



Seasonal Variability in Atmospheric Methane Mixing Ratio and Coastal Methane Emission from the Southwest United Kingdom

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We report 2+ year observations of atmospheric methane (CH₄) mixing ratio and water-to-air CH₄ fluxes from the Penlee Point Atmospheric Observatory (PPAO) on the southwest coast of the UK. About 6 km southwest of Plymouth, this coastal site is located at the mouth of the Plymouth Sound, ~10 m above mean sea level, and ~30 m from the water's edge. Air from the southwest encounters little terrestrial influence and appears to be largely representative of the background North Atlantic. The other wind sectors are affected to a varying degree by natural and anthropogenic terrestrial emissions as well as discharge from the nearby Tamar estuary/Plymouth Sound. Compared to the southwest wind sector, CH₄ mixing ratios from terrestrially influenced wind sectors are greater in the mean and also show stronger seasonality (higher in winter than in summer). Novel application of the eddy covariance technique enables a direct and continuous quantification of the water-to-air CH₄ fluxes. CH₄ emissions from this region exceed predicted CH₄ fluxes over the open ocean but are less than estimates from polar regions or freshwater systems. Within the water-facing wind sectors, CH₄ emissions are a few times higher when winds are over the Plymouth Sound than when winds are from the southwest, suggesting a source from riverine outflow. Long-term measurements of CH₄ fluxes allow us to examine the dependence on wind speed, tide, and water temperature.