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Interactive comment on "Climate engineering by mimicking the natural dust climate control: the Iron Salt Aerosols method" *by* Franz Dietrich Oeste et al.

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The authors would like to thank Professor Scott M. Elliott for the careful reading of our manuscript and for his very constructive comments that helped us to improve our manuscript.

Our responses to the Reviewer 1 comments are included in the followings.

Comment 1: Starting end of page C3 till page C7, the referee formulates a basic critic point directed to most of the climate engineering methods. Even the methods aimed to remove greenhouse gases like CO2 from the atmosphere (CDR) including the ISA method proposed in this manuscript: "But the notion really boils down to combatting

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Discussion paper

one form of the large scale pollution with another."

Answer 1: Anderson (2016) reminded that of the 400 IPCC scenarios that keep warming below the Paris agreement target, "344 involve the deployment of negative emissions technologies", which he qualifies of "speculative" or requiring geoengineering.

A large part of the research devoted to climate engineering methods concerns SRM (sunlight reduction methods), like mimicking the effects of large volcanic emissions by adding sulphates aerosols into the stratosphere as suggested for instance by Crutzen (2006). Numerous other types of particles have been suggested for these aerosols for instance titania by Jones (2015). But SRM only buys time and has numerous drawbacks. On the one hand, SRM did not address the main cause of global warming (GHG emissions), nor prevents ocean acidification. On the other hand, several CDR technologies do, but their costs are much larger than SRM and the scale requested poses many technological challenges, for instance "scaling up carbon dioxide capture and storage from megatons to gigatons" (Herzog, 2011).

Very few CDR methods without emission of disadvantageous pollution are known. One of those is the Terra Preta method: it is characterized by the mixing of grinded bio-char into agricultural soils. The climate relevancies of this method are sustained fixation of former CO2 carbon, minimizing fertilizer consumption and N2O emission reduction from the fertilized Terra Preta soils. Char has similar properties within the soil environment like humic substance, but in the environment char is resistant against oxidation. Comparing the Terra Preta method to other CDR methods like fertilizing the ocean by micro nutrients, results in lower specific material expenses by CDR methods per unit of CO2 removed from the atmosphere (Betz et al. 2011). The ISA method we propose is a member of this CDR group, thus this result is also valid. In addition the further climate effects of the ISA method (like depletion of CH4, tropospheric ozone, and soot, plus cloud whitening) reduce the specific material expense level. Also the ISA method mimics a natural phenomenon (mineral iron-dust transport and deposition) and only proposes to improve the efficiency of an already existing anthropogenic pollution.

Myriokefalitakis et al (2015) estimates that “The present level of atmospheric deposition of dissolved Fe over the global ocean is calculated to be about 3 times higher than for 1850 emissions, and about a 30% decrease is projected for 2100 emissions. These changes are expected to impact most on the high-nutrient–low-chlorophyll oceanic regions.”Their model “results show a 5-fold decrease in Fe emissions from anthropogenic combustion sources in the year 2100 against in the present day, and about 45% reduction in mineral-Fe dissolution compared to the present day”. Recently Boyd and Bressac (2016) suggested rapidly starting tests to determine efficiency and side effects of CDR ocean iron fertilizing methods.

Several experts, for instance Hansen et al. (2016), expressed recently the urgent warning that mankind has only short time left to address and control climate warming. As a consequence mankind ought to find out as soon as possible climate controlling matter which might generate the most effective and reversible climate cooling effects within the shortest period. Lifetime of ISA emissions in the troposphere are much shorter that of sulphates in the stratosphere. Of course, such tools and agents have to be rapidly evaluated against side-effects to ecosystems, human health, and last but not least their economic burdens.

Comment 2: (page C2) Due in large part to its (breathtaking) scope, the Oeste paper is exceptionally difficult to ingest. Problems will be compounded for certain readers by a consistent use of highly nonstandard scientific English, with a strongly European tone. (page C7) I have with me a thorough listing of edits to the European English along with a few typo identifications, but I will only send such trivia if requested to do so.

Answer 2: The authors would greatly appreciate if the Reviewer can send them his English, grammatical and other edits suggestions to improve their manuscript digestibility and readability.

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