2. WEATHER CONDITIONS

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At the start of the expedition leg the *Polarstern* and the *MOSAiC* floe were influenced by a high pressure system above the North Pole. From December 13th to 20th visibility reductions due to fog occurred, whereas on December 19th fog was present the entire day. At the edge of the high a low from the Chukchi Sea moved from December 14th on westwards, was located on December 17th above Severnaya Zemlya and finally filled on December 18th close to Franz Josef Land. Thereby the wind rapidly increased from 2 Bft on December 15th to 6 Bft on 16th and slowly decreased the following days.

From December 21st on the high moved towards Severnaya Zemlya, whereas weak winds remained above the research area. From December 25th to 28th the high moved into the Eastsiberian Sea while weakening. At the same time a low moved from Svalbard above the Kara Sea to Russia and led to a wind speed increase to 4 to 5 Bft from December 23rd to 26th and a wind direction shift to Southwest.

Following, based on the high above the Eastsiberian Sea a high pressure ridge formed (starting December 29th) which extended up to the research area. Simultaneously a low developed between the Queen Elizabeth Islands and the North Pole. Consequently, a westerly wind prevailed which increased to 5 Bft by December 30th. On the early morning of December 29th the coldest temperature to date during *MOSAiC* was measured with -35°C. This temperature was measured in 29 m height, close to the ice it was about 2 to 5 K colder due to the strong temperature inversion.

Around New Year low pressure influence more and more increased. A strong low moved from December 28th from the Norwegian Sea into the Barents Sea (December 30th) while deepening, reached its minimum pressure above Nowaya Zemlya and filled by January 3rd Influenced by the low the wind above the research area shifted Southeast on December 31st and increased to 5 Bft by New Year.

The low was replaced by a new low on January 4th which moved from the Norwegian Sea above the southern Barents Sea and the Kara Sea into the Laptev Sea where it filled on January 9th. At the same time a high from the Eastsiberian Sea moved into the Beaufort Sea and starting January 6th formed a ridge which expanded up to Franz Josef Land by January 8th. In the following days the ridge swung westwards and reached towards northeastern Greenland from January 10th. Starting January 11th, the ridge shrunk and the high in the Beaufort Sea weakened. At first in the influence area of the low a moderate to fresh wind from southeast to east prevailed above the research area. Reaching the northern flank of the high pressure ridge from January 4th to 8th the wind slowly shifted from Southeast over Southwest to West with wind speeds about 3 Bft.

Starting January 9th, the *MOSAiC* area got more and more influenced by a strong low which moved from the Barents Sea into the Kara Sea, on January 13th made a turn towards Severnaya Zemlya and reached Franz Josef Land on January 16th where it filled. From January 9th to 16th a moderate to fresh east wind occurred which temporarily increased up to 6 Bft.

On January 16th the wind shifted to Northeast and on 17th to Northwest. On January 18th a new low made the wind shift Southwest. This low came from the Eastsiberian Sea (January 16th), crossed the North Pole on January 18th and reached the Queen Elizabeth Islands on January 19th.

On the back side of the low an extended high pressure system developed which reached from the Eastsiberian Sea to the Beaufort Sea. On January 22nd it moved to the North Pole and influenced the weather in the research area until January 25th. Starting January 24th this high moved towards Svalbard and slowly weakened.

From January 27th on frequent low pressure influence resulted to partly extreme variations in pressure, temperature and wind:

On January 25th north of Greenland a low developed which moved to the North Pole on January 26th and on 27th further on to the Queen Elizabeth Islands while weakening. Another low developed on January 27th north of Svalbard and moved eastwards while weakening whereas it transported humid air to the research area. On January 28th it filled between Franz Josef Land and the North Pole. This low was followed by another low which moved from the northeastern coast of Greenland towards the *MOSAiC* floe and on January 30th crossed the North Pole heading towards the Beaufort Sea. This low caused temporary wind speeds about 6 Bft and a rapid short warming to -11°C on January 30th, followed by a rapid cooling to -35°C in the night to the January 31st after the wind had changed to North on the back side.

From January 31st to February 1st a new low moved from Svalbard to the *MOSAiC* research area while deepening to a gale. At begin with a southerly flow relatively mild air was brought in on January 31st whereby in the night to the February 1st the temperature rose to -11.4°C. In the morning of the February 1st this low led to a rapid wind speed increase to 8 Bft, a significant wind direction change from South to North and a resulting advection of very cold air masses. Consequently, the temperature decreased remarkably – at first with 10 K per hour – within 16 hours about 27 K to -38.2°C. With that a new temperature record during *MOSAiC* was reached. During the passage of the gale the pressure temporary went down to 975 hPa and temporary blowing snow reduced visibilities to below 1 km. The same day the gale slowly moved towards the Beaufort Sea and consequently the wind decreased.

After intermediate high pressure influence on February 2nd with wind speeds of 3 to 4 Bft, on February 3rd the research area was crossed by a warm front of a low above Svalbard. With a moderate to fresh wind from Southeast on its backside the temperature quickly raised to temporary -14.7°C. Further on the low moved into the Kara Sea until February 8th and weakened.

In the meantime, a high pressure system formed above the Laptev Sea and moved until February 7th slowly into the Eastsiberian Sea while strengthening. From February 4th to 12th the research area was located at its northwestern flank in a firstly southerly flow with wind speeds of 3 to 4 Bft, from February 8th finally wind from southeasterly directions that increased by February 10th to 4 to 5 Bft.

From February 11th on the high moved from the Eastsiberian Sea towards the Queen Elizabeth Islands. At the same time a deep low approached from Scandinavia. It was located above the Barents Sea on February 12th, on 13th between Franz Josef Land and Severnaya Zemlya and crossed the *MOSAiC* research area on 14th towards Greenland and later moved towards Franz Josef Land. Hence, the southeasterly wind also increased after February 10th and reached average wind speeds of about 7 Bft on 13th. Due to the strong winds on February 13th blowing snow was causing significant reductions of visibility. The low brought

relatively humid and mild air which caused the temperature to rise to -19°C by February 14th noon and on this day and the evening before to continuous snow fall. With crossing of the cold front the wind quickly shifted from Eastsoutheast to West on February 14th and slowed down to 3 Bft whereas the temperature decreased to -36°C on 15th.

After a short intermediate high pressure influence the research area got in the influence area of a new strong low on February 17th. This low moved from the Norwegian Sea above the Barents Sea (February 18th) to Franz Josef Land (February 19th) and finally in the southwest of the research area towards Greenland where it filled until February 23rd between the North Pole and Greenland. This low again led to an increase of the air pressure gradient which made the wind significantly increase again on February 18th to 7 Bft in average with some peaks of 8 Bft. It was accompanied by blowing snow and heavy snowfalls. On February 19th and 20th the wind slowly decreased to 5 to 6 Bft. The low moved to Greenland while weakening. On its backside very mild air was transported into the research area reaching -9°C on February 20th. In the following days the temperature levelled off to -15 to -20°C.

After a short calmer period on February 22nd and on 23rd a new strong low from the Barents Sea approached and let the wind increase to 5 to 6 Bft. At the final end of the expedition leg on February 24th this low was situated already as a gale above Franz Josef Land and the wind above the research area increased to 7 to 8 Bft, which led again to heavy snow falls and blowing snow. Due to those weather conditions from February 18th to 24th helicopter flights were possible only for limited times and on 22nd only in the close vicinity of *Polarstern*.

Weather statistics

December 13th 2019 00 UTC to February 24th 2020 12 UTC

Tab. 2.1: General weather statistics

Complete duration of PS122-2	**73 days**		
Days with sun shine	0	0 %	
Days with fog	9	12 %	
Days with diamond dust	55	75 %	
Days with snow	44	60 %	
Days with storm (v>=34KT)	3	4 %	01., 19. & 20.02.2020
Days with *temperatures* below 0°C	73	100 %	

Tab. 2.2: Mean and extreme values

Wind speed in 39 m height	Mean	7.1 m/s	13.9 KT	
	Min	0.1 m/s	0.2 KT	21.12.2019
	Max (10 min)	21.4 m/s	41.6 KT	01.02.2020
Wind direction	Most frequent	East and Southeast		
Temperature in 29 m height	Mean	-26.1 °C		
	Min	-38.2 °C		01.02.2020
	Max	-9.3 °C		20.02.2020
Wind chill	Mean	-35 to -45°C		
	Max	-60 °C		01.02.2020
Air pressure	Mean	1008 hPa		
	Min	974.6 hPa		01.02.2020
	Max	1029.8 hPa		19.12.2019

Tab. 2.3: Drift

Highest drift speed	0.9 KT	01.02.2020
Mean drift speed	0.2 KT	
Most northern position	88.6°N 59.3°E	23.02.2020
Absolute drift distance	339 nm	
Relative drift distance	185 nm	

Distribution of wind direction and time series

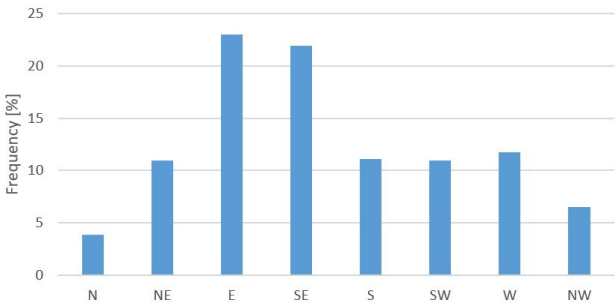

Fig. 2.1: Frequency distribution of the wind direction [%]

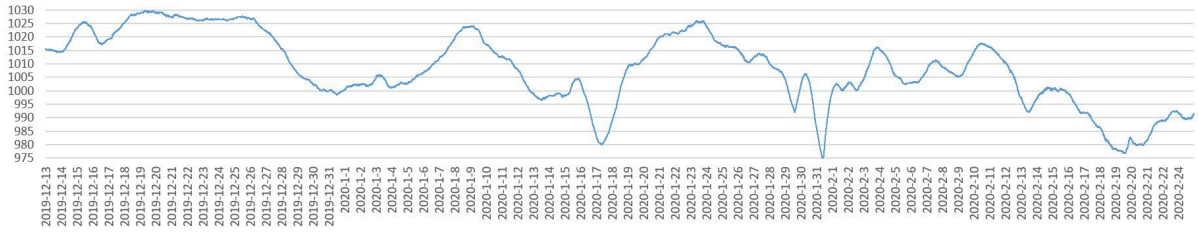

Fig. 2.2: Air pressure [hPa]

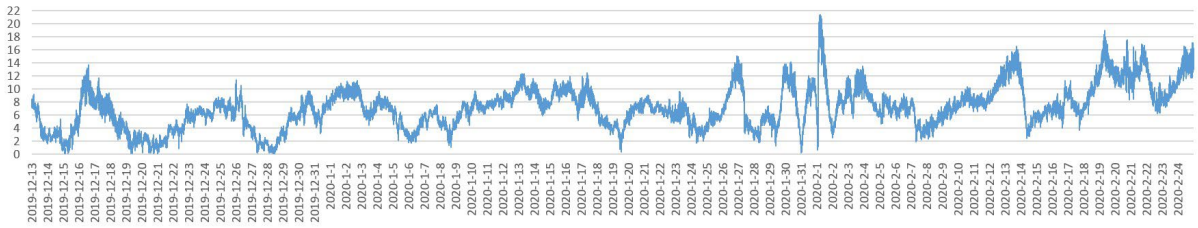

Fig. 2.3: Mean wind speed [m/s] in 39 m height

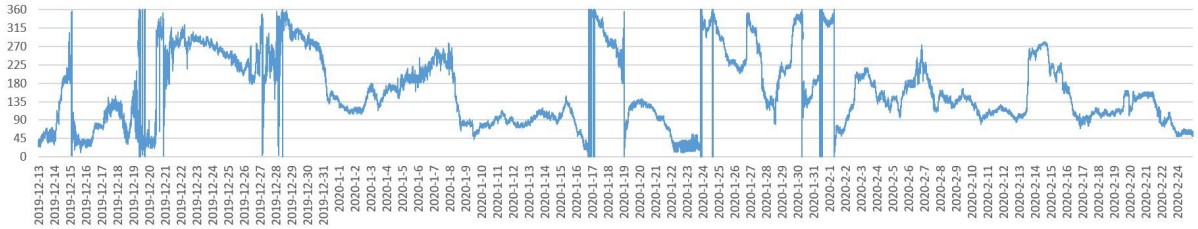

Fig. 2.4: Wind direction [°]

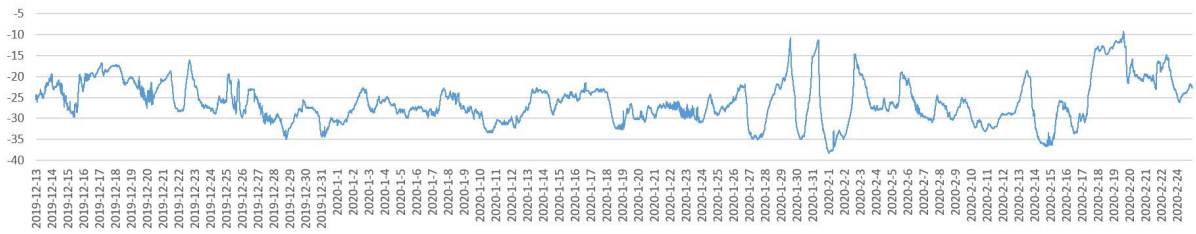

Fig. 2.5: Temperature [°C] in 29 m height

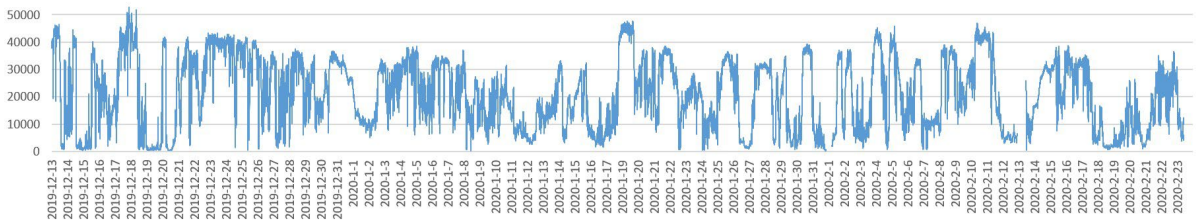

Fig. 2.6: Visibility [m]

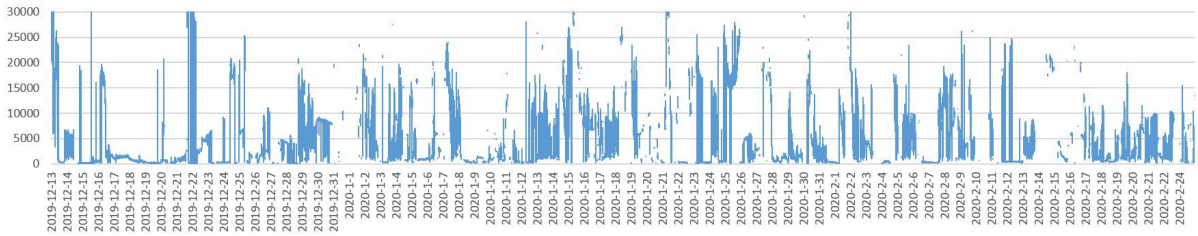

Fig. 2.7: Cloud height [ft]