



PlantTech

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Weather, Climate and Avocados



**New Zealand
Avocado**

Overview

- Business problem
- Irregular bearing
- Case study
- Data
- Methodology
- Conclusions

Business problem



- Avocado industry is experiencing high growth
- Weather impacts production
- Which weather factors are the most important?

Irregular bearing

- Management and marketing problem for the industry
- Can only be reduced and not eliminated (encoded in avocado genes - Whiley, 2002)
- Management practices can reduce irregular bearing
- Other causes not clear



Irregular bearing

- Usually encountered after the first abnormal crop
- Often ascribed to pollination and fruit set being reduced
- The best temperatures for the most effective pollination is thought to be 25°C during the day and 20°C nights.





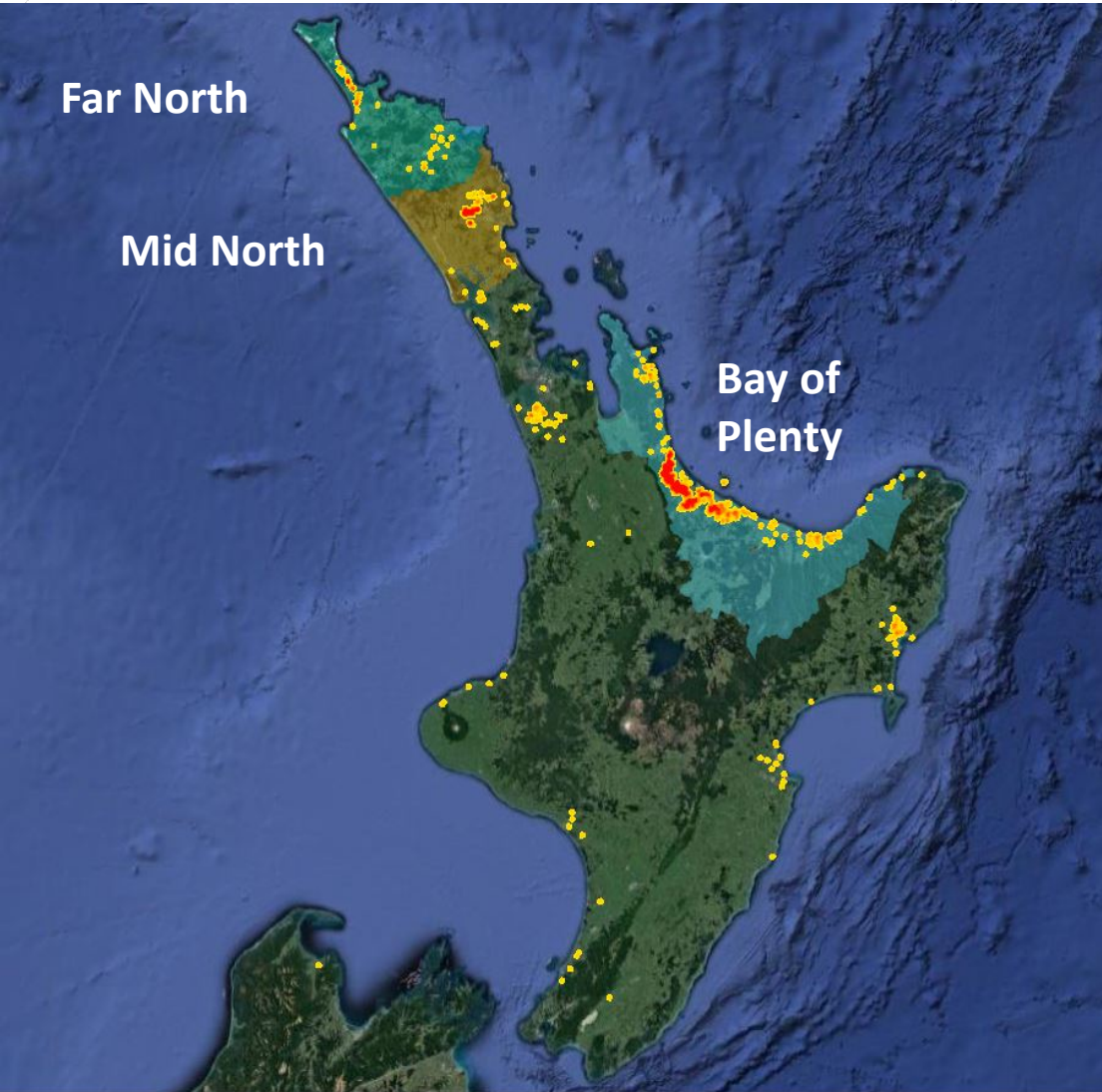
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New Zealand Avocado

Average industry yield - in tonnes per hectare





New Zealand's climate

- Plays a large role in orchard productivity
- Example: Temperature impacts on flowering, pollination, fruit set and carbohydrate partitioning
- New Zealand avocado orchards are in regions with mean annual temperatures about 14°C considered to be at the climatic margin for successful avocado production.

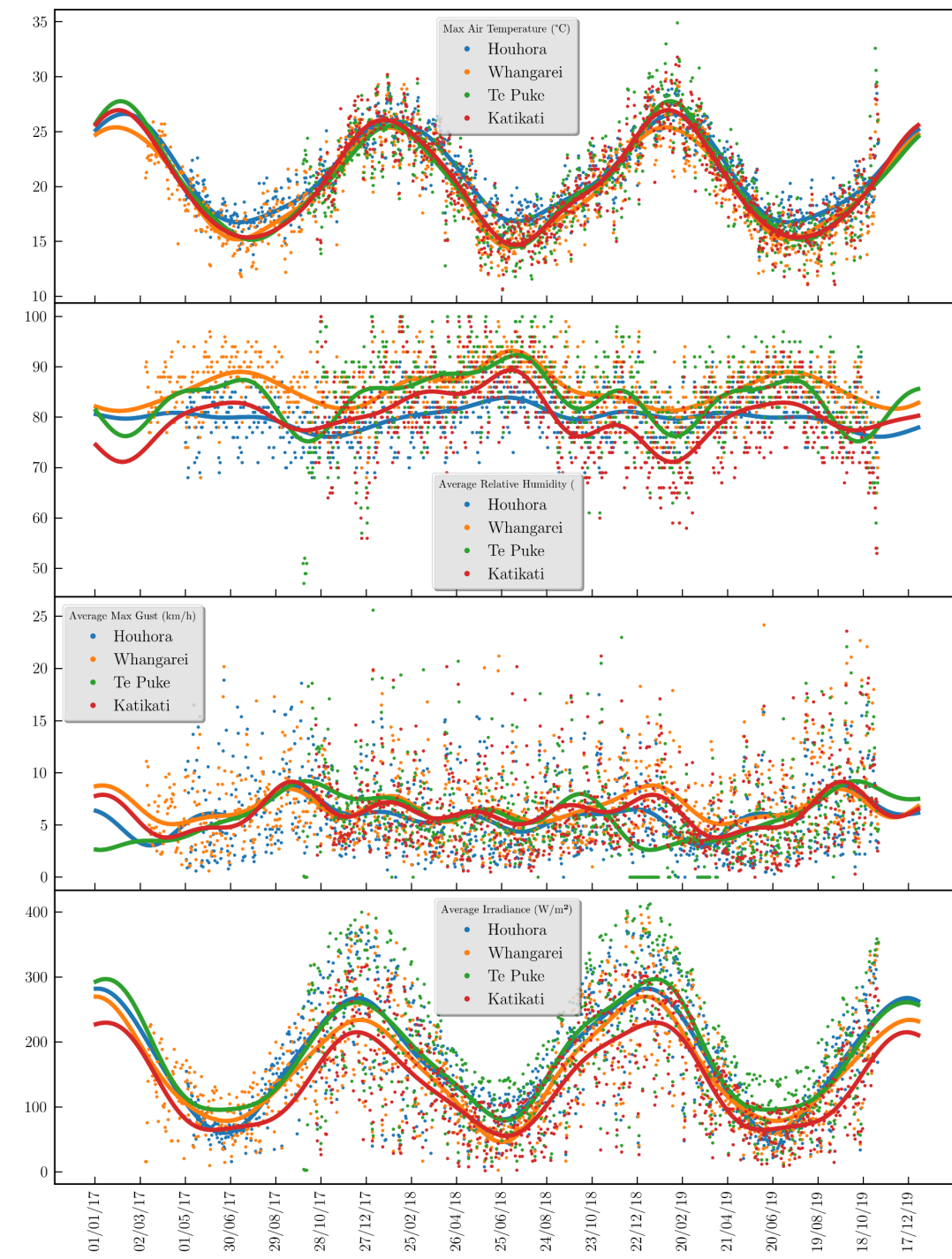
Case study

- Understanding the effect of weather variables to maximise crop
- Challenging to identify the specific variables that have an impact on production
- Machine learning to identify the most important set of variables that affect specific environmental factors



- Data provided by NZ Avocado
- 1800 orchards over 10 growing years
- Weather data (from real weather stations, NOAA and remote sensing data)



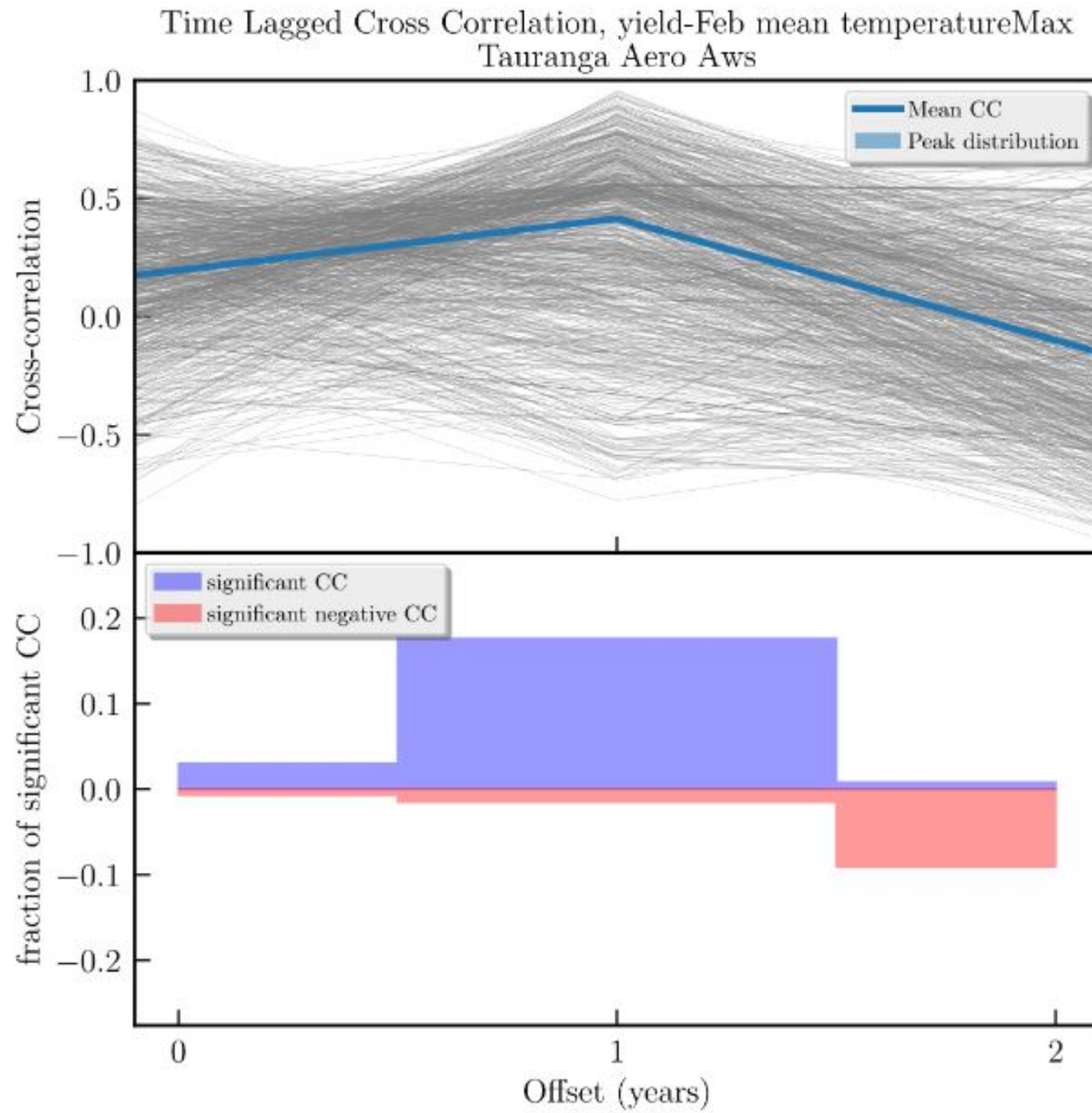


The data consists of daily frequency weather variables with different time-span coverage for each weather station.

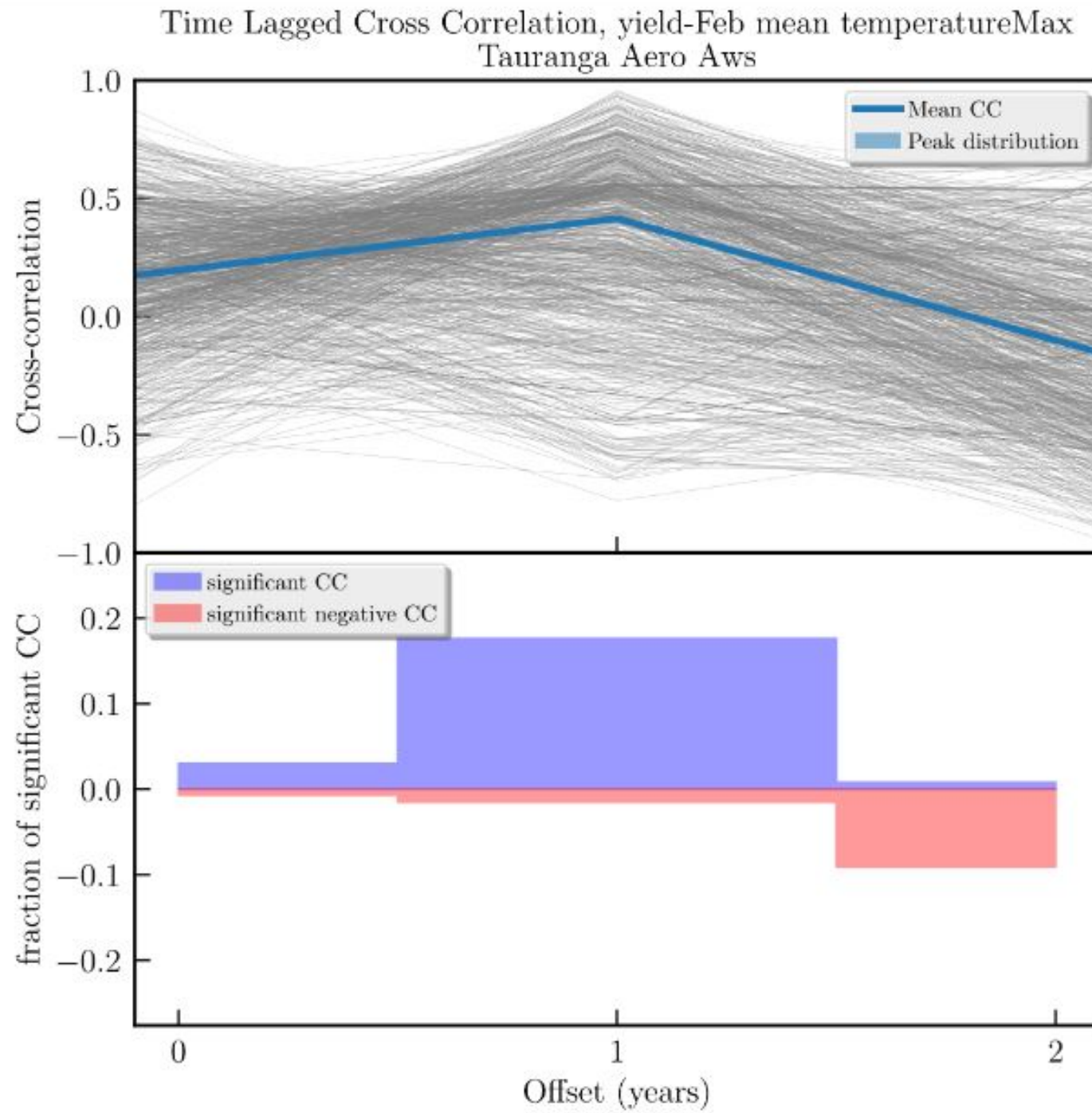
The lines correspond to the most significant modes of the inverse of the signal's *Fourier transform*.

This help us highlight the most important seasonal cycles in the data.

The longest coverage is of 3 years, (~2017-2019).

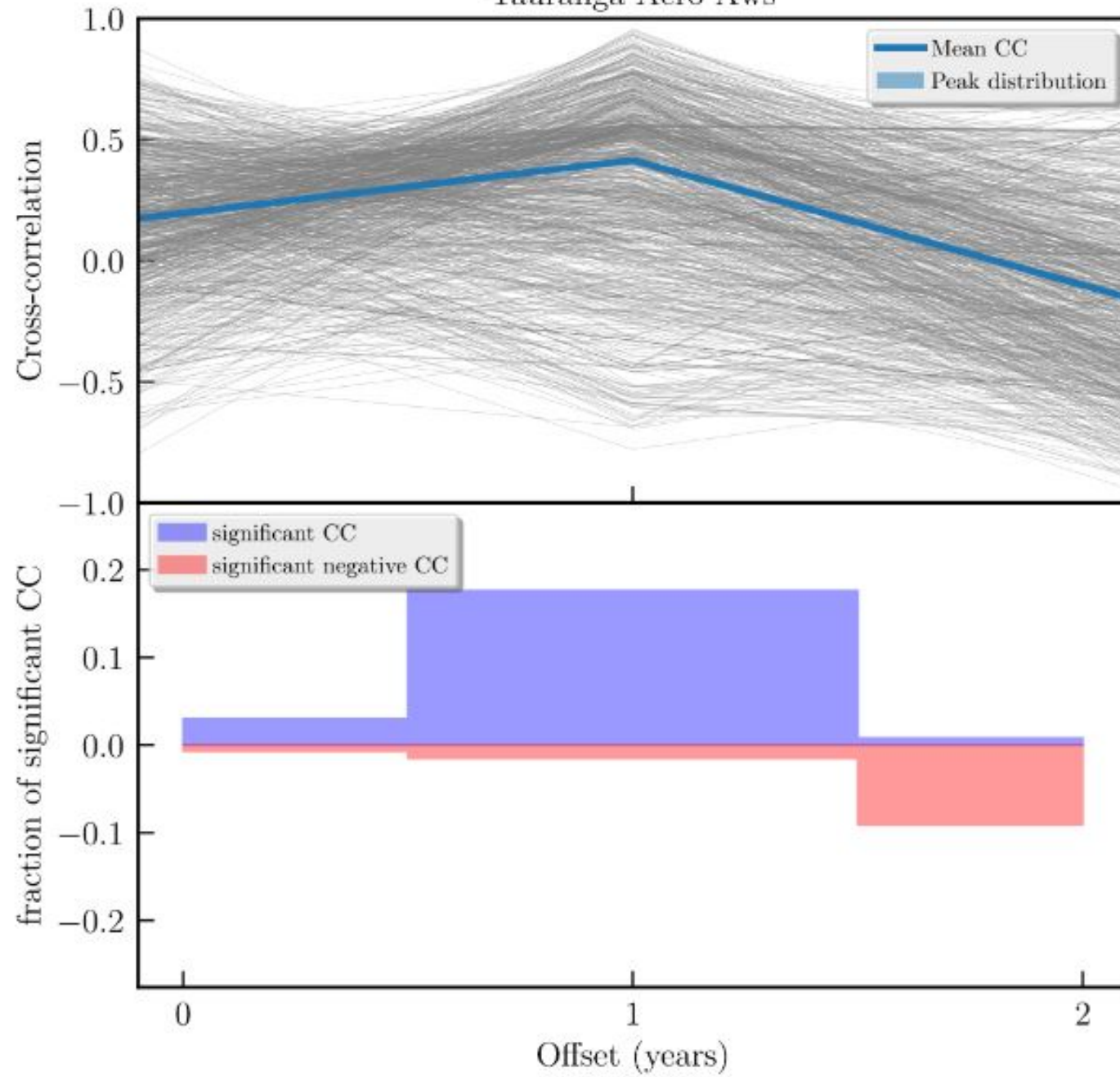


- The top panel shows the Cross correlation as a function of the offset in years between Max. Mean Temperature and yield.
- Each line represents one of the orchards in the study



- The bottom panel shows the fraction of significant cross-correlations (i.e. above 95% confidence when compared to a random distribution).

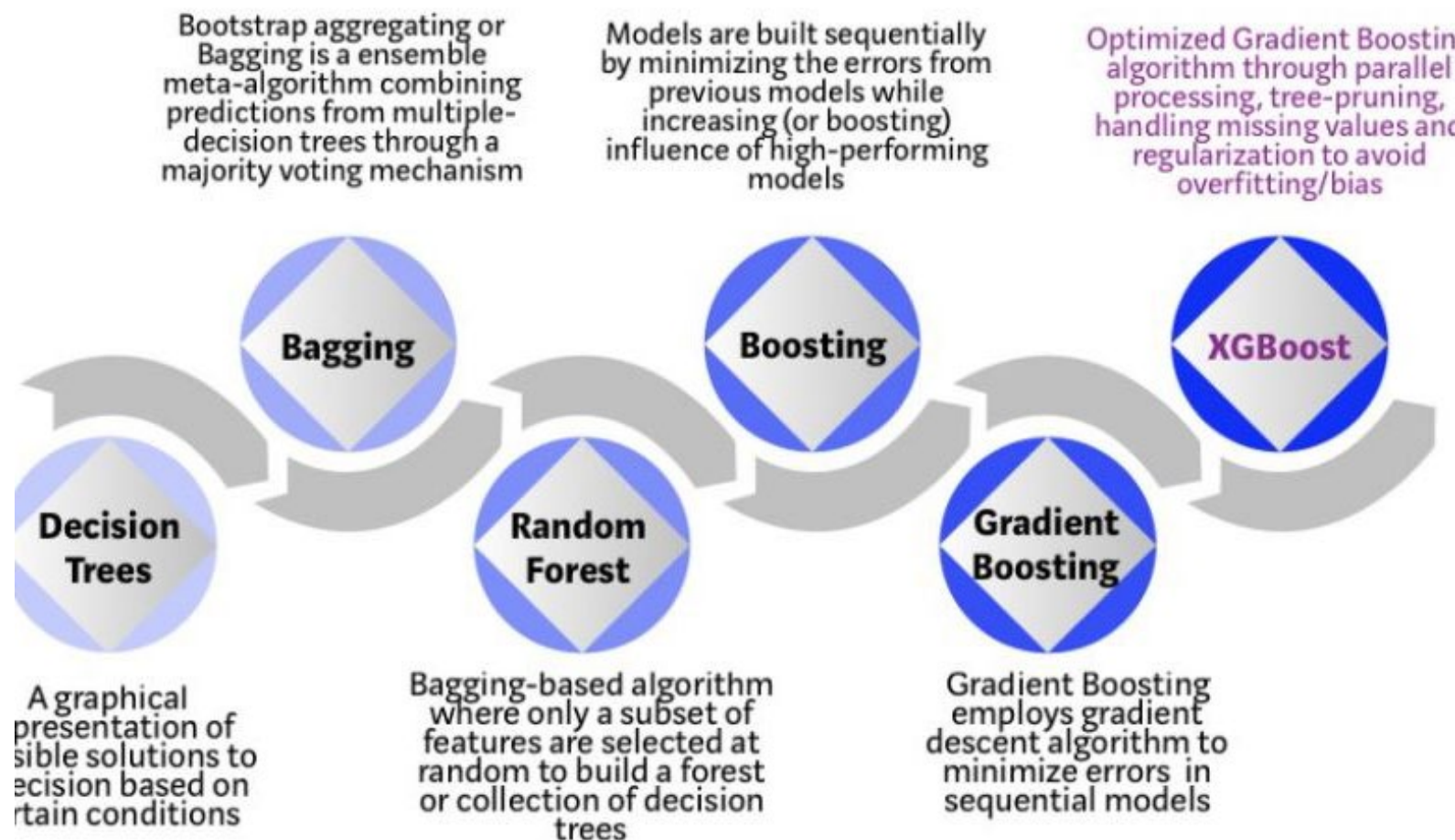
Time Lagged Cross Correlation, yield-Feb mean temperatureMax
Tauranga Aero Aws



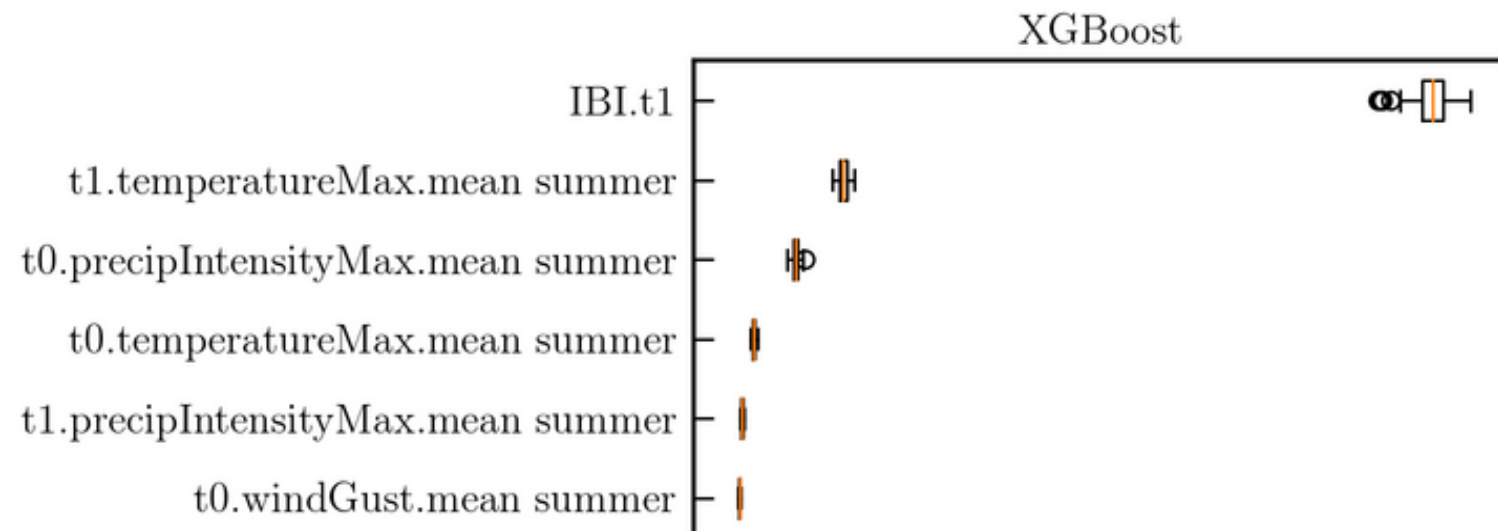
- Temperature variations over the time of a season could be a factor influencing the observed yields of future seasons.

Methodology

- Use of machine learning algorithm - XGBoost
- Used to identify features that have high importance



Evolution of XGBoost Algorithm from Decision Trees



The plot on the right shows the relative importance of all variables in terms of their impact.

The **Max. temperature** of the previous year is the second most important variable.

The yield at present time and hectares (i.e. size) are the third and fourth importance quantities.

All other weather variables add virtually nothing to the accuracy of the model.

Conclusions

- Previous crop was the most important factor
- Spring temperatures being thought to be most important weather factors data did not show this on the orchards studied
- Management practices are important



Future work

- Still under development.
- Looking at new models.
- Attempting to gather management data from growers to understand influence of grower practice
- Looking at high computer processing power for processing large amount of data.



References

- NZ Avocado webpage (<https://www.nzavocado.co.nz/>)
- Wolstenholme, B. N., Partridge, C., & Wilely, A. W. (2010). Alternate bearing in avocado: an overview. *Obtenido de: [http://www. avocadosource. com/papers/southafrica_papers/wolstenholmenigel2010. pdf](http://www.avocadosource.com/papers/southafrica_papers/wolstenholmenigel2010.pdf).*
- Lahav, E., & Wilely, A. W. (2002). Irrigation and mineral nutrition. *The avocado: botany, production and uses*, 259-297.