AUTOMATING EARLY WARNING SYSTEMS FOR CYCLONES IN VANUATU

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This poster is used to inform readers about the work towards creating an automated early warning system for cyclones in Vanuatu to detect extreme weather such as cyclone and hurricanes.

INTRODUCTION

The original proposal for this project was Automating early warning systems in the Pacific. We decided to narrow down the scope in consultation with Engineers Without Borders (EWB) to increase what we could achieve in this project.

Cyclones were chosen as the natural event we would focus on as they are common in the Pacific region and are possible to predict through already existing technology.

Vanuatu was chosen as the country to focus on.

OBJECTIVE

Train deep neural network with historical cyclone data to generate satellite images and create a user manual for the people of Vanuatu

REFERENCES

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BACKGROUND

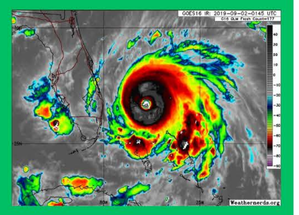
Vanuatu, a Pacific island nation, faces significant cyclone risks, often leading to severe damage. In October 2023, Tropical Cyclone Lola caused nearly $550 million AUD in recovery costs [1].

The country's current manual early warning system can be slow, especially for remote communities across its many islands. Automating the system with AI and satellite data could greatly improve disaster response by offering faster, more accurate alerts. AI systems predict cyclone paths, intensity, and impacts, delivering warnings via SMS or apps, helping communities prepare better and reducing both lives lost and economic damages [2].

RESULTS/FINDINGS

The model trained for 100 epochs initially struggled to provide accurate cyclone predictions. However, increasing the training to 1000 epochs with larger datasets significantly improved the performance.

In the case of Hurricane Dorian (2019), the model successfully captured key storm features, such as the spiral structure and core intensity. Using this refined model, we predicted Cyclone Lola's path (24/10/23), which closely matched real satellite imagery, especially around Vanuatu, with only minor deviations.

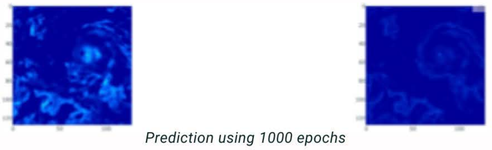


CONCLUSION

This study demonstrates the potential of automating cyclone early warning systems in Vanuatu using deep learning. Training the model for 1000 epochs significantly improved accuracy, allowing it to capture fine cyclone patterns, as shown in the successful predictions of Hurricane Dorian (2019) and Cyclone Lola (24/10/23), both closely matching real satellite data. The refined model, based on Dorian's data, proved effective for forecasting Lola with only minor deviations. Future efforts should focus on fine-tuning the model, incorporating real-time data, and expanding the system to improve disaster response across the Pacific region.

DISCUSSION

The results confirm that extending training to 1000 epochs significantly improved the model's ability to predict cyclone behavior. With only 100 epochs, the model struggled to capture complex atmospheric patterns. However, longer training with larger datasets allowed it to recognize finer details, such as the spiral structure and intense core typical of powerful storms.



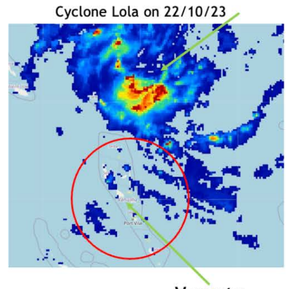
Prediction using 1000 epochs

Prediction using 1000 epochs

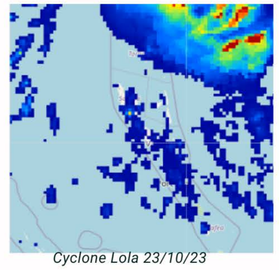
Real Satellite image 2/9/19

The Hurricane Dorian case study played a key role in refining the model, as it provided historical data that helped the model learn important cyclone dynamics. This training enabled it to accurately predict Cyclone Lola's path on 24/10/23.

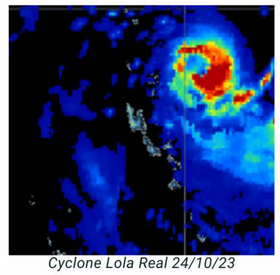
The comparison between the predicted and actual satellite images of Cyclone Lola demonstrates that the model can effectively generalise to new, unseen weather systems. Although there were minor discrepancies in location and intensity, the overall prediction closely aligned with real image, showing that the model is robust and reliable for forecasting. Future improvements could include fine-tuning the model further or incorporating real-time data to enhance accuracy.



Cyclone Lola Predicted 24/10/23



Cyclone Lola 23/10/23



Cyclone Lola Real 24/10/23