**Table S1. Normalized numbers of particles of each class detected by the LAAPToF, for aerosol samples summarized for each flow regime.**

| Particle Type | Below-cloud Aerosol | | | Above-cloud Aerosol | | |
|---|---|---|---|---|---|---|
| | *Northerly* | *Canadian* | *BLNFTC* | *Northerly* | *Canadian* | *BLNFTC* |
| Fresh sea salt | 4674 | 3297 | 4044 | 15 | 207 | 15 |
| Aged sea salt | 135 | 207 | 51 | 12 | 9 | 6 |
| dust/bio-dust | 0 | 0 | 10 | 0 | 20 | 20 |
| bioaerosol | 0 | 0 | 0 | 0 | 10 | 0 |
| sulfates | 6 | 3 | 0 | 2 | 7 | 8 |
| undefined | 0 | 1 | 0 | 0 | 0 | 0 |

Note: The number was normalized with relative collection efficiency of different particle types, except for the undefined particle type.

**Table S2. Normalized numbers of particles of each class detected by the LAAPToF, for cloud residue samples summarized for each flow regime.**

| Particle Type | total cloud residue | | | liquid cloud | | | mixed-phase cloud | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Northerly* | *Canadian* | *BLNFTC* | *Northerly* | *Canadian* | *BLNFTC* | *Northerly* | *Canadian* | *BLNFTC* |
| Fresh sea salt | 30702 | 9696 | 15207 | 24798 | 2733 | 13176 | 5904 | 6963 | 2031 |
| Aged sea salt | 87 | 813 | 96 | 57 | 21 | 36 | 30 | 792 | 60 |
| dust/bio-dust | 30 | 250 | 70 | 10 | 10 | 20 | 20 | 240 | 50 |
| bioaerosol | 0 | 30 | 50 | 0 | 0 | 30 | 0 | 30 | 20 |
| sulfates | 3 | 0 | 9 | 3 | 0 | 7 | 0 | 0 | 2 |
| undefined | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |

Note: The number was normalized with relative collection efficiency of different particle types, except for the undefined particle type.

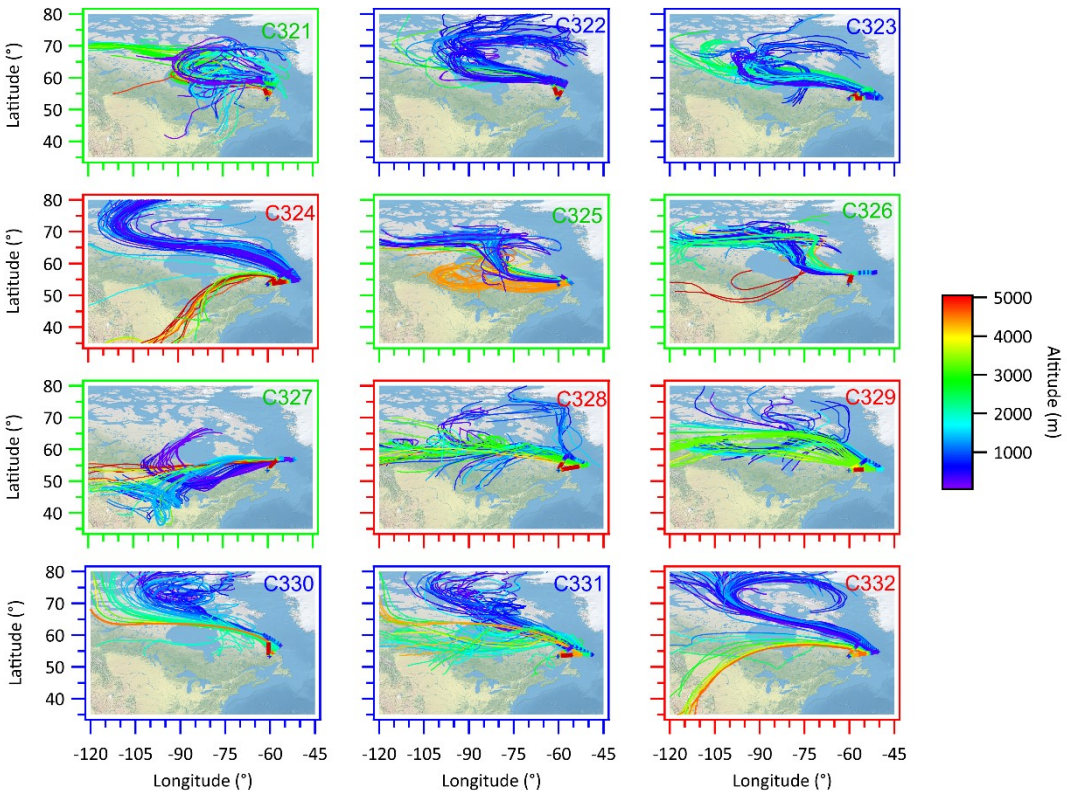


Figure S1. 5-days back trajectories along the flight track over the Labrador Sea for each flight. The trajectories were calculated every two minutes along the flight track for each of the flights labelled in the top right-hand corner of each panel. The heights of the back trajectories in metres represent the release location height, which are shown as colours given by the scale bar. The flight numbers and plot borders are coloured to identify the flow regime sampled during the flight: Green: Canadian; blue: northerly; red: BLNFTC.