

Reply to the Comment on "Volcanic forcing improves Atmosphere-Ocean Coupled General Circulation Model scaling performance"

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The Comment by Blender and Fraedrich (BF) [Blender and Fraedrich, 2004] consists of 3 statements. All the statements are not new and appeared already in [Fraedrich and Blender, 2003] and [Blender and Fraedrich, 2003]. As shown below, these statements are in contradiction with the observations.

In the first statement, BF claim that the fluctuation exponent α is close to 1 over the ocean (corresponding to $1/f$ noise), varies between 0.6 and 0.7 for coastal areas, and is 0.5 (white spectra) in inner continents. The white noise statement is in marked contrast to direct measurements of α at the available long-term records from inner continental stations in North America and North Asia [Bunde et al., 2004] and [Eichner et al., 2003] and in Australia [Kiraly and Janosi, 2004].

As has been shown in detail, the exponents are mostly around 0.65, similar to coastline stations, and there is no systematic dependence of α on the distance from the ocean. [Blender and Fraedrich, 2004] support their claims using the analysis of Australian stations by [Pattantyus-Abraham et al., 2003]. We could not find support in this paper. However, a recent manuscript [Kiraly and Janosi, 2004] by the same two authors shows that α is mainly between 0.6 and 0.7 and there is no decline of α with increasing station distance from the ocean, i.e. no sign of a white spectra in the inner continents (see figure 4c in this ms.).

It was also pointed out in [Bunde et al., 2004] that the white-noise claim is even not supported by the analysis presented in [Fraedrich and Blender, 2003], since a close inspection of the results presented in Fig. 1a of [Fraedrich and Blender, 2003] shows an exponent α greater or equal than 0.6. In addition, the BF-claim for the oceans ($1/f$ -noise) neither agrees with their own work [Blender and Fraedrich, 2003] nor with earlier work by [Monetti et al., 2003]. [Blender and Fraedrich, 2003] and [Monetti et al., 2003] found that over the ocean α varies between 0.7 and 1, and only a minority of sites has exponents α close to one, i.e. $1/f$ -noise.

The second statement that AOGCM control runs without external forcings as well as with greenhouse gas forcing only reproduce the observed temperature variations is one of the main claims in [Fraedrich and Blender, 2003]. We fully disagree with this statement as shown in detail in [Govindan et al., 2002] and [Vyushin et al., 2004]. Only when volcanic forcing is included, the model simulations are able to reproduce the observed LFV (on land) nearly quantitatively. For the oceans, volcanic forcing also improves the model performance, but the agreement is not yet complete. Greenhouse gas forcing alone cannot at all reproduce the climate variability, and is even worse than the control run alone (for details see [Govindan et al., 2002] and [Vyushin et al., 2004]).

The third statement regards the error bars. As stated in the caption of Fig. 3 in [Vyushin et al., 2004], the error bars of the exponent α are not above 0.03 and have been calculated using the method described in [Peng et al., 1993]. In contrast to [Fraedrich and Blender, 2003] and [Blender and Fraedrich, 2003], details of the calculations and the fluctuation curves have been presented in [Vyushin et al., 2004], so it is easy for a reader to estimate the quality of the conclusions. The error bars are considerably smaller than the α -variations between the different scenarios.

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