

# 21<sup>st</sup> surge-height variability along the Belgian coast under A1b SRES scenario



Ullmann A.(\*), Monbaliu J.(\*)

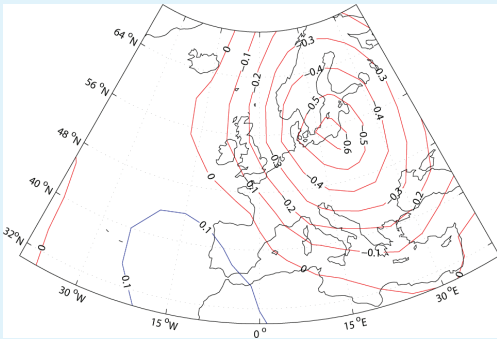
\* Katholieke Universiteit te Leuven, Hydraulics Laboratory, Kasteelpark Arenberg 40, B-3001 Heverlee



## 1. Aim and localisation

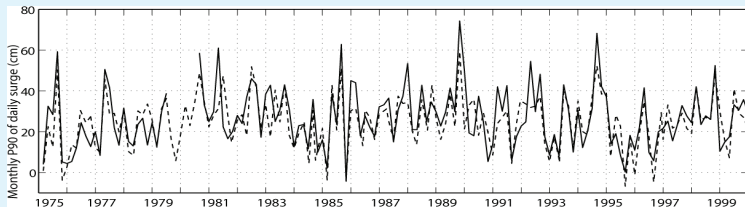
The aim of this study is to predict the long-term variability of extreme surges along the Belgian coast in a future climate. A downscaling approach is used to build a statistical model for surges, which are required for impact calculation. The downscaling approach is based on the relationship between surges and large-scale atmospheric features well resolved by global circulation models.

## 2. Sea surge and SLP: statistical model set-up in the 20th century



**Figure 1.** Correlation between daily surge height at Oostende and each ERA-40 grid-point of SLP over [40°W-40°E], [30°N-70°N] on the period 1950-2000.

**Figure 1** shows a significant correlation between the daily surge height at Oostende and sea-level pressure (SLP) over the Baltic Sea. A linear regression is performed to relate the daily surge height at Oostende to the daily SLP averaged over the Baltic Sea: **Surge = a\*SLP+cst (1)**. Daily surge height time series is inflated with a coefficient of inflation (Std. obs / Std. sim). In cross validation on 1950-2000, **the interannual variability of the monthly 90% percentile of surge at Oostende is robustly reproduced by the linear regression (fig.2, tab. 1).**



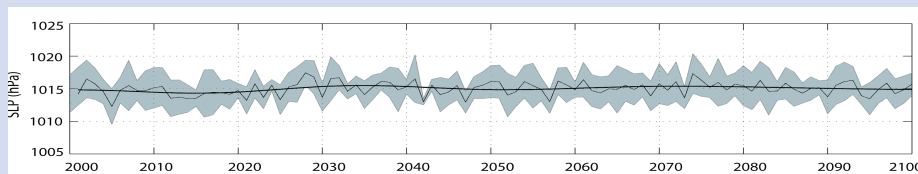
**Figure 2.** Time series of the monthly 90% percentile of surge at Oostende as derived from *in situ* observation (full line) and simulated (dashed line) with the linear regression using daily SLP averaged over the Baltic Sea as predictor of daily surge height and after inflation. The regression is learned on the period 1950-1974 and tested on the period 1975-2000.

**Table 1.** Goodness-of-fit statistics of the monthly 90% percentile of surge estimated with the linear regression using daily SLP averaged over the Baltic Sea as predictor of daily surge height and after inflation. In second (third) line when the regression is learned on the period 1950-1974 (1975-2000) and tested on the period 1975-2000 (1950-1974). The linear correlation (r), roots mean square error (RMSE) and standard deviation (Std). Three stars indicates the 99% level of confidence.

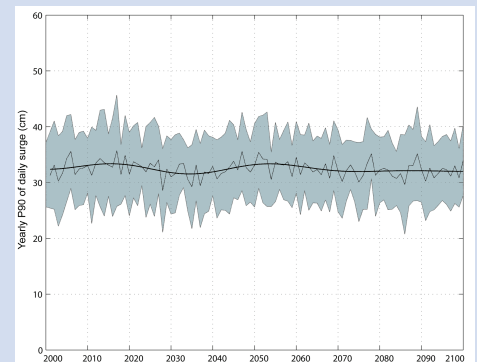
	r (observation vs simulation)	RMSE (cm)	Mean (cm)		Std. (cm)	
			Obs	Sim.	Obs .	Sim.
P90 (1975-2000)	0.76***	7.9	32.1	30.2	14.2	14.8
P90 (1950-1974)	0.72***	7.6	28.2	26.8	13.5	13.9

## 3. Surge and atmospheric conditions in the 21st century

Linear regression (1) is applied to a 17-ensembles runs of SLP simulated from 1950 to 2100 by ECHAM/MPI-OM GCM under A1b climate change scenario. **No significant changes in the yearly 90% of surge are found within the 17 runs on the period 2000-2100 (fig. 3), associated with stationary SLP conditions over the Baltic Sea (fig. 4).**



**Figure 4.** Thin line: mean of the 17 ensembles A1b time series of yearly SLP averaged over the Baltic Sea. Bold line: 30 year low-pass variations. The gray shading: yearly mean +/-  $\sigma$ .



**Figure 3.** Thin line: mean of the 17 ensembles A1b time series of yearly 90% percentile of sea surges on the period 2000-2100. Bold line: 30 year low-pass variations. The gray shading: the yearly mean +/-  $\sigma$ .