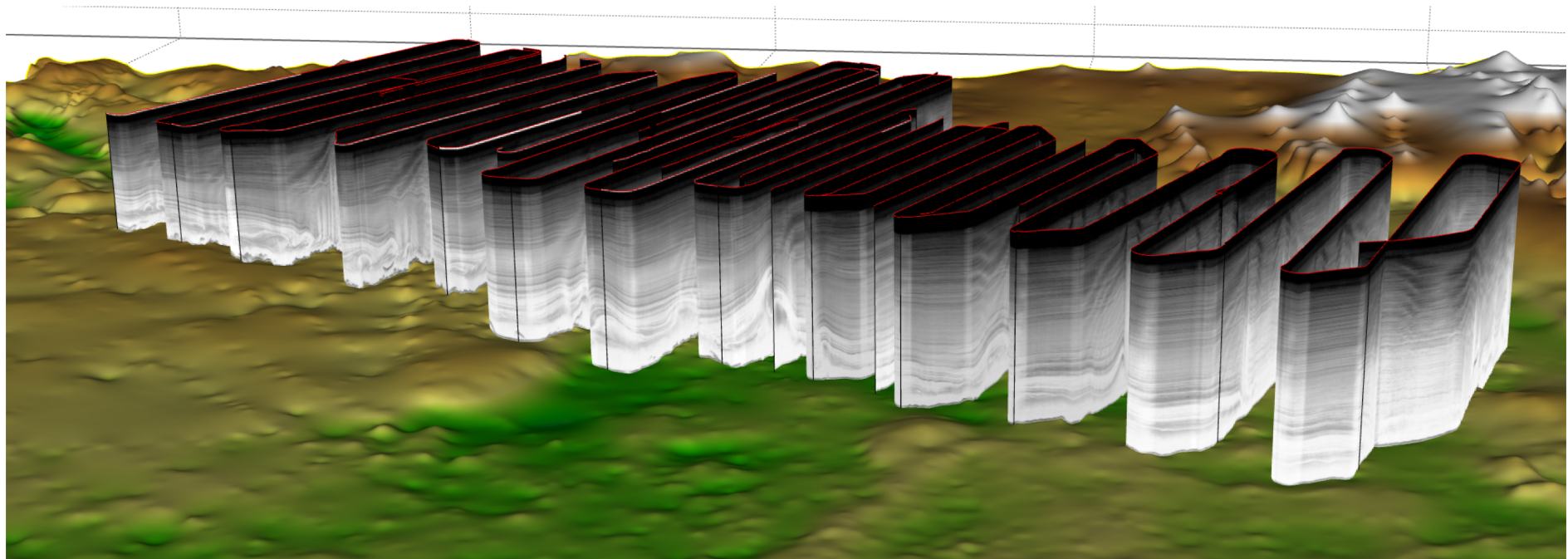


# 3D-Structure of NEGIS shear margins from radar stratigraphy

Daniela Jansen<sup>1</sup>, Steven Franke<sup>1</sup>, Tobias Binder<sup>1</sup>, Paul Bons<sup>2</sup>, Dorthe Dahl-Jensen<sup>3,4</sup>, Olaf Eisen<sup>1,5</sup>, Veit Helm<sup>1</sup>, Heinrich Miller<sup>1</sup>, Niklas Neckel<sup>1</sup>, John Paden<sup>6</sup>, Daniel Steinhage<sup>1</sup>, and Ilka Weikusat<sup>1,2</sup>



1: Alfred Wegener Institute for Polar and Marine Research

2: Tübingen University, Department of Geosciences

3: Niels Bohr Institute, University of Copenhagen, Denmark

4: Centre for Earth Observation Science, University of Manitoba, Canada

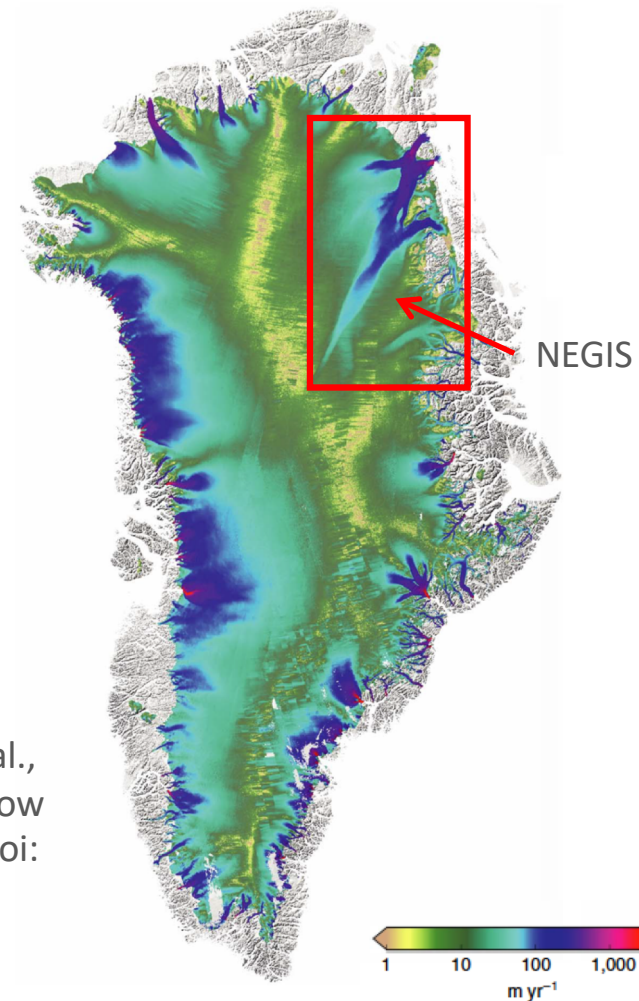
5: Bremen University, Department of Geosciences

6: Center for Remote Sensing of ice Sheets, Kansas, USA

# Ice streams today

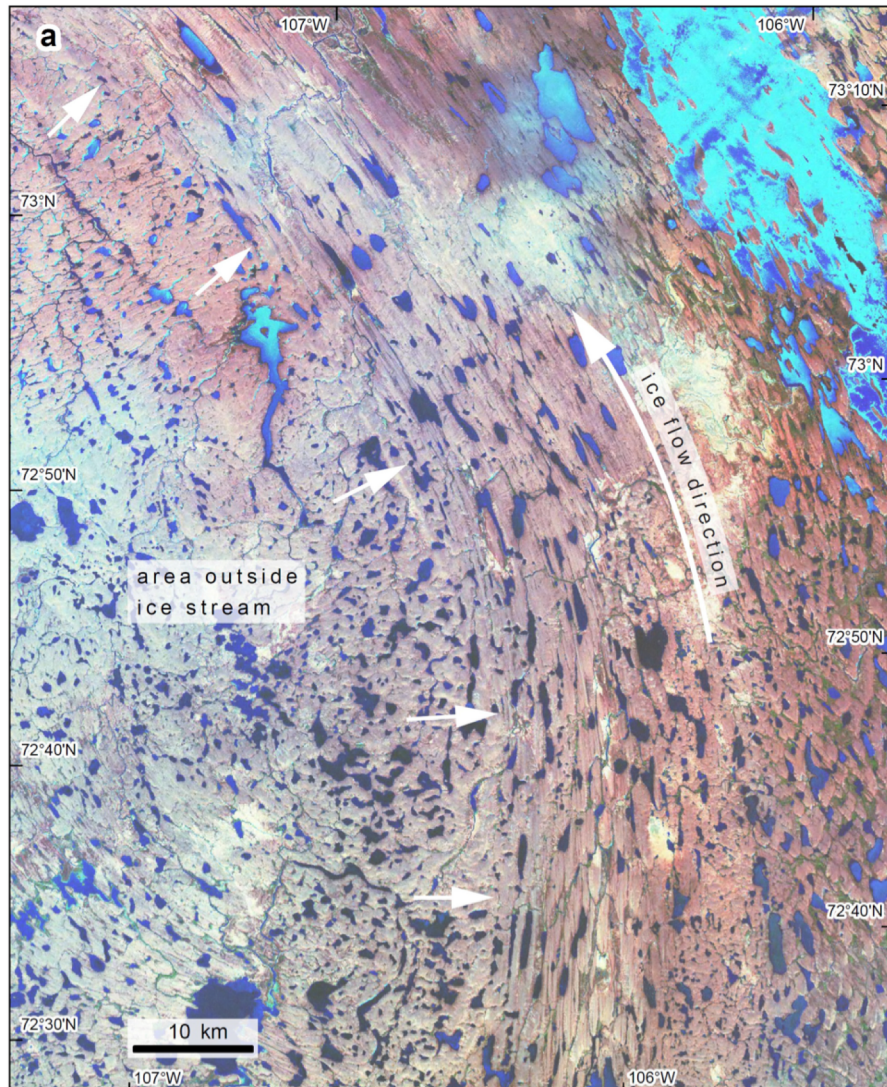
- Snapshot in time: Current status from satellite remote sensing data
- Deformation regime can be deduced, but only for the surface
- How does system evolve over longer timescales?

observed



modified from Aschwanden, A. et al.,  
Complex greenland outlet glacier flow  
captured. Nat. Commun. 7:10524 doi:  
10.1038/ncomms10524 (2016).

# Ice streams in the past

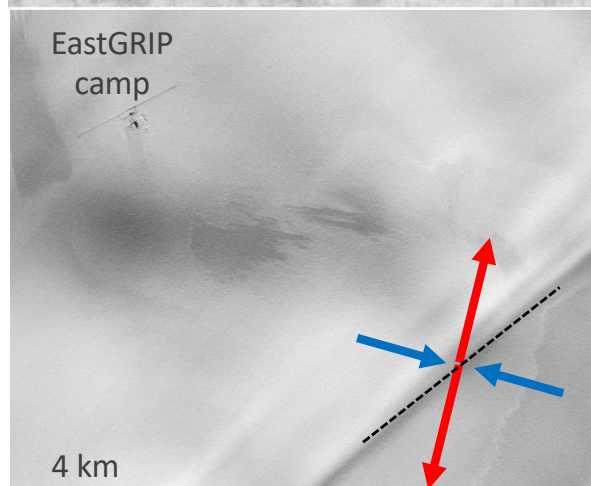
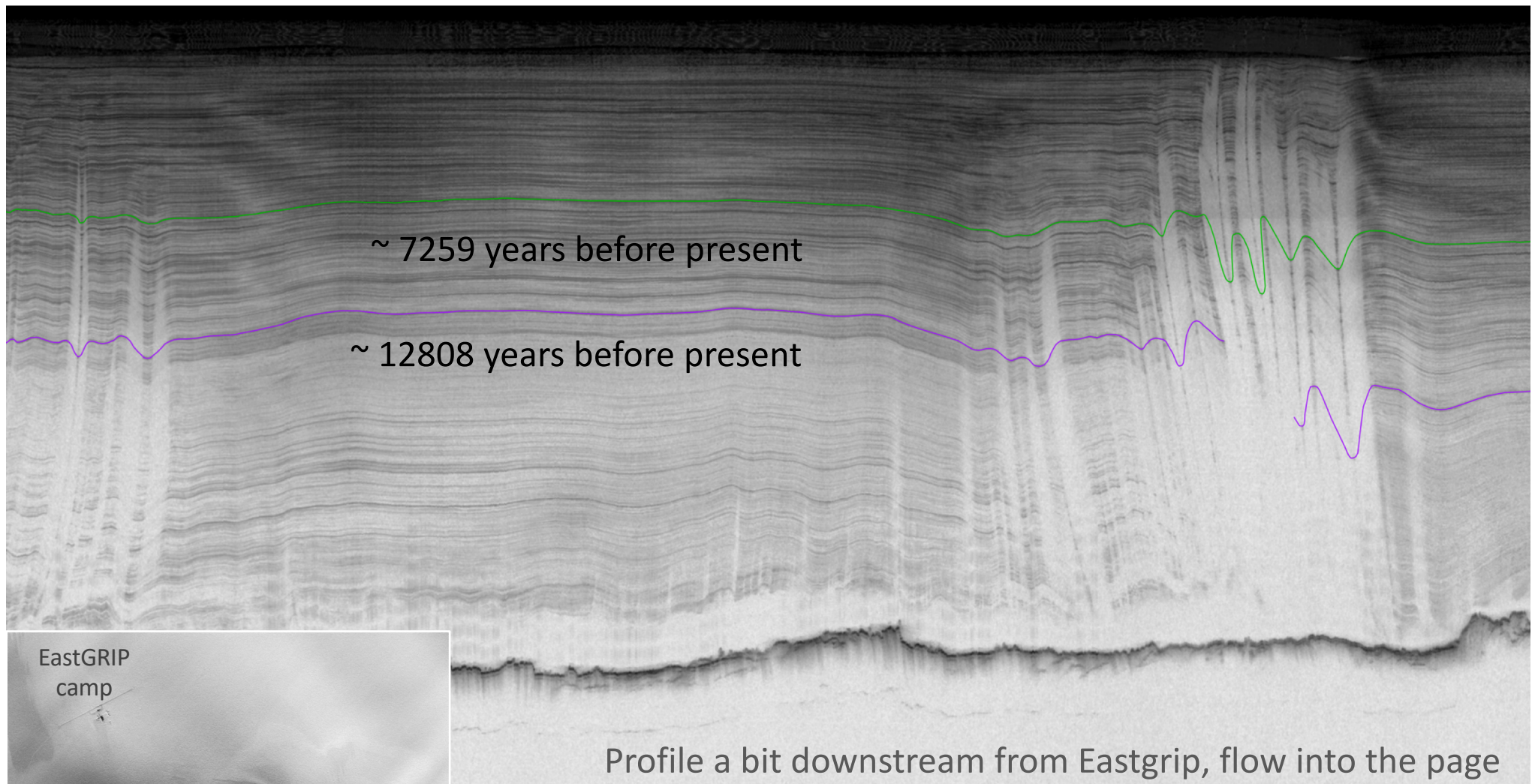


- ice streams leave **traces on bedrock** or in sediments on the continental shelves
- not well constrained: **temporal activity**, or the extent at a specific time

From: Stokes et al., 2016: Ice stream activity scaled to ice sheet volume during Laurentide Ice Sheet deglaciation, Nature (530), doi:10.1038/nature16947

Landsat satellite image from the Canadian Arctic, former Laurentide Ice Sheet (LIS)

# Ice stream signatures



- Radar stratigraphy maps isochrones, passive markers: **recorded deformation**

 We have to look **into** the ice

# Learning from structural geology



How to interpret  
what we see in  
the ice?

# EGRIP-NOR Survey 2018

## Radioglaciology:

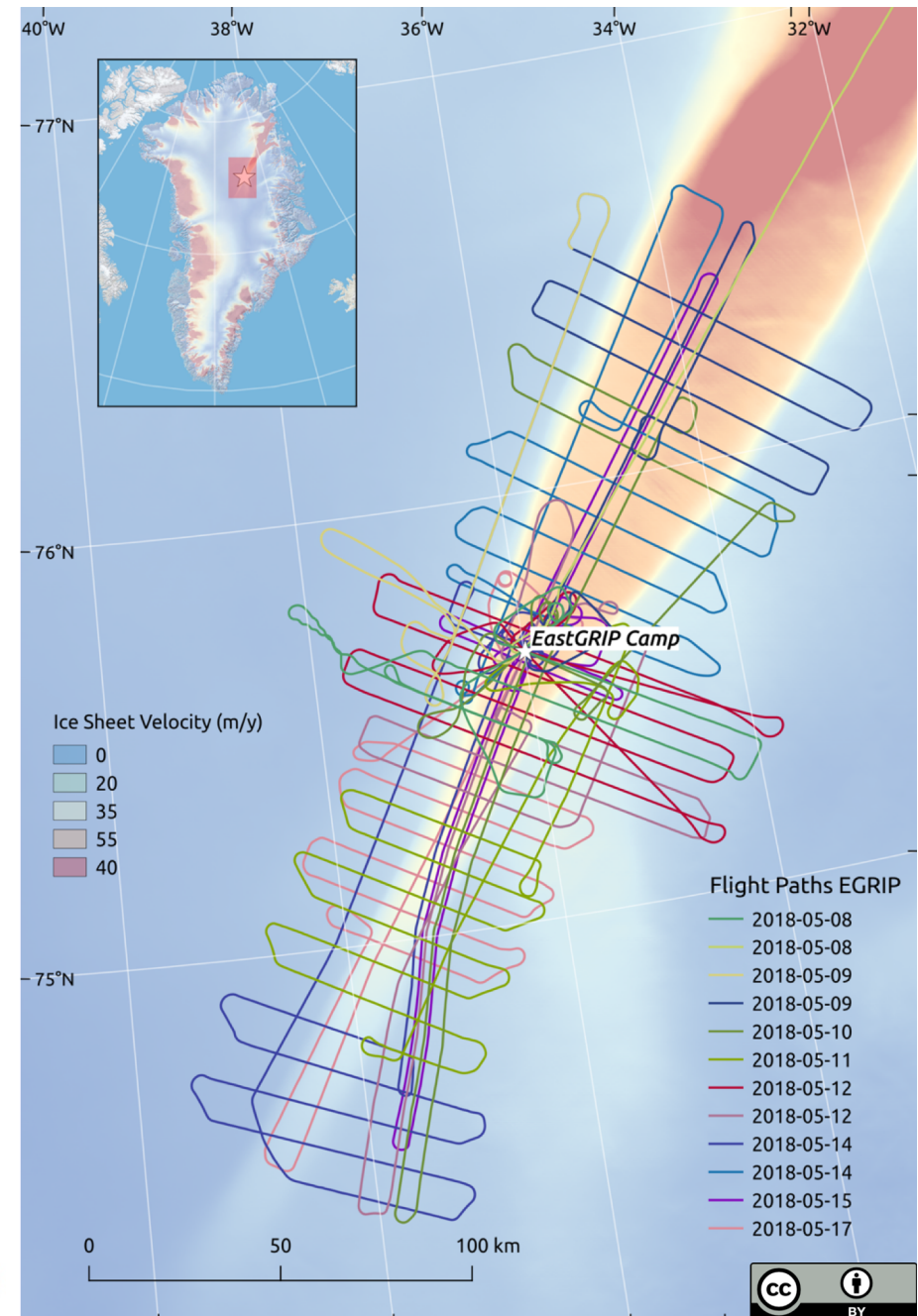
We have the advantage compared to structural geology that we can cut through the ice!

## Aims:

- Map the stratigraphy with the focus on **shear margins**
- Learning from an active system: Folding as it happens!

## New **bedrock data** set published:

Franke et al., 2020, annals of glaciology  
DOI: <https://doi.org/10.1017/aog.2020.12>



# EGRIP-NOR Data

## Radioglaciology:

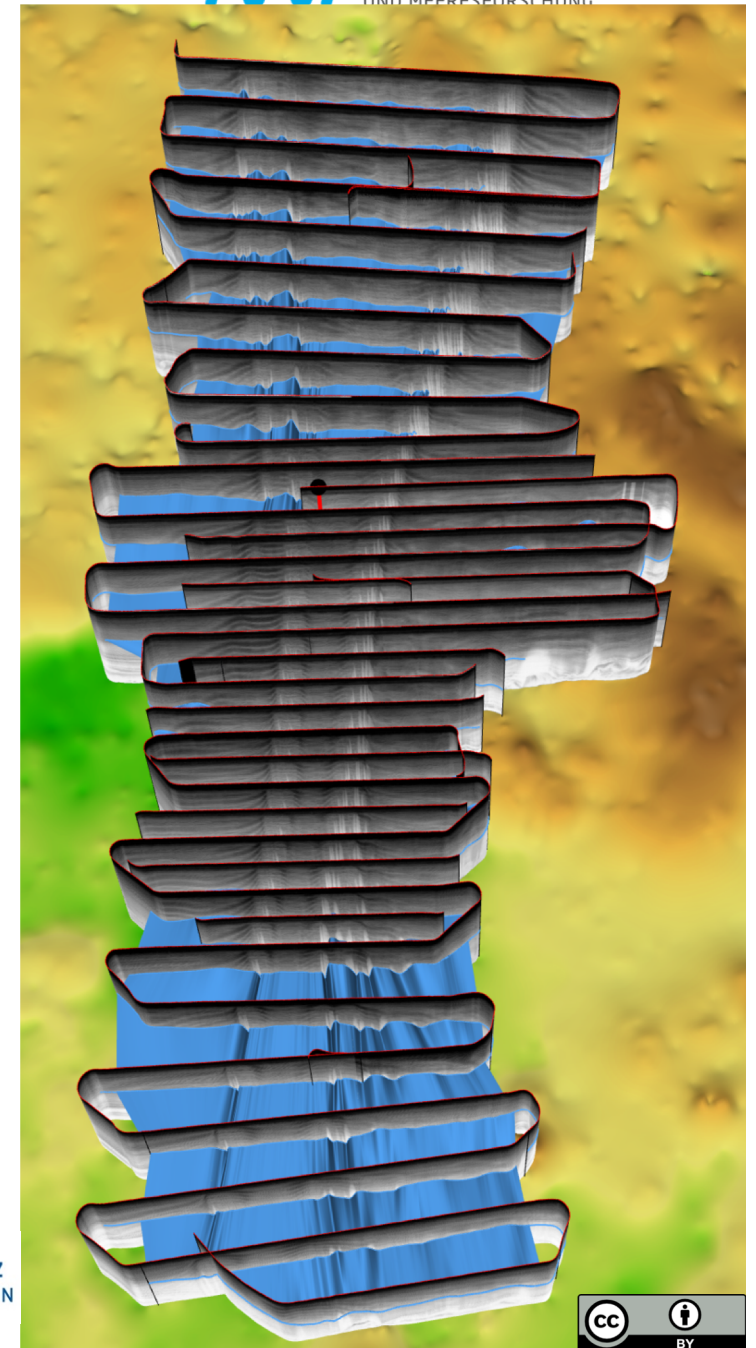
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## Aims:

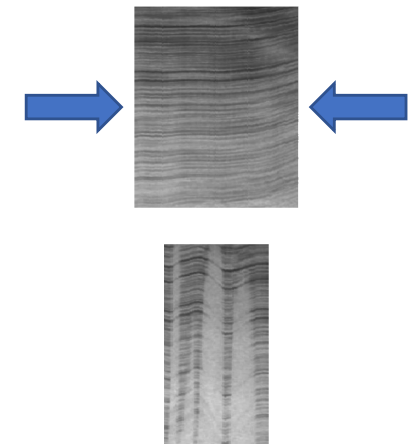
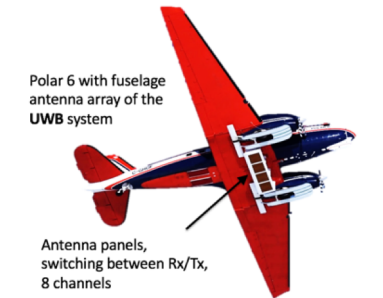
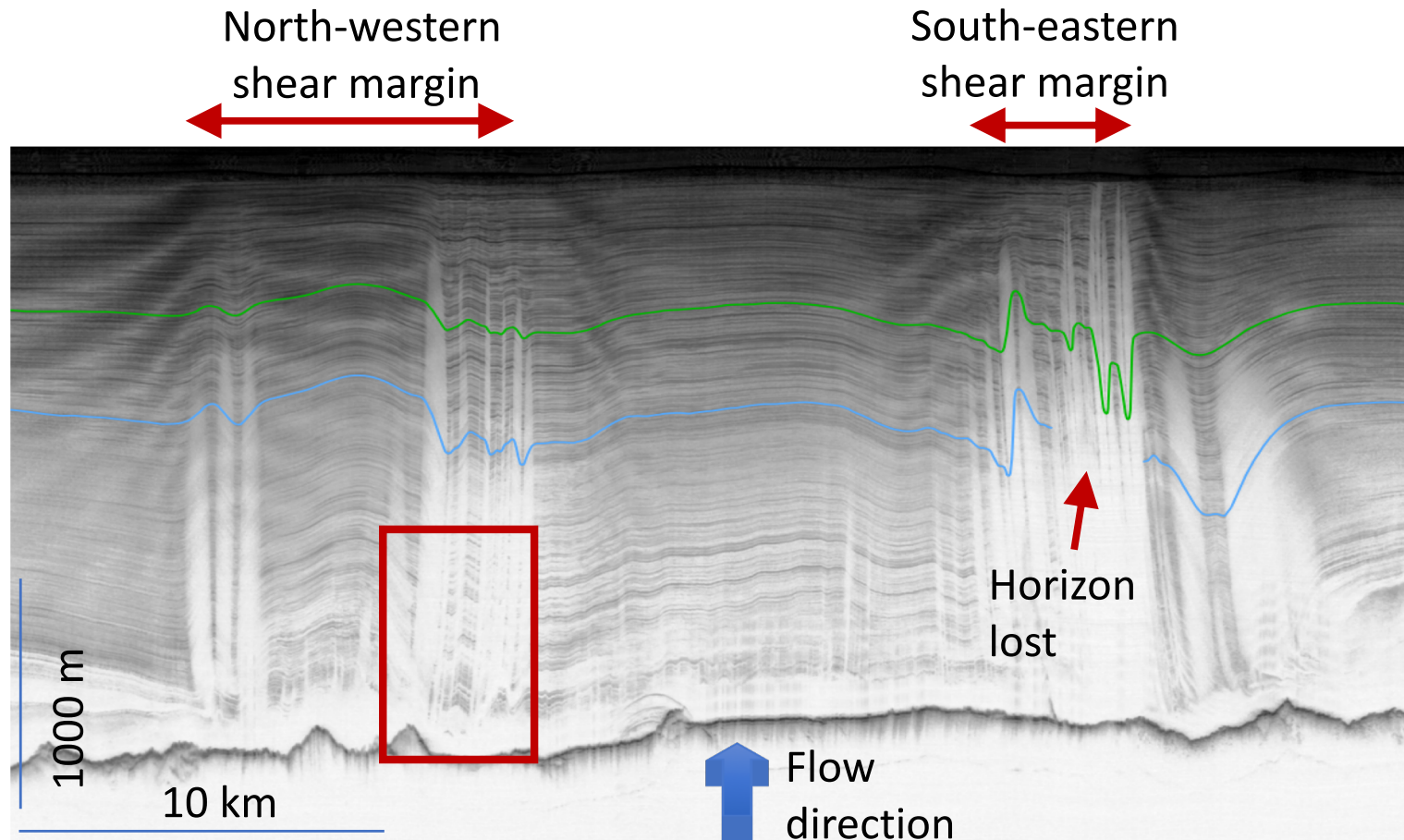
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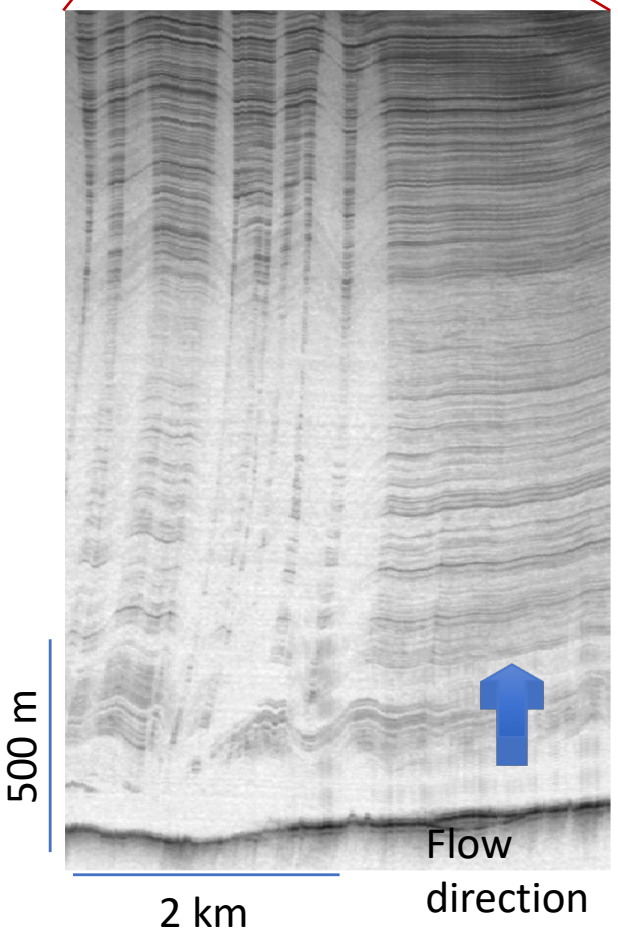
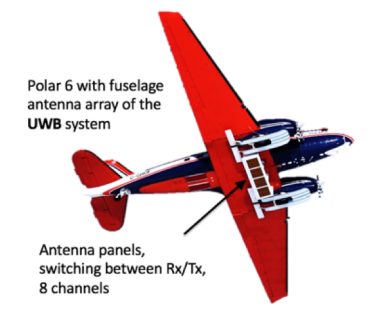
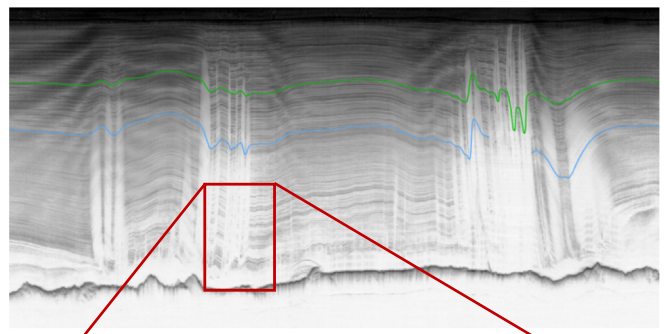
# EGRIP-NOR Data



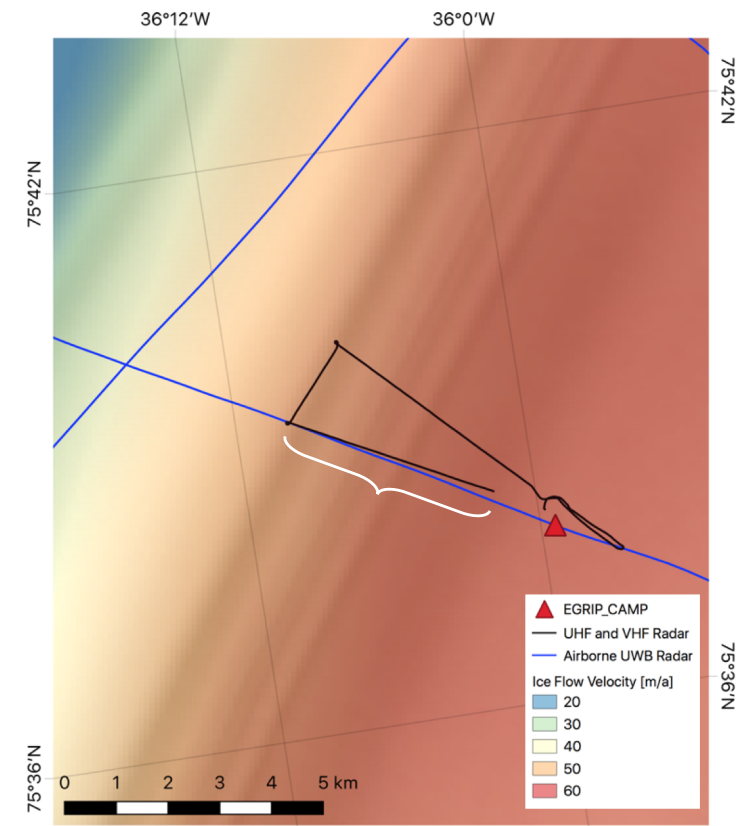
- Profile located 5 km upstream of EGRIP Camp
- Chevron or zig-zag folding in the active margin
- Folding is preserved when entering different regimes



# EGRIP-NOR Data



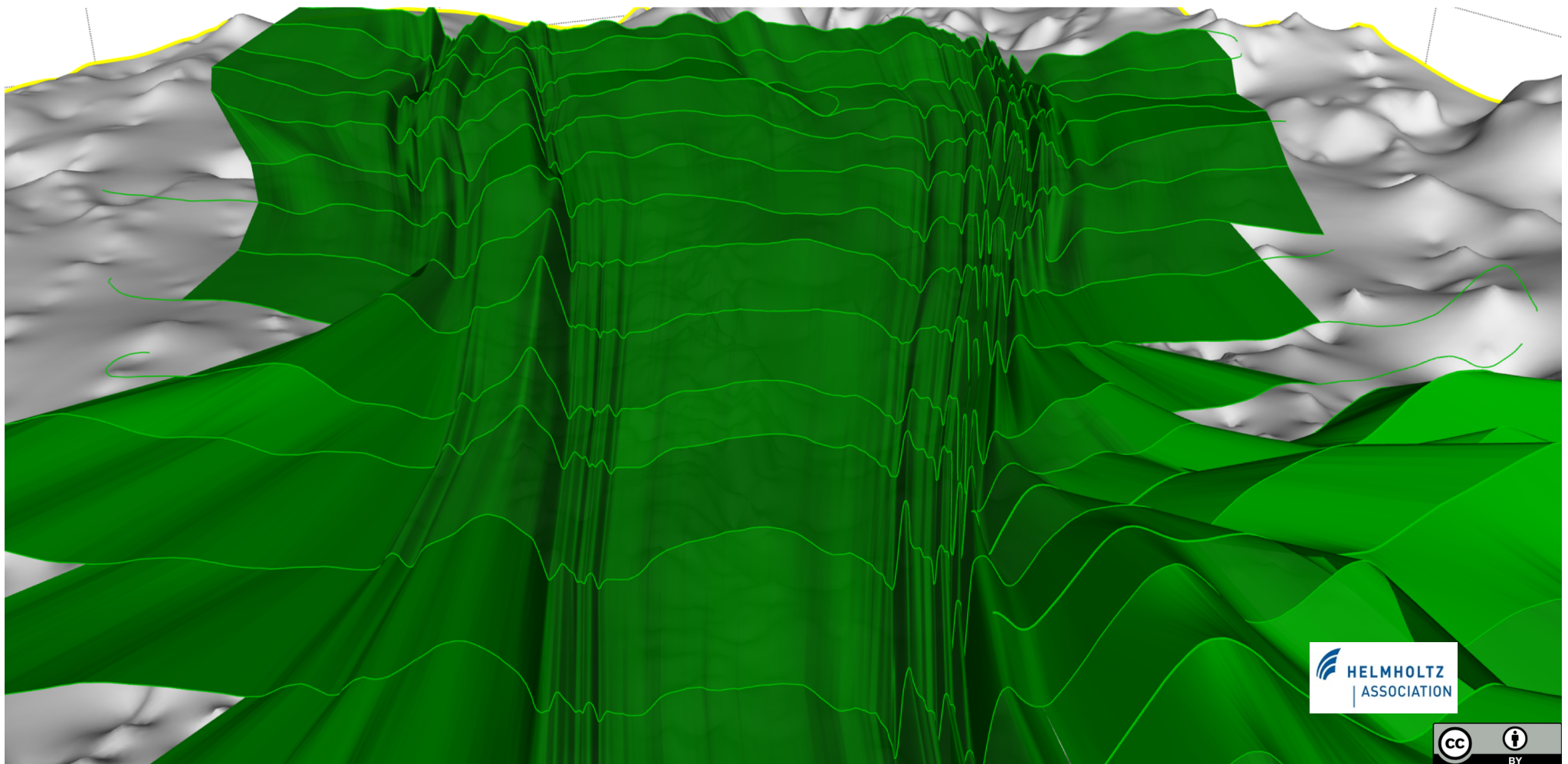
- The section to the left shows an area no longer subject to strong shear, but folds are preserved downstream
- Advection of older features outside of the ice stream leads to a tilt in the vertical fold plane



Velocity data: N. Neckel, pers. Comm

# EGRIP-NOR Data

Picking internal reflectors throughout the entire survey area and connecting them to horizons show the 3D-imprint of the ice stream at depth.



# Summary

- Airborne radar data are essential for understanding large scale structures in ice sheet stratigraphy
- The quality of the data allows for analysing highly deformed structures, as found in the shear margins of ice streams
- The 3D horizons illustrate how the ice stream is influencing its surroundings and assimilates old structures into the margins

## Questions?

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