What is Statistical and Dynamical downscaling?

Global Climate Models (GCMs) are important tools to assess the impact of future greenhouse gas concentration on changes in temperature, precipitation and wind speed. However GCMs are run at a very coarse resolution, with grids often larger than 100*100 km^2. This is too coarse for many applications. To resolve this issue, different downscaling techniques have been developed. **There are two main approaches to downscaling climate model outputs: Statistical and Dynamical downscaling.**

For **Dynamical downscaling** a higher resolution climate model is used. These models are often called regional climate models (RCM). RCM use lower resolution climate models (in most cases GCMs) as boundary conditions and physical principles to reproduce local climate. RCM are computationally intensive, so for some regions only limited RCM output data is available. RCM for CORDEX with a grid size of 0.44 degrees are often used (grid sizes of ~45 * 45 km^2).

If RCM data is not available for your region or is still too coarse, you can use **Statistical downscaling**. A whole range of statistical downscaling methods have been developed. Essential for doing a statistical downscaling is the availability of local weather data. The results of the statistical downscaling become better with higher quality and longer duration of historic observed weather data. If you have good data for a particular weather station (or a range of stations) you can downscale the climate model to that particular station. If you have a good gridded data set you can downscale to that grid.

For **Statistical downscaling,** a statistical relationship is developed between the historic observed climate data and the output of the climate model for the same historical period. The relationship is used to develop the future climate data.

Statistical downscaling can be combined with bias correction.

A linear regression is a simple widely used method for bias correction. The method establishes a linear relationship between one large-scale climate indicator for example GCM or RCM -simulated humidity, and local scale observed humidity. This is in equation 1 as *x* and *y.* This relationship is developed by assessing locally observed data and correlating it with GCM or RCM output. The *α* and β values are estimated based on a historic time period and are used to derive downscaled future climate projections.

$$y = \alpha + \beta x \qquad (1)$$

Links and references

SDSM (Statistical DownScaling Model) by University of Loughborough http://co-public.lboro.ac.uk/cocwd/SDSM/sdsmmain.html