Exploring the potential of hydrodynamical models for nadir and swath internal tide corrections

Badarvada Yadidya, Ritabrata Thakur, Brian K. Arbic, Arin Nelson, Edward D. Zaron, Richard Ray, Maarten C. Buijsman

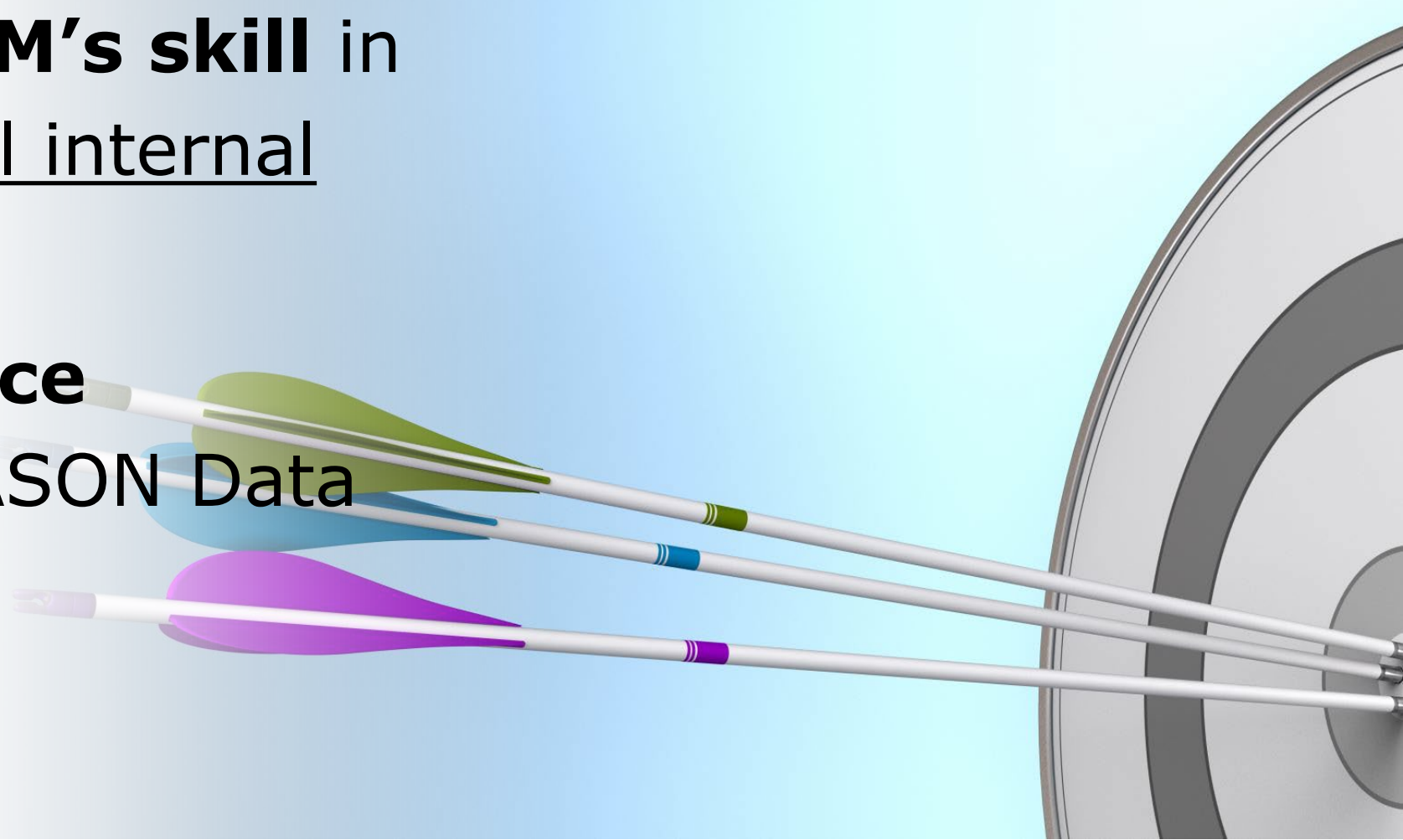
UNIVERSITY OF MICHIGAN

NASA

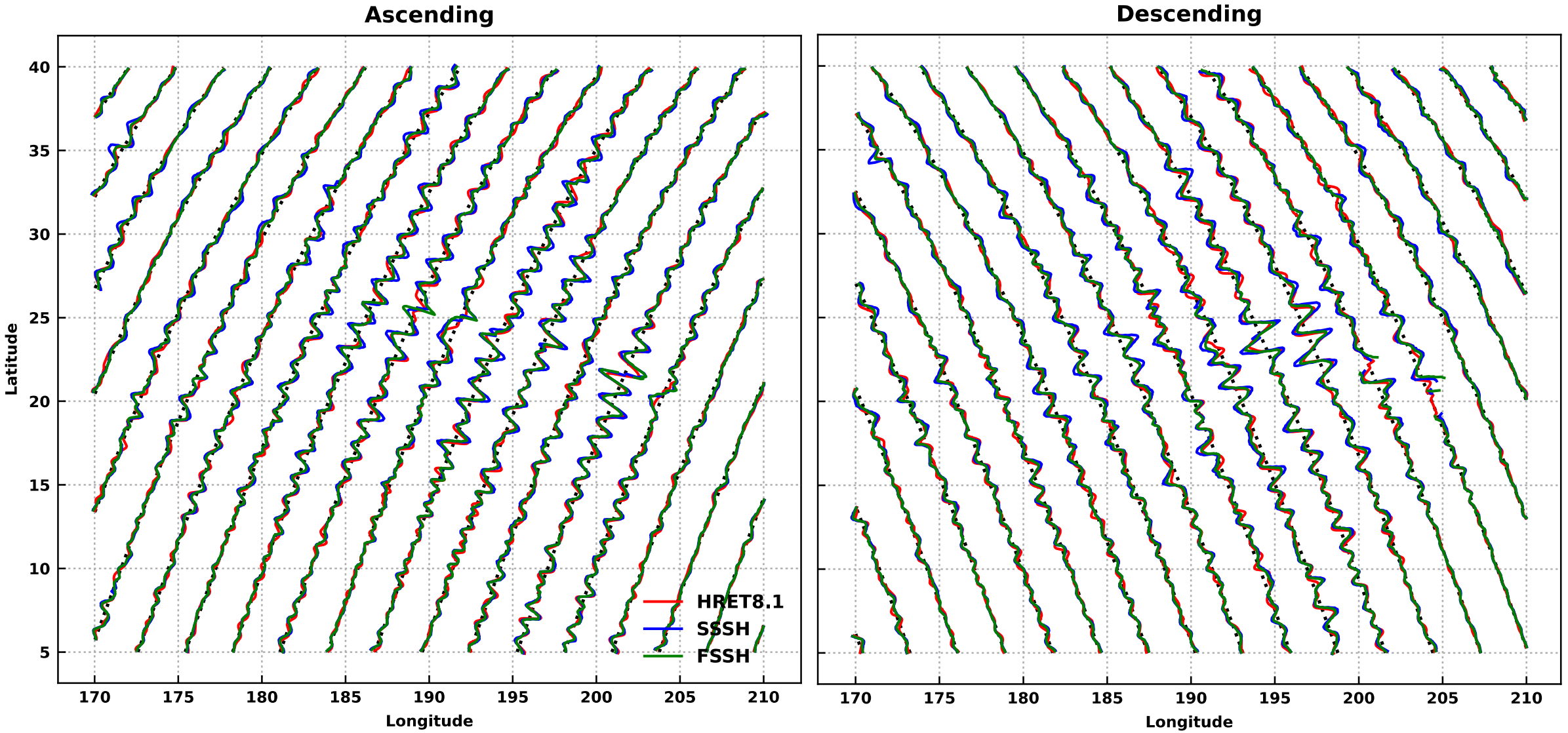
Office of Naval Research
Science & Technology

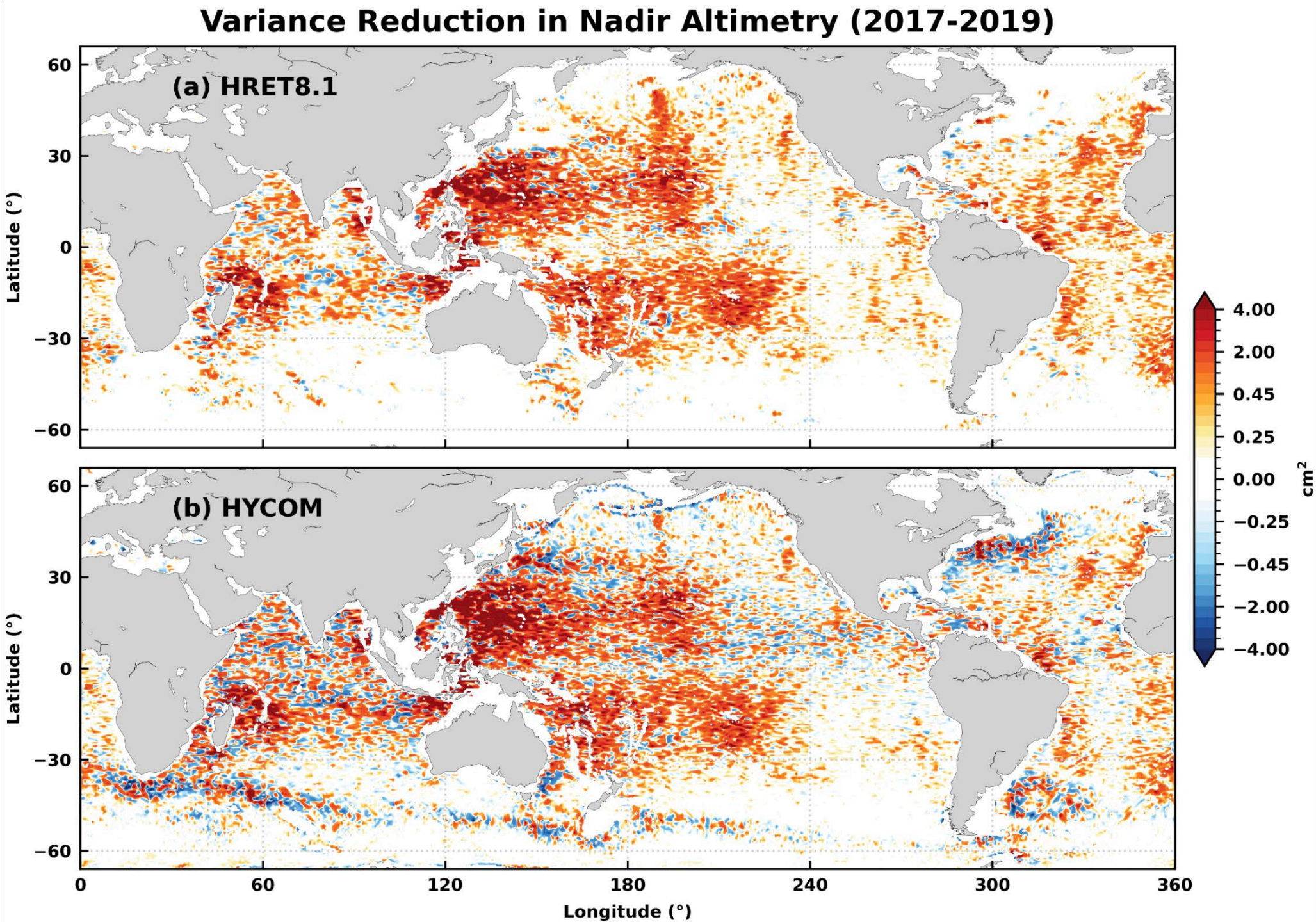
Objectives

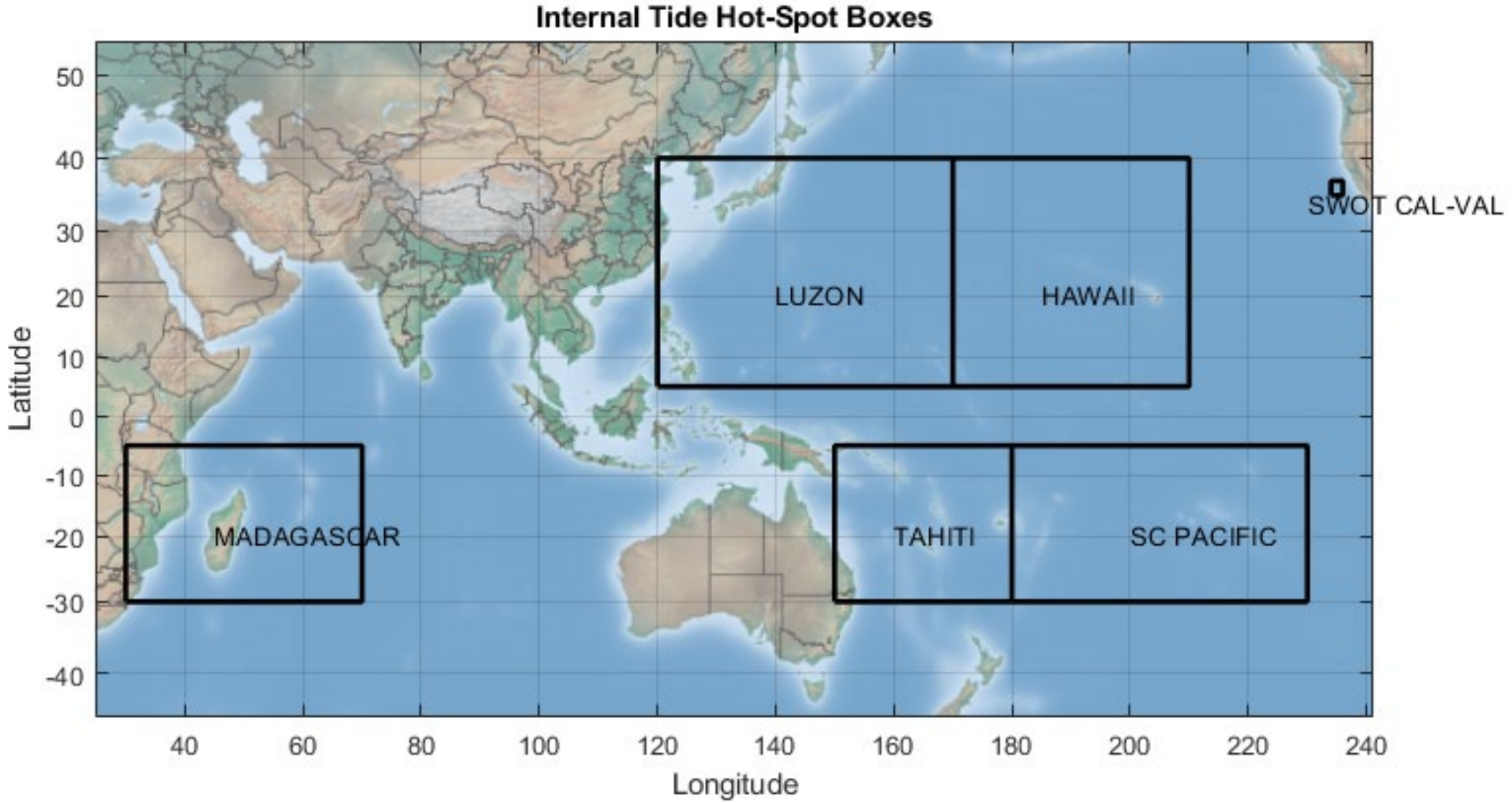
- Evaluate **HYCOM's skill** in simulating global internal tides
- Analyze **Variance Reduction** in JASON Data (2017-2019)



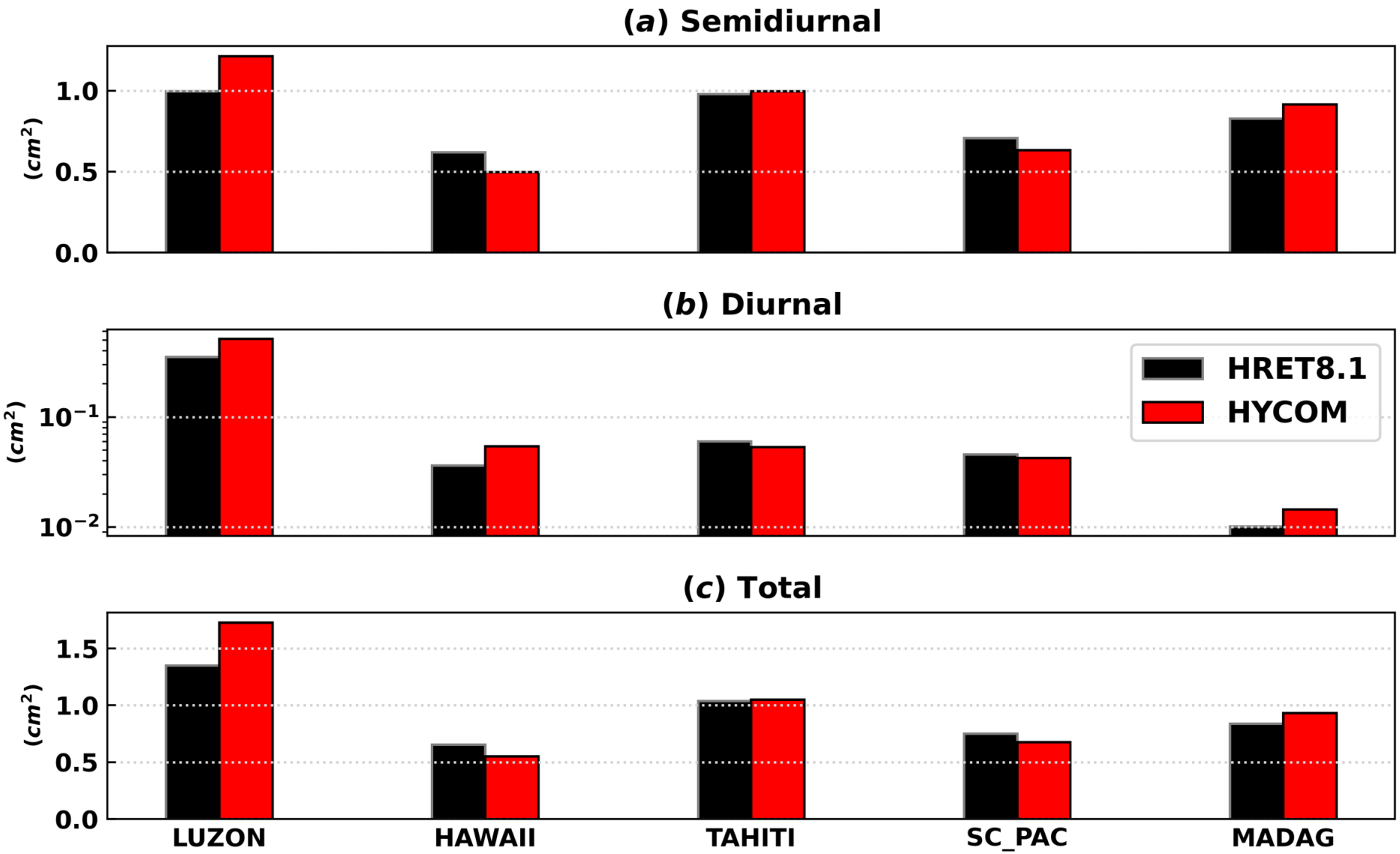
M_2 internal tide SSH amplitude * sin(phase) in HAWAII



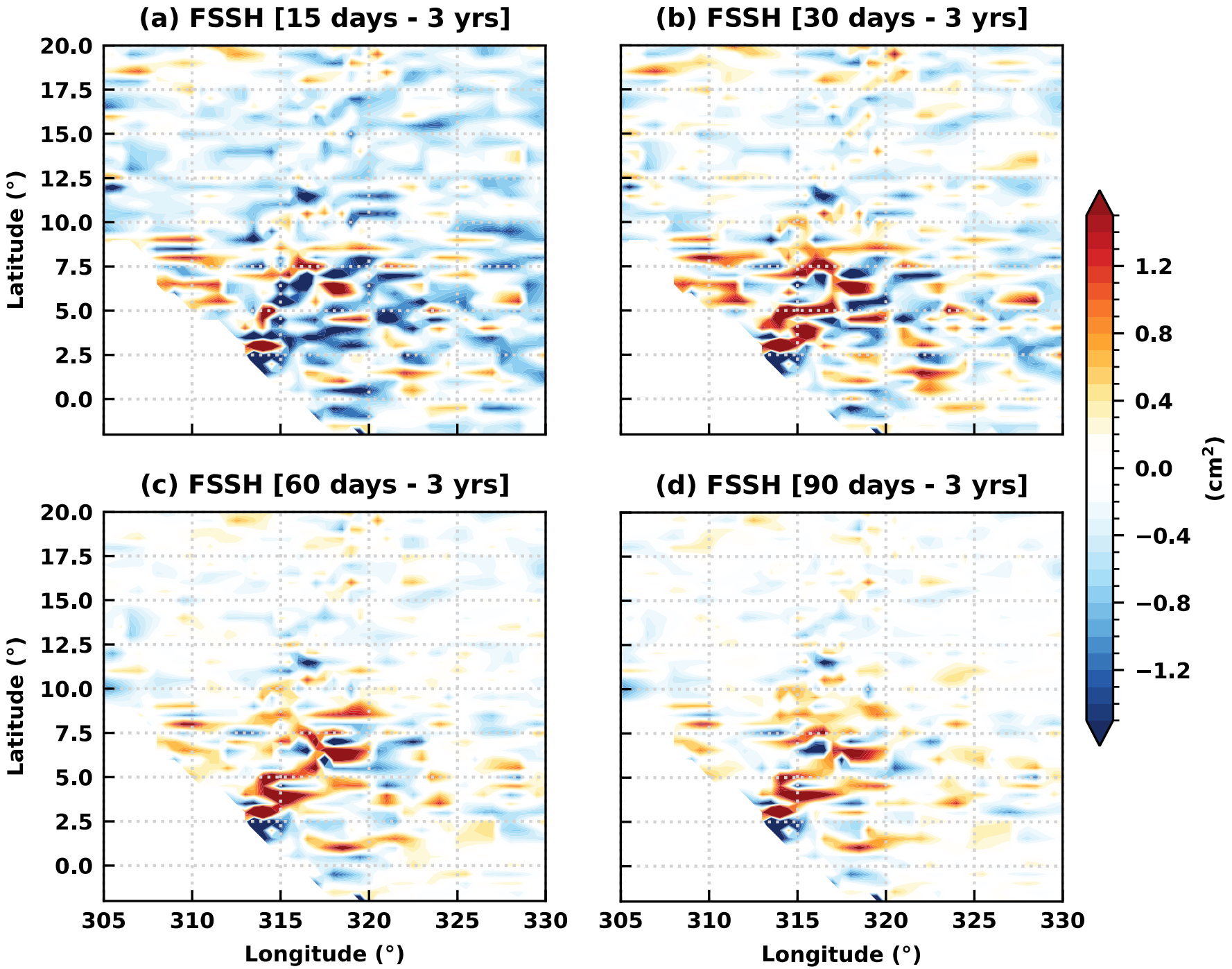

Variance Reduction in Nadir Altimetry (2017-2019)
(a) HRET8.1
(b) HYCOM
Latitude (°)
Longitude (°)
60
30
0
−30
−60
0
60
120
180
240
300
360
4.00
2.00
0.45
0.25
0.00
−0.25
−0.45
−2.00
−4.00
cm²


Internal Tide Hot-Spot Boxes
Latitude
Longitude
50
40
30
20
10
0
-10
-20
-30
-40
40
60
80
100
120
140
160
180
200
220
240
LUZON
HAWAII
SWOT CAL-VAL
MADAGASCAR
TAHITI
SC PACIFIC

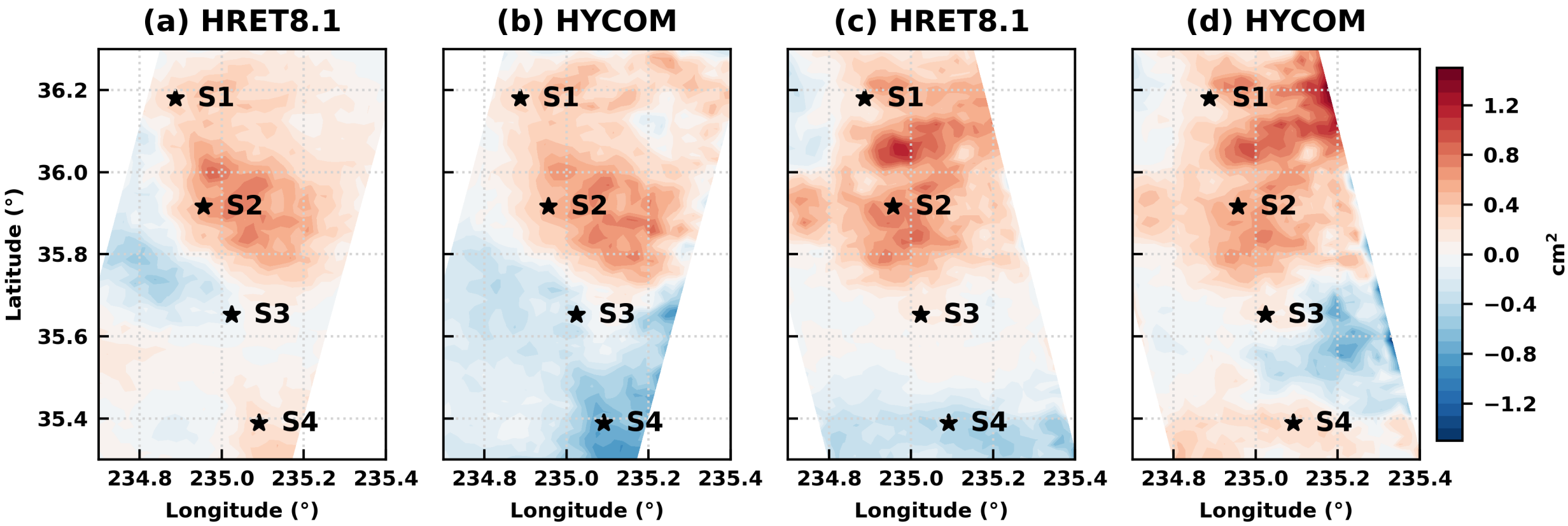
Variance reduction from JASON (2017-2019): Regional averages



Short-term harmonic analysis picks up some **<u>incoherent internal tide</u>** signal: **AMAZON region**



Preliminary results - SWOT Cal/Val region



Looking ahead…

- SWOT
- Baroclinic SSH

- Using HYCOM-derived spatio-temporal basis functions to create estimates of incoherent internal tides

$$h_{kn}(\mathbf{x}) = \sum_{l=1}^{L} U_{kl}(\mathbf{x}) v_{kln}$$

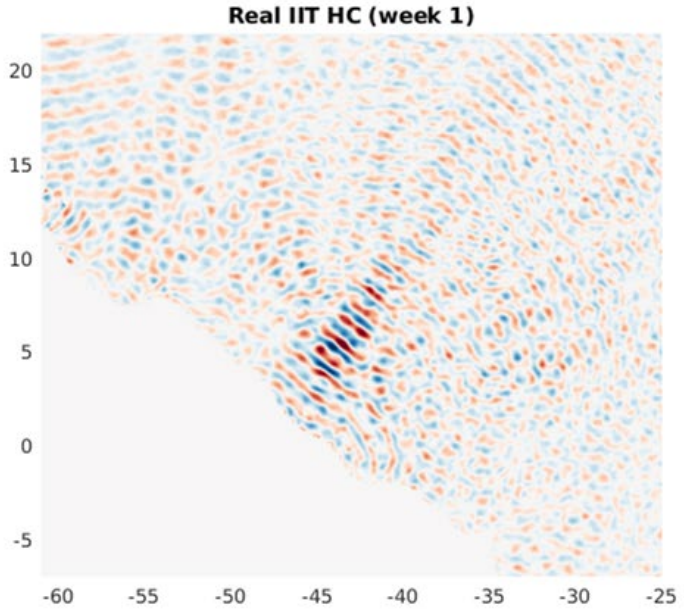
Temporal modes

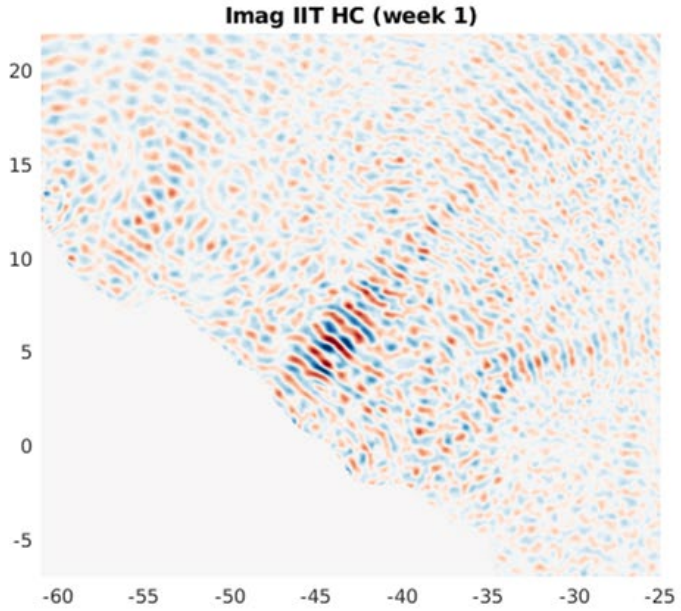
Sequence of harmonic constants

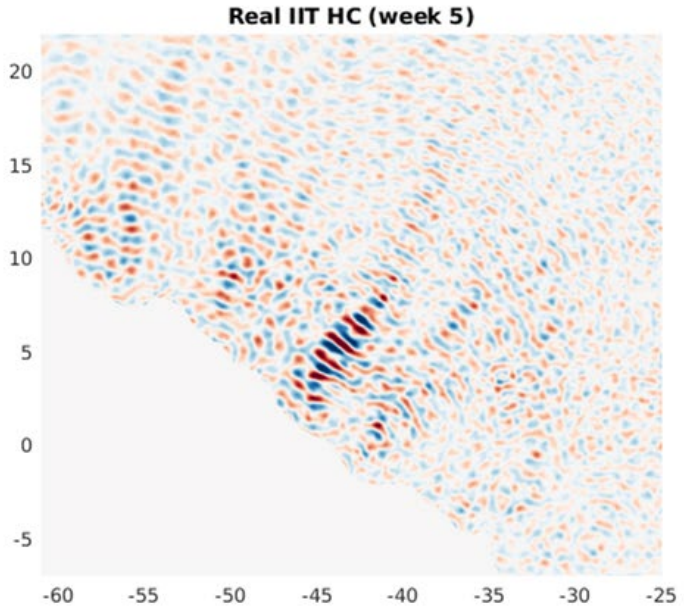
Spatial modes

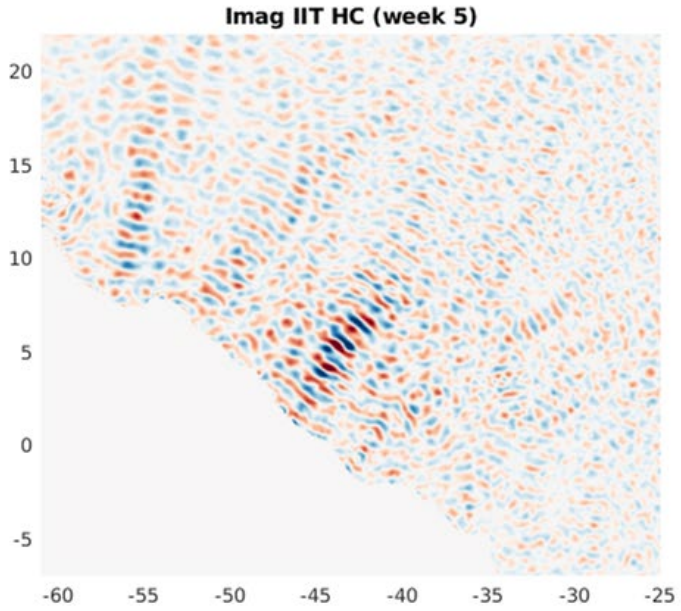
Based on Egbert and Erofeeva, *Geophysical Research Letters*, 2021

Maps of M2 incoherent internal tides



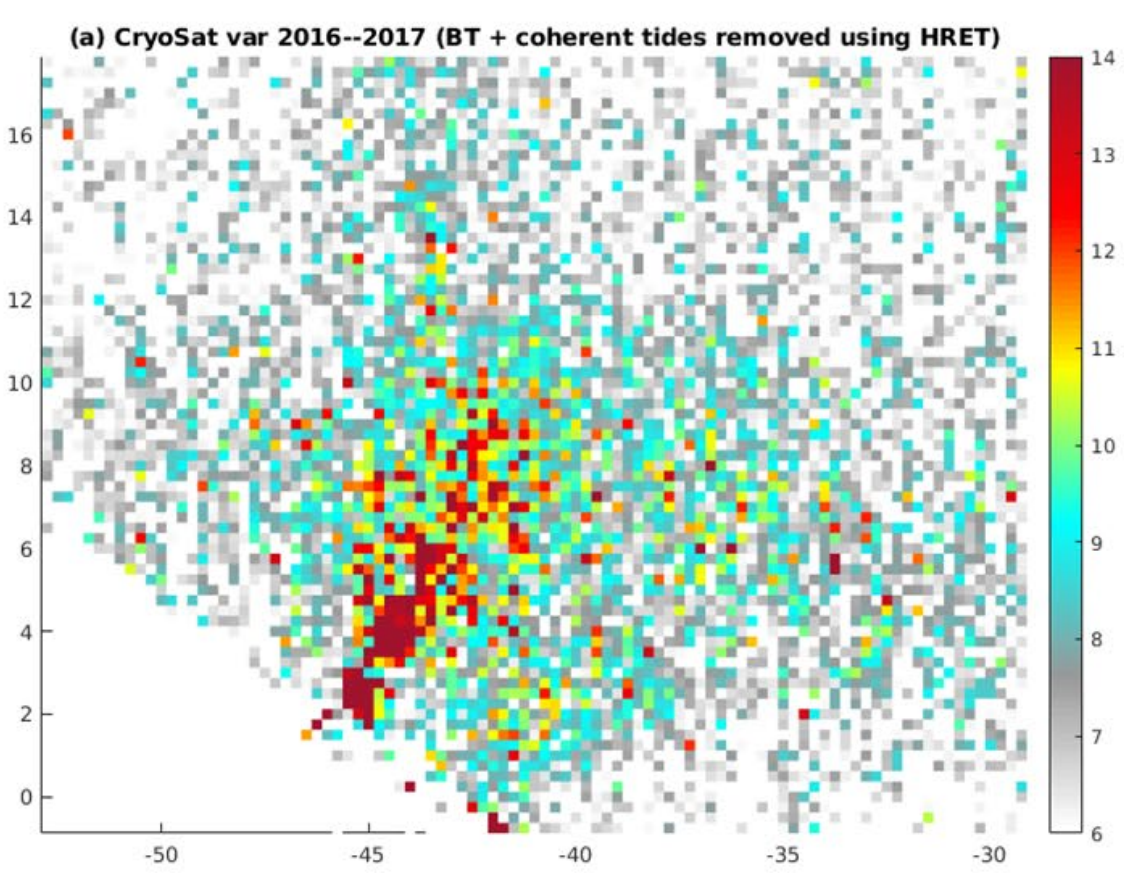


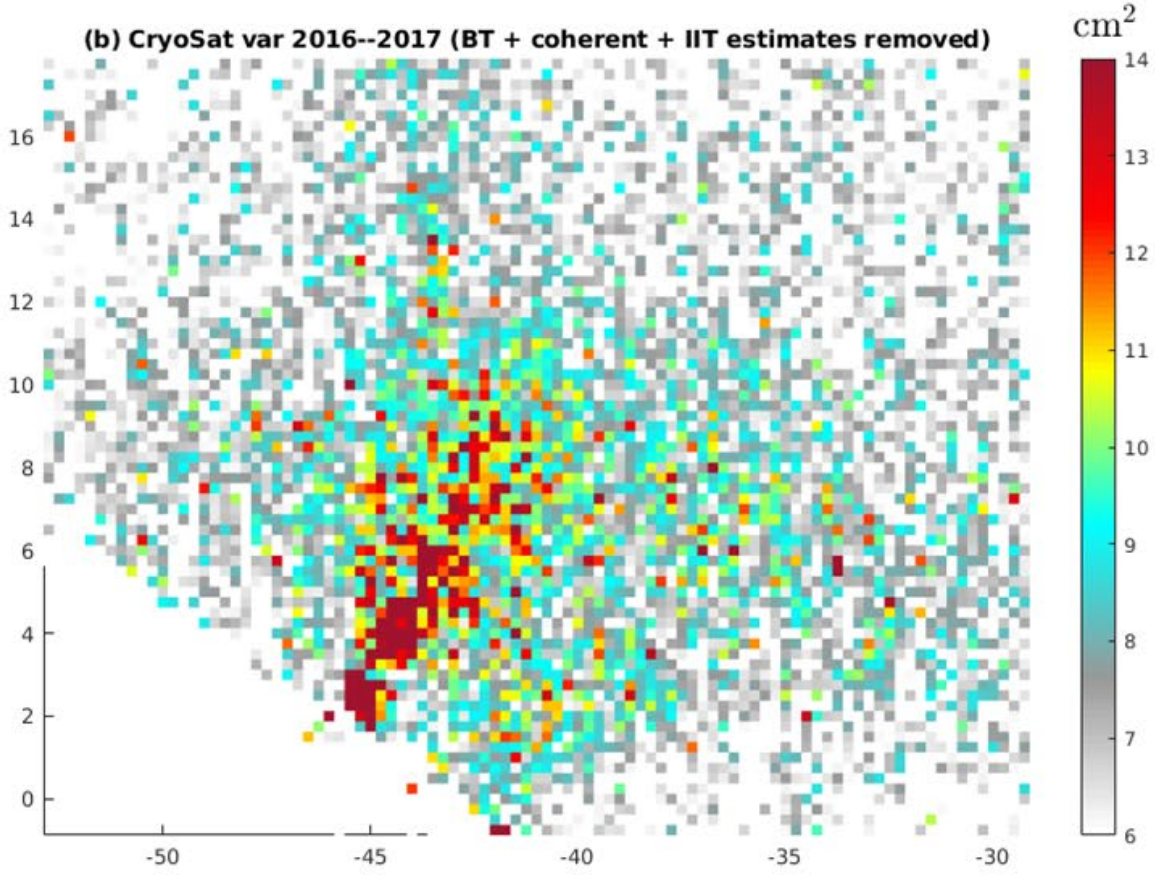




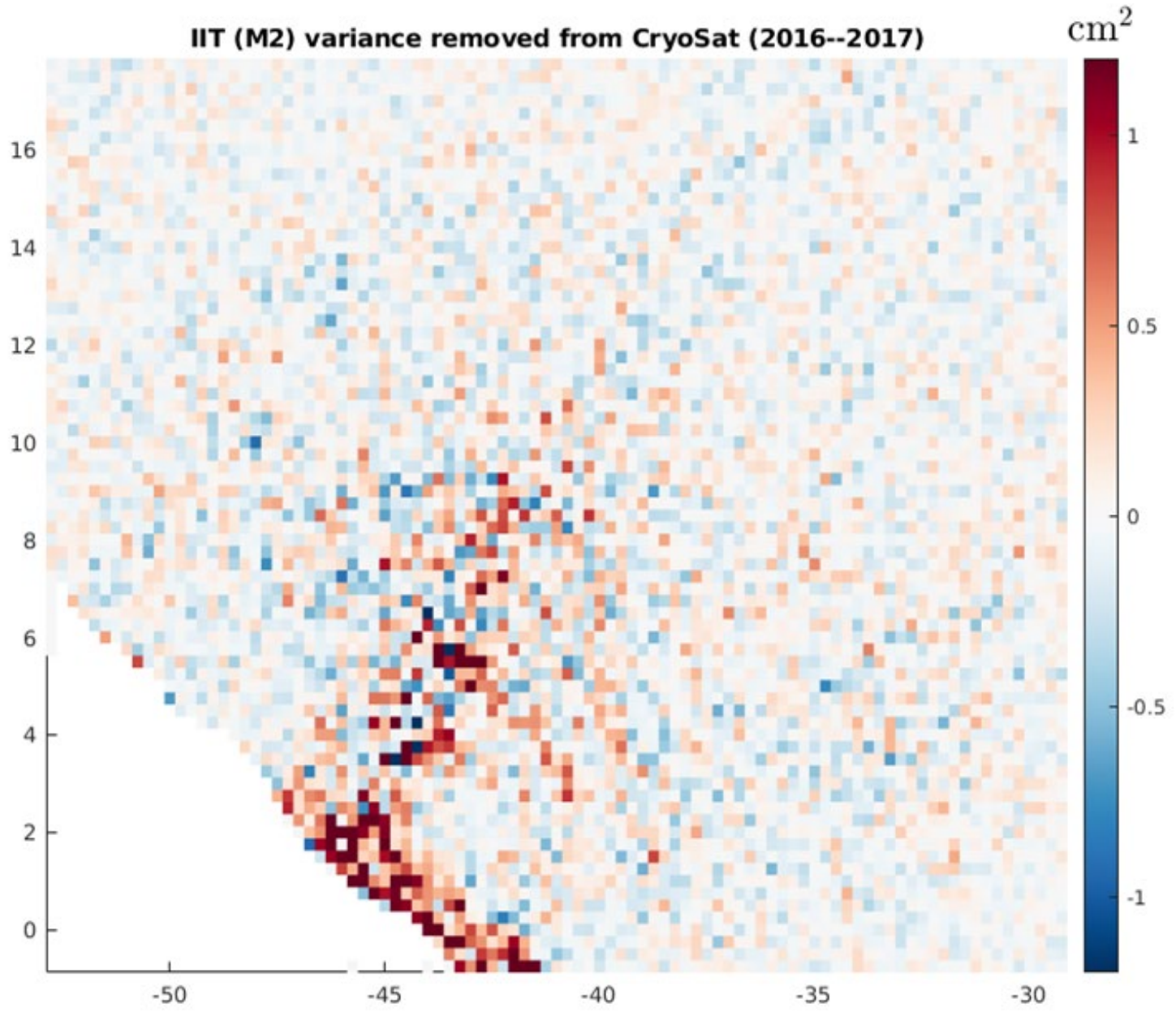
- Obtained by fitting traditional altimeter (Jason, Sentinel, SA) data with model basis functions
- Variable in space and time
- Strongest amplitudes near the Amazon shelf area

CryoSat-2 variance before and after removal of M2 incoherent ITs

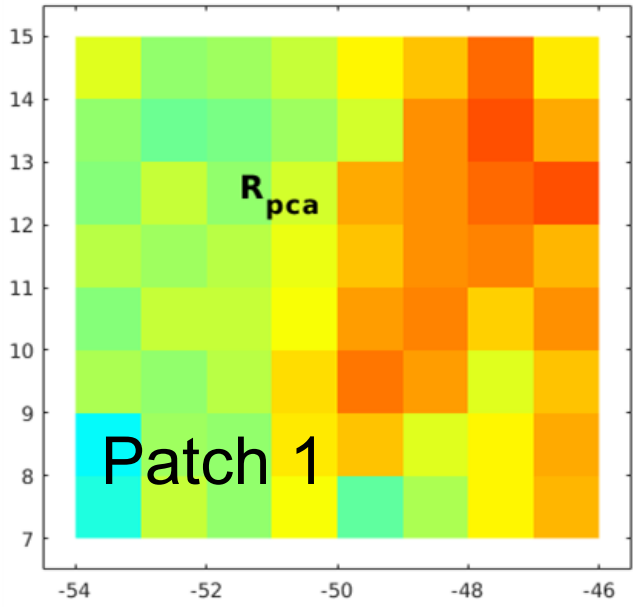


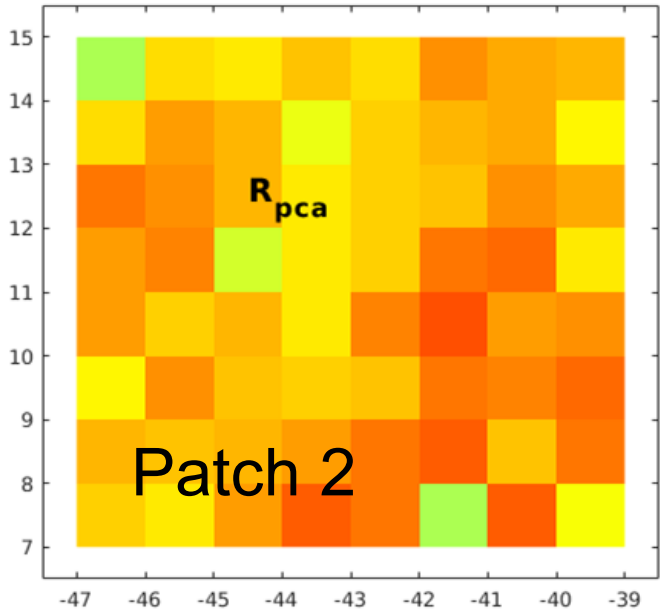


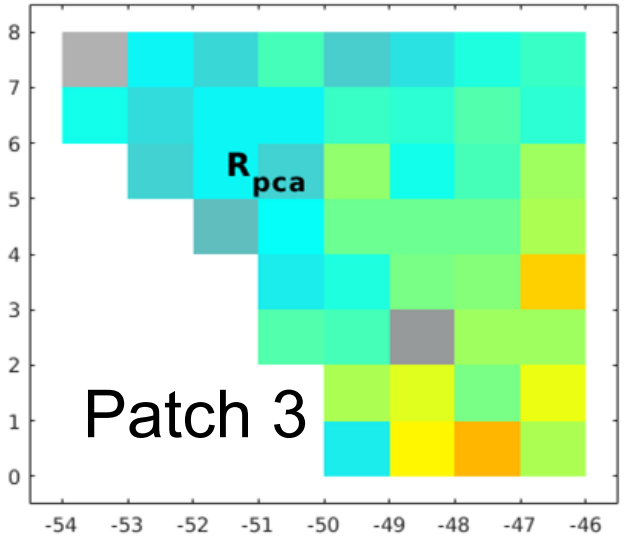
CryoSat-2 incoherent M2 IT variance removed

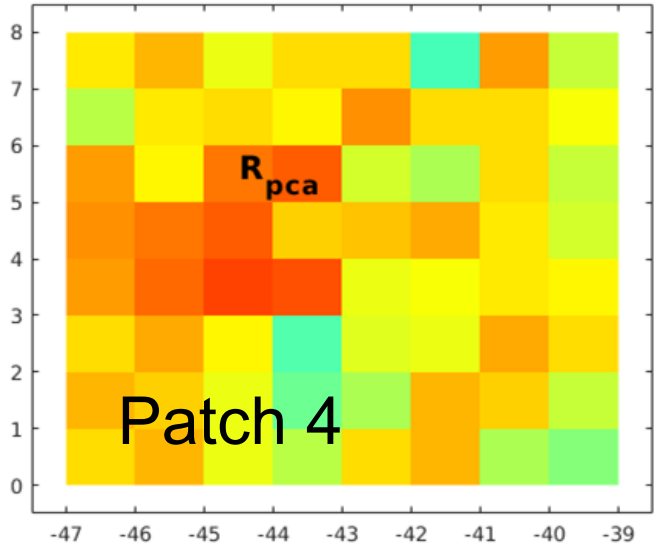


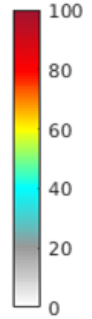
Variance explained in SWOT simulator noise + HYCOM SSH











Fraction of non-stationary variance in the M2 band recovered by fitting the sparse synthetic SWOT dataset

Avg R_pca for:

Patch1 = 62%
Patch2 = 68%
Patch3 = 45%
Patch4 = 65%