# Heat and Desiccation Risk Prediction in Intertidal Shellfisheries

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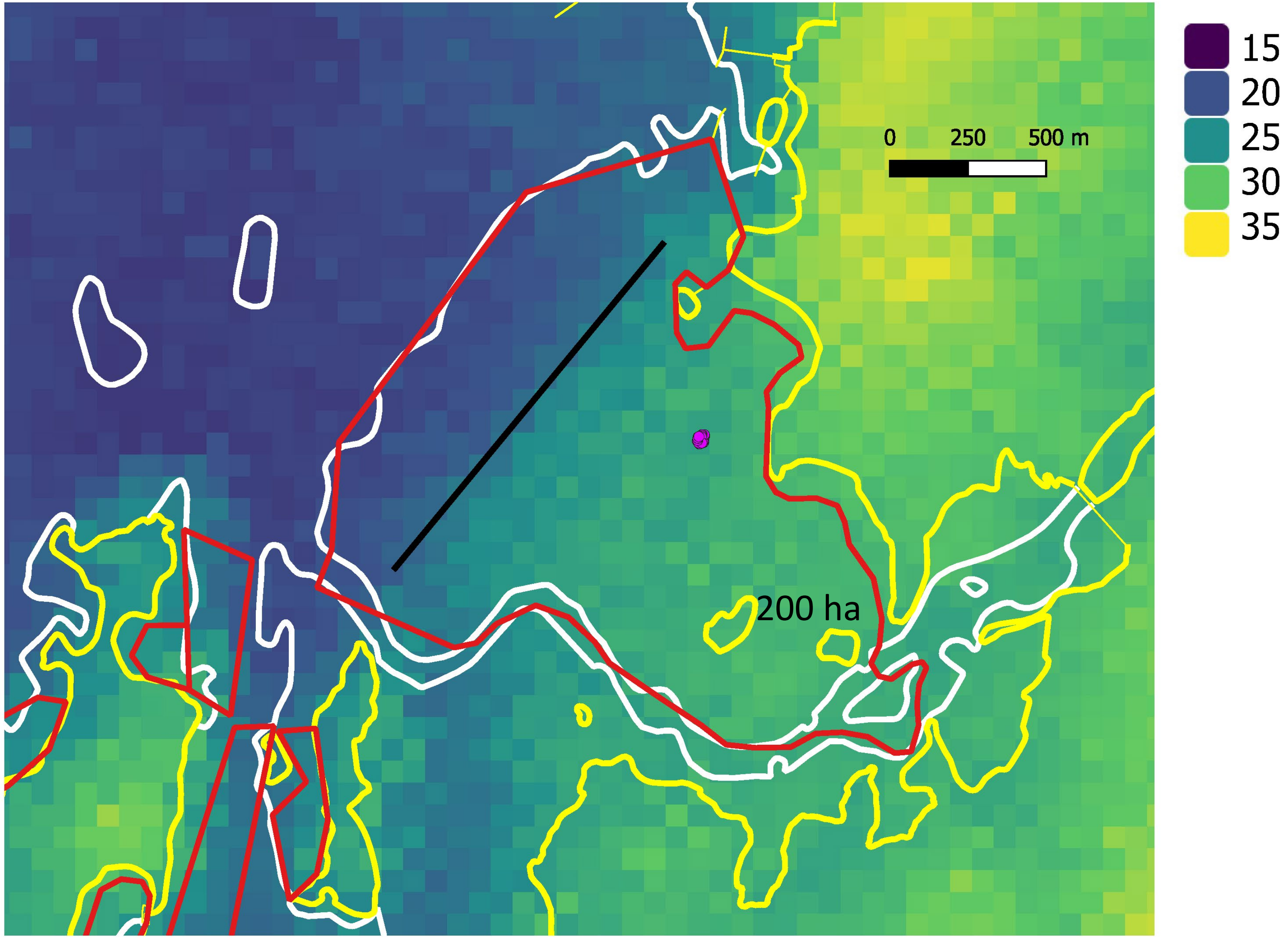
# Intertidal Shellfish beds in Galicia, NW Spain

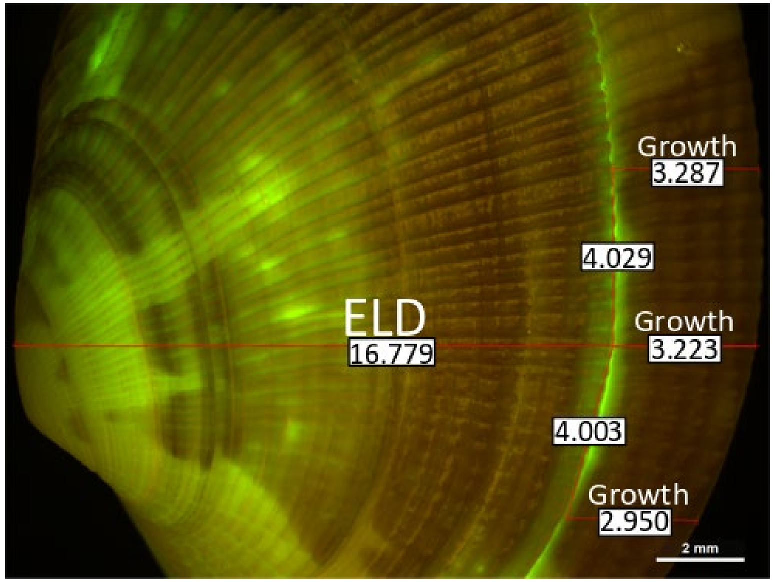
Aug 22, 2020 13:01 UTC
Low Tide: 0.49 m at 11:02 UTC

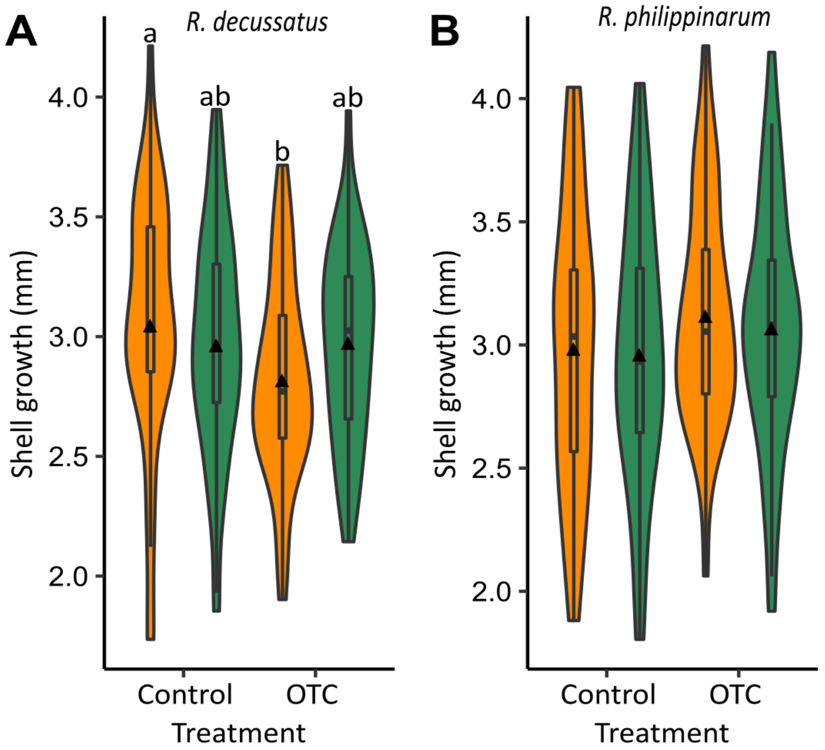
Temperature gradients from high to low tide marks well resolved: 8° C difference between high and low tide marks.

The most commercially valuable clam species are at the highest risk of mortality and stunted growth from heat waves, so identifying hot spots to be avoided and cool areas that are best for clam production is important for the fishery.



Field experiment to create heat waves with open-top chambers




Bare sand areas were compared to areas with seagrasses that provide shade and may mitigate effects of heat waves. Two 7-day low intensity heat waves (+3°C) created by the open top chambers reduced clam growth over 30 days in one of two species.  Seagrasses reduced the effects of the heat waves.

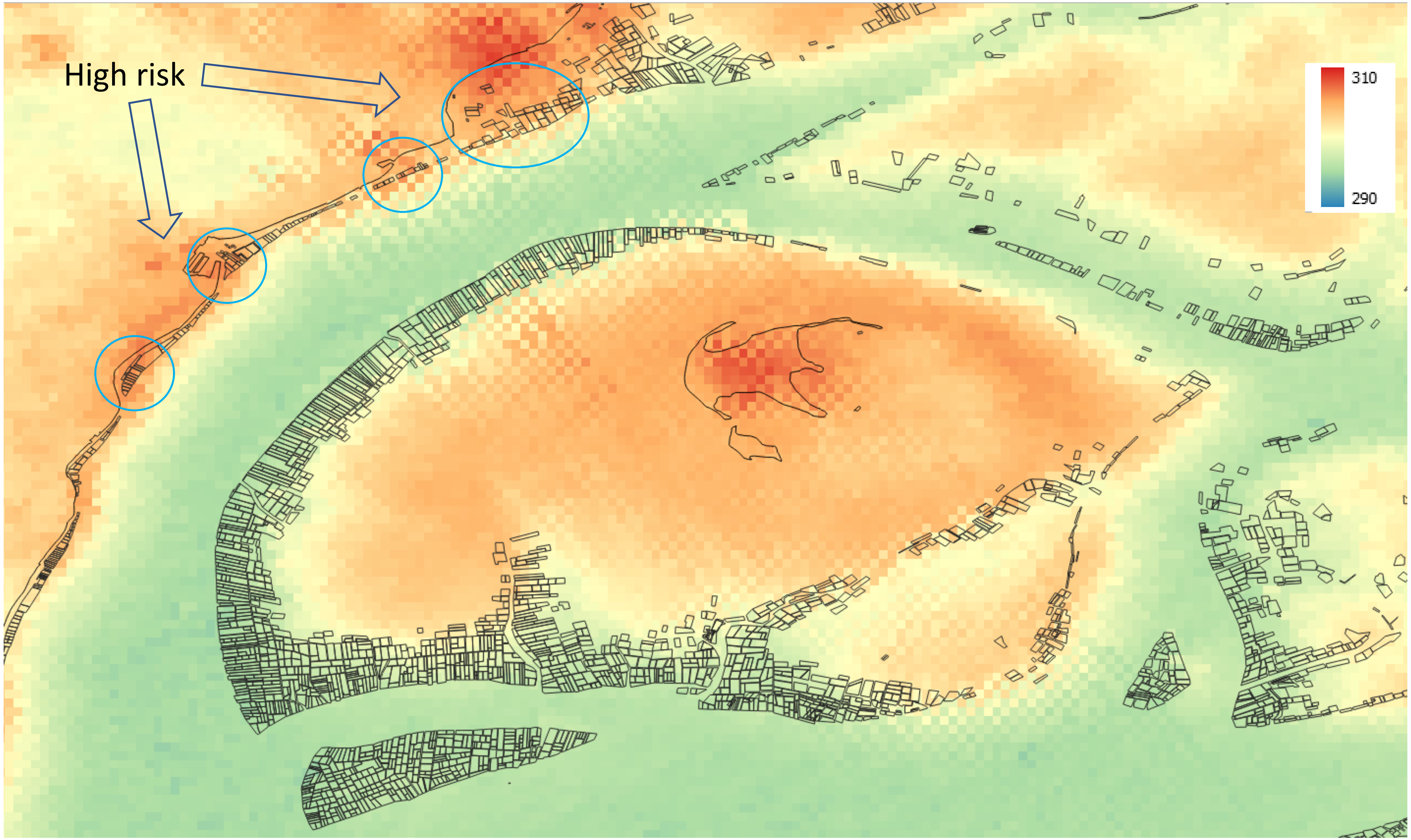
# We can identify individual 1-hectare plots where the risk to the oyster harvest is greatest

Artifacts in the ECOSTRESS retrievals

Checkerboard patterns: which pixels best represent actual temperature?

Clearly checkerboard patterns are not physically possible in tidal creeks.

How much of the spatial variation is instrument noise and how much is actual in-situ variability?

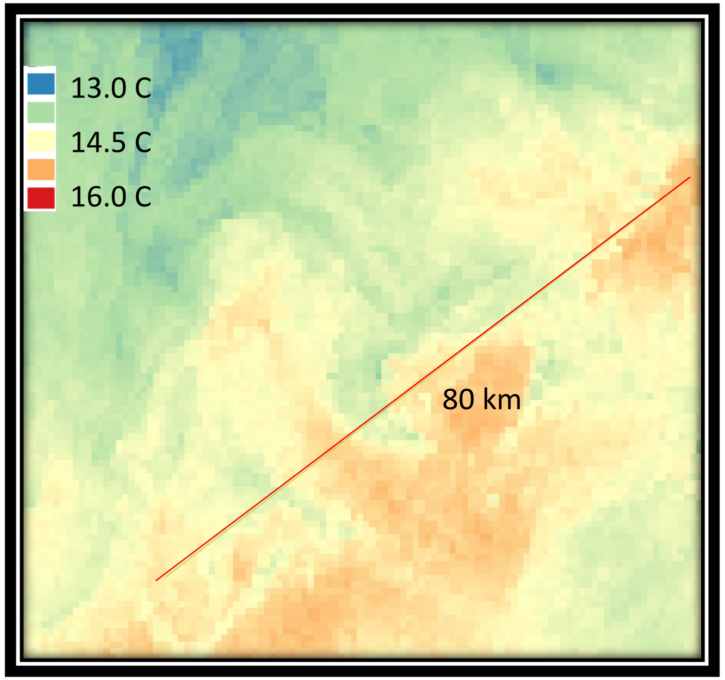



Intertidal temperatures reach 35C on oyster racks at some sites, above thermal optimum for oysters.

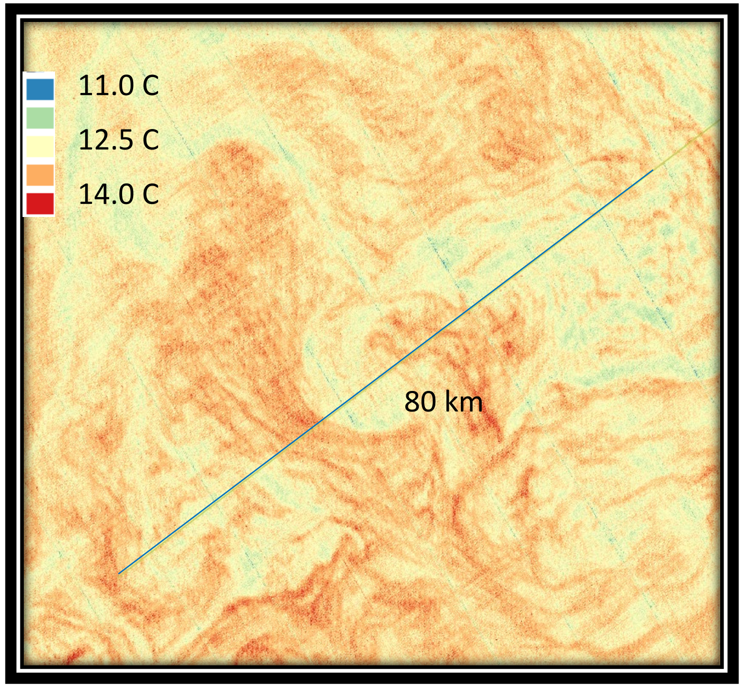
# ECOSTRESS Importance for Coastal Oceanography

NW Spain: Upwelling filaments and internal waves 2021-03-28

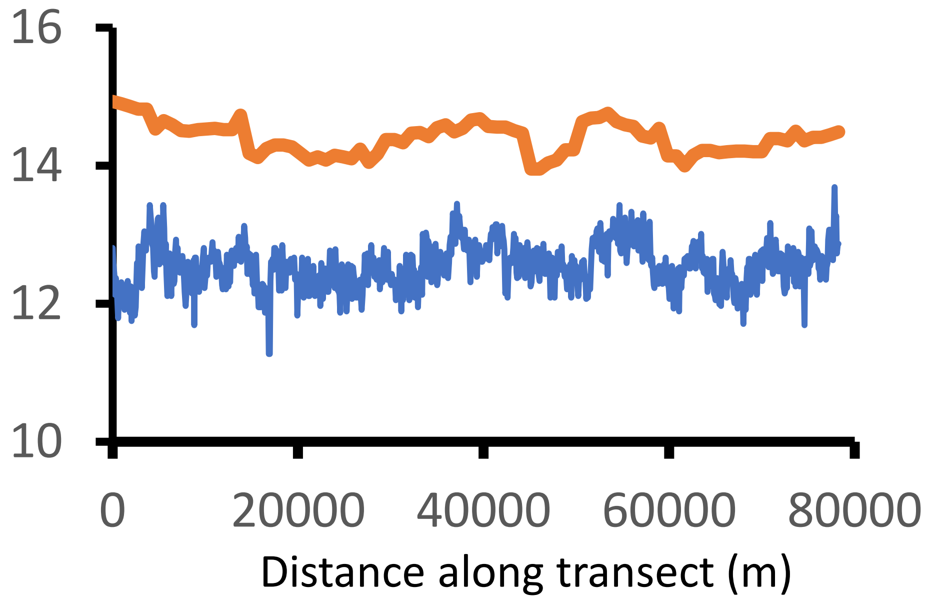
SST-VIIRS N20: 750 m pixels



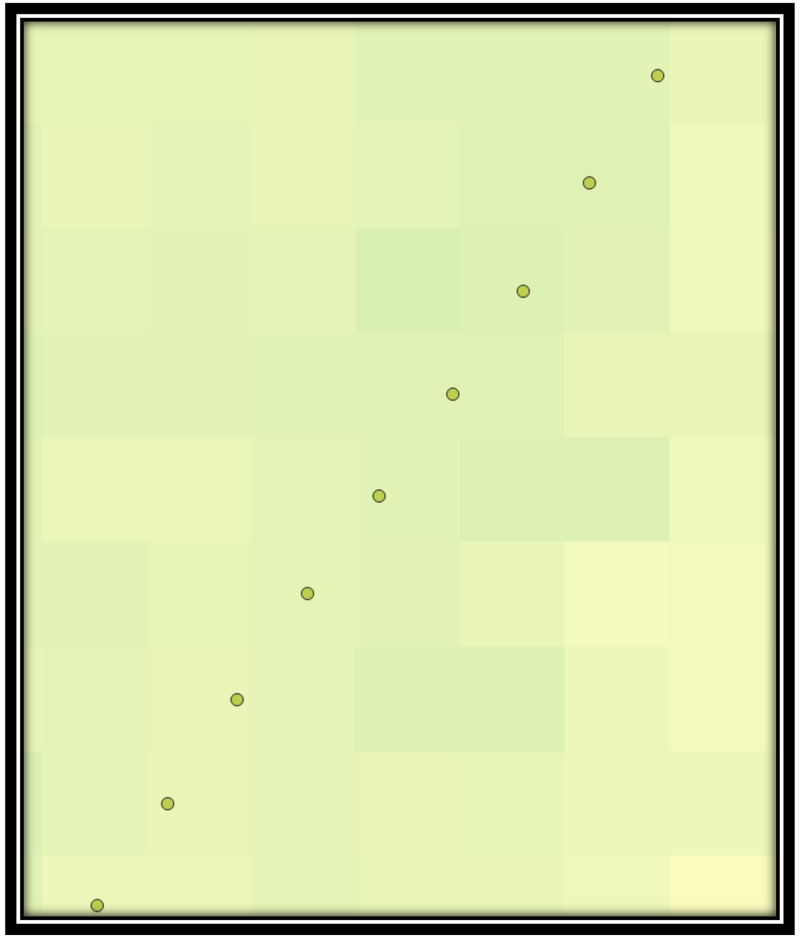

SST-ECOSTRESS: 70 m pixels




High spatial resolution of ECOSTRESS allows the detection of small scale SST structures that cannot be captured by operational satellite SST products from other satellite platforms but the signal is noisy.



# 4-9-2019 ECOSTRESS_L2_LSTE_06598_001 vs Saildrone 1039 NOAA

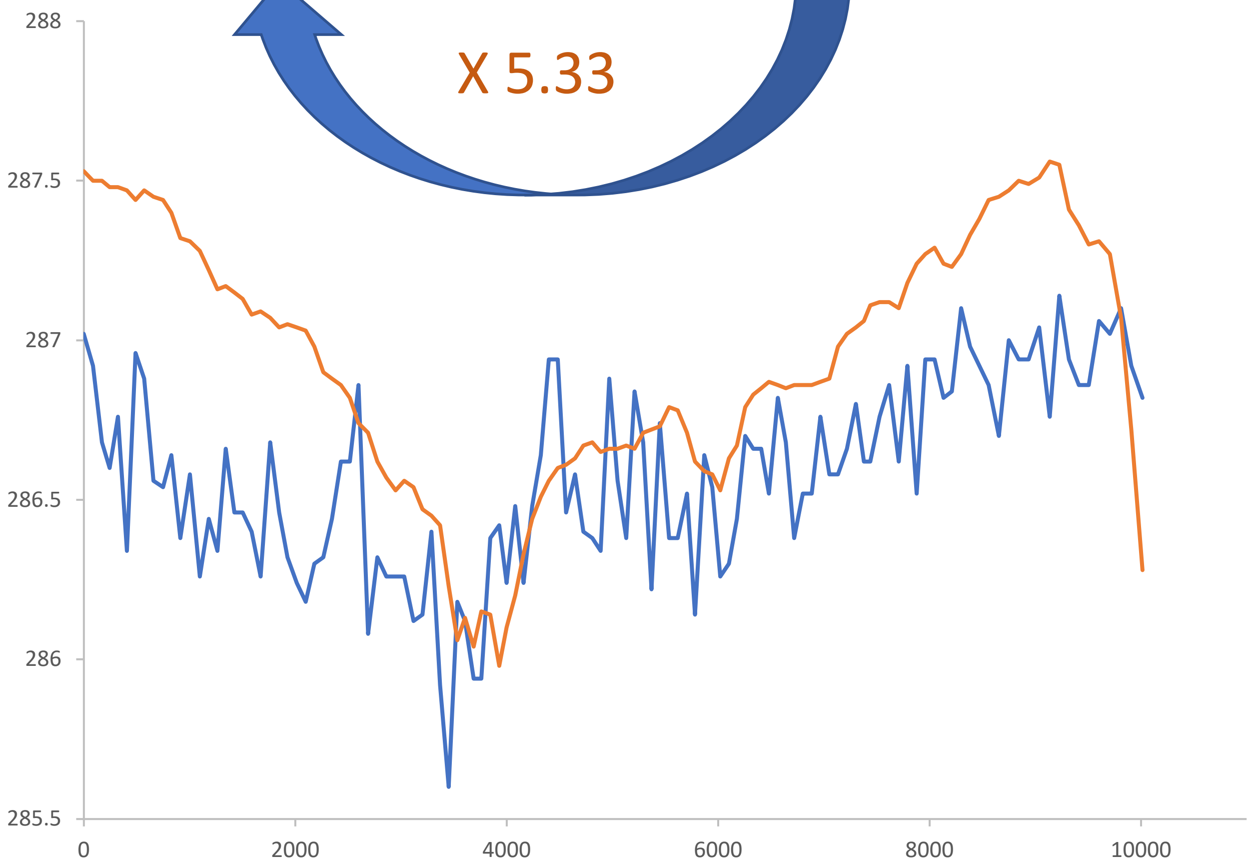


1 ECOSTRESS pixel = 1 saildrone measurement

ECOSTRESS
Von Neumann SD =0.1677

Saildrone RBR CTD
Von Neumann SD=0.0314

X 5.33



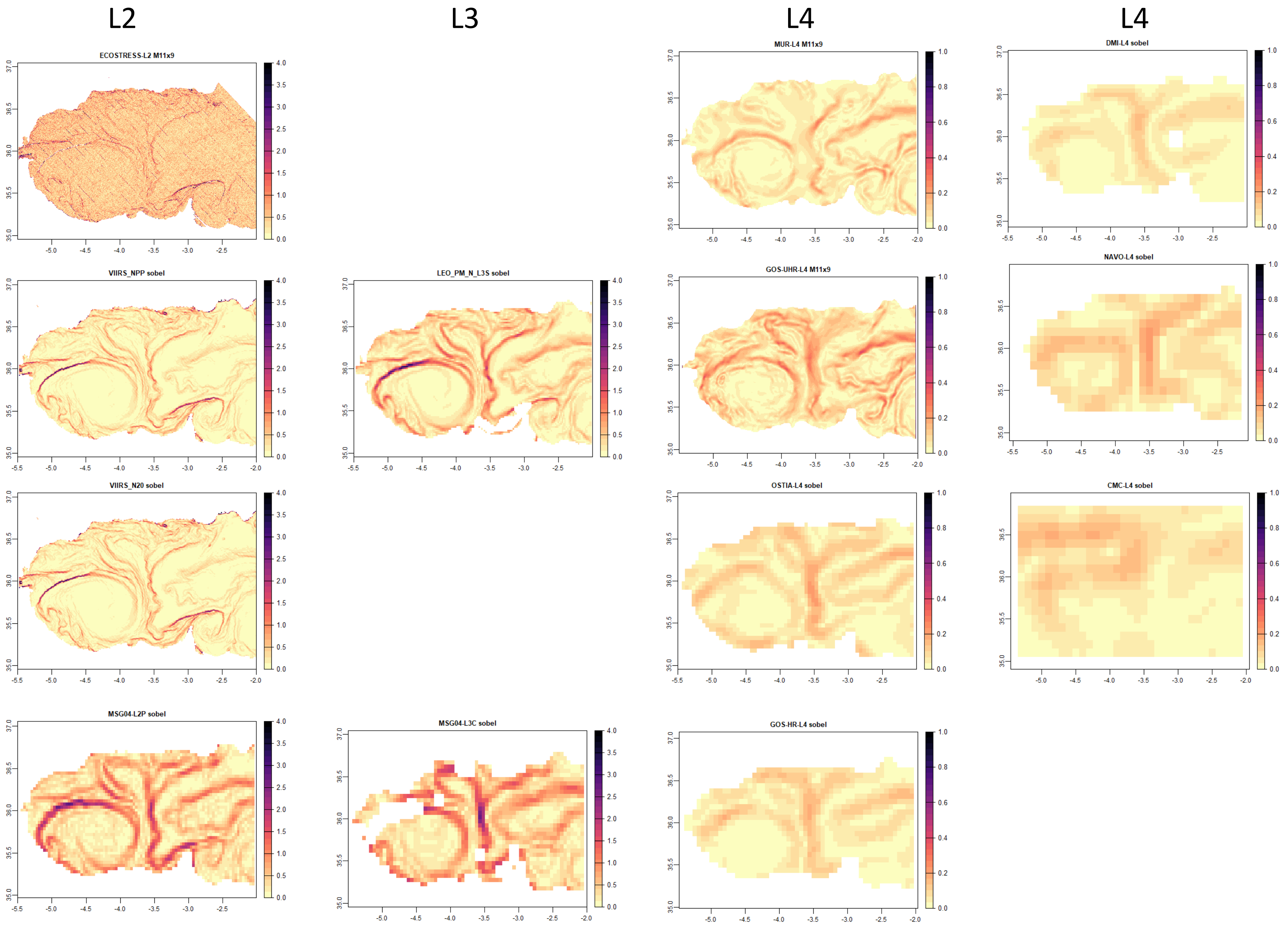

Robust SD of successive differences is measure of NEdT

Mediterranean Gyres
2021-08-30 02:26

ECOSTRESS resolves locations and intensities of gradients better than any other ocean product, but due to the high noise level, only the steepest gradients are resolved.

ECOSTRESS requires 11×9 Holoborodko smooth low noise gradient kernel to resolve gradients.

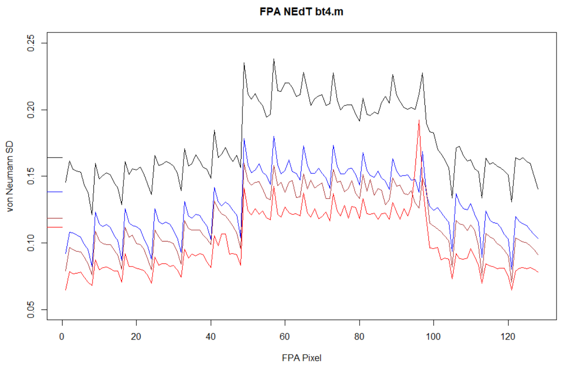
All other products resolve gradients with 3×3 Sobel operator.



# Origins of the noise

Noise level variation within Focal Plane Array (FPA)

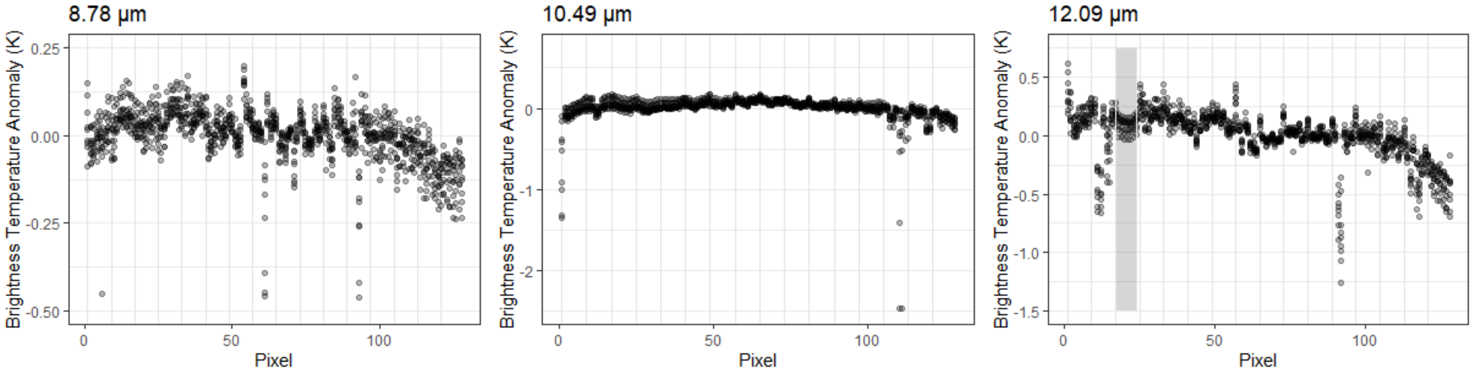
Cross track noise measured with median absolute deviation of successive ocean pixel BT differences (von Neumann SD).
Middle of focal plane array noisier than ends.
8-pixel periodicity in the noise level.
Cold scenes have higher noise levels.




Black – Sakhalin Island BT 271.4
Blue – English Channel BT 279.7
Brn – Australia BT 291.0
Red – Arabian Gulf BT 301.8

Variation in pixel sensitivity within Focal Plane Array

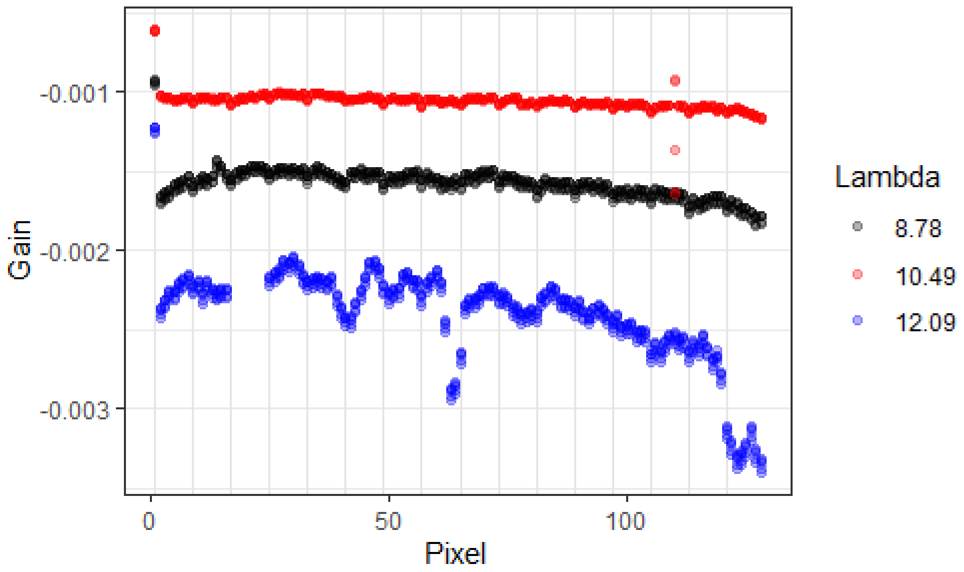
Brightness Temperature anomalies relative to mean focal plane BT of ocean pixels (5400×44 per scene).
Pixels 100-128 have negative anomalies in all bands.
This is the origin of the checkerboard pattern because pixels 1-30 overlap pixels 86-128 in scenes.
8-pixel periodicity in anomalies.




Each dot is mean pixel anomaly within Focal Plane Array in a scene.
9 scenes of English Channel Feb 2019 – Sept 2021.
Grey area pixels at 12.09 μm are non responsive and radiance data are interpolated in JPL processing.

# Noise Reduction and Striping in Scenes

Mean FPA Gain vs Lambda




7 scenes of English Channel May 2019 – Sept 2021.

8-pixel periodicity in gain values

Gain values work perfectly for the black bodies, yielding constant radiance across the black bodies but there is striping in the matching scene radiance and LST products.

Gain and offset values may be over-specified.

HgCdTe sensors like ECOSTRESS and AVHRR are somewhat non-linear, so the non-linearities may cause the anomalies in focal plane array calibrations for scene temperatures lower than that of the cold black body (293 K).

e.g. Mittaz et al. 2009, J Ocean Atmos Tech 26:996-1019

Possible work-around: use ocean scenes with collocated satellite skin temperatures – radiance transfer modeling to predict brightness temperatures for non-linear calibration.

Alternative: destriping software e.g. Bouali & Ignatov 2014, J Ocean Atmos Tech 31:150-162 (this reduces resolution).