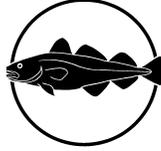


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Fiskirannsóknarstovan



Nordic WOCE shallow-water ADCP calibrations 1996 - 97

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.

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). Tables 1 and 2 list locations and measuring periods for the four calibration rig deployments as well as their associated ADCP deployments. The two Aanderaa current meters were set to 5 minute intervals while the ADCP's logged at 20 minute intervals.

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.

NWSA current direction calibration

For NWSA the instrument heading (and pitch and roll) measured by the ADCP changed slowly during the first 10 months of the deployment period from 352° in the beginning to 350° in mid-May. Then, on 16th of May 1997, between 15:00 and 15:20 hour the heading decreased to 346° at the same time as the pitch decreased from 4.8 to 1.5 and the roll increased from 1.4 to 9.1. Clearly the instrument package - possibly including the surrounding steel frame - was turned physically. After that, the measured heading decreased slowly to 345° during the remainder of the deployment.

At the NWSA site, the calibration rig was deployed for about six hours in June 1996 immediately after deployment of the ADCP and for about three hours in May 1997 before recovery (Table 1). Tables 3 and 4 summarize the results of the two calibration experiments at NWSA.

Table 1. Positions, bottom depths, measuring period and intervals for the 1996 - 97 NWSA ADCP and associated Aanderaa calibration deployments.

Instrum.	Latitude	Longitude	Bott. depth	Measuring period	Interval
ADCP	60° 59.818'N	05° 50.459'W	295 m	96/06/14 07:20 - 97/05/23 12:00	20 min.
Calibration rig	60° 59.858'N	05° 50.715'W	296 m	96/06/14 08:20 - 96/06/14 14:20	05 min.
Calibration rig	61° 00.480'N	05° 51.331'W	294 m	97/05/23 07:20 - 97/05/23 10:40	05 min.

Table 2. Positions, bottom depths, measuring period and intervals for the 1996 - 97 NWSA ADCP and associated Aanderaa calibration deployments.

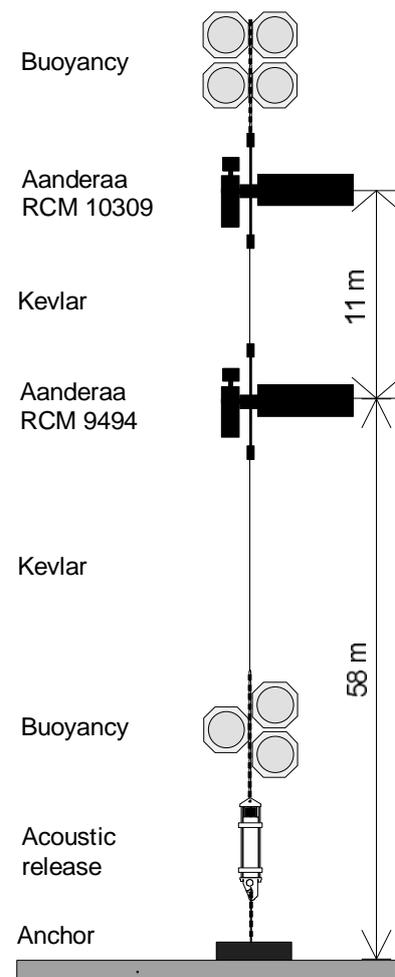


Figure 1. Calibration rig. Vertical distances not to scale.

Instrum.	Latitude	Longitude	Bott. depth	Measuring period	Interval
ADCP	62° 41.928'N	06° 04.665'W	292 m	96/06/16 12:40 - 97/05/22 13:00	20 min.
Calibration rig	62° 42.007'N	06° 04.995'W	293 m	96/06/16 13:00 - 96/06/16 15:40	05 min.
Calibration rig	62° 41.636'N	06° 05.404'W	282 m	97/05/22 04:40 - 97/05/22 07:00	05 min.

For the calibration experiment at the start of the NWSA ADCP deployment, Table 3 indicates that the ADCP current directions should be corrected by adding $81^{\circ} \pm 6^{\circ}$ which implies that the heading of the ADCP was $73^{\circ} \pm 6^{\circ}$ instead of the measured 352° .

Table 3. Comparison of current direction measured by the NWSA ADCP and the two Aanderaa current meters during the first calibration experiment in June 1996. For the Aanderaa current meters, the speed and direction shown are the averages of the two instruments (direction corrected for magnetic deviation by adding -15°), 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		
14 June 1996 08:20	24.8	97°	2°	18°	79°
14 June 1996 08:40	22.4	101°	2°	9°	92°
14 June 1996 09:00	16.4	105°	3°	25°	80°
14 June 1996 09:20	13.2	117°	7°	31°	86°
14 June 1996 09:40	11.6	137°	13°	50°	87°
14 June 1996 10:00	11.9	161°	9°	69°	92°
14 June 1996 10:20	13.2	177°	8°	96°	81°
14 June 1996 10:40	17.0	197°	7°	127°	70°
14 June 1996 11:00	21.9	216°	1°	138°	78°
14 June 1996 11:20	22.6	221°	-1°	141°	80°
14 June 1996 11:40	29.0	231°	-1°	150°	81°
14 June 1996 12:00	33.2	233°	0°	153°	80°
14 June 1996 12:20	34.2	236°	-2°	150°	86°
14 June 1996 12:40	35.9	236°	2°	161°	75°
14 June 1996 13:00	38.0	239°	-1°	163°	76°
14 June 1996 13:20	37.9	244°	1°	166°	78°
14 June 1996 13:40	38.8	245°	0°	165°	80°
14 June 1996 14:00	38.2	247°	-2°	167°	80°
14 June 1996 14:20	33.8	253°	-1°	177°	76°

Average for the first NWSA calibration period:

$81^{\circ} \pm 6^{\circ}$

For the calibration at the end of the ADCP deployment, Table 4 similarly indicates a correction of $96^{\circ} \pm 6^{\circ}$ to be added to the ADCP current directions, implying that the heading was $81^{\circ} \pm 6^{\circ}$ instead of the measured value 345° . Taking into account the scatter in the data, the two values for the “corrected” heading are not inconsistent with a constant “true” heading, but a more probable explanation is that the event on 16 April 1997 involved a change in the “true” heading of the ADCP from 73° to 81° . This change is about the double of that observed (from 350° to 346°) but apparently the steel frame has such a large effect on the ADCP compass that this is not inconceivable. Based on this, the current direction measurements in file NWSA9606.DIR have been corrected in the following way (which includes correction for magnetic deviation):

Until 16 May 1997 15:00: Corrected current direction = Measured current direction + (73° - Measured heading)

After 16 May 1997 15:00: Corrected current direction = Measured current direction + (81° - Measured heading)

Table 4. Comparison of current direction measured by the NWSA ADCP and the two Aanderaa current meters during the second calibration experiment in May 1997. For the Aanderaa current meters, the speed and direction

shown are the averages of the two instruments (direction corrected for magnetic deviation by adding -15°), 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	Aanderaa - ADCP
	Speed (cm/s)	Direction	Shear	Direction	Direction
23 May 1997 07:20	15.3	54°	8°	-36°	90°
23 May 1997 07:40	24.7	58°	14°	-27°	85°
23 May 1997 08:00	28.3	65°	8°	-34°	99°
23 May 1997 08:20	30.0	72°	9°	-29°	101°
23 May 1997 08:40	30.5	79°	10°	-26°	105°
23 May 1997 09:00	30.9	81°	8°	-14°	95°
23 May 1997 09:20	29.3	80°	8°	-16°	96°
23 May 1997 09:40	27.1	82°	12°	-13°	95°
23 May 1997 10:00	25.5	86°	9°	-11°	97°
23 May 1997 10:20	20.9	91°	8°	-9°	100°

Average for the second NWSA calibration period:

$96^\circ \pm 6^\circ$

NWNA current direction calibration

For NWNA the instrument heading (and pitch and roll) measured by the ADCP exhibited no sudden jumps but changed slowly from 212° in the beginning to 210° at the end of the deployment.

As for NWSA, two calibration experiments were carried out, but the latter experiment failed, probably due to entanglement of the calibration rig. Table 5 lists the results of the first calibration experiment which indicates that the ADCP current directions should be “corrected” by adding $-42^\circ \pm 3^\circ$ which implies that the heading of the ADCP was $170^\circ \pm 3^\circ$ instead of the measured 212° .

Table 5. Comparison of current direction measured by the NWNA ADCP and the two Aanderaa current meters during the first calibration experiment in June 1996. For the Aanderaa current meters, the speed and direction shown are the averages of the two instruments (direction corrected for magnetic deviation by adding -15°), 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	Aanderaa - ADCP
	Speed (cm/s)	Direction	Shear	Direction	Direction
16 June 1996 13:00	59.6	118°	1°	157°	-39°
16 June 1996 13:20	64.3	123°	1°	164°	-41°
16 June 1996 13:40	64.2	122°	0°	163°	-41°
16 June 1996 14:00	57.8	125°	-1°	167°	-42°
16 June 1996 14:20	46.5	120°	1°	162°	-42°
16 June 1996 14:40	39.5	121°	2°	168°	-47°
16 June 1996 15:00	38.2	118°	1°	162°	-44°
16 June 1996 15:20	35.9	115°	1°	159°	-44°
16 June 1996 15:40	31.0	108°	3°	145°	-37°

Average for the NWNA calibration period:

$-42^\circ \pm 3^\circ$

Based on this, the current direction measurements in file Nwana9606.DIR have been corrected in the following way (which includes correction for magnetic deviation):

Calibration for Nwana: Corrected current direction = Measured current direction + (170° - Measured heading)

Tórshavn 9 June 1997