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Session L01 – Invited speaker

Estimating land-to-coast ocean fluxes of dissolved organic carbon using satellite observations and catchment models

S L Kesav Unnithan [a], Nagur Cherukuru [a], Eric Lehmann [b], Tim Ingleton [c], Josep Canadell [a]

[a] *Commonwealth Scientific and Industrial Research Organisation, Environment, Canberra, 2601, Australia*
[b] *Commonwealth Scientific and Industrial Research Organisation, Data61, Canberra, 2601, Australia*
[c] *NSW Department of Climate Change, Energy, the Environment, and Water, Sydney, 2141, Australia*

Email: Kesav.unnithan@csiro.au

Abstract: Dissolved Organic Carbon (DOC) plays a pivotal role in regulating aquatic ecosystem function, influencing euphotic depth, primary production, and carbon cycling. Global assessments indicate that, among inland waters, riverine, coastal and marine systems, coastal waters contribute more than 90% of total organic carbon burial within the global carbon cycle. Evidence suggests that DOC export from rivers to the coastal domain is increasing due to changing climatic and anthropogenic pressures, with significant consequences for coastal water quality [1]. Despite its importance, no comprehensive measurements are available to quantify DOC fluxes across large spatial and temporal scales, limiting our understanding of land–sea carbon connectivity.

In this study, we present a novel modelling framework that integrates satellite remote sensing with catchment-scale hydrological data to estimate land-to-coast ocean DOC fluxes. Building on our deep learning–remote sensing (DL-RS) approach [2] to estimate pixel-based DOC concentrations from remote sensing imagery, we extend its application by coupling multi-year Landsat 8 derived DOC observations (2014 – 2024) with gridded rainfall and Australian Landscape Water Balance model (AWRA-L V7) runoff datasets to quantify DOC export from major Australian catchments. Fluxes were stratified by hydroclimatic zones to resolve spatiotemporal variability in terrestrial organic matter delivery to the coastal ocean.

Our preliminary results indicate strong interannual variability, with DOC fluxes ranging from <10 Gt/yr during dry years to >2800 Gt/yr during flood-dominated years, particularly in the Clarence and Hawkesbury catchments. Episodic events, such as floods, were responsible for disproportionately large DOC pulses, highlighting the nonlinear nature of terrestrial carbon delivery. These fluxes are known to have cascading impacts on underwater light regimes, benthic habitats, and estuarine carbon cycling. This work demonstrates the feasibility and value of integrating satellite archives, deep learning bio-optical models, and hydrological datasets to resolve DOC fluxes across vast scales. By providing decision-ready datasets on DOC delivery and flux estimates, this framework advances predictive capabilities for water quality managers and offers a scalable pathway for monitoring terrestrial-to-marine carbon transfers globally.

REFERENCES

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