Landscape risk analysis of pesticides applied in rice paddy areas in Europe: a case study for a watershed in Lombardy

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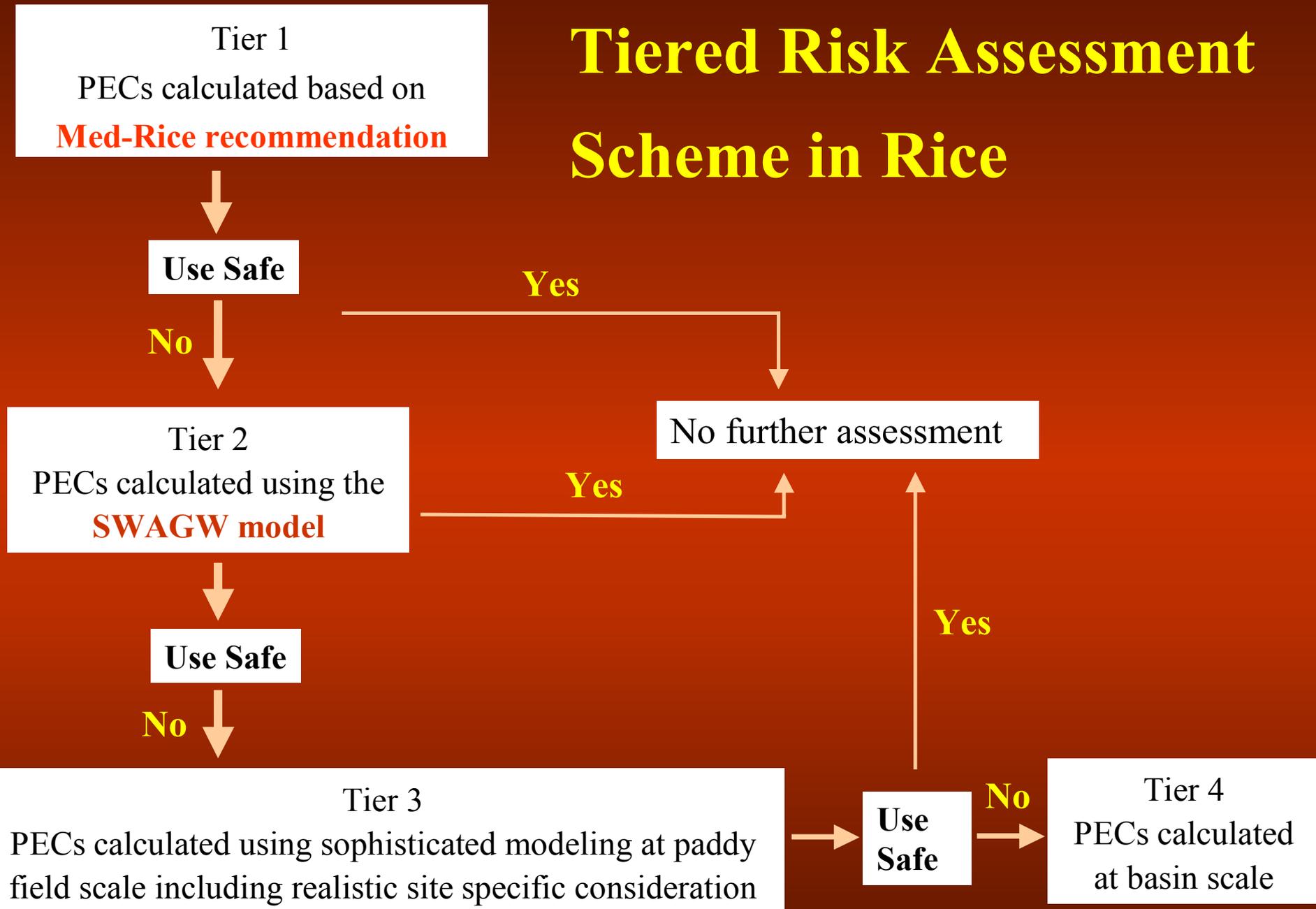
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Πανεπιστήμιο Θεσσαλίας

Risk Assessment in rice in EU

" Council and Commission recognized that due to particular conditions associated to rice cultivation and the specific criteria and principles referred to in Annex IV **were inappropriate**"

Tiered Risk Assessment Scheme in Rice

Tier 1 — PECs calculated based on **Med-Rice recommendation**

Use Safe — Yes → No further assessment

No ↓

Tier 2 — PECs calculated using the **SWAGW model**

Use Safe — Yes → No further assessment

No ↓

Tier 3 — PECs calculated using sophisticated modeling at paddy field scale including realistic site specific consideration

→ **Use Safe** — Yes → No further assessment

No → **Tier 4** — PECs calculated at basin scale

Mathematical Models for higher tier exposure assessment in rice (Tiers 3 and 4)

- ➤ **RICEWQ 1.6.4v:** PECs in paddy water, paddy sediment and PECs GW when used in an interface with the VADOFT sub-model (Tier 3)

- ➤ **RIVWQ 2.02v:** Surface water model used in combination with RICEWQ for receiving water systems (Tier 4)
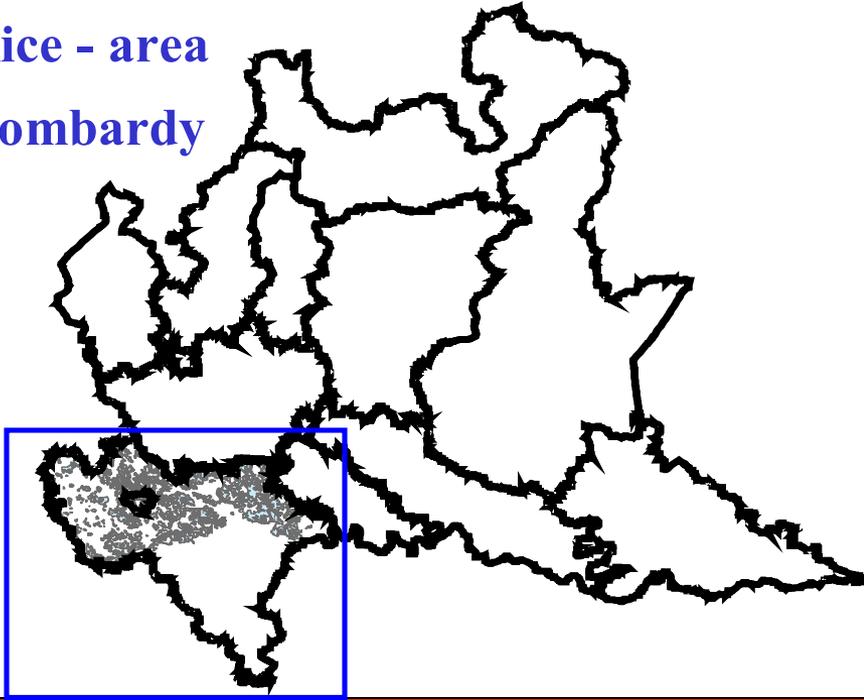
Tier 4 - Basin Scale Exposure Assessment

Rice paddies, drainage and irrigation canals *and* related natural surface water bodies like streams and rivers *create a unique ecosystem which should be studied as a whole*
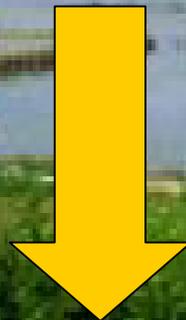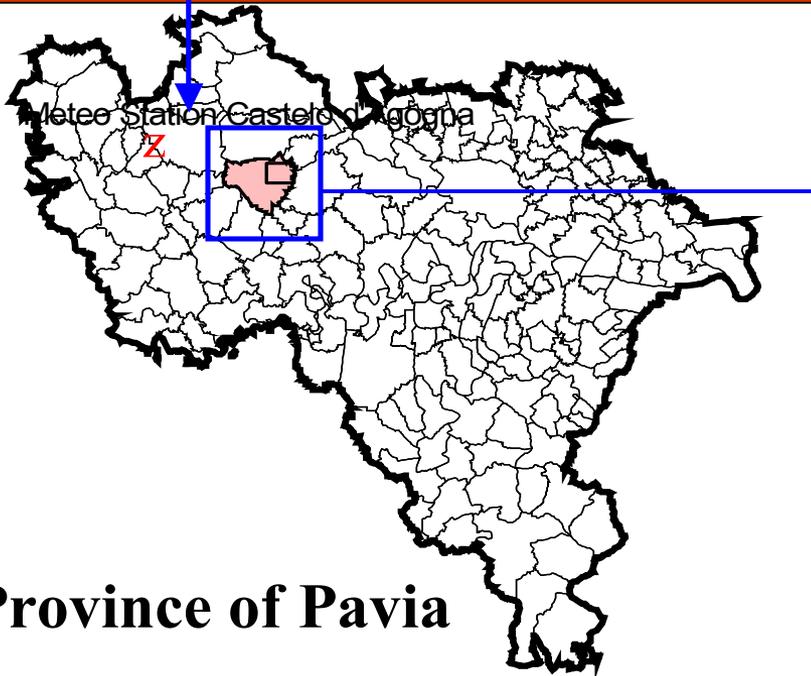
Spatial scaling up is relevant

Rice - area Lombardy

Province of Pavia

Case study: pesticide exposure assessment for a small rice-cultivated watershed in Lombardy, Italy

Soil Texture
- Loam
- Loamy Sand
- Sandy
- Sandy Loam
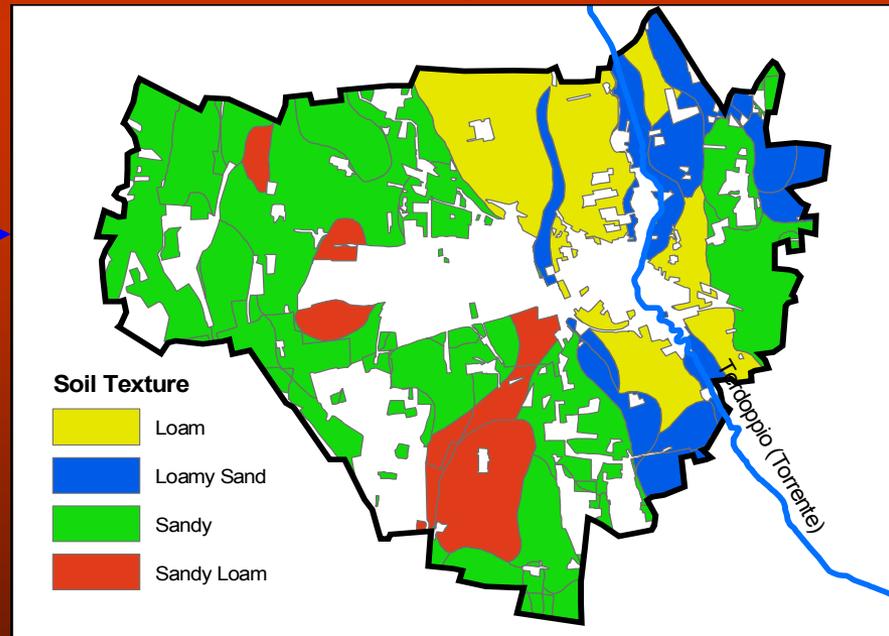
Community of Tromello

What data were available?

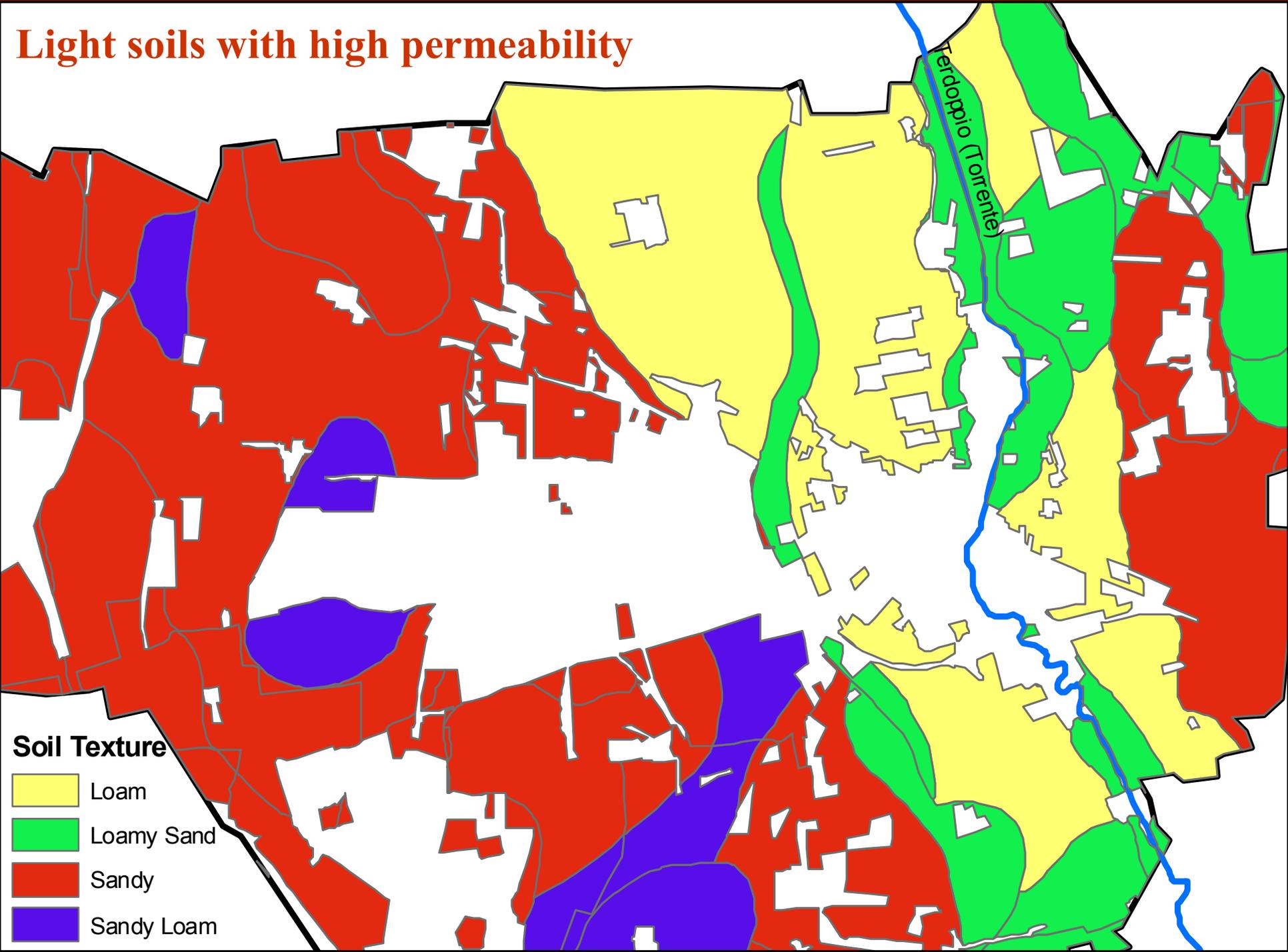Spatial data at scale 1:50,000 for the rice cultivated area of Lombardy (Lomellina), **Community of Tromello**

- Technical card

- Aerial photographs

- Landuse

- Soil data (soil texture, OM, pH, permeability etc)

- Network of surface water bodies
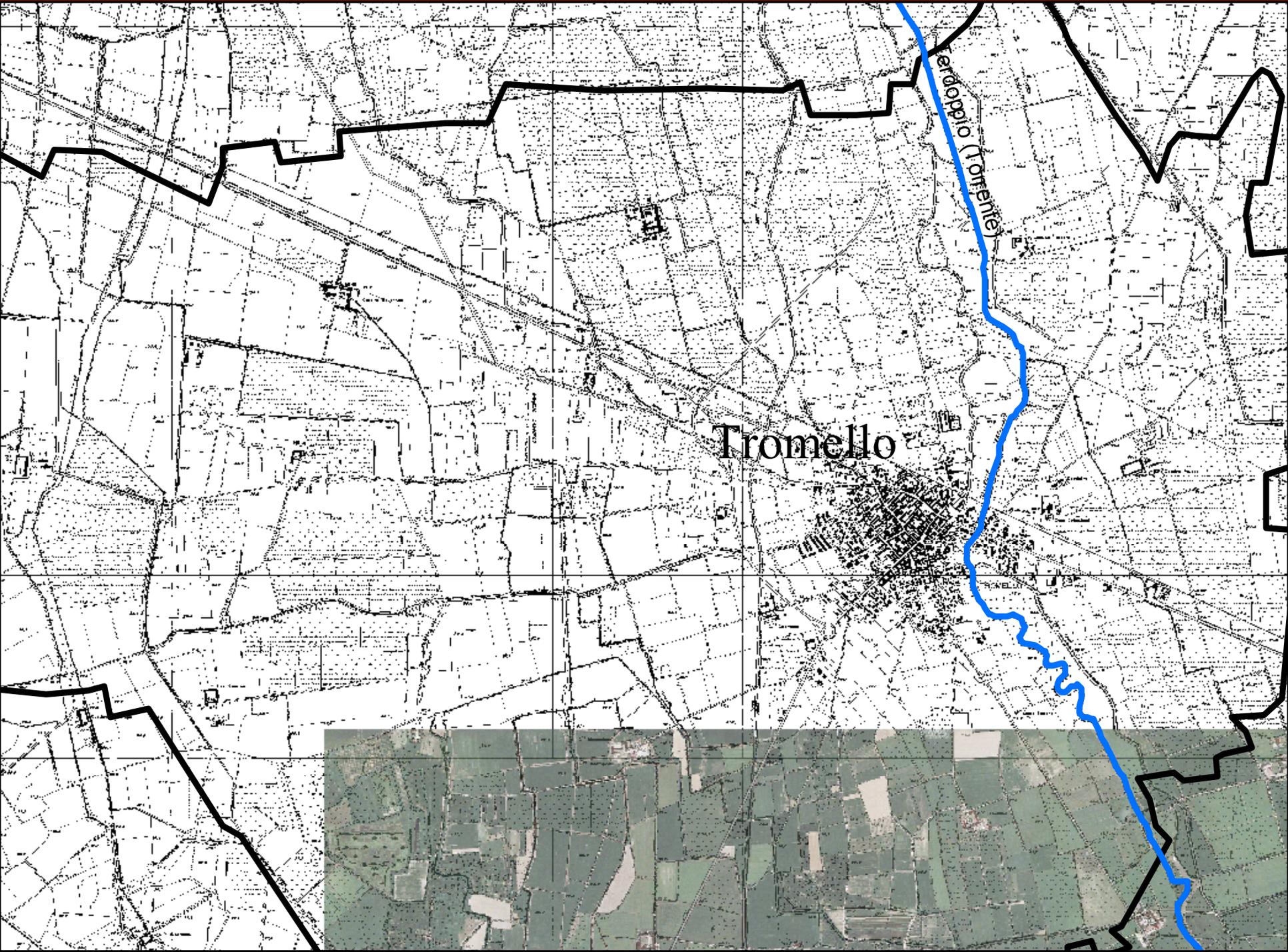
Tromello
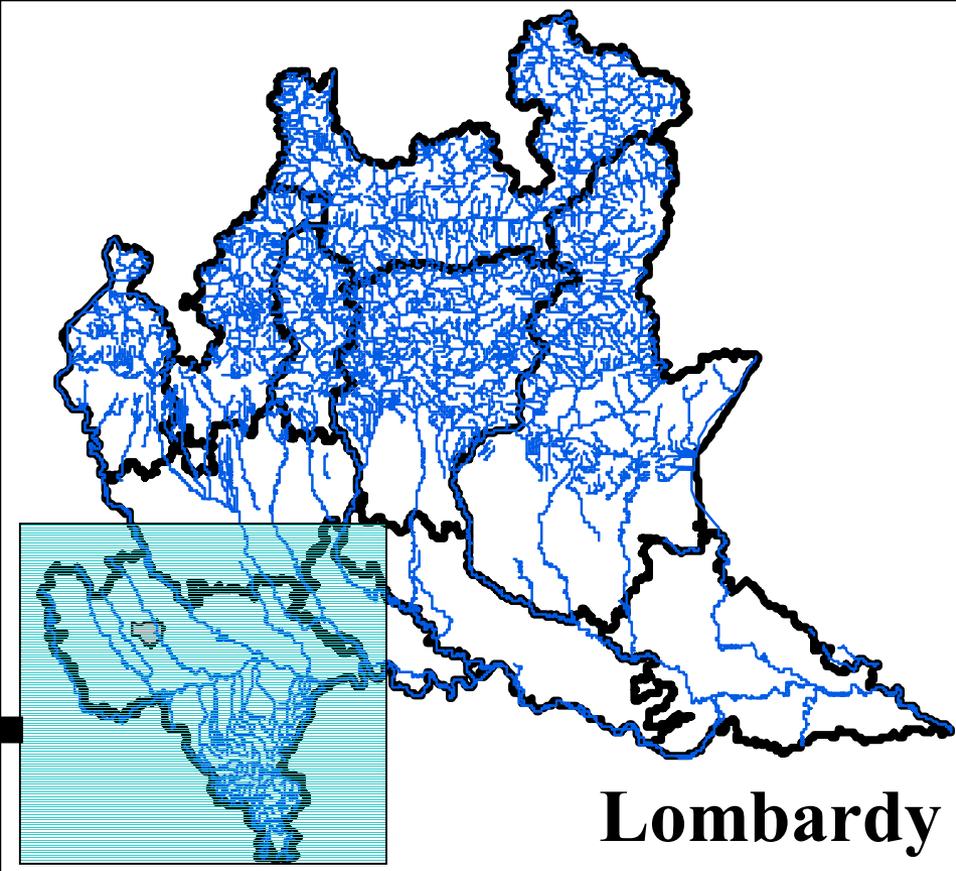
erdoppio (Torrente)
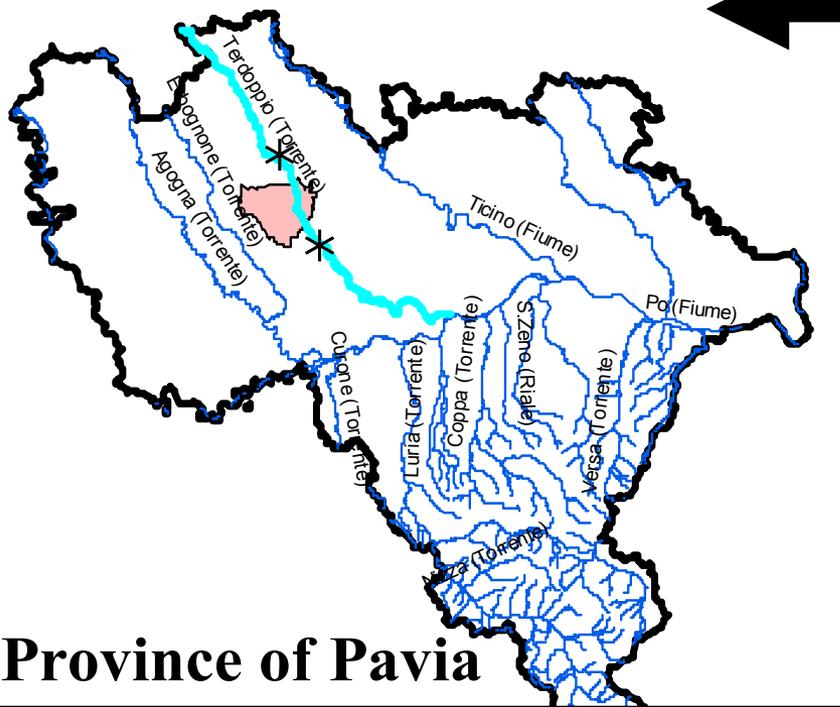
Light soils with high permeability

Terdoppio (Torrente)

Soil Texture

Loam

Loamy Sand

Sandy

Sandy Loam

Surface water bodies in Lombardy

Lombardy

Province of Pavia

Availability of monitoring data for herbicides propanil and molinate at points just before and after the simulated watershed

Aim of the work

➢ Use of available GIS spatial data in combination with

RICEWQ and RIVWQ models to assess the exposure of

groundwater and surface water systems **(river Terdoppio)**

to pesticides **(propanil and molinate)** used in a rice

cultivated watershed in the community of Tromello,

Lombardy

Studied Rice Cultivated Watershed

Total Watershed Area: 467 ha (201 paddy fields)

Pesticide Treatment (Scouting and interviews with farmers)

- **Molinate treated area: 73 ha (31 fields)**
- **Propanil treated area: 243.4 ha (85 fields)**
- **Area untreated or treated with other herbicides: 150.6 ha**
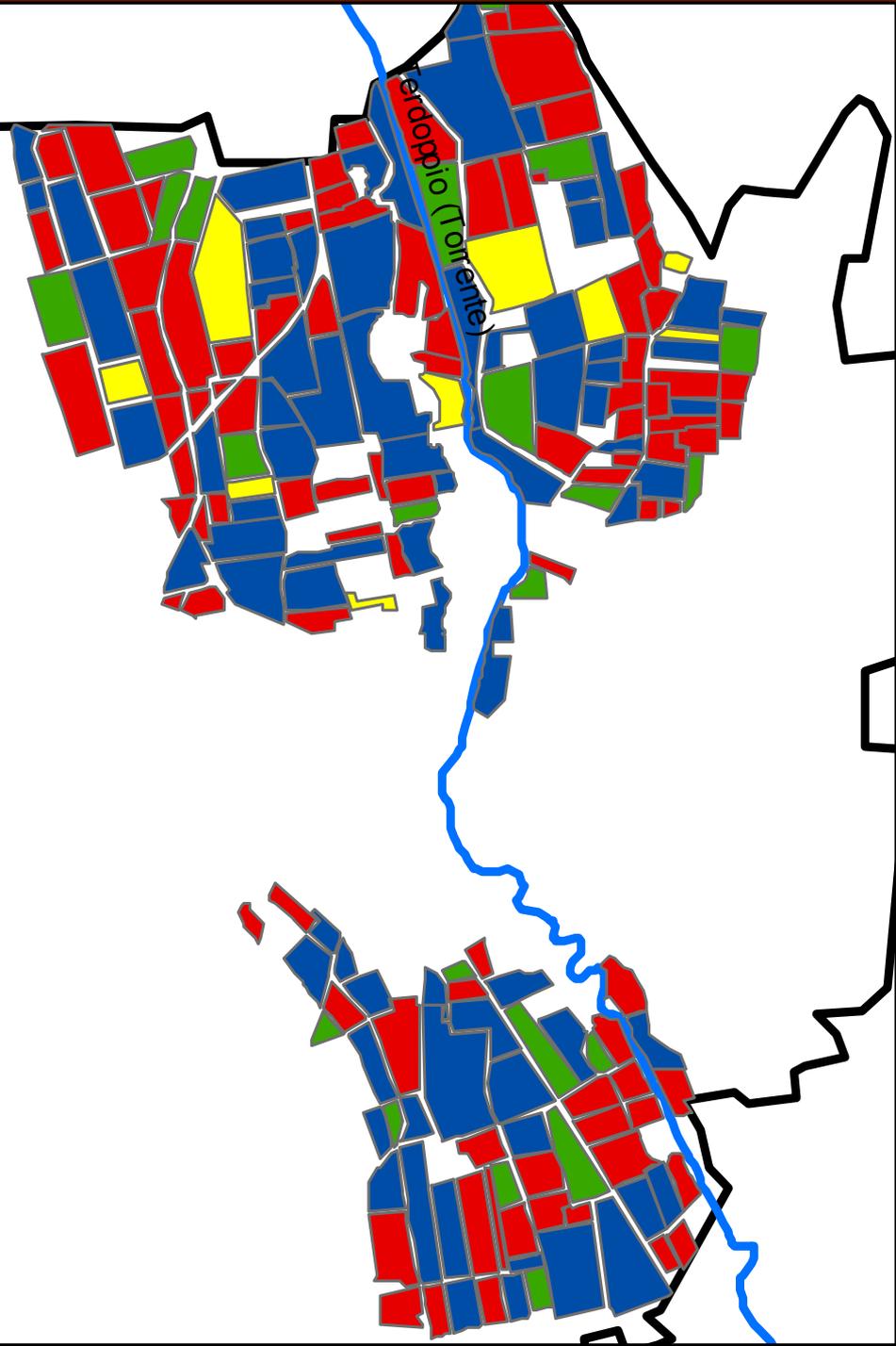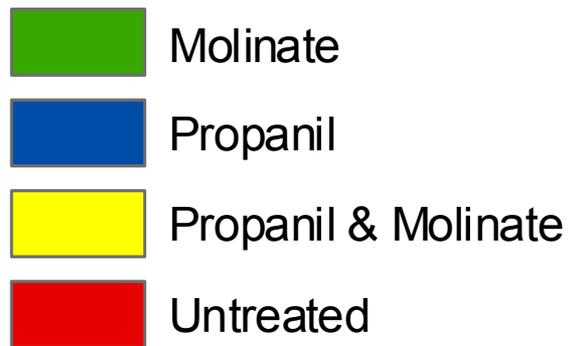
Mode of Cultivation (Local experts and interviews)

- **Traditional: 326.9 ha**
- **Dry – seeded: 140.1 ha**

Mode of Irrigation – Drainage

- **Continuous Flow-through system**

Paddy Pesticide Treatments

- Molinate
- Propanil
- Propanil & Molinate
- Untreated

Surface water systems simulated

20 Drainage Canals

6 Streams

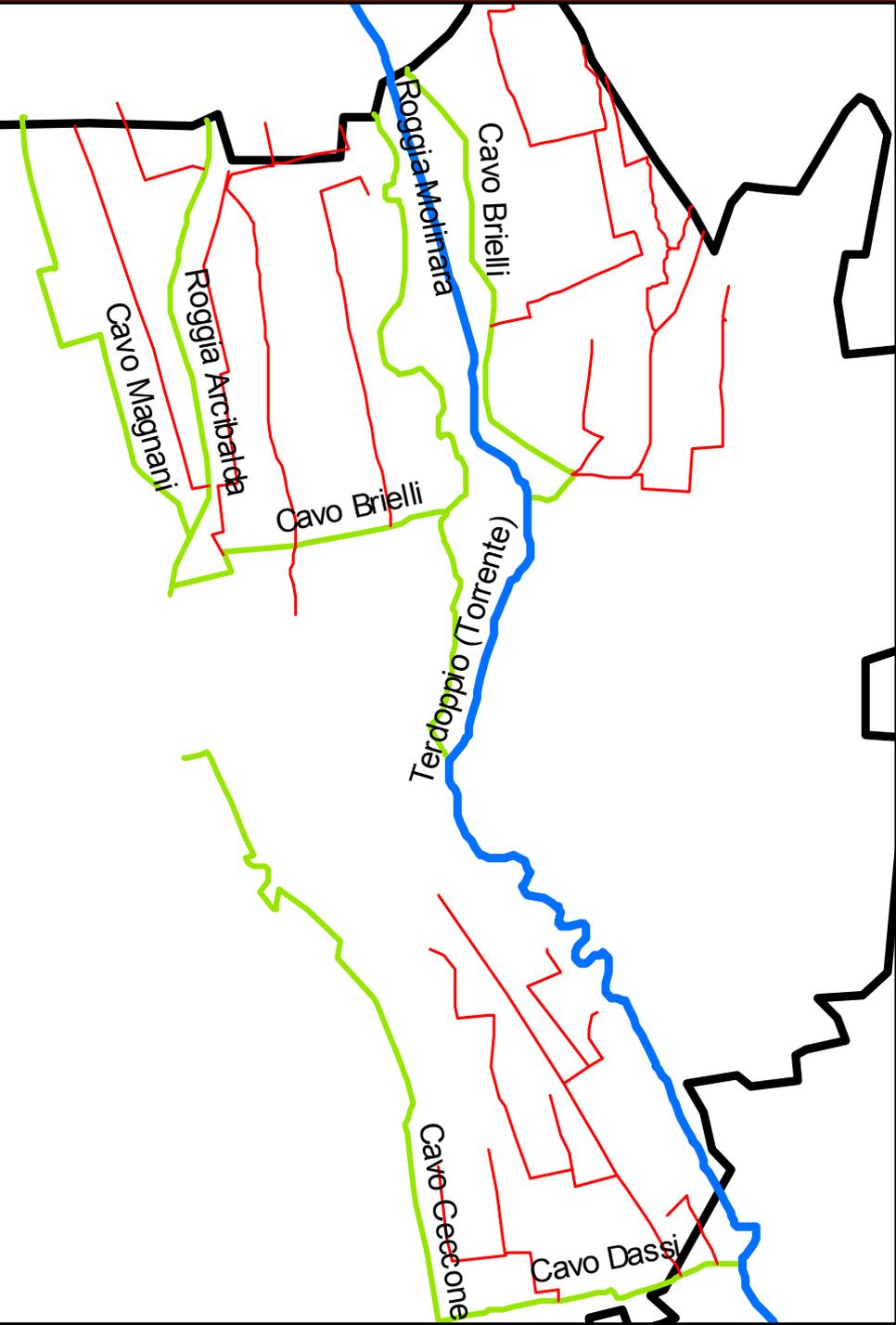C. Brielli, R.Molinara, R. Arcibalda, C. Magnani, C. Ceccone, C. Dassi

River Terdoppio

Surface water bodies network

- ———— river terdoppio
- ———— drainage canals
- ———— streams

Cavo Molinara
Cavo Brielli
Roggia Molinara
Roggia Arcibalda
Cavo Magnani
Cavo Brielli
Terdoppio (Torrente)
Cavo Ceccone
Cavo Dassi

PECs calculation

RICEWQ 10-year simulation in 201 paddies of the simulated watershed

→ **PECs GW for year 1999**

↓

Overflow/Runoff/Controlled Drainage outputs of RICEWQ used as inputs for RIVWQ

PECs SW on the simulated river Terdoppio for the year 1999

↑

↓

RIVWQ simulation of the rice-cultivated watershed with 20 drainage canals linked to 6 streams which discharge their water into river Terdoppio

RICEWQ parameterization

➤ **Irrigation/drainage and crop practices:** Local experts

➤ **Pesticide Treatment:** Scouting and interviews with farmers

➤ **Mode of Application:** Local experts

   - No drift for **molinate (granular application)**

   - Drift losses 2.77% of the application rate for **propanil**

➤ **Frequency of application:** 1 per year for molinate (4.5 kg/ha)

   2 per year for propanil (4 kg/ha)

➤ **Pesticide Properties (K_{deg}, K_d, S_w):** Literature studies in aerobic water/sediment systems

➤ **Soil – Hydrology (percolation rate, soil texture):** Spatial GIS data

RIVWQ parameterization

Characteristics	Drainage Canals	Streams	River Terdoppio
Shape	Rectangular	Rectangular	Rectangular
Length (km)	Variable	Variable	7
Top Width (m)	1.5	6	15
Depth (m)	1.5	2	4
Flow velocity (cm/d)	0.01	0.07	0.2

GW Risk Assessment - Molinate

molinate PECs (µg/L) 2m

- 0.00 - 0.01
- 0.01 - 0.10
- 0.10 - 1.00
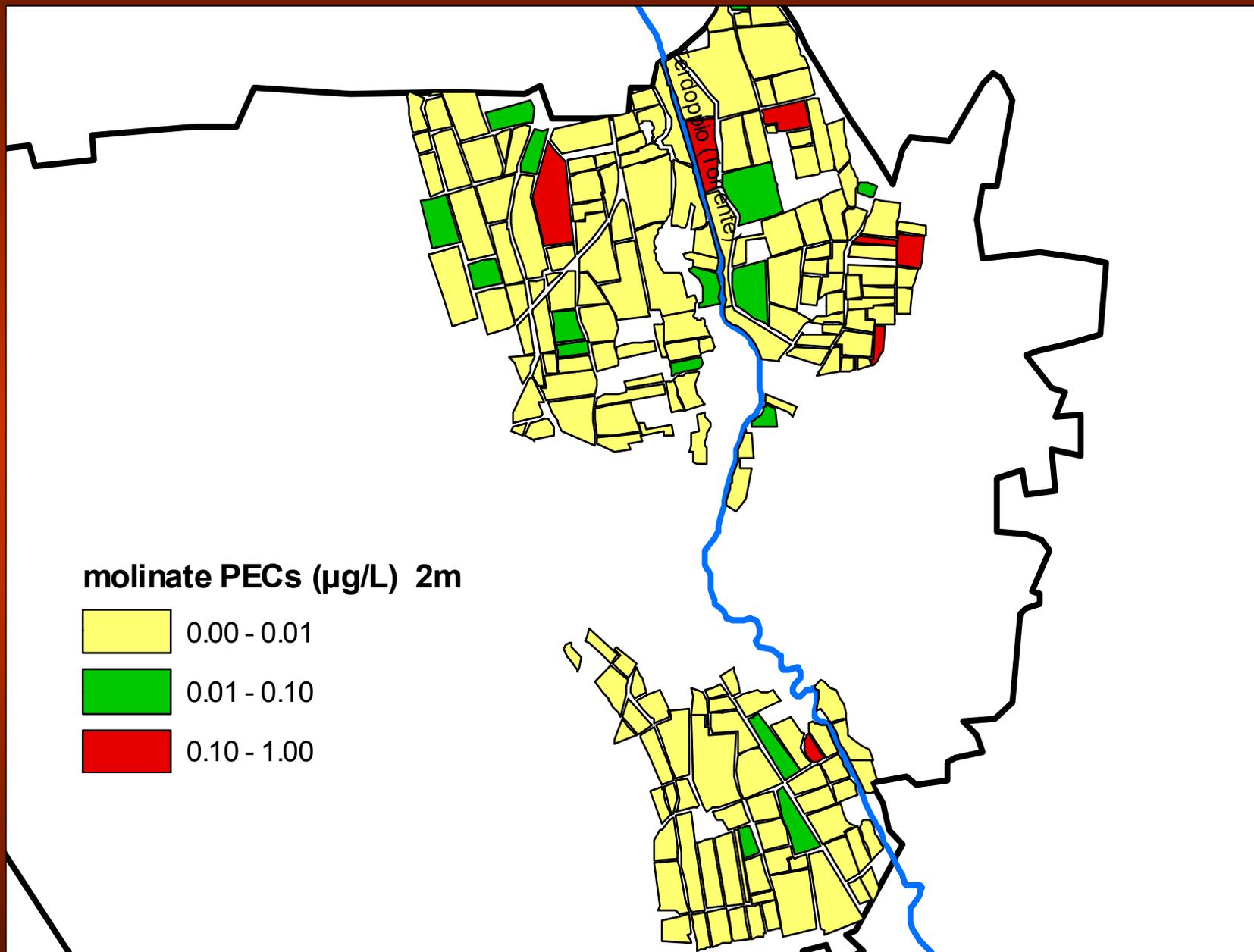
Validation – Surface water predictions

➢ **Comparison of** PECs for propanil and molinate **at the point 6.5 km along the length of the simulated part of the river Terdoppio for the year 1999 with** measured values **at approximately the same point of the river**

➢ **Measured data were kindly provided by the Analytical Laboratory of the Province of Pavia**

Validation - molinate
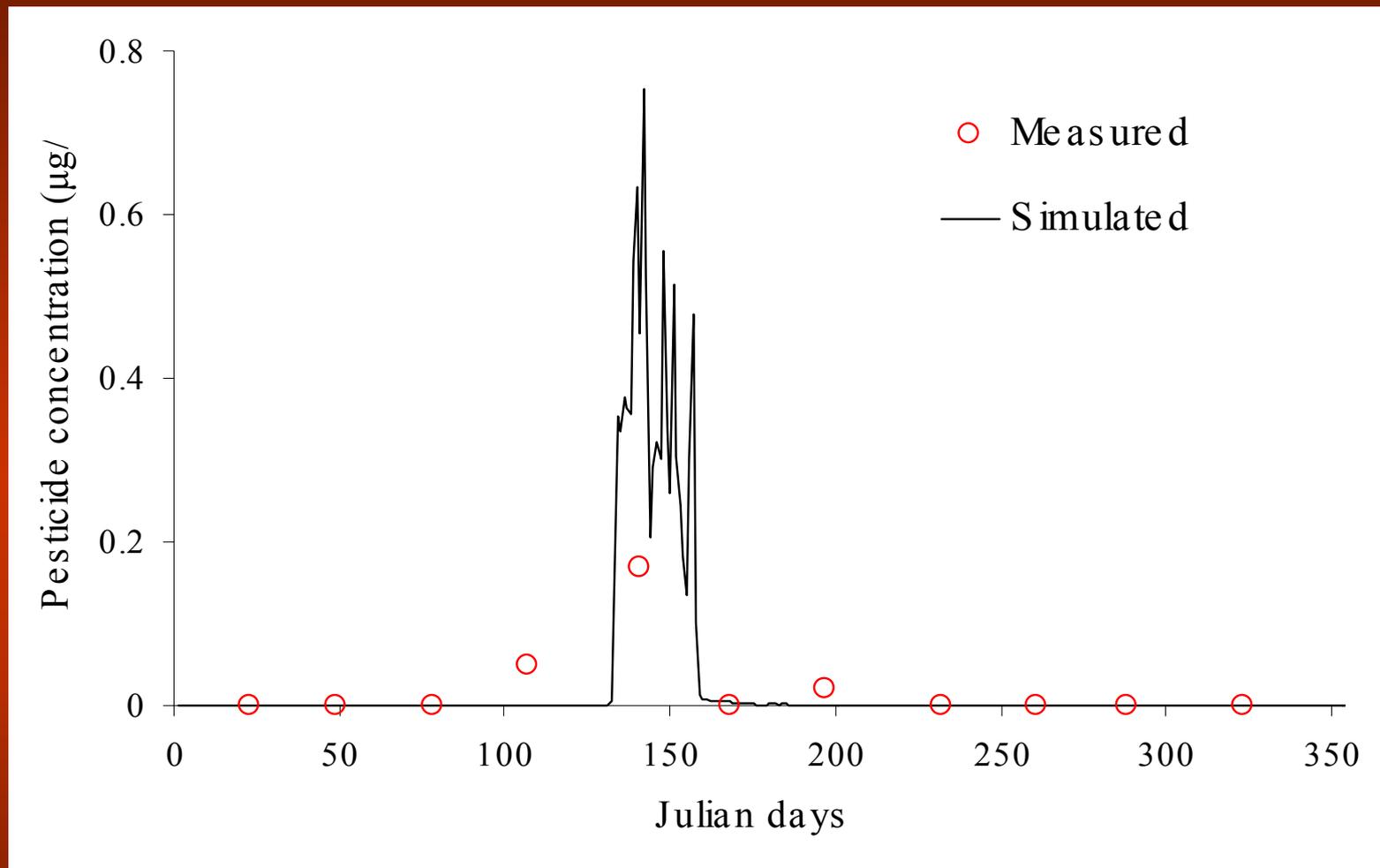
Generally good agreement between simulated and measured concentrations of molinate also at temporal level

Validation - propanil
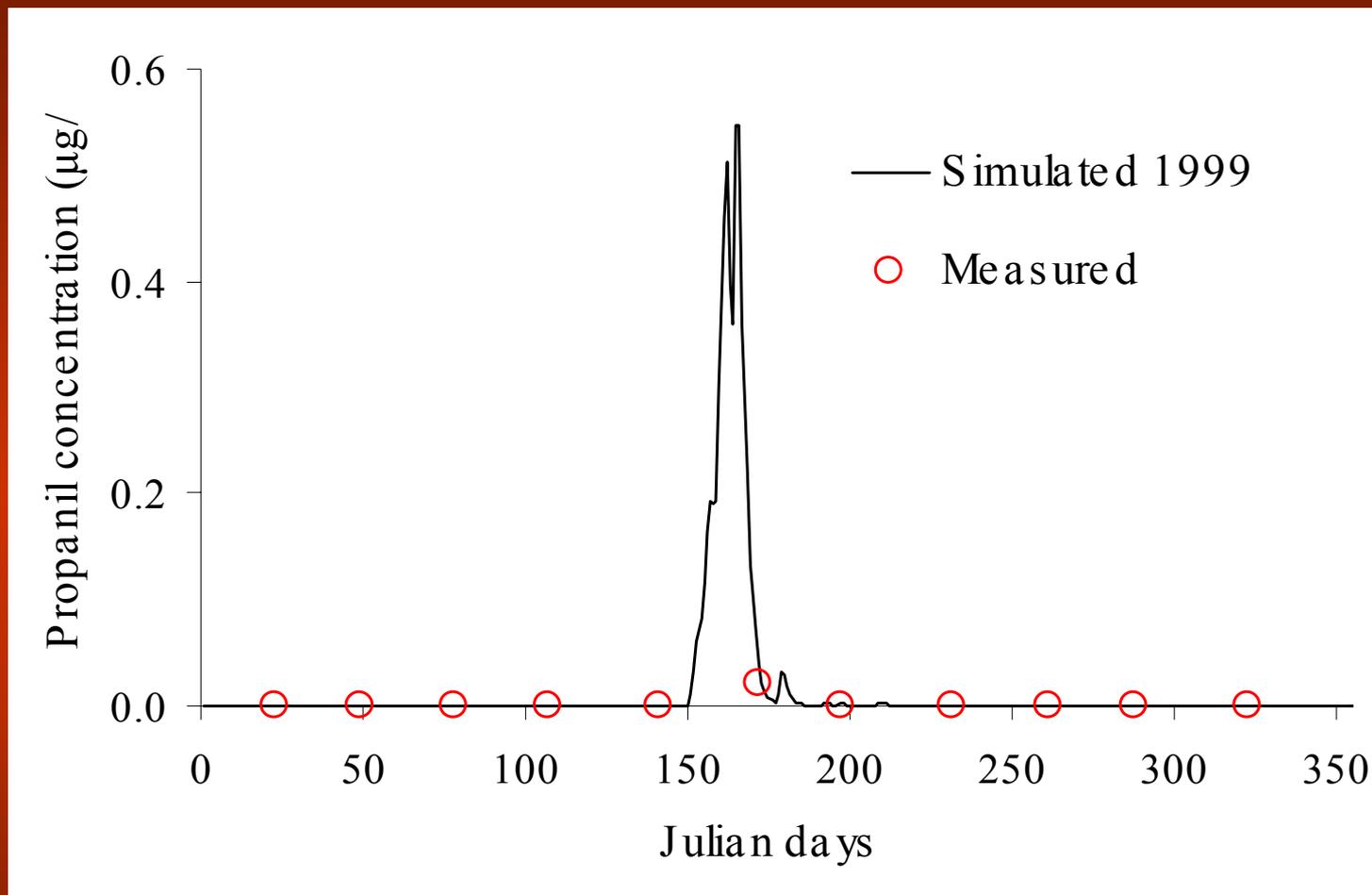
Generally good agreement between simulated and measured concentrations of propanil

Closing remarks

➢ **Propanil entails low risk for GW contamination unlike molinate whose PECs exceeded 0.1 µg/L in certain fields**

➢ **Good agreement between measured and simulated values of molinate and propanil in the river Terdoppio**

➢ **Landscape risk assessment using GIS as pre- or post-processing tool in combination with RICEWQ, RIVWQ models could be used in higher tier exposure analysis in rice cultivated basins**

More information in our website
www.ricewq.org