Data processing: Masfjorden moorings 2021

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1 Background

Two moorings, $MF_{sill}21$ and $MF_{inner}21$, were deployed in Masfjorden, western Norway in February 2021 to study the flow across the sill and the evolution of water mass properties in the deep basin of the fjord. The moorings deployment is part of the educational activity at the Geophysical Institute, UiB.

2 Mooring overview

2.1 Deployment and recovery

The moorings were deployed during KB2021605 in February 2021, and were recovered in February 2022 during KB2022602 (Table 1).

Mooring	**Latitude**	**Longitude**	**Deployment**	**Recovery**
MF_{sill}	60°48.231	5°17.875	26/02/2021 10:00	04/02/2022 09:30
MF_{inner}	60°52.193	5°22.042	26/02/2021 13:05	03/02/2022 11:25

Table 1: Overview of mooring locations, and date and time of the moorings' deployment and recovery.

2.2 Instrumentation

The mooring set up of MF_{sill} and MF_{inner} is shown in Figure 1 and Figure 2, and information about the instruments is given in Table 2 and Table 3.

2.3 Instrument failure

The RDCP at MF_{sill} did not record any velocities. The SBE37-ODO (sn 12338) at MF_{inner} had leaked and no data were recorded.

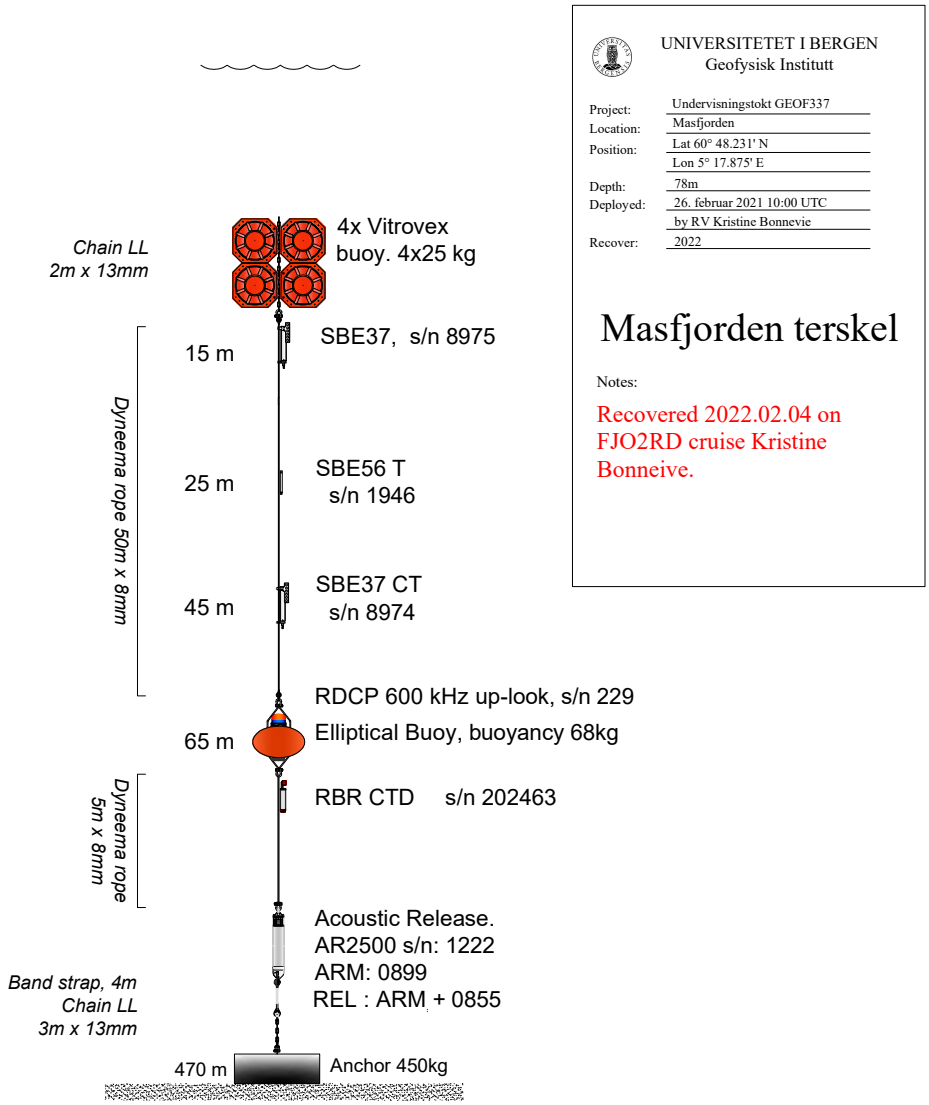

Figure 1: Schematic of MF_{sill}.

Instrument (depth)	**Start**	**End**	**Sampling interval**	**Parameters**
SBE37 s/n 8975 (15 m)	25/02/2021 10:00	04/02/2022 16:40	Every 5. minute	C, T
SBE56 s/n 1946 (25 m)	25/02/2021 10:00	04/02/2022 15:43	Every minute	T
SBE37 s/n 8974 (45 m)	25/02/2021 10:00	04/02/2022 16:05	Every 5. minute	C, T
RDCP s/n 229 (65 m)	- -	- -	- -	No data
RBR s/n 202463 (66 m)	25/02/2021 10:00	04/02/2022 15:03	Every minute	C, T, P

Table 2: Overview of the instrumentation on MF_{sill} (T - temperature, C - conductivity, P - pressure).

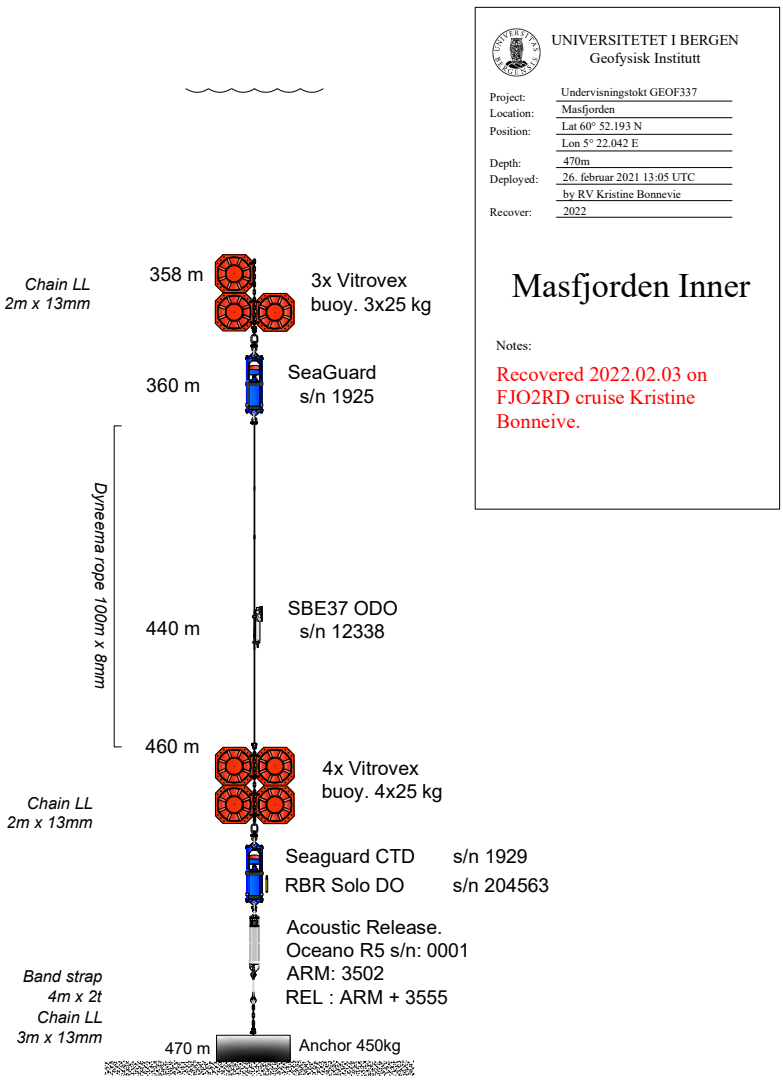

Figure 2: Schematic of MF Inner.

Instrument (depth)	**Start**	**End**	**Sampling interval**	**Parameters**
SeaGuard s/n 1925 (370 m)	25/02/2021 11:00	03/02/2022 14:00	Hourly	T, C, P, u,v
SBE37 ODO s/n 12338 (440 m)	- -	- -	- -	No data
SeaGuard s/n 1929 (460 m)	26/02/2021 12:00	03/02/2022 13:00	Hourly	T, C, P, u,v
RBR Solo DO s/n 204563 (460 m)	25/02/2021 10:00	03/02/2022 13:13	Every minute	DO

Table 3: Overview of the instrumentation on MF_{inner} (T - temperature, C - conductivity, P - pressure, DO - dissolved oxygen, and u,v - components of the current).

3 Data processing

3.1 Temperature records at MF_{inner}

The temperature records at MF_{inner}, collected by Seaguards, were compared to the temperature observed by CTD profiles obtained within 5 km of the mooring position on cruises KB2021605 (February, mooring deployment), KB2021610 (August), DFN2021406 (September) and KB2022602 (February, mooring recovery). For each cruise, the mean offset between the temperature registered at the mooring (in a one day long time-window around the time of occupation) and that recorded by the CTD (vertical mean of temperatures observed 10 m above/below the instrument depth) were inferred, and the cruise mean offset at each instrument level (Table 4) was then used to correct the mooring records (Figure 3).

Serial number	Correction [°C]
1929	0.006
1925	0.022

Table 4: Corrections applied to the temperature records from MF_{inner}.

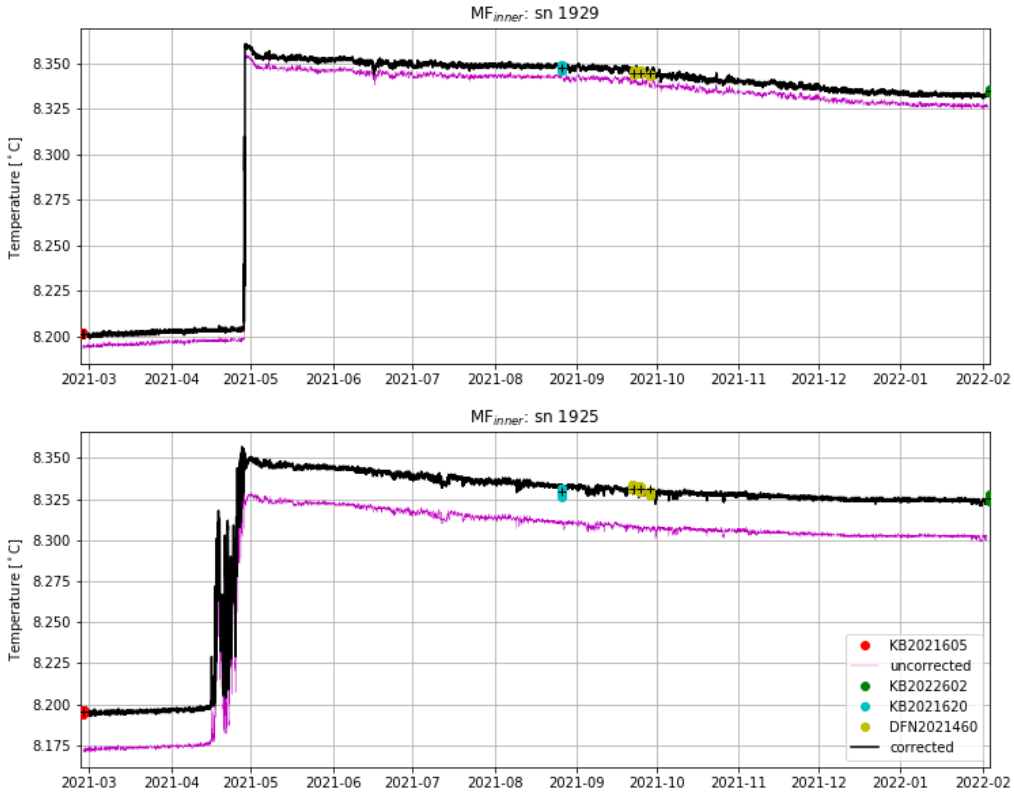

Figure 3: Raw (magenta) and corrected (black) temperature records from MF_{inner} and the corresponding temperature observed at the mooring depths in nearby CTD-profiles (circles). The black crosses show the mean temperature from each cast in the depth range included (see text for details).

3.2 Salinity records at MF_{inner} and MF_{sill}

All salinity records were despiked. Outliers were identified (and removed) as follows: mean and standard deviation were found in 1000 data points long segments, and values deviating from the mean value by more than 4 x std were removed, the procedure was repeated once, and the second time values deviating from the mean value by more than 3 x std were removed.

3.2.1 MF_{inner}

The salinity records from MF_{inner} were compared to the salinity observed by CTD following the same procedure as for temperature (see above, Fig. 4). Since sn 1929 show a large drift (1.5 salinity units over the deployment period) and sn 1925 show an unphysical increase ("bump") in the first part of the record it was concluded that salinity records can not be trusted and the data were discarded.

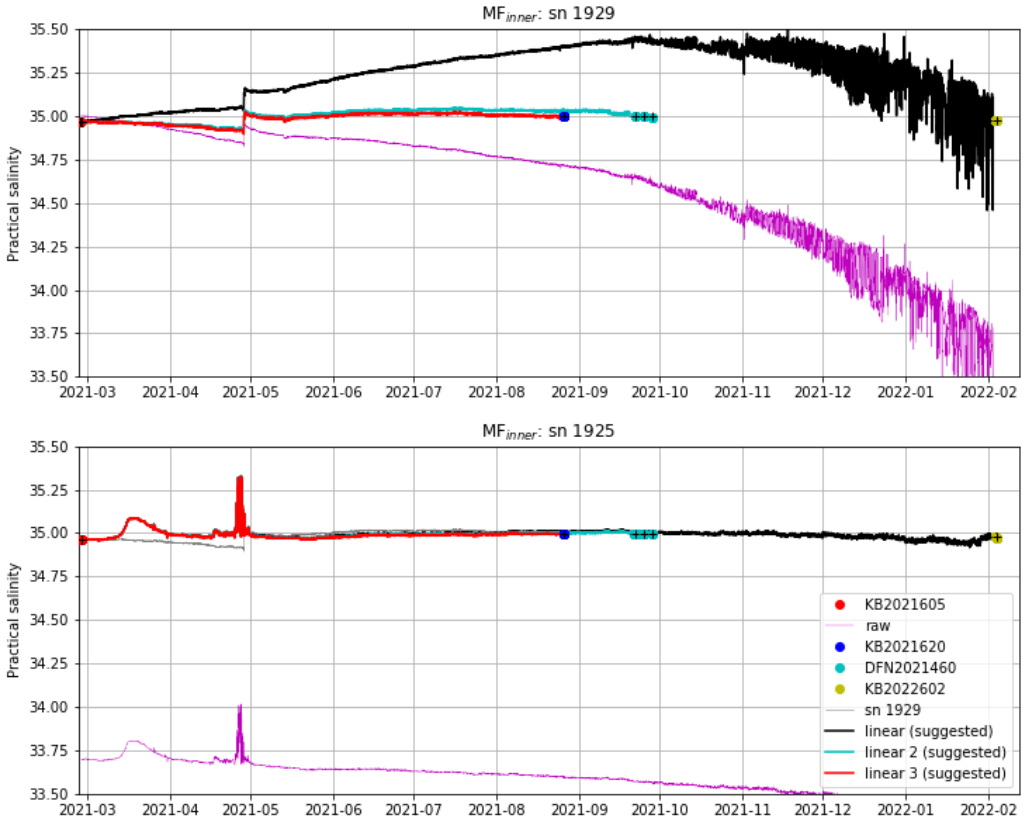

Figure 4: Raw (magenta) and attempts to correct the time series for drift using linear correction based (black) salinity records from MF_{inner} and the corresponding salinity observed at the mooring depths in nearby CTD-profiles (circles). The black crosses show the mean salinity from each cast in the depth range included (see text for details).

3.2.2 MF_{sill}

The salinity records from MF_{sill} were compared to CTD measurements in temperature-salinity (TS) - diagrams. We identified CTD profiles from within 1 km of the mooring location from cruises KB2021605, DFN2021406, and KB2022602, and compared them to mooring data from a 1-day-long time window centered around the time of CTD occupation. The data was divided into 0.1°C wide

temperature bins, and the mean and standard deviation in each bin was calculated (Fig. 5).

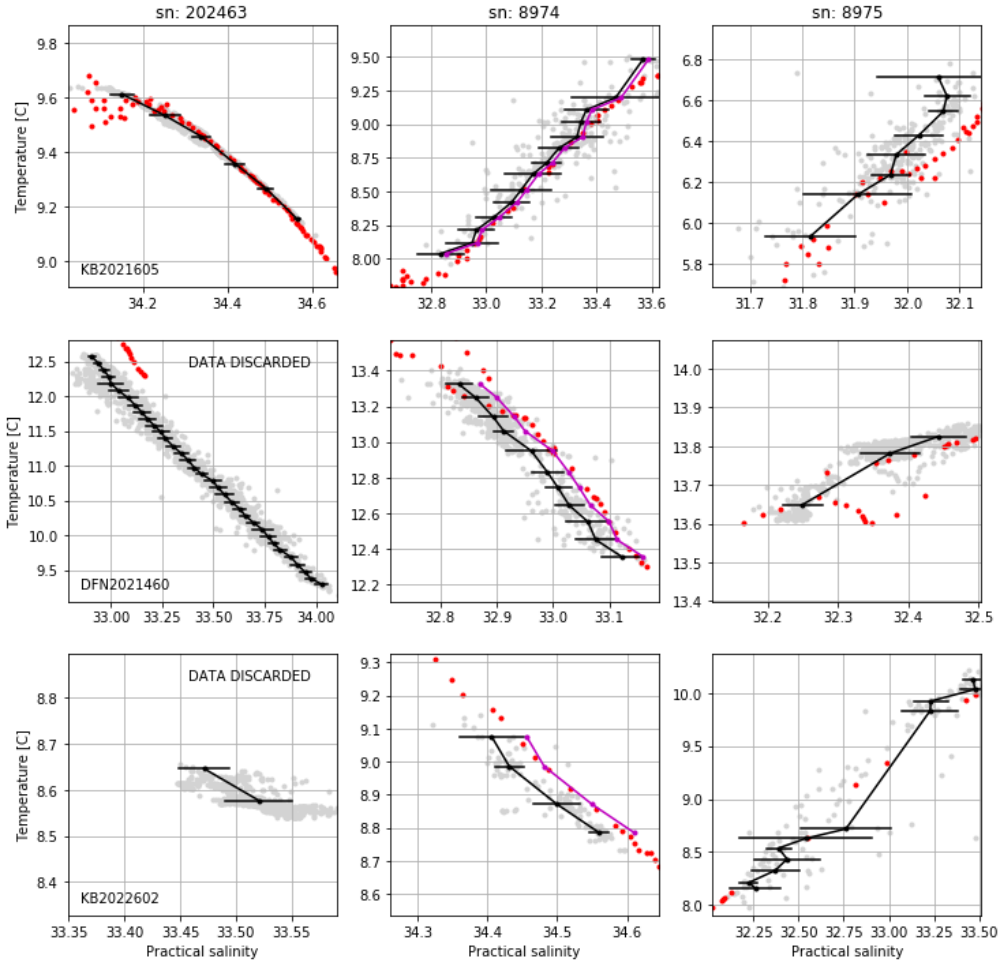

Figure 5: Comparison between CTD-profiles (red dots) and mooring data (grey dots). The black dots(horizontal lines) show the mooring mean (standard deviation) salinity in temperature bins. Only results from bins with more than 10 data points are shown. The magenta lines show the correction applied (middle column only, see text)

Visual inspection suggest offsets of dS=0.02 (dS=0.07), where $S_{corrected}$=S_{raw}+dS, for sn 8974 at deployment (recovery). Assuming a linear drift in time we applied a correction that varies linarly in time to the raw time series. The agreement in September (Fig. 5 second row, middle panel) suggest that the correction is reasonable.

No correction was applied to the other two instruments. We note, however, that the variability at the shallowest level (sn 8975) was high and that the uncertainty in this record accordingly is higher. Large offsets for sn 202463 was observed in the comparison with CTD data from DFN2021406 and KB2022602 (Figure 5, first column, middle and lower panel). By investigating the evolution of mooring data in TS diagrams from a 2-day window starting at mooring deployment, we identified strange measurements and unrealistic behaviour beginning mid-August (not shown). Hence, data recorded after 1. August 2021 by sn 202463 were discarded. An additional comparison of sn 202463 to corrected sn 8974 was carried out to further investigate the offset evolution in sn202463, which showed

a non-linear behaviour between February 2021 and July 2021 (Figure 6).

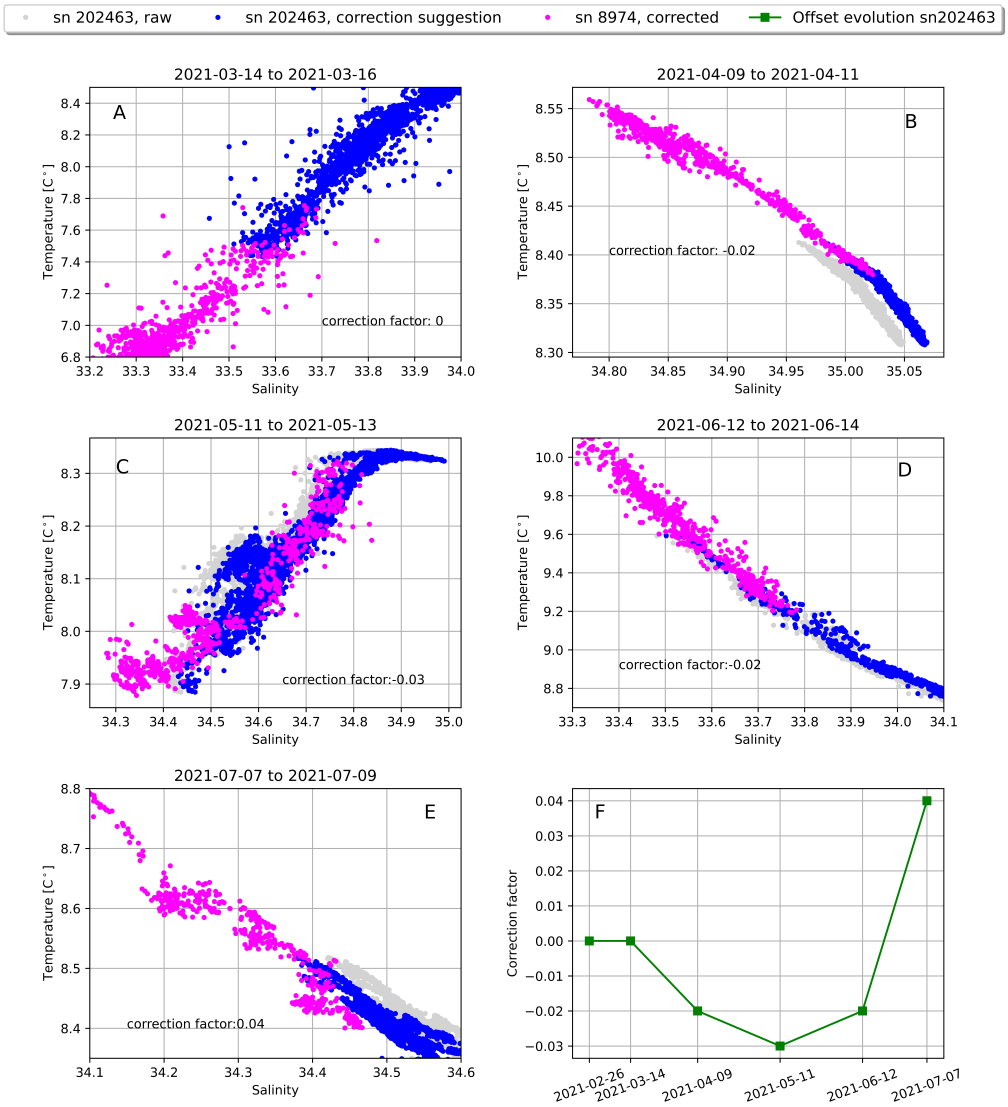

Figure 6: A-E) Raw (grey) and suggested correction (blue) sn 202463 for March 2021 - July 2021, where offset/suggested correction factor was determined from comparison with corrected sn 8974 (orange). F) Offset evolution for sn 202463 between deployment and July 2021, where offset at deployment was determined from comparison with CTD (Figure 5, first column, upper panel) and the rest is the results from A-E.

3.3 Oxygen records at MF_{inner}

3.3.1 MF_{inner}

The oxygen record from MF_{inner} were compared to the oxygen observed by CTD following the same procedure as for temperature (see above, Fig. 7). There is poor agreement between the mooring

records and the CTD observations and it was concluded that the oxygen record can not be trusted and the data were discarded.

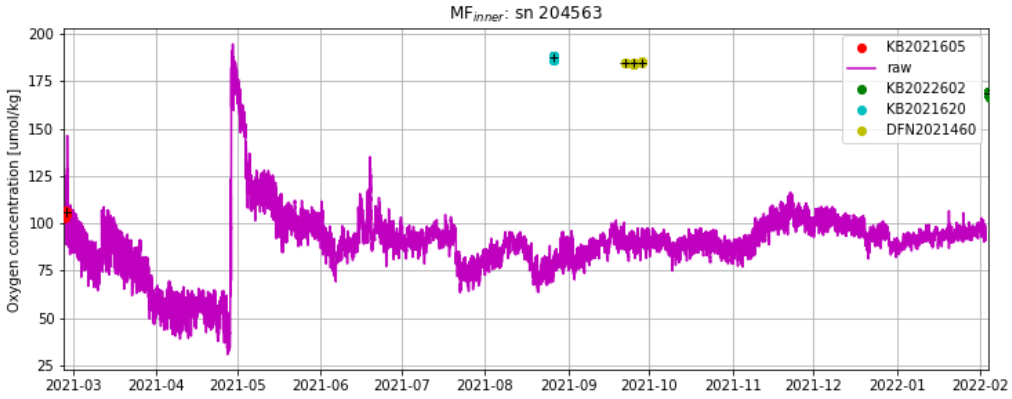

Figure 7: Raw (magenta) oxygen records from MF$_{inner}$ and the corresponding oxygen observed at the mooring depths in nearby CTD-profiles (circles). The black crosses show the mean oxygen from each cast in the depth range included (see text for details).