Why use a model ensemble?

A climate model is a numerical representation of the climate system, and thus not a perfect description of the system. The description of the physical laws governing the climate system differs between models. The model complexity differs between climate models, some models include more processes that others. This means that all climate models will give different results. The size of these differences can be large or small depending on model, region, season, variable etc. A model may perform well for some region/ season/ variable and worse for another, while another model performs well for yet another region/season/variable. The usual way to handle these differences is to use model ensembles.

What's the advantage of model ensembles?

A method that is usually used in studies of climate scenarios is ensembles; where several climate models are used together. The use of ensembles enables estimations of the certainty of results. The spread can be significant, partly because models describe climatological processes in different ways. It's in the nature of the problem that it is difficult to estimate the future climatic response, since this is what the models are supposed to study. The correct answer will not show until the future occurs. This is the advantage of model ensembles. If the same response is seen in several models the result is considered to be certain. If the responses are different in different models the result is considered to be less certain.

Is there a way to reduce the ensemble?

Many impact modellers find difficulties using the large amount of data available from the wide range of combinations of climate models and scenarios. Therefore, often a subset of the data is used. The selections of these subsets are usually based on how the models perform with respect to temperature; or just by which data that is easily available.

- By using specific information about user needs it could be possible to make a subset that better fits the needs of a particular impact study.
- It is possible to group the members of an ensemble so that all ensemble members that give similar results are put in one group. In this way the ensemble could be reduced by only using one member from each group that represents the whole group. The similarity of the models can be evaluated against the representativeness of one or many variables. First the user requirements have to be identified (i.e. the variables used). Then the ensemble members are grouped in how they relate to the selected variables. At last the ensemble members that are closest to group's mean are chosen to represent the group. The groups depend on the variables, regions and seasons that are interesting for each impact study.

There is no general method to do the ensemble reduction. This means that it is important to think about what variables actually are important in an impact study. Disadvantages with reductions are that that the selection may change if the preferred number of members is changed and that different selections may lead to inconsistencies between users with different needs.

Read more

Wilcke, R.A.I. and Bärring, L., 2016: Selecting regional climate scenarios for impact modelling studies. Environmental Modelling & Software 78, 191-201.
http://dx.doi.org/10.1016/j.envsoft.2016.01.002