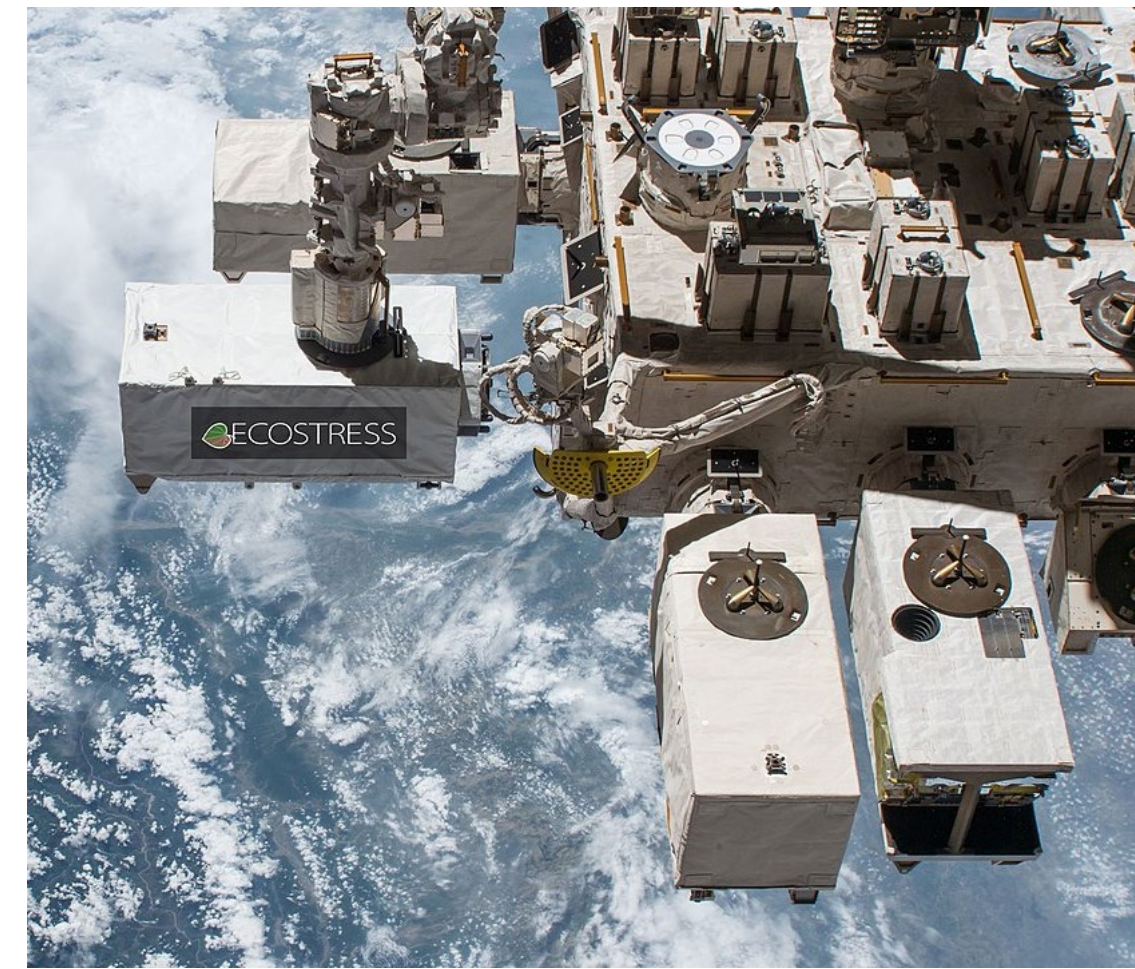# Validation and use of the new high resolution NASA ECOSTRESS instrument in highly valuable harvested intertidal environments

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ECOSTRESS Instrument: Designed for Terrestrial Applications (LST)

NASA-JPL design & data processing
TIR Bands 8.78, 10.49, 12.09 µm
Pixel size 69×38 m aggregated to 69×69m
Swath width 384 km
Scene size 5400 × 5632 pixels
Nominal Radiometric accuracy 0.5°K
Precision per band 0.13,0.10,0.29°K
Blackbodies 20°C, 46°C

Return interval subdaily to 5 days

>260,000 scenes since 2018-07-09
Archived by USGS-LPDAAC

ECOSTRESS LST Algorithm

Derived from Landsat LST Algorithm
Uses 8.78, 10.49, 12.09 µm bands
Temperature-Emissivity Separation Method
Iterative convergent solution
Emissivity solutions over water can be
    erroneous so SST is subject to errors

Validation: Comparison of Cloud-Free ECOSTRESS pixels co-located with Cloud-Free NOAA/ESA Geostationary Pixels and NOAA iQuam in-situ SST observations collected within 30 minutes of ECOSTRESS scenes

1 K cold bias relative to in situ observations. Same bias seen relative to VIIRS (Weidberg et al. 2021)

Validation: Comparison of Brightness Temperature Observations to Radiance Transfer Simulations
RTTOV/ERA-5 Observation-Model Double Differences
ECOSTRESS – NOAA Geostationary Brightness Temperatures
$$DD_{SAT-REF} = ECO[(Obs - RTTOV)] - ABI[(Obs - RTTOV)]$$

ECOSTRESS Brightness Temperatures are consistently colder than simulations and bias is temporally stable

ECOSTRESS BT bias is colder than NOAA Geostationary BT bias

ECOSTRESS 70m Pixel Resolution is Same Spatial Scale as Oyster Leases in Arcachon Bay, France

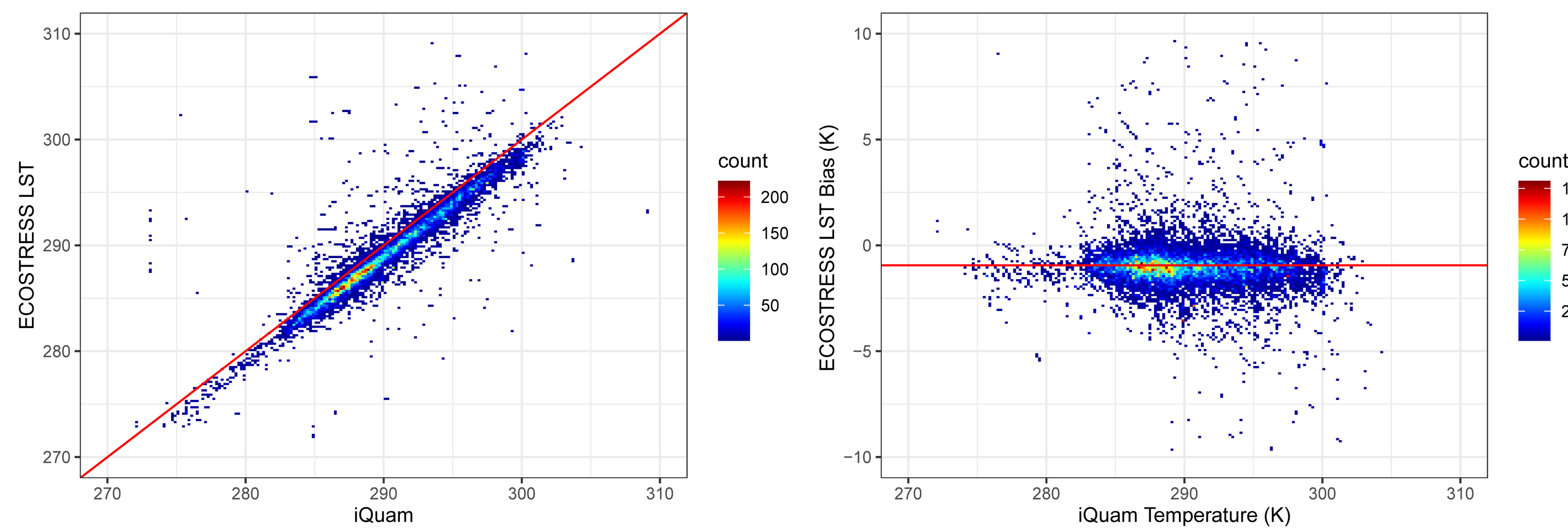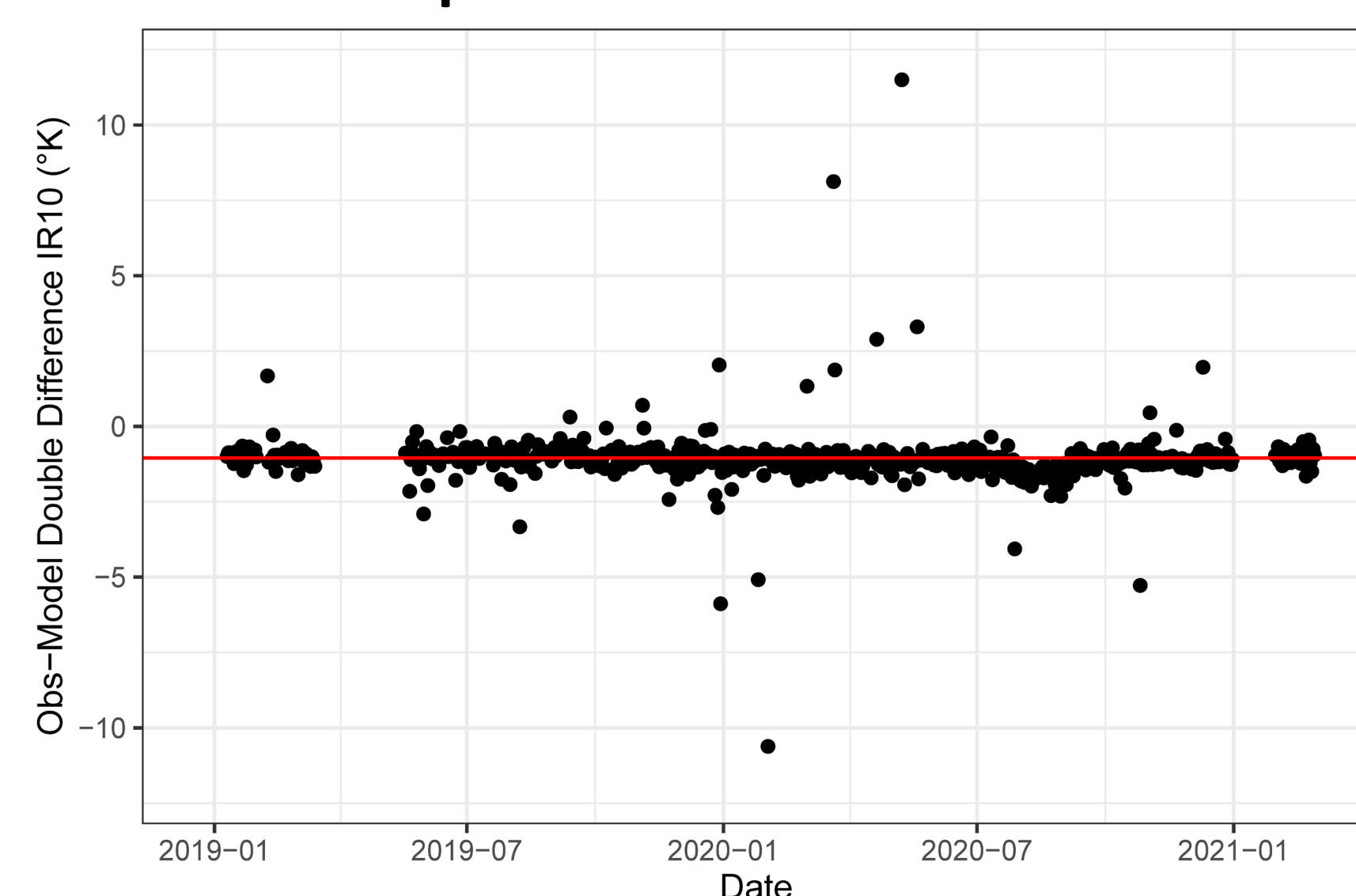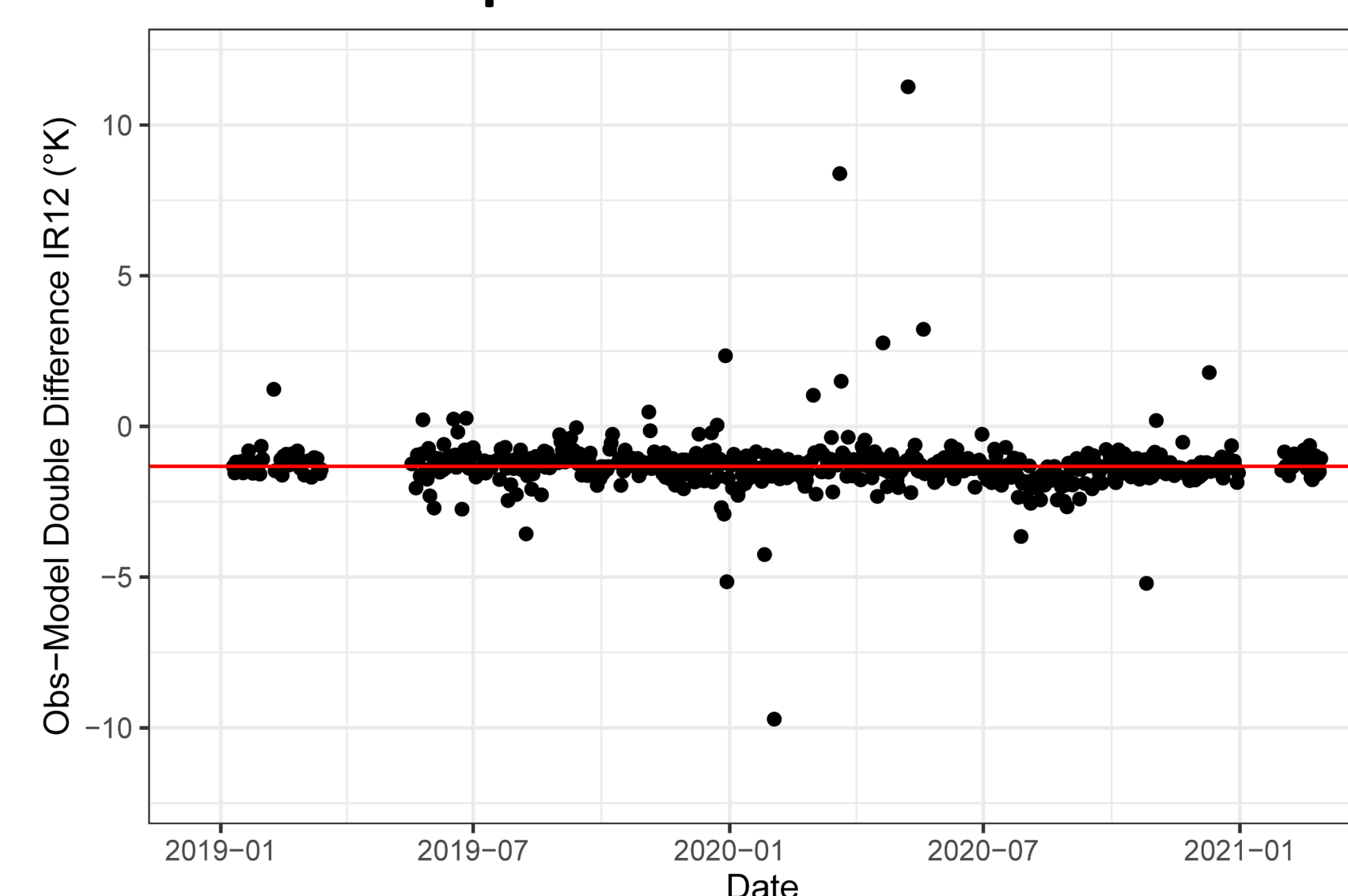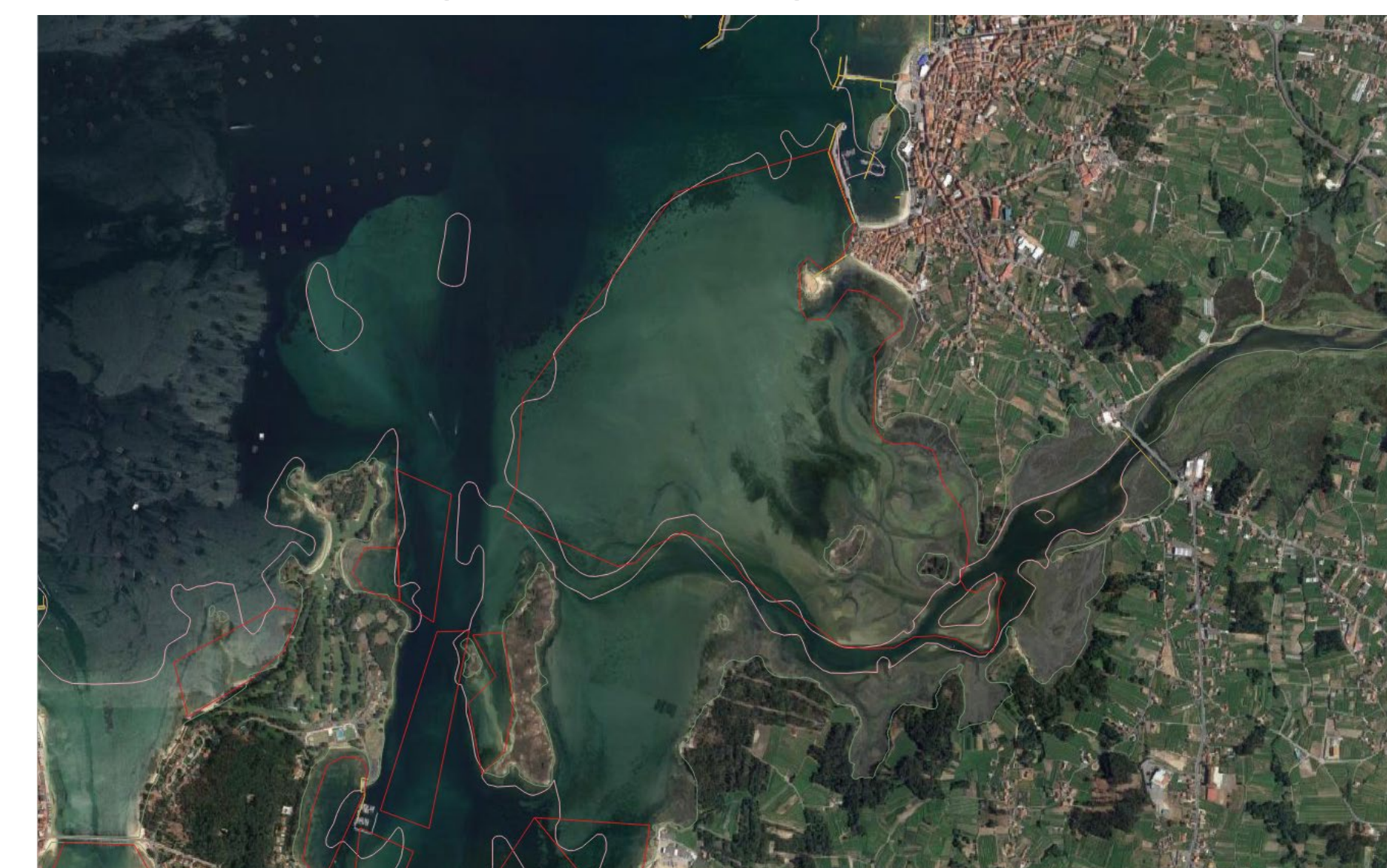**Bias-Corrected ECOSTRESS 2021-08-11 10:58+--**   **VIIRS N-20 2021-08-11 12:30**
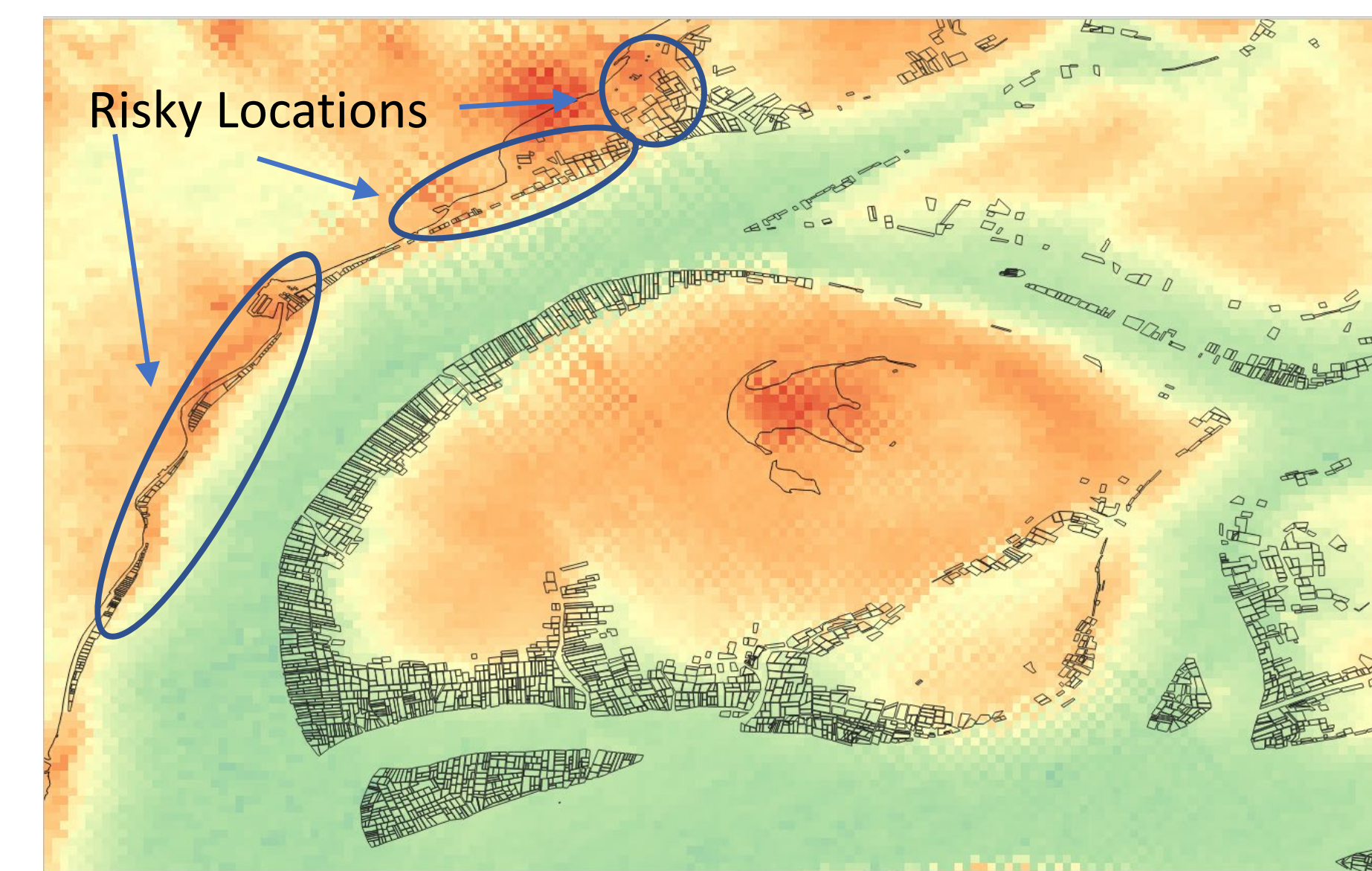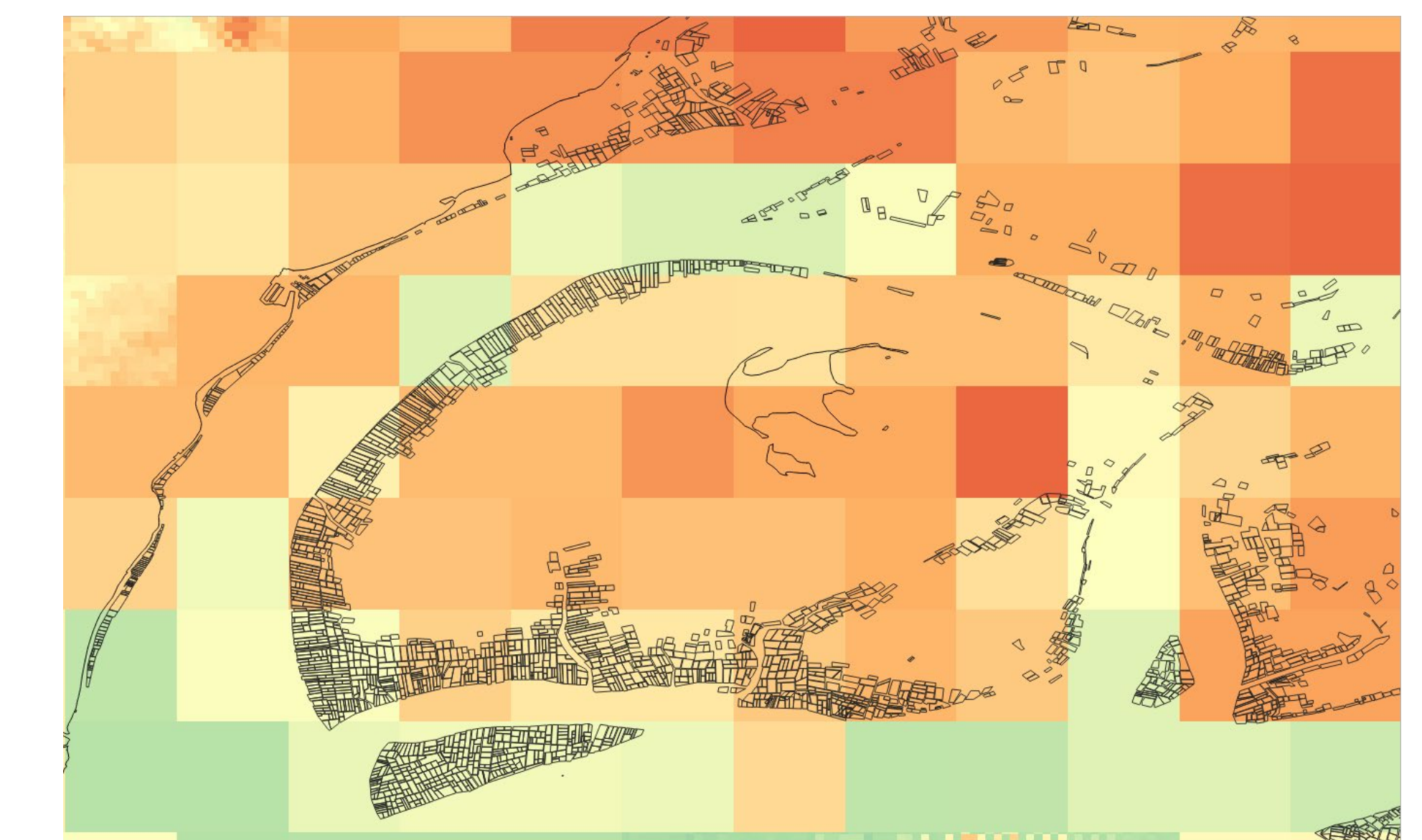
ECOSTRESS identifies individual leases where temperatures are near the upper thermal tolerance limit of oysters
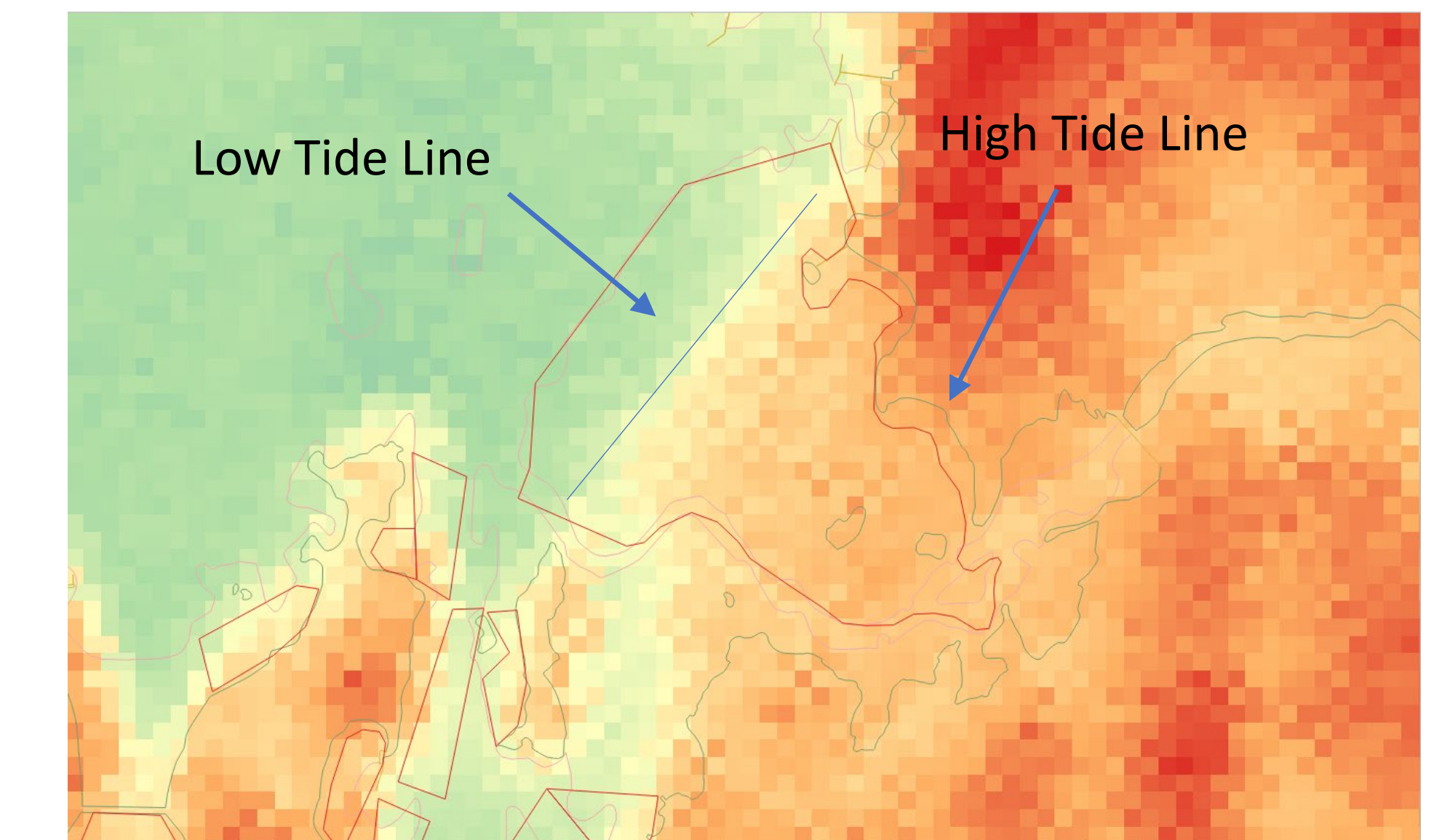VIIRS does not resolve temperature variation at necessary spatial scale to be useful.

ECOSTRESS Resolves Temperature Gradients in Clam Beds in Galicia, Spain

Google Earth Image   **Bias-Corrected ECOSTRESS 2020-08-22 13:01**

8°C temperature difference between
high and low tide marks in shellfish bed during low tide
Surface T at high tide line near lethal limit for clams

ECOSTRESS SST spatial resolution is 10× greater than VIIRS, and the sensor is temporally stable.

The cold bias of ~1°K in the sensor brightness temperatures can be easily compensated.

Bias correction of ECOSTRESS data yields a ultra-high resolution product with broad applications in biological oceanography and aquaculture, especially in the coastal zone.

ECOSTRESS provides a preview of what will be possible with TRISHNA starting in 2024-2025.

References
Weidberg N, Wethey DS, Woodin SA. 2021. Global intercomparison of hyper-resolution ECOSTRESS coastal sea surface temperature measurements from the Space Station with VIIRS-N20. Remote Sensing 13, 5021.