

# Comparative Impact Analysis of Cyclone Ana in the Mozambique Channel Using Satellite Data

- Independent Research Project  
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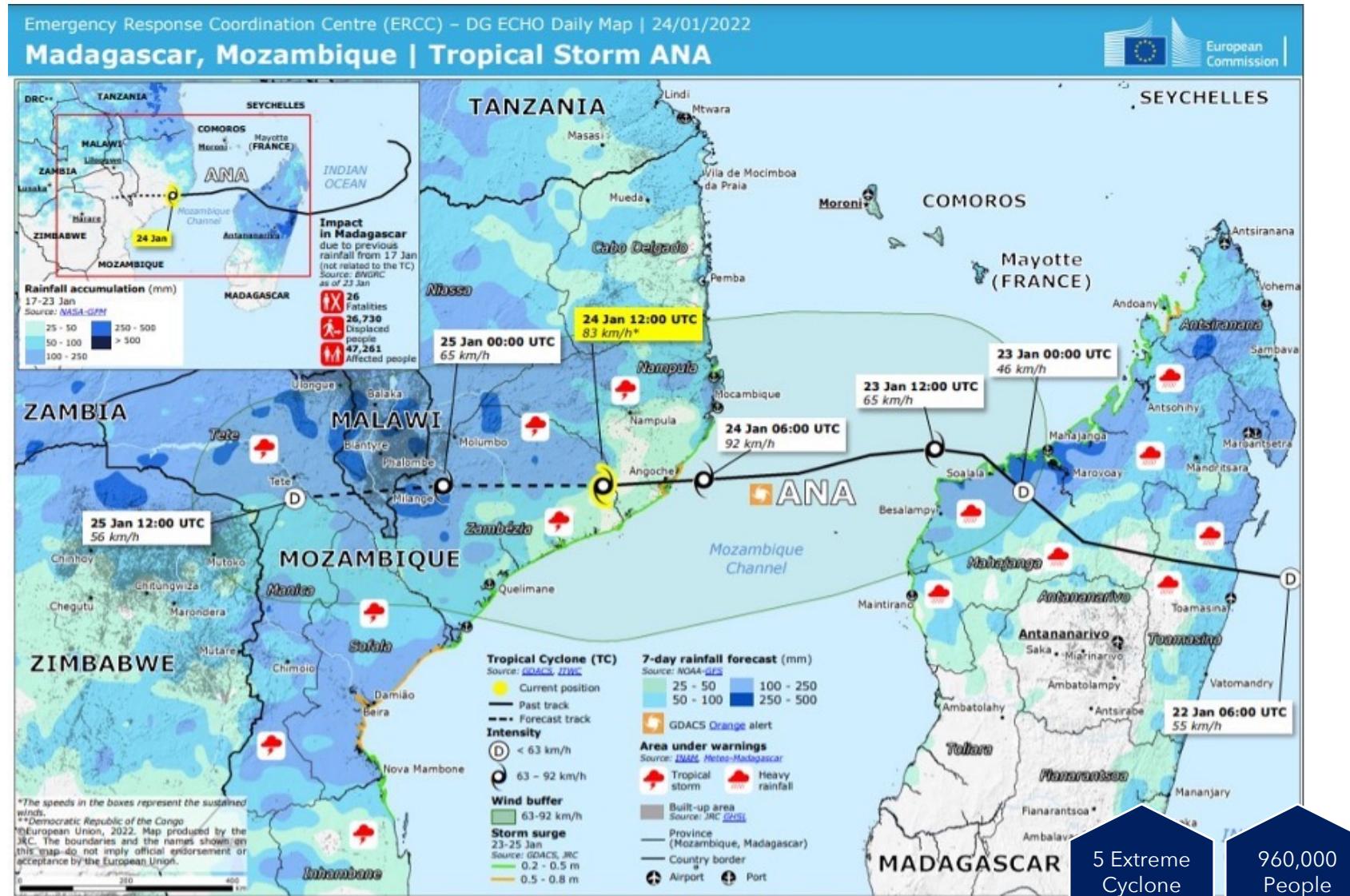
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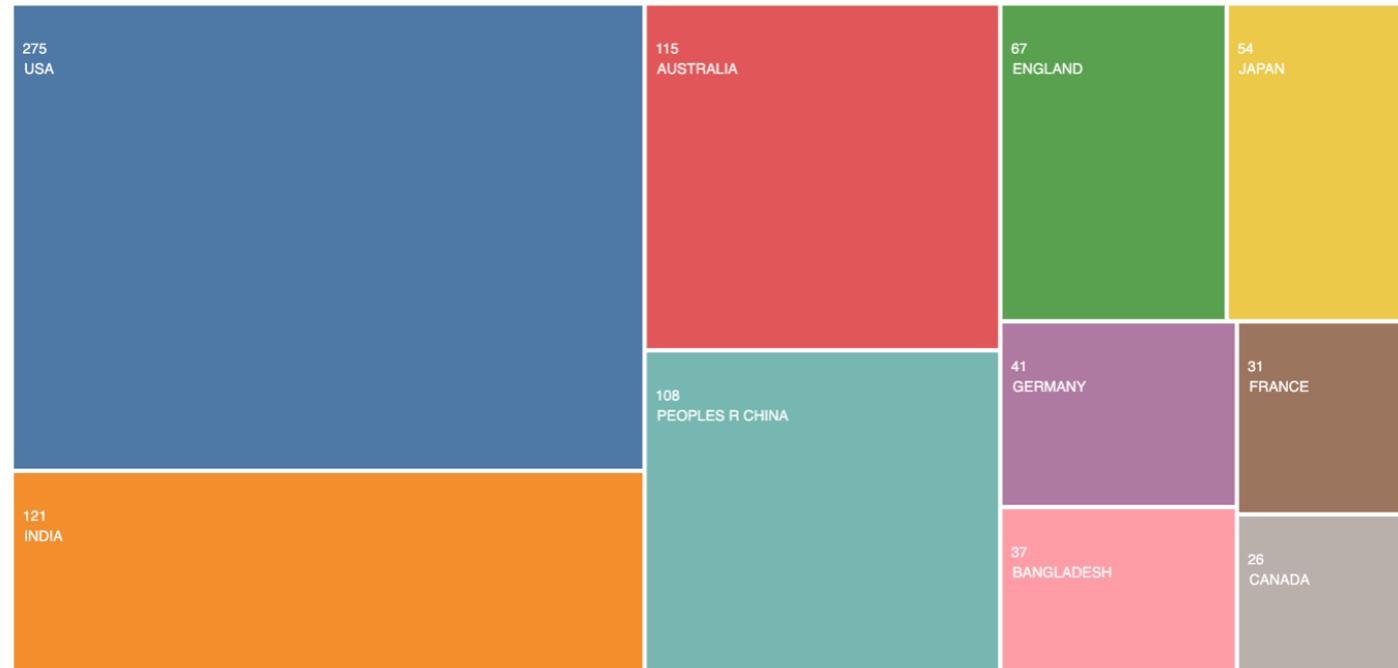
# Background

- Tropical cyclone Ana occurred between the 20th of January-25th January 2022 over the Mozambique Channel
  - Cyclone season in the Mozambique Channel: November and March in Madagascar & November to April in Mozambique



## 2021-2022 Cyclone Season in Numbers, Mozambique Channel

# Knowledge Gap & Objectives



Publications Related to 'Impact assessment' and 'cyclone' Keywords by Country of Case Study  
(Web of Science).

- **35% of cyclone impact studies based in the USA**

- **0.6% of studies based in Mozambique Channel**

## Objectives:

- Are there differences in the climatic and anthropogenic impacts after tropical cyclones in coastal Mozambique and Madagascar?
- Specifically, were mangrove forests degraded after the tropical cyclone?
- Were there regional differences in the degradation extent and pattern? For example, do areas in the vicinity of the mangrove hit by the tropical cyclone fare better than non-mangrove areas?

# Methodology

## Regions of Interests:

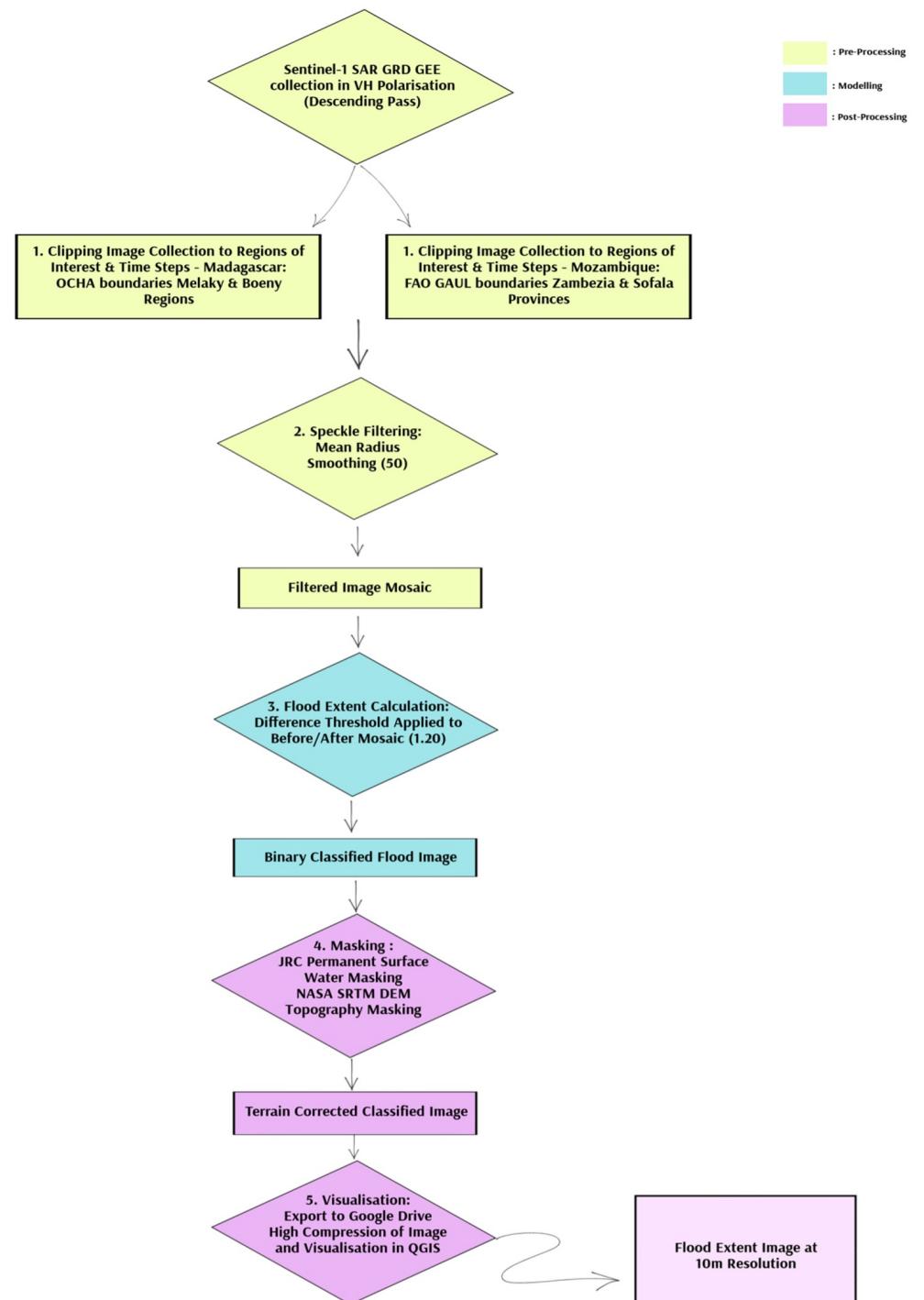
- Boeny, Melaky - Madagascar
- Sofala, Zambezia - Mozambique

## Flood Model:

- Adapted Methodology from UN-SPIDER Recommended Practice using Sentinel-1 SAR Data in Google Earth Engine and Python

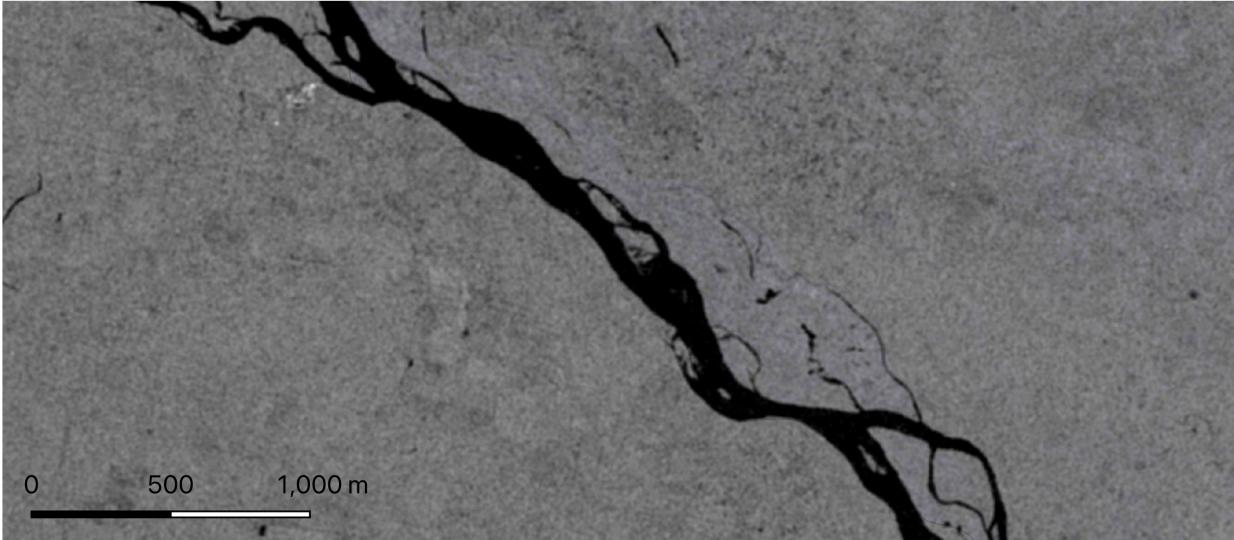
## Impact Assessment Model:

- Intersections of World Population Data: Population Density and Exposed Population
- ESA World Cover Data: Affected Land Cover Types eg. Urban Areas
- Sentinel-2 Data: Mangrove Degradation

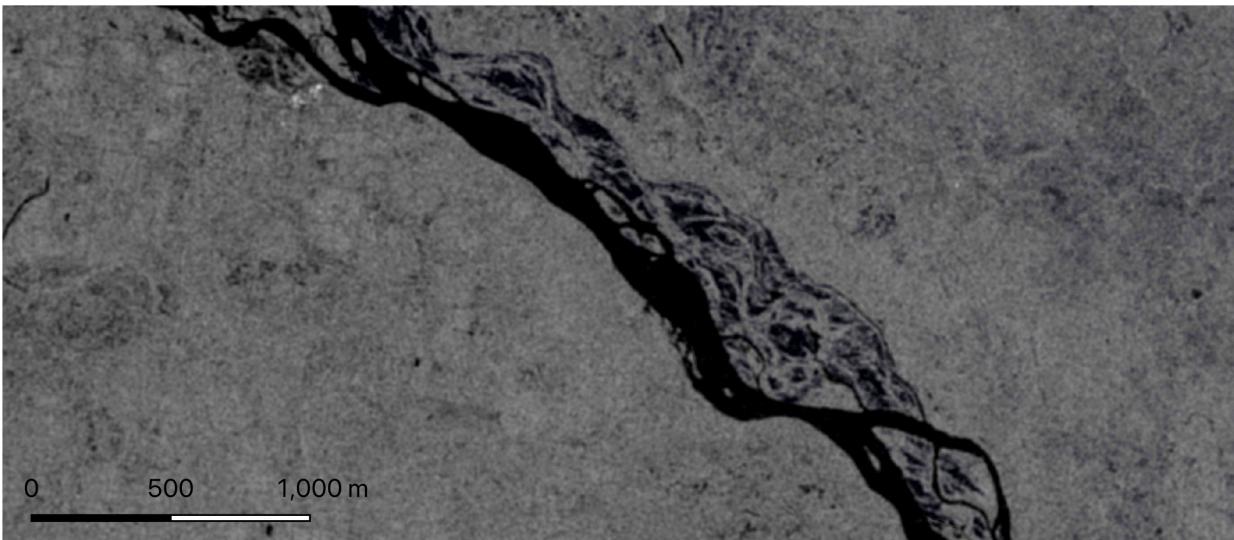


# Results

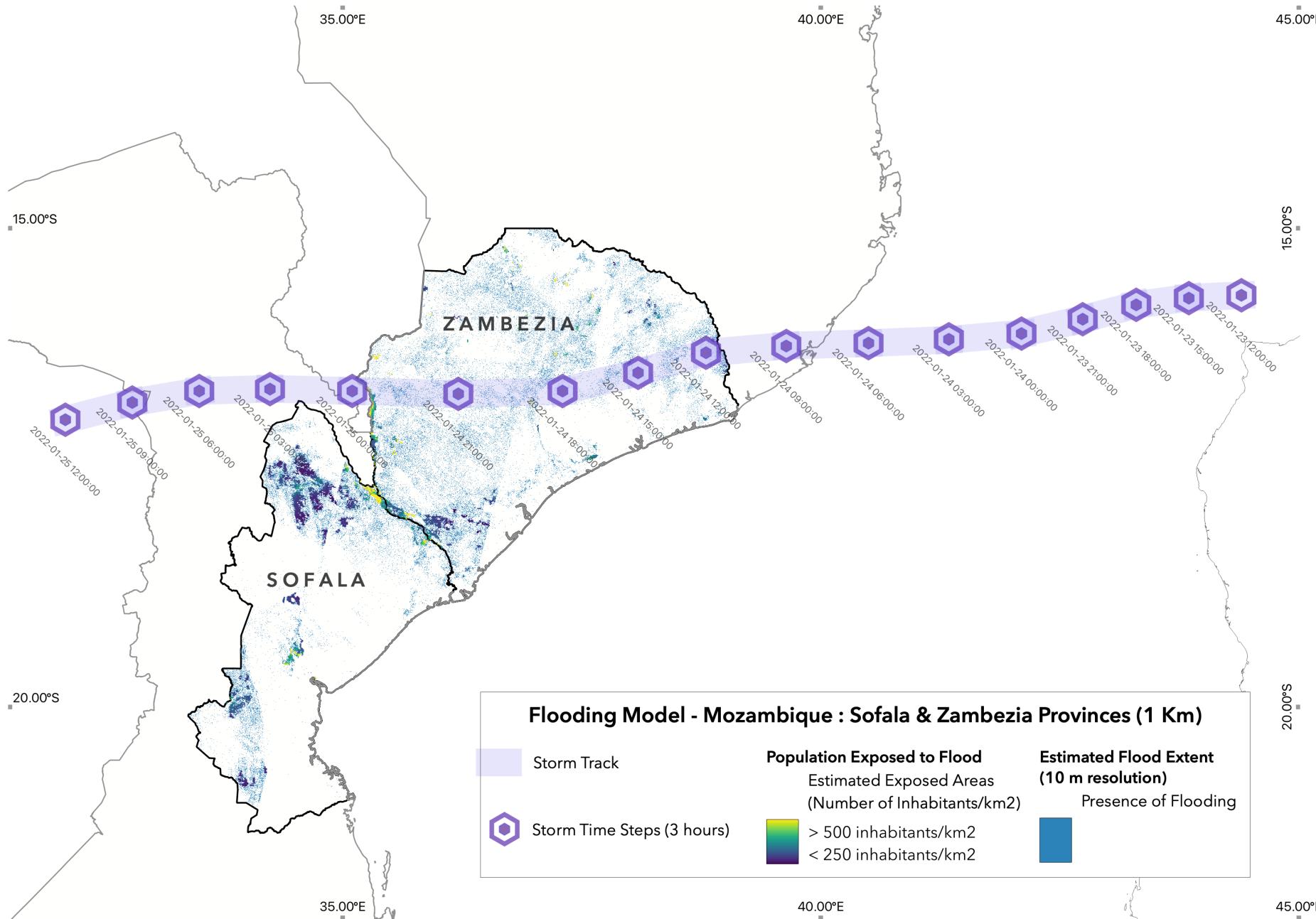
- Before and After radar Images show clear differences in water extent
- Significant flooding around the Zambezi River, Mozambique
- Flooding in croplands on the east flank of the river



(A) Before Flood Sentinel-1 SAR GRD mosaic, Morrimeu, Sofala, Mozambique - 02/01/22 - 20/01/22



(B) After Flood Sentinel-1 SAR GRD mosaic, Morrimeu, Sofala, Mozambique - 25/01/22 - 10/02/22



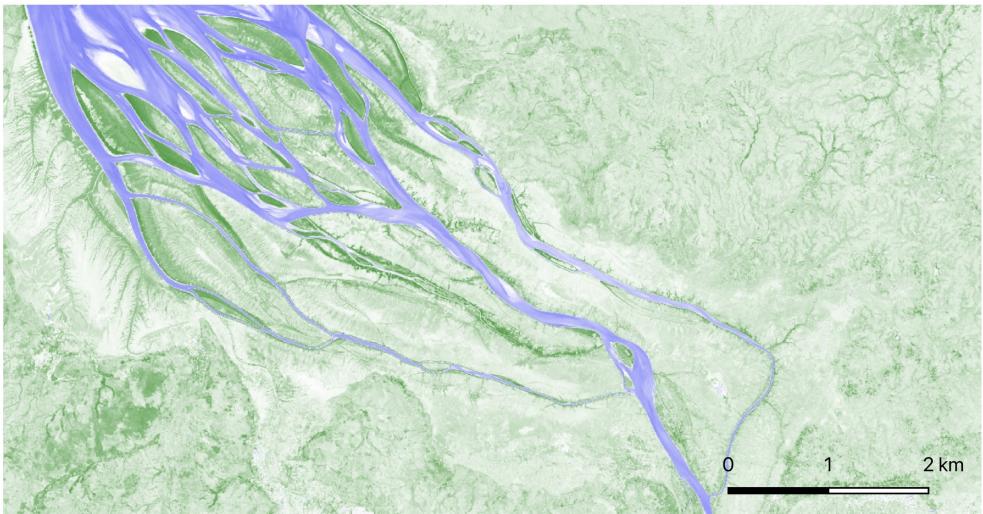
- Areas with highest number of people affected per km<sup>2</sup> located in areas around the Zambezi River, in the **Sofala province, Mozambique.**
- Especially in riverside cities such as Caia and Marromeu, Sofala (light yellow)

# Summary Table of Comparative Flood Model

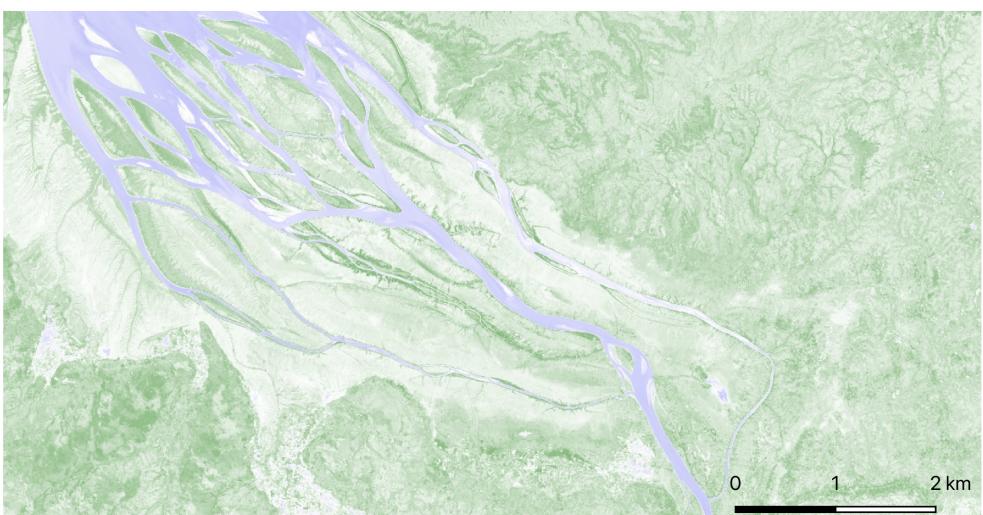
	Region	Area Affected by Flood (ha)	Relative Area Flooded (%)	Number of Exposed Population	Relative Exposed Population (%)	Affected Urban Areas (ha)	Relative Affected Urban Areas (%)
<b>Mozambique</b>	Zambezia	595,872	5.78 %	87,577	1.71 %	6741	1.13 %
	Sofala	456,120	6.71 %	108,400	4.80 %	7860	1.72 %
<b>Madagascar</b>	Boeny	451,731	14.55 %	66,591	7.15 %	4042	0.89 %
	Melaky	254,984	6.56 %	12,412	4.01 %	767	0.30 %



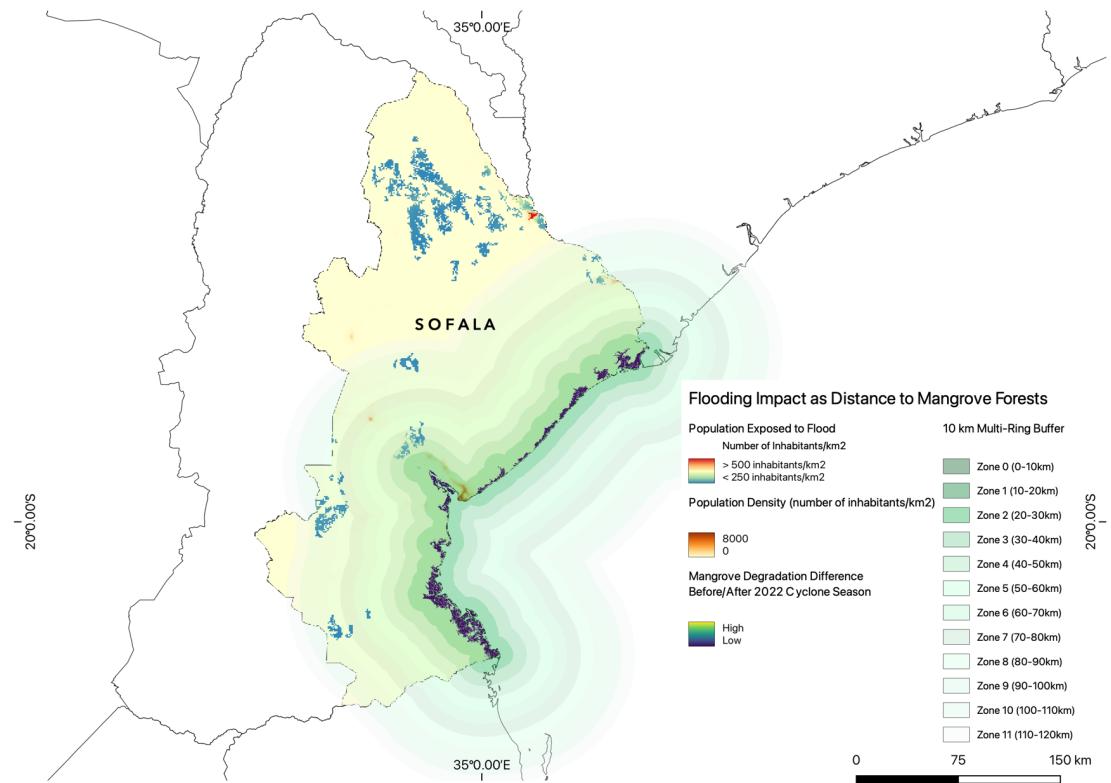
Bureau National de Gestion des Risques et des Catastrophes



(A) NDVI before cyclone season in Bombetoka Bay, Boeny, Madagascar

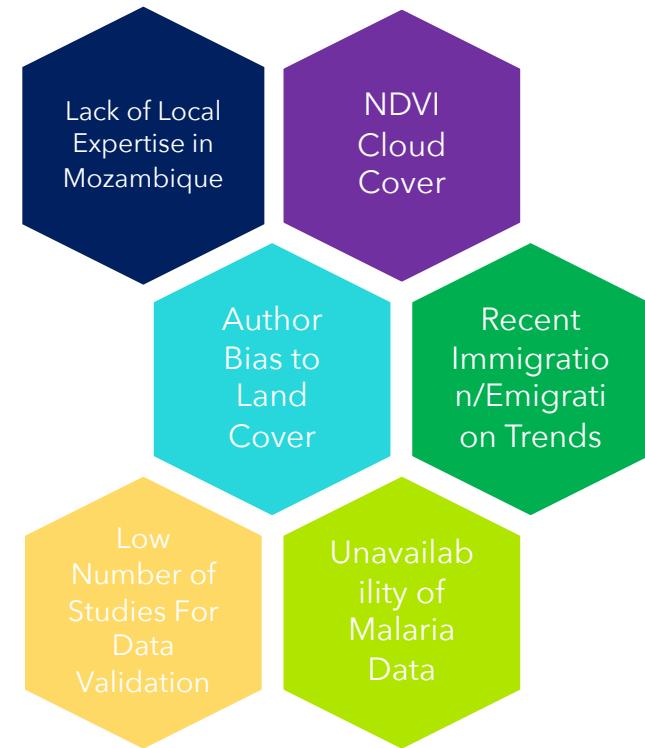


(B) NDVI after cyclone season in Bombetoka Bay, Boeny, Madagascar



# Discussion & Limitations

- **5-15% of the study areas flooded** - less damaging cyclone than cyclone Idai in 2019 (Mozambique)
- Our numbers agree with ReliefWeb numbers :185,429 people estimated to have been affected by cyclone Ana in Mozambique, concurs with our model's prediction of **195,977 affected people**.
- Majority of flooding in Mozambique along the Zambezi River, easily flooded croplands and low elevation areas – threat to food security.
- To a lesser extent, majority of flooding in Madagascar mostly in croplands, barren areas and along the Betsiboka River
- Mangroves in Mozambique were found to be unaffected by the cyclone season – low degradation and potential recovery from previously tough cyclone seasons in 2019, 2020?
- Similar pattern in Madagascar, despite more differences at fine scale especially in mangroves patches close to barren areas – increased vulnerability
- Mangroves found to be successful at protected vulnerable coastal populations from cyclone impacts in Mozambique Channel



**IRP Study Limitations**

# Conclusion

- ✓ Study successfully mapped flood extent and impacts in Mozambique Channel after Cyclone Ana in January 2022
- ✓ Found generally undegraded mangrove ecosystems in Madagascar and Mozambique
- ✓ Offers an accessible, reproduceable method for rapid cyclone impact assessment.

## Further Applications

- ❑ Integrative Impact Assessment for Global South, particularly to underrepresented South Indian Ocean island nations.
- ❑ Beyond humanitarian approach : potential for rapid assessments of causes and buffers to cyclone damage.
- ❑ Can be associated to studies (Cabral et al., 2017) looking at Exposure Index (EI) to discuss vulnerability.
- ❑ Further studies, depending on data availability, should integrate gender and malaria data in post-cyclone impact assessments.