



*Supplement of*

## **Ice-nucleating particles at Ny-Ålesund: a study of condensation freezing by the Dynamic Filter Processing Chamber**

**Matteo Rinaldi et al.**

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Table S1. Sampling start and stop time of all the aerosol samples

| Sample ID # | Filter Sampling Start Time<br>UTC | Filter Sampling Stop Time<br>UTC |
|-------------|-----------------------------------|----------------------------------|
| GVB_spr_01  | 17/04/2018 08:00                  | 17/04/2018 11:00                 |
| GVB_spr_02  | 18/04/2018 08:00                  | 18/04/2018 11:00                 |
| GVB_spr_03  | 19/04/2018 08:00                  | 19/04/2018 11:00                 |
| GVB_spr_04  | 20/04/2018 15:00                  | 20/04/2018 18:00                 |
| GVB_spr_05  | 21/04/2018 13:00                  | 21/04/2018 16:00                 |
| GVB_spr_06  | 22/04/2018 14:00                  | 22/04/2018 17:00                 |
| GVB_spr_07  | 23/04/2018 12:40                  | 23/04/2018 15:40                 |
| GVB_spr_08  | 24/04/2018 15:00                  | 24/04/2018 18:00                 |
| GVB_spr_09  | 25/04/2018 10:00                  | 25/04/2018 13:00                 |
| GVB_spr_10  | 26/04/2018 16:00                  | 26/04/2018 19:00                 |
| GVB_spr_11  | 27/04/2018 18:00                  | 27/04/2018 21:00                 |
| GVB_spr_12  | 28/04/2018 19:00                  | 28/04/2018 22:00                 |
| GVB_spr_13  | 29/04/2018 14:00                  | 29/04/2018 17:00                 |
| GVB_spr_14  | 30/04/2018 10:00                  | 30/04/2018 13:00                 |
| GVB_spr_15  | 01/05/2018 12:00                  | 01/05/2018 15:00                 |
| GVB_spr_16  | 02/05/2018 10:00                  | 02/05/2018 16:00                 |
| GVB_sum_01  | 11/07/2018 18:05                  | 11/07/2018 21:05                 |
| GVB_sum_02  | 12/07/2018 19:30                  | 12/07/2018 22:30                 |
| GVB_sum_03  | 13/07/2018 19:30                  | 13/07/2018 22:30                 |
| GVB_sum_04  | 14/07/2018 18:00                  | 14/07/2018 21:00                 |
| GVB_sum_05  | 15/07/2018 19:00                  | 15/07/2018 22:00                 |
| GVB_sum_06  | 16/07/2018 19:00                  | 16/07/2018 22:00                 |
| GVB_sum_07  | 17/07/2018 17:00                  | 17/07/2018 20:00                 |
| GVB_sum_08  | 18/07/2018 18:00                  | 18/07/2018 21:00                 |
| GVB_sum_09  | 19/07/2018 18:00                  | 19/07/2018 21:00                 |
| GVB_sum_10  | 20/07/2018 18:00                  | 20/07/2018 21:00                 |
| GVB_sum_11  | 21/07/2018 16:00                  | 21/07/2018 19:00                 |
| GVB_sum_12  | 22/07/2018 16:00                  | 22/07/2018 19:00                 |
| GVB_sum_13  | 23/07/2018 18:00                  | 23/07/2018 21:00                 |
| GVB_sum_14  | 24/07/2018 19:00                  | 24/07/2018 22:00                 |
| GVB_sum_15  | 25/07/2018 17:00                  | 25/07/2018 20:00                 |
| GVB_sum_16  | 26/07/2018 18:00                  | 26/07/2018 21:00                 |
| GVB_sum_17  | 27/07/2018 16:00                  | 27/07/2018 19:00                 |
| GVB_spr_17  | 12/04/2019 12:45                  | 12/04/2019 15:45                 |
| GVB_spr_18  | 13/04/2019 11:40                  | 13/04/2019 14:40                 |
| GVB_spr_19  | 14/04/2019 14:50                  | 14/04/2019 17:50                 |
| GVB_spr_20  | 15/04/2019 16:04                  | 15/04/2019 19:04                 |
| GVB_spr_21  | 16/04/2019 16:04                  | 16/04/2019 19:04                 |
| GVB_spr_22  | 17/04/2019 16:25                  | 17/04/2019 19:25                 |
| GVB_spr_23  | 18/04/2019 11:45                  | 18/04/2019 14:45                 |
| GVB_spr_24  | 19/04/2019 14:50                  | 19/04/2019 17:50                 |
| GVB_spr_25  | 20/04/2019 14:00                  | 20/04/2019 17:00                 |
| GVB_spr_26  | 21/04/2019 14:24                  | 21/04/2019 17:24                 |

|            |                  |                  |
|------------|------------------|------------------|
| GVB_spr_27 | 22/04/2019 09:53 | 22/04/2019 12:53 |
| GVB_spr_28 | 23/04/2019 11:26 | 23/04/2019 14:26 |
| GVB_sum_18 | 05/07/2019 00:01 | 05/07/2019 03:01 |
| GVB_sum_19 | 06/07/2019 00:01 | 06/07/2019 03:01 |
| GVB_sum_20 | 07/07/2019 00:01 | 07/07/2019 03:01 |
| GVB_sum_21 | 08/07/2019 00:01 | 08/07/2019 03:01 |
| GVB_sum_22 | 09/07/2019 00:01 | 09/07/2019 03:01 |
| GVB_sum_23 | 10/07/2019 00:01 | 10/07/2019 03:01 |
| GVB_sum_24 | 11/07/2019 00:01 | 11/07/2019 03:01 |
| GVB_sum_25 | 12/07/2019 00:01 | 12/07/2019 03:01 |
| GVB_sum_26 | 13/07/2019 00:01 | 13/07/2019 03:01 |
| GVB_sum_27 | 14/07/2019 00:01 | 14/07/2019 03:01 |
| GVB_sum_28 | 15/07/2019 00:01 | 15/07/2019 03:01 |
| GVB_sum_29 | 16/07/2019 00:01 | 16/07/2019 03:01 |
| GVB_sum_30 | 17/07/2019 00:01 | 17/07/2019 03:01 |
| GVB_sum_31 | 18/07/2019 00:01 | 18/07/2019 03:01 |
| GVB_sum_32 | 19/07/2019 00:01 | 19/07/2019 03:01 |
| GVB_sum_33 | 20/07/2019 00:01 | 20/07/2019 03:01 |
| GVB_aut_01 | 04/10/2019 10:00 | 04/10/2019 13:00 |
| GVB_aut_02 | 05/10/2019 10:00 | 05/10/2019 13:00 |
| GVB_aut_03 | 06/10/2019 10:00 | 06/10/2019 13:00 |
| GVB_aut_04 | 07/10/2019 10:00 | 07/10/2019 13:00 |
| GVB_aut_05 | 08/10/2019 10:00 | 08/10/2019 13:00 |
| GVB_aut_06 | 09/10/2019 10:00 | 09/10/2019 13:00 |
| GVB_aut_07 | 10/10/2019 10:00 | 10/10/2019 13:00 |
| GVB_aut_08 | 11/10/2019 10:00 | 11/10/2019 13:00 |
| GVB_aut_09 | 12/10/2019 10:00 | 12/10/2019 13:00 |
| GVB_aut_10 | 13/10/2019 10:00 | 13/10/2019 13:00 |
| GVB_aut_11 | 14/10/2019 10:00 | 14/10/2019 13:00 |
| GVB_aut_12 | 15/10/2019 10:00 | 15/10/2019 13:00 |
| GVB_aut_13 | 16/10/2019 10:00 | 16/10/2019 13:00 |
| GVB_aut_14 | 17/10/2019 10:00 | 17/10/2019 13:00 |
| GVB_aut_15 | 18/10/2019 10:00 | 18/10/2019 13:00 |
| GVB_aut_16 | 19/10/2019 10:00 | 19/10/2019 13:00 |
| GVB_aut_17 | 20/10/2019 10:00 | 20/10/2019 13:00 |
| GVB_aut_18 | 21/10/2019 10:00 | 21/10/2019 13:00 |
| GVB_aut_19 | 22/10/2019 10:00 | 22/10/2019 13:00 |
| GVB_aut_20 | 23/10/2019 10:00 | 23/10/2019 13:00 |
| GVB_aut_21 | 24/10/2019 10:00 | 24/10/2019 13:00 |
| GVB_aut_22 | 25/10/2019 10:00 | 25/10/2019 13:00 |
| GVB_aut_23 | 26/10/2019 10:00 | 26/10/2019 13:00 |
| GVB_aut_24 | 27/10/2019 09:00 | 27/10/2019 12:00 |
| GVB_aut_25 | 28/10/2019 09:00 | 28/10/2019 12:00 |
| GVB_aut_26 | 29/10/2019 09:00 | 29/10/2019 12:00 |
| GVB_aut_27 | 30/10/2019 09:00 | 30/10/2019 12:00 |
| GVB_aut_28 | 31/10/2019 09:00 | 31/10/2019 12:00 |
| GVB_aut_29 | 01/11/2019 09:00 | 01/11/2019 12:00 |

|            |                  |                  |
|------------|------------------|------------------|
| GVB_aut_30 | 02/11/2019 09:00 | 02/11/2019 12:00 |
| GVB_aut_31 | 04/11/2019 09:00 | 04/11/2019 12:00 |
| GVB_aut_32 | 05/11/2019 09:00 | 05/11/2019 12:00 |
| GVB_aut_33 | 06/11/2019 09:00 | 06/11/2019 12:00 |
| GVB_aut_34 | 09/11/2019 09:00 | 09/11/2019 12:00 |
| GVB_aut_35 | 10/11/2019 09:00 | 10/11/2019 12:00 |
| GVB_aut_36 | 12/11/2019 09:00 | 12/11/2019 12:00 |
| GVB_aut_37 | 14/11/2019 09:00 | 14/11/2019 12:00 |
| GVB_aut_38 | 18/11/2019 09:00 | 18/11/2019 12:00 |
| GVB_aut_39 | 22/11/2019 09:00 | 22/11/2019 12:00 |
| GVB_aut_40 | 24/11/2019 09:00 | 24/11/2019 12:00 |
| GVB_aut_41 | 15/09/2020 00:01 | 15/09/2020 03:01 |
| GVB_aut_42 | 16/09/2020 00:01 | 16/09/2020 03:01 |
| GVB_aut_43 | 17/09/2020 00:01 | 17/09/2020 03:01 |
| GVB_aut_44 | 18/09/2020 00:01 | 18/09/2020 03:01 |
| GVB_aut_45 | 19/09/2020 00:01 | 19/09/2020 03:01 |
| GVB_aut_46 | 20/09/2020 00:01 | 20/09/2020 03:01 |
| GVB_aut_47 | 21/09/2020 00:01 | 21/09/2020 03:01 |
| GVB_aut_48 | 22/09/2020 00:01 | 22/09/2020 03:01 |
| GVB_aut_49 | 23/09/2020 00:01 | 23/09/2020 03:01 |
| GVB_aut_50 | 24/09/2020 00:01 | 24/09/2020 03:01 |
| GVB_aut_51 | 25/09/2020 00:01 | 25/09/2020 03:01 |
| GVB_aut_52 | 26/09/2020 00:01 | 26/09/2020 03:01 |

Table S2. DFPC ice crystals background levels measured in the different campaigns.

|                               | -22°C | -18°C | -15°C |
|-------------------------------|-------|-------|-------|
| Spring + Summer 2018          | 30±4  | 16±6  | 19±6  |
| Spring + Summer + Autumn 2019 | 13±3  | 11±4  | 5±1   |
| Autumn 2020                   | 32±8  | 17±4  | 7±3   |

Table S3. Median and min-max range of the estimate aerosol particle AF in this study and in Li et al. (2023). For the present study, two lower size cuts have been considered for the calculations: 100 nm (AF100) and 500 nm (AF500).

|        | This study<br>AF100  | This study<br>AF500  | Li et al., (2023)<br>AF500 |
|--------|----------------------|----------------------|----------------------------|
| Min    | $2.4 \times 10^{-8}$ | $3.1 \times 10^{-7}$ | $3.0 \times 10^{-7}$       |
| Median | $7.1 \times 10^{-7}$ | $1.6 \times 10^{-5}$ | $1.2 \times 10^{-5}$       |
| Max    | $5.3 \times 10^{-6}$ | $1.1 \times 10^{-3}$ | $2.0 \times 10^{-4}$       |

Tab. S4. Comparison of *n*INP data distributions during consistent periods in 2018 and 2019.

|                           | Ratio           | -22°C | -18°C | -15°C |
|---------------------------|-----------------|-------|-------|-------|
| spring 2018 / spring 2019 | Median          | 1.27  | 1.19  | 1.73  |
|                           | 75th percentile | 0.69  | 1.21  | 1.21  |
|                           | 25th percentile | 1.44  | 2.20  | 5.62  |
| summer 2018 / summer 2019 | Median          | 0.92  | 1.22  | 0.87  |
|                           | 75th percentile | 0.60  | 0.79  | 0.79  |
|                           | 25th percentile | 0.69  | 1.19  | 0.86  |

Table S5. INP levels, precipitations, snow depth and land type contact data for the October – November 2019 campaign. The division in three periods of the campaign refers to the considerations done in Sect. 3.3.

| Period | Date                   | <i>n</i> INP<br>T =<br>-22°C | <i>n</i> INP<br>T =<br>-18°C | <i>n</i> INP<br>T =<br>-15°C | Cumulative<br>precipitation<br>(mm) | Snow<br>depth<br>(cm) | Contact with<br>Sea Water<br>(%) | Contact with<br>Sea Ice<br>(%) |
|--------|------------------------|------------------------------|------------------------------|------------------------------|-------------------------------------|-----------------------|----------------------------------|--------------------------------|
| 1      | Up to 16/10            | 75.8                         | 29.0                         | 11.0                         | 6.1                                 | 0.0                   | 68.6                             | 1.1                            |
| 2      | From 17/10 to<br>08/11 | 64.7                         | 27.1                         | 6.3                          | 9.8                                 | 3.0                   | 28.4                             | 55.6                           |
| 3      | From 09/11             | 39.5                         | 20.3                         | 3.1                          | 25.4                                | 16.5                  | 42.7                             | 28.1                           |

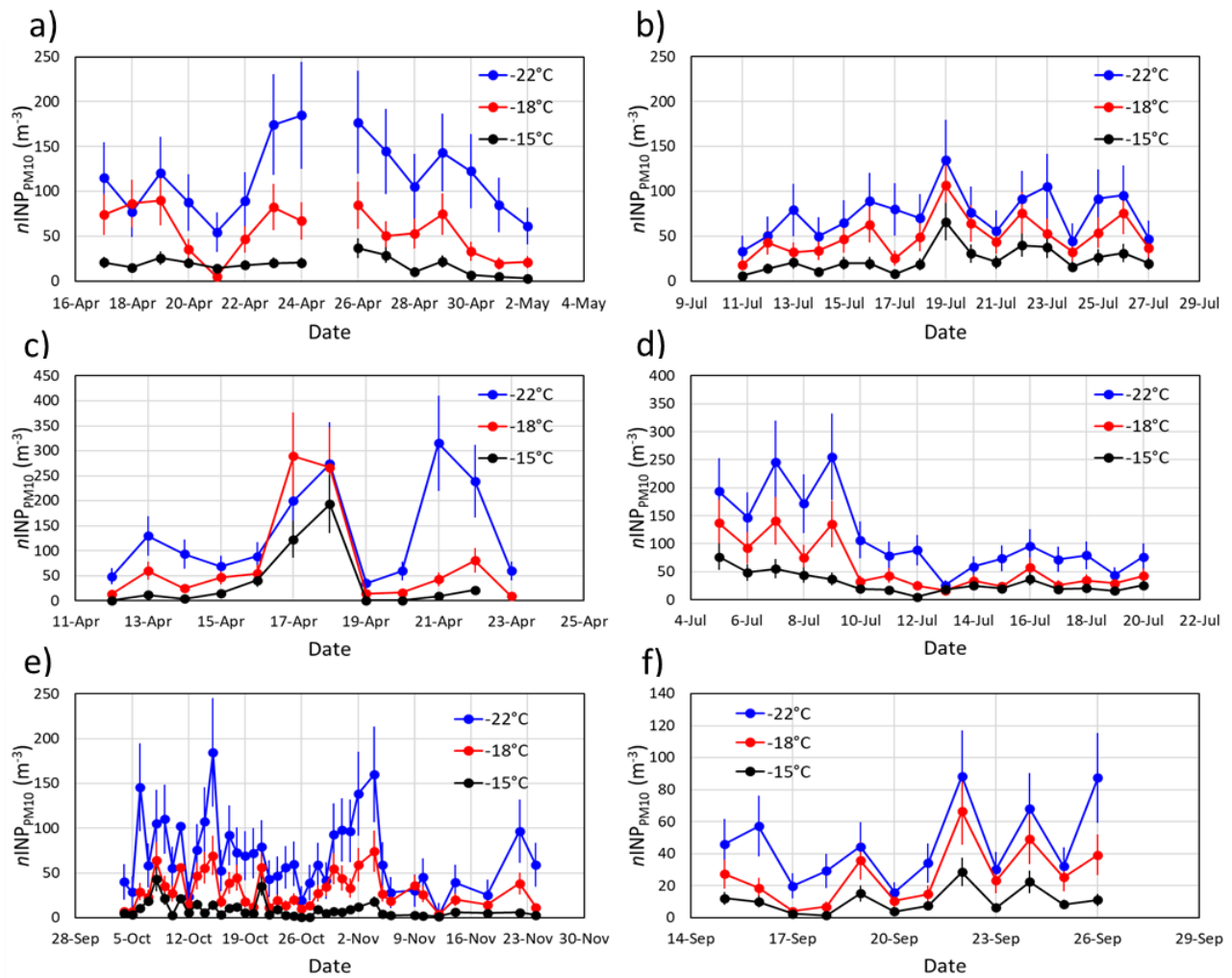


Figure S1.  $nINP$ , in the  $PM_{10}$  size range, measured during the (a) spring 2018, (b) summer 2018, (c) spring 2019, (d) summer 2019, (e) autumn 2019 and (f) autumn 2020 campaign.

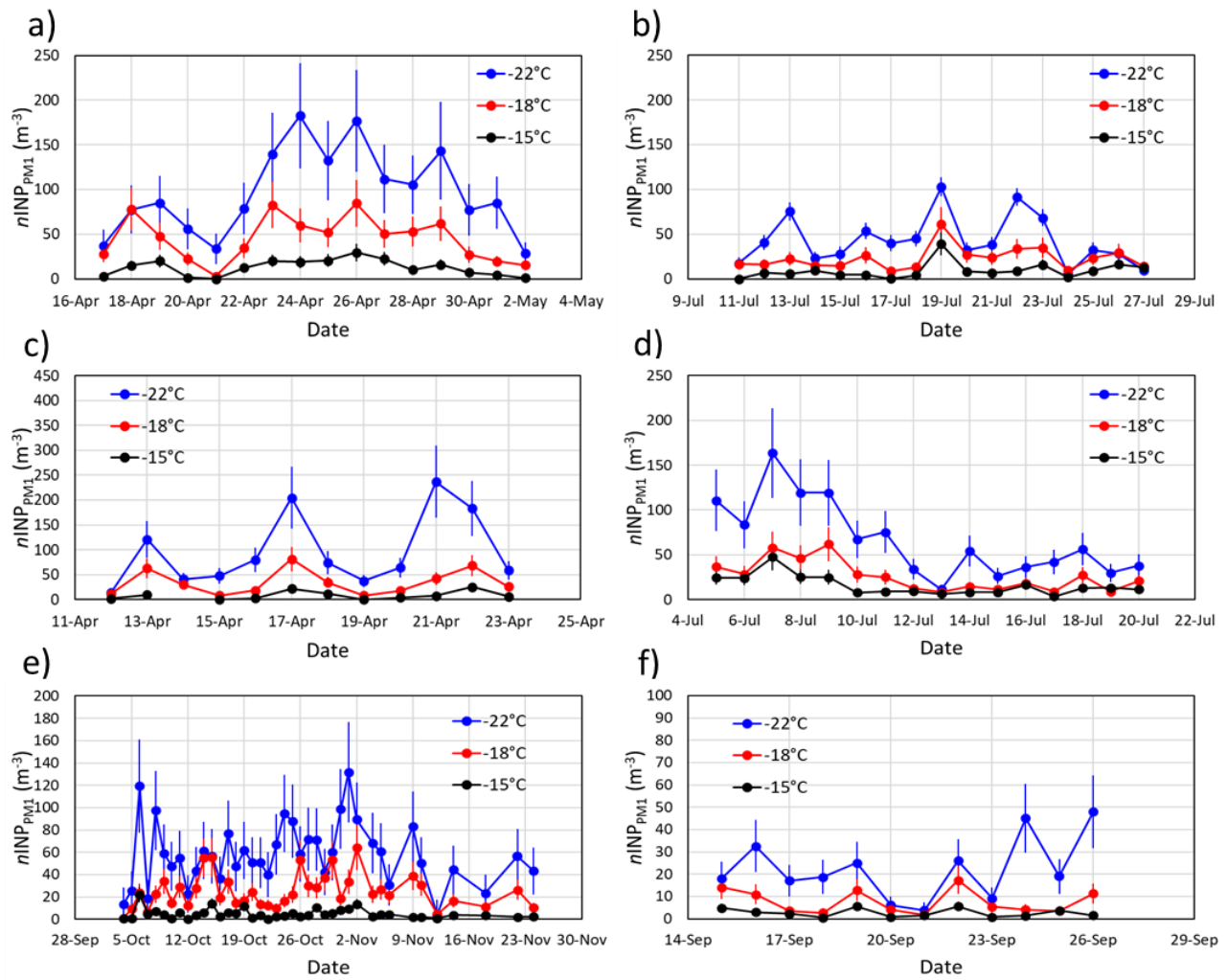


Figure S2.  $nINP$ , in the  $PM1$  size range, measured during the (a) spring 2018, (b) summer 2018, (c) spring 2019, (d) summer 2019, (e) autumn 2019 and (f) autumn 2020 campaign.

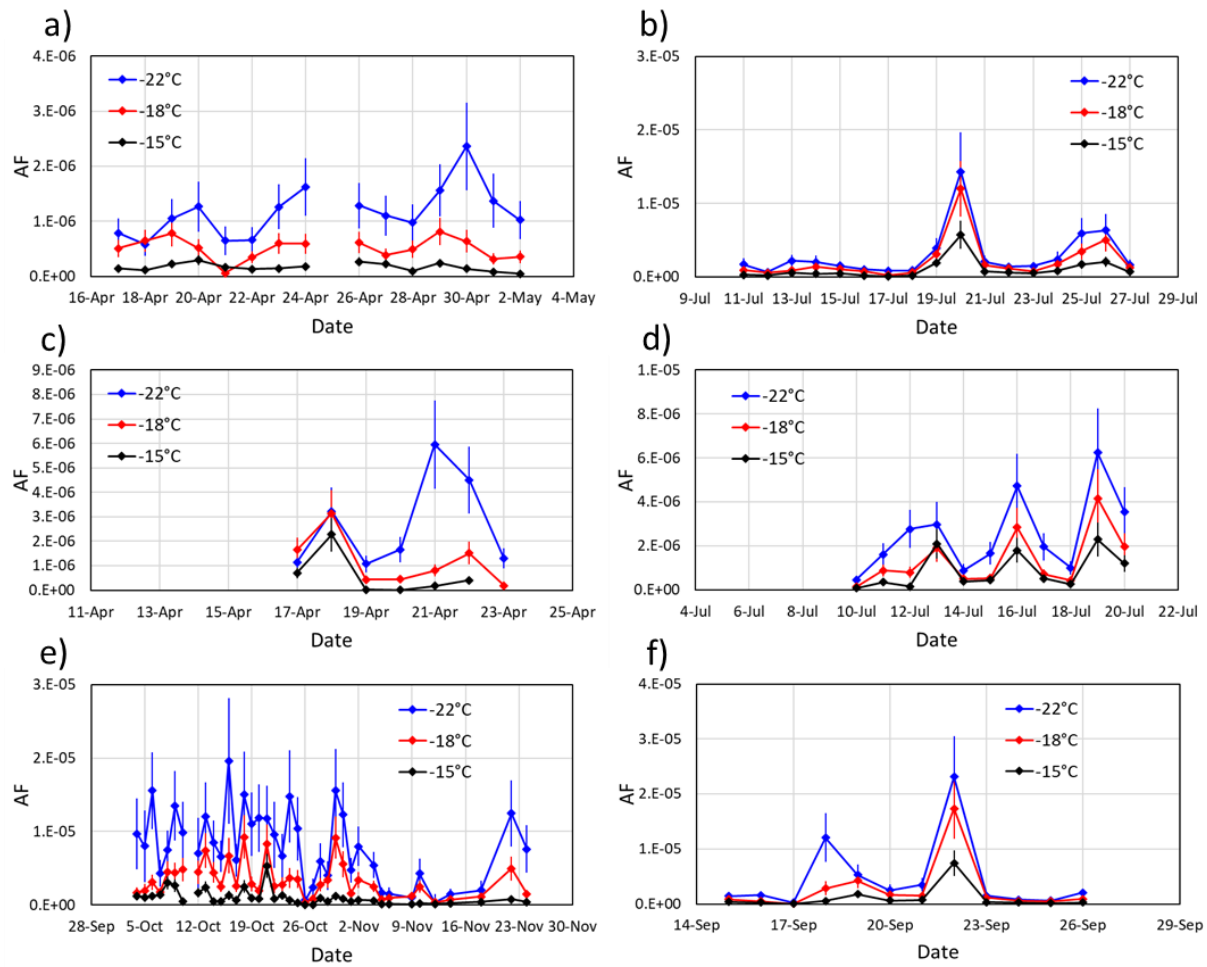


Figure S3. AF, in the  $PM_{10}$  size range, measured during the (a) spring 2018, (b) summer 2018, (c) spring 2019, (d) summer 2019, (e) autumn 2019 and (f) autumn 2020 campaign. Missing AF data in (c) and (d) are due to unavailable particle number concentration data.

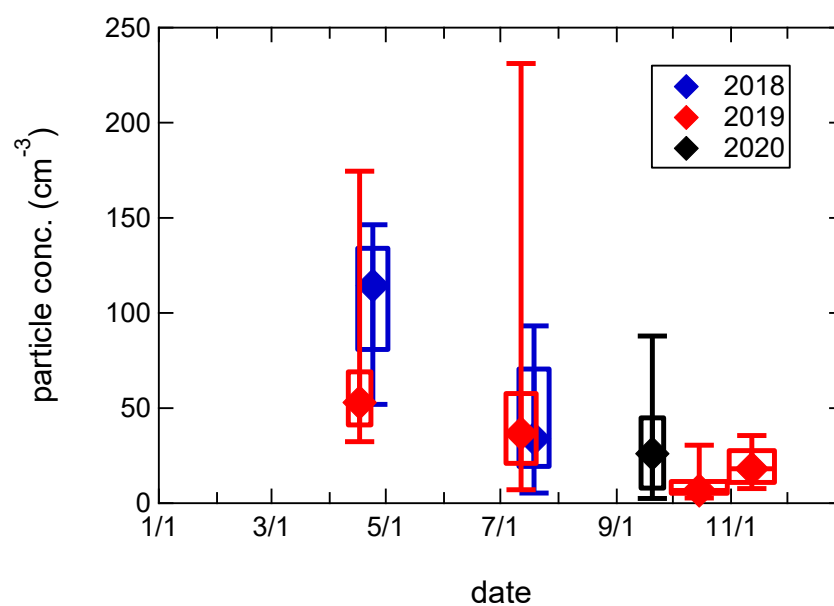


Figure S4. Seasonal variation of the particle number concentration in the 0.1 – 10  $\mu\text{m}$  size range. The diamonds indicate the median value, the box represents the interquartile range and the whiskers the min-max range. The width of the box indicates the time span of each measurement period.

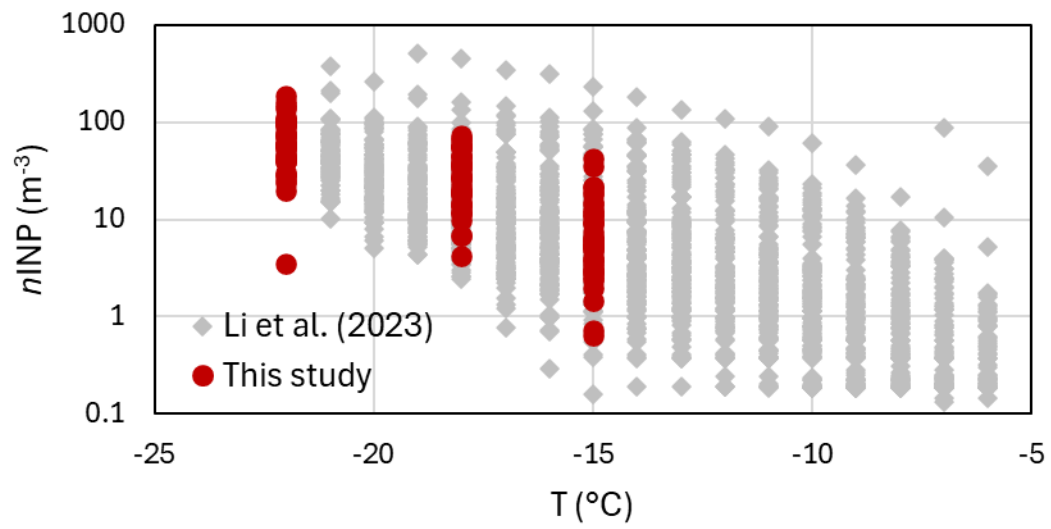


Figure S5.  $n_{\text{INP}}$  as a function of  $T$  measured at GVB during autumn 2019. Data from Li et al. (2023) were obtained by immersion freezing.

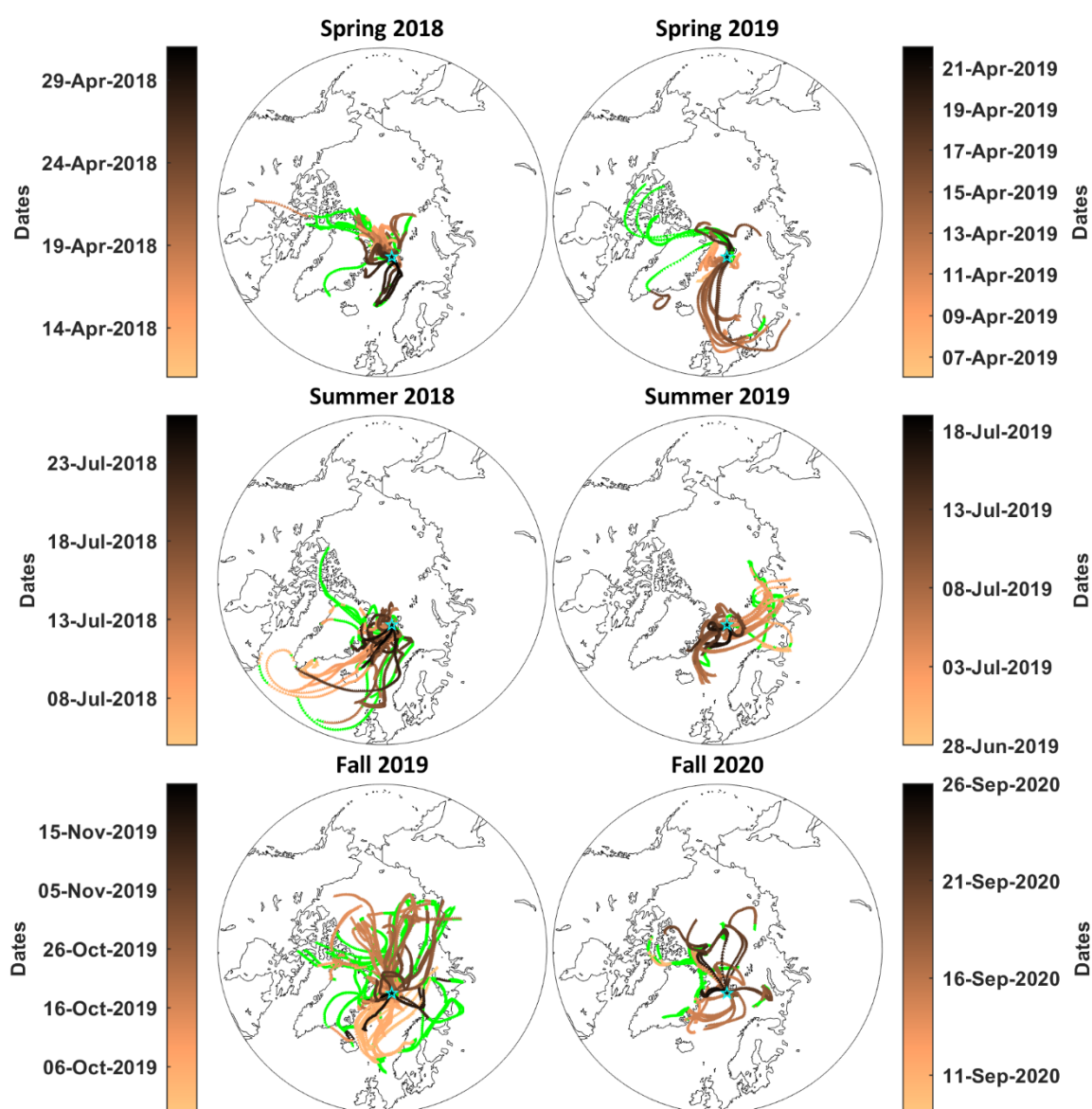


Figure S6. Back trajectories associated to the analysed samples colour-coded based on the sampling date. In dark light green are represented trajectories travelling above the planetary boundary layer height and therefore excluded from the analyses.

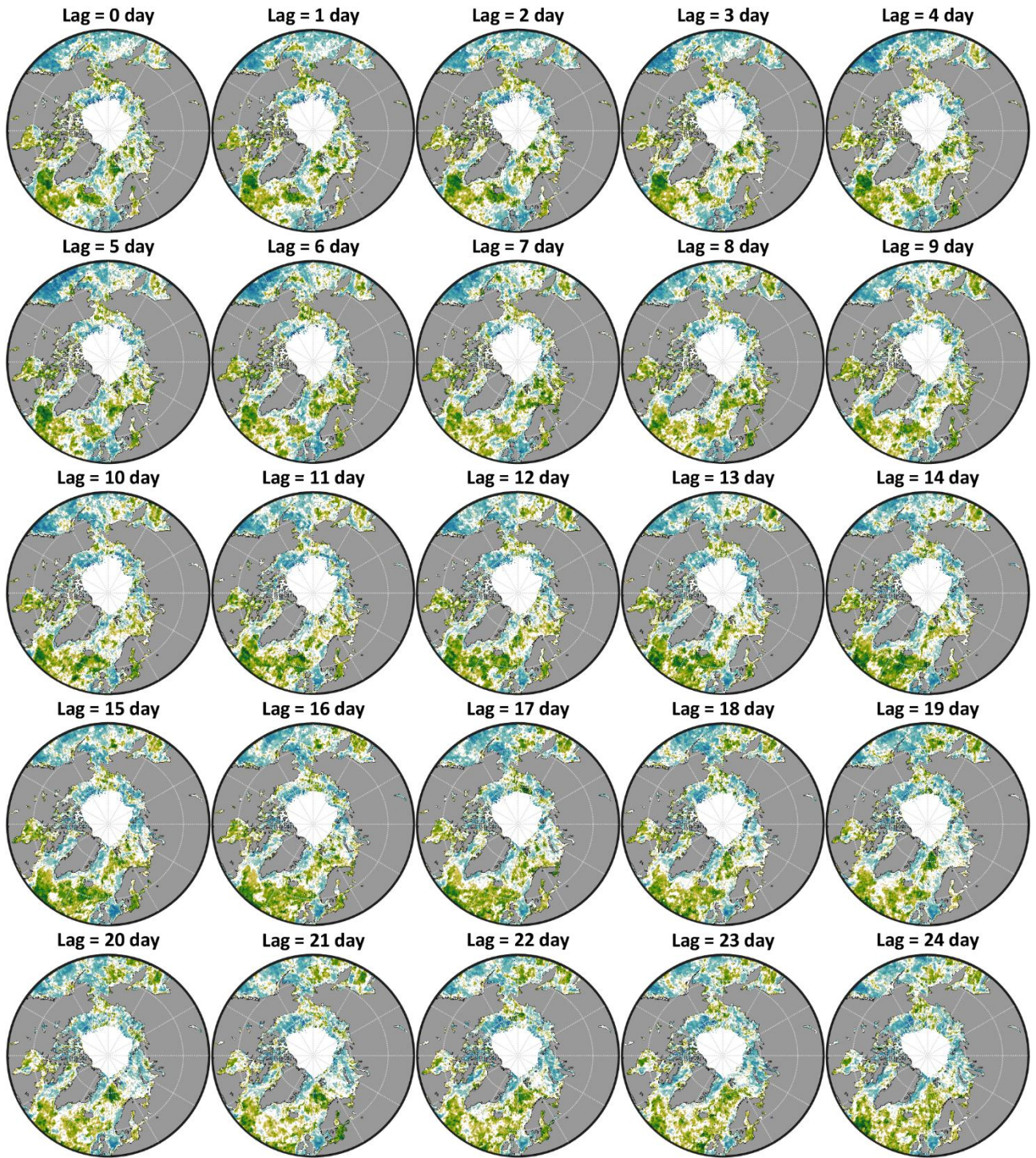


Figure S7. Spatial distribution of the correlation coefficient between  $nINP_{PM1}$  [ $T = -15\text{ °C}$ ] measured at GVB and CHL over the Arctic and Atlantic Ocean at different time-lags from 0 to 24 days. The grey colour represents non-significant correlation coefficients ( $p < 0.05$ ). The colour scale is the same as in Figure 9a.

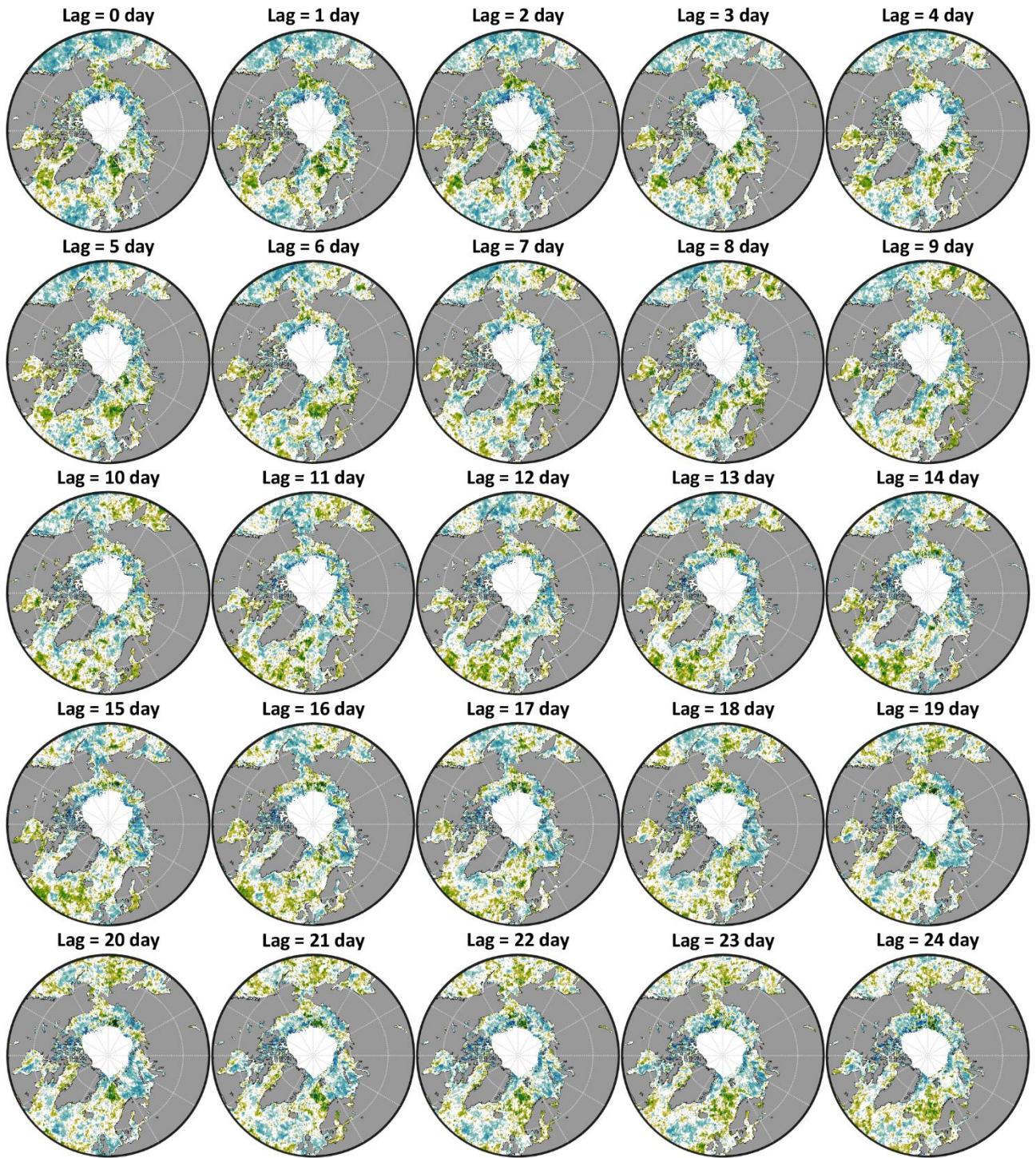


Figure S8. Spatial distribution of the correlation coefficient between  $nINP_{PM1}$  [T = -18 °C] measured at GVB and CHL over the Arctic and Atlantic Ocean at different time-lags from 0 to 24 days. The grey colour represents non-significant correlation coefficients ( $p < 0.05$ ). The colour scale is the same as in Figure 9a.

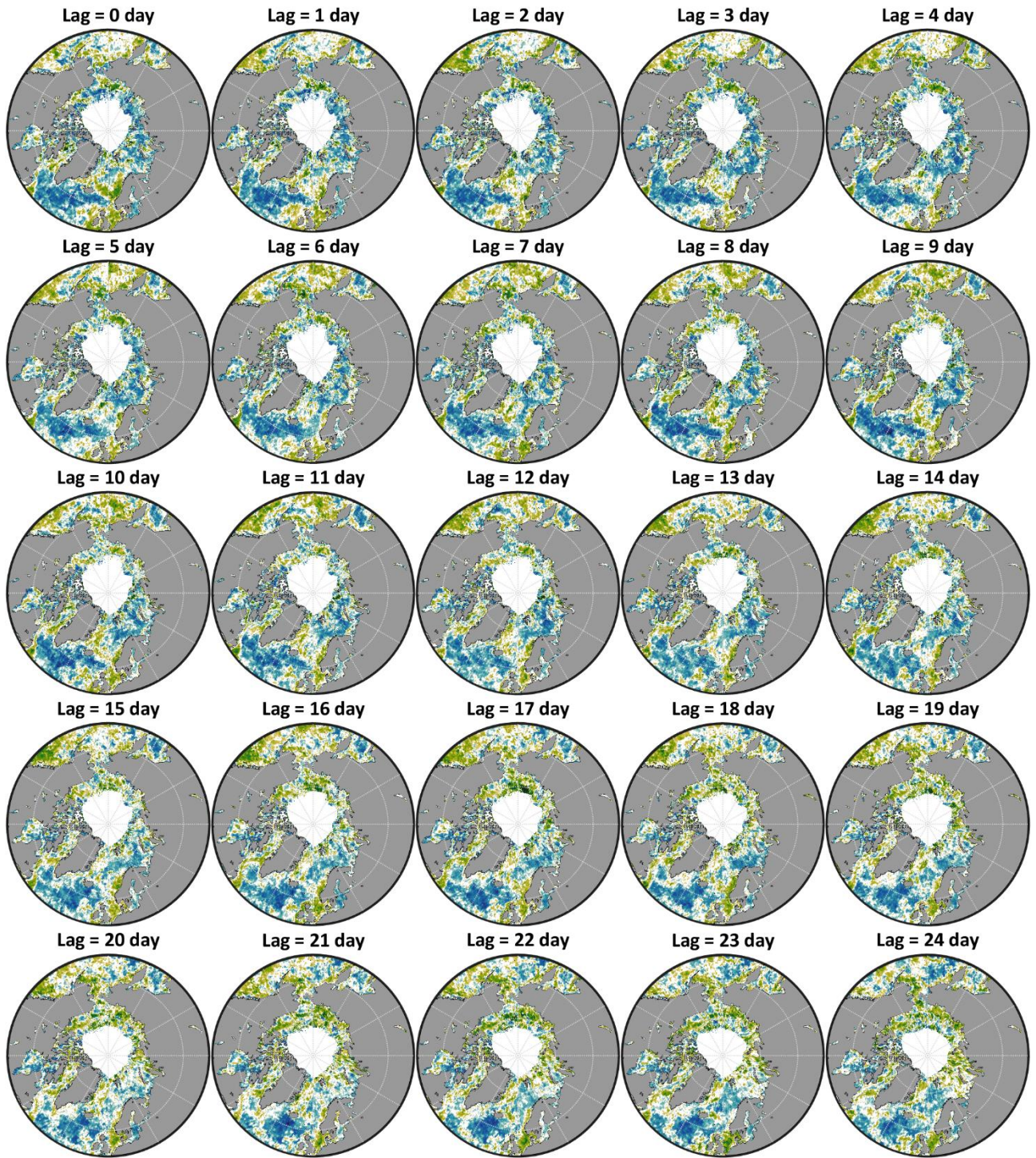


Figure S9. Spatial distribution of the correlation coefficient between  $nINP_{PM1}$  [ $T = -22\text{ °C}$ ] measured at GVB and CHL over the Arctic and Atlantic Ocean at different time-lags from 0 to 24 days. The grey colour represents non-significant correlation coefficients ( $p < 0.05$ ). The colour scale is the same as in Figure 9a.