**The multi-peak adaptive landscape of crocodylomorph body size evolution**

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**Additional file 1**

Supplementary methods

*Expected error for total body length estimated from cranial measurements*

Table S1. List of fossil specimens with complete skeleton preserved which data was used for creating Figure 1 of the manuscript. “DCL” is the total length estimated using the cranial measurement dorsal cranial length, “ODCL” is the total length estimated when using dorsal orbito-cranial length, and “Real TL” is the real total body length measured from the specimen. All measurements in centimetres.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Species (specimen) | DCL | ODCL | Real TL | Source of information |
| *Shantungosuchus chuhsienensis* (IVPP V2484) | 37.66 | N/A | 25 | First-hand observation |
| *Alligatorellus beaumonti* (BSPG 1937 I 26) | 33.77 | 35.72 | 30 | First-hand observation |
| *Diplocynodon ratelii* (MNHN.F SG 13728ab) | 216.15 | 254.74 | 152 | First-hand observation |
| *Diplocynodon darwini* (HLMD-Me 10262) | 90.02 | 81.86 | 75 | First-hand observation |
| *Platysuchus multiscrobiculatus* (SMNS 9930) | 220.22 | 334.08 | 279 | Young *et al*. (2016) |
| *Steneosaurus bollensis* (SMNS 54063) | 565.97 | 545.90 | 430 | Young *et al*. (2016) |
| *Steneosaurus leedsi* (NHMUK R 3806) | 646.58 | 698.01 | 428 | Young *et al*. (2016) |

*Supertree construction and alternative topologies*

The supertree used as the phylogenetic framework for the macroevolutionary analyses was constructed using an informal approach. For such, we started with the MRP (matrix representations with parsimony) supertree of Bronzati *et al.* (2015), and then used some recently published phylogenetic hypotheses to create and updated version, by manually modifying the tree using the software Mesquite (Version 3.51; Maddison & Maddison, 2018). For this updated version, we added some taxa, removed others, and also changed the position of a few more, always aiming to include as many species as possible (especially the ones for which we had body size data available), but also to incorporate more well-resolved relationships from recent studies.

The supertree presented by Bronzati *et al.* (2015) is restricted to Crocodyliformes, which is less inclusive than Crocodylomorpha. Thus, we added non-crocodyliform crocodylomorphs taxa following the phylogenetic hypotheses presented by Pol *et al.* (2013) and Leardi *et al*., (2017). Within Crocodyliformes, as in Bronzati *et al.* (2015) and other recent studies (e.g. Andrade *et al.,* 2011; Montefeltro *et al.,* 2013; Pol *et al.,* 2014; Turner & Pritchard, 2015; Buscalioni, 2017), taxa classically associated to “Protosuchia” are paraphyletic arranged in relation to Mesoeucrocodylia, with smaller subgroups displayed following Bronzati *et al.* (2015) (but see below for differences in this region of the tree in the alternative topologies). Accordingly, *Hsisosuchus* is the sister-group of Mesoeucrocodylia (as in Clark, 2011, Pol *et al.,* 2014; Buscalioni, 2017) and the following groups represent taxa successively more distant to Mesoeucrocodylia: Shartegosuchidae (following Clark2011); an unnamed clade composed by taxa such as *Sichuanosuchus* and *Shantungosuchus;* an unnamed clade composed by *Zaraasuchus* and *Gobiosuchus* (following Pol *et al.,* 2014)*;* Protosuchidae (following Clark2011; Pol *et al.,* 2014; Turner & Pritchard, 2015).

Within Mesoeucrocodylia, Notosuchia corresponds to the sister group of all the other mesoeucrocodylians (= Neosuchia in our topology), similar to what is presented by Andrade *et al.* (2011), Pol *et al.* (2014), and Turner & Pritchard (2015). Yet, Notosuchia comprises forms such as baurusuchids, sebecosuchians, peirosaurids, sphagesaurids, uruguaysuchids, and *Araripesuchus.* The relationships among taxa within Notosuchia follow the general arrangement presented by Pol *et al.* (2014).

One of the branches at the basal split of Neosuchia leads to a clade composed by longirostrine forms, which includes Thalattosuchia and Tethysuchia (i.e. Dyrosauridae and “pholidosaurids”). Arrangement between these groups (i.e. sister-group relationship between Thalattosuchia and Tethysuchia) follows that recovered in the supertree of Bronzati *et al.* (2015). Within Tethysuchia, “pholidosaurids” are paraphyletic in relation to Dyrosauridae (also found in Pol *et al.,* 2014; Young *et al.*,2017 and Meunier & Larsson, 2017). Relationships among Dyrosauridae follow Hastings *et al.* (2015). Relationships among thalattosuchians follow Young (2014) and Herrera *et al*. (2015).

The sister-group of the longirostrine clade mentioned above contains Eusuchia and its closest relatives such as Atoposauridae and Goniopholididae. The latter is depicted as the sister group of Eusuchia, whereas the former corresponds to the sister group of Eusuchia + Goniopholididae. This arrangement follows that recovered in Pol *et al.* (2014) and Bronzati *et al.* (2015). Regarding the internal relationships of Goniopholididae, we follow the hypotheses of Martin *et al.* (2016) and Ristevski et al. (2018). For Atoposauridae, we follow the arrangements presented by Tennant *et al*. (2016) and Schwarz *et al*. (2017). For Paralligatoridae and Susisuchidae, we followed the phylogenetic hypotheses of Turner (2015) and Turner & Pritchard (2015).

In relation to non-crocodylian eusuchians, we mainly follow the topology of Bronzati *et al.* (2015), with modifications to accommodate the arrangements proposed by Turner (2015) and Turner & Pritchard (2015) within Paralligatoridae and Susisuchidae. Regarding the interrelationships of the crown-group, as well as the position of Hylaeochampsidae + Allodaposuchidae as the sister group of Crocodylia, we follow the topology of Narváez *et al.* (2015). For the relationships within the crown-group, we follow Brochu (2012), Brochu *et al*. (2012), Scheyer *et al*. (2013) and Narváez *et al*. (2015).

Additionally, two alternative topologies were also manually constructed, for testing the impact of alternative positions of Thalattosuchia. The “longirostrine problem”, which mostly concerns the position of Thalattosuchia, has been largely debated in phylogenetic studies of Crocodylomorpha (e.g. Clark, 1994; Pol & Gasparini, 2009; Wilberg, 2015). Because of the possible impact that a group like Thalattosuchia (i.e. of relatively old origin and many species within it) can inflict in our model-fitting analyses, we built two alternative trees to test the effects related to this phylogenetic uncertainty. Apart from the position of Thalattosuchia described above (within Neosuchia), two main alternative scenarios for the position of the group within Crocodylomorpha were proposed (see Wilberg, 2015). The first places Thalattosuchia as the sister group of all other mesoeucrocodylians (= Notosuchia + Neosuchia) (e.g. Larsson & Sues, 2007; Montefeltro *et al.,* 2013), and was depicted in one of our alternative topologies. The other alternative topology places Thalattosuchia as the sister group of Crocodyliformes (following Wilberg, 2015). Only the position of Thalattosuchia has been altered in these alternative topologies. Relationships among other taxa, including the relationship among thalattosuchians, were kept as in the first topology, described above.

*Time bins used for time series correlations and disparity calculation*

|  |  |
| --- | --- |
| **Lower limit (in Myr)** | **Upper limit (in Myr)** |
| 7.246 | 0 |
| 15.97 | 7.246 |
| 23.03 | 15.97 |
| 33.9 | 23.03 |
| 40.4 | 33.9 |
| 48.6 | 40.4 |
| 55.8 | 48.6 |
| 61.7 | 55.8 |
| 66.043 | 61.7 |
| 70.6 | 66.043 |
| 84.9 | 70.6 |
| 94.3 | 84.9 |
| 99.7 | 94.3 |
| 112.6 | 99.7 |
| 125.45 | 112.6 |
| 136.4 | 125.45 |
| 145.5 | 136.4 |
| 155.7 | 145.5 |
| 164.7 | 155.7 |
| 171.6 | 164.7 |
| 183 | 171.6 |
| 189.6 | 183 |
| 201.6 | 189.6 |
| 205.6 | 201.6 |
| 221.5 | 205.6 |
| 235 | 221.5 |
| 242 | 235 |
| 252.3 | 242 |

Supplementary results

*Correlations with palaeotemperature proxies*

Table S2. Results of regressions of body size proxy (maximum and mean log-transformed ODCL, using all species in the dataset) on the palaeotemperature proxies (δ18O data for tropical and temperate regions from Prokoph *et al*. (2008), and global δ18O data from Zachos *et al*. (2008)). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

|  |  |
| --- | --- |
|  | **Prokoph (Early Triassic -recent): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 26 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.643 | 2.363 | 0.019 (0.75) | 2.565 | -0.004 | 2.438 | 0.063(0.359) | 11.94 | 0.741 | 1.973 | -0.015 (0.685) | -20.353 | 0.004 | 2.073 | 0.049(0.299) | -7.032 |
|  | **Prokoph (Early Triassic -recent): temperate palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 23 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.241 | 2.428 | -0.015 (0.729) | -15.324 | -0.038 | 2.426 | -0.017 (0.671) | -16.034 | 0.412 | 2.067 | 0.011 (0.755) | -22.54 | -0.027 | 2.079 | 0.022 (0.529) | -20.973 |
|  | **Zachos (Late Cretaceous - recent): global palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 10 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.347 | 2.34 | 0.045 (0.397) | -9.539 | -0.016 | 2.346 | 0.039 (0.383) | -10.306 | -0.046 | 2.022 | 0.055\* (0.002) | -31.576 | 0.635 | 2.023 | 0.054\*(0.003) | -33.557 |

Table S3. Results of regressions of body size proxy (maximum and mean log-transformed DCL, using all species in the dataset) on the palaeotemperature proxies (δ18O data for tropical and temperate regions from Prokoph *et al*. (2008), and global δ18O data from Zachos *et al*. (2008)). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

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| --- | --- |
|  | **Prokoph (Early Triassic -recent): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 26 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.634 | 2.909 | 0.048 (0.508) | 11.415 | 0.031 | 3.01 | 0.106 (0.19) | 20.16 | 0.723 | 2.367 | -0.029 (0.565) | -6.284 | -0.027 | 2.47 | 0.035 (0.564) | 7.111 |
|  | **Prokoph (Early Triassic -recent): temperate palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 23 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.108 | 2.956 | -0.025 (0.57) | -11.036 | -0.033 | 2.958 | -0.022 (0.602) | -12.782 | 0.505 | 2.468 | -0.007 (0.888) | -6.265 | -0.041 | 2.496 | 0.019 (0.725) | -2.48 |
|  | **Zachos (Late Cretaceous - recent): global palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 10 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.265 | 2.9 | 0.049 (0.126) | -19.517 | 0.27 | 2.898 | 0.052 (0.07) | -20.96 | 0.014 | 2.433 | 0.081\* (0.011) | -19.577 | 0.527 | 2.433 | 0.081\* (0.01) | -21.575 |

Table S4. Results of regressions of body size proxy (maximum and mean log-transformed ODCL, using only marine species in the dataset) on the palaeotemperature proxies (δ18O data for tropical and temperate regions from Prokoph *et al*. (2008), and global δ18O data from Zachos *et al*. (2008)). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

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|  | **Prokoph (Early Triassic -recent): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 18 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.56 | 2.358 | -0.025 (0.536) | -25.542 | 0.201 | 2.276 | -0.11\* (0.035) | -24.167 | 0.014 | 2.239 | -0.017 (0.451) | -49.171 | -0.023 | 2.239 | -0.017 (0.448) | -51.167 |
|  | **Prokoph (Early Triassic -recent): temperate palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 17 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.708 | 2.423 | 0.079 (0.059) | -23.953 | -0.066 | 2.398 | -0.002 (0.955) | -16.916 | 0.758 | 2.273 | 0.022 (0.058) | -66.294 | -0.027 | 2.273 | 0.011 (0.463) | -56.901 |
|  | **Zachos (Late Cretaceous - recent): global palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 10 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| -0.143 | 2.422 | -0.045 (0.054) | -21.432 | 0.22 | 2.417 | -0.042 (0.096) | -23.261 | 0.627 | 2.252 | -0.006 (0.654) | -39.327 | -0.088 | 2.241 | 0.005 (0.617) | -38.084 |

Table S5. Results of regressions of body size proxy (maximum and mean log-transformed DCL, using only marine species in the dataset) on the palaeotemperature proxies (δ18O data for tropical and temperate regions from Prokoph *et al*. (2008), and global δ18O data from Zachos *et al*. (2008)). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

|  |  |
| --- | --- |
|  | **Prokoph (Early Triassic -recent): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 18 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.601 | 2.936 | -0.01 (0.714) | -35.977 | -0.052 | 2.932 | -0.015 (0.705) | -31.507 | 0.752 | 2.82 | -0.015 (0.545) | -39.362 | -0.004 | 2.862 | 0.04 (0.35) | -29.321 |
|  | **Prokoph (Early Triassic -recent): temperate palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 18 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.449 | 2.984 | 0.055\* (0.028) | -40.881 | 0.335 | 2.996 | 0.071\* (0.006) | -39.789 | 0.657 | 2.865 | 0.052\* (0.016) | -45.475 | 0.471 | 2.878 | 0.09\* (0.0009) | -40.862 |
|  | **Zachos (Late Cretaceous - recent): global palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 10 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.208 | 2.906 | 0.042 (0.148) | -20.859 | 0.215 | 2.906 | 0.043 (0.099) | -22.527 | 0.824 | 2.781 | 0.036 (0.256) | -24.953 | 0.692 | 2.715 | 0.092\* (0.001) | -25.525 |

Table S6. Results of regressions of body size proxy (maximum and mean log-transformed ODCL, using only non-marine species in the dataset) on the palaeotemperature proxies (δ18O data for tropical and temperate regions from Prokoph *et al*. (2008), and global δ18O data from Zachos *et al*. (2008)). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

|  |  |
| --- | --- |
|  | **Prokoph (Early Triassic -recent): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 26 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.553 | 2.32 | 0.043 (0.504) | 4.843 | 0.011 | 2.366 | 0.075 (0.264) | 11.094 | 0.64 | 1.978 | 0.029 (0.453) | -21.012 | 0.049 | 2.023 | 0.065 (0.142) | -11.564 |
|  | **Prokoph (Early Triassic -recent): temperate palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 23 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.354 | 2.291 | -0.065 (0.232) | -6.825 | 0.022 | 2.291 | -0.06 (0.232) | -6.129 | 0.523 | 1.947 | -0.042 (0.299) | -21.071 | -0.037 | 1.967 | -0.017 (0.65) | -17.942 |
|  | **Zachos (Late Cretaceous - recent): global palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 10 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.209 | 2.228 | 0.068 (0.366) | -0.829 | -0.011 | 2.236 | 0.06 (0.371) | -2.397 | -0.157 | 1.964 | 0.06\* (0.007) | -24.96 | 0.502 | 1.965 | 0.06\* (0.013) | -26.706 |

Table S7. Results of regressions of body size proxy (maximum and mean log-transformed DCL, using only non-marine species in the dataset) on the palaeotemperature proxies (δ18O data for tropical and temperate regions from Prokoph *et al*. (2008), and global δ18O data from Zachos *et al*. (2008)). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

|  |  |
| --- | --- |
|  | **Prokoph (Early Triassic -recent): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 26 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.563 | 2.753 | 0.024 (0.763) | 15.858 | -0.011 | 2.82 | 0.069 (0.406) | 22.285 | 0.624 | 2.339 | 0.017 (0.725) | -8.74 | -0.018 | 2.366 | 0.04 (0.466) | 0.623 |
|  | **Prokoph (Early Triassic -recent): temperate palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 23 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.317 | 2.76 | -0.071 (0.312) | 5.801 | 0.003 | 2.762 | -0.066 (0.309) | 5.997 | 0.518 | 2.32 | -0.046 (0.387) | -7.779 | -0.033 | 2.335 | -0.027 (0.6) | -4.075 |
|  | **Zachos (Late Cretaceous - recent): global palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 10 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| -0.083 | 2.633 | 0.095 (0.172) | 0.504 | 0.104 | 2.633 | 0.096 (0.189) | -1.426 | -0.089 | 2.345 | 0.07\* (0.027) | -16.045 | 0.376 | 2.346 | 0.07\* (0.034) | -18.272 |

Table S8. Results of regressions of body size proxy (maximum and mean log-transformed ODCL, using only crocodylian species in the dataset) on the palaeotemperature proxies (global δ18O data from Zachos *et al*. (2008), from the Late Cretaceous to Recent). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

|  |  |
| --- | --- |
|  | **Zachos (Late Cretaceous - recent): global palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 10 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.19 | 2.133 | 0.121\* (0.017) | -11.989 | 0.554 | 2.124 | 0.127\* (0.008) | -13.662 | -0.297 | 1.98 | 0.075\* (0.0003) | -29.953 | 0.698 | 1.987 | 0.07\* (0.001) | -31.137 |

Table S9. Results of regressions of body size proxy (maximum and mean log-transformed DCL, using only crocodylian species in the dataset) on the palaeotemperature proxies (global δ18O data from Zachos *et al*. (2008), from the Late Cretaceous to Recent). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

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| --- | --- |
|  | **Zachos (Late Cretaceous - recent): global palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 10 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| -0.215 | 2.618 | 0.165\* (0.001) | -10.724 | 0.632 | 2.627 | 0.157\* (0.003) | -12.355 | -0.235 | 2.386 | 0.105\* (0.0007) | -20.748 | 0.647 | 2.395 | 0.098\* (0.003) | -22.325 |

Table S10. Results of regressions of body size proxy (maximum and mean log-transformed ODCL, using only notosuchian species in the dataset) on the palaeotemperature proxies (tropical δ18O data from Prokoph *et al*. (2008), from the Aptian to the Eocene). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

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|  | **Prokoph (Aptian - Eocene): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 10 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.272 | 2.114 | -0.013 (0.812) | -5.557 | -0.115 | 2.118 | -0.014 (0.798) | -6.786 | 0.702 | 1.925 | -0.029 (0.472) | -11.724 | -0.122 | 1.957 | -0.005 (0.904) | -10.071 |

Table S11. Results of regressions of body size proxy (maximum and mean log-transformed DCL, using only notosuchian species in the dataset) on the palaeotemperature proxies (tropical δ18O data from Prokoph *et al*. (2008), from the Aptian to the Eocene). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

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|  | **Prokoph (Aptian - Eocene): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 10 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.06 | 2.622 | -0.014 (0.699) | -12.63 | -0.092 | 2.618 | -0.017 (0.64) | -14.601 | 0.758 | 2.313 | -0.055 (0.3) | -6.073 | -0.123 | 2.355 | -0.005 (0.928) | -3.54 |

Table S12. Results of regressions of body size proxy (maximum and mean log-transformed ODCL, using only thalattosuchian species in the dataset) on the palaeotemperature proxies (tropical δ18O data from Prokoph *et al*. (2008), for the Jurassic). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

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|  | **Prokoph (Jurassic): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 7 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.809 | 2.396 | -0.051 (0.308) | -5.062 | 0.059 | 2.322 | -0.11 (0.292) | -2.309 | -0.184 | 2.224 | -0.038 (0.455) | -10.311 | -0.09 | 2.232 | -0.033 (0.509) | -12.067 |
|  | **Prokoph (Jurassic): temperate palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 7 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.808 | 2.526 | 0.074 (0.098) | -7.658 | 0.452 | 2.633 | 0.152 (0.058) | -6.096 | -0.369 | 2.366 | 0.082\* (0.003) | -22.184 | 0.778 | 2.369 | 0.086\* (0.005) | -23.214 |

Table S13. Results of regressions of body size proxy (maximum and mean log-transformed DCL, using only thalattosuchian species in the dataset) on the palaeotemperature proxies (tropical δ18O data from Prokoph *et al*. (2008), for the Jurassic). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

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|  | **Prokoph (Jurassic): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 7 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.661 | 2.856 | -0.054 (0.176) | -10.26 | 0.192 | 2.814 | -0.088 (0.179) | -9.432 | -0.124 | 2.727 | -0.042 (0.391) | -10.851 | -0.022 | 2.728 | -0.041 (0.394) | -12.753 |
|  | **Prokoph (Jurassic): temperate palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 7 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.553 | 2.995 | 0.07 (0.069) | -12.556 | 0.563 | 3.046 | 0.107\* (0.031) | -13.734 | 0.582 | 2.852 | 0.072 (0.056) | -12.788 | 0.162 | 2.839 | 0.051 (0.201) | -14.155 |

Table S14. Results of regressions of body size proxy (maximum and mean log-transformed ODCL, using only tethysuchian species in the dataset) on the palaeotemperature proxies (tropical δ18O data from Prokoph *et al*. (2008), from the Late Jurassic to the Eocene). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

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|  | **Prokoph (Late Jurassic – Eocene): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 13 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| -0.554 | 2.243 | -0.145\* (0.004) | -5.113 | 0.138 | 2.288 | -0.108 (0.115) | -2.267 | -0.448 | 2.096 | -0.154\* (0.0002) | -15.18 | 0.493 | 2.116 | -0.142\* (0.004) | -14.409 |
|  | **Prokoph (Late Jurassic – Eocene): temperate palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 13 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| -0.223 | 2.276 | -0.142 (0.051) | -1.969 | 0.202 | 2.27 | -0.15 (0.069) | -3.281 | 0.113 | 2.165 | -0.129 (0.063) | -7.028 | 0.226 | 2.163 | -0.127 (0.057) | -8.891 |

Table S15. Results of regressions of body size proxy (maximum and mean log-transformed DCL, using only tethysuchian species in the dataset) on the palaeotemperature proxies (tropical δ18O data from Prokoph *et al*. (2008), from the Late Jurassic to the Eocene). Possible correlation was analysed using generalised least squares (GLS) regressions, incorporating a first-order autoregressive model, as well as ordinary least squares (OLS) regressions using untransformed data (assuming no serial correlation). \*Significant at alpha = 0.05.

|  |  |
| --- | --- |
|  | **Prokoph (Late Jurassic – Eocene): tropical palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 12 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.53 | 3.02 | -0.004 (0.914) | -11.772 | -0.061 | 2.993 | -0.03 (0.559) | -10.039 | 0.483 | 2.848 | -0.045 (0.327) | -10.28 | 0.075 | 2.814 | -0.07 (0.198) | -9.441 |
|  | **Prokoph (Late Jurassic – Eocene): temperate palaeotemperatures** |
| **N** | **Maximum size** | **Mean size** |
| **GLS** | **OLS (untransformed)** | **GLS** | **OLS (untransformed)** |
| 12 | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** | **Phi** | **Int.** | **Slope** | **AIC** | **R2** | **Int.** | **Slope** | **AIC** |
| 0.528 | 2.941 | -0.08 (0.15) | -14.367 | 0.105 | 2.941 | -0.083 (0.16) | -12.088 | 0.503 | 2.799 | -0.105 (0.081) | -12.934 | 0.221 | 2.782 | -0.114 (0.069) | -11.507 |

*Correlations with palaeolatitude*

Table S16. Results of regressions of log-transformed body length proxy (using all species in the ODCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 195 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| 0.013 | 2.13 | -0.002 (0.059) | 43.284 | 0.018 | 1.797 | -0.002\* (0.03) | -64.301 |

Table S17. Results of regressions of log-transformed body length proxy (using all species in the DCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

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| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 178 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| 0.022 | 2.595 | -0.004\* (0.024) | 150.74 | 0.05 | 2.203 | -0.004\* (0.001) | -8.04 |

Table S18. Results of regressions of log-transformed body length proxy (using only marine species in the ODCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 48 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| -0.019 | 2.289 | -0.0008 (0.739) | -21.925 | 0.022 | 2.349 | -0.003 (0.156) | -21.287 |

Table S19. Results of regressions of log-transformed body length proxy (using only marine species in the DCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 43 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| 0.014 | 2.873 | -0.002 (0.21) | -28.625 | -0.023 | 2.67 | 0.0005 (0.846) | -28.397 |

Table S20. Results of regressions of log-transformed body length proxy (using only non-marine species in the ODCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 147 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| 0.037 | 2.09 | -0.003\* (0.01) | 14.567 | 0.031 | 1.806 | -0.002\* (0.018) | -39.316 |

Table S21. Results of regressions of log-transformed body length proxy (using only non-marine species in the DCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 135 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| 0.036 | 2.508 | -0.005\* (0.014) | 102.424 | 0.086 | 2.247 | -0.005\* (0.0003) | 21.398 |

Table S22. Results of regressions of log-transformed body length proxy (using only crocodylian species in the ODCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 70 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| 0.175 | 2.265 | -0.004\* (0.0001) | -49.408 | 0.06 | 2.204 | -0.003\* (0.022) | -42.659 |

Table S23. Results of regressions of log-transformed body length proxy (using only crocodylian species in the DCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 64 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| 0.178 | 2.81 | -0.007\* (0.0003) | 8.976 | 0.059 | 2.745 | -0.005\* (0.028) | -5.956 |

Table S24. Results of regressions of log-transformed body length proxy (using only notosuchian species in the ODCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 34 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| 0.012 | 1.849 | 0.003 (0.245) | -8.644 | -0.012 | 1.751 | -0.001 (0.448) | -19.106 |

Table S25. Results of regressions of log-transformed body length proxy (using only notosuchian species in the DCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 30 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| -0.035 | 2.26 | 0.0002 (0.945) | 14.931 | 0.202 | 2.427 | -0.011\* (0.007) | 6.876 |

Table S26. Results of regressions of log-transformed body length proxy (using only thalattosuchian species in the ODCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 30 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| -0.019 | 2.115 | 0.004 (0.509) | -4.607 | -0.015 | 2.338 | -0.003 (0.464) | -12.911 |

Table S27. Results of regressions of log-transformed body length proxy (using only thalattosuchian species in the DCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 26 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| -0.004 | 2.579 | 0.004 (0.357) | -14.111 | 0.041 | 2.682 | 0.0004 (0.903) | -21.035 |

Table S28. Results of regressions of log-transformed body length proxy (using only tethysuchian species in the ODCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 16 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| 0.251 | 2.468 | -0.009\* (0.027) | -5.781 | 0.524 | 2.597 | -0.013\* (0.0009) | -6.172 |

Table S29. Results of regressions of log-transformed body length proxy (using only tethysuchian species in the DCL cranial measurement dataset) on the palaeolatitudinal data. Possible correlation was analysed using ordinary least squares (OLS) and phylogenetic generalised least squares (PGLS) regressions. \*Significant at alpha = 0.05.

|  |  |  |
| --- | --- | --- |
| **N** | **OLS** | **PGLS** |
| 14 | **R2** | **Intercept** | **Slope** | **AIC** | **R2** | **Intercept** | **Slope** | **AIC** |
| -0.002 | 2.898 | -0.004 (0.345) | -1.387 | 0.115 | 2.978 | -0.007 (0.126) | -2.652 |

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