

climate change initiative

→ SEA SURFACE TEMPERATURE

Variability, persistence and re-emergence of sea surface temperature anomalies

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SST CCI Data Record (1)

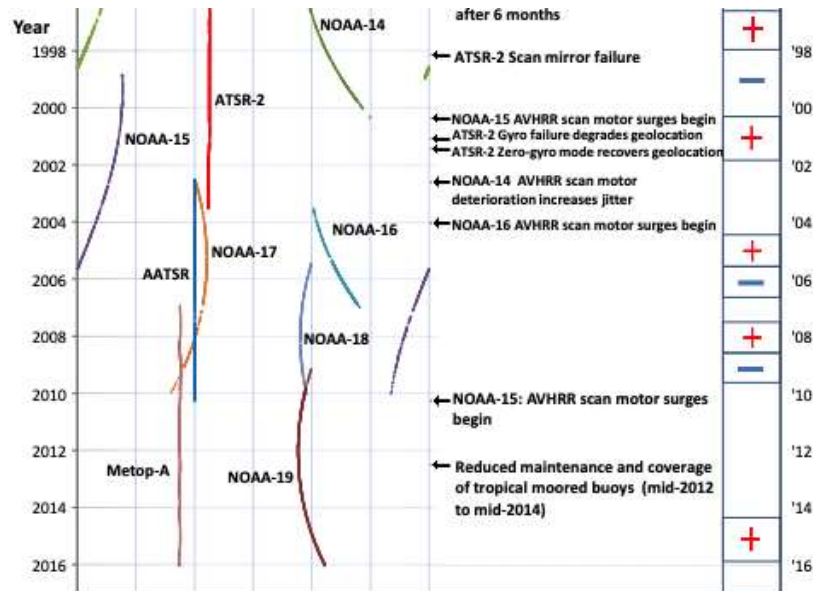
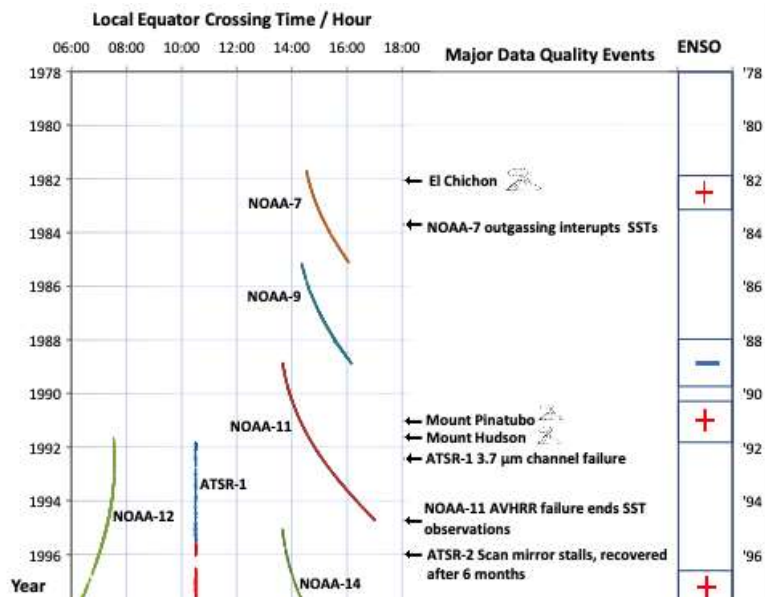


The European Space Agency (ESA) Sea Surface Temperature (SST) dataset is:

- Gap-filled, daily mean sea surface temperature (L4 Analysis Product).
- Funded by the Climate Change Initiative (CCI) program.
- Combines retrievals from:
 1. The Advanced Very High Resolution Radiometers (AVHRR's):
 - 4 km spatial resolution at nadir
 - Includes NOAA 7-19 and MetopA, spanning 1981-2018.
 2. The Along-Track Scanning Radiometers (ATSR's):
 - 1 km spatial resolution at nadir
 - Includes ATSR 1/2 and AATSR, spanning 1991-2012.
- Data are generated at 0.05 degree spatial resolution but re-gridded to 0.25 degrees preserving the feature resolution of ~20 km.



SST CCI Data Record (2)



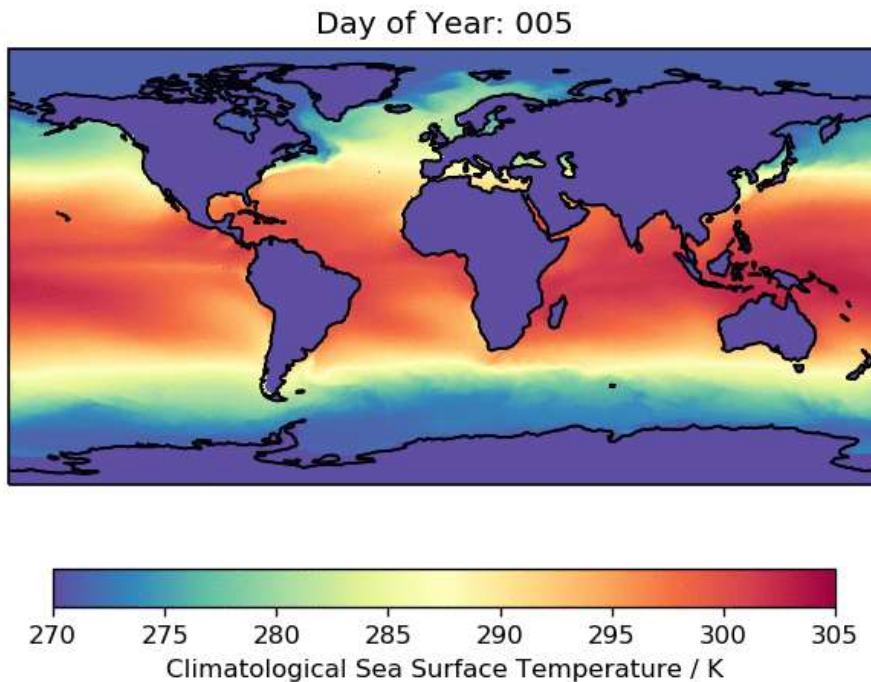


SST Anomalies

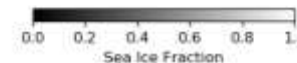
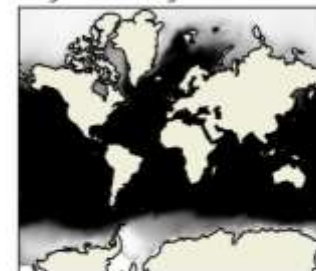


Our analysis uses SST anomalies, calculated using a daily climatology between 1982-2010.

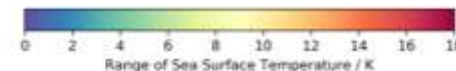
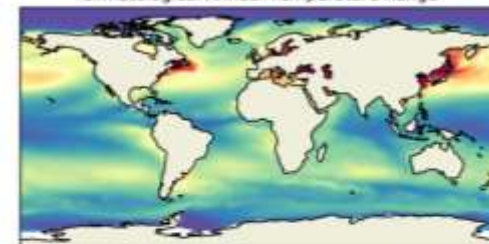
Climatology (pentad)



Long-term average sea ice fraction

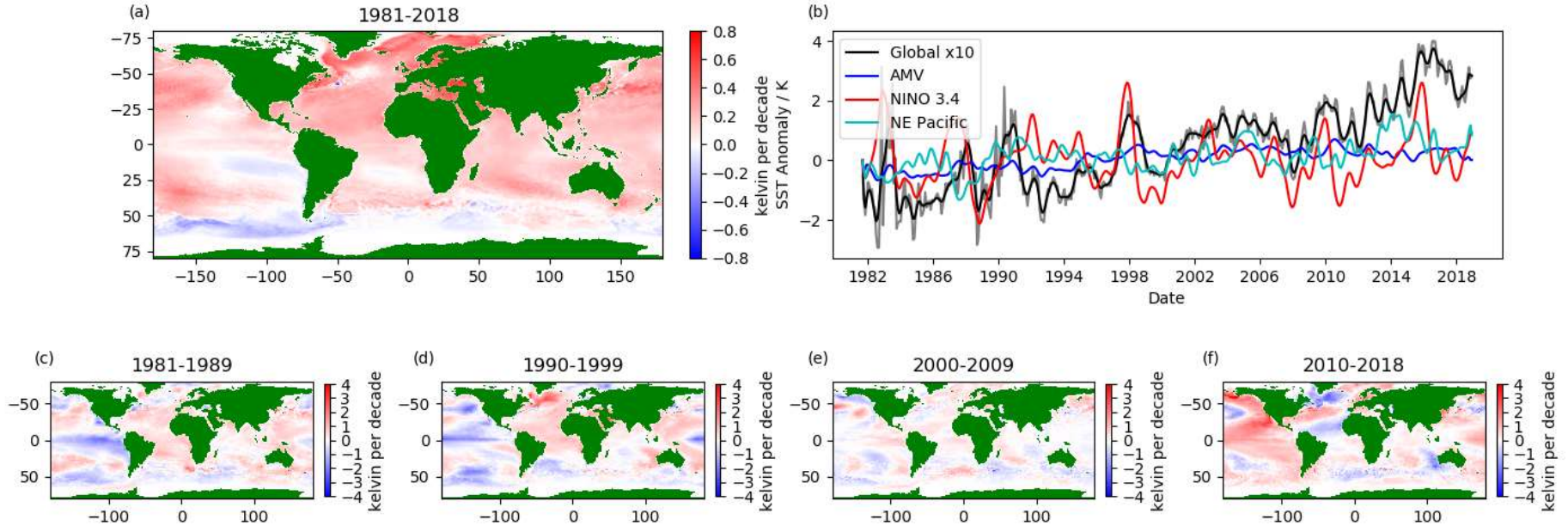


Climatological Annual Temperature Range





Global SST Anomaly Trends



- Global mean warming trend of 0.4 K between 1981-2018.



The rest of this presentation focuses on de-trended SST anomalies. We present analysis for two aspects of the SST data record:

1. SSTA Variability

- How does the SSTA variability compare to climatological variability?
- On what timescale do the processes determining SSTA variability operate?

2. SSTA Persistence

- How long do SSTA anomalies persist in the short-term (30-days) and on longer timescales (up to 9 months)?

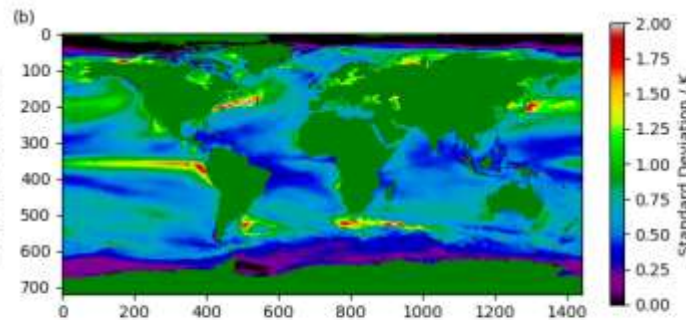
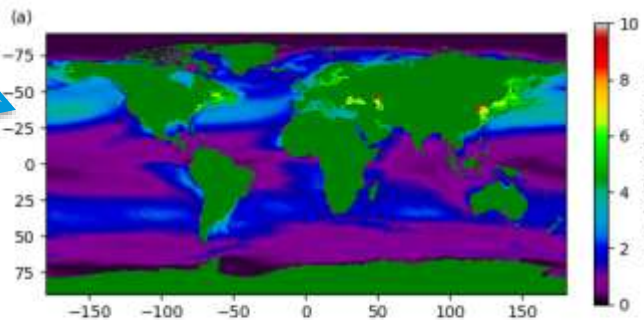


SST Variability



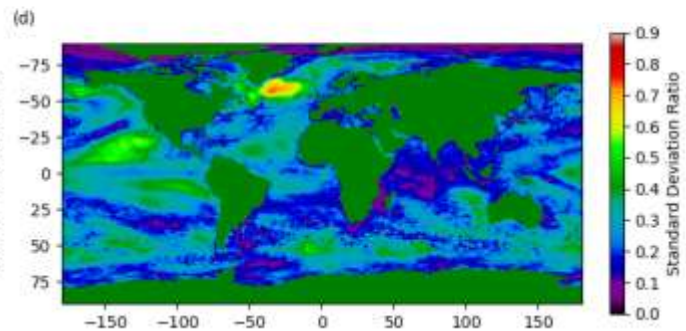
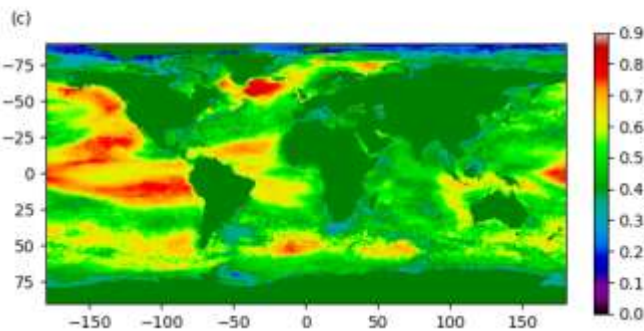
Climatological
variability

Dekadal
variability



Dekadal
variability
/ annual
variability

Dekadal
variability
/ Five-Year
variability



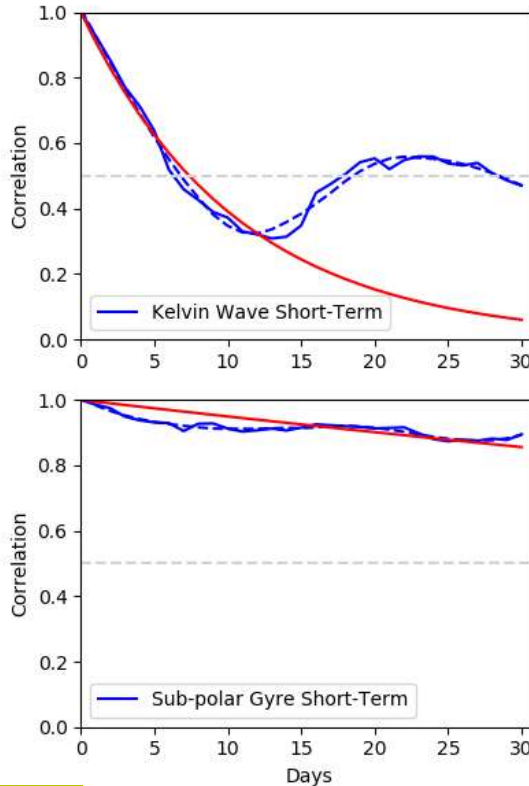


Estimating SST Anomaly Persistence



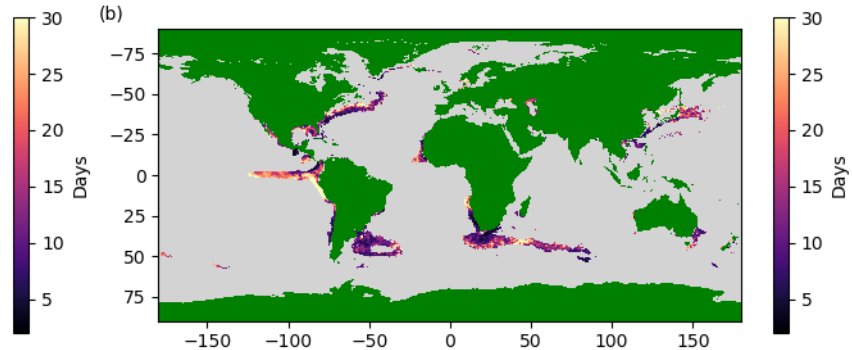
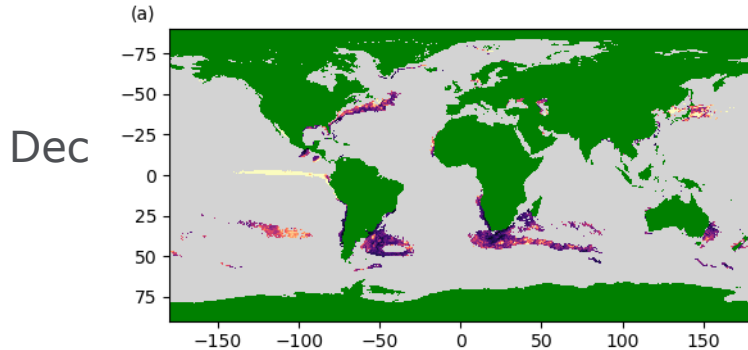
SSTA anomaly persistence is typically model as an exponential decay in the SSTA autocorrelation over time.

- We classify SSTA persistence using the SSTA half-life, e.g. when the exponential crosses the correlation threshold of 0.5.
- Correlation timescales are important for deriving the exponential fit as persistence characteristics vary globally.

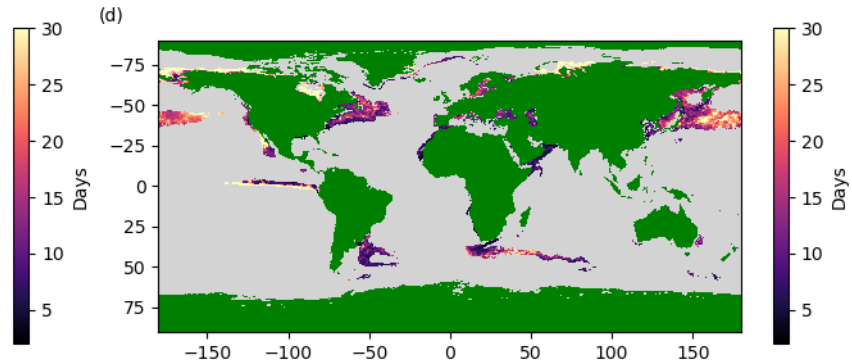
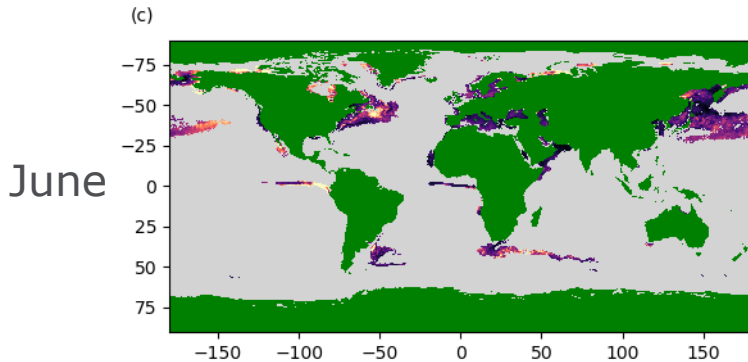




Short-term SST Persistence (30-days)



March



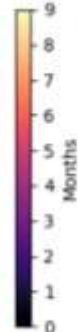
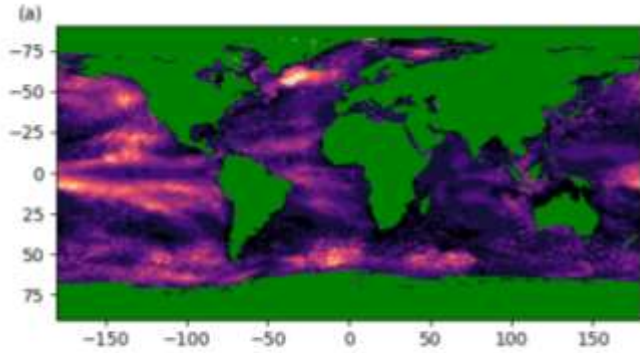
Sept



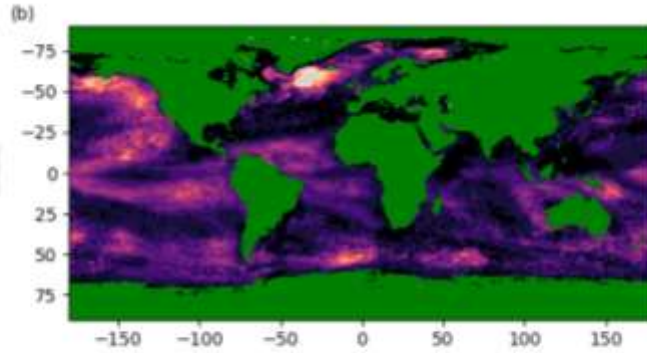
Long-term SST Persistence (up to 9 months)



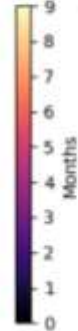
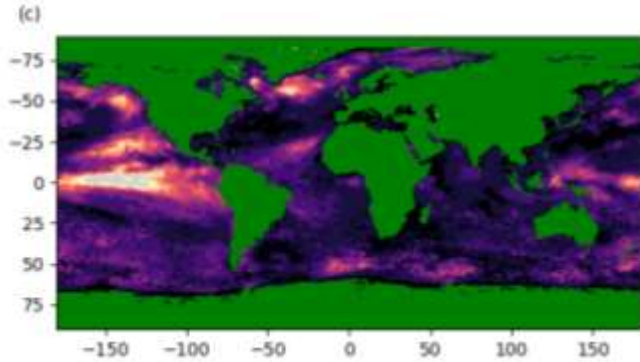
Dec



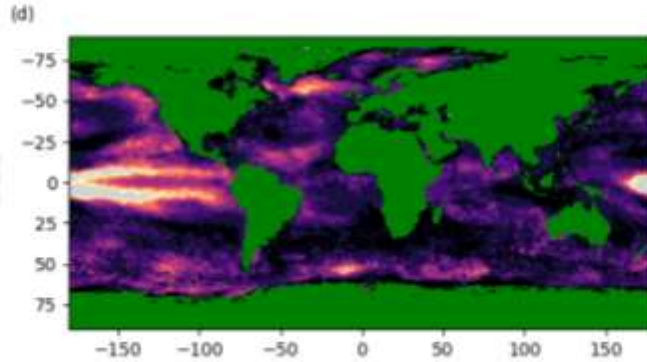
March



June



Sept





We use the gap-filled, daily mean sea surface temperature from the ESA SST CCI project to look at SSTA trends, variability, persistence and re-emergence over the satellite era (1981-2018).

- Globally we see an SST warming of 0.4 K over four decades.
- SSTA variability and persistence is dominated by mesoscale processes in western boundary currents and Kelvin wave regions.
- SSTA variability and persistence is dominated by longer SST modes in the sub-polar gyre and ENSO regions.
- There is so much more to see in this dataset than can be explained in 12 minutes – please look out for an upcoming paper!



SST Winter-to-Winter Re-emergence



Winter-to-winter re-emergence occurs in regions characterised by strong seasonal variation in the mixed-layer depth (MLD). Winter SSTA's persist at depth beneath a shallow summer mixed-layer and re-emerge the following winter when the summer thermocline erodes.

- The re-emergence index (RI) is calculated from the SSTA correlation with a six and twelve month lag (12-6 month correlation).
- We only show the RI where the 12 month correlation is statistically significant ($p_value < 0.1$).

