AvH6-41, 2010
6th Alexander von Humboldt International Conference

Fuzzy Modeling and the Climate Change Problem

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The long term scenarios (until year 2100) developed by the the Intergovernmental Panel on Climate Change show a wide range of future concentration of greenhouse gases. It can be inferred from these data that higher temperature increases are directly related with higher emission levels of greenhouse gases and the related increase of their concentration in the atmosphere. From these data, it is also evident that lower temperature increases are related with smaller amounts of emissions and, therefore, with lower greenhouse gases concentrations. In this work, simple linguistic rules are extracted from the IPCC reports in a subjective way. These rules describe the relations among the greenhouse gases emissions, their concentrations, the radiative forcing associated with concentrations, and the temperature changes. These rules are used to build a model, based on fuzzy logic, that uses emission and concentration values of greenhouse gases as input variables and gives, as output, the temperature increase projected at year 2100.

Different clustering alternatives are studied for the input and output variables. For instance, if the emissions and the concentrations are discretized into 5 classes, i.e. very low, low, medium, high and very high; and the temperatures increase are discretized in the same classes, a linguistic rule will be: if the greenhouse gas concentrations are very high then the temperature global increment is very high. A second fuzzy model is also build based on temperature values obtained from a simple, deterministic climate system model. This kind of fuzzy model is very useful due to its simplicity and to the fact that it includes the uncertainties associated to the input and output variables. It is a simple model containing the information of a sophisticated, deterministic model (or a set of them). These characteristics of the fuzzy model allow not only the understanding but also the discussion of the processes involved in the problem under study.