Levee hazards from earthquakes and high water

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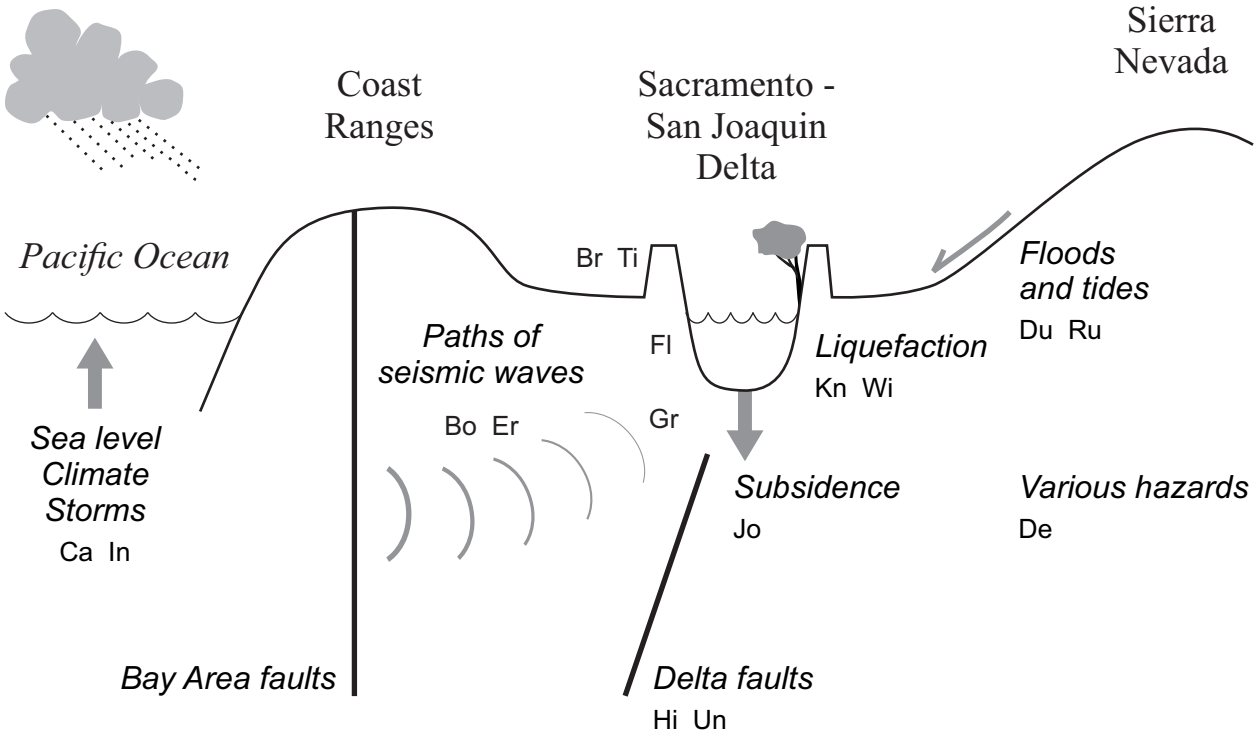

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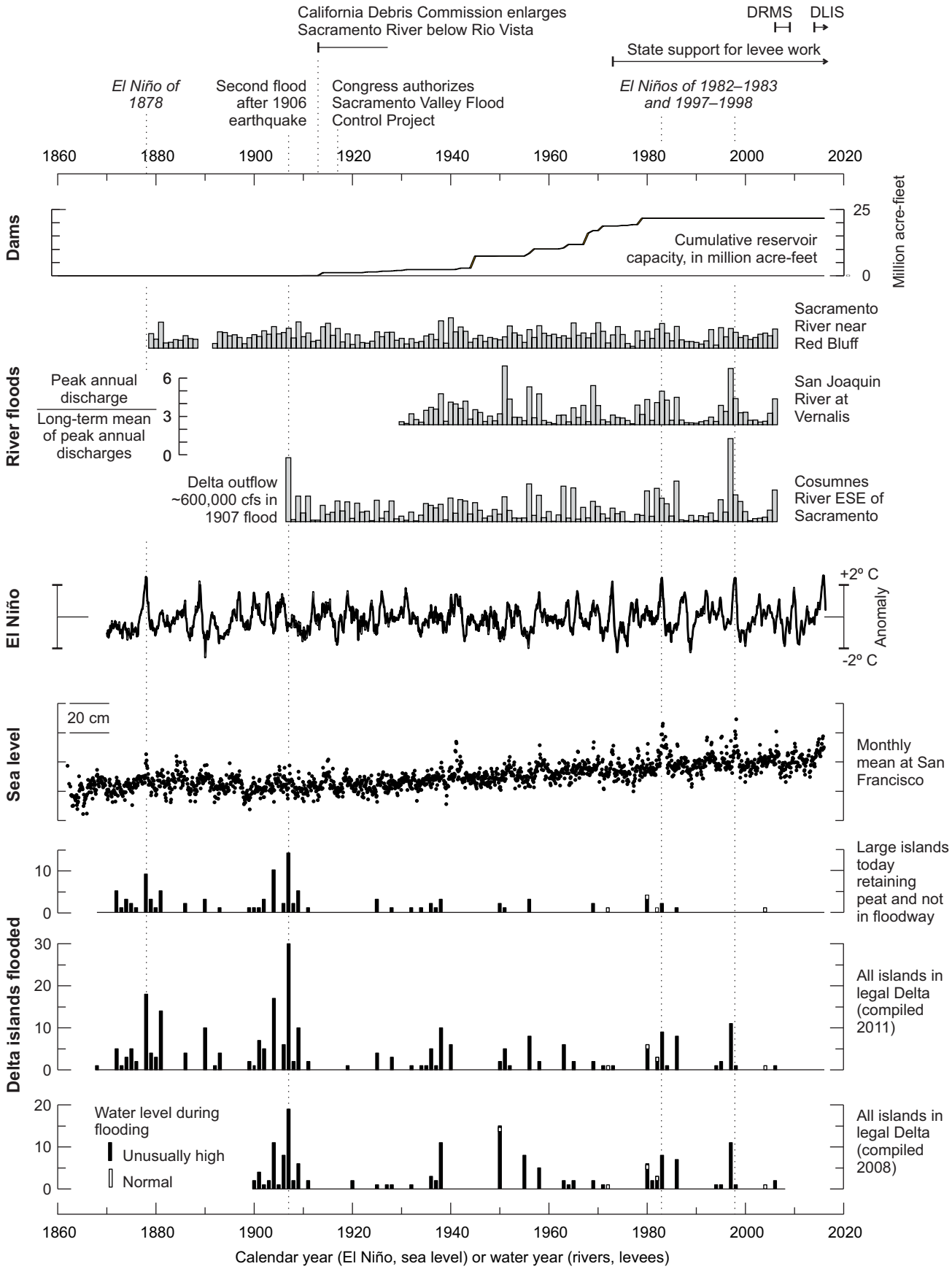
"The past is no longer a guide to the future of the Delta"



Sources for historical graphs prepared for the Delta Independent Science Board's meeting of July 14, 2016 on Delta levee science

Headnotes

Moore and Shlemon (2008, p. 117) stated that "The past is no longer a guide to the future of the Delta."

"[T]he major El Niño events of 1878, 1982/83, and 1997/98" were called out by Trenberth and Stepaniak (2001, p. 1698) in reference to their graph of the El Niño indicator cited below (Niño 3.4).

The second large Delta flood after the April 1906 earthquake took place in March 1907 (discharge cited below). A prior post-earthquake flood occurred in June and July 1906. Levees reportedly failed at Union Island (6/25); Venice Island, Twitchell Island, and Sherman Island (7/9); and Upper Jones Tract (7/11) (Hopf, 2011, p. 279-280, 367). In addition, flood fights were reported from Clifton Court (7/17), Fabian Tract (7/9) and from Lower Roberts Island, Victoria Island, Woodward Island, and Lower Jones Tract (7/10) (Hopf, 2011, p. 389). The central Sierra Nevada received above-average snowfall in the winter of 1906 (Central Sierra Snow Laboratory, 2015; Curry, 1969, p. 28).

On early 20th-century enlargement of the Sacramento River below Rio Vista and congressional authorization of comprehensive flood-control works, see Kelley (1989) and James and Singer (2008). The work below Rio Vista, including a dredged cut across Horseshoe Bend, was 80 percent complete in 1927 (Kelley, 1989, p. 300).

A recent review of Delta levee issues recounts the history of state support for Delta levee maintenance and upgrades (Delta Stewardship Council staff, 2015, p. 36-43). DRMS, Delta Risk Management Study (California Department of Water Resources, 2009; URS Corporation and Jack R. Benjamin & Associates Inc., 2011). DLIS, Delta Levee Investment Strategy.

Dams

The graph of reservoir capacity in the watershed of the Sacramento – San Joaquin Delta is based on Table 2-2 of MacDonald et al. (2008).

River floods

The dimensionless flood flows are redrawn from Florsheim and Dettinger (2007). The measurements were made at USGS gauges 11377100 (Sacramento River at Bend Bridge), 11303500 (San Joaquin River at Vernalis), and 11335000 (Cosumnes River at Michigan Bar). The discharge estimate for the 1907 flood is from Kelley (1989, p. 277, a secondary source).

El Niño

The graph shows Niño 3.4, a tropical sea-surface temperature anomaly averaged across the equatorial Pacific east of the International Date Line (Trenberth and Stepaniak, 2001). The data source is Working Group on Surface Pressure (2015). The compilation there includes historical data from Rayner et al. (2003), who provide "monthly globally complete fields of SST and sea ice concentration on a 1° latitude-longitude grid from 1871."

Sea level

Monthly data from National Oceanic and Atmospheric Administration (2016). The plot ignores an "apparent datum shift" in 1897.

Island flooding

The histograms of island flooding compare two compilations (bottom, middle) and show the further effects of limiting the history plotted to the large, mainly central Delta islands where peat is still present (upper). The term "island" here refers also to places called "tracts."

The *bottom histogram* is from the list of island flooding since 1900 in Salah-Mars et al. (2008, Tables 4-1 and 4-2). The graph shows all events listed except for some in Suisun Marsh that are outside the legal Delta.

The *middle histogram* show revisions by Hopf (2011). It depicts all the failures reported in his complete list of island flooding in the legal Delta (in his Appendix Q, p. 389-391).

The *upper histogram* may pertain more directly to hazards from peat that both underlies and adjoins Delta levees—a topic of several of the presentations at the July 14, 2016 meeting.

- The data source is the same as in the middle histogram, but the islands are limited to those meeting all four of these criteria:
    1. Remain subject to interior subsidence, as judged from peaty deposits mapped most recently about four decades ago (Atwater, 1982; Deverel and Leighton, 2010, Fig. 1);
    2. Are not completely fringed by mapped natural-levee deposits—a criterion that excludes Pierson Tract (southeast of Courtland);
    3. Cover about 150 hectares or more, thereby excluding Fay Island, Little Mandeville Island, and Little Franks Tract—all thought to contain "very little farmable area, particularly on a per mile of levee basis" (Hopf, 2011, p. 269)
    4. Are outside the floodways of Yolo Bypass and of the Mokelumne River and Cosumnes River, where levees are restricted in height according to Hopf (2011, p. 266-268). This criterion excludes Liberty Island, Prospect Island, and McCormack-Williamson Tract.
- Islands and tracts thus included: Andrus Island, Bacon Island, Bethel Island, Big Break, Bouldin Island, Brack Tract, Bradford Island, Brannan Island, Canal Tract, Donlon Island, Empire Tract, Frank's Tract, Grand Island, Holland Tract, Jersey Island, Lower Jones Tract, Lower Roberts Island, Mandeville Island, McDonald Island, Medford Island, Mildred Island, Palm Tract, Quimby Island, Rindge Tract, Sherman Island, Staten Island, Terminous Tract, Twitchell Island, Tyler Island, Upper Jones Tract, Venice Island, Victoria Island, Webb Tract, and Woodward Island.

Compiler

The diagram was compiled by Brian Atwater as a member of the Delta Independent Science Board.

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