

# Earth Observation of inland waters for reporting to targets of the post-2020 Global Biodiversity Framework

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science & innovation

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Science and Innovation  
REPUBLIC OF SOUTH AFRICA



CSIR  
Touching lives through innovation

# **Wetlands are valuable but highly threatened**

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**“75% of the land surface is significantly altered,  
66% of the ocean area is experiencing  
increasing cumulative impacts,  
and over 85% of wetlands (area) has been lost.”**

**(IPBES 2019)**

# Convention on Biological Diversity (CBD)

## Aichi targets of 2020

Overall Goal	Aichi target number
Goal B	5: <b>Habitat loss</b> halved or reduced
	6: Sustainable management of marine
	9: <b>Invasive alien species</b> prevented and controlled
	10: Pressures on vulnerable ecosystems reduced
Goal C	11: <b>Protected areas</b> increased and improved
	12: Extinction prevented
Goal D	14: Ecosystems and essential services safeguarded
	15: Ecosystems restored and resilience enhanced

### Target 11 - protection

Generic indicator	Specific indicator
Trends in area of terrestrial and inland water areas conserved	Percentage of terrestrial and inland water areas covered by protected area
Trends in area of coastal and marine areas conserved	Percentage of marine and coastal areas covered by protected area Coverage of protected areas in relation to marine areas (proposed indicator for Sustainable Development Goal [SDG] target 14.5)
Trends in areas of particular importance for biodiversity conserved	Protected area coverage of Key Biodiversity Areas (including Important Bird and Biodiversity Areas, Alliance for Zero Extinction sites) Protected Area Overlays with Biodiversity
Trends in areas of particular importance for ecosystem services conserved	No specific indicators identified
Trends in ecological representativeness of areas conserved	Protected area coverage of terrestrial, <u>marine</u> and freshwater ecoregions Species Protection Index Protected Area Representativeness Index
Trends in effectiveness and/or equitability of management of conserved areas	Management effectiveness of protected areas The Wildlife Picture Index (disaggregated by protected area)
Trends in connectivity and integration of conserved areas	Protected Area Connectedness Index

Summit held 2010 in Nagoya, located in Japan's Aichi prefecture

<https://www.cbd.int/aichi-targets/>

# Post-2020 Global Biodiversity Framework

Goal Milestones, Components	
A1: Natural systems	Area
	Connectivity
	Integrity
A2: Species Populations	Extinction rate
	Extinction risk, Threat status
	Population abundance (size)
	Population Distribution
A3: Species Genetics	Genetic diversity

- Post-2020 GBF set new targets for measuring changes in the extent and condition of wetlands, reporting by 2030 and 2050
- Target 1: Plan and manage all areas to reduce biodiversity loss
- Target 2: 30% of the extent of degraded systems to be under restoration by 2030
- Target 3: Minimum 30% extent of each type to be conserved



November 2021. Version 1.0



## Indicator metadata sheet

*Indicator metadata form for compilation of data relating to headline indicators proposed in the first draft of the monitoring framework for the post-2020 global biodiversity framework*

# CBD definition of “Inland waters”

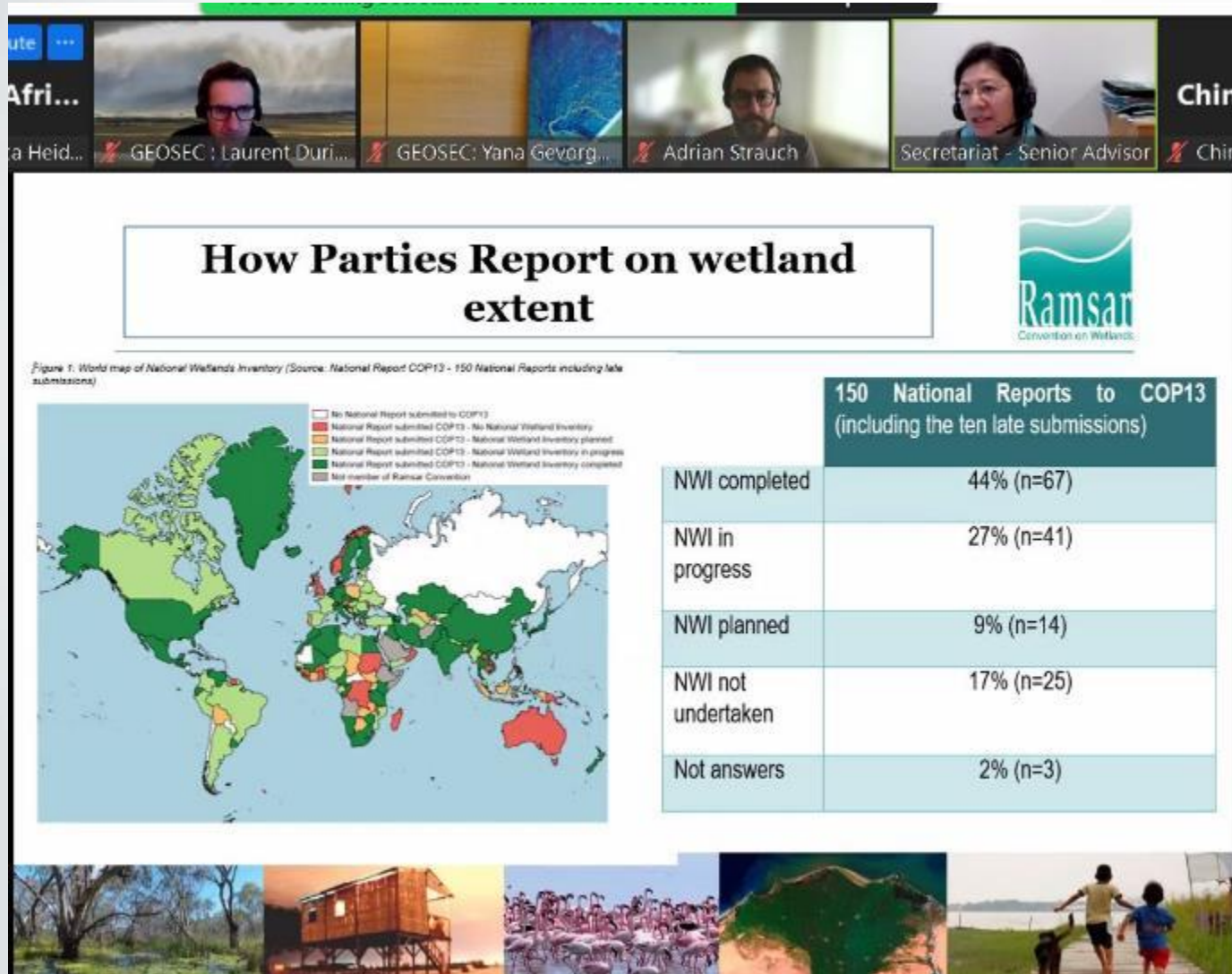
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**“Inland waters” are aquatic-influenced environments located within land boundaries.** This includes those located in coastal areas, even where adjacent to marine environments. Inland water systems can be fresh, saline or a mix of the two (brackishwater). ...

- **Estuaries are transitional zones between rivers and the sea.** In practice, “inland waters” considerations tend to focus on fresh water – partly because freshwater environments dominate inland waters – but mainly because of the importance of fresh water globally. The programme of work on inland waters and that for [marine and coastal biodiversity](#) collaborate for relevant coastal areas.
- The CBD has adopted the **Ramsar Convention's definition of “wetland.”** The Ramsar Convention takes a broad approach in determining the wetlands that come under its aegis. Under the text of the Convention (Article 1.1), wetlands are defined as:
- *"Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres."*



# Global inventories of rivers and wetlands



GeoWetlands  
Meeting May 2022

# IUCN Global ecosystem types for freshwater

## Freshwater

### F1. Rivers and streams

### F2. Lakes

### F3. Artificial

F 1.1 Permanent upland streams

F 1.2 Permanent lowland rivers

F1.3 Freeze-thaw rivers and streams

F 1.4 Seasonal upland streams

F 1.5 Seasonal lowland rivers

F 1.6 Episodic arid rivers

F2.1 Large permanent freshwater lakes

F2.2 Small permanent freshwater lakes

F2.3 Seasonal freshwater lakes

F2.4 Freeze-thaw freshwater lakes

F2.5 Ephemeral freshwater lakes

F2.6 Permanent inland salt lakes

F2.7 Ephemeral salt lakes

F2.8 Artesian springs and oases

F2.9 Geothermal wetlands

F2.10 Subglacial lakes

F3.1 Large reservoirs

F3.2 Constructed lacustrine wetlands

F3.3 Rice paddies

F3.4 Freshwater aquafarms

F3.5 Canals and storm water drains

## Subterranean-Freshwater

### SF1. Subterranean freshwaters

### SF2. Anthropogenic subterranean freshwaters

## Freshwater-Terrestrial transitional realm

### TF1. Palustrine

TF1.1 Tropical flooded forests and peat forests

TF1.2 Subtropical/temperate forested wetlands

TF1.3 Permanent marshes

TF1.4 Seasonal floodplain marshes

TF1.5 Episodic arid floodplains

TF1.6 Boreal, temperate and montane peat bogs

TF1.7 Boreal and temperate fens


## Freshwater-Marine

### FM1. Transitional waters

# Essential biodiversity variables for freshwater

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- Genetic composition
- Species populations
- Species traits
- Community composition
  - Extent of wetland vegetation distribution
- Ecosystem structure
  - Plant species communities
  - Above-ground biomass
- Ecosystem function
  - Hydrological regime metrics



Extent &  
Ecological condition/  
Integrity indices

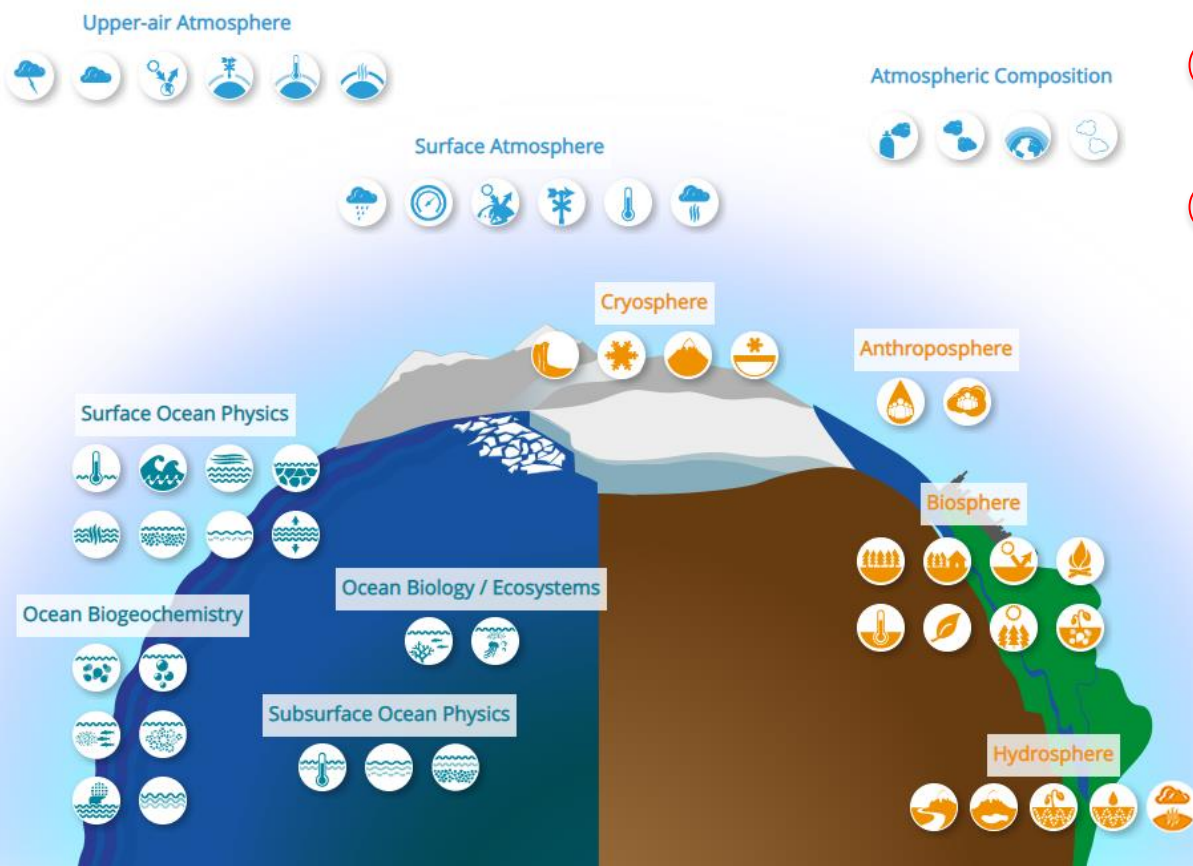


# Essential climate variables: Biosphere

## Essential Climate Variables

[For table version click here](#)

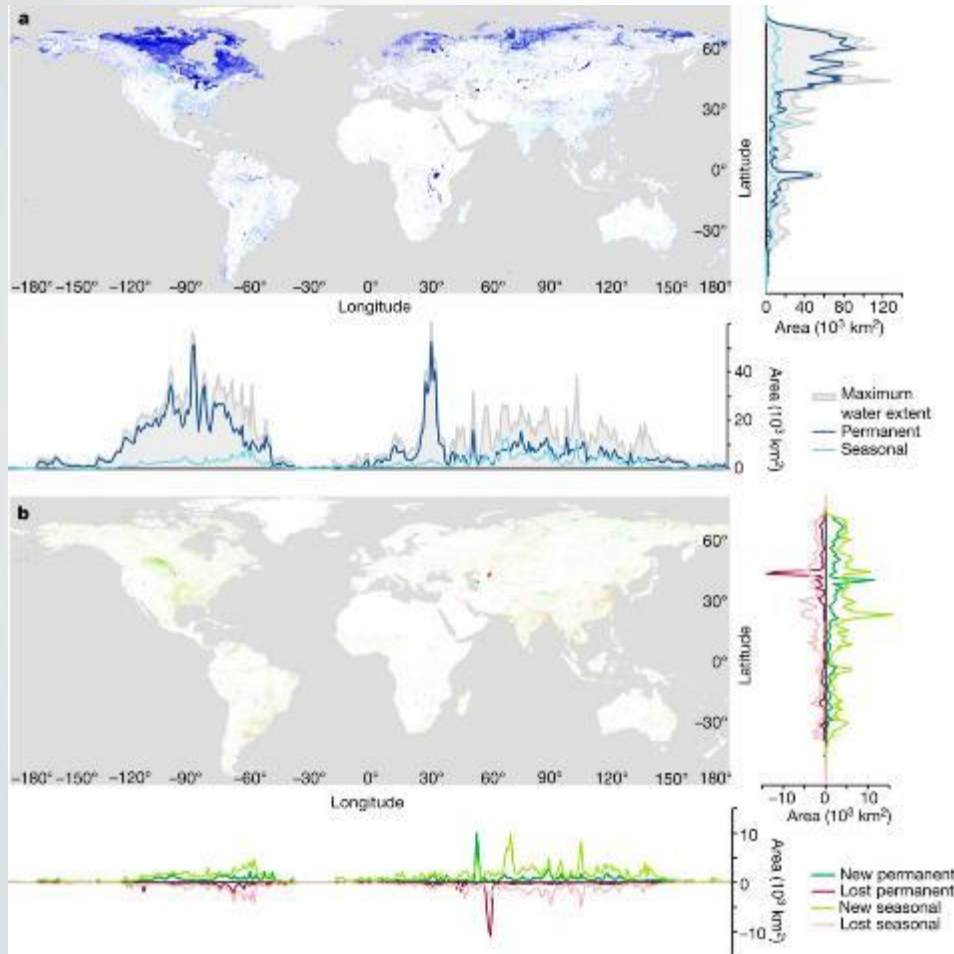
[What are Essential Climate Variables \(ECVs\)?](#)



## Biosphere

- [Above-ground biomass](#)
- [Albedo](#)
- [Evaporation from land](#)
- [Fire](#)
- [Fraction of absorbed photosynthetically active radiation \(FAPAR\)](#)
- [Land cover](#)
- [Land surface temperature](#)
- [Leaf area index](#)
- [Soil carbon](#)
- [Soil moisture](#)

# EO of lacustrine wetlands



- EO enabled monitoring of open water (lacustrine) wetlands since 1984 through Landsat and since 2016 with Sentinel-2
- SDG indicator 6.6.1a
- In RSA, the GSWP represents only 13% of the extent of our wetlands mapped in NWM5: 11% open water, 2% seasonal

Lacustrine wetland biome:  
(F2.1) Large permanent freshwater lakes  
F3. (Large) Artificial reservoirs

# Global monitoring of estuarine habitats

DATASET DETAIL

Global Mangrove Watch (1996 - 2016)

DESCRIPTION

Please use the main download button to download all years.  
To download individual years please use the following links:

- [GMW 1996](#)
- [GMW 2007](#)
- [GMW 2008](#)
- [GMW 2009](#)
- [GMW 2010](#)
- [GMW 2015](#)
- [GMW 2016](#)

The [Global Mangrove Watch](#) (GMW) was initiated as part of the [JAXA Kyoto & Carbon Initiative](#) in 2011. It is led by [Aberystwyth University](#) and [solo Earth Observation](#), in collaboration with [Wetlands International](#), the [International Water Management Institute](#) and the [UN Environment World Conservation Monitoring Centre](#) (U.K.). The African part is supported by [DOB Ecology](#) through the [Mangrove Capital Africa](#) project. The GMW aims to provide geospatial information about mangrove extent and changes to the Ramsar Convention, national wetland practitioners, decision makers and NGOs. It is part of the Ramsar Science and Technical Review Panel (STRP) work plan for 2016-2018 and a Pilot Project to the Ramsar Global Wetlands Observation System (GWOS), which is implemented under the GEO-Wetlands Initiative. The

ACCESS

Maintained

Lost

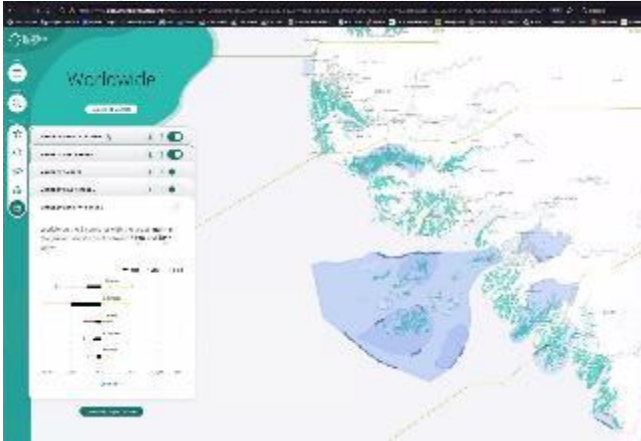
Gained

Download

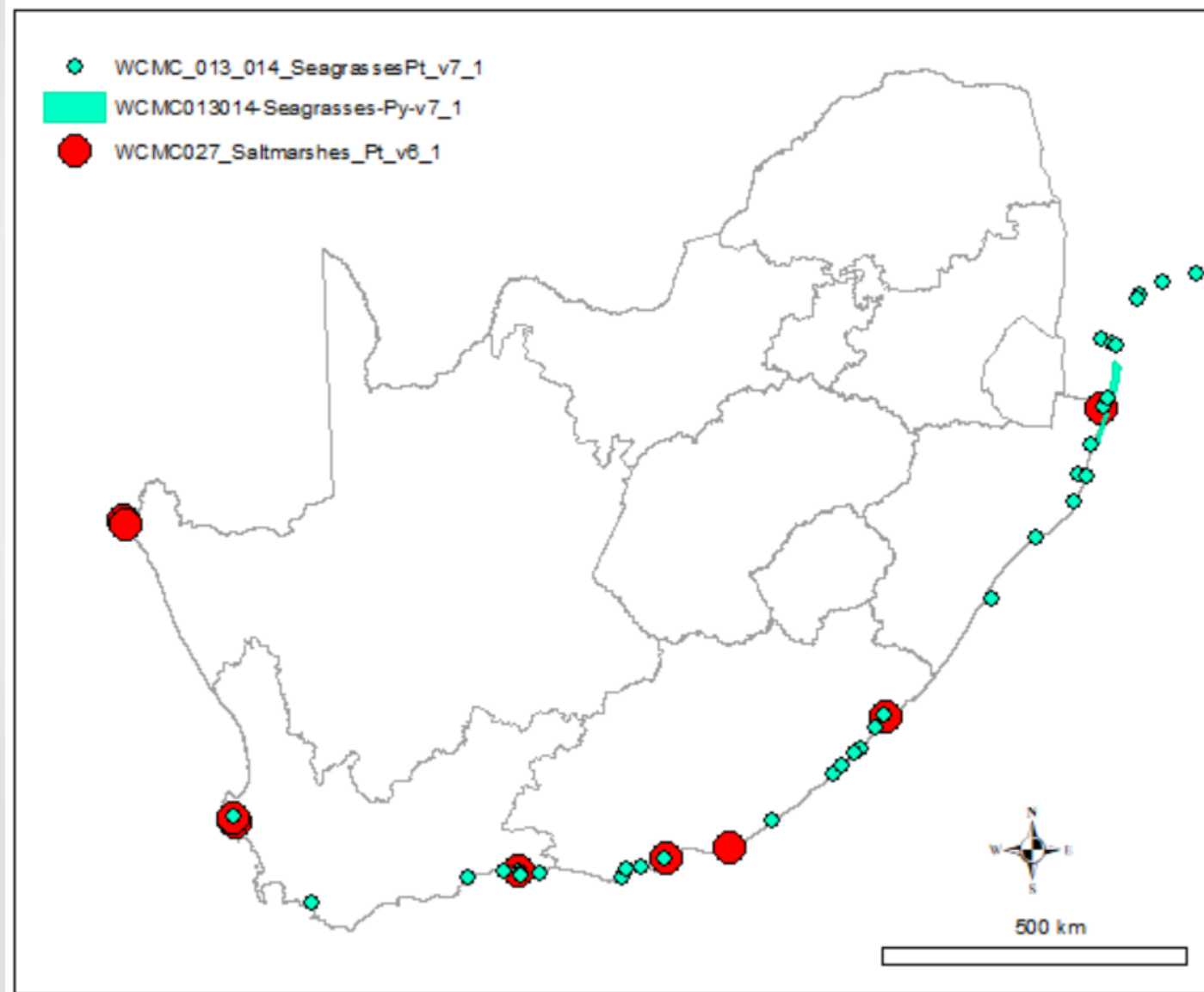
Metadata

Factsheet

ArcGIS



# Global datasets of seagrasses and salt marshes



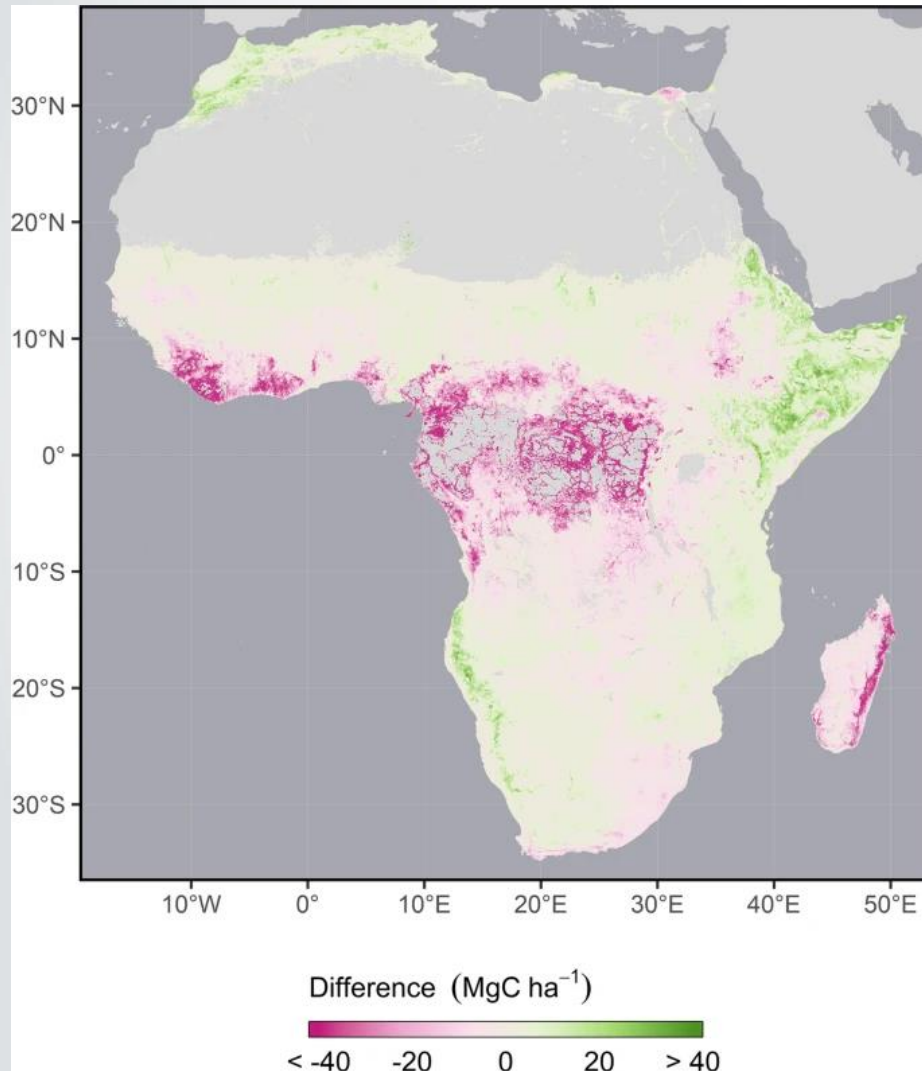
<https://archive.org/details/worldatlasofseag03gree>







# Above and below biomass carbon density 2010

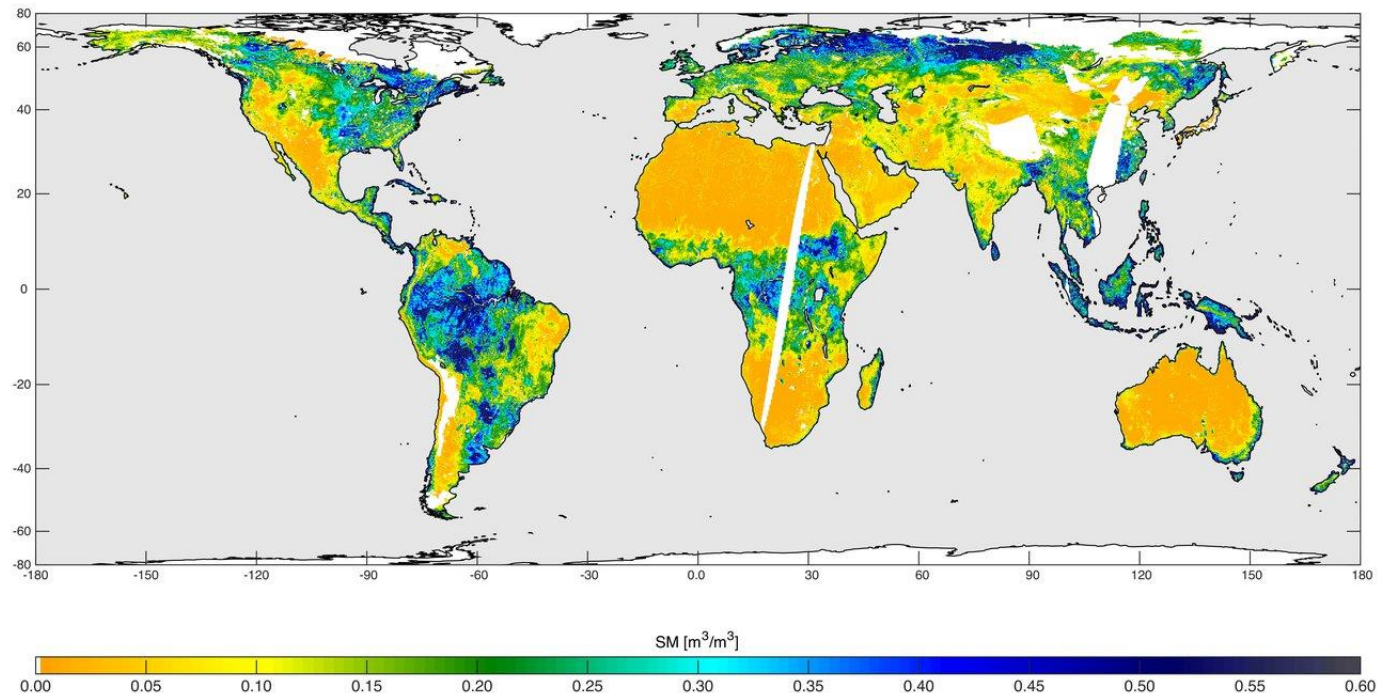


Difference between underlying woody aboveground biomass maps in Africa. Maps considered are the GlobBiomass30 global map and the Bouvet35 map of Africa. Both maps were aggregated to a 300 m spatial resolution and converted to C density prior to comparison using the same schema. The difference map was subsequently aggregated to a 3 km spatial resolution and reprojected for visualization. Negative values denote lower estimates by Bouvet et al.<sup>35</sup>, while positive values denote higher estimates.

# Palustrine wetlands – soil moisture

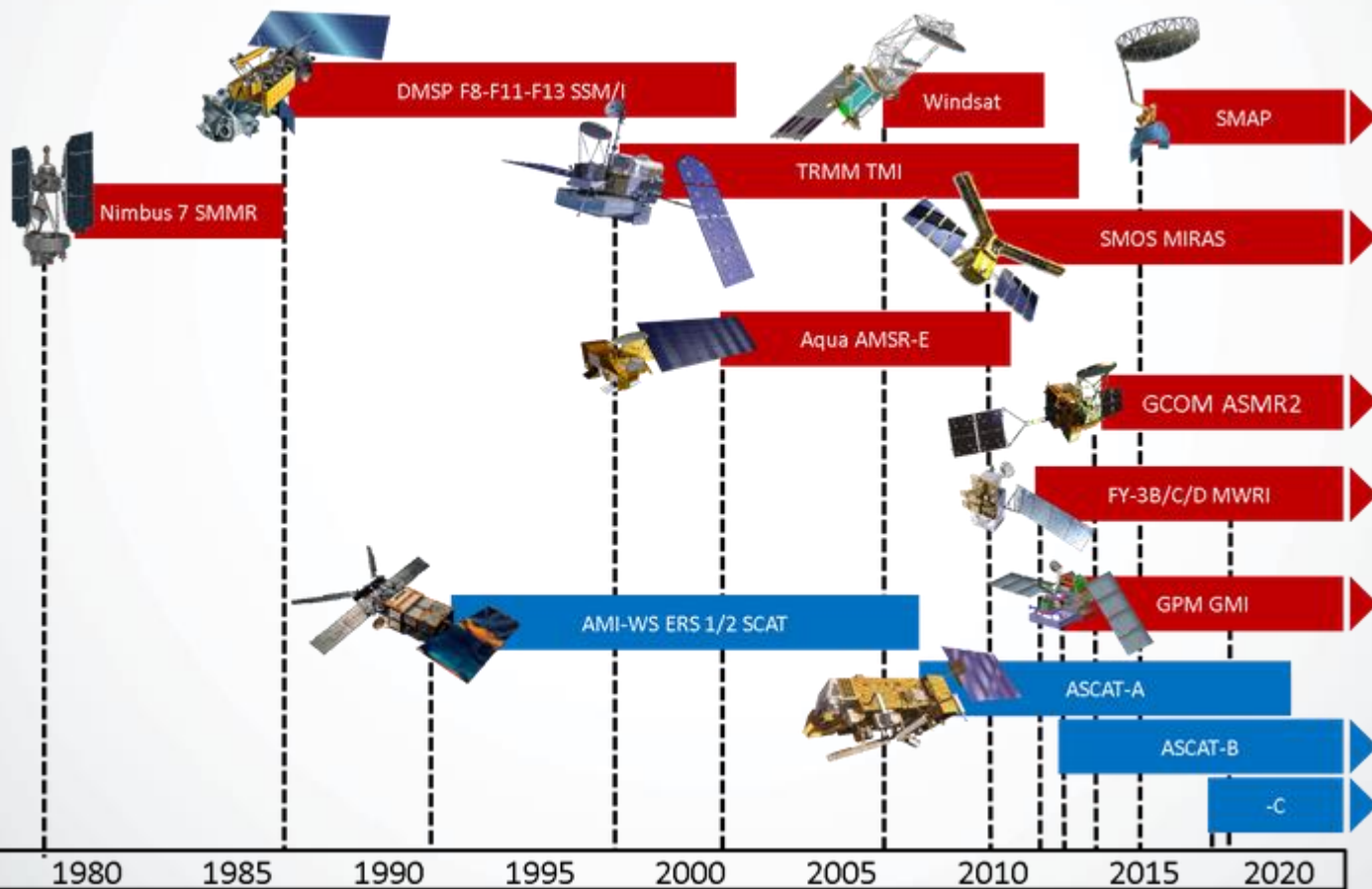
SMAP's combined radar and radiometer instruments, acquired between May 4 and May 11, 2015 during SMAP's commissioning phase; 9 km spatial resolution.

*High-Resolution Global Soil Moisture Map – NASA Jet Propulsion Laboratory  
May 19, 2015*



# Improved sensors & GEE

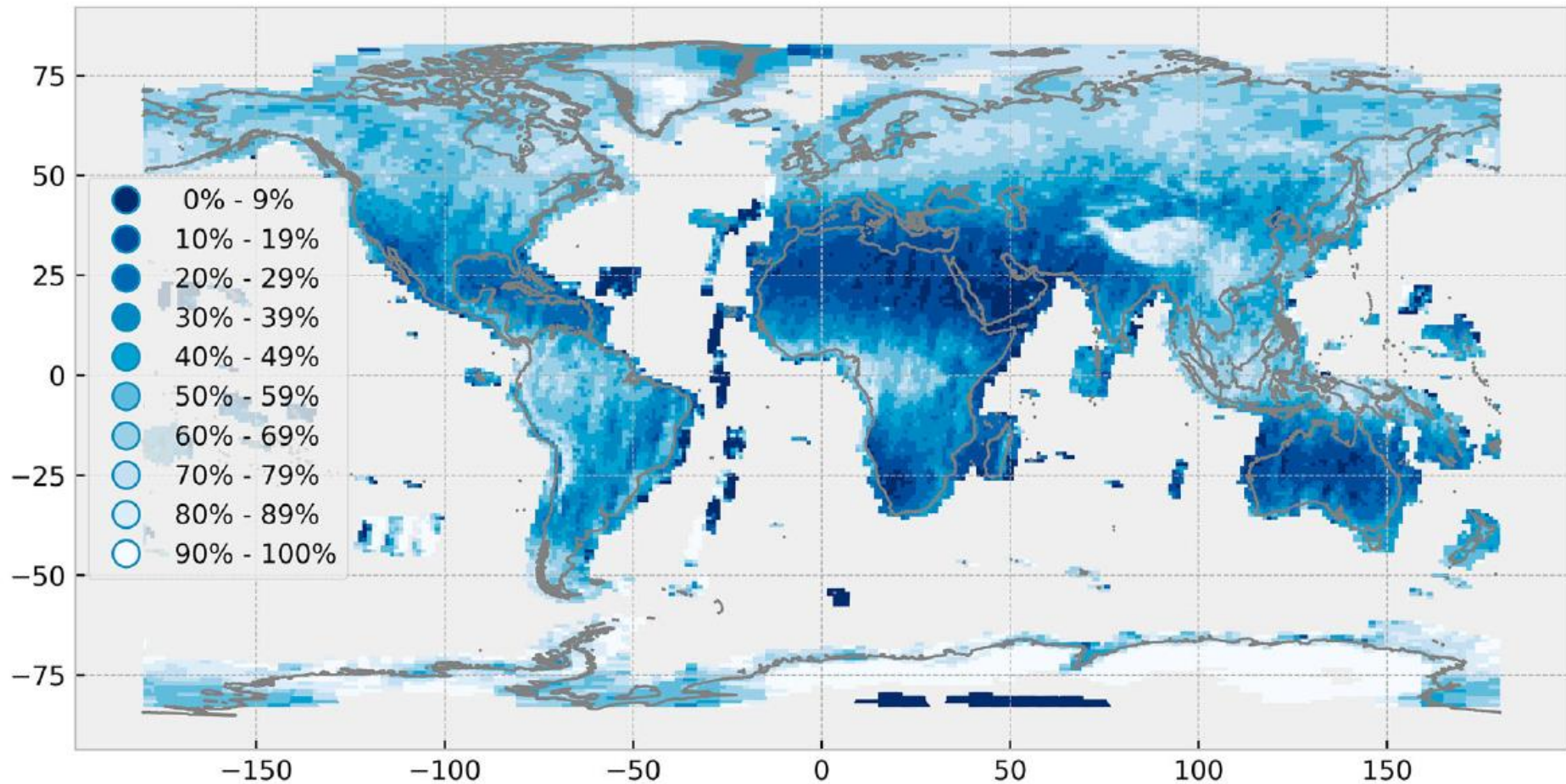
*ESA CCI soil moisture v07.1 product utilizes 5 active and 12 passive microwave sensors.*



<https://climate.esa.int/en/projects/soil-moisture/about/>



# Cloud cover issues



**Figure 3.** Global spatial distribution of the average cloud cover of Sentinel-2A and Sentinel-2B Level-1C scenes acquired in the year 2017. Own cartographic representation.

# NWM5



Provinces (MDB, 2011, edited)

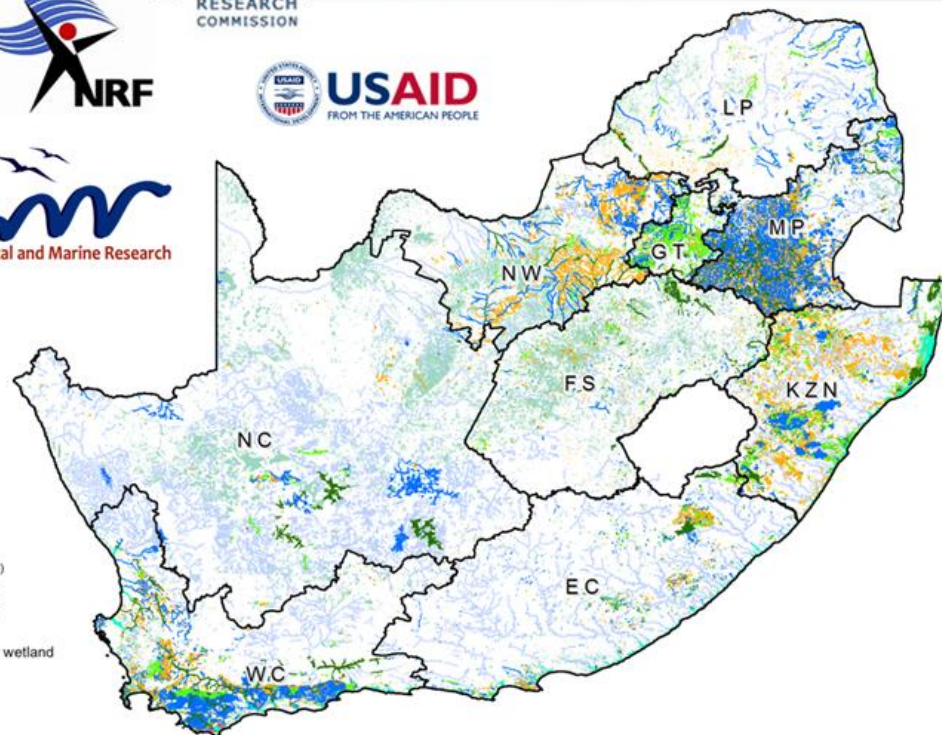
## National Wetland Map 5:

- Estuarine functional zone
- Estuarine microsystems
- Channelled valley-bottom wetland
- Depression wetland
- Floodplain wetland
- River
- Seep wetland
- Unchannelled valley-bottom wetland
- Wetland flat

Provinces (MDB, 2011, edited)

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250 125 0 250 km

1:11 500 000

## INLAND AQUATIC

222 river ecosystem types

**64%**

Threatened

**13%**

Well Protected

**42%**

Not Protected

135 inland wetland ecosystem types

**79%**

Threatened

**6%**

Well Protected

**61%**

Not Protected

**68%**

of 501 taxa assessed  
Well Protected

**18%**

of freshwater fishes  
Well Protected

**17%**

of 658 taxa assessed  
Threatened



- 1 Changes to the hydrological regime
- 2 Pollution
- 3 Habitat loss
- 4 Biological invasions
- 5 Climate change

DOI:

<https://doi.org/10.17159/ws-a/2020.v46.i1.7887>



# Estuaries mapped in RSA

## Manual mapping:

- 43% of 290 EFZs
- <10% of 42 micro-estuaries
- Random years
- Single layer

## Remote sensing:

- Global datasets not mapping all
- Small area evidence available using Landsat, Spot, RapidEye & WV
- Varying accuracies
- Representivity/error?
- Random years

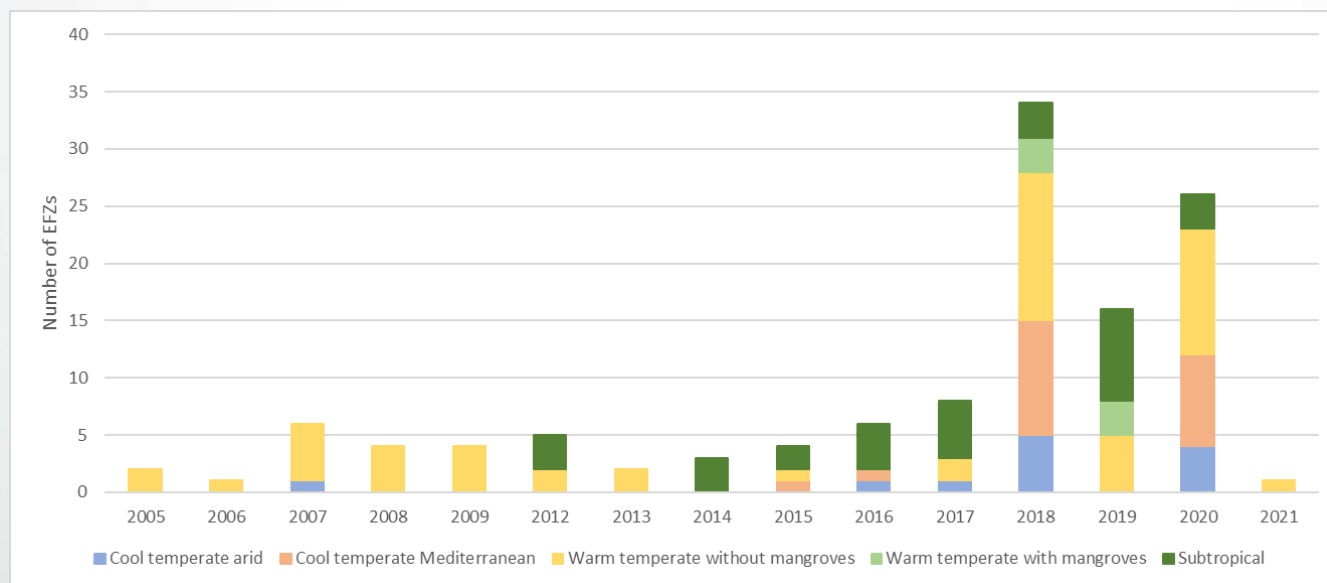
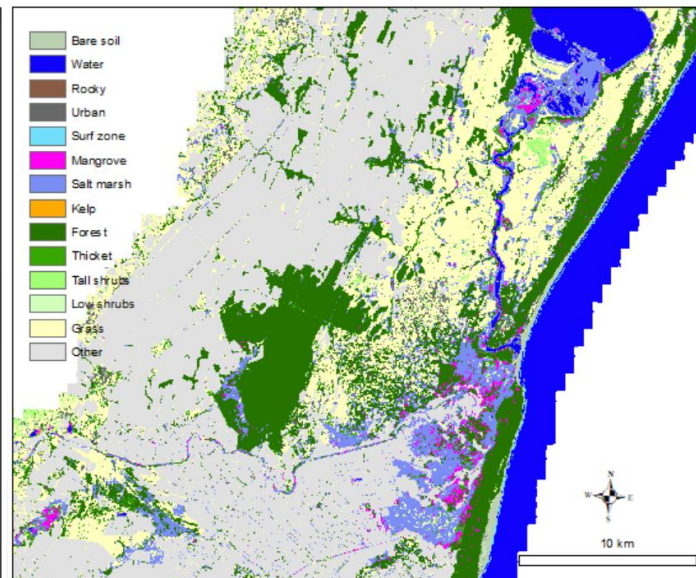
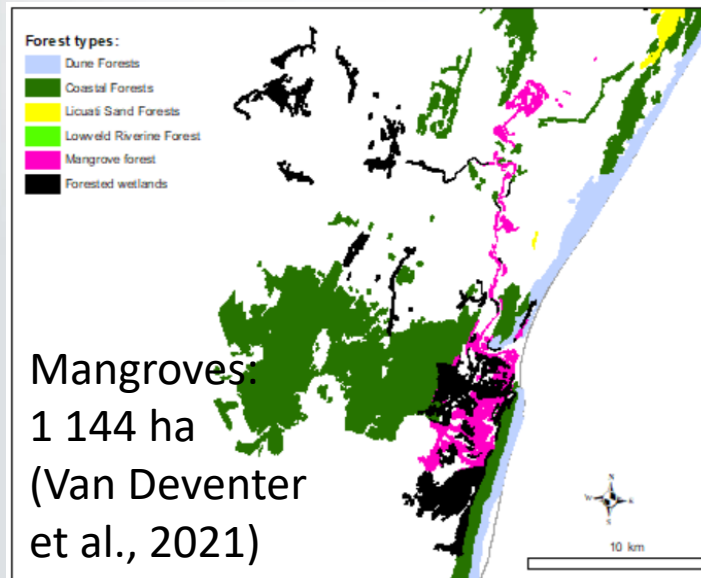
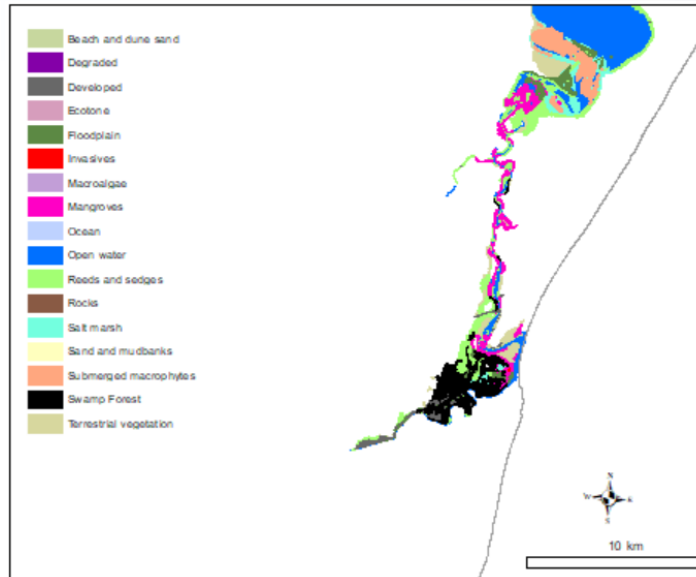
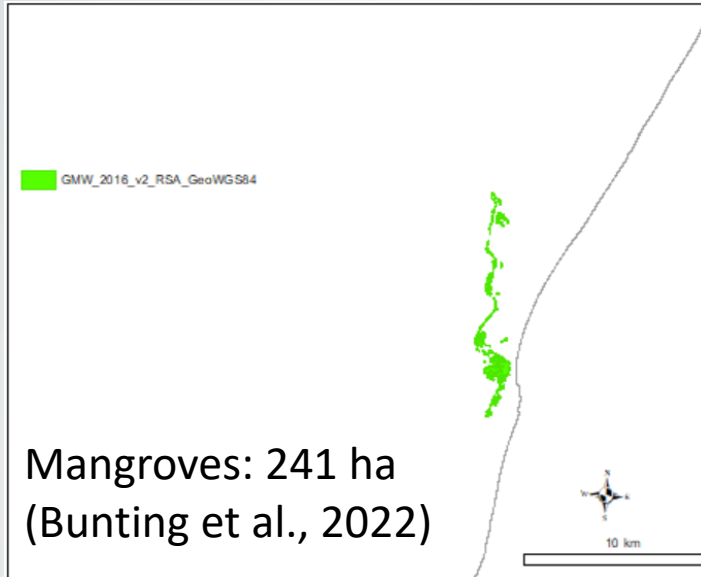
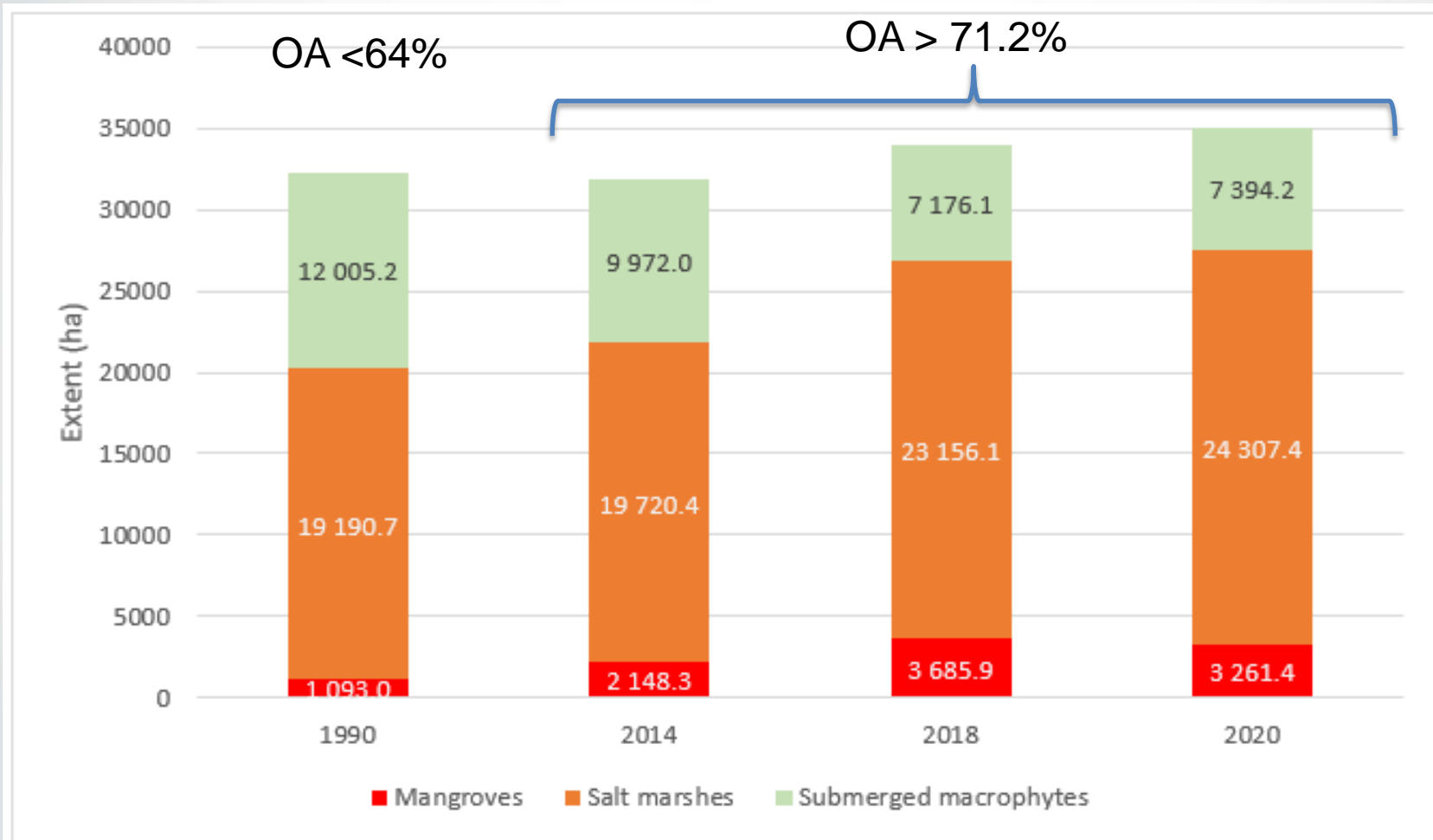


Figure 1. Number of EFZs for which estuarine habitats were mapped across five coastal regions and years.

# Comparison of mangroves



# Results of BCE extent and OA



**Figure A.5:** Changes in the extent of estuarine Ecosystem Functional Groups (EFGs) or Blue Carbon Ecosystems (BCEs) between 1990 and 2020 for South Africa.

# User's accuracies

BCE	# of (sub) classes	1990	2014	2018	2020
Mangroves	1	53%, 66%  - Underestimation of extent	82%, 85%	85%, 81%	87%, 83%  - <u>114-5%</u> of habitats mapped by NMU & GMW
Salt marshes	6	M: >78% NM: 33%	M: >78% NM: 38-85%	M>78% NM:38-85%	M>78% NM:38-85%  - <u>165%</u> of habitats mapped by NMU
Seagrasses	3	M: 65%, 85% NM: 56%	M: 74%, 98% NM: 63%	M: 77%, 90% NM: 68%	M: >78%, 90% NM: 64%  - Overpredicted by <u>232%; 410-684%</u> of habitats mapped by NMU

# Examples of results

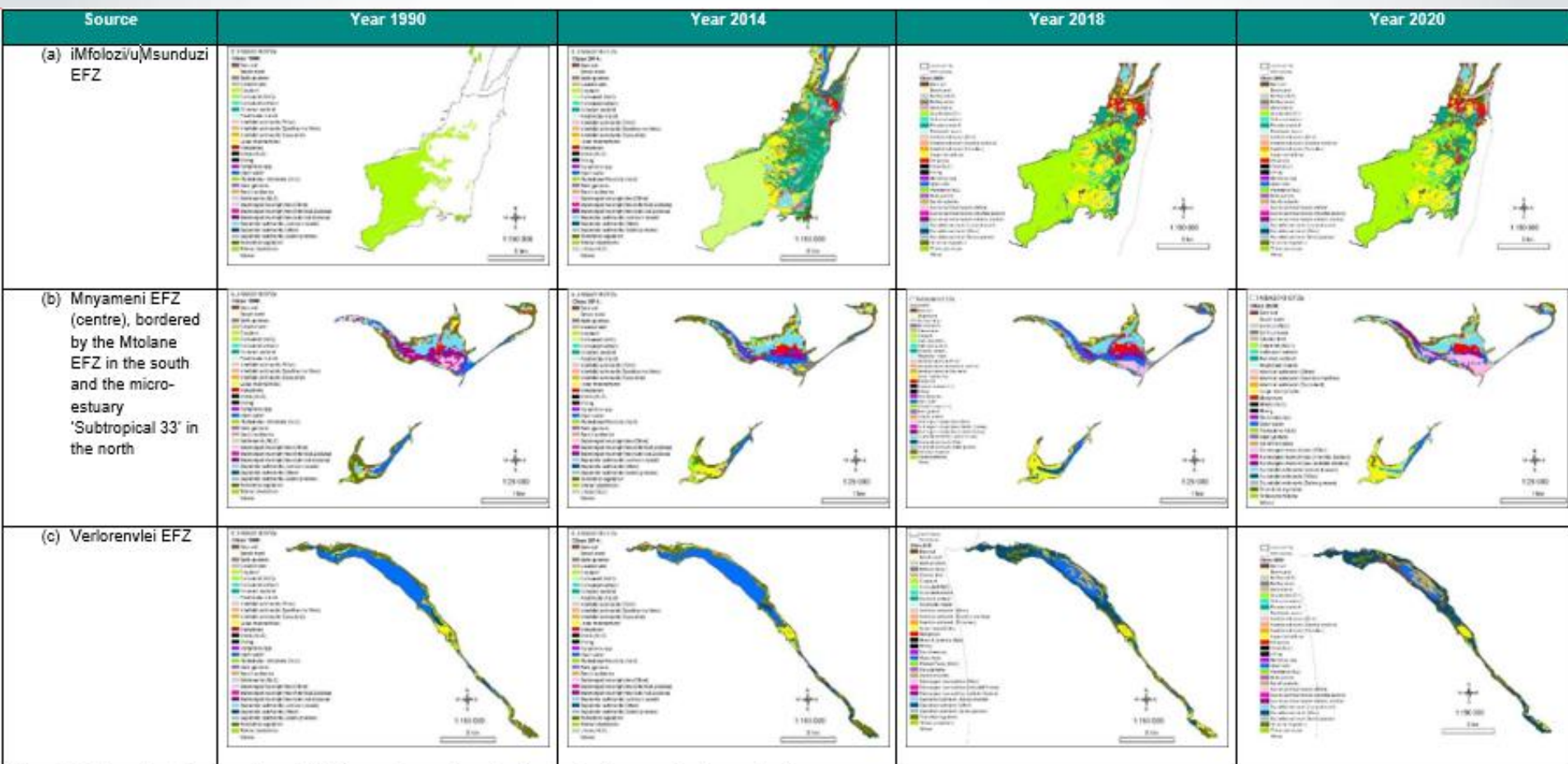


Figure A.6: Examples of maps produced with the remote sensing classification for four years for three estuaries.



# Existing provincial land cover categories underestimate extent of transformation; types

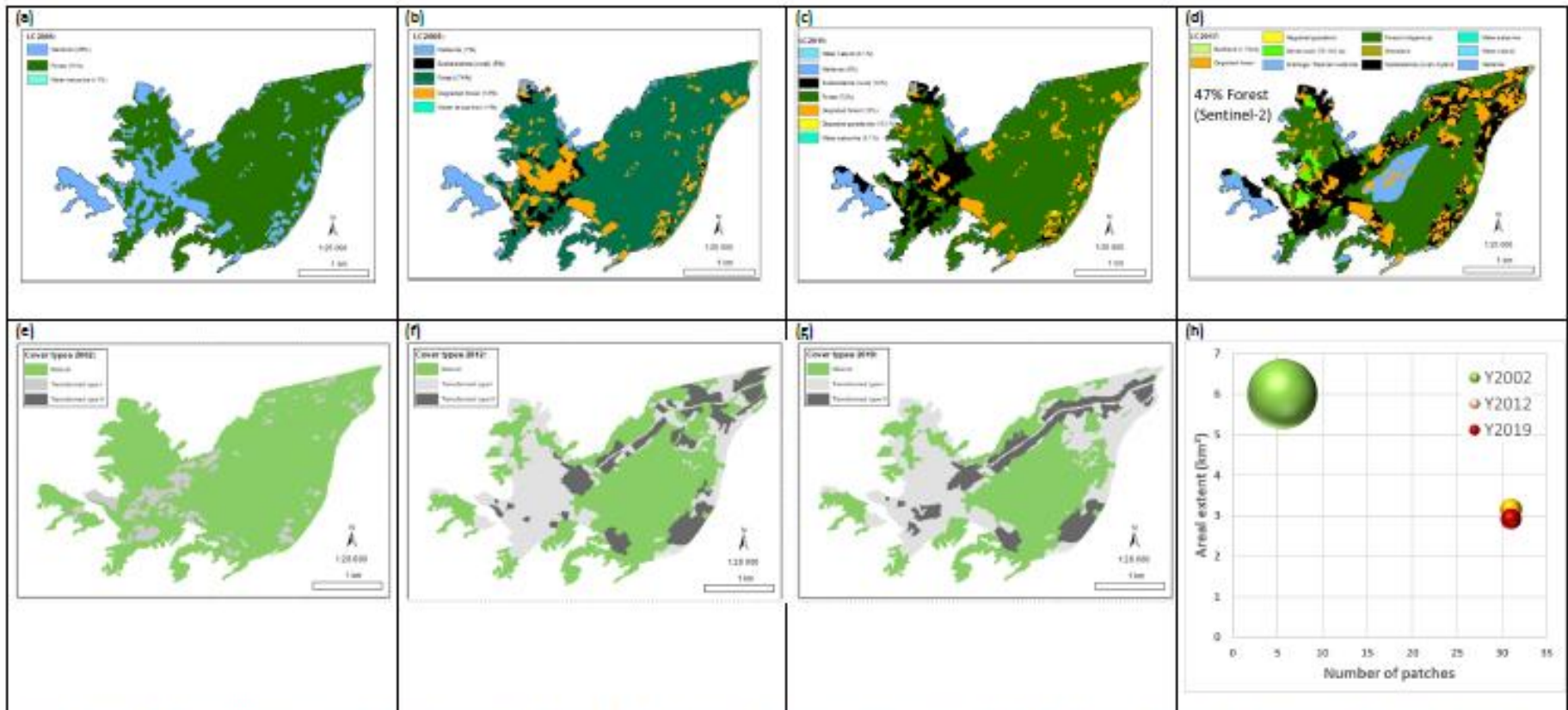


Figure C1: Changes in the extent of coastal swamp and floodplain forest cover for the focus area in the iMfolozi/ulundi Estuary where the full extent of the patch = 6 km<sup>2</sup> and was assumed to be completely coastal swamp and floodplain forest cover in the reference epoch of 2000. Changes reflected by the KZN land cover datasets for (a) 2005, (b) 2008, (c) 2011 and (d) 2017 (EKZNV, 2011; EKZNV, 2013a; EKZNV, 2013b; EKZNV and GTI, 2018). Changes mapped at a fine scale show transformation of the patch in (e) 2002 using the Quickbird image; (f) the colour orthophotos of 2012 and (g) 2019 for GEP images. Changes in the fragmentation metrics patch size and number for the focus area is shown in (h)

# Red listing of ecosystem types

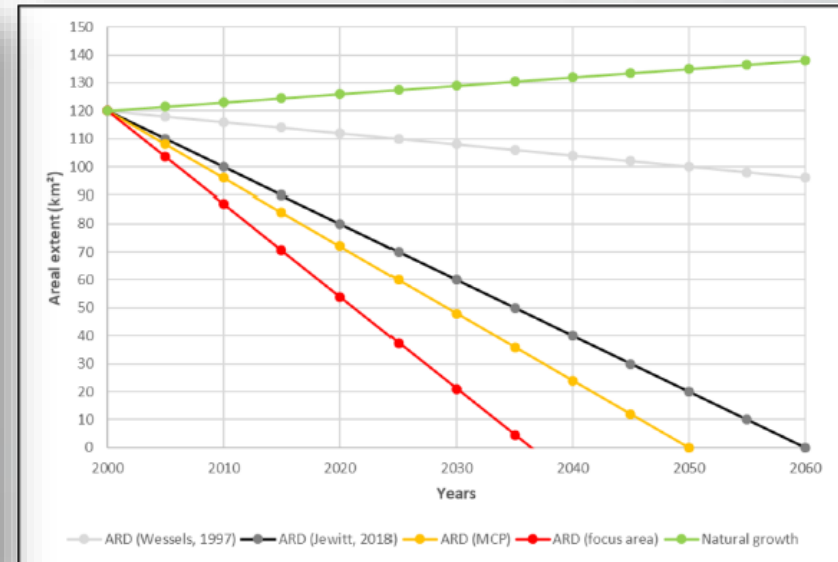
## IUCN red listing of ecosystem types guidelines (Bland et al., 2017)

- Criterion A: Determining the areal extent lost and rate of loss
- Criterion B: Range-restricted (Extent Of Occurrence (EOO) should be < 50 000 km<sup>2</sup> to be considered threatened)
- Criterion C: Indicators of environmental degradation
- Criterion D: Loss of biotic processes
- Criterion E: Quantitative analysis

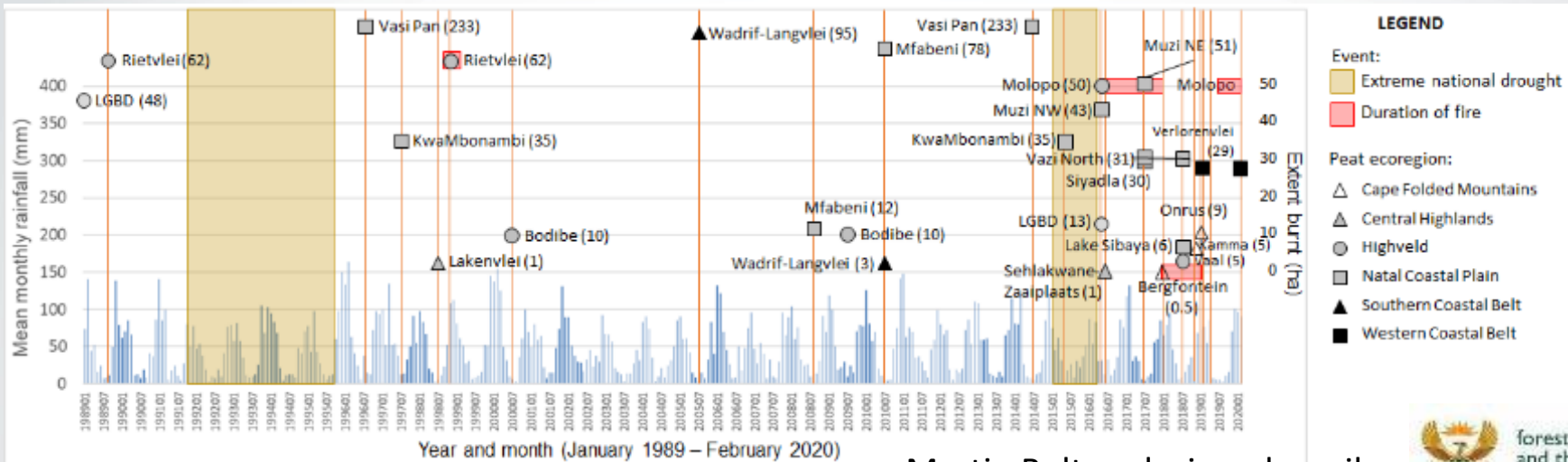
Red list assessment evaluation of the subtropical-temperate coastal forested wetlands (swamp and floodplain) in South Africa according to the IUCN criteria (Bland et al., 2017). Threat status: CR = Critically Endangered; EN = Endangered; NT = Near Threatened; VU = Vulnerable. Other categories: DD – Data Deficient; NE – Not Evaluated.

Criterion (across); subcriterion (down):	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E
Subcriterion 1	CR <sup>3</sup> A2a	CR <sup>3</sup> B1 (a)i	DD	NT <sup>1</sup> *	CR <sup>3</sup>
Subcriterion 2	CR <sup>3</sup> A2b	CR <sup>1</sup>	DD	DD	
Subcriterion 3	CR <sup>3</sup> A2c	CR <sup>1</sup>	DD	DD	

Accuracy levels: <sup>1</sup>Virtually certain (99–100% probability); <sup>2</sup>Very likely (90–100%); <sup>3</sup>Likely (66–100%); <sup>4</sup>More likely than not (50–100%); <sup>5</sup>About as likely as not (33–66%); <sup>6</sup>Unlikely (0–33%); <sup>7</sup>Very unlikely (0–10%); and <sup>8</sup>Exceptionally unlikely (0–1%). \* Faunal species association.



# EO of burning peatlands?



Martin Bolton designed a spike branch spray for Working on Fire

## Case studies



# Conclusion

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- Remote sensing remains an **important tool for monitoring and assessment** of inland waters, their ecosystems, ecological condition, catchments and trends over time.
  - Choice of sensor NB (spectral, spatial & temporal resolution // band)
- Continuous **field validation** of occurrence and ecological condition is critical for improved reporting
  - bioblitzes
- Each study contributes to **improved understanding** and reporting of habitat changes within RSA and to the global frameworks.





## SANBI Living Catchments NEWSLETTER

Issue 10, 2024

www.sanbi.org

Overview

234,227  
OBSERVATIONS

26,680  
SPECIES

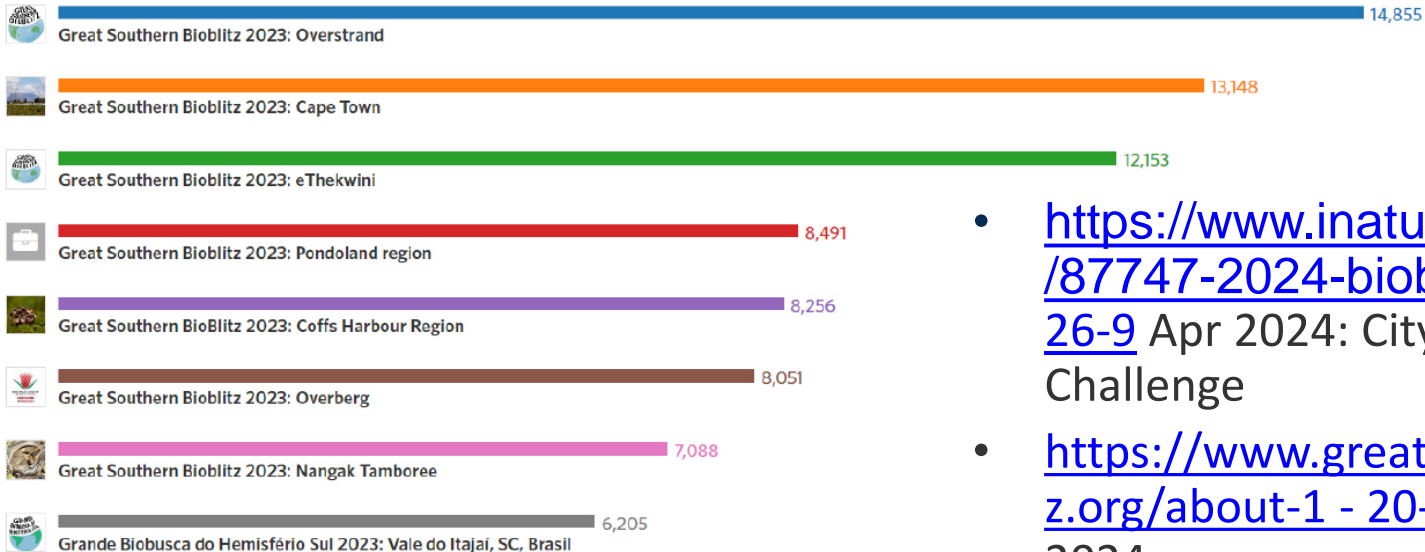
4,751  
IDENTIFIERS

7,503  
OBSERVERS

Stats

### Leaderboard

Sort By: **Observations** | Species | Observers



- <https://www.inaturalist.org/posts/87747-2024-bioblitz-planning-26-9> Apr 2024: City Nature Challenge
- <https://www.greatsouthernbioblitz.org/about-1-20-23> September 2024

Great Southern Bioblitz 2023 results.



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