



Supplement of

Drivers governing the seasonality of new particle formation in the Arctic

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Supplement

S1 Diffusional loss calculation for DMPS

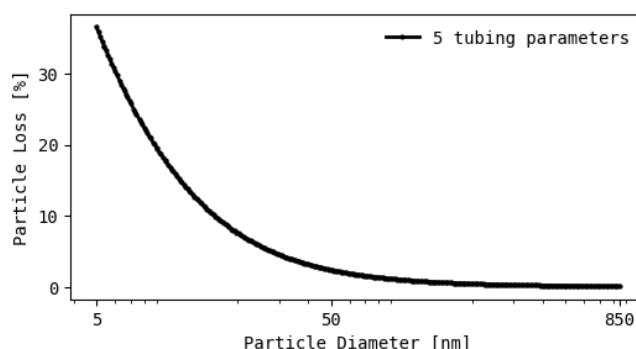


Fig. S1: The particle loss from the whole-air inlet to the DMPS estimated using the Particle Loss Calculator (PLC) using a total of 5 tubing sets of measurements (1) 22mm, 21LPM, 479cm, 2) 5.35mm, 6.3lpm, 138cm 3) 5.35mm, 3.8lpm, 13cm, 4) 5.35mm, 2lpm, 92cm, 5) 5.35mm, 1lpm, 51cm)

S2 Data screening and quality control

Here we describe the data screening and quality control procedure, describing the artefacts, comment on possible mechanisms and their frequency, and removal. We outline here two artefacts we removed when calculating the intensity parameter ($\Delta N_{\max, 2.82-5}$) namely in-cloud events (S2.1) and windblown snow events (S2.2). We used visibility and wind speed measurements to help screen for these events. Visibility was used to ascertain whether the station was in-cloud, while the wind speed measurements were used to help identify windblown snow events. Isolating and removing these types of events was important when calculating the intensity parameter ($\Delta N_{\max, 2.82-5}$), as we argue that in-cloud and wind-blown snow events should not be counted towards the production of nucleation mode particles via NPF.

S2.1 In-cloud events

When ZEP is submerged by dense clouds, there appears to be a sudden increase in the particle number concentration ($\sim 3\text{-}25\text{nm}$, both polarities) as measured by the NAIS. The increase in number concentration is typically centred around 5nm. Furthermore, this is combined with a reduction in the concentration of both negative and positive ions. The increase in the particle concentration occurs when visibility dips below $\sim 100\text{m}$. We have labelled this type of occurrence as an in-cloud event (see an example of an in-cloud event on the 18th of August 2023, Fig S2). It was observed that the appearance of the 5nm mode was not dependent on the type of cloud (i.e. ice crystals compared with liquid water droplets using the Cloudnet data).

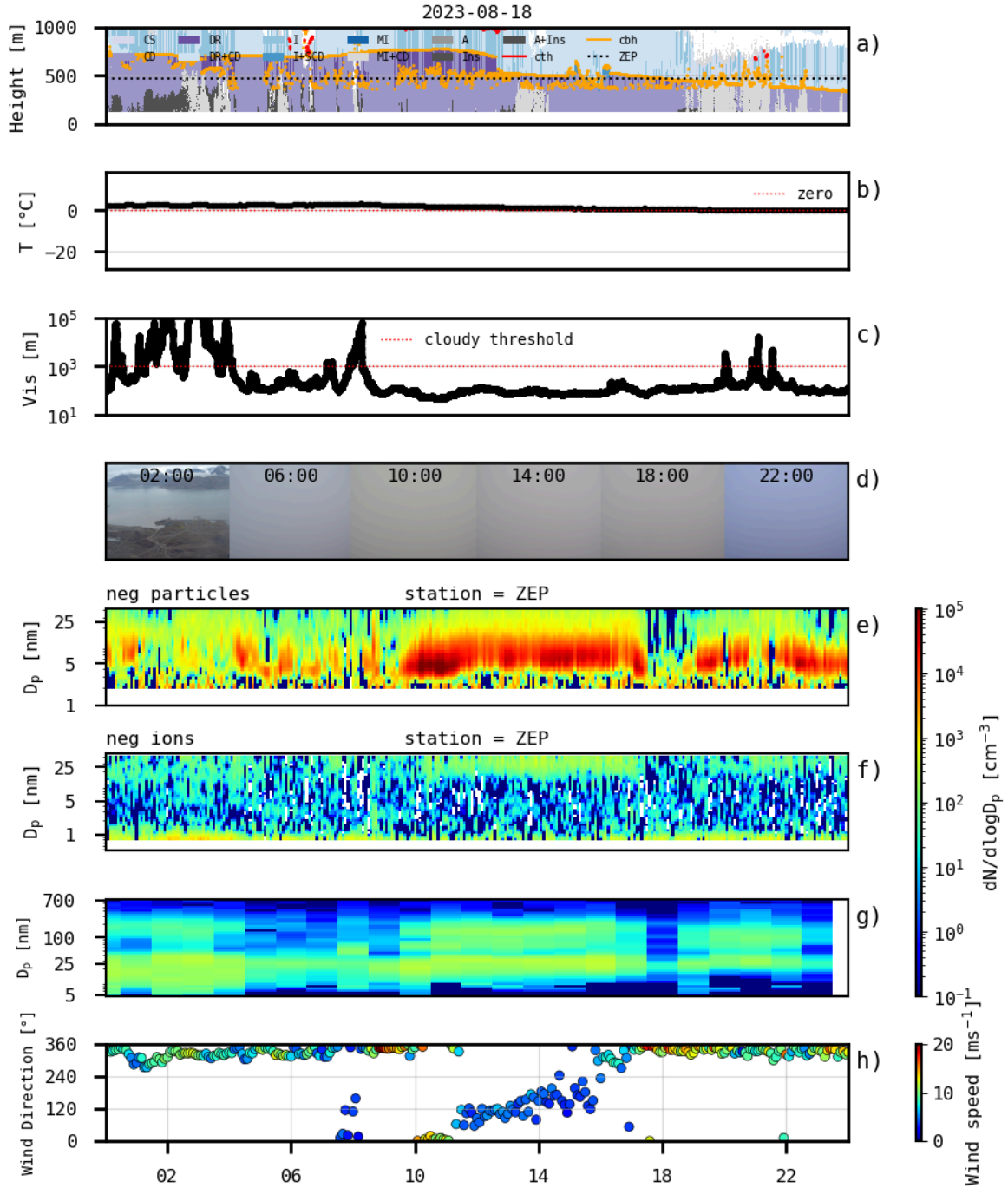


Fig. S2: Example of an in-cloud event on 2023-08-18 whereby a dense cloud submerges the observatory. The panels display (a) Cloudnet data where Clear Sky (CS), Drizzle (DR), Ice (I), Melting Ice (MI), Aerosol (A), Aerosol and Insects (A+Ins), yellow line is the cloud base height (cbh), Cloud Droplet (CD) is purple, Drizzle and cloud droplet (DR+CD), Ice and Supercooled droplets (I+SCD), Melting Ice and Cloud Droplets (MI+CD), Insects (I), red line is the cloud top height (cth) and ZEP is the height of the observatory at 474m a.s.l., (b) ambient temperature, (c) visibility, (d) webcam, (e) NAIS measurements for the negative particles, (f) NAIS measurements for ions, (g) DMPS measurements, (h) wind speed and wind direction.

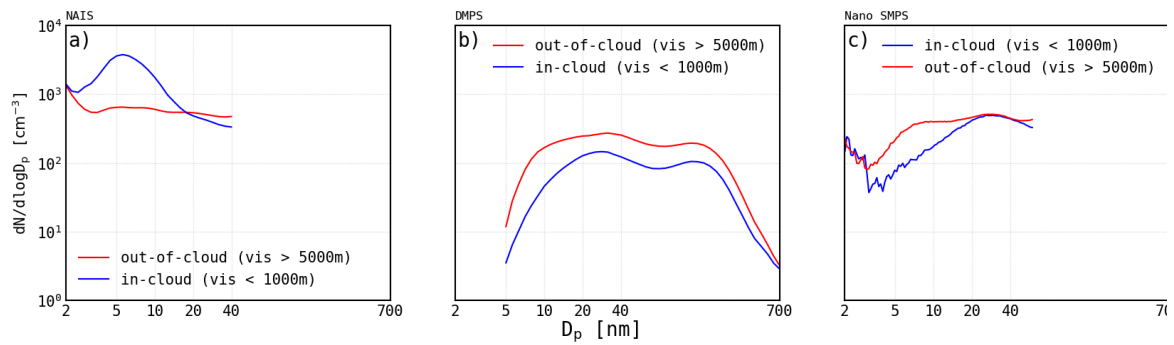


Fig. S3: Arithmetic mean particle number size distributions (PNSDs) comparing out of cloud (red) and in-cloud (blue) for (a) NAIS measurements (negative particle channel), b) DMPS data, and c) Nano SMPS. The in-cloud and out of cloud conditions are selected based on visibility measurements collocated with PNSD measurements. There is a substantial increase in the PNSD around 5nm for the NAIS data during in-cloud periods. Notice there is no increase around the 5nm mode for inside cloud measurements for both the DMPS and Nano SMPS PNSDs. Note that this is not showing the transition from in-cloud to cloud free conditions, but is the entire average for the PNSD measurements for each respective condition.

In the DMPS data, as opposed to NAIS measurements, we observe a distinct reduction in all particle sizes during in-cloud conditions when compared with out of cloud conditions (see Fig. S3 b) for average size distributions). In addition, the Nano-SMPS displays reductions within the size range of 3nm-20nm (see Fig. S3 c)). Both the DMPS system and Nano-SMPS display observations counter to that of the NAIS. For the NAIS there is a distinct increase around 5nm when we compare in-cloud with out of cloud data (see Fig. S3 a)). The differences between these sets of measurements suggests that when the NAIS measures during in-cloud conditions, some instrumental artefact leads to the observation that the number of small neutralised nucleation mode particles (around 5nm) increases. This cannot be explained by interstitial mode particles or the evaporation of cloud droplets (sampled and dried via the whole air inlet of the NAIS). We have to assume that this mode in the NAIS data generated by in-cloud conditions is an instrumental artefact. Moreover, we would typically expect a reduction in the concentration of small nucleation mode particles due to the large sink effect resulting from large cloud droplets. The ion loss associated with cloud/fog formation, reported by Chen et al. (2017) is similar to the loss of ions during the observed in-cloud events at ZEP.

Size distributions of aerosol particles and ions have been measured in and out of cloud before (Lihavainen et al., 2007). Lihavainen et al. (2007) observed, during a whole day in which the observatory was in-cloud, there were no particles in the range 100-500nm, but a growing interstitial mode 20-30nm. They also observed an ion mode 10-40nm, originating from the coagulation of cluster ions. During a measurement period when the observatory transitioned from in-cloud to cloud free the 100-500nm mode reappeared potentially as a result of the evaporation of cloud droplets (i.e. residuals), and the cluster ion mode increased.

S2.2 Windblown snow events

In the NAIS measurements, we observe sudden increases in both ion and particle concentrations when wind speeds typically exceeded 10 ms^{-1} and the surface albedo was greater than 0.8, indicating a layer of snow on the ground (see an example of a windblown snow event on the 12th of December 2022, Fig S4). We term these types of events as windblown snow events. From the NAIS data, the increased ion concentrations, during windblown snow events are substantial for sizes around 1nm and 2-5nm; negligible increases are observed beyond sizes of 20nm (see Fig. S5). During windblown snow events, increases in concentrations measured by the DMPS can be observed between 20-60nm (see Fig S5, DMPS 5-700nm), this is contrary to the NAIS measurements, which as stated before see no noticeable increase at sizes greater than 20nm. These windblown snow events are similar to the wind-induced ion formation reported by Chen et al. (2017).

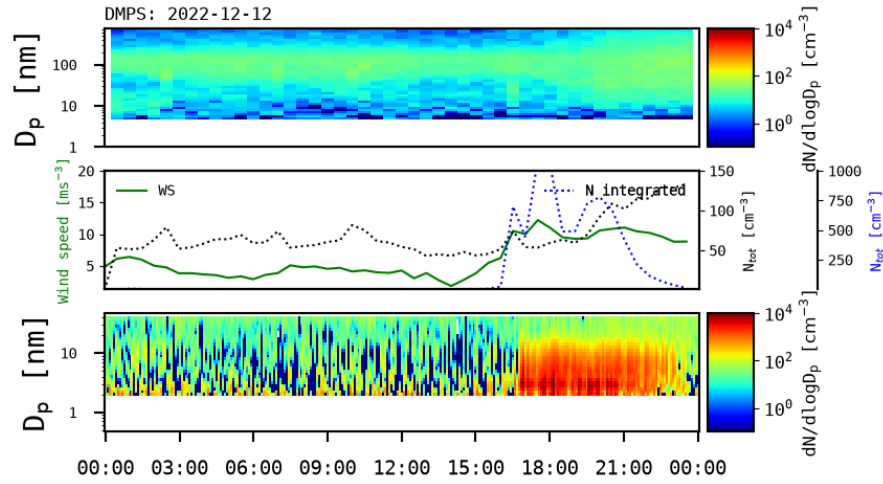


Fig. S4: Example of windblown snow event on 2022-12-12 whereby the wind speeds increased above 10 ms^{-1} , at 16:00 and a sustained burst of negative ions 1nm and larger could be observed. Panel (a) displays the particle number size distribution as measured by the DMPS, (b) shows the wind speed, concentration of total negative ions (dashed blue line), and total number as measured by the DMPS (dotted black line) (c) the ion number size distribution as measured by the NAIS (negative polarity).

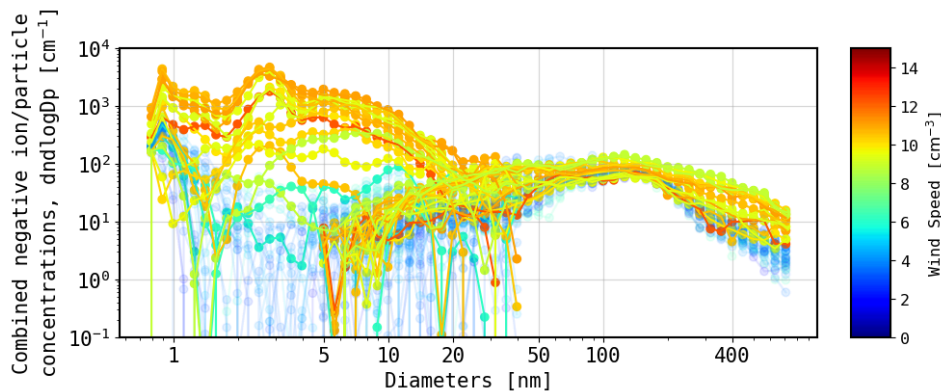


Fig. S5: The negative ion concentration coloured by wind speed, and the DMPS particle number size concentration combined. Notice the log scale on the yaxis. The largest increase occurs beyond 10 ms^{-1} . The increases in ion

concentrations are most apparent at around 3nm, but are present from 1nm to 20nm. For the DMPS, wind speeds beyond 10ms⁻¹ coincide with slightly increased particle concentrations between 20nm to 50nm and beyond 200nm.

It is not clear whether these observations detail differing production mechanisms for ions and particles from blowing snow or whether it is an instrumental artefact related to the NAIS. The exact mechanism behind the increased concentrations in particles and ions and whether they constitute any climatic relevance remains unknown. Chen et al. (2017) suggested that these bursts in wind-induced ions are formed via the clustering of vapours released from resuspension processes, and that the shattering of resuspended snowflakes and ice particles by turbulence can lead to ions mostly below 7nm. For particles, the sublimation of blowing snow has been suggested to generate high concentrations of aerosol, potentially enhancing CCN concentrations and cloud properties (Gong et al., 2023). However, whether or not these ion bursts are relevant for the climate (i.e. are able to grow to sizes which can influence clouds (e.g. beyond 25nm) or interact substantially with light), needs to be seen.

S2.3 Frequency of occurrence

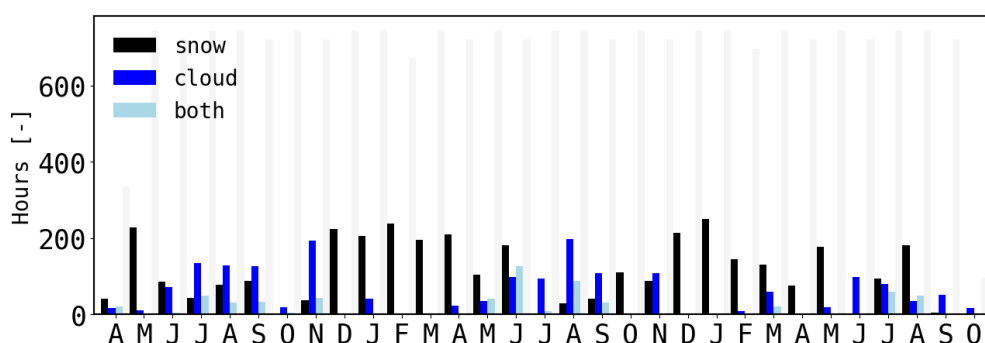


Fig. S6: Number of hours of data (i.e. time steps) containing observed windblown snow periods (black), cloud-events when the station is submerged within dense clouds (dark blue), and when both events are occurring at the same time. Note the increased frequency of windblown snow events ('snow', black bar) in the winter and early spring and the increased frequency of In-cloud events ('cloud', blue bars) in the summer months.

S2.4 Removal of in-cloud and windblown events

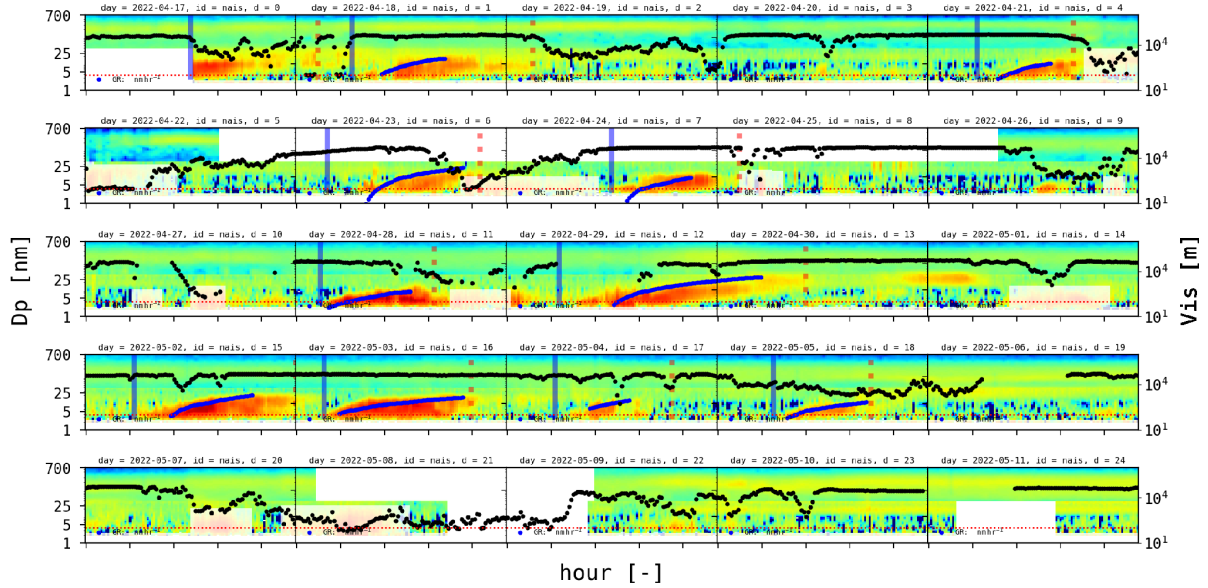


Fig. S7: Consecutive days examining the particle number size distribution measured by the negative particle channel of the NAIS. Periods which experienced in-cloud events (i.e. sustained bursts of elevated particle number concentration typically in the 5nm mode during low visibility) and windblown snow events (i.e. sustained high ion number concentrations during wind speeds typically greater than 10ms^{-1}) are deselected (semi-transparent). The curve representing the growth of the nucleation mode that is used for the site of nucleation estimations is represented by the blue dots. The examples of days presented are from 2023-04-27 to 2023-05-21.

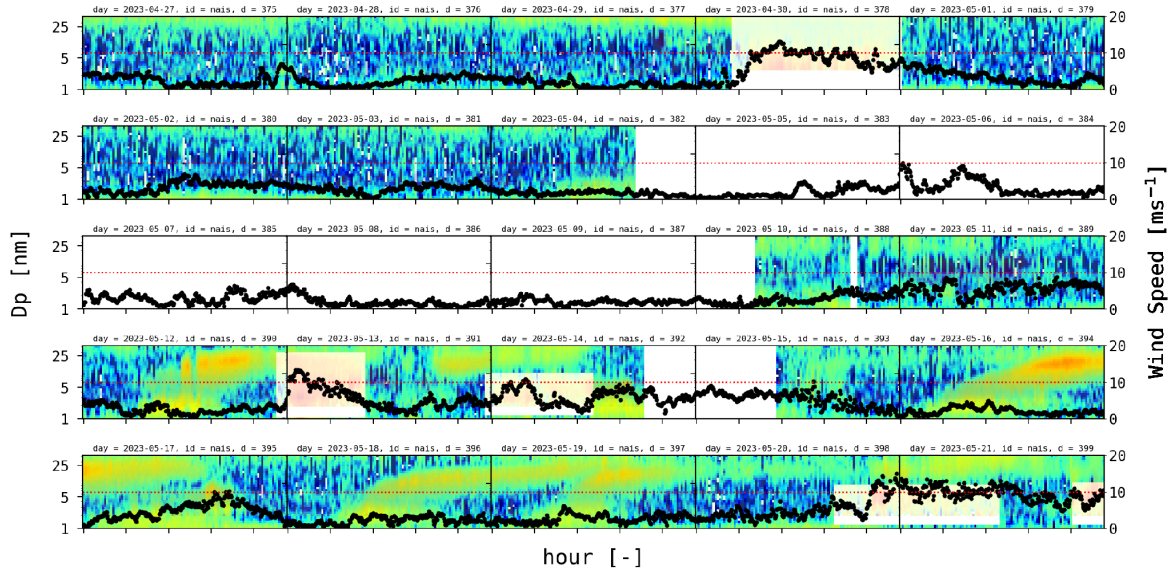


Fig. S8: Consecutive days examining the negative ion number size distribution measured by the NAIS. Periods which experience windblown snow events (i.e. sustained high ion number concentrations during wind speeds typically greater than 10ms^{-1}) are deselected (semi-transparent). The examples of days presented are from 2023-04-27 to 2023-05-21.

S2.5 Comparison of NAIS and DMPS PSNDs

When comparing NAIS to DMPS/SMPS systems, the NAIS is often seen to overestimate concentrations. The problem is due to the multiple charge effect, where large particles are “given too much charge”. NAIS can be

expected to overestimate particle concentration by up to a factor of 10 compared to the DMPS (Kangasluoma et al., 2020). There are numerous papers which highlight this common discrepancy e.g., Dada et al. (2023). Both the positive and negative NAIS measurements overestimate the particle number size distribution as measured by the DMPS. Currently, NAIS particle mode transfer functions need improving above 20nm.

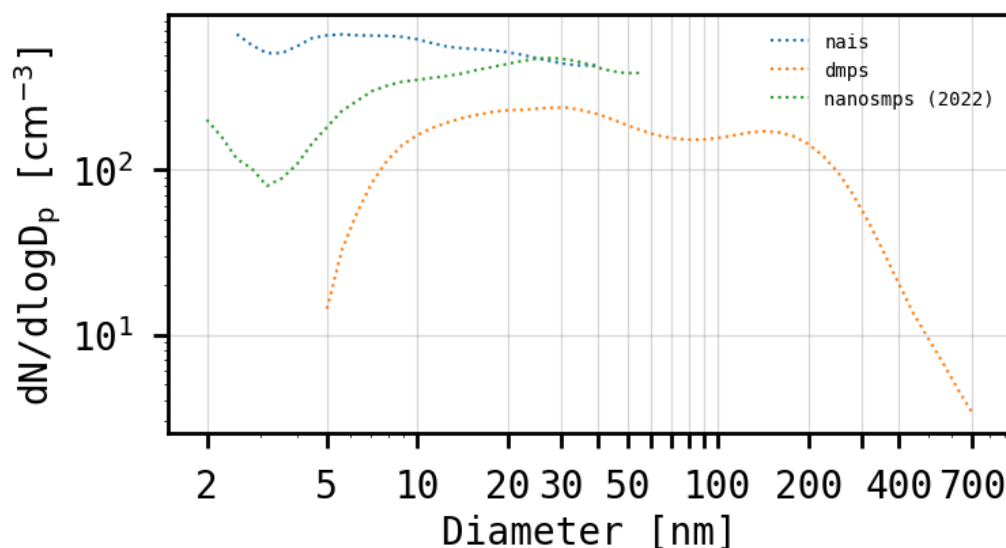


Fig. S9: Particle number size concentrations for the NAIS, DMPS and Nano-SMPS.

Here we observe the seasonal dependence of the comparison between the NAIS and DMPS data. Notice that in summer and spring months (see Fig. S11) the slope of the regression line is much closer to the 1:1 line, however, in autumn and winter the slope is around 0.2 (similar to the correction factor suggested by Dada et al., (2023)). Hence, when there is an increased number of nucleation mode particles, i.e. during the spring and summer season, the two instruments perform better.

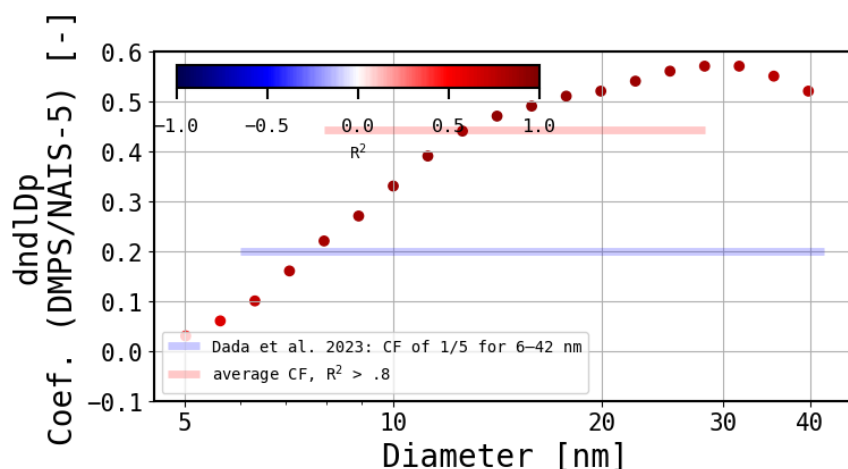


Fig. S10: The correlation of determinations and gradients when comparing temporally collocated DMPS and NAIS-5 particle number concentrations. The data is re-gridded such that direct comparisons can be made for each size range. Each comparison for a respective size bin takes the form of an ordinary least squares (OLS) regression

such that the slope is displayed on the y-axis and the coefficient of determination (R^2) is displayed by the colour of the circle marker. Red presents a positive correlation whilst blue a negative correlation. Dada et al., (2023) found that the NAIS overestimated the particle concentrations by a factor of 5 in the overlapping size range of 6–42 nm, and applied a correction factor of 1/5 to the NAIS measurements. Hence, a blue horizontal line represents the factor used by Dada et al., (2023). The red line signifies the average slope across all the different size bins (i.e., diameters).

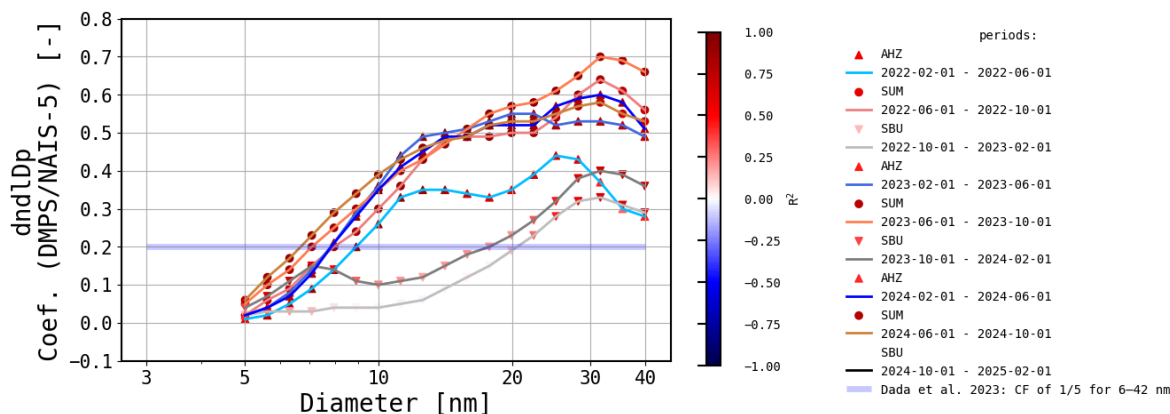


Fig. S11: The regression line (i.e. slope) is on the y-axis and the diameter in which the comparison is performed is on the x-axis. For each comparison, the correlation of coefficients is calculated and is displayed by the colormap, red signifies a better correlation whilst blue a worse correlation. Arctic Haze is denoted by AHZ, Summer by SUM, and Slow Build up season by SBU and the months they represent are given in the legend.

S2.6 Loss of cluster ions

It should be noted that there is a reduced negative cluster ion mode apparent for the NIAS5 at ZEP; the exact reasons for this are unknown, but could be due to a build-up of dirt on the honeycomb mesh, the inlet, or the lack of proper grounding of the instrument. The negative cluster ions have the highest ion mobility and therefore most readily scavenged, hence the reduced concentration of the negative polarity compared with the positive.

S3 Dal Maso Classification

S3.1 Examples of Class Ia, Class Ib and Class II defined using the Dal Maso et al., (2005) scheme

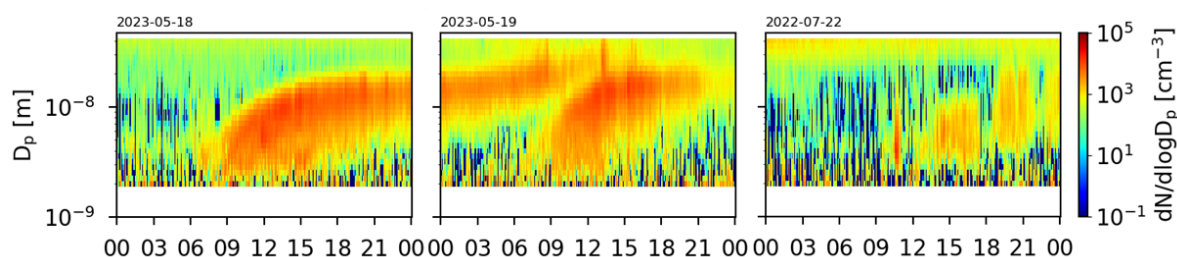


Fig. S12: Examples of new particle formation events as classified using the Dal Maso scheme. From left to right we have Class Ia, Class Ib and Class II. Class Ia shows a clear growing nucleation mode with no other modes present. Class Ib events have a mode present interfering with growing nucleation mode. Class II show growth but interrupted.

S3.2 Averaged Dal maso events

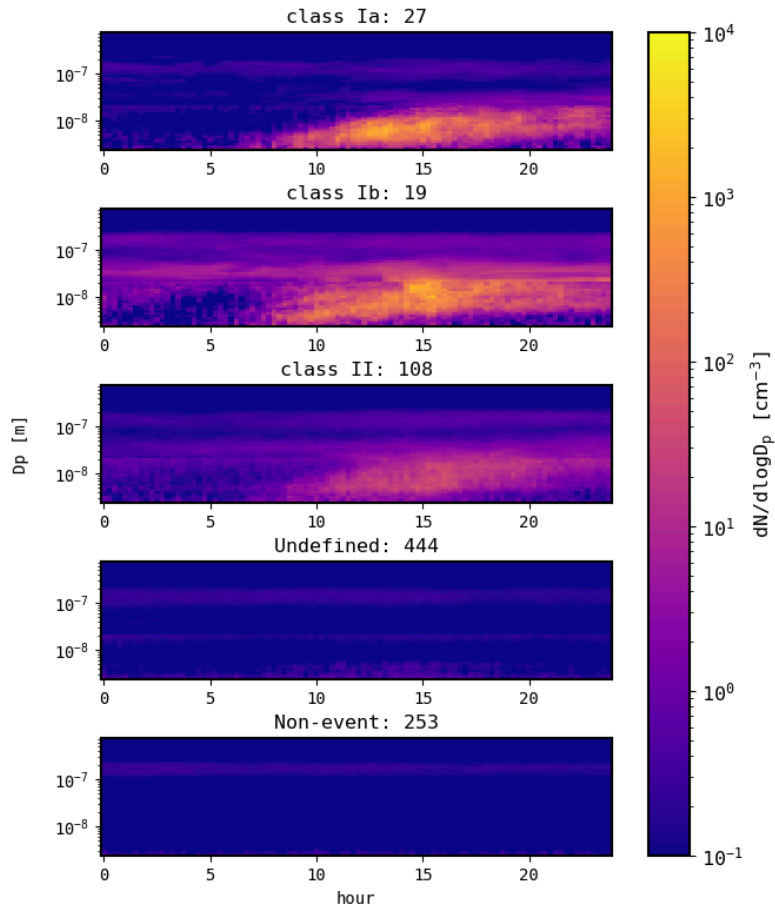


Fig. S13: Average events, as defined by the Dal Maso et al. (2005) scheme (from top to bottom: class Ia, class Ib, class II, Undefined, and non-event). The number of events is given in the title of each subplot.

S4 Nanoparticle ranking analysis

The nanoparticle ranking analysis utilised the daily maximum concentration of 2.8-5nm particles ($\Delta N_{\max, 2.8-5}$) from the negative channel of the NAIS. $\Delta N_{\max, 2.8-5}$ provided the best results when compared with the Dal Maso et al. (2005) classification. The nanoparticle ranking analysis developed by Aliaga et al. (2023) shows clear similarities with the classification performed in line with the Dal Maso et al. (2005) scheme (see Fig. S14).

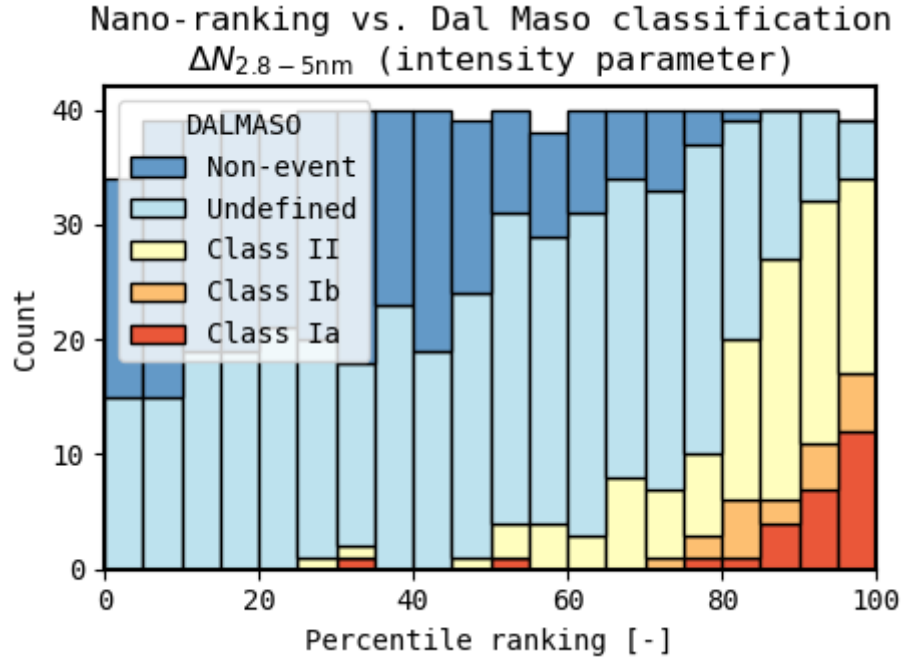


Fig. S14: The results of the nanoparticle ranking analysis compared with the Dal Maso et al. (2005) classification: the daily maximum for the total number concentration of 2.8 nm and 5 nm particles ($\Delta N_{2.8-5\text{ nm}}$) is used as the intensity parameter to gauge the strength of the NPF day. As well as using the daily maximum we also tested the daily ratio of the 90th percentile and 20th percentile for the particle number concentration between 2.8 nm and 5 nm (i.e. 90th/20th ratio of $\Delta N_{2.8-5}$). The daily maximum for $\Delta N_{2.8-5\text{ nm}}$ was found to be more in agreement with the Dal Maso et al. (2005) classification, and hence preferred in this study.

S4.1 Fitted classes for the Nanoranking analysis

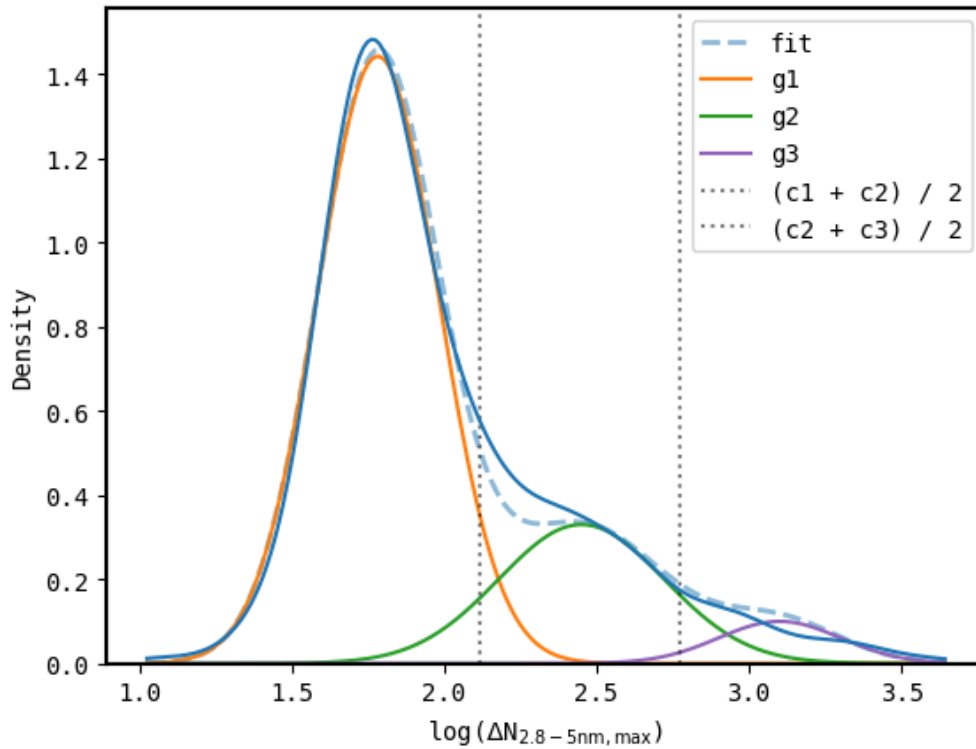


Fig. S15: Fitting for the intensity parameter. The $\log(\Delta N_{2.8-5\text{nm}})$ distribution is depicted. The three different intensity groupings i.e., g1, g2, g3 are created by taking the log of the intensity parameter i.e., the daily maximum in the concentration of particles between 2.8 and 5nm ($\Delta N_{2.8-5\text{nm}}$). The fitting of the groups is based on the log of the

strength parameter. A visual inspection and trial and error is used to fit the Gaussian curves. Note that the mapping used between $\log(\Delta N_{2.8-5nm})$ and the class of events i.e. g1, g2 g3 is 1:1. The dashed lines are calculated by calculating the distance between the adjacent Gaussian curve centres (centre c1 for curve g1, centre c2 for curve g2, centre c3 for curve g3). See Section about NPF mode fitting (Sect. 2.1.2) in Aliaga et al. (2023).

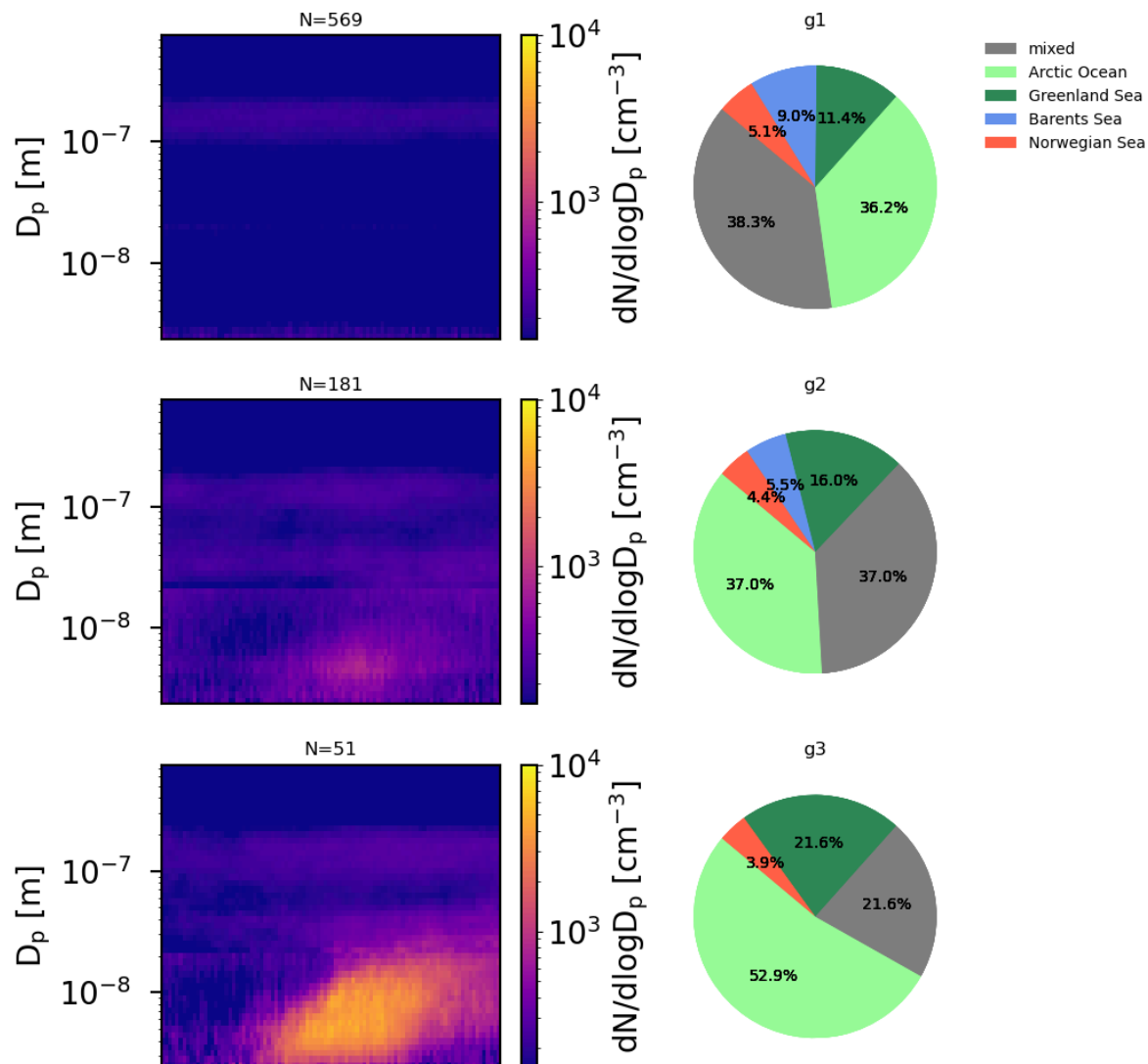


Fig. S16: Using the nanoranking we divided the days in three classifications using a pdf fitting on the intensity parameter. Barents is linked to very few events. The Arctic Ocean covers the majority of NPF. You can see the fit in the supplement. In total about 51 g3s, 181 g2s and 569 g1.

S5 Calculation of growth rates and formation rates

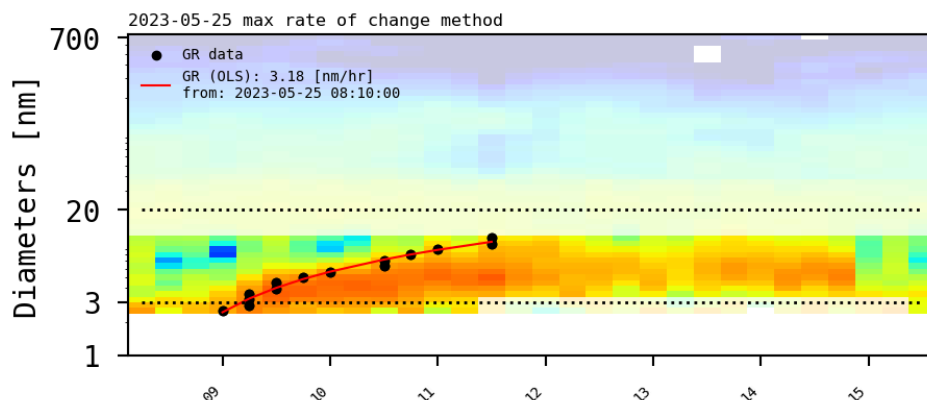


Fig. S17: Example event day (2023-05-25) with growth rate (GR) calculations. The slightly translucent areas display the data which is not used in the calculation. The rate of change method is used to find the datetime at which an individual size bin (D_p) experiences the largest increase in number concentration; for each D_p the time at which this occurs is displayed by the black dot. The red curve is the ordinary least squares method (OLS) providing a linear fit. GR is the gradient of the red curve.

S5.1 Calculation formation rates

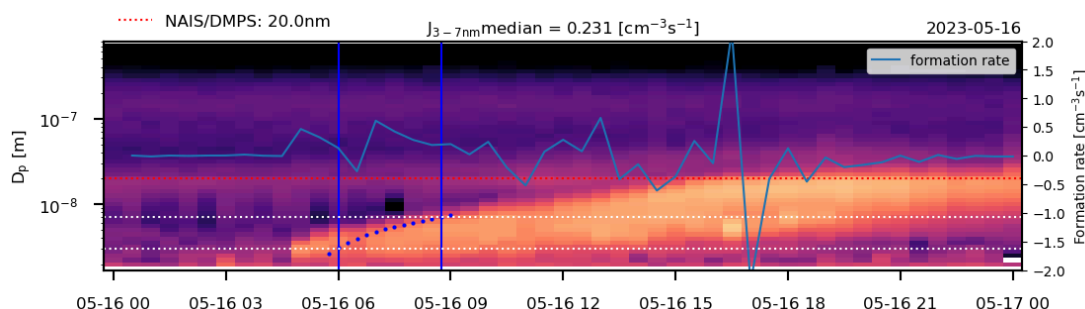


Fig. S18: Example event day (2023-05-16) for the calculation of formation rates. The dotted red line shows where the NAIS and DMPS merge at 20nm. The dotted white lines show the 3nm and 7nm diameters. The dark blue vertical lines show the datetimes when the growing nucleation mode was at 3nm and 7nm. The estimated formation rates are displayed in light blue and superimposed. The median formation rate (J_{3-7nm} median) is the median value within the blue vertical lines.

S6 Polar night events

The polar night events include the following:

1. 2022-11-25 20:00 - 2022-11-26 15:00, 2. 2023-10-25 20:00 - 2023-10-26 23:50, 3a. 2023-10-28 01:00 – 2023-10-29 02:00, 3b. 2023-10-28 12:00 – 2023-10-29 15:00, 4. 2023-11-01 09:00 - 2023-11-02 18:00, 5. 2023-11-02 21:00 -2023-11-03 06:00.

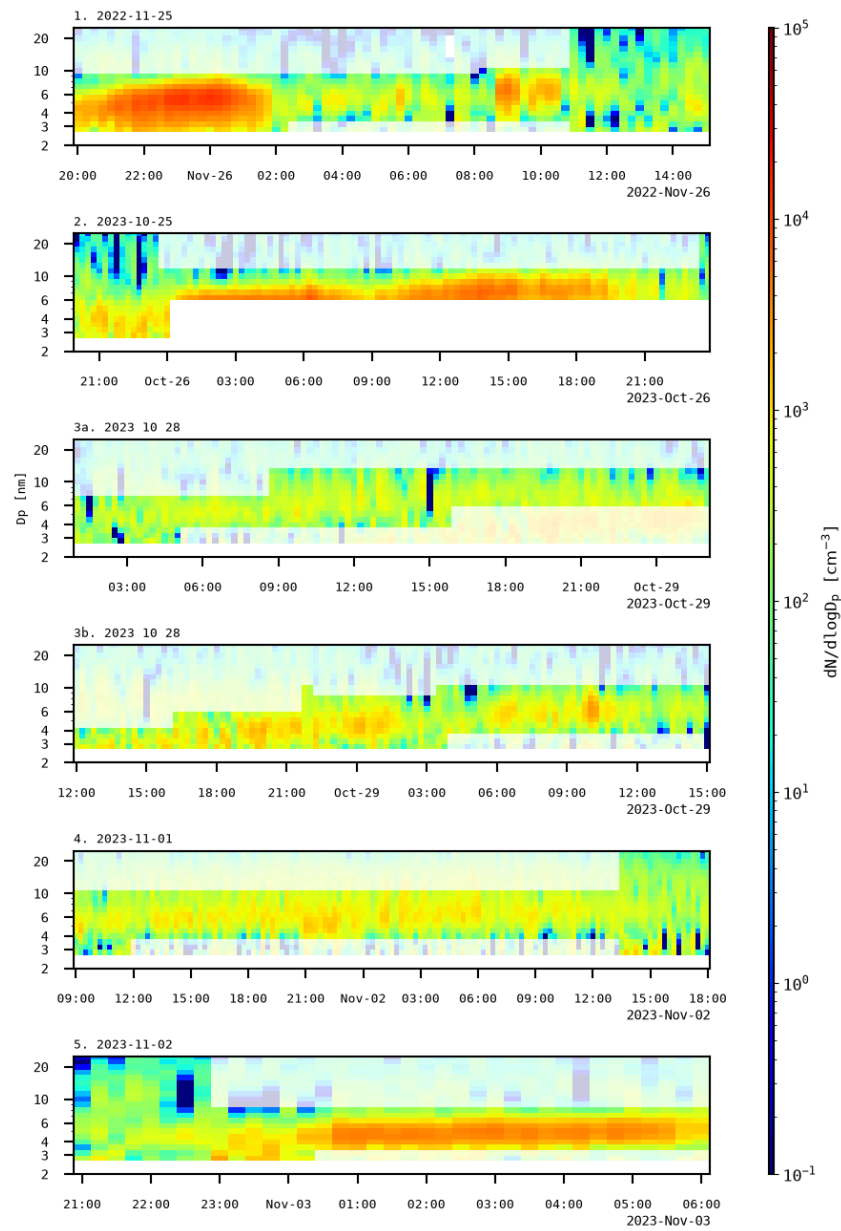


Fig. S19: Particle number size distribution surface plots for the polar night events.

S6.1 Altitude of all polar night events

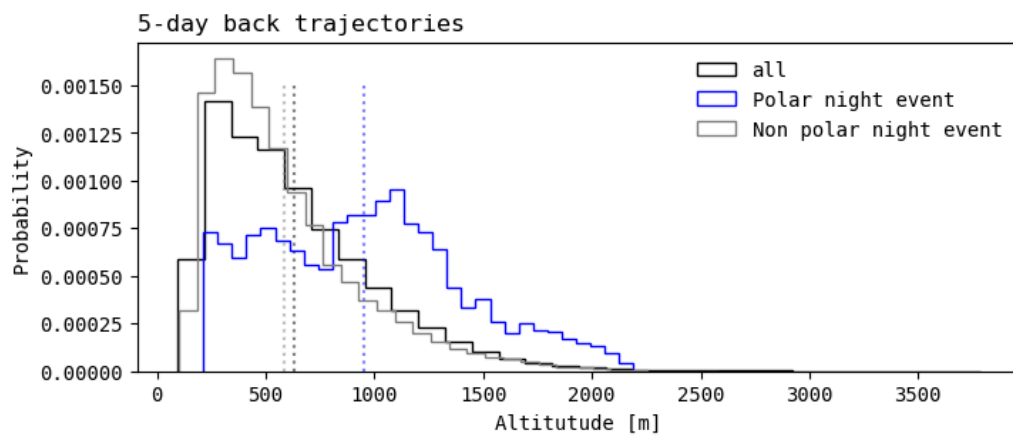


Fig. S20: Histogram for the altitudes of all the endpoints that make up the 5-day back trajectories, comparing all NPF events not during the polar day and all the polar night events (defined as events after the 26th of October). The vertical lines represent the mean altitudes for the various subsections of the data, the colours of the dashed lines correspond to the various subsets.

S7 Marine air mass sectors

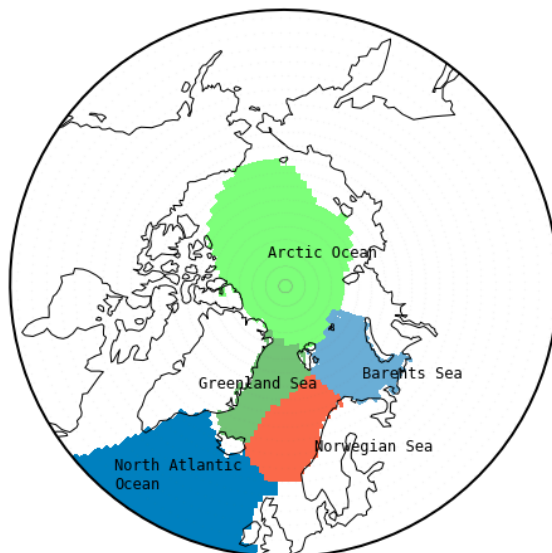


Fig S21: The definitions for the marine air mass sectors based on marine domains. Using the marine areas / Ocean basins outlined in https://regionmask.readthedocs.io/en/stable/defined_ocean_basins.html and obtained by Natural Earth <https://www.naturalearthdata.com/>

S7.1 Air mass origin (marine sectors)

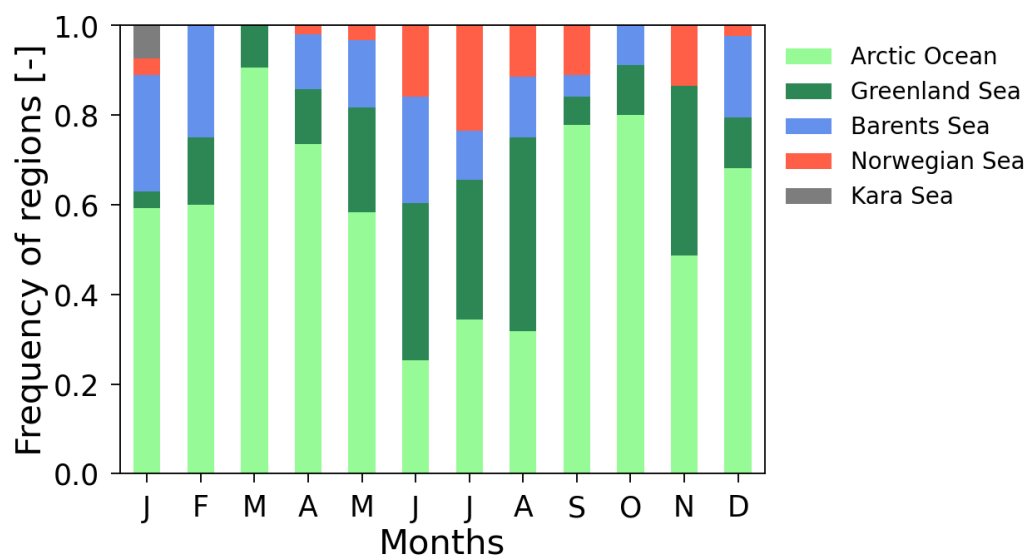


Fig S22: The air mass origin based on the different marine sectors. The relative monthly frequency for each basin with the other basins removed. The basins are defined as shown in Fig. S20.

S8 Comparison of estimated condensable vapours with Boyer et al. (2024)

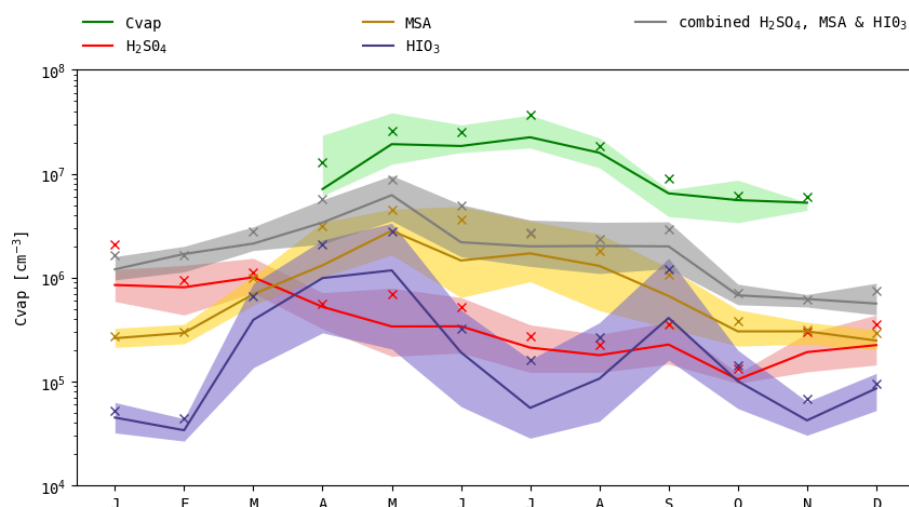


Fig S23: The monthly means (crosses) and medians (thick line), along with the 25th and 75th percentiles (shaded region) for the estimated concentration of equivalent condensational vapours (Cv, green), and the concentrations of measured high Arctic precursor vapours namely sulphuric acid (H_2SO_4 , red), methanesulphonic acid (MSA, gold) and iodic acid (HIO_3 , purple) and combined (grey) from (Boyer et al., 2024), covering the years 2022 to 2024.

S9 Regime shift: Comparing the concentration of Highly Oxygenated Molecules with the polarity ratio

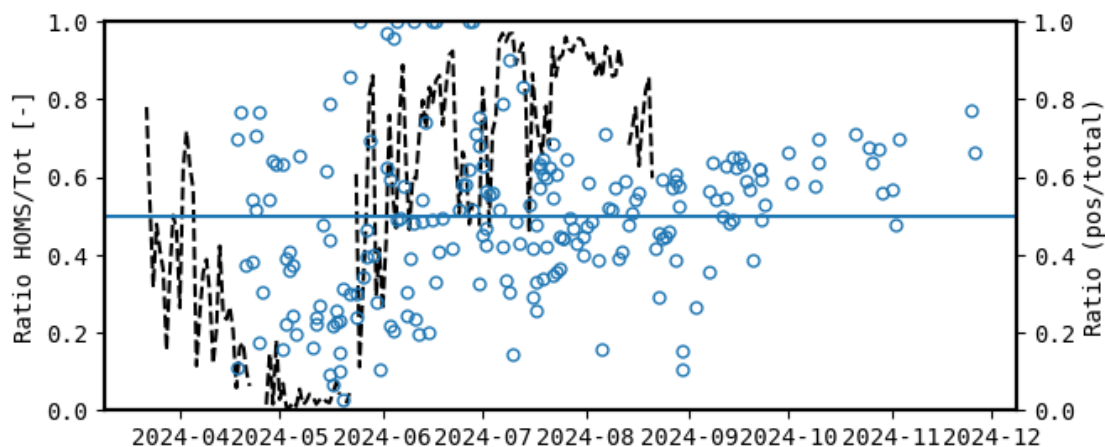


Fig. S24: The ratio of the concentration of HOMs to the total concentration of the combined HOMs, H_2SO_4 , MSA and HIO_3 precursor gases taken from Beck et al., (2021) is represented by a black dashed line, i.e. HOMs/Tot. The blue circles display the ratio of the concentration of positive ions between 2-4nm with the total concentrations of 2-4nm ions. Note that the Ny-Ålesund HOMs data is from April 12 to the end of August 2017.

S10 Predictive model: Region of Interest and Solar Flux/Condensation sink

In this section we detail the two approaches carried out in the study i.e., defining a ROI and using Solar insolation divided by condensation sink (Sun flux/CS).

S10.1 Defining the Region of Interest (ROI)

The normalised plot in the study is constructed by taking the ratio of the figures below (i.e., the ratio of Fig. S25 a) and b)).

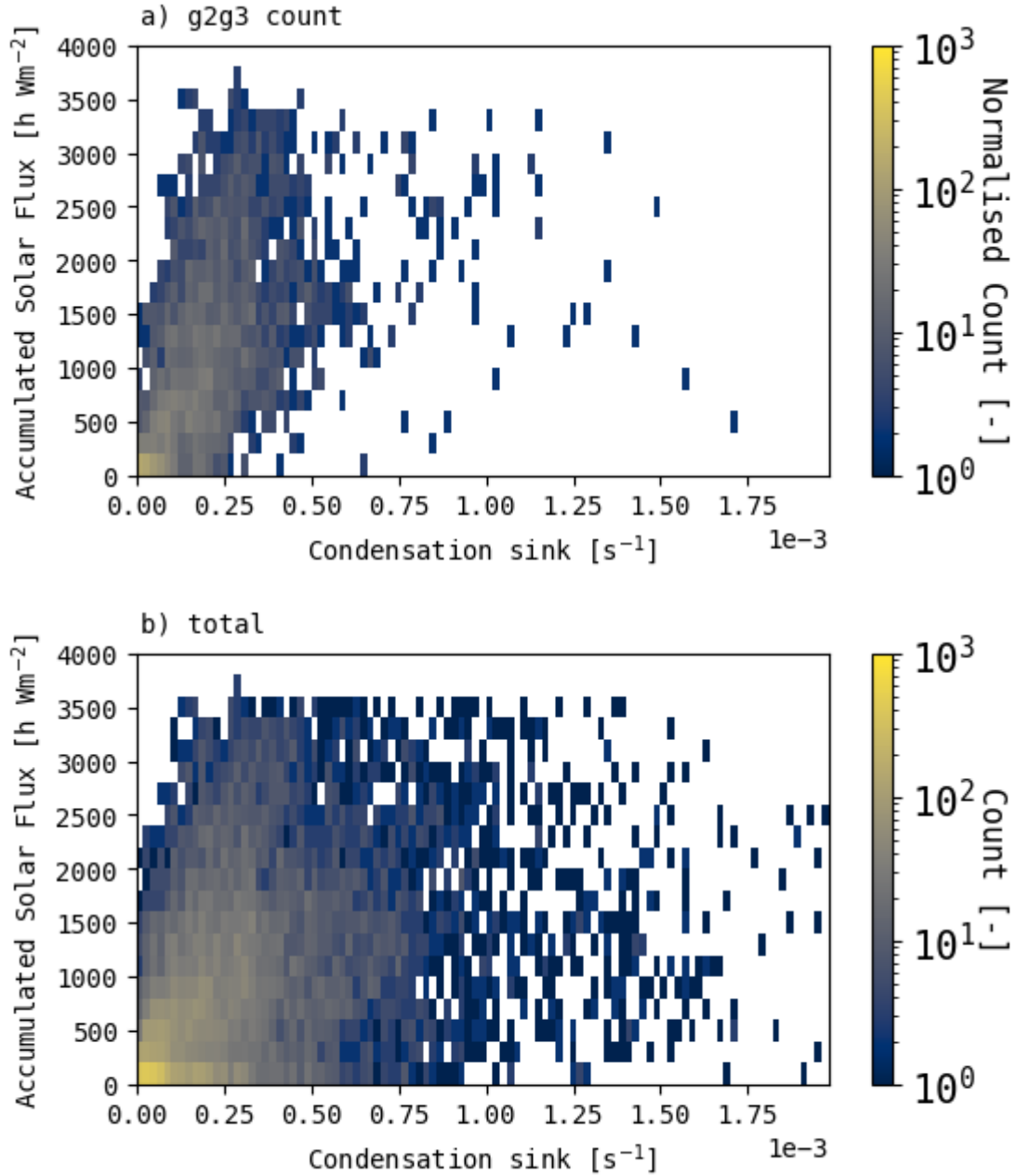


Fig. S25: a) The total number of data points during either g2 or g3 events (as defined by using Aliaga et al. (2023)) for between 2022-04-17 to 2024-10-04. b) The total number of data points for the entire measurement period between 2022-04-17 to 2024-10-04. The data is binned by the hourly accumulated solar insolation and condensation sink (CS) (CS between $0 - 10^{-3} \text{ s}^{-1}$ every $2 \cdot 10^{-5} \text{ s}^{-1}$ and solar insolation between $0 - 4 \cdot 10^4 \text{ Wm}^{-2}$ every 200 Wm^{-2}). A count threshold of 1 has been applied. Notice the colourscale is in log scale.

S10.2 Verification of predictive model: Region of Interest and Solar Flux/Condensation sink

Figure S26 shows that there is a good agreement between the nano-ranking method and the parameters for solar insolation/condensation sink (Sun flux/CS). Note that a rolling 30-day average has been applied here, which is fairly large. However, a R^2 of 0.78 is achieved. It is important to mention though that the exact coefficient of determination depends heavily on the amount of smoothing (as shown in the manuscript). Smoothing of the NPF frequency data is required though as the daily values are given as 1s (NPF event i.e. g2 & g3) and 0s (non-NPF event, i.e., g1

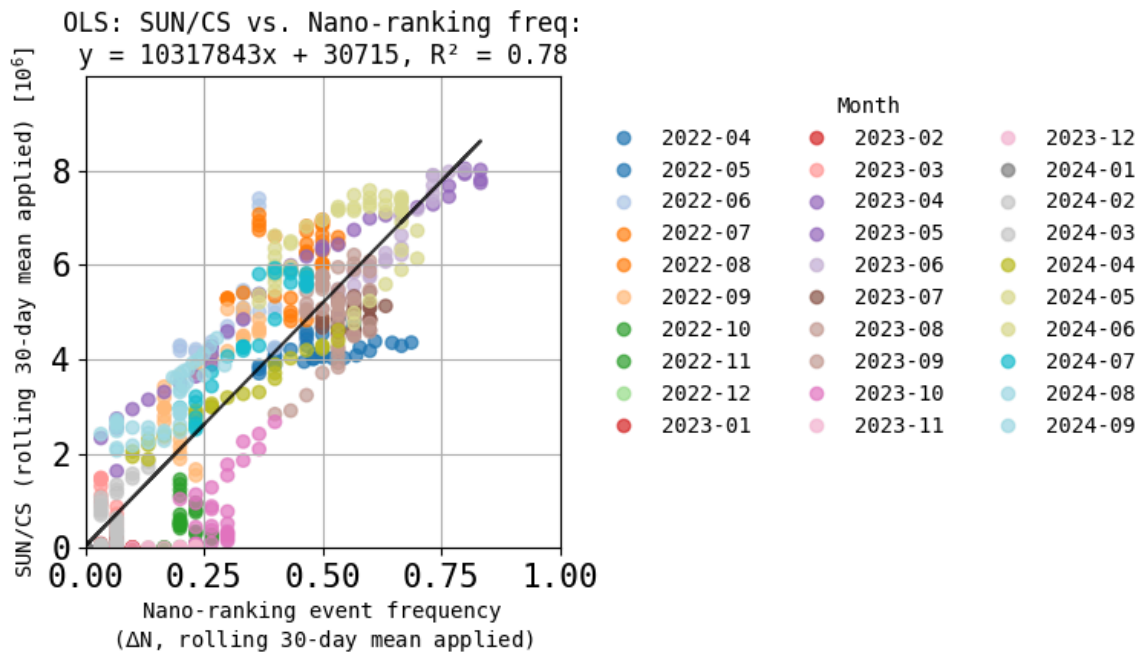


Fig. S26: The comparison between the solar insolation divided by the condensation sink and the frequency of events defined using Aliaga et al. (2023). The ordinary least square method is used to compare the SUN/CS parameter and the event frequency. A rolling 30-day mean is applied to both the SUN/CS and the event frequency. The data points are coloured by the month they occur in. R^2 of 0.78 is estimated.

S10.3 Comparing the Solar insolation, Solar insolation/Condensation Sink with the intensity parameter (i.e. Nano-ranking)

Figure S27 presents how the parameters ‘solar insolation’ and ‘solar insolation/condensation sink’ correlate with the smoothed daily intensity parameter ($\Delta N_{2.8-5nm}$). We argue that 10-20 days of averaging/smoothing ensures that the features (characteristic/seasonal peaks) remain present above the variability, and the data is not smoothed too much. After 10-20 days of smoothing the distinctive seasonal peaks in $\Delta N_{2.8-5nm}$ appear. Using only accumulated solar flux i.e. solar insolation shows better R^2 values compared with solar insolation/condensation sink. Also,

selecting the parts of the back trajectories which traverse through the mixed-layer (ML) improves the R^2 s (i.e., compared to using the accumulated flux along the entire back trajectory).

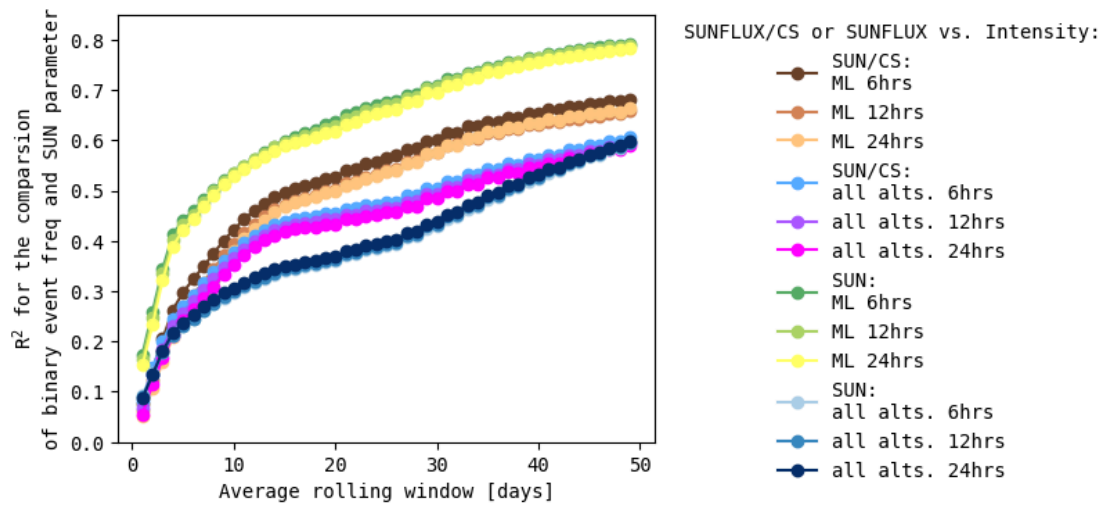


Fig. S27: The coefficient of determination is displayed as a function of the size of the rolling window average (in number of days). The length of the back trajectory varies from the first 6, 12 and 24 hours. Each length is given a slightly different shade. A rolling average is applied to the accumulated solar insolation (SUN) and the accumulated solar insolation divided by the condensation sink (SUN/CS). Parts of the back trajectory which only traversed through the mixed-layer are labelled as ML, whilst the entire back trajectory is given by all alts. The brown curves represent the comparison between the SUN/CS within the mixed-layer part of the back trajectory and the event intensity. Blue and pink curves are the comparison between SUN (for all alts.)/CS and the event intensity, green curves the SUN within the ML and event intensity, and blue curves the SUN for all alts and event intensity.

S10.4 Comparing the Nano-ranking with the Region of Interest (ROI)

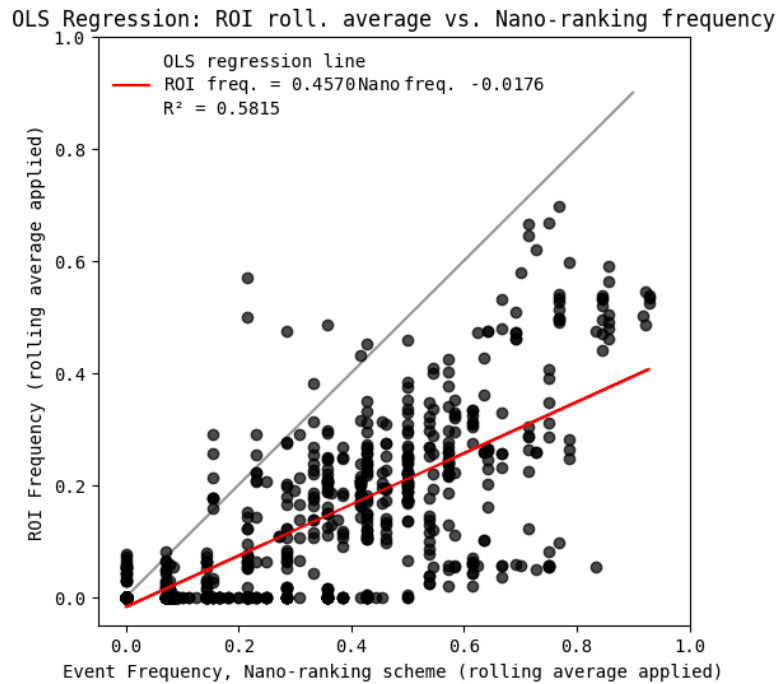


Fig. S28: Comparison of the frequency in the occurrence of the values in the ROI and the frequency of occurrence of g2 and g3 events as described by the Nano-ranking method i.e. Aliaga et al. (2023). The ordinary least square (OLS) is used here to compare the two parameters.

S11 Solar insolation and Condensation Sink (Mann-Whitney U test)

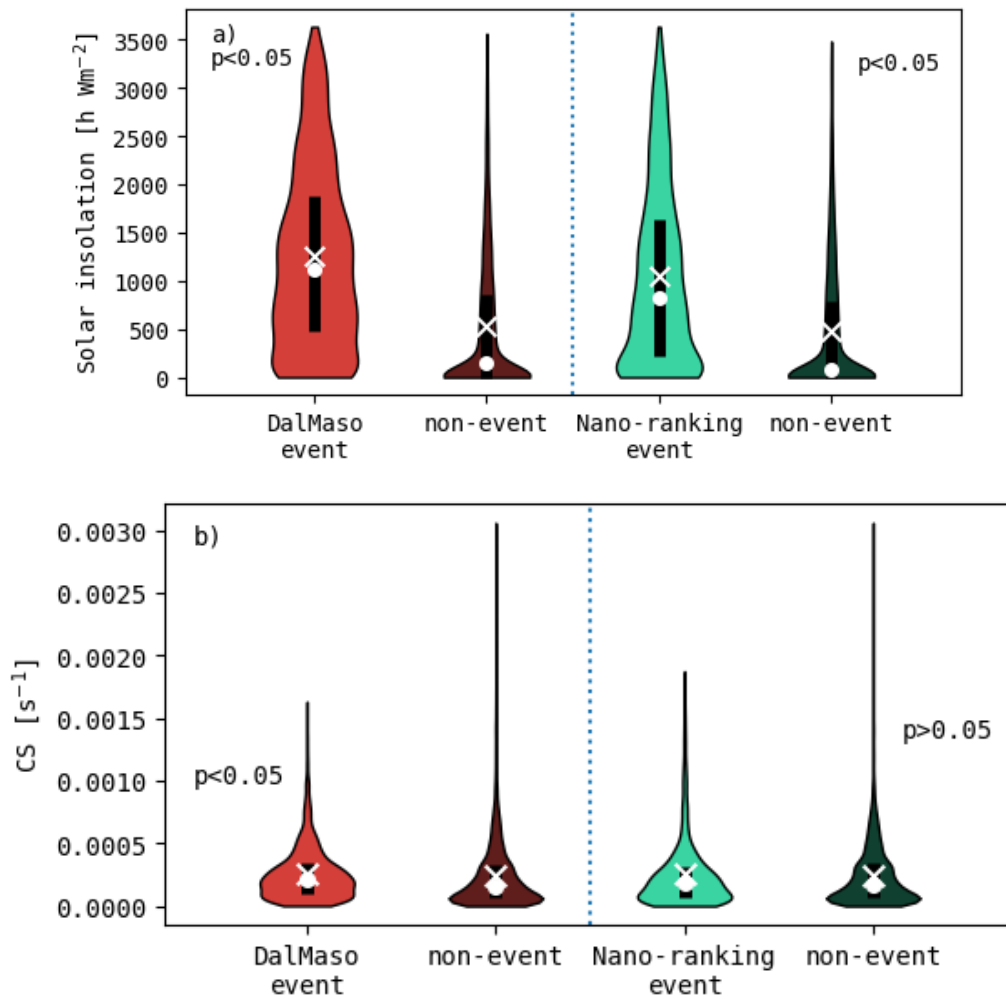


Fig S29: Comparisons of the distributions of (a) solar insolation and (b) CS for events and non-events. Distributions are presented as shaded violins. Red denotes the separation of events classified using the Dal Maso scheme. Green denotes the separation of events and non-events based on the Nano-ranking approach. The light shaded violin denotes the events and the darker shaded violin displays the non-events. If the distributions are deemed to be statistically significantly different a $p < 0.05$ is stated, otherwise $p > 0.05$ is shown.

S12 DMS and Chlorophyll a (S30-S37)

We attempted to follow Park et al. (2018) as best we could in trying to replicate their analysis. The following steps were taken:

- Daily Aqua MODIS Chlorophyll data was downloaded and for each date an 8-day data set was created
- For all the DMS data ensemble back trajectories were read in. Endpoints which experienced pressure less than 850hPa were excluded from the analysis. All back trajectories were shortened to 2-days

- Using the latitude and longitude the closest chlorophyll data point was selected (this approach differs from Park et al., (2018) as they created a 25km radius)
- The exponential term was appended for each datetime i.e. $e^{-\alpha\left(\frac{t}{24}\right)}$
- The distance between each endpoint was calculated and divided by 60·60 to estimate the wind speed for an endpoint
- The chlorophyll term Chl_t was multiplied by the exponential term to create an exposure term which was then summed for the entire 2-day back trajectory
- The term was then normalised by the number of chlorophyll data points i.e. n

$$E_{chl} = \frac{\sum_{t=1}^{48} Chl_t \cdot e^{-\alpha\left(\frac{t}{24}\right)}}{n},$$

where 0.43 was used for α (35% DMS loss per day in Arctic atmosphere). This could also be varied as it depends on the lifetime of DMS.

After calculating the chlorophyll exposure, the data was filtered as follows:

- Apply a sector mask where Greenland Sea is defined as $70 < \text{latitude} < 80$, $-25 < \text{longitude} < 16$. Sea ice zone ($80 < \text{latitude}$) and Barents Sea ($70 < \text{latitude} < 80$, $16 < \text{longitude} < 50$).
- Any 2-day air mass back trajectory for which valid chlorophyll concentration data were not available for >50% of the time points were excluded from our analysis
- Data where the windspeed was below 3ms^{-1} was excluded
- In Lee et al., back trajectories that had >90% retention in a given ocean domain were used. However, here we have decided to use lower retention times as they did not match due to the use of ensembles. Also, we present a $R2$ dependent on retention for the ensemble timestep
- use monthly mean chlorophyll values if 8 day mean chlorophyll values were not available

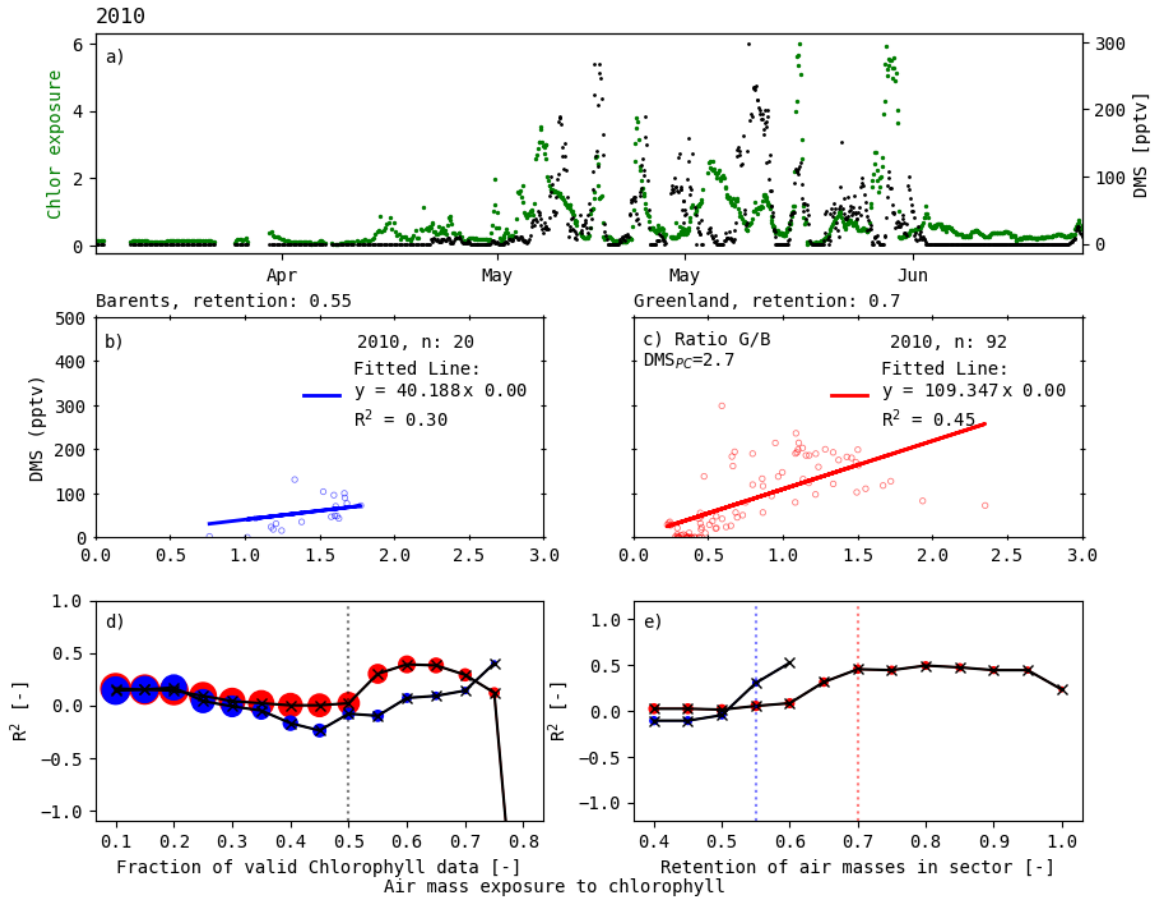


Figure S30: Atmospheric DMS and its relation to phytoplankton Biomass: (a) the timeseries displaying the air mass exposure to chlorophyll (green) and DMS measurements as measured at ZEP (black) for the year 2010. b) – c) the back trajectories split into Barents Sea sector (blue) and Greenland Sea sector (red). The ordinary least square displays the correlation between DMS and Air mass exposure to chlorophyll after filters (mentioned above) have been applied to the data. d) and e) split the data in the respective sectors however the fraction of valid chlorophyll data is altered to see the change in R^2 and the retention (i.e., the fraction of time valid data points spent in each sector) is also altered. The ratio between the Greenland (G) and Barents (B) Sea DMS production capacity is denoted in the left-hand corner of c) as Ratio G/B DMS_{PC}.

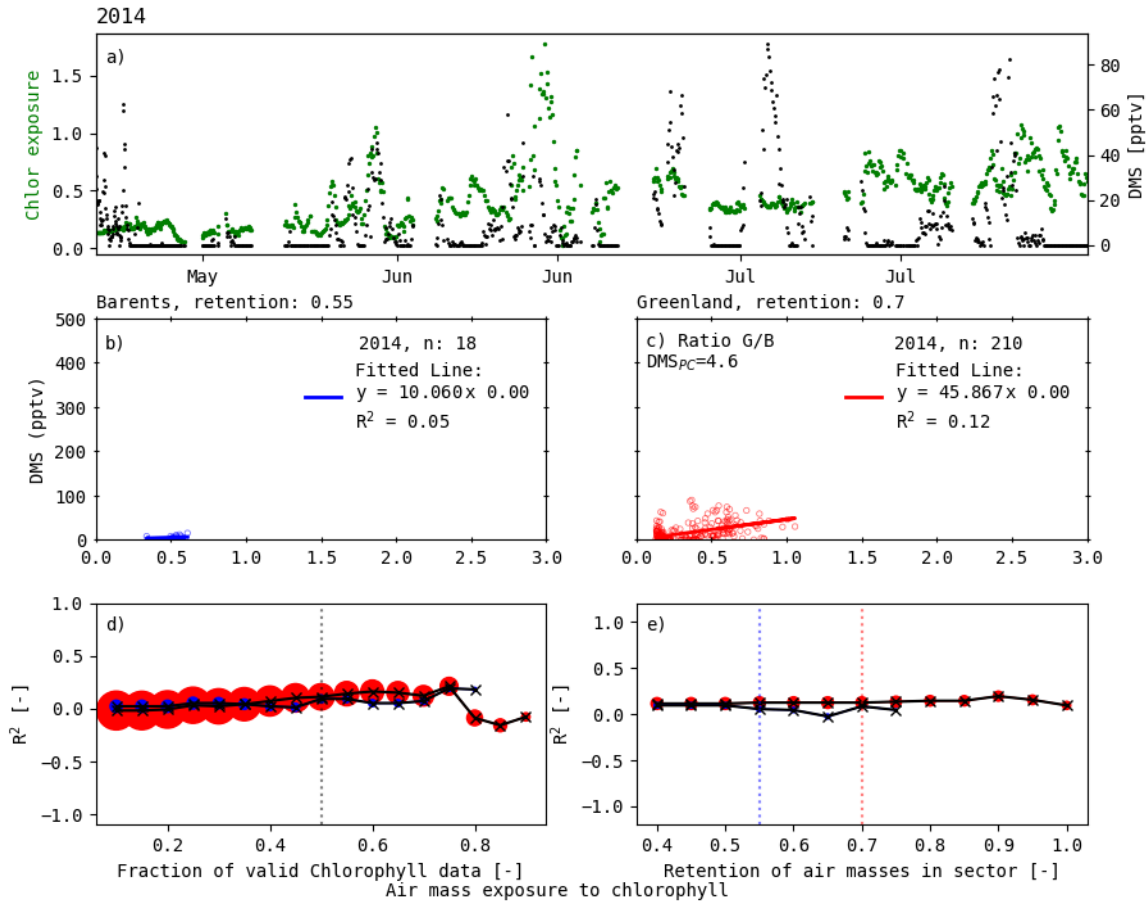


Figure S31: Atmospheric DMS and its relation to phytoplankton Biomass: (a) the timeseries displaying the air mass exposure to chlorophyll (green) and DMS measurements as measured at ZEP (black) for the year 2014. b) – c) the back trajectories split into Barents Sea sector (blue) and Greenland Sea sector (red). The ordinary least square displays the correlation between DMS and Air mass exposure to chlorophyll after filters (mentioned above) have been applied to the data. d) and e) split the data in the respective sectors however the fraction of valid chlorophyll data is altered to see the change in R^2 and the retention (i.e., the fraction of time valid data points spent in each sector) is also altered. The ratio between the Greenland (G) and Barents (B) Sea DMS production capacity is denoted in the left-hand corner of c) as Ratio G/B DMS_{PC} .

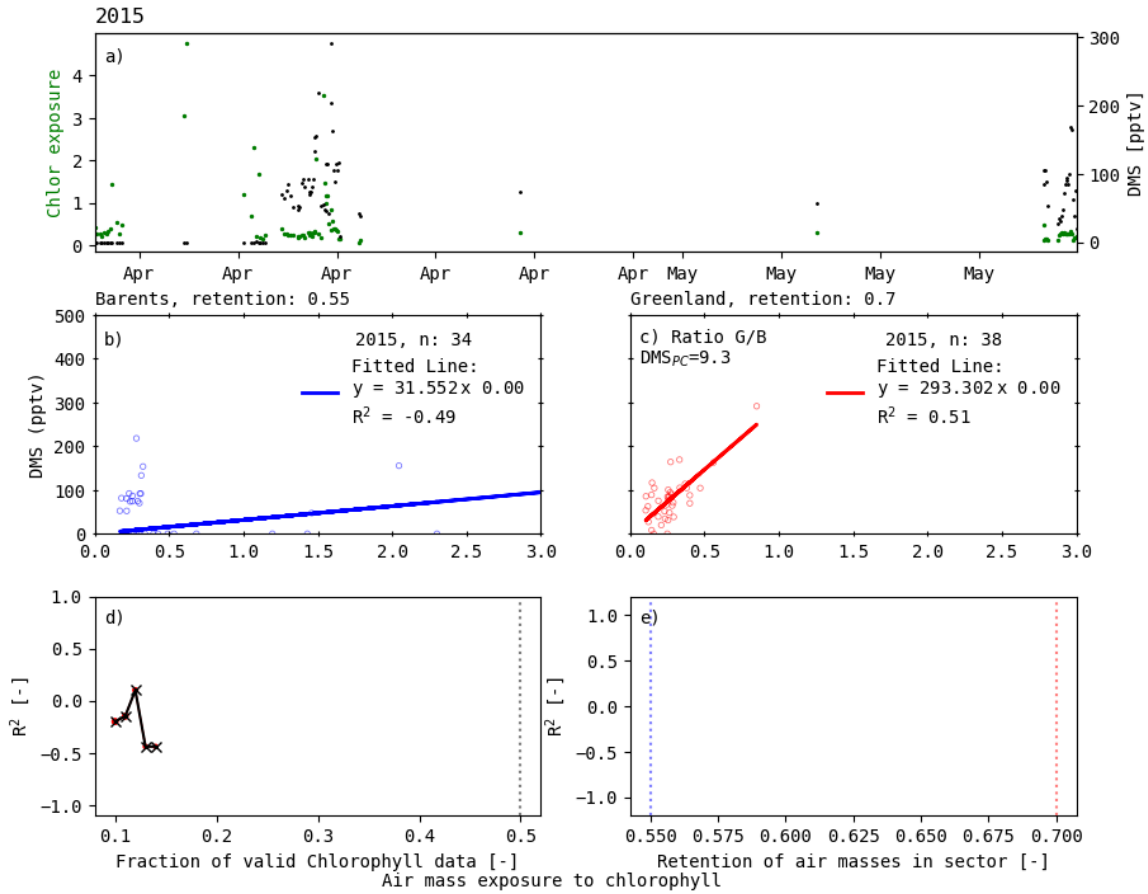


Figure S32: Atmospheric DMS and its relation to phytoplankton Biomass: (a) the timeseries displaying the air mass exposure to chlorophyll (green) and DMS measurements as measured at ZEP (black) for the year 2015. b) – c) the back trajectories split into Barents Sea sector (blue) and Greenland Sea sector (red). The ordinary least square displays the correlation between DMS and Air mass exposure to chlorophyll after filters (mentioned above) have been applied to the data. d) and e) split the data in the respective sectors however the fraction of valid chlorophyll data is altered to see the change in R^2 and the retention (i.e., the fraction of time valid data points spent in each sector) is also altered. The ratio between the Greenland (G) and Barents (B) Sea DMS production capacity is denoted in the left-hand corner of c) as Ratio G/B DMS_{PC} .

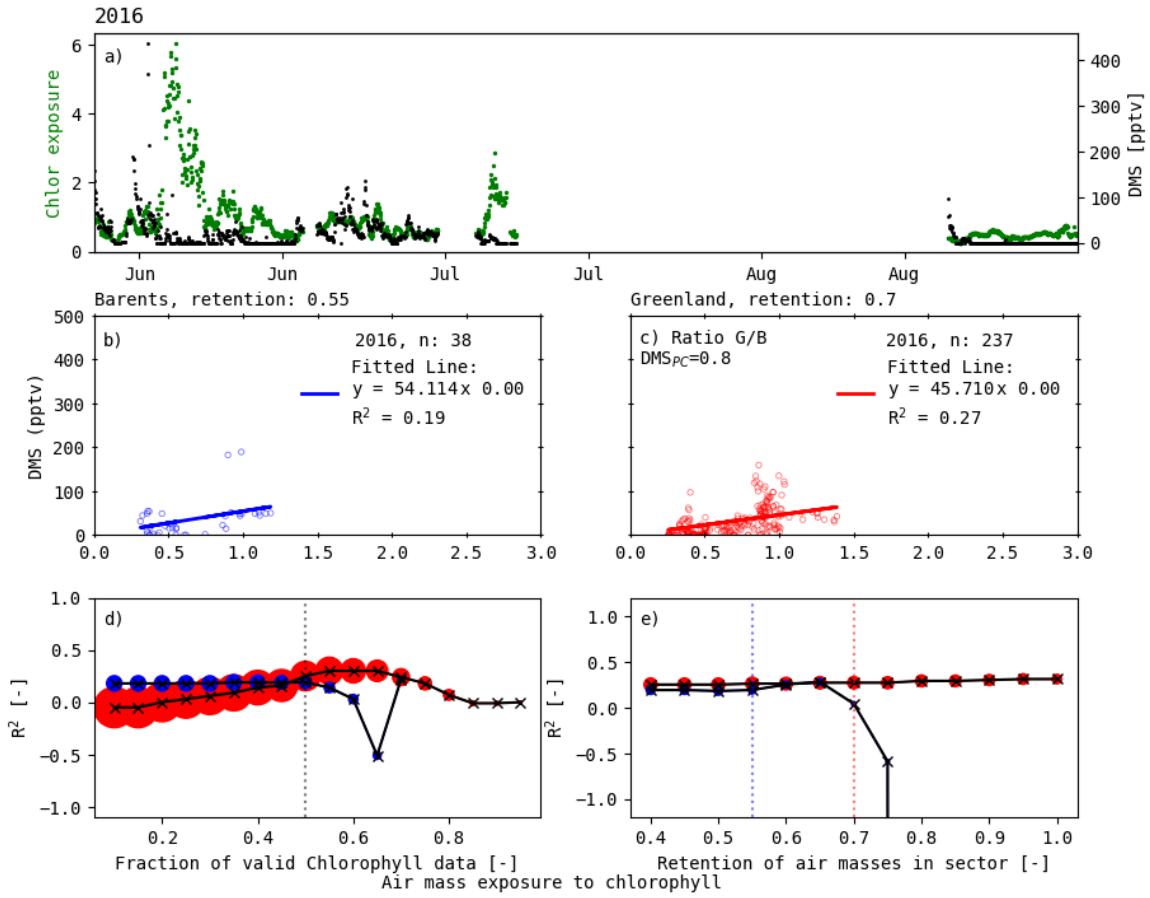


Figure S33: Atmospheric DMS and its relation to phytoplankton Biomass: (a) the timeseries displaying the air mass exposure to chlorophyll (green) and DMS measurements as measured at ZEP (black) for the year 2016. (b) – (c) the back trajectories split into Barents Sea sector (blue) and Greenland Sea sector (red). The ordinary least square displays the correlation between DMS and Air mass exposure to chlorophyll after filters (mentioned above) have been applied to the data. (d) and (e) split the data in the respective sectors however the fraction of valid chlorophyll data is altered to see the change in R^2 and the retention (i.e., the fraction of time valid data points spent in each sector) is also altered. The ratio between the Greenland (G) and Barents (B) Sea DMS production capacity is denoted in the left-hand corner of (c) as Ratio G/B DMS_{PC} .

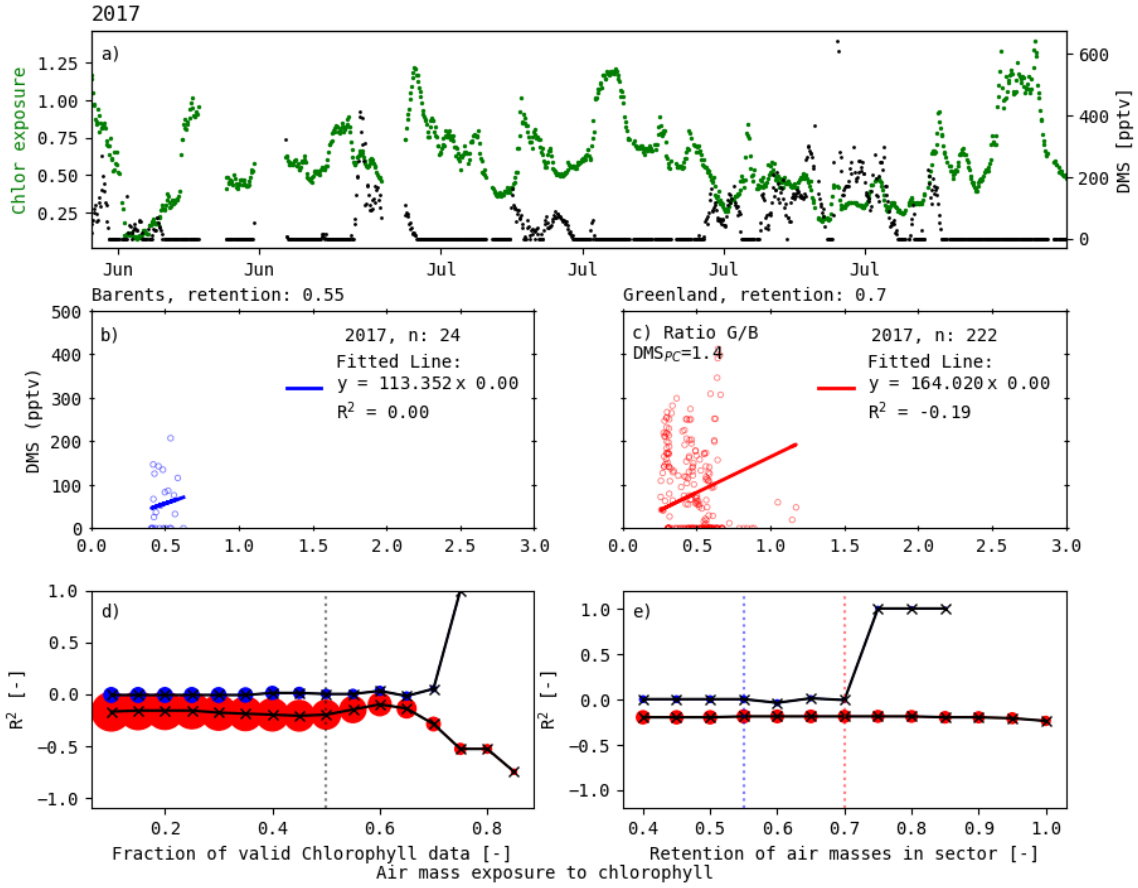


Figure S34: Atmospheric DMS and its relation to phytoplankton Biomass: (a) the timeseries displaying the air mass exposure to chlorophyll (green) and DMS measurements as measured at ZEP (black) for the year 2017. b) – c) the back trajectories split into Barents Sea sector (blue) and Greenland Sea sector (red). The ordinary least square displays the correlation between DMS and Air mass exposure to chlorophyll after filters (mentioned above) have been applied to the data. d) and e) split the data in the respective sectors however the fraction of valid chlorophyll data is altered to see the change in R^2 and the retention (i.e., the fraction of time valid data points spent in each sector) is also altered. The ratio between the Greenland (G) and Barents (B) Sea DMS production capacity is denoted in the left-hand corner of c) as Ratio G/B DMS_{PC} .

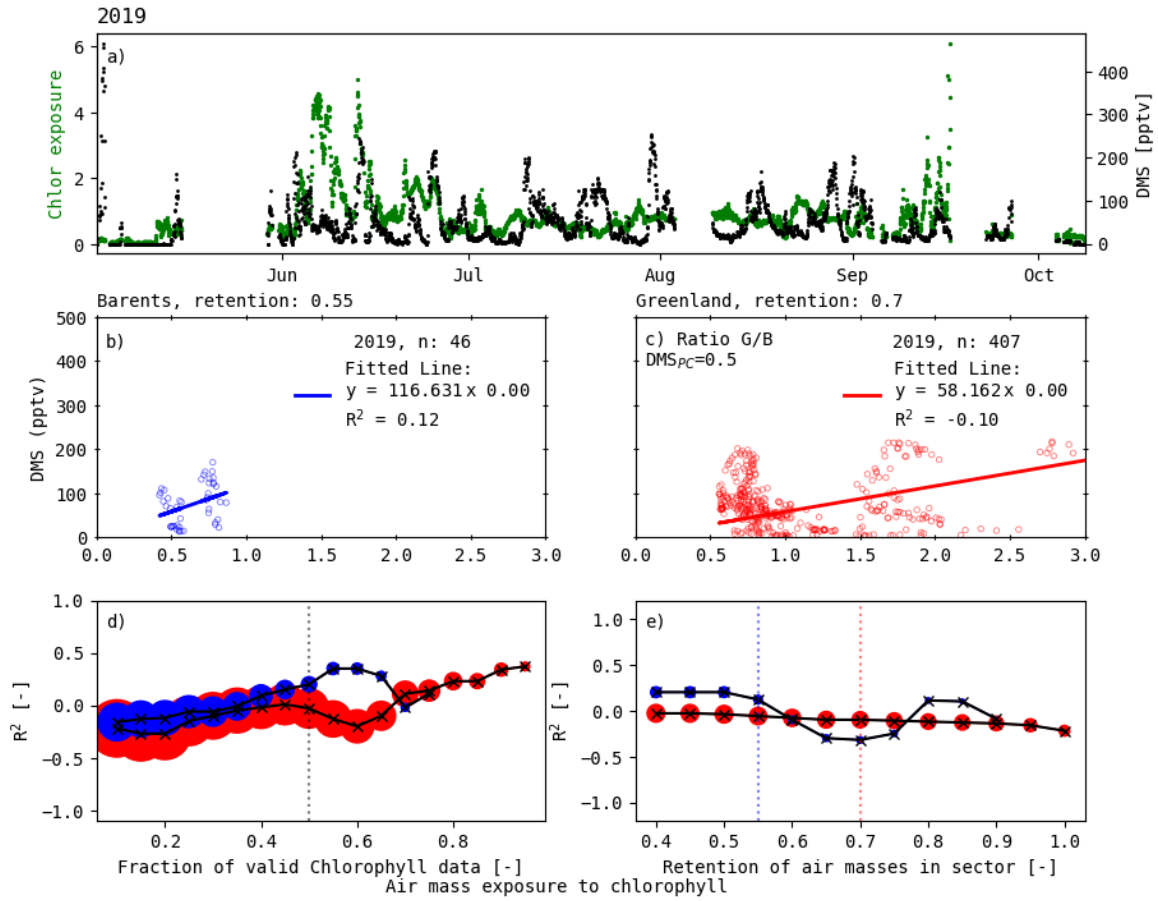


Figure S35: Atmospheric DMS and its relation to phytoplankton Biomass: (a) the timeseries displaying the air mass exposure to chlorophyll (green) and DMS measurements as measured at ZEP (black) for the year 2019. b) – c) the back trajectories split into Barents Sea sector (blue) and Greenland Sea sector (red). The ordinary least square displays the correlation between DMS and Air mass exposure to chlorophyll after filters (mentioned above) have been applied to the data. d) and e) split the data in the respective sectors however the fraction of valid chlorophyll data is altered to see the change in R^2 and the retention (i.e., the fraction of time valid data points spent in each sector) is also altered. The ratio between the Greenland (G) and Barents (B) Sea DMS production capacity is denoted in the left-hand corner of c) as Ratio G/B DMS_{PC} .

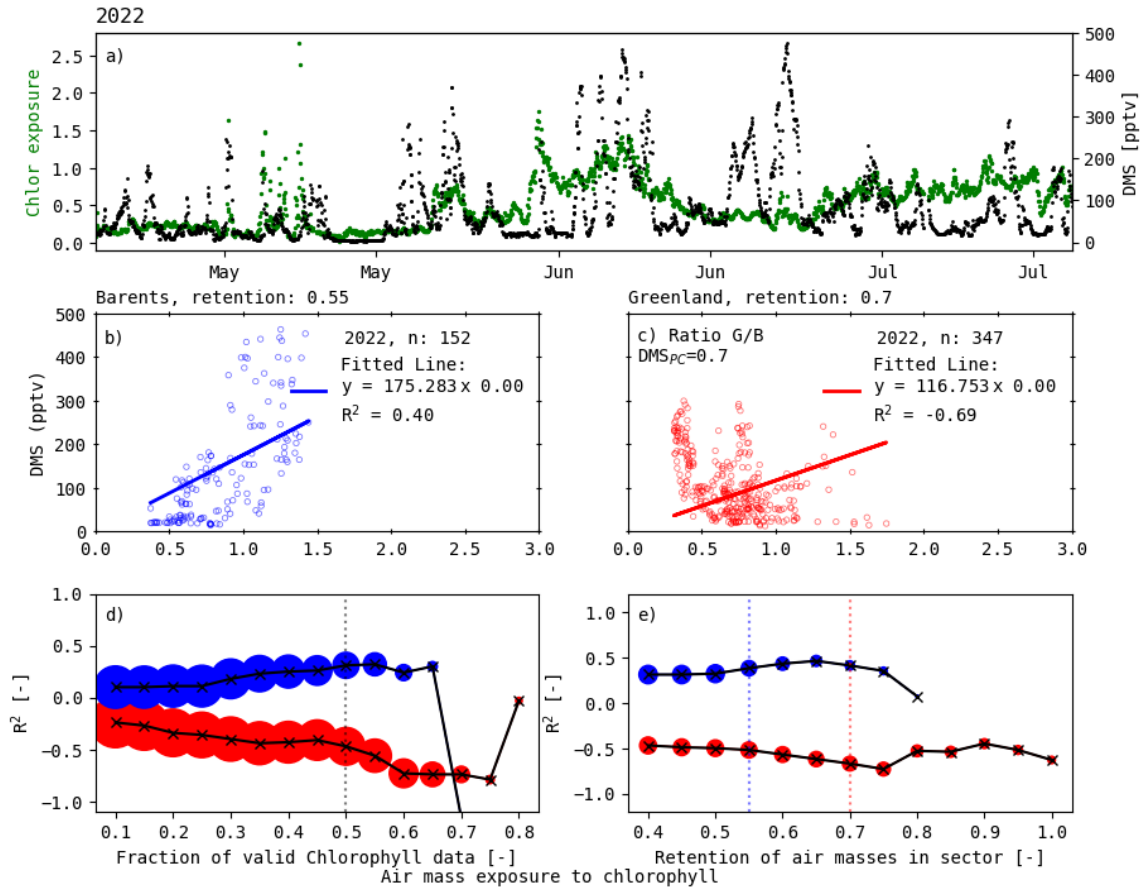


Figure S36: Atmospheric DMS and its relation to phytoplankton Biomass: (a) the timeseries displaying the air mass exposure to chlorophyll (green) and DMS measurements as measured at ZEP (black) for the year 2022. b) – c) the back trajectories split into Barents Sea sector (blue) and Greenland Sea sector (red). The ordinary least square displays the correlation between DMS and Air mass exposure to chlorophyll after filters (mentioned above) have been applied to the data. d) and e) split the data in the respective sectors however the fraction of valid chlorophyll data is altered to see the change in R^2 and the retention (i.e., the fraction of time valid data points spent in each sector) is also altered. The ratio between the Greenland (G) and Barents (B) Sea DMS production capacity is denoted in the left-hand corner of c) as Ratio G/B DMS_{PC} .

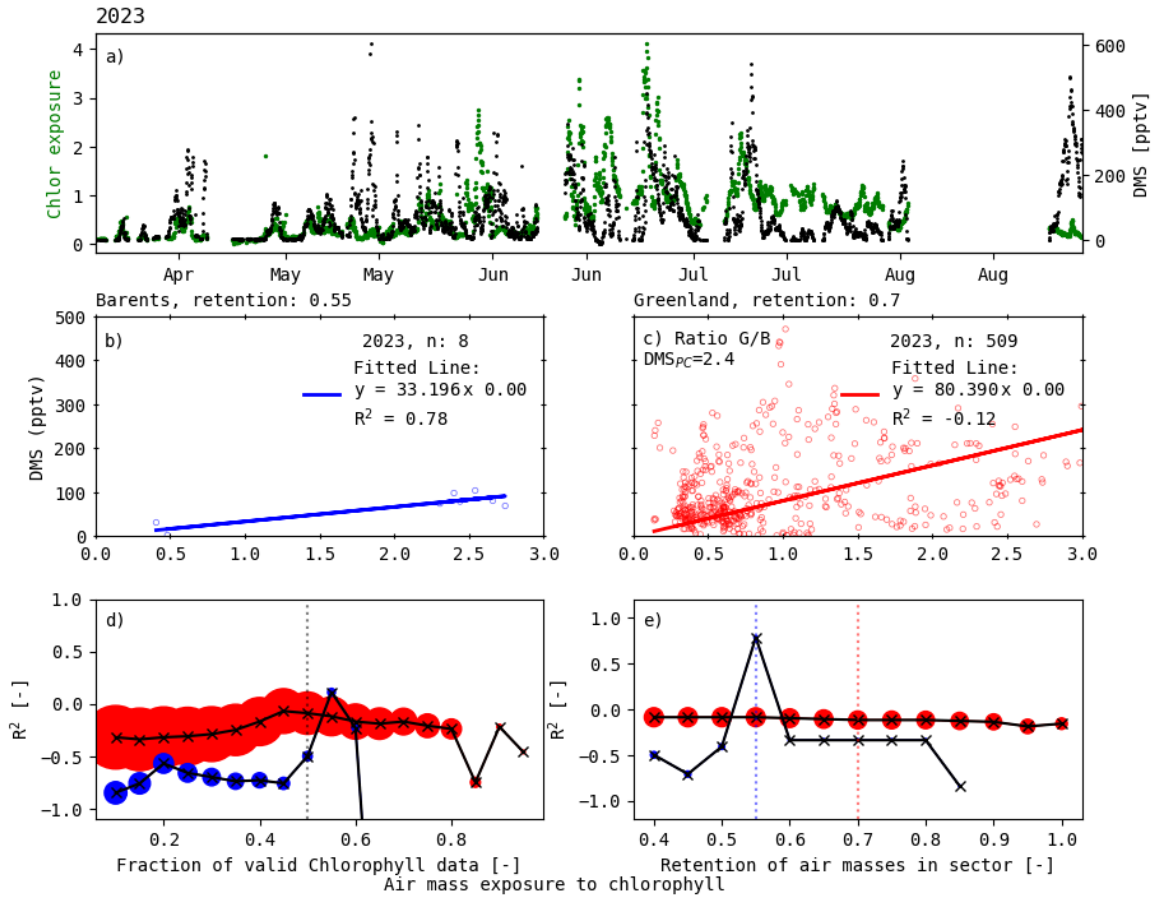


Figure S37: Atmospheric DMS and its relation to phytoplankton Biomass: (a) the timeseries displaying the air mass exposure to chlorophyll (green) and DMS measurements as measured at ZEP (black) for the year 2022. b) – c) the back trajectories split into Barents Sea sector (blue) and Greenland Sea sector (red). The ordinary least square displays the correlation between DMS and Air mass exposure to chlorophyll after filters (mentioned above) have been applied to the data. d) and e) split the data in the respective sectors however the fraction of valid chlorophyll data is altered to see the change in R^2 and the retention (i.e., the fraction of time valid data points spent in each sector) is also altered. The ratio between the Greenland (G) and Barents (B) Sea DMS production capacity is denoted in the left-hand corner of c) as Ratio G/B DMS_{PC} .

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