CarBioCial- Carbon-optimized land management strategies for southern Amazonia

SP 10: Development and implementation of a hierarchical model chain for modelling regional climate variability and climate change over southern Amazonia

Researchers

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Objectives

Within CarBioCial, the subproject SP10 analyses and models present and future atmospheric processes, boundary layer dynamics and spatiotemporal climate variations in southern Amazonia under different climate and land use scenarios. Fundamental research issues, to be addressed are:

- To analyse and model present and future climate variability in the target area at appropriate spatiotemporal scales.
- To investigate, assess and quantify the sensitivity of regional weather and climate responses to global climate change and land use change.
- To provide spatiotemporal high resolved climatological information for various impact studies in the CarBioCial framework for present and future time slices.

Model components

To generate spatiotemporal high resolution climate basic data sets a three component hierarchical model chain is utilized which contains dynamical and statistical downscaling approaches:

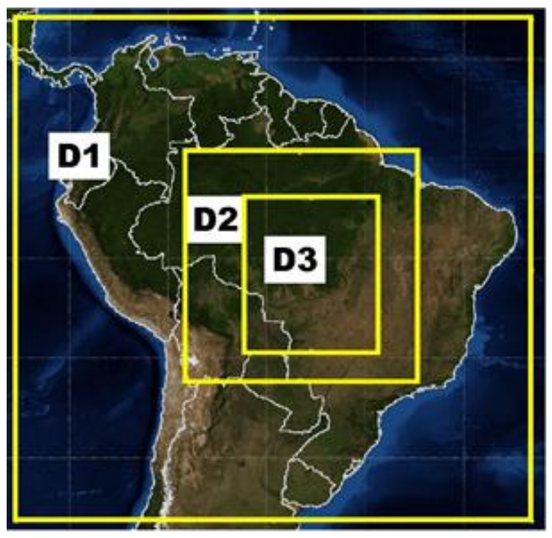
- External forcing is represented by Global Forecast System (GFS; forecast) data, reanalysis (ERA-interim; hindcast) or General Circulation Model (GCM; scenario) output.
- Dynamical downscaling by a local multi domain set up of the Advanced Research WRF (Weather Research and Forecast) model (from NCAR).
- Statistical downscaling via regression-based, empirical-statistical downscaling techniques considering a complex surface parameterization.

Nesting architecture & research area

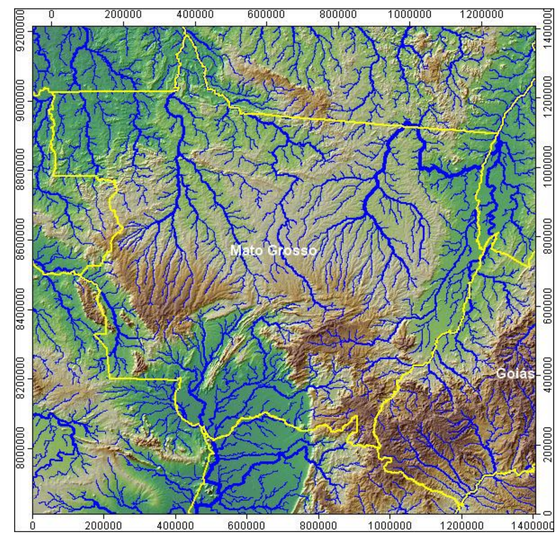
For the dynamical downscaling via WRF three nesting levels and a one-way nesting approach are used:

- The main domain D1 covers the north of Southern America and has a horizontal Grid spacing of about 30 km.
- The nested sub domain D2 has a horizontal resolution of about 10 km.
- The third domain D3 of the target area has a resolution of about 3 km.

This setup is used for retroactive climate simulations and forecasts. However, for the climate projections an additional nesting level of about 90x90km is needed due to the coarser resolution of the input.



WRF nesting structure.

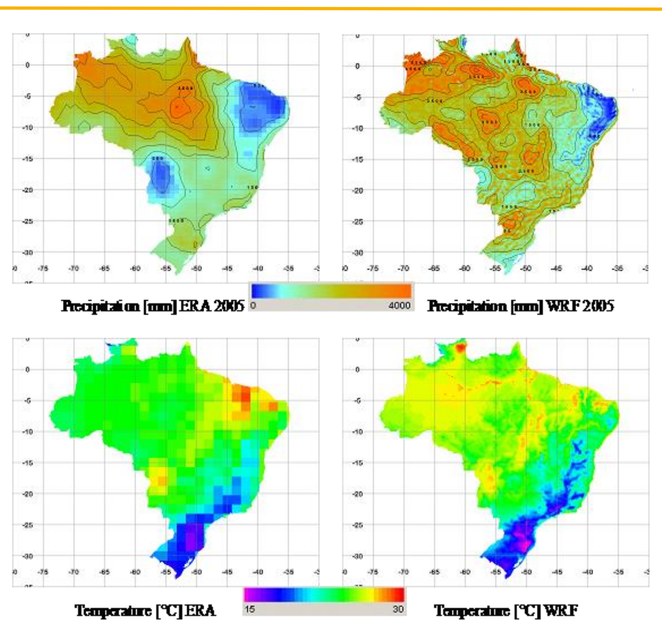


Digital Elevation Model of WRF Domain D3.

Results

So far, the retroactive simulations for 2001 to 2011 driven by ERA-interim-reanalysis are completed in the coarsest resolution (first nesting level; about 30x30km). Preliminary results are:

- WRF reproduces the mean large scale features of the forcing data set.
- Small scale features can be observed in, i.e., total precipitation even when considering long averages (yearly sums).
- These features are, in large part, the effect of the higher resolution, e.g. by the sensitivity to higher resolved surface properties.



Comparison of the annual sum of precipitation and the yearly mean temperature for Brazil from WRF output (right) with the driving ERA input (left).

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