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General presentation of the Seychelles report

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Presentation Outline

1.0 Introduction
- Seychelles Landscape
- Marine Areas

2.0 Sea level Monitoring Stations
- Pointe Larue
- Denis Island
- Wave Buoy

3.0 Sea level related coastal hazards
- Coastal risks and climate change effects
- Hazard monitoring within the marine areas
- Measures to build coastal resilience

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1) Introduction

- Seychelles is a small island developing state (SIDS), which relies heavily on its coastal zone for economic development, critical infrastructure, and housing
- It has a total of 115 islands, with Mahé, Praslin, and La Digue being the main populated ones.

- Given its mountainous topography, about 90 % of the population and most critical infrastructure is concentrated in the narrow coastal plateau

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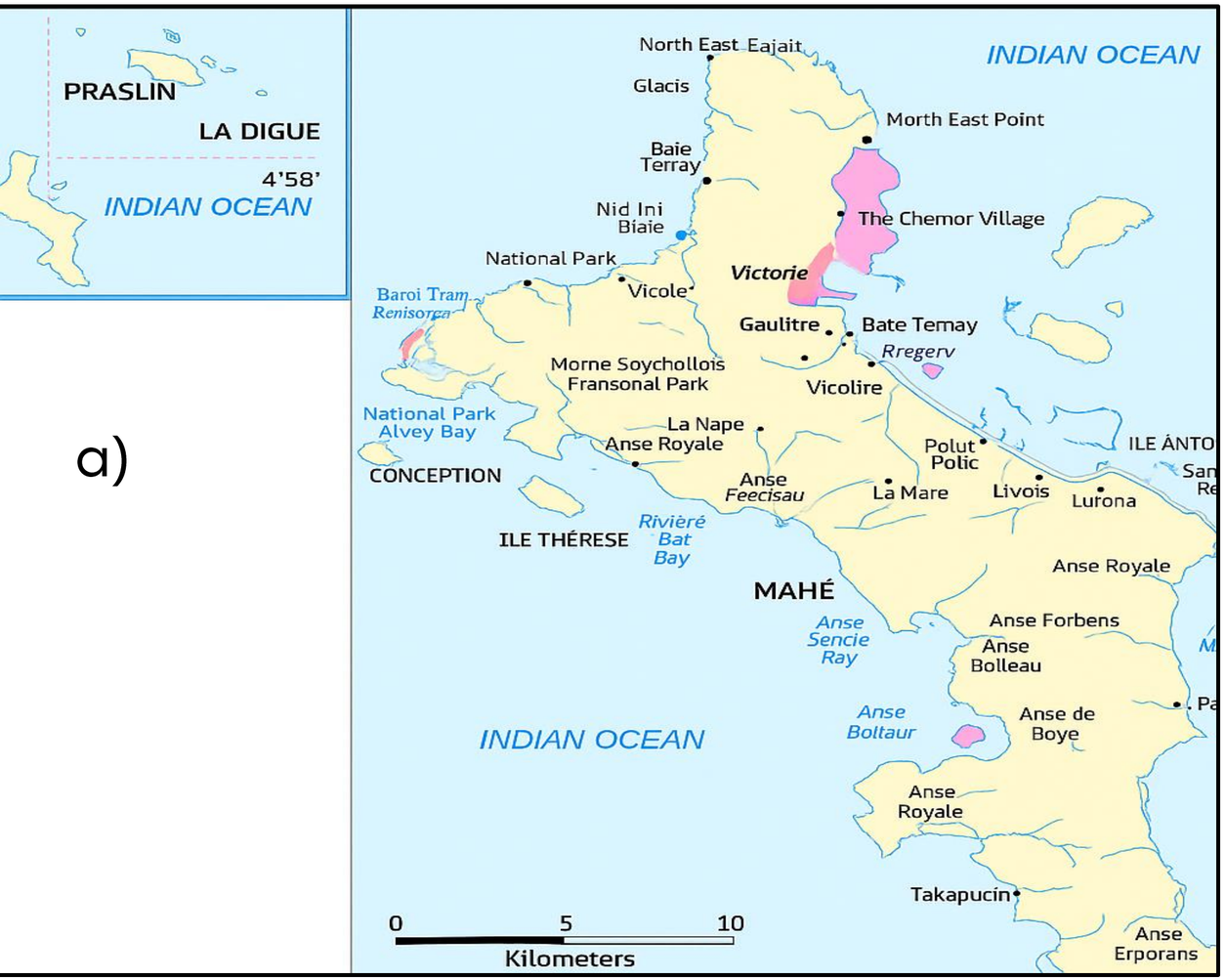
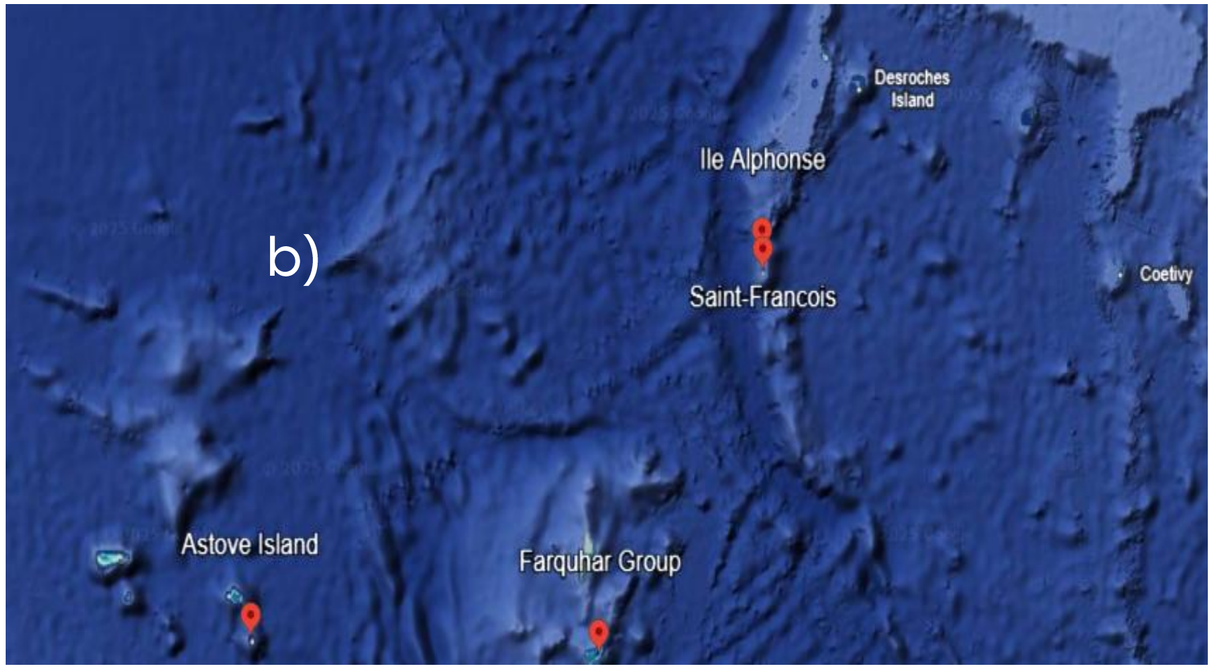
Introduction ...

- The mean elevation of the coastal plateau around the main islands ranges between 2 and 10 metres above sea level.
- Most of the critical infrastructure (i.e., roads, power stations, and food storage facilities are situated within this range (I,e.,2-10m)
- Thus most vulnerable to coastal flooding, coastal erosion, and the effects of sea level rise (Government of Seychelles 2017).

1a) Seychelles Landscape



a)

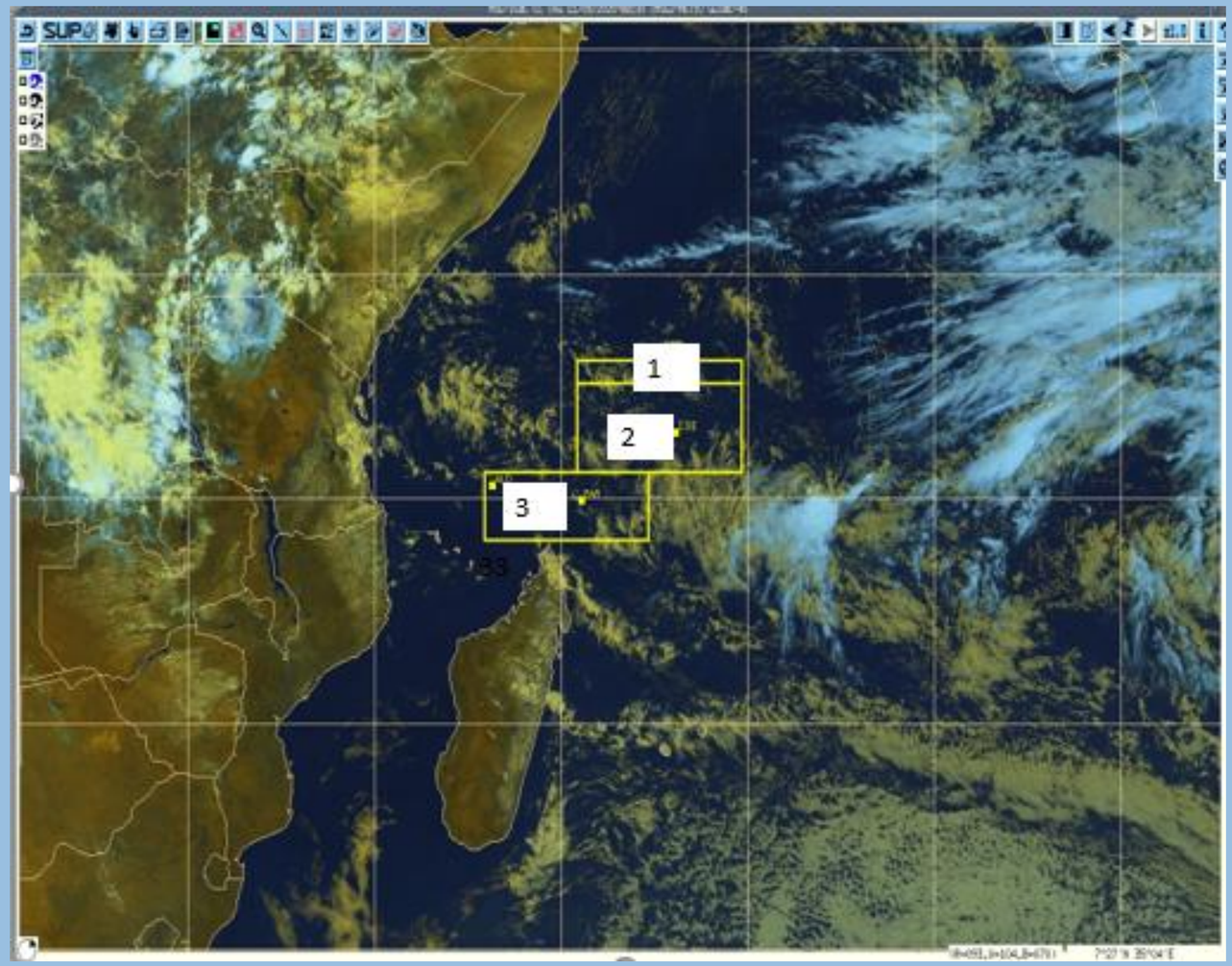


b)

Figure 1: Map of Seychelles showing the inner (a) and outer islands (b)

1b) Seychelles Marine Areas

1. Mahe, Praslin, La Digue, Silhouette, Bird and Denis Island
2. Amirates, Alphonse & Coetivy
3. Aldabra, Assuption , Cosmollendo & Farquar



2) Sea Level Monitoring Stations

a) Tide Gauges

Sea level monitoring in Seychelles dates back to the early 1960's as follows:

- ❑Float Stilling Well, Ile Hodoul, Port Victoria 1962-1975
- ❑Pneumatic bubble gauge, Aldabra 1975
- ❑Mechanical Autographic gauge, Port Victoria, 1986
- ❑Several Ad-hoc sea level measurement, 1991

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Sea level monitoring stations

i) Pointe Larue

- In 1993, a sea level monitoring station under the Tropical Ocean Global Atmosphere Sea Level Centre program was installed at the Seychelles international airport.

Fig:2.0 :Pointe Larue Sea level monitoring stations

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- The station has been operational since 1993 and relays reliable sea level data in near real-time to the University of Hawaii Sea Level Center via satellite telemetry.

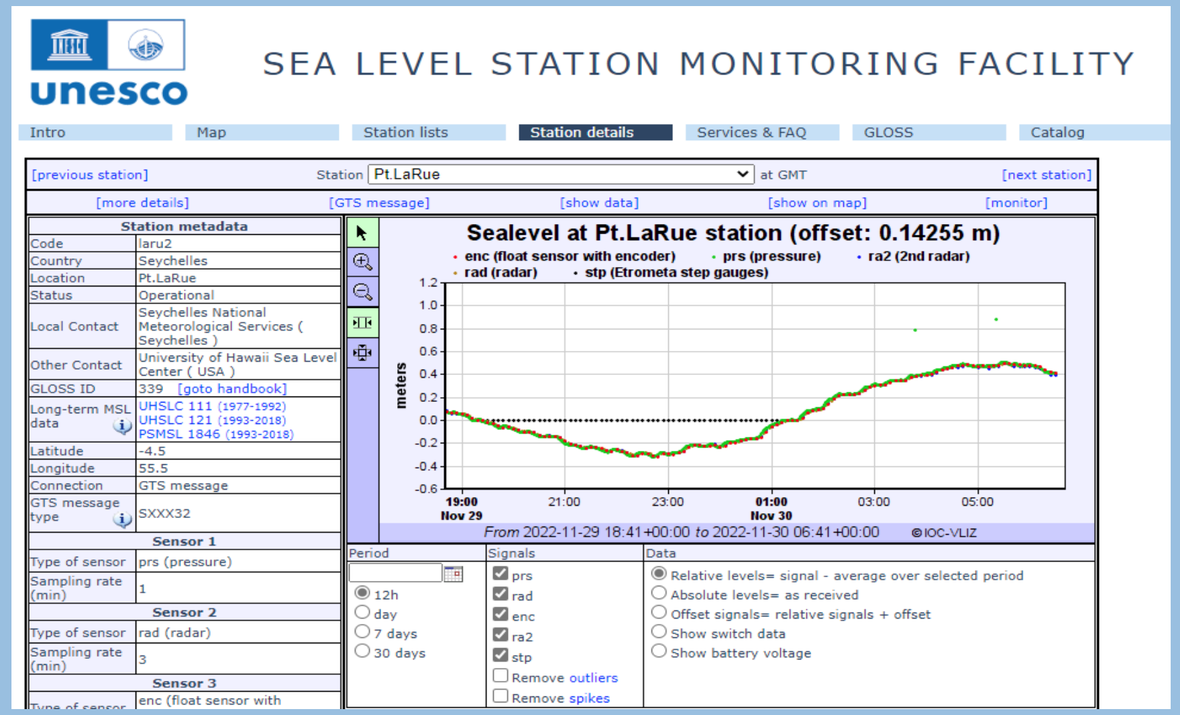

Fig. 2a: Interface of Pointe Larue Sea level monitoring stations

Parameters measured:

- ❑Sea level (water level/height)
- ❑Tidal variations
- ❑Storm surge levels
- ❑Long-term sea-level trends
- ❑Waves and swells
- ❑Temperature

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ii) Denis Island station

- In the aftermath of the 2004 Tsunami which considerably impacted the Seychelles coastline, a tide gauge was proposed for installation on Denis Island.
- The main purpose of the tide gauge was to provide near real time data for the purpose of Tsunami wave propagation monitoring and tsunami alert generation respectively.

Fig. 2b: Location of Danis Island

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- The Denis Island tide gauge was installed in 2008-2009 at latitude -3.8 and longitude 55.6667 through the financial support of the United Nations Development Program, with the involvement of the Seychelles Meteorological Authority and the Seychelles Department of Risk & Disaster management.

- Data from the tide gauge is available from 28th May 2009 until late January 2013 with intermittent breaks in the data set.
- Status: Not operational

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iii) Wave Buoy (RIMES)

- In 2016, SMA benefited from its 1st ocean buoy (WaveRider)
- INCOIS assisted with the installation
- The buoy was funded by RIMES
- Status: Working but with battery issues
- Data is available during the daytime because it operates on solar energy.

Fig. 2c: Wave Buoy

- Data from the Wave Rider Buoy was transmitted to the SMA via VHF radio and to the INCOIS via satellite.
- The buoy supported the validation of INCOIS forecasts on waves and sea surface temperatures around Seychelles.

- Real-time data also strengthened Indian Ocean states' capacity to track high swell events from the Southern Ocean.
- Buoy safety is maintained through a drift alert system that notifies stakeholders if it moves more than 200 meters from its deployment site.

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iv) Monitoring for Environment and Security in Africa (MESA) Wave Buoy

- Given under MESA program, through the funding of the EU and implementation by the Mauritius Oceanography Institute
- MESA was a 3year project , during which the buoy worked effectively. On the 4th year, it was decommissioned due to high license fees charges (i.e., satellite license charges).
- The wave buoy was installed about 5 Kilometers from the shore on the Northern coast of the main island of Mahe.
- The data was transmitted in real time via GSM and satellite telemetry

- The buoy monitored ocean-relat risks such as swells, storm surge
- The buoy is currently non-operational.

3) Sea level related coastal hazards

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i) Coastal flooding:

-Coastal flooding often occurs during extreme water-level events

- Results from the simultaneous and combined contributions of different factors: a) astronomical tides, b) storm surge, c) large waves, and mean sea level anomalies (Losada *et al*. 2013).

ii) Tropical cyclones

-occur about 500 to 600 kilometres from Seychelles, from October to May
are a rare phenomenon in Seychelles (JICA 2014)

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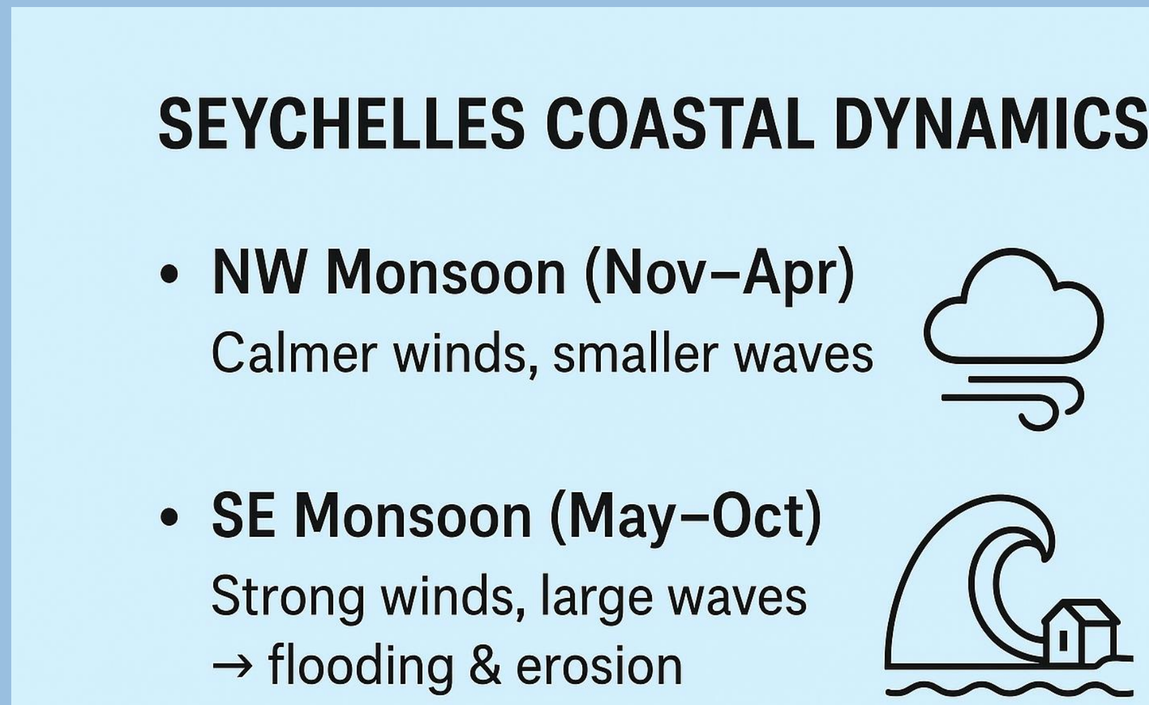
But, 1953 and 2006 cyclones: Both caused significant damage in Seychelles i.e., 2016 Cyclone Fantala devastated infrastructure in Farquhar Atoll, leaving almost all facilities severely damaged except those built to be cyclone-proof (Government of Seychelles 2017).

iii) Offshore wave conditions and extreme sea levels (Refer to the infographic)



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iv) Tidal variations

-The tidal range in Mahé has a mean high-water spring of 1.63 metres and mean low-water spring of 1.11 metres and 0.45 metres at Pointe La Rue (JICA 2014).

tide gauge observations reveal a long-term rising sea-level trend of approximately 0.65 centimetres per year (Borrero *et al*. 2016)

Summary of sea level related hazards

- 2004 : Indian Ocean Tsunami
  -caused significant coastal inundation, damage to infrastructure, and loss of property in Seychelles

- 2013 – Cyclone Felleng Flooding
  -Combination of intense rainfall and high tides
  -Caused widespread floods and landslides on Mahé.

Summary of sea level hazard...

❑ 2016 – Cyclone Fantala

-Did not directly hit the main islands

-but generated powerful swell waves and rains.

❑ 2010s–2020s – Recurrent tidal flooding

-Gradual increase in tidal flooding episodes,

-These recurrent events reflect the growing influence of sea-level rise ,and natural tidal variability.

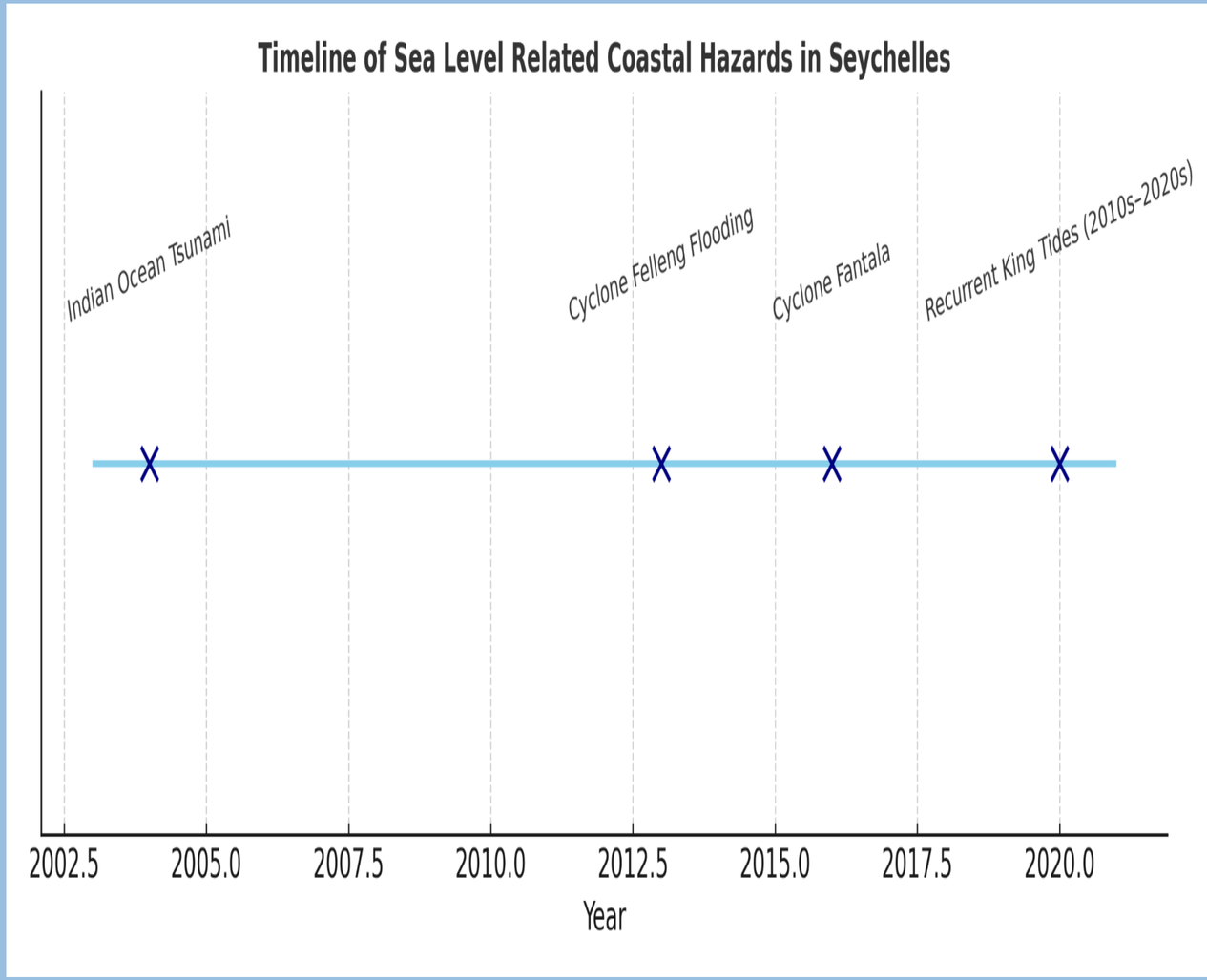

Fig 3.0 gives a summary of sea level related hazards

3a) Coastal risks and climate change effects

- Sea level rise and future changes in storms are the two major elements of climate change that create coastal hazards and vulnerability on the coastal zone in Seychelles.

- The sea level in Seychelles has been monitored since 1993 at Pointe La Rue, Mahé.
- The analysis of 18 years of data showed a sea level rise rate of 5.6–6.6 millimetres per year between 1993 and 2010.
- Projections of rise above the sea level is shown below

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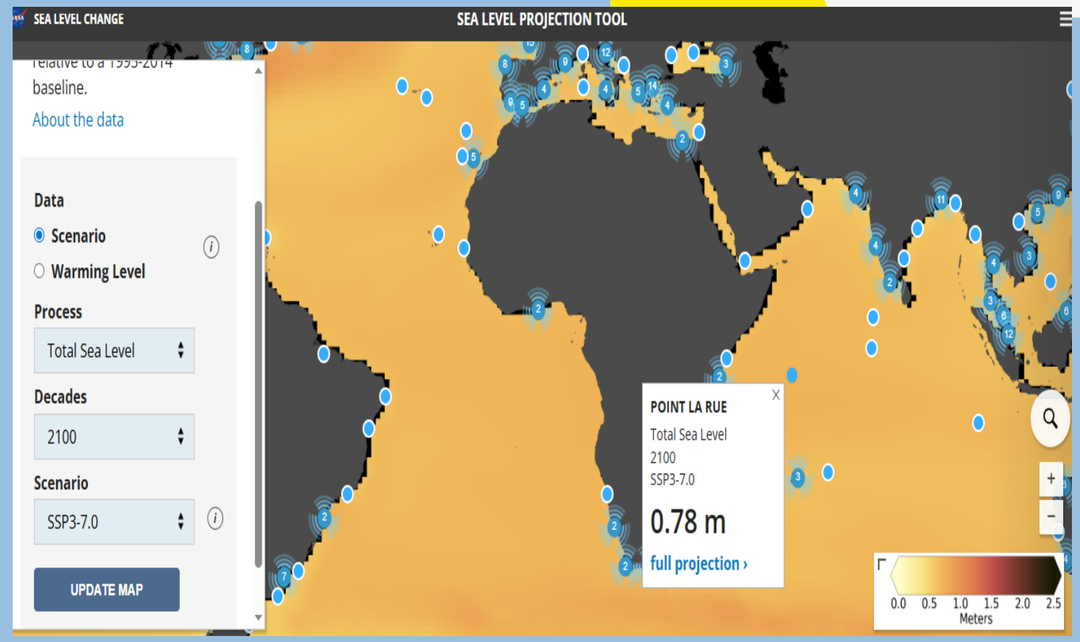
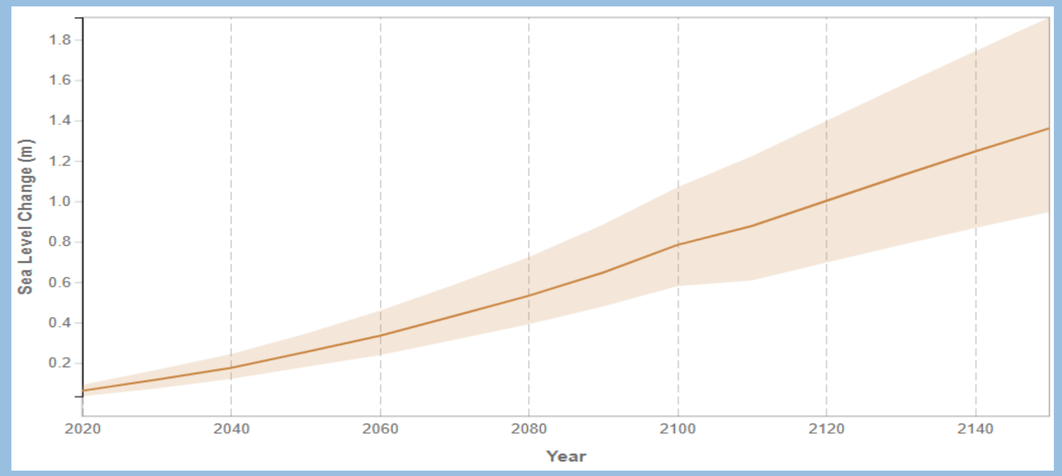
3b) Sea Level projections

-These projections are based on the assessment presented in the IPCC Sixth Assessment Report

- Projections baseline period 1995–2014, for five Shared Socioeconomic Pathway (SSP) scenarios and five different future Global Mean Surface Temperatures (from 2080-2100)

Sea level projection Tool





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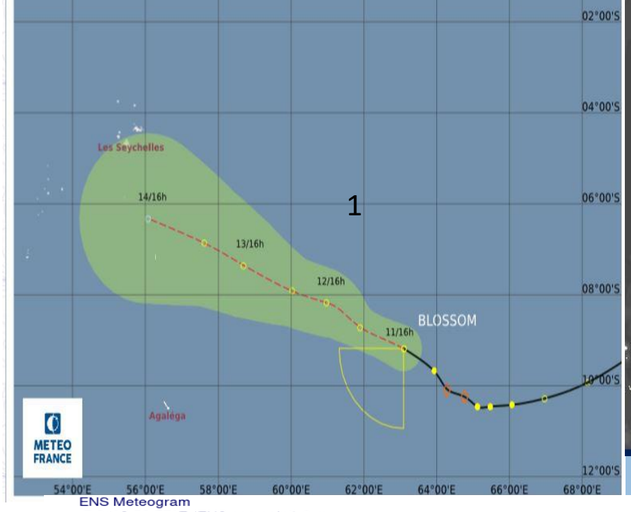
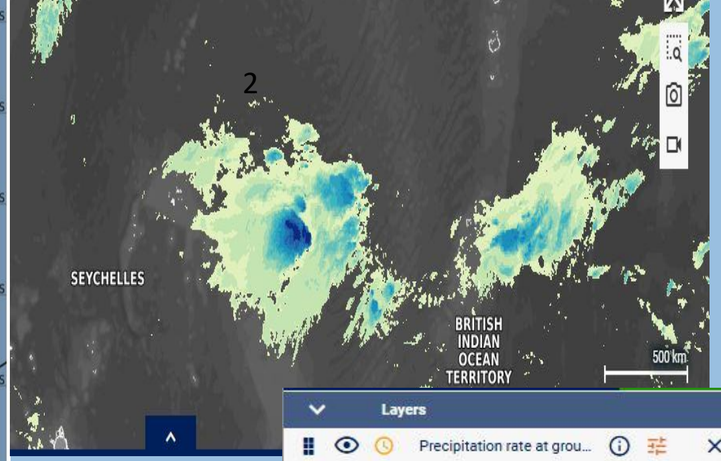
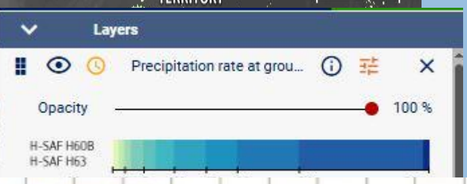
3c) Hazard monitoring within the marine areas

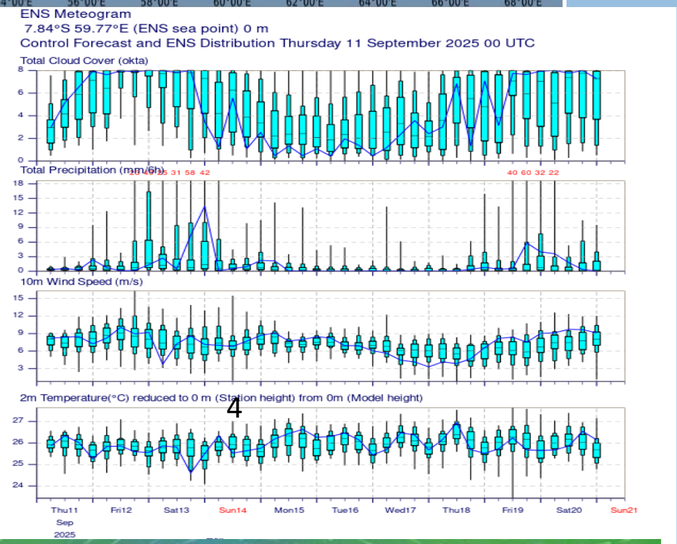
Key:

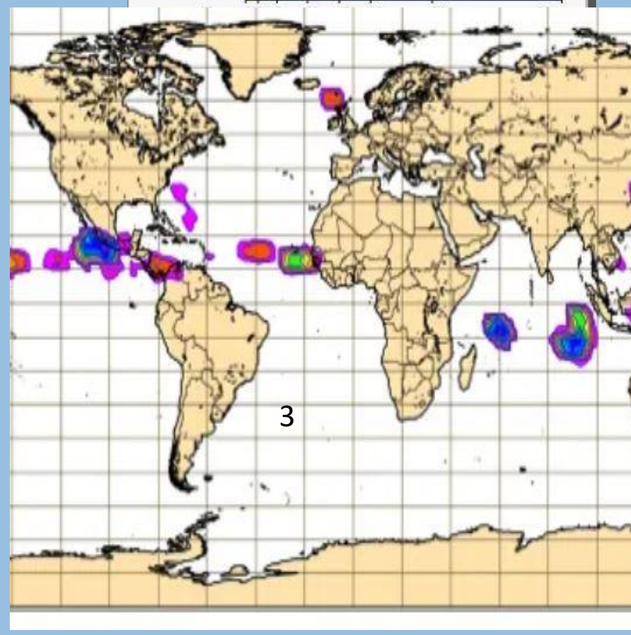
1. TCAC (Reunion)
2. Satellite
3. NWP (ECMWF)
4. NWP (ECMWF)
5. Other Sources, including Tsunami alert and modeling











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- In the sea level projections, likely ranges are assessed based upon the combination of uncertainty in the temperature change associated with an emissions scenarios, and
- Uncertainty in the relationships between temperature and drivers of projected sea level change: thermal expansion, ocean dynamics, and glacier and ice sheet mass loss

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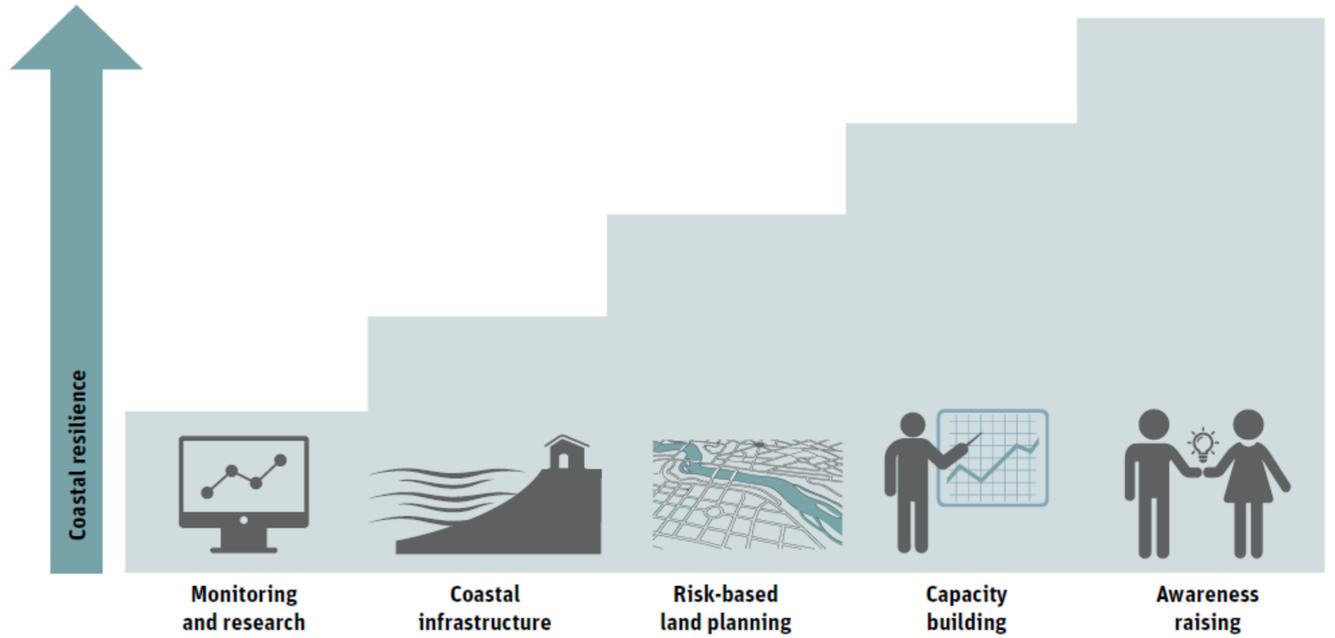
3b) A Suite of Measures to Build Coastal Resilience and Implement Better Coastal Management



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Recaps

- ❑Introduction
- ❑Sea level Monitoring stations
- ❑Sea level Related Coastal Hazards

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THANK YOU