# Publishable Summary Figures
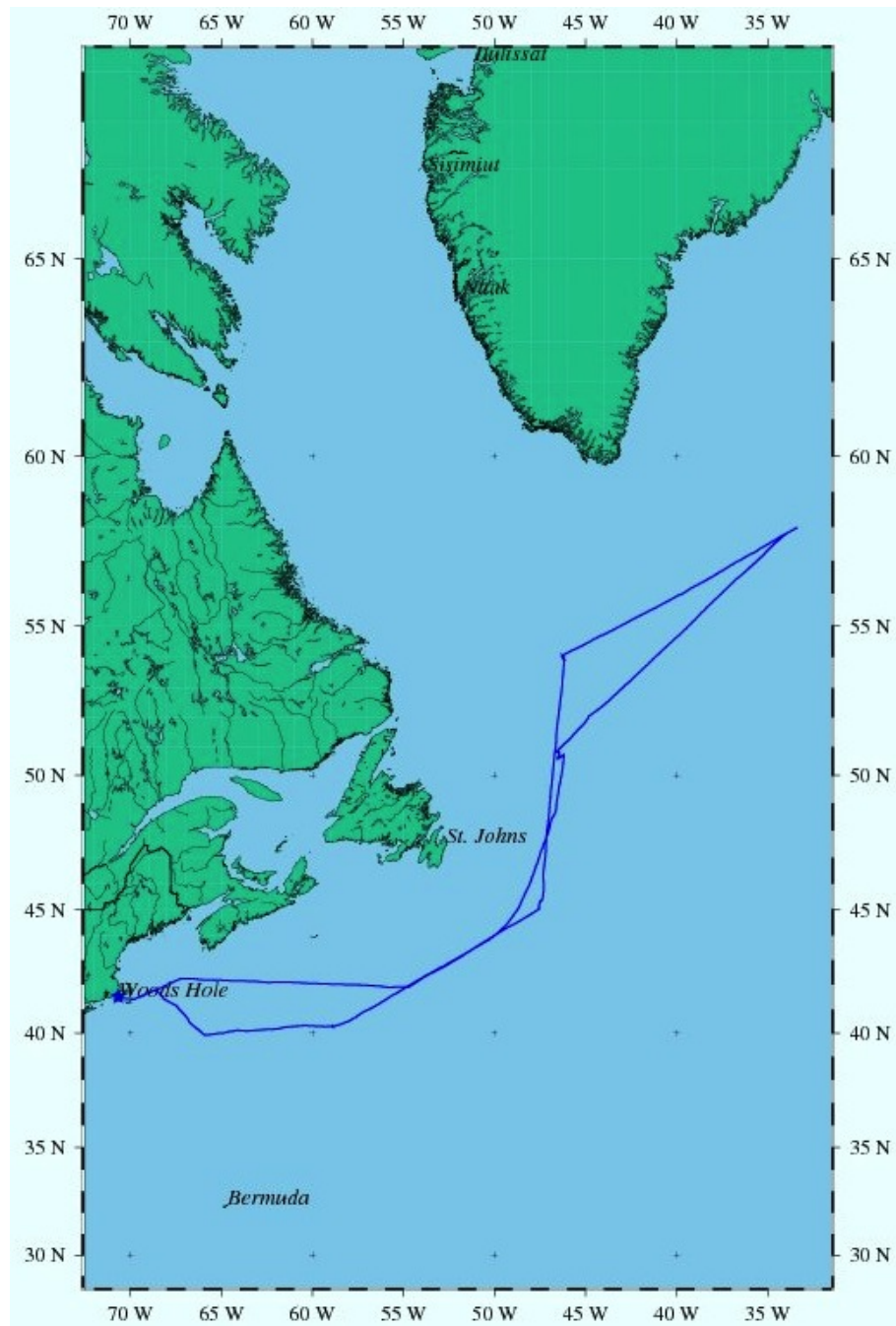


Figure 1: Cruise Track of the R/V Knorr during the North Atlantic experiment in June 2011.

Figure 2: Photograph of ASIP ascending towads the ocean surface taken from below the instrument.
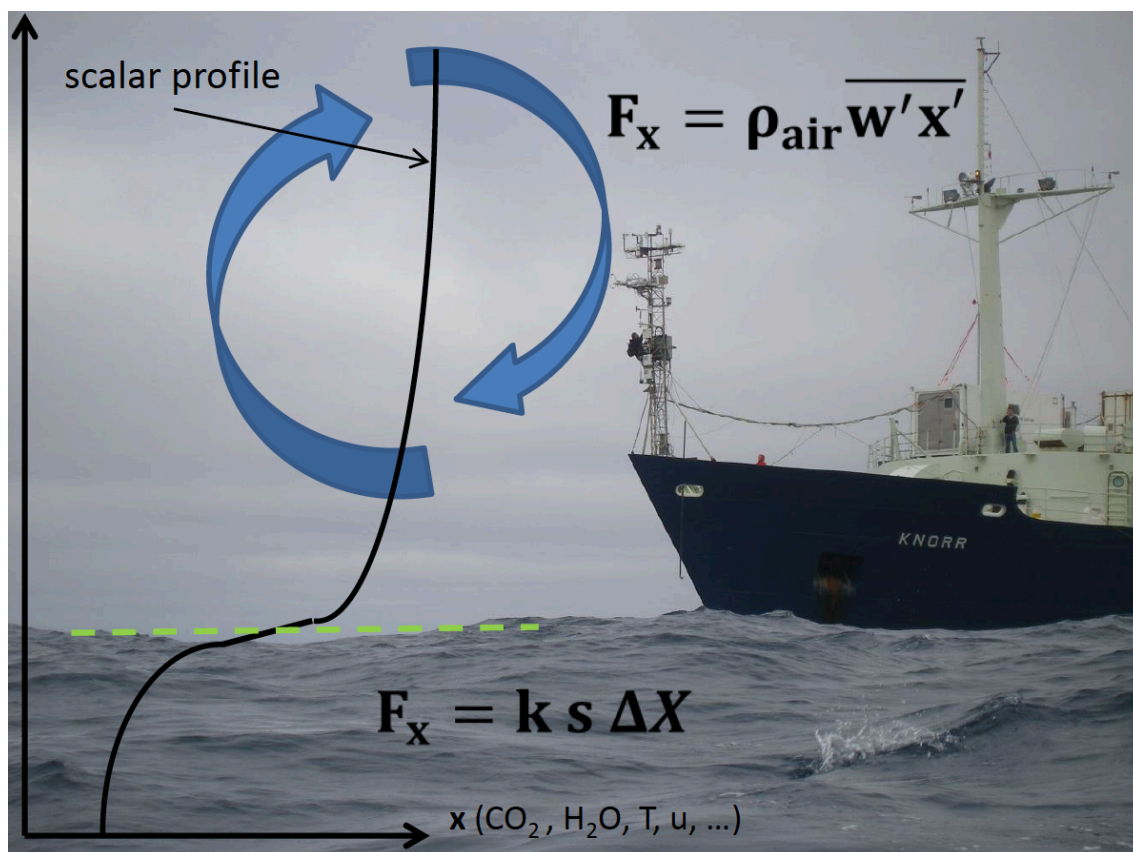
Figure 3: Photograph of the Eddy-Covariance setup on the R/V Knorr during the air-sea gas exchange field experiment in the North Atlantic. Using this method we made direct measurements of the air-sea fluxes of $CO_2$.
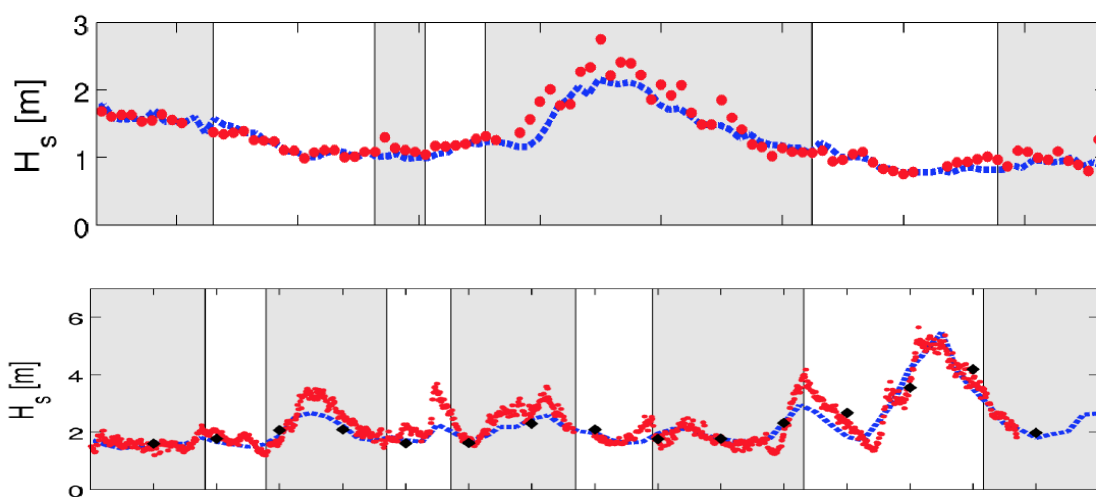
Figure 4: Upper panel shows significant wave height (SWH) between the waverider (blue) and the ultrasonic sensor (red). The lower panel shows SWH from the ultrasonic (red dots), model outputs (blue), and AVISO gridded satellite observations (black).
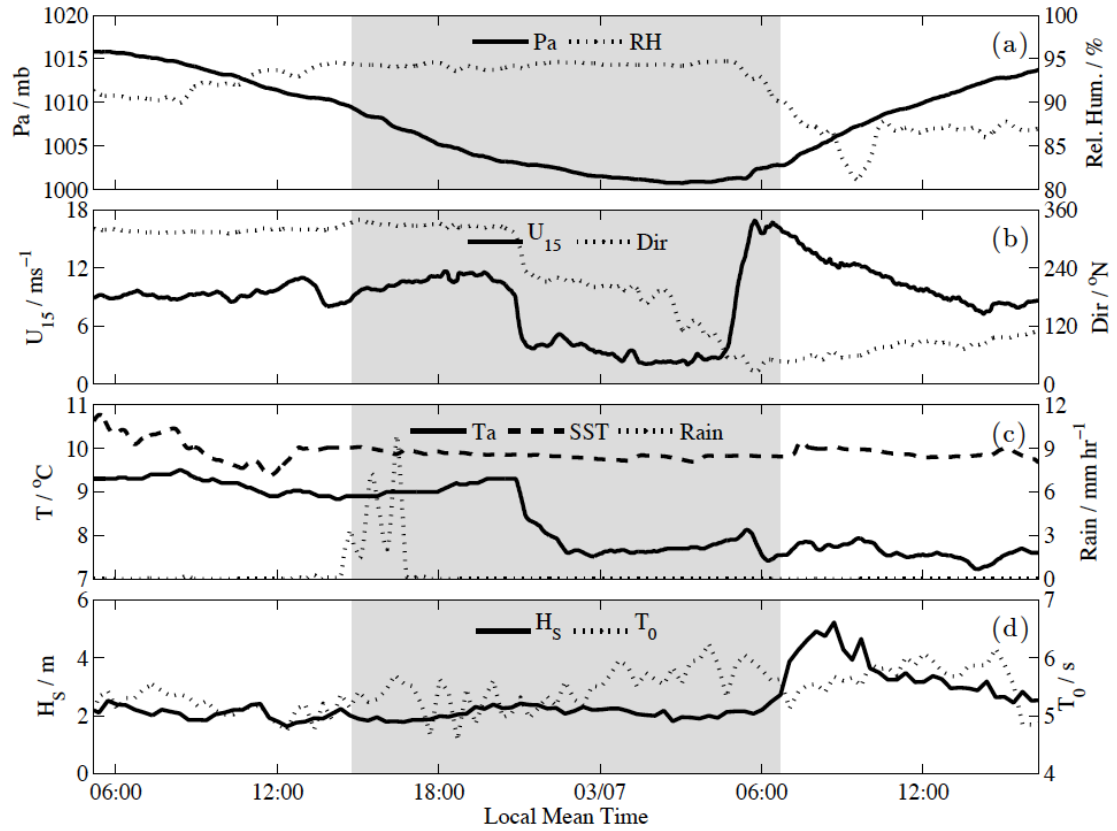
Figure 5: (a) Pressure (Pa), relative humidity (RH), (b) wind speed at 15.5 m (U15), wind direction (Dir, clockwise from North), (c) air temperature (Ta), sea surface temperature (SST), rainfall rate (Rain), (d) significant wave height ( and mean crossing period are shipboard measurements from the R/V Knorr for the deployment location in the North Atlantic. The shaded region corresponds to the time when ASIP was profiling.
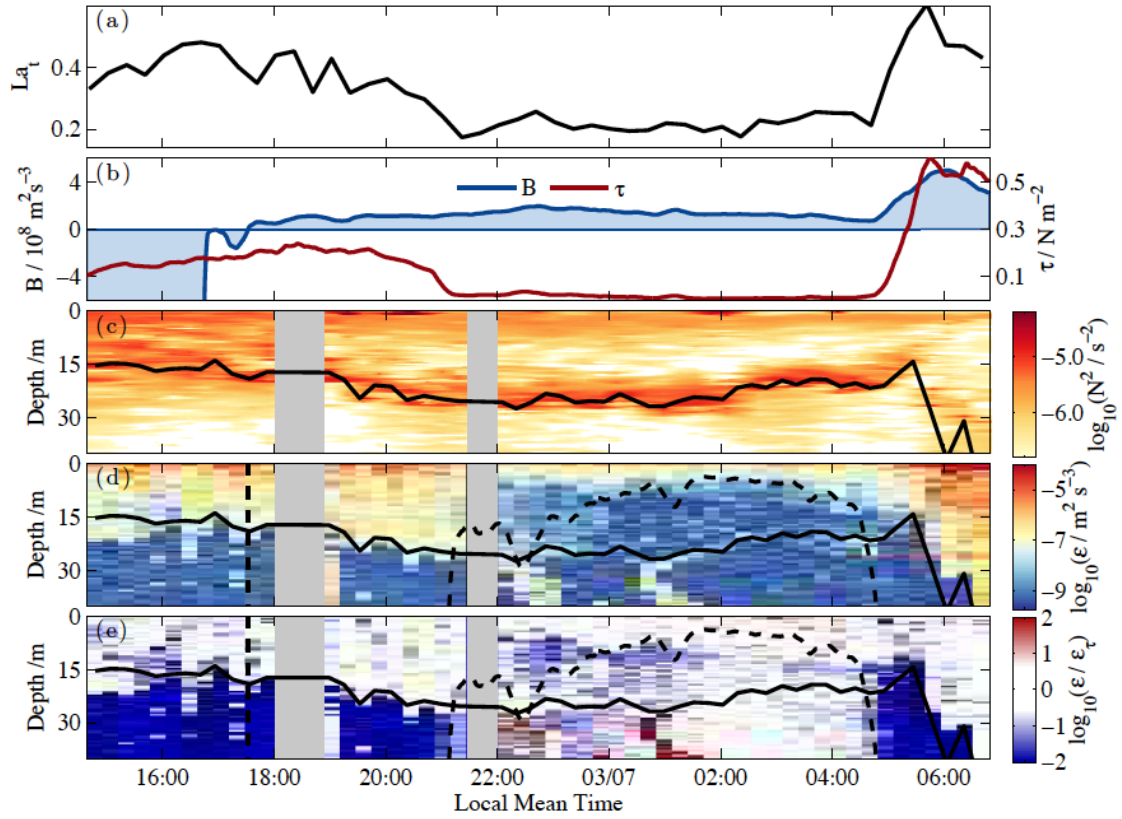
Figure 6: (a) Turbulent Langmuir number, (b) buoyancy and wind stress forcing, (c) Brunt-Väisälä frequency $N^2$, (d) dissipation $\varepsilon$ and dissipation normalized by the law of the wall (e). The solid black line in panels (c-e) denote the mixed layer depth $D$ and the dashed line in (d) and (e) is the Monin-Obukhov length. All times have been converted to Local Mean Time.
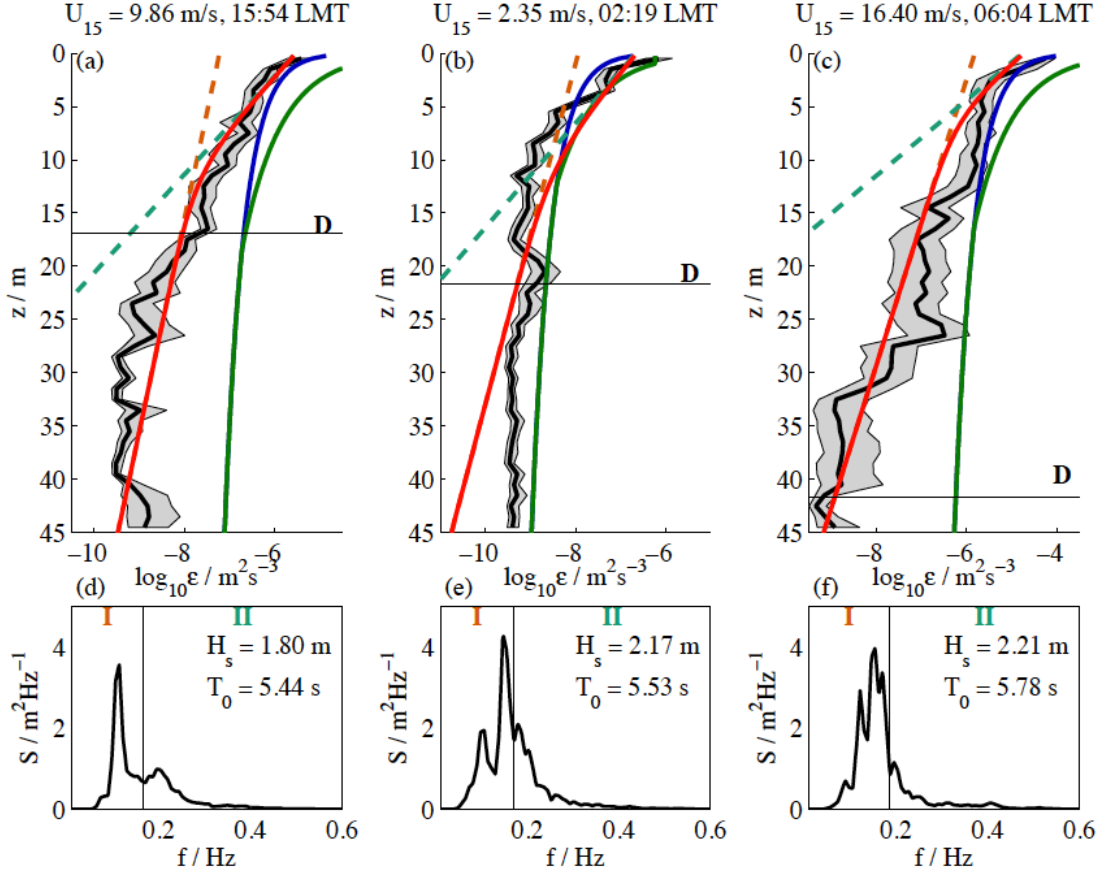
Figure 7: Profiles of turbulent kinetic energy dissipation (a-c) for a particular wave spectra (d-f). Five successive profiles of $\varepsilon$ taken over one hour are averaged vertically into 1 meter bins with the solid black line showing the mean and the grey shaded region the 95% confidence intervals determined using a bootstrap method. The depth dependence of $\varepsilon$ is compared with law-of-wall scaling (blue line), scaling of Terray et al. (1996) (green line), and the wave scaling of Huang and Qiao (2010) (red line) using portions of the wave spectra (dashed lines with colours matching the corresponding spectral region marked by I, and II in (d-f)). The red line denotes the sum of the wave scaling turbulence profiles from section I and II, i.e. the dashed orange line plus the dashed green line. The values of $H_s$ (significant wave height) and $T_0$ (aero crossing) for each wave spectra are computed for the entire spectra. The mixed layer depth is the black horizontal line denoted by $D$.