katlow20@bas.ac.uk

Channelized Melt evolution from CryoSat-2 Swath Observation: A case Study of Pine Island Glacier

Katie Lowery [1, 2] , Pierre Dutrieux [1], Paul Holland [1], Anna Hogg [2], Noel Gourmelen [3]
[1] British Antarctic Survey, [2] University of Leeds, [3] University of Edinburgh

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

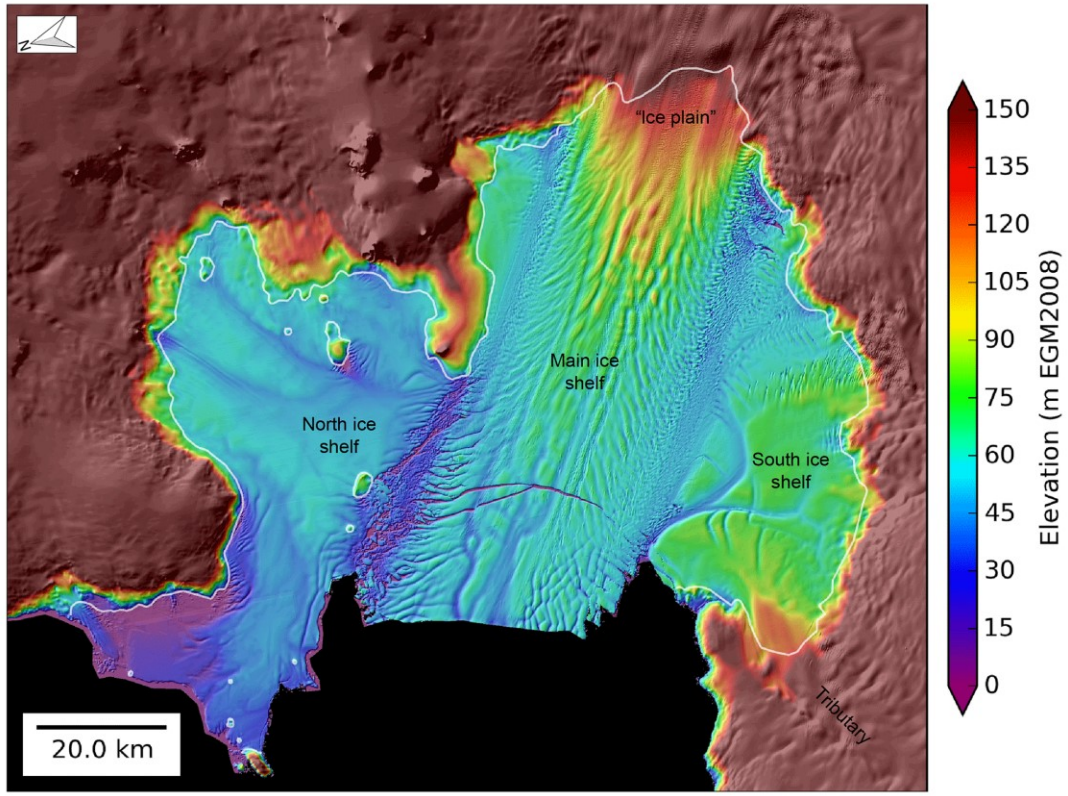
SENSE Centre for Satellite Data in Environmental Science

UNIVERSITY OF LEEDS

POLAR SCIENCE FOR PLANET EARTH

katlow20@bas.ac.uk

Ice Shelf Basal Channels



Shean et al., 2019

- Basal channels form at the base of an ice shelf and can be tens of kilometers long, 500m-3km in width and up to 600m deep
- Longitudinal and transverse
- Elevated and unevenly distributed basal melt rates lead to indents in the ice shelf base
- Ice shelf basal geometry plays a role both in modulating melt rates and in the stability of an ice shelf

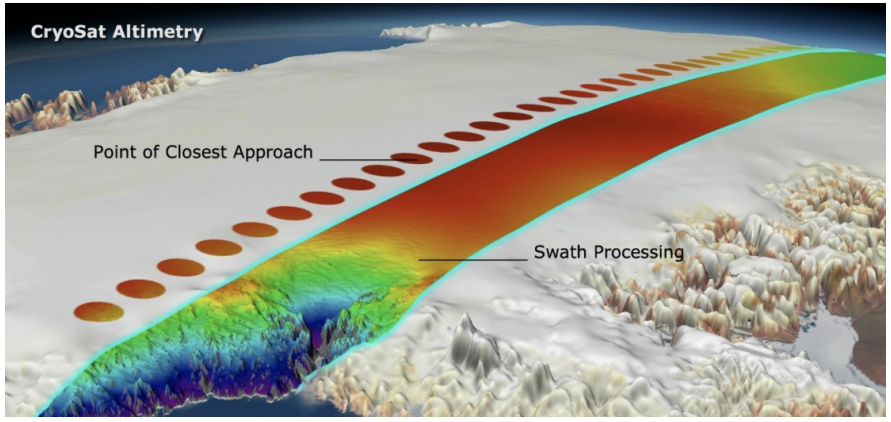
katlow20@bas.ac.uk

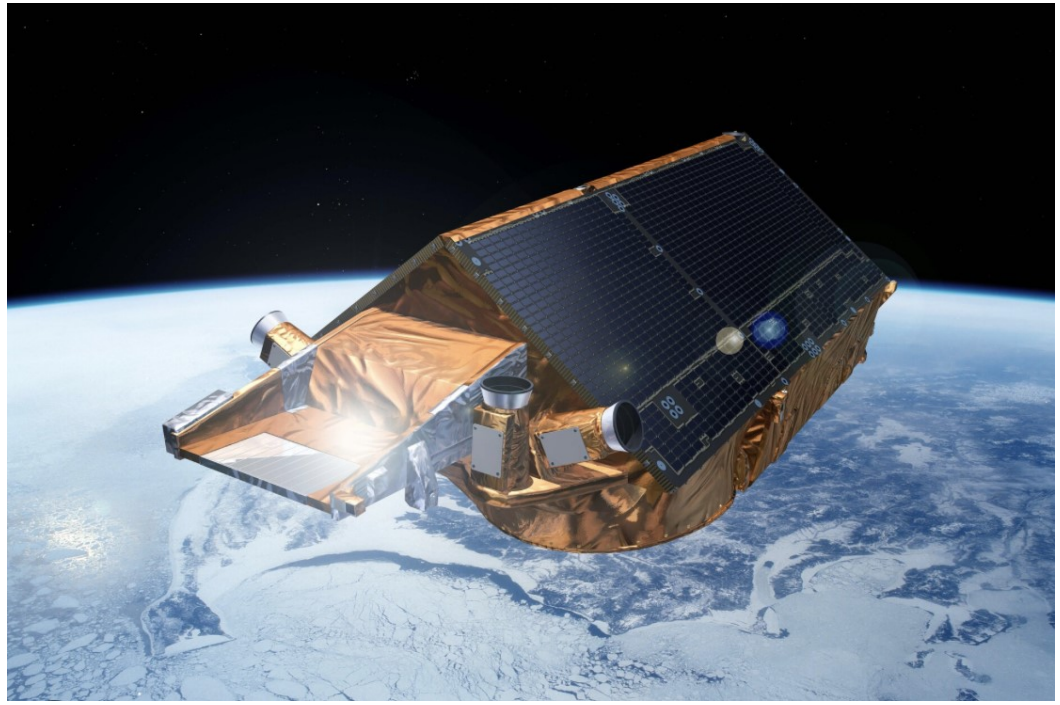
CryoSat-2 Swath Observations

- Radar altimeter

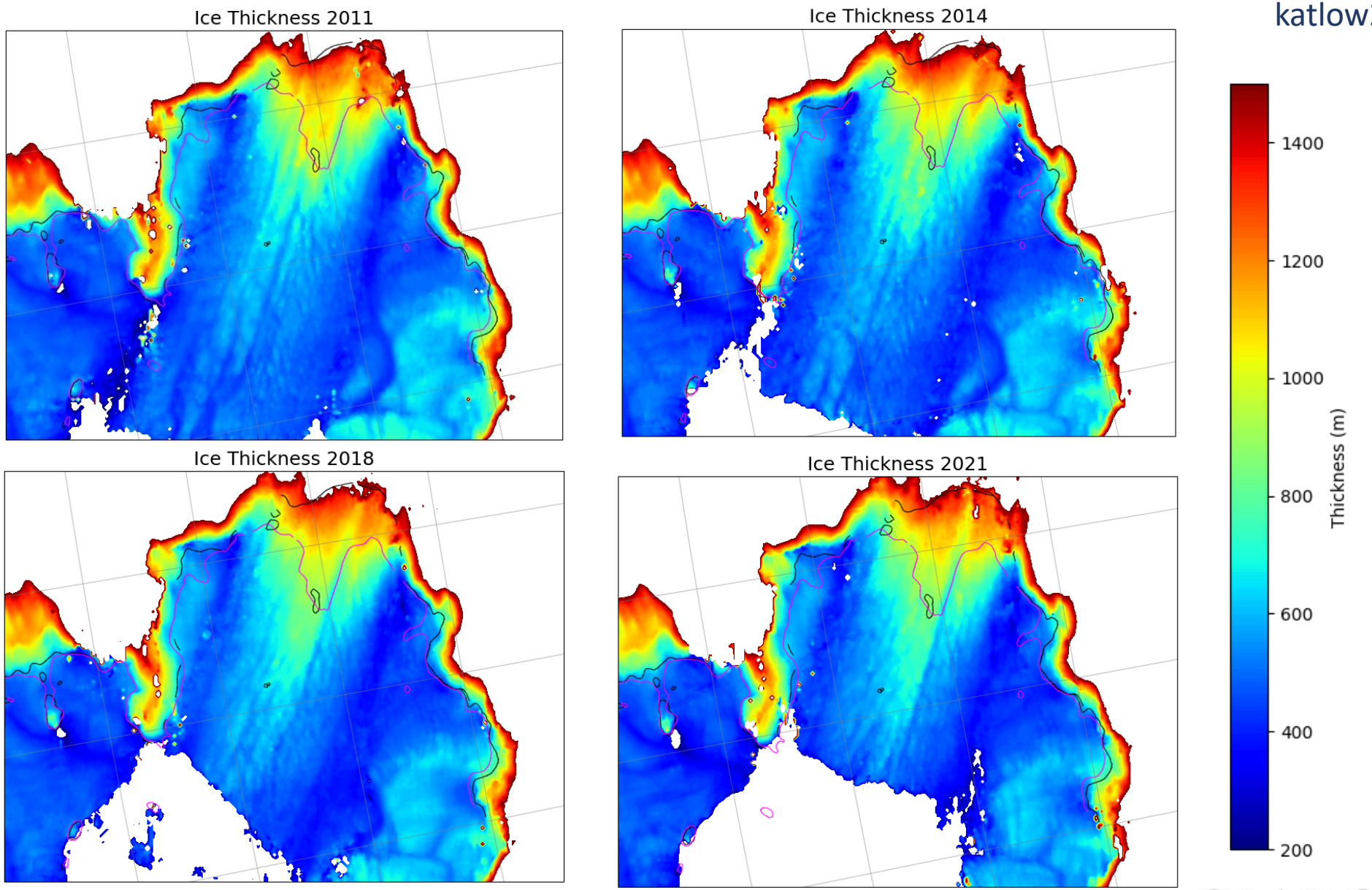
- SARIn swath data, gives orders of magnitude more data than the traditional Point of Closest Approach processing method.

- Point cloud of surface elevation measurements





katlow20@bas.ac.uk



British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE FOR PLANET EARTH

katlow20@bas.ac.uk

Deriving Lagrangian Melt

$$M_l = \frac{DH}{Dt} + H(\nabla \cdot U) \qquad \text{such that} \qquad \frac{DH}{Dt} = \frac{dH}{dt} + U \cdot (\nabla H)$$

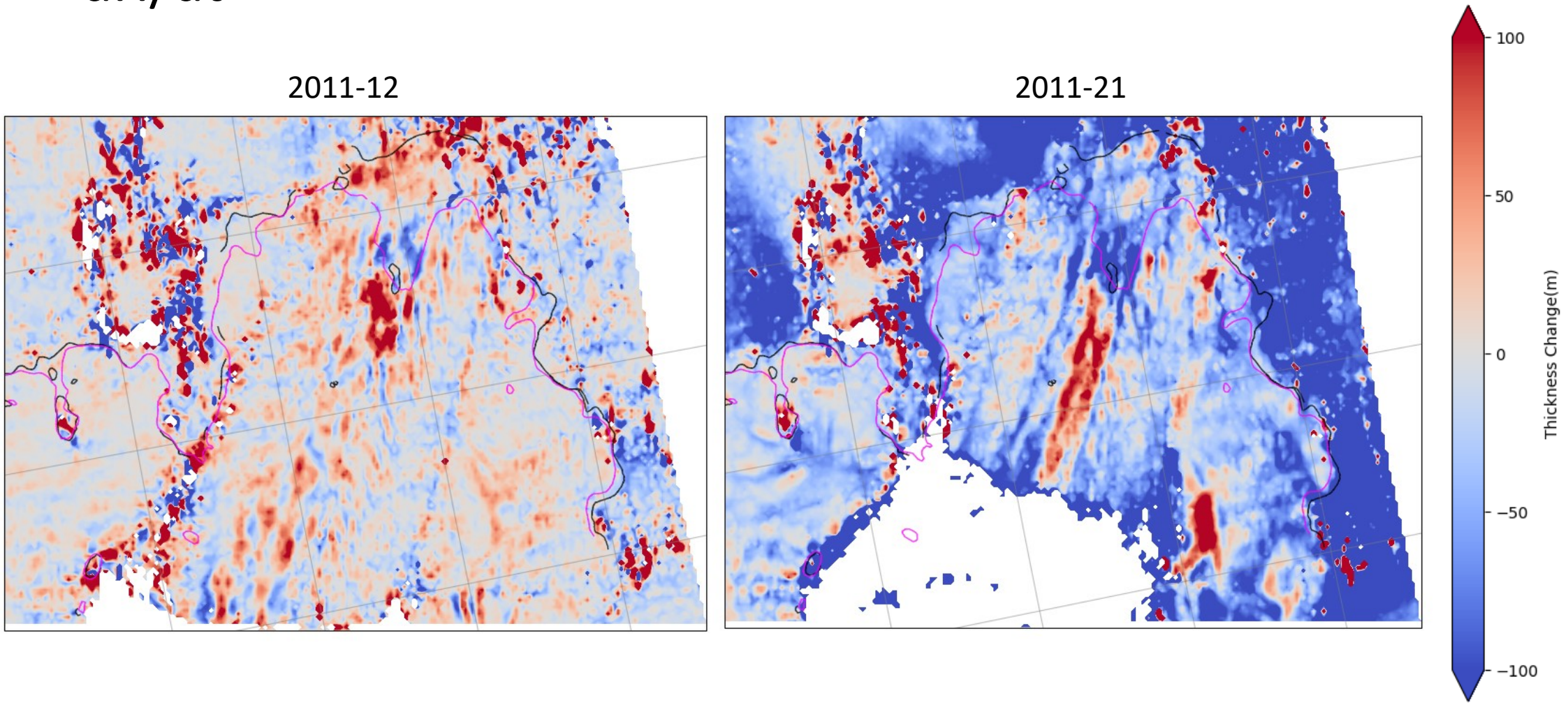
H = ice thickness
U = velocity
t = time
∇ = del operator
DH/Dt = Lagrangian thickness change
dH/dt = Eulerian thickness change

katlow20@bas.ac.uk

dH/dt

2011-12

2011-21

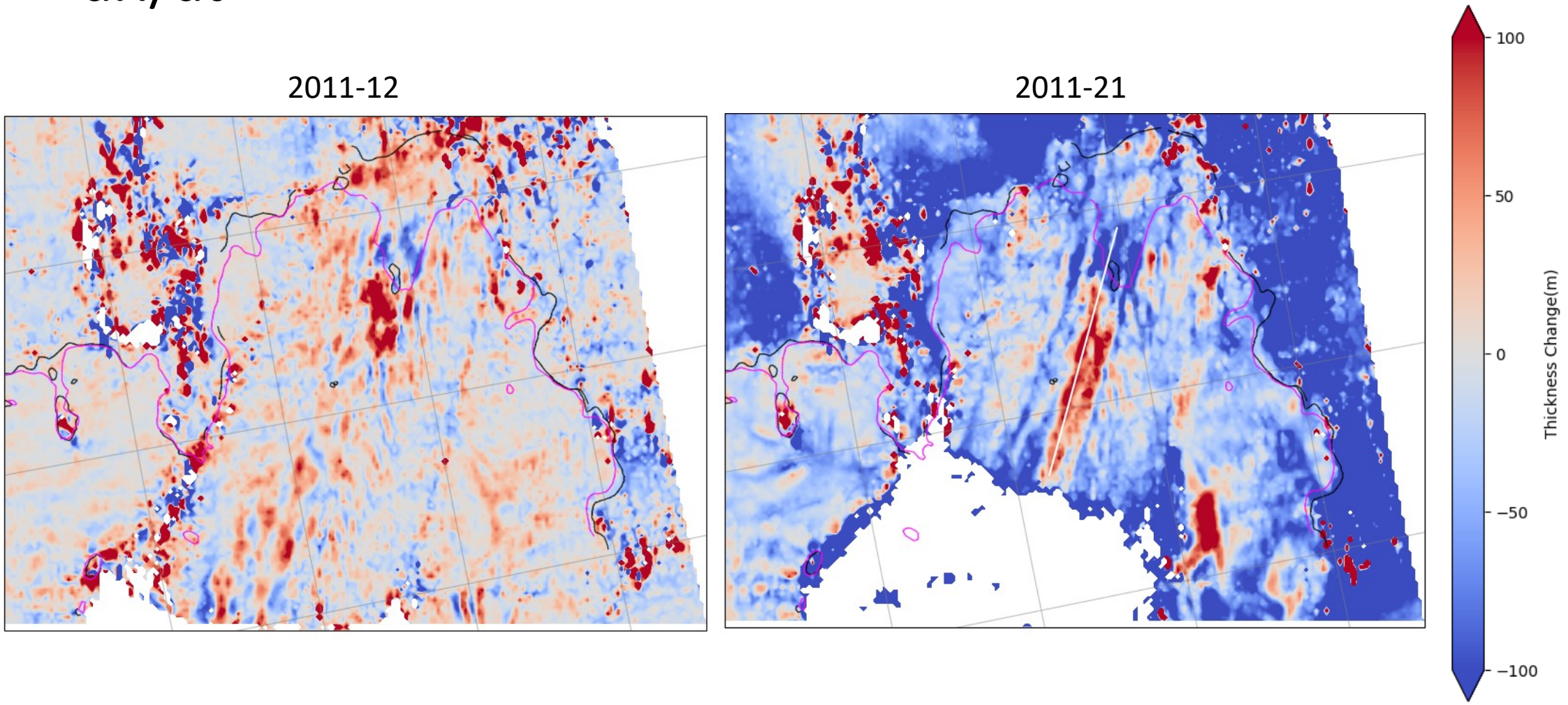


katlow20@bas.ac.uk

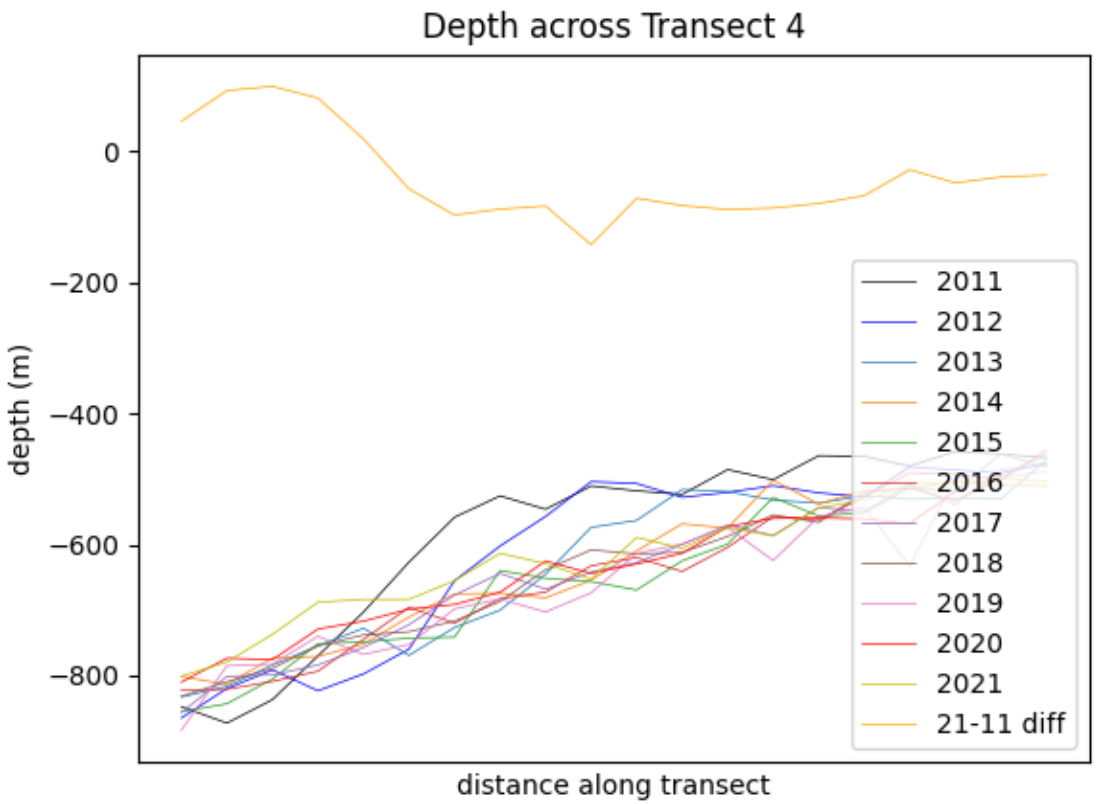
dH/dt

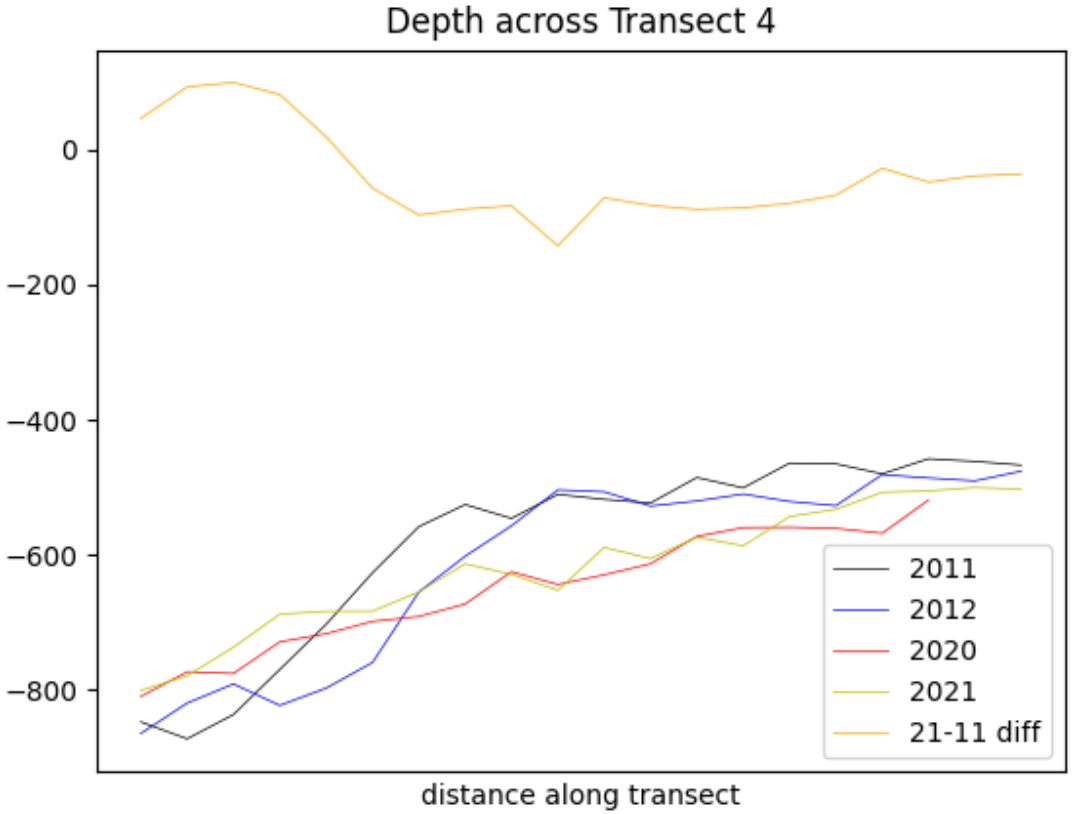
2011-12

2011-21

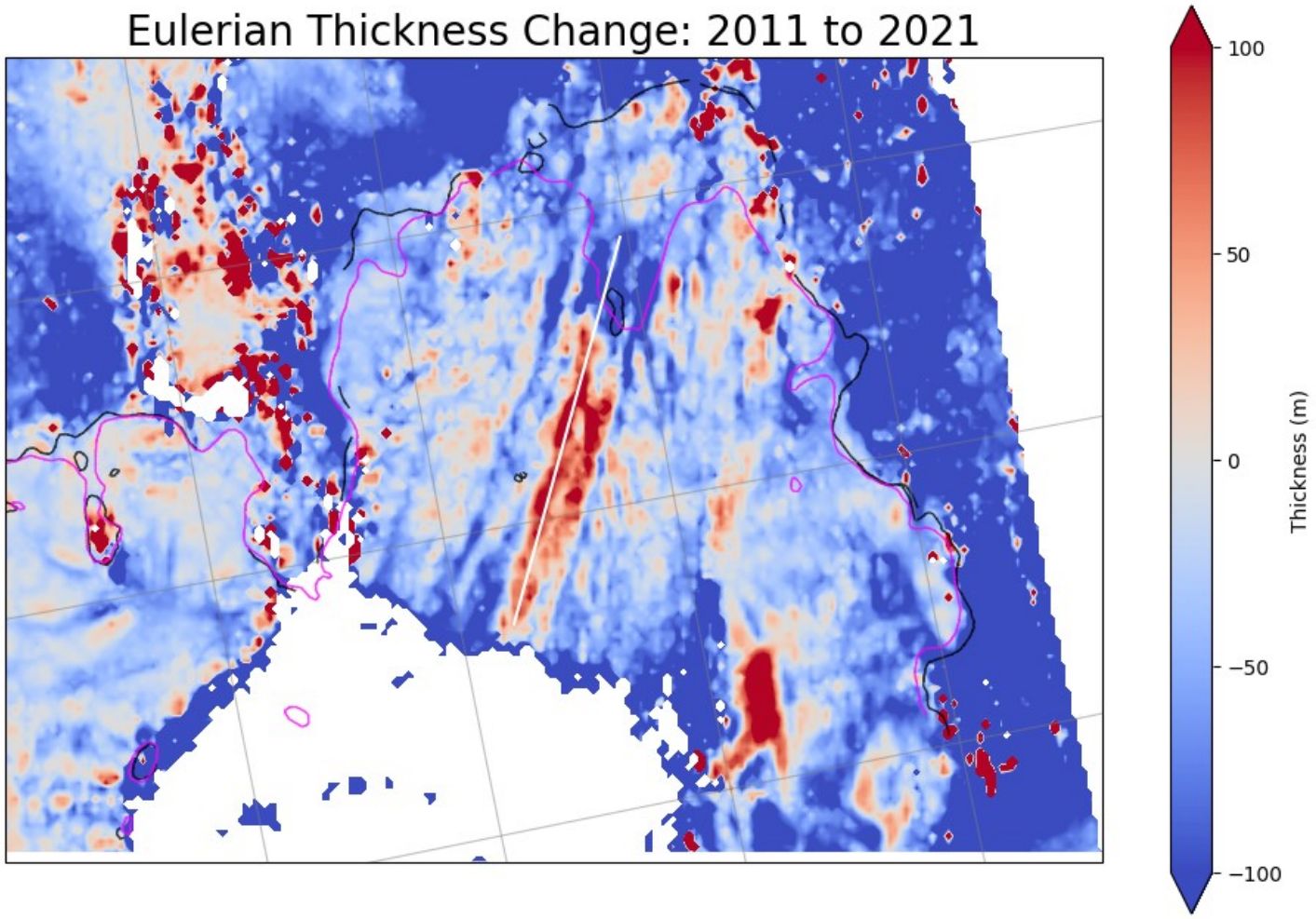


katlow20@bas.ac.uk

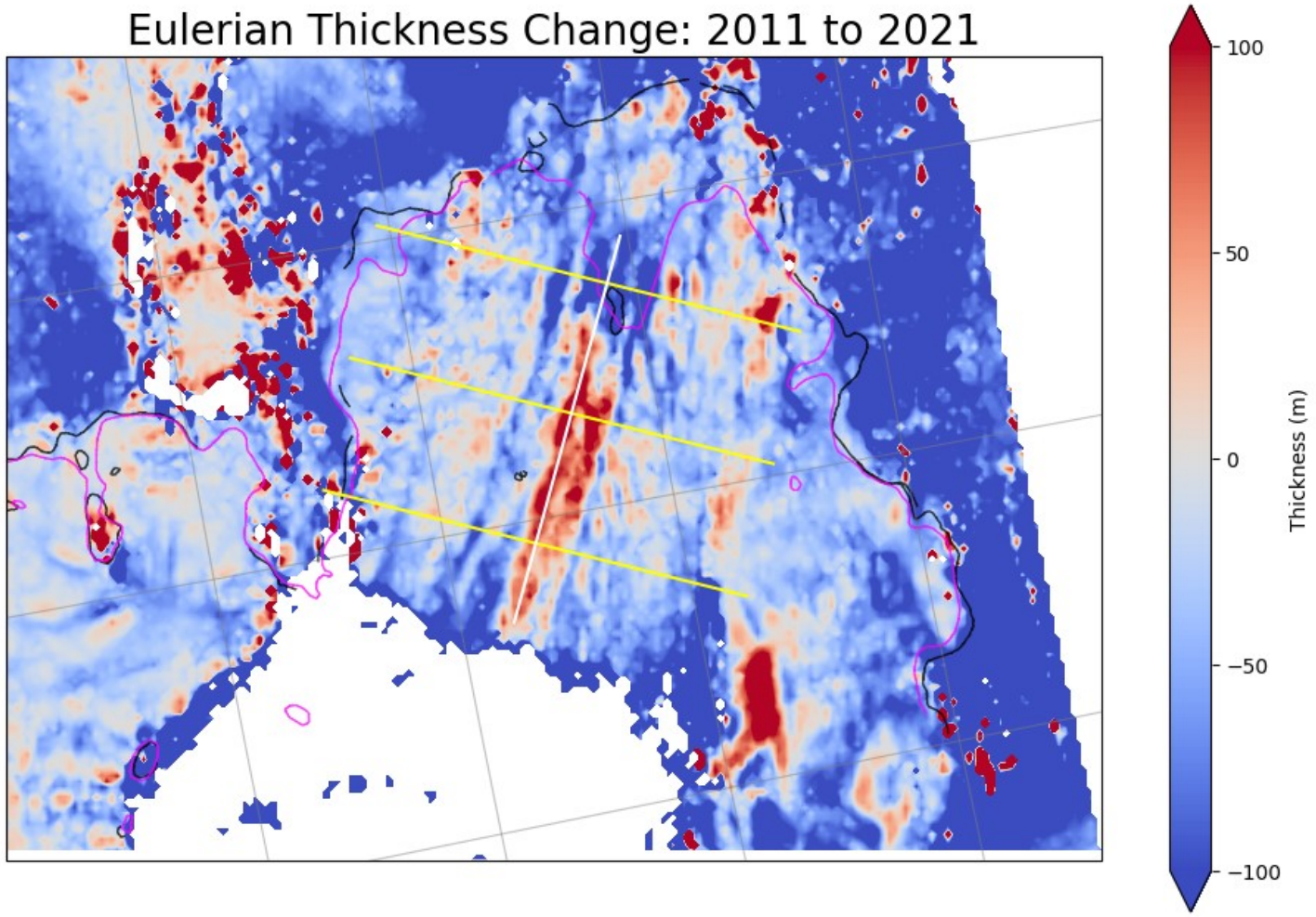




katlow20@bas.ac.uk



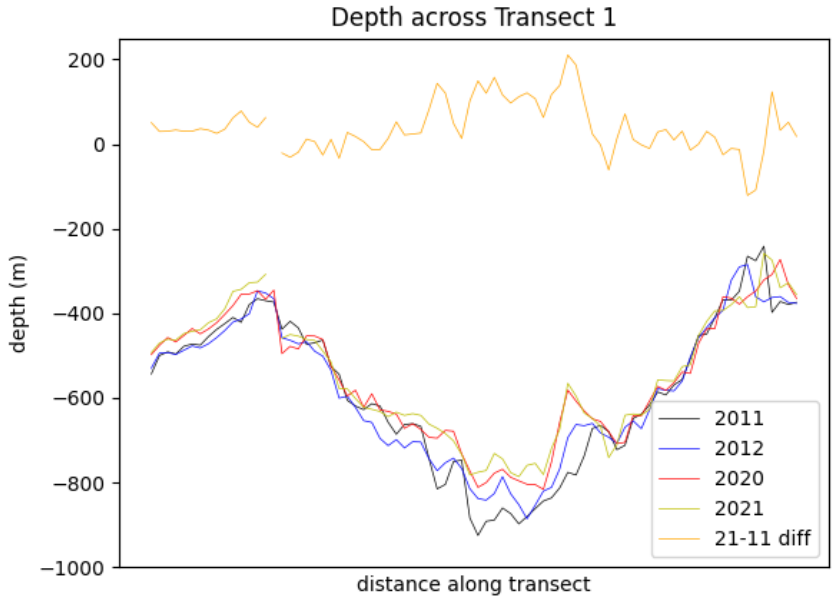
katlow20@bas.ac.uk

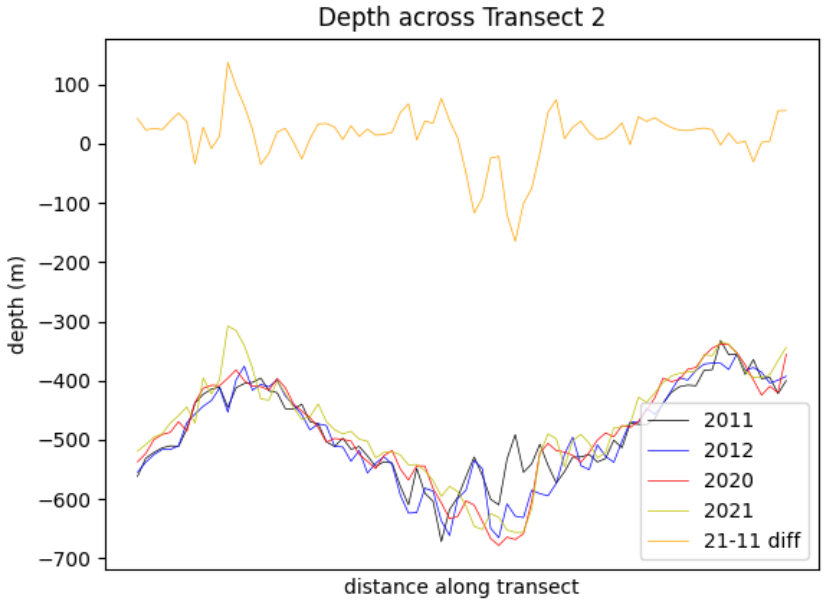


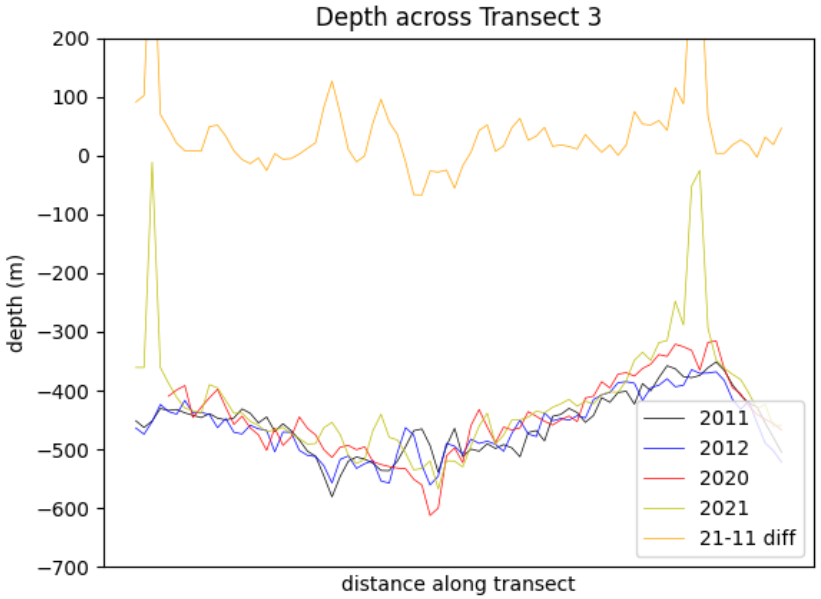
British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

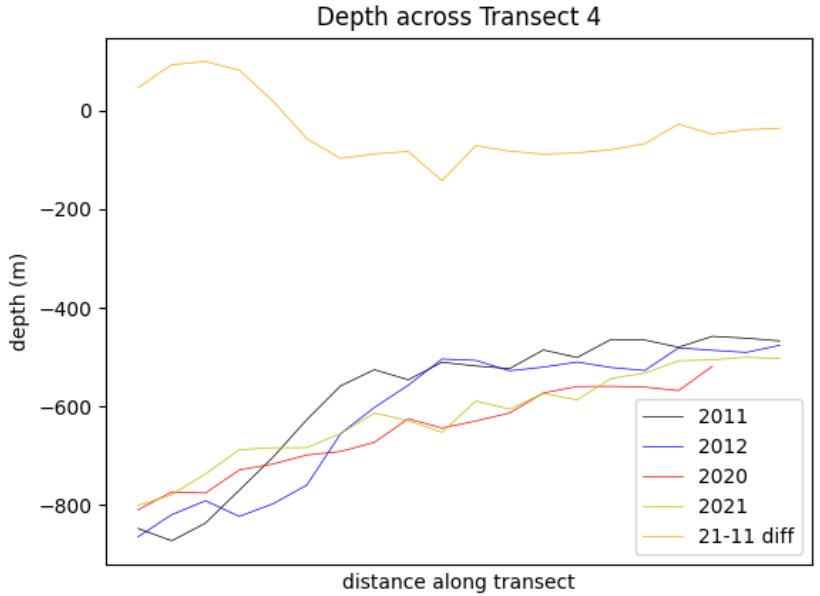
POLAR SCIENCE FOR PLANET EARTH

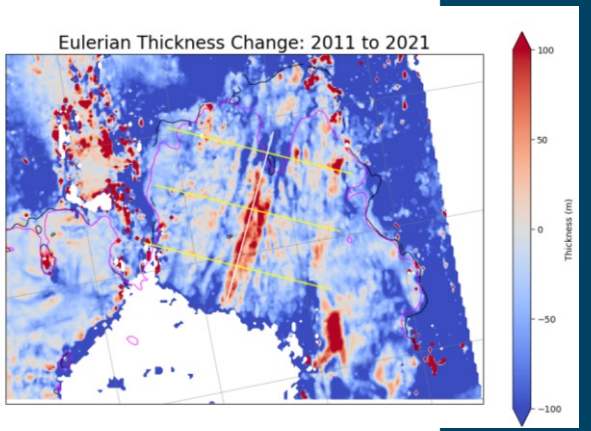
katlow20@bas.ac.uk









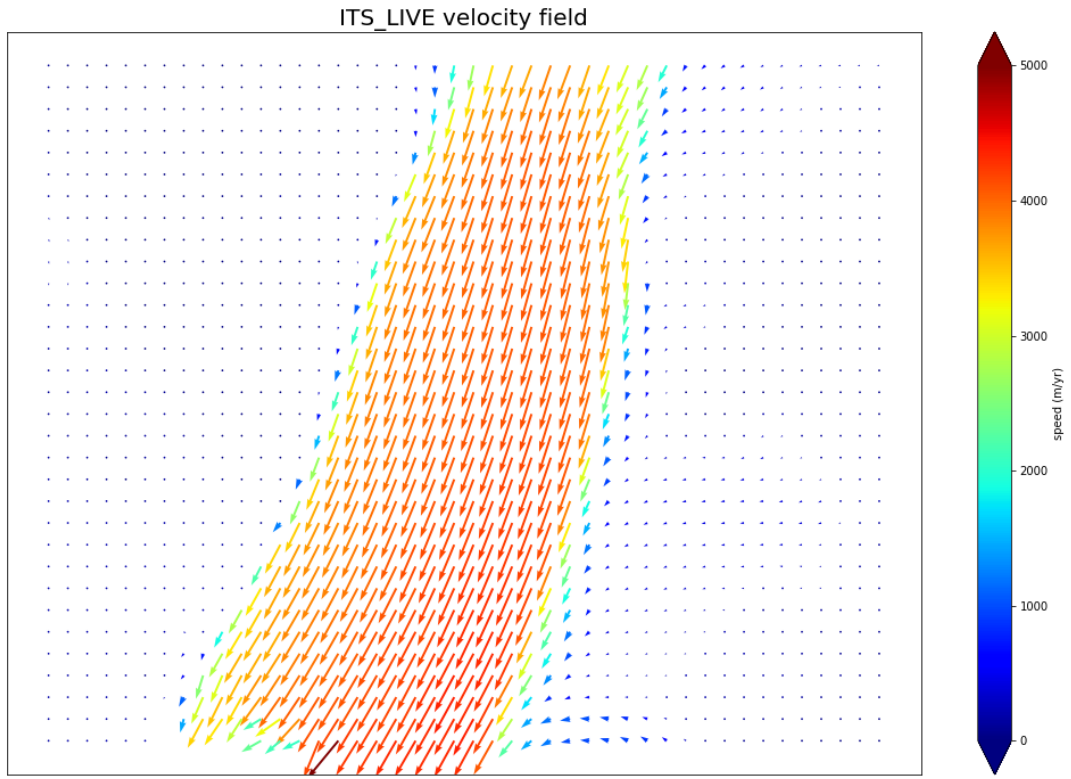


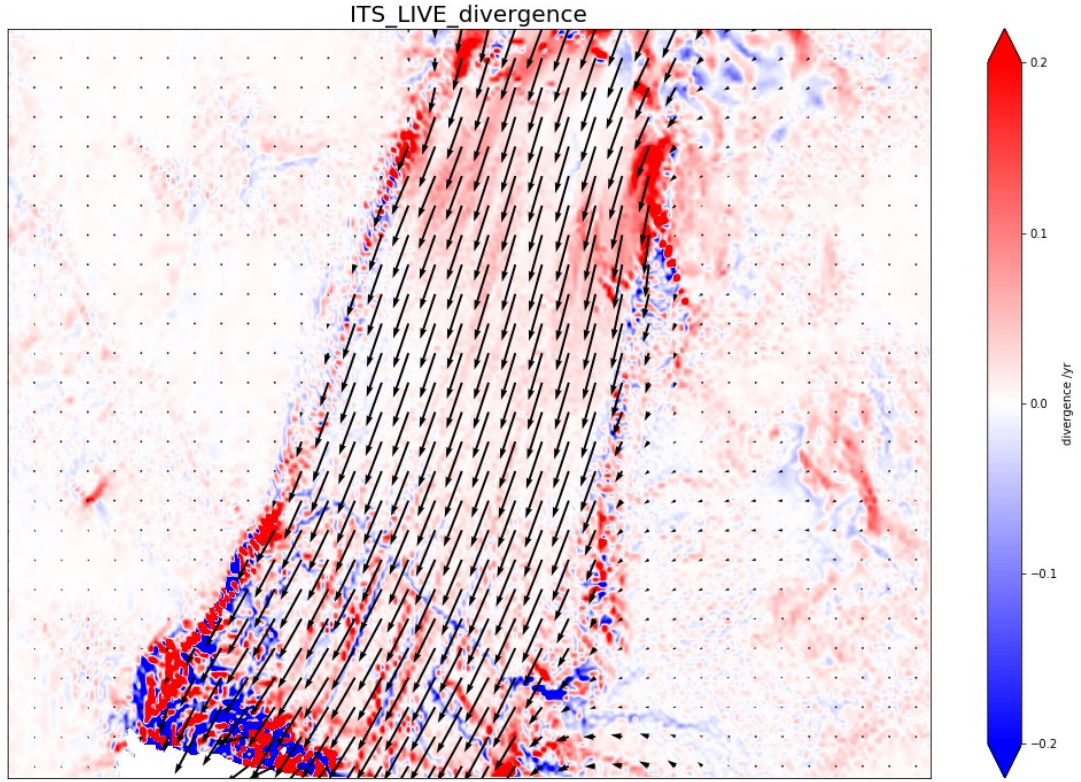
British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE FOR PLANET EARTH

katlow20@bas.ac.uk

ITS_LIVE Velocity field



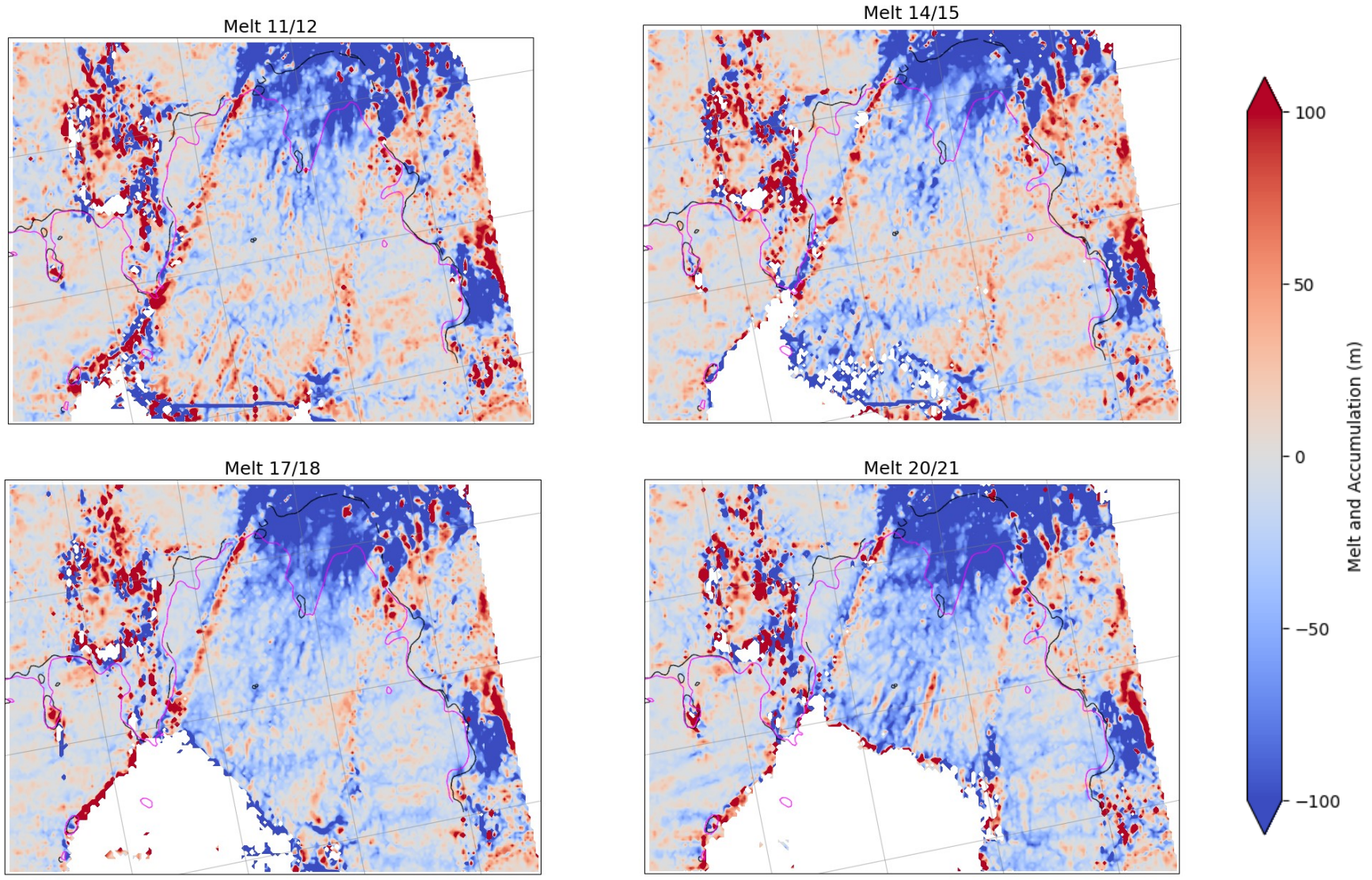


British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE FOR PLANET EARTH

Thickness change as a result of Melt and Accumulation

katlow20@bas.ac.uk



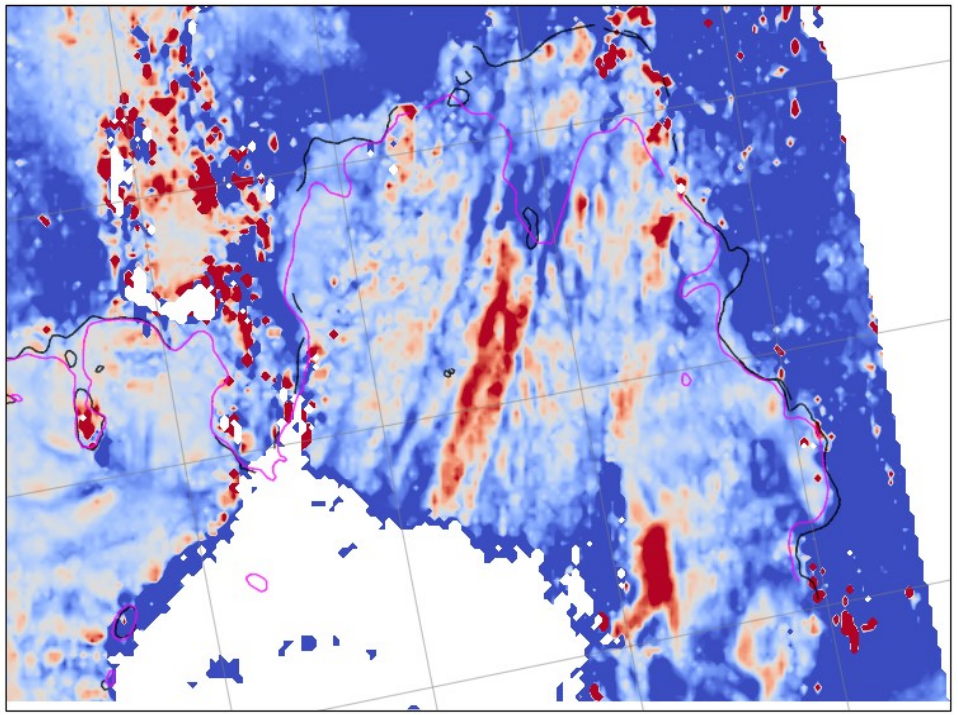
British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

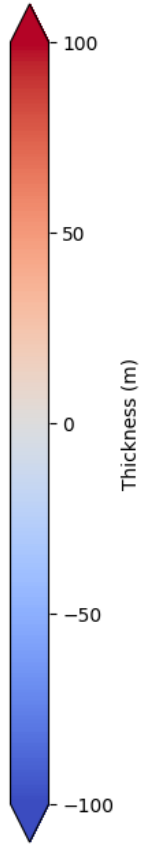
POLAR SCIENCE FOR PLANET EARTH

katlow20@bas.ac.uk

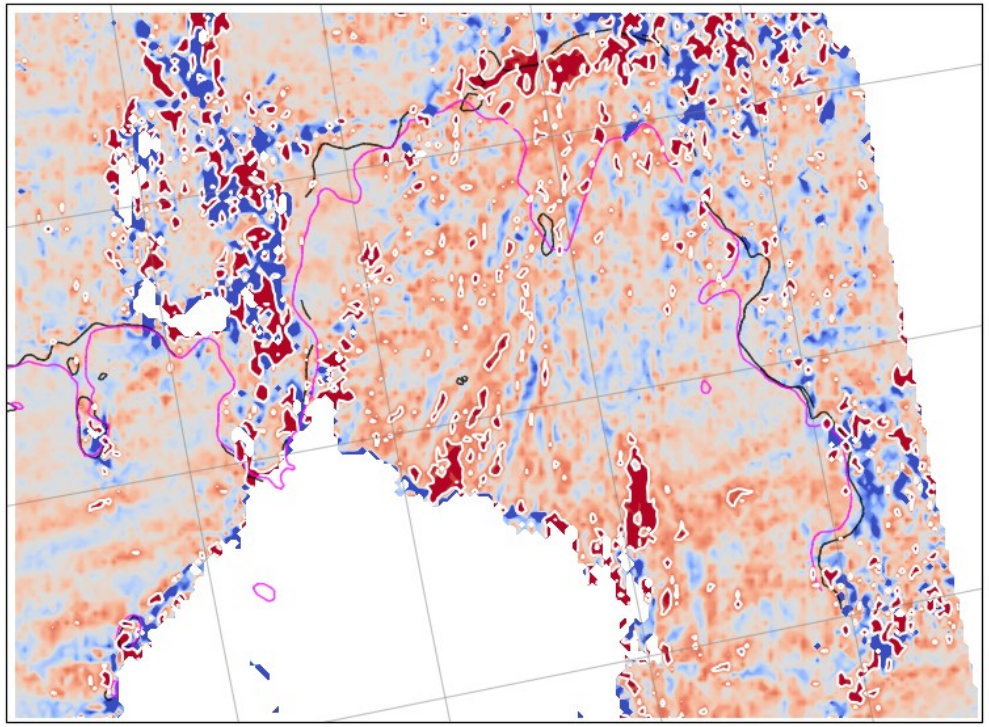
Comparing thickness and melt changes between 2011 and 2021

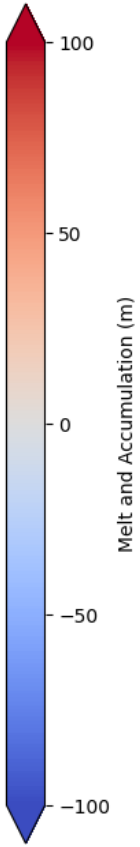
Change in thickness





Change in Melt and Accumulation





British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE FOR PLANET EARTH

katlow20@bas.ac.uk

Summary

- Large-scale geometric changes (such as ungrounding) at the base of PIG are both driven by and affect melt and melting efficiency

- Results suggest this relationship might also be seen on the small channelised scale

- At present there is too much noise to make definite channelised conclusions but it is hoped this will be improved by including time-varying velocity data and changes due to accumulation, these relationships will be better seen.

katlow20@bas.ac.uk

Thanks for listening!

Questions?

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

SENSE Centre for Satellite Data in Environmental Science

UNIVERSITY OF LEEDS

POLAR SCIENCE FOR PLANET EARTH