Acoustic Doppler Current Profiler (ADCP) data

Nansen and Amundsen Basins Observational System (NABOS) program

September 2013 – September 2015

1. Variables included in this data set

Separate files are used for output of each ADCP instrument. The ADCP data files contain the following observations:

- Depth of the first ADCP bin (m),
- Vertical bin resolution (m),
- Eastward velocity (mm/s; magnetic declination has been introduced),
- Northward velocities (mm/s; magnetic declination has been introduced)

In addition, directory raw_data for each instrument includes binary files (in PD0-format) and ASCII export file produced by WinADCP software (Teledyne RD Instruments). ASCII files include time stamp, actual depth of the instrument (in meters), echo amplitudes for four ADCP beams, eastward, northward, and vertical velocities in mm/s, and percent of good signals (four types). Magnetic declination was not introduced into velocities.

All velocity measurements are in mm/s as they converted from acoustic signals by the RD Instrument software.

2. Equipment

Workhorse Sentinel ADCP (300 kHz)
Workhorse Long Ranger ADCP (75 kHz)

Long Ranger ADCP specification:
Frequency: 75 kHz
Max Range: up to 600m
Configuration: Self-contained
Velocity accuracy: ± 1% ± 5mm/s
Velocity resolution: 1mm/s
Velocity range: ± 5m/s default, ± 10m/s max
Depth cell size: 4–32m
Number of depth cells: 1–128
Ping rate: 1Hz (typical)

Workhorse Sentinel ADCP specification:
Frequency: 300 kHz
Max Range: 110 meters
Configuration: Self-contained
Velocity accuracy: 0.5% of the water velocity relative to ADCP ±0.5cm/s
Velocity resolution: 0.1cm/s

Velocity range: ±5m/s (default) ±20m/s (max)
Number of depth cells: 1–255
Ping rate: Up to 10Hz

ADCP calibration:
- ADCP compasses were calibrated as per manufacturers instructions in Kirkenes, Norway (Lat 69.7N, Lon 30E) prior to embarkation;
- Data requiring speed of sound in water is corrected by the ADCP using the water temperature measured by the ADCP (if available);
- Intensity of returned signals is not specially calibrated.

3. Data format

ADCP data file includes a short header with information about vertical bin resolution, bin number, and titles for data columns. Each data row starts with date/time stamp, which has the following format: DDMMYYYYhhmm, where DD, MM, YYYY, hh, and mm are day, month, year, hour, and minutes of ADCP measurements, respectively. All ADCP instruments used GMT for this time stamp. The second column contains real depth of the first (nearest to the instrument) ADCP bin – the center of this bin was calculated taking into account instrumental blank space and bin resolution. Depths of other bins can be calculated by adding depth increment specified in the file header. After the date/time stamp, two components of current velocities (eastward and northward) for each ADCP bin are provided, starting from the first bin. In case of missing values or data quality concerns the specific error code (-9999) was used to replace observations.

4. Data processing

In September 2015, all ADCP instruments from moorings deployed in 2013 were successfully recovered during 2015 NABOS Cruise aboard the *R/V Academik Tryoshnikov (see Cruise Report for details).* Data processing of ADCP data includes conversion from original (binary) files, collected at the instrument's flash card, to Matlab formats, which was performed using WinADCP software available at RDI website (http://rdinstruments.com). After conversion magnetic declination determined from the International Geomagnetic Reference Field for the mooring positions (see www.ngdc.noaa.gov/IAGA/vmod/) was added to the ADCP current direction. ADCP data files include all bins up to the surface although bins near the surface contain much larger errors (likely due to surface effects) and should be treated with caution. Processed data have been archived in different formats and converted to ASCII files using Matlab scripts.

Processing of the 75kHz ADCP (s/n 19062) from the $M1_4$ mooring required additional effort. During processing it was discovered that if data was processed using the standard procedure very noisy results were produced. A comparison with data from the 300 kHz ADCP (s/n 11240), located higher up the mooring, indicated that there was a useful signal component within the noise (Fig 1), however additional analysis was required to understand the source of the high noise level and to extract useful metrics from the data.

The manufacturers (Teledyne RD Instruments) were contacted and provided valuable guidance throughout this process. The pre-deployment records were checked and revealed no indication of any problems at that point. Diagnostic data recovered from the instrument after its deployment suggest that the third beam suffered a deterioration in performance soon after deployment and the instrument reverted to a 3-beam solution for velocities for the remainder of its time in the water (Fig 2, Fig 3). However, numerous attempts to suppress the noise using 3-beam solutions coupled with a variety of corrections, for example those based on percentage of good data returns, failed. We could not get comparable statistical estimates of current velocities (means, standard deviations) that would correspond to the nearest bins from ADCP 300 kHz (s/n 11240). Through a process of trial and error we found that by applying a 24 hour running average filter we could achieve substantial improvement in the current record. For example, original level of variations estimated by SD was 15.89 (21.22) cm/s for the U (V) current component provided by the 55th bin. After filtering, SD became 2.41 (2.88) cm/s for U (V) current components (compare with 2.73 (2.99) cm/s from the ADCP 300 kHz nearest bin). Filtered records are shown in Fig. 4. Comparison of filtered ADCP 75 kHz 55th bin record and ADCP 300 kHz nearest second bin record suggests that the processed and filtered ADCP 75 kHz data may be used for analysis of low-frequency variability (Fig. 5); high-frequency processes cannot be analyzed using this record, however.

5. Acknowledgements and contact information

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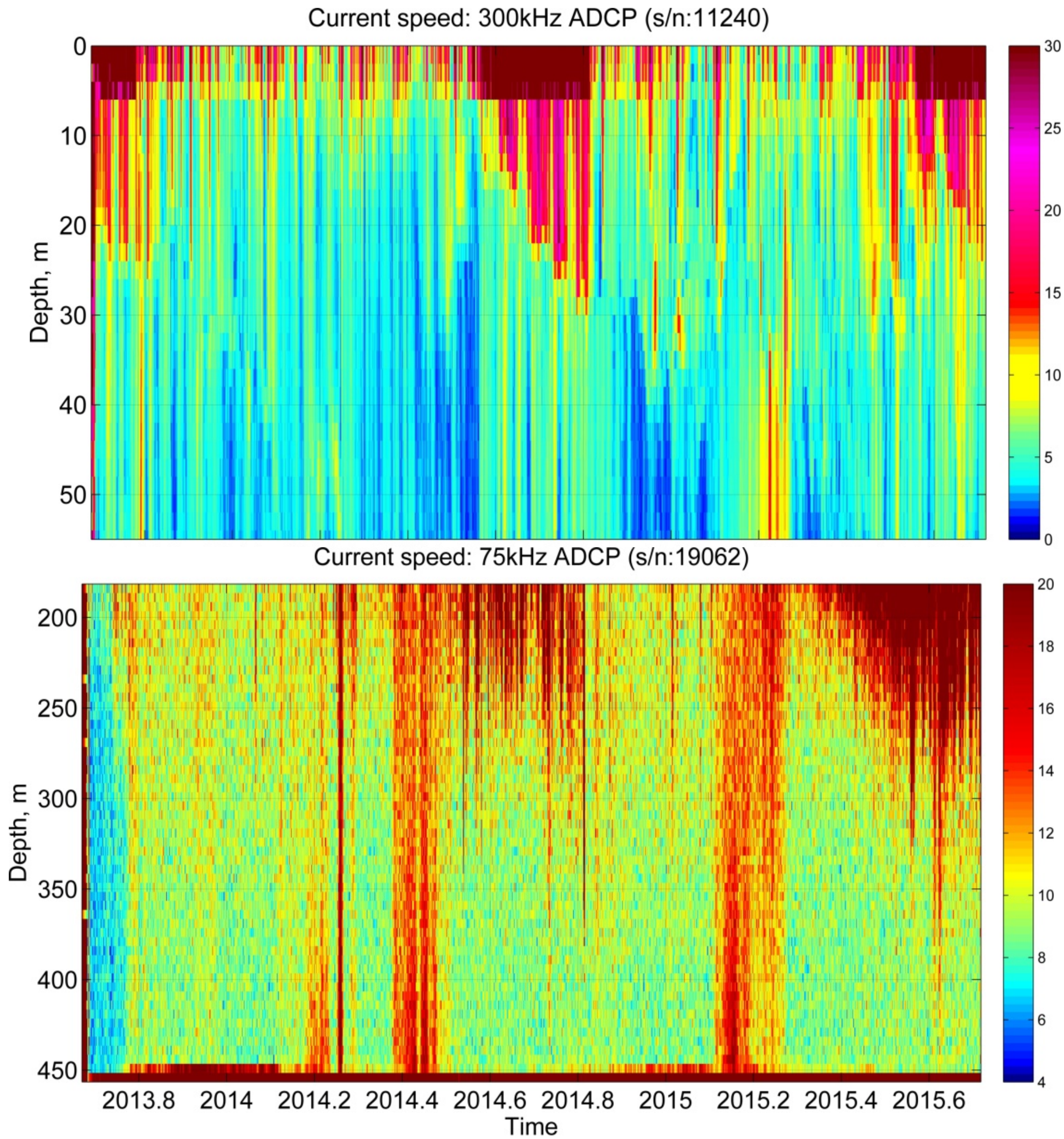

Figure 1: Depth vs. time diagram of current speed (cm/s) derived from ADCP-300 #11240 (top) and ADCP-75 #19062 (bottom) deployed at M1-4a mooring.

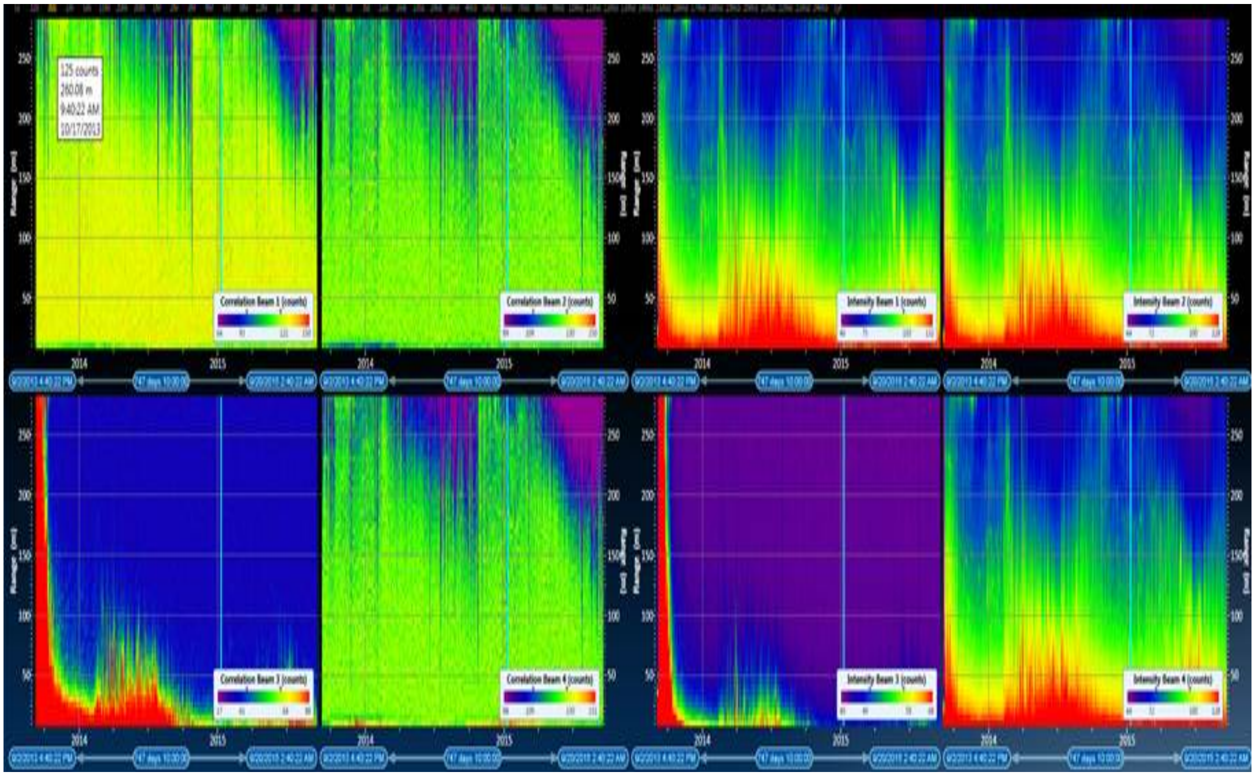

Figure 2: Correlations (left four panels) and the received signal strength indicator value (RSSI, right four panels) for four beams from the ADCP 75 kHz s/n 19062. The third beam (left bottom panels of the two halves of figure) shows erroneous data; other beams provided good records. Figure provided by RDI.

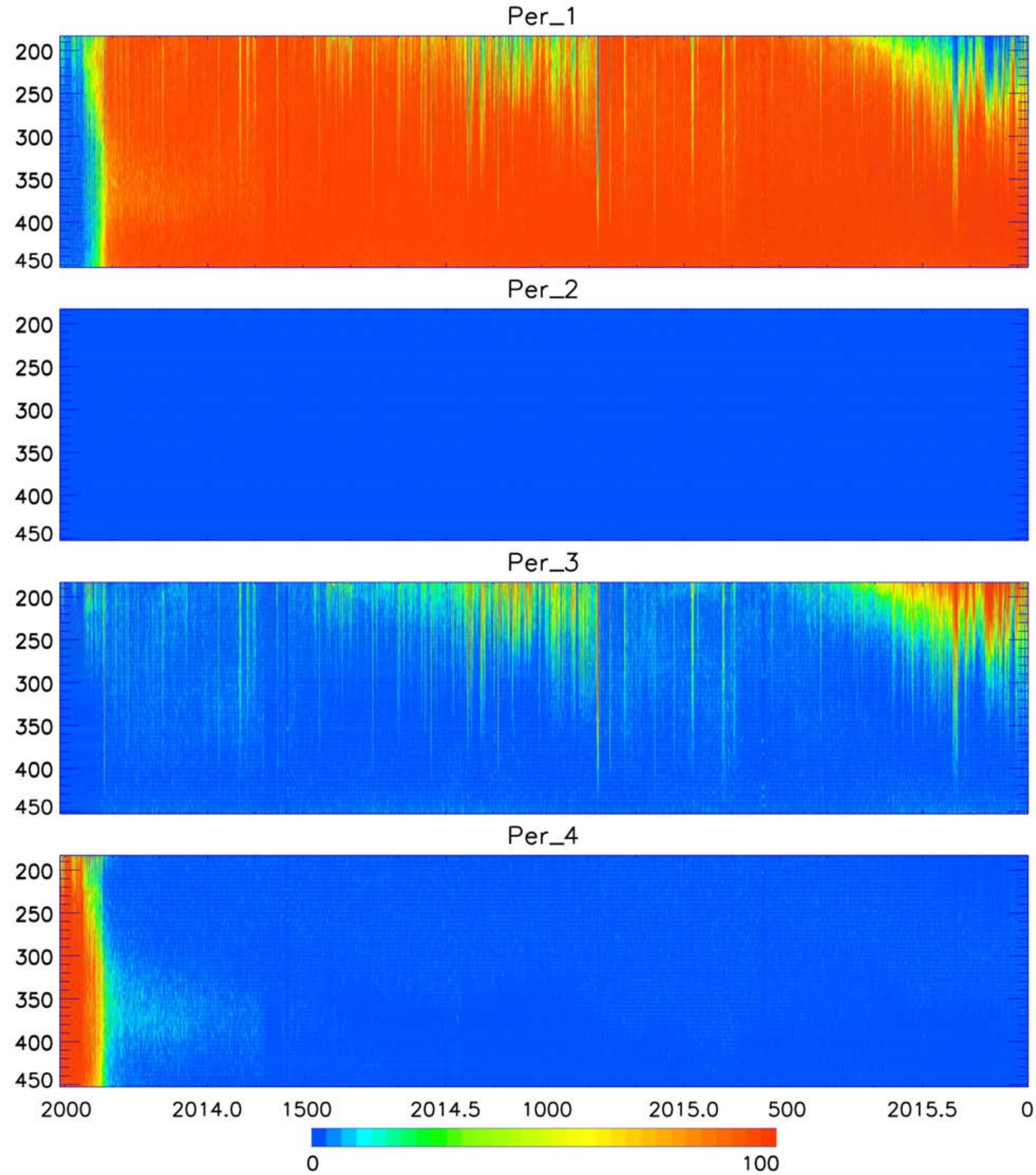

Figure 3: ADCP 75 kHz s/n 19062 PER (percent of good data) parameter for four beams.

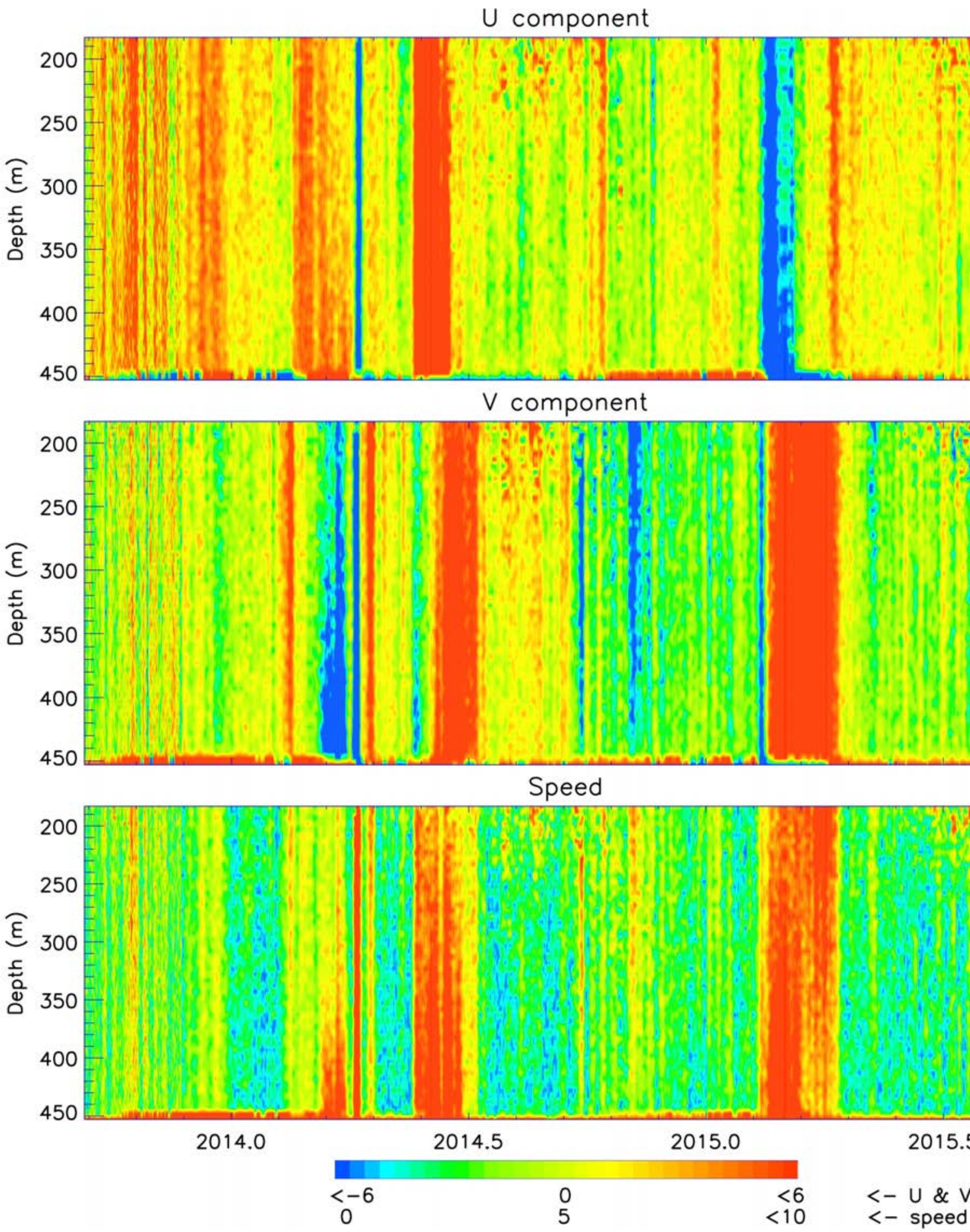

Figure 4: ADCP 75 kHz s/n 19062 current record after processing using standard processing procedures and a *low-pass filter*.

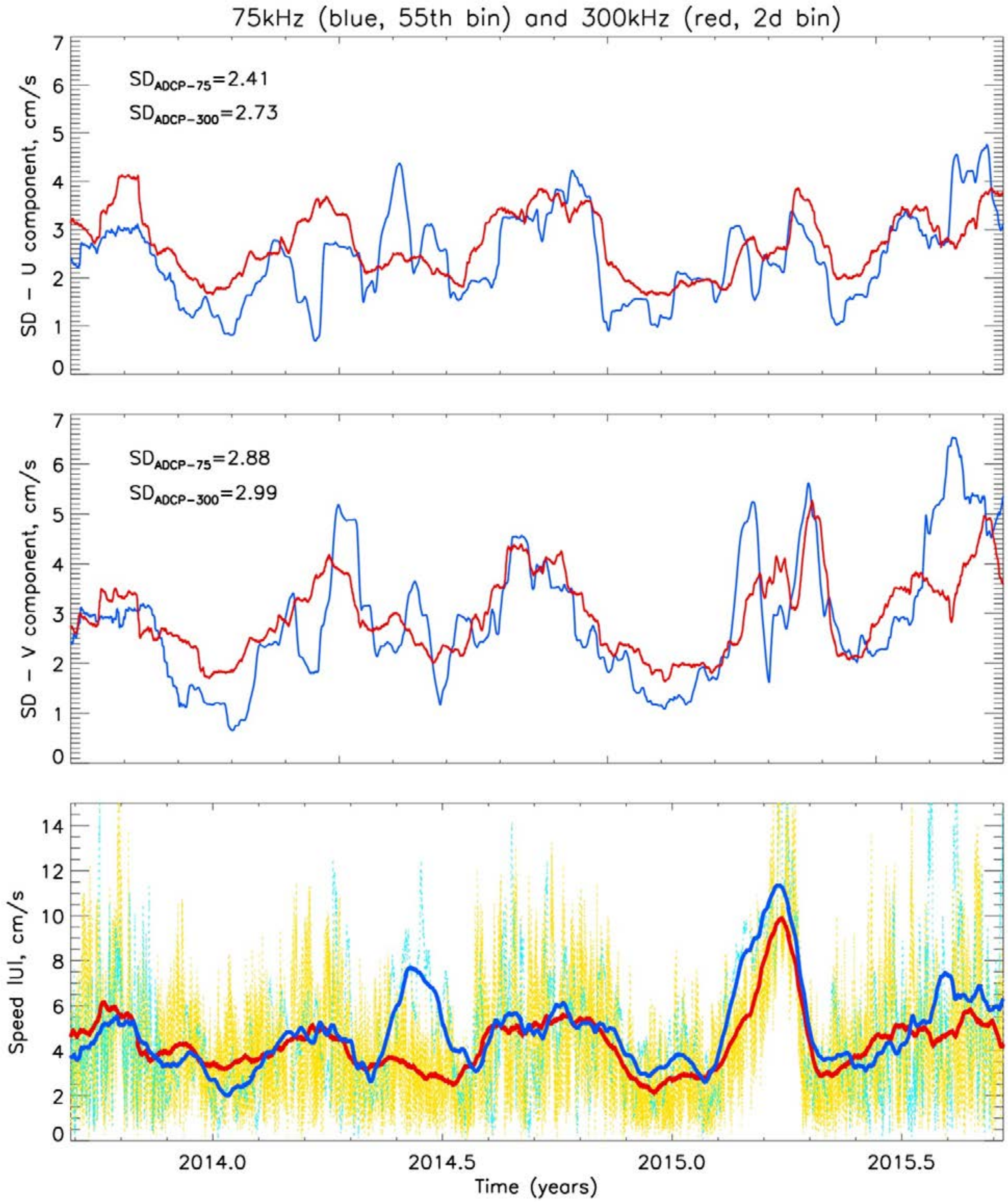

Figure 5: (Top and middle) Standard deviations (SD) computed from 30-day running window for ADCP 75 kHz 55 bin and ADCP 300 kHz 2 bin for U (top) and V (middle) current components; the ADCP 75 kHz record was filtered using low-pass filter. (Bottom) Current speed for the same ADCP records (raw data are shown by dotted lines, 30-day running mean data are shown by solid lines).