Rapa Nui: A World Heritage Site Threatened by Sea Level Rise

Protoceratops_Jitterbug_Legato

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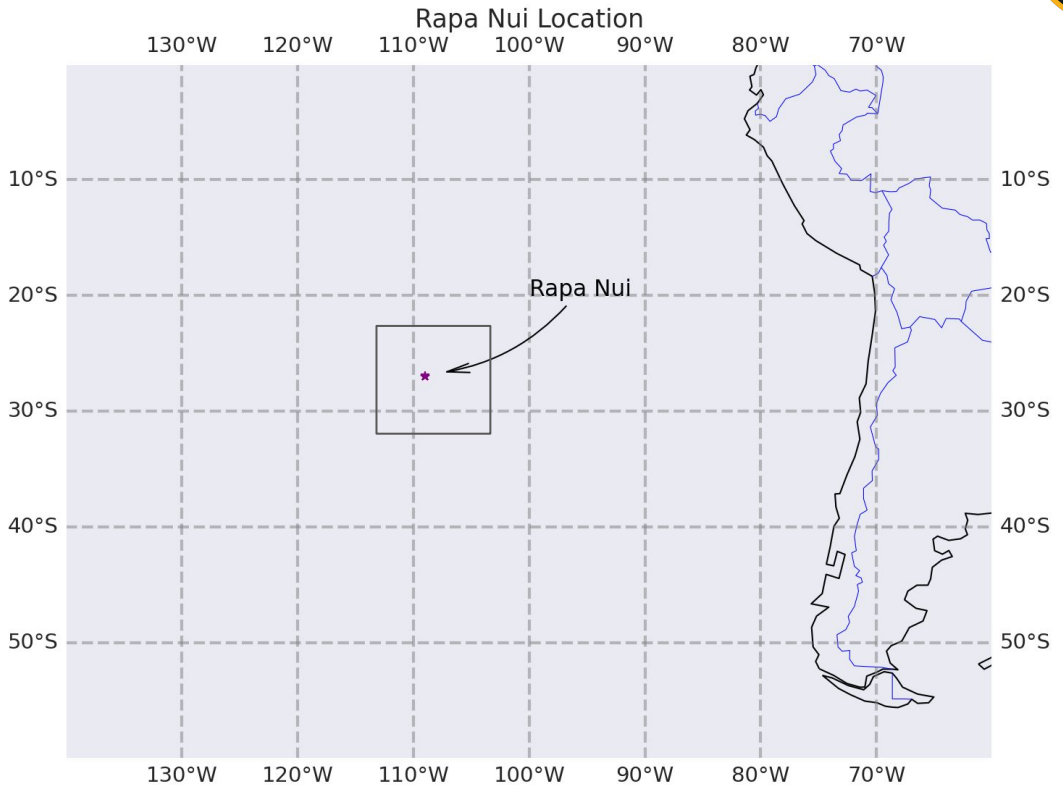
Rapa Nui: A World Heritage Site

- Isla de Pascua is the remotest inhabited island in the world.
- Parque Nacional Rapa Nui: Giant Polynesian stone sculptures “Moai”
- Inscribed in the UNESCO World Heritage List in 1995: Outstanding Universal Value
- Vulnerable to climate change: erosion, wave impact, sea level rise...

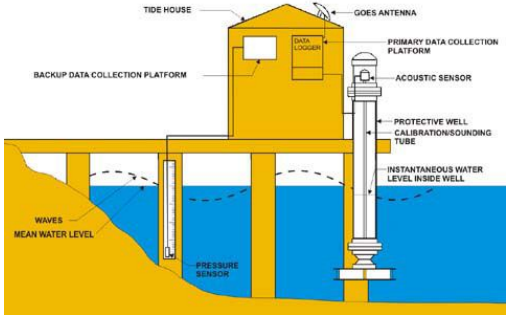


Research Question and Hypotheses

- **How is the Sea Level Rise affecting the World Heritage Site?**
- H1: The Tidal Gauge and ECCO Reanalysis data, although similar, should have some differences because ECCO is a coarse resolution oceanic product and may not represent the same coastal processes as the tidal gauge will capture.
- H2: Extreme periods of El Niño and La Niña will impact the sea surface height.

What data are we using?

Tidal Gauges

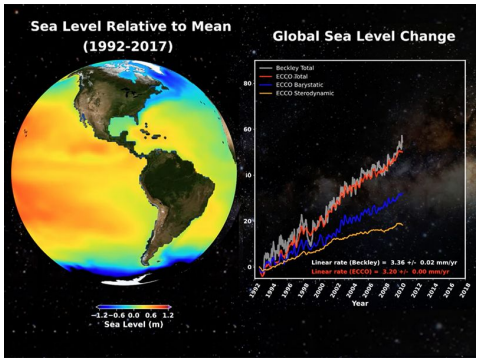


Credits to NOAA

UNIVERSITY OF HAWAII SEA LEVEL CENTER

- 1917-2023
- Daily
- SSH (mm)

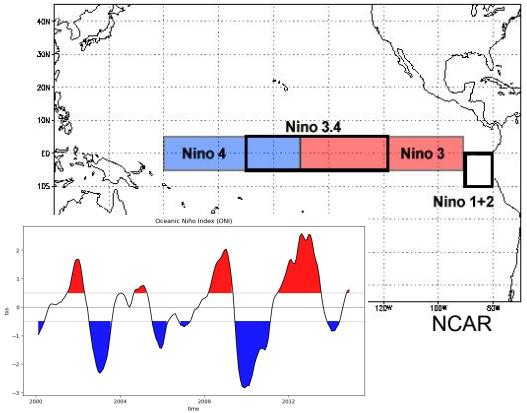
ECCO Reanalysis



NASA PODAAC

- 1992 - 2017
- Monthly
- 0.5 x 0.5 degrees
- SSH(mm)

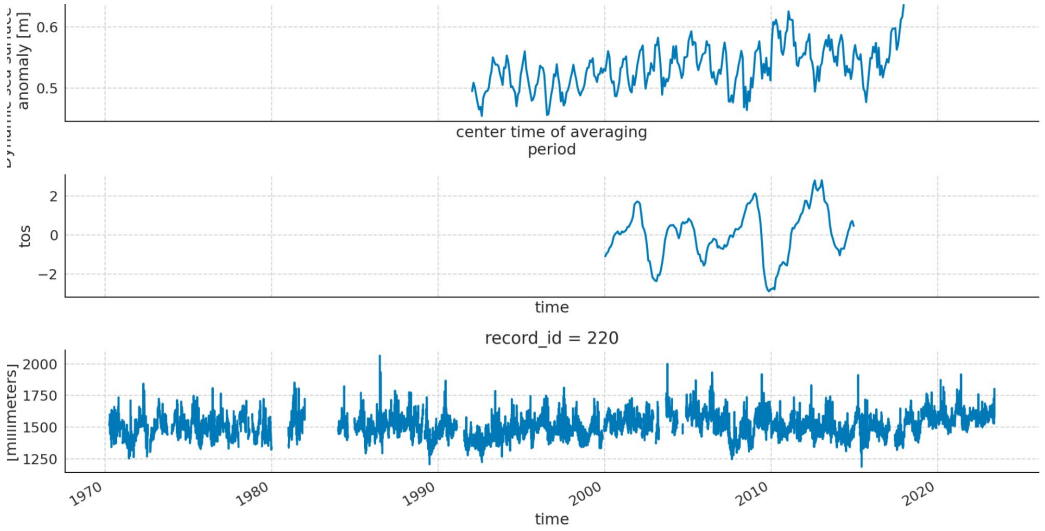
Niño 3.4 Anomalies (CESM2)



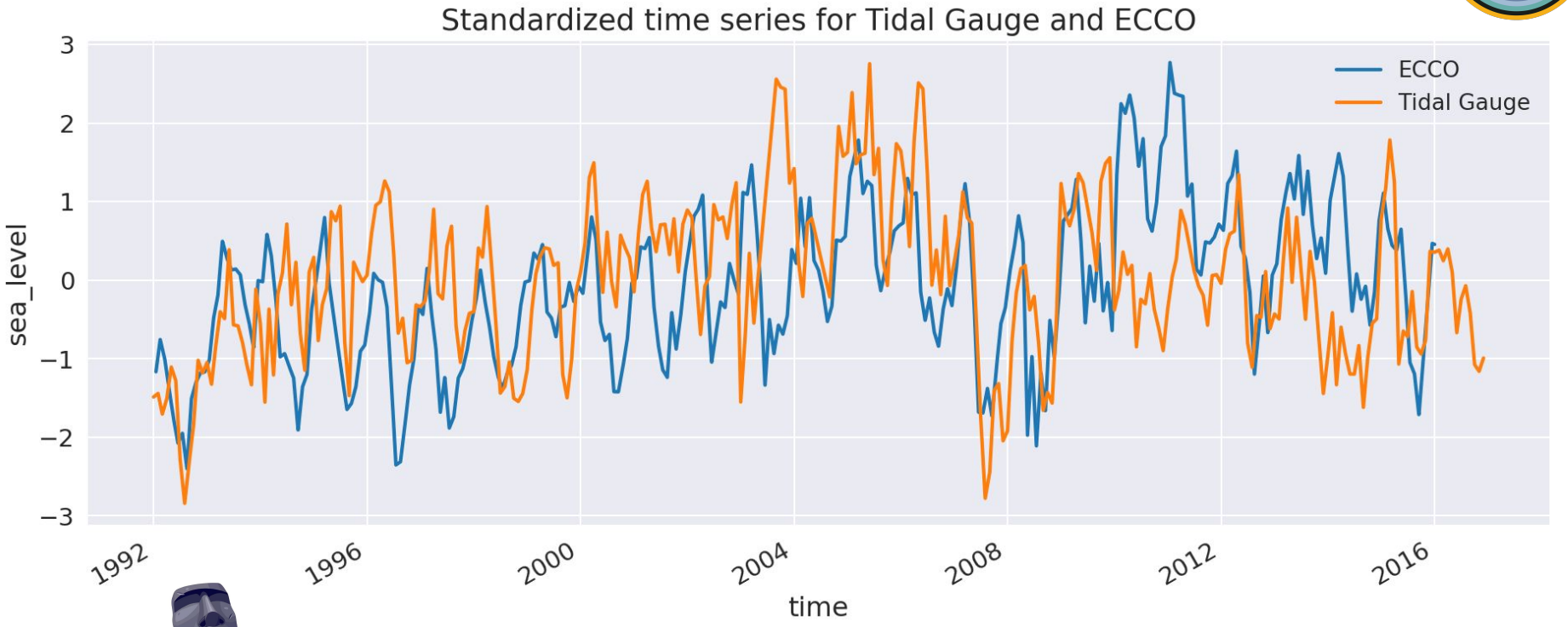
- 2000 - 2014
- Monthly
- 1 x 1 degrees
- SST(°C)

Dataset processing

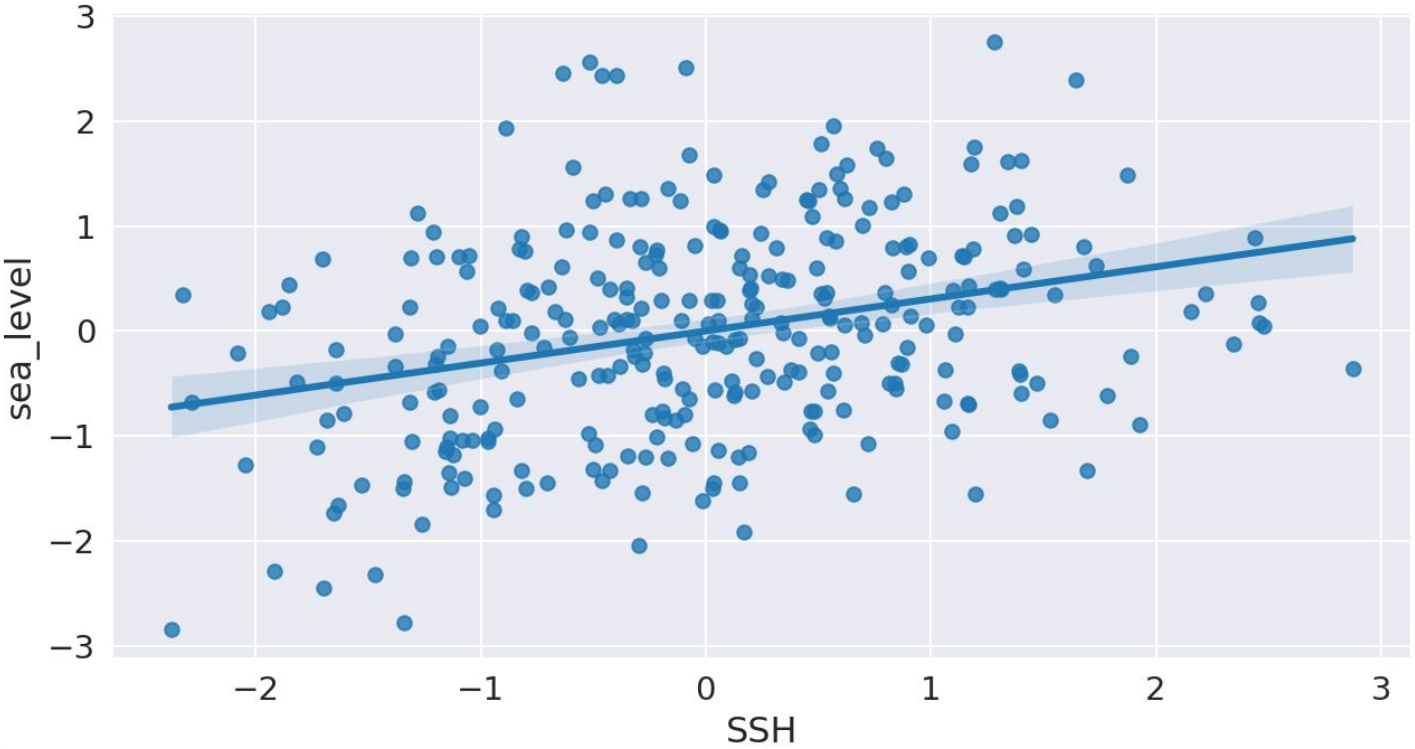
- Tidal Gauge: resampling monthly to have same timepoints
- Standardization (difference over baseline)
- Fill gaps with interpolation
- Time Length 2000-2016



How both SSH dataset evolve over time?



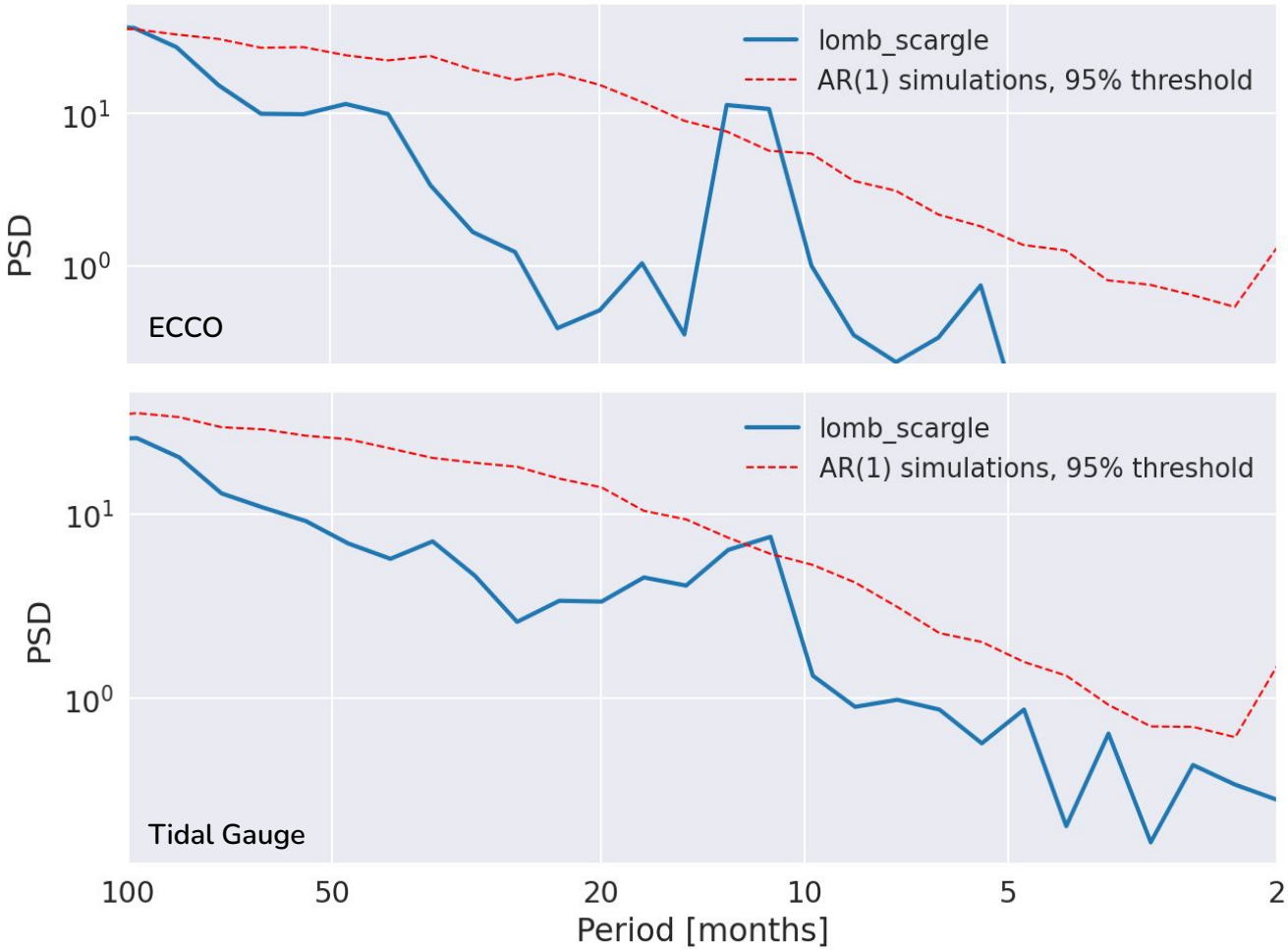
Is there any correlation between Tidal Gauge data and ECCO SSH?



Correlation coefficient: **0.306**

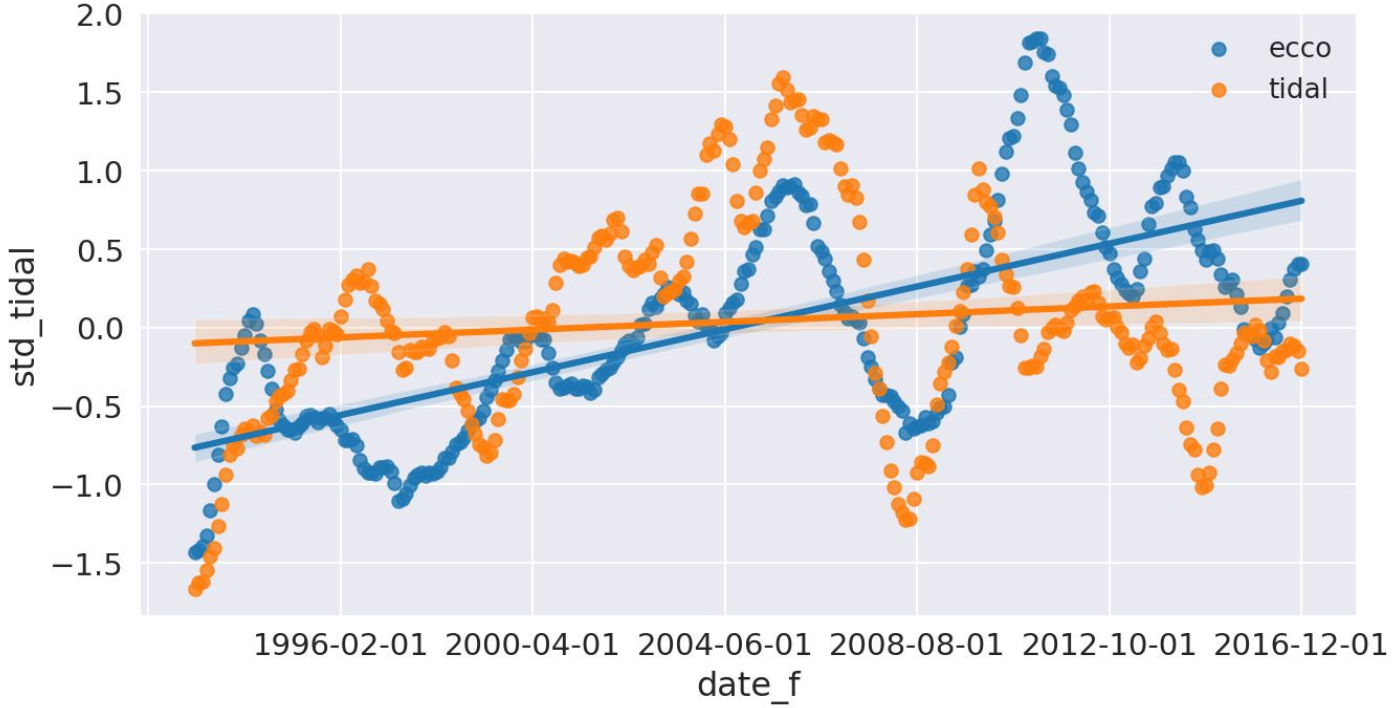
Is the variation cyclical?

Spectral analysis to find dominant temporal patterns

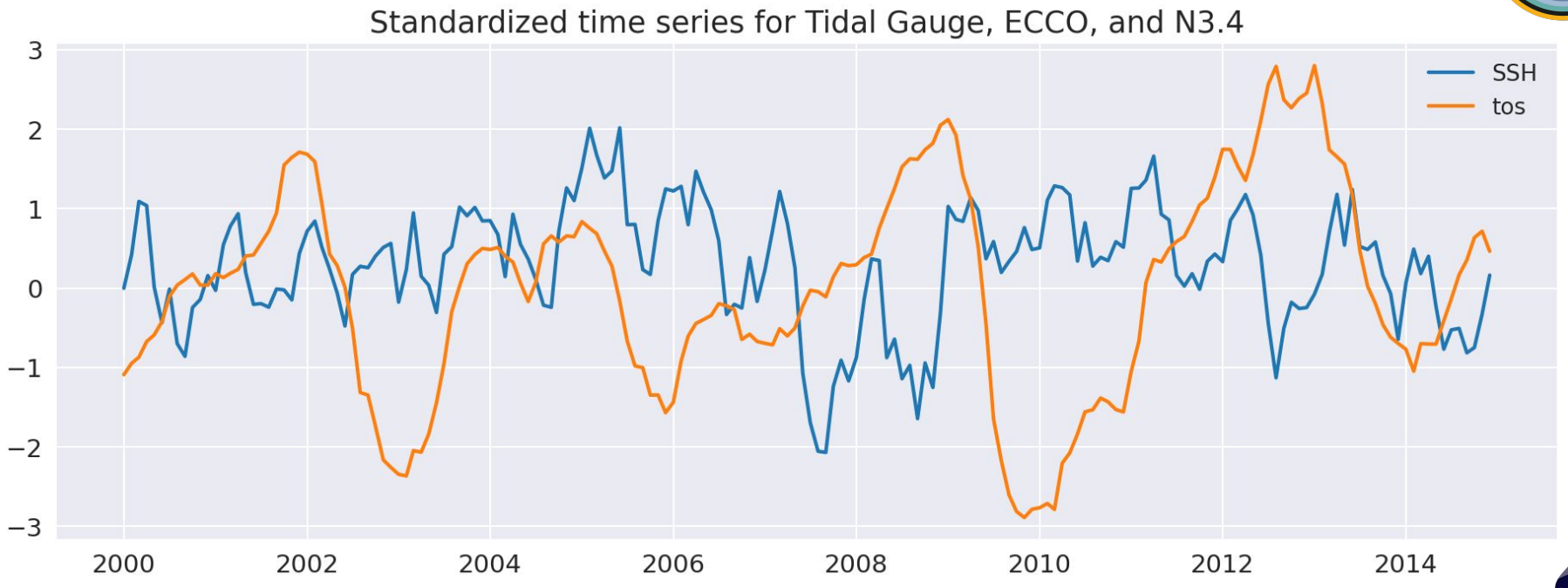


What is the general trend of SSH datasets?

We removed the seasonality with a rolling mean over 12 months



Is there any correlation between N3.4 index and sea SSH?

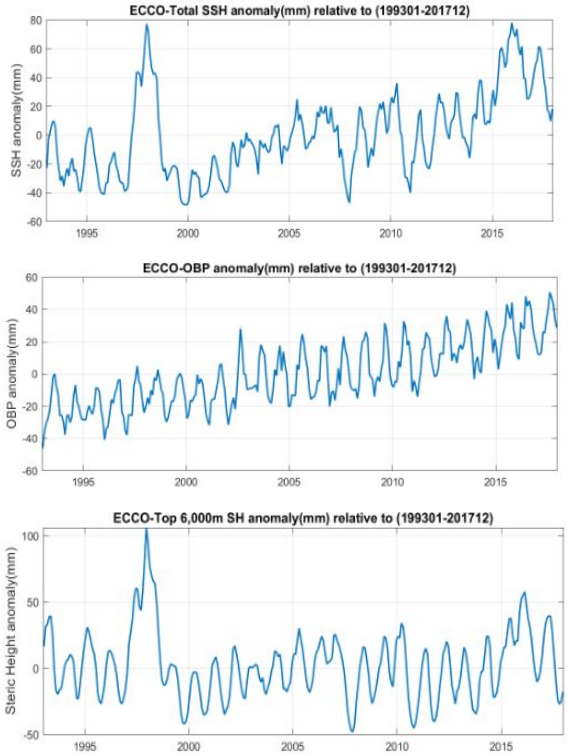


Correlation coefficient Tidal vs. TOS: **-0.191**

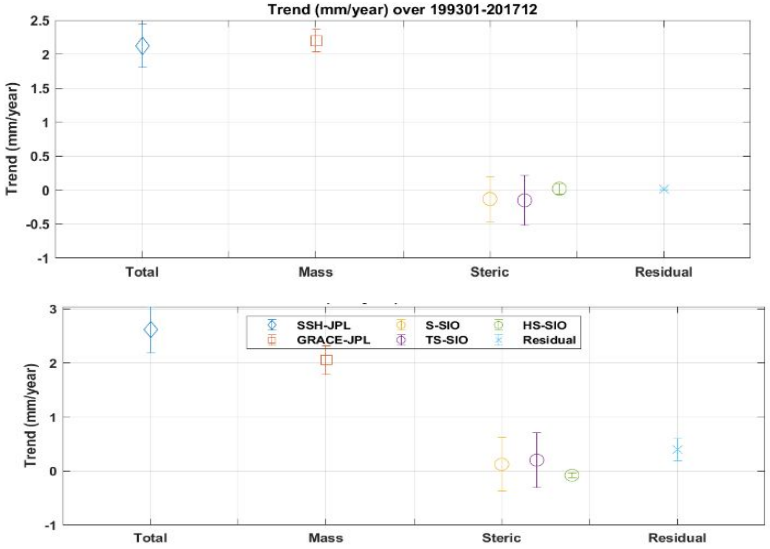
Analysis

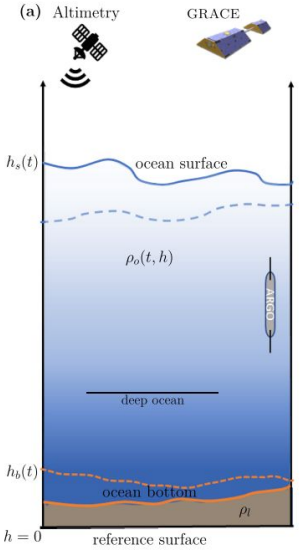
SLR = SL_upper_steric + SL_mass + SL_deep

(Satellite Altimetry) (Argo: Temperature, Salinity) (GRACE) (Residual term)



Gravity Recovery and Climate Experiment





Vishwakarma et al., (2019)

In our study area, Sea Level Rise (SLR) is primarily driven by Mass Flux.

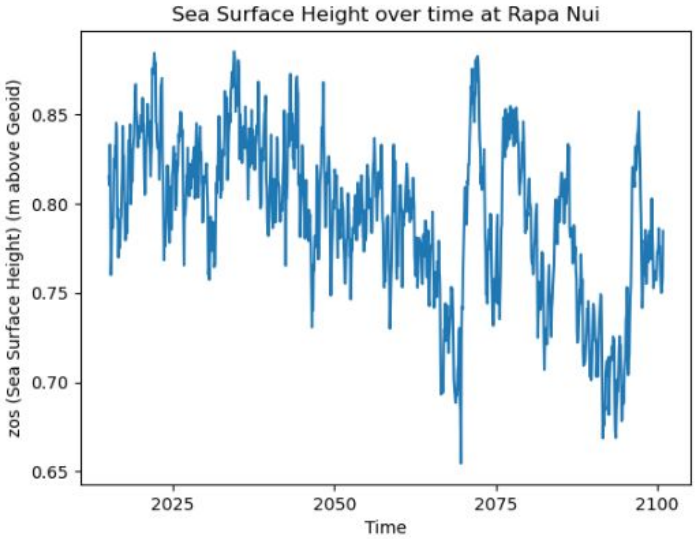
Conclusion

- ECCO reanalysis and tidal gauge data have some similarities, but also differences. Notably, the ECCO SSH is increasing at a faster rate than the tidal gauge dataset.
- Since both datasets have positive trends with time, in the future, Rapa Nui will experience more inundation and impacts from sea level rise to the cultural heritage.
- Correlation with ENSO, although showing a slight correlation betwee Niña and higher SSH, is weak and inconclusive.

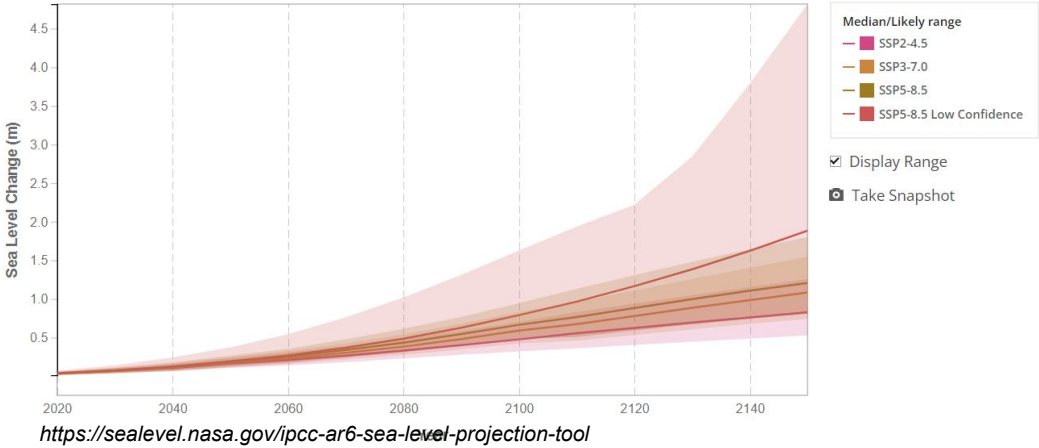
Next Steps:

- Incorporating sea level change projections from CMIP6 models
- Extract El Niño and La Niña segments from the TS and compare both SSH distributions
- Other options: precipitation projections, elevation data, erosion, flooding

Sea Surface Height projection from MPI-ESM1-2-LR model



For future use: CMIP6 multi-model ensemble sea level change projections



https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool

Thanks for your attention!