

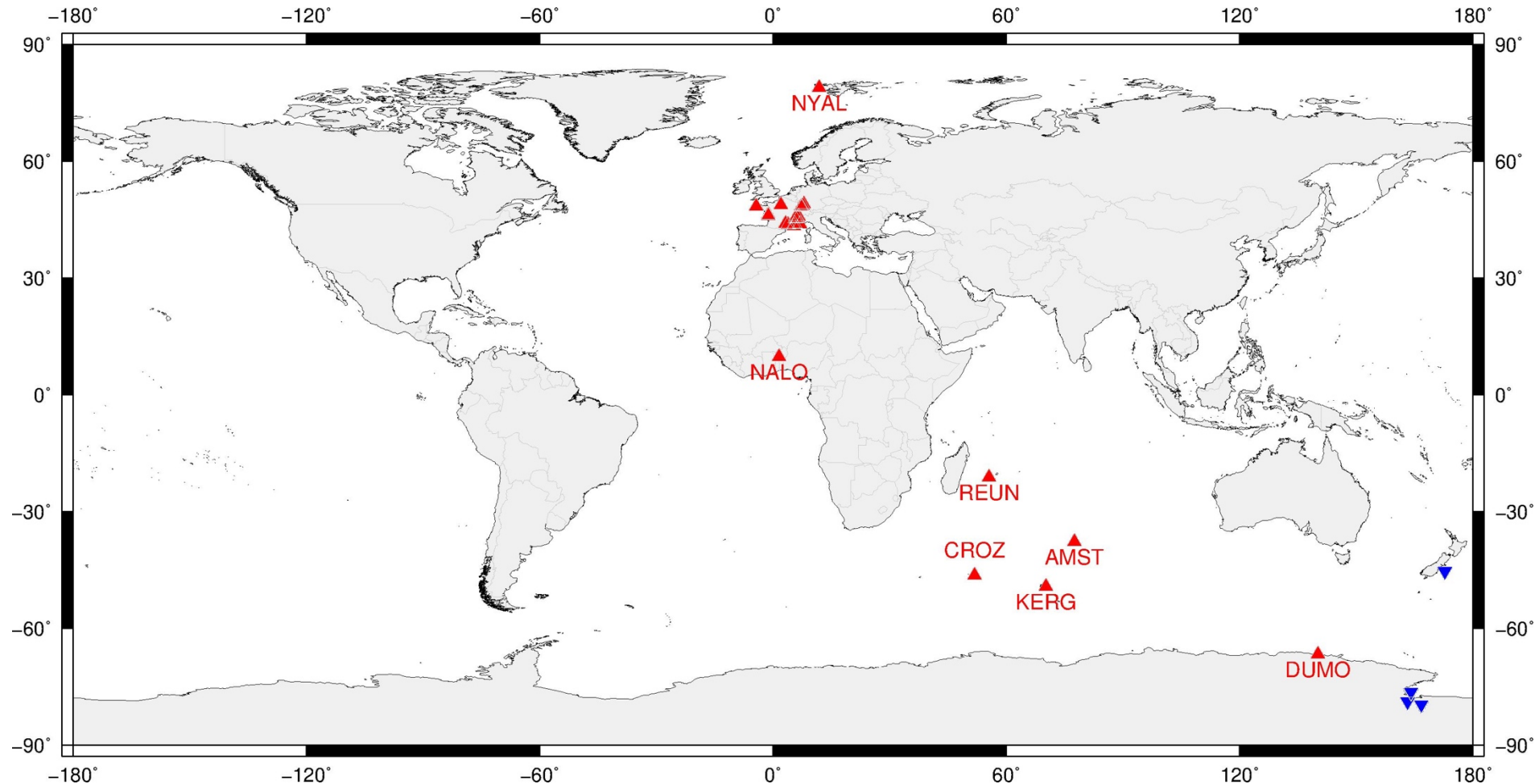
Gravimétrie polaire

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Points répétés gravi. absolue



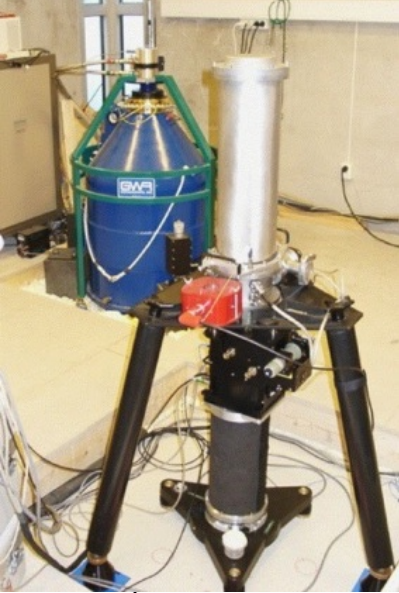
Svalbard (Ny Ålesund), Antarctique (Dumont d'Urville) et Océan Indien (Amsterdam, Crozet et Kerguelen)

Bases américaines (Scott & McMurdo), néo-zélandaise (Cape Roberts) & italienne (Mario-Zucchelli) en 2011 et 2015.

Gravimétrie polaire : objectifs

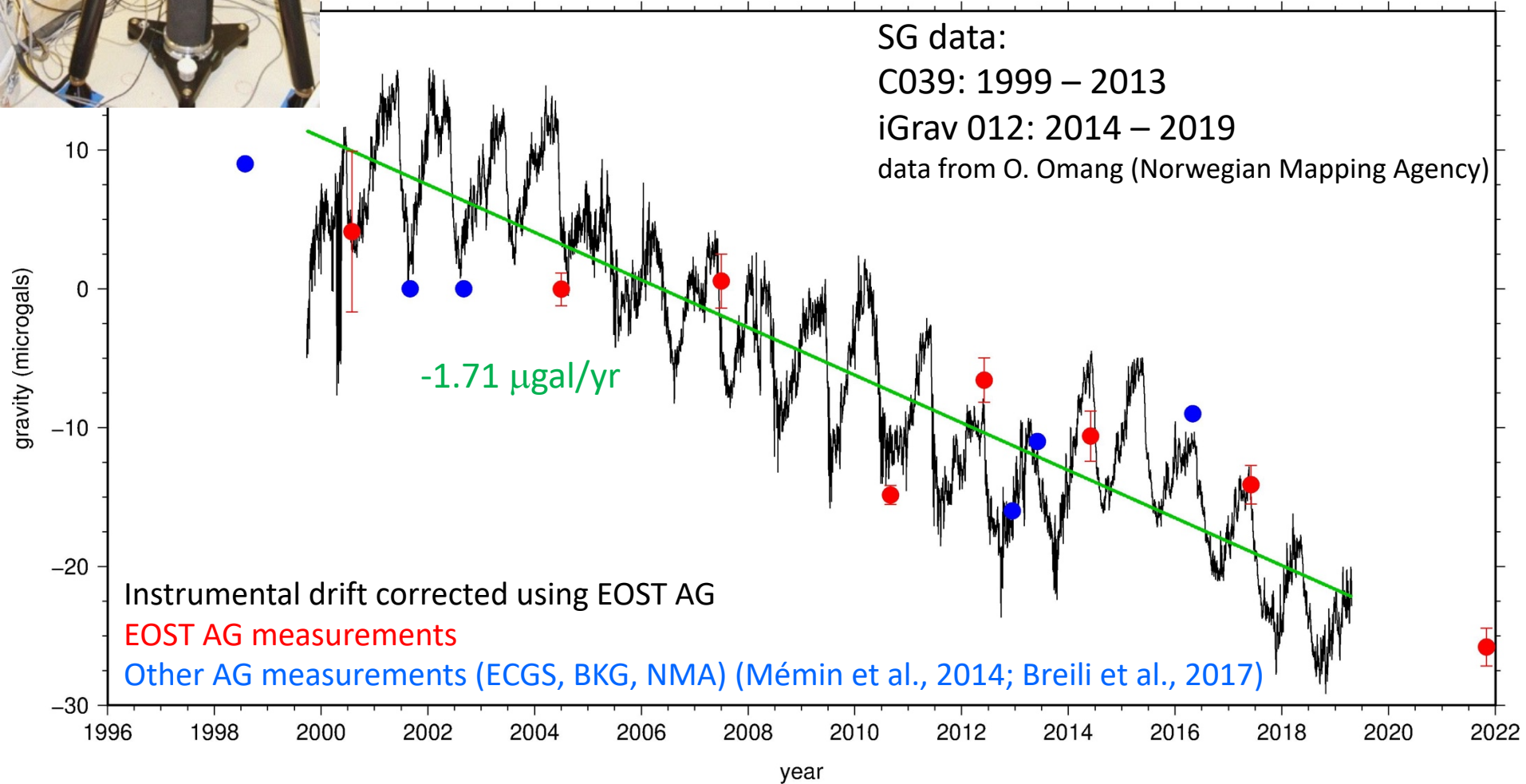
- Mesure absolue (FG5 #206) tous les 2 ans au Svalbard, tous les 4 ans en Antarctique et dans l'Océan Indien (projets IPEV sur 4 ans).
- Séparation des contributions dues aux fontes passées (rebond post-glaciaire) et actuelles.
- Détermination de la rhéologie visco-élastique du manteau.
- Combinaison avec d'autres mesures géodésiques, notamment les composantes verticales GNSS et DORIS.
- Ny Ålesund : site privilégié (gravi. supra., "core site" pour l'ITRF...).

Variations de gravité à Ny-Ålesund



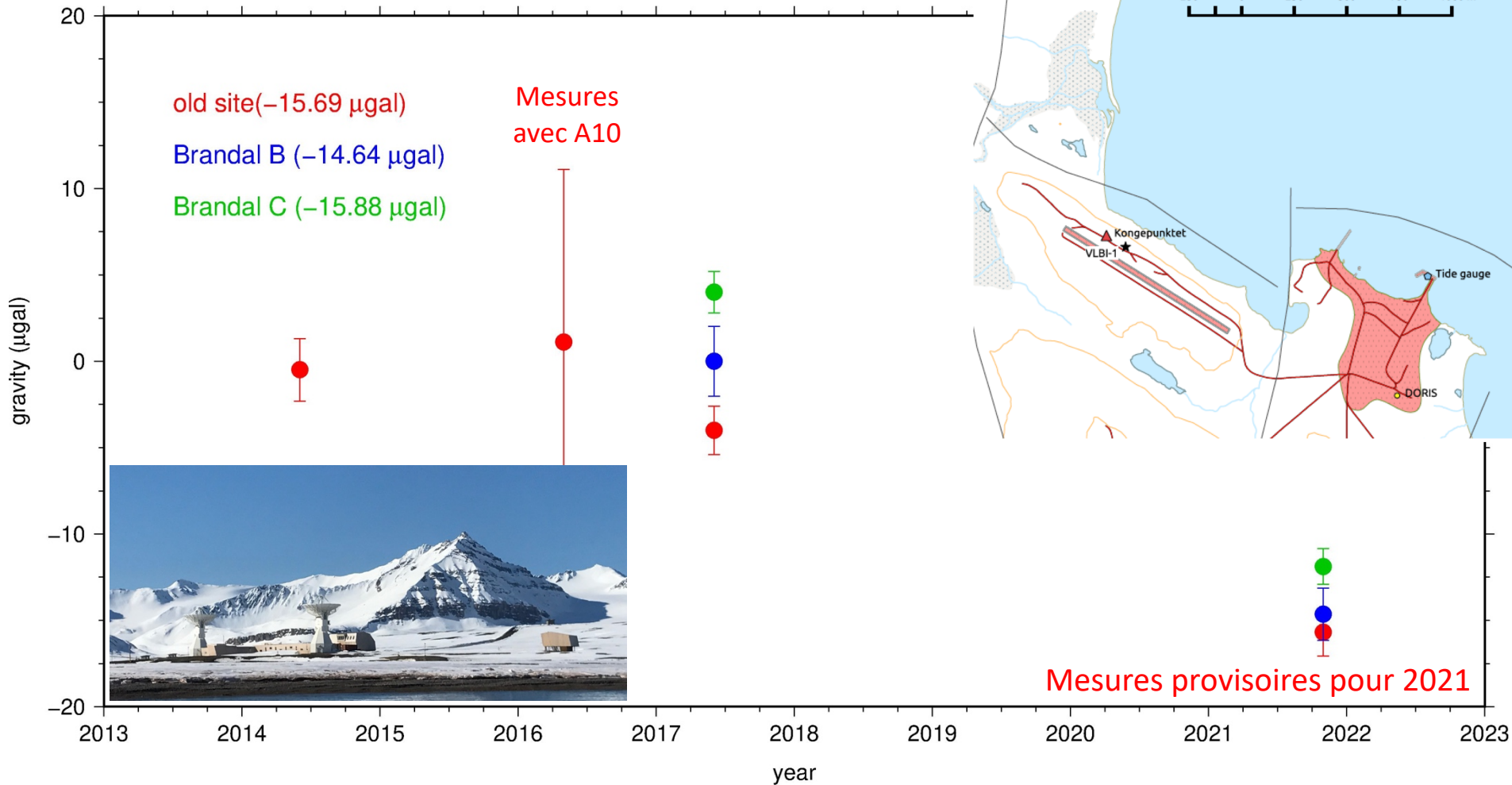
AG & SG measurements
(from Ihde et al., 2005)

@ Kongepunktet

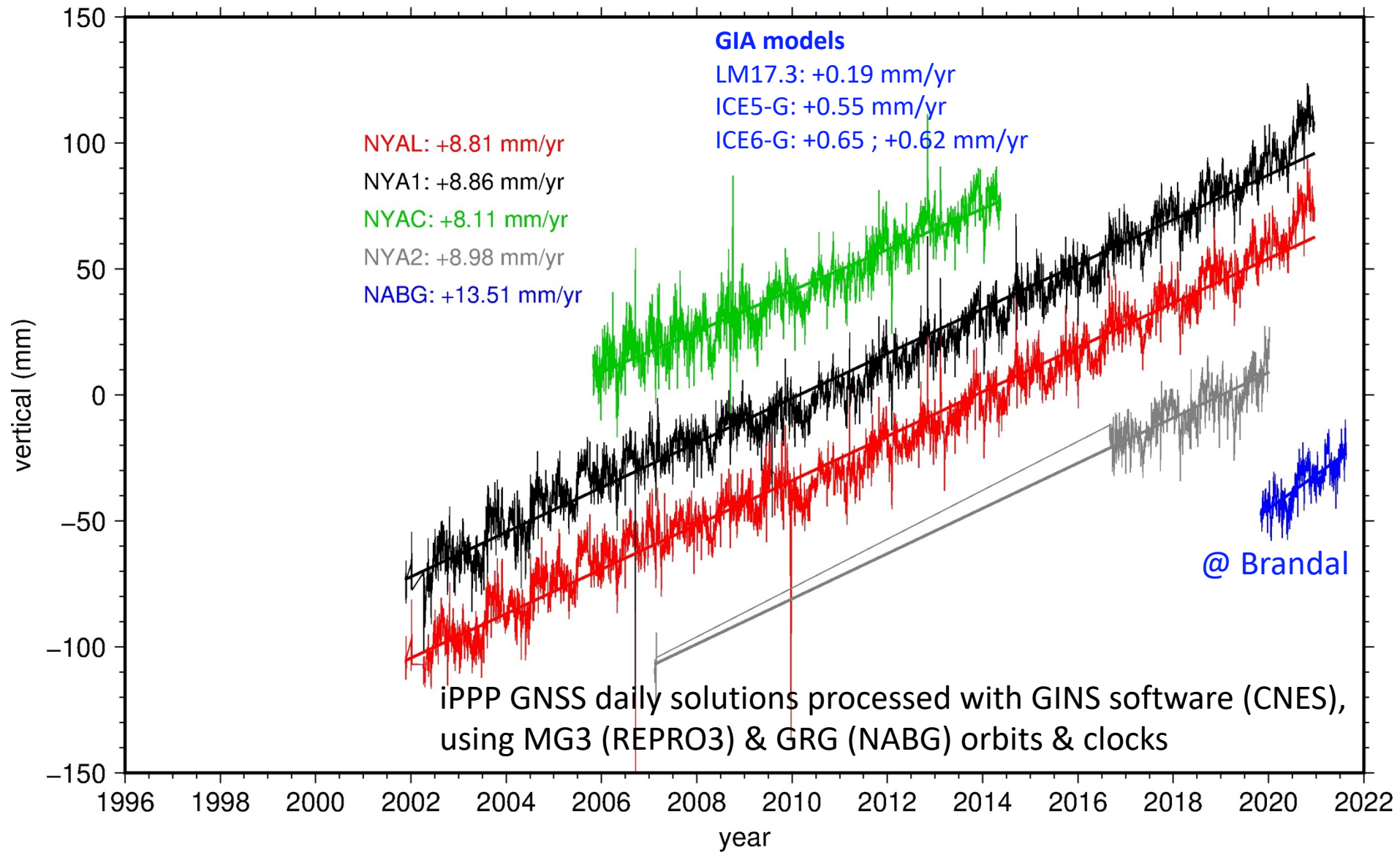


Variations de g suivant le site

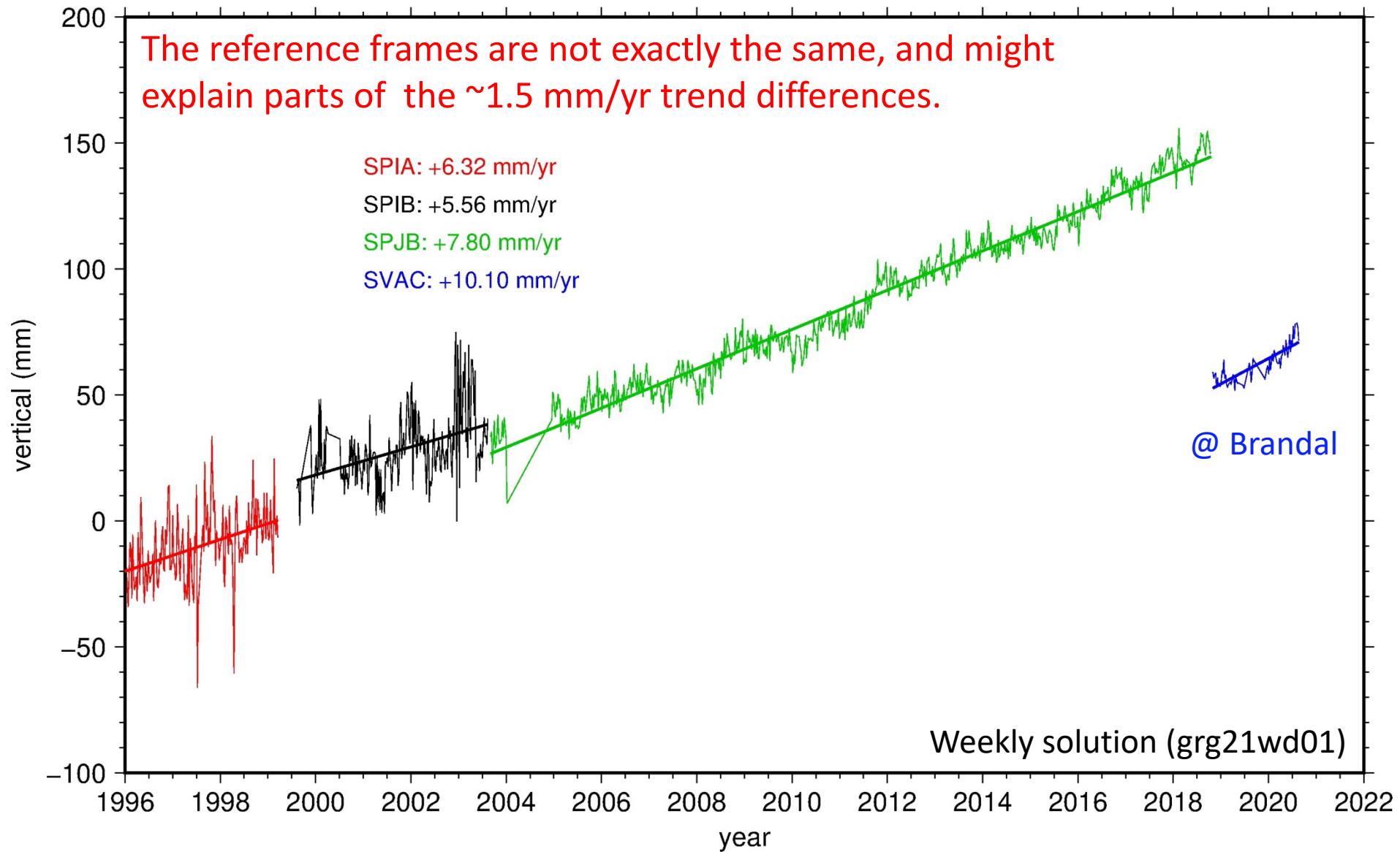
Différences entre oct. 2021 et mai 2017



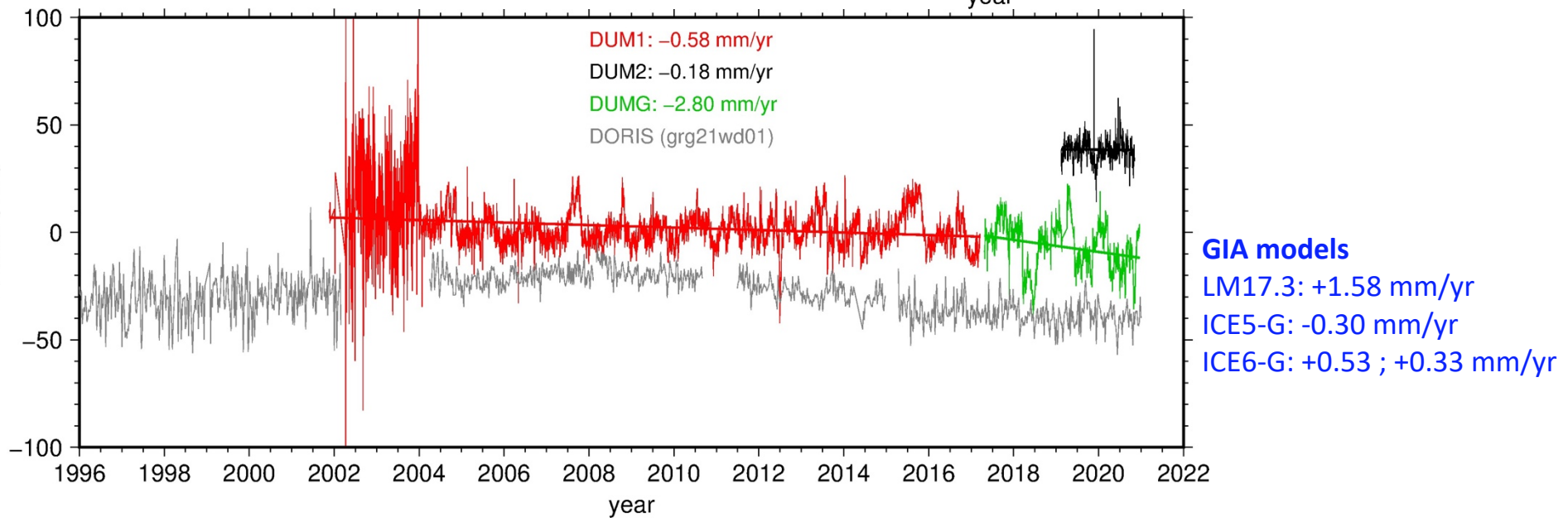
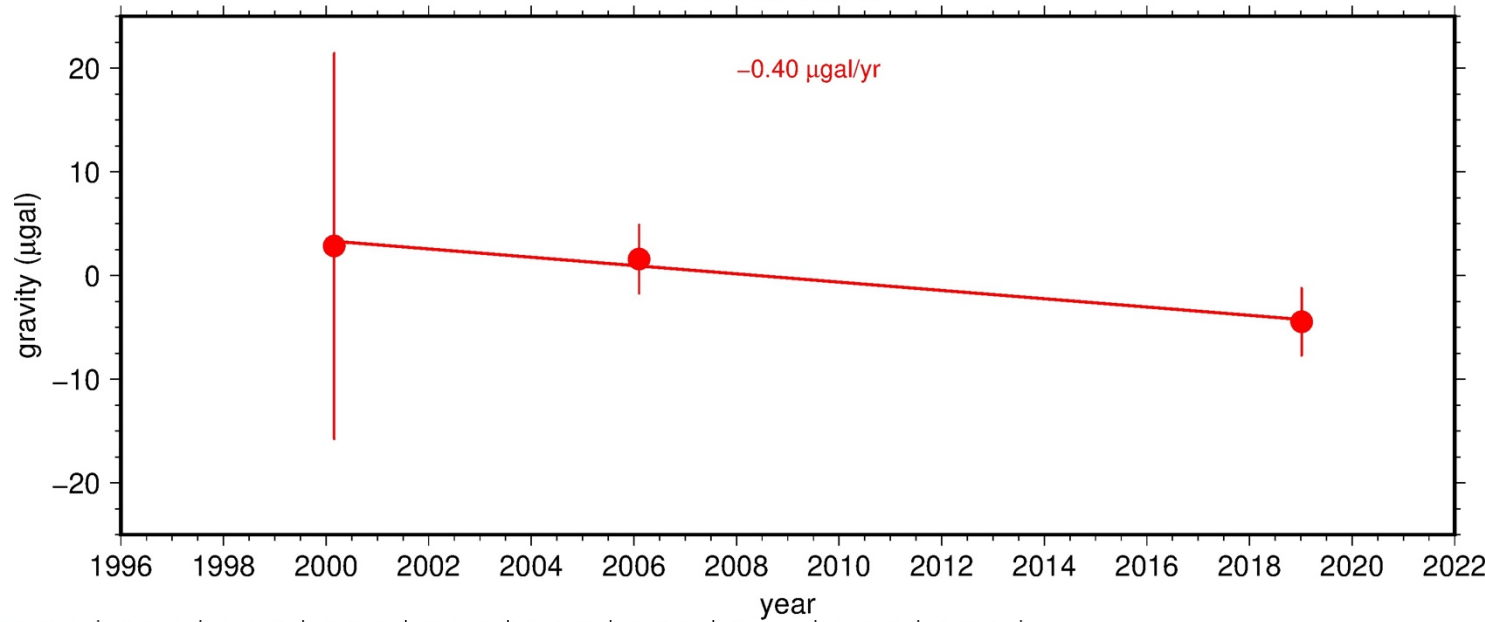
Vertical displacements (GNSS)



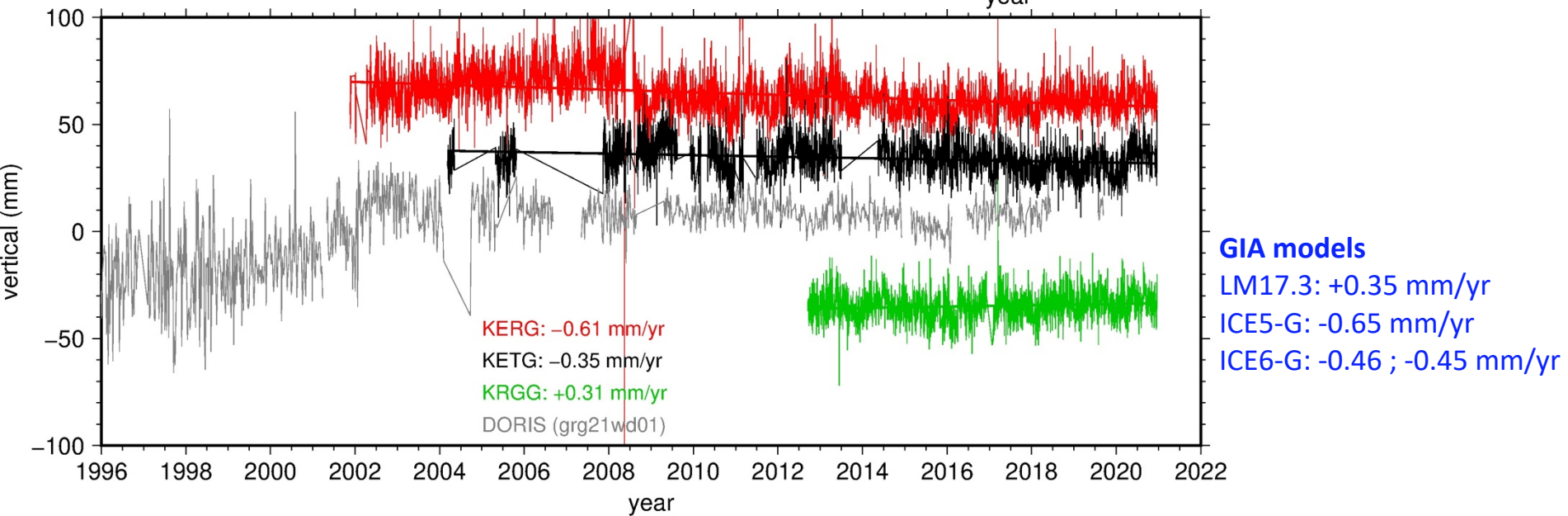
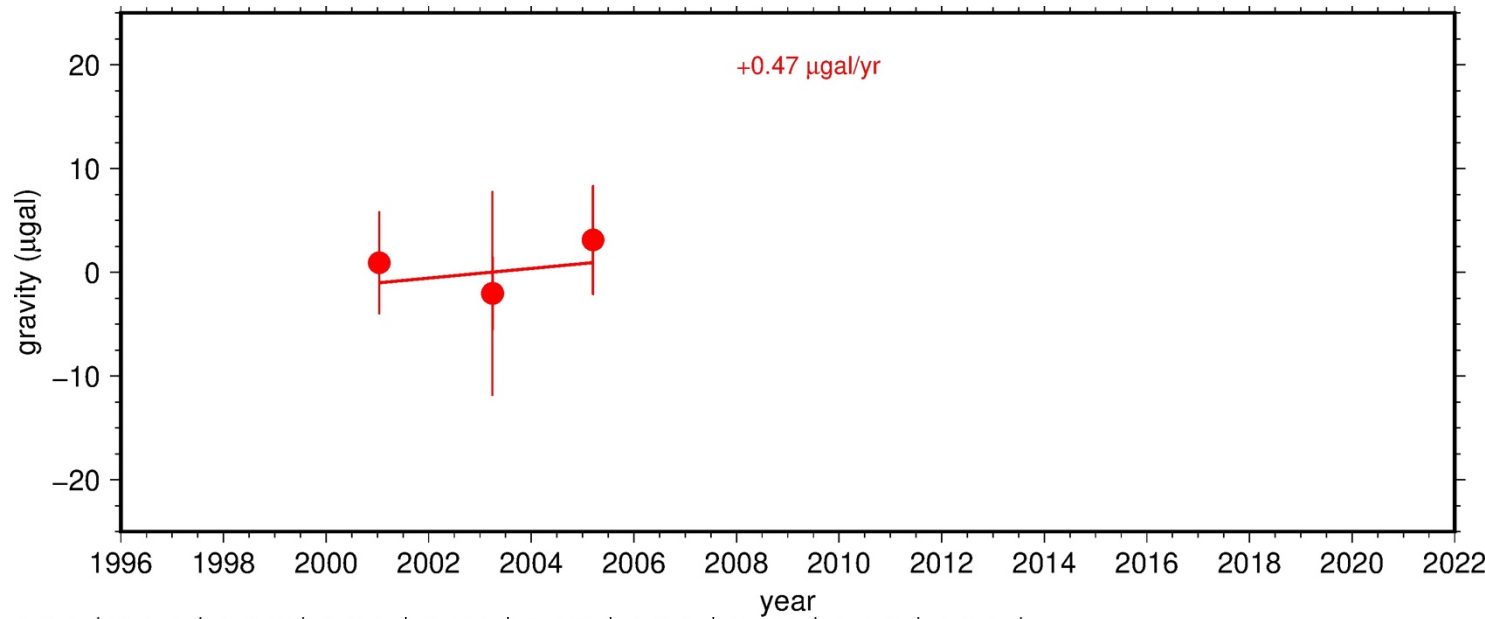
Vertical displacements (DORIS)



Dumont d'Urville (Antarctique)



Kerguelen (Océan Indien)



Rapport dg/dh (gravité/dep. vertical)

Ny-Ålesund (Svalbard): $dg/dh = -0.197 \mu\text{gal}/\text{mm}$

($dg/dt = -1.71 \mu\text{gal}/\text{yr}$ & $dh/dt = 8.70 \text{ mm}/\text{yr}$)

Valeurs “théoriques” :

- $-0.260 \mu\text{gal}/\text{mm}$ (élastique, de Linage et al., 2007)
- $-0.154 \mu\text{gal}/\text{mm}$ (rebond visco-élastique, Wahr et al., 1995)

Autres exemples :

- **Scandinavie** (Olsson et al., 2015):

$$dg/dh = -0.163 \mu\text{gal}/\text{mm}$$

- **Groenland** (Kulusuk, van Dam et al., 2017):

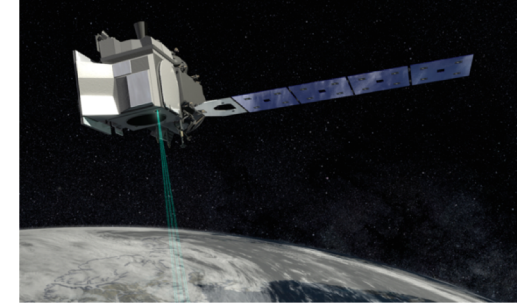
$$dg/dh = -0.224 \pm 0.05 \mu\text{gal}/\text{mm}$$

$$(dg/dt = -1.95 \pm 0.16 \mu\text{gal}/\text{yr}, dh/dt = 8.71 \pm 0.13 \text{ mm}/\text{yr})$$

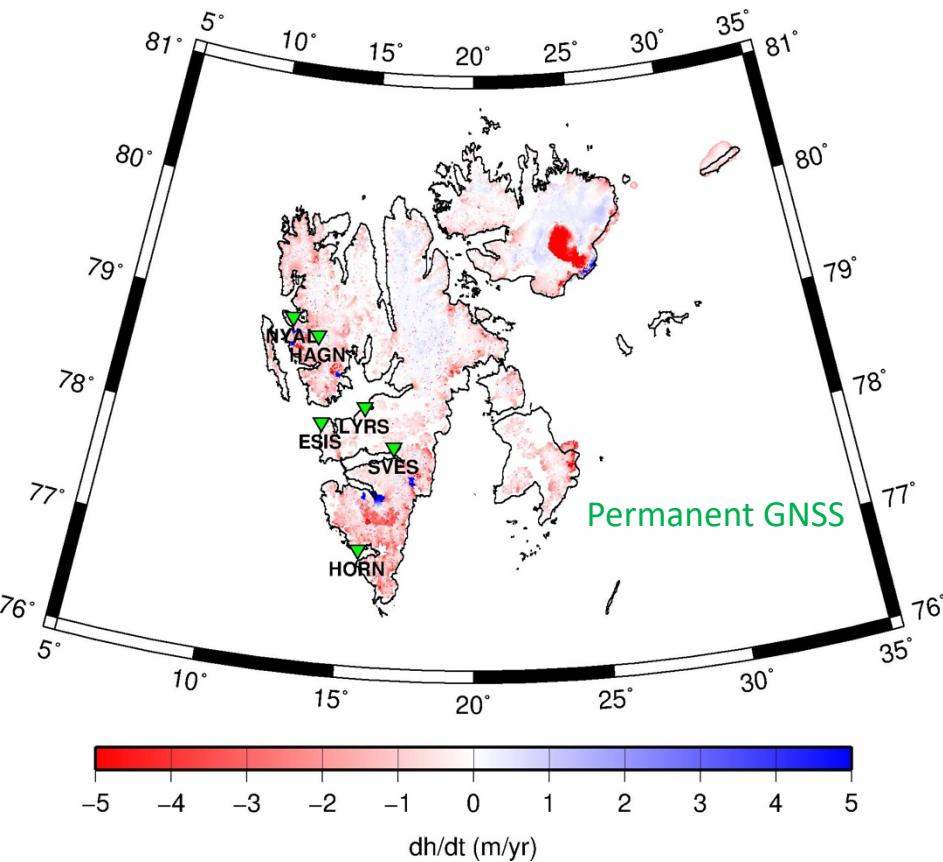
$$(GIA: 3.90 \pm 1.7 \text{ mm}/\text{yr} \quad \text{PDIM: } 4.22 \pm 1.4 \text{ mm}/\text{yr})$$



Present-Day Ice Melting (radar/laser altimetry)

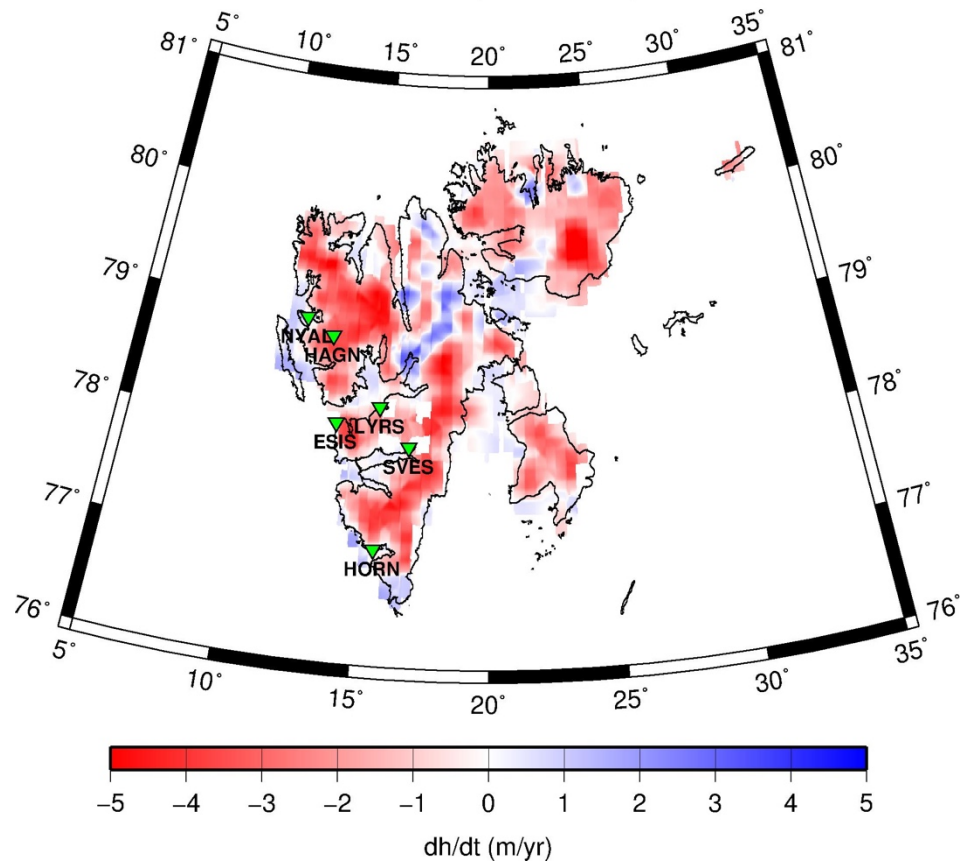


CryoSat-2 (2011–2017)

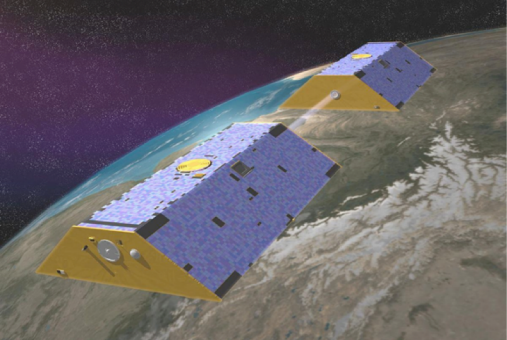


-27.5 km³/yr (Morris et al., 2019; 2020)

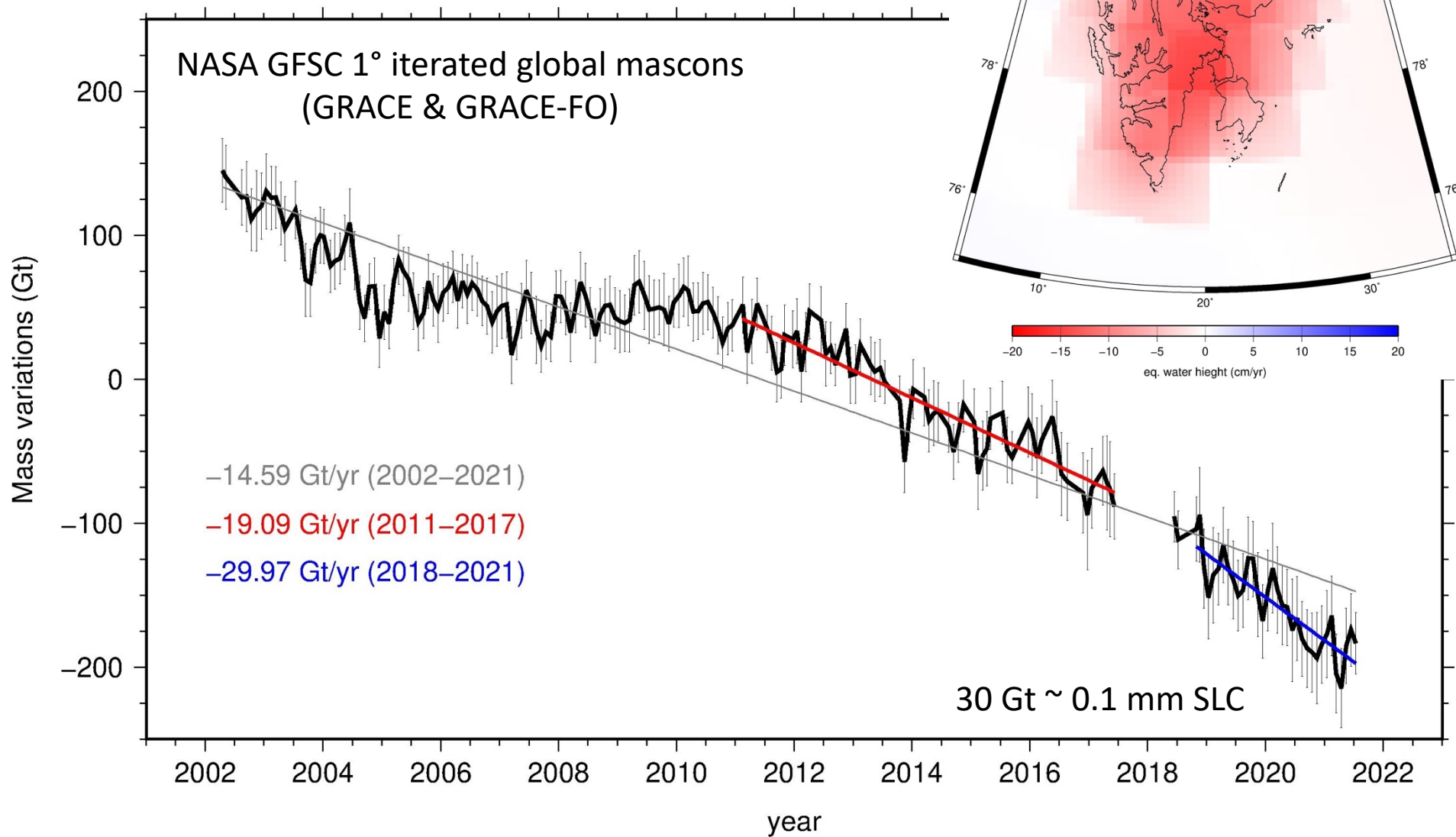
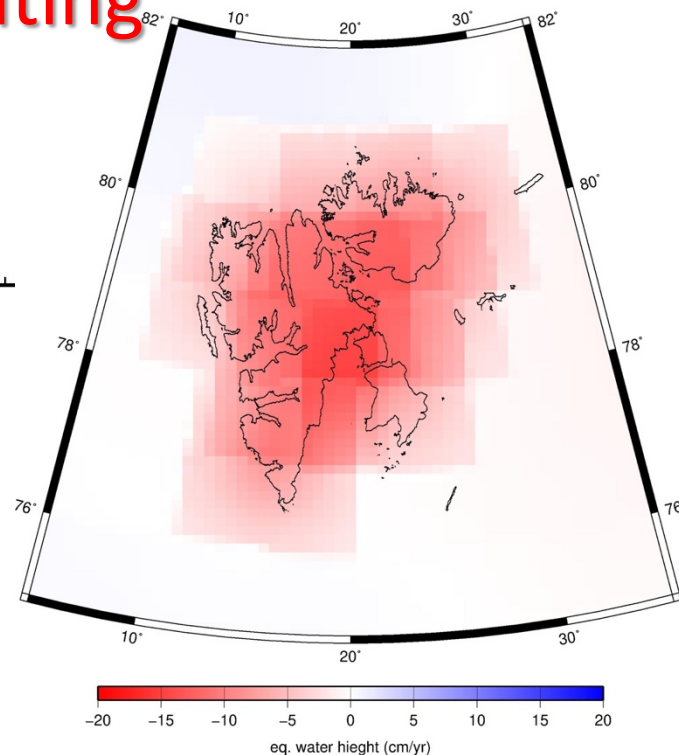
ICESat-2 (2019–2020)



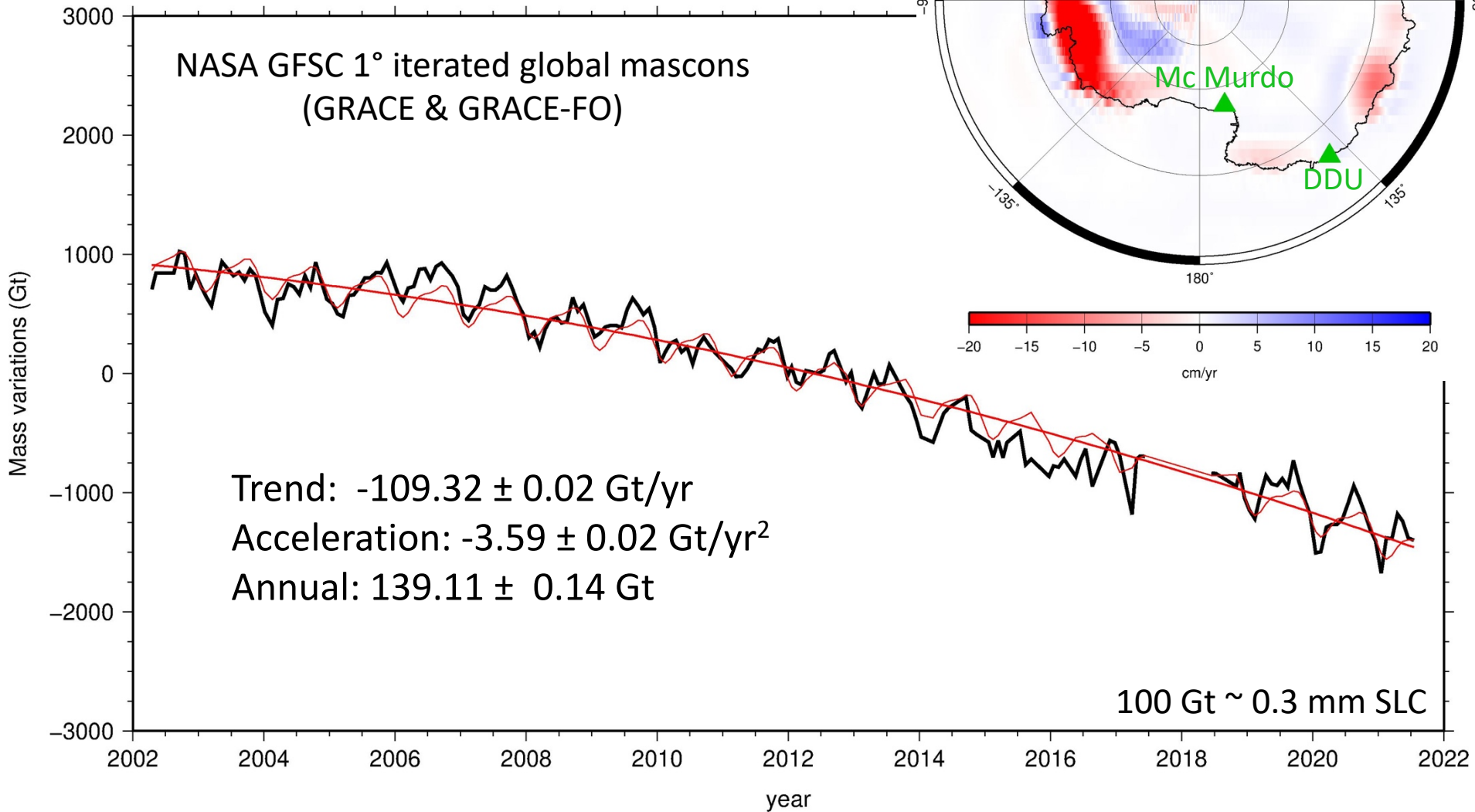
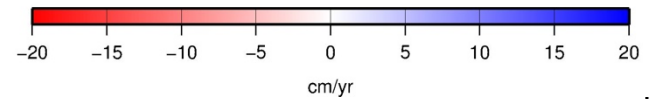
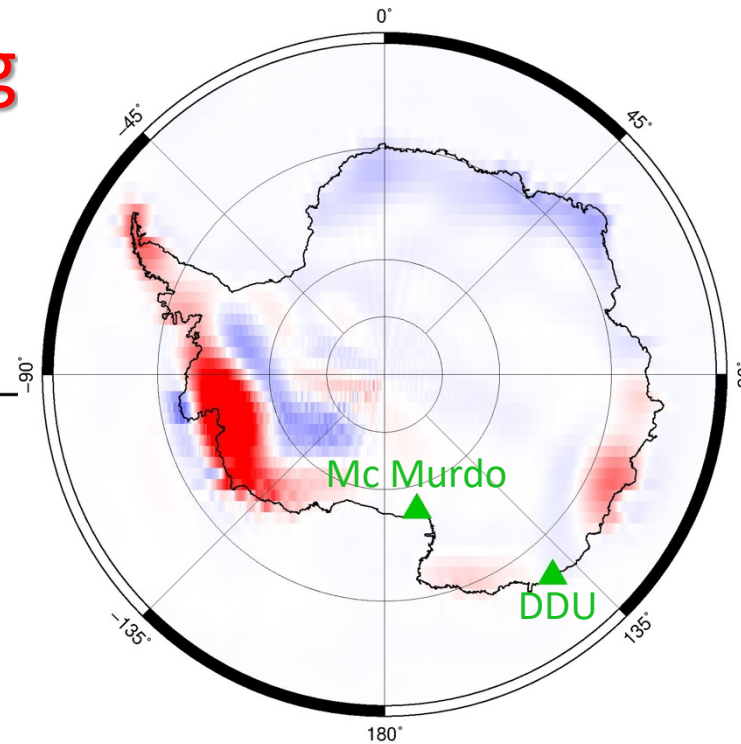
-58.1 ± 3.5 km³/yr (Mazzolo, 2021)



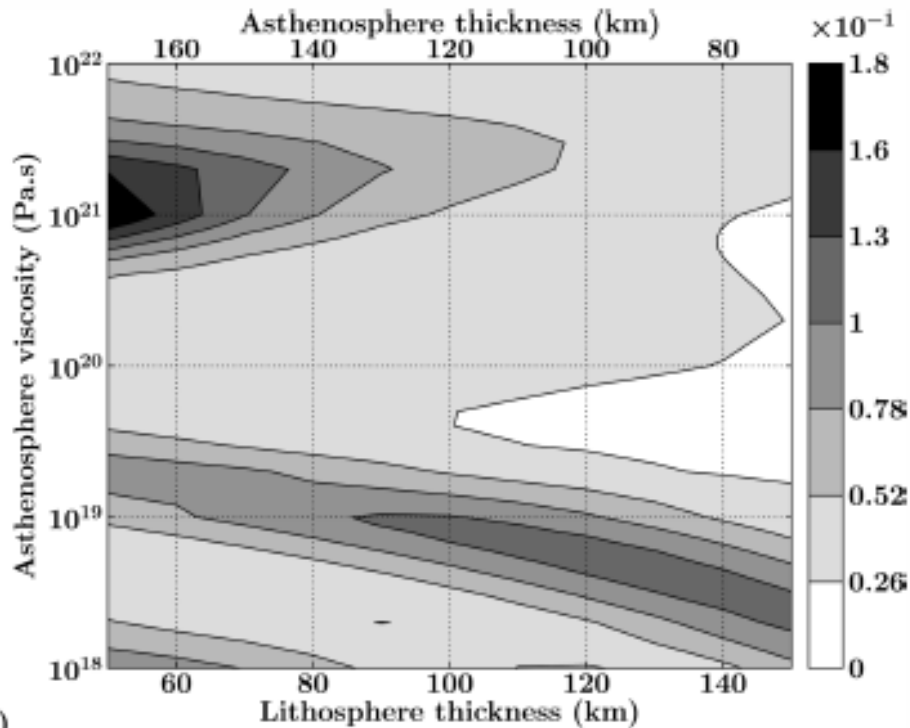
Present-Day Ice Melting Svalbard



Present-Day Ice Melting Antarctica

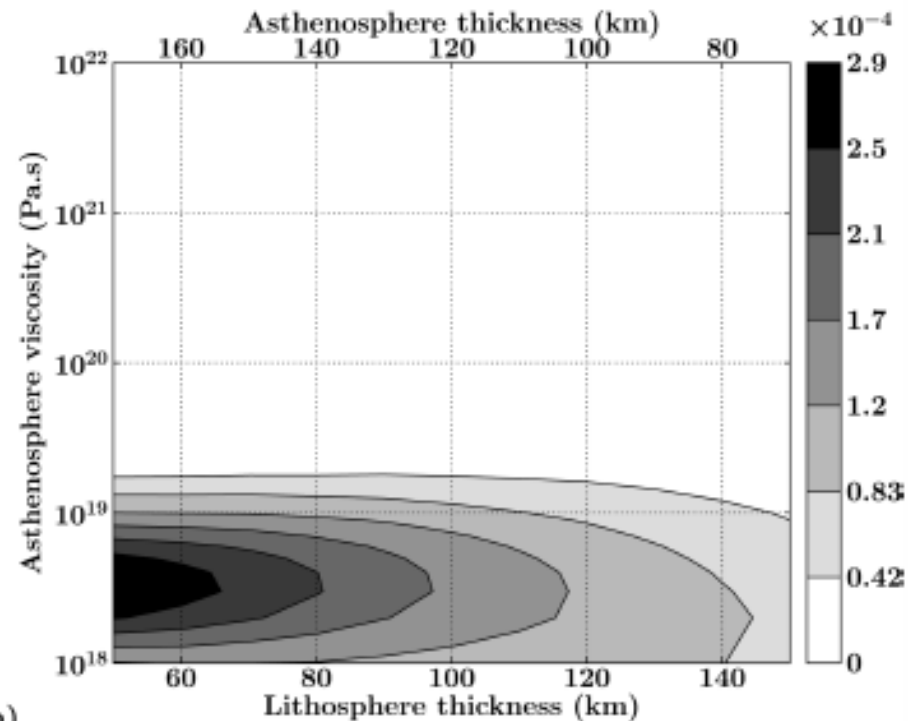


Constraints on the Earth's rheology

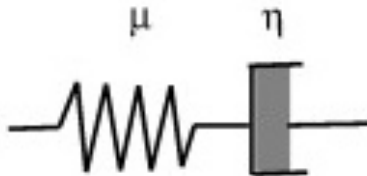


(a) Glacial Isostatic Adjustment
(b) Little Ice Age

Variance of the displacement rate (mm^2/yr^2) for different viscosity (asthenosphere) and thickness (asthenosphere and lithosphere) (from Mémin et al., 2014).



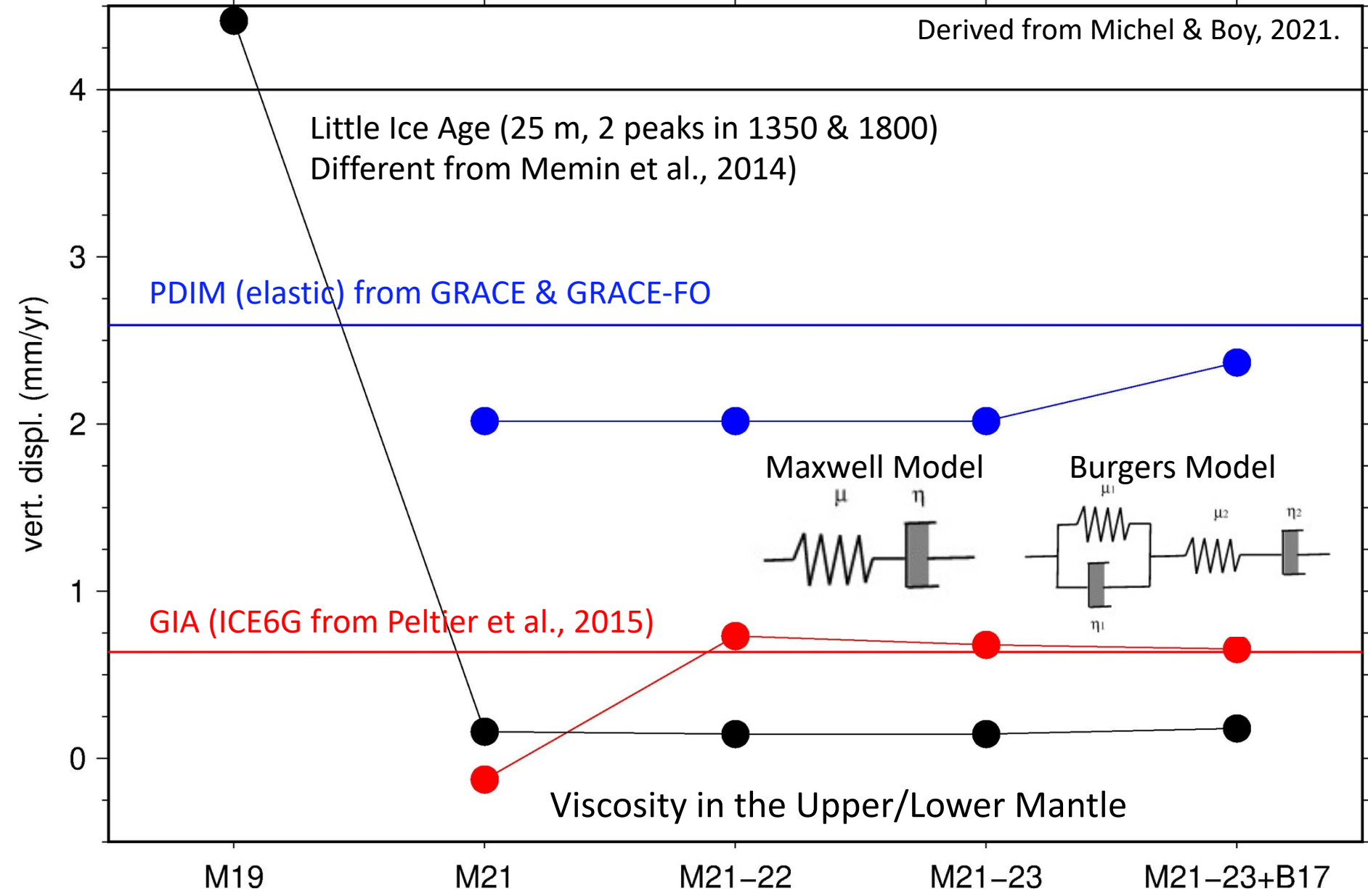
Maxwell Model



(b)

Sensibilité à la rhéologie du Manteau

Derived from Michel & Boy, 2021.

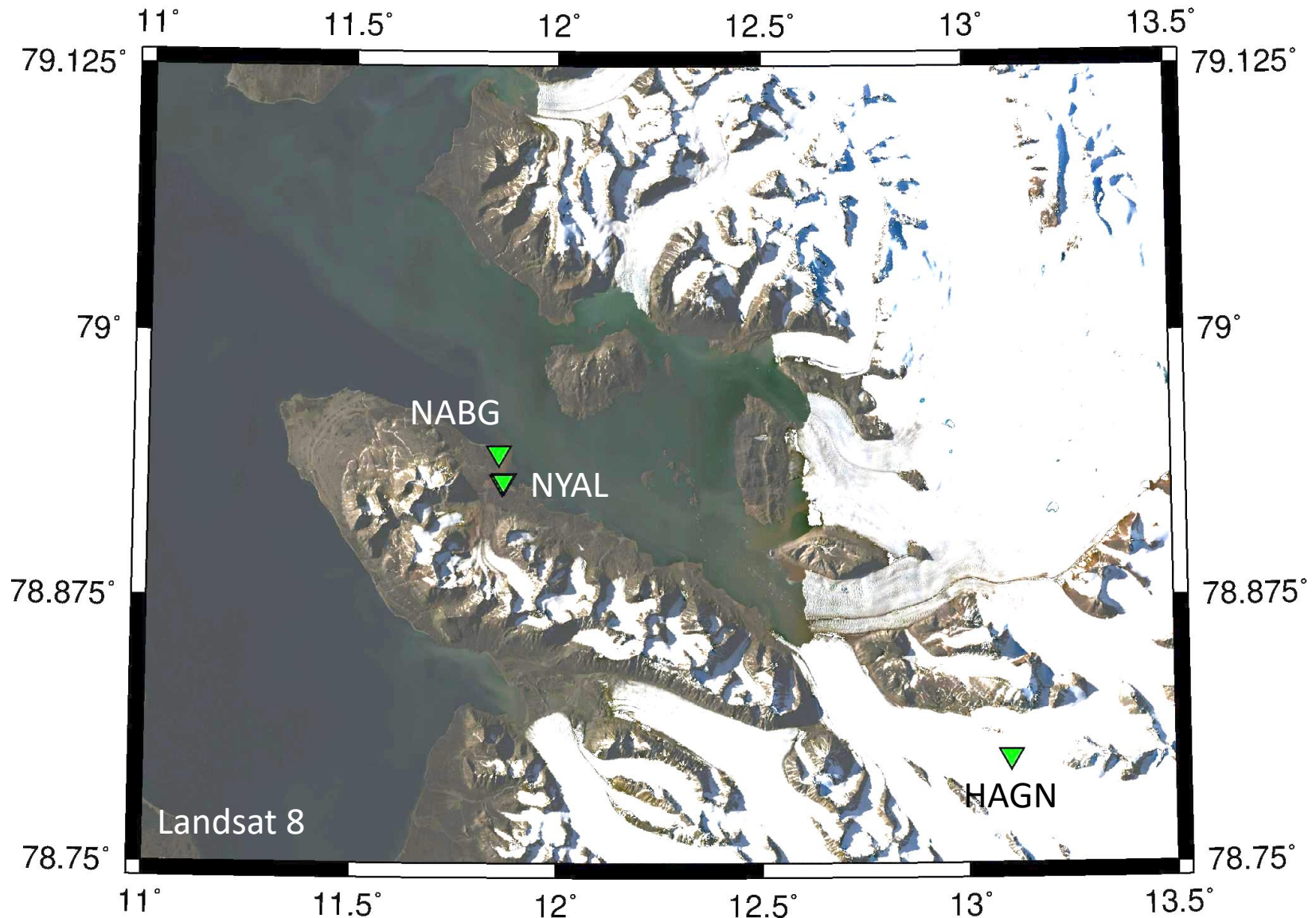


Conclusions et perspectives

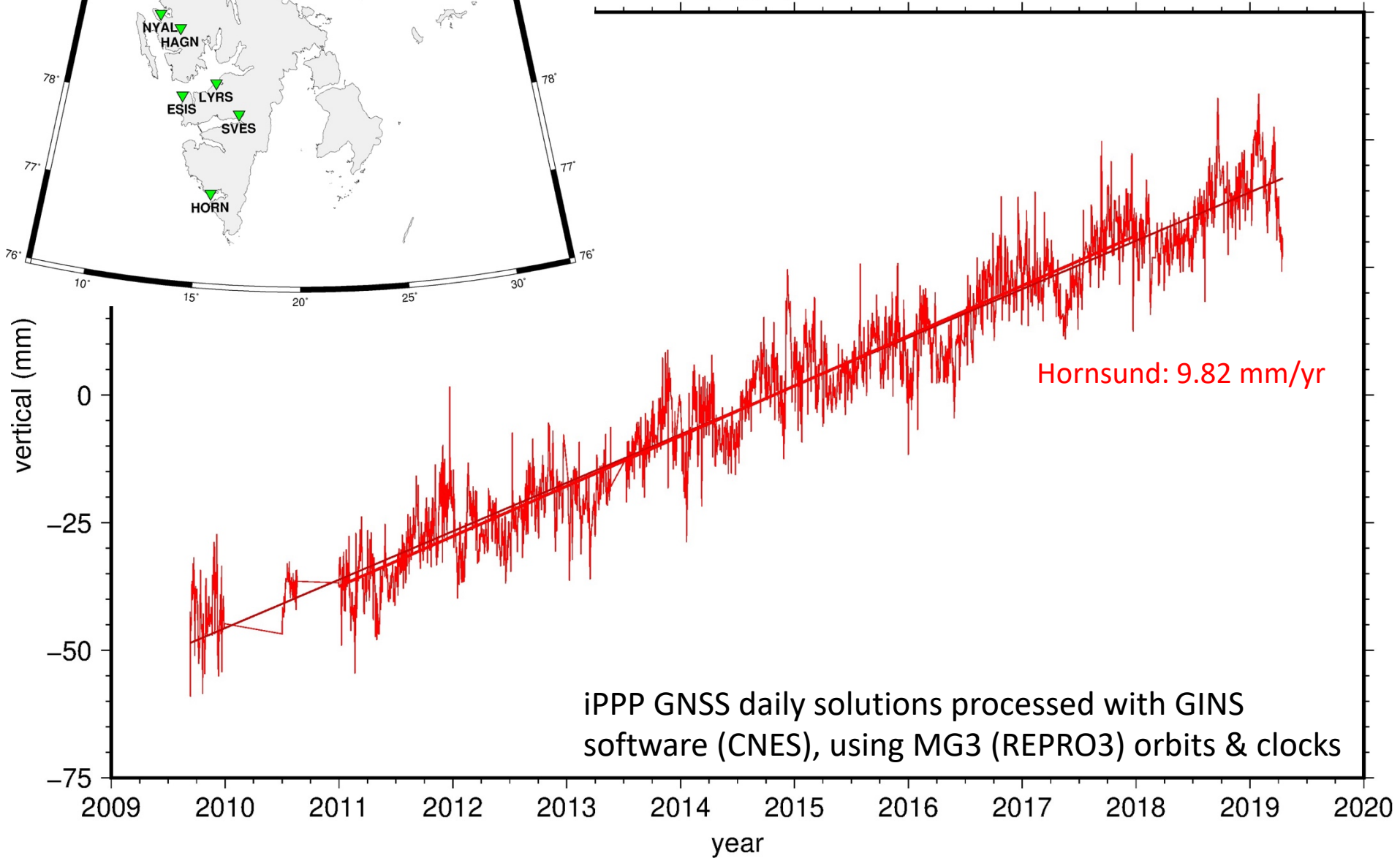
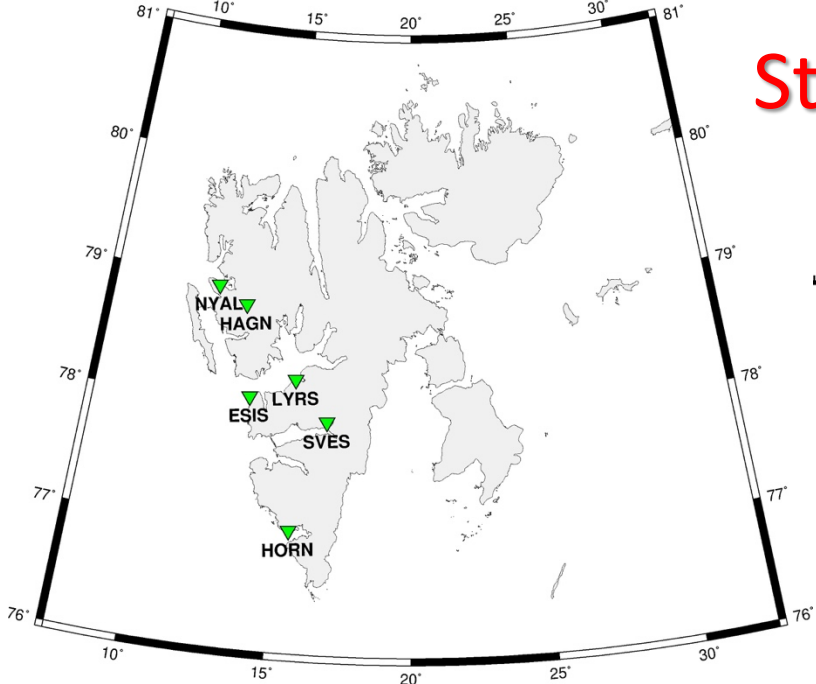
- Compléter les mesures dans l'hémisphère sud (Océan Indien).
- Modélisation des contributions dues aux glaciers proches (Ny Ålesund et Dumont d'Urville).
- Analyse des variations de gravité aux deux sites à Ny Ålesund.
- Unique modèle de Terre (rhéologie de Burger?) pour estimer les contributions du GIA, du petit-âge glaciaire et de la fonte actuelle.
- Améliorer l'histoire de la glace (LIA).

Modélisation des contributions locales

2020/07/01

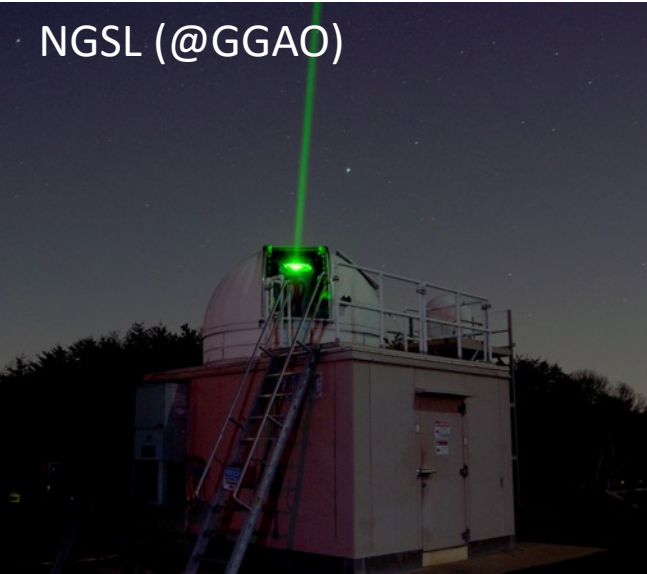


Stations GPS permanentes au Svalbard



Ny-Ålesund Geodetic Observatory

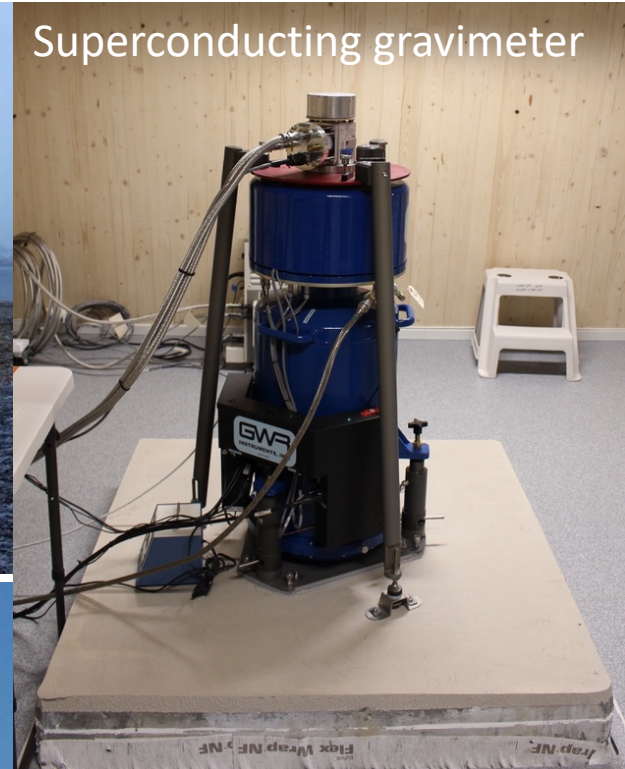
NGSL (@GGAO)



DORIS antenna



Superconducting gravimeter

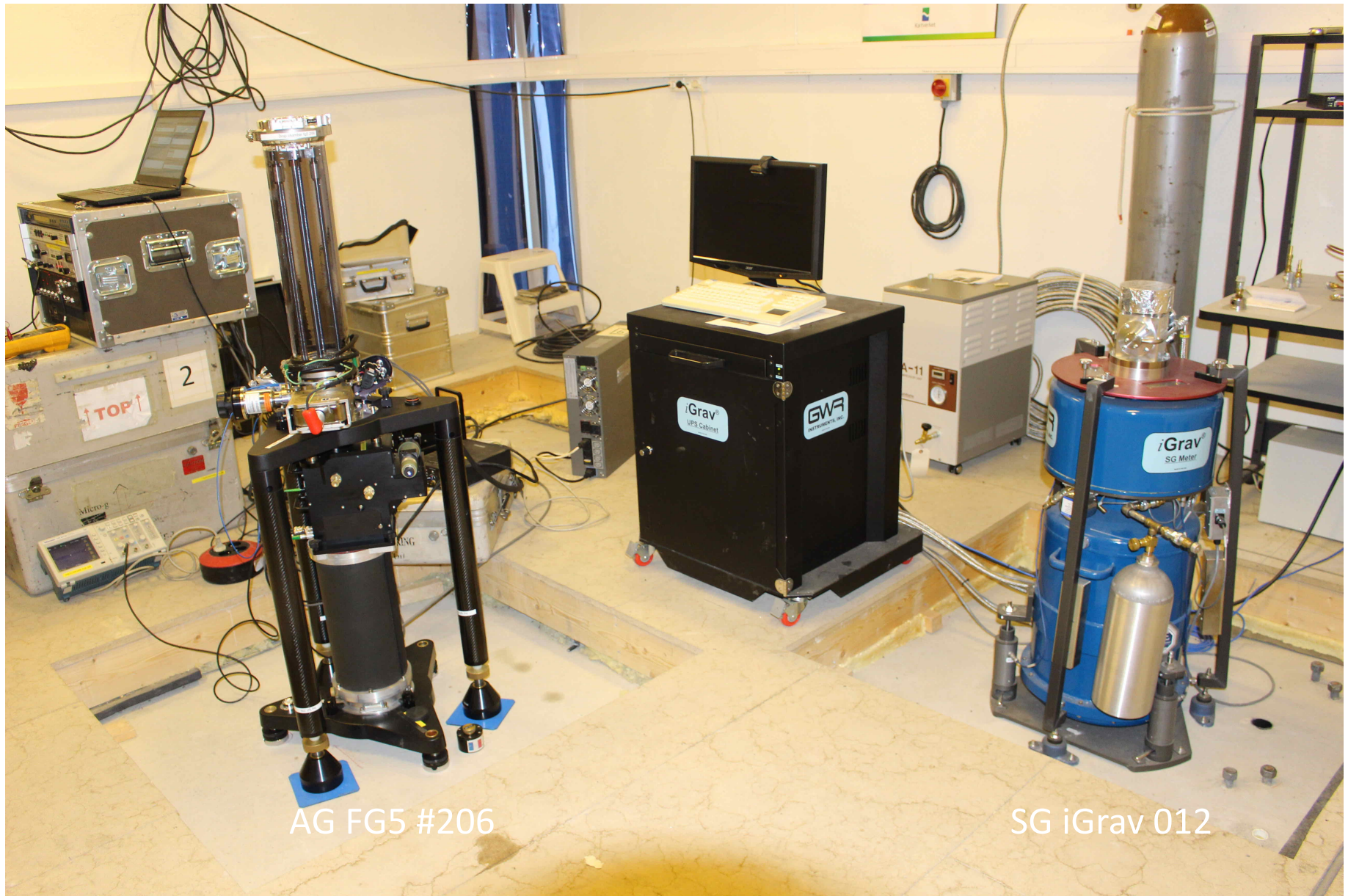


VLBI antennas



New station at Brandal

Gravity Observations (AG / SG)



AG FG5 #206

SG iGrav 012