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Introduction

Severe convective weather is a catastrophic weather that can cause great harm to the public. One of the key studies for meteorological practitioners is how to recognize severe convection weather accurately and effectively, and it is an important issue in government climate risk management.

However, most existing methods extract features from satellite data by classifying individual pixels instead of using tightly integrated spatial information, ignoring the fact the clouds are highly dynamic.

In this paper, we propose a new classification model, which is based on image segmentation of deep learning. And it uses U-net architecture as the technology platform to identify all weather conditions in the datasets accurately.

Methods

1. Data Preprocessing

In the real world, satellite data is generally incomplete and inconsistent, data preprocessing is needed before model establishment. In the data preprocessing, mining the relationship between data and labels not only helps solve the problem of data redundancy but also save valuable storage resources.

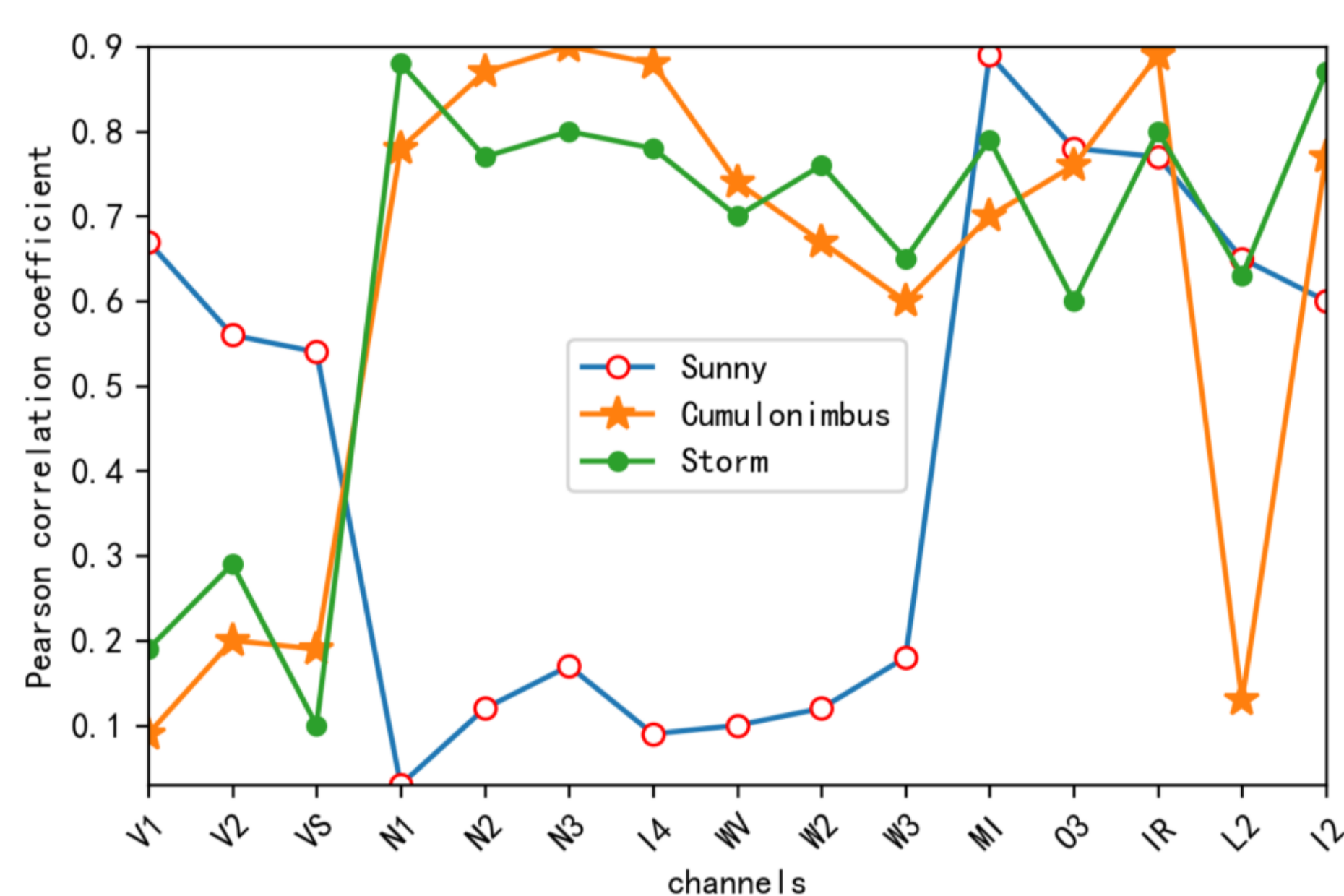


Fig.1. The image of correlations between data and labels.

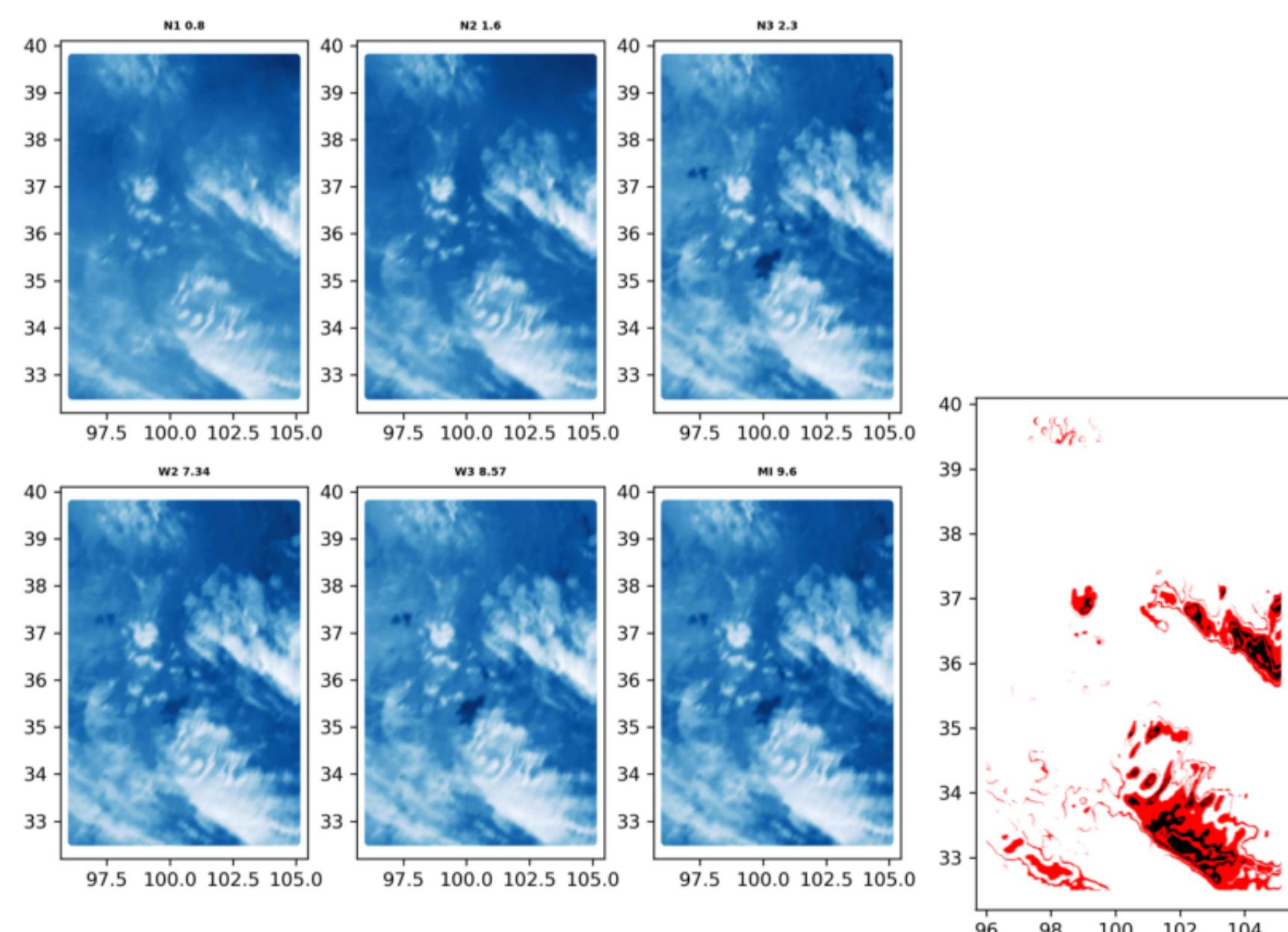


Fig.2. The image of input data and labels.

2. Model Design

First of all, compared with the classical U-net structure, the copy and crop operations are cancelled. Secondly, in the SCW-CNN model, the number of filters is greatly decreased in the convolution operation.

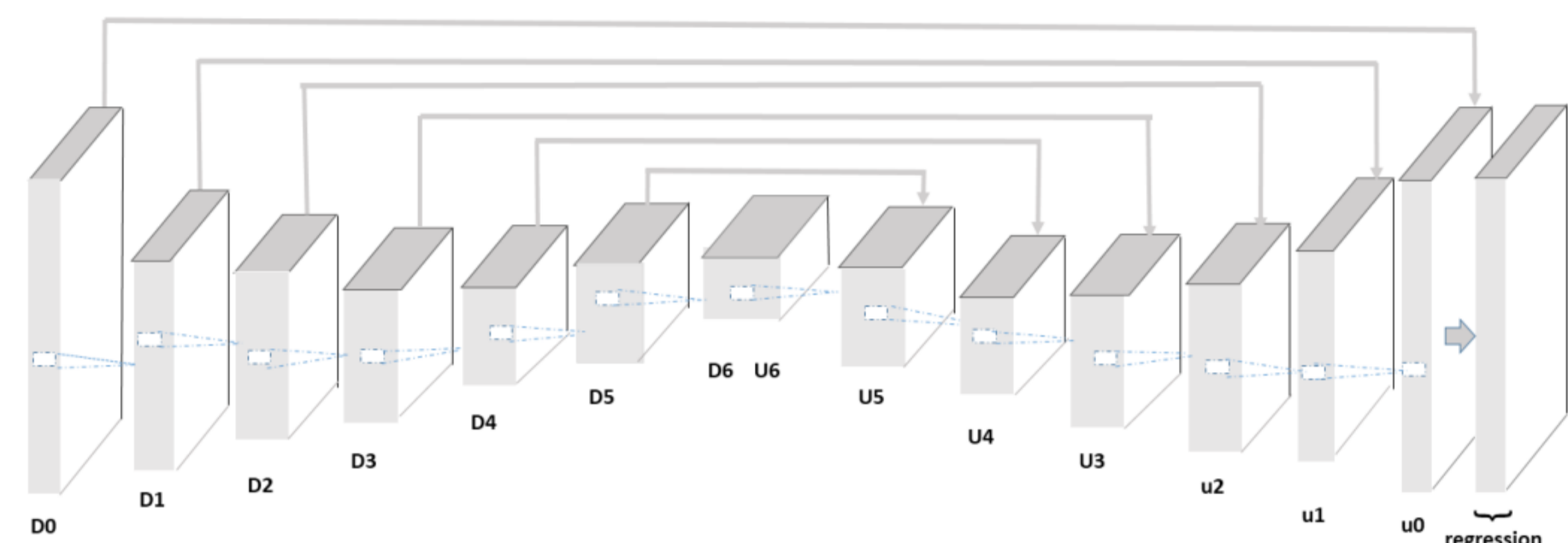


Fig.3. SCW-CNN architecture used for detecting severe convection weather.

3. Evaluation Metrics

In meteorology, if cumulonimbus clouds rise to the height of stratocumulus, they will merge with each other. Therefore, in this study, we propose a more accurate detecting area.

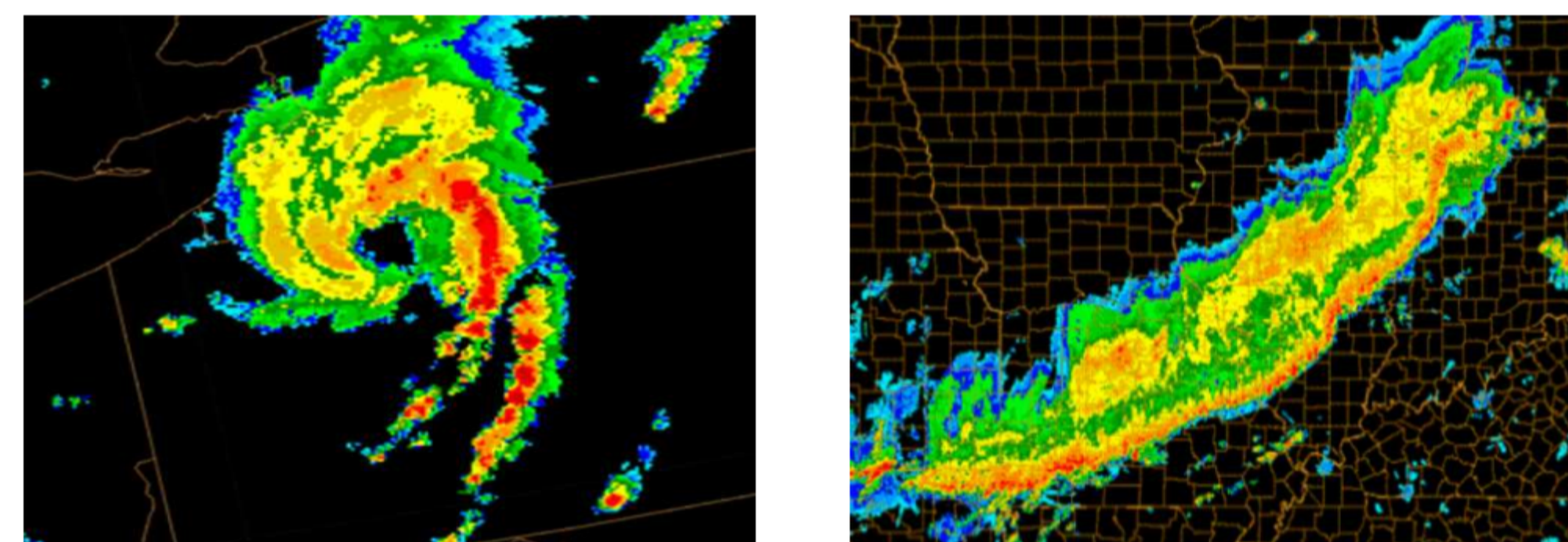


Fig.4. The heat map of severe convective weather.

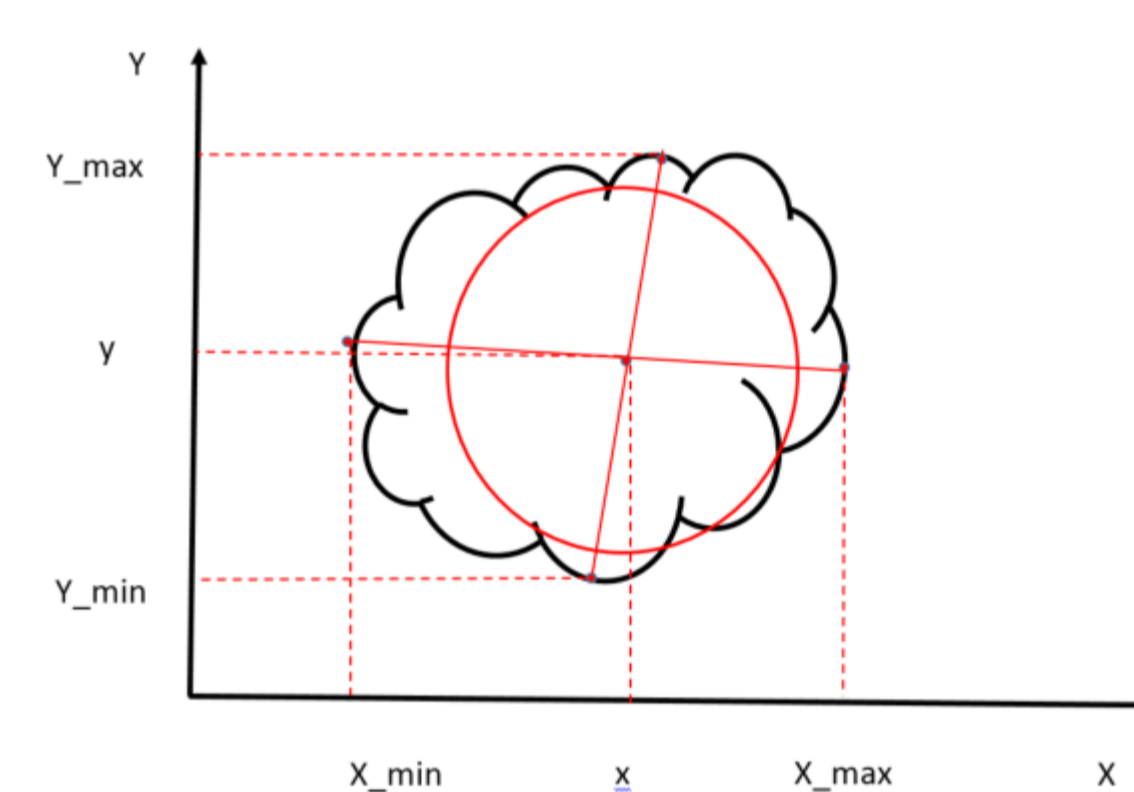


Fig.5. The distribution map of heavy rainfall in a storm cell.

Results

In this section, compared with evaluation results with original metrics, we have evaluated the performance of model to classify cumulonimbus with new evaluation metric we proposed.

Datasets	A		B		The whole dataset	
	PA	MIoU	PA	MIoU	PA	MIoU
Original metric	0.784	0.683	0.712	0.623	0.730	0.629
New metric	0.912	0.865	0.892	0.856	0.902	0.850

Table1. Statistics for 3 datasets with different metrics to detect cumulonimbus