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Modeling the dispersal of the San Francisco Bay plume over the northern and central California shelf

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ABSTRACT

High-resolution simulations by the Regional Ocean Modeling System (ROMS) were used to investigate the dispersal of the San Francisco Bay (SFB) plume over the northern-central California continental shelf during the period of 2011 to 2012. The modeled bulk dynamics of surface currents and state variables showed many similarities to corresponding observations. After entering the Pacific Ocean through the Golden Gate, the SFB plume is dispersed across the shelf via three pathways: (i) along the southern coast towards Monterey Bay, (ii) along the northern coast towards Point Arena, and (iii) an offshore pathway restricted within the shelf break. On the two-year mean timescale, the along-shore zone of impact of the northward-dispersed plume is about 1.5 times longer than that of the southern branch. Due to the opposite surface Ekman transports induced by the northerly or southerly winds, the southern plume branch occupies a broader cross-shore extent, roughly twice as wide as the northern branch which extends roughly two times deeper due to coastal downwelling. Besides these mean characteristics, the SFB plume dispersal also shows considerable temporal variability in response to various forcings, with wind and surface-current forcing most strongly related to the dispersing direction. Applying constituent-oriented age theory, we determine that it can be as long as 50 days since the SFB plume was last in contact with SFB before being flushed away from the Gulf of the Farallones. This study sheds light on the transport and fate of SFB plume and its impact zone with implications for California's marine ecosystems.

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