

Report on SDU UAS Center mission to Ilulissat for data collection in relation to project ArtDrone



By:

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Rev. 1.0

Day #0 – Tuesday 2019.11.12

All day travel from Odense via Copenhagen and Kangerlussuaq to Ilulissat. All travel according to planned schedule, except for the last flight to Ilulissat, which was delayed due to strong winds at the destination.

It seemed that no snow had fallen in the area until now, which according to locals is quite unusual, as first snow is typically seen in October.

Day #1 – Wednesday 2019.11.13

Weather forecast: Wind 130°, 6 m/s, Visibility >10km, Temperature +1°C.

Conditions for flying were good.

Initially flights were performed from position B with Mavic (#2 & #5) and DJI M210 (#3, #4 & #6)

Only few minor icebergs were in the area and within VLOS range, but good RGB and Thermal video and photos were recorded of the ones in range. Radio range on all channels was good and found reliable at all distances reached.

Mission continued until all batteries had been in use, and remaining flight time was found safe for the return flight

After all batteries had been in use, we returned to the hotel to charge the batteries.

After charging the batteries we went to Position A, for the next mission with the same drones (#2 and #3) and same configuration. Again, only minor icebergs were found in the area, but at this position the distance to the icebergs was less. The flights continued into the Twilight period, as long as we were confident with the operation

Clothing was found more than suitable, for the actual weather conditions during all day.

No unusual behavior of the operated drones or related equipment was experienced.

Flight statistics:

Item no:	Type:	Flight time:	No of flights:
1	DJI Mavic 2 Pro	00:00	0
2	DJI Mavic 2 Enterprise Dual	02:11	7
3	DJI M210	00:17	2

Day #2 – Thursday 2019.11.14

Weather forecast: Wind 150°, 13 m/s, max. 26 m/s, Visibility more than 10km, Temperature +4°C.

Storm made flights impossible this day, and snow followed later on in the evening. All AirGreenland flights to and from Ilulissat was cancelled this day, due to the weather.

We went for a walk into the town and ended up on the other side of the town, at the cliffs near to the mouth of the fjord. Suitable take off locations was found here. Position "C" seemed to be a good location

and easily accessible with our equipment, although it would require a Taxi to bring our equipment all the way from the hotel and back.

Talking to the hotel personnel, we got informed that well marked hiking routes could lead us into the fjord and perhaps better take off locations and get us closer to larger formations of icebergs, within VLOS range. We discussed this in the evening and decided to prepare for a hike into the fjord, when the weather gets better on Saturday. To make shure we would not run out of batteries for the drones on this remote tour, we decided to go into the town on the following day, as we would be grounded due to bad weather anyway, to get a few more batteries for the Mavic in the local DJI store. To fly drones within the fjord, we would need a dispensation from TBST, which was pending, but even if we did not get the dispensation in time, the hike would still be beneficial to us, as we could get as close to the boundary of the dispensation area, and still keep clear of the area to do valuable data recording here.

Day #3 – Friday 2019.11.15

Weather forecast: Wind 200°, 14 m/s, max. 25 m/s, Visibility less than 8km, Temperature +4°C.

As expected, the weather conditions were not for flying drones, so we went into town as planned, to shop batteries.

Day #4 – Saturday 2019.11.16

Weather forecast: Wind 110°, 6 m/s, Visibility more than 10km, Temperature -5°C.

Conditions for flying were good.

The previous days with strong winds and , have led more larger ice formations out of the fjord and within VLOS range, from our two take off position's "A" and "B", close to the hotel Arctic. We decided to do the flights today at these positions, where we also easily would be able to bring the M210 drone, for good RGB data collection. The flights at the mouth of the Ice fjord, we decided to postpone for day #5 (Sunday 2019.11.17), where the weather forecast also looks promising.

For the M210 we only managed to do one flight with the first set of batteries this day, as the second set of batteries were not able to initialize correctly. Assumable the temperature was causing this, even though the batteries are specified operation down to -10 °C. Further investigation on this, will be performed when back in DK.

Clothing was found suitable, for the actual weather conditions during all day.

Flight statistics:

Item no:	Type:	Flight time:	No of flights:
1	DJI Mavic 2 Pro	00:00	0
2	DJI Mavic 2 Enterprise Dual	01:31	5
3	DJI M210	00:16	1

Day #5 – Sunday 2019.11.17

Weather forecast: Wind 060°, 6 m/s, Visibility more than 10km, Temperature -8°C.

Conditions for flying were good. Forecasted Temperature this day, is the lowest for the period of us being in Ilulissat.

This was the last day of data gathering, and as planned we went to do our mission from a takeoff position at the mouth of fjord towards the open sea, where large ice formations have gathered. A taxi took us near to the take-off site "C", and a few minutes of walk brought us to the destination located on a cliff formation. We brought all three drones, to get as much data as possible this last day of flight. Weather conditions were good, and we collected good data.

This day we had an incident with the Mavic 2 Enterprise drone. With the drone in line of sight over open sea, a return to home (RTH) was executed from the control station by the pilot. As the drone climbed to the RTH altitude, it reached the lower limit of the Ilulissat Airport (BGJN) No Fly Zone. At this point the drone became uncontrollable from the control station and stayed at the present position and altitude. Video feed became lost and the indicated position on the map of the control station, became frozen. Several attempts were made to regain control of the drone, but without luck.

When the battery was about to run out, the drone started an Autoland cycle, and when it came down into the normal flight operations area again, control could be regained. We activated the "sport" mode on the control station, and managed to get it back and land safely at the take-off position, shortly before the battery was exhausted. During the return flight, we never restored video feed or position of the drone on the map of the control station.

For the M210 we only managed to do one flight with the first set of batteries, as the second set of batteries again were not able to initialize correctly. Like for the flight on day #4, assumable the temperature was causing this.

Clothing was found more than suitable, for the actual weather conditions during all day, but chemical hand and foot warmers were brought and used this day, as we had no chance of quickly getting inside if we became cold.

Flight statistics:

Item no:	Type:	Flight time:	No of flights:
1	DJI Mavic 2 Pro	00:15	1
2	DJI Mavic 2 Enterprise Dual	01:33	6
3	DJI M210	00:17	1

Day #6 – Monday 2019.11.18

All day travel back to Denmark, via the same route as we came. Arrival at Odense Railway Station was at 23:10.

General:

When back in Denmark, the incidents described will have to be investigated further.

For all weather conditions experienced during this mission, all clothing was found suitable by both participants. Operating the DJI control station, were made with either bare hands or thin wind resistant gloves, to get a good grip on the joysticks and to be able to use the touch screens. Although this in some situations lead to cold fingers, the woolen mitts, soon restored normal temperature. Standing still on the cold ground, generally did not lead to cold feet, as the boots had thick rubber soles. Chemical hand and foot warmers also came in handy on day #5, being the coldest day during our stay in Ilulissat.

Total flight statistics:

Item no:	Type:	Flight time:	No of flights:
1	DJI Mavic 2 Pro	00:15	1
2	DJI Mavic 2 Enterprise Dual	05:15	18
3	DJI M210	00:50	4

All drone operations were performed within the specifications provided by the manufacturer (DJI).

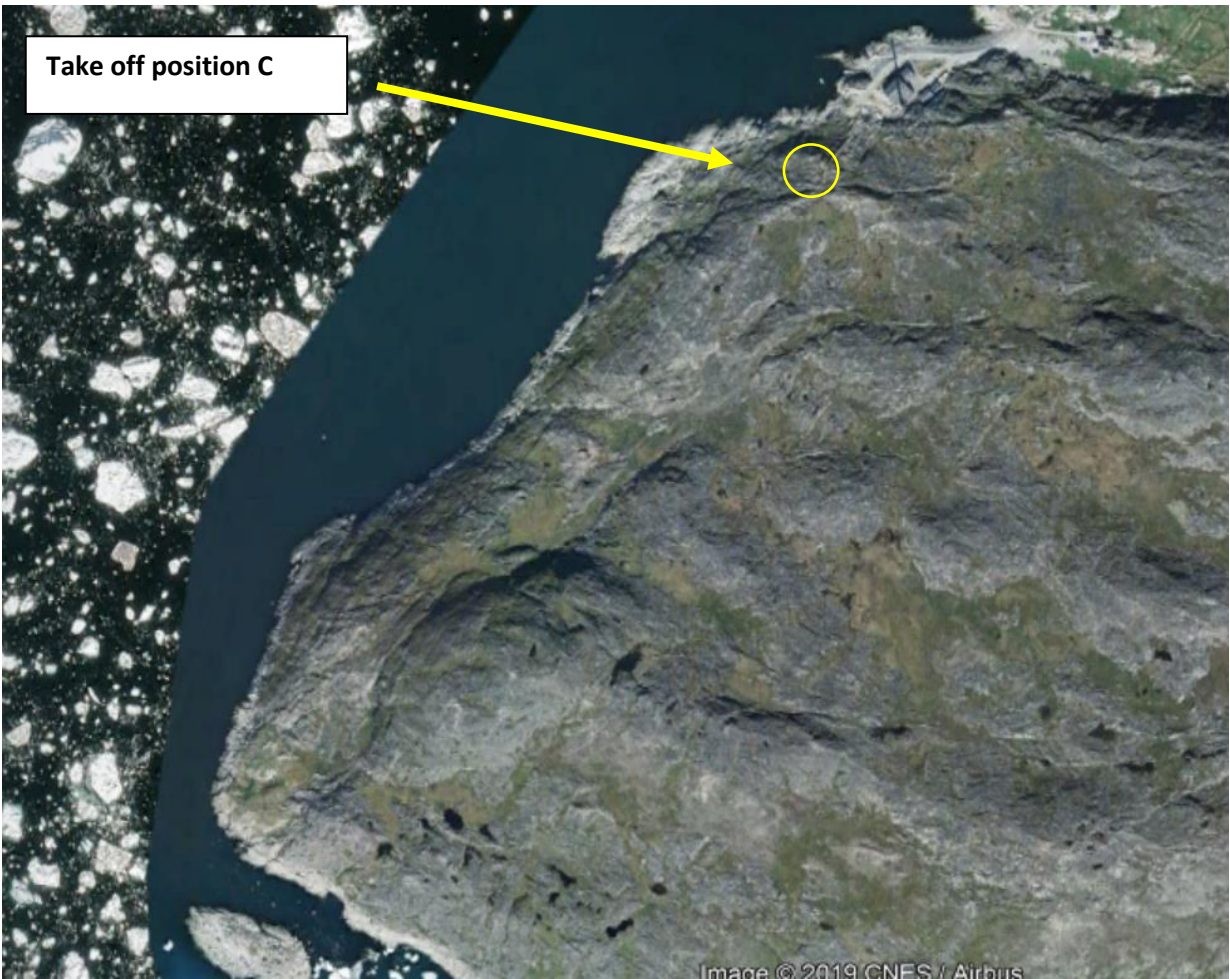
Ilulissat, Greenland



Take off locations



Ref: Google Earth

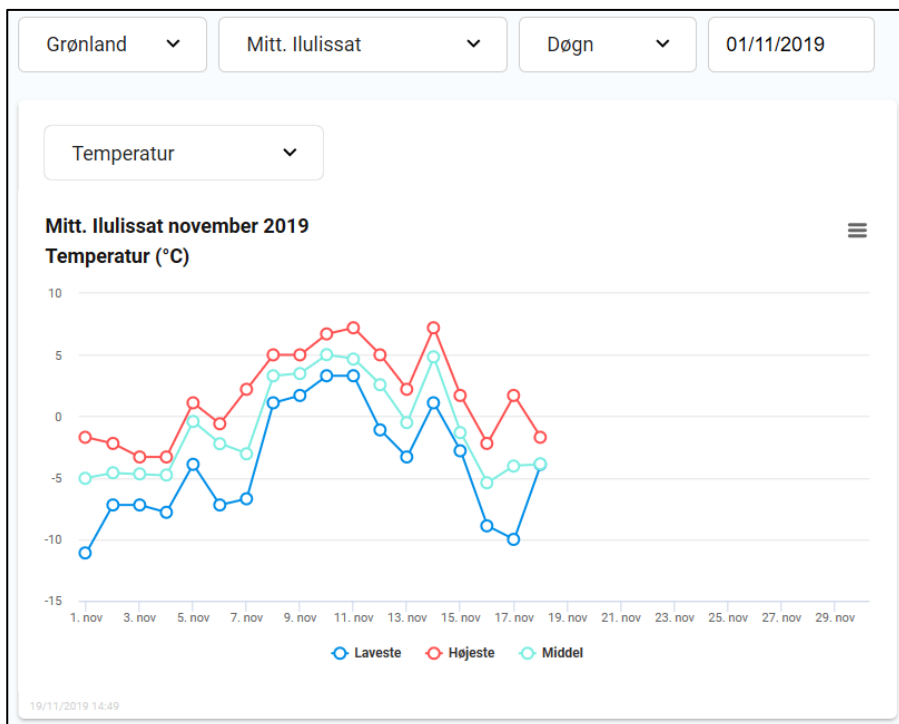


Sun rise/Sun set table (Time is UTC/GMT):

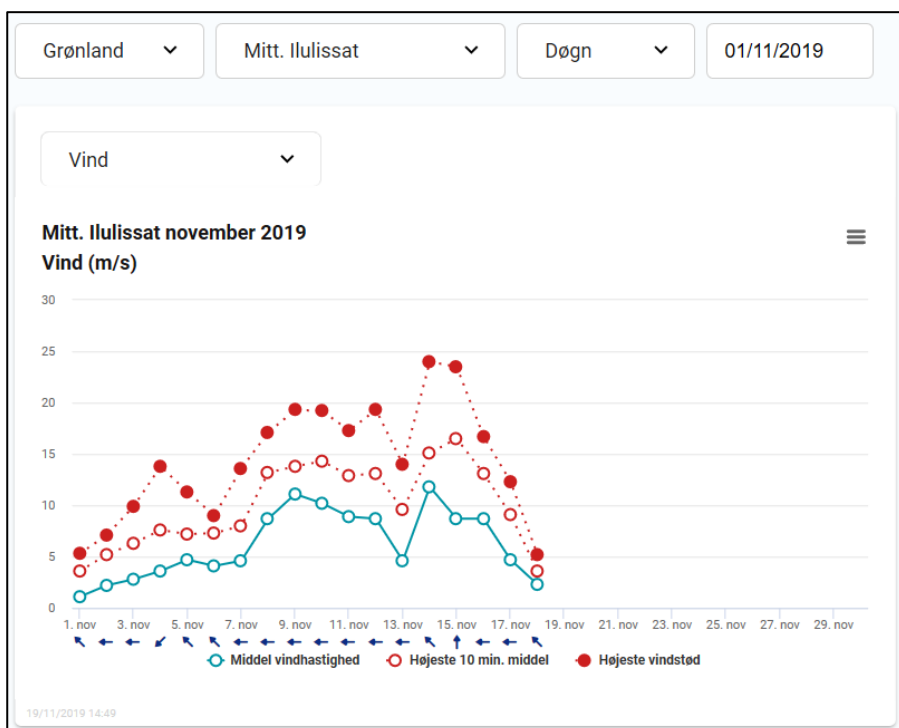
MONTH/DAT	TWIL FROM	SR	SS	TWIL TO	
NOV	2	1042	1154	1821	1933
-	4	1050	1203	1812	1925
-	6	1057	1213	1802	1918
-	8	1105	1223	1752	1911
-	10	1112	1233	1743	1904
-	12	1119	1244	1733	1857
-	14	1127	1255	1722	1850
-	16	1134	1306	1712	1843
-	18	1141	1318	1701	1837
-	20	1149	1331	1649	1831
-	22	1156	1344	1636	1825
-	24	1203	1359	1623	1819
-	26	1209	1417	1606	1814
-	28	1216	1440	1545	1809
-	30	1222	-----	-----	1804

Ref: https://aim.naviar.dk/media/files/gm0la1tbnpt/BG_GEN_2_7_en.pdf

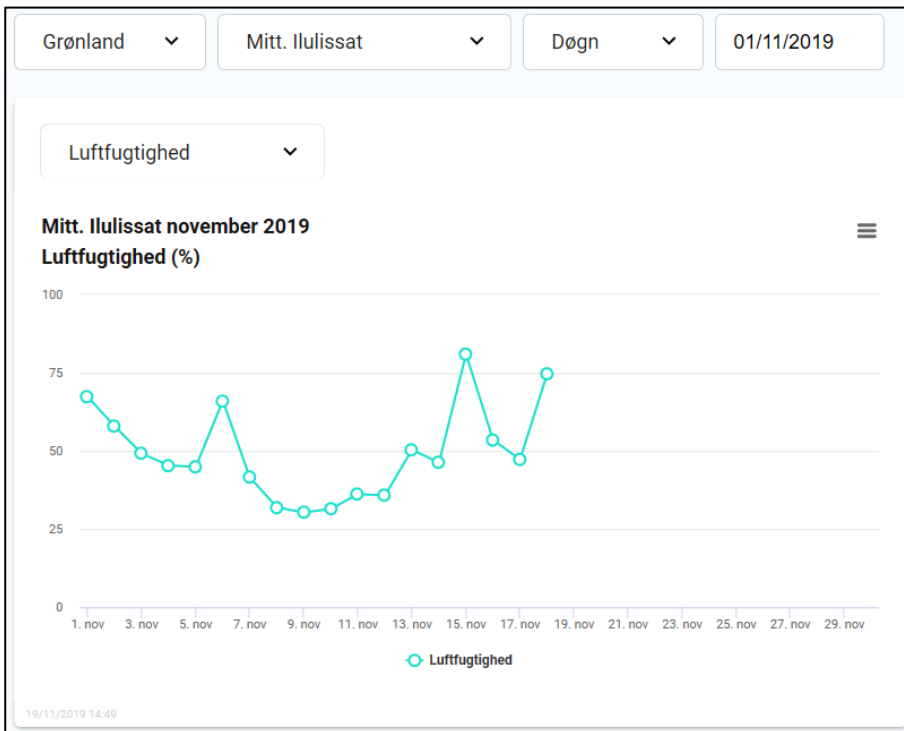
Weather data (Weather archive data by DMI):



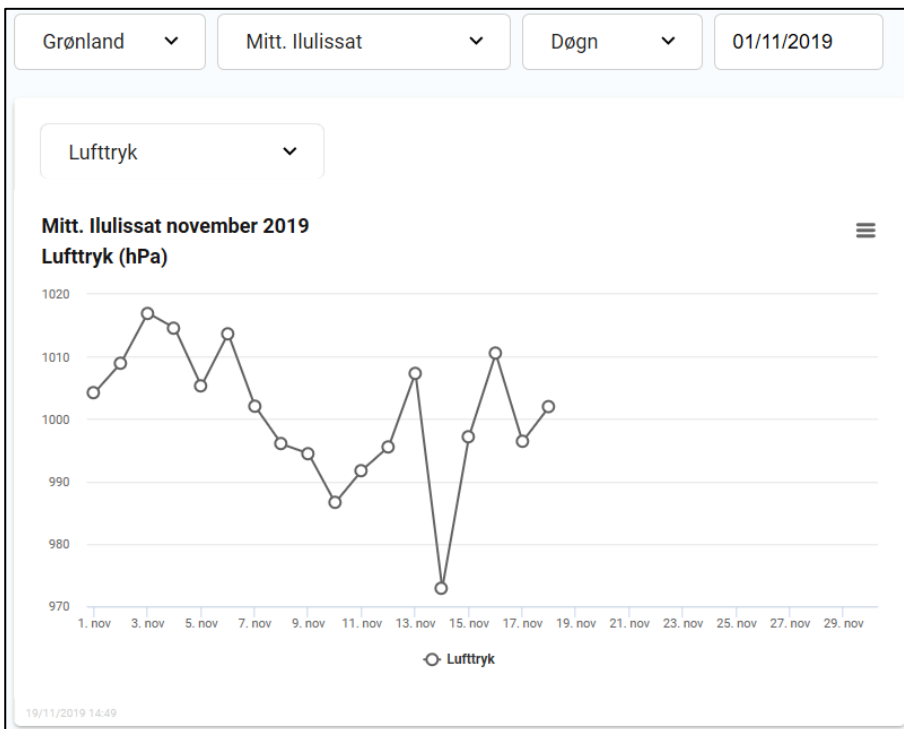
Date [yy.mm.dd]	Mean temp. [°C]	Low temp. [°C]	High temp. [°C]
2019.11.01	-5,0	-11,1	-1,7
2019.11.02	-4,6	-7,2	-2,2
2019.11.03	-4,7	-7,2	-3,3
2019.11.04	-4,8	-7,8	-3,3
2019.11.05	-0,4	-3,9	1,1
2019.11.06	-2,2	-7,2	-0,6
2019.11.07	-3,0	-6,7	2,2
2019.11.08	3,3	1,1	5,0
2019.11.09	3,5	1,7	5,0
2019.11.10	5,0	3,3	6,7
2019.11.11	4,7	3,3	7,2
2019.11.12	2,6	-1,1	5,0
2019.11.13	-0,5	-3,3	2,2
2019.11.14	4,8	1,1	7,2
2019.11.15	-1,3	-2,8	1,7
2019.11.16	-5,4	-8,9	-2,2
2019.11.17	-4,0	-10,0	1,7
2019.11.18	-3,9	-8,3	-1,7



Date [yy.mm.dd]	Mean wind [m/s]	Gust wind [m/s]
2019.11.01	1,1	5,3
2019.11.02	2,2	7,1
2019.11.03	2,8	9,9
2019.11.04	3,6	13,8
2019.11.05	4,7	11,3
2019.11.06	4,1	9,0
2019.11.07	4,6	13,6
2019.11.08	8,7	17,1
2019.11.09	11,1	19,3
2019.11.10	10,2	19,2
2019.11.11	8,9	17,3
2019.11.12	8,7	19,3
2019.11.13	4,6	14,0
2019.11.14	11,8	24,0
2019.11.15	8,7	23,5
2019.11.16	8,7	16,7
2019.11.17	4,7	12,3
2019.11.18	2,4	5,2



DateTime	Humidity [%]
2019.11.01	67,3
2019.11.02	57,9
2019.11.03	49,2
2019.11.04	45,4
2019.11.05	44,9
2019.11.06	66,1
2019.11.07	41,5
2019.11.08	32,0
2019.11.09	30,3
2019.11.10	31,5
2019.11.11	36,2
2019.11.12	35,8
2019.11.13	50,4
2019.11.14	46,3
2019.11.15	81,0
2019.11.16	53,5
2019.11.17	47,3
2019.11.18	75,0



Date [yy.mm.dd]	Pressure [hPa]
2019.11.01	1004,2
2019.11.02	1009,0
2019.11.03	1017,0
2019.11.04	1014,6
2019.11.05	1005,3
2019.11.06	1013,7
2019.11.07	1002,1
2019.11.08	996,0
2019.11.09	994,5
2019.11.10	986,6
2019.11.11	991,8
2019.11.12	995,6
2019.11.13	1007,4
2019.11.14	972,9
2019.11.15	970,0
2019.11.16	997,2
2019.11.17	1010,1
2019.11.18	996,4
2019.11.19	1002,2

Ref: <https://www.dmi.dk/vejrarkiv/>

Reference weather forecast (Aeronautical weather briefing by Northavimet)

NorthAviMet - 16:53 UTC, november 13, 2019

BGJN ILULISSAT/JAKOBSHAVN rwy: 04T/22T

taf **bgjn** **131356z 1315/1322 12010kt 9999 few030 sct060 bkn100 tempo 1315/1322**
bkn030=

metar **bgjn** **131550z 04003kt 9999 few032 sct044 bkn090 m01/m04 q1011=**

NorthAviMet - 12:07 UTC, november 14, 2019

BGJN ILULISSAT/JAKOBSHAVN rwy: 04T/22T

taf **bgjn** **141115z 1410/1421 15025g35kt 9999 few012 bkn080 tempo 1410/1415**
15030g45kt sct080 tempo 1415/1419 15035g50kt tempo 1419/1421
12020g30kt=

metar **bgjn** **141150z 14028kt 9999 bkn050 04/m04 q0977=**

NorthAviMet - 12:25 UTC, november 15, 2019

BGJN ILULISSAT/JAKOBSHAVN rwy: 04T/22T

taf **bgjn** **151127z 1512/1521 20028g40kt 8000 -sn sct008 bkn020 tempo 1512/1514**
22035g50kt 0800 sn blsn vv004 becmg 1514/1516 22018kt tempo
1515/1521 sct025 bkn040=

metar **bgjn** **151150z 21034g46kt 3000 -sn drsn sct009 bkn018 m01/m03 q0984=**

NorthAviMet - 17:29 UTC, november 16, 2019

BGJN ILULISSAT/JAKOBSHAVN rwy: 04T/22T

taf **bgjn** **161413z 1615/1623 11012kt 9999 sct120 tempo 1615/1623 drsn bkn080=**

metar **bgjn** **161650z 10019kt 9999 drsn few060 m05/m12 q1011=**

NorthAviMet - 11:55 UTC, november 17, 2019

BGJN ILULISSAT/JAKOBSHAVN rwy: 04T/22T

taf **bgjn** **171120z 1712/1720 06012kt 9999 few050 sct120 tempo 1715/1720**
12015g25kt=

metar **bgjn** **171150z 04013kt 9999 few180 m08/m19 q0997=**

NorthAviMet - 10:32 UTC, november 18, 2019

BGJN ILULISSAT/JAKOBSHAVN rwy: 04T/22T

taf **bgjn** **180910z 1809/1818 vrb08kt 9999 bkn060 tempo 1809/1818 12010g20kt**
sct060=

metar **bgjn** **180950z 14005kt 9999 bkn075 m03/m07 q0999=**

Equipment used:

Item no.	Item type	Manufacturer	Type	Serial number	SDU Registration no.	TBST Owner no.	TBST Registration no.
1	Drone	DJI	Mavic 2 PRO	163DF9L	-	4620021	12969
2	Drone	DJI	Mavic 2 Enterprise Dual	298DG3E0011L60	MR1904-001	4620021	14324
3	Drone	DJI	Matrice 210	0G0DF680230075	MR1811-001	4620021	14325
4	Camera	DJI	Zenmuse Z3	GD1DF110000199	-	-	-
5	Control unit	DJI	Smart Controller		-	-	-
6	Control unit	DJI	Crystal Sky	0JADF620C3006L	-	-	-