

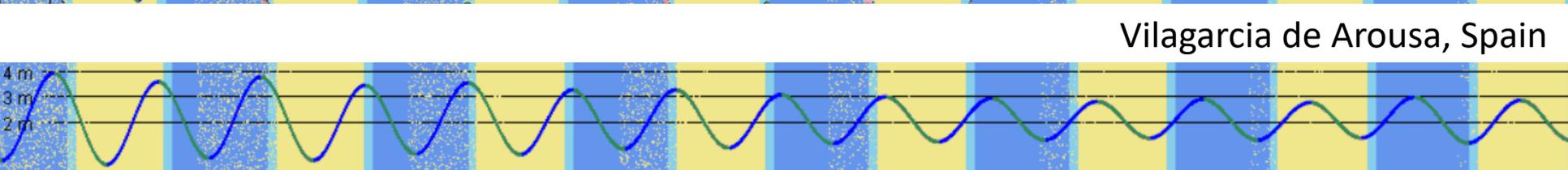
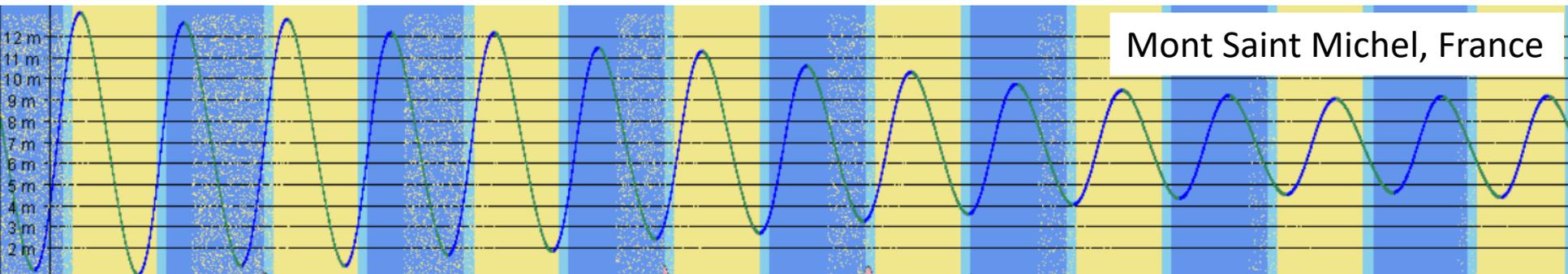
Heat and Desiccation Risk Prediction in Intertidal Shellfisheries

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80NSSC20K0074

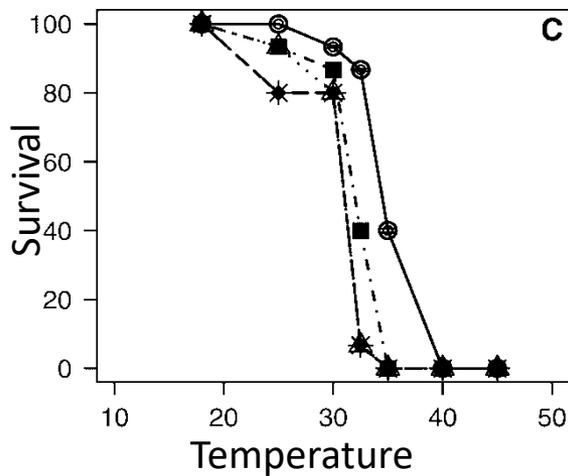
Shellfisheries

- Worldwide - Clams, Mussels, Oysters 13 M t /y, \$20.5 B/y
- France - Yearly ex farm value ~ \$1 B
 - 700 mussel farms, 2600 oyster operations
- Spain - Yearly ex farm value ~ \$1 B
 - 70 fisheries guilds, 1600 delineated shellfish beds
- Industrial scale farming on tidal sandflats
- Heat & desiccation stress during low tide causes mortality and reduced growth
- Stress potentially quantifiable by ECOSTRESS at scale relevant to the farmers
- Timing of stress varies with site, phase of the moon, weather, and shore level



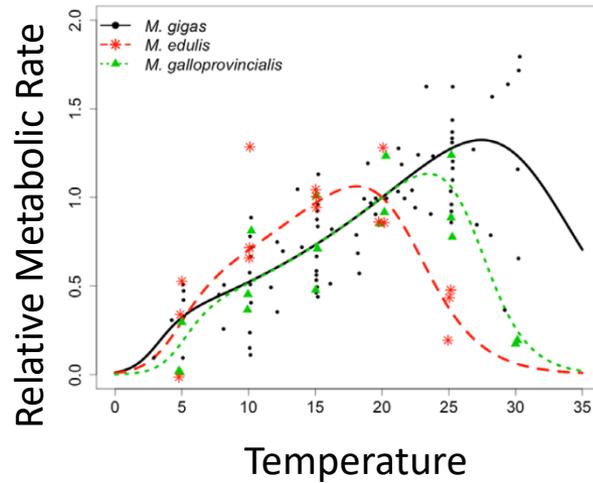
Temperature and Desiccation Matter a Lot

Mussel Survival after 6 hr exposure on 5 successive days



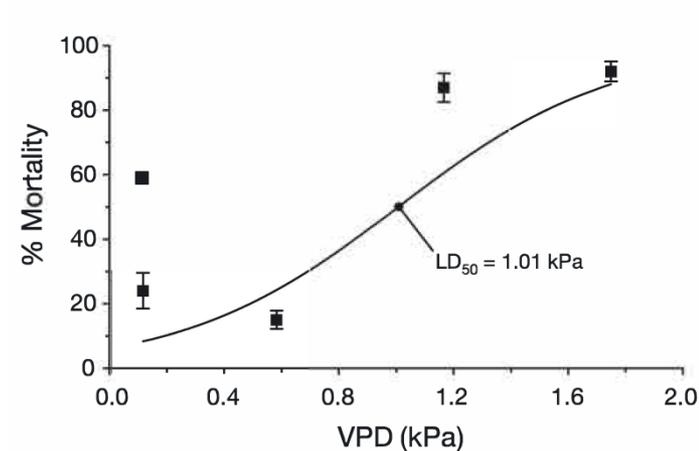
Jones et al 2010
J Biogeography

Metabolic Rates of Mussels and Oysters Relative to 20°C



Thomas & Bacher 2018
Global Change Biology

Mortality Rates of Mussels vs Desiccation Stress



Jenewein & Gosselin 2013
Marine Ecology Progress Series

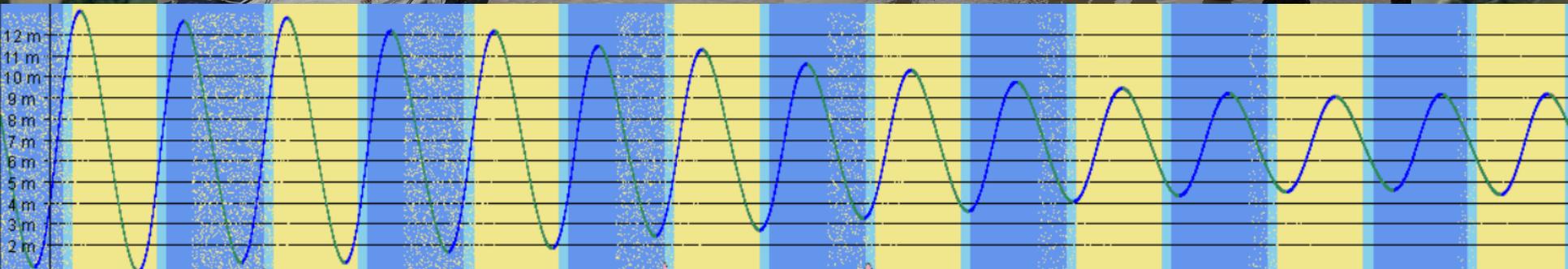
Intertidal Mussel and Oyster Culture France

2 km

Oyster Racks



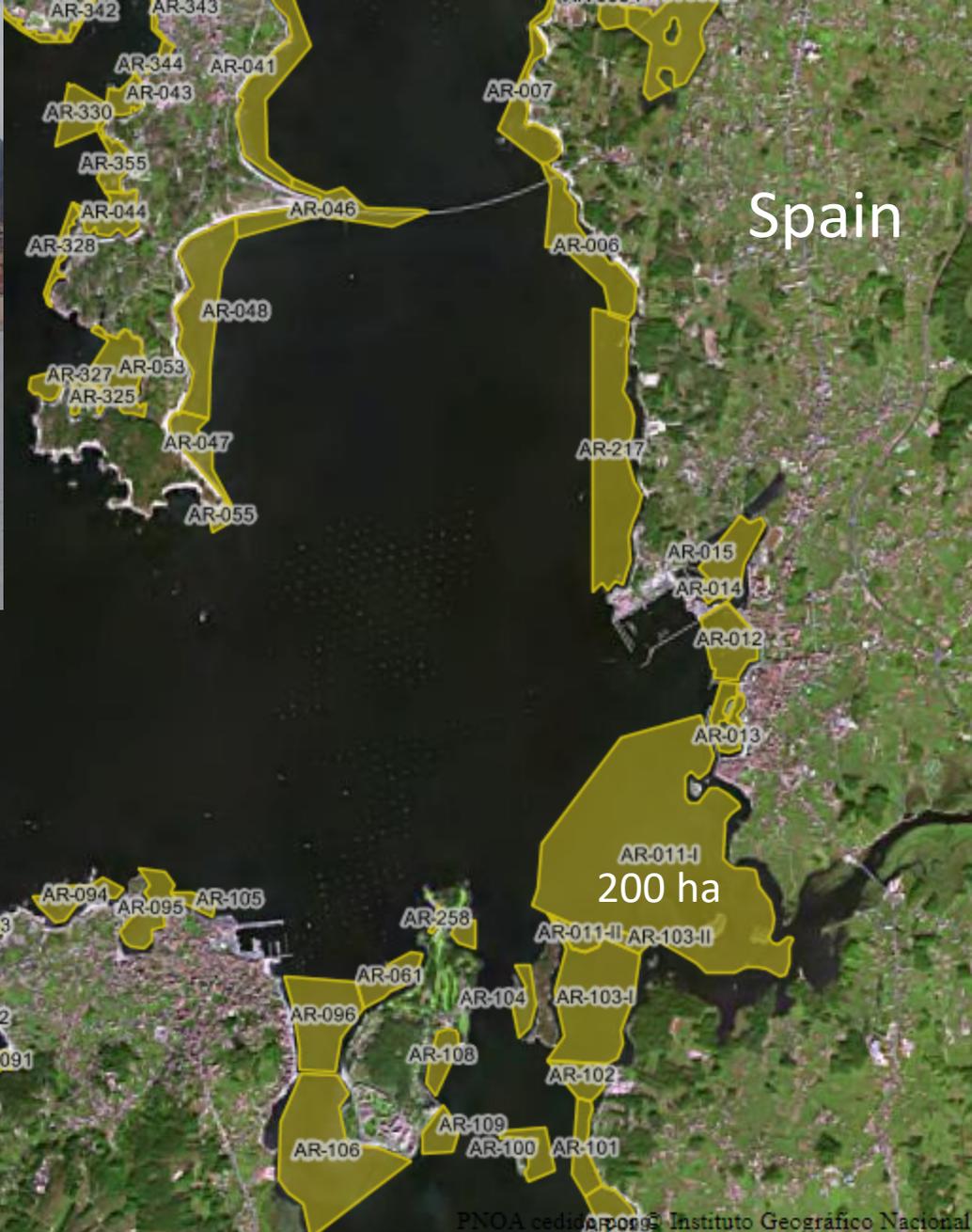
Mussel Bouchots



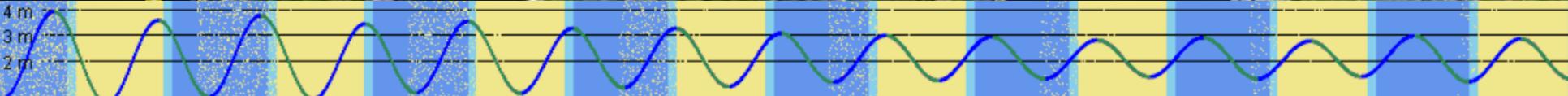
Clam Harvest on Foot



2 km



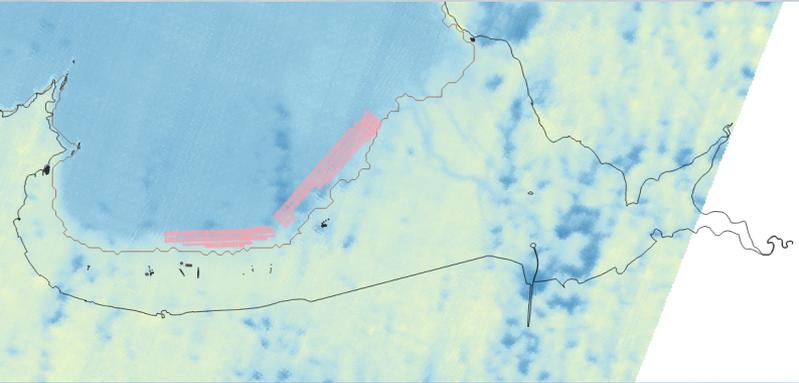
PNOA cedido por el Instituto Geográfico Nacional



ECOSTRESS Resolves Tide Position

03556_013_20190220T1257

Tide 0.31m



03477_003_20190215T1048

Tide 6.13m



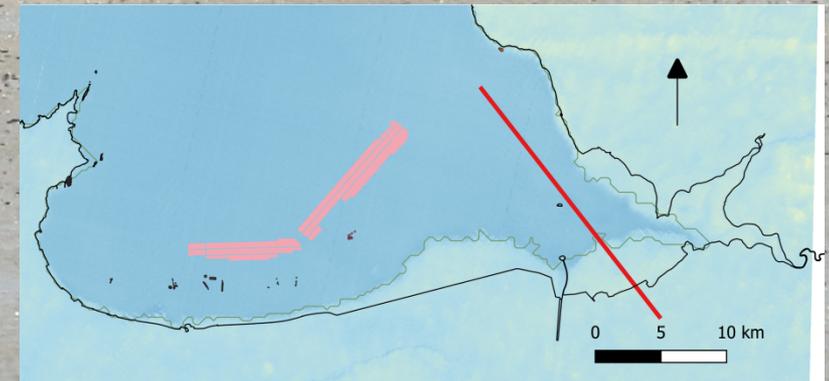
03479_009_20190215T1402

Tide 9.33m



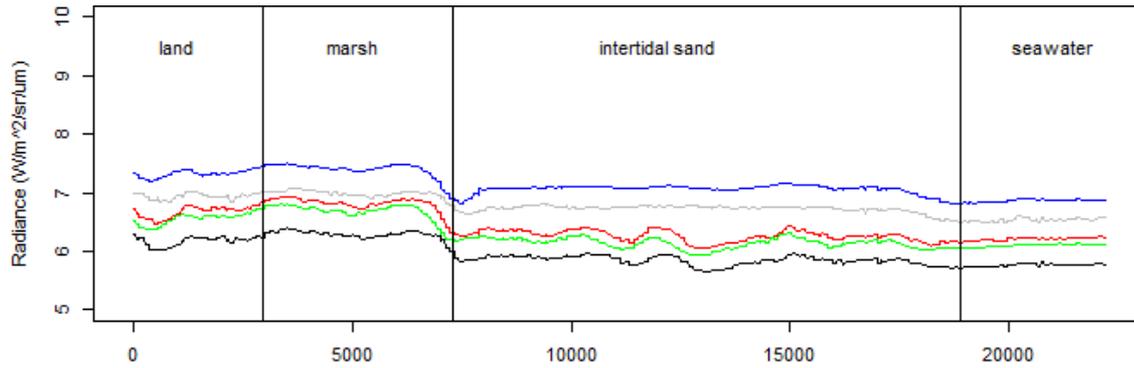
03632_010_20190225T1017

Tide 11.26

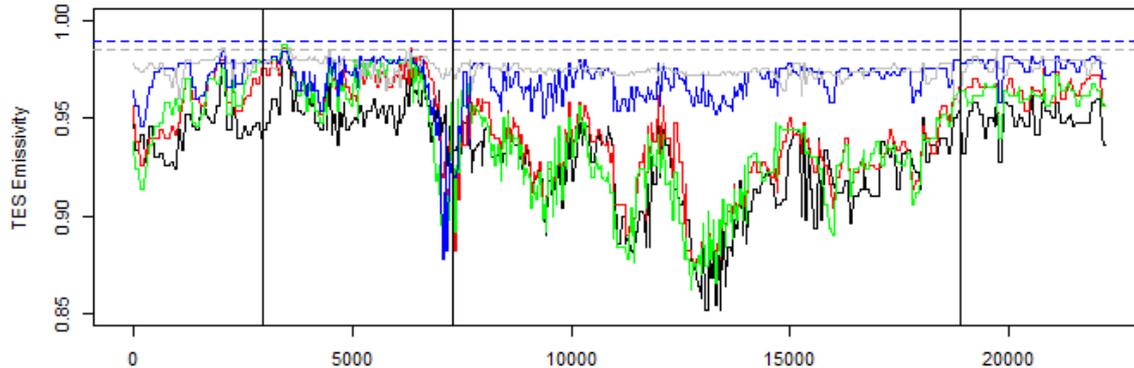


Contours: IFREMER WW3 tide prediction | Black Line: France digital coastline

TES algorithm does not capture emissivity of wet intertidal surfaces or ocean surface

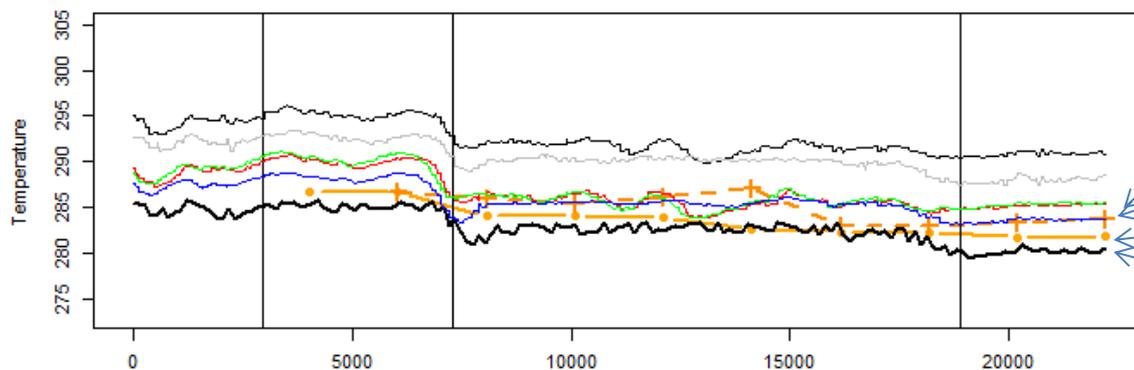


At sensor radiances



← ASTER seawater emissivities

TES emissivities



VIIRS SST \approx ECOSTRESS + 3.5°K
MODIS SST \approx ECOSTRESS + 2°K

— LST from ASTER emissivity

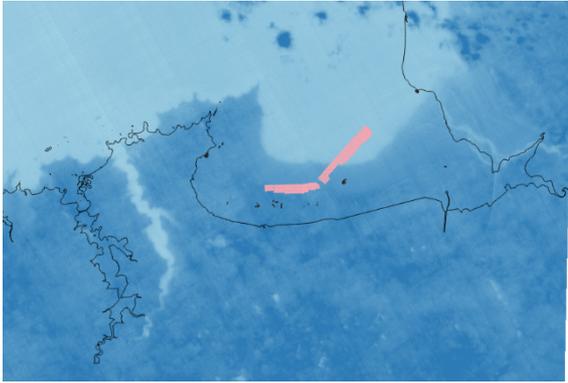
+ VIIRS 1km SST

● MODIS 1km SST

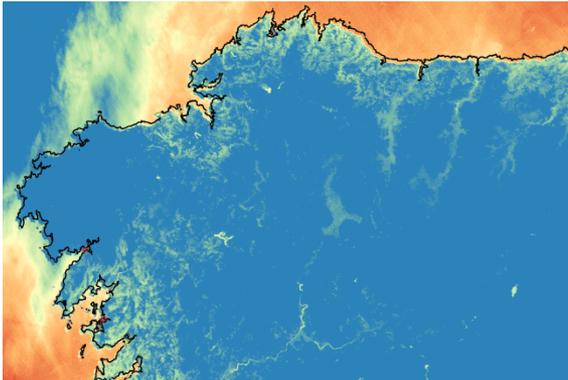
— ECOSTRESS LST and SST

Position along transect (m)

Geolocation



3798_001 No clouds **8.8 km error**
Build ID 0503
Orbit Correction TRUE
Automatic Quality Flag PASS (Why ?)



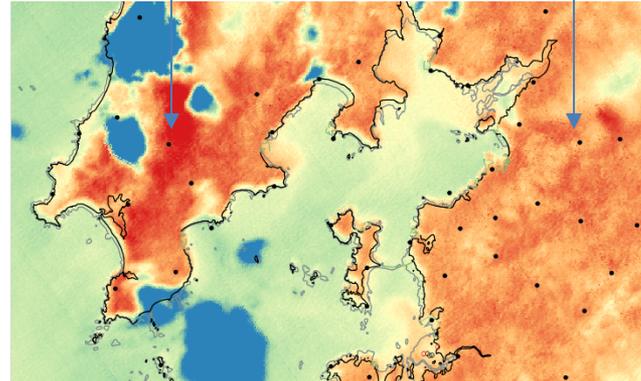
8592_001 No coastal clouds **2 km error**
Build ID 0600
Orbit Correction FALSE (Why not ?)
Automatic Quality Flag SUSPECT

ECOSTRESS products are experimental
Geolocation errors can be large
May not be flagged in metadata

Problem for AppEEARS analyses

Need coastline ground control points

Landsat Ground Control Points

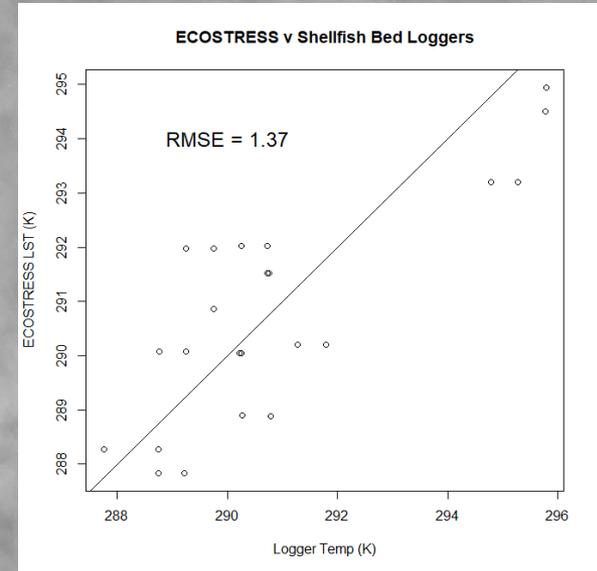


6761_001 Few clouds **500 m error**
Build ID 0600
Orbit Correction TRUE
Automatic Quality Flag PASS (Why ?)

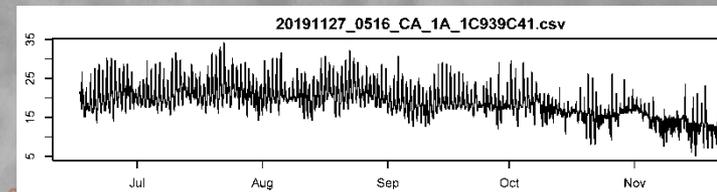
Project Goals

- Thermal Stress Index
 - LST from TES emissivity vs ASTER seawater emissivity for wet surfaces
 - Atmospheric transmittance from RTTOV model
 - Validate with in-situ data loggers
 - Spain: shellfish beds – collab with U Vigo and 3 Shellfisheries Guilds
 - France: mussel and oyster grow-out areas – collab with IFREMER
 - Portugal – UK: rocky shores – collab with CIBIO (U Porto)
 - **NEED MORE COASTAL SCENES in Western Spain/Portugal**
- Evaporative Stress Index
 - Modified LST from ECOSTRESS
 - Humidity from NASA/GEOS5, WRF forecasts, local weather stations
 - Evaporative Stress from water vapor pressure deficit
- First we need a solution for geolocation problem in coastal zone

LST Validation With Intertidal Sensors



- Spanish Shellfish Bed Logger Sites
- Only 5 usable scenes June – Nov 2019
- ≥ 500 m geolocation errors in 3 of them
 - Makes the use of AppEEARS risky
- **Turn the sensor on before coastline**
- **Need More Western Spain Coastal Scenes**
- Landsat has many more usable scenes



Collaborators

Data Logger Network

- Univ Vigo / Shellfish Guilds

- Elsa Vázquez

- Celia Olabarria

- Cofradías de Mariscadoras de Noia, Combados, Combarro



- Univ Porto / CIBIO

- Fernando Lima

- Rui Seabra

- IFREMER

- Stanislas Dubois

- Cedric Bacher

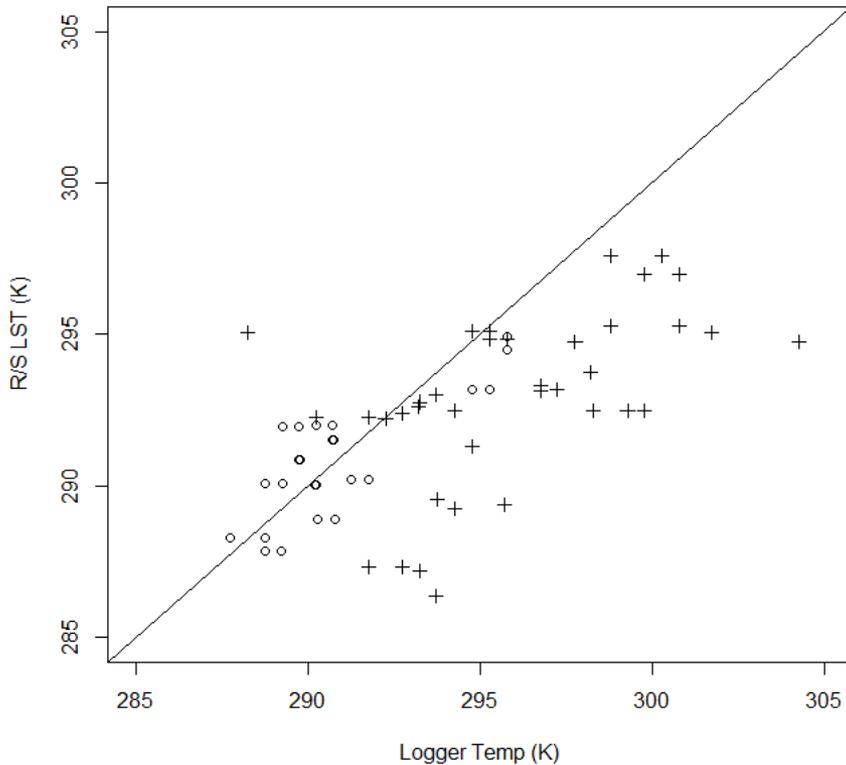
FCT

Fundação para a Ciência e a Tecnologia

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

Quick Look Logger Temp vs R/S Temp

ECOSTRESS (o) Landsat8 (+) v Loggers



Spain shellfish bed iButton loggers

ECOSTRESS LST
(atmospheric correction)

Landsat -8 Band 10 Sensor Brightness Temp
(no atmospheric correction)

Many more Landsat-8 scenes are available
than ECOSTRESS scenes since Jun 2019.