**Supplementary Information for: Large regional variability in coastal erosion caused by ENSO**

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**Figure 1.** Criteria used to select wave-dominated sandy coastlines across the Pacific Basin that are suitable for satellite-derived shoreline detection.

**Figure 2.** Number of sandy beaches and their orientation along each selected stretch of coastline.

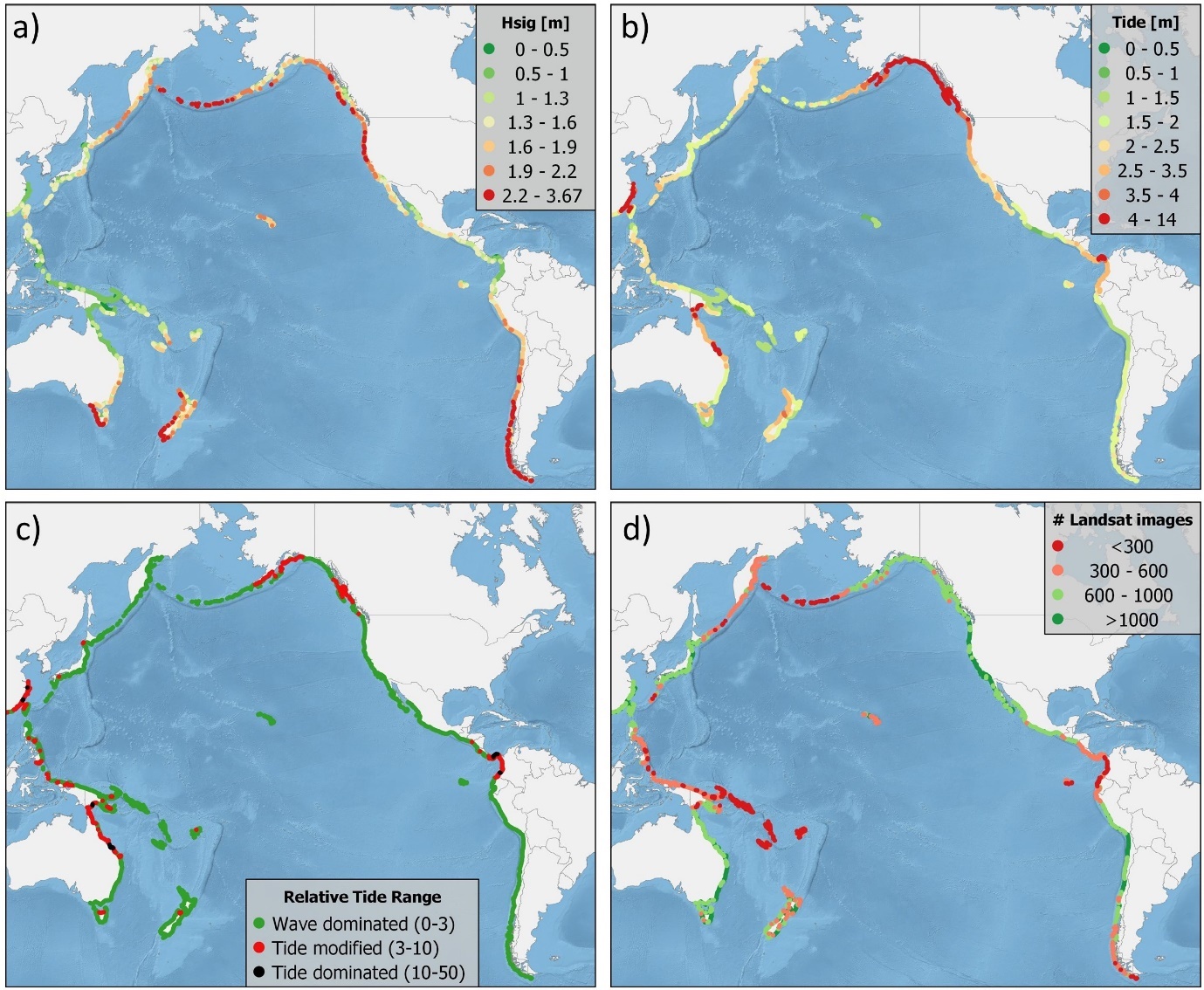
**Figure 3.** Example of shoreline time-series at Ocean Beach (San Francisco, USA) and associated ENSO anomalies.

**Figure 4.** Example of shoreline time-series at Narrabeen (Australia) and associated ENSO anomalies.

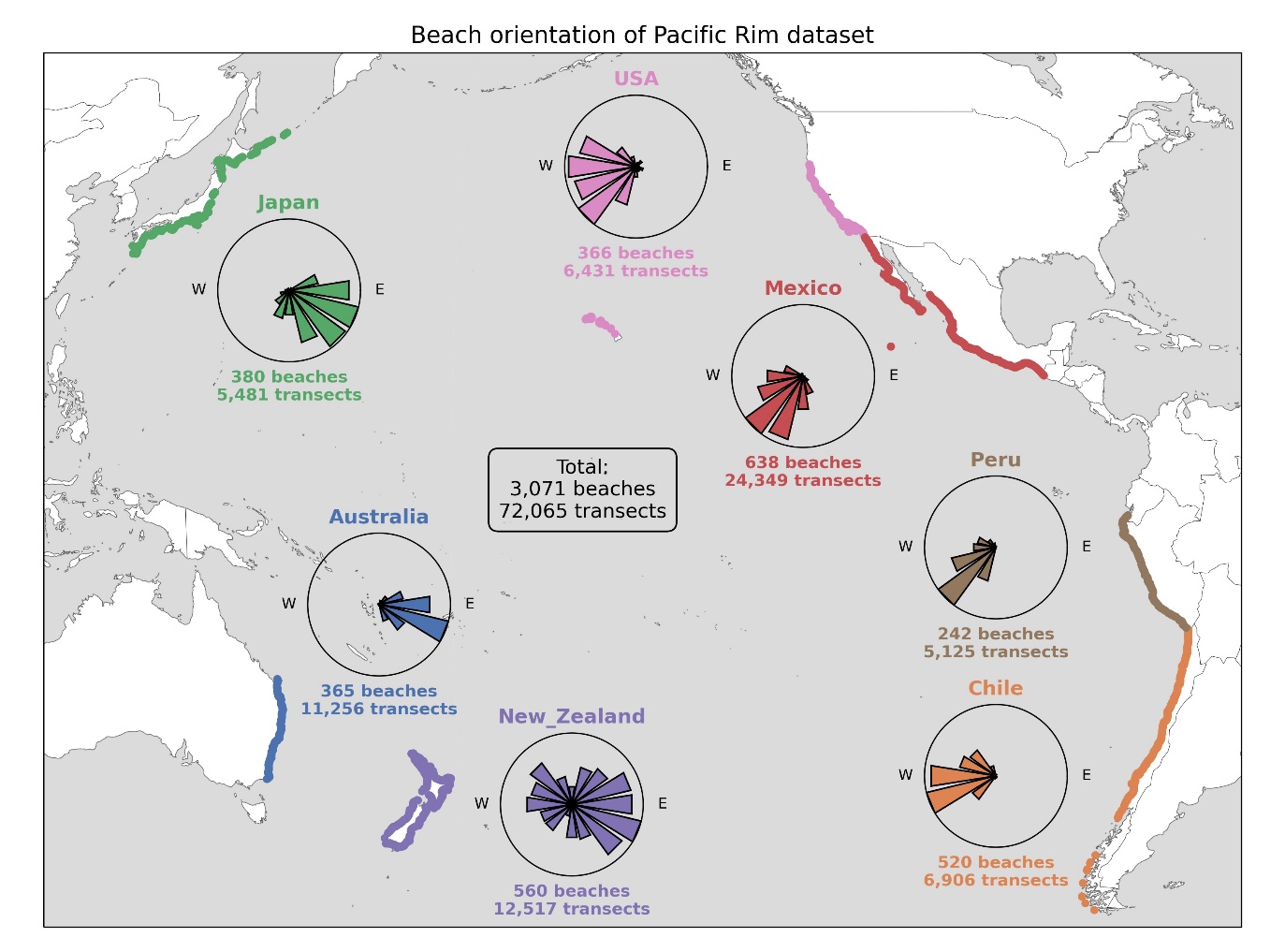
**Figure 5.** Example of wave energy flux time-series at Ocean Beach (San Francisco, USA) and associated ENSO anomalies.

**Figure 6.** Example of sea level anomalies time-series at Ocean Beach (San Francisco, USA) and associated changes during ENSO phases.

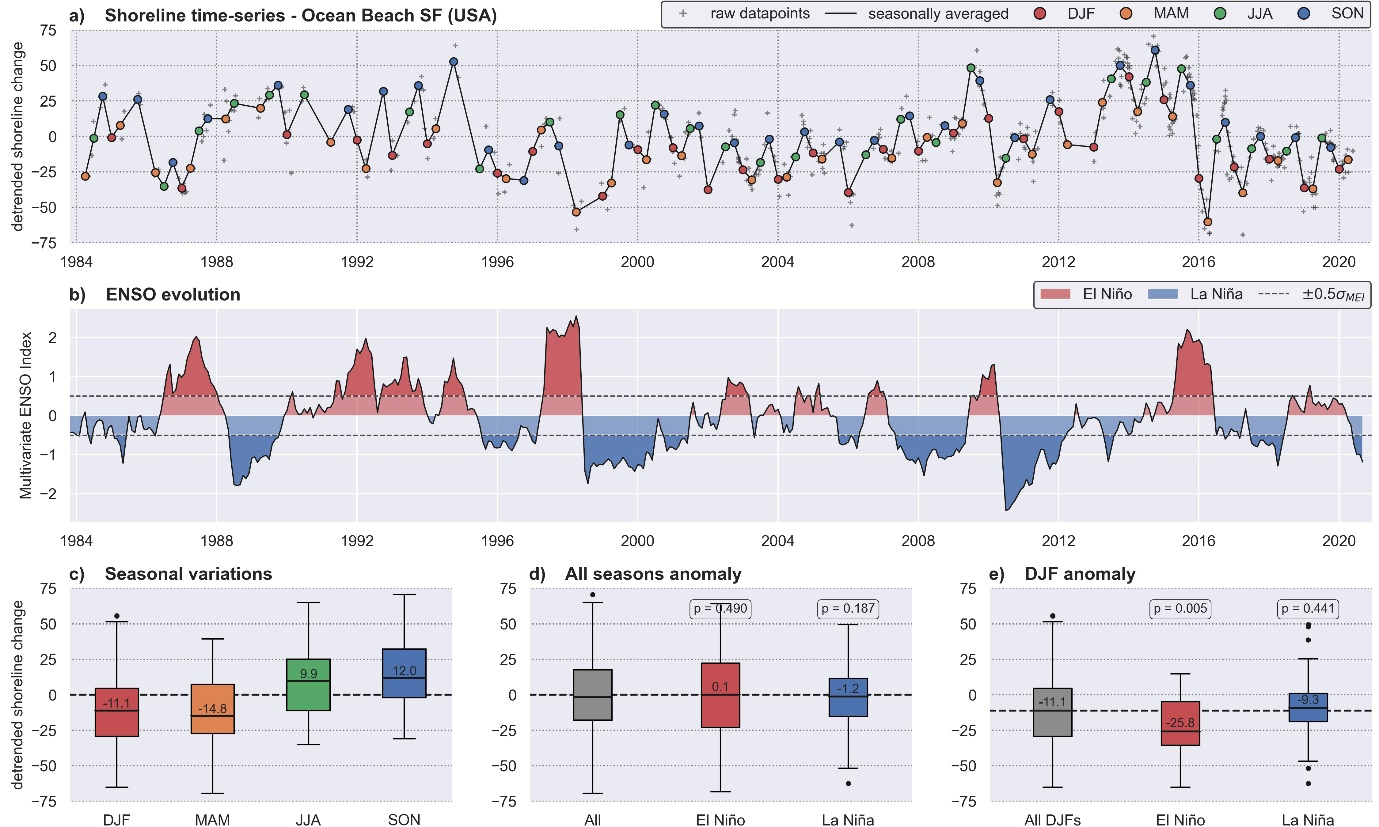
**Figure 7.** Anomalies in oceanographic forcing during the past three major El Niño events (1997/1998, 2009/2010, 2015/2016).



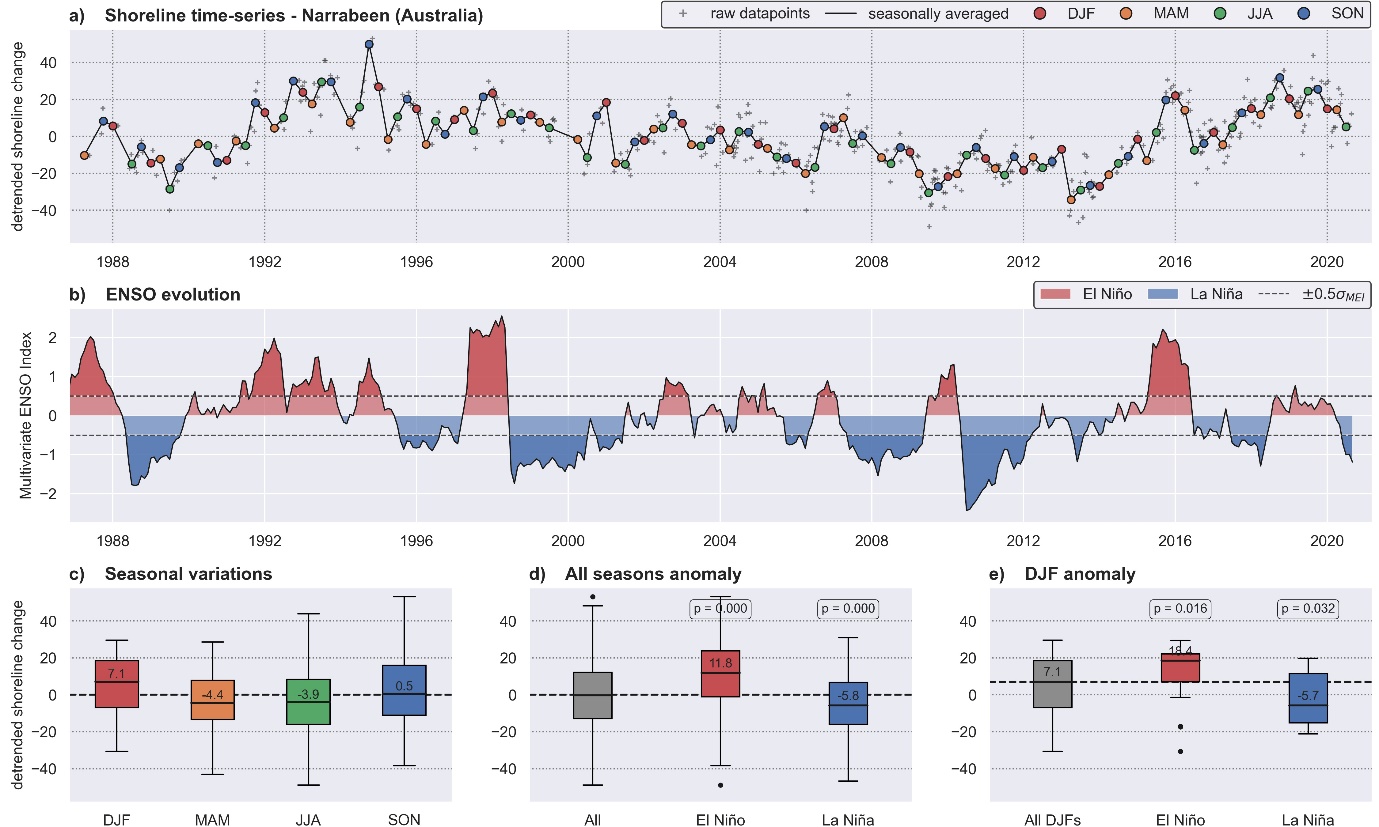
**Figure 1 | Selection of wave-dominated coastlines across the Pacific Basin for satellite-derived shoreline detection.** **a)** Mean deep-water significant wave height from ERA5 reanalysis (1979-2020). **b)** Springs tidal range from FES2014 global tide model. **c)** Relative Tide Range calculated as the ratio between the significant wave height and the springs tidal range. **d)** Number of images available on Google Earth Engine for Landsat 5, 7 and 8 Tier 1 collections.



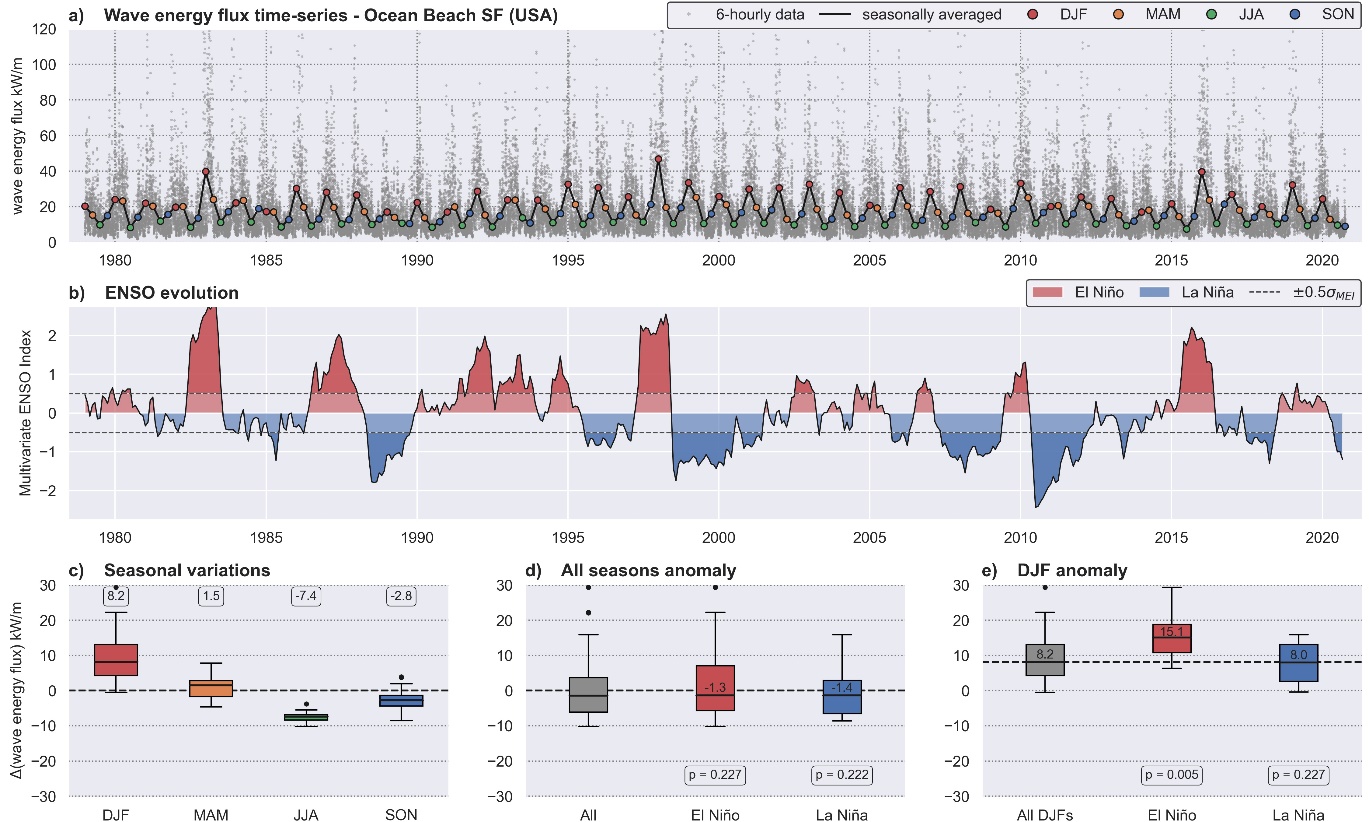
**Figure 2 | Dataset of sandy beaches and cross-shore transects for 7 selected wave-dominated regions.** The roses show the orientation of the sandy beaches along each stretch of coastline. The number of individual beaches and shore-normal transects are also reported for each region.



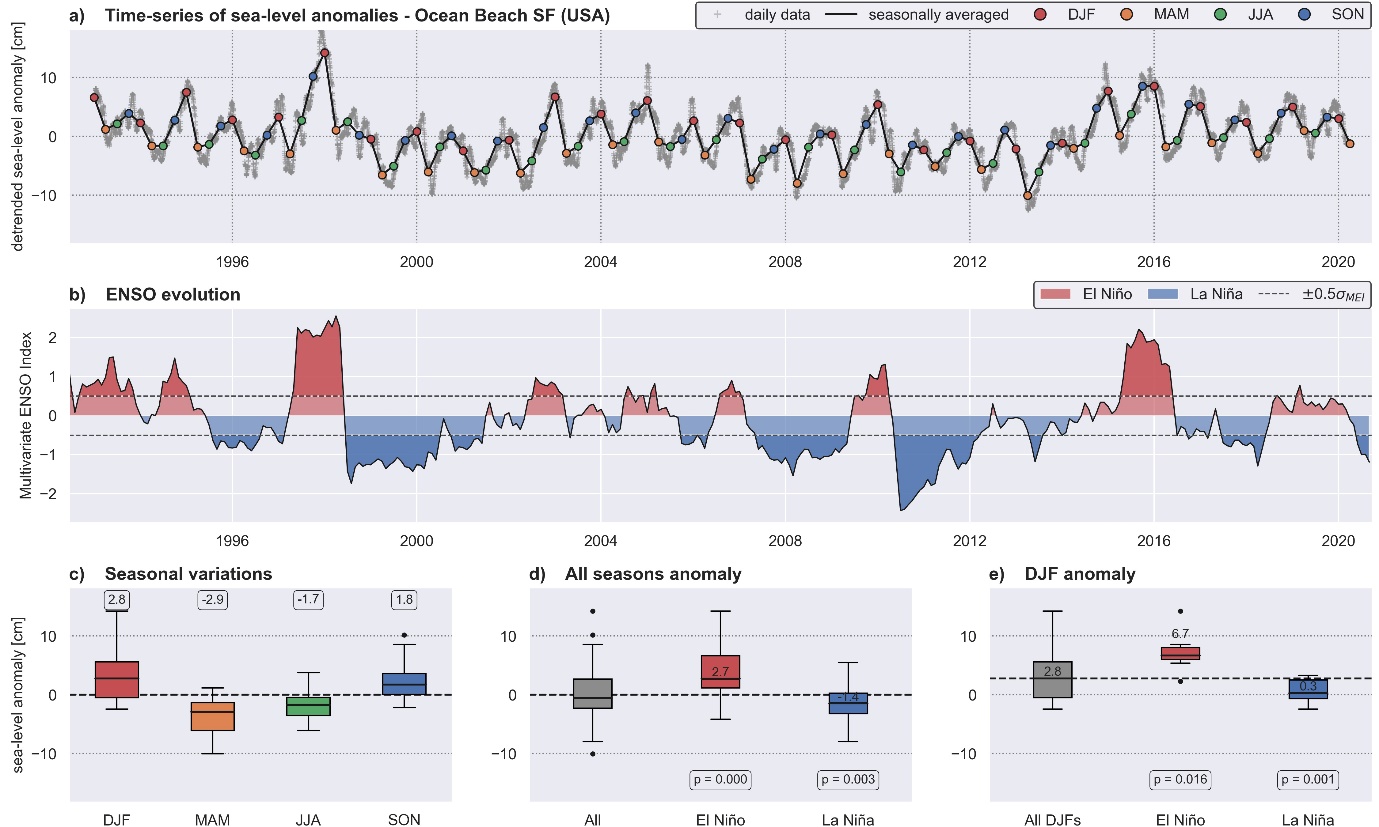
**Figure 3 | Anomalies in shoreline position during ENSO phases, example at a seasonal northern hemisphere beach: Ocean Beach, San Francisco, USA.** **a)** Detrended time-series of shoreline change at Ocean beach (San Francisco, USA), including seasonal averages (DJF, MAM, JJA, SON), between 1984 and 2020. **b)** Time-series of the intensity and phase of ENSO as described by the Multivariate ENSO Index (MEI). A threshold of 0.5 standard deviation was used to identify El Niño and La Niña phases. **c)** Seasonal variations in shoreline position. **d)** Anomaly in shoreline position during El Niño and La Niña phases for all seasons and with respect to the long-term average. **e)** Anomaly in shoreline position during El Niño and La Niña phases for the boreal winter (DJF) and with respect to the long-term DJF average.



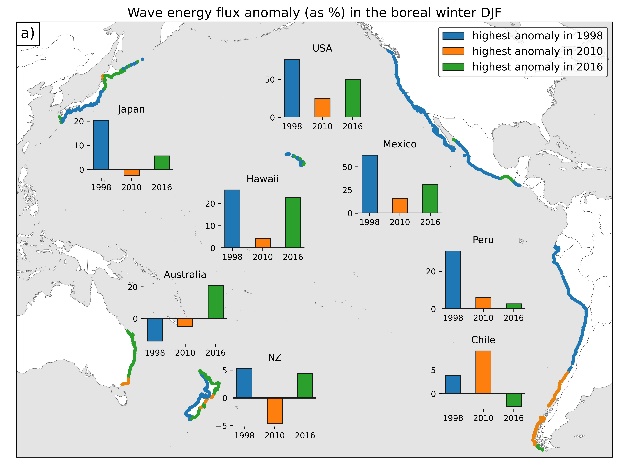
**Figure 4 | Anomalies in shoreline position during ENSO phases, example at a non-seasonal beach: Narrabeen, Sydney, Australia.** **a)** Detrended time-series of shoreline change at Narrabeen, Australia, including seasonal averages (DJF, MAM, JJA, SON), between 1987 and 2020. **b)** Time-series of the intensity and phase of ENSO as described by the Multivariate ENSO Index (MEI). A threshold of 0.5 standard deviation was used to identify El Niño and La Niña phases. **c)** Seasonal variations in shoreline position. **d)** Anomaly in shoreline position during El Niño and La Niña phases for all seasons and with respect to the long-term average. **e)** Anomaly in shoreline position during El Niño and La Niña phases for the boreal winter (DJF) and with respect to the long-term DJF average.

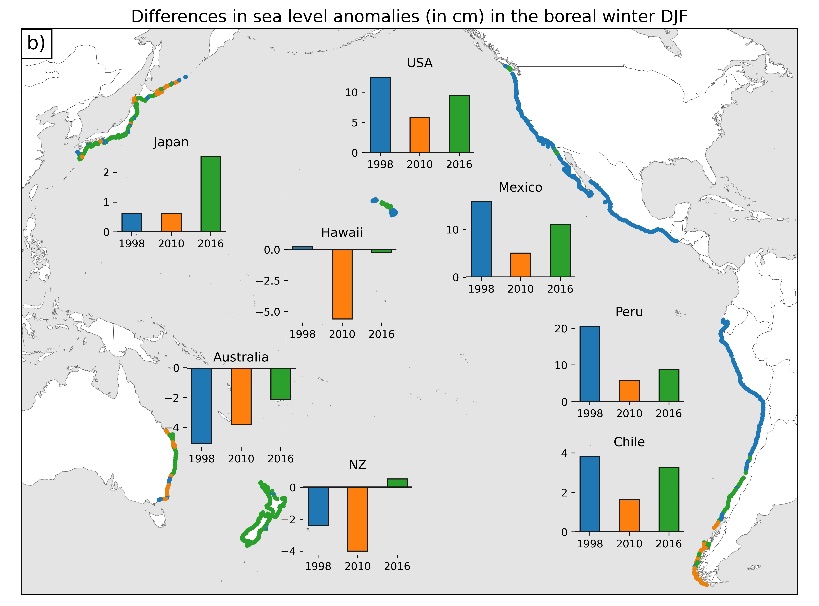


**Figure 5 | Anomalies in wave energy flux during ENSO phases.** **a)** Time-series of wave energy flux, including seasonal averages (DJF, MAM, JJA, SON), between 1970 and 2020 offshore of Ocean Beach (San Francisco, USA). **b)** Time-series of the intensity and phase of ENSO as described by the Multivariate ENSO Index (MEI). A threshold of 0.5 standard deviation was used to identify El Niño and La Niña phases. **c)** Seasonal variations in wave energy flux with respect to the long-term average flux (17.5kW/m). **d)** Anomaly in wave energy flux during El Niño and La Niña phases for all seasons and with respect to the long-term average. **e)** Anomaly in wave energy flux during El Niño and La Niña phases for the boreal winter (DJF) and with respect to the long-term DJF average.



**Figure 6 | Sea-level anomalies during ENSO phases.** **a)** Time-series of detrended sea-level anomalies, including seasonal averages (DJF, MAM, JJA, SON) between 1993 and 2020 at Ocean Beach (San Francisco, USA). **b)** Time-series of the intensity and phase of ENSO as described by the Multivariate ENSO Index (MEI). A threshold of 0.5 standard deviation was used to identify El Niño and La Niña phases. **c)** Seasonal variations in sea-level anomalies. **d)** Change in sea-level anomalies during El Niño and La Niña phases for all seasons. **e)** Change in sea-level anomalies during El Niño and La Niña phases for the boreal winter (DJF) and with respect to the long-term DJF average.





**Figure 7 | Oceanographic forcing during the past three major El Niño** **events (1997/1998, 2009/2010, 2015/2016).** Percentage increase in wave energy flux during boreal winter (DJF) relative to the long-term average (**a**) and differences in sea-level anomalies in centimetres (**b**) for the three events. Dots along the coast are color-coded with the event when the largest anomaly occurred.