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Title: Drivers of Mississippi freshwater plume variability and export toward Florida: insights from long term remote sensing observations and a regional ocean model ensemble

Abstract: The Mississippi River delivers large volumes of freshwater (~18,000 m^3/s) to the northern Gulf of Mexico, creating an extensive plume that affects the stratification of the upper ocean, its biogeochemical conditions and its coastal ecosystems. Previous analyses based on satellite observations have shown that the export of freshwater towards the Florida Straits is episodic and mainly depends on river discharge and interactions with the Loop Current (LC). In this study, we revisit this issue using 21 years (2002–2023) of remote sensing observations of the plume based on C and X-bands, as well as an ensemble of ten long-term simulations of a 1/12° regional ocean model (GOLFO12, 1980–2023). The results show that wind forcing and river runoff primarily modulate plume variability on synoptic timescales (days to weeks) and on the interannual timescale, while the chaotic dynamics of the LC exert a secondary control by either constraining the plume along the northern shelf or facilitating offshore export towards the eastern Gulf.

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