1 km Climate Surface for South America

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This report is an Addendum Report to Report 3a - The Case for a 3 Minute Climate Surface for South America written in May 2003.

Background:

In May 2003, I wrote a report to CRIA setting out the case for the development of climate surfaces for South America at a resolution of 0.05º resolution as no such surfaces then existed, and it was essential that surfaces of at least that resolution be available for use in environmental modelling (Chapman 2003a).

It was pointed out in that report that surfaces at that resolution were already available for a large portion of the world, but that there had been no attempt to prepare like surfaces for either Central or South America. South America was one of the last great regions of the world not covered. The finest resolution climate surface coverage for South America was at a resolution of 10' of latitude (Jones 1991) as part of an effort for a global climate surface at 10' resolution (Hijmans 1999, New *et al.* 2002). These efforts however used limited climate data and/or are at a resolution of 10' rather than the 3' resolution proposed in my earlier report.

It was also argued in that paper, that the ANUSPLIN method of Hutchinson (Hutchinson 2001) be the method used to develop such a surface. ANUSPLIN is a technique developed in the 1980's and has been refined since. It is a proven methodology, and one that has achieved wide acceptance across the world. The advantages in using the ANUSPLIN methodology over the other available methods, is that the surfaces created are consistent with surfaces developed for other parts of the world and is a tried and proven methodology that caters well for areas where meteorological data is sparse.

Developments:

Following the presentation of the report to CRIA, I was able to obtain 10-minute resolution data for South and Central America from CIAT in Columbia (Jones 1991). This data was a considerable improvement on the data previously available for modelling in CRIA which was generally at a scale of 0.5 degrees.

This data took considerable manipulation before it was suitable for use in GARP for species modelling, and required some modification of the GARP algorithms. Because of the method of preparation, the data did include some artefacts, such as circling

around sparse meteorological data points. It was, however, a great improvement on that previously available, and an improvement in the scale available for modelling by a factor of 25 times.

30-arc second Global Data Set

Recently (in December 2003) I was made aware of a project being run jointly between the Museum of Vertebrate Zoology in the United States, Centro Internacional de Agricultura Tropical (CIAT) in Columbia and the Cooperative Research Centre for Tropical Rainforest and Ecology (Rainforest CRC) in Queensland, Australia to develop globally consistent, 30-second or 1 km climate surfaces for the world (Hijmans *et al.* in prep.).

On contacting two of the developers (Karen Richardson at the Rainforest CRC in Australia and Robert Hijmans at the Museum of Vertebrate Zoology), I was given access to a Beta version of the data for testing and for providing feedback to the developers. The data was developed using ANUSPLIN (Hutchinson 2001).

I have since (January 2004) downloaded the data covering South and Central America, and manipulated it into a format for use in the GARP modelling tool. Preliminary examination of the data did elicit a few minor problems and these were fed back to the developers and corrections made. The data does look good, however, and seems to be consistent across the continent, in spite of a sparsity of meteorological data in some parts of the continent (e.g. the Amazon and southern Patagonia). An advantage of using ANUSPLIN is that it handles areas of sparse data well.

Issues

The data will not be officially released in late March or April 2004, and use of it in CRIA until that time must be regarded as experimental only.

In the previous paper (Chapman 2003), a 3-arc minute coverage was argued for instead of a 30-arc second for the following reasons:

- There is a massive increase in computing power needed to prepare and use GRIDS at 30-arc seconds as opposed to 3-arc minutes
- The accuracy of the majority of species distribution data (and especially historic museum and herbarium data) can generally be regarded as no better than about 5 km (Chapman and Busby 1994, Chapman 1998). Thus to use finer surfaces for species modelling could be misleading and lead to errors.
- Most of the rest of the world's land areas has climate surfaces at 3-arc minutes, and surfaces prepared for South America would help complete a coverage for the globe at this scale.

The developers have informed me that they plan to reclassify their data to make available additional surfaces at 2.5 minute and 5 minute resolution. Once these are completed, it may be more appropriate and efficient to use the 2.5-minute data rather than the 30-second. This will need to be looked at once the data are available.

The increased computing power needed may be an issue, however, a preliminary test using the 30-second data has show that it is possible to use the data in GARP, at least over small areas (i.e. 1/3 of the continent). Further tests will be carried out in the coming months.

The issue of the quality of the species data vis-à-vis the climate data continues to apply, and for this reason alone, it may be best to move to the 2.5 minute data when available.

The third point no longer applies, as the 30-second dataset has been prepared for the whole world.

The developers of the dataset wish to make improvements to it, and are seeking collaboration to obtain more meteorological data from South America, especially from those areas where the data is sparse (e.g. the Amazon and southern Patagonia) (see maps of coverage at http://bnhm.berkeley.museum/gisdata/worldclim/methods.htm).

Conclusions:

The availability of the 30-second data set (and the subsequently to be derived 2.5 min data sets) negates the need to develop a separate 3-arc minute climate surface for South America. It is opportune that this dataset has been prepared at this stage, and will allow for a major advance in environmental modelling for South and Central America.

The 30-second resolution dataset is an increase of resolution of 3600 times over the 0.5 degree data being used twelve months ago, and a 400 times resolution improvement over the 10-minute data being used now. If it is decided to use the 2.5 minute data as I have recommended, then this will be an improvement of 16 times over what is being used now, and 900 times over the layers in use twelve months ago.

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