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Development of scenarios for leaching of pesticides to groundwater in China

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Goals PERAP Project

PERAP
Pesticide Environmental Risk Assessement Project

- To support ICAMA to include environmental risk assessment methodologies and criteria in the pesticide registration procedures

- To form a Chinese-EU science platform that is able to support the regulators with scientific advice in the future

Dutch partners

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For quality of life

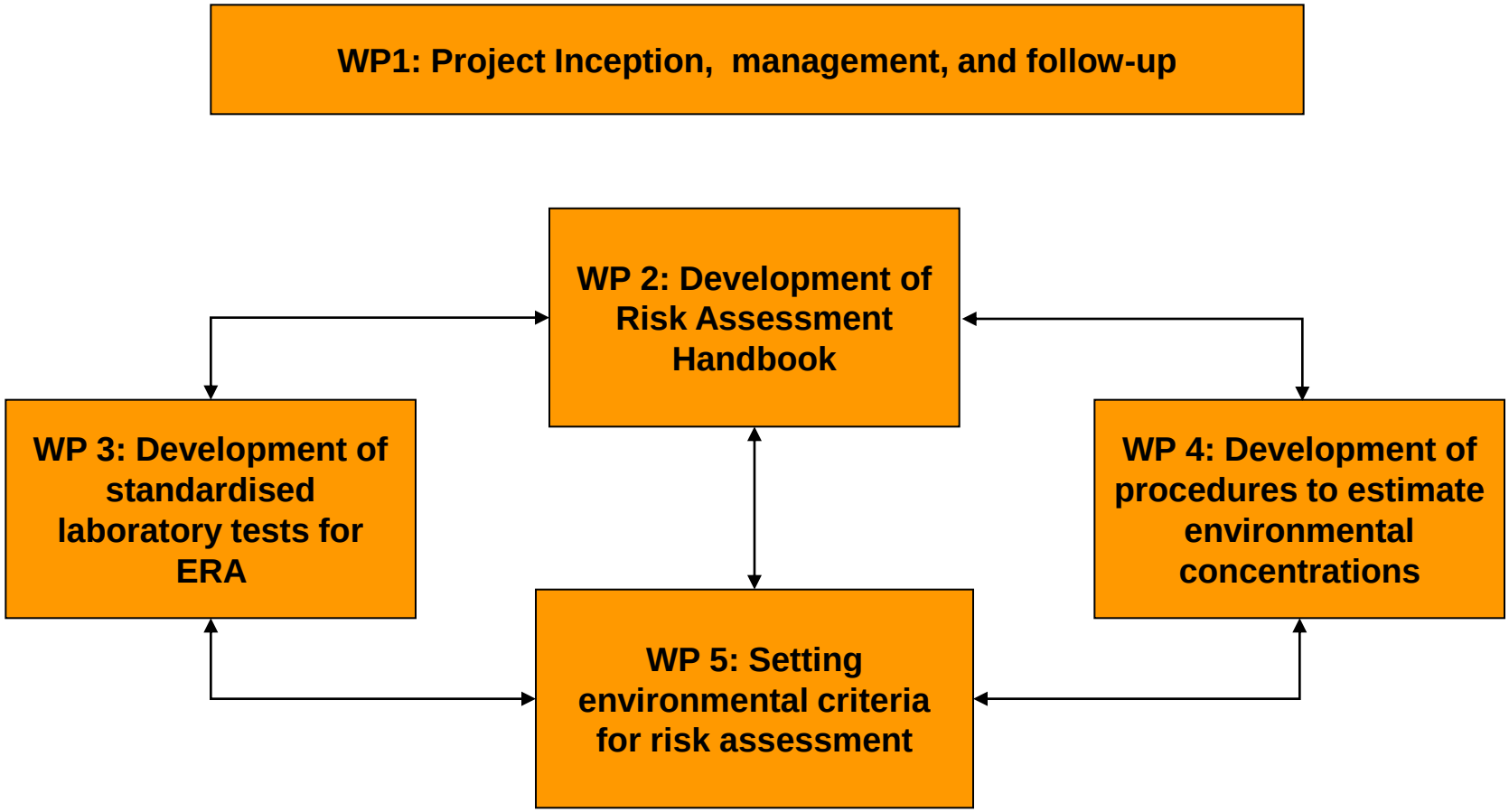
NOTOX
Dedicated. Crystal clear.

Chinese partners

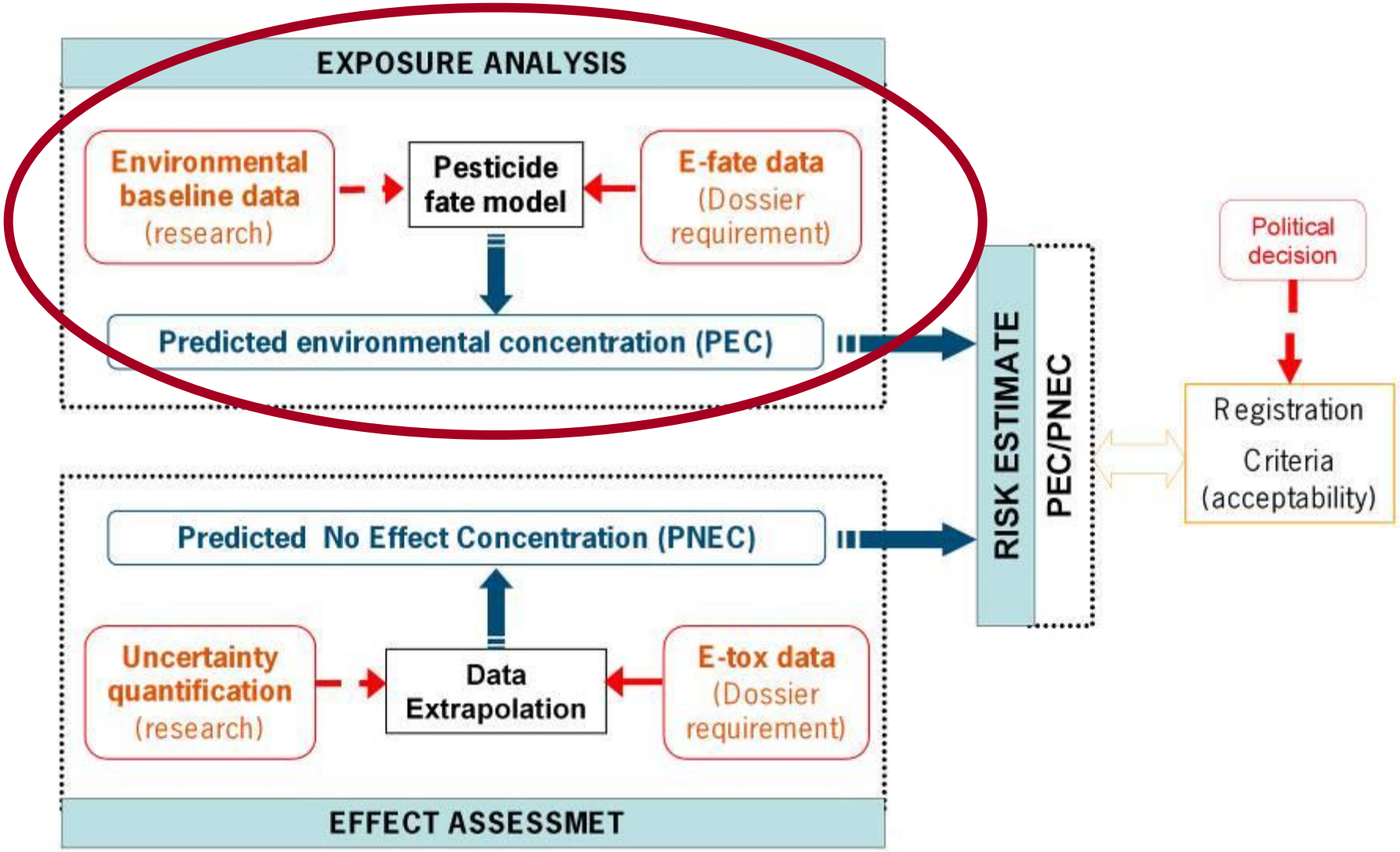
CAAS

ICAMA

Set-up of the PERAP project



Principles of Environmental Risk Assessment



Protection goals

- **Aquatic organisms**

- **Leaching to groundwater**

- Birds (including rodenticides)

- Bees

- Silkworms

Goal of WP4

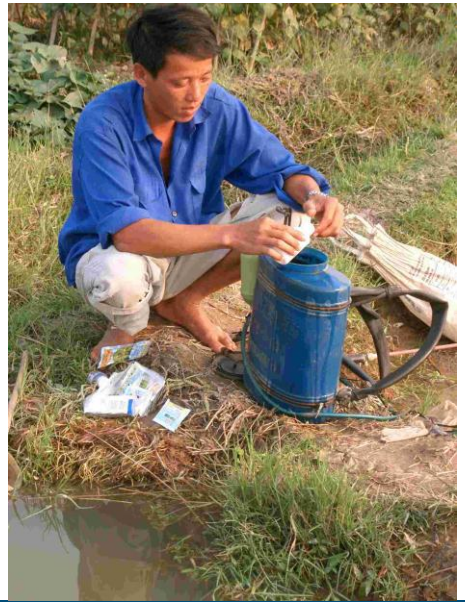
Models and scenarios to estimate:

Focus of this presentation

- Leaching to groundwater
- Exposure in surface water

as a result of normal use of pesticides

normal use



point source pollution

Process: workshops in China

- June 2007:
  - Introduce ICAMA and CAAS to EU methods for assessment of environmental risks of pesticide use.
- October 2007:
  - discuss what and where to protect in China
  - data inventory
  - development of method for China

Solid financial basis from EVD

- February 2008:
  - make work plan for coming 1.5 years,
  - explain method for groundwater in detail
- June 2008:
  - discuss the work done so far on groundwater scenarios
  - field trip
  - rediscuss where to protect aquatic organisms

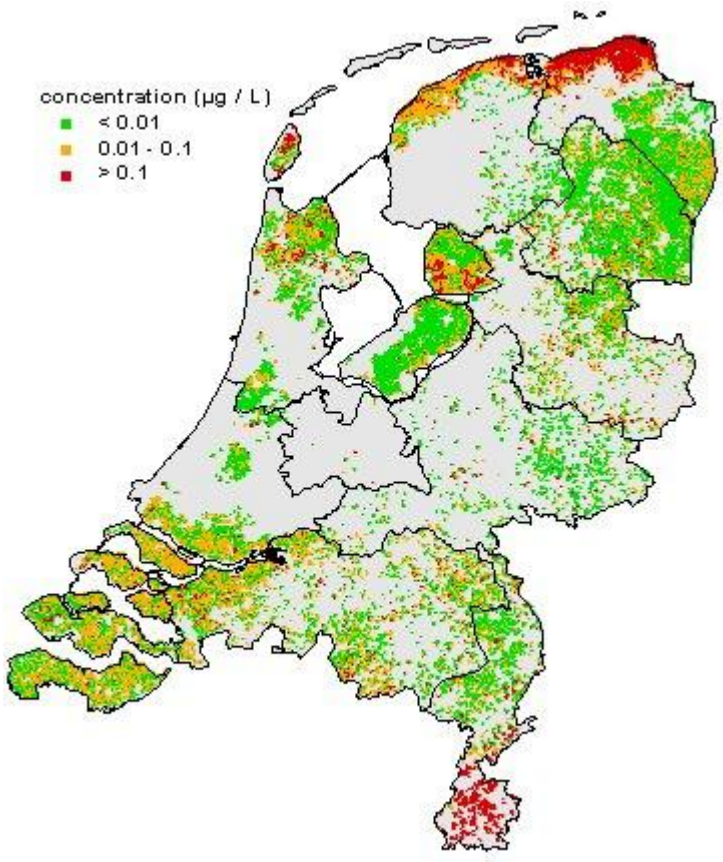
Groundwater scenarios: where is protection needed and what are consequences ?

- groundwater at 2 m depth in southern China:
  - drinking water for small communities
  - estimates on scale of ha are end result

- groundwater at 20 m depth in drinking water wells in northern China:
  - larger scale
  - dilution based on crop area treated can be included
  - later perhaps also degradation in subsoil

Groundwater scenarios

- first: what would be needed for sophisticated approach (GeoPEARL) ?
- then: pragmatic approach

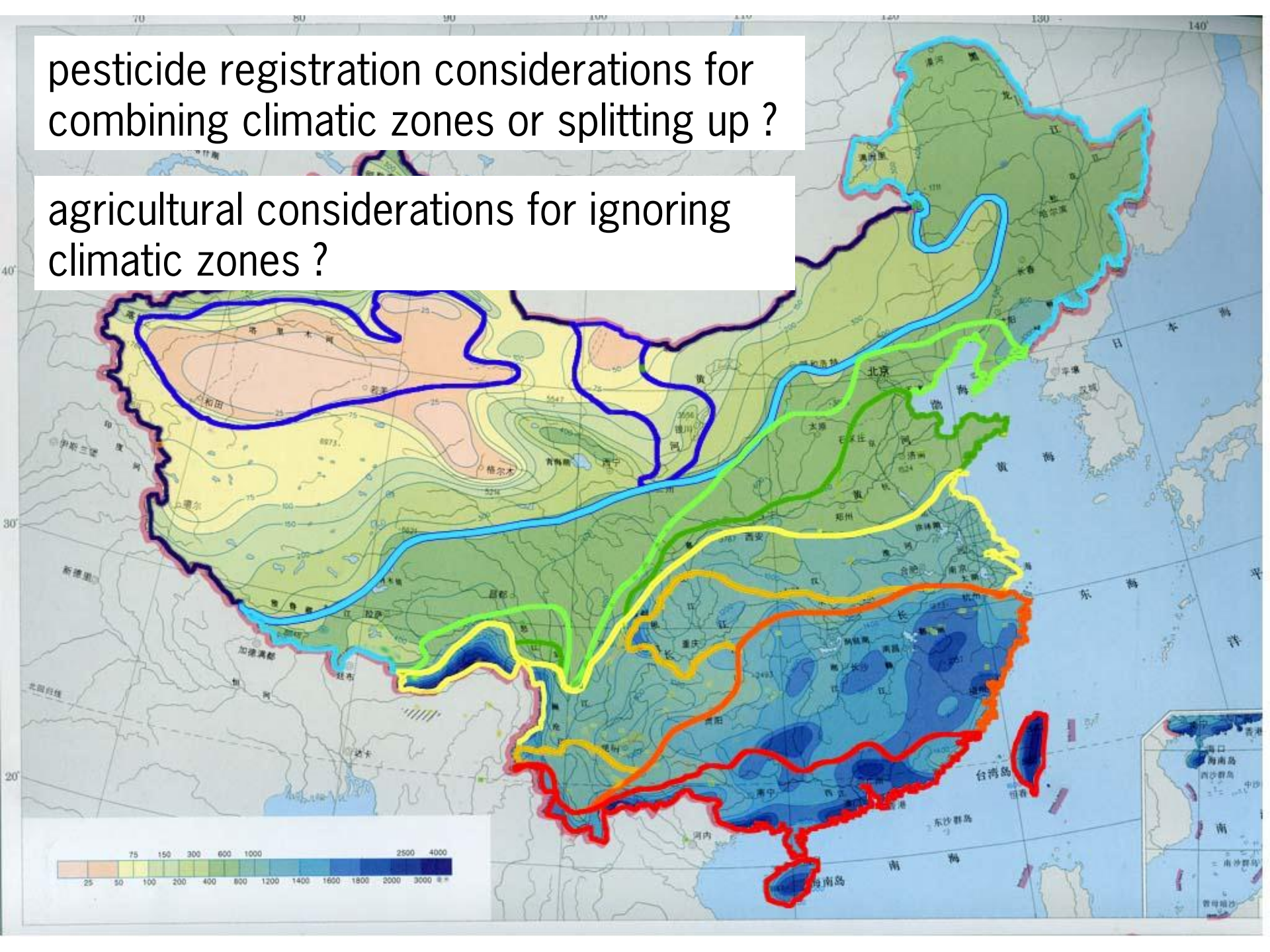


Groundwater scenarios: what needed for GeoPEARL ?

- 250 meteorological stations: OK
- GIS information on land use: available
- **a few hundred soil profiles linked to soil map units**
  - **is this available ? → NO**

Groundwater scenarios

- GeoPEARL China not possible, so pragmatic approach
- Oktober 2007: Chinese Academy of Agricultural Sciences (CAAS) produced nine major climate zones


pesticide registration considerations for combining climatic zones or splitting up ?
agricultural considerations for ignoring climatic zones ?

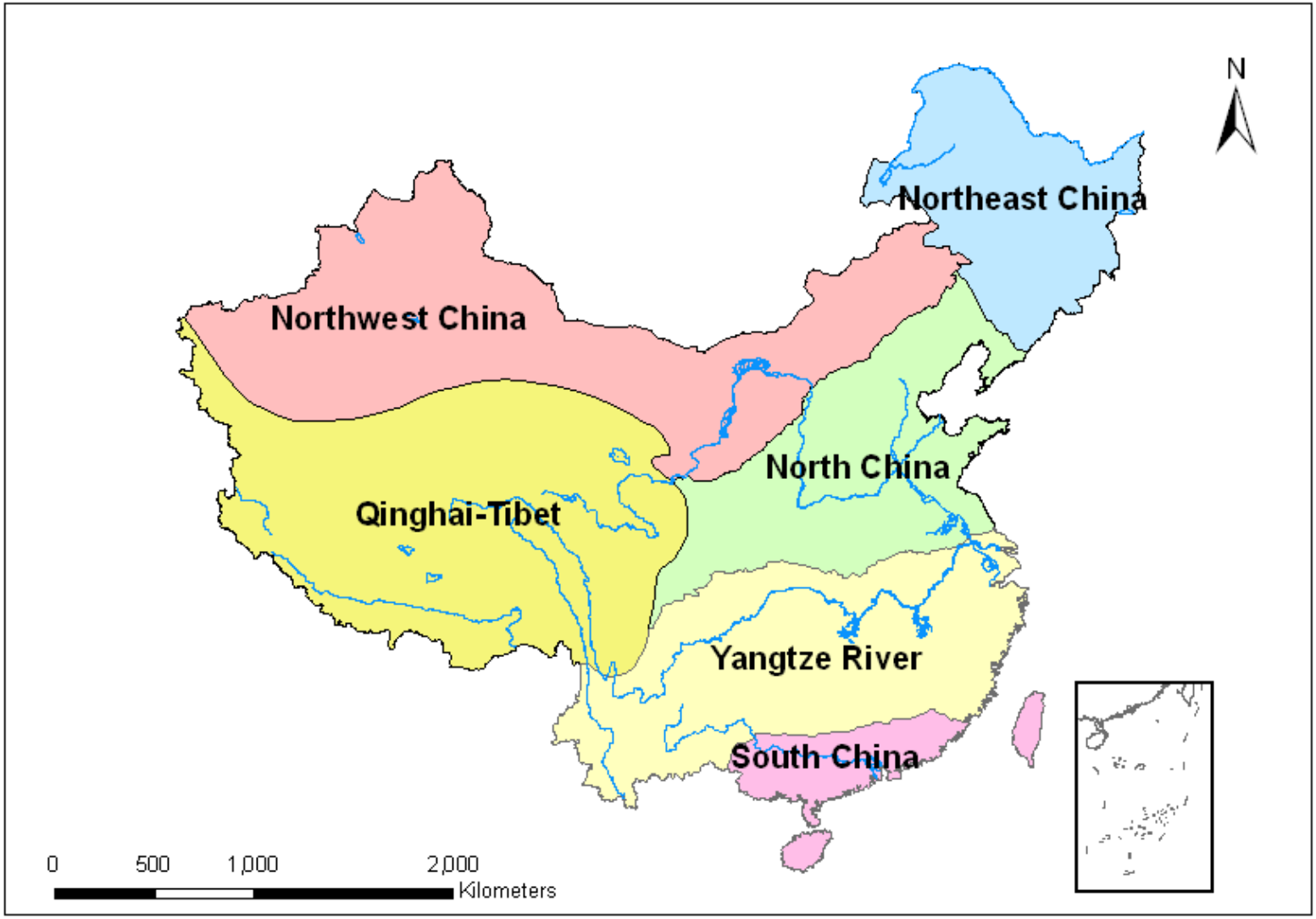
February 2008 → workshop discussions

Result:

- scenario zones were defined and accepted by policy makers and scientists

- developed method was applied in spring 2008

Scenario zones: defined by CAAS, spring 2008



Groundwater scenarios: general strategy:

(1) split forest and agricultural land

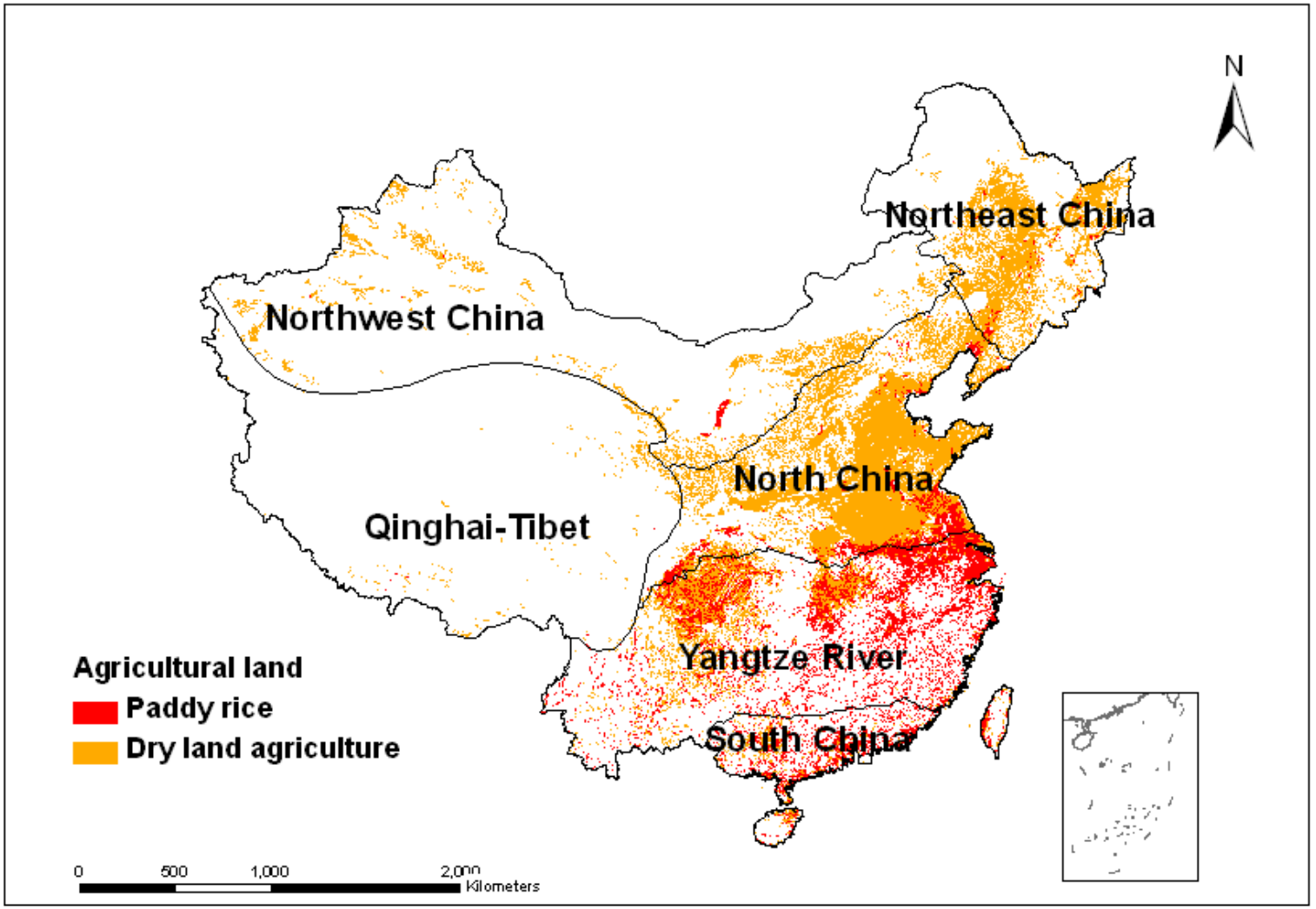
- area of forest may be very large
  - 90th percentile would often be a forest scenario for a normal agricultural pesticide application
- suggestion: split in all zones forest and agricultural land
- develop scenario for each (ICAMA is not interested in forest)

Groundwater scenarios: general strategy:

(2) split agricultural land into paddy rice and dry land agriculture

- Paddy rice is important economically
  - large fraction of pesticide use in rice
- leaching scenario for paddy rice completely different from normal agriculture
- different scenarios for paddy rice

Groundwater scenarios: general strategy: (2) split agricultural land into paddy rice and dry land agriculture



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no scenarios for Qinghai-Tibet → hardly any agriculture

Groundwater scenarios: general strategy:

(2) split agricultural land into paddy rice and dry land agriculture

Northern scenario zones (1 crop cycle a year)

- divide each climatic zone into:
  - dry land agriculture area (priority for Northern scenario zones)
  - paddy rice area

- develop within each climatic zone one scenario for:
  - dry land agriculture
  - paddy rice

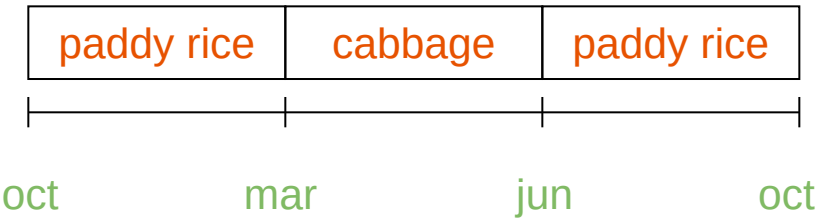
  but only in case of a significant surface area in zone (no scenarios for Qinghai-Tibet → hardly any agriculture)

Groundwater scenarios: general strategy:

(2) split agricultural land into paddy rice and dry land agriculture

Yangtze River basin and South China (multi crops)

- Dry land agriculture and paddy rice grow alternately in the same fields → splitting not a good idea!
- develop within the 2 climatic zones multi crop scenarios
  - leaching of pesticide happens on a time scale of years, not days



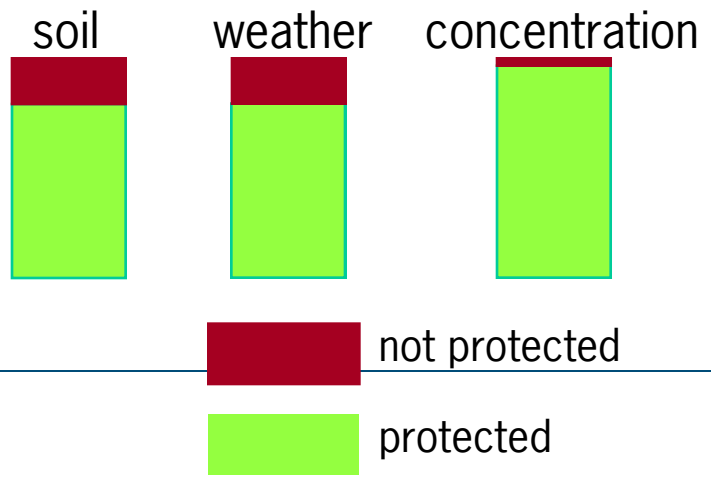
Groundwater scenarios: realistic worst case in each climatic zone

- EU risk management: use 90th percentile in each zone
  - in combination with 0.1 μg/L groundwater criterion
- China: groundwater criterion based on human toxicology
  - acceptable levels in order of 10-100 μg/L
- China: 99th percentile in each zone

Groundwater scenarios: vulnerability concept: dry land agriculture

Northern scenario zones: dry land agriculture

- main vulnerability drivers for >70% of pesticides:
  - organic matter
  - rainfall + irrigation
- FOCUS concept: 80%+80%=90%
  - 80th percentile soil
  - 80th percentile weather
- in analogy for China: 90%+90%=99%
  - 90th percentile soil
  - 90th percentile weather



Groundwater scenarios: vulnerability concept: multi crop, paddy rice

Northern scenario zones: paddy rice
Yangtze river and South China: multi crop

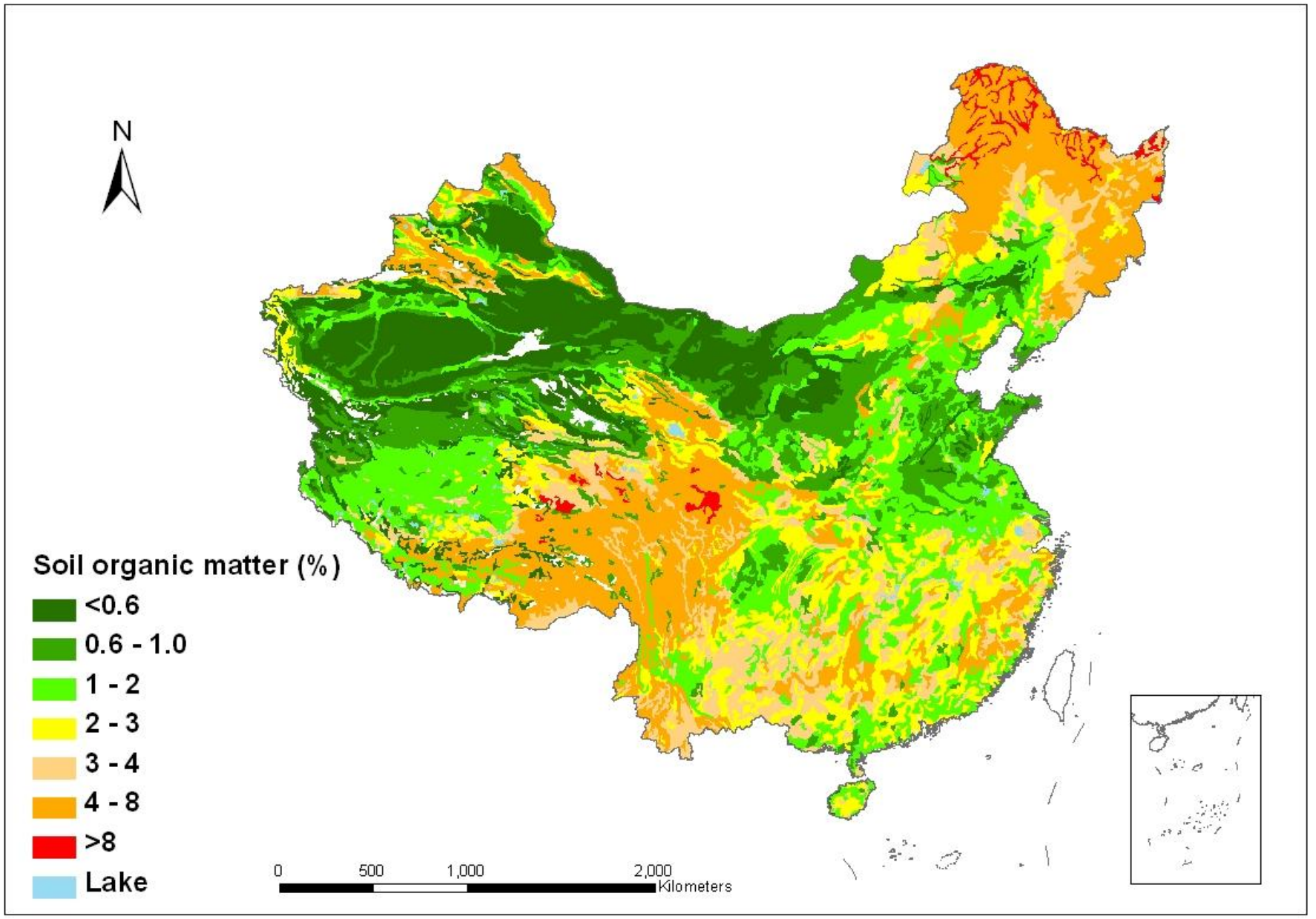
- main vulnerability drivers for >70% of pesticides:
  - organic matter
  - total annual percolation

- FOCUS concept: 80%+80%=90%
  - 80th percentile soil
  - 80th percentile weather

- in analogy for China: 90%+90%=99%
  - 90th percentile soil
  - 90th percentile annual percolation

Groundwater scenarios: 90th percentile soil in each climatic zone

- Consider each scenario zone separately
- target: average organic matter content of top meter of soil
  - if not available, use organic matter content for top layer
- consider organic matter maps
  - for each: pre-selection of three sites close to 90th percentile
  - northern scenario zones: dry land agriculture & paddy rice
    + separate actions for dry land agriculture and paddy rice
  - Yangtze River and South China: multi crop
    + 1 action for dry land agriculture and paddy rice combined → multi crop



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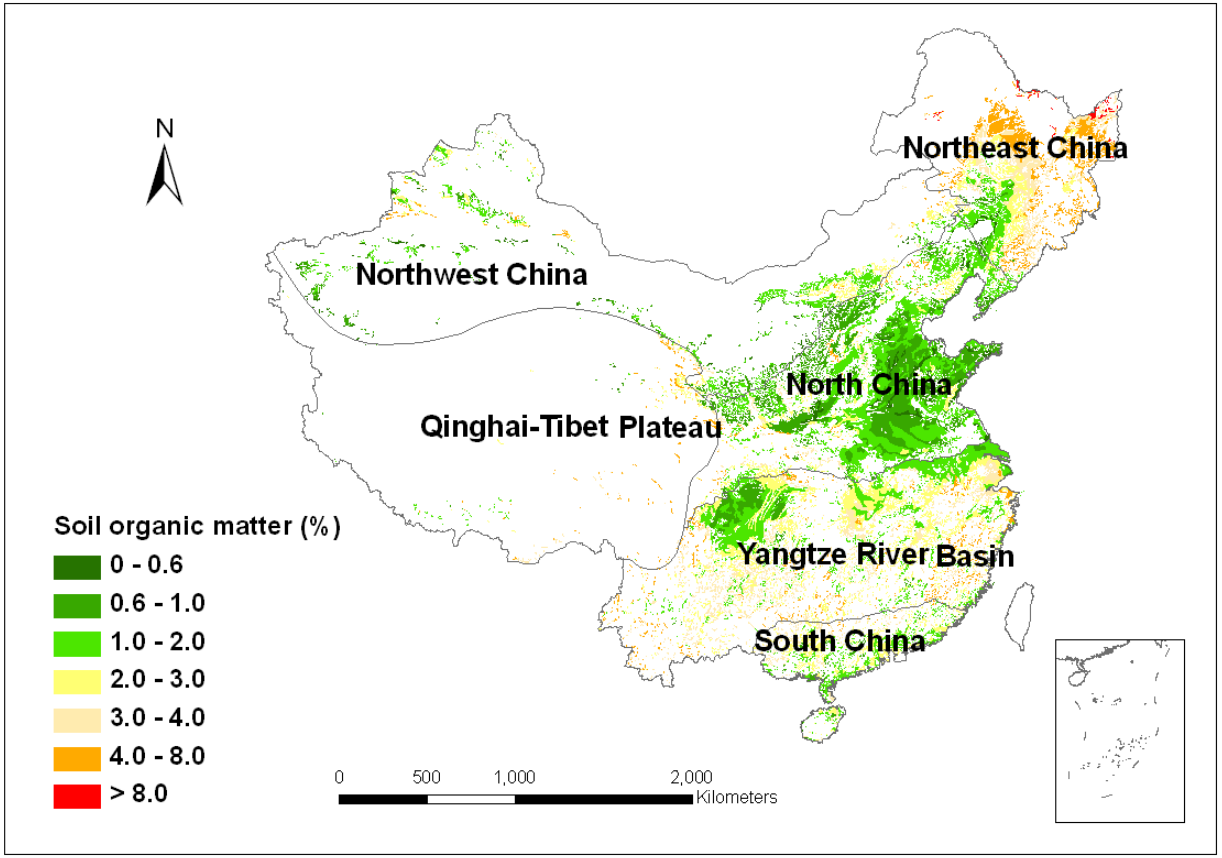
Organic matter content in top soil (0 -20 cm)

Overlay organic matter map and land use map

- Northern scenario zones: overlay of organic matter and land use dry land agriculture
- Yangtze River Basin and South China: overlay of organic matter and land use dry land agriculture + paddy rice



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Calculating 90th percentile of organic matter

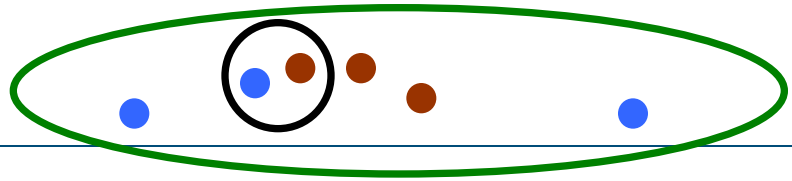
Land use	Scenario zone	calculated 90th percentile organic matter (%)	corresponding organic matter content class (%)
Dry land agriculture	Northeast China	1.4	1 - 2
	Northwest China	0.61	0.6 - 1
	North China	0.66	0.6 - 1
Multi crop	Yangtze River	1.08	1 - 2
	South China	1.04	1 - 2

Northern scenario zones + paddy rice → not done yet

Groundwater scenarios: 90th percentile weather in each scenario zone

Actions for dry land agriculture in northern zones

- target: meteorological station with average rainfall for the zone
  - pre-selection of three meteorological stations
- combine three soil locations with three meteorological locations and take best combination
  - no scenario in Taiwan (political decision)
  - no scenario Qinghai-Tibet Plateau (no agriculture)
- 90th percentile weather: take 90th percentile FOCUS concentration



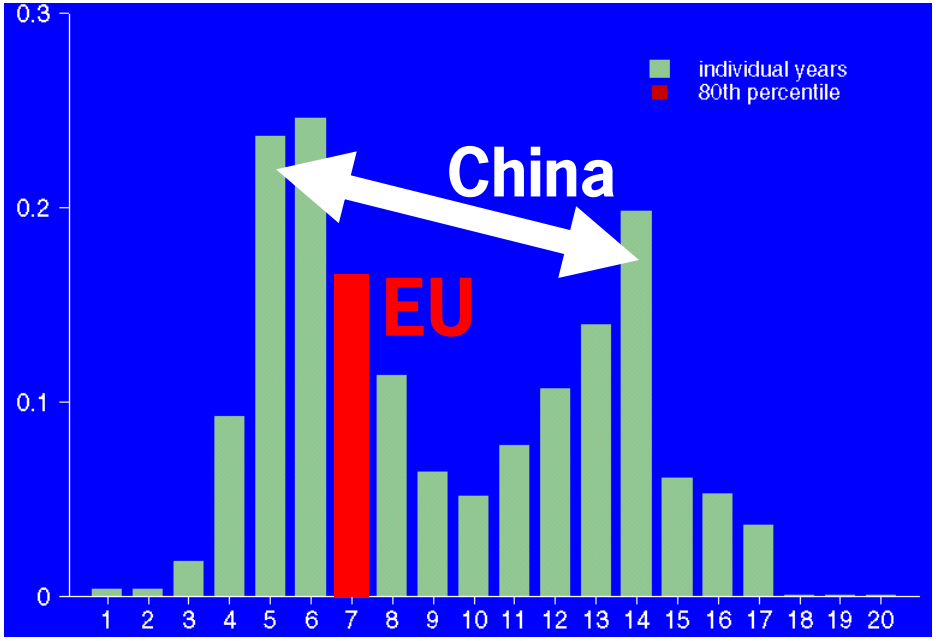
80th percentile weather in FOCUS groundwater scenarios

Run model for scenario (location includes 80th percentile of soil)

each location (80th percentile of soil):
- weather series of 20 years
- applications every year

Output model: 80th percentile yearly average leaching concentration at 1 m depth

Leaching concentration at 1 m depth (µg/L)



80th percentile = 17th of 20 ranked values

90th percentile = mean of 18th and 19th of 20 ranked values

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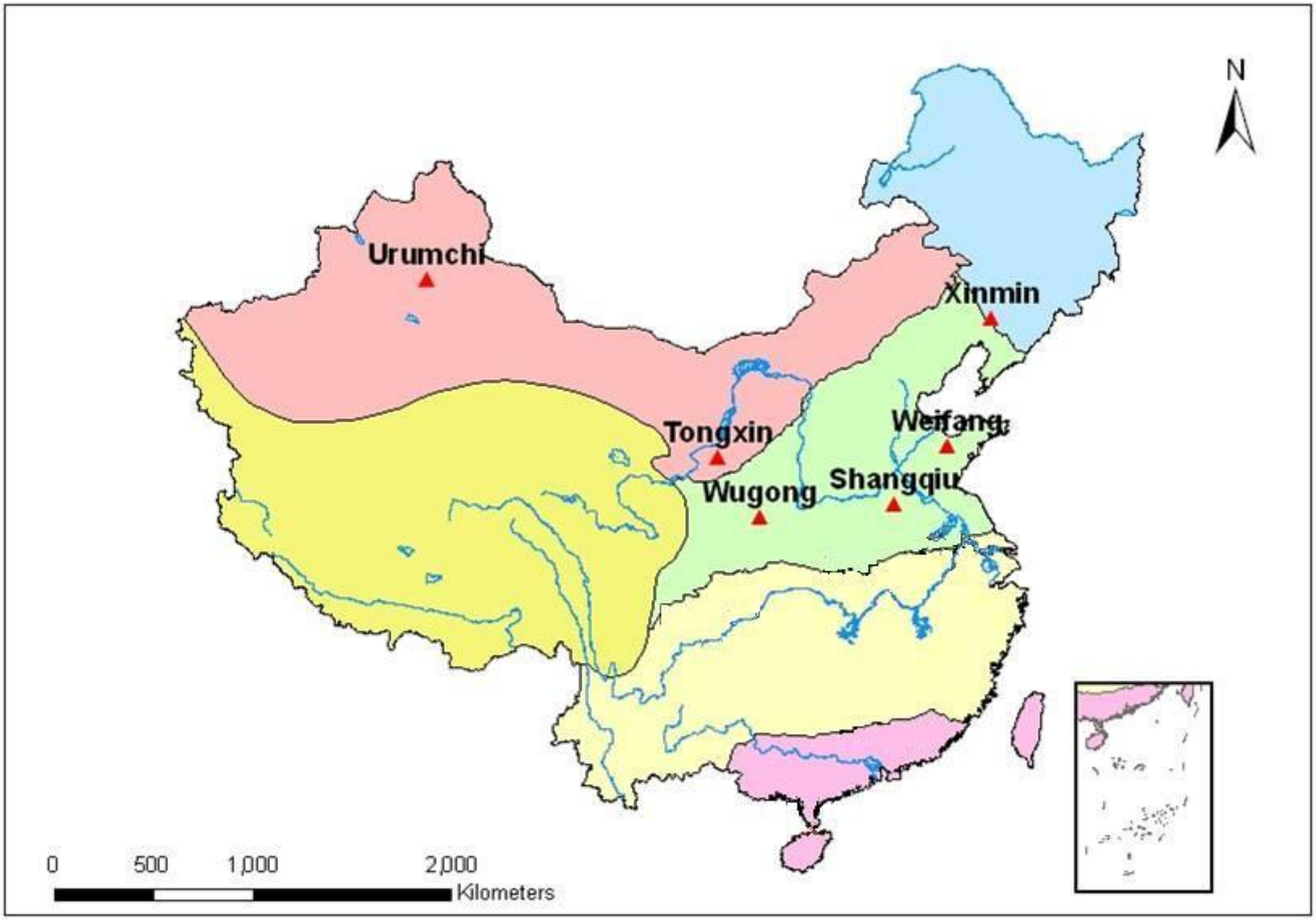
Groundwater scenarios: selected locations for dry land agriculture



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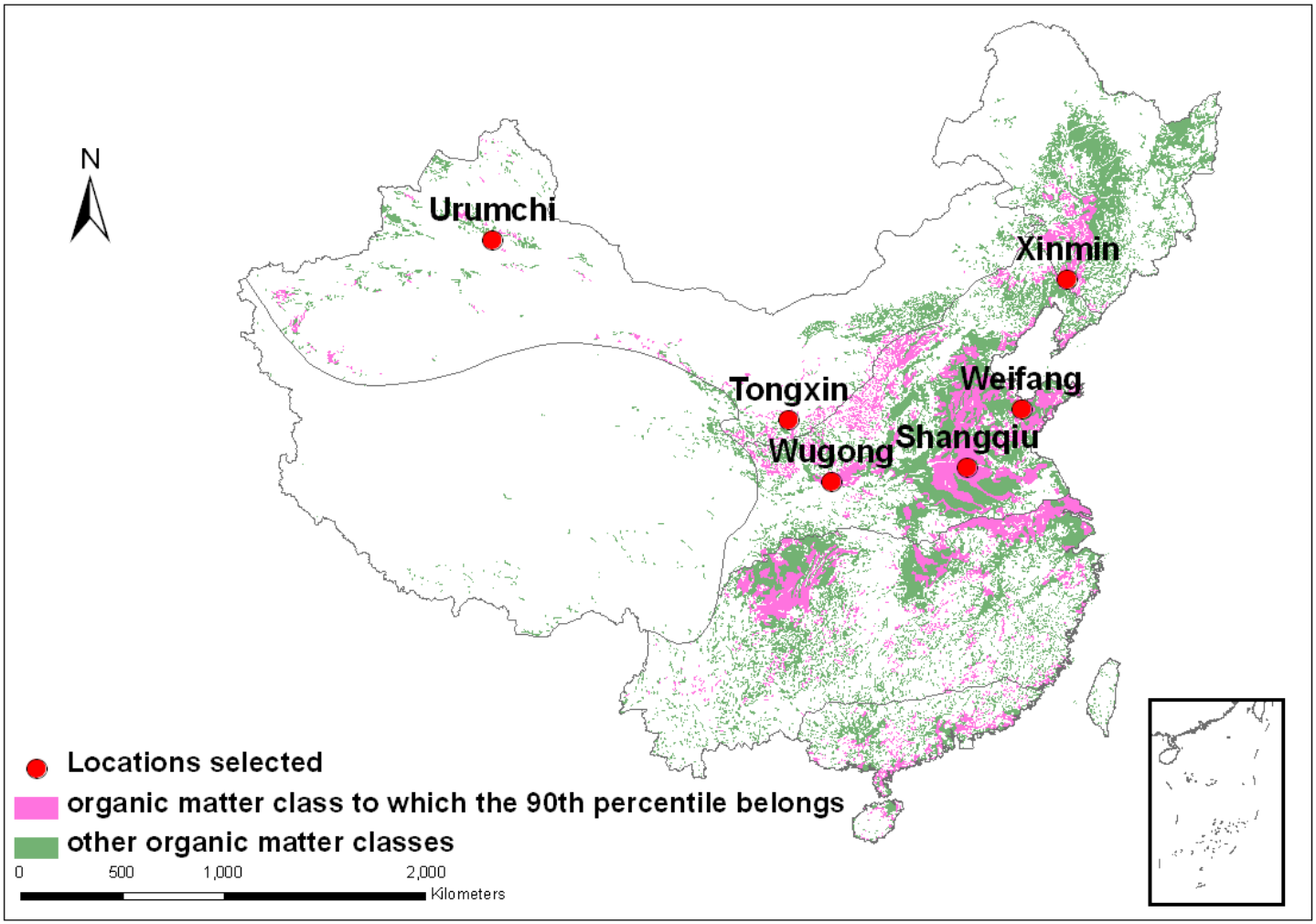
Groundwater scenarios: selected locations for dry land agriculture



Selected locations with organic matter close to the 90th percentile and average annual rainfall of the corresponding scenario zone

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Groundwater scenarios: 90th percentile weather in each scenario zone

Actions for paddy rice in northern zones and multi crop in Yangtze river basin and South China

- Target: 90th percentile annual percolation
  - Procedure finalised, not relevant for Ethiopia in this stage

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