Cruise Report
and preliminary results

DUST2019

Cruise No. 64PE464

11 – 22 November 2019
Las Palmas de Gran Canaria (Spain) – Mindelo, Sao Vicente (Cape Verde)

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1. Summary

RV Pelagia cruise 64PE464 was dedicated to service dust-collecting buoys *Carmen* and *Laura* as well as high-resolution sediment-trap mooring M1. These instruments were originally deployed in November 2012 in the framework of a set of research projects focussing on Saharan dust:

1) TRAFFIC (NWO funded),
2) DUSTTRAFFIC (ERC funded),
3) Mineral aerosols in the Earth system (DFG funded)

After the termination of these projects in 2017, it was decided to continue the monitoring of Saharan-dust deposition in the eastern part of the north equatorial Atlantic Ocean through collaboration with German colleagues from MARUM, Bremen, who have been sampling Saharan dust deposition off Cape Blanc since 1988. Since 2013, dust-collecting buoy *Carmen* was added to this sediment-trap mooring, in order to compare Saharan dust that is being blown through the atmosphere with the dust that is deposited into the ocean. At station M1, south of the Cape Verde Islands, a similar set up of dust-collecting buoy *Laura* and a high-resolution sediment-trap mooring (sampling at 4-days' resolution) has been installed since 2016 during cruise JC134 onboard RRS *James Cook*.

The instruments were deployed for a bit more than one year and are to be serviced in the spring of 2021 during a joint NIOZ-MARUM "SIPA" expedition onboard FS *Maria S. Merian.* In addition to servicing the dust-monitoring instruments, cruise 64PE464 was also dedicated to sampling Saharan dust from the atmosphere and directly analysing its mobile iron content, in order to compare it to the ongoing Saharan-dust monitoring campaign at the Cape Verde Atmosphere Observatory on the island of Sao Vicente, operated by TROPOS-Leipzig. Along the entire cruise track (figure 3.1) plankton was sampled in six-hour intervals by pumping surface water through plankton nets. Finally, settling sediments were collected with a set of so-called drifting traps in the vicinity of station M1 during a period of 24 hours.

Aim

Following the approach of combining dust-buoy data and samples and marine sediment-trap mooring samples, we aim to study the marine environmental impacts of Saharan-dust deposition.

Table 1.1: key data of dust-monitoring instruments, recovered/(re-)deployed during 64PE464

Instrument	Start date	Lat (° 'N)	Lon (° 'E)	End date	Nr cups	Interval
Buoy Carmen	15 Nov 2019	21°15.624'	21°00.170'	2 Apr 2021	24	21 days
Buoy Laura	19 Nov 2019	11°22.075'	22°58.080'	6 Apr 2021	24	21 days
Sed trap M1	22 Nov 2019	11°29.324'	22°42.242'	21 Apr 2021	98	4-8 days

2. Participants

Table 2.1: participants of cruise 64PE464

Name, title	Discipline	Affiliation
Bob Koster	Marine Electronics	NIOZ
Dave Huijsman	Marine Technology	NIOZ
Geert-Jan A. Brummer, Prof Dr	Paleoceanography	NIOZ & VU
Jan-Berend W. Stuut, Dr	Marine Geology, chief scientist	NIOZ & VU
Jan-Dirk de Visser	Marine Technology	NIOZ
Wadinga K. Fomba, Dr	Atmospheric chemistry	TROPOS

NIOZ – Royal Netherlands Institute for Sea Research, and Utrecht University, Texel, the Netherlands
VU – Vrije Universiteit Amsterdam, the Netherlands
TROPOS – Leibniz Institute for Tropospheric Research, Leipzig, Germany

3. Research program

The purpose of cruise 64PE464 was to recover and re-deploy dust-collecting buoys *Carmen* and *Laura*, as well as recover and re-deploy the high-resolution sediment-trap mooring M1, which is located at virtually the same position as buoy *Laura* (figure 3.1). At sea, dust was also collected *en route* from the ship's top deck, where two Anderson-type high-volume dust collectors were mounted. In addition, an *OMNI* 3000 aerosol sampler was used to collect dust in sterile water in the southern part of the study area. Finally, dust was also collected in rain through a prototype wet-dust collector, which was mounted on buoy *Laura* before she was re-deployed. To also get an idea about the plankton content of the waters that we sailed through, water was pumped continuously over so-called plankton nets with a mesh size of 150μm and sampled four times a day. Finally, at one station close to site M1, a set of drifting traps was deployed for 24 hours to study particles settling towards the sea floor.

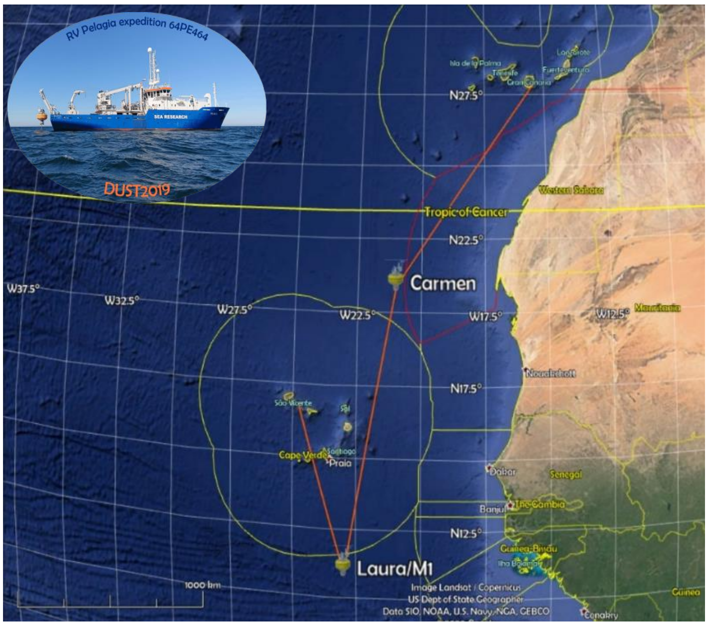


Figure 3.1: study area off the northwest coast of the African continent and cruise track (orange line) of cruise 64PE464. The two monitoring stations Carmen *and* Laura/M1 *as well as the 200-miles' zones (EEZ) of the individual states are shown.*

4. Narrative of the cruise

On Monday 11 November 2019, after receiving fresh stores in the morning, Research Vessel *Pelagia* left the harbour of Las Palmas de Gran Canaria at around 13.^{30} local time (=UTC) with four cruise participants from NIOZ/TROPOS. The sky is overcast but both air and sea water are about 21°C, which is a pleasant change from the weather in northern Europe.

Figure 4.1: leaving the port of Las Palmas de Gran Canaria, Spain.

The sea is a bit choppy as a result of the storm that raged north of the Canary Islands over the weekend and which caused the delay in the arrival of RV *Pelagia*, which arrived only on the Sunday before. The ever-present Trades blow gently at about 4-5 Bft from the northeast. Passage to buoy *Carmen*'s position at about 21°N/21W° is easy thanks to tail wind and the Canary Current, which allow a ground speed of 12.6 knots. We arrive at the station on Wednesday 13 November, just after lunch.

Recovery of the buoy from the aft of the ship goes very smoothly, despite the fact that the sea is too rough to recover the buoy from the dinghy. Instead, the lines are attached to the buoy from deck, and *Carmen* is recovered nicely and without any damage.

Figure 4.2: dust-collecting buoy Carmen *is safely secured from the A-frame by Jan Dirk (l) and Dave (r) and crew.*

The largest challenge is always to get the buoy on deck safely. After that, recovery of the mooring line is usually just a matter of spooling the mooring line on the reels. Fortunately, this is also the case at station *Carmen* and at 19.30 the releasers –the lowermost part of the mooring— are on deck. During the late evening we experience a short black out of the ship, but within five minutes chief engineer Martin has everything up and running again.

Thursday 14 November has an early start, when we begin deploying buoy *Carmen* at 6.^{00} in the morning. Always, such a deployment is started with the shallowest units first, which is obviously the buoy. However, we don't deploy the buoy itself directly but use a dummy buoy instead. From this dummy buoy downward, the top part of the mooring consists of a solid chain to keep the buoy upright and then a 350m steel cable to prevent fishing hooks from cutting the mooring loose. Below, there is a fist-thick rubber stretcher that handles sudden movements by waves and then another float (smartie) at about 1000m water depth. Below this smartie the mooring is mostly composed of nylon line until the anchor, which is deployed last. From experience we know that once the whole mooring line has been deployed and the anchor is thrown in, the whole mooring will behave as a swing with so much momentum that the top buoy is drawn under water. Therefore, the last action of the deployment is always to replace the dummy buoy with the real one.

Thanks to great team work of technicians Jan Dirk and Dave, bosun Norberto and his ship's crew on deck in close collaboration with master Bert and his officers Peter and Kelly on the bridge, the deployment runs very smoothly; the anchor can be lowered overboard at 10.^{30} already. Obviously, the occasion is used to make a big splash (figure 4.3).

Figure 4.3: a 3500kg weight splashes!

It takes about 45 minutes for the 3.5 Ton anchor weight to reach the sea floor at 4300m water depth. Once the dummy buoy has surfaced again, it can be picked up and exchanged for the real buoy. At 13.[15] buoy *Carmen* is floating in the ocean again, happily collecting Saharan dust until we pick her up again in the spring of 2021.

As we are on a tight schedule, we head towards the next station at the southern edge of the Cape Verde EEZ, which we expect to reach in the early morning of Sunday 17 November. The 2½ day transit is used to try out the *Omni* sampler, with which dust can be sampled in sterile water, so that the microbial composition of the atmosphere can be analysed (see Figure 5.1.1, 5.1.2, and 5.1.3 and Tables 5.1.1 and 5.1.2 for detailed metadata of all dust samples). The transit is also used to fine-tune the instruments for chemical analyses of the dust that was collected *en route* (see paragraph 5.6).

On our way south we sail into better weather and calmer seas with both air and water having a temperature of about 25°C and a gentle Trade-wind breeze of 4-10 knots. The sky is mostly overcast, which is clearly demonstrated by the satellite images of the study area (Figure 4.4).

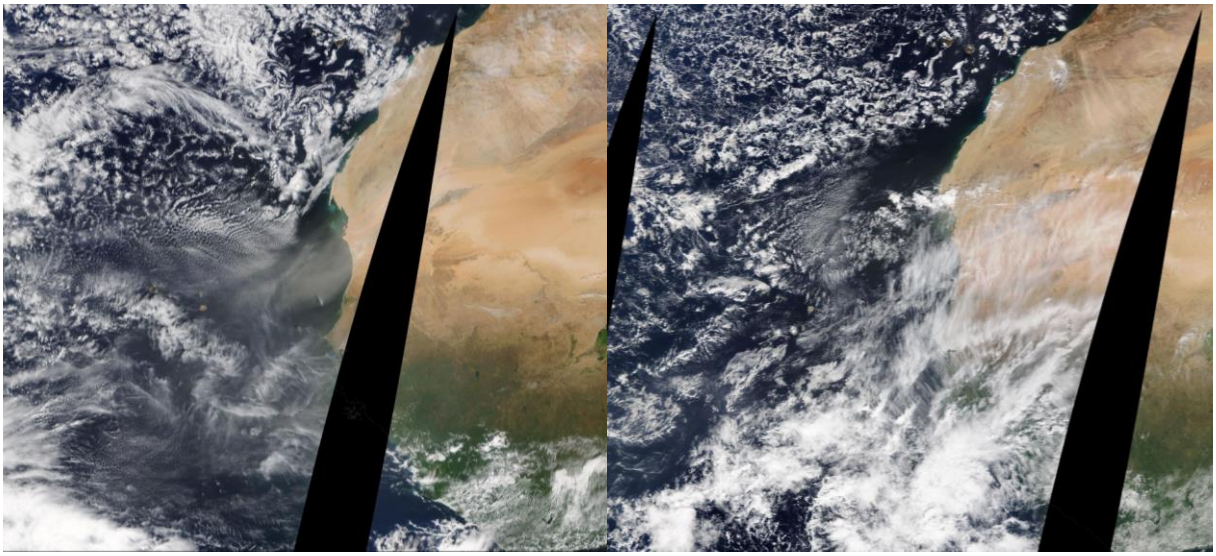


Figure 4.4: satellite (Terra) images of the study area from NASA's Eosdis website. On 12 November 2019 (left) a dust cloud can be seen off the coast of central Mauritania. The rest of the expedition the dust is invisible due to clouds as exemplified by the picture of 16 November 2019 (right).

However, most filters through which air is pumped show a typical orange colour characteristic for Saharan dust (Figure 4.5).

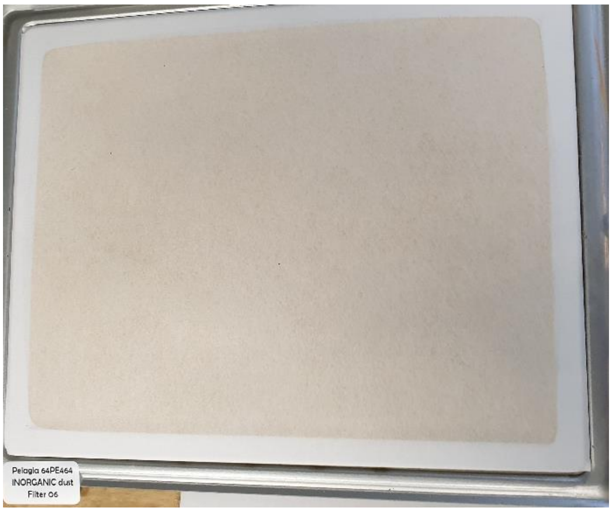


Figure 4.5: Saharan dust collected on a glass-fibre filter and showing the characteristic orange colour.

The transit also provides the time to assess the problems that both dust-collecting buoys seem to have had; the status messages that the buoys had sent twice a day had already indicated that there were issues with the air flow. This could still mean that the pump had worked well and 'only' the flow meter had a malfunction but we soon found that the pump had actually stopped soon after deployment in 2018 and most filters on buoy *Carmen* were empty. This did not look very promising for the filters that we were to find on buoy *Laura*... We had anticipated this and therefore had brought two new pumps, so that the buoys would work flawlessly again after re-deployment.

In the early morning of Sunday 17 November, we reach buoy *Laura* and start her recovery at $6.^{30}$. Initially, there is no response whatsoever from the releasers and we fear for a battery malfunction. Fortunately, the upper smartie is sighted from the bridge at $9.^{15}$ so that we can start the recovery of the mooring. Despite a relatively calm sea state, some damage bestows the buoy upon recovery thanks to it dangling from one line from the A-frame. In hind sight, it would have been better to use the dinghy to attach the lines to the buoy. The rest of the mooring recovery runs very smoothly and at $12.^{30}$ the releasers are on deck.

After lunch we continue with the deployment of a set of drifting traps to collect material sinking through the water column. These traps will stay in the water for at least 24 hours, collecting material settling through the ocean, trapping it in four tubes at 100m, 200m, and 400m water depth. At each level one tube has a petri dish sitting on the bottom of the tube to collect marine-snow particles that stay intact in these gels (Figure 4.6).

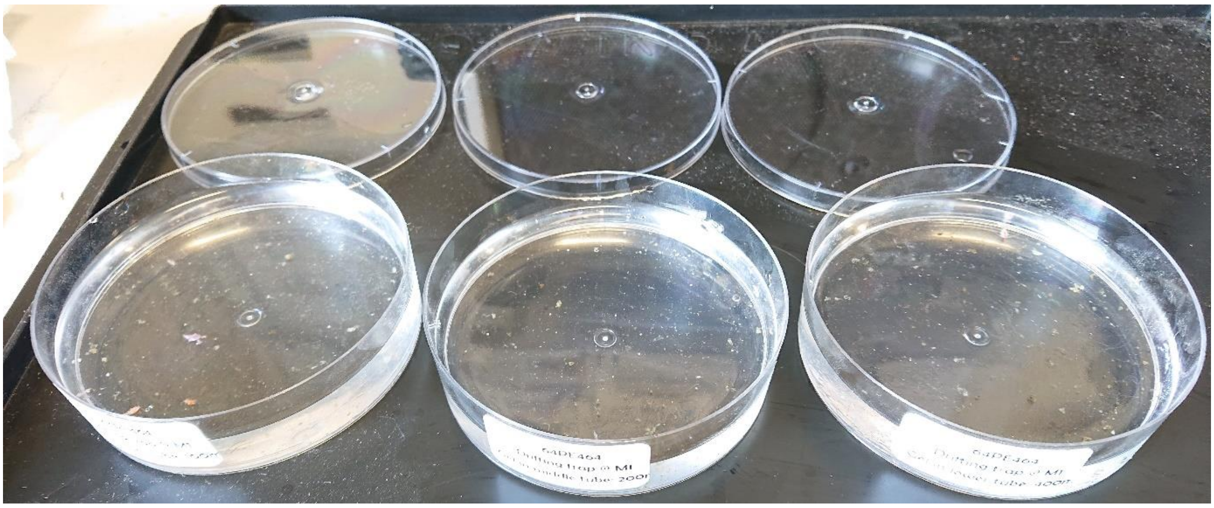


Figure 4.6: Petri dishes with gel containing marine-snow particles collected by drifting traps at M1.

Directly after the drifting traps have been deployed we sail towards station M1 and continue with the recovery of the high-resolution sediment-trap mooring. At $17.^{00}$ the mooring is released successfully and at $17.^{35}$ the top smartie is already collected. At $19.^{30}$ the whole mooring is on deck. Unfortunately, one of the trap motors suffered from a malfunction, but despite this fact the traps have collected a nice time series, see paragraph 5.3. The evening is used to prepare for the deployment of buoy *Laura* on the next day; the mooring lines are checked and laid out on the deck. The buoy is assembled and fit with new filters, buoy parts and batteries and programmed for another year of dust sampling.

During the night of 17-18 November, we experience a big rain shower, which is entirely collected by the prototype wet-dust collector (Figure 4.7) that had already been assembled on the buoy that was standing on deck. Inevitably, also some material from the ship's chimney will have ended up in the sampler. However, we are happy that the prototype works well. The material is harvested and filtered through a polycarbonate filter.

On Monday 18 November we start the re-deployment of buoy Laura at $7.^{30}$ in the morning. After the rain shower of the previous night, the air is very clear but it also seems as if a new dust front is approaching. Therefore, dust sampling with both the

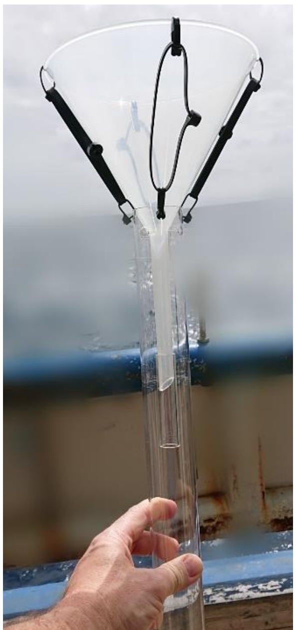


Figure 4.7: Prototype wet-dust collector, to be assembled on buoy Laura.

high-volume samplers and the *Omni* sampler is continued. Just after noon the anchor is deployed with a big splash at a water depth of 5200m.

At 13.30 the dummy buoy/smartie is on deck and buoy *Laura* can be deployed. However, that is the moment when bad luck strikes again; thanks to a malfunctioning of a releaser hook, one of the lines trips from the A-frame and the buoy tips over on deck. Fortunately, no one is injured but there is considerable damage to the buoy's tower with instruments like wind vane and one solar panel. The most sensitive antennas have been spared and the metal work can be fixed on deck. After a thorough check of all the buoy's functionalities she is finally deployed at 19.^{20}.

We then continue searching for the drifting traps that are soon found thanks to the messages it sends with her position through satellite communication. At 21.^{15} the traps are alongside the ship and at 21.^{45} the lowermost tubes are on deck.

Figure 4.8: AB Jacco handles the drifting traps

On Tuesday 19 November we start at first daylight at 7.^{15} with the release of the weight of the test mooring close to station M1. This test mooring had been deployed two years ago for the first time and is meant to provide a durability test of the Dyneema® lines. At 8.^{00} the floats are sighted and at 9.^{30} the whole mooring is on deck. Technicians Jan-Dirk and Dave replace one part of the test mooring after which she can be re-deployed again. Shortly before noon she is re-deployed and we move on to the position of station M1.

Due to the malfunctioning of one of the motors on the high-resolution sediment-trap mooring, we will have to re-deploy it with five carrousels instead of six, see paragraph 5.3. The re-deployment of the sediment-trap mooring is started at 13.^{00} and runs very smoothly; at 15.^{45} the anchor is dropped and we are finished with our deployment program so that we can set sail towards Mindelo on Sao Vicente, Cape Verde Islands.

En route towards the north we stop two times for a short test of the video frame that technician Bob Koster had built and which shall be used during a follow-up cruise in the Caribbean. These test dips are carried out and offer Bob the chance to adjust some small things like orientation of the lights to improve the quality of the different camera systems on the frame.

On Wednesday 20 November we celebrate both master Bert's birthday as well as the successful cruise with a bbq on the aft. Cook Leon and steward Aleks have been taking very good care of us during the past two weeks and now we are invited to prepare our own food for a change.

On Thursday 21 November we have one more dip with the video frame before we head to the harbour of Mindelo where we arrive at 15.^{00}.

Figure 4.9: RV Pelagia *'by night' in the harbour of Mindelo.*

5. Preliminary results

5.1 Saharan-dust collection

Every year, 180Mton (180,000,000 kg!) Saharan dust are blown from the northwest African coast westward across the tropical North Atlantic Ocean (Yu et al., 2015). This material delivers nutrients and metals to the ocean, which potentially promote algal growth and thereby atmospheric CO_2 sequestration through the photosynthesis that these algae perform (e.g. Guerreiro et al., 2017). In addition, the dust particles play a role in the oceanic carbon cycle through ballasting of organic matter from the surface ocean towards the deep (e.g. Van der Jagt et al., 2018). We know very little as yet about aeolian transport and deposition processes of mineral-dust particles nor about the fertilisation and ballasting potential of mineral dust. Therefore, we are monitoring transport and deposition of Saharan dust using both dust-collecting buoys, which filter air underneath the main Saharan dust path out of Africa as well as moored sediment traps that collect material settling through the ocean. During the expeditions to service the monitoring instruments, we also collect atmospheric dust on board the ship using so-called high-volume samplers, a wet-dust/rain collector, and an *Omni* 3000 aerosol sampler (all in figure 5.1.1), which is designed to pump air through sterile water from which the microbiological content can be analysed.

During cruise 64PE464, we also collected dust *en route* using the aforementioned devices.

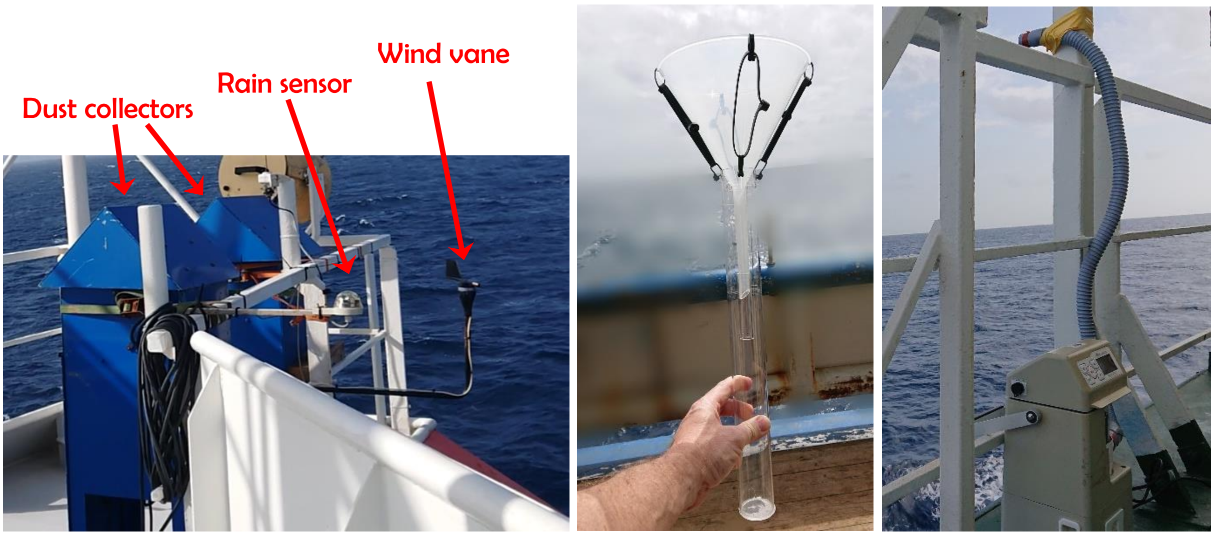


Figure 5.1.1: Dust collectors: high-volume | wet-dust/rain | Omni 3000

One of the largest risks with dust sampling is sources of contamination. We routinely try to stay away from anthropogenic sources of aerosols by only sampling outside the 12-miles' zone. To prevent contamination from e.g., the ship's chimney, we use an intelligent wind vane, which causes the samplers to switch off whenever the wind is from outside a pre-defined angle. In addition, we direct the inlet of e.g., the *Omni* sampler away from the ship. A rain sensor is connected to the high-volume samplers to avoid water on the filters.

This trip we deliberately sampled air when the wind was blowing polluted air in the direction of the high-volume dust collectors on the ship's top deck (samples D01 and D03) so as to be able to detect if we can discern "clean" dust from "ship's-polluted" dust on the basis of the metal content that was analysed on board the ship (paragraph 5.6).

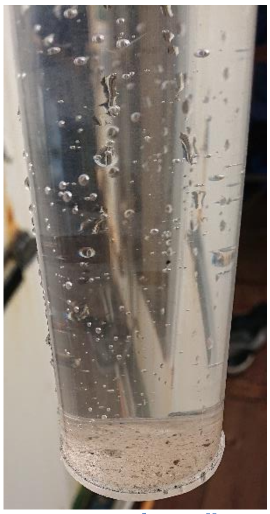


Figure 5.1.2: the collected wet dust contains some large (soot?) fragments...

For details on the *en route* dust collection, please see figures 5.1.3 – 5.1.5 and tables 5.1.1. and 5.1.2.

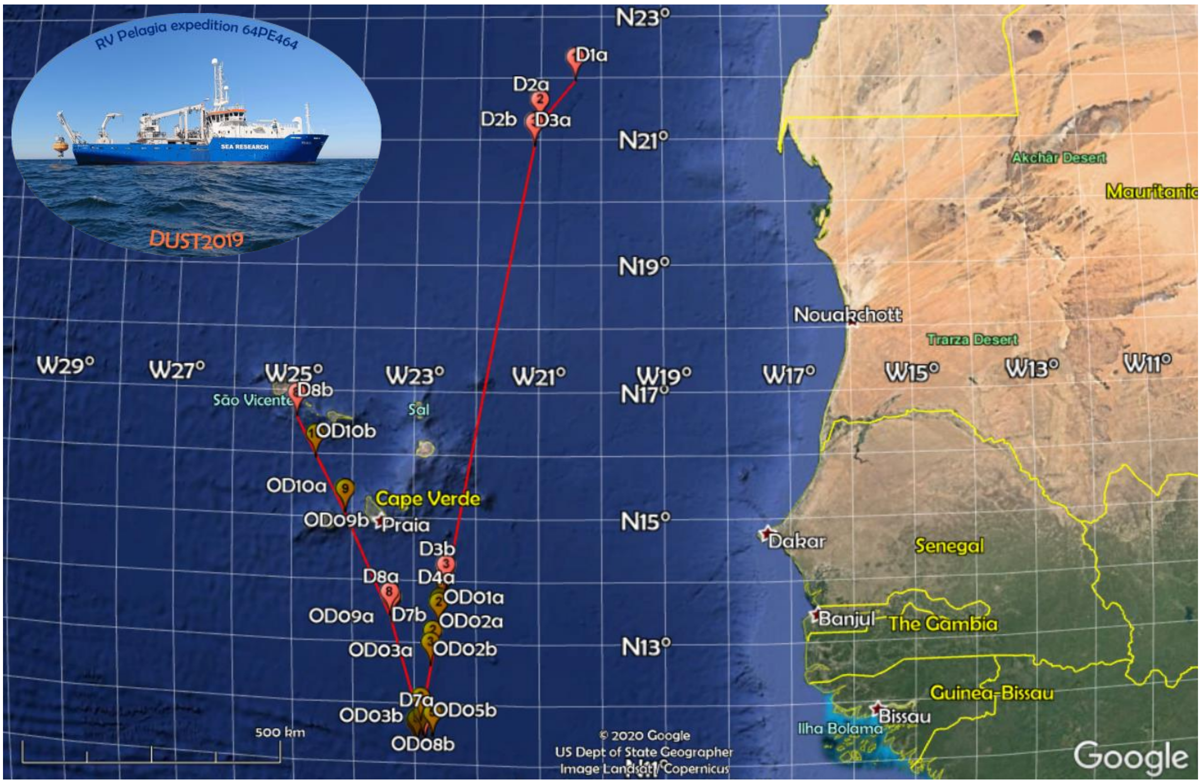


Figure 5.1.3: dust samples collected during 64PE464. Samples were collected between xxa and xxb. D0x = HiVol dust samples Miele *(inorganic dust) and* Nilfisk *(organic dust), ODxx =* Omni *samples.*

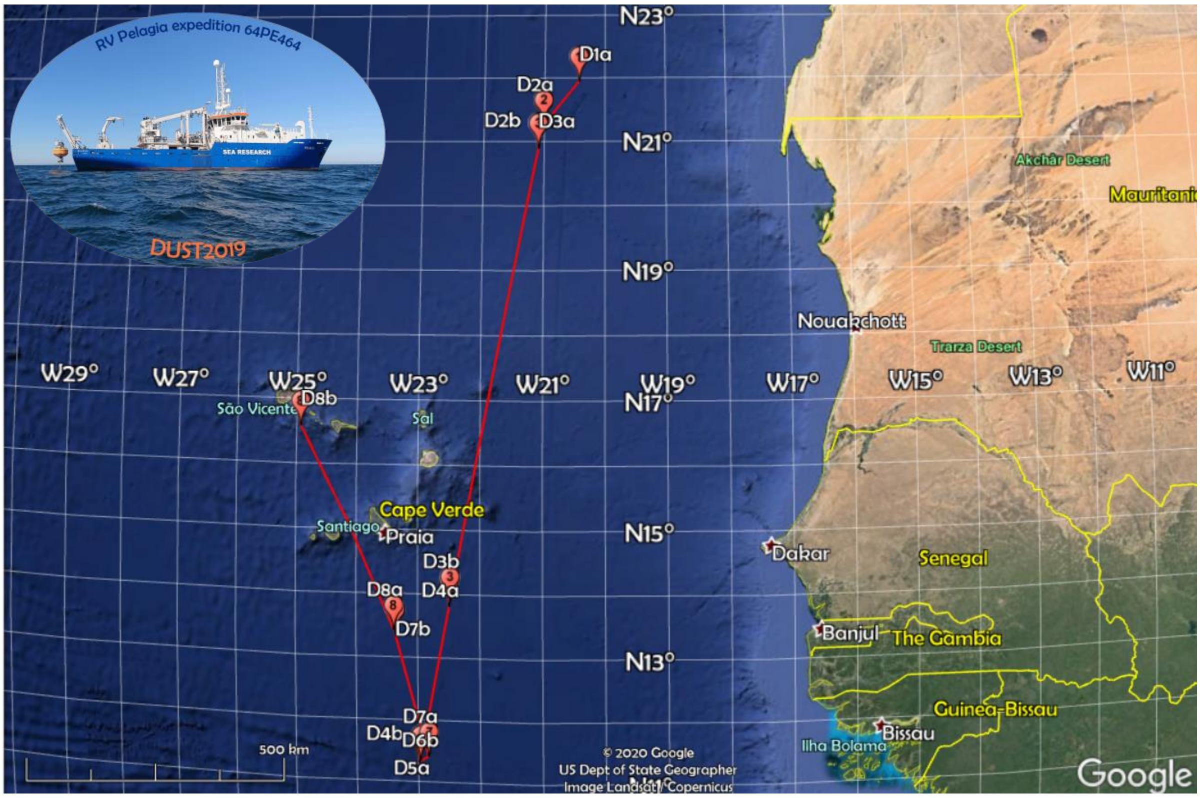
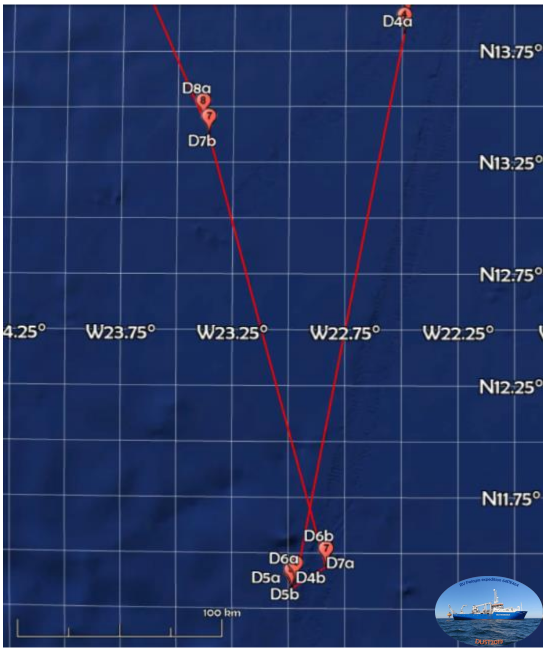


Figure 5.1.4: All High-Volume dust samples (N=8) collected during 64PE464.



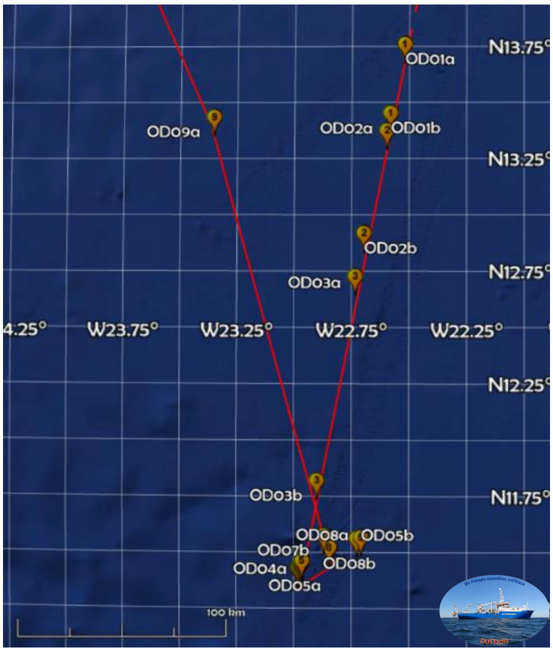


Figure 5.1.5: zoom on southern part of the study area to show the positions of dust samples.

During the cruise we often observed a hazy atmosphere, and the dust samples that we harvested showed a typical orange colour, which is characteristic for Saharan dust (figure 5.1.6). Unfortunately, the clouds on the satellite images prevent a clear view on the dust outbreaks that must have happened during the time we were at sea.

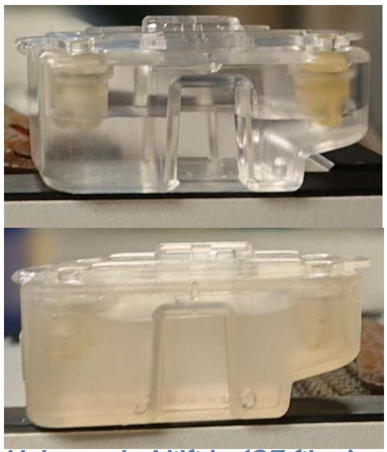


Figure 5.1.6: Saharan dust collected during 64PE464.
L2R: Sample D03 from Hi-Vol sampler Nilfisk *(GF filter); 47mm polycarbonate filter with dust from rain sampler; 2 cartridges from* Omni *sample OD09 (top: clean water)*

Table 5.1.1: Details of the dust filters (both Nilfisk*-GFF and* Miele*-CA) collected during 64PE4364*

Date	Time	Lat (deg. min.milli)	Lon (deg. min.milli)	Miele|Nilfisk	Remarks	Miele	Nilfisk	Heading	Gr speed	True wind
13/11/2019	09:10	N 21° 56' 51.785"	W 20° 25' 45.599"	D1a	en route to *Carmen*			214°	10.2 kn	199° @ 1.4 m/s
13/11/2019	15:00	N 21° 15' 38.236"	W 21° 1' 0.93"	D1b	chimney 1, little dust	402 m³	304 m³	57°	1.1 kn	56° @ 12.3 m/s
13/11/2019	16:00	N 21° 15' 49.039"	W 21° 0' 34.484"	D2a	station *Carmen*			62°	0.4 kn	60° @ 10.7 m/s
14/11/2019	15:55	N 20° 54' 30.956"	W 21° 5' 30.7"	D2b	little dust	1273 m³	972 m³	188°	9.1 kn	186° @ 4.0 m/s
14/11/2019	16:00	N 20° 53' 50.096"	W 21° 5' 38.864"	D3a	en route to *Laura*			186°	9.2 kn	183° @ 2.1 m/s
16/11/2019	13:30	N 13° 54' 12.143"	W 22° 28' 32.524"	D3b	chimney 2, full filter	3102 m³	2379 m³	193°	9.1 kn	5° @ 2.3 m/s
16/11/2019	14:00	N 13° 49' 38.723"	W 22° 29' 24.385"	D4a	station *Laura*			192°	9.2 kn	7° @ 1.9 m/s
17/11/2019	07:00	N 11° 22' 14.729"	W 22° 57' 59.166"	D4b	full filter	1142 m³	877 m³	23°	0.3 kn	24° @ 7.1 m/s
17/11/2019	08:30	N 11° 22' 19.556"	W 22° 57' 55.094"	D5a	full filter, wet dust			34°	0.2 kn	33° @ 8.1 m/s
18/11/2019	08:45	N 11° 19' 22.379"	W 22° 59' 44.772"	D5b	CAF shifted | GFF torn	1159 m³	888 m³	44°	1.3 kn	44° @ 7.7 m/s
18/11/2019	09:30	N 11° 20' 9.6"	W 22° 59' 17.081"	D6a	station *Laura*			48°	1.4 kn	47° @ 7.6 m/s
19/11/2019	07:00	N 11° 26' 16.642"	W 22° 49' 58.49"	D6b	full filter	1374 m³	1056 m³	22°	1.4 kn	21° @ 5.9 m/s
19/11/2019	07:30	N 11° 26' 15.155"	W 22° 49' 55.445"	D7a	en route to Mindelo			317°	0.5 kn	320° @ 6.9 m/s
20/11/2019	07:30	N 13° 22' 22.577"	W 23° 21' 35.698"	D7b	full filter	1406 m³	1079 m³	346°	8.9 kn	349° @ 10.5 m/s
20/11/2019	08:00	N 13° 26' 34.775"	W 23° 23' 6.778"	D8a	en route to Mindelo			347°	8.6 kn	352° @ 9.6 m/s
21/11/2019	08:30	N 16° 35' 0.902"	W 24° 55' 42.906"	D8b	little dust	487 m³	373 m³	336°	8.8 kn	337° @ 9.1 m/s

Table 5.1.2: Details of the dust samples collected with the Omni *3000 sampler during 64PE4364*

Date	Time	Lat (deg. min.milli)	Lon (deg. min.milli)	Sample	Remarks	Heading	Gr speed	True wind
16/11/2019	15:00	N 13° 40' 29.924"	W 22° 31' 8.602"	Omni1a	en route to *Laura*	192°	8.9 kn	10° @ 3.1 m/s
16/11/2019	17:00	N 13° 22' 3.63"	W 22° 34' 48.025"	Omni1b	2 hours, in dust cloud	192°	9.8 kn	10° @ 2.7 m/s
16/11/2019	17:30	N 13° 17' 22.999"	W 22° 35' 46.392"	Omni2a	en route to *Laura*	193°	8.9 kn	7° @ 2.1 m/s
16/11/2019	20:30	N 12° 50' 1.126"	W 22° 41' 43.775"	Omni2b	3 hours, in dust cloud	192°	9.1 kn	350° @ 0.5 m/s
16/11/2019	21:45	N 12° 38' 32.219"	W 22° 43' 58.354"	Omni3a	en route to *Laura*	190°	9.4 kn	6° @ 0.7 m/s
17/11/2019	03:45	N 11° 44' 9.773"	W 22° 53' 54.834"	Omni3b	6 hours, good catch	190°	9.1 kn	3° @ 0.9 m/s
17/11/2019	06:30	N 11° 22' 14.909"	W 22° 57' 59.425"	Omni4a	station *Laura*	24°	0.7 kn	23° @ 7.1 m/s
17/11/2019	11:00	N 11° 22' 37.657"	W 22° 57' 47.473"	Omni4b	4.5 hours, good catch	27°	0.2 kn	26° @ 8.5 m/s
17/11/2019	11:15	N 11° 22' 42.629"	W 22° 57' 47.794"	Omni5a	station *Laura*	34°	0.4 kn	32° @ 8.4 m/s
17/11/2019	17:15	N 11° 28' 57.205"	W 22° 42' 25.052"	Omni5b	6 hours, good catch	30°	0.4 kn	30° @ 6.9 m/s
18/11/2019	10:05	N 11° 20' 43.775"	W 22° 58' 57.432"	Omni6a	station *Laura*	54°	1.3 kn	58° @ 7.8 m/s
18/11/2019	16:05	N 11° 22' 0.113"	W 22° 58' 6.805"	Omni6b	6 hours, good catch	72°	0.2 kn	69° @ 9.0 m/s
18/11/2019	17:00	N 11° 22' 2.402"	W 22° 58' 3.774"	Omni7a	station *Laura*	72°	0.6 kn	70° @ 10.3 m/s
18/11/2019	23:00	N 11° 29' 29.684"	W 22° 52' 7.669"	Omni7b	6 hours, good catch	134°	4.2 kn	134° @ 5.8 m/s
19/11/2019	10:25	N 11° 26' 17.275"	W 22° 50' 37.28"	Omni8a	station *Laura*	248°	4.5 kn	252° @ 4.5 m/s
19/11/2019	16:25	N 11° 28' 41.844"	W 22° 43' 34.014"	Omni8b	6 hours, good catch	46°	1.6 kn	46° @ 8.7 m/s
20/11/2019	07:20	N 13° 21' 0.137"	W 23° 21' 7.16"	Omni9a	en route to Mindelo	346°	9.1 kn	349° @ 10.0 m/s
20/11/2019	20:10	N 15° 4' 18.221"	W 24° 6' 36.054"	Omni9b	12hr 50m rich sample	298°	9.3 kn	300° @ 6.6 m/s
20/11/2019	20:15	N 15° 4' 38.647"	W 24° 7' 19.373"	Omni10a	en route to Mindelo	299°	9.3 kn	302° @ 5.9 m/s
21/11/2019	03:35	N 15° 56' 11.155"	W 24° 36' 22.867"	Omni10b	7 hours 20 minutes	349°	8.3 kn	350° @ 10.7 m/s

Dust-sample handling and storage

- All cellulose acetate filters (N=8) from high-volume sampler *Miele* were folded twice and kept in individual sealed plastic bags at room temperature. One quarter filter was cut out and processed in the ICS 900 Dionex ion chromatograph for metal analyses (paragraph 5.6);
- One wet-dust sample, collected during the night of 17-18 November was filtered over a 47mm polycarbonate filter and stored at room temperature;
- All glass-fibre filters (N=8) from high-volume sampler *Nilfisk* were folded twice, wrapped in pre-combusted aluminium foil, and stored at -20°C;
- All cartridges (N=10) from the *Omni* 3000 sampler were packed into their original plastic wrapping and stored at -80°C.

5.2a Dust-collecting buoys – recovery of series 19Carmen and 19Laura

Twice daily, the buoys send home an eMail containing a status report on their position, meteorological conditions, filter number, pumping sessions, total air being pumped so far, and battery status. From these messages we had learnt already that there were some issues with both buoys regarding the amount of air being pumped through the filters. This could still mean that air was being pumped but not recorded (malfunctioning of the flow meter) or that indeed the pump itself was jammed. The latter turned out to be the case for the pumps on both buoys. Unfortunately, both pumps started working again after a little "encouragement" (read: gentle tap with a hammer). As the pump manufacturer does not provide an expected lifetime, we decided that pumps should be exchanged every time we service the buoys as they do not function reliably for more than one year.

Next to air sampling, the buoys are equipped with a microcat CTD, which monitors water temperature, salinity and depth. A comparison of air- and water data from buoy *Carmen* nicely shows how upwelling intensity –related to wind intensity and wind direction—is reflected in both air- and water temperature. In previous years, large individual rain showers also had a large direct impact on the sea-surface salinity, but in the present time series, this relationship is less clear (figure 5.2.1). In addition very little rain was recorded in the first place. The CTD on buoy *Carmen* stopped on 20/09/2019 thanks to battery issues.

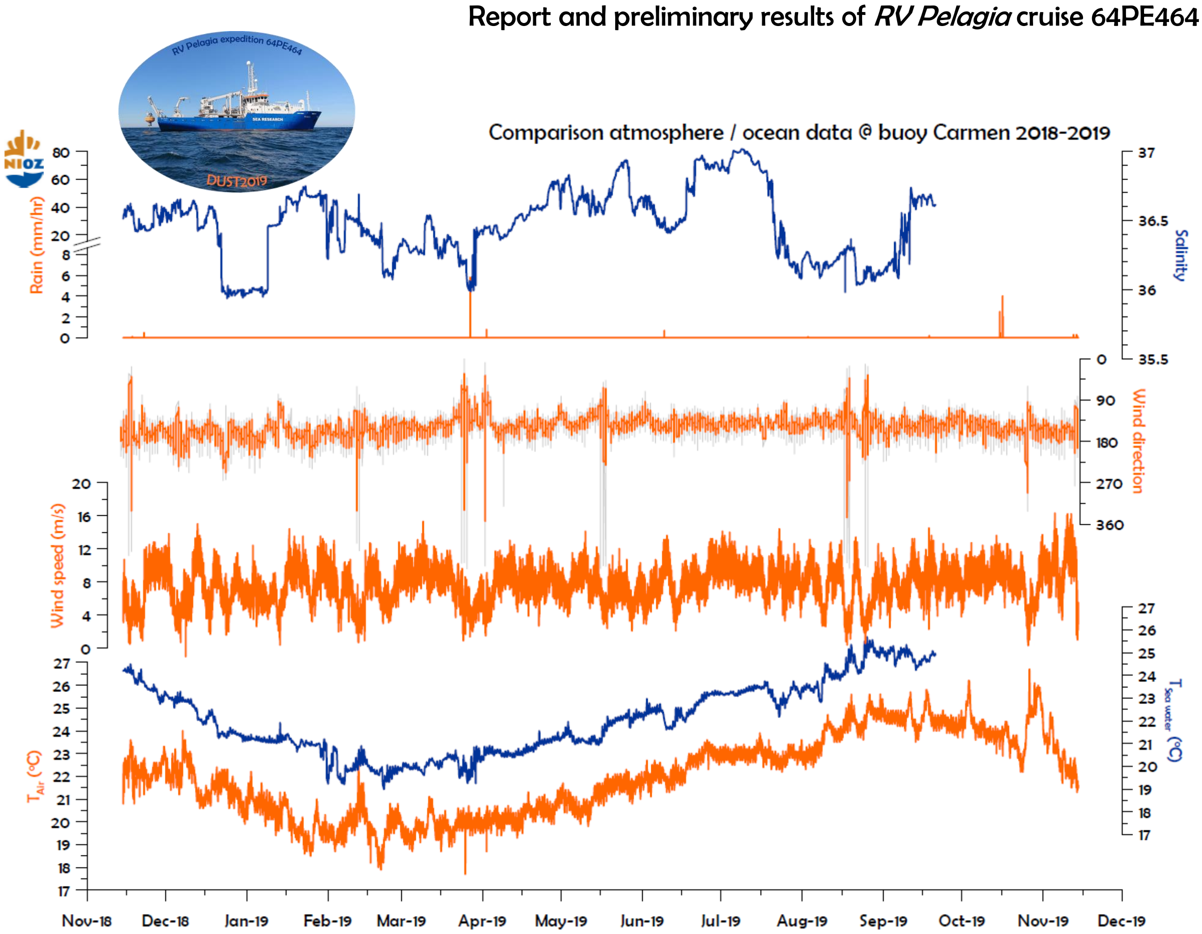


Figure 5.2.1: timeseries of buoy Carmen from November 2018 – November 2019. Blue graphs [salinity and water temperature] from sea-surface CTD, orange graphs [rain, wind direction, wind speed and air temperature] from VAISALA® meteorological sensor.

The time series of data and filters are labelled according to the year during which they sampled most of the time. As a result, the data recovered during cruise 64PE464 with buoys *Carmen* and *Laura* are labelled 19Carmen and 19Laura.

Time series 19Carmen resulted in seven filters containing significant amounts of dust, some of which also showed traces of water, or aggregates caused by water on the filter. Fortunately, the polycarbonate filters that we use, can stand water.

Figure 5.2.2: filter nr 4 of time series 19Carmen, on the carrousel inside the buoy, showing the typical orange colouration caused by Saharan dust.

Time series 19Laura unfortunately is a lot shorter; during the first filter the pump had stopped working already. Nevertheless, there are a number of samples that contain a large amount of aggregates that had probably accumulated in the chimney before falling on the filter carrousel. There is no way of telling when this happened but the data can be analysed for particle-size distributions nonetheless.

In addition to sampling dust by pumping air through filters, both buoys are also equipped with passive air samplers, so-called MWAC [Modified Wilson And Cook] samplers (Goossens et al., 2000) which functioned well for both buoys. These samples provide an integrated signal for the whole year during which they were deployed.

Figure 5.2.3: MWAC sampler on buoy Carmen*, positioned directly underneath the inlet through which air is being pumped into chimney, which is connected to the filter cups. The air vane on the buoy guarantees that the MWAC's opening is directed into the wind.*

5.2b Dust-collecting buoys – deployment of series 20Carmen and 20Laura

Both buoys were deployed successfully –although buoy *Laura* fell over on deck shortly before deployment. Fortunately, she could be repaired successfully and tested extensively before final deployment— and were programmed to sample at a resolution of 21 days per sample and 4 hours per day. See table 5.2.1 for details on the exact position of the buoys and details on the timing of the sampling programs.

Table 5.2.1: key data of dust-collecting buoys Carmen and Laura deployed during 64PE464

Instrument	Start date	Lat (° 'N)	Lon (° 'E)	End date	Nr cups	Interval
Buoy Carmen	15 Nov 2019	21°15.624'	21°00.170'	2 Apr 2021	24	21 days
Buoy Laura	19 Nov 2019	11°22.075'	22°58.080'	6 Apr 2021	24	21 days

We plan to service the buoys again in the spring of 2021 during the SIPA cruise onboard FS *Maria S. Merian* organised by colleagues from MARUM-Bremen, Germany.

5.3 Sediment-trap mooring M1

(yet to be written by GJB, latest update: 30 December 2020)

5.4 Plankton sampling

(yet to be written by GJB, latest update: 30 December 2020)

5.5 Drifting traps

In the vicinity of station M1, we deployed one set of drifting traps on Sunday 17 November at $14.^{25}$. The drifting traps were recovered on Monday 18 November at $21.^{45}$, meaning that they have been collecting settling particles for a period of about 31½ hours. During this time they drifted about 9 nm (16.5 km) towards the northwest (figure 5.5.1). The traps were filled with filtered and densified [0.7µm glass-fibre filter] sea water. 250g NaCl was dissolved in 6 liters of filtered sea water, of which 500ml was poured gently into the tubes. Three sets of four tubes were prepared to be suspended at water depths of 100m, 200m and 400m. Each set contained one petri dish with Tissue-Tek® O.C.T.^{TM} Compound, which is a gel that does not change composition (form crystals) when frozen/thawed even several times. Fragile marine-snow particles, that would otherwise fall apart, sink into the gel and are thus preserved for further study (figure 5.5.2). The petri dishes with frozen gel needed about six hours to thaw inside the tubes with filtered sea water.

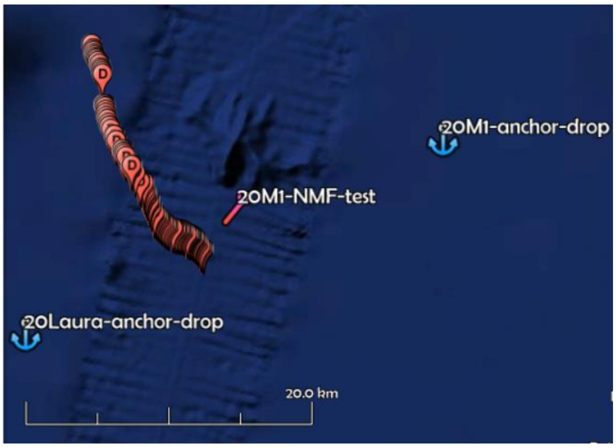


Figure 5.5.1: Path of the drifting traps during ~31.5 hours between 17 and 18 November 2019.

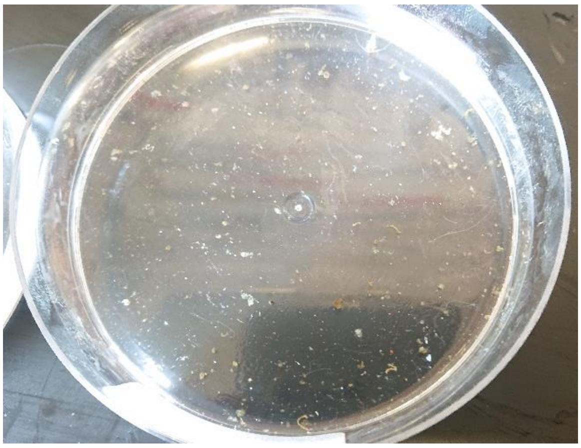


Figure 5.5.2: Marine-snow particles captured in gel in the lowermost tube at 400m water depth.

During the night of 17-18 November, the skies were washed clean by a big rain shower, which was also collected in the rain collector. Further detailed analyses back home at NIOZ will reveal the influence of this rain on the deposition of dust. Two tubes per depth were filtered over polycarbonate filters, one tube per depth over glass-fibre filters (figure 5.5.3).

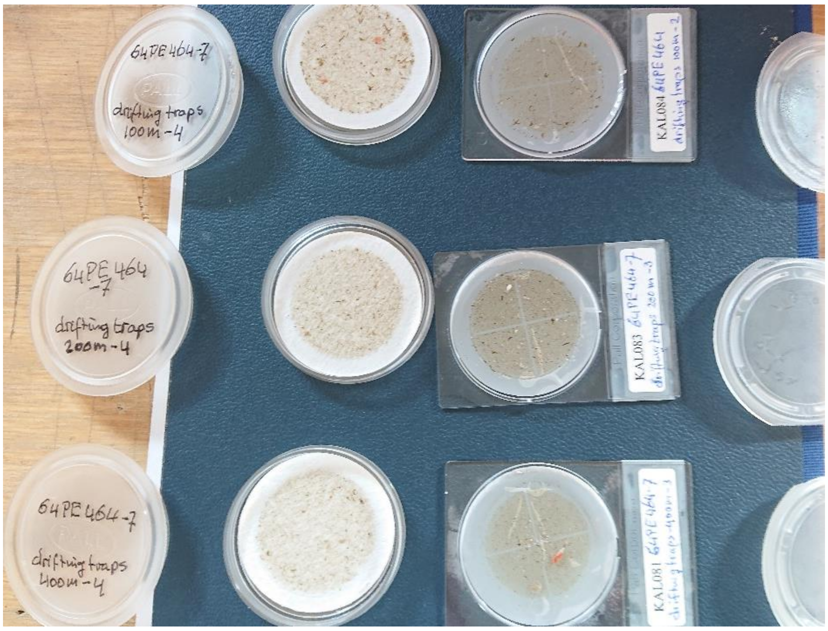


Figure 5.5.3: dust particles as well as 'marine organics' (including alive animals, marine-snow particles as well as fossil remains of e.g., foraminifera, coccoliths and diatoms) on
** gf filters (left, in petri dishes) and on*
** polycarbonate filters (right, in petri slides).*

5.6 Trace-metal analyses

Trace metals in Saharan dust are mostly in their oxide state which is often less soluble. However, reactions of reactive species with the dust particles in the atmosphere can influence the soluble content of trace metals in the dust particles such as iron. This process can increase the soluble content of nutrients such as iron in the dust and enhance its bioavailability to microorganisms in comparison to its insoluble form.

To access the soluble trace metal contents deposited into the open ocean through Saharan dust and to compare their temporal fluxes to those observed at the Cape Verde Atmospheric Observatory, aerosol samples were collected using a high-volume sampler on cellulose acetate filters (see Section 5.1). The filters were cut into strips of 2 cm² with a ceramic knife and extracted with different solutions (1.5 ml) to mimic the effect of different atmospheric processes on the particles. HCl at pH 3 and 4 and distilled water were used as solvents. The extraction was done via shaking for 1 h. The extracts were filtered with a 0.45 µm syringe filter to prevent the clogging of the columns and measured with the help of an ICS 900 Dionex ion chromatography instrument (Figure 5.6.1) firmly attached to the tables in the chemistry lab of the Pelagia with the help of elastic cords.

Figure 5.6.1: Ion chromatography system ICS 900 (l) and rotatory shaker used for the extraction of the samples.

The soluble metal content was determined by the use of a post-column derivatization method with the application of the reddish 4- (2-pyridylazo) resorcinol as a post-column reagent (Figure 5.6.2) and a Pyridine dicarboxylic acid (PDCA) eluent (Fomba et al. 2015). This method separates eight transition metal ions including Fe (III), Fe (II), Mn (II), Cu(II), Cd(II), Zn(II), Co(II) and Ni(II) and simultaneously quantify their complexes using a UV-VIS detector.

Figure 5.6.2: Eluent and reagents used for the quantification of soluble iron and transition metal ions

Subsequently, the total iron and trace metal contents of the samples will be analysed to provide information about the solubility of the trace metals under different ambient conditions especially under periods with and without Saharan dust influence. These results will improve our understanding of the spatial variation of aerosol trace metal solubility in the open Ocean in comparison to that at coastal sites and their fate in these regions.

6 *Acknowledgements*

Our sincere thanks go to Master Bert Puijman and his crew for the friendly cooperative atmosphere during the entire cruise as well as their competent technical assistance during all operations. You made us all really feel at home!

Figure 6.1: the 64PE464 dreamteam. Standing R2L: Leon, Peter, Martin, Jan-Dirk, Peter, Freddy, Bert (with birthday balloon), Aleks, Kelly, Jan-Berend. In net L2R: Geert-Jan, Bob, Wadinga, Robin, Norberto, Dave, Jacco.

This expedition was funded by the Dutch National Science Foundation (NWO-I) through NIOZ.

Appendix 1: event table of MedDust2017 (14 April 2017 – 19 May 2018)

Date	Time (UTC)	Lat (deg. min.milli)	Lon (deg. min.milli)	Action	Depth (m)
Monday 11-11-2019	13:01	N 28° 8' 33.353"	W 15° 24' 52.391"	Start transit to buoy Carmen	19
Wednesday 13-11-2019	14:23	N 21° 15' 32.933"	W 21° 1' 10.6"	Recover buoy 19Carmen	4306
Wednesday 13-11-2019	19:19	N 21° 16' 40.638"	W 20° 59' 28.021"	Releasers on deck	4294
Thursday 14-11-2019	06:14	N 21° 13' 50.869"	W 21° 3' 23.202"	Deployment buoy 20Carmen	4300
Thursday 14-11-2019	10:28	N 21° 15' 37.368"	W 21° 0' 10.566"	Anchor deployed	4303
Thursday 14-11-2019	13:16	N 21° 15' 48.294"	W 20° 59' 49.178"	Buoy 20Carmen deployed	4303
Thursday 14-11-2019	13:20	N 21° 15' 48.294"	W 20° 59' 49.178"	Start transit to buoy Laura	4302
Sunday 17-11-2019	08:05	N 11° 22' 13.436"	W 22° 58' 0.944"	Recover buoy 19Laura	5187
Sunday 17-11-2019	12:41	N 11° 23' 16.663"	W 22° 57' 6.588"	Releasers on deck	5187
Sunday 17-11-2019	14:26	N 11° 25' 1.657"	W 22° 51' 12.168"	Deployment drifting traps	4996
Sunday 17-11-2019	15:47	N 11° 28' 14.765"	W 22° 44' 21.077"	Test-dip video frame 1	3284
Sunday 17-11-2019	16:52	N 11° 28' 57.515"	W 22° 42' 29.506"	Recover mooring 19M1	3284
Sunday 17-11-2019	19:25	N 11° 30' 19.472"	W 22° 41' 59.842"	Releasers on deck	3284
Monday 18-11-2019	07:26	N 11° 18' 16.985"	W 23° 0' 27.112"	Deployment buoy 20Laura	3284
Monday 18-11-2019	12:10	N 11° 22' 7.5"	W 22° 58' 8.0"	Anchor deployed	3284
Monday 18-11-2019	19:22	N 11° 22' 3.778"	W 22° 58' 3.817"	Buoy 20Laura deployed	3284
Monday 18-11-2019	19:28	N 11° 22' 23.624"	W 22° 57' 53.845"	Start search for drifting traps	5137
Monday 18-11-2019	21:14	N 11° 32' 54.604"	W 22° 55' 31.469"	Recover drifting traps	5137
Tuesday 19-11-2019	09:37	N 11° 26' 52.793"	W 22° 49' 37.834"	Recover 19NMF test mooring	5159
Tuesday 19-11-2019	11:48	N 11° 26' 48.073"	W 22° 49' 52.766"	Deploy 20NMF test mooring	5159
Tuesday 19-11-2019	11:54	N 11° 26' 54.348"	W 22° 49' 34.604"	Start transit to station 20M1	5173
Tuesday 19-11-2019	15:04	N 11° 28' 6.157"	W 22° 44' 45.254"	Deployment station 20M1	5135
Tuesday 19-11-2019	17:45	N 11° 29' 25.966"	W 22° 42' 0.169"	Anchor deployed	5133
Tuesday 19-11-2019	17:45	N 11° 29' 26.182"	W 22° 41' 59.852"	Start transit to Mindelo	5143
Thursday 21-11-2019	09:34	N 16° 41' 57.71"	W 24° 59' 12.052"	Test-dip video frame 2	1152
Thursday 21-11-2019	10:07	N 16° 42' 3.971"	W 24° 59' 1.385"	Start track	1139
Thursday 21-11-2019	10:18	N 16° 42' 8.885"	W 24° 58' 55.744"	End track	1145
Thursday 21-11-2019	11:40	N 16° 42' 56.344"	W 24° 58' 10.049"	Test-dip video frame 3	1068
Thursday 21-11-2019	12:29	N 16° 43' 16.55"	W 24° 58' 12.216"	Start track	981
Thursday 21-11-2019	12:49	N 16° 43' 24.798"	W 24° 58' 10.963"	End track	945
Thursday 21-11-2019	13:03	N 16° 43' 33.164"	W 24° 58' 11.788"	Continue transit to Mindelo	911
Thursday 21-11-2019	16:15	N 16° 53' 23.878"	W 24° 59' 46.828"	Moored in Mindelo, Sao Vicente	12

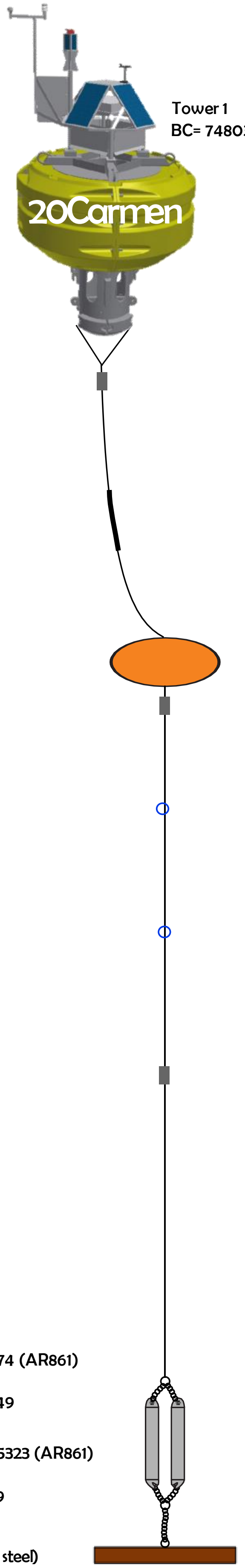
Appendix 2: sketch of mooring dust-collecting buoy 20Carmen

Final version 26 March 2020

T&T: 950671

Buoy 20Carmen
Depth 4200m
Deployed 14 November 2019

Location anchor drop point:
Lat 21°15.624´N
Lon 21°00.170´W
Nylon/PP mooring line 26mm



Tower 1
BC= 74803

Surface buoy
BC=200804

0m — Iridium beacon IMEI: 3004.3406.0116.850

Xeos beacon IMEI BC:34586
IMEI: 3000.3401.3705.980
New batteries

SBE37 CTD S/N:4687 BC:7306
New batteries

5m 20mm chain

350m 18mm steel cable, *new*

250m 26mm mooring line, *new*

3x 15m rubber stretch line with 120m *new* safety cord

900m 26mm mooring line

892m — Smartie 531 kg BC: 2844

Swivel

600m 26mm mooring line

900m 26mm mooring line

900m 26mm mooring line

3292m — Swivel

900m 26mm mooring line

4192m — Acoustic release S/N 172 BC=2974 (AR861)
Arm + rel. code: 04DC + 0455
Arm + diagn. code: 04DC + 0449
Batteries *new*

Acoustic release S/N 1893 BC=35323 (AR861)
Arm + rel. code: 1A73 + 0455
Arm + diagn. code: 1A73 + 0449
Batteries *new*

5m 22mm chain

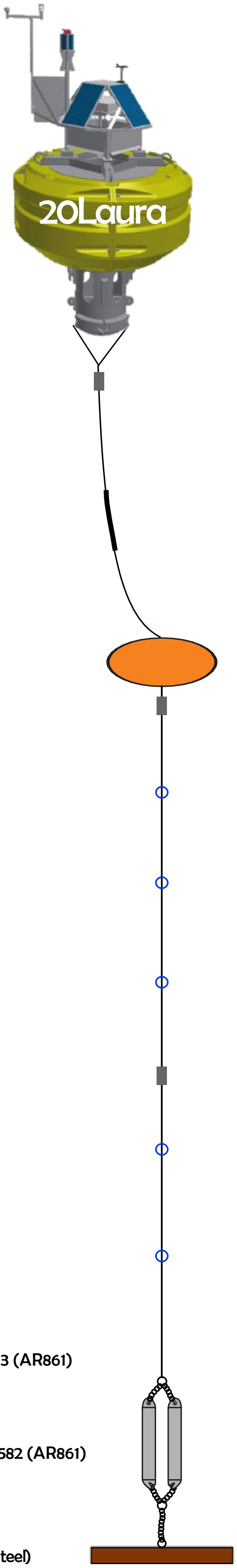
30m 32mm chain

4227m — Anchor weight 3000kg (in air, steel)

Appendix 3: sketch of mooring dust-collecting buoy 20Laura

Final version 26 March 2020

Track & Trace: 950680

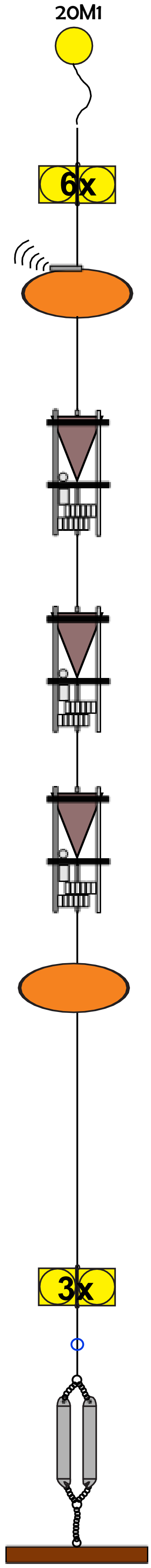


	Surface buoy BC=200798	
0m	Iridium beacon IMEI 3004.3406.0111.760	
	Xeos beacon IMEI BG39116 IMEI: 3002.3401.1444.700 New batteries	10m 25mm chain, *new*
	SBE37 CTD S/N:4612 BC:7283 New batteries	350m 18mm steel cable, *new*
	Wet-dust collector installed Buoy not cleaned One solar panel swapped with tower 2, all functions tested after incident on deck	250m 26mm mooring line 3x 15m rubber stretch line with 120m *new* grey dyneema line 900m 26mm mooring line
948m	Smartie 533 kg BC 2868	
	Swivel	250m 26mm mooring line 900m 26mm mooring line 100m 26mm mooring line 200m 26mm mooring line
3648m	Swivel	900m 26mm mooring line 900m 26mm mooring line 900m 26mm mooring line
5098m	Acoustic release S/N 480 BC=7313 (AR861) Arm + rel. code: 1531 + 0455 Arm + diagn. code: 1531 + 0449 Batteries *new*	
	Acoustic release S/N 1276 BC=32582 (AR861) Arm + rel. code: 08D1 + 0855 Arm + diagn. code: 08D1 + 0849 Batteries *new*	4m 22mm chain 15m 32mm chain
5117m	Anchor weight 3000kg (in air, steel)	

Appendix 4: sketch of high-resolution sediment-trap mooring 20M1

Final version 26 March 2020

Track & Trace: 950699



Pick up buoy (17" Benthos)

10m floating line

971m Buoyancy 17" Benthos

44m cable

1015m XEOS Iridium beacon IMEI:3002.3401.1445.680
BC:39437, horizontally mounted on frame
New batteries

CRP 1500/500 BC: 3940
buoyancy: 516kg

68m cable

1083m Sediment trap KUM Funnel S/N: 2014421, BC: 60240
KUM electr. unit S/N: 2014421, BC: 39789
New batteries
KUM motor 1 S/N: 2014421A, BC: 39758
KUM motor 2 removed
Sampling start: 12/11/2020, interval: 8 days, ends 21/04/2021
Tilt data logger S/N B7, BC: 7252
FLNTU S/N 2774, BC 74575
SBE 37 MicroCat S/N: 4351, BC: 12768 (*old* batteries)

91m cable

1174m Sediment trap KUM Funnel S/N: 2014422, BC: 60264
KUM electr. unit S/N: 2014422, BC: 39765
New batteries
KUM motor 1 S/N: 2014422A, BC: 39741
KUM motor 2 S/N: 2014422B, BC: 39727
Sampling start: 26/04/2020 interval: 4-8 days, ends 12/11/2020

110m cable

1284m Sediment trap KUM Funnel S/N: 2014420, BC: 60257
KUM electr. unit S/N: 2014420, BC: 39802
New batteries
KUM motor 1 S/N: 2014420A, BC: 39796
KUM motor 2 S/N: 2014420B, BC: 39772
Sampling start: 22/11/2019 interval: 4 days, ends 26/04/2020

186m cable

1470m CRP 1500/400 BC: 1175
buoyancy: 434kg

3498m cable

50m cable

50m cable

IXSEA Acoustic releasers AR861
S/N: 2010, BC: 35309
Arm code: 0B23, Release code: 0455
New batteries

S/N: 170, BC: 819
Arm code: 04DA, Release code: 0455
New Batteries

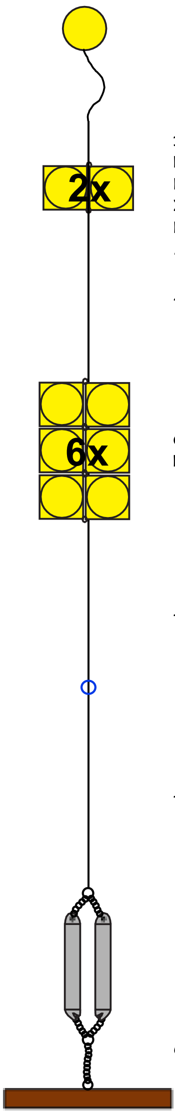
Chain 5m

5073m Anchor weight 1200kg (dry, steel)

Appendix 5: sketch of NMF Dyneema® test mooring

Final version 26 March 2020

Track & Trace: 950705



Appendix 6: Time table of buoys 20Carmen *and* 20Laura

Buoy 20Carmen					Buoy 20Laura			
Interval	21				Interval	21		
bottle	start	end	days		bottle	start	end	days
1	15/nov/2019	6/dec/2019	21		1	19/nov/2019	10/dec/2019	21
2	6/dec/2019	27/dec/2019	21		2	10/dec/2019	31/dec/2019	21
3	27/dec/2019	17/jan/2020	21		3	31/dec/2019	21/jan/2020	21
4	17/jan/2020	7/feb/2020	21		4	21/jan/2020	11/feb/2020	21
5	7/feb/2020	28/feb/2020	21		5	11/feb/2020	3/mrt/2020	21
6	28/feb/2020	20/mrt/2020	21		6	3/mrt/2020	24/mrt/2020	21
7	20/mrt/2020	10/apr/2020	21		7	24/mrt/2020	14/apr/2020	21
8	10/apr/2020	1/mei/2020	21		8	14/apr/2020	5/mei/2020	21
9	1/mei/2020	22/mei/2020	21		9	5/mei/2020	26/mei/2020	21
10	22/mei/2020	12/jun/2020	21		10	26/mei/2020	16/jun/2020	21
11	12/jun/2020	3/jul/2020	21		11	16/jun/2020	7/jul/2020	21
12	3/jul/2020	24/jul/2020	21		12	7/jul/2020	28/jul/2020	21
13	24/jul/2020	14/aug/2020	21		13	28/jul/2020	18/aug/2020	21
14	14/aug/2020	4/sep/2020	21		14	18/aug/2020	8/sep/2020	21
15	4/sep/2020	25/sep/2020	21		15	8/sep/2020	29/sep/2020	21
16	25/sep/2020	16/okt/2020	21		16	29/sep/2020	20/okt/2020	21
17	16/okt/2020	6/nov/2020	21		17	20/okt/2020	10/nov/2020	21
18	6/nov/2020	27/nov/2020	21		18	10/nov/2020	1/dec/2020	21
19	27/nov/2020	18/dec/2020	21		19	1/dec/2020	22/dec/2020	21
20	18/dec/2020	8/jan/2021	21		20	22/dec/2020	12/jan/2021	21
21	8/jan/2021	29/jan/2021	21		21	12/jan/2021	2/feb/2021	21
22	29/jan/2021	19/feb/2021	21		22	2/feb/2021	23/feb/2021	21
23	19/feb/2021	12/mrt/2021	21		23	23/feb/2021	16/mrt/2021	21
24	12/mrt/2021	2/apr/2021	21		24	16/mrt/2021	6/apr/2021	21

Appendix 7: Time table of high-resolution sediment-trap mooring 20M1

Lower				Middle				Upper			
Mooring 20M1 - KUM-1250				Mooring 20M1 - KUM-1150				Mooring 20M1 - KUM-1050			
Interval		4		Interval				Interval	0	8	
bott	start	end	days	bottle	start	end	days	bottle	start	end	days
1	22/nov/2019	26/nov/2019	4	1	26/apr/2020	30/apr/2020	4	1	12/nov/2020	20/nov/2020	8
2	26/nov/2019	30/nov/2019	4	2	30/apr/2020	4/mei/2020	4	2	20/nov/2020	28/nov/2020	8
3	30/nov/2019	4/dec/2019	4	3	4/mei/2020	8/mei/2020	4	3	28/nov/2020	6/dec/2020	8
4	4/dec/2019	8/dec/2019	4	4	8/mei/2020	12/mei/2020	4	4	6/dec/2020	14/dec/2020	8
5	8/dec/2019	12/dec/2019	4	5	12/mei/2020	16/mei/2020	4	5	14/dec/2020	22/dec/2020	8
6	12/dec/2019	16/dec/2019	4	6	16/mei/2020	20/mei/2020	4	6	22/dec/2020	30/dec/2020	8
7	16/dec/2019	20/dec/2019	4	7	20/mei/2020	24/mei/2020	4	7	30/dec/2020	7/jan/2021	8
8	20/dec/2019	24/dec/2019	4	8	24/mei/2020	28/mei/2020	4	8	7/jan/2021	15/jan/2021	8
9	24/dec/2019	28/dec/2019	4	9	28/mei/2020	1/jun/2020	4	9	15/jan/2021	23/jan/2021	8
10	28/dec/2019	1/jan/2020	4	10	1/jun/2020	5/jun/2020	4	10	23/jan/2021	31/jan/2021	8
11	1/jan/2020	5/jan/2020	4	11	5/jun/2020	9/jun/2020	4	11	31/jan/2021	8/feb/2021	8
12	5/jan/2020	9/jan/2020	4	12	9/jun/2020	13/jun/2020	4	12	8/feb/2021	16/feb/2021	8
13	9/jan/2020	13/jan/2020	4	13	13/jun/2020	17/jun/2020	4	13	16/feb/2021	24/feb/2021	8
14	13/jan/2020	17/jan/2020	4	14	17/jun/2020	21/jun/2020	4	14	24/feb/2021	4/mrt/2021	8
15	17/jan/2020	21/jan/2020	4	15	21/jun/2020	25/jun/2020	4	15	4/mrt/2021	12/mrt/2021	8
16	21/jan/2020	25/jan/2020	4	16	25/jun/2020	29/jun/2020	4	16	12/mrt/2021	20/mrt/2021	8
17	25/jan/2020	29/jan/2020	4	17	29/jun/2020	3/jul/2020	4	17	20/mrt/2021	28/mrt/2021	8
18	29/jan/2020	2/feb/2020	4	18	3/jul/2020	7/jul/2020	4	18	28/mrt/2021	5/apr/2021	8
19	2/feb/2020	6/feb/2020	4	19	7/jul/2020	11/jul/2020	4	19	5/apr/2021	13/apr/2021	8
20	6/feb/2020	10/feb/2020	4	20	11/jul/2020	15/jul/2020	4	20	13/apr/2021	21/apr/2021	8
						8					
21	10/feb/2020	14/feb/2020	4	21	15/jul/2020	19/jul/2020	4	21			
22	14/feb/2020	18/feb/2020	4	22	19/jul/2020	23/jul/2020	4	22			
23	18/feb/2020	22/feb/2020	4	23	23/jul/2020	27/jul/2020	4	23			
24	22/feb/2020	26/feb/2020	4	24	27/jul/2020	31/jul/2020	4	24			
25	26/feb/2020	1/mrt/2020	4	25	31/jul/2020	4/aug/2020	4	25			
26	1/mrt/2020	5/mrt/2020	4	26	4/aug/2020	8/aug/2020	4	26			
27	5/mrt/2020	9/mrt/2020	4	27	8/aug/2020	12/aug/2020	4	27			
28	9/mrt/2020	13/mrt/2020	4	28	12/aug/2020	16/aug/2020	4	28			
29	13/mrt/2020	17/mrt/2020	4	29	16/aug/2020	24/aug/2020	8	29			
30	17/mrt/2020	21/mrt/2020	4	30	24/aug/2020	1/sep/2020	8	30			
31	21/mrt/2020	25/mrt/2020	4	31	1/sep/2020	9/sep/2020	8	31			
32	25/mrt/2020	29/mrt/2020	4	32	9/sep/2020	17/sep/2020	8	32			
33	29/mrt/2020	2/apr/2020	4	33	17/sep/2020	25/sep/2020	8	33			
34	2/apr/2020	6/apr/2020	4	34	25/sep/2020	3/okt/2020	8	34			
35	6/apr/2020	10/apr/2020	4	35	3/okt/2020	11/okt/2020	8	35			
36	10/apr/2020	14/apr/2020	4	36	11/okt/2020	19/okt/2020	8	36			
37	14/apr/2020	18/apr/2020	4	37	19/okt/2020	27/okt/2020	8	37			
38	18/apr/2020	22/apr/2020	4	38	27/okt/2020	4/nov/2020	8	38			
39	22/apr/2020	26/apr/2020	4	39	4/nov/2020	12/nov/2020	8	39			