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Projecting century scale change in UK extreme sea level for the UK

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In order to prepare and adapt for a changing climate, it is vital to have specific and accurate information on which to base decisions. Whilst the IPCC AR4 provides excellent information at a global scale, there is insufficient information specifically for the UK. For this reason, the UK government funded a set of projections through the UK Climate Impact Programme (UKCIP). In 2009, the UKCIP released its latest set of projections: UKCP09. These projections were more than a science update on the previous projections and have a completely different methodological approach. For the first time considerable effort has been invested in quantifying uncertainty. This led to a Perturbed Physics Ensemble (PPE) of the Hadley Centre model HadCM3, with a consistent regional PPE (downscaled with HadRM3).

UKCP09 included a dedicated marine report giving projections of sea level rise, changes in the storm surge and wave climatology, and changes to shelf sea oceanography - changes in the mean and extreme sea levels will be described below. In addition to the model-based projections which give the most likely range of impacts, a H++ (high impact, low probability) scenario was developed to incorporate the aspects of science that are not understood well enough to be included in the models, but which may significantly increase the level of impact. This high-end scenario was requested to allow contingency planning.

The AR4 provides global projections of sea level rise (SLR) for the end of the 21st century (with uncertainty). These values were regionalised for the UK by looking at the distribution of the ratio of the SLR in the AR4 GCM grid-boxes around the UK compared to the global average. To convert to spatially varying relative sea level rise the UK absolute SLR was combining with a map of modelled vertical land movement (validated by observations).

The regional PPE provided the wind and pressure forcing which drive the storm surge model POLCS3. This was run for the full 150 year simulations, for each of the 11 downscaled ensemble members. The results were analysed using the generalised extreme value approach for the five largest values of each year, giving the time-varying 2, 10, 20 and 50 year return level (with uncertainty).

The storm surge return periods calculated from the projections were validated against observations and compared to the previous simulations (the basis of the UKCIP02 projections). The modelling system tended to slightly under-predict compared to observations, but exhibited considerable skill in simulating extreme surge events and was an improvement on UKCIP02. The model based projections show little change in storm surge return levels (the 50 year return level is projected to change by less than 0.9mm/yr over the 21st century). The H++ scenario was developed by scaling one of the regional PPE members up to the most extreme AR4 model (in terms of storm intensity). This gave a maximum increase in the 20 year return period of 1m by 2100, which is considered to be possible but very unlikely.