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Observations of internal waves in the near field of the Rhine River Plume

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Previous studies have shown the release of internal waves by the Columbia tidal plume front, which are an important source for ocean mixing. In this study we present observations of internal waves generated by fronts in the Rhine River Plume. We used a large dataset collected 10 km north of the river mouth 6 km offshore in a water depth of about 18 m. Current velocity was measured with a 4 beam ADCP (1200kHz RDI Workhorse) with a resolution of 0.25 m and a frequency of 1 Hz. A running average of 30 seconds with steps 10 seconds has been applied to the ADCP data. Density information has been retrieved from a mooring with 4 CTD instruments over the vertical. Strong up- and downward velocities are observed ahead, behind and at the head of a freshwater front. These vertical velocities suggest the presence of internal waves, which coincide with the signal of the backscatter of the ADCP. Multiple wave trains are observed in the data, which happen under different conditions when ambient stratification is present. Preliminary analyses shows wave periods in the range of 1 to 3.5 minutes, amplitudes between 0.5 and 2 meters. Linear phase speeds are calculated and have values of 0.22 - 0.24 m/s in ambient waters and between 0.28 - 0.33 m/s in the river plume. Our data provide evidence that tidal plume fronts, formed by the discharge of freshwater lenses every tidal cycle into a shallow frictional river plume system, are a source of internal waves.