Università di Genova | DICCA DIPARTIMENTO DI INGEGNERIA CIVILE, CHIMICA E AMBIENTALE

Assessing Future Compound Flooding in Chiavari, Liguria

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meteocean.science

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Contextualization of the Problem

Coastal Vulnerability in the Mediterranean Sea is exacerbated by changes in climate forcing

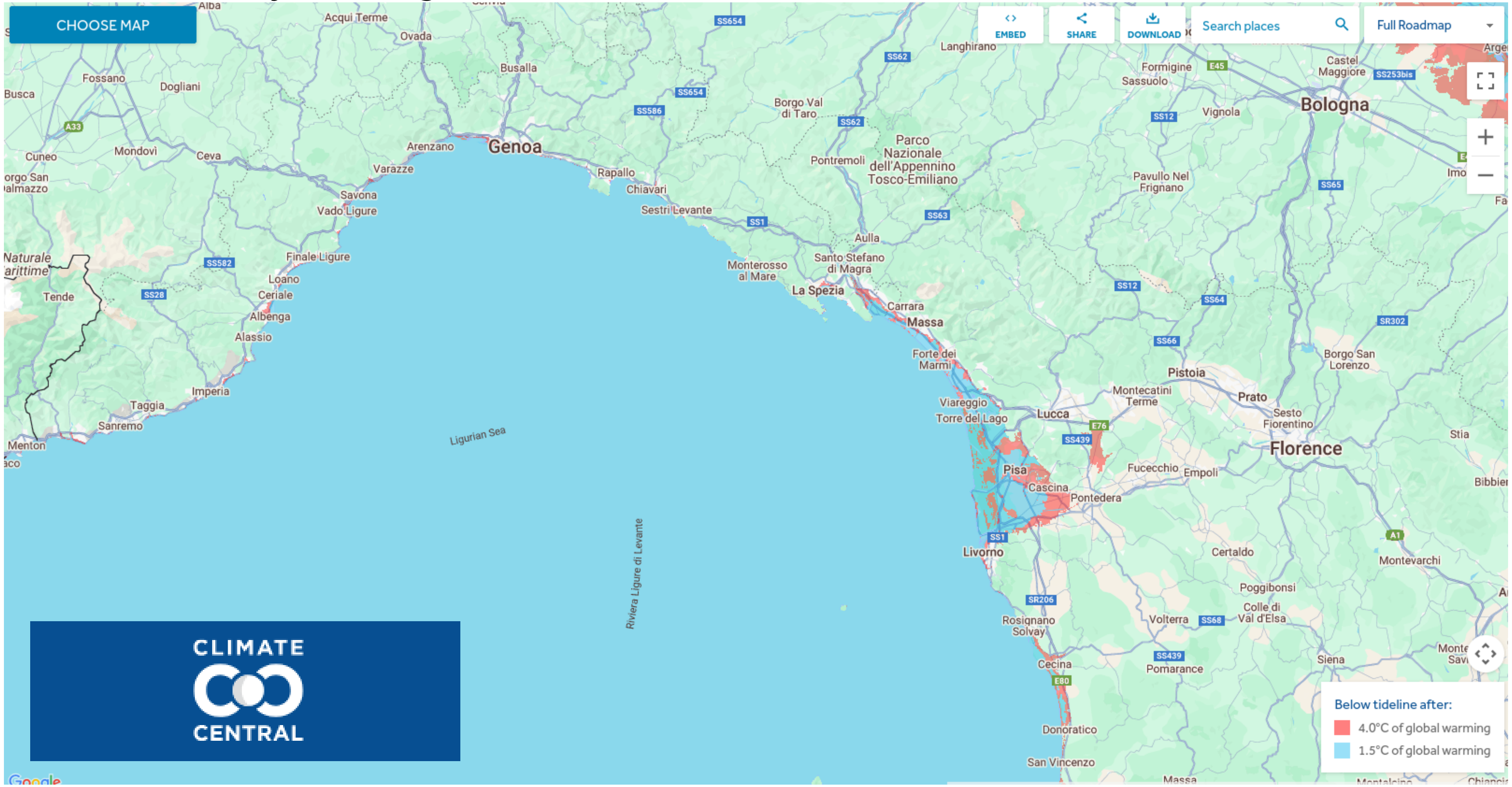
- Frequency of Storms
- Intensity of Storms
- Direction of Storms

Adrian/Vaia Storm 28/10/2018

Coastal Vulnerability

Coastal Vulnerability in the Mediterranean Sea is exacerbated by changes in climate forcing

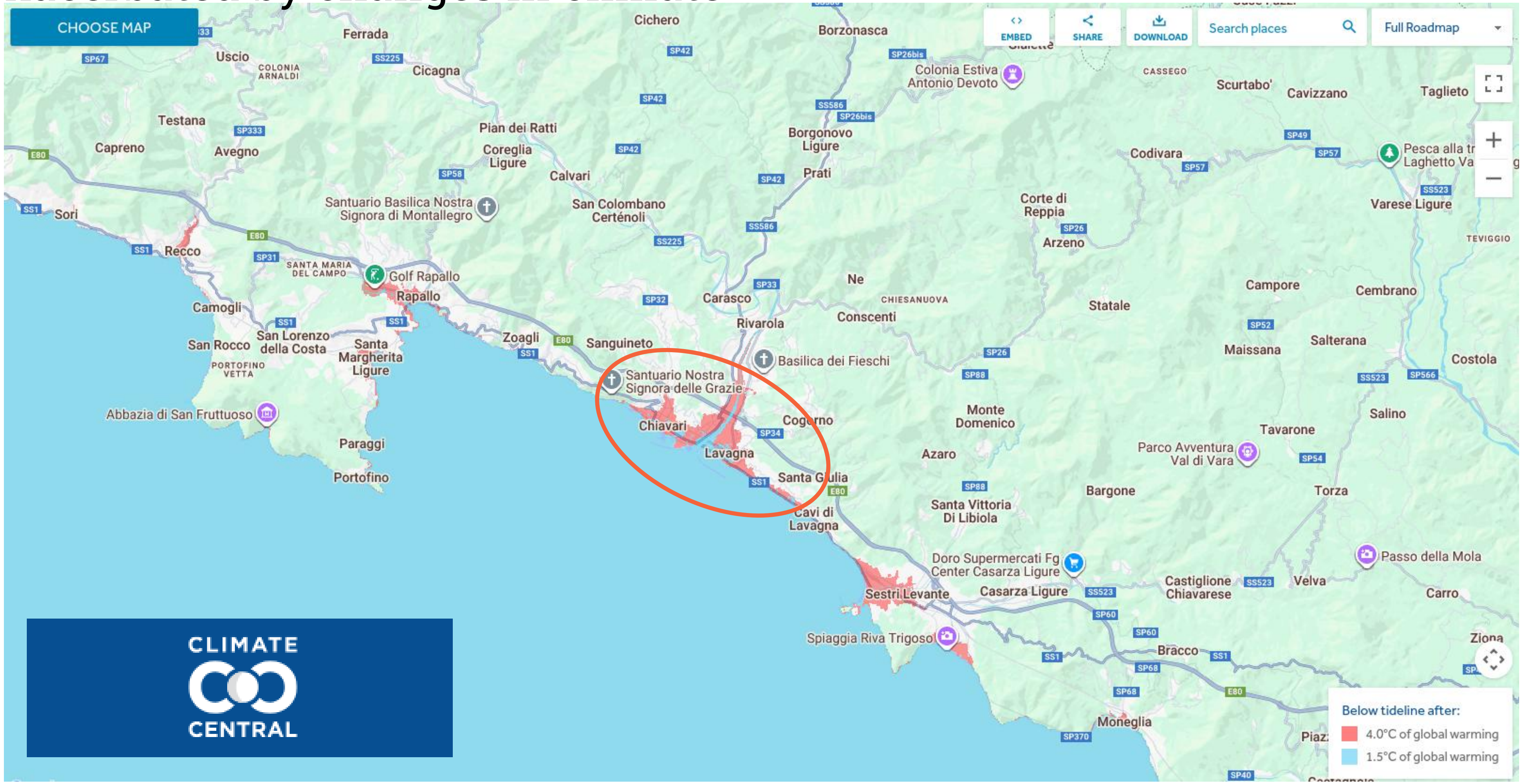
Storms adding up to SLR



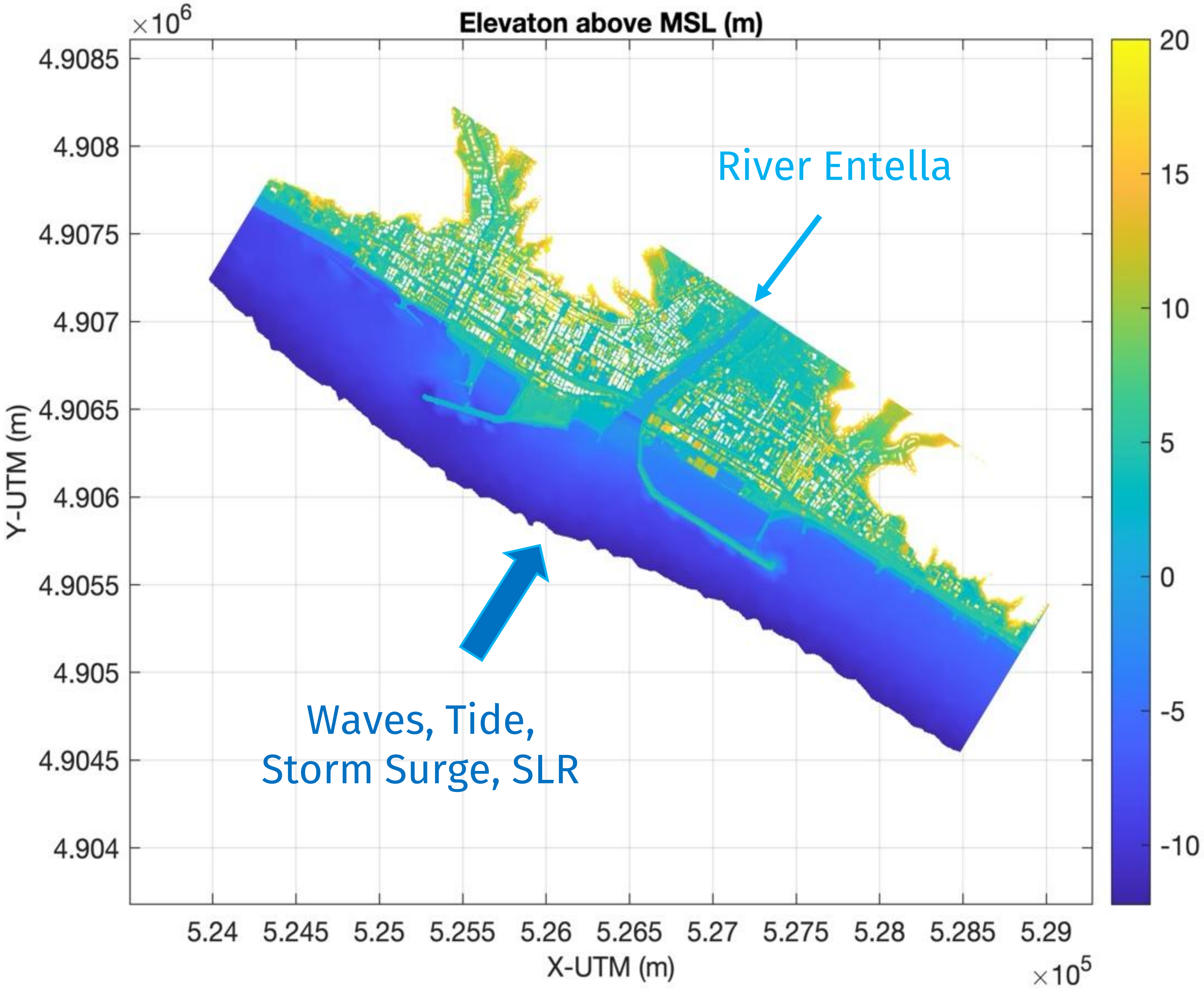
Coastal Vulnerability

Coastal Vulnerability in the Mediterranean Sea is exacerbated by changes in climate forcing

Storms adding up to SLR



Data and Methods



SFINCS Model setup

Grid resolution 5x5 m

Coastal structures modeled as weirds to assure equivalent overtopping conditions

Maximum surface elevation: 20 m

Maximum offshore water depth: 12 m

River discharge: distributed along upstream boundary cells

Digital Surface Model (1x1 res)

High Resolution Bathymetry

Data and Methods

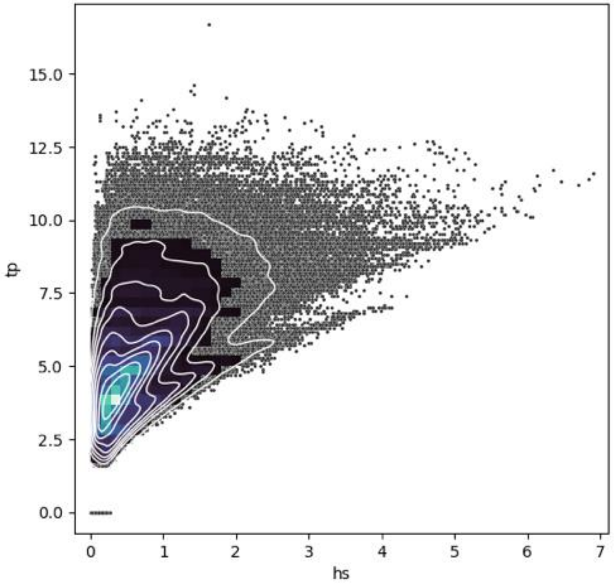
<u>Environmental Forcings</u>

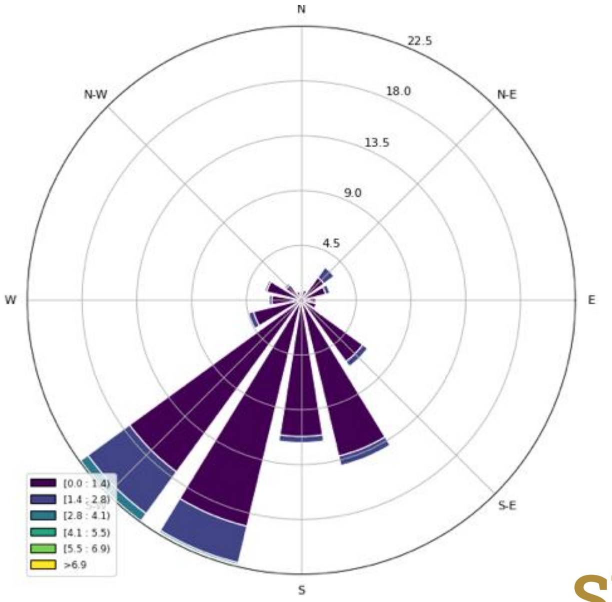
HISTORICAL

Sea Waves
DICCA Hindcast

Storm Surge
DICCA Hindcast
(pres by F. Giaroli)

River Flooding Discharge
2014 Event





FUTURE SCENARIOS

Sea Waves
DICCA-IMEDEA Proj
(pres by T. Toomey)

Storm Surge
DICCA Proj
(pres by F. Giaroli)

Sea Level Rise
NASA dataset

Waves – RCP8.5

Storm Surge – RCP8.5

SLR – Nasa AR6 SSP5-8.5

Data and Methods

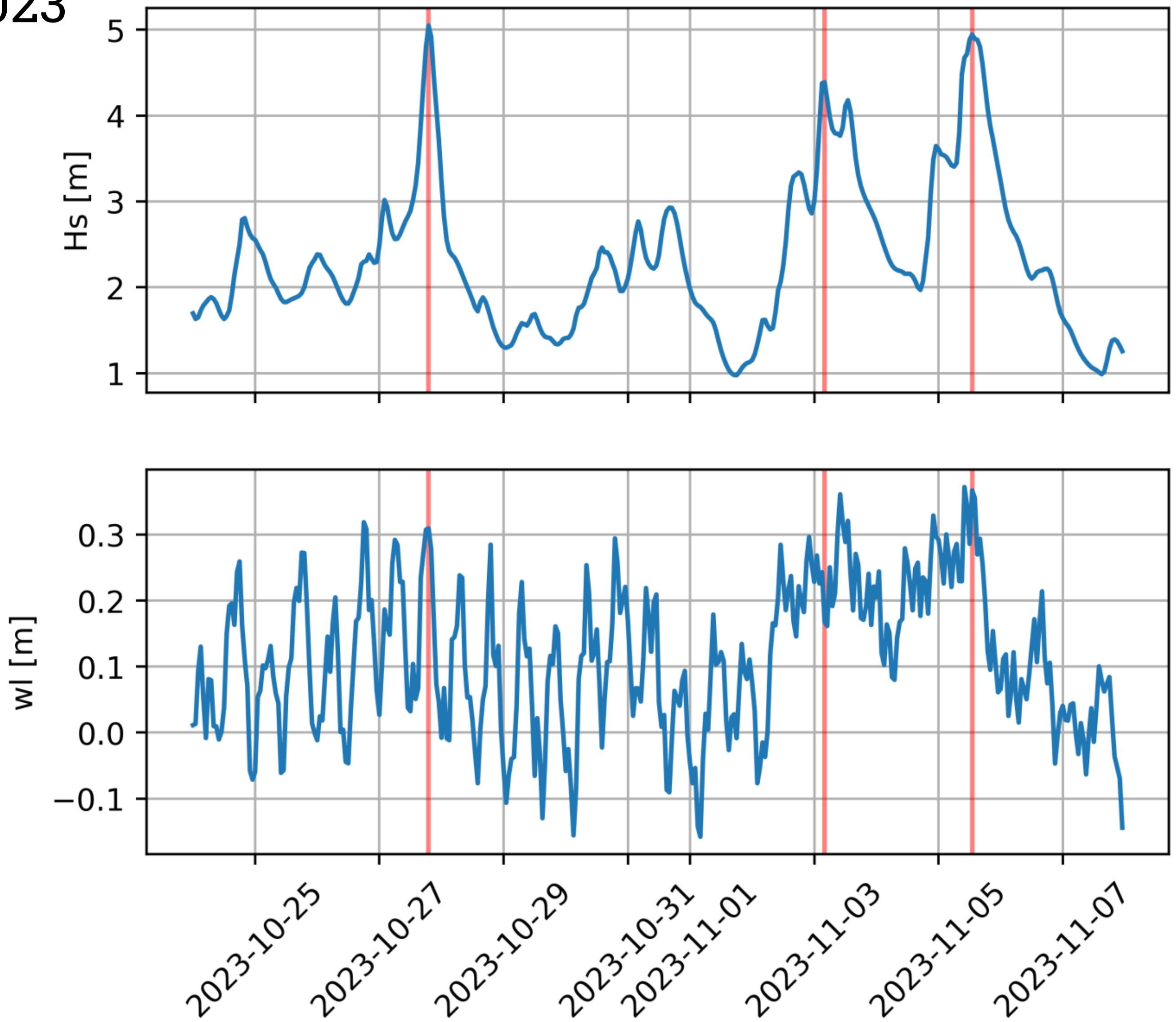
Environmental Forcings

Case	Series	Tr (years)	Hs (m)	Tp (s)	Dir (º)	SLR (m)	Storm surge (m)	Tide (m)	Q (m3/s)
1	Historical	50	6,07	12	225	0	0,383	0,1	1719
2	Historical	100	6,26	12	225	0	0,398	0,1	1719
3	Historical	200	6,44	12	225	0	0,413	0,1	1719
4	End-century	50	6,33	12	225	0,72	0,378	0,1	1719
5	End-century	100	6,52	12	225	0,72	0,392	0,1	1719
6	End-century	200	6,66	12	225	0,72	0,405	0,1	1719
7		200	6,66	12	225	0,72	0,405	0,1	10
8	Validation	0	5,05	9,9	226	0	0,17	0,14	1719
9	Validation	0	4,39	10,3	220	0	0,25	-0,08	1719
10	Validation	0	4,94	9,9	225	0	0,29	0,08	1719

Data and Methods

27/10 – 05/11 - 2023

Environmental Forcings



Data and Methods

Environmental Forcings

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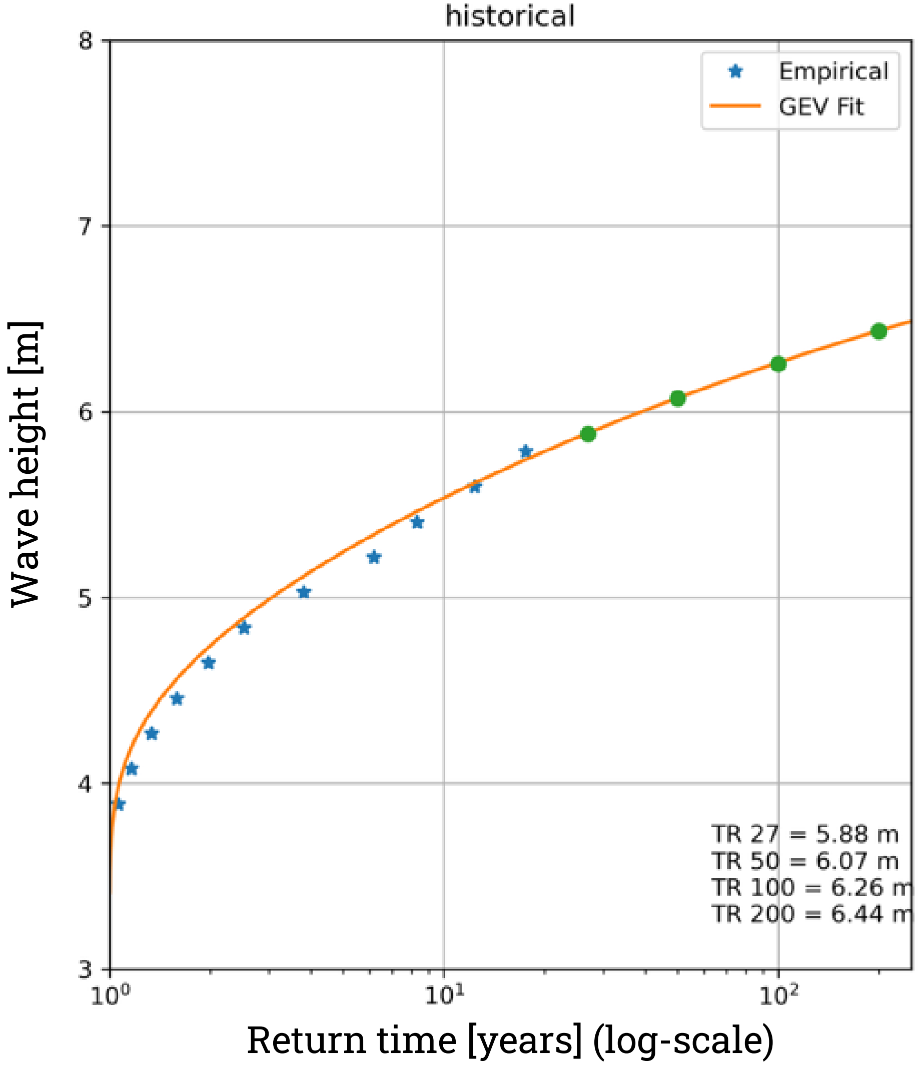
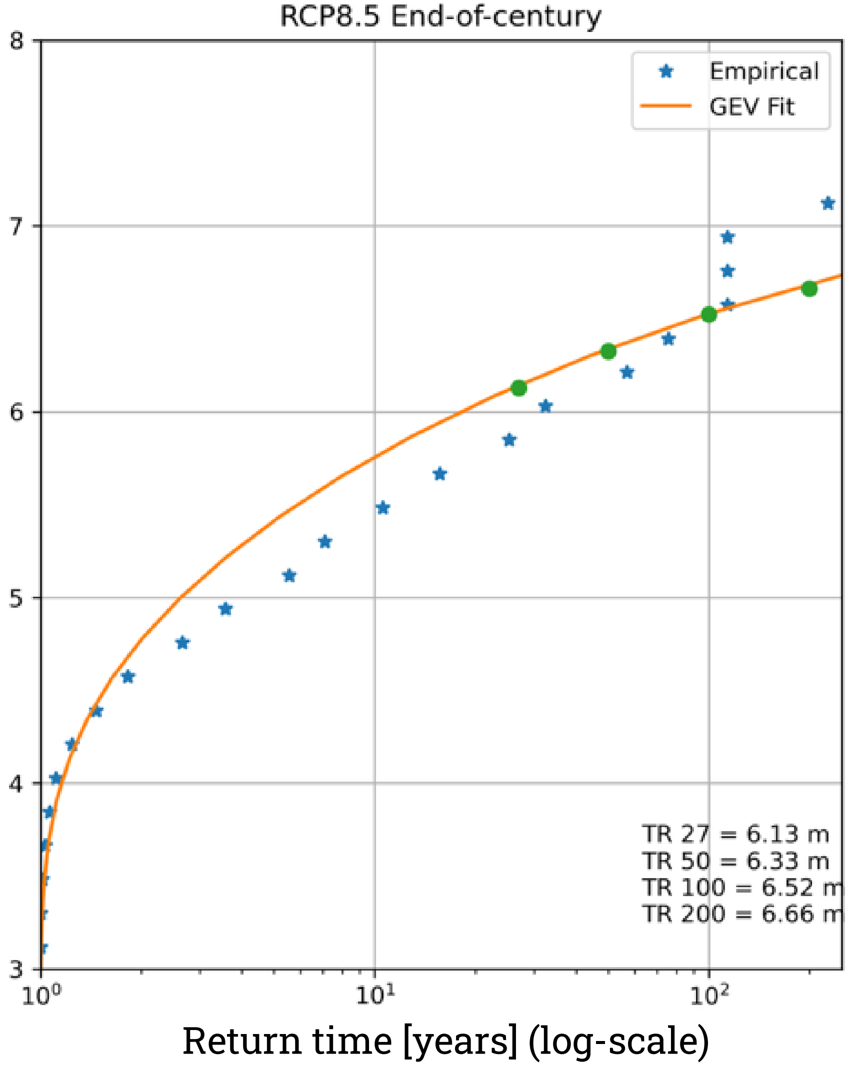
Data and Methods

Environmental Forcings

SIGNIFICANT WAVE HEIGHT H_s





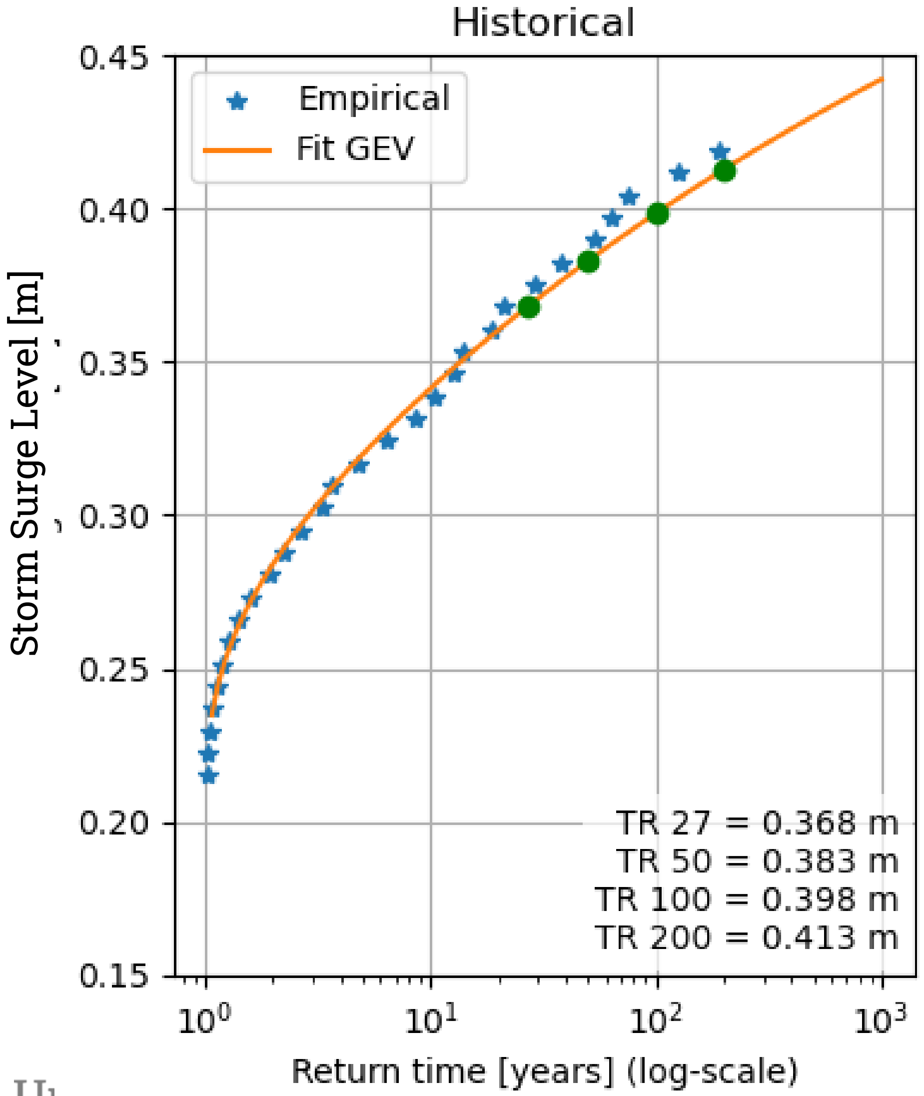
Maxima Bias Adjustment with Annual Maxima and Gumbel

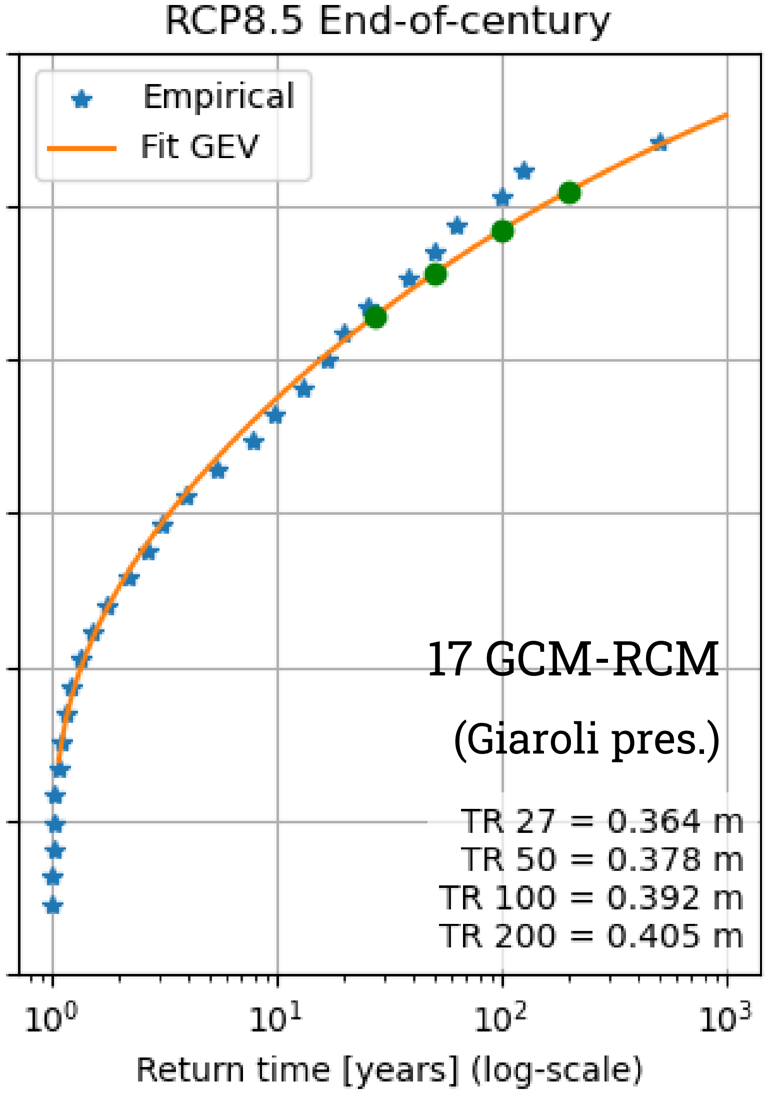
Return Period with Pooled Ensemble and GEV fit

Data and Methods

Environmental Forcings

STORM SURGE *S*





Maxima Bias Adjustment with Annual Maxima and Gumbel

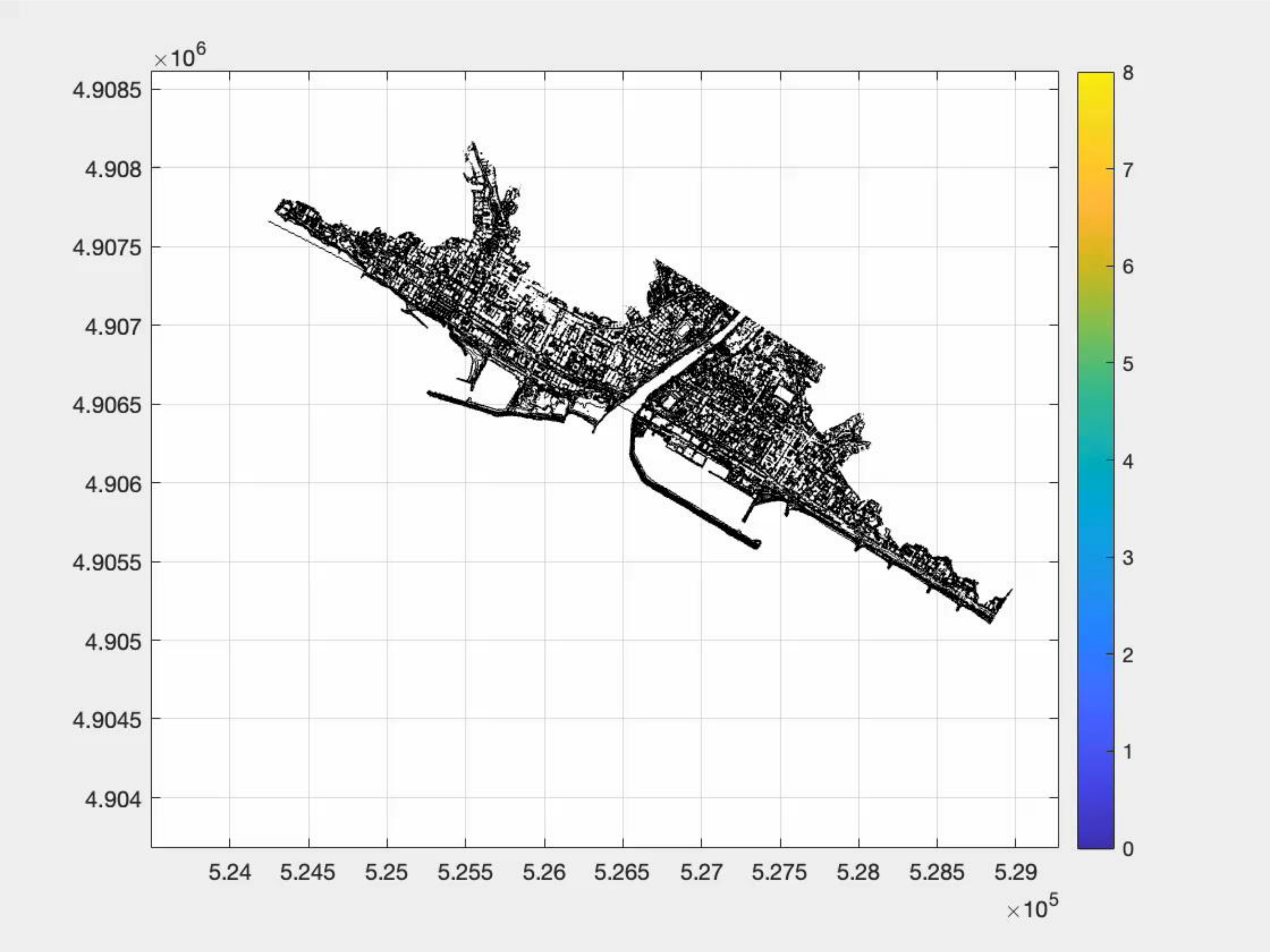
Return Period with Pooled Ensemble and GEV fit

Results

Case 5

End of Century

Tr=100 yrs

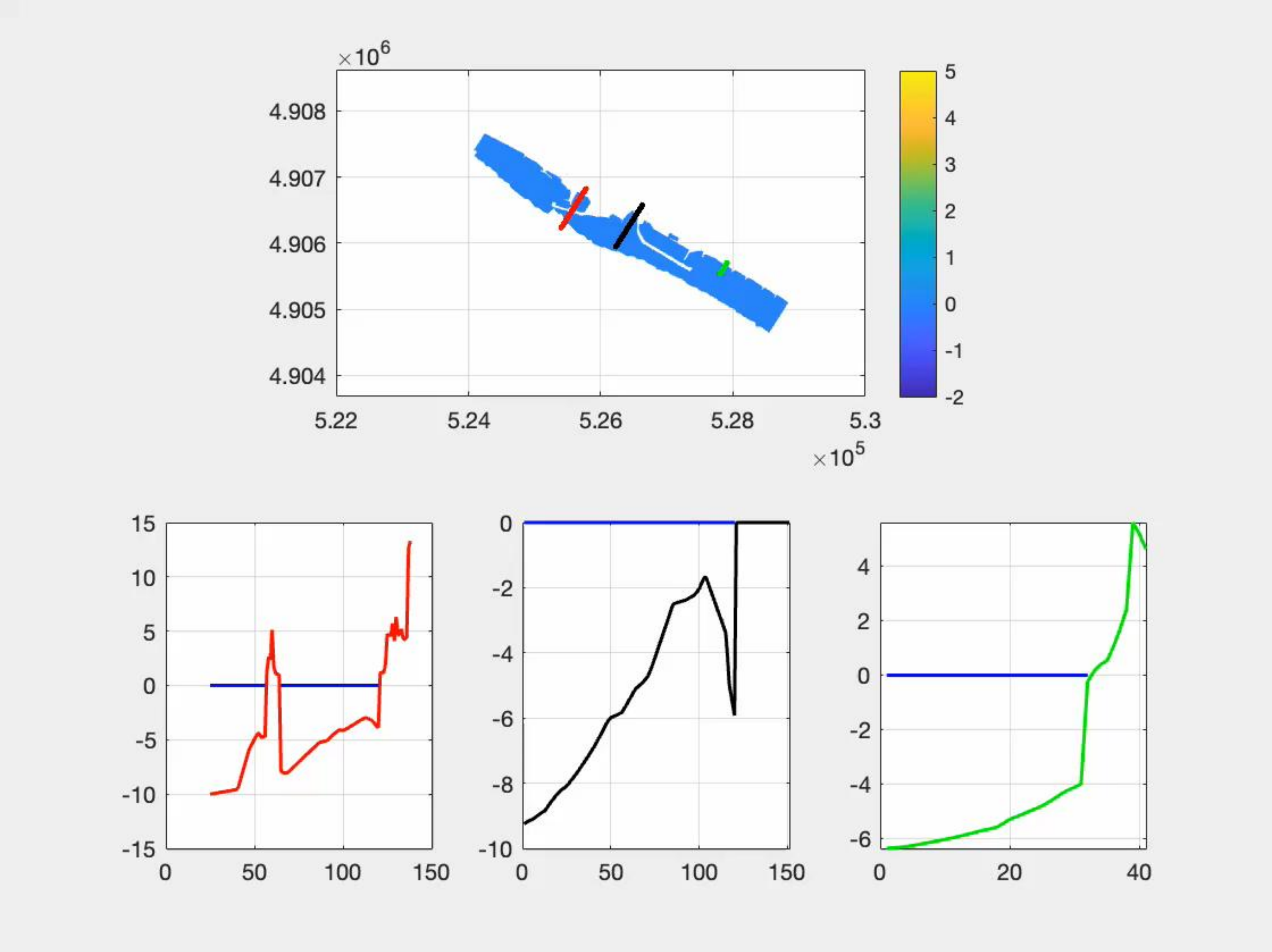


Results

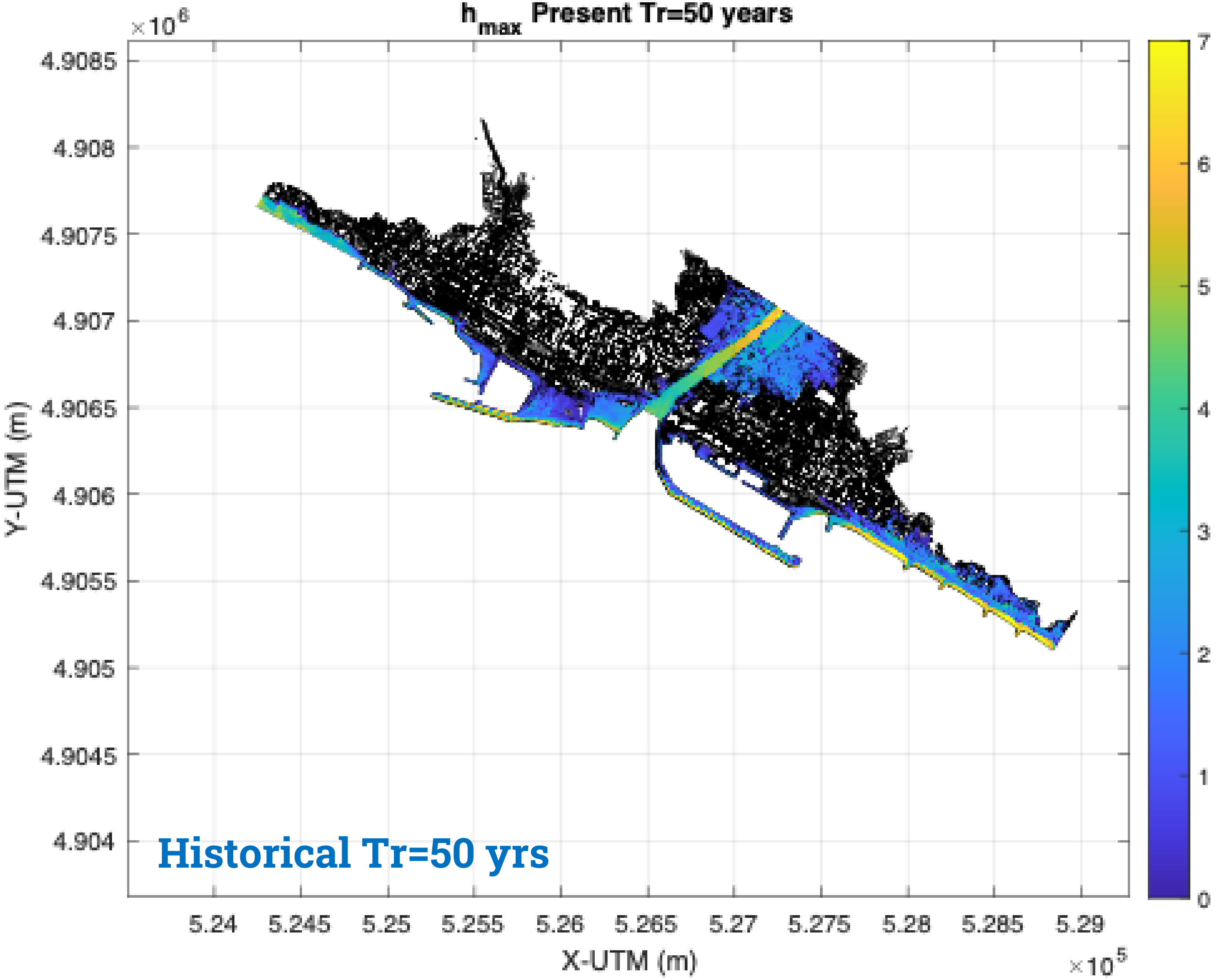
Case 5

End of Century

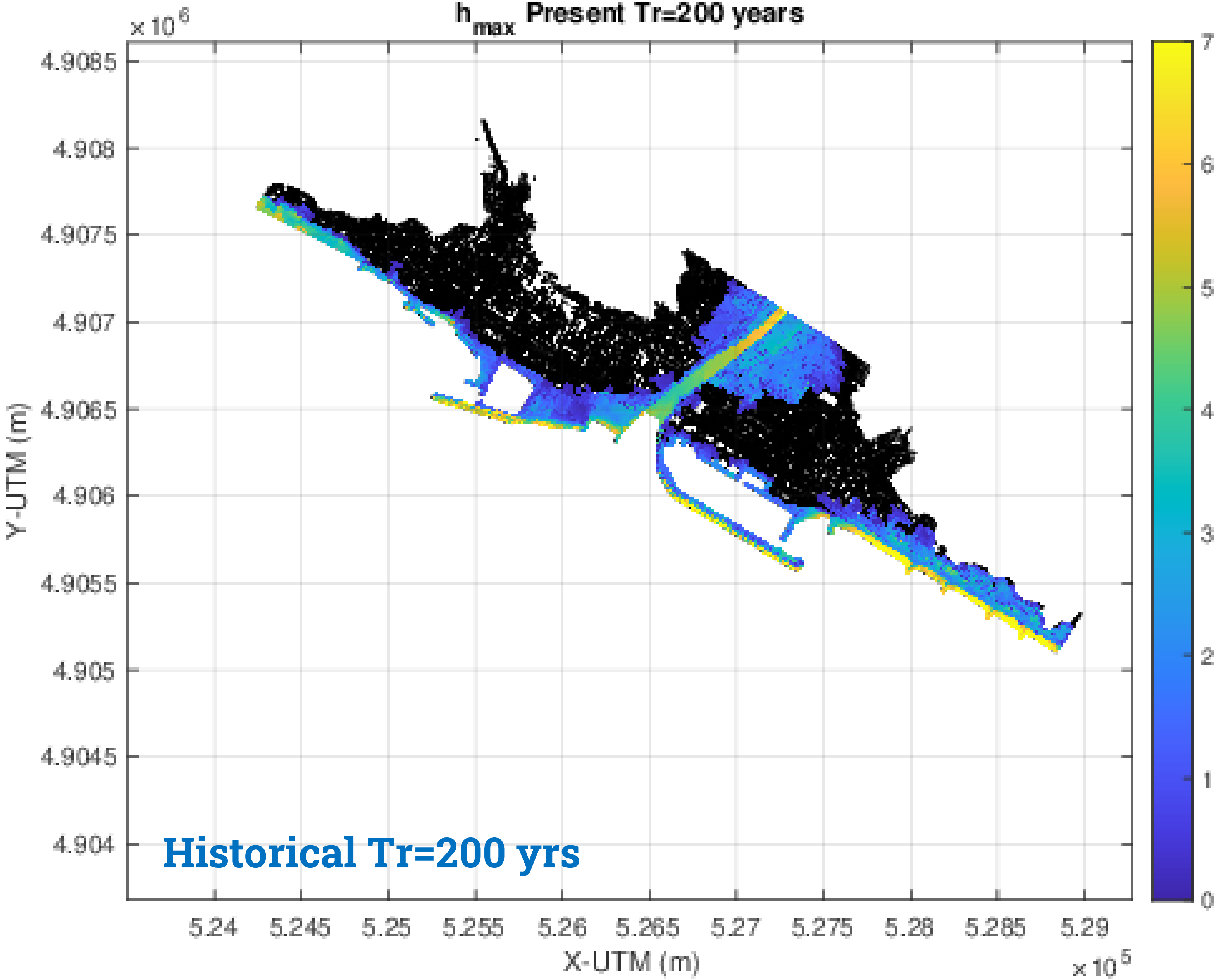
Tr=100 yrs



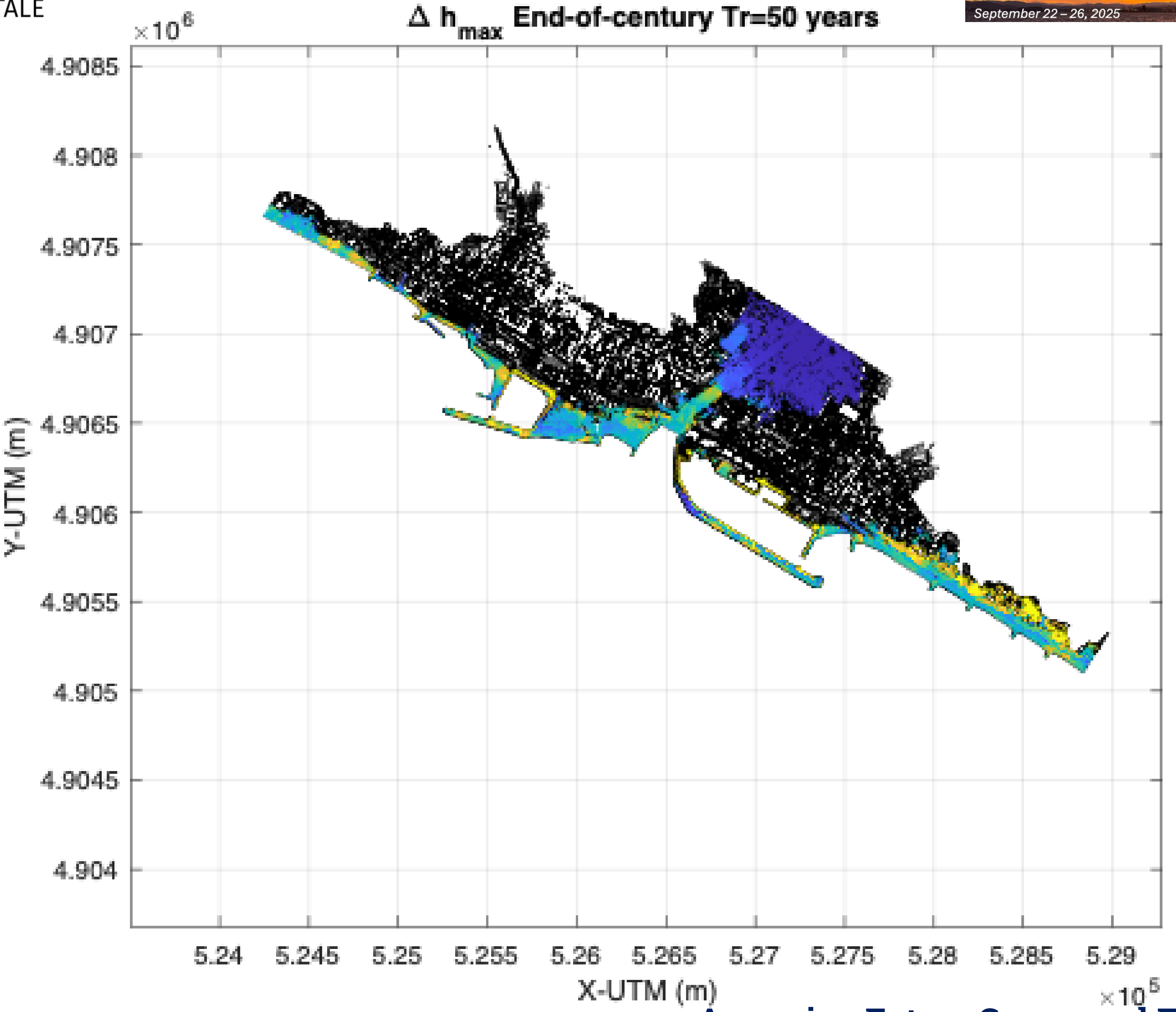
Results


h_{max} Present Tr=50 years
$\times 10^6$
4.9085
4.908
4.9075
4.907
4.9065
4.906
4.9055
4.905
4.9045
4.904
Y-UTM (m)
5.24
5.245
5.25
5.255
5.26
5.265
5.27
5.275
5.28
5.285
5.29
X-UTM (m)
$\times 10^5$
0
1
2
3
4
5
6
7
Historical Tr=50 yrs

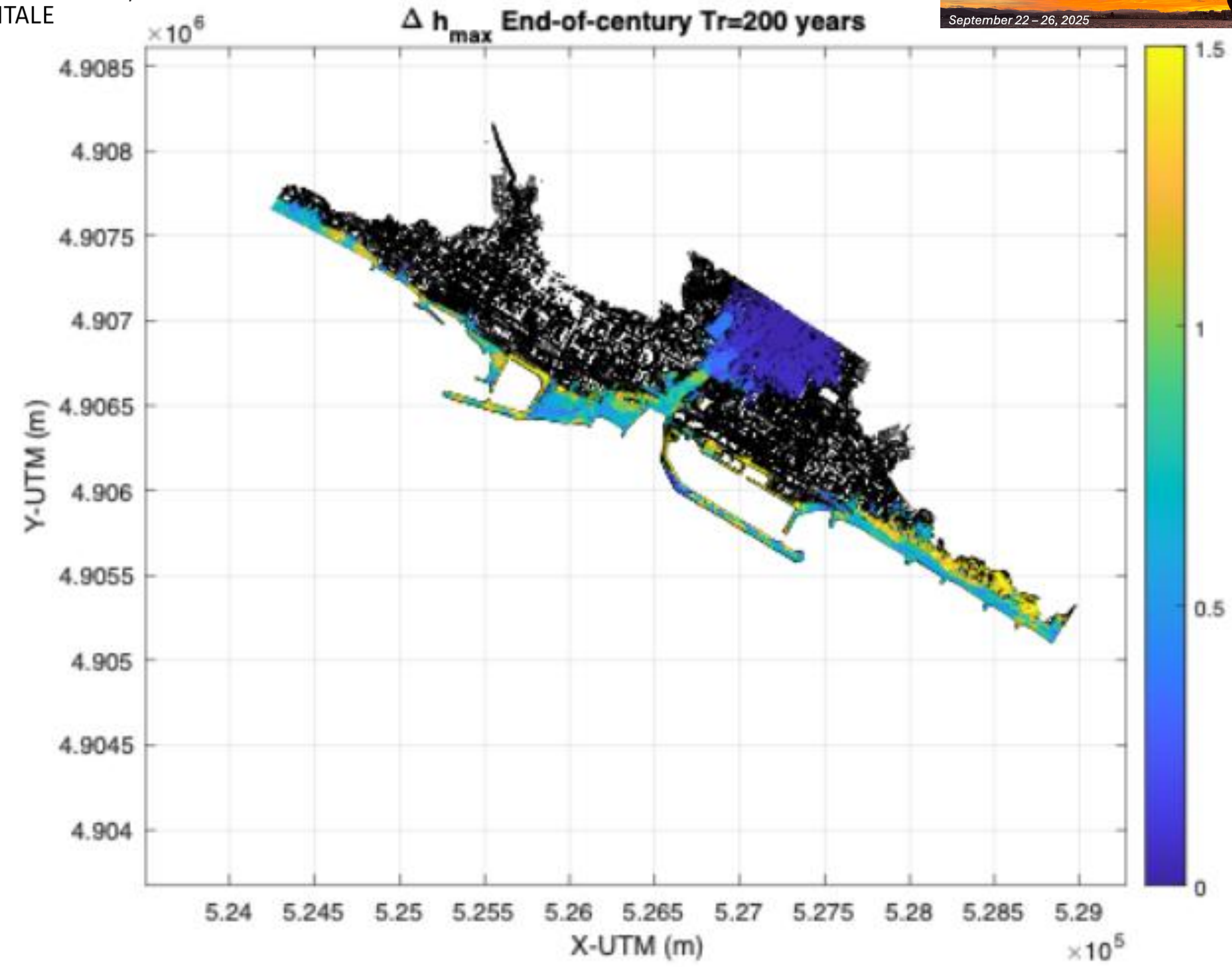
Results


h_{max} Present Tr=200 years
$\times 10^6$
4.9085
4.908
4.9075
4.907
4.9065
4.906
4.9055
4.905
4.9045
4.904
Y-UTM (m)
5.24
5.245
5.25
5.255
5.26
5.265
5.27
5.275
5.28
5.285
5.29
X-UTM (m)
$\times 10^5$
7
6
5
4
3
2
1
0
Historical Tr=200 yrs

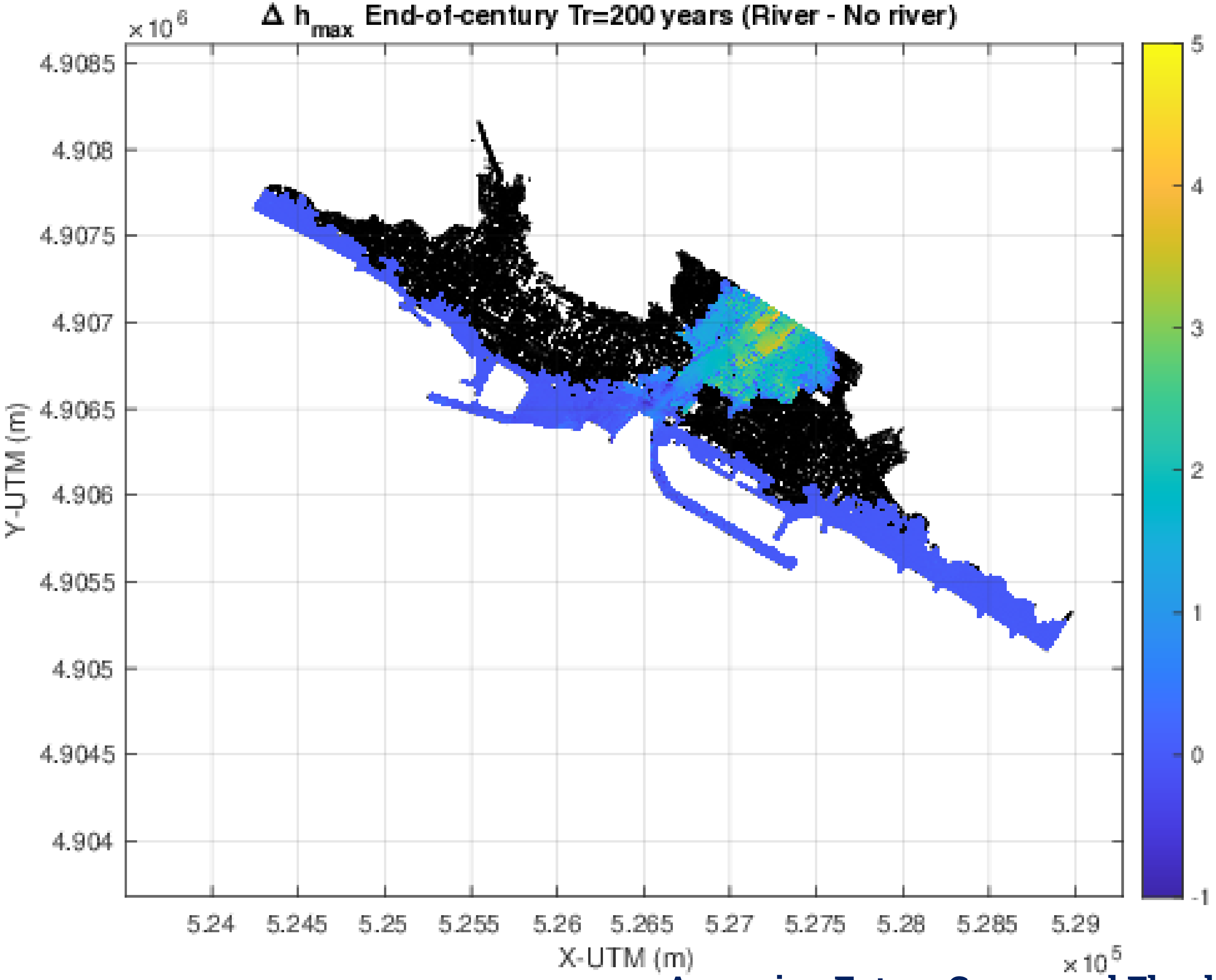
Results


Δ h max End-of-century Tr=50 years
×10^6
4.9085
4.908
4.9075
4.907
4.9065
4.906
4.9055
4.905
4.9045
4.904
Y-UTM (m)
5.24
5.245
5.25
5.255
5.26
5.265
5.27
5.275
5.28
5.285
5.29
×10^5
X-UTM (m)
1.5
1
0.5
0

Results

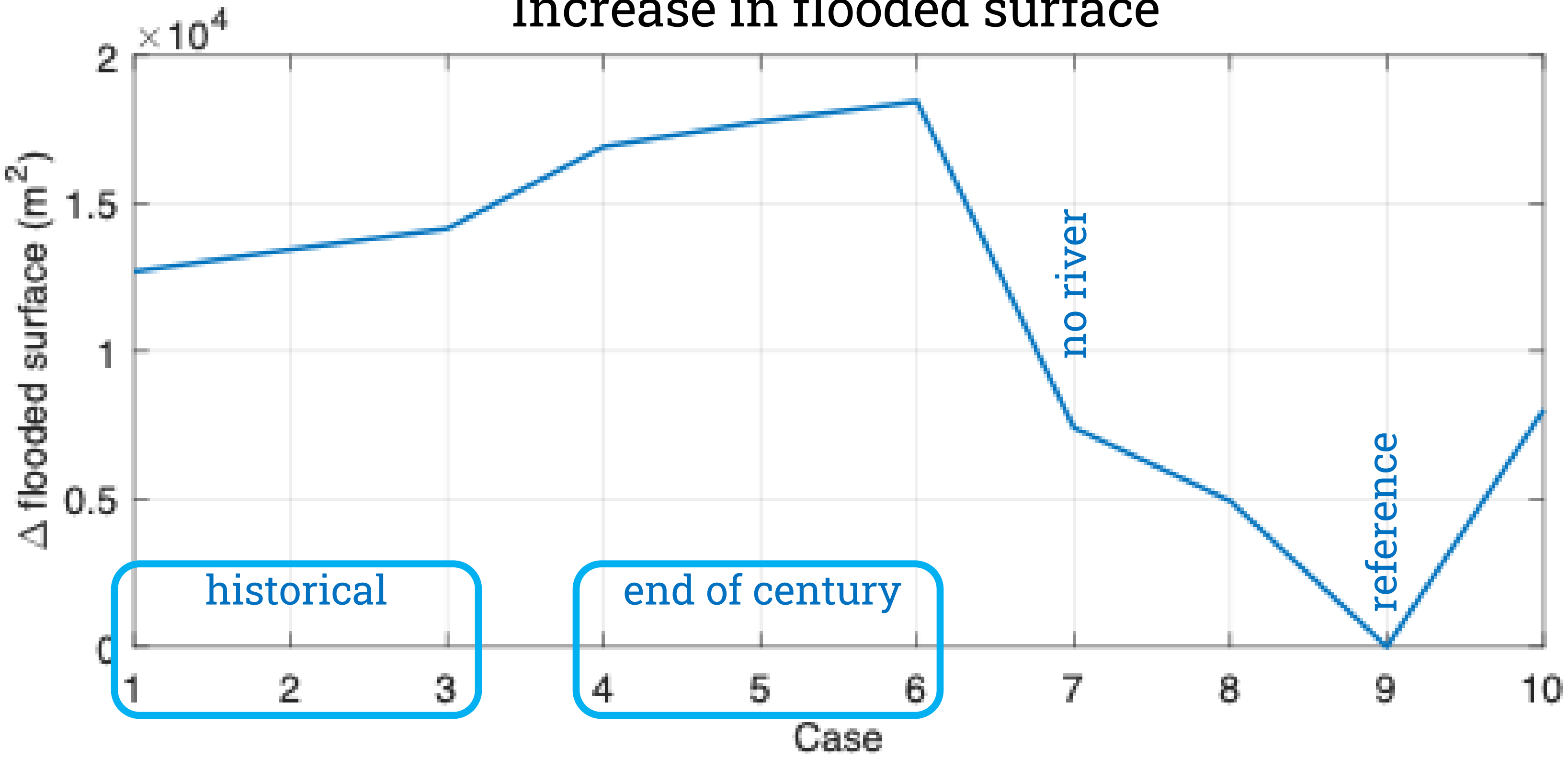

Δ h_{max} End-of-century Tr=200 years
×10^6
4.9085
4.908
4.9075
4.907
4.9065
4.906
4.9055
4.905
4.9045
4.904
Y-UTM (m)
5.24
5.245
5.25
5.255
5.26
5.265
5.27
5.275
5.28
5.285
5.29
X-UTM (m)
×10^5
1.5
1
0.5
0

Results


Δ h_{max} End-of-century Tr=200 years (River - No river)
× 10^6
4.9085
4.908
4.9075
4.907
4.9065
4.906
4.9055
4.905
4.9045
4.904
Y-UTM (m)
5.24
5.245
5.25
5.255
5.26
5.265
5.27
5.275
5.28
5.285
5.29
X-UTM (m)
× 10^5
5
4
3
2
1
0
-1

Results

Increase in flooded surface



The base line is the maximum flooded surface during the validation event. Only cells above the MSL are considered

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Conclusions and Futures

- SFINCS it is a reliable tool to simulate coastal and compound flooding processes
- Needs to transfer offshore forcing to shallow waters (snapWave?)
- Slight increase of H_s for higher return period
- Slight decrease of Storm Surge for higher return period
- Most important forcing is SLR
- Flooding due to river play an important role

Development of operational tool linked to DICCA forecast (Dynamic/Hybrid?)

Implementation of Morphodynamics (?)

UniGe

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