The role of emission scenarios and Antarctica in 21st century extreme water level changes

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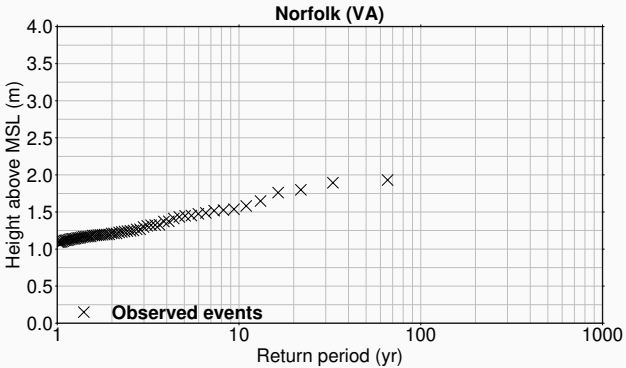
Future changes in coastal Extreme Water Level (EWL) events

- Sea-level rise will cause changes in the occurrence of EWL events
- Estimates of EWL changes important for decision makers
- However, contribution from the Antarctic Ice Sheet poorly constrained
- What is the role of emissions (i.e. RCP scenarios) and the Antarctic Ice Sheet for future changes in EWL events?

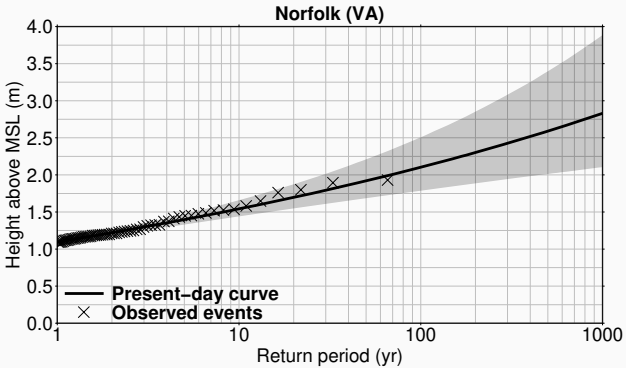
Sea-level rise and extreme water levels



Tide-gauge data: GESLA2, Woodworth et al., 2017

- Return curve: How often do we expect a specific water level?

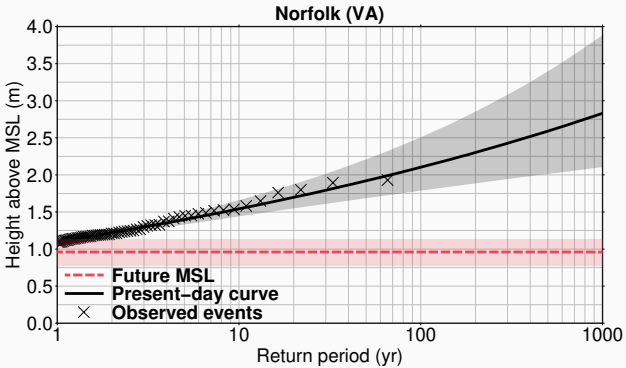
Sea-level rise and extreme water levels



Tide-gauge data: GESLA2, Woodworth et al., 2017

- Return curve: How often do we expect a specific water level?
- Estimate extreme-value distribution (here: GPD) from EWL observations

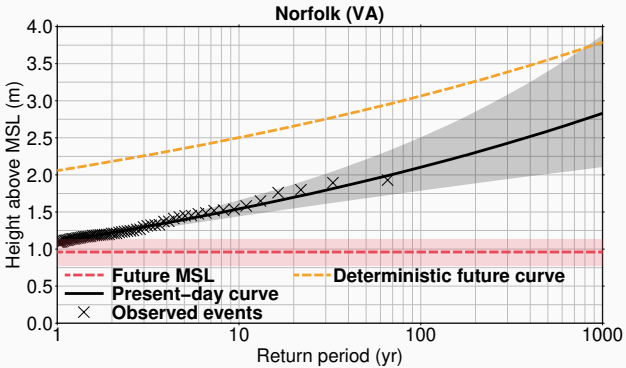
Sea-level rise and extreme water levels



Tide-gauge data: GESLA2, Woodworth et al., 2017

- What happens if mean sea level changes?

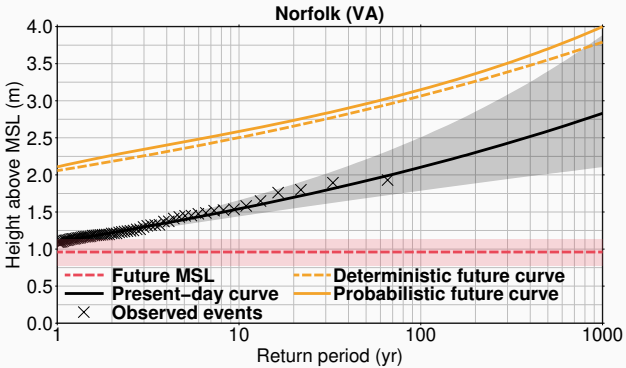
Sea-level rise and extreme water levels



Tide-gauge data: GESLA2, Woodworth et al., 2017

- Return curve: How often do we expect EWL?
- MSL change shifts return curve

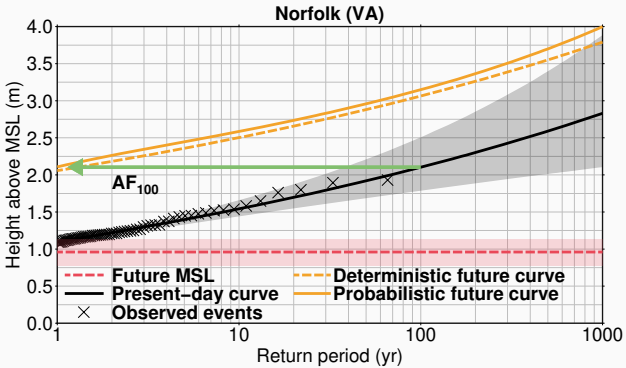
Sea-level rise and extreme water levels



Tide-gauge data: GESLA2, Woodworth et al., 2017

- Return curve: How often do we expect EWL?
- Compute heights for which *expected* return frequency stays constant

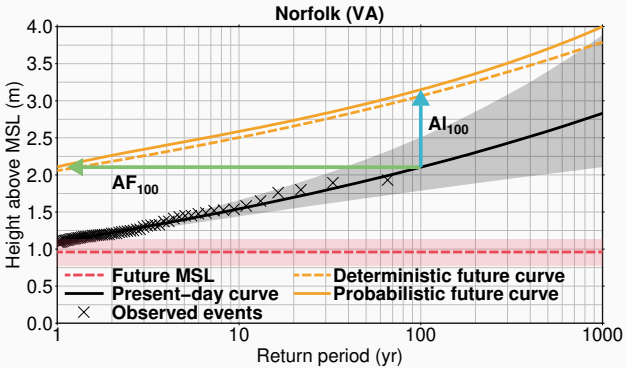
Sea-level rise and extreme water levels



Tide-gauge data: GESLA2, Woodworth et al., 2017

- Amplification factor (AF_{100}): The increase in expected frequency of present-day once-in-100-year events
- Indicator for 'What if we do nothing?'

Sea-level rise and extreme water levels

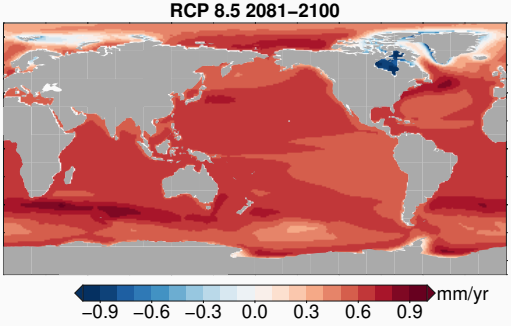


Tide-gauge data: GESLA2, Woodworth et al., 2017

- Allowance (AI_{100}): The extra height above present needed to preserve exceedance frequency
- Indicator for 'What should we do to stay safe?'

MSL changes: RCP scenarios versus AIS contribution

- Add IPCC AR5 scenario with custom AIS contribution



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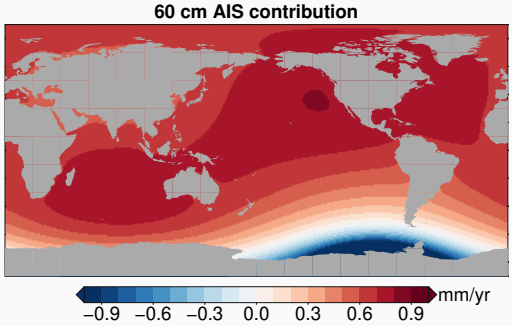
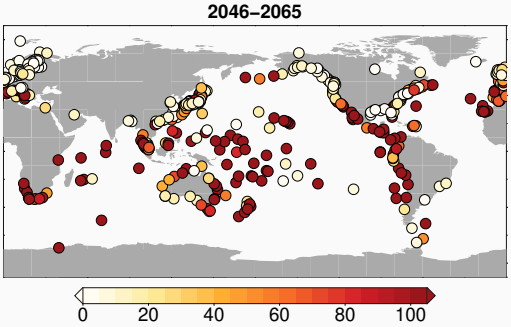
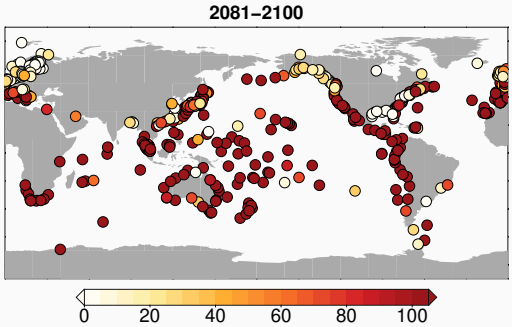


IPCC AR5, Data from ICDC

The most optimistic scenario: low emissions, no AIS contribution

- No AIS contribution, RCP2.6

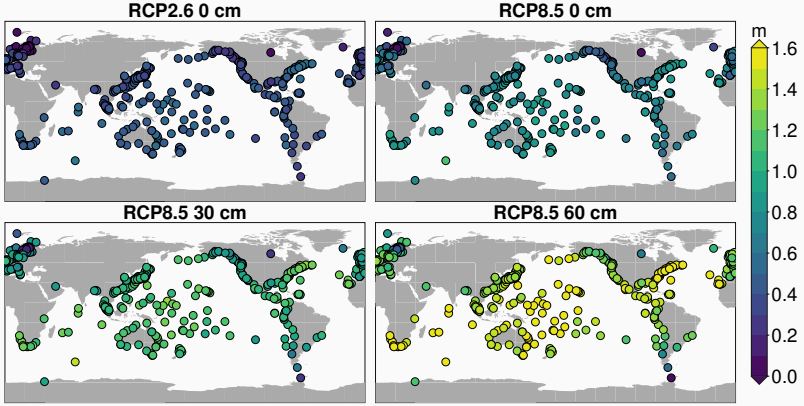




IPCC AR5, Data from ICDC

- Even in most optimistic scenario, many locations will face present-day 1-in-100 year event annually or more

Allowances and the AIS contribution



Tropics require largest allowances

Emission scenarios and AIS have similar impact on allowances

Conclusions

- We computed changes in coastal EWL events resulting from MSL changes
- Even for optimistic scenarios, many places face an amplification factor of 100 or more
- For many tropical islands, large amplification factors already halfway 21st century
- Allowances depend as strong on AIS contribution as on emission scenario
- Again, tropics see above-average allowances