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Supplement of

Characterization of transport regimes and the polar dome during Arctic spring and summer using in situ aircraft measurements

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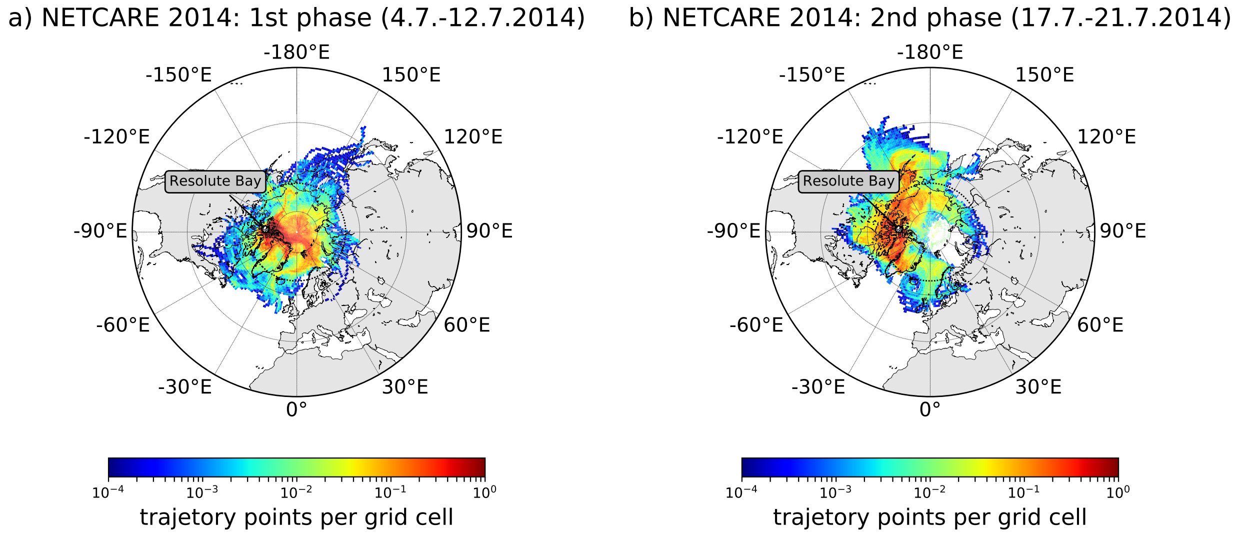

Figure S 1. Area weighted trajectory density during the different campaign phases in July 2014 (gridded by 1° x 1°). The colour code represents the amount of trajectory points per grid box weighted by the area of the grid box. The individual panels show the results for the first phase (a) and the second phase (b). The bold black dashed line denotes the Arctic circle.

1 Air mass history

During the flights of the first period of NETCARE 2014 until July 12^{th} high pressure influence was prevailing. Air masses tended to stay within the high Arctic and circled around the measurement region. Almost no mid-latitude influence in terms of trajectory origin was observed when using the Arctic circle as a boundary between the Arctic and mid-latitudes. This is evident in Fig. S1a, which shows the area weighted accumulated number of trajectory points per grid box (1° x 1°) for the last ten days before the measurements during the summer campaign in July 2014. The highest density of trajectory points is observed significantly north of the Arctic circle. Note that multiple "hits" of one trajectory in a specific grid box are possible during the 10 day travel of the air mass associated with the trajectory.

In contrast, during the flights within the second period (July 17^{th} to July 21^{st}) more air masses originated in regions south of the Arctic circle (see Fig. S1b). Highest trajectory densities are found slightly north of the Arctic circle in the Canadian Arctic Archipelago extending southward to continental Canada and the Bering Sea. The stable low pressure system over King William Island thus favoured the transport of mid-latitude air masses to the high Arctic, and the potential for a stronger impact of mid-latitudinal sources on the Arctic chemical composition.

During pan-Arctic measurements in April 2015 probed air masses show very different histories depending on the respective measurement location in the Arctic (see Figs. S2a-d). Measurements performed from the two northernmost stations Alert and Eureka have been less influenced by air masses of mid-latitudinal origin than those further south. This indicates that synoptic disturbances did not have a strong influence on the high Arctic stations at least during the one month period, which is covered by our measurements and the backward trajectories. Based on the "density maps" of the trajectory locations, the strongest mid-latitude influence is indicated during the measurements in Inuvik between April 20^{th} and April 21^{st} (Fig. S2d). During three flights a warm conveyor belt (WCB) type transport associated with a strong low pressure system over Alaska influenced the tropospheric composition in the measurement region by advecting pollution from South-East-Asia. The high Arctic stations in Eureka and Alert were much less affected by air masses from mid-latitudes, which is confirmed by the analysis of the air mass history for the flights between April 7^{th} and April 13^{th} (Figs. S2b and c) when only a few trajectories travelled over

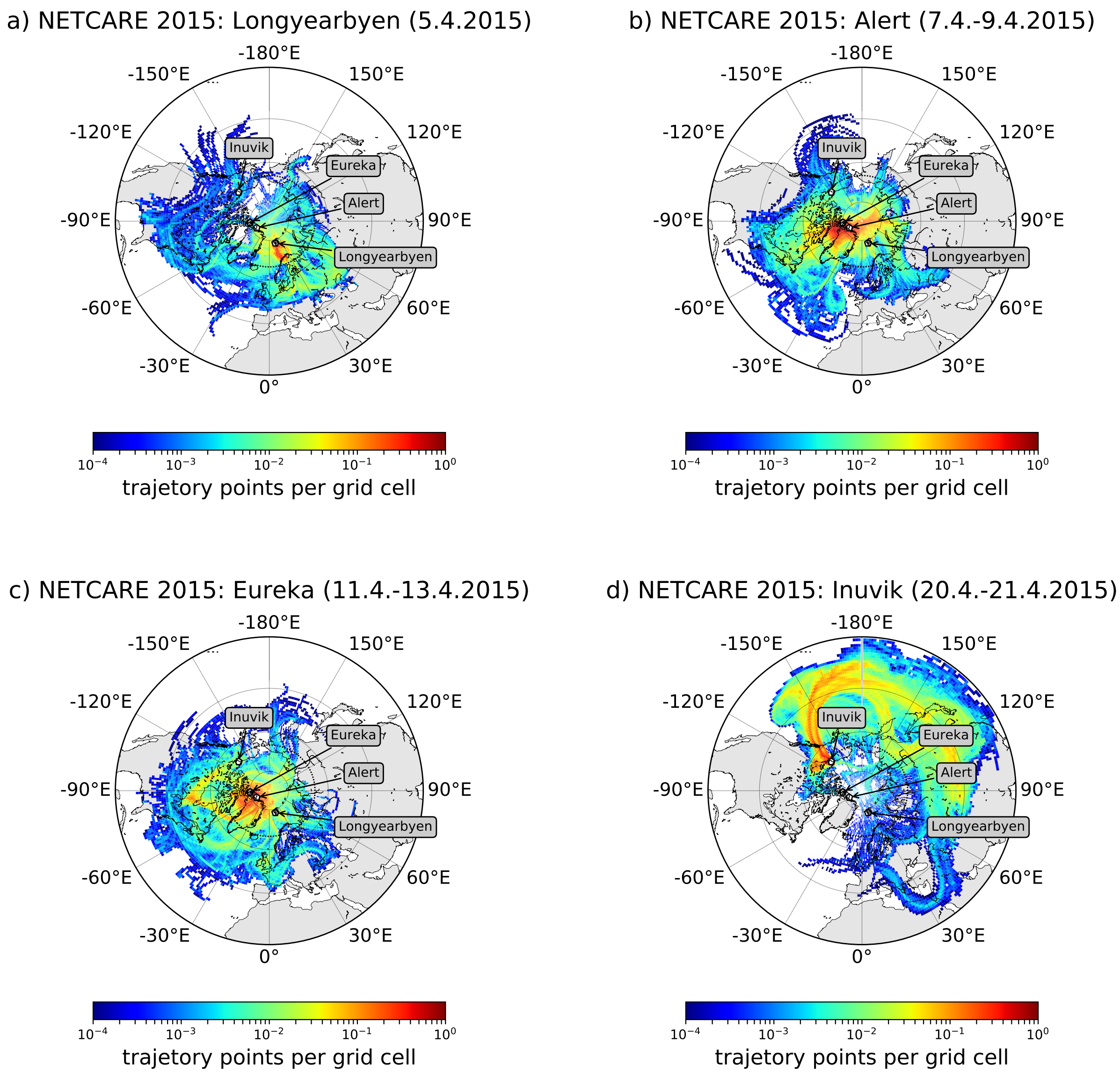

Figure S 2. Area weighted trajectory density during the different campaign locations in April 2015 (gridded by 1° x 1°). The colour code represents the amount of trajectory points per grid box weighted by the area of the grid box. The individual panels show the results for the measurements in Longyearbyen (a), Alert (b), Eureka (c) and Inuvik (d). The bold black dashed line denotes the Arctic circle.

areas outside the Arctic circle. Air masses mainly resided over the Canadian Arctic Archipelago and northern Greenland with only episodic influence from the North American continent and Siberia. In Longyearbyen only one flight was performed on April 5^{th}, which shows a mixture of mid-latitude and Arctic air masses (Fig. S2a). The origin of the majority of air masses contributing to the observations in Longyearbyen was in northern and eastern parts of Europe.

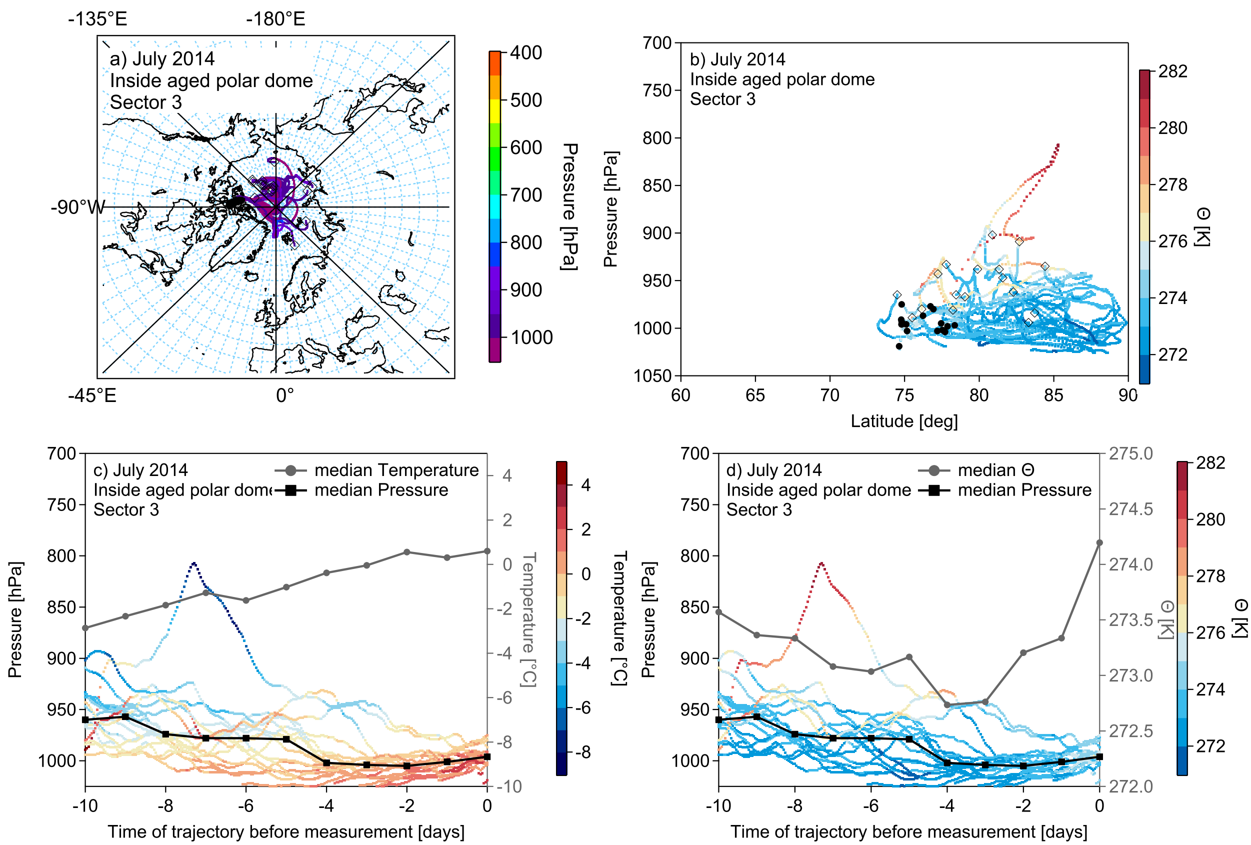

Figure S 3. (a) Trajectories of the most dominant sector 3 for air masses inside the aged polar dome. The color code represents the pressure along the trajectories. (b) The same trajectories as in (a) as a function of pressure and latitude, color coded by potential temperature. In both (a) and (b) black circles denote the initialization point of the trajectory along the flight track. The black open squares show the position of the trajectory 10 days back in time. Panels (c) and (d) show height-time cross-sections with pressure representing the altitude of the trajectories (left axis) for the trajectory evolution over the 10 days of travel with the color code denoting the temperature (c) and potential temperature (d). The black line marks the median pressure of the trajectory cluster at the individual time steps and the grey line indicates the median temperature and median potential temperature, respectively. Note that only every 20th trajectory is plotted for figure clarity.

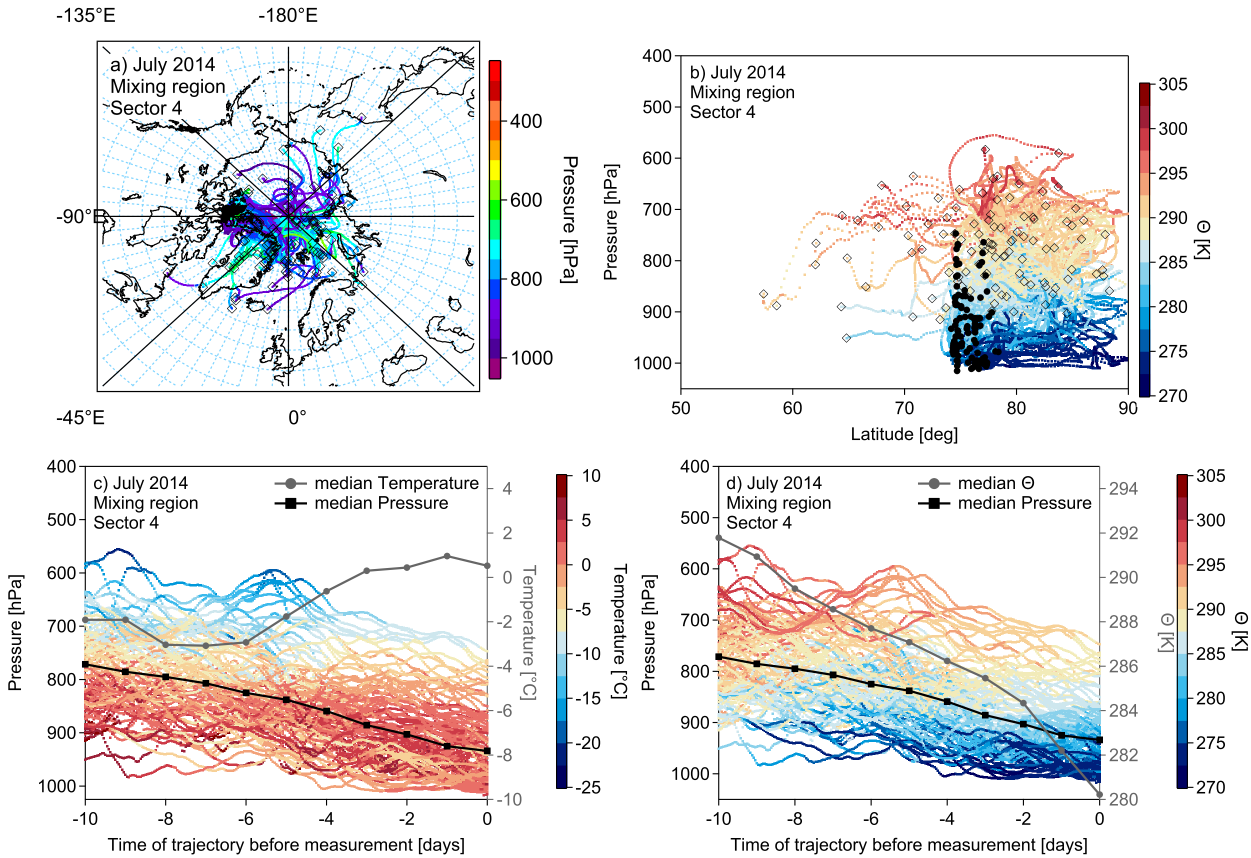

Figure S 4. (a) Trajectories of the most dominant sector 4 for air masses inside the mixing region. The color code represents the pressure along the trajectories. (b) The same trajectories as in (a) as a function of pressure and latitude, color coded by potential temperature. In both (a) and (b) black circles denote the initialization point of the trajectory along the flight track. The black open squares show the position of the trajectory 10 days back in time. Panels (c) and (d) show height-time cross-sections with pressure representing the altitude of the trajectories (left axis) for the trajectory evolution over the 10 days of travel with the color code denoting the temperature (c) and potential temperature (d). The black line marks the median pressure of the trajectory cluster at the individual time steps and the grey line indicates the median temperature and median potential temperature, respectively. Note that only every 20th trajectory is plotted for figure clarity.

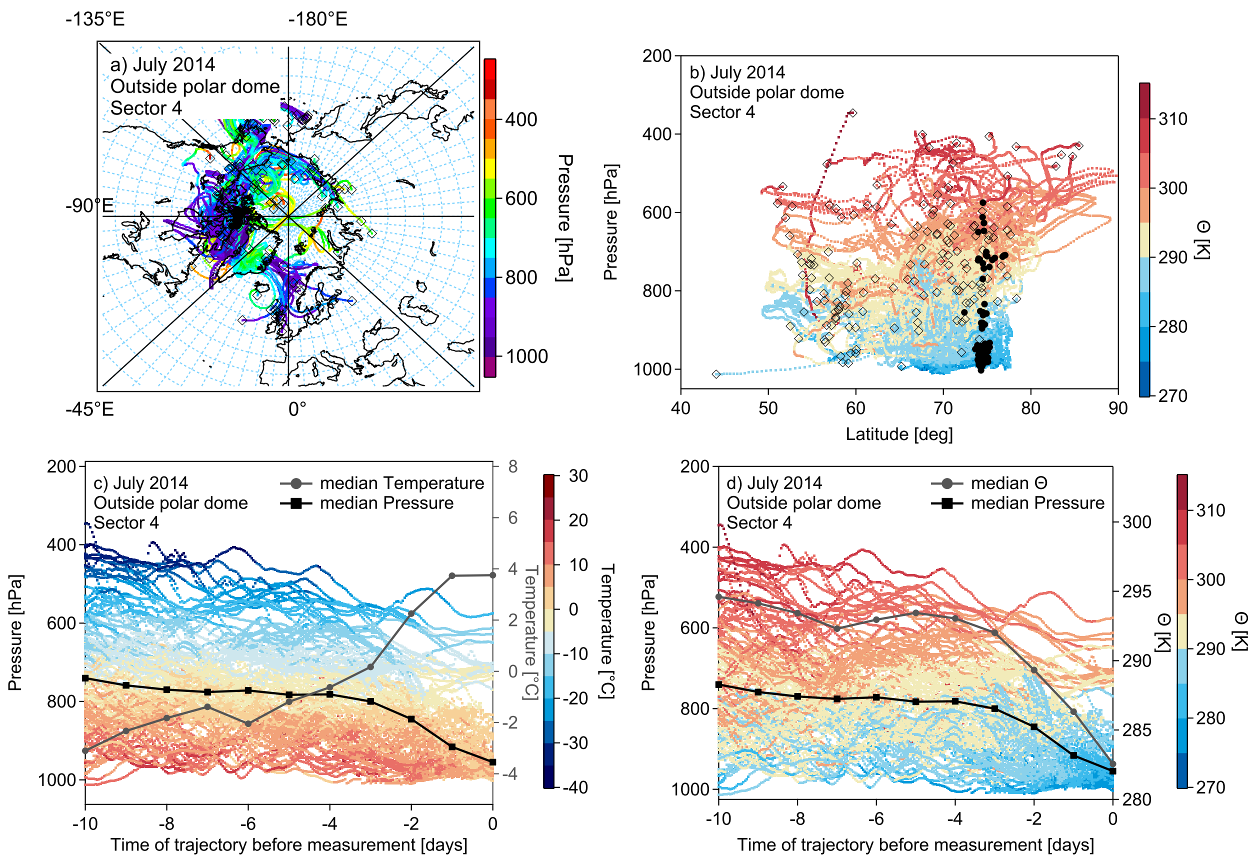

Figure S 5. (a) Trajectories of the most dominant sector 4 for air masses outside the polar dome. The color code represents the pressure along the trajectories. (b) The same trajectories as in (a) as a function of pressure and latitude, color coded by potential temperature. In both (a) and (b) black circles denote the initialization point of the trajectory along the flight track. The black open squares show the position of the trajectory 10 days back in time. Panels (c) and (d) show height-time cross-sections with pressure representing the altitude of the trajectories (left axis) for the trajectory evolution over the 10 days of travel with the color code denoting the temperature (c) and potential temperature (d). The black line marks the median pressure of the trajectory cluster at the individual time steps and the grey line indicates the median temperature and median potential temperature, respectively. Note that only every 20th trajectory is plotted for figure clarity.

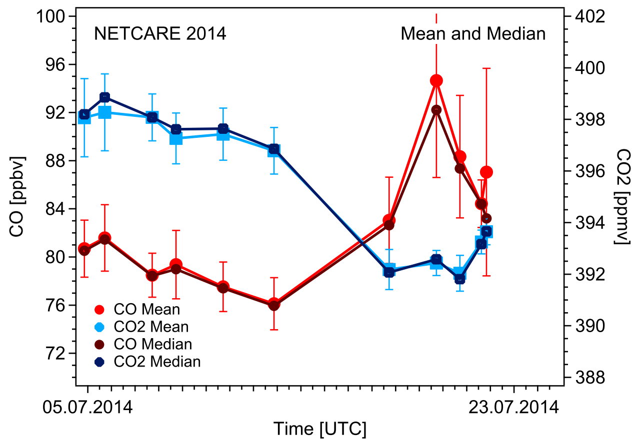

Figure S 6. CO (red) and CO_2 (blue) data for NETCARE 2014. Shown are the respective mean and median value of all data points on the individual flight.