Summary

Rationale

Increasing atmospheric CO_2 concentrations cause an overall increase of CO_2 concentrations in surface seawater and, consequently, a pH decrease (CO_2 is a weak acid). This mechanism is known in the scientific literature as Ocean Acidification (OA) although seawater does not really become acidic but only moves from its present alkaline character towards the future less alkaline state. It has been recognized by both the scientific community and policy makers as one of the greatest threats to marine ecosystems but also to the well-being of society, through impacts on fisheries, aquaculture and tourism. The mechanism of OA is already fairly well understood and traceable in open ocean waters. In the coastal and shelf seas, however, OA is still considerably understudied despite their high socio-economic importance and potentially great vulnerability to acidification due to often lower salinity and corresponding lower buffer capacity of waters as compared to open ocean.

The Baltic Sea through its specific topography and the hydrological setting is one of the largest brackish water bodies on Earth. The brackishness of the basin creates a unique ecological structure but is also a root cause for a generally low buffer capacity of waters to mitigate OA. The buffer capacity is expressed and measured by the so-called total alkalinity, which consists mostly of carbonate and bicarbonate ions. However, the alkalinity budget for the Baltic Sea remains unbalanced as there is missing a source term. Therefore, it is impossible to study the large-scale variability of pH changes and to forecast the development of OA in the Baltic Sea in the future high-CO_2 world

Hypothesis and objectives

The main hypothesis in the project assumes that total alkalinity loads from continental rivers are increasing which substantially influences the alkalinity budget and pH variability in the Baltic Sea (Fig. 1).

To verify this hypothesis the following objectives have been set:

1) to identify long-term trends and seasonal variability of total alkalinity concentrations and loads from continental rivers to the Baltic Sea.
2) to identify long-term trends, seasonal variability (and corresponding drivers) of total alkalinity concentrations and pH in the coastal regions of the southern Baltic Sea
3) to assess the role of calcium carbonate formation and dissolution in the transport of riverine alkalinity to the Baltic Sea
4) to quantify the net air/sea CO_2 exchange in the lower sections of the continental rivers and coastal zone affected by the riverine total alkalinity supply.

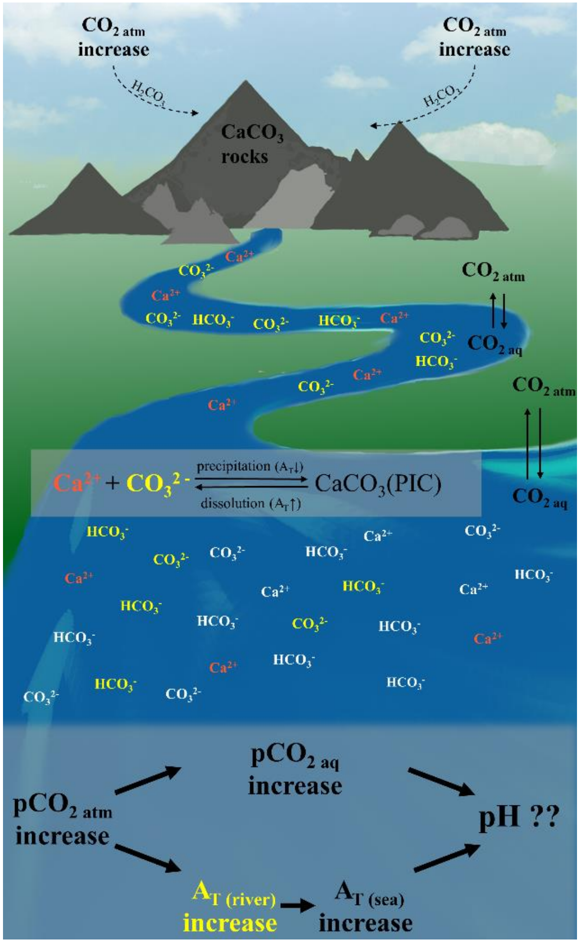

Fig. 1. Conceptual scheme showing the scientific problem to be solved in the project

Work plan and expected outcome

The work planned in the project has been distributed into 5 work packages and 11 tasks. It includes experimental observations extending from river mouths to the open sea, laboratory-based microcosm experiments and analysis of the historical, monitoring data. Furthermore, the project results will also be immediately transferred into the ERGOM biogeochemical model to improve its accuracy in simulating pH variability in the Baltic Sea and to assess the large-scale transport of alkalinity from land and its influence on OA mechanism in the Baltic Sea.