



## **The R package ‘*icosa*’ for coarse resolution global triangular and penta-hexagonal gridding**

Adam T. Kocsis (1,2)

(1) GeoZentrum Nordbayern, Department of Geography and Geosciences, Universität Erlangen-Nürnberg, Loewenichstraße 28, 91054 Erlangen, Germany (adam.kocsis@fau.de), (2) MTA-MTM-ELTE Research Group for Paleontology, P.O. Box 137, H-1431 Budapest, Hungary

With the development of the internet and the computational power of personal computers, open source programming environments have become indispensable for science in the past decade. This includes the increase of the GIS capacity of the free R environment, which was originally developed for statistical analyses.

The flexibility of R made it a preferred programming tool in a multitude of disciplines from the area of the biological and geological sciences. Many of these subdisciplines operate with incidence (occurrence) data that are in a large number of cases to be grained before further analyses can be conducted. This graining is executed mostly by gridding data to cells of a Gaussian grid of various resolutions to increase the density of data in a single unit of the analyses. This method has obvious shortcomings despite the ease of its application: well-known systematic biases are induced to cell sizes and shapes that can interfere with the results of statistical procedures, especially if the number of incidence points influences the metrics in question.

The ‘*icosa*’ package employs a common method to overcome this obstacle by implementing grids with roughly equal cell sizes and shapes that are based on tessellated icosahedra. These grid objects are essentially polyhedra with xyz Cartesian vertex data that are linked to tables of faces and edges. At its current developmental stage, the package uses a single method of tessellation which balances grid cell size and shape distortions, but its structure allows the implementation of various other types of tessellation algorithms. The resolution of the grids can be set by the number of breakpoints inserted into a segment forming an edge of the original icosahedron. Both the triangular and their inverted penta-hexagonal grids are available for creation with the package.

The package also incorporates functions to look up coordinates in the grid very effectively and data containers to link data to the grid structure. The classes defined in the package are communicating with classes of the ‘*sp*’ and ‘*raster*’ packages and functions are supplied that allow resolution change and type conversions. Three-dimensional rendering is made available with the ‘*rgl*’ package and two-dimensional projections can be calculated using ‘*sp*’ and ‘*rgdal*’.

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