7. PHYSICAL CHARACTERISTICS OF MELT PONDS

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Objectives

Improving the predictive capabilities for the development of Arctic sea ice cover strongly depends on a better understanding of the ice-albedo feedback mechanism. Using a combination of multi- and hyperspectral airborne imagery, field spectroscopy and bio-optical modelling we aim to quantify melt pond fraction, melt pond depth, thickness of underlying ice, pond water constituents (chlorophyll, suspended organic and inorganic matter) and surface albedo in different ice regimes. The main goal is to develop a semi-automated application for melt pond analysis for airborne hyperspectral instruments. A further goal is to employ the collected data to validate and improve parameterizations of melt pond properties used in regional and global climate models. The ground based measurements are essential for the parameterization of bio-optical models as well as for the validation of results derived from airborne measurements, which is crucial for accuracy assessment.

Fig. 7.1: Image taken by the airborne DSLR camera during a sampling area overflight on 10 June, 2017

Work at sea

a) Airborne acquisition of sea ice and melt pond characteristics-

Airborne measurements were carried out by use of a helicopter (Tab. 7.1 and 7.2). Two instruments, a Canon DSLR camera and an AISA$_{eagle}$ hyperspectral camera, were mounted at the helicopter. Airborne measurements were conducted mostly under fully overcast conditions, but a few times also under clear sky conditions. To couple ground based and airborne measurements, the flight pattern included several overflights of the sampling areas at different altitudes ranging from 200 ft to 10,000 ft. To correct for ice drift, stable targets (dark targets) were used (see Fig. 7.1). To collect as much airborne data over ponded sea ice as possible, camera flights had also been conducted during steaming.

b) Measurements of melt pond characteristics

Field measurements were carried out stand-alone and simultaneously to helicopter overflights and satellite overpasses (Sentinel 2 and 3) to provide match ups (Tab. 7.1 and 7.2). During PS106/1 melt ponds started to appear with pond depths of up to 30 cm. Optical properties of ice-free, shallow ponds were therefore determined using hyperspectral radiance and irradiance measurements (Ocean Optics, 350 – 850 nm, ~2 nm spectral resolution) above the water surface. To characterize surface reflectance as a function of bottom depth we measured along horizontal transects in the ponds. At each radiation measurement point along these transects pond depth had been measured using a centimetre stick. To determine ice thickness under the pond, ice drillings accompanied spectral and depth measurements. Measurements of pond length and width were conducted using a laser distance-meter.

To determine the influence of the pond bottom on above-water observations we took Ocean Optics reflectance measurements of very shallow pond areas and bidirectional reflectance spectra of bare ice. To obtain spectral data of pond bottom reflectance, we measured the irradiance reflectance of the area directly neighbouring the pond with a field spectrometer (ASD, 350 – 2,500 nm, spectral resolution 3-8 nm).

c) Determination of optically active water constituents

The water colour is determined by spectral absorption and scattering properties of water constituents: pure pond water, phytoplankton, coloured dissolved organic matter (CDOM), and non-algae particles. During ice stations, water samples of melt ponds have been collected. The spectral (UV, VIS, NIR) absorption of particles and dissolved organic matter (CDOM) was directly analysed in the wet laboratory by means of two absorption spectrometers (Psicam and LWCC). GF/F filters with pond particles have been stored for later analysis of the total suspended matter and pigment biomass (chlorophyll) concentration (HPLC). Chlorophyll concentrations have also been derived via *in-situ* measurements using a fluorometer (algae torch).

d) Determination of reflectance properties of surrounding sea ice surfaces

The Arctic environment shows high contrasts between water surfaces with relatively low reflectance and neighbouring areas of high reflecting ice and snow. To consider adjacency effects in remote sensing observations, ice and snow covered areas neighbouring the melt ponds were measured using different types of field spectrometer covering different wavelength regions, i.e. ASD and Ocean Optics.

To determine near-surface broadband up- and downwelling irradiance a radiation rack with ventilated short- and longwave radiation sensors mounted on a Nansen-sledge and a mobile tripod with a net radiometer were operated during PS106/1 over sea ice surfaces.

The analysis of remote sensing data from melt ponds has to account for the spectral and angular properties of the areas neighbouring the ponds in order to correct for atmospheric stray light from these areas (adjacency effect). For this purpose bi-directional reflectance properties of four snow and ice surfaces were measured during clear sky conditions on an ice floe using the FELGO goniometer. A vertical arm allows to point the fore-optics of a spectrometer in 10° steps from nadir (0°) to a zenith angle of 60°, and using a circular frame attached to the ground with ice screws, the arm can be rotated in a full circle covering all azimuth angles in 10° steps. The collected light is transferred via glass fibre to a spectrometer (Ibsen FREEDOM VIS FSV-305) covering the spectral range from 320 to 850 nm with a resolution better than 2 nm. As an example of the preliminary results, Fig. 7.2 shows the anisotropy factor of ice in the principal plane, i.e. the reflectance spectra relative to nadir for an azimuth angle of 0 relative to the sun.

Snow and ice sampling had been performed in collaboration with the sea ice physics and SIEMO groups.

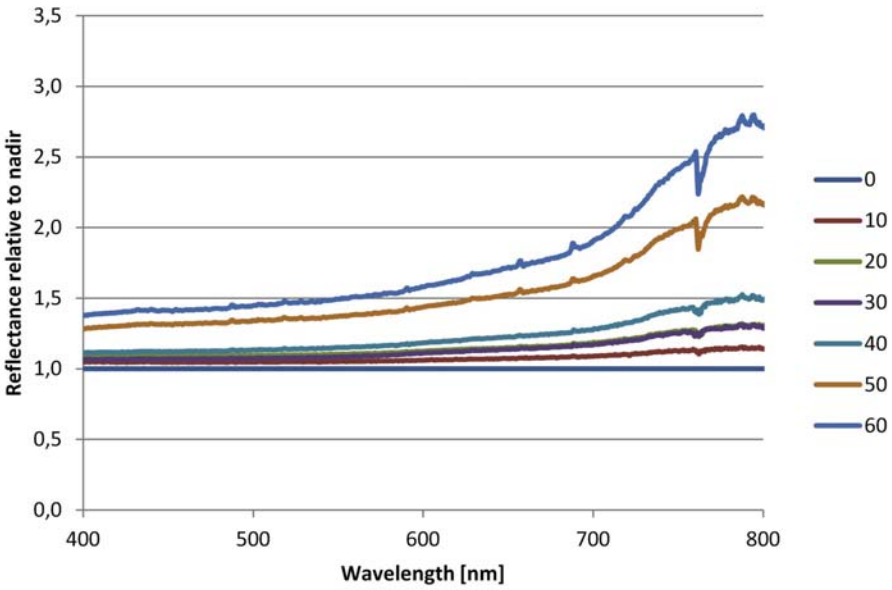

Fig. 7.2: Anisotropy factor of ice in the principal plane for zenith angles from 0 to 60°

e) Model development

A spectral model of a three layer system pond – ice – ocean has been developed and programmed during the cruise. It shall be used for data analysis of the airborne hyperspectral measurements introduced in section (a). The measurements described in (b) and (c) will be used to validate and further improve the model.

Tab. 7.1: List of helicopter flights

Nr.	Helicopter	Date/Time start [UTC]	Date/Time end [UTC]	Flight time
1	SUR	2017-06-05T08:46:00	2017-06-05T09:24:00	0:38
2	AIRRGBCAM	2017-06-05T11:55:00	2017-06-05T12:26:00	0:31
3	AIRRGBCAM, AIRHYPCAM	2017-06-07T11:18:00	2017-06-07T12:18:00	1:00
4	SUR	2017-06-08T08:15:00	2017-06-08T08:19:00	0:04
5	SUR	2017-06-08T09:19:00	2017-06-08T09:35:00	0:16
6	AIRRGBCAM, AIRHYPCAM	2017-06-08T13:25:00	2017-06-08T14:20:00	0:55
7	AIRRGBCAM, AIRHYPCAM	2017-06-10T07:16:00	2017-06-10T09:07:00	1:51
8	AIRRGBCAM, AIRHYPCAM	2017-06-10T11:42:00	2017-06-10T13:12:00	1:30
9	AIRRGBCAM, AIRHYPCAM	2017-06-14T11:38:00	2017-06-14T12:52:00	1:14
10	AIRRGBCAM, AIRHYPCAM	2017-06-15T11:39:00	2017-06-15T13:12:00	1:33

Nr.	Helicopter	Date/Time start [UTC]	Date/Time end [UTC]	Flight time
11	AIRRGBCAM, AIRHYPCAM	2017-06-17T11:41:00	2017-06-17T13:34:00	1:53
12	AIRRGBCAM, AIRHYPCAM	2017-06-18T07:53:00	2017-06-18T09:52:00	1:59
13	AIRRGBCAM, AIRHYPCAM	2017-06-25T19:07:00	2017-06-25T21:01:00	1:54
14	AIRRGBCAM, AIRHYPCAM	2017-06-26T11:25:00	2017-06-26T13:14:00	1:49
15	AIRRGBCAM	2017-06-27T13:58:00	2017-06-27T14:23:00	0:25
16	AIRRGBCAM	2017-06-27T15:07:00	2017-06-27T16:43:00	1:36
17	AIRRGBCAM, AIRHYPCAM	2017-06-30T13:40:00	2017-06-30T14:57:00	1:17
18	AIRRGBCAM, AIRHYPCAM	2017-07-01T13:37:00	2017-07-01T15:23:00	1:46
19	AIRRGBCAM, AIRHYPCAM	2017-07-02T16:41:00	2017-07-02T18:42:00	2:01
20	AIRRGBCAM, AIRHYPCAM	2017-07-03T09:44:00	2017-07-03T11:41:00	1:57
21	AIRRGBCAM, AIRHYPCAM	2017-07-03T16:00:00	2017-07-03T17:26:00	1:26
22	AIRRGBCAM	2017-07-05T10:17:00	2017-07-05T11:52:00	1:35
23	AIRRGBCAM	2017-07-09T13:31:00	2017-07-09T15:14:00	1:43
24	AIRRGBCAM, AIRHYPCAM	2017-07-11T10:38:00	2017-07-11T12:34:00	1:56
25	AIRRGBCAM, AIRHYPCAM	2017-07-12T08:28:00	2017-07-12T10:23:00	1:55
26	AIRRGBCAM	2017-07-14T13:19:00	2017-07-14T14:15:00	0:56
27	AIRRGBCAM, AIRHYPCAM	2017-07-15T12:36:00	2017-07-15T14:36:00	2:00

Table 7.2: List of waypoints and measurements during helicopter flights

Nr.	Waypoint	Lat	Lon	Time start [UTC]	Time end [UTC]
1	21_CAME_1	81.94984	10.44637	2017-06-04T09:19:00	2017-06-04T23:59:00
2	22_CAME_1	81.93833	10.74068	2017-06-05T00:00:00	2017-06-05T12:11:00
3	22_RADSLD_1	81.94095	10.74649	2017-06-05T00:00:00	2017-06-15T23:59:59
4	22_SPRA_ASD_1	81.93348	10.93500	2017-06-05T12:17:12	2017-06-05T12:59:41
5	22_SPRA_ASD_2	81.92759	10.92187	2017-06-05T13:15:10	2017-06-05T13:47:26
6	22_SPRA_ASD_3	81.92777	10.94574	2017-06-05T14:27:24	2017-06-05T15:01:56
7	22_USA_1	81.94095	10.74649	2017-06-05T00:00:00	2017-06-15T23:59:59
8	23_CAME_1	81.94854	10.85298	2017-06-06T12:08:00	2017-06-06T23:59:00
9	23_RADSTA-BB_1	81.93378	10.87807	2017-06-06T00:00:00	2017-06-15T23:59:59
10	24_CAME_1	81.94952	10.50581	2017-06-07T00:00:00	2017-06-07T23:59:00
11	24_SPRA_ASD_1	81.92521	10.10560	2017-06-07T12:13:03	2017-06-07T12:20:52
12	24_SPRA_OO_1	81.92389	10.03052	2017-06-07T13:41:59	2017-06-07T13:48:26
13	24_SPRA_OO_2	81.91746	10.01679	2017-06-07T14:10:19	2017-06-07T14:30:22
14	24_SPRA_OO_3	81.91169	10.00877	2017-06-07T14:42:23	2017-06-07T14:55:01
15	24_SRPA_ASD_2	81.92630	10.06404	2017-06-07T12:51:01	2017-06-07T12:53:43
16	25_CAME_1	81.90958	9.86426	2017-06-08T00:00:00	2017-06-08T23:59:00
17	25_SPRA_OO_1	81.90183	9.81412	2017-06-08T11:54:13	2017-06-08T12:43:38
18	26_CAME_1	81.89744	9.86908	2017-06-09T00:00:00	2017-06-09T23:59:00
19	26_FLU_1	81.89973	9.99384	2017-06-09T14:19:29	2017-06-09T14:23:45
20	26_FLU_2	81.90167	10.00027	2017-06-09T15:26:11	2017-06-09T15:27:54
21	26_SPRA_OO_1	81.89946	9.99513	2017-06-09T14:31:25	2017-06-09T14:48:31
22	26_SPRA_OO_2	81.89944	9.99643	2017-06-09T14:50:21	2017-06-09T14:57:33
23	26_SPRA_OO_3	81.90166	10.00042	2017-06-09T15:27:25	2017-06-09T15:29:20
24	26_WS_1	81.89973	9.99384	2017-06-09T14:19:29	2017-06-09T14:23:45
25	26_WS_2	81.90167	10.00027	2017-06-09T15:26:11	2017-06-09T15:27:54
26	27_CAME_1	81.90114	10.02681	2017-06-10T00:00:00	2017-06-10T13:48:00
27	27_FLU_1	81.88360	10.34526	2017-06-10T12:07:44	2017-06-10T12:09:28
28	27_FLU_2	81.88050	10.35797	2017-06-10T12:50:39	2017-06-10T12:56:57
29	27_FLU_3	81.87933	10.36450	2017-06-10T13:14:56	2017-06-10T13:26:52
30	27_FLU_4	81.87051	10.45177	2017-06-10T17:32:30	2017-06-10T17:39:56
31	27_HID_1	81.88504	10.33912	2017-06-10T11:45:47	2017-06-10T12:01:19
32	27_HID_2	81.88238	10.35116	2017-06-10T12:23:25	2017-06-10T13:05:02
33	27_HID_3	81.87907	10.36469	2017-06-10T13:23:07	2017-06-10T14:05:51
34	27_HID_4	81.87049	10.45185	2017-06-10T17:31:19	2017-06-10T17:41:37

Nr.	Waypoint	Lat	Lon	Time start [UTC]	Time end [UTC]
35	27_MPDS_1	81.88504	10.33912	2017-06-10T11:45:47	2017-06-10T12:01:19
36	27_MPDS_2	81.88238	10.35116	2017-06-10T12:23:25	2017-06-10T13:05:02
37	27_MPDS_3	81.87907	10.36469	2017-06-10T13:23:07	2017-06-10T14:05:51
38	27_MPDS_4	81.87049	10.45185	2017-06-10T17:31:19	2017-06-10T17:41:37
39	27_SPRA_ASD_1	81.87572	10.38375	2017-06-10T14:30:20	2017-06-10T14:48:23
40	27_SPRA_OO_1	81.88504	10.33912	2017-06-10T11:45:47	2017-06-10T12:01:19
41	27_SPRA_OO_2	81.88238	10.35116	2017-06-10T12:23:25	2017-06-10T13:05:02
42	27_SPRA_OO_3	81.87907	10.36469	2017-06-10T13:23:07	2017-06-10T14:05:51
43	27_SPRA_OO_4	81.87049	10.45185	2017-06-10T17:31:19	2017-06-10T17:41:37
44	27_WS_1	81.88360	10.34526	2017-06-10T12:07:44	2017-06-10T12:09:28
45	27_WS_2	81.88050	10.35797	2017-06-10T12:50:39	2017-06-10T12:56:57
46	27_WS_3	81.87933	10.36450	2017-06-10T13:14:56	2017-06-10T13:26:52
47	27_WS_4	81.87051	10.45177	2017-06-10T17:32:30	2017-06-10T17:39:56
48	28_CAME_1	81.84240	11.10107	2017-06-11T12:11:00	2017-06-11T23:59:00
49	29_CAME_1	81.82124	11.29774	2017-06-12T00:00:00	2017-06-12T23:59:00
50	29_FLU_1	81.82296	11.54930	2017-06-12T11:33:31	2017-06-12T11:35:44
51	29_SPRA_OO_1	81.82296	11.54930	2017-06-12T11:33:31	2017-06-12T11:35:44
52	29_WS_1	81.82296	11.54930	2017-06-12T11:33:31	2017-06-12T11:35:44
53	30_CAME_1	81.81453	11.49574	2017-06-13T00:00:00	2017-06-13T23:59:00
54	31_CAME_1	81.80575	11.33666	2017-06-14T00:00:00	2017-06-14T23:59:00
55	31_FLU_1	81.77628	11.24378	2017-06-14T11:18:02	2017-06-14T11:20:42
56	31_FLU_2	81.77378	11.23164	2017-06-14T11:50:03	2017-06-14T11:55:27
57	31_FLU_3	81.77058	11.21463	2017-06-14T12:30:31	2017-06-14T12:36:05
58	31_FLU_4	81.76526	11.16834	2017-06-14T13:54:39	2017-06-14T13:58:03
59	31_HID_1	81.77628	11.24378	2017-06-14T11:18:02	2017-06-14T11:20:42
60	31_HID_2	81.77378	11.23164	2017-06-14T11:50:03	2017-06-14T11:55:27
61	31_HID_3	81.77058	11.21463	2017-06-14T12:30:31	2017-06-14T12:36:05
62	31_MPDS_1	81.77628	11.24378	2017-06-14T11:18:02	2017-06-14T11:20:42
63	31_MPDS_2	81.77378	11.23164	2017-06-14T11:50:03	2017-06-14T11:55:27
64	31_MPDS_3	81.77058	11.21463	2017-06-14T12:30:31	2017-06-14T12:36:05
65	31_SPRA_OO_1	81.77628	11.24378	2017-06-14T11:18:02	2017-06-14T11:20:42
66	31_SPRA_OO_2	81.77378	11.23164	2017-06-14T11:50:03	2017-06-14T11:55:27
67	31_SPRA_OO_3	81.77058	11.21463	2017-06-14T12:30:31	2017-06-14T12:36:05
68	31_SPRA_OO_4	81.76526	11.16834	2017-06-14T13:54:39	2017-06-14T13:58:03
69	31_WS_1	81.77628	11.24378	2017-06-14T11:18:02	2017-06-14T11:20:42

Nr.	Waypoint	Lat	Lon	Time start [UTC]	Time end [UTC]
70	31_WS_2	81.77378	11.23164	2017-06-14T11:50:03	2017-06-14T11:55:27
71	31_WS_3	81.77058	11.21463	2017-06-14T12:30:31	2017-06-14T12:36:05
72	31_WS_4	81.76526	11.16834	2017-06-14T13:54:39	2017-06-14T13:58:03
73	32_CAME_1	81.74059	10.88348	2017-06-15T00:00:00	2017-06-15T23:59:00
74	32_FLU_1	81.72278	10.80896	2017-06-15T11:41:33	2017-06-15T11:43:53
75	32_FLU_2	81.71956	10.75311	2017-06-15T13:54:02	2017-06-15T13:56:04
76	32_FLU_3	81.70929	10.81542	2017-06-15T14:58:45	2017-06-15T15:02:01
77	32_FLU_4	81.70776	10.80700	2017-06-15T15:24:28	2017-06-15T15:27:46
78	32_FLU_5	81.70707	10.79787	2017-06-15T15:45:21	2017-06-15T15:47:34
79	32_SPRA_ASD_1	81.72284	10.81035	2017-06-15T11:50:17	2017-06-15T12:13:00
80	32_SPRA_ASD_2	81.71865	10.80156	2017-06-15T12:20:24	2017-06-15T12:58:31
81	32_SPRA_ASD_3	81.71111	10.78664	2017-06-15T13:15:26	2017-06-15T13:22:34
82	32_SPRA_OO_1	81.72173	10.80308	2017-06-15T12:05:00	2017-06-15T12:04:07
83	32_SPRA_OO_2	81.71682	10.79113	2017-06-15T13:02:13	2017-06-15T13:22:22
84	32_SPRA_OO_3	81.71886	10.75288	2017-06-15T13:58:10	2017-06-15T13:57:31
85	32_SPRA_OO_4	81.70880	10.81181	2017-06-15T15:07:40	2017-06-15T14:10:12
86	32_SPRA_OO_5	81.71799	10.74369	2017-06-15T14:21:54	2017-06-15T14:25:39
87	32_SPRA_OO_6	81.70866	10.81104	2017-06-15T15:09:37	2017-06-15T15:19:25
88	32_SPRA_OO_7	81.70758	10.80384	2017-06-15T15:29:34	2017-06-15T15:38:59
89	32_SPRA_OO_8	81.70681	10.79667	2017-06-15T15:48:15	2017-06-15T16:01:34
90	32_WS_1	81.72278	10.80896	2017-06-15T11:41:33	2017-06-15T11:43:53
91	32_WS_2	81.71956	10.75311	2017-06-15T13:54:02	2017-06-15T13:56:04
92	32_WS_3	81.71766	10.74216	2017-06-15T14:29:07	2017-06-15T14:29:40
93	32_WS_4	81.70929	10.81542	2017-06-15T14:58:45	2017-06-15T15:02:01
94	32_WS_5	81.70776	10.80700	2017-06-15T15:24:28	2017-06-15T15:27:46
95	32_WS_6	81.70707	10.79787	2017-06-15T15:45:21	2017-06-15T15:47:34
96	33_CAME_1	81.70583	10.59459	2017-06-16T00:00:00	2017-06-16T08:49:00
97	35_FLU_1	81.00209	10.34703	2017-06-17T12:22:34	2017-06-17T12:50:26
98	35_MER_1	81.00209	10.34703	2017-06-17T12:22:34	2017-06-17T12:50:26
99	40_FLU_1	80.15243	10.63666	2017-06-18T10:56:34	2017-06-18T11:53:34
100	40_MER_1	80.15243	10.63666	2017-06-18T10:56:34	2017-06-18T11:53:34
101	41_FLU_1	78.66592	4.57039	2017-06-19T13:32:05	2017-06-19T13:59:53
102	41_MER_1	78.66592	4.57039	2017-06-19T13:32:05	2017-06-19T13:59:53
103	45_CAME_1	78.09705	30.48085	2017-06-25T20:55:00	2017-06-25T03:13:00
104	45_FLU_1	78.09180	30.46654	2017-06-25T20:20:04	2017-06-25T20:24:56

Nr.	Waypoint	Lat	Lon	Time start [UTC]	Time end [UTC]
105	45_FLU_2	78.09187	30.44959	2017-06-25T22:27:23	2017-06-25T22:29:26
106	45_FLU_3	78.09273	30.44791	2017-06-25T22:48:13	2017-06-25T22:50:07
107	45_FLU_4	78.09387	30.44411	2017-06-25T23:23:24	2017-06-25T23:25:17
108	45_FLU_5	78.09692	30.45172	2017-06-25T00:22:32	2017-06-25T00:24:56
109	45_SPRA_OO_1	78.09180	30.46654	2017-06-25T19:53:51	2017-06-25T20:03:07
110	45_SPRA_OO_2	78.09187	30.44959	2017-06-25T22:16:21	2017-06-25T22:21:29
111	45_SPRA_OO_3	78.09273	30.44791	2017-06-25T22:39:42	2017-06-25T22:45:36
112	45_SPRA_OO_4	78.09387	30.44411	2017-06-25T23:12:54	2017-06-25T23:20:26
113	45_SPRA_OO_5	78.09692	30.45172	2017-06-25T00:39:19	2017-06-25T00:58:54
114	45_WS_1	78.09180	30.46654	2017-06-25T20:20:04	2017-06-25T20:24:56
115	45_WS_2	78.09187	30.44959	2017-06-25T22:27:23	2017-06-25T22:29:26
116	45_WS_3	78.09273	30.44791	2017-06-25T22:48:13	2017-06-25T22:50:07
117	45_WS_4	78.09387	30.44411	2017-06-25T23:23:24	2017-06-25T23:25:17
118	45_WS_5	78.09692	30.45172	2017-06-25T00:22:32	2017-06-25T00:24:56
119	49_FLU_1	80.52209	30.96378	2017-06-28T23:16:10	2017-06-28T23:19:26
120	49_FLU_2	80.53041	30.95812	2017-06-28T23:49:55	2017-06-28T23:51:29
121	49_FLU_3	80.53841	30.96515	2017-06-29T00:24:09	2017-06-29T00:27:10
122	49_FLU_4	80.55048	30.99424	2017-06-29T01:21:57	2017-06-29T01:22:51
123	49_SPRA_OO_1	80.52209	30.96378	2017-06-28T22:53:08	2017-06-28T23:13:31
124	49_SPRA_OO_2	80.53041	30.95812	2017-06-28T23:46:43	2017-06-28T23:58:13
125	49_SPRA_OO_3	80.53841	30.96515	2017-06-29T00:07:59	2017-06-29T00:21:15
126	49_SPRA_OO_4	80.55048	30.99424	2017-06-29T01:10:03	2017-06-29T01:12:56
127	49_WS_1	80.52209	30.96378	2017-06-28T23:16:10	2017-06-28T23:19:26
128	49_WS_2	80.53041	30.95812	2017-06-28T23:49:55	2017-06-28T23:51:29
129	49_WS_3	80.53841	30.96515	2017-06-29T00:24:09	2017-06-29T00:27:10
130	49_WS_4	80.55048	30.99424	2017-06-29T01:21:57	2017-06-29T01:22:51
131	66_CAME_1	81.65337	32.35975	2017-07-02T20:40:00	2017-07-03T04:58:00
132	66_FLU_1	81.64901	32.43541	2017-07-03T01:05:43	2017-07-03T01:07:35
133	66_FLU_2	81.64951	32.44425	2017-07-03T01:38:03	2017-07-03T01:39:37
134	66_SPRA_ASD_1	81.65149	32.36788	2017-07-02T19:36:44	2017-07-02T21:01:06
135	66_SPRA_ASD_3	81.64887	32.42188	2017-07-03T00:07:27	2017-07-03T00:12:11
136	66_SPRA_IBS_1	81.65000	32.45000	2017-07-03T02:08:13	2017-07-03T02:39:33
137	66_SPRA_IBS_3	81.65000	32.45000	2017-07-02T19:05:33	2017-07-02T20:06:48
138	66_SPRA_IBS_4	81.65000	32.45000	2017-07-02T20:33:34	2017-07-02T21:33:02
139	66_SPRA_OO_1	81.64901	32.43541	2017-07-03T00:54:56	2017-07-03T01:01:19

Nr.	Waypoint	Lat	Lon	Time start [UTC]	Time end [UTC]
140	66_SPRA_OO_2	81.64951	32.44425	2017-07-03T01:29:19	2017-07-03T01:35:08
141	66_SRPA_ASD_2	81.65000	32.45000	2017-07-02T21:53:41	2017-07-03T00:02:34
142	66_SRPA_IBS_2	81.65000	32.45000	2017-07-02T22:28:59	2017-07-02T23:14:30
143	66_WS_1	81.64901	32.43541	2017-07-03T01:05:43	2017-07-03T01:07:35
144	66_WS_2	81.64951	32.44425	2017-07-03T01:38:03	2017-07-03T01:39:37
145	67_FLU_1	81.96740	32.37925	2017-07-03T13:13:43	2017-07-03T13:47:44
146	67_MER_1	81.96740	32.37925	2017-07-03T13:13:43	2017-07-03T13:47:44
147	80_CAME_1	81.30849	16.90150	2017-07-12T04:53:00	2017-07-12T10:39:00
148	80_FLU_1	81.30895	16.90702	2017-07-12T03:07:02	2017-07-12T03:08:16
149	80_FLU_2	81.31256	16.93816	2017-07-12T04:06:56	2017-07-12T04:07:21
150	80_FLU_3	81.31431	16.95381	2017-07-12T04:36:11	2017-07-12T04:38:19
151	80_FLU_4	81.31718	16.97559	2017-07-12T05:30:11	2017-07-12T05:31:22
152	80_FLU_5	81.32155	16.99990	2017-07-12T06:28:59	2017-07-12T06:30:09
153	80_FLU_6	81.32464	17.00817	2017-07-12T07:06:33	2017-07-12T07:12:52
154	80_SPRA_OO_1	81.30895	16.90702	2017-07-12T03:24:00	2017-07-12T03:31:51
155	80_SPRA_OO_2	81.31256	16.93816	2017-07-12T03:55:58	2017-07-12T04:03:31
156	80_SPRA_OO_3	81.31431	16.95381	2017-07-12T04:27:05	2017-07-12T04:33:29
157	80_SPRA_OO_4	81.31718	16.97559	2017-07-12T05:21:55	2017-07-12T05:27:36
158	80_SPRA_OO_5	81.32155	16.99990	2017-07-12T05:42:34	2017-07-12T06:02:42
159	80_SPRA_OO_6	81.32464	17.00817	2017-07-12T06:36:37	2017-07-12T06:49:39
160	80_WS_1	81.30895	16.90702	2017-07-12T03:07:02	2017-07-12T03:08:16
161	80_WS_2	81.31256	16.93816	2017-07-12T04:06:56	2017-07-12T04:07:21
162	80_WS_3	81.31431	16.95381	2017-07-12T04:36:11	2017-07-12T04:38:19
163	80_WS_4	81.31718	16.97559	2017-07-12T05:30:11	2017-07-12T05:31:22
164	80_WS_5	81.32155	16.99990	2017-07-12T06:28:59	2017-07-12T06:30:09
165	80_WS_6	81.32464	17.00817	2017-07-12T07:06:33	2017-07-12T07:12:52