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Interactive comment on "Mediterranean Precipitation Response to Greenhouse Gases and Aerosols" *by* Tao Tang et al.

Anonymous Referee #2

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This paper's focus is the local and large scale effects of radiative forcing by greenhouse gasses and aerosol on precipitation in the Mediterranean region. A decrease trend was observed for precipitation in this region during the last few decades and this study aims to explore the main processes behind this trend. To do so they use the outputs of set of climate models participating in the Precipitation Driver and Response Model Intercomparison Project.

This work suggests that both GHG and aerosols contribute to this decrease trend, by local as well as large scale effects. In particular, the contribution of shortwave absorption by black carbon (BC) is highlighted. Clear sky radiative effects are treated in details while hardly no attention is given to the aerosol effect on clouds' processes and properties (defined here in general as the indirect effect, although some of the models

do treat it). This work concludes that in addition to the local effects, BC absorption drives changes in large scale (global scale systems) such as enhanced positive North Atlantic Oscillation (NAO)/Arctic and it links it to a shift in the jet location (storm track) that implies drying of the Mediterranean and more rain over Europe. Let me start with the strength of the work. The insights on the link between the local BC absorption to the large-scale dynamics are interesting. Radiative effects on the local scale could be estimated by simpler radiation models but the derived effect on the dynamics could be resolved only by GCMs. Such dynamical results can be more important than the local effects and if all climate models show the same dynamical trend, it is important.

But even here, as in many (most) of the GCM studies, it is hard for someone who does not belong to the GCM community to evaluate this work. It is presented as model results and we have to believe it. One way to make such messages more approachable to all the climate researcher is to try to show the trend using as much as possible simpler models (toward an ideal GCM) such that the governing processes are demonstrated in a clearer way.

Apart from this, two main components are missing in this study: (1) The most important aerosol type over the Mediterranean is dust. Mostly Saharan dust. There are many studies that have shown how important are radiative and microphysical effect of Saharan dust. In this study which is dedicated to aerosol effects the word "dust" does not appear. Even if the authors want to focus on other processes they should first discuss dust in the introduction and explain why dust is not considered in this work. (2) On a similar note, since this paper deals with aerosols, clouds and precipitation, much more attention should be given to cloud aerosol interactions. Even if the authors estimate that this effect is negligible compared to other effects, they should invest efforts in proving it. They write in the conclusions part that the indirect and semi-direct effects are estimated to be small. I fail to understand how they know it and why they are so sure about it. I expect clouds to be extremely sensitive both to changes in the aerosol loading internally and to changes in the temperature (and RH) profiles due to

BC warming. Since rain is the sink of clouds it is not clear why such effects are less important.

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