

Training and Capacity Building on the Coastal Climate Change Tool

Oct 2023

**NATIONAL COASTAL CLIMATE CHANGE
VULNERABILITY ASSESSMENT**



forestry, fisheries
and the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA





Training Workshop Agenda

Time	Item	Presenter
08:30 – 09:00	Tea and Registration	All
9h00 – 9h10	Opening & Welcome note	DFFE
9h10 – 9h30	Introductions	All
9h30 – 9h45	Organisation & purpose of the Workshop	DFFE
9h45 – 10h15	Coastal Management Lines: Brief overview on the why and how	CSIR
10h15 – 10h30	WC Province - Progress and Update on the Risk line development & Establishment of Coastal Management Lines	WC DEADP
10h30 – 10h45	Discussion	All
10h45 – 11h00	Tea Break	
11h00 – 12h00	Introduction of the CoVu Indices: - Coastal flood risk - Estuarine erosion risk - Coastal short-term erosion (storm event) - Coastal long-term erosion (SLR related) - Estuarine erosion	CSIR
12h00 – 12h15	Questions on the CoVu indices	All
12h15 – 13h15	Lunch Break	
13h15 – 13h45	Example on how to use the CoVu indices for ICM purposes	CSIR
13h45 – 14h15	Questions	All
14h15 – 14h30	Final remarks & Closure	DFFE

Workshop Dates:

18 Apr 2023: Mthatha
20 Apr 2023: Port Shepstone
16 May 2023: St Lucia
17 May 2023: Richards Bay
18 May 2023: Ballito
04 Sept 2023: Springbok
30 Oct 2023: Strand

Organisation

- PPT presentation will be made available, together with other supporting material
- Presentation slides are numbered, for easier commenting & questions

Purpose of this Training Workshop

To support the DFFE with facilitating Climate Change Adaptation Capacity Development through training workshops in South African coastal District Municipalities

- in order to build the capacity and understanding in the use of the Coastal Climate Change Vulnerability Index and Decision Support Tool in their area of work when planning for long-term climate change adaptation ...
- ... and creating resilient cities and infrastructure along South Africa's coastline.
- Also to integrate the National Climate Change Adaptation Strategy at sub-national level in the Oceans and Coasts sector.



What does South Africa's future look like?

Some scenarios for 2050 from the GreenBook Adaptation Tool

GREENBOOK

adapting settlements for the future

<https://greenbook.co.za/>

The Green Book online tool supports municipal planning with the development of climate resilient settlements. It ultimately facilitates the mainstreaming of climate change adaptation into local government planning instruments and processes.

YOUR GUIDE TO THE GREEN BOOK

A CALL TO ACTION



ABOUT

STORY MAPS

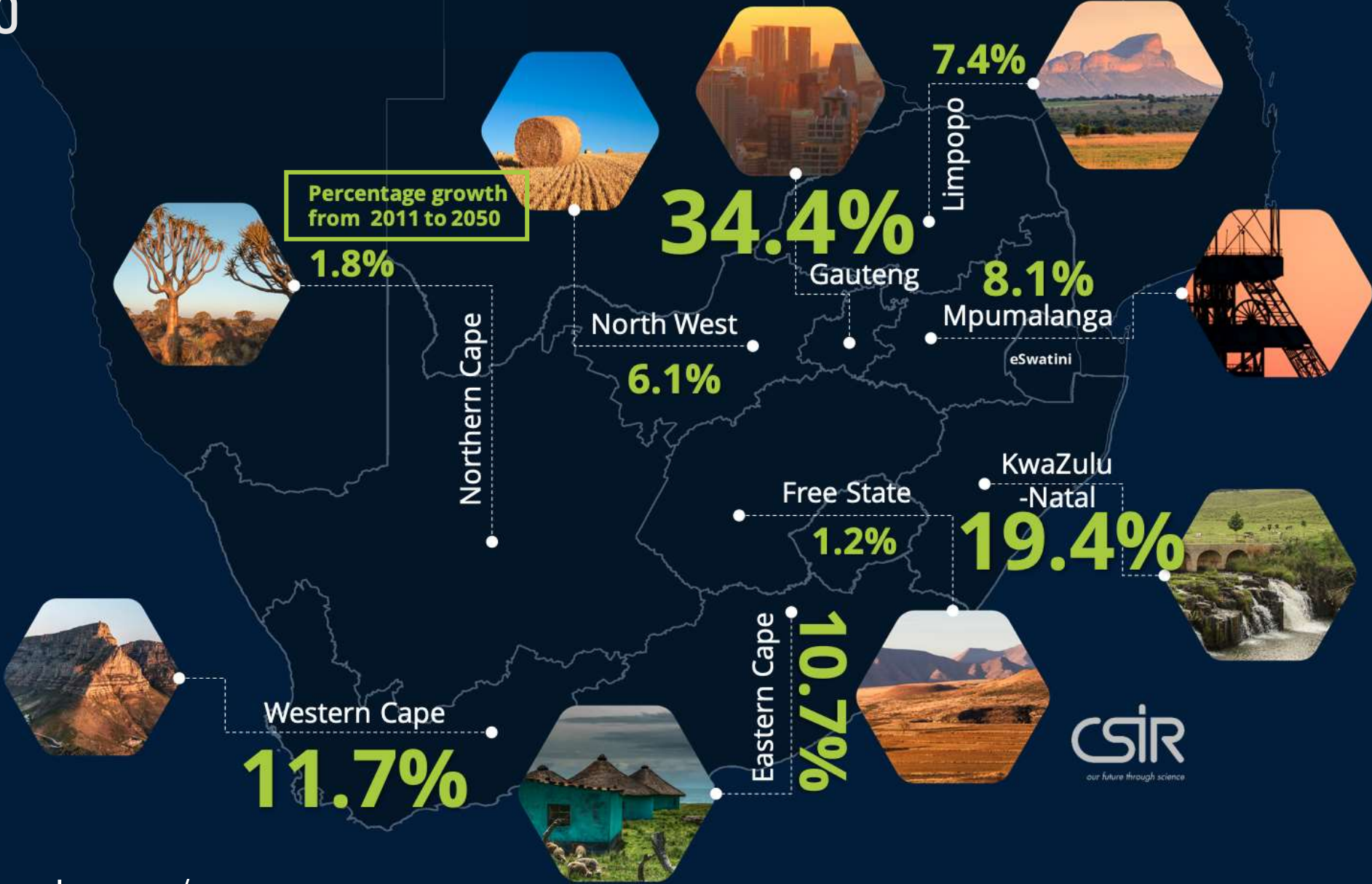
RISK TOOL

ADAPTATION TOOL

TRAINING

CONTACT

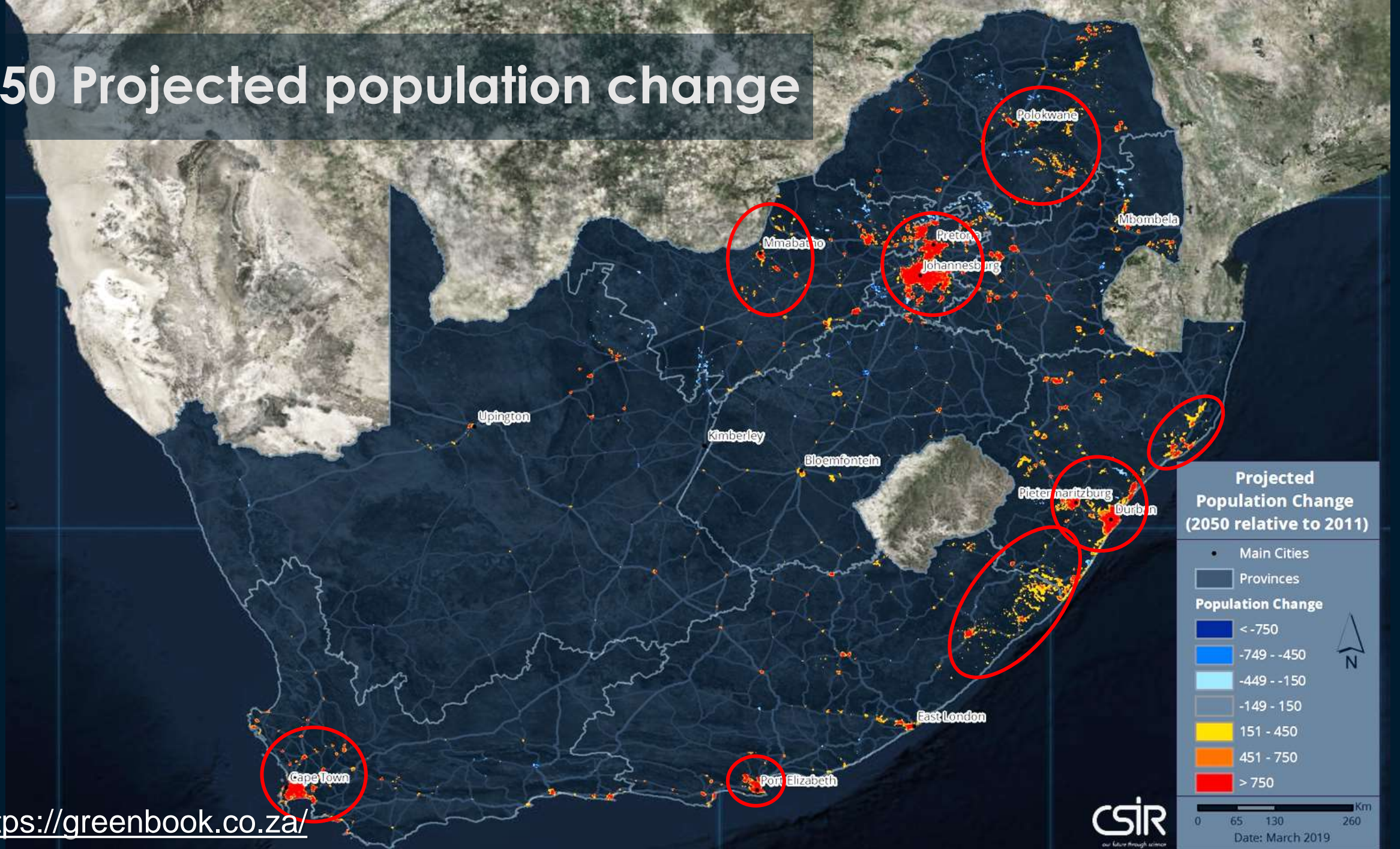
Projected population growth 2011-2050



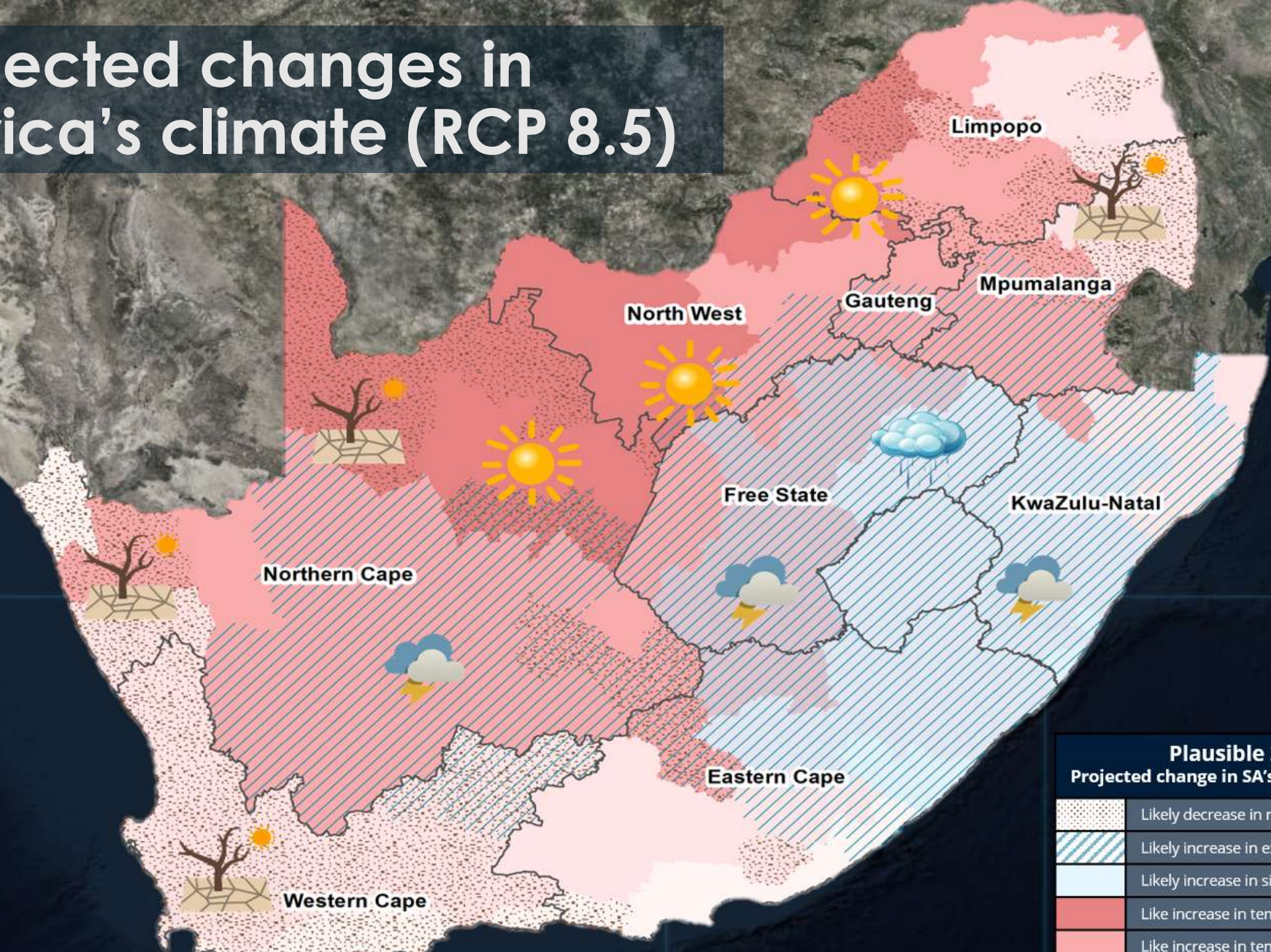
Population growth 1960-2050



2050 Projected population change



2050 Projected changes in South Africa's climate (RCP 8.5)



Plausible 2050:
Projected change in SA's Climate (RCP 8.5)

	Likely decrease in rainfall
	Likely increase in extreme rainfall events
	Likely increase in significant rainfall
	Like increase in temperature > 3°C
	Like increase in temperature 2.5- 3°C
	Like increase in temperature 2- 2.5°C
	Like increase in temperature < 2°C



Coastal Management Lines (CMLs)



- The National Coastal Management Programme identified the **need for effective planning in response to global change** for coastal development. This addresses the more short-term priorities of the NCMP, but also the goals set out in the National Development Plan 2030.
- **CMLs are intended to protect** coastal property, the coastal protection zone, people and infrastructure from the dynamic processes of the coast in the interest of public safety, and preservation of the aesthetic value of the coastal zone.
- The Establishment of **CMLs is a requirement** of the ICM Act (Act 24 of 2008), as amended.
- CMLs are planning tools with the purpose of avoiding or minimizing negative impacts that emanate from natural processes that may have detrimental effects to the people and property, while also serving to protect the coast from human- induced threats to biodiversity and physical features and in so doing, preserve the coastal space.

CMLs: Multi-dimensional & multi-functional

- CMLs **contribute to spatial planning and disaster risk management** and as such, they may have an impact on land ownership and land uses along the coast.
- The cross-cutting nature of CMLs requires that **a range of stakeholders be consulted** through this process.
- *In support of these processes, public engagement is crucial. It will also be beneficial to engage stakeholders that could have a post-planning influence on affected areas e.g. insurance industry and potentially form partnerships to assist in public engagements.*

CMLs: Whose responsibility?

9.2 Responsibilities of the Minister

The Minister, after consultation with the relevant MEC, is responsible for the establishment of CMLs in an area that:

1. Is National Protected Area as defined in the Protected Areas Act (Act No. 57 of 2003);
2. Straddle a coastal boundary between two provinces, such as a self-contained area e.g. estuary; or
3. Extend up to, or straddles, the borders of the Republic such as the Orange River and iSimangaliso Wetland Park.

CMLs: Whose responsibility?

9.2 Responsibilities of the Minister

The Minister, after consultation with establishment of CMLs in an area that:

1. Is National Protected Area as defined in section 57 of 2003);
2. Straddle a coastal boundary between a protected area e.g. estuary; or
3. Extend up to, or straddles, the border of the Orange River and iSimangaliso Wetland Park.

9.3 Responsibilities of the MEC

Once CMLs have been established, they need to be incorporated into spatial planning tools. The following should be taken into account:

1. A MEC must, by notice in the gazette, establish or change coastal management lines.
2. Taking into account that in terms of SPLUMA, the spatial planning mandate at provincial level lies with the Premier, and thus the MEC must consult with the Premier's office to ensure that the MEC's role is reflected in the provincial SDF.
3. The MEC must consult with any other relevant authority in its jurisdiction the coastal management lines to ensure that such lines are incorporated into the relevant Development Plan and the subsequent Spatial Development Framework such as the Spatial Development Framework.
4. The coastal management line(s) must be incorporated for the purpose of overlaying on any relevant spatial planning tool.
5. The resulting coastal management lines must be incorporated in relevant Spatial Development Frameworks.
6. In terms of S84(1)(e) of the ICM Act, the Minister, make regulations to ensure that the MEC, or standards that may have been established, including the granting of permission for the alteration or extension of a structure, a coastal management line or such permission, including the conditions on which such permission may be given.

9.4 Responsibilities of Municipalities

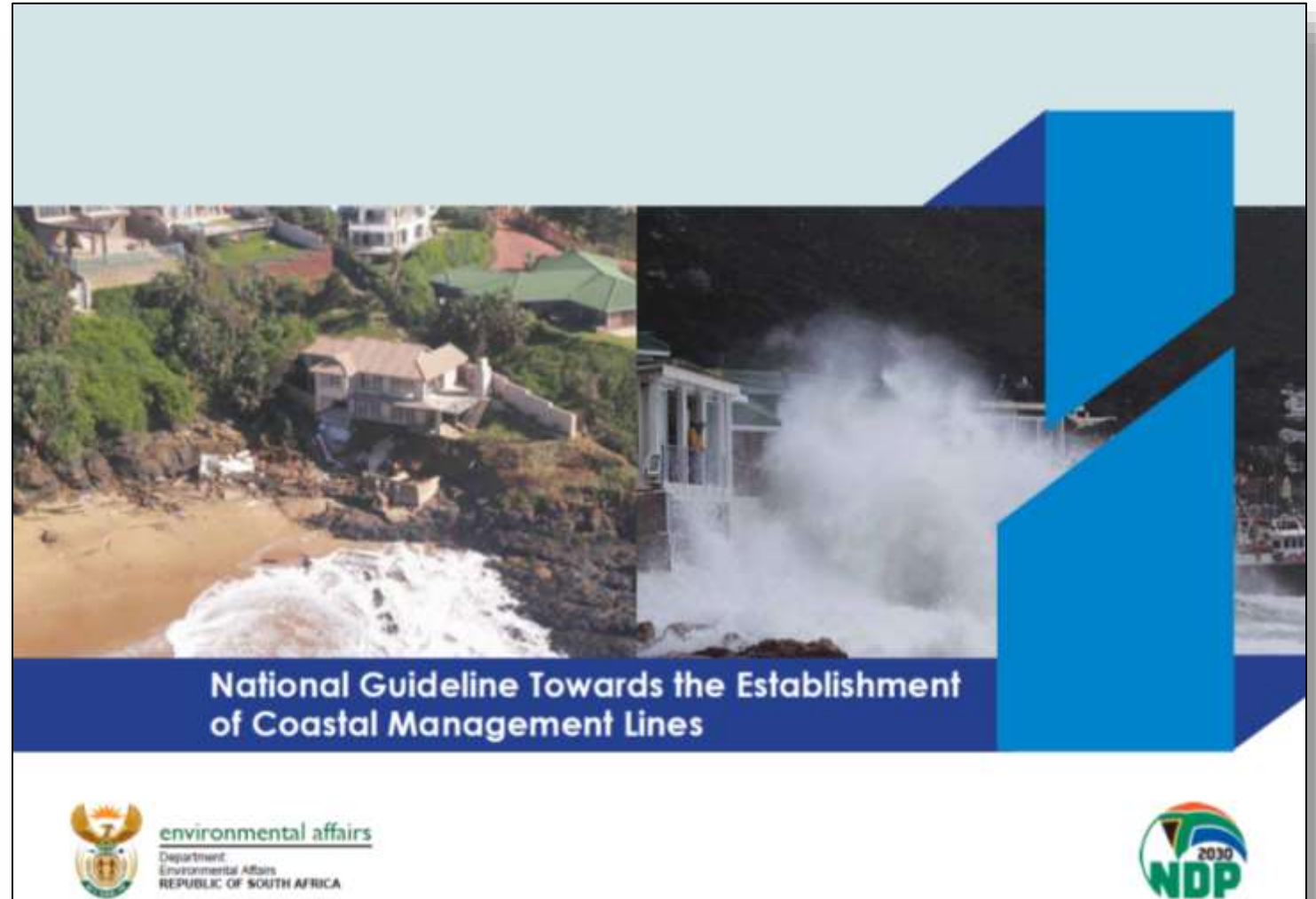
1. A Municipality should fully participate, led by Province, in the process of delineating the CMLs in the areas of their respective jurisdiction and ensure that:
 - a. Affected local communities are encouraged to participate in the process;
 - b. The proposed CMLs are aligned with the strategic development goals and objectives of that municipality;
2. A municipality must ensure that any coastal management line that has been established in its area of jurisdiction is incorporated in the relevant:
 - a. Municipal Spatial Development Framework;
 - b. Land Use Scheme; and
 - c. Any other relevant tools related to spatial development planning.

How to establish CMLs? The National Guideline

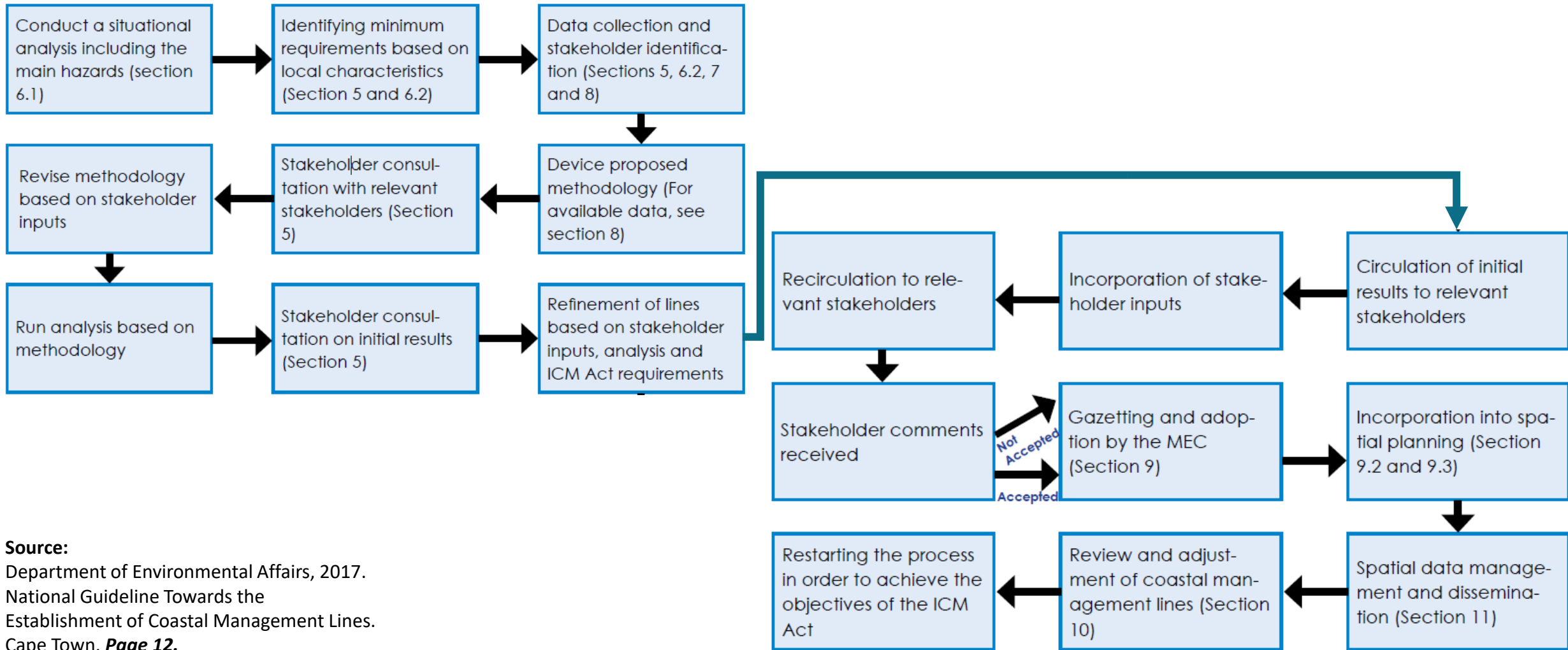
Purpose:

to provide guidance to Lead Agencies of Coastal Provinces on the establishment of Coastal Management Lines by the MECs

In the context of 'risk', it also aims to create a broad, basic understanding of disaster risk management and related concepts.



Recommended Process for the Establishment of CMLs



Source:
 Department of Environmental Affairs, 2017.
 National Guideline Towards the
 Establishment of Coastal Management Lines.
 Cape Town. **Page 12.**

CMLs: Situational Analysis

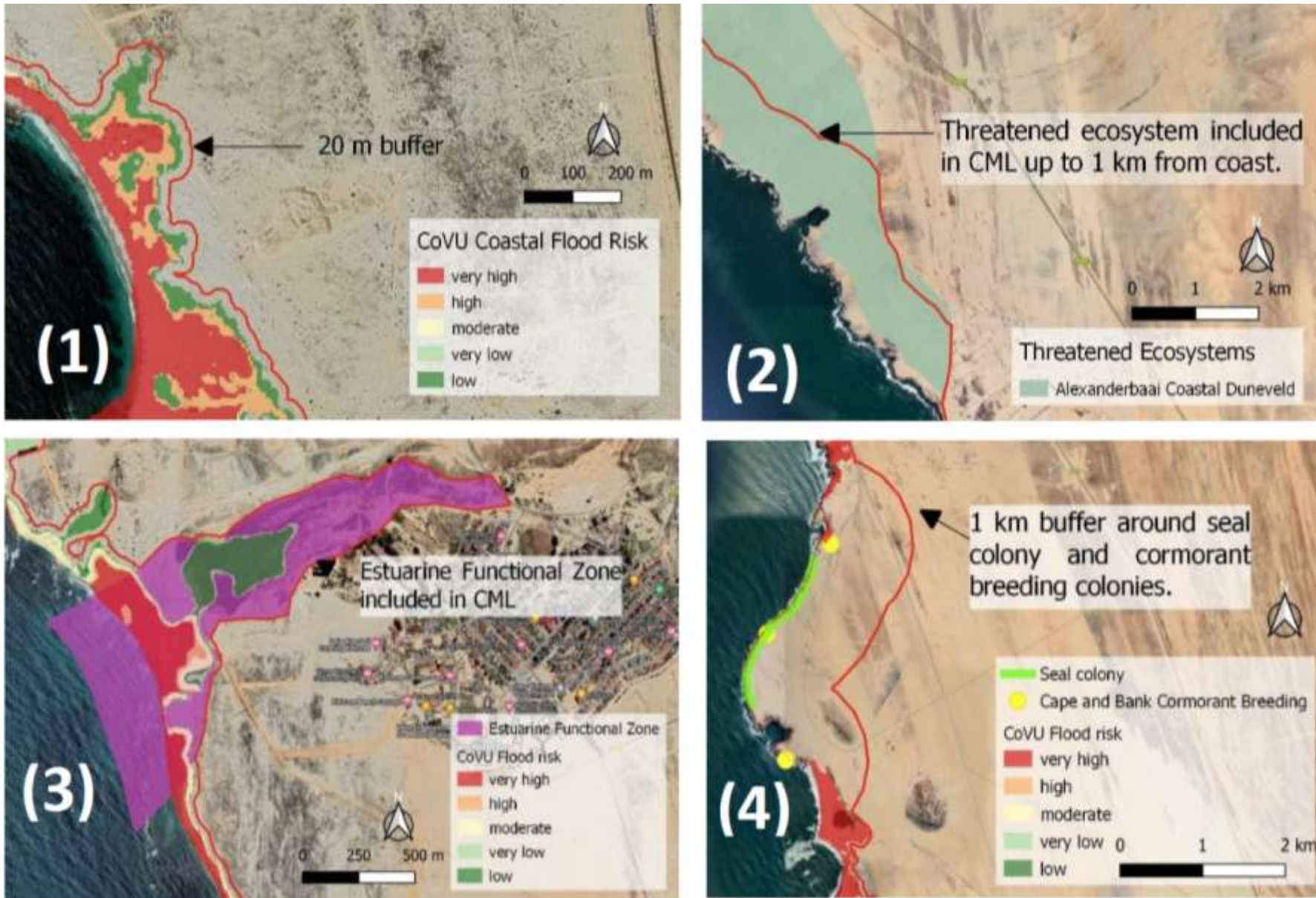
Legal	<ul style="list-style-type: none">• National Legislation, Provincial Legislation, Municipal By-Laws
Physical	<ul style="list-style-type: none">• Coastal hazards such as erosion, sand movement, inundation, storm surge etc.
Environmental	<ul style="list-style-type: none">• Biodiversity and conservation requirements
Heritage	<ul style="list-style-type: none">• Sites and areas of preservation/cultural significance e.g caves, baptism areas, hiking trails
Social	<ul style="list-style-type: none">• Development rights, coastal access, existence of rural or cultural dwellings
Economic	<ul style="list-style-type: none">• Activities which are reliant or proximity to the sea e.g ecotourism

Source:

Department of Environmental Affairs, 2017. National Guideline Towards the Establishment of Coastal Management Lines. Cape Town.

Figure 8: General considerations for the establishment of coastal management lines

The Northern Cape draft CML



Source:



agriculture, environmental affairs,
rural development and land reform
Department, agriculture, environmental affairs,
rural development and land reform
NORTHERN CAPE PROVINCE
REPUBLIC OF SOUTH AFRICA

Northern Cape Coastal Management Line Methodology

Prepared by the Northern Cape Coastal Management Line Task Team:

Mr. Bronwen Cornelissen
Ms. Adeleen Cloete
Ms. Louise Goldenhuys
Mr. Enrico Gosthuysen

2nd Draft, August 2022

Figure 5 Spatial representation of input layers that form the CML

Limitations & way forward (WC CMLs)

*“The scale at which this and similar projects are undertaken means that **some data gaps or uncertainties remain unresolved**. Although measures were put in place to minimise the effect that such uncertainties had on the overall project, a need remains for further refinement over time.*

Some of the core assumptions made in this project involved projections of climate change (in particular, sea level rise) for the West Coast. Although there is no doubt that climate change is taking place, projections for specific locations are still not very accurate due to the inherent complexities of climate, weather and marine systems. Internationally accepted estimates of sea level rise were therefore employed. In a similar vein, projections of storm wave height increase used for other long-term risk studies on the West Coast were also used in this study as a way to build consistency between similar studies.

*[...] **Specific studies on individual properties could be recommended before any final decisions are made regarding proposed development or restrictions thereof**. This is necessary in order to confirm the projected rates of erosion and to tailor the proposed development designs to the risks emanating from sea level rise, erosion, wave action, inundation etc.”*

Source:

Coastal Management/Set back Lines for the West Coast District. Final Project Report.

Western Cape Department of Environmental Affairs & Development Planning. July 2014, p. 38.

State of CML & Risk line development in the workshopped District

Please share.



CMLs: Situational Analysis

Legal	<ul style="list-style-type: none">• National Legislation, Provincial Legislation, Municipal By-Laws
Physical	<ul style="list-style-type: none">• Coastal hazards such as erosion, sand movement, inundation, storm surge etc.
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← Focus of our Coastal Climate Change Vulnerability Index and Decision Support Tool

Source:

Department of Environmental Affairs, 2017. National Guideline Towards the Establishment of Coastal Management Lines. Cape Town.

Figure 8: General considerations for the establishment of coastal management lines

Previous coastal vulnerability work at national level

Coastal Vulnerability Index Assessment (DEFF, 2011-2014)

- 500m resolution, based on Delft hydrodynamic modelling and literature. Conducted for all coastal areas inhabiting ports, harbours and major urban developments, i.e. for about 70% of the South African coastline. Output: wave run-up for five defined storm scenarios and two future sea level rise scenarios assigned to the coastline.
- Disadvantages:
 - the inland inundation area in the case of these storm events was not assessed;
 - 30% of coast were not assessed
 - Relatively coarse resolution of outputs

Previous coastal vulnerability work at national level

National Coastal Assessment (DEFF, 2017-2020)

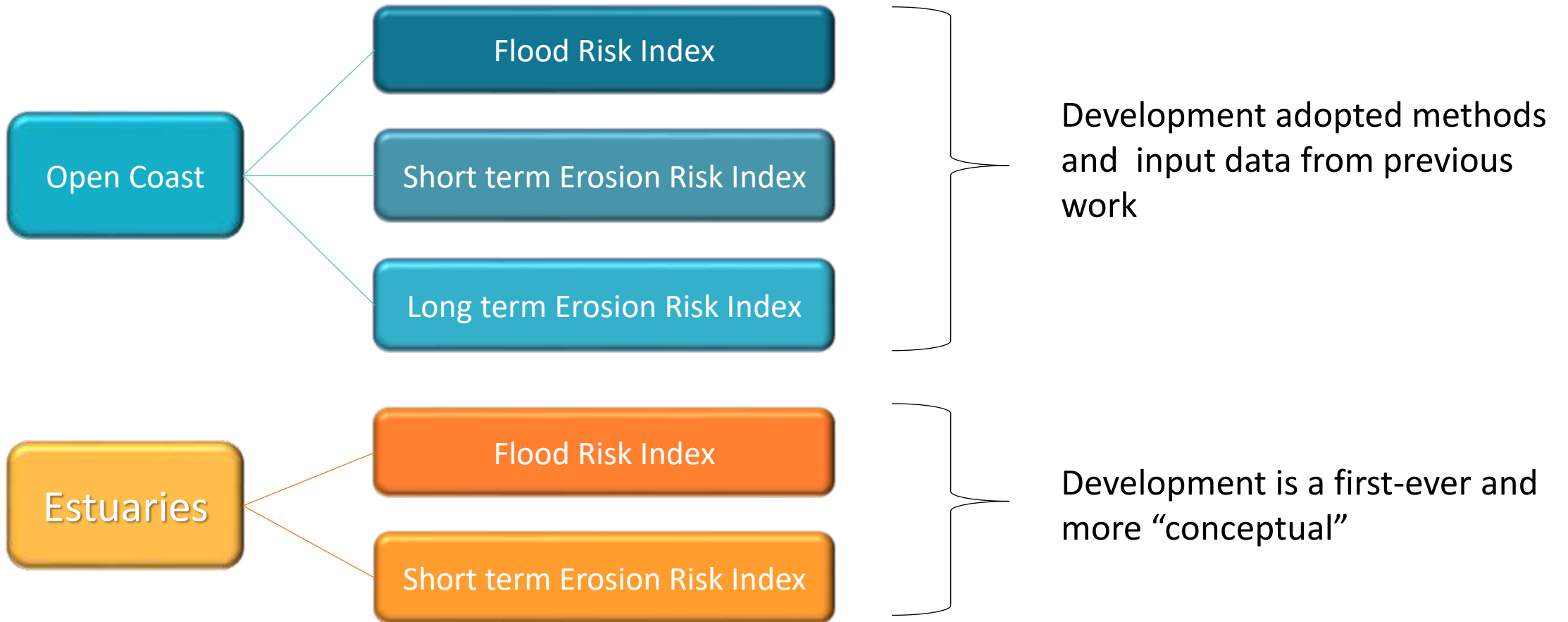
- Interdisciplinary status-quo assessment of the SA coastal space as relevant to ICMA, i.t.o. physical, chemical, biological and socio-economic aspects.
- Coastal flood and erosion were assessed using simplistic GIS methods, expert input and previous experience
- Whole SA coastline was assessed
 - Disadvantages:
 - No hydrodynamics considered
 - Status quo, i.e. not looking forward i.t.o. climate change and population dynamics
 - Flooding was modelled using only sandy-shore conditions (sub-optimal for rocky shores)
 - Estuaries were not assessed (scale issues)

National Coastal Climate Change Vulnerability Assessment 2019-2020

1. Developed a geospatial index for the vulnerability of SA's coasts in terms of climate change impacts. These are impacts primarily associated with flooding (through storm surge, wave runup and sea level rise) and shoreline erosion;
2. Developed an interactive decision support tool (DeST) that allows the users, primarily government officials in all spheres of government, to view and assess the various aspects of coastal risk and use of the spatially explicit information for spatial planning and climate change adaptation, and
3. Integrated the Index and DeST with existing tools or platforms.

→ Respond to the urgent need for a **National Coastal Spatial Vulnerability Index** to inform coastal spatial management in response to the national climate change adaptation strategy.

Technical background on indices



Key input parameters

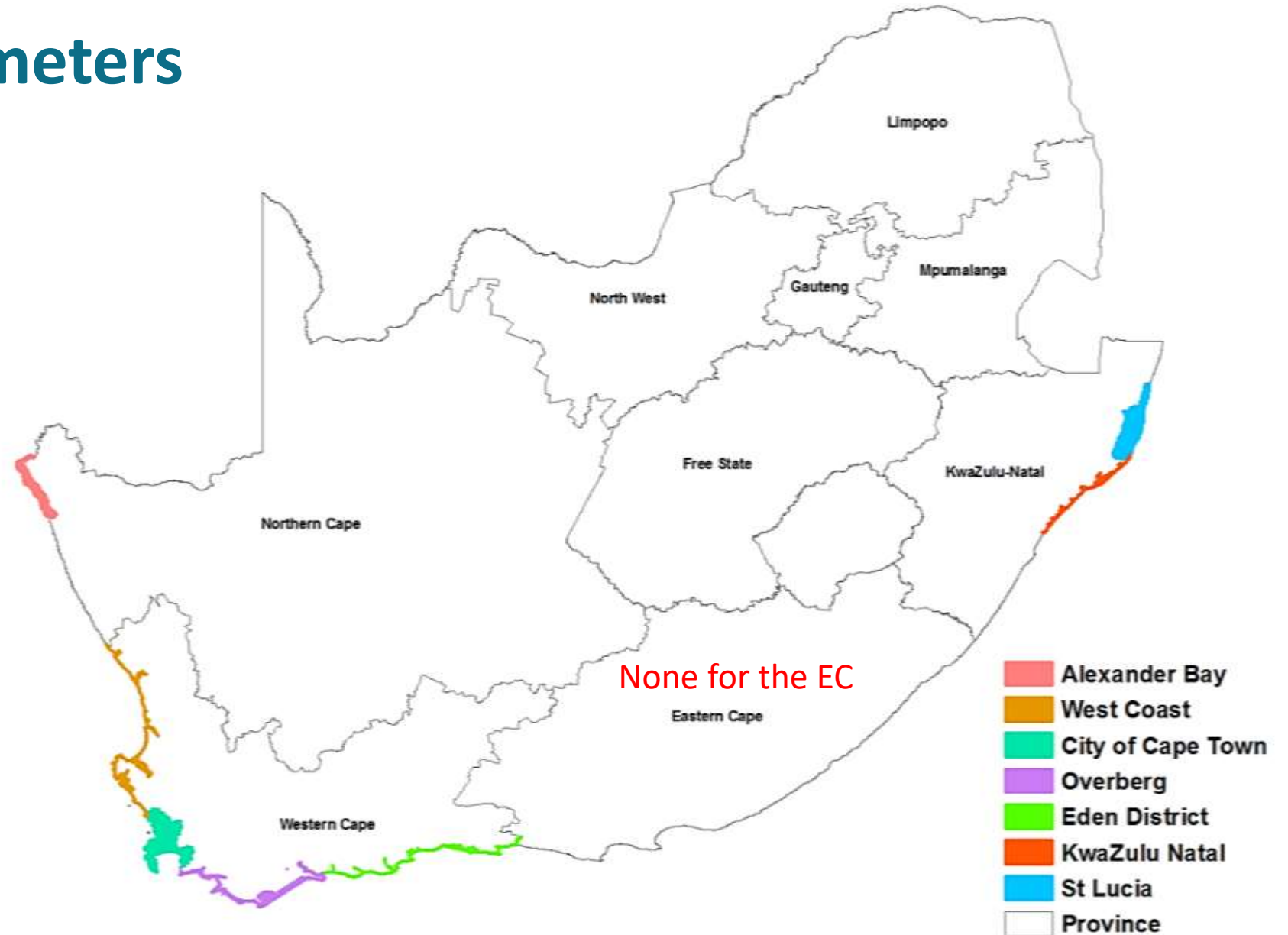
- **Reference coastline**
National_Coast_Types.shp
from NBA 2011



Key input parameters

- Reference coastline
- **Topographic elevation:**
LiDAR & SUDEM fusion
5x5 m pixel size

Coastal LiDAR coverage
for this project



Key input parameters

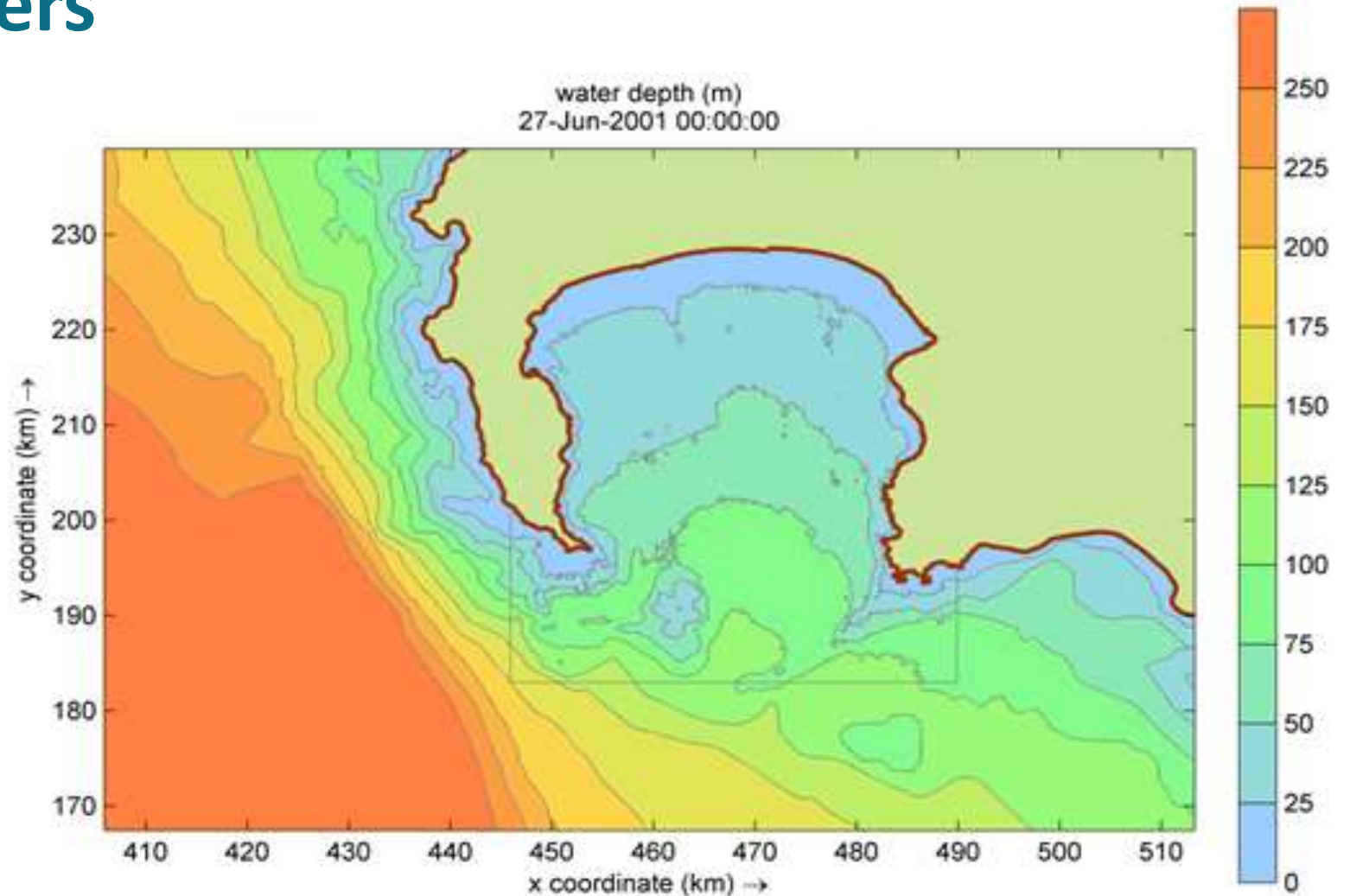
- Reference coastline
- Topographic elevation
- **Sea level rise scenarios**

SLR scenario (m)	Expected by year*
0.15	2030
0.35	2050
0.5	2070
1.0	2100
2.0	2200

**according to projections for RCP8.5 at 50%; Kopp et al. (2017).*

Key input parameters

- Reference coastline
- Topographic elevation
- Sea level rise scenarios
- **Bathymetry**
nearshore bathy interpolated from 15 m bathy contour from nautical charts



Key input parameters

- Reference coastline
- Topographic elevation
- Sea level rise scenarios
- Bathymetry
- **Wave modelling & return periods**

Extreme events

1:10 yrs, 0.3 m SLR

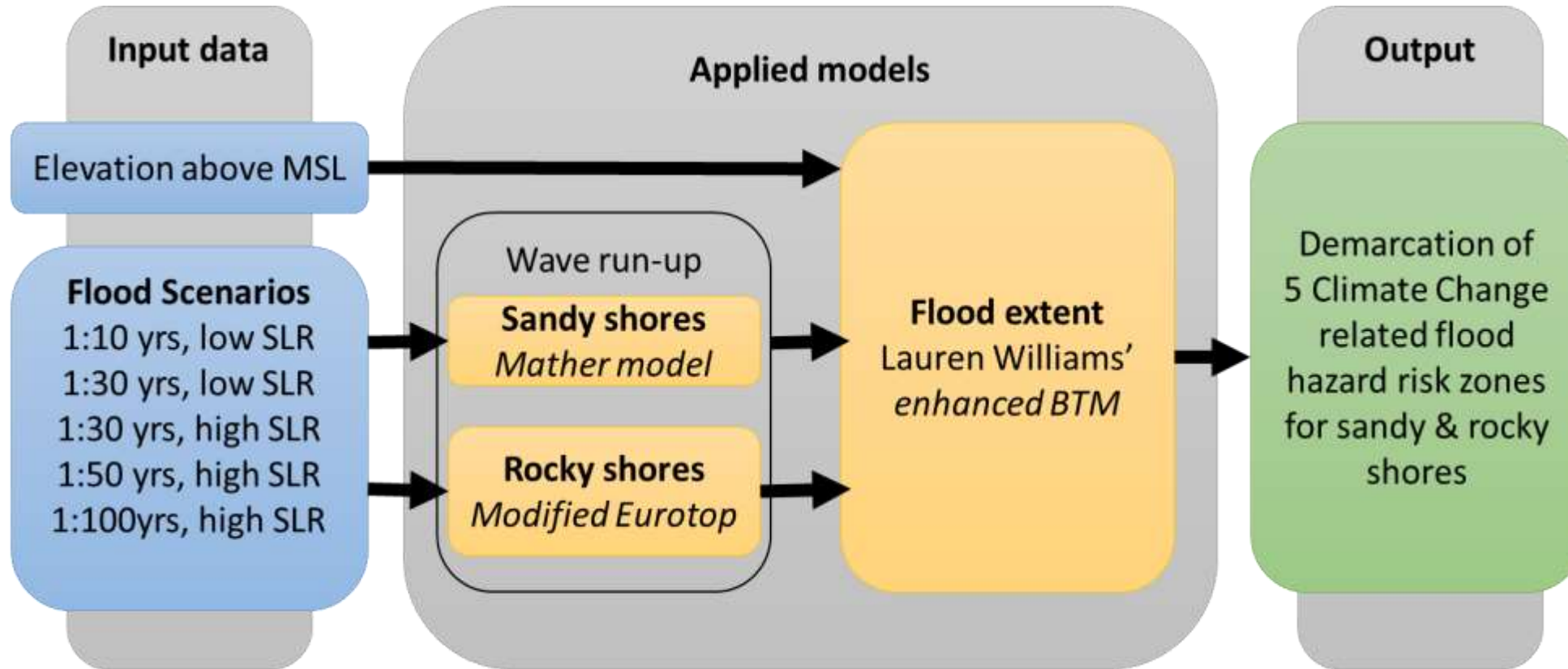
1:30 yrs, 0.3 m SLR

1:30 yrs, 1.0 m SLR

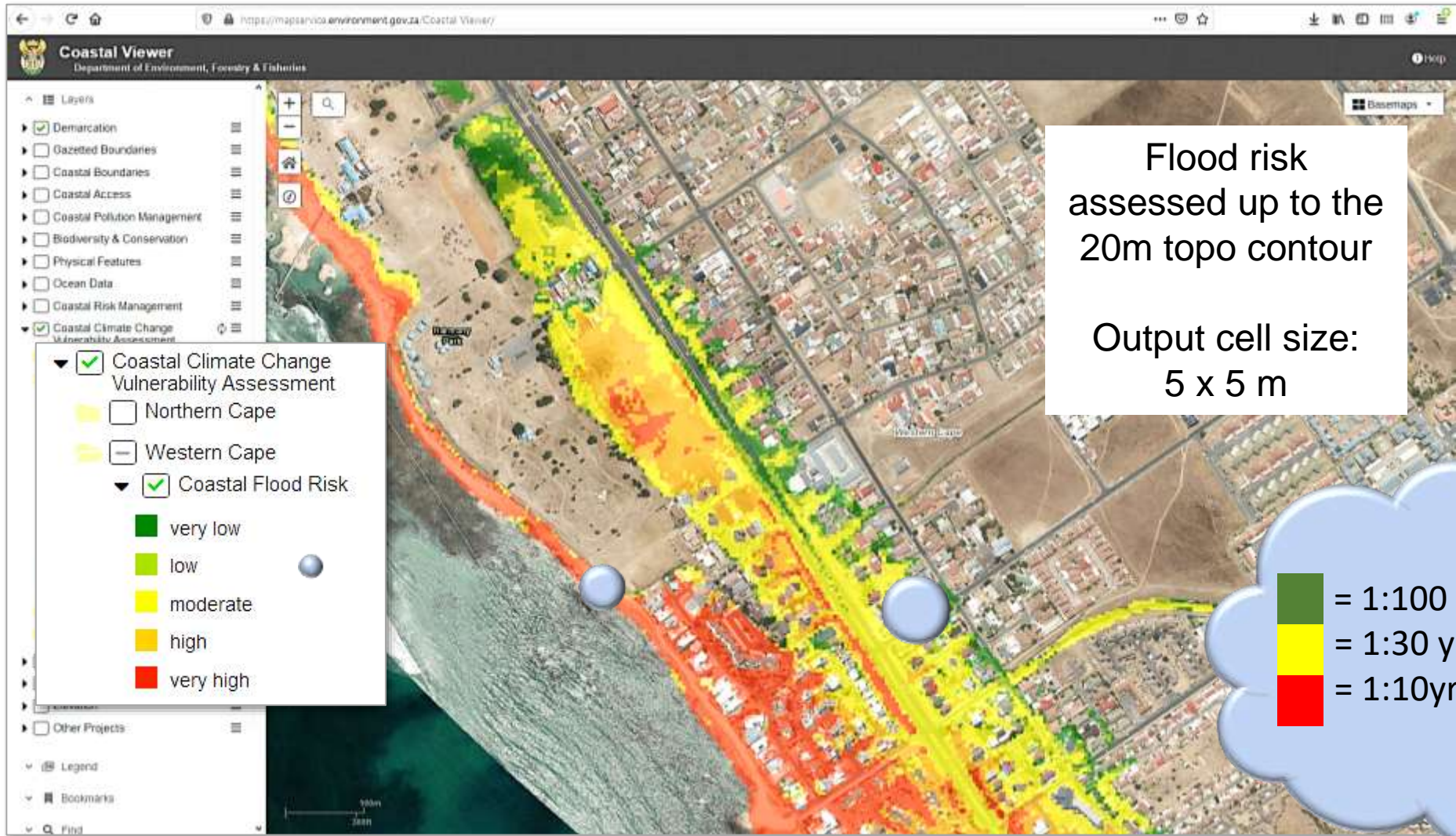
1:50 yrs, 1.0 m SLR

1:100 yrs, 1.0 m SLR

Open Coast Flood Risk Index



Open Coast Flood Risk Index



How can we validate the modelling results?

Challenge:

modelled scenarios
lie in the **Future**

Flood Scenarios

1:10 yrs, low SLR
1:30 yrs, low SLR
1:30 yrs, high SLR
1:50 yrs, high SLR
1:100yrs, high SLR



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1:10 yrs, low SLR
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1:50 yrs, high SLR
1:100yrs, high SLR

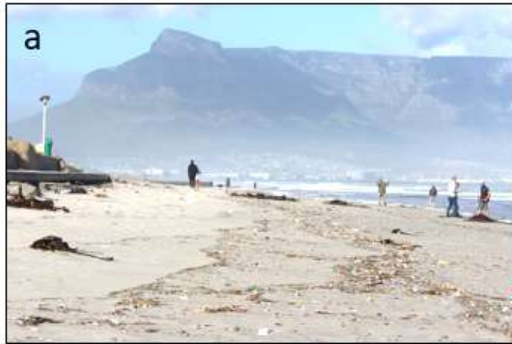


Solution:

Do not validate the **results**, but the **approach**.

Re-run the flood model for a past storm event for which validation data are available from ground observations.

BscHons thesis on storm from 16 Sept 2023



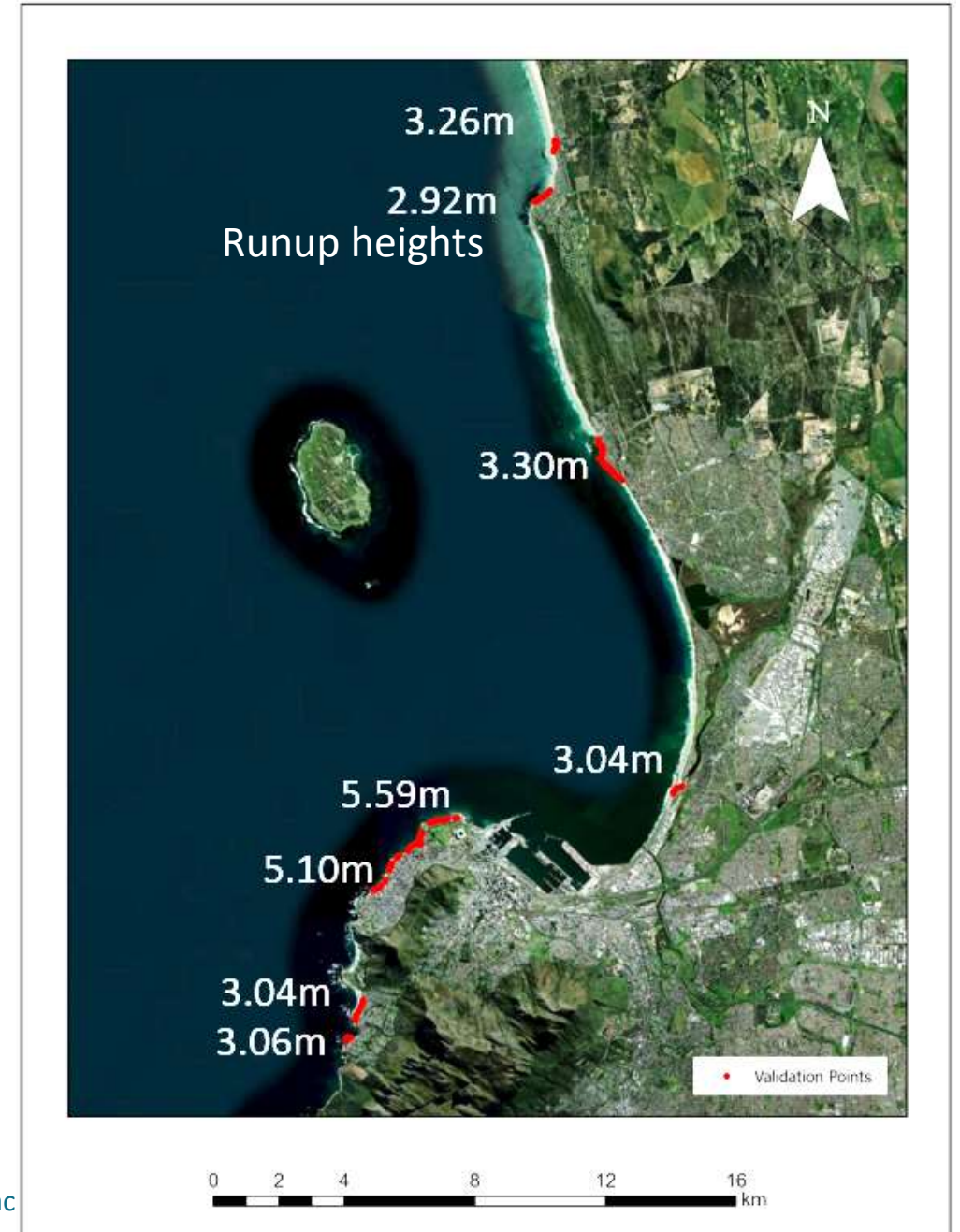
*Joshua van Coller:
Assessing the
Enhanced Bathtub
Model for Coastal
Flood Risk
Assessment in Table
Bay. BSc Hons thesis
Stellenbosch
University,
Department for
Geography &
Environmental
Studies, to be
completed in Nov.
2023*

Model setup

Input data for enhanced bathtub model:

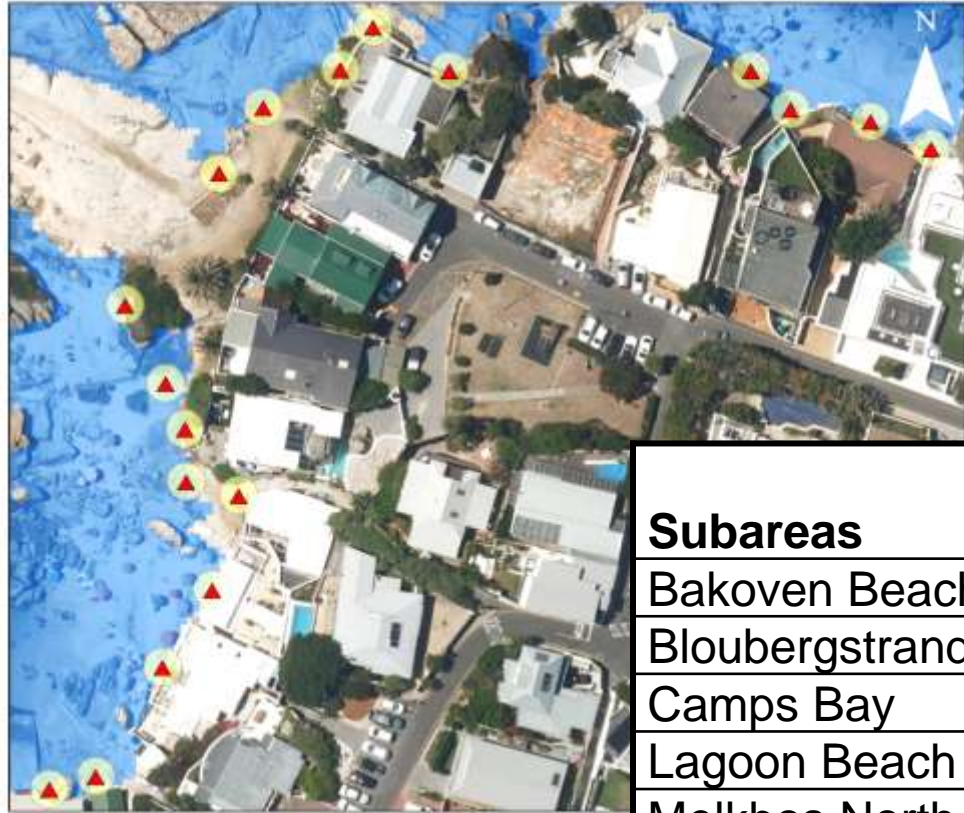
- CoCT Lidar from 2021 and 2023
- Roughness coefficient to best representative local conditions
- Wave-runup heights from local post-storm ground observation (instead of hydrodynamic and future scenarios)

Source: Joshua van Coller: **Assessing the Enhanced Bathtub Model for Coastal Flood Risk Assessment in Table Bay**. BSc Hons thesis Stellenbosch University, Department for Geography & Environmental Studies, to be completed in Nov. 2023



Results

Bakoven & Beta Beach



Subareas	Average of Error (m)
Bakoven Beach	1,07
Bloubergstrand	5,38
Camps Bay	2,27
Lagoon Beach	0,63
Melkbos North	4,46
Melkbos South	2,76
The Promenade	4,63
Sea Point	6,06

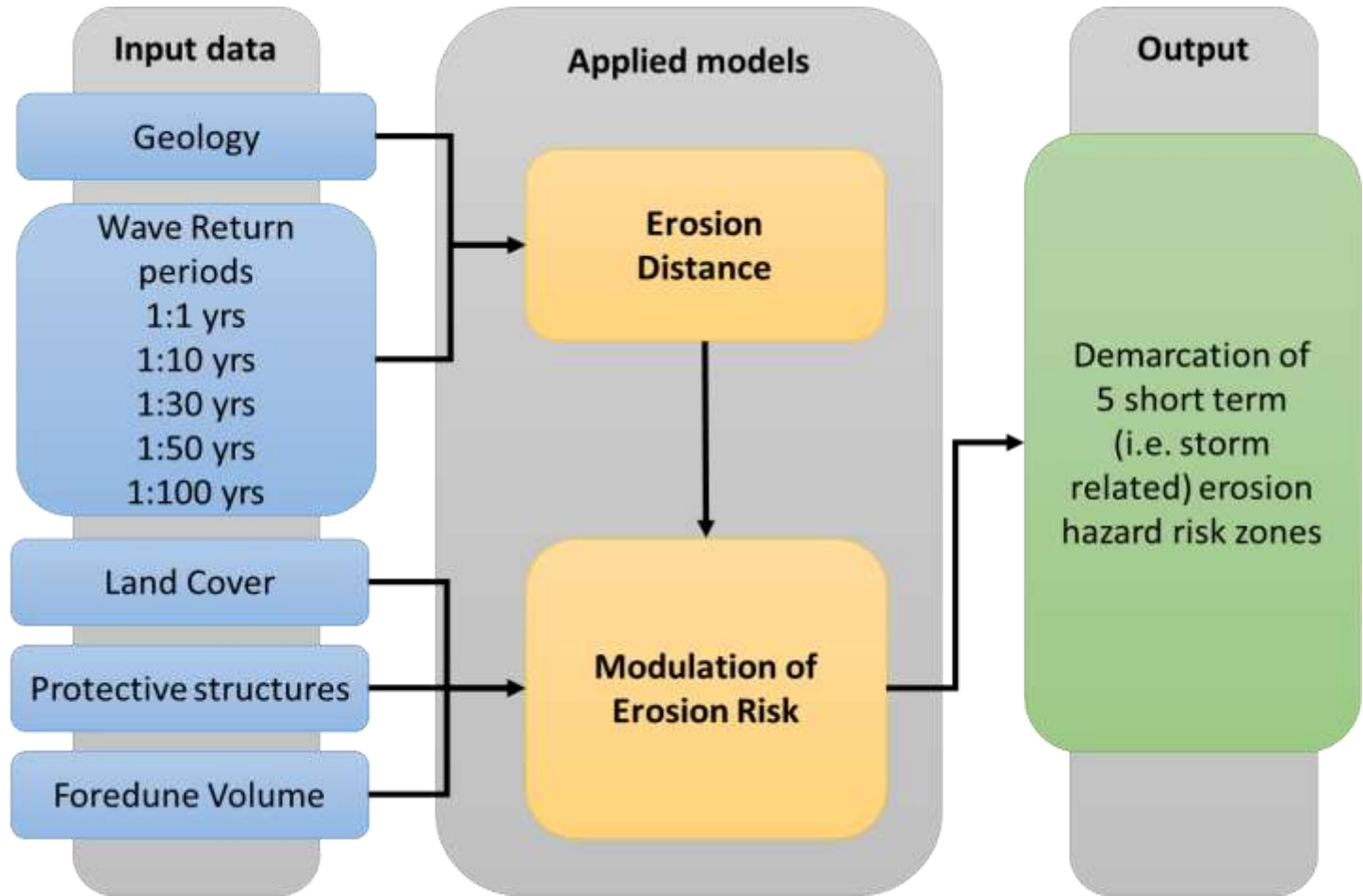
Accuracy Matrix	
Actual/Predicted	Predicted
Actual Positives	
Actual Negatives	
OA	0.94

Sea Point



Accuracy Matrix		Actual/Predicted	Predicted Positives	Predicted Negatives
Actual Positives			22	9
Actual Negatives			16	0
Overall Accuracy				0.47

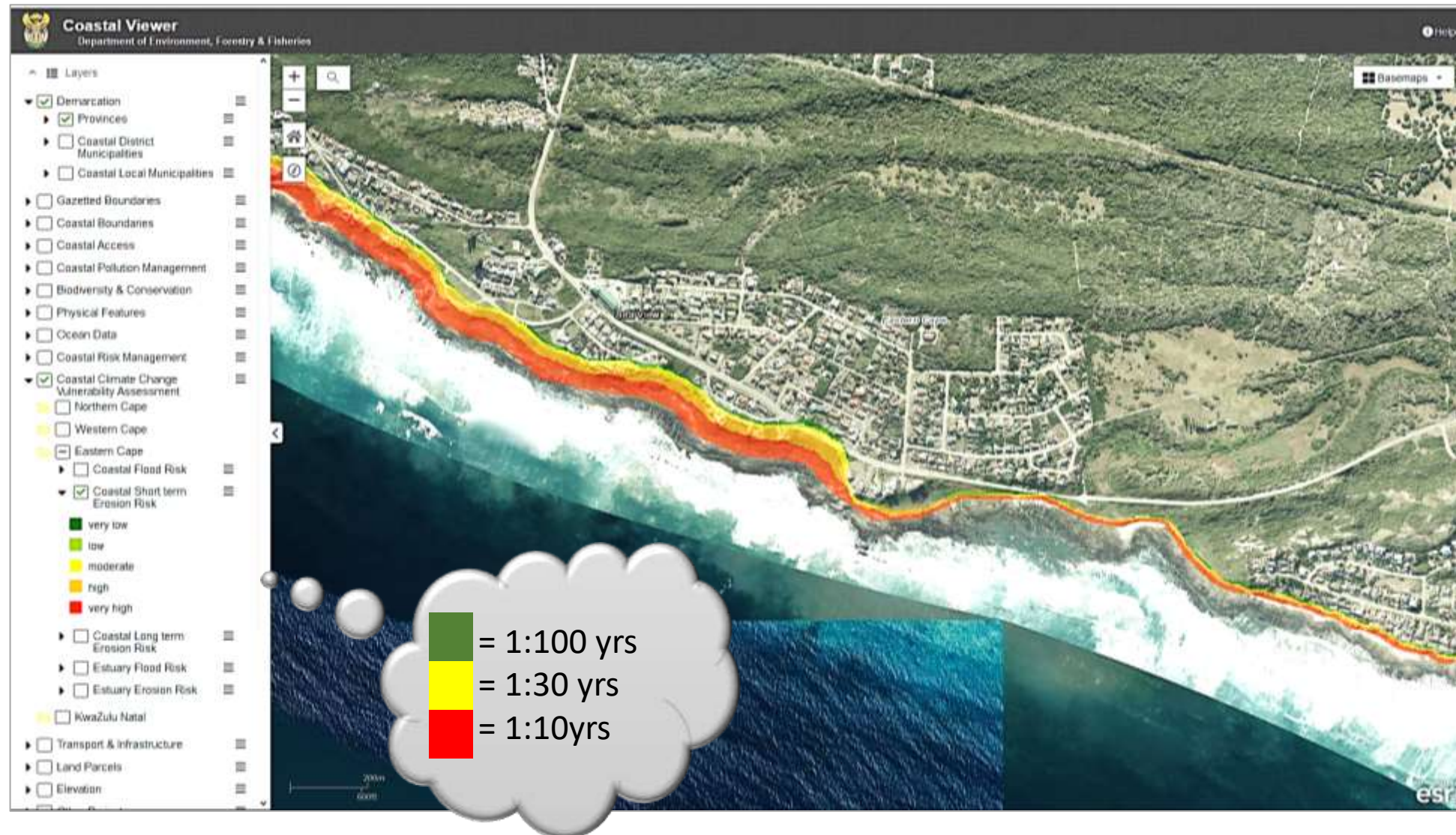
Open Coast Short-term Erosion Risk Index



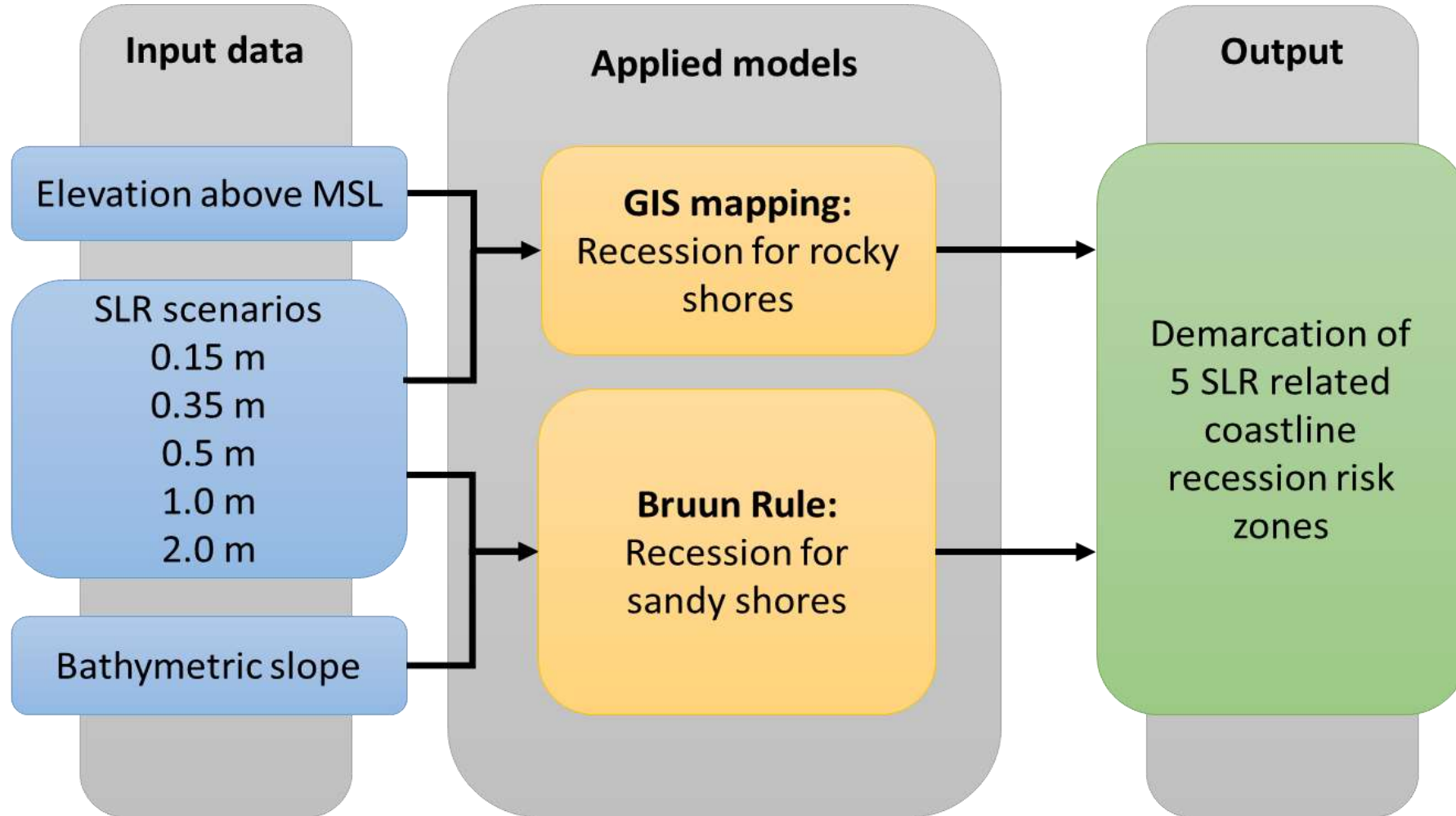
Open Coast Short-term Erosion Risk Index



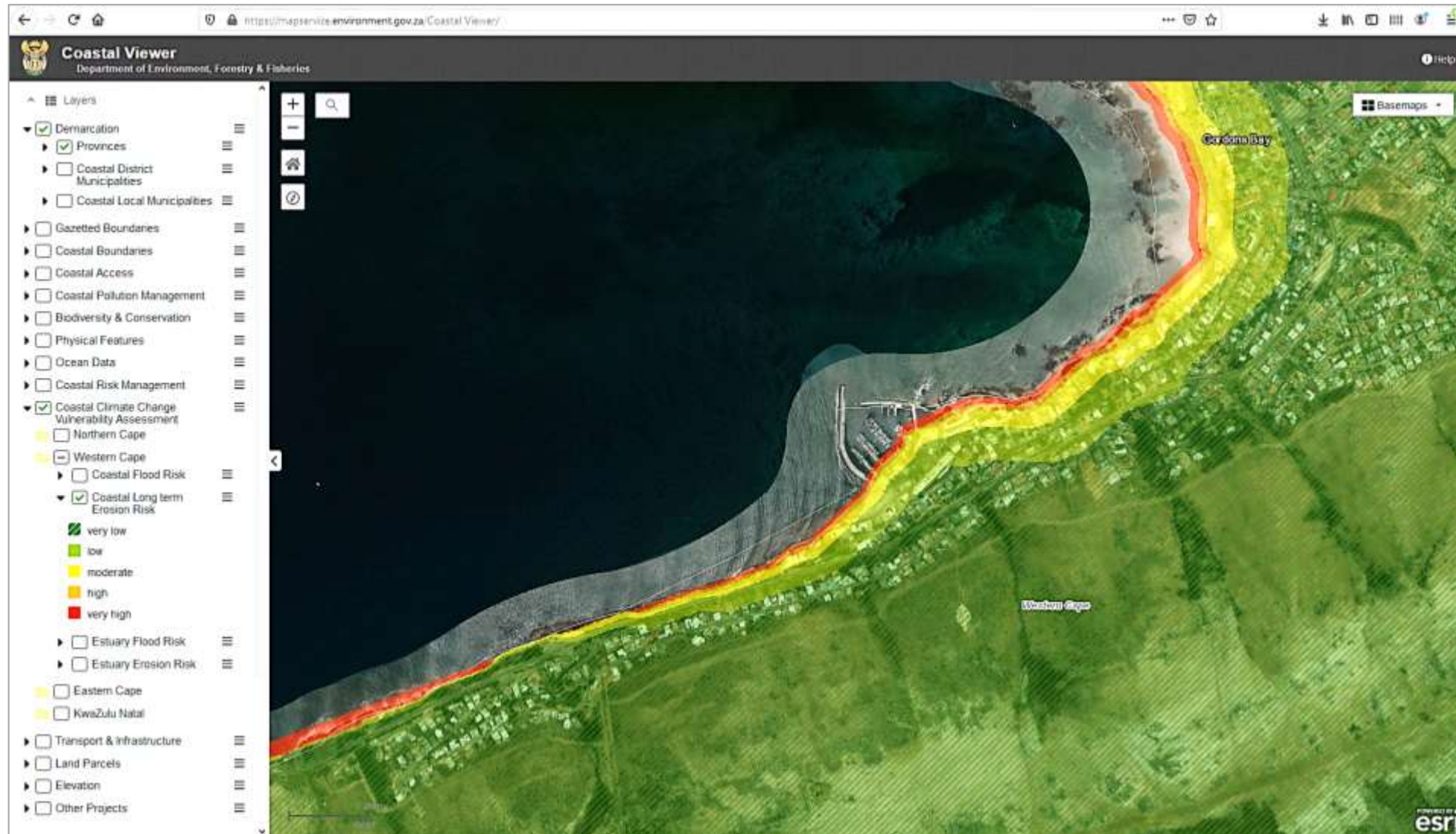
Open Coast Short-term Erosion Risk Index



Open Coast Long-term Erosion Risk Index



Open Coast Long-term Erosion Risk Index



Estuaries Flood Risk Index

This index assesses flood risk originating from the inland

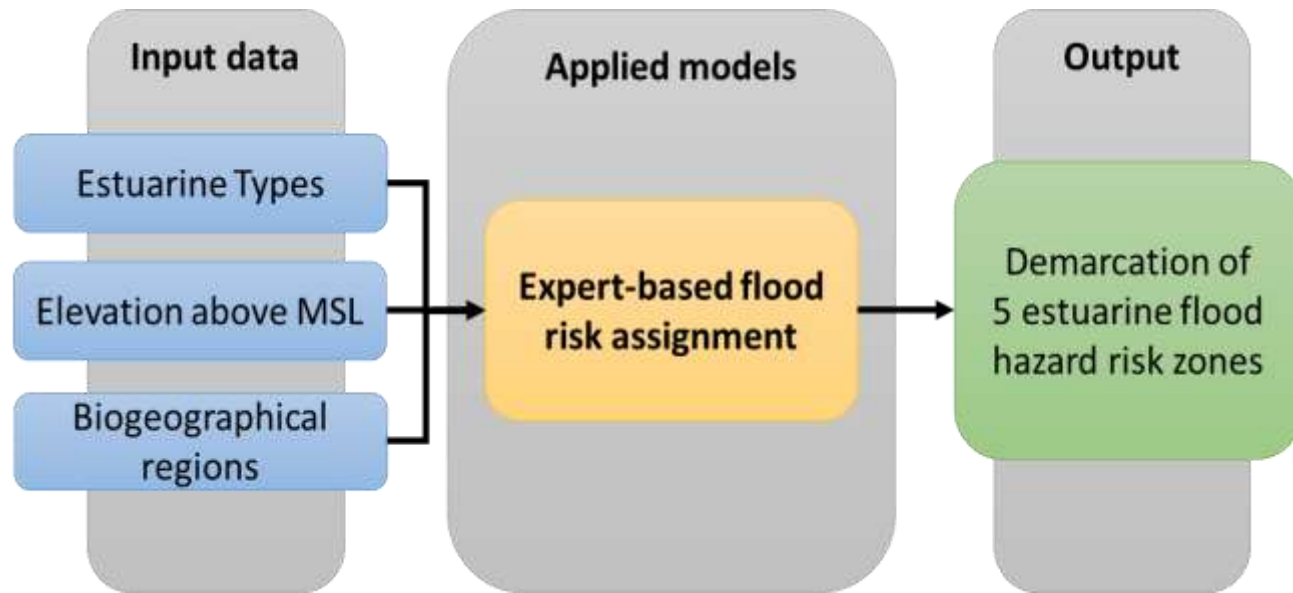


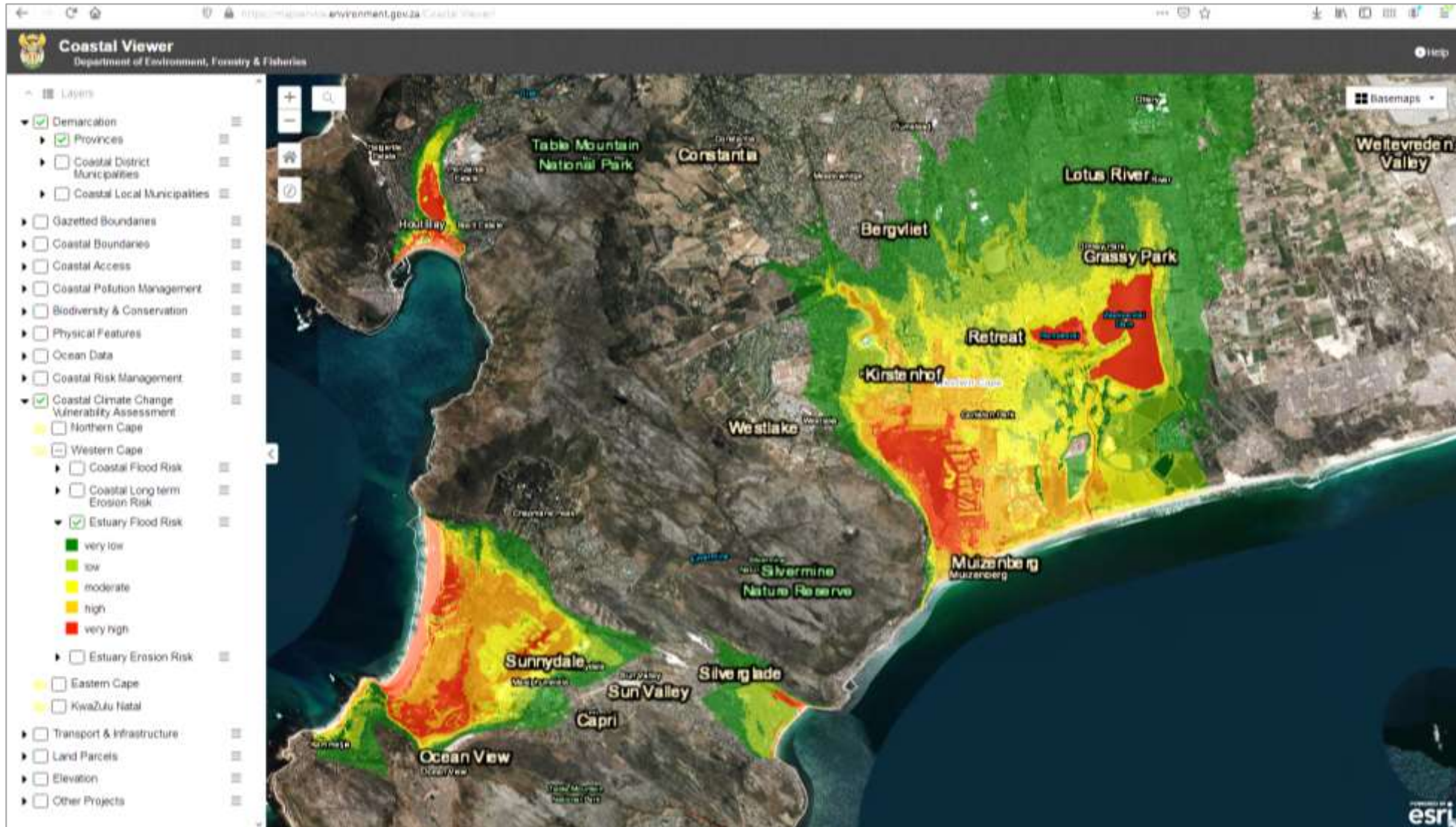
Table 11: Flood hazard risk categories allocated to Estuarine Lagoon type estuaries

Contour level (m)	Cool Temperate	Warm Temperate	Subtropical	Tropical
0 - 2.5	Very High			
2.5 - 5.0	Low			
5.0 - 7.5	Very Low			
7.5 - 10.0	Very Low			
10.0 - 12.5	Very Low			
12.5 - 15.0	Very Low			
15.0 - 17.5	Very Low			
17.5 - 20	Very Low			

Table 10: Flood hazard risk categories allocated to Estuarine Bay type estuaries

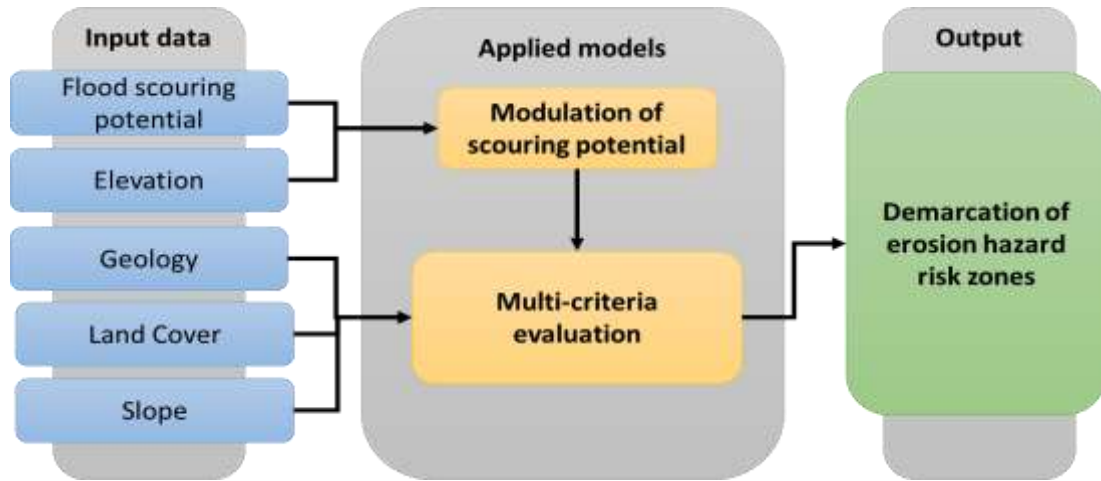
Contour level (m)	Cool Temperate	Warm Temperate	Subtropical	Tropical
0 - 2.5		Very High	Very High	
2.5 - 5.0		Medium	Medium	
5.0 - 7.5		Very Low	Very Low	
7.5 - 10.0		Very Low	Very Low	
10.0 - 12.5		Very Low	Very Low	
12.5 - 15.0		Very Low	Very Low	
15.0 - 17.5		Very Low	Very Low	
17.5 - 20		Very Low	Very Low	

Estuaries Flood Risk Index



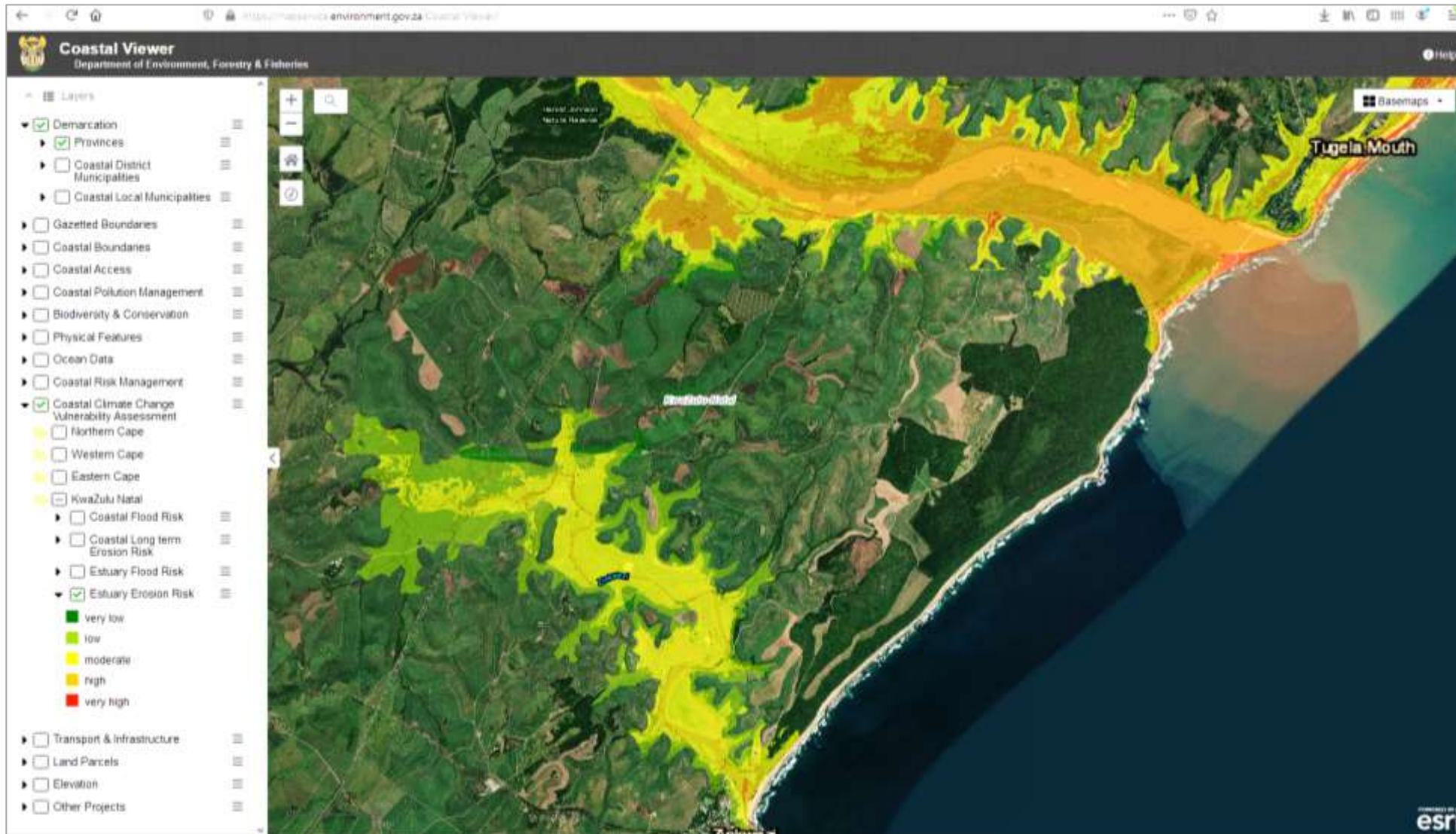
Estuaries Erosion Risk Index

This index assesses erosion risk caused by inland waters



Flood Scouring Potential					
	Very Low	Low	Medium	High	Very High
	1	2	3	4	5
Conceptual	Low MAR Large channel storage area	Low - moderate MAR Large - medium channel storage area	Moderate MAR Medium channel storage area	Moderate - high MAR Medium - small storage area	High MAR Small channel storage area
MAR (m ³ x10 ⁶) Channel volume (m ³)	0 - < 20	20 - < 50	50 - < 200	200 - < 400	400 - 10,000

Estuaries Erosion Risk Index



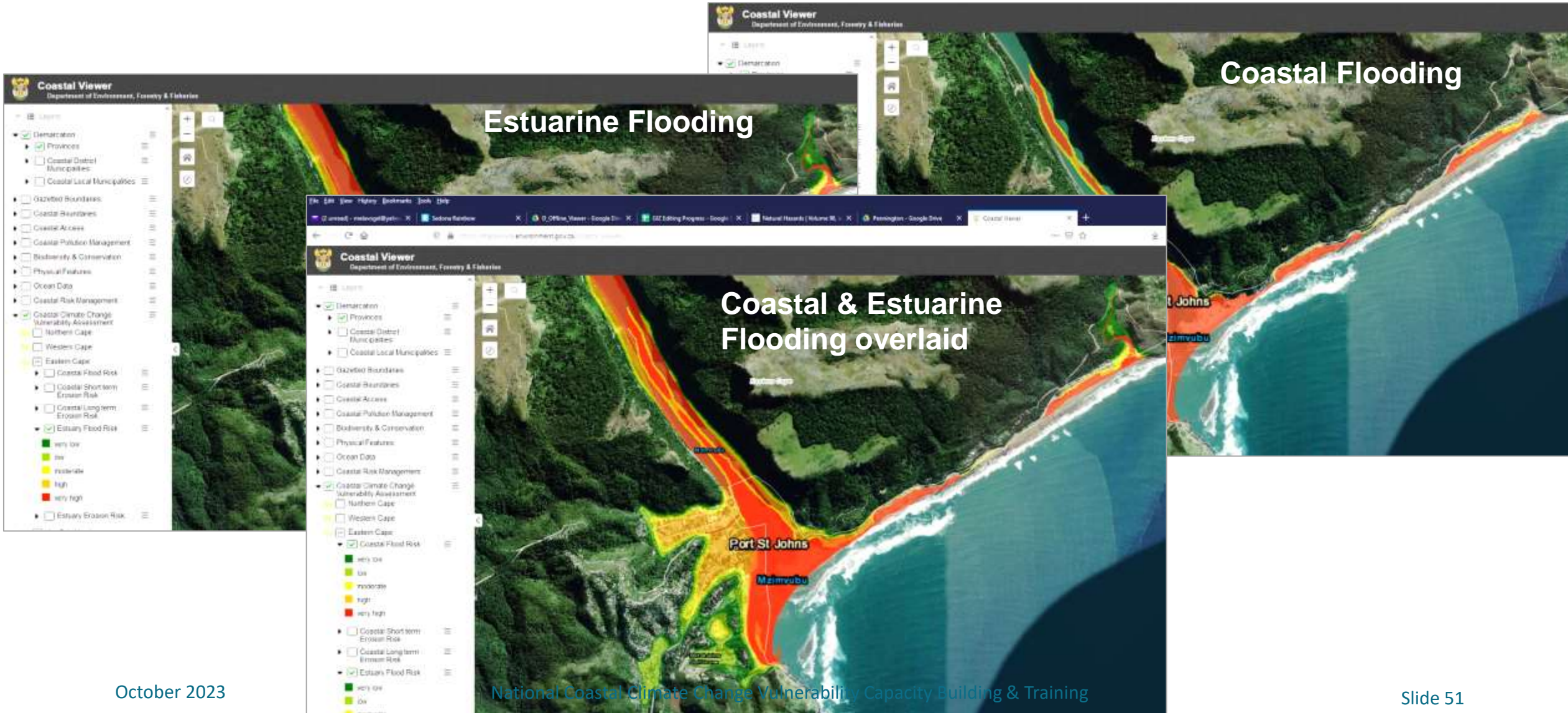
Combined use of layers in estuary areas



Combined use of layers in estuary areas



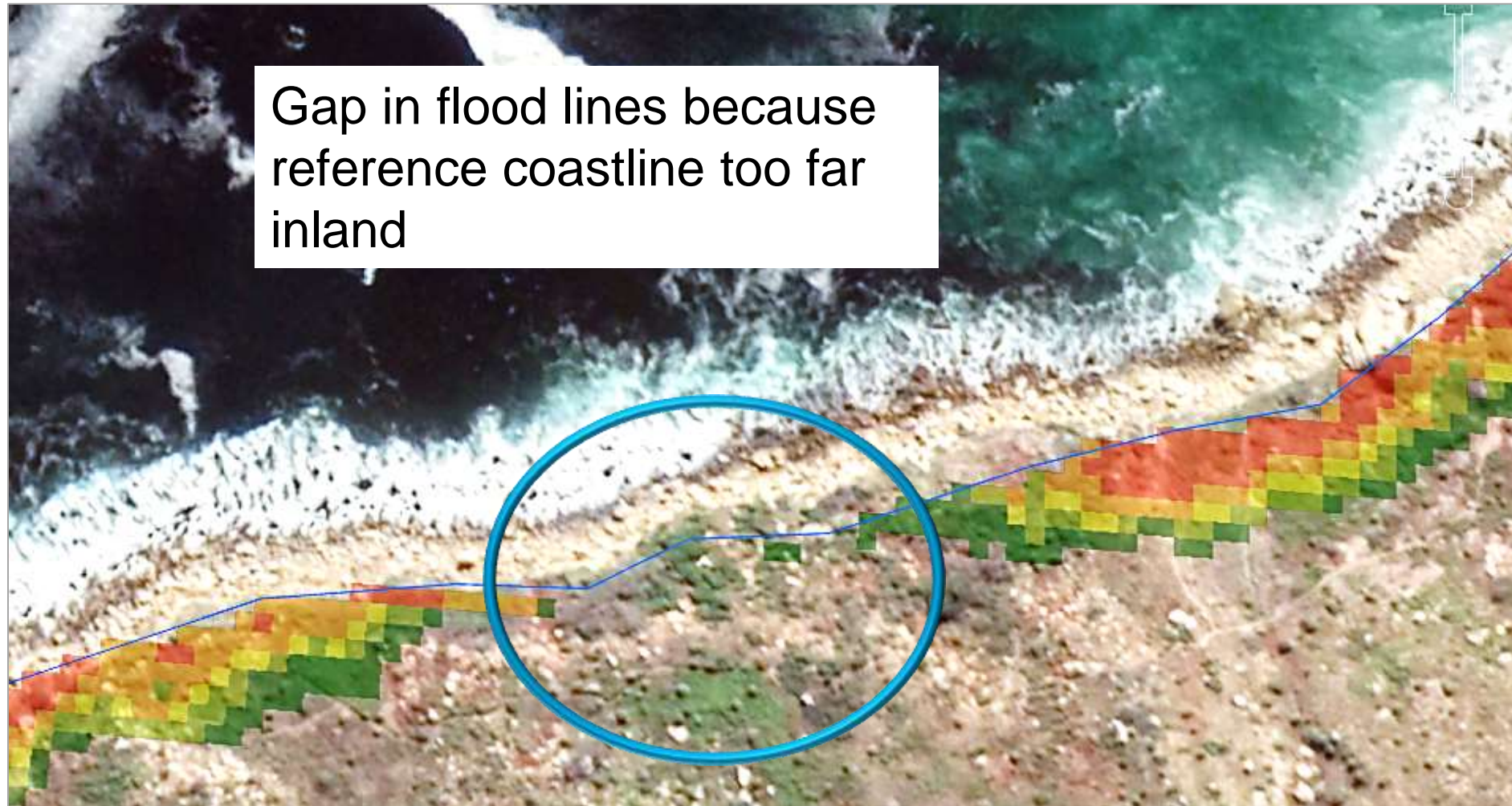
Combined use of layers in estuary areas



Implications of the used methods for the Index usage

- Quality of model outputs is dependent on model input:
→ sub-optimal *input* → suboptimal *outputs*
- Methods used affect output characteristics

Discrepancies between mapped flood lines and Google Earth



Discrepancies between mapped flood lines and Google Earth



Discrepancies between mapped flood lines and Google Earth



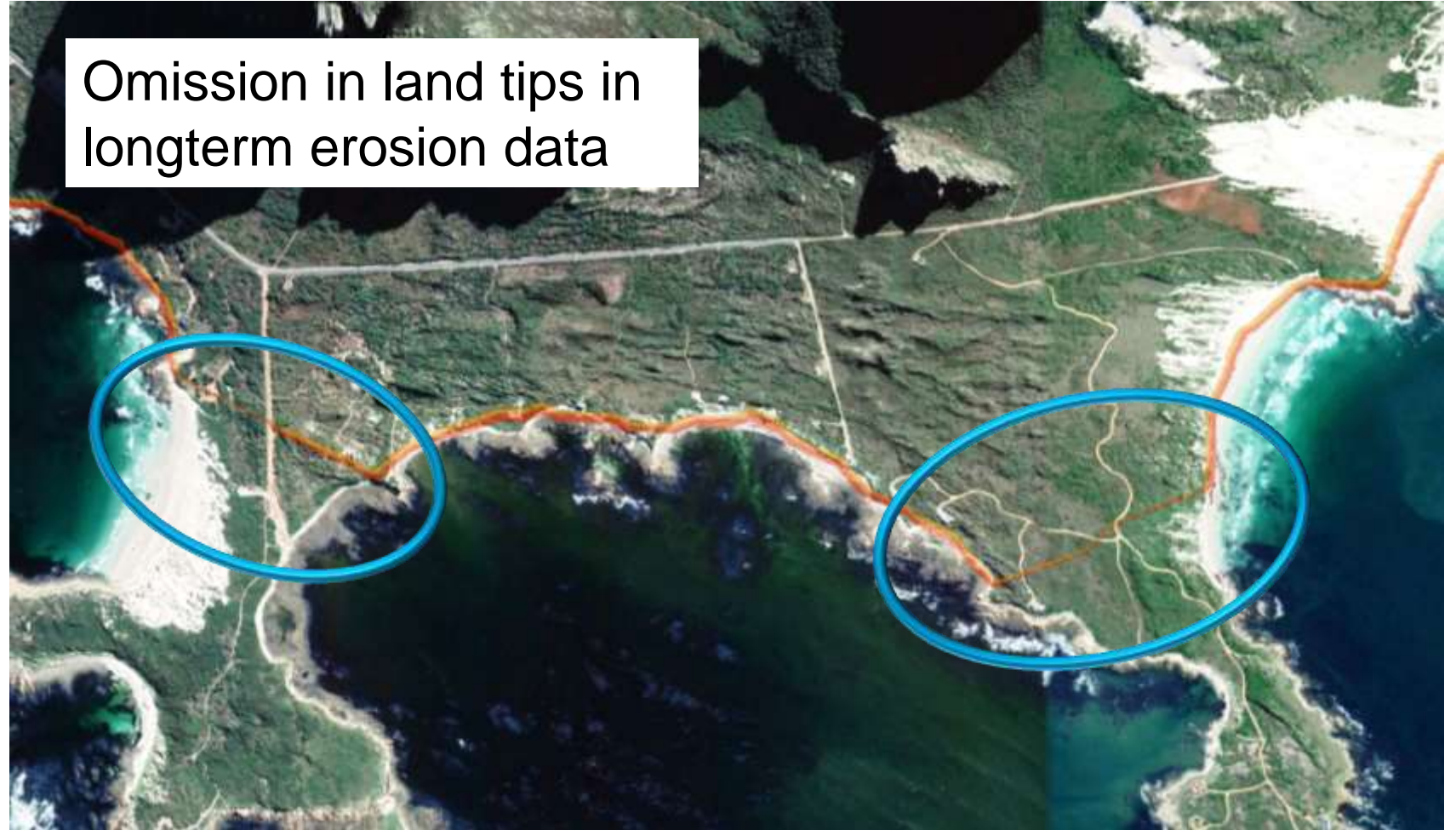
Topography does not match what is on the ground, e.g. due to development.

Discrepancies between mapped flood lines and Google Earth

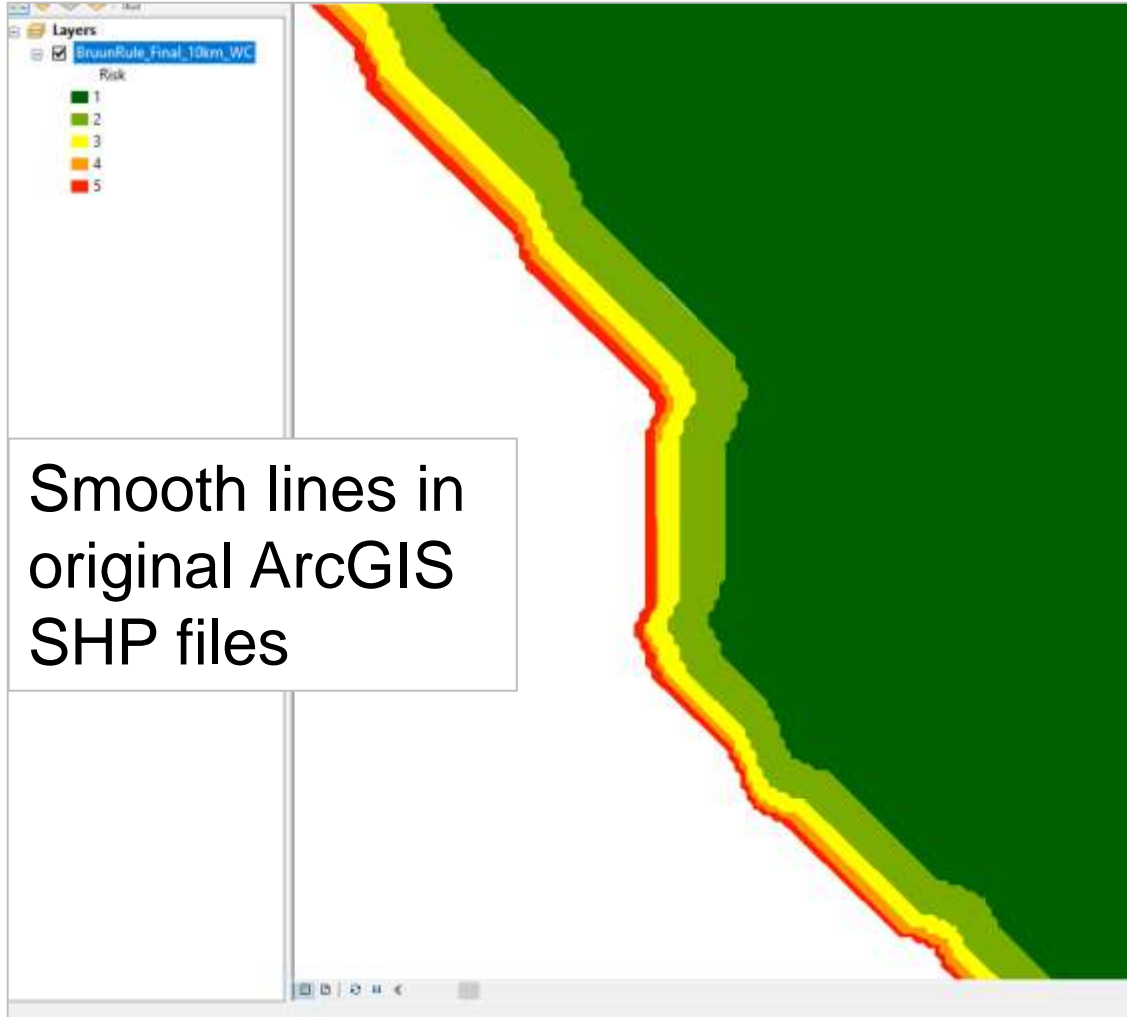


Topography has changed naturally

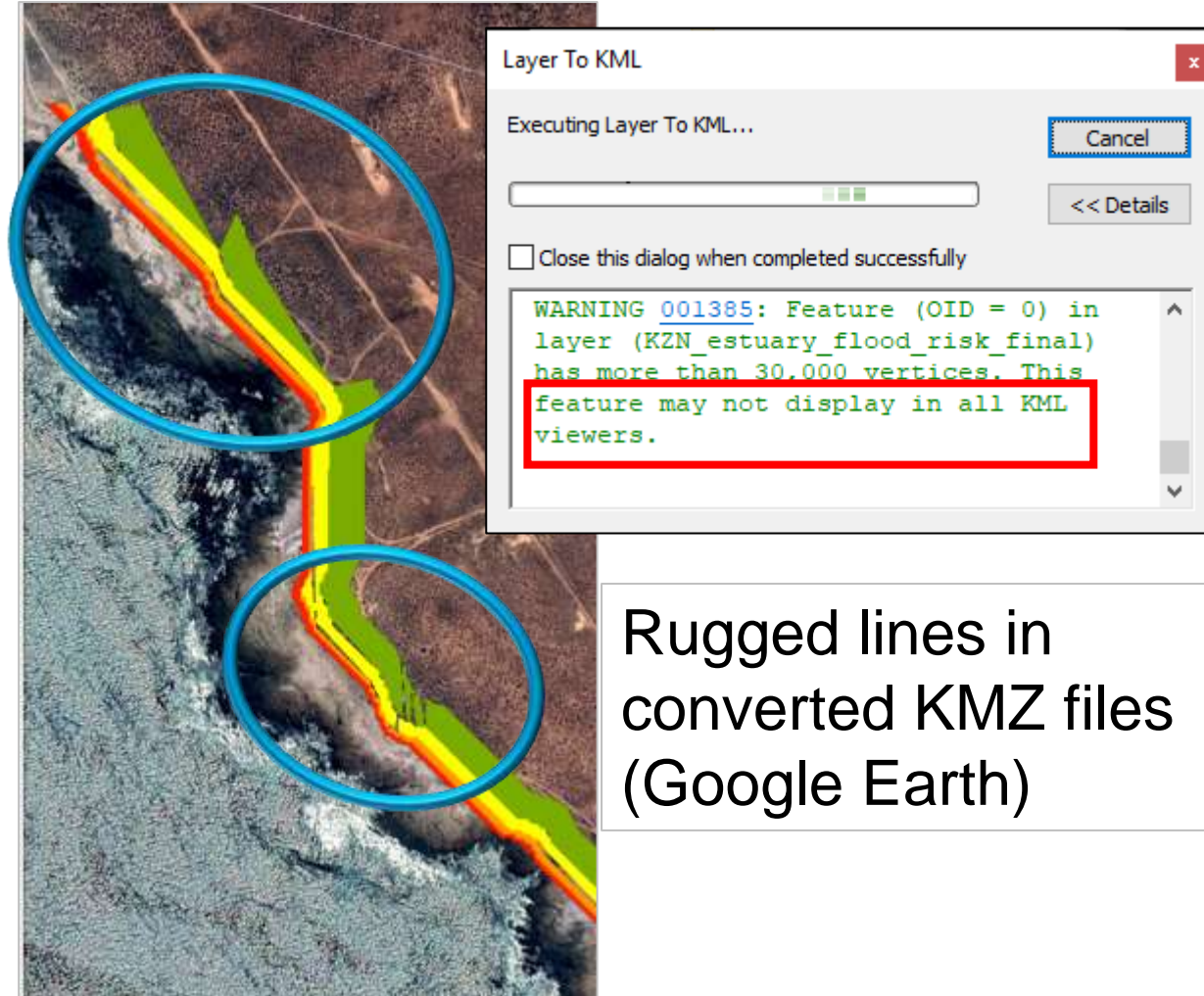
GIS related artefacts on land tips



Artefacts through data format conversions

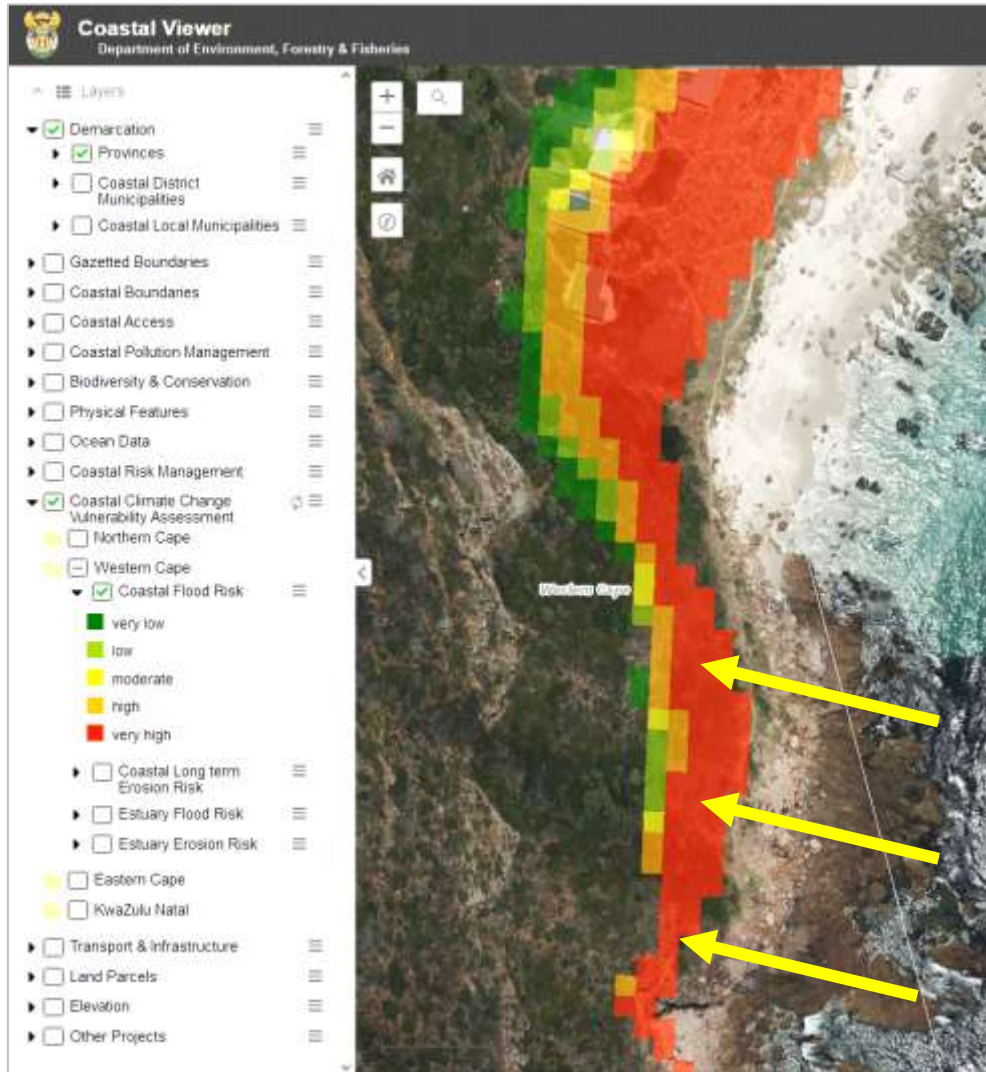


Smooth lines in original ArcGIS SHP files

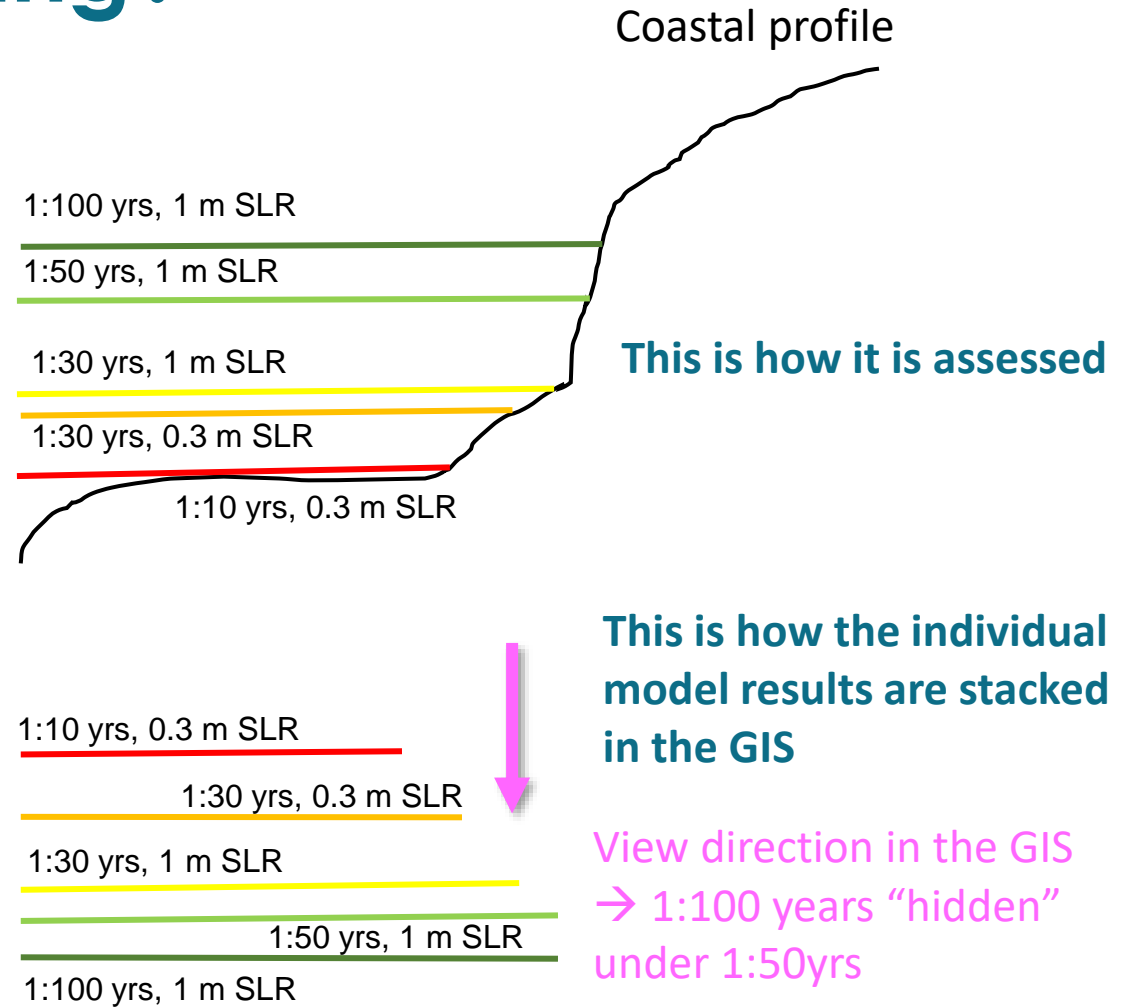


Rugged lines in converted KMZ files (Google Earth)

Are there scenarios missing?



Flood scenario run up height





Questions?

How to access the Index GIS data?

- CoVu Offline DeST:
 - Can be made available for download (about 12 GB per Province)
 - Provided by DEFF on USB stick to government instances (full package or for selected Provinces)
 - Allows offline viewing of 5 index layers and simple map export

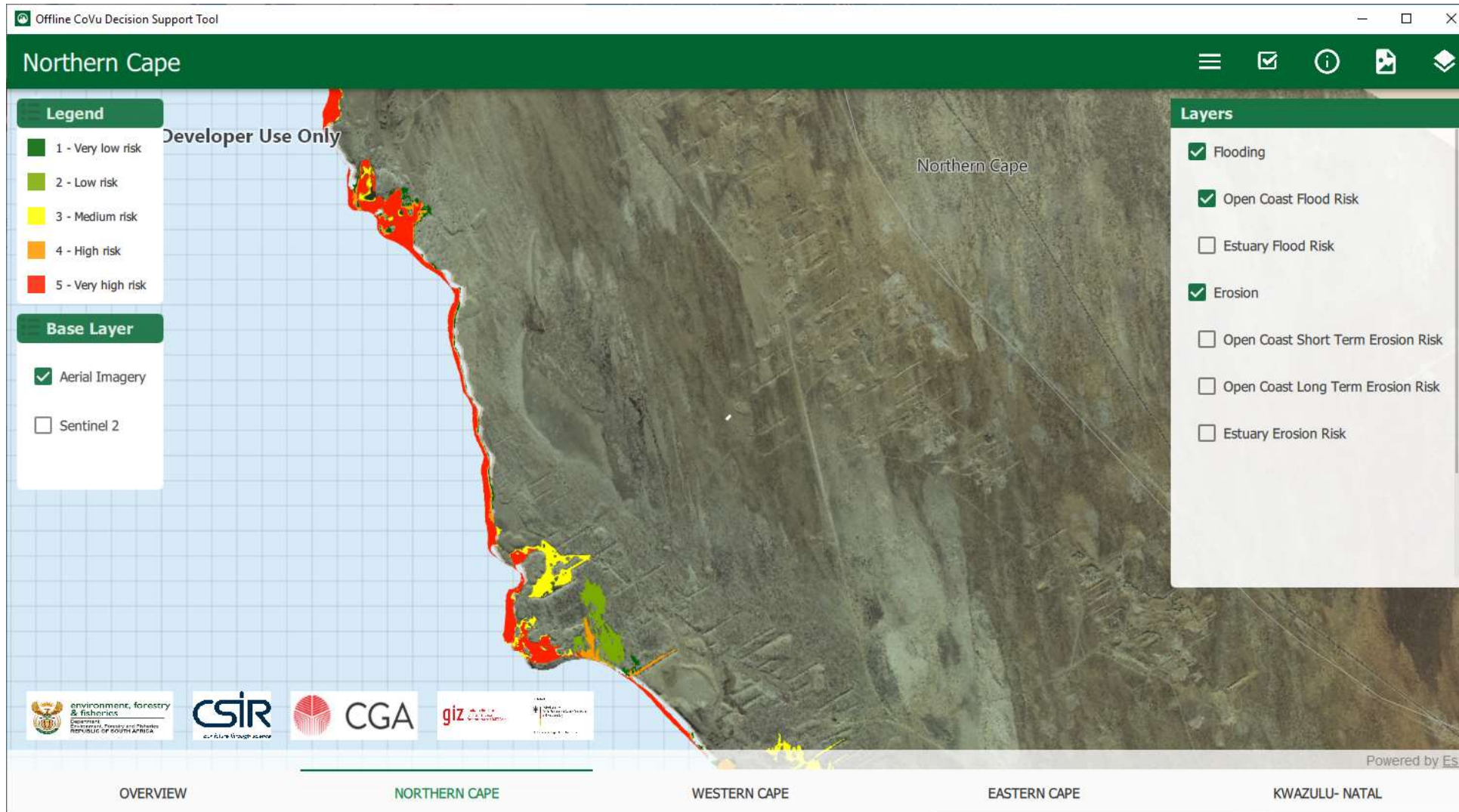
Why an Offline GIS Viewer DeST?

Challenge: How can the CoVu Index be packaged for coastal managers to use?

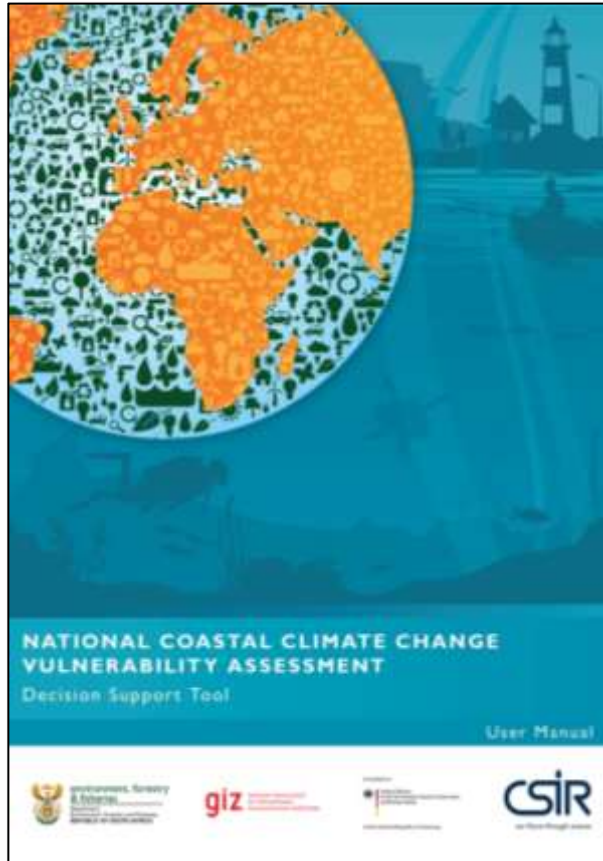
User requirements assessed in provincial stakeholder workshops:

- Large discrepancy in needs:
 - “we have our own data and tools” vs. “we don’t have GIS and/or internet”
- Main function requirements:
 - Map Viewing & downloading
 - Data download
 - Not internet dependent

This is the result...



How to use the tool - Manuals



PDF version



5 minutes video instruction

How to access the Index GIS data?

- CoVu Offline DeST:
 - Allows offline viewing of 5 index layers and simple map export
 - Provided by DFFE on USB stick to government instances
- DFFE Coastal Viewer:
 - Allows overlay of 5 risk layers with a large variety of ICM-relevant GIS data & multiple GIS functions
 - <https://mapservice.environment.gov.za/Coastal%20Viewer/>
- **Download of SHP files of 5 Risk layers:**
 - Allows data integration in user's own GIS environment
 - <https://catalogue.saeon.ac.za/records> (search for "South African climate change")

How to access the Index GIS data?

Home / Records <https://catalogue.saeon.ac.za/records> SUBMIT DATA SIGN UP / LOG IN

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KEYWORDS

- SOUTH AFRICAN CLIMATE CHANGE RELATED COASTAL FLOOD RISK LINES**
Refer to the Technical Report to the National Coastal Climate Change Vulnerability Assessment, November 2020, Section 3: 10.15493/DEA.MIMS.09032022.
MELANIE LÜCK-VOGEL, ANDRE THERON, CHRISTIAAN THERON, LAUREN WILLIAMS, GERT WESSELS, POTLAKO K... | UNKNOWN DATA FORMAT
- SOUTH AFRICAN CLIMATE CHANGE RELATED COASTAL LONG TERM EROSION RISK LINES**
Refer to the Technical Report to the National Coastal Climate Change Vulnerability Assessment, November 2020, Section 3: 10.15493/DEA.MIMS.09032022.
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- SOUTH AFRICAN CLIMATE CHANGE RELATED COASTAL SHORT TERM EROSION RISK LINES**
Refer to the Technical Report to the National Coastal Climate Change Vulnerability Assessment, November 2020, Section 3: 10.15493/DEA.MIMS.09032022.
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 - On request from CSIR
- **Download of KMZ files for use of 5 layers in Google Earth:**
 - <https://catalogue.saeon.ac.za/records> (part of the SHP file package; search for "South African climate change")
 - On request from CSIR



Practical use case example

Audience to define...



Questions?



**NATIONAL COASTAL
CLIMATE CHANGE
VULNERABILITY
ASSESSMENT**

Thank you

Presenter

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