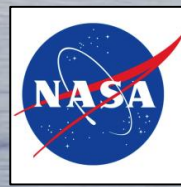
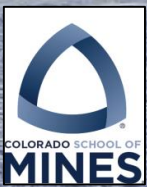


# Application of a new polar Landsat SST algorithm in West Antarctica

T. Snow (ESSIC), A. Harris (ESSIC), T. Scambos (CIRES), S. Grigsby (CIRES), E. Abrahams (Stanford), F. Pérez (Berkeley), E. Savidge (Mines), C. Shuman (UMBC), W. Abdalati (CIRES), M. Siegfried (Mines)



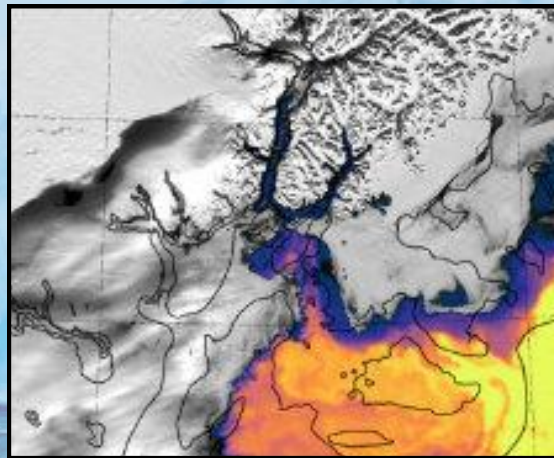


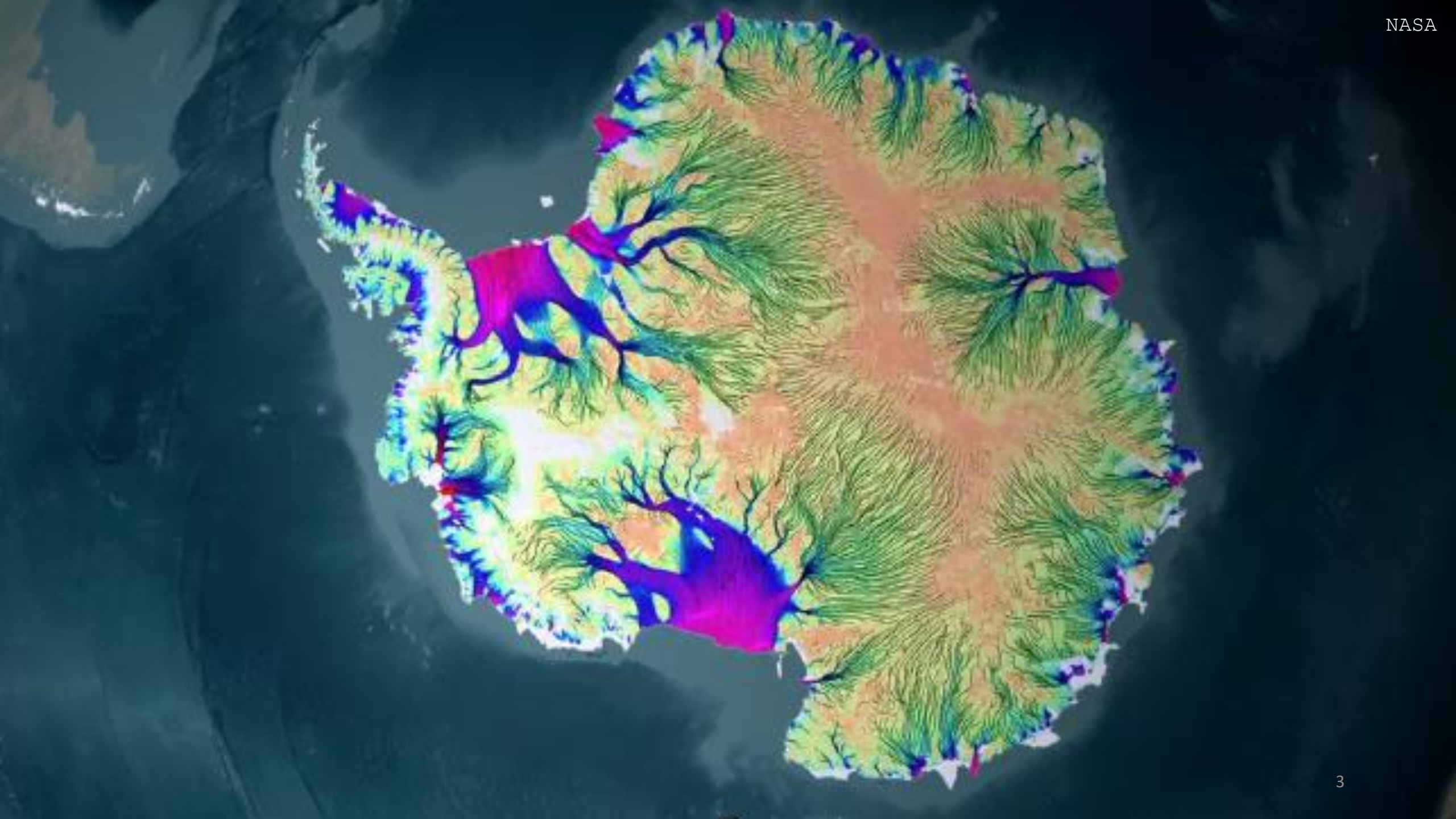
# New Landsat 8 algorithm & applications

Why SST to study ice-ocean interactions in Antarctica?

Landsat 8 single-channel SST algorithm

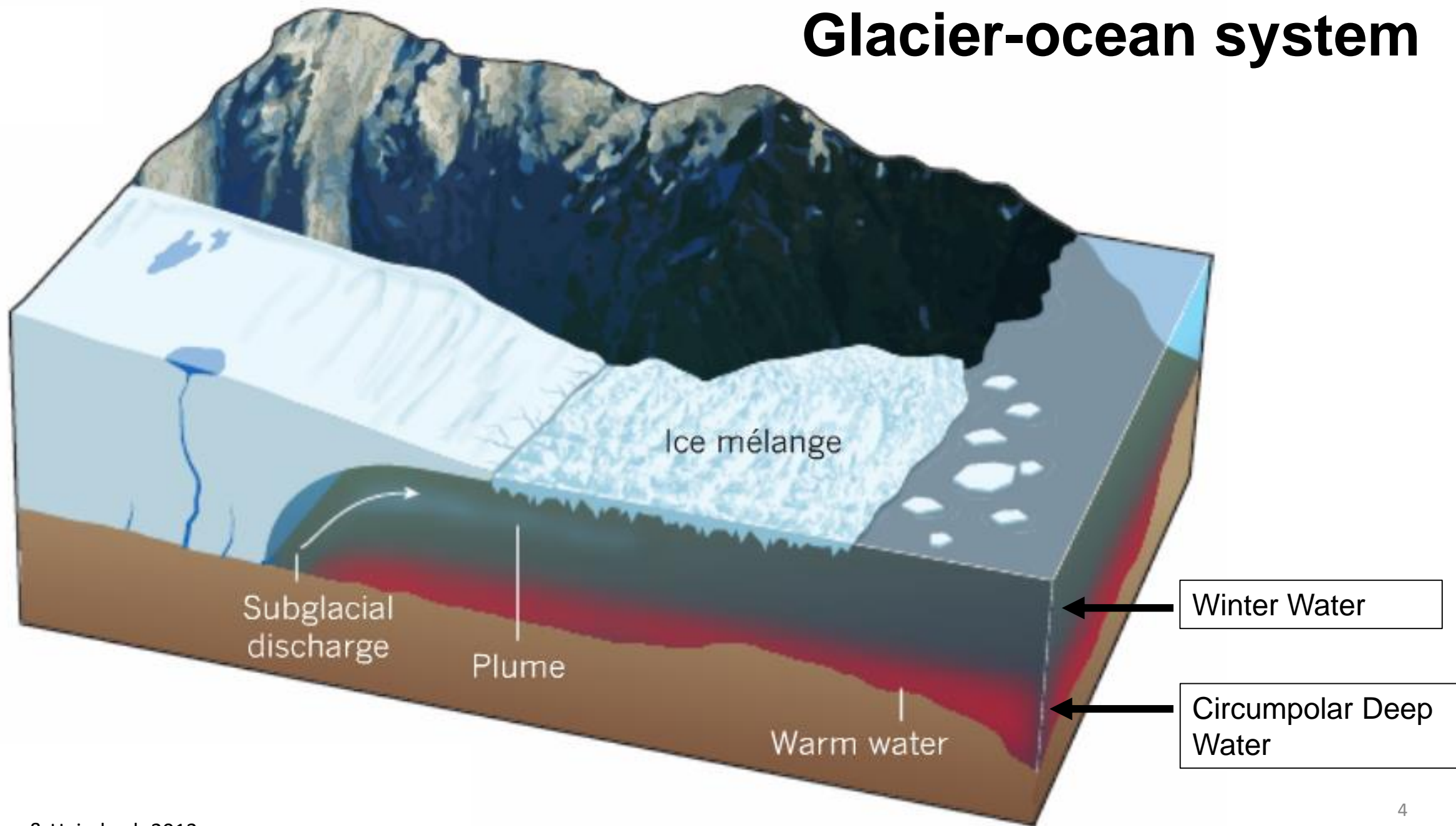
Surface circulation and variability from SST

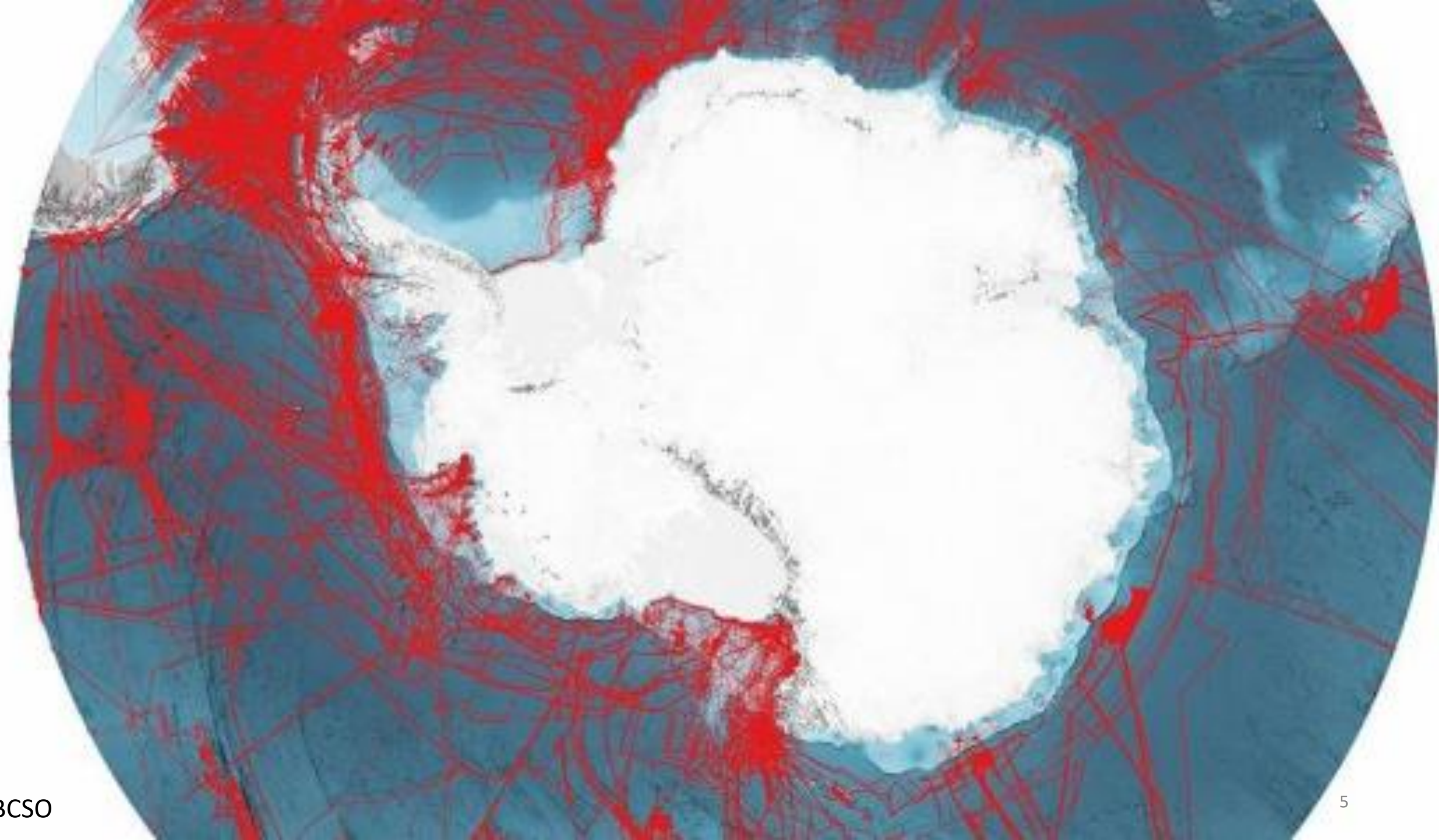






# Glacier-ocean system



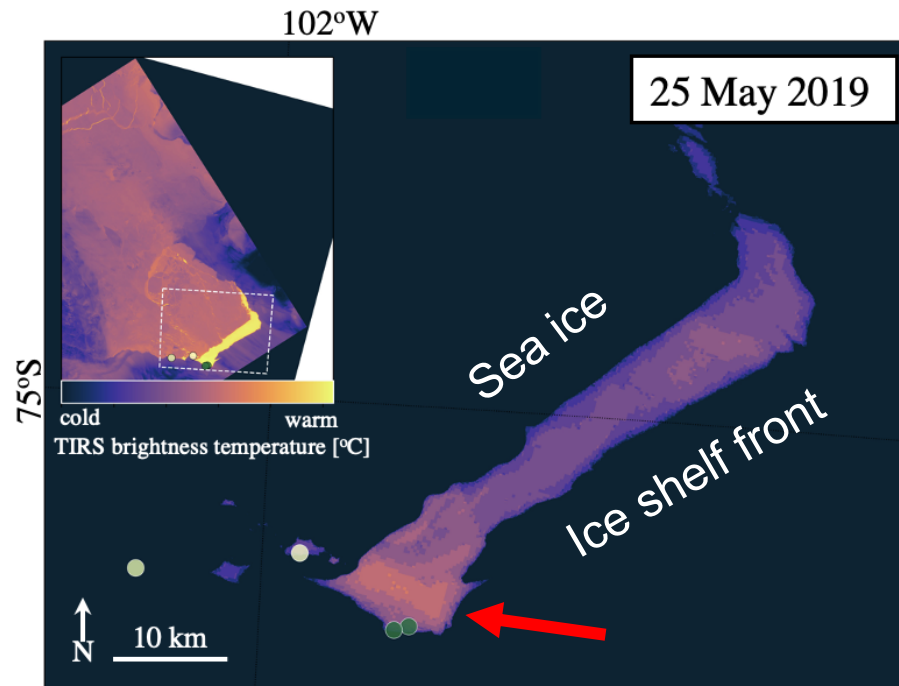




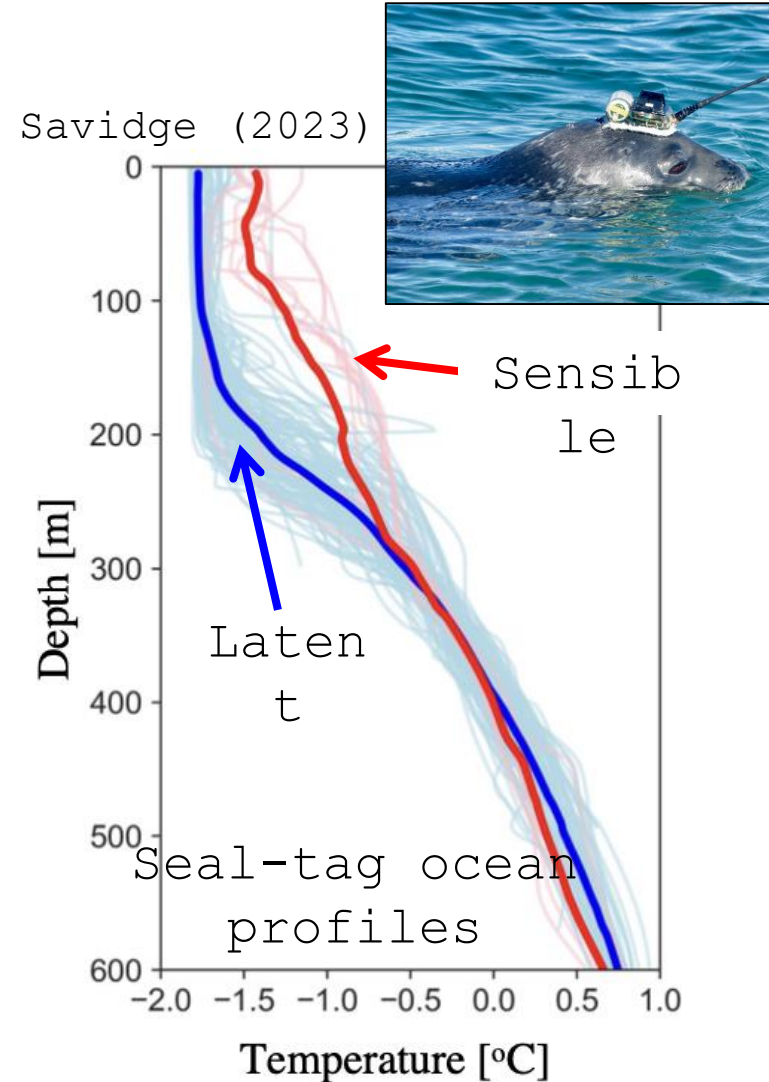
# Thermal infrared shows sensible heat polynyas within a latent heat polynya



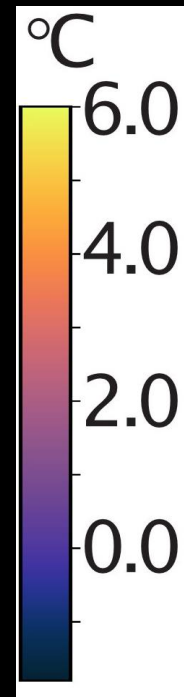
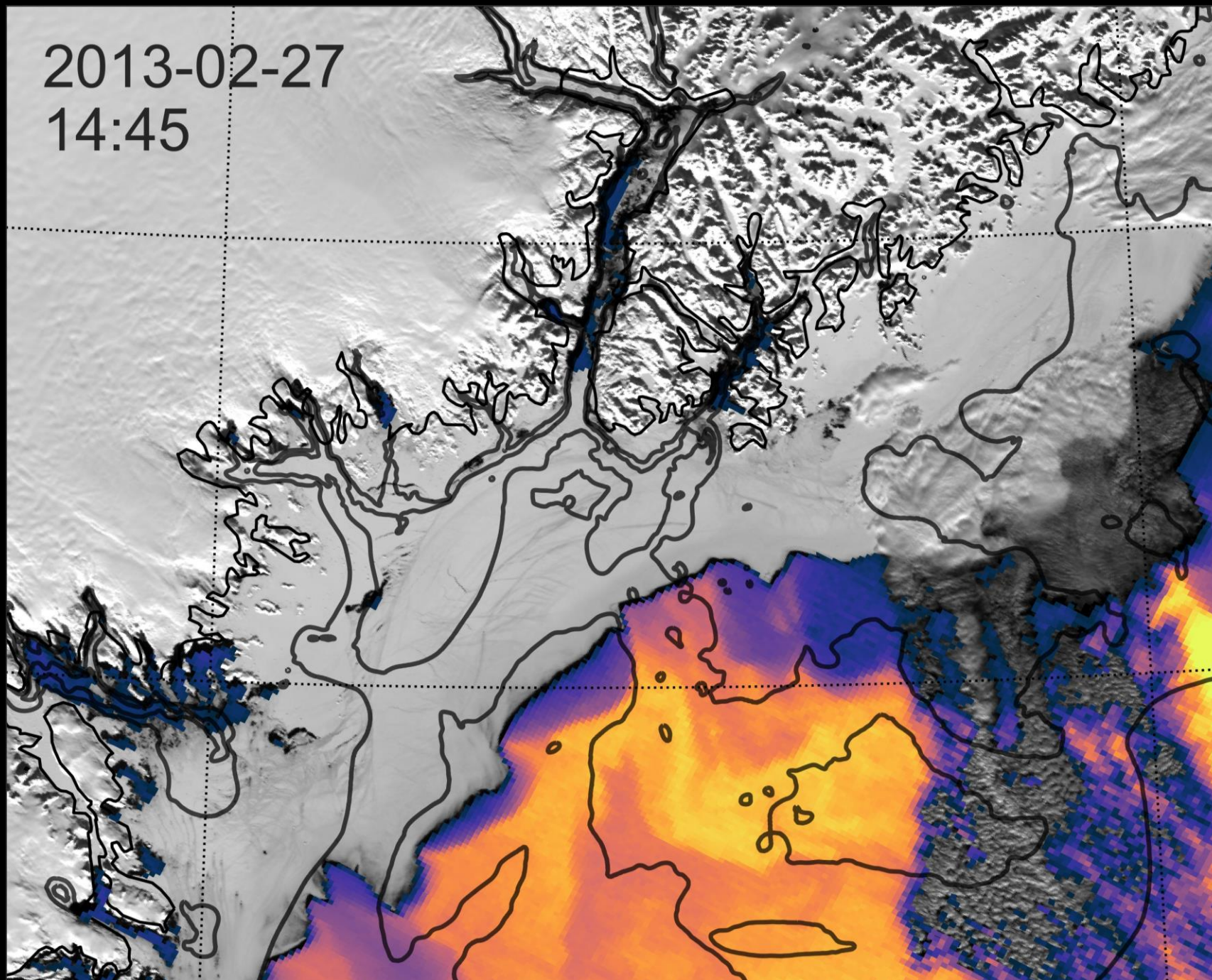
Elena Savidge



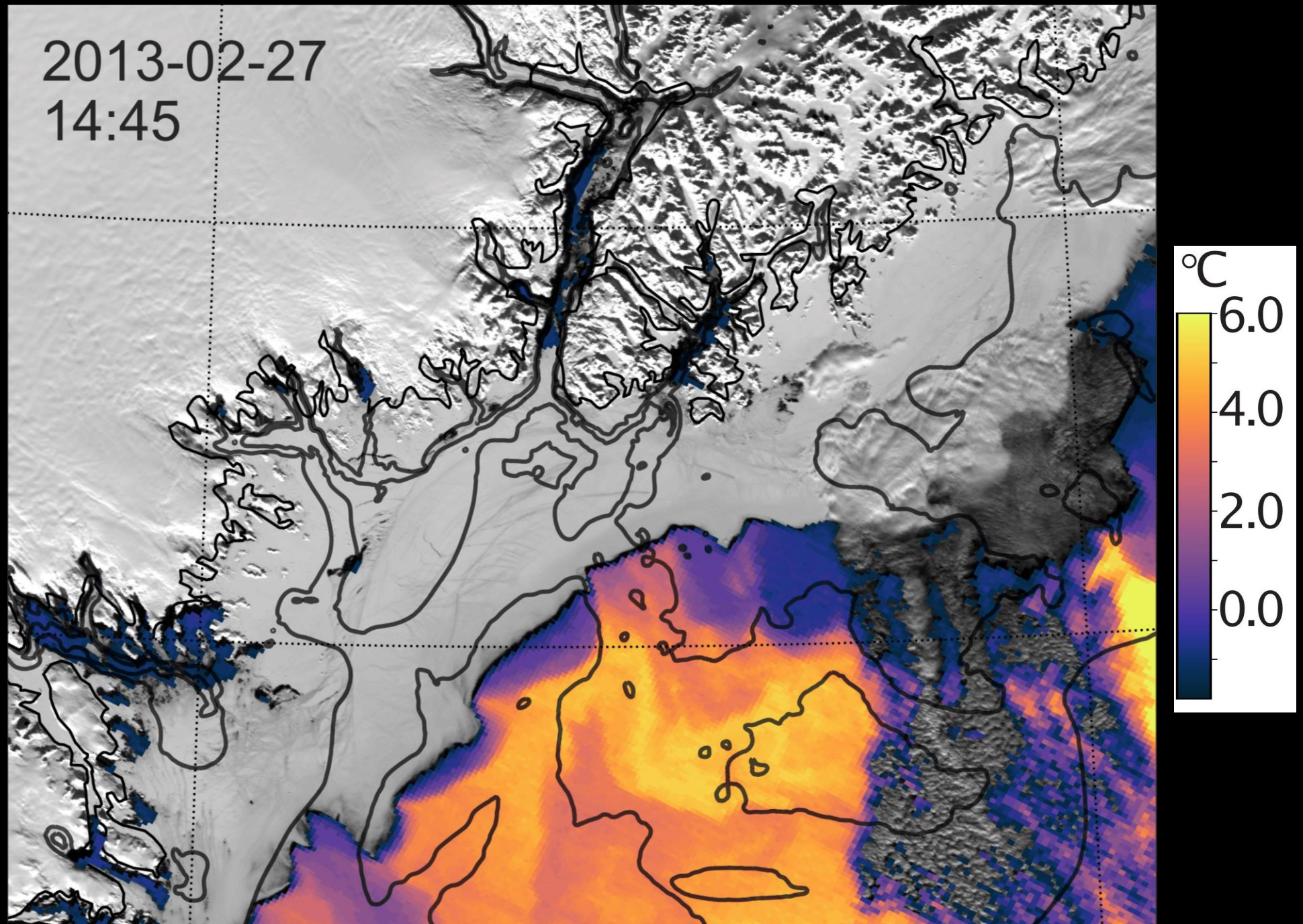
Landsat satellite thermal



2013-02-27  
14:45

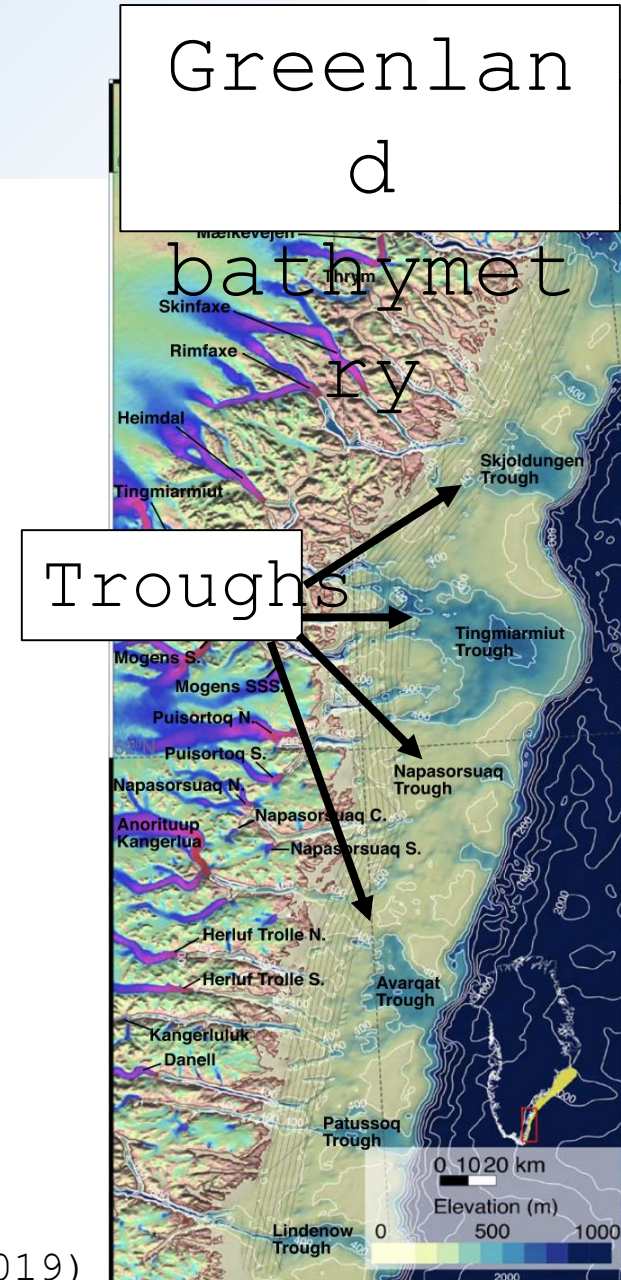
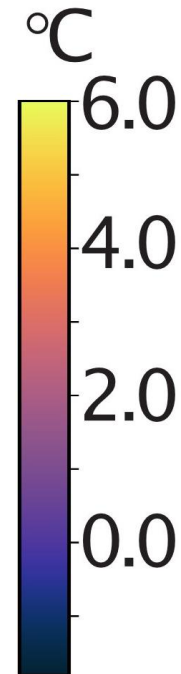
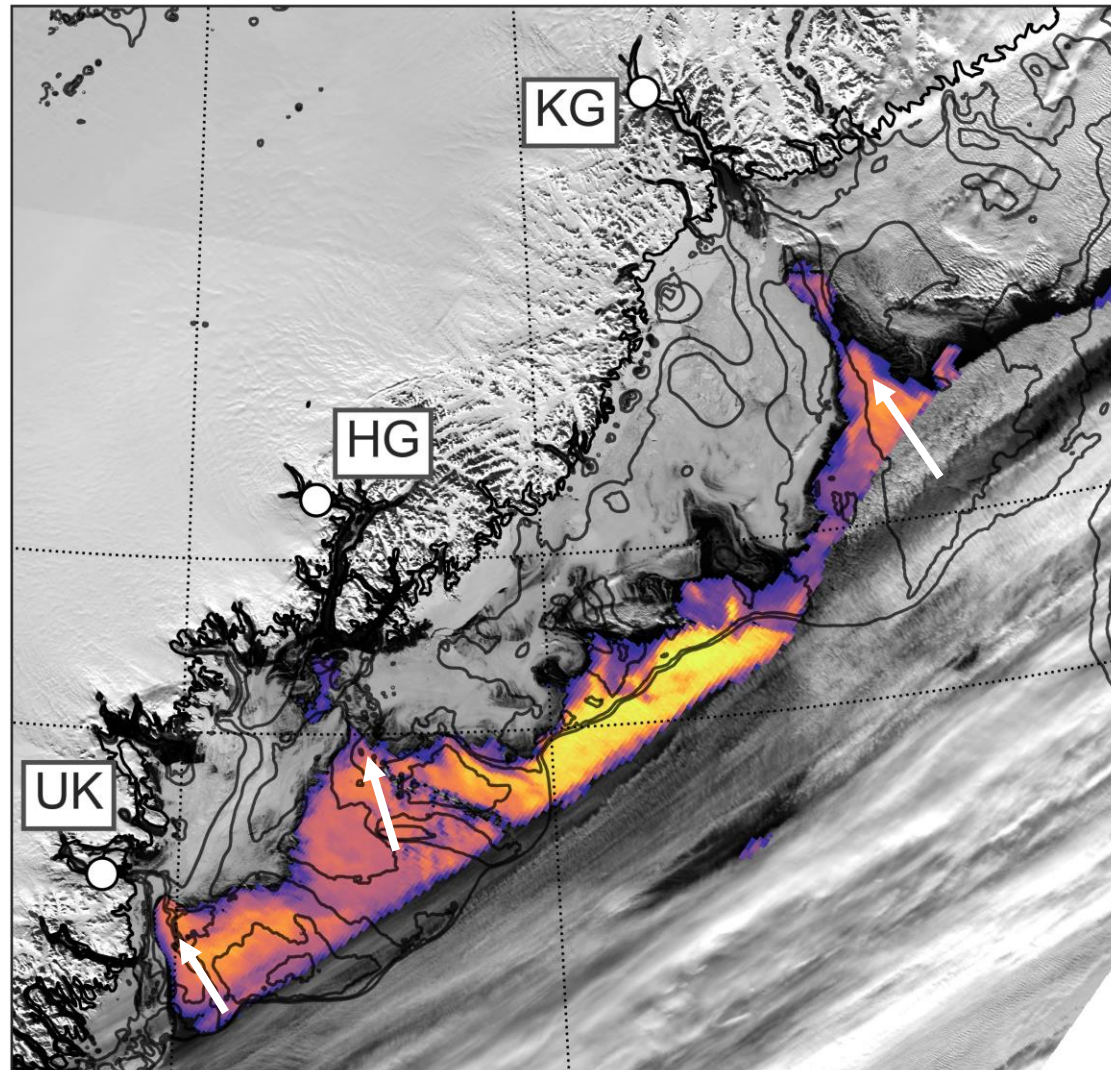








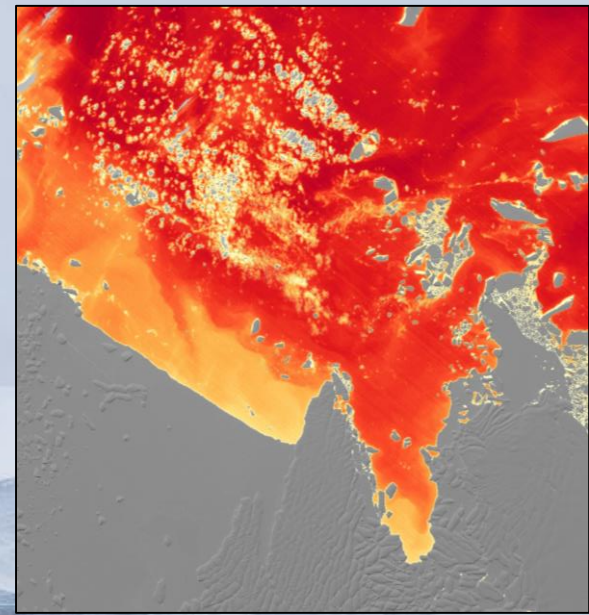
# Intrusions drive warm AW inshore and warm subsurface waters along troughs



Lu An et al. (2019)



# Landsat 8 single-channel SSTs from an open cloud workflow





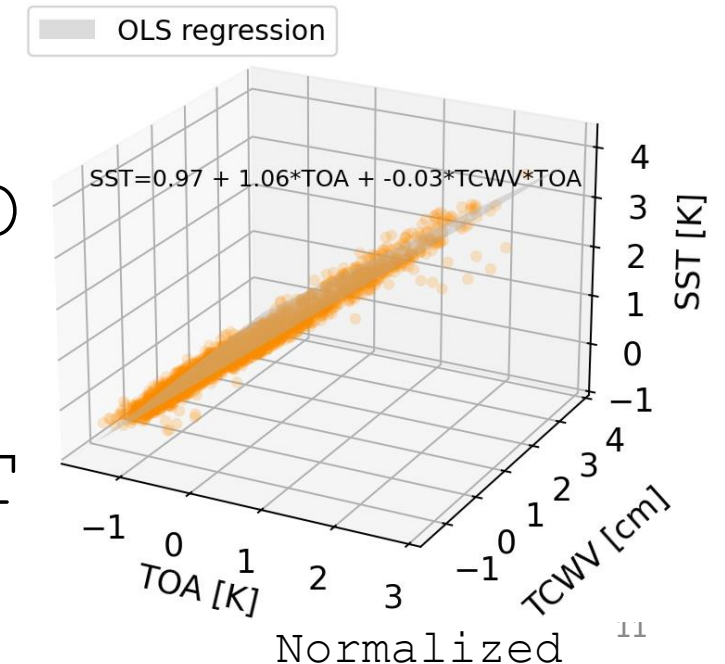
# SST retrieval with the aid of MODTRAN

$$SST = a_1 T_{11} + a_2 W_v(T_{11}) + a_0$$

Simulate monthly coefficients using ECMWF ERA-5 atmospheric profiles with total column water vapor ( $W_v$ )

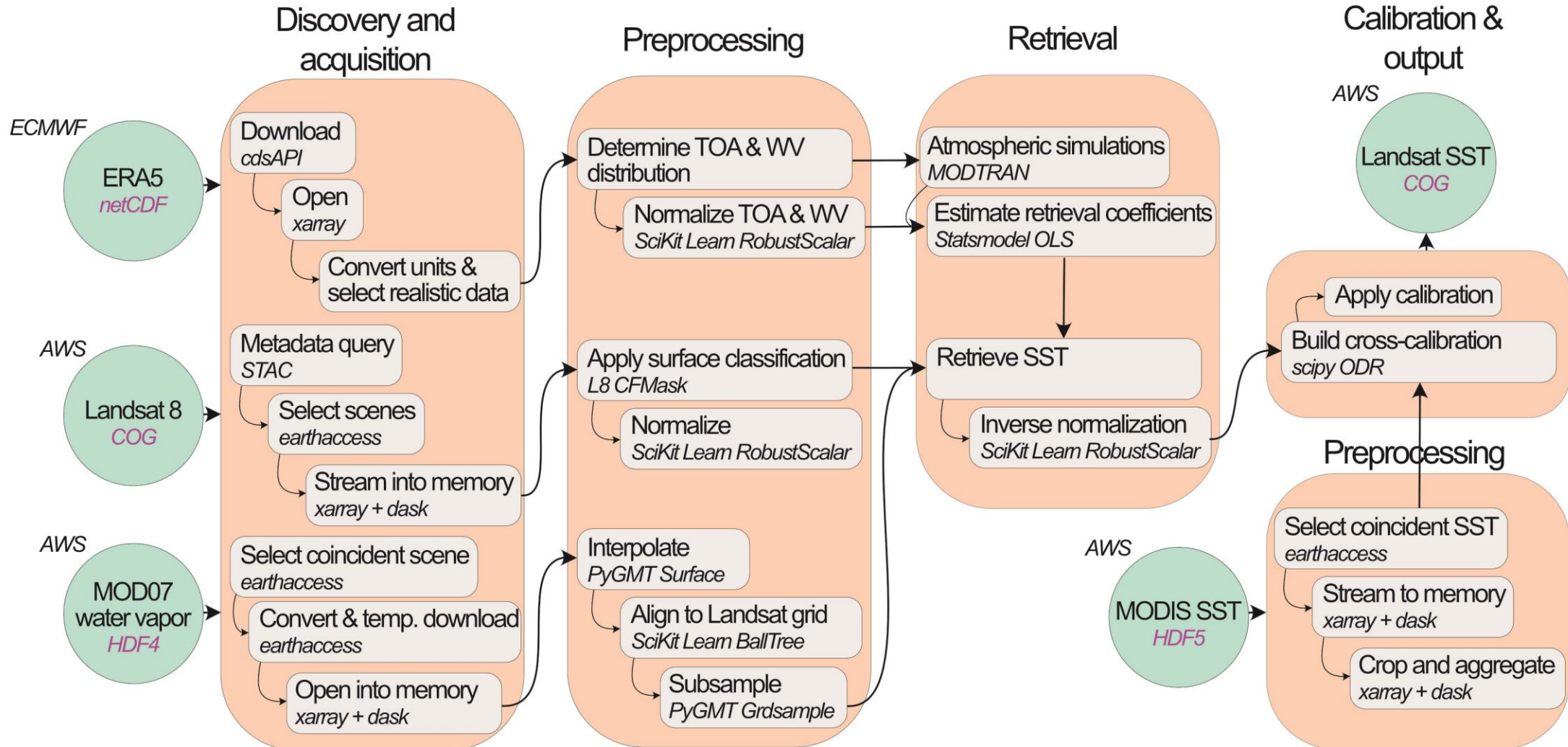
Use water vapor from closest MO (MOD09) to apply retrieval

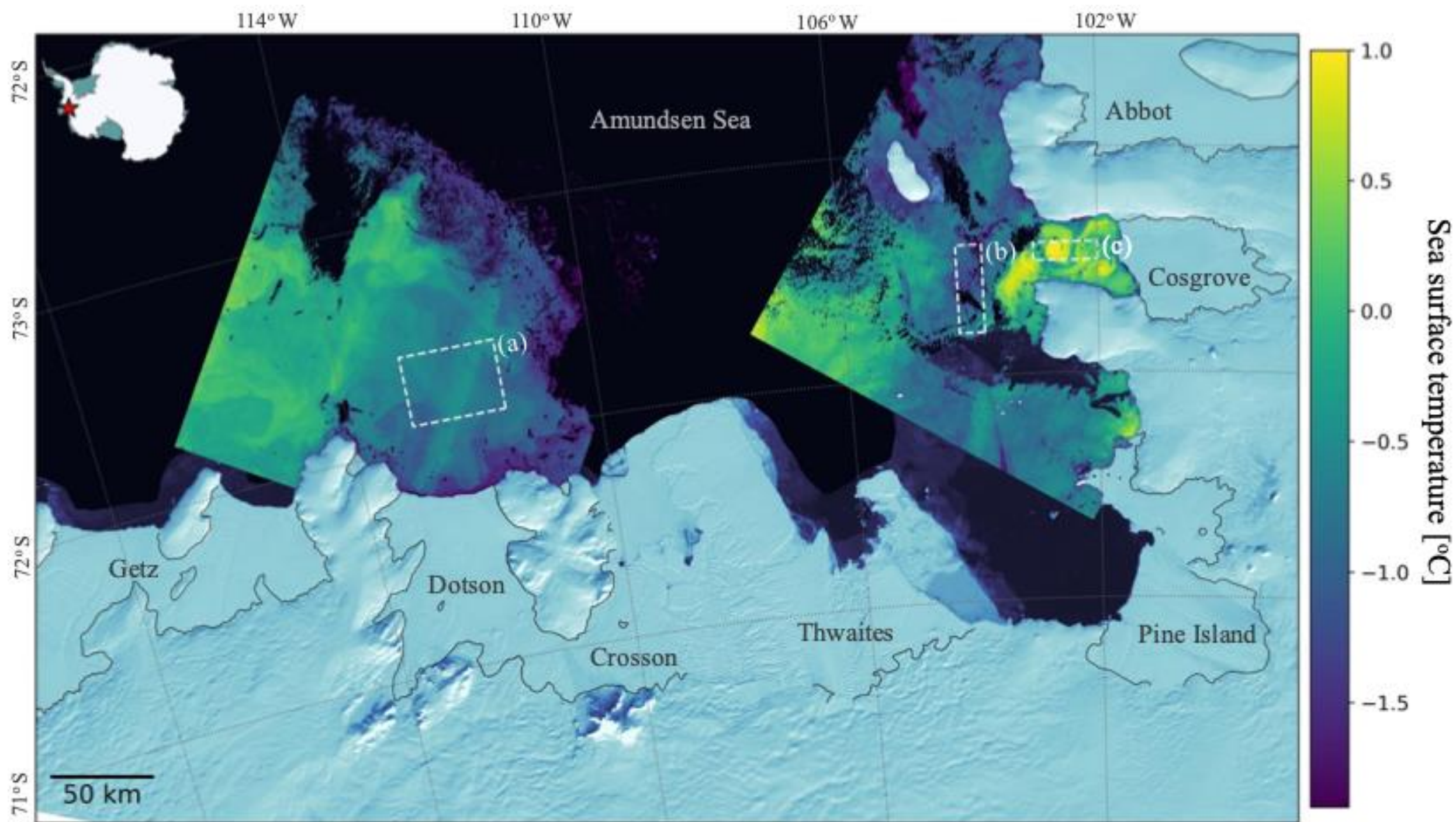
Cross-calibrate using MODIS SST





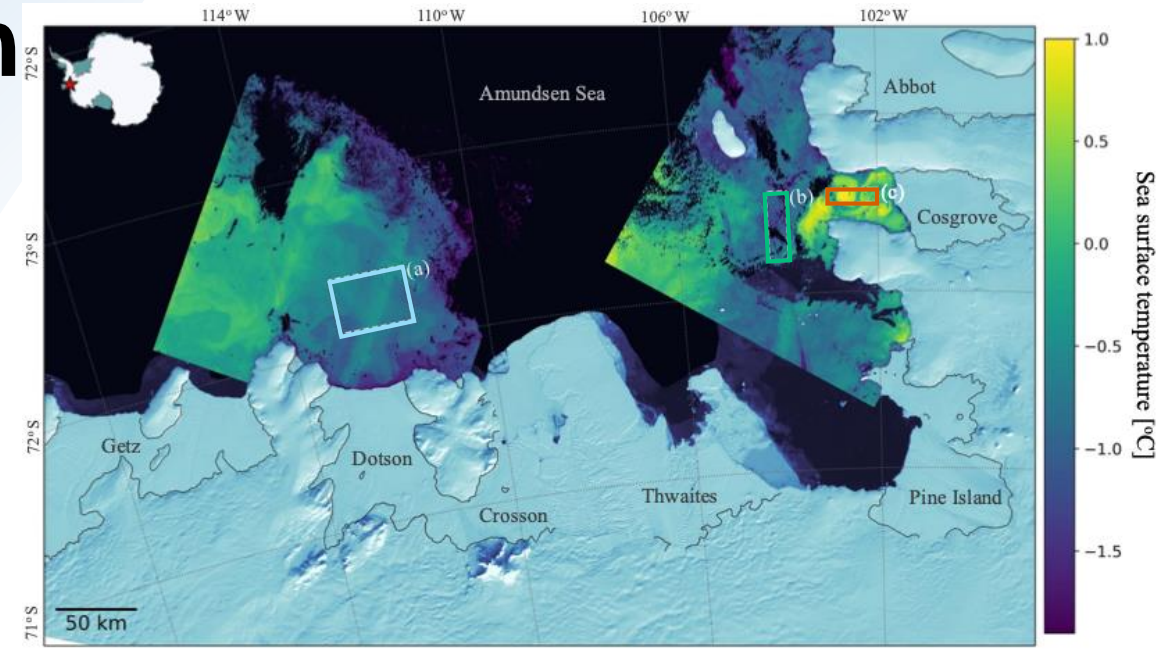
# Open-source SST retrieval pipeline





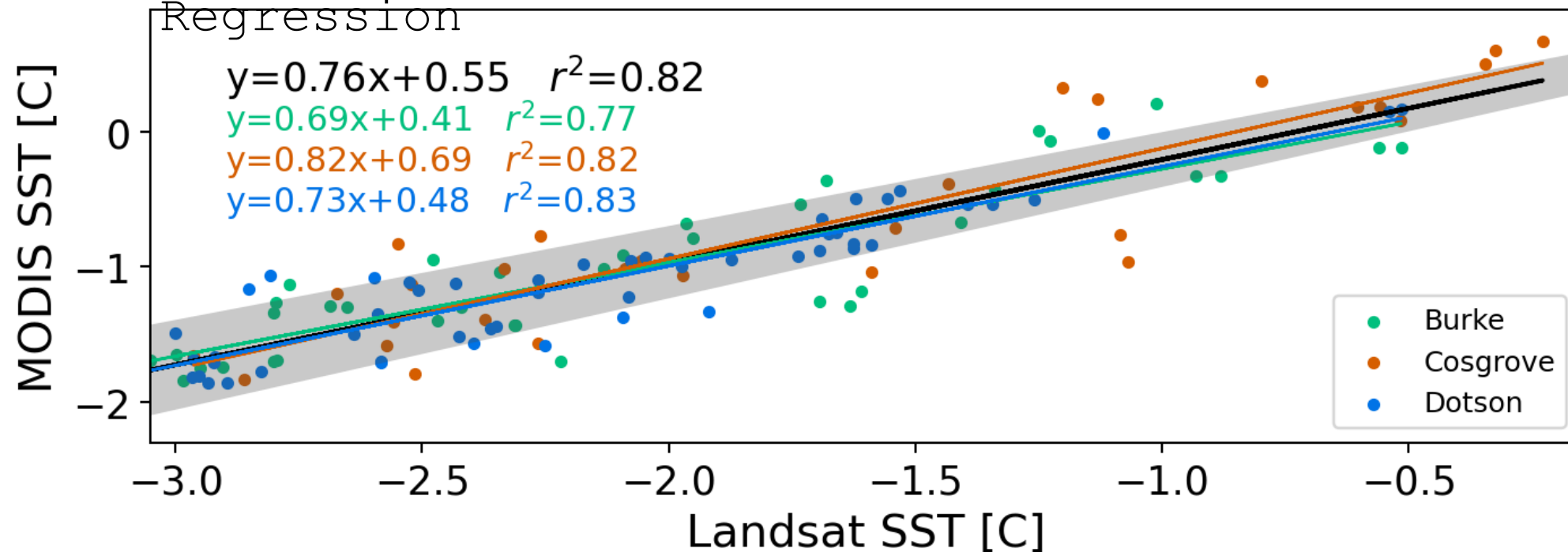


# High-fidelity cross-calibration with MODIS across 3 sites

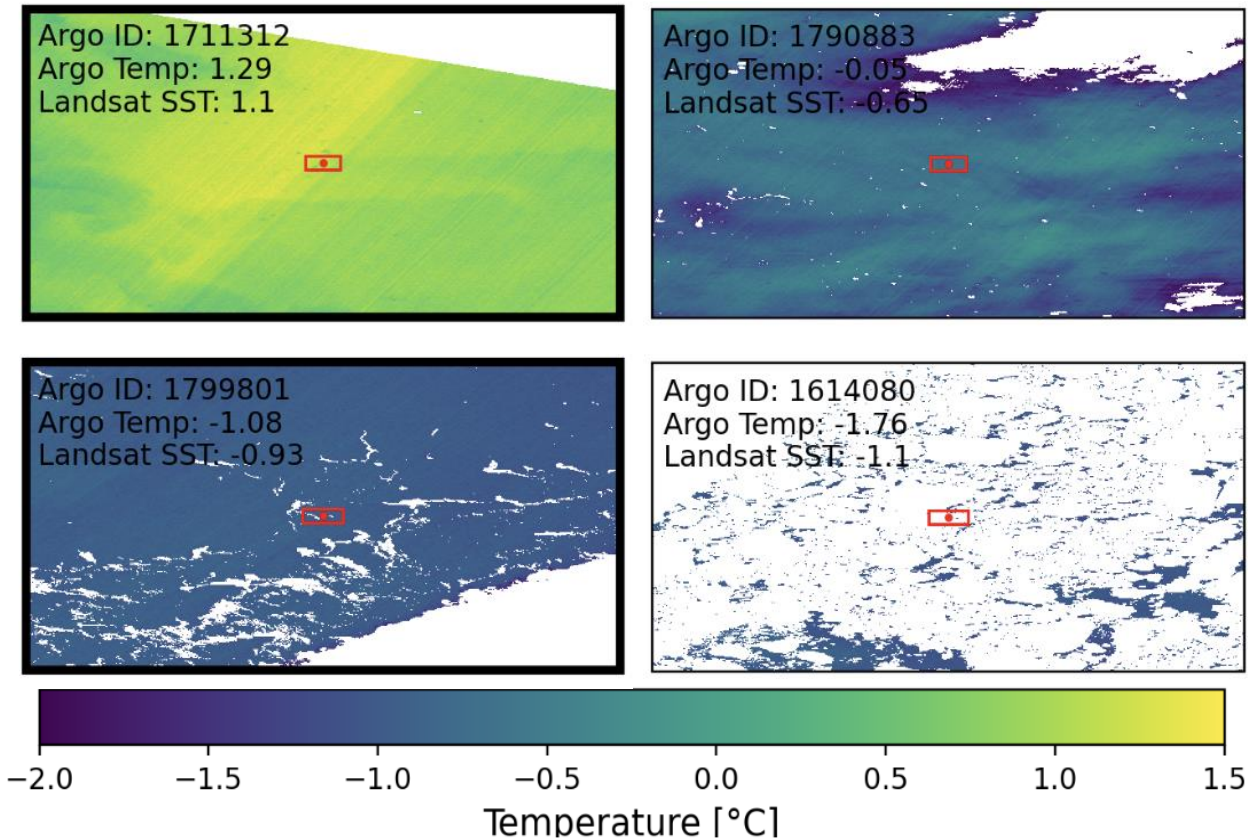


Orthogonal Distance

Regression

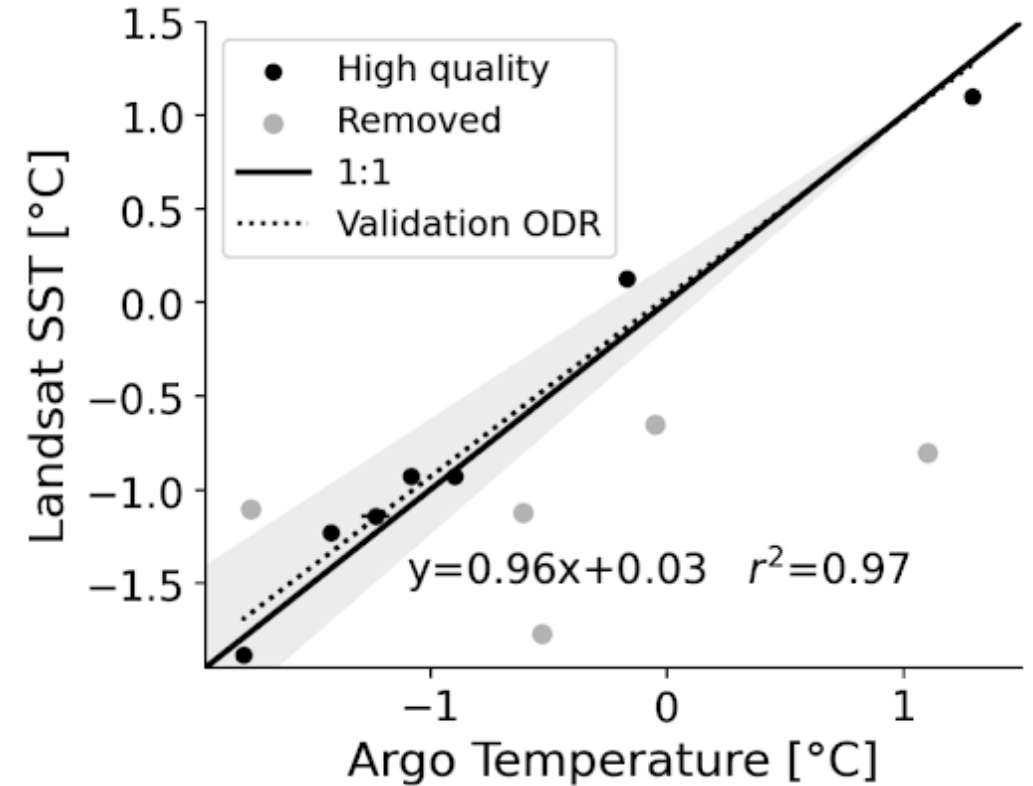
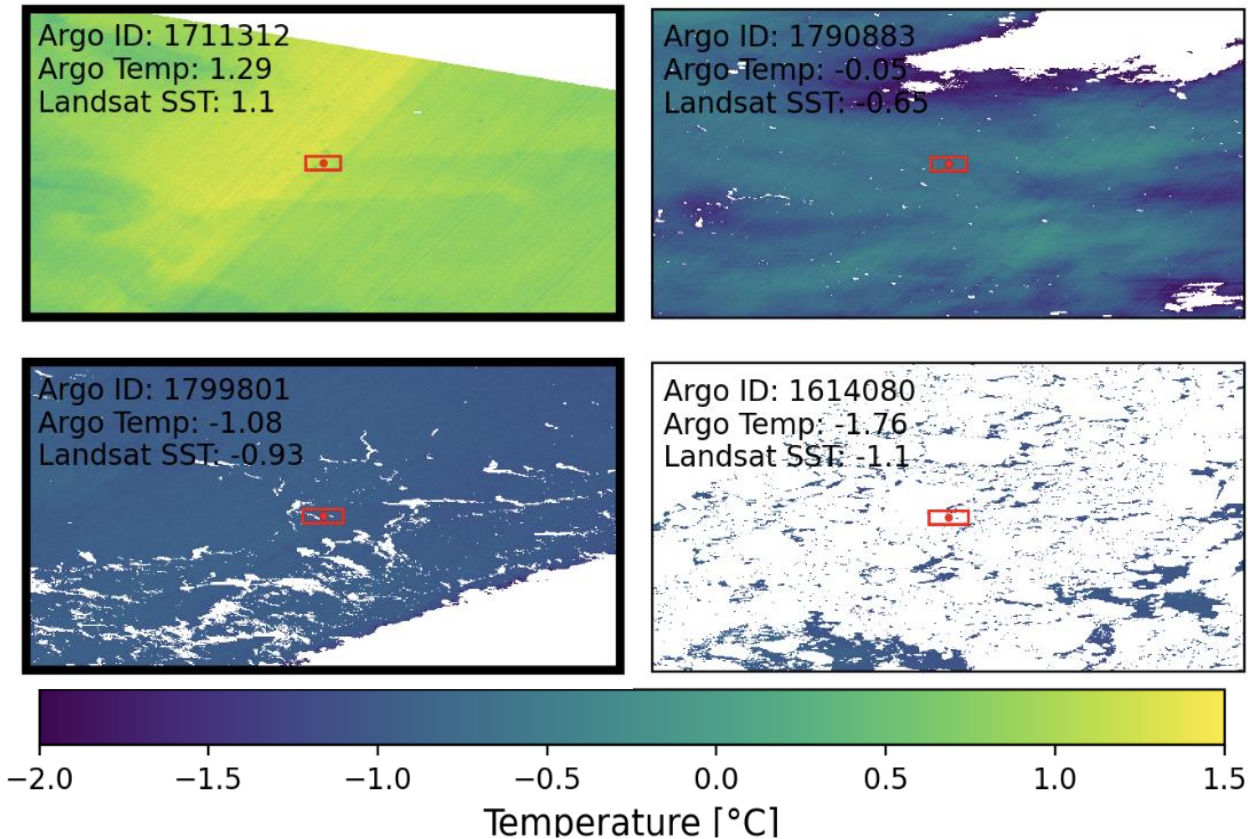


# Scarce validation matchups across ten years of Argo buoy SSTs yield a 0.15°C RMSE



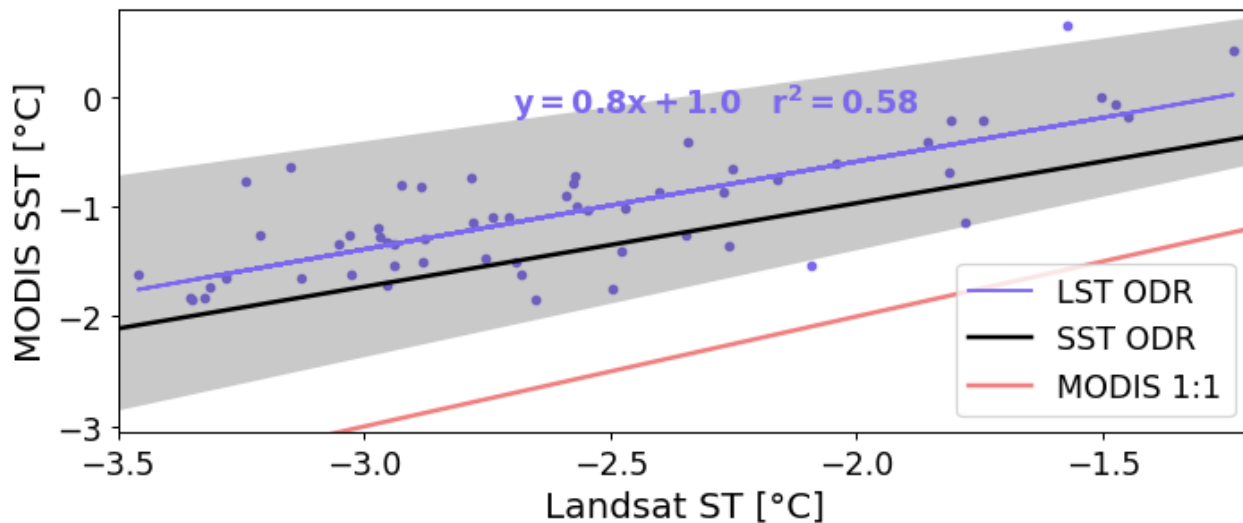


# Scarce validation matchups across ten years of Argo buoy SSTs yield a 0.15°C RMSE



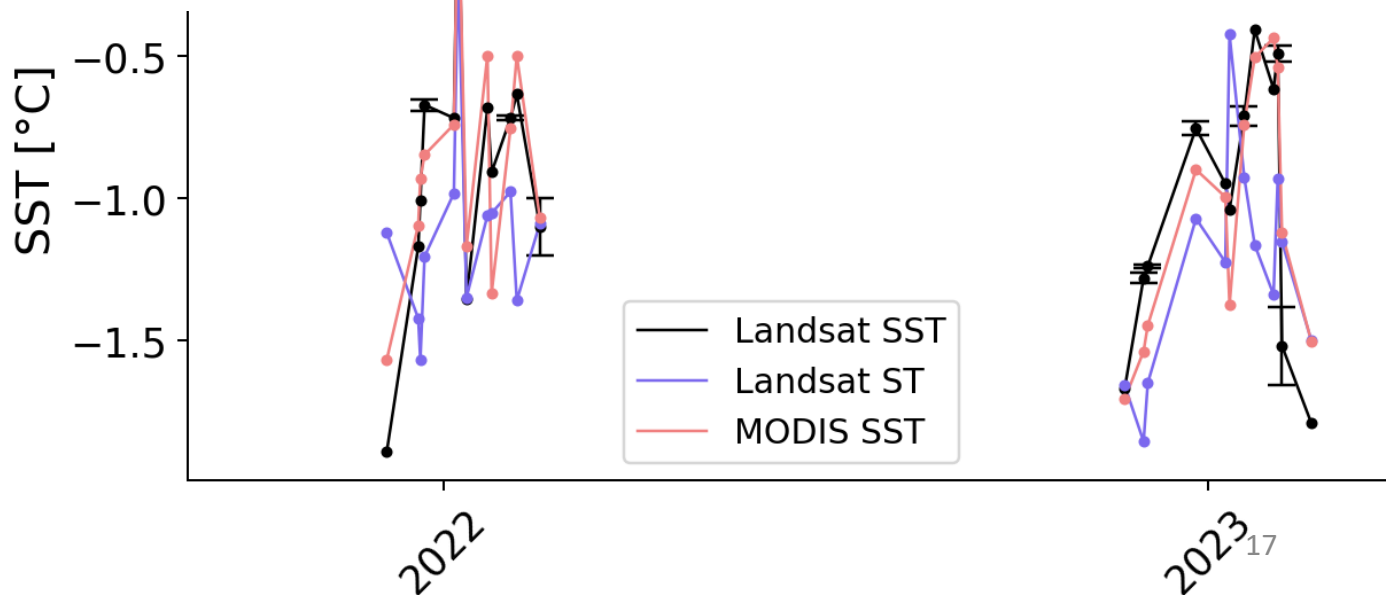
Scarcity of field data prevents us from sampling the full range of variability

# SST retrieval outperforms LST retrieval



Cross-calibration

	<i>RMSE</i>	<i>r</i> <sup>2</sup>
<i>LST</i>	0.37°C	0.54
<i>SST</i>	0.26°C	0.90





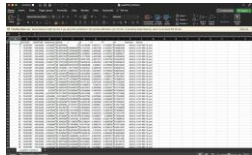
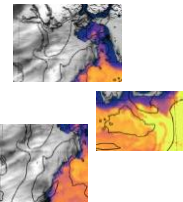
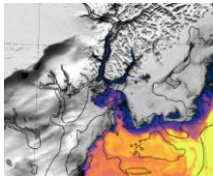
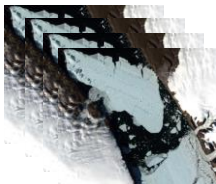
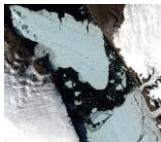
# 6 Tb of data storage and a weeks-long pipeline

Timeline

>week

+ 1 hour per image

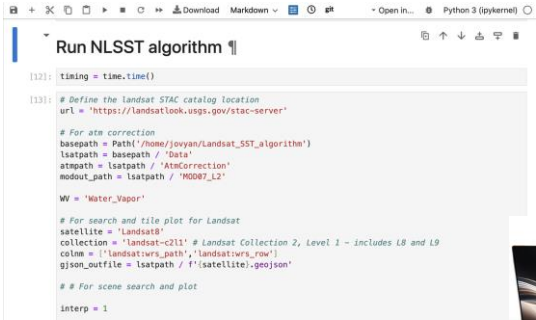
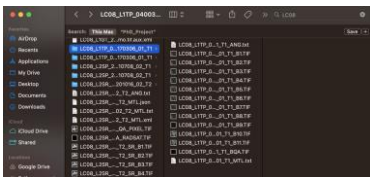
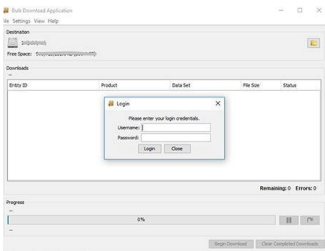
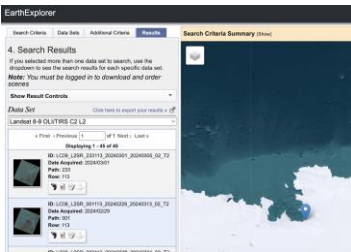
Storage



Tasks



Tools

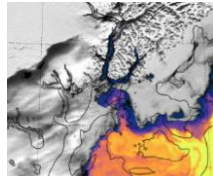


# 6 years later: Modernization leads to orders of magnitude less processing time and data storage

Timeline

1 min

Storage



Tasks



Tools

```
Run NLSST algorithm ¶

[12]: timing = time.time()

[13]: # Define the landsat STAC catalog location
url = 'https://landsatlook.usgs.gov/stac-server'

# For atm correction
basepath = Path('/home/jovyan/Landsat_SST_algorithm')
lsatpath = basepath / 'Data'
atmpath = lsatpath / 'AtmCorrection'
modout_path = lsatpath / 'MOD07_L2'

WV = 'Water_Vapor'

# For search and tile plot for Landsat
satellite = 'Landsat9'
collection = 'landsat-c2l1' # Landsat Collection 2, Level 1 - Includes L8 and L9
colnm = ['landsat:wrs_path', 'landsat:wrs_row']
gjson_outfile = lsatpath / f'{satellite}.geojson'

## For scene search and plot

Interp = 1
```



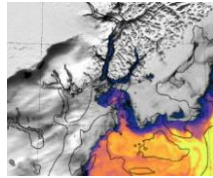


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Timeline

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Storage



Tasks



Tools

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Code

Platform

Data  
format

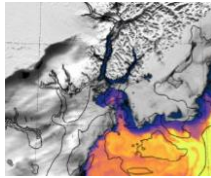
Data  
access

# 6 years later: Modernization leads to orders of magnitude less processing time and data storage

Timeline

1 min

Storage



Tasks



Tools

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Code



Platform



Data



Data

access

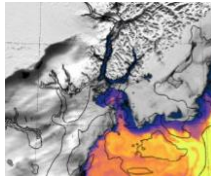


# 6 years later: Modernization leads to orders of magnitude less processing time and data storage

Timeline

1 min

Storage



Tasks



Consolidation and  
streamlining



Time for iteration

Time to solution

Impact

Tools

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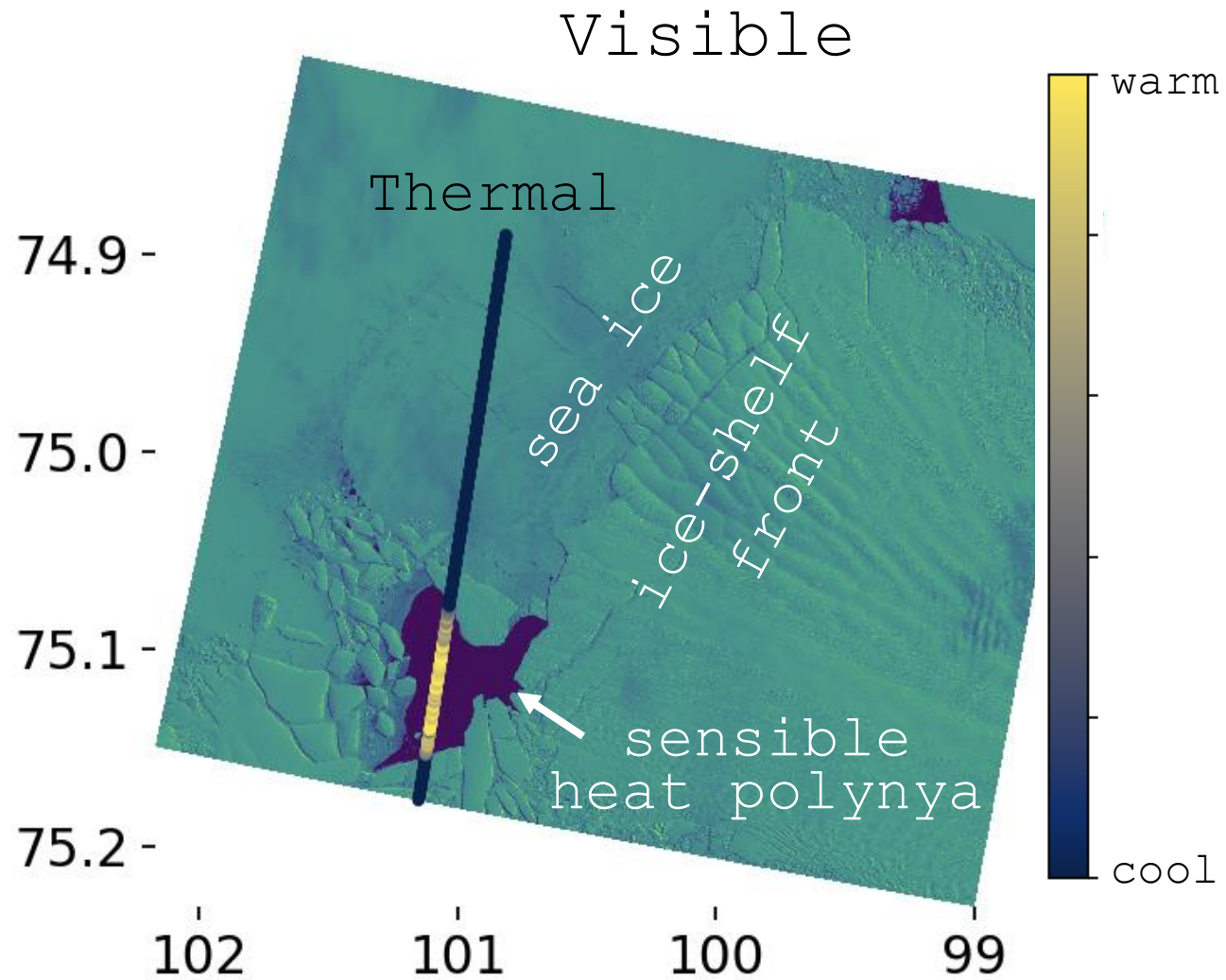
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```

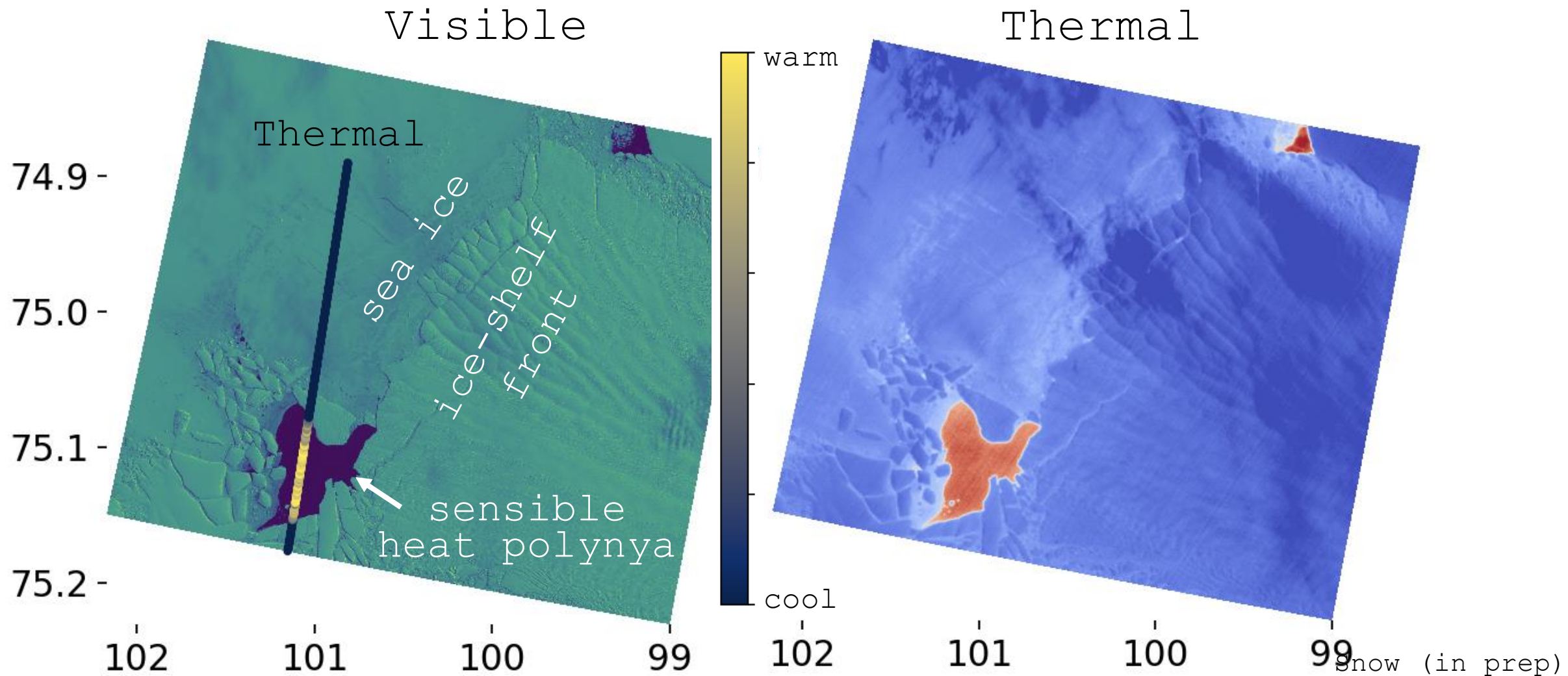


# Acquire temperatures along specific tracks

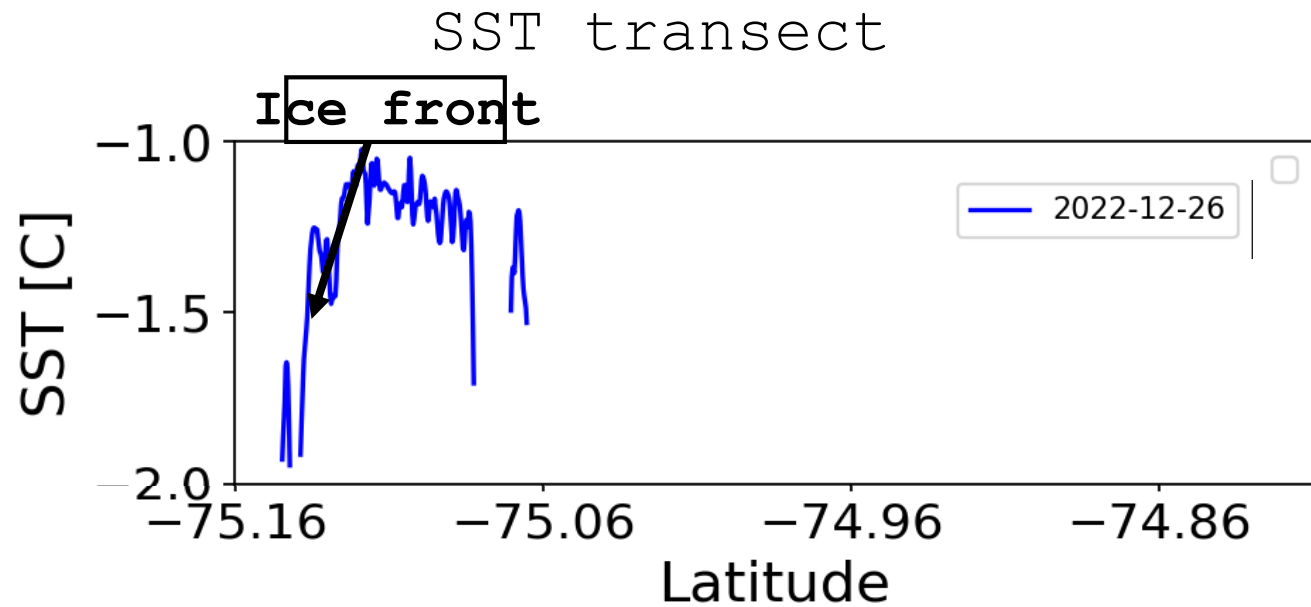
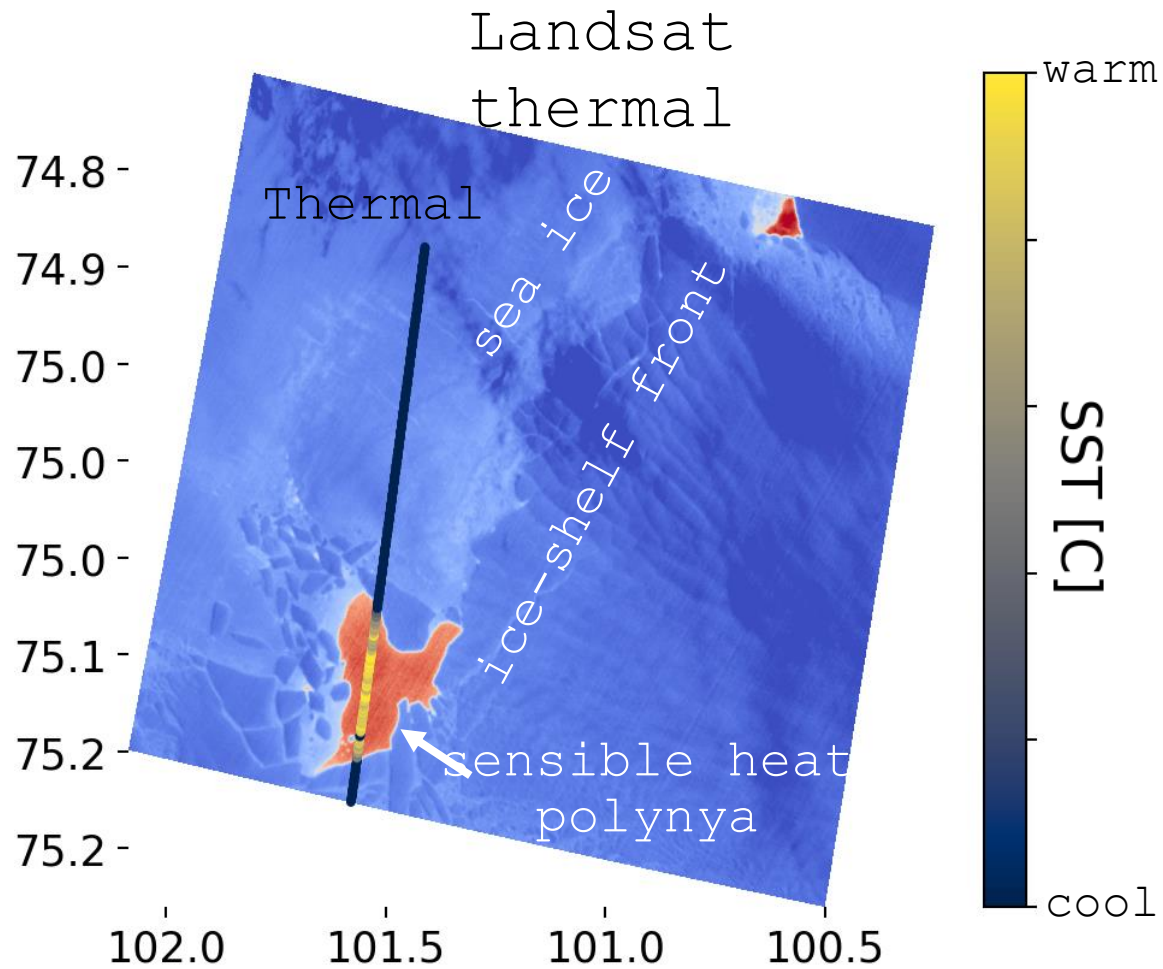




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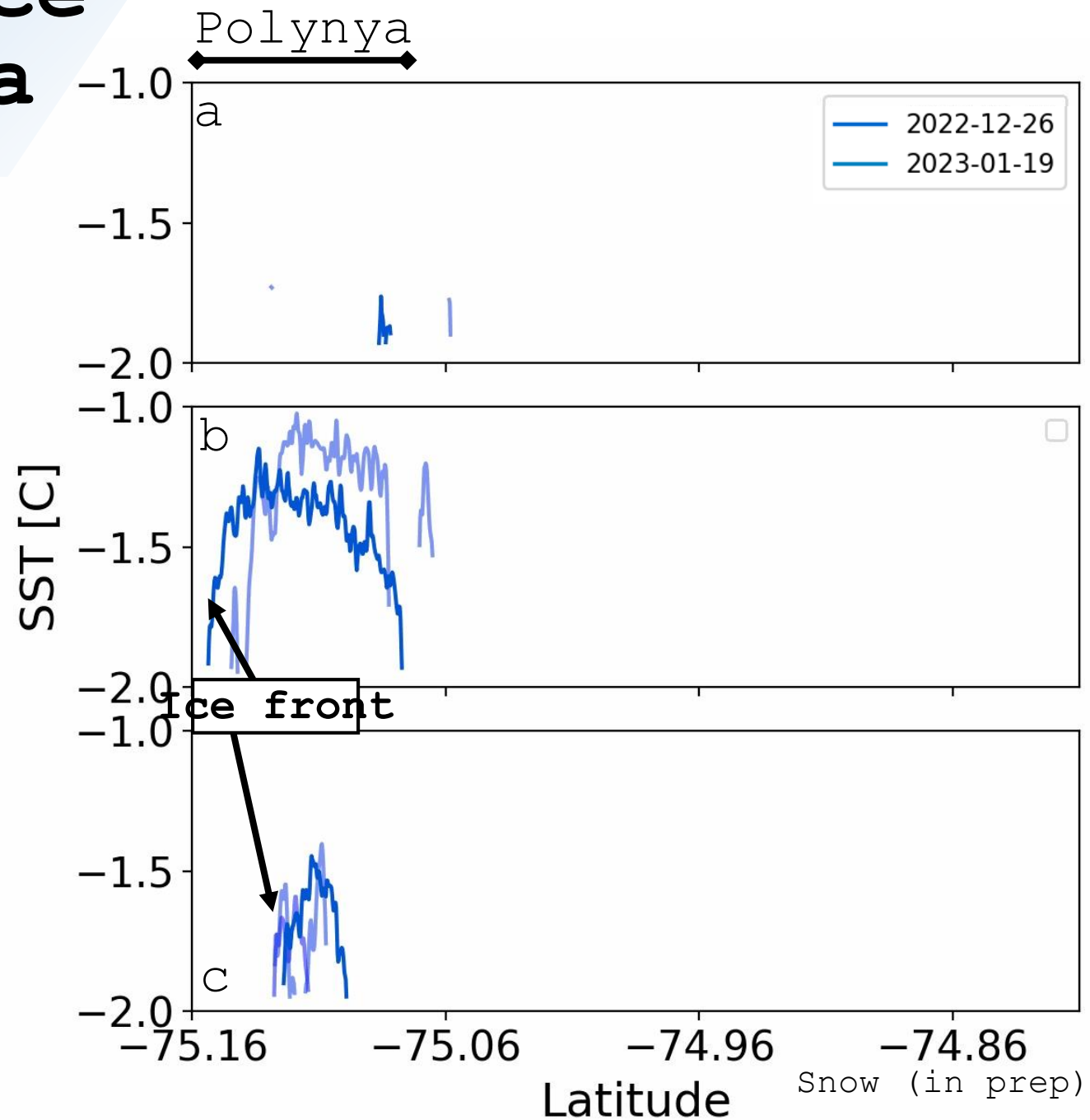
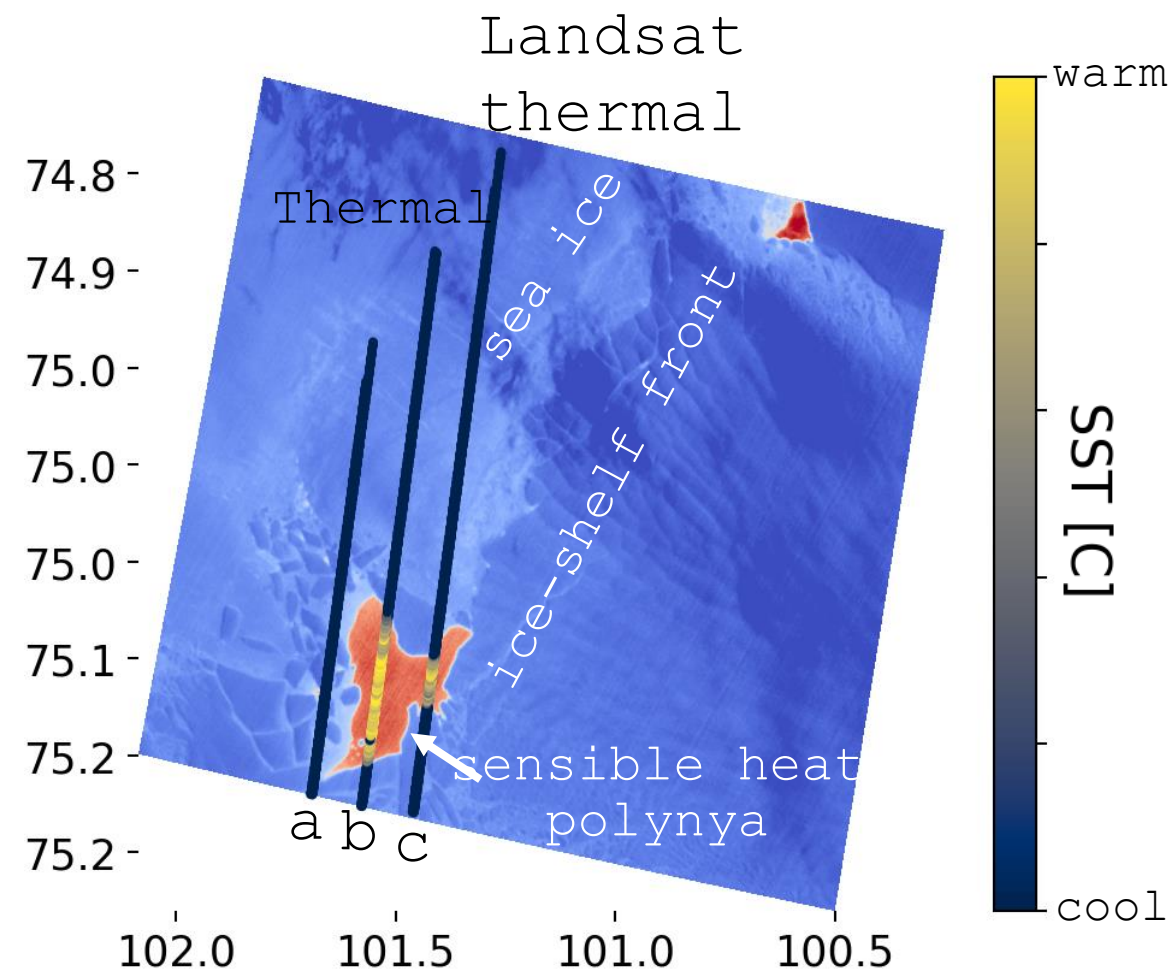


# SSTs extracted from a sensible heat polynya in summertime

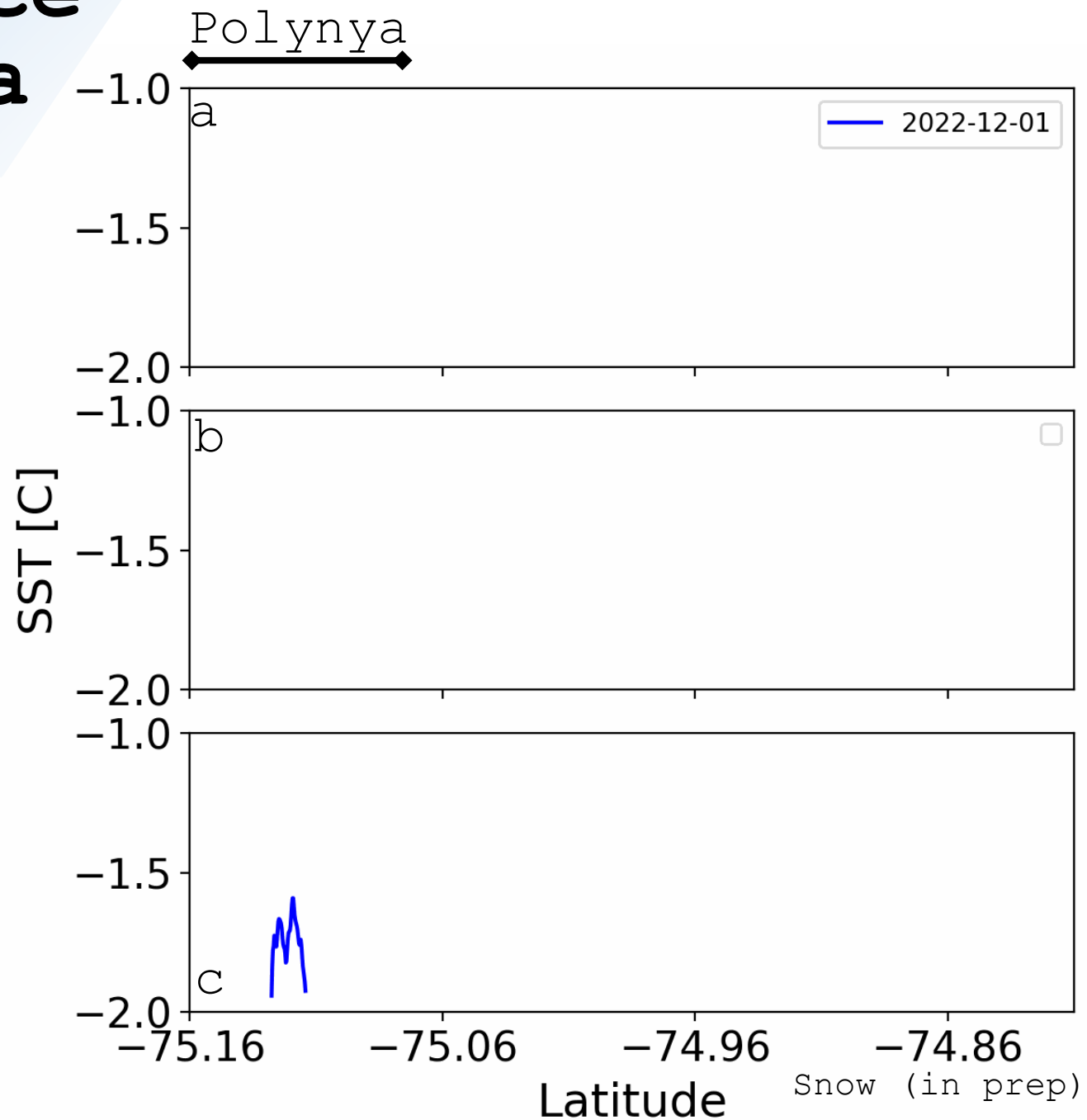
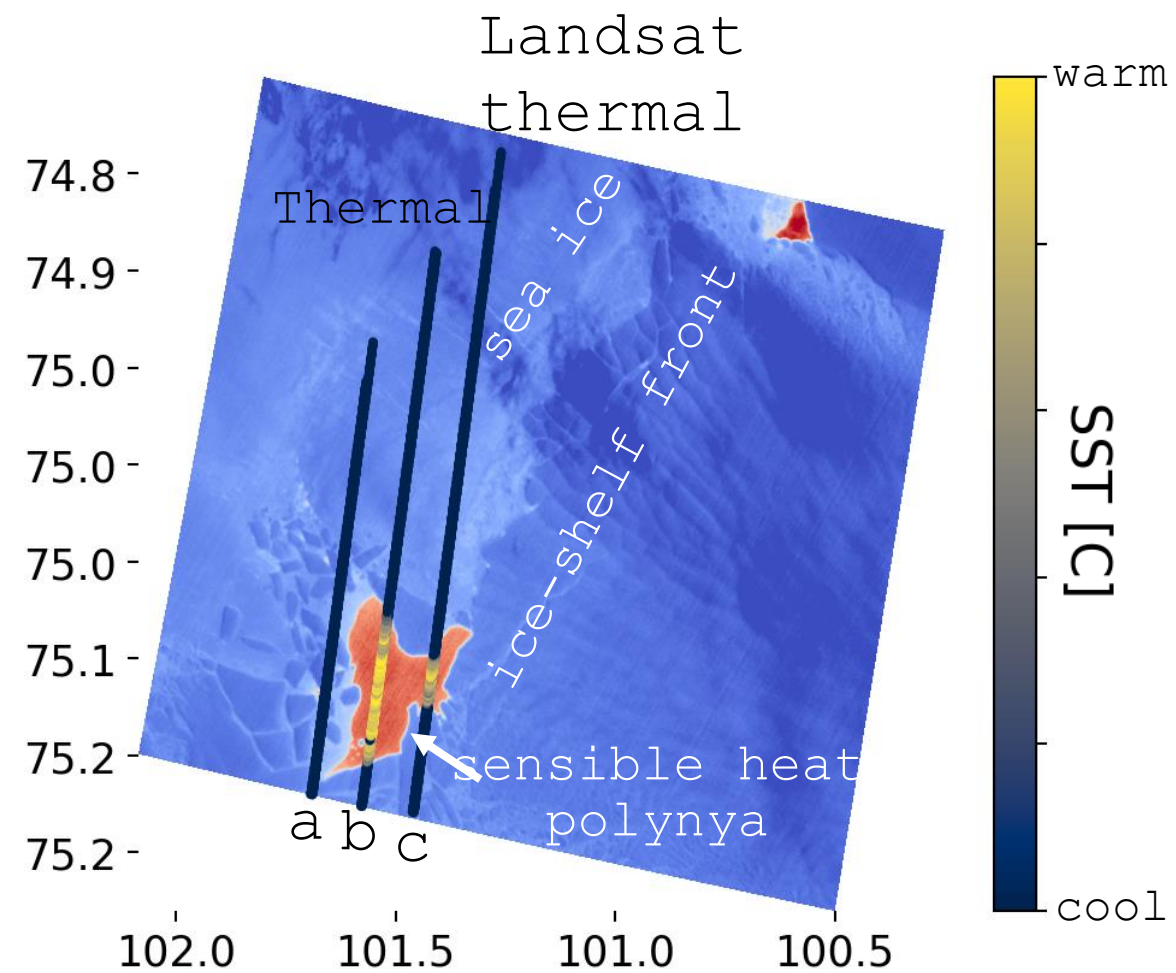




# SST warmest near ice front while polynya present

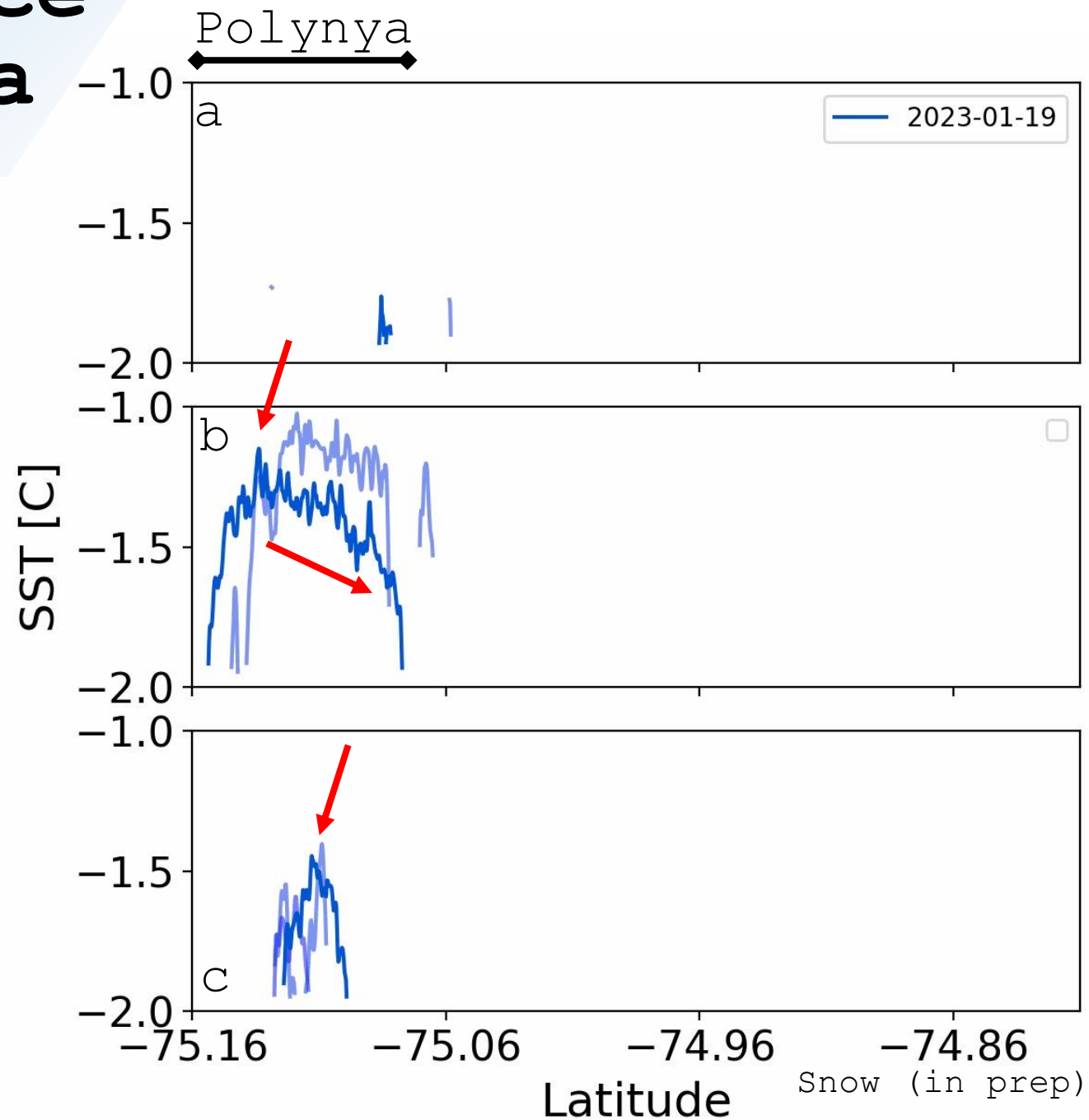
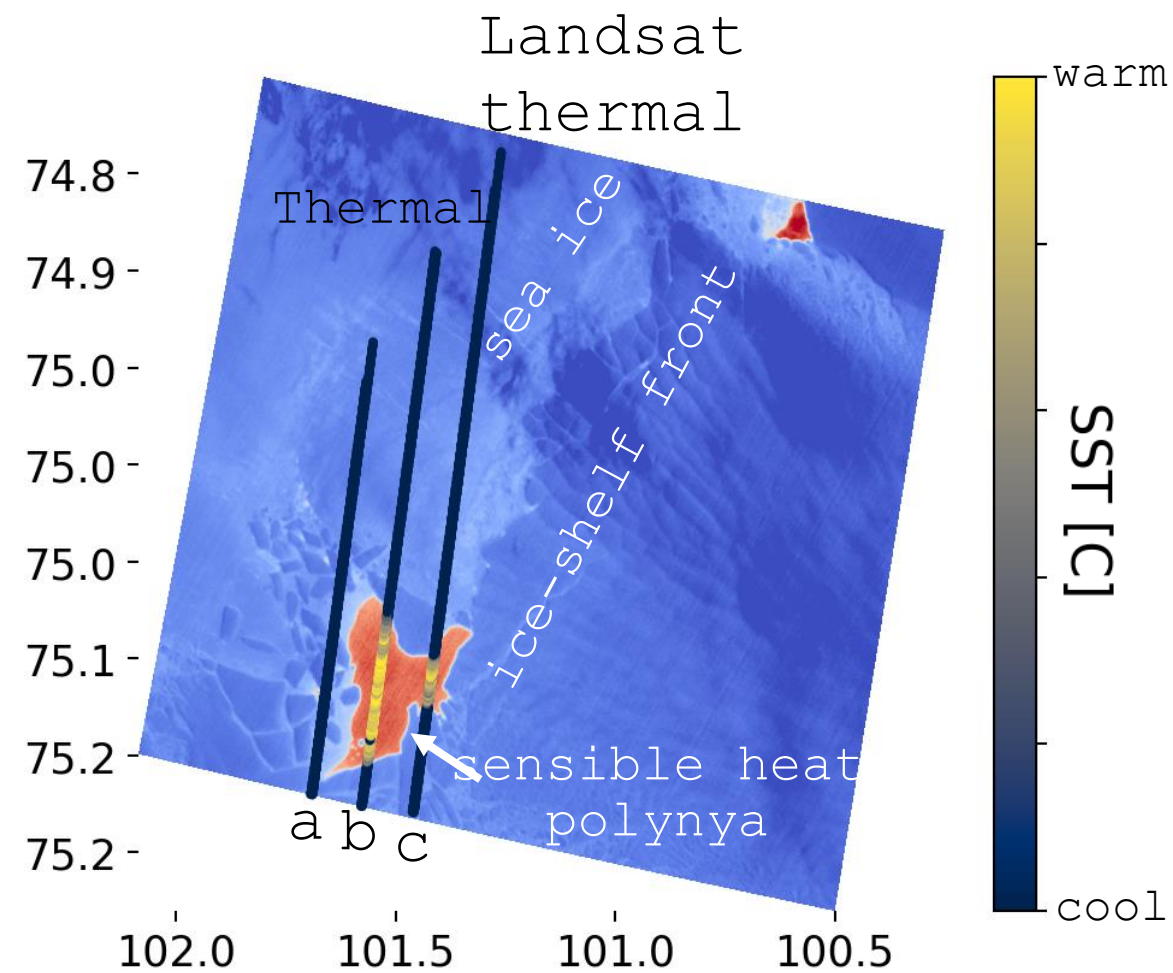


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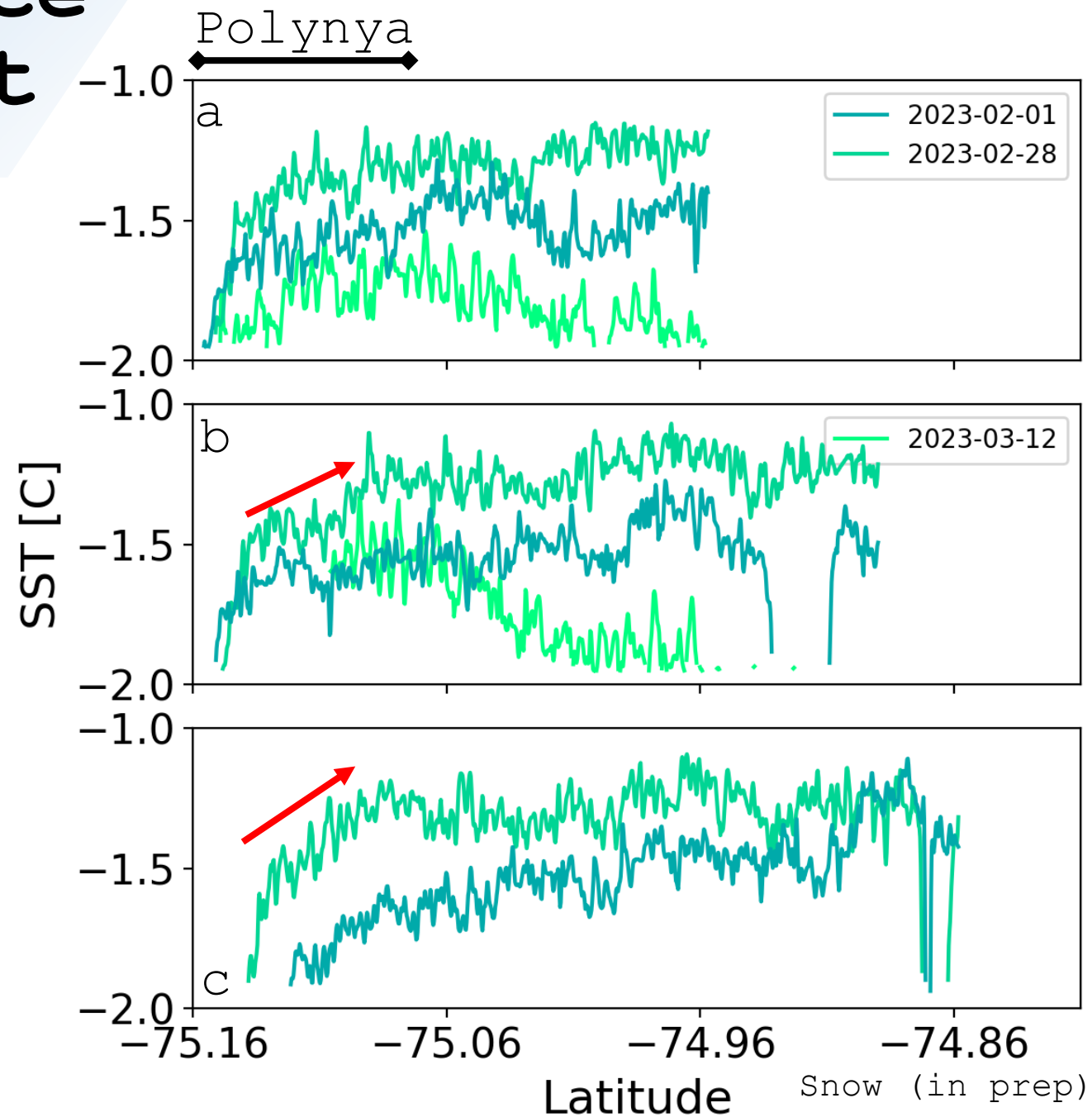
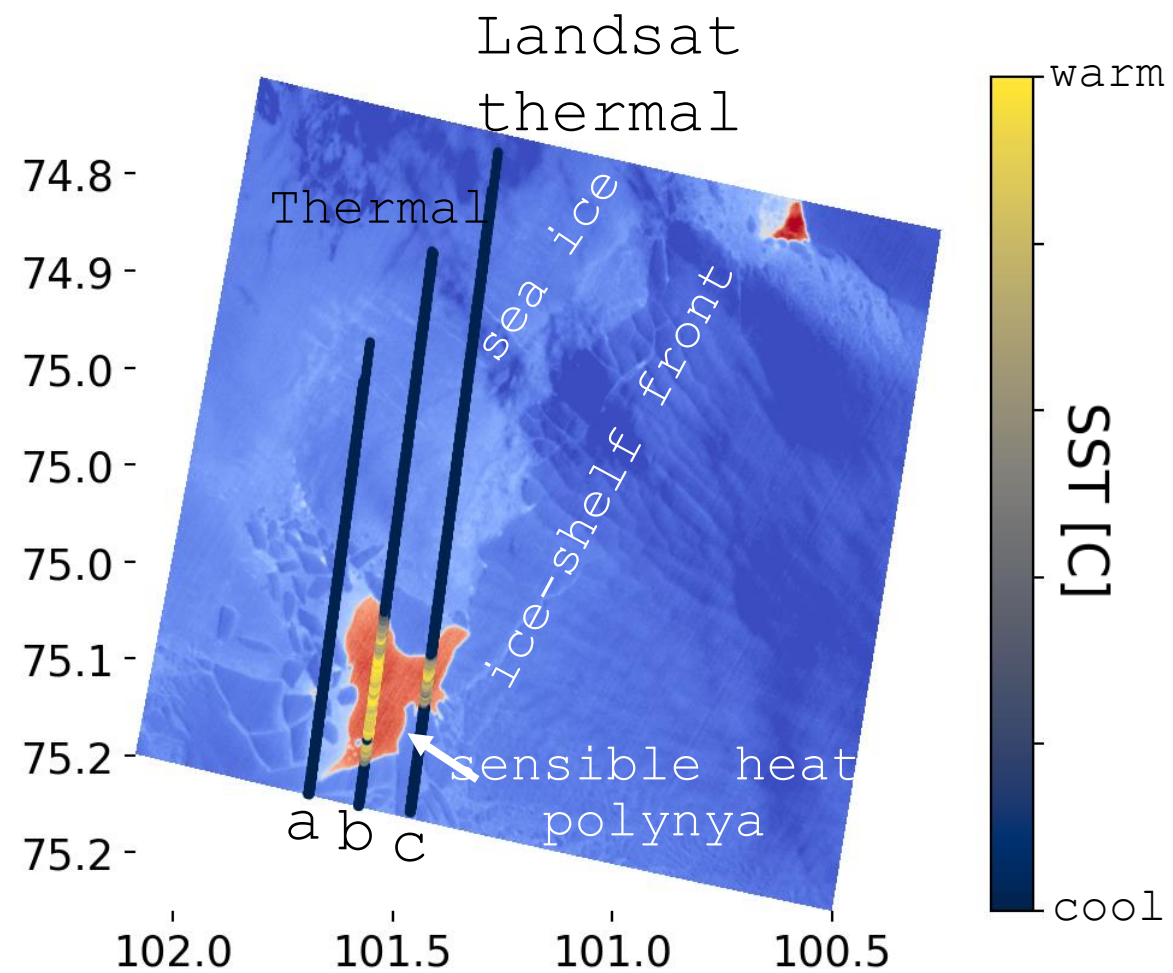




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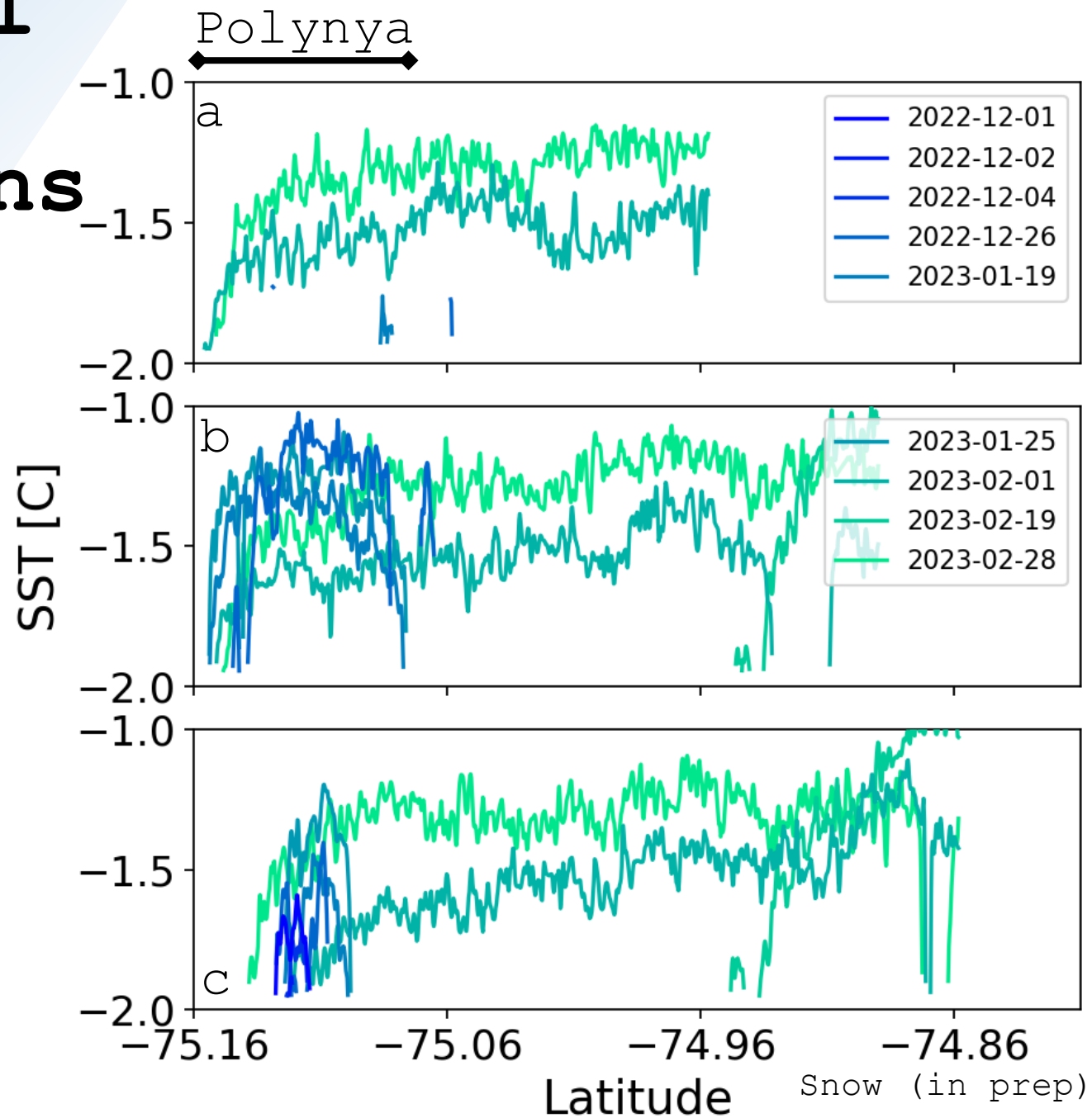
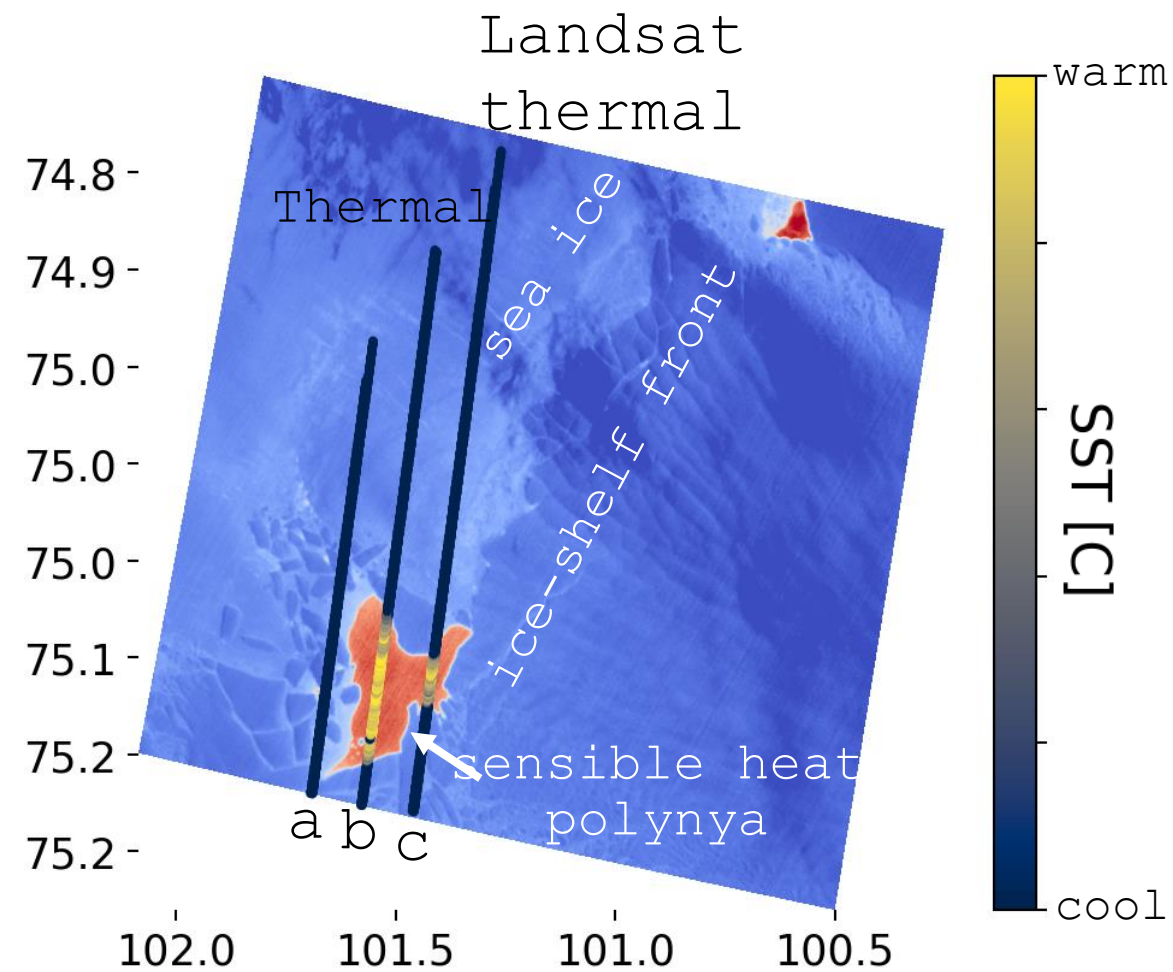


# SST coolest near ice front when landfast ice gone

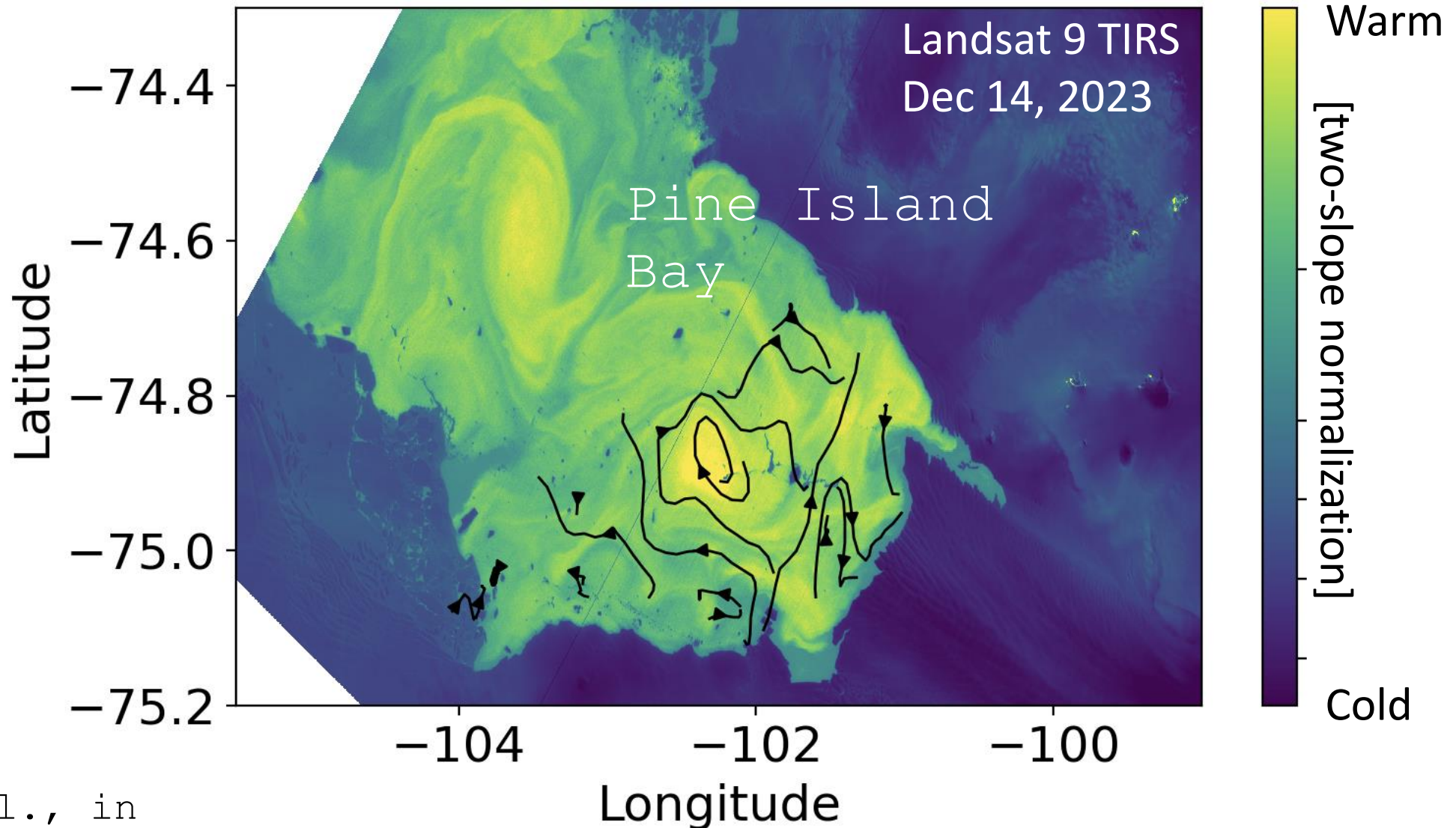




# SST profiles reveal plume and ocean circulation patterns



# First order alignment between SWOT velocities and Landsat sea surface temperatures over gyre







# Thank you

Tasha Snow  
tsnow03.github.io  
@tsnow03  
@TashaMSno  
tsnow03@umd.edu



## ***Funding sources:***

NASA Transform to Open Science Program (80NSSC23K0002)

NASA Cryosphere Program (80NSSC22K0385, 80NSSC22K1877)

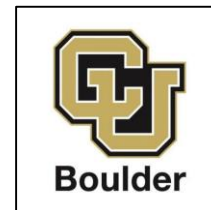
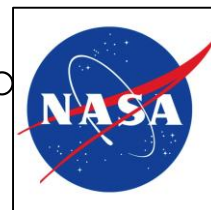
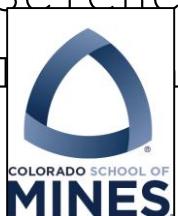
NSF Graduate Research Fellowship Program (DGE1650115)

NASA Earth and Space Science Fellowship Program  
(NNX16AO33H)

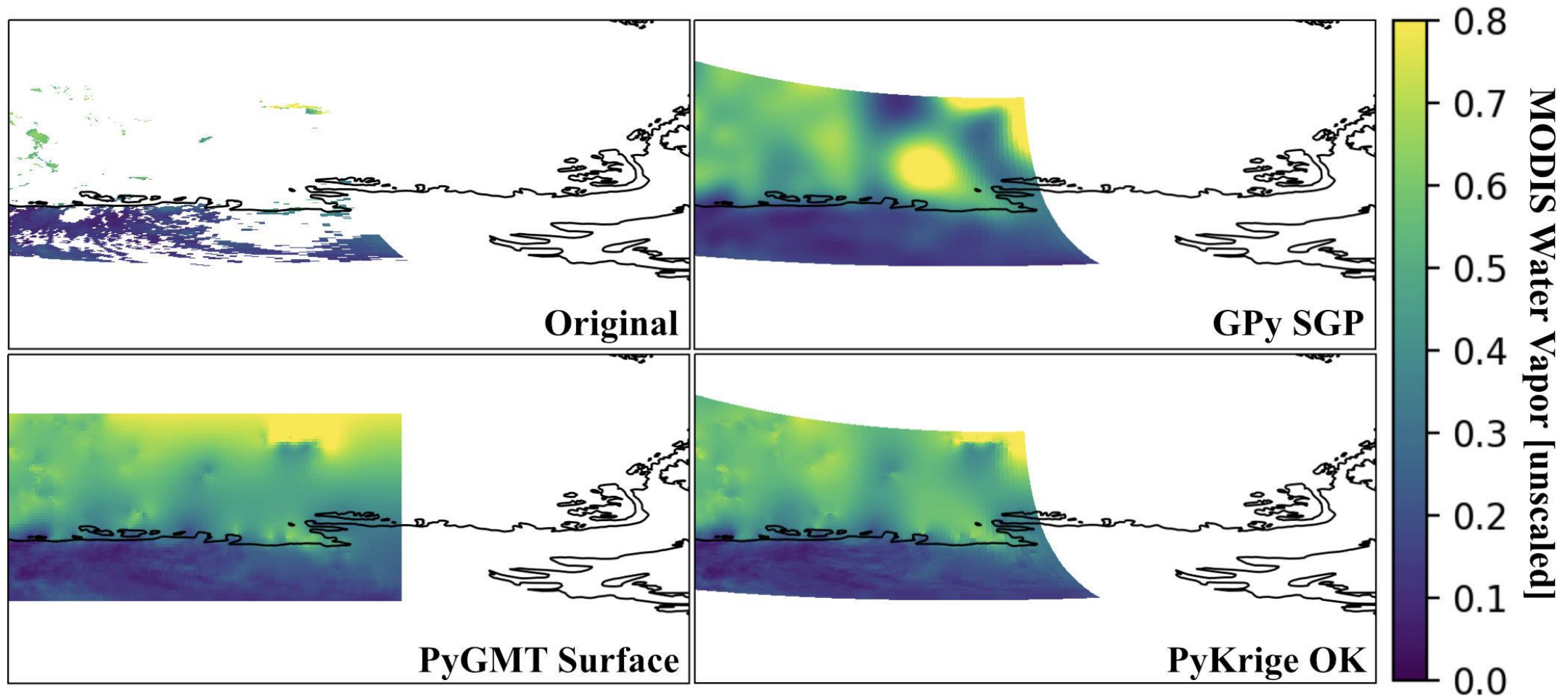
Colorado School of Mines

Earth System Science Interdisciplinary Center,  
University of Maryland

Cooperative Institute for Research in Environmental  
Sciences

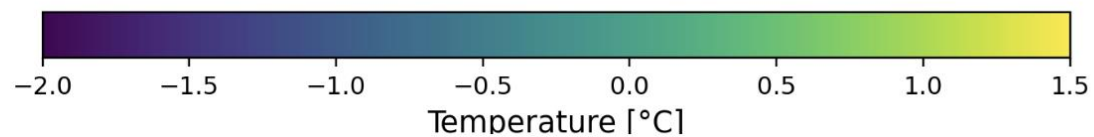
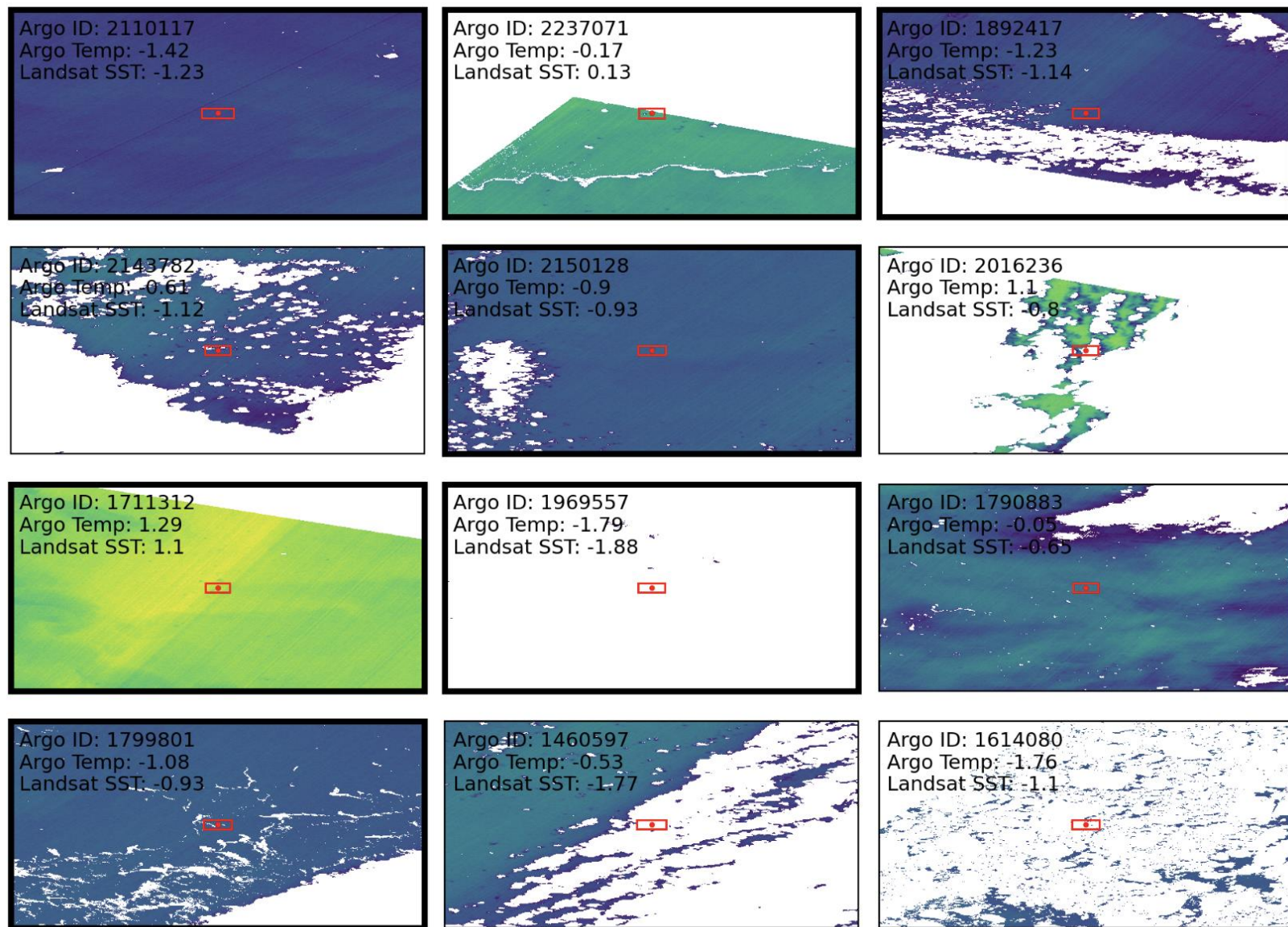


# Interpolation of MOD09 water vapor





# Validation matchups



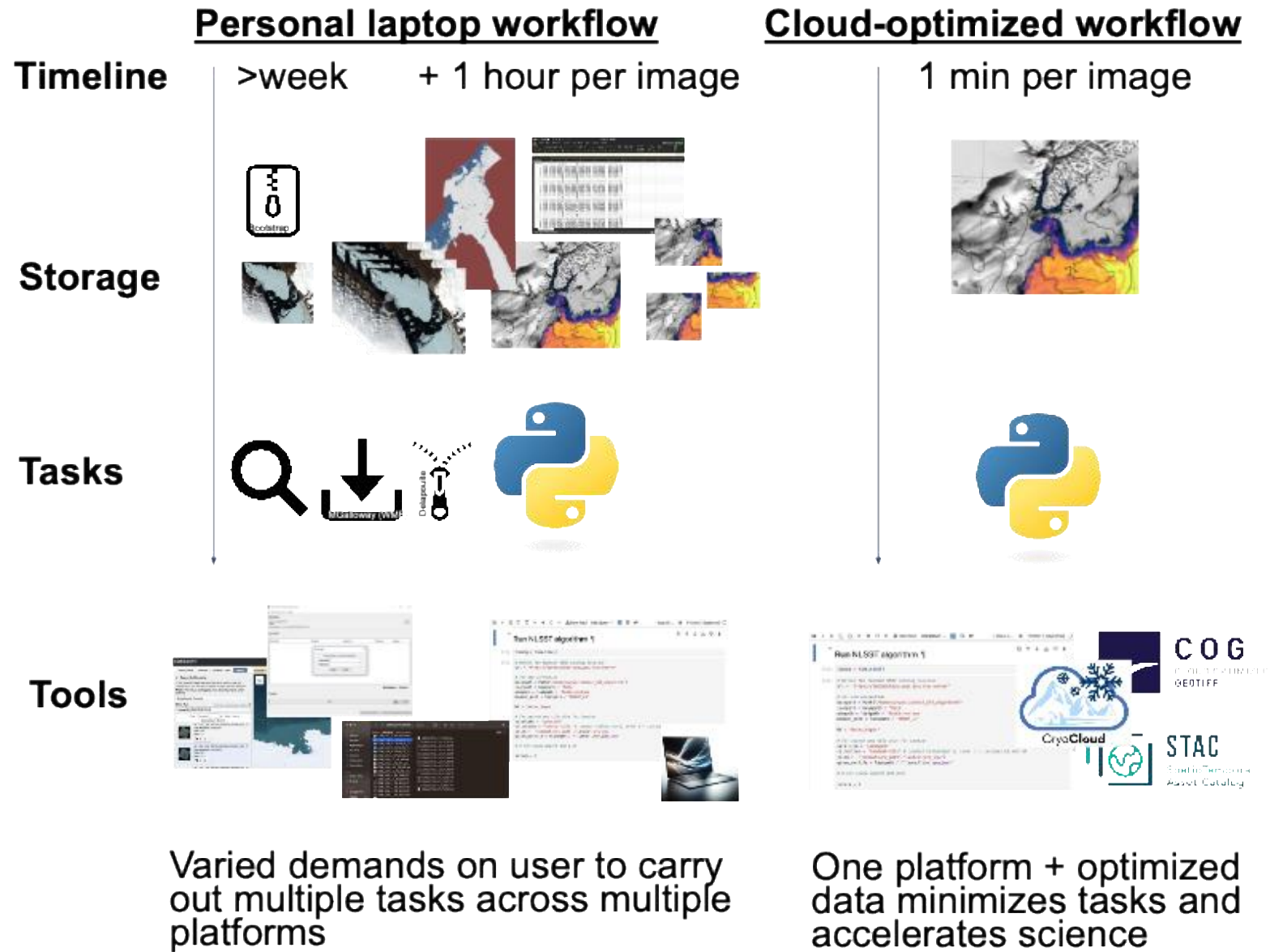
# 2 orders of magnitude less data storage and processing times now



Time for iteration

Time to solution

Impact



**Same SST output!**