Response to points (1)-(11) of Reviewer II

(1) & (2) We agree with the Reviewer that the Method section is lengthy and difficult to understand. We will revise that section and improve the structuring by introducing two sections with subsections. The new sections are:

2. Model description
2.1 Climate model
2.2 Dust cycle model
2.3 Experimental design
3. Model verification
3.1 Dust load
3.2 Dust shortwave DRF

(3)
The present study is in line with the model configuration shown in the flow diagram (Fig. 1 in Ganopolski, Calov and Claussen, 2010). New is the method of calculating the radiative forcing by aeolian dust (indicated by RDST in that Fig. 1). RDST is now replaced by a consistently calculated dust direct radiative forcing (called dust DRF in the manuscript). This consistency is achieved by the physically based schemes of the shortwave radiation transfer and of the dust cycle model (indicated by box DUSTER in that Fig. 1). The present study still describes the dust effect on ice and snow albedo (indicated by DDST in that Fig. 1) as before.

(4)
We will describe the experimental design more clearly and we will avoid the terms off-line and online in the revised manuscript. The present study uses a physically based link between dust DRF and the atmosphere model. The link between dust deposition on ice and snow surfaces (DDST in Fig. 1 in Ganopolski, Calov and Claussen, 2010) is as in previous studies. The previously used RDST was found to have a rather small effect and the control simulation in the present study is without RDRF. The present study discusses the uncertainty range of dust DRF obtained in simulations in which the previously external RDST is switched off. New is, that now the dust DRF is calculated interactively and consistently with climate characteristics. Subsequently the DRF-induced climate response is discussed.

(5)
We will describe the calculation of the radiative transfer in an Appendix. The complex refractive index is an essential parameter in the calculation of the radiative transport equation of light through the atmosphere and we refer to the standard definition. We use the two-stream delta-Eddington approximation which assumes a plane-parallel layering of the atmosphere. The scattering of light at particles in the atmosphere during the radiation transport is a function of the cosine of the zenith angle from sunrise to sunset, of the optical depth of aerosols and the imaginary part of the aerosol refractive index (RI). Values of RI are usually calculated by inversion schemes using theoretical spectral models, spectral measurements and particle property distributions. The paper by Dubovik et al. (J. Atmos.Sci., 2002) and the references therein give an overview of the methodology and about revisions of the values of RI for dust aerosols.

(6)
The previous Section 2.2 (Shortwave scheme for dust radiative forcing) is now better structured (see our response to item 1 and 2). The dust cycle model is the same as in Bauer and Ganopolski (2010) but parameter values in the deposition scheme which were poorly constrained have been varied and calibrated using dust deposition data. So, the results on the uncertainty range for dust lifetime are

new. In turn, uncertainty ranges of dust load and dust AOT are estimated. This is now more clearly presented in section 3.1.
The previous section 2.2 also contained a validation of the calculated dust DRF. This validation is now presented in section 3.2.

(7)
The dust effect on the albedo of ice and snow surfaces as in previous studies (see also response to item 3).

(8)
The glacial simulation results (in section 3.2 and in the revised section 4.2) with interactive DRF from atmospheric dust show the response with respect to the control simulation (with DDST effect on ice and snow albedo). In that sense, the climate sensitivity was not changed, although we emphasize that the model configuration uses no climate sensitivity parameter.

(9)
We will extend the discussion on the climate response induced by the interactive dust DRF. We show in Fig 7a,b,c the global mean response in SAT, dust emission flux and sea level for the last glacial cycle. We will describe more clearly the uncertainty ranges of these prognostic climate variables and the anomaly series with respect to the control simulation. The response behavior is similar for all four glacial cycles and no new information will be seen from time series over four glacial cycles.
Fig. 8 will be changed to show the ice sheet distribution for the entire northern hemisphere. Unfortunately the plot showed incorrect longitudes.

(10)
The dust effect of ice sheet darking is important for melting of the ice and snow fields at glacial terminations. The dust effect from the shortwave radiative forcing is important for the cooling of the climate during glacials. We will include this discussion in the revised manuscript.

(11)
We will refer to Lambert et al. (2013). As can be seen from Fig. 9, our simulations show a polar amplification. Our results suggest that the amplified cooling in the northern high latitudes is connected with the dust DRF concentrated in the northern hemisphere, in particular over Asia, and connected to the positive ice-albedo feedback.