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Monitoring the spreading of the Amazon freshwater plume by MODIS, SMOS, Aquarius and TOPAZ

Anton Korosov, Francois Counillon, and Johnny A. Johannessen
Nansen Environmental and Remote Sensing Center, Bergen, Norway

A synergistic tool for studying the Amazon River Plume dynamics based on a novel algorithm for deriving sea surface salinity (SSS) from MODIS reflectance data together with SSS data from the SMOS and Aquarius satellites and the TOPAZ data assimilation system is proposed. The new algorithm is based on a neural network to relate spectral remote sensing reflectance measured by MODIS with SSS measured by SMOS in the Amazon river plume. The algorithm is validated against independent in-situ data and is found to be valid in the range of SSS from 29 to 35 psu, for the period of highest rates of Amazon River discharge with RMSE=0.79 psu and R2=0.84. Monthly SSS fields were reconstructed from the MODIS data for late summers from 2002 to 2012 at a 10 km resolution and compared to surface currents and SSS derived from the TOPAZ reanalysis system. The two datasets reveal striking agreement, suggesting that the TOPAZ system could be used for a detailed study of the Amazon River plume dynamics. Both the position and speed of the North Brazilian Current as well as the spreading of the Amazon River plume are monitored. In particular a recurrent mechanism was observed for the spreading of the rivers plumes, notably that the fresh water is usually advected towards the Caribbean Sea by the North Brazilian Current but get diverted into the tropical Atlantic when North Brazilian Current rings are shed. Innovative method for satellite data temporal morphing based on remotely sensed surface ocean currents allow to derive SSS at unprecedented spatial (1km) and temporal (1 day) resolution.