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Dynamic topographic observations of Antarctica and its fringing oceanic basins

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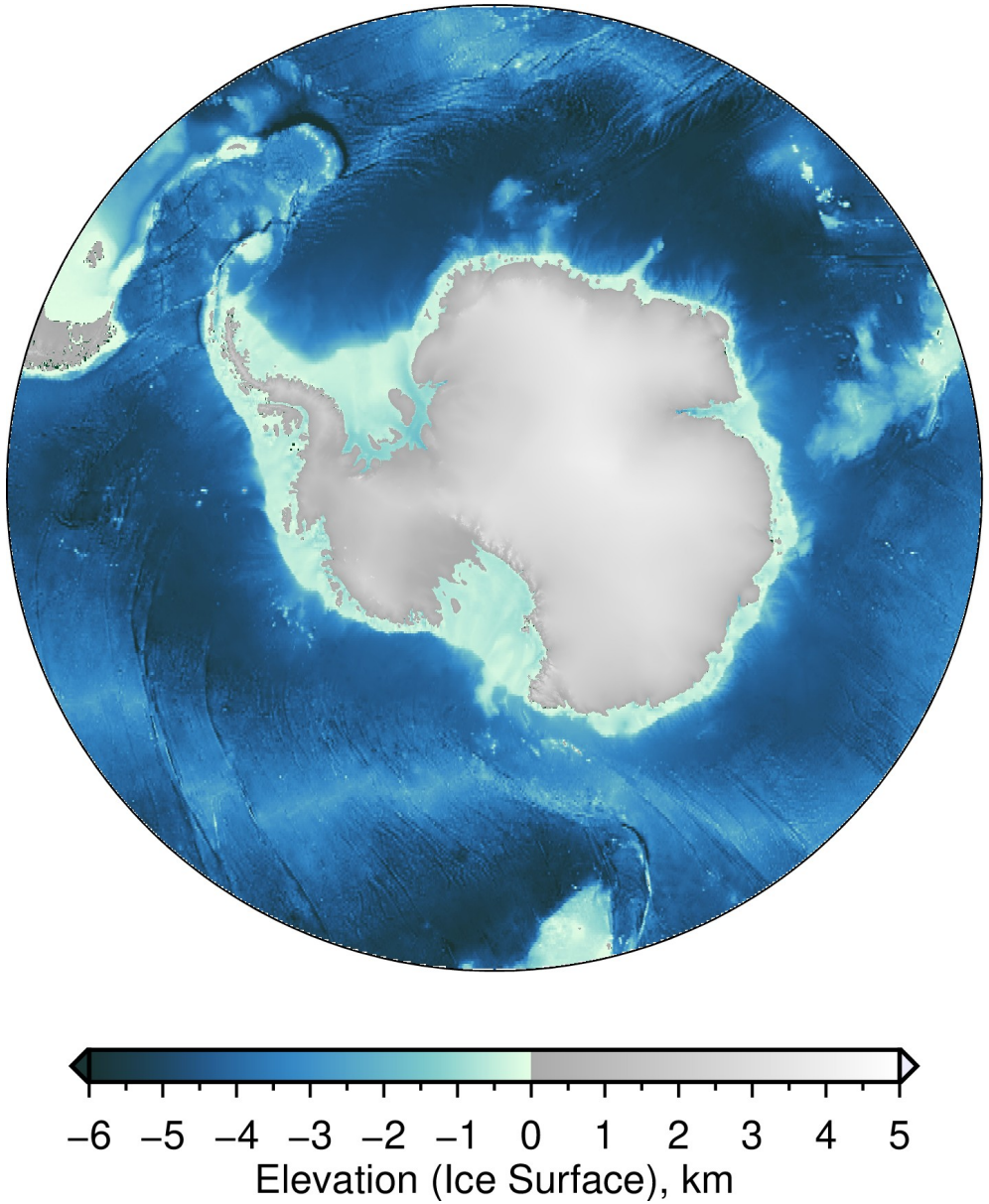
UKRI Natural Environment Research Council

Image credit: Court Whelan

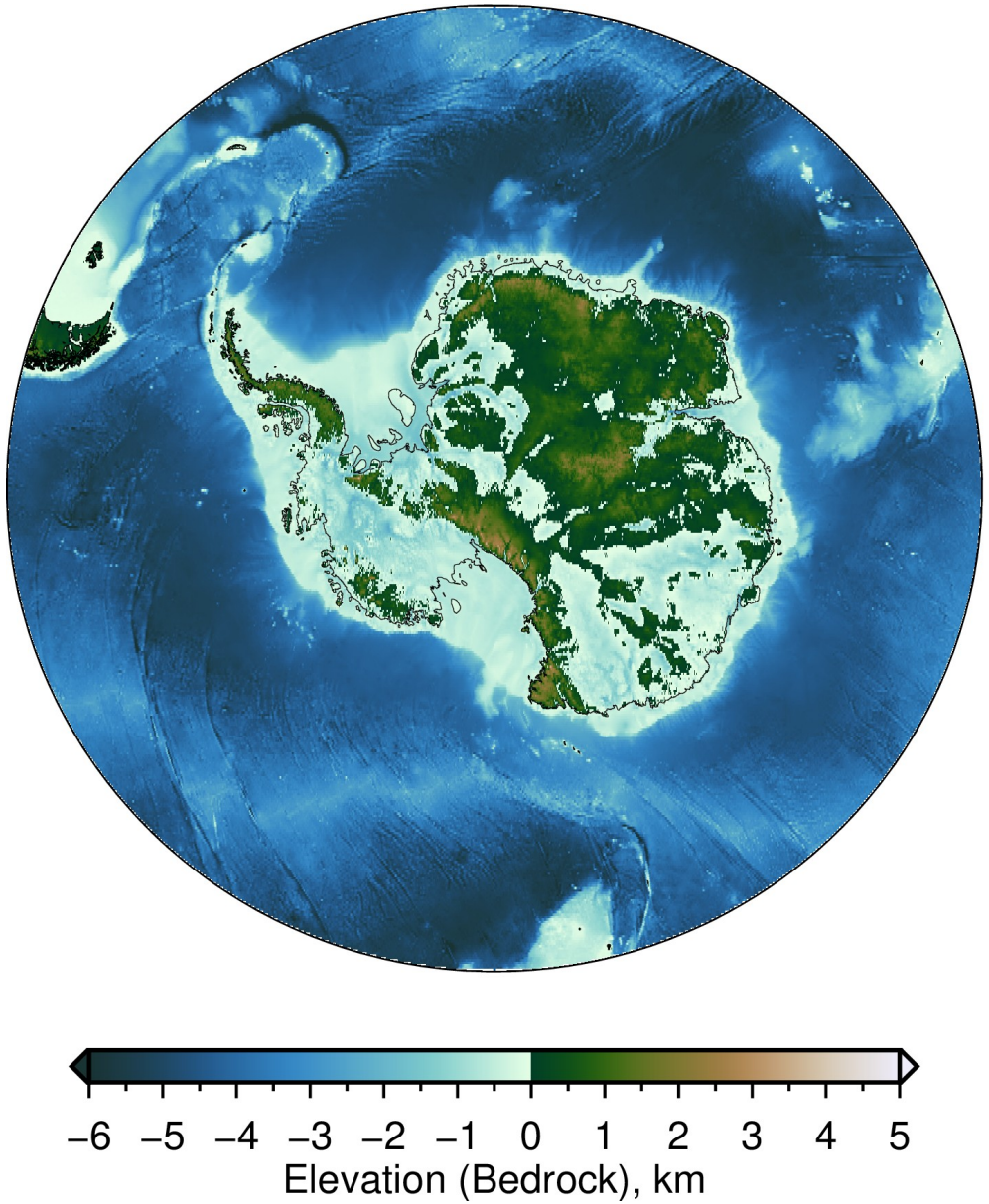
Motivation



- Dynamic topography is the vertical deflection of the Earth's surface due to mantle convection.
- In Antarctica, quantifying dynamic support in space and time helps define key boundary conditions in ice sheet modelling e.g palaeotopgraphy, heat flux

(Morlighem, M. 2020. *MEaSUREs BedMachine Antarctica, v2)*

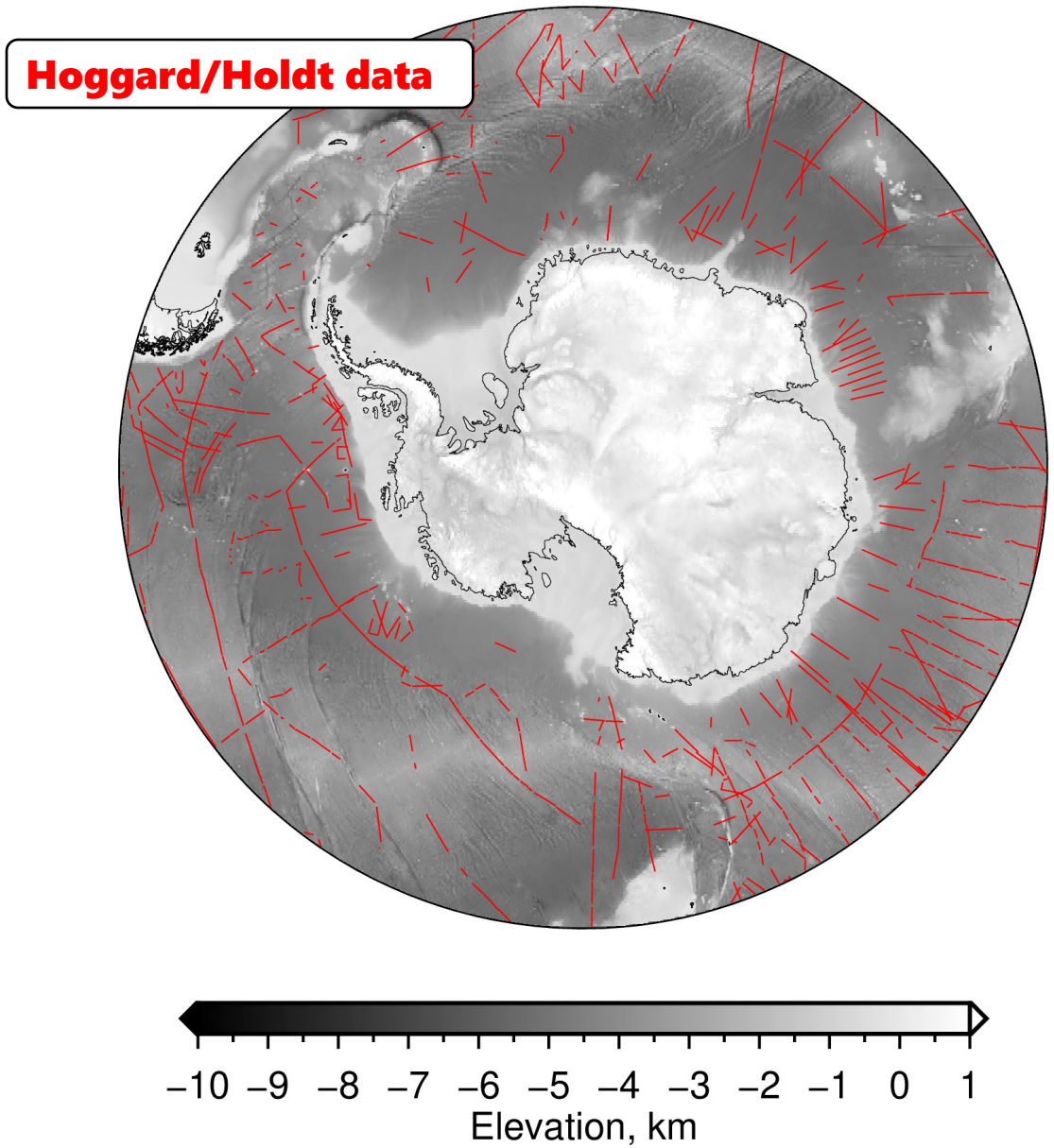
Motivation

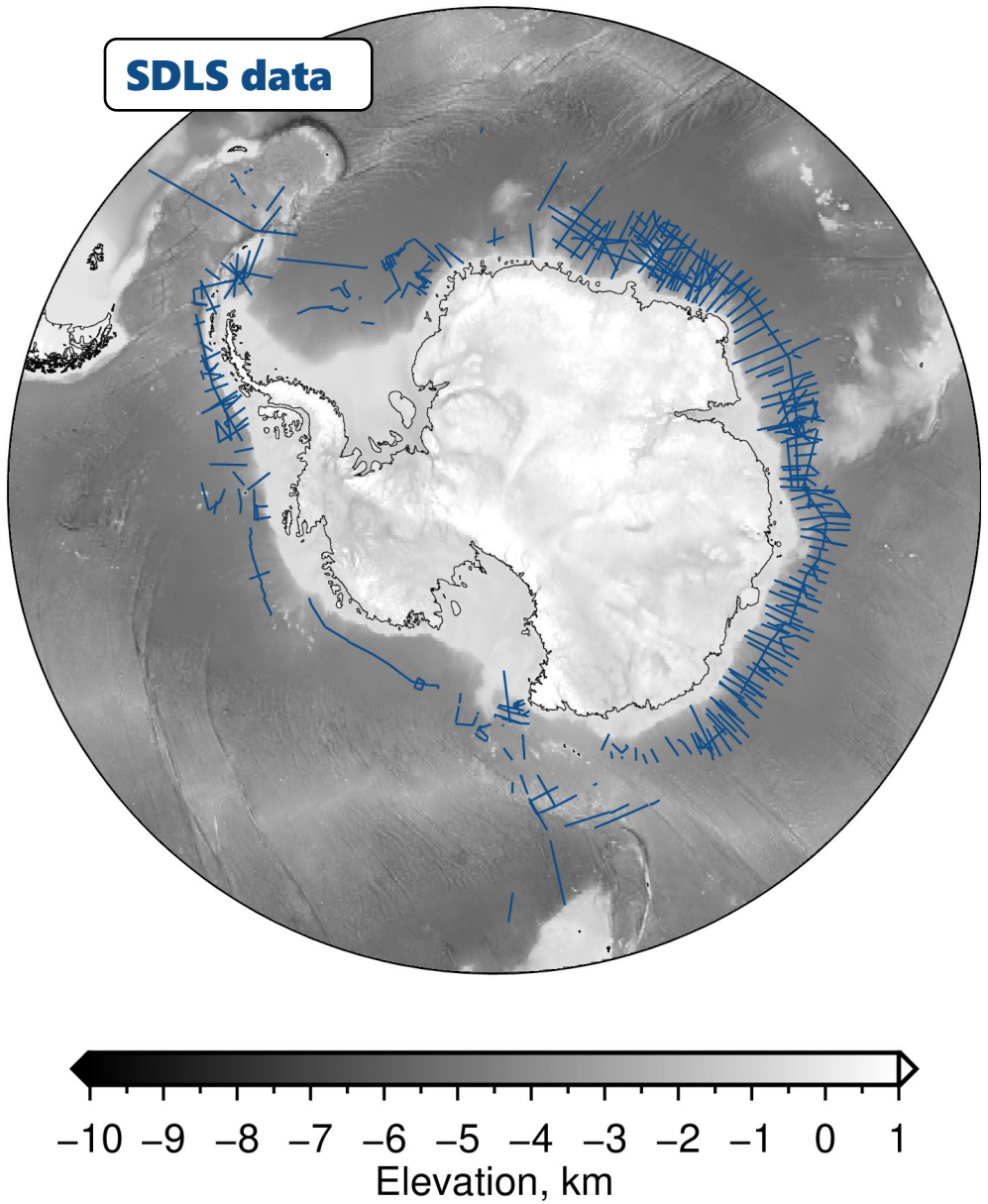


- Radar data reveals major topographic features, but crustal heterogeneities and ice coverage make it hard to quantify continental dynamic support.
- Initial work is therefore beginning in the oceanic realm, which will provide spatial context to the more complex onshore work in the future.
- Residual depths are calculated using seismic reflection data from the Southern Ocean

(Morlighem, M. 2020. *MEaSUREs BedMachine Antarctica, v2)*

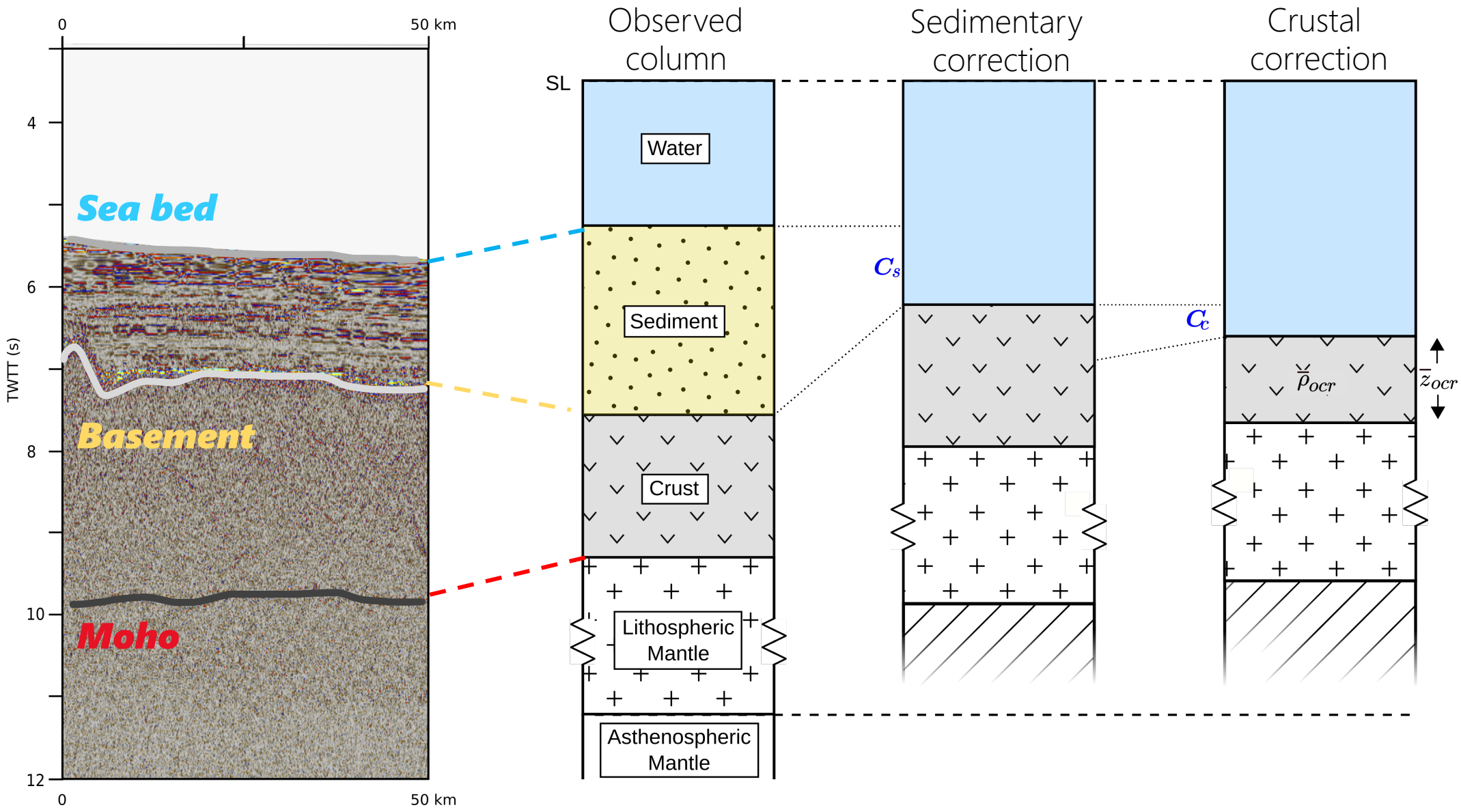
Seismic Reflection Data





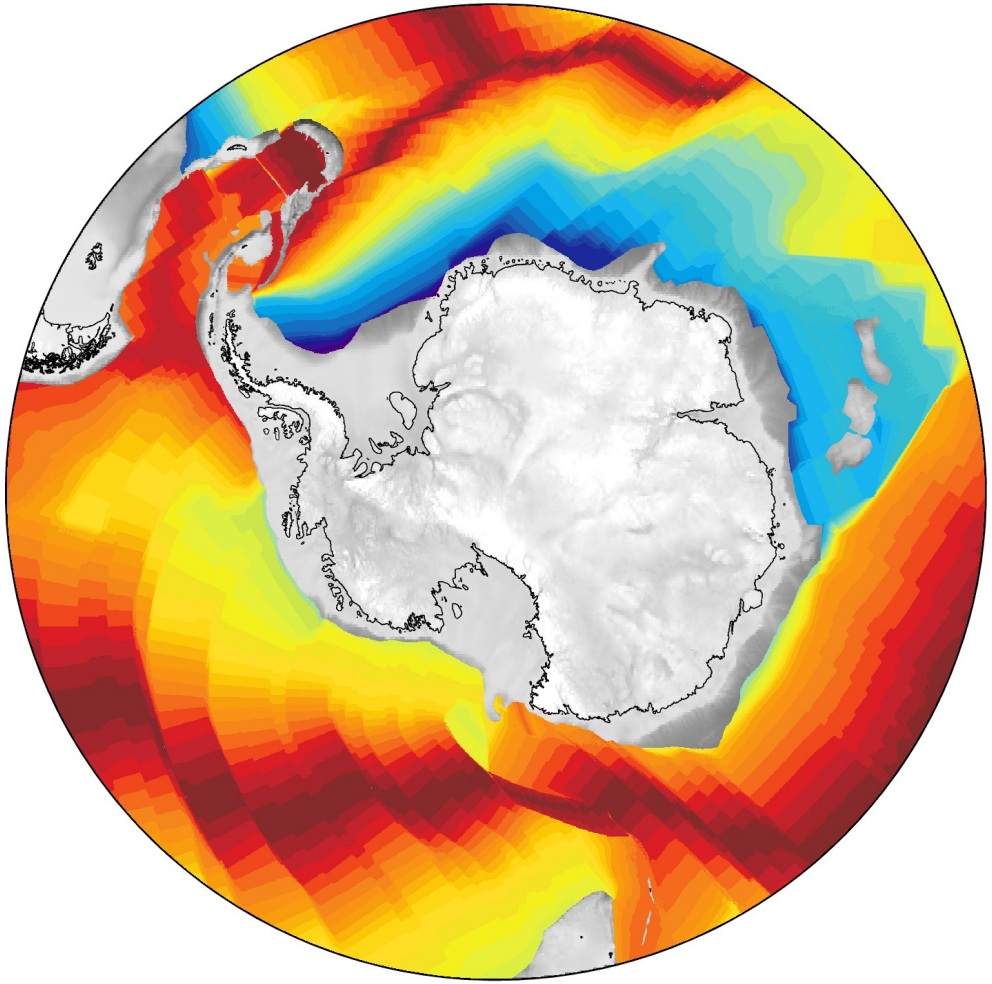
(Hoggard et al, 2016; Holdt et al, in review 2022)

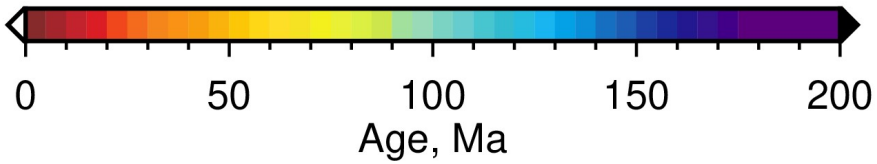
Calculating Water-loaded Basement Depths

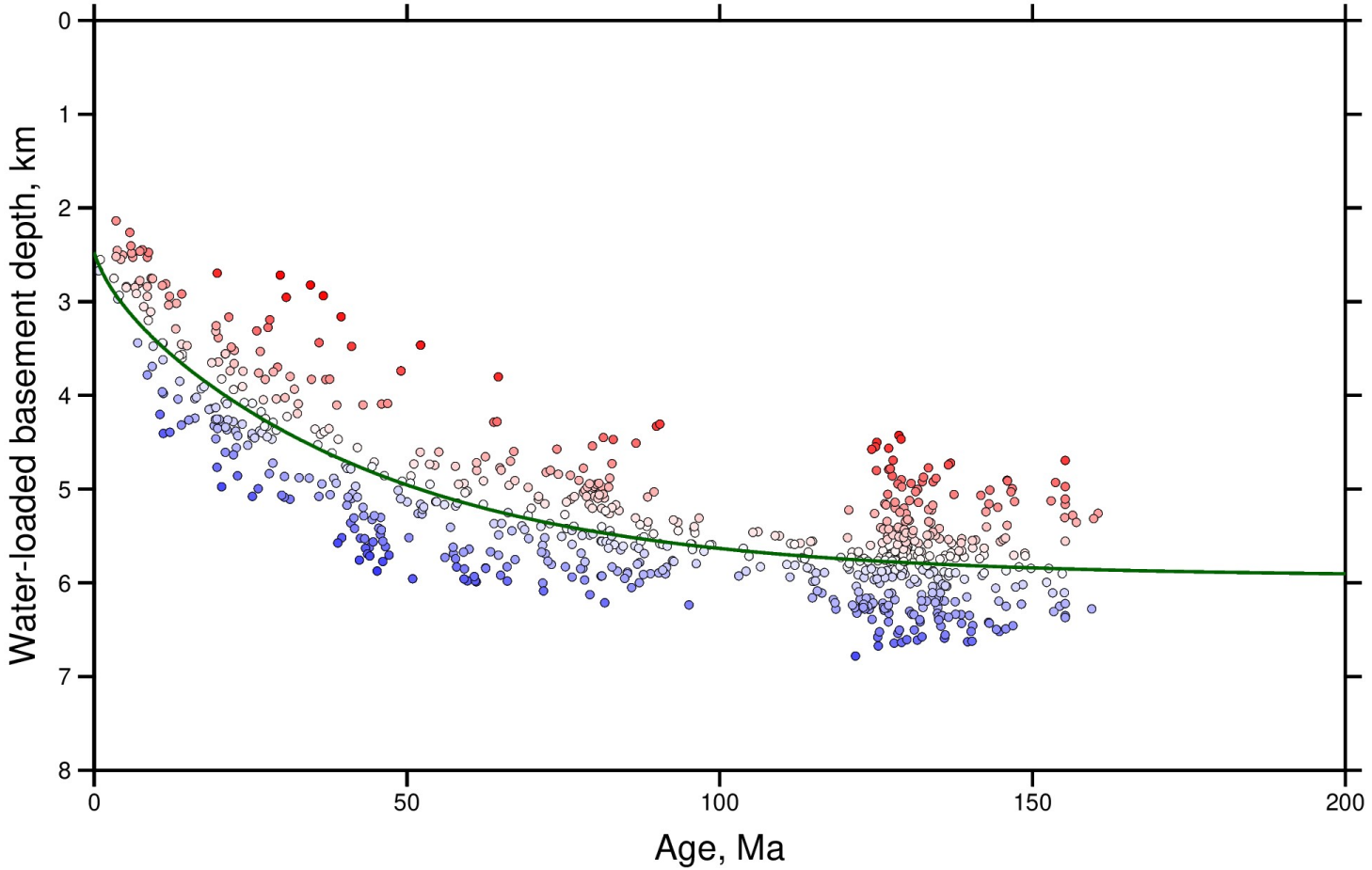


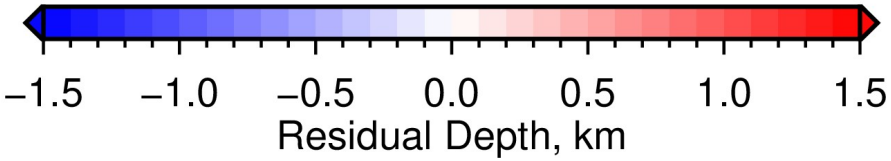
(Holdt et al, in review 2022)

Calculating Residual Depths



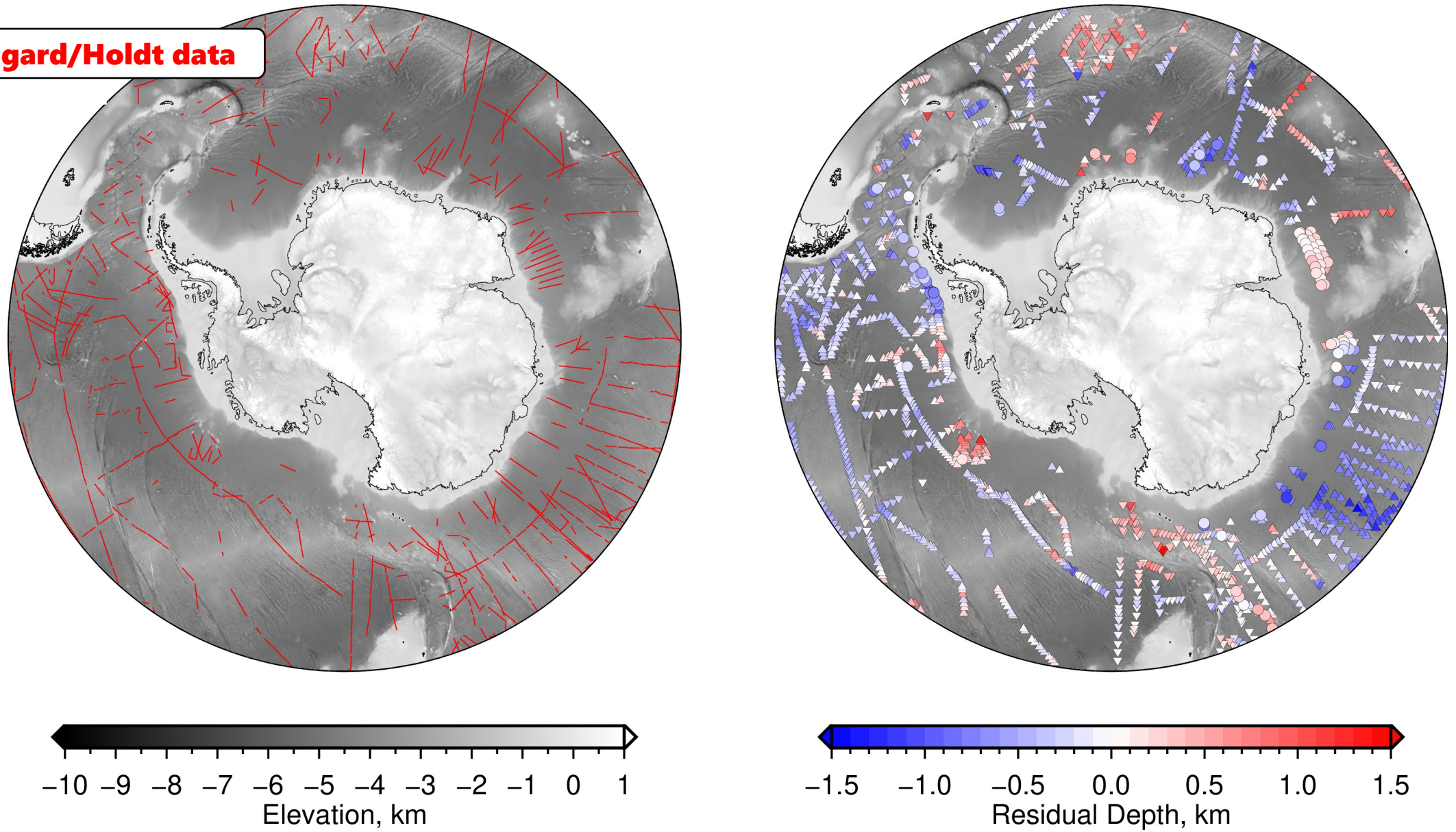






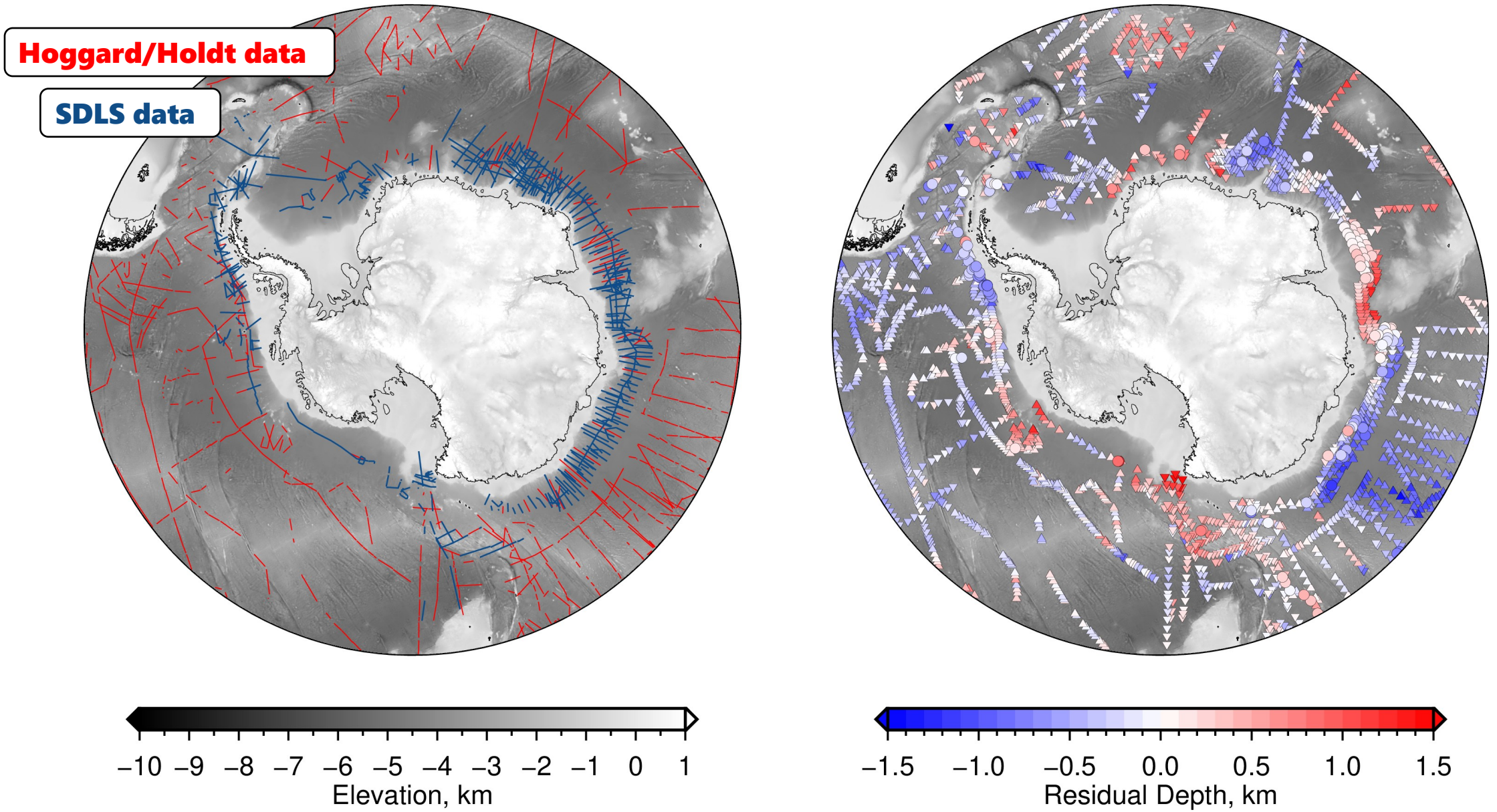
(Seton et al, 2020; Holdt et al, in review 2022)

Results – Holdt et al (in review, 2022)



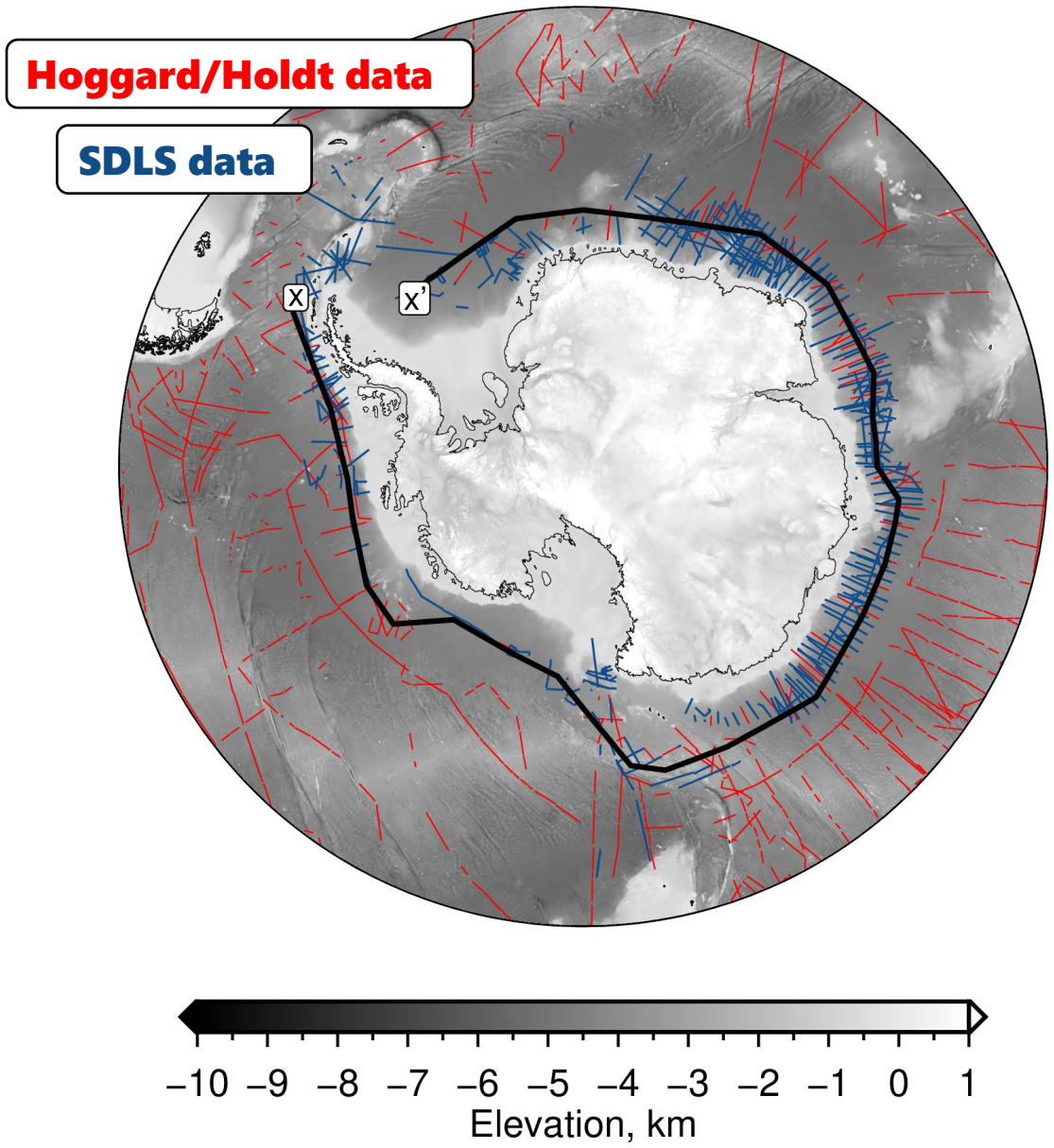
(Holdt et al, in review 2022)

Results – This Study



(This study)

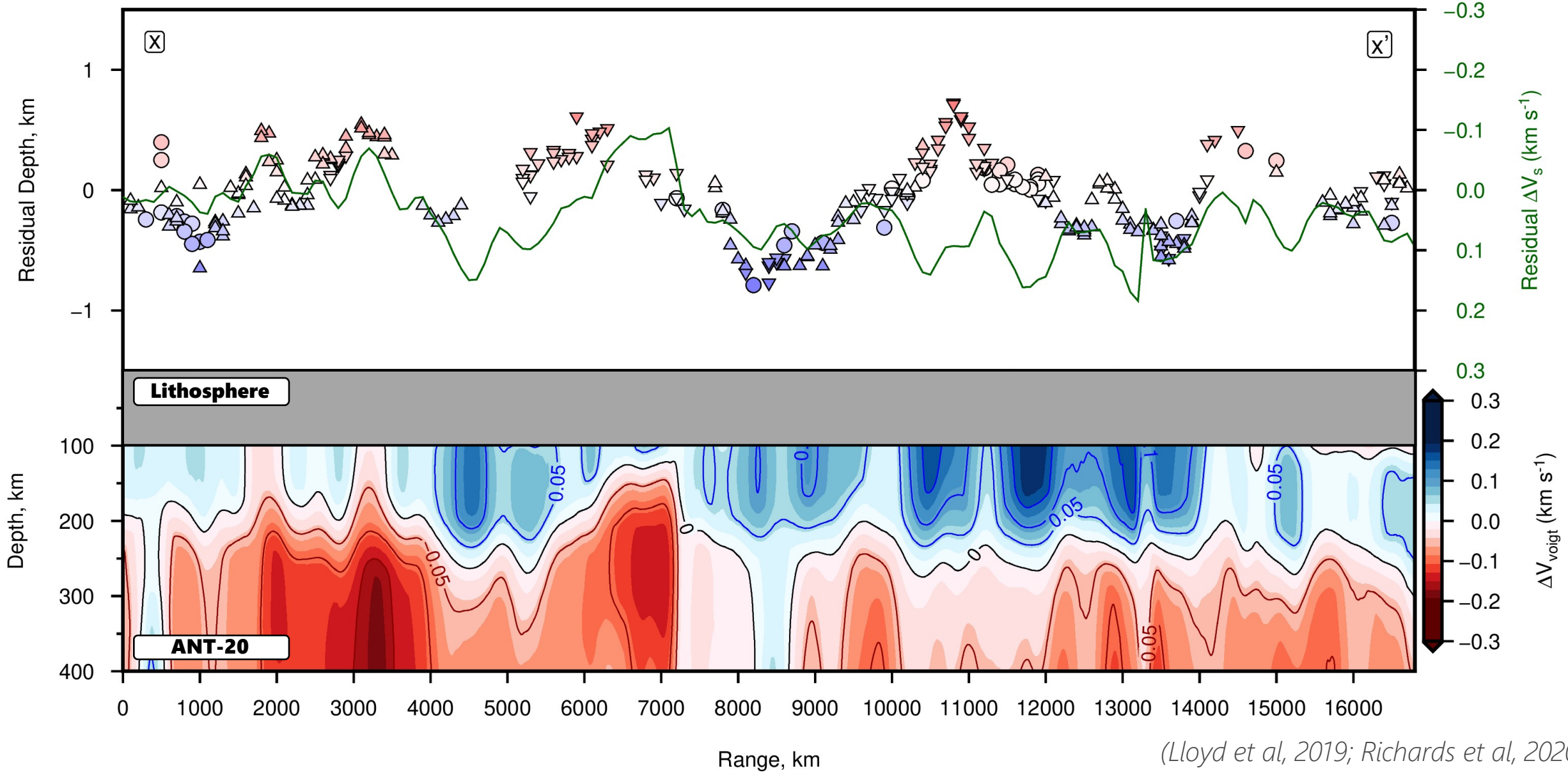
Tomography



- Results can be compared to shear wave tomography to help understand the mantle.
- A transect through the new data will highlight areas where the expected anti-correlation between shear wave velocity anomalies and residual depths is present, suggesting residual topography is the result of upper mantle processes
- Areas where it deviates may be the result of deeper mantle processes and are interesting areas to focus future research

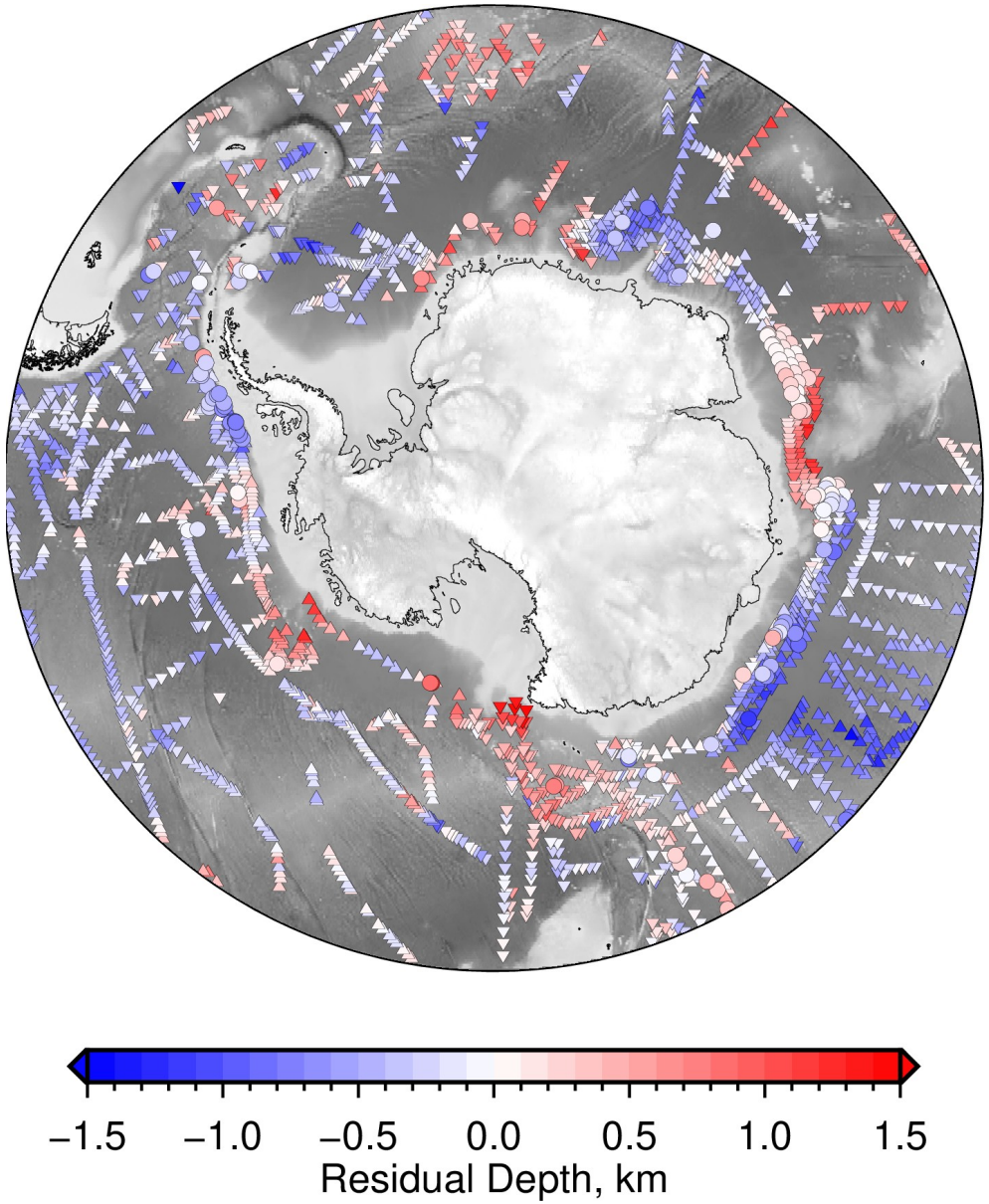
(This study)

Tomography



(Lloyd et al, 2019; Richards et al, 2020)

Summary



- 480 additional seismic reflection profiles
- Greater spatial constraints on dynamic topography
- First step in creating an Antarctic wide database of dynamic topography observations
- Provides context to future work onshore