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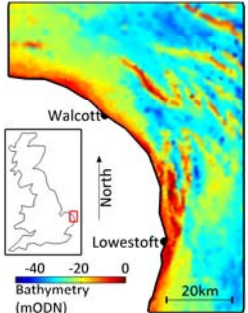
Nearshore coastal hydrodynamics

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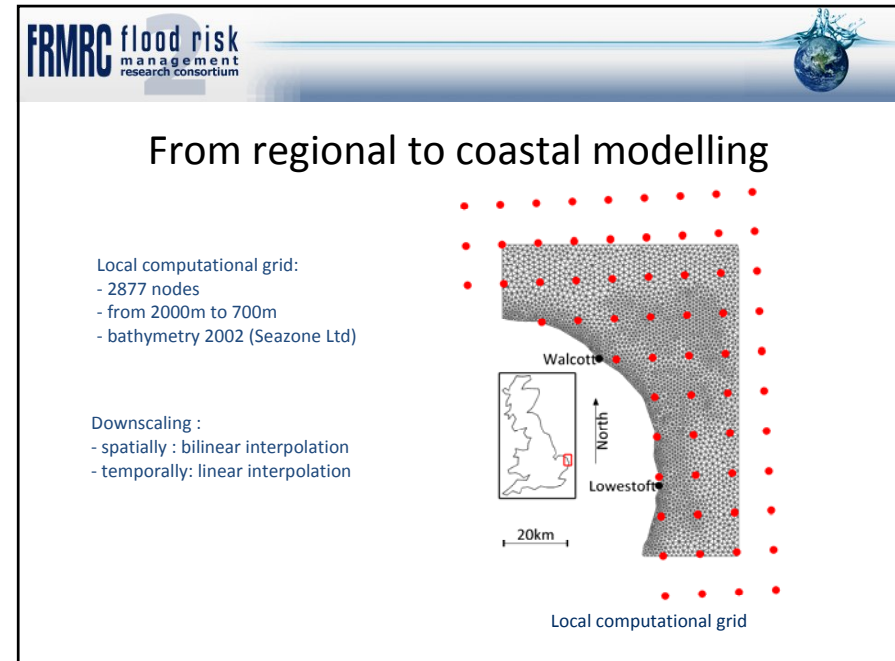
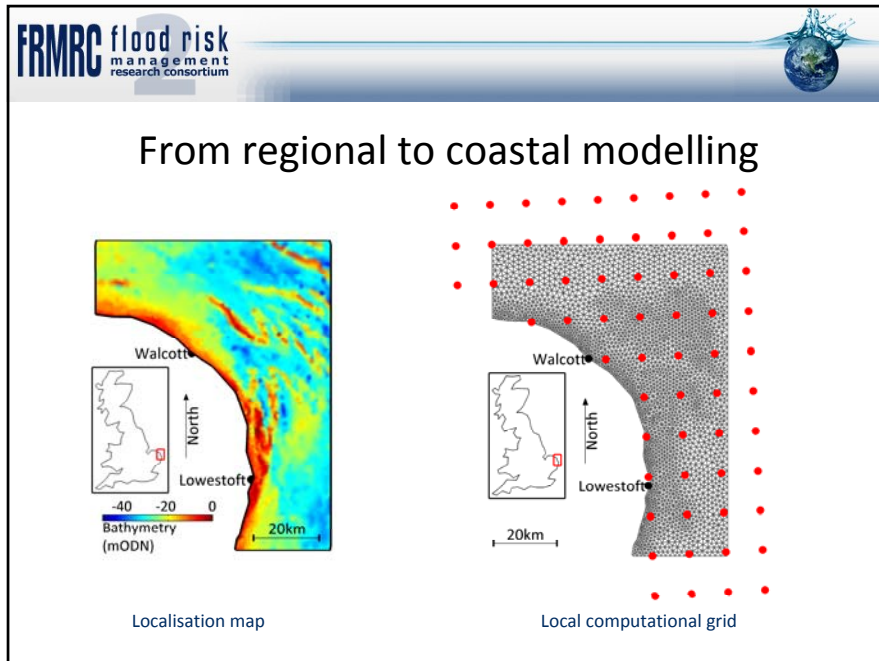
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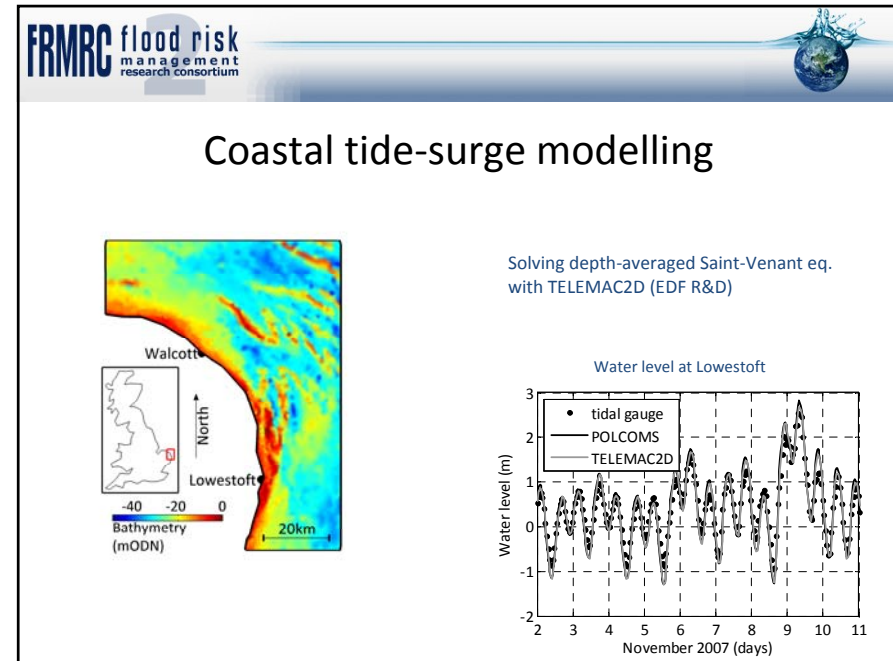
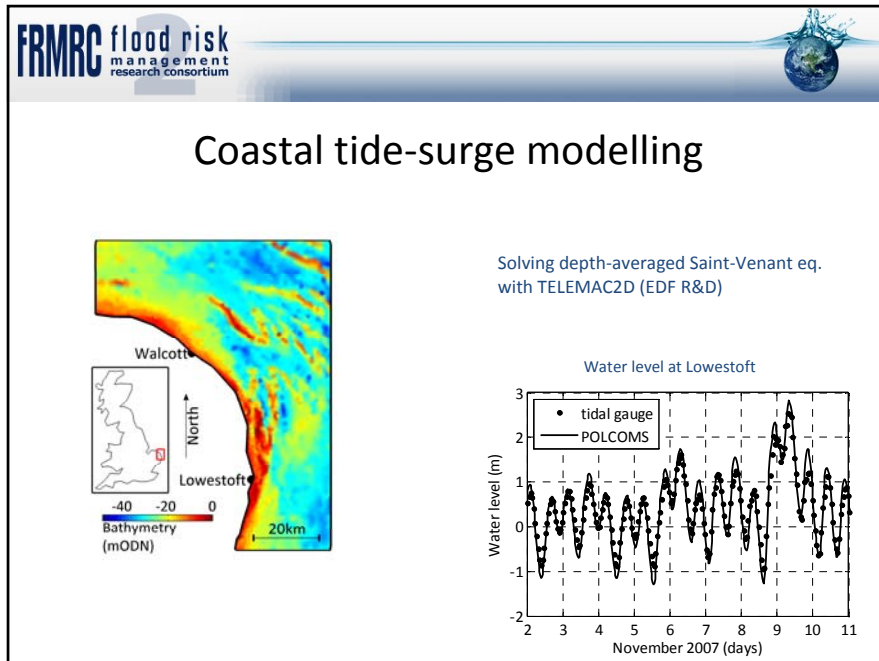
Context and Motivations

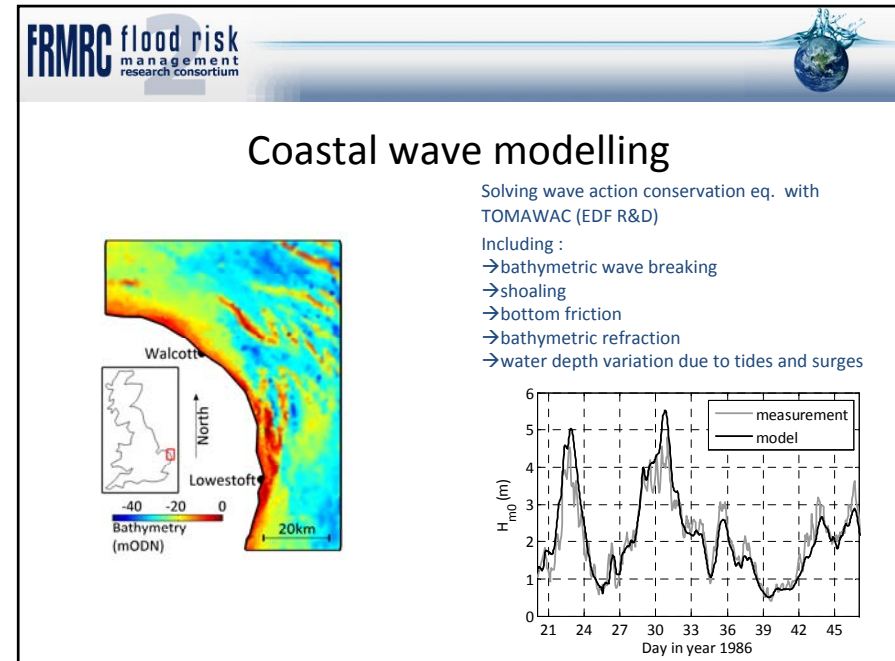
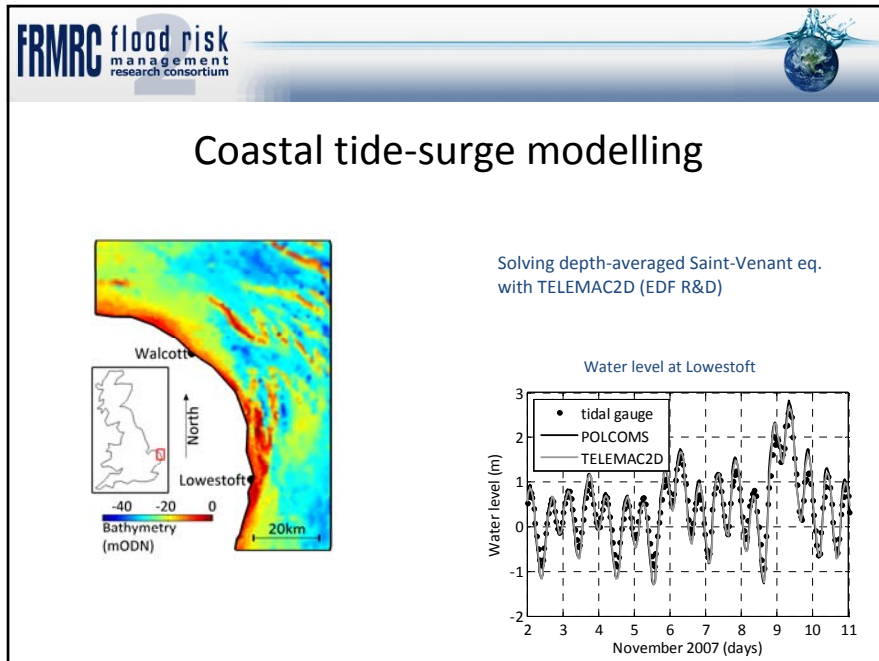


→ How to predict nearshore conditions from offshore operational modelling systems
→ Will sea level rise (SLR) and climate change (CC) modify the occurrence of extremes?
→ How to deal with long term simulation (~100 years)?

1. Model description
2. Long term methodology
3. Historical hindcast and 2007 event hindcast
4. Nearshore extreme values analysis
5. Impact of SLR and CC on extreme values







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Long term coastal wave modelling

Transfer ~100 years of deep water waves conditions towards the shoreline → Creation of a look-up table of simulations for discrete offshore wave conditions (hs, tp, dir) and local water elevations.

Methodology:

1. Creation of the look-up table : simulations of regularly distributed offshore wave conditions and water levels (24000 runs) $\Delta = (\Delta H_{m0}, \Delta T_p, \Delta \theta_m, \Delta Z)$
2. For any offshore conditions, localisation within the look-up table: $\delta_i = |X - X_0(i)| \leq \Delta$
3. Linear interpolation scheme: $x = \sum_{j=1} W_j x_0(j)$

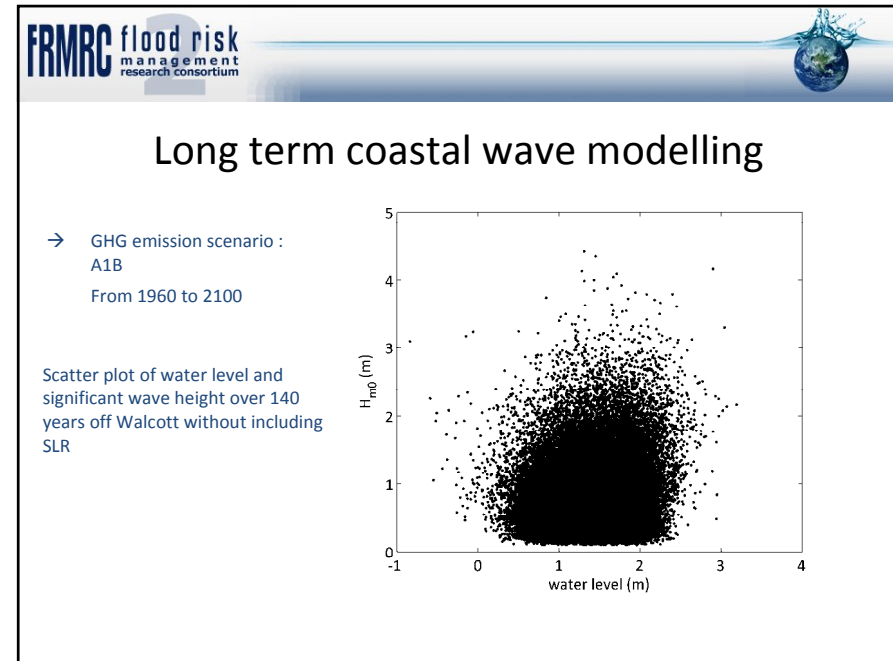
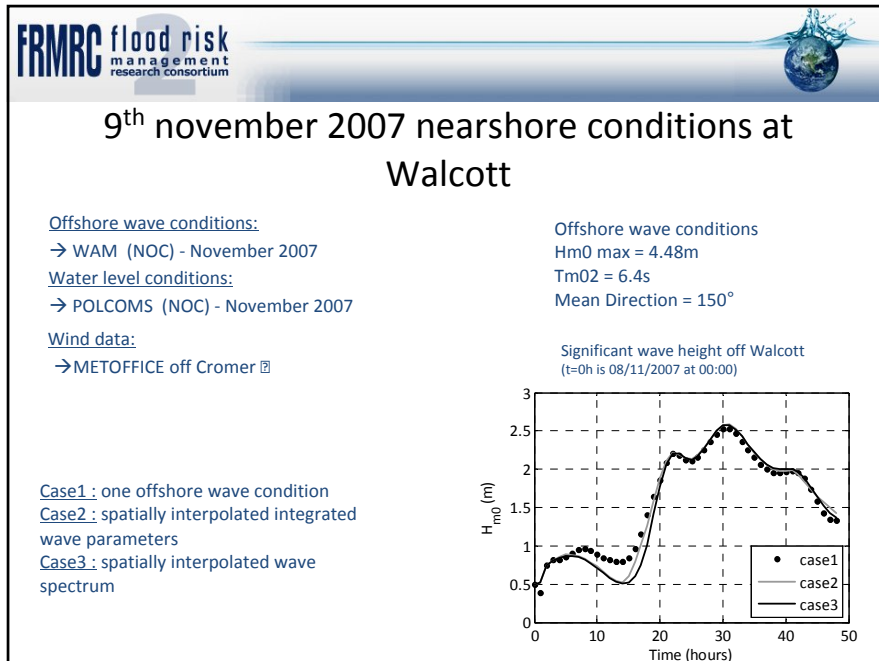
$$W_j = \frac{\alpha_j^{-1}}{\sum_{j=1}^{16} \alpha_j^{-1}} \quad \alpha_j = \prod_{i=1}^4 \left(1 - \frac{\delta_j(i)}{\Delta(i)} \right)$$

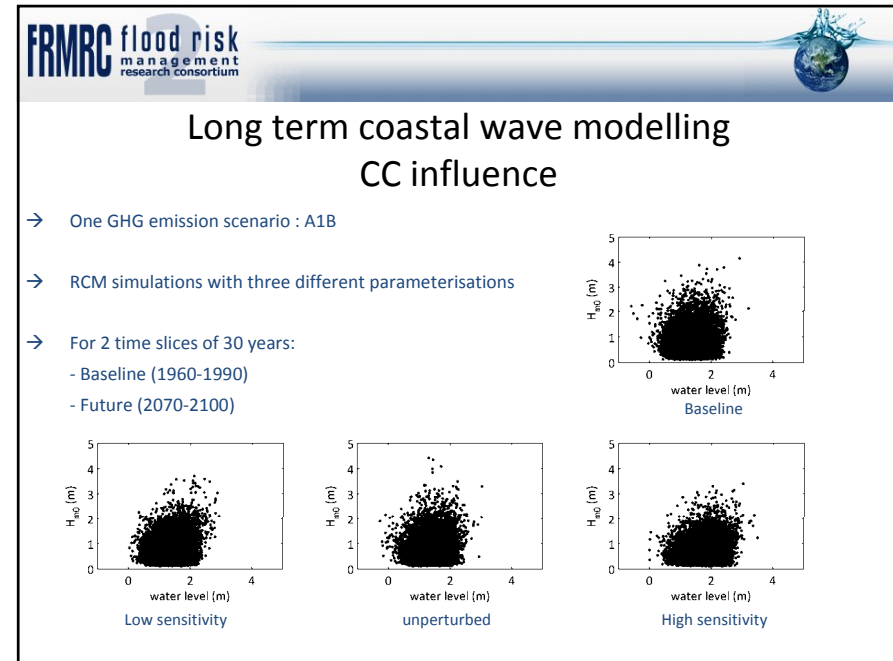
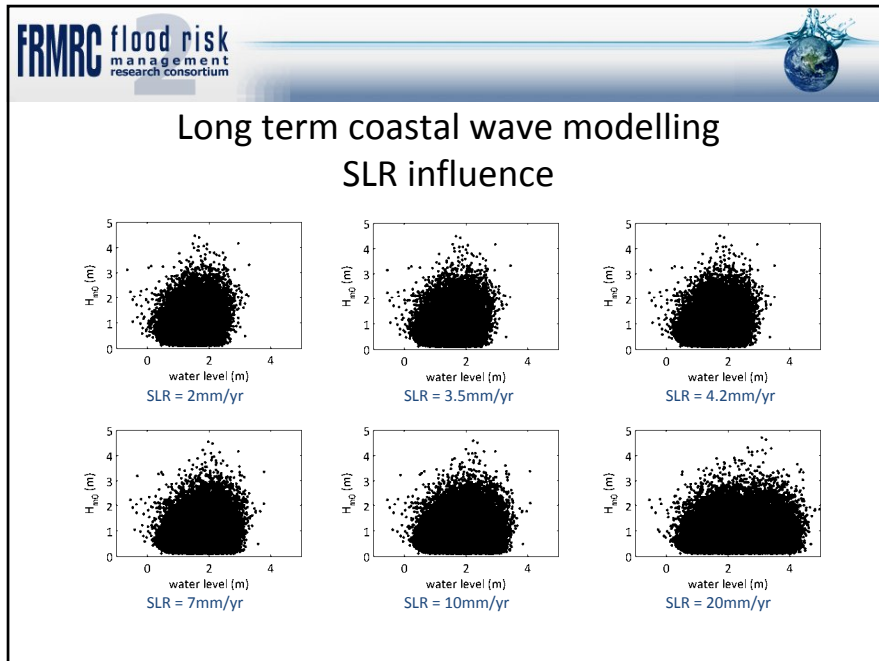
Significant wave height off Walcott (water depth 14m)

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Historical hindcast

→ Profiles from Strategic surveys (EA)
→ Offshore wave conditions from CETMEF (1979-2002)





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Extreme value analyses for nearshore conditions

- Analysis requests long term temporal series and invalid for future predictions
- The framework is run from 1960 to 2100 to estimate nearshore water levels and waves heights off Walcott
- Fit of GEV distribution to 10-largest annual maxima

$$F(x; \mu, \sigma, \xi) = \exp \left[- \left[1 + \xi \left(\frac{x - \mu}{\sigma} \right)^{-1/\xi} \right] \right]$$

- linear trends test on μ

$$\mu = \mu_0 + \mu_1 t$$

- Estimation of return periods and return levels

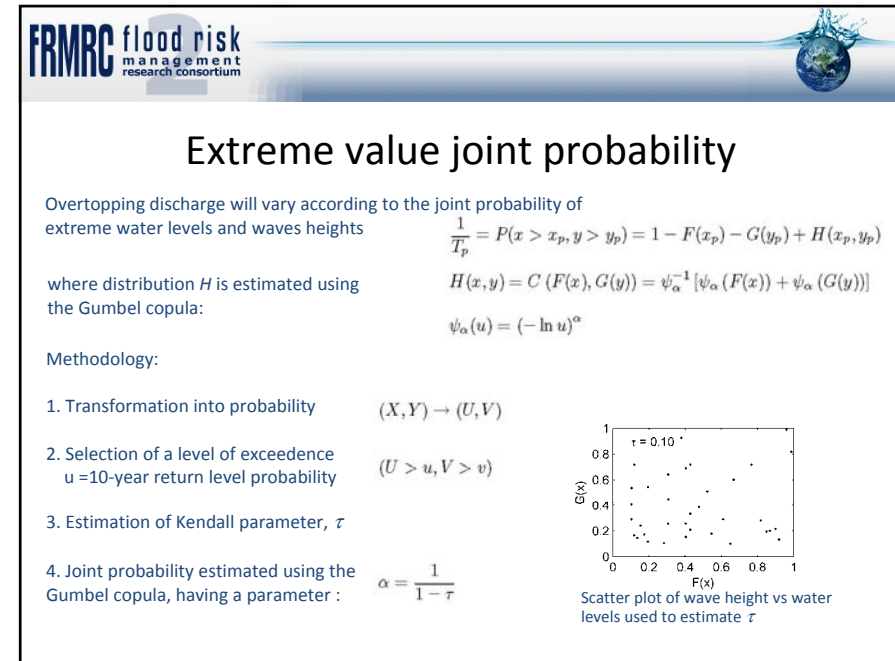
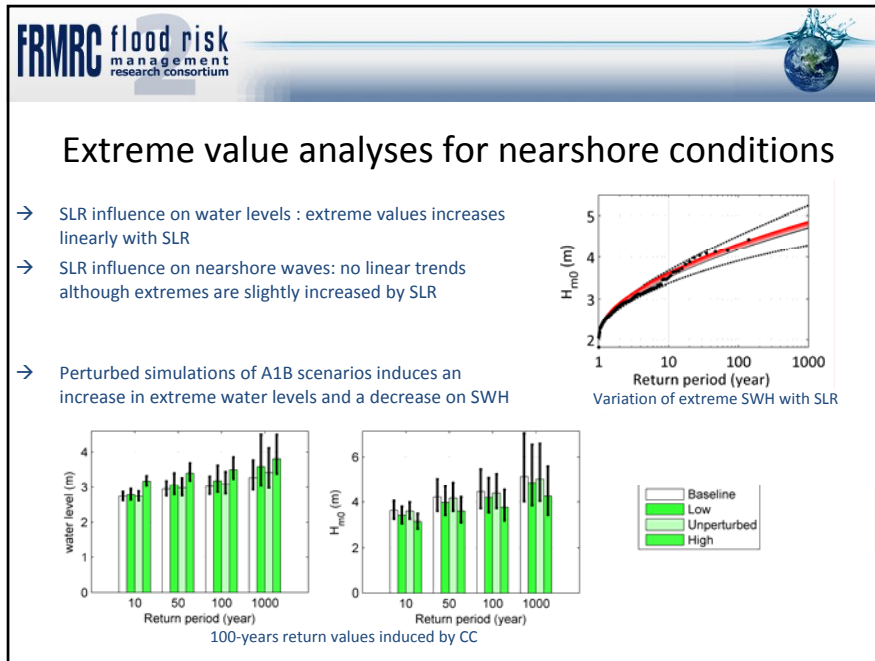
$$\frac{1}{T_p} = P(x > x_p) = 1 - F(x_p)$$

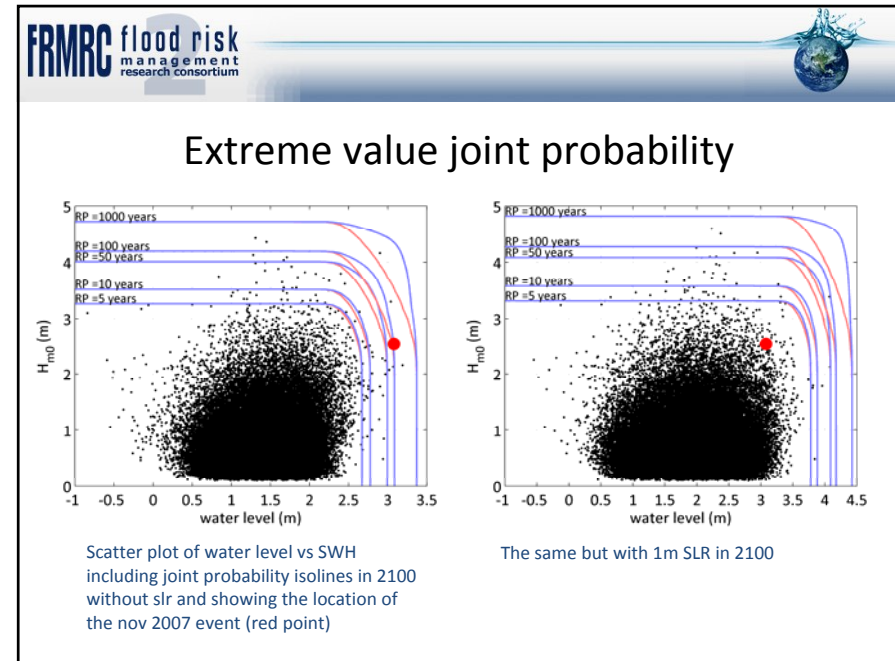
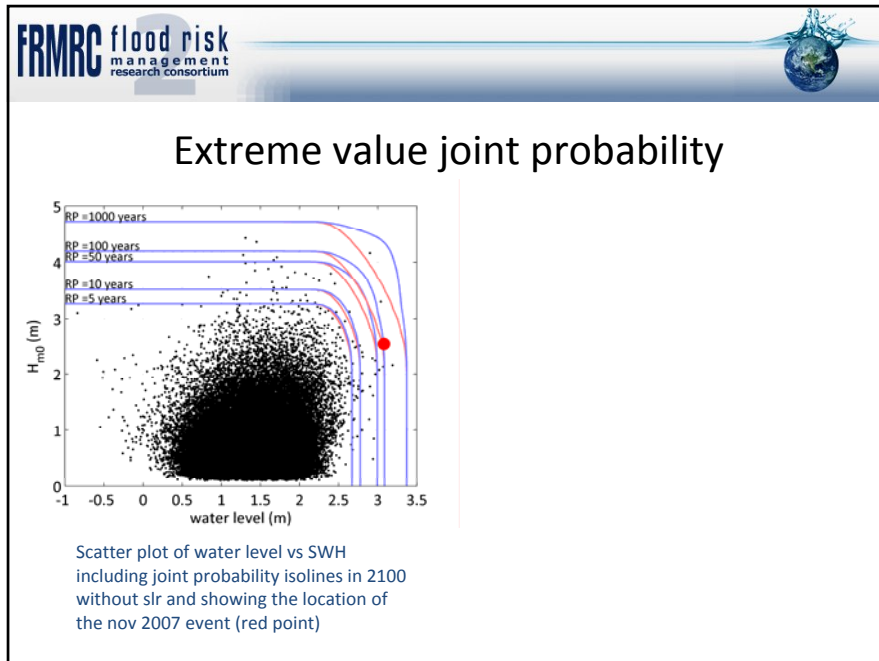
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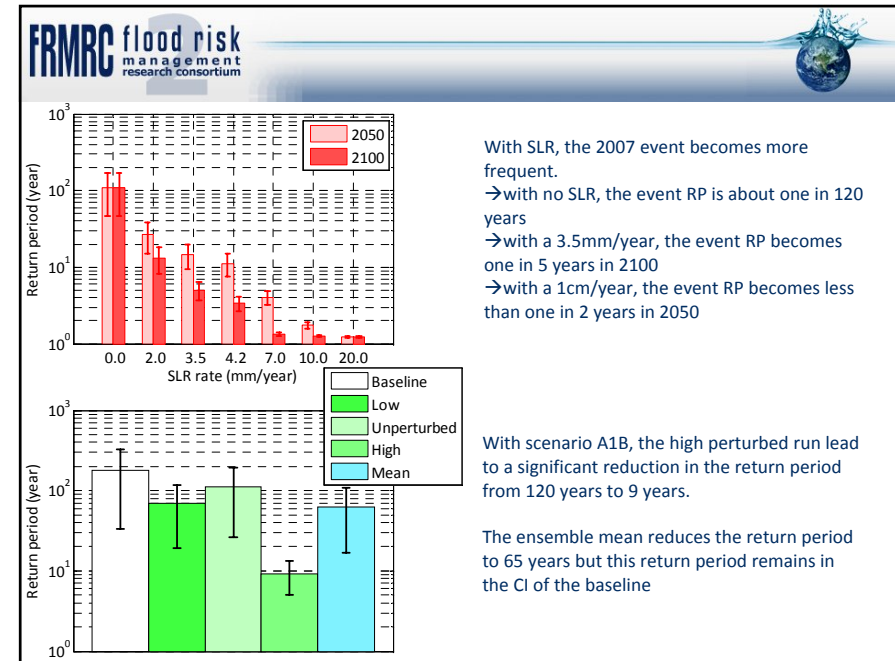
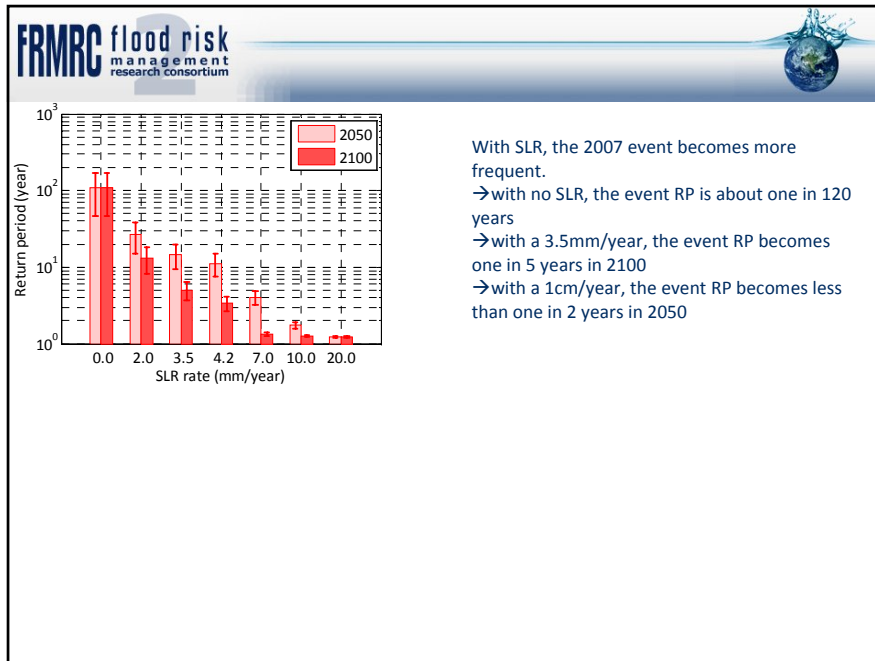
Extreme value analyses for nearshore conditions


- SLR influence on water levels : extreme values increases linearly with SLR
- SLR influence on nearshore waves: no linear trends although extremes are slightly increased by SLR

Variation of extreme SWH with SLR









Conclusions

- A model has been set up and validated to transfer wave parameters towards the shore including the effect of varying water depth, with a reasonable computational time.
- Regional modelling of water levels is sufficient for predicting nearshore conditions
- Assessment of climate change scenarios and SLR impacts on nearshore wave conditions
- Simulation of the nearshore conditions of 2007 event at Walcott → inputs for overtopping modelling



Acknowledgement

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