Climatic thresholds for dengue incidence by climate zones in Peru from 2001 to 2022

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Dengue in Perú

Dengue is an **acute viral disease** that affects Peru

Significant public health problem, especially in the **north coast and the Amazon regions.**

Its incidence is **associated with climatic conditions** that favor the **reproduction of the vector** that transmits the disease

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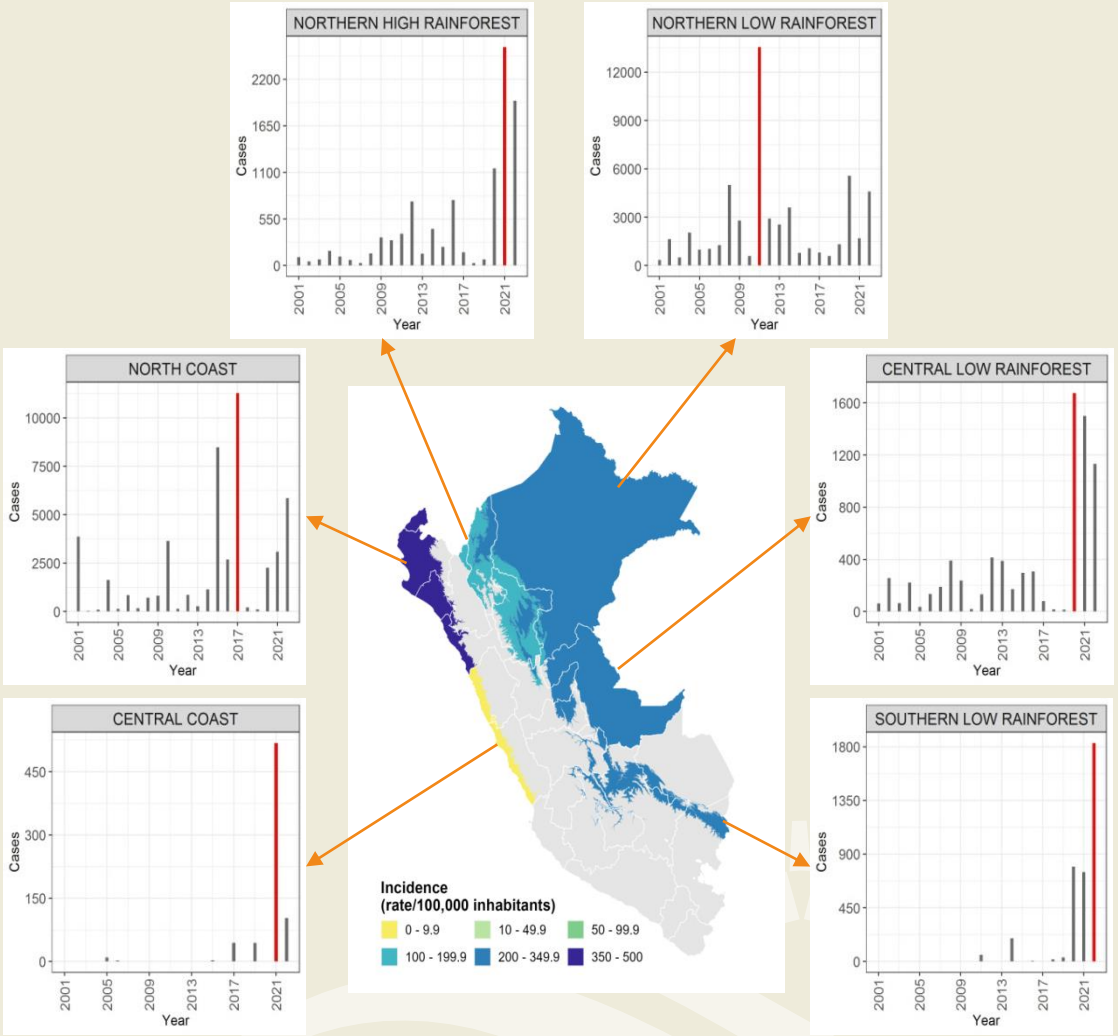
Dengue in Peru during the study period

There is a trend of increasing dengue cases over the past 20 years



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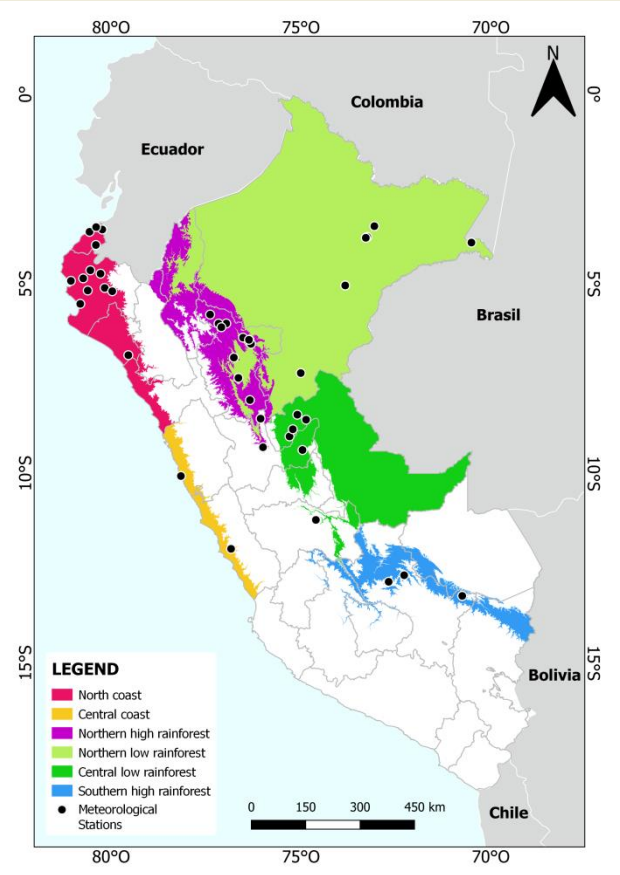
Objetive

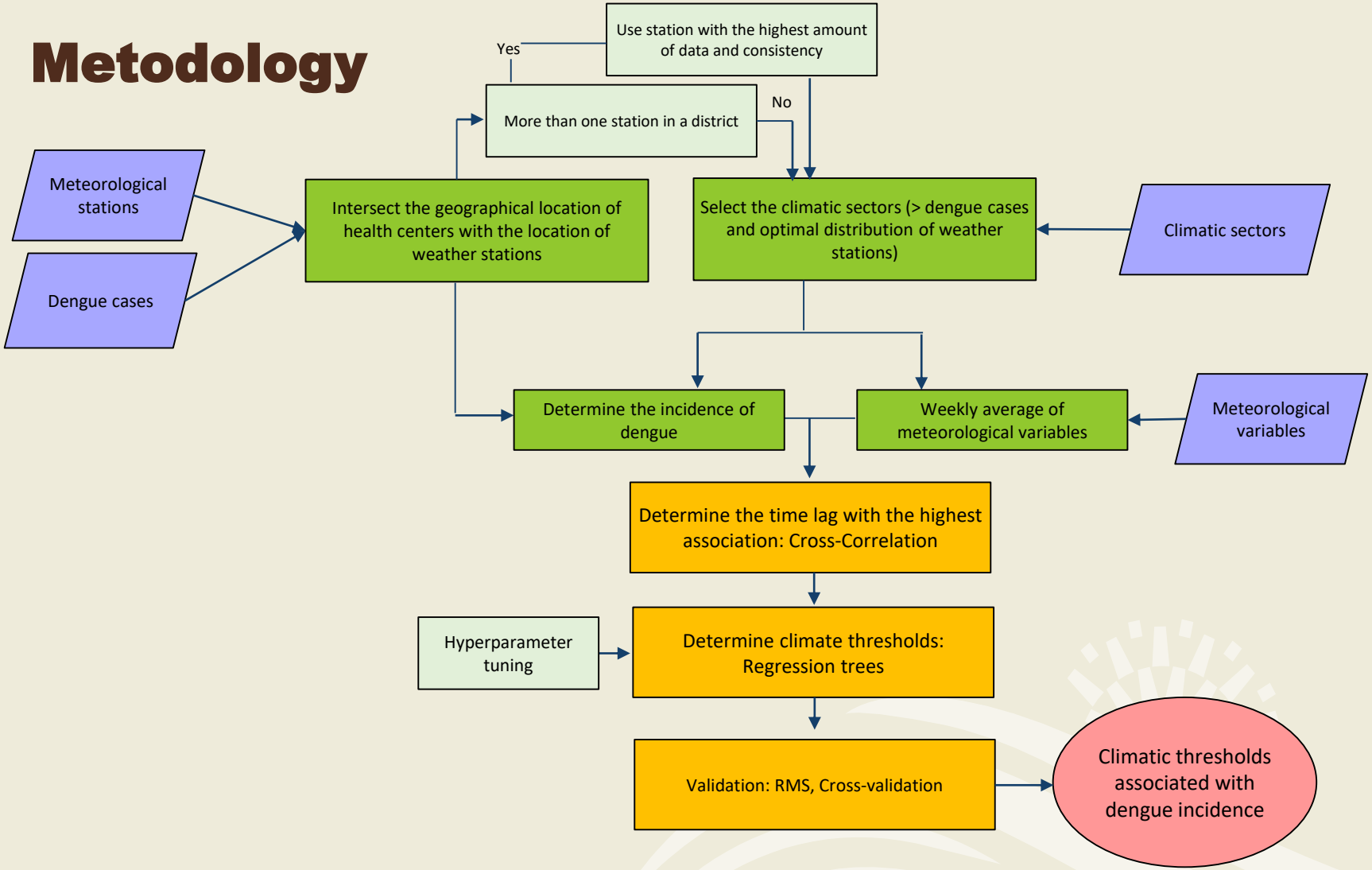
"To identify significant climatic thresholds and their associated temporal lag in relation to elevated dengue incidence across six climate zones in Peru"

Material and methods



- Study period 2001 to 2022.
- Dengue cases from CDC-Peru.
- Data from 41 Senamhi weather stations.
- Meteorological variables: temperature, precipitation and relative humidity.
- Weekly evaluation scale.
- Statistical significance at 95% confidence level

Metodology

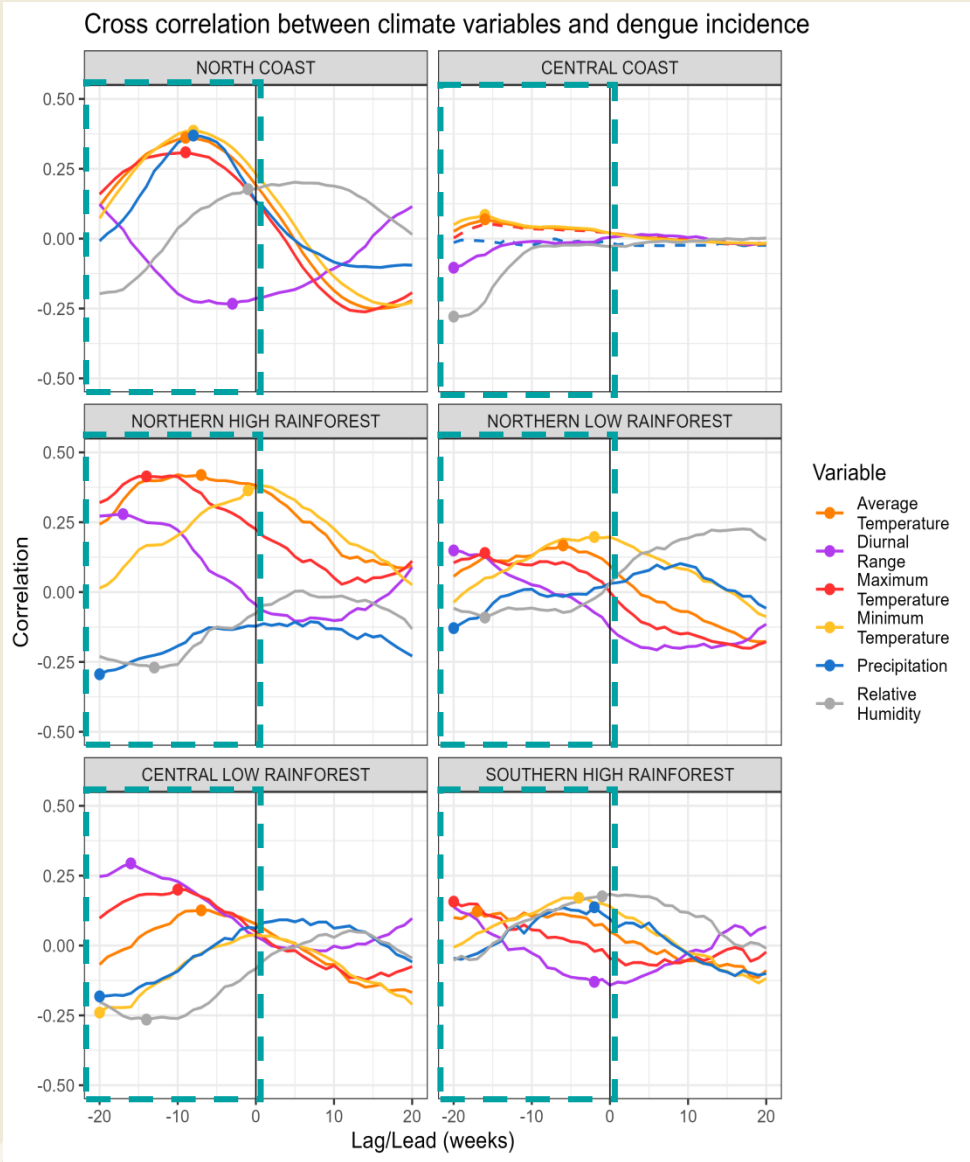

Use station with the highest amount of data and consistency
Yes
More than one station in a district
No
Meteorological stations
Dengue cases
Intersect the geographical location of health centers with the location of weather stations
Select the climatic sectors (> dengue cases and optimal distribution of weather stations)
Climatic sectors
Determine the incidence of dengue
Weekly average of meteorological variables
Meteorological variables
Determine the time lag with the highest association: Cross-Correlation
Hyperparameter tuning
Determine climate thresholds: Regression trees
Validation: RMS, Cross-validation
Climatic thresholds associated with dengue incidence

Results:
Cross correlation

The time lag with the strongest association varied from 1 to 20 weeks.

Average of **12 weeks (3 months)** over the six climatic zones.

Temperature variables are positively associated with dengue incidence in every climatic zone



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Results: Regression trees

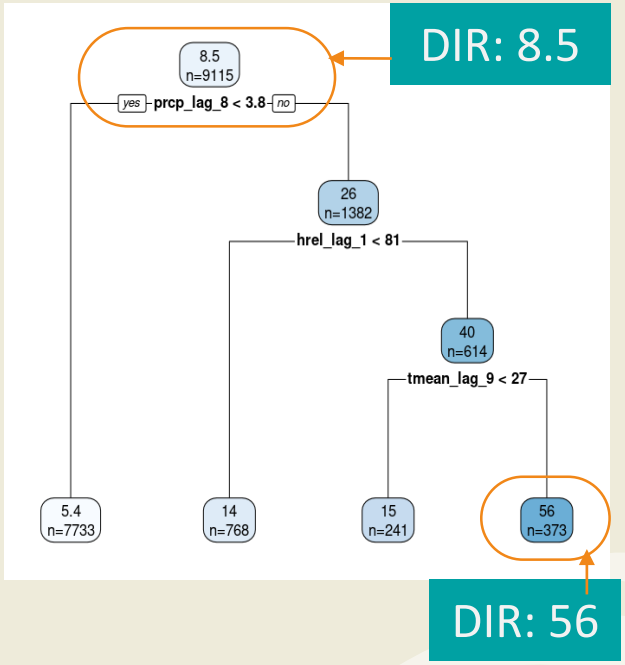
For the Northern Coast, **precipitation** is the key factor, while for the Central Coast, the **diurnal range** is the primary determinant of incidence.

NORTH COAST:
7 times: relative humidity and mean temperature.

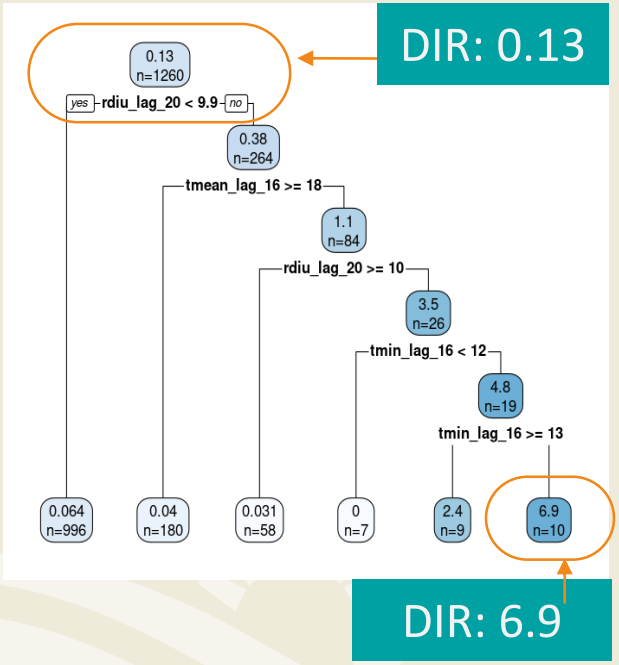
CENTRAL COAST:
53 times: temperatures and diurnal range

DIR: Dengue incidence rate

North coast



Central coast



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Results: Regression trees

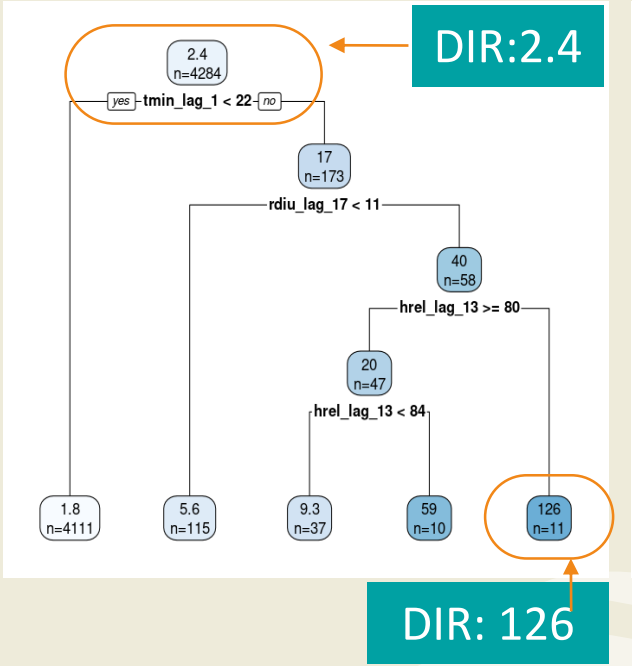
The model indicates that for the North-low and North-high rainforest, it is the **minimum temperature**.

NORTH-HIGH RAINFOREST
53 times: Diurnal range and relative humidity

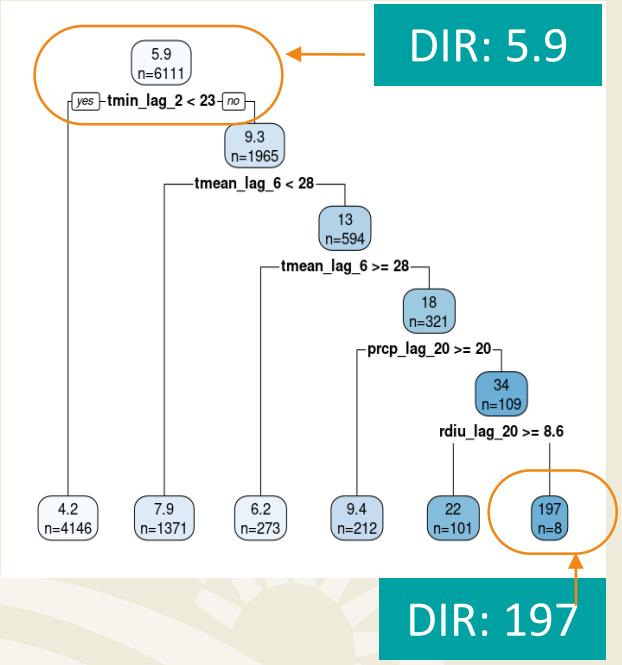
NORTH-LOW RAINFOREST
33 times: mean temperature, precipitation, and diurnal range

DIR: Dengue incidence rate

North-high rainforest



North-low rainforest



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Results: Regression trees

The model identifies **relative humidity** as the primary variable for the Central Low Rainforest and **precipitation** for the South-High Rainforest.

SOUTH-HIGH RAINFOREST

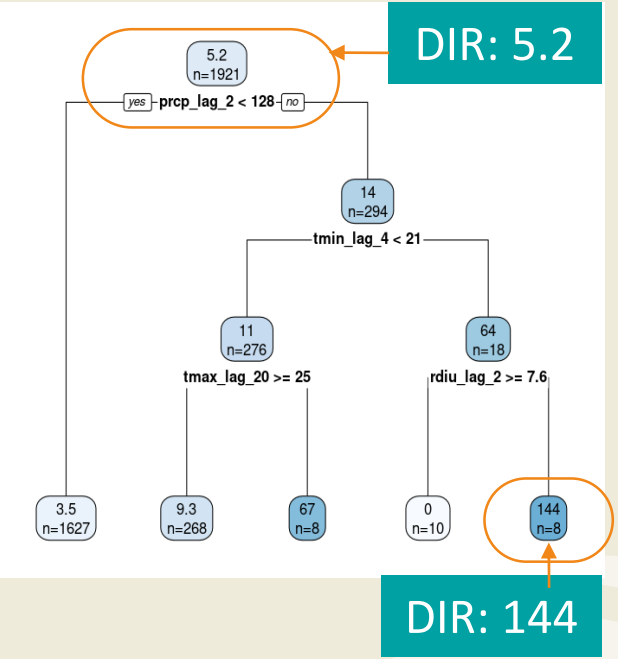
28 times: minimum temperature and diurnal range

CENTRAL LOW RAINFOREST

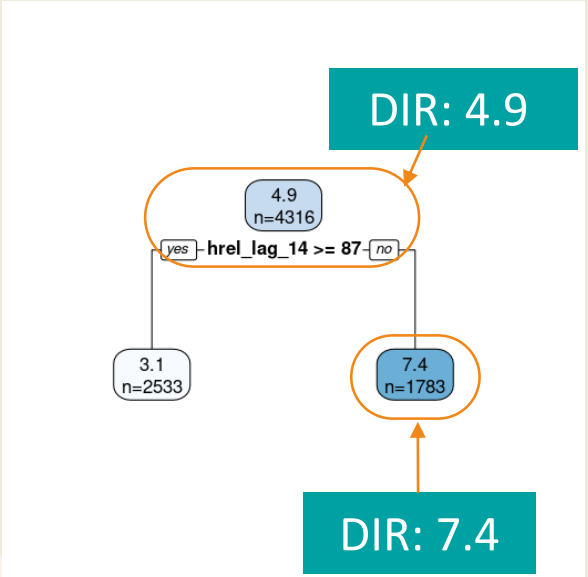
1.5 times: relative humidity

DIR: Dengue incidence rate

South-high rainforest



Central low rainforest



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Conclusions

- **Climatic Variables and Thresholds:** Significant climatic variables and the number of climatic thresholds differ across climatic zones.
- **Interactions Over Time:** Temperature, precipitation, and relative humidity show significant interactions within a 4.5-month period preceding a peak in dengue incidence.
- **Key Predictor:** Air temperature emerged as the most frequent predictor of high weekly dengue incidence.
- **Regional Variability:** The northern coast exhibited the highest frequency of weekly dengue incidence, with rates increasing up to six fold under optimal conditions.
- **Greatest Increase:** The Central coast and North-High Rainforest experienced the most substantial increase in dengue incidence, with rates escalating 53 times compared to the general incidence.

By forecasting regional climatic conditions, we can not only manage **dengue outbreaks** more effectively but also significantly enhance our public health responses, paving the way for a healthier future

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