Review of the paper: **Sensitivity of atmospheric rivers to aerosol treatment in regional climate simulations: Insights from the AIRA identification algorithm** by Eloisa Raluy-López, Juan Pedro Montávez, and Pedro Jiménez-Guerrero

This investigation aims to develop a robust approach to identify ARs (called AIRA algorithm) under the constraint of the regional domain provided by the area-limited simulations. By developing this approach, the authors are able to inspect the impact of online aerosols on this meteorological phenomenon. The key finding of this work is how aerosols are treated in simulations may influence both in ARs intensity and trajectory by radiative changes cooling or heating the air.

General comments

The paper is well structured, and the algorithm adopted is easy to understand thanks to the illustrative figures. Although several approaches have been developed to identify ARs, their innovation relies on overcoming the RCMs' limitations where most of the runs are focused over land, and this precludes capturing the long way over the ocean. The success of this approach will allow the use of RCMs to provide more accurate precipitation amounts than GCMs and to perform less computationally costly simulations such as online aerosol runs to understand ARs mechanisms. Then, I found this work a valuable advance to analyze the impacts of the AR's landfalling.

Under these arguments, I recommend accepting this work after addressing a minor revision detailed below.

1. Introduction. In line 55, the authors mention the lack of research about the impact of aerosols on ARs but they did not discuss the challenges nor mention previous works such as any Counterbalancing influences of aerosols and greenhouse gases on atmospheric rivers by Baek and Lora

2. Methods.

   How can the AIRA be sure that is detecting an AR and not the branch of a low system with a bigger enough radius? Does $\Delta\Theta < 25$ guarantees this fact? Maybe introducing SLP values will avoid this concern.

   In Table 1 the authors show the imposed parameters. To demonstrate the robustness of the approach some discussions about the sensitivity of these parameters are needed. For instance, how many percentages of ARs increase/decrease if the IVT threshold is modified?

To better contextualize your methodology, I missed a discussion comparing AIRA approach with other methodologies of other tracking approaches, For instance, a review can be found in: *Atmospheric River Tracking Method Intercomparison Project (ARTMIP): project goals and experimental design by Ruth et al.*

3. Results

Following the previous comment, some validation against observations (e.g. satellite images) and/or using the ARs inventory/catalogs is needed to be the coherence of your approach with the ARs already identified along the bibliography.

In line 196 the authors mention. "It was found that most of the ARs identified by AIRA also matched those identified by global-scale algorithms, as reported by Brands et al. (2017)." How many coincidences did you find? Did you find more 'real' ARs in BASE or in ARCI? Do you think that some discrepancies may be due to a different approach or the use of an RCM instead of a GCM?

In Line 224 the authors assert that the ARs explain the 30% of the precipitation, it is not clear what area did you use to obtain this value, and the Fig. 5 shows strong spatial variability to perform a spatial average. Furthermore, how accurate is the precipitation during these events? Is ARCI or BASE more representative of the observed precipitation?

In Line 232. Only 37 % of the coincidence of ARs between ARCI and BASE looks like a few percent. When the simulations are described there isn't any mention of nudging or re-initialization of initial conditions has been mentioned. What percentage of these discrepancies could be due to different treatments of aerosols or due to internal variability of the simulations?

When sea salt and dust clusters are analyzed (Fig. 7 and 10) It will be interesting to see mean ARs trajectories for each cluster (for instance superimposed with dotted lines).

In the analysis of the differences to better understand the thermodynamics and dynamics changes, it will be illustrative to analyze whether the IVT changes are more due to IWV or/and winds.

Throughout the work, I missed more analysis about the impacts of ARs on precipitation. I understand that may be the scope of future work. For the case studies will be interesting

to show the spatial distributions of the precipitation (accumulated during the whole event and/or hourly) for the three simulations; BASE, ARI, and ARCI. These will provide some insights about how the intensity and trajectory of ARs impact on the precipitation distributions. Furthermore, the authors found around 30% of ARs impact precipitation but this percentage will have spatial and temporal variability. For instance, as ARs have an interannual variability also their impact on precipitation will be significant. Finally, it will be interesting a further understand the low impact on precipitation of the ARs over Galicia, Is it less frequency of ARs, more precipitation due to cold fronts, or orographic arguments?