CLIMATE NARRATIVE, August 2019 and as noted

WEST COAST OF UNITED STATES AND NORTH PACIFIC

At the end of August 2019 positive **sea surface temperature** (SST_{Ag}) anomaly (≤3°C), that appeared to form offshore, developed toward the US west coast north of 40°N. This area (>3x10^6 km^2) extends westward beyond 180°E/W and northward, with varying intensity into the Gulf of Alaska, the Bering and the Chukchi Seas. Smaller coastal areas of negative SST_{Ag} anomaly (≥ -2°C) occurred south of 35°N to 20°N and extended as much as 500 km seaward off Mexico. Negative SST_{Ag} anomalies were also found from 120°W to 180°E/W and across the eastern tropical Pacific. During August negative **sea level height anomaly** (SLA), generally more than -15 centimeters (cm), became common in large areas (>10^6 km^2) off the west coast of North America (0°N to 40°N). Negative SLA was also centered near 0°-20°N, 125°E. This area was continuous with areas extending northeast to an area of positive SLA anomaly centered near 20°N, 140°W. Positive SLA (≤20 cm) was common in the western Pacific north of 20°N.
https://www.ospo.noaa.gov/Products/ocean/sst/anomaly/
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html (current)
https://coastwatch.pfeg.noaa.gov https://climatereanalyzer.org/wx/DailySummary/#sstanom (current)
https://www.ospo.noaa.gov/Products/ocean/sst/contour/index.html (current)

During late August, **NOAA VIIRS** and other satellite derived imagery showed filaments (≥1,000 km^2) of surface **chlorophyll-a** (chl-a) with concentration between 0.4-4.0 mg/m^3 extending 200-500 kilometers (km) offshore south of 43°N. These structures appeared to have less seaward development from 43°N to Vancouver Island (52°N). Surface chl-a concentrations of 0.4-4.0 mg/m^3 were found across the Gulf of Alaska and Bering Sea north of 45°N. Higher chl-a concentrations ≤ 10 mg/m^3 occurred in coastal strips 30-70 km wide, with particularly strong development from Cape Mendocino to Cape Blanco (40°-43°N).
https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdVHNchla8day.graph?chla[(2019-08-26T00:00:00Z)][(0.0)][(83.65125):(-0.10875)][(-193.76625):(-110.00625)]&.draw=surface&.vars=longitude%7Clatitude%7Cchla&.colorBar=%7C%7C%7C%7C%7C&.bgColor=0xffccccff
https://coastwatch.pfeg.noaa.gov/coastwatch/CWBrowserWW180.jsp#

SST_{Ag} at Buoys

Offshore **Torrey Pines,** (46225) 32.9°N, 177.4°W at 549 meter depth, the average SST during August 2019 (SST_{Ag}) was 22.2°C with range 20.7-24.5°C. Average temperatures were 22.0, 21.9, 22.7°C for the first, second and final thirds of August. Noted below as [22.0, 21.9, 22.7°C]. **Santa Barbara Channel** Buoy (34.3°N, 119.9°W) multi-year SST average **(**SSTa) and SST_{Ag} were 17.6 and 16.9 (14.1-20.3°C), respectively [15.4, 16.6, 18.7°C]. At the **San Francisco** Buoy (46026) 18 NM west of San Francisco (37.8°N, 122.8°W), SSTa and SST_{Ag} were 14.0 and 14.8 (12.9-18.2°C), respectively, [14.0,14.3,16.0°C]. **Eel River** Buoy SST_{Ag} was not available. At the **Tillamook Buoy** (46089), 85 nautical miles WNW of Tillamook, OR (46°N, 125.8°W), the aSST and SST_{Ag} were 17.3°C and 19.2°C (18.4-20.9°C), respectively [18.9, 19.6, 19.0°C]. Near **Cape Elizabeth** (46041), 45 NM northwest of Aberdeen, WA (47.4°N,124.7°W) SSTa and SST_{Ag} were 13.5°C and 15.8°C (13.8-18.8°C), respectively [16.1, 15.3,15.8°C]. **Neah Bay** Buoy (46087), 6 NM north of Cape Flattery (48.5°N,124.7°W), August SSTa and SST_{Ag} were 11.9°C and 12.5°C (10.8-15.4°C), respectively [12.3, 12.3,12.7°C]. SST is measured 0.4-1.0 m below the level sea surface, depending on buoy type.

https://www.ndbc.noaa.gov/station_page.php?station=46087

Temperature at shore stations

The **La Jolla** (32.9°N) **SIO-Manual Shore** Station Program found SST_{Ag} anomaly increased to 2.2°C above the daily average of 21°C on August 1st, then dropped to 2°C below the daily average before increasing again to 23.4°C with 2.5-3°C anomaly on 30 August. The multi-year SIO monthly mean (SSTa) for August is 21.0°C. https://scripps.ucsd.edu/programs/shorestations/ **La Jolla Subtidal Water Temperature** (STWT), measured at fixed depth below the lowest tide at tide monitoring stations, had August mean of 19.9°C with range from 13.3 to 24.7 (13.3-24.7). Averages during the first, second and third 10-day July periods were 19.6, 19.4 and 20.1°C, respectively [19.6, 19.4, 20.1°C]. At the **Santa Monica** pier (34°N) August average STWT was 21.0°C (16.1-24.5°C) with [20.7, 20.5, 21.9]. In Southern **Monterey Bay** (36.6°N) average August STWT was 16.0°C (12.1-19.3°C) with [15.2, 15.8, 17.0°C]. **Arena Cove** (38.9°N) average STWT for August was 11.0°C (9.2-16.0°C), with [10.0, 10.6, 12.5°C]. **Crescent City** (41.7°N) average STWT was 14.9°C (11.0-18.2°C), with [15.4, 13.9, 15.4°C]. **Port Orford (**42.7°N) average STWT was 10.6°C (8.1- 16.6°C), with [10.6, 10.4, 10.9°C]. **Neah Bay** (48.4°N) August STWT average was 11.6° (9.3-14.2°C) with [11.6, 11.1, 12.1°C].
https://tidesandcurrents.noaa.gov/stations.html?type=Physical%20Oceanography

EQUITORIAL AND SOUTH PACIFIC

During August 2019 El Niño neutral conditions developed in the Equatorial Pacific (EP). Negative **SST_{Ag} anomaly** (≥-2°C) became common in the EP, east of 160°W. Eastern EP upper 300-meter (m) heat content anomaly moved into negative range in August. Subsurface temperature anomalies remained positive in the central EP at 0-200m depth and negative subsurface temperature anomalies intensified (≥-2.5°C) in the eastern EP at 50-150 m depth. Where positive SST_{Ag} anomaly is more common in the North Pacific, negative SST_{Ag} is more common in the South Pacific (SP). Neutral to negative SST_{Ag} was found in the South Pacific (SP) east of 140°W and around Australia (≥-1.5°C). **Sea level height anomaly** (SLA) was negative along the eastern Pacific boundary (30°S to 40°N); extending west to 140°W in tropical regions. Positive SLA was seen in the central SP north of 30°S and in the western Pacific between 10°S-10°N.
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

The NOAA **Oceanic El Niño Index** (ONI) (3-month running mean of SST anomalies in the Nino 3.4 region) continued to weaken with 0.7 for April-June (AMJ), 0.5 for MJJ and 0.3 for JJA. 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 (alternate)

The monthly NOAA/NCEI **Pacific Decadal Oscillation Index** (PDO), calculated from ERSST.v4, had July 2019 value was 0.41, the highest value since April 2017, but PDO decreased again to neutral (-.10) in August. PDO and ONI indices are recalculated and may change initially as data are assimilated into the data base.
https://www.ncdc.noaa.gov/teleconnections/pdo/ http://research.jisao.washington.edu/pdo/PDO.latest.txt

The **Pacific / North American Teleconnection Index** (PNA), computed from atmospheric pressure over the Pacific Ocean and North America had weakly positive daily values in August with 0.18 as the monthly index. Neutral values have been typical of ONI, PDO, PNA during the last several months.
https://www.cpc.ncep.noaa.gov/data/teledoc/pna.shtml (note computational alternatives)

August ERD/SWFSC coastal **Upwelling Indices** (UI) show 42°-60°N with variable winds and increasing atmospheric low pressure influence, 27°-39°N had robust upwelling conditions (≥ 20% stronger than seasonal averages).
https://upwell.pfeg.noaa.gov/products/PFELData/upwell/monthly/table.1908

PRECIPITATION and RUNOFF (late August**)**

Drought conditions persisted from Oregon's north coast to SE Alaska. https://droughtmonitor.unl.edu. Cumulative water-year precipitation totals for California stations remained 90-120% of normal on 30 August, but there has been little additional precipitation since May. The **Fraser River**, measured at Hope (130 km upriver from Vancouver, B.C.), was flowing at 2,800 m^3/s (98,868 cubic feet /sec or cfs), near the July median. https://wateroffice.ec.gc.ca The **Puyallup River** at Puyallup, WA was flowing at 1,720 cfs [1,790 historical median as cfs in brackets]. The **Skagit River** was flowing at 6,490 [8,820 cfs] near Mount Vernon. **Stillaguamish River** discharge was 177 [333 cfs] at Arlington. **Columbia River** discharge at the Dalles was 117,000 [136,000 cfs] and 138,000 cfs [139,000 cfs] at Vancouver WA. At Elkton, OR, **Umpqua River** transport was 920 [1,080 cfs]. **Rogue River** flow was 2,410 [1,660 cfs] at Grants Pass and 2,580 [2,140 cfs] at Agnees. The **Klamath River** near Klamath, CA was transporting 2,500 [3,000 cfs]. Near Crescent City **Smith River** discharge was 250 [280 cfs]. **Eel River** at Scotia had transport of 110 [104 cfs]. At the **Battle Creek,** Coleman National Fish Hatchery, the flow was 314 [239 cfs]. **Butte Creek** at Chico had discharge of 180 [141 cfs]. **Sacramento River** transport was 19,040 [14,450 cfs] at Verona and 21,000 [14,300 cfs] at Freeport. **San Joaquin River** flow was 3,050 [1,140 cfs] at Vernalis. The **Salinas River** was flowing at 67 [1.1 cfs] near Spreckles and the **Carmel River** at Carmel was flowing at 6 [0 cfs]. 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= (current)
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

Historically the most abundant Chinook salmon run in California, spring-run Chinook enter the Sacramento-San Joaquin River system from late March through September. Adults hold in cool water habitats (when available) through the summer, then spawn from mid-August through early October. Only remnant California spring-run Chinook populations return to Butte, Mill, Deer, Antelope, and Beegum Creeks. The largest surviving population returns to Butte Creek, east of Chico, CA. Recent July and August 2019 escapement surveys estimated 6,253 spawners. This is a possible improvement over the previous five years when fewer than 6,000 spring-run Chinook were counted in Butte Creek. High counts occurred in 2001, 2005, 2012 and 2013 when the escapement was estimated to be 15,000 or more. colin.purdy@wildlife.ca.gov ,
https://www.wildlife.ca.gov/Conservation/Fishes/Chinook-Salmon

Global and hemispheric analyses is leading to success in longer term (weeks to seasonal) weather and ecosystem prediction. A forecast of anomalously high **tornadic thunder storms** across the central US in May 2019 was driven by observed anomalous convective forcing in portions of the tropical Indian and Pacific Oceans during April. The convective forcing, measured in part by the Madden-Julian Oscillation, caused subsequent changes in the northern hemisphere atmospheric angular momentum and the jet stream, providing an environment for enhanced tornado formation. (Geophysical Research Letters v46: https://doi.org/10.1029/2019GL084470 , http://atlas.niu.edu/ertaf/). The upper level semi-permanent trough over the western US associated with continental tornadoes in May, is also associated with the prevalence of late-season precipitation across California in May.

Ecosystem management applications of global perspectives, in earth system models, are being explored using basin scale chlorophyll and SST changes on seasonal to multiannual scales to anticipate ocean productivity and fish production variations (Science, v.365, 6450, p284. jongyeon.park@jbnu.ac.kr). Another example of larger scale analysis uses sea surface salinity. As water evaporates from the ocean, salt content of the remaining water increases. When the geophysical water cycle is considered, there will be an increase in sea surface salinity somewhere in the ocean before major **precipitation events** that may lead to flooding. Improved water cycle estimates incorporating sea surface salinity into the analysis are being used in predicting precipitation events on land with longer lead times. https://ummenhofer.whoi.edu , https://www2.whoi.edu/site/globalwatercycle/

This Narrative may be found,
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html
Jerrold.G.Norton@noaa.gov Phone:831-648-9031