Comment on acp-2021-609

Anonymous Referee #2

General comments:

This paper explores the differences of atmospheric rivers' characteristics and meteorology in reanalyses and the regional climate model HIRHAM5 in Svalbard. Using field campaign identification of water vapor transport events in May and June 2017, independent atmospheric river events were detected at a research station over an 11-day period. This paper analyzes how using integrated vapor transport versus integrated water vapor affects atmospheric river detection. Additionally, the differences between reanalyses, the regional climate model, and observations demonstrate the importance of using a high spatial and temporal resolution model for AR identification. This paper was a thorough study in how applications of AR detection schemes vary in the Arctic, where lower atmospheric moisture content must be considered. Additionally, the synoptic and precipitation analyses were very interesting, particularly how the results varied amongst the reanalyses. There were some points that needed clarification, but overall, the manuscript was scientifically interesting, novel, and important work. For these reasons, I am recommending this manuscript for acceptance to ACP with minor revisions.

The authors thank the referee for taking the time to carefully review the manuscript. We believe the manuscript will benefit from these revisions. Below we addressed all the questions raised by the referee. Comments from the referee are in **black** and the responses from the authors are in **blue**.

Specific comments:

Section 3.2: Some added clarification on which datasets the algorithms were applied to would be helpful. The final two sentences (L208-210) specifically state that the Guan2018 algorithm was only applied to MERRA-2, but I was confused until getting into the results about which datasets Gorodetskaya2020 was applied to. It is not stated until L230-231.

The authors agree that due to the several reanalysis products and algorithms used in this manuscript it is important to include a clarification about their application. Gorodetskaya et al. (2020) was applied to ERA-Interim, ERA5, CFSv2, JRA-55, MERRA-2 and HIRHAM5. This additional information was included in a new sentence in the updated version of the manuscript:

"ERA-Interim, ERA5, CFSv2, MERRA-2 and JRA-55 reanalysis were used to identify pARs/ARs, while HIRHAM5 model was only used to identify pARs, due to its limitation on spatial coverage (approximately, northern 65° N), both based on Gorodetskaya2020."

Also, the sentence about which datasets were applied to Guan et al. (2018) was improved:

"Only MERRA-2 reanalysis, covering a period from 1980 to 2019, were used to calculate IVT and to detect the ARs based on Guan2018."

L 228-230: Why were these specific datasets chosen to display in Figure 2, when you also applied Gorodetskaya2020 to JRA55 and CFSv2?

With the purpose to keep Figure 2 as simple as possible, for the maps to have a reasonable size, and to compare the three events, we decided to just show the maps for some datasets and only for the time of maximum IWV. Figures S1, S2 and S3 show all datasets, the timing previous, during and after the maximum IWV, and a wider map with more longitudes.

For Figure 2, we decided to only include results from ERA-Interim, ERA5 and MERRA-2 reanalyses, HIRHAM5 model and IASI observations. The choice of these datasets was done in a way to compare the reanalyses, model (HIRHAM5) and observations (IASI). Concerning the reanalyses, we chose ERA-Interim because it is one of the most widely used datasets, while ERA5 has the higher spatial and temporal resolution. Regarding MERRA-2, it was important to include this dataset in this figure in order to compare results from Gorodetskaya et al. (2020) algorithm and Guan et al. (2018) algorithm (only applied on MERRA-2 reanalysis).

L 242-244: While it is later elaborated on in L272-277, it might be helpful to mention, after stating that the geometrical criteria was applied, that the current geometrical applications of the algorithm prevent the June 6 case from being identified as an AR (and is instead a pAR).

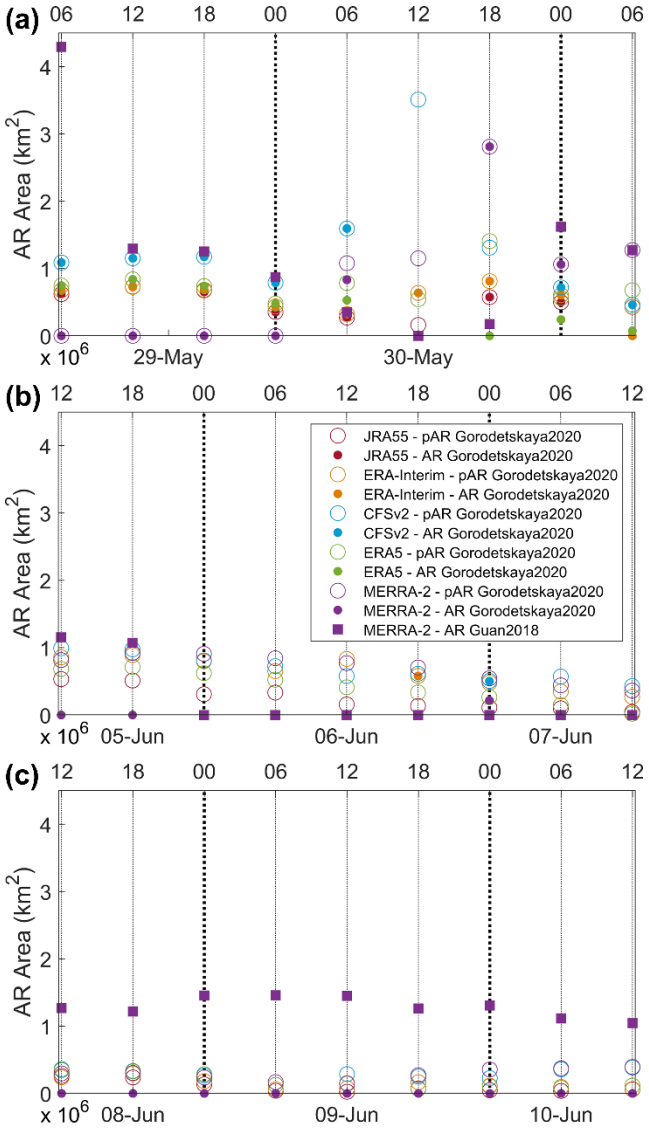
The authors thank the suggestion from the referee. This information was included in the new version of the manuscript, referring to a more detailed explanation later in the document:

"After applying Gorodetskaya2020 tracking algorithm, two of the four events were detected as pARs: 30 May and 6 June (Figs.2a and 2b, red lines; Figs. 3a and 3b, coloured circles). With the inclusion of the geometrical criteria only the first event was identified as an AR (Fig. 2a, magenta line; Fig. 3a, coloured dots), since the current geometrical criteria prevent the 6 June event to be identified as an AR (explained later)."

Figure 3: Yellow color is difficult to see - could this be changed to a darker yellow?

Figure 3 was updated in order to be more visible. The yellow colour, previously used to represent the results from CFSv2, was changed to blue. Furthermore, the display of the figure was changed since referee #3 suggested the figure was not attractive. The

updated figure is shown below and it was included in the revised version of the manuscript.



L 383-384, Figure S7: Should this also be the beginning of the second event? You are referencing the band of high IVT, which appears nearest to Ny-Ålesund at 12 UTC on June 6.

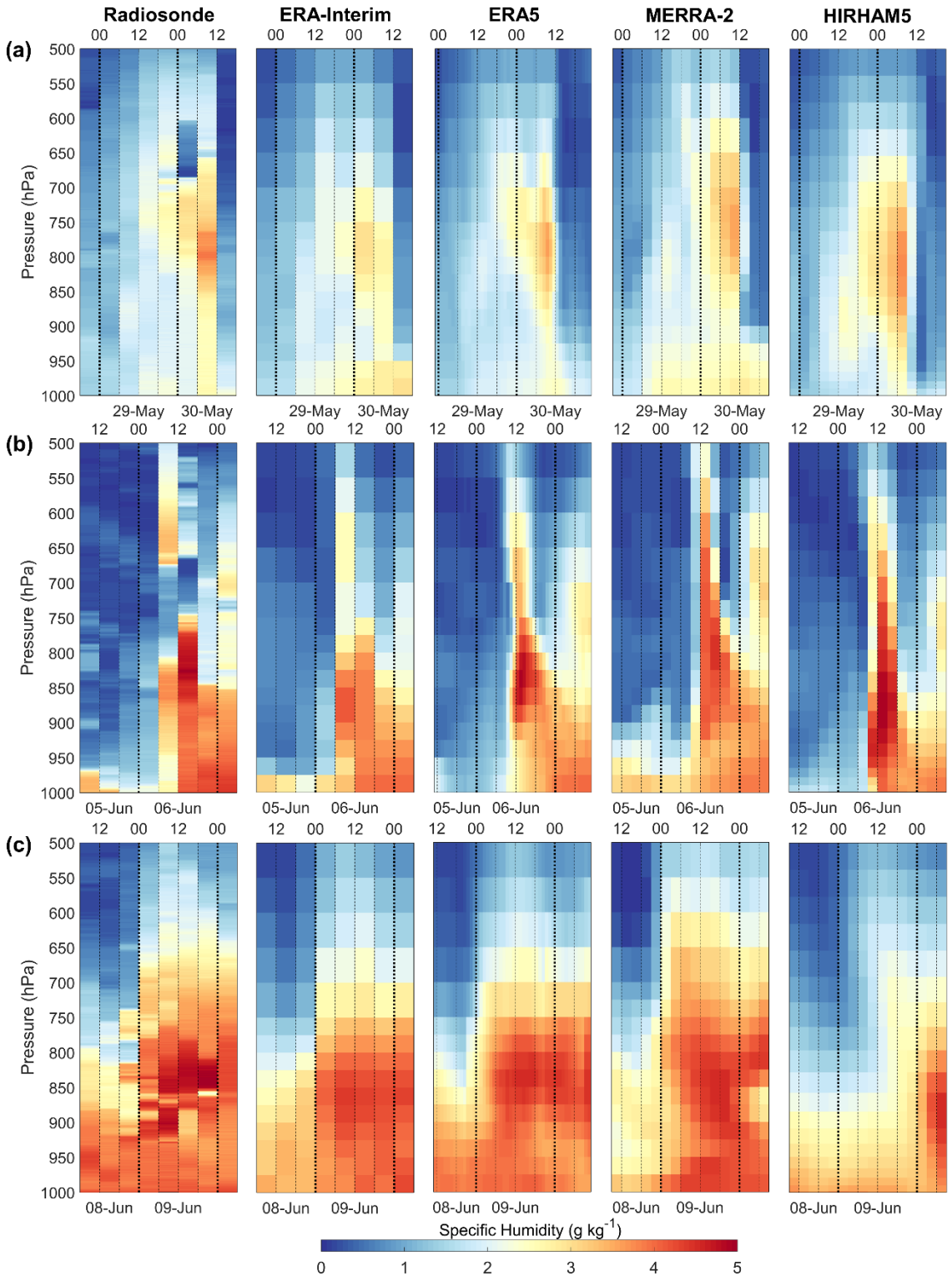
The authors thank the comment from the referee. We noticed that the sentence was not clear. In here, we are not referring to time, but to location. When we refer to *"in the first event in the beginning (Fig. S6) and in the second event at the end (Fig. S7)"*, our purpose was to mention the position of the band of high IVT in relation to Ny-Ålesund. In the case of the 30 May event (Figure S6), the beginning of the edge of the band with high IVT is located near Ny-Ålesund, while in the 6 June event (Figure S7) it is the end of the edge of the band with high IVT that is located near Ny-Ålesund.

The sentence was updated in the new version of the manuscript, in order to be clearer:

“Since in the first event the beginning of the edge of the band of high IVT is located around Ny-Ålesund (Fig. S6) and in the second event it is the end of this band located near Ny-Ålesund (Fig. S7), a minor difference in its location, e.g. due to slight shifts of the low and high pressure systems, induces large changes in IVT at Ny-Ålesund.”

Figure 7: These figures could probably be made wider by cutting whitespace on the edges to make the timestamps more clear.

The plots from Figure 7 were changed in order to get wider and more visible for the readers. The space between plots and their height was reduced. The new version of the figure is shown below:



Technical comments:

L 301: Should be “Figure 4” not “Figure 3”

The authors thank the correction from the referee. The number of the figure was corrected in the manuscript.

L 317: “Siberia” not “Siberian”
L 539: “These were associated” not “These was associated”

These changes were accommodated in the new version of the manuscript.