CLIMATE NARRATIVE, July 2020 and as noted

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

UNITED STATES WEST COAST AND NORTH PACIFIC

During late July 2020, US west coast (20-200 km offshore) satellite derived sea surface temperature (SST_{Jy}) anomaly was negative to neutral (≥ -2.0°C) off Oregon and Washington, where SST_{Jy} was 11°-14°C. Negative SST anomaly seen along the northern California coast (37°-42°N) in June was replaced by positive SST_{Jy} anomaly with SST_{Jy} between 12°-16°C. Low magnitude positive and negative anomalies occurred from Point Conception to Point Pinos (36.5°-34.4°N) where SST_{Jy} was 15°-17°C. SST_{Jy} anomalies along the Southern California Bight and northern Mexico were negative (≥ -2°C) to neutral with SST between 18°-23°C. Negative west coast and equatorial SST_{Jy} anomalies were unlike the anomalously warm North Pacific Ocean. Except for a relatively small area between (35°-50°N) west of the date line (180°), the North Pacific had predominantly positive anomaly (≤3.0°C) that extended into the Bering and Chukchi Seas. Bering Sea temperatures remained above average but became cooler than the extremes of 2019. A band of positive anomaly (≤2.5°C), more than 900 km wide, extended zonally across the Pacific Ocean at 30°-45°N. This band angled poleward in the east into the Gulf of Alaska and equatorward west of 180° into the South China Sea and about Indonesia. Positive SST anomaly (≤ 2.5°C) occurred in the Gulf of Alaska. West of 180° neutral to positive anomaly occurred from the equator to 30°N. Weakly positive SST anomaly also occurred off the coasts of Central America and southern Mexico extending 300-800 km offshore.

https://psl.noaa.gov/data/gridded/data.noaa.oisst.v2.highres.html https://www.ospo.noaa.gov/Products/ocean/sst/anomaly/
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html (current)
https://www.ospo.noaa.gov/Products/ocean/sst/contour/index.html
https://www.fisheries.noaa.gov/feature-story/current-sea-surface-temperatures-eastern-bering-sea

July **Sea Level Height Anomaly** (SLA) analyses of the Pacific Ocean (30°S-40°N) showed patterns similar to those observed in May and June. Negative SLA persisted along the eastern boundary from the equator poleward of 40°N and west to 140°W. At 5°-20°N negative SLA (≥ -15 cm) reached across the Pacific Ocean from North America to Indonesia to the Philippine Islands and Southeast Asia. This trough included a SLA depression of -25 cm centered near 10°N, 150°W, possibly related to July tropical cyclones. Weak negative SLA (>10 cm) occurred in the central north Pacific from 20°-35°N flanked on the north by a SLA zonal ridge (≤ 20cm), generally corresponding to the persisting trans-Pacific band of elevated SST_{Jy} noted above.

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ocean/weeklyenso_clim_81-10/wksl_anm.gif (current)
https://www.nhc.noaa.gov/?cpac https://blogs.nasa.gov/hurricanes/2020/07/26/douglas-eastern-pacific-ocean-5/

During July, surface **chlorophyll-a** (chl-a) of 0.5- 2.0 mg/m^3 was seen more than 200 km offshore between Guerrero Negro, Mexico and Vancouver Island, Canada (28°-50°N). This coastal zone of high chl-a appeared widest, reaching 300 km seaward, between 40°-47°N. Areas of chl-a concentration between 5-10 mg/m^3 occurred in a 25-150 km band inshore between 40°-48°N. These 5-10 mg/m^3 chl-a coastal areas were less frequent and less extensive south of 40°N. Coastal 0.5- 2.5 mg/m^3 chl-a distributions were observed around the Gulf of Alaska and into the Bering Sea. Areas south of Point Conception (34.4°N), along the Southern California Bight and northern Mexico, had 0.5-

2.0 mg/m^3 but coastal bands appeared related to local coastal processes and were less continuous along shore. Oceanic chl-a concentrations 500-1500 km off Washington were about 0.3-1.0 mg/m^3. An area of 0.5-1.5 mg/m^3 chl-a extended more than 60 km south of Point Conception. Coastal areas south of 36°N were frequently obscured by clouds during late July, making analysis more difficult. Recent imagery available.
https://coastwatch.pfeg.noaa.gov/coastwatch/CWBrowserWW180.jsp#
https://coastwatch.pfeg.noaa.gov/elnino/coastal_conditions.html (current)

July sea temperature list from shore stations and **near-shore buoys**

The following list gives shore and nearshore water temperature measurement locations in decreasing latitude. Each line begins with a shore station or buoy abbreviation followed by latitude. Temperature values are in brackets with the average of available monthly values first (followed by the range and standard deviation) in parens and change from previous monthly mean. Averages for the (first, second and third) monthly terciles are within the second parens, followed by the multiyear monthly average, where available. Subscripts H and L indicate terciles containing Highest and Lowest monthly temperatures.

Amphitrite Point, B.C. 48.9°N

Neah,48.5°N,124.7°W [11.8 (10.6 -13.9, 0.6)0.2 (11.6$_L$, 11.9$_H$, 12.0$_H$) 11.9°C]

Cape Flattery 48.4°N

NeBy,48.4°N [11.6 (9.8-14.4, 1.0) 0.1(10.8$_L$ 12.4$_{LH}$, 11.7$_{LH}$)°C]

CpEz,47.4°N,124.7°W [14.1 (11.3-16.3, 0.9)0.4(14.2$_H$, 14.3, 13.6$_L$) 13.6°C]

Cape Blanco 42.8°N

PrtO,42.7°N [8.9 (7.2 -14.8, 1.8) -0.8(8.0, 8.1$_L$, 10.6$_H$)°C]
CCty,41.7°N [13.2(8.9 -17.1, 2.3) 0.3(10.6$_L$ 13.6, 15.5$_H$)°C]

EelR,40.7°N,124.5°W [11.8 (10.0 -14.7, 0.9)-0.7(12.1$_L$,11.9$_H$,11.3$_L$)12.5°C]

Point Arena 39°N

ArCv,38.9°N [12.1(9.3 -15.3, 1.7) 0.9(10.8, 12.2$_L$, 13.2$_H$)°C]

Point Reyes 38°N

SFrn,37.8°N,122.8°W [13.1 (10.1-15.0, 1.0)0.6 (12.4$_L$,12.9,14.1$_H$) 13.1°C]
Mtry,36.6°N [16.0(12.4- 18.2, 1.2) -0.1(16.5$_H$, 15.1$_L$, 16.3)°C]

Point Sur (36.3°N)

PrtS,35.1°N [14.8(13.0-17.4, 1.0) 0.3(15.6, 14.9$_H$, 13.9$_L$)°C]

PtCn,34.5°N,120.8°W [14.9 (11.9-18.2, 1.3)0.6(14.4$_L$, 15.4$_L$, 14.8$_H$)°C]

Point Conception,34.4°N

SBCh,34.3°N,119.9°W [17.2 (15.0-19.8, 1.0) 0.9(17.4, 17.8$_H$, 16.4$_L$) 17.0 °C]

SMca,34°N [18.9 (14.1 -23.5, 2.3)0.6(20.4, 19.6$_H$, 16.8$_L$)°C]

Tory,32.9°N,177.4°W [20.6 (15.6 -22.9, 1.1) 2.3(20.5, 21.3 $_H$, 20.1 $_L$)°C]
LaJo,32.9°N [18.8 (12.2 -24.5, 3.4)-0.8(20.3, 19.8$_{LH}$,16.3$_L$)°C]

Point Loma, 32.7°N

July temperatures were within the 10°-20°C range, except at PrtO (8.9°C) and Tory (20.6°C). Multi-year July means, where available, were within 1°C of July 2020 means. Monthly temperature range was ≤5°C for about half the stations, generally coincident to locations with standard deviations ≤1.0°C. June-to-July temperature changes were ≤ 1.0°C except at Tory (2.3°C) and positive except at EelR (-0.7°C) and PrtO (-0.8°C). Extreme temperatures suggest most variability in second and third July terciles.

Shore temperature measurements, taken at fixed depth below the lowest tide at NOAA **tide stations**, are indicated in italics by: *NeBy* (9443090), *PrtO* (9431647), *CCty* (9419750), *ArCv* (9416841), *Mtry* (9413450), *PrtS* (9412110), *SMca* (9410840), *LaJo* (9410230). (Numbers) lead to detailed location and station descriptions, https://tidesandcurrents.noaa.gov/stations.html?type=Physical%20Oceanography

. Near shore **buoy** measurement details are obtained from number designations: Neah (46087), CpEz (46041),TlMk (46089), EelR (46022), SFrn (46026), PtCn (46218), SBCh (46053),Tory (46225) . https://www.ndbc.noaa.gov/station_page.php?station=46087

EQUATORIAL AND SOUTH PACIFIC (late July and as noted)

During July El Niño neutral conditions were expected to continue across the Equatorial Pacific (EP) through the boreal summer with a 50% chance of becoming La Niña conditions in the fall. Negative subsurface temperature anomalies (≥ -2.5°C) became more extensive in the central EP between 100-150 m as negative SST_{Jn} anomaly increased in areal extent across the EP. The eastern EP upper 300 m heat content anomaly reversed trend and became more strongly negative during July. The South Pacific Ocean had predominantly negative to neutral SST_{Jn} anomaly east of 130°W and positive SST_{Jn} anomaly to the west. Negative SST_{Jn} anomaly (≥-2°C) occurred off the coast of Ecuador, Peru and northern Chile and across the EP to 120°W. Negative SST_{Jn} anomaly persisted south of Australia. http://www.ospo.noaa.gov/Products/ocean/sst/anomaly/
https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf
https://www.ospo.noaa.gov/Products/index.html

Late July **Sea level height anomaly** (SLA) analyses for the south Pacific Ocean (0°-30°S) showed negative SLA (≥-10 cm) along the South and Central American coasts. Negative to neutral SLA was most common east of 170°W and neutral to positive SLA more common in the west. Negative SLA (≥ -15 cm) extended from South America westward across the EP to 165°E. Negative SLA was found in an intermittent zonal band across the South Pacific between 10°-25°S. West of 170°W, areas of positive SLA (≤ 15 cm) were observed north and south of this band. These patterns appear stable and are similar to those seen in May and June SLA analyses.
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) (3-month running mean of SST anomalies in the Nino 3.4 region) decreased from El Niño-positive range in the March-April-May (MAM) mean (0.3). The AMJ and MJJ means decreased again to 0.0 and -0.2, respectively. 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 El Niño index)

The **Southern Oscillation Index** (SOI) is the difference in sea level atmospheric pressure (SLP) anomalies at Darwin in Northern Australia (12.5°S, 130.8°E) and at Tahiti in the central South Pacific (17.5°S, 149.5°W). Persistent negative SOI values are correlated with warmer than average ocean waters across the eastern tropical Pacific, typical of El Niño. NOAA/PSL SOI values for January-July 2020 are 0.30, -0.10, -0.20, 0.30, 0.70, -0.60, 0.70. https://psl.noaa.gov/data/correlation/soi.data https://psl.noaa.gov/site_index.html#s
https://www.longpaddock.qld.gov.au/soi/

The NOAA/NCEI **Pacific Decadal Oscillation Index** (PDO), calculated from Pacific Basin wide ERSST.v4 was less than -1.30 from January through April and increased to -0.52, -0.75 and -0.81 during May through July, respectively.
https://www.ncdc.noaa.gov/teleconnections/pdo/ , http://research.jisao.washington.edu/pdo/PDO.latest.txt

North Pacific Gyre Oscillation (NPGO) variability is positively correlated with fluctuations of salinity, nutrients and chlorophyll in the northeastern Pacific. Monthly NPGO values for 2020 have been between -2.0 and -1.0, with -1.25 for July. The last positive NPGO value was December 2016.
http://www.o3d.org/npgo/npgo.php https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2007GL032838#

In July the **Pacific / North American Teleconnection Index** (PNA), computed from atmospheric pressure over the Pacific Ocean and North America, had neutral to positive daily values, with a monthly "Historical PNA index" of 1.20. The Historical PNA indices are monthly averages, standardized by the 1981-2010 climatology. Positive values are associated with above-average temperatures over western Canada and the US west coast and positive ENSO phases. https://www.cpc.ncep.noaa.gov/data/teledoc/pna.shtml (Historical Index)
https://www.cpc.ncep.noaa.gov/data/teledoc/pna.shtml (computational alternatives).

July west coast ERD/SWFSC monthly **Upwelling Indices** (UI) were positive from 24°N to 42°N. Values computed for 33°N and 42°N were strongly positive with large positive anomalies. UI was weakly positive at the 45°N and 48°N locations. These values, with those of June, are characteristic of a fully developed upwelling season. At 51°N northward UI values were small and about average.
https://upwell.pfeg.noaa.gov/products/PFELData/upwell/monthly/table.2007

At 36°N and 39°N, daily upwelling conditions, indicated by UI, were strongly favorable during 5-12 July, with a less intense 5-day event around 24 July. At 42°N, UI was relatively high during the month with largest values from 12 to 22 July.
https://oceanwatch.pfeg.noaa.gov/products/PFELData/upwell/daily/p09dayac.all (see computational alternatives)
https://oceanview.pfeg.noaa.gov/products/upwelling/dnld (current)

PRECIPITATION and RUNOFF (late July)

At the end of July northwestern Washington and the Columbia River basins had received about average precipitation for the water-year (beginning 1 October 2019). Precipitation deficits, where they occurred, were less than 8 inches. However, southern Washington, Oregon and northern California had large water-year deficits, exceeding 20 inches and falling below 80% of water-year average for most river basins. Oregon and northern California remained in moderate to severe drought conditions.
https://droughtmonitor.unl.edu.
https://www.cpc.ncep.noaa.gov/products/global_monitoring/precipitation/global_precip_accum.shtml
https://waterdata.usgs.gov/ca/nwis/nwis https://watermonitor.gov/naww/index.php
https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=4

Northwest and Washington River Discharge

Fraser River discharge, measured at Hope (130 km upriver from Vancouver, B.C.) reached a high of 10,600 m^3/s on 6 July and fell to 6,250 m^3/s (220,700 cfs) by 31 July. The multi-year median for 31 July is 4,100 m^3/s.
The **Queets** River at Clearwater, WA was flowing at 824 [854/ -806 cfs], historical median/ and change from previous month as cfs in brackets]. The **Puyallup** at Puyallup was flowing at 2,700 [2,400/ -1,000 cfs]. **Skagit** flow was 13,000 [12,900/ -11,000 cfs] near Mount Vernon. **Stillaguamish** discharge was 376 [419/ -458 cfs] at Arlington. **Columbia** transport was 166,000 [198,000/ -146,000 cfs]at Vancouver, WA.

Oregon River Discharge

The **Columbia** at the Dalles was 187,000 [198,000/ -140,000 cfs]. The **Wilson** at Tillamook, was flowing at 127 [104/ -198 cfs]. At Elkton, **Umpqua** transport was dischargeing 932 [1,220/ -968 cfs]. **Rogue** River flow was 1,600 [1,520/ -140 cfs]at Grants Pass and 1,950 [1,900/ -610 cfs]at Agness OR.

California River Discharge

The **Klamath** near Klamath was transporting 2,590 [3050/ -1,300 cfs]. **Smith** River discharge was 342 [353/ -356 cfs] near Crescent City. The **Eel** at Scotia had 76 [168/-221 cfs] transport. The **Battle Creek,** Coleman National Fish Hatchery flow was 226 [251/ -35 cfs]. **Butte Creek** at Chico had 115 [136/ -26 cfs] transport. **Sacramento** transport was 110,200 [13,400/0 cfs]at Verona and 14,000 [15,500/-2,700 cfs] at Freeport. **San Joaquin** flow was 549 [1,120/ -296 cfs] at Vernalis. **Pescadero Creek** transport was 2 [3/ 0 cfs] near Pescadero. **San Lorenzo R.** discharge was 9 [11/ -4 cfs] at Santa Cruz. The **Pajaro** at Chittenden was flowing at 9 [7/ -2 cfs]. The **Salinas** River near Spreckels had flow of 34 [2/ -1.3 cfs]. The **Carmel** at Carmel was flowing at 1.1 [0/ -7.4 cfs]. The **Big Sur** River near Big Sur, CA discharged at 23 [17/ -8 cfs] during the final days of July

Notes

California commercial catch of *Doryteuthis (Loligo) opalescens* (**Market Squid**) is one of the most valuable remaining California fisheries. The commercial fishing season is April through March of the following year and the season is closed when state officials believe landings will exceed 107,000 metric tons (mt). During the current harvest season (2020-2021 Season) about 3,000 mt were landed in each month from April through July. The current season total (12,479 mt) is about 90% of the catch from the entire 2019-2020 season. Comparison of July squid catch to total seasonal catch shows that July landings may be an indicator of the season's total. The total commercial landings (and July landings) in mt for the 2013 through 2019 seasons were: 106,371 (30,498), 104,062 (35,219), 36,326 (13,400), 38,510 (9,363), 68,169 (4,120), 31,059 (2,984), 13,801 (1,178), respectively. Linear correlation gives R^2=0.78, including the 2017-2018 outlier when the July catch was not a good predictor of total seasonal catch. The catch for July 2020 suggests that the 2020-2021 total landings will be between 30 to 40 thousand mt. Notes in the April 2020 Climate Narrative give a few details on a developing Oregon squid fishery. http://wildlife.ca.gov/Conservation/Marine/CPS-HMS/Landings
https://scripps.ucsd.edu/zooplanktonguide/species/doryteuthis-loligo-opalescens
https://coastwatch.pfeg.noaa.gov/elnino/docs/Apr2020_Climate_Narrative.pdf