Machine Learning Model for Estimating Predicting and Forecasting (EPF) of Tropical Cyclone Intensity using Satellite Images

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CONTENTS

INTRODUCTION

- Meteorological phenomenon characterized by large-scale rotating and converging air mass around a center of low atmospheric pressure

- Determining the direction of cyclone and the intensity at which it occurs is one of the elements that is crucial in cyclone detection

- Many existing works have been designed in cyclone prediction for attaining better prediction accuracy.

- Manual estimation has prone to errors

LITERATURE SURVEY

Tropical Cyclone Intensity Classification and Estimation Using Infrared Satellite Images With Deep Learning

Chang-Jiang Zhang , Xiao-Jie Wang, Lei-Ming Ma , and Xiao-Qin Lu

CNN method is used

In this paper the proposed model consists of two modules : Classification and Estimation of Intensity of Tropical cyclone,which minimizes burden of computation

This model does not include parameters like temperature, latitude and longitude

Tropical Cyclone Intensity Estimation Using a Deep Convolutional Neural Network

CNN method is used

In this paper the model has achieved better accuracy and lower root-mean-square error by using satellite images

Refinement in regularization and normalization are missing in this model

Ritesh Pradhan , Ramazan S. Aygun, Senior Member, Manil Maskey

Estimating tropical cyclone intensity by satellite imagery utilizing convolutional neural networks

In this paper the TC intensity is estimated by making a number of changes to the general CNN, such as skipping the pooling and dropout

This paper uses CNN method

The detailed study on the size and structure of TC is missing

Chen, B. -F., Chen, B., Lin, H. -T., & Elsberry, R. L.

Tropical Cyclone Tracking and Forecasting using BiGRU

Aryan Khandelwal,Ramya R S,Ayushi S,Bhumika R,Adhoksh P,Keshav Jhawar,Ayush Shah,Venugopal K R.

This paper identifies the location of cyclones in order to avoid damages caused by them

The proposed technique is K-means clustering

A hybrid model of CNN and Bidirectional Gated Recurrent Unit (GRU) is created to estimate the position of the next cyclone

Tropical Cyclone Intensity Estimation using Temporal And Spatial Features From Satellite Data

In this paper TC intensity is identified based on the existing historical satellite images alone

The proposed method is Dvorak technique

The model is prompted to higher error rate which leads to inaccurate reading

Dr.Abdollah Homaifar,Dr.Kenneth Knapp

Convolution Neural Network Based Algorithm for Estimating the Intensity of Tropical Cyclone from Infrared Satellite Images

In this paper the methodology used is two phase unsupervised Machine Learning algorithm

Makes use of CNN method

The performance of the CNN model is measured by computing the mean square error value

Shiv Mehta; Reetu Jain

Real-time Tropical Cyclone Intensity Estimation by Handling Temporally Heterogeneous Satellite Data

This paper improves the utility of deep learning in TC intensity estimation for practical scenarios

Giving the TC warning operations

Makes use of GAN-CNN model

Boyo Chen, Buo-Fu Chen,Yun-Nung Chen

Survival study on cyclone prediction methods with remote sensing images.

In this paper comparison of different existing cyclone prediction methods was illustrated

New scene classification network architecture framework (SceneNet) is used

Deep learning is used for cyclone prediction

B.Suresh Kumar,Dr.D Jayaraj

Tropical and Extratropical Cyclone Detection Using Deep Learning

Christina Kumler-Bonfanti,Jebb Stewart,David Hall,Mark Govett

In this paper,four individual U-Net models created to detect cyclone ROI from two different data sources and two different labelling sources

A multi-GPU system was used to significantly decrease the data processing and U-Net model training times

Neural Network techniques are used

A CNN based Hybrid Model for Tropical Cyclone Intensity Estimation in Meteorological Industry

In this paper,the TC intensity estimation is done using satellite remote sensing.

The infrared images achieves high accuracy and low root means square error.

Makes use of CNN method

Wei Tian,Wei Huang,Lei Yi,Liguang Wu,Chao Wang

MOTIVATIONAL CHALLENGES

According to the National Hurricane Center (NHC), an accurate assessment of intensity using satellite data remains a challenge.
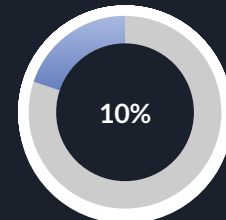
Several modified Dvorak techniques have been evolved over the last three decades.In general, these methods are subjective, and it takes a lot of time and financial resources to train-related personnel.

100

Deaths

10k

Worldwide

10%
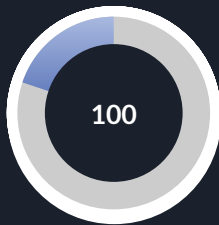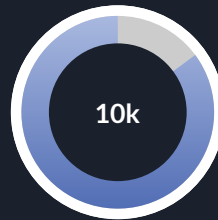
cyclones

PROBLEM STATEMENT

An accurate assessment of intensity using satellite data remains a challenge.Visual inspection is manual ,subjective and often leads to inconsistent estimates, which leads to designing and developing a model using Machine learning techniques which predicts the hurricane's intensity using satellite images.

Project objective

01 **Dataset acquisition**

02 **To find the intensity of the cyclone using satellite images**

03 **Determining the central eye of cyclone**

04 **Notifying the user about the possibility of occurrence of cyclone**

PROPOSED METHODOLOGY

First phase

Data acquisition that extracts data satellites and merges them

Second phase

Involves convolutional neural networks (CNN).Here Convolution is the main operation where the weights of the inputs are learned during each iteration of the network.

REQUIREMENTS

Software

Hardware

Jupyter Notebook

Web based interactive computing platform.

TensorFlow

Machine learning software library .

Scikit-Learn

Machine learning software library.

Processor

Intel i5 1.6 GHz.

Memory

Ram 4GB

Hard Disk 250GB SSD

Architecture

64-bit

EXPECTED OUTCOMES

Intensity

A reliable and robust technique for estimating the intensity of tropical cyclones using a convolutional neural network

Classification

Categorize the cyclones based on intensity

Alert

Warning signals if intensity is above a certain level.

CONCLUSIONS

Tropical cyclones have been a concern of meteorologists for more than 100 years.

The mentioned model presented a reliable and robust technique for estimating the intensity of tropical cyclones using a deep convolutional neural network(CNN).

It can be concluded that machine learning in TC forecasts is both promising and challenging, which means that it requires researchers to have a good understanding of TC as well as a knowledge of machine learning in order to discover the key problems faced and to solve them by building suitable machine learning models.

REFERENCES

Chang-Jiang Zhang , Xiao-Jie Wang, Lei-Ming Ma , and Xiao-Qin Lu :Tropical Cyclone Intensity Classification and Estimation Using Infrared Satellite Images With Deep Learning; https:/doi.org/10.1109/JSTARS.2021.3050767

Ritesh Pradhan , Ramazan S. Aygun, Senior Member, IEEE, Manil Maskey, Tropical Cyclone Intensity Estimation Using a Deep Convolutional Neural Network https:/ieeexplore.ieee.org/document/8082557

Chen, B. -F., Chen, B., Lin, H. -T., & Elsberry, R. L. (2019). Estimating tropical cyclone intensity by satellite imagery utilizing convolutional neural networks. *Weather And Forecasting*, *34*, 447-465. https:/doi.org/10.1175/WAF-D-18-0136.1

Thank you!