

# Decoding the Protein Puzzle: Understanding Variability in Grain Protein Content

**Mikaela Tilse**  
Thomas Bishop  
Patrick Filippi

*Precision Agriculture Laboratory,  
Sydney Institute of Agriculture*



THE UNIVERSITY OF  
SYDNEY



---

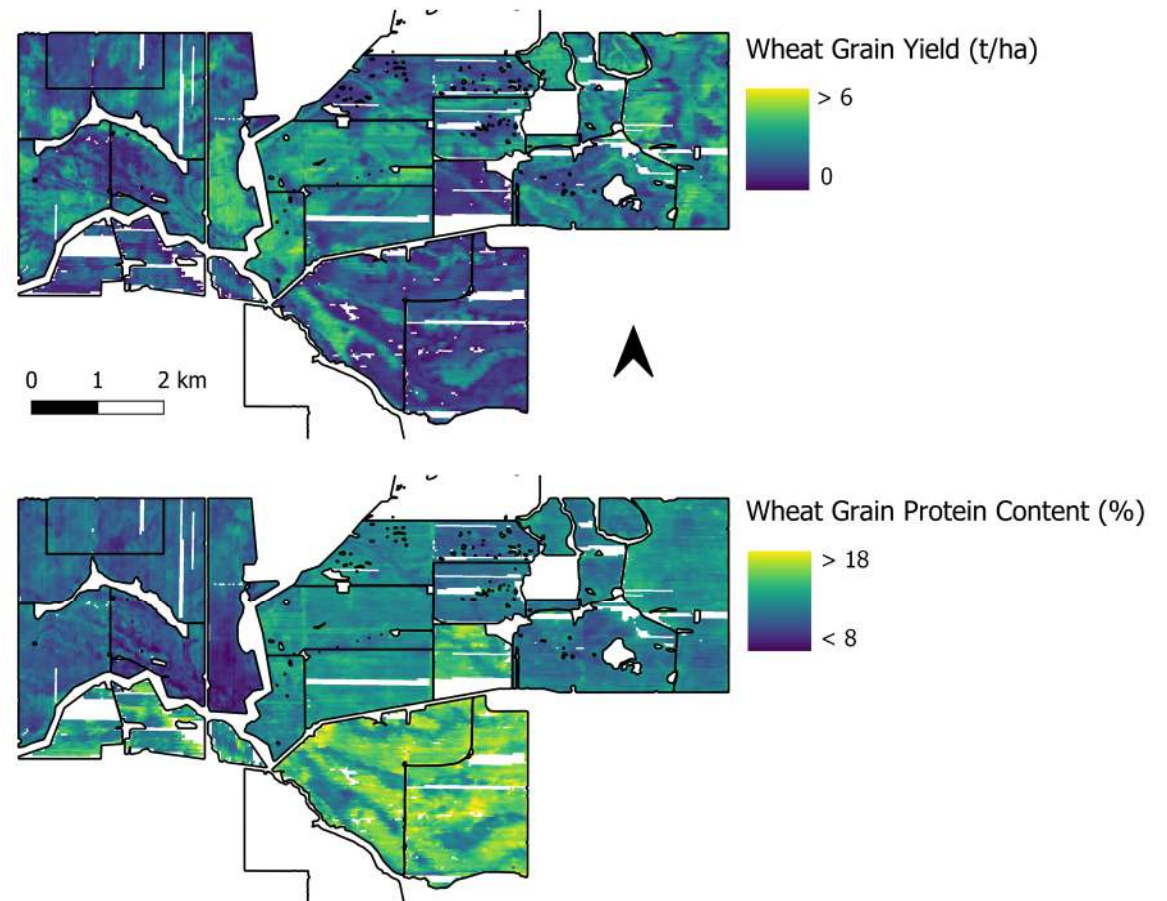
## Wheat grain yield and quality is variable

Quality = Grain Protein Content

Both yield and quality are important:

- Determine price
- Highly variable
- Need to optimize management

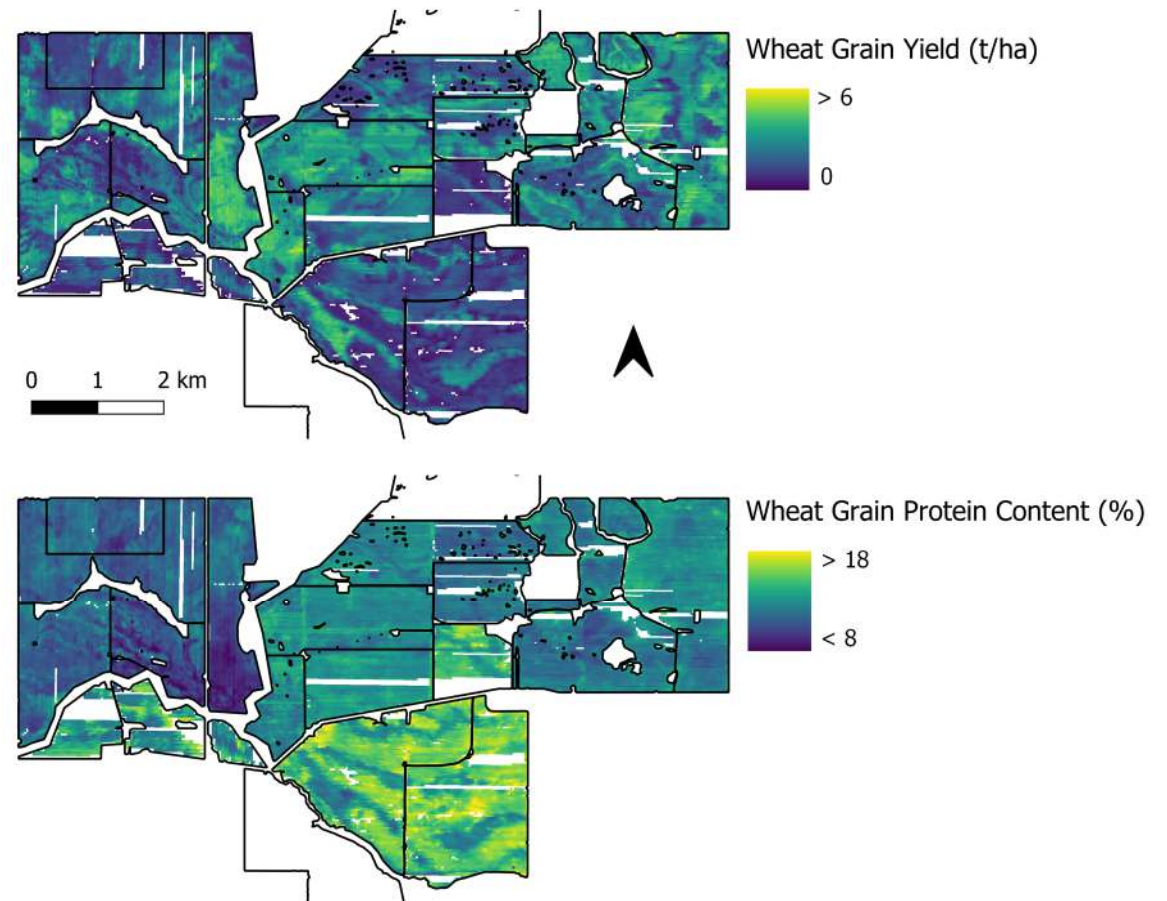
*Aim: Improve our understanding of the drivers of variability*



---

## We have more data available than ever before

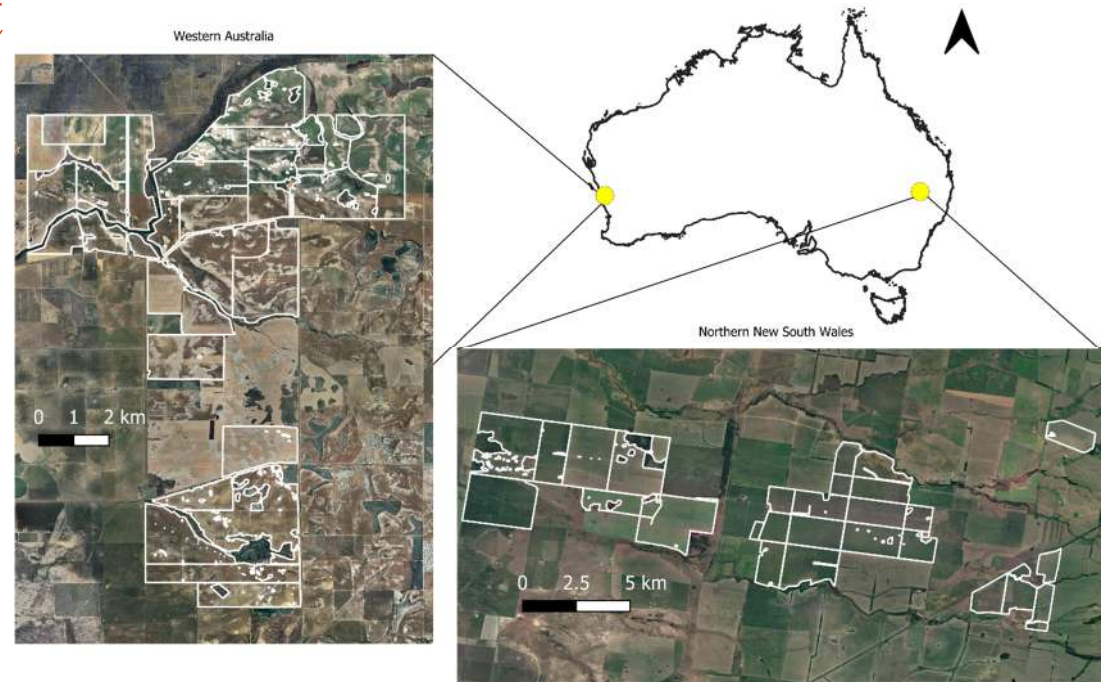
- On-farm + Publicly-available data
- Uptake of grain protein sensors is (slowly) increasing
- Can we fill-in knowledge gaps using existing, readily-available data layers?



---

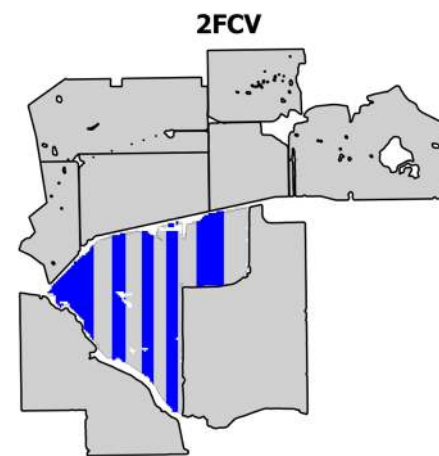
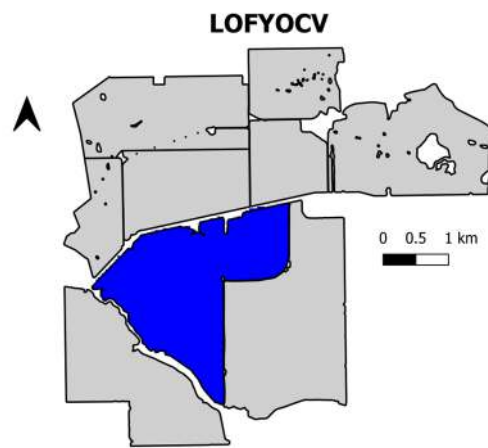
## Mapping grain protein content

- 46 fields over 4 seasons (2020 – 2023) = 63 Field-Years
- Dryland fields, 40 – 1200 ha in size
- Machine learning (Random Forest) models to map protein



---

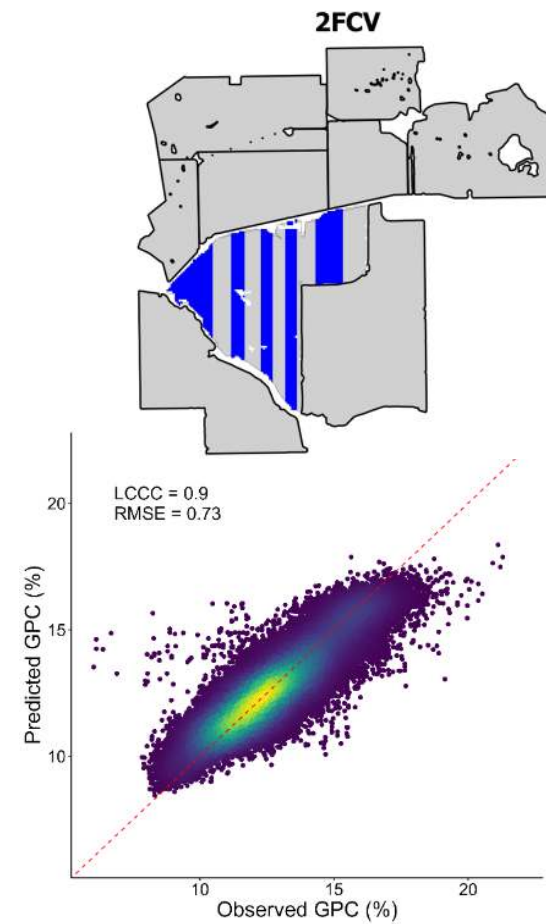
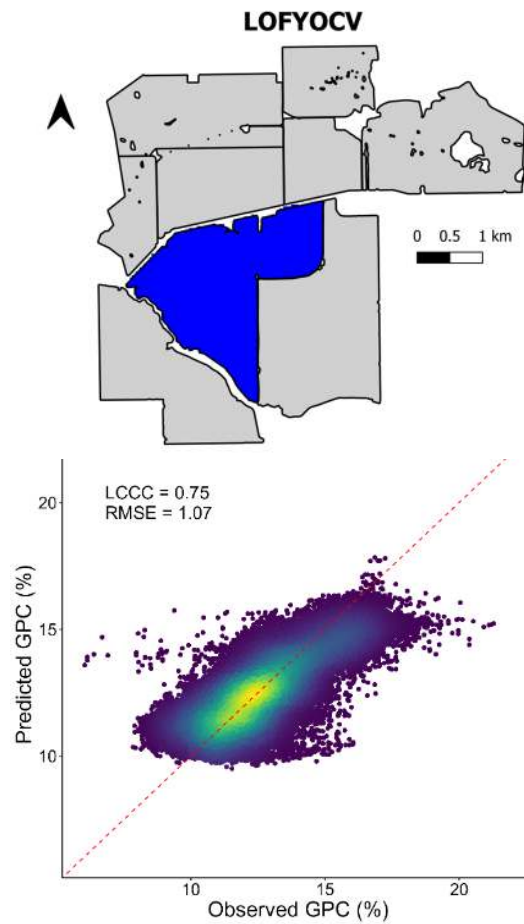
# Modelling grain protein content



# Modelling grain protein content

*LCCC: Measure of accuracy and precision.*

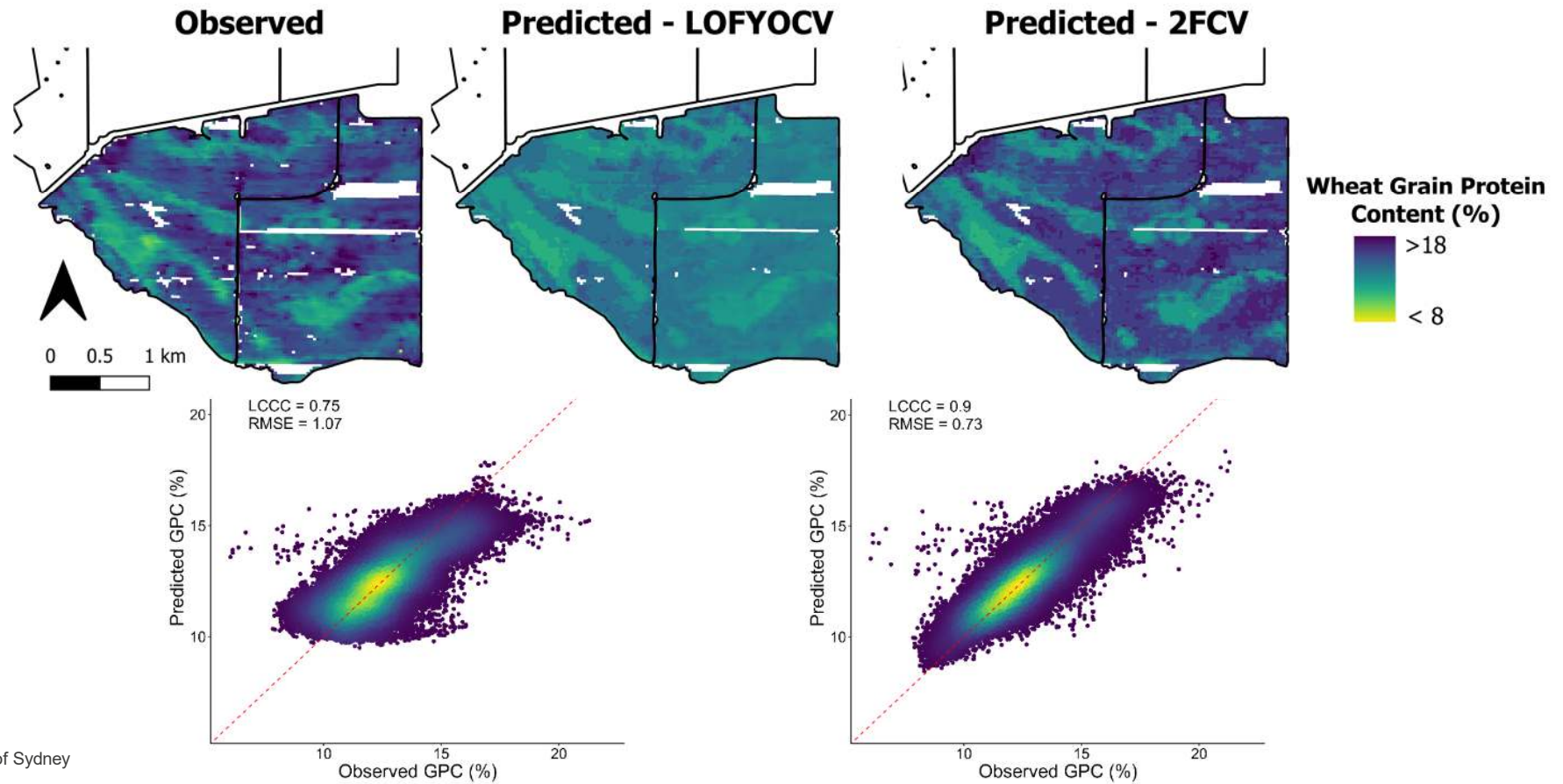
*1 is a perfect fit*



# Modelling grain protein content

*LCCC: Measure of accuracy and precision.*

*1 is a perfect fit*



---

## Why do we care?

### **High Yield / Low Protein**

Soil N levels low = sub-optimal N management

### **High Yield / High Protein**

“Optimum scenario”

Yield potential achieved with no limitations

### **Low Yield / Low Protein**

Sub-optimal N management = N deficiency

Yield potential not met

### **Low Yield / High Protein**

Non-N related problem. Soil moisture stress or subsoil constraint?

Oversupply of N = yield penalty

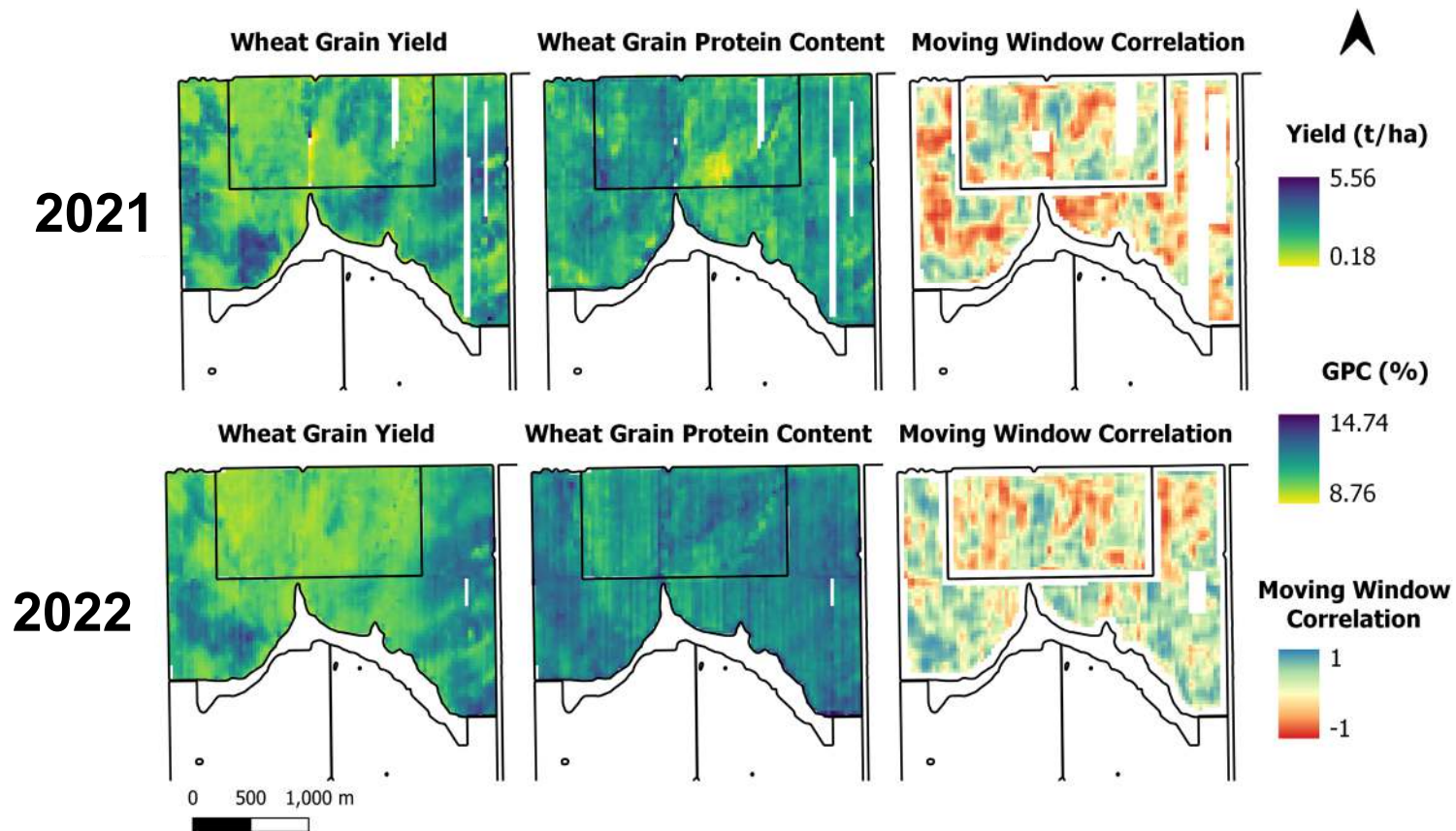
Adapted from Scott 2022: <https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2022/02/protein-mapping-getting-more-bang-for-your-fertiliser-buck>

---

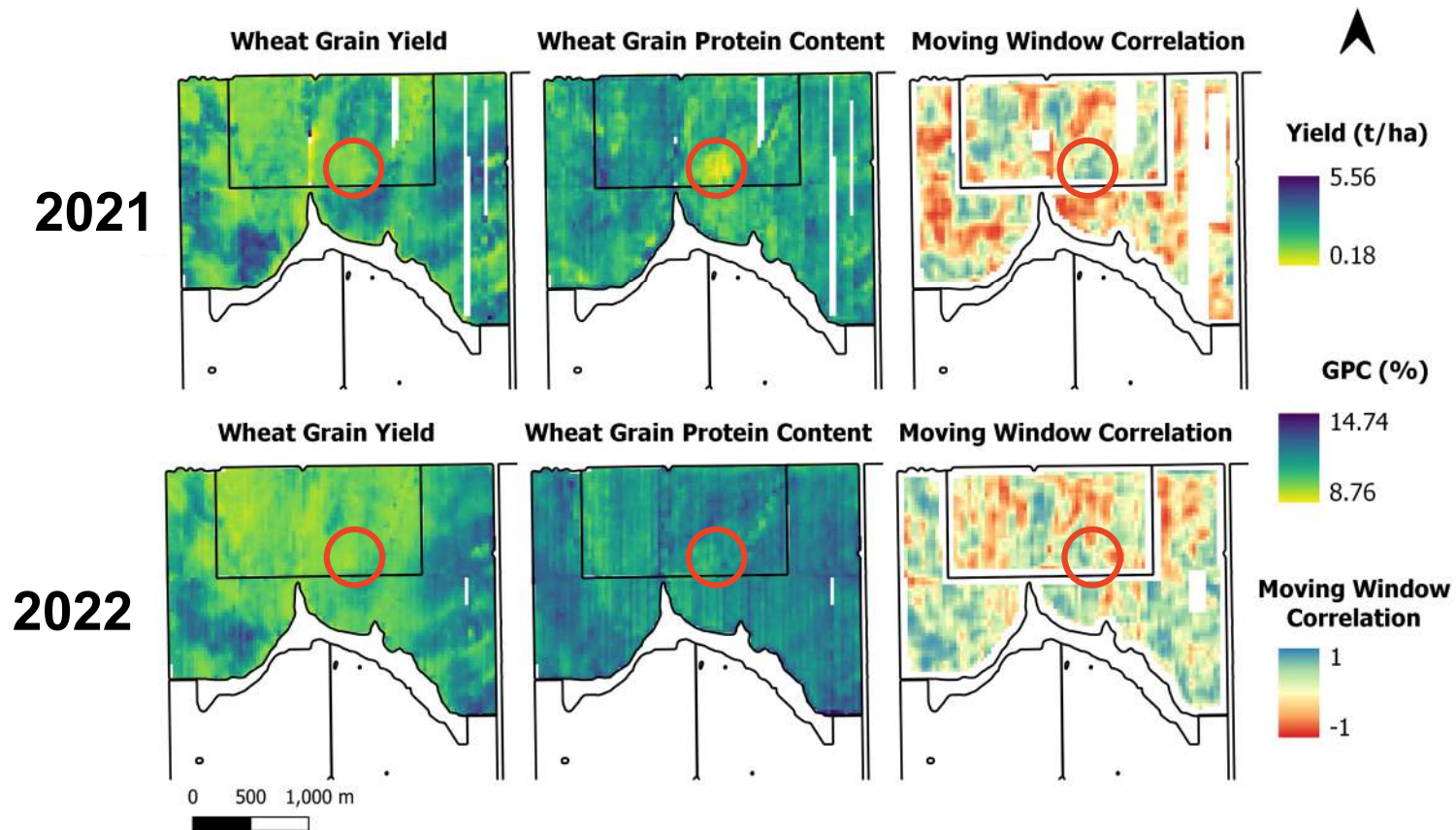
## Decoding the protein puzzle

1. Map the relationship between yield and protein
2. Understand the drivers of the yield-protein relationship
3. Assess the implications for management decisions

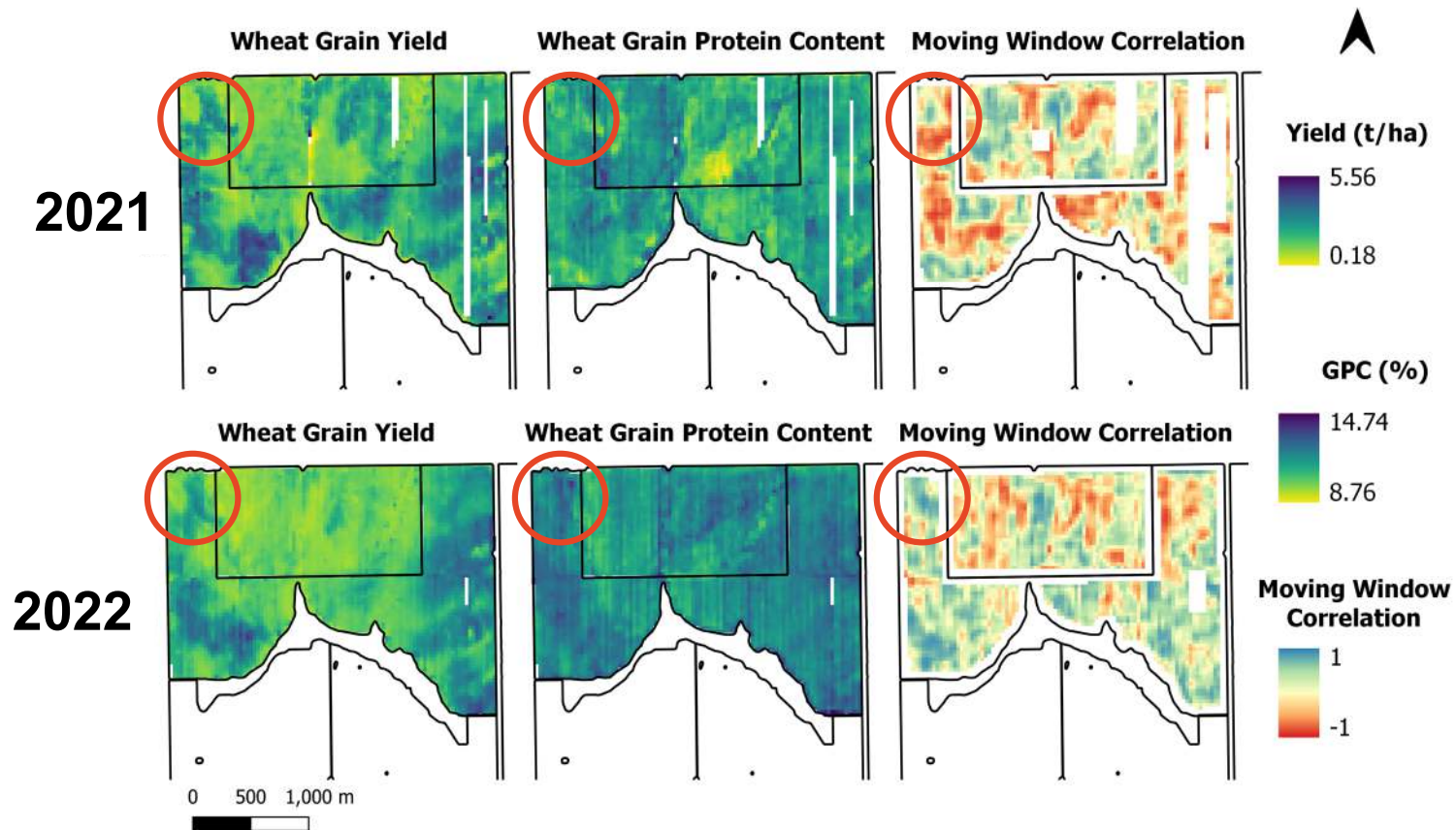
# 1) Map the yield-protein relationship



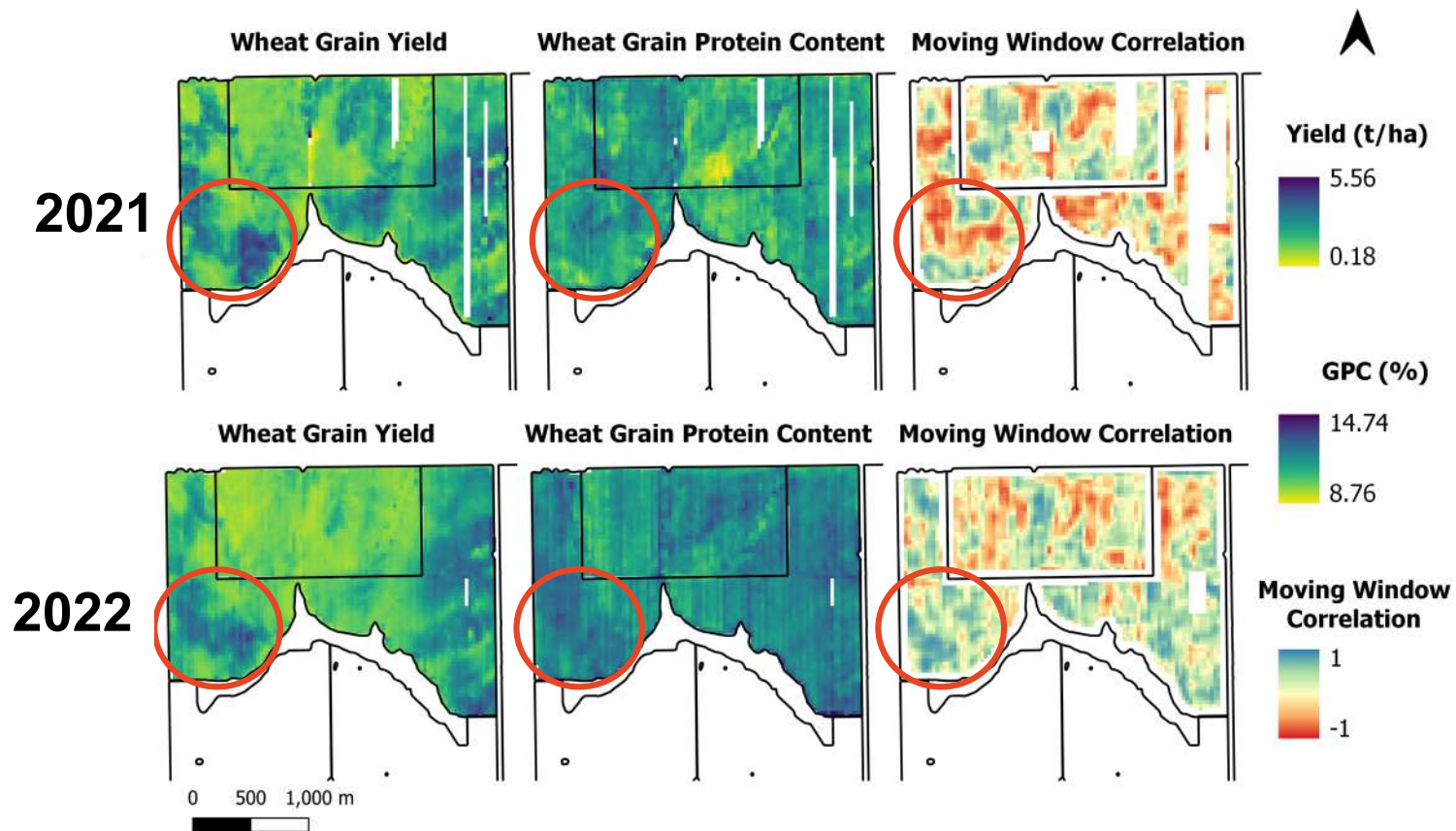
# 1) Map the yield-protein relationship



# 1) Map the moving window correlations

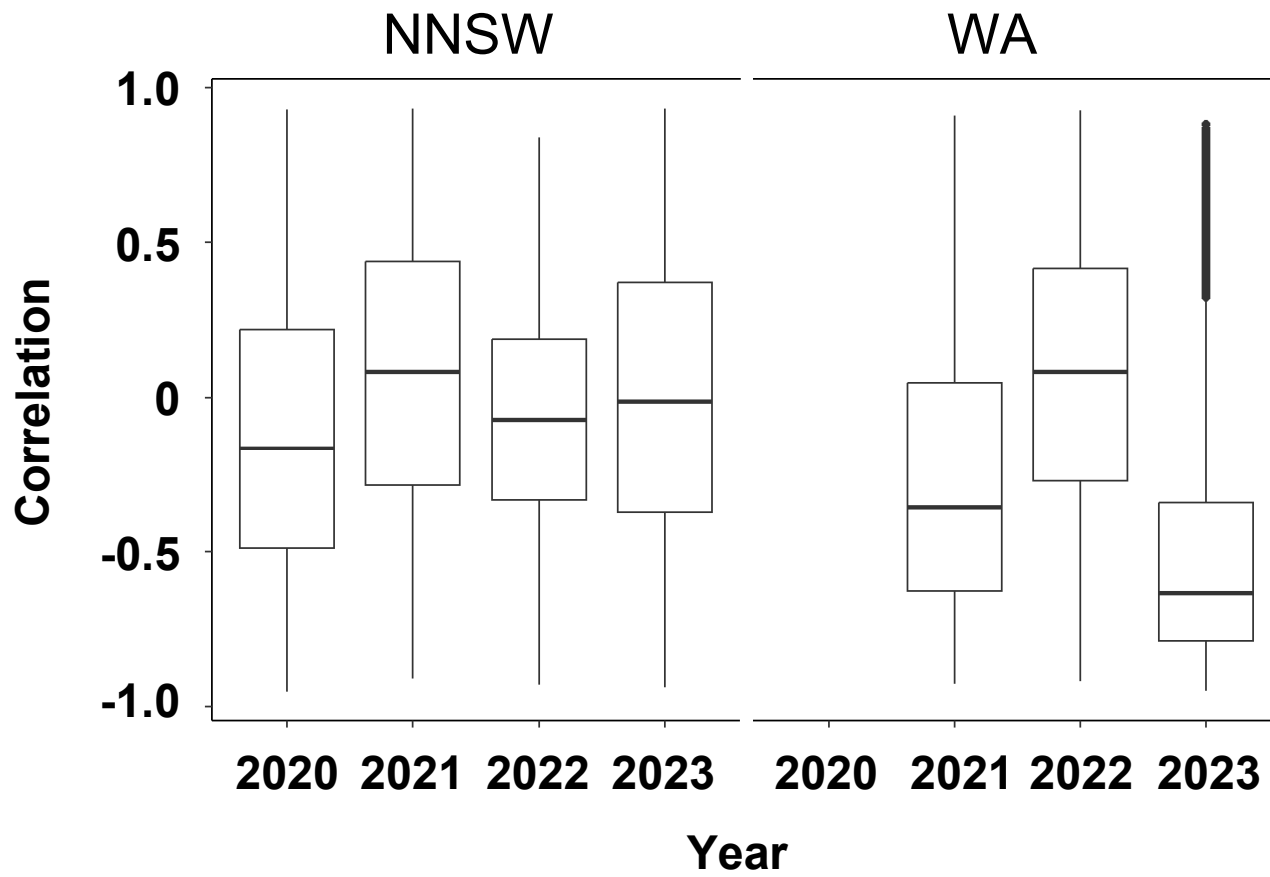


# 1) Map the yield-protein relationship



---

# 1) Map the yield-protein relationship



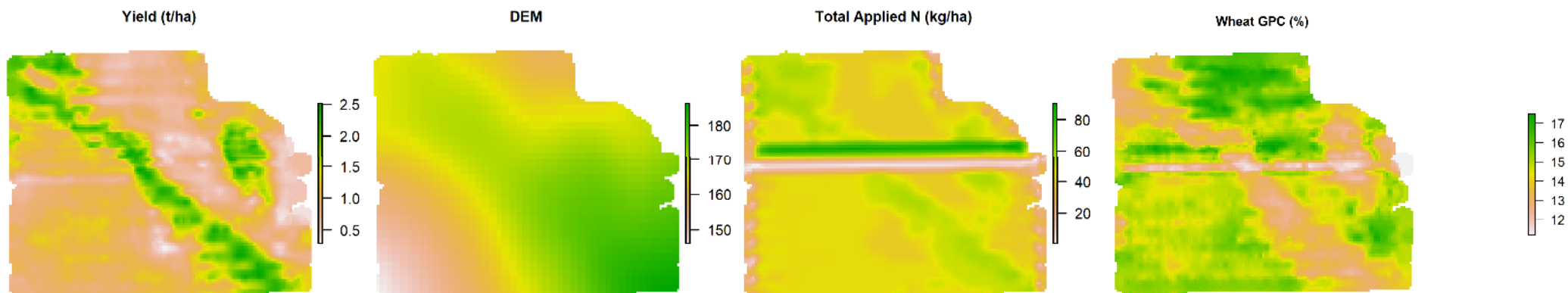
---

## Decoding the protein puzzle

1. Map yield x protein moving window correlations
2. Understand the drivers of the yield-protein relationship
3. Assess the implications for management decisions

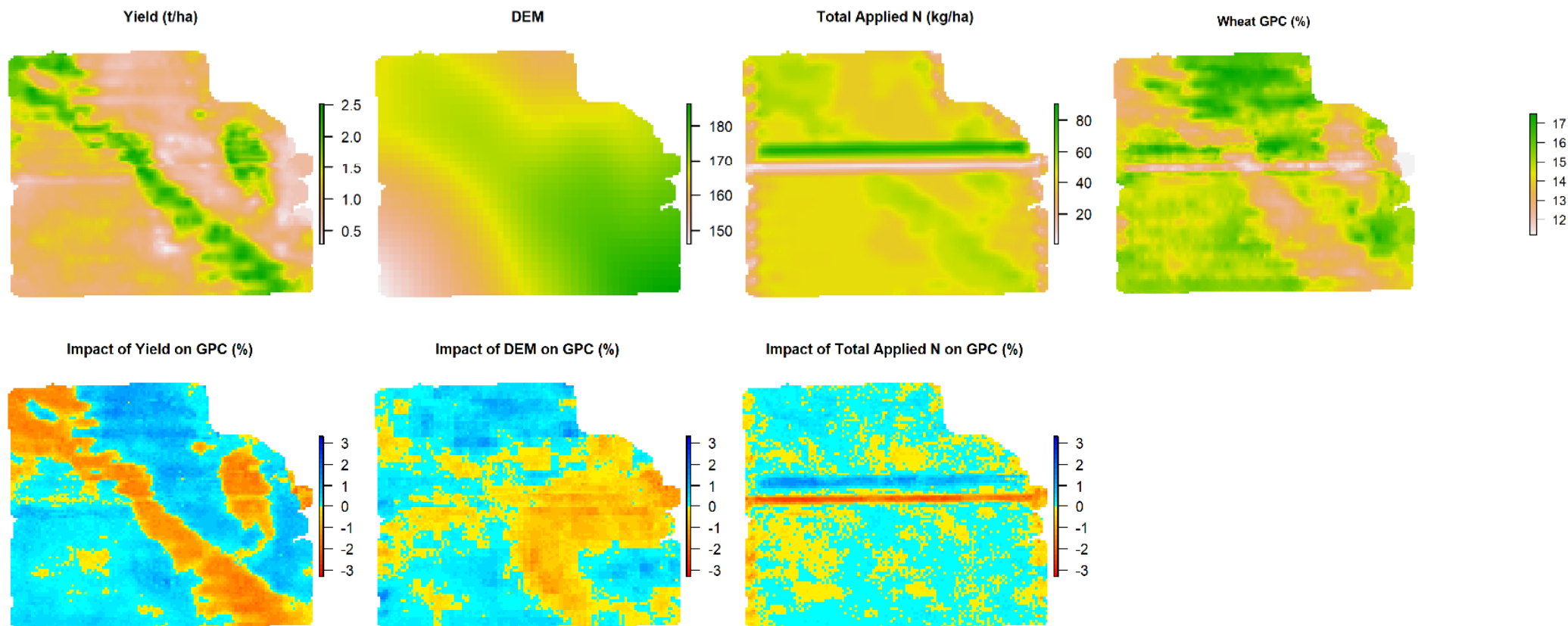
---

# Impact of variables on grain protein content

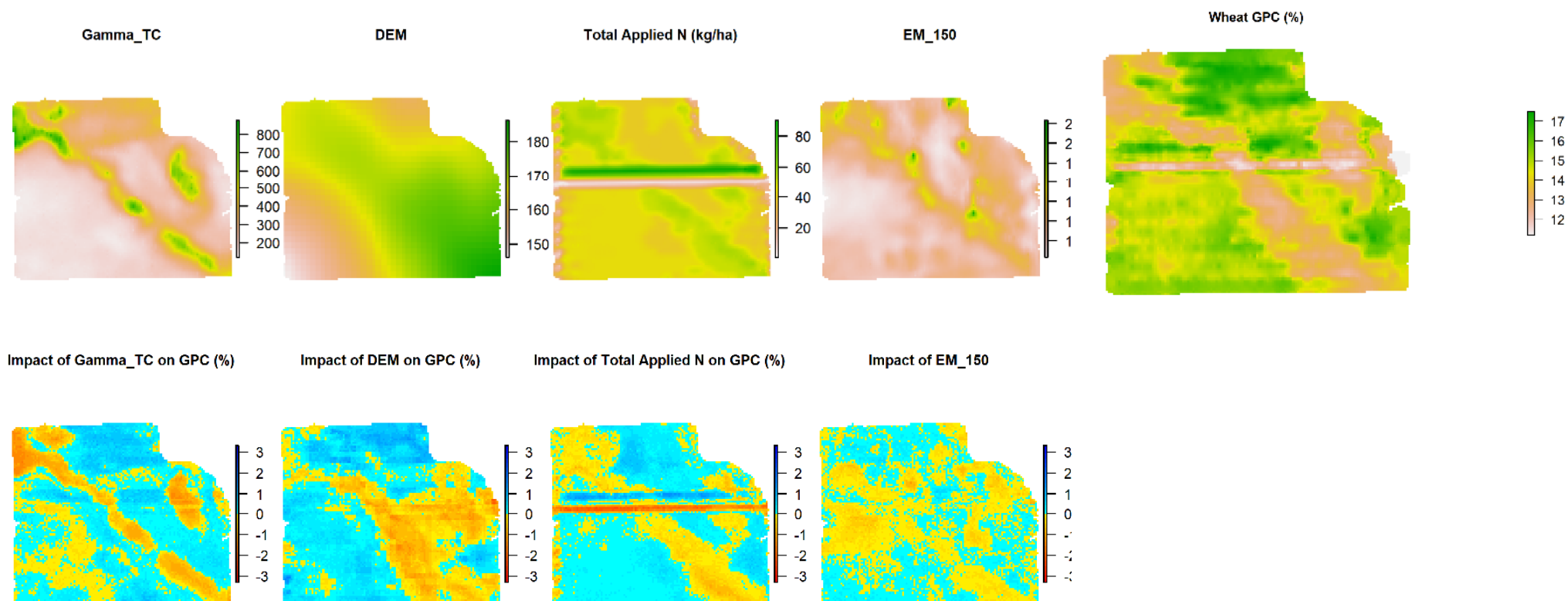


---

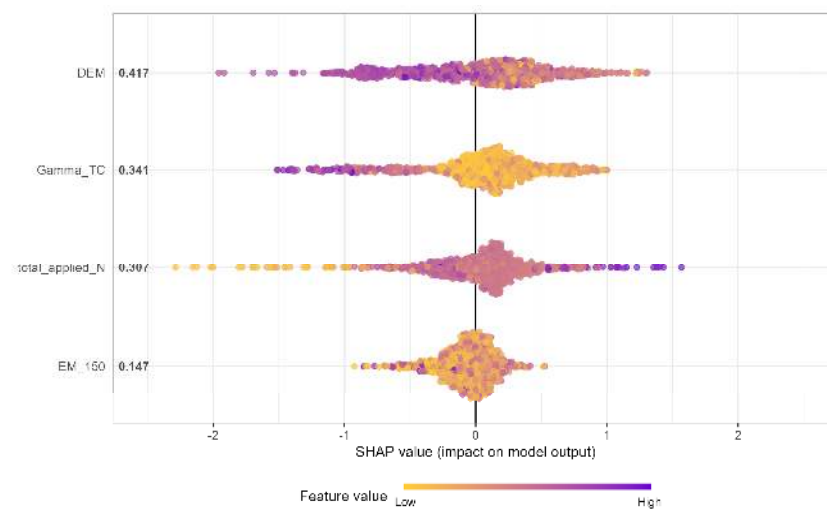
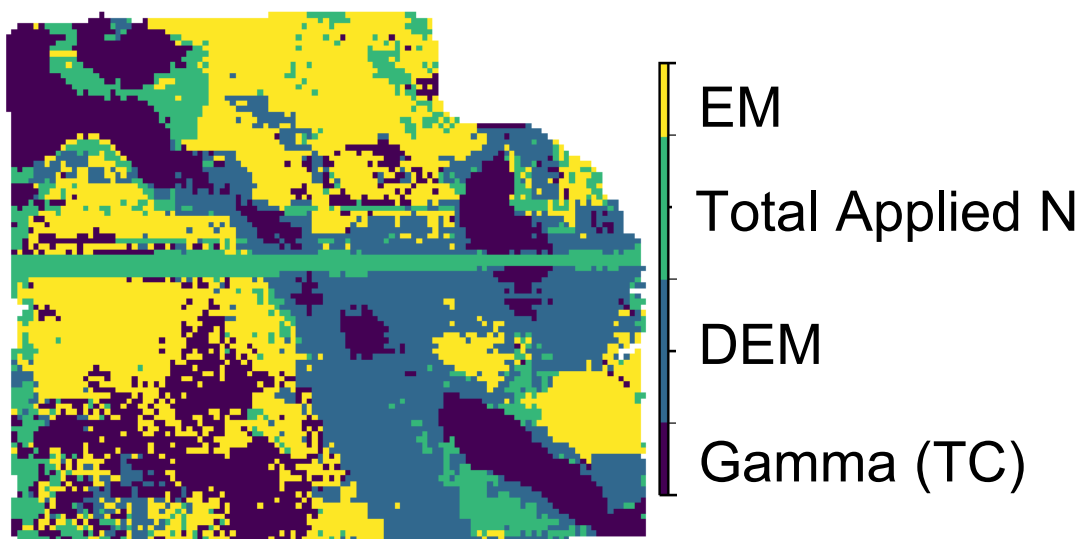
# Impact of variables on grain protein content



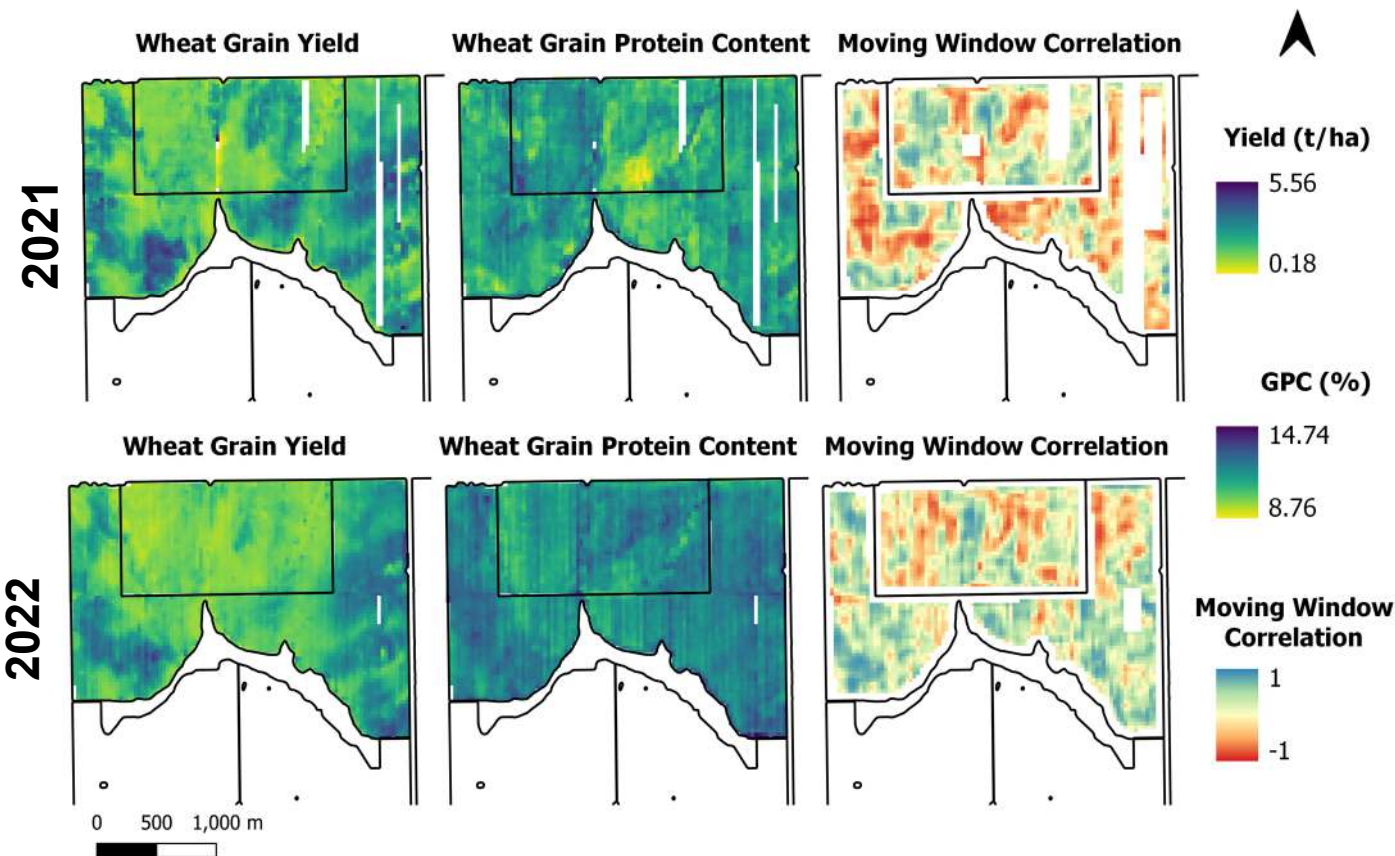
# Impact of variables on grain protein content



# Impact of variables on grain protein content



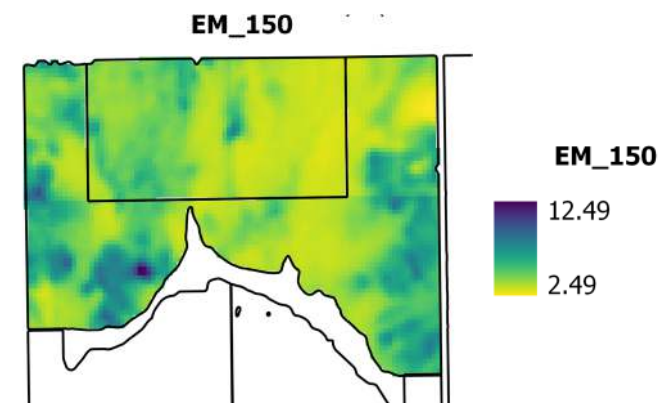
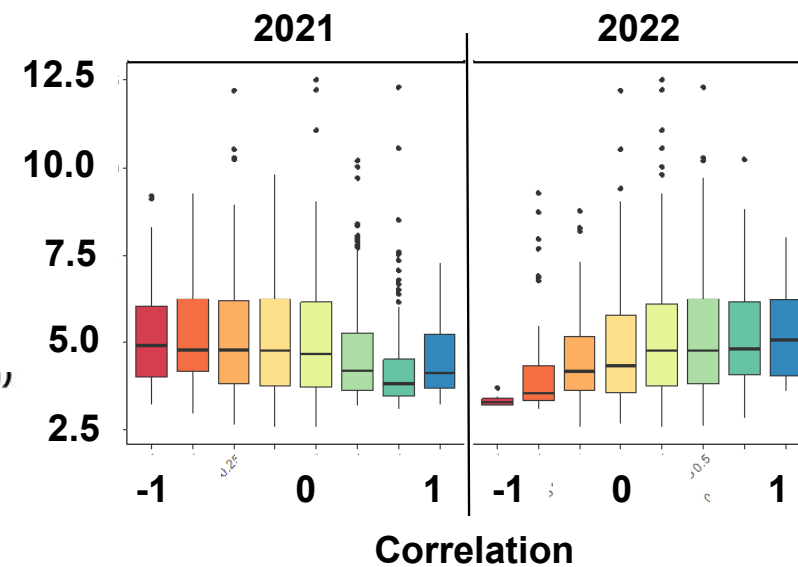
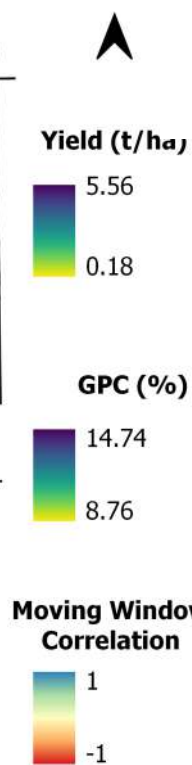
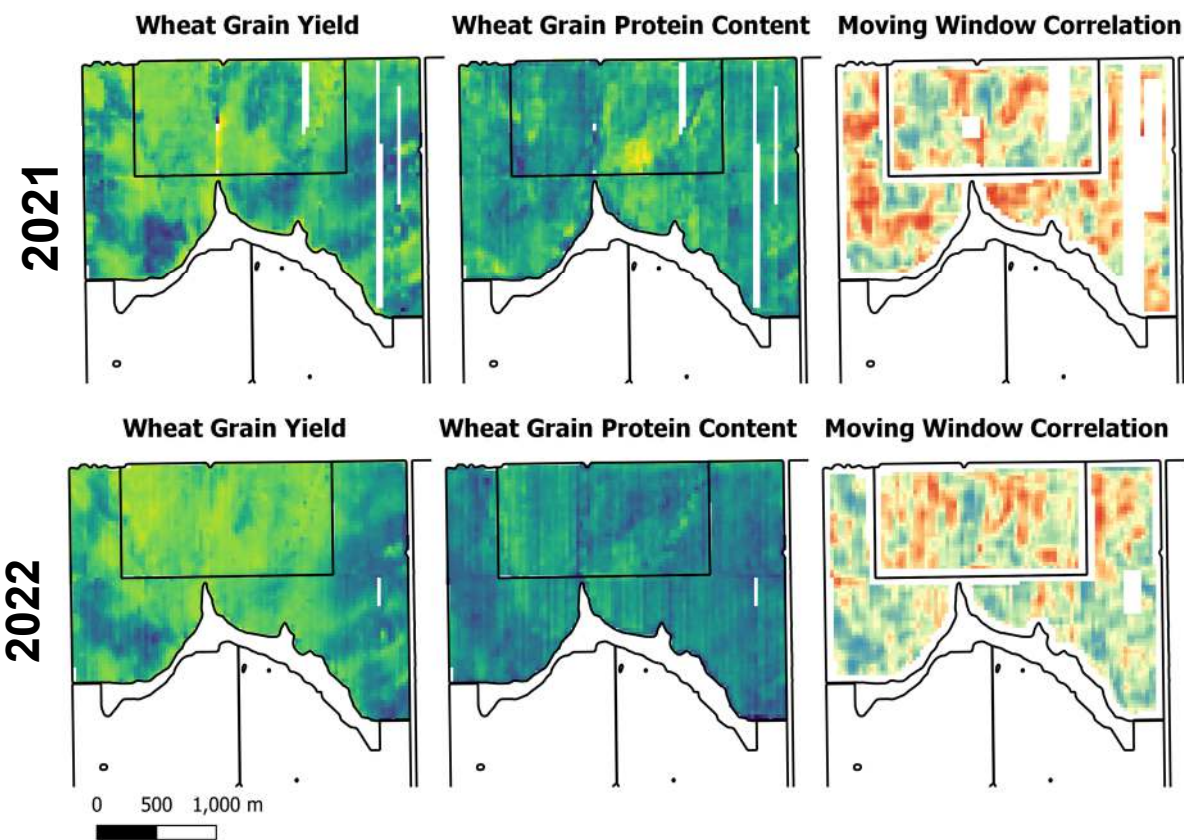
## 2) Understand the drivers



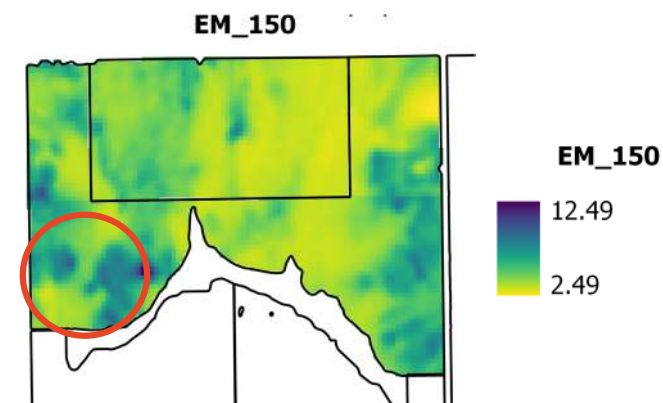
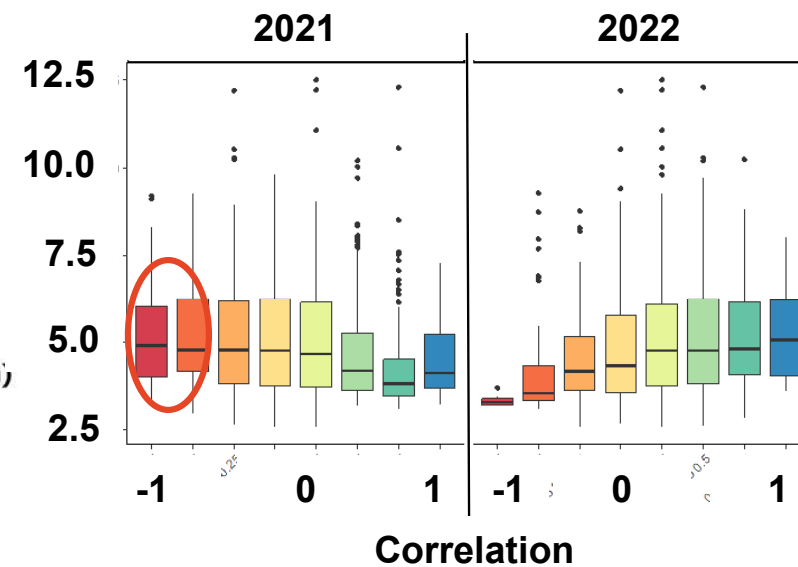
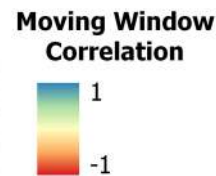
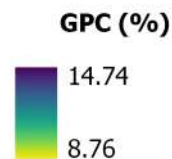
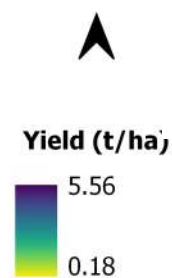
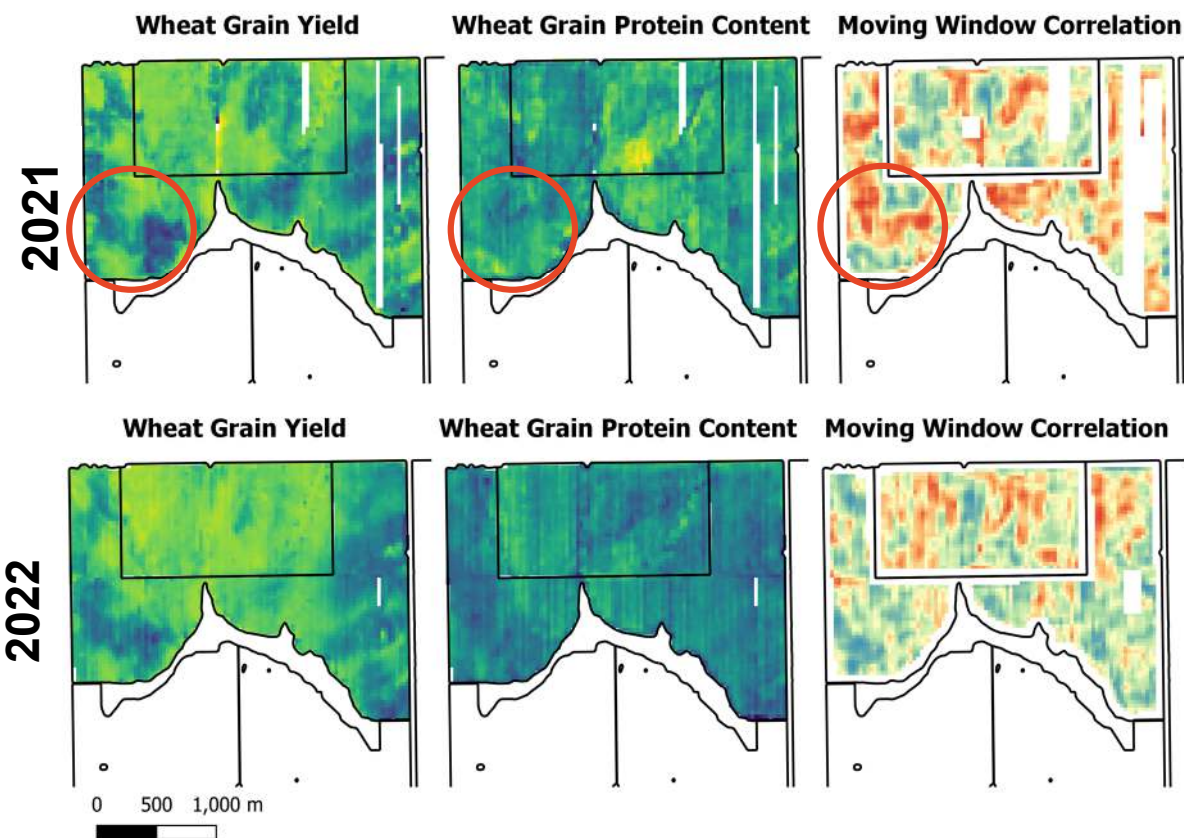
Yield-protein relationship is variable through space and time

- Key drivers:*
- *Nitrogen*
  - *Soil moisture*

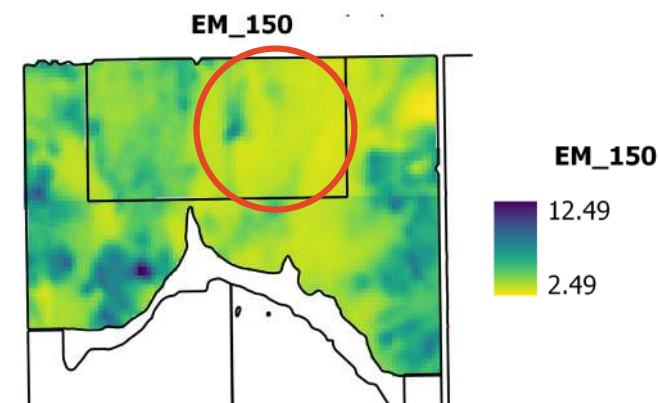
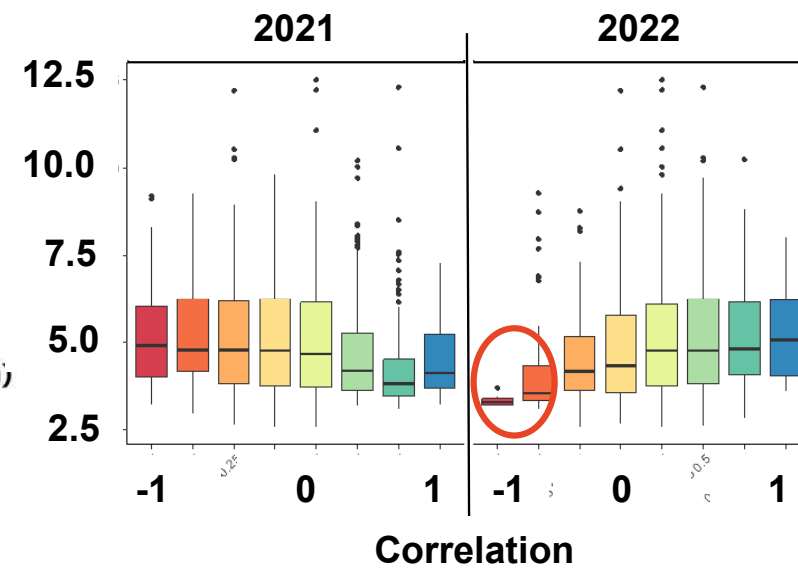
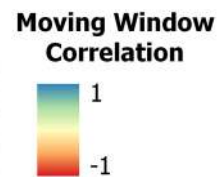
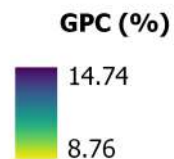
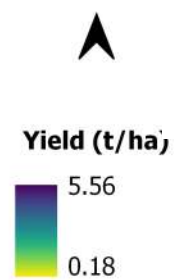
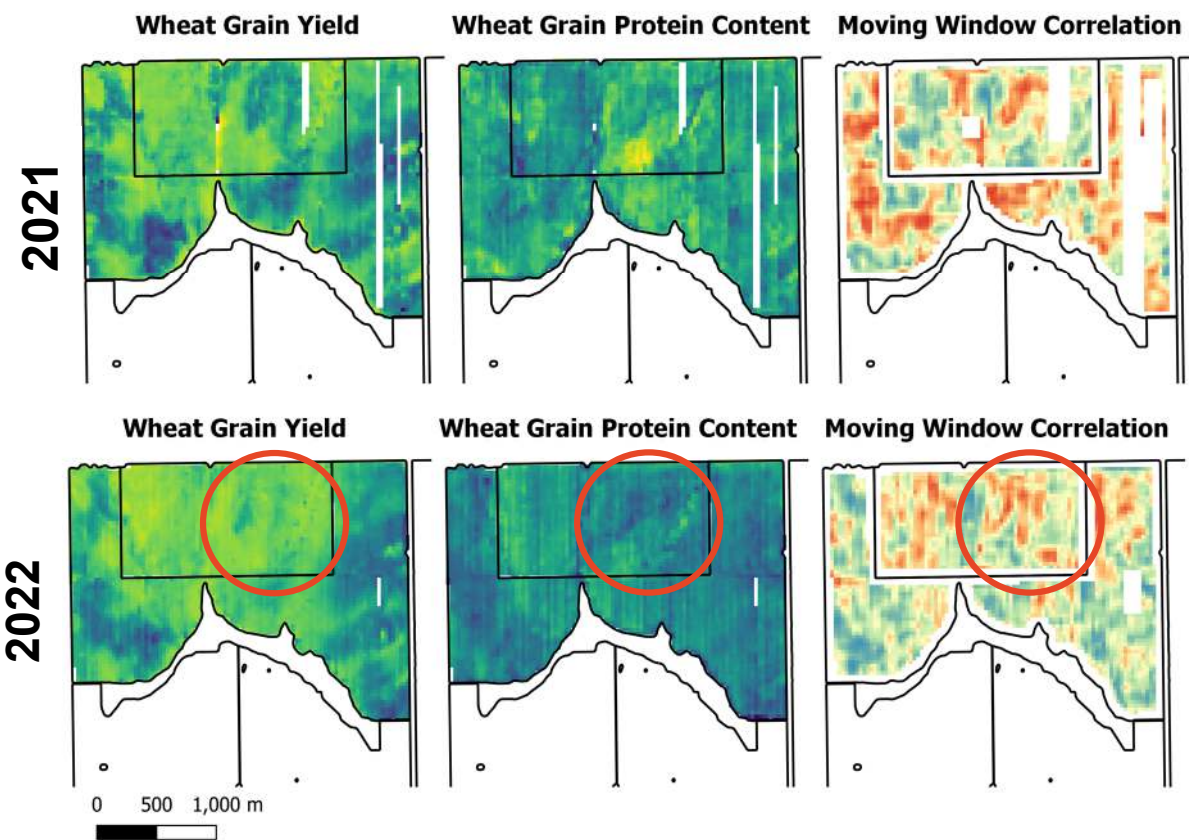
## 2) Understand the drivers



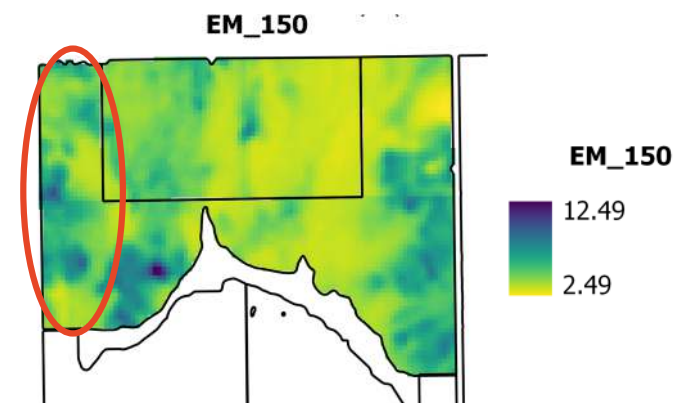
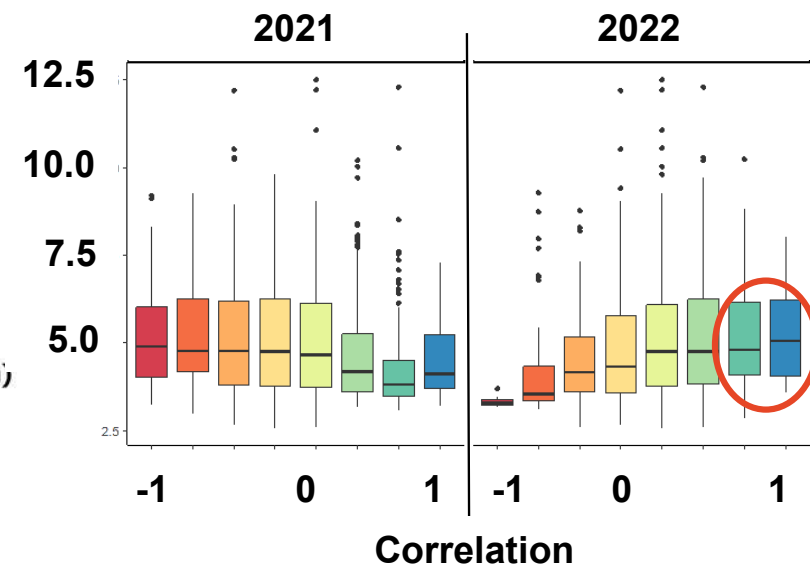
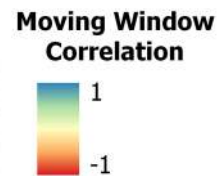
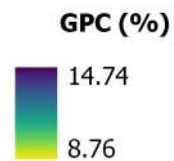
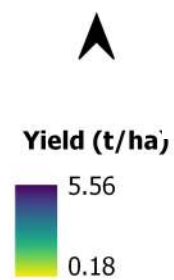
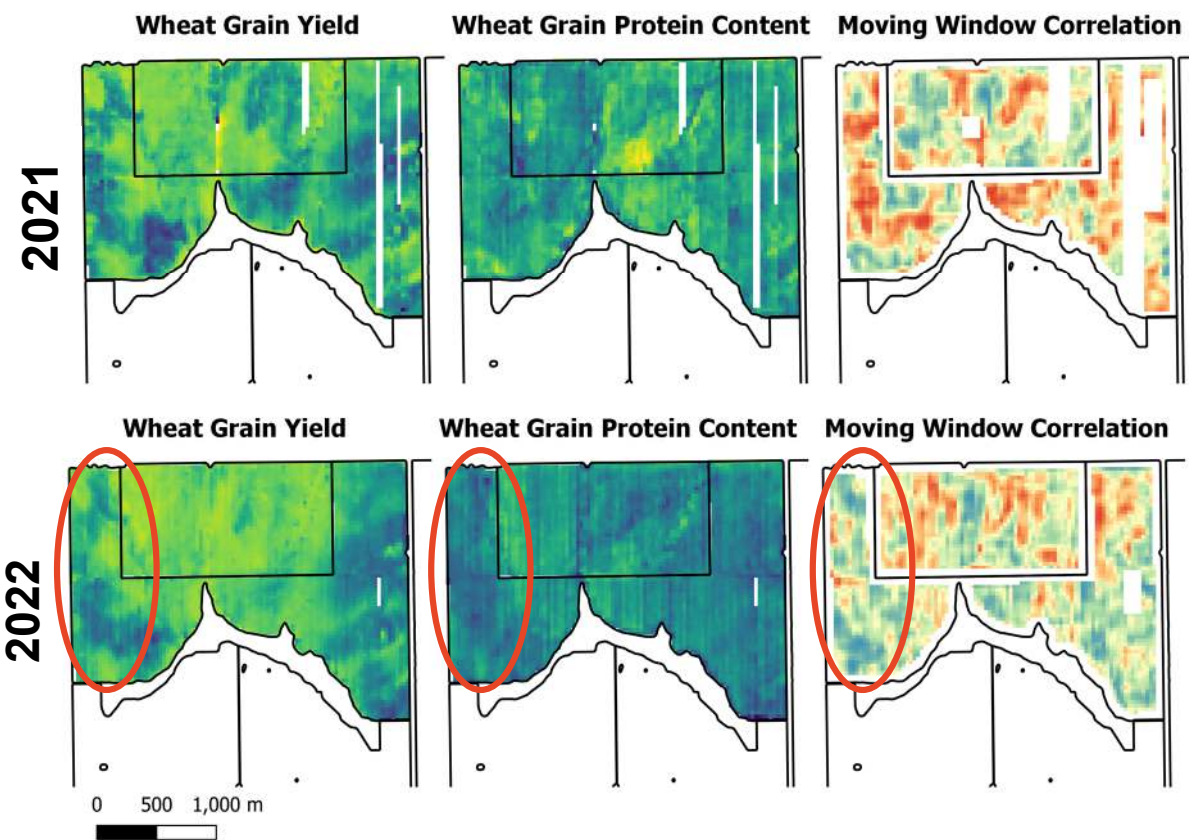
## 2) Understand the drivers



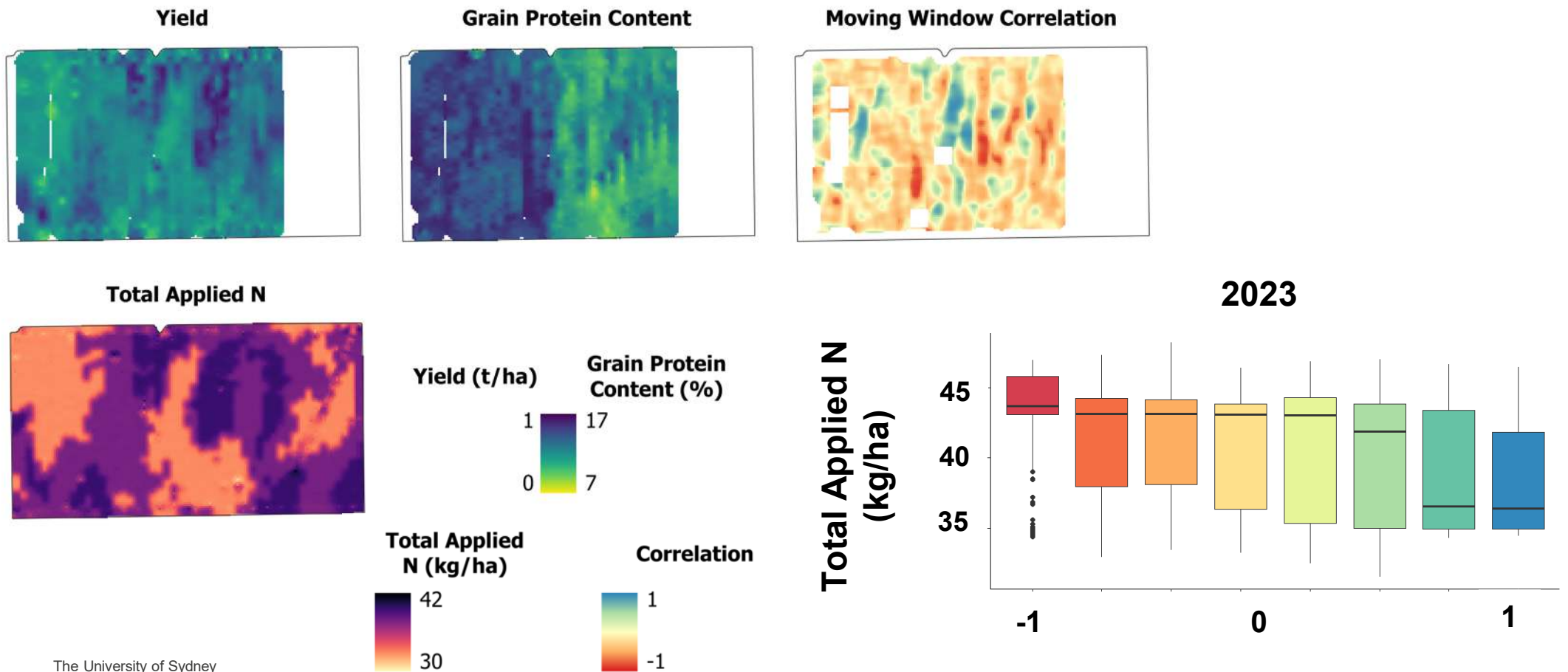
## 2) Understand the drivers



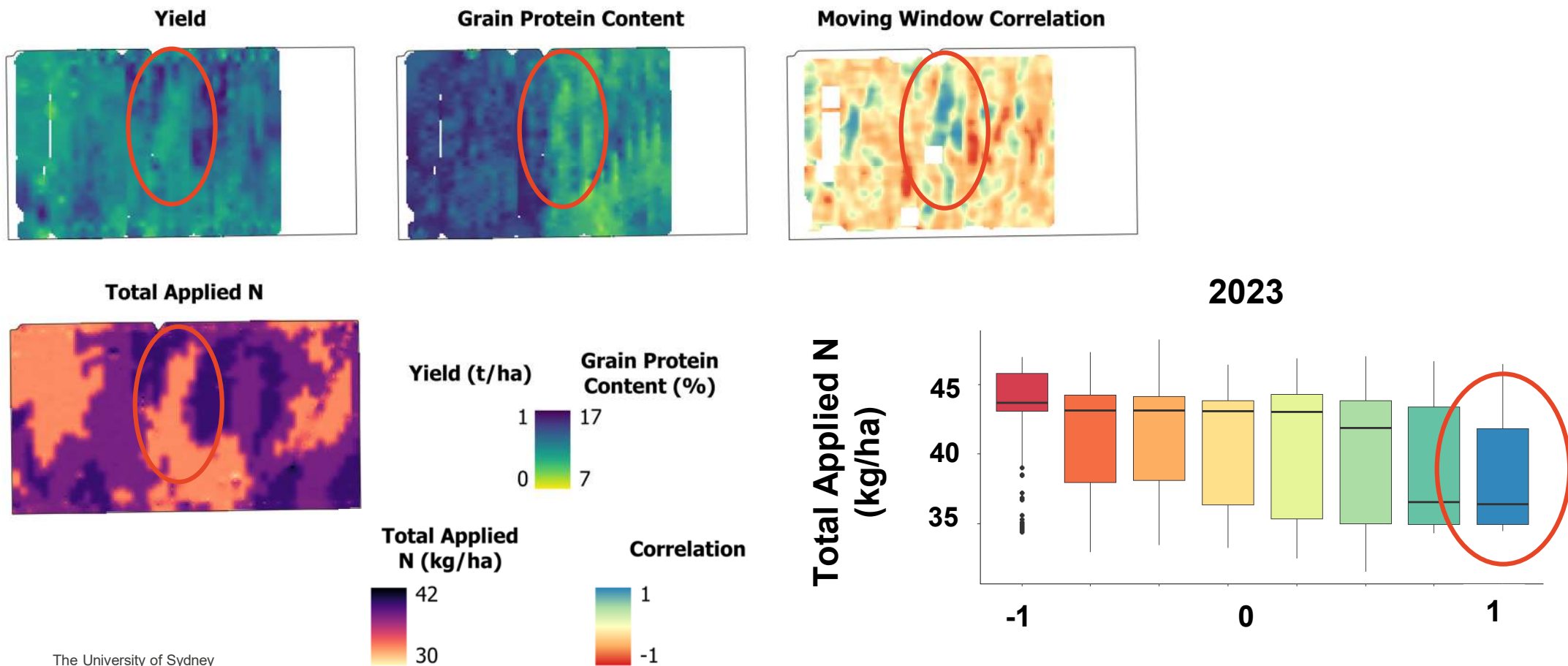
## 2) Understand the drivers



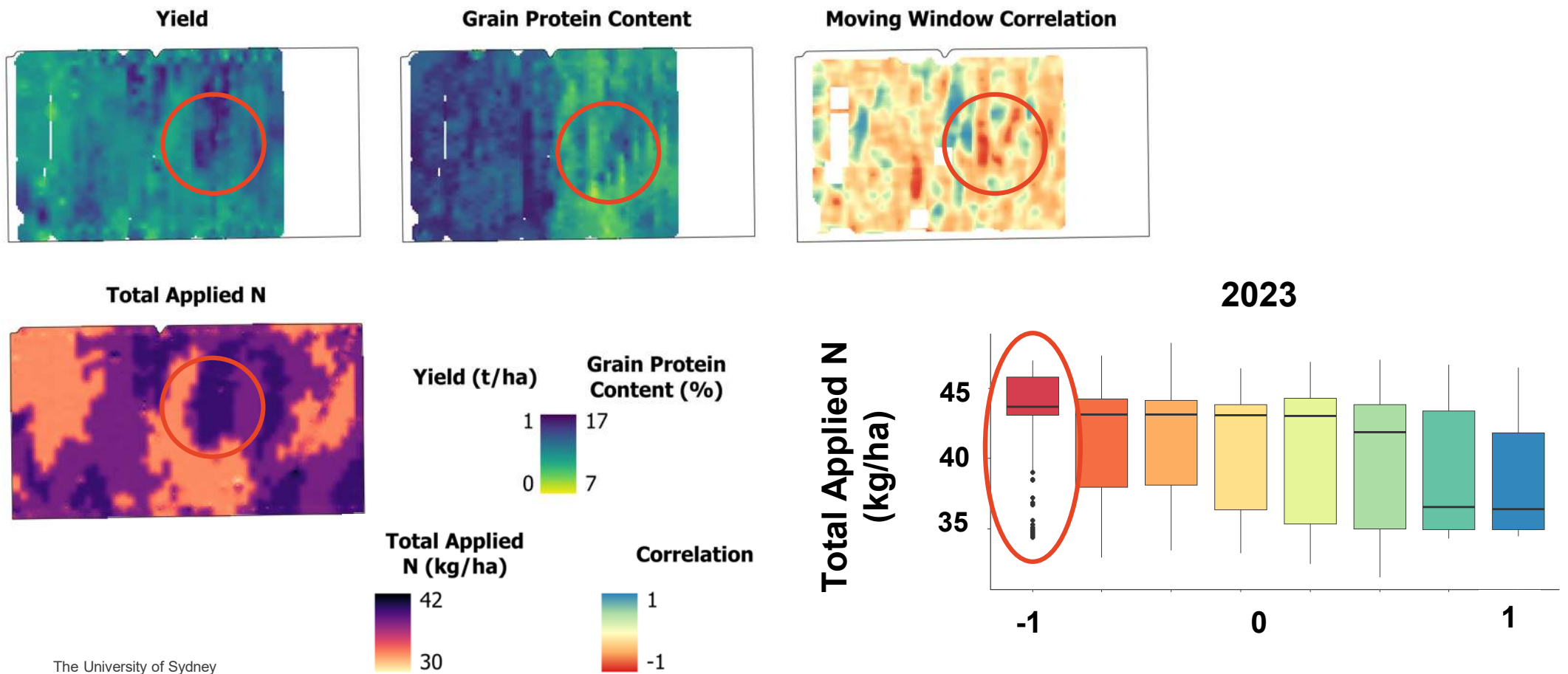
## 2) Understand the drivers of the yield-protein relationship



## 2) Understand the drivers of the yield-protein relationship



## 2) Understand the drivers of the yield-protein relationship



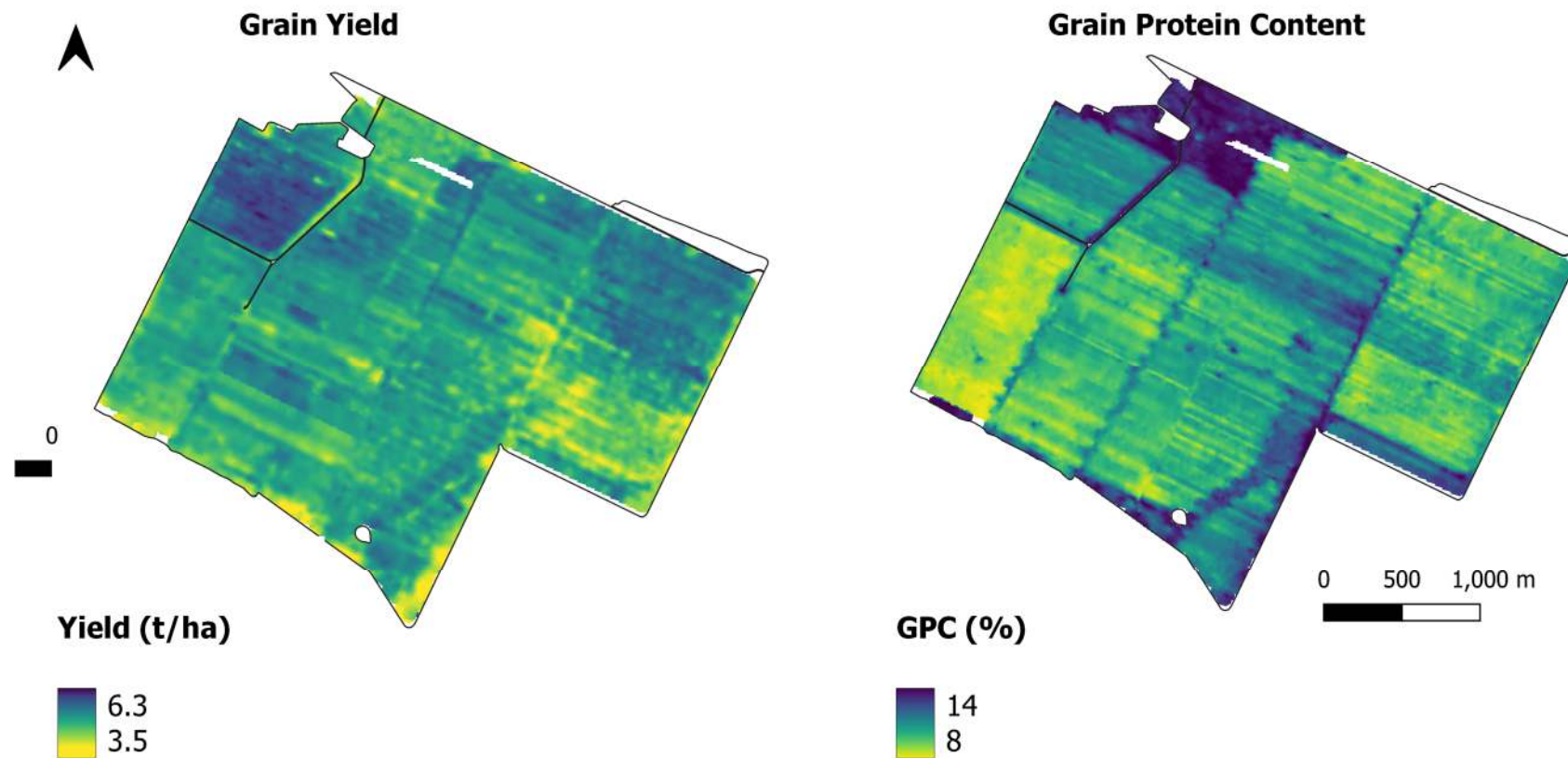
---

## Decoding the protein puzzle

1. Map yield x protein moving window correlations
2. Understand the drivers of the yield-protein relationship
3. Assess the implications for management decisions

---

### 3) Assess implications for management decisions



---

## What's next?

- What does the correlation between yield and protein actually mean?
- Can we use IML to understand the yield-protein relationship?
- New/alternate data layers and methods:
  - More fields, more farms, more seasons – long-term variability
  - What can be done with existing on-farm/public data?
  - Field trials
- Implementation in decision making:
  - How can we utilise protein maps to make decisions?
  - Long-term N management and protein?

# Decoding the Protein Puzzle: Understanding Variability in Grain Protein Content

Mikaela Tilse (Presenter, PhD Candidate, [mikaela.tilse@sydney.edu.au](mailto:mikaela.tilse@sydney.edu.au))

Thomas FA Bishop

Patrick Filippi

*Precision Agriculture Laboratory, Sydney Institute of Agriculture*



THE UNIVERSITY OF  
**SYDNEY**

The University of Sydney

