



Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Infrastructuur en Milieu



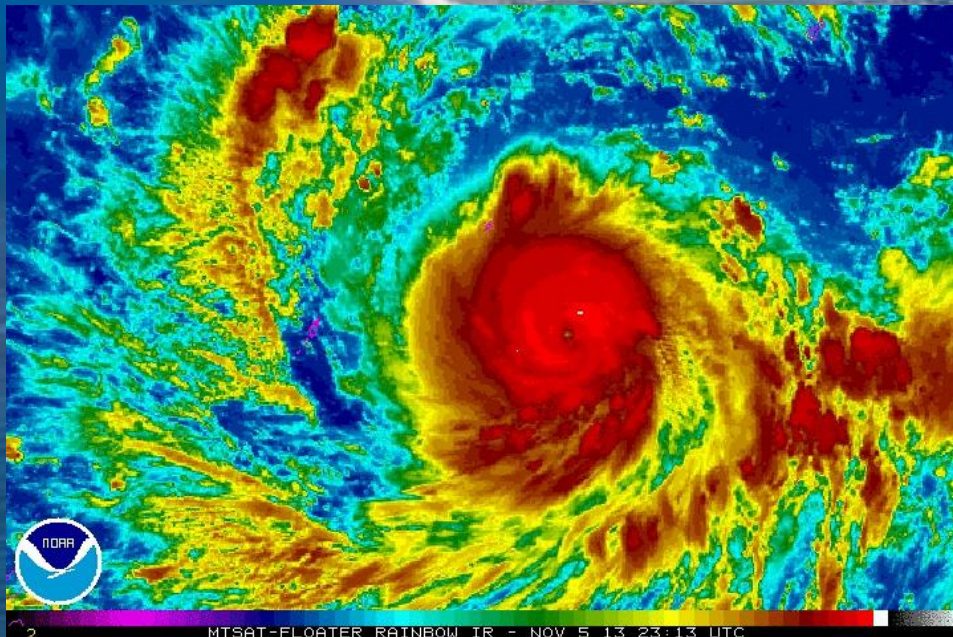
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KNMI '14

klimaatscenario's
voor Nederland

Scenarios of future weather

Bart van den Hurk
KNMI/VU

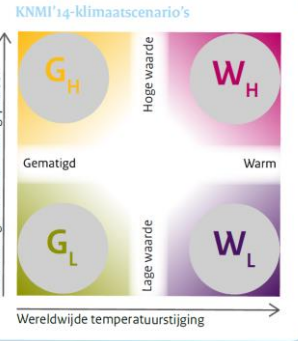
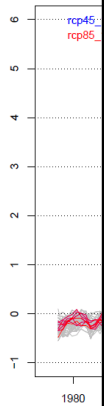


Climate scenarios as developed at KNMI

- A collection of

ensemble of climate projections

But a lot of **essential information** on weather, disasters, predictability, compounding effects is hidden



Scenario	Scenario change values for the climate around 2050*				Scenario change values for the climate around 2085*				Natural greenhouse forcing over 10years**
	G _L	G _H	W _L	W _H	G _L	G _H	W _L	W _H	
Low value	High value	Low value	High value	Low value	High value	Low value	High value		
4.15 to +4.00 cm	+15 to +10 cm	+20 to +10 cm	+20 to +10 cm	+20 to +10 cm	+25 to +10 cm	+25 to +10 cm	+45 to +10 cm	+45 to +10 cm	+1.6 (0.1)
+15 to +5.5 mm/year	+15 to +5.5 mm/year	+15 to +5.5 mm/year	+15 to +5.5 mm/year	+15 to +5.5 mm/year	+15 to +5.5 mm/year	+15 to +5.5 mm/year	+15 to +5.5 mm/year	+15 to +5.5 mm/year	+1.8 mm/year
+0.8%	+2.5%	+3.5%	+5.5%	+5%	+7%	+8%	+12%	+14%	+1.4%
+0.8%	+1.0%	+0.8%	+2.2%	+2.5%	+3.5%	+1.5%	+2.8%	+1.4%	+1.6%
+7%	+8%	+8%	+7%	+2.5%	+3.5%	+4%	+10%	+10%	+1.9%
-100 mm	-100 mm	-100 mm	-100 mm	-100 mm	-100 mm	-100 mm	-100 mm	-100 mm	+1.0 (0.1)
-0%	-10%	-10%	-20%	-10%	-10%	-10%	-10%	-10%	-1.0 (0.1)
+1.1°C	+1.6°C	+2.0°C	+2.5°C	+1.9°C	+2.4°C	+2.8°C	+3.3°C	+3.8°C	+0.6 (0.2)
+1.1°C	+1.7°C	+2.2°C	+2.8°C	+1.8°C	+2.3°C	+2.8°C	+3.3°C	+3.8°C	+0.5 (0.2)
+0.0°C	+0.6°C	+0.9°C	+1.5°C	+0.7°C	+1.2°C	+1.6°C	+2.1°C	+2.6°C	+0.0 (0.0)
+0.4°C	+0.8°C	+1.2°C	+1.7°C	+1.0°C	+1.2°C	+2.4°C	+3.1°C	+3.8°C	+0.4 (0.2)
-10%	-8%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	+0.9%
-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	+0.9%
-1%	-8%	-8%	-17%	+1.0%	+1.0%	+1.0%	+1.0%	+1.0%	+0.8%
-1.5%	-10%	-10%	-17%	+0.5%	+0.5%	+0.5%	+0.5%	+0.5%	+0.7%
-1%	-1.6%	-1%	-1%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	+0.8%
-1.4%	-1%	-1%	-1%	+1.5%	+1.5%	+1.5%	+1.5%	+1.5%	+1.6%
+0.9°C	+1.1°C	+1.8°C	+1.5°C	+1.1°C	+1.1°C	+2.4°C	+3.1°C	+3.8°C	+0.6 (0.2)
+0.5%	+2.7%	+3.7%	+5%	+0%	+1.7%	+1.7%	+1.7%	+1.7%	+0.9%
+1.0°C	+1.4%	+1.9%	+2.4%	+1.2°C	+1.2°C	+2.2°C	+2.7°C	+3.2°C	+0.5 (0.2)
+1.5%	+2.5%	+3%	+3.5%	+0%	+0%	+0%	+0%	+0%	-1.0 (0.1)
+0.0°C	+1.4%	+1.9%	+2.4%	+1.0°C	+1.0°C	+2.0°C	+2.5°C	+3.0°C	+0.8 (0.3)
+1.1°C	+1.3°C	+1.9°C	+2.2°C	+1.2°C	+1.2°C	+2.2°C	+2.7°C	+3.2°C	+0.1 (0.1)
+0.0°C	+1.1°C	+1.6°C	+2.0°C	+1.0°C	+1.0°C	+2.0°C	+2.5°C	+3.0°C	+0.0 (0.0)
+1.6°C	+1.9%	+2.3%	+2.6%	+1.3%	+1.3%	+2.3%	+2.8%	+3.3%	+0.5 (0.2)
+2.2%	+3.0%	+3.8%	+4.6%	+2.0%	+2.0%	+3.0%	+3.8%	+4.6%	+1.0 (0.4)
+0.1%	+0.9%	+1.6%	+2.3%	+0.9%	+0.9%	+1.9%	+2.6%	+3.3%	+0.7 (0.3)
+1.2%	+0%	+1.6%	+1.9%	+1.0%	+0%	+1.0%	+1.3%	+1.6%	+0.9%
+2.1 to +10%	+2.1 to +10%	+1.6 to 17%	+1.6 to 17%	+1.6 to 17%	+1.6 to 17%	+2.1 to 10%	+2.1 to 10%	+2.1 to 10%	-1.0 (0.4)
+1.7 to +10%	+2.0 to +10%	+1.3 to +20%	+1.3 to +20%	+2.0 to +10%	+2.0 to +10%	+2.0 to +10%	+2.0 to +10%	+2.0 to +10%	+1.0%
+5.0 to +17%	+7 to +10%	+12 to +20%	+12 to +20%	+8 to +10%	+8 to +10%	+10 to +10%	+10 to +10%	+10 to +10%	+1.6%
+0.2%	+0.5%	+0.7%	+0.7%	+0.2%	+0.2%	+0.2%	+0.2%	+0.2%	+0.4 (0.1)
+4.0 to +10%	+4.5 to +10%	+6 to +10%	+6 to +10%	+3.0 to +10%	+3.0 to +10%	+3.0 to +10%	+3.0 to +10%	+3.0 to +10%	+2.0%
+2.1%	+0%	+0%	+0%	+0.5%	+0.5%	+0.5%	+0.5%	+0.5%	+0.8 (0.3)
-0.6%	-2.0%	-0.1%	-1.5%	-1.0%	-2.0%	-0.6%	-0.6%	-0.6%	+0.9 (0.4)
+4%	+7%	+8%	+8%	+1%	+1%	+1%	+1%	+1%	+1.0 (0.4)
+4.5%	+10%	+10%	+10%	+10%	+10%	+10%	+10%	+10%	+1.1%
-1%	+1.7%	+2.5%	+2.5%	+2.5%	+2.5%	+1.7%	+1.7%	+1.7%	+0.9%
+1.1%	+1.5%	+1.9%	+1.9%	+1.5%	+1.5%	+1.5%	+1.5%	+1.5%	+0.2 (0.1)
+7%	+8%	+7%	+7.5%	+7.5%	+7.5%	+0%	+0%	+0%	+0.2 (0.1)

- A local interpretation of this summary

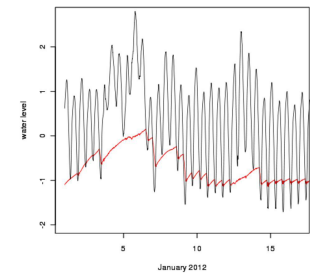
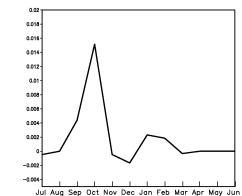
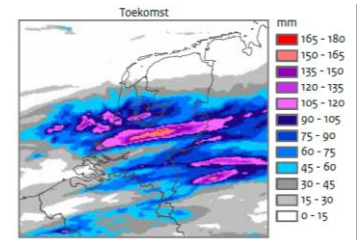
→ A framework supporting detailed risk analysis

- Used in e.g. Dutch Delta program & Adaptation strategy

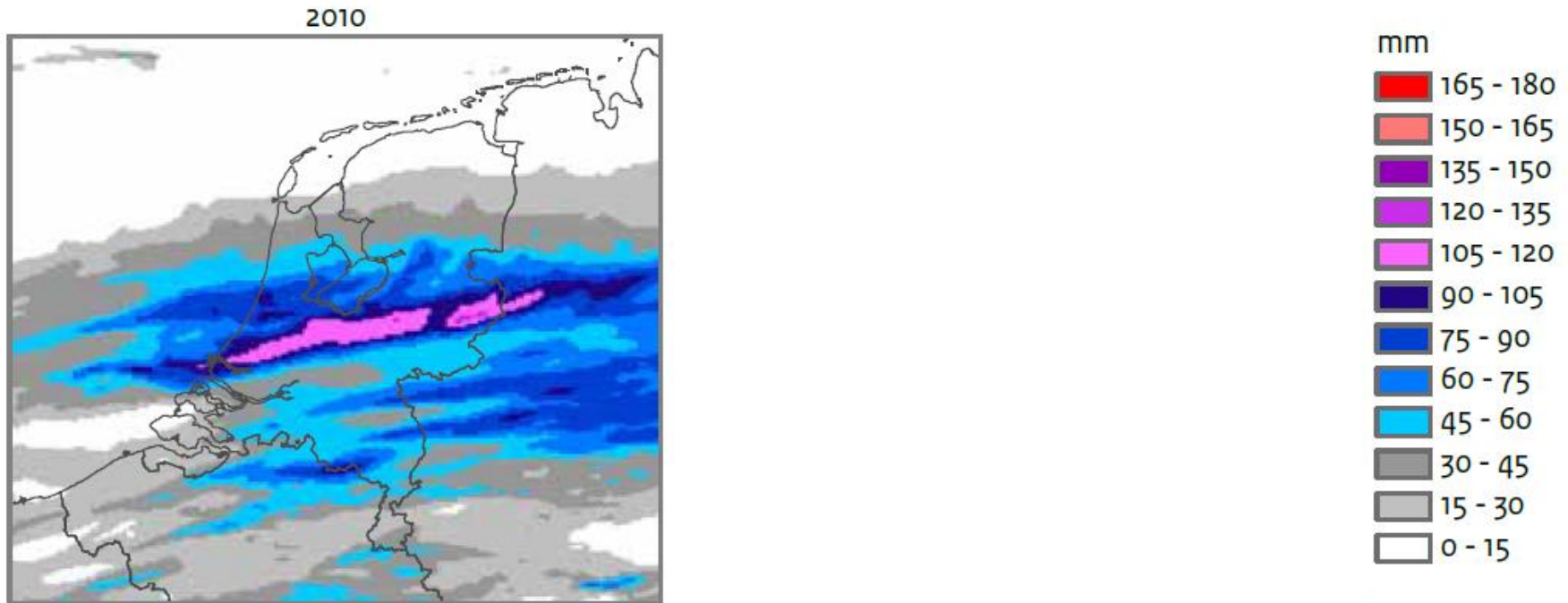


Alternative information frameworks

- Make explicit reference to **present day weather**
 - Attribution of events
 - Putting events in the context of a different (climate) setting
- Explore the **unresolved and unprecedented features** in a changing climate
 - e.g. by high resolution climate simulations
- Explicitly analyse statistics of **compounding events**
 - including features that are non-climatic
- Address predictability and **early warning actions**

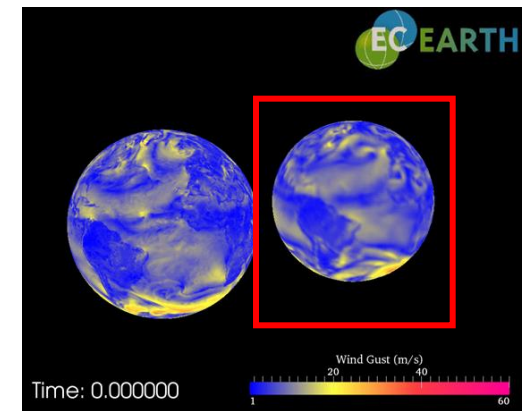
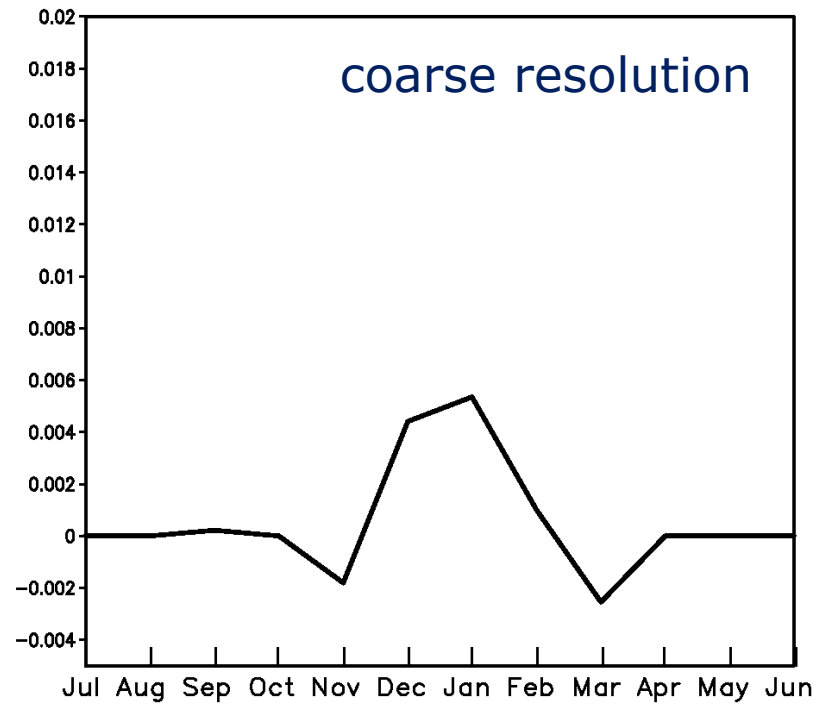


Extreme weather in a future climate (+2°C)



Simulating unprecedented events

Beaufort 11 or higher

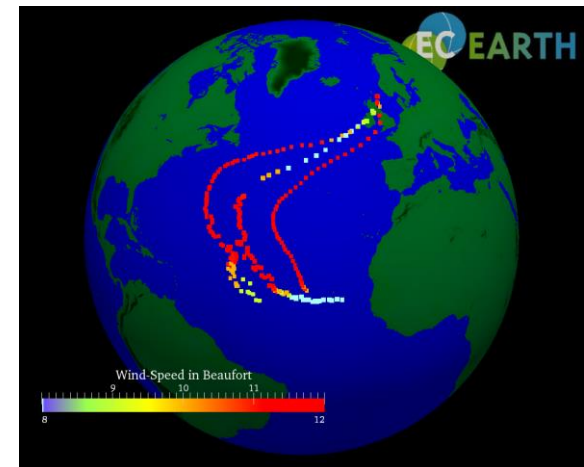
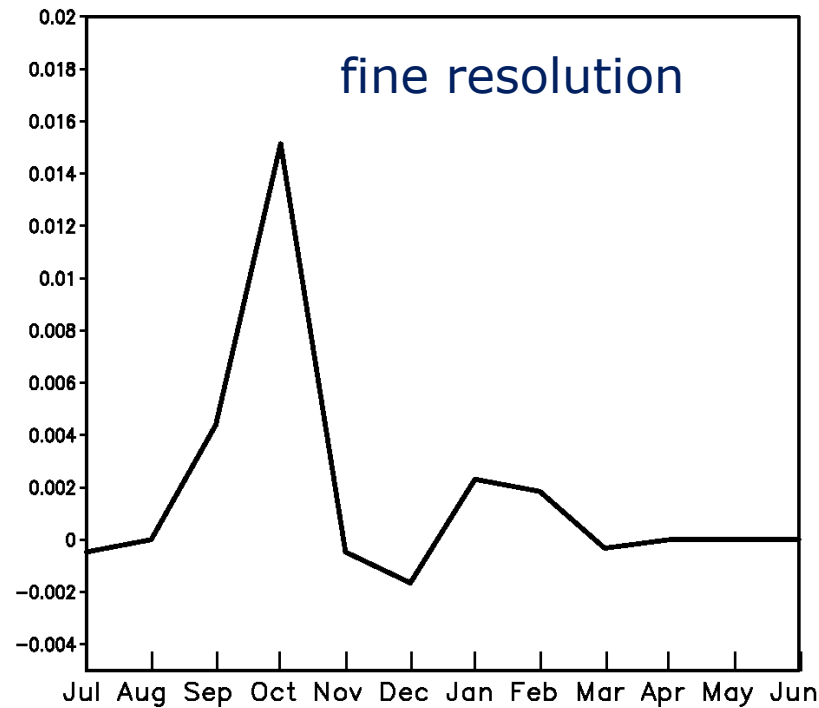


Difference 20th – 21st century



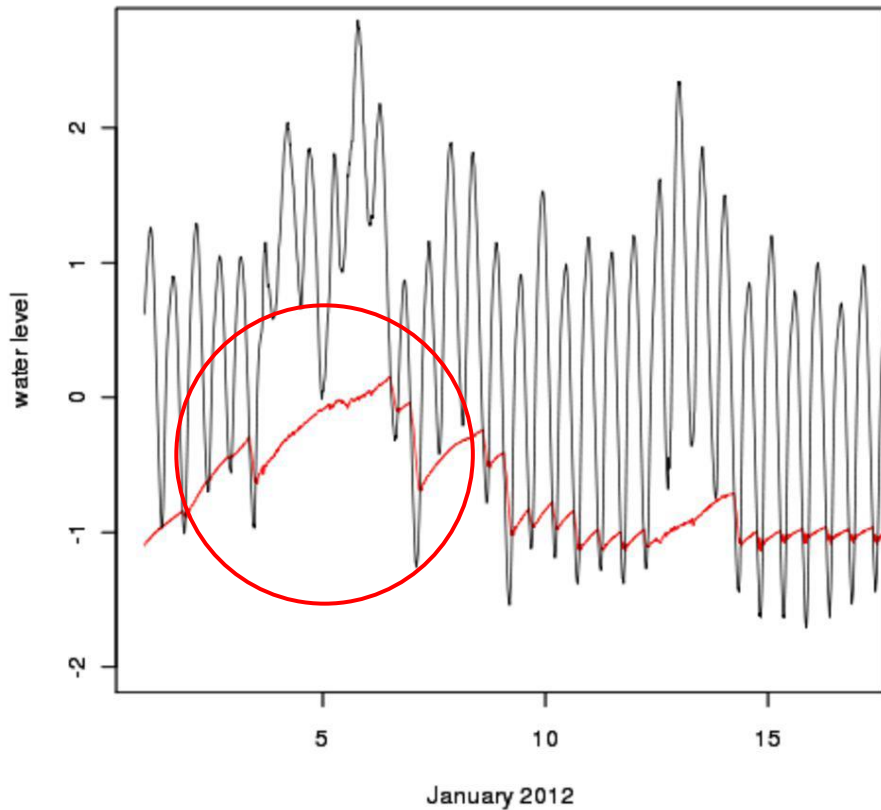
Simulating unprecedented events

Beaufort 11 or higher

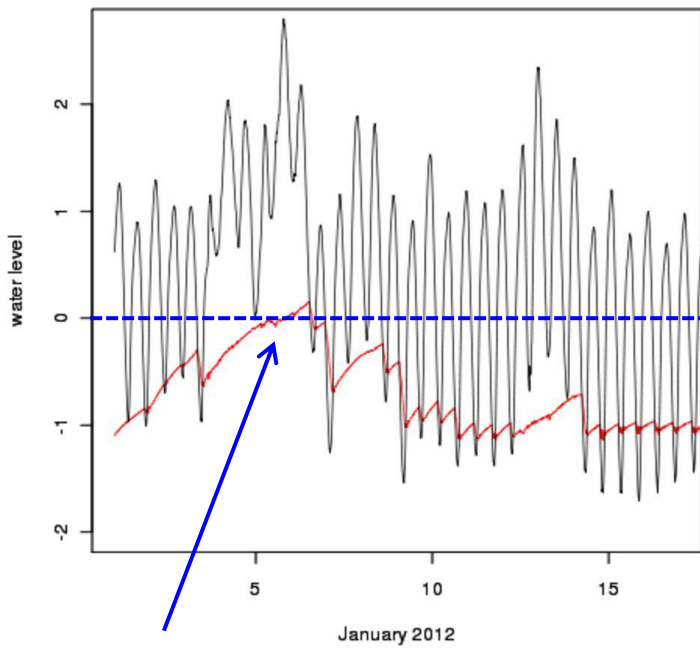


Difference 20th – 21st century

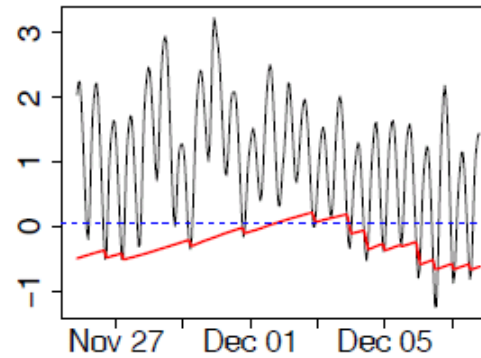
Near-flooding Jan 2012: Compounding events



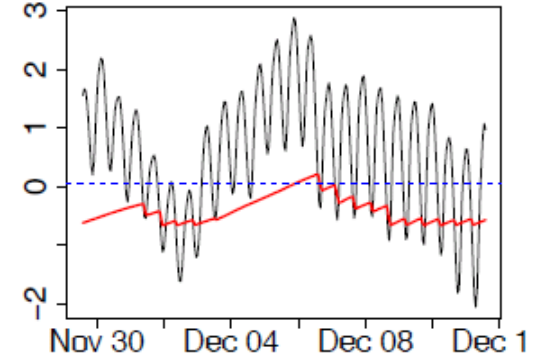
Realistic simulation of similar events



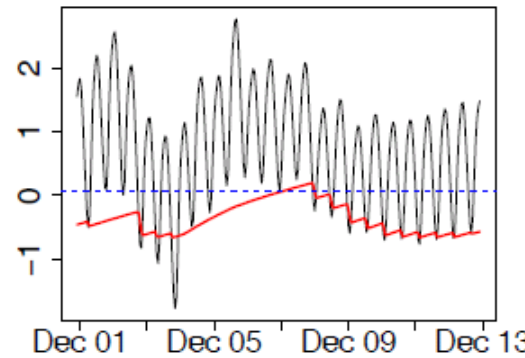
snapshot simulation 1



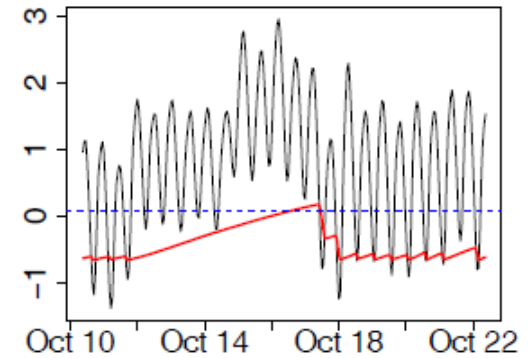
snapshot simulation 2



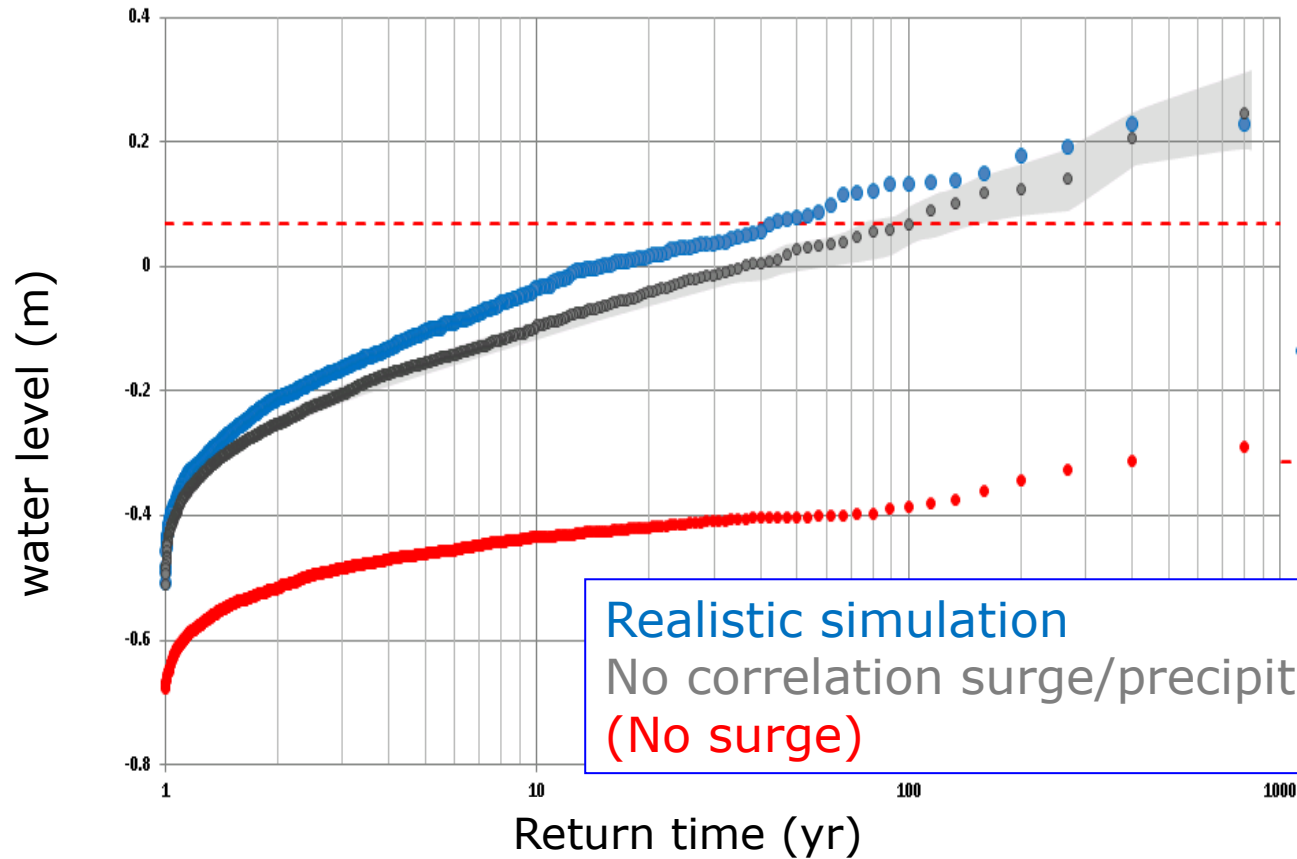
snapshot simulation 3



snapshot simulation 4



Local water level in Lauwersmeer



Realistic simulation
No correlation surge/precipitation
(No surge)



Key challenges

1. Adequate synthesis of a virtually infinite nr of possible futures
2. Framing single events as a relevant indicator of climate change
3. Utilizing local information to assess their operational value

