

# Modeling Inflammatory Skin Disease Visits in Association with Regional Environmental Data

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## Background<sup>1</sup>

- Environmental influences on chronic inflammatory skin diseases remain **poorly characterized**.
- Conditions such as **psoriasis, atopic dermatitis (AD), and hidradenitis suppurativa (HS)** may be affected by **weather and air pollution**.
- **Machine learning (ML)** offers new opportunities to model complex relationships between environmental exposures and healthcare utilization.

## Objective

Evaluate the utility of **machine learning** models incorporating **environmental variables** for **predicting** weekly counts of **inflammatory skin disease** related healthcare visits.

## Methods

### Patient Data

- Emergency department (ED) and dermatology clinic visit dates at University of Nebraska Medical Center (grouped psoriasis, AD, and HS)

### Environmental Data for Omaha, NE

- Temperature, humidity (Omaha Eppley Airport)
- Ultraviolet (UV) index (NOAA)
- Air pollutants: PM<sub>2.5</sub>, PM<sub>10</sub>, ozone, SO<sub>2</sub>, CO (EPA)

### Predictive Machine Learning Model

- Training data: 2018–2019 and 2022
- Testing data: 2023

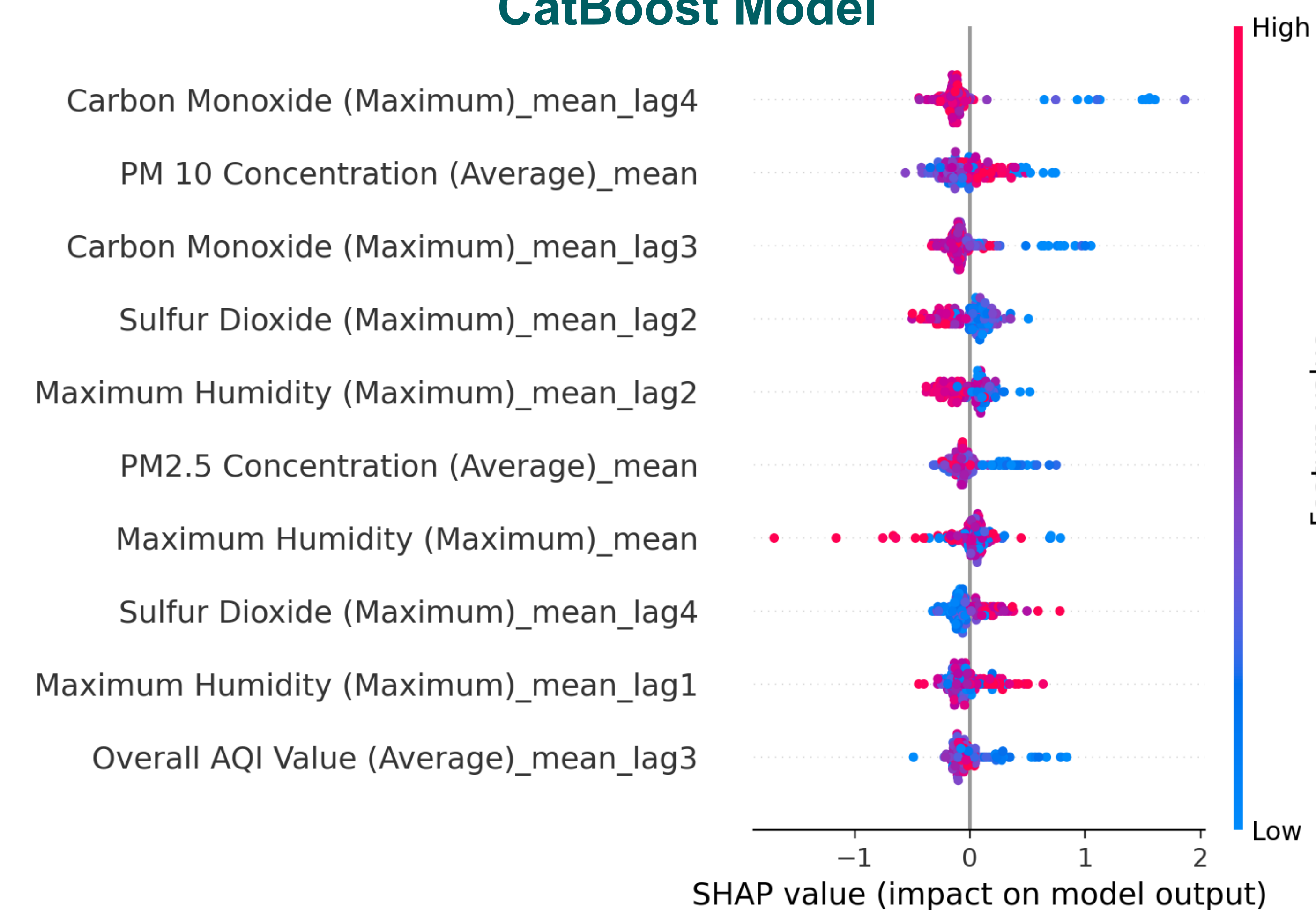
## Results

**290 ED visits** and **4,777 dermatology clinic visits** with a primary diagnosis of psoriasis, AD, or HS were identified

**Top 5** influential environmental predictors:

1. Carbon Monoxide (Maximum) lag 4 weeks
2. Humidity (Maximum) lag 1 week
3. Sulfur Dioxide (Maximum) lag 2 weeks
4. Carbon Monoxide (Maximum) lag 3 weeks
5. Sulfur Dioxide (Maximum) lag 1 week

## CatBoost Model

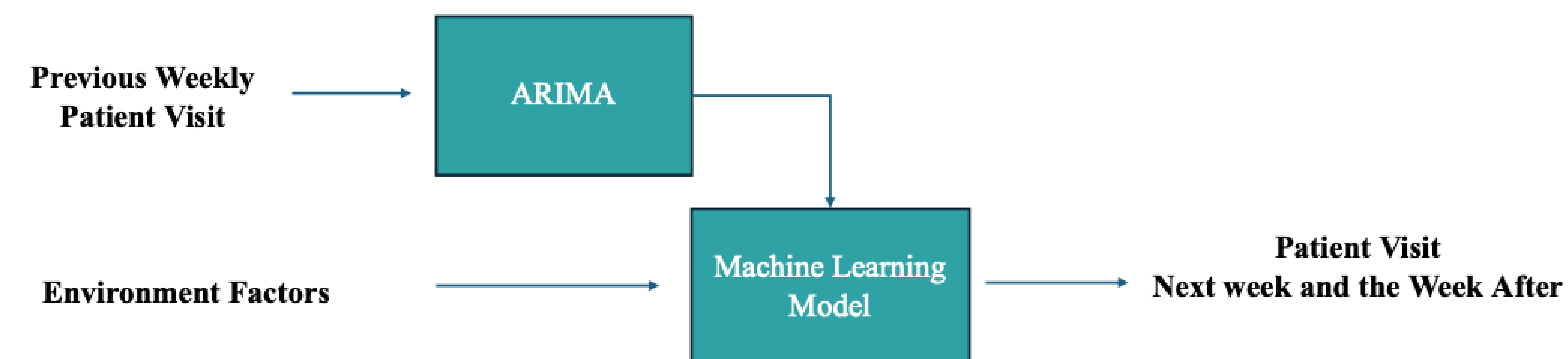


## Discussion

- Environmental variables showed limited improvement beyond historical visit trends alone
- Hybrid **time-series + machine learning framework** offers a novel approach to studying environmental influences on inflammatory skin disease
- Grouping diagnoses to provide sufficient sample size for model training limited disease-specific insights

## Future Directions:

- Incorporate **patient-level symptom severity** or **flare tracking**
- AI-driven approaches with larger datasets to further clarify **skin–environment relationships**



## Hybrid modeling framework

- **ARIMA** model used to capture baseline trends and seasonality.
- **ML** models trained on residuals to capture nonlinear relationships with environmental variables
- Weekly predictions **combined ARIMA** with **ML** residuals **incorporating environmental data** for 2023 which were compared to observed counts

## References

1. Zieneldien T, Ma S, Tan JJ, Kim J, Busot D, Cohen BA. The Environmental Determinants of Skin Health: Linking Climate Change, Air Pollution, and the Dermatologic Disease Burden. *Int J Environ Res Public Health*. 2025;22(12):1820. Published 2025 Dec 4. Doi:10.3390/ijerph22121820

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