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# Macroevolution and megaclimate: revealing the domains of the Court Jester and biotic equilibration

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The fundamental question of the biodiversity dynamics field is whether global diversity of organisms is driven by multiple random forces resulting in unsteady pattern or is it constrained by sufficiently strong biotic interactions. The first set of hypotheses is combined under the umbrella of the “Court Jester”, reflecting non-steady nature of the process. The latter set of hypotheses is sometimes combined under the header of the “Red Queen”, an epitomization of perpetual change at constant equilibrium diversity level. Based on the Haar fluctuation analyses of the classical Sepkoski database and Paleobiology Database occurrence based biodiversity data, it was revealed that both datasets show that marine animal genus level diversity is characterized by the two regimes. The first, up to time scales of 30 to 40 Myrs, has a positive scaling exponent implying that fluctuations diverging with time scale i.e. behaviour like the Court Jester that is apparently unstable. The second regime, at longer time scales has a negative fluctuation exponent so that on average anomalies converge, the system is appears stable: a biodiversity regulating Red Queen regime. The smaller scale diverging regime (unstable) is characterized by nearly the same scaling exponent as megaclimate paleotemperatures, suggests a causal connection with diversity.

To investigate this further, we use a new multi-scale Haar fluctuation correlation analysis to quantify the scale by scale correlations. We found a persistent trend of increasing correlation of macroevolutionary rates with the surface water temperatures with increasing time scales. At the same time, the diversity shows increasingly negative correlations with the temperatures at longer time scales, which suggest that positive largest scale temperature fluctuations although increased biotic turnover had a regulating effect on the global marine animal diversity levels.

Based on the consideration of dominant processes at the longest time scales we propose that the equilibration of biota is a result of continuous geodispersal and consequently mixing and competition of regional biotas, which becomes increasingly more likely on the deca-million-year time scales.

We conclude that the Earth system processes play a significant role in driving both diverging and equilibrating global biodiversity regimes: both Court Jester and Red Queen regimes may operate, with the former dominant up to ≈ 40 Myrs, and the latter at longer time scales.