The Relationship Between Sea Surface Temperature and Ocean Acidification in Shanghai during 1990 and 2010

[Speaker Zoom video]

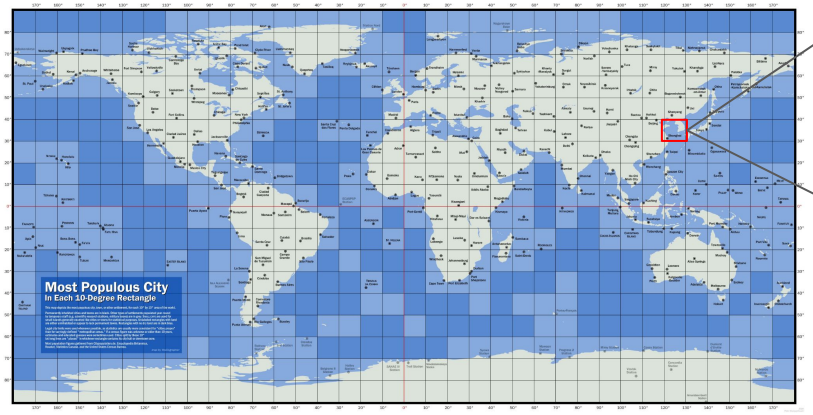
Bactrosaurus_Lavani_Energico

Climatematch Academy

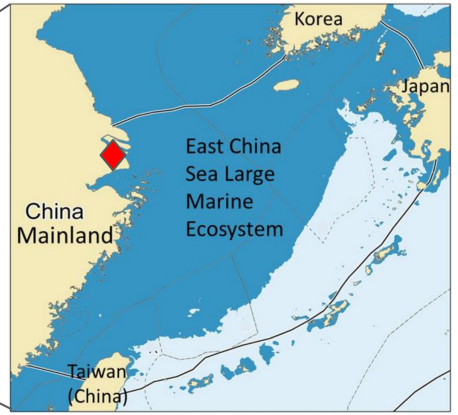
Study Area

[Speaker Zoom video]

East China Sea (ECS) - Shanghai´s coastal region



Shanghai



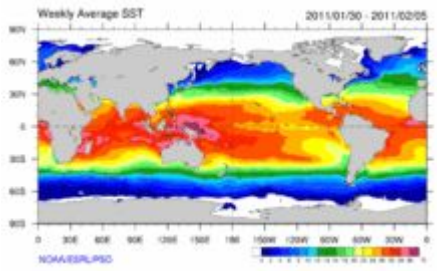
It is a semi-enclosed marginal sea spanning an area of 744,000 km^2, and its ***boundaries*** are approximately ***25° to 40° North and 120° to 130° East***

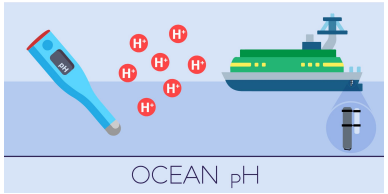
We take the city or social community of reference to the metropolis of Shanghai and its coastal region.

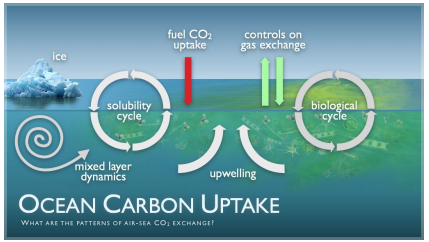
[Speaker Zoom video]

Scientific background

- The sea surface temperature (SST) of Shanghai coastal region had ***experienced a drastic upward trend*** in the last 100 years, increasing ***by around 1.5 degree Celsius.***
- In contrast, ***the pH level*** of this region ***decreased rapidly*** from 8.13 in 1900 to 8.06 in 2010, ***indicating*** the occurrence of ***ocean acidification***.
- The ECS is generally considered a CO2 ***source in autumn*** and a CO2 ***sink in other seasons***, based on limited field observation.







Source: Liu & Zhang, (2013); Liu et al. (2022); Liu et al. (2023)

Knowledge gap

How does the sea surface temperature (***SST***) influences the ocean ***pH*** and ***pCO2*** value in Shanghai's coastal and marine region in different seasons (during ***1990 to 2010***)?

Our hypothesis

- We expect that two variables we focus on are inversely proportional (i.e., increase sea surface temperature means decreased pH).
- In same way, we expect that two variables are inversely proportional (i.e., increase sea surface temperature means decreased pCO2).
- In the warm season (i.e., spring and summer), increase in dissolved inorganic carbon will result in decreased pH level.

[Speaker Zoom video]

[Speaker Zoom video]

Datasets

CO2 concentration

Trends in Atmospheric - Ocean Carbon Dioxide

Source: NOAA Global Monitoring Laboratory

Units: u-atm

Version: 2023-07

pH level

Global surface ocean acidification indicators from 1750 to 2100

Source: NOAA National Centers for Environmental Information

Abbreviation: pHT

pH scale: Total scale (T)

Sea Surface Temperature (SST)

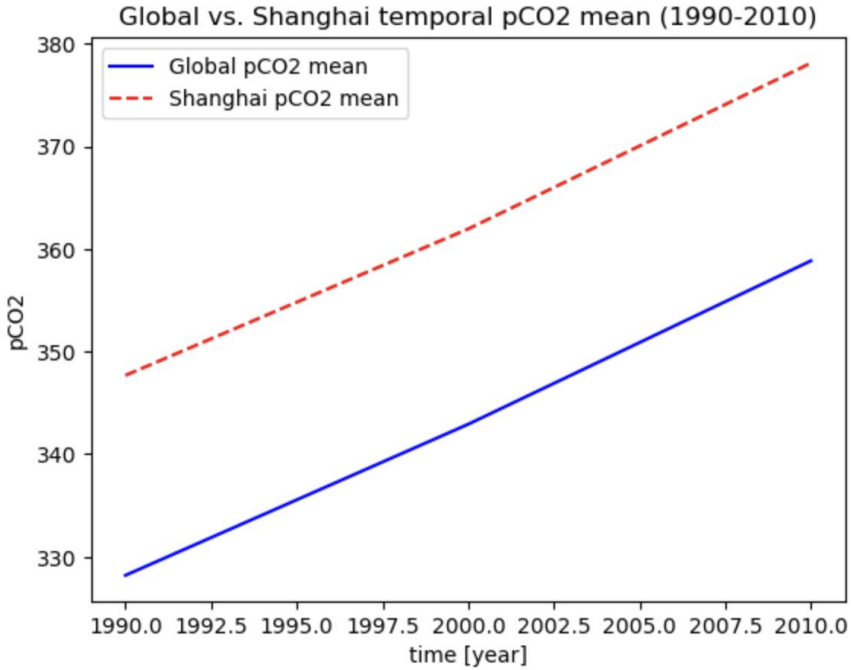
Source: NOAA Global Monitoring Laboratory and Coupled Model Intercomparison Project (CMIP)

Abbreviation: tos

Units: Celsius degrees

Results - pCO2 trend

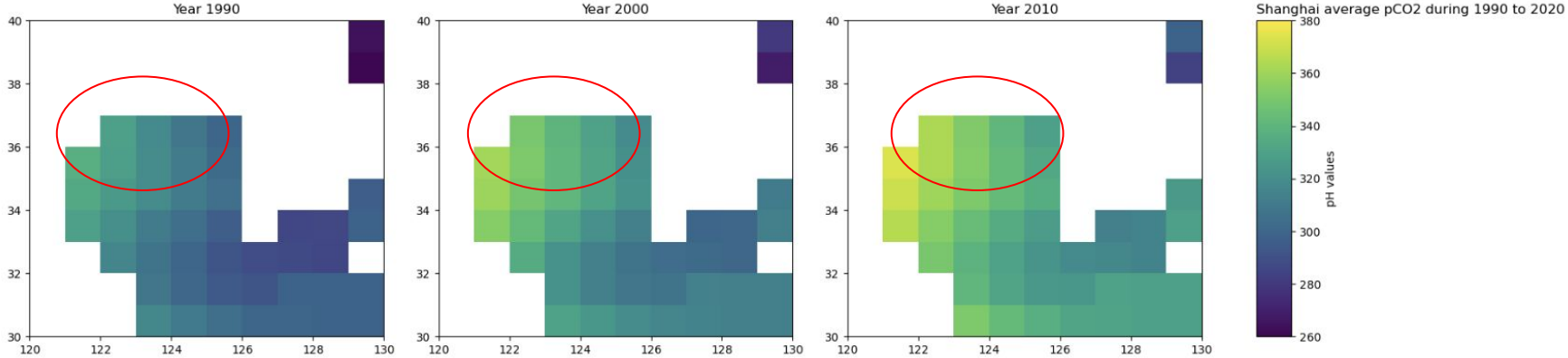
[Speaker Zoom video]



In the selected time interval, the partial pressure of carbon dioxide (pCO2) in the waters of the East China Sea (ECS) near the coast of Shanghai increased by about 20 uatm from 1990 to 2010. Likewise, the concentration takes values higher than the average concentrations of CO2 in the world; ***which could indicate a greater susceptibility to capture atmospheric CO2.***

[Speaker Zoom video]

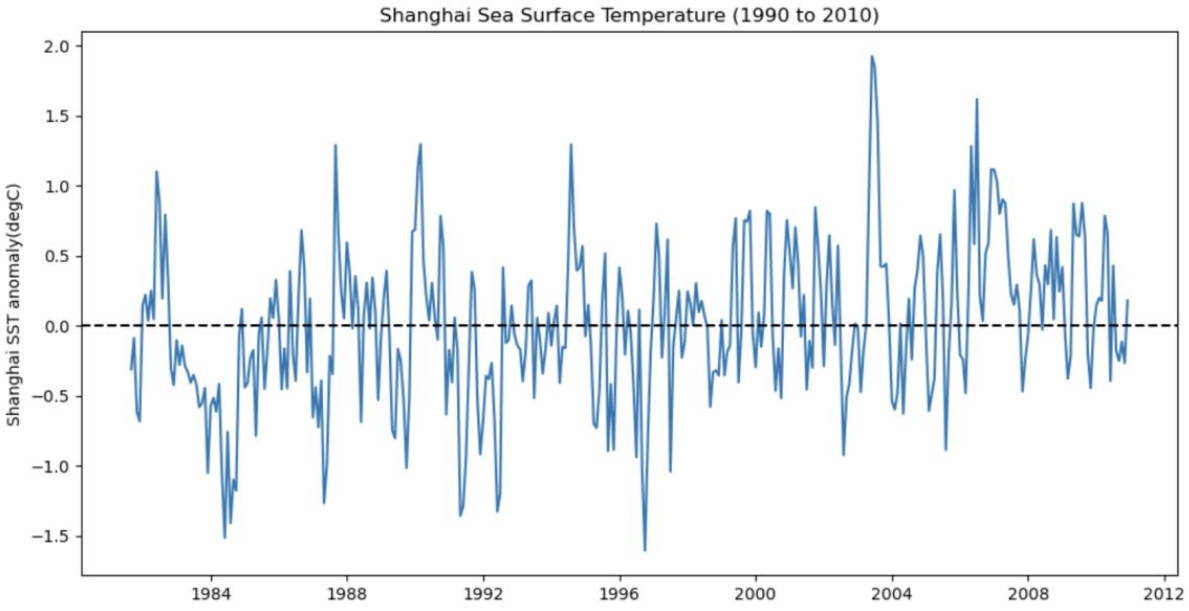
Results - pCO2 trend



In this graph we can see the evolution at the rate of decades with respect to pCO2, with a marked tendency to ***increase the concentration of CO2, specifically the regions closest to the Shanghai coast (circled in red).***

Results - Sea Surface Temperature trend

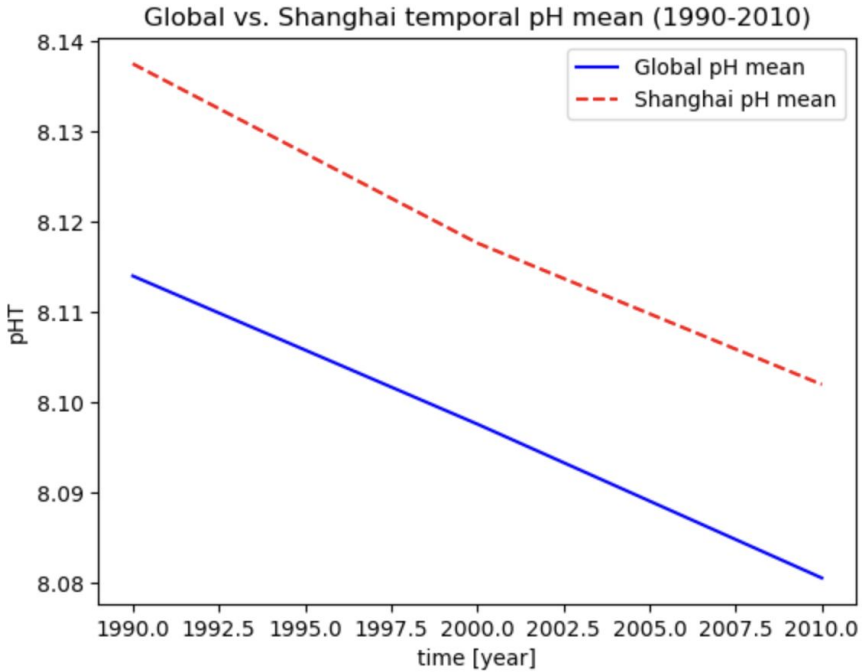
[Speaker Zoom video]



Regarding the surface temperature of the East China Sea, it can be observed that there are insignificant changes throughout the interval 1990 and 2010, where temperature fluctuated between the range of -1.5 to 1.5 °C, however ***a slight tendency of increase*** can be seen here.

[Speaker Zoom video]

Results - pH trend

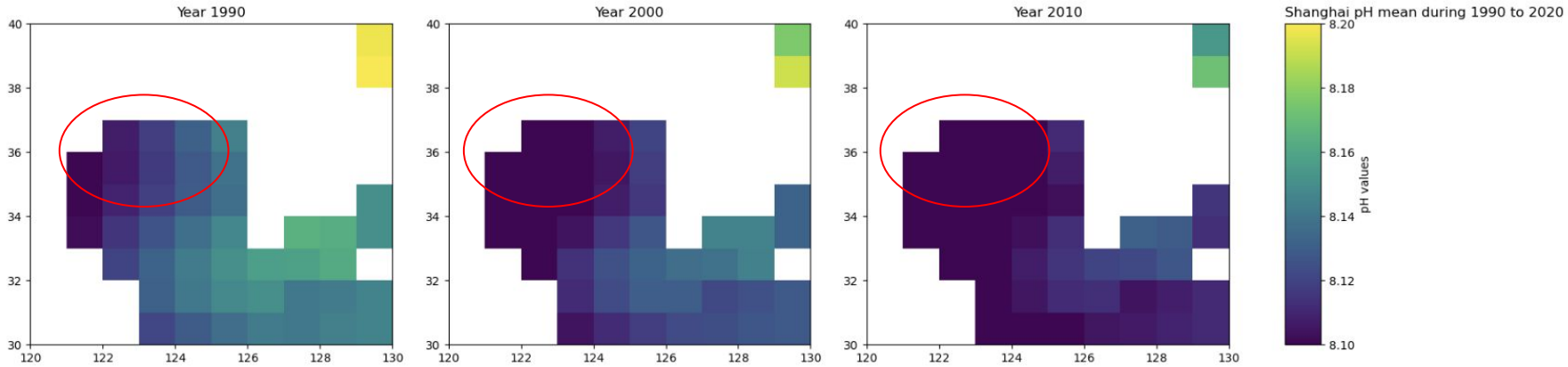


Along the same lines, it can be seen that the pH of the waters of the East China Sea (ECS) decreased to values very close to 8 between the years 1990 and 2010, which ***is a sign of ocean acidification off the coast of Shanghai.***

The perceived magnitude of that alteration may not seem substantial at first glance, but due to ***pH being measured on a logarithmic scale***, it corresponds to an approximately ***30% rise in acidity.*** As a result, this change has ***notable repercussions on seawater chemistry*** and the dependent ecosystems.

[Speaker Zoom video]

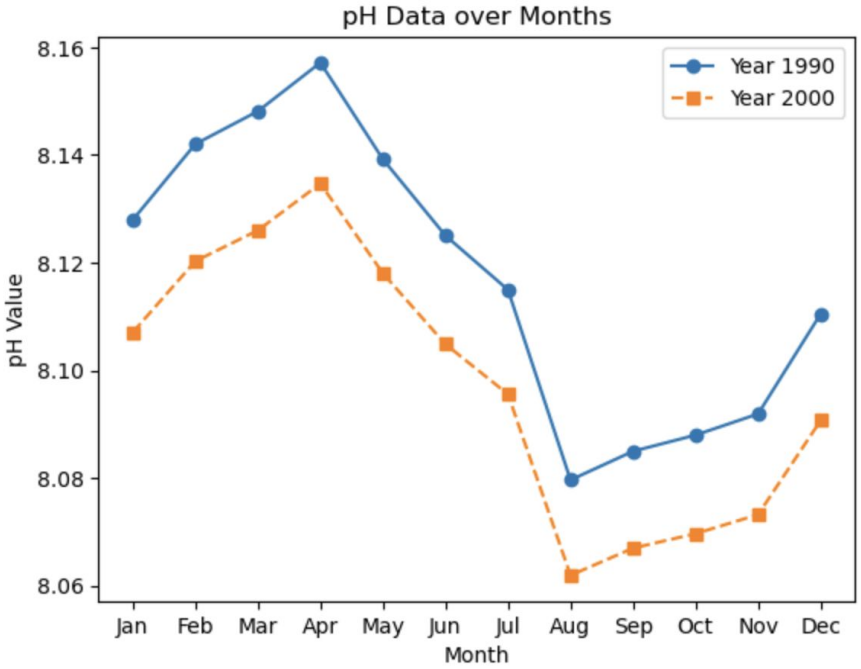
Results - pH trend (annual)



In this graph we can see the ***decrease in the pH level, specifically the regions closest to the coast of Shanghai (circled in red)***, which ***indicates greater acidity conditions for the ecosystems*** coastal marine. This would be attributed to the increased CO2 concentration, the incoming flows of nutrients and other chemical substances from Chajjang River, or sea surface temperature (SST).

[Speaker Zoom video]

Results - pH trend (seasonal)



Here we can see the marked changes that the pH level has in the months of the year, showing the influence of seasonality. Reaching conditions of greater acidity in the warm months compared to the months of cold conditions of the sea.

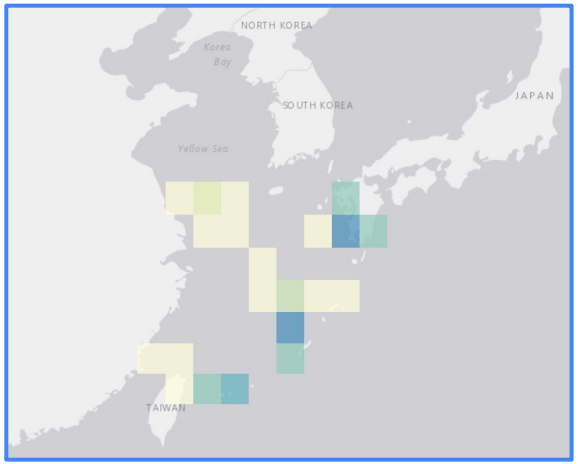
Significance and societal impact

[Speaker Zoom video]

The region's rugged coastlines and well-developed continental shelf makes it ***suitable for marine fisheries and coastal aquaculture*** of finfish, shellfish, and seaweed (Kang 2006).

The ECS is characterised ***by high biodiversity*** (Liu 2013a), with up to 12,933 tropical and subtropical species. Importantly, almost half (***48%***) of ECS ***species are endemic*** (Ding et al. 2008).

Clams Distribution in ECS



Based on this information, we can see that ocean acidification ***would have impacts on marine biodiversity*** and ***risk the stability of fishing and aquaculture*** activities.

Conclusions

[Speaker Zoom video]

- The pH level and sea surface temperature in Shanghai coastal region are inversely proportional (i.e., increased SST means decreased pH).
- We can conclude that SST has a seasonal effect on pH, since during hot seasons in Shanghai, the pH level decreases significantly, contrast to the cold seasons.
- Societal impacts have not been made clear in any form of public communication; however, we should be aware of the potential influences of ocean acidification.