a: *evaluation of the effect of spatial autocorrelation on the performance of environmental models fitted to morphological diversity (MDiv) and species richness (SR)* - We checked the adequacy of the environmental models shown on Tables I (main text) to account for the geographic variation in MDiv and SR in the presence of spatial autocorrelation.

We elaborated spatial correlograms using Moran's I coefficient to describe the magnitude of autocorrelation of MDiv and SR for different distance classes. Then, we examined the spatial patterns of autocorrelation in their residuals after the fit of the models shown on Table I. Independently of the pattern of autocorrelation in the original (predictors and response) variables, if no spatial autocorrelation is found in the residuals it can be concluded that the model had taken into account all spatial structure in the original data and that there was no statistical bias in the overall statistical analysis (Diniz-Filho et al. 2003).

The spatial correlogram for MDiv (Fig. S2A) showed a quadratic pattern that indicated the presence of positive autocorrelation up to c.3100 km, then the negative autocorrelation increased strongly to reach -0.8 at c.6200 km and then it progressively decreased to approach low values (i.e. between 0-0.2) at the largest distance classes. SR showed high positively autocorrelation (0.61) at the shortest distance class (c.400km), then the autocorrelation decreased up to c.4,000 km and then it increased again to reach -0.49 at c.7,500 km (Fig. S2B).

After model fit, the autocorrelation in the residuals of MDiv at the shortest distance classes (c.400 km) (Fig. S2A) decreases from 0.80-0.30 and decreases to < 0.1 for all subsequent distance classes up to c.7,400 km; the spatial autocorrelation increases again at distance classes > 8,000 km, although coefficients are never larger than 0.2 (Fig. S2A). Similarly, the autocorrelation in the residuals of SR decreases from 0.61-0.38 at the shortest distance classes and then remained between 0-0.15 for all subsequent distance classes (Fig. S2B).

b*: the modeling of the spatial patterns of autocorrelation of MDiv and SR* - We modeled the spatial structure of MDiv and SR by the spatial eigenvector mapping (SEVM) routine in SAM v4 (Rangel et al. 2010). We conducted separate SVEM analyses for MDiv and SR. The SEVM uses the spatial coordinates of the grid cells to construct a spatial matrix from which to extract eigenvectors that allow the decomposition of the whole spatial structure in the data into spatial patterns at different spatial scales [see Borcard and Legendre (2002) for a formal description of method] (Diniz-Filho & Bini 2005, Rangel et al. 2010). In this way, the neighborhood relationships among the grid cells were used to reveal the spatial autocorrelation of our data set over the whole range of scales encompassed by the sampling design (Borcard & Legendre 2002, Borcard et al. 2004, Diniz-Filho & Bini 2005).

We detrended the data on SR from a significant linear longitudinal trend fitted by least squares and data on MDiv from two significant (linear and quadratic) latitudinal trends so that the method would be able to recover finer spatial structures (Borcard & Legendre 2002, Borcard et al. 2004). We adopted the criterion of minimisation of Moran's I in model residuals available in SAM v.4 to select those eigenvectors that were the best spatial descriptors of the spatial patterns of autocorrelation for MDiv and SR (Rangel et al. 2010).

SAM v.4 selected 61 positive eigenvectors as spatial descriptors of the latitudinally detrended MDiv and 63 were selected to model the spatial variation in longitudinally detrended SR (eigenvectors not shown) that reduced the spatial structure in MDiv and SR at all spatial scales to almost zero (Fig. S3A, B). The spatial descriptors of SR and MDiv were poorly correlated with the environmental variables retained in models shown on Table I; for SR, the correlation coefficients (r) ranged from r = -0.32-0.31 and for MDiv, from -0.38-0.28. Hence, the spatial descriptors provided complementary information about the spatial structure of MDiv and SR not fully accounted by the environmental variables.

c: *partial regression analysis to partition the variation in MDiv and SR* - We combined the spatial descriptors obtained from SEVM with the environmental predictors shown in Table I (main text) in a partial regression analysis. Given that the environmental predictors and spatial descriptors were poorly correlated (see above), the combination of them in statistical models did not introduce a serious problem of multicollinearity (Hawkins 2012).

As explained in Borcard et al. (1992), we partitioned the variation in MDiv and SR into: (a) the fraction of MDiv and SR explained by environmental descriptors independently of any spatial structure; (b) the fraction of the variation in MDiv and SR explained by the shared variation between spatial descriptors and environmental variables; (c) the spatial variation in MDiv or SR not shared by the environmental variables analysed, which suggests the operation of some underlying biological process that has no apparent relation to the environmental variables that were included in our analysis and (d) the fraction of the MDiv and SR variation explained neither by the spatial coordinates nor by environmental data. All calculations were done for MDiv and SR separately and based on:

The R^2 of the regression model that combined the environmental descriptors in Table I (main text) that provided information of fractions (a) and (b) above ($R^2 = a + b$).

The R^2 of the regression model that combined the spatial descriptors obtained from SVEM and that provided information about fractions (c) and (b) above ($R^2 = c + b$). The spatial descriptors of MDiv were the linear and quadratic terms of latitude and 61 positive eigenvectors selected by the SVEM routine; for SR, the spatial descriptors were longitude and 63 positive eigenvectors.

The R^2 of the regression model that combined the whole set of environmental and spatial descriptors (full regression model) that provided information about fractions (a), (b) and (c) above ($R^2 = a + b + c$).

According to Borcard et al. (1992), each component of variation was computed from simple calculations:

$$b = (a + b) + (b + c) - (a + b + c),$$
$$a = (a + b) - b,$$
$$c = (b + c) - b,$$
$$d = 1 - (a + b + c)$$

Results are given in main text.

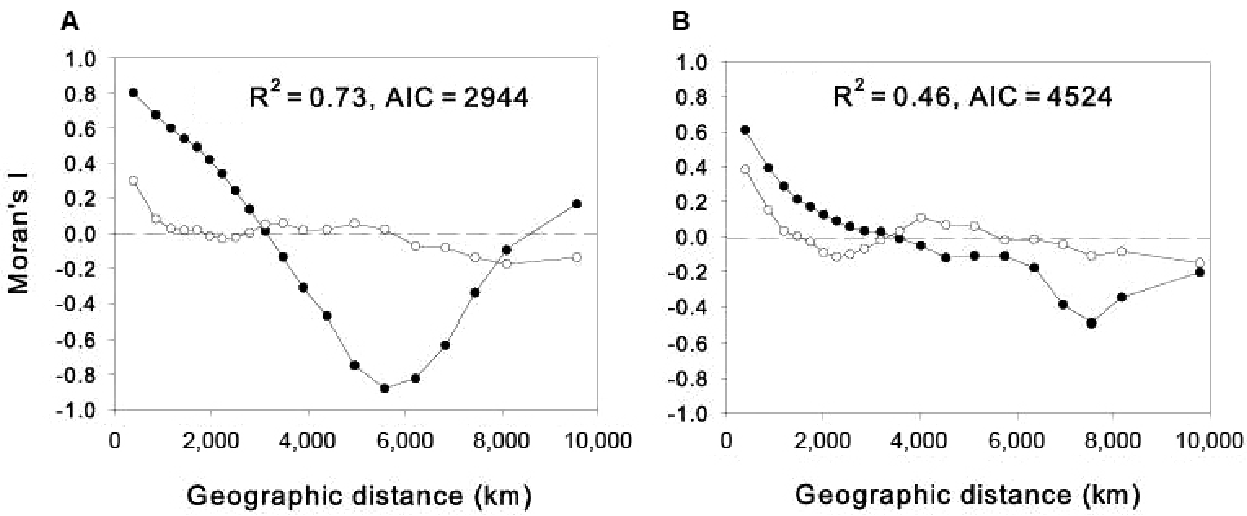

Fig. S2: spatial correlograms for (A) morphological diversity and (B) species richness (SR) (solid circles) and residuals (open circles) of morphological diversity (A) and SR (B) after fitting the environmental models shown on Table I (main text). AIC: Akaike's information criterion.

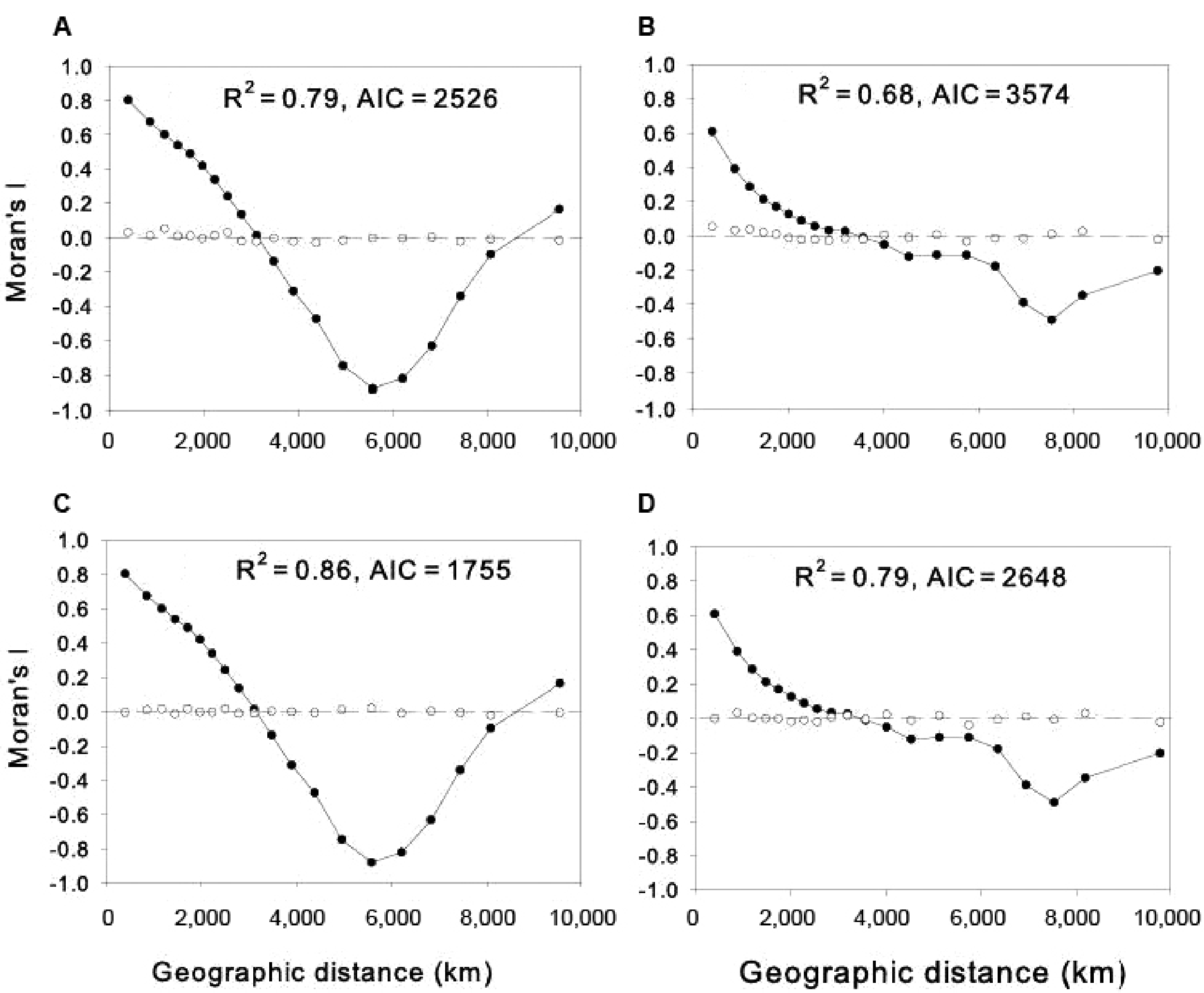

Fig. S3: spatial correlograms for morphological diversity (MDiv) and species richness (SR) (solid circles) and residuals (open circles) after fitting the spatial models to MDiv (A) and SR (B) and full models that combined environmental predictors in Table I (main text) and spatial descriptors obtained from spatial eigenvector mapping to MDiv (C) and SR (D). AIC: Akaike's information criterion.