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Biogenic halocarbons from coastal oceanic upwelling regions as tropospheric halogen source

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Halogenated very short lived substances (VSLS) are naturally produced in the ocean and emitted to the atmosphere. Recently, oceanic upwelling regions in the tropical East Atlantic were identified as strong sources of brominated halocarbons to the troposphere. During a cruise of R/V METEOR in December 2012 the oceanic sources and emissions of various halogenated trace gases and their mixing ratios in the marine atmospheric boundary layer (MABL) were investigated above the Peruvian Upwelling for the first time. This study presents novel observations of the three VSLS bromoform, dibromomethane and methyl iodide together with high resolution meteorological measurements and Lagrangian transport modelling. Although relatively low oceanic emissions were observed, except for methyl iodide, surface atmospheric abundances were elevated. Radiosonde launches during the cruise revealed a low, stable MABL and a distinct trade inversion above acting both as strong barriers for convection and trace gas transport in this region. Significant correlations between observed atmospheric VSLS abundances, sea surface temperature, relative humidity and MABL height were found. We used a simple source-loss estimate to identify the contribution of oceanic emissions to observed atmospheric concentrations which revealed that the observed marine VSLS abundances were dominated by horizontal advection below the trade inversion. The observed VSLS variations can be explained by the low emissions and their accumulation under different MABL and trade inversion conditions. Finally, observations from a second Peruvian Upwelling cruise with R/V SONNE during El Nino in October 2015 will be compared to highlight the role of different El Nino Southern Oscillation conditions. This study confirms the importance of coastal oceanic upwelling and trade wind systems on creating effective transport barriers in the lowermost atmosphere controlling the distribution of VSLS abundances above coastal ocean upwelling regions.