

Protect  
CRYOSPHERE & SEA LEVEL

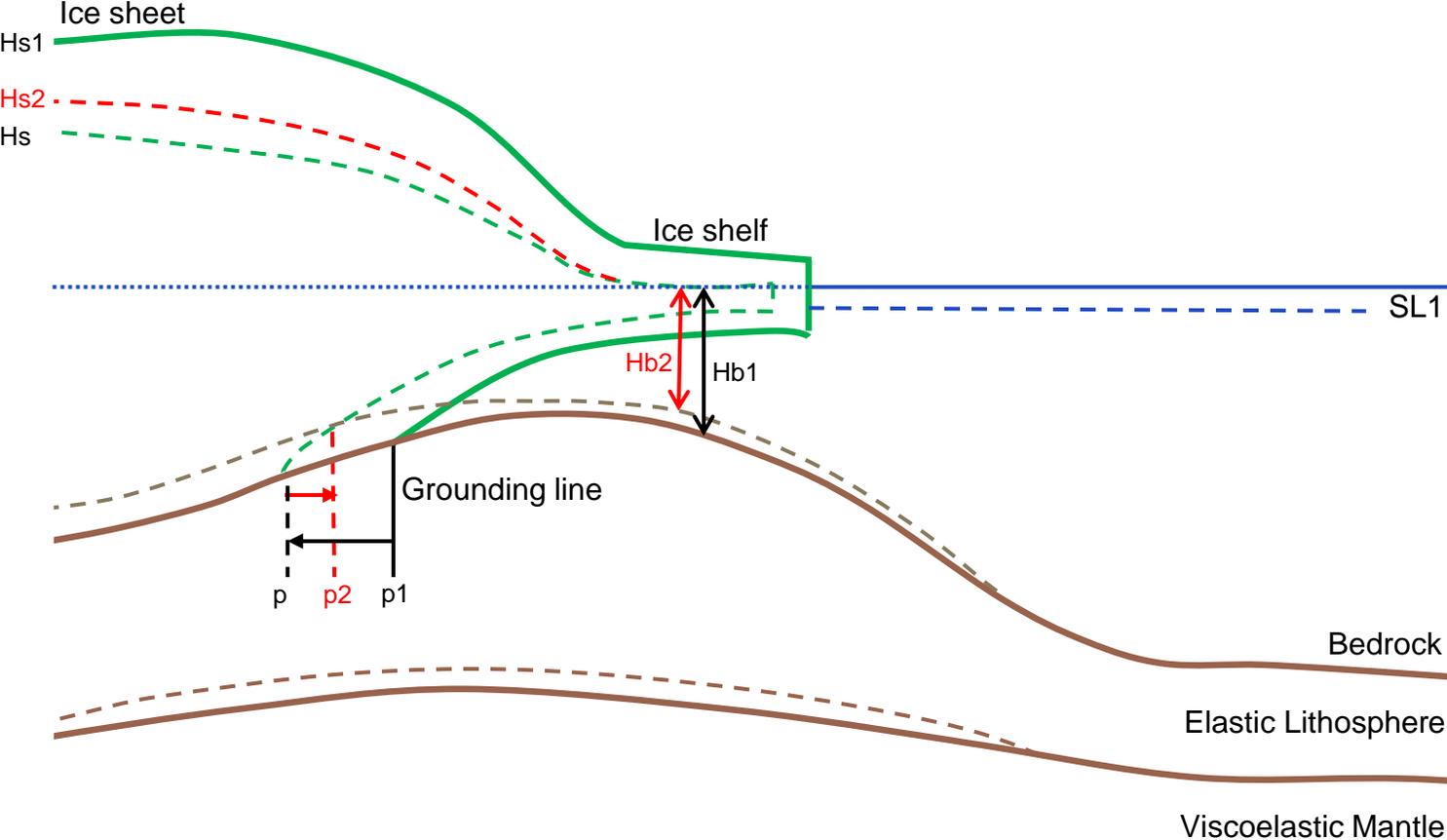
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# Interactions between the Antarctic ice sheet & solid Earth

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# Ice sheet dynamics & solid Earth deformation





How much will the **Antarctic ice sheet** be affected by **solid Earth deformation** in the **coming 500 years?**



# The structure of the Earth

Seismic observations (Lloyd et al., 2020) → Mantle temperature

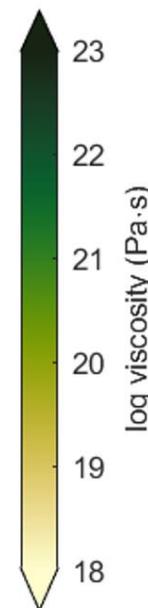
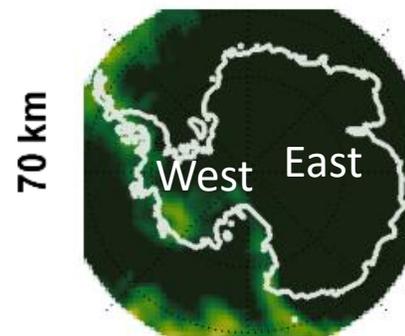
Stresses  
Grain size  
Water content

**IMAU-ICE**



Mantle Viscosity →

Constraint by regional studies using GNSS data (e.g. Barletta et al., 2018)



23 → ~150000 years

21 → ~3000 years

19 → ~200 years

18 → ~50 years

Lower viscosity → Faster response → Less ice melt

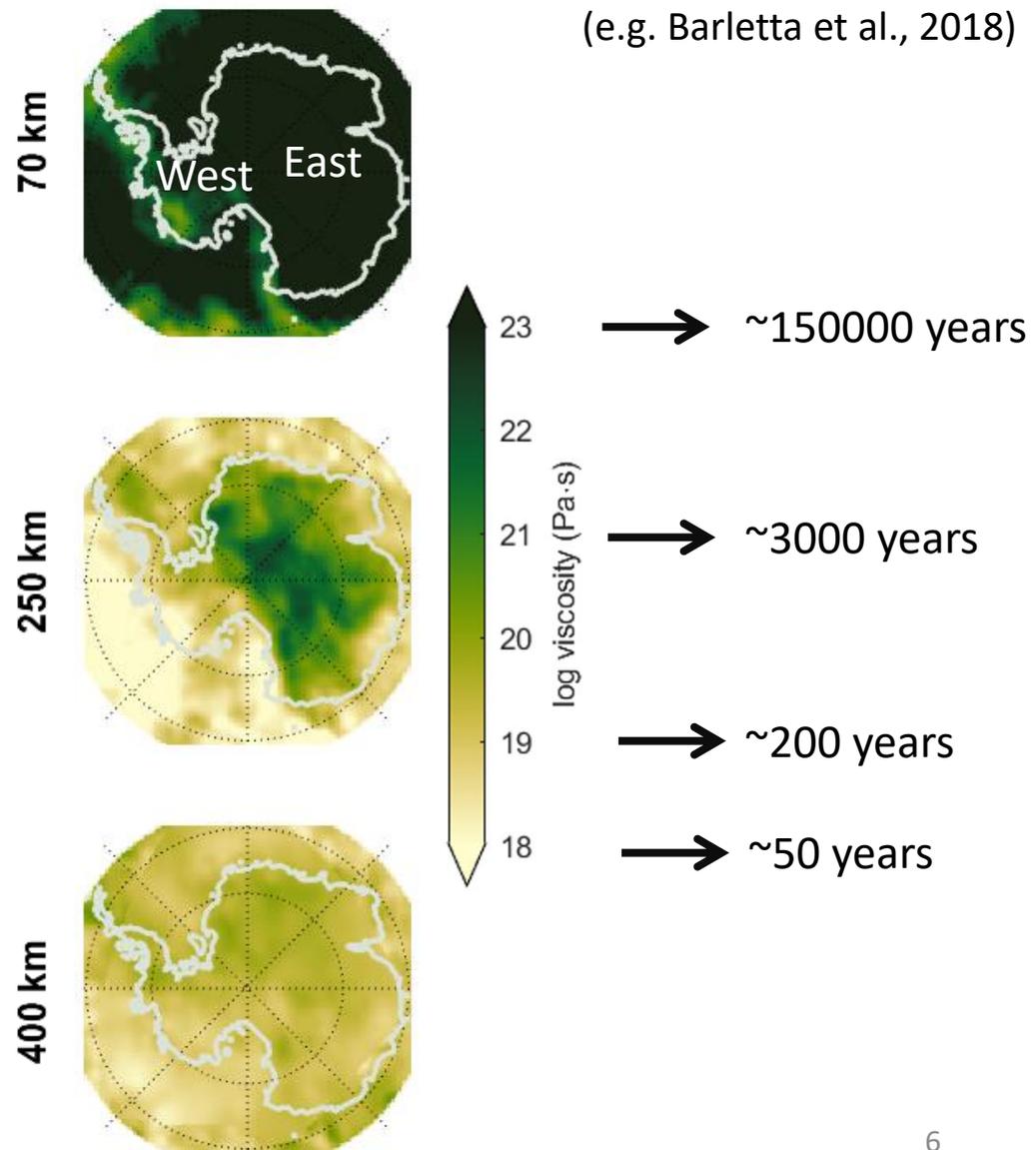
- Bedmachine v3 (Morlighem et al., 2020: CryoSat-2, IceSat and many other observations)
- Ocean and atmospheric temperature, and salinity anomalies, and precipitation ratio's from CMIP6 models (Coulon et al., 2024)

**MAU-ICE**



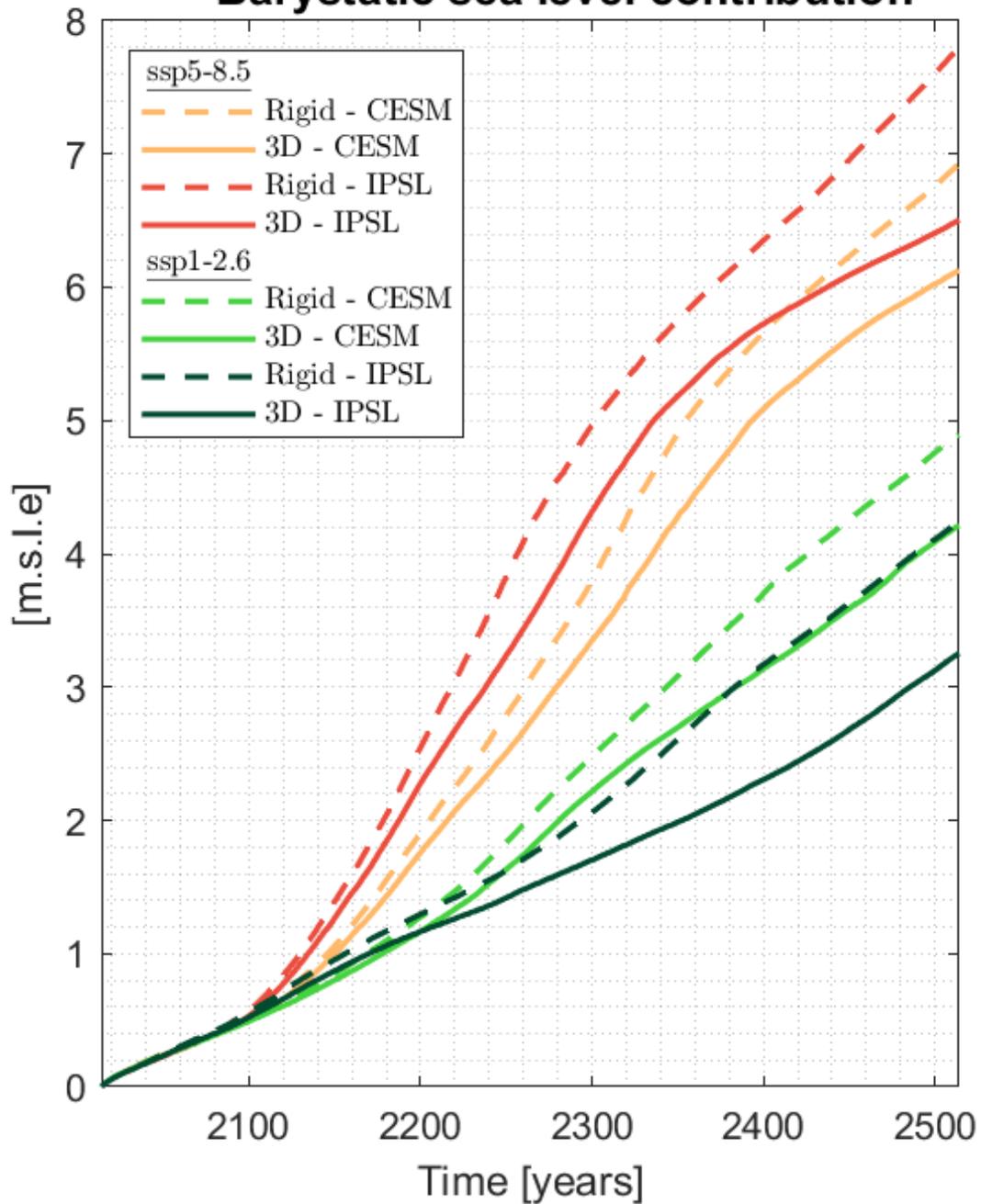
Mantle Viscosity

Constraint by regional studies using GNSS data (e.g. Barletta et al., 2018)



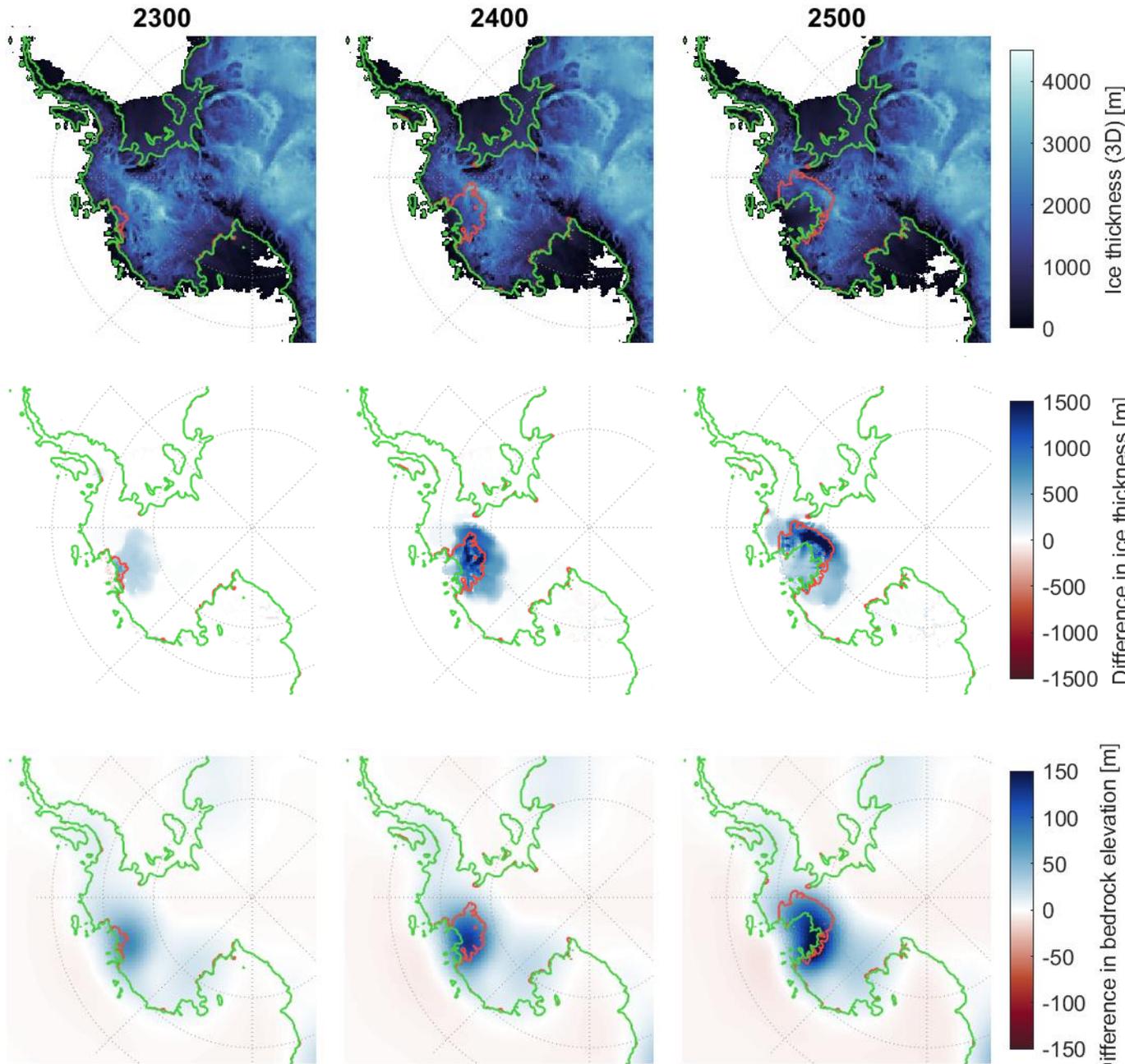
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## Barystatic sea level contribution



- The emission scenario causes the largest uncertainty
- The effect of GIA can be larger than the uncertainty from GCM
- GIA plays a bigger role when retreat occurs in the Amundsen Sea Embayment (IPSL)





— Grounding line rigid Earth structure  
— Grounding line 3D Earth structure

## 3D Solid Earth deformation:

- **Reduces** sea level rise by **9-23%** in 2500
- **Delays** ice sheet retreat by **50-130 years** from 2300

## Recommendations:

- Improved solid Earth structures (e.g. satellite gravity + seismic observations)
- Test different mantle flow laws



An aerial photograph of a vast, textured ice sheet, likely in Antarctica, with a blue color overlay. The ice surface is highly irregular, showing numerous small ridges and depressions. The text is centered over the image.

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- Improved bedrock elevation observations
- Test different mantle flow laws