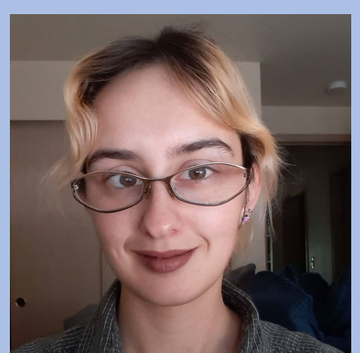
# Marine heat waves in the Chile-Peru Eastern Boundary Upwelling System:

## Rates of change in sea-surface temperature anomalies near a major upwelling center



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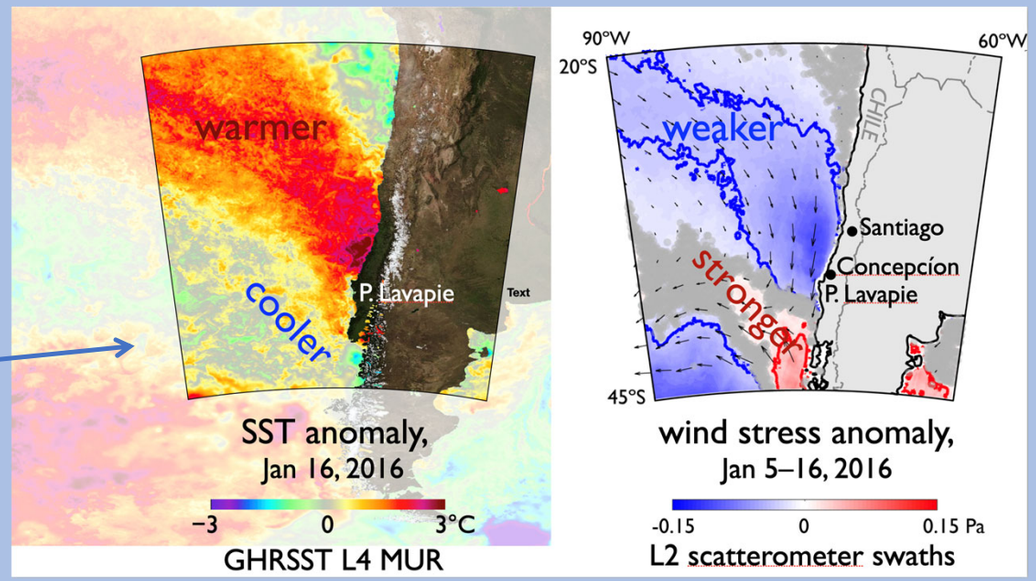
# **Marine heat waves (MHWs) affected the Chile-Peru System (CPS)** in 2014-2016 and 2019-2020

**Background:**

- In the California Current System (CCS), there is a relationship between warm SST and weak wind stress, or conversely cold SST and strong wind stress.

- This relationship is also present in a 2016 MHW event in the CPS

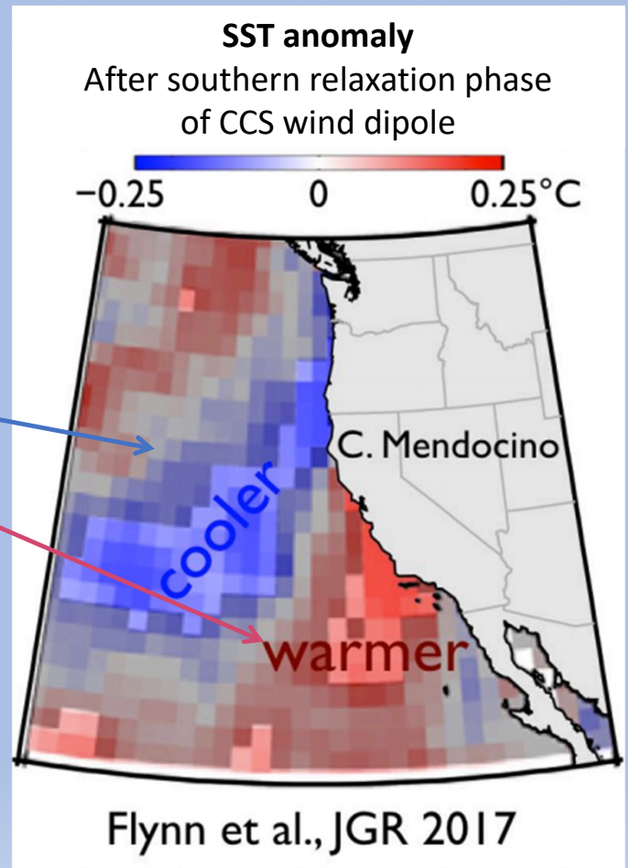
- Similar dipole structures in wind stress and sea surface temperature (SST) as Fewings and Brown 2019 observed in the 2015 MHW in the CCS



# **Dominant forcing mechanisms of the surface ocean heat budget** in the CPS during MHWs are not well defined

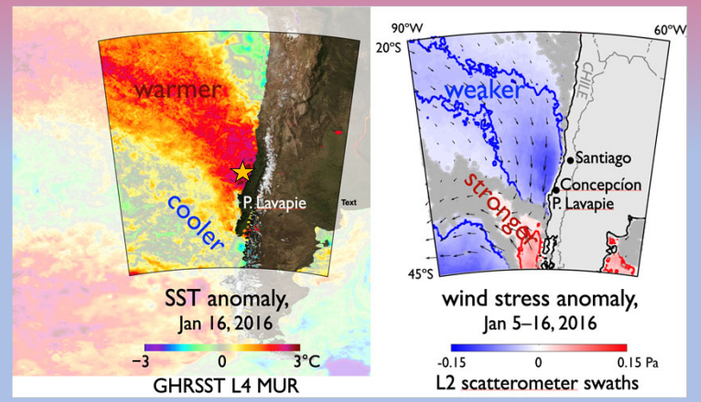
- Dominant forcing mechanisms during wind dipole events in the CCS have been found through analysis of the surface ocean heat budget
  - Surface latent heat flux
  - Decreased entrainment and Ekman pumping at the mixed layer base

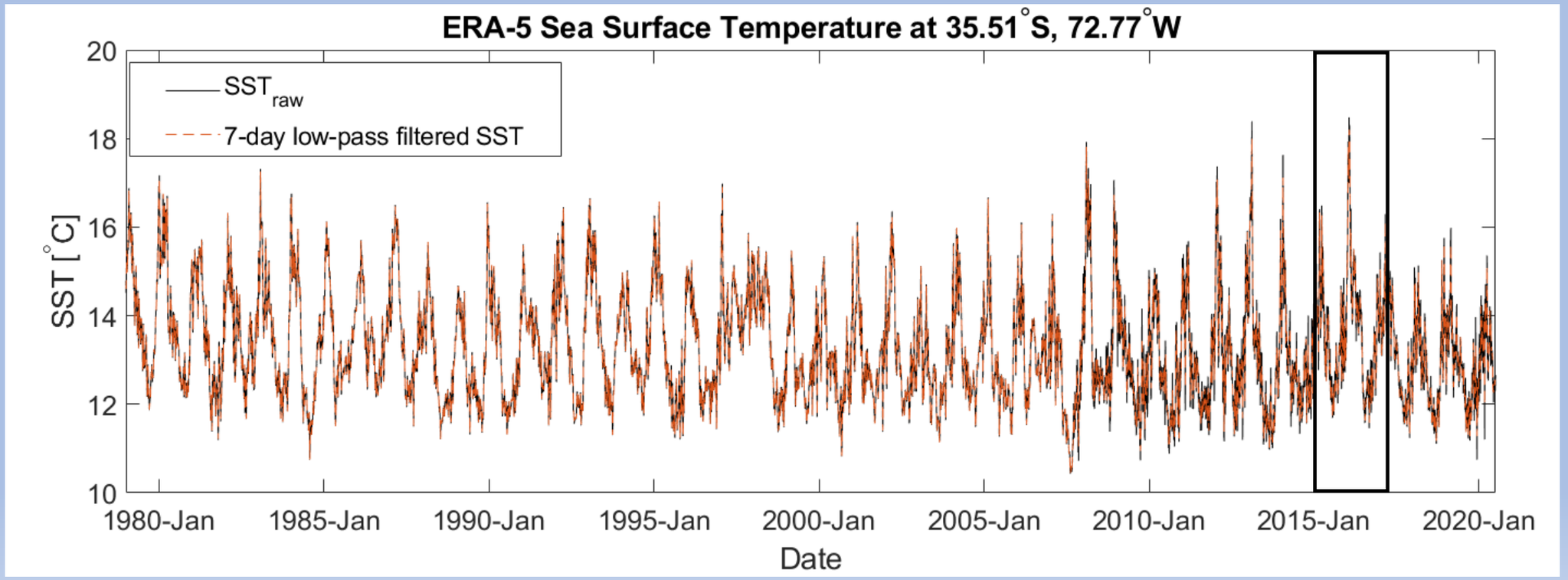
- *Do these processes also drive MHW warming in the CPS?*



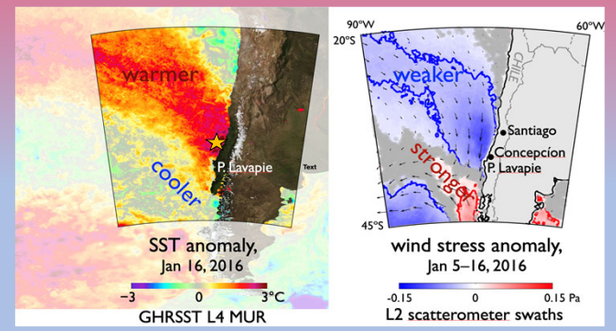
# Isolating strong warm anomalies in CPS, Part 1

We use SST near **Punta Lavapié upwelling center** from 5th generation European Centre for Medium-Range Weather Forecasts reanalysis (**ERA5**)

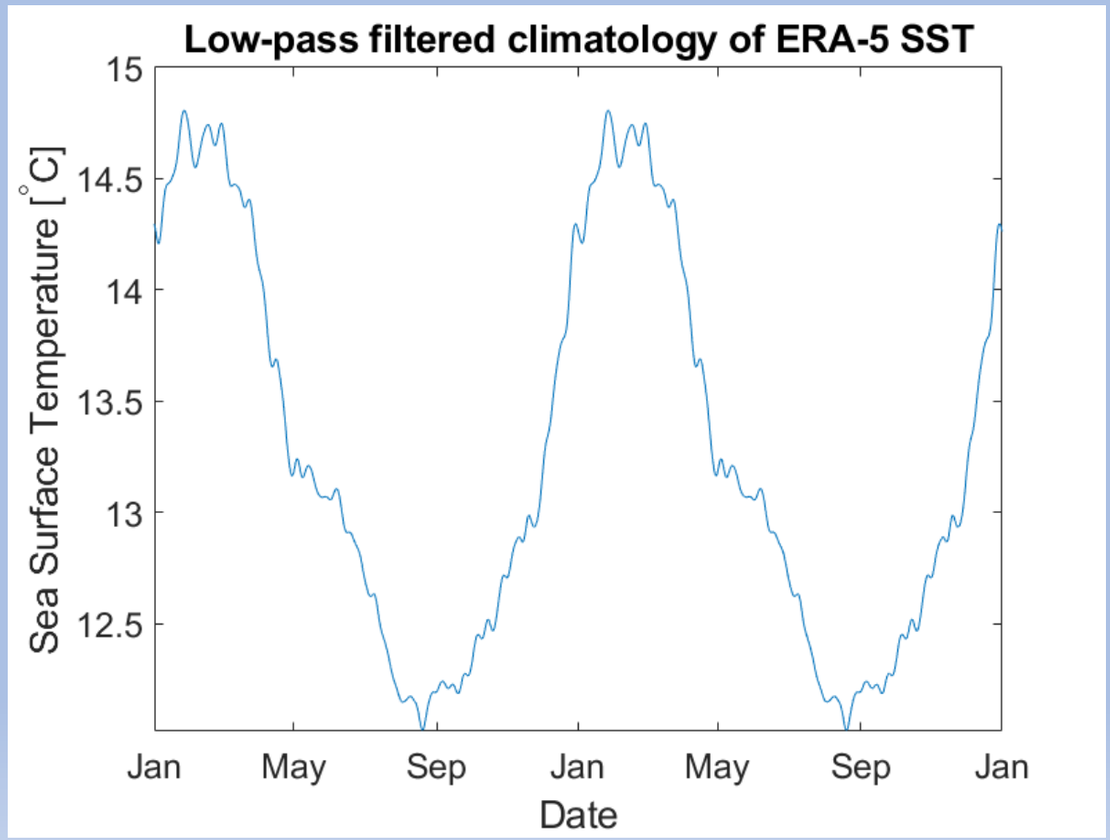


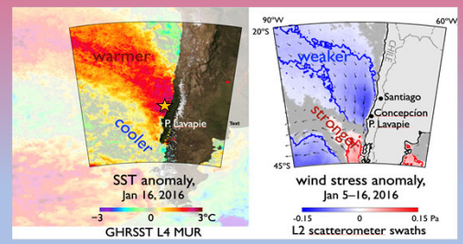



# Isolating strong warm anomalies in CPS, Part 2



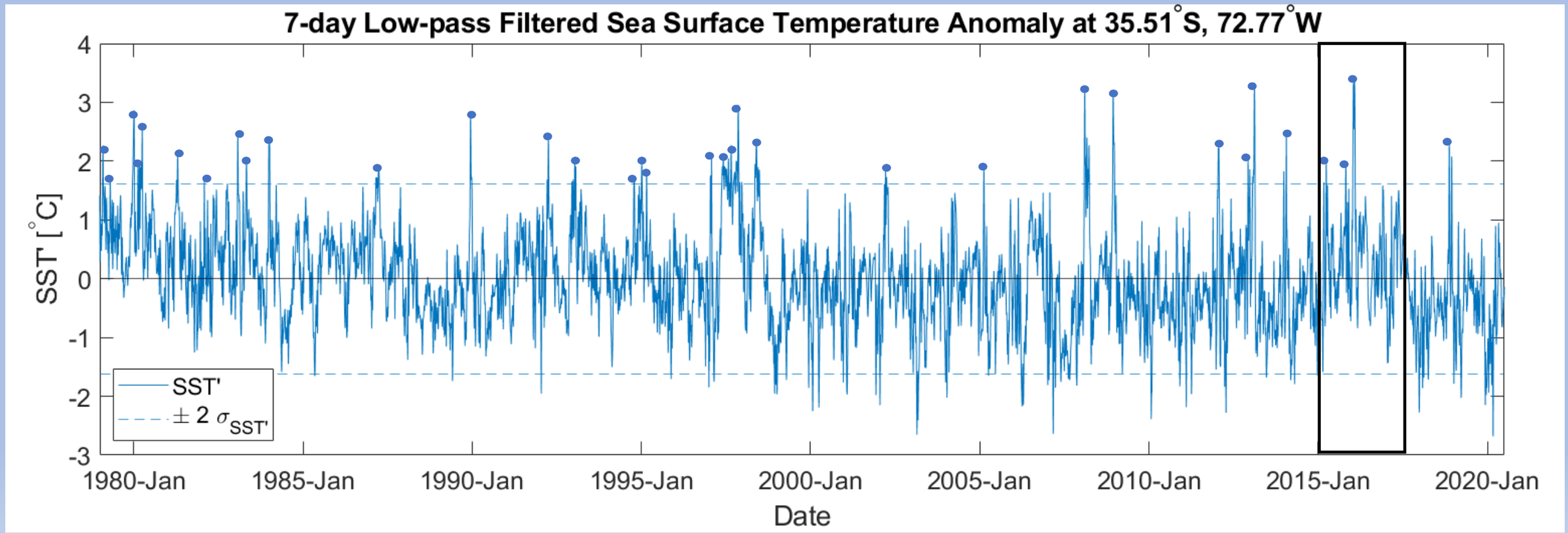

First, we calculate the **climatological annual cycle**
We subtract this annual climatology from SST to calculate the anomaly, SST'





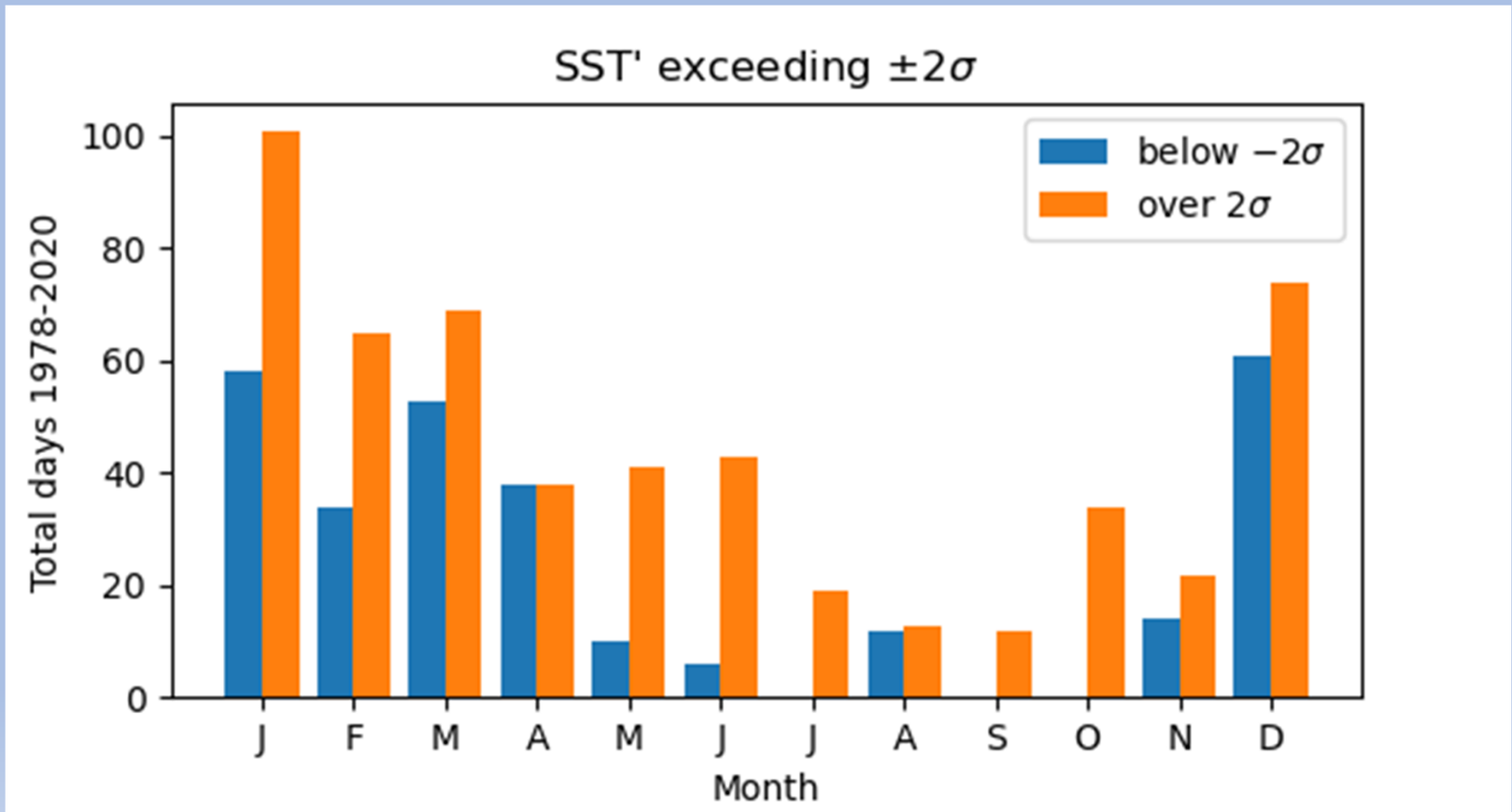

# Isolating strong warm anomalies in CPS, Part 3

We focus on periods of intense warm anomalies
where **SST' exceeds two standard deviations** from the mean



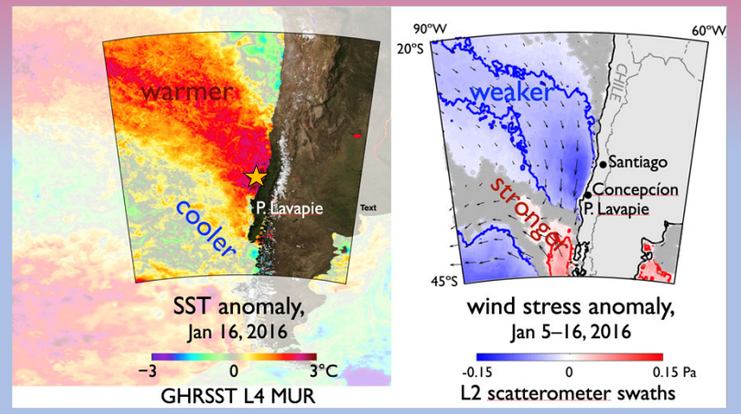
# Isolating strong warm anomalies in CPS, Part 4

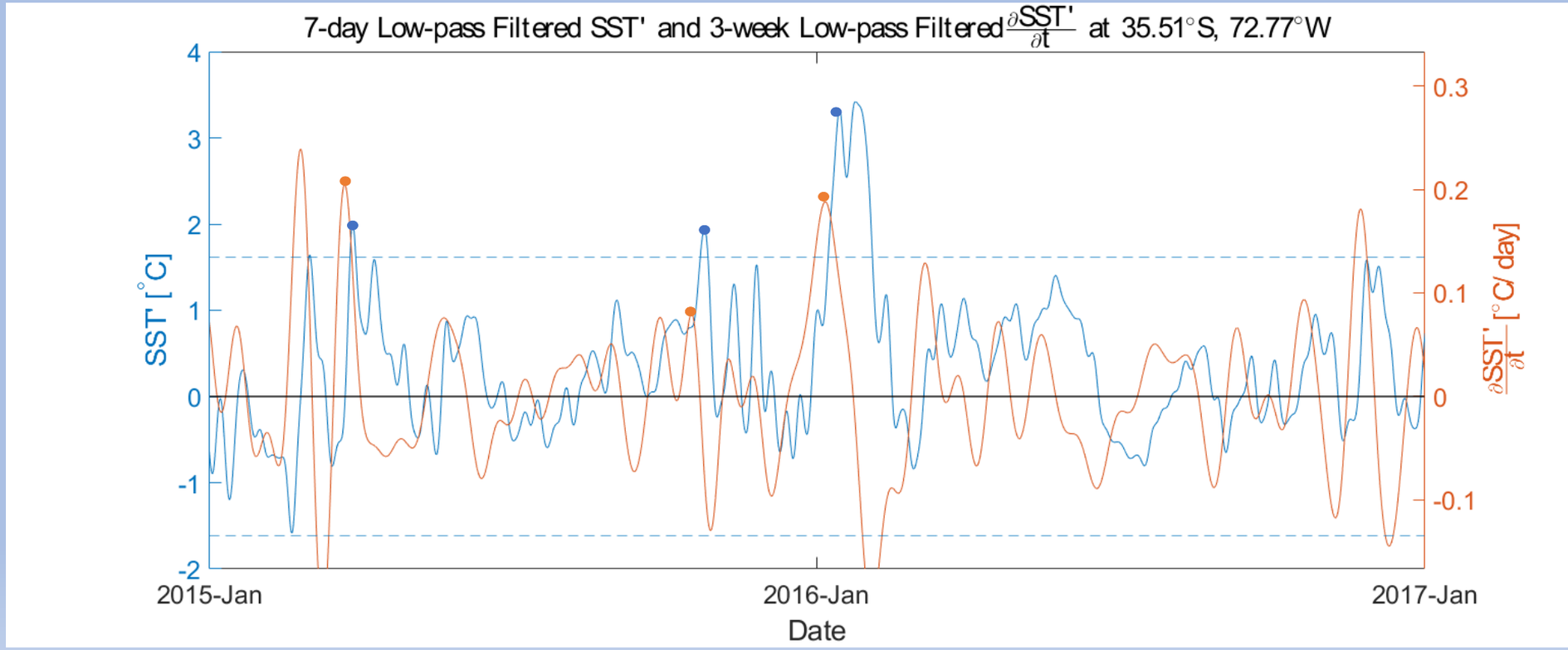
Strong warm (and cold) anomalies occur most often in **December through March**



# Calculating rates of anomalous warming

**Estimate time derivative** of the temperature anomaly, SST’,
to determine time periods of warming leading to peaks in SST’



# Future Work:

- Sea surface mixed layer heat budget terms for each period of anomalous warming during 1979-present following Flynn et al. 2017; Fewings and Brown 2019, but within the mean spatial region of the strongest SST anomaly (SST') signals
- Examine which terms are dominant leading to warmest periods
- Utilize ERA5 and satellite-derived air-sea heat fluxes OAFlux and SeaFlux, and Argo floats
- Satellite ocean vector wind L2 swath data will be used to resolve the coastal wind features 1999-present

What do we hypothesize finding?

- Coastal wind features determine the spatial shape of the SST' signals
- Different forcing mechanisms in northern and southern SST' regions
- Warming in northern region mimics CCS southern region forcing mechanisms:
    - Decreased entrainment and Ekman pumping at mixed layer base
    - Additional warming driven by advection of SST gradients
- Cooling in southern region mimics CCS northern region forcing mechanisms:
    - Latent heat flux dominates offshore