PML | Plymouth Marine Laboratory

Marine Matters

The other CO_2 problem from a different angle: studying Ocean Acidification using satellite Earth observation

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Ocean Acidification using Earth observation

- Understanding of Ocean Acidification has been limited by availability of carbonate system data
- In 2012, OA researchers formed the Global OA Observing Network to bring together datasets, research and resources

GOA-ON
Global Ocean Acidification Observing Network

- Algorithms using in situ hydrographic, Earth observation and/or model data have been developed
- Increase in data, e.g. from the Ship of Opportunity Programme and data buoys provides opportunity to test algorithms

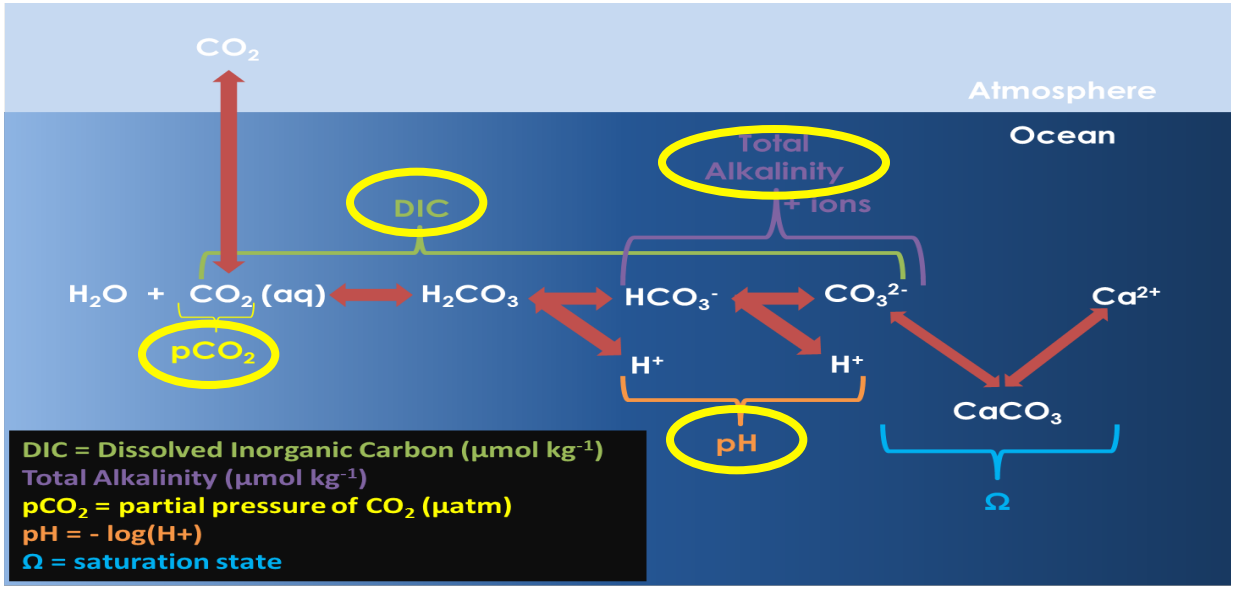
Ocean Acidification using Earth observation

- Pathfinders-OA is an 18 month ESA project to exploit Earth observation to research and monitor Ocean Acidification
- Collect relevant datasets (in situ, EO and model)
- Create a large database of EO-in situ matchups
- Develop and validate algorithms to retrieve OA parameters from EO
- Generate open source software tools and journal publications

esa

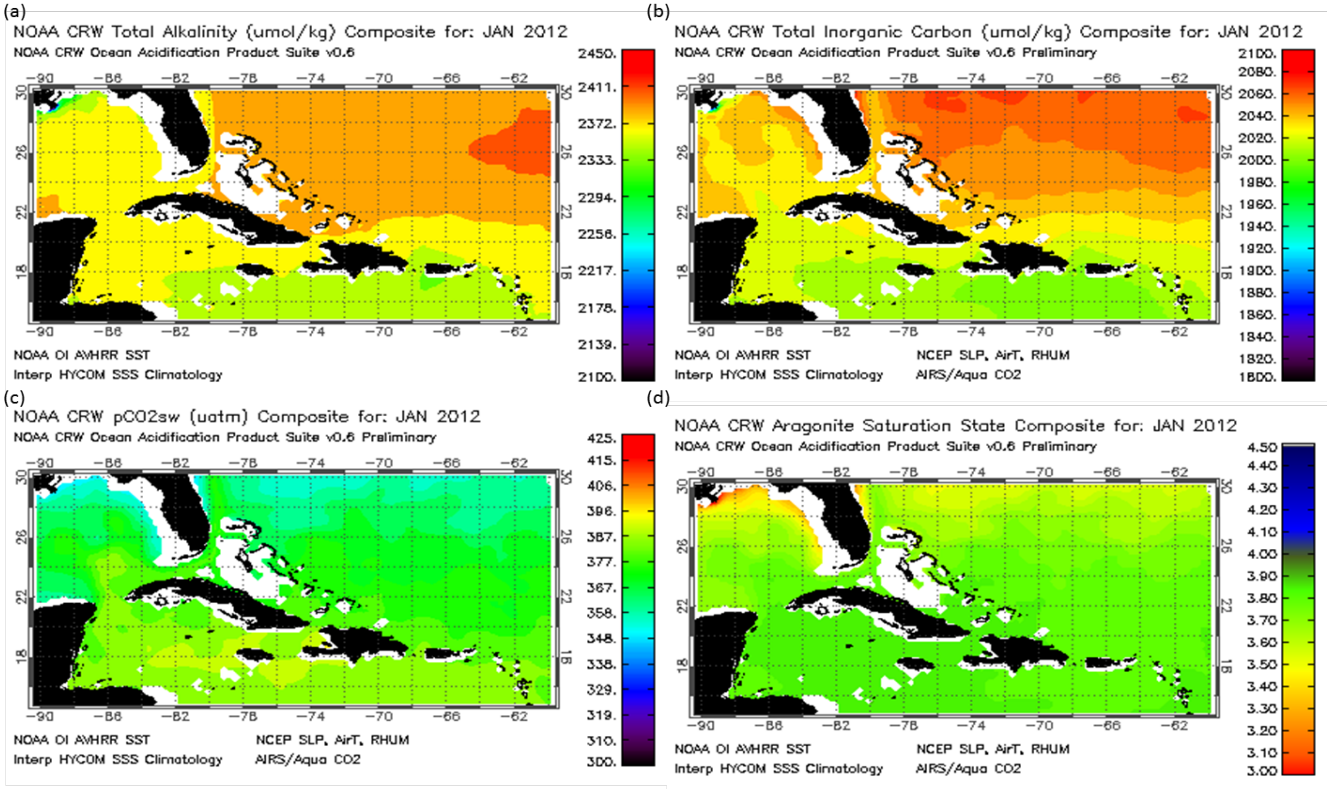
stse
support to science element

Ocean Acidification using Earth observation



- Oceans absorb up to 30% of anthropogenic CO_2 emissions
- This makes the seawater more acidic (lower pH) and can lead to a decrease in calcium carbonate saturation state Ω, with potential implications for marine animals, especially calcifying organisms
- Measuring any two of the four “key” parameters (DIC, A_T, pCO_2, pH) can be used to calculate the remaining components of the carbonate system

Ocean Acidification using Earth observation



- Many regional algorithms exist (e. g. NOAA OAPS in the Greater Caribbean) using combinations of EO and model data to retrieve OA parameters
- These algorithms can be modified to exploit new EO data

Ocean Acidification using Earth observation

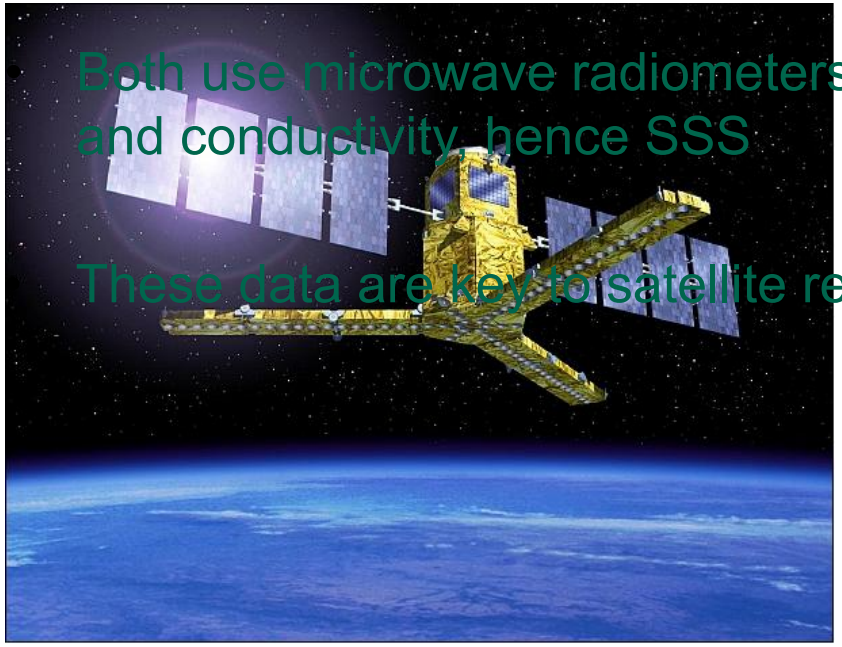
Proposed approach

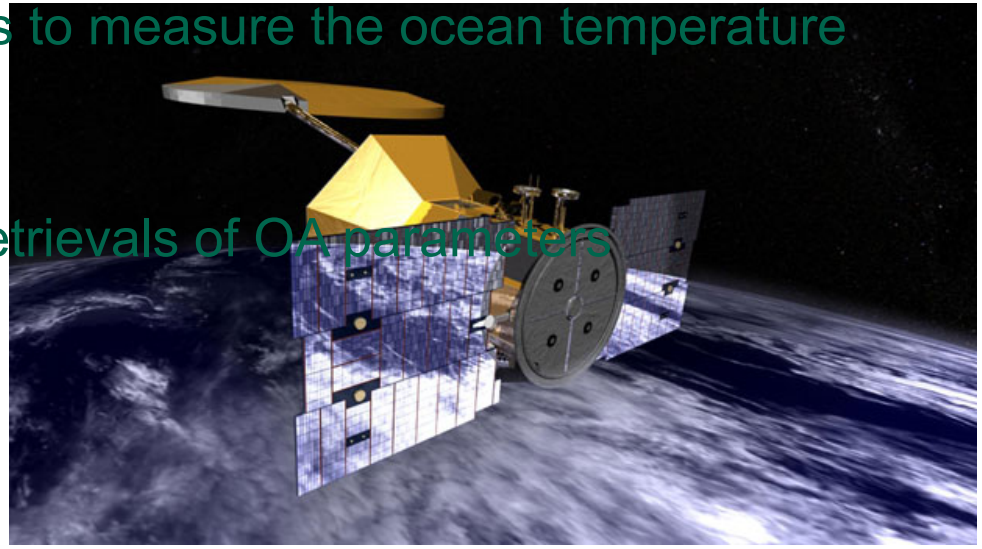
- Implement a suite of existing algorithms using EO data
- Develop additional novel algorithms
- Use combinations of two algorithms to calculate all carbonate parameters
- ‘Round robin’ test of algorithms against in situ data

Ocean Acidification using Earth observation

Measuring sea surface salinity from space

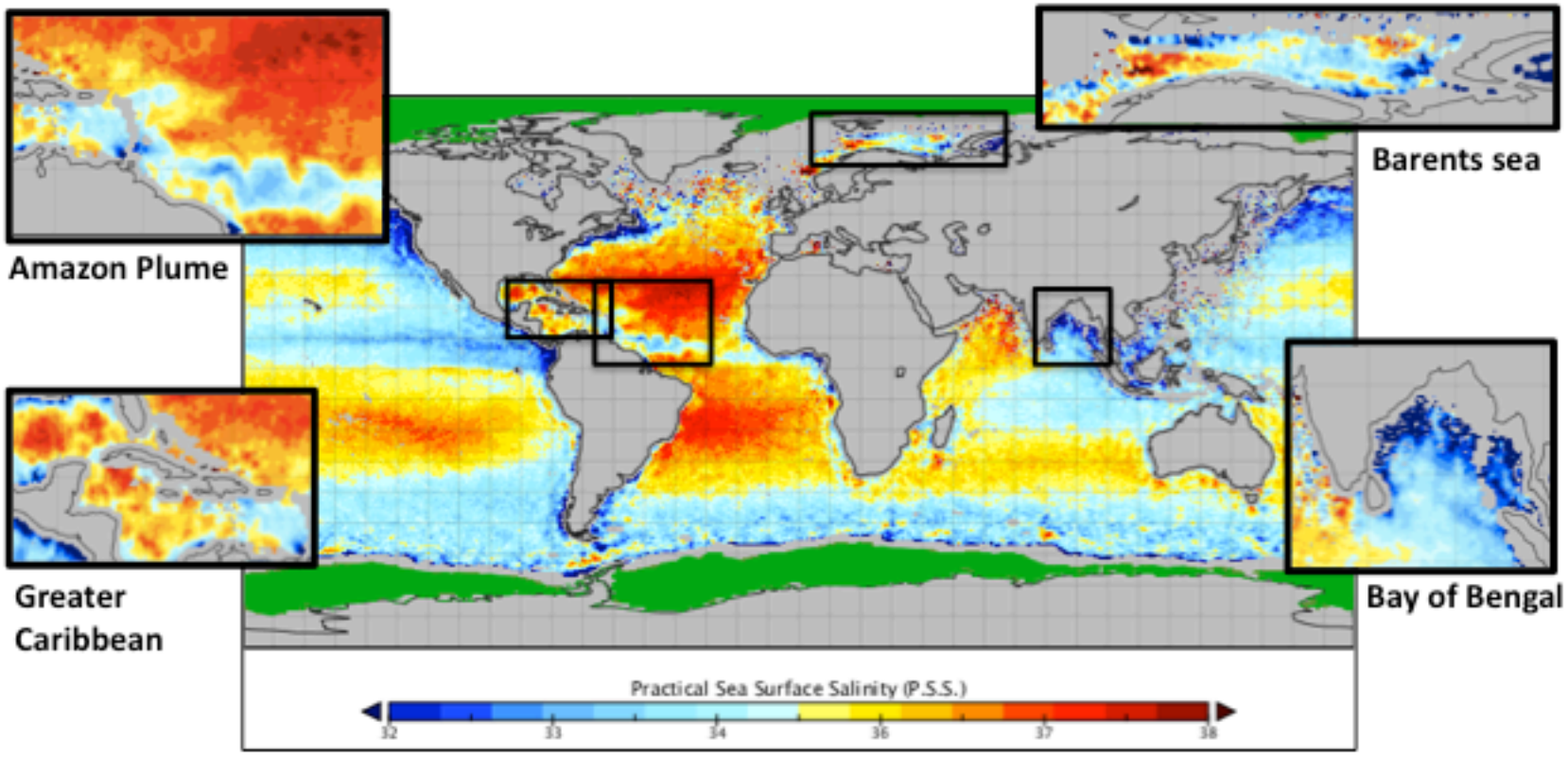
- ESA SMOS and NASA-CONAE Aquarius were launched in 2009 and 2011, both measuring global SSS
- Both use microwave radiometers to measure the ocean temperature and conductivity, hence SSS
- These data are key to satellite retrievals of OA parameters





Ocean Acidification using Earth observation

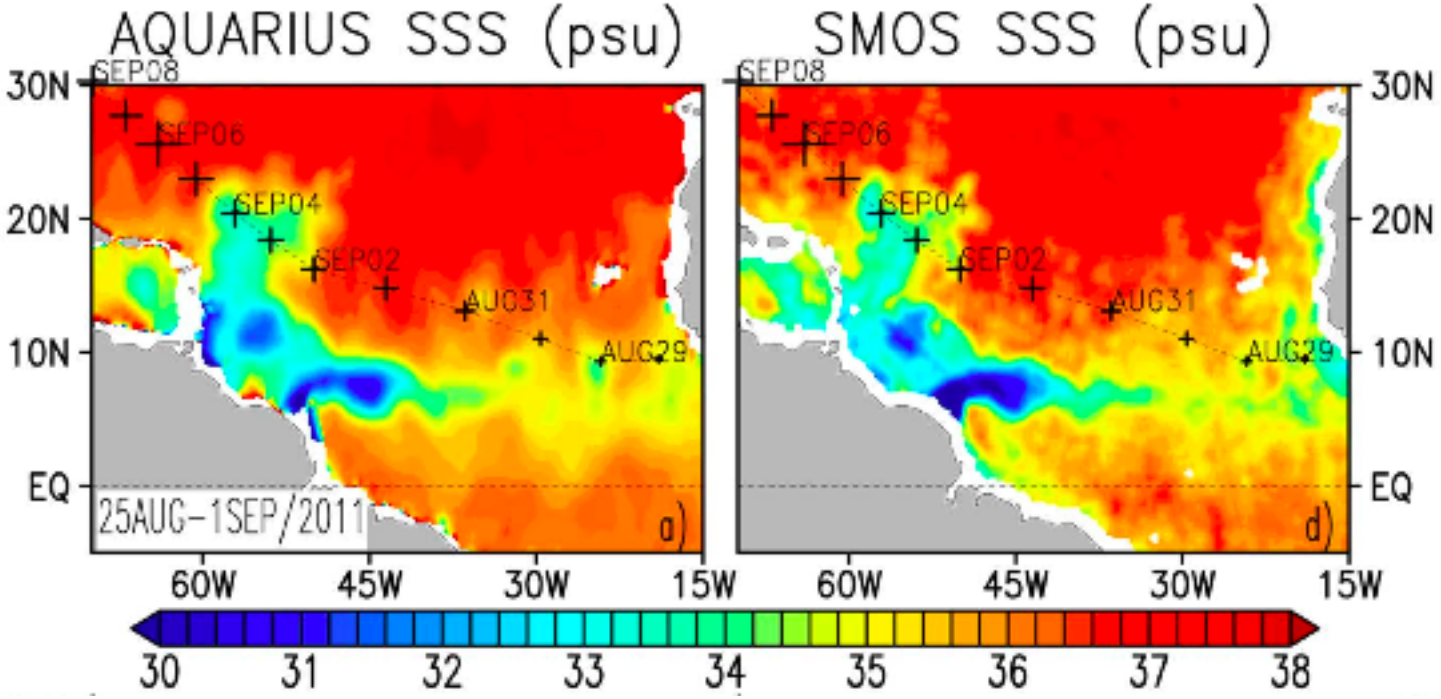
Case study regions from SMOS



Global, SMOS salinity for October 2010 (blue-red)
Sea ice (green)

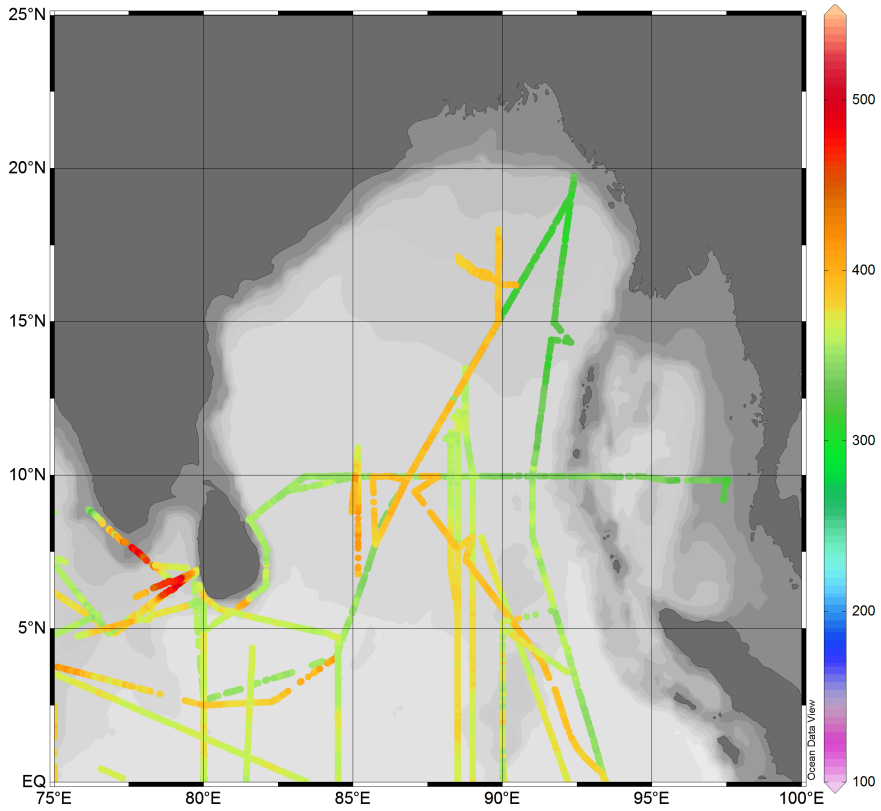
Ocean Acidification using Earth observation

Case study regions: Amazon plume from Aquarius and SMOS



Ocean Acidification using Earth observation

Case study regions: Bay of Bengal fCO_2 (closely related to pCO_2)

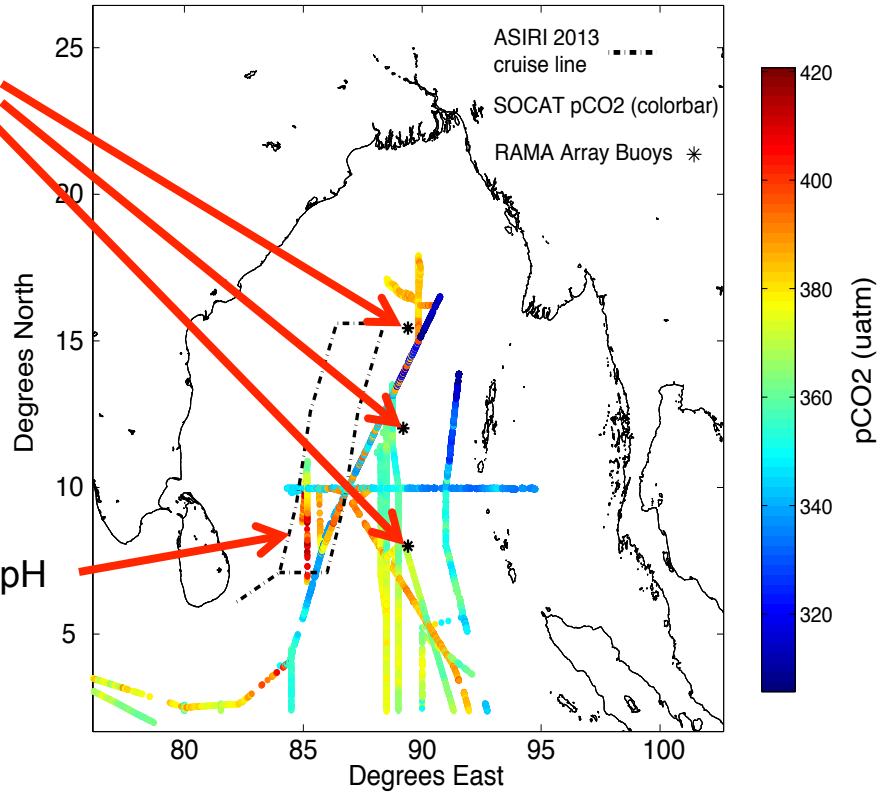


Ocean Acidification using Earth observation

Case study regions: Bay of Bengal fCO_2

SSS, SST 2007 onwards

SSS, SST, A_T, pCO_2, DIC, pH



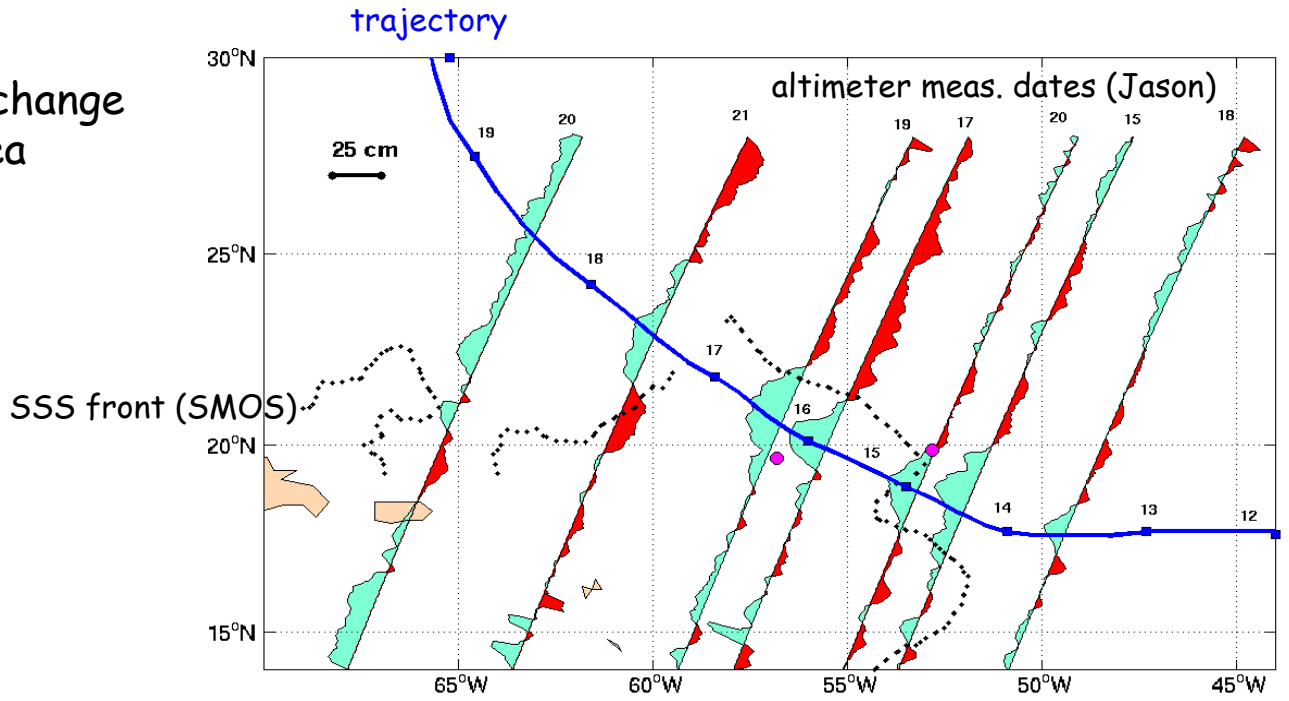
Ocean Acidification using Earth observation

Upwelling

Upwelling observed in the wake of hurricanes

see Grodsky et al 2012

hurricane → change in SST and sea level



Example with Igor hurricane

Ocean Acidification using Earth observation

Upwelling

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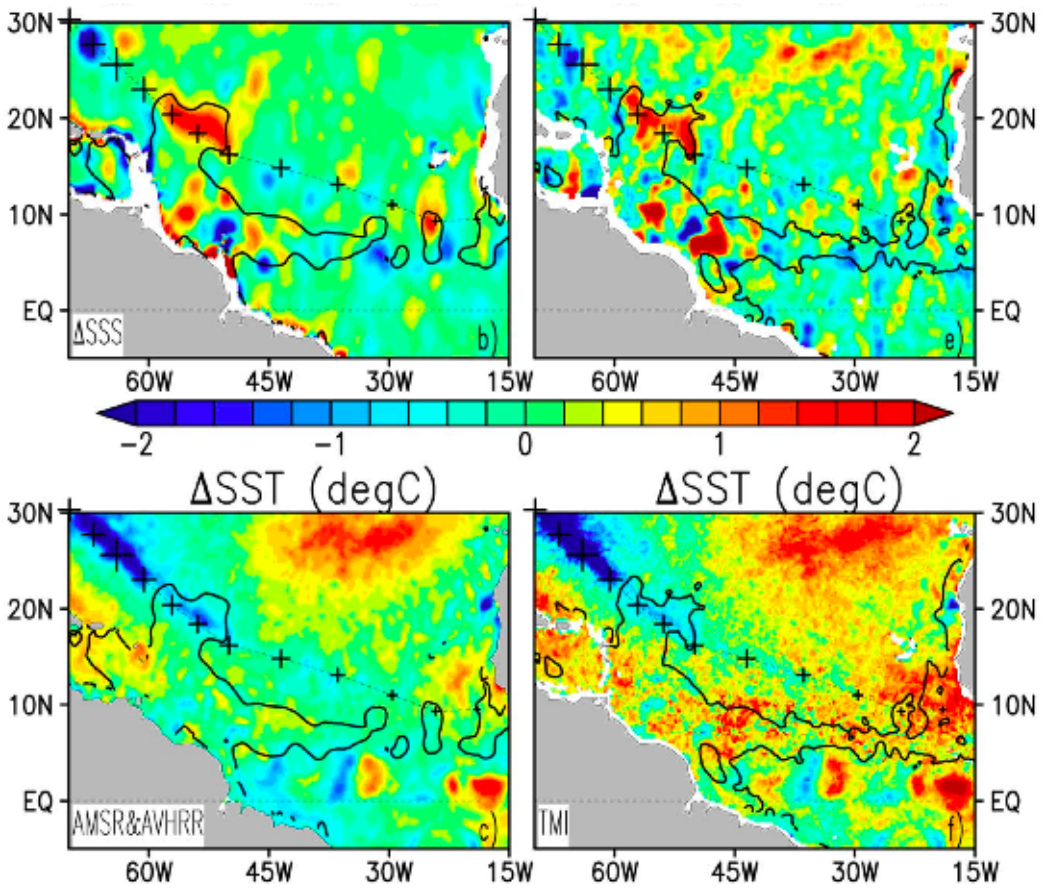
see Grodsky et al 2012

hurricane → change in SSS

hurricane → change in SST



Ocean Acidification using Earth observation

www.pathfinders-oceanacidification.org