Regional and Global Drivers of Marine Heat Waves and Related Atmosphere-Ocean Anomalies in the Eastern North Pacific

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Introduction, Data, and Methods

1. Persistent sea surface temperature anomalies (SSTAs) in the eastern North Pacific (ENP) have strong impacts on marine ecosystems, regional climate, and public health.
2. We investigated positive and negative SSTA events in the ENP, which we refer to as warm and cool events.
3. Our focus was on the summer ENP SSTAs and the atmosphere-ocean variables in the prior winter-spring that lead to summer anomalies

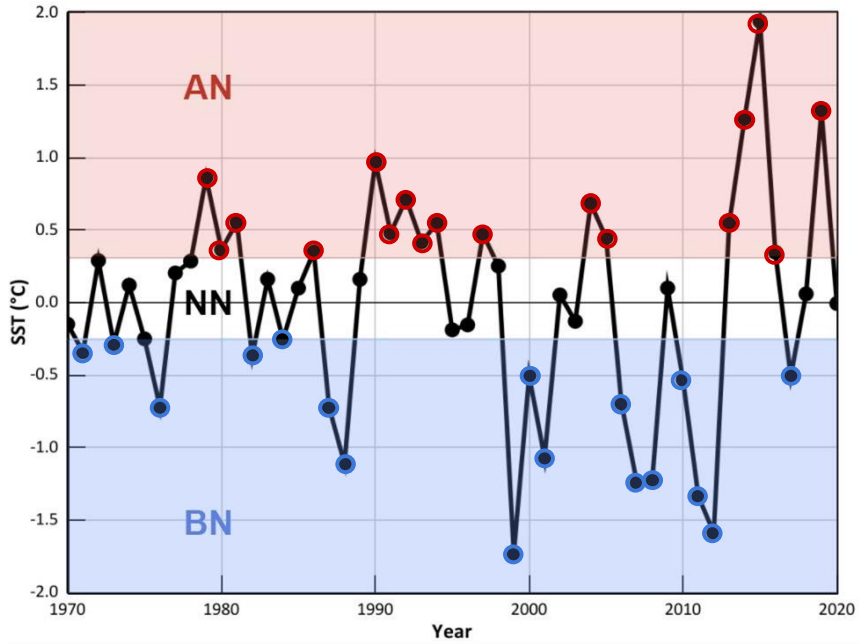


Figure 2. Detrended ENP SST (°C) from June-August 1970-2020. The 17 cool (warm) events are located in the blue (red) shaded region.

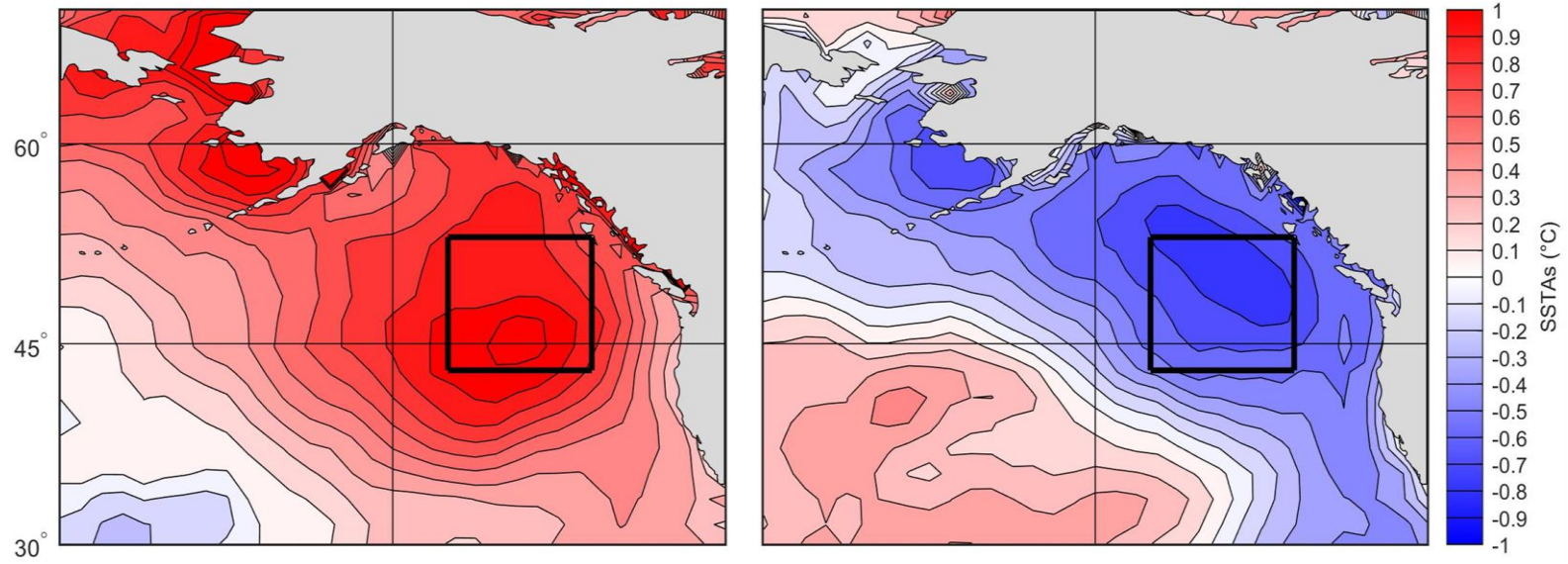


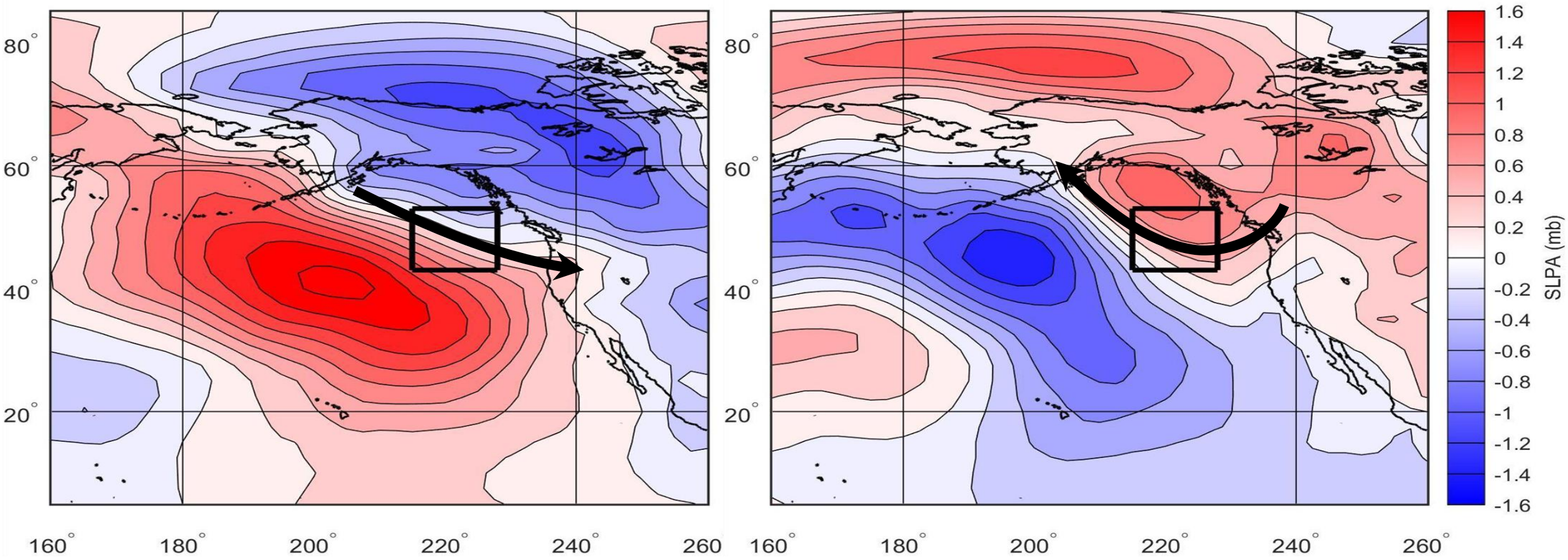
Figure 1. Composite SSTAs (°C) of the 17 warmest (coolest) summers: Jun-Aug. The black focus box shows ENP region of maximum positive and negative SSTAs.

1. NCEP/NCAR Reanalysis (R1), 1970-2020
2. The 17 coolest (warmest) June-August periods were identified as cool (warm) events (Figure 2).
3. Base period for anomalies: 1981-2010
4. Monthly means of atmosphere and ocean variables associated with ENP SSTs were analyzed using a range of statistical and dynamical analyses.

Prior Winter-Spring (Dec-May) SLPAs and Surface Wind Speed Anomalies

Composite Cool Events

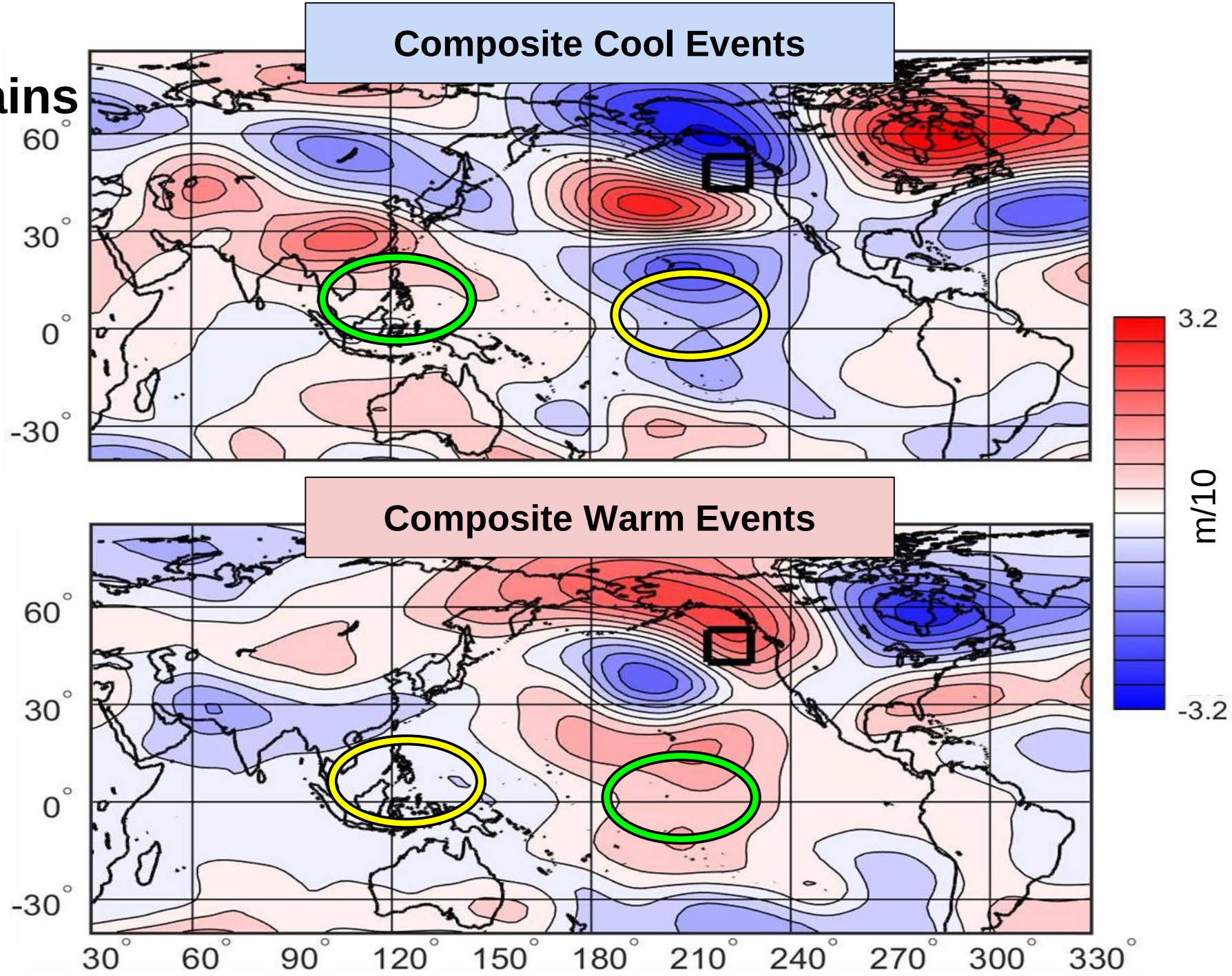
Composite Warm Events



1. Notice the opposite SLPA dipoles and patterns for cool and warm events
2. Winter and spring SLPAs drive positive (negative) surface wind anomalies for cool (warm) events

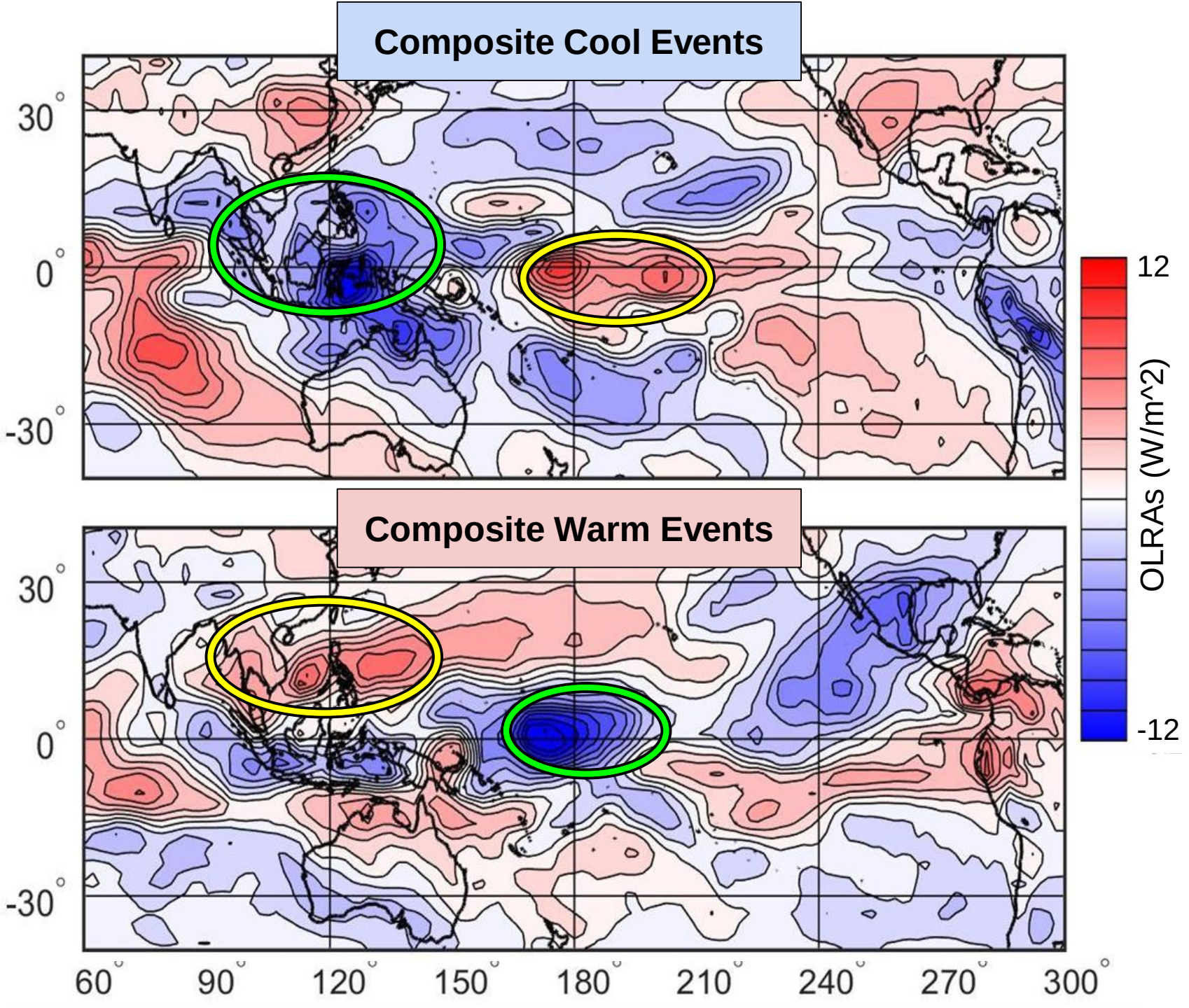
Prior Winter-Spring ZA200s and Wave Trains

1. Cool and warm events have extremely similar evidence of wave trains emanating from the tropics but with opposite signs.
2. Arcing and zonal wave trains constructively interfere in the eastern North Pacific.
3. Yellow (Green) ovals show regions of anomalously strong (weak) convection indicated by ZA200 patterns and other information.



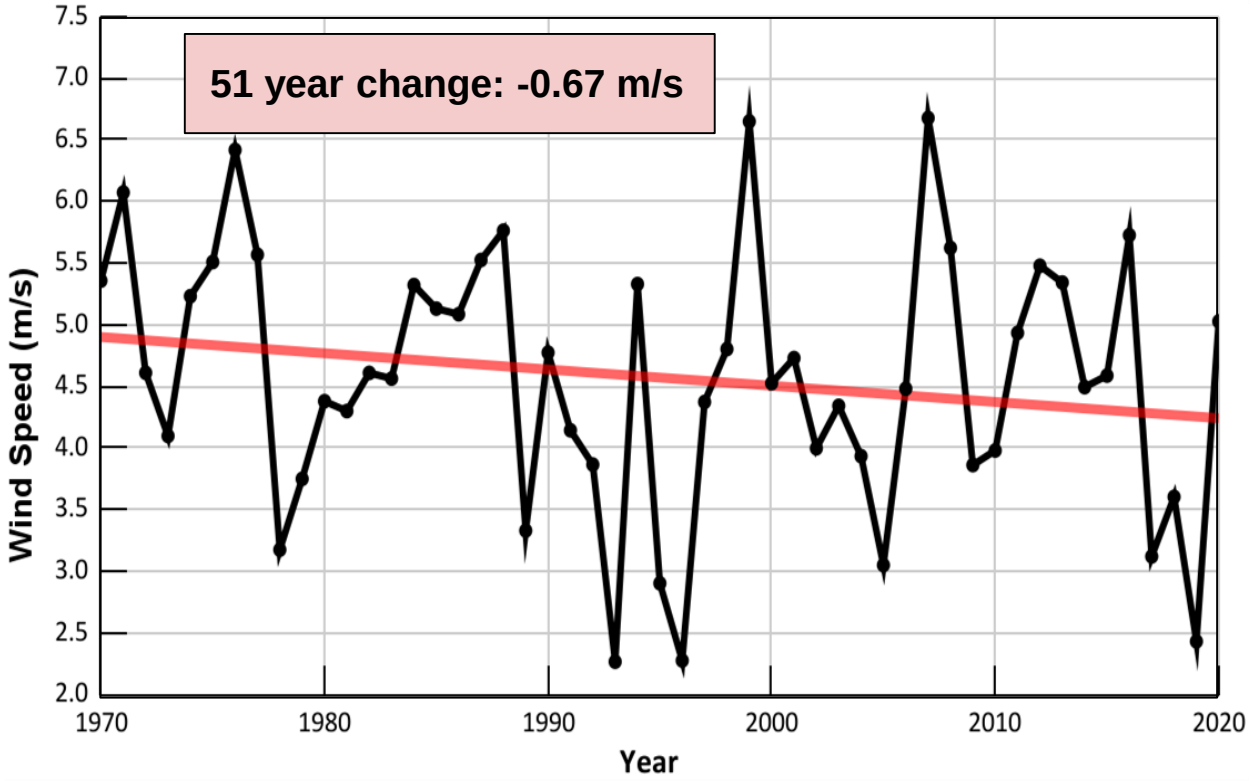
Prior Winter-Spring Outgoing Longwave Radiation Anomalies (OLRAs)

1. Negative (positive) OLRAs indicate enhanced (reduced) atmospheric convection
2. Note the OLRA dipole extending between the western tropical pacific and the central tropical Pacific
3. Cool (warm) events appear to be favored by an early (late) onset of the Asian summer monsoon in the maritime continent region

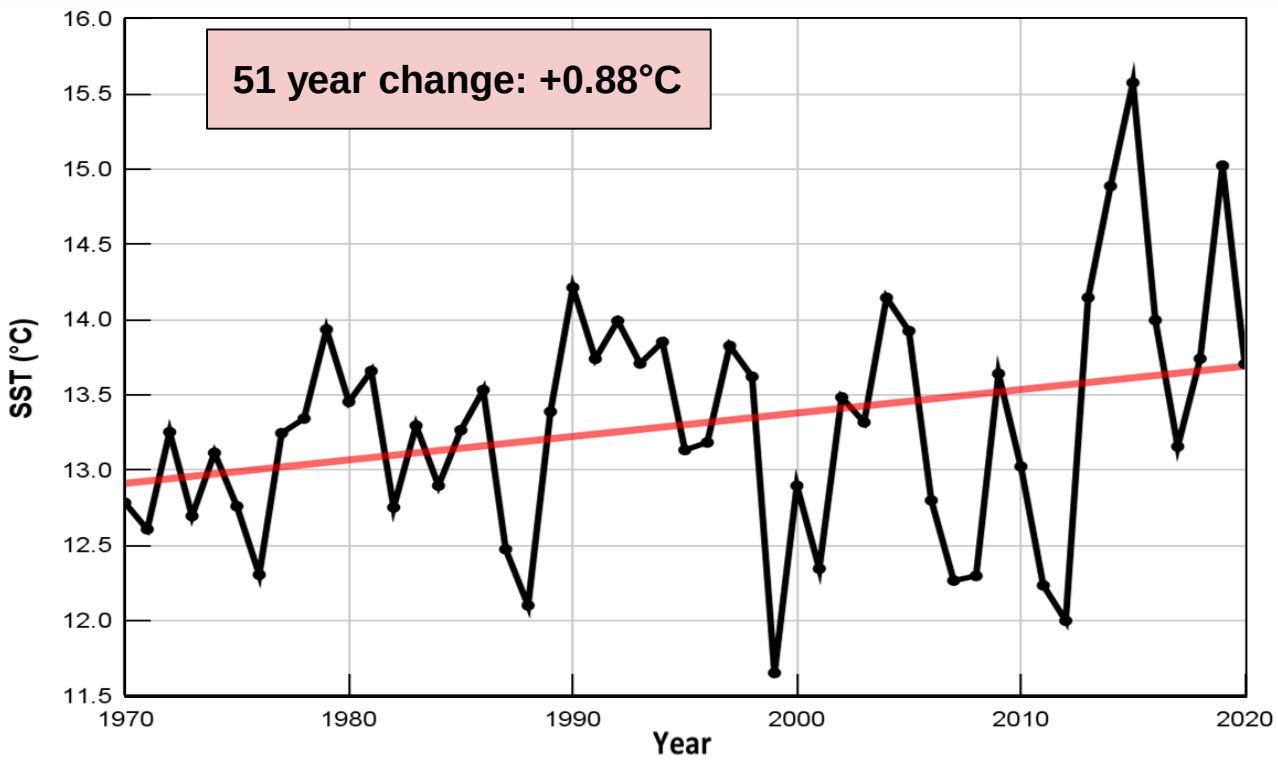


Multidecadal Climate Change

ENP Wind Speed Dec-May 1970-2020



ENP SST June-Aug 1970-2020



1. Both ENP wind speeds and SSTs have undergone large multidecadal changes.
2. The multidecadal decrease in wind speed is consistent with the multidecadal increase in SSTs.
3. This suggests that atmospheric climate change is leading to oceanic climate change in the ENP.

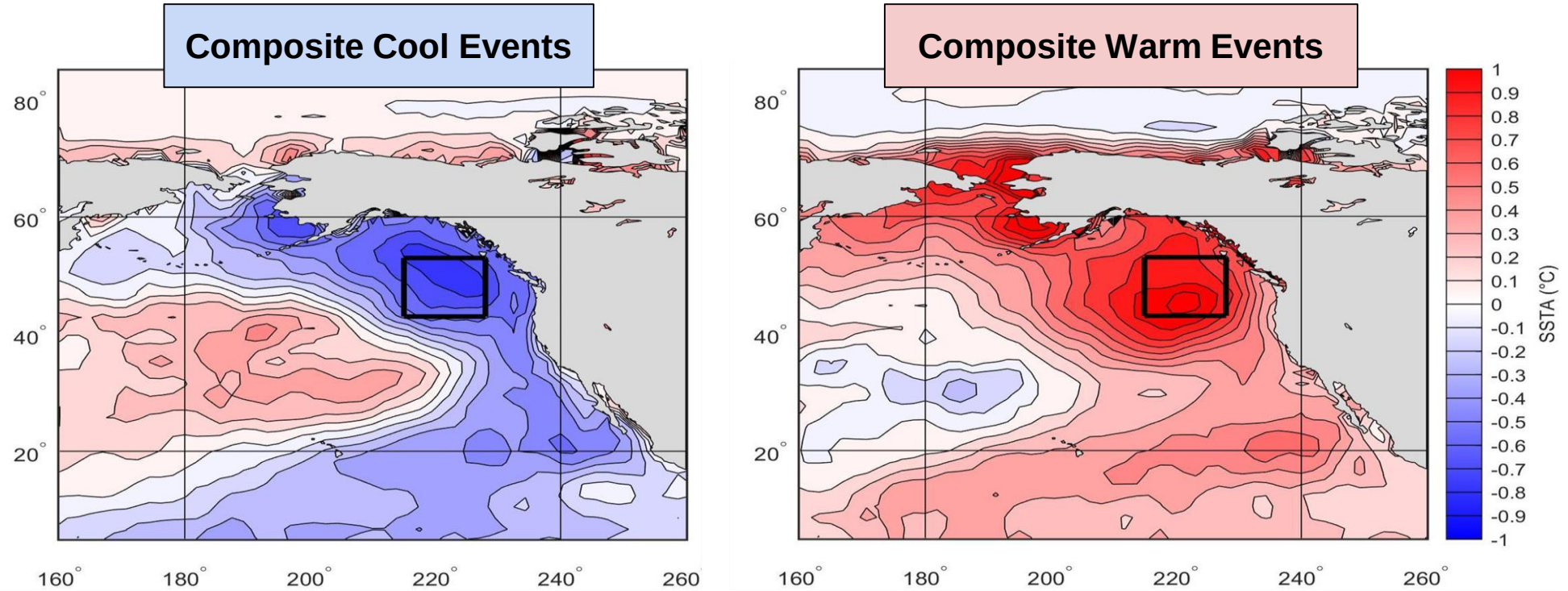
Discussion

Results

1. ENP SSTs in the summer are influenced by tropical-extratropical teleconnections.
2. Teleconnections in the prior winter and spring conditions are especially important.
3. The spring Asian monsoon may play a role in determining ENP summer SSTAs.
4. Atmospheric climate change is leading to oceanic climate change in the ENP.

Broader Impacts

1. Aid in the development of a monitoring and prediction system for cool and warm events.
2. Contribute to subseasonal to seasonal climate prediction for North America.
3. Contribute to public policy for marine ecosystem and fisheries management.



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