DILA AG
DIGITALIZATION AND INNOVATION

BOKU
University of Natural Resources and Life Sciences, Vienna

TU WIEN
TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

FORUM MORGEN

vetmeduni vienna

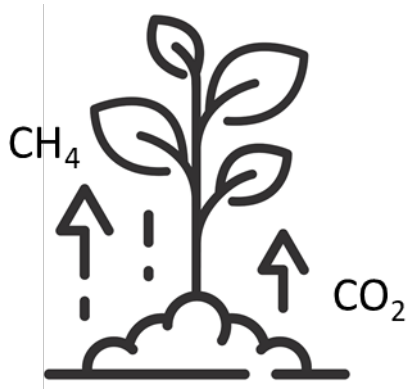
An Environmental Analysis of Precision Agriculture Technologies (PATs)

Name: Francisco Medel

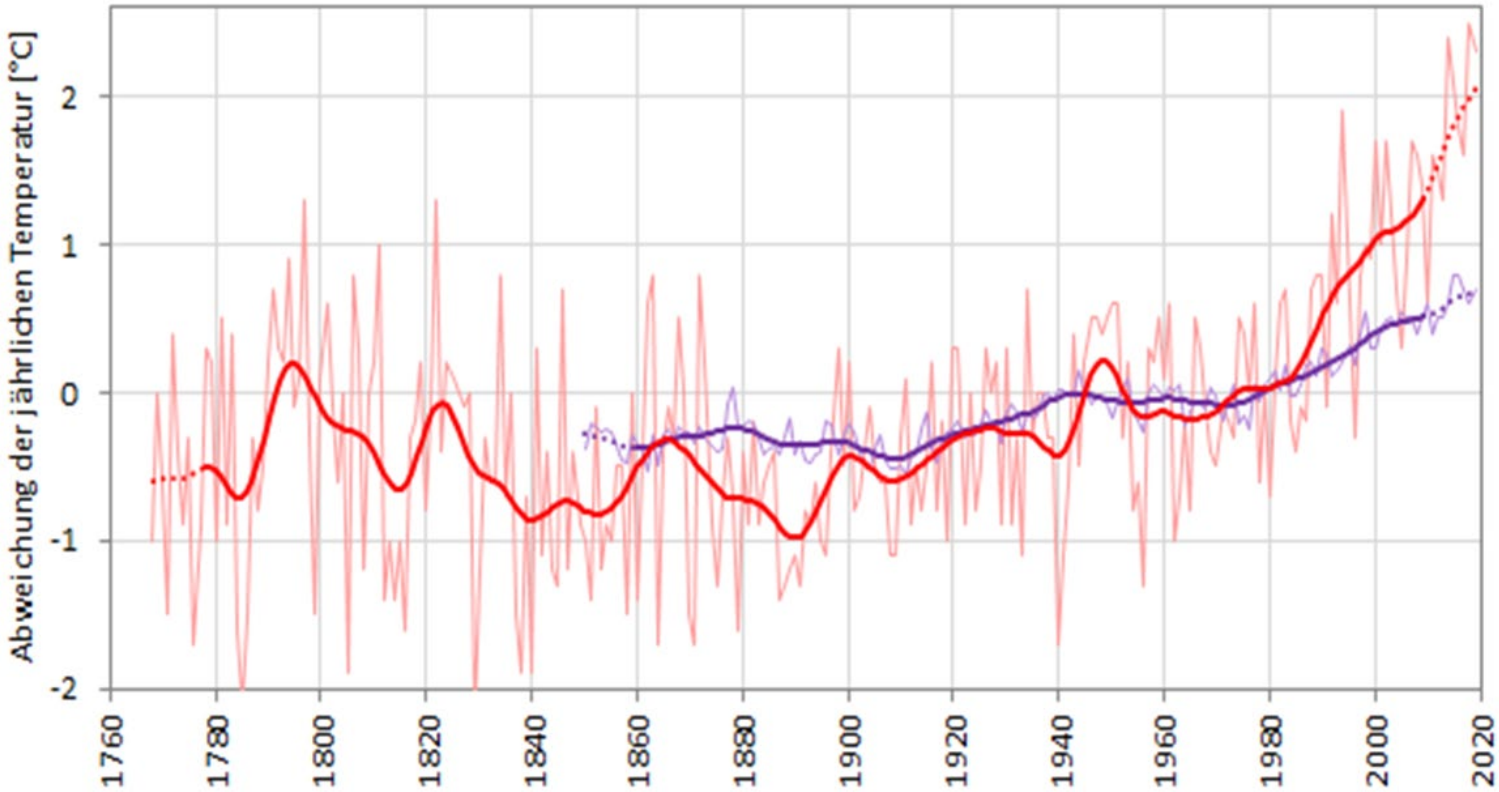
Supervisor: Andreas Gronauer and Iris Kral

Table of Contents:

DILAAG
DIGITALIZATION AND INNOVATION



Deviation of Mean Annual Temperature in Relation to Average Worldwide and in Austria

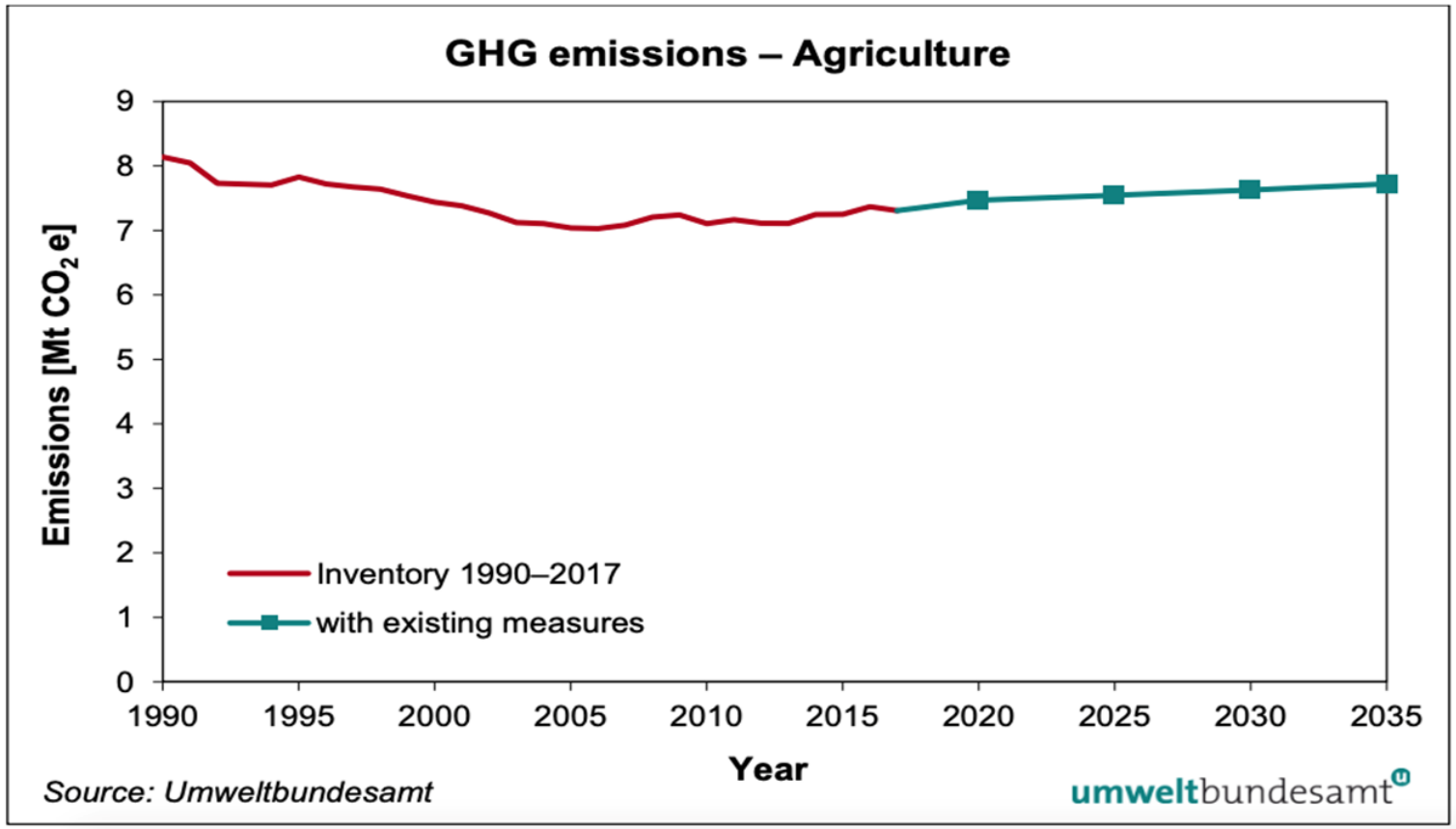


Austria

Worldwide

(Morice et. al. 2021, Auer et. al, 2007).

Greenhouse Gas Emissions in the Agricultural Sector



(Environmental Agency Austria, 2019)

- 8.9% of Austria's total emissions in 2017
- 71% of Austria's total N_2O and CH_4 emissions
- *"Between 2017 and 2035 an increase in emissions by 5.7% can be expected in this sector"*

(Environmental Agency Austria, 2019)

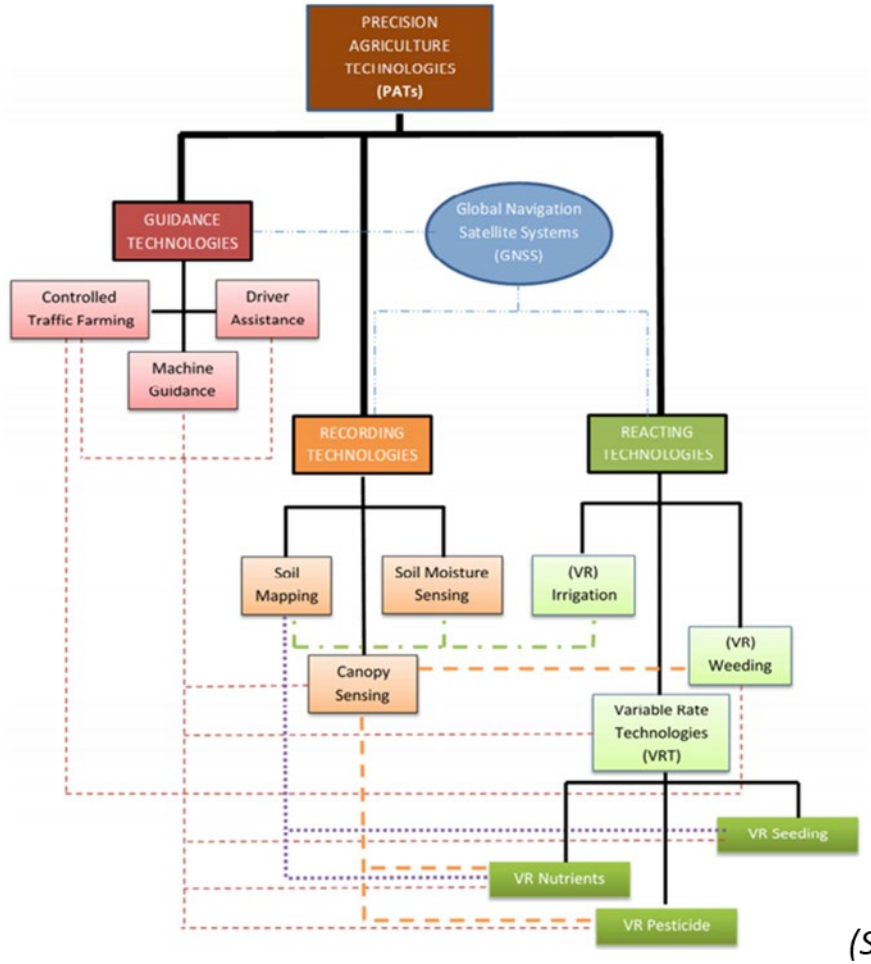
Precision Agriculture Technologies (PATs)

DILAAG
DIGITALIZATION AND INNOVATION

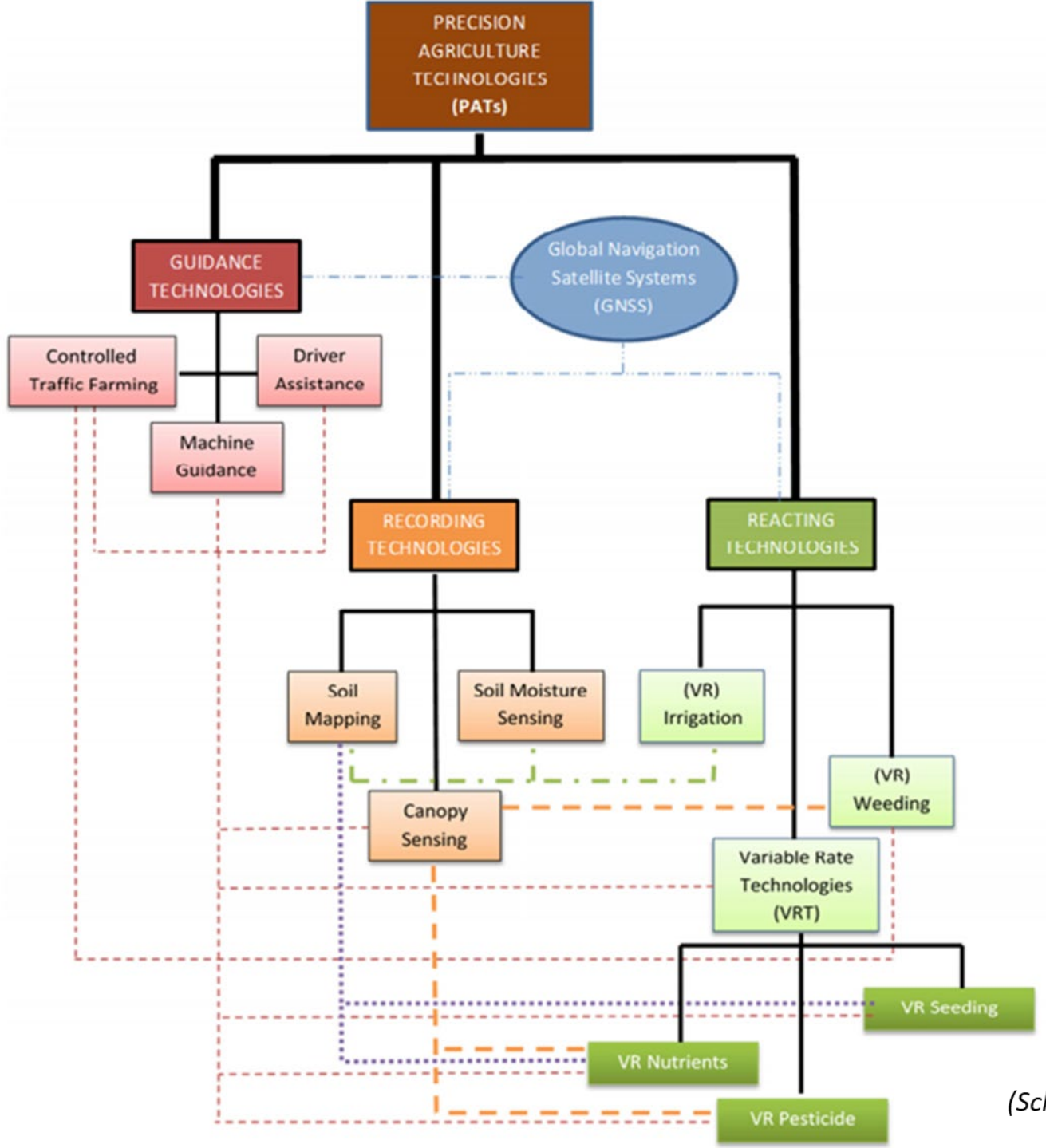
- More with less = + efficiency
- Merges information and technology with raw data
- Responding to spatial and temporal variability

(Norbert Barta, 2020)

Classification of PATs



(Schwarz et al., 2011)



(Schwarz et al., 2011)

Reacting Technologies

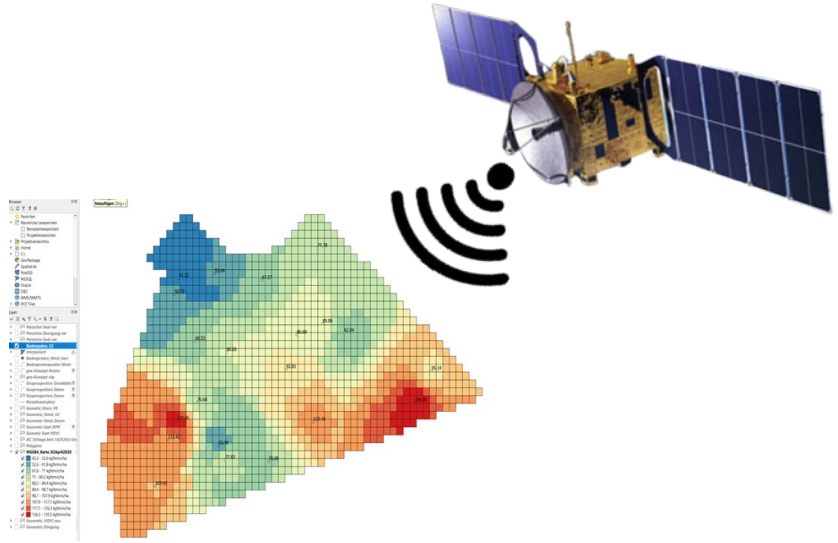
DILAAG
DIGITALIZATION AND INNOVATION

- Variable rate fertilizer application

(Sensor based)

- Variable rate fertilizer application

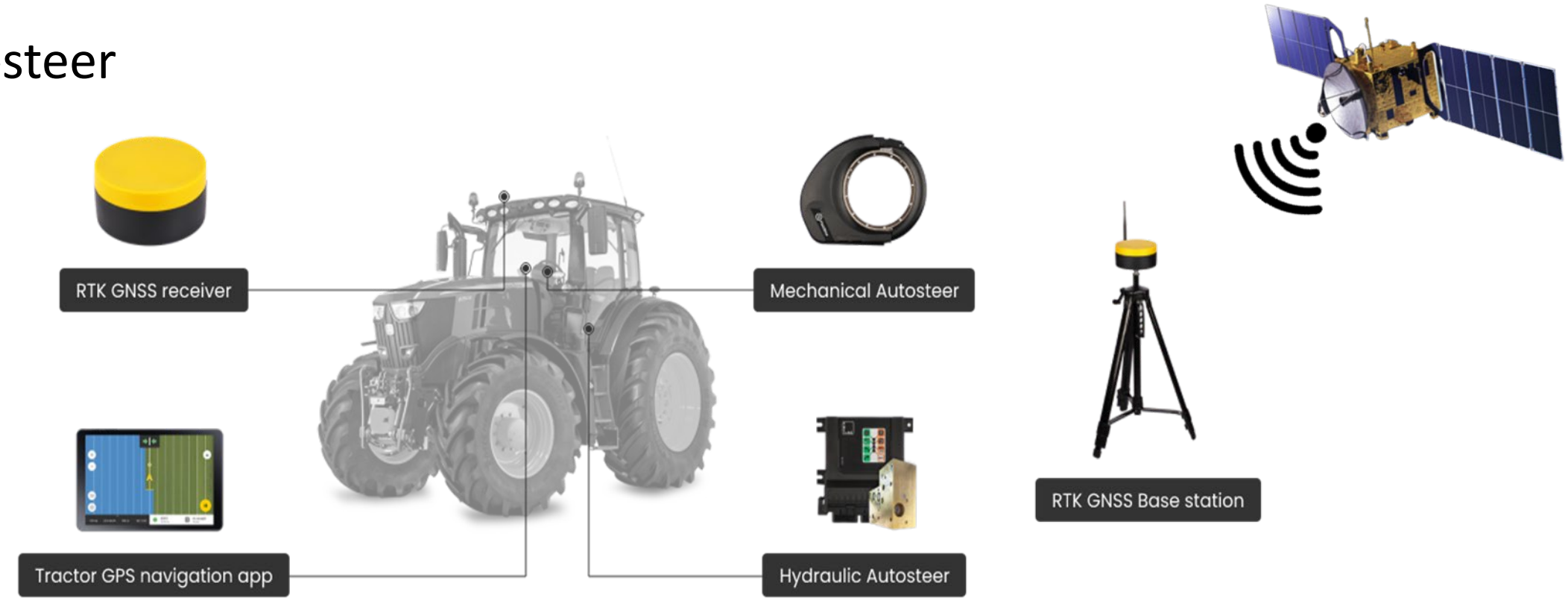
(Map based)



Guidance Technologies

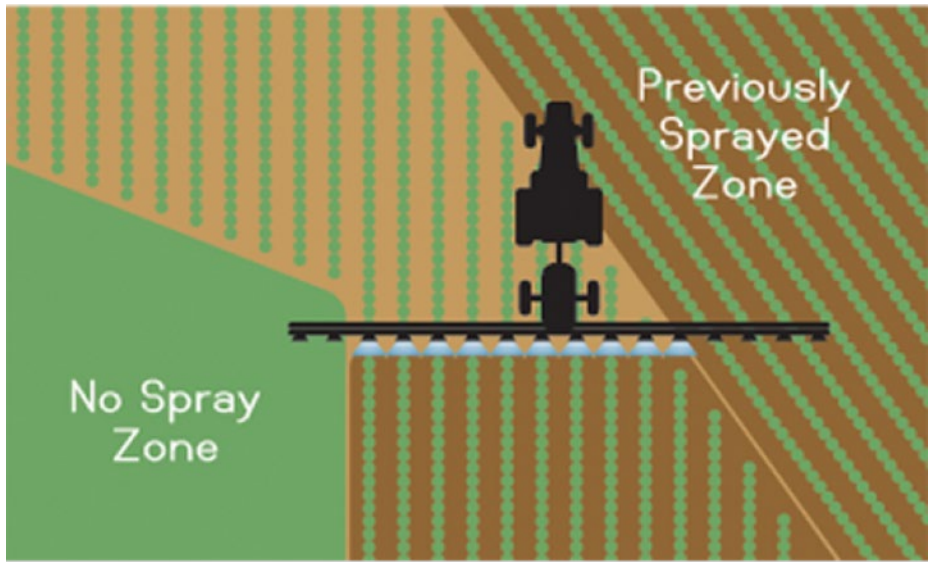
DILAAG
DIGITALIZATION AND INNOVATION

- Auto-steer

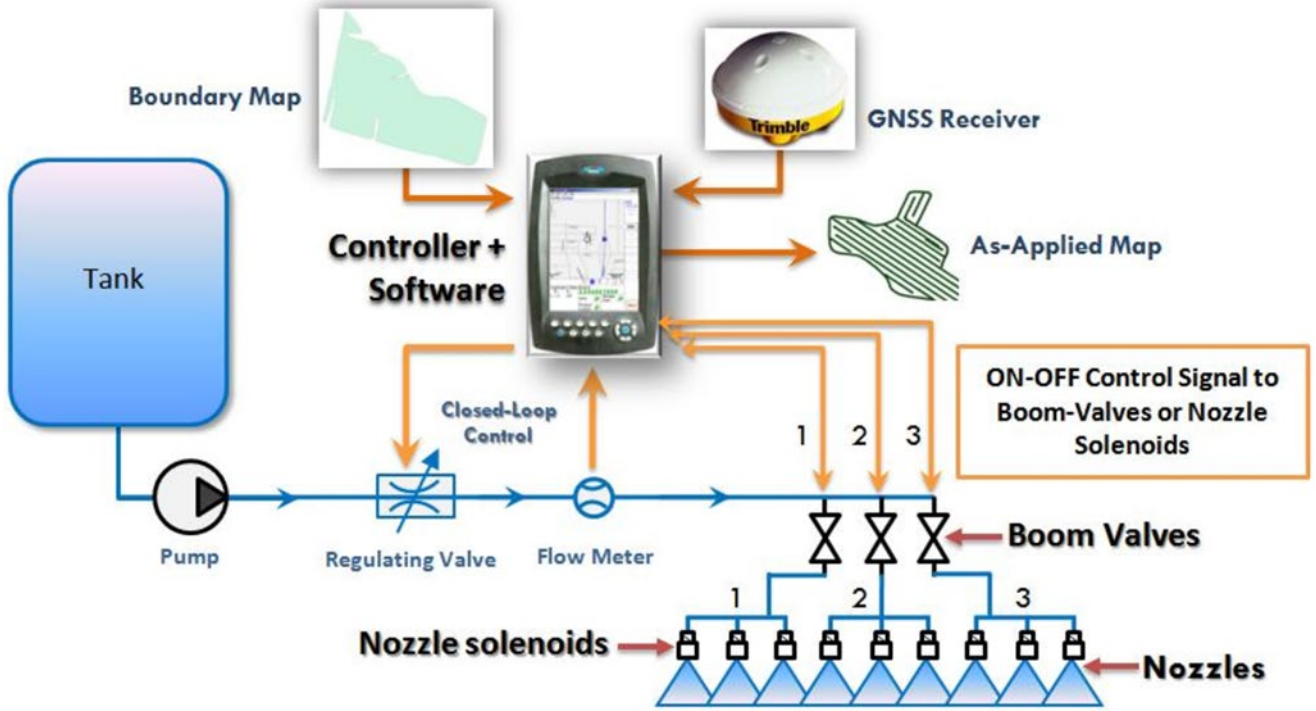


(fieldbee.com, 2021)

- Automatic Section Control (ASC)



(ravenprecision.com, 2021)



(Sharda, 2011)

Expected environmental benefits of using selected PATs

Table 1.0 Expected input and environmental gains from selected PATs. Adapted from Precision Agriculture and the Future of Smart Farming by European Parliamentary Research Service [EPRS], 2016.

Technology classification	Technology/Technique	Expected gains
Recording and reacting	- Variable rate fertilizer application using optical crop sensor	Improvement of nitrogen use efficiency Reduction of residual Nitrogen in soils by 30 to 50 %
Recording and reacting	- Variable rate fertilizer application using nutrient maps	Improvement of nitrogen use efficiency Reduction of residual Nitrogen in soils by 30 to 50 %
Guidance technology	- Auto-steering	- Reduction in soil compaction - Reduce carbon footprint (10 % reduced fuel consumption in field operations due to overlap reduction)
Guidance technology	- Automatic section control (ASC)	- Possible 5% overlap reduction using a planter and 13% using a sprayer - Reduce/avoid excessive chemical input in soil and risk of water pollution

Aim of my research

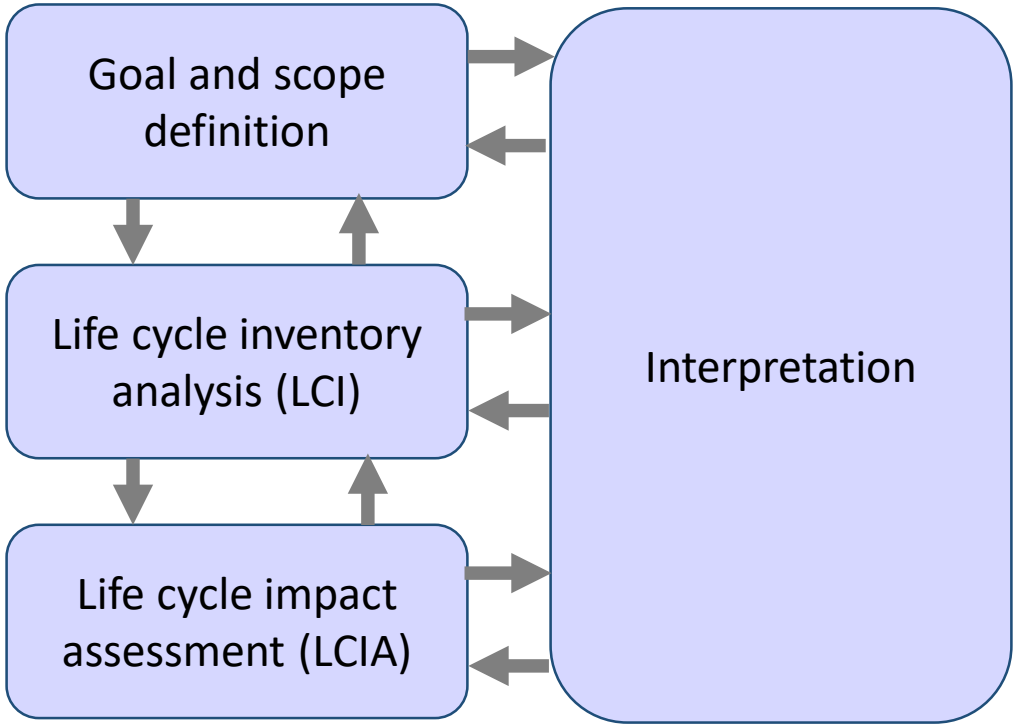
1. What are the environmental impacts of using PATs relative to conventional agriculture? e.g. global warming potential

2. What are the implications of using PATs on soil emissions and soil biogeochemical interactions?

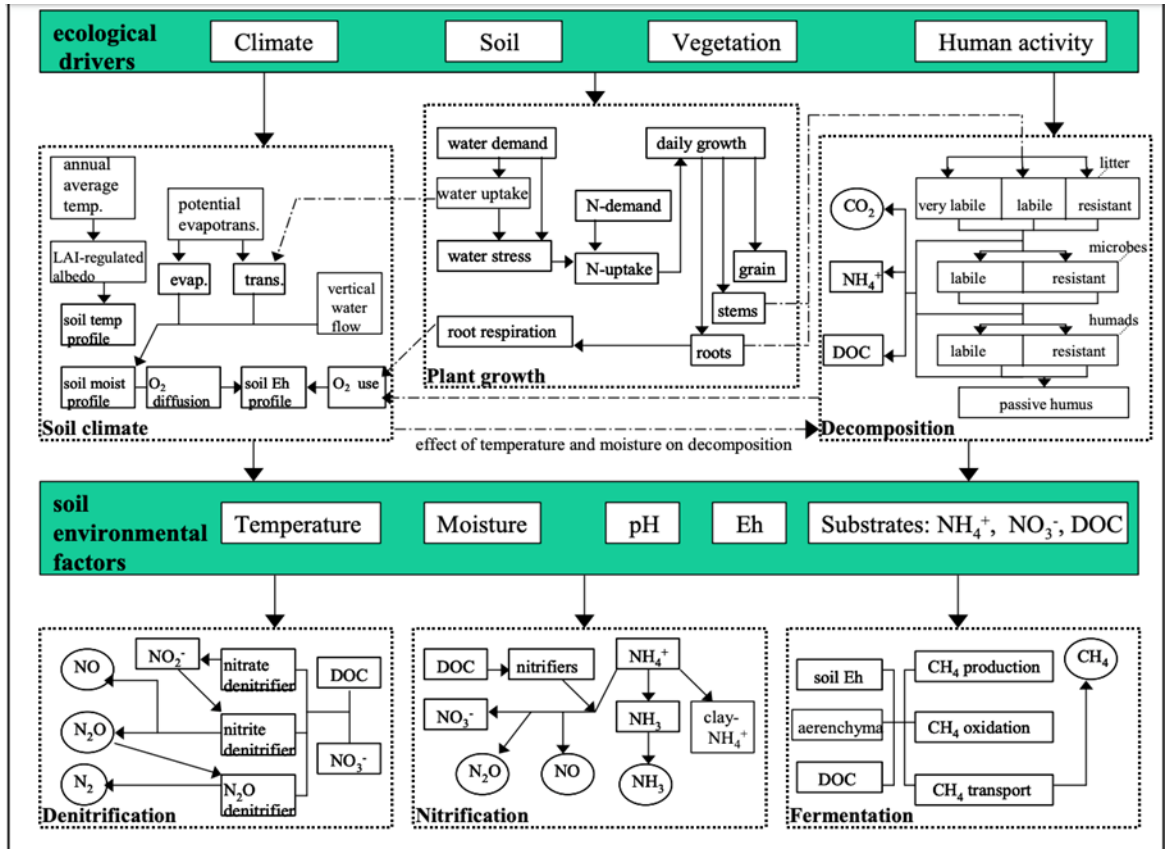
Methods

DILAAG
DIGITALIZATION AND INNOVATION

Life Cycle Assessment Framework



(ISO 1440, 2016)



(Institute for the Study of Earth, Oceans, and Space, University of New Hampshire, 2012)

Conclusion

- PATs bring environmental benefits (no the same)
- Importance of scientific research to quantify environmental impacts
- Information to farmers
- Policy making

References

Auer et al. HISTALP – historical instrumental climatological surface time series of the greater Alpine region 1760–2003. 2007. International Journal of Climatology 27, 17–46, doi: 10.1002/joc.1377

Barta, Norbert. "Picture of Crop Sensor and Tractor During Fertilization in the Field Experiment.", 2020.

fieldbee.com. "Smartphone Based Professional Solutions for Your Tractor." 2021. https://www.fieldbee.com/.

Institute for the Study of Earth, Oceans and Space. User's Guide for the DNDC Model (Version 9.5). University of New Hampshire (2012). https://www.dndc.sr.unh.edu/model/GuideDNDC95.pdf.

ISO. ISO 14040:2006 Environmental Management - Life Cycle Assessment - Principles and Framework. Internationa Organization for Standardization (Geneva, Switzerland: 2006).

Morice et al. An updated assessment of near-surface temperature change from 1850: the HadCRUT5 dataset. 2021. Journal of Geophysical Research: Atmospheres 126, 3, doi:10.1029/2019JD032361

ravenprecision.com. "Accuboom." 2021. https://ravenprecision.com/products/boom-controls/accuboom

J. Schwarz, L. Herold, and B. Pölling. "Typology of Pf Technologies." FP7 Project Future Farm, 2011, 2020, http://www.futurefarm.eu/

Service, European Parliamentary Research. Precision Agriculture and the Future of Farming in Europe. Scientific Foresight Unit (2016). https://www.europarl.europa.eu/RegData/etudes/STUD/2016/581892/EPRS_STU(2016)581892_EN.pdf

Sharda, Ajay. "Boom Dynamics During Control System Response on Agricultural Sprayers." 2011.

DILAAG
DIGITALIZATION AND INNOVATION

University of Natural Resources and Life Sciences, Vienna

Department of Sustainable Agricultural Systems
Institute of Agricultural Engineering

Francisco MEDEL, PhD student

Peter-Jordan-Street 82, A-1190 Vienna
Tel.: +43 1 47654-93100, Fax: +43 1 47654-93109
https://dilaag.boku.ac.at; www.boku.ac.at/ilt