

CLIMATE NARRATIVE, Draft for APRIL 2019 and as noted

WEST COAST OF UNITED STATES AND NORTH PACIFIC

During late April 2019, AVHRR satellite imagery showed large positive and negative **sea surface temperature (SST)** anomalies along the west coast of the US. Anomalies were generally positive from Monterey Bay (36.7°N) southward and negative north of San Francisco (37.8°N). A cool ($8\text{-}11^{\circ}\text{C}$) band 100-250 km wide was found from 37°N to 44°N , were negative anomalies were as low as -3°C . South of Monterey Bay, coastal areas with positive SST anomalies as high as 2.5°C occurred within areas of less extreme anomaly that extended more than 1000 km southwest. The largest coastal SST anomalies occurred north of the Mexican border (32.9°N) and from $34\text{-}36^{\circ}\text{N}$. Patchy negative anomaly ($\geq -2^{\circ}\text{C}$) occurred 300 to 2500 km offshore North America between 20° and 40°N and within the similar latitudes west of 160°W . Negative SST anomaly persisted east of Indonesia and in the central Pacific about 15°N . Positive SST anomalies persisted in the eastern equatorial Pacific. <https://coastwatch.pfeg.noaa.gov> (archive) <https://www.ospo.noaa.gov/Products/ocean/sst/anomaly/>
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html (current)
<https://coastwatch.pfeg.noaa.gov/coastwatch/CWBrowserWW180.jsp#>
<https://www.ospo.noaa.gov/Products/ocean/sst/contour/index.html> (current)

Negative **sea level height anomaly (SLA)** persisted, east of Indonesia ($\geq -30 \text{ cm}$) and extended northeast, diminishing in depth, to the North American coast ($\geq -5 \text{ cm}$). East of 175°W this zone was flanked on the south by positive SLA ($\leq 10 \text{ cm}$) between 5°N - 20°N . Areas of positive SLA ($15\text{-}25 \text{ cm}$) occurred off the coast of Japan and Kamchatka, diminishing in height eastward to 170°W .

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ocean/weeklyenso_clim_81-10/wksl_anm.gif (current 30°S - 40°N)

Aqua MODIS imagery covering several April days showed surface bands of higher **chlorophyll-a** concentration (chl-a), $1.0\text{-}3.0 \text{ mg/m}^3$, in narrow coastal areas off southern California, south of 33°N . Chl-a concentrations $1.0\text{-}3.0 \text{ mg/m}^3$ occurred in coastal areas of the Santa Barbara Channel (34°N), around Point Conception and northward to 36.6°N . North of 36°N , more extensive coastal chl-a bands, frequently reaching more than 150 km seaward, were common. Areas of chl-a at $4\text{-}10 \text{ mg/m}^3$ were embedded inshore within the areas of lower surface chl-a concentration. Offshore ($\geq 200 \text{ km}$), concentrations were less than 0.2 mg/m^3 .

<https://coastwatch.pfeg.noaa.gov/coastwatch/CWBrowserWW180.jsp#>

At the **Cape San Martine Data Buoy** (46028), off **Central California (35.7°N)**, the multi-year average surface temperature (aSST) for April was $12.0\text{-}12.2^{\circ}\text{C}$ compared to an April 2019 average of 14.7°C (range, $13.0\text{-}17.1^{\circ}\text{C}$). Ten-day averages for Buoy 46028 were 14.4, 14.0 and 15.9 °for the beginning, middle and end of the month, respectively. Noted for the other buoys as [14.4, 14.0, 15.9°C]. At the 46026 Buoy, 18 nautical miles (nm) west of **San Francisco (37°N)**, SSTa and April SST were $11.3\text{-}11.6^{\circ}\text{C}$ and 12.3°C ($9.9\text{-}14.8^{\circ}\text{C}$), respectively [13.8, 11.3, 11.7°C]. At 46°N , 85 nm WNW of **Tillamook, OR**, aSST and April 2019 SST were $10.8\text{-}11.0^{\circ}\text{C}$ and 10.3°C ($10\text{-}11.1^{\circ}\text{C}$), respectively [10.4, 10.2, 10.3°C]. At buoy 46041, 45 nm NW of **Aberdeen, WA** (47.3°N) SSTa and April SST were $10.2\text{-}10.5^{\circ}\text{C}$ and 11.1°C ($9.6\text{-}13.4^{\circ}\text{C}$), respectively [10.9, 11.2, 11.2°C]. https://www.ndbc.noaa.gov/station_page.php?station=46028

The **SIO Manual Shore Station Program** (32.9°N) found SST near multi-year

averages in early April. By 30 April SST was 3°C above 15.9°C, the multi-year April mean. <https://scripps.ucsd.edu/programs/shorestations/> **La Jolla Subtidal Water Temperature** (STWT) measured at fixed depth below the lowest tide, averaged 15°C on April first and 17.8°C on 30 April. Max SST was 19.3°C on 28 April and minimum SST was 13.1°C on 14 April. Remembering that the SST for the first and the last days of April are estimated means and that the extremes are individual hourly values, these SSTs and dates are noted below as: 15°-A1, 17.8°-A30, 19.3°-A28, 13.1°C-A14. **Santa Monica** pier (34°N) STWT was: 17.2°-A1, 17.3°-A30, 17.8°-A24, 12.9°C-A10. In Southern **Monterey Bay** (36.6°N) April STWT was: 15.1-A1, 13.8-A30, 16.3°-A23, 11.5°C-A26. **Arena Cove** (38.9°N) STWT was: 12°-A1, 11.0°-A30, 13.7°-A9, 8.5°C-A15. **Crescent City** (41.7°N) STWT was, 12.4°-A1, 10°-A30, 13.3°-A4, 8.4°C-A30. At **Neah Bay** (48.4°N) April STWT was, 10.9°-A1, 11.1°-A30, 11.8°-A20, 9.4°C-A20 for April 2019.
<https://tidesandcurrents.noaa.gov/stations.html?type=Physical%20Oceanography>

EQUITORIAL AND SOUTH PACIFIC

During April, weak El Niño SST conditions persisted. Eastern equatorial Pacific upper 300-meter (m) heat content anomaly reached a maximum in March, then decreased through April. East of 160°W equatorial subsurface temperature anomalies persisted about 2°-3°C at 50-100 m. Much of the South Pacific (SP) had neutral to weakly positive SST anomalies, but negative SST anomaly (>-2°C) was found in a global wave-like pattern south of 20°S. Cusps of negative anomaly extended equatorward from the southern circumpolar ocean along the west coasts of South Africa and South America, in the central SP, reaching the west coast of Australia and along east coast of South Africa. Between 5-15°S, an area positive sea level height anomaly (5-15 cm) extended from 160°W to 100°E. <http://www.ospo.noaa.gov/Products/ocean/sst/anomaly/>
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ocean/weeklyenso_clim_81-10/wksl_anm.gif (current)

The NOAA **OCEANIC El Niño INDEX** (ONI) was 0.8 for FMA (February-April) for sixth consecutive El Niño-level (≥ 0.5) value.

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf
<https://climatedataguide.ucar.edu/climate-data/multivariate-enso-index>

The NOAA/NCEI **PACIFIC DECADAL OSCILLATION INDEX** (PDO) series calculated from ERSST.v4, has recently had 15 consecutive negative or neutral monthly values including 0.08 for April. <https://www.ncdc.noaa.gov/teleconnections/pdo/>
<http://research.jisao.washington.edu/pdo/PDO.latest.txt>

The **PACIFIC / NORTH AMERICAN Teleconnection Index** (PNA), had near neutral values throughout April, with a monthly mean of 0.17.
<https://www.cpc.ncep.noaa.gov/data/teledoc/pna.shtml> (note computational alternatives)

April Upwelling Indices (UI) indicate re-initiation of the spring upwelling season along the Pacific coast from 42°N southward. Pacific low atmospheric pressure systems continued to propagate across the coast to the north, where monthly UI and UI anomalies were low. <https://upwell.pfeg.noaa.gov/products/PFELData/upwell/monthly/table.1904>
Daily UI values for 36°N show upwelling episodes during 8-22, and 26-30 April.
<https://www.pfeg.noaa.gov/products/PFELData/upwell/daily/p10dayac.all>

PRECIPITATION and RUNOFF (Late April)

California was at or above average seasonal precipitation at the end of April. In western Oregon and Washington, April precipitation made up part of the season's deficit and the drought index decreased.

<https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?west> The **Fraser River**, measured 130 km upriver from Vancouver, B.C., was flowing at near the seasonal median at 108,700 cubic feet per second (cfs) <https://wateroffice.ec.gc.ca> The **Skagit River** near Mount Vernon, WA was flowing at 12,100 [15,800 cfs]. The **Columbia River** was transporting 274,000 [173,000 cfs] at Vancouver, WA. The **Rogue River** in Oregon was flowing at 6,160 [5,380 cfs] at Agnes. The **Umpqua River** was transporting 5,700 [6,540 cfs] at Elkton, CA. **Klamath River** transport near Klamath was 32,700 [18,000 cfs]. The **Eel River** at Scotia had discharge of 6,190 [3,930 cfs]. **Sacramento River** transport was 35,600 [13,600 cfs] at Verona and 44,600 [16,500 cfs] at Freeport. **San Joaquin River** flow was 8,390 [3,320 cfs] at Vernalis.

<https://waterdata.usgs.gov/ca/nwis/current/?type=flow>

<https://www.cnrfc.noaa.gov/awipsProducts/RNOWRKCLI.php>=

https://wateroffice.ec.gc.ca/search/real_time_results_e.html

https://www.cpc.ncep.noaa.gov/products/global_monitoring/precipitation/global_precip_accum.shtml

NOTES

Anthropogenic changes in the rivers flowing into the inland Salish Sea (47°- 50°N) where **Southern Resident Orcas** (*Orcinus orca*) feed, the Cook Inlet, AK where **Beluga Whales** (*Delphinapterus leucas*) feed and in the northern coastal oceans, where **Gray Whales** (*Eschrichtius robustus*) feed, are influencing survival rates of these cetaceans. Various sources of local environmental pollution are thought to be decreasing reproductive rates of *O. orca* and *D. leucas* to below sustainable levels. Unusually large numbers of *E. robustus*, returning to northern feeding areas, are showing signs of emaciation and more than 80 have stranded on North American beaches. Recent changes in arctic sea ice conditions may have adversely impacted *E. robustus* foraging during summer and fall of 2018. These strandings have led NOAA to declare an Unusual Mortality Event (UME) for this species.

<https://www.fisheries.noaa.gov/feature-story/noaa-fisheries-declares-elevated-west-coast-gray-whale-strandings-unusual-mortality>

<https://www.mmc.gov/priority-topics/species-of-concern/southern-resident-killer-whale/>

https://www.pcouncil.org/wp-content/uploads/2019/04/F3a_Supp_NMFS_Rpt1_APRApr2019BB.pdf

<https://www.fisheries.noaa.gov/species/beluga-whale#science>

Adult Chinook Salmon returns at Bonneville Dam, on the Columbia River, through April 30 totaled 4,705, which is the 2nd lowest passage in the last 10 years and only 9% of the 2009-2018 average cumulative count (50,527) for this date. Recent 10-year average for the 50% passage date at Bonneville Dam is May 9. Columbia River conditions measured at Bonneville Dam, 235 km up stream, are about average for flow with roughly half the visibility, when compared to the recent 5-year averages for 30 April. https://www.dfw.state.or.us/fish/OSCRP/CRM/FS/19/19_05_01sfu1.pdf

The Climate Narrative for April 2019 and previous months may be found,

https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html

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