Fraedrich and Blender Reply: Our Letter [1] demonstrates power law scaling of surface temperature spectra in the climate system. In observations and a 1000-years coupled model simulation detrended fluctuation analysis (DFA) leads to the scaling exponents $\alpha \approx 1$ over oceans and $\alpha \approx 0.5$ over inner continents within 1–15 years [the spectral exponent in $S(f) \sim f^{-\beta}$ is $\beta = 2\alpha - 1$]. This general behavior is also found in the available global observations and reproduced within global warming simulations [2]. The 1000 year simulation yields regional standard deviations of roughly 0.05 for α. These analyses supplement a preceding Letter [3] claiming global universality of the power law $\alpha \approx 0.65$, which we identified as a coastal transition regime. While a recent paper [4] substantiates our ocean results in several locations, the preceding Comment [5] attempts to cast doubt on our findings in the inner continents.

The major issue of the Comment is whether $\alpha \approx 0.65$ is valid everywhere on the continents (Comment and [3]) or, as in [1,2], α decays to ≈ 0.5 in their interiors. Our result is based on centennial observations in central Asia (see, for example, the station Krasnojarsk, Fig. 1 in Ref. [1]) and in North America. These observations agree well with several climate model simulations which support $\alpha \approx 0.5$ in the interior of all continents [2]. A test simulation without an ocean model but, instead, with forcing prescribed by climatological sea surface temperatures, yields no memory over land [1].

A first concern is the unavoidable uncertainty ≈ 0.05 of α. Because of this we identify the "universal law" $\alpha \approx 0.65$ within 0.6–0.7. Values $\alpha < 0.6$, found in the inner continents, are considered as white noise, and the range 0.8–1.4, which occurs over large parts of the oceans, is considered as $1/f$ noise. Thus, the choice of the threshold $\alpha = 0.6$ is relevant for our identification of white noise.

In the Comment, the slope of the fluctuation function at the station Krasnojarsk (Fig. 1 in Ref. [1]) is questioned. This station is not included and analyzed in their set. In addition to our previous DFA result, we present the power spectrum $S(f)$ of the daily temperature in Krasnojarsk (Fig. 1) and compare this to two power laws $f^{-\beta}$. The fit in 150–2500 days, as in the Comment, yields $\beta = 0.045$, which indicates white noise and is clearly different from the "universal" $\beta = 0.3$ ($\alpha = 0.65$) included for comparison. Therefore, we adhere to our finding that $\alpha \approx 0.5$ within 1–15 years.

The fitting interval for the power law is crucial and may explain some differences between our Letter and the Comment. While we use 1–15 years, shorter time scales of 150–2500 days are used in the Comment. The motivation for the position of our fit interval is that power laws emerge reliably above 1 year and persist up to 15 years in the 100 year data set. The choice of this interval is relevant since the exponent α is typically larger for smaller time intervals (see Fig. 1 in the Comment and the note on the crossover at the end of the Comment). A minor point is that the Comment does not mention the locations of the 20 stations, although these are relevant since the mere distances to the ocean are not sufficient (Fig. 2 in Ref. [1]).

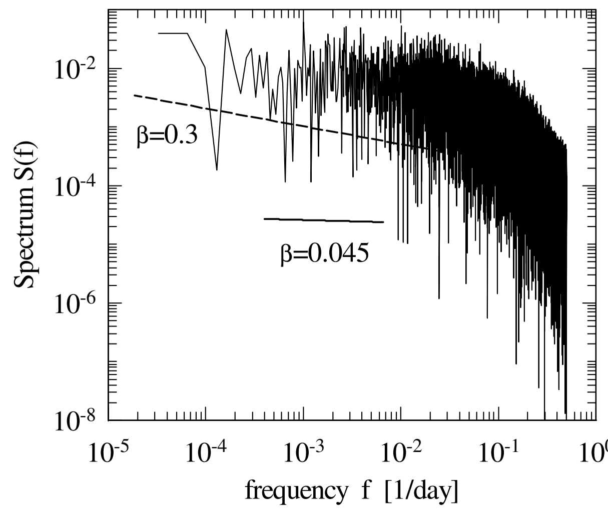

FIG. 1. Power spectrum of daily temperature at Krasnojarsk (93E, 52N); fit $\beta = 0.045$ in 150–2500 days (solid line), and $\beta = 0.3$ (dashed line).

In conclusion, the different interpretations of the results in our Letter and in the Comment are based on different fit intervals, incomplete data, and the disregard of uncertainties. We see no reason for a correction of our result that global memory originates over the oceans with a $1/f$ spectrum and decays gradually towards white noise over the inner continents.

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Klaus Fraedrich* and Richard Blender
Meteorologisches Institut
Universität Hamburg
Bundesstrasse 55, D-20146 Hamburg, Germany

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*Email address: fraedrich@dkrz.de

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