Paper: Two drastically different climate states on an Earth-like terra-planet
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Overview: The authors run a sophisticated global climate model (GCM) with a surface that is covered by a sophisticated land model. They assume a globally uniform ground water table, representing efficient surface water transport. Interestingly, they find bistability between two climate states, a hot and dry (HD) state and a cold and wet (CW) state. I have never seen anything like this before and it is definitely worth publishing. I think the authors should do a bit more work to understand why the model produces this behavior, then the paper will be ready to be published. I have some comments that hopefully will help with this.

Comments:

1. Mechanism: In the final paragraph of the introduction the authors restrict the scope of the paper so that it doesn't include investigating the mechanism of bistability. I think at least some investigation of the mechanism is necessary so that this paper stands as an independent work that doesn't rely on future work and to convince the reader that the observed behavior isn't simply due to some bug in the land surface scheme.

The way I would approach this is to first run the model in "swamp" configuration: with a global mixed layer ocean of 1 m depth and zero ocean heat transport. Presumably you will reproduce a roughly Earth-like climate. Then I would turn on the land surface model, but choose schemes and parameters to match the swamp configuration as closely as possible. Then slowly turn more schemes on or change parameters until you get bistability. This should allow you to identify the specific physical parameterization that allows for bistability. It must be related to evapotranspiration, since that's the key difference between a swamp surface and a real land surface.

2. Surface energy balance: Surface energy balance is important for global-mean evaporation, and therefore precipitation. All else equal, more absorbed shortwave at the surface should mean more evaporation and more precipitation. That's why it seems odd that the planetary albedo should be lower in the HD state, but the global-mean precipitation should also be so much lower. One possibility is that much more of the surface heat is lost through sensible rather than latent heat in the HD state. Another is that the planetary shortwave absorption is not a good proxy for surface shortwave absorption because of differential atmospheric absorption of radiation in the two cases. I think it's worth calculating the terms in the surface energy balance (both zonal mean and global mean) and using this to explain why the HD state seems to be able to absorb so much more shortwave yet have such a low evaporation. If you can explain this, it might also help your investigation into the mechanism for bistability. Also, I wonder if this could be connected to why bistability is lost for Earth-like obliquity. It would be really great if you could explain why increasing obliquity disrupts the bistability, and maybe analyzing the surface energy balance would help.

3. Vertical Temperature Structure: One thing I was wondering about is the vertical temperature structure in the two states, since convection is probably important for the bistability. I think it would be worth plotting and thinking about this. A related point is that near the outer edge of the habitable zone we expect very high CO_2 levels, probably at least 1 bar. A large radiative cooling in the atmosphere could strongly affect the vertical temperature structure. It would be interesting to do some test runs at very high CO_2 and see if the HD state can persist under these conditions, since the authors connect the HD state with the outer edge of the habitable zone.