Digital Earth Africa Coastlines: a continental-scale service for monitoring coastline changes around Africa

Plenary session #3

Coastal Hazards

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Digital Earth Africa

5th Symposium | Accra, Ghana | 24 – 28 October 2022

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Digital Earth Africa Coastlines: A Continental Coastline Monitoring Service

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Australian Government
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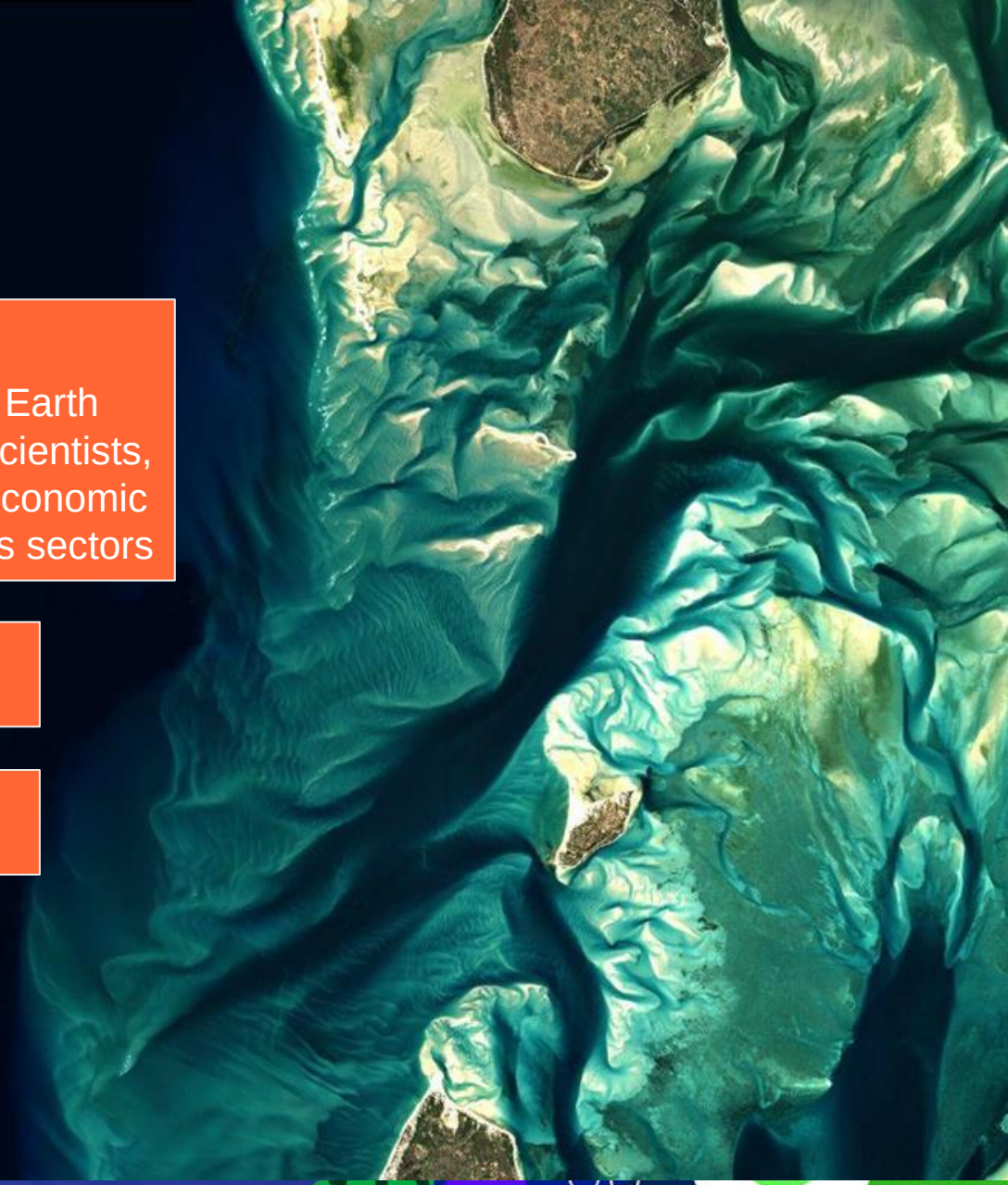
Australian Government
Geoscience Australia

Digital Earth AFRICA



Our Vision

DE Africa will provide a routine, reliable and operational service, using Earth observations to deliver decision-ready products enabling policy makers, scientists, the private sector and civil society to address social, environmental and economic changes on the continent and develop an ecosystem for innovation across sectors

- Land degradation
- Urbanisation
- Water resources and flood risks
- Agriculture and food security
- Coastline change

Digital Earth Africa's continental-scale satellite data archive

- 36 years (> 3 petabytes) of Landsat and Sentinel-2 satellite imagery from 1986
- Freely accessible in the cloud via Open Data Cube and AWS S3 + STAC
- Continental scale products and services
- Analysis tools and training materials
- Different interfaces for difference needs

The Context:

Coasts serve as major socio-economic hubs for 38 African countries:

- Africa's coastal areas host half of the 15 African megacities which are fast expanding due to rural-urban migration and population growth
- The African blue economy is expected to be worth $405 billion and employ more than 57 million people by 2030
- Coastal communities and the blue economy are vulnerable to the impacts of climate change

Ocean Decade: Blue economy presents vast opportunities for Africa, Africa Renewal, 2022.

The Issues:

Rising sea levels and rates of coastal erosion represents a pressing threat for African coastal communities, real estate, agriculture and aquaculture:

- Coastal erosion has a severe impact on African land and buildings with estimated losses of $8 billion per year
- Coastal erosion has consequences for fish populations, marine ecosystems and local communities

Effective management of coastal changes and mitigation of risk, as well as sustainable coastal zone management, rely on consistent and regularly updated data across the continent

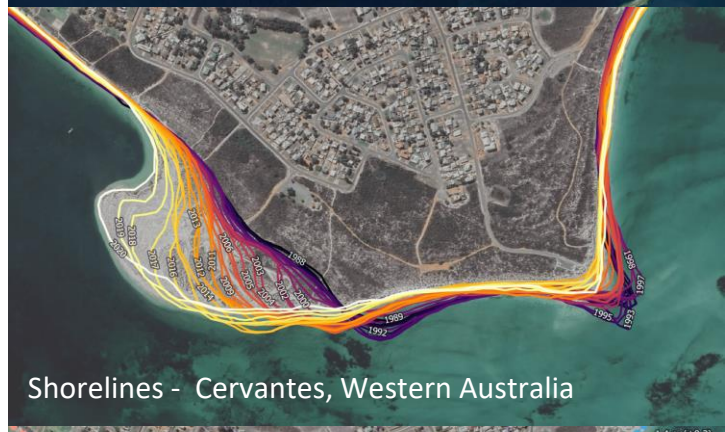
Monitoring coastlines is challenging:

- Dynamic - constantly changing with hazardous conditions
- Intensive coastal monitoring expensive and impractical at scale
- Usually restricted to well studied local sites and populated areas

Freely available satellite image archives can offer a powerful and cost-effective tool for monitoring coastlines at regional and national scales

Digital Earth Australia Coastlines: A Coastline Monitoring Service

- Based on Australian innovation @ Geoscience Australia - Open Data Cube
- **First Continent-wide** Coastlines monitoring service
- Based on historical satellite imagery – Landsat
- Includes tidal modelling
- Accurate down to 10m
- Track continental changes since 1988, updated annually
- Monitors more than 33,000 km of coast
- Used by industry and local councils

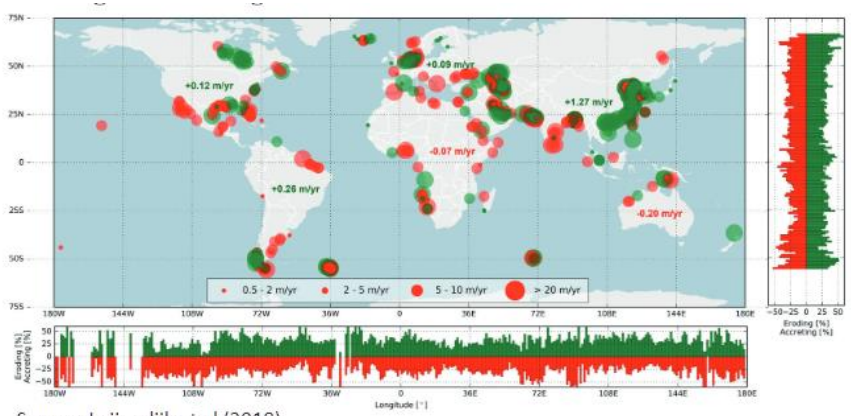


Shorelines - Cervantes, Western Australia

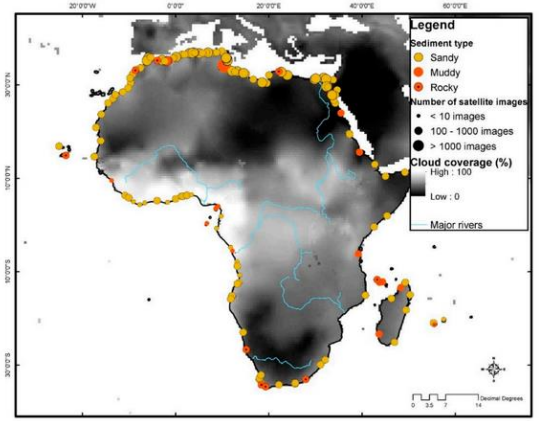
Hotspots and rate of changes - Cervantes, Western Australia

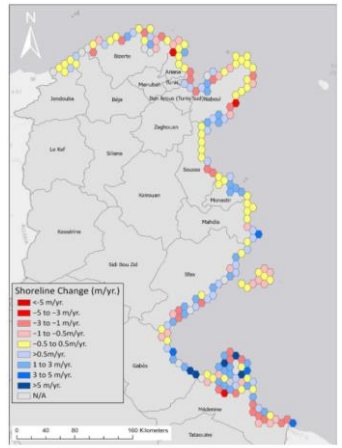
State of Knowledge:EO Studies covering Africa

- Worldwide Luijendijk et al (2018) - 500m transect - https://aqua-monitor.appspot.com/?datasets=shoreline, unvalidated,Google Earth Engine, no tidal correction
- Sandy Beach Evolution Around Seaports (Wiebe de Boer et al. 2019) ports only, Google Earth Engine
- Maghreb, Tunisia and Morocco - National Oceanography Center (Marines resource, ESA, World Bank, 2020), unvalidated, no tide modelling - Google Earth Engine

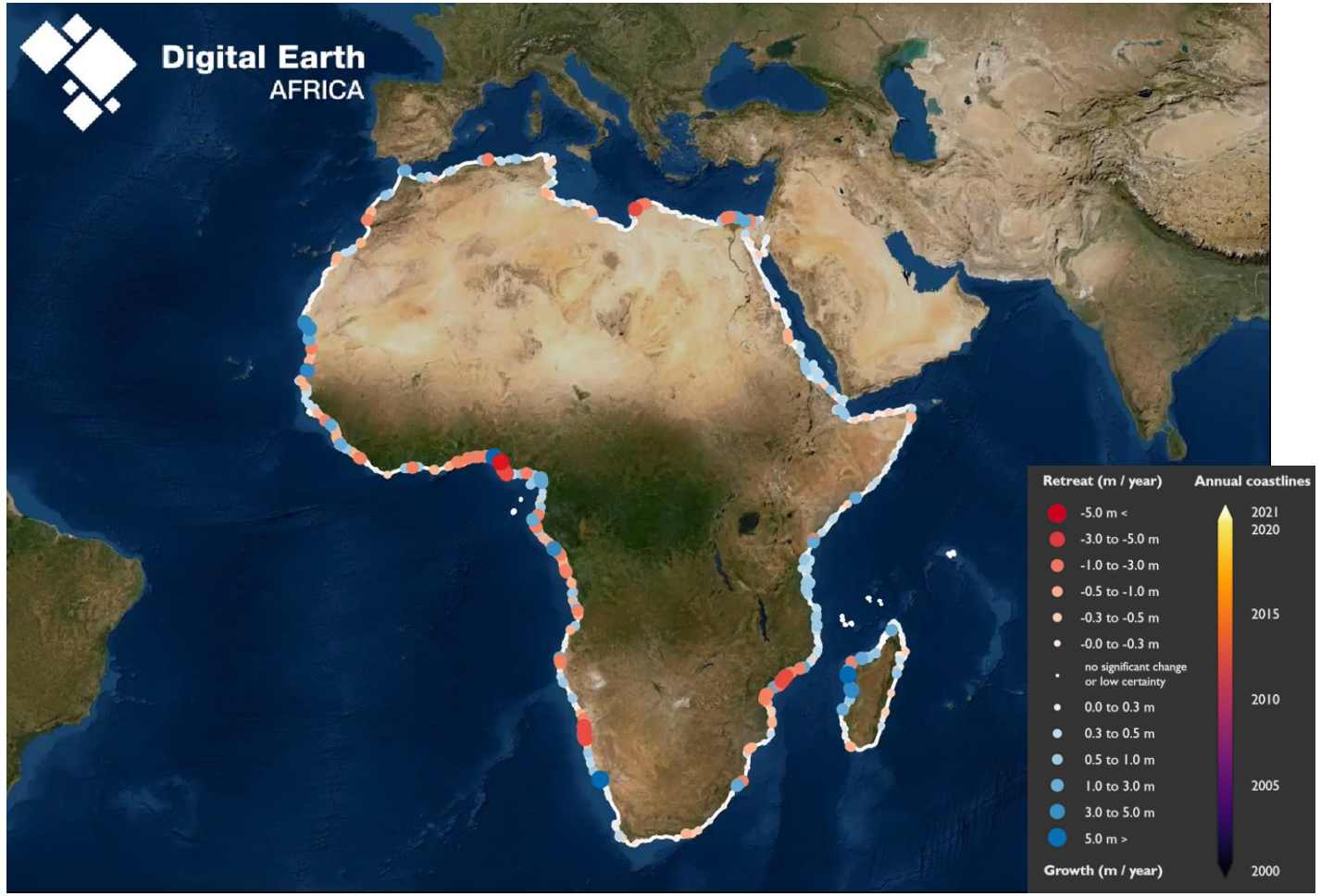


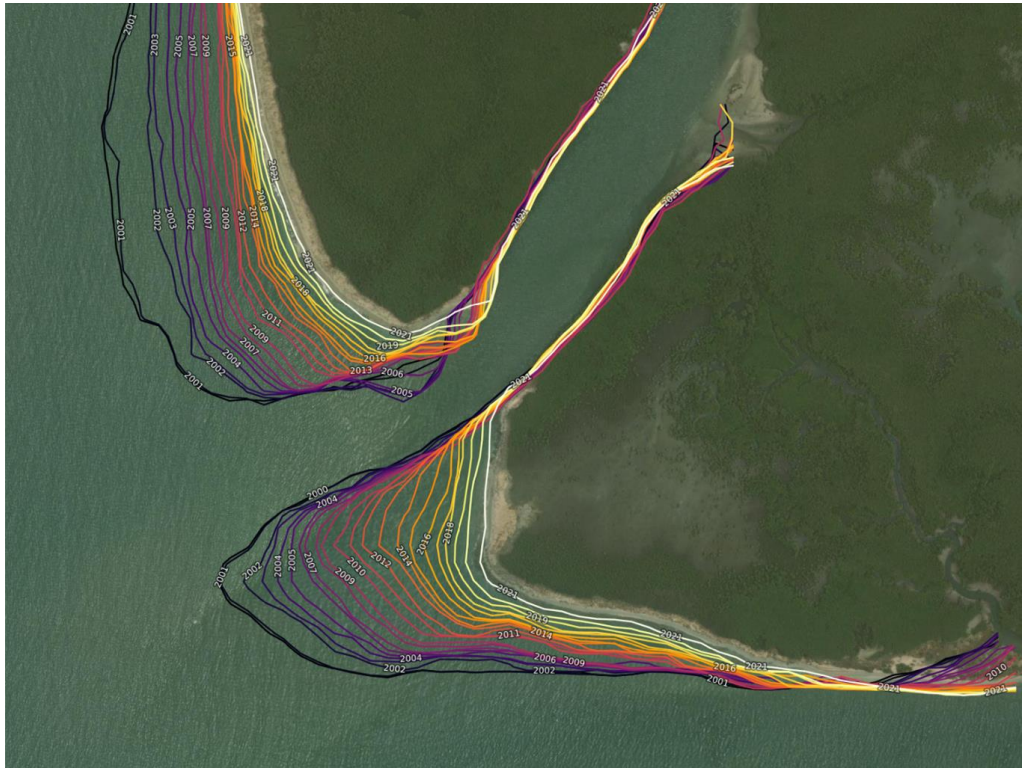
Source: Luijendijk et al (2018)





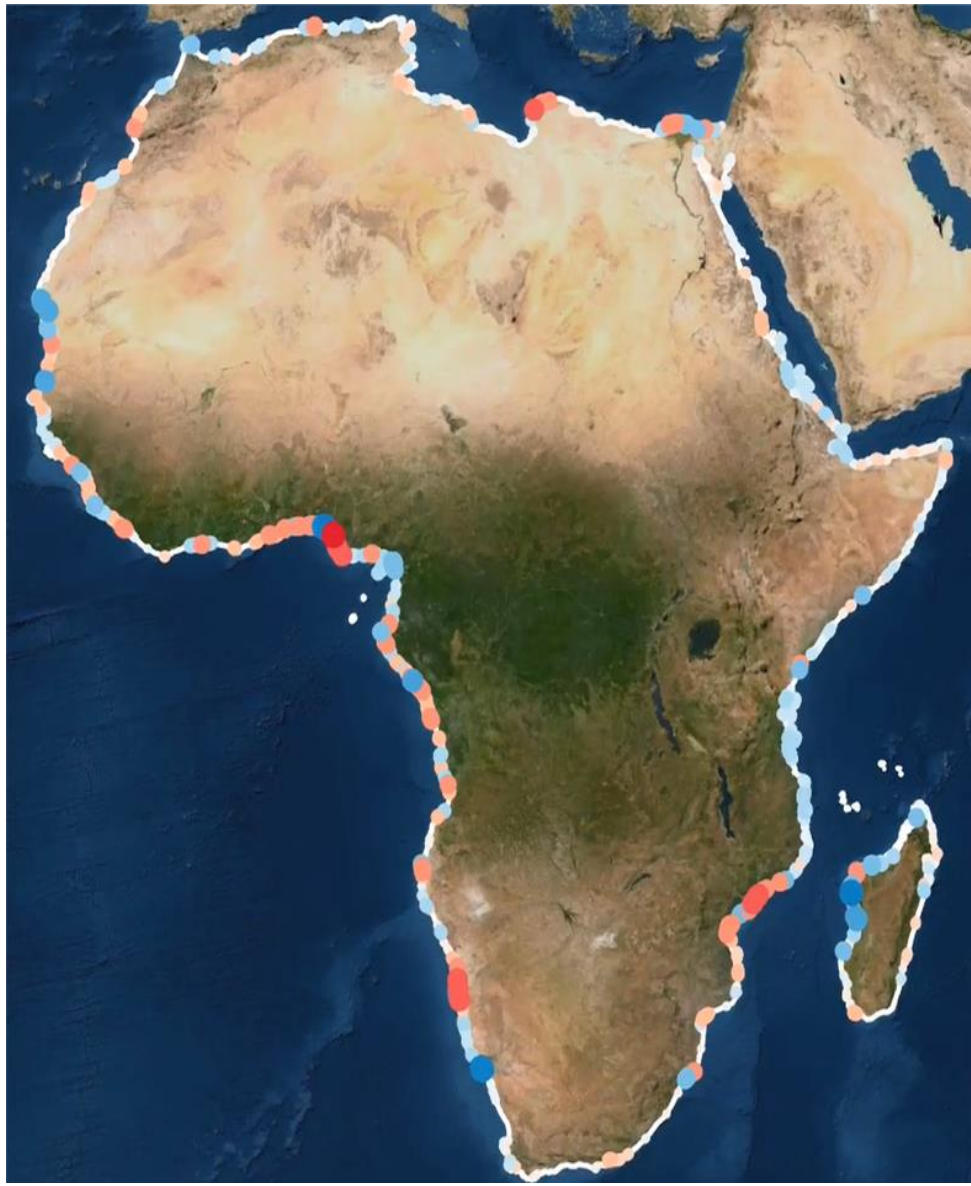
Digital Earth Africa Coastline Monitoring Service



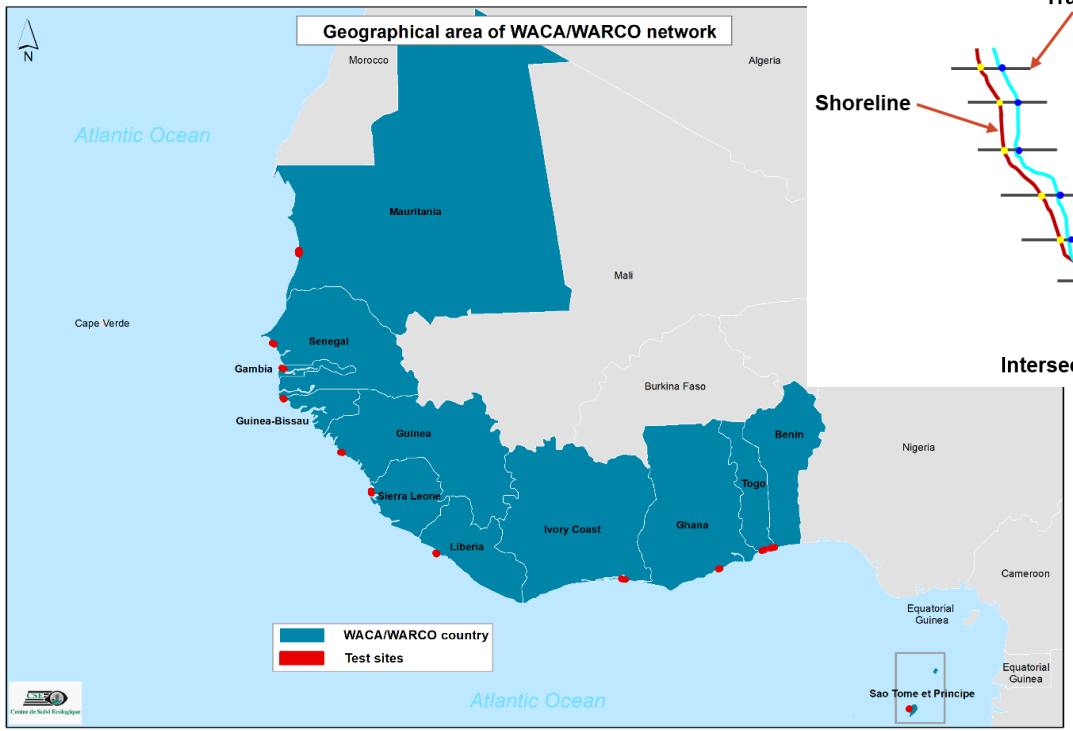


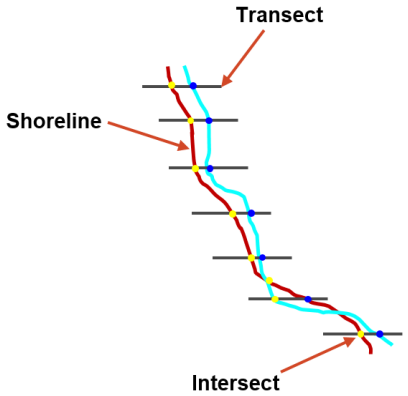
Digital Earth Africa Coastlines

- **Improved version** of the Australian Coastlines
- **Co-developed and validated** with implementing **partners in Africa**
- **First Africa-wide** Coastlines monitoring service
- Tracks continental changes **from 2000 to present**
- Monitor more than **60,000 km of coast**
- Provides f**ree interactive access** to
  - Hotspots
  - Rates of changes
  - Average yearly shorelines



Coastlines Validation:



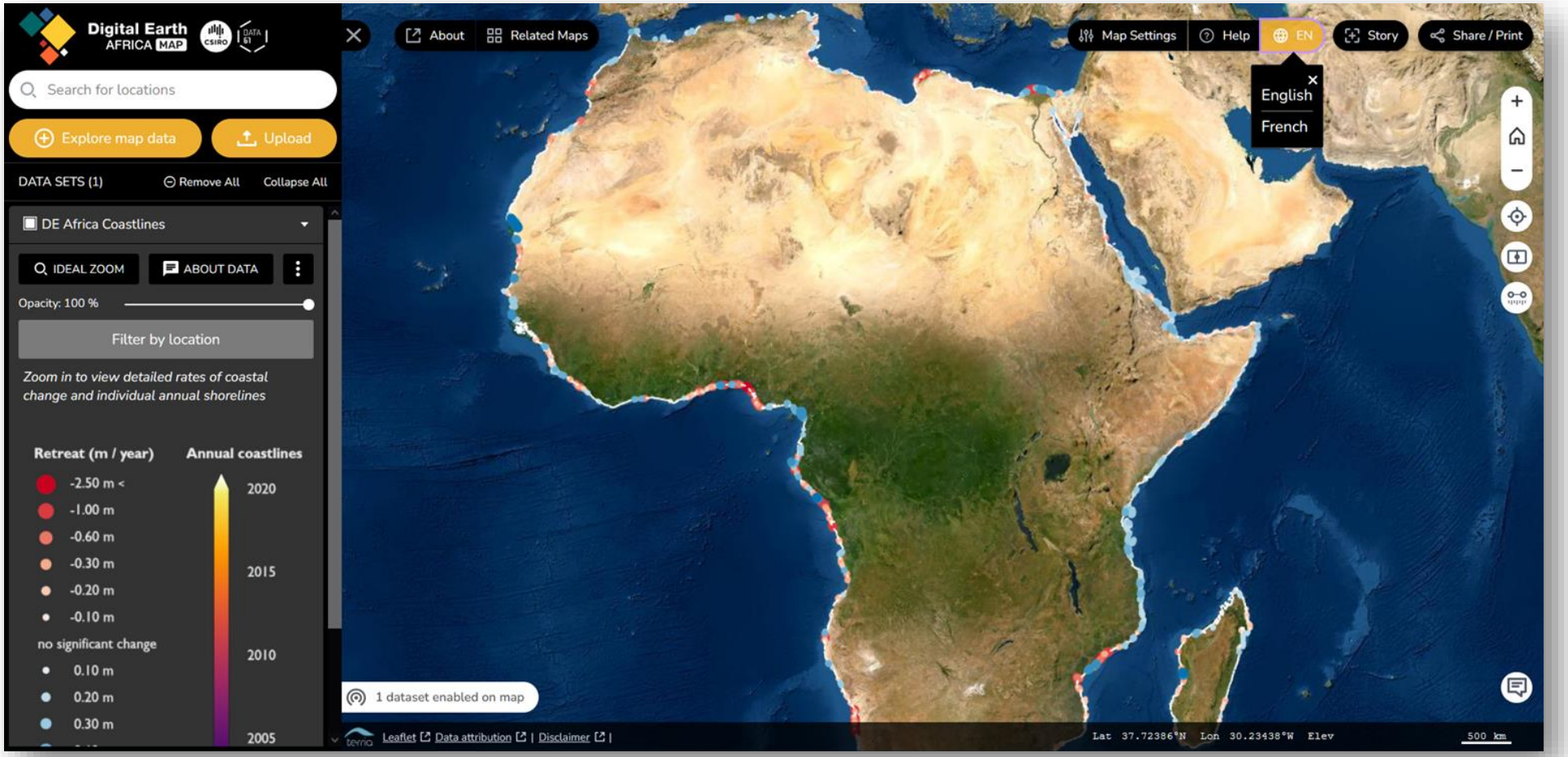


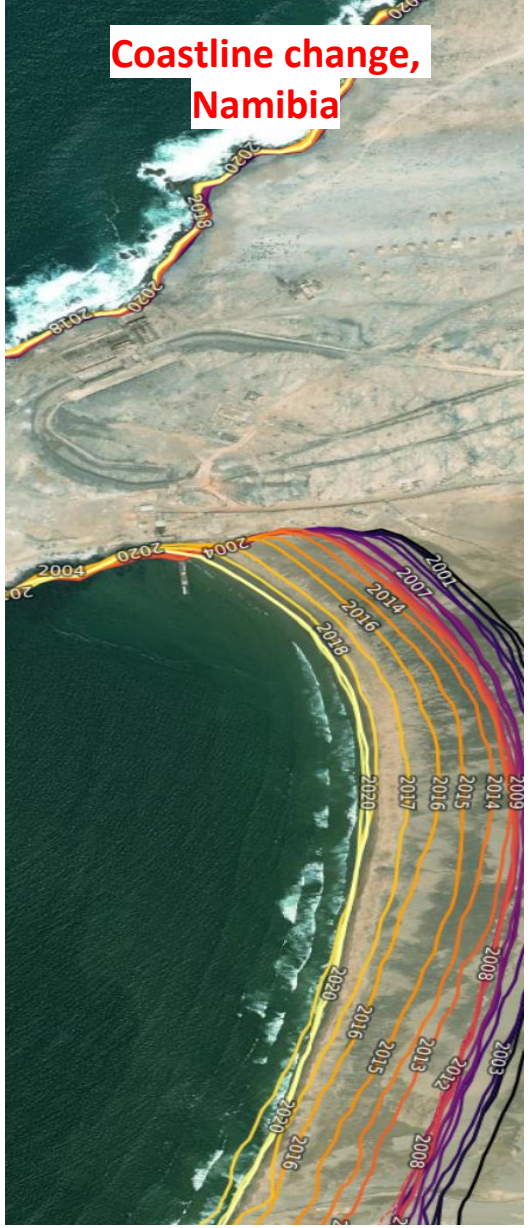
Pays	Min	Max	MAE	RMSE (m)	RMSE %	RMSE (Px)	PRECISION
Mauritanie	0,00	31,29	7,17	8,79	29,30	2/5	Bonne
Sénégal	0,36	10,17	4,51	5,42	18,07	1/5	Très bonne
Gambie	0,00	22,32	5,26	7,77	25,90	2/5	Bonne
Guinée Bissau	0,37	16,00	6,41	7,80	26,00	2/5	Bonne
Guinée	0,25	24,81	8,14	9,75	32,50	2/5	Bonne
Libéria	0,12	17,15	8,21	9,31	31,03	2/5	Bonne
Sierra Leone	0,02	21,43	6,21	7,87	26,23	2/5	Bonne
Côte d'Ivoire	0,15	12,50	4,34	5,48	18,27	1/5	Très bonne
Ghana	2,43	17,44	10,33	10,91	36,37	2/5	Bonne
Togo	0,01	16,30	2,95	4,39	14,63	1/5	Très bonne
Benin	0,00	14,85	4,83	5,61	18,70	1/5	Très bonne
Sao Tomé et Principe	0,02	12,19	2,64	4,12	13,73	1/5	Très bonne
Moyenne	0,31	18,04	5,92	7,27	24,23	2/5	Bonne

Centre de Suivi Ecologique

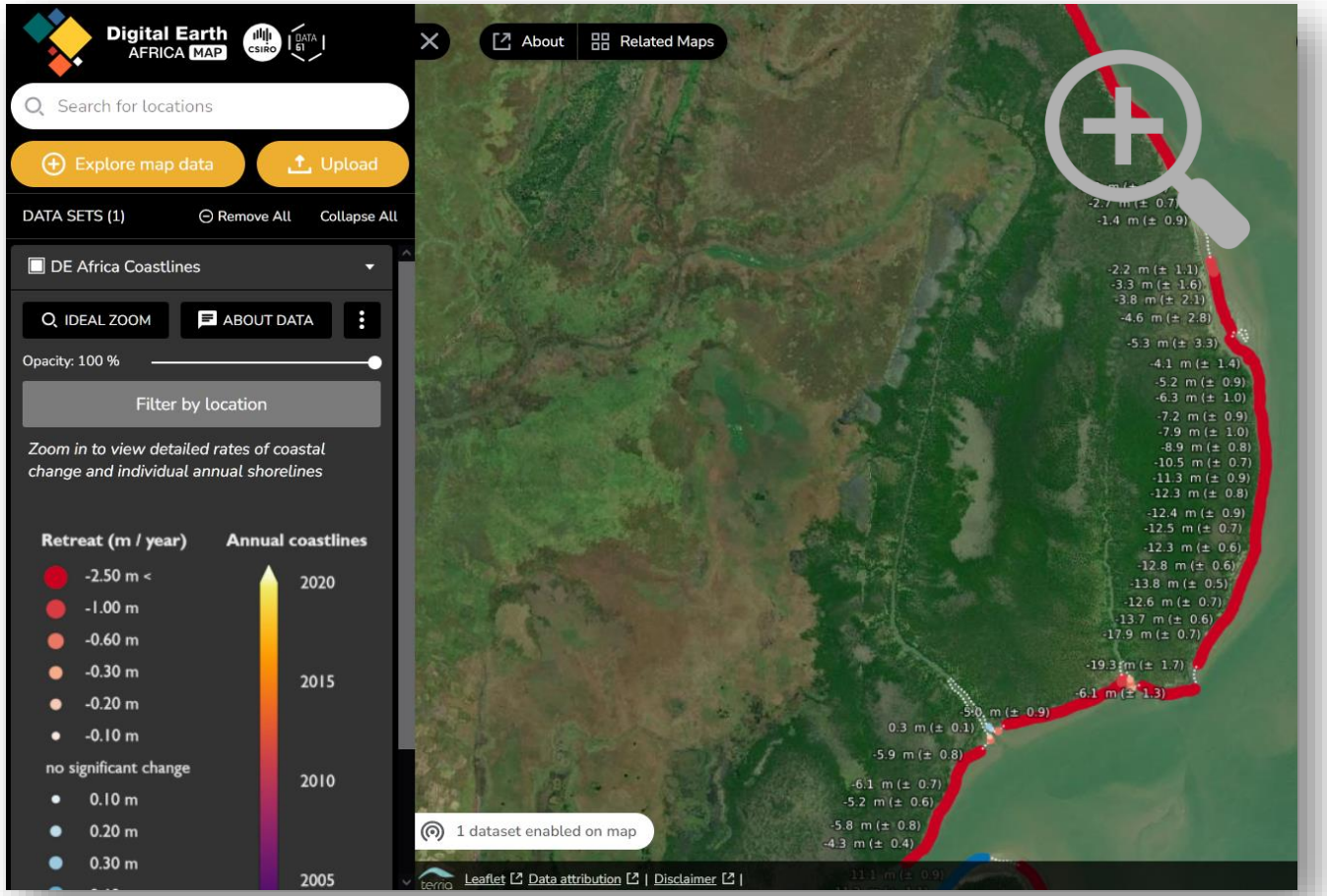
View it on the Maps

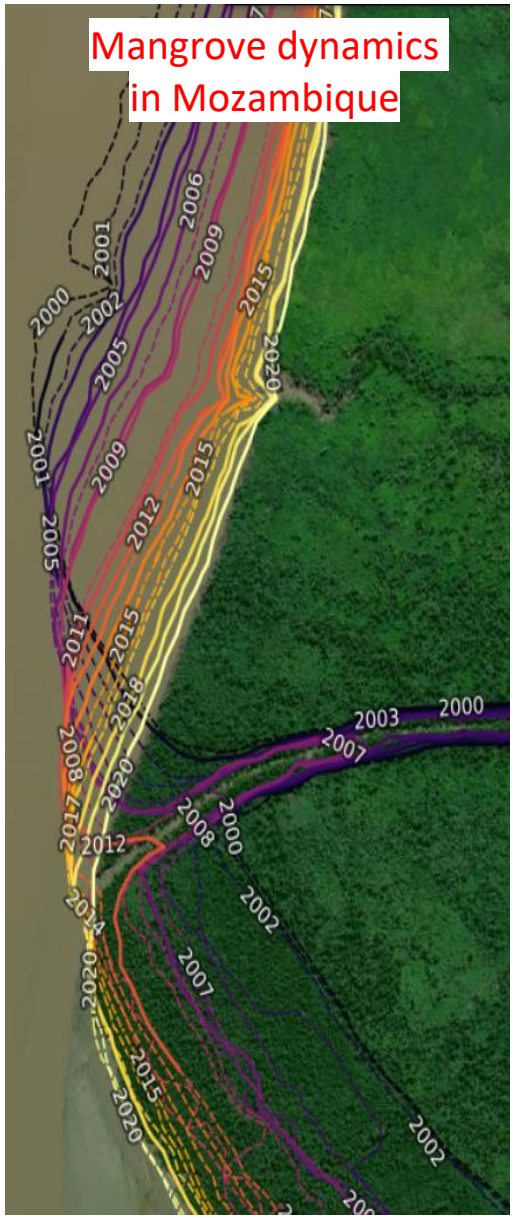
https://maps.digitalearth.africa/





Identify hot spots and rates of change

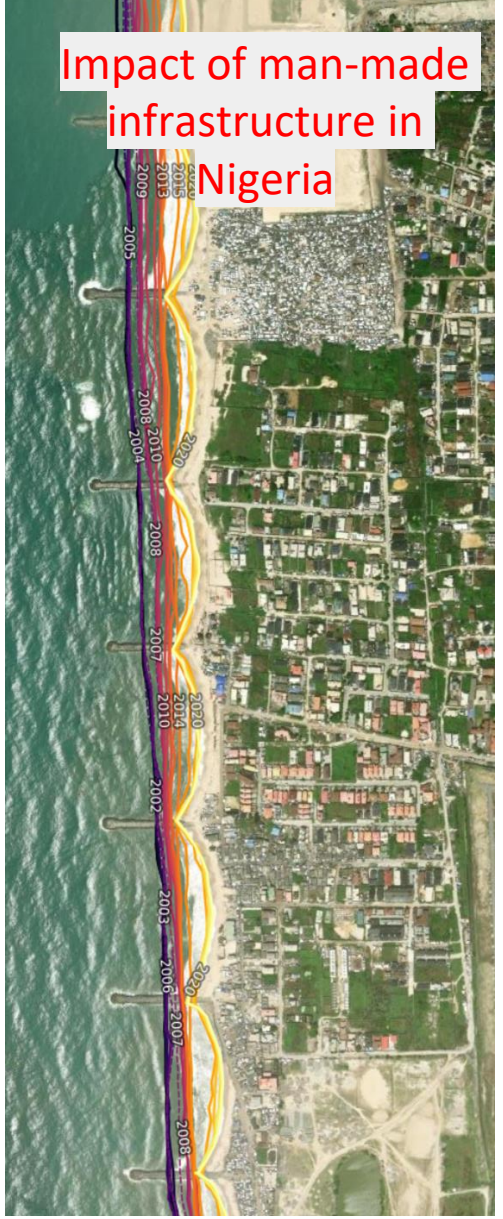




Understand uncertainties, identify impacts

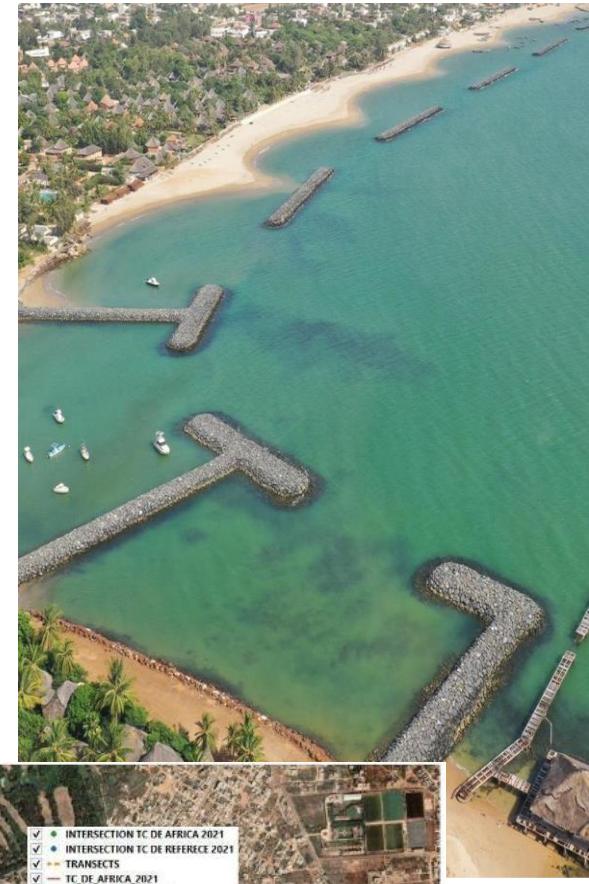
Good quality shorelines
— 2000

Low quality shorelines
-- 2000



Integrate and Redistribute the Data

- WMS and WFS links allows direct integration in QGIS, ArcGIS or **any OGC Web Service compatible platform**
- No commercial license, **free for all users, including Industry to create own Services**
- **Training tools** are available to understand better the methods used and also to tailor the outputs to your need



The Benefits – Economic Valuation

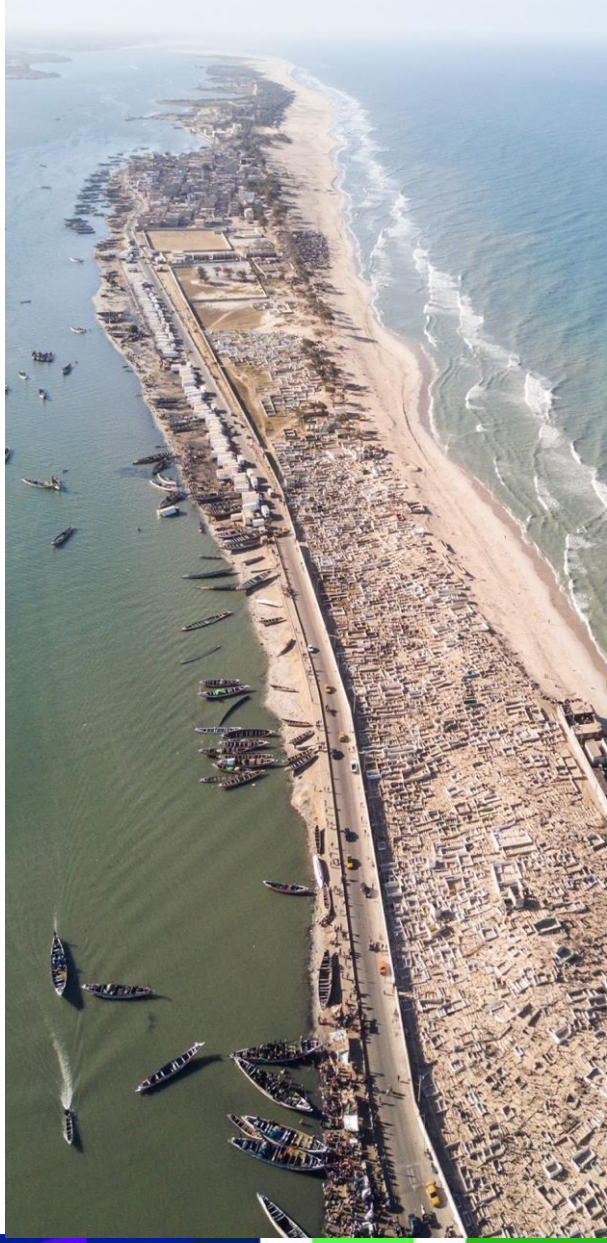
By mitigating coastal erosion risks in 3 key sectors, Digital Earth Africa could inject ~$460 million per year into Africa's economy and change the lives of ~270 million people.

DISAL consulting

REAL ESTATE & AGRICULTURE	FISHERY	INSURANCE
$101 MILLION	**$185 MILLION**	**$176 MILLION**
of asset value (land & buildings) saved per year	the potential benefits per year by alleviating the loss of fish catches	per year in additional profits & jobs for the insurance industry

Visit: digitalearthafrica.org | **Explore:** maps.digitalearth.africa

Tweet: @DEarthAfrica | **Linkedin:** Digital Earth Africa



Get involved and send us feedback

- Access the data: https://maps.digitalearth.africa/
- View the documentation: https://docs.digitalearthafrica.org
- Let us know what you are doing with the data info@digitalearthafrica.org
- Join our live sessions! 11am (GMT Zero time) https://us02web.zoom.us/j/5890793425
  - 2 Nov 2022 Joseph Tuyishimire French
  - 9 Nov 2022 Kenneth Mubea English
- Visit our booth at GEO WEEK (next week)
- Go to the helpdesk https://helpdesk.digitalearthafrica.org if you have any questions

Training modules will be available soon on the Digital Earth Africa learning platform

Authors & Acknowledgements

Authors: *Dr Lisa-Maria Rebelo, Dr Robbi Bishop-Taylor, Dr Cedric Jorand, Joseph Tuyishimire, Edward Boamah, Mamadou Lamine Ndiaye, Dr Moussa Sall, Dr Amadou Sall, Victoria Neema, Ndeye Fatou Sane, Lissong Diop, David Ongo, Rose Waswa, Dr Lisa Hall, Dr Fang Yuan, Dr Stephen Sagar, Dr Adam Lewis*

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FRONTIER SI

UENR University of Energy & Natural Resources

COOi studios

World Economic Forum

CEOS Committee on Earth Observation Satellites

Open Data Cube

ITC

IWMI International Water Management Institute

Element 84

SINERGISE

riis enabling innovation

Radiant Earth Foundation Earth Imagery for Impact

KARTOZA Open Source Geospatial Solutions

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Thank You.
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