

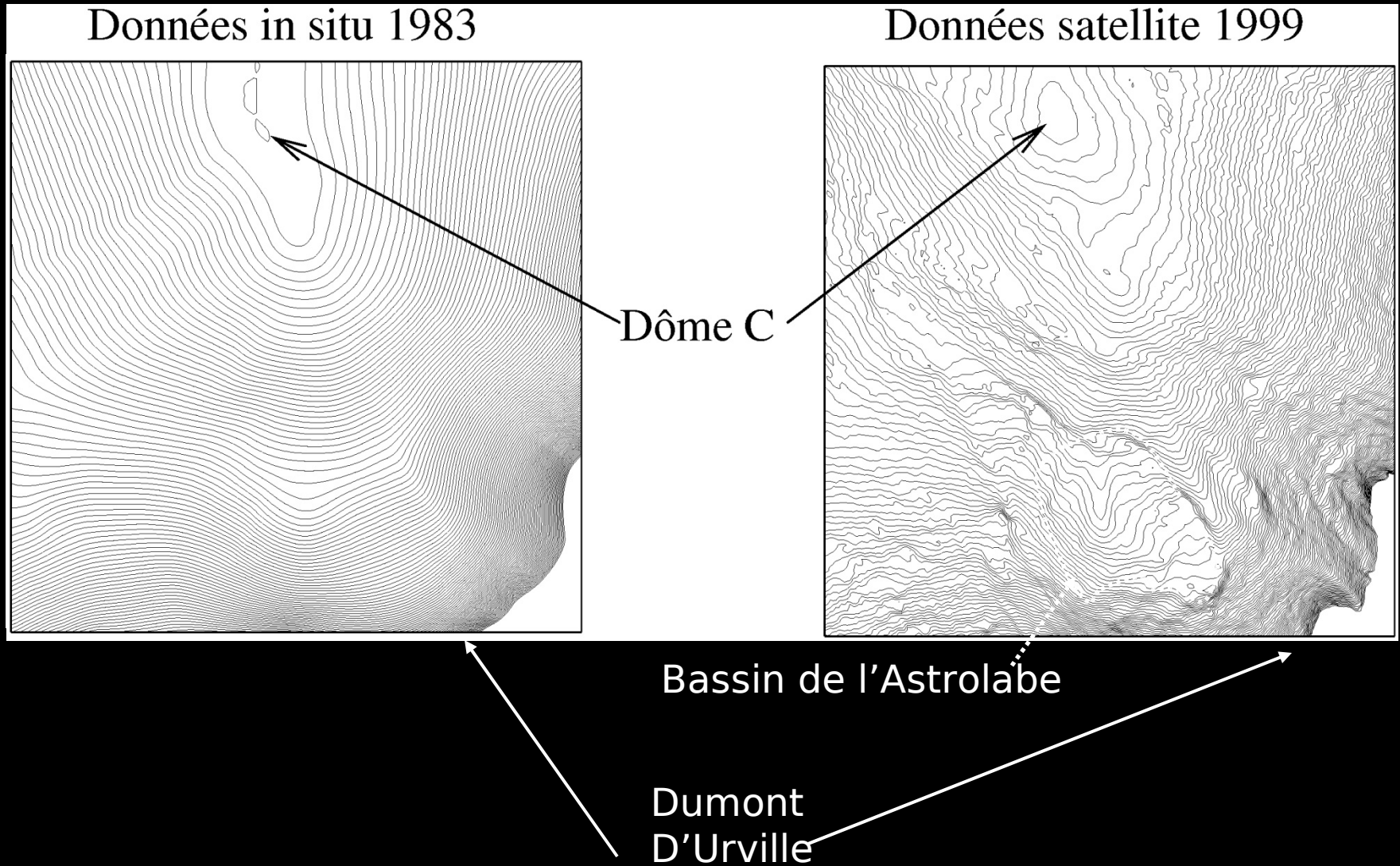
OBSERVATION OF THE ANTARCTICA ICE SHEET BY RADAR ALTIMETRY AND GRAVIMETRY

F. RÉMY

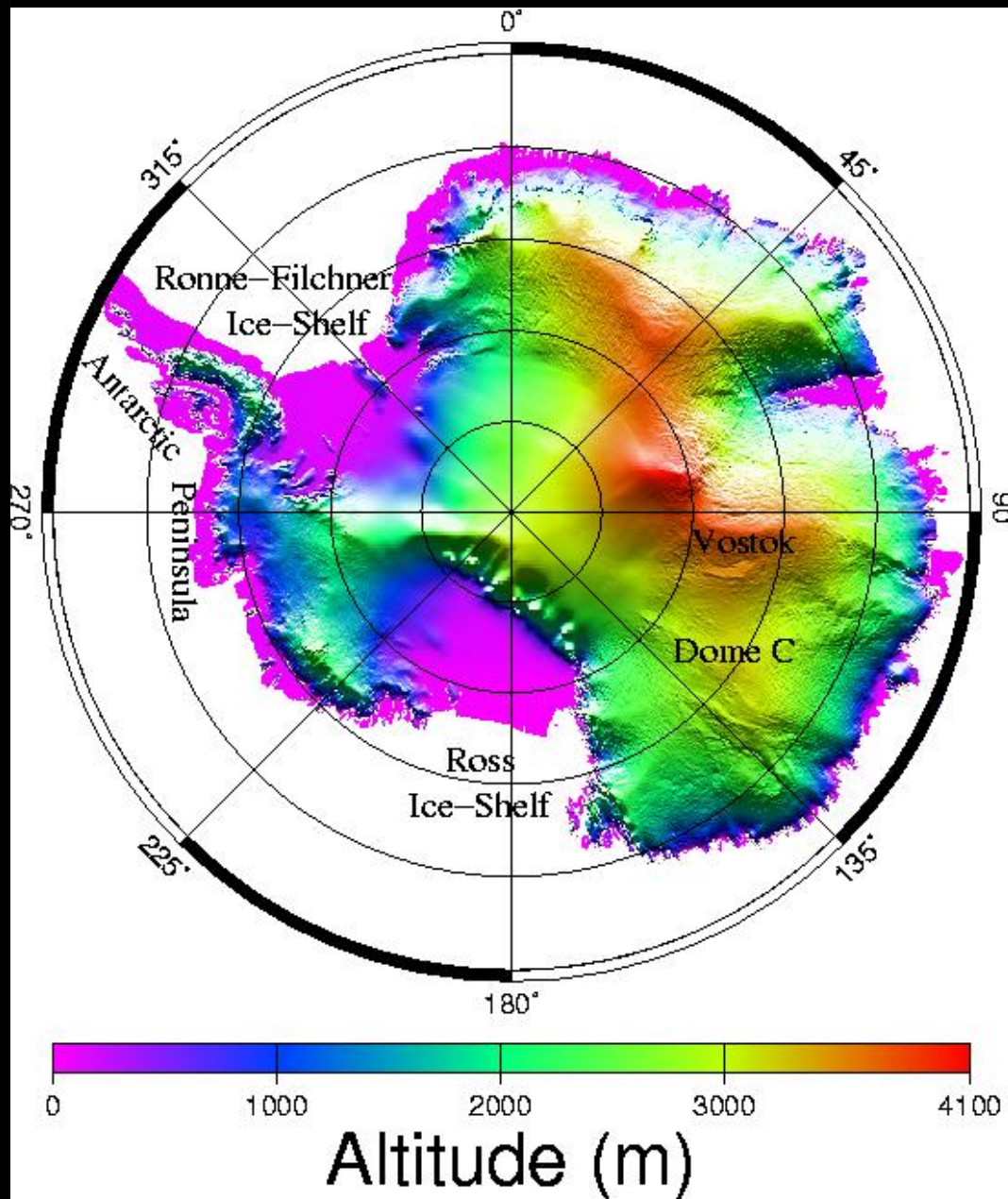
OMP/TOULOUSE

- SOME EXAMPLES DEALING WITH ICE DYNAMICS
- MASS BALANCE

Launch of ERS1 in 1991

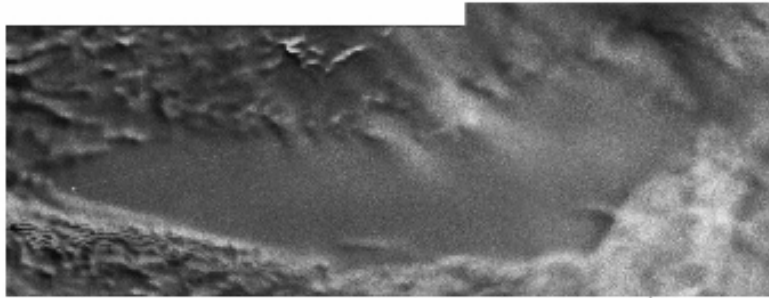


Antarctica ice sheet topography : ERS1 - geodetic orbit

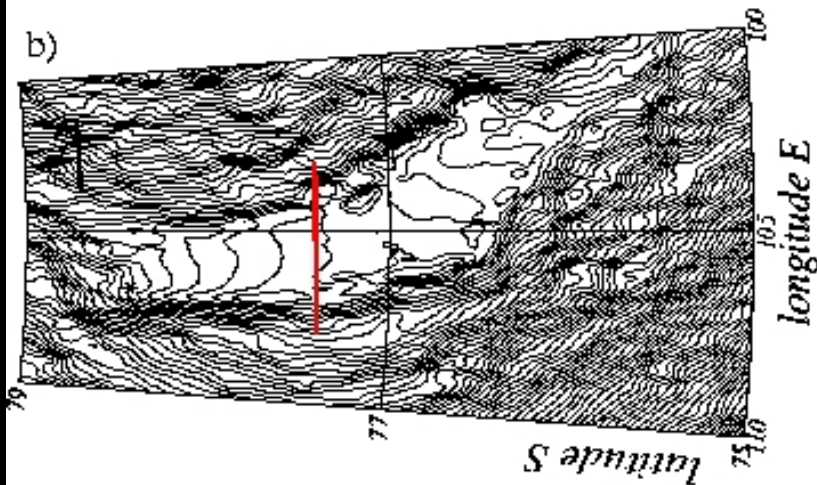


Test or constraint model
Detect subglacial lakes
or subglacial hydrological networks
Point out physical processes
(longitudinal stress, sliding)
Estimate balance velocity
Constraint rheological parameters
Give a reference surface
Estimate change in volume

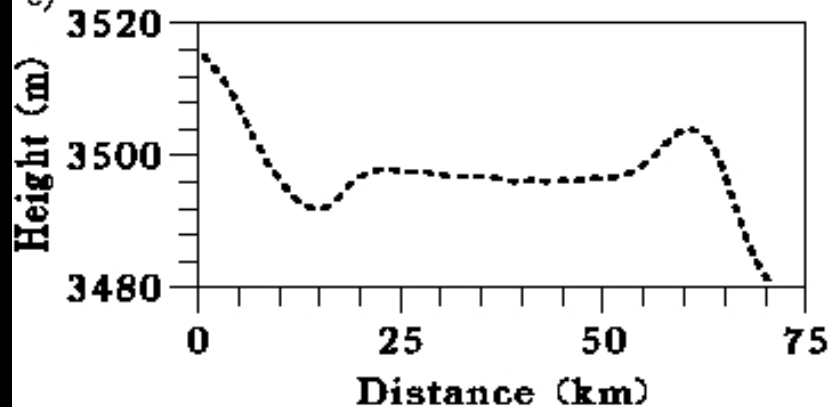
a)



b)

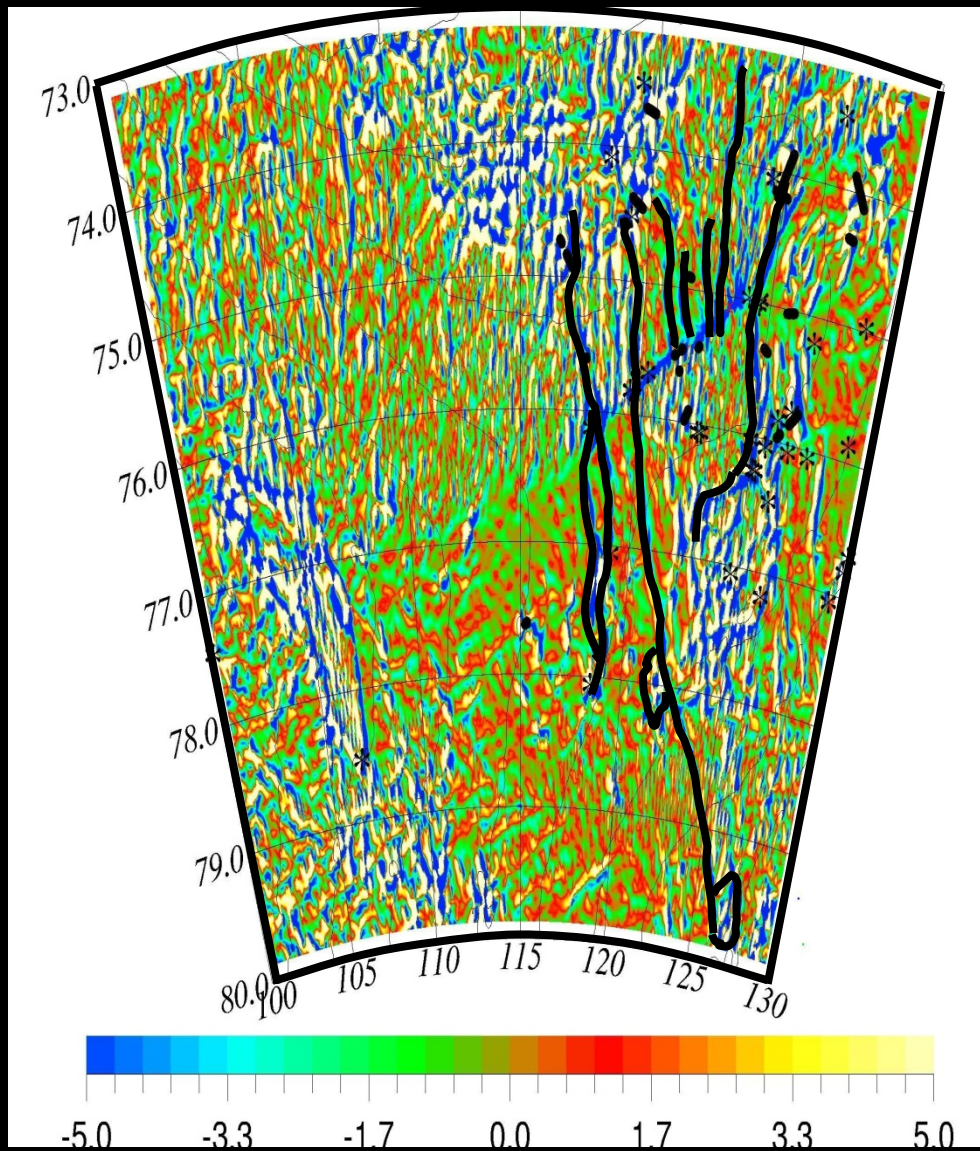


c)



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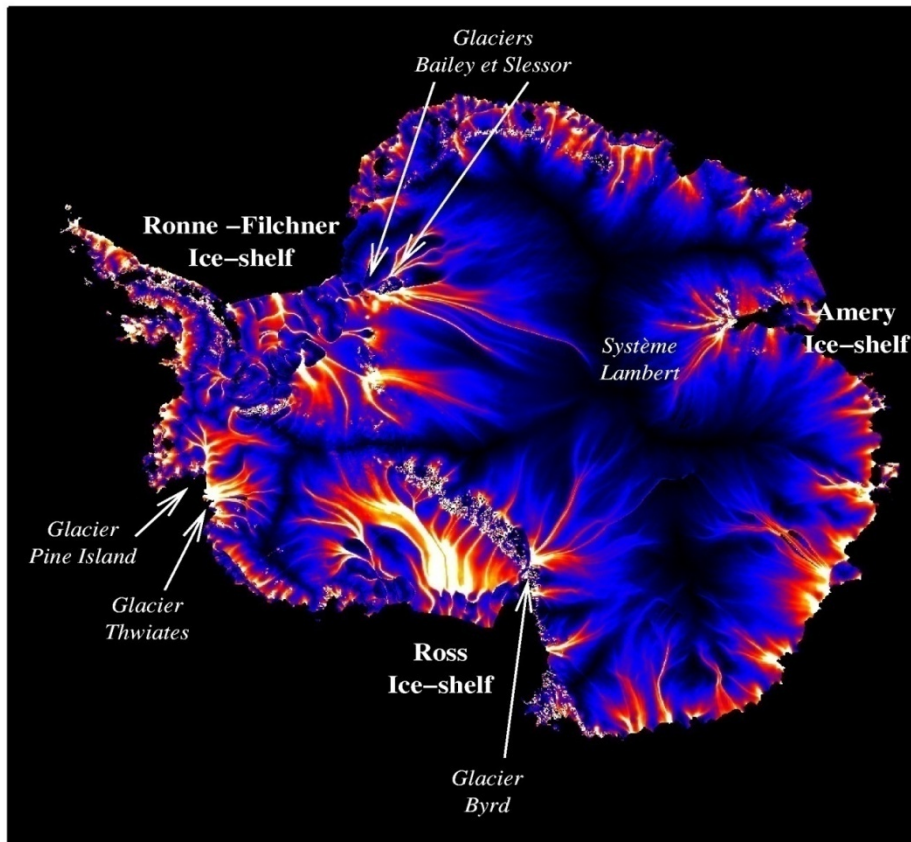


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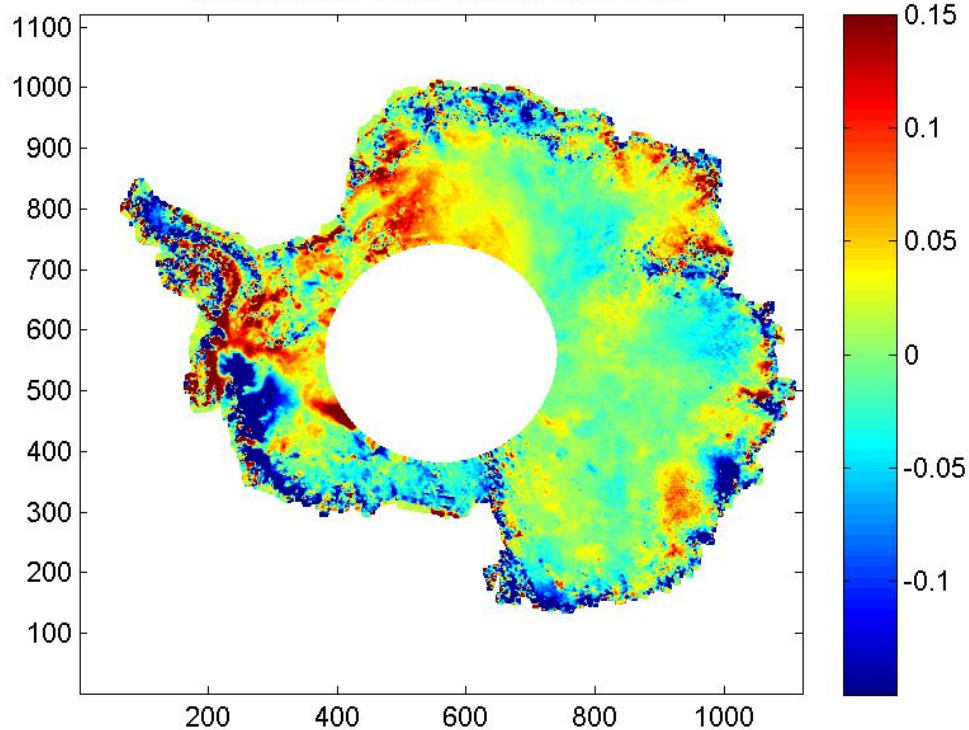
Vitesse de Bilan



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Antarctica ice sheet topography : ERS1 - geodetic orbit

mass balance from Envisat (2002-2009)

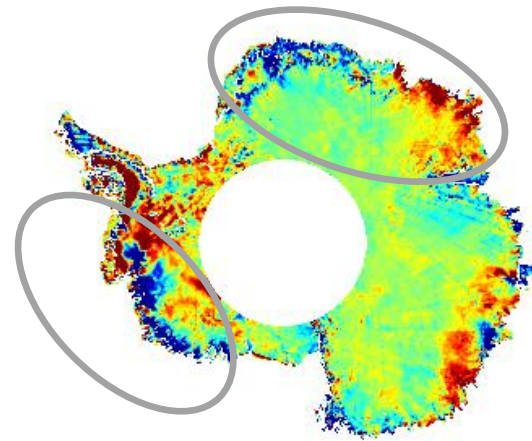
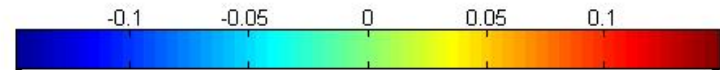
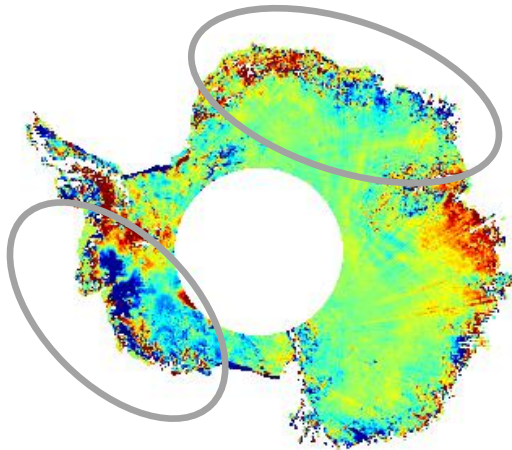


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Antarctica ice sheet

ERS 1995-2003
 $dH = 0.004 \pm 0.28$ m

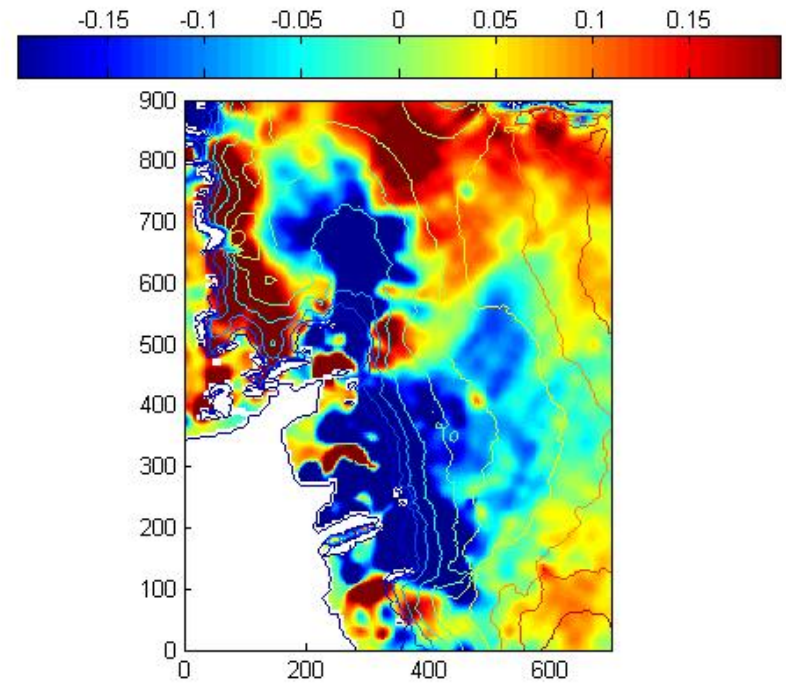
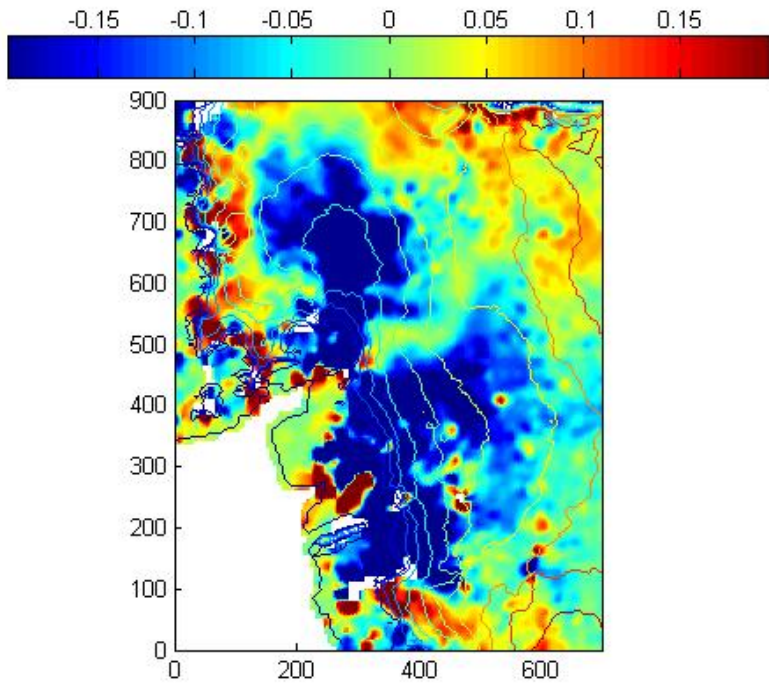
Envisat (2002-2007)
 $dH = 0.011 \pm 0.33$ m



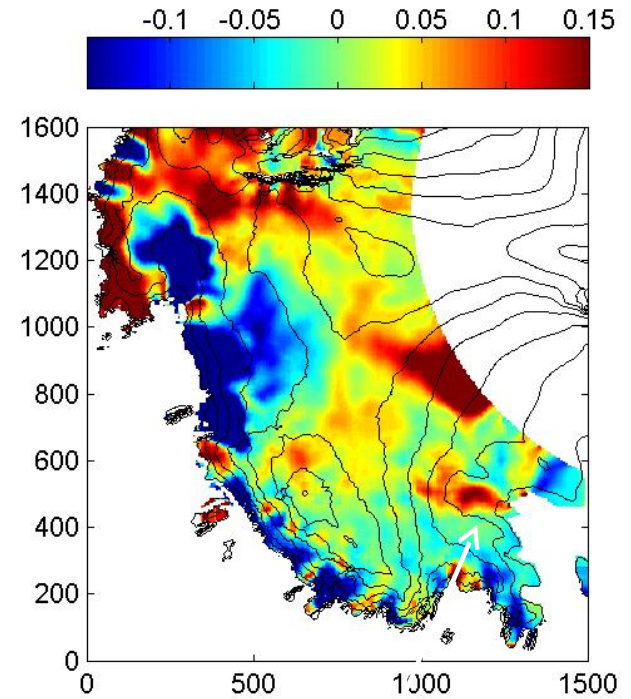
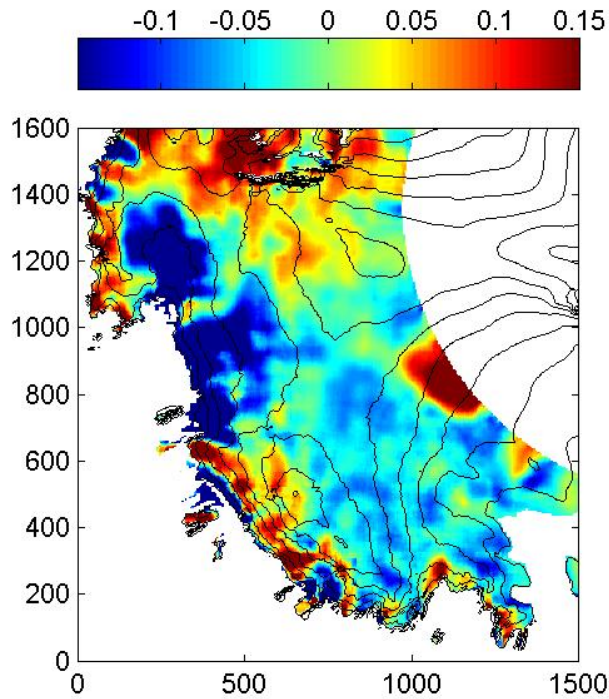
Pine Island Glacier- Twaites sector

ERS loss : 58 km³/yr

Envisat loss: 53 km³/yr

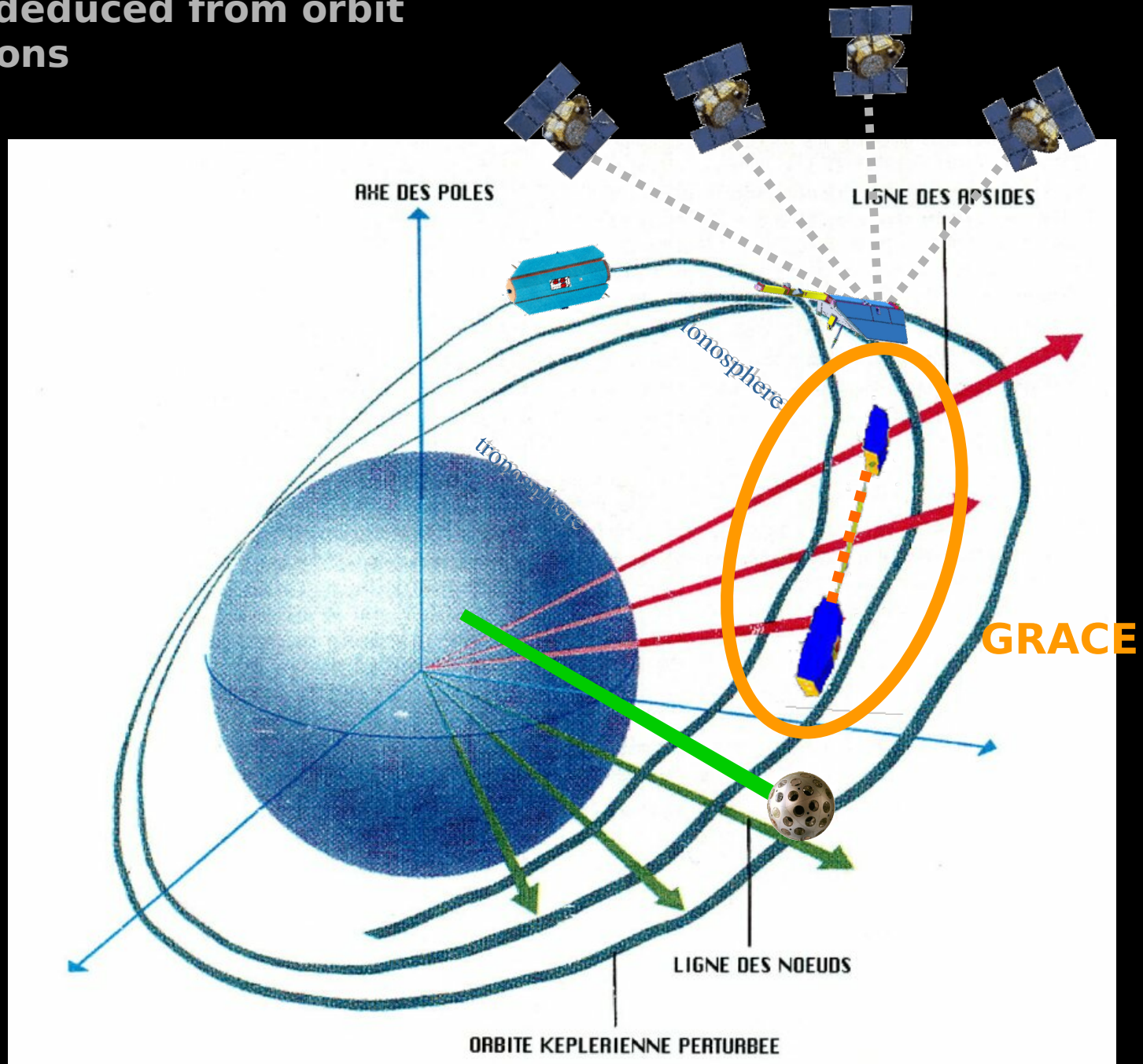


WAIS



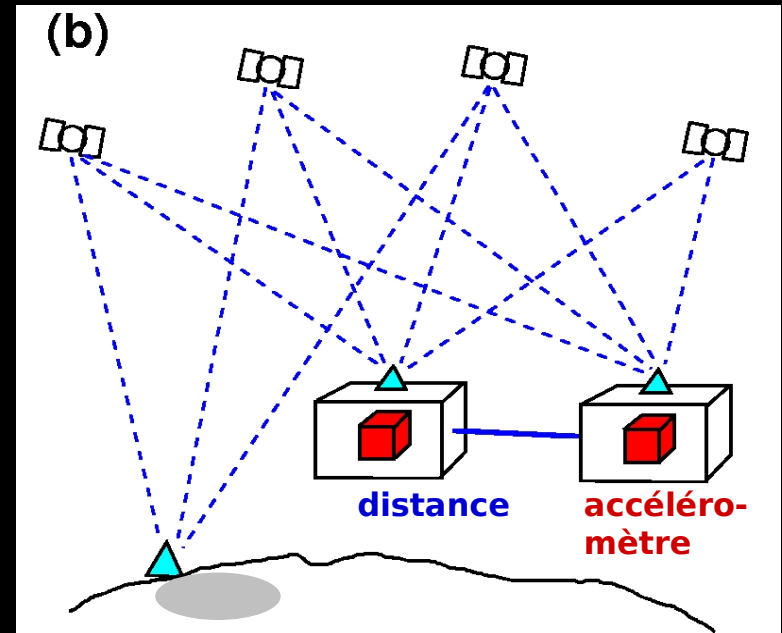
Signature of a rapid response of an outlet glacier

Gravity is deduced from orbit perturbations



GRACE mission (Gravity Recovery and Climate Experiment)

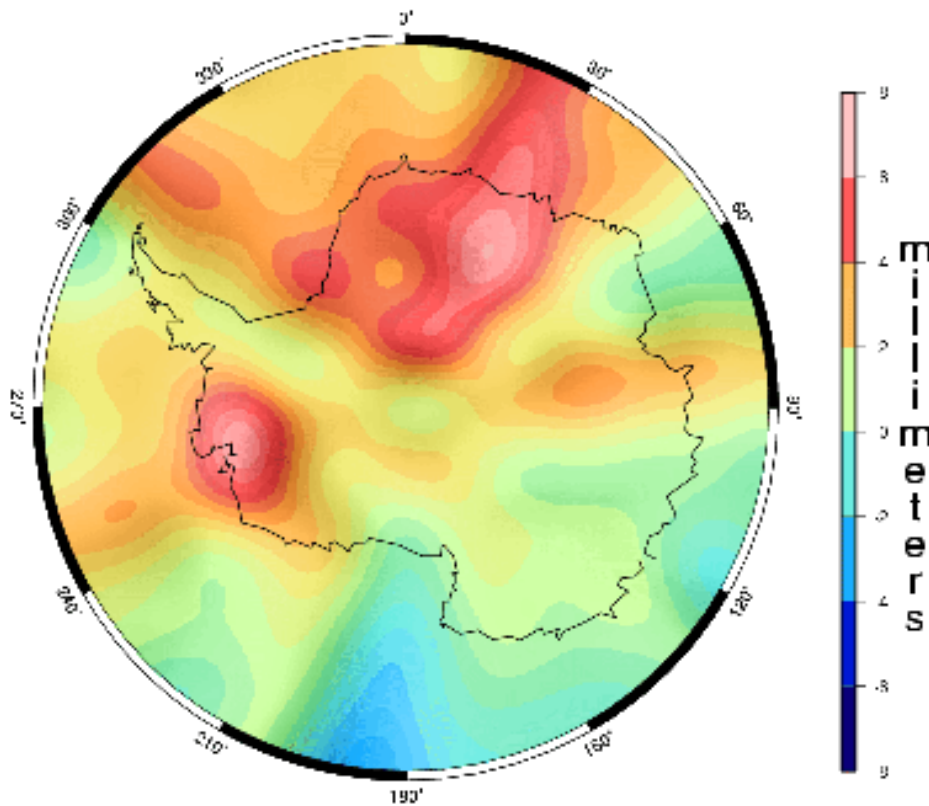
~ 200 km
measured within the 1 μm



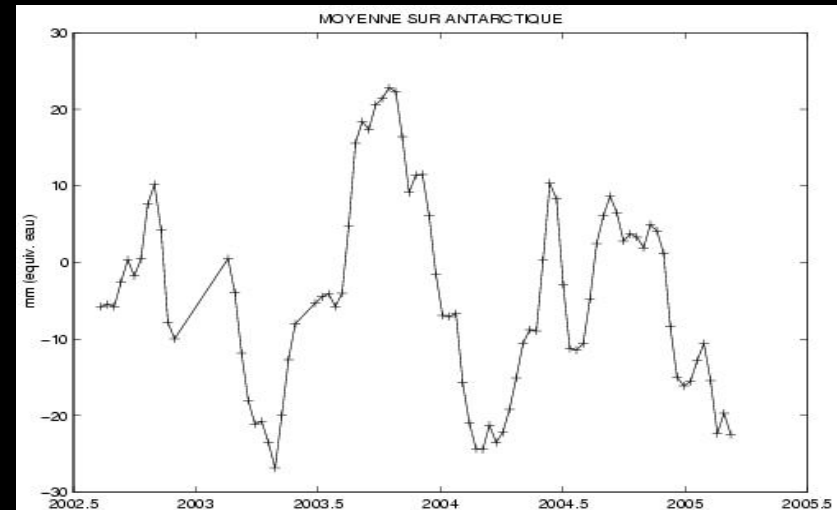
Opérateur: NASA + DLR (Allemagne)
Temps de mission: 2002 - ~ 2013
Hauteur d'orbite: 500-300 km
Inclinaison: 89°

Instruments:
mesure de distance micro-onde
capteur GPS
accéléromètre 3D

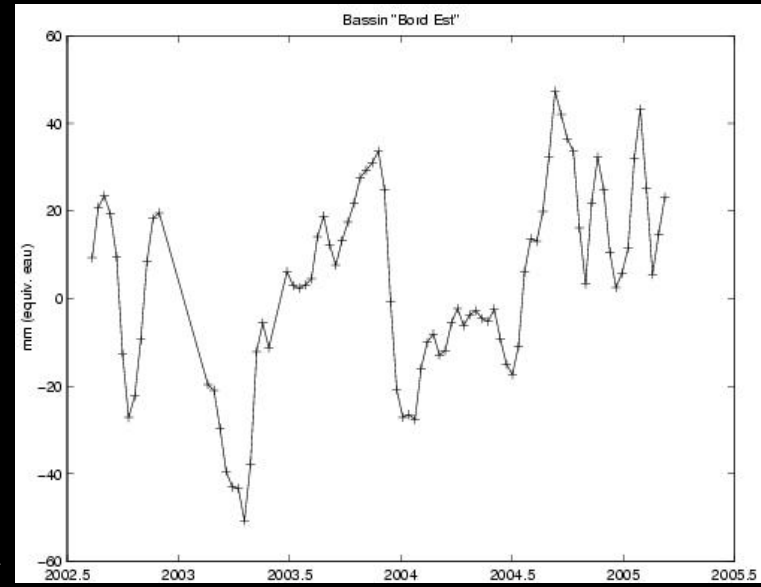
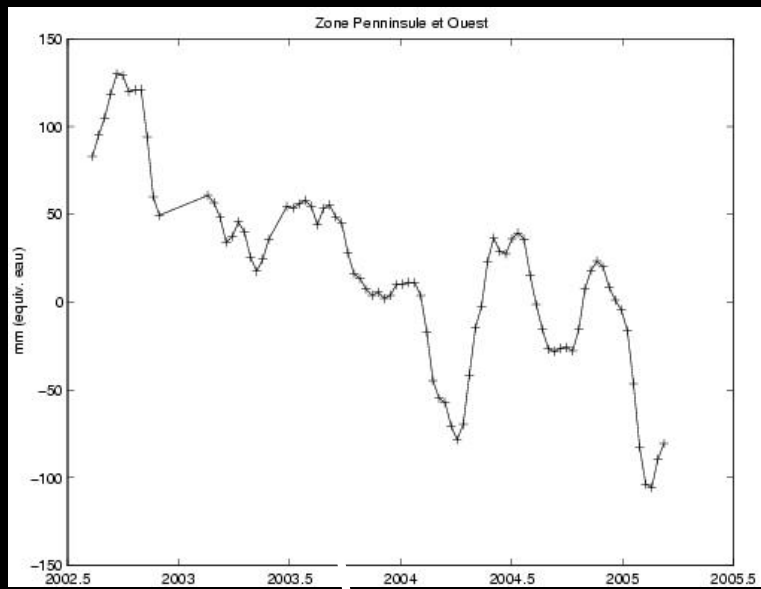
GRACE animations



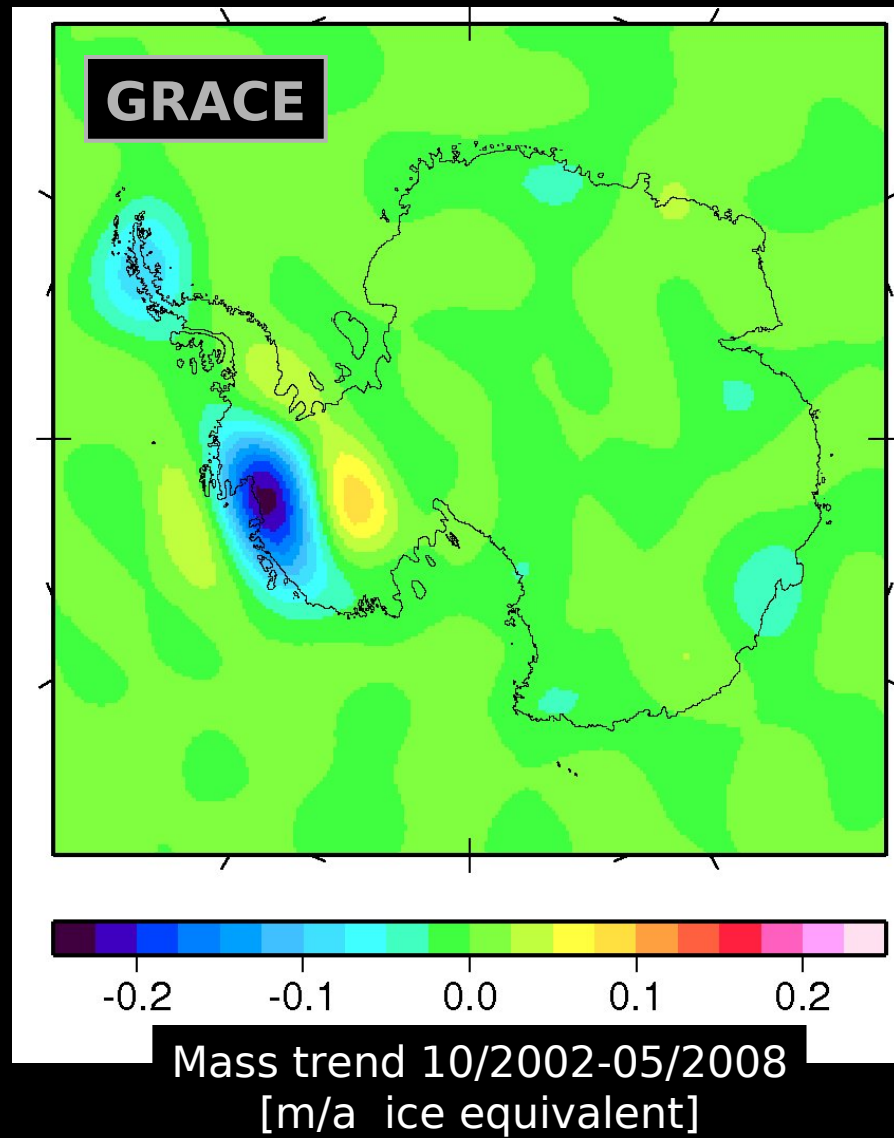
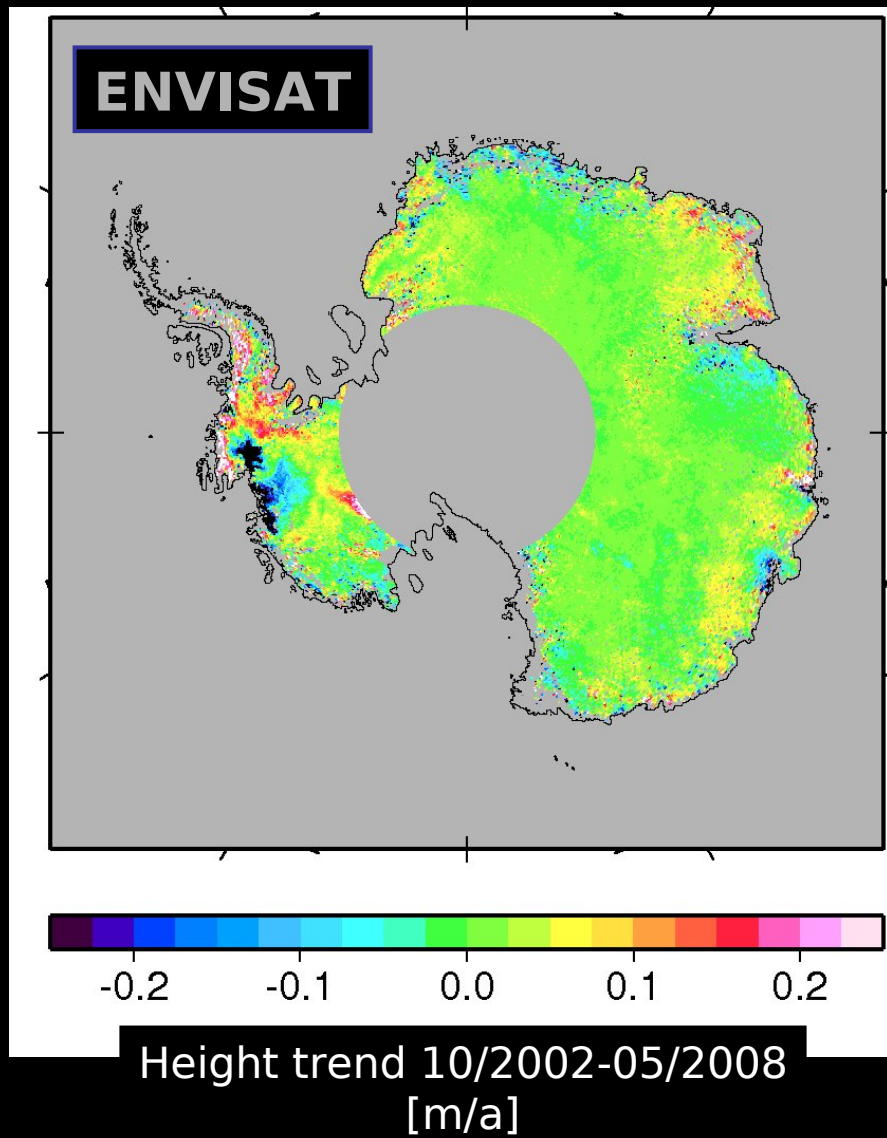
In average



Llubes

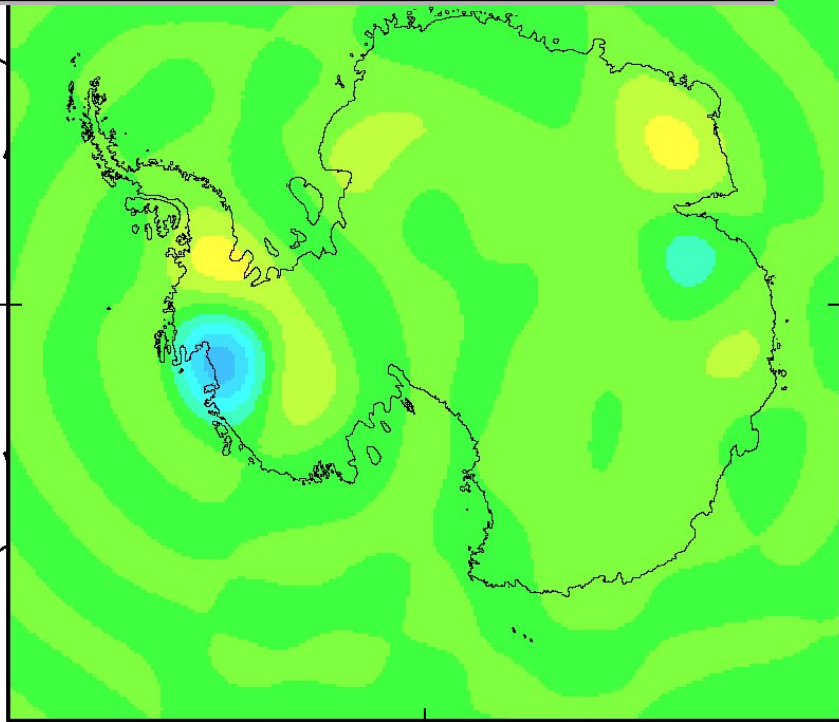


Altimetry and Gravimetry: comparison over the same periods



Altimetry and Gravimetry

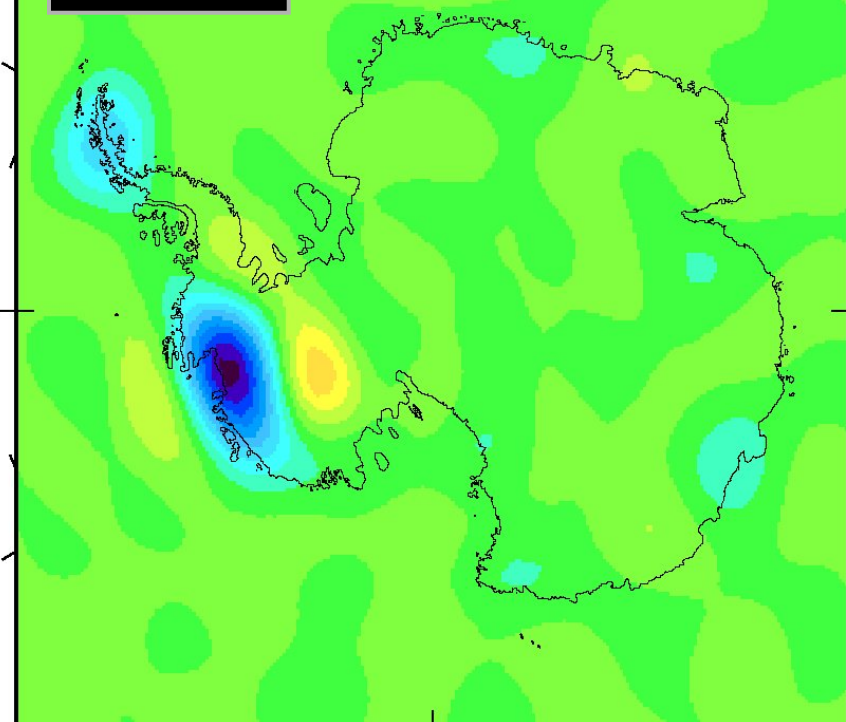
ENVISAT, filtrée ~GRACE



-0.2 -0.1 0.0 0.1 0.2

Height trend 10/2002-05/2008
[m/a]

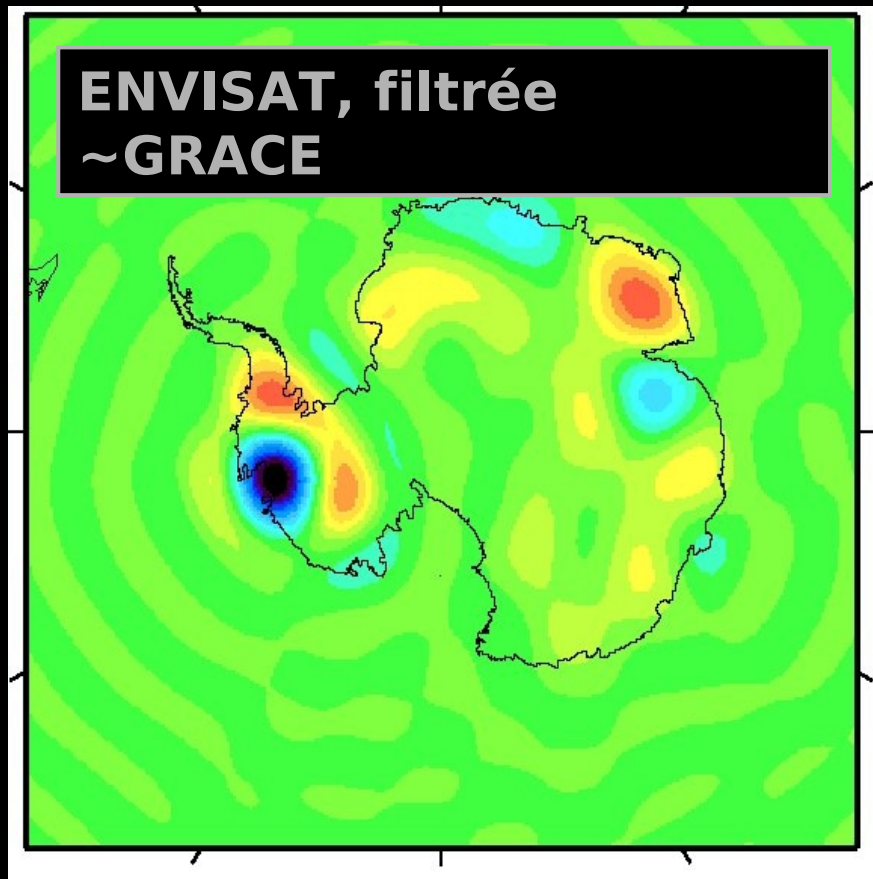
GRACE



-0.2 -0.1 0.0 0.1 0.2

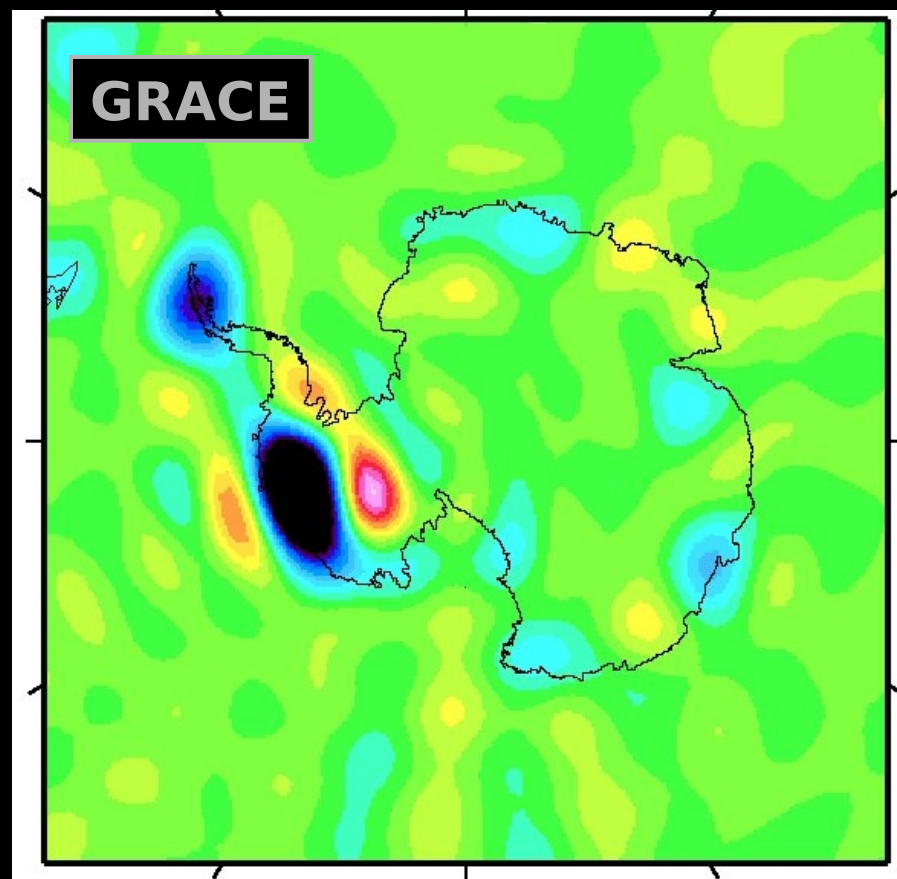
Mass trend 10/2002-05/2008
[m/a ice equivalent]

Altimétrie et Gravimétrie



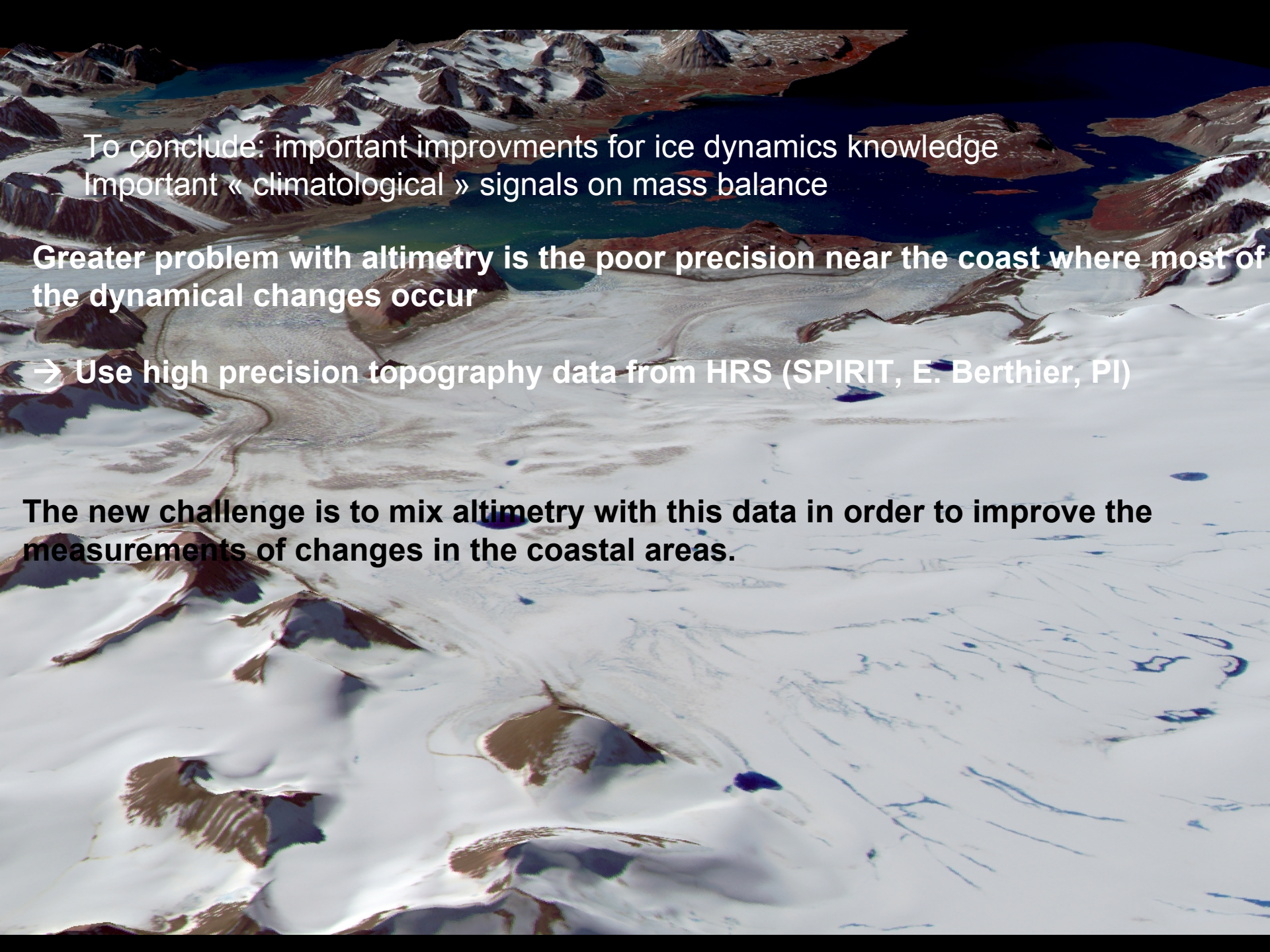
-0.1 0.1

Height trend 10/2002-05/2008
[m/a]



-0.1 0.1

Mass trend 10/2002-05/2008
[m/a ice equivalent]

An aerial photograph of a vast glacier system, likely in Antarctica or Greenland. The glacier is a complex network of white and light blue ice, with numerous crevasses and meltwater channels. In the background, rugged brown mountains rise above the ice. The sky is a clear, pale blue.

To conclude: important improvements for ice dynamics knowledge
Important « climatological » signals on mass balance

Greater problem with altimetry is the poor precision near the coast where most of the dynamical changes occur

→ Use high precision topography data from HRS (SPIRIT, E. Berthier, PI)

The new challenge is to mix altimetry with this data in order to improve the measurements of changes in the coastal areas.