Geophysical Research Abstracts,
Vol. 11, EGU2009-8303, 2009
EGU General Assembly 2009

The Impact of SST-anomaly Gradients on Cloud Base and Precipitation - Implications for Long Range Forecasts

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Precipitation intensity at the ground depends strongly on cloud base height and the relative humidity of the sub-cloud layer, primarily because these factors affect particle evaporation. As airmasses move from the ocean towards Western Europe (and other geographically similar parts of the world) they cross sea surface temperature (SST) gradients, and heat and moisture fluxes to/from the ocean change. A simple hypothesis will be presented for NW Europe to illustrate how different signs of the along-trajectory SST-anomaly gradient will influence the relative moistening or drying of the lower troposphere, and hence cloud base height. In turn this can affect the intensity and amounts of precipitation falling from fronts and cyclonic systems as they move across this region. Numerical model evidence for this effect will be presented using operational ECMWF ensemble output for the exceptionally wet summer of 2007 over the UK. Once SSTs around the UK had undergone a marked reduction, at the end of June, due to passage of a major cyclonic storm, the longer range forecasts became systematically wetter. Soil moisture anomalies are likely to have been an additional contributory factor, notably when the low level airmass trajectory was from the near continent.

One tentative, positive conclusion from the above is that there may be scope for cheap, statistical forecasts of precipitation anomalies to have some skill for as long as current SST anomaly patterns persist. Meanwhile one downside is that numerical model predictions of the same are liable to fail if they do not capture a major cyclonic storm, at long range, which disrupts the SST pattern. They would also need to correctly represent the impact on SSTs, and thereby on SST-anomaly gradients, of such a storm. These are major challenges.

Possible feedbacks between cloud base height, storm structure and cyclonic activity will also be briefly mentioned.