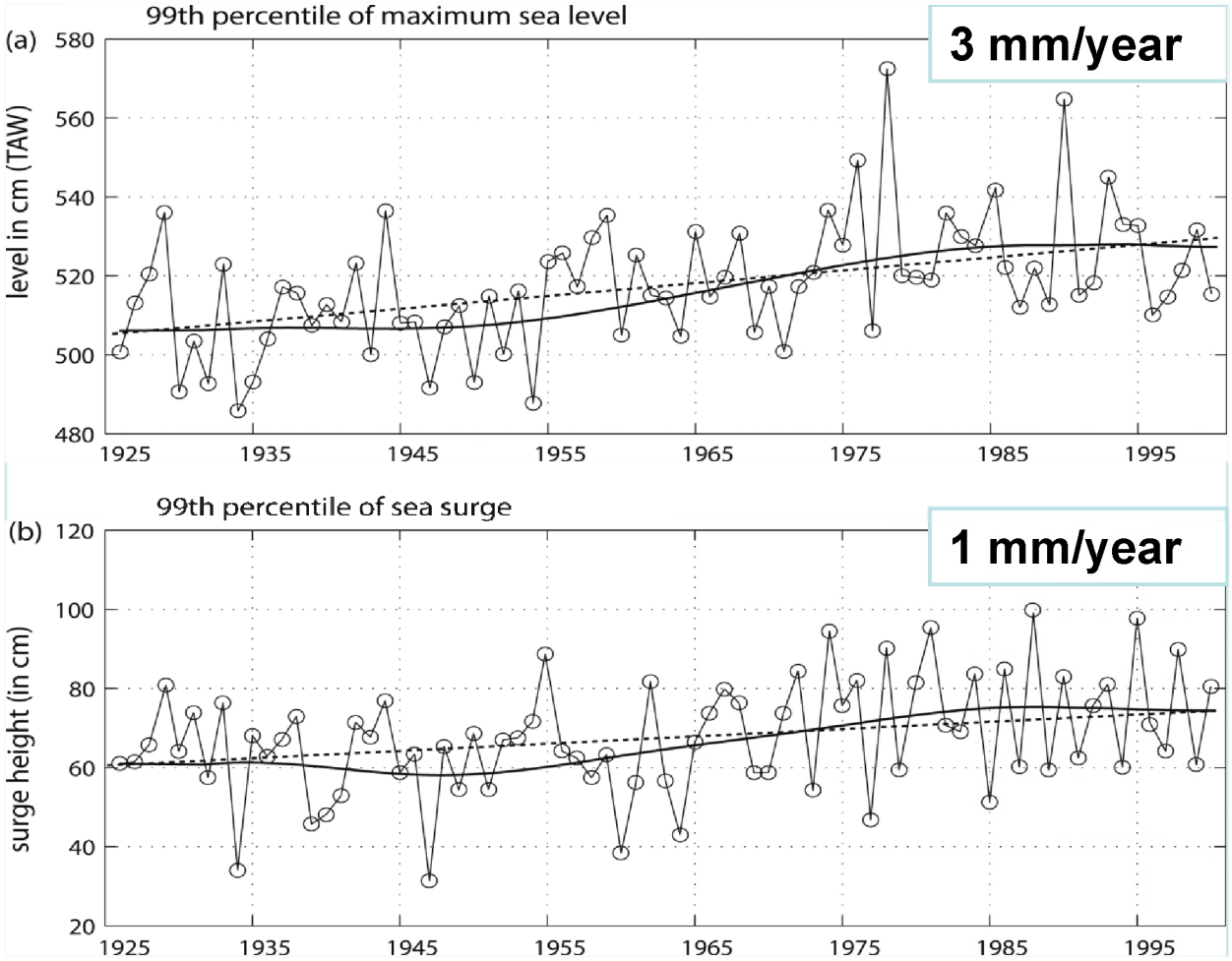
Hydro-meteo and climate change

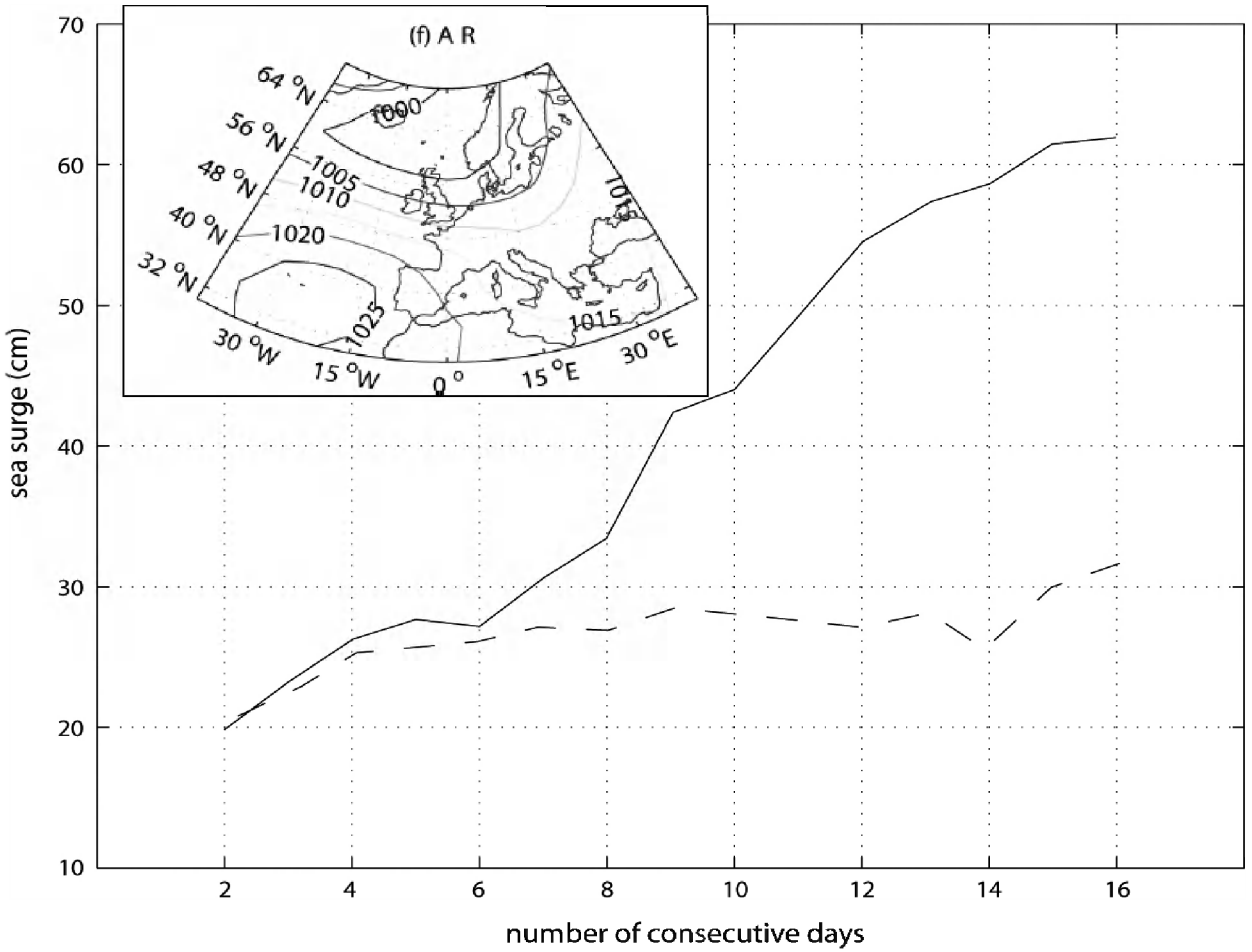
Jaak Monbaliu (K.U.Leuven)

99th percentile daily maximum sea level (top) and surge (bottom)



Wintertime (October–March) 99th percentile of daily maximum (a) sea level and (b) daily sea surge at Ostend station in the period 1925–2000 (line with circle). The low-pass variations removing periods below 1/30 cycles per year superimposed as bold full line and linear trends in dashed lines. (Ullmann and Monbaliu, 2010)

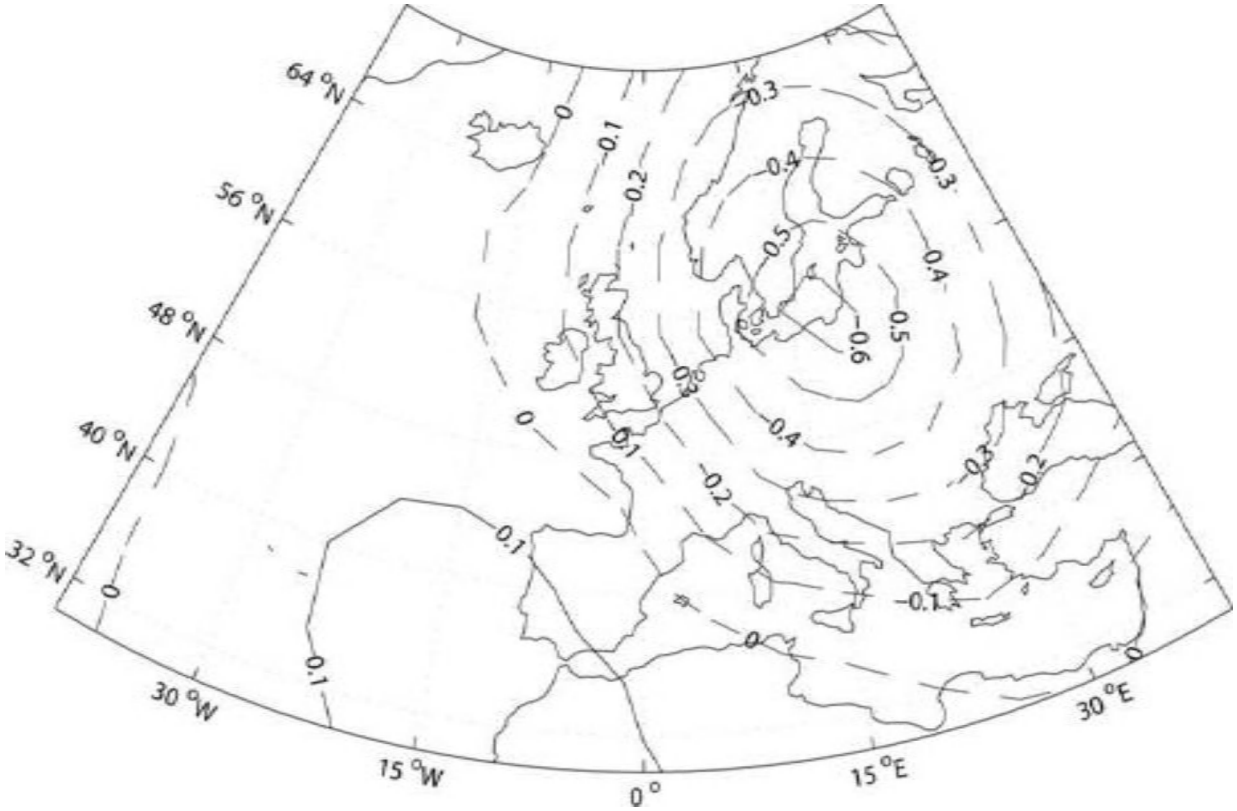
Persistency of weather type important

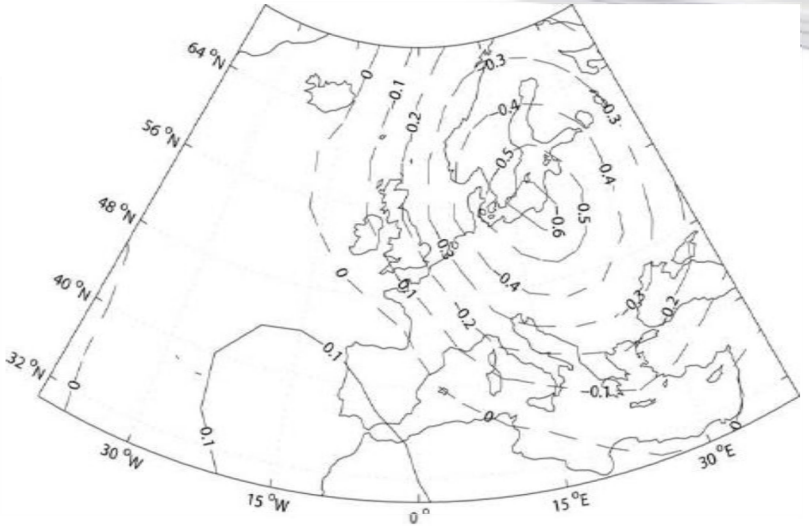


Full line: average maximum daily surge at Ostend for consistent spells of AR weather regime

Dashed line: average of the last day maximum daily surge at Ostend of persistent spells

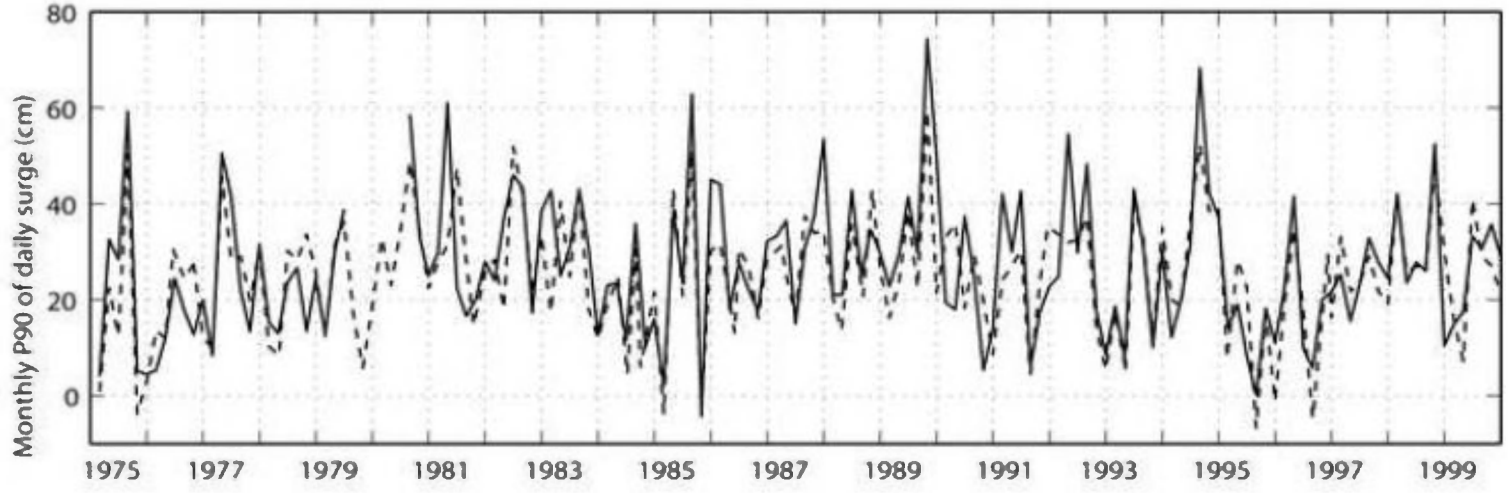
Correlation between surge and sea level pressure (daily basis)





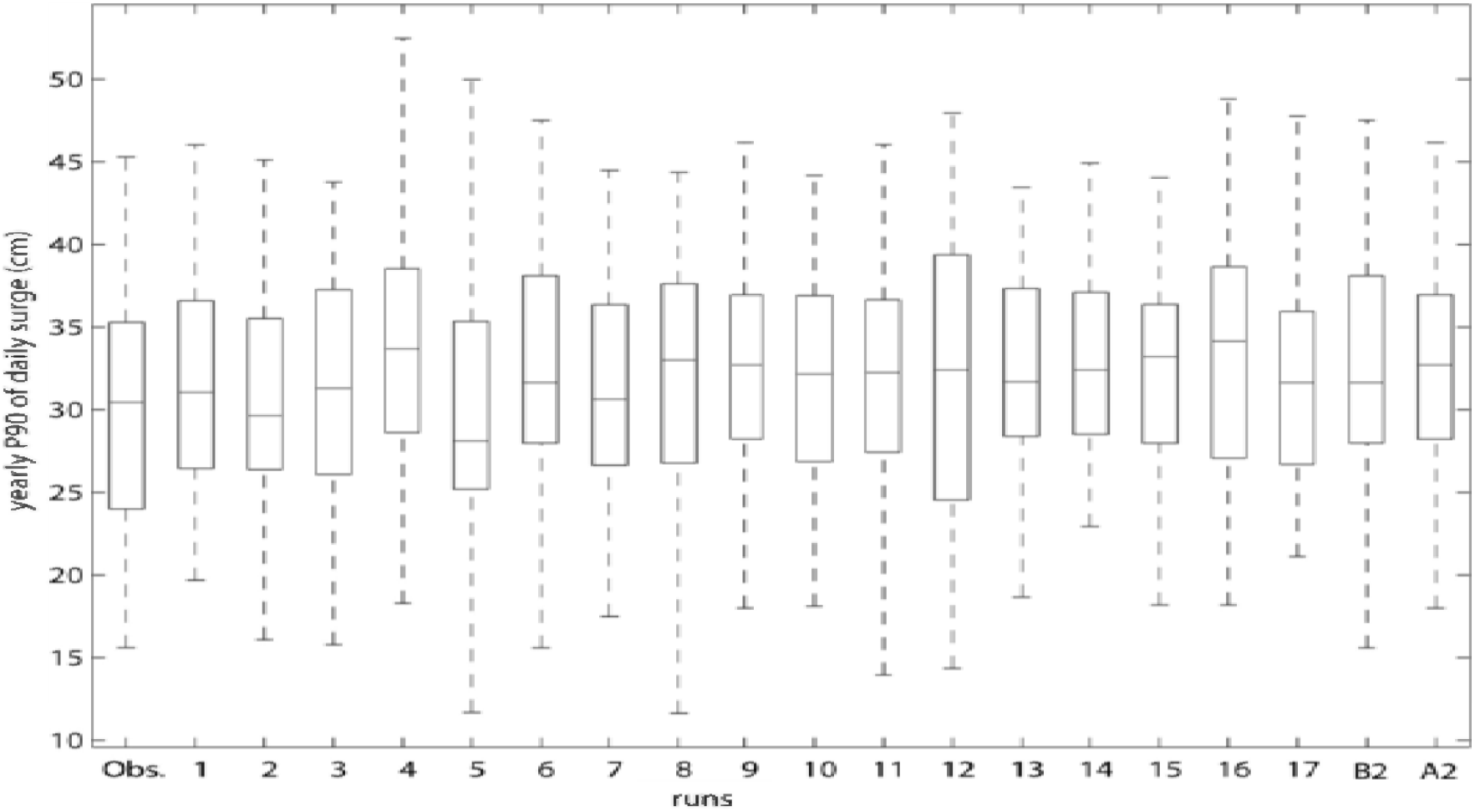
Predictor surge =
f (pressure Baltic Sea, pressure gradient between BS and Azores)

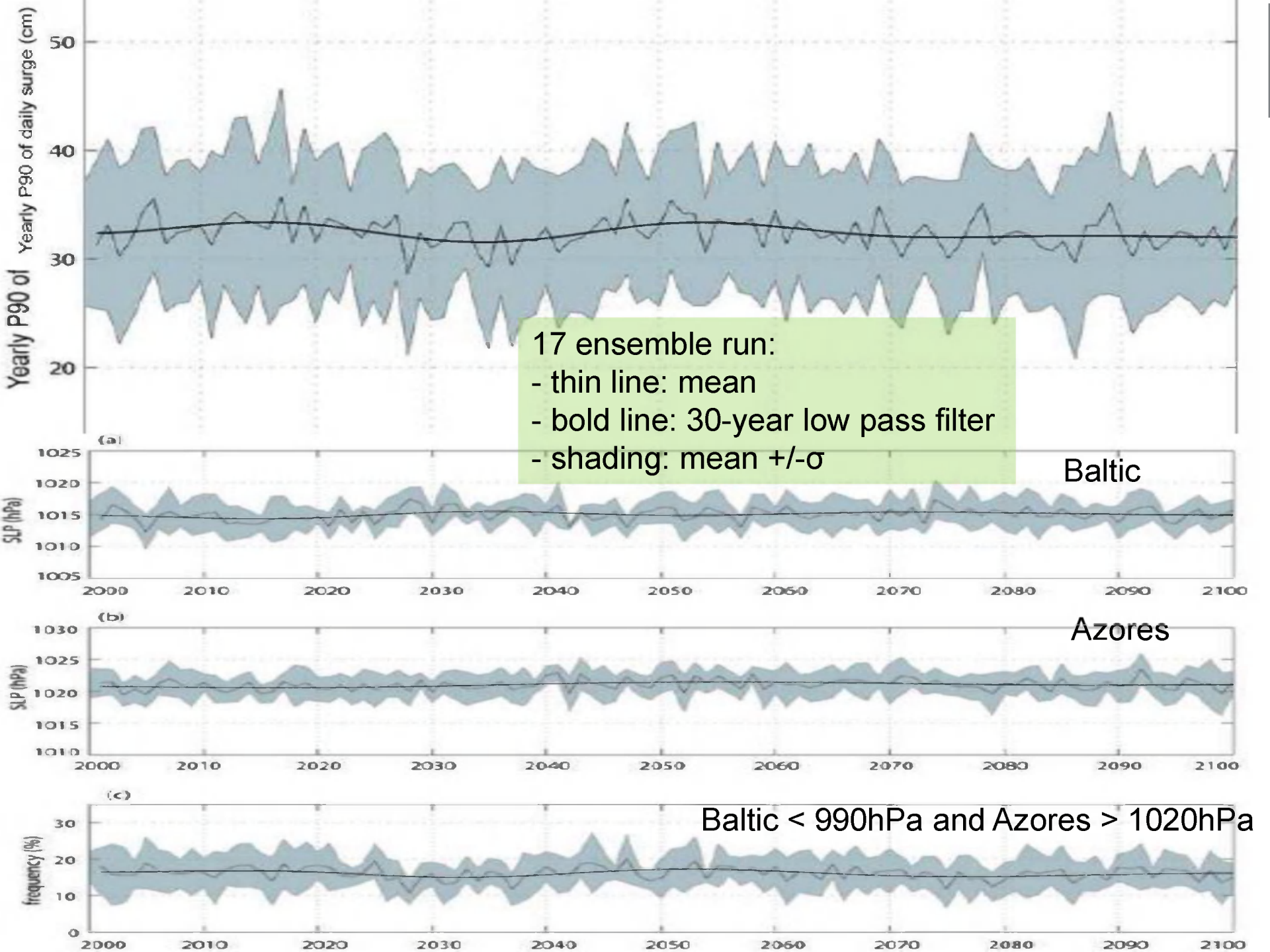
(a) full line: observations ; dashed line: predictor



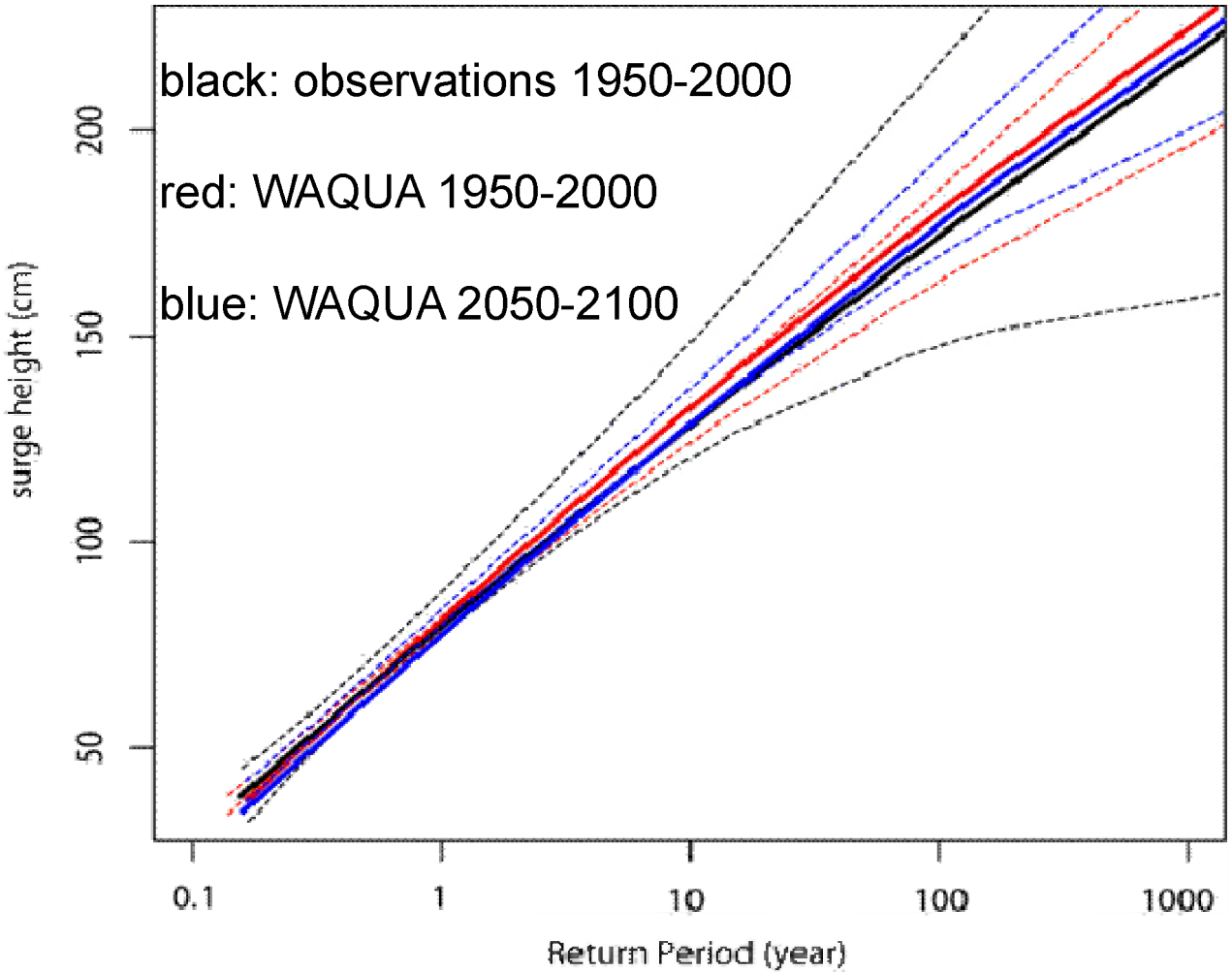
Future climate projection
application to climate model output control run
reproduction of value and variability of observations

ESSENCE ensemble 17 runs using ECHAM/MPI-OM GCM A1b + 2 ARPEGE runs




Yearly P90 of daily surge (cm)
50
40
30
20
17 ensemble run:
- thin line: mean
- bold line: 30-year low pass filter
- shading: mean +/-σ
(a)
SLP (hPa)
1025
1020
1015
1010
1005
Baltic
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
(b)
SLP (hPa)
1030
1025
1020
1015
1010
Azores
(c)
frequency (%)
30
20
10
0
Baltic < 990hPa and Azores > 1020hPa

Extreme values for surges from hydrodynamic simulations (WAQUA) using ESSENCE GCM fields



Conclusions

- Surge height (and wave height) correlated with SLP over the Baltic and with the gradient of SLP between Baltic and Azores.
- Statistical downscaling reproduces high surge values (P90->P99) well.
- From statistical downscaling: high surges values expected to stay stationary for the period 2000-2100.
- Hydrodynamic model results indicate that statistical distribution extreme surges are not expected to change for the period until 2100.
- **BUT**: do not forget about sea level rise → **CLIMAR** project

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