Storm Surges Congress, Hamburg, Germany
13–17 September 2010
SSC2010-111

The Effects of Climate Mitigation on The Exposure Of Worlds Large Port Cities To Extreme Coastal Water Levels

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This paper investigates the effect of climate mitigation on the levels of population and asset exposure to the 1:100 year storm surge for 136 of the world's large port cities, important foci for economic activity. This builds on the initial scoping study carried out as part of the OECD Environmental-Social Interface programme (Nicholls et al., 2007).

Global data has been used to estimate population by elevation and storm surge levels for each port city from which exposure to the 1:100 year storm surge event is calculated. Future exposure levels are based on projections of sea level and socio-economic conditions under the A1B storyline under both unmitigated and mitigated climate projections. Climate mitigation scenarios considered include scenarios with peak greenhouse gas emissions in 2016 and 2030 with annual emissions reductions between 2 and 5%. Socio-economic projections include urbanisation rates, reflecting the concentration of population in cities and changes in per capita Gross Domestic Product from which asset values are estimated. In this work, the presence of flood defences is not considered so numbers reported are representative of a worst-case scenario - or what may happen if defences fail.

The results illustrate that the effects of climate mitigation will not be appreciable in terms of coastal water levels until the latter half of this century due to the 'commitment to sea-level rise'. Significant amounts of adaptation to reduce the potential impact of future storm surges will therefore still be needed during this century. For population, socio-economic change is the main driver of increases in exposure, particularly for developing countries (notably in Asia) where future exposure levels increase substantially even without considering environmental change. These areas therefore also show the greatest benefit of climate mitigation - the highest reduction in population exposure being found in China. For assets, higher exposure levels tend to be found in the more developed economies with Japan, China and the US benefiting most from the effects of climate mitigation, particularly with the peak in 2016. Individual cities with high future population exposure levels illustrate the concentration in parts of Asia and include Ho Chi Minh City, Shanghai, Kolkata, Mumbai, Guangdong, Dhaka, Miami, Hai Phòng, Alexandria and Bangkok. Unsurprisingly, many of these are located in deltaic environments where subsidence, particularly when anthropogenically-induced, is an important factor in exposure levels. For asset exposure the top ranked cities include Miami, Shanghai, Guangdong, Tokyo, Ho-Chí-Minh City, Osaka-Kobe, Bangkok, Amsterdam, Rotterdam and Nagoya.

This global analysis shows that the growth in exposure to coastal flooding in port cities over this century has a range of drivers and, while climate mitigation has long-term benefits, there is an on-going need to adapt to the influence of other factors, particularly population growth, which mitigation cannot avoid. To be effective, adaptation measures would need to include spatial planning and improved water resource management as well as constructed defences. However, it is important to note that while the use of appropriate coastal defence/management strategies will reduce the risk of the exposure levels reported here, their possibility will not be eliminated.

Acknowledgements: This work was funded by the AVOID Programme

Nicholls R. J., Hanson S, Herweijer C, Patmore N, Hallegatte S, Corfee-Morlot J, Chateau J, Muir-Wood R, (2007). "Ranking port cities with high exposure and vulnerability to climate extremes - Exposure estimates." OECD Environment Working Paper 1, ENV/WKP(2007)1. Paris: OECD.