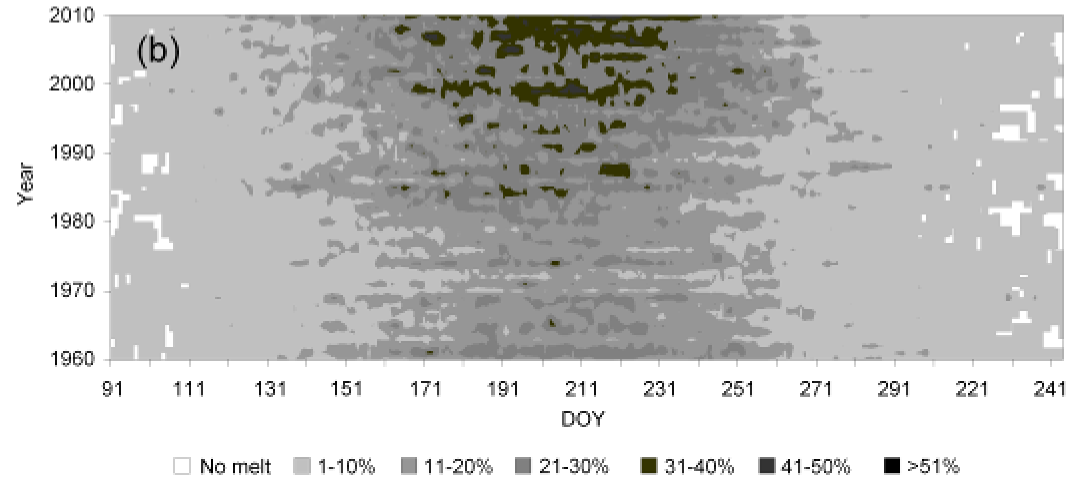
Source: Mernild et al. review

Simulated GrIS surface melt extent, 1960-2010



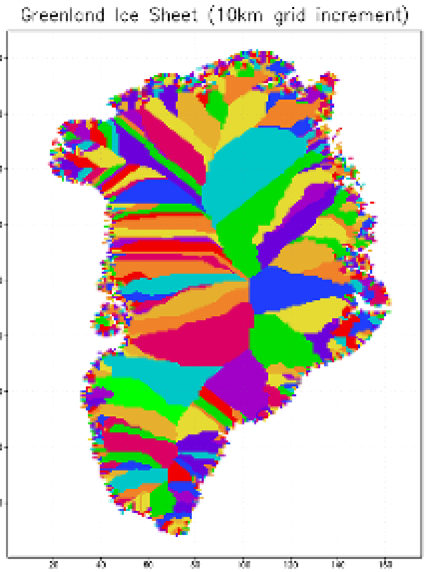


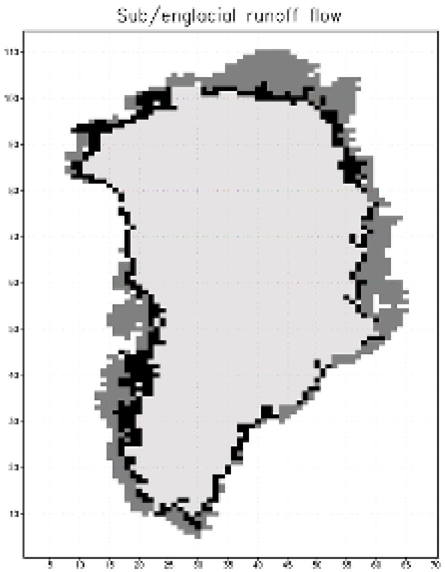


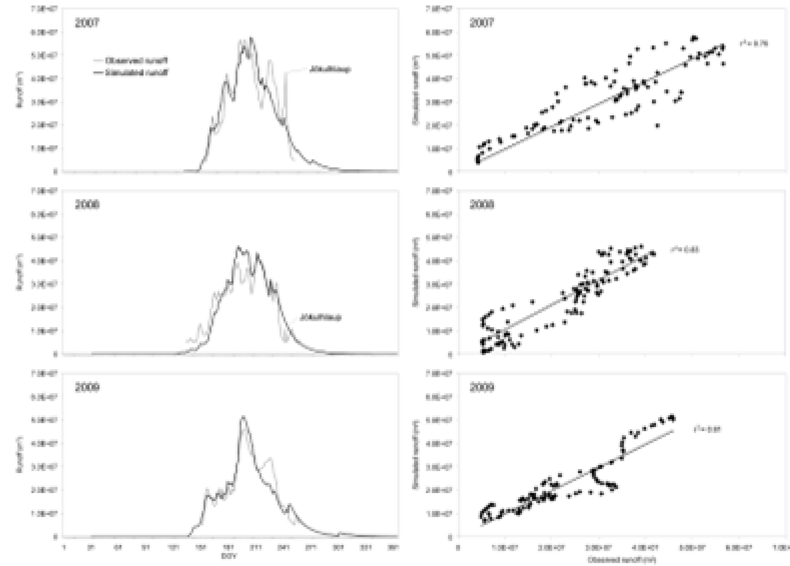


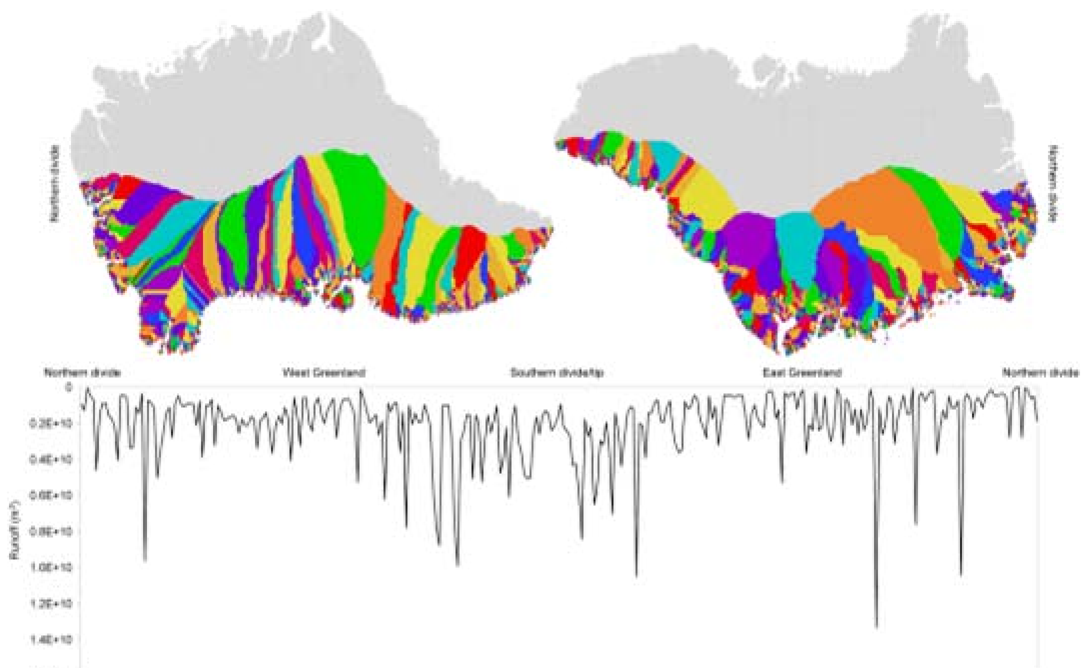
Source: Mernild et al. review

Runoff from Greenland Ice Sheet (Kangerlussuaq)










Thank you!