Multi-tracer data assimilation for biogeochemical flux and rate estimation

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The distributions of dissolved oxygen, nutrients, carbon, man-made chlorofluorocarbons and the radioactive carbon isotope ^{14}C show unique and pronounced features that are the result of the combined action of physical as well as biogeochemical processes. Usage of these tracers therefore offers promise to quantify the underlying processes, such as water mass transports, rates of biological productivity and particle export as well as the fluxes of oxygen and CO_2 between ocean and atmosphere. In this talk I provide an introduction to the methodology of inverse modeling aiming at utilizing (or assimilating) multi-tracer data to infer quantitative information about the underlying physical and biogeochemical processes. The *Method of Lagrange Multipliers* (called *Adjoint Method* in the meteorological and oceanographic communities) is described in general terms and the suitability for widely different applications is emphasized. Results for the global ocean carbon export into the deep sea and the air-sea CO_2 flux are presented.