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Reply to:

Comments on: "Will greenhouse gas-induced warming over the next 50 years lead to higher frequency and greater intensity of hurricanes?" by C. W. Landsea

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Landsea has questioned the validity of some of the results in Bengtsson et al. (1996) (hereafter referred to as BBE-2) with respect to (i) an anticipated inconsistency by using a different atmospheric model in the coupled run than in BBE-2 and (ii) an objection to a statement in BBE-2 concerning the maximum windspeed in the strongest of the simulated hurricanes.

The overriding objective in BBE-2 as well as in the previous paper by Bengtsson et al. (1995) (hereafter referred to as BBE-1) was to demonstrate the capability of an atmospheric general circulation model to generate hurricane-like vortices and to demonstrate the importance of atmospheric dynamics and thermodynamics in that process. The importance of atmospheric processes is clearly seen in the considerable interannual variability in the model experiments (with the same SSTs) as well as in reality (in situations with very similar SSTs). The interested reader is invited to examine the substantial statistical information provided in BBE-1 and BBE-2.

We consider the SST data calculated by the simple coupled model by Cubasch et al. (1992) as useful in this experiment in spite of the fact that the atmospheric model used by Cubasch et al. (1992) had several deficiencies mainly related to the very poor horizontal resolution being used. Nevertheless, the calculated SSTs at the time when the atmospheric concentration of CO_2 was doubled compared to present, are very similar to what has been obtained by more advanced models in later experiments (Bengtsson, 1997). This is partly due to the use of empirical correction of systematic errors in the calculation of the ocean/atmosphere fluxes normally used in the climate change experiments and applied in Cubasch et al. (1992). Needless to say, we have expressed the need for a cautious interpretation of our results in this respect (see page 65, 66 and 72 in BBE-2). Regrettably, the possibility to run the coupled model at T106 resolution was not possible due to the excessive computer demands for such an experiment.

With respect to the comments on the most intense storm, we agree that the modelling results actually suggests "no significant change" in the strongest storms between today's climate and a doubled CO_2 one. The following quotations from BBE-2 stress this further "very similar distribution and almost the same average maximum windspeed" (p. 61); "no reduction in their overall strength." (p. 72) The most intense storm is occuring in the $2*CO_2$ integration and is described by "rare occasion, although hardly significant," (p. 61). The authors just wanted to point out that this outstanding event is not necessarily in contradiction with the overall reduction of the number of storms.

Finally, we wish to comment on the remark by Landsea "moderately realistic resemblance to

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observed tropical cyclones." This is in our view essentially a question of horizontal resolution. As can be seen from Bengtsson et al. (1997), when a very high resolution is implied (by means of a nested limited area model) the actual vortices are further intensified and reduced in size. Characteristic features such as an eye structure and coherent rainbands can easily be seen.

In concluding, we are somewhat surprised over the comments by Landsea which do not really add anything of substance to the important issue of the possible role of hurricanes in a future climate and the key role the use of comprehensive numerical models have in that respect. We also believe that the original paper as exemplified above already had recognized the caveats in this type of studies.

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