AI Prediction of Cardiovascular Disease Incidence under Climate Change

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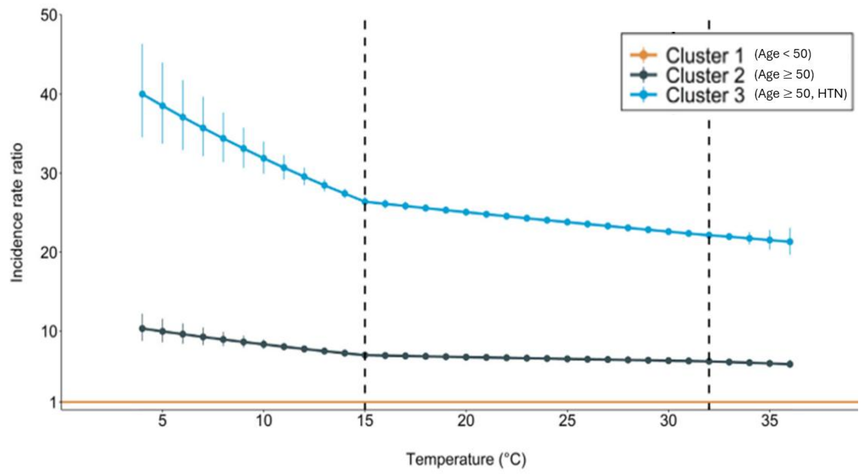
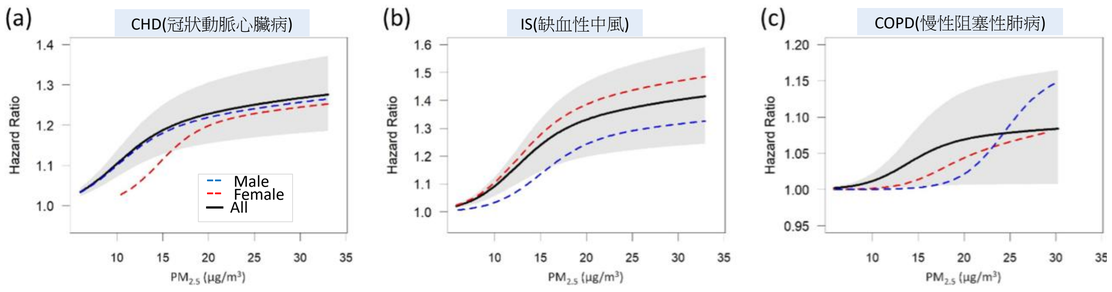
Introduction

- Cardiovascular diseases (CVDs) are the leading global cause of death (~18 million annually, 32% of deaths).
- Climate change poses risks to cardiovascular health, especially under extreme weather conditions.
- Environmental factors (e.g., temperature, air pollution) are largely modifiable.
- Low temperature correspond to higher rates of CVD in Taiwan.
- Air pollution correlate with CVD in Taiwan.



(Tseng et al., 2023, JACC Asia)



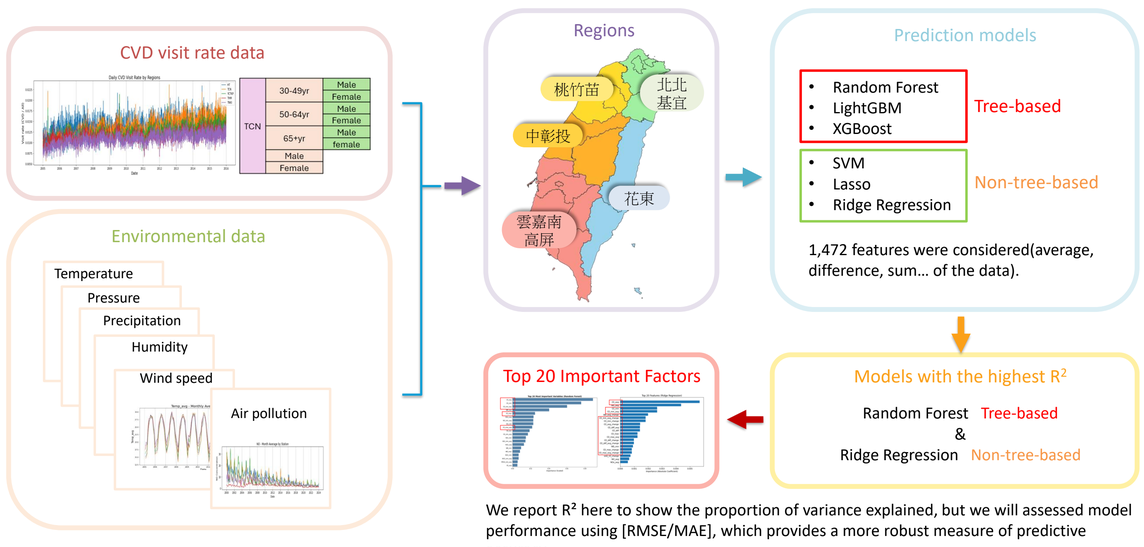
(Chen et al., 2024, Ecotoxicology and Environmental Safety)

Objectives

- Build a climate sensitivity model of CVD in Taiwan.
- Identify vulnerable populations and regions.
- Apply machine learning models to predict CVD morbidity (using visit rate as proxy).

Data & Methods

- Data
  - Period: 2000–2022
  - CVD daily visit rate by region/sex/age group (65+, 50-64, 30-49 yr)
  - Meteorological data: temperature, pressure, humidity, precipitation, wind speed by region
  - Air quality data: PM2.5, PM10, NO_2, NO, NOx, SO_2, CO, O_3 by region
  - Regions: TNKI(Taipei, New Taipei City, Keelung, Yilan), THM(Taoyuan, Hsinchu, Miaoli), TCN(Taichung, Changhua, Nantou), YCTKP(Yunlin, Chiayi, Tainan, Kaohsiung, Pingtung), HT(Hualien, Taitung)
- Models
  - Three tree-based and three non-tree-based models are selected to reduce redundancy resulting from similar algorithms.
  - Evaluation:
    R^2, RMSE, MAE, Cross-validation



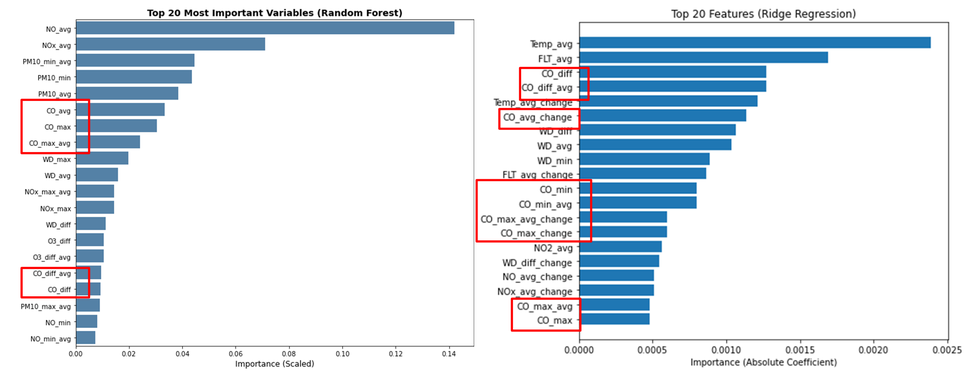
We report R^2 here to show the proportion of variance explained, but we will assessed model performance using [RMSE/MAE], which provides a more robust measure of predictive accuracy.

Results

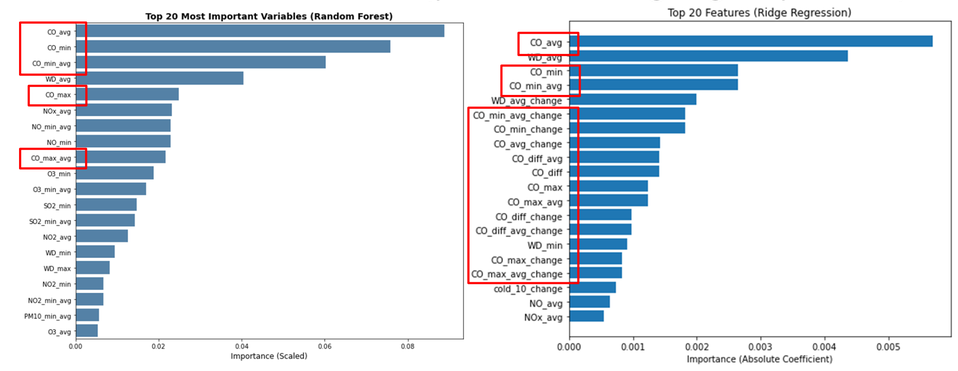
- $R^2 > 0.5$ indicates that the selected environmental predictors capture a substantial proportion of the variability in acute CVD visits.

	TNKI 北北基宜	THM 桃竹苗	TCN 中彰投	YCTKP 雲嘉南高屏	HT 花東
All	0.421	0.154	0.491	0.443	0.157
All_female	0.480	0.226	0.410	0.344	0.064
All_male	0.396	0.121	0.578	0.481	0.172
65+ male	0.590	0.317	0.233	0.290	0.064
65+ female	0.705	0.410	0.315	0.502	0.178
50-64 male	0.203	0.128	0.124	0.107	0.055
50-64 female	0.614	0.406	0.356	0.556	0.180
30-49 male	0.367	0.079	0.474	0.422	0.080
30-49 female	0.191	0.082	0.088	0.105	0.018

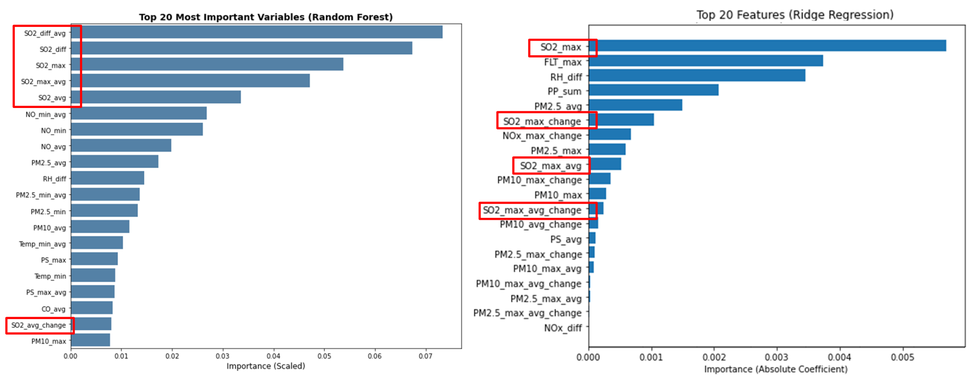
- TNKI (Taipei metropolitan area)
  - Most common factor: CO (prediction target group: 65+ female)



- TCN (Central Taiwan)
  - Most common factor: CO (prediction target group: male)



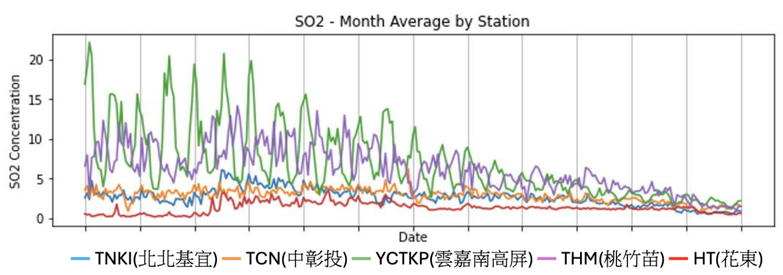
- YCTKP (Southern Taiwan)
  - Most common factor: SO_2 (prediction target group: 50-64 female)



- THM and HT were not included in the discussion due to the low R^2.

Conclusion

- Higher predictability was observed in the Taipei metropolitan area, Taichung, and Southern Taiwan.
- Predictability was highest in the Taipei metropolitan area, where the most influential predictor was CO. In Taichung, CO was also the dominant predictor, consistent with traffic emissions as the major source.
- In contrast, Southern Taiwan showed the strongest association with SO_2, which also has the highest concentrations in this region nationwide.



Limitations

- Need to refine acute CVD case definitions (emergency admissions only).
- Broader evaluation metrics (RMSE, MAE, correlation).
- Interpret the key features resolved at different areas.