Detection of regional ice mass variation using GNSS measurements at Svalbard

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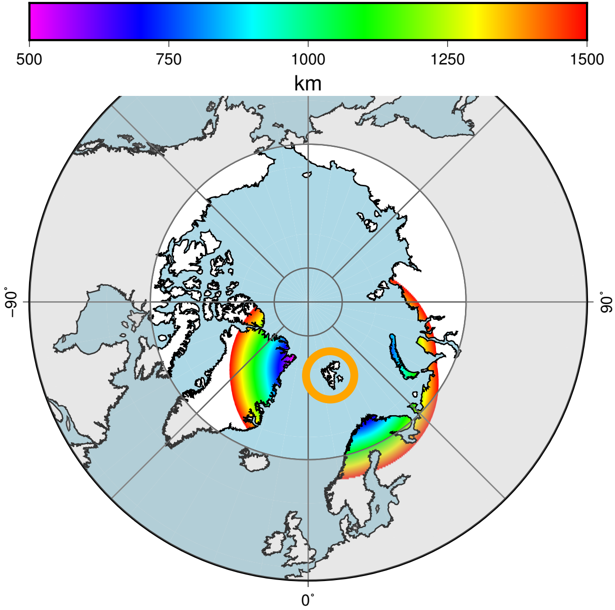
Svalbard

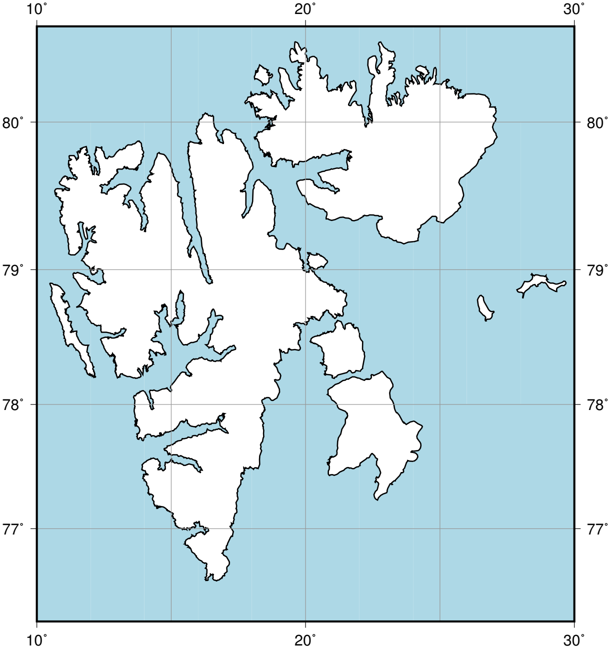
Svalbard

distances to other land, ice masses

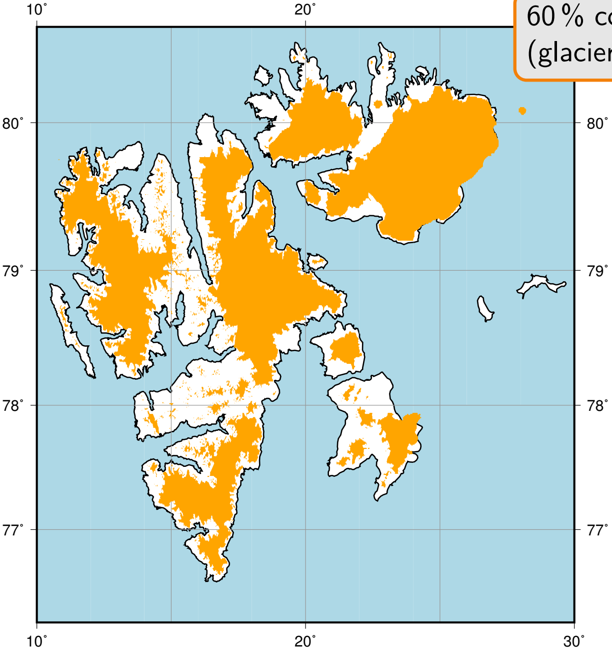


GNSS sites

Area of $61 \cdot 10^3\,\mathrm{km}^2$



GNSS sites



Area of $61 \cdot 10^3\,\mathrm{km}^2$

60 % covered with ice (glaciers, ice fields, ice caps)

GNSS sites

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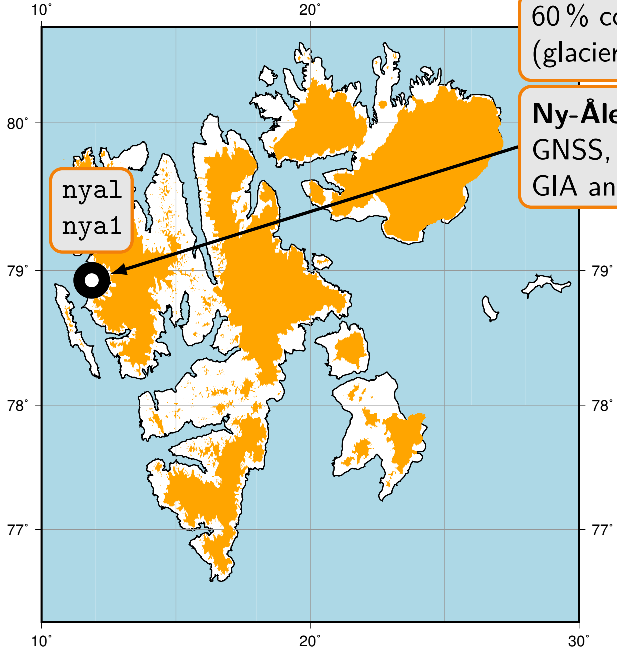
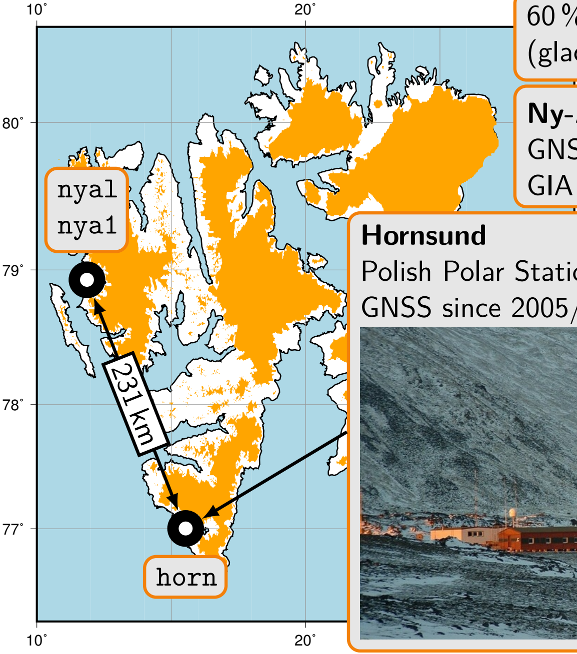
Ny-Ålesund
GNSS, VLBI, DORIS, SG, AG
GIA and PDIM studies



GNSS sites



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Ny-Ålesund
GNSS, VLBI, DORIS, SG, AG
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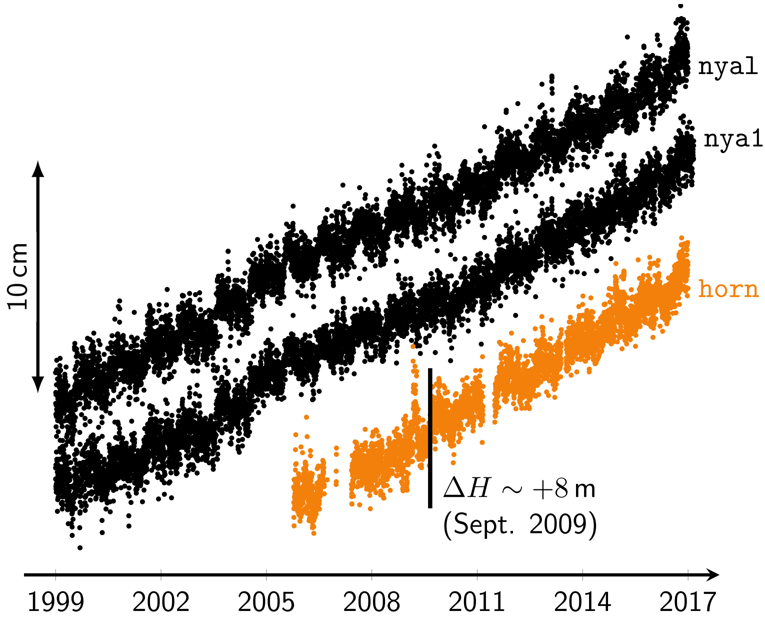
Hornsund
Polish Polar Station (77.00 °N 15.50 °E)
GNSS since 2005/2006

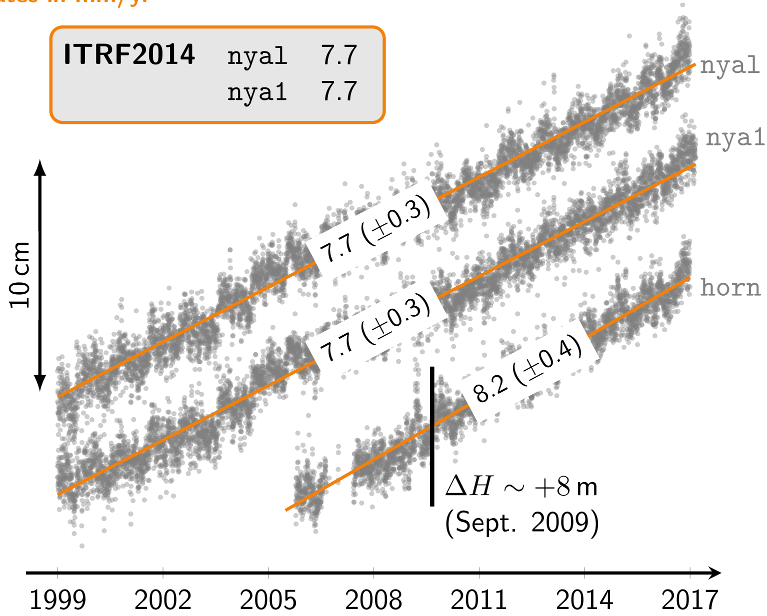
GNSS time series – height change



GNSS time series – height change

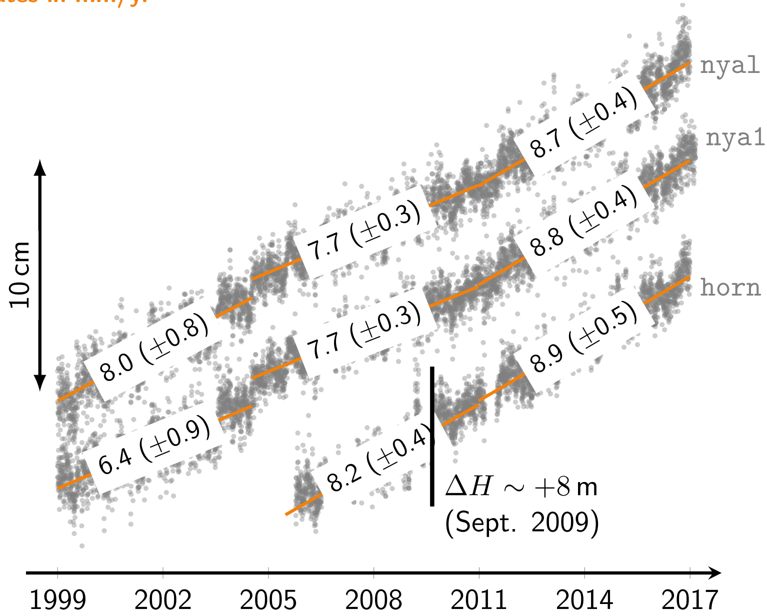
rates in mm/yr

ITRF2014	nyal	7.7
	nya1	7.7



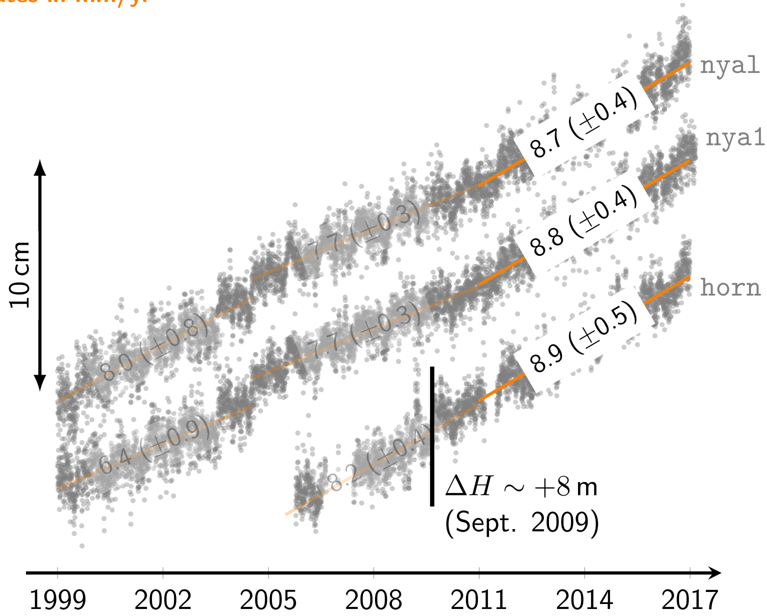
GNSS time series – height change

rates in mm/yr

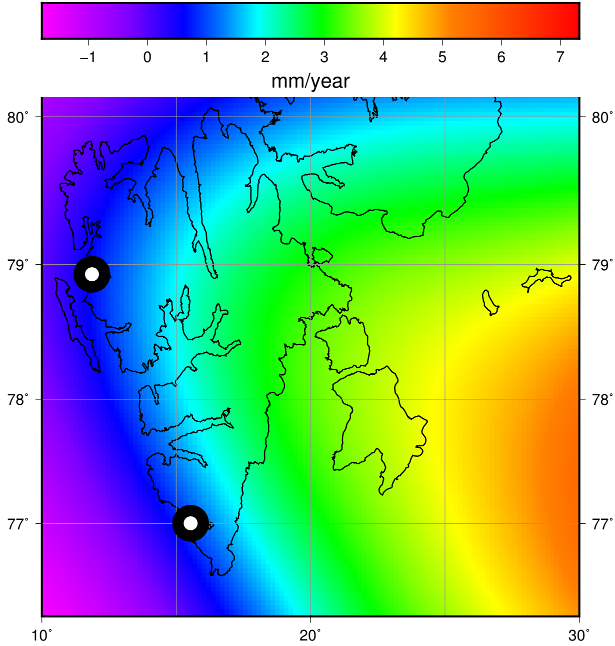


GNSS time series – height change

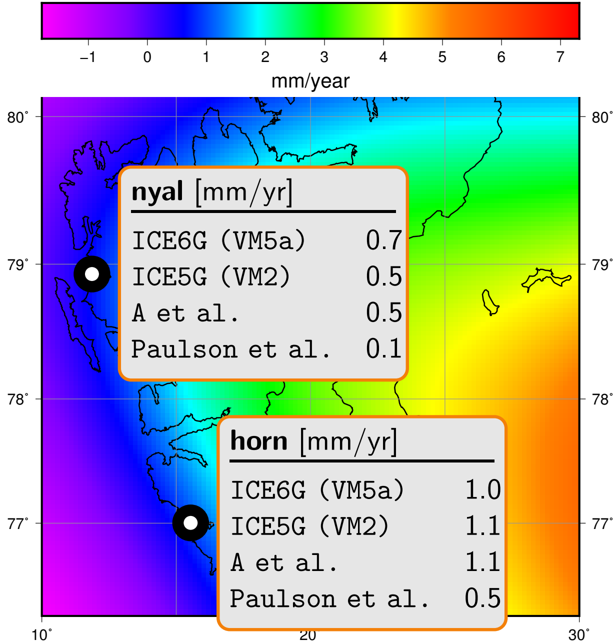
rates in mm/yr



GIA uplift rates



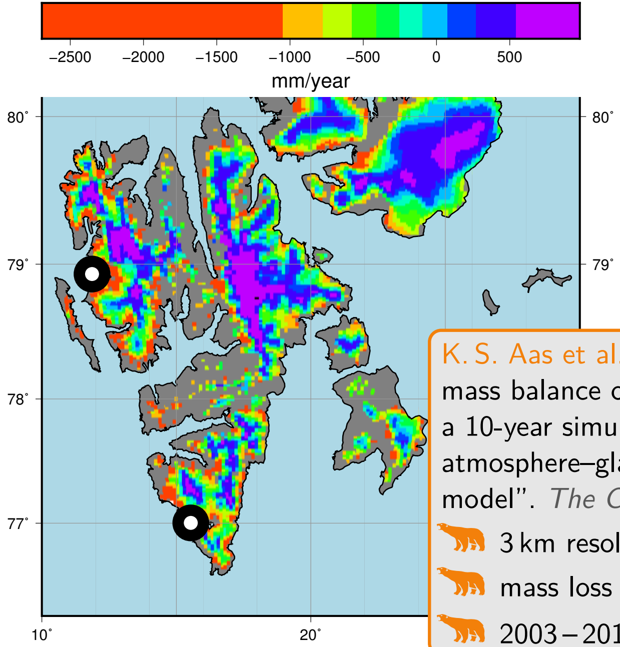
GIA uplift rates



nyal [mm/yr]	
ICE6G (VM5a)	0.7
ICE5G (VM2)	0.5
A et al.	0.5
Paulson et al.	0.1

horn [mm/yr]	
ICE6G (VM5a)	1.0
ICE5G (VM2)	1.1
A et al.	1.1
Paulson et al.	0.5

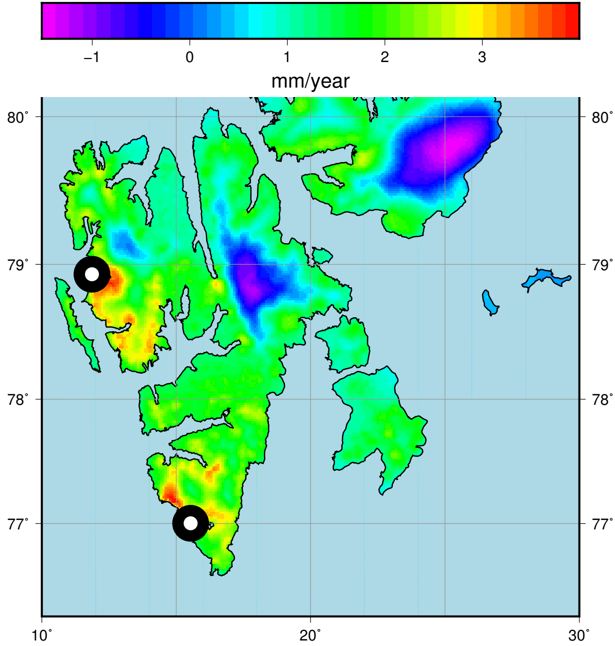
Realistic mass balance model



K. S. Aas et al. (2016). "The climatic mass balance of Svalbard glaciers: a 10-year simulation with a coupled atmosphere–glacier mass balance model". *The Cryosphere* 10.3

- 3 km resolution
- mass loss 8.7 Gt/yr (−257 mm/yr)
- 2003 – 2013 mean

Mass balance – loading modelling



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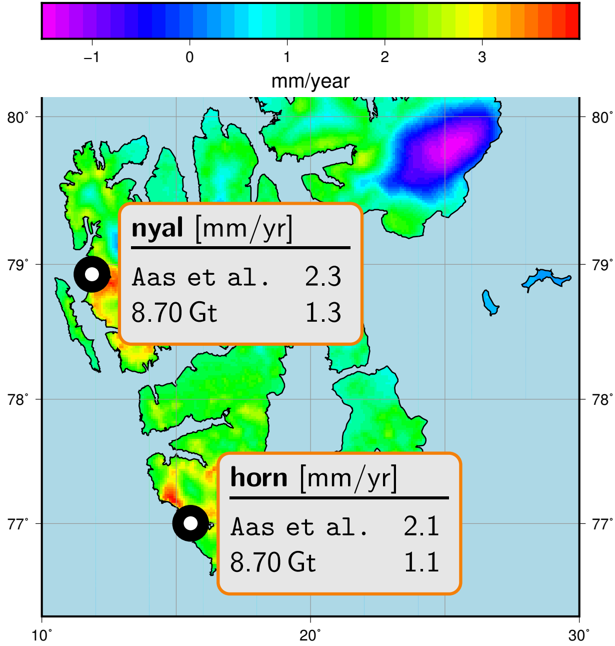
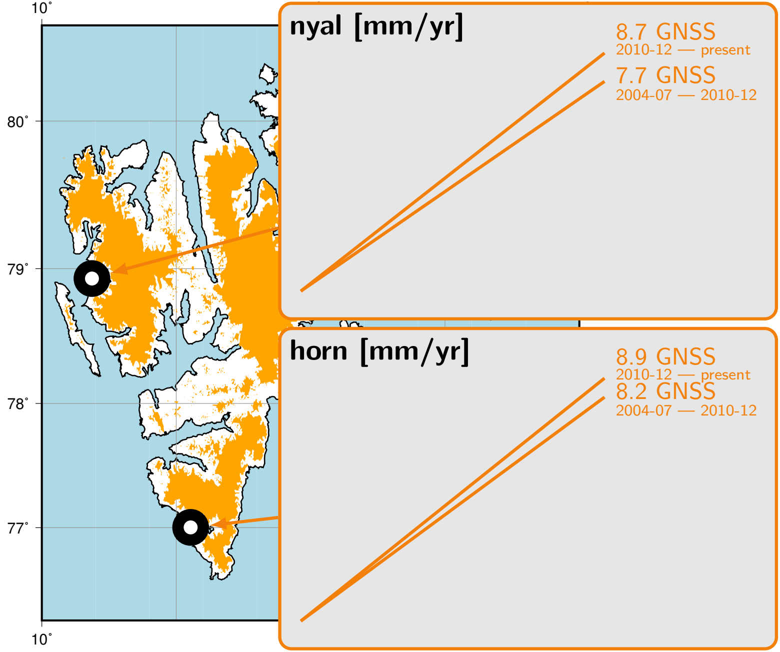


Comparison of models with observations



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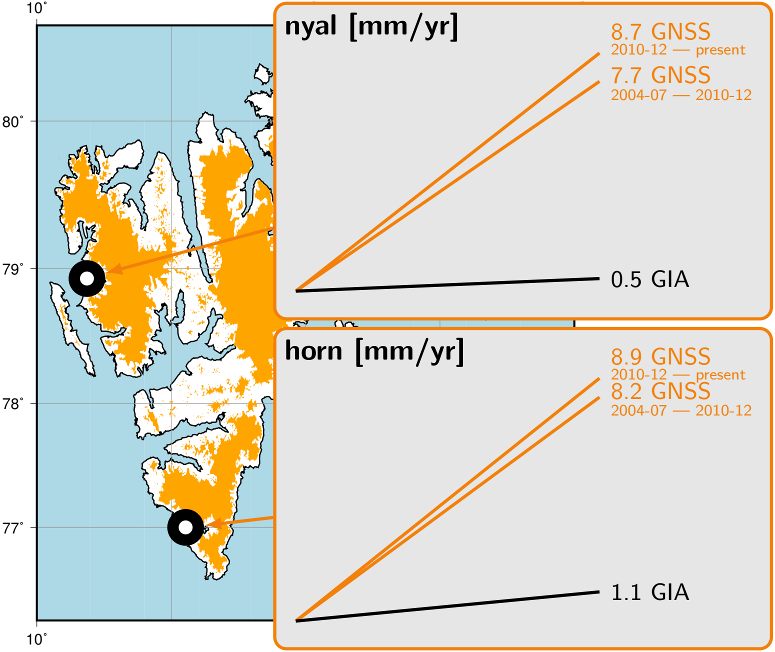

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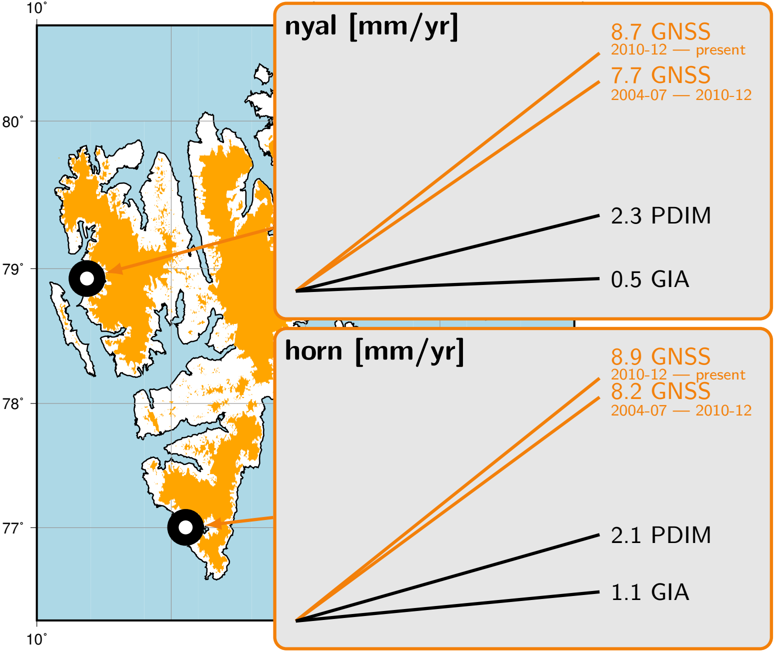

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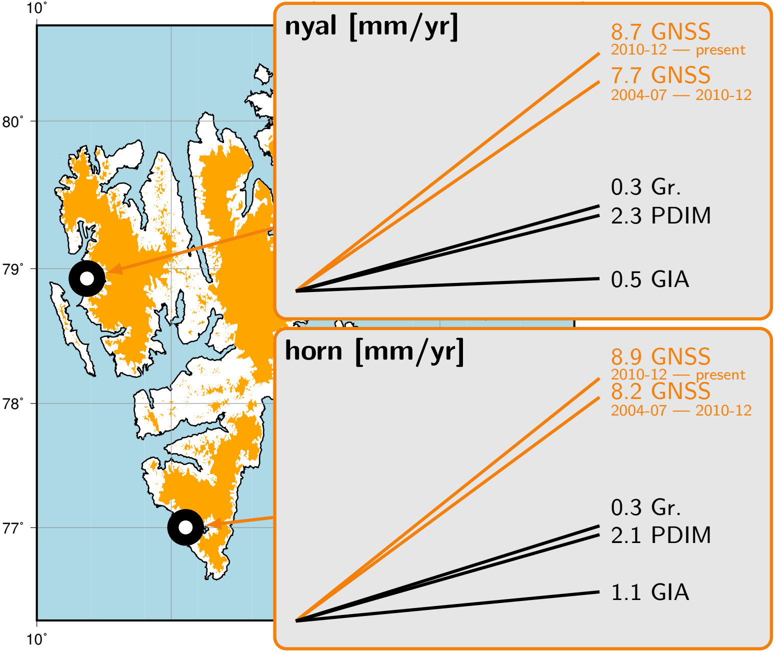

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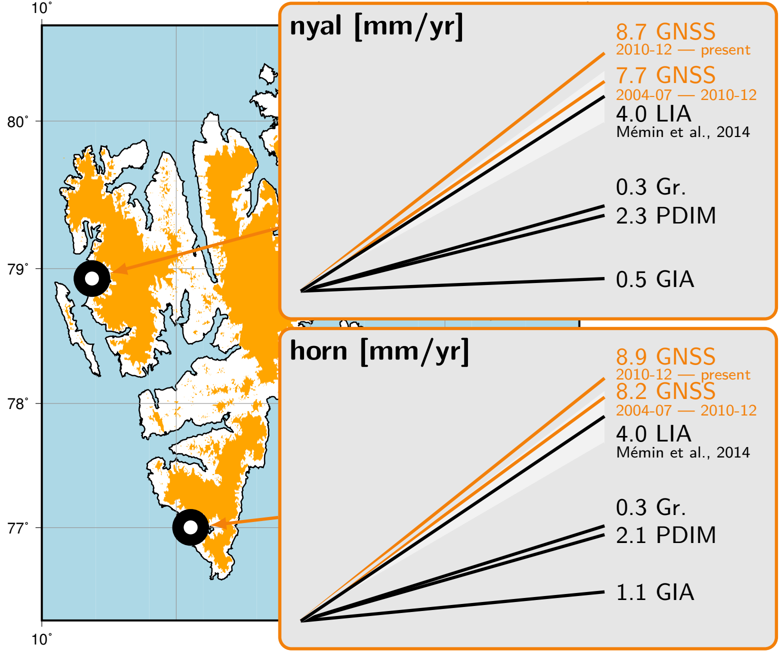
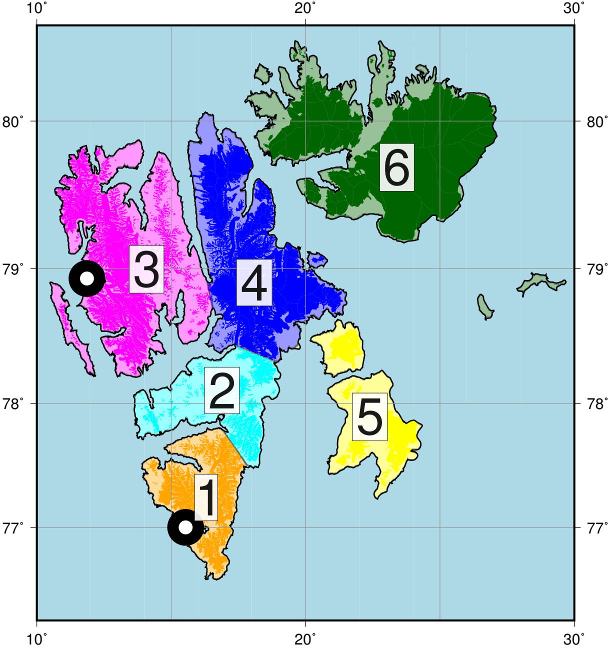


Regional loading discrimination



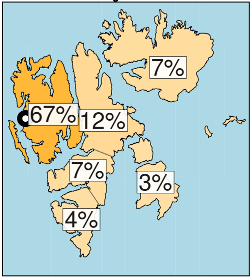
no	area [km^2]	glac. [%]
1	7	71
2	7	35
3	14	53
4	12	74
5	6	41
6	15	71
total	61	60

Conclusions

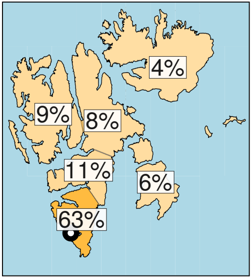
Regional loading discrimination

contribution of selected areas in total load signal

nyal



horn



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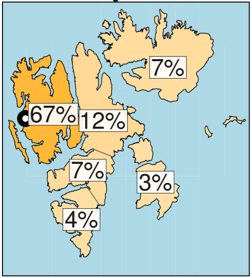
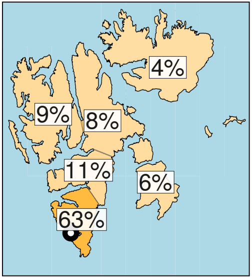


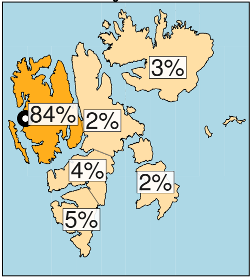
horn



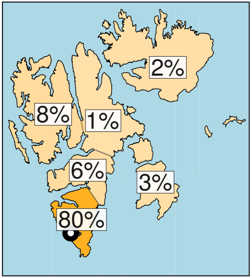
assuming uniform mass loss over glaciated area

using realistic MB model

nyal

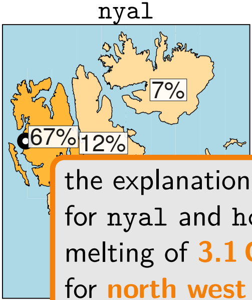


horn

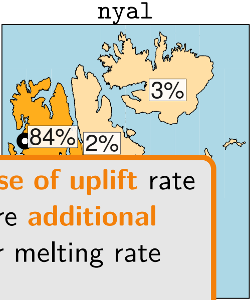


Regional loading discrimination

contribution of selected areas in total load signal

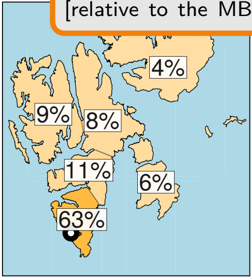


assuming uniform mass loss over

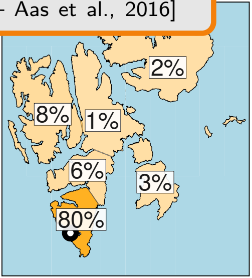


the explanation of recent **increase of uplift** rate for `nyal` and `horn` station require **additional** melting of **3.1 Gt/yr** with higher melting rate for **north west** Spitsbergen

[relative to the MB model for Svalbard – Aas et al., 2016]



using realistic MB model



Conclusions

- We presented,
  - new results from `horn` GNSS site
  - update of the uplift rate for `nyal` and `nya1` GNSS site
  - recent acceleration of uplift rates for Svalbard as the result of increased melting
  - differences of uplift rates for `horn` and `nyal` sites points out regional (north west/south west) melting differences
  - uncertainties in models of uplift components
- We consider,
  - AG measurements in Hornsund

Thank you for attention

We acknowledge all geoscience data and products providers

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backup slides

References

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