

## ***Interactive comment on “Geoengineering as a design problem” by B. Kravitz et al.***

### **Anonymous Referee #1**

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#### General comments:

This paper is of good quality and a very interesting topic. I do not feel adequately qualified to review large sections of it as the details of the feedback and control theory are out of my area of expertise and I found it difficult to follow as a newcomer to the subject. I do feel able to comment generally on the climate results.

#### Specific comments:

1. p.1638 line 10: Keller et al 2014 compared several carbon dioxide removal schemes but only one type of SRM (solar constant reduction) so does not seem an appropriate reference here. Crook et al. JGR 2015 and Niemeier et al. JGR 2013 also showed some common features and some differences of several SRM schemes.

2. p.1638 line 13: But Niemeier et al. JGR 2013 and Ferraro et al. Environ. Res. Lett. 2014 showed precipitation changes are quite different for solar reduction compared to C554

stratospheric aerosols.

3. section 3: I don't have enough familiarity with the mathematical terms and control theory in this section to comment on this. I found it very difficult to follow.

4. p. 1660 lines 13-14 : why do you have repeated symbols?

5. Section 3.7: It would have been helpful to see an influence matrix for this 3x3 case as in equation (20).

6. Equation (25): what do the dashes mean? Why are these blank if they are indistinguishable from zero, why not just zero?

7. Equations (27), (28) and (29) what are  $u_1$ ,  $u_2$  and  $u_3$ ? Are these the amounts of the 3 patterns of solar reductions described in equation (3)?

8. Figure 14: it's quite hard to see the changes to precipitation centroid.

9. p. 1672 lines 18-19: how does converging in 9-10 years indicate a 2-3 year timescale. I don't understand why  $L_1$  isn't held constant after some period rather than going toward zero. Surely the CO<sub>2</sub> warming is continuing to warm the NH more? I am not sure what the figures are showing now. Is it the change each year in  $L_0, L_1, L_2$  which are added on top of the previous year solar reductions, or the actual solar reductions?

10. Table 1: I am not sure why PI control has such large RMS. Why is it not 0? Surely the PI control is your reference climate and that's what you want to achieve in term of Arctic temp and precipitation centroid?

11. Same applies to Table 2.

12. Why did you plot maps for the mean of only the last 10 years? Why not 30 years? Would it make a difference?

#### Technical corrections:

1. There are two Kravitz et al 2015 papers in the reference list differentiated as 2015a

and 2015b but all references to these in the text are just 2015. Please clarify which reference you mean.

2. p.1644 line 7: change 'a a' to 'a'.

3. p. 1645 line 10: change 'would need be' to 'would need to be'.

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Interactive comment on Earth Syst. Dynam. Discuss., 6, 1635, 2015.