Evaluation of Surface Water and Energy Cycles in the Met Office Global NWP Model using CEOP data.

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The water and energy balance components in the Met Office global NWP short range forecasts are evaluated using CEOP in-situ reference site data across a number of climatic regimes. The global hydrological cycle in the model is in reasonable balance. However, comparison against available observations suggest that both precipitation and evaporation are currently overestimated over extratropical land masses and oceans, with largest errors over the tropical oceans. Comparison of the model's seasonal and diurnal cycles of surface fluxes, temperature, precipitation, and moisture with the CEOP sites reveals several issues with model parameterization performance. For the high latitude (Arctic) sites low cloud is overestimated during boreal winter leading to an enhanced greenhouse effect and too warm near surface temperatures in the model. Snow melt occurs too early in boreal summer in the model forecasts which currently have no snow analysis component. Possible reasons for early snow melt are discussed including the specification of albedo over heterogeneous terrain and sublimation of snow in the model. The mid-latitude CEOP sites all show excessive evaporation and precipitation during boreal spring and summer. High evaporation is partly driven by errors in the net surface radiation due to a lack of cloud cover or cloud radiative forcing during summer over land. However, poor specification of soil moisture in the initial conditions may also play a role. The worst biases in surface fluxes are during daytime on non-precipitating cloudy days where the model overestimates the downward SW radiation. Finally, over tropical land we see a tendency to underestimate precipitation which is in direct contrast to tropical oceans where precipitation accumulations are too large.