Review of "Characterization of liquid cloud profiles using global collocated active radar and passive polarimetric cloud measurements" by Wang et al.

<u>**General Summary**</u>
This paper presents an innovative methodology for characterizing vertical profiles of stratiform liquid clouds. The authors identify dominant morphological patterns of cloud effective radius profiles using CloudSat radar data, and then develop a way to retrieve profile information from passive polarimetric (POLDER) satellite observations. The paper is technically strong and well-written. However, after reading the paper I was left with a few key questions that should be addressed before publication.

<u>**Major Comments**</u>

1) The authors state that cloud-base height is retrieved "based on POLDER data" (line 116). How, exactly, is this retrieval performed? I was not aware that cloud base height could be retrieved from POLDER. Does the multivariate regression model mentioned in line 367 also use cloud base height from POLDER?

2) The spatial resolution of CWC-RO (less than 2km) in vastly different from the spatial resolution of POLDER (~50km). I'd like to see more details about how the observations were matched up in creating Figure 9, and more discussion about whether relationships between variables derived at CloudSat resolution should be expected to hold at POLDER resolution, when there will be a lot of sub-pixel heterogeneity.

<u>**Minor Comments**</u>

Line 136: Why 2013, 2019, and the first eight months of 2020? This seems like a very arbitrary group of years to use.

Line 204: As far as I am aware, there is no "Colorado State University regional climate model." Do you mean the CSU Regional Atmospheric Modeling System (RAMS)?

Line 223: It should be noted that the CloudSat CWC-RO product misses many (perhaps the majority of) single-layer liquid clouds, either because the clouds are masked by surface clutter or because they are below the radar's noise threshold (e.g., Lamar et al., 2020; Schulte et al., 2023). So the true nonprecipitating-to-precipitating ratio is likely much higher.

> Lamer, K., Kollias, P., Battaglia, A., and Preval, S.: Mind the gap – Part 1: Accurately locating warm marine boundary layer clouds and precipitation using spaceborne radars, Atmos. Meas. Tech., 13, 2363–2379, https://doi.org/10.5194/amt-13-2363-2020, 2020.

> Schulte, R. M., Lebsock, M. D., and Haynes, J. M.: What CloudSat cannot see: liquid water content profiles inferred from MODIS and CALIOP observations, Atmos. Meas. Tech., 16, 3531–3546, https://doi.org/10.5194/amt-16-3531-2023, 2023.

Line 240: I believe you mean Table A4 here, but even so, I do not understand what the table is intended to show.

Line 327: Any idea whether these two density centers have physical meaning?