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Physical limitations of dissolved methane fluxes: The role of bottom-boundary layer processes

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The idea of the present paper is to bring together in situ methane emission rates with back scatter anomalies recorded in the water column by an ADCP instrument integrated into a benthic observatory. During the first video-guided lander deployment of cruise SO191 to the Hikurangi margin, the Fluid Flux Observatory (FLUFO) was deployed at a cold seep site in the LM9 area. The sediments incubated in the 2 benthic chambers of the lander contained many small and larger tube worms, juvenile bivalves of the genus Acharax and some juvenile clams. The water samples obtained from the overlying water during the first 26 hours of incubation revealed low to moderate methane fluxes of 0.01 to 0.4 mmol m^{-2} d^{-1} in the backup and flux chamber, respectively. The methane concentration in the flux chamber reached a 3-fold value in the following sampling sequence whereas the methane concentration in the backup chamber remained low without a change. At the same time of the sudden methane discharge an increase in the back scatter data of an Acoustic Doppler Current Profiler (ADCP) mounted on the lander was recorded. The acoustic signal can most likely be attributed to the emission of free gas; they persisted for 30 min and covered the whole acoustic range (100m) of the ADCP. The data presented in this paper demonstrate the temporal and spatial variability of sea bed methane emission which have to be considered when budgets of methane emission rates are extrapolated from single deployments.