國立中央大學
National Central University

EGU General Assembly

Establishing a macroscopic-scale rainfall climate and water resources estimation model by machine learning method

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Introduction

Motivation

Taiwan's mountains are high and the water is urgent, so it is not easy to store water resources.

The main rainfall is concentrated in the plum rain season and typhoon season.

Research shows that solar activity and El Niño may affect Earth's climate.

Objective

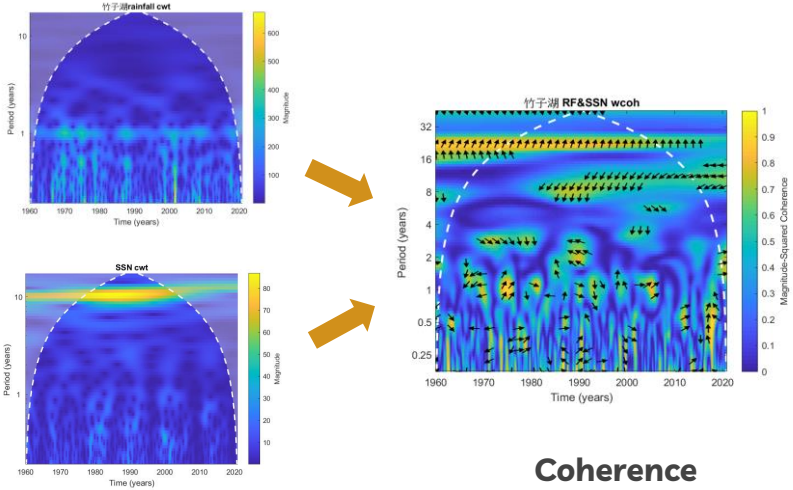
- Analyze the correlation between each factor and rainfall
- Accurate predictions with machine learning models

Adopted Data

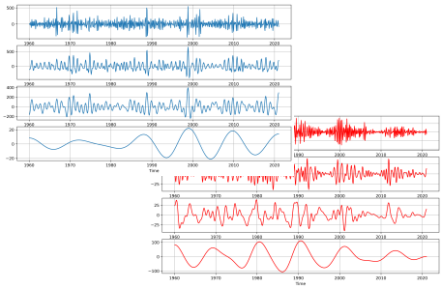
① Meteorological data
② Sunspot number(SSN)
③ Southern Oscillator Index (SOI)

Methods Wavelet signal analysis / Machine learning models

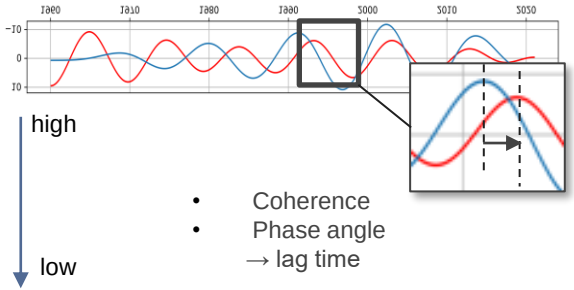
Wavelet signal analysis



CWT



Coherence



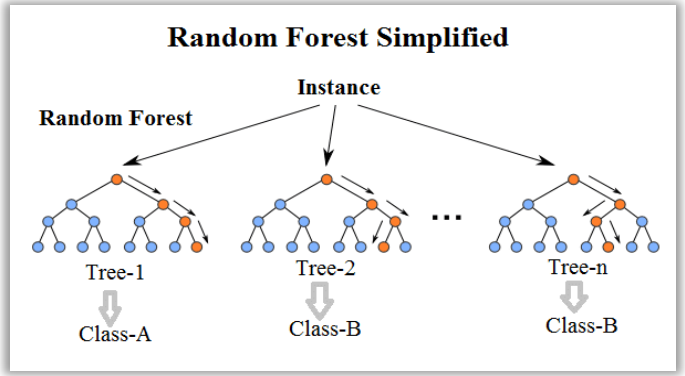
- Coherence
- Phase angle
  → lag time

Machine learning models

① Naive Bayes classifier

② Decision tree Classifier

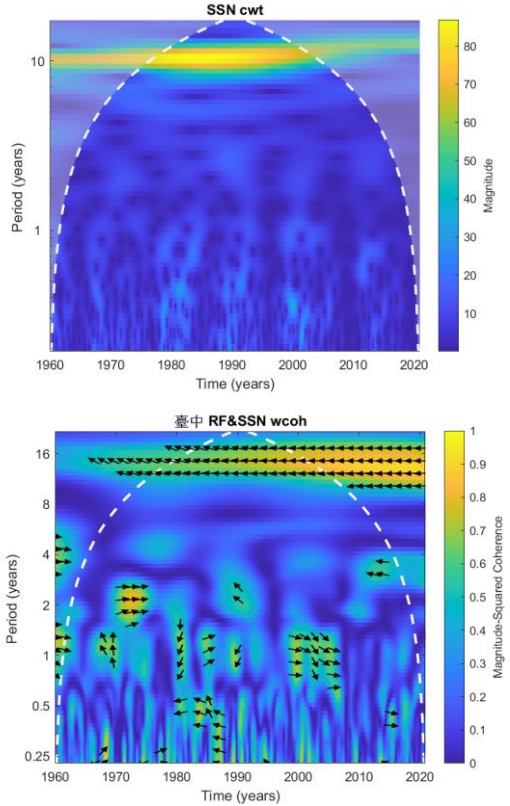
③ Random Forest Classifier



Result & Discussion

Wavelet coherence

1 Rainfall & Sunspot number

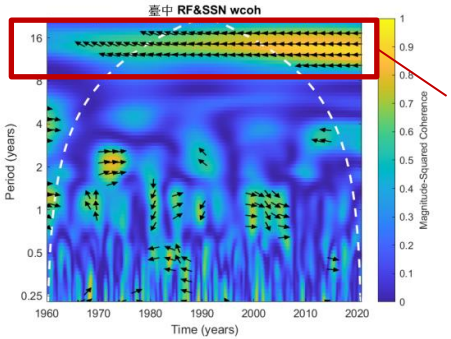


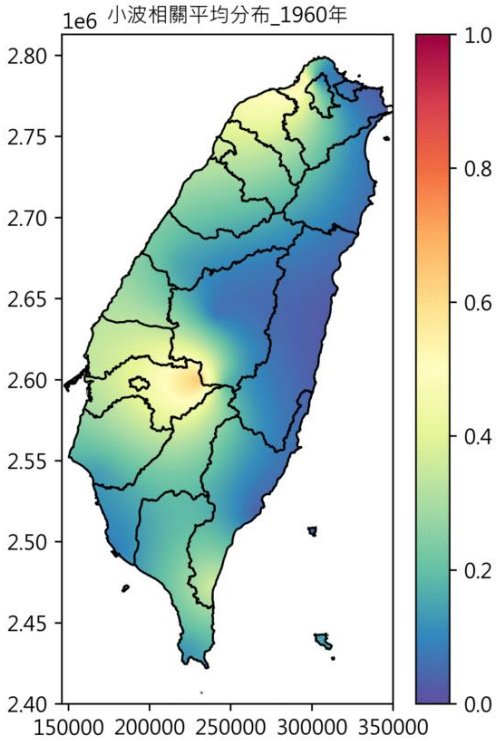
- Sunspots have a pronounced 11-year cycle.
- There is a significant 10- to 12-year correlation between SSN and rainfall.
- The correlation between SSN and rainfall increases over time.

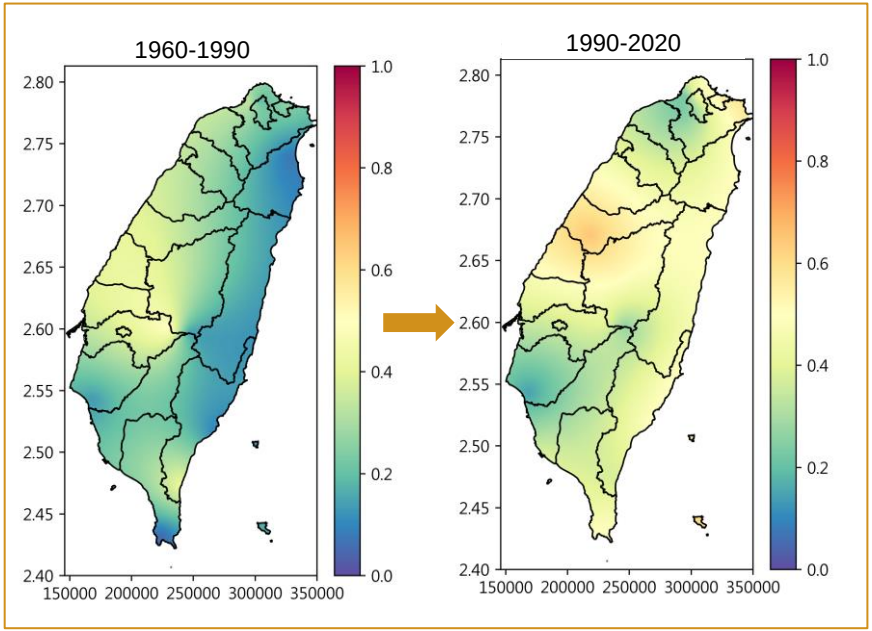
Result & Discussion

Wavelet coherence

1 Rainfall & Sunspot number





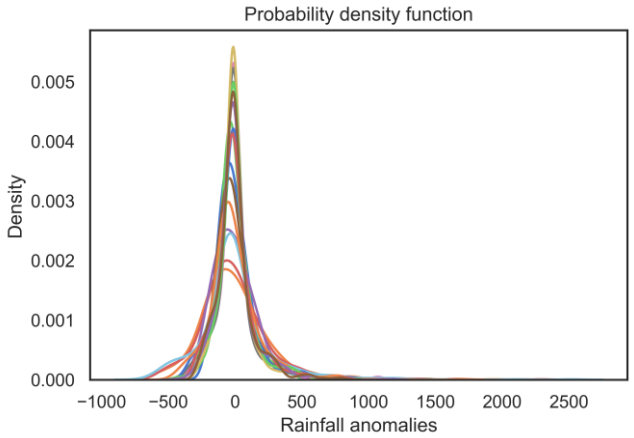


- The correlation between rainfall and sunspots in Taiwan is increasing over time.
- Region with higher correlations moves northward year by year.

Result & Discussion

Machine learning

Rainfall grading



Very high、High、Middle、Low、Very low

Training : 80%
Testing : 20%

10-fold
cross-validation

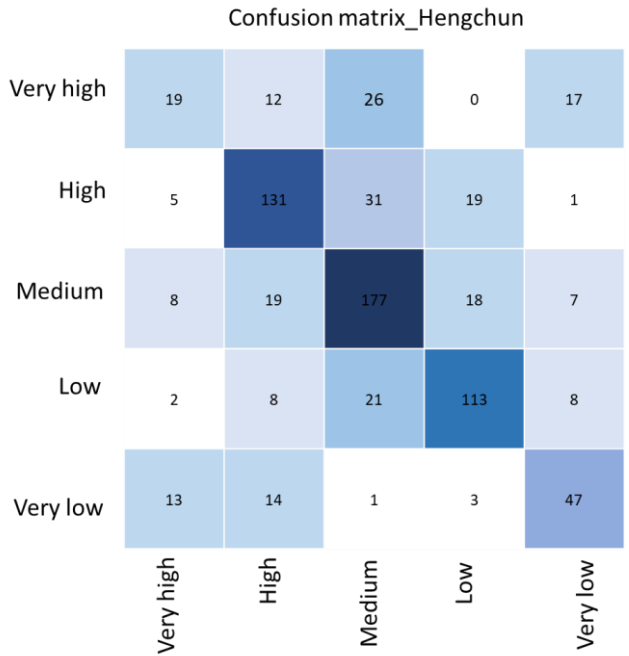
Accuracy

	Naive bayes	Random Forest	Decision Tree
Tamsui	0.833	0.841	0.818
Anbu	0.872	0.873	0.855
Taipei	0.811	0.805	0.773
Jutzuhu	0.899	0.886	0.873
Jilung	0.776	0.764	0.705
Yilan	0.888	0.895	0.882
Tainan	0.758	0.505	0.409
Kaohsiung	0.765	0.527	0.473
Taichung	0.656	0.541	0.482
Alishan	0.647	0.555	0.505
Dawu	0.609	0.677	0.595
Yushan	0.809	0.768	0.736
Hengchun	0.738	0.477	0.432
Chenggung	0.885	0.850	0.832
Sunmoonlake	0.711	0.700	0.682
Taitung	0.662	0.677	0.573

Result & Discussion

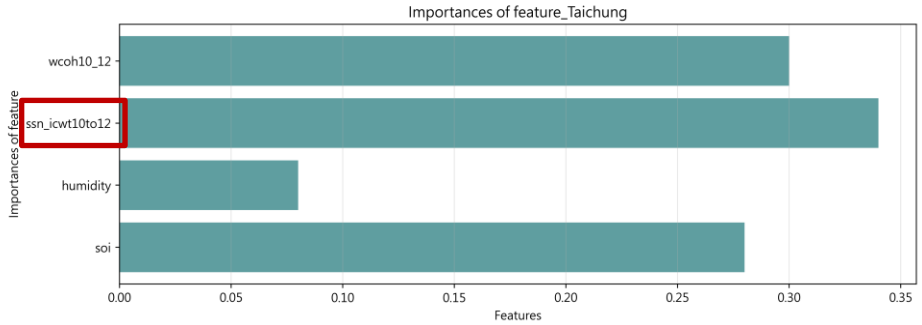
Machine learning

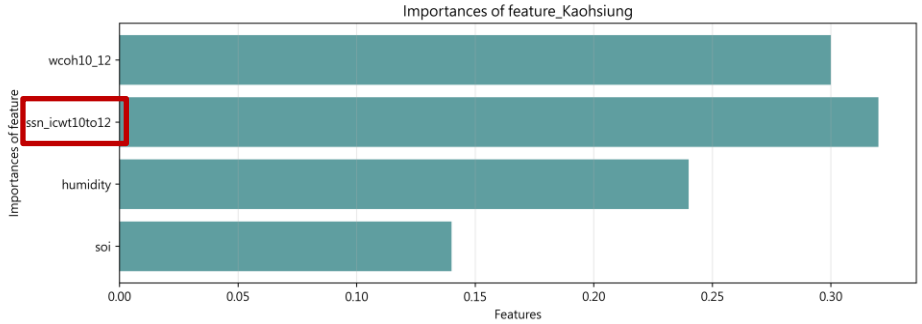
Confusion matrix



	precision	recall	f1
	0.85	0.88	0.86

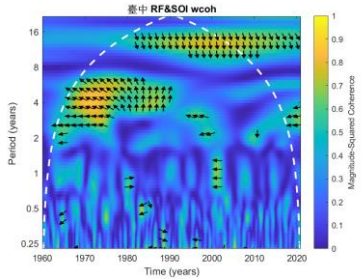
Importance of feature





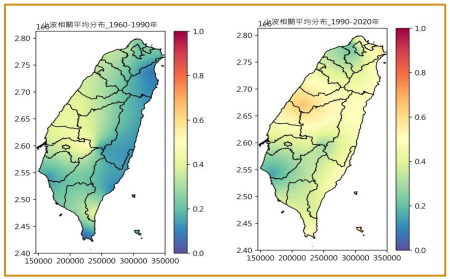
Conclusions

1



SSN, SOI and rainfall are highly correlated in 10 to 12 years, and also in 2 to 8 years.

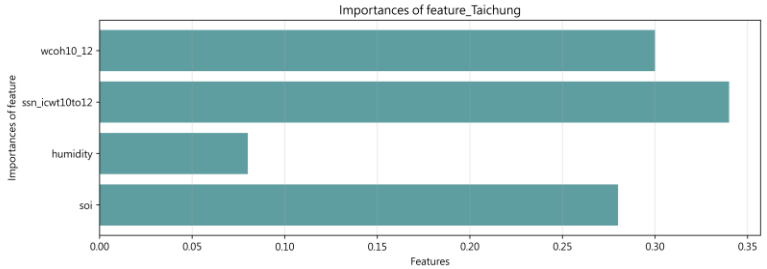
2



The correlation between sunspots and rainfall has increased significantly, and the most correlated area has moved northward.

3

Using three machine learning models to predict classification factors, the accuracy rate can reach 89.9%, and sunspot is the most significant influencing factor.



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