WUR SCIENTIFIC MACHINE LEARNING NETWORK
(JANUARY 2024)

DATA SCIENCE IN AGRICULTURE

Data Science and Crop Mapping in Southern Brazil

PhD in Agricultural Engineering

MBA in Data Science and Artificial Intelligence

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Data Science in Agriculture DSA - YouTube

Agenda

- Big Topics
  - Data Science for general purposes
  - Data Science for agriculture
- Applications in Agriculture
- Conclusions
- References

Big Topics

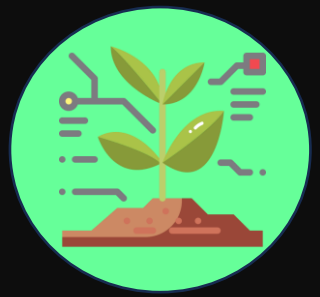
Big data

Internet of things

Cloud computing

Artificial intelligence

Crop modeling

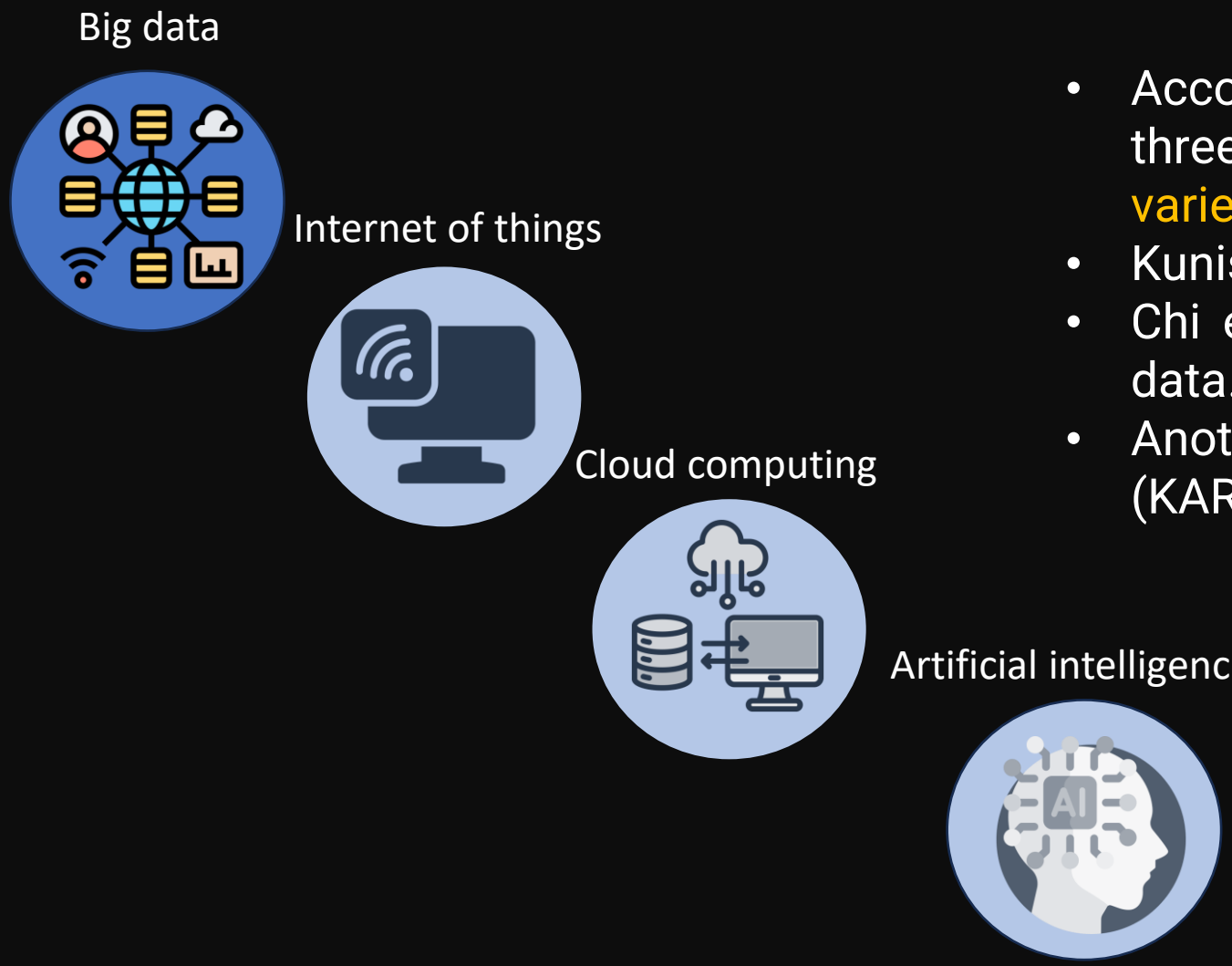


Remote sensing

Precision agriculture

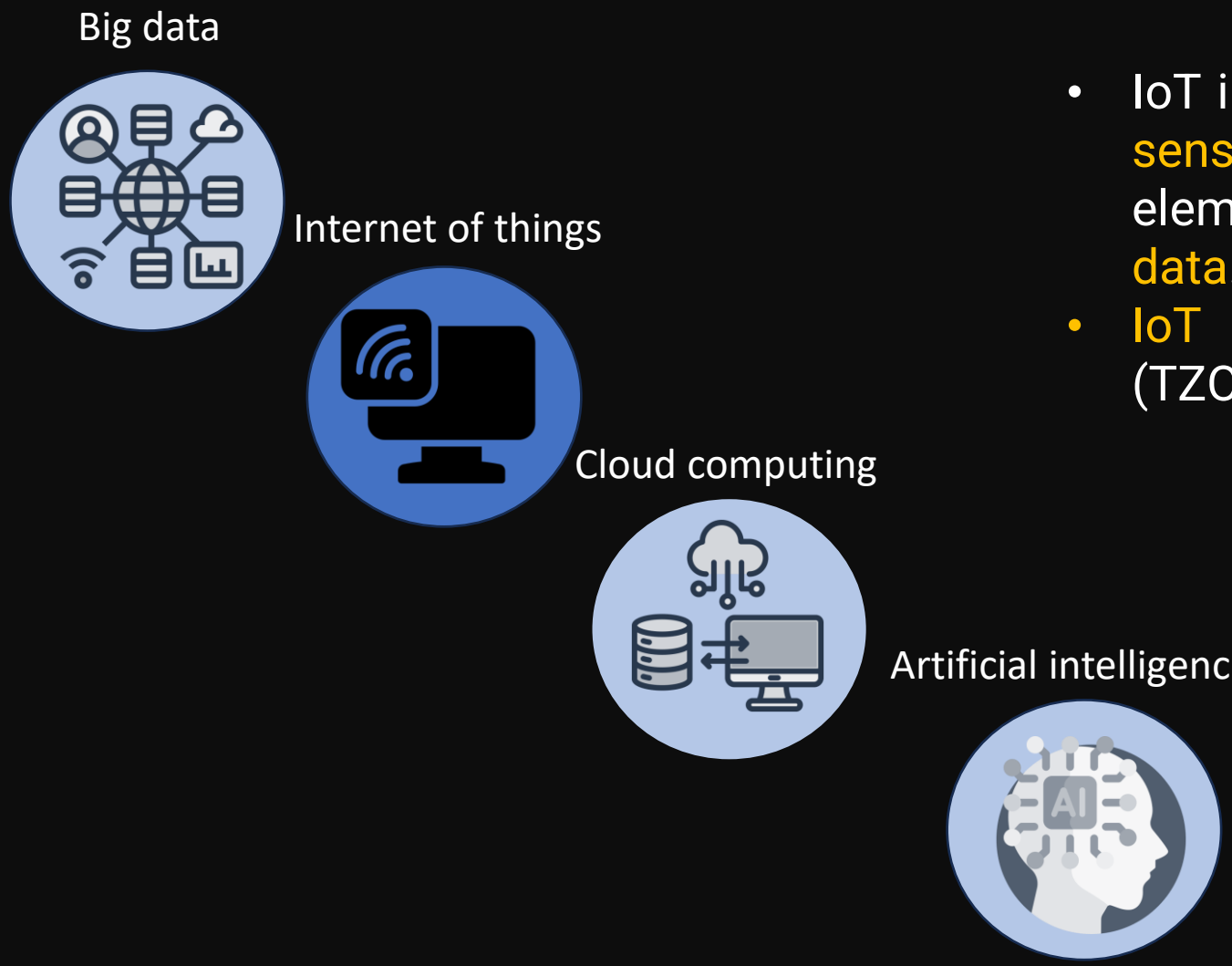
Digital agriculture

Data Science for general purposes – Big Data



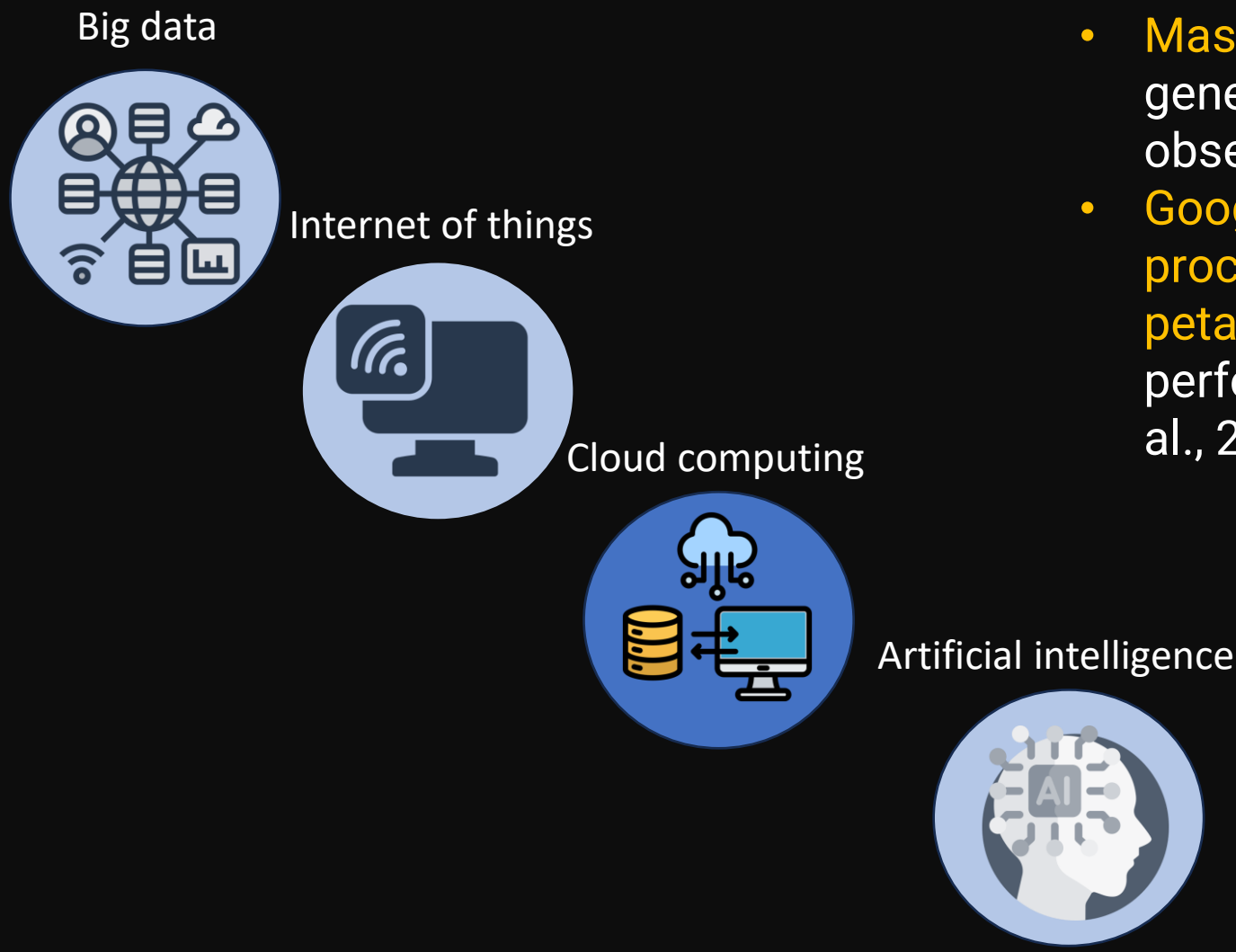
- According to Laney (2001), the term big data has three dimensions ("3V"): volume, velocity, and variety.
- Kunisch (2016) added a fourth "V" for veracity.
- Chi et al. (2016) added a fifth "V" to value the data.
- Another relevant "V" could be visualization (KARMAS et al., 2016).

Data Science for general purposes – Internet of things



- IoT in an agricultural context refers to the use of sensors and other devices to transform every element and action involved in agriculture into data.
- IoT drives the digitalization of agriculture (TZOUNIS et al., 2017).

Data Science for general purposes – Cloud computing



- Massive growth in the scale of data or big data generated through cloud computing has been observed (HASHEM et al., 2015).
- Google Earth Engine (GEE) enables cloud access, processing, and analysis, consisting of a multi-petabyte catalog of data along with a high-performance computing service (GORELICK et al., 2017).

Data Science for general purposes – Artificial Intelligence

Big data

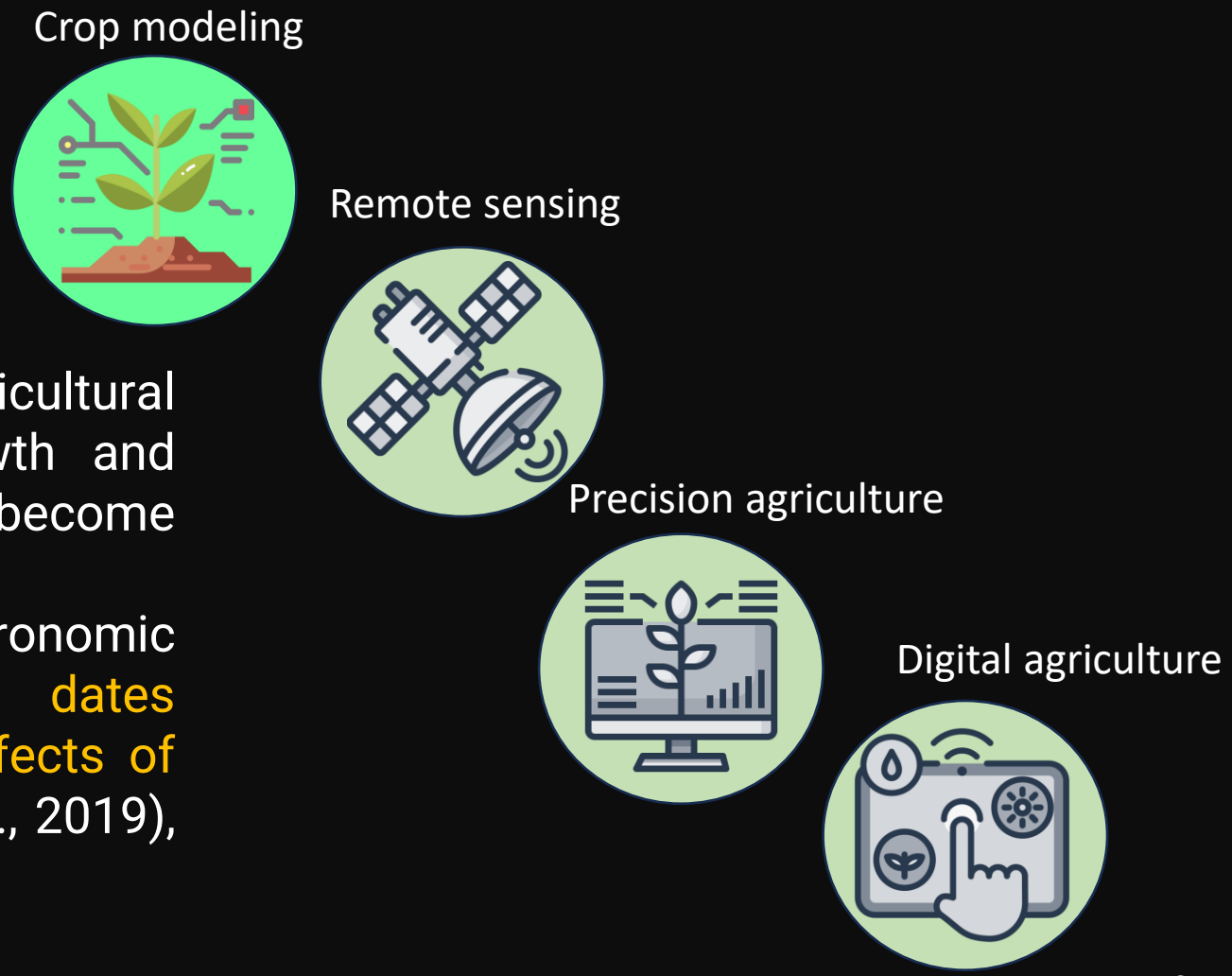
Internet of things

Cloud computing

Artificial intelligence

- Artificial intelligence is a comprehensive field of study, involving robotics, machine learning techniques, deep learning, which began in the 1940s, when the first artificial neural network was described.
- The field of study incorporates several areas of study, but mainly programming, mathematics, and statistics.

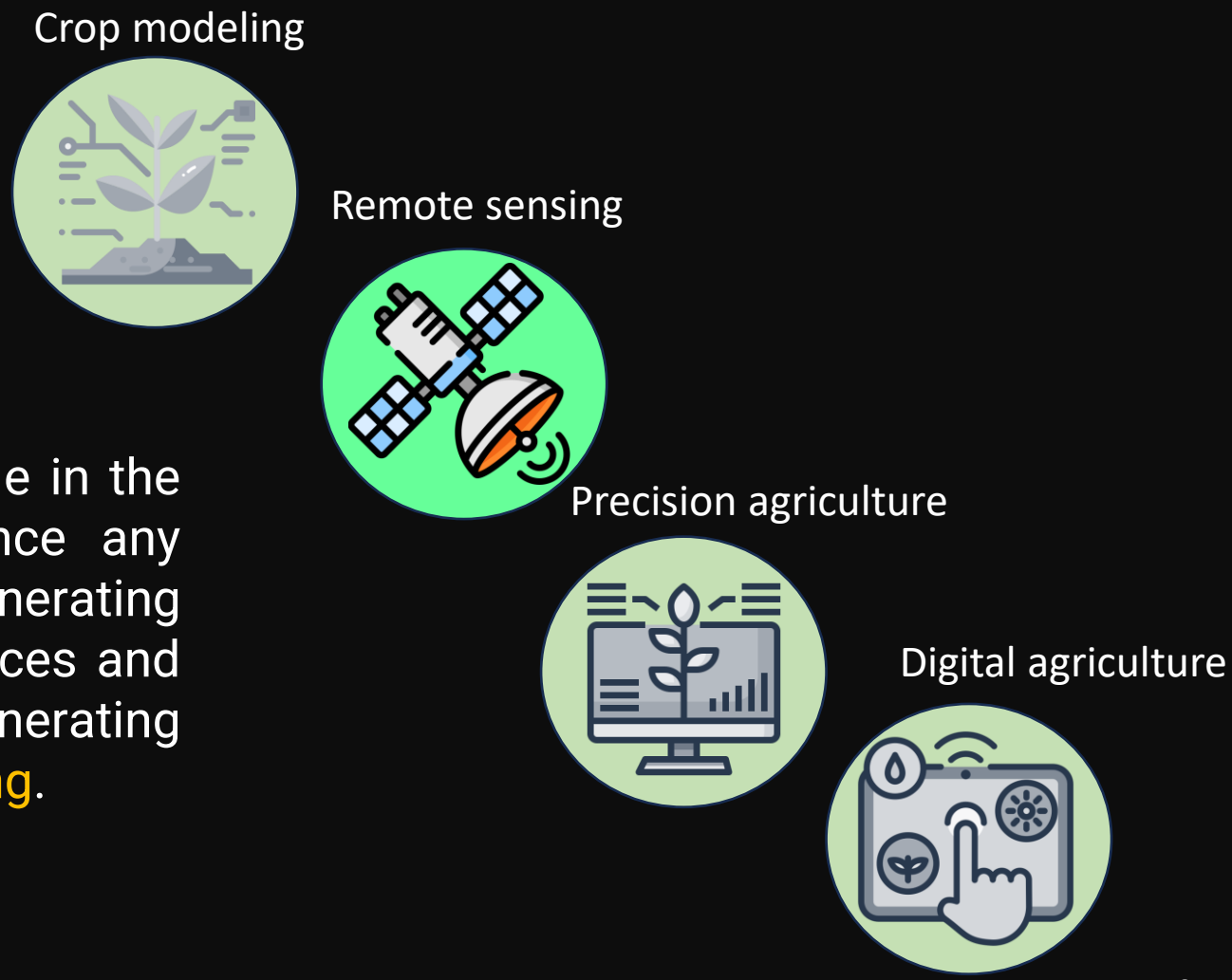
Data Science for agriculture – Crop modeling



- In the era of data-driven agriculture, agricultural crop modeling to generate crop growth and development simulations has become widespread.
- In this context, there are studies with agronomic performance at the best planting dates (BATTISTI & SENTELHAS, 2014), the effects of climate change on productivity (JIN et al., 2019), and predicting yield (DEINES et al., 2020).

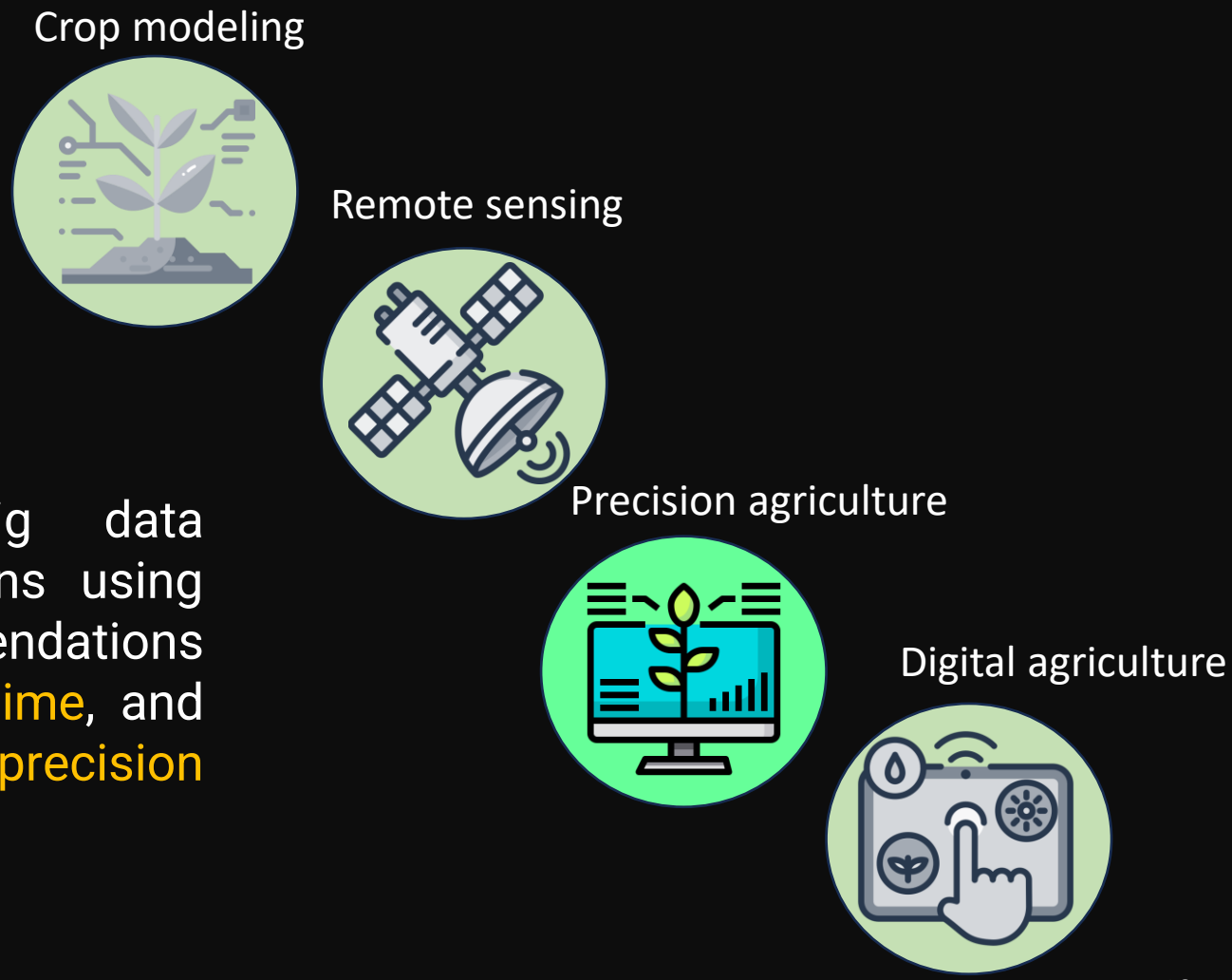
Data Science for agriculture– Remote Sensing

- Remote sensing plays a fundamental role in the advancement of digital agriculture, since any agricultural plot can be accessed by generating vegetation indices that highlight differences and highlight knowledge capable of generating information to data-driven decision-making.



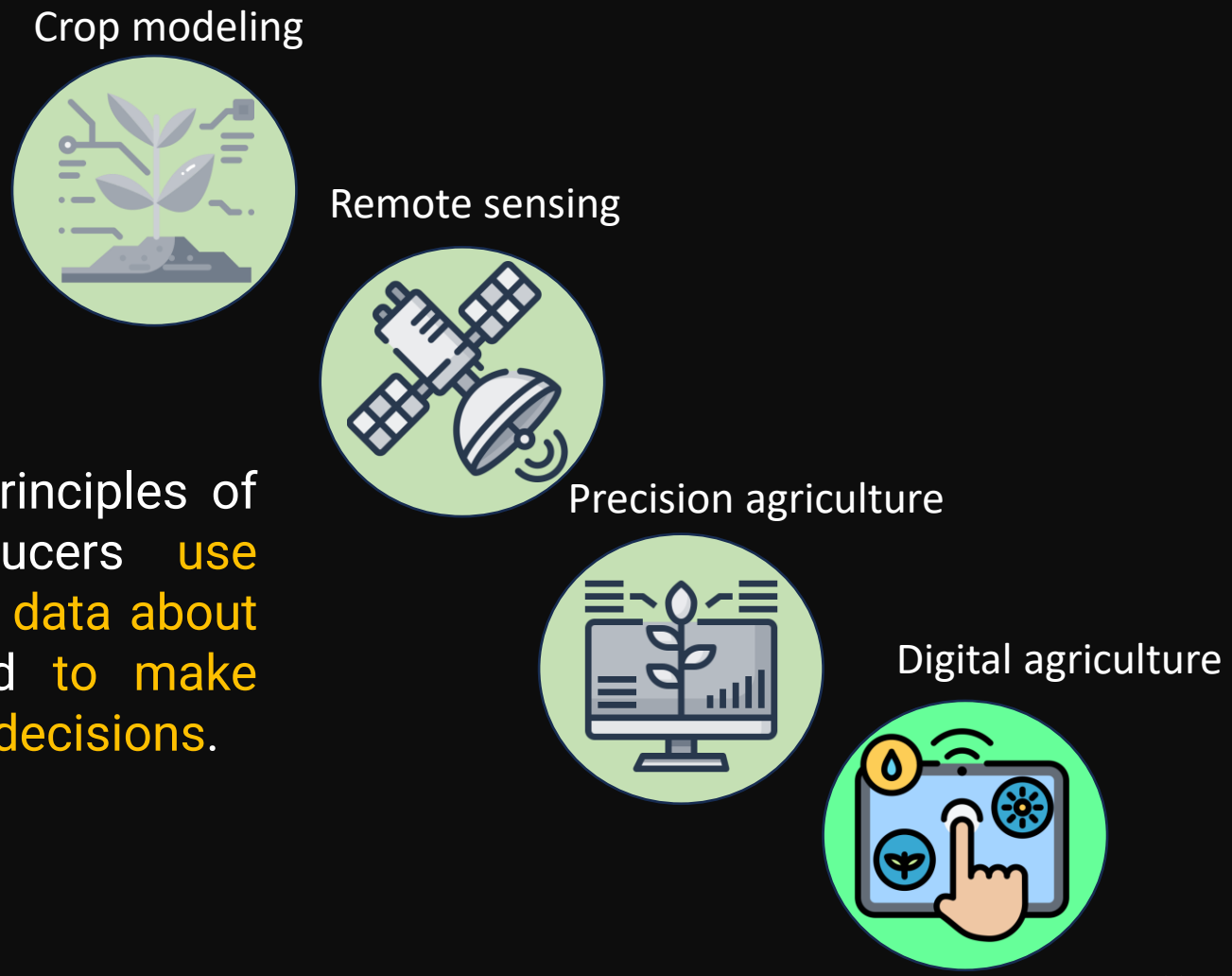
Data Science for agriculture– Precision Ag.

- Data-driven agriculture uses big data techniques to make better decisions using agricultural data to generate recommendations for input use at the right location, time, and amounts, adding to the philosophy of precision agriculture.



Data Science for agriculture– Digital Ag.

- Digital agriculture is based on the principles of precision agriculture, where producers use systems and platforms that generate data about their lots, which will be processed to make appropriate strategic and operational decisions.

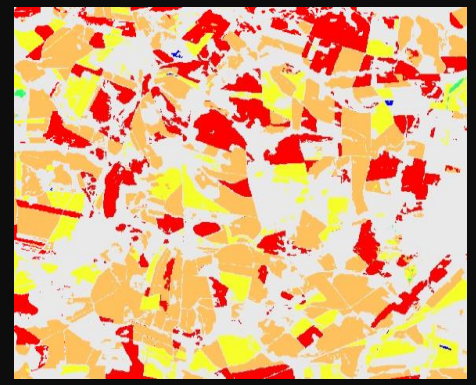


Applications in Agriculture

Satellite-based data fusion crop type classification and mapping in Rio Grande do Sul, Brazil.

Crop type classification in Southern Brazil: Integrating remote sensing, crop modeling and machine learning.

Mapping crop rotation by satellite-based data fusion in Southern Brazil.



Study 1

Satellite-based data fusion crop type classification and mapping in Rio Grande do Sul, Brazil

- Objective of the study:

  Develop a crop classification model to map and estimate the soybean, maize, and rice crop area in the state of Rio Grande do Sul, Brazil.

Materials and methods:

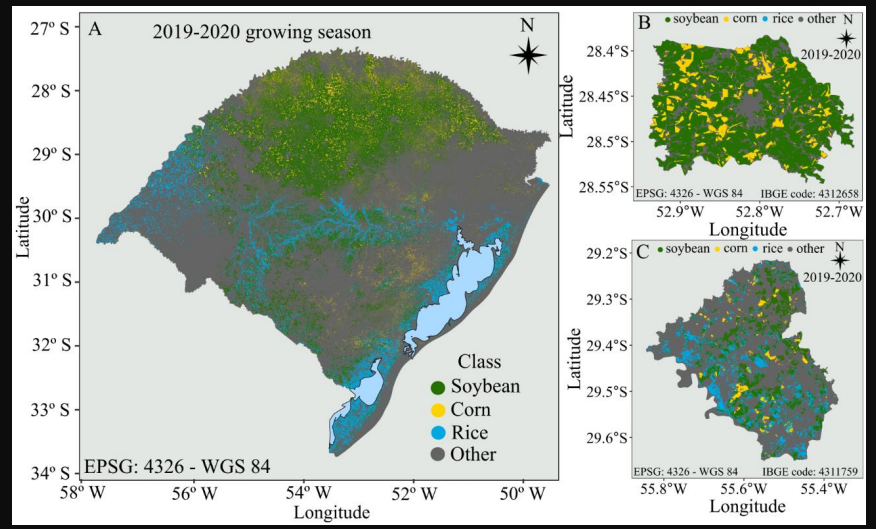
Use of satellite imagery from Sentinel-2, Sentinel-1 and SRTM digital elevation.

Random forest

R + Python (Rstudio + Google Earth Engine)

Results:

Acuracy of the model was 0.95



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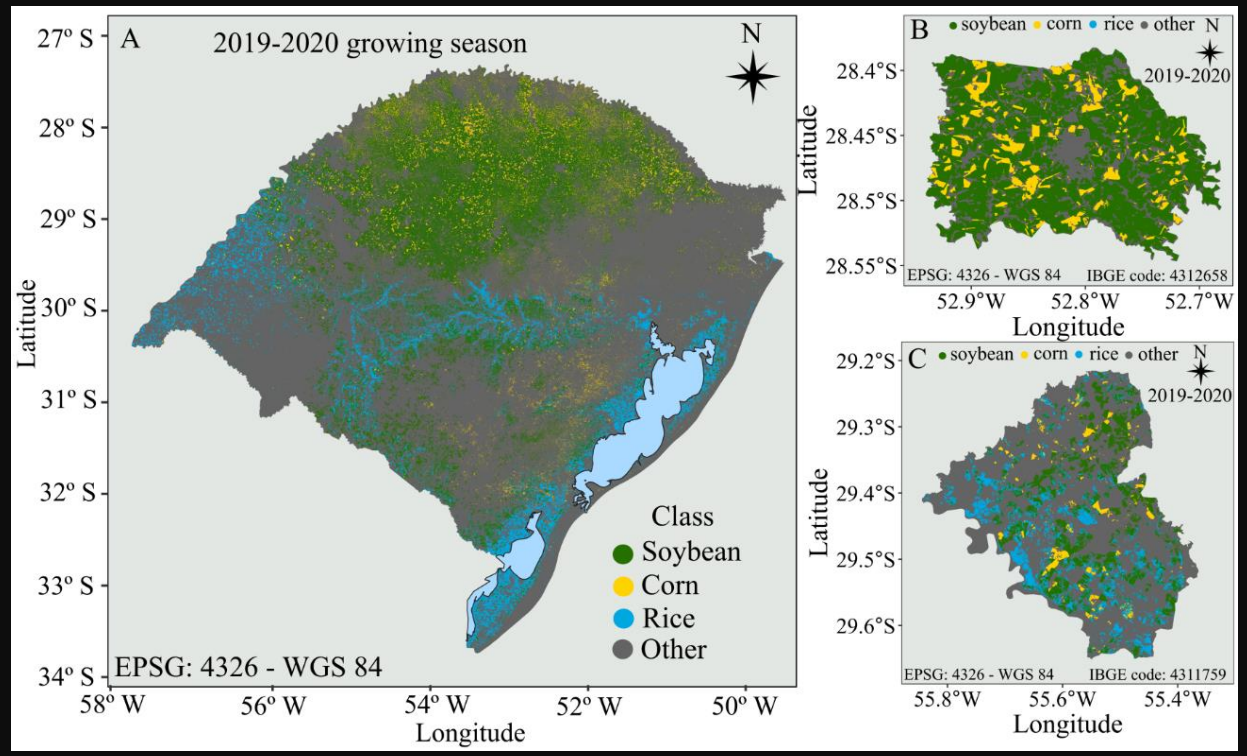


Study 2

Crop type classification in Southern Brazil: Integrating remote sensing, crop modeling and machine learning

- Objective of the study:

Evaluate models of a) unsupervised classification, b) supervised classification with 1-year data, c) with 2-years data, d) supervised classification with crop modeling data, e) supervised with the combination of crop modeling and 1-year data, and (f) 2 years data.

Materials and methods:

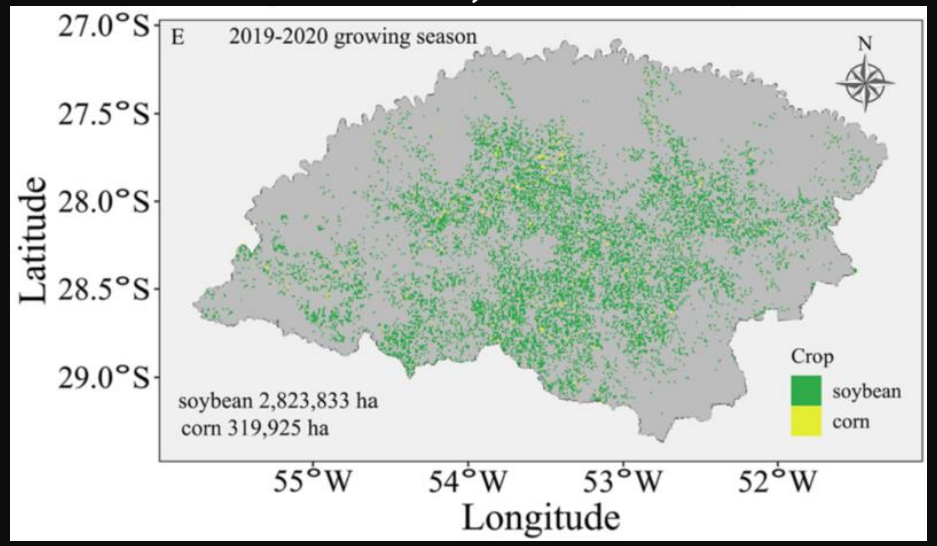
Using satellite imagery from Sentinel-2 and APSIM (conversion of LAI to GCVI)

Random forest

APSIM + R + Python (Rstudio + Google Earth Engine)

Results:

Acuracy of the model was 0.94



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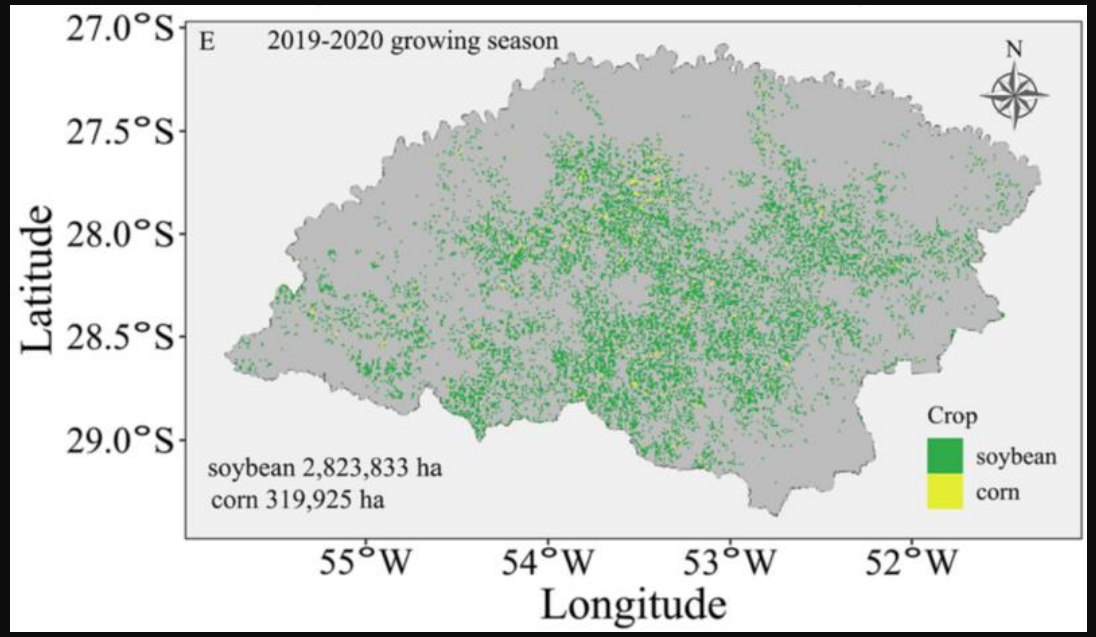
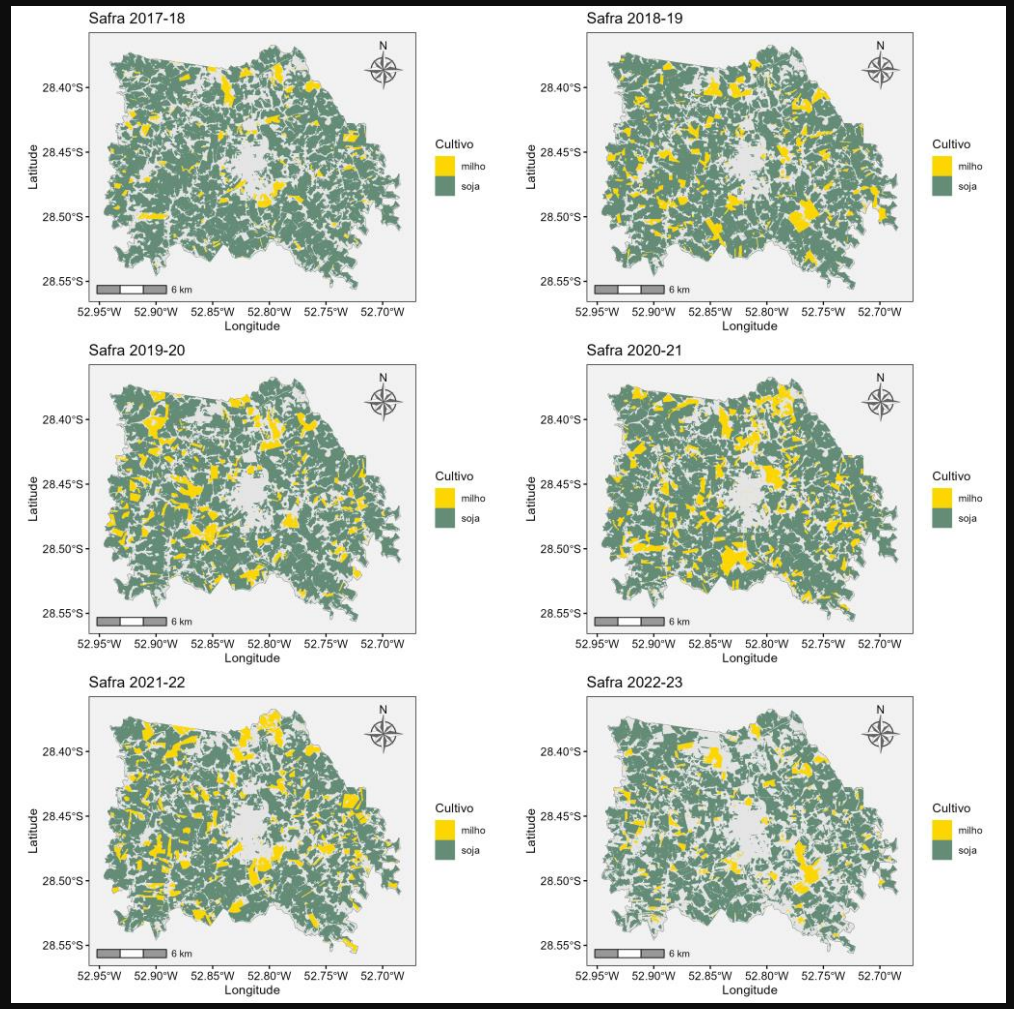




Study 3

Mapping crop rotation by satellite-based data fusion in Southern Brazil

- Objective of the study:

  Generate a satellite-based data fusion approach to map crop rotation at the field scale.

- Materials and methods:

  Use of temporal crop layers associated with data analyses;

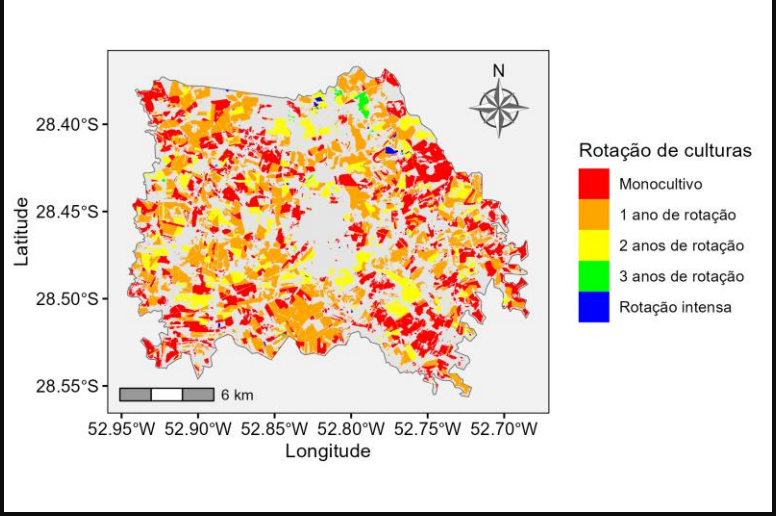
  Crop Layers + Crop field delineation

  R + Python (Rstudio + Google Earth Engine)

Results:

No common rotation usage for Southern Brazil.

Continuous soybean.



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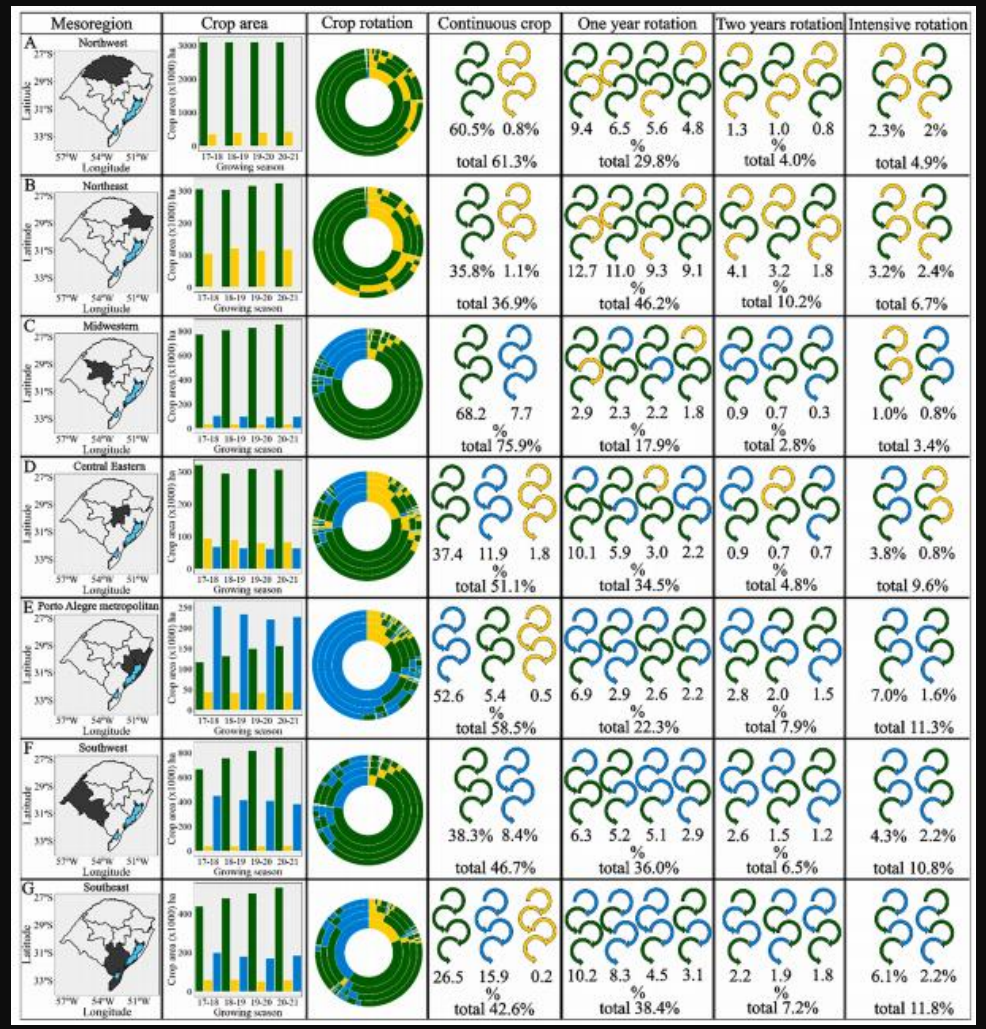

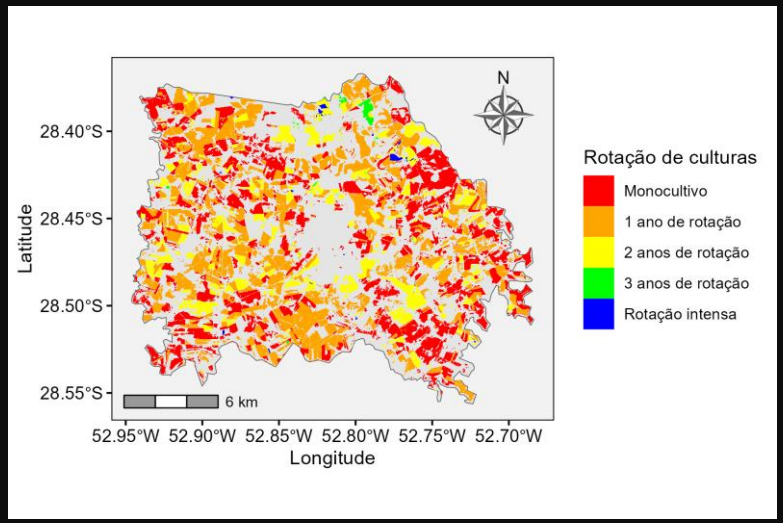

Conclusions

- Data science is rapidly reshaping the agricultural landscape. By harnessing the power of data analytics, farmers can make more informed decisions about crop management, resource allocation, and risk mitigation.

- In addition, data-driven predictive models help farmers anticipate and respond to weather fluctuations, disease problems, and other challenges, improving overall agricultural productivity and sustainability.

- As technology and data sources continue to advance, the role of data science in agriculture is poised to drive innovation and ensure food security for a growing global population.

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Presentation

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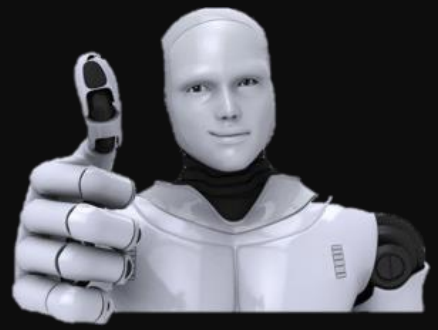
Thank you so much for the invitation!

Joost Iwema

Bernardo Maestrini



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