

## **A global record of large storm surges and loss of life**

Laurens Bouwer (1) and Sebastiaan Jonkman (2)

(1) Deltares, Delft, Netherlands (laurens.bouwer@deltares.nl), (2) Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, The Netherlands

Storm surges can cause very high numbers of loss of life (fatalities) in single events, and these events are expected to increase due to sea-level rise and increasing population in coastal zones. However, compared to fatalities from fresh water flooding, for storm surges these fatality numbers are not consistently recorded, and often neglected in scientific assessments. In order to assess the impacts of major coastal storm surge events at the global level, we have developed a record of these events and associated loss of life. Information was compiled from the EM-DAT database for the period 1900-2013, using the two key categories of “Tropical cyclone” and “Storm surge/coastal flood”, complemented with other databases and sources of information, and records of observed surge levels. We find that globally, each year on average about 8,500 people are killed and 1.3 million people are affected by storm surges. The occurrence of very substantial loss of life (>10,000 persons) from single events has decreased over time, which is in contrast with the slight increasing trends in fatalities observed for fresh water flooding. Also, there is a consistent and strong decrease in event mortality, which is the fraction of the people exposed to surges that lose their life, for all global regions, except South-East Asia. Thus, reduction in vulnerability to loss of life over time plays a significant role in storm surge impacts. We also find that for the same coastal surge water level, mortality appears to have decreased over time, showing the robustness of this finding. This quantified decline can be attributed to risk reduction efforts over the last decades, including improved forecasting, early warning and evacuation, but also improved coastal protection. These results have important implications for assessment studies on current and projected future coastal flood risk, as historical mortality fractions may not be valid to assess impacts from future events.