Yield gap analysis of cereals in Europe

Supported by local knowledge

MACSUR conference, Reading (UK), April 2015

René Schils, Kurt-Christian Kersebaum, Anna Nieróbca, Katarzyna Żyłowska, Inés Minguez, Alba Castaneda Vera, Jørgen Olesen, Behzad Sharif, Hendrik Boogaard, Hugo de Groot, Lenny van Bussel, Joost Wolf, Bert Rijk, Martin van Ittersum

WAGENINGEN UR
For quality of life

zalf

ceigram
Centro de Estudios e Investigación para la Gestión de Riesgos Agrarios y Medioambientales

iUNG

AARHUS UNIVERSITY

Cereal yield gaps in Europe

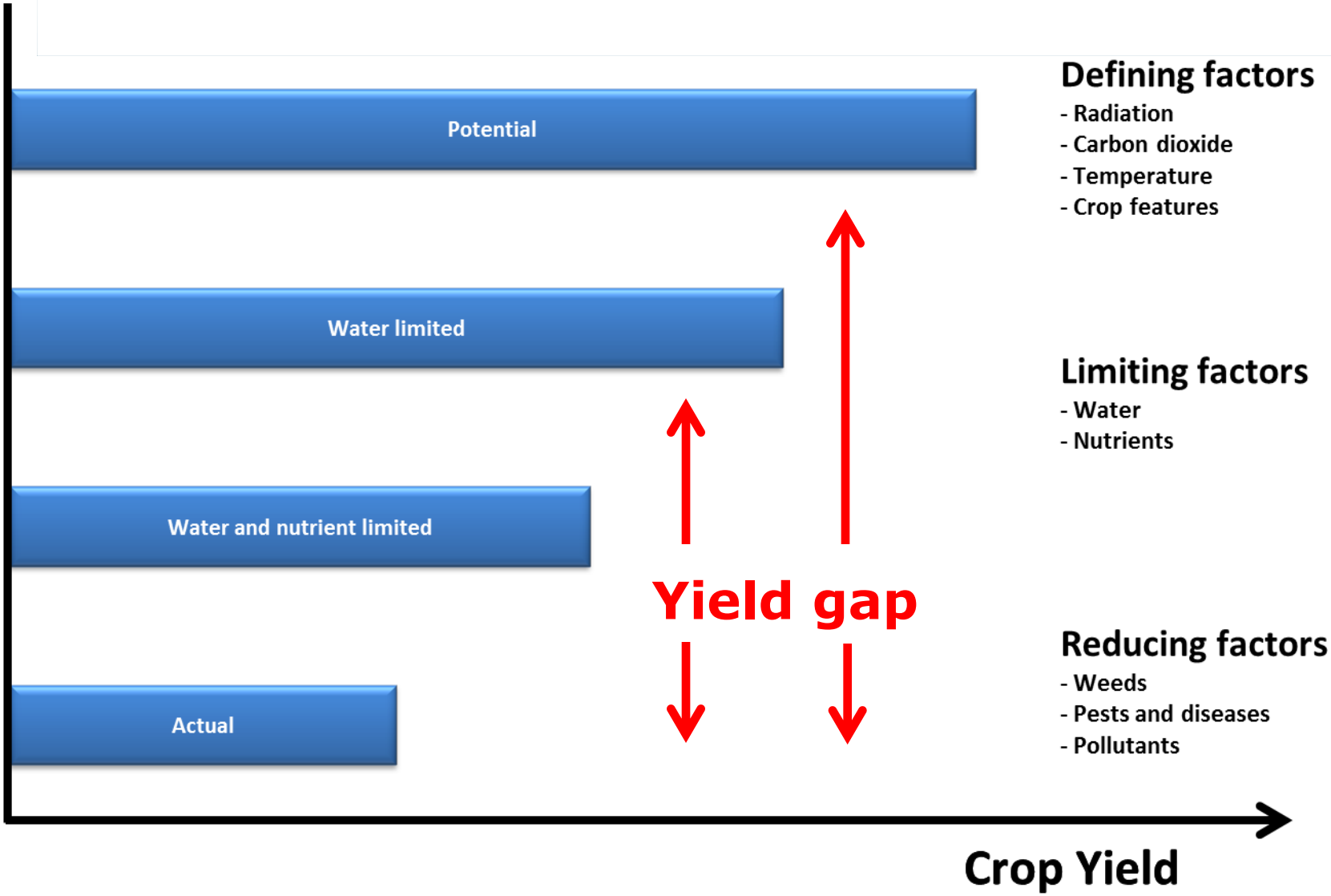
- **Background**
  - Global Yield Gap Atlas
  - Benchmarking Atlas
- Cereal yield gaps
  - Yield gap protocol
  - Results so far
- Outlook
- Questions

WAGENINGEN UR
For quality of life

Background of yield gap analysis

- Challenge to keep production on track with demand
- Identify regions with unlocked yield capacity
- Identify regional causes of yield gaps
- Develop options to reduce yield gaps

Production ecological principles



WAGENINGEN UR
For quality of life

eg. Van Ittersum & Rabbinge, 1997

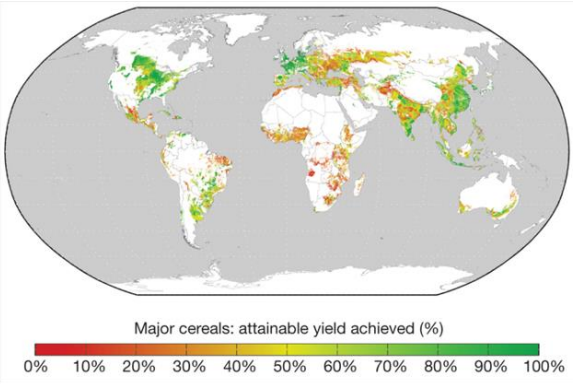
Earlier yield gap studies

Regional and local approaches

- Inconsistent concepts and methods
- models, experiments, best management practices
- local relevance, but difficult to compare

Global and continental approaches

- Consistent
- Generic crop growth models
- Coarse, lacking local detail and hence less agronomic relevance



Mueller et al., 2012

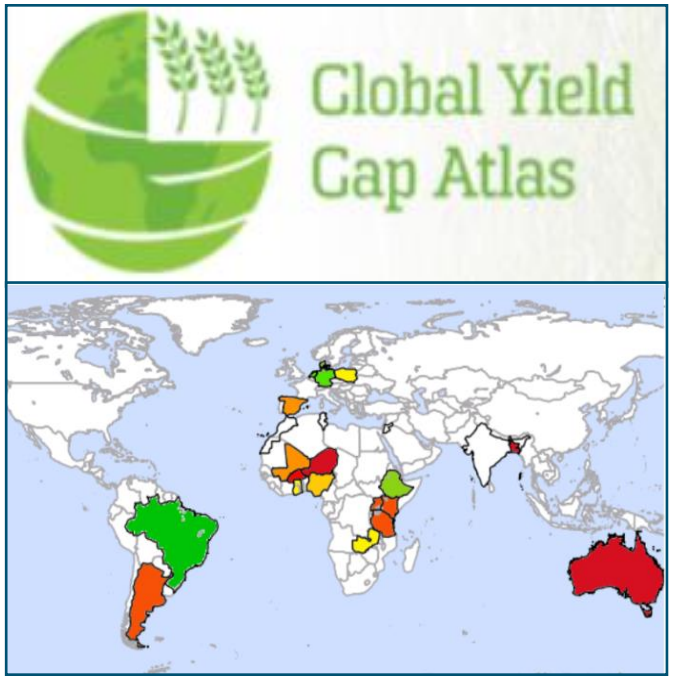
GYGA approach

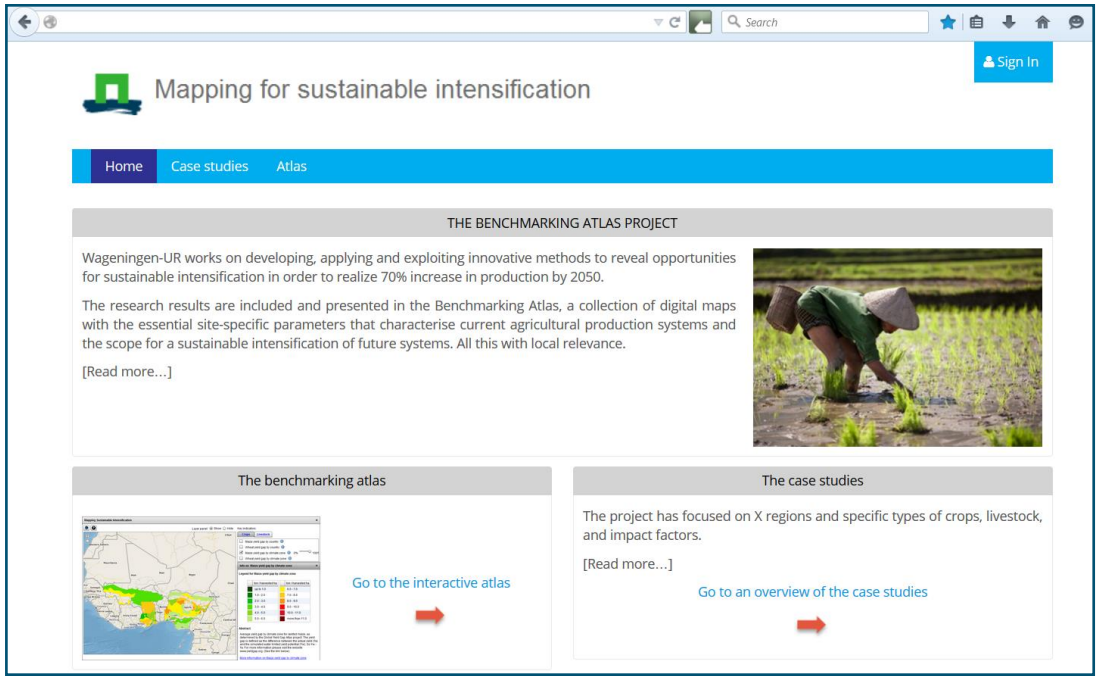
- Bottom-up
  - local data for weather, cropping systems and soils
  - involving local scientists
  - upscaling to national, continental and global levels
- Standard protocols
- Transparency
  - data available at www.yieldgap.org

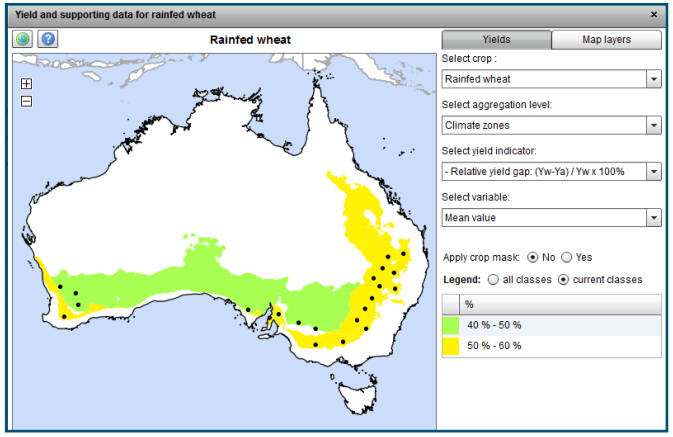
WAGENINGEN UR
For quality of life

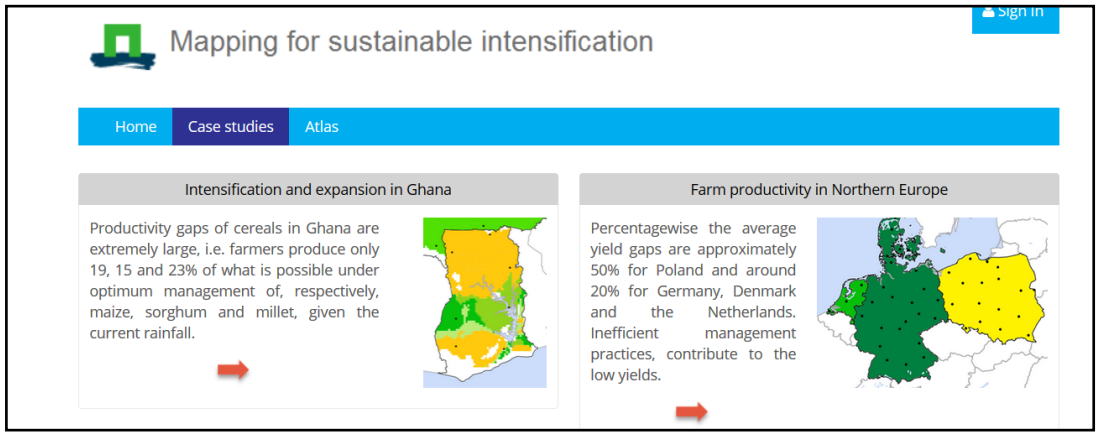
Global Yield Gap Atlas

Dissemination of results







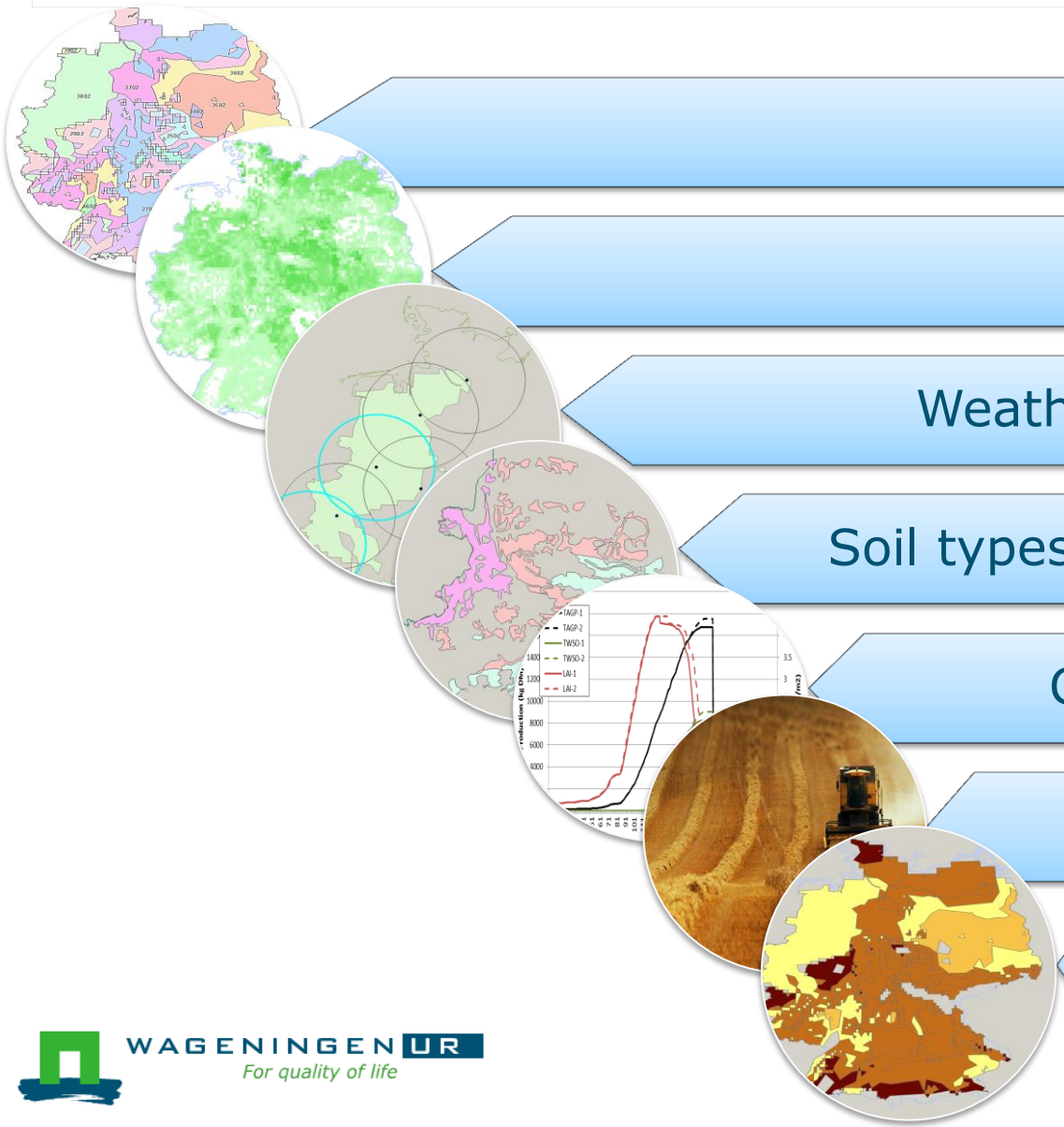


Cereal yield gaps in Europe

- Background
  - Global Yield Gap Atlas
  - Benchmarking Atlas
- Cereal yield gaps
  - **Yield gap protocol**
  - Results so far
- Outlook
- Questions

WAGENINGEN UR
For quality of life

Yield gap analysis, step by step



Climate zones

Harvested areas

Weather station buffer zones

Soil types and cropping systems

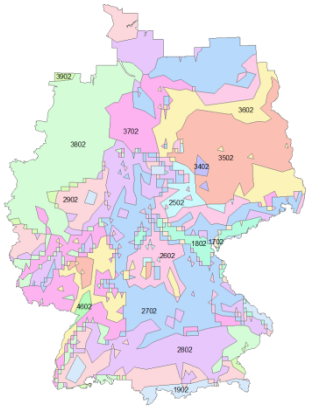
Crop model simulations

Actual yields

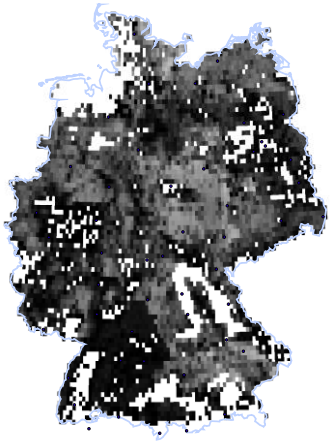
Yield gaps

WAGENINGEN UR
For quality of life

Selected climate zones for wheat



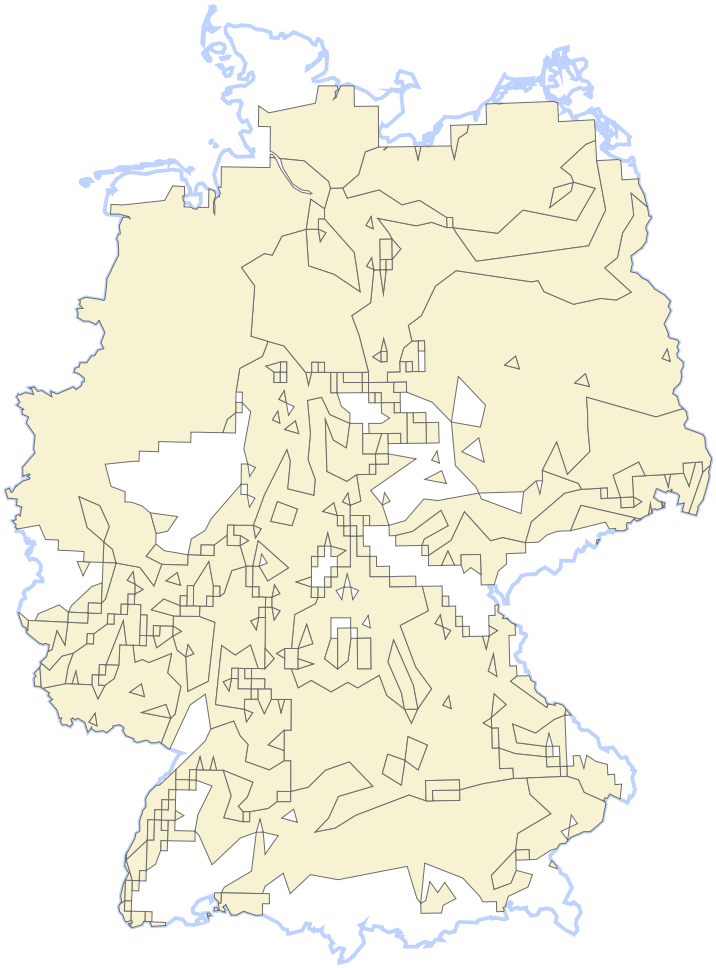
Climate zones



Harvested areas

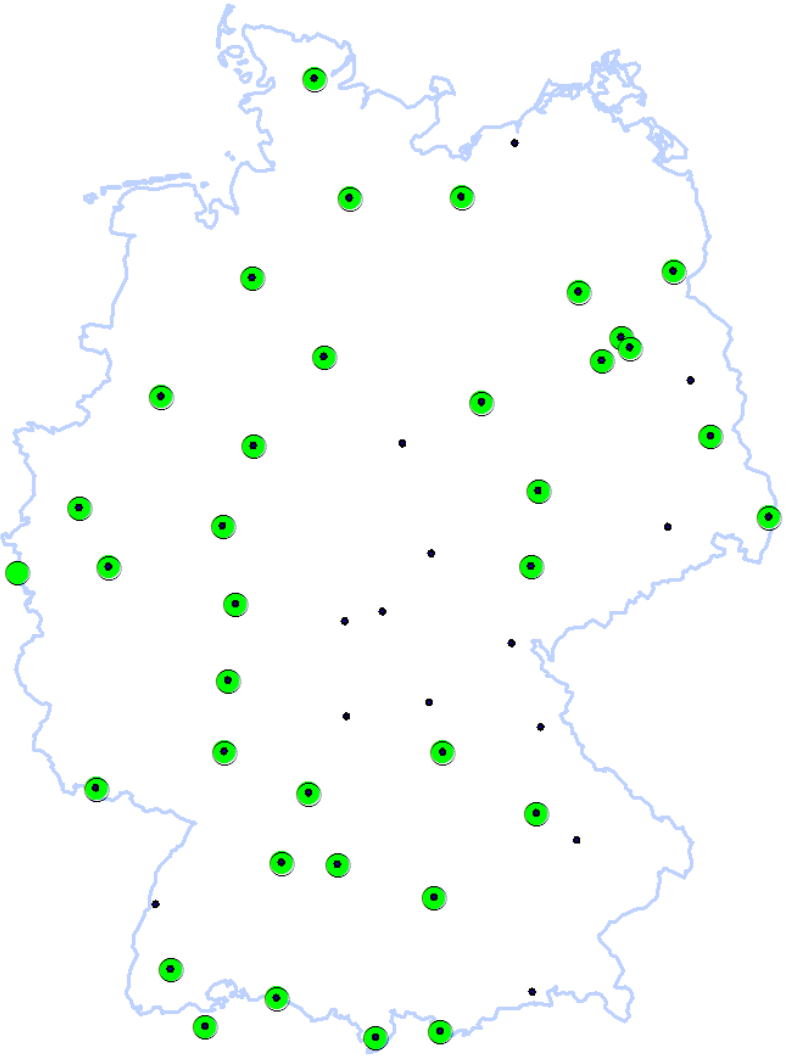
Selected zones:

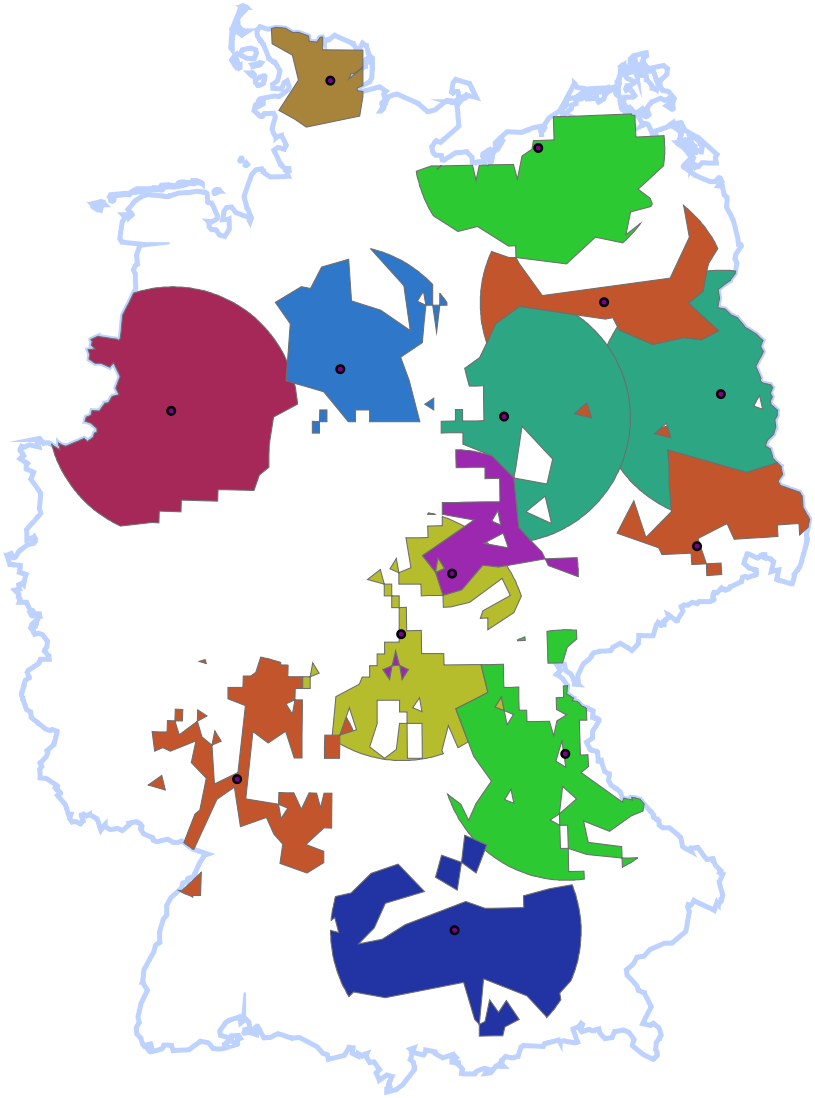
>5% of national harvested area



WAGENINGEN UR
For quality of life

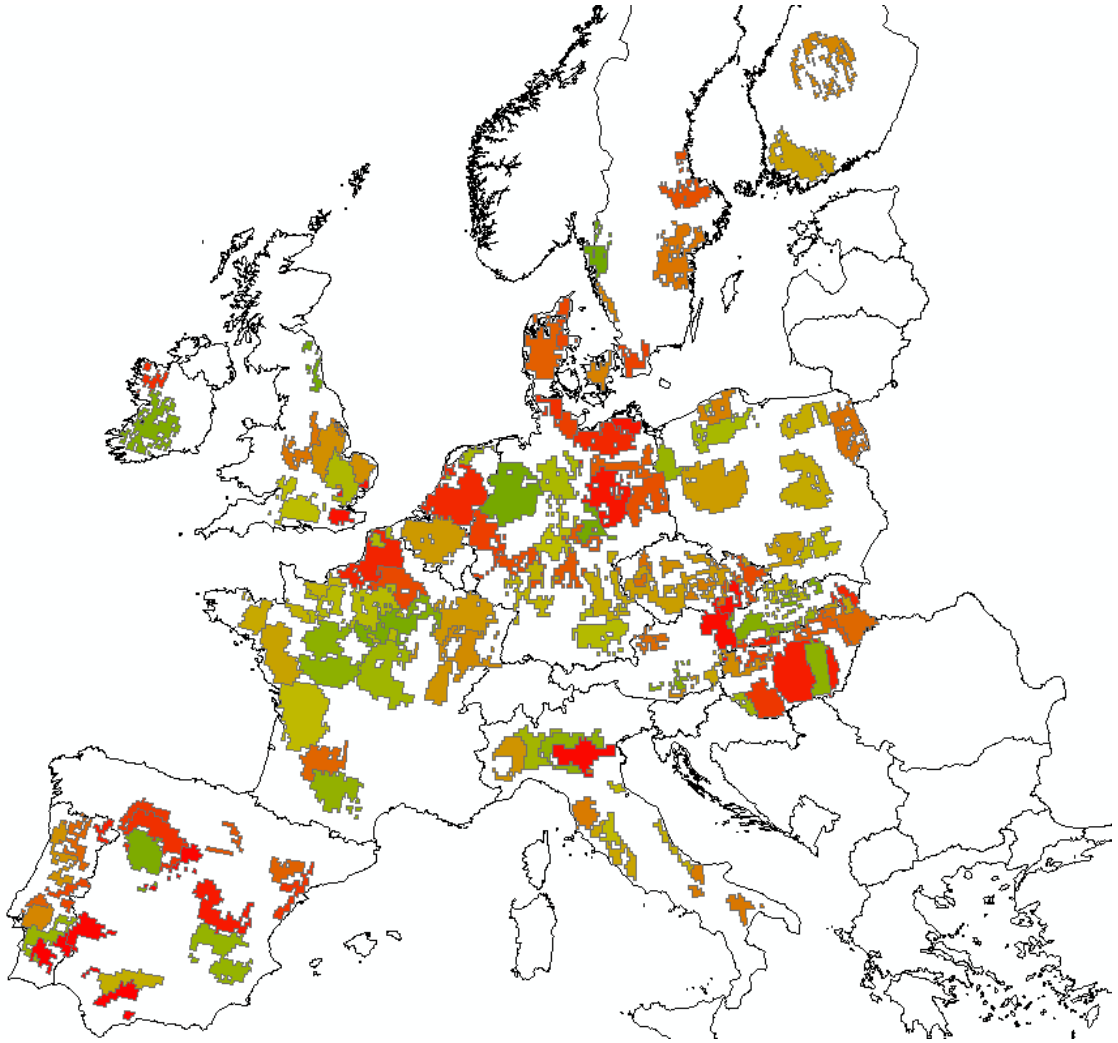
Selected weather station buffer zones



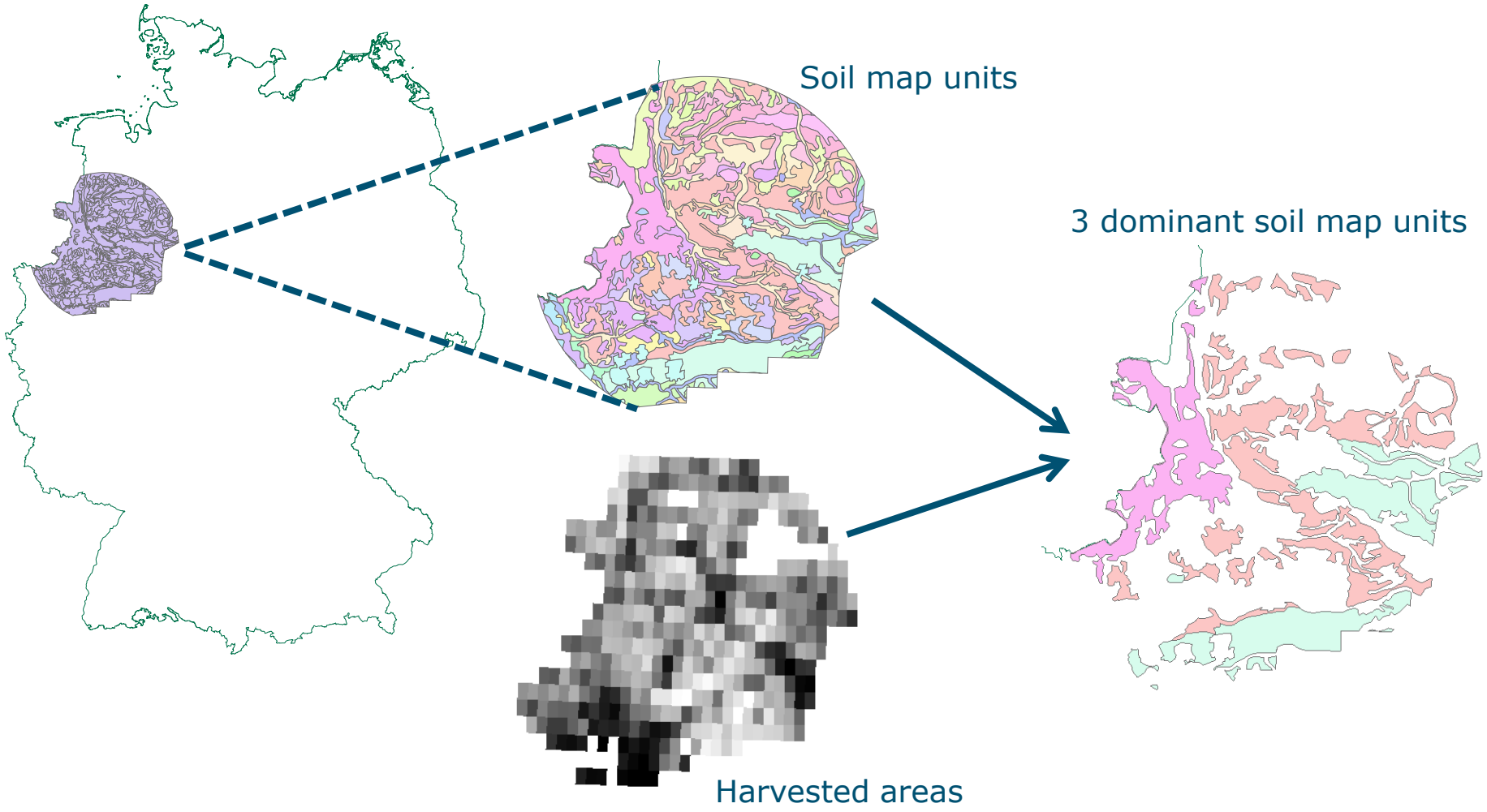


WAGENINGEN UR
For quality of life

Selected areas - wheat



Select dominant soil map units



Crop model simulations

- Potential and water-limited yield

- Simulation runs are combinations of
  - 3 to 4 crops
  - 3 to 40 weather buffer zones per crop
  - 3 soil map units x 5 soil type units
  - 13 to 25 years

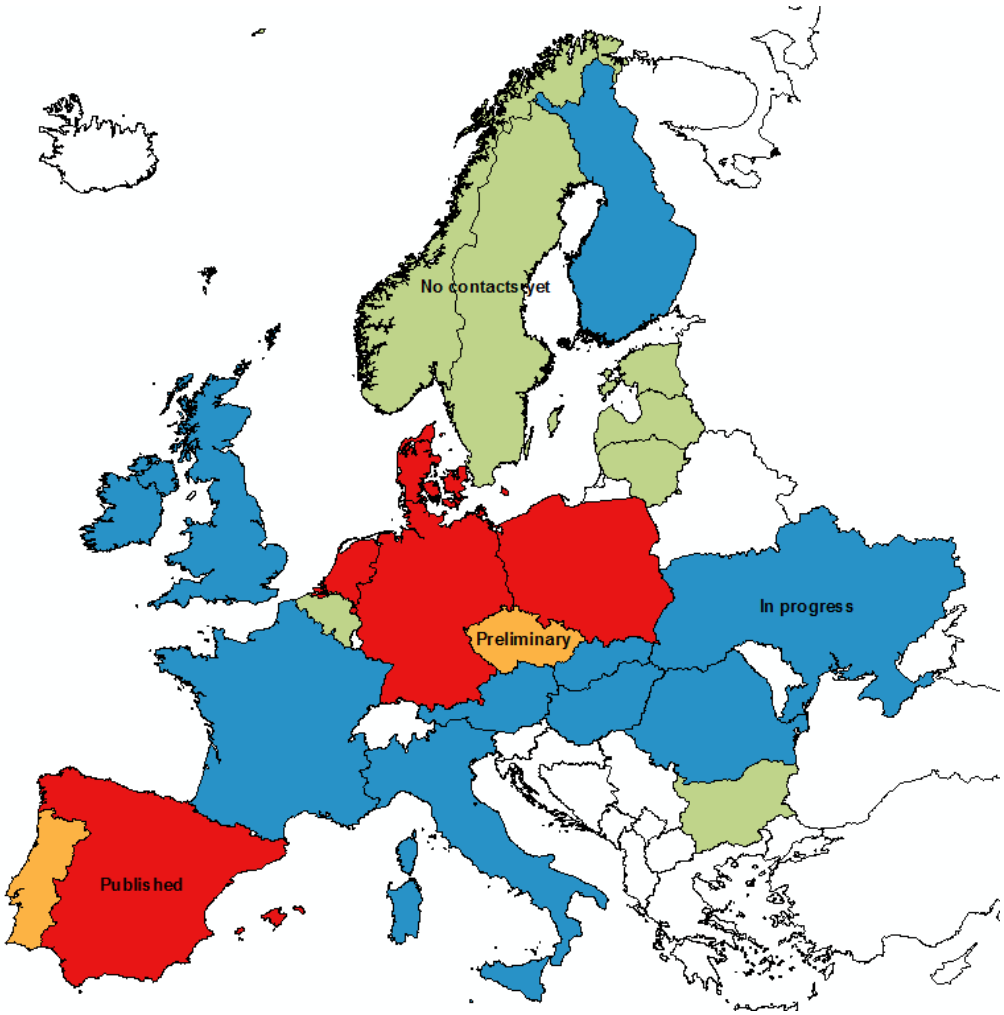
- Crop models
  - WOFOST for all countries
  - Local model (optional)

Cereal yield gaps in Europe

- Background
  - Global Yield Gap Atlas
  - Benchmarking Atlas
- Cereal yield gaps
  - Yield gap protocol
  - **Results so far**
- Outlook
- Questions

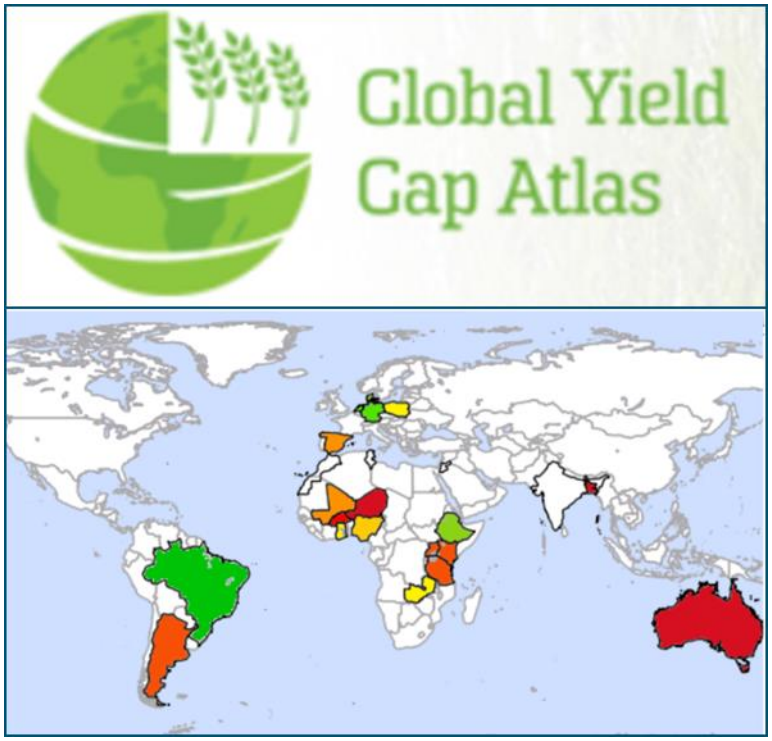
WAGENINGEN UR
For quality of life

Countries under study



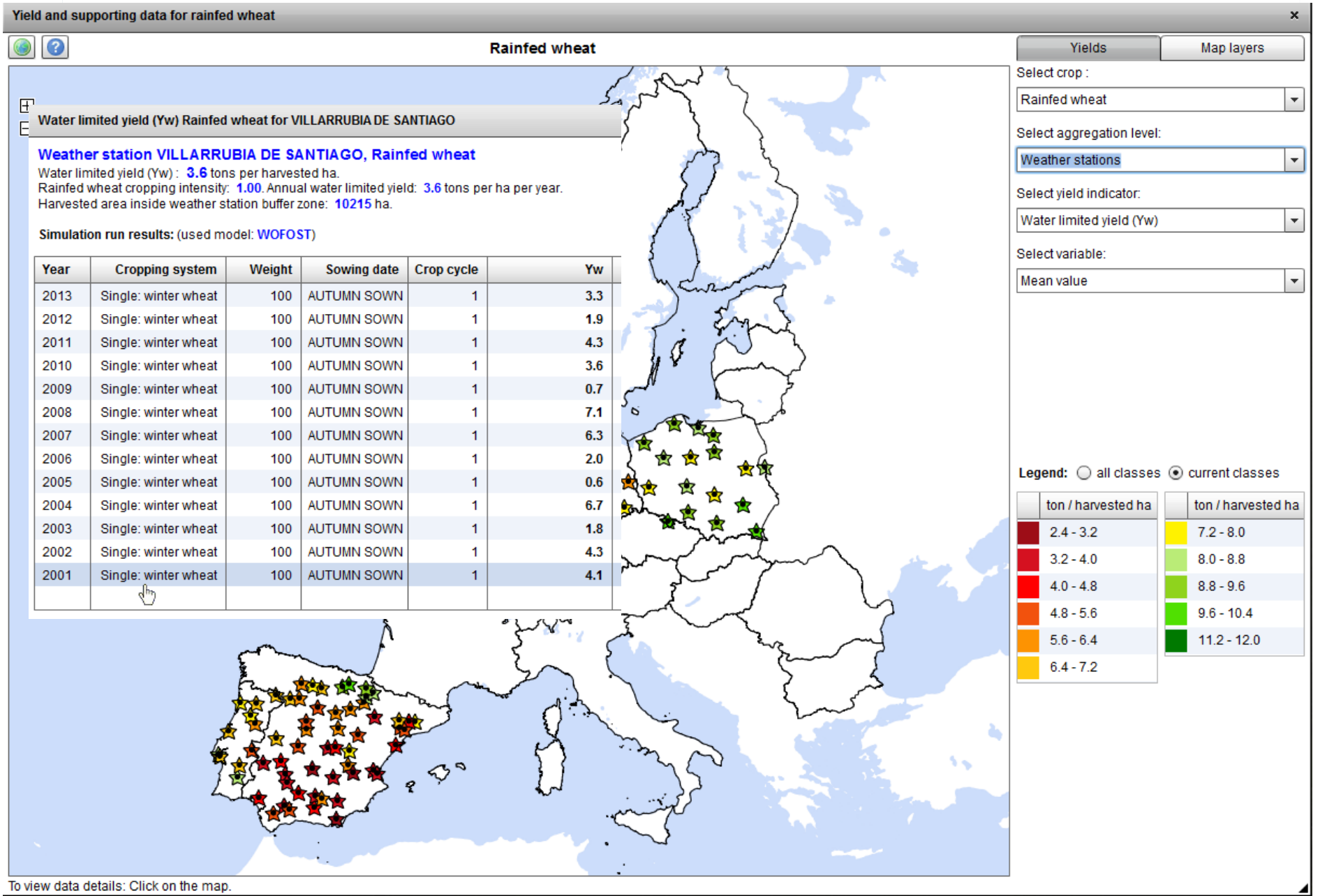
WAGENINGEN UR
For quality of life

Published results

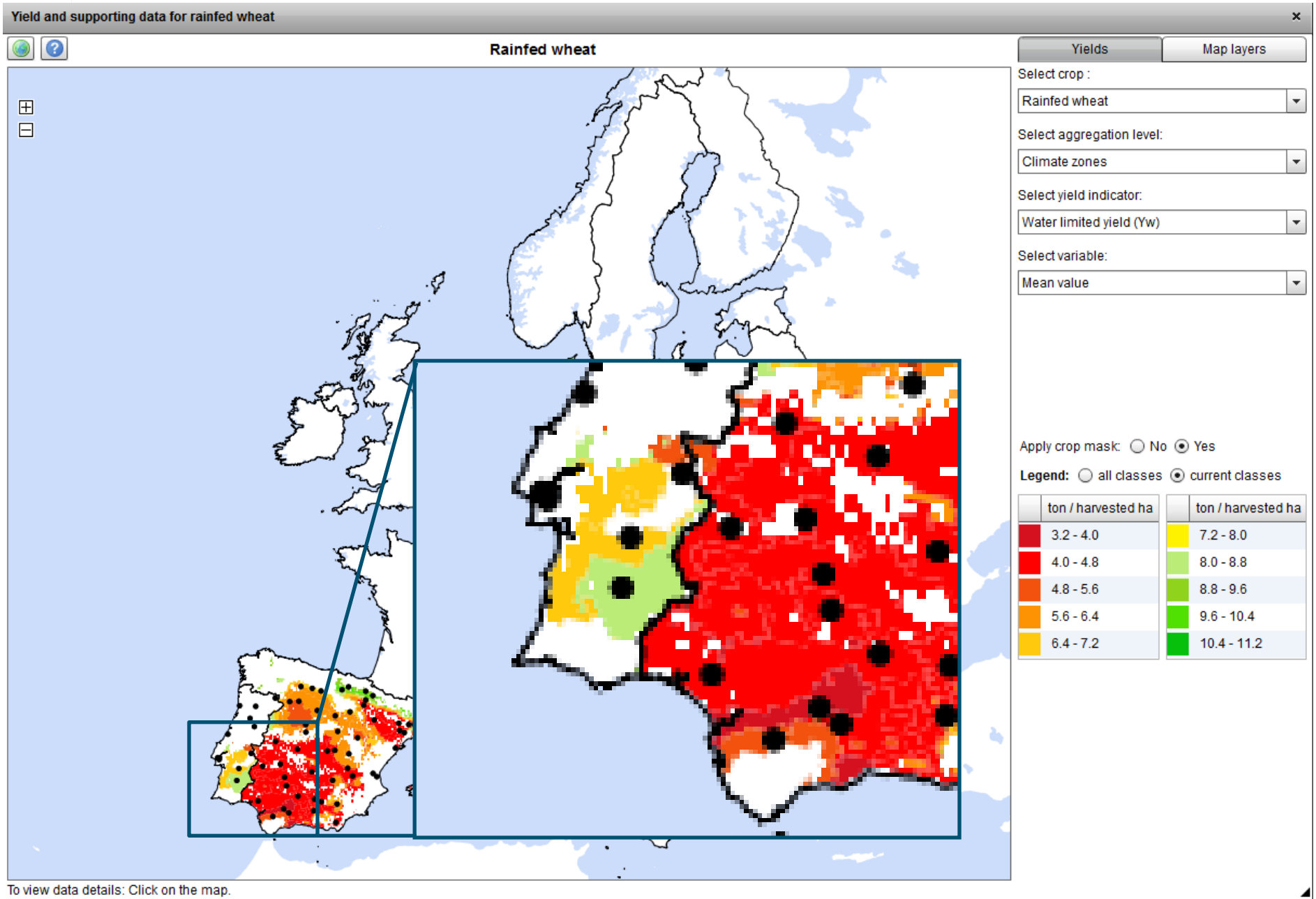


www.yieldgap.org

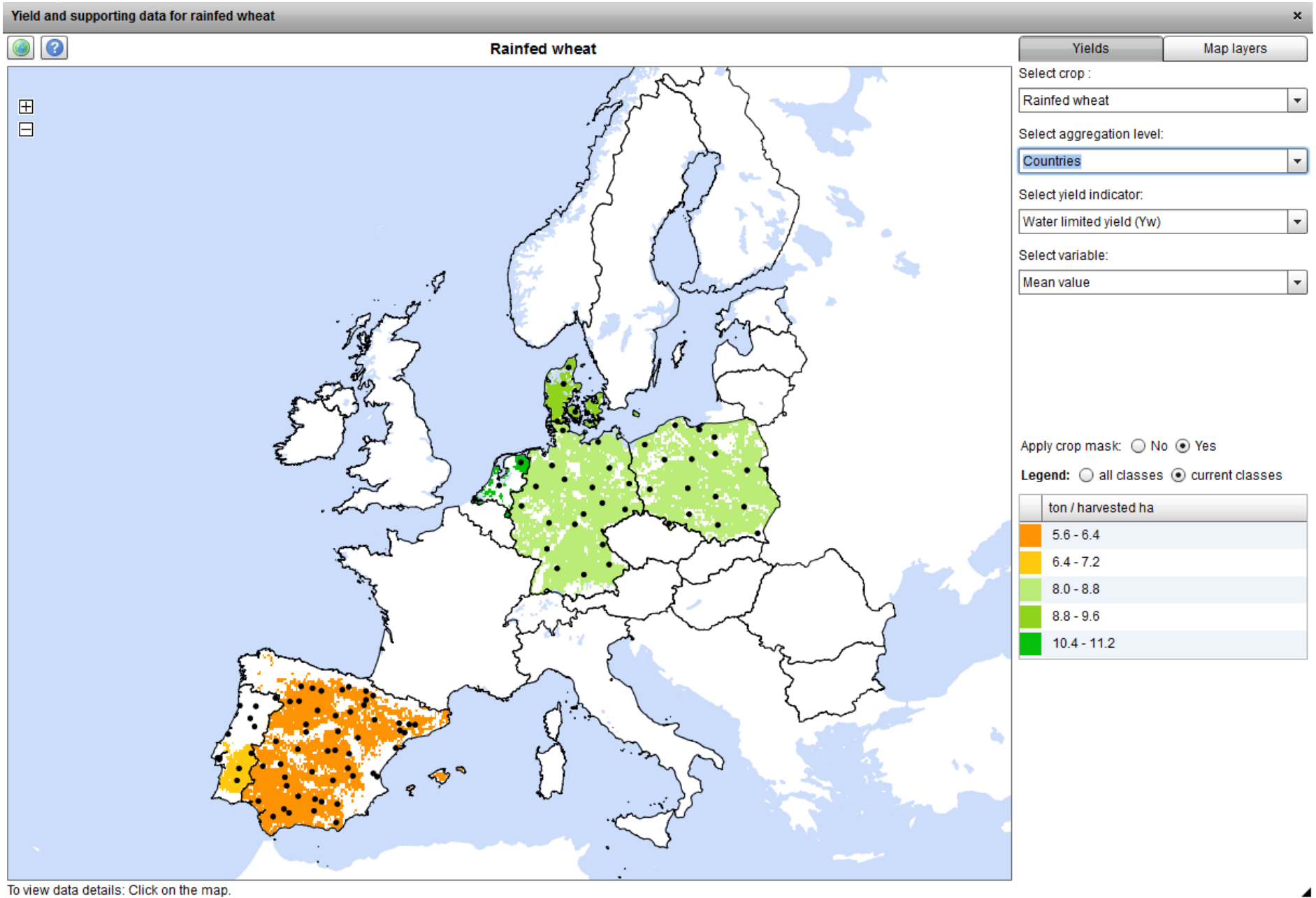
Rainfed wheat - water-limited yield



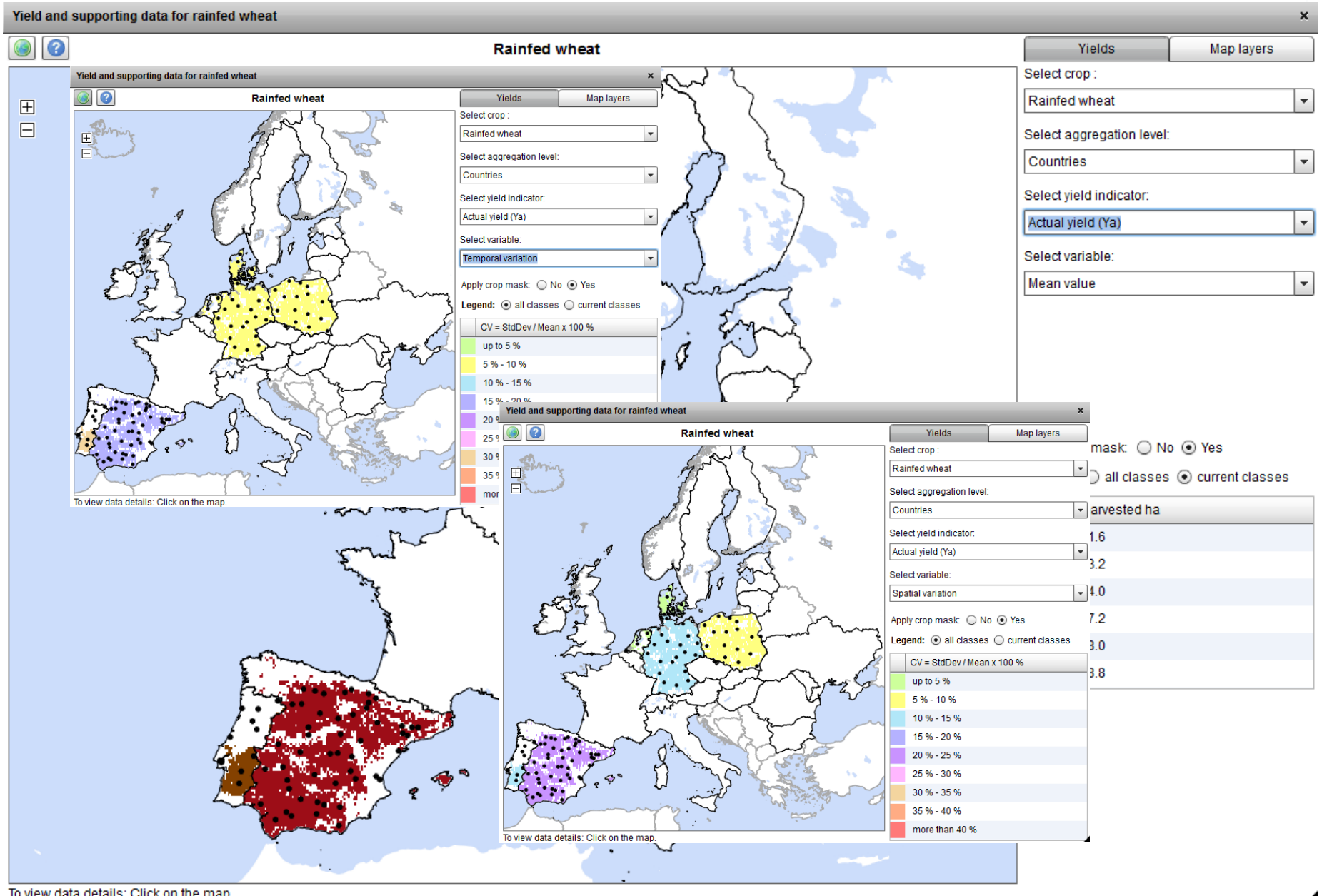
Rainfed wheat - water-limited yield



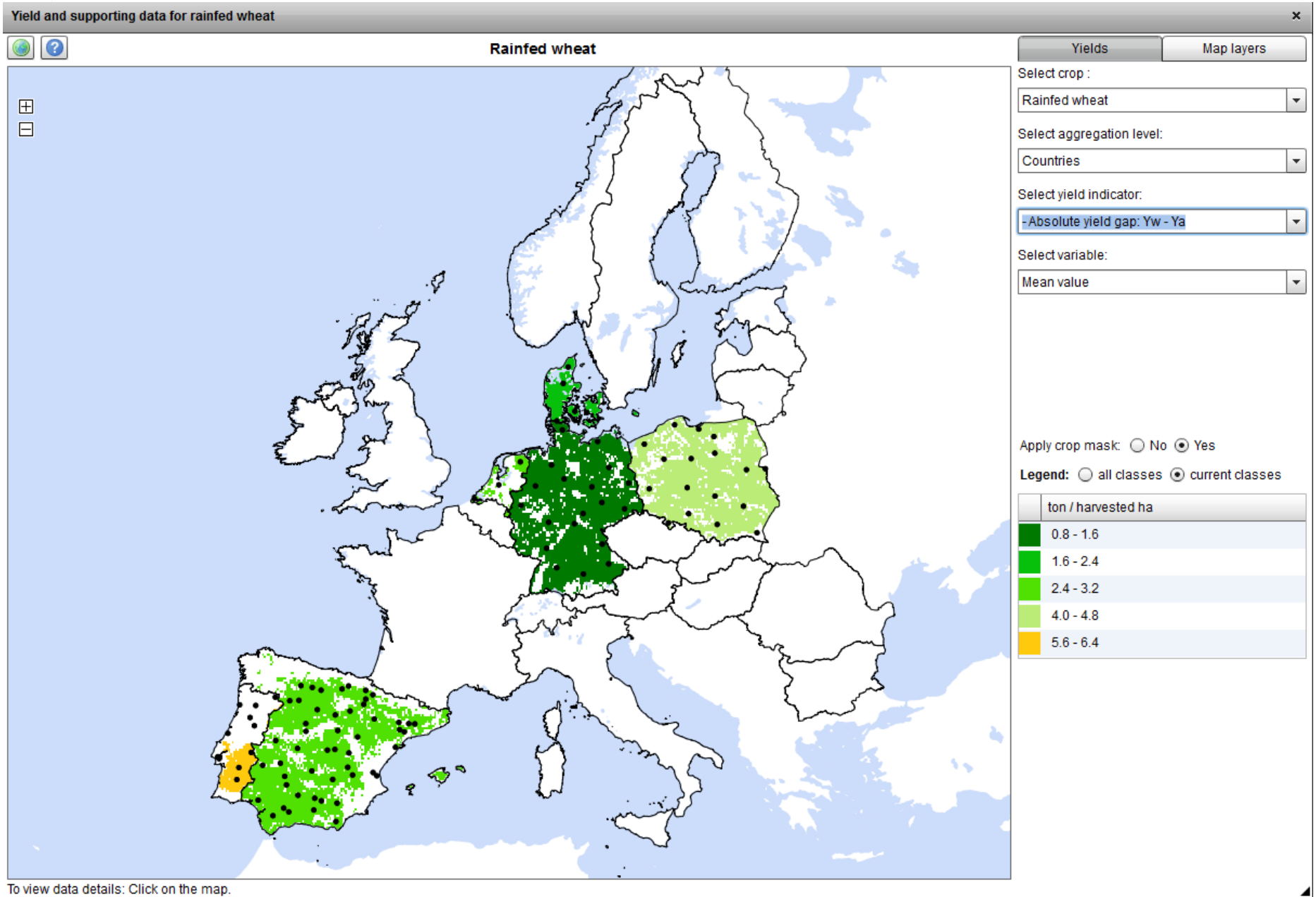
Rainfed wheat - water-limited yield



Actual yield – rainfed wheat



rainfed wheat – yield gap

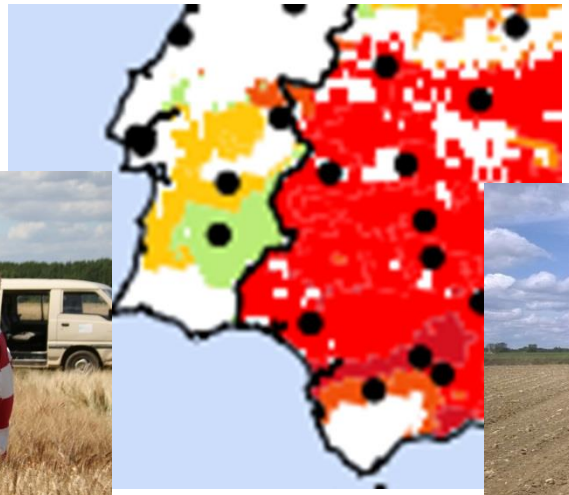


Local approach

- Country agronomist
- Additional data
- Reality check

Local approach

- Country agronomist - bias
- Border effects
- Is the assessment per country really ‘standard’ ?
- Time consuming
- Rigorous selection: leaves valuable information unused

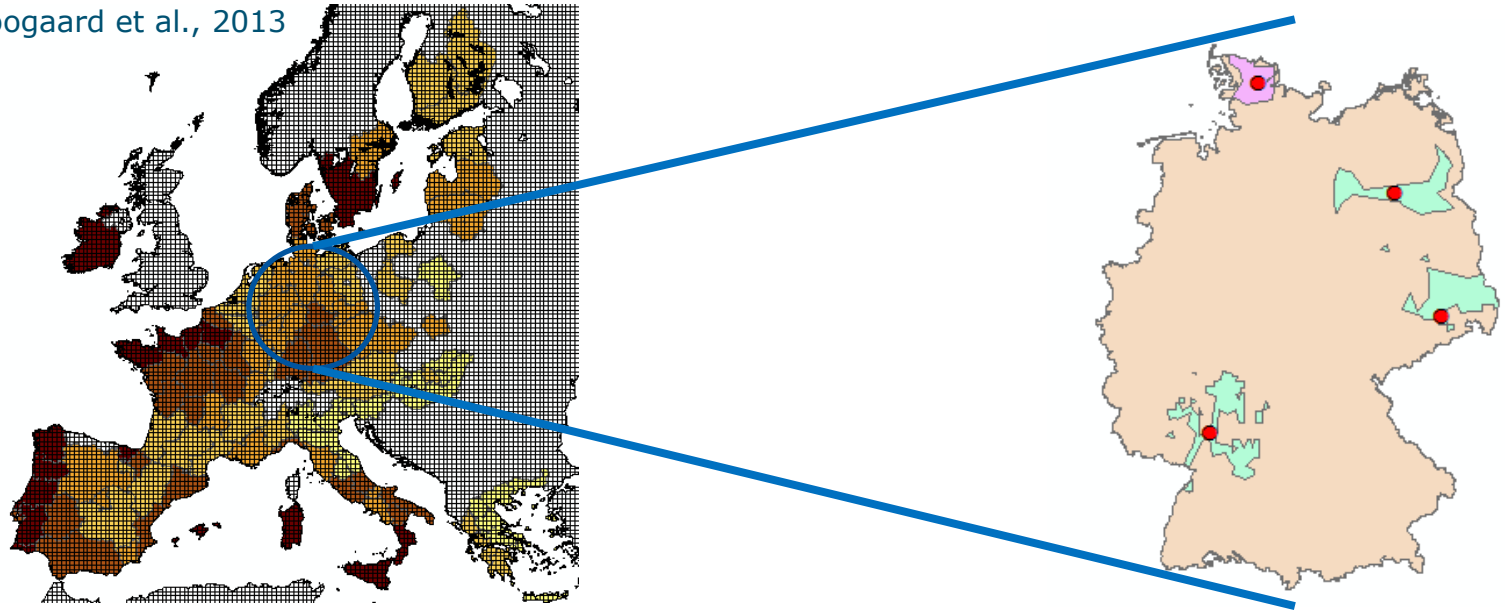


GYGA compared to a grid approach (CGMS)

		GYGA	Boogaard et al., 2013 (CGMS)
Meteo	Source	WMO / additional stations / NASA	WMO / additional stations
	Spatial	Sampled point in climate zone	Grid: 25 km x 25 km
	Temporal	13-23 years of daily data	16 years of daily data
	Data	Actual / different parameters	Derived / Consistent
Soils	Source	European soil map (JRC)	European soil map (JRC)
	Spatial	1 km x 1 km	1 km x 1 km
	Temporal	-	-
	Data	3 dominant soil map units	All soil map units
Crop calender	Source	AgroPheno + additional sources	AgroPheno
	Spatial	Point -> Weather station zone	Point -> Grid 25 km x 25 km
	Temporal	Later than 1990	16 year
Actual yield	Source	National statistics	FADN
	Spatial	NUTS2 – NUTS3	FADN-regions
	Temporal	5 to 10 year	16 year
Crop simulation	Model	WOFOST + others	WOFOST
	Calibration	Boons-Prins/ASEMARS + local data	Boons-Prins/ASEMARS
	Spatial	Weather station -> climate zone	Grid: 25 km x 25 km
	Temporal	13-23 year	16 year

Comparison CGMS – GYGA: Potential yield

Boogaard et al., 2013



Crop Growth Monitoring System

- 25 x 25 km grid
- Interpolated weather per grid cell
- Model inputs per grid cell

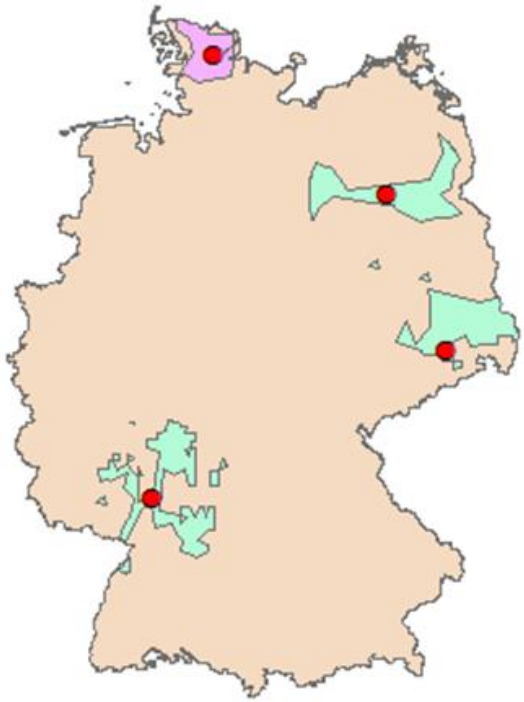
Global Yield Gap Atlas

- Selected zones
- Actual weather per station zone
- Model inputs per zone

WAGENINGEN UR
For quality of life

Comparison CGMS – GYGA: Potential yield

	Yield (t DM/ha)		
Method	**CGMS**	**GYGA**	**GYGA**
Meteo	**grid**	**grid**	**zone**
Schleswig	**9.0**		**9.9**
Neuruppin	**8.5**		**8.0**
Dresden	**9.0**		**7.8**
Mannheim	**8.8**		**7.8**



WAGENINGEN UR
For quality of life

Cereal yield gaps in Europe - outlook

- Continue 'standard' GYGA-work on Europe
  - Global Yield Gap Atlas
  - Benchmarking Atlas

- MACSUR-2 cross cutting activity (XC 9)

- Methods
  - Look for improvements
  - Compare GYGA to CGMS
  - Uncertainty analysis
  - Using empirical data to estimate attainable yield

WAGENINGEN UR
For quality of life

Yield gap analysis of cereals in Europe

Supported by local knowledge

MACSUR conference, Reading (UK), April 2015

René Schils, Kurt-Christian Kersebaum, Anna Nieróbca, Katarzyna Żyłowska, Inés Minguez, Alba Castaneda Vera, Jørgen Olesen, Behzad Sharif, Hendrik Boogaard, Hugo de Groot, Lenny van Bussel, Joost Wolf, Bert Rijk, Martin van Ittersum

WAGENINGEN UR
For quality of life

zalf

ceigram
Centro de Estudios e Investigación para la Gestión de Riesgos Agrarios y Medioambientales

iUNG

AARHUS UNIVERSITY