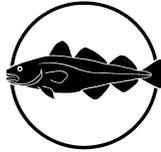


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Fiskirannsóknarstovan



Nordic WOCE shallow-water ADCP calibrations 1995 - 96

by

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In the shallow-water ADCP deployments, the ADCP's are surrounded by large steel frames, which affect the ADCP compass so much, that the measurements of heading are heavily biased. Attempts to perform on-shore calibration failed to give reliable results and instead, a special calibration rig has been deployed at each of the two sites NWSA and NWSA for a few hours immediately after deployment and prior to recovery of the ADCP's.

In the usual setup, the calibration rig includes two Aanderaa RCM7 current meters with serial numbers 9494 and 10309 which are 58 and 69 meters above bottom respectively (Fig. 1). At the very first deployment in Nov. 1995, two other instruments were used, RCM 10069 at the top and RCM 10067 at the deeper level; otherwise this rig was identical to the others. Tables 1 and 2 list locations and measuring periods for the four calibration rig deployments as well as their associated ADCP deployments.

To evaluate the compass heading bias, ADCP current directions from bin 5 and bin 6 (centered at 56 and 66 m above bottom) were compared to the compass readings from RCM 9494 and RCM 10309 respectively for each reading during the calibration periods. The result is discussed below for each site separately.

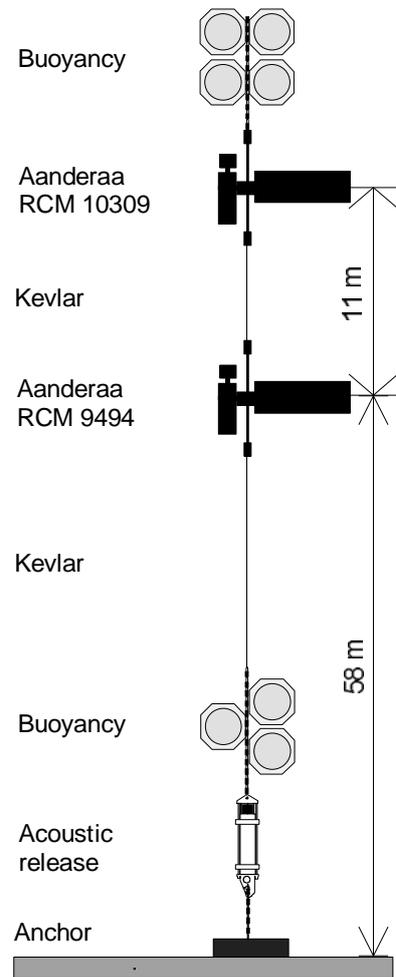


Figure 1. Calibration rig. Vertical distances not to scale.

Table 1. Positions, bottom depths, measuring period and intervals for the 1995 - 96 NWSA ADCP and associated Aanderaa calibration deployments.

Instrum.	Latitude	Longitude	Bott. depth	Measuring period	Interval
ADCP	61° 00.069'N	05° 50.027'W	298 m	95/11/10 09:00 - 96/05/27 17:30	15 min.
Calibration rig	60° 59.987'N	05° 49.303'W	300 m	95/11/10 10:20 - 95/11/10 12:00	05 min.
Calibration rig	60° 59.851'N	05° 49.025'W	298 m	96/05/24 04:25 - 96/05/24 06:00	05 min.

Table 2. Positions, bottom depths, measuring period and intervals for the 1995 - 96 NWSA ADCP and associated Aanderaa calibration deployments.

Instrum.	Latitude	Longitude	Bott. depth	Measuring period	Interval
ADCP	62° 42.370'N	06° 05.310'W	302 m	96/01/24 10:31 - 96/05/26 10:16	15 min.
Calibration rig	62° 42.351'N	06° 05.562'W	303 m	96/01/24 10:54 - 96/01/24 12:40	01 min.
Calibration rig	62° 42.430'N	06° 05.508'W	304 m	96/05/23 06:00 - 96/05/23 15:25	05 min.

NWSA current direction calibration

For NWSA, the instrument heading measured by the ADCP was unchanged 21° (within 2°) throughout the measuring period with constant pitch (about 2.5°) and roll (about 2°). Thus, there is no indication that the ADCP changed direction during the deployment.

At this site, the calibration rig was deployed for about two hours in November 1995 immediately after deployment of the ADCP and for about two hours in May 1997 before recovery (Table 1). Tables 3 and 4 summarize the results of the two calibration experiments at NWSA.

Table 3. Comparison of current direction measured by the NWSA ADCP and the two Aanderaa current meters during the first calibration experiment in November 1995. For the Aanderaa current meters, the speed and direction shown are the averages of the two instruments (with direction corrected for magnetic deviation by adding -11°), while shear is the difference in direction between them. The direction shown for the ADCP is the direction of the vectorially averaged current vectors of bin 5 and bin 6.

Time (GMT)	Measured by Aanderaa current meters			Measured by ADCP Direction	Aanderaa - ADCP Direction
	Speed (cm/s)	Direction	Shear		
10 Nov 1995 10:30	26.7	109°	2°	98°	+11°
10 Nov 1995 10:45	25.1	88°	0°	84°	+4°
10 Nov 1995 11:00	23.9	102°	3°	100°	+2°
10 Nov 1995 11:15	22.8	125°	1°	93°	+32°
10 Nov 1995 11:30	8.0	106°	0°	113°	-7°

Average for the first NWSA calibration period: $+8^{\circ} \pm 7^{\circ}$

Table 4. Comparison of current direction measured by the NWSA ADCP and the two Aanderaa current meters during the second calibration experiment in May 1996. For the Aanderaa current meters, the speed and direction shown are the averages of the two instruments (with direction corrected for magnetic deviation by adding -11°), while shear is the difference in direction between them. The direction shown for the ADCP is the direction of the vectorially averaged current vectors of bin 5 and bin 6.

Time (GMT)	Measured by Aanderaa current meters			Measured by ADCP Direction	Aanderaa - ADCP Direction
	Speed (cm/s)	Direction	Shear		
24 May 1996 04:40	16.7	179°	3°	192°	-3°
24 May 1996 04:55	16.5	188°	1°	160°	+28°
24 May 1996 05:10	15.3	194°	4°	189°	+5°
24 May 1996 05:25	15.5	201°	1°	206°	-5°
24 May 1996 05:40	16.7	213°	1°	217°	-4°
24 May 1996 05:55	20.0	221°	0°	214°	+7°
24 May 1996 06:10	21.2	225°	3°	256°	-31°

Average for the second NWSA calibration period: $0^{\circ} \pm 7^{\circ}$

The last line in Tables 3 and 4 shows the average value of the difference between the Aanderaa and the ADCP directions as well as its standard error. Since the measured heading is constant, this value is the compass correction which should be added to the measured ADCP current directions. The Compass corrections from Table 3 and Table 4 are consistent with one another within the standard errors. We have chosen to use the average correction from both experiments:

Calibration for NWSA: Corrected current direction = Measured current direction + 4°

NWNA current direction calibration

For NWNA, the instrument heading measured by the ADCP was unchanged 281° (within 2°) throughout the measuring period with constant pitch (about -4°) and roll (about -2°). Thus, there is no indication that the ADCP changed direction during the deployment.

At this site, the calibration rig was deployed for about two hours in January 1996 immediately after deployment of the ADCP and for about nine hours in May 1997 before recovery (Table 1). Tables 5 and 6 summarize the results of the two calibration experiments at NWNA.

Table 5. Comparison of current direction measured by the NWNA ADCP and the two Aanderaa current meters during the first calibration experiment in January 1996. For the Aanderaa current meters, the speed and direction shown are the averages of the two instruments (with direction corrected for magnetic deviation by adding -12°), while shear is the difference in direction between them. The direction shown for the ADCP is the direction of the vectorially averaged current vectors of bin 5 and bin 6.

Time (GMT)	Measured by Aanderaa current meters			Measured by ADCP Direction	Aanderaa - ADCP Direction
	Speed (cm/s)	Direction	Shear		
24 Jan 1996 11:01	26.9	20°	2°	42°	-22°
24 Jan 1996 11:16	26.6	30°	2°	15°	+15°
24 Jan 1996 11:31	25.7	36°	2°	38°	-2°
24 Jan 1996 11:46	25.4	43°	5°	51°	-8°
24 Jan 1996 12:01	27.6	51°	2°	50°	+1°
24 Jan 1996 12:16	28.0	55°	6°	56°	-1°
24 Jan 1996 12:31	27.1	59°	3°	57°	+2°

Average for the first NWNA calibration period: $-2^{\circ} \pm 4^{\circ}$

Table 6. Comparison of current direction measured by the NWNA ADCP and the two Aanderaa current meters during the second calibration experiment in May 1996. For the Aanderaa current meters, the speed and direction shown are the averages of the two instruments (with direction corrected for magnetic deviation by adding -12°), while shear is the difference in direction between them. The direction shown for the ADCP is the direction of the vectorially averaged current vectors of bin 5 and bin 6. Only the period with speed exceeding 10 cm/sec is included.

Time (GMT)	Measured by Aanderaa current meters			Measured by ADCP Direction	Aanderaa - ADCP Direction
	Speed (cm/s)	Direction	Shear		
23 May 1996 11:05	11.0	14°	4°	4°	+10°
23 May 1996 11:20	11.3	23°	10°	-9°	+32°
23 May 1996 11:35	11.9	31°	11°	-9°	+40°
23 May 1996 11:50	13.6	34°	7°	23°	+11°
23 May 1996 12:05	15.0	39°	8°	34°	+5°
23 May 1996 12:20	15.2	43°	5°	16°	+27°
23 May 1996 12:35	15.1	47°	7°	31°	+16°
23 May 1996 12:50	13.3	51°	8°	46°	+5°
23 May 1996 13:05	14.6	59°	17°	41°	+18°
23 May 1996 13:20	14.5	60°	3°	46°	+14°
23 May 1996 13:35	14.8	67°	1°	58°	+9°
23 May 1996 13:50	14.9	76°	9°	56°	+20°
23 May 1996 14:05	16.0	86°	11°	61°	+25°
23 May 1996 14:20	16.1	98°	11°	89°	+9°
23 May 1996 14:35	15.9	107°	12°	91°	+16°
23 May 1996 14:50	16.5	114°	10°	98°	+16°

Average for the second NWNA calibration period: $+17^{\circ} \pm 3^{\circ}$

Comparing Table 5 and table 6, a discrepancy is found. The two directional corrections found in the first and the second calibration experiment, respectively do not agree within the standard errors. This is perhaps not surprising, taking into account the low current speeds and high shears observed during the second calibration experiment especially. We have chosen to use the average correction from both experiments:

Calibration for Nwana: Corrected current direction = Measured current direction + 8°

Tórshavn 8 April 1998