Earth Syst. Dynam. Discuss., 6, C574–C575, 2015
www.earth-syst-dynam-discuss.net/6/C574/2015/

Earth System Dynamics Discussions
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Interactive comment on "Attribution in the presence of a long-memory climate response" *by* K. Rypdal

Anonymous Referee #2

Received and published: 22 September 2015

This paper, which is an extension of the Rypdal and Rypdal (2014) attribution of the global instrumental mean surface temperature record to three known forcing components: Variations in global solar radiation, volcanism and atmospheric greenhouse gasses. Furthermore, the effect of heat exchange with the ocean from the Atlantic Multidecadal Oscillation (AMO) and the El Nino is investigated.

The new approach is to extend the analysis from merely a regression of the temperature signal onto the forcing components (zero response time model (ZRT)) to a long range memory (LRM) (1/f noise, fractional Brownian motion process). This is done by applying an integral filter to the forcing functions.

The paper is well written and I can recommend it for publication after minor revisions.

I agree with reviewer #1's comments, especially the use of the terms fingerprint and footprint. I actually find the transformation of a fingerprint into a footprint a little silly. Perhaps the authors could come up with better words. I prefer using "forcing function", "response function" etc., though I know it is not usually defined to be completely equivalent.

Two more points:

What I would like to see added is a discussion of the physical origin of the time scales involved in the temperature response. Especially, why should we expect these time scales to be the same for the different components: The reorganization of the climate system to radiative imbalances in the short wave radiation (changed in volcanic and solar forcing) and the long wave radiation (greenhouse trapping) could well involve different time scales. This perhaps is even more so with the AMO and Nino heat exchange with the ocean.

Regarding the many internal variations (or modes of oscillation, it you want), it should be discussed why AMO and Nino are the ones chosen. Nino I can understand, as it is the biggest reorganization of heat. It seems that the AMO is "convenient" since it is the only one of the five forcing component, which seems to be correlated with the warm forties/cold sixties seen in the global temperature (please use calendar years in figures).

Interactive comment on Earth Syst. Dynam. Discuss., 6, 1309, 2015.

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