Review of manuscript no. egusphere-2023-2644: "**Numerical Simulation of Aerosol Concentration Effects on Cloud Spectral Evolutions of Warm Stratiform Clouds in Jiangxi, China**" by Yi Li, Xiaoli Liu and Hengjia Cai.

General

This revised manuscript uses the WRF model, combined with the SBM-FAST bin scheme, to simulate warm shallow clouds in Jiangxi, China. Numerical experiments were performed on a specific case study, including a reference case and additional experiments that altered the aerosol concentrations. The primary objective is to examine how these changes impact the properties of warm clouds. The numerical results were validated against airplane and satellite measurements. The study analyzed variations in cloud microphysical parameters in relation to aerosol concentrations, with a particular emphasis on the relationship between relative dispersion, mean radius, and drop concentration.

The authors have made significant revisions and improvements to the manuscript. However, several general issues still need to be addressed before publication. The main concern is the quality of writing, which is, in some parts of the manuscript, inaccurate and unclear (see specific examples in the comments below). These sections should be rewritten to accurately convey the physical concepts.

Despite these issues, the research is interesting and relevant to the cloud physics and climate communities. Understanding the relative dispersion's dependence on aerosol conditions is crucial, as it is a key factor used to parameterize cloud processes in general circulation models (GCMs) and bulk microphysical schemes.

I have a few comments that should be addressed before publication:

1) The title is not clear. What is the meaning of spectral evolutions?
2) The Abstract: The abstract needs to be rewritten in a more precise and accurate manner, as it contains several unclear and incomplete statements.

For example, consider the first sentence: "Aerosols, as cloud condensation nuclei (CCN), may impact cloud droplet spectrum relative dispersion (ε), affecting precipitation and climate change."

This should be rewritten to provide more detail and accuracy, such as: "Changes in aerosol amount and size distribution may impact the size distribution of cloud droplets (since they serve as CCN), as well as their relative dispersion. Relative dispersion is a key factor used to parameterize cloud processes in general circulation models (GCMs) and bulk microphysical schemes, and thus influences precipitation estimates and various aspects of climate predictions."

Another example is the second sentence: "However, the influence of various aerosol modes on cloud microphysics remains controversial, and this effect varies with area and cloud type."

Again, this statement is unclear and inaccurate. It should be rewritten as: "However, the influence of changes in the concentration of various aerosol modes on cloud microphysical processes is still a subject of debate, and it depends significantly on thermodynamic conditions and cloud type."

3) The introduction: line 47 states: "On the one hand, ε influences the effective radius of cloud droplets and the auto-conversion process, thereby affecting cloud precipitation processes … . On the other hand, impacting climate".

   This description is partial and unclear. Phrases like "ε influences the effective radius of cloud droplets" and "ε affects cloud-aerosol interactions" lack specificity. These statements need to be rewritten for clarity and accuracy.

4) The introduction: Throughout the entire introduction, it is crucial to specify the exact type of cloud being studied in each referenced work. While "warm shallow clouds" is a broad term encompassing various cloud types, it is important to clearly identify the specific cloud types under investigation. This distinction is necessary because different cloud types are governed by unique controlling processes, which significantly influence their formation, behavior, and interaction with aerosols.

   Moreover, throughout the paper, it should be clear what specific type of cloud is being simulated and studied. Simply referring to "warm shallow clouds" or warm processes is insufficient and could lead to ambiguity in interpreting the results. Precise

terminology should be used consistently to describe the cloud type under investigation in this study. This will ensure that the findings are accurately interpreted and compared with previous studies on similar cloud types. Adjustments should be made to the manuscript to address this issue.

5) In the results section, it is important in my opinion to provide some information about changes in cloud fraction across the different simulations. Cloud fraction is a significant factor in cloud-aerosol interactions and can substantially influence the interpretation of results related to cloud properties and processes. Understanding how cloud fraction varies with different aerosol concentrations is crucial for assessing the broader implications of the study.
6) To enhance the clarity of the study, I recommend including more comprehensive meteorological data for the event under investigation. The current version of the manuscript presents a single snapshot of the 500 mb height and 700 mb winds, which is insufficient for a thorough analysis of the conditions affecting cloud formation and development. Adding detailed meteorological context will greatly assist in interpreting the results and understanding the processes involved in cloud dynamics. Adding 850 mb and surface pressure maps will provide insights into low-level dynamics and synoptic influences affecting cloud formation. Instead of a single snapshot, present meteorological data at multiple time points to show how conditions evolve during the event, correlating with cloud development. Include radiosonde data to provide thermal and humidity profiles, helping to understand atmospheric stability and conditions relevant to cloud formation.
7) Results: Fig 5: The figure presents the validation of the simulated cloud top temperature against satellite measurements. There are significant differences between the two that should be addressed and explained. The validation is a bit questionable.
8) Fig. 15,16,17: What time in the simulation do these presented results represent? How general they are?
9) Fig. 18: Very informative schematic figure that should be explained more clearly in the text.