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Trend fitting of GCM temperature extremes

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Modelled extremes are computed from daily variables generated by long climate simulations of the IPSL-CM4 GCM over period 1860-2100. The simulations are part of IPSL contribution to the 5th IPCC Report Assessment. Concentrations of the GHG and aerosols are prescribed during the whole simulations using observations prior to 2000 and according to a SRES-A2 IPCC scenario for 2000-2100.

Structural trend models are difficult to formulate in many circumstances, owing to the complex way in which different factors combine to influence extremes. The analysis of annual extremes of daily maximum temperatures is performed by means of Vector Generalized Additive Modelling of the Generalized Extreme Values Distribution. This method, introduced by Yee (1996), allows modelling the position and scale parameters of the GEV as a combination of smooth functions of time and of the potential predictors (global mean temperature, CO2 concentration, etc).

The main features revealed by this analysis is a strong rise of the position parameter, whose dependency is quasi-linear on the CO2 concentration of the scenario, while the behaviour of the scale parameter varies strongly according to the latitude and the land/sea surface. Modelling extremes of maximum temperatures is repeated for all grid points, which allows draw global return level maps at different epochs. From these results, several conclusions can be drawn: (1) Extremes generated by the A2 scenario in the IPSL-CM4 model show a generalized strong rise in the position parameter. (2) CO2 concentration plays a major role in this increase. (3) Extremes are higher, but their variability may decrease: most marine gridpoints exhibit significant decreasing values of the scale parameter. These features are probably due to the physics of the IPSL-CM4 model (cooling influence of Ocean).