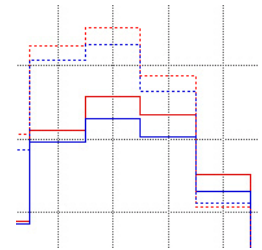
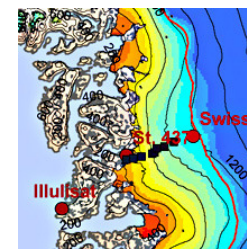
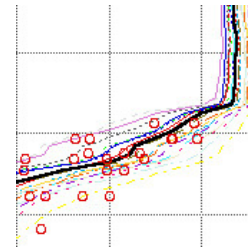
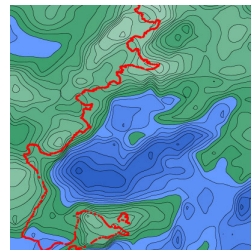
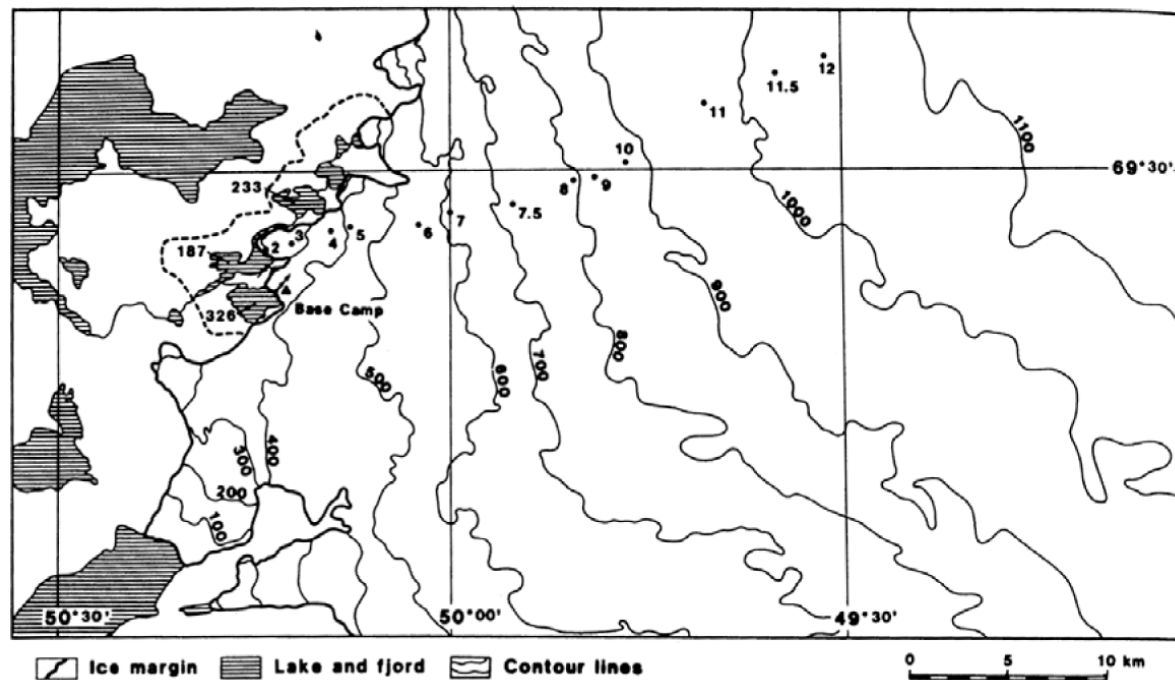


Surface Mass Balance of the Greenland Ice Sheet in the Paakitsoq Area, Illulisat, West Greenland - Scenarios and Related Uncertainties

*Horst Machguth, Andreas Ahlstrøm,
GEUS, Copenhagen*



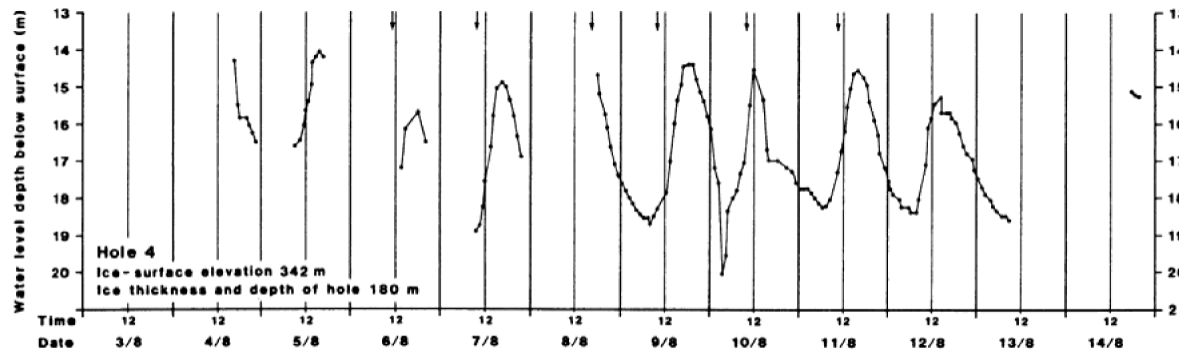


Thomsen & Olesen
(1990)

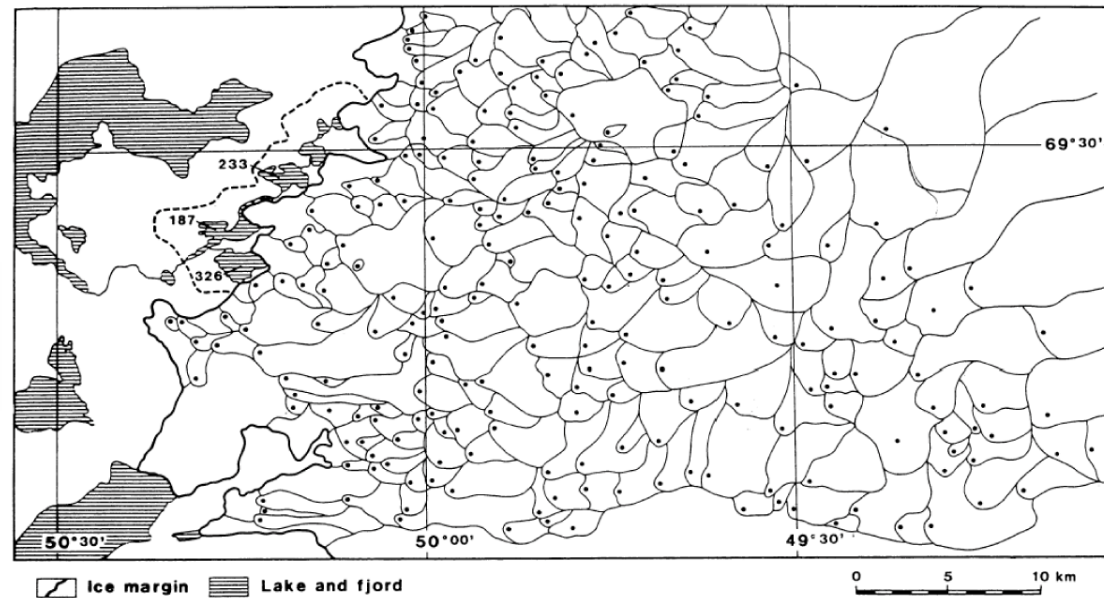


A. P. Ahlstrøm

glacial hydrology with respect to hydropower

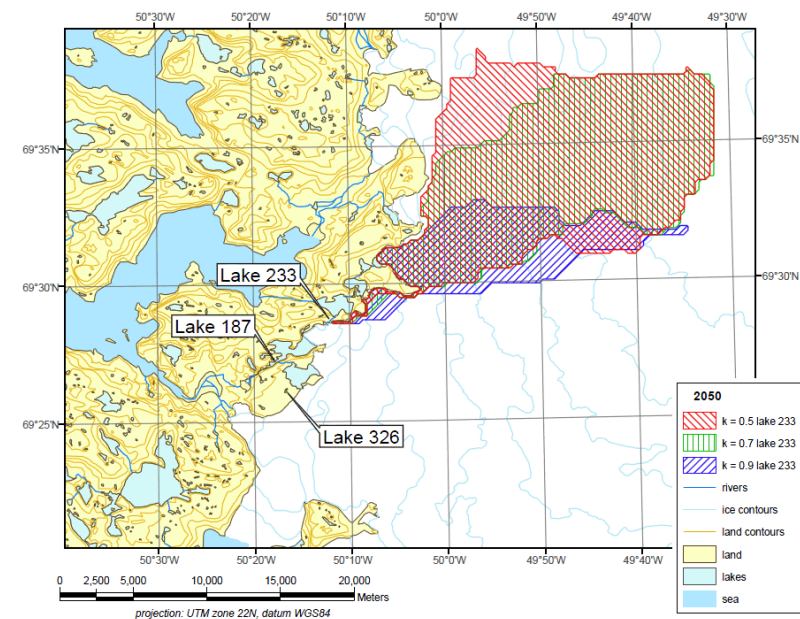
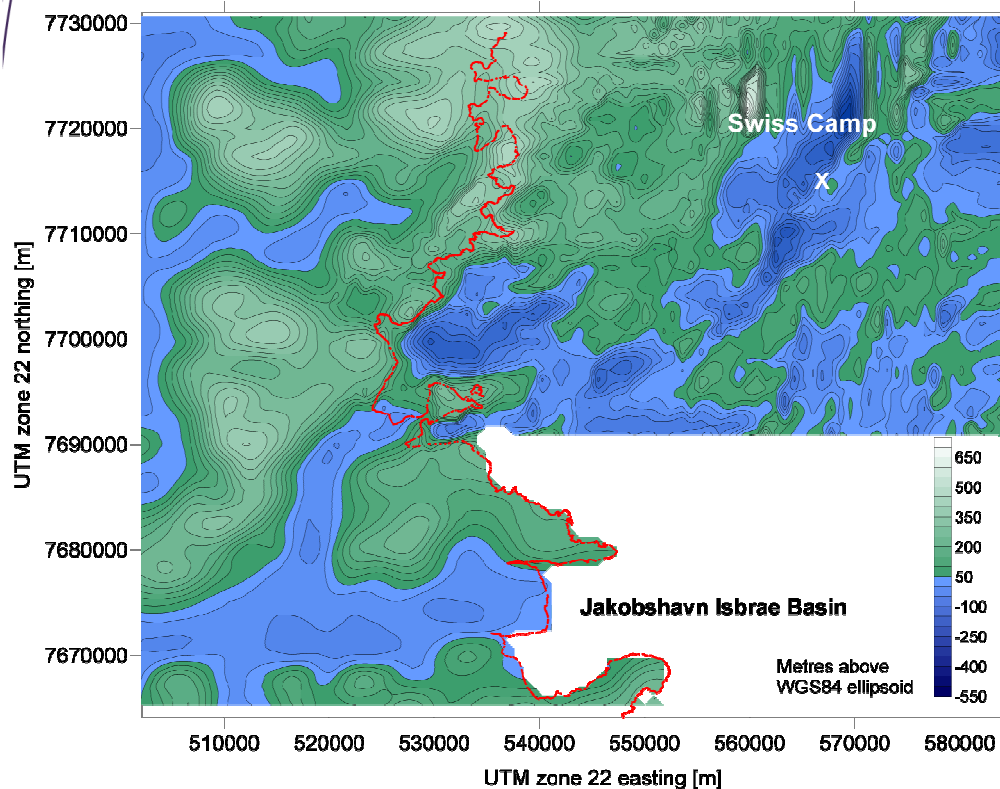


Thomsen & Olesen (1991)



Thomsen (1989)

- recent evaluation of the future hydropower potential (Ahlstrøm et al., 2009)
- bed and surface topography (radar and LiDAR)
- scenarios of ice flow, mass balance and basin delineation



Ahlstrøm et al., 2009

Ahlstrøm et al. (2009):

- only one RCM (HIRHAM4)
- limitations in mass balance modelling

CES project:

- 2 months
- conduct experiments with different RCM's
- explore RCM biases
- apply a different mass balance model

2 RCM's

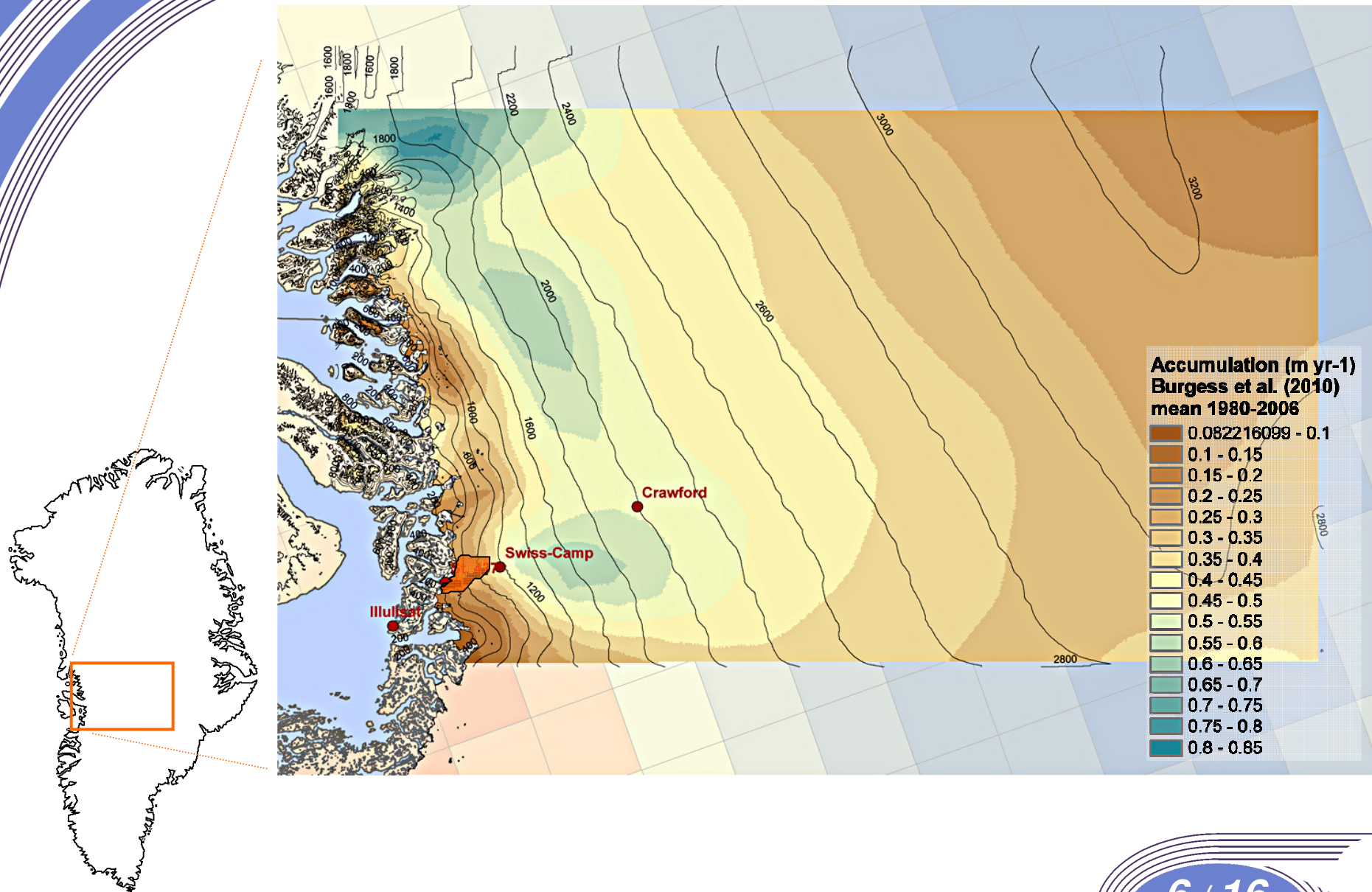
- HIRHAM4, Scenario A1B, 25 km, 1950-2100, Greenland
- RCAO, Scenario A1B, 50 km, 1960-2100, Pan-Arctic

4 Weather Stations (T_a , S_{in})

- GC-Net Swiss Camp: 1150 m a.s.l. (1995 – 2006)
- GC-Net Crawford: 2020 m a.s.l. (1995 – 2006)
- Asiaq Station 437: 300 m a.s.l. (1983 – 2006)
- DMI Illulisat: 50 m a.s.l. (1980 – 2006)

Accumulation, Mass Balance

- Burgess et al., 2010 (1980 – 2006)
- Stake network Paakitsoq (1982-1992)



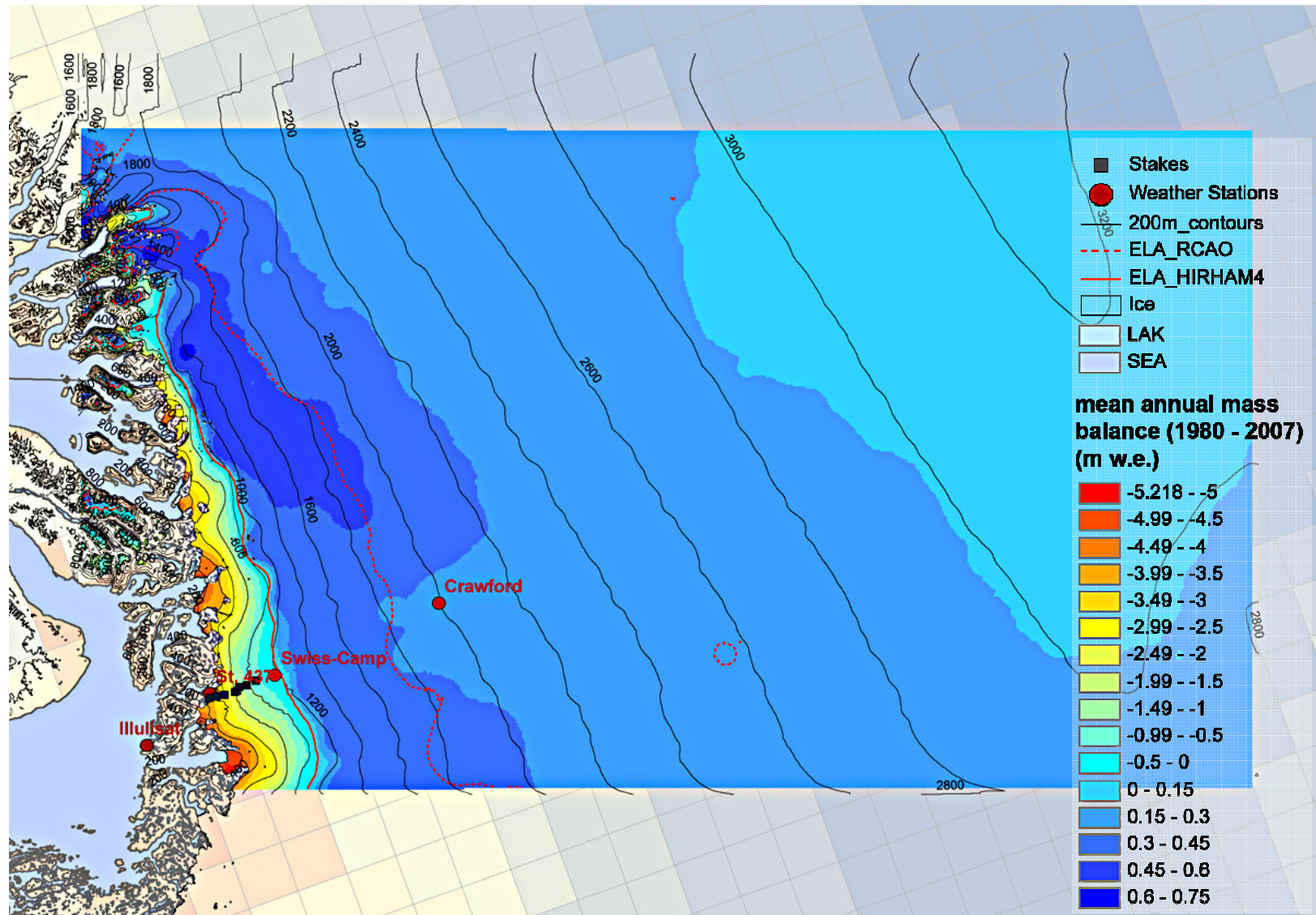
simple energy balance model (based on *Oerlemans, 2001*)

- numerical at daily steps
- melt water retention (*Reeh, 1991*)
- model input: 2 m air temperature (T_a), precipitation (P), global radiation (S_{in}) and/or cloudiness (n)

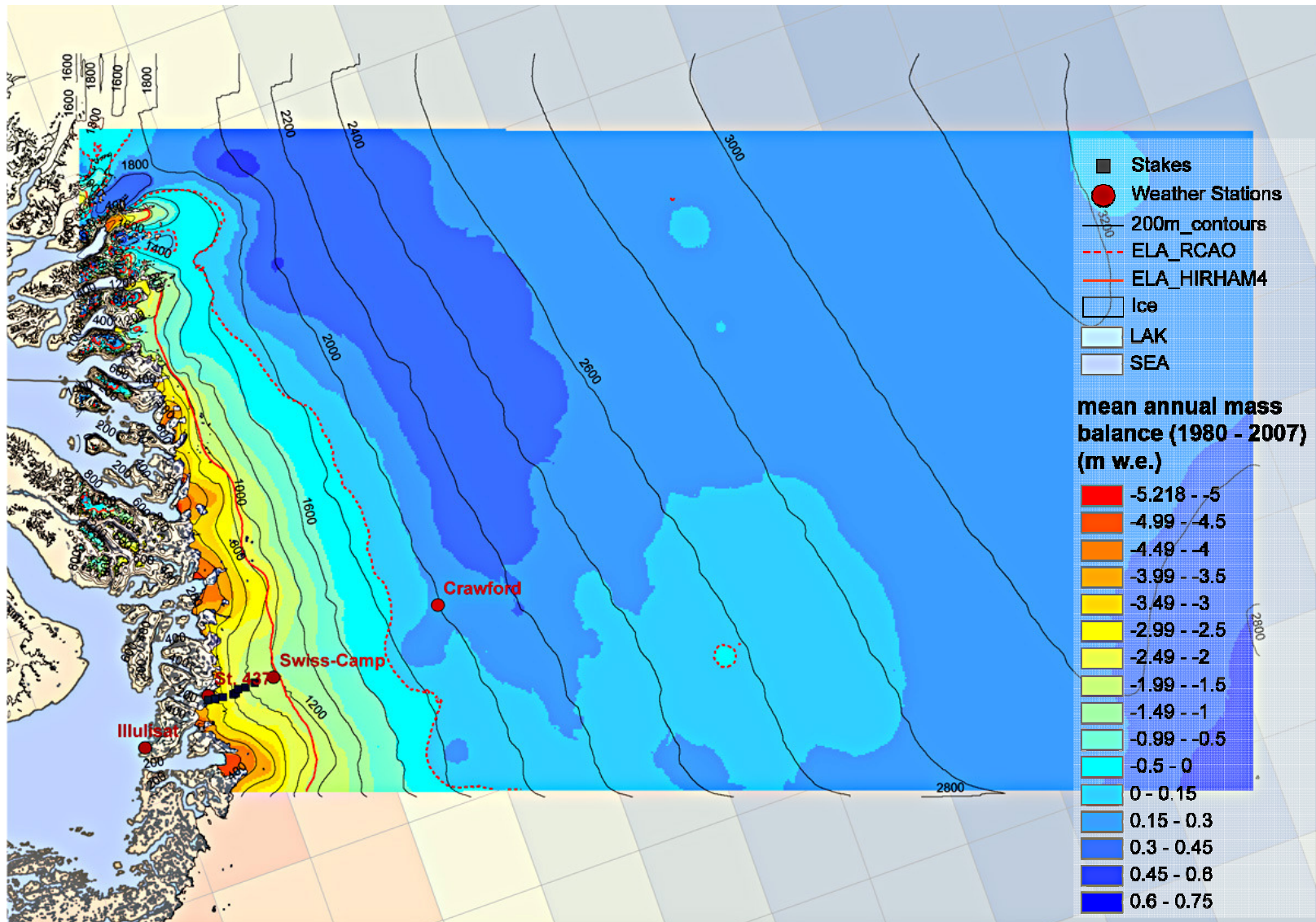
offline coupling RCM and mass balance model

- 25 and 50 km to 1 km spatial resolution
- downscaling of the daily RCM grids
- interpolation techniques and vertical gradients (T_a , P)
- more complex approach for S_{in}

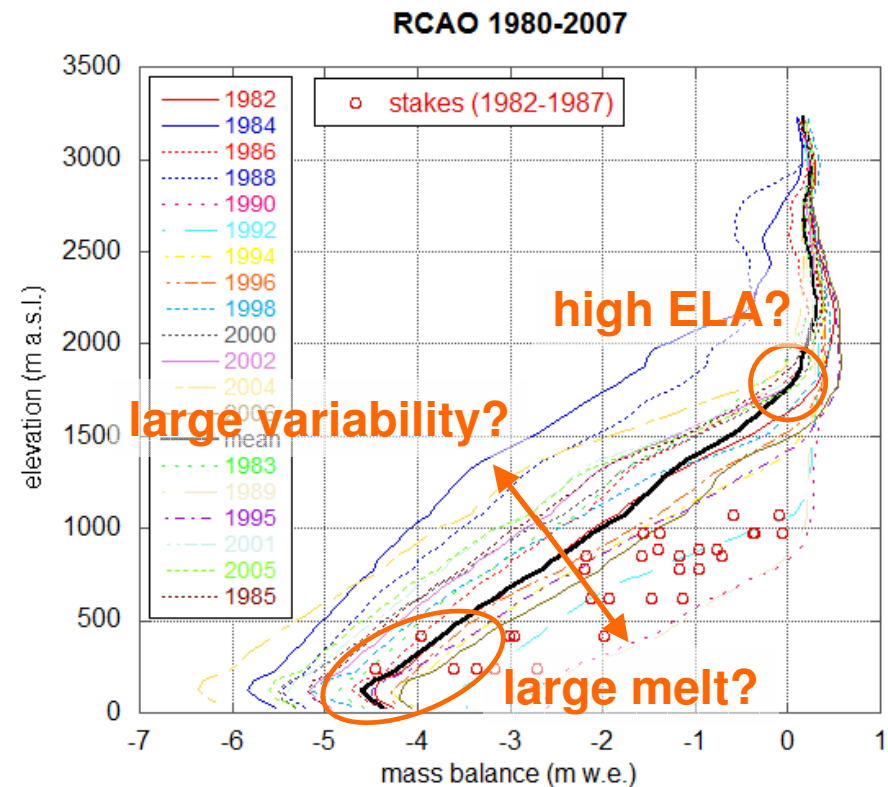
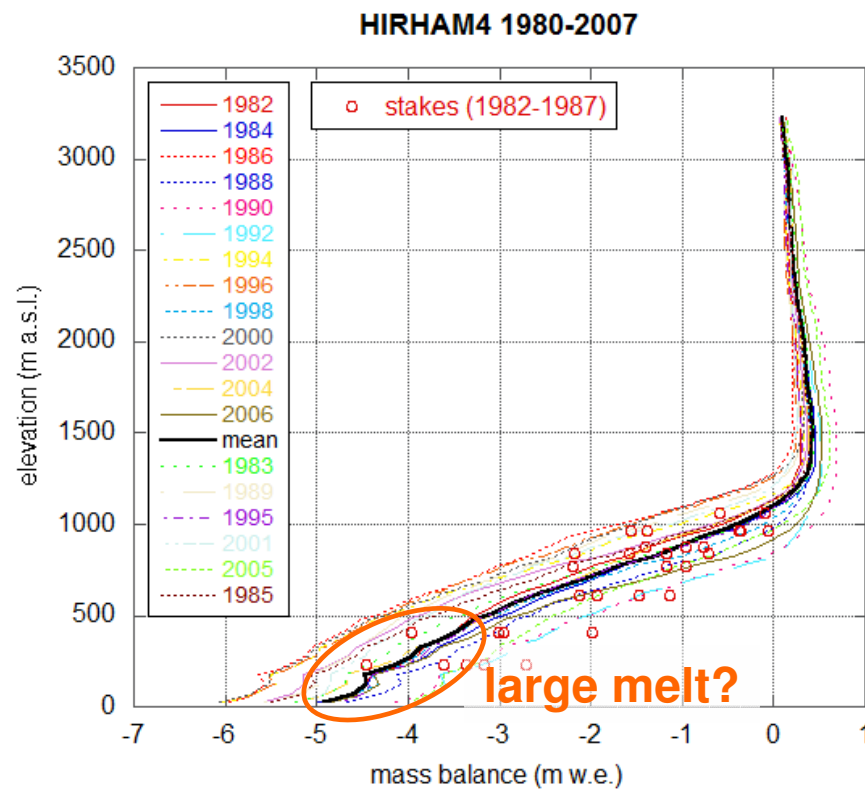
Initial run 1980 – 2007: mass balance HIRHAM4



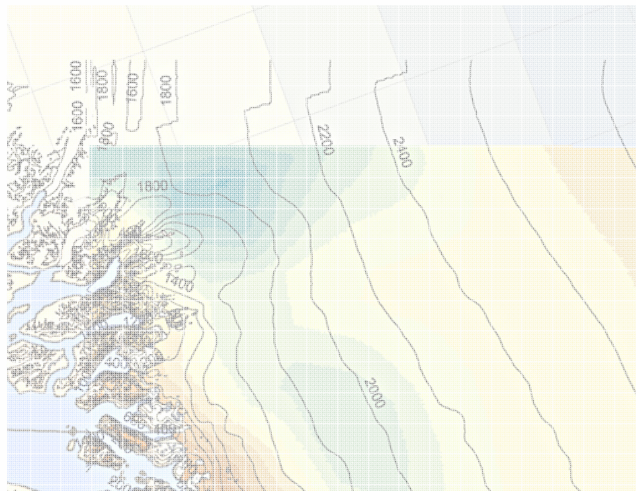
Initial run 1980 – 2007: mass balance RCAO



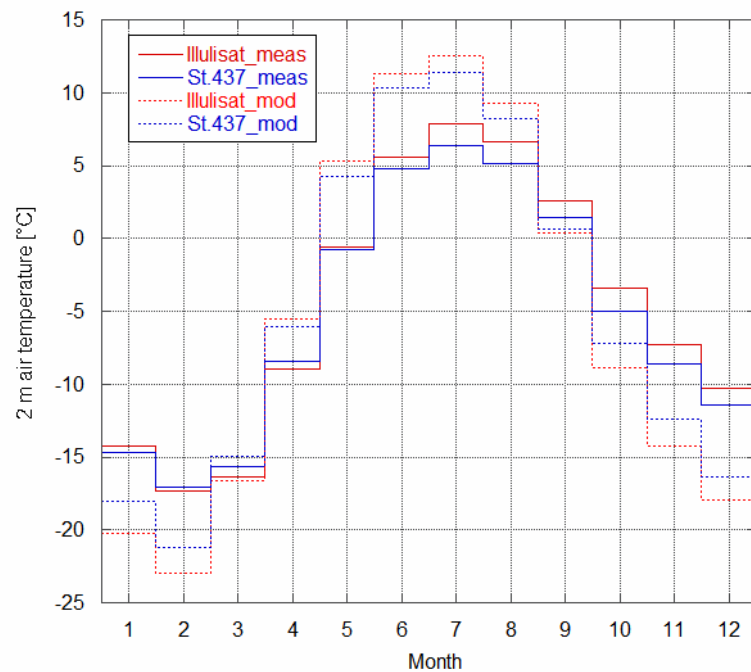
initial run 1980 – 2007: Mass balance profiles



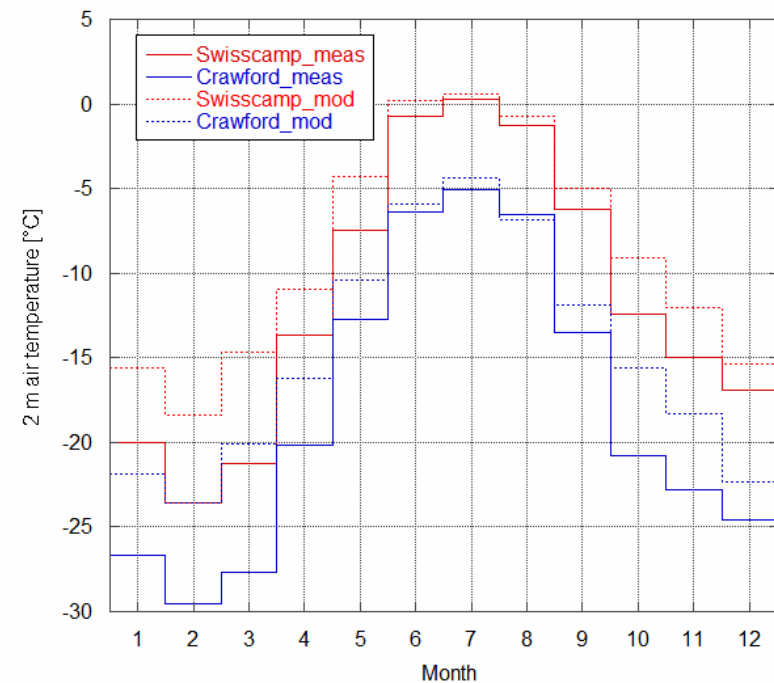
HIRHAM4: bias T_a



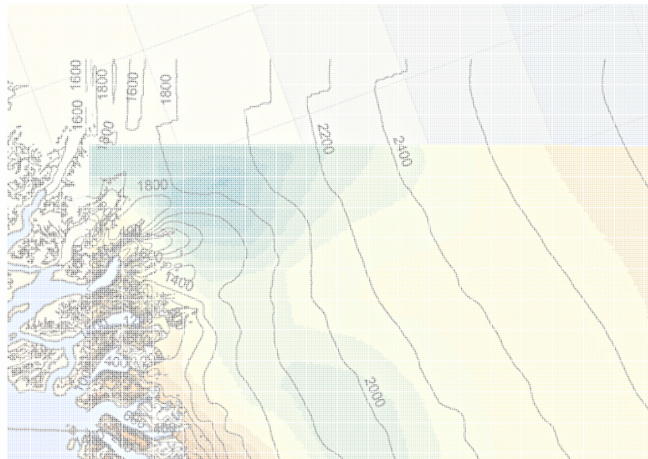
HIRHAM4 1981(83)-2006



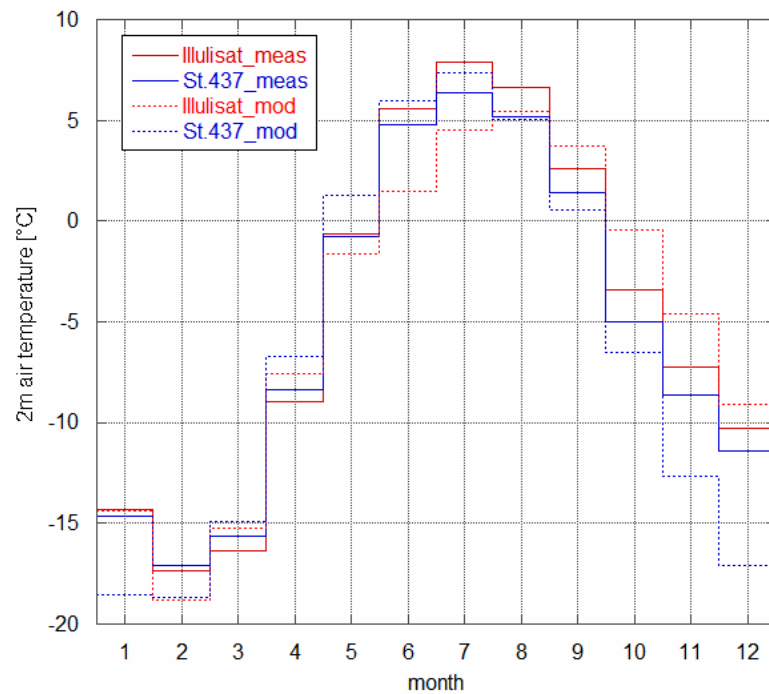
HIRHAM4 1995-2006



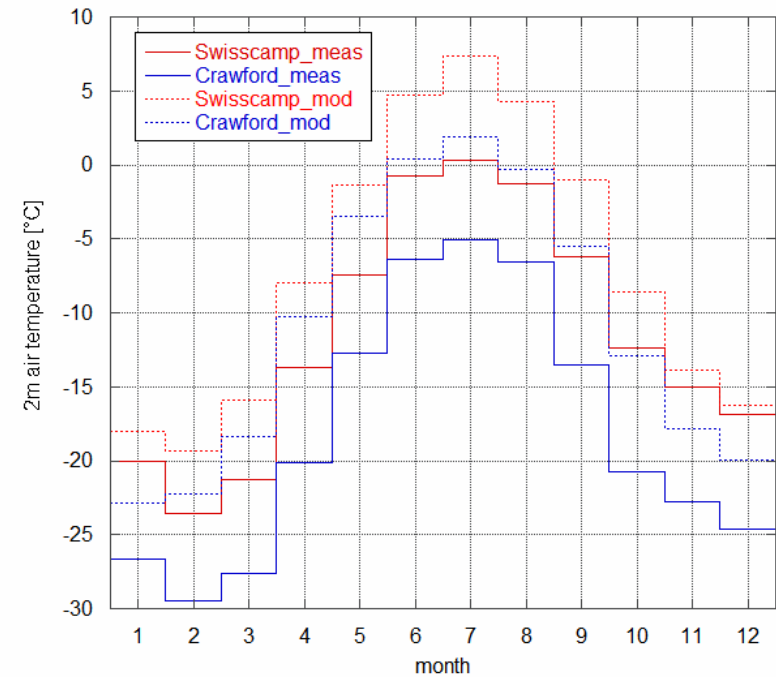
RCAO:
bias T_a



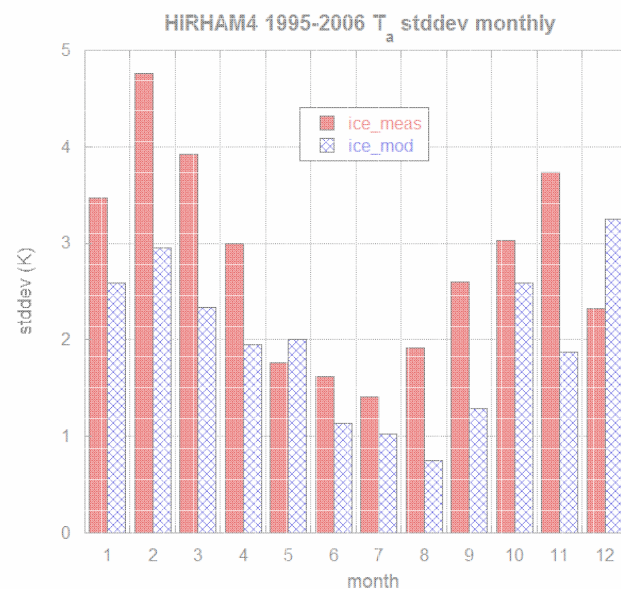
RCAO 1981(83) - 2006



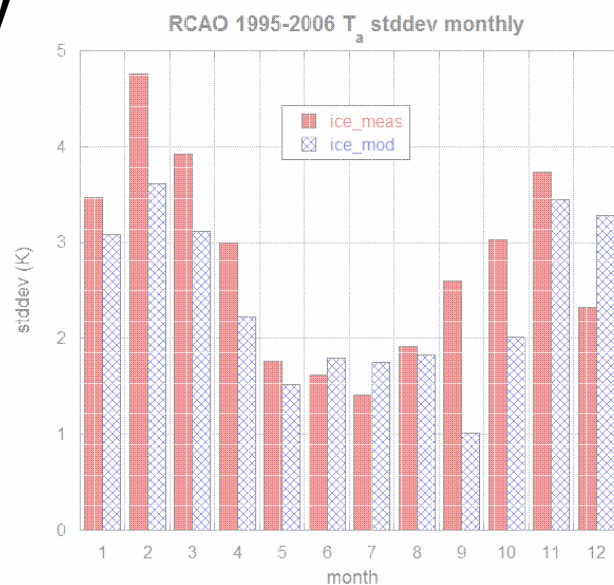
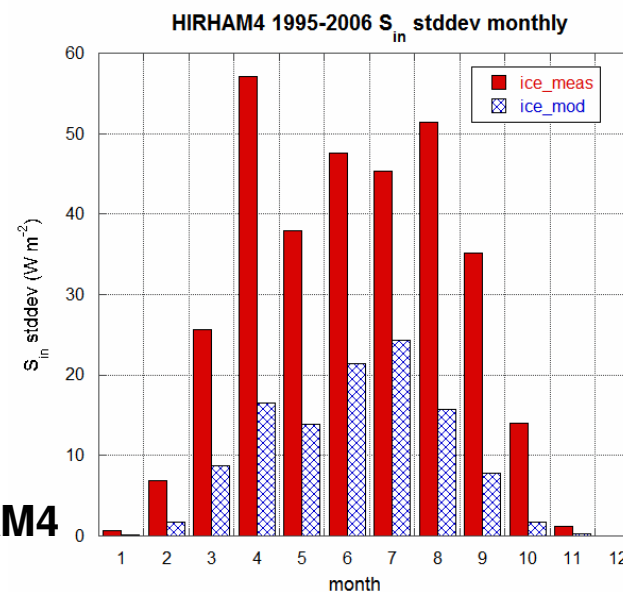
RCAO 1995-2006



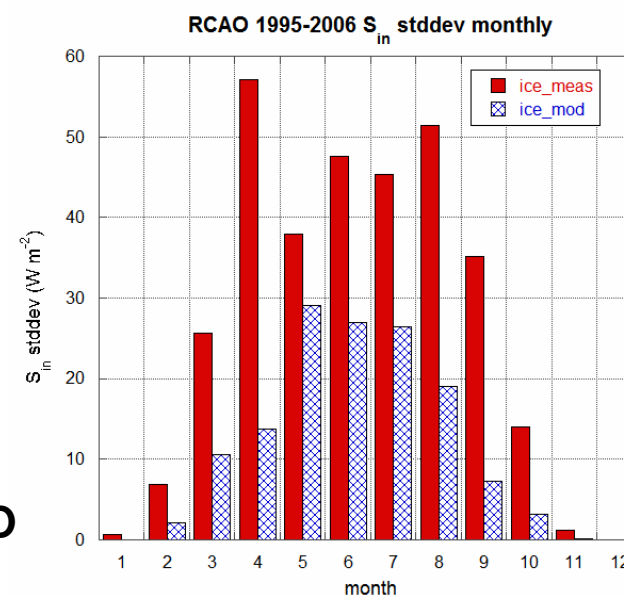
Standard
deviations
of all monthly
means



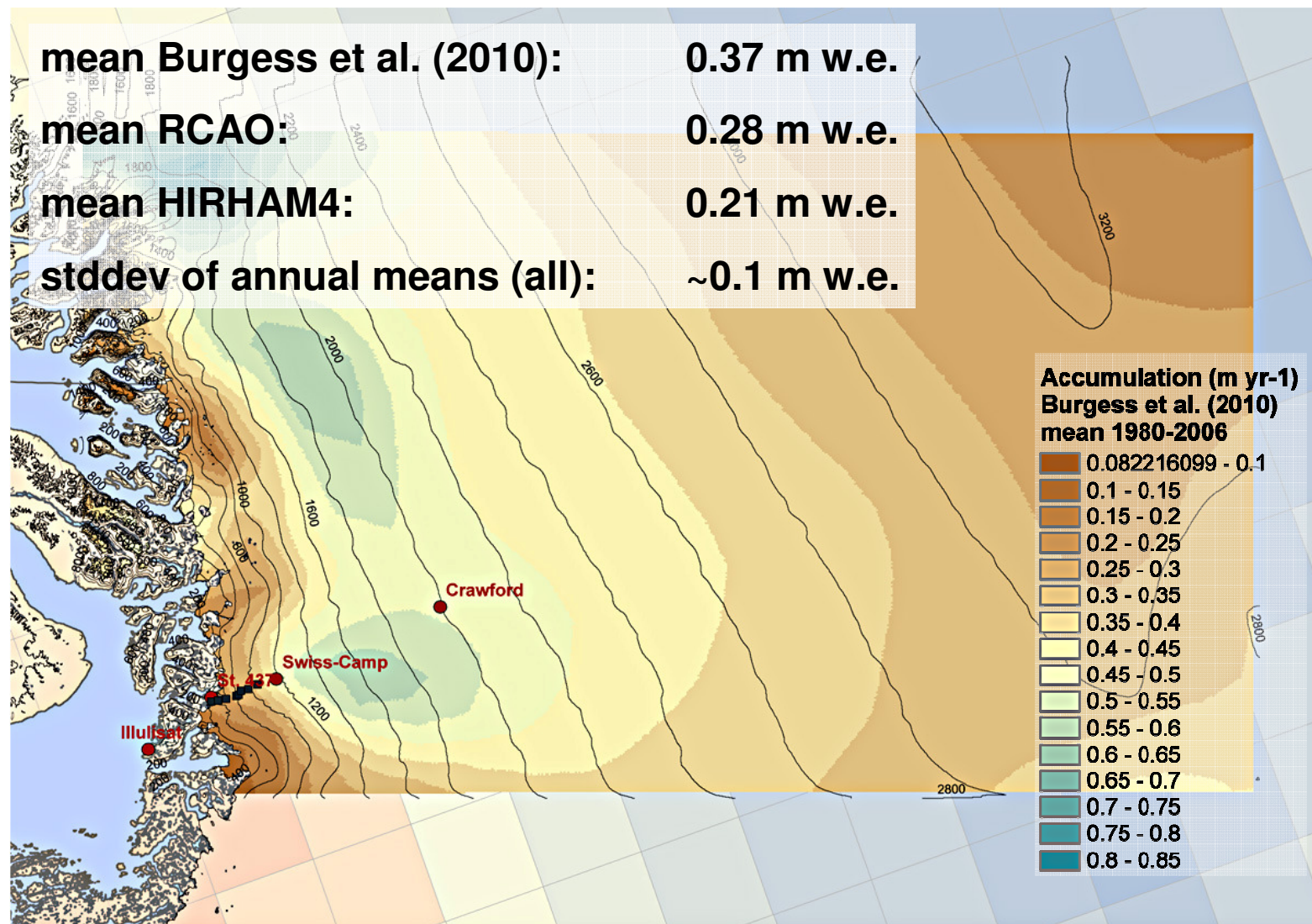
HIRHAM4



RCAO



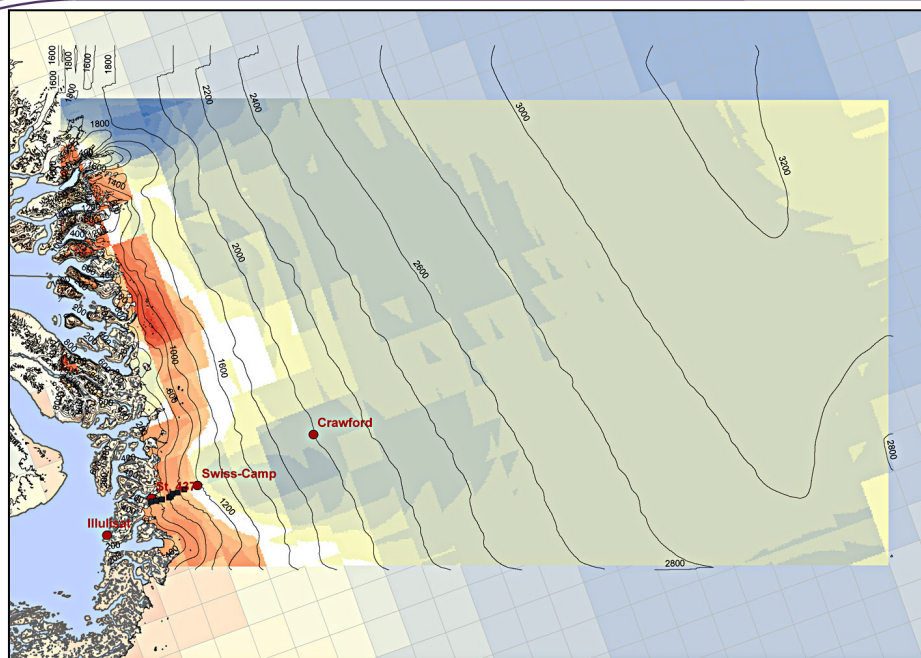
accumulation reference: Burgess et al. (2010)



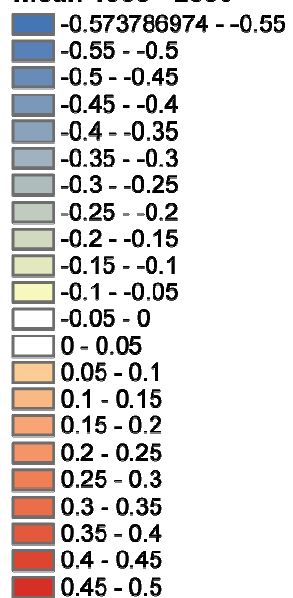
RCM analysis

HIRHAM4

mean corr: 0.16 m w.e.

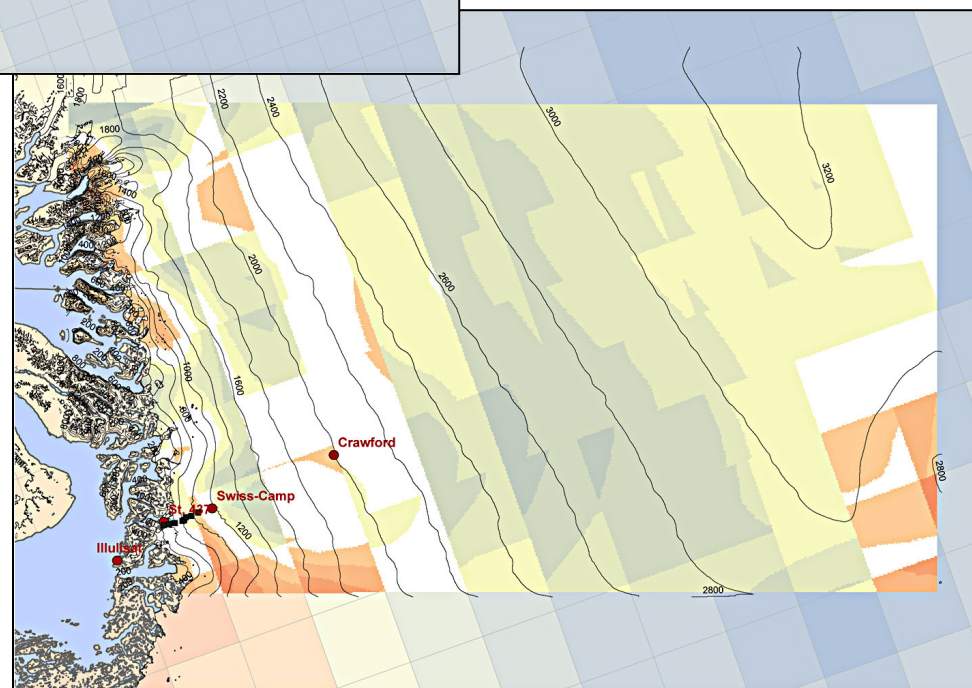


**Accumulation
modelled - 'measured'
m w.e. yr⁻¹
mean 1980 - 2006**



RCAO

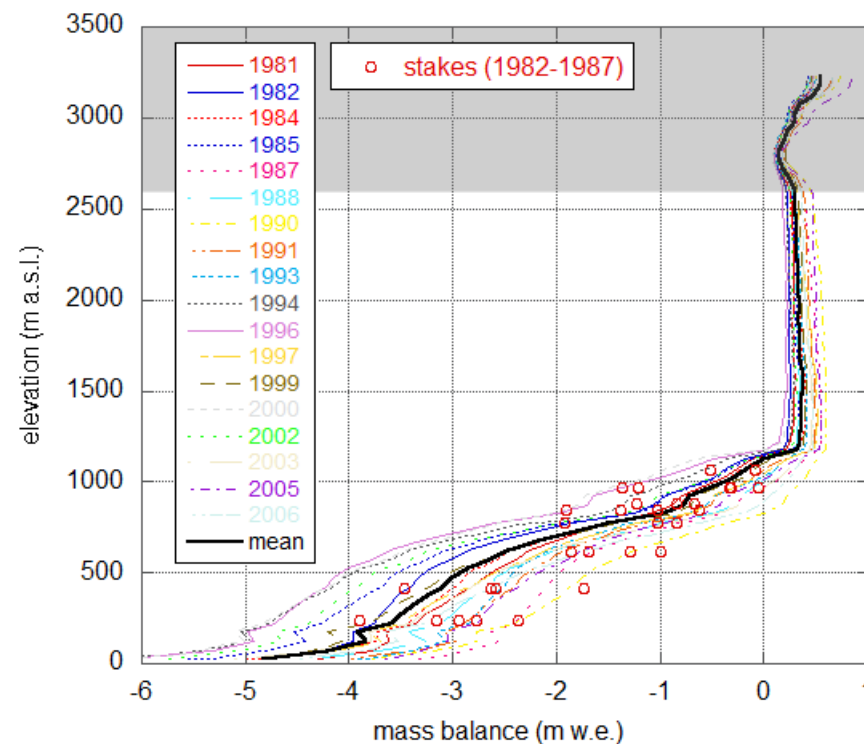
mean corr: 0.09 m w.e.



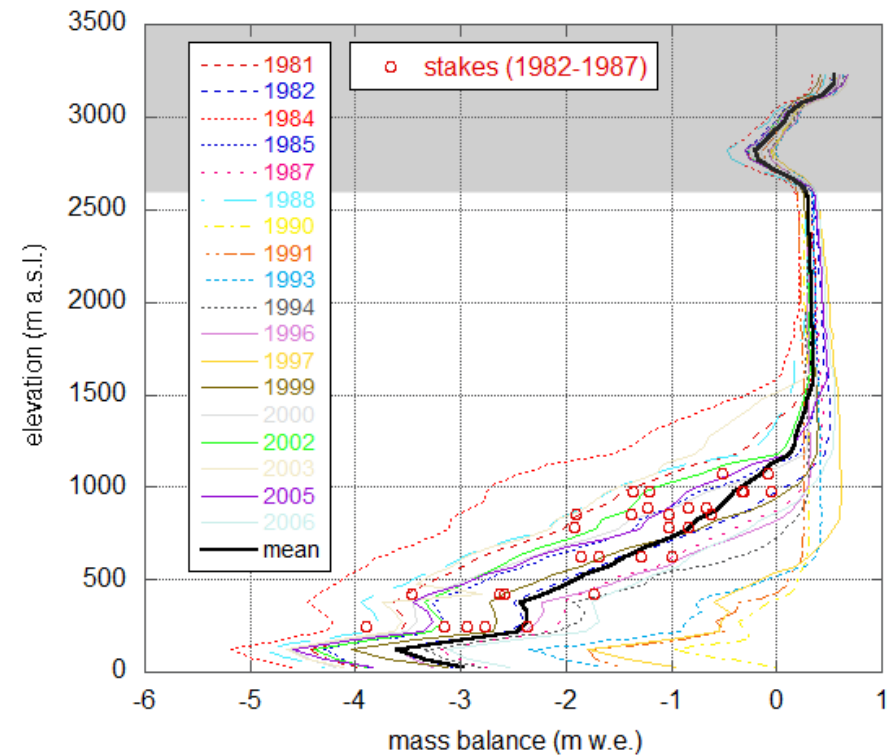
bias correction:

- $T_a = T_{aRCM} + T_{offset}$
- $P_{daily} = P_{RCM(daily)} \cdot (P_{meas(80-06)} / P_{RCM(80-06)})$
- S_{in} : no bias correction required

HIRHAM4 1980-2007 bias corrected



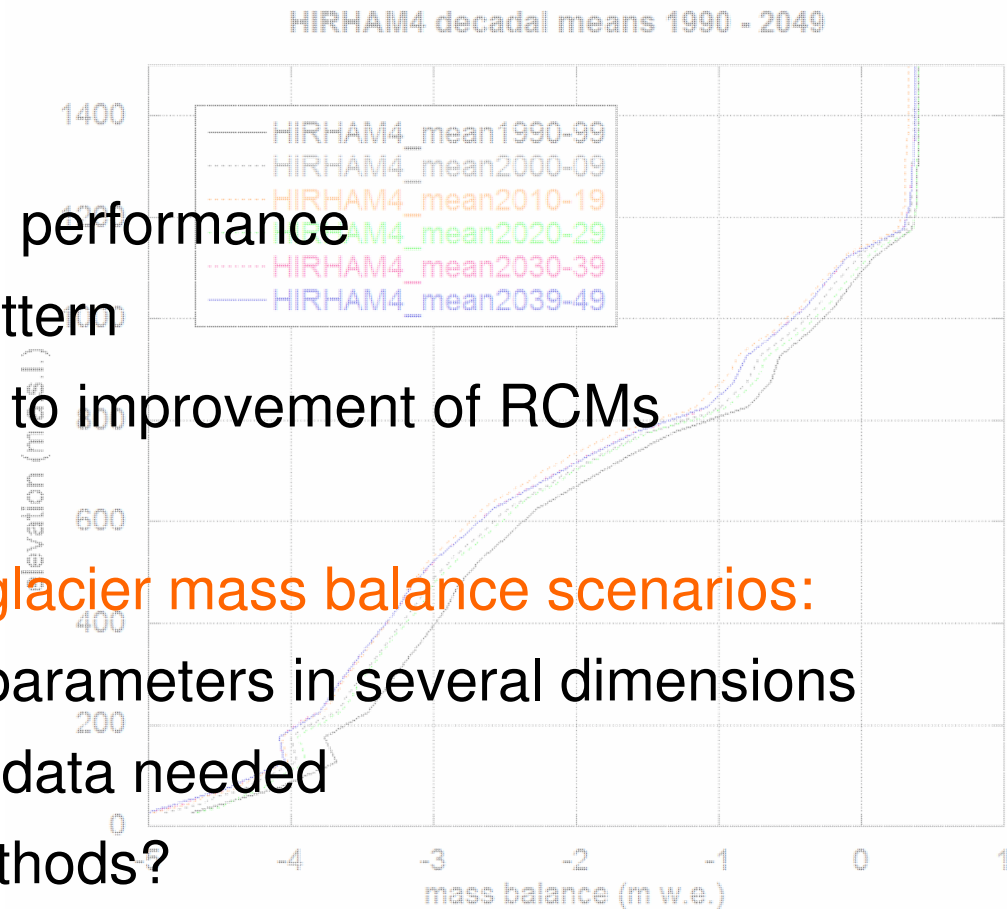
RCAO 1980-2007 bias corrected



- scenarios?
- analysis of RCM performance
- complex bias pattern
- might contribute to improvement of RCMs

➔ RCMs for local glacier mass balance scenarios:

- correct several parameters in several dimensions
- large amount of data needed
- more simple methods?
- e.g. general trends from climate-model ensembles superimposed to measurements



Thank You

We greatly acknowledge the Rossby Center
and Ralf Döscher for providing us with the
RCAO output and DMI for the HIRHAM4 data

Thomsen and Reeh (1986)

