Spatial variability of GHG dynamics in coastal environment during summer

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Background and objectives:

Coastal ecosystems are highly productive and dynamic in terms of ocean-atmosphere carbon fluxes, potentially acting as powerhouses to mitigate climate change. While comprehensive understanding on how coastal biodiversity contributes to carbon sequestration and air-sea greenhouse gases exchange is still very much needed, the large spatial heterogeneity of coastal ecosystems makes this task quite difficult.

Here we present preliminary data collected last summer along a salinity gradient in the archipelago of the Southern Finland, around the Tvärminne zoological station (TZS). This fieldwork aimed to characterize the surface water biogeochemical properties and estimate its potential for CO_2 and CH_4 exchange with the atmosphere.

Method:

A flowthrough system (Fig. 1) is equipped with an equilibrator and gas analyzer for CO_2 and CH_4 concentrations (Licor LI-7810), a thermosalinograph (Sea-Bird SBE 45 MicroTSG), and sensors for dissolved oxygen concentration (Aanderaa oxygene optode 4531), and chlorophyll-*a* concentration (Chelsea TriLux). Air-sea exchanges of CO_2 and CH_4 were measured using the chamber of accumulation technique associated with the LI-7810 (Fig. 2).

Fig. 1: Flowthrough system on the boat.

Fig. 2: Deployment of the chamber of accumulation equipped with the LI-7810.

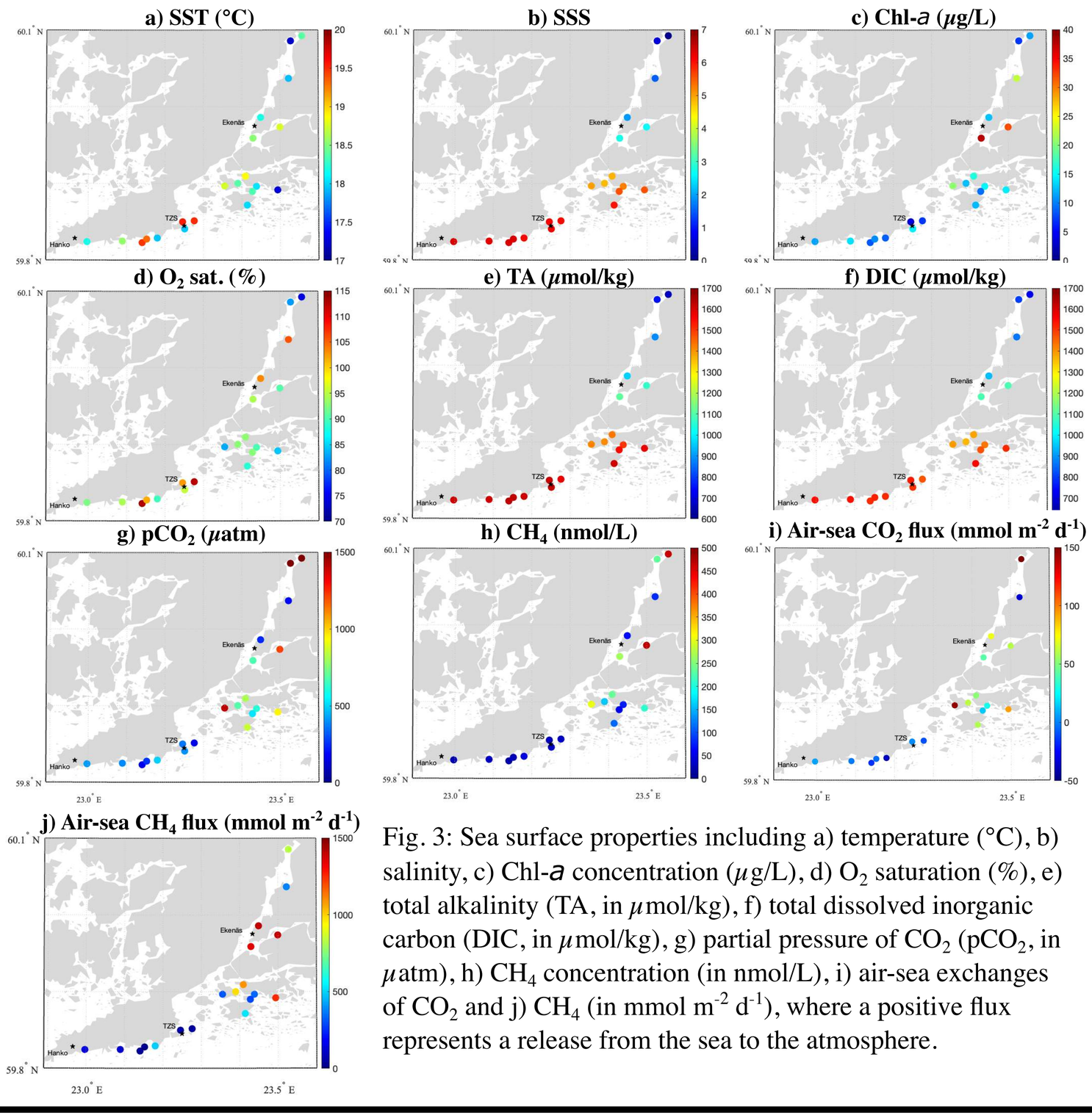

Fig. 3: Sea surface properties including a) temperature (°C), b) salinity, c) Chl-*a* concentration (μg/L), d) O_2 saturation (%), e) total alkalinity (TA, in μmol/kg), f) total dissolved inorganic carbon (DIC, in μmol/kg), g) partial pressure of CO_2 (pCO_2, in μatm), h) CH_4 concentration (in nmol/L), i) air-sea exchanges of CO_2 and j) CH_4 (in mmol m^{-2} d^{-1}), where a positive flux represents a release from the sea to the atmosphere.

Results:

The carbonate system appears to be strongly correlated with salinity (Fig. 3b, e, f). Partial pressure of CO_2 (pCO_2) ranged from 163 to 2570 μatm, with higher values observed at lower salinity or in semi closed and sheltered bay (Fig. 3g). Strong spatial variability was observed over the 4- weeks survey over the research area that acted both as source and sink for atmospheric CO_2 (Fig. 3i). Methane concentration in surface seawater ranged from 19 to 468 nmol/L (Fig. 3h) supporting a net release of CH_4 to the atmosphere (Fig. 3j).

Future work:

Characterization of local benthic communities is in progress and will be used to understand how benthic ecosystems can regulate seawater biogeochemical properties and contribute to the GHG exchanges with the atmosphere.

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