

Increasing sea level, mitigation measures and water management



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IZOLA/ISOLA, 4.12.2024

CLIMATE CHANGE



When the climate change „touched“ me:

Advisory Group on
Greenhouse Gases

Beljak, Avstrija 1985



Baseline for the article: IPCC 3rd assessment report (2001)

Znanja za načrtovanje in izvajanje ukrepov prilagajanja podnebnim spremembam

When were you really aware of climate change?



An inconvenient truth Al Gore 2006

The image shows the cover of the book 'STORMS OF MY GRANDCHILDREN' by James Hansen, published in 2009. The title is in large, bold, blue and white letters. Below the title, it says 'THE TRUTH ABOUT THE COMING CLIMATE CATASTROPHE AND OUR LAST CHANCE TO SAVE HUMANITY'. The author's name 'JAMES HANSEN' is at the bottom. The background is a blue sky with a mountain range at the bottom.

The image shows a graph with two lines: a red line for CO2 concentration and a blue line for temperature. The red line shows a sharp increase starting around 1800, reaching a peak around 1950, and then a sharp decline. The blue line shows a similar trend but with a much smaller increase. The graph is titled '650,000 Years of CO₂ and Temperature'. The x-axis is labeled 'Time' and the y-axis is labeled 'Temp. in F°'. The graph is part of a presentation slide, with a speaker visible on the right side.

2009

STORMS
OF MY
GRANDCHILDREN

THE TRUTH ABOUT THE
COMING CLIMATE CATASTROPHE
AND OUR LAST CHANCE TO
SAVE HUMANITY

JAMES HANSEN

650,000 Years of CO₂ and Temperature

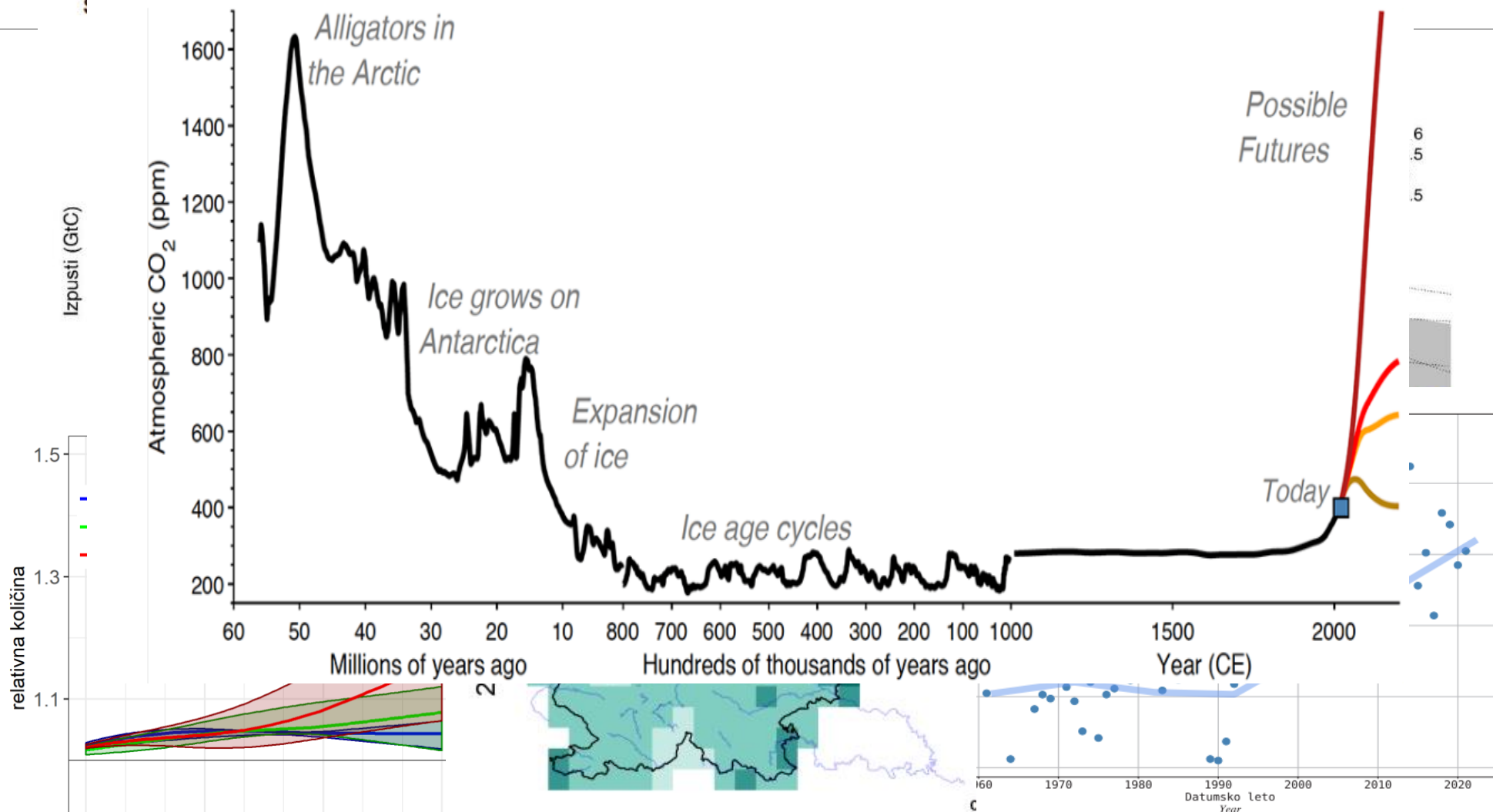
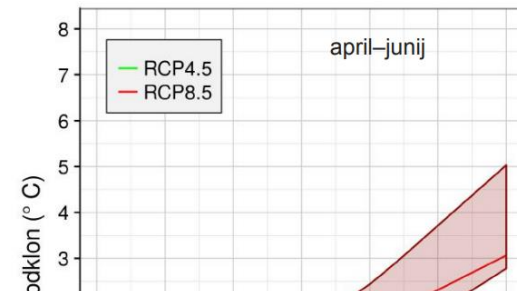
Temp. in F°

100,000

Today's CO₂ concentration

Projected concentration for 20 more years of unabated fossil fuel burning

Ocena podnebnih sprememb v Sloveniji do konca 21. stoletja



Trend srednjih letnih višin morja (10-letno drseče povprečje) v obdobju 1961–2021



Scenarios

The pessimistic scenario of greenhouse gas emissions (RCP8.5) compared to the average of the period 1986-2005, the expected maximum sea level rise along the Slovenian coast in the middle of the century (period 2046-2065) is **0.40 m**,

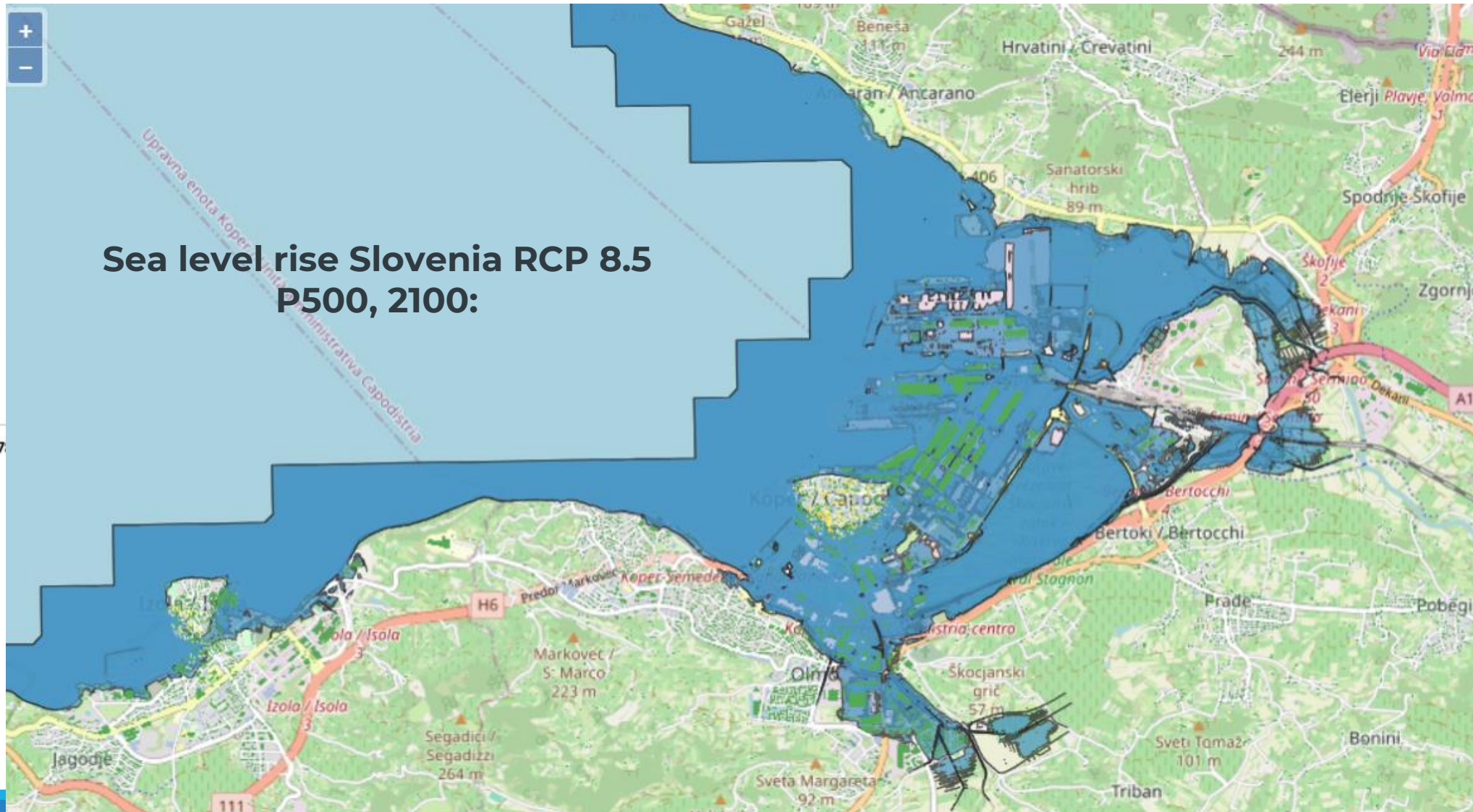
The pessimistic scenario of greenhouse gas emissions (RCP8.5) compared to the average of the period 1986-2005, the expected minimum sea level rise along the Slovenian coast by the end of the century (year 2100) is **0.61 m**,

The pessimistic scenario of greenhouse gas emissions (RCP8.5) compared to the average of the period 1986-2005, the expected maximum sea level rise along the Slovenian coast by the end of the century (year 2100) is **1.10 m**.

Trends soil temperature 1 meter

Increased precipitation intensity

Temperatura (°C)
22,0
21,0
20,0
19,0
18,0
17,0
16,0
15,0
14,0
13,0
12,0
197



RCP 4.5 - 1,2 degrees increase (+8,6%), 1,2°C temp increase, year 2100		
	%	mm
	44%	23
	32%	33
	28%	41
	30%	48
	33%	57
	42%	68
	49%	76
	58%	90
	58%	101
	58%	115
	58%	126
	53%	133
	51%	140
	48%	154
	46%	164
	45%	171
	48%	179
	43%	192

CLIMATE CHANGE ADAPTATION



Climate neutrality Mitigation of climate change	Climate resilience Adaptation to climate change
<p>Screening – Phase 1 (mitigation):</p> <p>Compare the project with the screening list in Table 2 of this guidance:</p> <ul style="list-style-type: none"> — If the project does not require a carbon footprint assessment, summarise the analysis in a <i>climate neutrality screening statement</i>, which in principle ⁽¹⁾ gives a conclusion on climate proofing as regards climate neutrality; — If the project requires a carbon footprint assessment, proceed to phase 2 below. 	<p>Screening – Phase 1 (adaptation):</p> <p>Carry out a climate sensitivity, exposure and vulnerability analysis in line with this guidance:</p> <ul style="list-style-type: none"> — If there are no significant climate risks warranting further analysis, compile the documentation and summarise the analysis in a climate resilience screening statement, which in principle gives a conclusion on climate proofing as regards climate resilience; — If there are significant climate risks warranting further analysis, proceed to phase 2 below.
<p>Detailed analysis – Phase 2 (mitigation):</p> <ul style="list-style-type: none"> — Quantify GHG emissions in a typical year of operation using the carbon footprint method. Compare with the thresholds for absolute and relative GHG emissions (see Table 4). If the GHG emissions exceed any of the thresholds, carry out the following analysis: <ul style="list-style-type: none"> — Monetise GHG emissions using the shadow cost of carbon (see Table 6) and firmly integrate the ‘energy efficiency first’ principle in the project design, options analysis, and cost-benefit analysis. — Verify the project’s compatibility with a credible pathway to achieve the overall 2030 and 2050 GHG emission reduction targets. As part hereof, for infrastructure with a lifespan beyond 2050, verify the project’s compatibility with operation, maintenance and final decommissioning under conditions of climate neutrality. 	<p>Detailed analysis – Phase 2 (adaptation):</p> <ul style="list-style-type: none"> — Carry out the climate risk assessment including the likelihood and impact analyses in line with this guidance. — Address significant climate risk by identifying, appraising, planning and implementing relevant and suitable adaptation measures. — Assess the scope and need for regular monitoring and follow-up, for example critical assumptions in relation to future climate change. — Verify consistency with EU and, as applicable, national, regional and local strategies and plans on the adaptation to climate change, and other relevant strategic and planning documents.

16.9.2021

EN

Official Journal of the European Union

C 373/1

COMMISSION NOTICE —

Technical guidance on the climate proofing of infrastructure in the period 2021-2027

(2021/C 373/01)



6.9.2021

EN

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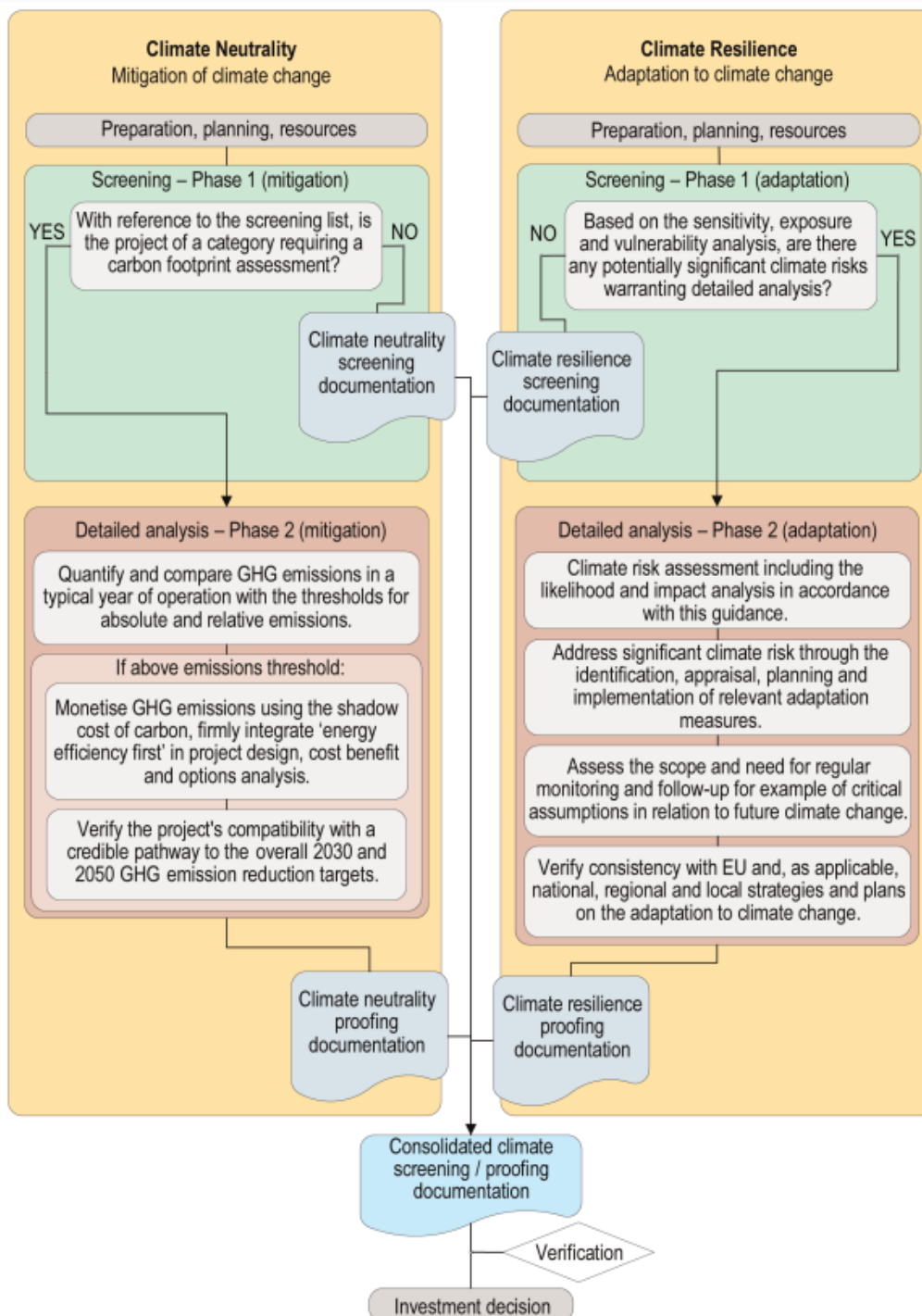
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(2021/C 373/01)

Important question:

Preparation of strategies, action plans, individual measures





Adaptation approach:



Analysis of the effects of anticipated sea level rise



Catalogue of measures



Adaptation - Constructive measures



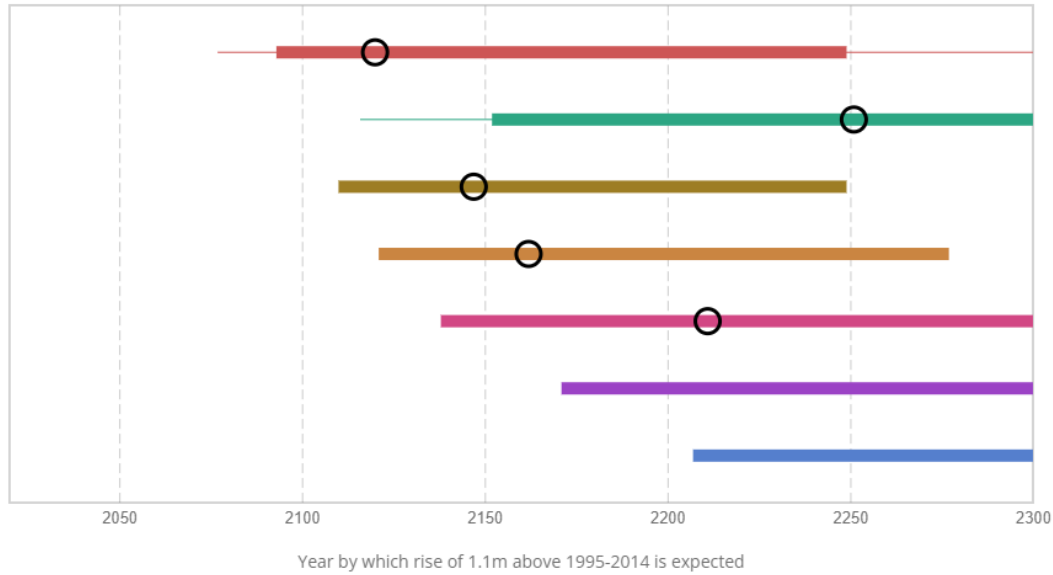
Adaptation – Non constructive measures



Trans-generational challenge

Projected Timing of Sea-Level Rise Milestones

Timing of exceedance of different thresholds (increments of 0.1 m) under different SSPs. Thick bars show 17th-83rd percentile ranges, and black circles show median value. Thin bars also show 5th-95th percentile ranges for SSP1-2.6 Low Confidence and SSP5-8.5 Low Confidence scenarios.



METERS

1.1m

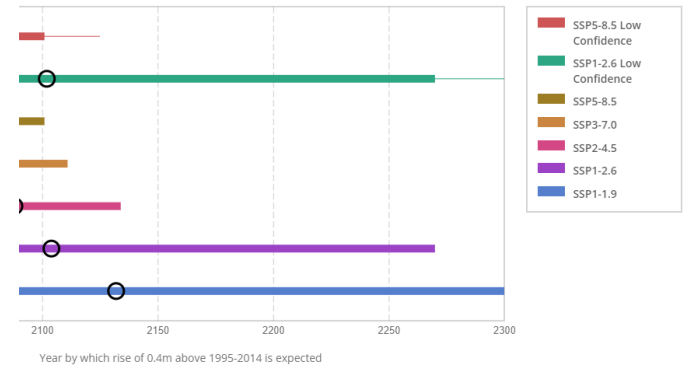


Trend srednjih letnih višin morja (10-letno drseče povprečje) v obdobju 1961–2021
Annual mean sea level trend (10-year moving average) for the period 1961–2021

+16 cm od 1902, trenutno cca 4 mm/leto, pospešuje do 10 mm/leto

Timing of Sea-Level Rise Milestones

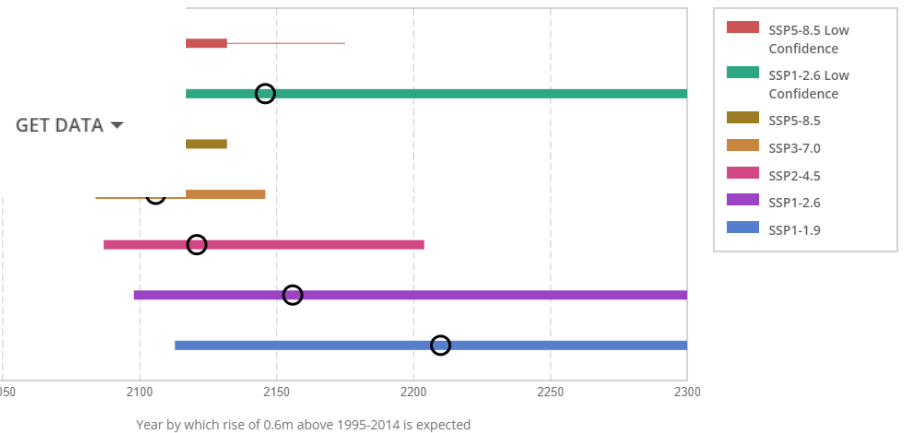
Timing of exceedance of different thresholds (increments of 0.1 m) under different SSPs. Thick bars show 17th-83rd percentile ranges, and black circles also show 5th-95th percentile ranges for SSP1-2.6 Low Confidence and SSP5-8.5 Low Confidence scenarios.



GET DATA

Timing of Sea-Level Rise Milestones

Timing of exceedance of different thresholds (increments of 0.1 m) under different SSPs. Thick bars show 17th-83rd percentile ranges, and black circles also show 5th-95th percentile ranges for SSP1-2.6 Low Confidence and SSP5-8.5 Low Confidence scenarios.



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METERS

0.6m

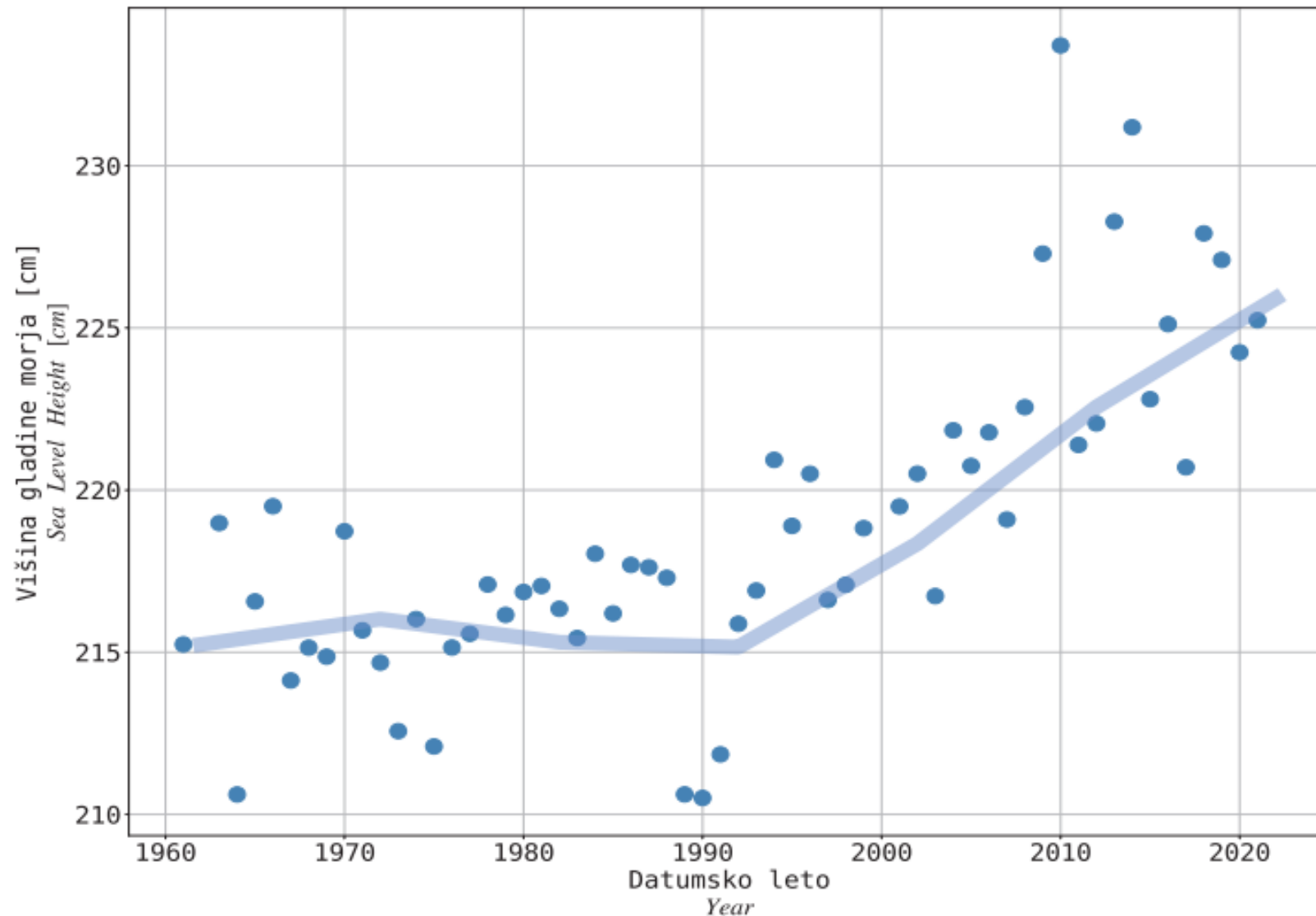
GET DATA



ARSO sea level rise monitoring

How to measure the sea level

Adaptation in different environments



Trend srednjih letnih višin morja (10-letno drseče povprečje) v obdobju 1961–2021
Annual mean sea level trend (10-year moving average) for the period 1961–2021



Easy task: (Izola P500, 2100, d_{vig} + 1,1 m)

Return periods
of extreme
tides?

(superposition)

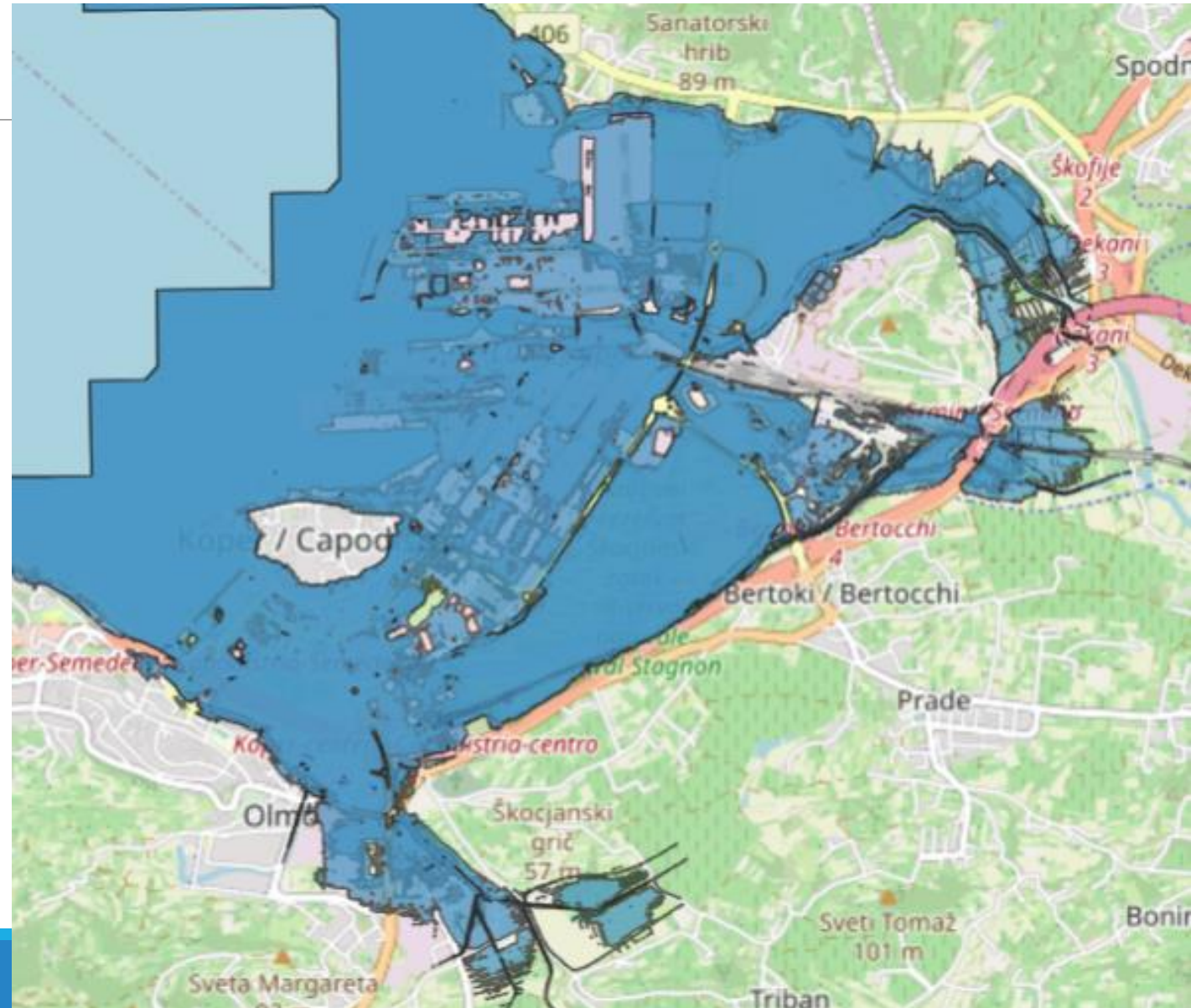




Koper P500, 2100, d_{vig} + 1,1 m

Return periods
of extreme
tides?

(superposition)

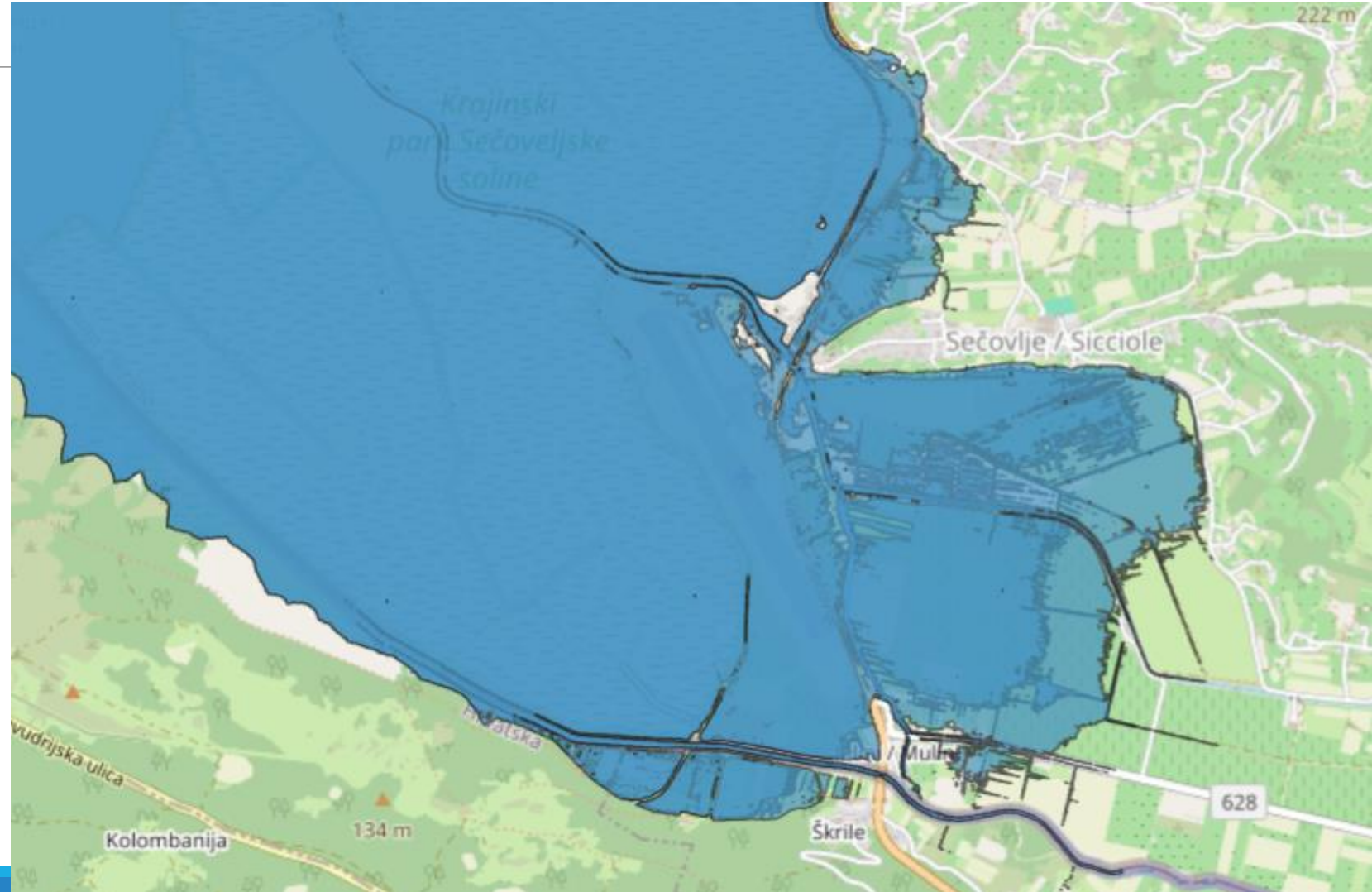




Sečovlje P500, 2100, dvig + 1,1 m

Return periods
of extreme
tides?

(superposition)





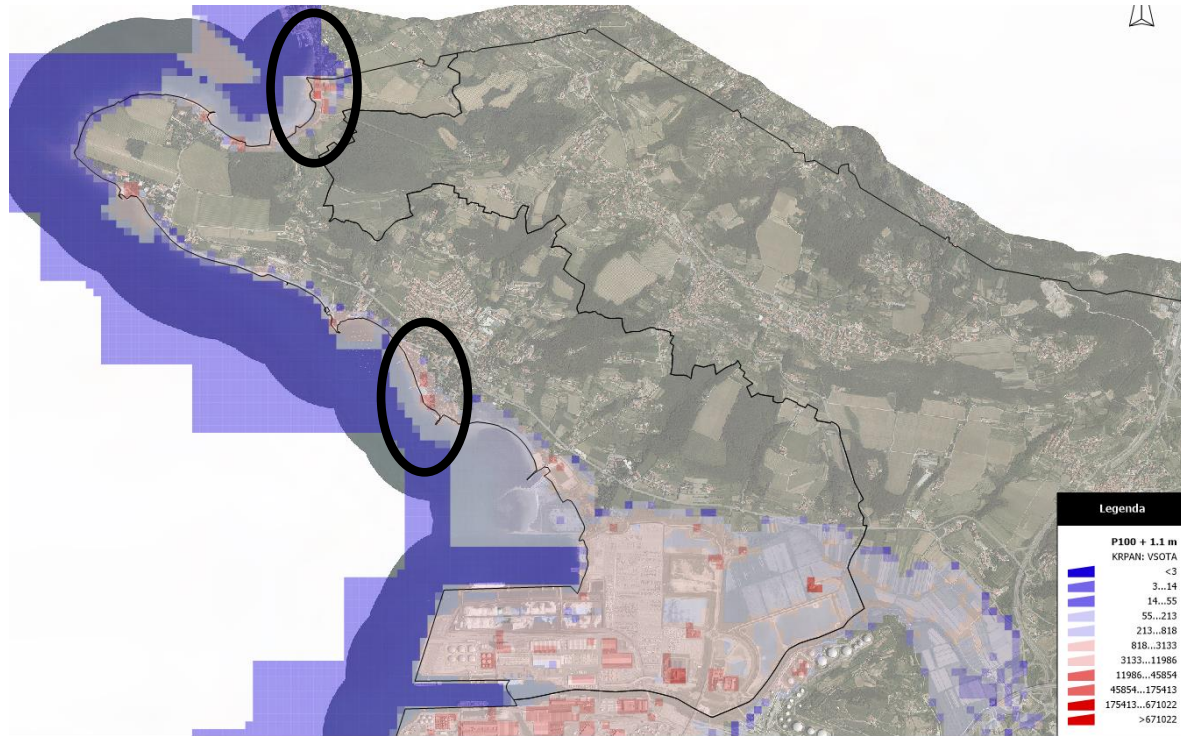
Modelling expected flood damage for specific event (P100 + 1,1 sea level rise)

Področje škod - generirano po področjih	P100+0,4 - EUR	P100+0,61 - EUR	P100+1,1 - EUR
KULTURNA DEDIŠČINA	2.171.980	2.401.071	2.740.900
INFRASTRUKTURA	3.524.294	4.181.728	5.263.638
KMETIJSTVO	194.960	234.316	321.586
GRAJENE POVRŠINE	10.156.433	12.351.658	15.798.959
STAVBE	255.450.043	260.138.234	279.152.474
OKOLJE	977.864	1.017.639	1.101.885
PROMET	3.611.507	4.106.399	5.579.691
STANOVANJA	3.409.093	3.876.241	5.266.996
INDU. IN POSLOVNI SUBJEKTI	4.332.600	5.341.200	8.124.200
SKUPAJ VIŠINA ŠKOD	283.828.774	293.648.486	323.350.329
Področje škod - generirano po področjih	P100+0,4 - %	P100+0,61 - %	P100+1,1 - %
KULTURNA DEDIŠČINA	0,77%	0,82%	0,85%
INFRASTRUKTURA	1,24%	1,42%	1,63%
KMETIJSTVO	0,07%	0,08%	0,10%
GRAJENE POVRŠINE	3,58%	4,21%	4,89%
STAVBE	90,00%	88,59%	86,33%
OKOLJE	0,34%	0,35%	0,34%
PROMET	1,27%	1,40%	1,73%
STANOVANJA	1,20%	1,32%	1,63%
INDU. IN POSLOVNI SUBJEKTI	1,53%	1,82%	2,51%
SKUPAJ VIŠINA ŠKOD	100,00%	100,00%	100,00%

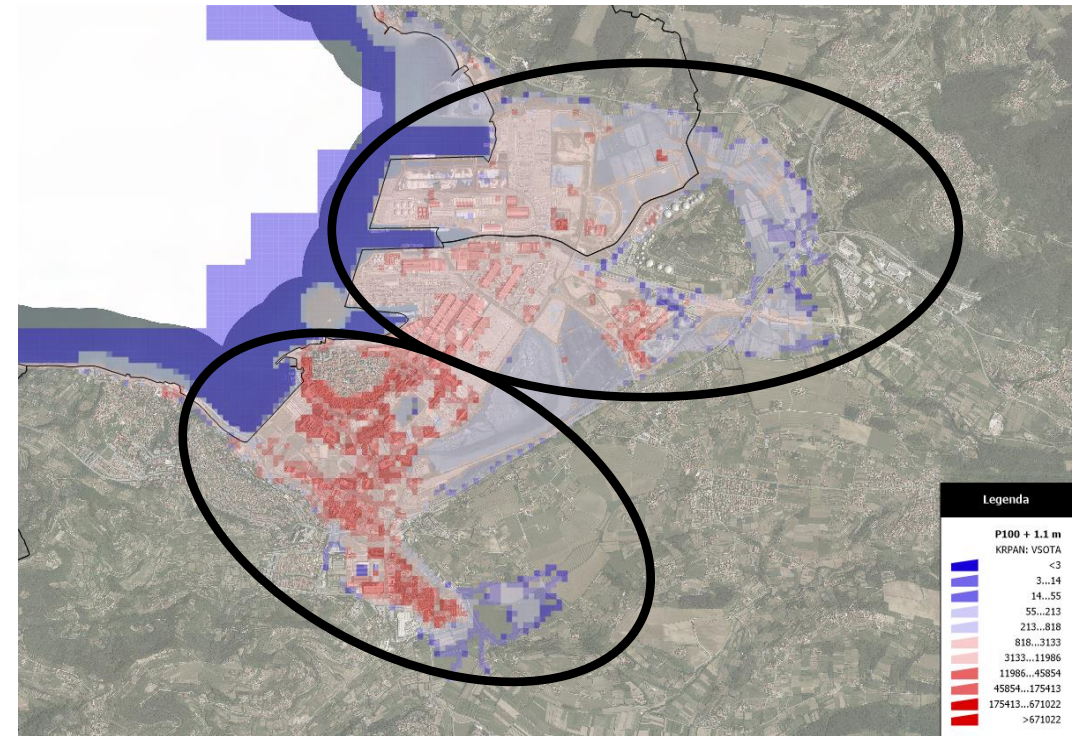
Interpretation!



Spatial distribution of flood damage for specific return event + sea level rise



Območji: občina Ankaran – Lazaret in Avtokamp Adria



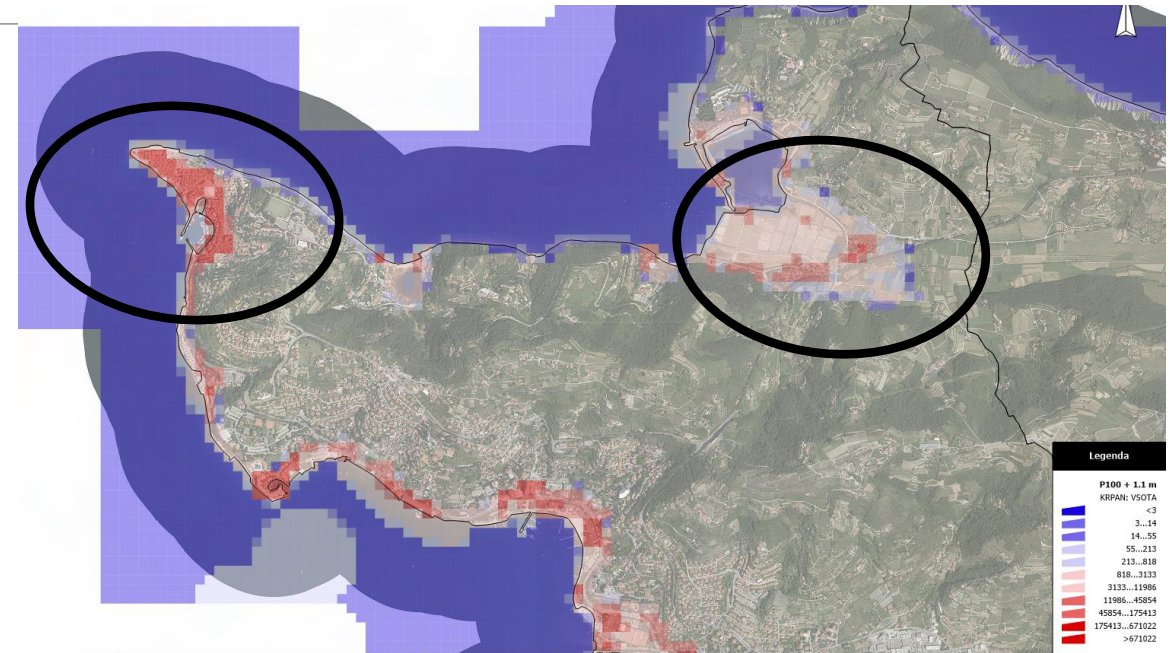
Območji: Mestna občina Koper – Luka Koper in Badaševica



Spatial distribution of flood damage for specific return event + sea level rise



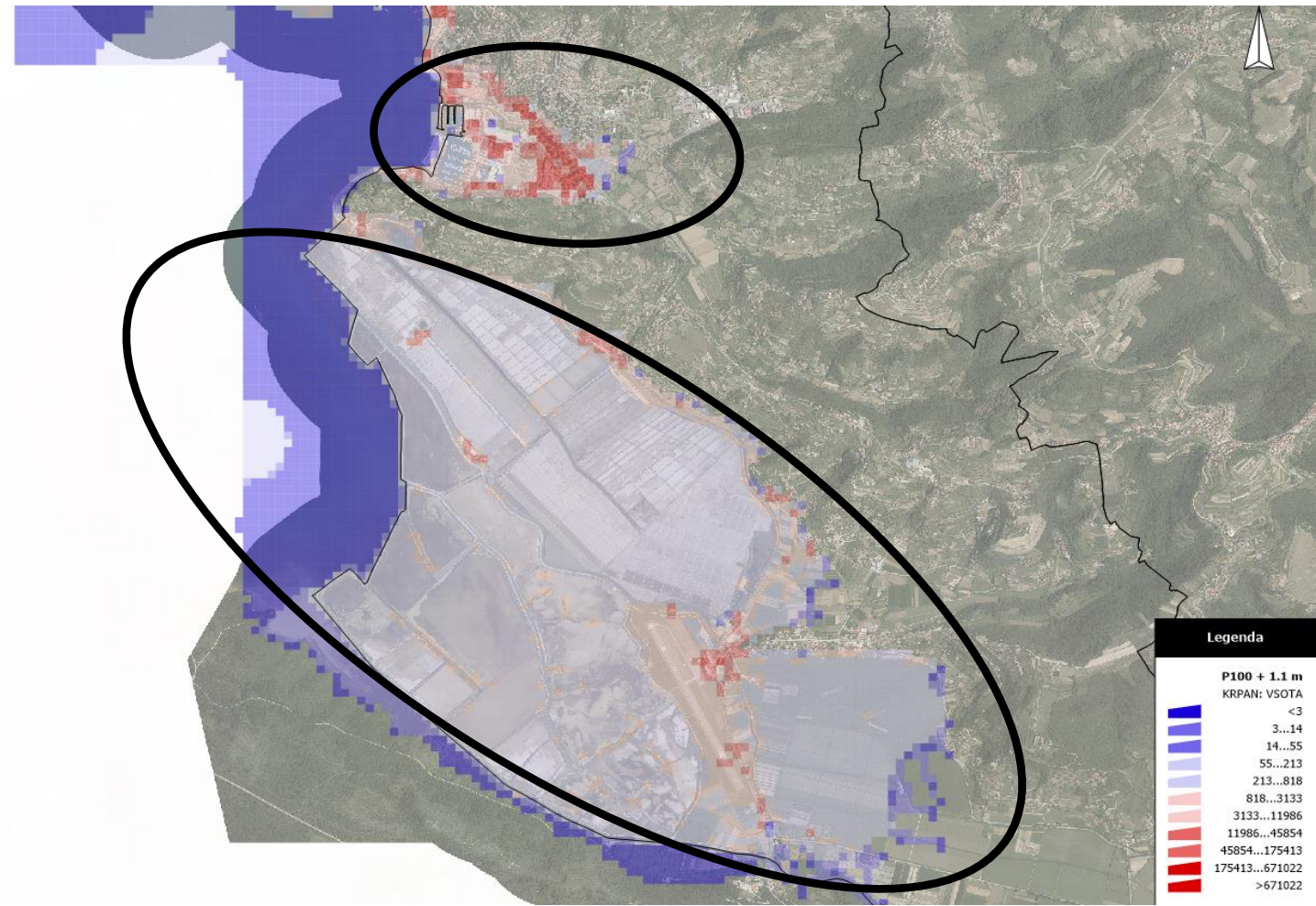
Območji: občina Izola – Ladjedelnica in Marina



Območji: občina Piran – Strunjan in Piran



Spatial distribution of flood damage for specific return event + sea level rise



Območji: občina Piran –
Lucija in
Sečovlje



Target areas for systematic adaptation measures:

1. Ankaran Lazaret
2. Ankaran Avtokamp
3. Koper Luka Koper
4. Koper Badaševica
5. Izola Ladjedelnica
6. Izola Marina
7. Piran Strunjan
8. Piran Piran
9. Piran Lucija
10. Piran Sečoveljske soline in Jernejev kanal



Population in specific target areas:

P100+0,40

P100+0,61

Št.	Občina	območje	Sum of PREB_NOCNI	Sum of PREB_DNEVNI	Sum of m2	Občina	območje	Sum of PREB_NOCNI	Sum of PREB_DNEVNI	Sum of m2
1	Ankaran	AdriaCamp	0	17.7	1211.4	Ankaran	AdriaCamp	0	17.7	1211.4
2	MO Koper	Badaševica	1216	9695.9	561497.4	MO Koper	Badaševica	1371	9809.2	573371.5
3	Izola	Ladjedelnica	124	664.8	27905.1	Izola	Ladjedelnica	169	790.4	32718.1
4	Ankaran	Lazaret	0	24.6	1332.6	Ankaran	Lazaret	0	24.7	1336.6
5	Piran	Lucija	751	835.8	108869.2	Piran	Lucija	817	933.5	119455.1
6	MO Koper	Luka Koper							5554.1	467515.8
7	Izola	Marina Izola							2325.7	94514.9
8	Piran	Piran							752.1	133774.6
9	Piran	Sečovelje							248.6	34060.3
10	Piran	Strunjan							96.6	13281.5
Skupna vsota	Skupna vsota	Skupna vsota							20552.7	1471239.8
			Občina	Oznake vrstic	Sum of PREB_NOCNI	Sum of PREB_DNEVNI	Sum of m2			
			Ankaran	AdriaCamp	0	17.7	1584.6			
			MO Koper	Badaševica	1903	10291.7	629149.3			
			Izola	Ladjedelnica	259	810.6	37281.7			
			Ankaran	Lazaret	0	34.7	1892.2			
			Piran	Lucija	1285	1086.6	148482.2			
			MO Koper	Luka Koper	18	6009.7	519714.9			
			Izola	Marina Izola	1494	3606.6	128793.2			
			Piran	Piran	2115	771.9	142871.9			
			Piran	Sečovelje	227	263.1	39276.4			
			Piran	Strunjan	67	96.6	13416.7			
				Skupna vsota	7368	22989.4	1662463.1			

P100+1,1



Scenarij P100 leto 2100 (pesimistični + 1,1m) – m2 rabe v pritličjih objektov v območju - Agregatno za analizirano območje	Luka Koper	Marina Izola	Piran	Sečovelje	Strunjan
Gasilski dom					
Hanger, baza, remiza	235.7			1193.4	
Hladilnice in specializirana skladišča	16139.5			1512.5	
Hlev	378.5			36	
Hotel, motel	1155.3	51	5399.3		1875.5
Industrijski del stavbe	19958.7	1940.7	50.1	3960.6	
Kiosk	25.8	10.2			13.5
Klet	154.9	399.3	926.6	44.2	23.1
Klinika, ambulanta		110.1	1118		
Koča, dom		6.7	31.1	42	129
Kolesarnica, čolnarna		127.8	72.4	335.2	
Kontrolni stolp				256.9	
Kurilnica	128.8		26.6	41.9	
Letališče				239.9	
Muzej, knjižnica			2641.6		204.3
Nadstrešnica	66.5	6			
Nakupovalni center	85.3	21.6	226.5	337.4	139.2
Nedokončan industrijski del stavbe	14553.6			34	
Nedokončan nestanovanjski del stavbe	1610.4				

Ciljno analizirana
območja in učinki
dviga na njih
(raba v pritličju objekta –
PRIMER - Del)

(vir: register nepremičnin)



Adaptation of infrastructure

Specific
infrastru
cture!

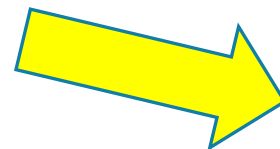
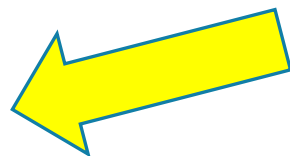


Type	mechanism	Risk assessment
Traffic		Medium
Energy		Low
Utilities	Of the municipal infrastructure (water supply, wastewater disposal, landfills), the municipal wastewater and stormwater disposal system is particularly vulnerable to the rise in mean sea level due to climate change.	Very high – urban drainage, waste water collection and treatment
Water management infrastrucutre		Srednja (protierozijska zaščita in obstoječi nasipi)
Monitoring infrastucture		Nizka
Other		Nizka
Communication		Nizka



Proces prilagajanja - Vrste ukrepov

Negradbeni ukrepi:



Gradbeni ukrepi

Pripravljen celovit katalog ukrepov – za obe vrste ukrepov:

- V okviru sprejemanja strategije se bo potrebno opredeliti katere ukrepe bomo izvajali
- Glede na kompleksnost izziva se bo potrebno ukvarjati s kombinacijo številnih ukrepov
- Povezanost z ukrepi iz NZPO, vendar so tu ukrepi bolj specifični
- Ukrepi opredeljeni na nivoju strateške opredelitve, način izvedbe ukrepa je stvar akcijskega načrta (operativni program) in konkretne izvedbe opredeljenih ukrepov (ukrepa)
- Primerjava z ukrepi v tujini – razvoj terminologije

V okviru oblikovanja strategije se moramo znati pogovarjati o vseh ukrepih in njihovi izvedljivosti

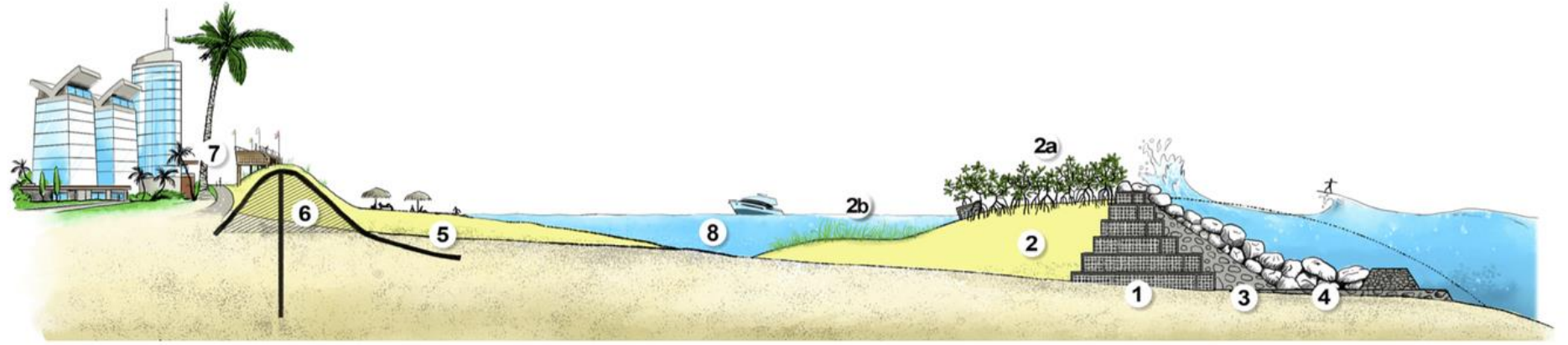
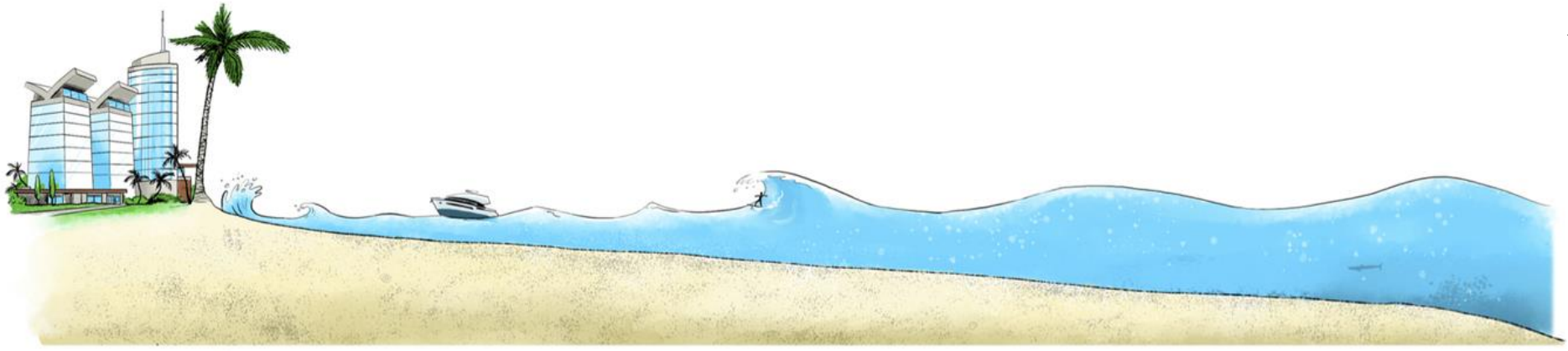


Main categories of constructive measures

- Measures for **individual adaptation** (protection) of individual facilities, activities or infrastructure to sea level rise (measure U17 according to the NZPO)
- According to the reviewed literature, system measures are divided into the following three typologies of measures:
 - System measures, with which protective measures are implemented on the **existing coastline** before sea level rise,
 - System measures, with which protective measures are **implemented seaward** before sea level rise (example: the Netherlands),
 - System measures, with which protective measures are **implemented landward before** sea level rise, activities, settlements and infrastructure are retreating due to sea level rise – (more suitable for sparsely populated areas that are difficult to protect).



Erosion protection measures





Adaptation process – catalogue of measures

72 measures for which open discussion is necessary

Št. ukrepa	GR/negr	Kratki naziv/SLO	Kratki naziv/ENG	Opis SLO
CC1	negradbeni	Celoviti načrti	Comprehensive Plans	Providing long-term planning tools, which are used primarily to guide the future strategic and spatial development of the community.
CC2	negradbeni	Coniranje	Zoning and Overlay Zones	Providing a legal framework that governs the use and development of land in a community. Zoning maps divide a community into areas based on the type of permitted use (e.g., residential, commercial, and industrial), and within each zone, an ordinance sets forth planning requirements
CC3	negradbeni	Regulativa na področju gradnje na poplavnih območjih	Floodplain Regulations	Minimum requirements for regulating development in floodplains should be introduced. In these areas, structures should be constructed in a way that minimizes flood damage (e.g., raised, watertight structures). Use restrictions may be imposed in the 100-year floodplain (e.g., limiting permitted uses to low-density residential, agricultural, or recreational uses). Planning requirements may also be imposed in the 500-year floodplain.



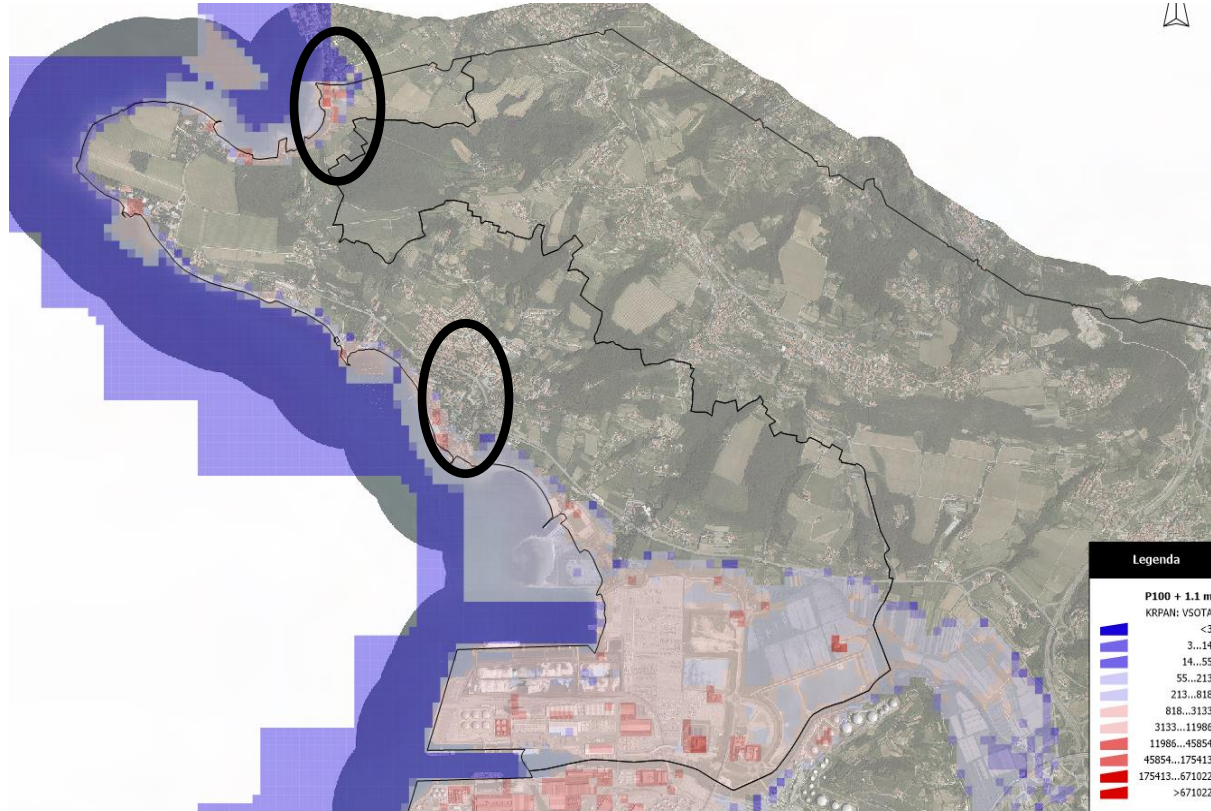
Potential measures in specific target areas

Systemic measures by area are the basis for starting a discussion on the method of implementing measures in areas where a higher risk has been identified and comprehensive (not individual) measures of protection against harmful effects due to mean sea level rise could be implemented.



Measures on specific target areas

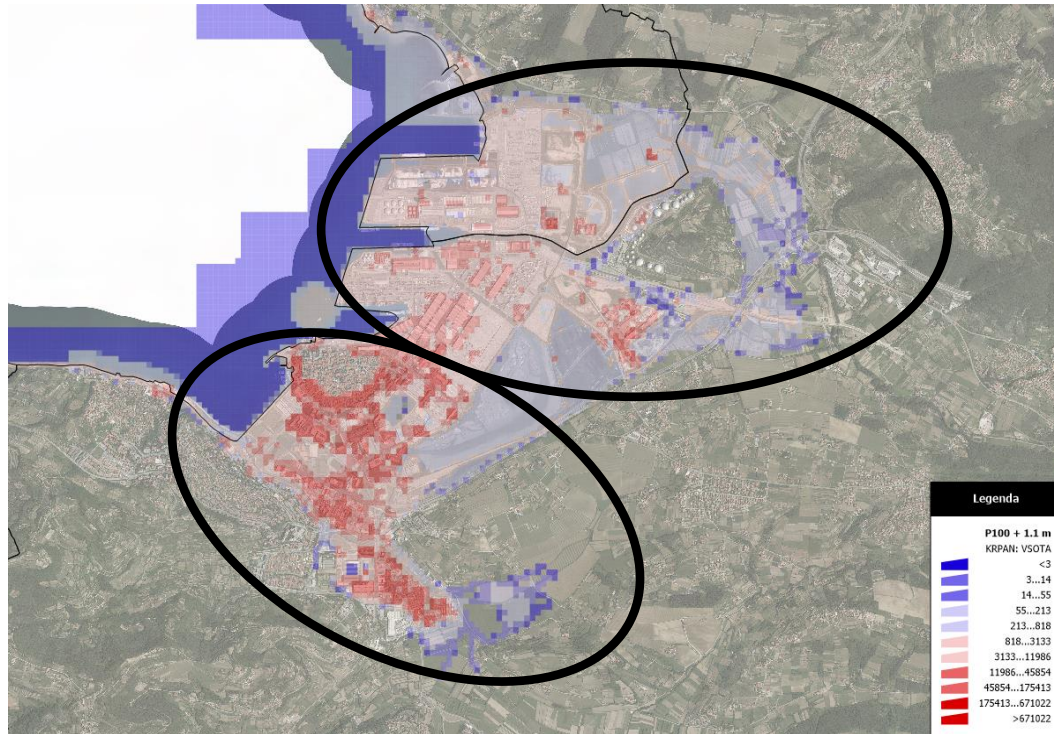
BLUE ECONOMY FORUM 2024:
Increasing sea level, mitigation measures and water management



Območji: občina Ankaran – Lazaret in Avtokamp Adria



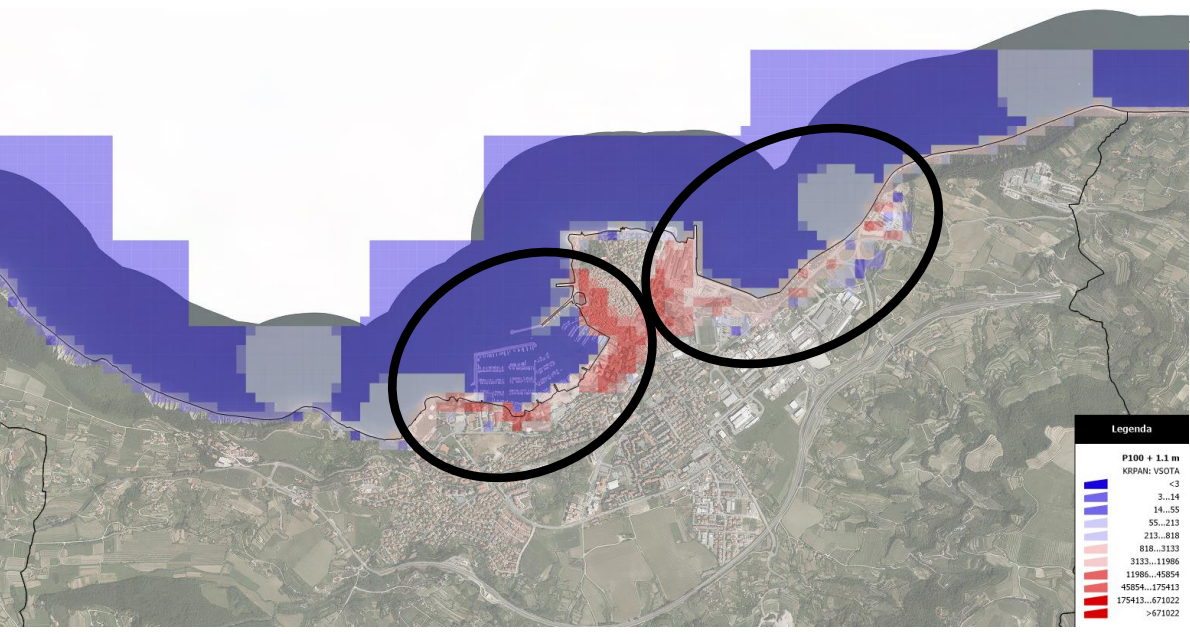
Measures on specific target areas



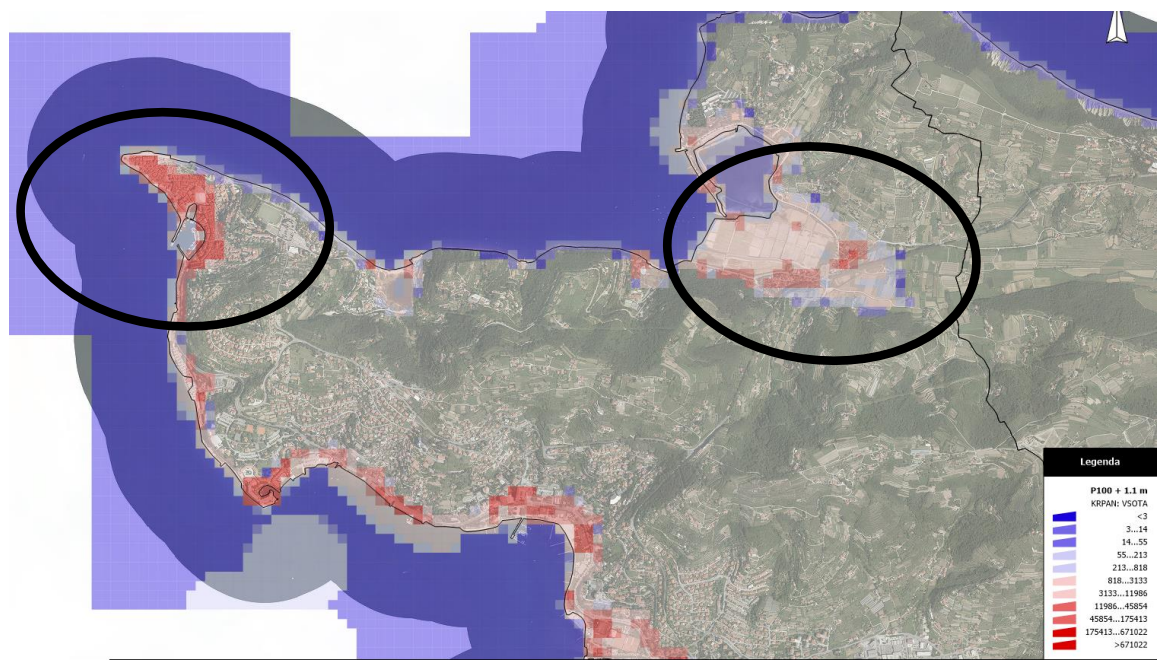
Območji: Mestna občina Koper – Luka Koper in Badaševica



Adaptation measures on specific target areas

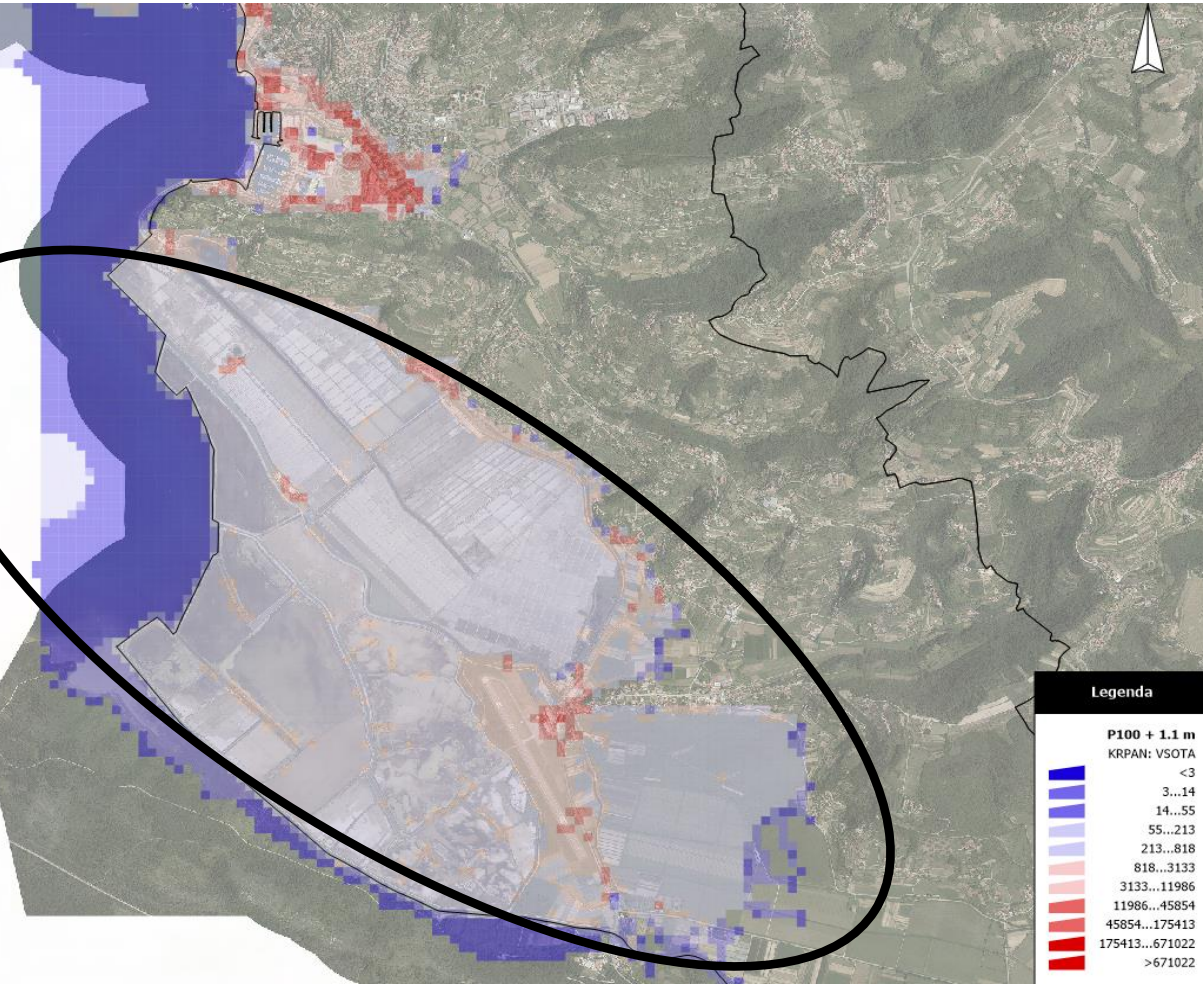


Območji: občina Izola – Ladjedelnica in Marina



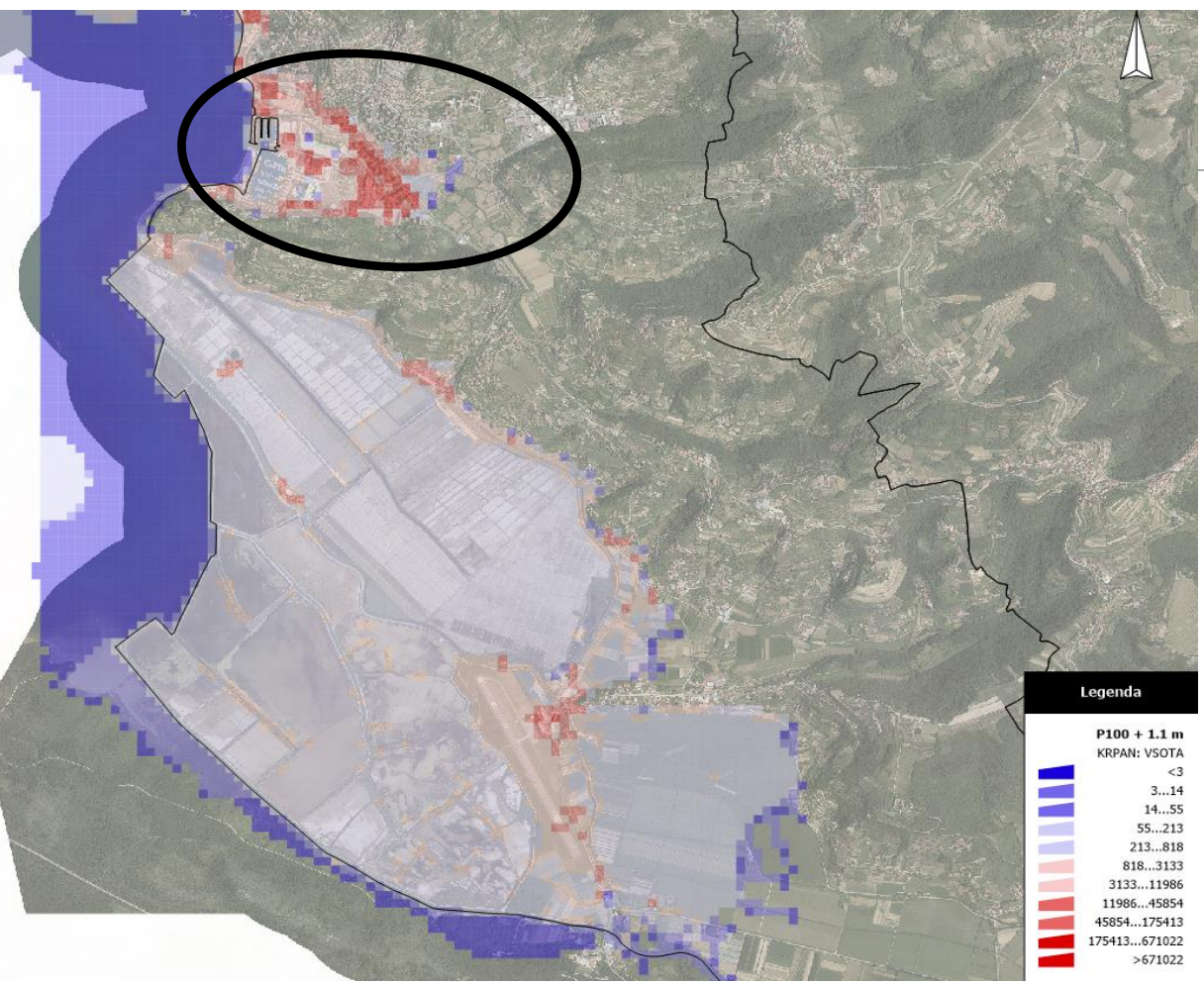
Adapation measures on specific target areas

Območji: občina Piran – Strunjan in Piran



Adapation measures on specific target areas

Območji: občina Piran – Lucija in Sečovlje



Adapation measures on specific target areas

Območji: občina Piran – Lucija in Sečovlje

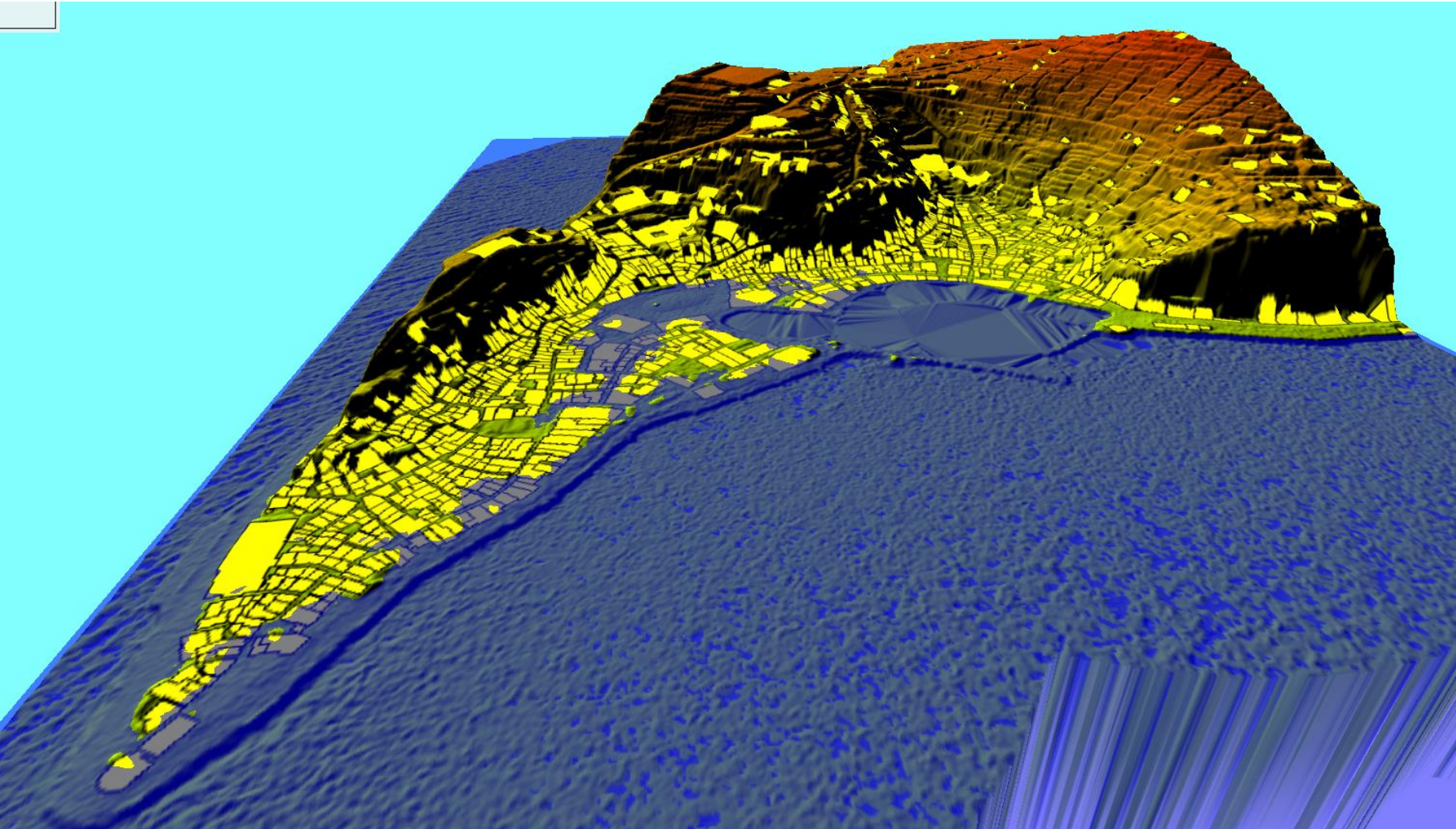


Cost assessment

High, distributed in time



Not only extreme events, gradually also regular tides:

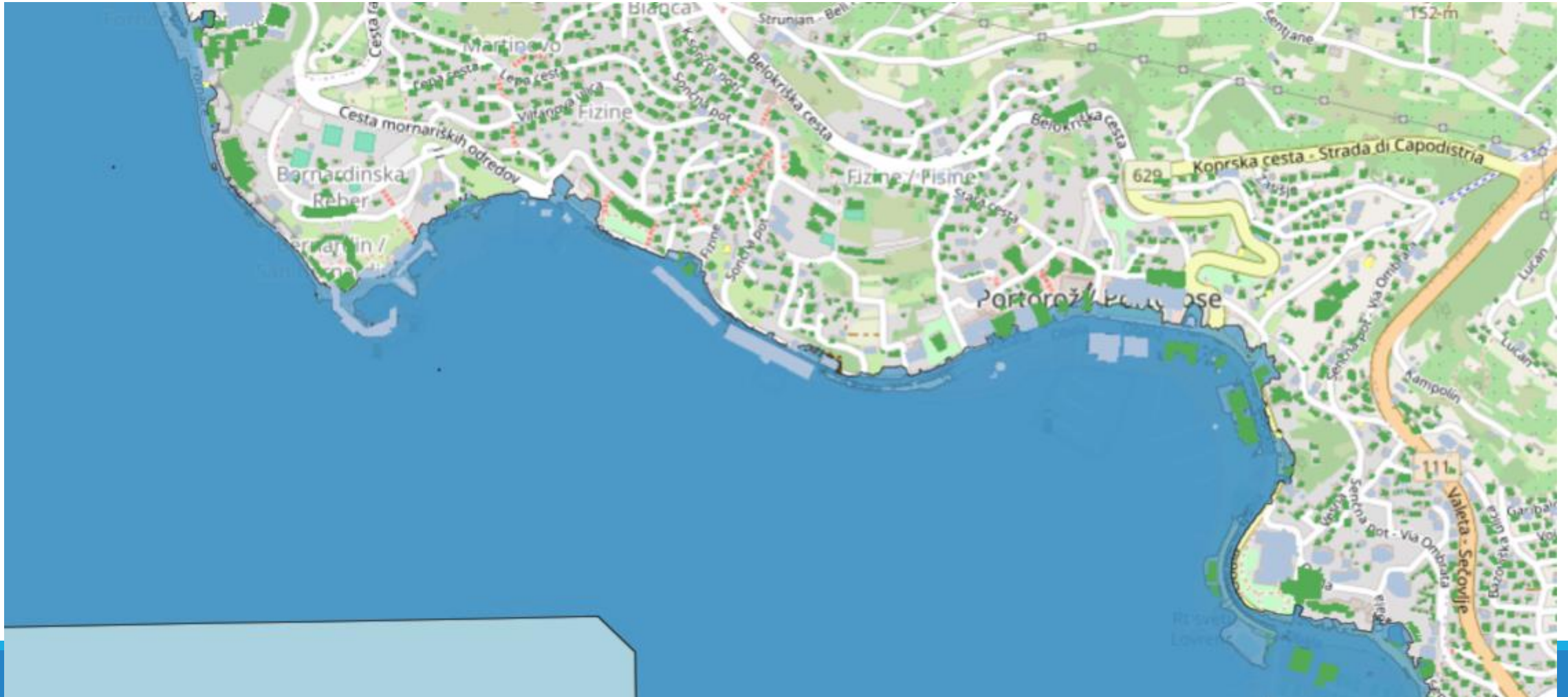


Scenario (+ 0,61 m) +
Regular tide (+0,7 m)

Area of Piran



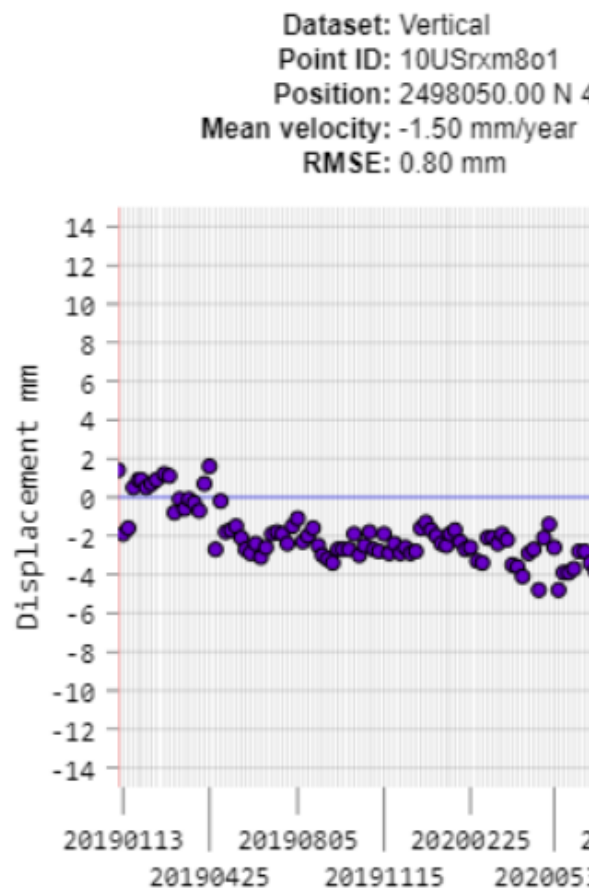
Adaptation outside the specific target areas





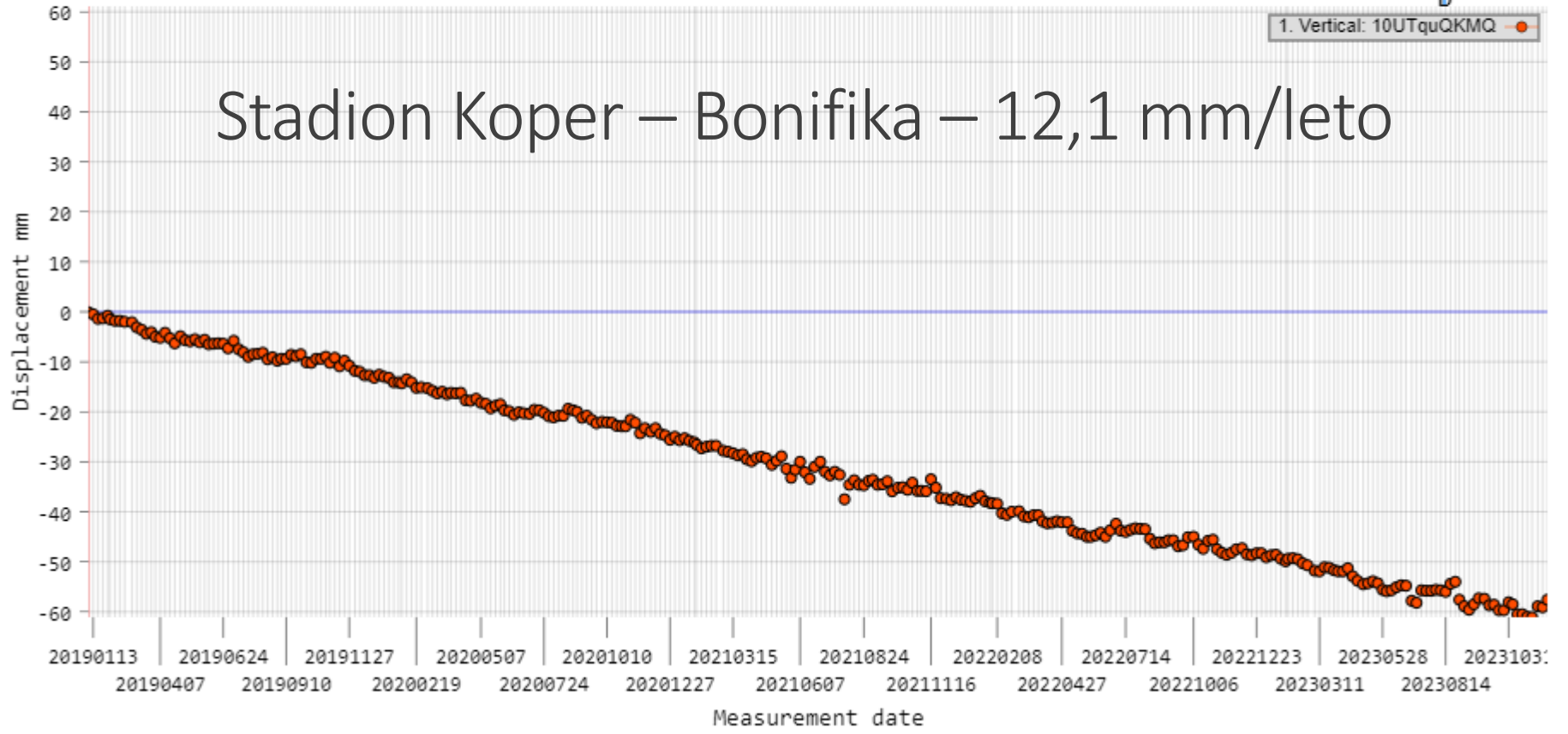
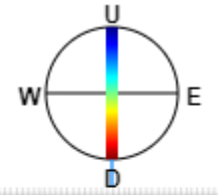
Other impacts – without climate change:

1. Vertical: 10USrxm8o1 ▾



Dataset: Vertical
Point ID: 10UTquQKMQ
Position: 2499350.00 N 4612650.00 E -0.50 m
Mean velocity: -12.10 mm/year
RMSE: 0.90 mm

Incidence angle: 0.00°





Conclusions – being able to discuss about the future – challenge of generations



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Naročnik: Direkcija RS za vode,
Mariborska cesta 88 3000 Celje,
november 2022

Strategija prilagajanja rabe in
dejavnosti na slovenski obali zaradi
vpliva podnebnih sprememb na višino
gladine morja
(strokovne podlage)

Can we discuss about adaptation measures while the sea is rising?