CLIMATE NARRATIVE for May 2019 and as noted

WEST COAST OF UNITED STATES AND NORTH PACIFIC

In early May, AVHRR imagery showed the US West Coast waters were warmer than usual south of 37°N and cooler than usual from 38°N to 43°N. Extreme positive sea surface temperature (SST) anomalies (≤ 3°C) were embedded within areas of lesser positive anomaly that extended west and southwest from central and southern California and northern Mexico. In early May, an area of extreme positive coastal anomaly occurred south of Monterey Bay (33.5°-36.5°N). These overall patterns remained as coastal anomalies became less extreme through May. Negative SST anomaly (≥-2°C) off North America north of 30°N and east of 140°W reached toward the coast between 40°N and 43°N. Negative SST anomaly occurred along and south of the Baja California peninsula. Predominately positive SST anomaly (≤2°C) occurred across the world's oceans between 10°S and 20°N and in the Bering Sea. Equatorial El Niño conditions continued. 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)

During May, areas of negative North Pacific SLA, **sea level height anomaly**, (≥ -30 cm) centered near 10°N, 130°E persisted, but weakened as these areas extended spatially to the northeast filling the region west of 180°E/W from 0°-30°N. Negative SLA extended toward the North American coast between 25°-45°N (≥-5 cm). Positive SLA to 25 cm occurred in the northwestern Pacific, north of 28°N.

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

Late May Aqua MODIS average images showed bands of surface **chlorophyll-a** (chl-a) of 1-3 mg/m3, extending as far as 200 km seaward off Point Conception and the upper Southern California Bight (33°-35°N) and extending 400 to 500 km seaward off Capes Mendocino and Blanco (40°-43°N). Concentrations exceeding 4 mg/m3 occurred intermittently inshore along the coast from northern Mexico to Vancouver Island. Higher concentrations (4-10 mg/m3) were found inshore from the Columbia River mouth (46°N) poleward to beyond 52°N. https://coastwatch.pfeg.noaa.gov
https://coastwatch.pfeg.noaa.gov/coastwatch/CWBrowserWW180.jsp#

Sea temperature at NDBC Buoys

Offshore **Torrey Pines,** (46225), 32.9°N, 177.4°W at 549 meter (m) depth, the average SST during May was 17.7°C with a range of 12.3-19.6°C. Average temperatures were 17.3, 18, 17.8°C for the May's first, second and final thirds, noted below as [17.3, 18, 17.8°C]. **Santa Barbara Channel** Buoy (34.3°N, 119.9°W) multi-year SST average **(**SSTa) and May 2019 SST were 13.6-13.8 and 14.2 (12.1- 17.1), respectively, [15.3, 14.3, 13°C]. At the **San Francisco** Buoy (46026) moored at 37.8°N, 122.8°W, SSTa and May 2019 SST were 11.4-11.6 and 13.2 (10.7-14.7), respectively, [13.3,13.8,12.6°C]. At the **Eel River** Buoy (46022), moored at 40.7°N, 124.5°W, SSTa and May SST were 11.3-11.5°C and 11.1°C (9.4-12.8°C), respectively, [10.0, 11.3, 12.1°C]. At the **Tillamook Buoy** (46089), moored at 46°N, 125.8°W, the SSTa and May 2019 SST were 12.2-12.3°C and 12.1°C (10.8-13.9°C), respectively, [11.6, 12.4, 12.5°C]. Near **Cape Elizabeth** (46041), anchored at 47.4°N,124.7°W, SSTa and May SST were 11.9-12.2°C

and 12.4°C (10.2-14.8°C), respectively, [11.3, 12.5,13.5°C].
https://www.ndbc.noaa.gov/station_page.php?station=46026

Sea temperature at shore stations

The **La Jolla** (32.9°N) SIO-Manual Shore Station Program found 2°-3°C SST anomaly in early May 2019. SST drifted toward average daily values (18°C) through May. The multi-year May mean is 17°C https://scripps.ucsd.edu/programs/shorestations/
La Jolla Subtidal Water Temperature (STWT), measured at fixed depth below the lowest tide, had May mean of 17.7°C with range from 12.3 to 19.6 (12.3-19.6). Averages during the first, second and third 10-day May periods were 17.8, 18 and 17.3°C respectively, [17.8, 18, 17.3°C]. At the **Santa Monica** pier (34°N) May Average STWT was 16.6°C (13.7-18.3), with [17, 16.8, 16.0]. In Southern **Monterey Bay** (36.6°N) Average May STWT was 15.3°C (13.9-16.7°C) with [15, 15.4, 15.4°C]. **Crescent City** (41.7°N) average STWT was 11.9°C (8.5-14.1°C) with [11.4, 12.2, 12°C]. At **Neah Bay** (48.4°N) May STWT average was, 11.5 (9.4-13.9°C) with [11, 11, 12.6].
https://tidesandcurrents.noaa.gov/stations.html?type=Physical%20Oceanography

EQUITORIAL AND SOUTH PACIFIC

During May, weak El Niño SST conditions (1-2°C) persisted across the central tropical Pacific and were predicted to persist through the boreal summer. Eastern equatorial Pacific (EP) upper 300-meter (m) heat content anomaly became negative in May, then increased to about 25% of the March maximum. Positive subsurface temperature anomalies (≤2 C°) persisted at 50-100 m in the central EP. Negative subsurface temperature anomalies appeared at 50 m in the eastern and at 150-200 m in the western EP. Much of the South Pacific had neutral to weakly positive SST anomalies, but negative SST anomaly (>-2°C) was found in large areas (10^3-10^5 km^2), making a global wave-like pattern south of 20°S (see April Narrative). Negative SST anomaly appears to be increasing in the eastern South Pacific.
https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf
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 0.7 for SON (September-November), 0.9 for OND, 0.8 for NDJ, DJF, JFM, FMA and MAM for seven consecutive El Niño-level values more than or equal 0.5.
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 has 15 consecutive negative or neutral values, including 0.18 for May 2019.
https://www.ncdc.noaa.gov/teleconnections/pdo/
http://research.jisao.washington.edu/pdo/PDO.latest.txt

The **Pacific/North American Teleconnection Index** (PNA), had a weakly positive value (0.47) for May. Daily values were not extreme in May 2019.
https://www.cpc.ncep.noaa.gov/data/teledoc/pna.shtml (note computational alternatives)
Above indices are recalculated as data are assimilated into the data bases.

ERD/SWFSC **Upwelling Indices** (UI) were positive throughout the 27°-60°N range. Large UIs (≥100) indicated active upwelling systems from 42°N southward along the west coast to 27°N. Negative UI anomalies between 36°N and 27°N indicated

weaker than average seasonal upwelling.
https://upwell.pfeg.noaa.gov/products/PFELData/upwell/monthly/table.1905
Daily UI values for 36°N show that upwelling episodes were most likely after 20 May.
https://www.pfeg.noaa.gov/products/PFELData/upwell/daily/p10dayac.all

PRECIPITATION and RUNOFF (late May**)**

Drought conditions continued along the west coast from northern Oregon into Canada. The March through May 2019 precipitation was tied as the 13th driest on record for Washington state since 1895. Cumulative water year precipitation totals for California stations remained 100-160% of normal. Late-season storms brought the snow pack total to the largest since 2011, 200% of seasonal average.
https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?west The **Fraser River**, measured at Hope (130 km upriver from Vancouver, B.C.), was flowing at about the seasonal median at 6,500 m^3/s (229,450 cubic feet /sec or cfs) at the end of May.
https://wateroffice.ec.gc.ca The **Puyallup River** at Puyallup, WA was flowing at 1,030 cfs [1,900 historical median as cfs in brackets]. The **Skagit River** near Mount Vernon was flowing at 17,200 [22,500 cfs]. **Columbia River** discharge was 305,000 [396,000 cfs] at Vancouver WA. The **Rogue River** was flowing at 4,100 [3,930 cfs] at Agnees, OR. The **Klamath River** near Klamath, CA was transporting 16,400 [12,200 cfs]. The **Eel River** at Scotia had discharge of 5,250 [1,270 cfs]. **Sacramento River** transport was 42,600 [14,099 cfs] at Freeport. **San Joaquin River** flow was 15,800 [3,150 cfs] at Vernalis. Water runoff is important to nearshore ocean dynamics.
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:

The Monterey Bay Area noted two infrequent visitors during May 2019. **Pacific Bluefin (BF) Tuna** (*Thunnus orientalis*) were seen surface-feeding on many occasions and were taken by recreational anglers in early May. BF are usually observed around Monterey Bay during September and October.
https://swfsc.noaa.gov/Pacificbluefintuna/ California tuna fisheries were built on BF availability off southern California https://www.sciencedirect.com/science/article/pii/S1040618211006513
A group of more than 24 adult and calf **Baird's Beaked Whale** (*Berardius bairdii*) was spotted off Monterey Bay on 29 May. This observation was documented:
https://www.sanluisobispo.com/news/local/environment/article231157498.html
https://twitter.com/Quad_Finn/status/1134281696218456064 http://www.montereybaywhalewatch.com .

Section 120 of the Marine Mammal Protection Act (MMPA) allows the Oregon Department of Fish and Wildlife to remove **California sea lions** (*Zalophus californianus*) that habitually prey on salmonids below Bonneville Dam and Willamette Falls. Removals for 2019 were 33 for Willamette Falls and 19 for Bonneville Dam. The majority of these removals were during April and May, when the most Sea Lions were present. https://www.dfw.state.or.us/fish/SeaLion/
https://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/authorized_states.html
https://www.westcoast.fisheries.noaa.gov/newsroom/2016/05_noaa_fisheries_authorizes_states_to_remove_sea_lions_that_threaten_salmon.html

This report may be found, https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html and
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