Final response

We would like to thank the third reviewer for his comments and would like to thank all reviewers and our editor, Xiaohong Liu, again for their help in improving the manuscript. Please find the response to the comments by anonymous referee #3 below.
Best regards,
Vivek Sant

Comments by anonymous referee #3

In this work the authors augment the cloud microphysical scheme of the ECHAM model by including prognostic treatment of drizzle and snow. The authors carry out a detailed analysis of the sensitivity of the simulated cloud properties to the new implementation. They show that the simulation of accretion and autoconversion processes as well as of cloud glaciation move in the right direction as compared to observations. It is too early to tell whether such improvement leads to a better representation of aerosol effects and of climate. Still, I find the work interesting and of importance for the atmospheric community, and recommend its publication in ACP. Coming late to the review process I see that the work has been quite improved with respect to the initial submission. Therefore I have just very few, minor comments to be addressed before publication (line numbers refer to the revisited submission).

- It is not clear why the total aerosol indirect effect is increased while at the same time the sensitivity of liquid cloud properties to CCN concentration is reduced. This seems counterintuitive and a sentence explaining this must be added to Section 3.3.

We agree that this result seems counter-intuitive and have added the following paragraph at the end of Section 3.3:

> *It may seem counter-intuitive that the sensitivity of the CLWP to the aerosol forcing is reduced with the prognostic treatment, but at the same time increasing ERFaci + ari, i.e. making F_{net} more negative. However, note that the sensitivity of the CLWP to changes in CCN concentrations is measured on a microphysical scale and is no measure for the amount and distribution of clouds over the whole earth, as is F_{net}. As discussed earlier, the introduction of prognostic precipitation affects the conversion rates within the hydrological cycle and leads to a redistribution of cloud liquid and ice, which in turn depends on the model physics (cf. Gettelman et al., 2015). Herein lies the difficulty and further research investigating the coupling of prognostic precipitation to the model physics is needed to improve the uncertainty in the anthropogenic aerosol forcing.*

- Line 40, page 3. Remove the word clouds.

Done.

- Line 63, page 4. It must be offsets.

Done.

- Line 181, page 8. Specify that these are microphysical rates. I assume that the total tendency should also include terms for advection and turbulent diffusion which are not shown.

Indeed, these are only the microphysical rates and has been specified. As you say, other tendencies such as advection are not shown.

- Line 190, page 9. Please add a sentence explaining how the precipitation cloud fraction is calculated. Is it the same for rain and drizzle?

The precipitation fraction, $\mathrm{b_r}$*, does in fact represent the total fraction of precipitating drizzle, rain and snow and is calculated as in CTRL, where at a given level it is weighted by the incoming and locally produced mass flux or defined as* $\mathrm{b_r} = \mathrm{b_c}$ *if the locally produced precipitation exceeds the incoming flux. More details can be found in Roeckner et al. (2003, chap. 10.3.6.). We have added this to the manuscript.*

- Line 275, page 12. An exponential distribution implies μ_s=0 not 1.

Refering to Eq. (9) on page 10, an exponential distribution does imply $\mu_s = 1$*, as* $f_i(D) \propto D^{\mu_i - 1}$*. We see that it is easy to miss* D^{-1} *in the first part of the equation, so we have tried to emphasise this by writing "[...], i.e.* $\mu_s = 1$ *with respect to Eq. (9).", on page 12, line 275.*