Associate editor comment:

If the authors submit a final version of the manuscript, then it will be necessary to include some evidence (a figure or a reference) showing that the current spatial and temporal density of RO leads to a need for better coverage when approaching specific goals.

Dear Associate Editor, thank you very much for the comment.

We use a scenario of an Atmospheric River (AR) to show the importance of higher temporal and spatial RO density to detect such a structure. We provide an example of how we need improved spatial and temporal density of RO measurements for the case of an atmospheric river, and we have added a figure (Figure 11) to the manuscript to help clarify this.
We have displayed such experiments in *Shehaj 2023, Space Geodetic Techniques for Retrieval of High-Resolution Atmospheric Water Vapor Fields, PhD thesis, ETH Zurich, No. 29245, Zurich, Switzerland.* The following plots summarize the results in the thesis. The assessment is performed for a height of 2 km.

We identified an AR scenario on the West Coast of the US (on the website of US National Weather Service, NOAA, *«National Weather Service,» [Online]. Available: https://www.weather.gov/mtr/AtmosphericRiver_10_24-25_2021. [Accessed 15 February 2023]*), during 24th and 25th of October 2021. The AR (blue stream) hits the US coast from the Pacific Ocean, in the right plot of Figure 1. This AR was visualized using ECMWF hourly forecasts.

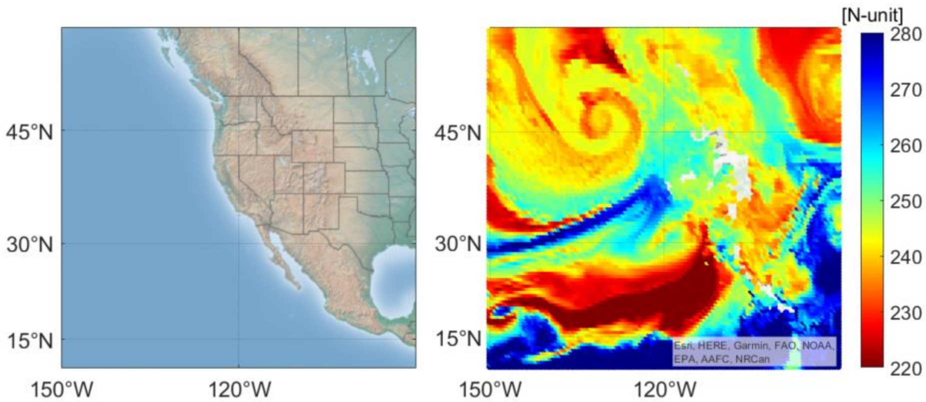

Figure 1: River scenario in ECMWF data, refractivity at 2 km height, 24 October 2021 at 19:00 (similar to *Shehaj 2023*), (not in manuscript).

To evaluate our method to detect such structures, we utilize RO observations for a simulated constellation of 60 satellites. In total, we obtain 743499 occultations globally for 4 days (23-26th of October), while in the study region [10°N to 60°N latitudes and 90°W to 160°W longitudes] the number of occultations is 53995. Similar tests were done for 48, 24 and 12 satellites constellations. Figure 2 displays the RO refractivity at 2 km altitude.

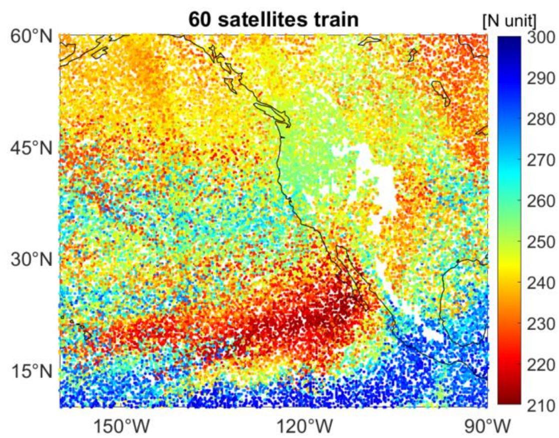

Figure 2: Training datasets for a simulated constellation of 60 satellites (similar to *Shehaj 2023*), (not in manuscript).

Figure 3 displays the ECMWF and the ML mapped refractivity for the 60 satellites constellation. Similar experiments were performed for the 12, 24, and 48 satellites shown in *Shehaj 2023*. We showed that for this assessment a 48-satellite constellation can detect the AR structure at 2 km quite well.

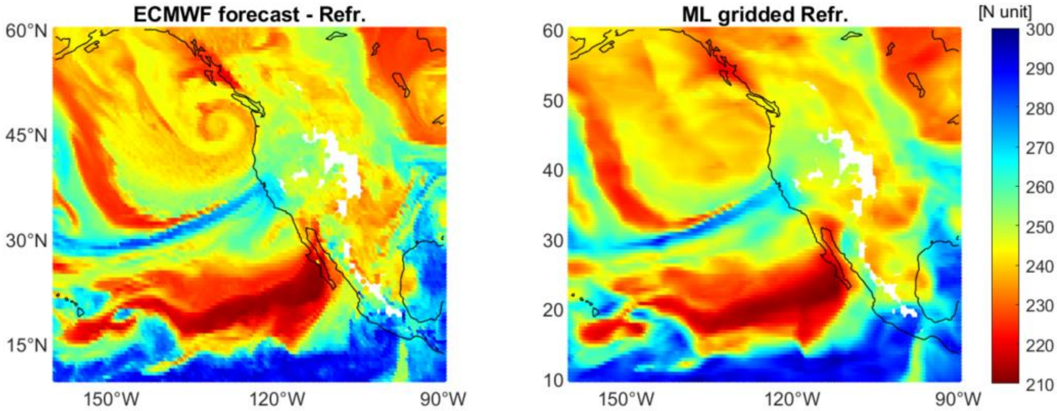

Figure 3: ECMWF reference refractivity field and the refractivity field obtained using ML, 24 Oct 2021 at 16:00, (not in manuscript).

We point out that in *Shehaj 2023*, similar experiments were performed for this AR scenario using observations of the COSMIC-2 constellation; the number of RO observations is much smaller compared to the simulated example shown here. After applying the ML model to grid the COSMIC-2 refractivity (at 2 km height) we cannot properly observe the spatial and temporal evolution of the AR structure.

In the paper, in the discussion and conclusions section, we have added the following section:
'When approaching specific atmospheric structures, the current spatial and temporal density of RO observations leads to a need for better coverage. (Shehaj, 2023) shows an example of using RO observations to detect atmospheric rivers (AR). ARs are long and narrow bands in the atmosphere that transport water vapor in regions beyond the tropics. Plot (a) of Figure 11 shows an AR that occurred in October 2021, visualized as a blue stream using ECMWF refractivity at 2 km altitude. In plot (b) of Figure 11, ML was applied to simulated RO using ECMWF 12-hour forecast, assuming a 60-satellite LEO constellation tracking four GNSS constellations to generate a 2 km refractivity field. For the example in Figure 11, we can see that with the ML-mapped field, we can resolve the AR structure. The ML field also depicts the dry patch located in the tropics. We also notice that there are structures more difficult to resolve, such as the cyclone close to British Columbia, as well as the high refractivity patch close to Hawaii.

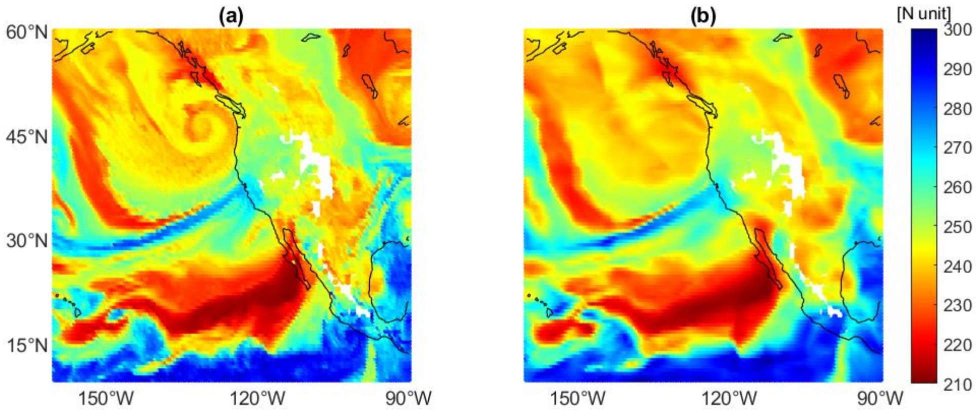

Figure 11: Refractivity at 2 km altitude example for 24 Oct 2021 at 16:00, similar to (Shehaj, 2023). Plot (a): ECMWF reference field. Plot (b): the field mapped using ML (for the 60 satellites constellation).

We point out that in (Shehaj, 2023) similar experiments were performed for this AR scenario using observations of the COSMIC-2 constellation; the number of RO observations is much smaller compared to the simulated example shown here. After applying the ML model to grid the COSMIC-2 refractivity (at 2 km height), we cannot properly observe the spatial and temporal evolution of the AR structure.

The example in Figure 11 shows the need for higher spatial and temporal density of RO observations and the benefit of using ML as a method to further enhance the resolution of the observations. In future studies, we will further explore the feasibility of GNSS RO for detection and monitoring of ARs.'