MINUTES
WATER RESOURCES COMMITTEE
Tuesday, August 31, 2021, at 9 a.m.
UNITED WATER CONSERVATION DISTRICT
Boardroom, 1701 N. Lombard Street, Oxnard CA 93030

Committee Members Present:
Chair Edwin McFadden – Chair
Director Naumann
Director Maulhardt – joined the meeting at 9:17 am (participated via Webex)

Staff Present:
Mauricio E. Guardado Jr., general manager
Dr. Maryam Bral, chief engineer
Dan Detmer, supervising hydrogeologist
Dr. Zachary Hanson, hydrogeologist
Kathleen Kuepper, hydrogeologist
John Lindquist, senior hydrogeologist
Zachary Plummer, IT administrator
Dr. Bram Sercu, senior hydrologist
Dr. Jason Sun, senior hydrogeologist/modeler

Public Present: Attendance List (attached)
Tim Nicely
Martin Gramckow
Jurgen Gramckow
Jennifer Tribo

OPEN SESSION: 9:08 a.m.
Chair McFadden called the Water Resources Committee Meeting to order at 9:08 a.m.

1. **Public Comment**
   Chair McFadden asked if there were any public comments for the Water Resources Committee. None were offered.

2. **Approval of Minutes - Motion**
   Motion to approve the July 8, 2021, Water Resources Committee meeting minutes, Director Naumann; Second, Director McFadden. Voice vote: two ayes (McFadden and Naumann); none opposed; one absent (Maulhardt), motion carries 2/0/1.

3. Expert Panel Technical Review Memo, UWCD Regional GW Flow Model

Senior Hydrogeologist/Modeler Dr. Jason Sun provided updates and slides (see attached) on the expert panel technical review memo and the UWCD regional groundwater flow model.

Director Maulhardt joined the meeting at 9:17 am.

4. Coastal Brackish Groundwater Extraction Simulation with MODFLOW-USG

Dr. Sun provided updates and slides (see attached) on the Coastal Brackish Groundwater Extraction simulation with MODFLOW-USG. Chair McFadden asked if the chloride concentrations listed offshore are derived from the model estimate. Dr. Sun stated that staff starts with ocean and aquifers chloride estimates.

Director Maulhardt asked for clarification on the simulation. Dr. Sun stated that the blue areas indicate a chloride concentration of 100 mg/l. He added, what we see in the simulation is the seawater intrusion moving back and forth a bit and drifting towards the Mugu Navy Base.

Supervising Hydrogeologist Dan Detmer stated that staff had worked quickly to calibrate this model as the project is funded by a Prop 1 grant. Staff has now calibrated the solute transport and will begin running scenarios for Coastal Brackish Groundwater Extraction and Treatment Plant Project (CBG-WET). He added that the Mugu aquifer plume does not move much on the inland extent north of the Mugu base, where there is vertical flow down into the Fox Canyon aquifer.

Chief Engineer Dr. Maryam Bral mentioned the work that the Engineering department had been doing to support this project. Engineering coordinated another set of water quality data, which is being collected from Oxnard and Mugu aquifers for a wide range of constituents beyond just chloride and TDS.

Director Maulhardt stated that he was in awe at how transparent staff has been in the model development process and how willing staff has been to use outsiders to critique and inspect the work that has been done. He then complimented the General Manager and Senior Managers for creating an environment where the technical staff can excel.

5. When Will the Current Local Dry Cycle End?

Senior Hydrogeologist John Lindquist provided updates and slides (see attached) on historical patterns of drought and flood and commented that the current local dry cycle could continue for a few more years.

Chair McFadden stated that with amplification of the wetter conditions, systems that depend on snowfall will be in trouble in the future and systems that depend on stormwater will have an advantage. Mr. Lindquist agreed with this statement and noted that with warmer conditions there is a lot of water that is being evapotranspired. He added that high flows will still source from the Sespe watershed, and it will be a challenge to divert more muddy water.

6. Water Resources Department Update

Mr. Detmer provided a verbal update to the Committee regarding Water Resources department activities for the previous month. He stated that work continues on the groundwater modeling and the final draft of the model expansion report just needs final internal review. Staff addressed

comments from the panel and there is interest from the GSAs since Mound Basin and Fillmore Piru Basin rely on the model for their GSPs.

Mr. Detmer stated that there is another round of the Prop 1 Groundwater Grant program, which is for implementation projects only. He added the deadline is September 7 and staff will be applying. The intention is to apply for the first four (4) full scale production wells for the CBG-WET project. Letters of support were received from both the US Navy and Fox Canyon GMA.

Mr. Detmer stated that one challenge is to identify what will be done with the product water. There is saline water at the base of the perched aquifer, and the degree of confinement is a question there. He added that the District needs to prove it out to satisfy regulators that there are no organic contaminants in the water. Mr. Detmer stated that staff have been discussing requirements for a surface water discharge permit with the Regional Board for test pumping of the new production wells.

Director Maulhardt raised some concerns regarding the pumping of the product brine, and staff clarified that brine from the treatment plant will be routed to existing permitted ocean outfalls. Staff proposes temporary discharge piping for the test pumping and Director Maulhardt is hopeful the pipe will not need to be buried.

Dr. Bral stated that staff is only speaking about the scope of the Prop 1 Round 3 grant proposal, not the full scale project that includes RO treatment. Staff has been discussing use of the Salinity Management Pipeline (SMP) for the CBG-WET project but that will be discussed in the future. Mr. Detmer clarified the new grant proposal is for test pumping and additional monitoring wells in the deep perched zone are also proposed to assess the downward gradients and potential for vertical groundwater flow.

7. Groundwater Sustainability Agencies Update

Mr. Detmer provided a verbal update to the Committee regarding the activities of the various GSAs within United's service area, and activities related to Santa Paula basin management.

FUTURE AGENDA ITEMS

None were suggested.

ADJOURNMENT

Chair McFadden adjourned the meeting at 10:53 am.

I certify that the above is a true and correct copy of the Minutes of the UWCD Water Resources Committee Meeting of August 31, 2021.

Edwin T. McFadden III

Chair Edwin McFadden

United Water
CONSERVATION DISTRICT

ATTENDANCE LIST

MEETING DATE: Tuesday, August 31, 2021

MEETING: UWCD Water Resources Committee Meeting

The signing or registering of your name on this sign-up form is not required but is voluntary. All persons may attend the meetings of the Board of Directors of United Water Conservation District without signing or registering their names on this form.

~~Name~~ (Please Print)	Representing
Tim Nicely	Santa Paula
Jennifer Tribo	City of Ventura

United Water CONSERVATION DISTRICT

Expert Panel Technical Review Memo

UWCD Regional Groundwater Flow Model

Presented by Dr. Jason Sun, Ph.D., P.E, Senior Groundwater Modeler
Water Resources Committee Meeting
August 31, 2021

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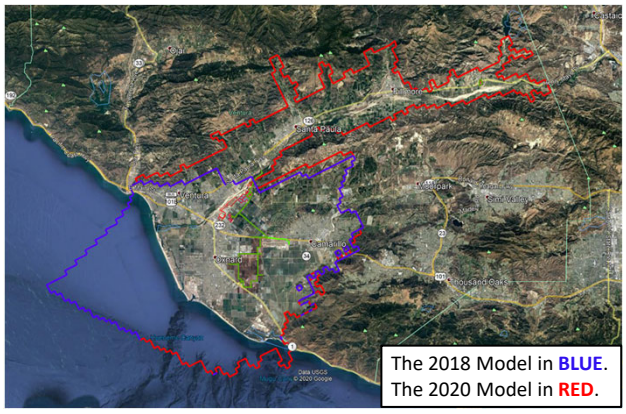
Expert Review Panel

- **Jim Rumbaugh**
  Developer of the widely used MODFLOW pre- and post-processor, Groundwater Vistas
- **Dr. Sorab Panday**
  Co-author of MODFLOW
  Author of MODFLOW-USG
  Member of National Academy of Engineering
- **John Porcello**
  Licensed Geologist and Hydrogeologist
  Principal groundwater hydrologist, with focus on western U.S.

The expert panel started to review in 2016
The expert panel has reviewed the 2018 and 2020 GW models



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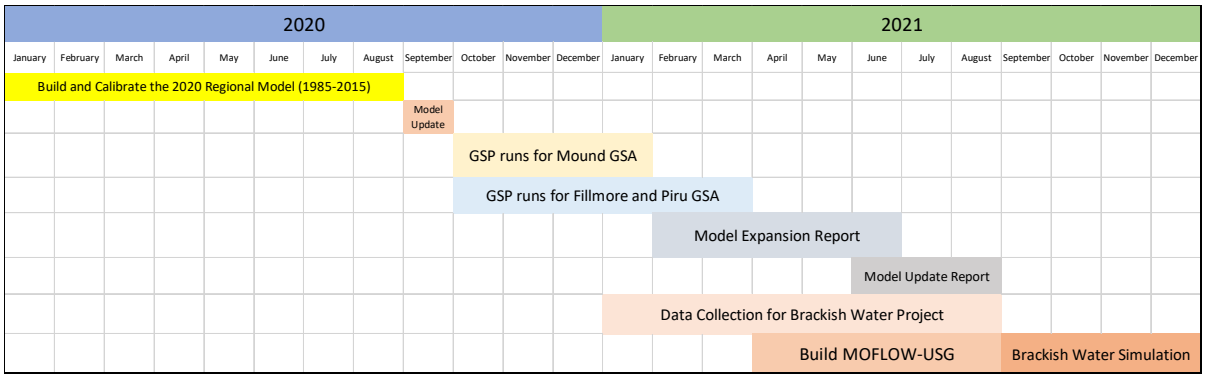
Groundwater Model Development and Applications



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GW Model Review

- Paper Review: Read the model report
- In Depth Review:
  - Review the GW model input/output files
  - Review the report
- **Thorough Review** (UWCD):
  - Review the GW model input/output files
  - Receive the measurements and independently verify the model calibration with data
  - Review the model report
- The expert panel releases the tech memo on the model on August 19, 2021

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Summary of Model Review Tech Memo

1. The numerical GW model is well-designed and well-calibrated
2. The numerical GW model compares well with the description of geology and hydrogeology developed from the data
3. The model calibration remains of good quality in the update period
4. The model is viewed by the expert review panel as an appropriate tool for…assisting with long-term sustainable management of the groundwater resources in these seven groundwater basins.
5. …the UWCD team should be proud of the current model.

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Acknowledgement:

Management:
General Manager
- Mauricio Guardado
Chief Engineer
- Dr. Maryam Bral

Water Resources Department:
Dan Detmer
Eric Elliot
Murray McEachron
Dr. Bram Sercu
Dr. Zach Hanson
John Lindquist
Kath Kuepper
Robert Marshall

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Battle-Tested Model

- The model has been reviewed internally by UWCD surface water hydrologists and hydrogeologists
- The model has been reviewed externally by an expert panel composed of nationally recognized modelers (Dr. Sorab Panday, Mr. John Porcello, and Mr. Jim Rumbaugh).
- The model has been reviewed by Stanford professor, Dr. Daniel Tartakovsky
- City of Oxnard hires a consultant to review the model

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Questions/Comments

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United Water CONSERVATION DISTRICT

Coastal Brackish Groundwater Simulation with MODFLOW-USG

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- Prop 1 Grant
- The 2018 Model (Coastal Plain Model) has been converted into MODFLOW-USG
- Model refinement (model layers and grids) has been applied
- Flow model calibration was reviewed to be good
- Transport model (seawater intrusion) is calibrated preliminarily

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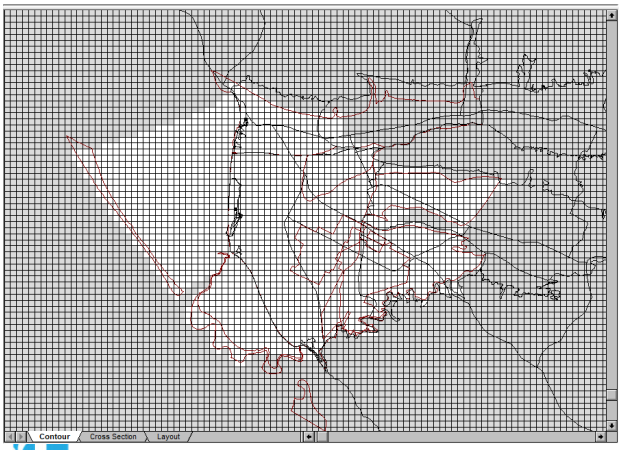
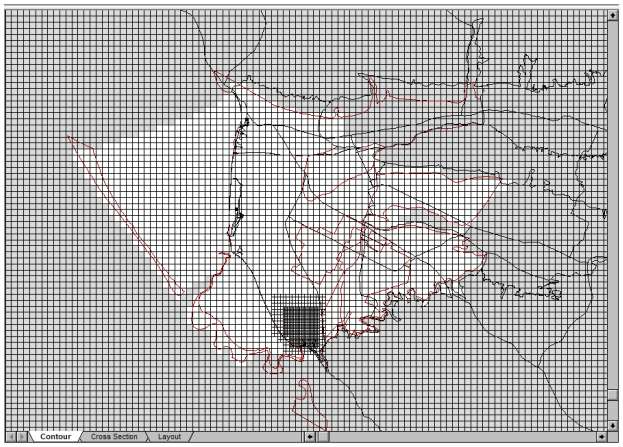
Numerical Model Refinement

MODFLOW-NWT



MODFLOW-USG



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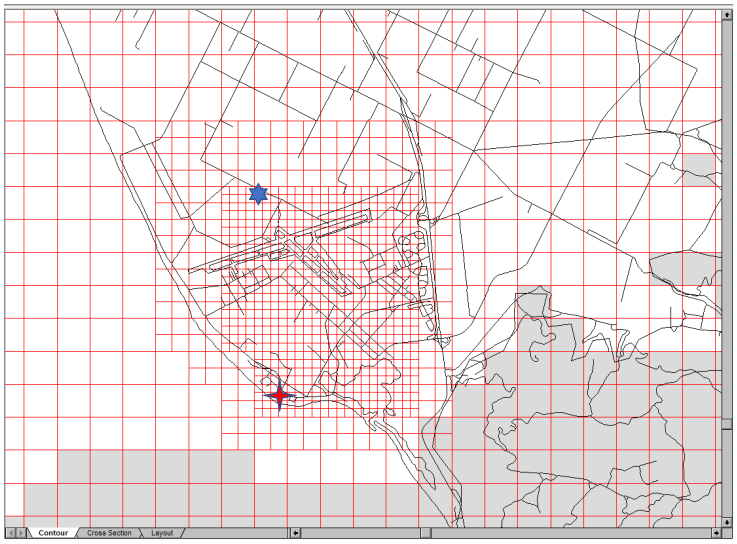
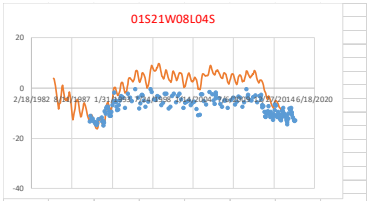


Grid size: 2000 ft, 1000 ft, 500 ft

01N22W36K08S

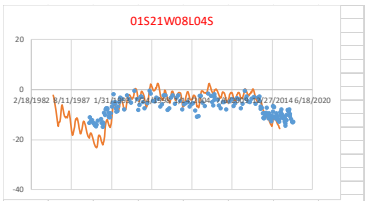
01S21W08L04S

MODFLOW-NWT



01S21W08L04S	200	0	220	0	220
01S21W08L04S	3	3	-6.4	7.5	6.6
01S21W08L04S	5		-6.4	7.5	6.6

MODFLOW-USG



01S21W08L04S	200	0	220	0	220
01S21W08L04S	3	3	0.3	3.9	3.2
01S21W08L04S	4		0.2	3.7	3.1
	G.S.	2.73	OBS #	152	

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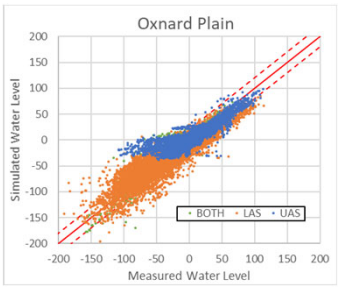
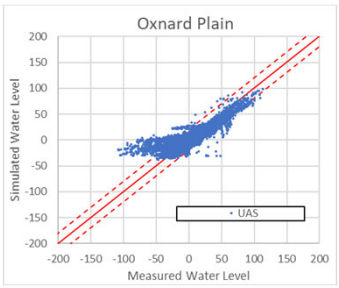
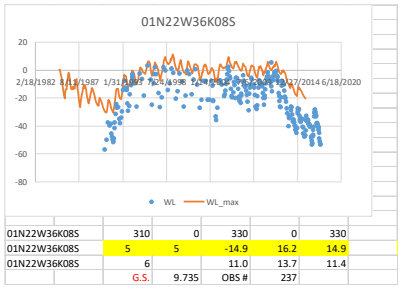
MODFLOW-NWT

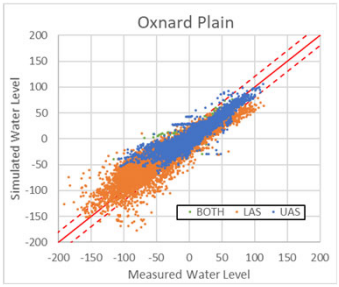


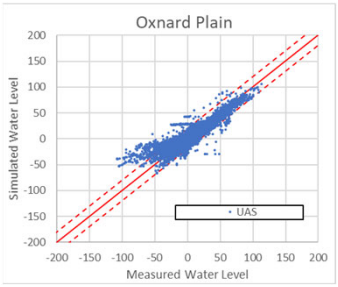


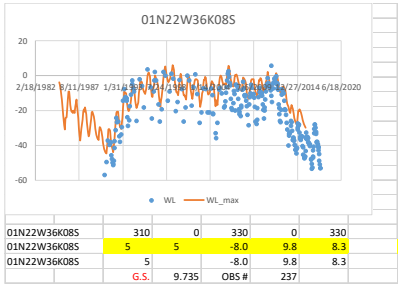


01N22W36K08S	310	0	330	0	330
01N22W36K08S	5	5	-14.9	16.2	14.9
01N22W36K08S	6		11.0	13.7	11.4
	G.S.	9.735	OBS #	237	

MODFLOW-USG







01N22W36K08S	310	0	330	0	330
01N22W36K08S	5	5	-8.0	9.8	8.3
01N22W36K08S	5		-8.0	9.8	8.3
	G.S.	9.735	OBS #	237	

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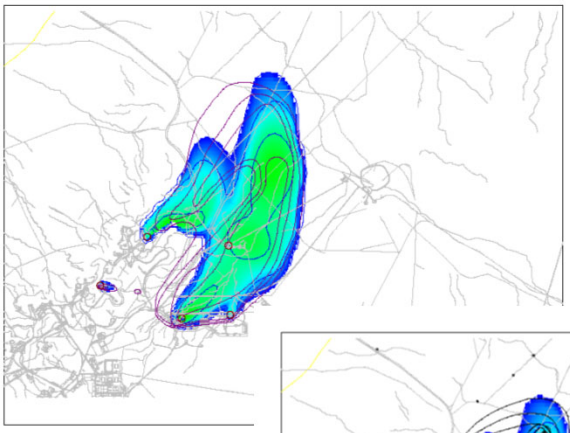
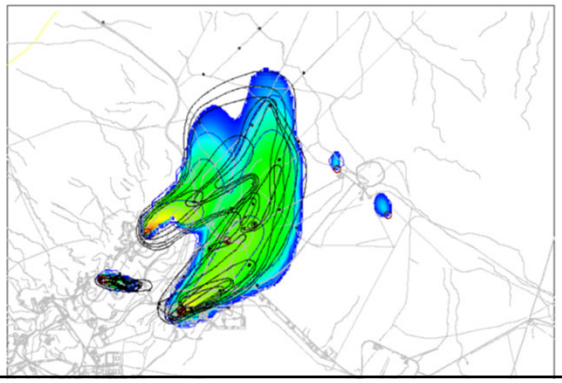


Perchlorate vs. VOCs

Jason's work from previous employer



Transport model for contaminant plumes is relatively easy to calibrate because of the steady growth of contaminants over time

- The seawater intrusion tends to move back and forth over wet/dry years. More difficult to calibrate
- The 1985 seawater intrusion was not well defined

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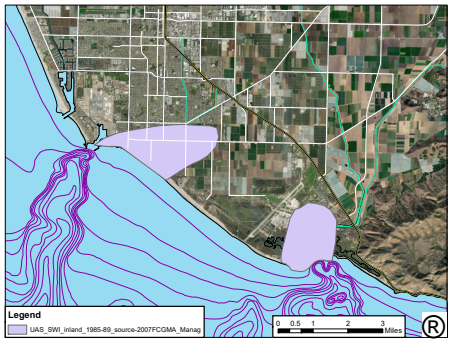
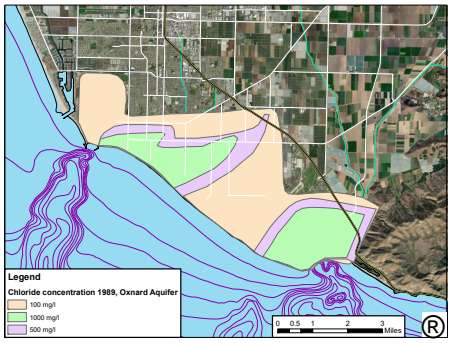
Seawater Intrusion (SWI) Investigation



1985-1989 UAS SWI Inland Extent (FCGMA)



1989 Oxnard Aquifer SWI Inland Extent (USGS)
USGS revised the extent to be smaller later

More investigations in 1994, 1999, 2002, 2005 and 2015

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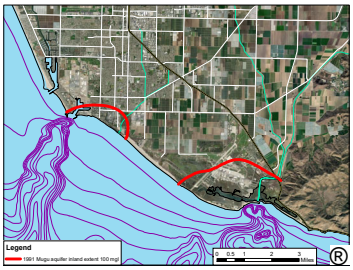
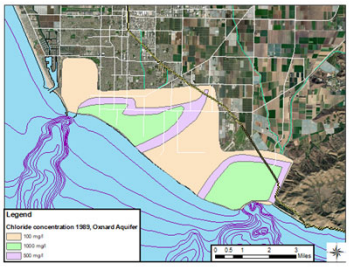
Seawater Intrusion (SWI) Investigation

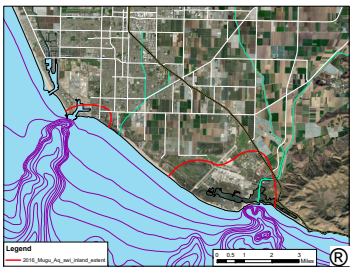
Preliminary 1991 Mugu Aquifer SWI Inland Extent (UWCD)

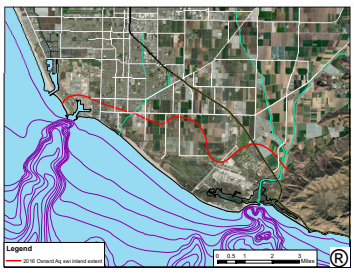




1989 Oxnard Aquifer SWI Inland Extent (USGS)

2015 Mugu Aquifer SWI Inland Extent (UWCD)





2015 Oxnard Aquifer SWI Inland Extent (UWCD)

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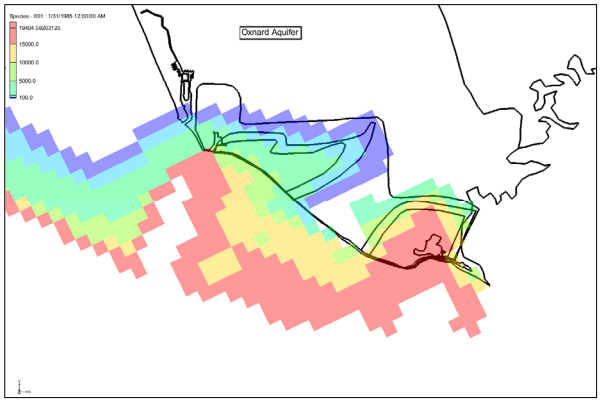
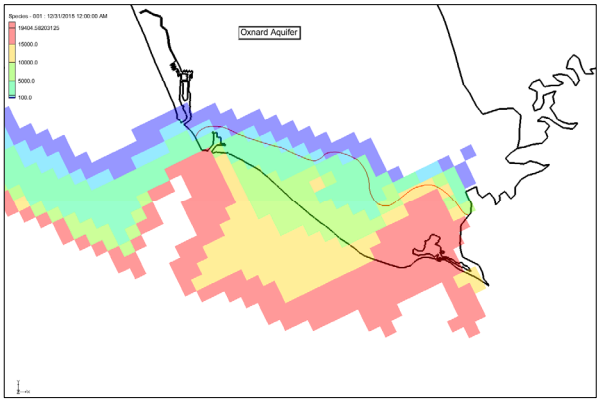
Oxnard Aquifer

Estimated Initial Chloride Conc in 1985



Black line:
1989 Oxnard Aquifer SWI inland extent (USGS)

Simulated Chloride Conc in 2015



Red line:
2015-2016 Oxnard Aquifer SWI inland extent (UWCD)

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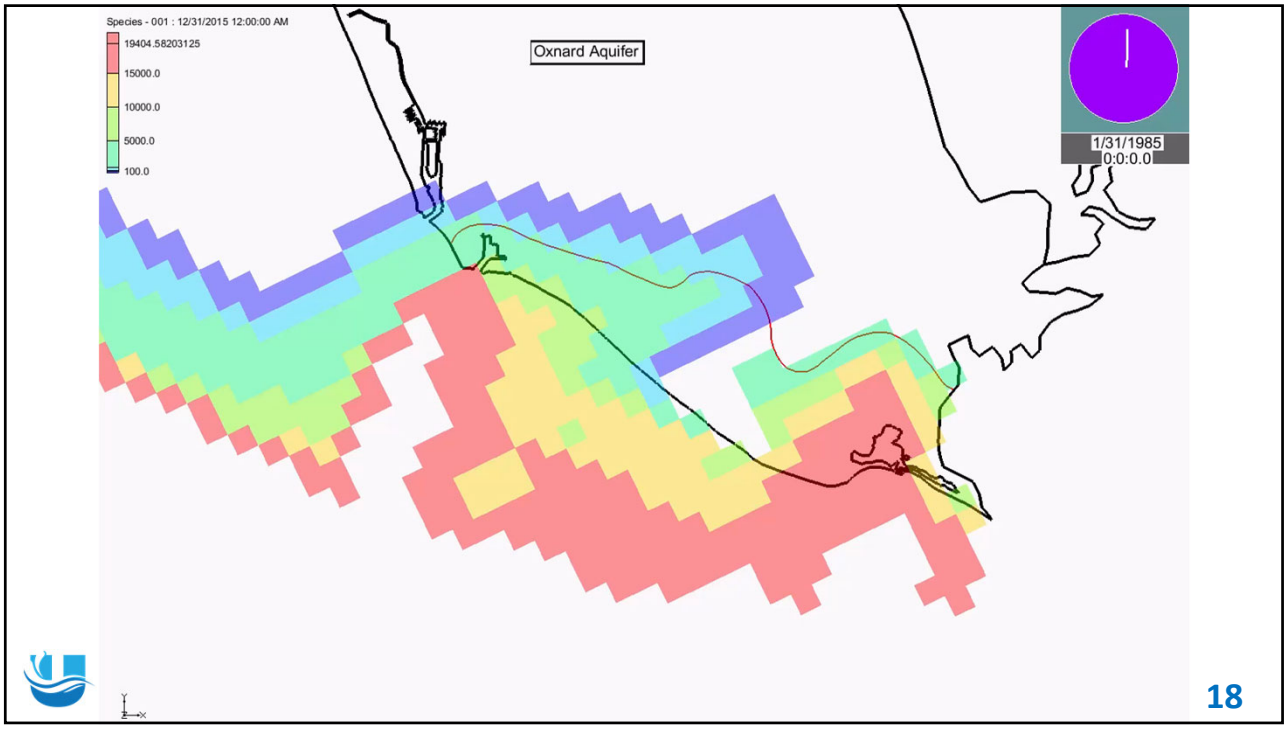

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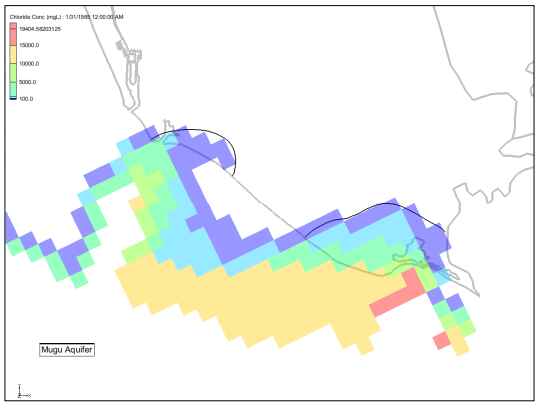
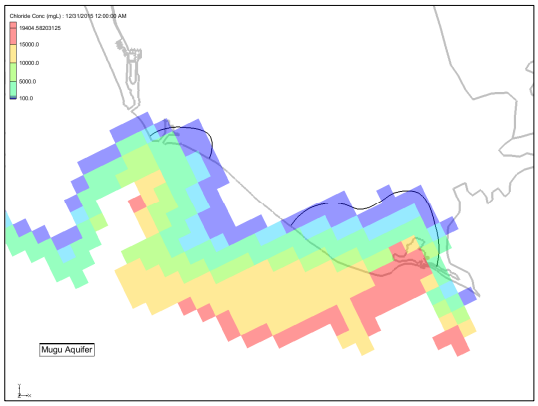
Mugu Aquifer

Estimated Initial Chloride Conc in 1985



Black line:
Preliminary 1991 Mugu aquifer inland extent

Simulated Chloride Conc in 2015



Black line:
2015 Mugu aquifer inland extent (UWCD)

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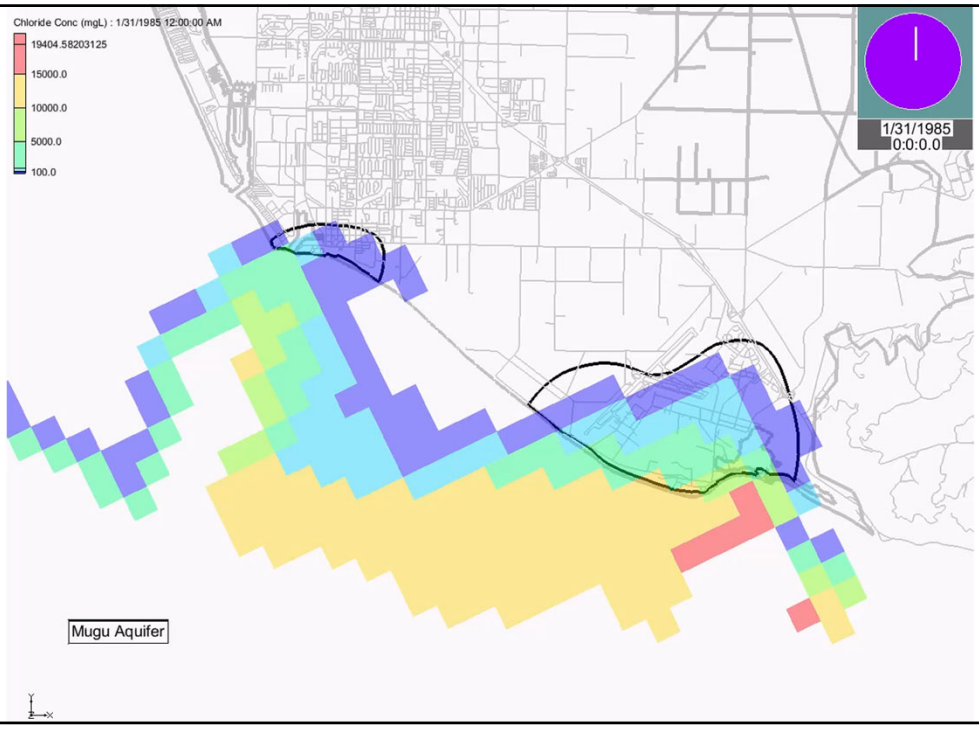

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Conclusions

- A detailed analysis on the seawater intrusion data from 1985 to 2015 may be beneficial
- The MODFLOW-USG model is ready for the brackish water project
- The MOFLOW-USG model will be sent to the Expert Panel for review
- The MODFLOW-USG model may continue to be improved while simulating the brackish water project in parallel

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Questions/Comments

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When Will the Current Local Dry Cycle End?

A Brief Review of Historical Data and a Peek at What the National Weather Service Expects in 2022

Presented by John Lindquist, Senior Hydrogeologist

Water Resources Committee Meeting

August 31, 2021

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OUTLINE

1. How severe is our current drought compared to historical droughts?
2. What can we learn about ***local*** drought frequency and duration from long-term rainfall-proxy data (tree rings)?
3. How are droughts and wet periods expected to change in the future?
4. Please, just tell me when it's going to rain again…

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1. THE HISTORICAL RECORD

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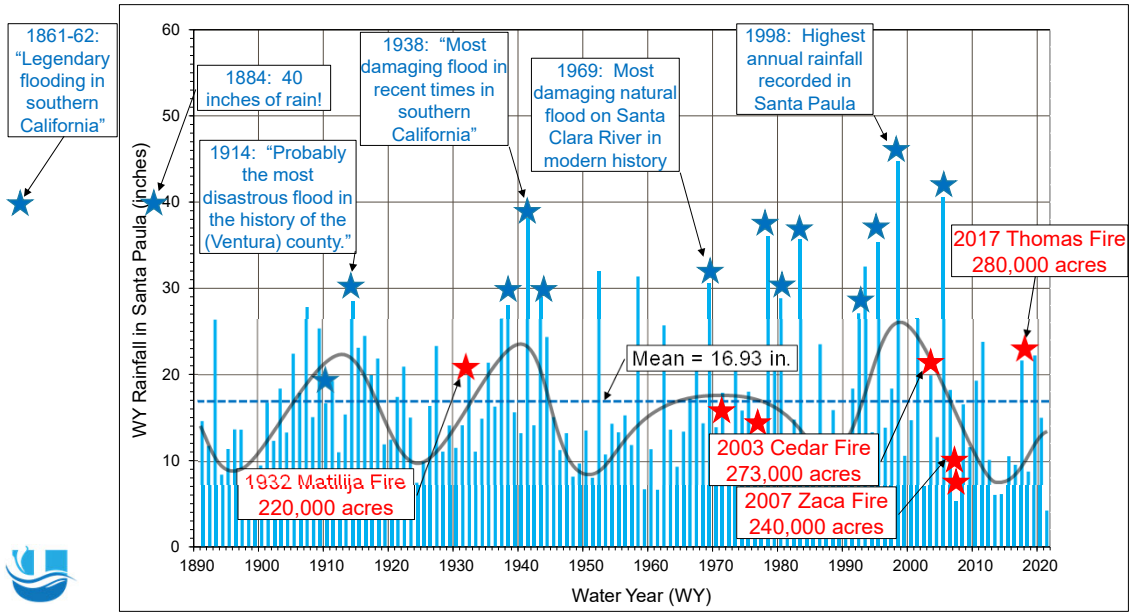
Measured (WY) Rainfall in Santa Paula |1891-2021



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Local Cycles of Dry and Wet Periods Aren't New

"The length of a complete wet and dry period during the time rainfall has been measured and recorded at Santa Paula…is in the order of twenty to thirty years."

Vernon Freeman, "People – Land – Water" (1968)

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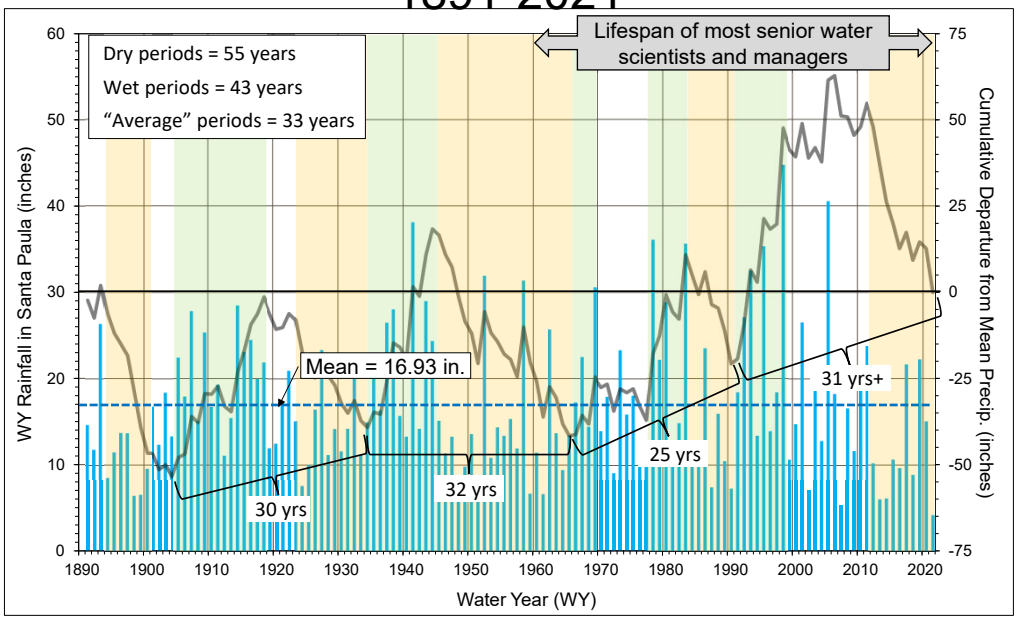
Cumulative Departure from Mean Precipitation 1891-2021



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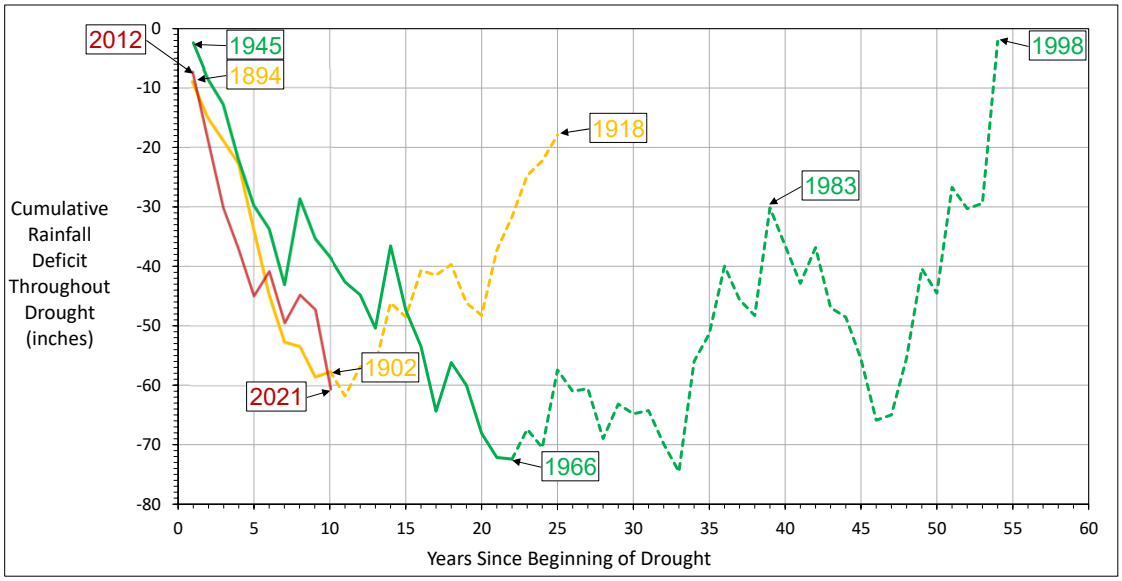
Cumulative Rainfall Deficit During Past Droughts

(based on measured water-year rainfall at Santa Paula, CA, 1891-present)



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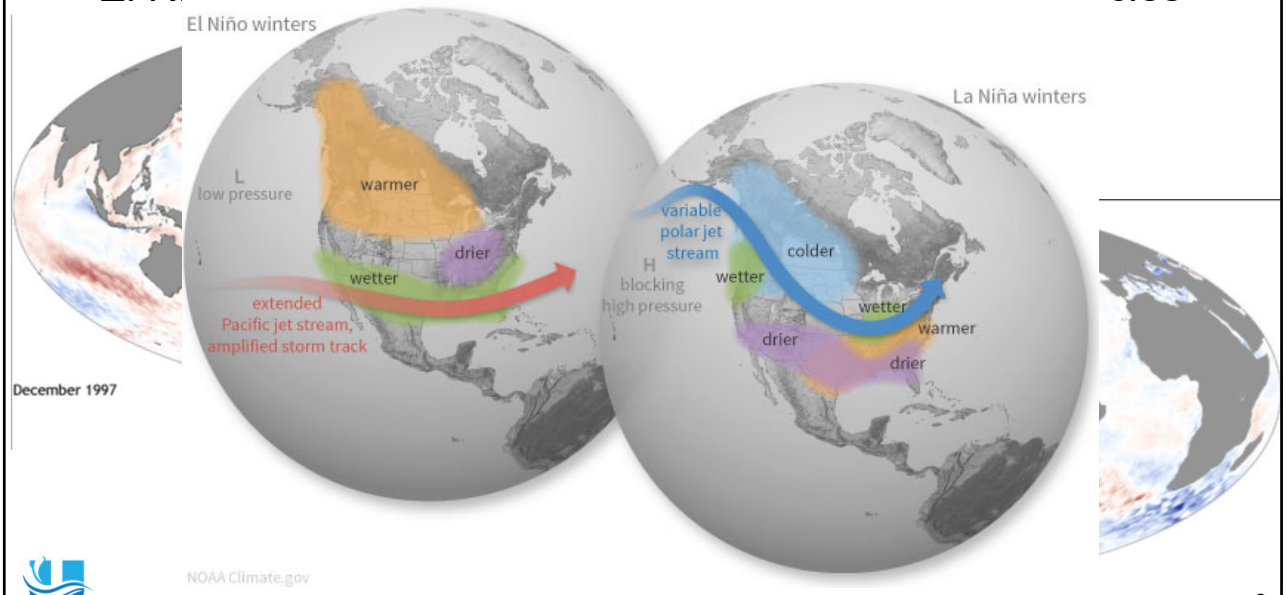
Impacts of El Nino and La Nina on North American Climate, or El Ni... ...cles



(from https://www.climate.gov/enso)

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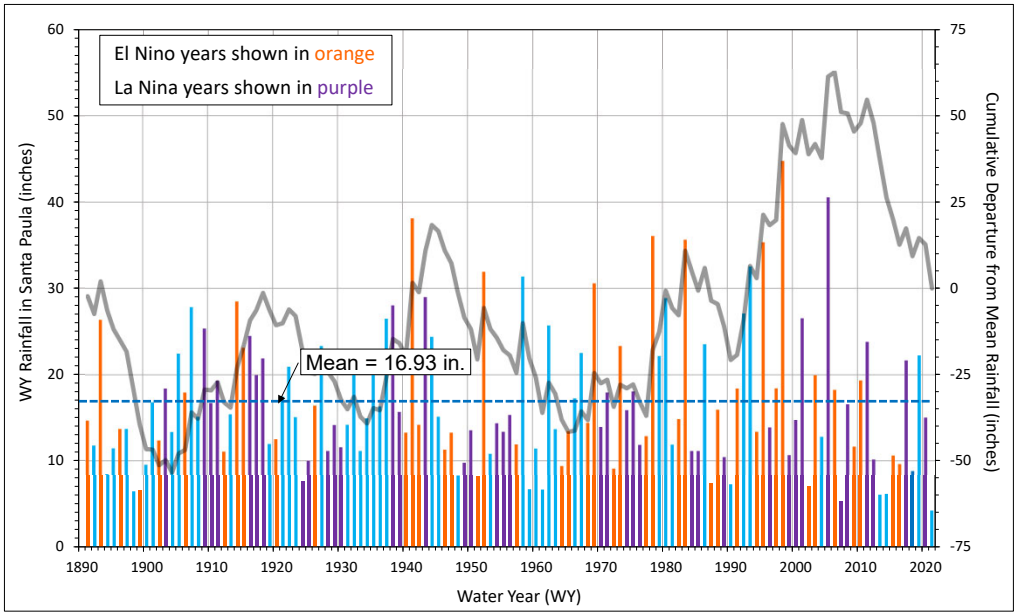
Effects of El Nino and La Nina on Local Rainfall



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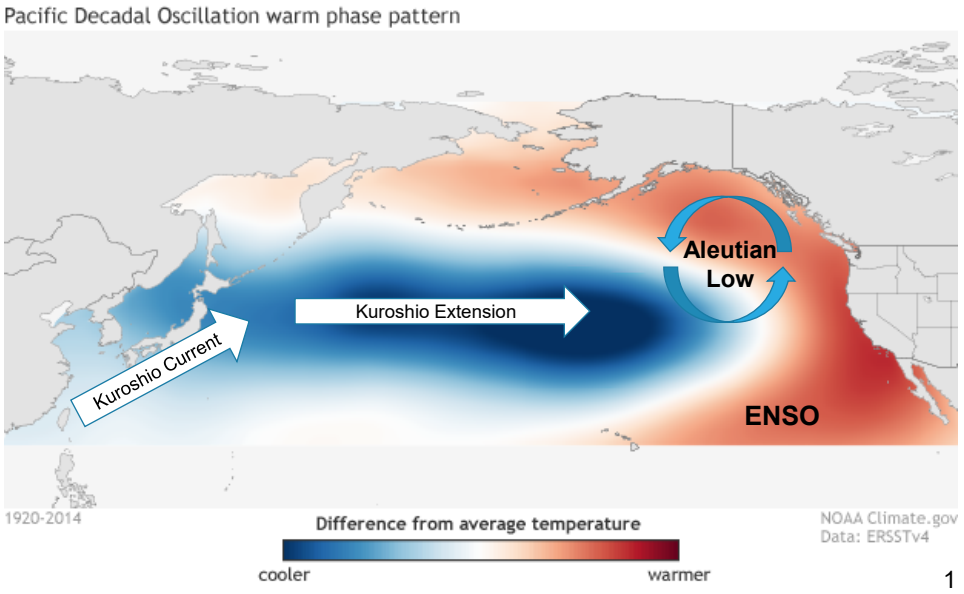
The Pacific Decadal Oscillation (PDO), 20- to 30-Year Cycles

(from https://www.climate.gov/news-features/blogs/enso/going-out-ice-cream-first-date-pacific-decadal-oscillation)

Driven by:

- Intensified Aleutian Low (affects El Nino)
- Re-emergence of sub-surface ocean-temperature anomalies
- Kuroshio Current extension



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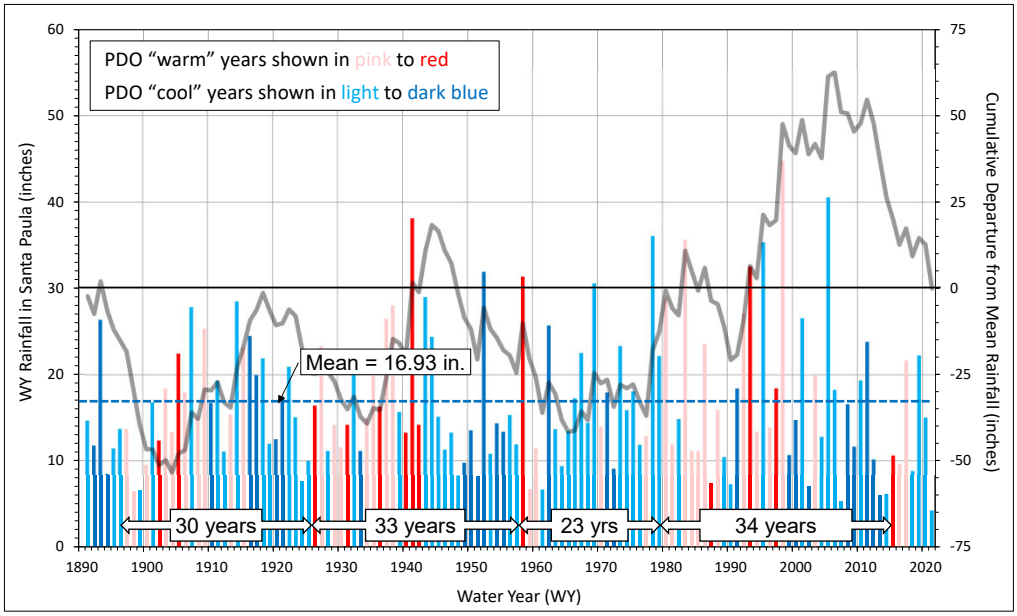
Impacts of PDO Warm and Cool Cycles (20- to 30-years each) on Local Rainfall



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Local Cycles of Dry and Wet Periods Aren't New

"Although the present drought years seem endless and normal to most of our people, the nearly 200 years of California's written history records six wet periods with major floods, which have run their course and were followed by periods of drought."

Vernon Freeman, "People – Land – Water" (1968)

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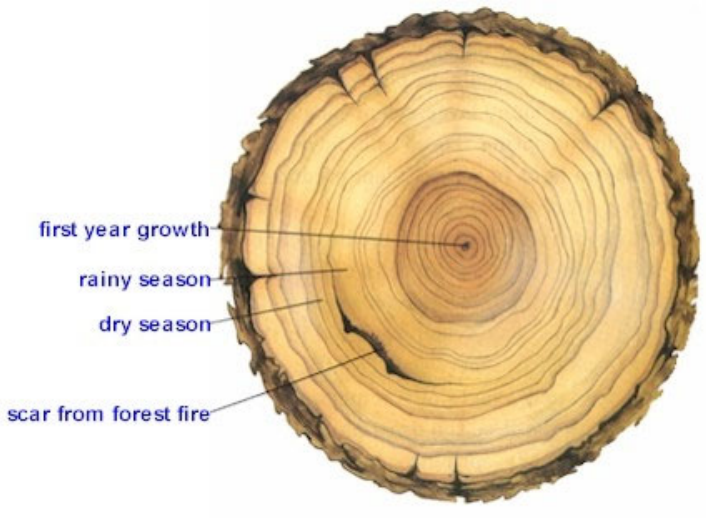

2. A LONGER VIEW (WY 1293-PRESENT)

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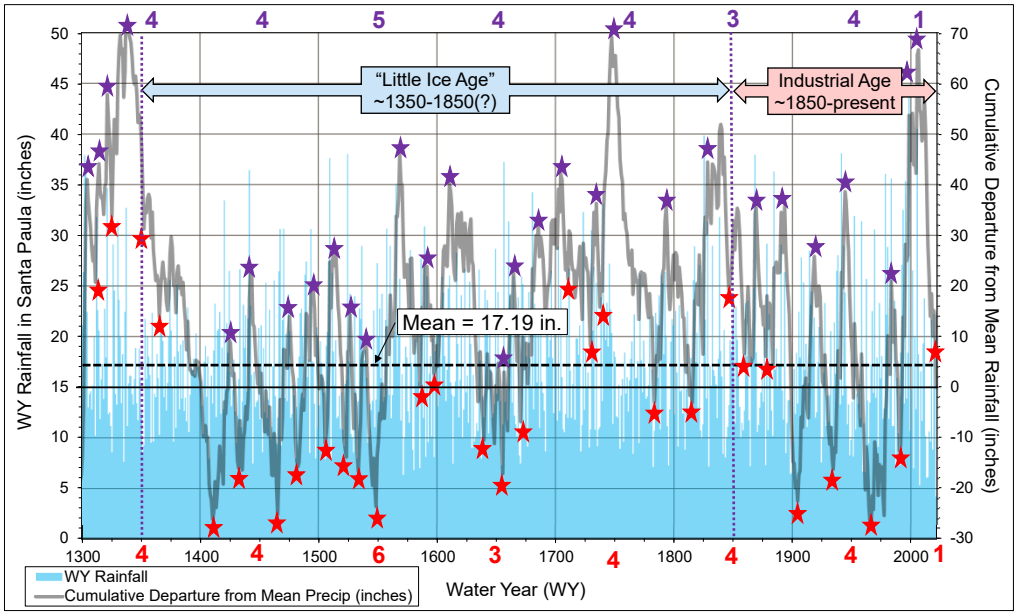
Cumulative Departure from Mean Precipitation, WY 1300-2021



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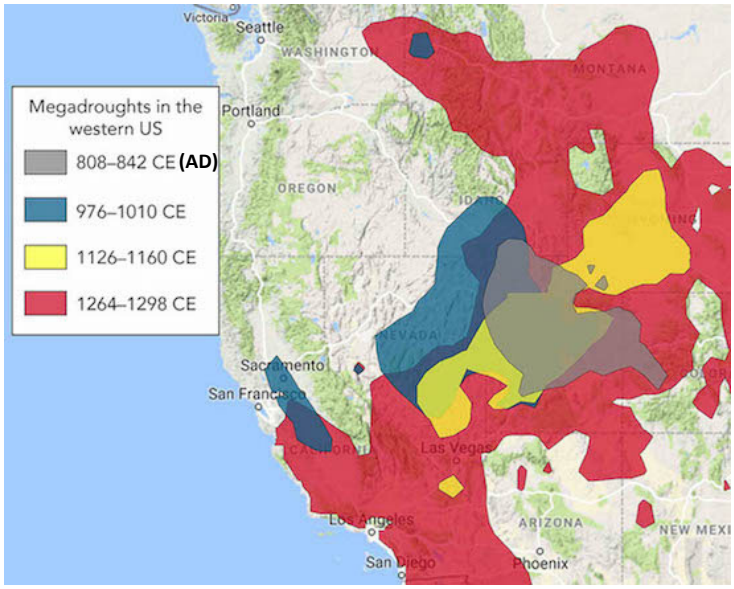
Megadroughts of the Past 1,200 Years
(Ault and St. George, 2018, in the journal Physics Today)



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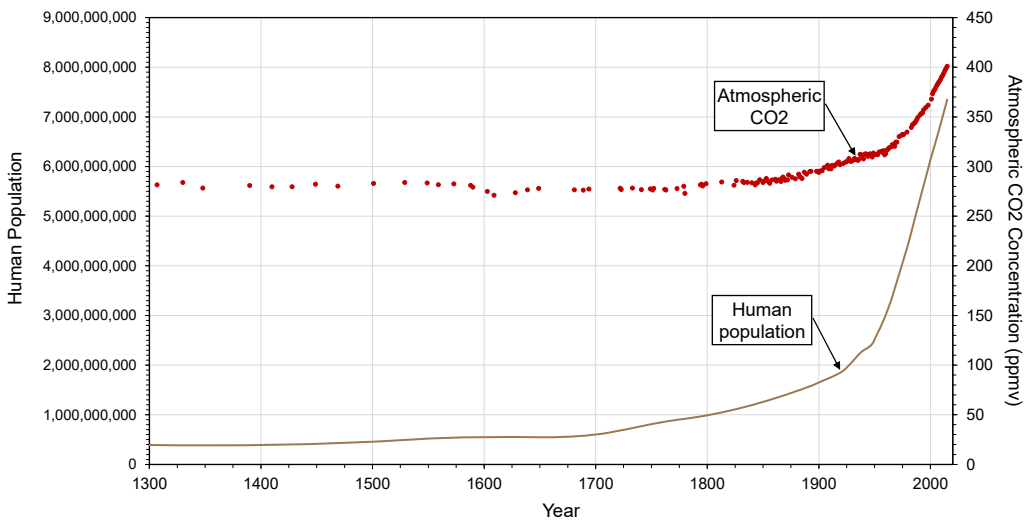

3. WHAT ABOUT ANTHROPOGENIC CLIMATE CHANGE IMPACTS LOCALLY?

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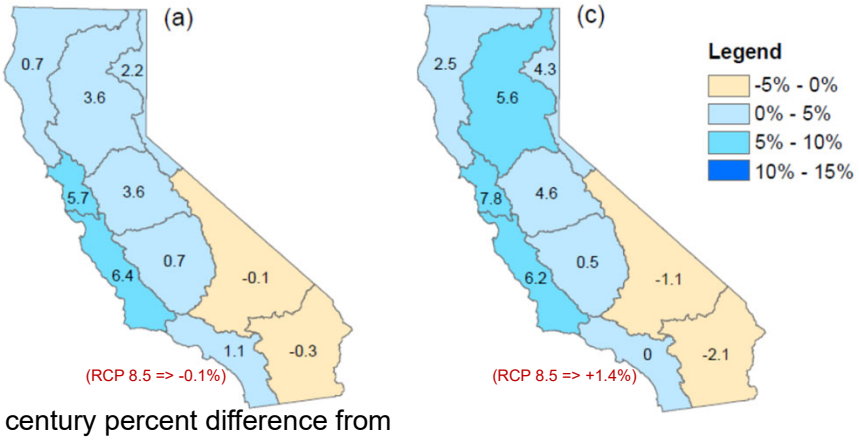
Precipitation-Change Forecasts for Mid- and Late-21st Century

From "California's Fourth Climate Change Assessment" (He and others, 2018)



Mid-21st century percent difference from historical precipitation (mean of representative concentration pathway [RCP] 4.5 projections)

Late-21st century percent difference from historical precipitation (mean of RCP 4.5 projections)

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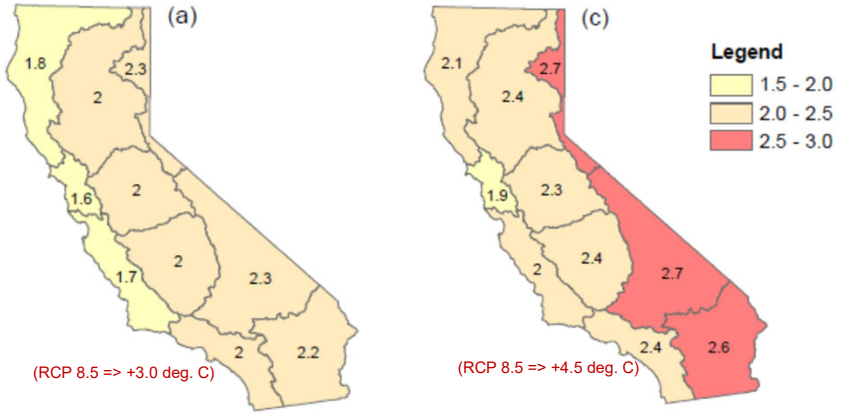
Temperature-Change Forecasts for Mid- and Late-21st Century

From "California's Fourth Climate Change Assessment" (He and others, 2018)



Mid-21st century change from historical max. temp. (mean of RCP 4.5 projections)

Late-21st century change from historical max. temp. (mean of RCP 4.5 projections)

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Runoff Predictions Based on DWR Change Factors

Climate Change Scenario	Sespe Runoff (AF)	Sespe Change	SCR at FMN Runoff (AF)	SCR at FMN Change
None	91,950		215,400	
2030 CF	87,640	-5 %	205,220	-5%
2070 CF	88,850	-3 %	209,200	-3%

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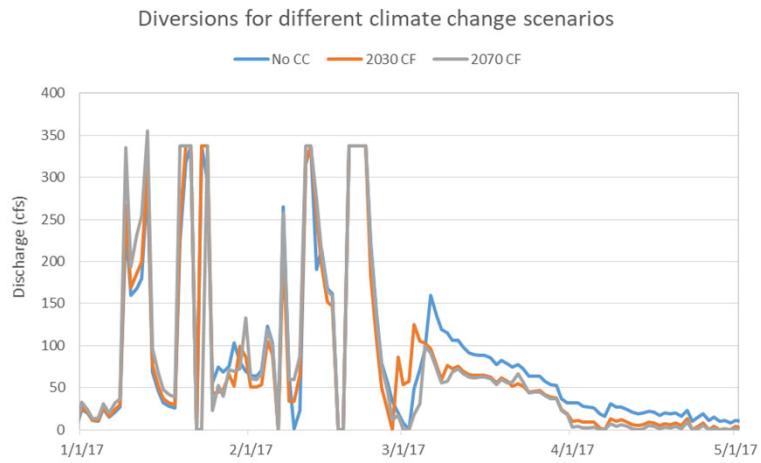
Diversion Predictions Based on DWR Change Factors



Climate Change Scenario	Annual Diversions (AF)*	Change
None	62,938**	
2030 CF	60,809	-3 %
2070 CF	58,994	-6 %

*2021 GSP model runs Mound/Filmore/Piru
**Preliminary results

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Other Key Points about Likely Climate-Change Effects Locally (from Oakley and others, 2019)

1. Winter expected to be slightly wetter, spring and fall expected to be slightly drier
   a) Number of "dry days" (without precipitation) likely to increase
   b) More intense rainfall on remaining "wet days"
   c) Implies larger, but less frequent, stormflows in rivers and streams in Ventura County (not a report conclusion, but consistent with California DWR climate-change forecasts)
2. Overall increase in temperature (seasonal, diurnal, extremes)
   a) Increased evaporation, potentially less runoff/streamflow
   b) Increased demand for water by people and crops

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4. Whatever… Just Tell Me When It's Going to Rain Again

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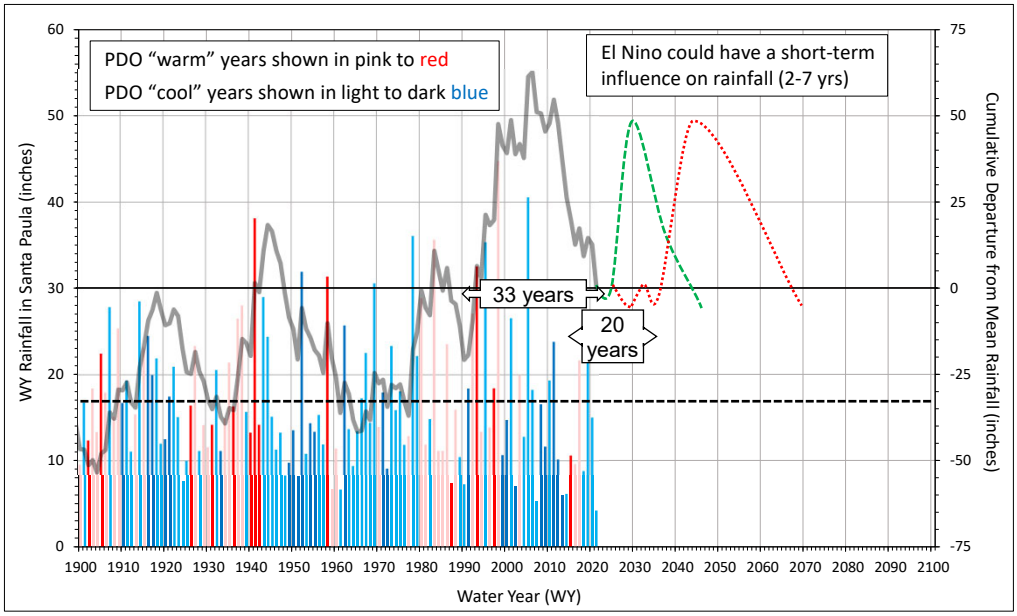
When Will the Next PDO Warm Cycle Arrive?



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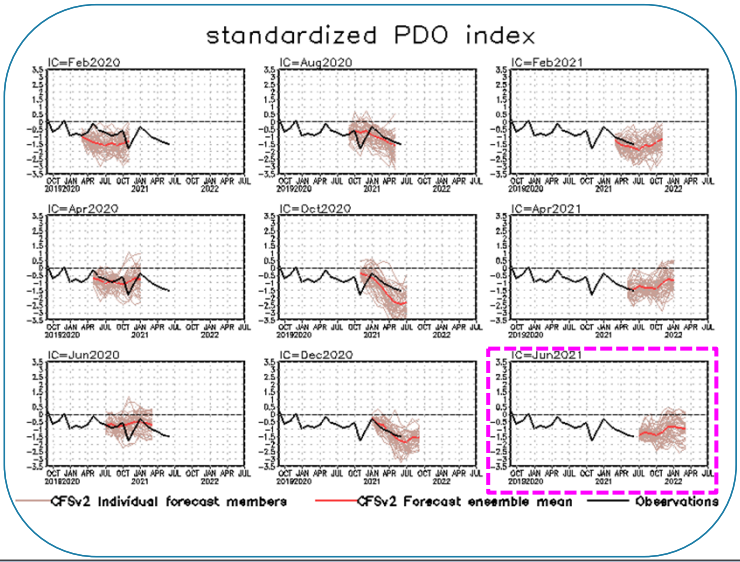
CFSv2 Pacific Decadal Oscillation (PDO) Index Predictions

http://www.cpc.ncep.noaa.gov/products/GODAS/



- CFSv2 predicts a negative phase of PDO in the coming seasons.

CFS Pacific Decadal Oscillation (PDO) index predictions from the latest 9 initial months. Displayed are 40 forecast members (brown) made four times per day initialized from the last 10 days of the initial month (labelled as IC=MonthYear) as well as ensemble mean (blue) and observations (black). Anomalies were computed with respect to the 1991-2020 base period means. PDO is the first EOF of monthly ERSSTv3b anomaly in the region of [110°E-100°W, 20°N-60°N]. CFS PDO index is the standardized projection of CFS SST forecast anomalies onto the PDO EOF pattern.

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In Summary

The past 10 to 20 years have been rough:

- Following the wettest decade in recorded history (1990s), we had an average decade (2000s) and then a very dry decade (2010s)
  - Extreme dry years in 2002, 2007, 2013, 2014, 2018, and 2021
- Not surprisingly, we've also seen major wildfires in the past 10 years

The 2000s and most of the 2010s coincided with a PDO cool phase:

- Drier conditions consistent with historical climate cycles
- ***However***—Most climate scientists now recognize some degree of amplification of the impacts of the PDO, ENSO, and other ocean/atmosphere circulation cycles resulting from anthropogenic climate change

We likely will enter a warm (and wet) PDO phase sometime in the next decade (or two?)

- Be prepared for further "amplification" and uncertainty

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Questions?

"It never rains in California
But girl, don't they warn ya?
It pours, man, it pours"

--Albert Hammond, 1972

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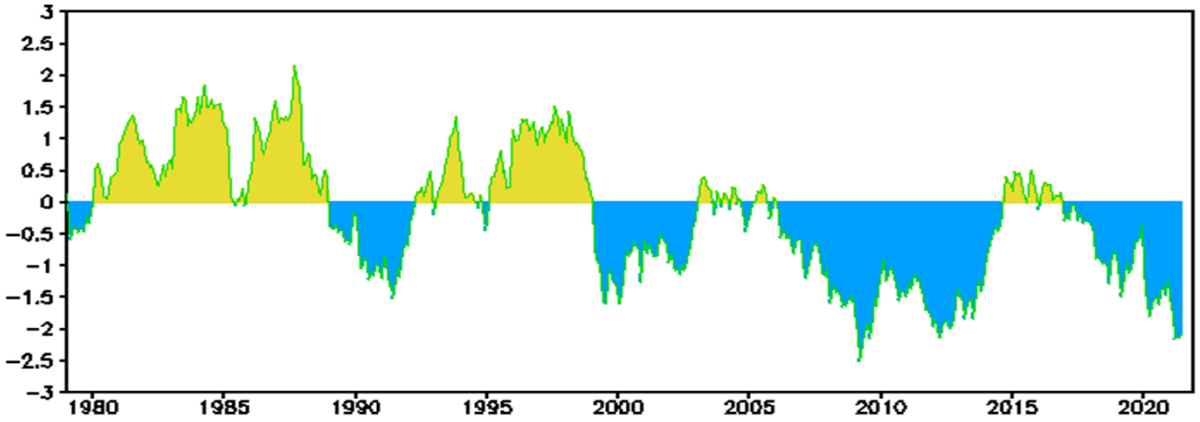
Where are We in the Current PDO Cycle?

H300-based PDO (Arun and Wen 2016:Mon.Wea.Rev.)



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