

Overview of US West Coast Observations: Radiosondes and Ground-Based Hydrometeorological Networks

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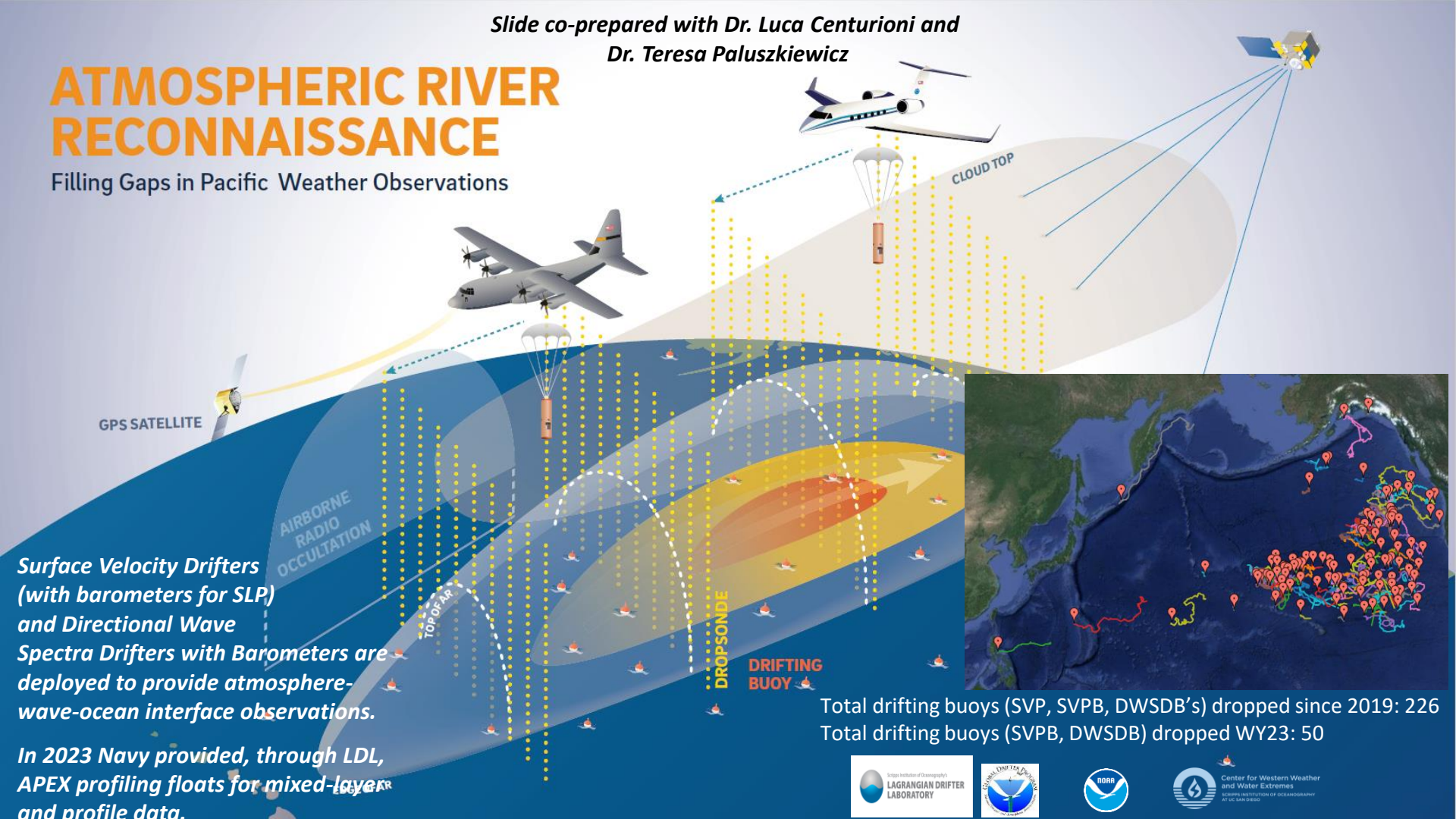
27 June 2023

Atmospheric River Reconnaissance Workshop

Slide co-prepared with Dr. Luca Centurioni and
Dr. Teresa Paluszkiwicz

ATMOSPHERIC RIVER RECONNAISSANCE

Filling Gaps in Pacific Weather Observations



GPS SATELLITE

AIRBORNE
RADIO
OCCULTATION

CLOUD TOP

TOP OF AIR

DROPSONDE

DRIFTING
BUOY

*Surface Velocity Drifters
(with barometers for SLP)
and Directional Wave
Spectra Drifters with Barometers are
deployed to provide atmosphere-
wave-ocean interface observations.*

*In 2023 Navy provided, through LDL,
APEX profiling floats for mixed-layer
and profile data.*

Total drifting buoys (SVP, SVPB, DWSDB's) dropped since 2019: 226
Total drifting buoys (SVPB, DWSDB) dropped WY23: 50



Center for Western Weather
and Water Extremes
NATIONAL INSTITUTE OF OCEANOGRAPHY
AT UC SAN DIEGO

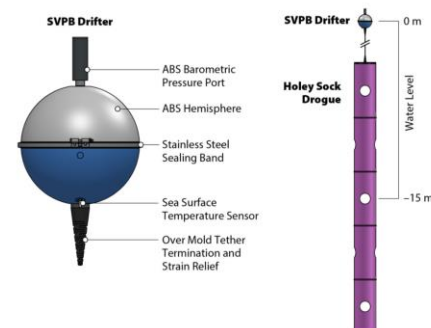
History of CW3E/LDL Drifting Buoy Deployments

Water Year	SVP-B - Air	DWS-B - Air	SVP-B – Ship	DWS-B - Ship
2019 – NE Pac	32	0	0	0
2020 – NE Pac	16	8	32	8
2021 – NE Pac	20	10	0	0
2022 - NE Pac	20	10	20	6
2023 – NE/NW Pac	40	10	0	0
2024 and on – <i>proposed – NE Pac</i>	20	10	28	6
2024 and on – <i>proposed – NW Pac</i>	20	10	28	6

2024 will be the sixth year in a row with buoy deployment collaboration between NOAA's Global Drifter Program (*PI: Luca Centurioni*), Scripps/CW3E AR Recon (*PI: Marty Ralph*) with planning support from the AR Recon Modeling and DA Steering Committee (*Scripps/CW3E, NCEP, ECMWF, NRL, NCAR, CU Boulder*)

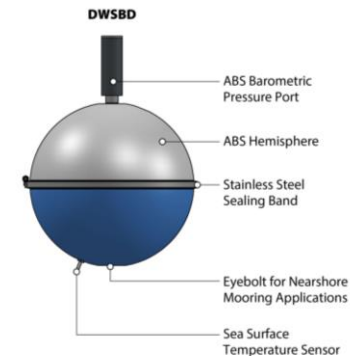
SURFACE VELOCITY PROGRAM BAROMETER (SVPB) DRIFTER

- Sea surface temperature
- Sea level barometric pressure



DIRECTIONAL WAVE SPECTRA BAROMETER DRIFTER (DWSBD)TM

- Sea surface temperature
- Sea level barometric pressure
- Wave spectra



Partnerships

- Drifters (Dr. Luca Centurioni, PI, Global Drifter Program): Data impact studies will be highlighted tomorrow
- Airborne Radio Occultation, (Dr. Jennifer Haase, PI): Will be highlighted in talks today and tomorrow

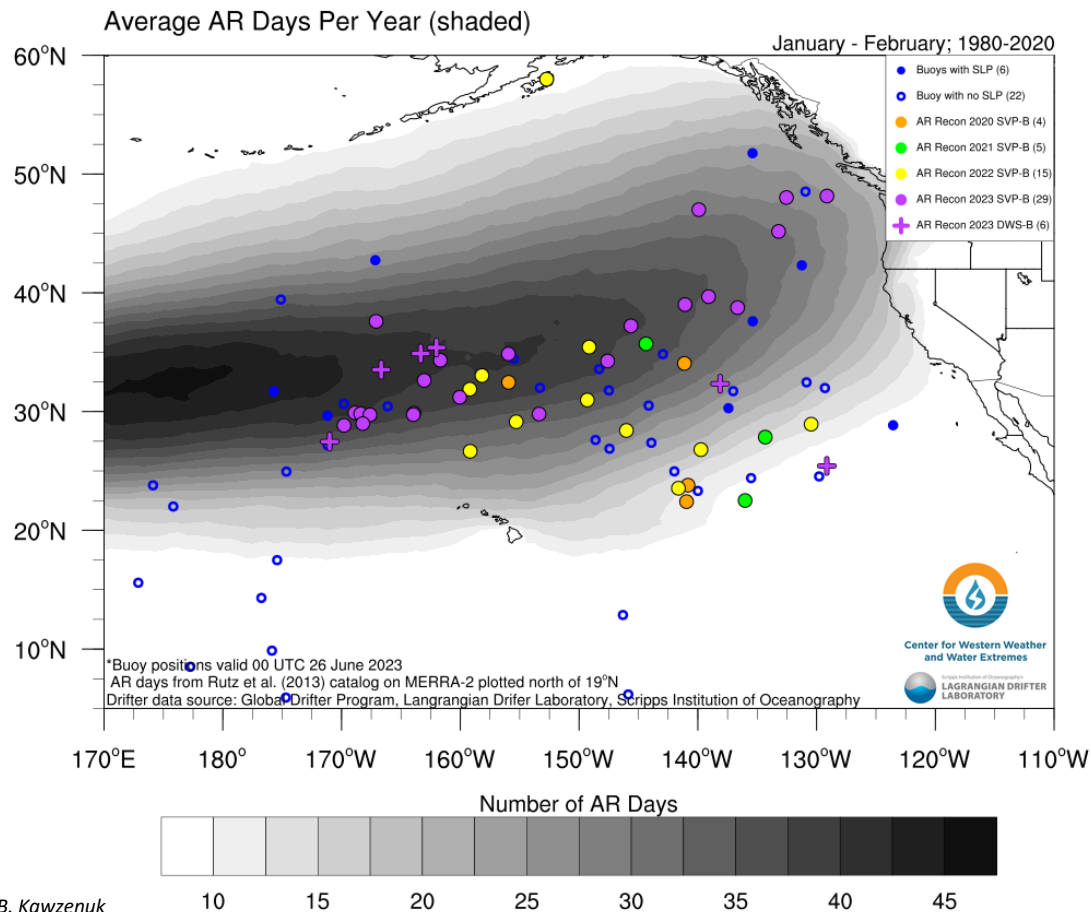


Figure provided by B. Kawzenuk

Radiosondes

- USACE-funded Forecast Informed Reservoir Operations enables CW3E to conduct storm sampling campaigns: radiosondes from 4 locations in CA simultaneously during storms, at least every 3 hours throughout storm conditions
- 400 radiosondes released this season
- New locations in Washington, with USACE and Tacoma Water, planned for next season

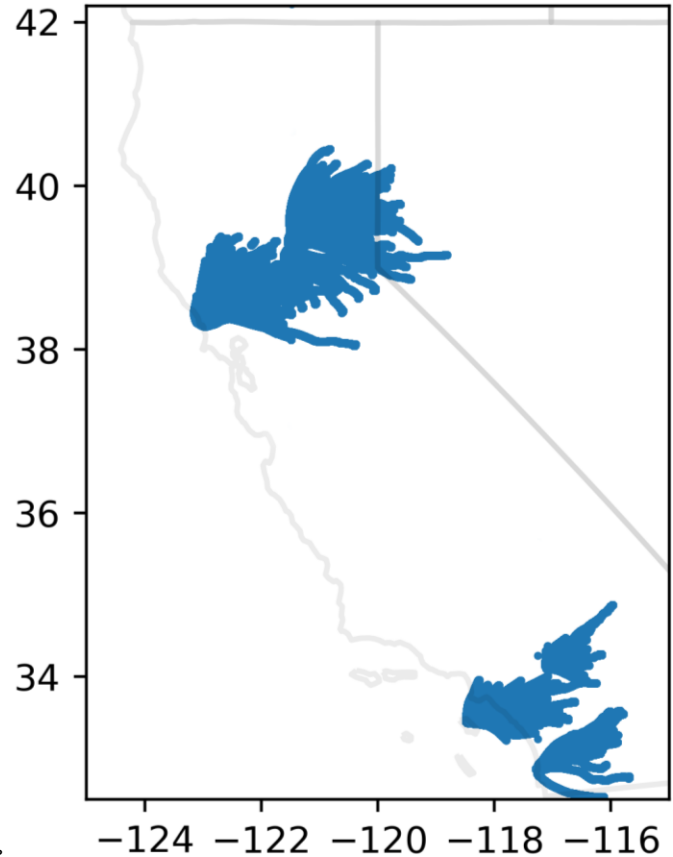
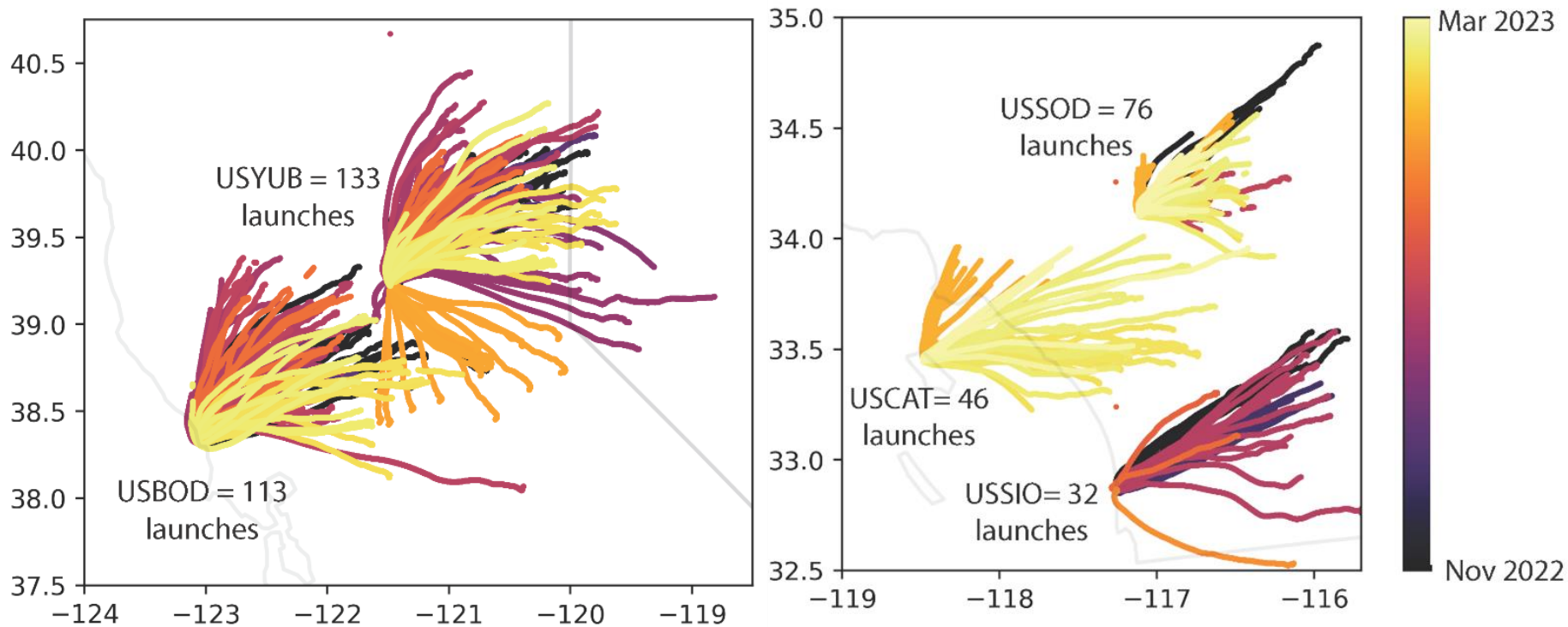


Figure provided by E. Knappe

Radiosondes



Figures provided by E. Knappe

CA'S FOUNDATIONAL STATEWIDE OBSERVATION NETWORK

AROs ~250km apart: all impactful ARs hitting the west coast will be sampled with this “picket fence” approach

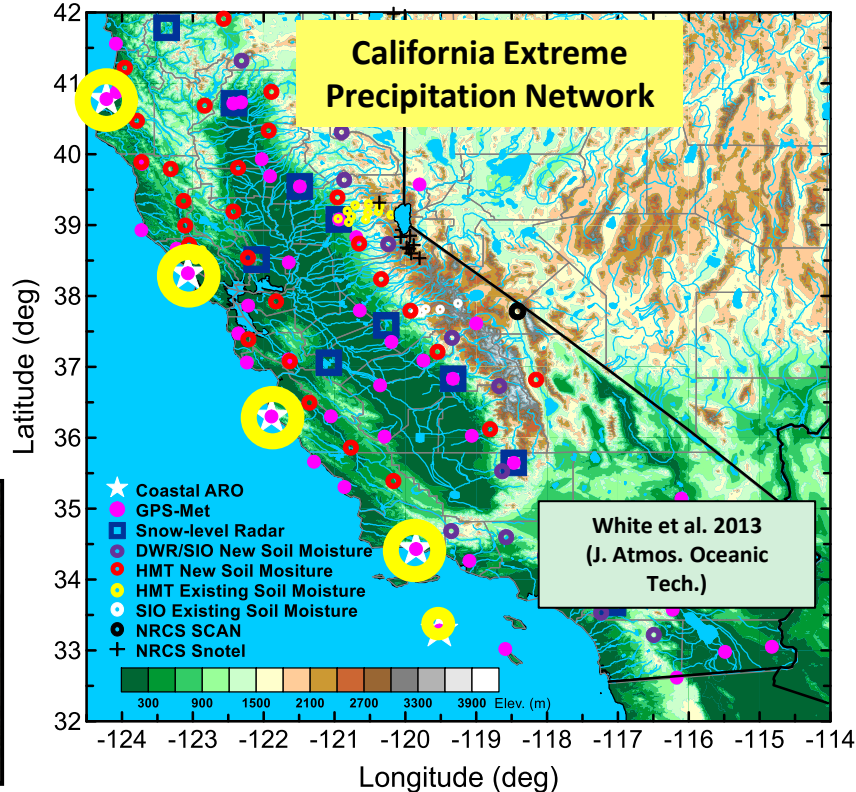
Hourly Obs: can pinpoint start & end times, peak



GPS receiver for integrated water vapor



Soil Moisture and Temperature Probes



An Atmospheric River-focused long-term observing network was installed in CA as part of a 5-year project between CA Dept. of Water Resources (DWR), NOAA and Scripps Inst. Of Oceanography

- Installed 2008-2014
- >100 field sites



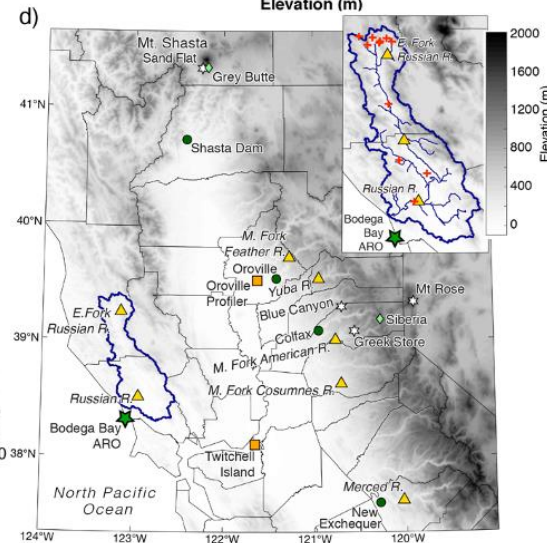
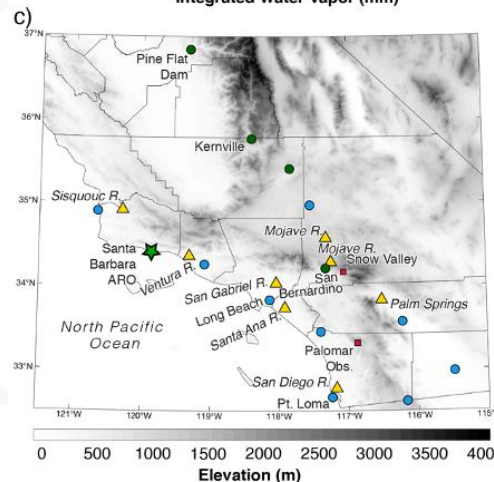
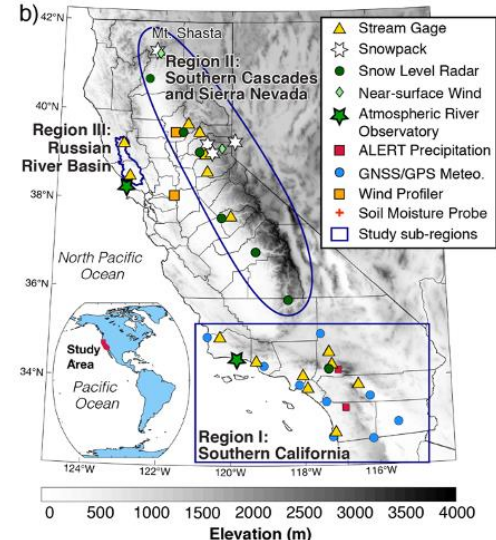
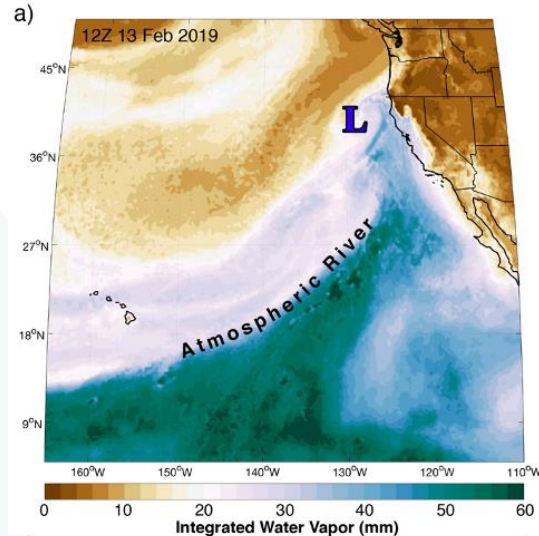
1/4-scale 449-MHz wind profiler with RASS



FM-CW snow-level radar

CA'S FOUNDATIONAL STATEWIDE OBSERVATION NETWORK

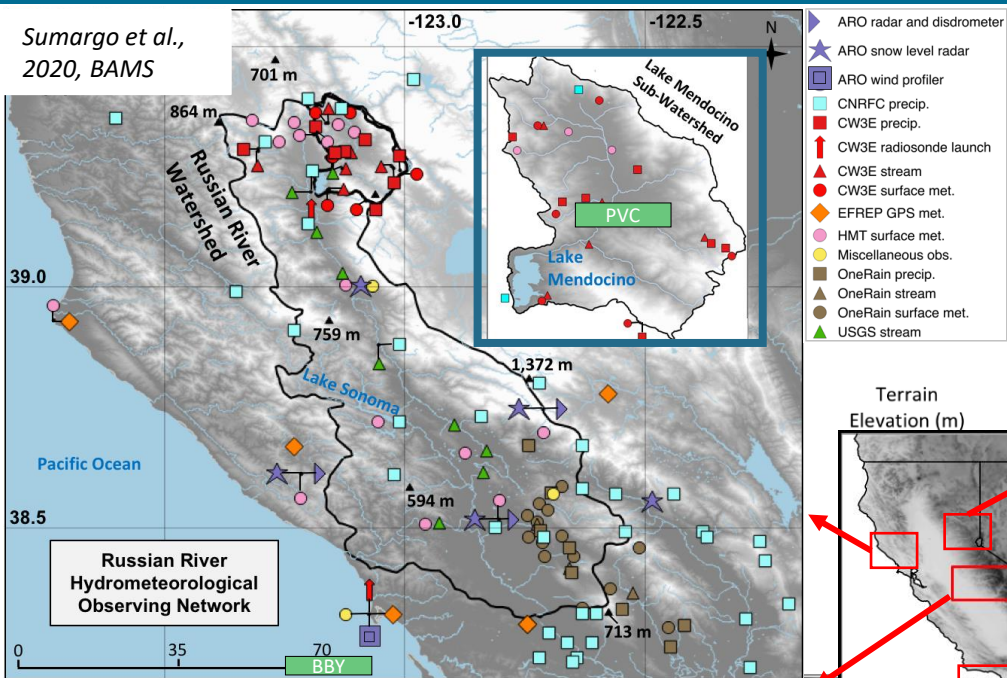
- Effective at storm scale (e.g., Feb 2019 Valentine's Day event) and monitoring at seasonal, annual, climate scales
- Storm Scale: Network able to validate record precipitable water and detect key mesoscale atmospheric processes driving flood, snowfall, and mass wasting events
- Diverse, high frequency observational networks are valuable investments for water resource management and natural hazard mitigation, especially in context of a changing climate: California agencies support a foundational onshore climate network



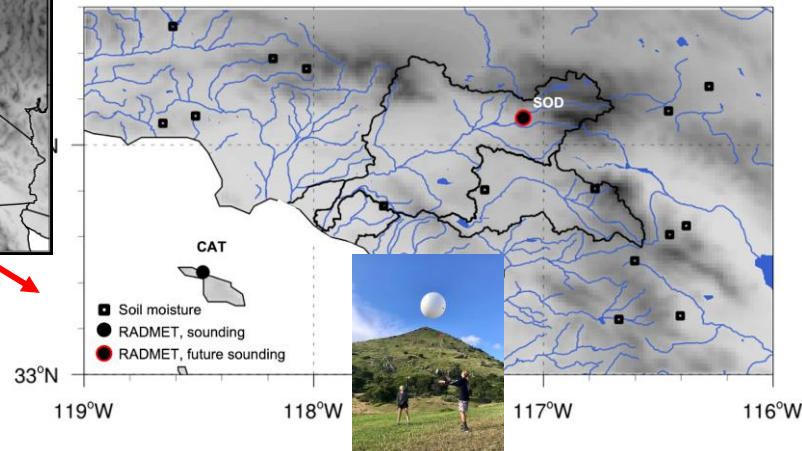
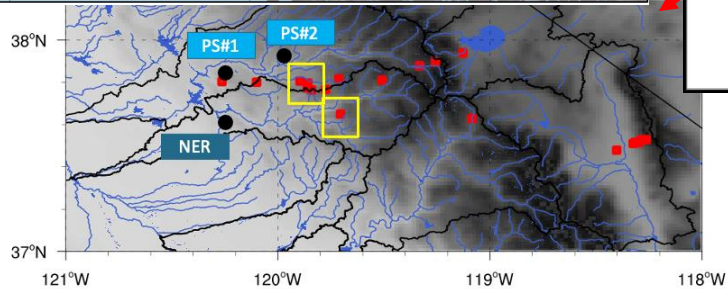
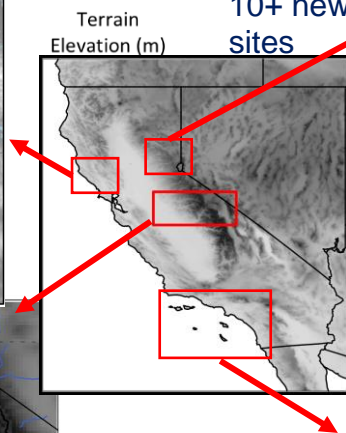
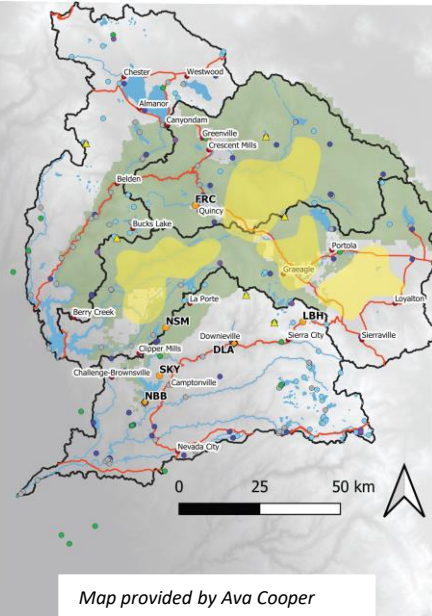
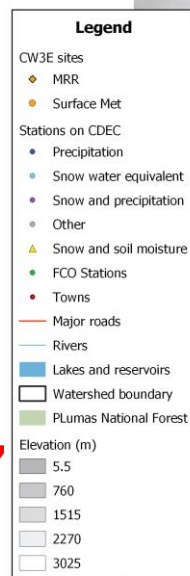
Hatchett et al., 2020: Observations of an extreme atmospheric river storm with a diverse sensor network. *Earth and Space Sciences*.

CW3E IN SITU OBSERVATIONS

Sumargo et al.,
2020, BAMS

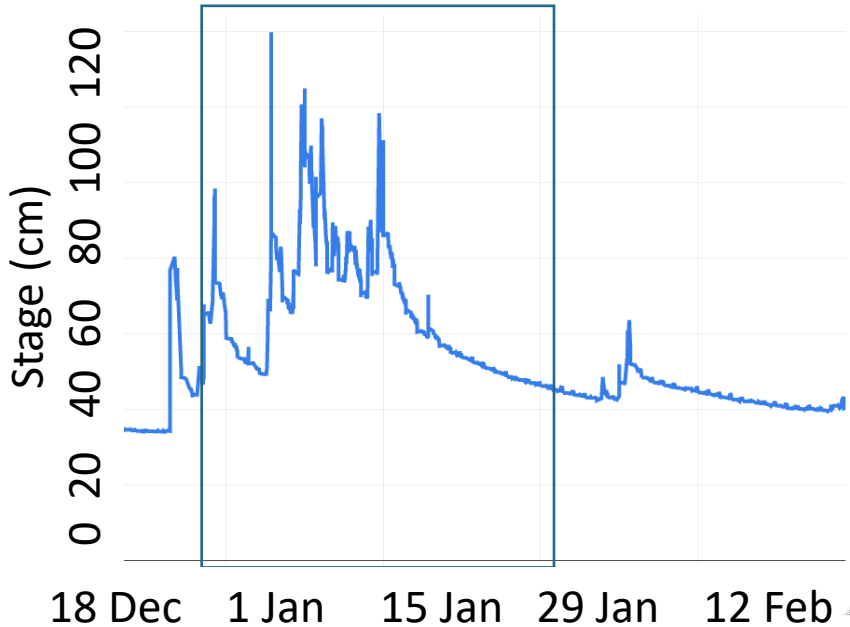
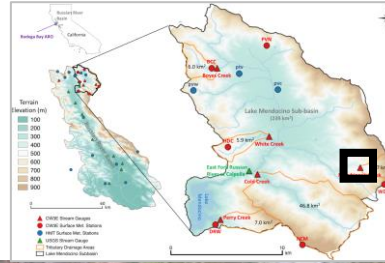


Current:
operating >60 sites in 10 California (CA) watersheds
Within this year:
expanding into additional CA, Colorado and Washington watersheds, 10+ new sites



Stream Sampling – AR Impacts

Mewhinney Creek – Water Year 2023



Graph and video provided by G. McGurk

Soil Moisture Sites

Russian River currently has a 6 year period of record (installations summer/fall 2017)

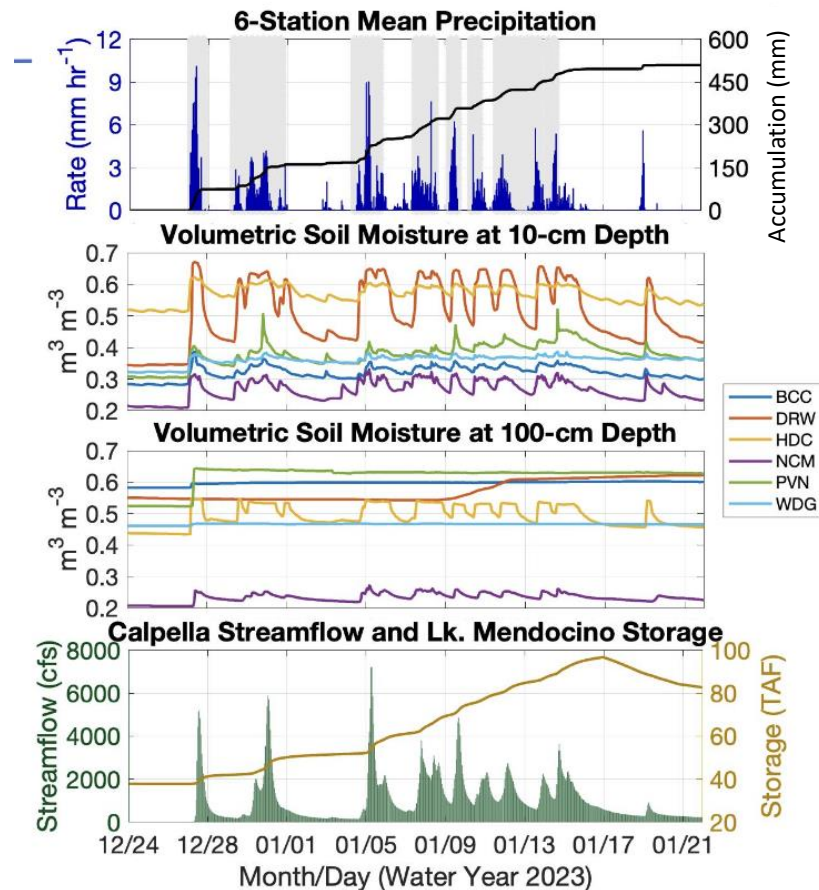
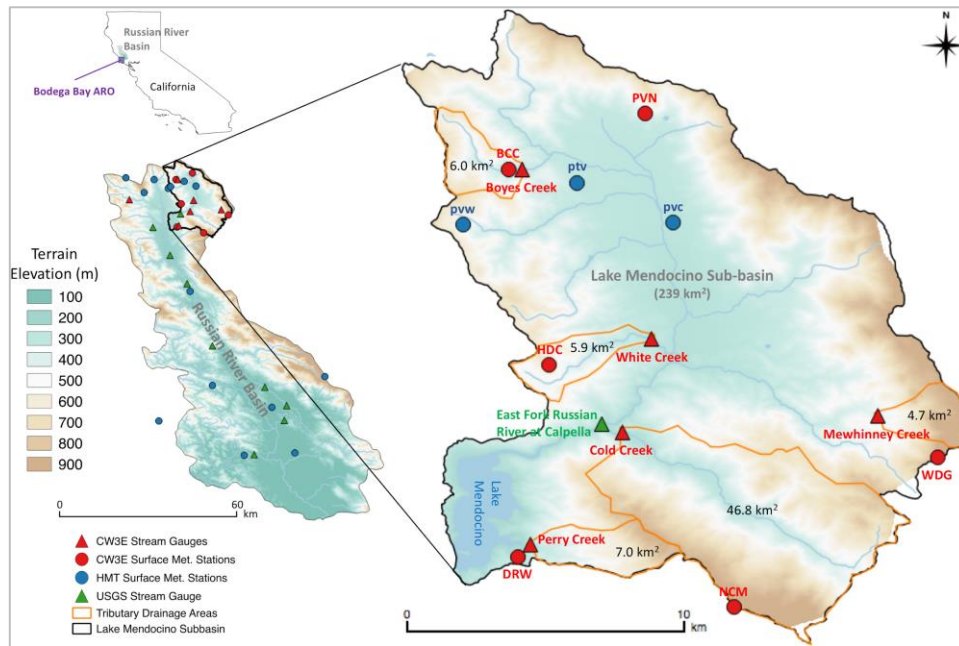
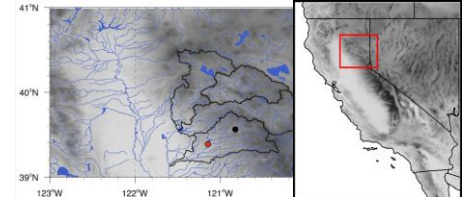


Figure provided by E. Sumargo

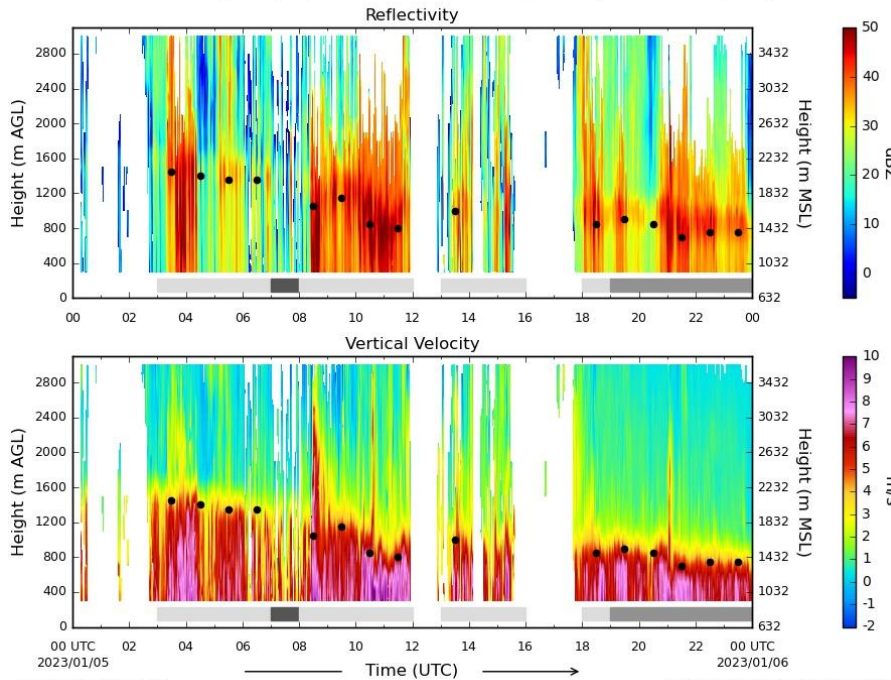
Gray shading denotes the AR event periods.

Vertically Pointing Radar Sites



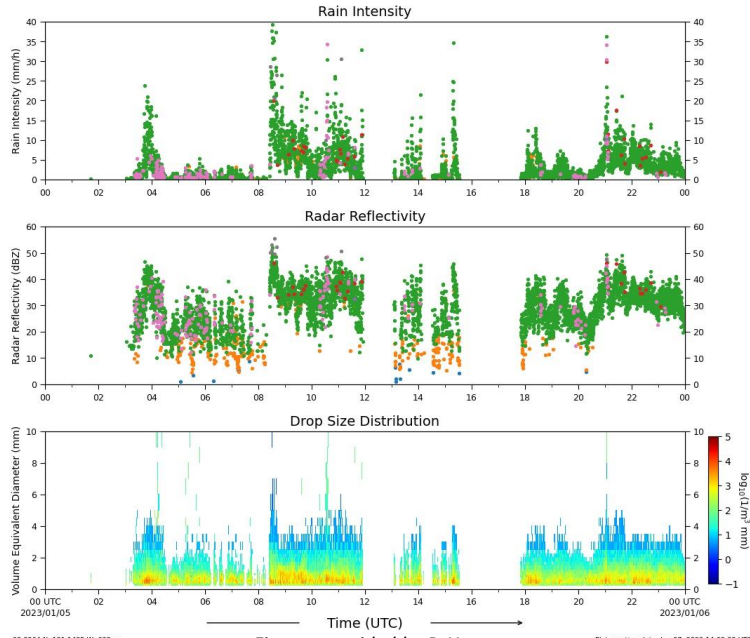
New Bullards Bar MRR: January 05, 2023 UTC

● BB Height ■ BB ■ Hybrid ■ NBB



New Bullards Bar (NBB) Disdrometer: January 05, 2023 UTC

■ Drizzle ■ Rain ■ Snow ■ Soft hail
 ■ Drizzle with rain ■ Rain, drizzle with snow ■ Snow grains ■ Hail



39.3964 N, 121.1435 W, 632 m

Plot creation date: Jan 07, 2023 14:13:38 UTC

39.3964 N, 121.1435 W, 632 m

Plot creation date: Jan 07, 2023 14:02:02 UTC

Figures provided by P. Yao

Wind Profilers

- Partnering with San Diego Gas & Electric, NWS
- Will be part of National Mesonet Program



UCSD Biology Field Station: 915 MHz Radar Wind Profiler

32.89°N, 117.23°W

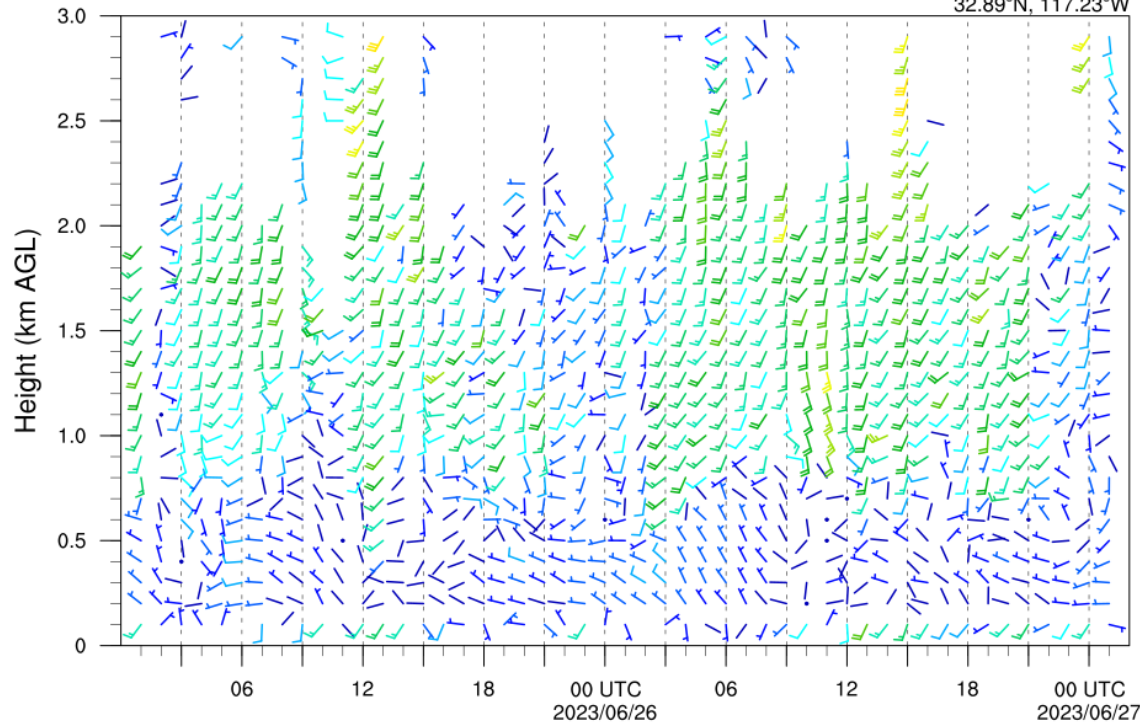
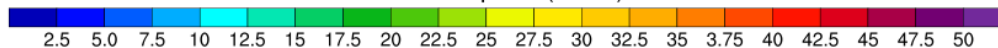


Figure provided by B. Kawzenuk

Time (UTC, PDT +7 hours)

Wind Speed (knots)



Summary – Future Work

- Partner to conduct science studies on ARs and their impacts once they make landfall, as well as the offshore work
- Data assimilation studies and tests will be ongoing, starting with radiosondes and drifters
- Expansion: WA, CO, other sensor types
- What else should we be thinking about?



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