Reference:
van Haren, H., 2011. Cruise report KM3NeT11: R/V Meteor cruise M83/4, 24 January-06 February 2011, NIOZ, 41 pp.

Cruise Report

KM3NeT11

R/V Meteor cruise M83/4

24 January – 06 February 2011
Valetta – Valetta (Malta)

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(with contributions from participants)

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0. Contents

1. Summary of R/V Meteor M83/4 cruise

In January 2011 R/V Meteor (University of Hamburg, Germany) sailed to the Ionian Sea (part of the Eastern basin of the Mediterranean Sea), mainly to perform several tests for the future cubic kilometer neutrino telescope KM3NeT. The research cruise was commissioned by NIOZ Royal Netherlands Institute for Sea Research and Nikhef, the Dutch National Institute for Subatomic physics, Amsterdam. Nikhef is the main contributor to European Project KM3NeT in the Netherlands, with minor contributors NIOZ and KVI (University Groningen). The Dutch contribution to KM3NeT is funded via a large investment program in the realm of ESFRI by NWO, the Netherlands Organization for the advancement of scientific research.

The purpose of the M83/4 cruise was to perform several test-deployments of moored instrumentation at two of the proposed KM3NeT sites, 'NEMO' east of Sicily Italy around 36.5°N, 15.8°E and 'NESTOR' west of Πελοπόννησος Greece around 36.5°N, 21.5°E. For better understanding of the internal wave field, optical, current and temperature variations over the period of a year, two long moorings were deployed in December 2009. They consist of a top-buoy at around 900 m holding a 75 kHz Acoustic Doppler Current Profiler (ADCP) and 5 acoustic current meters distributed along the mooring line, with concentration in the lower 700 m above the bottom. This 'near-bottom' layer is further investigated using between 60 and 100 NIOZ temperature sensors at 1 m distance and each mooring holds a glass sphere with two small Photo Multiplier Tubes. For short-term investigations of near-bottom fauna a lander has been deployed and recovered four times for the duration of about a day each. Every 1 minute photographs are taken of the environment around a fish-bait, showing abundance of life. Additional Conductivity Temperature Depth (CTD)-profiles were obtained, distributed over the sites. Two newly designed compact mooring have been launched and tested. The 2.02 m diameter sphere 'LOM' holding 37 glass spheres of 17″-diameter unrolled two 700-m lines with 25 glass spheres in between and surfaced freely. The compact Launcher for Oceanographic Equipment and Instruments (LOEI) unrolled a 1000 m line with 3 current meters from the surface downward. Both tests were satisfactory.

The cruise was quite successful, despite some adverse ropes in the ship's propulsion.

2. General research aim.

KM3NeT

KM3NeT, a European deep-sea research infrastructure, will host a neutrino telescope with a volume of at least one cubic kilometer at the bottom of the Mediterranean Sea that will open a new window on the Universe. The telescope will search for neutrinos from distant astrophysical sources like gamma ray bursters, supernovae or colliding stars and will be a powerful tool in the search for dark matter in the Universe. An array of thousands of optical sensors will detect the faint light in the deep sea from charged particles originating from collisions of the neutrinos and the Earth. The facility will also house instrumentation from Earth and marine sciences for long term and on-line monitoring of the deep sea environment and the sea bottom at depths of several kilometers. Presently, several MEuro EU-funding is granted to design and prepare the KM3NeT structure. Eventually, 150-250 MEuro is needed to actually build the telescope. Proposed sites are in the Northern Hemisphere, to compliment the IceCube-telescope in Antarctica, in the Mediterranean Sea where sufficiently deep waters are found within several tens of kilometers from coasts. Three sites are selected: ANTARES near Toulon France, NEMO east of Sicily Italy, NESTOR west of Peloponessos Greece.

KM3NeT-Esfri

The NWO investment programme for large European Structures has granted Nikhef-Amsterdam, NIOZ-Texel and KVI-Groningen 8.8 MEuro to set-up the dutch part of KM3NeT. This financial support is the first national funding in hopefully many more to come within the KM3NeT-consortium.

KM3NeT11 cruise

The purpose of the KM3NeT11 cruise in the Ionian Sea is to perform several test-deployments and to recover two long-term moorings. For better understanding of the internal wave field, optical, current and temperature variations over a period of a year, long moorings have been deployed at both NEMO and NESTOR sites. For short-term, near-bottom investigations two short lander/moorings are deployed and recovered several times. Additionally, Conductivity Temperature Depth (CTD)-yoyo are executed for further hydrographic and topographic support-data, respectively. Two different compact moorings are launched and tested a few times.

3. KM3NeT11 overview.

The proposed KM3NeT sites in the Ionian Sea are approximately located at 36.5°N, about 100 km East of Capo Passero (NEMO) and 40-60 km West of Πύλος (NESTOR), see Fig. 1. The working areas of the R/V Meteor during cruise M83/4 are at and around these sites, with long-term moorings deployed in about 3400 and 4500-5100 m, respectively. The precise location of the moorings followed after some shipborne Multibeam mapping, searching for approximately flat surroundings, and avoided sites presently occupied by INFN, GKSS and NESTOR. In shallow water on the Greek site, between 900 and 2000 m water depth, several mooring designs are tested.

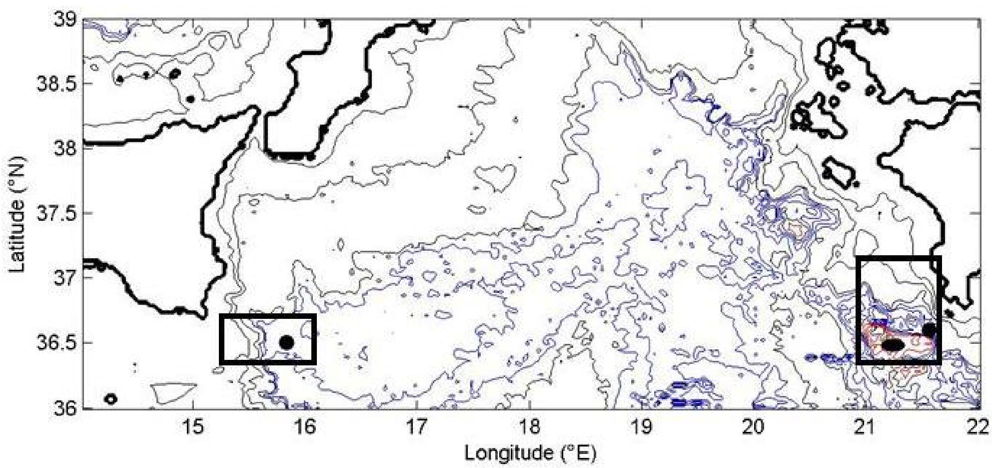

Fig. 1. Map of the Ionian Sea, with NEMO (~36.5N, 15.8E) and NESTOR (~36.5 N, 21.5E) sites. The dots indicate approximate proposed locations for KM3NeT, indeed two for NESTOR, and the rectangles indicate working areas of R/V Meteor.

Previously, over the past ten years or more, regular visits have been made to these sites. These visits were made to learn more about the general current regimes, local hydrography, light and suspended material variation with depth and from additional parameters like plankton abundance. The latter is important because life in the deep-sea, well below the range of sunlight penetration, depends largely on the capability of using light for predation: 'bioluminescence'. Large quantities of this light may obscure the weak light pulses caused by neutrino interactions.

The present Meteor cruise is to provide new information on specific oceanographic phenomena, and to test new equipment eventually to be used in and around the future telescope. One of these instruments is a small type of Photo Multiplier Tube (PMT), which is used here in a custom-made stand-alone fashion with local memory and power supply. It measures in bursts every 36 minutes for a year. Another instrument is NIOZ-designed high-resolution temperature sensor that may become mounted outside and perhaps inside the telescope-array. It has been specifically designed to study the internal wave field, and KM3NeT provides the unique opportunity to study deep-ocean internal waves in a 3-D fashion, despite its rather course vertical resolution. Another means that may be further developed in the future is deep-ocean photography of fauna. During the present cruise this photography is used very near (1-2 m from) the bottom only, which is outside the range of the future neutrino telescope that has planned instrumentation between 100 and about 700 m from the bottom. The photography provides new information for specific marine biology studies.

For calibration and additional information some CTD stations are made, of which 2 in deep yoyo-fashion over a limited period of time (~14 hours). Historic NESTOR data show a gradual increase in temperature with depth below 1200 m, mainly due to pressure effects, and very weak vertical density stratification below 3500 m (Fig. 2). This limits the internal wave band to half a decade, but long-term moored observations should prove its stability, or variation with time. At the French ANTARES site, variations by a factor of 10 in stratification are not uncommon.

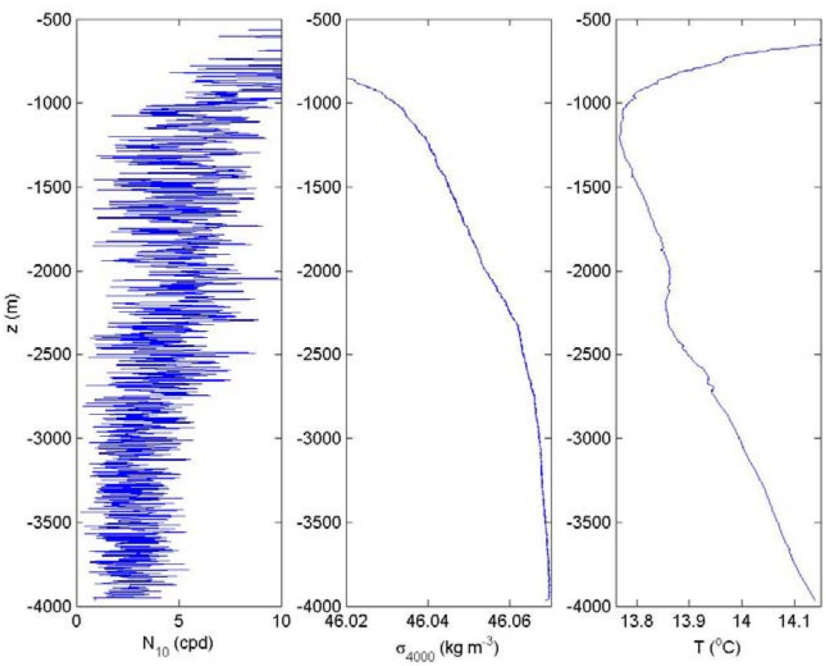

Fig. 2. Historic CTD-profiles with depth near NESTOR site. a. Buoyancy frequency, computed using 10 m vertical scale. b. Density anomaly referenced to 4000 m. c. In-situ temperature profile.

4. Participants.

Institute	*Name*
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NIOZ-MTM	Lorendz Boom
NIOZ-MTM	Yvo Witte
Nikhef/UAmsterdam	Els de Wolf
Nikhef/UUtrecht	Paul Kooijman
Nikhef	Jelle Hogenbirk
Nikhef	Eric Heine
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LEGI/Coriolis Grenoble F	Louis Gostiaux
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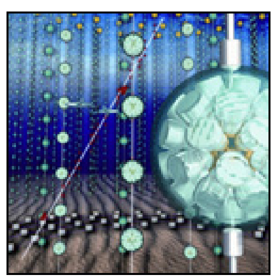
Nestor Pylos Gr	Tassos Belias

NIOZ departments

FYS	physical oceanography
MEE	marine ecology
MTE	electronics
MTI	fine mechanics instrumentation
MTM	sea technology



5. Data acquisition and instrumentation (see Appendix A for mooring diagrams).

a. KM3NeT09 long-term moorings

Both large NIOZ-moorings **(KM3NeT09_1** and **_2** at NESTOR and NEMO sites, respectively) have two ellipse-shaped buoyancy elements near the top, of which the upper one also holds an Iridium-satellite beacon. All instrumentation in the line is self-contained, with batteries and memory. An up- or downward looking 75 kHz ADCP is mounted in the top-buoy. The ADCP acoustically estimates currents every 10 m over a maximum vertical range of 600 m, upward from 700 m at NEMO and downward from 1100 m at NESTOR. They sample once per 900 s (15 min). Deeper below, five current meters are mounted, all acoustic Nortek AquaDopp that also sample once per 900 s. In the depth range of future KM3NeT antennas 61 and 104 new NIOZ-4 accurate temperature sensors are mounted at 1 m intervals on a 65 and 104 m long cable, respectively. These sensors measure at 1 Hz. At each mooring, some 100-200 m below these sensors, a test Optical Module (OM) is mounted holding 2 small PMTs (Fig. 3). Each PMT has two measurement circuits. One circuit collects all events in a condensator. This condensator is read every 2160 s (36 min): a ‘mean’ value. The other circuit measures a 0.1 s burst, also every 2160 s: a ‘peak’ value. On the NESTOR mooring, a Nortek Vector is mounted for testing the capability of measuring turbulence at such deep sites. The Vector measures currents down to the cm-turbulence scales, sampling 16-Hz bursts every 600 s. At each mooring about 5 m above the steel weight (850 kg in water) two iXSea acoustic releases are mounted.

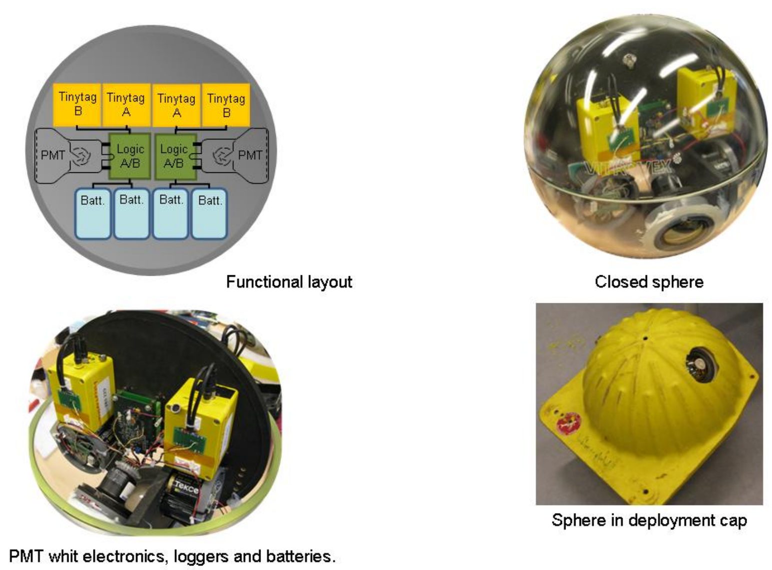


Fig. 3. Layout, electronics and mounting of in-situ sampling PMT (Nikhef).

German institute GKSS Geesthacht near Hamburg requested attempt to recover a single mooring, approximately 1000 m in length at 4500 m, NESTOR site. The mooring consists of several glass spheres and biofouling panels. It has been under water for about 3 years now. The release responded a year and two years ago, but did not surface.

b. Short-term mooring

A single small NIOZ-mooring **(NIOZ11_1)** is deployed once for a week above a moderate sloping bottom near the test-deployment site. It provides current and temperature /internal wave information around 1000 m, using two acoustic Nortek AquaDopp current meters and 61 NIOZ4-thermistors.

c. Lander short-term mooring

OceanLab moorings **OL11_1,…,_4** (1 at NEMO and 3 at NESTOR, respectively) is a free-falling bottomlander intended to become deployed and recovered after about 24 hours. The lander's main purpose is time-lapse photography of animals that are attracted to a whole ungutted mackerel bait. The camera (Kongsberg 5M pixel digital stills camera and flash unit) looks about 2 m down on a reference cross with the bait at the centre. The camera is manually setup to best capture objects in this plane. An image is taken every minute with a single fire of flash.

The lander also has a SeaGuard recording platform with an Aanderaa Doppler current meter and SeaBird CTD. It takes readings every 300 s. The current data is used to estimate the dispersal of the scent of the bait and can be used to make estimates of local fish abundance.

Deployment is a swift operation, although descent to, say, 4000 m takes some time due to its relatively slow sinking speed of about 0.5 m s^{-1}. Its recovery is slightly faster, mainly because its ascent-speed of nearly 1 m s^{-1} and its radio beacon and flag for quick visibility once at the surface.

d. Launcher Optical Module (LOM) new compact mooring test

NIOZ built a new concept mooring for compacting a single string holding glass spheres, which eventually is designed to be launched with 10-15 strings attached to a single sea-floor cable. The entire design is to minimize the number of underwater-connectors, quick deployment of multiple mooring-strings and minimal drag.

A single string has two 4-mm Dyneema-fibre lines for support and one 6 mm tube holding all electric cabling. Thirty-one small PMTs will eventually be held in one, presently 17″, glass-sphere, the OM. A string holds twenty OMs that are presently separated by approximately 30 m. The OMs are mounted ‘naked’ in between the two lines without further supporting or protecting materials. For compact mooring deployment, the entire nearly 700 m long string and five empty glass spheres for top-buoyancy are mounted in a 2.02 m diameter aluminum sphere, the Launcher of OMs (LOM), see Fig. 4. This LOM is mounted directly above a 960 kg weight (weight under water) to which a video system is attached. Upon release it unrolls its lines and instrument-spheres due to its positive buoyancy of some 5000N. After releasing the top-buoys it detaches itself and surfaces freely.

For the KM3NeT11 cruise a test-string has been developed, following the above dimensions, without PMTs and optical cable tube but with monitoring test-sensors and concrete dummy-weights of the same value as future PMT-weight. This mooring (**KM3NeT_LOM_#, #=2,3**…(#1 was in 2009)) is deployed in water between 850 and 950 m depth, near NESTOR. As this test-mooring had to be recovered to read the stand-alone test-sensors and video, it has been deployed in a U-fashion, with a ground-line to a second weight and extra line with separate surface marker. The test-sensors in each of the 20 instrument-glass-spheres measure tilt and compass at 2 Hz. For redundancy another 2 NIOZ4 temperature-tilt sensors are mounted inside the LOM. After deployment CTD-data are collected for reference temperature profile across the water column.

Deployment is done from the stern, separate surface marker going out first, followed by spooling out the 14 mm ground cable before the LOM package is lowered all the way to the bottom by the large stern-winch. The LOM-package includes the separate acoustic release in a beacon above the LOM and another acoustic release (Fig. 5) for detaching the winch-cable once bottom is hit. To move this cable away from the LOM two glass spheres are attached to it, some 20 m above the release.

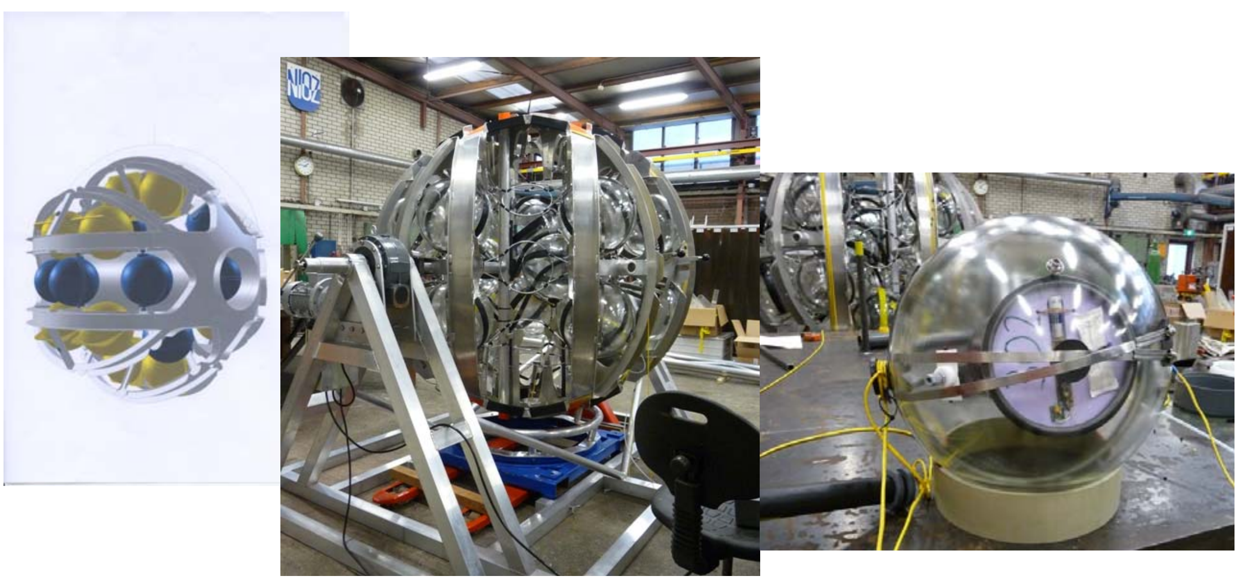


Fig. 4. Launcher of Optical Modules (LOM), its design (left), being built with own buoyancy (middle) and showing test-instruments and cable (right).

Recovery required assistance of the MOB-boat. This is because two items float separately, the LOM-release buoy and the LOM itself, but also because the unprotected glass-spheres easily bump into each other at the surface: the line needs to be stretched as soon as it surfaces. Lifting the LOM-weight from the bottom is not easy as it requires the ship simultaneously moving forward with continued hauling.

Fig. 5. Fully equipped LOM just before being put in the water. Below the LOM the bottom weight and video camera are visible. Above LOM, its own acoustic release in between six plastic-capped glass spheres and a second acoustic release for detaching the winch cable.

e. Launcher Oceanographic Equipment and Instrumentation (LOEI) test-deployments

Another compact mooring with a few (dummy) current meters is planned for test-deployment (**NIOZ11_LOEI_1,…,3**). It also uses the flexible Dyneema-fibre line, a single one in this case, which is spooled around the top-buoy that thus acts as a launcher and a carrier for the instrumentation. It unrolls from the surface (Fig. 6). During these tests it was equipped with 3 different current meters, a non-programmed mechanical Valeport, to test the impellor, and two acoustic current meters (Aanderaa RCM11 and Nortek AquaDopp).

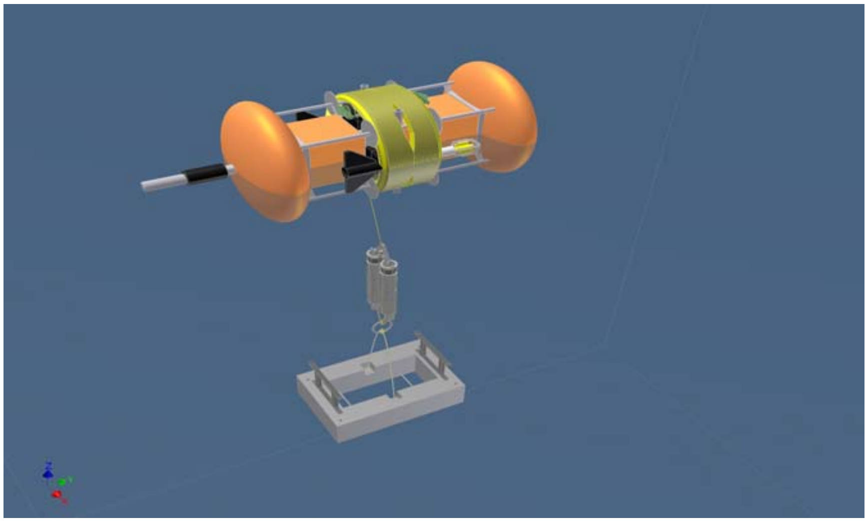


Fig. 6. Fully equipped LOEI just after being put in the water (R. Bakker).

f. Shipborne sampling

The NIOZ CTD/Rosette system contains a Seabird 911 Conductivity Temperature Depth sensor, with a Seapoint STM Optical BackScatterer (OBS). The CTD samples at a rate of 24 Hz. It is used to calibrate the NIOZ-temperature sensors and to perform several hydrographic stations, mainly in yoyo fashion of about half a day at the NEMO and NESTOR sites, and near the LOM-testsite.

6. Daily summary of KM3NeT11.

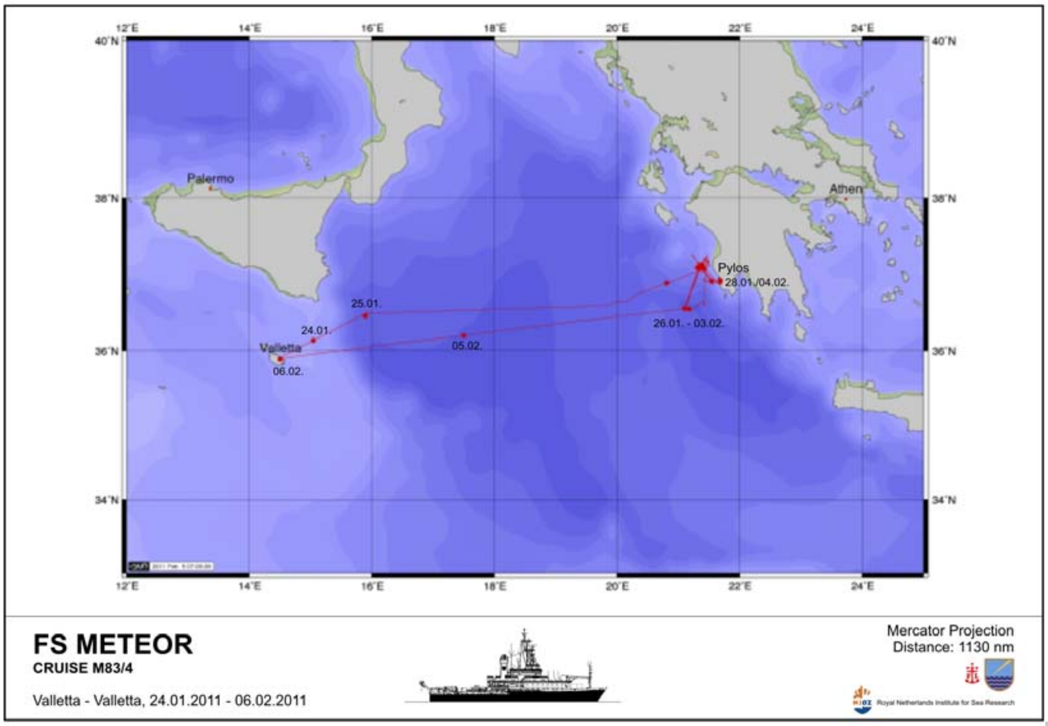


Fig. 7. KM3NeT11 cruise track (M. Hiehle).

Monday 24 January

10:00 LT (09 UTC). Departure from Valetta, Malta. NE1-2, calm weather. First station at NEMO site: deployment of bottom lander OL11_1 in the afternoon. Near the lander 11 h deep yoyo-CTD during night.

Tuesday 25 January

NNE4. 7 UTC. Recovery of long-term mooring KM3NeT09_2. Surfacing of the mooring without problems. However, nearly the entire mooring is covered by a “cannizzi” fishing line, which hampers the intake of the instruments and mooring line. Worst of all, the line drifts into the bow thruster, which we cannot use from this moment on (until repair in Pylos later in the week). In the afternoon OL11_1 succesfully recovered. Transfer to Nestor site.

Wednesday 26 January

NW3. 15 UTC. Deployment KM3NeT_LOM2. Entire operation from the stern, smoothly, until iXSea cable release refuses. LOM brought back to deck and NIOZ-Benthos release attached to cable, then lowered again and smoothly released at the bottom, with clearly cable tension drop visible.

Thursday 27 January

SE5-9. 06 UTC. Difficult recovery of KM3NeT_LOM2, partially due to lack of bow thruster. The LOM itself releases successfully, but the large sphere remains stuck to the string for half an hour (due to rubber-coated top glass spheres, as is learned later). The ship drifts away from the ground line and only with large tension on the cable the mooring is finally recovered: the bottom weight is dragged over a substantial distance over the sea floor. Under increasing winds (SE8) in the afternoon, successful deployment of short mooring NIOZ11_1.

Friday 28 January

E9-5. 08 UTC Test deployment of NIOZ_LOEI_1. This first test works very well, until halfway the unrolling, when the cable gets stuck to a current meter bolt and the LOEI sinks before all instruments are released. The problem is easily remedied upon recovery. 09 UTC. Deployment bottom lander OL11_2. Departure for Pylos, to exchange a few scientists and to have the bow-thruster inspected by diver. It turns out that the main propulsion also captured some fishing line (the bow-thruster was well-wrapped by line).

Saturday 29 January

SE3. 13 UTC. Recovery of OL11_2, followed by recovery of NIOZ_LOEI_1. During night, 11 hours of deep yoyo-CTD.

Sunday 30 January

SE7. 06 UTC. Successful recovery of long-term mooring KM3NeT09_1. Unsuccessful attempt to recover german(GKSS)/greek mooring : released five times, positive response from release, but no surfacing. In the afternoon, deployment of bottom lander OL11_3, followed by 13 hours of 'shallow' yoyo-CTD.

Monday 31 January

SSE3-4. 09 UTC. Deployment KM3NeT_LOM3. Smooth operation, except that a fishing long-line was caught by LOM. After removal of the line, LOM was safely lowered to the bottom. The LOM releases appropriately and the large sphere surfaces normally. Unfortunately, three small glass spheres surface independently (their strap bands were not completely fixed, as it turns out later). The entire afternoon is used for recovery of the U-shaped mooring. The evening and early night are used for a small Multibeam survey.

Tuesday 01 February

ESE5. 06 UTC. Recovery of OL11_3, followed by a CTD-thermistor string calibration. In the afternoon deployment of NIOZ_LOEI_2. This time the unrolling is smooth and perfect.

Wednesday 02 February

SE3-ESE5. 06 UTC. Recovery of NIOZ_LOEI_2, followed by deployment of bottom lander OL11_4. In the afternoon deployment of NIOZ_LOEI_3.

Thursday 03 February

ESE3. 06 UTC. Recovery of NIOZ_LOEI_3. 14 UTC. Recovery of bottom lander OL11_4. Within minutes NE3 changes to N7. The second package of 2 glass spheres is caught by the main propulsion. Line breaks, lander is salvaged, but the two glass spheres not. We have to go to Pylos for diver-assistance.

Friday 04 February

SE4. Divers arrive late by nearly 5 hours. 14 UTC. Recovery of short mooring NIOZ11_1. In the evening CTD-thermistor string calibration. Leave for Valetta.

Sunday 06 February

NE5. 08 UTC. Arrival in Valetta.

7. Scientific summary and preliminary results

The M83/4 cruise knew a substantial mooring program, varying from recovery of yearlong moorings, via short-term lander deployments&recoveries to a number of newly designed mooring technique tests. The positions and depths are in Table 1.

Table 1. Mooring positions KM3NeT09&11. The first two have been moored for a year and recovered during M83/4, all others are moored and recovered during M83/4.

Mooring	*Latitude*	*Longitude*	*depth*
KM3NeT09_1	36°37.657′N	021°24.907′E	4450 m
KM3NeT09_2	36°29.555′N	015°54.826′E	3320 m
NIOZ11_1	37°08.00′N	021°21.14′E	1200 m
OL11_1	36°28.44′N	015°50.87′E	3350 m
OL11_2	36°56.00′N	021°25.44′E	1850 m
OL11_3	36°33.11′N	021°06.83′E	5111 m (*deepest point Europe)*
OL11_4	37°05.35′N	021°18.88′E	1350 m
KM3NeT_LOM2,3	37°05.719′N	021°25.506′E	800 m
NIOZ11_LOEI_1	36°57.30′N	021°26.22′E	1800 m
NIOZ11_LOEI_2	37°05.14′N	021°22.26′E	1100 m
NIOZ11_LOEI_3	37°05.52′N	021°16.82′E	1600 m

a. Long-term mooring deployments KM3NeT09_1,2 (Appendix A for mooring diagrams)

The two 2.6 and 3.3 km long moorings were safely recovered from 36.5ºN at about 16 and 21.5ºE, respectively, after a year. The location of the long-term mooring at the NESTOR-site (Fig. 8a) is just north of NESTOR4.5 and east of NESTOR5.2. The long-term mooring just to the north of the NEMO-area is in a relatively flat area (Fig. 8b).

The recovery of **KM3NeT09_2** (Capo Passsero) caused substantial trouble, because virtually the entire mooring was covered in an anchor line of a “cannizzi” fisherman. This line was caught into the bow-thruster of the Meteor (and also the main propulsion as turned out later), so that we could not use the bow-thruster for four days of other operations, thereby hampering other, complex mooring trials. The line had to be removed by diver in port.

Fortunately all instrumentation was safely recovered and all instruments except some 15 (out of 164) temperature sensors worked appropriately. The data-return is thus very good. Table 2 gives an overview of the instruments, their sampling rates and their positions in the moorings.

Table 2. Long-term mooring details KM3NeT09 (R=TeleDyne-RDI; N = Nortek).
Moorings deployed on **15 and 18 December 2009**
Moorings recovered on **30 and 25 January 2011**

Mooring	**Instrument**	**BC**	**depth [m]**	**sampl. int. [s]**	**remarks**
KM3NeT09/1	R 75 kHz ADCP	1953	1125	900	60 10m bins. DO look
	N AquaDopp	2031	2475	900	100 sam diag/day
	N AquaDopp	13208	3225	900	100 sam diag/day
	N AquaDopp	12850	3975	900	100 sam diag/day
	N Vector	33589	3976	600	152 sam/burst 16Hz
	NIOZ-4 T-str	12980	3977	1	103 sensors@1m
	N AquaDopp	2295	4275	900	100 sam diag/day
	NikhefmoorPMT	*33251*	4280	2160	mean and 0.1s burst
	N AquaDopp	2325	4375	900	100 sam diag/day
KM3NeT09/2	R 75 kHz ADCP	1854	720	900	60 10m bins. UP look
	N AquaDopp	2271	1420	900	100 sam diag/day
	N AquaDopp	11488	2170	900	100 sam diag/day
	N AquaDopp	2264	2920	900	100 sam diag/day
	NIOZ-4 T-str	13130	2921	1	61 sensors@1m
	N AquaDopp	2288	3170	900	100 sam diag/day
	NikhefmoorPMT	*33268*	3172	2160	mean and 0.1s burst
	N AquaDopp	11471	3220	900	100 sam diag/day

a. *b.*

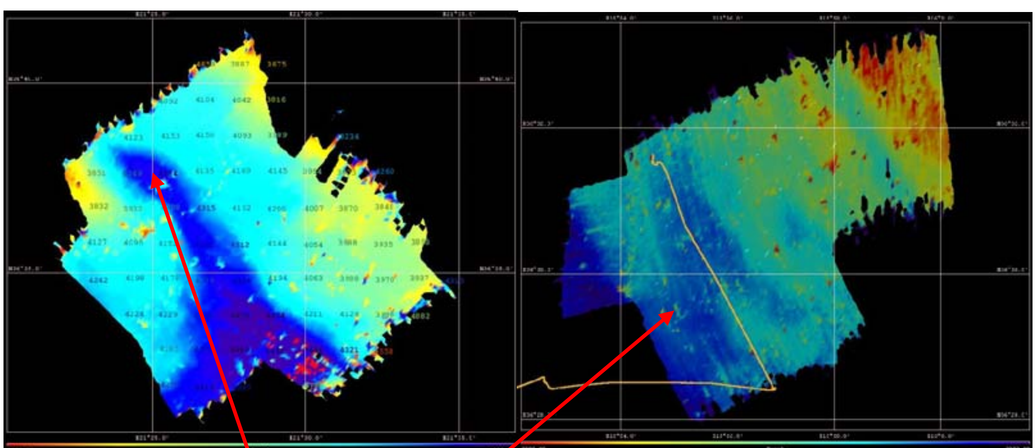


Fig. 8. Multibeam seafloor images.

a. Mooring KM3NeT09_1 in a small sub-basin to the north of site Nestor4.5.

b. Mooring KM3NeT09_2 slightly to the north of the NEMO area. Different color scale compared to a.

Although great care was taken in preparation for the mooring, using computational program of optimal mooring design by R. Dewey (Univ. Victoria, CDN) mimicking dynamical drag force, post-recovery verification is made. The requirement for this mooring was to have its vertical excursions at the height of the thermistors well less than 1 m (the distance between the sensors). It is seen that this is easily obtained (Fig. 9), noting the vertical range in the upper panel being 1 m. As the two pressure sensor records are dominated by static barotropic surface semidiurnal tide of 0.1 m amplitude and meso-scale (sub-inertial 10-50 day periodic) variations of similar amplitude, in contrast with horizontal currents being dominated by inertial motions, it is safely said that artificial mooring motions are below noise level (~0.1 m) and well within the required range.

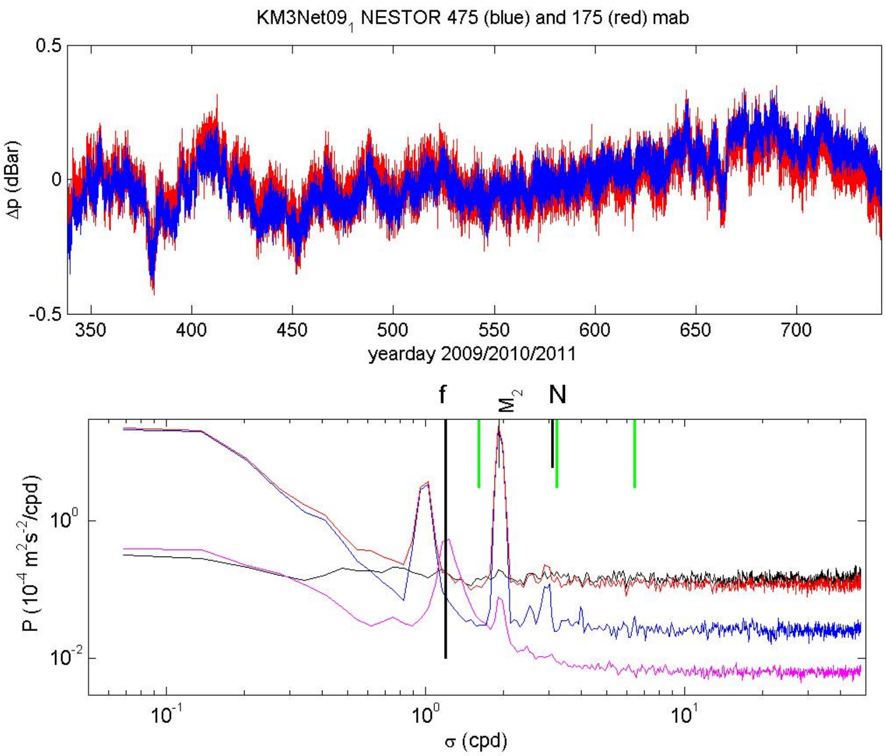


Fig. 9. KM3NeT09/1 mooring motion verification. Upper panel. Pressure with mean values subtracted, measured by current meters above (blue) and below (red) the NIOZ-thermistors. Lower panel. Corresponding spectra (arbitrary scale) of time series in upper panel (same colours), with in black the (white noise) difference spectrum. In purple kinetic energy spectrum. Denoted frequencies: f = inertial, N = buoyancy, M_2 = semidiurnal lunar tidal.

The currents at both long-term mooring sites are quite comparable: they are dominated by inertial and mesoscale (10-30 day periodic) motions, with weak semidiurnal tides (Figs 10,11). A major difference between the two is the amplitude: nearly twice as large at NEMO (Fig. 10; maximum current speed 0.14 m s^{-1} at 400 mab, m above the bottom), compared to NESTOR (Fig. 11; identical scales as Fig. 10; $|U|_{max}$ = 0.08 m s^{-1}). At NESTOR the weak spectral peak in the vertical current at the inertial frequency f is more clearly visible than at NEMO. This implies general weaker stratification at NESTOR which turns inertial motions, purely horizontal in infinitely strong stratification, away from gravity towards the earth rotational vector. The aspect (variance) ratio |w|/|u| ~ 0.1, so that |w| ~ 0.01 m s^{-1} are expected.

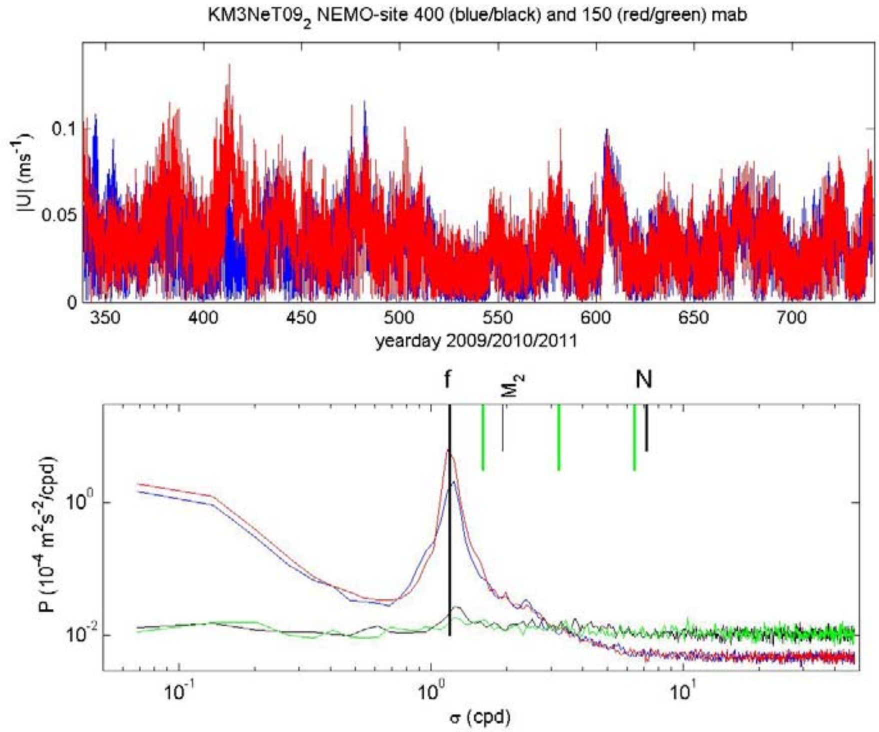


Fig. 10. KM3NeT09/2 currents at great depths around the cable with NIOZ-thermistors: time series of current speed (upper panel: blue (400 mab); red (150 mab)) and spectra (lower panel; horizontal kinetic energy (blue (400 mab); red (150 mab)), vertical current variance (black (400 mab); green (150 mab))).

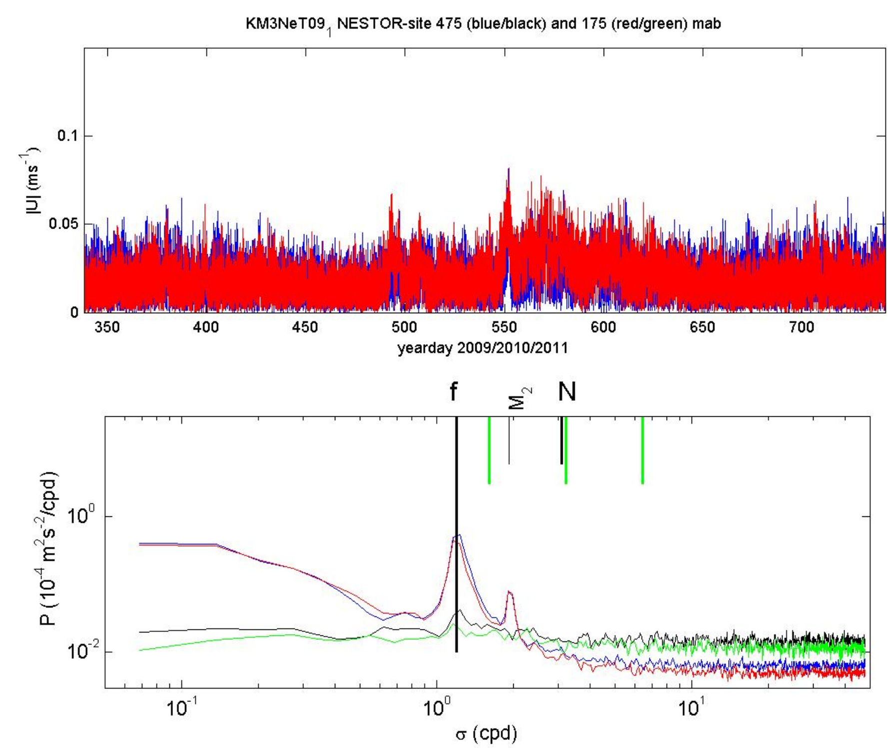


Fig. 11. As Fig. 10, but for KM3NeT09/1.

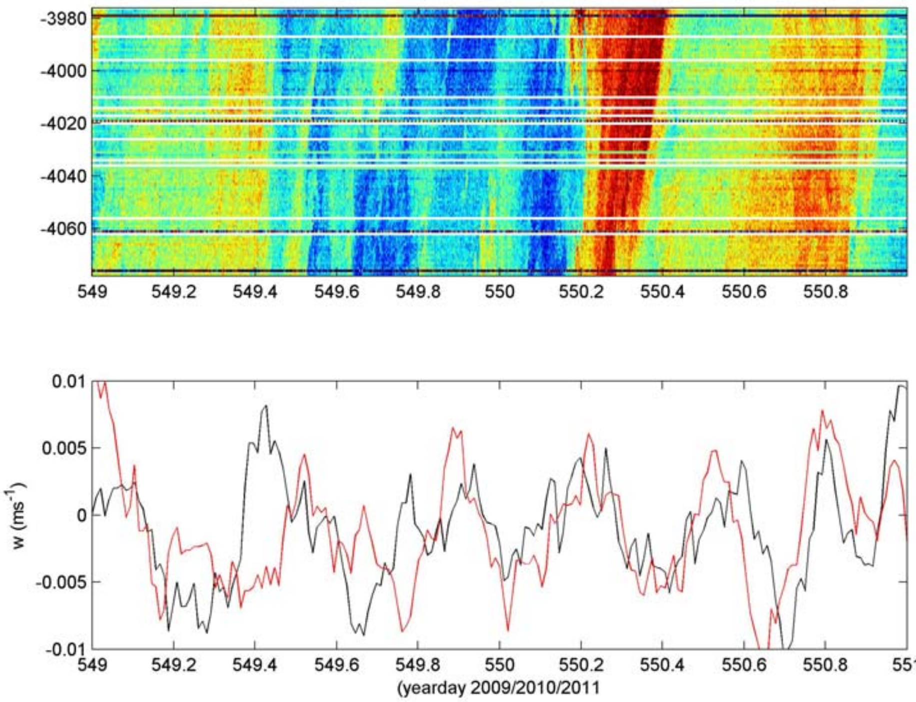


Fig. 12. Two days example of temperature depth-time series (upper panel) and vertical currents above (red) and below (black) the 103 thermistors (lower panel) for KM3NeT09/1. The temperature data are relative to the local adiabatic lapse rate, with relative colour range +0.001 °C: red to -0.001 °C: blue).

Such vertical currents are indeed observed, at many internal wave-scales (e.g., Fig. 12; the dominant period is 5-6 hours; fourth-diurnal). The motions are reflected in the vertical displacements of isotherms (Fig. 12, upper panel), which appear as near-vertical bands of alternating cold and warm water.

These detailed yearlong temperature data using 103 high-precision sensors reveal intense variability of internal waves and overturning around 4000 m, normally considered 'quiescent'. Even though temperature variations are within the range of a few mK only, the images are highly dynamic. Wave propagation is evidenced as the depth-time temperature also show quasi-coherent structures at scales smaller than inertial, with periods of a few hours and even approaching an hour or less. Over 100 m coherent in-phase motions are seen (e.g., day 550.2; implying waves having amplitudes well exceeding 100 m), but also variable phase differences (550.6) and up to 180° phase difference (549.6-549.8), the latter at half the periodicity of the others. Occasionally, internal waves start overturning and static instabilities, still coherent over appreciable scales, dominate (e.g., 549.35). Such overturning is ubiquitous in the images, implying active turbulence, of which we can only show the largest scales down to 2 m in the vertical. The association of these overturns with internal waves is evident, as near-inertial (20.1 hour periodic) motions are the main driving force.

b. Short-term mooring deployment and retrieval (by T. Linley)

Four lander deployments **OL11_1…4** were completed during which 54, 191, 247 and 242 photo-images were taken, respectively. The images were focused on the scavenging of near-bottom fauna species on a whole un-gutted mackerel bait. Additionally near-bottom currents were measured every 5 minutes, and every 0.5 minute during OL**11_3**. The lander deployment and recovery operation was generally a smooth operation, except for the last one. During the final recovery a sudden squall increased wind speed once the lander was on the surface. With its beam to the wind the vessel partially passed over the lander and became entangled in the mooring line. This potentially disastrous situation was soon brought under control by the vessels crew and NIOZ technical staff. The lander and the vast majority of the mooring were saved (Fig. 13).

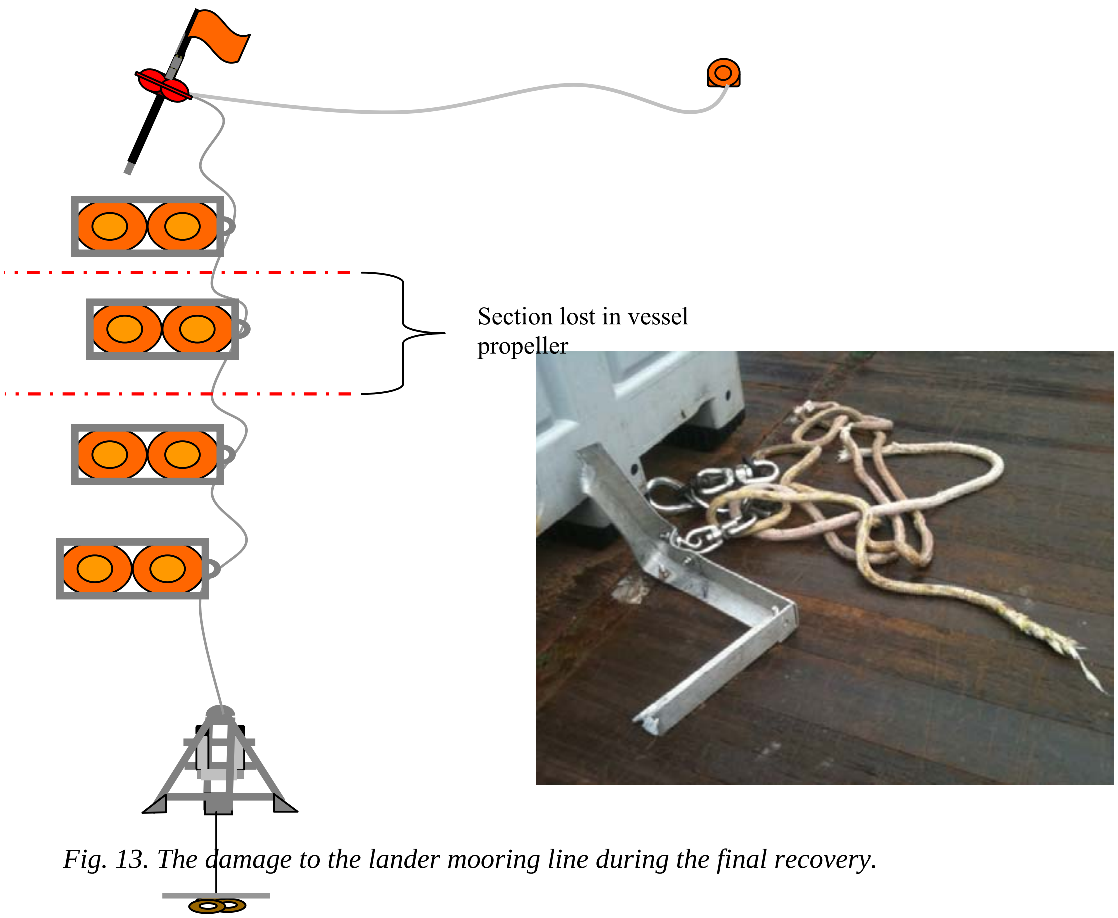


Fig. 13. The damage to the lander mooring line during the final recovery.

The scavenging species observed at each station is mostly dependent on water depth. From this standpoint it is best to approach the deployments by increasing depth. At 1364 m

(**OL11_4**) scavengers are dominated by the Bluntnose sixgill shark (*Hexanchus griseus*) (Fig. 14), large individuals of several meters that were seen attempting to attack the bait but were unable to navigate the reference cross and ballast.

Fig. 14. Bluntnose sixgill shark (Hexanchus griseus) seen at 1364 m.

An unknown eel species was also seen at this station (Fig. 15), often arriving in small groups between shark attacks. The anterior majority of their bodies were held rigid and the final portion undulated, giving them a distinctive swimming style. They were not seen to attack the bait directly but were seen feeding on the shrimp also attracted to the bait.

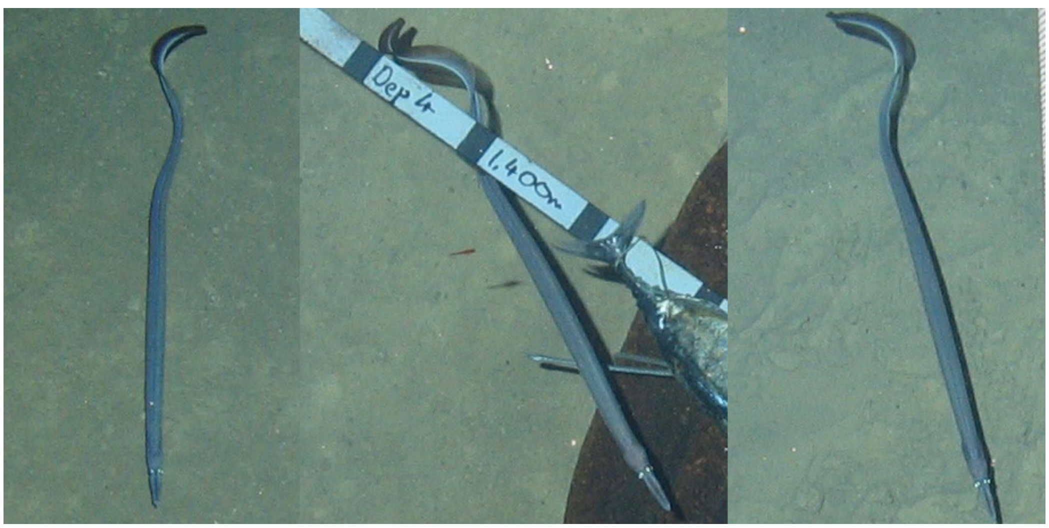


Fig. 15. Unknown eel species seen at 1364 m.

The final observed fish species appears to be a type of codling (*Lepidion sp.*) (Fig. 16). This species was only seen in a few image and may be the same individual.

Fig. 16. Unknown codling species (Lepidion sp.) seen at 1364 m.

The only invertebrate species seen was the deep-water shrimp *Acanthephyra eximia* (Fig. 17). This proves to be a very successful scavenging species and is seen at all subsequent stations.

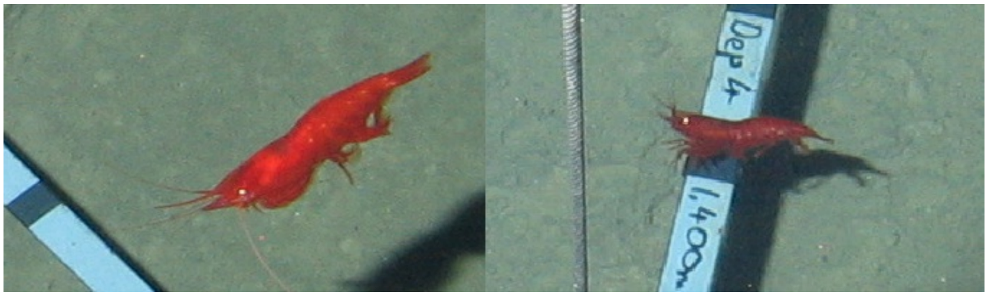


Fig. 17; the deep-water shrimp Acanthephyra eximia seen at 1364 m.

Deployment **OL11_2** at 1841m was still within the range of shark species. Individuals that were seen were smaller than above; approximately 0.4 m (Fig. 18). Further analysis is needed to determine if these are juveniles of *H.griseus*.

Fig. 18. Small unknown shark species seen at 1841 m.

What is likely the same codling species as above was also seen here (Fig. 19).

Fig. 19. Unknown codling species (Lepidion sp.) seen at 1841 m.

The invertebrate fauna once again included *A.eximia*, but also included a crab species (Fig. 20). A single individual eventually found the bait and fed for the remainder of the deployment.

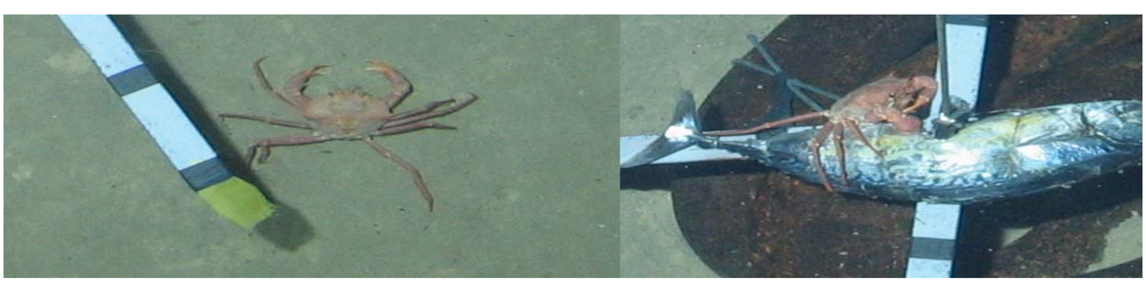


Fig. 20. Unknown crab species seen at 1841 m.

Deployment **OL11_1** exceeded 3,000 m water depth and thus the range of shark species. At this (NEMO) site the only fish species seen was the Mediterranean grenadier *Coryphaenoides mediterraneus* (Fig. 21). The only visible invertebrate was once again the deep-water shrimp *A.eximia*. Both in species composition and abundance this site closely resembled the deployment the previous year at 4,203m. There appears no strong change in scavenging fauna between 3396 and 4203m.

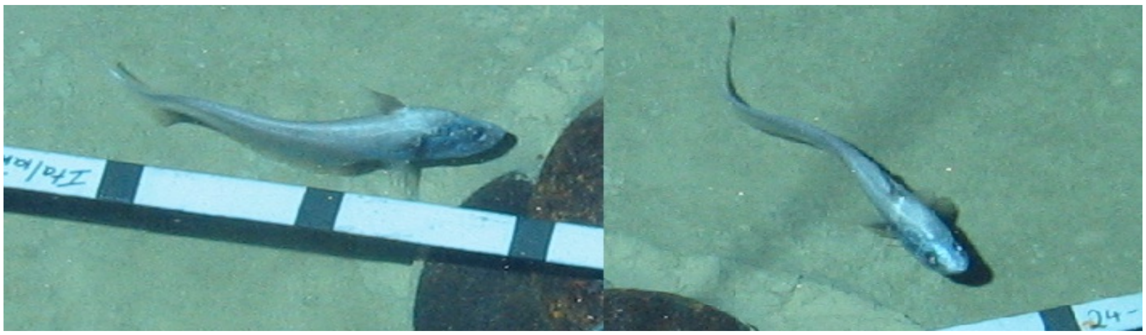


Fig. 21. the Mediterranean grenadier Coryphaenoides mediterraneus, the only fish at 3396 m.

Deployment **OL11_3** represents the deepest deployment during this project and indeed the deepest deployment possible in European waters. The images recovered may represent some of the first. In the species present this deployment resembles all of those beyond 3000 m. It contains only *C.mediterraneus* (Fig. 22) and *A.eximia* (Fig. 23) although each is present in reduced numbers. *C.mediterraneus* appears even more stunted in size.

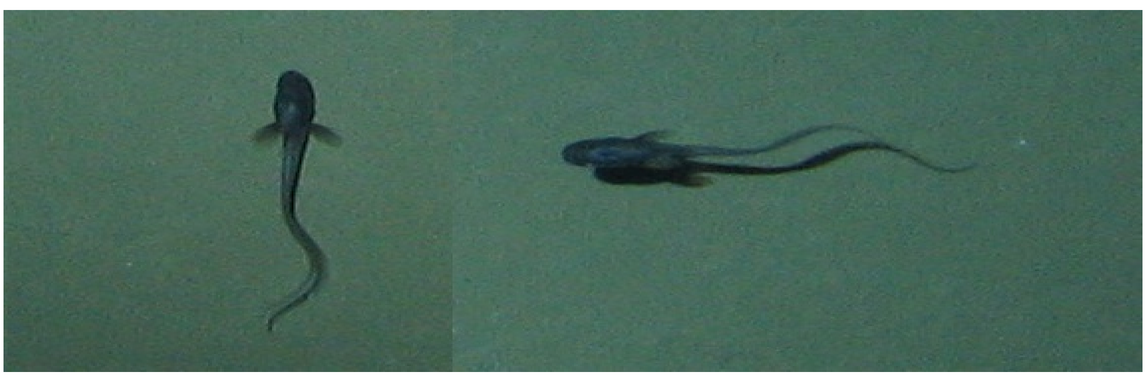


Fig. 22. Mediterranean grenadier Coryphaenoides mediterraneus: only fish seen at 5111 m.

Fig. 23. Deep-water shrimp Acanthephyra eximia: only invertebrate species seen at 5111 m.

All these deployments revealed a very clean silt/sand seabed with little visible infauna or detritivours, supporting that this is a highly oligotrophic area. **OL11_3**, the deepest, showed a strikingly uniform and undisturbed seabed.

c. LOM test mooring

Test-mooring **KM3NeT_LOM_2…3** was deployed two times in about 900 m on a smooth slope with a clean silty bottom just north of NESTOR sites (Table 1 for position). The overboard operation of the U-shaped mooring encountered some difficulty the first time. The LOM itself was smoothly lowered at 0.5 m s^{-1} using the large ship's winch, which was easily released after touchdown and brought back to the surface. During recovery of the U-shaped mooring against the wind the LOM-weight was dragged over the bottom for a considerable amount of time causing quite some tension in the relatively thin surface marker line. Also, the speed through the water with the trail of glass spheres behind the ship turned out too high, so that a few boulders were damaged. Learning from the first experience, the second recovery went smoother.

On the whole, the LOM-deployment was successful. Like in the trial a year ago, in the two attempts during this cruise a complete string was put upright on the sea floor, without a single twist or rotation: all compass/tilt sensors point in the same direction and the individual glass spheres do not deviate from the vertical (green) more than 10° (Fig. 24). In both attempts, the inherently unstable motion of the big sphere during the rapid unwinding causes it to rotate around its vertical axis. Up to 4 complete rotations were counted (Fig. 25; the first deployment 3.5) and during both deployments 1 twist. As soon as the big sphere stopped unwinding, either escaping as it should during the second deployment or stuck for half an hour due to a rubber coated top-glass sphere during the first one, the entire string back-rotated completely, including releasing the twist (a snap in the movies). Potentially, the twist could damage a future optical cable, but it has been proven that if such cable is loosely attached to one of the string lines, it will always stay on the outside of a twist thus remaining unharmed (Fig. 26).

The somewhat renewed release mechanism worked flawlessly. The main process of unwinding went rapidly even though two glass spheres were damaged (first time one of the rubber-paint coated glass spheres of the top got stuck during its release; second time a glass sphere was damaged during recovery). In general, the recovery (which is of course not common practice when such string is put in place as a neutrino telescope), caused most trouble, damaging material during the first recovery especially. It is better to sail slowly forward 0.5-1 knots, with the string gentle behind the ship as during the second recovery. Also, the rewinding of the entire LOM-big sphere was cumbersome on board. This caused a less perfect winding, less perfect mounting glass spheres (causing 3 escaping) and hence a less perfect deployment the second attempt. Future reloading of spheres should be done onshore.

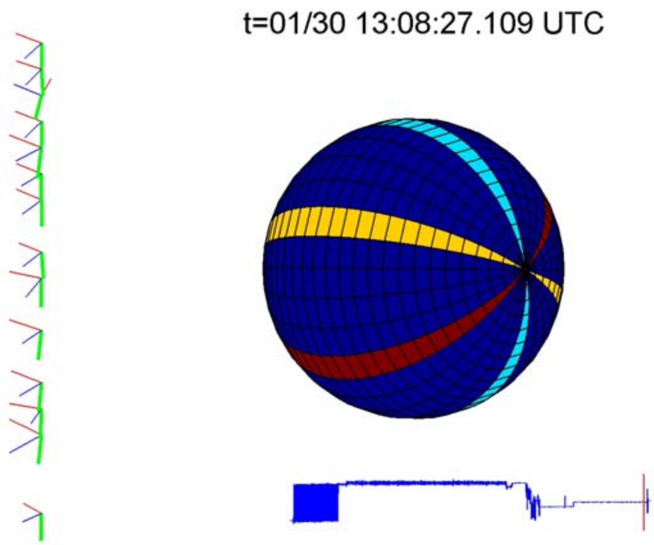


*Fig. 24. Movie-still at the end of unwinding ascent of big sphere (**KM3NeT_LOM_3**), showing the vectors of 14 (out of 20) of the individual instrumented glass spheres. One vector is off due to a bad (noisy) sensor; missing sensors had different problems (L. Gostiaux).*

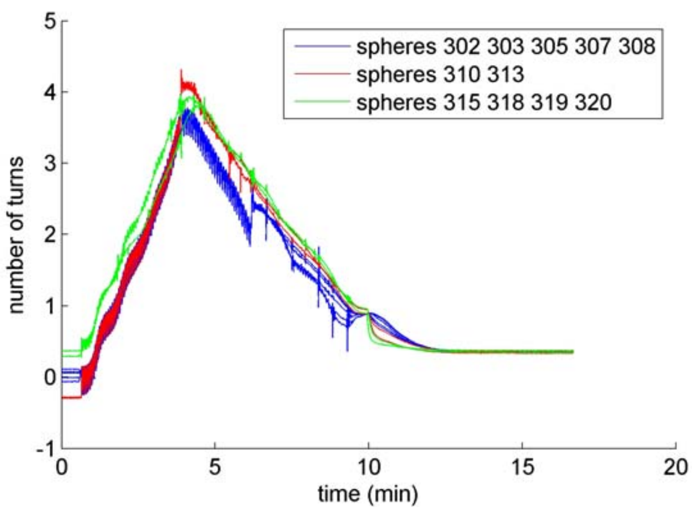


*Fig. 25. Number of complete rotations of individual compass/tilt sensors, grouped in the three main axes of large sphere (**KM3NeT_LOM_3**). In nearly 5 minutes ascent is completed; after release of big sphere the entire string is completely back-rotated in approximately the same amount of time, by chance (L. Gostiaux).*

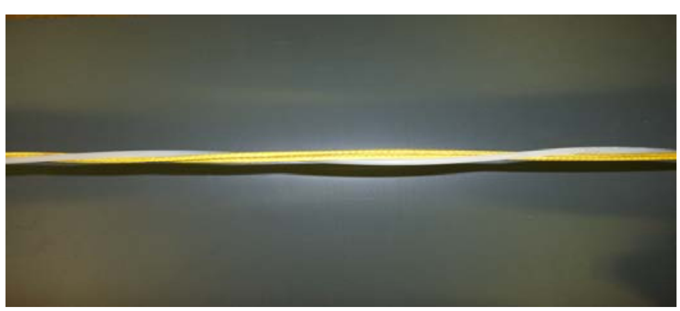


Fig. 26. Two twisted lines (yellow) and a fake-optical cable (white) attached to one of them.

d. LOEI test mooring

Test-mooring **NIOZ11_LOEI** was deployed three times on a gentle, silty slope between 1100 and 1800 m just north of NESTOR sites (Table 1 for positions). The overboard operation of this compact mooring was very smooth and took less than 10 minutes. Release and unfurling was quick after which the top of the mooring started to turn in circles with approximately 10 m diameter. Unfurling speed was maximally 2.3 m s^{-1} and the descent speed amounted 1.2 m s^{-1} until landing on the seabed (Fig. 27). During the first test, the mooring line got stuck behind a bolt of the RCM11-case. This was easily mended the second time by covering the bolts with a tube.

Rewinding the LOEI on board was not a problem, but an easy operation. The mounting stuts on the concrete anchor proved adequate holding the LOEI with cable and instruments wound around it.

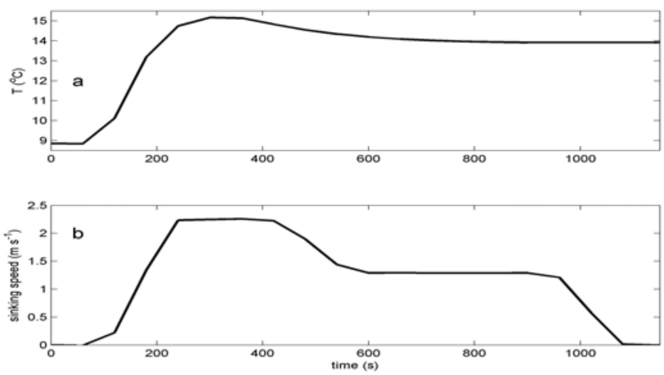


Fig. 27. NIOZ_LOEI_3 test data from AquaDopp. a. Temperature, b. Descent speed during unfurling (220-420 s) and during descent unfurled mooring (500-950 s) as inferred by first-differencing pressure sensor signal.

e. CTD sampling

The CTD operations were 'normal', noting that when the bow-thruster could be used the positioning of the ship was phenomenal: within some 10 m, also during yoyo-stations. The instrument, deck unit and the winch worked very fine. From some detailed yoyo-stations it is seen that only below 4050 m the water column seems truly homogeneous (Fig. 28). Above that depth stratification is weak, buoyancy frequency N ~ 2-4f, and more or less continuous with depth. However, the individual components of density (ρ) variations, $\delta\rho = -\alpha\delta T + \beta\delta S$, T denoting temperature and S salinity, show a variability that is similar nearly all the way to the bottom and in which T and S (nearly) compensate each other. This points at active slumping or mixing, as is typical for near-surface actively mixing layers.

The weak density stratification found in the CTD-profiles independently confirms the time series observations of very low-frequency internal waves (Fig. 12), which are limited by the buoyancy frequency. The density stratification at NEMO is about 2-4 times larger than at NESTOR, but otherwise similar (not shown).

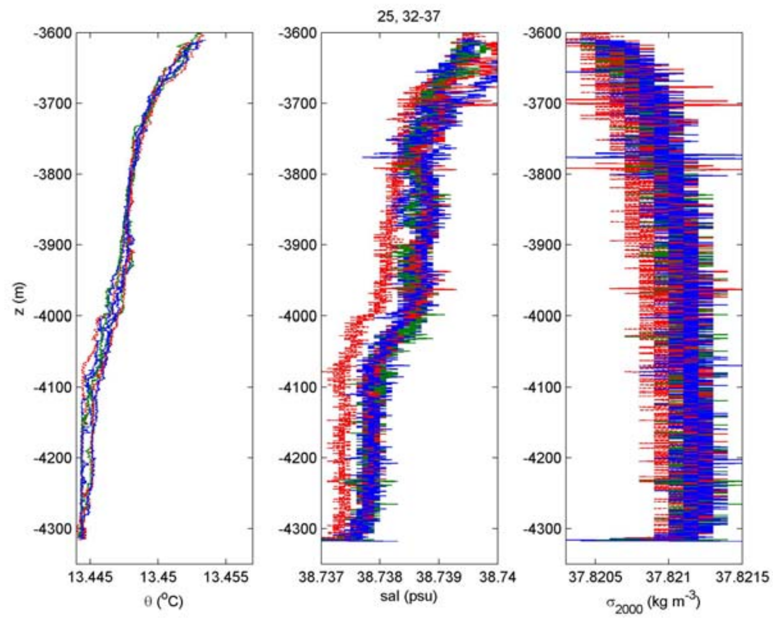


Fig. 28. Detail of lower 700 m of some parameters of yoyo-CTD-profiles near NESTOR-site of mooring KM3NeT09_1. a. Potential temperature. b. Salinity. c. Potential density.

The CTD-data also confirm the large apparent temperature stratification due to pressure variations (adiabatic lapse rate), around which the internal wave and turbulent mixing variations fluctuate (Fig. 29; Fig. 12).

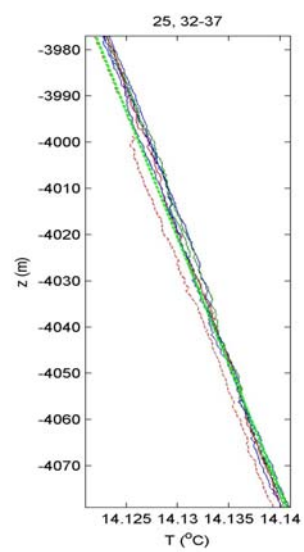


Fig. 29. Temperature profiles of CTD-data in Fig. 28, with in green local adiabatic lapse rate.

8. Achnowledgments

On behalf of all participants, I would like to thank captain Michael Schneider and the crew of R/V Meteor for the pleasant cooperation. Funding by the Netherlands Organization for the advancement of Scientific Research is gratefully acknowledged.

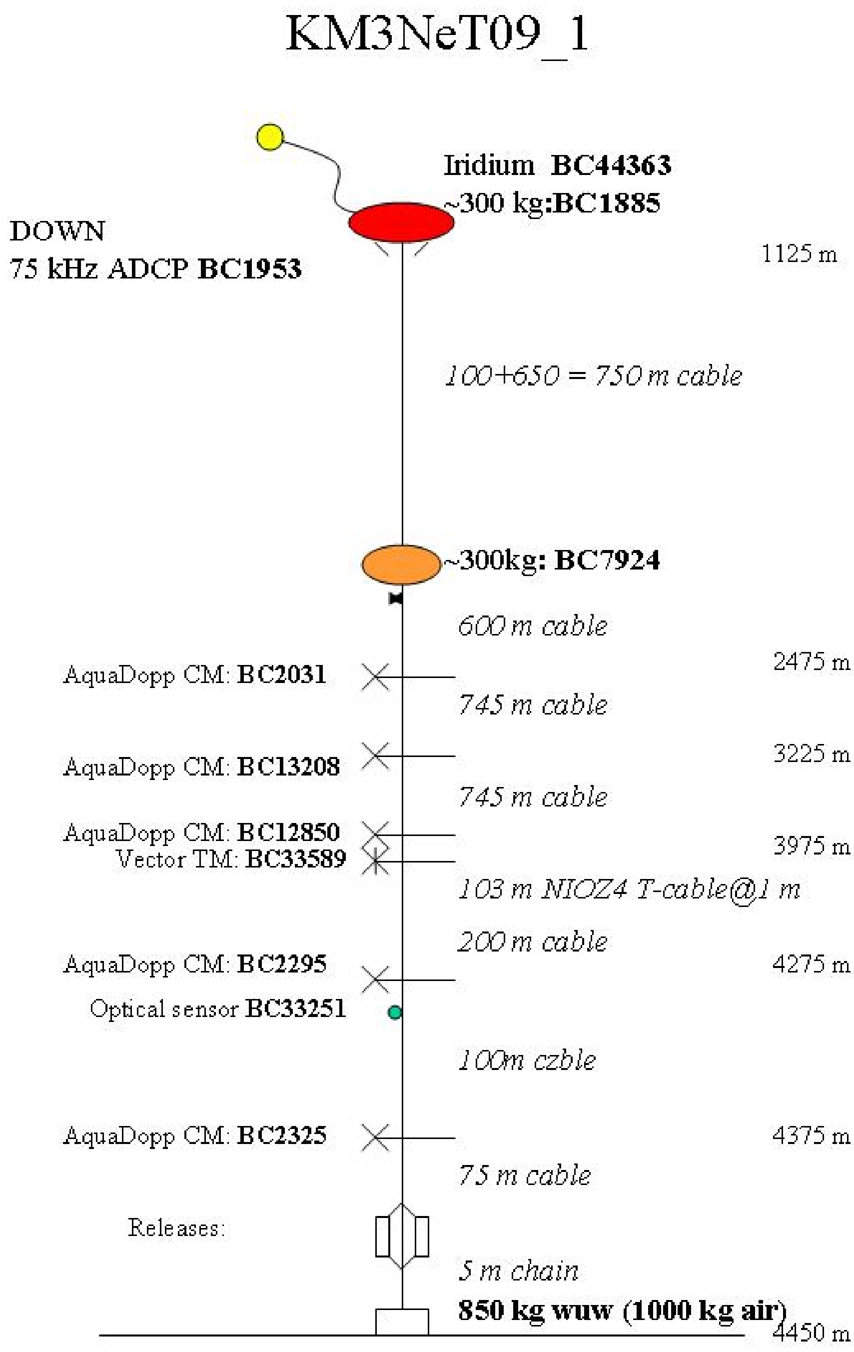
April 2011,

Hans van Haren

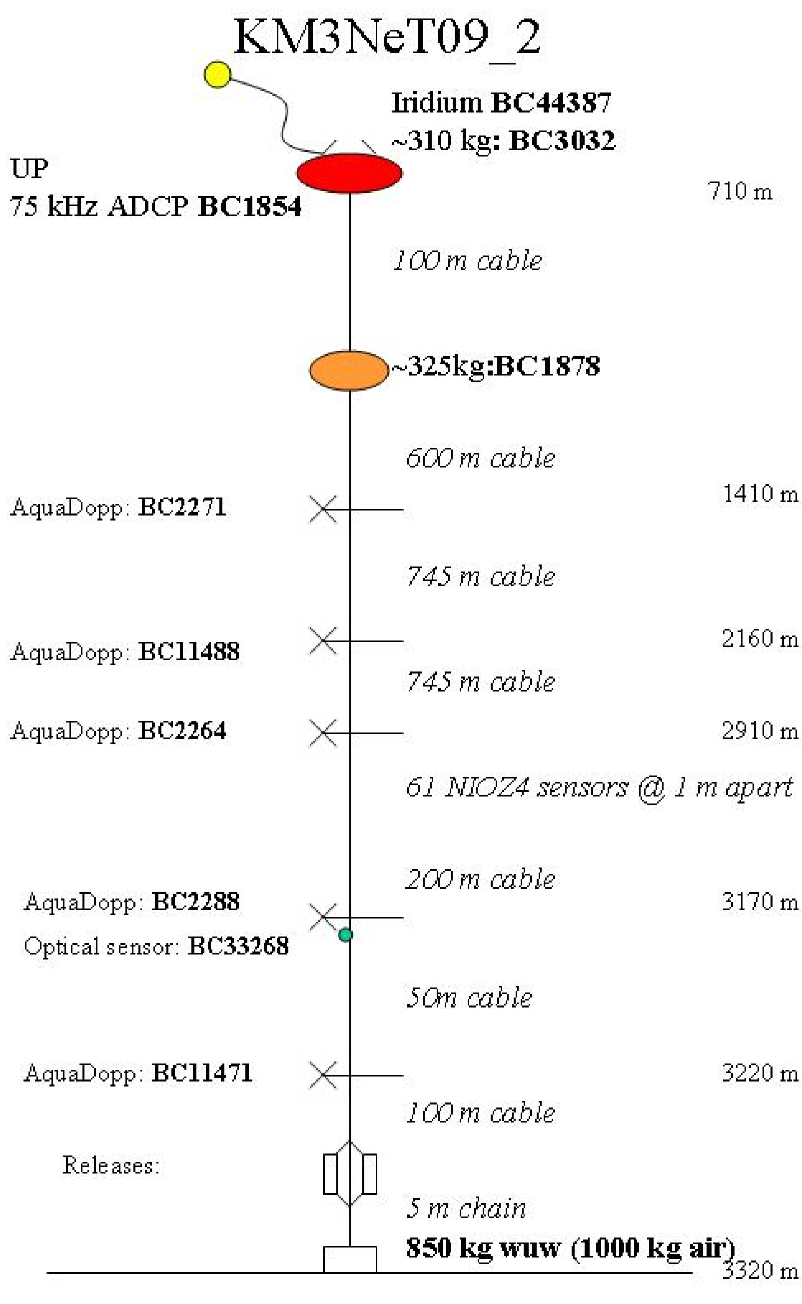
Appendix A ***Mooring diagrams KM3NeT09 and KM3NeT11***

(*by T. Hillebrand, T. Linley & NIOZ-Dept. MTM*)

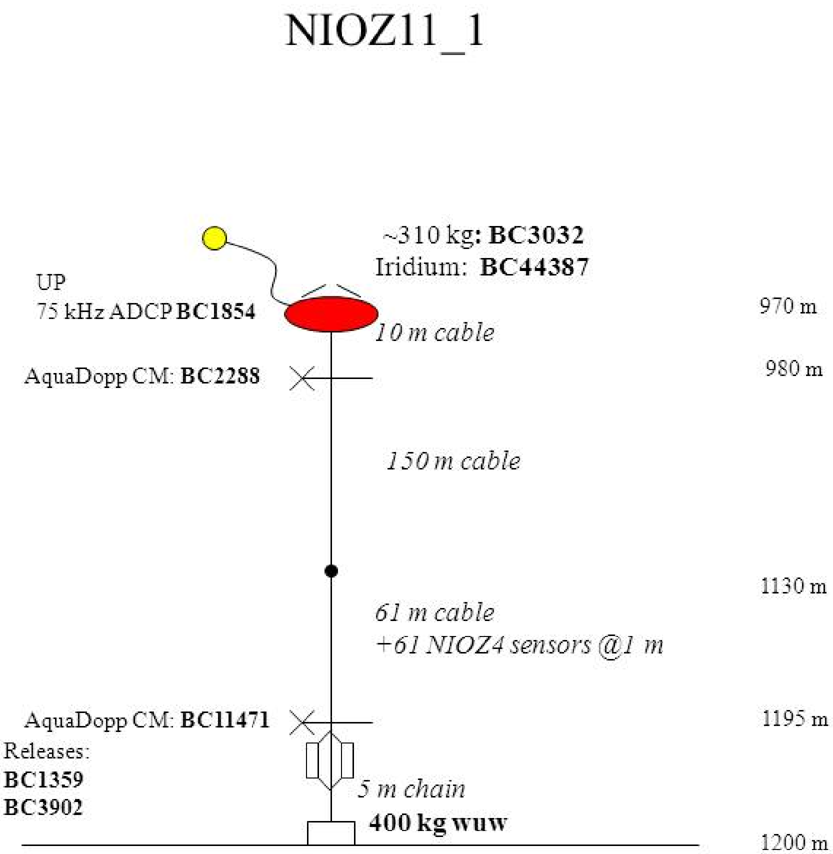
Long-term mooring KM3NeT09_1



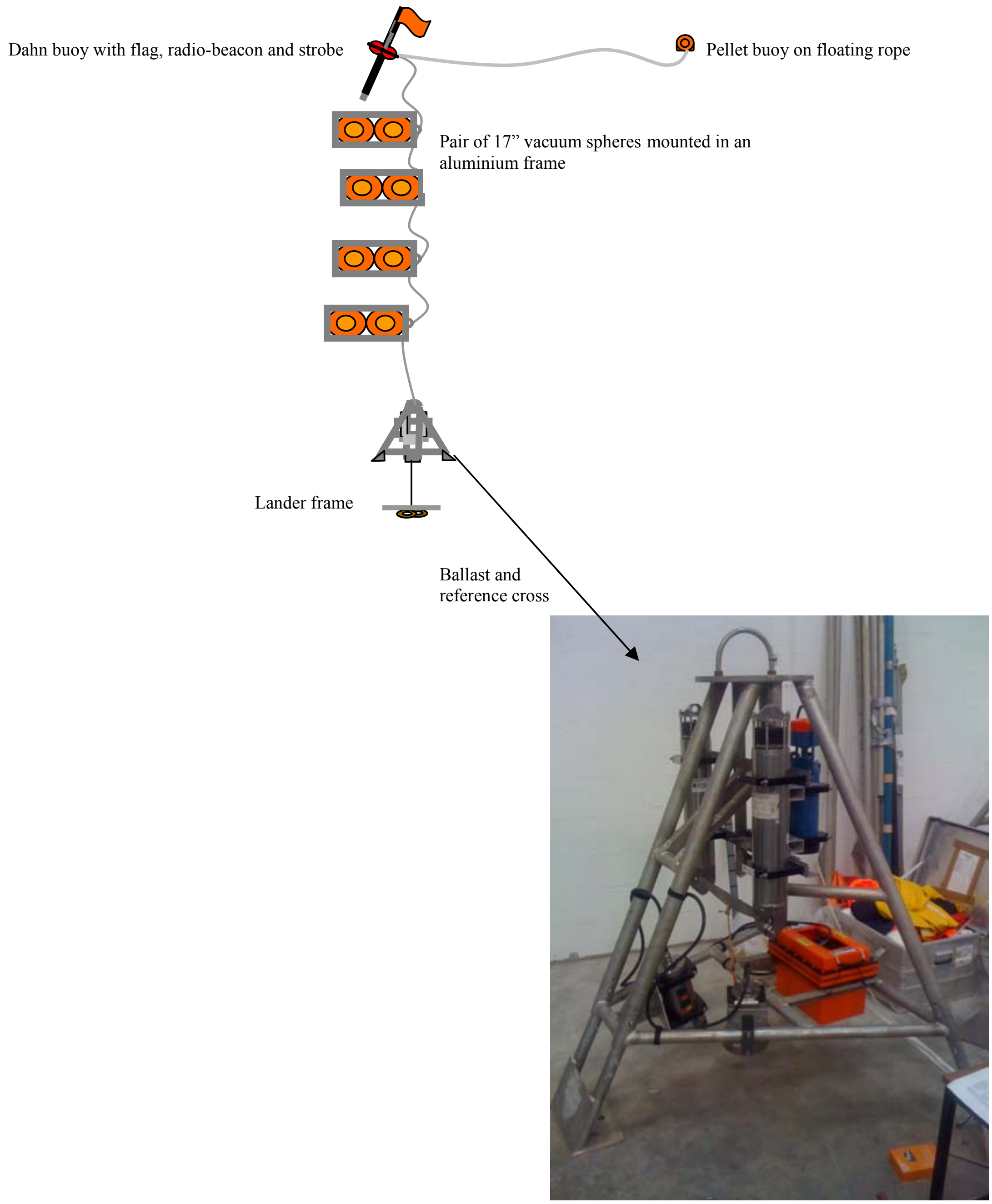
Long-term mooring KM3NeT09_2



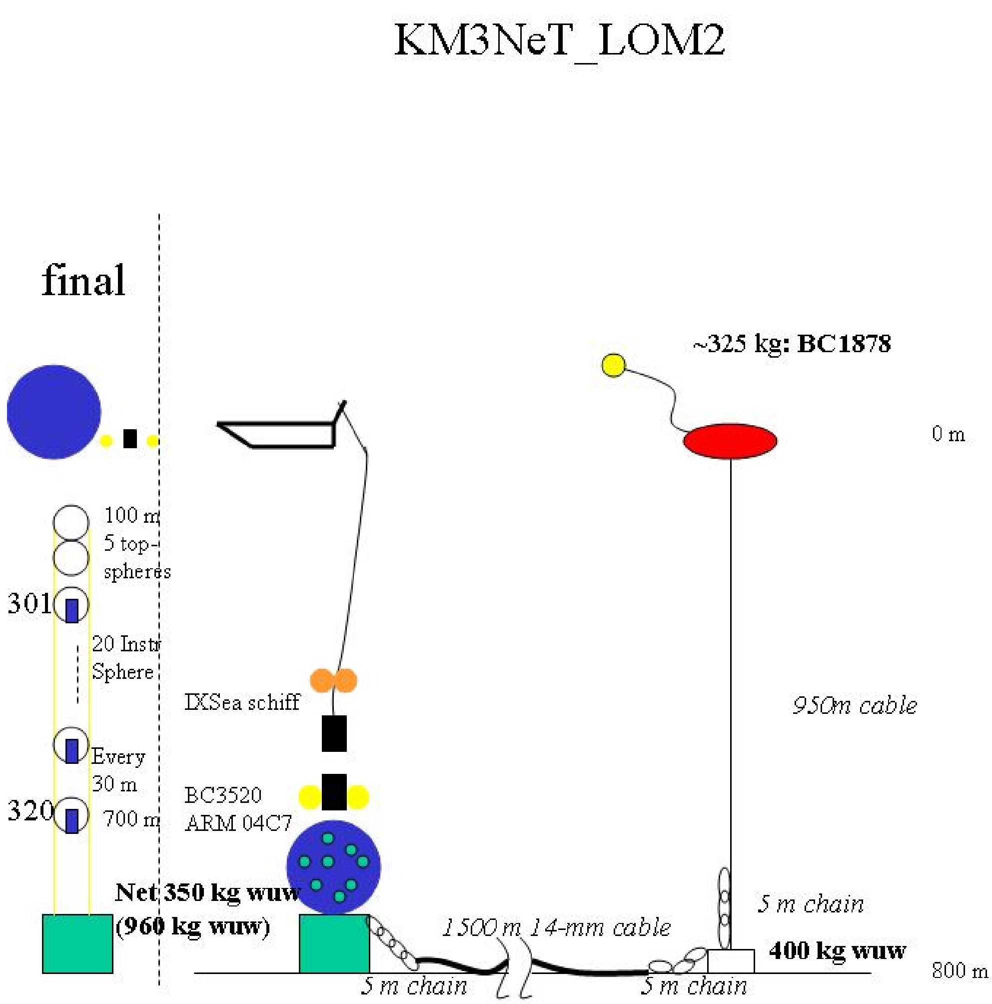
Short-term mooring NIOZ11_1



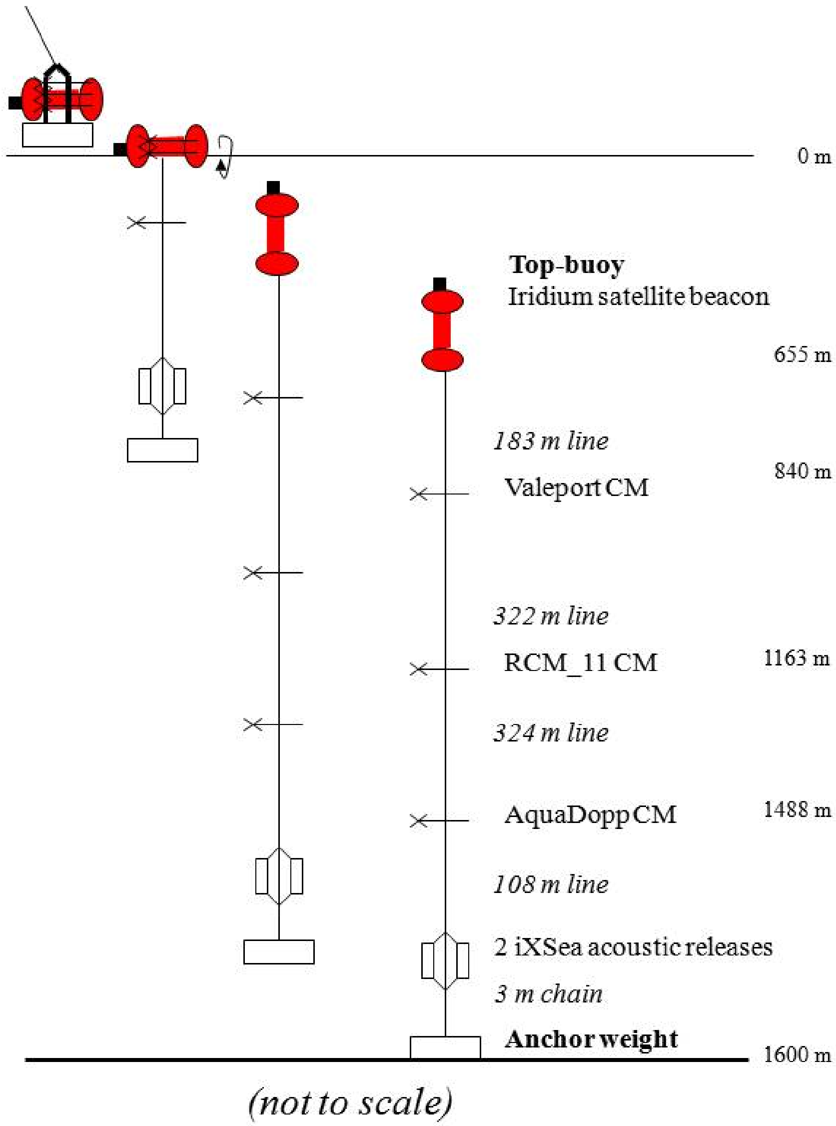
Bottom lander mooring OL11_1…4



KM3NeT_LOM mooring



NIOZ11_LOEI mooring



Appendix B ***Cruise summary of stations (activities) of KM3NeT11 (*** *Meteor* ***). Note the unfortunate American notation of date.***

Station	Date	Time UTC	Latitude	Longitude	Depth [m]	Wind [m/s]	Gear	Comment
ME834/078-1	1/24/2011	15:54	36° 28.43' N	15° 50.95' E	3351.1	NE 2	MOORST	Topbuoy t /water of Lander **OL11_1**
ME834/078-1	1/24/2011	15:58	36° 28.43' N	15° 50.92' E	3354.9	NNE 2	MOORST	Benthos with flag to water
ME834/078-1	1/24/2011	16:01	36° 28.44' N	15° 50.87' E	3352.3	NNE 3	MOORST	2x Benthos to water
ME834/078-1	1/24/2011	16:01	36° 28.44' N	15° 50.87' E	3352.3	NNE 3	MOORST	2x Benthos to water
ME834/078-1	1/24/2011	16:03	36° 28.44' N	15° 50.84' E	3353.7	NE 2	MOORST	2x Benthos to water
ME834/078-1	1/24/2011	16:11	36° 28.47' N	15° 50.72' E	3356	NE 3	MOORST	Lander to water
ME834/079-1	1/24/2011	17:07	36° 28.68' N	15° 51.88' E	3331.3	SSW 1	CTD/RO	Jo-Jo-CTD, W3
ME834/079-1	1/24/2011	18:20	36° 28.68' N	15° 51.88' E	3327.3	NW 3	CTD/RO	SLmax = 3321m
ME834/079-1	1/25/2011	6:42	36° 28.69' N	15° 51.91' E	3326.1	NE 7	CTD/RO	
ME834/080-1	1/25/2011	7:00	36° 29.38' N	15° 54.84' E	3288.2	NE 6	MOR	Recovery **KM3NeT09_2**
ME834/080-1	1/25/2011	7:18	36° 29.40' N	15° 54.71' E	0	NNE 8	MOR	
ME834/080-1	1/25/2011	7:18	36° 29.40' N	15° 54.71' E	0	NNE 8	MOR	
ME834/080-1	1/25/2011	7:35	36° 29.53' N	15° 54.80' E	0	NNE 8	MOR	Topbuoy a/Deck
ME834/080-1	1/25/2011	8:13	36° 29.78' N	15° 55.07' E	3286.6	NNE 5	MOR	Float BC1878
ME834/080-1	1/25/2011	8:37	36° 29.74' N	15° 54.96' E	3284.1	NNE 7	MOR	Aqua Dopp BC 2271
ME834/080-1	1/25/2011	9:01	36° 29.91' N	15° 55.13' E	3287.8	NNE 6	MOR	AquaDoppler BC11488 on deck
ME834/080-1	1/25/2011	9:24	36° 30.12' N	15° 55.30' E	3290	NNE 5	MOR	Aqua Doppler BC2264
ME834/080-1	1/25/2011	9:40	36° 30.29' N	15° 55.42' E	3291.4	NE 7	MOR	61 NIOZ3 sensors
ME834/080-1	1/25/2011	9:49	36° 30.39' N	15° 55.45' E	3291.6	NE 5	MOR	Aqua Doppler & Optical Sensor BC2288
ME834/080-1	1/25/2011	9:53	36° 30.42' N	15° 55.50' E	3290.4	NNE 5	MOR	Aqua Doppler BC11471
ME834/080-1	1/25/2011	9:56	36° 30.45' N	15° 55.54' E	3291.6	NE 6	MOR	
ME834/080-1	1/25/2011	9:56	36° 30.45' N	15° 55.54' E	3291.6	NE 6	MOR	
ME834/081-1	1/25/2011	13:14	36° 28.33' N	15° 50.48' E	0	NNE 3	MOORST	Recovery Lander **OL11_1**
ME834/081-1	1/25/2011	13:15	36° 28.33' N	15° 50.47' E	0	NE 3	MOORST	Hydrophon
ME834/081-1	1/25/2011	13:16	36° 28.33' N	15° 50.47' E	0	NE 3	MOORST	Ausgelöst
ME834/081-1	1/25/2011	13:20	36° 28.34' N	15° 50.44' E	0	ENE 2	MOORST	Hydrophon
ME834/081-1	1/25/2011	14:16	36° 28.47' N	15° 50.47' E	0	NE 3	MOORST	Aufgetaucht
ME834/081-1	1/25/2011	14:24	36° 28.43' N	15° 50.57' E	0	NNE 2	MOORST	Angepickt
ME834/081-1	1/25/2011	14:29	36° 28.42' N	15° 50.65' E	0	E 3	MOORST	Float w/flag
ME834/081-1	1/25/2011	14:29	36° 28.42' N	15° 50.65' E	0	E 3	MOORST	2x Benthos
ME834/081-1	1/25/2011	14:30	36° 28.42' N	15° 50.66' E	0	E 4	MOORST	2x Benthos
ME834/081-1	1/25/2011	14:31	36° 28.42' N	15° 50.67' E	0	E 3	MOORST	2x Benthos
ME834/081-1	1/25/2011	14:32	36° 28.42' N	15° 50.67' E	0	ESE 3	MOORST	2x Benthos
ME834/081-1	1/25/2011	14:33	36° 28.42' N	15° 50.68' E	0	E 3	MOORST	Lander komplett an Deck
ME834/082-1	1/26/2011	15:11	37° 4.48' N	21° 25.17' E	806.4	NNW 5	MOR	**KM3NeT LOM 2** - Station starts
ME834/082-1	1/26/2011	15:16	37° 4.49' N	21° 25.15' E	806	N 8	MOR	Topbouy & Float / ADCP
ME834/082-1	1/26/2011	15:54	37° 5.14' N	21° 24.81' E	865.8	NW 6	MOR	950m wire deployed
ME834/082-1	1/26/2011	16:00	37° 5.29' N	21° 24.82' E	868.6	NW 7	MOR	1st anchor weight
ME834/082-1	1/26/2011	16:38	37° 6.18' N	21° 24.86' E	882.1	NNW 5	MOR	1350m wire deployed
ME834/082-1	1/26/2011	17:03	37° 6.33' N	21° 25.15' E	865	NW 5	MOR	2nd anchor weight & Sphere
ME834/082-1	1/26/2011	17:10	37° 6.37' N	21° 25.27' E	859.3	NW 5	MOR	Posidonia Releaser - slack w/0,3-0,5 m/s
ME834/082-1	1/26/2011	17:11	37° 6.37' N	21° 25.28' E	861	NW 5	MOR	Vorlauf - 2x Benthos
ME834/082-1	1/26/2011	18:17	37° 6.49' N	21° 25.40' E	0	NW 5	MOR	Released via Hydrophon
ME834/082-1	1/26/2011	18:20	37° 6.49' N	21° 25.40' E	0	NW 4	MOR	Hieven
ME834/082-1	1/26/2011	18:52	37° 6.53' N	21° 25.42' E	0	NNW 4	MOR	Vorlauf - 2x Benthos out of water
ME834/082-1	1/26/2011	19:00	37° 6.51' N	21° 25.48' E	0	NW 4	MOR	Sphere w/Posidonia Releaser
ME834/082-1	1/26/2011	19:17	37° 6.42' N	21° 25.52' E	0	WNW 3	MOR	Sphere w/Releaser

ME834/082-1	1/26/2011	19:24	37° 6.39' N	21° 25.54' E	0	NW 3	MOR	Vorlauf - 2x Benthos
ME834/082-1	1/26/2011	19:55	37° 6.58' N	21° 25.49' E	0	WNW 4	MOR	Sphere w/anchor @ bottom
ME834/082-1	1/26/2011	20:16	37° 6.59' N	21° 25.35' E	871.4	NNW 4	MOR	Releaser & Vorlauf - 2x Benthos
ME834/083-1	1/27/2011	6:00	37° 6.80' N	21° 25.37' E	886.3	SE 5	MOR	Recovery **KM3NeT_LOM 2**
ME834/083-1	1/27/2011	6:02	37° 6.83' N	21° 25.37' E	890.6	SE 5	MOR	
ME834/083-1	1/27/2011	6:06	37° 6.88' N	21° 25.40' E	896.6	SE 7	MOR	
ME834/083-1	1/27/2011	6:12	37° 6.94' N	21° 25.46' E	898.5	SE 6	MOR	
ME834/083-1	1/27/2011	6:29	37° 6.76' N	21° 25.42' E	879.4	ESE 7	MOR	
ME834/083-1	1/27/2011	6:42	37° 6.85' N	21° 25.30' E	895.4	ESE 7	MOR	
ME834/083-1	1/27/2011	7:17	37° 6.15' N	21° 25.11' E	859	ESE 10	MOR	Topbuoy
ME834/083-1	1/27/2011	7:28	37° 6.22' N	21° 25.25' E	852.1	ESE 8	MOR	ADCP Float
ME834/083-1	1/27/2011	7:35	37° 6.33' N	21° 25.31' E	854.5	ESE 8	MOR	5x orange Glas Spheres
ME834/083-1	1/27/2011	8:16	37° 6.43' N	21° 24.88' E	891.4	SE 9	MOR	Dinghi alomngside w/Shere
ME834/083-1	1/27/2011	8:22	37° 6.58' N	21° 24.86' E	898.8	SE 10	MOR	Sphere
ME834/083-1	1/27/2011	8:24	37° 6.66' N	21° 24.86' E	903.8	SE 12	MOR	Dinghi w/5x orange spheres
ME834/083-1	1/27/2011	8:40	37° 7.01' N	21° 24.72' E	938.3	SE 10	MOR	Dinghi stowed
ME834/083-1	1/27/2011	10:12	37° 7.06' N	21° 24.94' E	932.8	SE 12	MOR	Ankerstein
ME834/083-1	1/27/2011	10:43	37° 7.18' N	21° 24.93' E	939.3	SE 10	MOR	Ankerstein aus dem Grund
ME834/083-1	1/27/2011	11:14	37° 8.22' N	21° 23.76' E	1025.8	SSE 13	MOR	Anchor weight
ME834/083-1	1/27/2011	11:54	37° 7.83' N	21° 22.62' E	1101.8	SE 11	MOR	Start heaving last 20 spheres
ME834/083-1	1/27/2011	13:52	37° 9.23' N	21° 17.71' E	1329.7	SE 15	MOR	komplette Verankerung geborgen
ME834/084-1	1/27/2011	16:00	37° 7.99' N	21° 21.18' E	1201.9	SE 18	MOR	Station starts **NIOZ 11_1**
ME834/084-1	1/27/2011	16:24	37° 7.98' N	21° 21.19' E	1202.1	SE 18	MOR	ADCP w/float
ME834/084-1	1/27/2011	16:27	37° 7.99' N	21° 21.13' E	1204.2	SE 18	MOR	RCM + Thermistorkette
ME834/084-1	1/27/2011	16:35	37° 7.87' N	21° 21.14' E	1205.5	SE 19	MOR	RCM + Releaser + anchor weight
ME834/084-1	1/27/2011	16:35	37° 7.87' N	21° 21.14' E	1205.5	SE 19	MOR	
ME834/085-1	1/28/2011	7:55	36° 56.86' N	21° 26.06' E	1773.1	ESE 9	MOR	**NIOZ LOEI 1** - Station starts
ME834/085-1	1/28/2011	8:28	36° 57.30' N	21° 26.22' E	1762.2	E 14	MOR	NIOZ LOEI 1
ME834/085-1	1/28/2011	8:28	36° 57.30' N	21° 26.22' E	1762.2	E 14	MOR	
ME834/086-1	1/28/2011	8:56	36° 56.00' N	21° 25.44' E	1849.4	ESE 11	MOORST	Lander **OL_11_2** / Station starts
ME834/086-1	1/28/2011	8:59	36° 56.01' N	21° 25.48' E	1846.1	ESE 10	MOORST	Float w/recovery line
ME834/086-1	1/28/2011	9:00	36° 56.01' N	21° 25.50' E	1863.8	ESE 11	MOORST	Float w/flag
ME834/086-1	1/28/2011	9:01	36° 56.02' N	21° 25.51' E	1857.2	SE 11	MOORST	2x Benthos
ME834/086-1	1/28/2011	9:02	36° 56.03' N	21° 25.54' E	1841.4	SE 10	MOORST	2x Benthos
ME834/086-1	1/28/2011	9:03	36° 56.04' N	21° 25.57' E	1846.3	SE 10	MOORST	2x Benthos
ME834/086-1	1/28/2011	9:04	36° 56.04' N	21° 25.59' E	1840.1	ESE 11	MOORST	2x Benthos
ME834/086-1	1/28/2011	9:15	36° 56.11' N	21° 25.94' E	1822.6	SE 9	MOORST	Lander w/camera, Releaser + Anchorweight
ME834/087-1	1/29/2011	12:45	36° 56.25' N	21° 25.70' E	1807.3	SE 5	MOR	Start Station - Recovery Lander **OL 11-2**
ME834/087-1	1/29/2011	12:46	36° 56.25' N	21° 25.71' E	1807.3	SE 6	MOR	
ME834/087-1	1/29/2011	12:47	36° 56.25' N	21° 25.71' E	1806.8	SE 5	MOR	
ME834/087-1	1/29/2011	12:54	36° 56.26' N	21° 25.71' E	1806.2	SSE 6	MOR	
ME834/087-1	1/29/2011	12:54	36° 56.26' N	21° 25.71' E	1806.2	SSE 6	MOR	
ME834/087-1	1/29/2011	13:20	36° 56.26' N	21° 25.71' E	1808.2	SE 5	MOR	
ME834/087-1	1/29/2011	13:36	36° 56.23' N	21° 25.89' E	1811.7	SE 5	MOR	
ME834/087-1	1/29/2011	13:41	36° 56.21' N	21° 25.92' E	1813.7	SE 5	MOR	Float w/flag
ME834/087-1	1/29/2011	13:43	36° 56.21' N	21° 25.93' E	1814.5	SE 5	MOR	2x Benthos
ME834/087-1	1/29/2011	13:44	36° 56.22' N	21° 25.93' E	1813.2	SE 5	MOR	2x Benthos
ME834/087-1	1/29/2011	13:44	36° 56.22' N	21° 25.93' E	1813.2	SE 5	MOR	2x Benthos
ME834/087-1	1/29/2011	13:44	36° 56.22' N	21° 25.93' E	1813.2	SE 5	MOR	2x Benthos
ME834/087-1	1/29/2011	13:46	36° 56.23' N	21° 25.94' E	1811.3	SE 6	MOR	Lander w/Releaser
ME834/087-1	1/29/2011	13:46	36° 56.23' N	21° 25.94' E	1811.3	SE 6	MOR	Mooring recovered
ME834/088-1	1/29/2011	14:08	36° 57.62' N	21° 25.85' E	0	SE 6	MOR	Start Recovery **NIOZ LOEI 1**

ME834/088-1	1/29/2011	14:14	36° 57.67' N	21° 25.85' E	0	SE 4	MOR	
ME834/088-1	1/29/2011	14:16	36° 57.68' N	21° 25.85' E	0	SSE 5	MOR	
ME834/088-1	1/29/2011	14:17	36° 57.69' N	21° 25.84' E	0	S 4	MOR	
ME834/088-1	1/29/2011	14:33	36° 57.48' N	21° 26.08' E	0	SSE 5	MOR	
ME834/088-1	1/29/2011	14:36	36° 57.49' N	21° 26.08' E	0	SE 4	MOR	Dinghi t/water
ME834/088-1	1/29/2011	14:54	36° 57.47' N	21° 26.07' E	1757.1	SSE 4	MOR	Top Buoy alongside
ME834/088-1	1/29/2011	14:57	36° 57.46' N	21° 26.10' E	1760.8	SE 5	MOR	Top Buoy
ME834/088-1	1/29/2011	15:15	36° 57.51' N	21° 26.12' E	1757.3	SE 7	MOR	Mooring recovered - Dinghi a/Deck
ME834/089-1	1/29/2011	17:28	36° 36.01' N	21° 25.99' E	4349.9	ESE 6	CTD/RO	Yo-yo-CTD
ME834/089-1	1/29/2011	19:05	36° 36.00' N	21° 26.00' E	4346.5	ESE 7	CTD/RO	SL max=4310m
ME834/089-1	1/30/2011	5:10	36° 36.00' N	21° 25.99' E	4349.7	SE 10	CTD/RO	
ME834/090-1	1/30/2011	6:05	36° 37.87' N	21° 24.63' E	4398.6	SE 12	MOR	**KM3NeT09-1** Recovery
ME834/090-1	1/30/2011	6:21	36° 38.06' N	21° 24.58' E	0	SE 13	MOR	
ME834/090-1	1/30/2011	6:27	36° 38.17' N	21° 24.52' E	0	SE 13	MOR	
ME834/090-1	1/30/2011	6:29	36° 38.21' N	21° 24.50' E	4257.3	SE 14	MOR	
ME834/090-1	1/30/2011	6:46	36° 38.13' N	21° 24.54' E	4278.9	SE 12	MOR	
ME834/090-1	1/30/2011	7:27	36° 37.63' N	21° 24.96' E	4458.8	SE 13	MOR	Kugel
ME834/090-1	1/30/2011	7:33	36° 37.59' N	21° 24.74' E	4457	SE 13	MOR	ADCP
ME834/090-1	1/30/2011	8:00	36° 37.91' N	21° 24.32' E	4437	SE 14	MOR	Float BC7924
ME834/090-1	1/30/2011	8:20	36° 38.11' N	21° 23.94' E	4393.4	SE 13	MOR	Aqua Dopp BC 2031
ME834/090-1	1/30/2011	8:40	36° 38.24' N	21° 23.74' E	4291.6	SE 13	MOR	Aqua Dopp BC 13208
ME834/090-1	1/30/2011	9:02	36° 38.41' N	21° 23.41' E	4215.1	SE 12	MOR	Aqua Dopp BC12850, Vector TM BC33589
ME834/090-1	1/30/2011	9:35	36° 38.67' N	21° 22.98' E	4111.1	SE 11	MOR	Aqua Dopp BC2295, Optical Sensor BC7382
ME834/090-1	1/30/2011	9:40	36° 38.72' N	21° 22.91' E	4090.9	SE 11	MOR	Aqua Dopp BC2325
ME834/090-1	1/30/2011	9:44	36° 38.81' N	21° 22.84' E	4065.8	SE 15	MOR	Releaser
ME834/091-1	1/30/2011	11:14	36° 32.05' N	21° 14.29' E	0	SE 13	MOR	Station starts
ME834/091-1	1/30/2011	11:20	36° 32.07' N	21° 14.28' E	0	SE 12	MOR	
ME834/091-1	1/30/2011	11:32	36° 32.10' N	21° 14.39' E	0	SE 12	MOR	5x ausgelöst
ME834/091-1	1/30/2011	11:34	36° 32.11' N	21° 14.39' E	0	SE 14	MOR	
ME834/091-1	1/30/2011	11:34	36° 32.11' N	21° 14.39' E	0	SE 14	MOR	Verankerung aufgegeben
ME834/092-1	1/30/2011	12:25	36° 33.13' N	21° 6.79' E	0	SE 14	MOORST	Start Deployment **OL 11-3**
ME834/092-1	1/30/2011	12:27	36° 33.11' N	21° 6.83' E	5104.6	SSE 15	MOORST	Top Buoy w/recovery line
ME834/092-1	1/30/2011	12:28	36° 33.11' N	21° 6.84' E	5106.4	SSE 14	MOORST	Float w/flag
ME834/092-1	1/30/2011	12:29	36° 33.12' N	21° 6.85' E	5105.9	SSE 15	MOORST	2x Benthos
ME834/092-1	1/30/2011	12:30	36° 33.11' N	21° 6.86' E	5102	SSE 14	MOORST	2x Benthos
ME834/092-1	1/30/2011	12:31	36° 33.10' N	21° 6.87' E	5105.8	SSE 13	MOORST	2x Benthos
ME834/092-1	1/30/2011	12:32	36° 33.10' N	21° 6.87' E	5105.7	SE 13	MOORST	2x Benthos
ME834/092-1	1/30/2011	12:42	36° 33.03' N	21° 6.97' E	5105.4	SSE 14	MOORST	Lander w/Releaser + anchor weight
ME834/093-1	1/30/2011	15:58	37° 6.02' N	21° 20.99' E	1178.8	SSE 13	CTD/RO	Yo-Yo-CTD, W3
ME834/093-1	1/30/2011	16:24	37° 6.00' N	21° 21.00' E	1177.9	SSE 12	CTD/RO	SLmax= 1163m
ME834/093-1	1/31/2011	5:00	37° 6.00' N	21° 21.00' E	1174.3	SSE 5	CTD/RO	
ME834/094-1	1/31/2011	7:11	37° 6.18' N	21° 24.73' E	894.1	SE 6	MOORST	Start Deployment **KM3NeT LOM 3**
ME834/094-1	1/31/2011	7:12	37° 6.18' N	21° 24.73' E	894.3	SSE 7	MOORST	Top Buoy w/Recovery line
ME834/094-1	1/31/2011	7:13	37° 6.17' N	21° 24.74' E	895.5	SE 6	MOORST	Float
ME834/094-1	1/31/2011	7:59	37° 5.83' N	21° 25.04' E	855.4	SSE 5	MOORST	Anchor weight w/5m chain (+950m line)
ME834/094-1	1/31/2011	9:17	37° 5.25' N	21° 25.52' E	793.4	SSE 6	MOORST	Sphere (2,3m diam), anchor weight, Buoyancy - Releaser
ME834/094-1	1/31/2011	9:24	37° 5.27' N	21° 25.52' E	794.9	SSE 5	MOORST	start heaving Sphere to deck because of fishery line
ME834/094-1	1/31/2011	9:47	37° 5.59' N	21° 25.54' E	799.1	SSE 6	MOORST	all cleared by fishery vesl. - station cont.
ME834/094-1	1/31/2011	10:05	37° 5.28' N	21° 25.51' E	796.3	SSE 6	MOORST	Anchor weight, Sphere w/float, Buoyancy + Releaser
ME834/094-1	1/31/2011	10:10	37° 5.28' N	21° 25.54' E	790.6	SSE 6	MOORST	2x Benthos
ME834/094-1	1/31/2011	10:30	37° 5.26' N	21° 25.53' E	0	SSE 6	MOORST	Hydrophone
ME834/094-1	1/31/2011	10:40	37° 5.26' N	21° 25.53' E	0	SSE 6	MOORST	Released

ME834/094-1	1/31/2011	11:12	37° 5.20' N	21° 25.58' E	0	SSE 5	MOORST	2x Benthos
ME834/094-1	1/31/2011	11:16	37° 5.18' N	21° 25.59' E	0	SSE 5	MOORST	Releaser
ME834/095-1	1/31/2011	12:00	37° 5.10' N	21° 25.66' E	0	SSE 3	MOORST	Recovery **KM3NeT LOM 3**
ME834/095-1	1/31/2011	12:00	37° 5.10' N	21° 25.66' E	0	SSE 3	MOORST	Hydrophon
ME834/095-1	1/31/2011	12:00	37° 5.10' N	21° 25.66' E	0	SSE 3	MOORST	Mooring ausgelöst
ME834/095-1	1/31/2011	12:01	37° 5.10' N	21° 25.66' E	0	SSE 3	MOORST	Hydrophone
ME834/095-1	1/31/2011	12:10	37° 5.09' N	21° 25.66' E	0	S 4	MOORST	Sphere + Buoyancy at surface
ME834/095-1	1/31/2011	12:12	37° 5.09' N	21° 25.66' E	0	SSE 4	MOORST	Dinghi
ME834/095-1	1/31/2011	12:29	37° 5.48' N	21° 25.53' E	796.4	SSE 2	MOORST	Buoyancy
ME834/095-1	1/31/2011	12:30	37° 5.50' N	21° 25.53' E	796.9	SSE 2	MOORST	3x glass sphere (small)
ME834/095-1	1/31/2011	12:40	37° 5.61' N	21° 25.56' E	801.9	ESE 2	MOORST	Sphere (2,3m diam)
ME834/095-1	1/31/2011	13:09	37° 5.90' N	21° 25.16' E	848	S 1	MOORST	Topbuoy + Float alongside
ME834/095-1	1/31/2011	13:17	37° 5.91' N	21° 25.06' E	854.2	SSE 2	MOORST	Top Buoy + Float
ME834/095-1	1/31/2011	14:14	37° 5.66' N	21° 25.36' E	819.2	S 4	MOORST	1. Anchor weight
ME834/095-1	1/31/2011	15:00	37° 5.50' N	21° 25.47' E	806.6	S 5	MOORST	5x glass sphere at surface
ME834/095-1	1/31/2011	15:17	37° 5.95' N	21° 25.43' E	827.7	S 5	MOORST	Dinghi w/5x glass sphere
ME834/095-1	1/31/2011	15:29	37° 6.28' N	21° 25.40' E	850.9	S 4	MOORST	2. Anchor weight + chain
ME834/095-1	1/31/2011	15:40	37° 6.57' N	21° 25.43' E	869.3	S 4	MOORST	start heaving remaining 17 spheres
ME834/095-1	1/31/2011	16:58	37° 8.59' N	21° 25.46' E	957.4	W 2	MOORST	17 spheres on deck
ME834/096-1	1/31/2011	17:48	37° 3.93' N	21° 25.01' E	1044.9	SSE 3	MB	rwK = 360
ME834/096-1	1/31/2011	18:24	37° 7.04' N	21° 25.01' E	934.4	N 2	MB	rwK=270°
ME834/096-1	1/31/2011	18:31	37° 7.18' N	21° 24.50' E	971.7	NNW 2	MB	rwk=180°
ME834/096-1	1/31/2011	19:10	37° 3.88' N	21° 24.29' E	1116.1	SE 6	MB	rwK=270°
ME834/096-1	1/31/2011	19:18	37° 3.92' N	21° 23.54' E	1213.2	SSE 3	MB	rwK000°
ME834/096-1	1/31/2011	19:54	37° 7.16' N	21° 23.54' E	1029	NNW 3	MB	rwK=270°
ME834/096-1	1/31/2011	20:00	37° 7.17' N	21° 23.03' E	1065.3	N 4	MB	rwk=180°
ME834/096-1	1/31/2011	20:38	37° 3.93' N	21° 22.89' E	1272.9	N 5	MB	rwK=270°
ME834/096-1	1/31/2011	20:44	37° 3.83' N	21° 22.38' E	1356.7	NNW 4	MB	rwK=000°
ME834/096-1	1/31/2011	21:20	37° 6.99' N	21° 22.21' E	1125.6	NE 4	MB	rwK=270°
ME834/096-1	1/31/2011	21:27	37° 7.17' N	21° 21.71' E	1162.3	NE 5	MB	rwK=180°
ME834/096-1	1/31/2011	22:05	37° 4.01' N	21° 21.50' E	1382.5	ENE 4	MB	rwK=270°
ME834/096-1	1/31/2011	22:13	37° 3.93' N	21° 20.84' E	1527	ENE 3	MB	rwk=000°
ME834/096-1	1/31/2011	22:50	37° 6.95' N	21° 20.80' E	1214.6	ENE 5	MB	rwk=270°
ME834/096-1	1/31/2011	23:03	37° 7.07' N	21° 20.13' E	1239.8	E 4	MB	rwk=180°
ME834/096-1	1/31/2011	23:40	37° 4.01' N	21° 20.06' E	1595.4	ESE 5	MB	Distance d=29,9nm
ME834/097-1	2/1/2011	6:10	36° 33.27' N	21° 7.06' E	0	ESE 11	MOR	Start recovery **OL 11-3**
ME834/097-1	2/1/2011	6:14	36° 33.27' N	21° 7.06' E	0	ESE 11	MOR	
ME834/097-1	2/1/2011	6:18	36° 33.27' N	21° 7.06' E	5106.6	ESE 11	MOR	
ME834/097-1	2/1/2011	7:43	36° 33.27' N	21° 7.06' E	5106	ESE 10	MOR	
ME834/097-1	2/1/2011	7:52	36° 33.13' N	21° 7.00' E	5102.7	ESE 10	MOR	Mooring alongside
ME834/097-1	2/1/2011	8:16	36° 33.21' N	21° 6.52' E	5190	ESE 10	MOR	Flag
ME834/097-1	2/1/2011	8:19	36° 33.24' N	21° 6.44' E	5106.4	ESE 10	MOR	1st buoyancy
ME834/097-1	2/1/2011	8:20	36° 33.25' N	21° 6.41' E	5109.7	ESE 11	MOR	2nd buoyancy
ME834/097-1	2/1/2011	8:20	36° 33.25' N	21° 6.41' E	5109.7	ESE 11	MOR	3rd buoyancy
ME834/097-1	2/1/2011	8:21	36° 33.27' N	21° 6.37' E	5105.8	ESE 10	MOR	4th buoyancy
ME834/097-1	2/1/2011	8:23	36° 33.30' N	21° 6.30' E	5105.4	ESE 9	MOR	
ME834/098-1	2/1/2011	8:34	36° 33.31' N	21° 6.12' E	5105.4	ESE 11	CTD	W3
ME834/098-1	2/1/2011	10:16	36° 33.31' N	21° 6.13' E	5107	ESE 8	CTD	SLmax = 5098m
ME834/098-1	2/1/2011	12:30	36° 33.33' N	21° 6.12' E	5106	SE 8	CTD	
ME834/099-1	2/1/2011	15:45	37° 5.10' N	21° 22.00' E	2233.6	SSW 4	MOORST	**LOEI_2** Launch Ocean Experiment Instrument (Spirale Mooring
ME834/099-1	2/1/2011	15:46	37° 5.10' N	21° 22.00' E	2265.2	SSW 4	MOORST	Sliped
ME834/099-1	2/1/2011	15:53	37° 5.08' N	21° 21.97' E	2225.7	S 4	MOORST	submerged abt. 60mtr. North of the ship

ME834/100-1	2/2/2011	5:52	37° 5.14' N	21° 22.26' E	1085.2	SE 4	MOORST	Hydrophon zu Wasser
ME834/100-1	2/2/2011	5:57	37° 5.14' N	21° 22.26' E	0	SSE 4	MOORST	Released
ME834/100-1	2/2/2011	6:02	37° 5.14' N	21° 22.26' E	1085.2	SSE 4	MOORST	Mooring @ surface
ME834/100-1	2/2/2011	6:12	37° 5.20' N	21° 22.12' E	1099.2	SE 4	MOORST	Dinghi
ME834/100-1	2/2/2011	6:35	37° 5.39' N	21° 21.97' E	1113.1	SE 4	MOORST	Mooring alongside
ME834/100-1	2/2/2011	6:45	37° 5.42' N	21° 22.06' E	1108	SE 4	MOORST	Top Buoy
ME834/100-1	2/2/2011	6:54	37° 5.66' N	21° 22.14' E	1105.8	SE 4	MOORST	Schlauchboot
ME834/100-1	2/2/2011	6:56	37° 5.72' N	21° 22.14' E	1108	SE 4	MOORST	RCM - current meter
ME834/100-1	2/2/2011	7:07	37° 6.04' N	21° 22.06' E	1116.3	ESE 4	MOORST	RCM - current meter
ME834/100-1	2/2/2011	7:21	37° 6.46' N	21° 21.89' E	1144.7	SSE 3	MOORST	RCM - current meter
ME834/100-1	2/2/2011	7:28	37° 6.65' N	21° 21.81' E	1154.1	SSE 4	MOORST	Releaser
ME834/101-1	2/2/2011	9:44	37° 5.34' N	21° 18.95' E	1345.9	ESE 4	MOORST	Top Buoy w/recovery line + Float w/flag (yellow) - **OL 11-4**
ME834/101-1	2/2/2011	9:46	37° 5.33' N	21° 18.97' E	1332.2	E 3	MOORST	2nd float
ME834/101-1	2/2/2011	9:47	37° 5.32' N	21° 18.98' E	1339.8	ESE 3	MOORST	3rd float
ME834/101-1	2/2/2011	9:48	37° 5.31' N	21° 18.99' E	1344.4	ESE 3	MOORST	4th float
ME834/101-1	2/2/2011	9:49	37° 5.30' N	21° 19.00' E	1345.1	ESE 4	MOORST	5th float
ME834/101-1	2/2/2011	9:54	37° 5.26' N	21° 19.06' E	1350.7	ESE 3	MOORST	Lander OL_11_4 geslipt
ME834/102-1	2/2/2011	12:32	37° 5.52' N	21° 16.82' E	1583.8	ESE 10	MOORST	Station starts, **LOEI-3**
ME834/102-1	2/2/2011	12:36	37° 5.54' N	21° 16.83' E	1581.9	E 9	MOORST	LOEI-3
ME834/102-1	2/2/2011	12:43	37° 5.55' N	21° 16.87' E	1582.7	ESE 10	MOORST	Submerged
ME834/103-1	2/3/2011	5:58	37° 5.76' N	21° 17.09' E	0	ESE 5	MOORST	Recovery LOEI-3, hydrophon into to water
ME834/103-1	2/3/2011	5:59	37° 5.76' N	21° 17.09' E	0	ESE 5	MOORST	Released
ME834/103-1	2/3/2011	6:00	37° 5.76' N	21° 17.09' E	0	E 5	MOORST	hydrophon on deck, Dinghy t/water
ME834/103-1	2/3/2011	6:12	37° 5.71' N	21° 17.03' E	1561.9	E 6	MOORST	at surface
ME834/103-1	2/3/2011	6:19	37° 5.53' N	21° 16.82' E	1582.1	E 5	MOORST	Alongside
ME834/103-1	2/3/2011	6:25	37° 5.50' N	21° 16.78' E	1583.8	E 4	MOORST	Top Buoy
ME834/103-1	2/3/2011	6:32	37° 5.45' N	21° 16.72' E	1584.6	E 4	MOORST	1. RCM
ME834/103-1	2/3/2011	6:33	37° 5.45' N	21° 16.71' E	1585.7	ESE 4	MOORST	Schlauchboot
ME834/103-1	2/3/2011	6:43	37° 5.41' N	21° 16.60' E	1585.3	E 4	MOORST	2. RCM
ME834/103-1	2/3/2011	6:51	37° 5.41' N	21° 16.51' E	1585	E 3	MOORST	Dinghy stowed
ME834/103-1	2/3/2011	6:55	37° 5.41' N	21° 16.47' E	1584.4	ENE 3	MOORST	3. RCM
ME834/103-1	2/3/2011	7:00	37° 5.41' N	21° 16.41' E	1584.2	E 3	MOORST	Releaser, all recovered
ME834/104-1	2/3/2011	13:54	37° 5.35' N	21° 18.87' E	1346.3	N 4	MOORST	Hydrophon t/water, **Mooring OL 11-4**
ME834/104-1	2/3/2011	13:56	37° 5.35' N	21° 18.88' E	1346.7	N 4	MOORST	Released
ME834/104-1	2/3/2011	14:03	37° 5.33' N	21° 18.86' E	0	NNE 11	MOORST	Hydrophone
ME834/104-1	2/3/2011	14:20	37° 5.05' N	21° 18.91' E	0	NNE 14	MOORST	Mooring @ surface
ME834/104-1	2/3/2011	14:34	37° 5.24' N	21° 18.99' E	0	NNE 13	MOORST	Mooring alongside
ME834/104-1	2/3/2011	14:35	37° 5.24' N	21° 18.99' E	0	NNE 14	MOORST	Top Buoy
ME834/104-1	2/3/2011	15:16	37° 4.83' N	21° 19.38' E	0	N 10	MOORST	2x Benthos
ME834/104-1	2/3/2011	15:20	37° 4.76' N	21° 19.40' E	0	N 10	MOORST	2x Benthos
ME834/104-1	2/3/2011	15:22	37° 4.73' N	21° 19.41' E	0	N 6	MOORST	Lander
ME834/104-1	2/3/2011	15:27	37° 4.68' N	21° 19.43' E	0	N 6	MOORST	Float w/flag
ME834/104-1	2/3/2011	15:35	37° 4.45' N	21° 19.63' E	0	NE 5	MOORST	2x Bentos damaged/broken and afloat
ME834/104-1	2/3/2011	15:40	37° 4.31' N	21° 19.62' E	0	NE 6	MOORST	2x Benthos
ME834/104-1	2/3/2011	16:15	37° 4.20' N	21° 19.53' E	0	NNE 13	MOORST	Camera
ME834/104-1	2/3/2011	16:55	37° 4.37' N	21° 19.54' E	0	N 14	MOORST	camera on deck
ME834/105-1	2/4/2011	14:15	37° 8.16' N	21° 21.17' E	0	SE 3	MOR	Station starts Recovery **NIOZ 11-1**
ME834/105-1	2/4/2011	14:20	37° 8.04' N	21° 21.37' E	0	SE 5	MOR	
ME834/105-1	2/4/2011	14:22	37° 8.04' N	21° 21.39' E	0	SE 5	MOR	
ME834/105-1	2/4/2011	14:22	37° 8.04' N	21° 21.39' E	0	SE 5	MOR	
ME834/105-1	2/4/2011	14:34	37° 8.09' N	21° 20.97' E	0	SE 7	MOR	
ME834/105-1	2/4/2011	14:42	37° 7.94' N	21° 21.16' E	0	SE 6	MOR	Mooring alongside

ME834/105-1	2/4/2011	14:46	37° 7.92' N	21° 21.21' E	0	ESE 5	MOR	ADCP Float
ME834/105-1	2/4/2011	14:54	37° 7.84' N	21° 21.32' E	1198.1	SE 4	MOR	RCM
ME834/105-1	2/4/2011	15:00	37° 7.78' N	21° 21.39' E	1193.1	SE 4	MOR	Thermistor chain
ME834/105-1	2/4/2011	15:01	37° 7.78' N	21° 21.40' E	1191.6	SE 4	MOR	RCM
ME834/105-1	2/4/2011	15:01	37° 7.78' N	21° 21.40' E	1191.6	SE 4	MOR	Releaser
ME834/106-1	2/4/2011	18:30	36° 33.33' N	21° 06.09' E	5103.8	S 3	CTD	W3
ME834/106-1	2/4/2011	19:44	36° 33.30' N	21° 06.11' E	5104.5	SW 4	CTD	SL max=3497m
ME834/106-1	2/4/2011	21:14	36° 33.30' N	21° 06.11' E	5105.3	SE 7	CTD	