INVESTIGATING MACHINE LEARNING ALGORITHMS TO FORECAST SOIL MATRIC POTENTIAL IN COTTON CROPS

Rodrigo F. Maia, Carlos B. Lurbe, Brenno T. Faria, John Hornbuckle
Deakin University

Australian Government
Department of Agriculture, Fisheries and Forestry

This project is supported by funding from the Australian Government Department of Agriculture Fisheries and Forestry as part of its Rural R&D for Profit program.

Research done within the

Smarter Irrigation for Profit 2

Objective: Support growers to monitor and control irrigation remotely based on Internet of Things and Remote Sensing

Challenge: How to automate the paddocks providing water efficiency, reducing labour and contributing with grower decision-making process?

Research done within the

Smarter Irrigation for Profit 2

New technologies integrated and automated smart sensing for cotton for

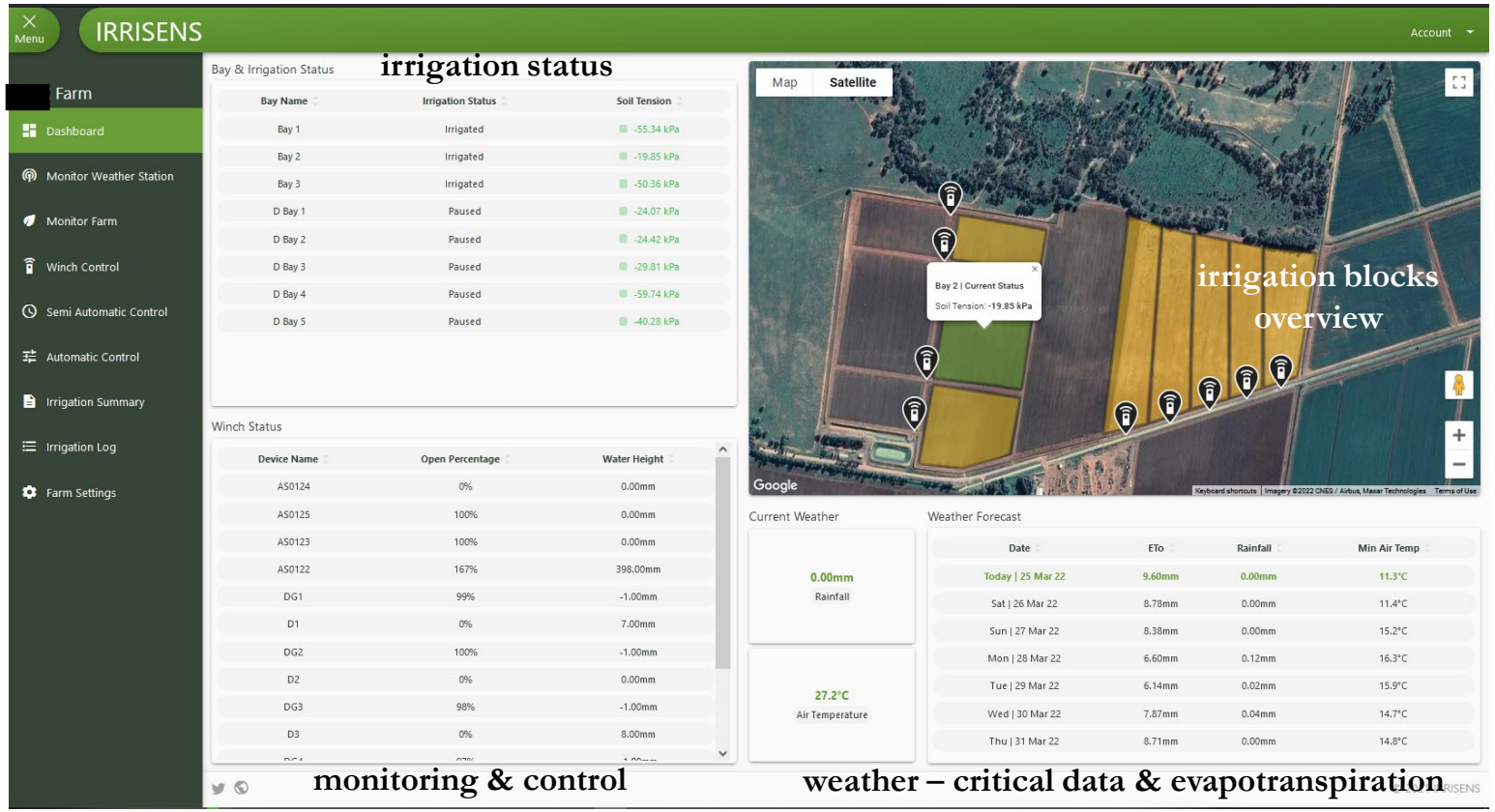
Forecast mechanism – save water in irrigation

Smart Irrigation Platform – IRRISENS

Wifield Logger / Automatic winches

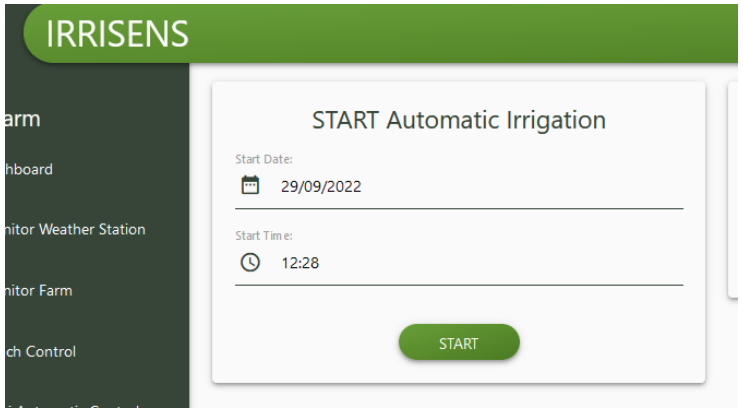
Wi-Fi communication (range around 700m)

Project outcomes – IRRISENS platform



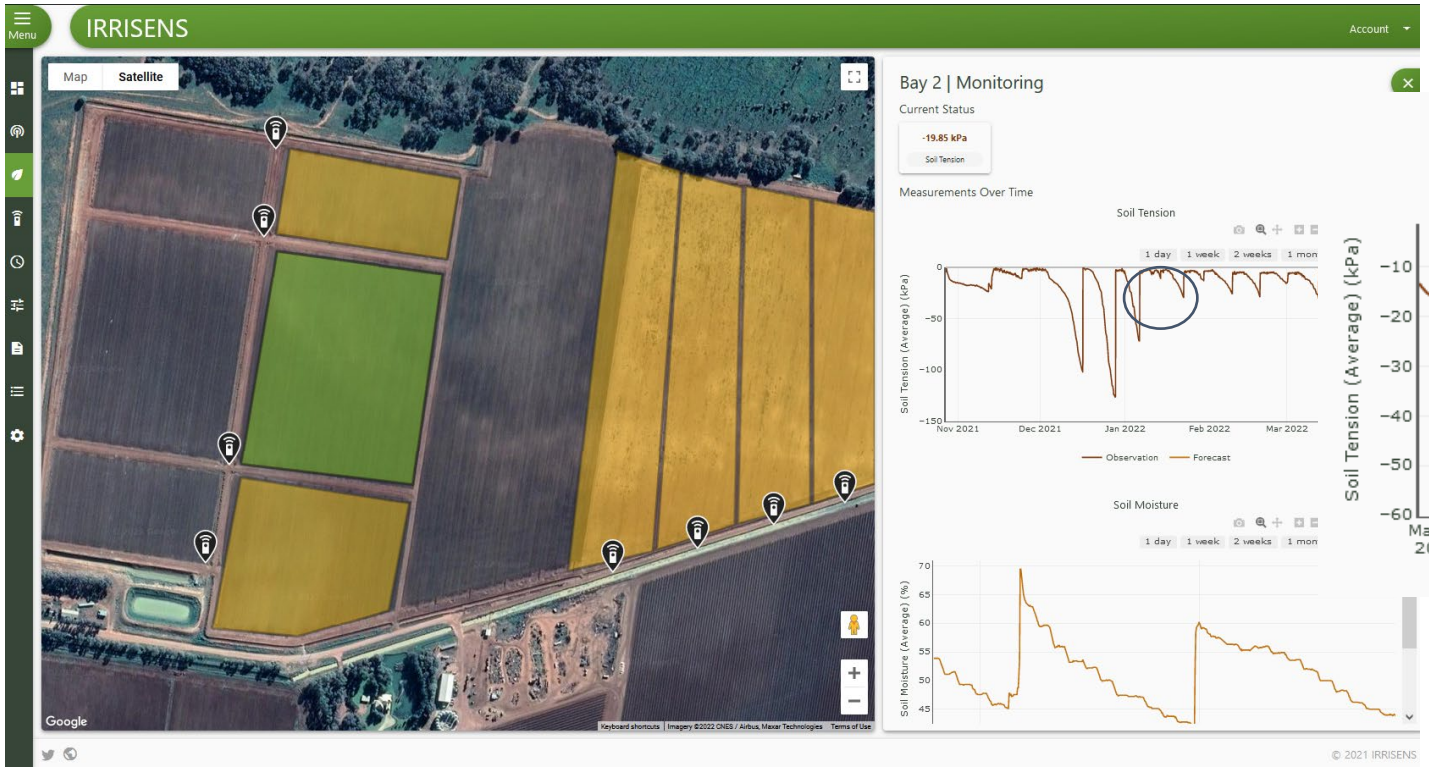
Features

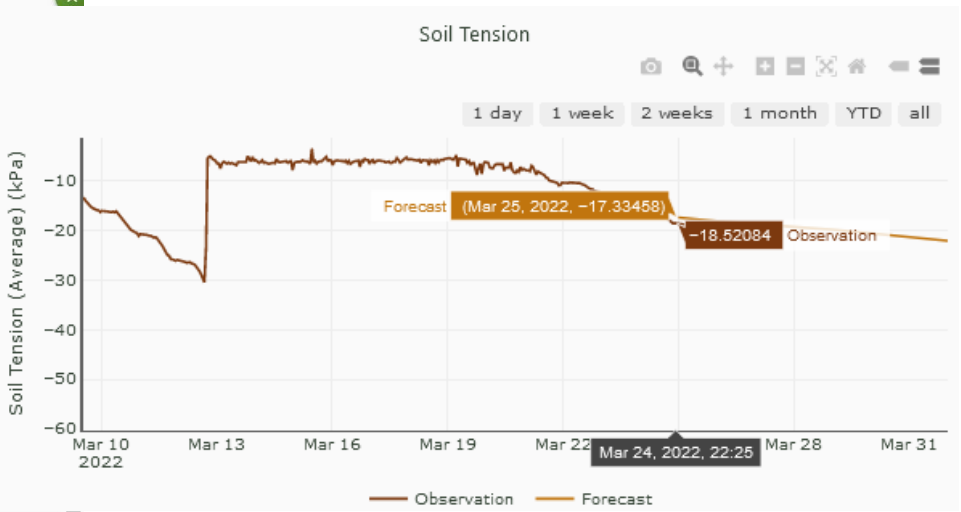
- Show monitoring bays, weather
- Forecast soil tension
- Automatic control – system control all gates openings and closings without manual operation



Project outcomes – IRRISENS platform

Monitor bay & machinery (field)





Internet of Things (IoT) drives innovation in AgTech

Electronics and equipment cheaper and reliable ✓

Communication spread through paddocks (robust Wi-Fi, LoRa, etc) ✓

Loggers / probes cover small areas 

Labour to install and maintain the equipment in larger fields may be a challenge

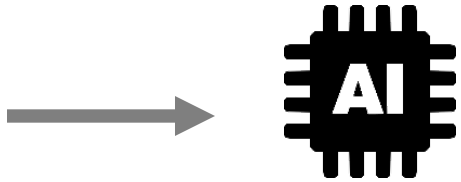
Is it possible to create a mechanism to estimate soil matric potential in larger areas reducing labour and maintenance?

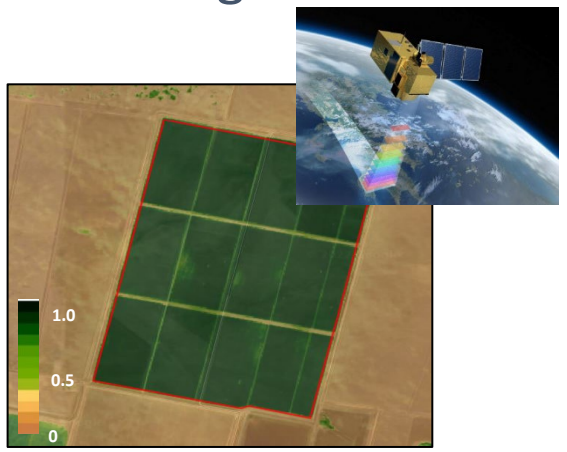
Inspiration: IrriSAT + Remote Sensing

IrriSAT provides Cummulative Evapotranspiration for growers in larger areas

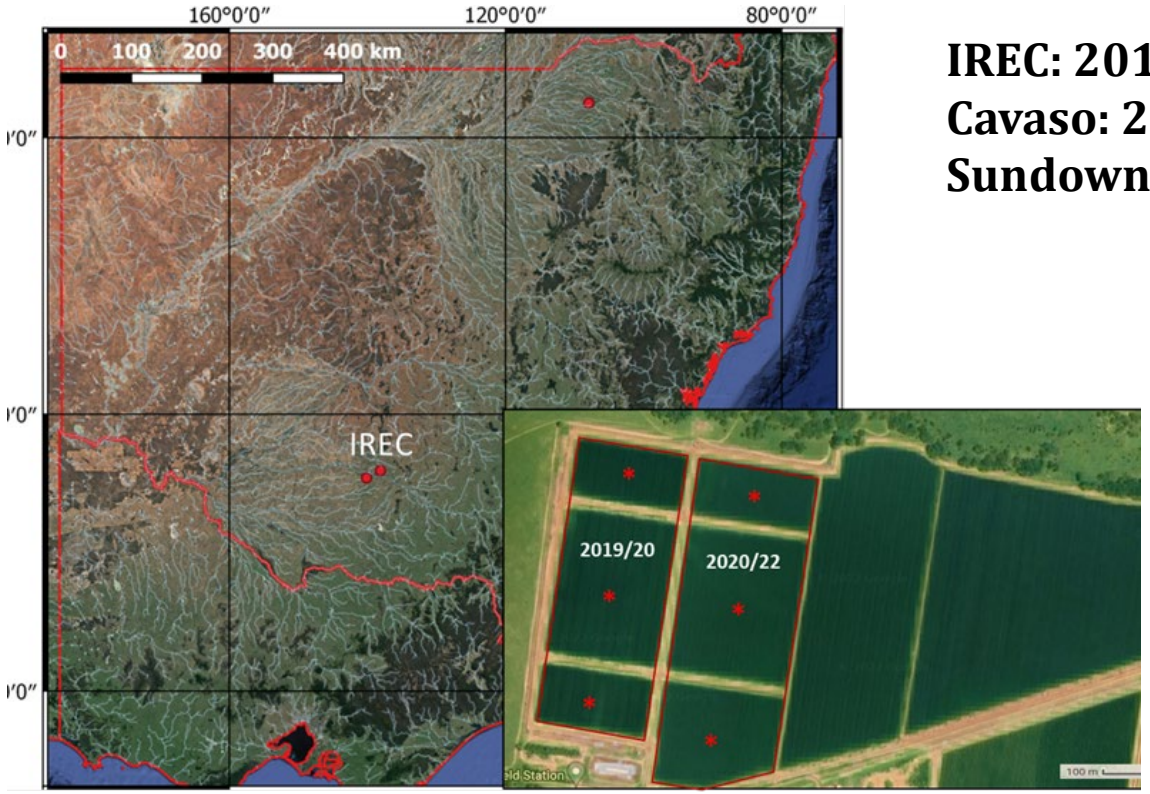
Limitation: Remote Sensing does not provide soil tension deeper in soil – root zone (20cm)

Challenge: Elaborate a machine learning model to combine sensors + remote sensing data to estimate soil tension in areas without sensors installed, considering climate events



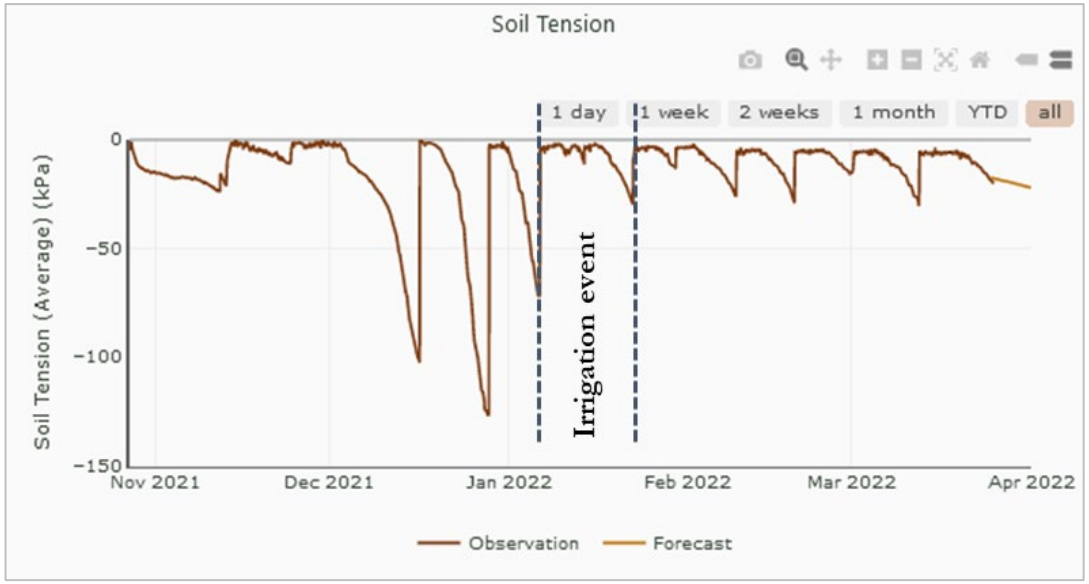


First Step Machine Learning – Data harvest and model training



Data haversted through Wifield Loggers – 3 seasons

IREC: 2019 – 2022
Cavaso: 2019/2020
Sundown Pastoral: 2020/2022



Dataset features – Algorithm Performance evaluation

Evaluation data

- Mixed data from all farms and all seasons
- Split data into training and testing
- window size 20 days (shuffled)
- 600 ≤ GDD ≤ 1700

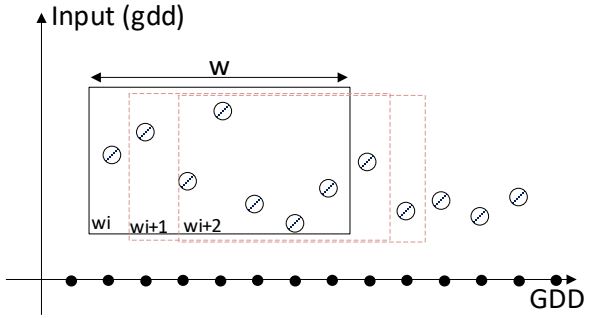
Testing

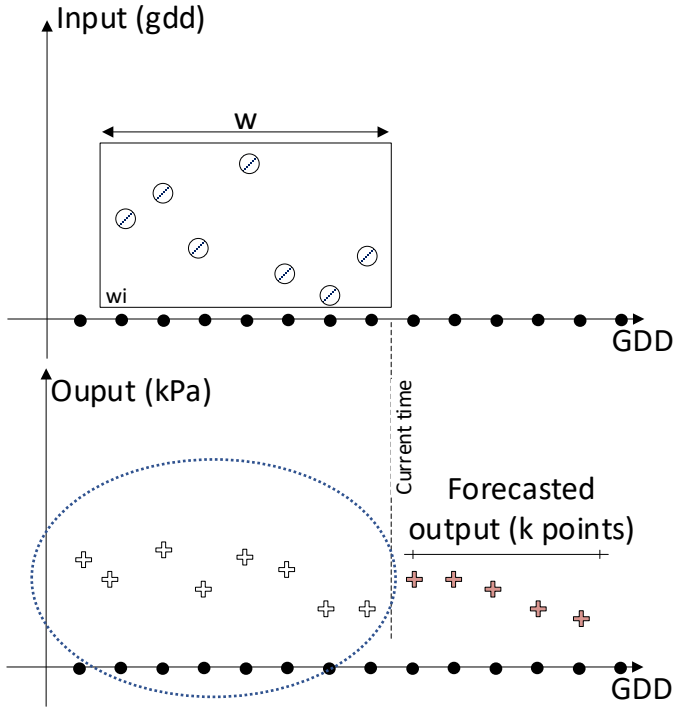
- Data from bays not trained
- window size 20 days (shuffled)
- 600 ≤ GDD ≤ 1700

Weather data:

2019/20 – hotter and dryer – highest temp recorded (47.1C)

2020/21 – colder and wet – lowest temp recorded (19.7C)



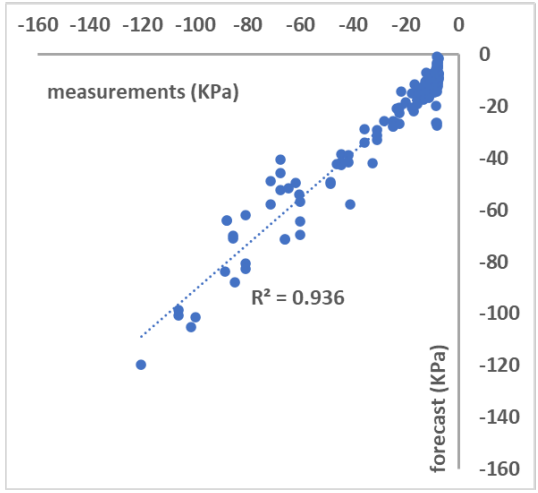


First Tentative

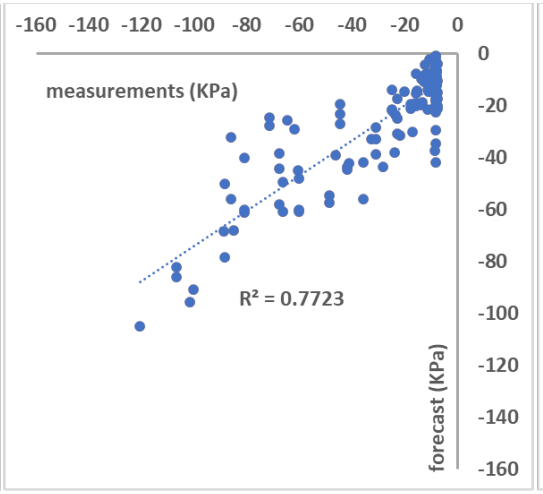
Use data only from IREC

"Machine learning model LSTM could estimate soil tension from non monitored bays successfully with one and two season data"

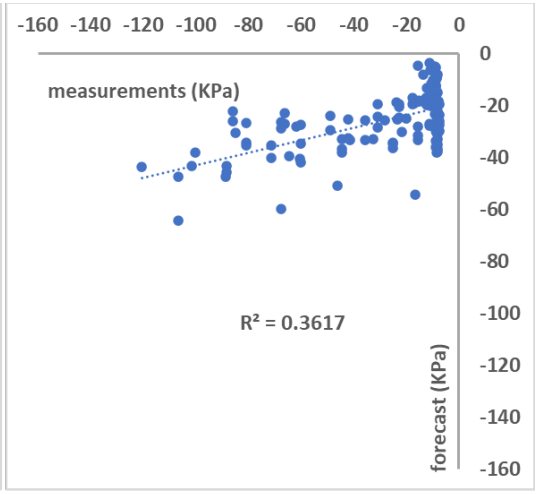
IREC: Model Effectiveness – One Season 7 days forecast



LSTM

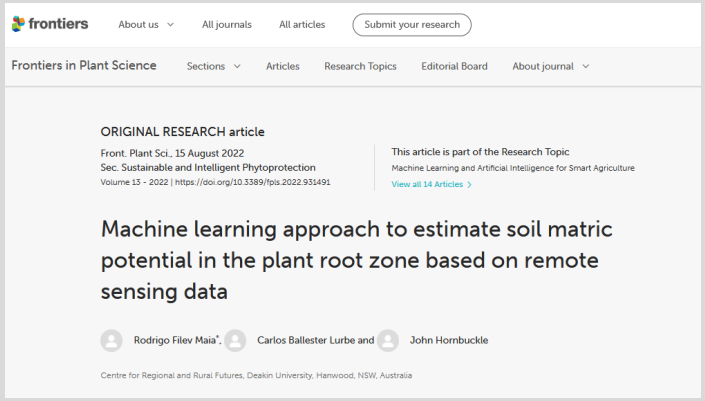


CNN



LINEAR

Results with data from all 3 farms


frontiers About us All journals All articles Submit your research

Frontiers in Plant Science Sections Articles Research Topics Editorial Board About journal

ORIGINAL RESEARCH article

Front. Plant Sci., 15 August 2022
Sec. Sustainable and Intelligent Phytoprotection
Volume 13 - 2022 | https://doi.org/10.3389/fpls.2022.931491

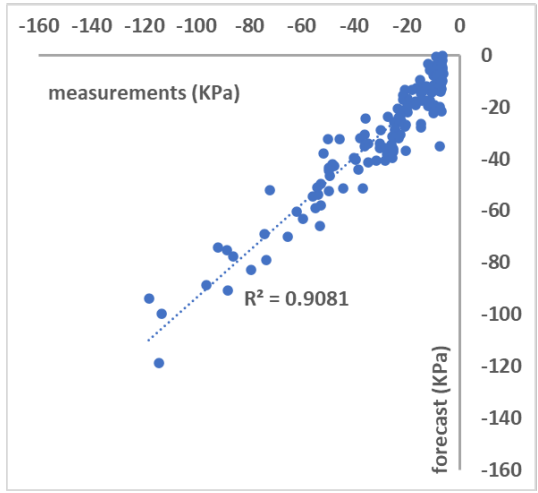
This article is part of the Research Topic
Machine Learning and Artificial Intelligence for Smart Agriculture
View all 14 Articles

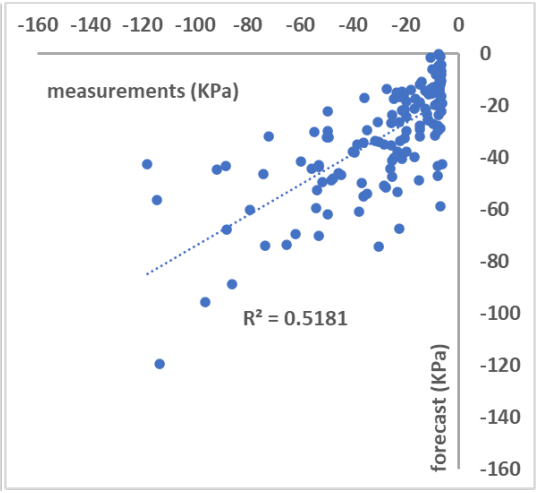
Machine learning approach to estimate soil matric potential in the plant root zone based on remote sensing data

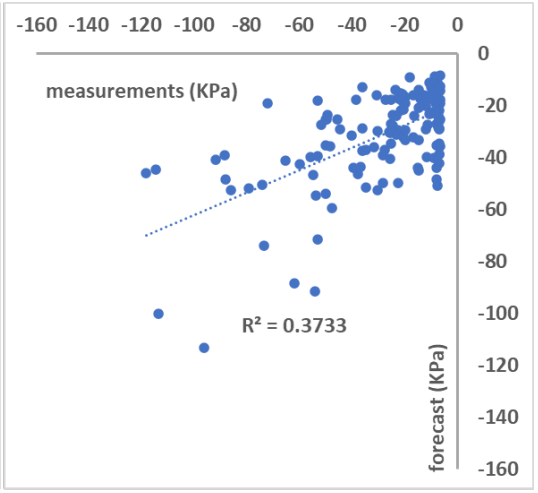
Rodrigo Filev Maia*, Carlos Ballester Lurbe and John Hornbuckle

Centre for Regional and Rural Futures, Deakin University, Hanwood, NSW, Australia

https://doi.org/10.3389/fpls.2022.931491







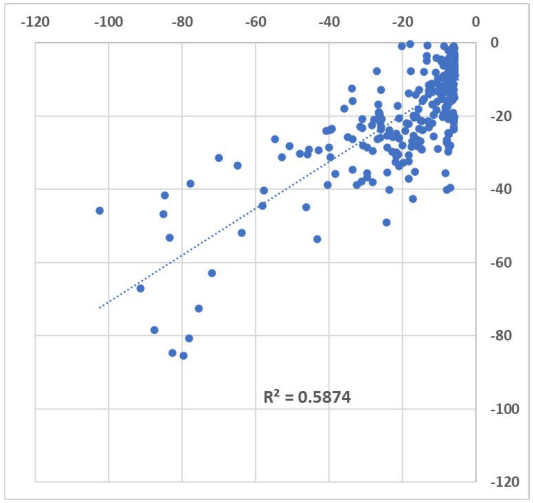
IREC: Model Effectiveness – Two Seasons 7 days forecast

Second Tentative

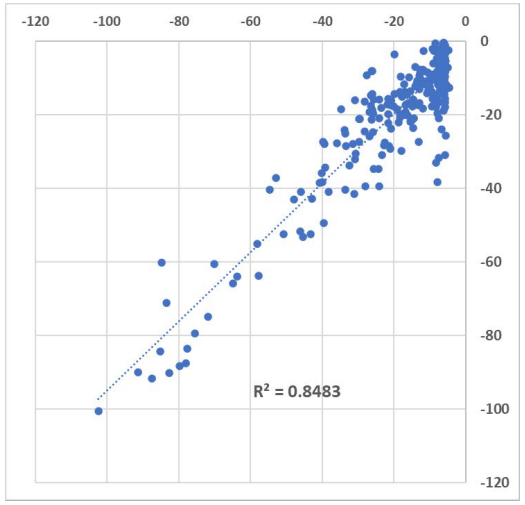
Use data from all farms and all seasons trying to forecast 14 days in advance

"Machine learning model CNN could estimate soil tension from non monitored bays successfully considering all farms"

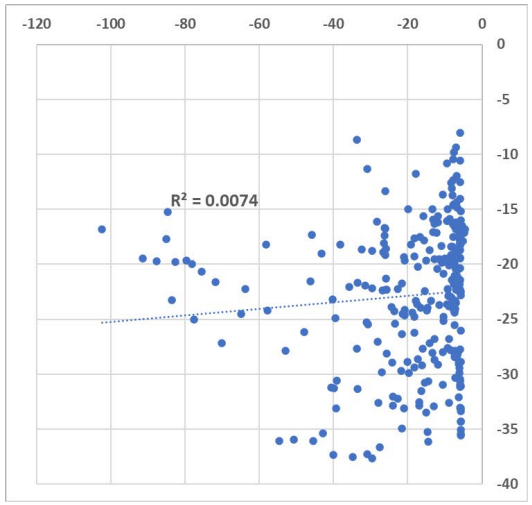
In CNN approx 83% of estimated soil tension present similar sensor measurement error



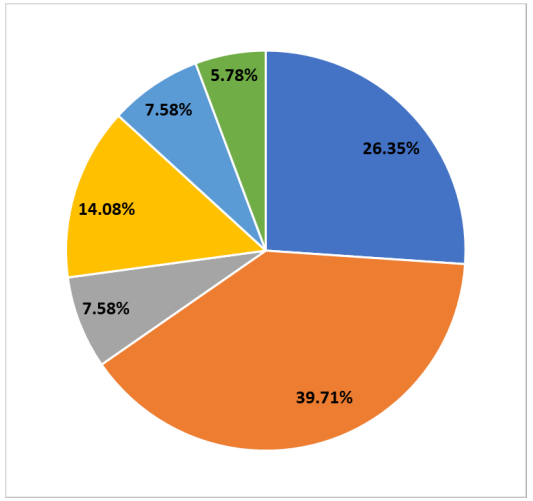
LSTM

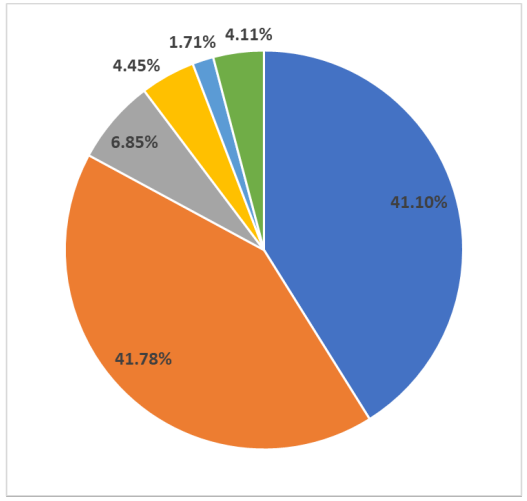


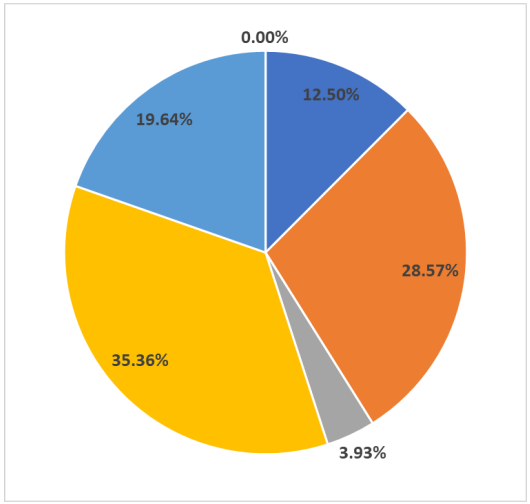
CNN



LINEAR







dryer than sensor <=10kPa | wetter than sensor <=10kPa | 10kPa < dryer/sensor <=20kpa | 10kPa <wetter/sensor<=20kPa | forecast/sensor > 20kPa | Error

Concluding remarks

Machine learning models are able to estimate soil tension in no-monitored bays, since the model has as input data from one monitored bay

Convolutional Neural Network (CNN) hits 83% of satisfactory soil tension results in non monitored bays

Models need at least 20 days of monitored data to estimate soil tension properly

Attention needed for wrong estimation provided by both LSTM (5%) and CNN (4%)

r.filevmaia@deakin.edu.au
+61 6969 6909
+61 409 021 047
Twitter. @CeRRF_Griffith

DEAKIN UNIVERSITY