Geophysical Research Abstracts
Vol. 17, EGU2015-10645, 2015
EGU General Assembly 2015

Global reconstructed daily storm surge levels from the 20th century reanalysis (1871-2010)

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The study of global patterns of wind and pressure gradients, and more specifically, their effect on the sea level variation (storm surge), is a key issue in the understanding of recent climate changes. The local effect of storm surges on coastal areas (zones particularly vulnerable to climate variability and changes in sea level), is also of great interest in, for instance, flooding risk assessment.

Studying the spatial and temporal variability of storm surges from observations is a difficult task to accomplish since observations are not homogeneous in time and scarce in space, and moreover, their temporal coverage is limited. The development of a global storm surge database (DAC, Dynamic Atmospheric Correction by Aviso, Carrère and Lyard, 2003) fulfils the lack of data in terms of spatial coverage, but not regarding time extent since it only includes last couple of decades (1992-2014).

In this work, we propose the use of the 20CR ensemble (Compo et al., 2011) which spans from 1871 to 2010 to statistically reconstruct storm surge at a global scale and for a long period of time. Therefore, the temporal and spatial variability of storm surges can be fully studied and with much less effort than performing a dynamical downscaling.

The statistical method chosen to carry out the reconstruction is based on multiple linear regression between an atmospheric predictor and the storm surge level at daily scale (Camus et al., 2014). The linear regression model is calibrated and validated using daily mean sea level pressure fields (and gradients) from the ERA-interim reanalysis and daily maxima surges from DAC.

The obtained daily database of maximum daily surges has allowed us to estimate global trends at a centennial scale and analyse the effect of the changing climate on storm surges during the 20th century.

Hence, this work improves the knowledge on historical storm-surge conditions and provides helpful information to the community concern on marine climate evolution and coastal impacts.

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