Short Report

ALKOR Cruise No. 489

Final Field Tests of the Autonomous Deep-sea Crawler/Lander System – MANSIO-VIATOR in the Geltinger Bucht, Western Baltic Sea

Kiel – Kiel: 24. - 28.02.2017

Cruise Lead: Dr. Sascha Flögel

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I. Objectives of the cruise

The expanding need for tools to investigate various parts of the world oceans such as the shelf seas and continental margins for scientific reasons is continually increasing while our ability to address questions concerning ocean change is fundamentally limited by the lack of key technologies for enabling in-situ experimentation and observation performing persistent sensor measurements in the ocean. The work carried out during this short ROBEX expedition will test the capability of the innovative GEOMAR MANSIO-VIATOR robotic system.
At the GEOMAR Helmholtz Centre for Ocean Research Kiel, the MANSIO-VIATOR (latin: harborage-traveller, Fig.1) system was designed. It comprises a stationary lander system and a mobile deep-sea crawler. The hangar is used for transport to the site of investigation and for recovery at the ocean surface as well as to recharge the lithium polymer accumulators on the crawler. The hangar facilitates data transfer from the lander system to the crawler and ultimately to the sea surface by acoustic modem. Within ROBEX, this approach is closest to the lander-rover systems used in space research and thus a true space analogue. After a video-guided deployment the system operates fully autonomous for scientific missions of up to one year. 2013 and 2014 saw the design and construction of both, the crawler VIATOR and the lander/hangar system MANSIO. This involved careful evaluation of existing energy resources (rechargeable LiPo cells) as well as development and testing of an inductive energy transfer system. Furthermore, we decided upon hard- and software needs for the far-field (camera

system, laser scan together with DFKI) and near-field navigation (optical, reflecting binary markers; AIRBUS) which included the design and construction of pressure housings. Furthermore, we have currently implemented a new USBL system to improve navigational needs on longer distances. This cruise meant to finally test the new system incl. USBL, wheel odometry and updated marker-based docking (Fig. 2) procedures.

Fig. 1: The new MANSIO-VIATOR system in a computer animation (© C.C. Meyer).

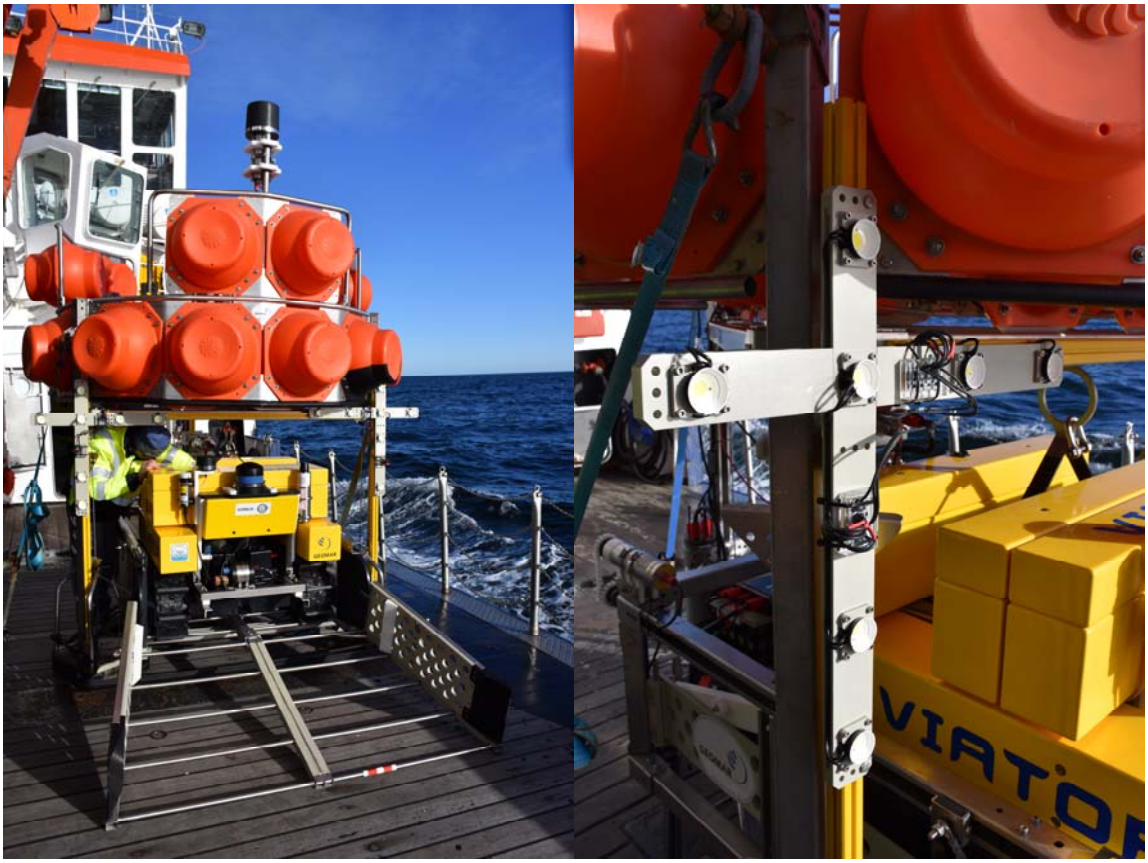

Fig. 2: MANSIO/VIATOR and LED marker on board RV ALKOR, cruise 489.

II. Narrative of the cruise

Friday, 24-2-2017: R/V ALKOR left the GEOMAR westhshore pier in Kiel harbor at 07:30 and headed towards the eastshore building where we loaded the equipment of the various working groups. At 08:30 we steamed north towards the Geltinger Bucht where we arrived in our working area at 54°46.95'N / 009°52.64'E in the German EEZ. Weather conditions were fair with moderate, 9 m/s, northwesterly winds. At 18:00 the system was prepared for deployment. First, we deployed the WLAN-buoy, followed by MANSIO-VIATOR (54°47.09´N and 009°52.70´E, 16 m water depth). After the successful deployment we started to test all components incl. the new USBL modem. The USBL system could not be initialized properly. The gate of the hangar was closed at 21:00. End of station work at 22:00.

Saturday, 25-2-2017: At 08:00 we picked up the station work by recovering MANSIO-VIATOR to fix the issues with the USBL system. This included a 'drytest' of the surface and the lander modems. After recharging the LiPo system, MANSIO-VIATOR was deployed again. Due to WLAN issues the system was recovered again. Station work ended at 22:00.

Sunday, 26-2-2017: After working all night, the system was prepared to be deployed again at 08:00. At 8:45 the system was deployed at 54°47.04'N / 009°52.52'E, 16 m water depth. All systems do work! USBL calibration group picks up the work. The lander unit was recovered at 14:00 due to issues with the LED drivers. This was followed by substantial work on the pressure housings computer system enabling proper LED control. Deployment of the lander was conducted at 17:00. At 18:00 two colleagues from Evologics left the vessel at Gelting Mole. The evening was spent with various docking trials and IMU tests.

Monday, 27-2-2017: At 08:00 we recovered (54°47.09'N / 009°52.70'E, 14 m) the MANSIO lander to manually control the LED strength. At 10:30 the lander was repositioned at the sea floor. The rest of the day was spent performing various docking trials under controlled conditions. During the afternoon, a misson control was set-up. Ultimately, we conducted multiple missions via timeline control. Station work ended at 01:30.

Tuesday, 28-2-2017: At 10:40 we lowered the hydrophone and released the system. At 10:45 the MANSIO-VIATOR system (incl. the WLAN-buoy) was recovered successfully. We left the working area at 11:30 and headed back to Kiel – eastshore pier where we arrived at 14:30 and unloaded the vessel.

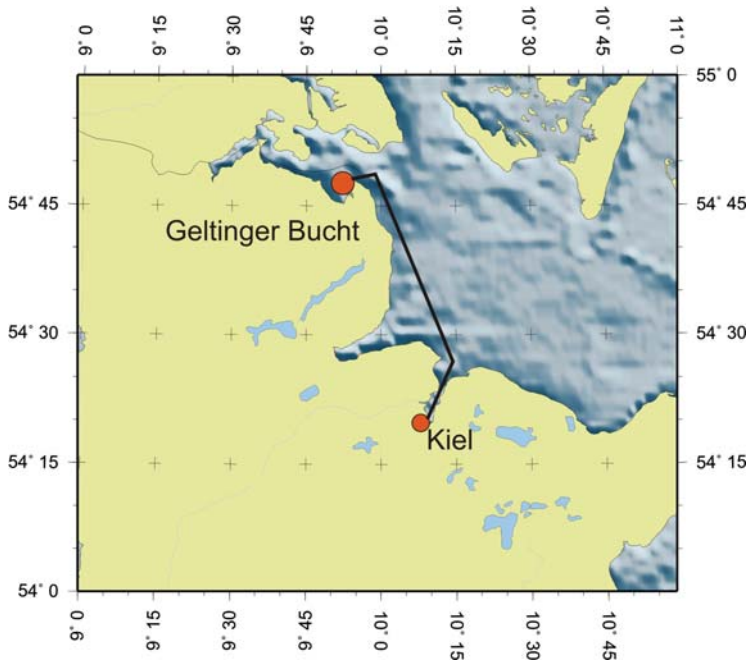

Fig. 3: Cruise track and area of investigation (Geltinger Bucht, western Baltic Sea).

III. Participants and participating institutions

Name	Profession	Institution / Company
S. Flögel	Chief Scientist	GEOMAR
O. Pfannkuche	Scientist	GEOMAR
T. Berghäuser	Engineer	GEOMAR
D. Saturov	Engineer	GEOMAR
D. Wilde	Engineer	AIRBUS
I. Ahrns	Engineer	AIRBUS
C. Nuber	Engineer	AIRBUS
J. Schwendner	Engineer	Kraken Robotics
N. Pech	Engineer	DFKI
M. Wilde	Scientist	AWI/DLR
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IV. Station list and gear abbreviations

Station List ALKOR 489: 24.2. - 28. 2. 2017

Station	Gear	No.	Date	Time	Coordi	nates	Depth
AL489-No.			2017	(UTC)	Lat. °N	Long. °E	(m)
01	WLAN-buoy	1	24.2.	16:23	54°47.09´	009°52.70´	16
02	MANSIO-VIATOR deployment	2	24.2.	17:00	54°47.09´	009°52.70´	16
03	MANSIO-VIATOR recovery	3	25.2.	7:45	54°47.09´	009°52.70´	16
04	MANSIO-VIATOR deployment	4	26.2.	8:15	54°47.09´	009°52.70´	14
05	MANSIO recovery	5	26.2.	13:00	54°47.09´	009°52.70´	14
06	MANSIO deployment	6	26.2.	15:35	54°47.06´	009°52.70´	14
07	MANSIO recovery	7	27.2.	07:10	54°47.09´	009°52.70´	14
08	MANSIO deployment	8	27.2.	09:30	54°47.06´	009°52.70´	14
09	Close MANSIO gate	9	28.2	01:30	54°47.09´	009°52.70´	14
10	MANSIO-VIATOR recovery	10	28.2.	10:00	54°47.06´	009°52.70´	14

Gear Abbreviations:

MANSIO/VIATOR	Deep-sea crawler and lander system
WLAN-buoy	