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Vertical CO2-Flux Gradients in the Marine Boundary Layer?

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A classical method to estimate CO2-fluxes through the air/sea-interface consist of measuring the vertical turbulent flux close to the surface by Eddy-Covariance assuming constant flux between the measuring height and the surface. To re-evaluate this assumption, a two level flux measurement was installed on the research platform FINO2 in order to search for vertical flux gradients. The research platform is located at 55° 00' north and 13°09' east in the Baltic Sea between the coasts of Sweden, Denmark and Germany. At FINO2 the water is about 25 meters deep. A 9 meter long boom carrying the flux sensors is mounted at the south-east corner of the platform pointing south. Raw data with 10 Hz sampling rate are stored locally since June 2008 and can be downloaded remotely via satellite-based internet link.
CO2-fluxes were calculated with 30 min time resolution applying a standard eddy covariance processing scheme including tilt- and Webb-corrections. In addition, power and cross spectra were calculated for selected (high wind) periods – mainly in order to verify that there are no artifacts due to wind- and wave-induced vibrations of the platform. Our first results over a period of two months in summer 2008 show significant flux gradients over extended periods (1-2 days).
Recent runs of mesoscale circulation models, which consider the time dependent sources and sinks of vegetation-covered land, predict patterns of CO2 concentration with horizontal gradients of considerable magnitude. Moreover these model results show that the gradients fade out over open oceans only very gradually on trajectories several hundred kilometers off the coast. We estimate that these horizontal gradients of atmospheric CO2 concentration in combination with vertical gradients of wind speed could be a potential reason for vertical flux gradients. In coastal waters the gradients can result in flux differences between the height of the flux sensor and the sea surface which can amount the same order of magnitude as the surface flux of CO2.
We are confident to determine the appearance and the amount of these gradients on the basis of our continuous, long-term measurements and to extrapolate the "real" surface flux.