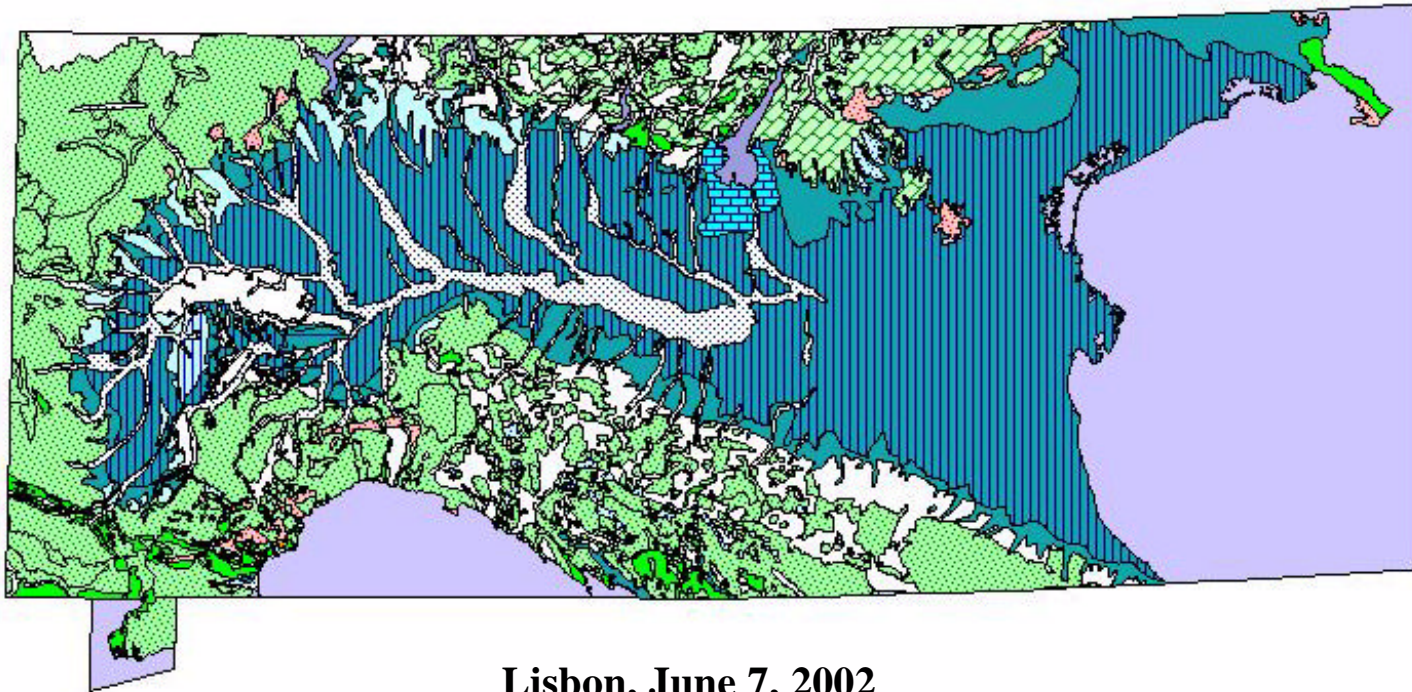


Mapping the depth to groundwater in Europe



Lisbon, June 7, 2002
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Mapping the depth to groundwater in Europe

- FOCUS groundwater higher tier leaching assessment
- Higher Tier assessment with geo-information data - description of the current situation
- Description of the groundwater map
- Description of the work to do
- Advantages and Limitations of the data set
- Description of the possible use areas

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Why do we need information about groundwater depth ???

- Establishing of the FOCUS Tier 1-evaluation of the leaching potential of plant protection products with nine realistic worst-case scenarios and four different models (MACRO, PEARL, PELMO, PRZM) in 2000. FOCUS Tier 2 or 3 leaching assessment on a national/local/regional scale is mentioned in the guidance document, but no detailed recommendations are given
 - SCP opinion: *"The SCP also encourages the Commission to consider the wider implications of this work which have not been fully addressed by the FOCUS Steering Committee, such as... the development of relevant EU databases, how to extrapolate PEC's from 1m depth to a groundwater catchment area"*
 - The full variability of agricultural situations on a national or regional level may not be covered by these nine standard scenarios, *".... the results of the entire leaching assessment at the EU level could then be used to assist local assessments of leaching at the member state level"* (FOCUS 2000)
 - Support Annex 3 national registrations if Annex 1 listing is conditional (*"... Member States should assess the leaching potential to groundwater in particularly vulnerable locations ..."*).
- ➔ **Need for geo-information in higher-tier leaching assessment - data about the distribution of crops, soils, climate and groundwater in Europe**

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■ Higher Tier assessment with geo-information - current situation

- Several approaches exist for the groundwater vulnerability assessment on a national or regional level, in many cases geo-information are used in combination with leaching models
- Different methodological approaches for the use of geo-information are already in use in some member states (selection):
 - a) Coverage of FOCUS-scenarios for one country (UK)
 - b) Definition of crop specific national worst-case scenarios if the crop is not defined by FOCUS or as a transfer of the FOCUS groundwater-concept to the national level (Austria, Belgium)
 - c) Coupling of geo-information data in a GIS (Geographical Information System) with a leaching model. Nation-wide modelling with a range of realistic scenarios, use of statistical approaches for evaluating the results (Netherlands)
- all approaches use geographically referenced information about crops, climate and soils

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■ Groundwater - one additional geo-information source

- In the FOCUS Tier 1 assessments the concentration of a substance is calculated for a aquifer in 1 m depth. No information about the real depth to groundwater is in the moment available for whole Europe, but on a national level groundwater information is used e.g. in UK and the Netherlands
- It is possible to classify aquifers according to their vulnerability of possible contamination with PPP's.
- Typical questions:
 - ➔ What is the real depth to groundwater in Europe , respectively where are different types of aquifers in Europe ?
 - ➔ Where are the vulnerable aquifers in Europe ?
 - ➔ Where are no aquifers at all ?

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■ Example: GEOPEARL (NL)

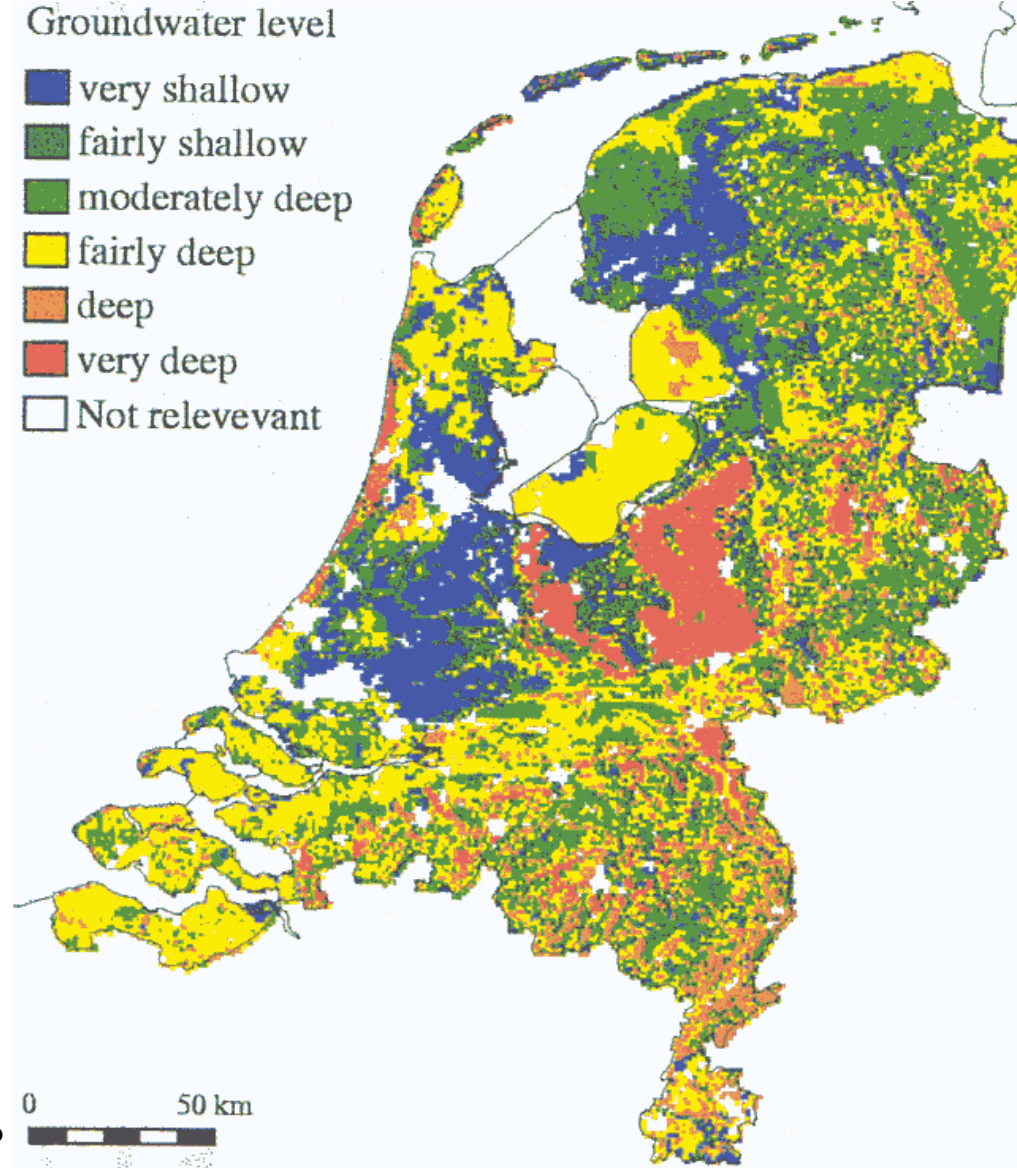
- GEOPEARL (NL) uses the regional groundwater level (= groundwater depth group) which defines the input groundwater level (*Tiktak 2002*), GEOPESTRAS as predecessor model uses six classes (long-term average minimum and maximum groundwater depths) from the Dutch soil map (1:50.000) (*Tiktak, van der Linden, Merkelbach 1996*)

■ Groundwater classification of GEOPESTRAS

groundwater table	mean highest water table (m)	mean lowest water table (m)
very shallow	0.1	0.5
shallow	0.2	1.1
moderately deep	0.3	1.4
fairly deep	0.6	1.6
deep	1	2
very deep	2	3

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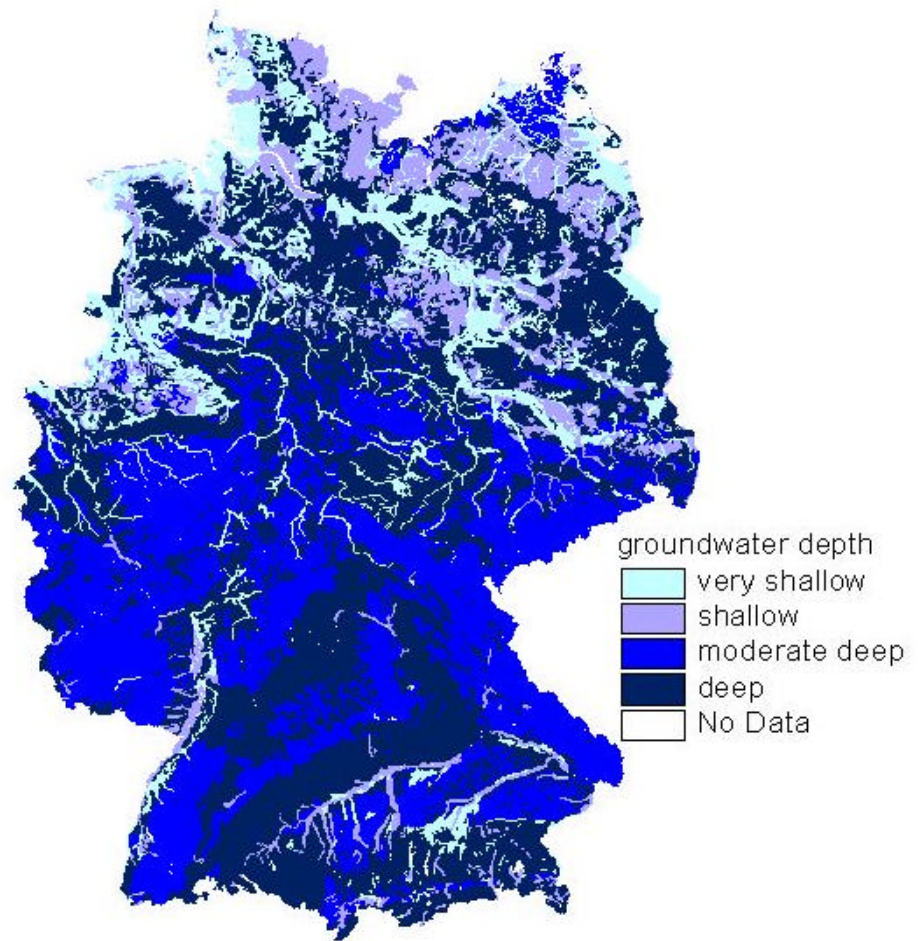
- Example GEOPESTRAS
- groundwater depth in the Netherlands



Tiktak et al 1996

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- Example Germany
- classification deduced from soil map of Lower-Saxony and extrapolated to Germany
- qualitative description of the depth, not real depth calculated



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■ Example: Relevance of European groundwater scenarios to UK agriculture

- The determination of the coverage of FOCUS-scenarios for the UK agricultural landscape (*Hollis, Smith, Brown 2001*) uses the definition of different kinds of aquifers according to their vulnerability for contamination with PPP's.

■ Types of aquifers

major aquifers: highly permeable formations, known or possible fracturing

minor aquifers: fractured or possible fractured rocks without high permeability or formation with variable permeability (unconsolidated deposits)

non-aquifers: formations with insignificant quantities of groundwater

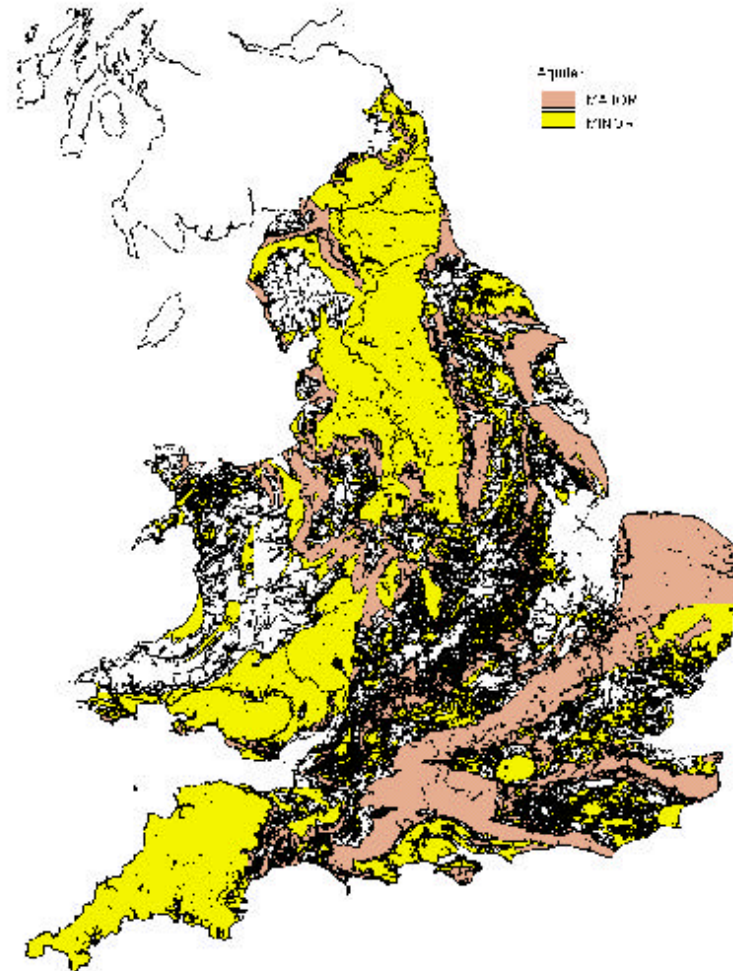
- Within each type separation according to the soil leaching potential, e.g.:

L: soils with dense subsoil that restricts downward water movement

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Major and minor aquifers in the UK

Extent of Major and Minor Aquifers



Hollis et al 2001

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■ **Compilation of European GIS data sets: ECPA GIS group**

■ proposal for a agenda of the group:

- ➔ inventory of existing geo-information data sets which could be used for risk assessment
- ➔ make data sets available for use in the registration process
- ➔ define the use areas of data
- ➔ give recommendations for the use
- ➔ ensure a common approach within industry
- ➔ ensure a valuable scientific basis

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■ Digitisation of the European groundwater paper map

- Project of ECPA GIS group in co-operation with NSRI (UK, former SSLRC) and the European Soil Bureau (EU, Ispra)
- Funding of the digitisation of the European groundwater paper map by ECPA
- **Data source:** 1:500.000 Hydrogeological paper maps from mid 1970ies, information compiled in an EU project under the co-ordination of the German BGR (Bundesanstalt für Geowissenschaften und Rohstoffe)
- Data covers Belgium, Denmark, France, the former German Federal Republic, Ireland, Italy, Luxembourg, Netherlands, UK
- Not covered are eastern part of Germany, Spain, Portugal, Greece, Austria (not EU member states to that time)
- Each paper map contains four information layers, maps will be digitised on a country basis with national boundaries from NUTS (NOMENCLATURE OF STATISTICAL TERRITORIAL UNITS from EUROSTAT), data will be supplied in the ESRI-format ARC/INFO and Arc View

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■ Information layers of the European groundwater map

■ Situation of Aquifers

(confined or unconfined aquifers, geology)

■ Groundwater Hydrology

(contours of the groundwater surface, direction of flow)

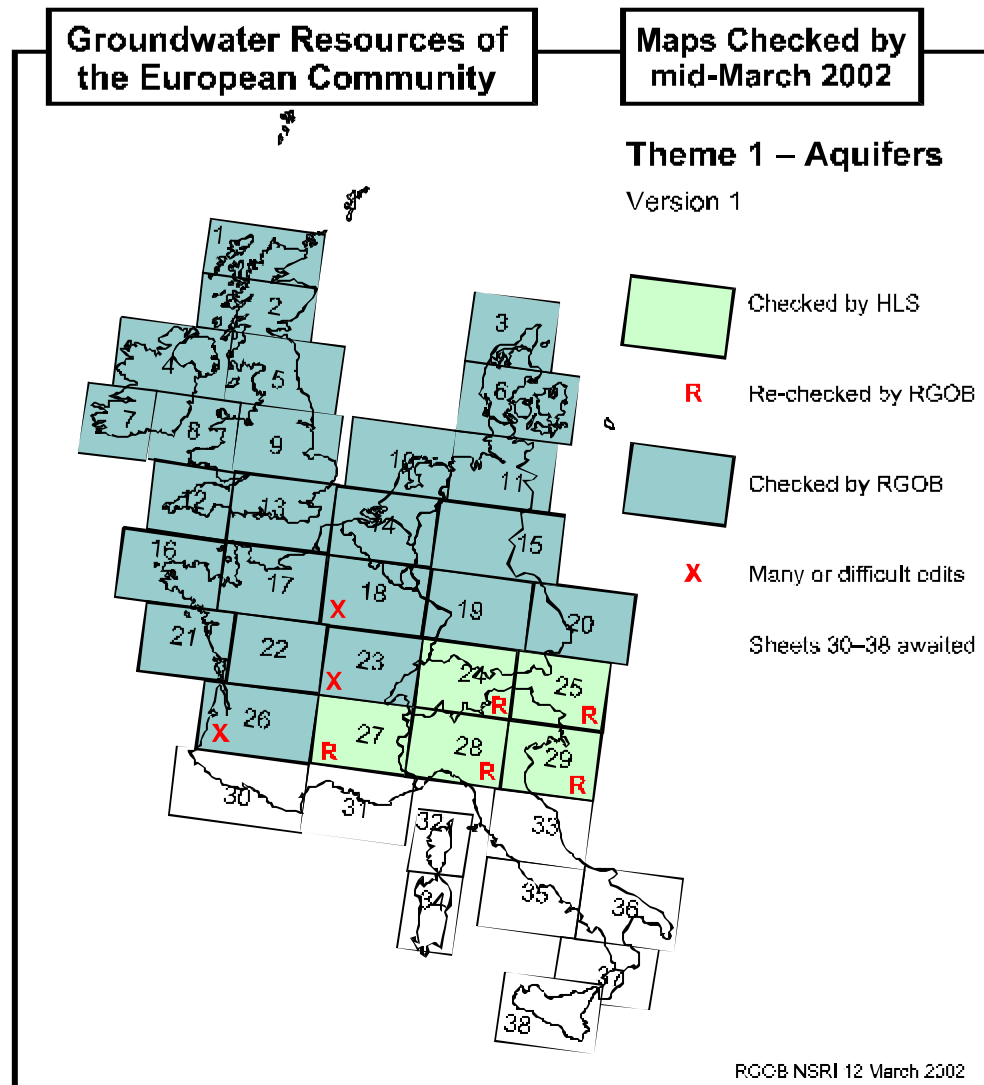
■ Abstraction data

(location of boreholes, catchments, springs and mine drainage)

■ Balance of Resources (not digitised because out of date)

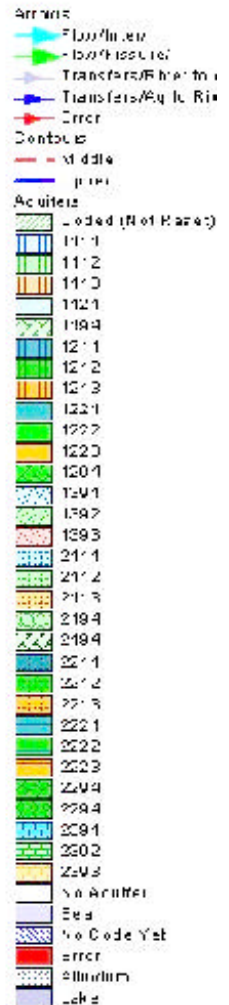
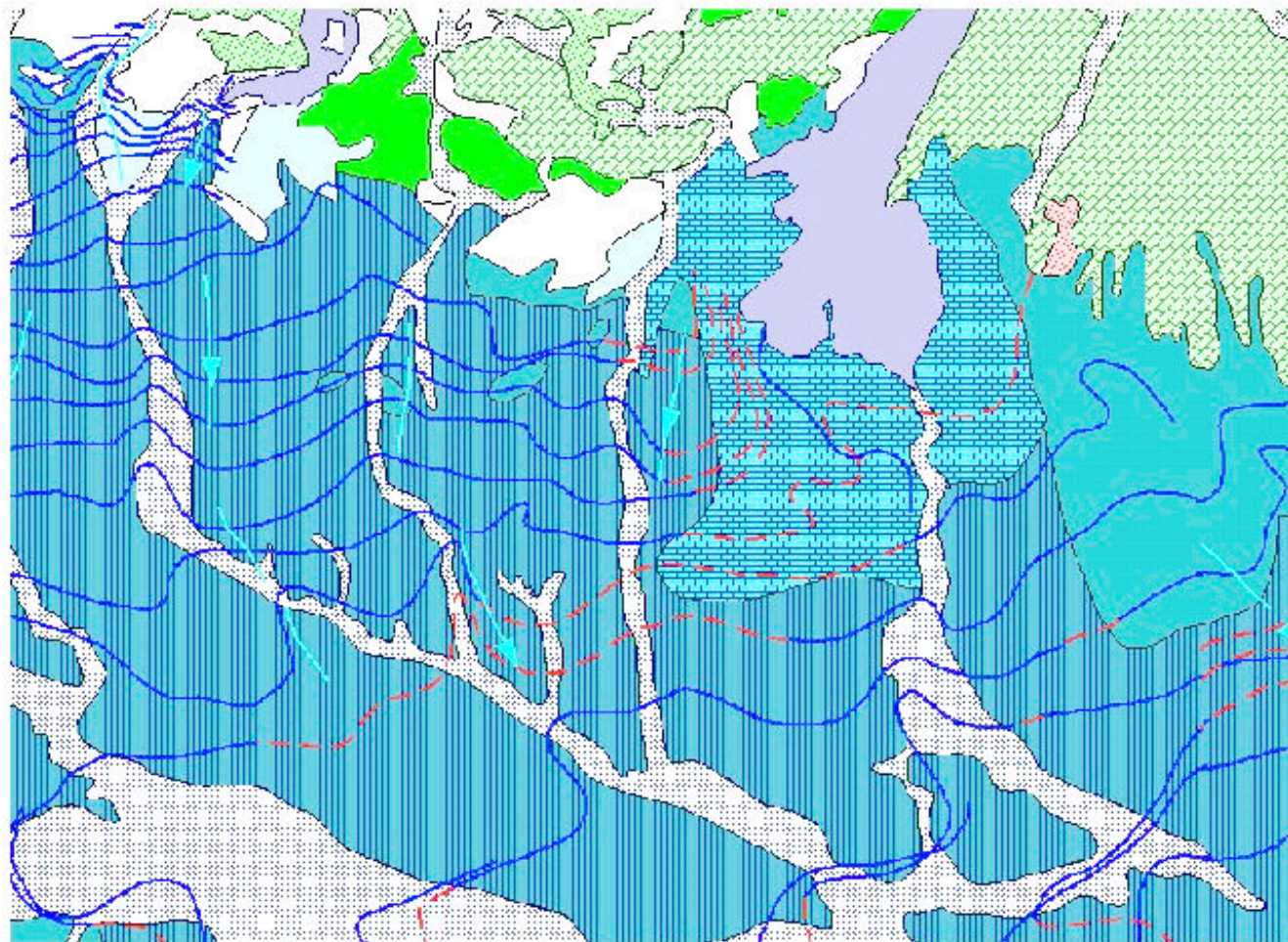
(Unit limits, areas with surplus, resources over-developed)

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Groundwater (test sheets 28 & 29)



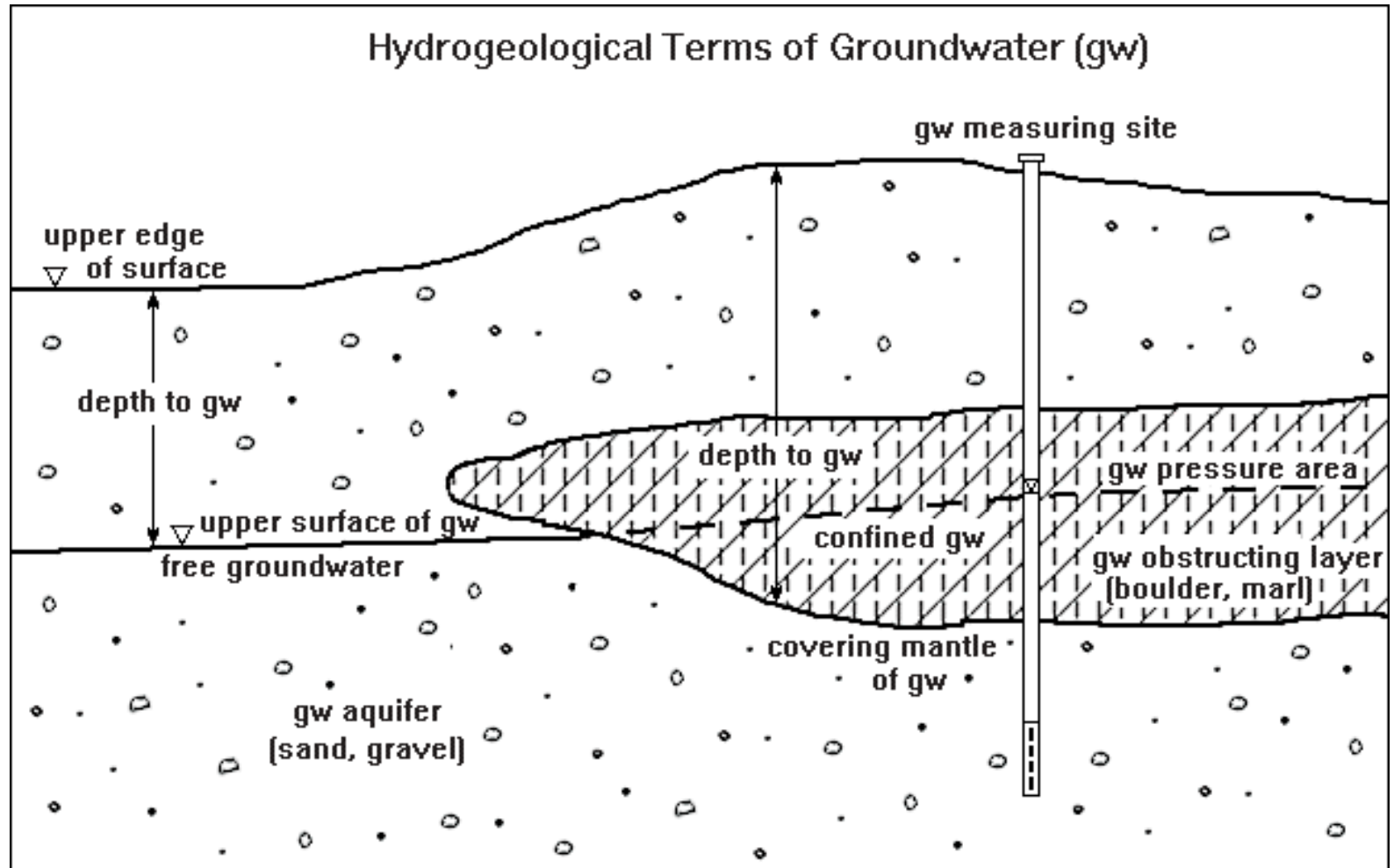
0 30 Kilometers

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■ Depth to groundwater

- The depth to groundwater is defined by calculating the vertical distance between the upper edge of the surface, and the upper surface of the groundwater.
When the groundwater aquifer is covered by relatively impermeable, binding soil layers (groundwater obstructing layer), the groundwater is unable to rise enough to reach the height of its hydrostatic pressure. It is under these conditions that the groundwater level becomes confined.

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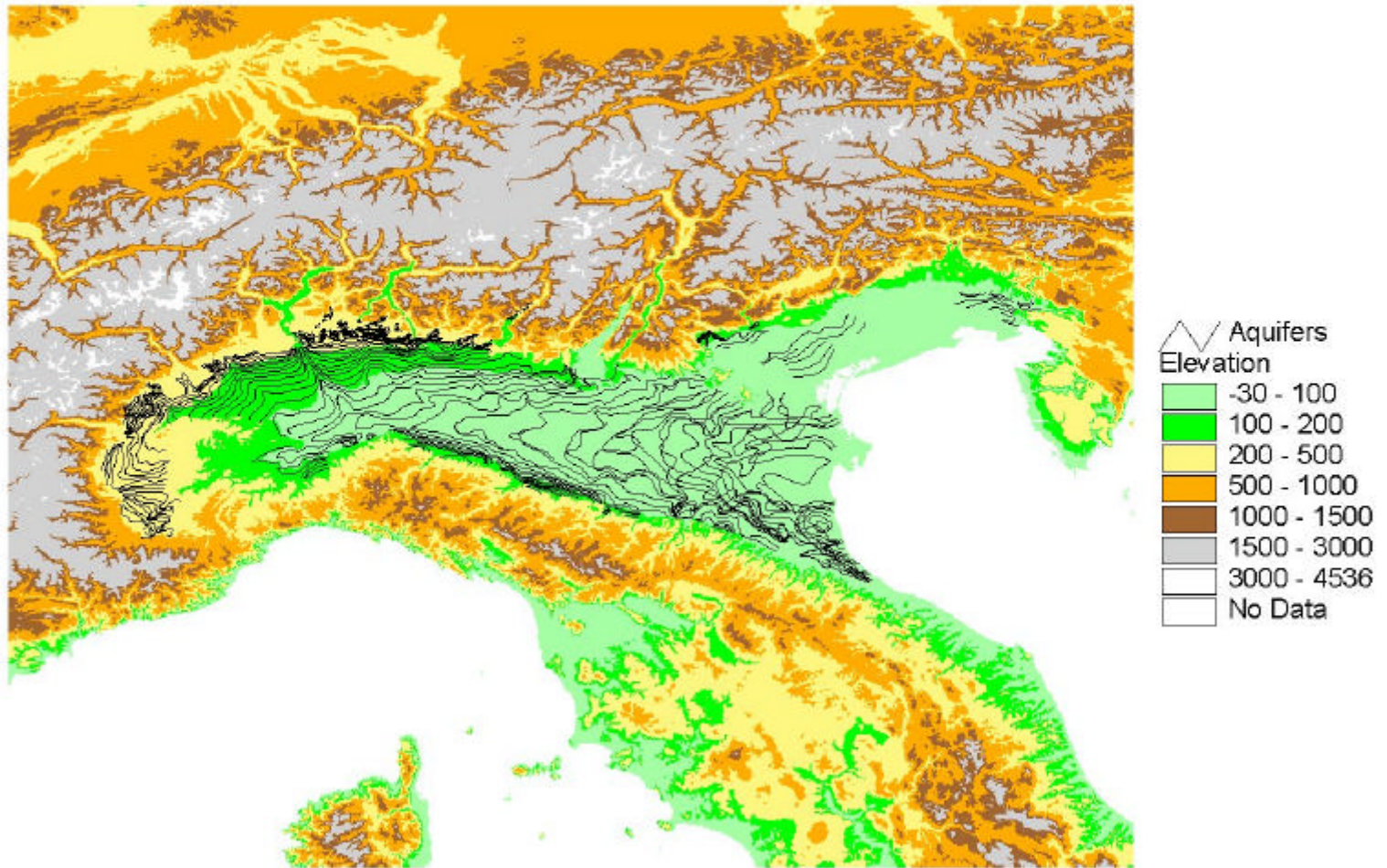
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■ Still a lot of work to do

- Overlaying of the aquifer contour lines (elevation of groundwater level above sea level) with an Digital Elevation Model (DEM, elevation of surface above sea level) to derive groundwater depth below surface
- Define classification scheme with range of groundwater depth (shallow 0-1 m ...)
- Use of other information sources to define useful classification, e.g. use of the EU soil database where information exists about impermeable soil horizons within the topsoil
- Analyse the permeability of the geologic layers between the surface and the groundwater to define vulnerability for contamination of the aquifer
- Validation of the data / the classification scheme with available national data about groundwater, e.g. UK or NL

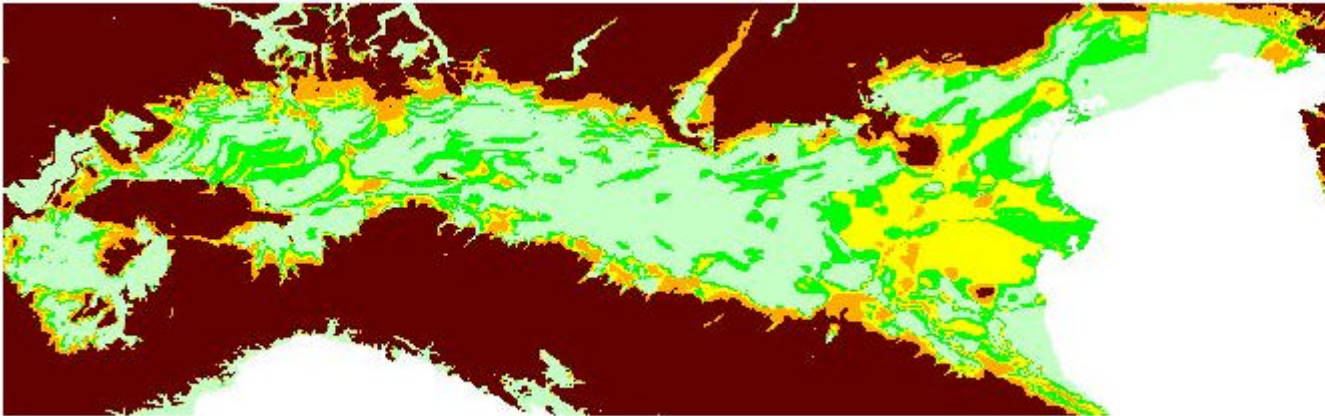
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Aquifers in the Po-plain



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- Possible classification of the depth to groundwater in the Po-plain



Depth to groundwater

very shallow
shallow
moderate
moderate deep
deep
No Data

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■ Limitations

- quality of the paper map,
mistakes like the mismatch between attributes of one polygon on both sides of a boundary
- free available DEM with relatively poor resolution not possible to derive “real-depth” (in future it is possible to use data from the ‘Shuttle Radar Topography Mission’ with accuracy of 4 m, but high costs)
- only one measurement of the groundwater depth does not account for fluctuating water table (Seasonal and long-term fluctuations occur in the quantity of recharge, leading also to fluctuations in depth of the water table)
- limited information about the original data acquisition and used methods are available

Mapping the depth to groundwater in Europe

■ Advantages

- covers a significant part of Europe with an uniform methodology
- possibility to extend database for other countries
- a commonly accepted database to be used in the registration process, not a range of stand-alone projects with different data sets
- due to co-ordinate approach single authorities, research institutes and companies do not have to obtain data separately
- through common approach easier access to these data for all
- with higher quality (groundwater) data the scientific evaluation is gaining confidence

Mapping the depth to groundwater in Europe

■ Availability of the data set

- Digitisation will be finished in summer 2002
- The database will be available to ECPA member companies. It will also be available to:
 - a) The ESB (JRC) for non-commercial use or for use 'exclusively for the activity of FOCUS models and inputs for pesticides registration in the context of 91/414/EEC'.
 - b) To EC or National Authorities or their representatives, Research Institutes and Universities for non-commercial use.
- All other use, whether by ECPA member companies, by the Soil Data Contributors (ESB, JRC) or other Organisations/Institutes will incur a charge. Such charges will be managed through ECPA and used to fund further development of the database or to assist in its administration.

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Possible use areas

- Use of groundwater depth information as additional data source during the process of selecting national / regional scenarios for groundwater vulnerability assessment with FOCUS models
- Use as a direct input for specific defined scenarios, parameterisation of the model (e.g. lower boundary conditions in PEARL)
- If additional information of the degradation of a substance in subsoil is available the concentration could be calculated at the real groundwater depth
- Possibility to use the data in already existing models as an additional information source
- Vulnerability assessment for a groundwater catchment areas

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Thank you for your attention