Amphibians' diversity and global climatic instability through space and time
Sidney F. Gouveia1 - Fernanda A. S. Cassemiro2 - José Alexandre F. Diniz-Filho2

Background
Amphibians are sensitive to environmental parameters so as the patterns of species richness is supposed to undergo the effects of climate variability, with remarkable consequences to their future as climate continues to change (1-3). However, what facade of climatic instability is involved in shaping the geography of species' richness globally remains elusive, and also with confounding conclusions. Two climatic instability hypotheses was proposed to explain large-scale gradients in species richness: the contemporary climatic stability (CCS), which predicts that stable environments allow finer adaptations, leading thus to an increase in species' richness; and the historical climatic stability (HCS), which states that long term undisturbed areas permit a greater species accumulation due to the time constraint to dispersal toward regions recently suitable (4-5).

A further question on the species-climate relationship is that variables often do not vary uniformly across space, i.e. they are nonstationary (6). In other words, a given relationship might be stronger in one place than in other, or they might even reverse according the location. We investigated the effects of both predictors of climatic instability on worldwide amphibians while accounting for nonstationarity. This approach provided us a clear picture of the relative contribution of each predictor across the space, allowing us to assess what type of climatic instability affects more the amphibian richness, and where.

Data and Methods
We overlaid the extents of occurrence of all three amphibians orders from the Global Amphibian Assessment (2009) onto a cells grid of 2.0° x 2.0° (latitude x longitude) of resolution. The grid covered the whole world, excluding Antarctica, remote islands and continental border cells over 50% of water. Two sets of variables were employed to outline both hypotheses' predictors: the current climatic (temperature and precipitation) seasonality for CCS (7); and the climatic anomaly from the Last Glacial Maximum (~21,000 years before present) to the contemporary mean conditions (also temperature and precipitation) as a measure of HCS (8).

We analyzed statistically with a Geographically-Weighted Regression - GWR (9). We further modify this technique by employing partial regression procedures, by replacing OLS (Ordinary Least Square) by GWR steps mean conditions (also temperature and precipitation) as a measure of HCS (8).

We analyzed statistically with a Geographically-Weighted Regression - GWR (9). We further modify this technique by employing partial regression procedures, by replacing OLS (Ordinary Least Square) by GWR steps with fixed parameters (bandwidth, truncation distance and decaying function).

Concluding Remarks
- Probably a set of other predictors has more explanatory power than climatic instability, such as the amount of energy and water as widely indicated (10-12).
- Our results shed light on the spatial dependence of the relationship of ectotherms and climatic parameters, suggesting a differential effect of climatic variability according the location.
- The effect of past climate is probably contingent upon the occurrence of specific events (e.g. glaciations) and their signals are erased with time.
- This finding has deep consequences to the geography of amphibians' distribution regarding their ability to cope with climate change.

Selected References