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Extending the fabric from the EGRIP ice core in space with geophysical methods and modelling

Tamara A. Gerber¹, David Lilien, Nicholas Rathmann, Steven Franke, Tun Jan Young, Fernando Valero-Delgado, Reza Ershadi, Reinhard Drews, Ole Zeising, Angelika Humbert, Nicolas Stoll, Ilka Weikusat, Aslak Grinsted, Christine Hvidberg, Daniela Jansen, Heinrich Miller, Veit Helm, Daniel Steinhage, Charles O'Neill, John Paden, Prasad Gogineni, Dorthe Dahl-Jensen, and **Olaf Eisen**

¹Section for the Physics of Ice, Climate and Earth, Niels Bohr Institute, University of Copenhagen

EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN



CReSIS
Center for Remote Sensing of Ice Sheets



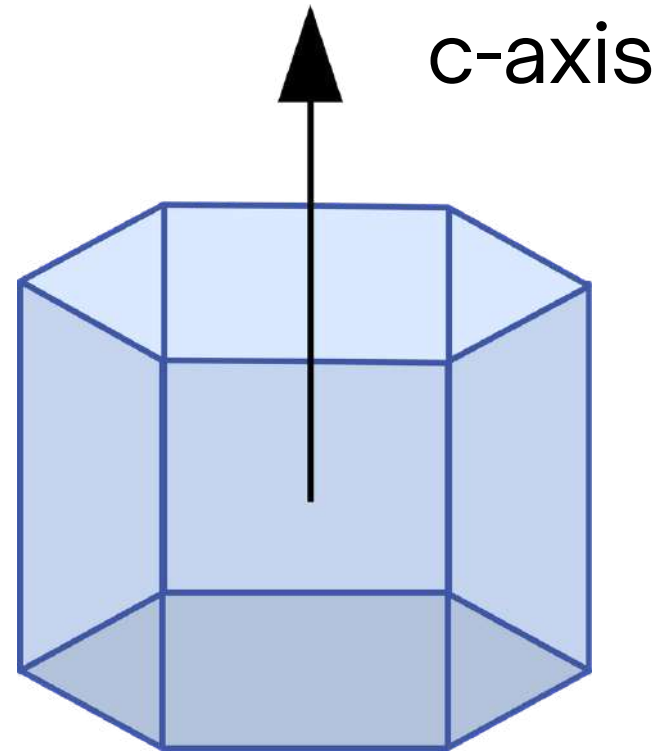
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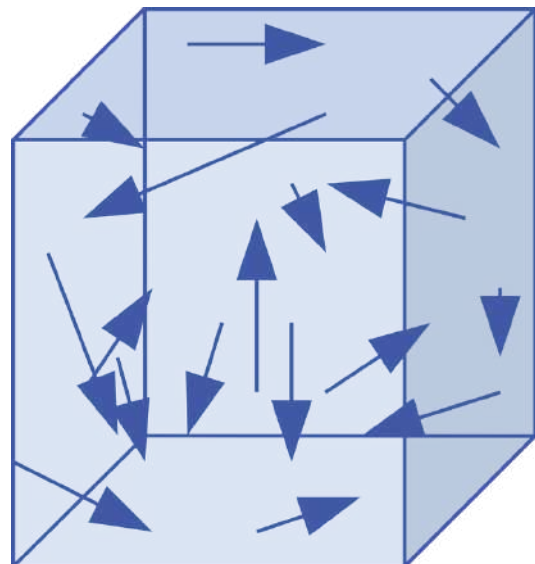
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ALABAMA

Why crystal orientation matters

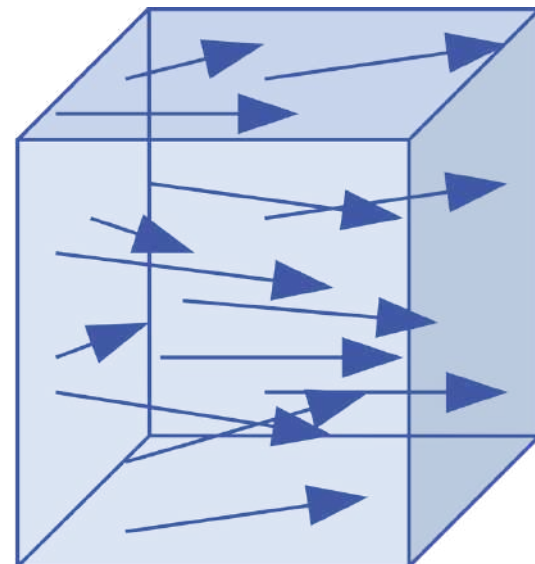


Ice crystals show **mechanical** and **dielectric anisotropy**

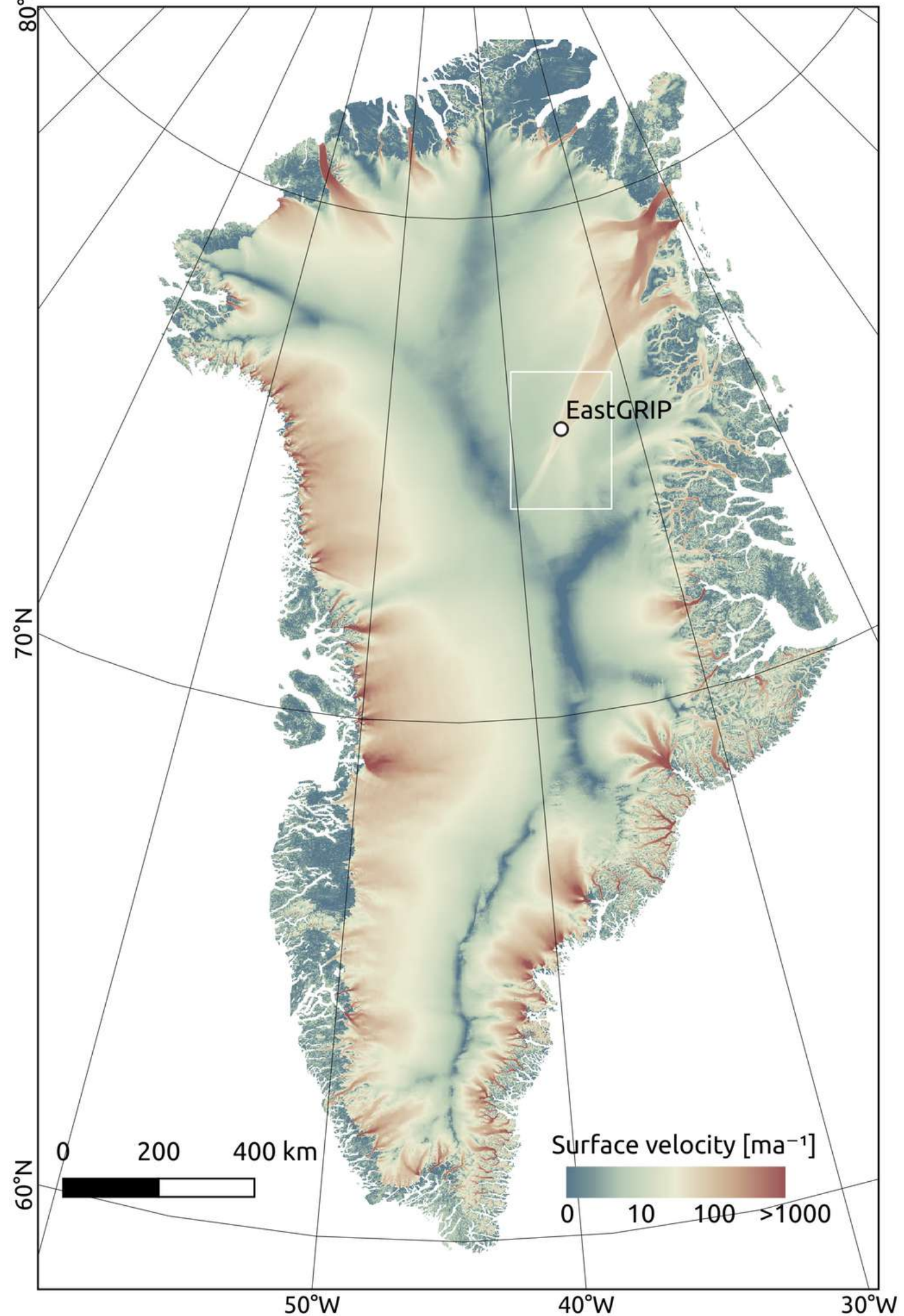
isotropic

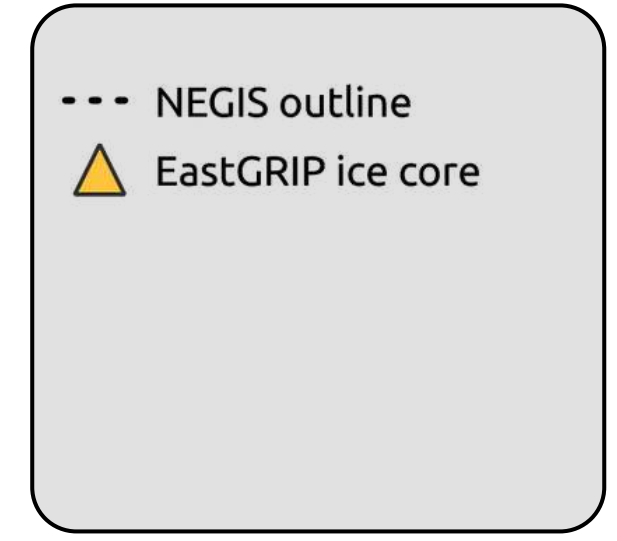
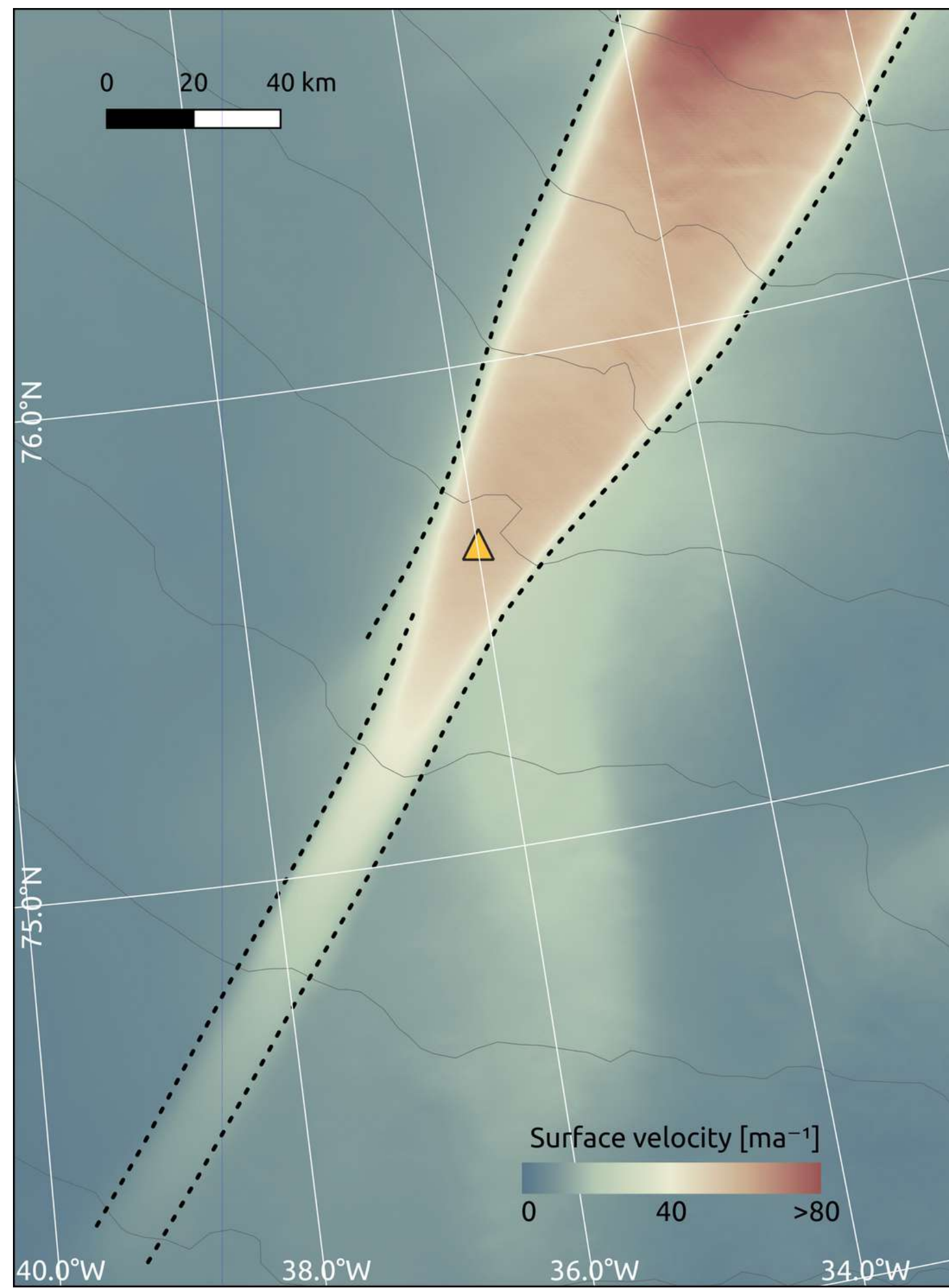
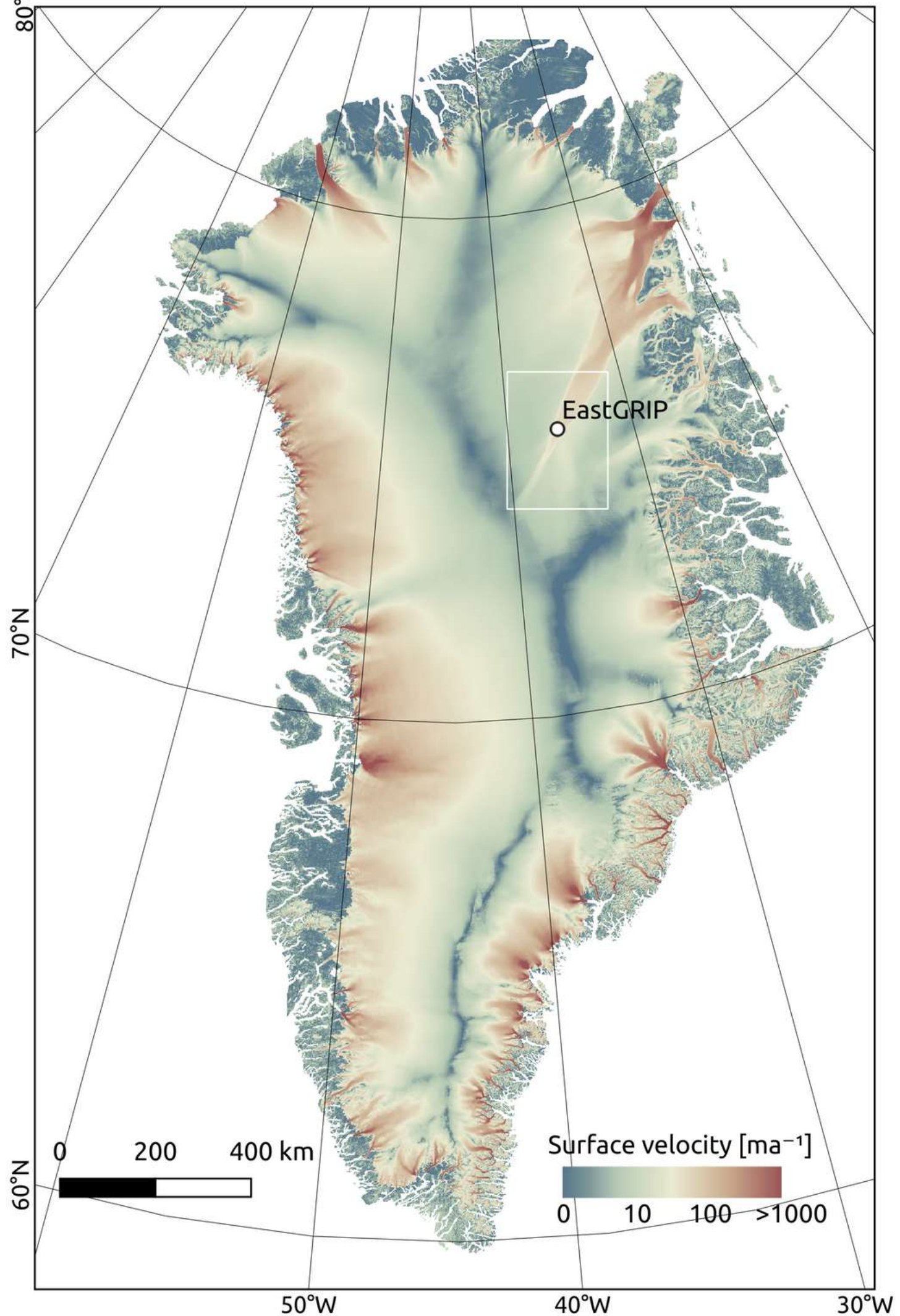


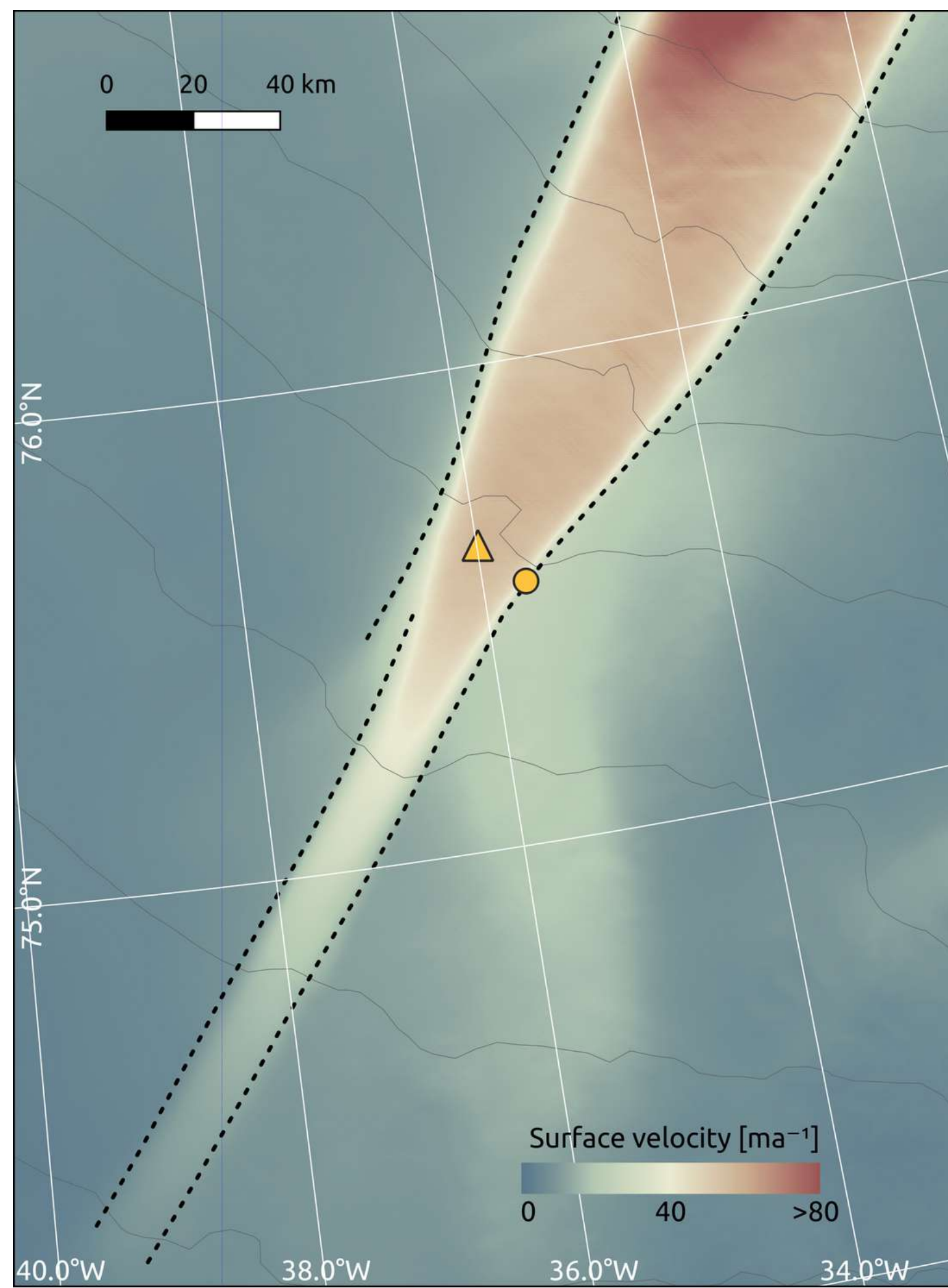
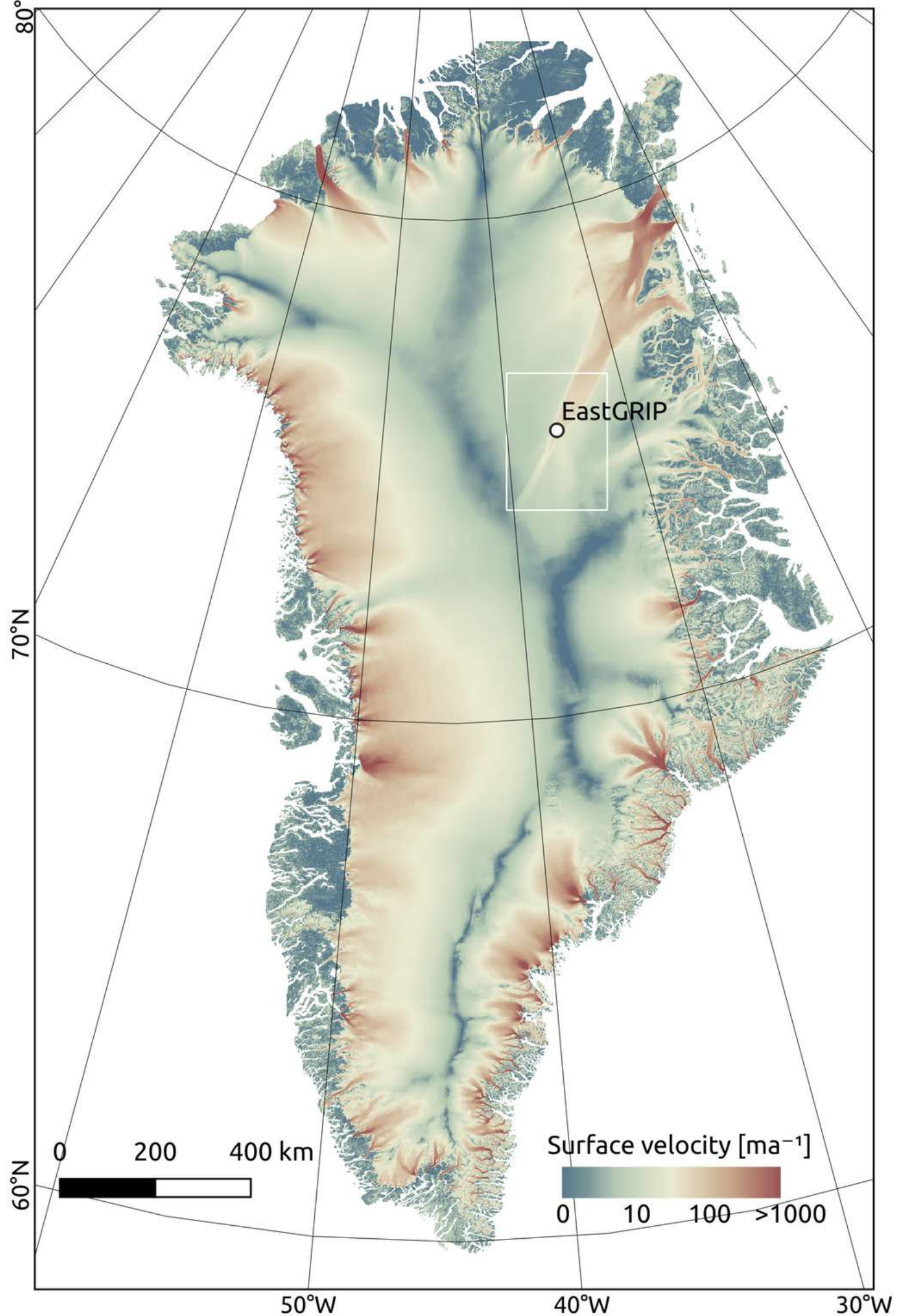
anisotropic



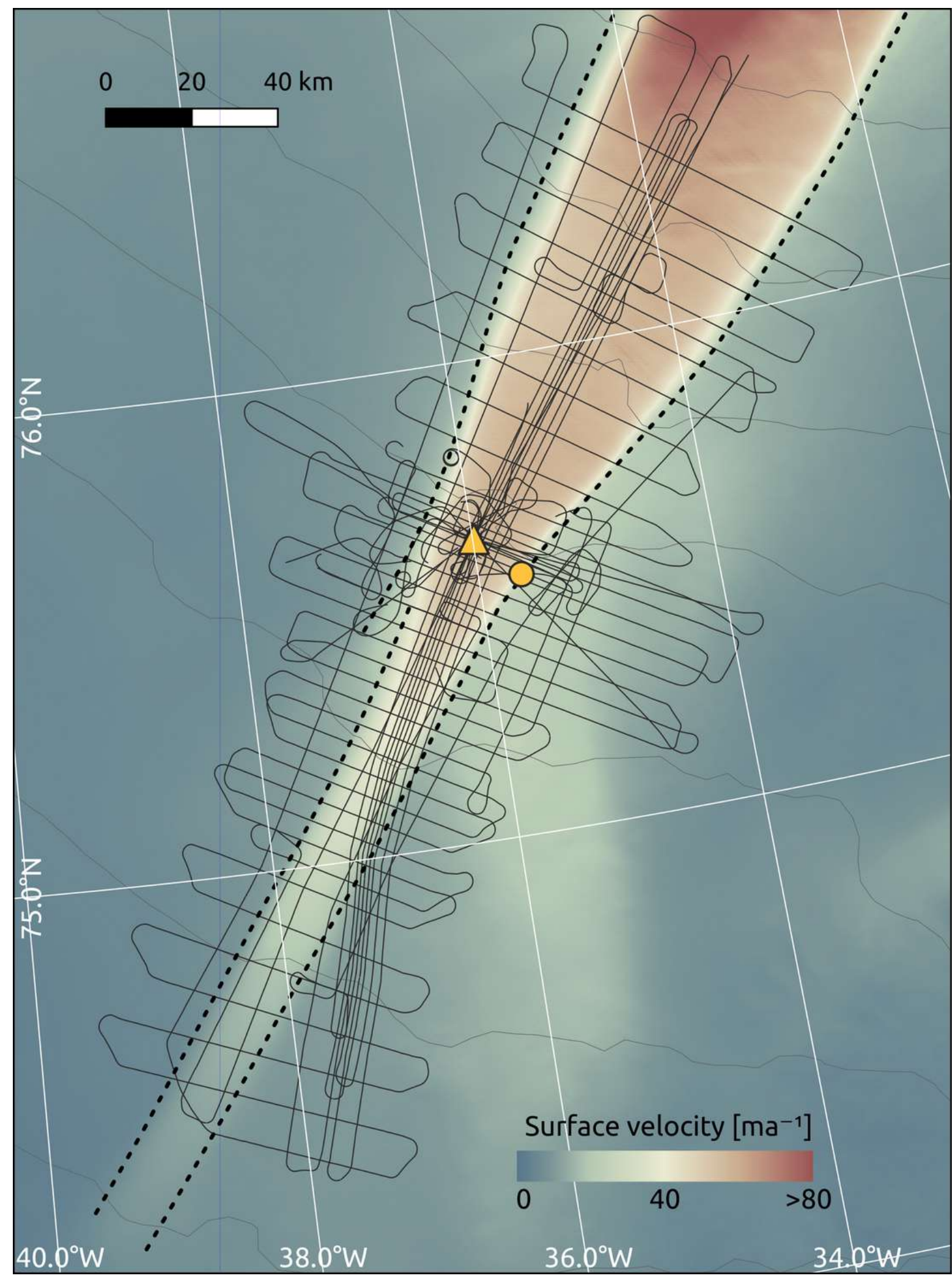
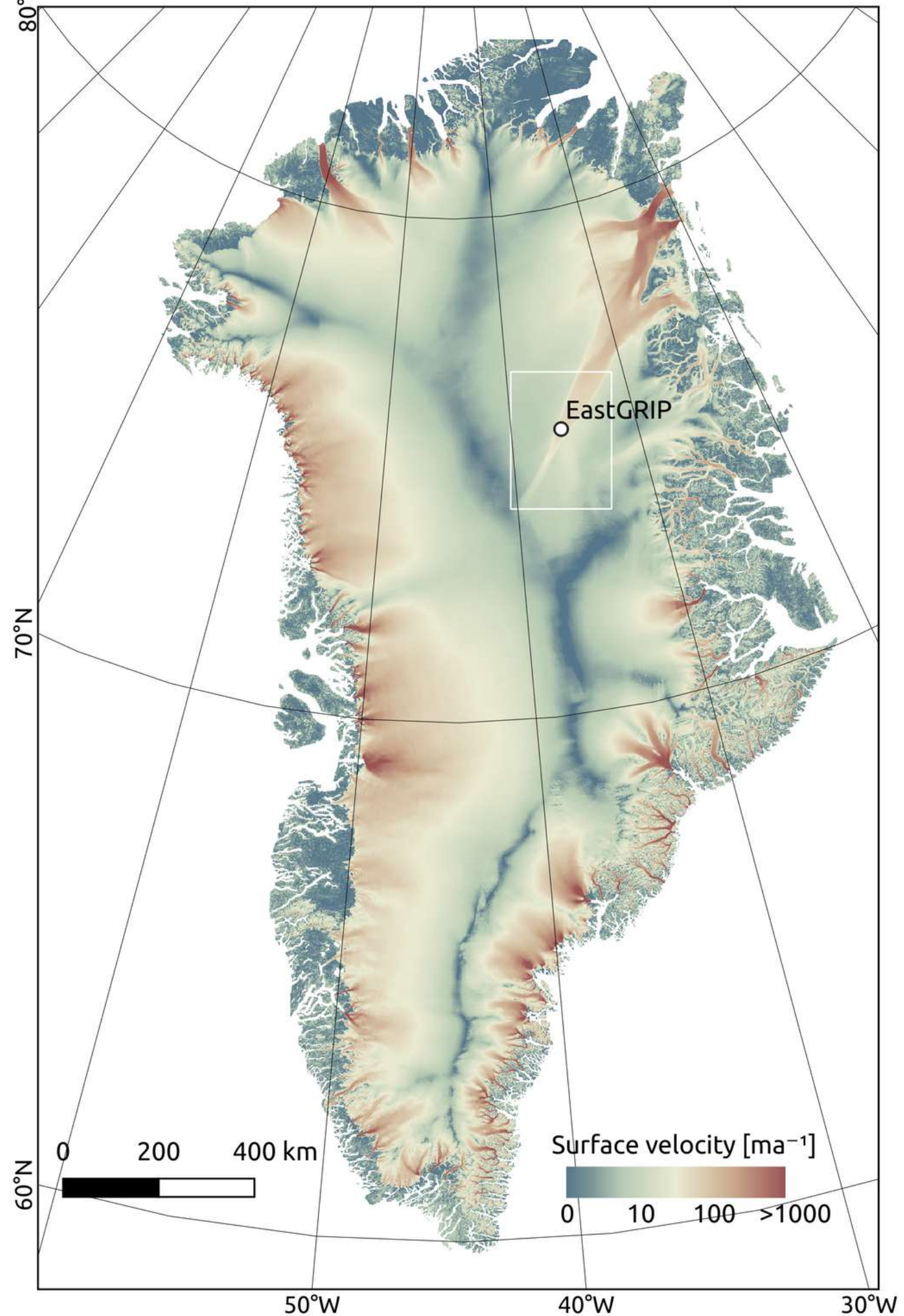
Cystal **O**rientation **F**abric (**COF**, or *fabric*) affects **bulk mechanical properties**



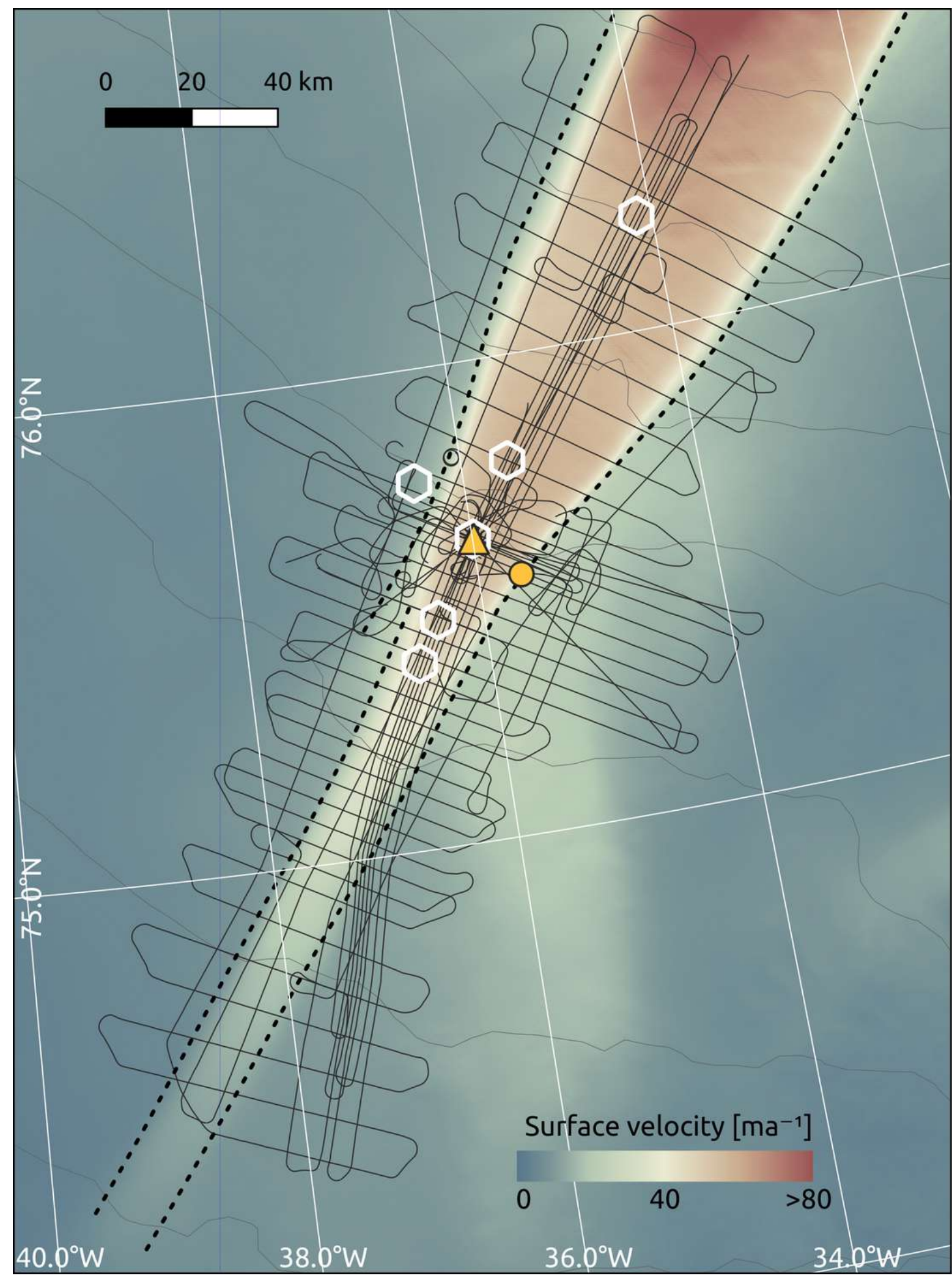
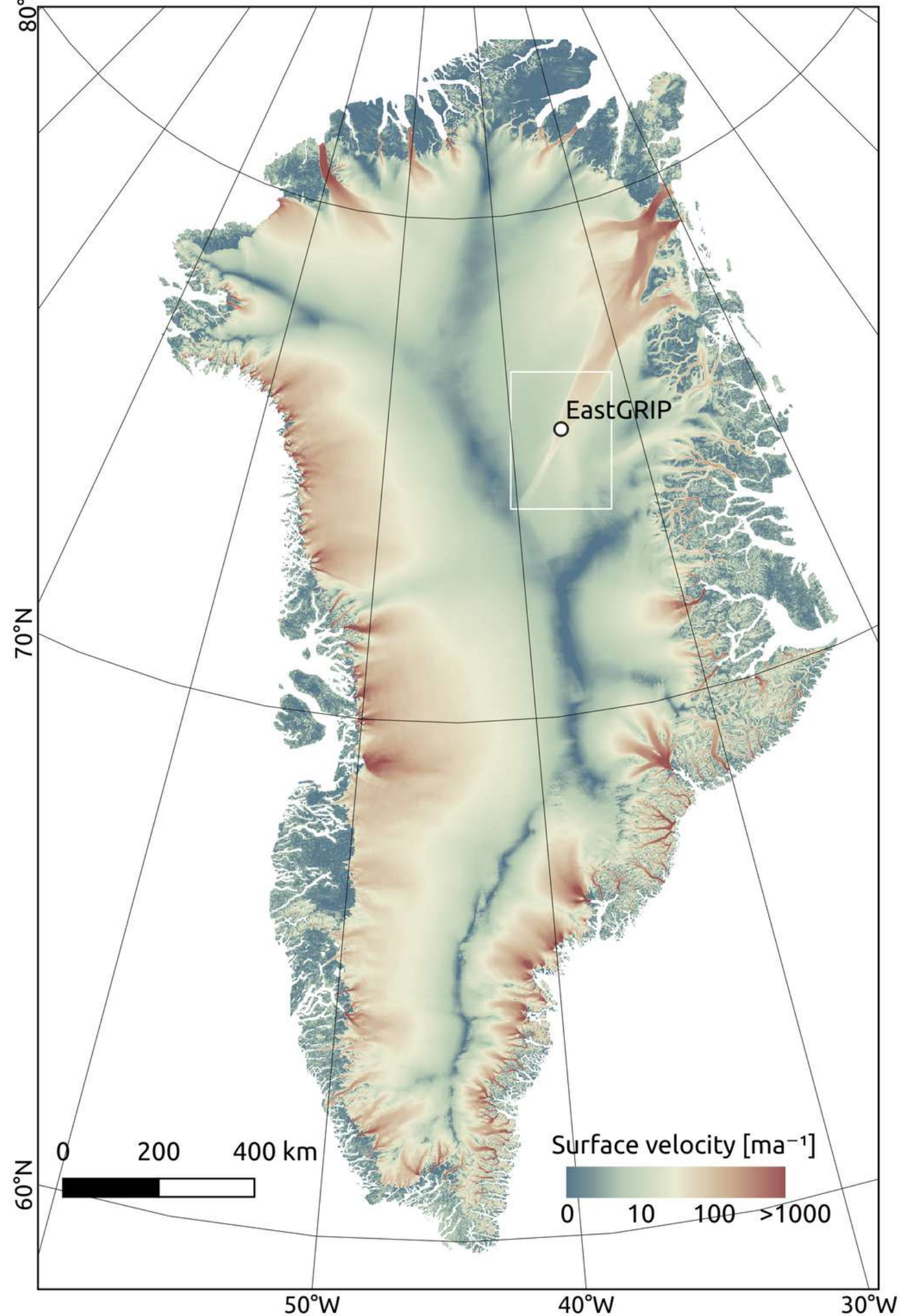




- NEGIS outline
- ▲ EastGRIP ice core
- S5 shallow core

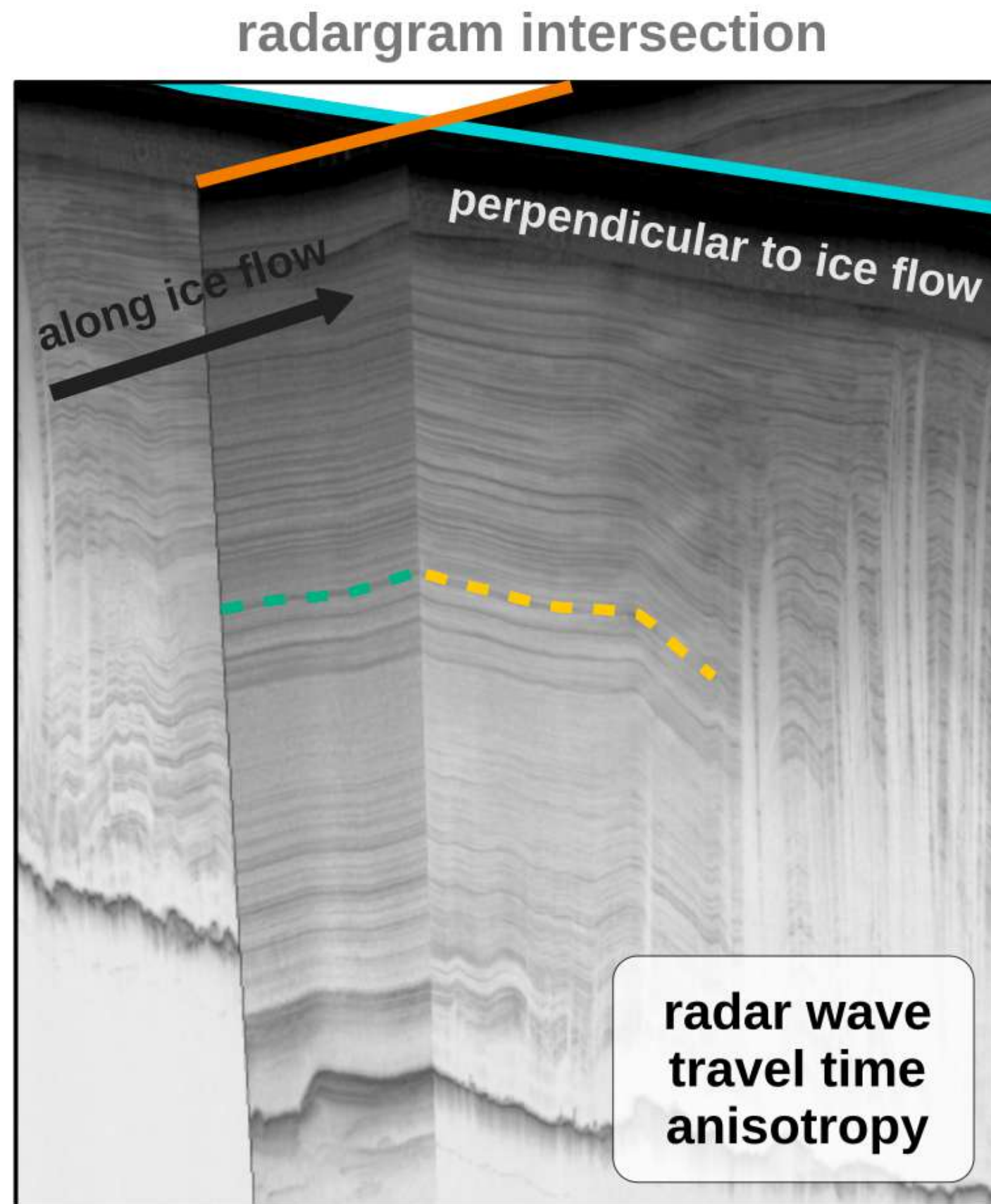


- NEGIS outline
- ▲ EastGRIP ice core
- S5 shallow core
- airborne radar lines

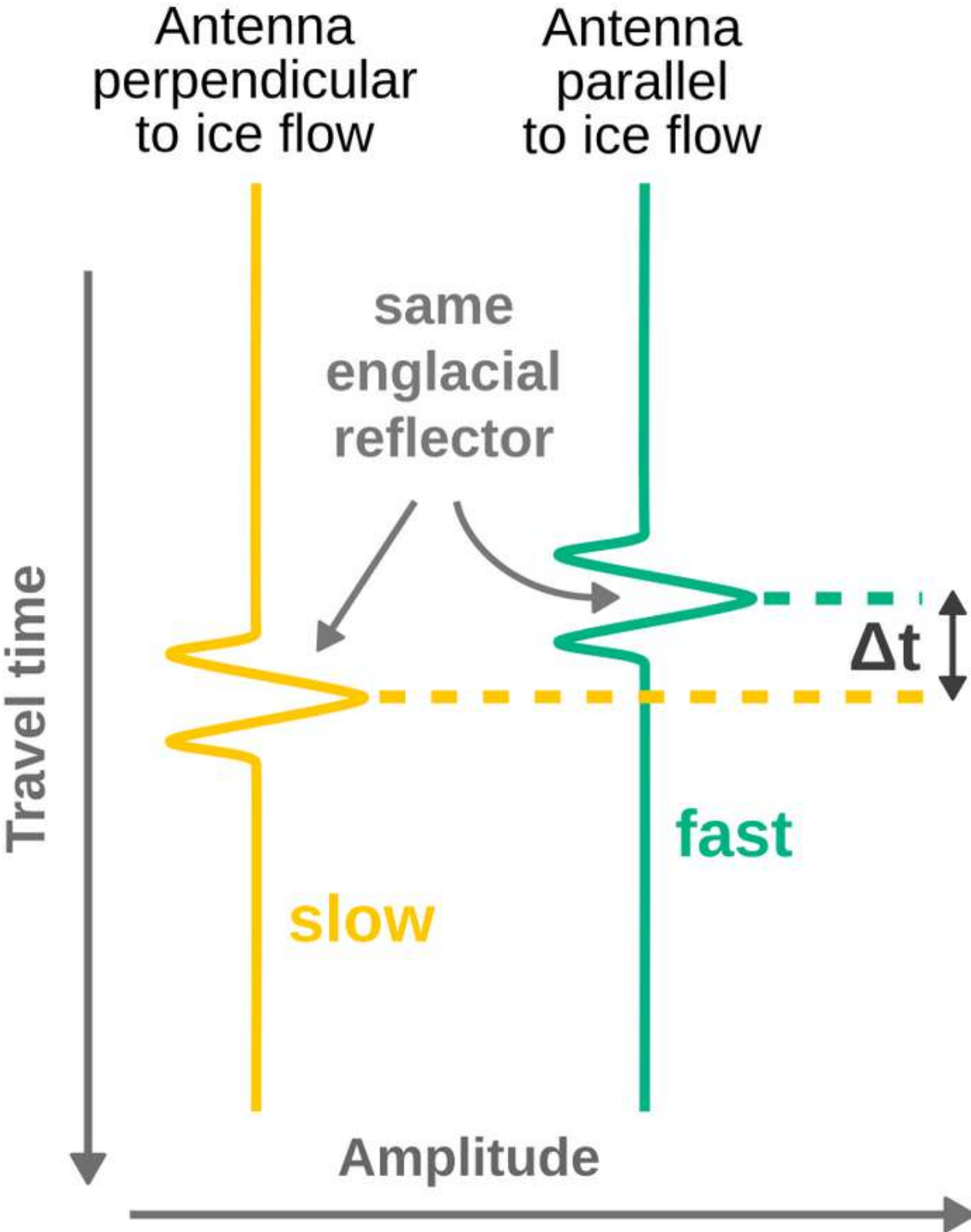
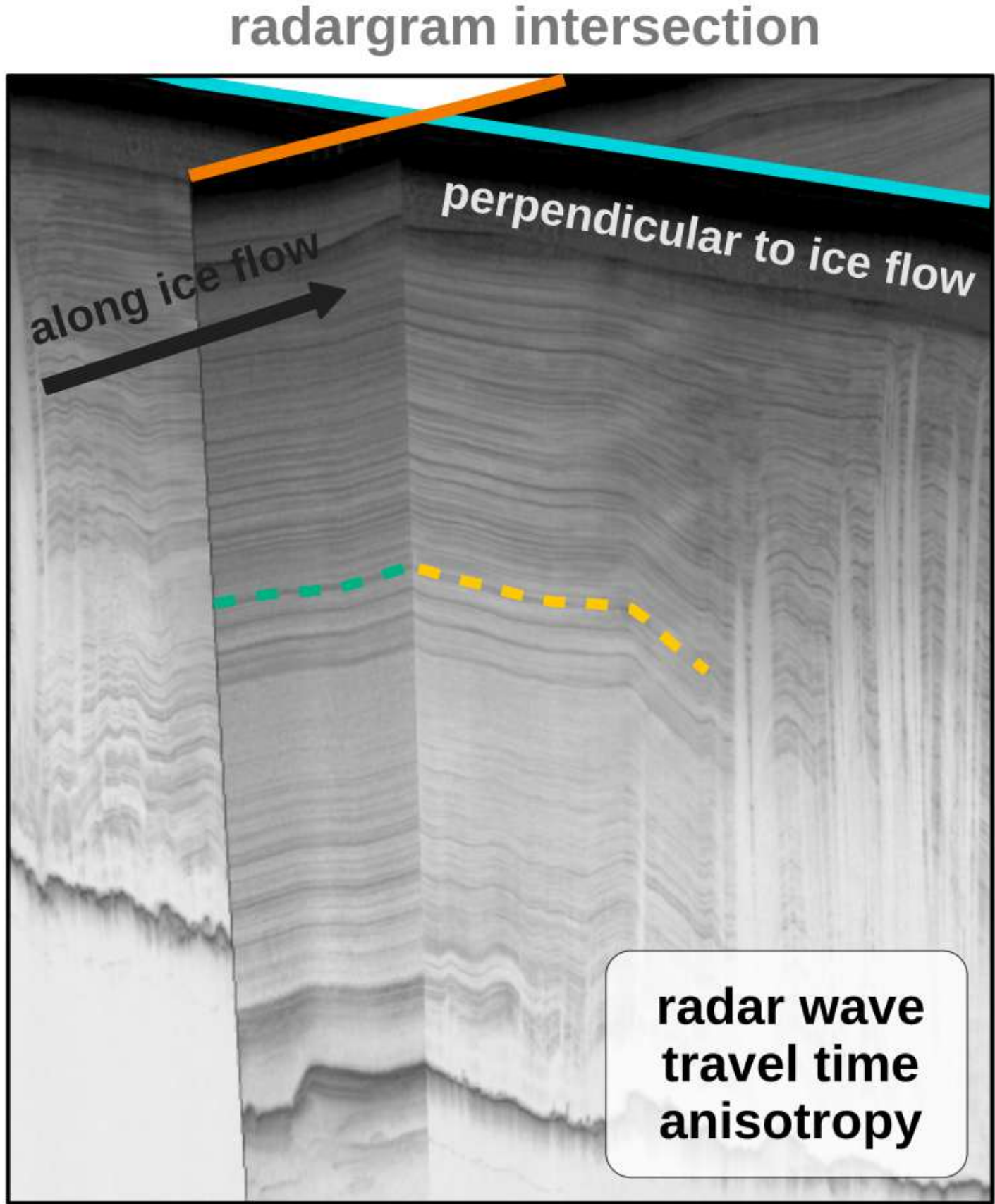


- NEGIS outline
- ▲ EastGRIP ice core
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- airborne radar lines
- ⬡ pRES locations

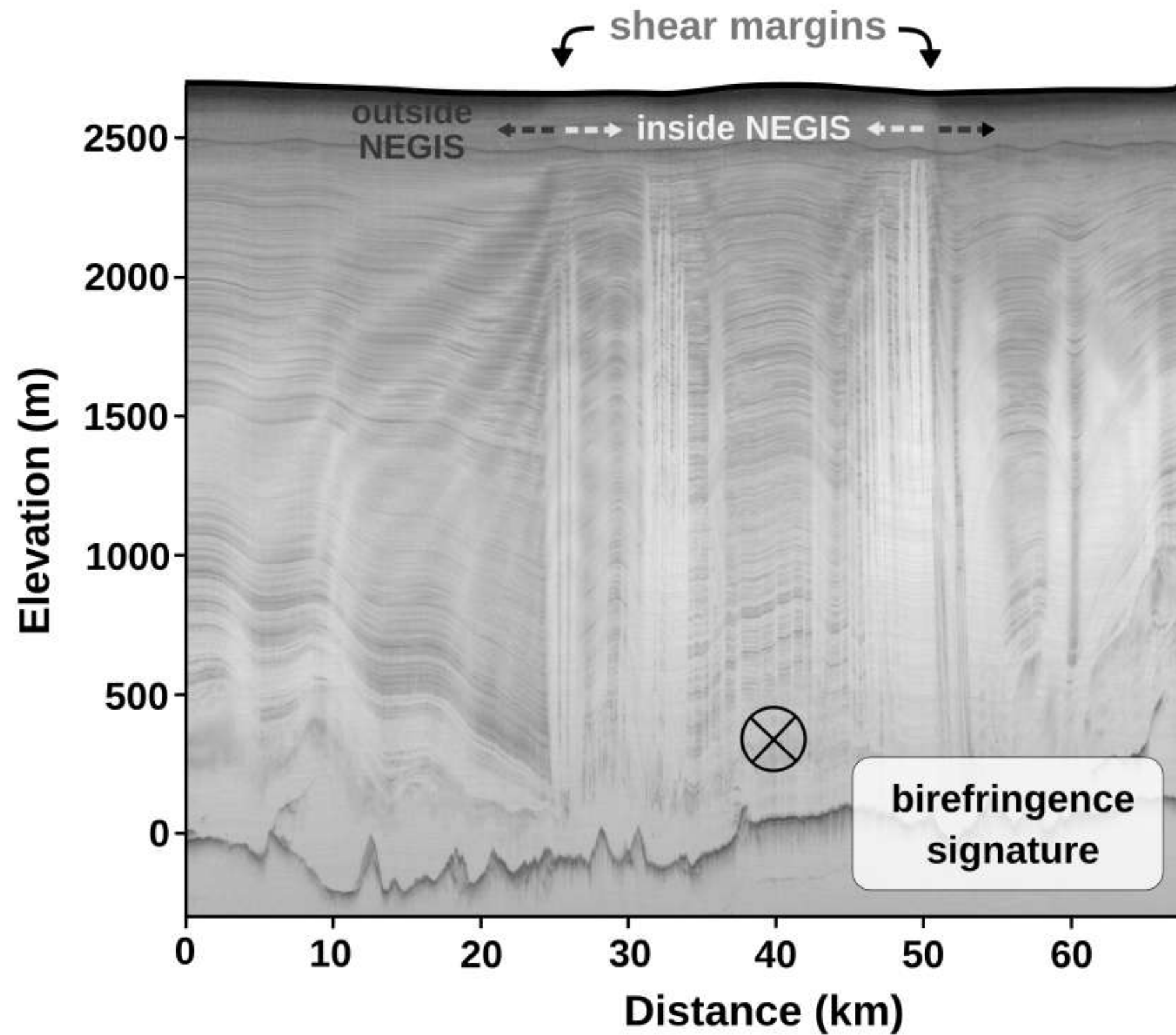
Effects of COF on radar signals: **travel-time anisotropy**



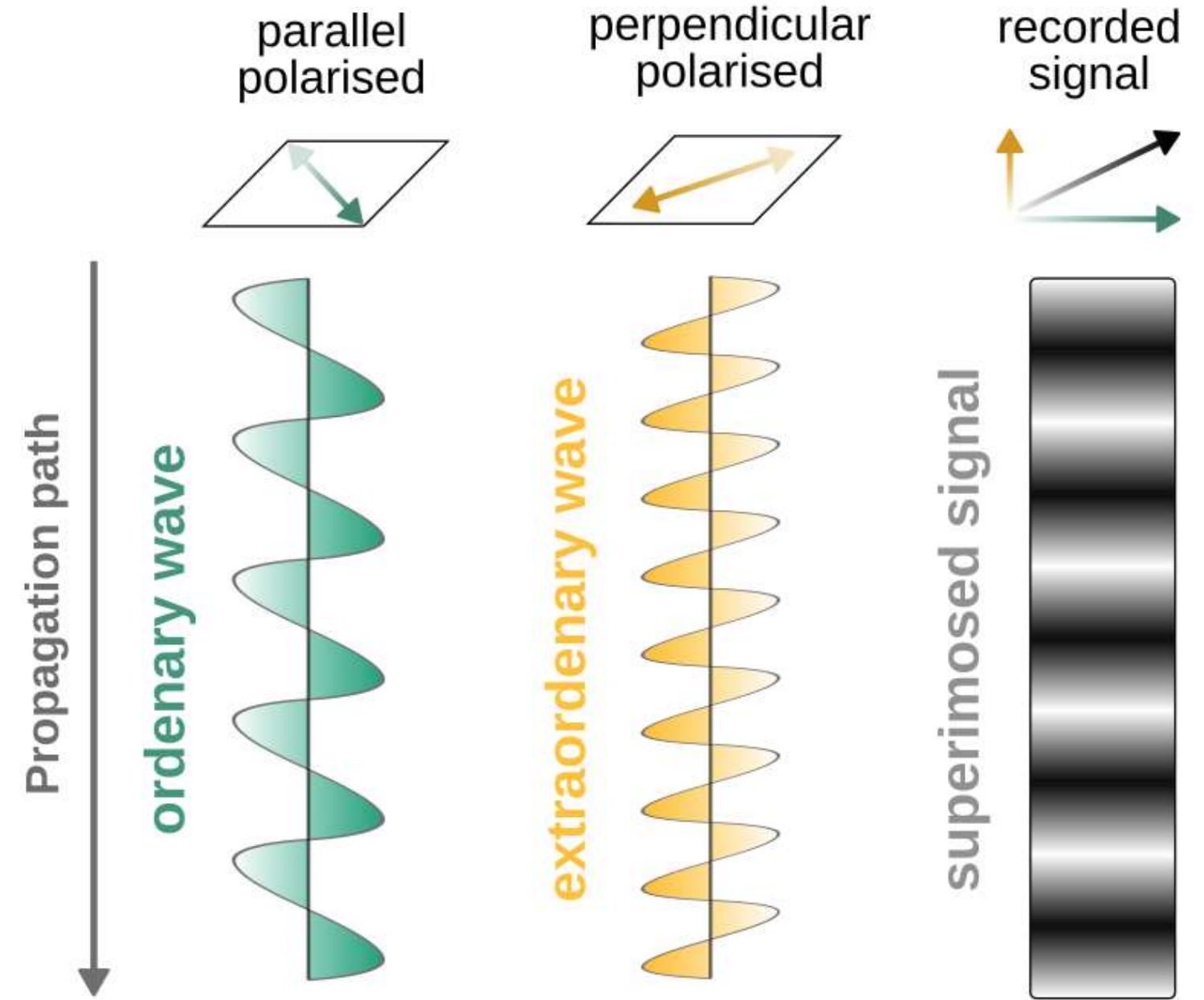
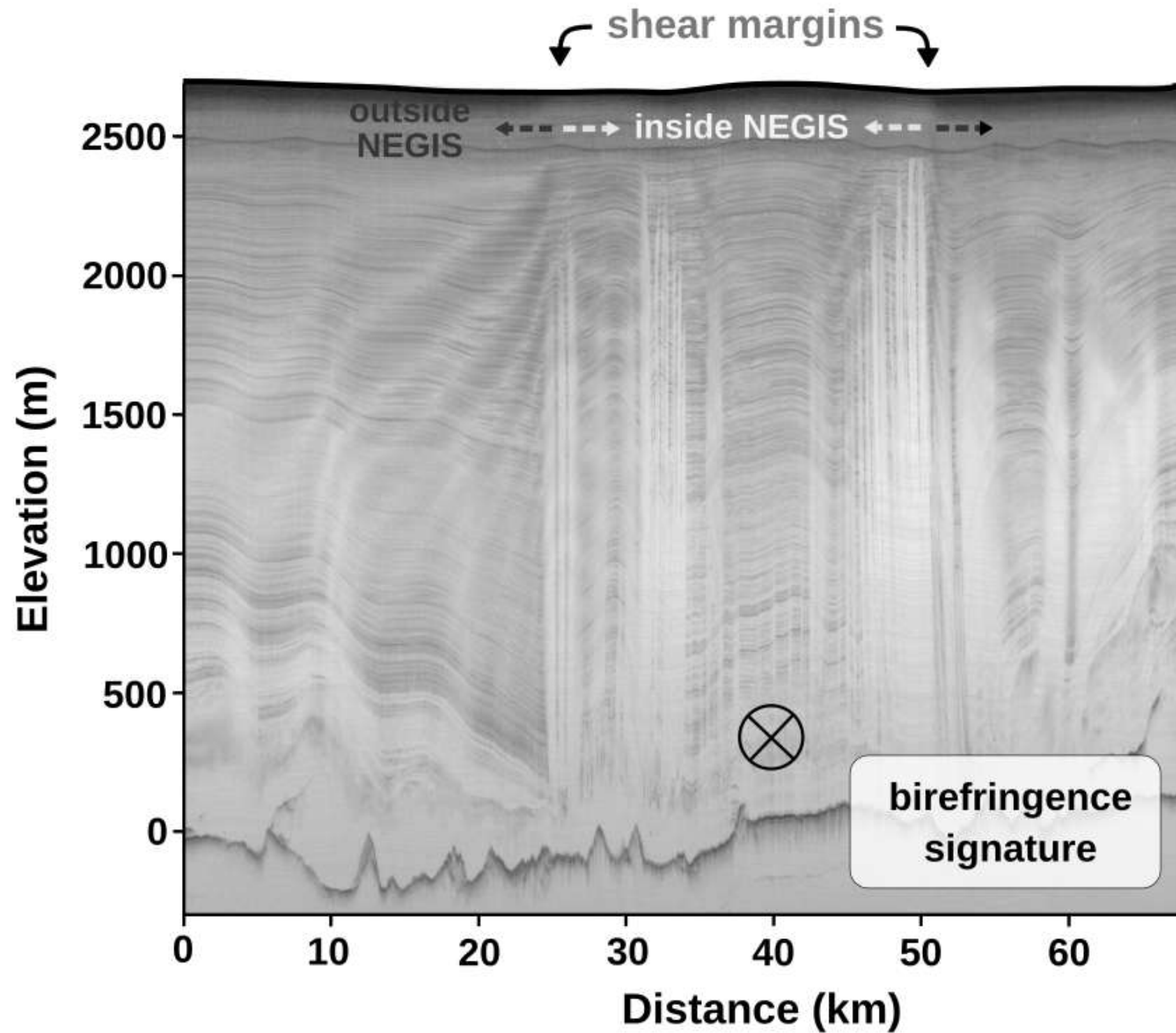
Effects of COF on radar signals: **travel-time anisotropy**



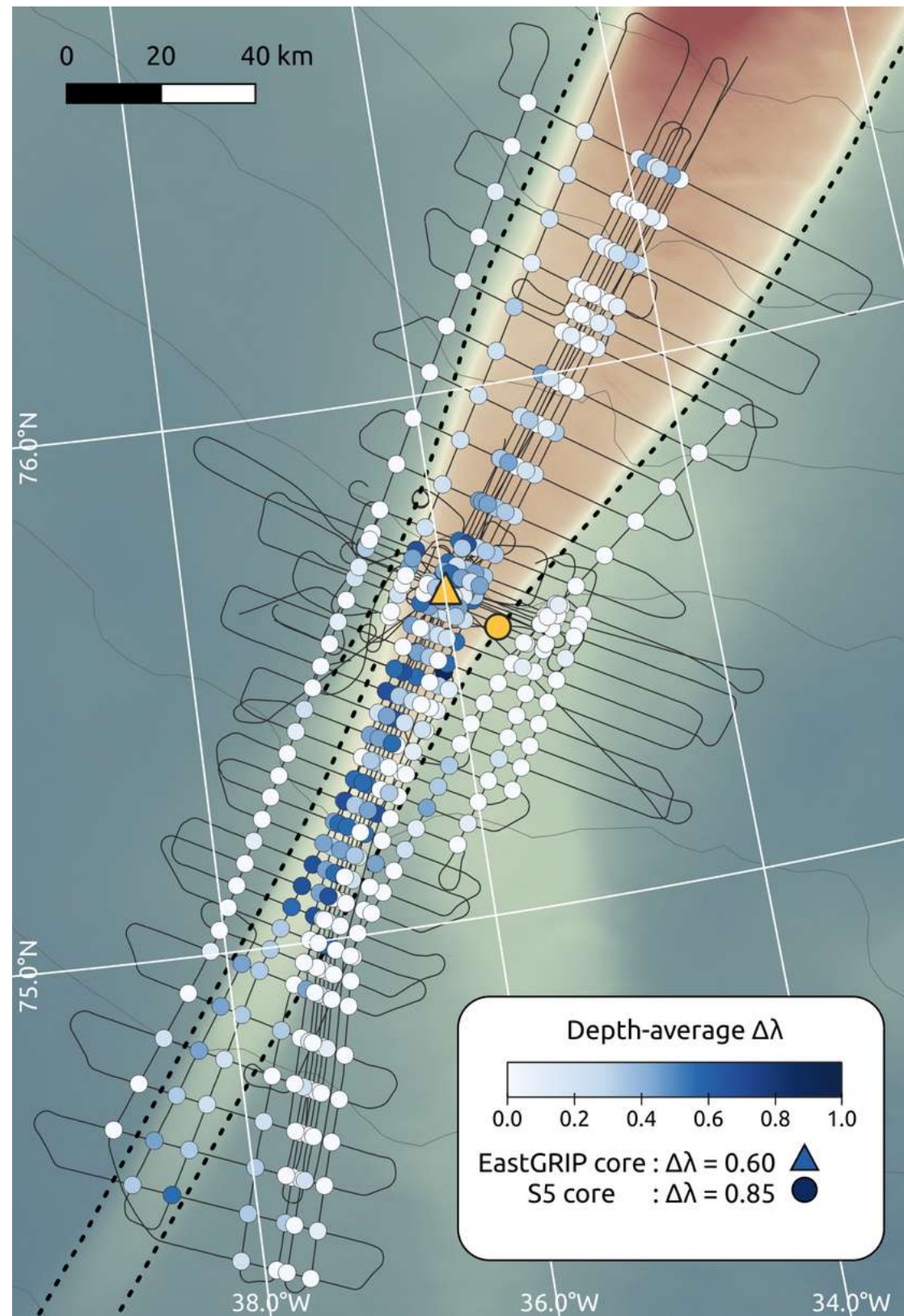
Effects of COF on radar signals: **beat signature**



Effects of COF on radar signals: beat signature

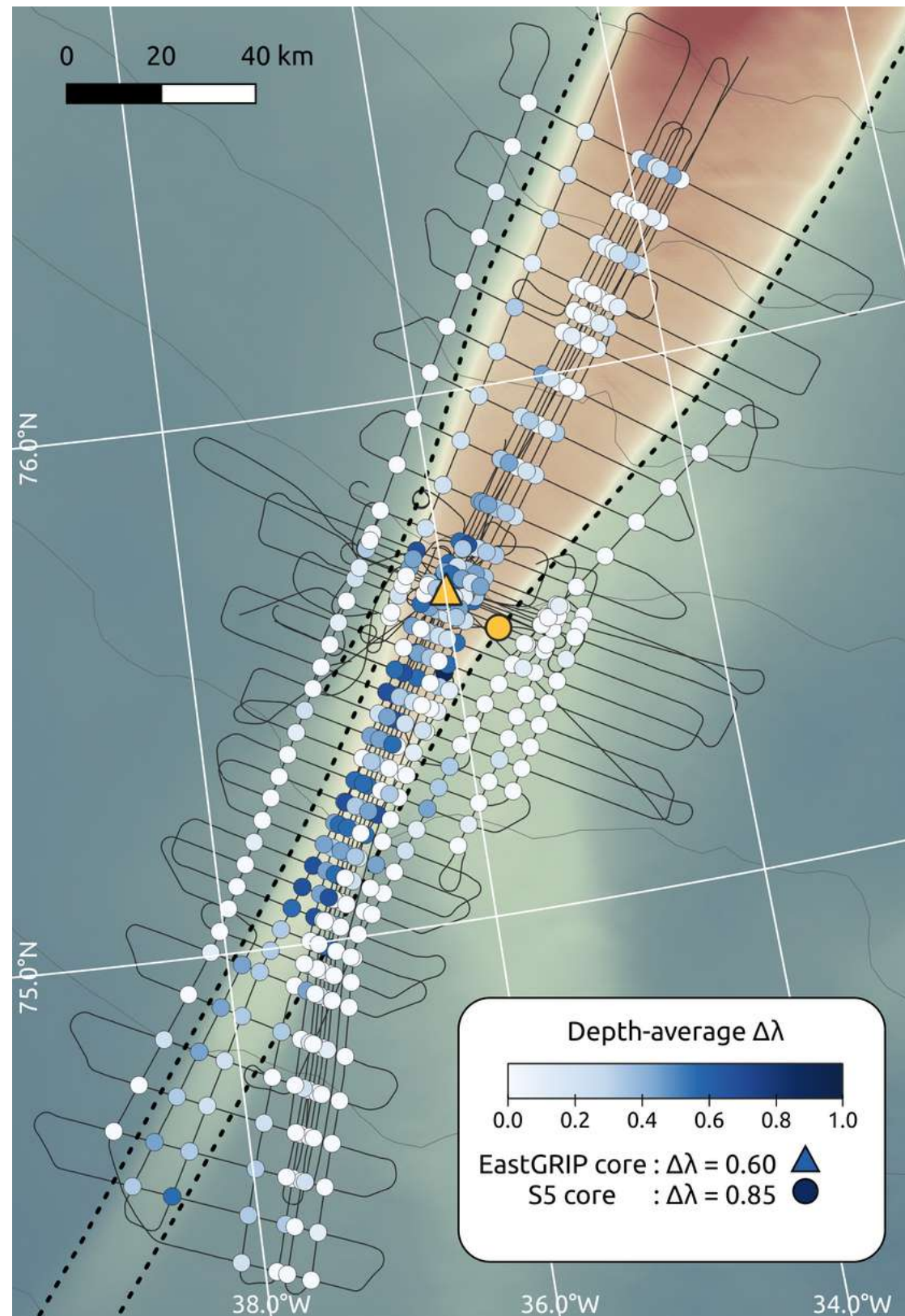


Horizontal fabric anisotropy (depth-average)

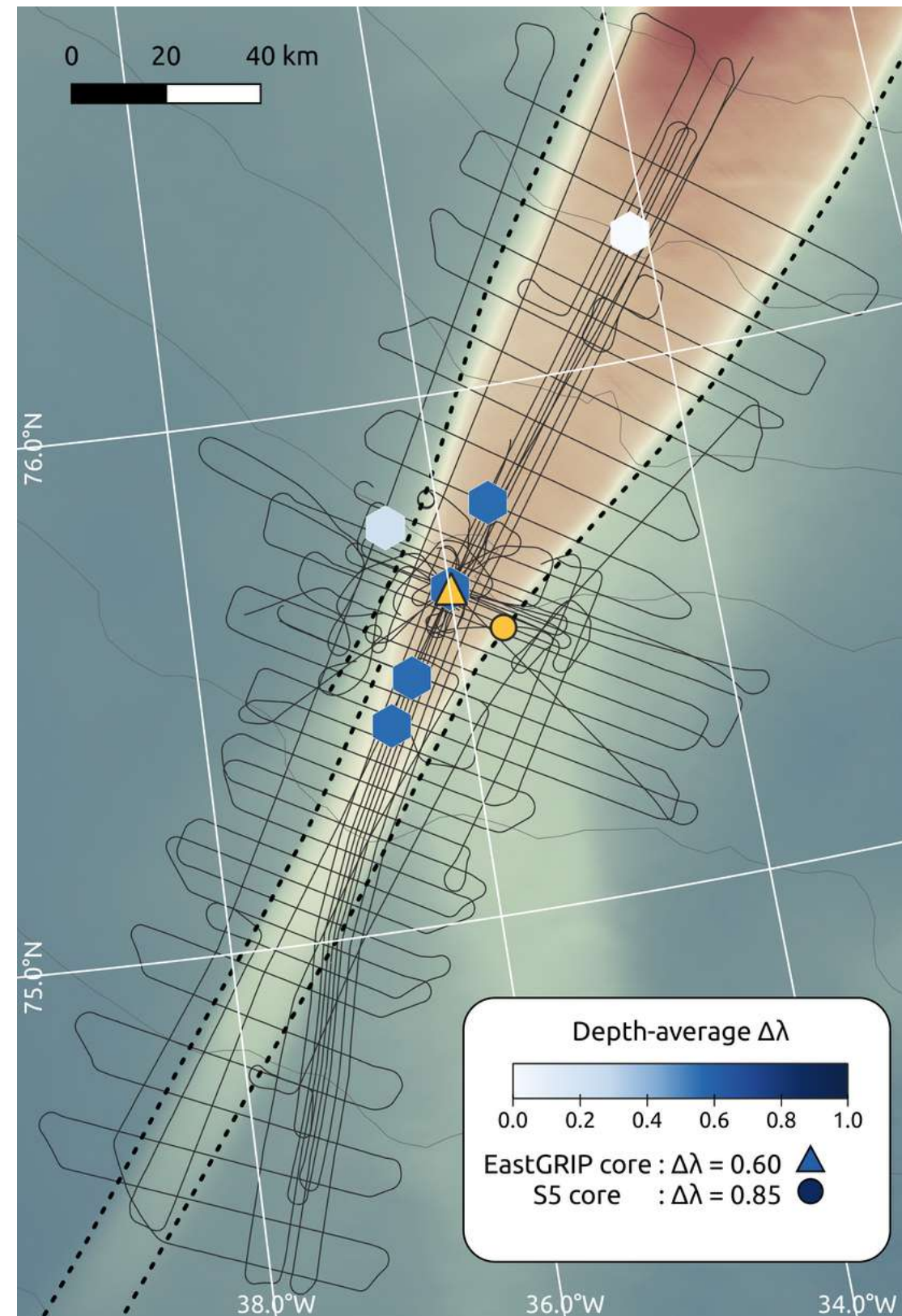


airborne travel-time anisotropy

Horizontal fabric anisotropy (depth-average)

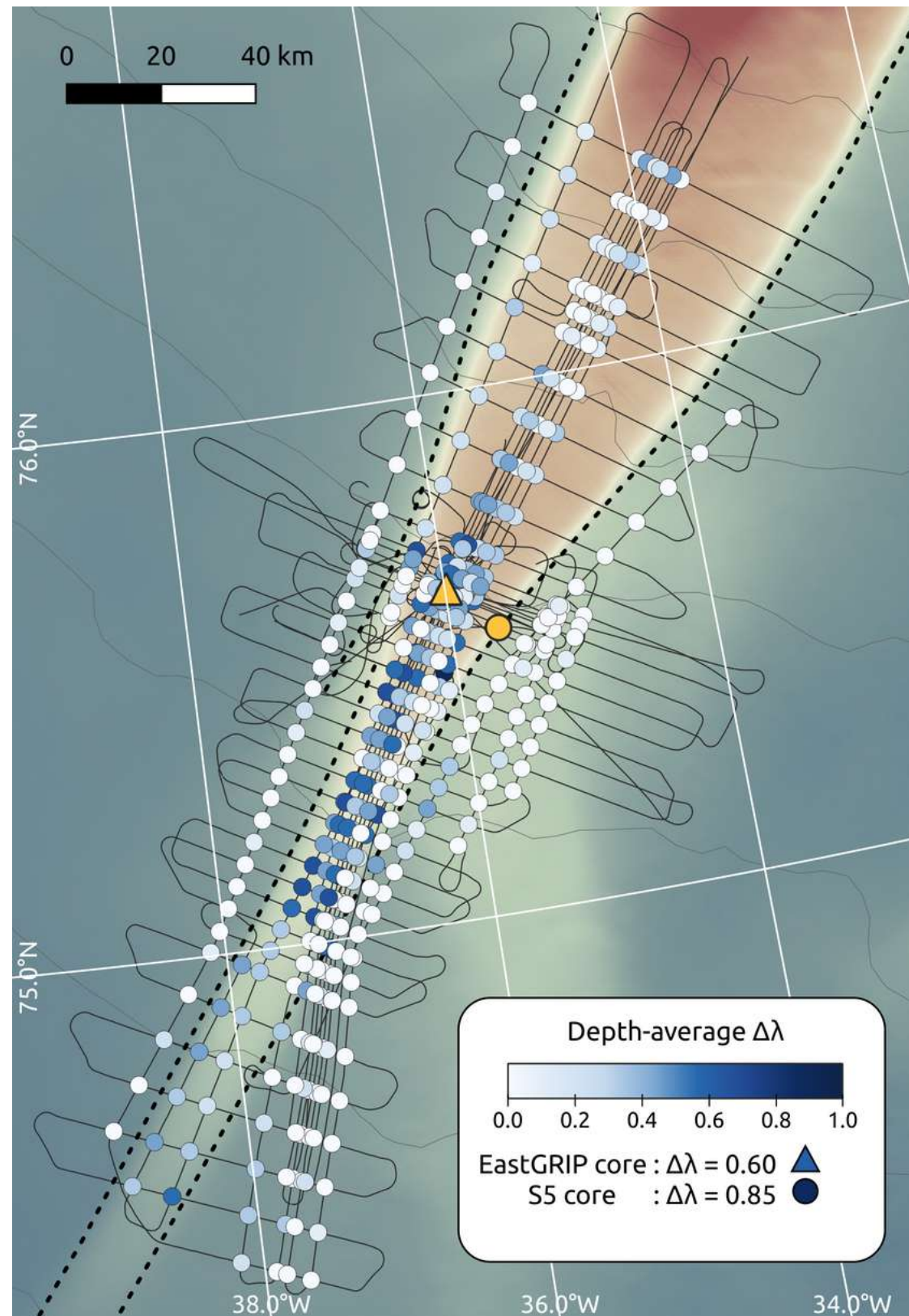


airborne travel-time anisotropy

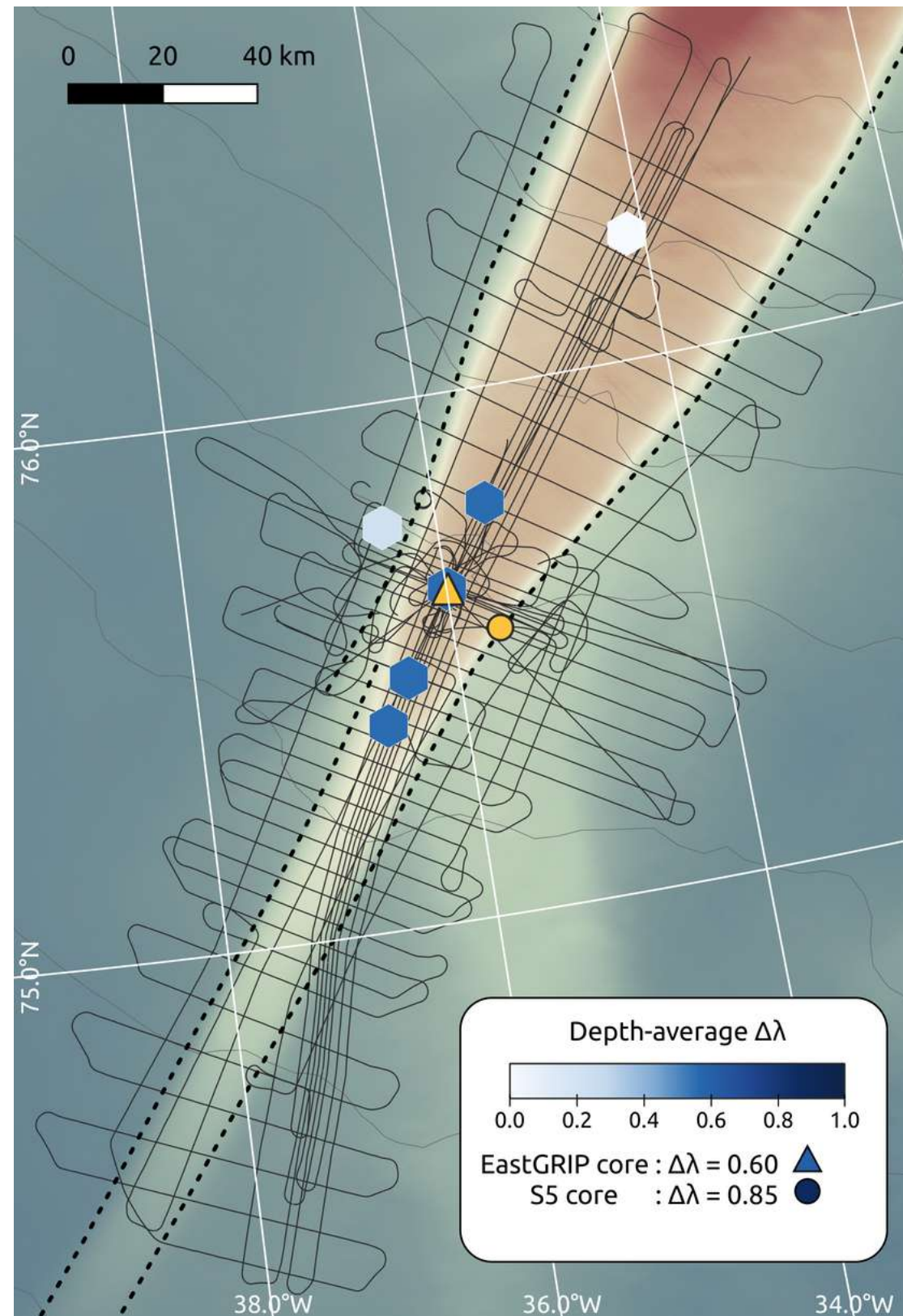


pRES travel-time anisotropy

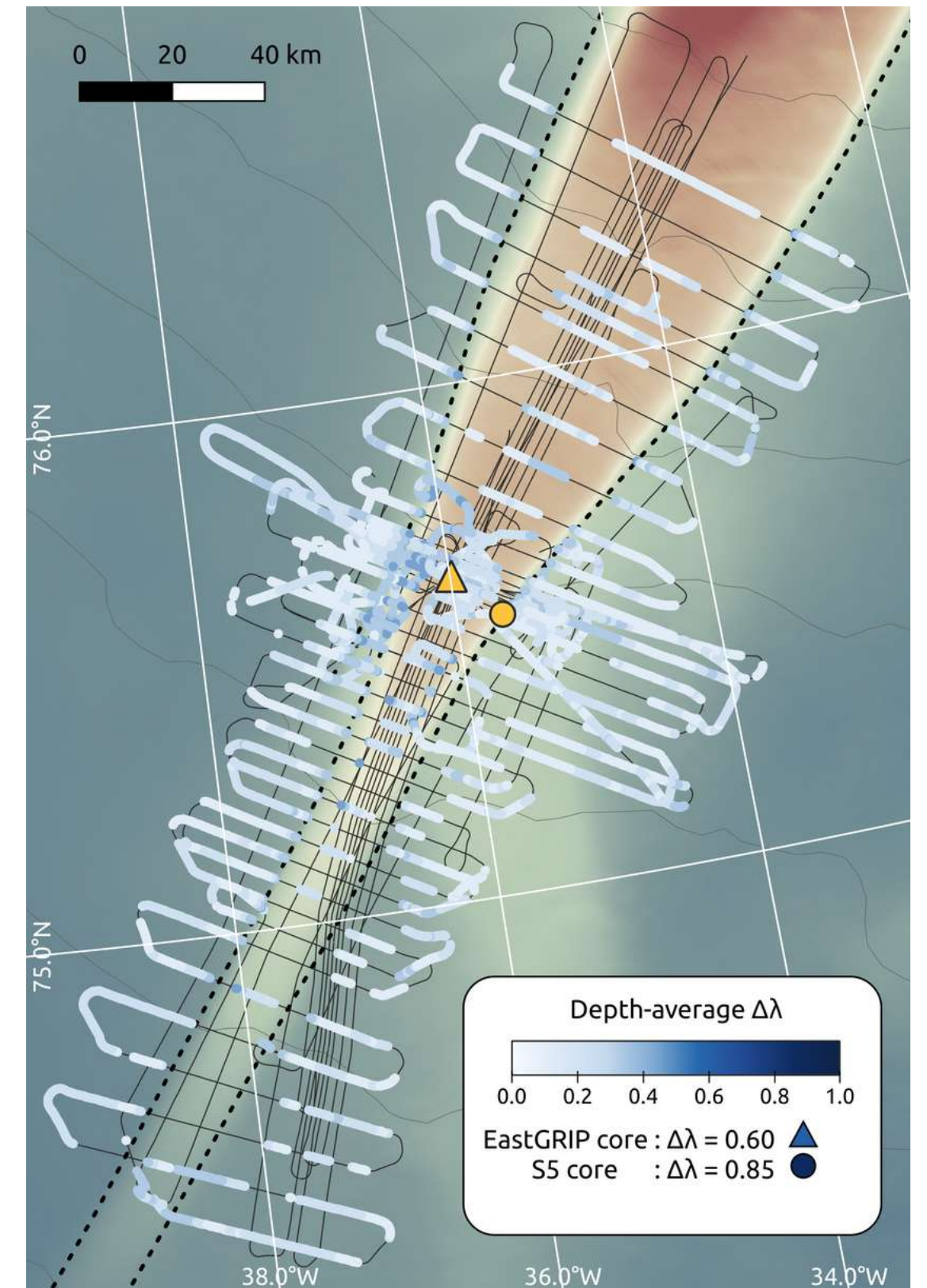
Horizontal fabric anisotropy (depth-average)



airborne travel-time anisotropy



pRES travel-time anisotropy

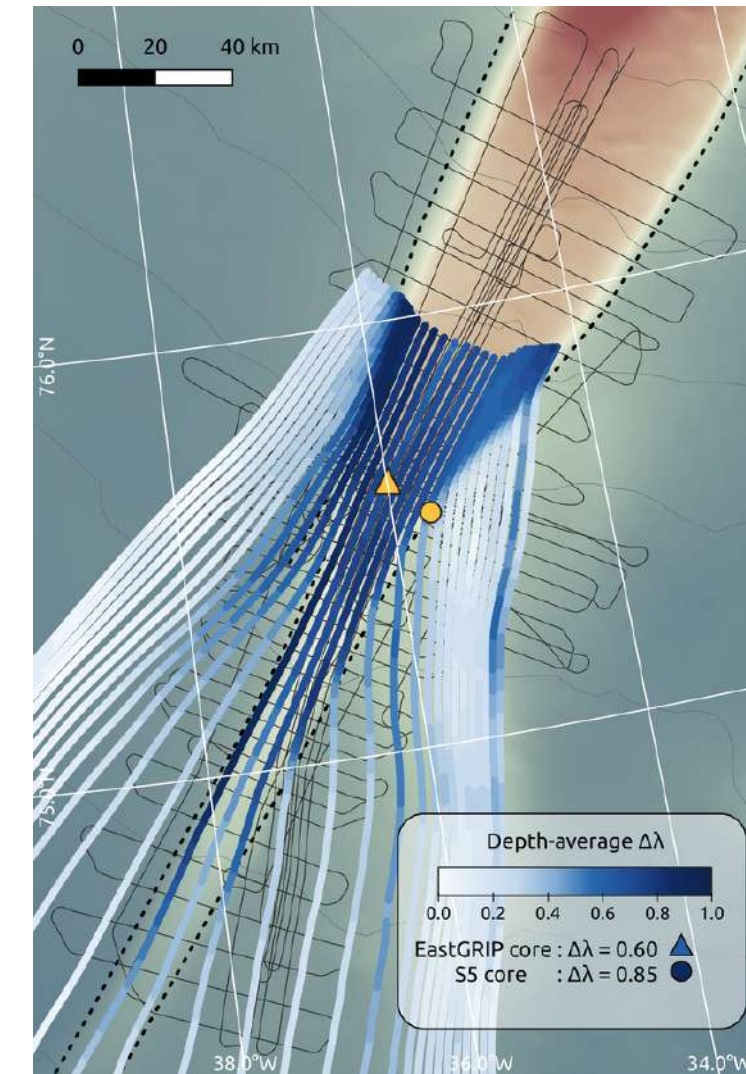
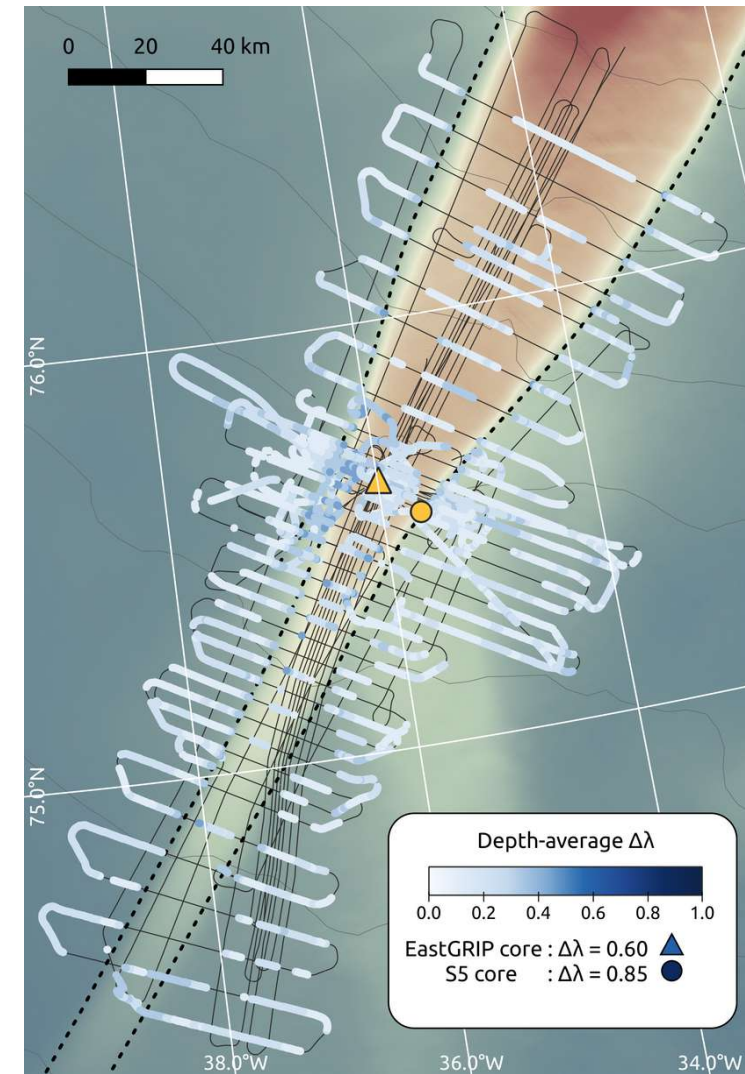
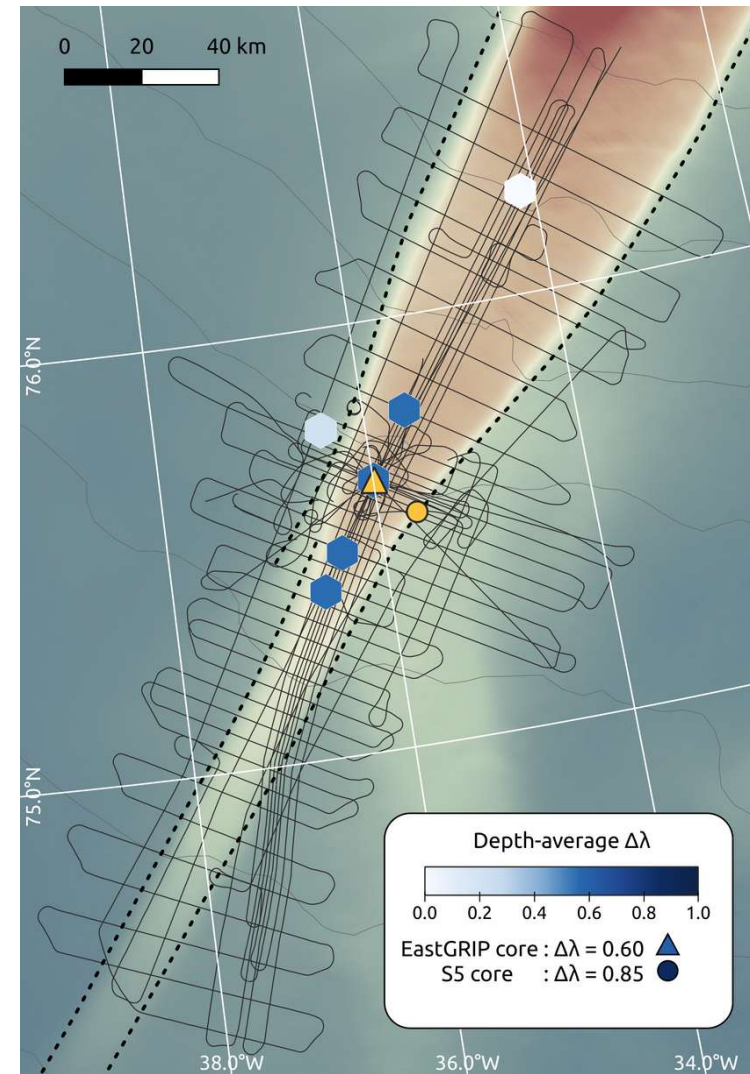
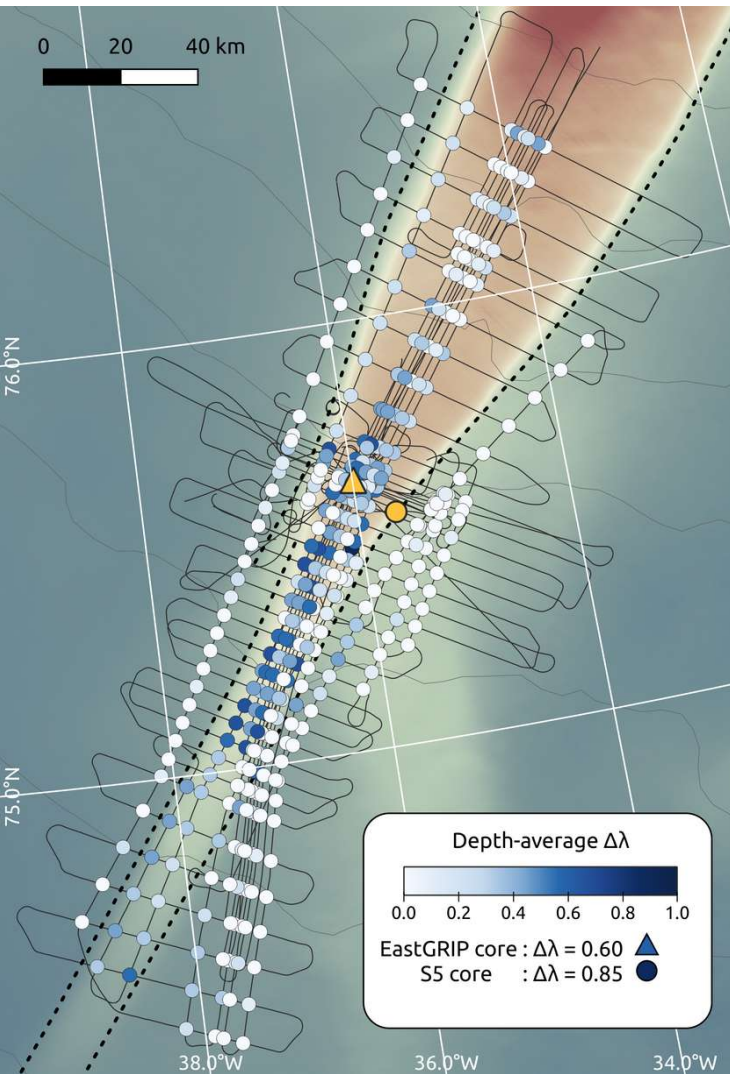


beat signature anisotropy

Horizontal fabric anisotropy (depth-average)

observation-based

modelled



airborne travel-time
anisotropy

pRES travel-time
anisotropy

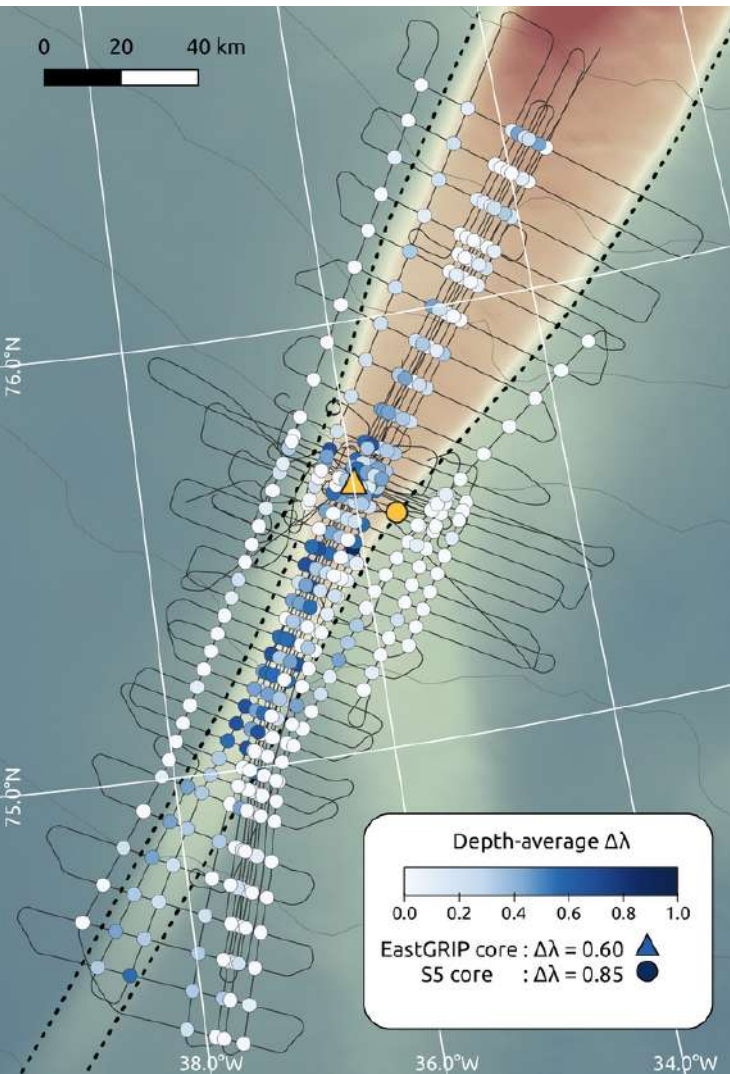
beat signature
anisotropy

Elmer/Ice

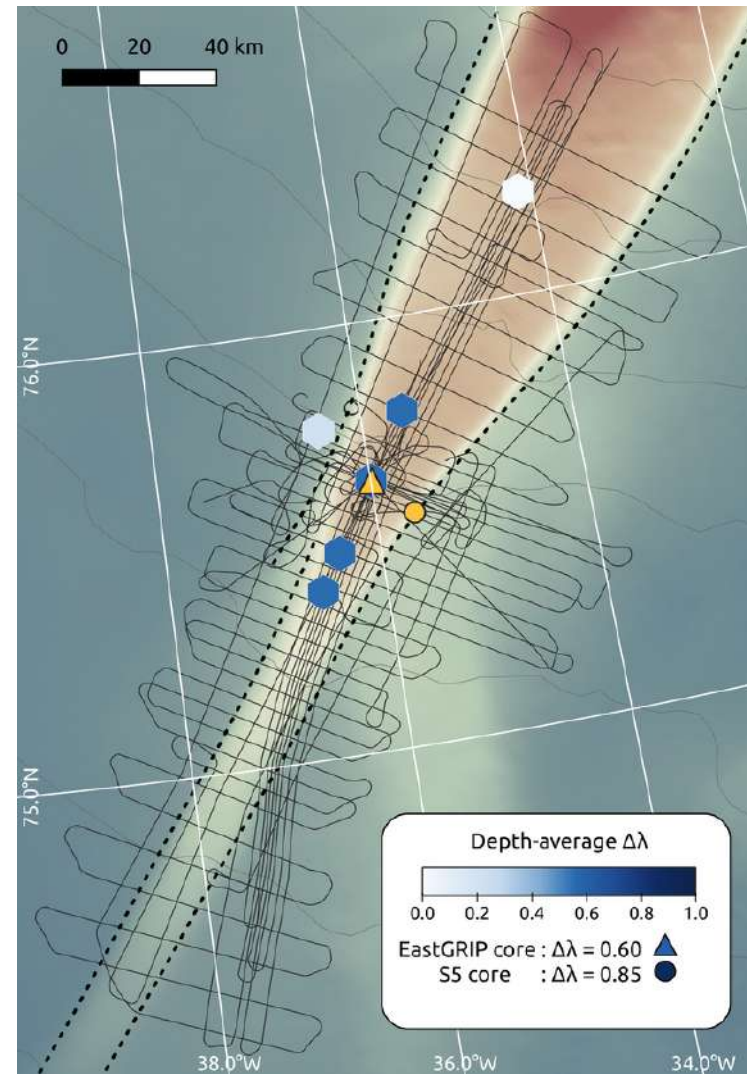
Horizontal fabric anisotropy (depth-average)

observation-based

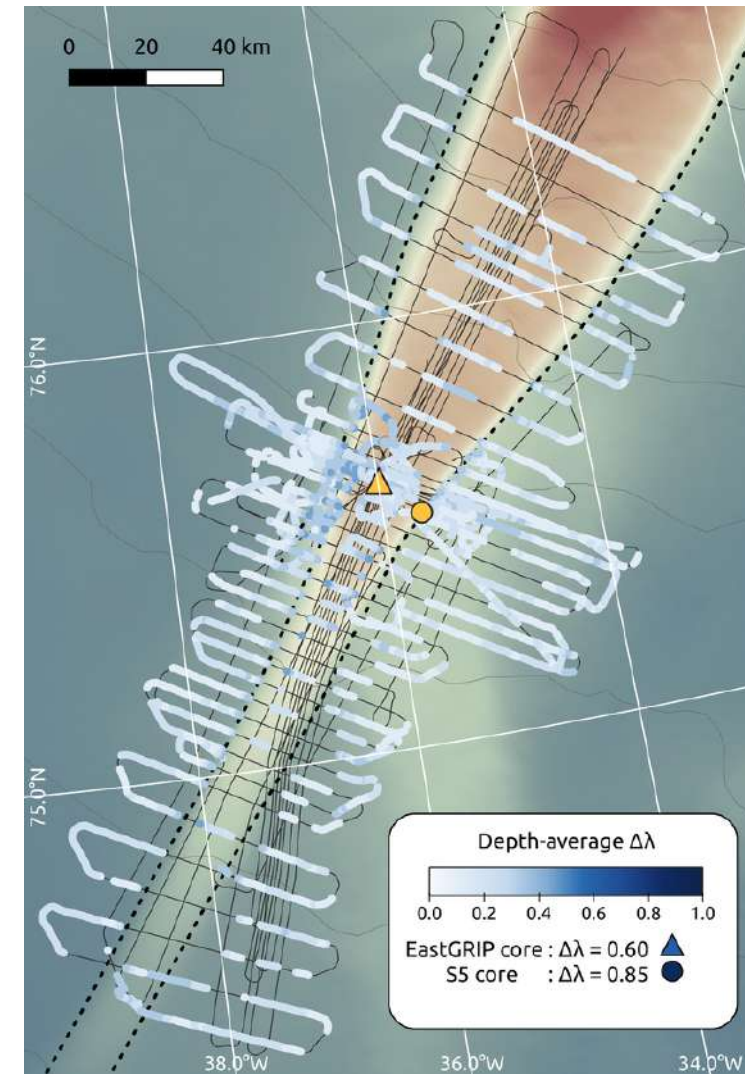
modelled



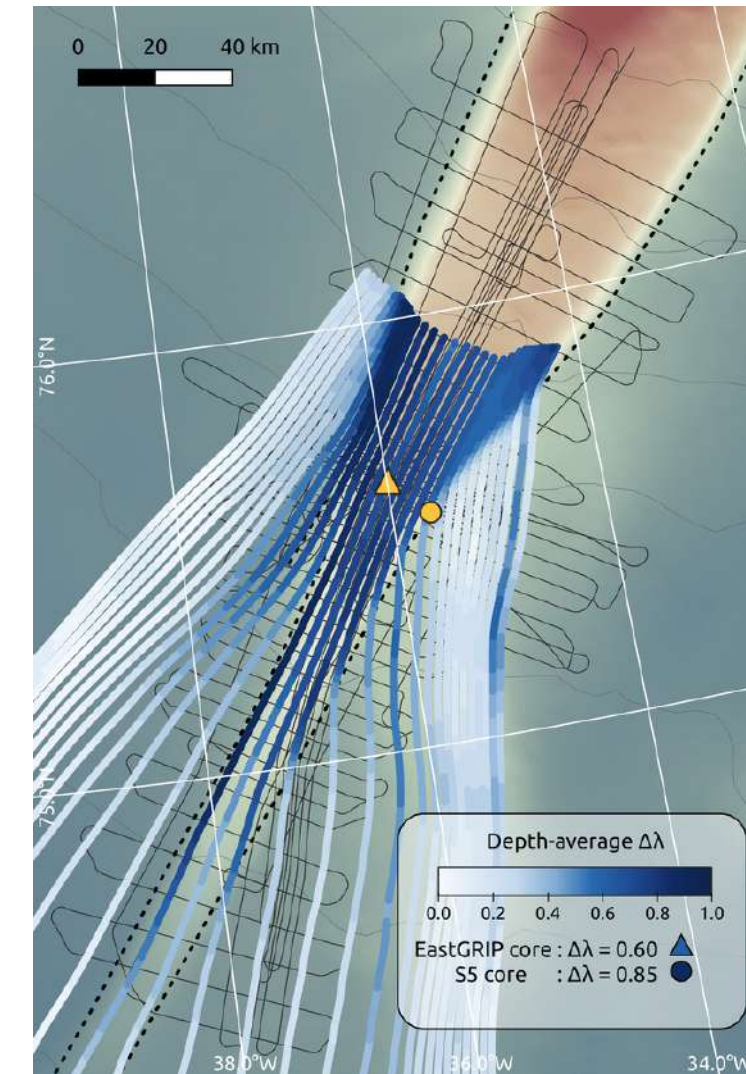
airborne travel-time
anisotropy



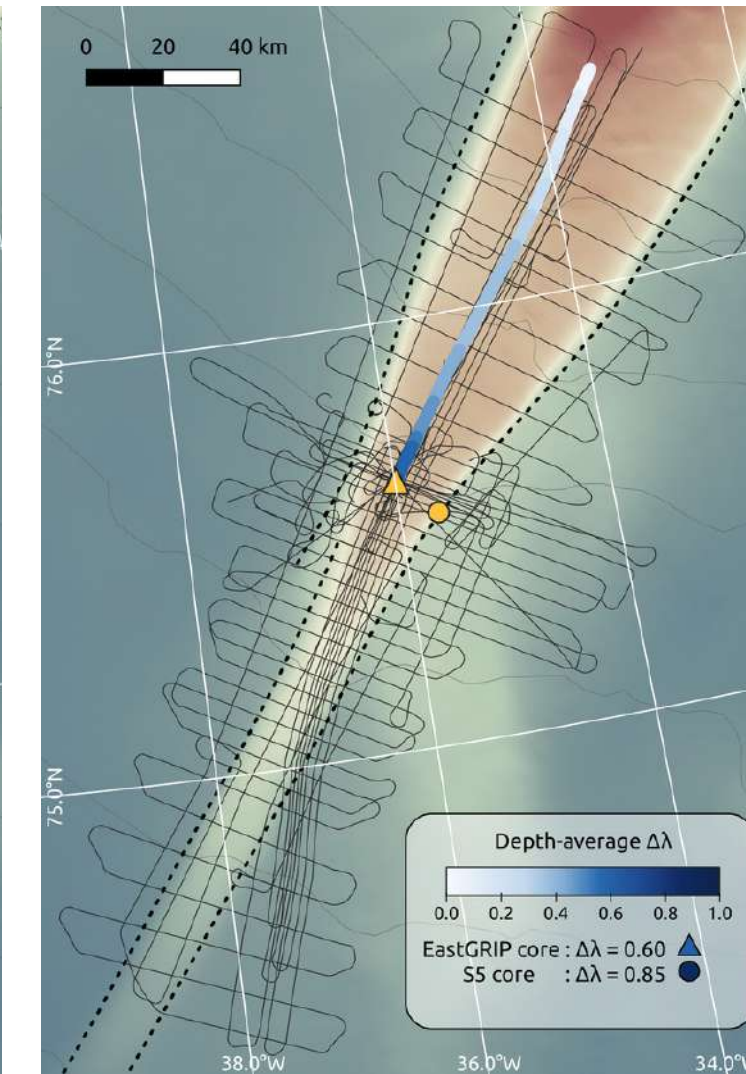
pRES travel-time
anisotropy



beat signature
anisotropy

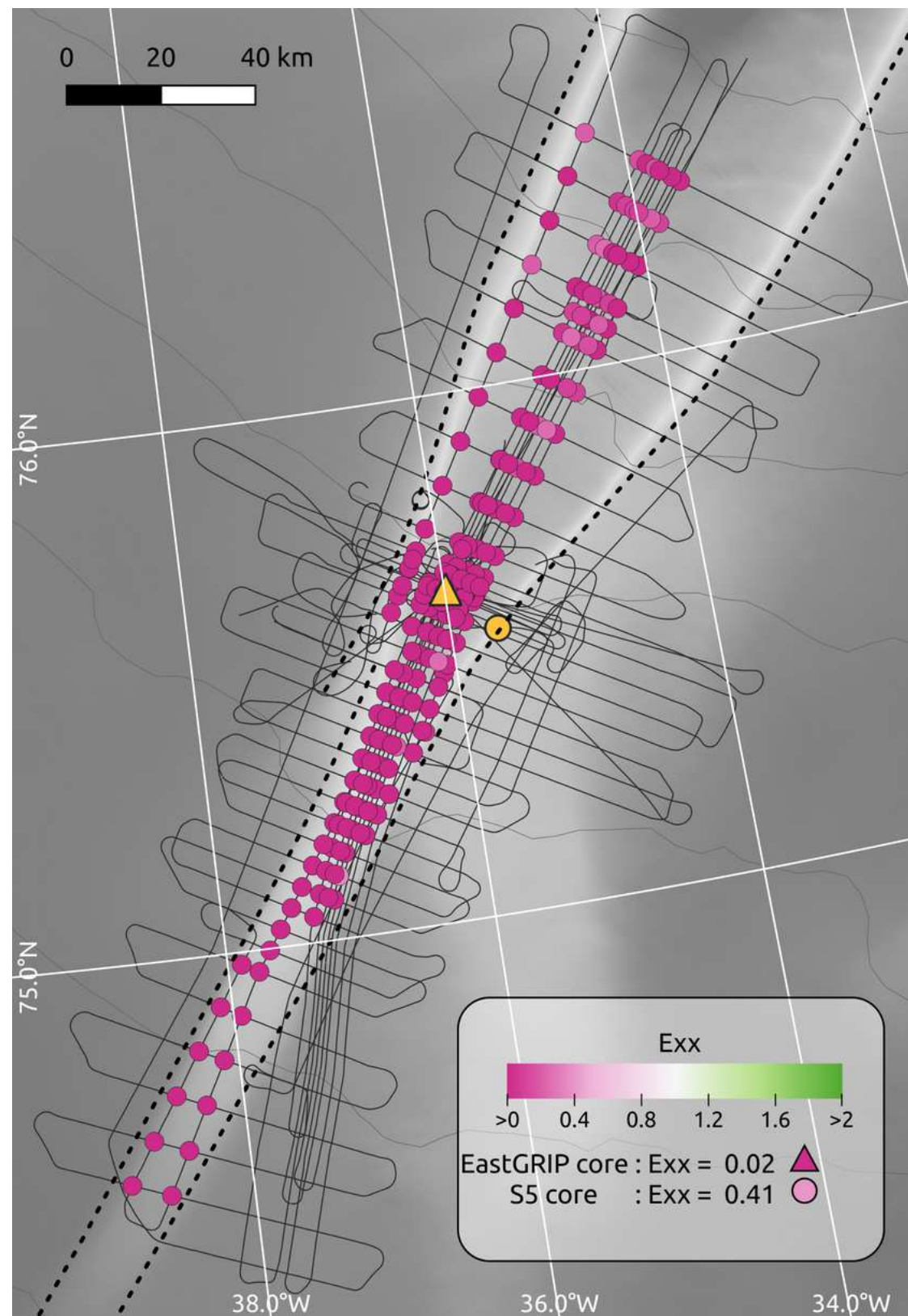


Elmer/Ice

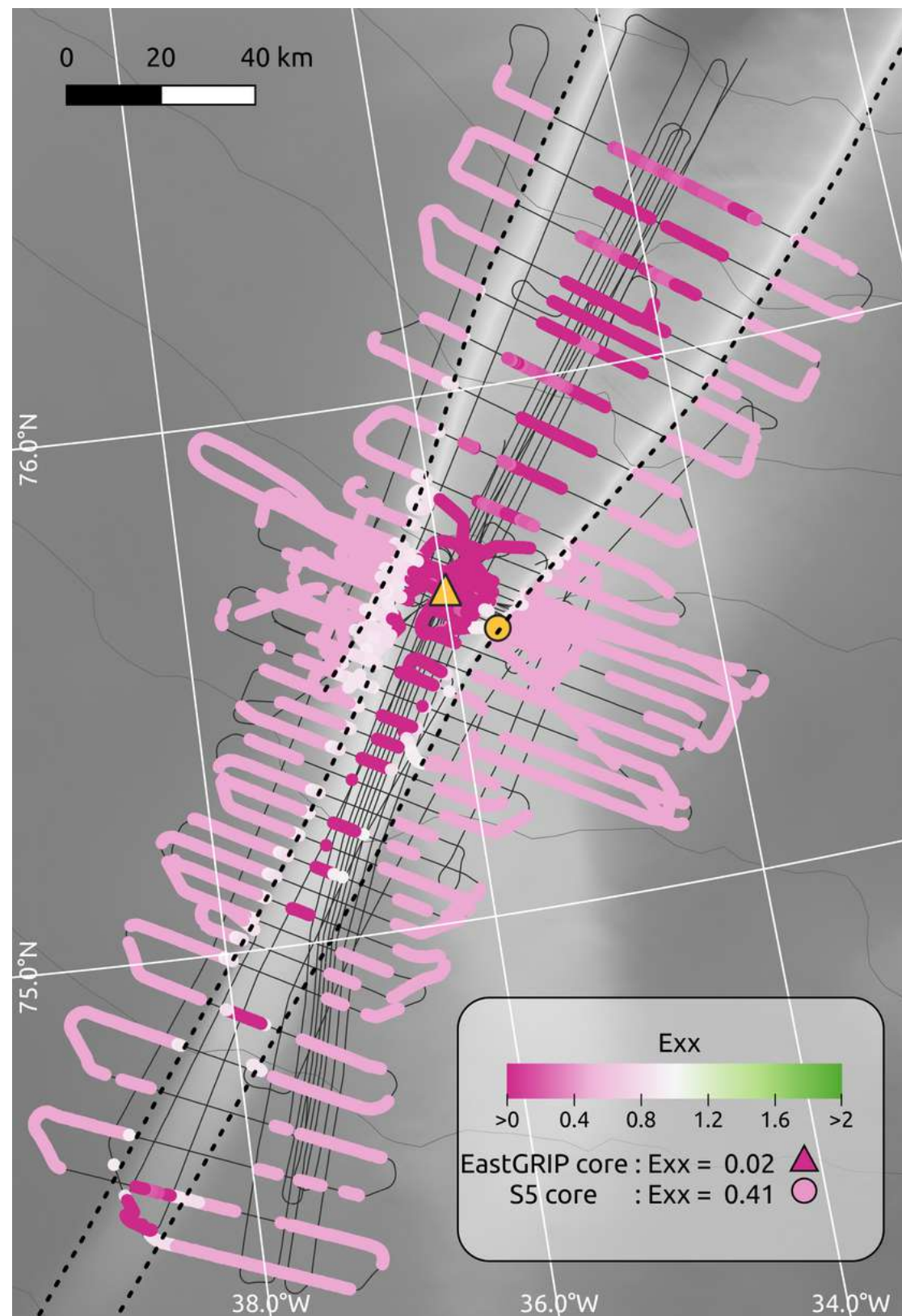


Specfab

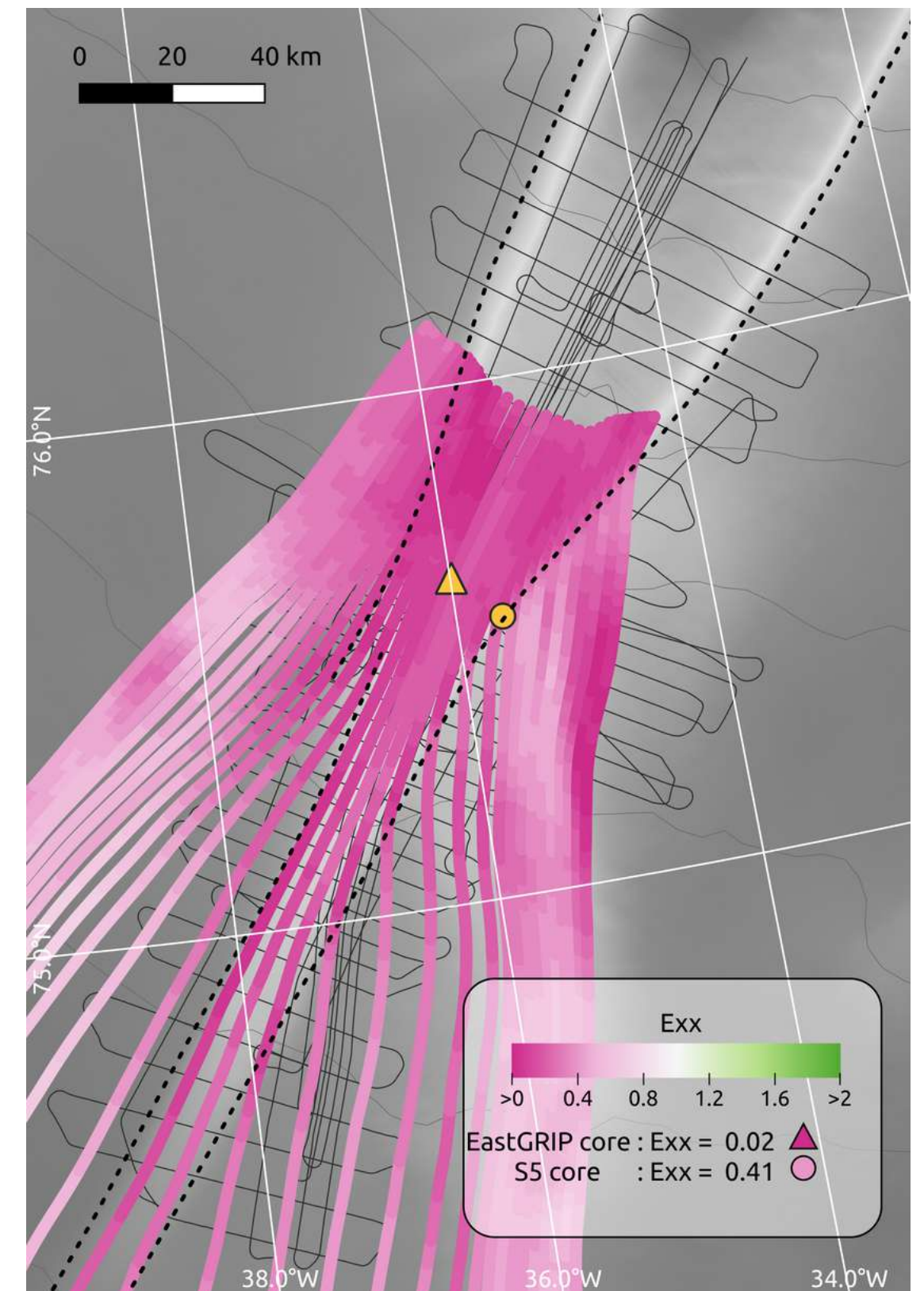
Flow enhancement factor - pure shear along-flow



airborne travel-time anisotropy

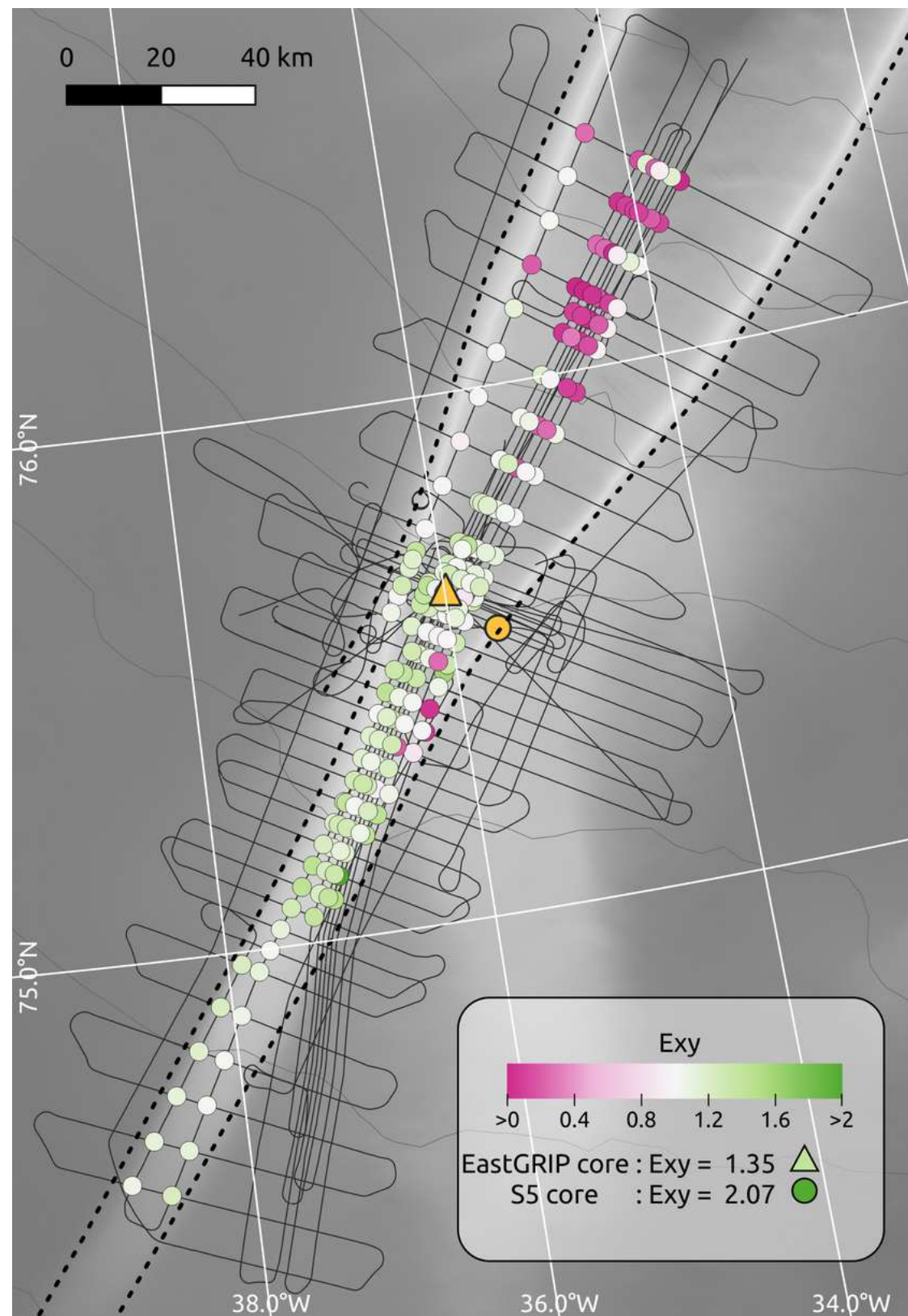


beat signature anisotropy

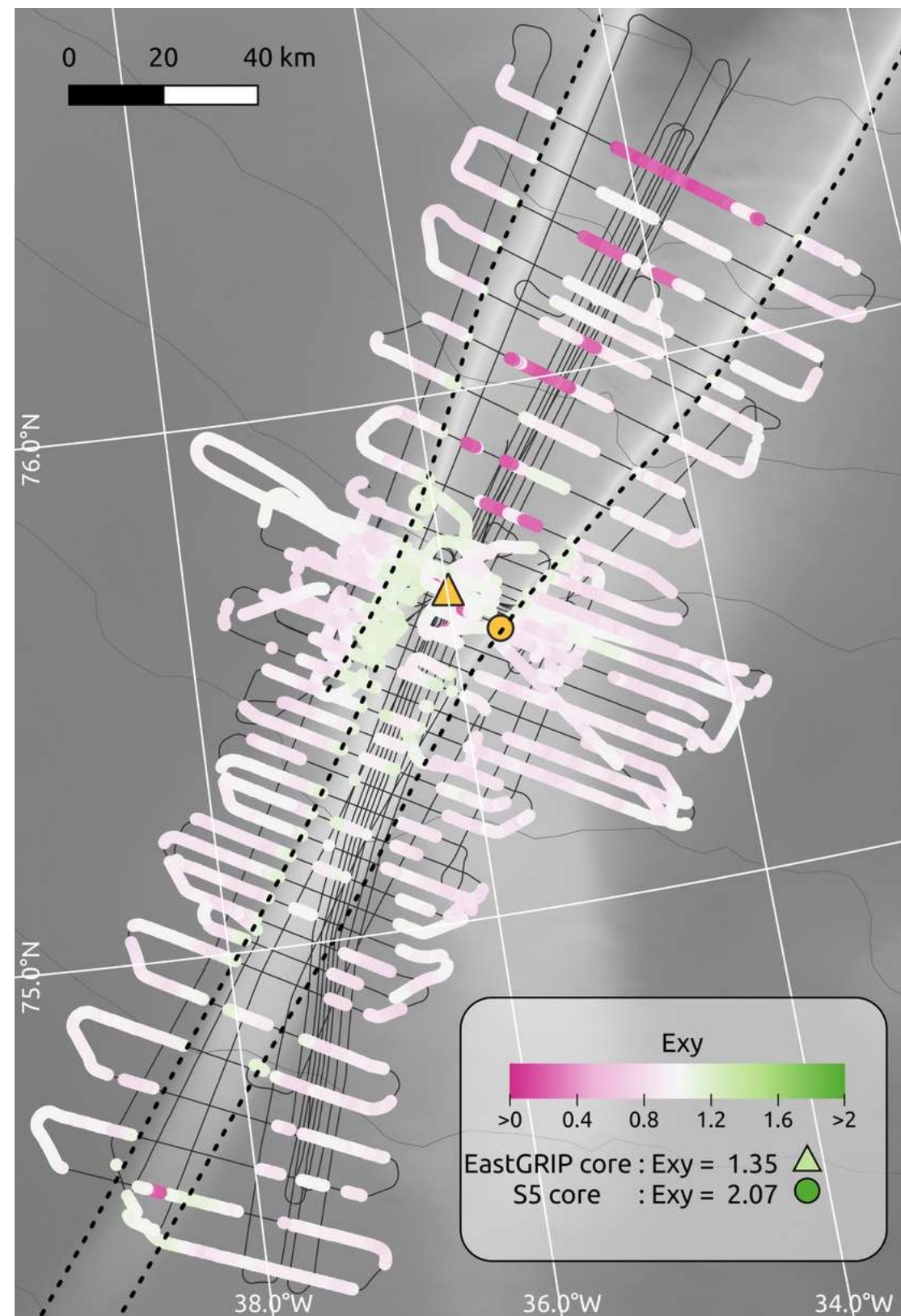


Elmer/Ice

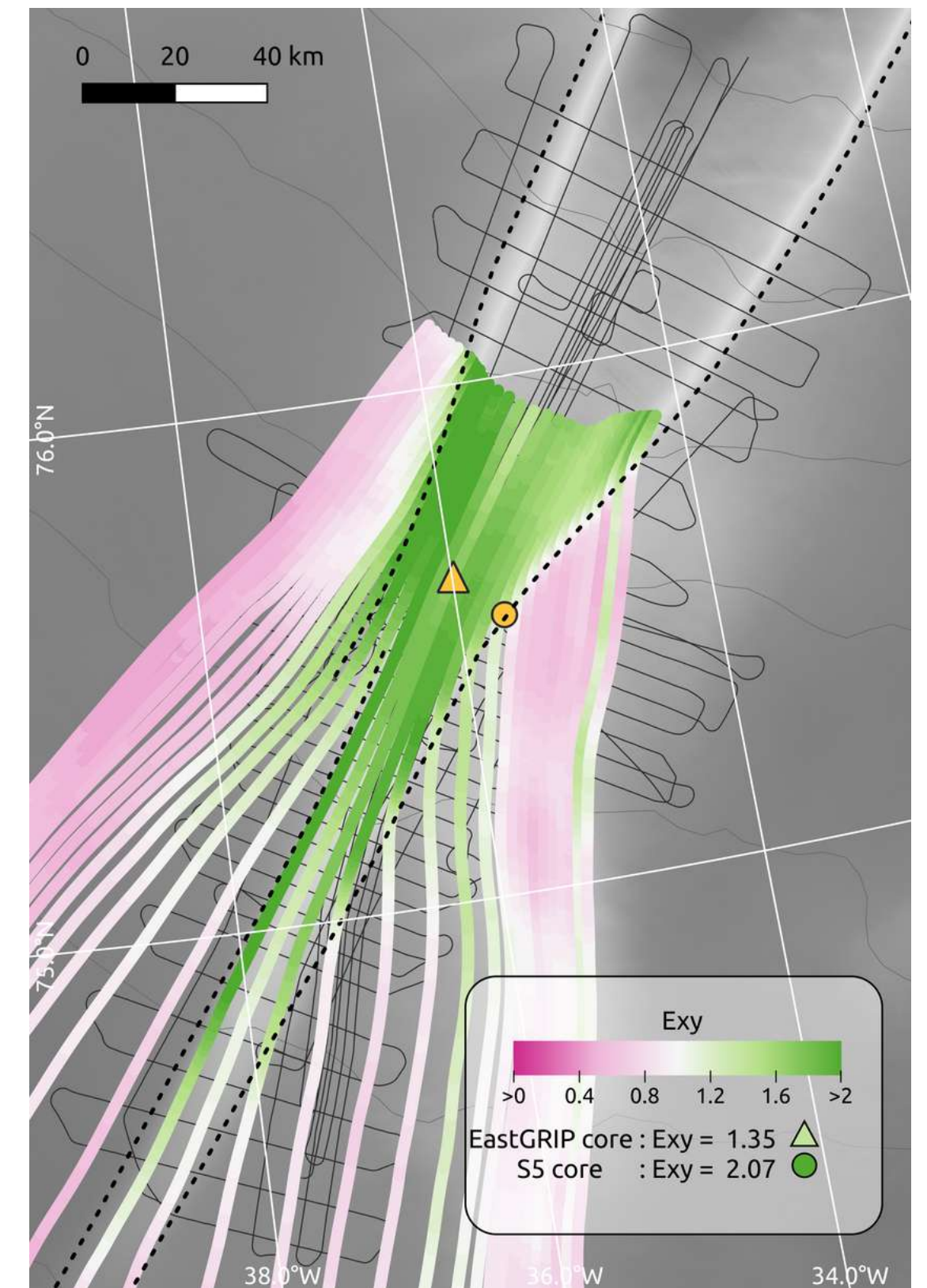
Flow enhancement factor - simple shear along-flow



airborne travel-time anisotropy



beat signature anisotropy



Elmer/Ice

Summary

Contact: tamara.gerber@nbi.ku.dk

Summary



Fabric adjusts on short spatial and temporal scales

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Ice viscosity -- a question of fabric and strain orientation

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Fabric adjusts on short spatial and temporal scales



Ice viscosity -- a question of fabric and strain orientation



considerable stiffening for pure shear along flow

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Fabric adjusts on short spatial and temporal scales



Ice viscosity -- a question of fabric and strain orientation



considerable stiffening for pure shear along flow



Implications for ice-stream sensitivity to external perturbations?

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Preprint: Crystal fabric anisotropy causes directional hardening of the Northeast Greenland Ice Stream



DOI: [10.21203/rs.3.rs-1812870/v1](https://doi.org/10.21203/rs.3.rs-1812870/v1)



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Ice viscosity -- a question of fabric and strain orientation



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Implications for ice-stream sensitivity to external perturbations?