Smart Fertilization Management for rapeseed to increase N-efficiency while ensuring compliance with new European fertilization legislations

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talkingfields

VISTA Remote Sensing in Geosciences GmbH

Mission and Vision

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founded 1995 in Munich

since 2017 part of BayWa AG

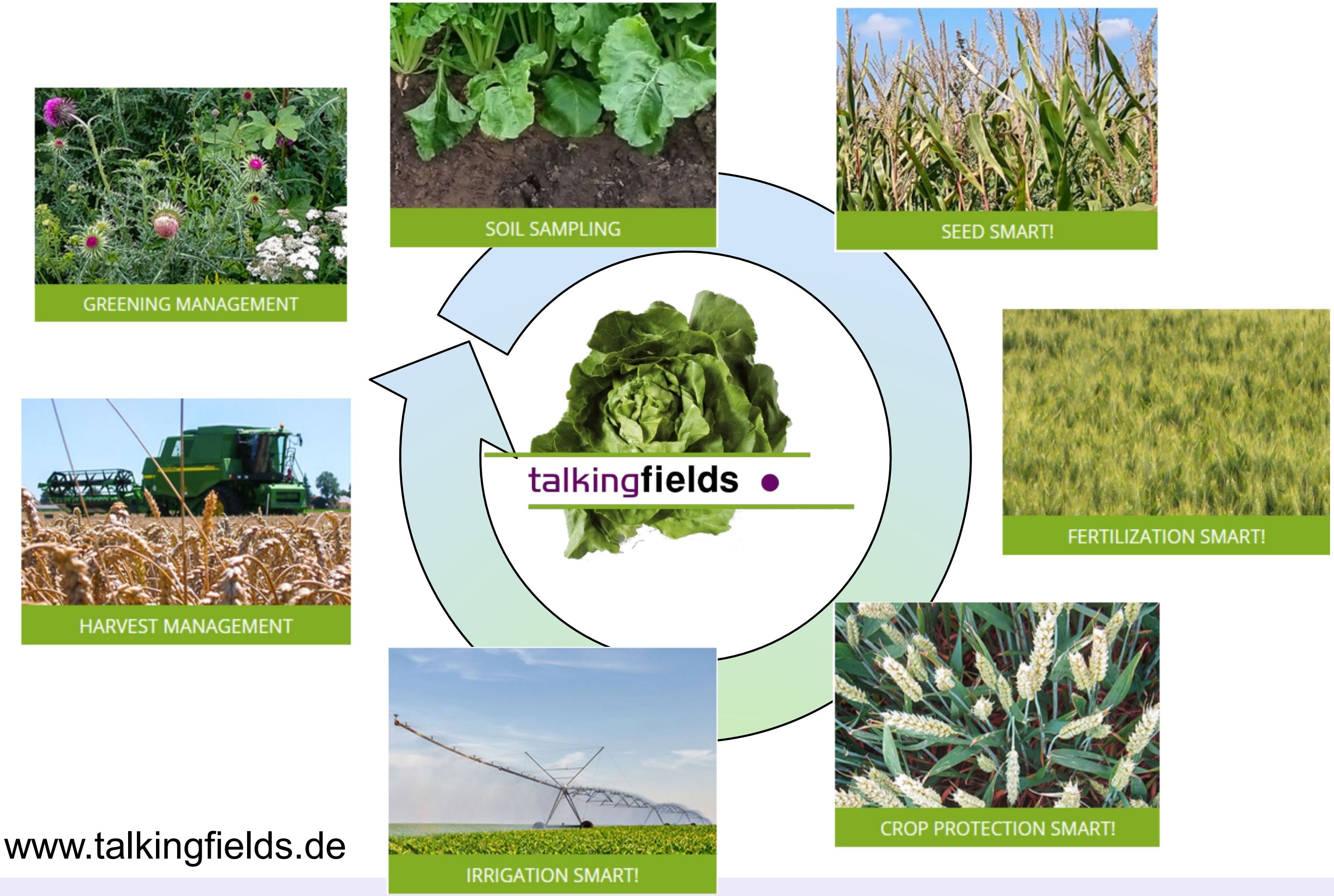
BayWa

VISTA GmbH

Integrated solutions for sustainable management of the water-energy-food nexus

- **Improve the global footprint of agriculture.**
- **Increase the resilience of the food system.**

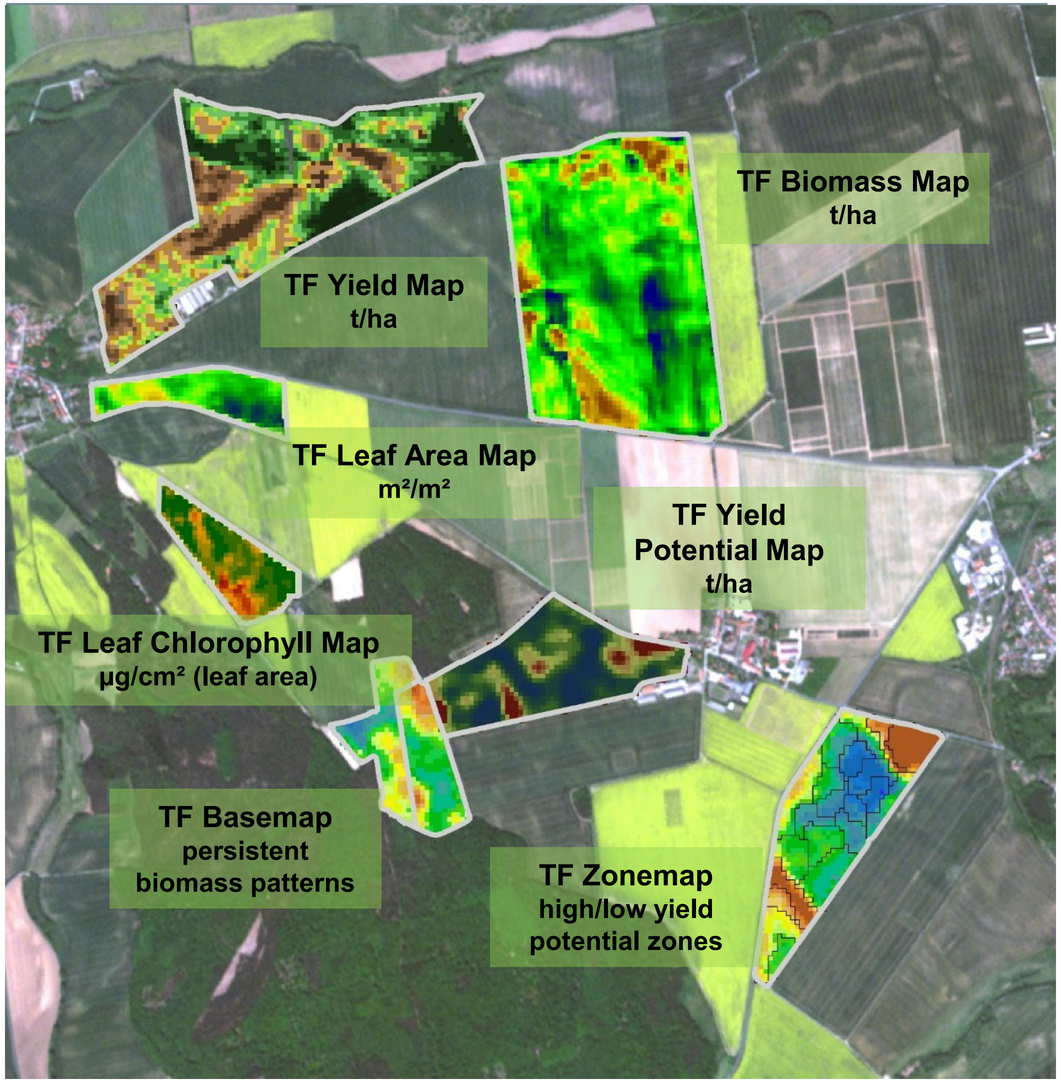
TalkingFields® - Innovative products provide decision support for farmers throughout the entire growing season



- Developed together with LMU & PC Agrar in ESA ARTES IAP project
- Introduction of products into market in 2011; larger rollout in 2016 with Sentinel-2 availability
- Products are available worldwide, current customers mainly distributed in Europe and Africa
- Cooperation with strong partners, e.g. BayWa, KWS or FarmFacts, supports acceptance by farmers

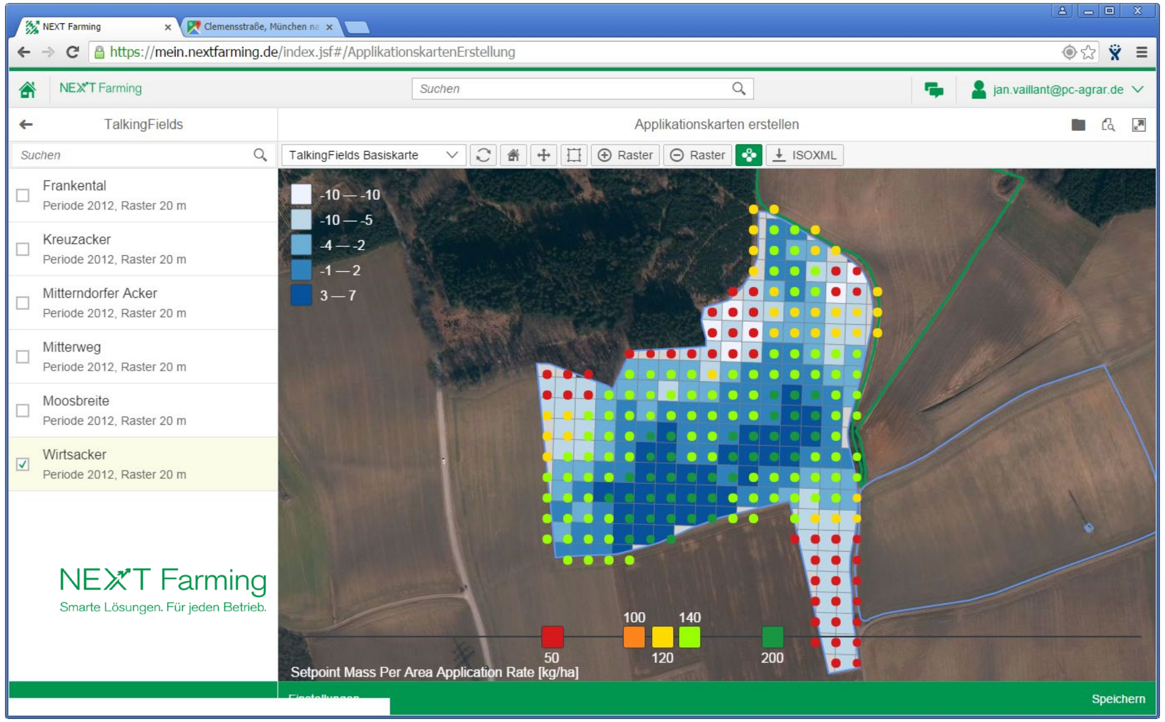
www.talkingfields.de

TalkingFields®
Basic principles of all delivered products

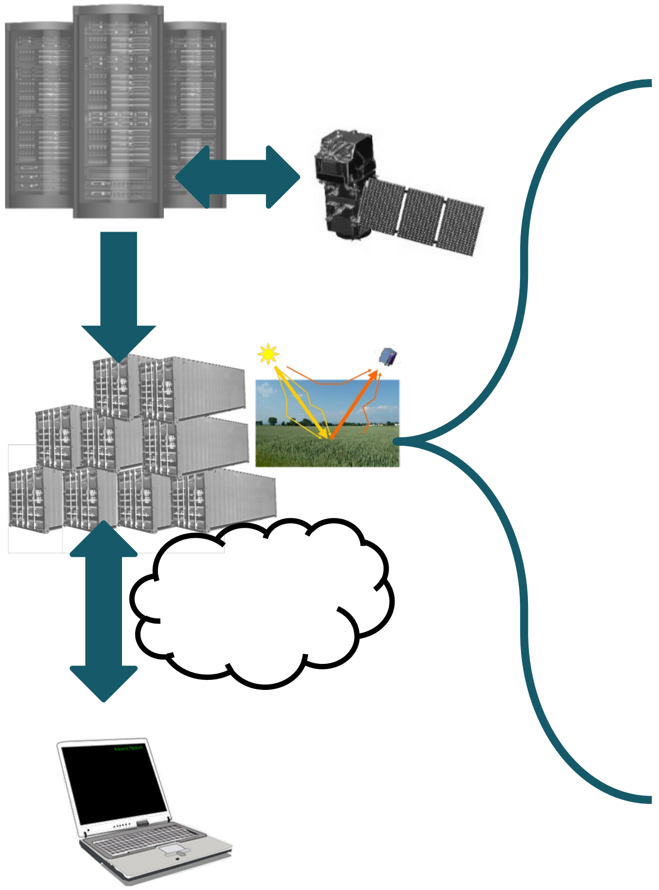


TalkingFields® products provide information in 10x10m resolution and physical units thereby

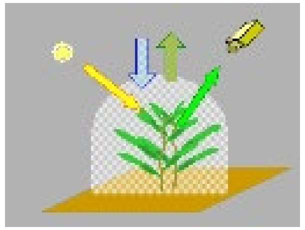
- allowing precise calculation of application maps and
- can be imported into common FMIS systems, which then enable the smooth transfer to the machine.



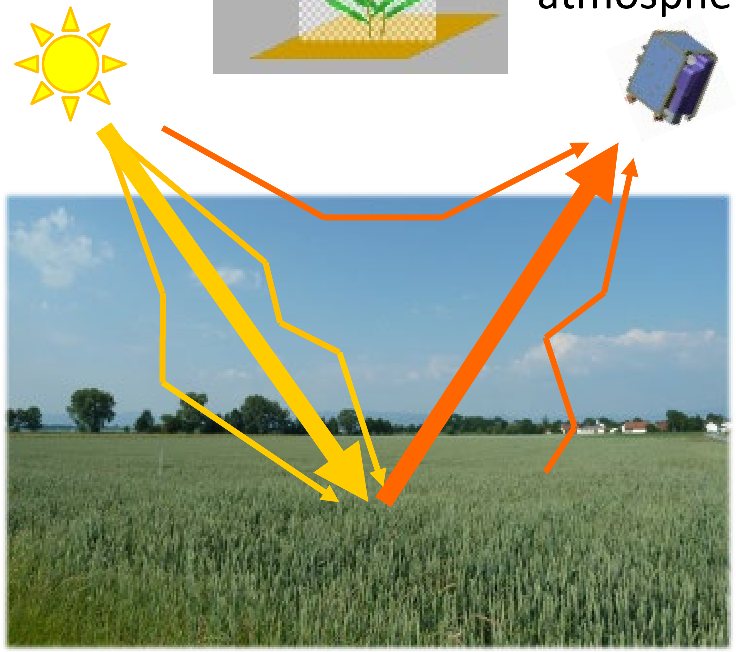
Vista's Big Data Analyses tools: Coupled crop growth and radiative transfer modelling with PROMET and SLC



Big Data Processing with e.g.
http://foodsecurity-tep.net/



SLC (Verhoef & Bach, RSE 2003, 2007 und 2012)
Radiative transfer model for soil, leaf, canopy and atmosphere



Radiative transfer in atmosphere

Radiative transfer land surface

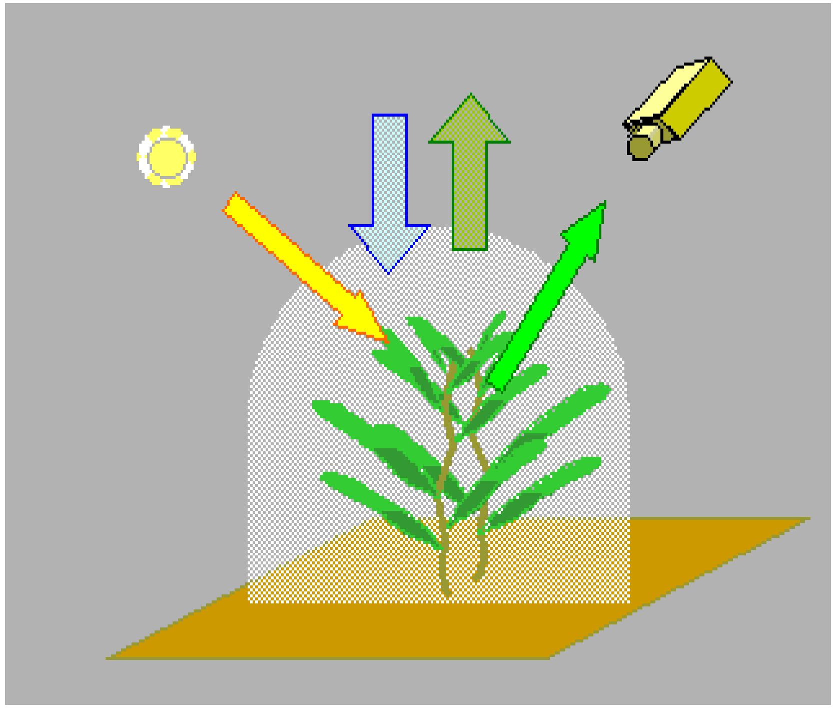
Land surface processes

PROMET (Mauser & Bach, J. of Hydrology 2009)
Multi-scale land surface process model

SLC parameters that can be inverted and adaptations for rapeseed

SLC – Radiative Transfer Model for Soil Leaf Canopy

(Verhoef & Bach, RSE, 2003, 2007, 2012)



Four-stream canopy reflectance model:

1. Direct solar flux
2. Diffuse downward flux
3. Diffuse upward flux
4. Direct observed flux (radiance)

Input Parameters / inverted

structural

- LAI - leaf area index
- Average leaf slope parameter a
- LIDF bimodality parameter b
- Hot spot parameter q
- Fraction 2nd layer (fe.g. blossoming)
- Layer dissociation factor D
- Soil BRDF Parameters (b, c, B0, h)
- Soil moisture
- Crown coverage

spectral

- Fraction diffuse sky irradiance
- Dry soil reflectance

observational

- Solar zenith angle
- Viewing zenith angle
- Relative azimuth angle

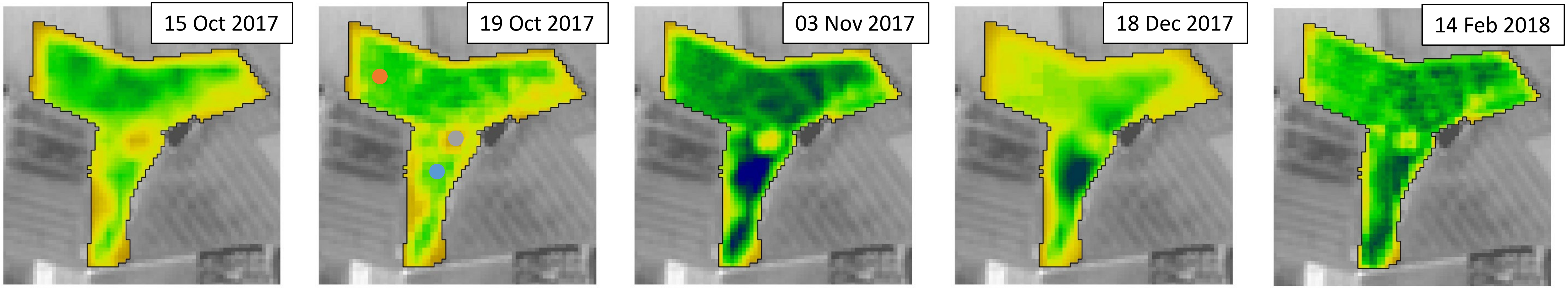
leaf

- Leaf chlorophyll
- Leaf water
- Leaf dry matter
- Leaf mesophyll structure N

SLC is an extension of SAIL and PROSPECT including soil reflectance simulation with variable soil moisture. SLC further splits the canopy in 2 layers that can have variable leaf optical properties.

For the rapeseed case the SLC model has been extended to simulate the yellow flowers of rapeseed that dominate the reflectance for a long time span. Blossoming intensity can thus be inverted.

TalkingFields® N-Uptake Canola for spring fertilization

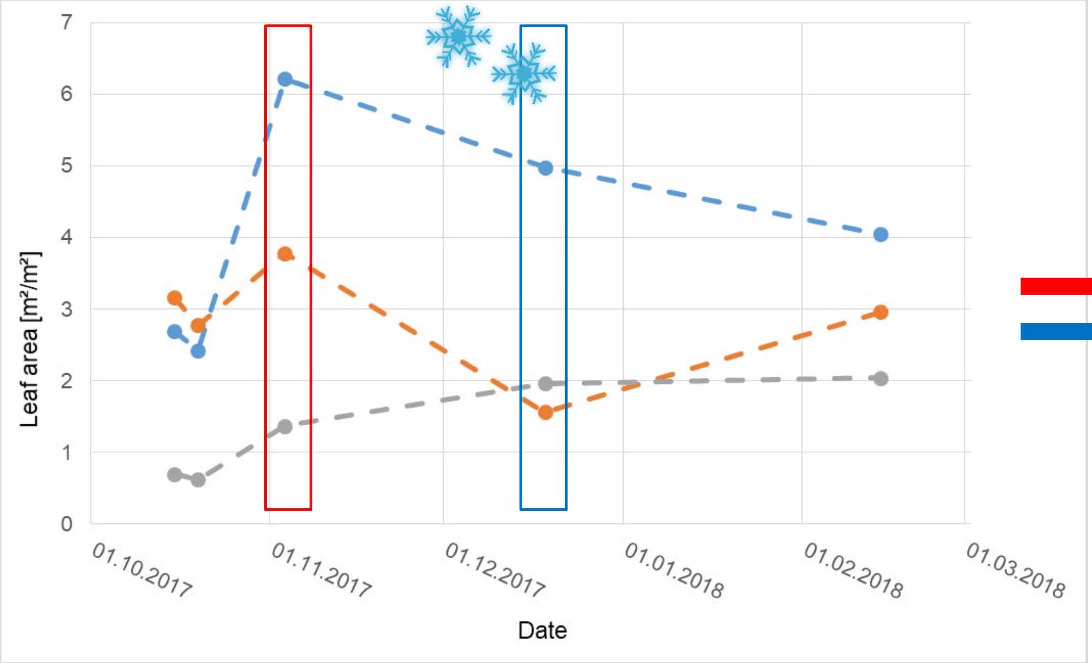


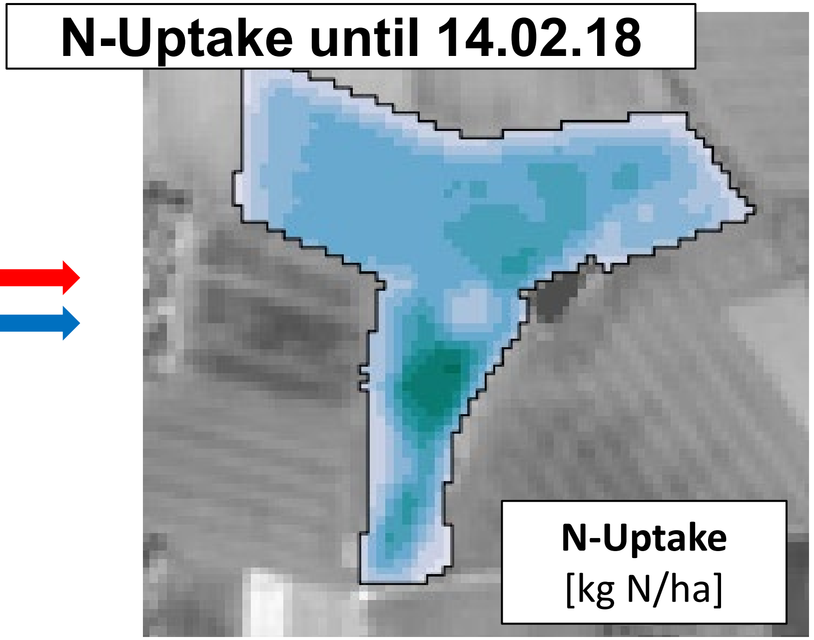
Leaf Area Oil Rapessed

Field boundary

Leaf Area [m²/m²]

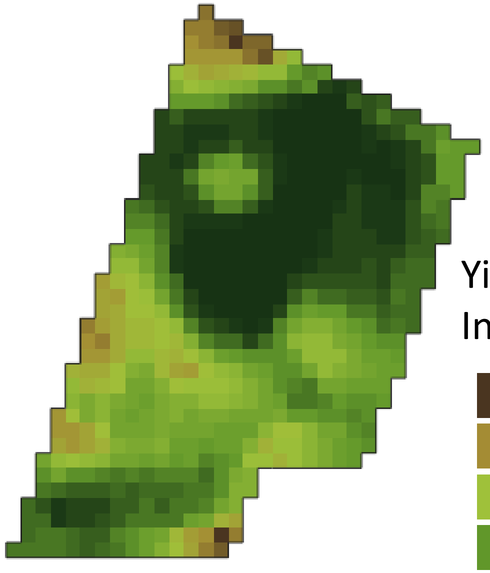
- 0
- 0.6
- 1.2
- 1.8
- 2.4
- 3.0
- 3.6
- 4.2
- 4.8
- 5.4
- 6.0





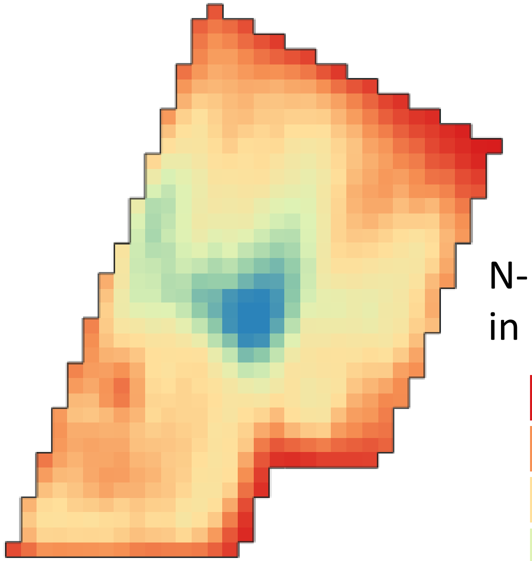
TalkingFields® NManager Pro Rapeseed

TalkingFields®
long-term Yield Potential [t/ha]

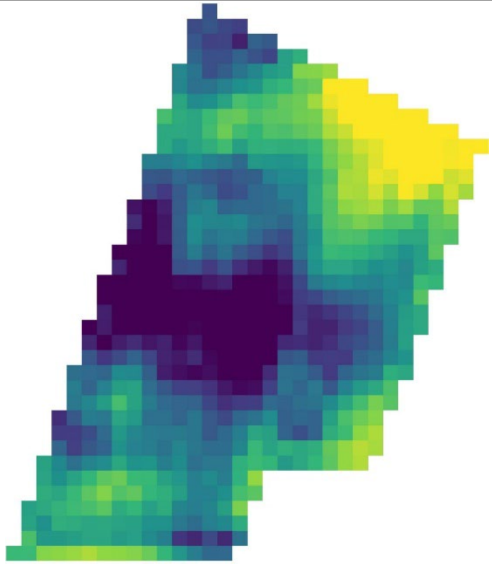


&

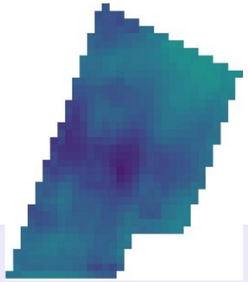
TalkingFields®
N-Uptake Rapeseed [kg N/ha]



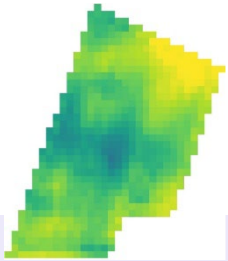
TalkingFields®
N-Demand total [kg N/ha]



N1

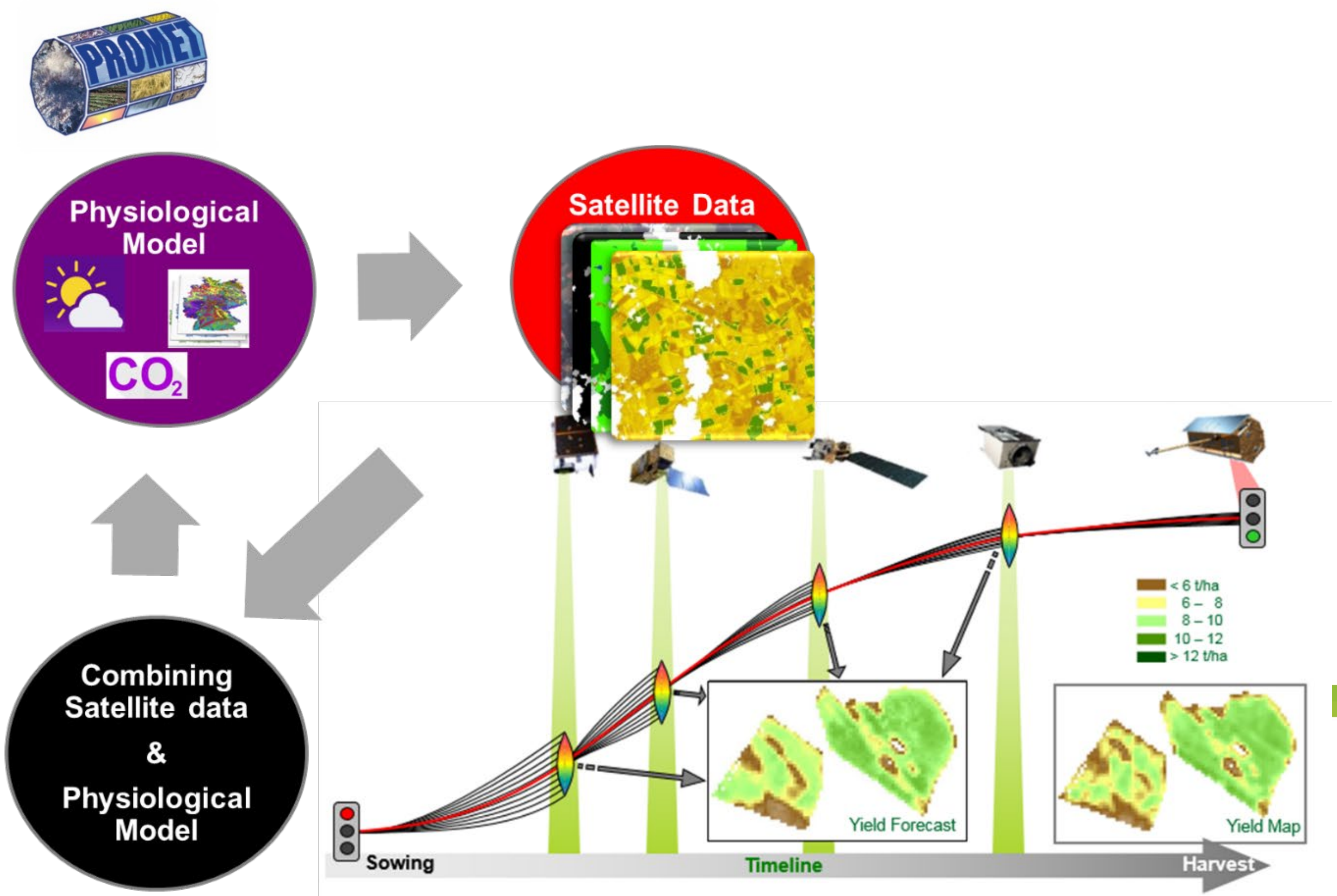


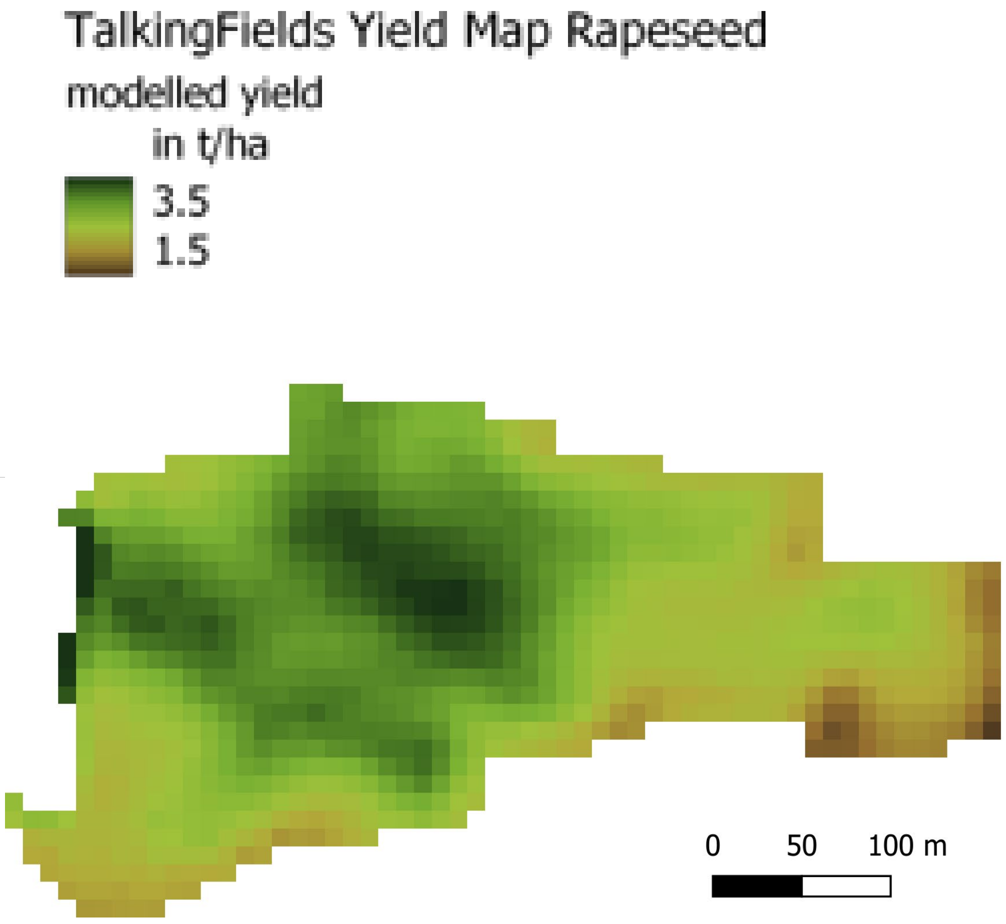
N2



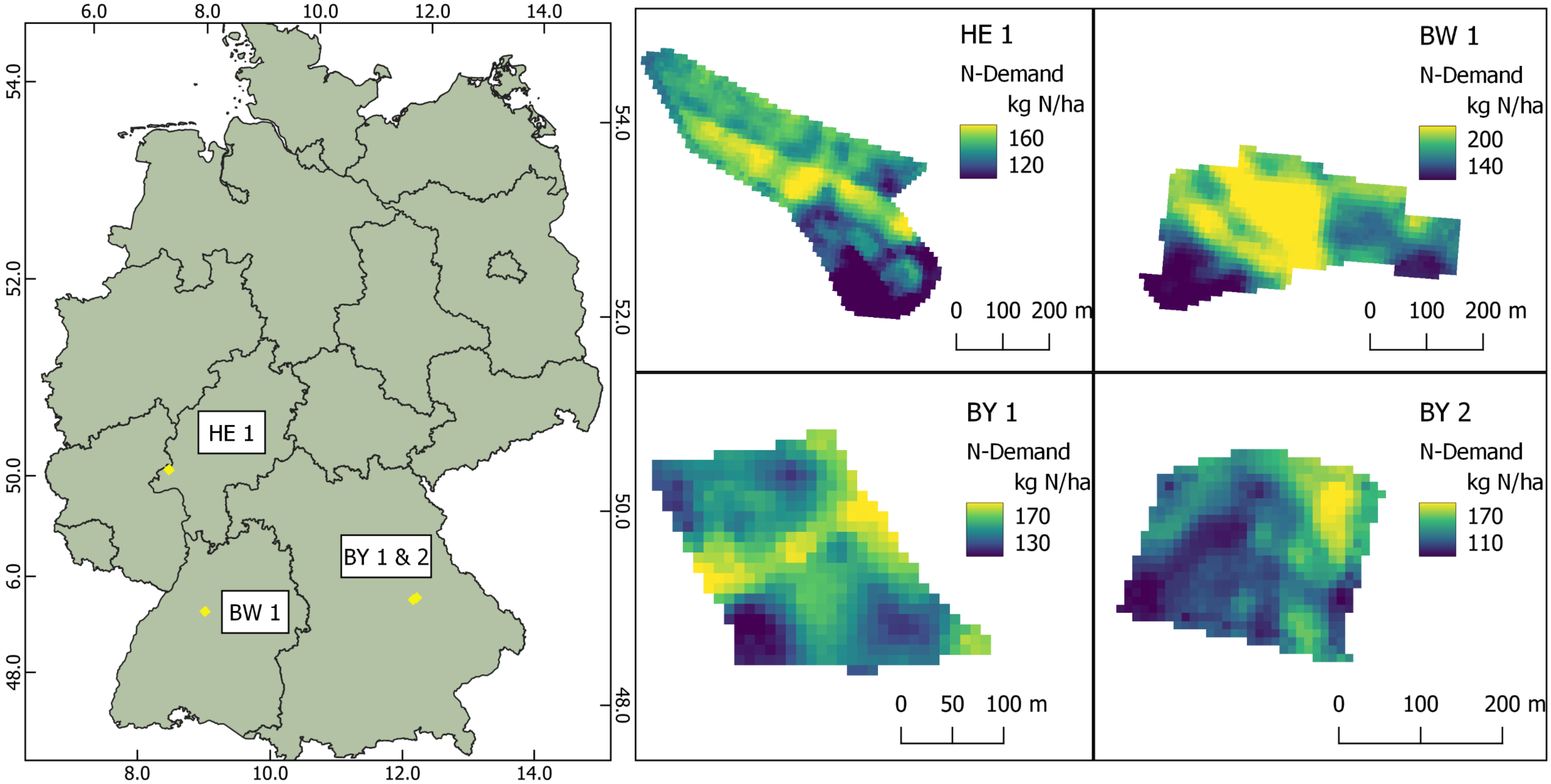
- In Germany the maximum amount of allowed fertilizer application is limited by law, depending on the planted crop and the expected yield
- German legislations are being taken into account so that the maximum allowed fertilization amount is not exceeded

Simulations with PROMET and satellite data assimilation allows to monitor the impact of site-specific measure on final yield





Validation testsites for NManager Pro Rapeseed



Validation of service performance: Calculation of N-efficiency

NManagerPro vs. constant fertilization (normal farm management)

Testsite	Trial	Yield in t/ha	Yield increase in %	N-Application in N/ha	Yield t/ kg N
BW 1	NManagerPro	4.55	6%	188.0	0.0242
	constant N-application	4.31		175.0	0.0246
BY 1	NManagerPro	4.69	15%	151.0	0.0311
	constant N-application	4.08		140.0	0.0292
BY 2	NManagerPro	4.22	0%	154.0	0.0274
	constant N-application	4.21		190.0	0.0222
HE 1	NManagerPro	4.83	18%	170.3	0.0284
	constant N-application	4.09		156.7	0.0261

→ In these trials, site-specific fertilization of winter rapeseed using NMananger Pro Rapeseed did not reduce fertilizer input, but led to increased yields.

→ On average the achieved yield increased by 10%

→ Higher yields are achieved with low increases in N-fertilization, similar yields are achieved with reduced N-input

→ **Overall N-Efficiency (tons of yield achieved per kg N) is increased**

Effects of site-specific fertilization on Greenhouse Gas (GHG) emissions

Szenario	Yield in t/ha	N-fertilization in kg N/ha	GHG emissions fertilization in kg CO2-eq./ha (1kg N = 10 kg CO2-eq)	GHG emissions from fertilizer in kg CO2-eq./ha per kg yield	GHG emissions as CO2-eq./ha per kg yield, relative
constant N-application	4.17	165.43	1,654.25	0.40	100%
NManagerPro	4.57	165.83	1,658.25	0.36	91%

→site-specific fertilization did not reduce total GHG-emissions through adapted fertilization since total fertilization-amount remains the same

→Site-specific fertilization reduced relative GHG-emissions per kg of yield by 9%

→This is due to increased yields with same level of fertilization

Vista's Local, Regional and Global Sustainability Services

- Vista offers data-driven information for farming decisions supporting sustainable agriculture.
- Starting with local, site-specific fertilization advice - as shown here for rapeseed - we support farmers to improve their nitrogen efficiency.
- It could be demonstrated in field trials that GHG emission were reduced by 9% using NManager Pro
- Besides fertilization, Vista offers a set of management solutions in agriculture based on integrated scenarios regarding water, nutrient, climate, economy, energy, biodiversity and sustainability.
- They are based on quantitative monitoring with focus in remote sensing, physics-based environmental simulations, data assimilation, and scenario analyses.