

Interactive comment on “Temporal and spatial variability of Icelandic dust emission and atmospheric transport” by Christine D. Groot Zwaaftink et al.

Anonymous Referee #1

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The authors present results from a multi-annual (27 years) study assessing the capability of the Lagrangian model FLEXPART to capture the Icelandic atmospheric dust life-cycle. Thereby, dust emission fluxes are estimated using FLEXDUST. Results of their study were further discussed regarding its interannual variability; results at high resolution were validated against measurements for the year 2012.

The manuscript is well structured and a nice read. However, I do have some comments I would like the authors to address.

2.1 Model description

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(1) In the subsection FLEXDUST you describe how dust sources were implemented in the model. You state that lower friction velocities and large soil fractions were assigned to dust hot spots as identified by Arnalds et al. (2016). I am wondering whether these dust hot spots occur due to enhanced levels of sediment supply or due to higher frequencies of stronger winds (maybe also channelled by orography).

(2) Can you spend some more words on how FLEXPART and FLEXDUST co-exist respectively intertwine as this remains somewhat diffuse. As far as I understand FLEXDUST is used to estimate dust emission fluxes based on ECMWF forecast analyses at 0.2deg horizontal grid spacing. The calculated emission fluxes are then read into FLEXPART and transported whereby FLEXPART is driven using the ERA-Interim reanalysis at 1deg horizontal grid spacing. Why were two different atmospheric data sets chosen to drive the models rather than using consistently ECMWF forecast analyses for both but on a different horizontal grid?

(3) How is dust deposition respectively removal parameterized? Please add some explaining words. Is wash-out and scavenging due to rain and clouds considered as particle removal processes?

(4) Simulation setup (section 2.2): As the input meteorological fields were available at a grid with a 0.2deg horizontal grid spacing, but dust emission fluxes were estimated on a grid with 0.01deg horizontal grid spacing, can you explain if there has been any upscaling or interpolation method applied, please? Is topography taken into account for the upscaling?

3. Results and discussion

(5) In section 3.2.1, numbers of days of active dust emission are provided as

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fraction per annum. How do these numbers of days compare to seasons? Some additional sentences presenting and discussing the seasonal distribution of dust emission events, transport and deposition can help here to draw a more thorough picture of the Icelandic atmospheric dust life-cycle - and eventually imply further mechanism controlling interannual variability.

(6) Is there any explanation why the NAO has no significant correlation with dust emission in Iceland? (section 3.2.2)

(7) As stated in section 3.2.2, the NAO has no significant impact on dust emission. However, why is the NAO used as measure describing Aeolian transport and deposition patterns (section 3.3)? May topography has an important and maybe dominating impact on the transport direction here?

(8) How is the dust vertically distributed? Is there any significant dependency between dust deposition region and transport height or mixing depth into the boundary layer over source regions that can be concluded from the FLEXPART simulations? An enlarged discussion on dust transport pattern and deposition regions is desirable in order to clarify the conditions under which Icelandic dust is transported far beyond its source region. Furthermore, the results may vary with season as the predominance of meteorological situations (e.g. occurrence of precipitation, cloud formation) and atmospheric circulation patterns changes.

(9) Can the hypothesis by Meinander et al. (2016) that “Icelandic dust may have a comparable or even larger effect on the cryosphere than soot” be confirmed by the presented study?

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