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On the relative importance of the climate change factors along the river Scheldt considering climate scenarios for upstream inland and downstream coastal (mean sea level and surge) boundary conditions

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To improve on the efficacy of flood risk mitigation measures, it is essential to investigate the relative importance of the future impact pressures. This is more so in areas which are found to be hot spots for flooding. One such area was identified in the Scheldt region located in Belgium. The Dendermonde area is a place where both the downstream coastal and the upstream river flow boundary conditions interact and jointly control the flood risk. Downstream of this area, the coastal level changes include both the sea level rise and storm surge changes due to climate change impacts on the wind climate over the North Atlantic and North Sea region. Upstream of the Dendermonde area lies the Dender river which introduces an extra pressure on the Dendermonde area. Against this back drop, impact analysis was performed using a hydrodynamic model that accounts for such changes. The climate data for future scenarios were extracted from the climate databases PRUDENCE (<http://prudence.dmi.dk>), ENSEMBLES (<http://www.ensembles-eu.org/>), IPCC AR4 (www.pcmdi.llnl.gov/ipcc/about_ipcc.php) and CERA (CLM from MPI-M/MaD).

Future changes were derived from the large ensemble set of climate model runs and their effects simulated in the hydrodynamic model based on statistically processed climate change scenarios of sea level rise, SLP change and related storm surge changes and upstream runoff due to changes in rainfall and potential evapotranspiration. Changes in SLP were transferred to changes in storm surges at the Scheldt mouth (at Vlissingen) based on a correlation model between the SLP at the Baltic Sea and the storm surge level. This model was derived after analysis of SLP composite maps and SLP-surge correlation maps for days where the surge exceeds given thresholds (for different return periods). Correlations between the inland (rainfall, runoff) and coastal climatic changes were considered.

The impact analysis to analyze the importance of the pressures for the Dendermonde area was based on hydrodynamic impact model results. From the water level impact results, it was deduced that the sea level rise and surges are by far the most important factors when evaluating the flood risk in the Dendermonde region. When the extreme changes for the three main boundary conditions (mean sea level, surge and upstream runoff) coincide, the impact is disastrous. For example, water levels at Dendermonde were simulated to change around +1.8m for return periods in the range between 100 and 10000 years and the scenario with +0.6m mean scenario for sea level rise, +21% high scenario change in surge levels, and +30% high scenario change in upstream flow. For the high mean sea level rise scenario of +2m, the changes are even much higher. Water management plans, which are currently under way such as the Sigma Plan, can be informed from such studies so as to test the robustness of the proposed flood mitigation measures.