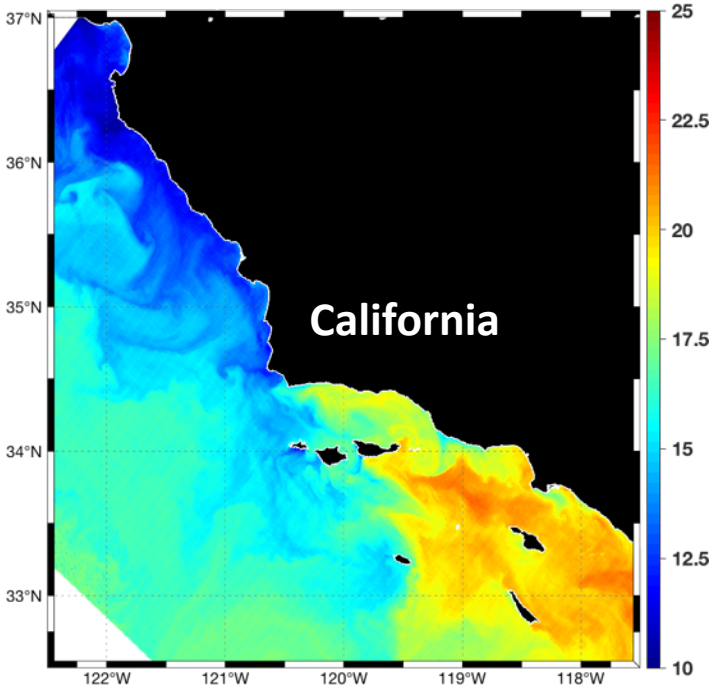
Examining the relation between biodiversity and surface temperature regimes in localized coastal upwelling zones using ECOSTRESS

ECOSTRESS Science and Applications Team Meeting - August 19, 2021

Dan Otis (PI)
Frank Muller-Karger (Co-I)
University of South Florida, College of Marine Science



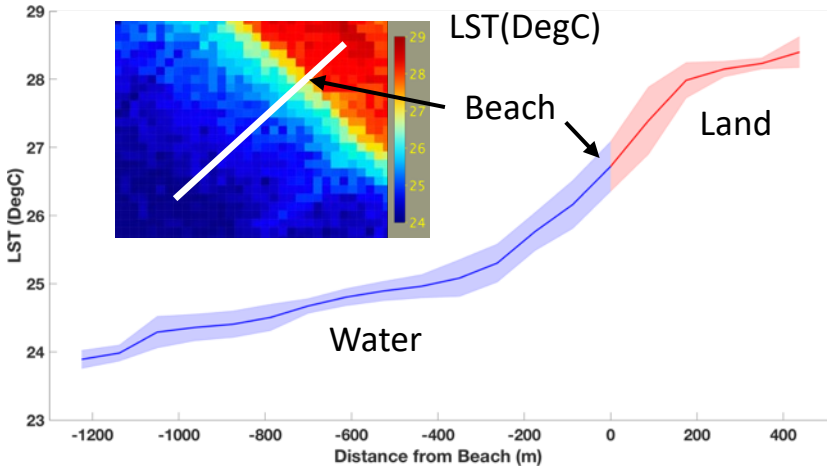
UNIVERSITY OF SOUTH FLORIDA
College of MARINE SCIENCE

ECOSTRESS
NASA • JPL

Project goals:

- Utilize the high spatial resolution and diurnal sampling of ECOSTRESS to measure surface temperature at the land-water interface, which is not possible with sensors like MODIS.

- Shoreline habitats are rich in biodiversity and are subjected to intense impacts from human activity. We characterize them in terms of temperature using transects called shore temperature profiles (STP).



Processing and QC workflow

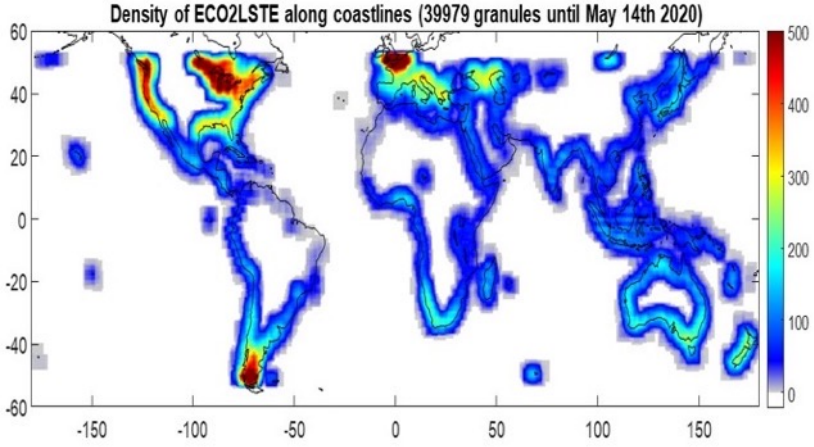
- Data (1/1/2019 - 6/30/2021) obtained using AppEARS (LP-DAAC)

- Ten regions of interest downloaded and QC'd

- Initial QC to remove files with very little data, heavy cloud cover

- Visual, iterative geolocation correction applied in MATLAB using digitized coastline from Google satellite basemap

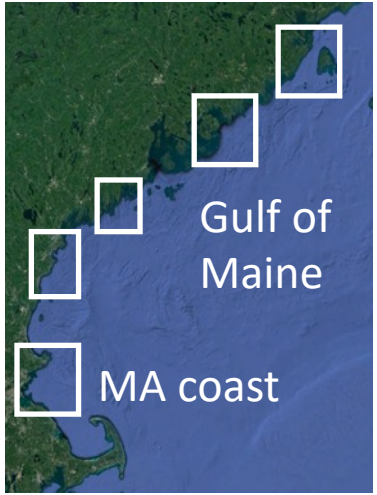
- Geo-correction parameters (x/y offsets) of each image are saved for future use

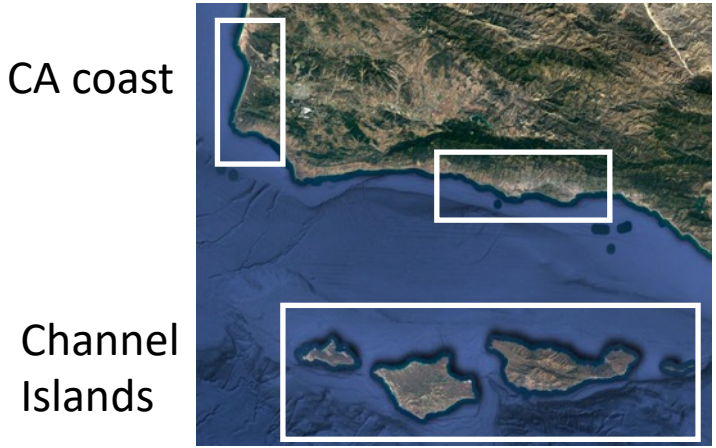


Heat map of ECOSTRESS coastal granules (through mid-2020)

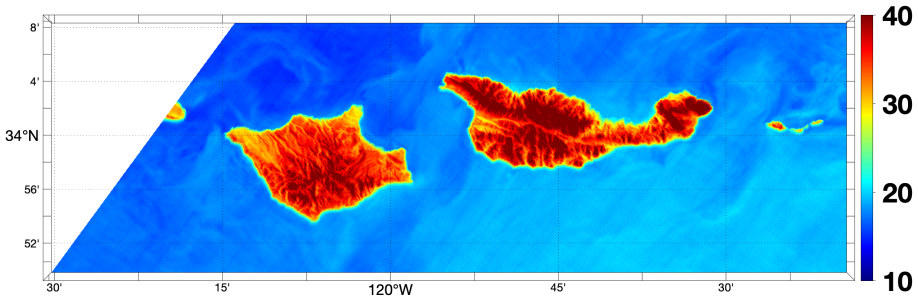
Regions of interest

Region	Raw Scenes	Geo-corrected, cloud-free images (1/2019-7/2021)
Channel Islands	486	120
Vancouver, B.C.	1140	139
Gulf of Maine (4)	1,684	284
Massachusetts Coast	379	78
California Coast (2)	944	185
Fortoleza, Brazil	92	8





Channel Islands



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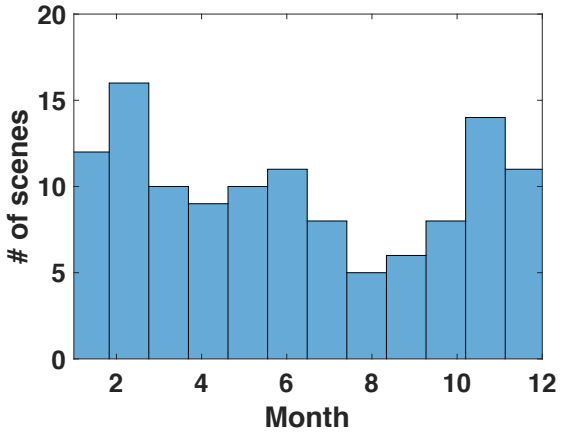
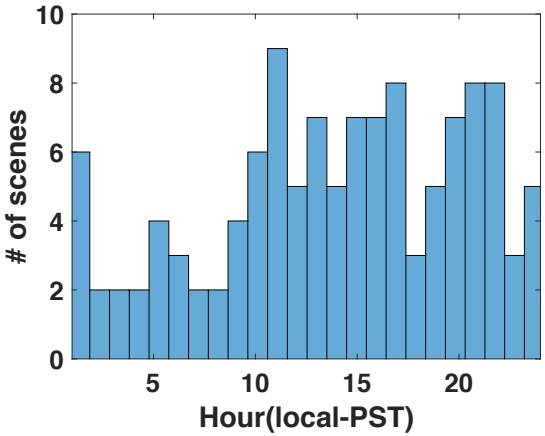
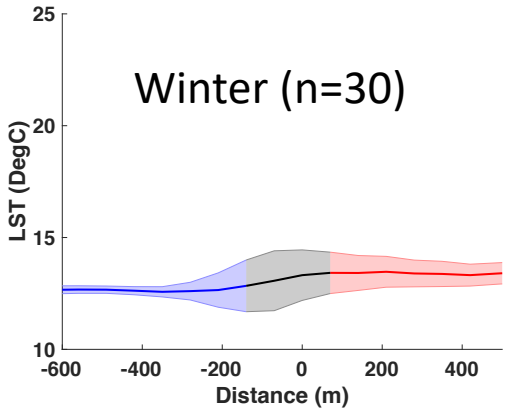
14 AUG 2020 16:56 PDT

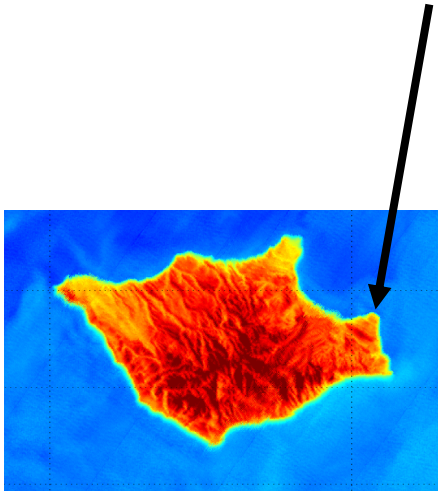




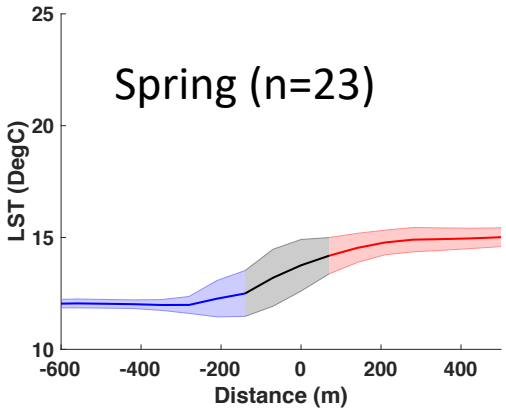
Overpass months and times for cloud-free Channel Island images (n=120)

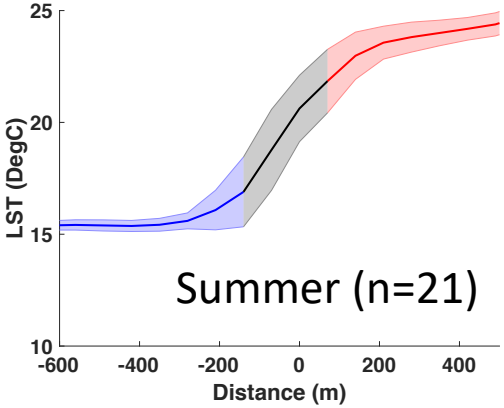
Shore Temperature Profiles (STP)

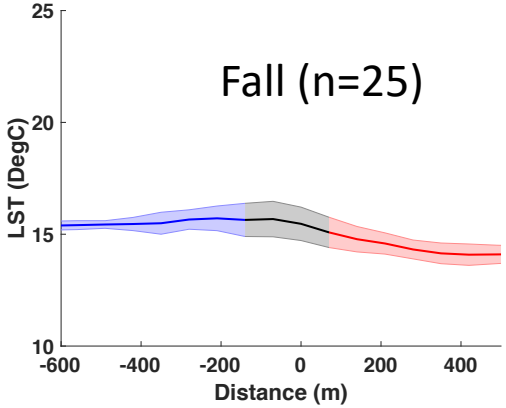




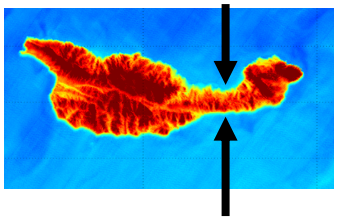
Santa Rosa Island



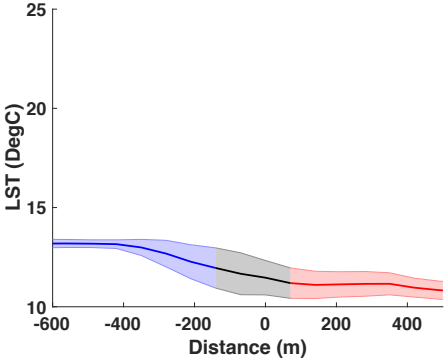


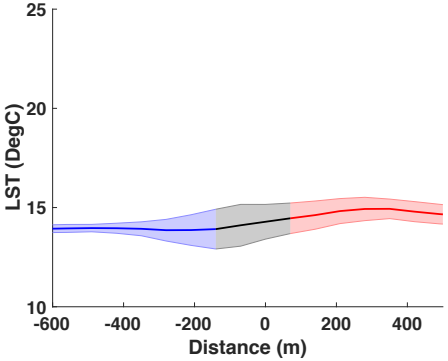


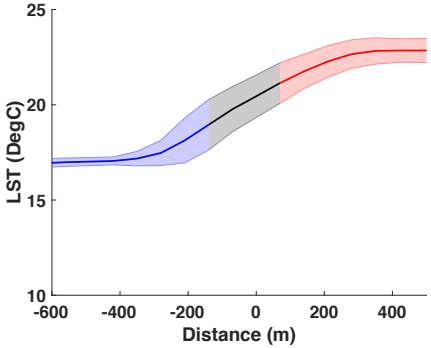
Shore Temperature Profiles (STP)

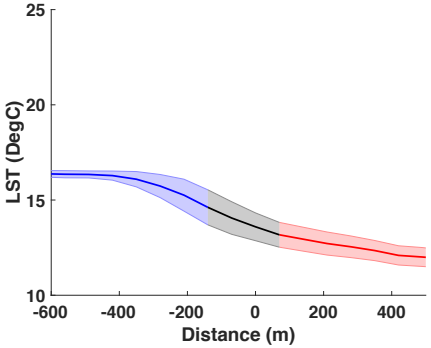


Northern side of Santa Cruz Island

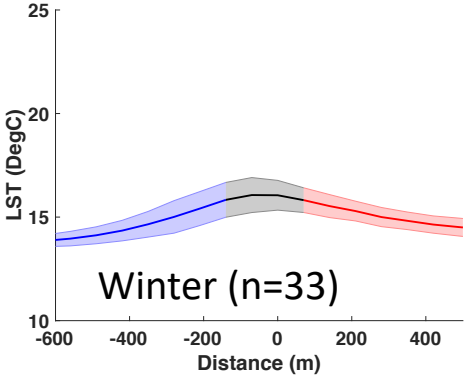


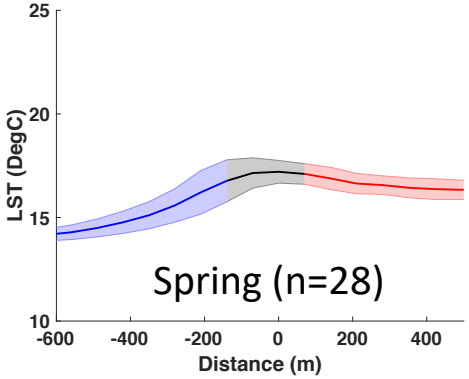


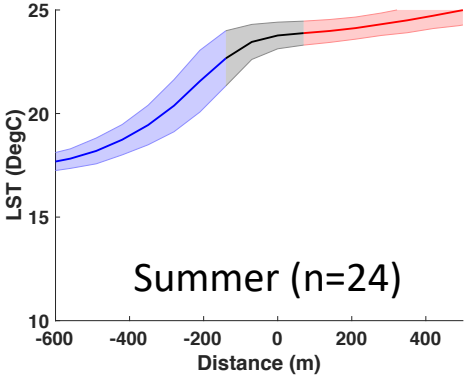


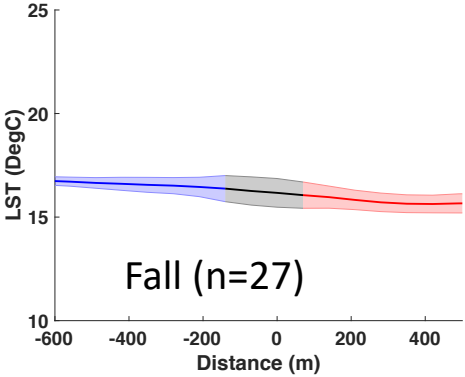


Southern side of Santa Cruz Island









Comparison of north and south sides of Santa Cruz Island

Season	Site	Water Temp.	Swash Temp.	Swash Range	Land Temp.
Winter	North	13.2	**12.8**	**6.2**	11.4
	South	14.0	**15.2**	**16.5**	15.3
Spring	North	13.9	**13.9**	**7.6**	14.5
	South	14.4	**15.9**	**15.9**	16.7
Summer	North	16.9	**17.5**	**9.3**	21.4
	South	17.9	**20.7**	**13.9**	24.12
Fall	North	16.3	**15.7**	**10.1**	13.0
	South	16.7	**16.5**	**13.3**	15.9

Average surface temperature values and ranges calculated from STPs in degrees C.

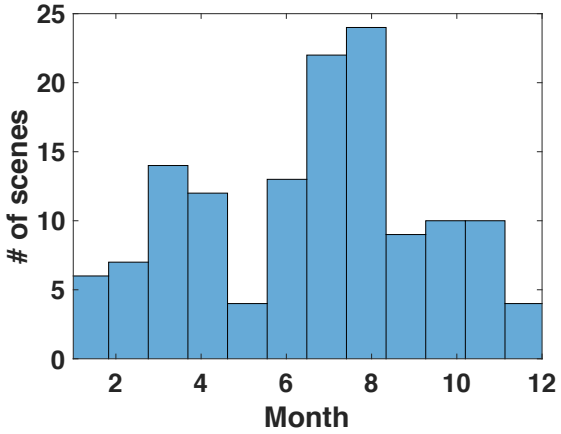
The Washington Post 7/8/2021

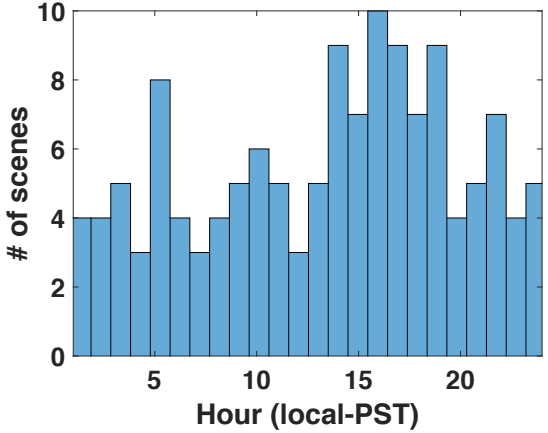
Crushing heat wave in Pacific Northwest and Canada cooked shellfish alive by the millions

Image courtesy of Hamahama Oysters

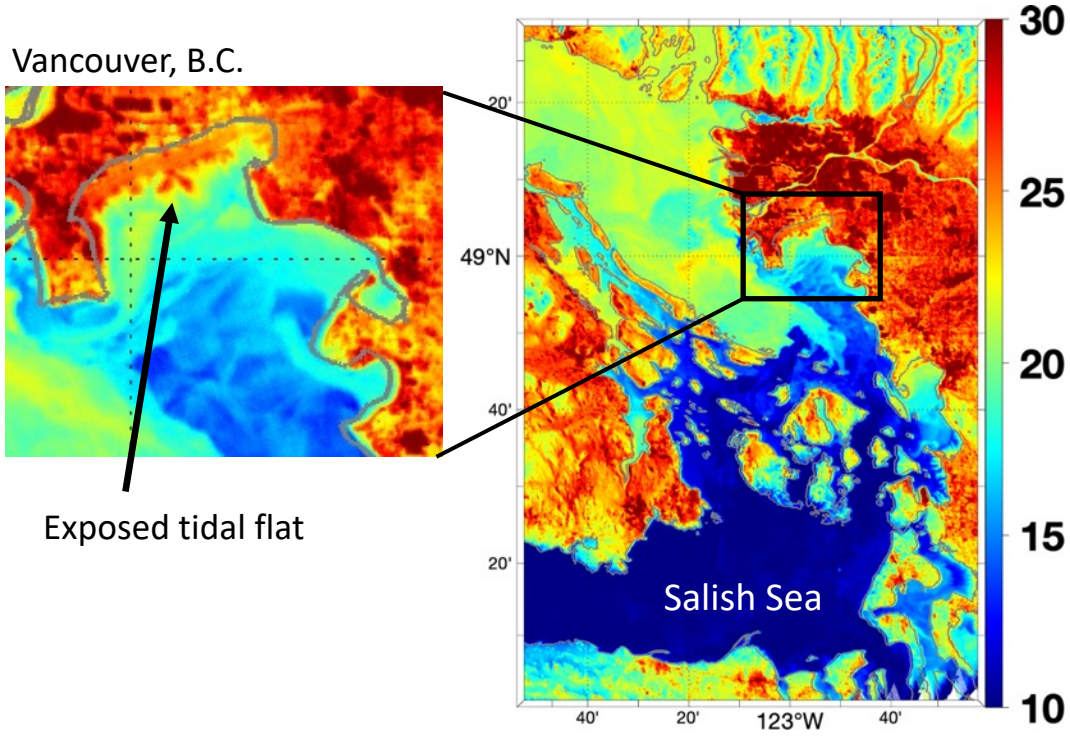
Image courtesy of Edward Aites

Vancouver, BC



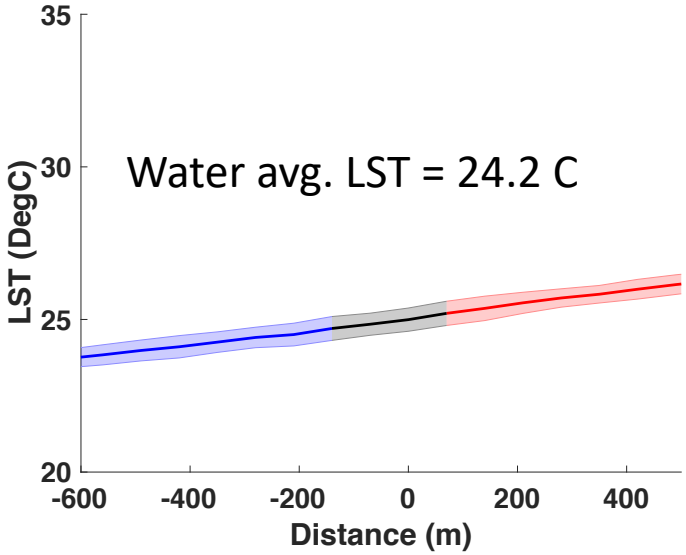


ECOSTRESS LST July 28, 2021 17:41 PDT

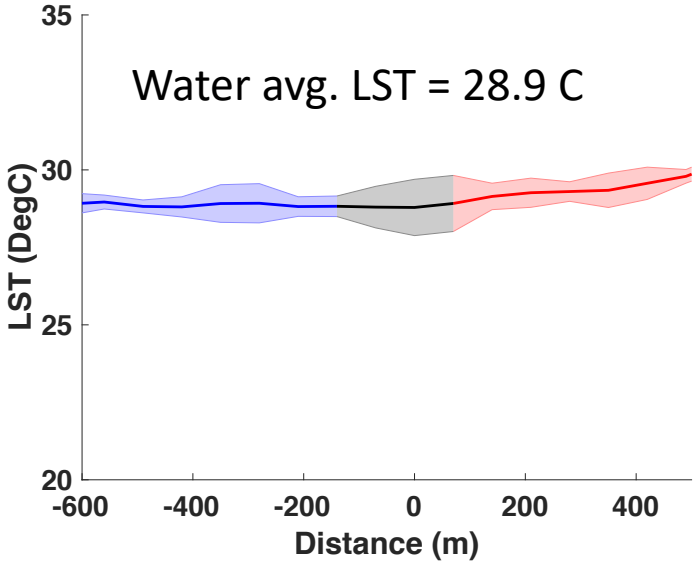


In June, July and August, beaches here experienced elevated surface temperatures and widespread mortality of mussel beds.

Vancouver, BC



Average summertime afternoon STP (n=23)

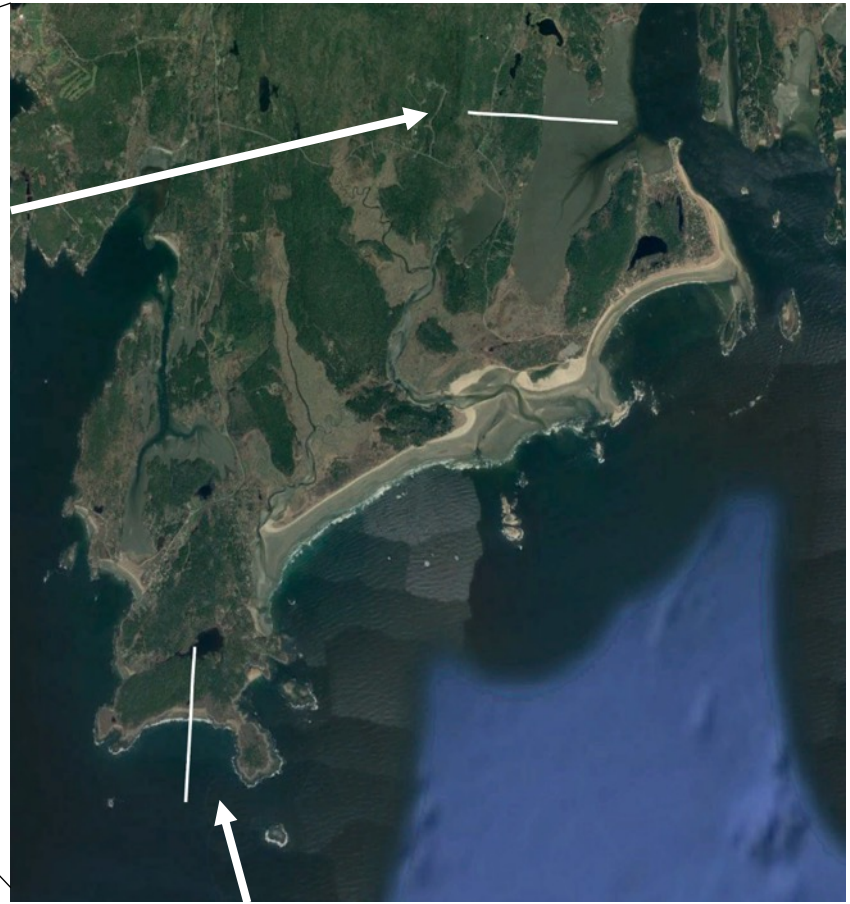


STP from August 12, 2021 14:46pm PDT

Heatwaves: June 26-29, July 28-30, August 12-13

Southern Gulf of Maine

Protected tidal flat



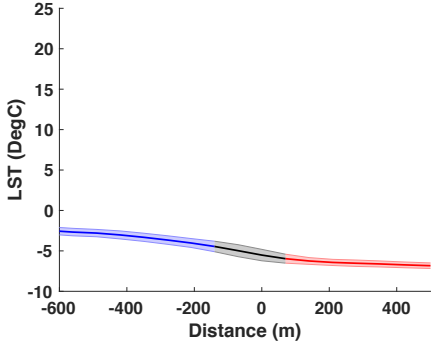
Exposed rocky shore

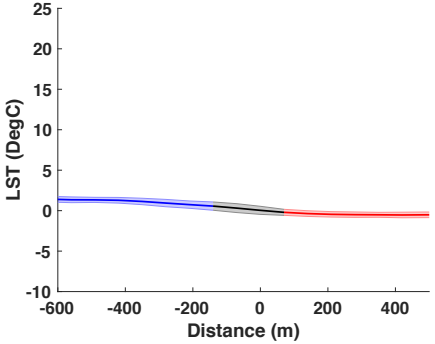
Southern Gulf of Maine

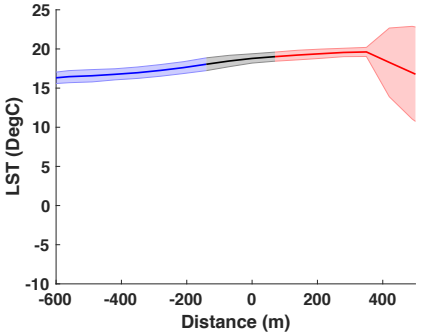
	Winter	Spring	Summer	Fall	Range
Protected:	-2.6	1.4	16.4	8.6	19.0
Exposed:	-0.1	2.4	15.2	8.7	15.3

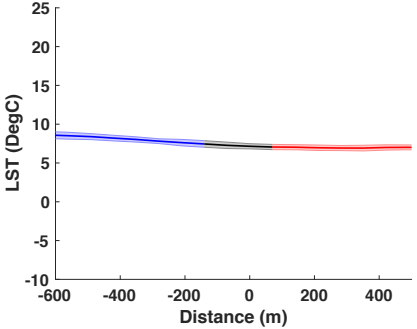
Swash temps (avg.)

Protected tidal flat

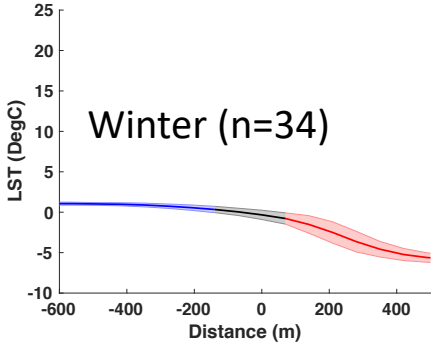


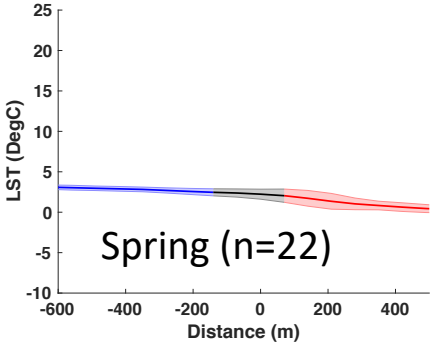


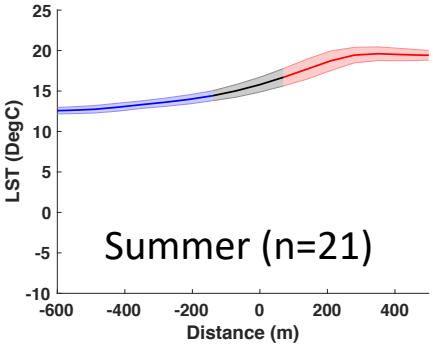


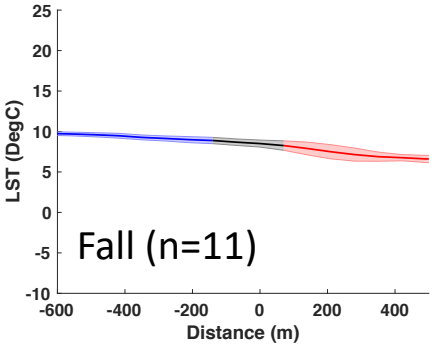


Exposed rocky shore

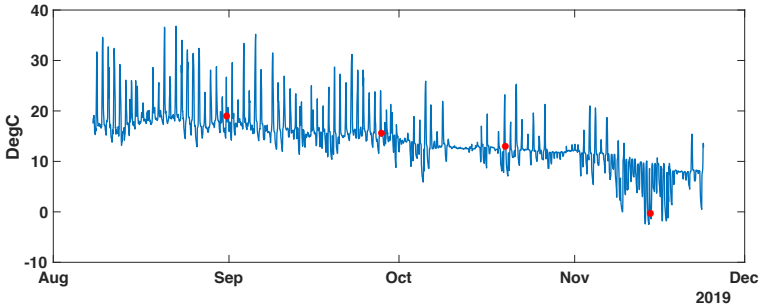


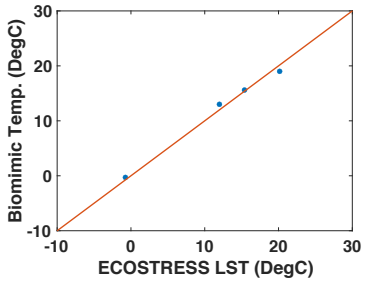




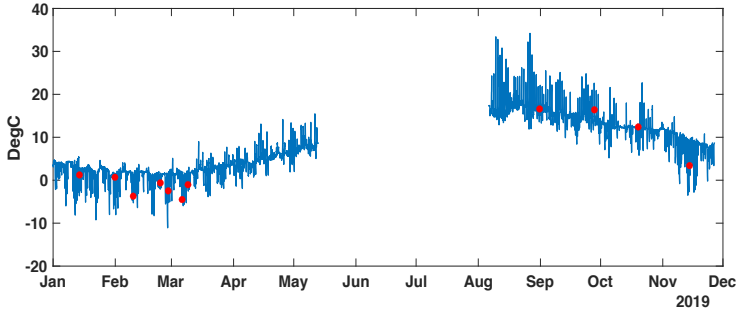


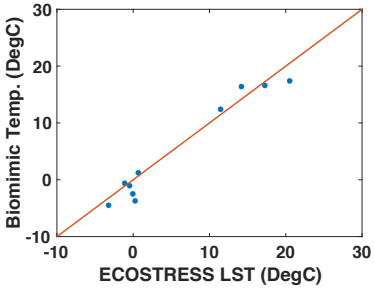
Validation with biomimic temperature loggers



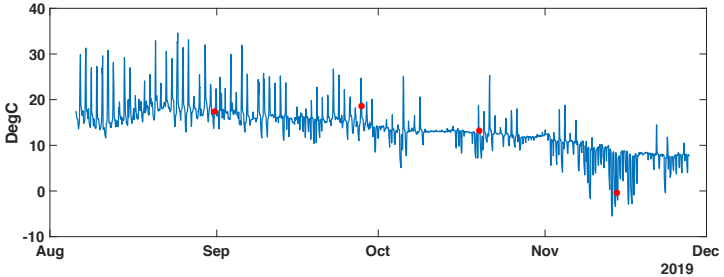


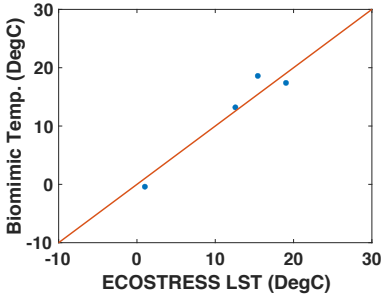
Rocky shore at Bailey Island, ME
Mid tidal zone, exposed location





Rocky shore at Chamberlain, ME
Mid tidal zone, exposed location





Rocky shore at Biddeford, ME
Mid tidal zone, exposed location

Data courtesy of Brian Helmuth Lab – Northeastern Univ.

How can we measure biodiversity in marine and coastal environments?

- Biodiversity records from Ocean Biodiversity Information System (OBIS)

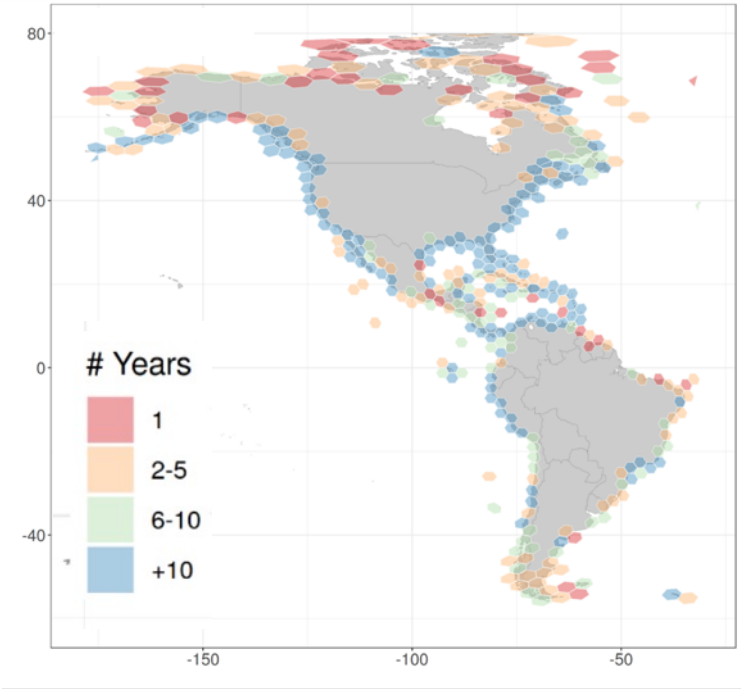
Issues:

- Biodiversity observations are uneven
- Can be hard to compare observations
- Lack of time series records

Solutions:

- Add more observations!
- Use common data formats and sampling methods
- Develop capacity for scientists to add and access these systems globally
- Utilize technologies like eDNA and autonomous plankton samplers

Biodiversity records in the Americas



Annelids, echinoderms and mollusks and plants

MBON
Marine Biodiversity Observation Network

OBIS
OCEAN BIODIVERSITY INFORMATION SYSTEM