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Variability of dissolved organic carbon (DOC) in the 6 largest Arctic rivers estimated using high resolution Sentinel-2 and Landsat-8 imageries over the 2013-2021 period.

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Climate warming with permafrost thaw will modify lateral carbon export, from terrestrial to aquatic ecosystems with a potential huge impact on the Arctic rivers, draining organic-rich soils and in fine into the Arctic Ocean. The majority of annual DOC fluxes by Arctic rivers are transported during the snowmelt break-up period, which makes field measurements of DOC difficult. Passive spatial remote sensing is a very relevant tool to increase the spatial and temporal coverage of these observed values.

In the framework of the French CNES DOC-Rivers project we proposed to apply the approach consisting in analyzing satellite imageries to evaluate DOC concentrations in the 6 great Arctic Rivers: Lena, Ob', Yenisey, Yukon, MacKenzie, Kolyma. The algorithm, first, establishes a multi-linear relationship between ground-based chromatic dissolved organic matter (CDOM) observations and specific satellite color bands to construct a complete satellite CDOM database. Another linear regression is used afterward with in-situ data from the Arctic Great Rivers Observatory (ArcticGRO) initiative to correlate CDOM and DOC observations. Using this second linear regression, we can predict the DOC content from the previous construct satellite CDOM database. River discharge measurements from the ArcticGRO database also enable to estimate the evolution of DOC export to the Arctic Ocean from satellite data.

We applied this approach to high-resolution satellite data issued from Sentinel 2 (A 2015-2022, B 2017-2022) and Landsat 8 (2013-2022) to create a multi-instrumental synergy. This new database provides an unprecedented source of information for understanding DOC dynamics of in Arctic rivers and assessing its transfer from large catchments to the Arctic Ocean. This database provides information on the variability of DOC during the whole ice-free season and serve to locate areas with higher concentrations and fluxes during the 2013-2021 period. We plan to complement our database on future period with data from new satellite missions (Landsat 9, Sentinel 2C), on the present time with data from on-going missions (Sentinel 3, MODIS) and on past period with data from low resolution observations as Landsat 5 and Landsat 7. This extension of the database over a longer period of time will furnish insight in response to climate warming.