AN EXAMPLE OF A LONG RANGE TIME INTEGRATION WITH A PRIMITIVE EQUATION NUMERICAL MODEL

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(Due to unforeseen circumstances this lecture will only be published as an extended abstract in these proceedings. A more detailed manuscript will appear later in the ECMWF Technical Report series).

A low resolution version of the ECMWF spectral model (triangular truncation at wavenumber 21, 15 vertical levels, see Baede et al, 1979) has been integrated for several years to study the model climatology and characteristic interannual variability, and to generate a dataset which can be used for future (model) climatological sensitivity studies. The study has been carried out as a joint project with the French Meteorological Office and the German Weather Service.

The model climatology has been described by Volmer et al (1981) and Cubasch (1981). The model displays a realistic but slightly underestimated seasonal variability as a response to changes in the solar angle and seasonally changing surface conditions. The variability on the time scale of days (baroclinic eddies) is also realistic although there is some tendency to overdevelop the cyclonic eddies. Compared with runs using a higher resolution this tendency is, however, much reduced in this low resolution version of the model.

An expansion of some model variables in a series of empirical orthogonal functions gives an indication of substantial interannual variability, Some persistent flow patterns which resemble atmospheric blocking have been identified.

The sensitivity of the model to sea-surface temperature anomalies has been tested using a Monte Carlo approach. Initial states were taken from five successive first of Januaries from the model generated data. This technique gave equivalent, but independent samples from which the statistical significance of the response to the sea surface temperature anomaly could be tested. It was found that a midlatitude anomaly did not give a statistically significant response when comparing all the samples with the reference run, while a tropical "superanomaly" did give a more coherent, significant response in the form of northward propagating wave-trains. The response to the tropical anomaly

thus agrees with the results obtained from linearized models by, amongst others, Simmons (1981). The response to midlatitude anomalies is more ambiguous, there is a detectable response in each case but it varies between the different runs. This indicates a nonlinear sensitivity to the initial conditions, but the reason for this sensitivity and the apparent instability has yet to be explained.

REFERENCES

Baede, A., Jarraud, M., Cubasch, U. 1979 Adiabatic formulation and organisation of ECMWF spectral model. ECMWF Tech.Rep.No.15, pp.40.

Cubasch, U. 1981 Preliminary assessment of long range integrations done with the ECMWF global model. ECMWF Tech.Memo.No.28, pp.21.

Simmons, A.J. 1981 Tropical influence on stationary wave motion in middle and high latitudes. ECMWF Tech.Rep.No.26, pp.59.

Volmer, J.P., Deque, M., Jarraud, M. 1981 Large scale fluctuations in a long integration of the ECMWF spectral model. Manuscript available from Meteorologie Nationale, EERM, 77 Rue de Sevres, Boulogne, France.