Atmospheric rivers and associated precipitation patterns during the ACLOUD/PASCAL campaigns near Svalbard (May-June 2017): case studies using observations, reanalyses, and a regional climate model

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Supplementary material



Figure S1. Maps of integrated water vapour (IWV, kg m⁻², colour shading) for the 30 May 2017 event, 6 hours before the IWV peak (a), during the peak (b) and 6 hours after the peak (c) based on reanalyses (ERA-Interim, CFSv2, MERRA-2, ERA5, JRA-55), HIRHAM5 model
and IASI observations. Magenta line shows AR shape (based on Gorodetskaya2020) and red line shows the shape of potential ARs (IWV≥IWV_{thres}, based on Gorodetskaya2020). White line shows AR shape (based on Guan2018) and orange arrows show integrated vapour transport (IVT, kg m⁻¹ s⁻¹), both based only on MERRA-2 reanalysis. Black star shows Ny-Ålesund location.



Figure S2. Same as Figure S1, but for the 6 June 2017 event.





Figure S3. Same as Figure S1, but for the 9 June 2017 event.



Figure S4. Maps of mean sea level pressure (hPa, colour shading) and geopotential height at 700hPa (m, contours) based on ERA5 reanalysis during the 30 May event [first row, (**a**)], 6 June event [second row, (**b**)] and 9 June event [third row, (**c**)]. Magenta line shows AR shape (based on Gorodetskaya2020) and red line shows the shape of potential ARs (IWV≥IWV_{thres}, based on Gorodetskaya2020). Black star shows Ny-Ålesund location.



Figure S5. Maps of potential temperature at 2 potential vorticity units (K, colour shading) and mean sea level pressure (hPa, contours) based on ERA5 reanalysis during the 30 May event [first row, (a)], 6 June event [second row, (b)] and 9 June event [third row, (c)]. Magenta line shows AR shape (based on Gorodetskaya2020) and red line shows the shape of potential ARs (IWV≥IWV_{thres}, based on Gorodetskaya2020). Black star shows Ny-Ålesund location.



Figure S6. Maps of integrated vapour transport (kg m⁻¹ s⁻¹, shading) based on ERA-Interim reanalysis (first row) and HIRHAM5 model (driven by ERA-Interim fields) (second row) during the 30 May 2017 event. Black star shows Ny-Ålesund location.



Figure S7. Same as Figure S6, but for the 6 June 2017 event.



Figure S8. Vertical profiles of specific humidity (g kg⁻¹, pink/orange colours) and wind speed (m s⁻¹, blue/green colours) at Ny-Ålesund based on radiosonde (solid lines), reanalyses (ERA-Interim, ERA5, CFSv2, JRA-55, MERRA-2, dashed lines) and HIRHAM5 model (dotted lines), during 30 May event [first row, (a)], 6 June event [second row, (b)] and 9 June event [third row, (c)].



Figure S9. Same as Figure S8, but with the differences of the vertical profiles based on reanalyses and model compared to the radiosondes (reference).



45 Figure S10. Temporal evolution of the vertical profiles of specific humidity (g kg⁻¹) based on radiosondes, reanalyses (ERA-Interim, ERA5, MERRA-2, CFSv2, JRA-55), and HIRHAM5 model, during 30 May 2017 event [first row, (a)], 6 June 2017 event [second row, (b)] and 9 June event [third row, (c)], at Ny-Ålesund. Time steps on the x-axis mark the end of observations/reanalyses/model.



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Figure S11. Maps of the total accumulated precipitation [mm, first column, (a)], accumulated rainfall [mm, second column, (b)] and accumulated snowfall [mm, third column, (c)] for the 30 May event during a 48 hours period (24 hours before and after the event reached Ny-Ålesund, shown by black star) based on reanalyses (ERA-Interim, CFSv2, MERRA-2, ERA5, JRA-55) and HIRHAM5 model. Grey lines show the sea-ice fraction using a 15% threshold (thin line represents 24 hours before the event and thick line 24 hours after the event). Magenta and red lines show the AR and pAR shapes, respectively, based on Gorodetskaya2020. Black line shows the AR shape based on Guan2018 (available only for MERRA-2). The AR shape lines here encompass the total area of the ARs/pARs during the 48 hours period.









Figure S13. Same as Figure S11, but for the 9 June 2017 event.



Figure S14. Computed ensemble of back trajectories (different colours) at 6 hours intervals (markers) ending at 06 UTC 30 May (left panel), 12 UTC 6 June (middle panel) and 12 UTC 9 June (right panel), at 800 hPa, from Ny-Ålesund (black star), using HYSPLIT model.