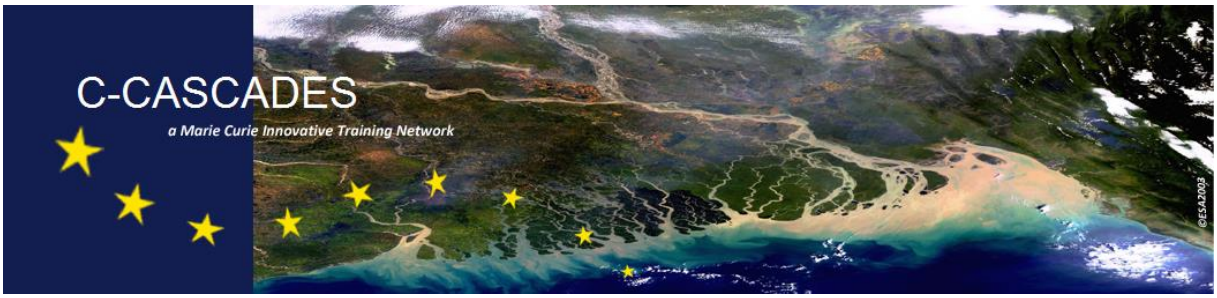

C-CASCADES
The journey of carbon from land to ocean and its importance for CO_2 budgets and climate projections

C-CASCADES Press Event – 25/10/2018 – Brussels

- Objectives of C-CASCADES -

The most recent Intergovernmental Panel on Climate Change Assessment Report[1] (IPCC AR5, 2013) mentions the **transport of carbon across the Land-Ocean Aquatic Continuum** (LOAC) as a **key component of the global carbon cycle**.

As of today, quantification of the role of the LOAC (inland and coastal waters) and its dynamics in the global carbon budget is still in its infancy:

- Earth System Models (ESMs) of the climate system and biogeochemical cycles used for the IPCC 5th AR do not account for the lateral flows of carbon along the LOAC and associated CO_2 exchange with the atmosphere.
- The perturbations of the LOAC carbon cycle due to human activities (e.g. land-use, climate change, hydraulic management, industrial activities) have not been quantified yet, which hampers the inclusion of these aquatic systems in the yearly CO_2 global budgets released by the Global Carbon Project (http://www.globalcarbonproject.org/).

This knowledge gap has major implications for assessing regional and global carbon budgets, climate projections and, thus, is crucial for climate policy. In order to make a breakthrough in the field, **C-CASCADES aimed to advance significantly the predictive capability of ESMs by integrating, for the first time, the transfer of carbon from land to ocean in analyses of the coupled carbon-climate system and its response to anthropogenic (human induced) perturbations.** This overarching objective was addressed across scales, from the local to the global.

[1] Ciais, P., Sabine, C., Govindasamy, B., Bopp, L., Brovkin, V. et al. (2013) Chapter 6: Carbon and Other Biogeochemical Cycles, in: Climate Change 2013 The Physical Science Basis, edited by: Stocker, T., Qin, D., and Platner, G.-K., Cambridge University Press, Cambridge.

- Results highlights –

During 3 years, 15 PhD students spread in 8 European research institutes from 7 countries studied different aspects of the lateral transfer of carbon and associated CO_2 emissions from land to ocean. Research focused on:

- Improved understanding of the processes that control carbon transport and transformations in different environments of the LOAC (from mountain streams to open ocean),
- Quantification of LOAC carbon fluxes and CO_2 emissions in hotspot regions (e.g. boreal lakes, highly impacted European catchments such as the Danube or the Seine, the Amazon plume or the Arctic Ocean)
- Integration of the LOAC C cycle science in 3 European Earth System Models for better constraining and reducing uncertainties in the global CO_2 budget.

Altogether, our results have allowed producing the most updated global map of CO_2 emissions from the LOAC at high spatial resolution. Results show that the LOAC emits about 1.90 PgC (10^9 T) each year, making it a crucial component of the global C budget (Fig. 1).

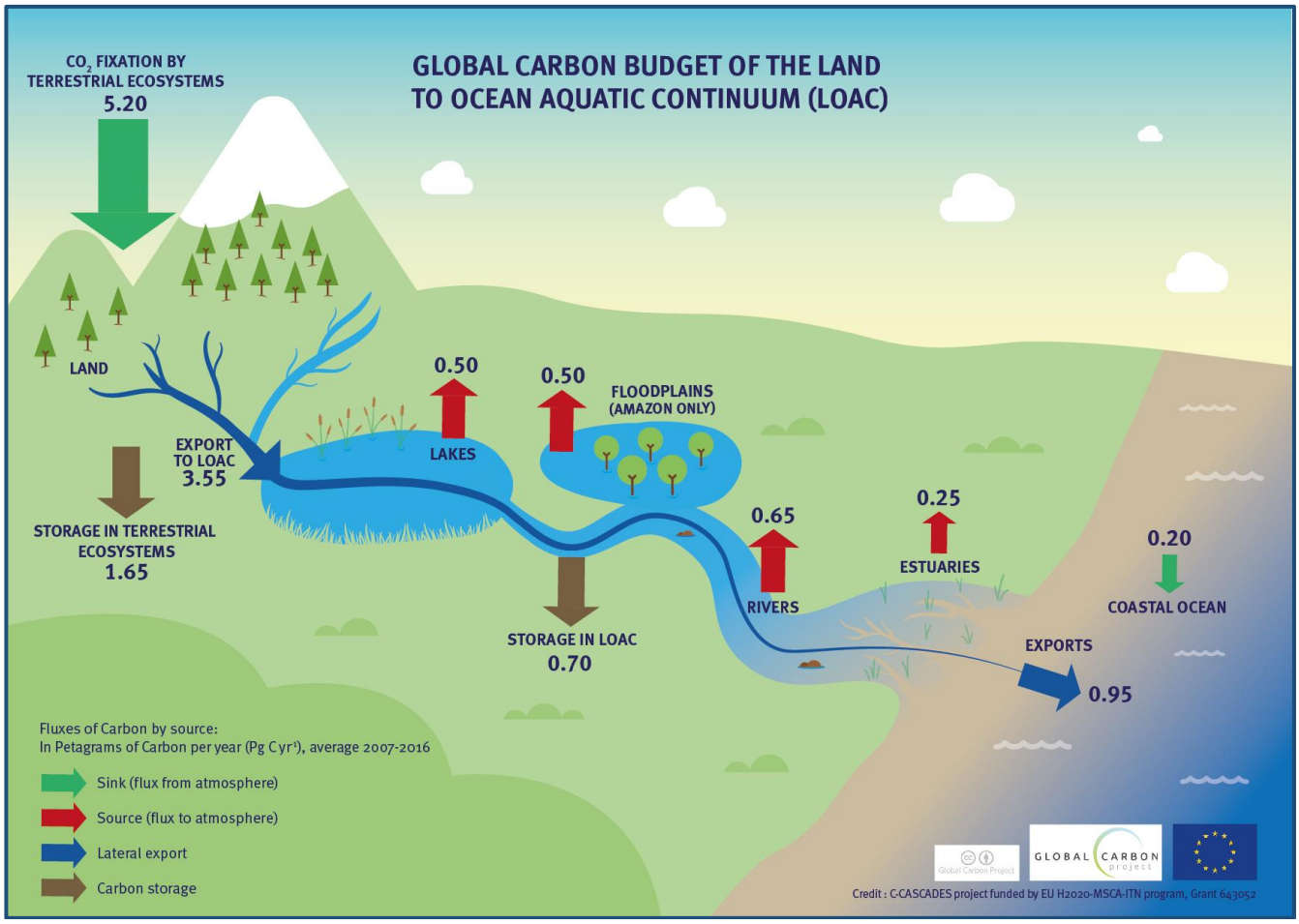

Fig. 1 – Global Carbon fluxes for the Land to Ocean Aquatic Continuum (unit: Pg C y^{-1}, average 2007-2016).
Credit: C-CASCADES, Global Carbon Project

From a policy perspective, our results also allow to quantify the contribution of each country or region (Fig.2).

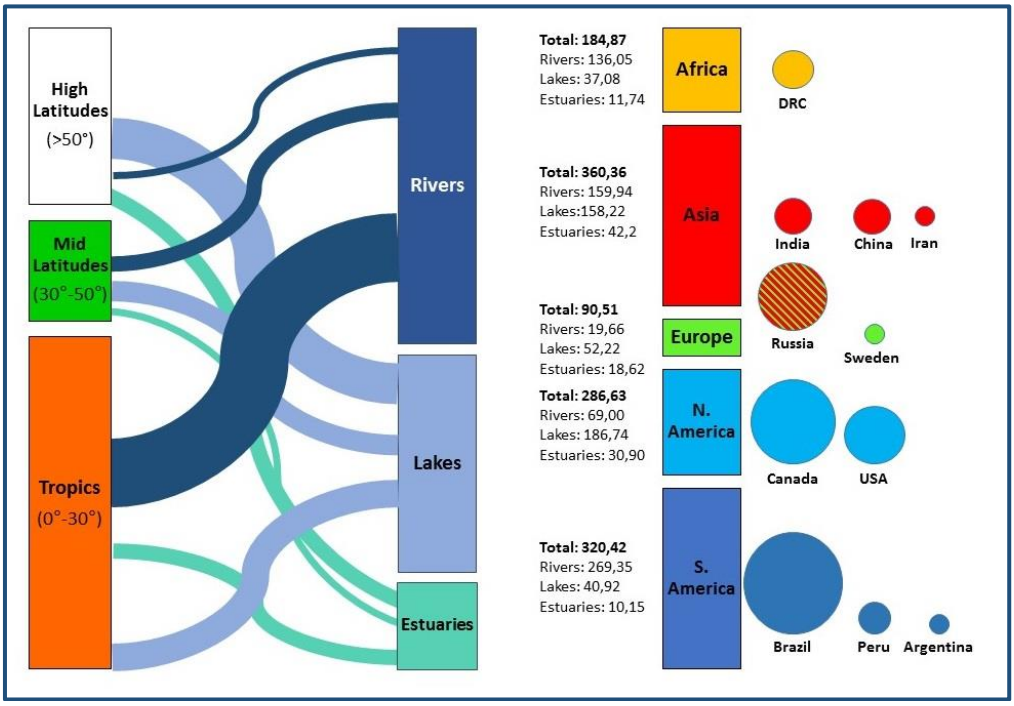

Fig. 2. Partitioning of CO_2 emission by the LOAC components, latitudes, continents and countries (unit: Tg C yr^{-1})

Our results also show that CO_2 emissions from the LOAC are likely to increase in the coming century due to increased leakage of terrestrial carbon in the LOAC, higher temperature and changes in hydrology. For instance, under the worst case CO_2 emission scenario RCP 8.5, the input of terrestrial Dissolved Organic Carbon (DOC) into the LOAC will increase by 60 % globally by the end of the century (Fig.2), the CO_2 emissions from boreal lakes will nearly double while those of the Amazon river network will be about 35 % higher under scenario RCP 6.0. We have also investigated the impact of LOAC carbon exports on the ocean. For example, our results show that enhanced DOC fluxes will significantly drop the pH in the Arctic Ocean shelves and turn several regions into CO_2 sources rather than present day sinks.

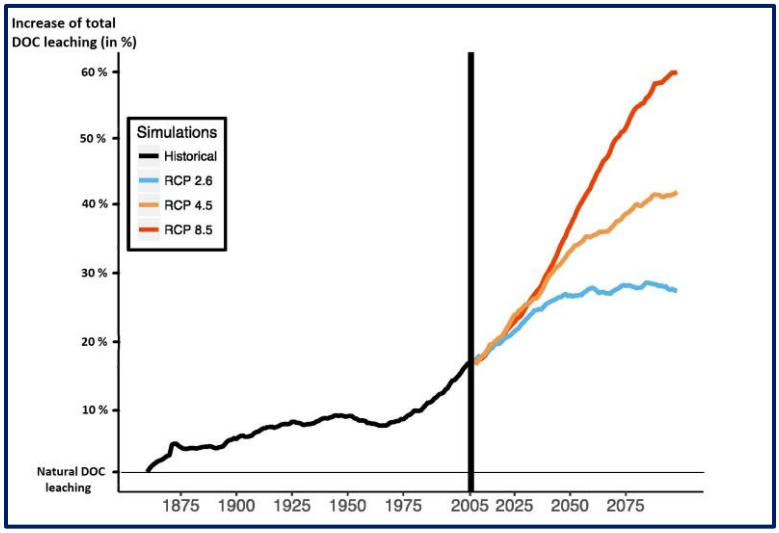

Fig. 3 – Accelerating Dissolved Organic Carbon leakage from terrestrial ecosystems. (Nakhavali et al, in prep.)

These results highlight that **the LOAC is not only an important contributor of the global carbon budget, but is also profoundly impacted by human activities.**

- Impact of C-CASCADES –

C-CASCADES has studied the impacts of human activities on the carbon cycle and its effects on anthropogenic climate change, more specifically for the emissions from inland and coastal waters into the atmosphere. C-Cascades has shown and quantified the growing importance of loss of carbon from natural and managed ecosystems through the lateral transport by rivers. These results allowed to better quantify the significant contribution of the LOAC to the global carbon budget and CO_2 emissions. Thus, it will enable experts to make better climate projections. Because of their high relevance for policy-making, the new interactive graphs representing the contribution of the LOAC to CO_2 emissions will be inserted on the portal of the Global Carbon Atlas: http://www.globalcarbonatlas.org/en/content/welcome-carbon-atlas. Their release will be coordinated with the publication of the next Global Carbon Budget at the end of November just before the COP24 in Poland. It is also anticipated that many of the results published by C-CASCADES participants will be integrated in the new IPCC Report (AR6) to be released in 2022.

From a more practical standpoint, our results aim to increase awareness about the need to reduce CO_2 emissions from the LOAC. This has been achieved through targeted communication towards stakeholders and the general public, but also through the active engagement of international companies working in the water management arena (Veolia, Deltares, Kongsberg Maritime Contros) in all C-CASCADES activities.

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C-CASCADES funding & contacts:

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