

# EDM\_SNI\_analysis

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*March 13, 2018*

Along with investigating dynamic species interactions, we also want to explore where physical forcing fits into our dynamic story. A body of other research has established that a combination of physical forcing (waves, storms), temperature, and lower frequency climate modes (e.g., El Ninos) have an important influence on the dynamics of kelp forests (???) (Reed et al., 2011; Cavanaugh et al., 2011; Bell et al., 2015; Young et al., 2015). With these data, we can draw connections between the physical variables and not just *Macrocystis pyrifera* dynamics, but all of the species in our constrained trophic web.

We have four datasets, already processed into the same time frame (periods) as the SNI benthic monitoring data (with separate code not included here):

- **The Multivariate ENSO index (MEI)**
  - The first principal component of a composite set of physical parameters
  - Positive values of the MEI index are generally associated with El Nino conditions, decreases in wind-driven upwelling, warmer surface waters and nutrient-poor conditions
  - Variable here is the average index value for the four months preceding each Spring or Fall monitoring period (i.e., December to March or June to September, respectively)
- **The Pacific Decadal Oscillation index (PDO)**
  - Leading empirical orthogonal function (EOF) of monthly sea surface temperature anomalies (SST-A) over the North Pacific (poleward of 20° N) after the global average sea surface temperature has been removed
  - Positive PDO values indicate warmer SST, and nutrient-poor conditions along the western coast of the contiguous United States
  - Aggregated and averaged the same way as MEI
- **The North Pacific Gyre Oscillation (NPGO)**
  - From (???)
  - Climate pattern that emerges as the 2nd dominant mode of sea surface height variability (2nd EOF SSH) in the Northeast Pacific
  - Better correlated with salinity, nutrients, and chlorophyll than PDO, showing forcing for the planktonic community
  - Strong predictor of upwelling cells south of 38 deg N
  - Aggregated and averaged the same way as MEI and PDO
- **Sea surface temperature (SST)**
  - Two sources (to fill in data gaps):
  - Sea surface temperature data directly from Begg Rock and San Nicolas Island buoys, from the Coastal Data Information Program (CDIP)
  - NOAA's Optimally Interpolated Sea Surface Temperature
  - Similar to the above, value is an average SST for the four months preceding each period
- **Maximum significant wave height (Hs)**
  - Also from the Begg and SNI buoys and the CDIP
  - Significant wave height is defined as the average height, in meters, of the one third highest waves in the record
  - Instead of an average, value here is the maximum significant wave height of the four months preceding each period. This is meant to capture any large storm events, as well as general level of physical disturbance

As with the other variables in our analysis, these physical variables have been normalized to zero mean and unit standard deviation to facilitate comparison among variables and not distort state-space reconstructions. Unlike the biological data, where there are unique spatial replicates, the physical data have only one value for

each of the 63 monitoring periods, and hence their values are replicated (copied) for each site to match the total length of the biological data.

## References