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*Supplement of*

## **Acoustic mapping of mixed layer depth**

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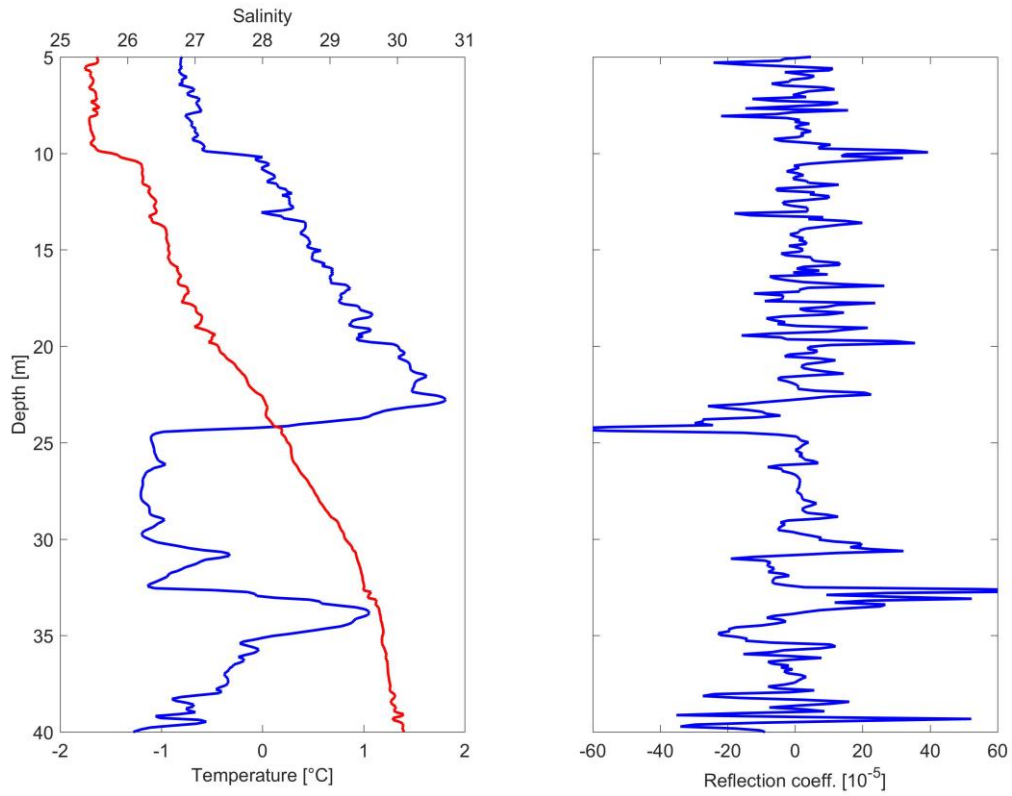


Figure S1. Example of a CTD station without a well-defined mixed layer (blue category). **a** CTD profiles of temperature (blue) and salinity (red). **b** reflection coefficient profile derived from CTD data (see methods section for details).

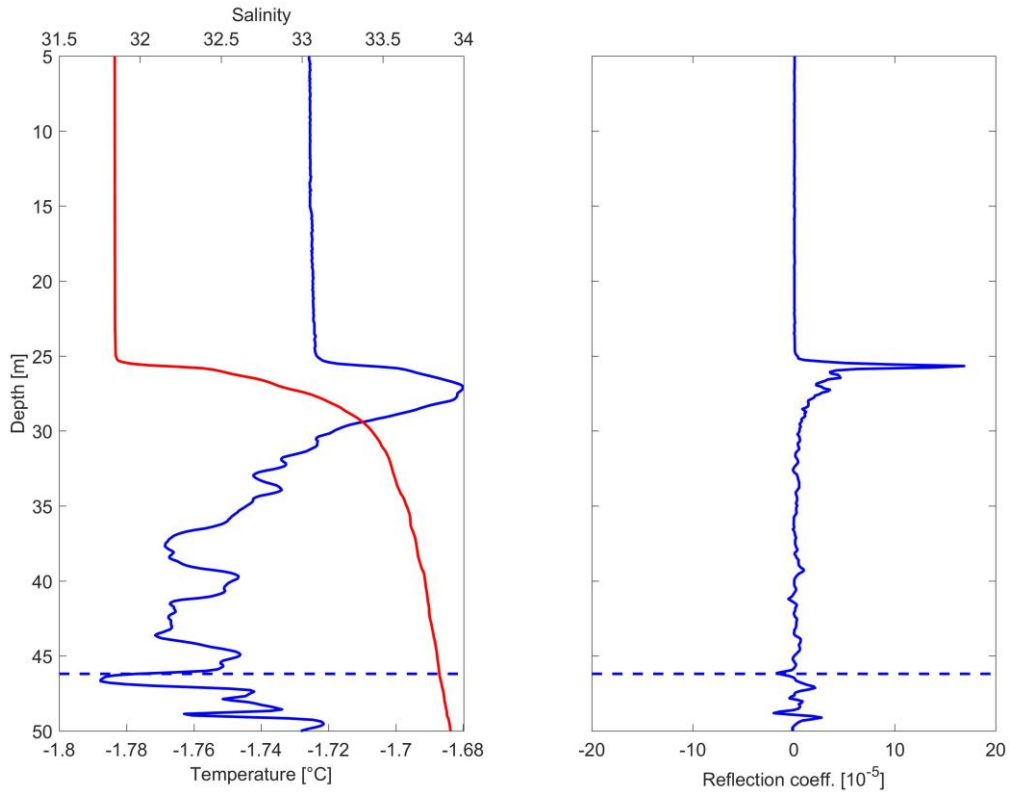


Figure S2. Example of a CTD station where the  $\Delta T$  threshold method fails (outlier marked as red cross in Fig 3). **a** CTD profiles of temperature (blue) and salinity (red). **b** reflection coefficient profile derived from CTD data (see methods section for details). Blue horizontal line show  $MLD_{CTD}$  derived from the  $\Delta T$  threshold method.

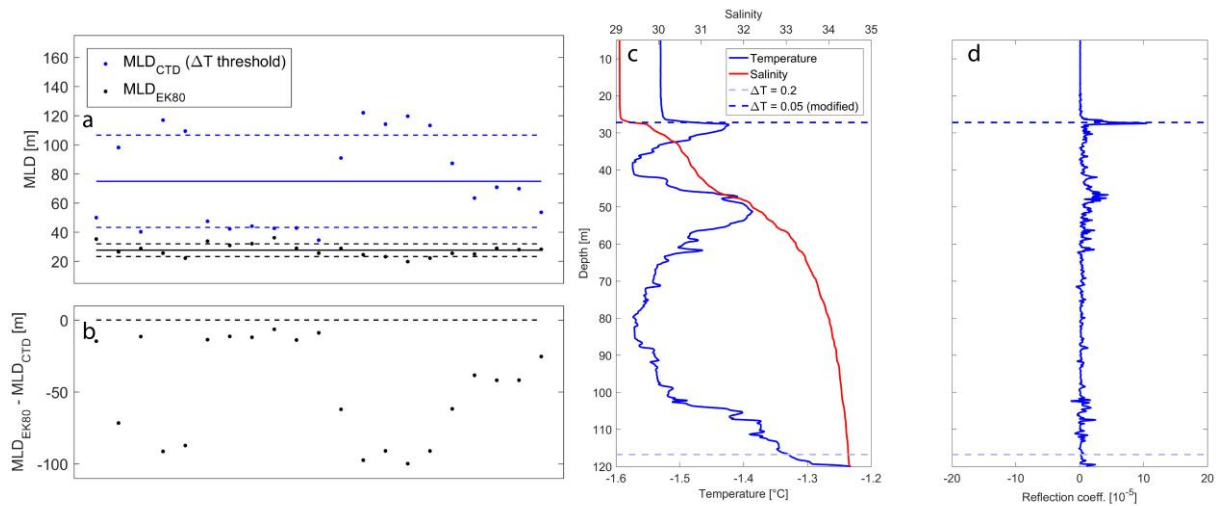


Figure S3. **a**  $MLD_{CTD}$  (blue dots) and  $MLD_{EK80}$  (black dots), mean values (solid lines) and plus/minus one standard deviation (dashed lines) for the AO2016 stations without  $\Delta T$  modification. **b** difference between  $MLD_{EK80}$  and  $MLD_{CTD}$ . **c** example of a CTD profile with temperature (blue) and salinity (red). **d** reflection coefficient profile derived from CTD data. Dark blue horizontal line show  $MLD_{CTD}$  derived from the modified  $\Delta T$  threshold and light blue from the non-modified  $\Delta T$  threshold. Note that the rmsd between  $MLD_{EK80}$  and  $MLD_{CTD}$  using the non-modified  $\Delta T$  is 58 m (compared to 3 when using the modified  $\Delta T$ ).

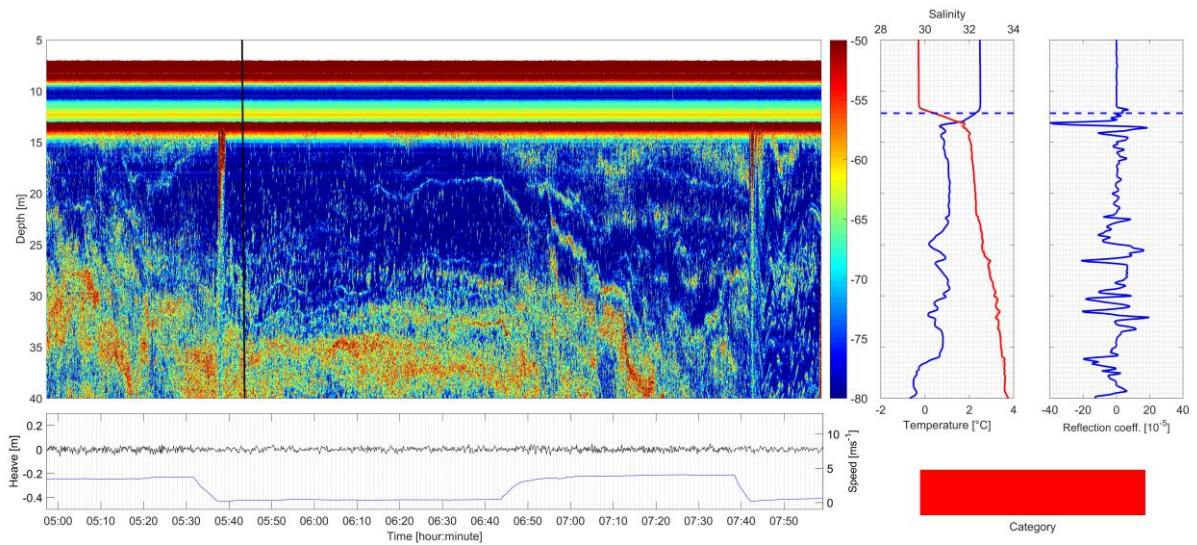


Figure S4. MLD detection failure due to loss of acoustic data close to the transducer. **a**, EK80 echogram. **b**, CTD profiles showing temperature (blue) and salinity (red). **c**, reflection coefficients derived from CTD data. **d**, heave (black), speed over ground (blue).

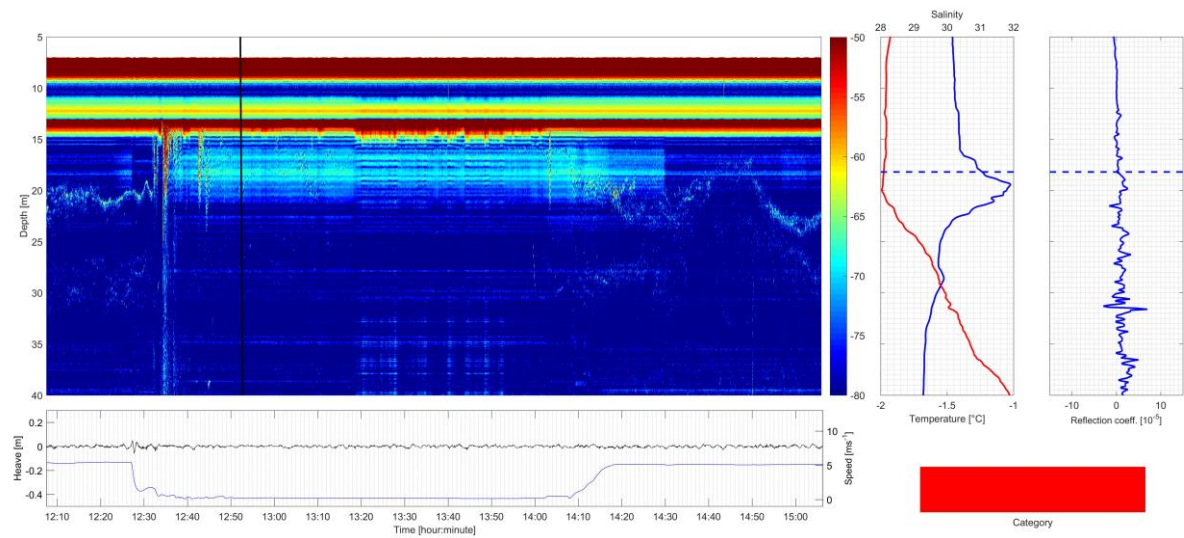


Figure S5. MLD detection failure due to noise from unknown source. **a**, EK80 echogram. **b**, CTD profiles showing temperature (blue) and salinity (red). **c**, reflection coefficients derived from CTD data. **d**, heave (black), speed over ground (blue).