Review of Future climatic drivers and their effect on PM 10 component in Europe and the Mediterranean Sea by Cholakian et al.

This study proposes an in depth analysis of the potential evolution of PM and related drivers over Europe and part of the Mediterranean basin. To do so, the CHIMERE-WRF regional climate chemistry system is driven dynamically and chemically by the LMDZ INCA GCM following different RCPs climate and emissions scenarios. Anthropogenic Emission within the regional domain follow ECLIPSE scenarios. The effect of regional climate change, boundary conditions change and emission change are assessed using ad-hoc sensitivity tests.

Overall this study presents a lot of interesting information and deserves to be published in ACP. There are however a few points and comments to be addressed before that.

Section 2 :

Modelling framework :

For any regional climate study it is good to have information on the driving system, especially because both dynamic and chemistry are driven by LMDZ-INCA here. If possible provide references where LMDZ-INCA scenarios are analyzed in term of climate change (e.g. CMIP5 intercomparison) and future PM conditions.

Are the LMDZ-INCA runs also driven by ECLIPSE emission for the chemistry part ?

Please specify the frequency of the chemical boundary coupling with CHIMERE. Is it monthly or higher frequency ? this could be relevant especially for dust outbreak simulations via the southern and eastern boundaries.

Vertical grid. The top of the model is 500 mb, but we know that Mediterranean basin could be influenced by long rage transport in the upper troposphere. Is there also a chemical boundary conditions at the top of the model, driven by INCA ?

Experimental design:

You choose to include natural emission change as part of regional climate change analysis. That makes senses but it should be clearly stated (perhaps natural emission should not go under the air pollutant umbrella). It is clear that MEGAN is used for BVOC, apparently but do you have also sea-salt and dust production within your regional WRF/CHIMERE domain ?

The description of chemical BC experiment is a bit unclear to me. You mentioned that you considered two emission scenarios RCP and ECLIPSE for the global CTM. This does not reflect in table 1 however.

Also another question is what would have been the dust boundary conditions change provided by INCA if you had considered another climate scenario ? In the global forcing fields, are there a lot of differences between dust change simulated under different RCP projections ?

In general, PM boundary condition change is driven by climate (and emission) change in the GCM. Caution should be taken in the final interpretation of BC change vs regional climate change, especially when discussing dust and the MED region.

Section 3 : climate impact.

Section 3.2 L 70. Actually for MED/RCP26 you have a slight increase of PM on figure 4 when in the text you mention -1.77% ?

L90-90. Can the summer increase in all scenario be related to biogenic emission and if yes make the link with section 3.4.2 .

Section 3.3 and 3.4

Decrease in nitrate: just a side question , is there a significant trend in gas phase HNO3 ?

Sulfate : you mention the importance of aqueous formation can you confirm that just by looking at cloud cover trend given by wrf ?

BVOC : that could also explain the seasonal pattern of total PM change (general decrease but increase in summer).

DUST : Again, caution should be taken since regional climate change impact on dust sources, strongly determined by the Mediterranean due to southern boundary location.

Section 4 .1

Line 20. See the above discussions. Dust boundary conditions change is related to Mediterranean climate change, as simulated by the GCM.

You mentioned land use change. Does the LMDZ-INCA simulation include CMIP land use change ?

Decrease of Sulfate : is it mainly related to a decrease in SO2 emission just outside the domain (northern Africa sources) that you could see from the ECLIPSE scenario used to drive LMDZ-INCA ?

Section 4.2

The decrease in BSOA associated to a decrease in anthropogenic aerosol is indeed very interesting… but the magnitude of this decrease is quite “impressive” especially when compared to the impact of biogenic emissions in a changing climate. How much confidence do we have in this result ? Do you see a large decrease of oxidant activity in the chimere outputs ? Do you see a relative increase of isoprene and monoterpenes concentration?

Section 5.

In line with previous comment, the discussion between regional climate change and boundary condition effect should mention that Mediterranean climate change and dust activity are linked but could not be captured in a fully consistent way because of the choice of the CORDEX domain.