



**British  
Antarctic Survey**

NATIONAL ENVIRONMENT RESEARCH COUNCIL

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# Artificial Intelligence Lab

supported by the

The  
**Alan Turing  
Institute**

Anita Faul [anfaul@bas.ac.uk](mailto:anfaul@bas.ac.uk)

## Artificial Intelligence Lab

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**Tom Andersson**  
Data Scientist  
Atmosphere, Ice and Climate team



**Anita Faul**  
Data Scientist  
Atmosphere, Ice and Climate team



**Andrew Fleming**  
Remote Sensing Manager  
Mapping and GIS team



**Peter Fretwell**  
Geographic Information Officer  
Mapping and GIS team



**Rachel Furner**  
PhD Student  
Polar Oceans team



**Premdeep Gill**  
PhD Student



**Scott Hosking**  
Environmental Data Scientist  
Atmosphere, Ice and Climate team



**Dan Jones**  
Physical Oceanographer (Adjoint Modelling)  
Polar Oceans team



**Andrew Meijers**  
Deputy Science Leader,  
Polar Oceans  
team



**Tony Phillips**  
Climate Model Data and Analysis Software Manager  
Atmosphere, Ice and Climate team



**Jonathan Rosser**  
PhD Student  
Polar Oceans team



**Emily Shuckburgh**  
Dynamical Oceanographer



**Charles Simpson**  
Environmental Data Scientist  
Atmosphere, Ice and Climate team



**Risa Ueno**  
PhD Student  
Atmosphere, Ice and Climate team

# The team



The total volume of climate model data  
is growing rapidly

2005-2006

36 TB

2011-2012

2,000 TB

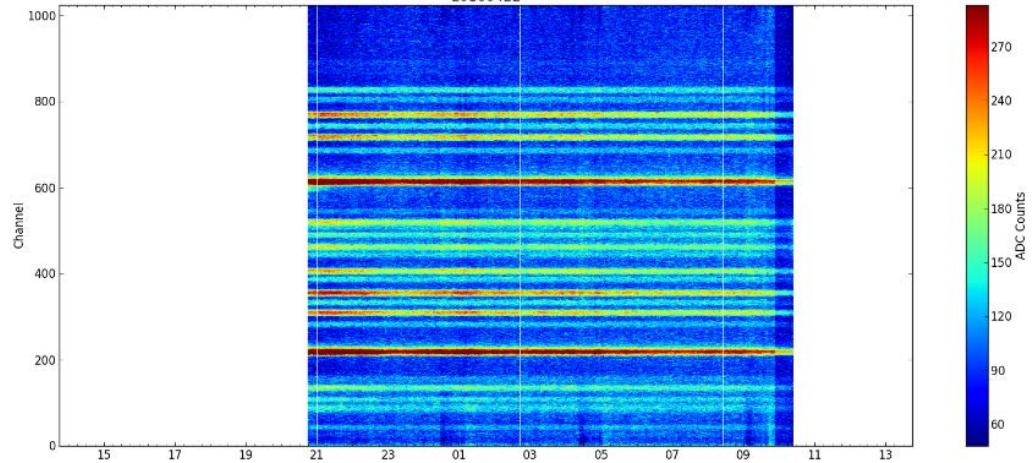
2017-Now

40,000 TB

Eyring et al. (2016), Earth System Dynamics



Spectrogram (Background corrected)  
20160422



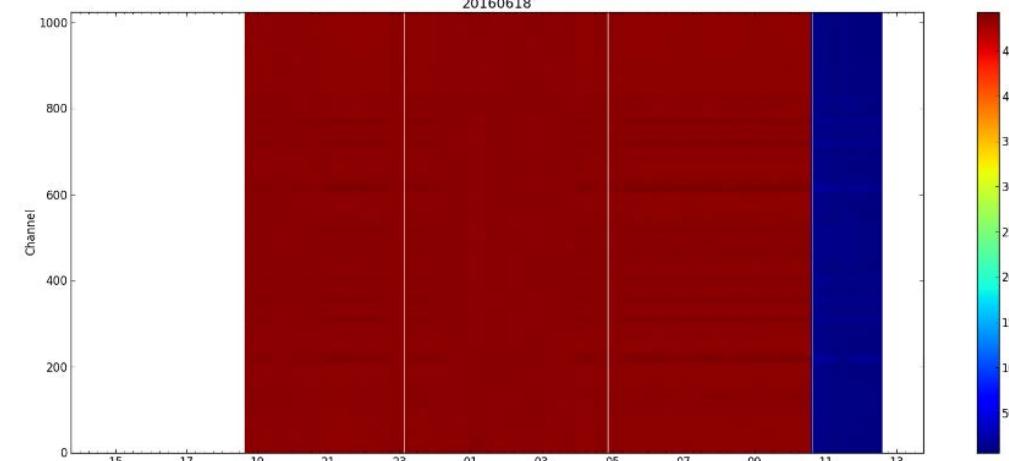
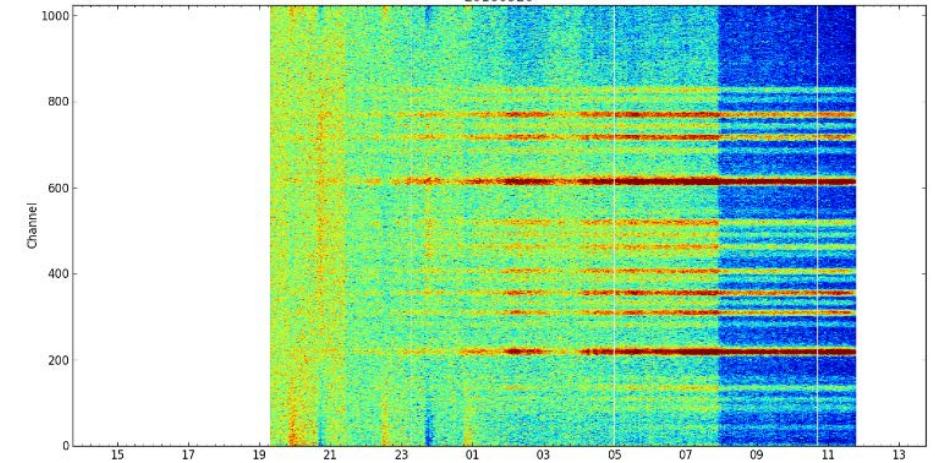
The good,

the bad,

and the ugly.

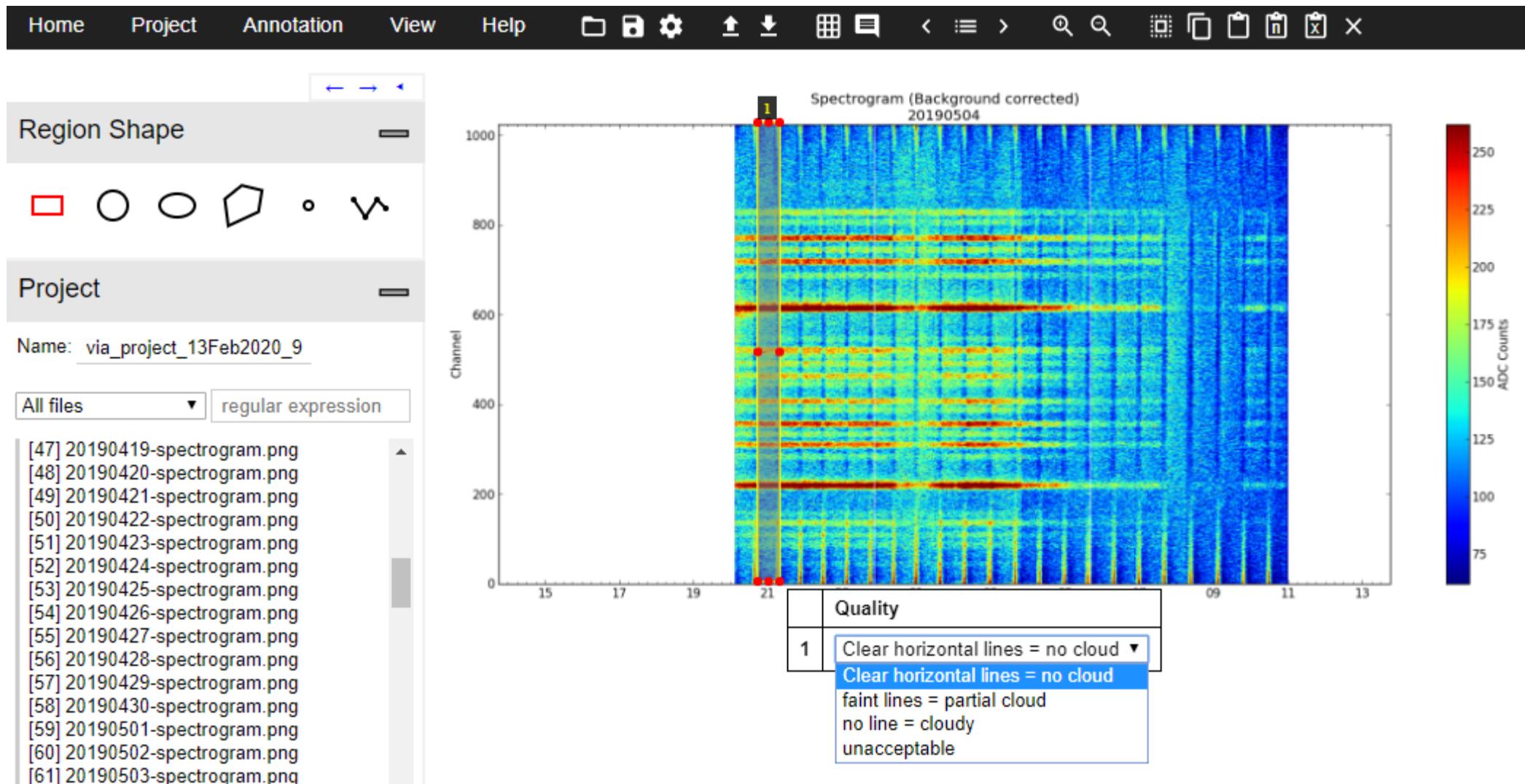
Tracy Moffat-Griffin (BAS)

Spectrogram (Background corrected)  
20160520



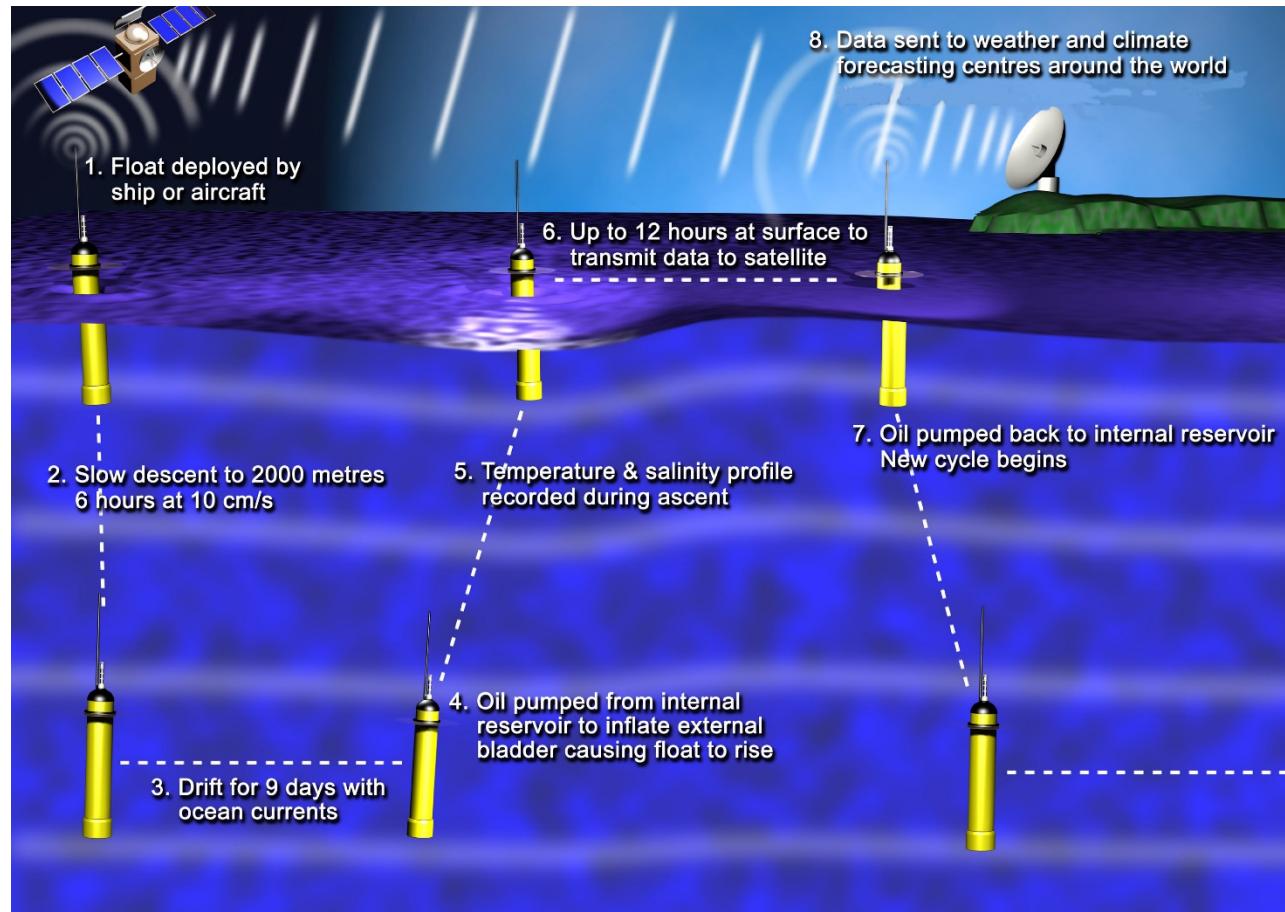
# VGG Image Annotator (VIA)

Abhishek Dutta, Ankush Gupta and Andrew Zisserman

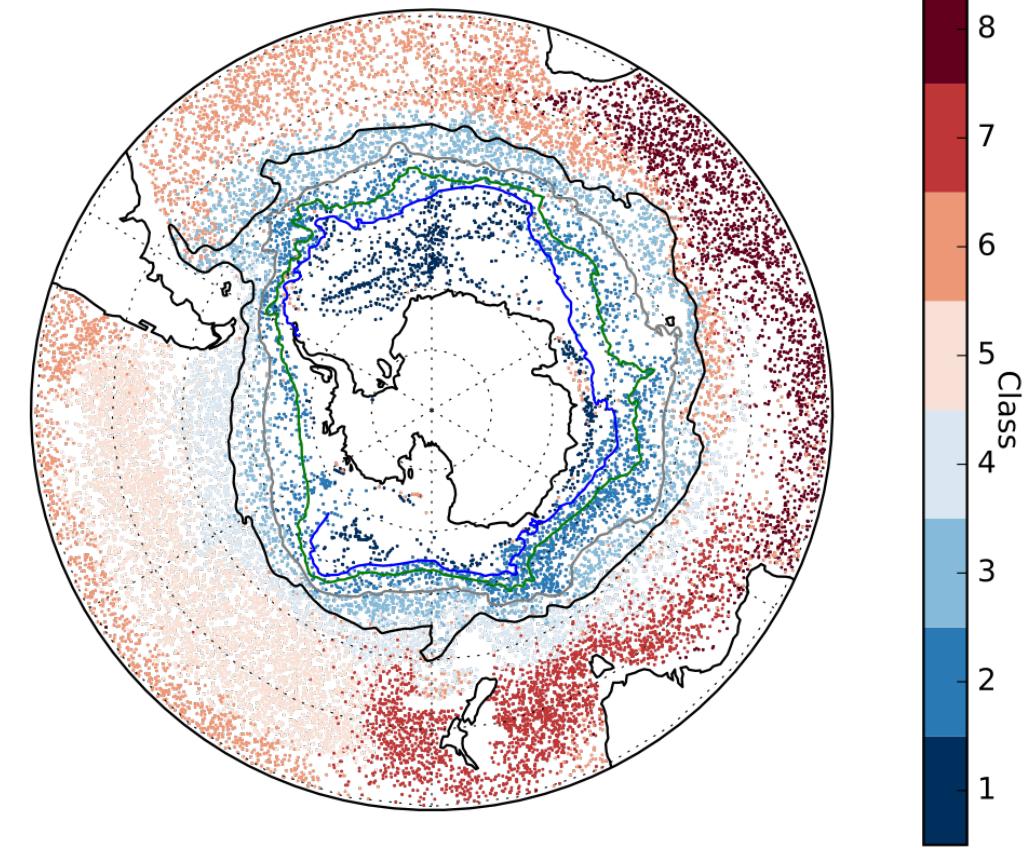


# Clustering to distinguish water masses

Array for Real-time Geostrophic Oceanography (ARGO)

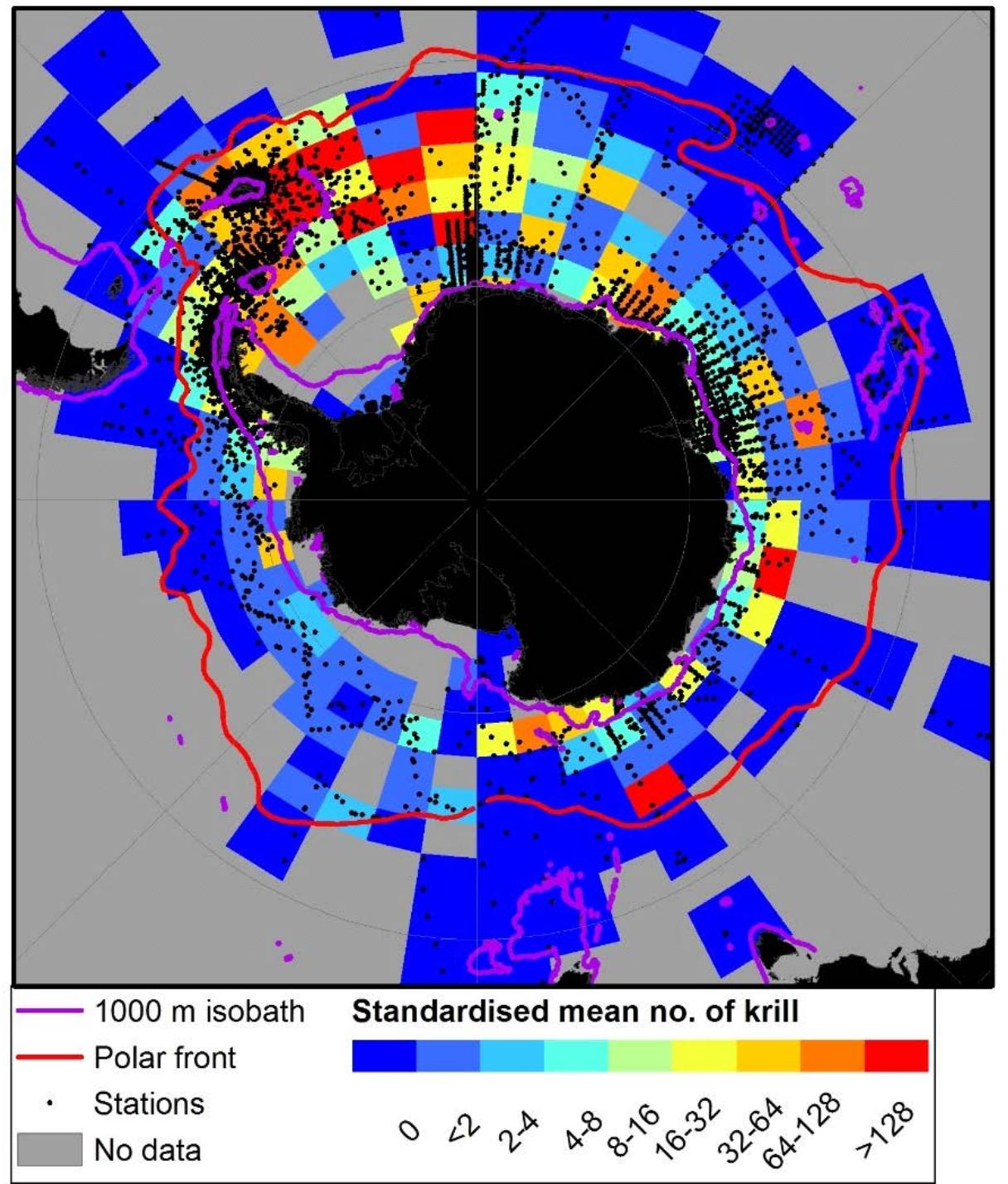


Dan Jones (BAS), Simon Thomas (BAS)

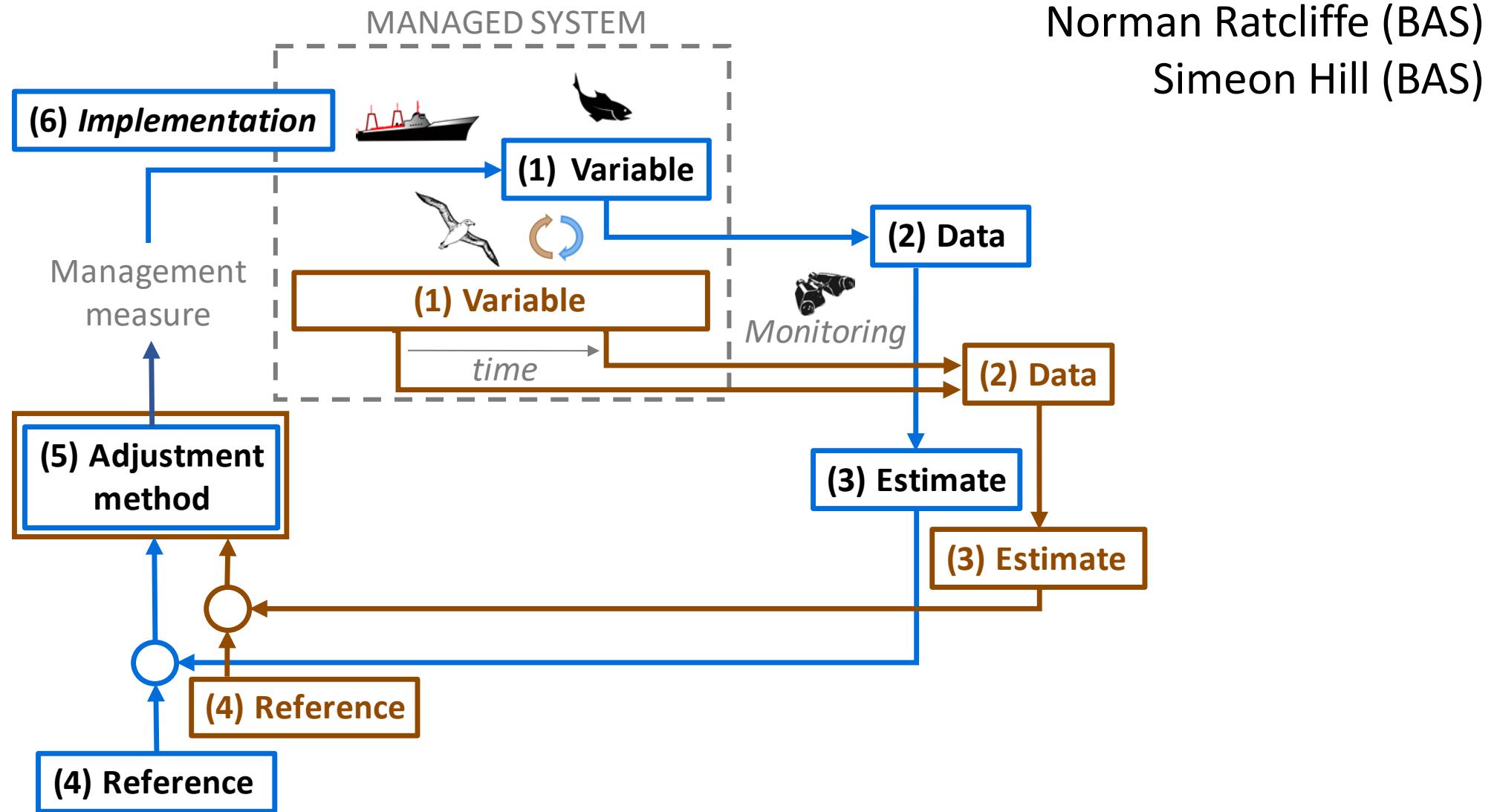


# Noisy and incomplete ecological datasets

Simeon Hill (BAS)

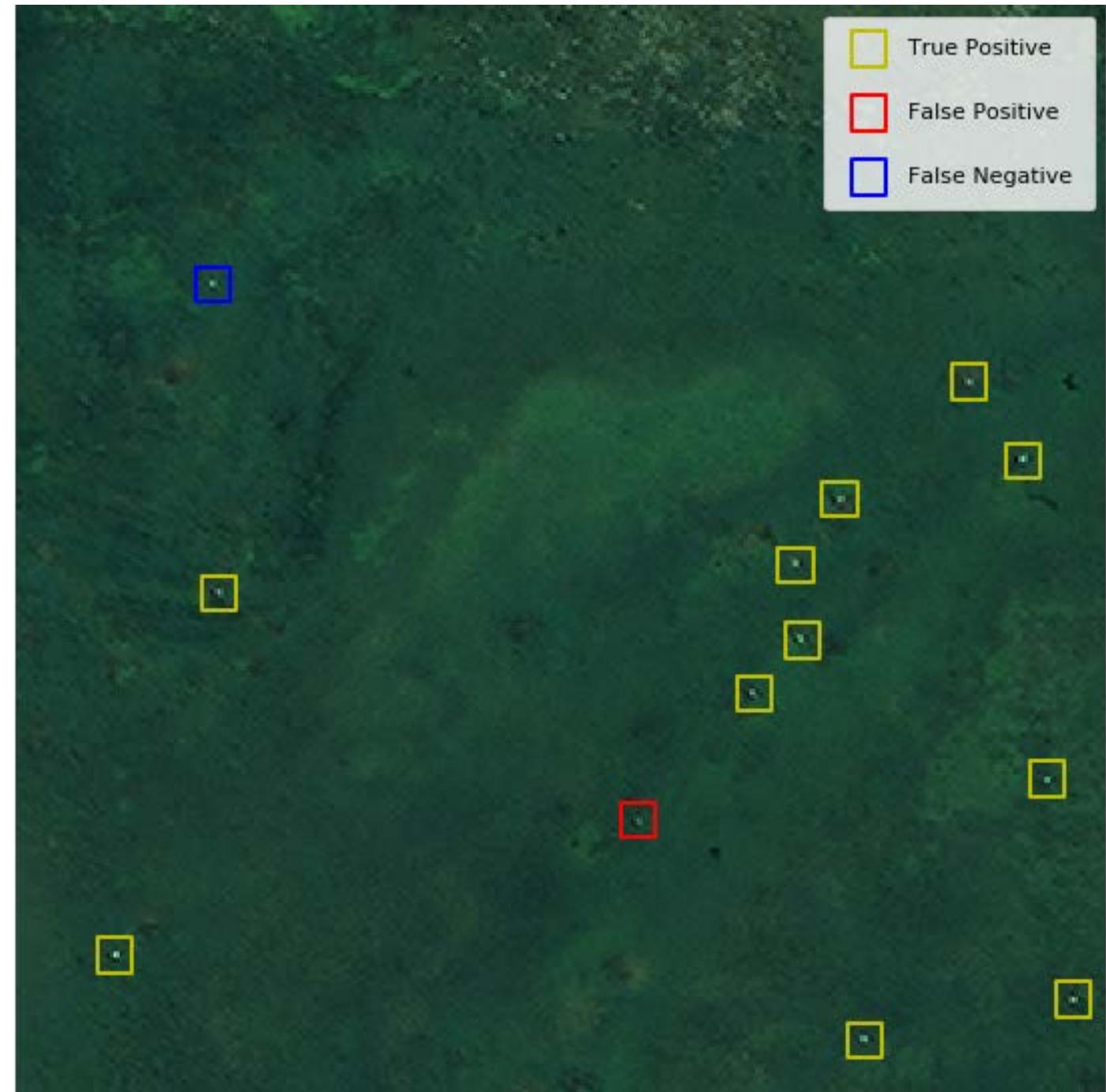


# Feedback Management of Fisheries

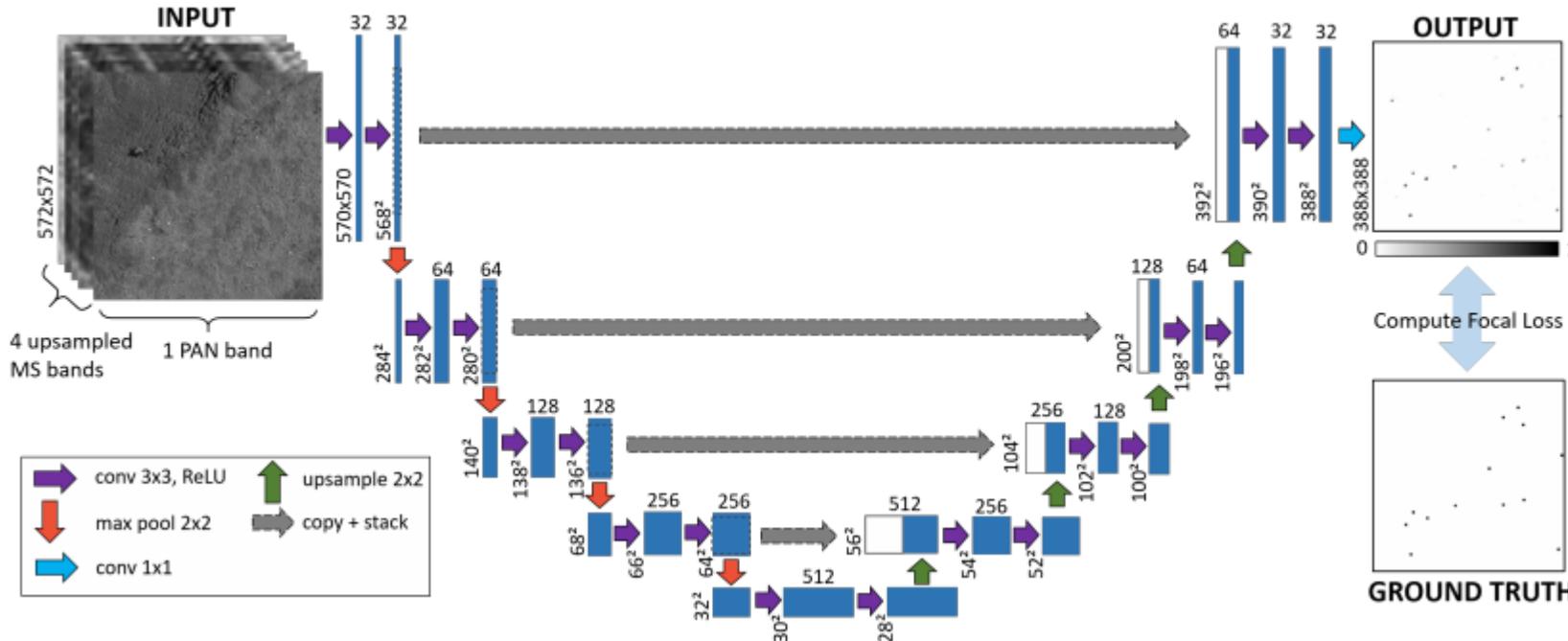


# Counting Albatrosses from space

Ellen Bowler (UEA)  
Peter T Fretwell (BAS)



# U-net architecture

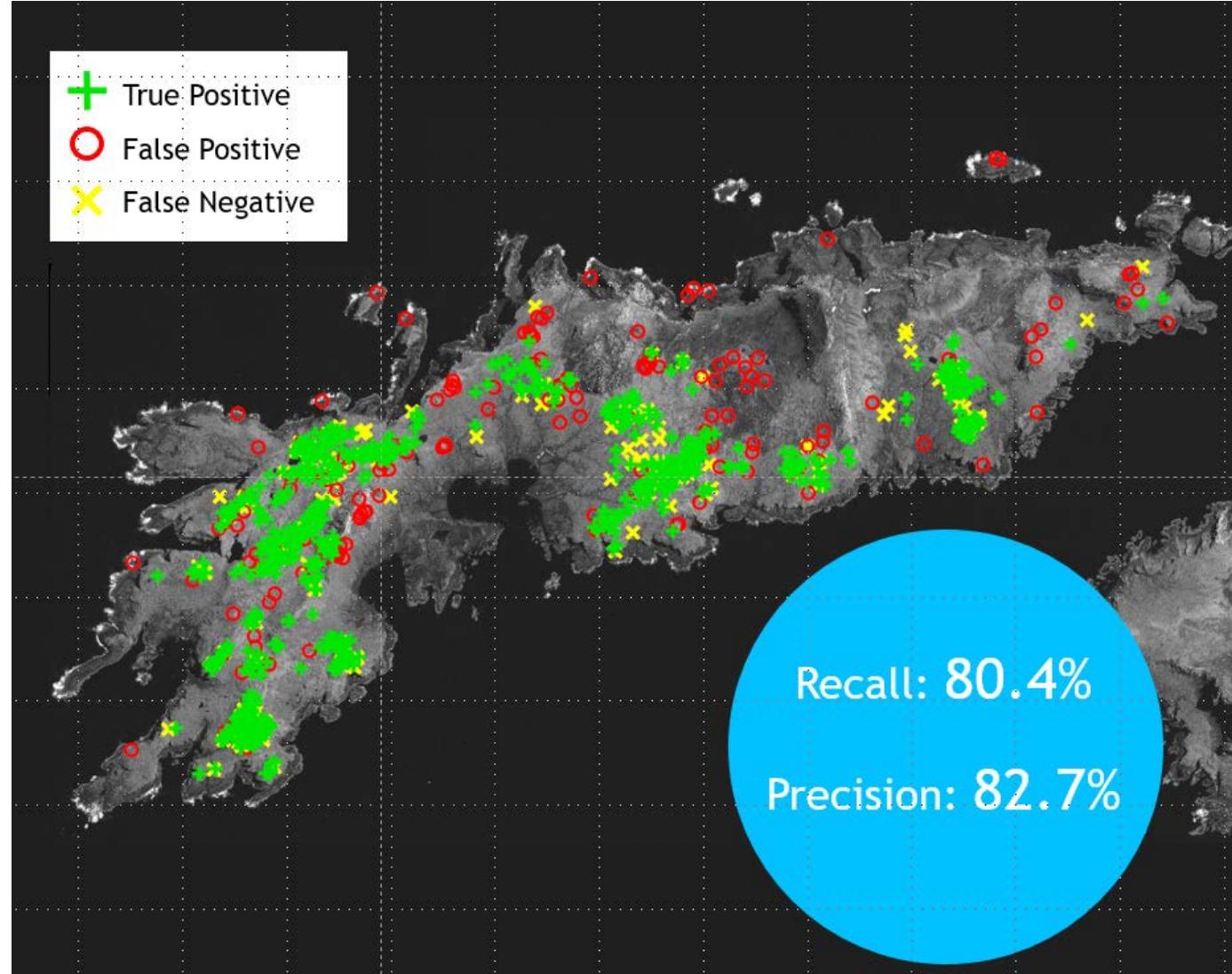


## Contracting path:

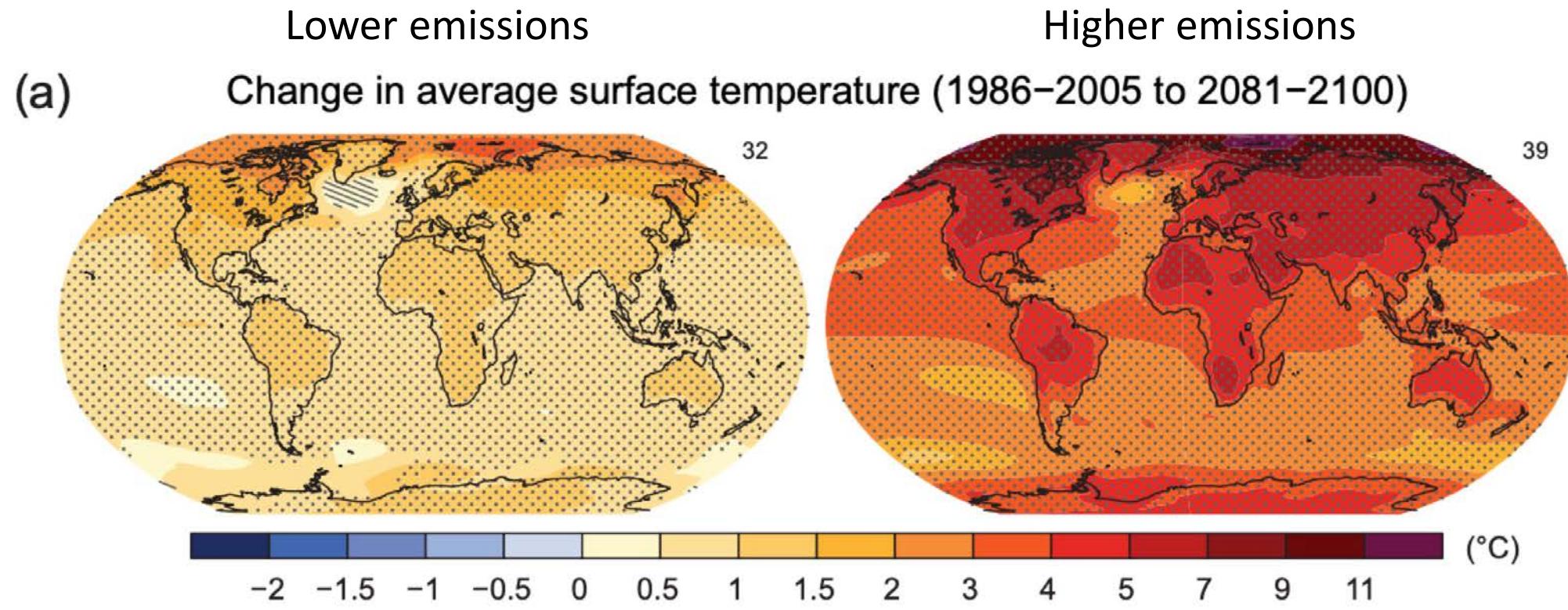
- convolutions with rectified linear unit (ramp) activation
- down sampling by max pooling
- decreasing spatial information
- increasing feature information

## Expanding path:

- up sampling
- concatenations with features at the same depth
- combining spatial information with feature information

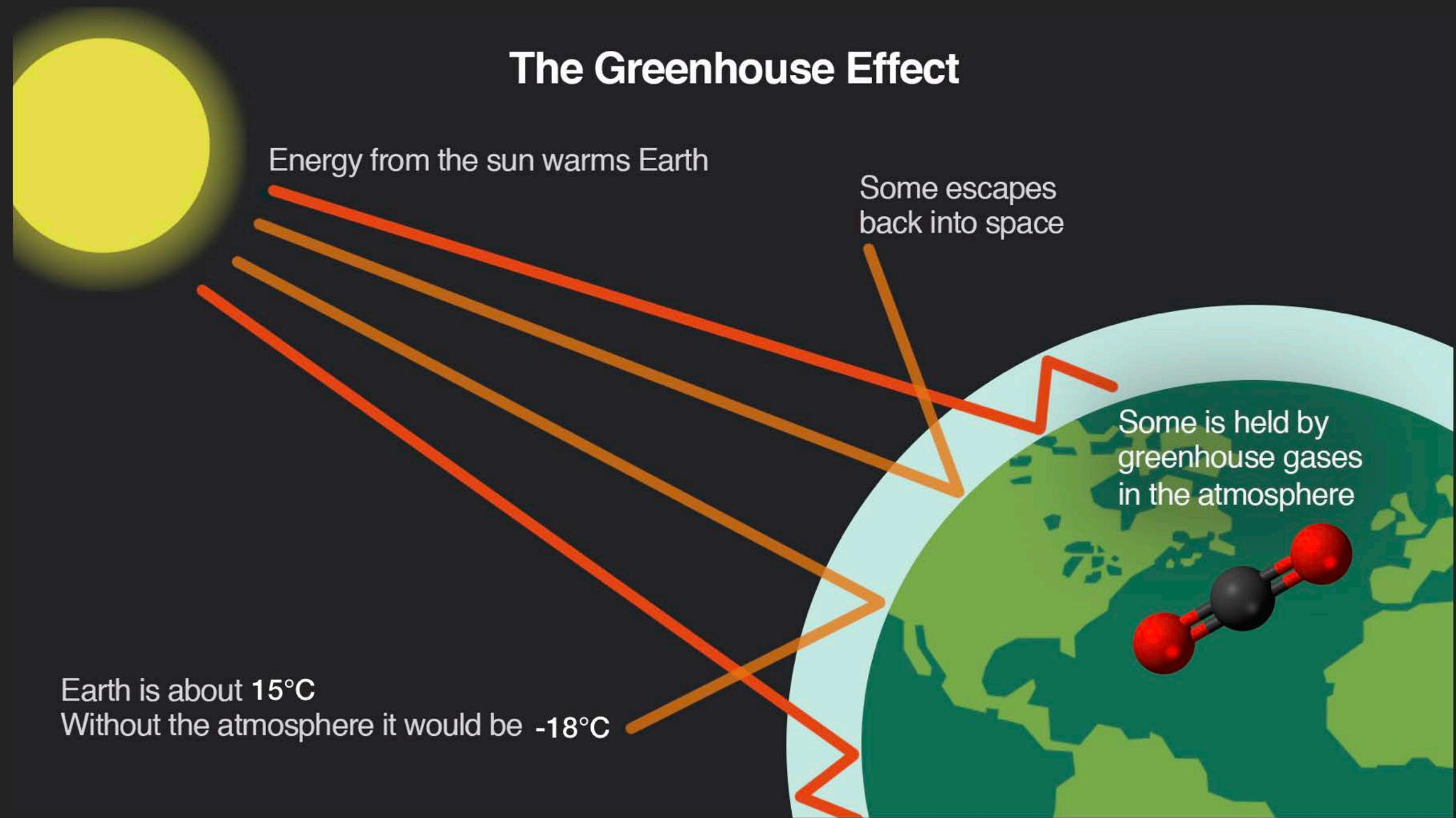


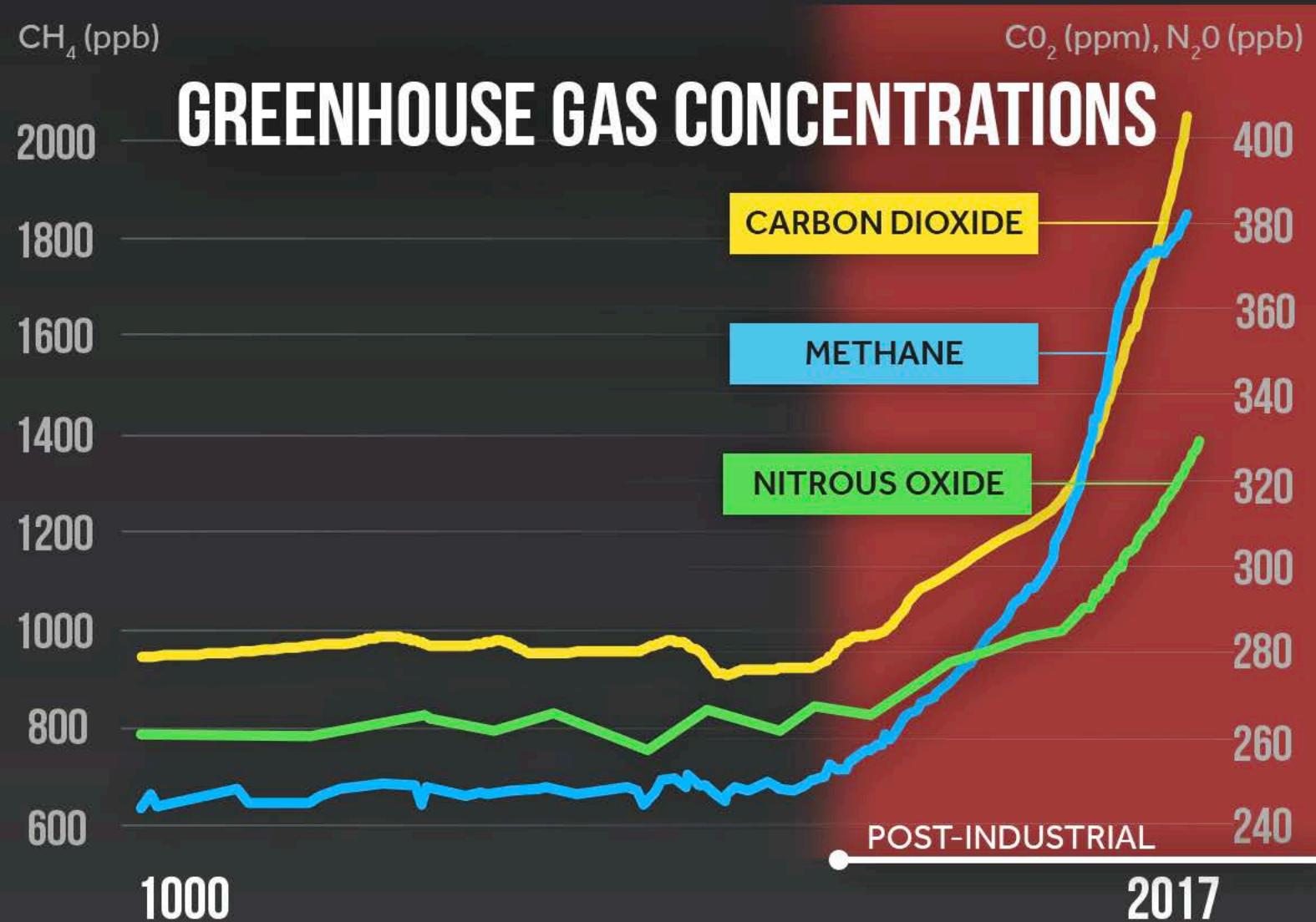
Comparable to human inter-observer variation



Credit: IPCC AR5 Summary for Policymakers

# The Greenhouse Effect





Post-Industrial defined as 1750 and beyond  
Source: US EPA's Climate Change Indicators

CLIMATE CENTRAL

# Where's the Heat?

## Earth's Accumulated Energy

Air, Land & Ice: 7%  
Oceans: 93%

1970

2010

ZJ\*

Upper  
Ocean  
172.8

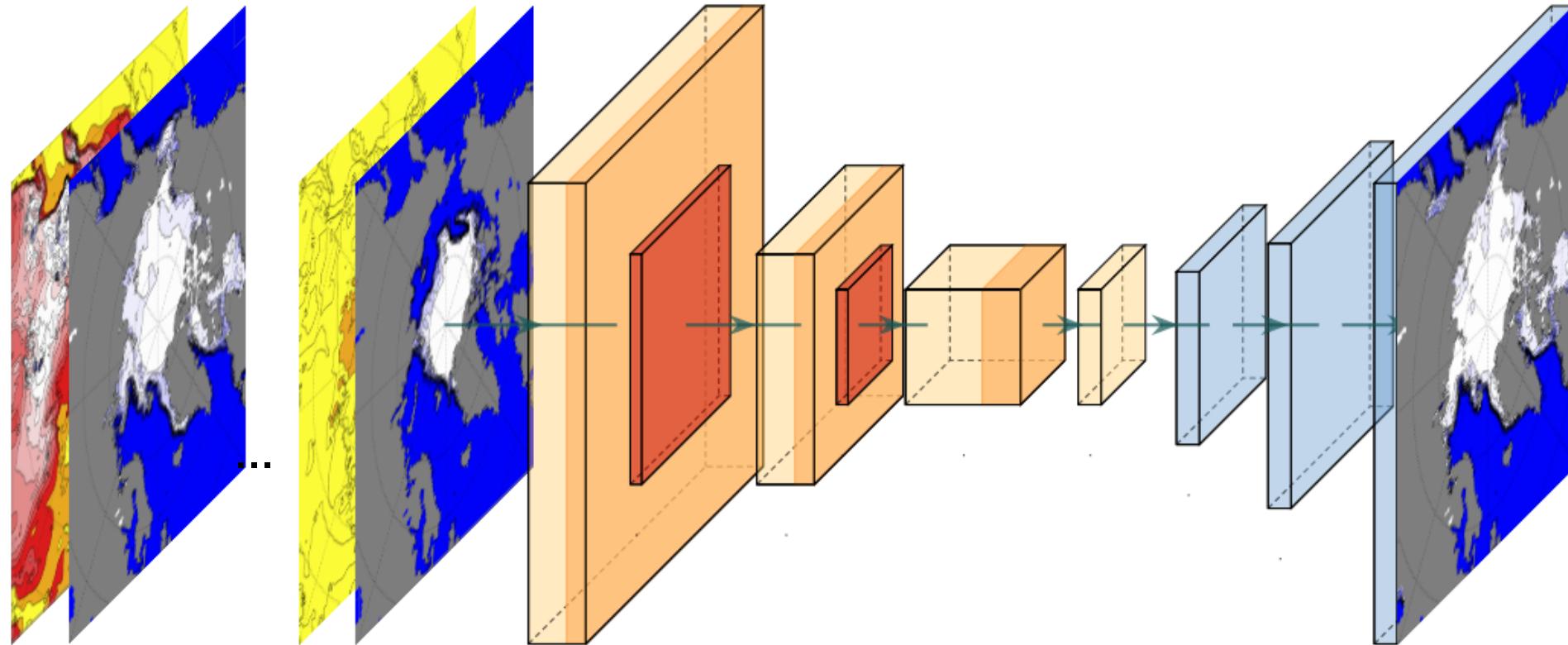
Deep  
Ocean  
78.2

One hurricane Sandy  
per second

Accumulated Heat Energy Measured in Zettajoules  
Source: Climate Change 2013: The Physical Science Basis (IPCC) Chapter 3

CLIMATE CENTRAL

# Deep learning for Arctic sea ice prediction



Scott Hosking (BAS), Dan Jones (BAS), Emily Shuckburgh (Cambridge University), Andrew Meijers (BAS), Tom Andersson (BAS), María Pérez-Ortiz (UCL), Yevgeny Aksenov (NOC)

# NEWS

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## Antarctica melting: Climate change and the journey to the 'doomsday glacier'

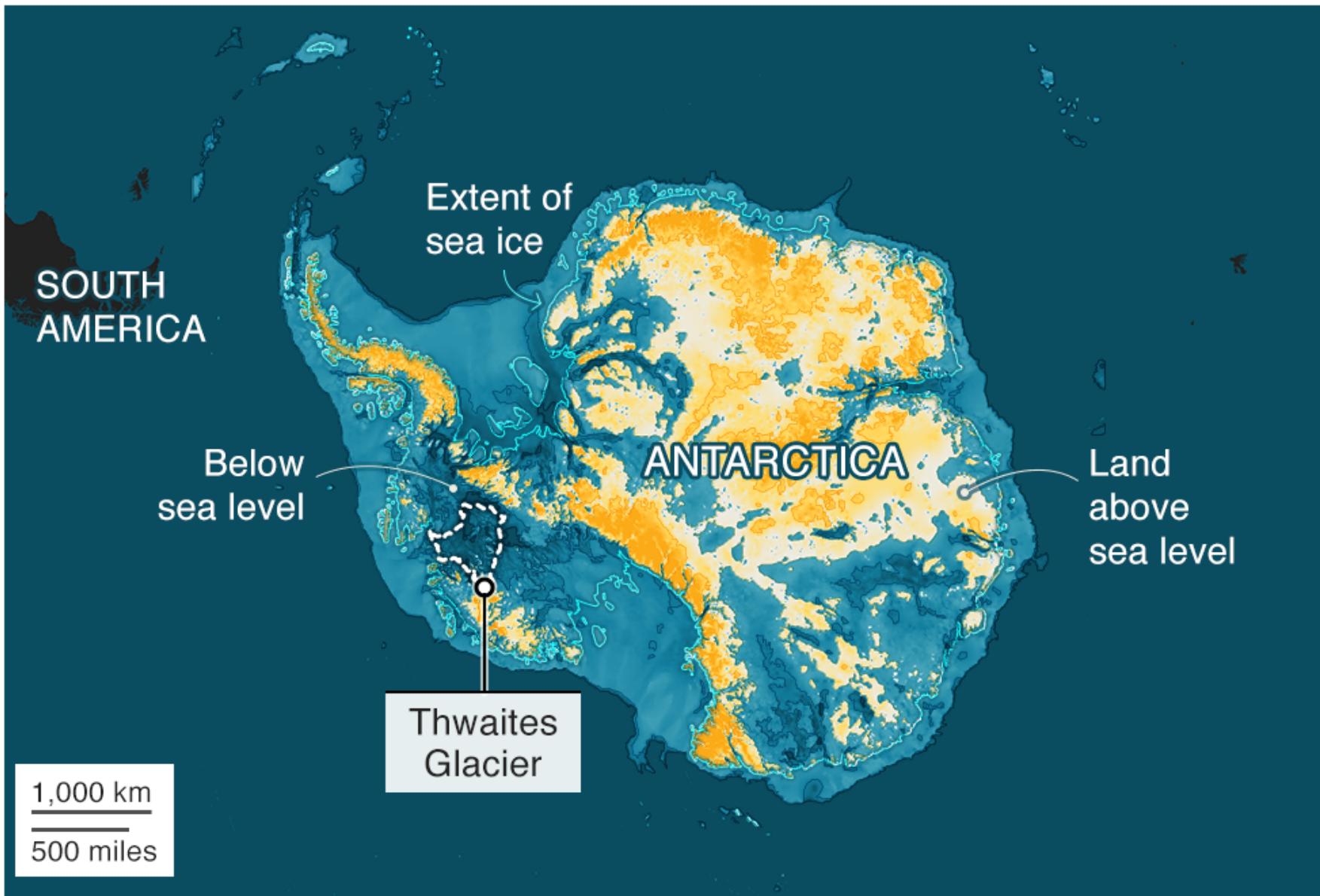
By Justin Rowlatt

Chief Environment correspondent

© 28 January 2020

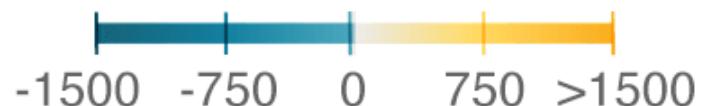
Share

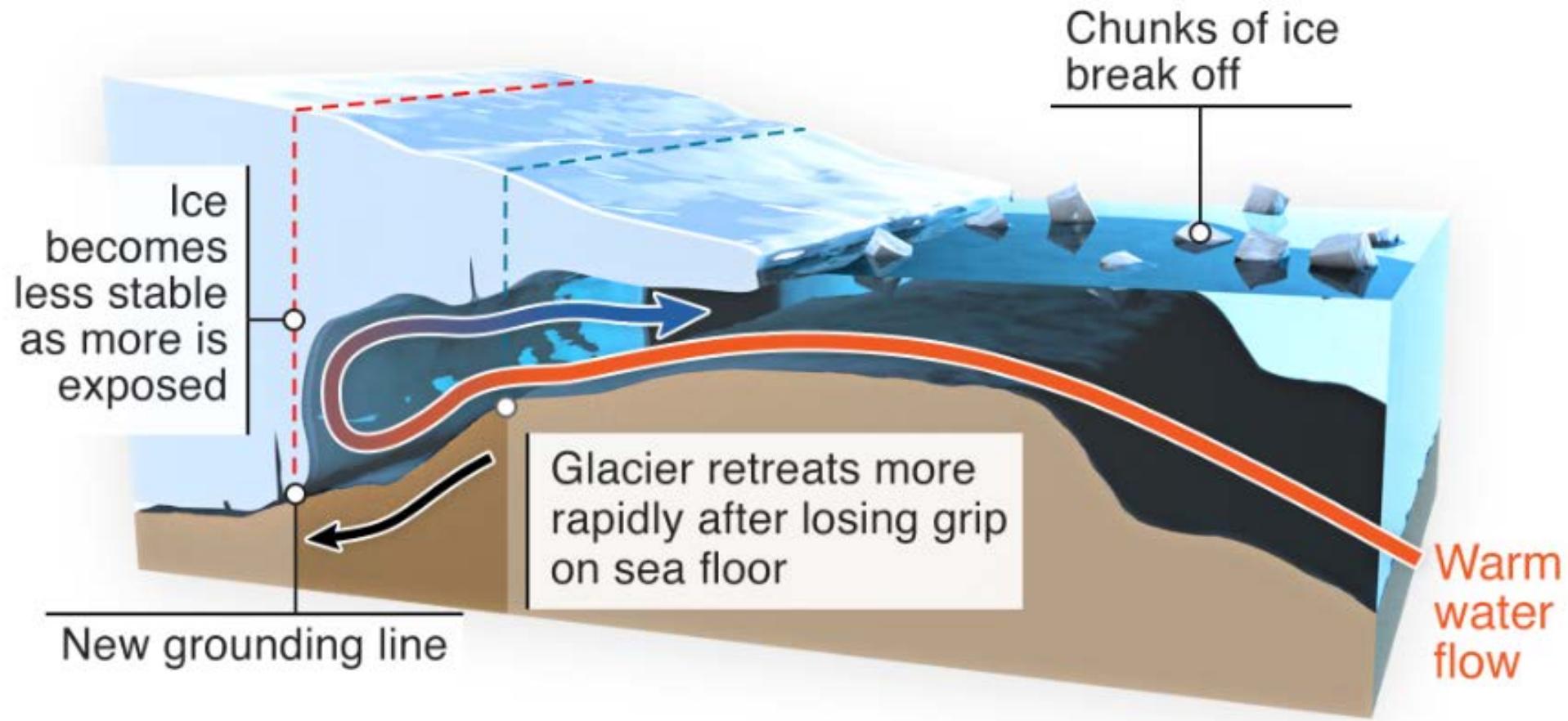




Source: Nasa/National Snow & Ice Data Center

Metres below/above sea level

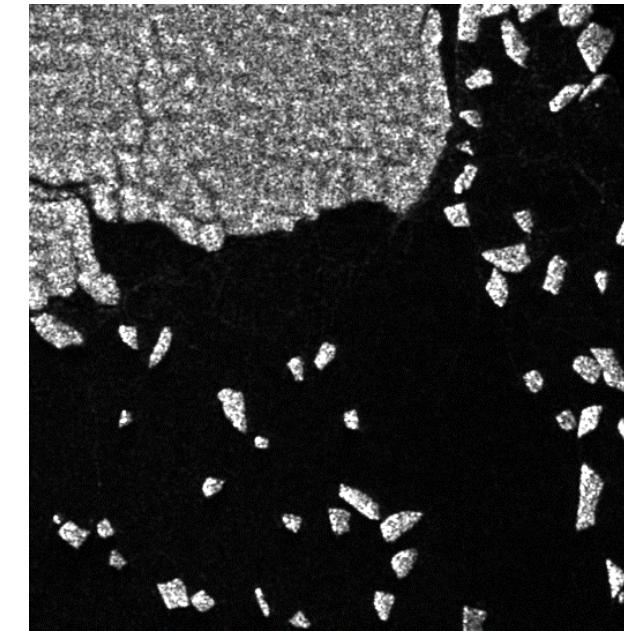
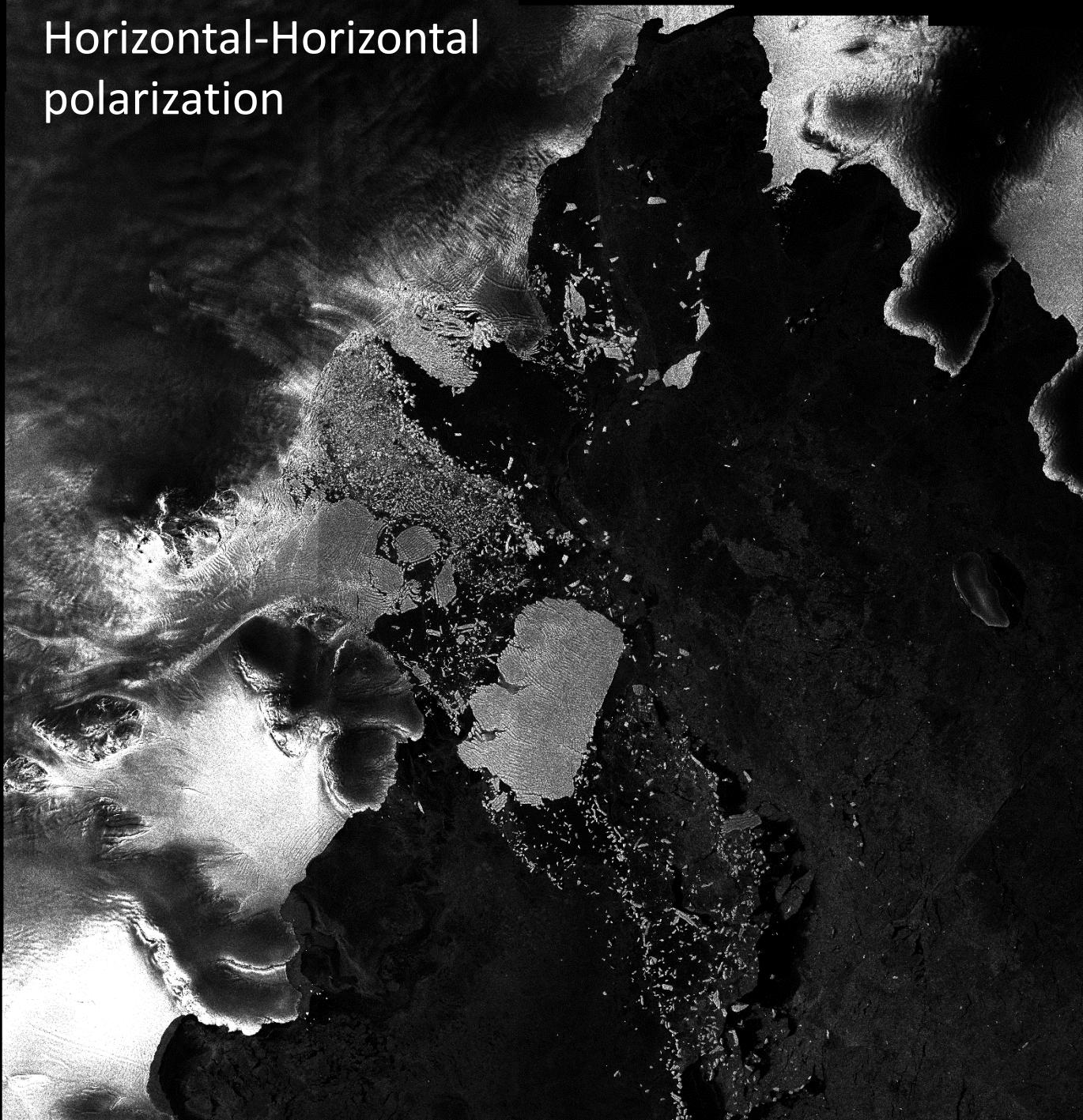




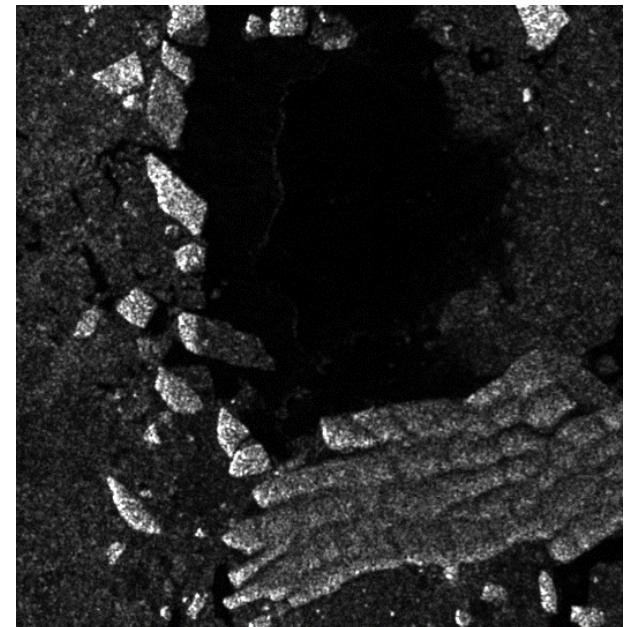
Drawing not to scale

Source: International Thwaites Glacier Collaboration

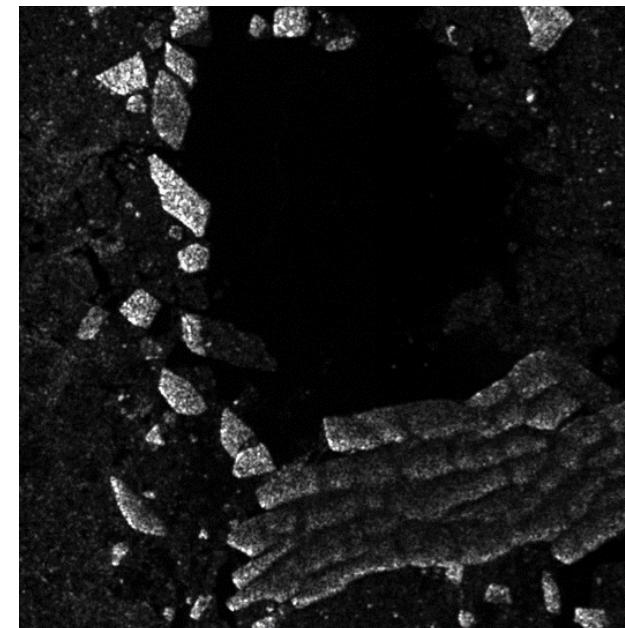
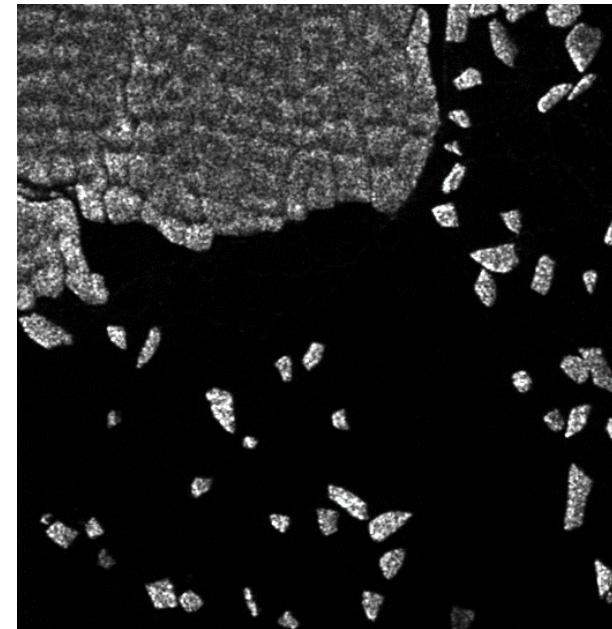
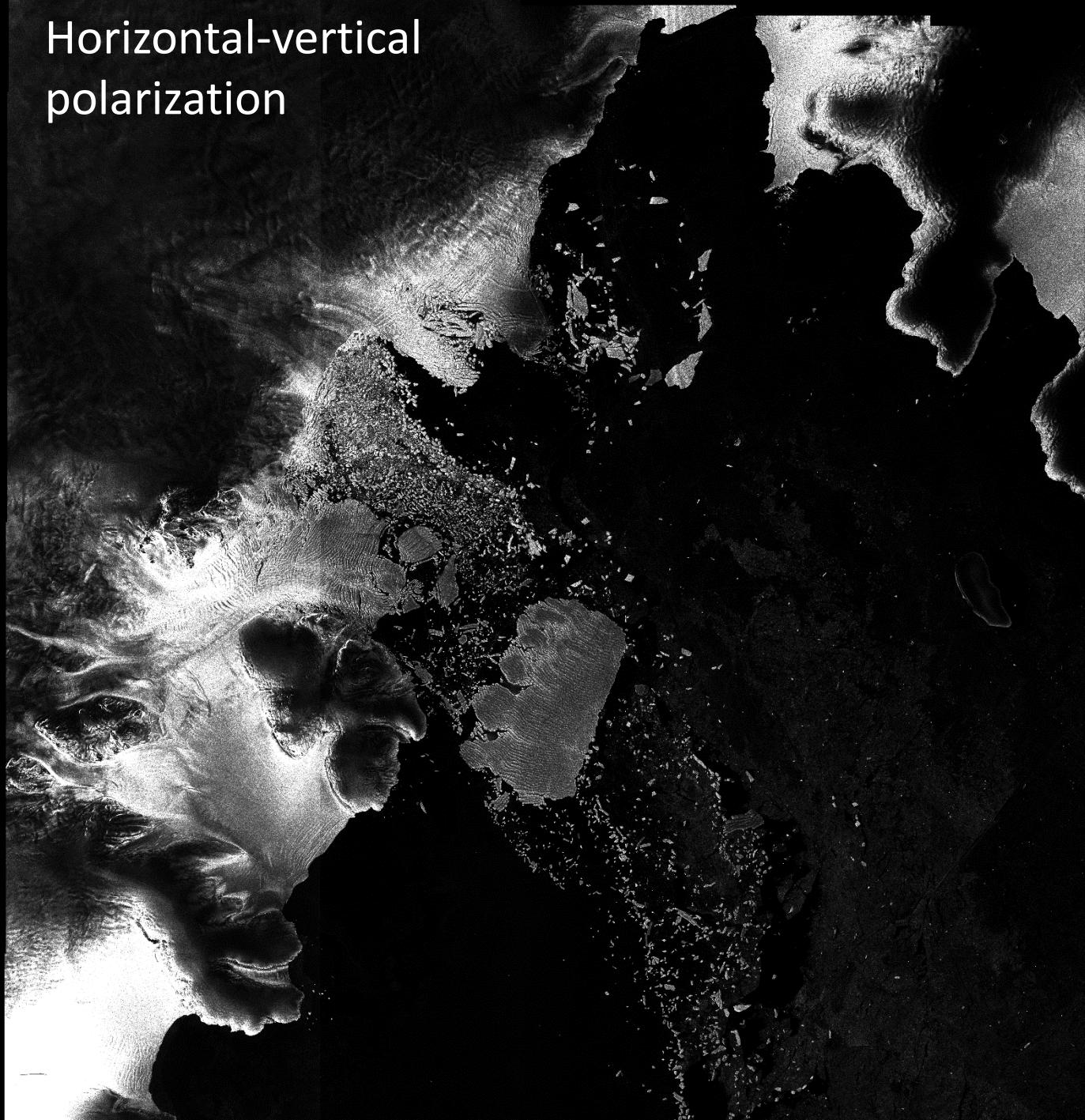
Horizontal-Horizontal  
polarization



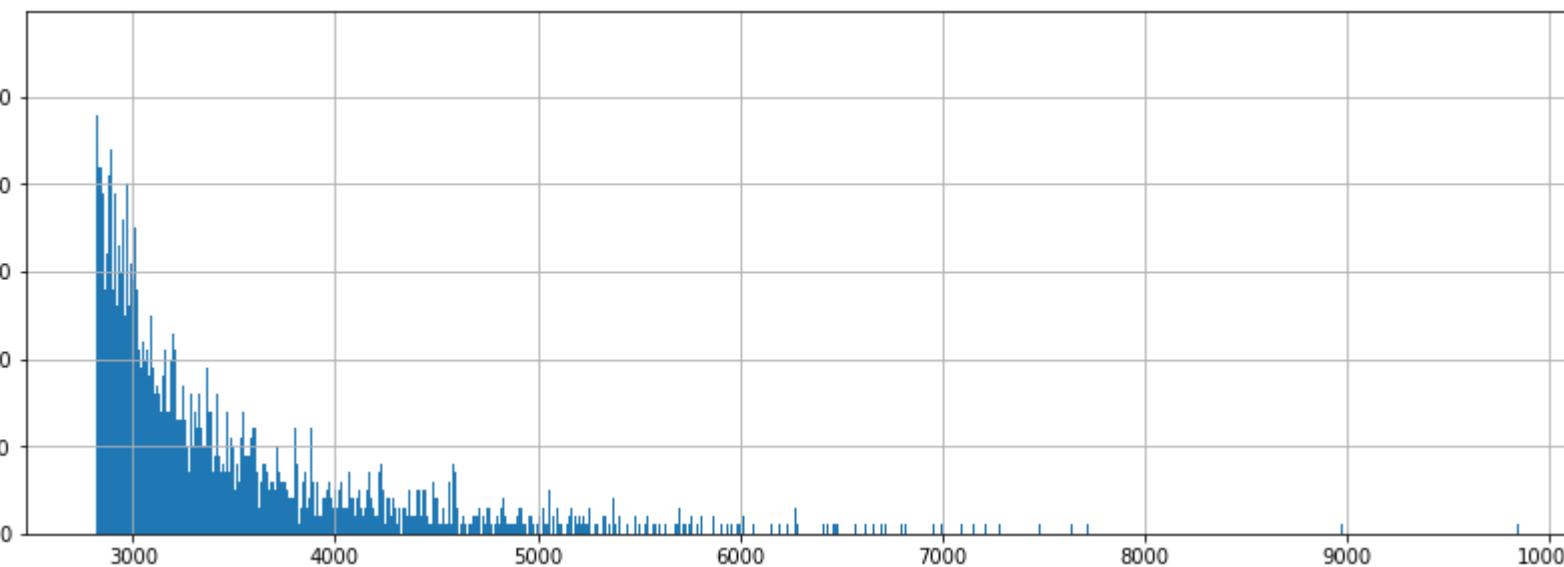
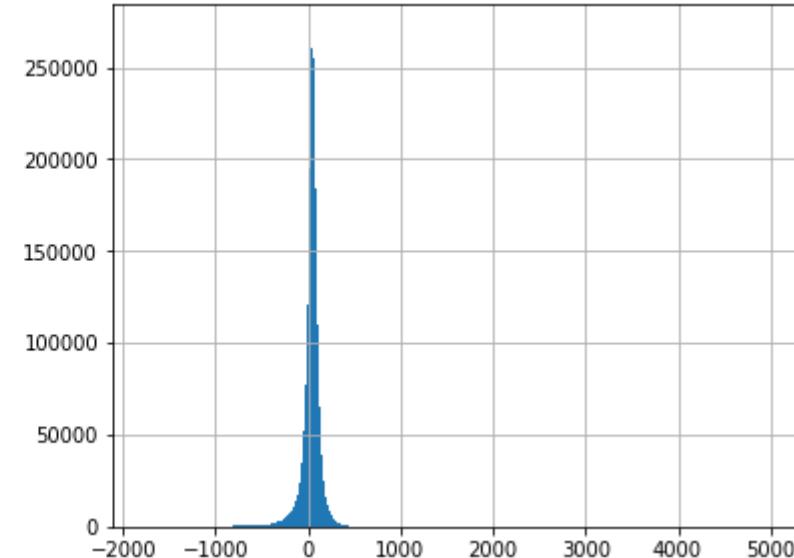
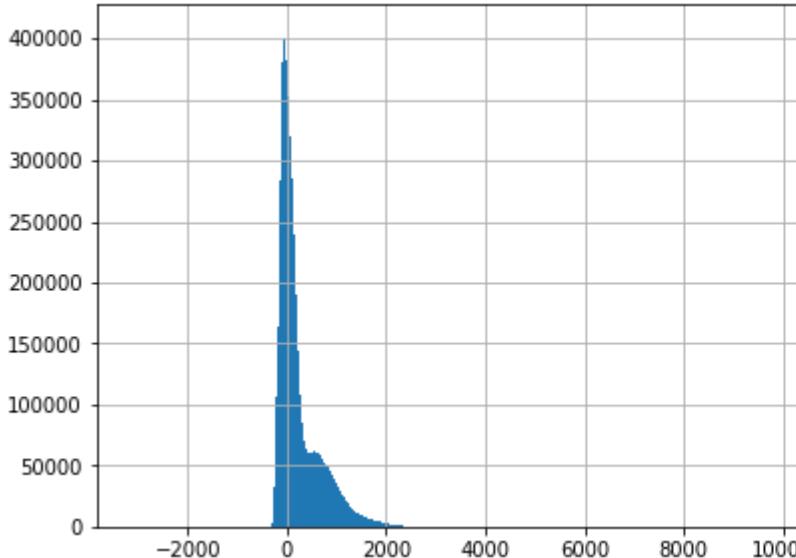
10862 x 10518  
pixels



Horizontal-vertical  
polarization

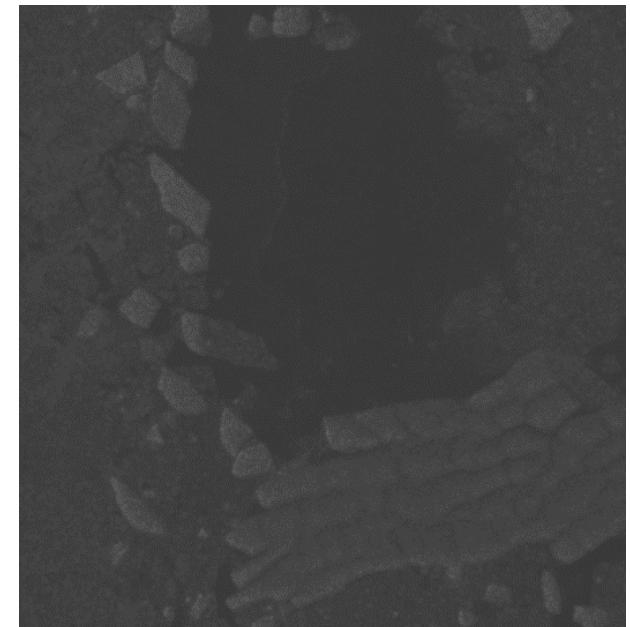
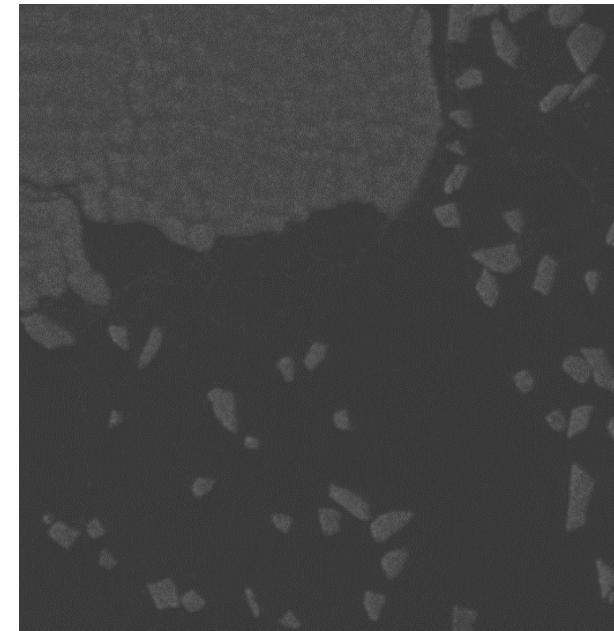


# Principal components



Training on  
0.1% of the data

# First principal component



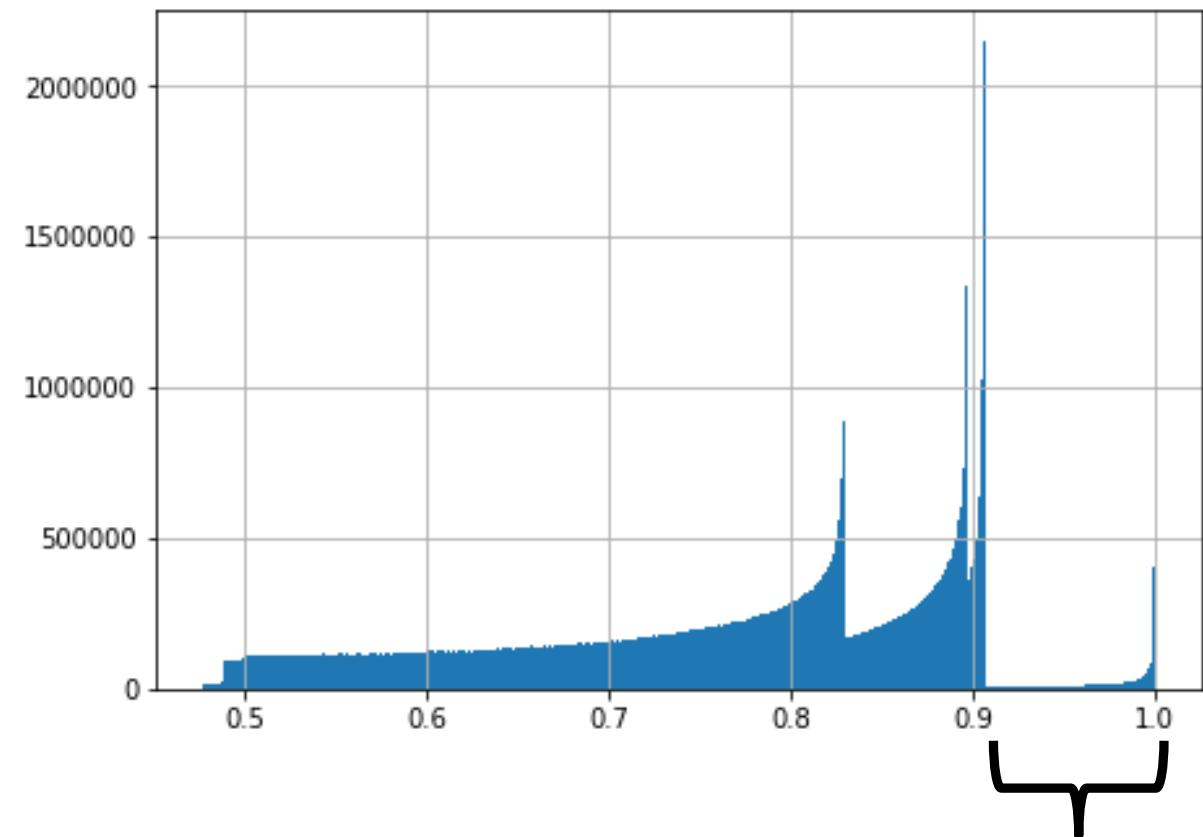


Cluster pixels into four components:

- open water
- sea ice
- ambiguous
- iceberg

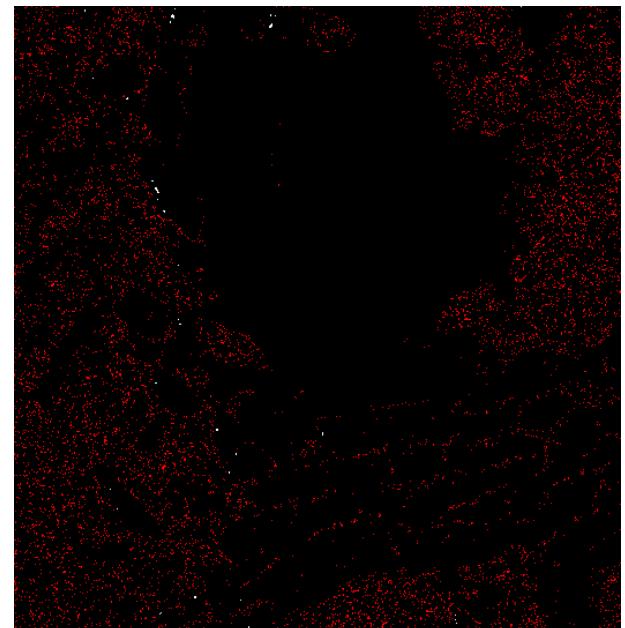
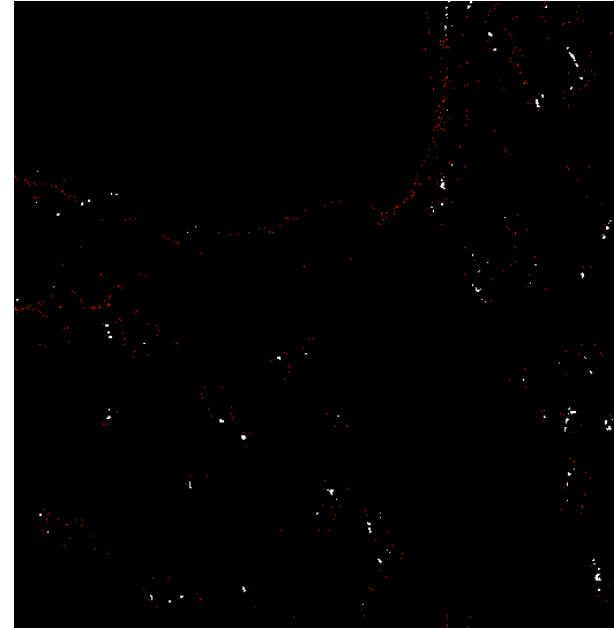
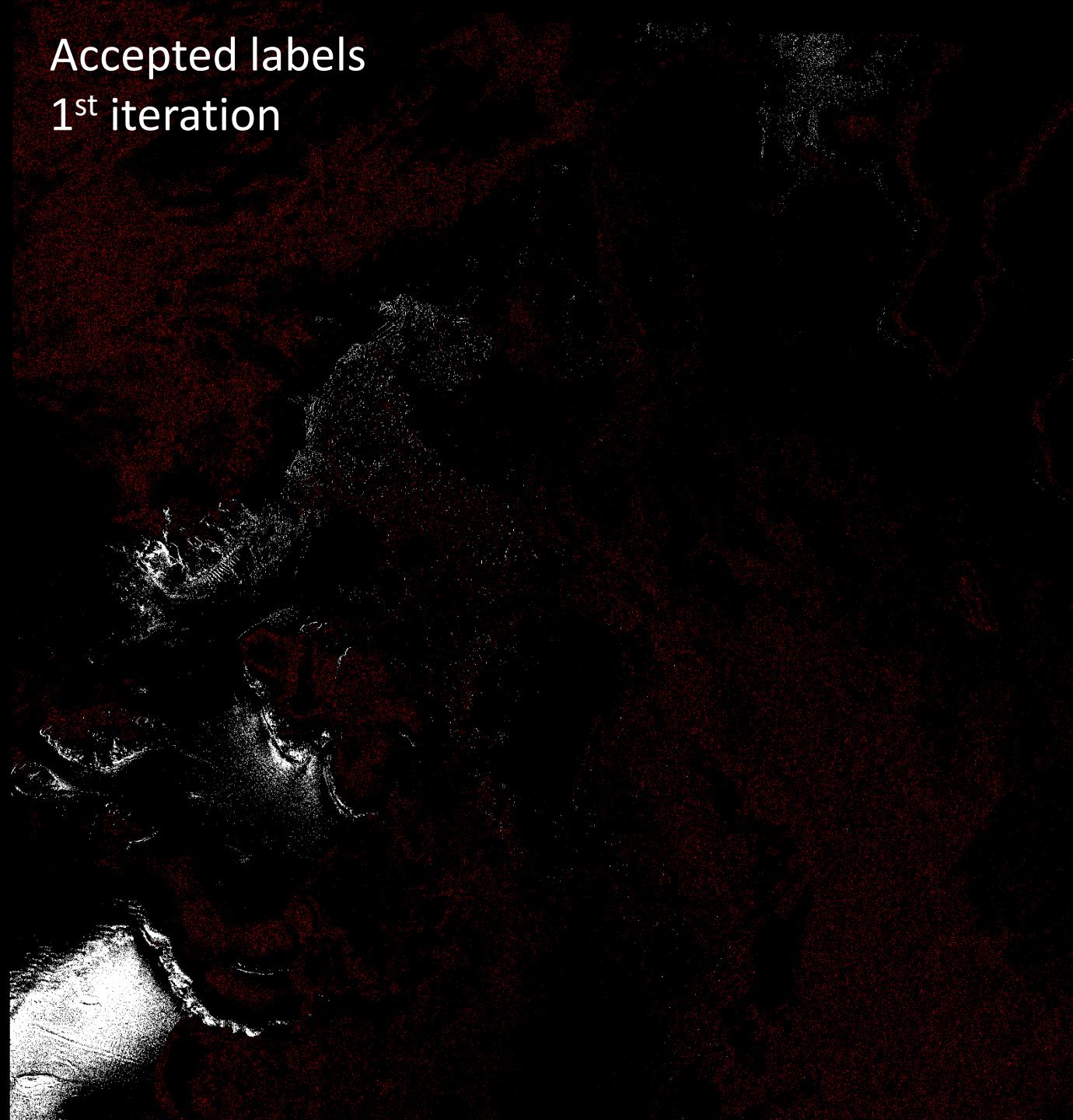
Note: Assignment probabilities are **not** confidence levels. They only mean that **within the given model** a pixel belongs to a particular cluster with this probability.

## Histogram of maximum assignment probabilities

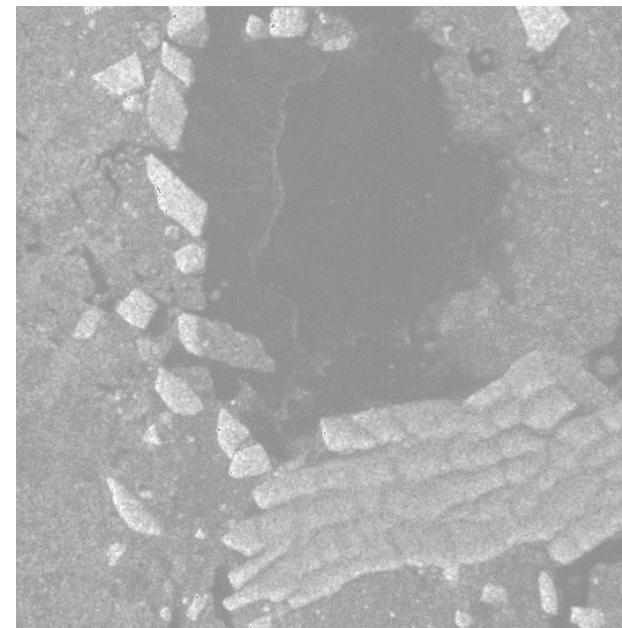
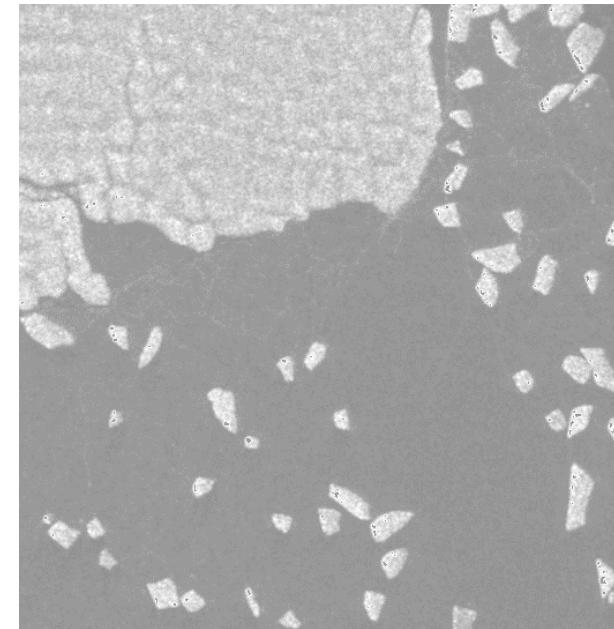


Accept labels  
~3%

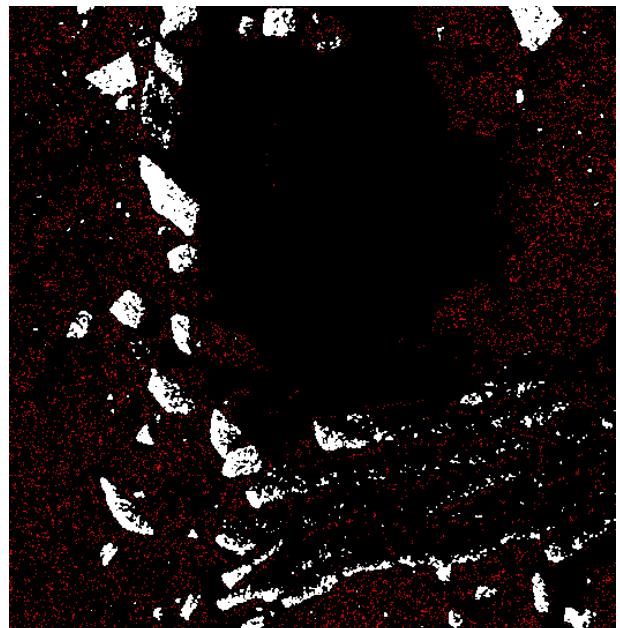
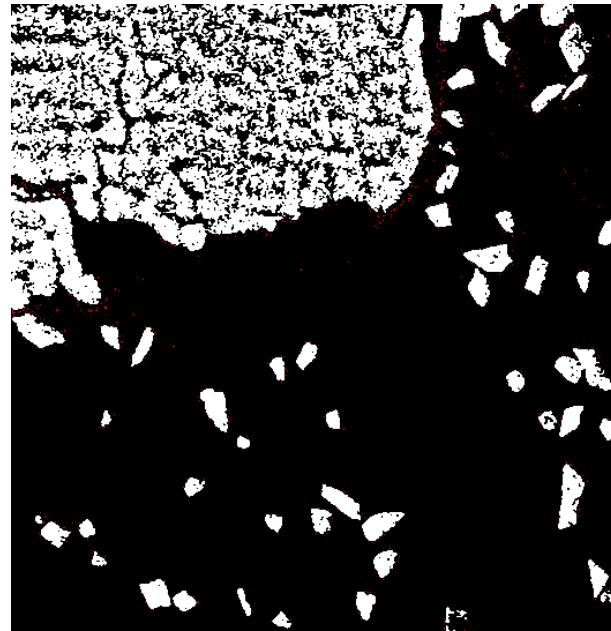
Accepted labels  
1<sup>st</sup> iteration



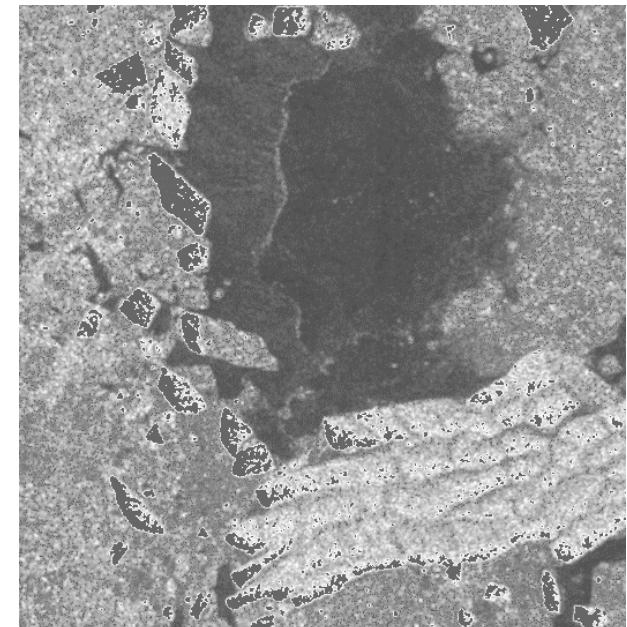
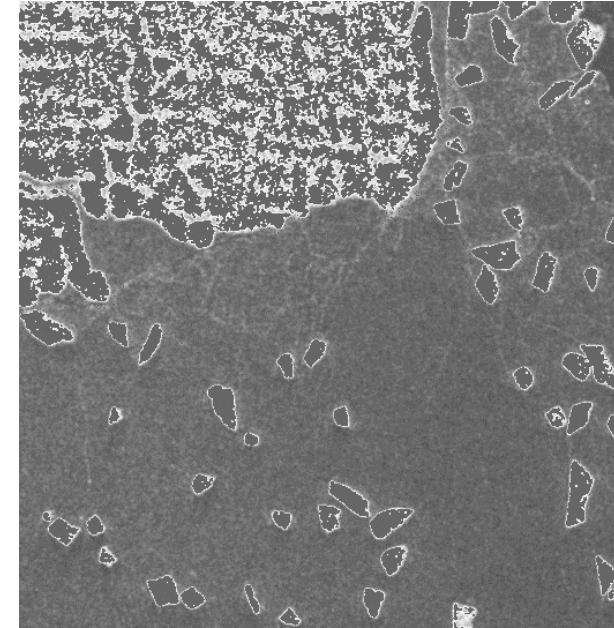
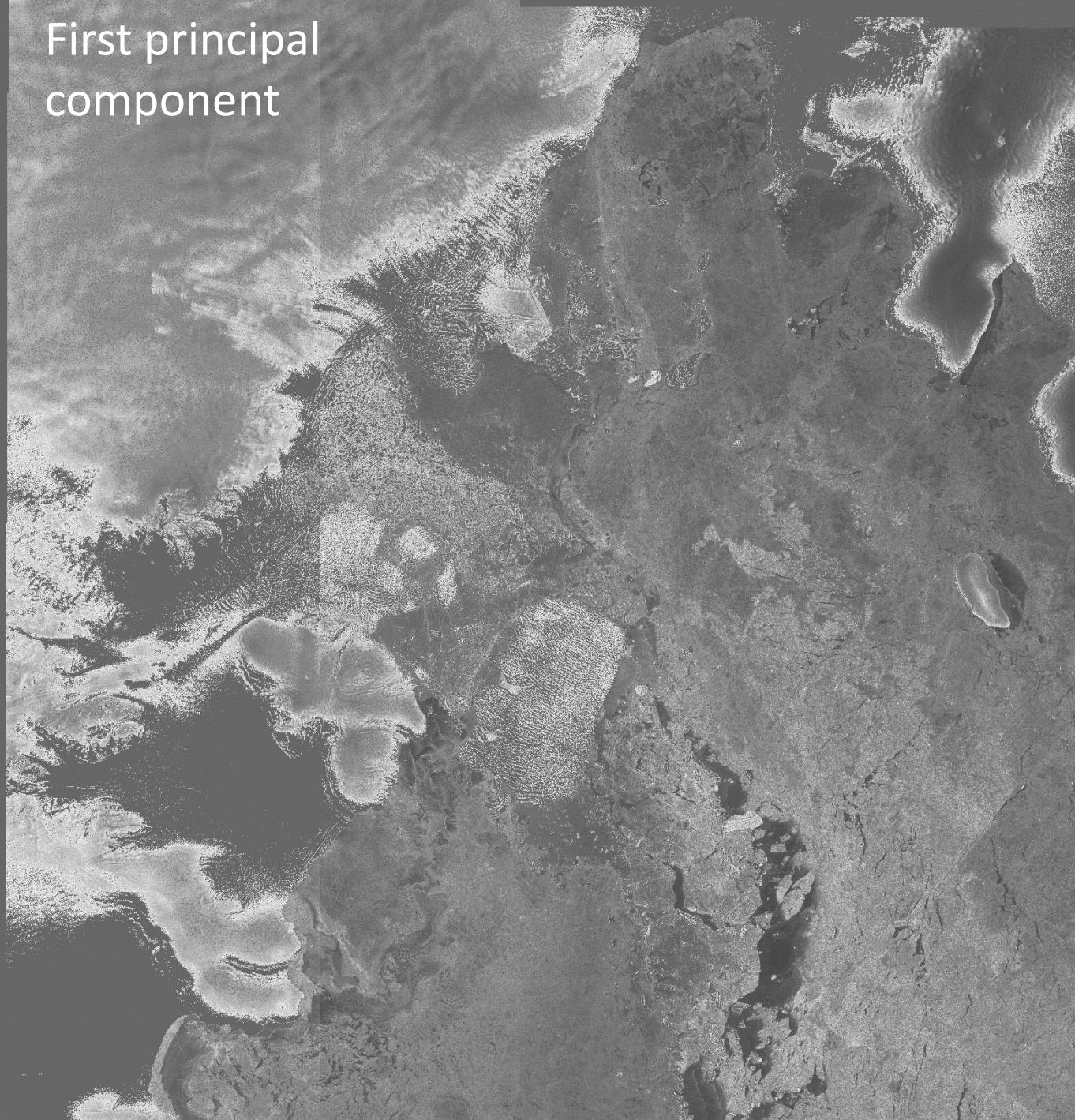
# First principal component



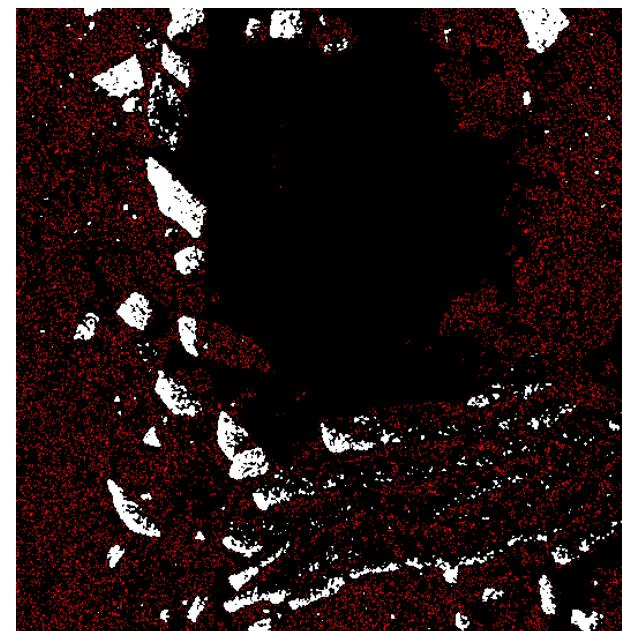
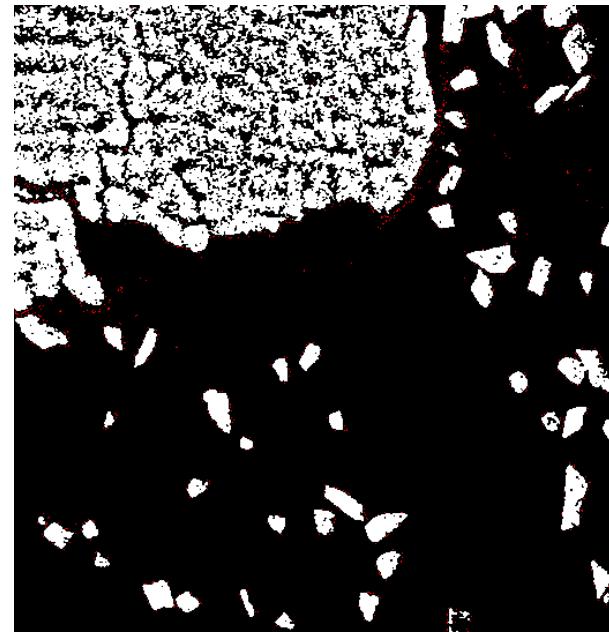
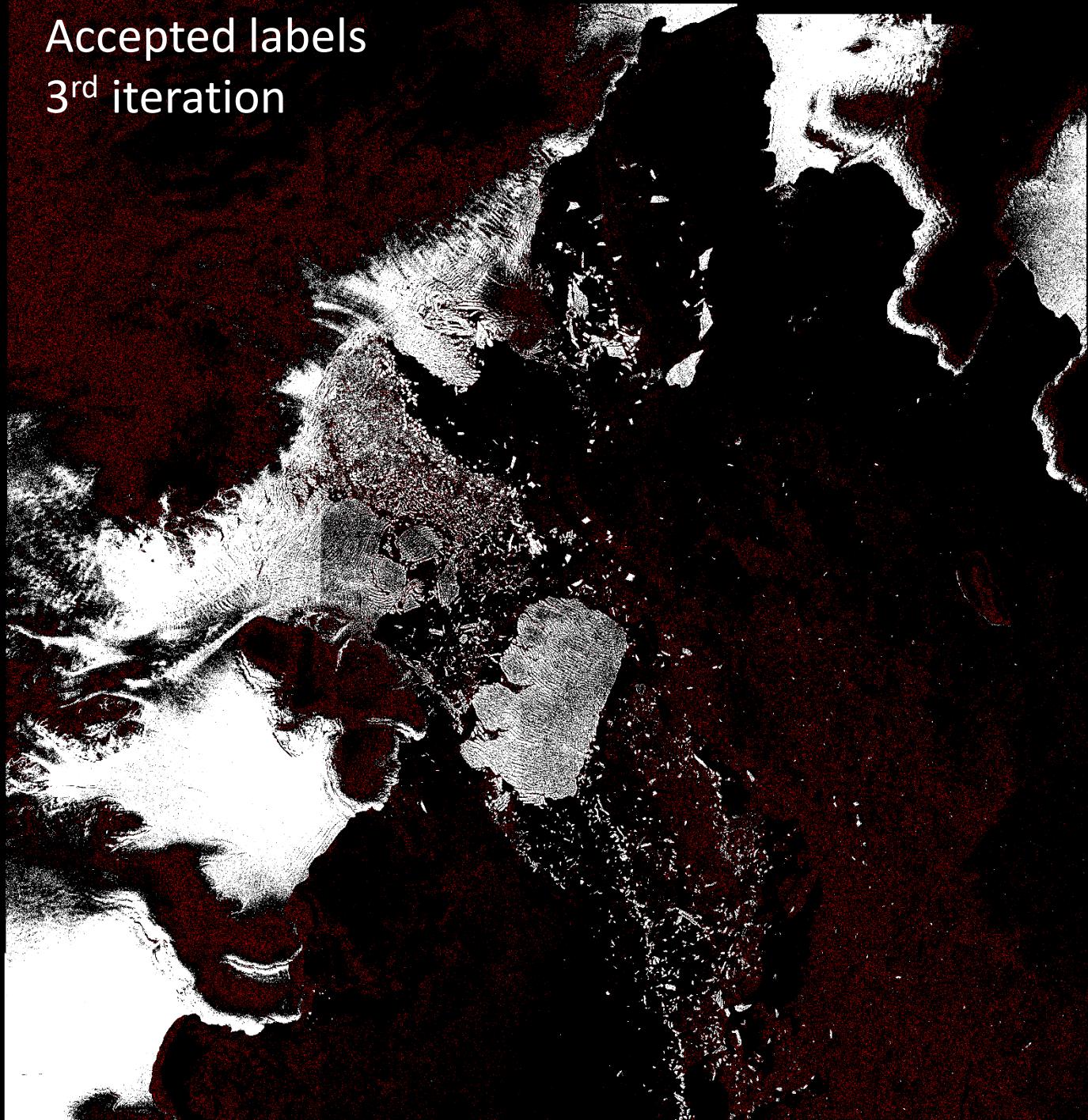
Accepted labels  
2<sup>nd</sup> iteration



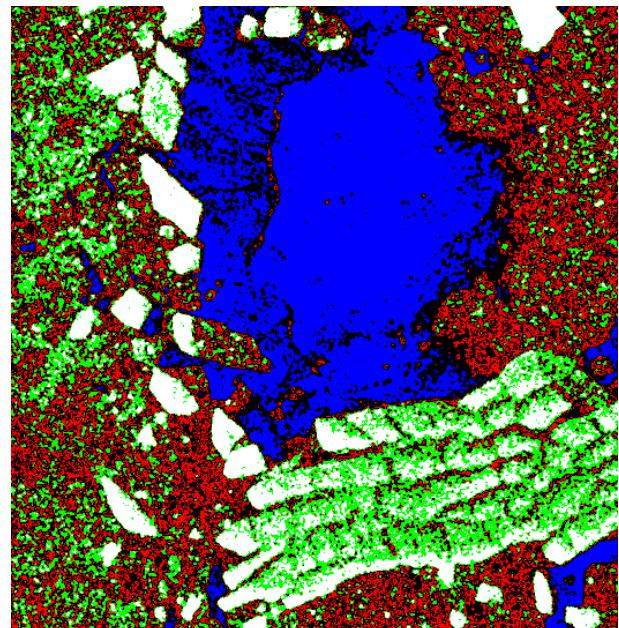
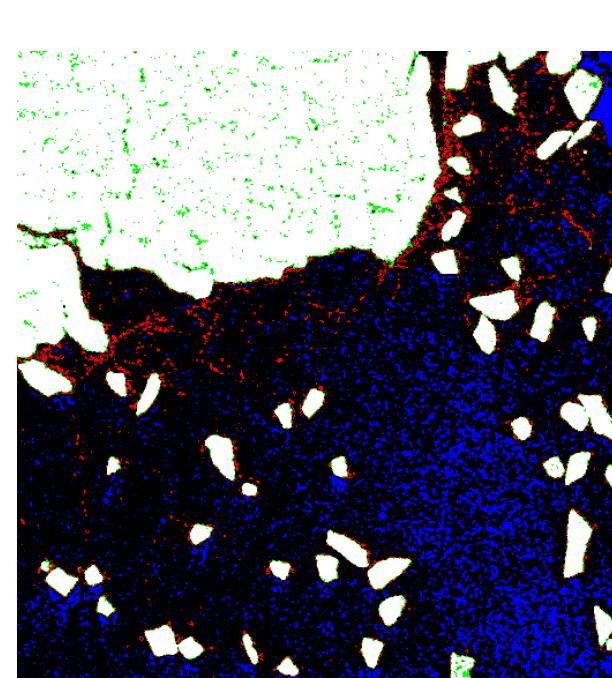
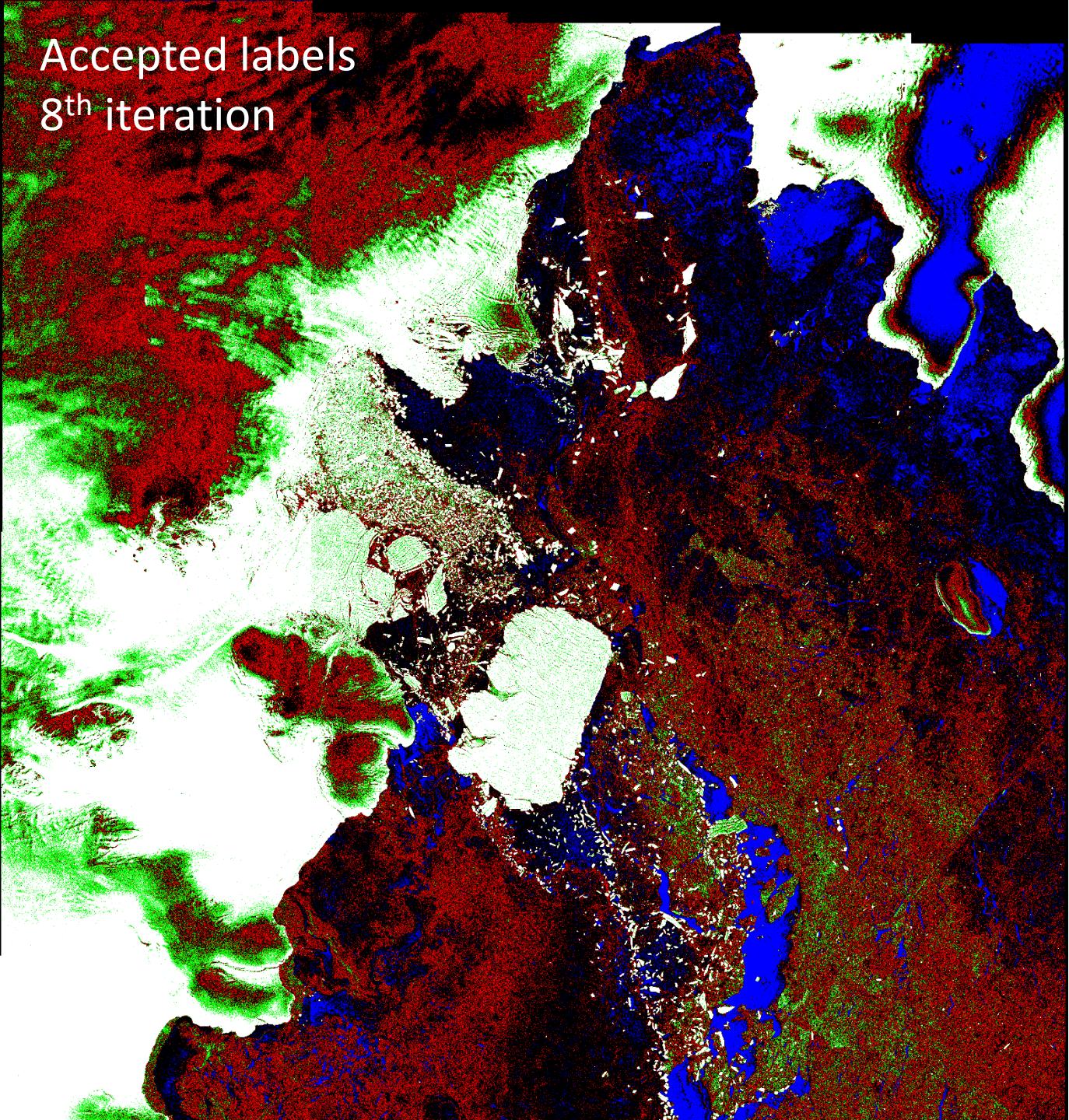
First principal component



Accepted labels  
3<sup>rd</sup> iteration



Accepted labels  
8<sup>th</sup> iteration



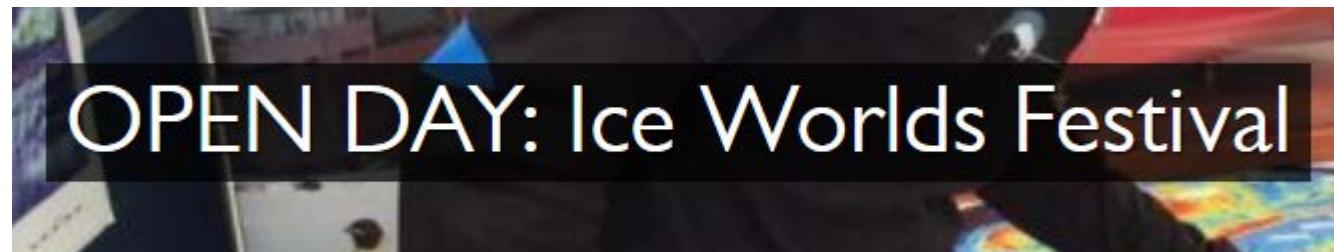
# Upcoming events



Meet your friendly neighbourhood climate scientists

<https://www.bas.ac.uk/event/meet-your-friendly-neighbourhood-climate-scientists-2/>

**Start**  
March 17 @ 6:00 pm  
**End**  
March 17 @ 7:30 pm  
**Venue**  
Aurora Cambridge  
**Address**  
High Cross, Madingley Road,  
Cambridge, CB3 OET



<https://www.bas.ac.uk/event/coming-soon-ice-worlds-festival-of-science-and-engineering/>

**Start**  
March 21 @ 10:00 am  
**End**  
March 21 @ 4:00 pm  
**Venue**  
British Antarctic Survey, Cambridge  
**Address**  
High Cross, Madingley Road,  
Cambridge, Cambridgeshire CB3  
0ET United Kingdom