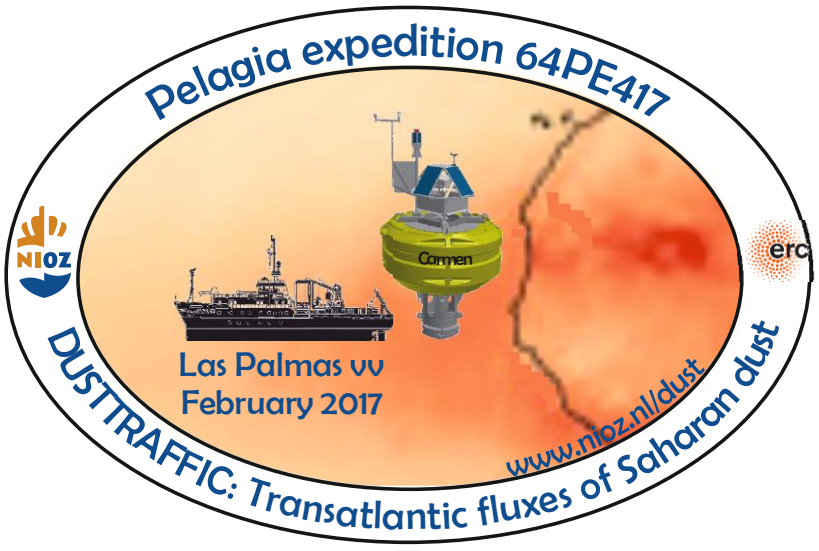
Cruise Report

and preliminary results

DUSTTRAFFIC: Transatlantic fluxes of Saharan dust

Cruise No. 64PE417

18 – 24 February 2017
Las Palmas de Gran Canaria (Spain) vv



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Bob Koster, Leon Wuis

1. Summary

RV Pelagia cruise 64PE417 was dedicated to service dust-collecting buoy "Carmen", which is one of three buoys that were originally deployed in November 2013 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)

The overall aim of these projects is to study the marine-environmental effects of Saharan dust deposition. Modern Saharan dust is monitored along a transatlantic transect between NW Africa and the Caribbean at the 12th parallel using sediment traps and floating dust collectors since 2012. In addition, a dust-collecting buy was deployed off Cape Blanc, Mauritania, where German colleagues from Bremen University have been collecting sediments since the late 1980's and ongoing. During cruise JC134 in April 2016, buoy Carmen had been serviced and re-deployed off Cape Blanc, Mauritania but "escaped" from her position in summer 2016. She was then picked up by German colleagues onboard *FS Meteor* in August 2016. Cruise 64PE417 was used to recover the remains of the mooring deployed in 2016 and to re-deploy buoy Carmen on her original position. A schematic drawing of the buoy is added as APPENDIX.

Table 1.1: key data of buoy Carmen*, renamed to* 2017-CB28*, re-deployed during 64PE417*

Series	Start date	Lat (° 'N)	Lon (° 'W)	End date	Nr filters	Interval
CB28	22 Feb 2017	21°16.25'	20°58.98'	24 Aug 2017	24	5-6 days

The buoy's sampling interval is synchronous with the sediment trap maintained by the German group, and which is sampling at an interval of 10½ days. As the buoy's sampling scheme does not allow half days, and since it can be adjusted remotely, we will sample at alternating intervals of 5 and 6 days as to keep synchronised with the sediment-trap data set. The buoy shall be serviced during *FS Meteor* cruise M140 in August 2017.

2. Participants

Table 2.1: Participants of cruise 64PE417

Name, title	Discipline	Affiliation
Jan-Berend Stuut, Dr	Marine Geology, chief scientist	NIOZ & MARUM
Barry Boersen	Marine Technology	NIOZ
Bob Koster	Marine Geology	NIOZ
Leon Wuis	Marine Technology	NIOZ

NIOZ – Royal Netherlands Institute for Sea Research, Texel, the Netherlands
MARUM – Center for Marine Environmental Sciences, Bremen, Germany

3. Research program

The sole purpose of cruise 64PE417 was to re-deploy dust-collecting buoy Carmen, which is moored offshore Cape Blanc, Mauritania, just outside Mauritania's EEZ (Economic Exclusive Zone, 200 miles) and at the same position of the Bremen moored sediment-trap station CB. The buoy had been deployed during the fifth DUSTTRAFFIC cruise onboard *RRS James Cook* in spring 2016. She then "escaped" from her mooring position in summer 2016, only three months after deployment, and was picked up by German colleagues onboard *FS Meteor* in August 2016. The buoy was renamed to 2017-CB28 and re-deployed again at virtually the same position.

Figure 3.1: Track of RV Pelagia cruise 64PE417. Position of the moored dust-collecting buoy "Carmen", re-named to 2017-CB28, is indicated.

4. Narrative of the cruise

On Saturday 18 February 2017 Research Vessel *Pelagia* left the harbour of Las Palmas de Gran Canaria at around 11.^{00} local time with four cruise participants from NIOZ/MARUM. The sole purpose of this cruise was to re-deploy dust-collecting buoy Carmen, offshore Cape Blanc, Mauritania. The sea is relatively calm and the wind from the Northeast blows a gentle 5 Bft. There is no Saharan dust to be seen and as the wind is from straight behind the ship, we are not able to sample the air with the dust collectors on the top deck of the ship, due to the fact that this dust would be polluted by combustion products from the ship's chimney. The passage to the buoy's position at about 21°N/21W° is easy thanks to tail wind and the Canary Current, and we arrive at the station on Monday 20 February, just after breakfast.

Pic. 4.1: leaving Las Palmas

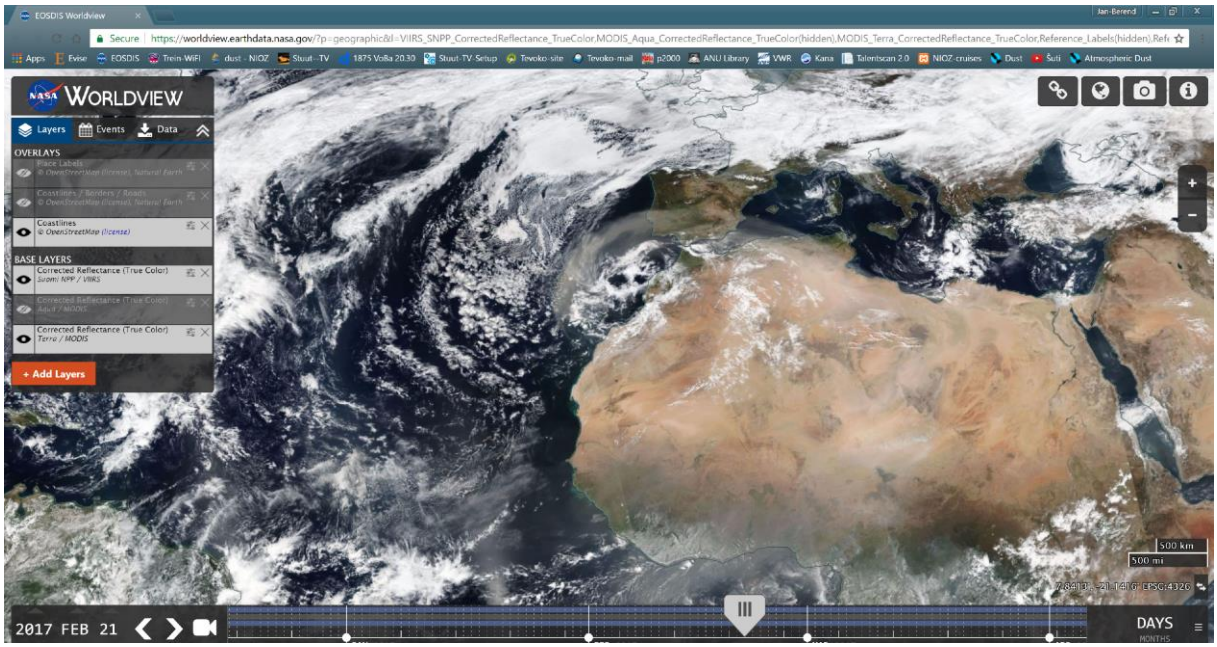
The first challenge is to recover the remainder of the mooring; the nylon line with which the buoy was fixed was cut just below the buoy. All the lines that were between the buoy and the smartie at 1000m water depth (see Appendix 1: sketch of the mooring) must have sank below the smartie. However, the buoyancy of the smartie should easily suffice to lift the whole package to the ocean's surface. During release of the mooring, only once do we get a message from the releasers with a distance that corresponds to the water depth: about 4170m. However, this is the only response that we get and therefore, we decide to keep sending signals to both releasers in order to get the mooring up.

Pic. 4.2: Bob and Barry try to get in touch with the releasers through the hydrophone that's hung over the side of the ship

Pic. 4.3: party on the bridge; the smartie has been spotted!

After six hours of searching and some grey hairs later, AB Martin de Vries finally spots the buoy at about 1nm distance. His eagle-eyed sight earn him a fitting reward. Once the smartie is in sight, picking it up and recovering the lines run very smoothly; the spaghetti of lines that was feared does not occur. At 19.^{30} the complete mooring line is on deck. The lack of contact between deck unit and releasers is most likely caused by noise from the engine room. For that reason, it is advised during future recoveries to contact the releasers from the far end of the aft deck.

On Tuesday 21 February, we wake up to the news that there is a huge amount of Saharan blowing over southern Spain. This outbreak can be clearly seen in the satellite image below:



Pic. 4.4: dust outbreak on 21 February 2017 as seen by NASA's Terra/Modis satellite

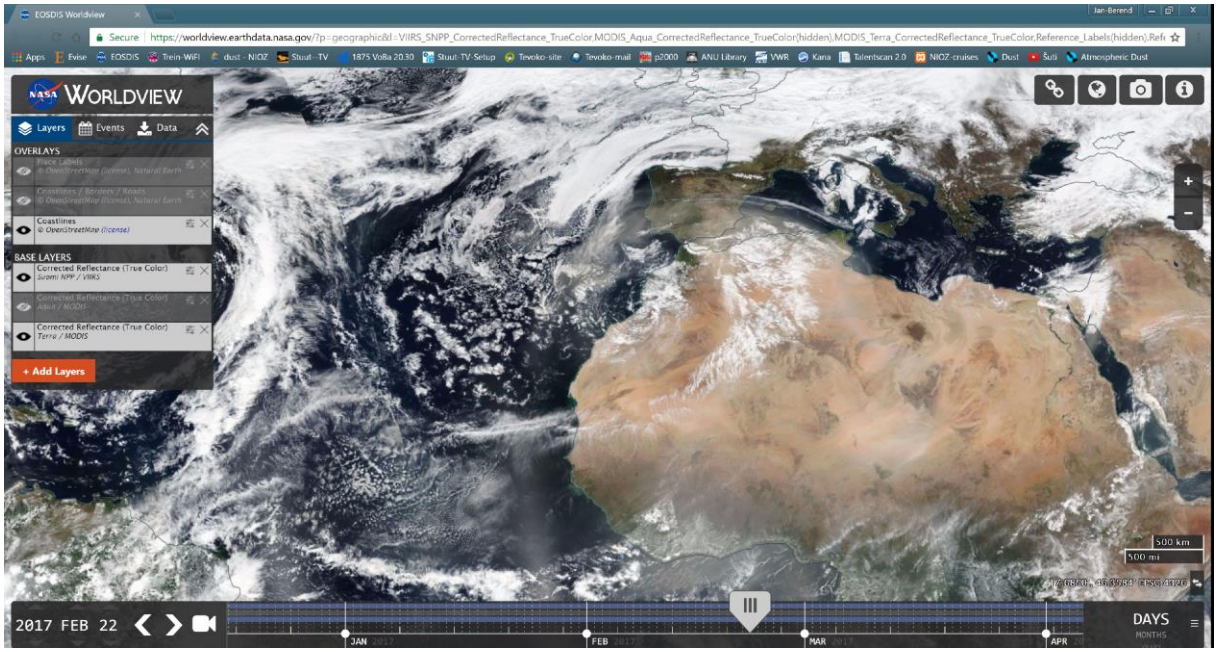
Pic. 4.5: We actually need two *smarties!!*

In summer 2016, the buoy's nylon line was cut by either a fisherman's long line (or by his knife), and to prevent this from happening again, we replace the upper nylon line with a 350m long 2-cm diameter steel cable. After realising that this complicates the deployment as we'll need two smarties as dummy buoys, we start the deployment of buoy 2017-CB28 at 10.^{15}. The anchor is dropped at 21°16.25N/20°59.654W and a water depth of 4225m at 14.^{10}. At 16.^{50} the dummy buoy is replaced by the actual buoy 2017-CB28 and we directly set sail to Las Palmas de Gran Canaria.

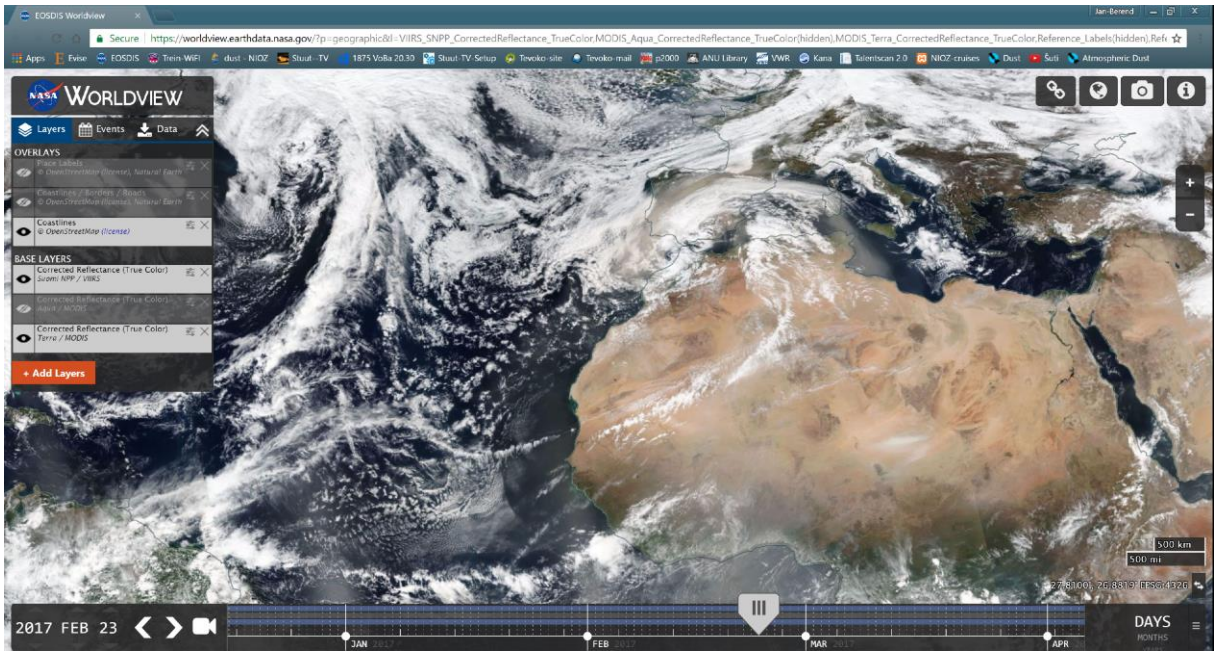
Note: at the very top of the line, just below the buoy, a swivel should have been installed.

The dust collection that we are doing from the bridge contains a pilot study; we are collecting dust on acid-cleaned filters following the ultra-clean procedures that are necessary to measure dissolved iron in seawater. Dust is collected by two parallel HiQ dust collectors using Whatman 41 cellulose acetate filters. The first sample collected on 20 February has some slight greyish colouring. Sample number two, collected between 21 and 22 February has a little clearer orange-ish colouration. Sample number three, collected between 22 and 23 February has a very dust load as can be seen in the orange colouration.

Pic. 4.6: Sample 3 has a very nice yield of dust



Pic. 4.7: Second day of the dust outbreak that started on 21 February 2017



Pic. 4.8: Third day of the dust outbreak that started on 21 February 2017, and which we sampled.

Pic. 4.9: Dust in the air causes nice diffuse sunsets…

On Friday 24 February we enter the harbour of Las Palmas de Gran Canaria at 7.00. Also dust sample number four contains a nice amount of Saharan dust.

The smooth mooring recovery and re-deployment of buoy Carmen is clearly the result of a very fruitful collaboration between all participants, and the very pleasant atmosphere on board the ship, for which I thank you all!

Pic. 4.10: Entering Las Palmas de Gran Canaria

24 February 2017, Las Palmas de Gran Canaria
Jan-Berend Stuut

5. Preliminary results

5.1 *Setup of 2017-CB28*

As can be seen in Figure 5.1, from bottom to top, the mooring consists of a steel bottom weight of 3000kg, to which a 30m chain is attached with 30mm thick shackles. Through a ring of 15cm diameter, a second chain is given, of which both ends are attached to a releaser.

The top of the frame to which the releasers are fixed, is connected to the first 900m piece of 26mm nylon line. This lowest 900m line is attached through a Titanium swivel (to allow rotation) to two other 900m pieces and one 600m piece of 26mm nylon line (3300m above the sea floor). Above these 3300m of line comes the first float, connected to the line with a Titanium swivel.

Above the float, there is a 900m piece of 26mm nylon line again. The top is of this line is attached to 3 pieces of 15m rubber stretch line parallel to a 120m piece of 26mm safety line.

The stretch line is connected to the upper piece of 26mm line, which is 250m long. This upper line is connected to the top line which is a 350m long 18mm steel cable. The top of this steel cable is finally connected to the buoy through two 5m pieces of 32mm steel chain again. The steel cable is meant to avoid being cut again. The line totals a length of 4885m, which, at a water depth of 4200m, gives the buoy a radius of free movement of a tick over 2500m.

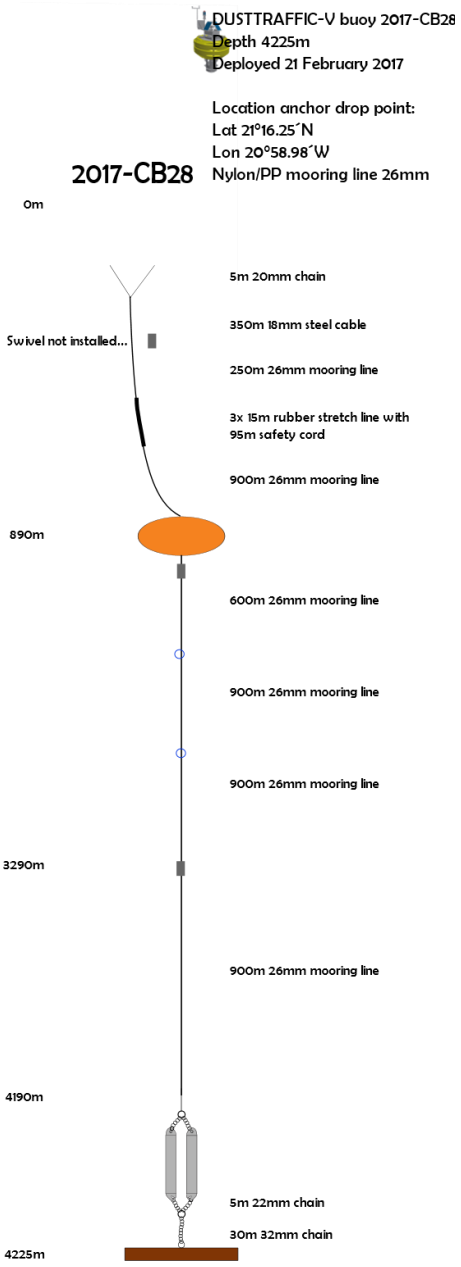


Fig. 5.1: Buoy's layout

Fig 5.2: buoy 2017-CB28 in action at sea.

6 *Acknowledgements*

Our sincere thanks go to Master Pieter Kuijt 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!

Back home, many people were involved in the preparation of the cruise and of all the instruments. Our genuine thanks go to Edwin Keijzer and Roel Bakker (NIOZ-MTI) and Matthias Schrama (Schrama Metaaltechniek) for designing and constructing the dust-collecting masts. Furthermore, we thank Jack Schilling, Harry de Porto, Jan Blom, and Piet Grisnigt (NIOZ-MTM) for helping out with the preparation of the moorings, cables, and swivels and transport of them. Peter-Roy Alkema, Mildred Jourdan, Erica Koning, and Thomas de Greef are thanked for help with logistics and planning and Marcel van der Linden and Irene Wernand for administrative support.
Frank van Maarsseveen, Martin Laan, and Walther Lenting (NIOZ-MTE) are thanked for writing the software for the dust-collecting buoys, creating the solar-panel electronics, and facilitating the electronic support, respectively. At MARUM also a number of people were involved in preparing this cruise, for which we would like to thank in particular Götz Ruhland, Eberhard Kopiske, Steffen Klar, and Gerrit Meinecke.

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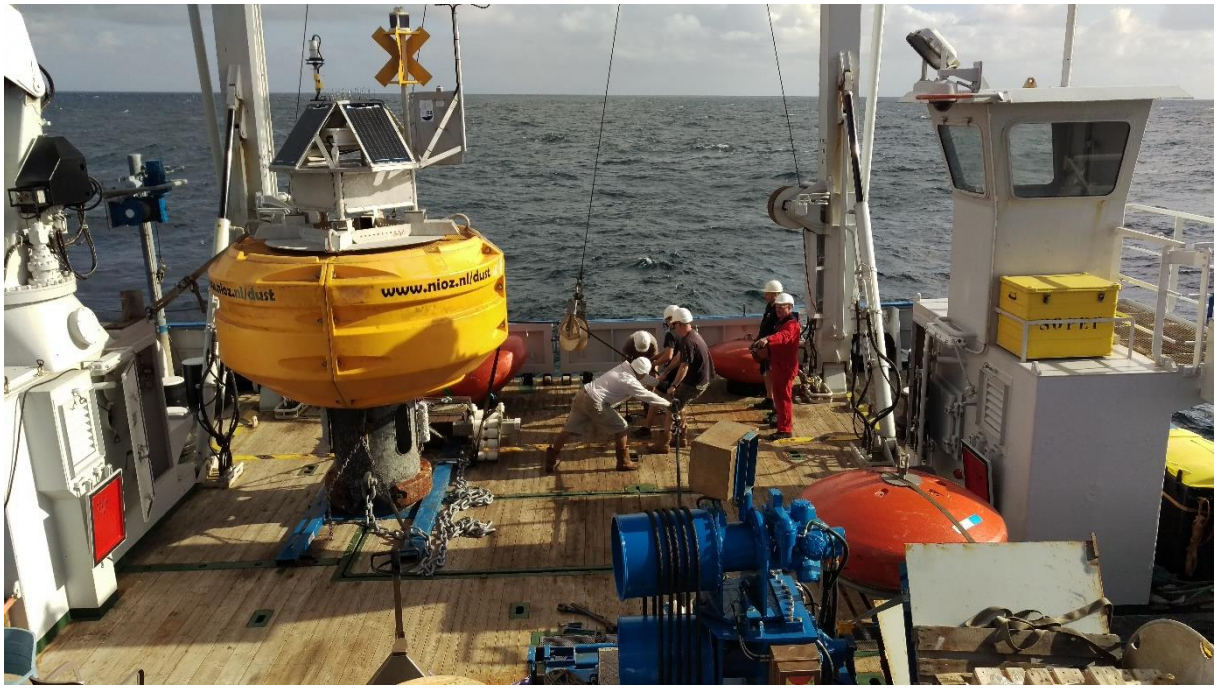

Pic. 6.1: buoy 2017-CB28 secured on deck of RV Pelagia.

Table 1: time table of filter changes of buoy (left) and sediment traps (right) at station CB

64PE417 - Buoy CB28					POS508 - Sediment-trap mooring CB28			
		5	10					10.5
		6	11		Sample	Start	End	Days
					1	28/01/2017 00:01	05/02/2017 12:01	8.5
Sample	Start	End	Days		2	05/02/2017 12:01	16/02/2017 00:01	10.5
1	22/02/2017	26/02/2017	4		3	16/02/2017 00:01	26/02/2017 12:01	10.5
2	26/02/2017	03/03/2017	5		4	26/02/2017 12:01		
3	03/03/2017	09/03/2017	6				09/03/2017 00:01	10.5
4	09/03/2017	14/03/2017	5		5	09/03/2017 00:01		
5	14/03/2017	19/03/2017	5				19/03/2017 12:01	10.5
6	19/03/2017	24/03/2017	5		6	19/03/2017 12:01		
7	24/03/2017	30/03/2017	6				30/03/2017 00:01	10.5
8	30/03/2017	04/04/2017	5		7	30/03/2017 00:01		
9	04/04/2017	09/04/2017	5				09/04/2017 12:01	10.5
10	09/04/2017	14/04/2017	5		8	09/04/2017 12:01		
11	14/04/2017	20/04/2017	6				20/04/2017 00:01	10.5
12	20/04/2017	25/04/2017	5		9	20/04/2017 00:01		
13	25/04/2017	30/04/2017	5				30/04/2017 12:01	10.5
14	30/04/2017	11/05/2017	11		10	30/04/2017 12:01	11/05/2017 00:01	10.5
15	11/05/2017	21/05/2017	10		11	11/05/2017 00:01	21/05/2017 12:01	10.5
16	21/05/2017	01/06/2017	11		12	21/05/2017 12:01	01/06/2017 00:01	10.5
17	01/06/2017	11/06/2017	10		13	01/06/2017 00:01	11/06/2017 12:01	10.5
18	11/06/2017	22/06/2017	11		14	11/06/2017 12:01	22/06/2017 00:01	10.5
19	22/06/2017	02/07/2017	10		15	22/06/2017 00:01	02/07/2017 12:01	10.5
20	02/07/2017	13/07/2017	11		16	02/07/2017 12:01	13/07/2017 00:01	10.5
21	13/07/2017	23/07/2017	10		17	13/07/2017 00:01	23/07/2017 12:01	10.5
22	23/07/2017	03/08/2017	11		18	23/07/2017 12:01	03/08/2017 00:01	10.5
23	03/08/2017	13/08/2017	10		19	03/08/2017 00:01	13/08/2017 12:01	10.5
24	13/08/2017	24/08/2017	11		20	13/08/2017 12:01	24/08/2017 00:01	10.5