18 July 2022

Dropsonde Data Report

Chemistry in the Arctic: Clouds, Halogens, and Aerosols
CHACHA (2022)

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Campaign Websites:
CHACHA at NCAR:
https://www.eol.ucar.edu/field_projects/chacha
CHACHA at the University of Wyoming:
http://flights.uwyo.edu/projects/chacha22/
CHACHA at SUNY Albany:
http://research.asrc.albany.edu/facstaff/lance/CHACHA/schedule.html
AVAPS dropsondes home page:
https://www.eol.ucar.edu/observing_facilities/avaps-dropsonde-system

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Cover photo: Dropsonde launch tube on the U. Wyoming King Air
Photo by Chris Rodgers of Code 10 Photography

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Table of Contents

1 Dataset overview

The Chemistry in the Arctic: Clouds, Halogens, and Aerosols (CHACHA) field campaign aimed to improve the understanding of atmospheric chemistry that impacts ozone, particulate matter, and cloud chemical composition in the context of a rapidly changing Arctic. The campaign used two instrumented aircraft to conduct airborne measurements around the Chukchi Sea, the Beaufort Sea, and the Alaska North Slope region. One of the important datasets for this field campaign is the thermodynamic structure of the atmosphere measured by dropsondes released from the University of Wyoming King Air research aircraft, which was stationed at Utqiagvik, Alaska, for the duration of the campaign. Between 24 February and 17 April 2022, forty dropsondes were released from sixteen research flights and targeted the atmosphere above and downwind of sea ice "leads" (areas of open water in otherwise sea-ice-covered ocean regions). Soundings were released from an altitude between 2.7 and 3.6 km. Of these soundings, 38 provided complete vertical profiles of all parameters with a nominal vertical resolution between 5 to 6 m from the surface to almost flight altitude. CHACHA deployed the NRD41 dropsonde, which is the most advanced model that has been developed at NCAR.

All flight tracks during which dropsondes were released are shown in Figure 1. Dropsondes were typically launched from above 10000 ft. For most dropsonde launches, the aircraft climbed from the typical boundary layer altitude to the dropsonde release altitude, launched the sonde, and loitered for the duration of the sounding (around 5 min) before descending back to boundary layer flight altitudes.

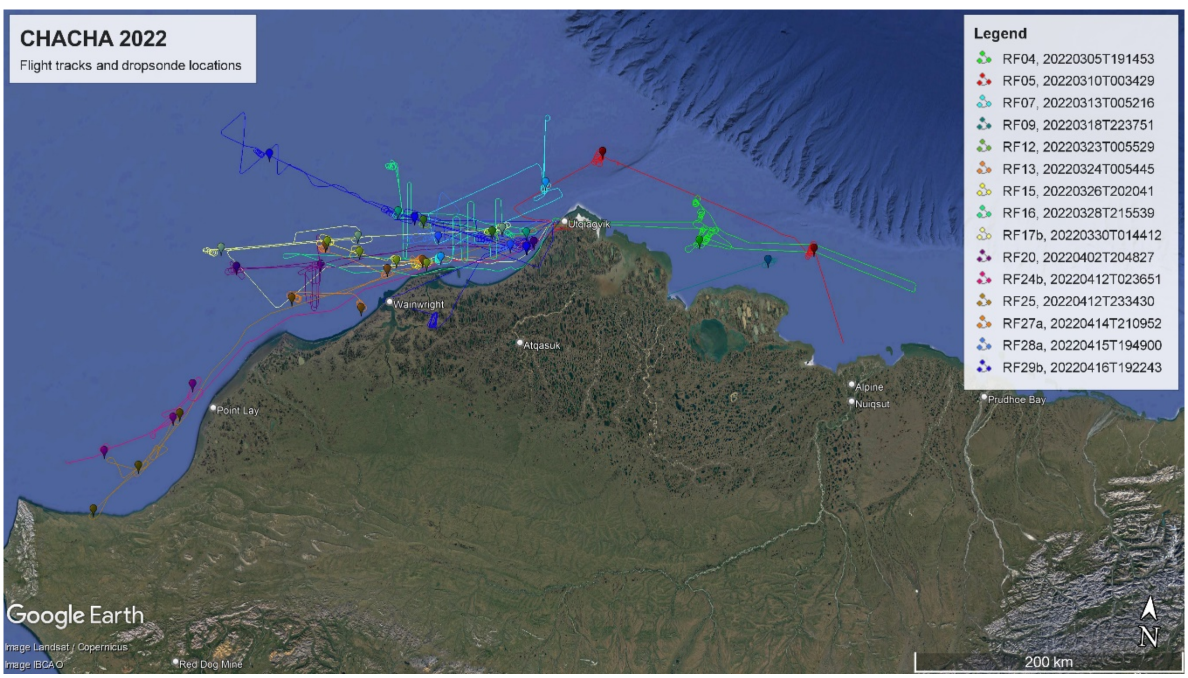


Figure 1: Flight tracks of all research flights that released dropsondes during CHACHA. Dropsonde locations are indicated as colored symbols.

Table 1 provides an overview over all NCAR NRD41 dropsondes released during CHACHA. Between one and four sondes were launched on research flights using dropsondes. All successful dropsonde releases are listed in Appendix A.

Table 2 provides an overview of the performance of the dropsonde system as a whole. In total, 40 sondes were released from the aircraft. Two soundings at the beginning of the campaign failed to separate from the aircraft due to launcher problems and did not produce any data. All other sondes reported complete atmospheric profiles to the ground.

The overall success rate of the dropsonde system for this campaign is at 95%.

Table 1: Overview over all flights releasing dropsondes during CHACHA.

Research Flight	Date	# of Sondes
RF04	05 Mar	3
RF05	10 Mar	2
RF07	13 Mar	2
RF09	18 Mar	1
RF12	23 Mar	2
RF13	24 Mar	3
RF15a	26 Mar	4
RF16	28 Mar	2
RF17b	30 Mar	3
RF20	02 Apr	3
RF24b	12 Apr	3
RF25	12 Apr	3
RF27a	14 Apr	2
RF28a	15 Apr	2
RF29a	16 Apr	3
RF29b	17 Apr	2

Table 2: Overview of the dropsonde system performance.

	# of Sondes	Percent
Total number of sondes released	40	100
Successful releases	38	95
Complete thermodynamic profiles to the ground	38	95
Complete wind profiles to the ground	34	85

2 Dropsonde sounding system

For CHACHA, an NCAR 2-channel AVAPS® dropsonde system was installed aboard the University of Wyoming King Air research aircraft using a manual dropsonde launch tube for the NCAR Research Dropsonde model NRD41.

This dropsonde uses the pressure, temperature, and humidity sensor of the Vaisala RS41 radiosonde and employs an improved version of the GPS, telemetry, and parachute release system of the previous NRD94 dropsonde, which had been in use between 2011 and 2018. It has been successfully deployed during several previous field campaigns including the Organization of Tropical East Pacific Convection (OTREC) field campaign in August and September of 2019 (Vömel et al, 2021).

Almost all dropsonde humidity sensors were reconditioned prior to launch. This process, which is unique to the xRD41 dropsondes, reduces the potential of humidity contamination to a minimum and assures the best measurement performance throughout the entire altitude and temperature range of the profiles.

The AVAPS LabVIEW based software system receives and stores data from the dropsondes, the aircraft data system, and the AVAPS receiving system, including a reference GPS.

The manual dropsonde launcher was installed towards the aft of the UWYO King Air research aircraft and was operated by the flight scientist during flight.

Profile data were collected after the completion of each research flight and transferred to the CHACHA field catalog, which is maintained by NCAR/EOL. Data were not transmitted to the Global Telecommunications System (GTS) of the WMO.

3 Quality control procedures

3.1 Standard quality control

Standard quality control in near real time and as part of the final data QC is based on the algorithms implemented in the ASPEN software. The following quality checks, corrections, and calculations are performed:

- Removal of outliers and suspect data points in pressure, temperature, humidity, zonal and meridional wind, latitude, and longitude
- Removal of data between release from the aircraft and equilibration with atmospheric conditions
- Dynamic correction to account for the lag of the NRD41 temperature sensor using the appropriate coefficients for the NRD41 dropsondes
- Dynamic correction to account for the sonde inertia in the determination of the wind profile using the appropriate parameters for the NRD41 dropsondes
- Smoothing of pressure, temperature, humidity, zonal and meridional wind
- Recomputing of wind speed and wind direction after smoothing of the wind components
- Extrapolation of the last reported pressure reading to a surface pressure value (where possible), based on the fall rate of the sonde
- Recalculation of the geopotential height from the surface to the top of the profile
- Computing a vertical wind speed component

This campaign used the NRD41 dropsonde, which has a faster temperature sensor and faster RH sensor than the older NRD94 sondes. This has been considered in the final dropsonde QC by changing the ASPEN QC parameters for these two sensors. The equilibration time for the temperature and RH sensor has been adjusted to 5 s, and the smoothing wavelength for both parameters has been adjusted to 5 s.

3.2 Custom quality control

3.2.1 GPS performance

The GPS unit in the dropsondes operated properly in all soundings, i.e. the reported uncertainty of the GPS was around 0.2 m/s.

However, the GPS re-radiation inside the launch tube of the King Air did not work properly. As a result, the dropsondes were released without GPS lock and forced all sondes to acquire GPS satellite signals from a cold start. This led to delayed satellite tracking and wind measurements in all soundings. All but four soundings started reporting winds within 500 m below the aircraft. Four soundings (Table 3) had longer delays acquiring GPS tracking and did not report winds between 1 and 2 km below the aircraft.

To adjust for the missing GPS re-radiation in the launch tube, the sondes were launched from higher flight levels during the second half of the campaign, leading to minimal loss of wind information in the lowest 1.5 km of the atmosphere.

Table 3: Soundings with delayed GPS tracking. The altitude indicates the level below which wind measurements are available down to the surface.

Research Flight	Sounding	Sequence in flight	Highest altitude for winds
RF15a	20220326_202844	1	1.5
RF20	20220402_213131	2	1.5
RF24b	20220412_025606	2	1.2
RF29b	20220417_015056	1	2.6

3.2.2 Time stamp

The time stamp of each data point during a sounding is measured by GPS. Since the GPS re-radiation inside the launch tube did not work properly, most profiles received an update of the number of GPS leap seconds in the middle of a sounding. This update leads to a small hiccup in the data acquisition and a minor jump in the time stamp, which leads to a noticeable spike in the derived vertical wind speed. All profiles were screened for a GPS time update and an appropriate correction was applied throughout. The time stamps and vertical winds in quality-controlled data (see Section 6.4) are free of these artificial jumps.

3.2.3 Missing data

Related to the missing GPS re-radiation, up to 15 s of data following release had been missing from the initially processed AVAPS data. These data have been recovered from raw data and appropriately processed.

3.2.4 Pressure validation

The pressure sensor of the NRD41 dropsonde is known to have a small bias. This sensor bias is measured during the production of the dropsondes and a correction is stored in the sonde to minimize the bias during observation.

The statistics of the pressure bias measured and corrected during production is shown in Figure 2. The median pressure correction is -1.23 hPa and the standard deviation 0.2 hPa. These measurements were used to correct the dropsonde pressure readings during production. Some drift between production and use of the sonde is possible, but still, the surface pressures reported by the dropsondes are expected to have only small systematic biases. The pressure inside the cabin or the launch tube was not measured and the pressure measurements of the dropsondes prior to launch could not be validated.

Sonde 20220330_021713 did not use a production pressure correction. The pressure readings of this sounding may be low biased by up to 1.5 hPa.

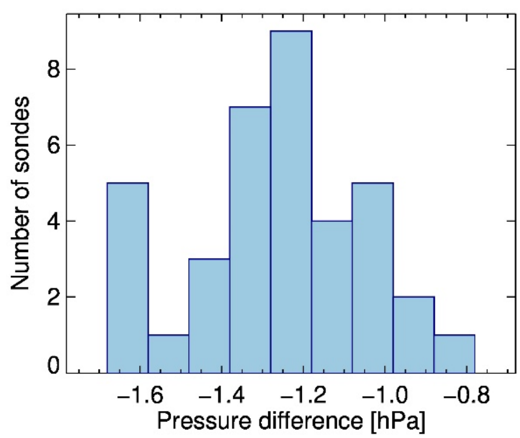


Figure 2: Pressure offset between the dropsonde and the reference sensor before launch.

During CHACHA, most sondes exhibited a small pressure measurement issue. For reasons currently unknown, the dropsondes occasionally repeated a reported pressure measurement. This happened up to 19 times per sounding. While this is barely noticeable in any vertical profile, it did lead to additional noise in the calculated vertical fall rate. In post processing, these repeated pressure readings were interpolated and the fall rates were recalculated excluding these values. Only pressure readings had to be corrected. Temperature and relative humidity readings did not show any artificial repetition of measurements.

3.2.5 Relative humidity

The RH sensor on the xRD41 dropsondes should be reconditioned prior to launch. The sondes store the information, whether the reconditioning was successful, and we were able to verify that all but three sondes were properly reconditioned prior to take off before each flight. Any contamination in the sensor material was removed and the relative humidity sensors were expected to perform with negligible calibration drift.

The soundings during which the humidity sensor was not reconditioned are listed in Table 4. In two soundings, the RH sensor was reconditioned within one week prior to the sounding. Although we have little experience with extended reconditioning times, these two soundings may only experience a small relative humidity bias. The relative humidity sensor of one sonde was never reconditioned. This humidity profile of this sounding is likely to be significantly low biased. A best guess estimate for a low bias is around 3.5% based on the relative humidity profile within the cloud layer that this sounding penetrated.

Table 4: Soundings without properly reconditioned RH sensor

Research Flight	Sounding	Time between reconditioning and sounding
RF09	20220318_230410	4 days
RF12	20220323_011855	6 days
RF24b	20220412_030846	Never reconditioned

The time response of the NRD41 relative humidity sensor is less than one second near the surface and up to 4 s at flight level of the UWYO KA. The effect of the time humidity sensor time lag correction is small for the observations during CHACHA and no correction was not applied in post processing.

We removed the first 5 s of the relative humidity and temperature profiles, while the sensors are equilibrating to the ambient environment. Since the sensor temperature changes from the warm cabin air to colder ambient air, equilibration of the humidity sensor is faster than it would be at the colder ambient conditions in steady state.

3.2.6 Launcher related problems

During the first dropsonde research flight 5 March 2022 (RF04), the gate valve in the manual launch tube malfunctioned and did not completely release the first two sondes. These sondes remained in the launch tube outside the fuselage. A launch-detect had been triggered and the downward spiraling of the aircraft mimicked a falling dropsonde. However, the data reported by these two sondes did not represent atmospheric conditions. These data were removed from the data set. A third sonde was initially stuck but was manually cleared from the launch tube. It detected launch early but functioned properly once it had separated from the aircraft. The gate valve problem was rectified after this flight and no other sonde was affected.

Table 5: Soundings removed from data set due to launcher problems.

Research Flight	Sounding
RF04	20220305_205729
RF04	20220305_222706

4 Data file format

The format follows that defined for the NCAR/EOL/ISF radiosonde NetCDF data files. It is based on the Climate and Forecasting (CF) convention version 1.6 and is compatible with any tool accepting this convention. The data file format is described in Vömel et al. (2019).

5 Sounding metrics

5.1 Surface pressure

The surface pressure reported by the sondes is an extrapolation of the last measured air pressure above the surface to sea level using the current fall rate and is shown in Figure 3 as sequence of soundings and not as function of time.

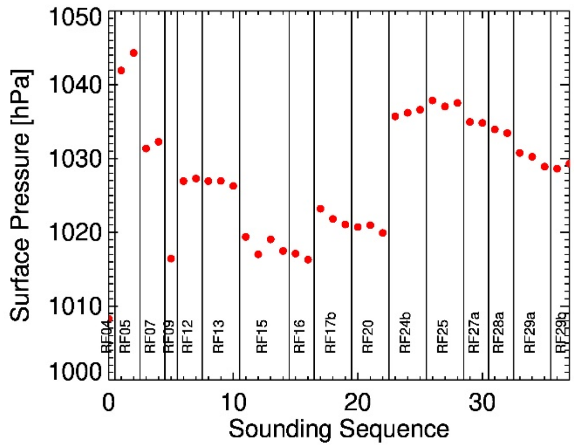


Figure 3: Surface pressure reported by all sondes

5.2 Fall rate

A histogram of the fall speed near the surface is shown in Figure 4. All parachutes functioned as expected. The fall time varied from 4.1 min during the early phase of the campaign to 5.5 min during the later phase when sondes were dropped from a higher altitude. All parachutes inflated within seconds after launch.

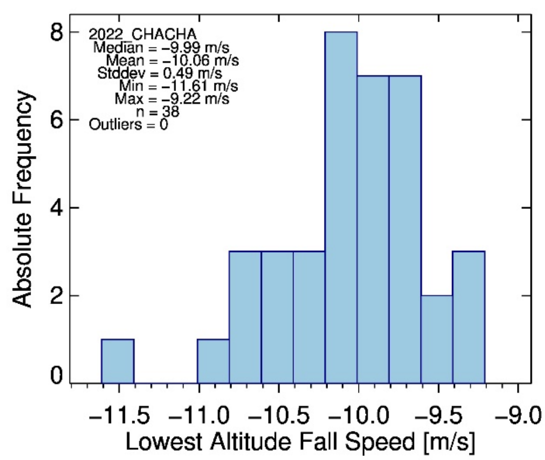


Figure 4: Distribution of the fall speed near the surface for all soundings.

5.3 Horizontal drift

Wind speeds during CHACHA were on average about 10 m/s and did not exceed 27 m/s in any sounding. No sounding travelled horizontally more than 6 km between release and landing (Figure 5).

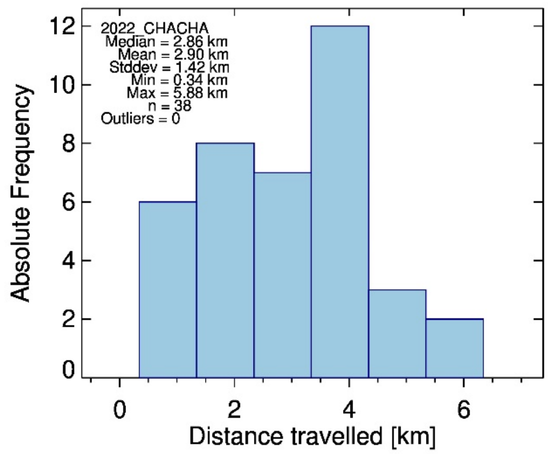


Figure 5: Distance between launch and landing for all dropsondes during CHACHA.

6 Observations

6.1 Temperature

The temperature measured by all dropsondes is shown as a contour plot in Figure 6. The individual research flights are separated by vertical lines. Temperatures at flight level were in the range of -26°C to -11°C and near the surface in the range of -27°C to -8°C. The warmest temperature measured at the top of the boundary layer inversion was -1.7°C.

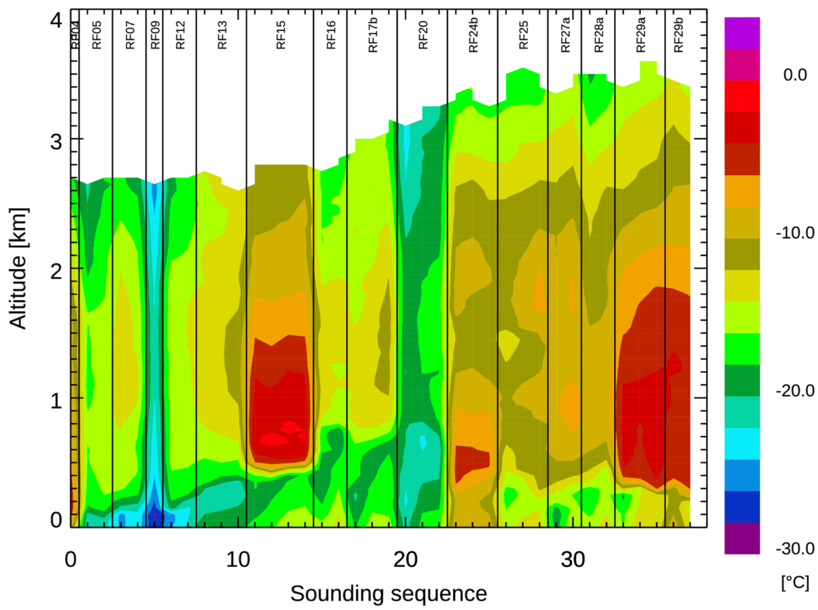


Figure 6: Color contours for all temperature measurements. All soundings are shown in the sequence in which they were released. The research flights are indicated near the top.

6.2 Relative humidity

Relative humidity reported by all dropsondes is shown in Figure 7. All dropsonde profiles were below 0°C and relative humidity is expressed as relative humidity over ice instead of the conventional relative humidity over liquid water. Supersaturation with respect to ice indicates the likely presence of supercooled liquid or mixed phase clouds.

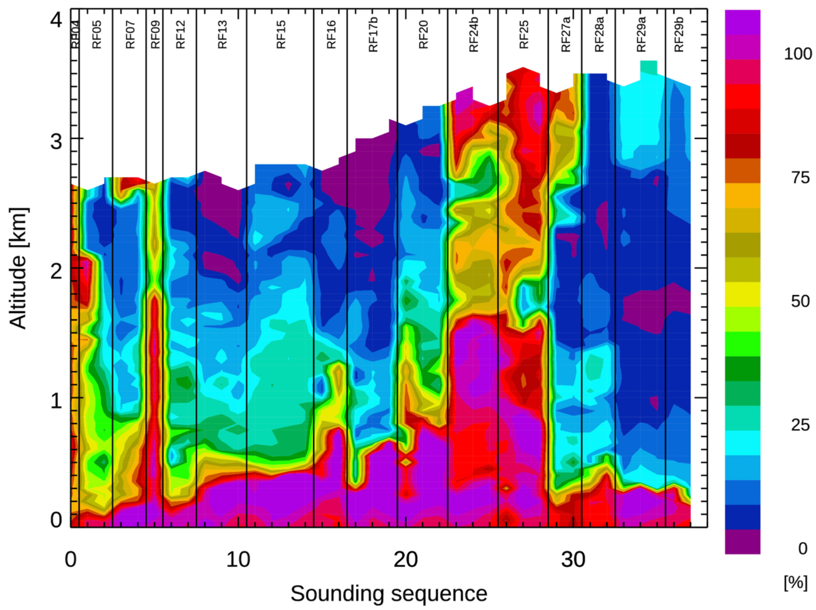


Figure 7: Color contours for relative humidity over ice.

6.3 Winds

Zonal and meridional wind speeds are shown in Figure 8.

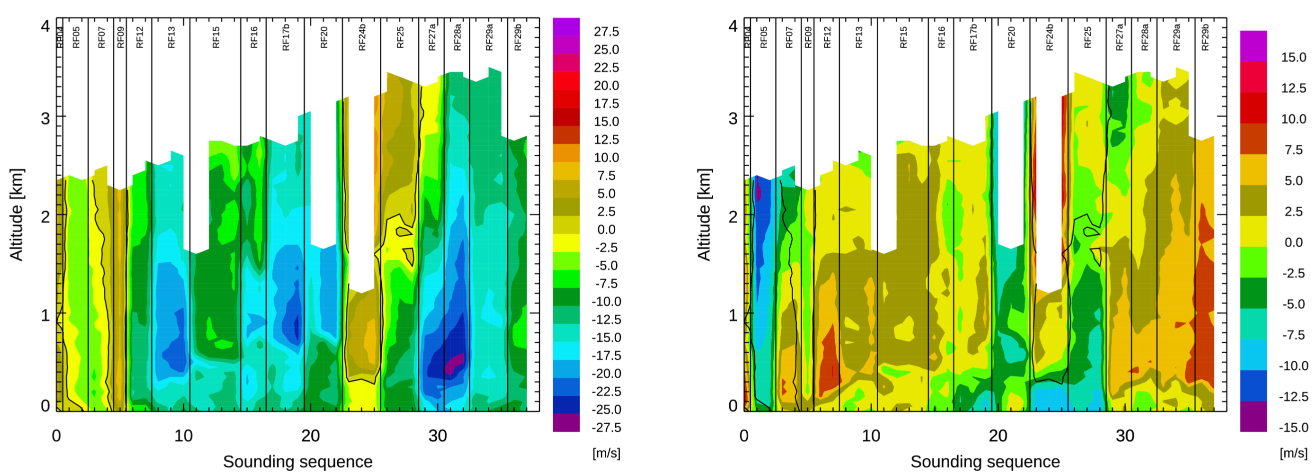


Figure 8: Color contours for all zonal and meridional wind speed measurements. Brown and red colors indicate westerly/southerly winds, green and blue colors indicate easterly/northerly winds.

6.4 Vertical winds

Dropsondes can sense stronger vertical winds, which are calculated as the difference between the theoretical and the measured fall rates (Wang et al., 2008). Seven soundings showed significant updrafts and downdrafts near the surface (Figure 9), indicating some turbulence in the boundary layer. The soundings showing significant up/downdrafts are listed in Table 6.

Some soundings show a spike in the vertical wind at the top of the profile. This is due to incomplete filtering of data, where the fall rate has not yet equilibrated. These data were left in the data set, since temperature and humidity measurements are believed to be within expected limits.

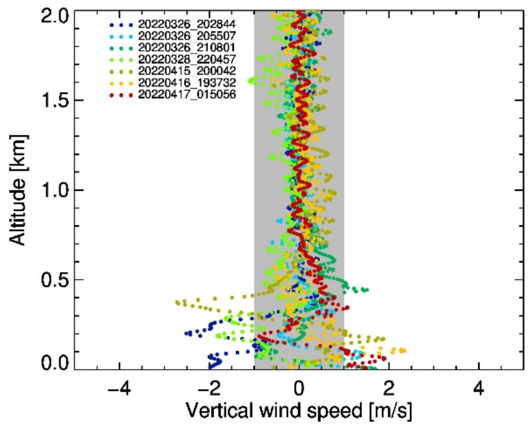


Figure 9: Vertical wind speed for some selected soundings derived from the measured fall rate. The grey shaded area indicates the estimated uncertainty for vertical winds derived by this method.

Table 6: Soundings showing significant updrafts and downdrafts including estimated peak vertical winds.

Research Flight	Sounding	Peak vertical wind [m/s]
RF15a	20220326_202844	-2.5
RF15a	20220326_205507	1.2
RF15a	20220326_210801	1.5
RF16	20220328_220457	-1.9
RF28	20220415_200042	-3.3
RF29a	20220416_193732	2.4
RF29b	20220417_015056	1.9

6.5 Surface observations

Dropsondes are designed for atmospheric observations during descent and usually stop transmitting once they fall into the water. During CHACHA, however, many sondes landed on sea ice and continued transmitting. A few sondes even continued transmitting for a few seconds from the water. The behavior at the end of the sounding provides some information about whether it landed in water or on land and possibly what the surface conditions were. Surface temperature, pressure, and humidity values were reported from the sonde lying on the ice, i.e. these observations are not of the same quality as standard 2 m meteorological observations inside a proper meteorological shelter. However, in absence of any other observations, these measurements may provide some information and are therefore reported here. Only measurements, which are reported for some time after landing are accepted to exclude artificial drifts or biases due to a damaged sensor. The pressure sensor is generally very robust and continues measuring after landing. The temperature and humidity sensors may suffer damage at landing and stop reporting.

Sondes typically stop transmitting upon landing in the water. In this case, the last reported measurements were taken about 8 m above the surface.

Occasionally, sondes continue transmitting from the ocean surface for a few seconds with the temperature sensor submerged under water. In this case, the reported temperature is that of the ocean surface. Measurements of the sea water temperature are reported only if they are reported at least four times before the sonde sinks below the ocean surface. All sea surface temperature measurements are close to the freezing temperature of ocean water.

As intended, all dropsondes launched upwind and directly over sea ice leads landed in the water and either stopped reporting immediately, or reported a sea surface temperature. Exceptions are the sonde launches during RF13 and RF24a, which all landed on ice, the sonde launches during RF15a, in which the second sonde landed in water, not the immediate upwind sonde, and the sonde launches during RF20, in which the first two landed in the water.

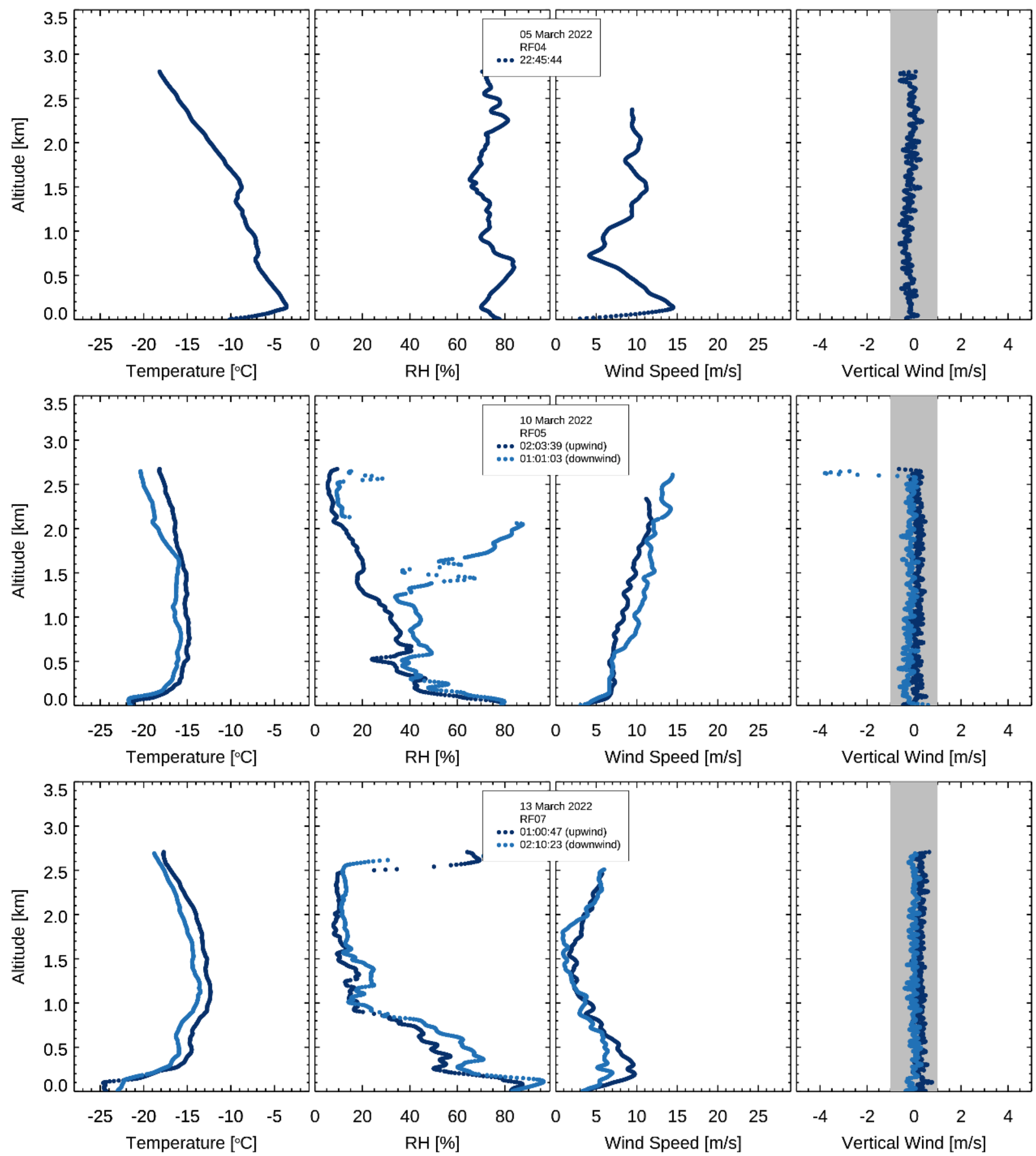
Table 7: Surface observations at the end of all dropsonde profiles

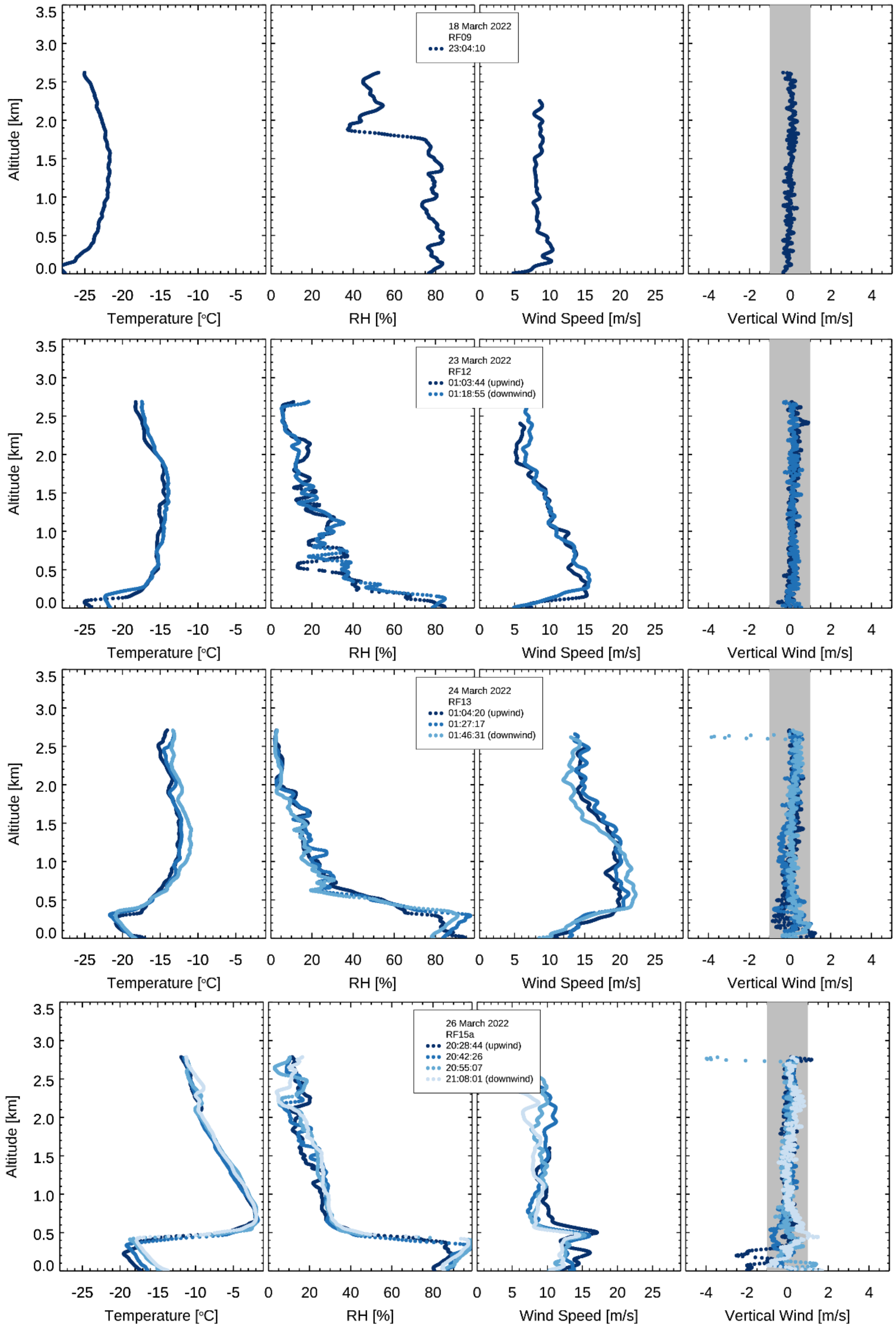
Research Flight	Sounding	P [hPa]	T air [°C]	RH [%]	T water [°C]	Comments
RF04	20220305_224544	1007.8				On sea ice
RF05	20220310_010103	1041.6	-20.8	78.5		On sea ice
RF05	20220310_020339	1043.6			-1.7	In water, reporting 4 min
RF07	20220313_010047					Telemetry stopped suddenly.
RF07	20220313_021023	1031.7	-19.5	76.3		On sea ice
RF09	20220318_230410	1016.0				On sea ice
RF12	20220323_010344	1028.2			-1.9	In water, reporting 2 sec
RF12	20220323_011855	1026.7				On sea ice
RF13	20220324_010420	1026.0				On sea ice
RF13	20220324_012717	1026.1				On sea ice
RF13	20220324_014631	1025.6				On sea ice
RF15a	20220326_202844	1018.5				On sea ice

Research Flight	Sounding	P [hPa]	T air [°C]	RH [%]	T water [°C]	Comments
RF15a	20220326_204226					Telemetry stopped suddenly.
RF15a	20220326_205507	1018.1				On sea ice
RF15a	20220326_210801	1017.8				On sea ice
RF16	20220328_220457	1017.2			-1.6	In water, reporting 2 sec
RF16	20220328_222626	1016.1	-5.5	86.7		On sea ice
RF17b	20220330_015418	1023.4			-1.7	In water, reporting 2 sec
RF17b	20220330_021713	1021.9	-12.2	89.8		On sea ice
RF17b	20220330_023918	1020.4	-13.9	88.0		On sea ice
RF20	20220402_210044	1021.4				In water
RF20	20220402_213131	1020.6			-1.7	In water, reporting 2.5 sec
RF20	20220402_214601	1019.5	-13.7	86.5		On sea ice
RF24b	20220412_024351	1035.9				On sea ice
RF24b	20220412_025606	1035.9	-5.2			On sea ice, humidity sensor drifting
RF24b	20220412_030846	1035.6	-7.8	89.6		On sea ice
RF25	20220412_234335					Telemetry stopped suddenly.
RF25	20220412_235633	1037.5				On sea ice
RF25	20220413_001028	1036.7				On sea ice
RF27a	20220414_212122					Telemetry stopped suddenly.
RF27a	20220414_213404	1034.6				On sea ice
RF28a	20220415_200042					Telemetry stopped suddenly.
RF28a	20220415_201340	1032.8				On sea ice
RF29a	20220416_193732					Telemetry stopped suddenly.
RF29a	20220416_195410	1029.3				On sea ice
RF29a	20220416_201625	1028.5	-13.2	84.9		On sea ice
RF29b	20220417_015056	1027.8	-7.8	93.2		On sea ice
RF29b	20220417_021027					Telemetry stopped suddenly.

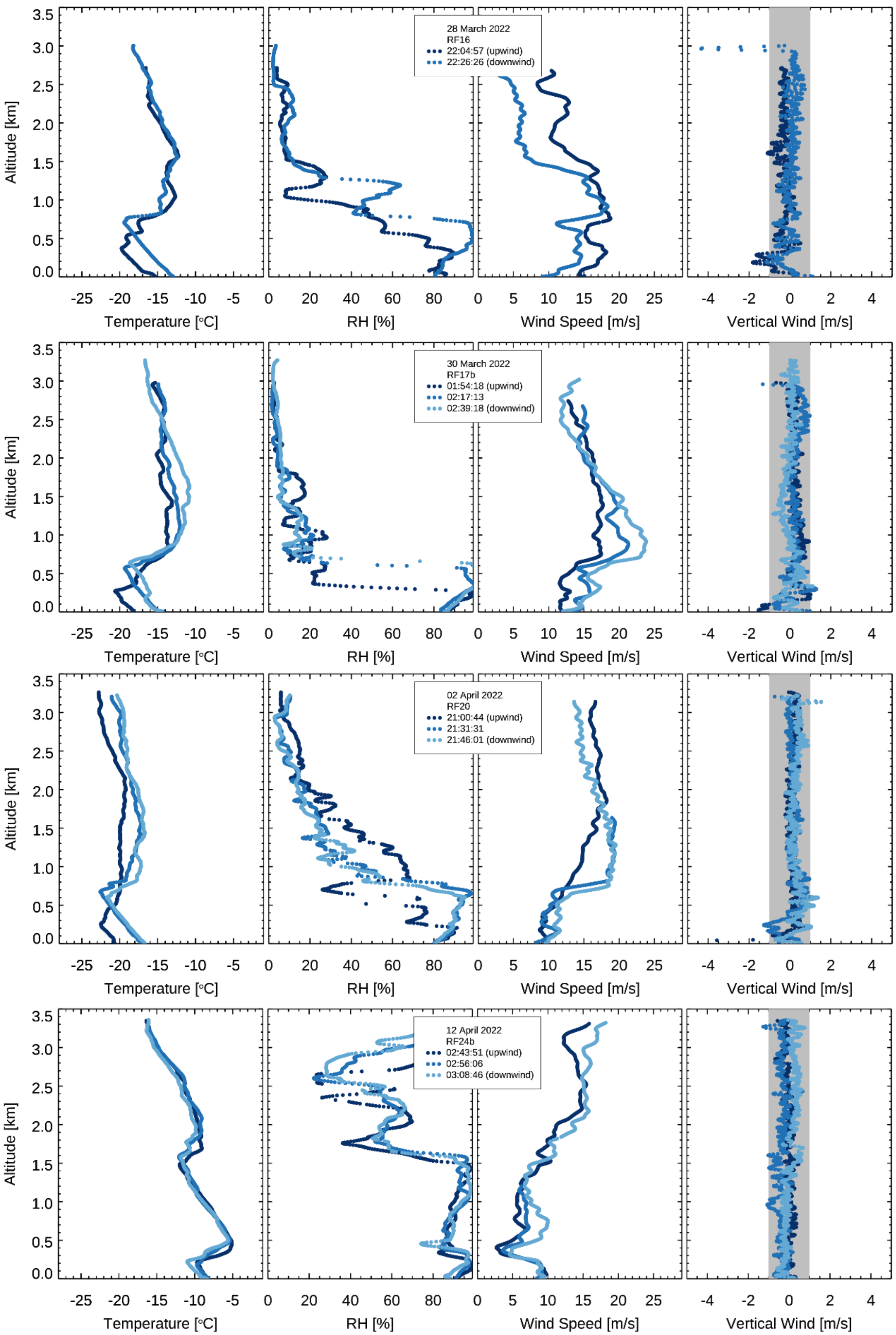
6.6 Summary plots

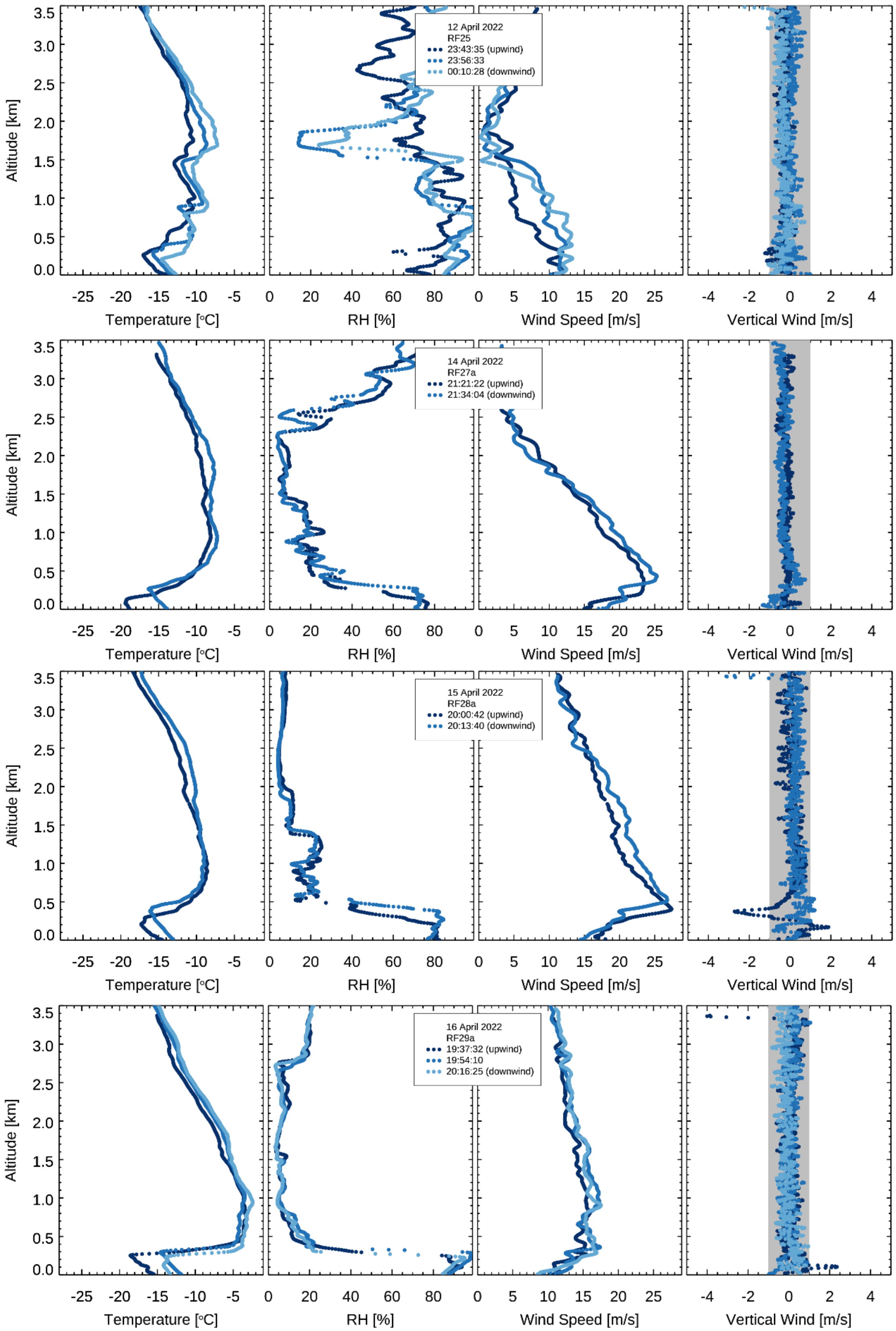
Flights using dropsondes targeted open leads and most flights released sondes just upwind or over the open water, followed by one or several sondes downwind into the developing cloud deck. The Figures below show the temperature, relative humidity, wind speed, and vertical wind for each research flight. In flights using multiple dropsondes the sequence of sondes is sorted from upwind to downwind of the lead using the wind direction at 500 m.

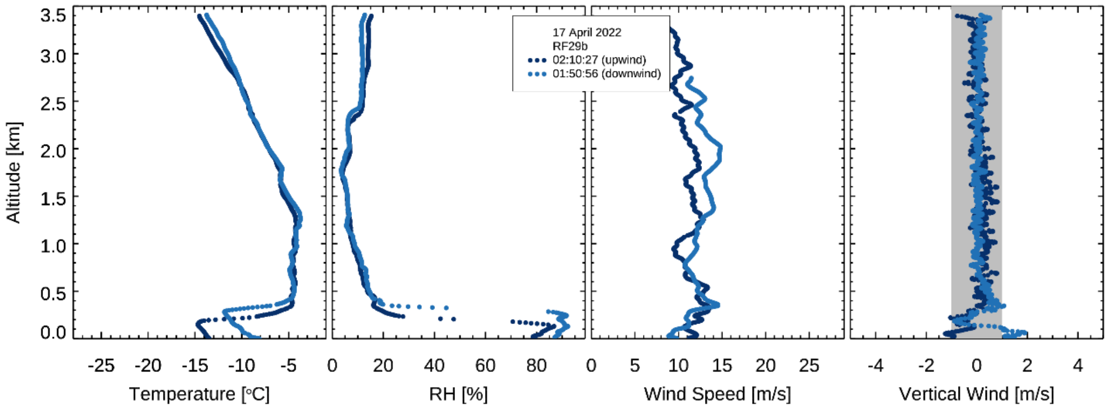




18 March 2022
RF09
23:04:10
23 March 2022
RF12
01:03:44 (upwind)
01:18:55 (downwind)
24 March 2022
RF13
01:04:20 (upwind)
01:27:17
01:46:31 (downwind)
26 March 2022
RF15a
20:28:44 (upwind)
20:42:26
20:55:07
21:08:01 (downwind)
Altitude [km]
Temperature [°C]
RH [%]
Wind Speed [m/s]
Vertical Wind [m/s]


28 March 2022
RF16
22:04:57 (upwind)
22:26:26 (downwind)
30 March 2022
RF17b
01:54:18 (upwind)
02:17:13
02:39:18 (downwind)
02 April 2022
RF20
21:00:44 (upwind)
21:31:31
21:46:01 (downwind)
12 April 2022
RF24b
02:43:51 (upwind)
02:56:06
03:08:46 (downwind)
Altitude [km]
Temperature [°C]
RH [%]
Wind Speed [m/s]
Vertical Wind [m/s]


12 April 2022
RF25
23:43:35 (upwind)
23:56:33
00:10:28 (downwind)
14 April 2022
RF27a
21:21:22 (upwind)
21:34:04 (downwind)
15 April 2022
RF28a
20:00:42 (upwind)
20:13:40 (downwind)
16 April 2022
RF29a
19:37:32 (upwind)
19:54:10
20:16:25 (downwind)
Altitude [km]
Temperature [°C]
RH [%]
Wind Speed [m/s]
Vertical Wind [m/s]


17 April 2022
RF29b
02:10:27 (upwind)
01:50:56 (downwind)
Altitude [km]
Temperature [°C]
RH [%]
Wind Speed [m/s]
Vertical Wind [m/s]

Appendix A: Listing of all sounding

#	Research Flight	Sounding	Latitude [°]	Longitude [°]	Altitude [km]	Fall rate [m/s]
1	RF04	20220305_224544	71.21284	-154.00688	2.9	-11.5
2	RF05	20220310_010103	71.18623	-151.72471	2.7	-10.9
3	RF05	20220310_020339	71.73448	-156.07153	2.8	-10.5
4	RF07	20220313_010047	70.95575	-159.05074	2.8	-10.5
5	RF07	20220313_021023	71.50746	-157.15961	2.8	-10.8
6	RF09	20220318_230410	71.10817	-152.62962	2.7	-10.7
7	RF12	20220323_010344	71.15886	-158.11495	2.8	-10.7
8	RF12	20220323_011855	71.17411	-159.49362	2.8	-10.7
9	RF13	20220324_010420	70.92136	-159.40624	2.8	-10.7
10	RF13	20220324_012717	70.83264	-160.05564	2.8	-10.9
11	RF13	20220324_014631	70.62570	-160.18853	2.8	-10.7
12	RF15a	20220326_202844	70.90961	-159.32978	2.9	-11.1
13	RF15a	20220326_204226	70.89668	-159.89638	2.9	-11.0
14	RF15a	20220326_205507	70.91504	-160.64327	2.9	-11.0
15	RF15a	20220326_210801	70.94802	-161.30709	2.9	-10.9
16	RF16	20220328_220457	71.16013	-157.82385	2.8	-11.2
17	RF16	20220328_222626	71.20638	-160.01441	3.1	-10.8
18	RF17b	20220330_015418	71.18978	-157.92390	3.1	-10.7
19	RF17b	20220330_021713	71.01459	-160.73900	3.1	-10.8
20	RF17b	20220330_023918	70.78061	-163.34633	3.4	-11.2
21	RF20	20220402_210044	71.12102	-157.26658	3.3	-10.8
22	RF20	20220402_213131	70.78817	-161.51607	3.3	-10.8
23	RF20	20220402_214601	70.67931	-162.96817	3.3	-10.8
24	RF24b	20220412_024351	69.34159	-164.70746	3.4	-11.1
25	RF24b	20220412_025606	69.66735	-163.53820	3.4	-12.1
26	RF24b	20220412_030846	69.66576	-163.52792	3.4	-10.8
27	RF25	20220412_234335	69.68556	-163.46353	3.6	-11.4
28	RF25	20220412_235633	69.29864	-164.02563	3.6	-11.2
29	RF25	20220413_001028	68.95627	-164.67395	3.6	-11.4
30	RF27a	20220414_212122	70.55949	-160.42794	3.4	-11.3
31	RF27a	20220414_213404	70.54882	-161.77339	3.6	-11.5
32	RF28a	20220415_200042	71.08595	-157.71687	3.6	-11.6
33	RF28a	20220415_201340	71.08295	-159.14898	3.6	-10.8
34	RF29a	20220416_193732	71.08689	-157.38843	3.5	-11.1
35	RF29a	20220416_195410	71.18312	-159.66087	3.6	-11.2
36	RF29a	20220416_201625	71.42975	-162.75815	3.6	-11.7
37	RF29b	20220417_015056	71.18710	-159.66586	3.5	-11.1
38	RF29b	20220417_021027	71.08417	-157.39847	3.5	-11.0

Appendix B: Operator comments

#	Research Flight	Sounding	Operator comments
1	RF04	20220305_224544	none; The vert speed was still not zero when altitude was zero. Otherwise, looks good. Got stuck in the tube but got it out and had a good drop.
2	RF05	20220310_010103	none; Good!
3	RF05	20220310_020339	Good Drop; none
4	RF07	20220313_010047	Good Drop; none
5	RF07	20220313_021023	Good Drop; none
6	RF09	20220318_230410	none; none
7	RF12	20220323_010344	Good Drop; none
8	RF12	20220323_011855	Good Drop; none
9	RF13	20220324_010420	Good Drop; none
10	RF13	20220324_012717	Good Drop; none
11	RF13	20220324_014631	Good Drop; none
12	RF15a	20220326_202844	Good Drop; upwind drop, into open water upwind of cloud field
13	RF15a	20220326_204226	Good Drop; 2nd drop of flight, over puffy cu field on seaice-side of open lead
14	RF15a	20220326_205507	Good Drop; 3rd dropsonde of flight, 2nd downwind into stratus deck, presumably over broken sea ice
15	RF15a	20220326_210801	Good Drop; 4th drop of flight, farthest downwind from lead through thinning stratus deck
16	RF16	20220328_220457	Good Drop; Drop 1 of flight upwind of clouds, into open water
17	RF16	20220328_222626	Good Drop; 2nd drop of flight downwind into thick of cloud field
18	RF17b	20220330_015418	Good Drop; 1st drop of flight, upwind over open water, looks like hit thin puffy cu.
19	RF17b	20220330_021713	Good Drop; 2nd drop of flight, into middle of cloud field, looked like shallow cloud deck at 1100 ft. Acquired gps about 8700 ft (11000 ft drop)
20	RF17b	20220330_023918	Good Drop; 3rd drop of flight, far downwind, into southern edge of cloud field, maybe near new air mass, tops maybe 1700, bottoms around 1000 ft.
21	RF20	20220402_210044	Good Drop; 1st drop of flight, over open lead, hard to get upwind of cloud field. RH peak in cloud ~400-600 ft. Drop from 12kft to pick up gps by 10kft.
22	RF20	20220402_213131	Late Winds; 2nd drop of flight, into middle of cloud field along juiciest spine. lat/long, T, RH came in quickly, altitude and winds not until around 5kft. RH peak in cloud around 2200-1800 ft, with depth around 90% to about 600 ft
23	RF20	20220402_214601	Good Drop; 3rd drop of flight, downwind into far extent of cloud field. All variables live by 10kft (drop from 12kft, can't acquire gps in tube). Cloud tops ~1900 ft, look bit sub-saturated compared to previous drops.
24	RF24b	20220412_024351	Good Drop; 1st drop of flight, over open lead, at least 3 cloud layers beneath us
25	RF24b	20220412_025606	Late Winds; 2nd drop of flight, winds and alt not in till 4kft

#	Research Flight	Sounding	Operator comments
26	RF24b	20220412_030846	Good Drop; 3rd drop of flight, all data in by 10.7kft, multiple cloud layers, farthest downwind from lead
27	RF25	20220412_234335	Good Drop; 1st drop of flight, into open lead bottleneck north of main lead, upwind of cloud field - several humid layers at lower levels
28	RF25	20220412_235633	Good Drop; 2nd drop of flight, downwind over wide open lead, several cloud layers at lower levels
29	RF25	20220413_001028	Good Drop; 3rd drop of flight, downwind of lead, over seaice, multiple cloud layers down low
30	RF27a	20220414_212122	Good Drop; 1st drop of flight upwind of lead over open water
31	RF27a	20220414_213404	Good Drop; 2nd drop of flight, downwind of lead over patchy ice
32	RF28a	20220415_200042	Good Drop; 1st drop of flight, all data streaming by 11.2kft, upwind drop over open lead, ahead of thin wispy cloud field
33	RF28a	20220415_201340	Good Drop; 2nd drop of flight, downwind over very scattered puffy cu/seaice, no big cloud field to sample.
34	RF29a	20220416_193732	Good Drop; 1st drop of flight, over open water of Barrow lead, just upwind of scattered cu field deriving from lead. Dry air aloft, very humid layer below 1kft
35	RF29a	20220416_195410	Good Drop; 2nd drop of flight, over downwind seaice edge of lead, into lead cu field, RH spike to 100% dropping through clouds ~300 to 1000 ft.
36	RF29a	20220416_201625	Good Drop; 3rd drop of flight, visually downwind beyond cloud field. Humid RH layer about 300-800 ft, visually no clouds though.
37	RF29b	20220417_015056	Late Winds; 1st drop of flight, downwind of lead over seaice/lead edge, fall on ice, drop at location of 2nd sonde from the morning flight. Late winds/alt, starting about 8900 ft. Spike in RH where dissipating cloud field was, between about 300-800 ft.
38	RF29b	20220417_021027	Good Drop; 2nd drop of flight, upwind of cloud field over open lead. RH spike to 95% between 600-300 ft. Drop in same location as 1st drop from morning flight.

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