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Spreading dynamics of small river plumes off the northeastern coast of the Black Sea observed by Landsat 8 and Sentinel-2

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We use near simultaneous ocean color satellite imagery from NASA's Landsat 8 and ESA's Sentinel-2 missions to reconstruct surface currents along the northeastern shore of the Black Sea and study spreading of small river plumes formed in this area. Several times a year Landsat 8 and Sentinel-2 satellites pass over the study area with small time interval (2-7 minutes). Analysis of near simultaneous ocean color composites obtained during these periods provides opportunity for precise and accurate reconstruction of surface currents. It is especially efficient for detecting energetic motion of frontal zones and internal waves associated with river plumes which are visible at optical satellite imagery. In this work we focus on structure and dynamics of small river plumes under different discharge conditions. Using optical flow algorithm we reconstruct surface currents associated with motion of small river plumes during drought, freshet, and flooding periods and analyze differences in their spreading dynamics. Also we identify propagation of high-frequency internal waves generated by river runoff to the sea and calculate their initial velocity, frequency and attenuation. Based on these data, we identify that structure and motion of river plumes non-linearly depend on river discharge volume and are significantly different under freshet and draught conditions. Also we show that collisions and coalescence of closely spaced river plumes, which frequently occurs during flooding events, significantly modify their dynamical behavior as compared to spreading of isolated river plumes. Finally, we use numerical modelling validated against the obtained data to study cumulative influence of drought, freshet, and flooding periods on transport of river-borne dissolved and suspended matter on annual time scale.