



Supplement of

Microphysics of Arctic Stratiform Boundary-layer Clouds during ARCSIX

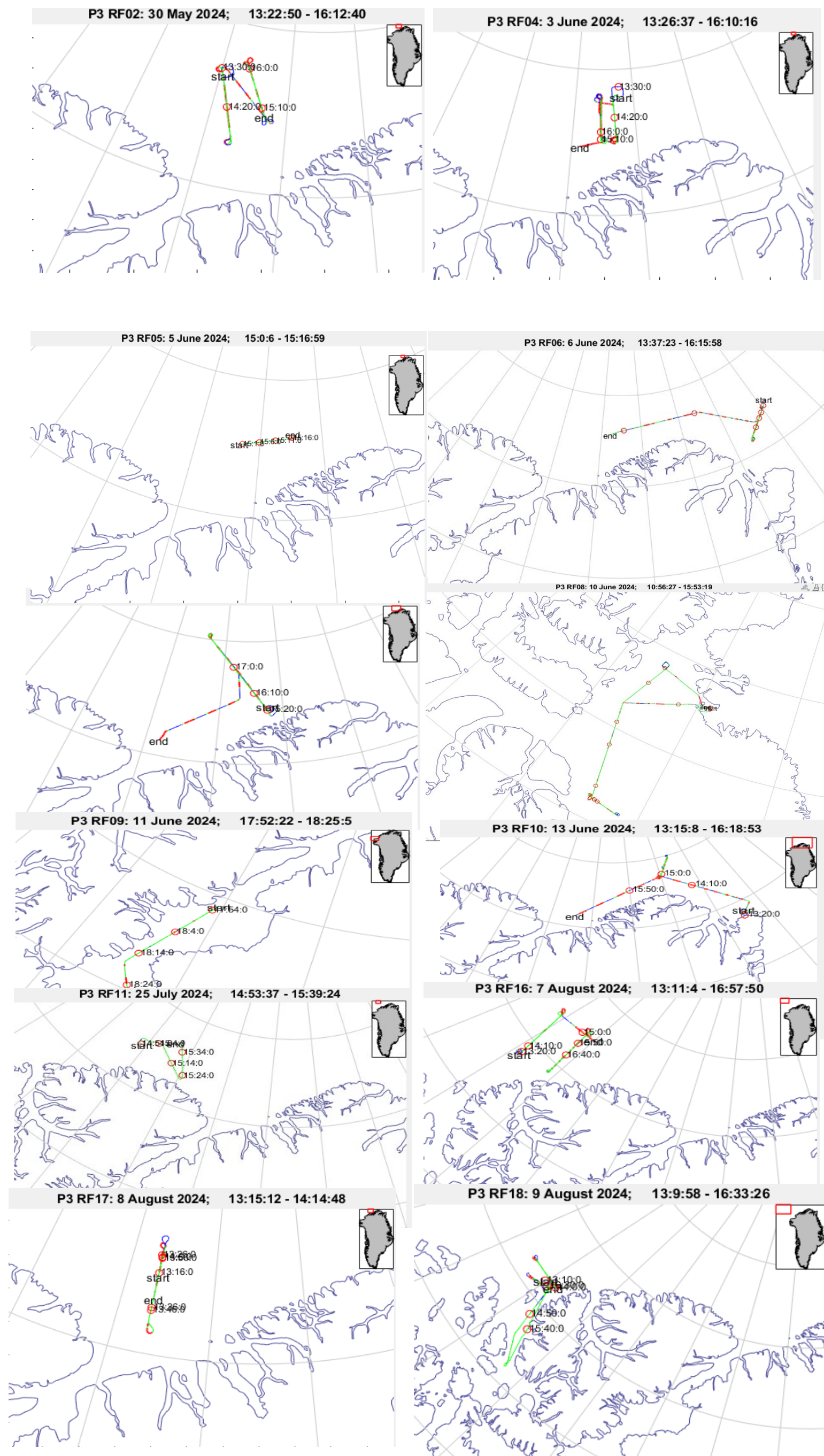
Alexei V. Korolev and R. Paul Lawson

Correspondence to: R. Paul Lawson (plawson@specinc.com)

The copyright of individual parts of the supplement might differ from the article licence.

Table S1
Supplement to: Microphysics of Arctic Stratiform Boundary-layer Clouds during ARCSIX
NASA P-3

CLOUDS SAMPLED IN THE TARGETED AREA OF OPERATIONS (e.g. "CLOUD WALLS") (P-3)																									
Flight #	date	t _{start} (hhmmss)	t _{end} (hhmmss)	cloud base (m)	cloud top (m)	Cloud depth ΔH (m)	T _{base} (C)	T _{Top} (C)	T _{max above} (C)	T _{max below} (C)	cloud top inversion ΔT (C)	N _{drop max} (cm-3)	LWC _{max}	D _{eff max} (um)	drizzle	N _{ice max} (L-1)	D _{ice max} (mm)	crystal type	cld phase intermitt	number of cloud layers	number of profiles	wind speed (m/s) wind dir (deg)	surface type	area of operation	comments
2	5/30/2024	132300	161400	1400 <300	1700 700-500	200-300 ~>300	-12 >-6	-15 -9	-15 -9	-5 >-6	5 0	40 40-100	0.2 0.3	25 27	yes/no	0.1-1 0.1-1	10 10	dendrites aggregates	mixed-phase	2	22	0.5-10 200-260	solid ice	Lincoln Sea	Two cloud layer+Z7,Z27f the lower layer. It may be a fog coupled to the ocean surface; dendrites are formed in the top cloud layer and then precipitate down to the surface of the ice; a few patches of drizzle.
4	6/3/2024	133100	160620	<300	1600-2200	<1200	>-3	-12	-8	>-3	3	50-500	0.5	25-30	yes	0.05-5	3	rimed ice columns needles	liquid & mixed-phase	3-5	14	4-10 260-330	solid ice with large polynyas	crown of Greenland	Multilayer cloud system with three inversions. Polluted upper layer N~400-600cm-3. The lowest cloud layer is relatively clean N~50-100cm-3. Upper layer generates drizzle and has highest LWC~0.5g/m3. Ice formed primarily in the low level clouds. Many cases of cloud segments with drizzle. Low ice particles concentration (Nice<0.01L-1)
5	6/5/2024	150400	151500	<100	100	~100	< -6	-5	0	?	5	40-60	0.25	18-24	yes/no	0.1-20	3	columns needles aggrev	mixed-phase	1	1	4-5 40-60	solid ice covered by snow, polynyas	crown of Greenland	Fog over the ocean surface. Ice forms right at the top of the fog layer; needles/columns & aggregates. Distinct cellular structure of ice. Patches of drizzle. Cloud microstructure is inhomogeneous
6	6/6/2024	133940	161400	?	250-300	>100	?	-3 to -4	4	?	4	60-150	0.2-0.4	17-25	yes/no	0.1-30	2	columns	mixed-phase	1	41	0.5-4 100-200	solid ice covered by snow, polynyas	crown of Greenland	Fog over the ocean ice topped by a positive temperature; isothermal layer ~1km deep; numerous small ice columns.
7	6/7/2024	151400	173000	200-300	400-500	200	-3 to -4	-4 to -5	2	?	6 to 10	50-100	0.3-0.4	20-24	no	0.1-60	10	columns needles aggrev	mixed-phase	1	24	8-18 40-80	solid ice, polynyas	crown of Greenland	No drizzle, no graupel, large aggregates of ice, spatial clusters of small ice particles.
8	6/10/2024	121200	152200	400-150	600-400	~200	-3 to -1	-4	6	1	6	60-200	0.45	10-15	yes/no	0.1-50	10	columns needles aggrev	liquid & mixed-phase	1-2	25	2-10 320-360	open water broken ice, solid ice	Baffin Bay	Cellular structure of ice regions; no drizzle in ice cloud regions
10	6/13/2024	132500	161500	<100	300-1000	200-300	-1	-5	2.5	1	5	60-100	0.5	20-25	yes/no	0.1-10	10	columns needles rimed ice aggrev	liquid & mixed-phase	1-3	40	2-8 280-340	solid or broken ice	crown of Greenland	Low level cloud system with varied number of layers (from 1 to 3). The upper layer is topped by warm inversion. High phase heterogeneity; extended regions with liquid drizzling clouds, followed by mixed-phase clouds.
11	7/25/2024	145430	155300	<100	300	~200-300	0.5	-1	0	?	0.5	50-150	0.1-0.5	20-25	yes/no	0.1-5	8	columns needles aggrev	liquid & mixed-phase	1-2	8	4-6 40-60	melt ice	North of Ellesmere Island Lincoln Sea	Precipitating mixed-phase clouds at subfreezing temperature, large aggregates of needles. The second cloud segment is drizzling T-0C, no ice
16	8/7/2024	131200	165500	1200 500	800 200	400 300	-6 -2	-10 -4	-5	0	4 2	50-250	0.2-0.7	20-35	yes/no	0.1-30	5	columns needles graupel rimed ice	liquid & mixed-phase	2	14	2-8 240-340	melt ice	Platypus	Two cloud layers, the upper layer generates drizzle, two cells of graupel with without small ice (no SIP), no SIP was observed in drizzle below cloud base; distinct cellular structure of ice formation.
17	8/8/2024	131540	155400	1900 1500	1600 700	300 800	-12 -8	-8 -4	-6	1	2 1	5-150	0.1-0.4	15-32	yes	5	1	columns needles lollipops broken drops	liquid & mixed-phase	2	4	2-8 240-260	melt ice	Lincoln Sea	Two cloud layers. Low level generates drizzle. Ice was observed during porpoising in the lower layer. No ice was found in the top layer.
18	8/9/2024	131200	163100	700-800	300-400	200-400	-7	-1	-1	2	6	20-100	0.5	22-32	yes/no	0.1-20	5	columns needles aggregates graupel rimed ice	liquid mixed-phase	1	13	6-15 20-320	melt ice	Platypus	Single cloud layer. Distinct cellular structure of ice formation. Ice shapes dominated by rimed ice and graupel.
LIQUID & MIXED-PHASE CLOUDS SAMPLED DURING TRANSIT TO/FROM THE AREA OF OPERATIONS (P-3)																									
Flight #	date	t _{start} (hhmmss)	t _{end} (hhmmss)	cloud base (m)	cloud top (m)	Cloud depth ΔH (m)	T _{base} (C)	T _{Top} (C)	T _{max above} (C)	T _{max below} (C)	cloud top inversion ΔT (C)	N _{drop max} (cm-3)	LWC _{max}	D _{eff max} (um)	drizzle	N _{ice max} (L-1)	D _{ice max} (mm)	crystal type	cld phase intermitt	number of cld layers	number of profiles	wind speed (km/h) wind dir (deg)	surface type	area of operation	comments
2	5/30/2024	105900	110645	1250	1900	650	-10	-15	-11	-1	4	50	0.4	27	no	10	7	dendrites irreglars aggregates	mixed-phase	2	1	10 140-155	solid ice	after take off from Pitufikk	Mixed phase cloud layer embedded into a deep ice cloud. Ice cloud top at >5km. Ice precipitate down to the ground level.
2	5/30/2024	175305	175555	<1450	>1450	?	<-12	>-12	?	0	?	100	0.3	22	no	0.1	5	dendrites	mixed-phase	1	n/a	7-14 160	ocean ice land	descending Pitufikk	mixed-phase cloud with low concentration dendrites, passed a few virgae of rimed ice
2	5/30/2024	80250	181105	<1450	>1450	?	<-12	>-12	?	0	?	100	0.4	22	no	0.1	5	dendrites	mixed-phase	1	n/a	7-14 160	ocean ice land	descending Pitufikk	mixed-phase cloud with low concentration dendrites, passed a few virgae of rimed ice
4	6/3/2024	110640	110905	4160	3300	900	-17	-22	-12	0	1	50-150	0.25	20	no	0.1-3	8	graupel plates smt column aggregates	mixed-phase	1	1	4-8 250-300	solid ice	ascending after take off	precipitating mixed-phase single layer; ice forming at the cloud top, precipitating down to the ground; riming process incise cloud, aggregation and deposition growth below cloud
6	6/6/2024	132805	132834	3200	3300	100	-9	-10	-8	?	1	200	0.1	12		0	0	n/a	liquid	1	1	6 300	solid ice some polynyas	North-West of Greenland	thin cloud layer during descent
9	6/11/2024	123220	123240	5300	5370	70	-23.5	-24	-24	?	0	100	0.02	8	no	1	0.5	compact irreglars	mixed-phase	1	1	12 60	solid ice	Lincoln Sea	thin liquid layer generating tiny ice
9	6/11/2024	140215	140405	3000	3000	?	-8	-8	?	?	?	300	0.04	9	no	0	0	n/a	liquid	1	n/a	9-11 50-60	solid ice	Lincoln Sea	sampling lower part of the cloud layer when flying along the cloud base
9	6/11/2024	175530	182400	<100	400	~400	0	-3	?	1	0.5	?	0.25	?	yes	30	10	columns needles aggrev	liquid & mixed-phase	1+	4	1-10 0-50	solid ice (<18:08) open water (>18:08)	Nares straight on approach to Pitufikk	Deep cloud system. A few cloud segments seeded from above by dendrites. Extended liquid drizzling area with no ice. The second cloud was in mixed-phase state. Large aggregates. Uniform mixed-phase. No cellular structure was observed.
10	6/13/2024	173620	175645	100	3700	3600	0	-16	-15	5	1	150	0.07	18	no	20	10	dendrites, smt columns rimed ice, aggregates	mixe-phase ice	9?	1	1-13 0-170	open water broken ice	Nares Strait	multilayer cloud with several embedded inversions
10	6/13/2024	180210	181500	1200	1900	700	-4	-6	-4	5	0	20-100	0.4	25	yes	30	1-2	columns rimed ice	liquid mixed-phase	1	1	5-7 150-170	open water	Baffin Bay	mixed-phase clouds on approach to Pitufikk , horizontally and vertically inhomogeneous
11	7/25/2024	113045	113245	2200	2300	100	-5	-8.8	7.8	8	1	20-50	0.2	20-30	yes	0	0	n/a	liquid	2	1	10-12 120-140	open water	ascending after take off from Pitufikk	drizzle, no ice
11	7/25/2024	123200	123700	4500	4600	100	-18	-19	-16	3	1	100-150	0.2	14-16	no	0.01-1	0.5	compact rimed	mixed-phase	1	n/a	4-6 80-100	melt ice	Lincoln Sea	small ice, rimed, very low concentration
11	7/25/2024	131400	131530	3300	2700	600	-10	-14	-10	4	1	100-200	0.4	22	yes	<0.01	2	stellar	mixed-phase	1	1	5-6 100-120	melt ice	Lincoln Sea	conditionally mixed-phase, very low ice conc. drizzle inside and below cloud
11	7/25/2024	133200	133400	3500	3000	500	-11	-15	-11	4	1	80-120	0.35	22	no	<0.01	2	stellar	mixed-phase	1	1	5-6 140	melt ice	Lincoln Sea	conditionally mixed-phase, very low ice conc.

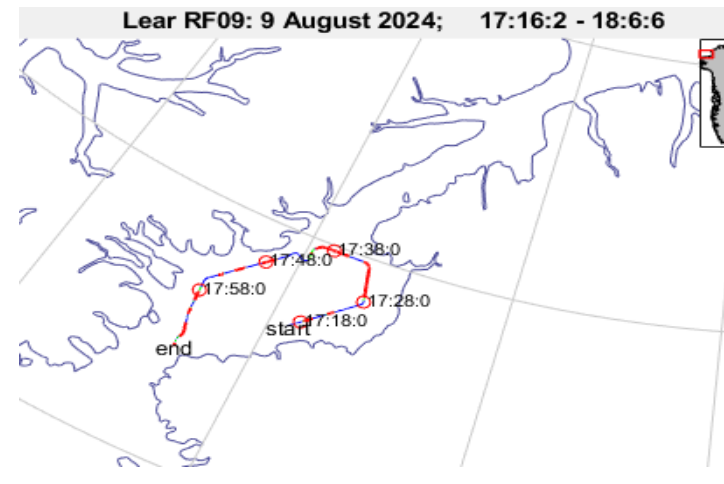
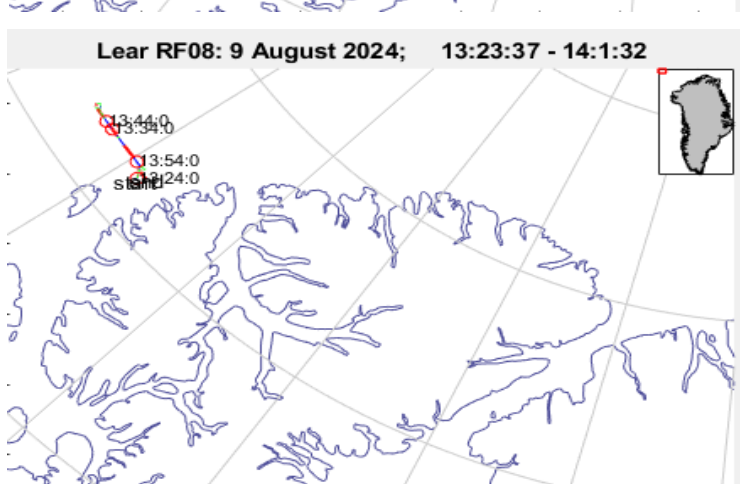
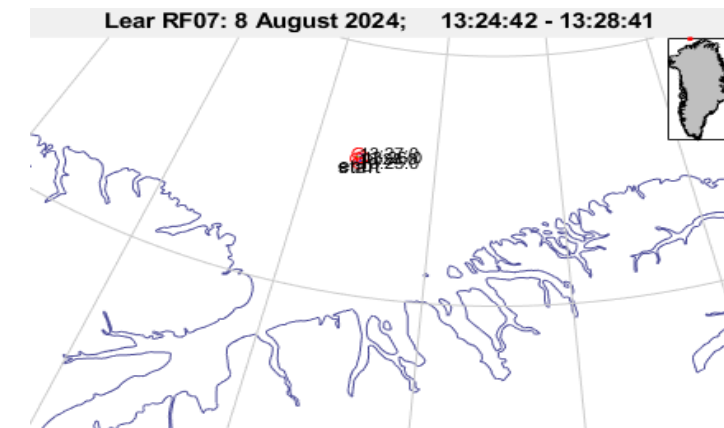
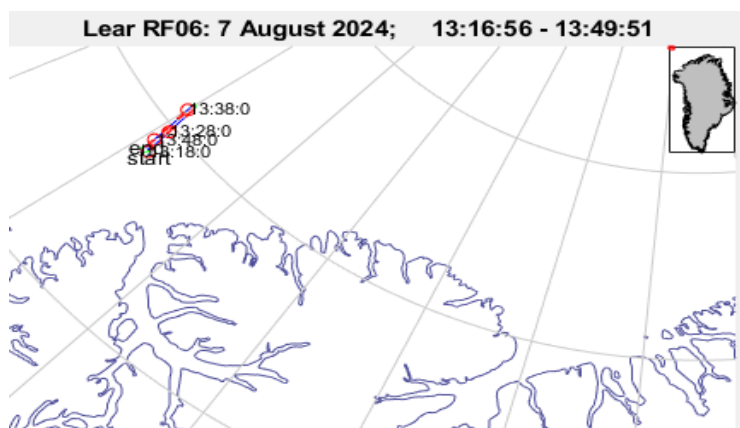
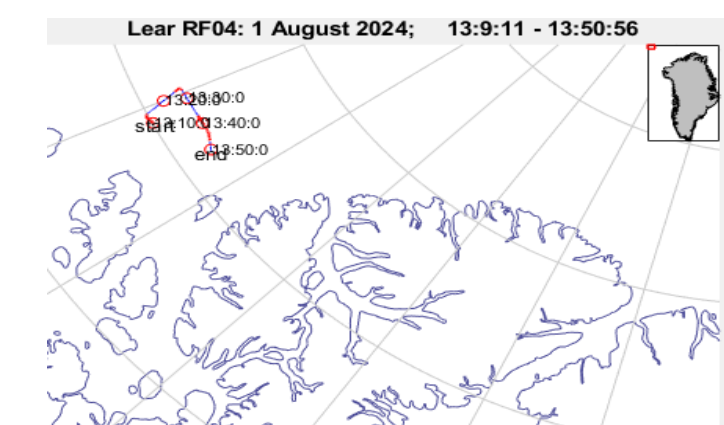
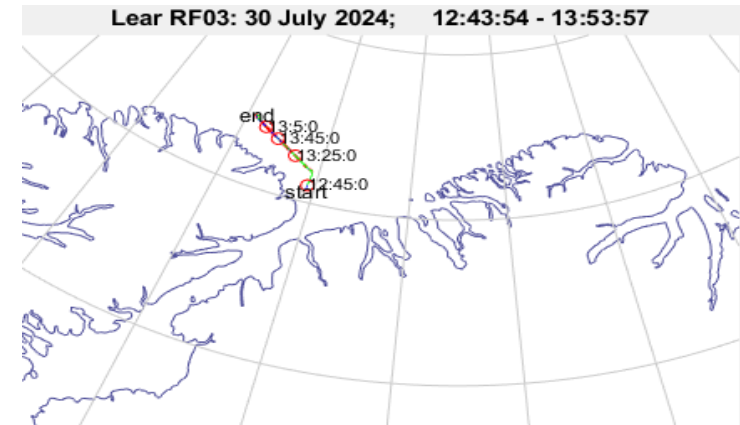
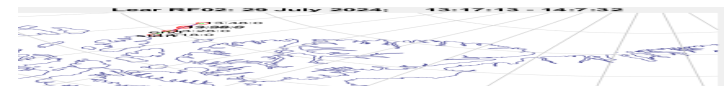
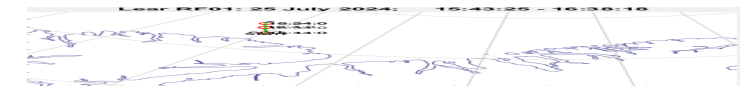


11		7/25/2024	134508	134545	3300	3100	200	-12	-13	-12.5	0.5	1	100	0.05	12	no	0	0	n/a	liquid	1	1	8-10 140	melt ice	Lincoln Sea	liquid, broken cloud
11		7/25/2024	135950	140030	2850	2850	?	-9	-9	?	?	?	30-50	0.1		yes	0	0	n/a	liquid	1	n/a	5 140	melt ice	Lincoln Sea	drizzle up to 300um
11		7/25/2024	141200	142130	2850	2850	?	-9	-9	?	?	?	20-50	0.05-0.1		yes	<0.1	1	rimed irregular	mixed-phase	1	n/a	4-6 80-110	melt ice	Lincoln Sea	firos part is liquid with drizzle, second part is mixed-phase with no drizzle
11		7/25/2024	162100	164130	650	770	?	0	-2	?	?	?	10-30	0.1-0.25	28	yes	0	0	n/a	liquid	1	n/a	1-5 0-100	melt ice	Lincoln Sea & North of Ellesmere Island	four intersections of cloud top of the low level St
11		7/25/2024	165700	165830	3200	3800	600	-11	-15	12.5	?	2.5	100	0.35	23	no	<0.1	4	dendrites	mixed-phase	2	1	3-5 90-120	melt ice	Lincoln Sea North of Ellesmere Island	very low ice concentration of ice <0.1L-1. Spatially sparce dendrites
11		7/25/2024	180420	183140	100	100	?	4	8	?	?	?	3	0.04	?	yes rain	0	0	n/a	liquid	1	n/a	0-13 0-60	open water	Descending to Pituffik	rain
12		7/29/2024	124630	130130	5900	5900	?	-23	-23	?	?	?	30-150	0.2	20		0.1-1	1	rimed irregular	mixed-phase	1	n/a	14-18 55-60	melt ice	Lincoln Sea	lower part of Ac-Cc
12		7/29/2024	143400	143440	5250	5250	?	-22	-22	?	?	?	100	0.05	9	no	0.1-1	1	rimed irregular	mixed-phase	1	n/a	10-11 85	melt ice	North of Crown of Greenland	lower part of the wave cloud
12		7/29/2024	144740	144830	3600	3600	?	-10	-10	?	?	?	400	0.01	11	no	<0.1	0.6	dendrites	mixed-phase	1	n/a	7 140-150	broken ice	crown of Greenland	very low ice concentration. Conditionally mixed-phase cloud
12		7/29/2024	162620	163600	100	100	?	-1	-1	12	?	10	100	0.4	32	yes	0	0	n/a	liquid	1	n/a	5 330-350	melt ice	Lincoln Sea	along the cloud top of the low level cloud/fog, drizzle at the cloud top
12		7/29/2024	170300	170525	270	270	?	-3	-3	8	?	10	20	0.4	38	yes	0	0	n/a	liquid	1	n/a	5 330	melt ice	Lincoln Sea	along the cloud top of the low level cloud/fog, drizzle at the cloud top
12		7/29/2024	172640	173050	250	500	250	0	0	6	?	7	200	0.1	18	no	0	0	n/a	liquid	1	n/a	10-16 5-50	melt ice	Nares Strait	multilayer cloud with several inversions, and several thin cloud layers, very unusual temperature profile
14		8/1/2024	122450	122610	5800	5800	?	?	-23	?	?	?	100	0.2	18	no	0.3	0.8	rimed ice	mixed-phase	1	n/a	12 255	land, glaciers	Northern part of Greenland	Top of As layer with low ice conc.
14		8/1/2024	154740	154815	1850	2000	150	-4	-5.5	-1.2	?	4	200	0.15	16	no	0	0	n/a	liquid	1	1	7 265	land	North of Crown of Greenland	
14		8/1/2024	163040	163500	4600	?	?	-18	?	?	?	?	100-200	0.2	18	no	0.1-0.3	0.8	rimed ice	mixed-phase	1	n/a	12 255	broken melt ice	North of Crown of Greenland	Top of As layer with low ice conc.
14		8/1/2024	172130	172620	5780	?	?	-20	?	?	?	?	200	0.2	16	no	0.1	0.8	rimed ice	mixed-phase	1	n/a	18 240	land, glaciers	West of Nares Strait	Top of Ac layer with low ice conc.
																			dendrites columns rimed irreg	mixed-phase	3-5	6	2-16 0-160	open water	Nares Strait Baffin Bay	Deep multilayer system with supercooled top and warm cloud base; variety of ice particle shapes & drizzle
17		8/8/2024	153510	153605	1850	2200	350	-9	-12	-9	5	3	80	0.3	22	no	0	0	n/a	liquid	1	1	8 240	melt ice	Nares Strait	ascent through solid St deck
17		8/8/2024	164220	164455	1700	1700	?	?	?	?	?	?	150	0.05	12	no	0	0	n/a	liquid	1	n/a	3 30	broken melt ice	Nares Strait	thin St
18		8/9/2024	111900	112000	5100	5200	100	-20	-22	-19	?	2	100-200	0.15	18	no	0.01	1	rimed irregular	mixed-phase	1	1	10 330	open water	Baffin Bay after take off	Ac broken layer with very low ice conc.
18		8/9/2024	181830	181850	3800	3900	100	-13	-13	?	?	no	140	0.06	14	no	0	0	n/a	liquid	1	1	9 315	land	descending to Pituffik	broken Ac
ICE CLOUDS SAMPLED DURING TRANSIT TO/FROM THE AREA OF OPERATIONS (P3)																										
Flight #		date	t _{start} (hhmmss)	t _{end} (hhmmss)	cloud base (m)	cloud top (m)	Cloud depth ΔH (m)	T _{base} (C)	T _{top} (C)	T _{max above} (C)	T _{max below} (C)	cloud top inversion ΔT (C)	N _{drop} (cm-3)	LWC _{max}	D _{eff max} (um)	drizzle	N _{ice max} (L-1)	D _{ice max} (mm)	crystal type	cld phase intermitt	number of cloud layers	number of profiles	wind speed (m/s) wind dir (deg)	surface type	area of operation	comments
2		5/30/2024	105900	111400	1300	5100	3800	-1	-32	?	-1	no	0	0	n/a	n/a	5	0.8	bull-ros columns compact ice	ice	3	1	1-14 80-180	land, glacier	north of Pituffik after take off	Deep ice cloud with a mixed-phase layer embedded below 1900m. Ice precipitate down to the ground level.
2		5/30/2024	173100	174700	>-2600	>4800	?	<-16	>-32	?	-1	no	0	0	n/a	n/a	10	2	bull-ros plates compact ice radiate plt	ice	?	1	2-14 170-270	transit from land to ocean ice	north of Pituffik after take off	descend though a sequence of virgae
3		5/31/2024	175800	180300	<5600	>5600	?	>-28	<-28	?	6	no	0	0	n/a	n/a	0.5	0.5	bull-ros compact ice	ice	?	n/a	16 110	land, glacier	descending to Pituffik	two virgae, likely sublimating ice
3		5/31/2024	174900	175700	2500	700	1800	-6	-11	?	1	1.5	200	0.15	15	n/a	1	5	dendrites, plates, irregulars	ice mixed-phase	1+3	1	2-8 150-340	ocean ice	descending to Pituffik	Deep ice cloud with embedded thin liquid layers. Embedded inversion into the ice cloud topping the upper LWC layer. The entire ice cloud is dominated by dendrites
4		6/3/2024	115145	120930	5700	5700	?	-29	-29	?	?	?	0	0	n/a	n/a	30	1.2	bull-ros compact	ice	1	1	10 320	TBD	Nares Strait	Ice cloud, central part appears like a generating cell with numerous small ice particles
6		6/6/2024	115244	120101	5750	5750	?	-25	-25	n/a	n/a	n/a	0	0	0	n/a	10	1.5	bull-ros	ice	1	1	9 120-130	glacier	Northern Greenland	optically thin ice clouds
6		6/6/2024	120626	120910	5800	5800	?	-25	-25	n/a	n/a	n/a	0	0	0	n/a	10	0.7	bull-ros	ice	1	1	13 125	glacier	Northern Greenland	optically thin ice clouds
6		6/6/2024	122542	122630	5800	5800	?	-25	-25	n/a	n/a	n/a	0	0	0	n/a	10	2	bull-ros	ice	1	1	13 145	glacier	Northern Greenland	optically thin ice clouds
6		6/6/2024	174750	175205	5800	5800	?	-25	-25	n/a	n/a	n/a	0	0	0	n/a	60	1	irreg columns	ice	1	n/a	10 85	glacier	West of Nares Strait	traverse through a virga
7		6/7/2024	140600	141300	6400	6400	?	-28	-28	n/a	n/a	n/a	0	0	0	n/a	15	0.8	tiny, bull-ros	ice	1	1	16 140	glacier	West of Nares Strait	clusters of tiny ice crystals
7		6/7/2024	142000	142600	5700	6700	1000	-31	-22	n/a	n/a	n/a	0	0	0	n/a	35	1	tiny, irreg, bull-ros, aggreg	ice	1	1	10 145	glacier	West of Nares Strait	clusters of tiny ice crystals
7		6/7/2024	142900	143700	5700	5700	?	-22	-22	n/a	n/a	n/a	0	0	0	n/a	1	1	tiny, bull-ros	ice	1	n/a	9 160-200	glacier	West of Nares Strait	clusters of tiny ice crystals
7		6/7/2024	144100	144200	5800	5800	?	-23	-23	n/a	n/a	n/a	0	0	0	n/a	5	0.5	tiny, bull-ros	ice	1	n/a	10 220	glacier	West of Nares Strait	clusters of tiny ice crystals
7		6/7/2024	173730	174040	4500	5800	1300	-23	-14	n/a	n/a	n/a	100	0.01	9	no	5	0.8	irreg, columns	ice	1	1	3-4 140-150	ocean ice	Lincoln Sea	Ice cloud with embedded LWC layer
9		6/11/2024	120100	120400	5600	5600	?	-26	-26	n/a	n/a	n/a	0	0	0	n/a	10	0.4	tiny, bull-ros	ice	1	n/a	20 65	glacier	Ellesmere Island East of Nares Strait	optically thin ice clouds
9		6/11/2024	121000	121500	5600	5600	?	-26	-26	n/a	n/a	n/a	0	0	0	n/a	15	0.5	tiny, bull-ros	ice	1	n/a	20 70	glacier	Ellesmere Island East of Nares Strait	optically thin ice clouds
9		6/11/2024	134700	135800	3000	3000	?	-8	-8	n/a	n/a	n/a	0	0	0	n/a	0.5	2	dendrites	ice	1	n/a	12-16 40-55	ocean ice	Lincoln Sea	precipitating dendrites from the upper mixed-phase cloud layer.
9		6/11/2024	111300	111830	<3400	>4200	?	-10	-16	n/a	n/a	n/a	0	0	0	n/a	2	2	bull-ros	ice	1	1	12-14 55-70	ocean ice	Lincoln Sea	precipitating bullet-rosettes from the upper mixed-phase cloud.
9		6/11/2024	161700	165700	<2300	>2500	?	-3	-7	n/a	n/a	n/a	0	0	0	n/a	4	6	bull-ros, columns dendrites, capped col. Irregulars	ice	3	n/a	7-11 0-50	ocean ice	Lincoln Sea	Ice precipitating from the upper layers. Good example of mixture of different ice habits
10		6/13/2024	1100415	110500	<1900	>2100	?	-7	-7	n/a	n/a	n/a	0	0	0	n/a	0.5	1	stellar plater & col.	ice	1	1	10 130	glacier	North of Pituffik after take off	traversing ice virga during ascent
10		6/13/2024	115445	115700	5700	5700	?	-24	-24	n/a	n/a	n/a	0	0	0	n/a	2	0.5	smt col.	ice	1	n/a	15 190	glacier	Northern Greenland	optically thin ice clouds
10		6/13/2024	121700	121900	5700	5700	?	-24	-24	n/a	n/a	n/a	0	0	0	n/a	1	0.8	bull-ros	ice	1	n/a	8 200	glacier	Northern Greenland	optically thin ice clouds

10	6/13/2024	122700	123440	5700	5700	?	-24	-24	n/a	n/a	n/a	0	0	0	n/a	1	0.6	tiny	ice	1	n/a	4 230	glacier	Northern Greenland	optically thin ice clouds
10	6/13/2024	123600	123810	5700	5700	?	-24	-24	n/a	n/a	n/a	0	0	0	n/a	3	0.4	tiny	ice	1	n/a	7 280	glacier	Northern Greenland	optically thin ice clouds
12	7/29/2024	114400	120400	5600	5600	?	-23	-23	?	?	?	0	0	0	n/a	30	1.5	tiny, bull-ros	ice	1	n/a	6-10 30-90	broken ice open water	Nares Strait	optically thin ice clouds, multilayer cloud system
12	7/29/2024	121930	124620	5900	5900	?	-23	-23	?	?	?	0	0	0	n/a	25	2	tiny, bull-ros	ice	1	n/a	8-13 30-60	mountains, glaciers	over Ellesmere Island	precipitation ice from the above optically thick later
12	7/29/2024	180745	181945	2400	2700	?	-4	-6	?	?	?	0	0	0	n/a	3	2	bull-ros	ice	1	n/a	4-6 40-80	broken ice open land glacier	Nares Strait	precipitating ice from high clouds
13	7/30/2024	111610	111750	4100	4500	?	-16	-19	?	?	?	0	0	0	n/a	5	1.5	bull-ros	ice	1	n/a	2 100	open land, glaciers	North of Pitufik	patches of optically thin ice clouds
13	7/30/2024	111945	112100	4900	4900	?	-21	-21	?	?	?	0	0	0	n/a	2.5	1.2	bull-ros	ice	1	n/a	3 50	open land, glaciers	West of Nares Strait	patches of optically thin ice clouds
13	7/30/2024	112805	112900	5400	5400	?	-24	-24	?	?	?	0	0	0	n/a	8	1	bull-ros	ice	1	n/a	4 45	open land, glaciers	West of Nares Strait	patches of optically thin ice clouds
13	7/30/2024	122730	123000	5500	5500	?	-26	-26	?	?	?	0	0	0	n/a	1	1.5	bull-ros	ice	1	n/a	3 40	open land, glaciers	West of Nares Strait	patches of optically thin ice clouds
14	8/1/2024	114010	120900	5800	5800	?	-18	-18	?	?	?	0	0	0	n/a	50	0.8	timy irregulars	ice	1	n/a	10-13 220-250	glacier	Greenland ice shield	optically thick ice clouds, close to the cloud top
14	8/1/2024	164240	164925	5700	5700	?	-22	-22	?	?	?	0	0	0	n/a	15	0.8	timy Irregulars smt columns	ice	1	n/a	16-18 240	melt ice	North of Crown of Greenland	optically thin ice clouds, below cloud, precipitating ice
14	8/1/2024	165650	170030	5700	5700	?	-22	-22	?	?	?	0	0	0	n/a	25	0.6	timy irregulars smt columns	ice	1	n/a	14-17 240	land	North of Crown of Greenland	optically thick ice clouds, middle of the cloud top
16	8/7/2024	111310	111810	5700	5700	?	-18	-18	?	?	?	0	0	0	n/a	20	1.5	tiny, bull-ros	ice	1	n/a	30-37 330	open water	Buffin Bay	along the cloud base of As, precipitating ice
16	8/7/2024	112240	112440	5700	5700	?	-18	-18	?	?	?	0	0	0	n/a	4	1	tiny, bull-ros	ice	1	n/a	34 330	open water	Buffin Bay	along the cloud base of As, precipitating ice
17	8/8/2024	111530	112630	4200	4200	?	-11	-11	?	?	?	0	0	0	n/a	5	1	plates, dendrites irreglars aggregates	ice	1	n/a	3-9 320	land, glacier	West of Nares Strait	ice precipitating from a broken Ac above the flight level.

Table S2
Supplement to: Microphysics of Arctic Stratiform Boundary-layer Clouds during ARCSIX
SPEC Learjet

CLOUDS IN THE TARGETED AREA OF OPERATIONS (LearJet)																								
Flight #	date	t _{start} (hhmmss)	t _{end} (hhmmss)	cloud base (m)	cloud top (m)	Cloud depth ΔH (m)	T _{base} (C)	T _{top} (C)	T _{max above} (C)	T _{max below} (C)	cloud top inversion ΔT (C)	N _{drop max} (cm-3)	LWC _{max}	D _{eff max} (um)	drizzle	N _{ice max} (L-1)	D _{ice max} (mm)	crystal type	cld phase intermitt	number of cloud layers	number of profiles	surface type	area of operation	comments
1	7/25/2024	154500	163800	450	600	300	-2	-2.5	?	-1	3	?	0.4	?	yes/no	<0.01	0.3	shrt columns	mainly liquid	2-3	6	broken ice	North of Ellesmere Island	Multilayer structure with variable altitudes cloud top and base. Mostly SLD and drizzle. A few small short columns were observed between 16:33 and 16:34.
2	7/29/2024	131700	140700	300	500	200	-4	-5.5	3.3	-3.5	8	20-40	0.3	25-30	no	0.1-40	2-3	columns aggregates	mixed-phase	1	10	melt ice	Platypus	Single layer clouds, distinct cellular structure of ice, no drizzle. Max size remains ~uniform for the entire sampled cloud. High concentration of ice
3	7/29/2024	124400	135300	350	650	300	-5	-7	4	-3	8	20-80	0.3	20-25	yes/no	0.1-30	1-4	columns aggregates	mixed-phase	1	14	melt ice broken ice	North of Ellesmere Island	Single layer clouds, distinct cellular structure of ice; drizzle when no ice. Ice aggregation below cloud base. High concentration of ice.
4	8/1/2024	125100	14000	2300	2800	500	-10	-6	-6	1.5	4	60-100	0.5-0.9	30-33	yes/no	0.1-100	1-2	columns rimed ice graupel	mixed-phase liquid	2	7	melt ice	Platypus	Two major cloud layers. The top layer generated drizzle with no ice. However, there were two sampled large cells generating ice. The generating cells were separated by 110 km. The lower layer was warm, with distinct melting layer, which excludes the effect of blowing ice of ice initiation in the cloud.
6	8/7/2024	131700	135000	500	900	400	-5	-8	-3	-2	4	40-80	0.6	25-30	yes/no	0.1-30	5	columns aggregates heavy rimed	mixed-phase liquid	1	12	melt ice	North-East of Ellesmere Island	Single layer clouds, distinct cellular structure of ice, drizzle when no ice. Aggregation below cloud base. High concentration of ice.
7	8/8/2024	132400	132900	1500	<200	~1300	>-2	-19	?	-2	0	20-40	0.2	25	yes	1-5	1	columns litypps	mixed-phase liquid	4	1	melt ice broken ice	Lincoln Sea & North of Greenland	Multilayer cloud, cloud top is liquid generating drizzle T= -10C, no ice. Ice forms in the lower part at T>-5C.
8	8/9/2024	132300	140100	700	300	400	-7	-10	-7	-4	3	20-50	0.5	30-35	yes/no	0.1-20	2	columns heavy rimed	mixed-phase liquid	1	12	melt ice	Platypus	Single layer clouds, distinct cellular structure of ice, drizzle (when no ice). Cloud top at ~10C outside of the columnar growth. Strong riming process. Many small ice below cloud base.
9	8/9/2024	171600	180100	2300	2600	300-400	-10	-13	-10	13	3	50-100	0.4	20-25	yes/no	0	0	0	liquid	1	17	broken ice open water	Baffin Bay	Spatially extended liquid layer. Ice was observed only in one location between 171200& 171400 UTC.
LIQUID & MIXED-PHASE CLOUDS SAMPLED DURING TRANSIT TO/FROM THE AREA OF OPERATIONS (LearJet)																								
Flight #	date	t _{start} (hhmmss)	t _{end} (hhmmss)	cloud base (m)	cloud top (m)	Cloud depth ΔH (m)	T _{base} (C)	T _{top} (C)	T _{max above} (C)	T _{max below} (C)	cloud top inversion ΔT (C)	N _{drop max} (cm-3)	LWC _{max}	D _{eff max} (um)	drizzle	N _{ice max} (L-1)	D _{ice max} (mm)	crystal type	cld phase intermitt	number of cloud layers	number of profiles	surface type	area of operation	comments
1	7/25/2024	142400	142600	1100	2900	1800	1	-9	-8	7	0.5	?	0.6	?	yes/no	0.1-0.001	1	columns graupel	mainly liquid	1	1	open water	Pituffik	Ascent through the cloud layer during take off. Deep layer, mainly liquid, very low conc of ice. No SIP or it has a very low rate.
1	7/25/2024	153300	153410	4100	4600	500	-14	-17	?	?	0.2	100	0.1	15	no	0.1	3	dendrites	mainly liquid	1	1	melt ice	North of Ellesmere Island	Inhomogeneous Ac cloud layer with a very low concentration of dendrites
1	7/25/2024	164320	164415	4800 4300	5100 4400	300 100	-15	-21	-19.5	?	1.5	150	0.15	16	no	0.1	2	graupel dendrites	mainly liquid	2	1	melt ice	North of Ellesmere Island	Ascend through two cloud layers. The upper As-Ac generates sparse graupel and seeds the lower cloud. The lower layer produces dendrites.
1	7/25/2024	174630	174700	4400	4500	100	-16.8	-18	-16.5	8	2.5	100	0.08	12	no	0	0	0	liquid	1	1	open water	Baffin Bay	Descending through approximately 4km deep cloud system
1	7/25/2024	174750	174830	3350	3900	550	-12.5	-14	-14	8	0	40	0.2	23	no	0	0	0	liquid	1	1	open water	Baffin Bay	Descending through approximately 4km deep cloud system
1	7/25/2024	174900	175000	2500	2900	400	-7	-9	-9	8	0	30	0.2	24	no	0	0	0	liquid	1	1	open water	Baffin Bay	Descending through approximately 4km deep cloud system
1	7/25/2024	175030	175405	1500	2300	800	-2	-6	-6	8	0	30	0.2	25	no	20	2	columns dendrites rimed ice	mixed-phase	1	1	open water melt ice	Baffin Bay	Descending through approximately 4km deep cloud system (see KPR.) The lower part was possibly seeded from above by dendrites. High conc of small columns
4	8/1/2024	113630	113800	3700 2700	3800 3200	100 500	-8 -5	-8.5 -4.5	-8	10	0.5	150	0.6	28	yes/no	100	2.5	smt columns graupel rimed ice	mixed-phase	2	1	open water	Pituffik	Dynamically driven offshore cloud band near Pituffik. Intense SIP near the cloud base. Graupel and rimed ice in the upper part of the cloud.
4	8/1/2024	120030	120040	6900	7000	100	-29.6	-30	?	?	0	50	0.01	8	no	0.5	0.4	rimed irreg	mixed-phase	1	1	open water	Baffin Bay to Ellesmere Island	thin mixed-phase layer
4	8/1/2024	151600	151830	2100	3000	900	-2	-4	-3.5	9	0.5	180	0.5	30	yes	0	0	n/a	liquid	1	1	open water	Baffin Bay	Descending through Ac with a distinct sequence of billows/cells. Precipitating clouds with drizzle up to 500um.
5	8/2/2024	164130	164300	1900	2700	800	1.5	-3	-2	10	0.5	80	0.06	24	yes	0	0	n/a	liquid	1	1	open water	Baffin Bay	As, very flat cloud top, drizzle Dmax~100um
5	8/2/2024	164340	164400	3200	3500	300	-4.3	-5.7	-5.7	10	0	200	0.06	13	no	0	0	n/a	liquid	1	1	open water	Baffin Bay	As, small droplet cloud layer
5	8/2/2024	164530	164600	4400	4700	300	-12	-14	-12	10	10	50	0.2	22	no	0	0	n/a	liquid	1	1	open water	Baffin Bay	Ac, small droplets
5	8/2/2024	142145	174620	4700	1500	variable	3	-14	?	10	2	25-400	0.7	30	yes/no	3	10	dendrites aggregates rimed ice graupel columns	mixed-phase liquid	1	1	open water	Baffin Bay	Deep precipitating cloud system with cloud top at ~5.4km. Cloud depth varies depending on the location. Variety of ice particle shapes. Patches of drizzle above the melting layer. Sampling of rain below the melting layer.
6	8/7/2024	112315	112405	3000	3100	100	-7	-8	-5	?	3	80	0.15	15	no	0	0	0	liquid	1	1	open water	Baffin Bay	thin Ac. All liquid, no ice
6	8/7/2024	115330	115400	6700	7000	300	-25.5	27.8	-27	?	~0	100	0.05	13	no	0.5-1	0.6-0.8	compact ice rimed ice	mixed-phase	1	1	open water	Baffin Bay	thin mixed-phase layer. Low ice concentration.
6	8/7/2024	145820	145840	4550	4800	250	-20	-20	-19	?	1	100	0.5	25	no	0.1	1	dendrites rimed ice	mixed-phase	1	1	open water	Baffin Bay	thin mixed-phase layer during descend to Pituffik. Low ice concentration.
7	8/8/2024	115845	115930	4500	4800	300	-14	-16	-15	?	0.5	60	0.15	20	no	0.01	1	dendrites	mixed-phase	1	1	open water	Baffin Bay	very low ice concentration
7	8/8/2024	144430	144510	3500	3700	200	-10	-12	-9.5	?	2	60	0.2	22	no	0	0	0	liquid	1	1	land, glaciers	West of the top of Baffin Bay	Descending to Pituffik through a thin liquid layer
8	8/9/2024	114410	114425	5200	5300	100	-22	-23	-21	?	2	70	0.05	10	no	<0.1	1	rimed irregulars	mixed-phase	1	1	open water	Baffin Bay	very low ice concentration
ICE CLOUDS SAMPLED DURING TRANSIT TO/FROM THE AREA OF OPERATIONS (LearJet)																								
Flight #	date	t _{start} (hhmmss)	t _{end} (hhmmss)	cloud base (m)	cloud top (m)	Cloud depth ΔH (m)	T _{base} (C)	T _{top} (C)	T _{max above} (C)	T _{max below} (C)	cloud top inversion ΔT (C)	N _{drop max} (cm-3)	LWC _{max}	D _{eff max} (um)	drizzle	N _{ice max} (L-1)	D _{ice max} (mm)	crystal type	cld phase intermitt	number of cloud layers	number of profiles	surface type	area of operation	comments
1	7/25/2024	150100	150915	7600	7600	?	-37	-37	?	?	?	0	0	0	no	7	0.4-0.8	bull-ros	ice	1	n/a	land, glaciers	Baffin Bay to Ellesmere Island	three virgae with precipitating ice from thin Ci above the flight level. No radar return
2	7/29/2024	123300	123655	8100	-42	?	-42	-42	?	?	?	0	0	0	no	12	0.5	tiny bull-ros	ice	1	n/a	land, glaciers	Ellesmere Island	optically thin Ci clouds
2	7/29/2024	144520	144600	7600	7600	?	-38	-38	?	?	?	0	0	0	no	15	0.2	tiny	ice	1	n/a	land, glaciers	Axel Heiberg Island	orographically induces Ci
2	7/29/2024	144630	144735	7600	7600	?	-38	-38	?	?	?	0	0	0	no	25	0.4	tiny	ice	1	n/a	land, glaciers	Axel Heiberg Island	orographically induces Ci
2	7/29/2024	145300	145635	7600	7600	?	-38	-38	?	?	?	0	0	0	no	30	0.4	tiny	ice	1	n/a	land, glaciers	Ellesmere Island	orographically induces Ci (see KPR)
2	7/29/2024	151930	152830	7600	7600	?	-38	-38	?	?	?	0	0	0	no	50	1	tiny bull-ros	ice	1	n/a	land, glaciers	Ellesmere Island Baffin Bay	orographically induces Ci, optically thick, two spikes of FCDP, high concentration of tiny crystals, no response from the RICE (see KPR)
2	7/29/2024	152110	152830	7600	5600	?	-38	-24	?	?	?	0	0	0	no	40	1	tiny bull-ros	ice	1	1	open water	Baffin Bay	descending through orographically induces Ci, optically thick (see KPR)
3	7/30/2024	113650	115930	5500	5500	?	-25	-25	?	?	?	0	0	0	no	4	0.5-2	fat bull-ros aggregates	ice	1	n/a	land, glaciers, open water	West of Nares Strait to Nares Strait	intersection of a sequence of Ci clouds with top at ~7km (see KPR)
3	7/30/2024	150200	150815	5800	5800	?	-27	-27	?	?	?	0	0	0	no	0.5	0.8-1.5	bull-ros columns	ice	1	n/a	open water	Baffin Bay	sequence of Ci clouds precipitating from above the flight level. Cirrus top at ~7km. (see KPR)



3	7/30/2024	152220	152310	5800	5800	?	-28	-28	?	?	?	0	0	0	no	6	0.8	built-ros columns	ice	1	n/a	land, glaciers, open water	West of Nares Strait	sequence of Ci clouds precipitating from above the flight level. Cirrus top at ~7km. (see KPR)
3	7/30/2024	152715	153400	5600	3500	?	-26	-23	?	?	?	0	0	0	no	2	1	built-ros columns plates irregulars	ice	1	1	land, glaciers, open water	descending to Pituffik	Descending through Ci clouds precipitating from above the flight level. Cirrus top at ~7km. (see KPR)
4	8/1/2024	120445	120645	7900	7900	?	-38	-38	?	?	?	0	0	0	no	25	0.2-1	tiny aggregates	ice	1	n/a	land, glaciers	Ellesmere Island	Optically thin Ci clouds with cloud top at ~9km
4	8/1/2024	121900	122100	7900	7900	?	-38	-38	?	?	?	0	0	0	no	10	0.6	tiny built-ros	ice	1	n/a	land, glaciers	Axel Heiberg Island	Optically thin Ci clouds with cloud top at ~9km
4	8/1/2024	122300	122510	7900	7900	?	-38	-38	?	?	?	0	0	0	no	10	0.6	tiny	ice	1	n/a	land, glaciers	Axel Heiberg Island	Optically thin Ci clouds with cloud top at ~9km
4	8/1/2024	123200	123220	7900	7900	?	-38	-38	?	?	?	0	0	0	no	5	1	tiny built-ros	ice	1	n/a	land, glaciers	Axel Heiberg Island	Optically thin Ci clouds with cloud top at ~9km
4	8/1/2024	124020	124240	7600	7400	?	-35	-34	?	?	?	0	0	0	no	30	0.5	tiny	ice	1	1	land, glaciers	Axel Heiberg Island	Optically thin Ci clouds
4	8/1/2024	140950	142110	7600	7600	?	-35	-35	?	?	?	0	0	0	no	80	1.2	tiny built-ros	ice	1	n/a	land, glaciers	Axel Heiberg Island	Optically thick Ci clouds with cloud top at ~8.5-9km
4	8/1/2024	144015	144050	7600	7600	?	-35	-35	?	?	?	0	0	0	no	4	0.3	tiny	ice	1	n/a	land, glaciers	Ellesmere Island	Optically thin Ci clouds
4	8/1/2024	144405	144415	7600	7600	?	-35	-35	?	?	?	0	0	0	no	0.4	0.5	tiny	ice	1	n/a	land, glaciers	Ellesmere Island	Optically thin Ci clouds with cloud top at 9km
4	8/1/2024	144535	144800	7600	7600	?	-35	-35	?	?	?	0	0	0	no	15	1.2	tiny built-ros	ice	1	n/a	land, glaciers	Ellesmere Island	Optically thick Ci clouds with cloud top at ~9km
4	8/1/2024	145045	145515	5600	7100	?	-31	-21	?	?	?	0	0	0	no	4	0.2-0.8	irregulars	ice	1	1	land, glaciers	Ellesmere Island	Optically thick Ci clouds with cloud top at ~8km
5	8/2/2024	164800	171020	6100	8500	?	-21	-40	?	?	?	0	0	0	no	20	0.2-1.2	tiny built-ros aggregates	ice	1	2	open water	Baffin Bay	Ci with cloud to at ~9km, Halo
7	8/8/2024	115955	120555	5000	5800	?	-16	-21	?	?	?	0	0	0	no	1-8	0.5-1	tiny built-ros plates columns	ice	1	1	land, glaciers	West of the top of Baffin Bay	ascent through precipitating ice virgae after take off in Pituffik