SDSS-Concepts and -Approaches: GIS- and RS-Based Spatial Decision Support

GLOWA Conference
Ouagadougou, 25th – 28th August 2008

Introduction   SDSS Interfaces   ISDSS   Summary & Conclusions

Georg Bareth[1], Rainer Laudien[1], Andreas Enders[2], Bernd Diekkrüger[2]

[1]GIS & RS Working Group, Geography Department, University of Cologne, Germany

[2]Hydrogeography Group, Geography Department, University of Bonn

Universität zu Köln

GLOWA

Ministry of Innovation, Science, Research and Technology of the German State of North Rhine-Westphalia

Bundesministerium für Bildung und Forschung

universitätbonn

Motivation

- **Is there a demand for
spatial decision support for environmental resource management?**

- **Are we ready for
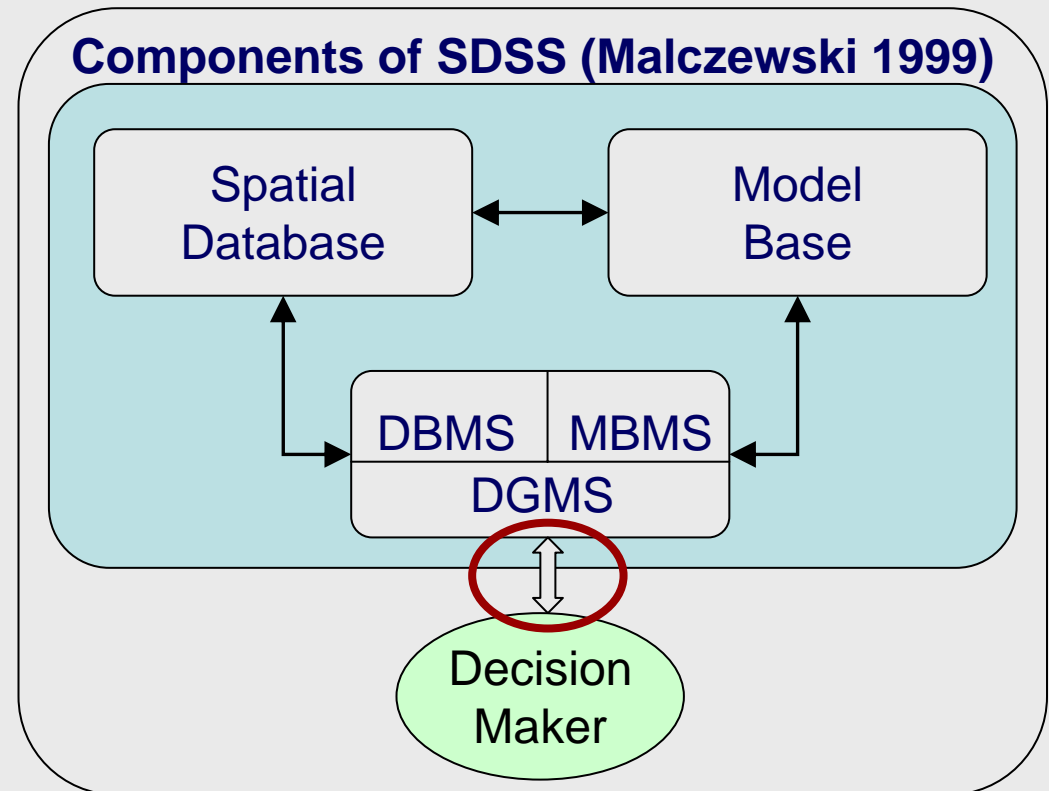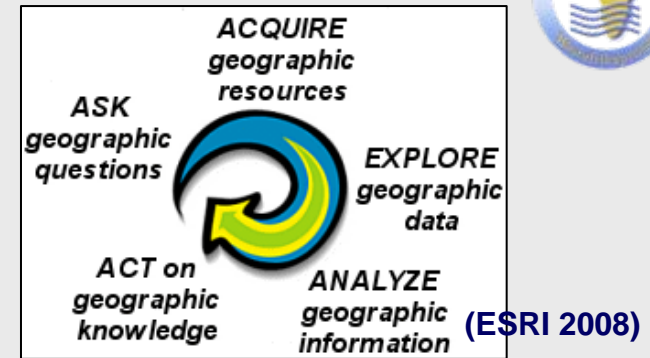spatial decision support for environmental resource management?**

Objective

- **Combination of latest developments in:**

    - ➢ **Geographic Information Systems   (GIS)**

    - ➢ **Remote Sensing   (RS)**

    - ➢ **Software Engineering   (SE)**

    - ➢ **Model Integration   (MI)**
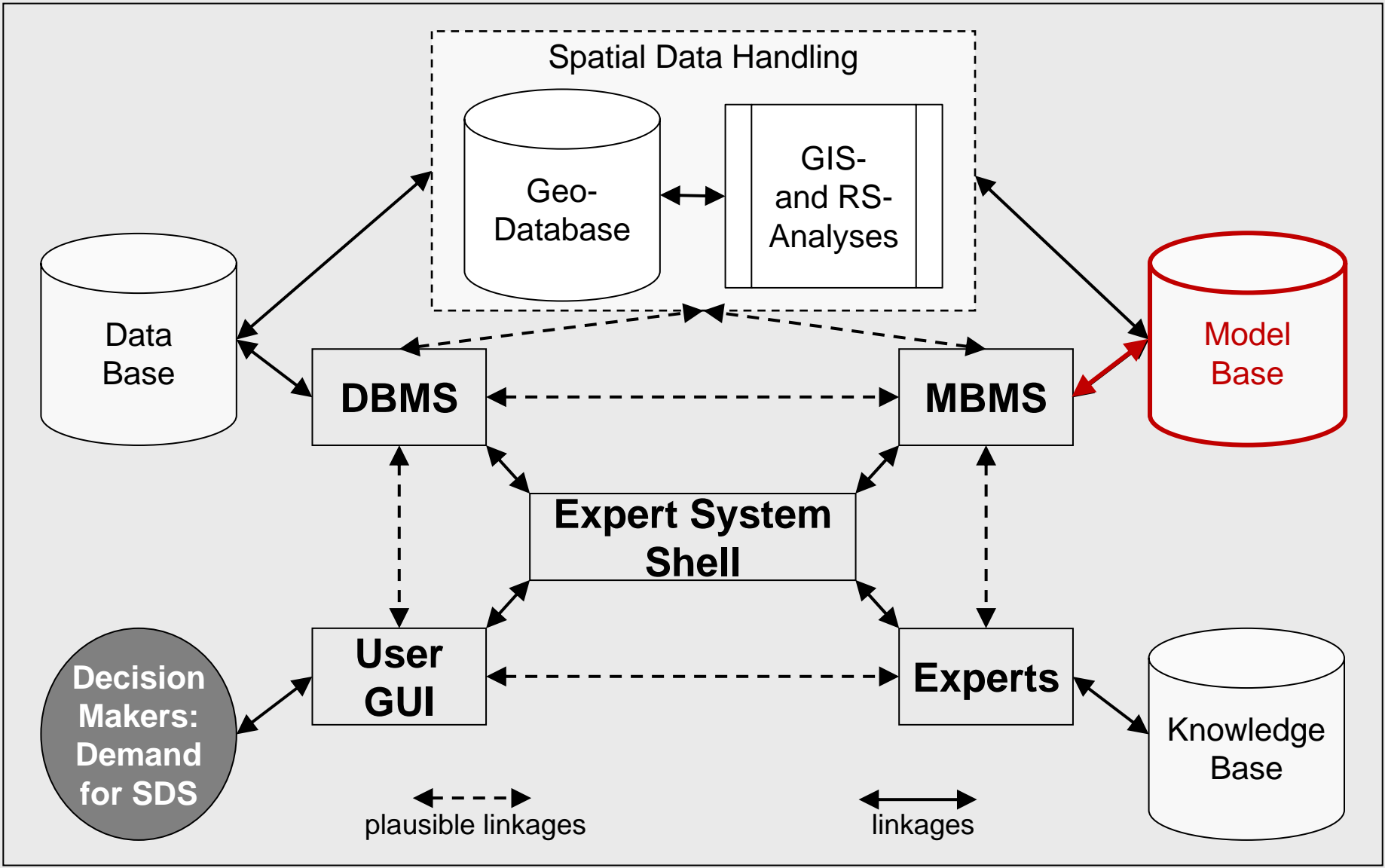
The Spatial Decision-Making Process

(ESRI 2008)

According to Gao et al. (2004) nine steps:

(1) problem identification

(2) problem modeling

(3) model instantiation

(4) model execution

(5) model integration / scenario modeling

(6) scenario instantiation

(7) scenario execution

(8) scenario evaluation

(9) decision making

Components of SDSS (Malczewski 1999)

Spatial Database ↔ Model Base

DBMS | MBMS

DGMS

Decision Maker

DGMS – Dialogue generation management system

Architecture of a SDSS

Models

1. Developed for which

- **problem**   **(process-based?)**

- **spatial resolution**   **(regional?)**

- **time steps**   **(daily?)**

2. Dependent on

- **data**   **(input?)**

- **expert knowledge**   **(quality?)**

- **user**   **(calibration?)**

- **scale**   **(generalization?)**

3. Applicable for

- **region**   **(data availability?)**

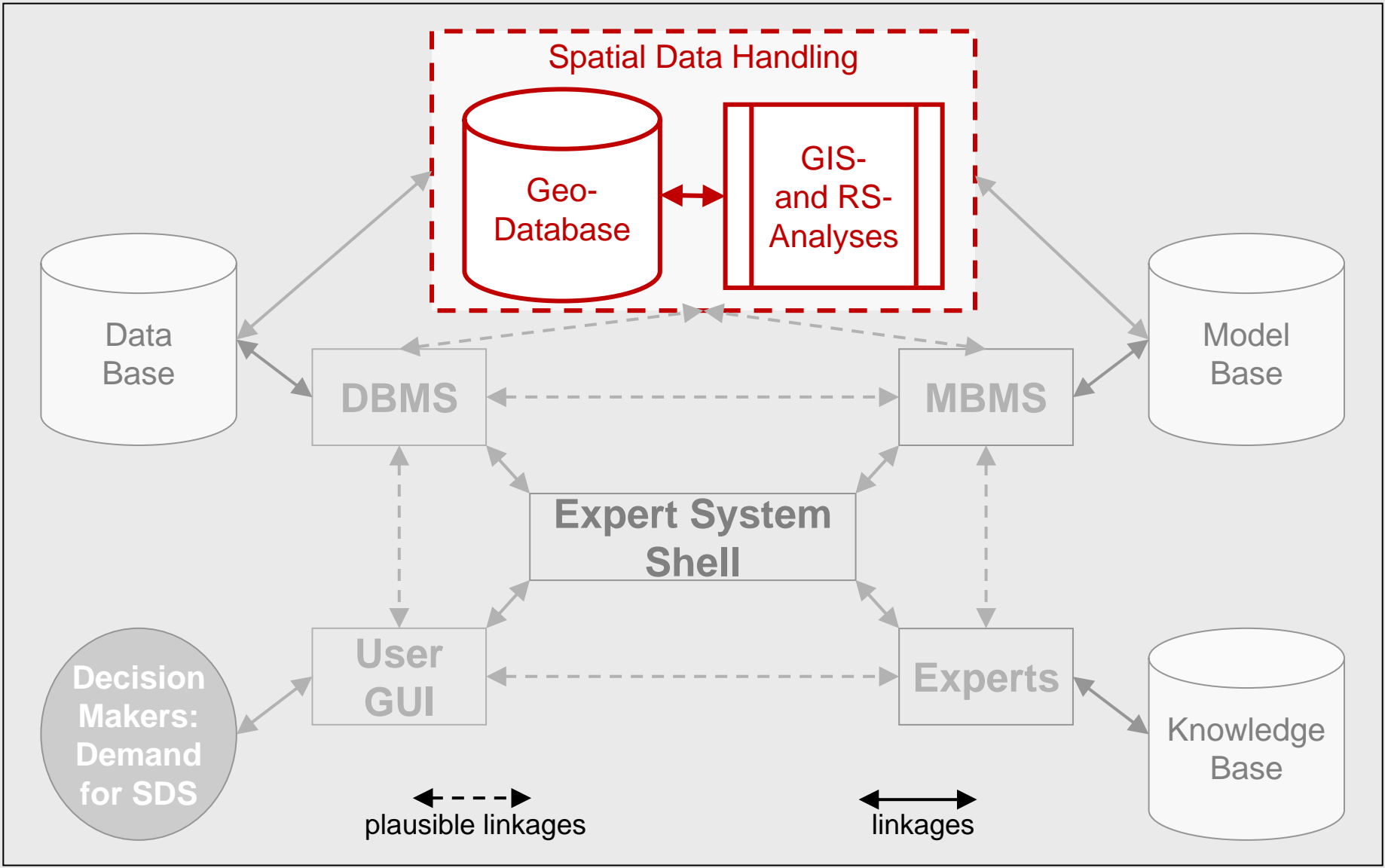- **scenarios**   **(centuries?)**

- **decision support**   **(evaluation?)**

Required Data
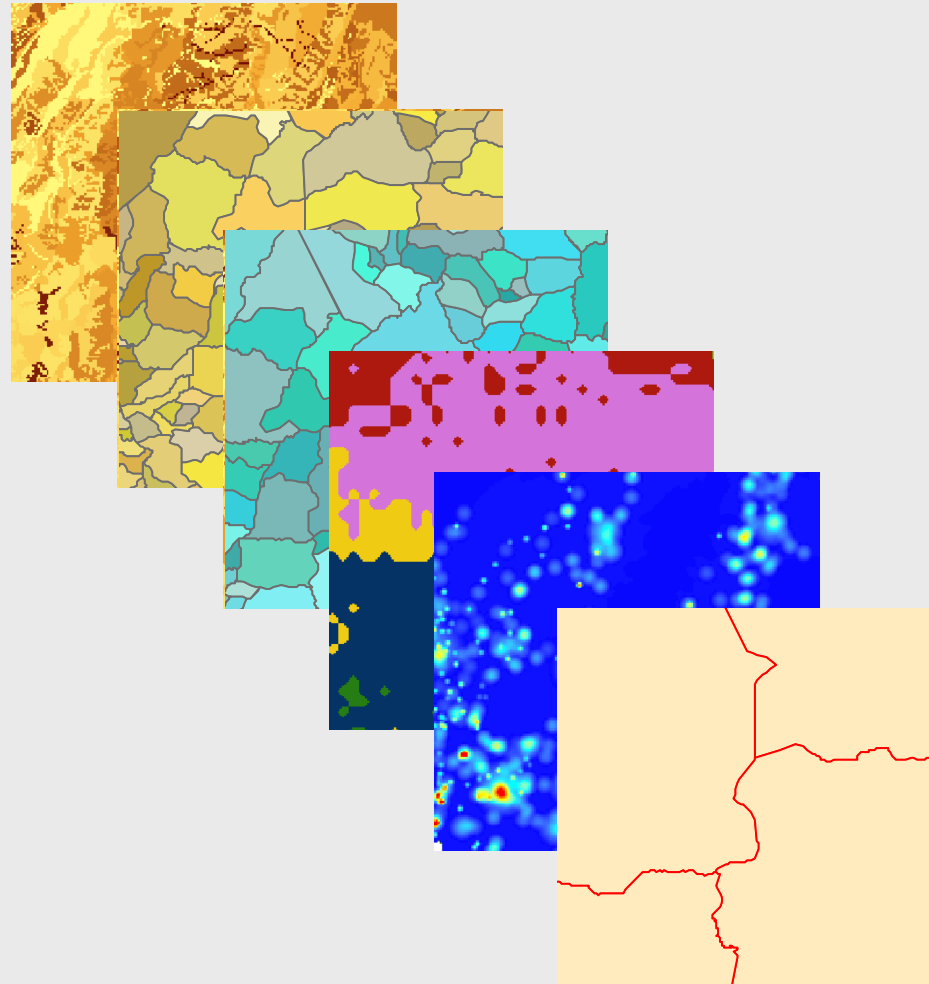
- soil

- land use

- weather

- management

- socio-economic

- administrative

- etc.

SDSS Architecture

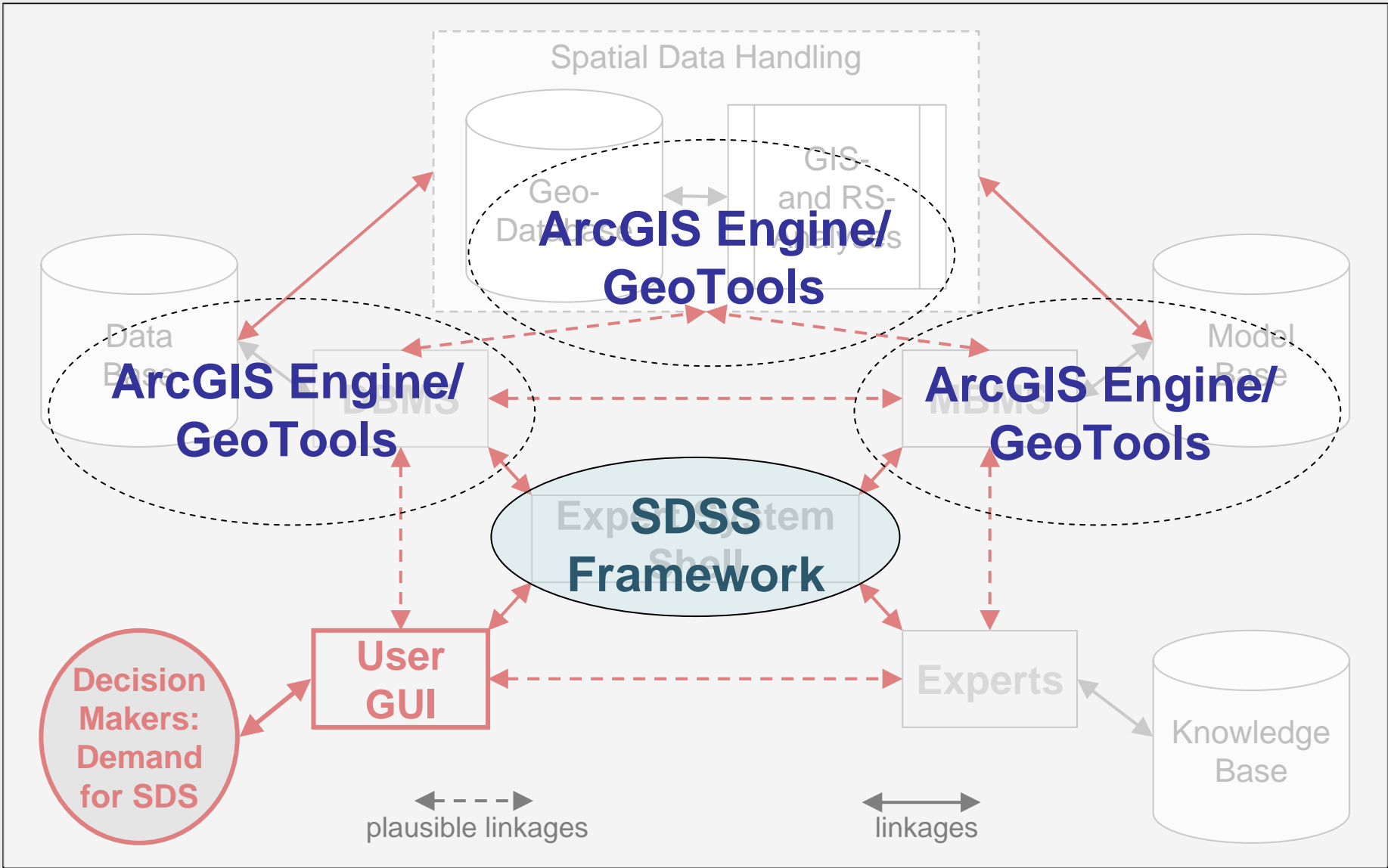Spatial Data Handling

Geo-Database ↔ GIS- and RS-Analyses

Data Base

DBMS

Model Base

MBMS

Expert System Shell

Decision Makers: Demand for SDS

User GUI

Experts

Knowledge Base

- - -► plausible linkages

◄──► linkages

(Bareth 2008, modified from Leung 1997)

Spatial Data Handling

Geo-Database

GIS- and RS-Analysis

ArcGIS Engine/ GeoTools

Data Base

DBMS

ArcGIS Engine/ GeoTools

Model Base

MBMS

ArcGIS Engine/ GeoTools

Expert System Shell

SDSS Framework

User GUI

Decision Makers: Demand for SDS

Experts

Knowledge Base

plausible linkages   linkages

(I)SDSS Framework

SDSS Framework

GUI
Graphical User Interface
- Mehrsprachig
- Dokumentation
- Benutzerführung
- Benutzerrechte
- Formulare

SMILEngine
Scientific Model Integraion pipeLine Engine
- PipeLine Engine
- Present Engine
- GIS Engine
- Formular Engine

System Config XML
XML Configuration of whole System
- Processors
- Interfaces
- Functions

Geographic Scientific Rational — Database

Scientific Models

external

SDSS Framework
IMPETUS Server — Server

SDSS Framework
IMPETUS Client — SDSS 1

SDSS Framework
other Client — SDSS 1

(Enders et al. 2008)

IMPETUS Client

Systems of the ISDSS

BENIN	
BenIMPACT	**BenIMPACT scenarios for landuse and food supply**
PEDRO	**Effects of land use change, climate change and crop management on soil degradation and crop yield in the Upper Ouémé Catchment**
PRESAPLUSIS	**Informations about climate modeling**
SYMBA	**System for the management of small scale barrages**
AGROLAND	**Natural and socioeconomic conditions for a sustainable agricultural land use**
BenIVIS	**Inland-valley information system for Benin**
LISUOC	**Livelihood security in the Upper Ouémé Catchment**
MalaRIS	**The impact of climate change on malaria risk in Africa**
SIQeau	**Supply and quality of drinking water in rural Upper Ouémé Catchment**
Benhydro	**Water availability and water consumption in the Ouémé catchment**
Beneau	**Water demand of households, agriculture and industry in Benin**
PrecipInfo	**Informationsystem rainfall distribution in Benin**
LUMIS	**Land use modelling and information system**
ILUPO	**Impetus – Land use change and Precipitation for the Ouémé area**
FARM-ADA-M	**Farm adaptation management as to water availability**
iMABFIRE	**Managing bush fire**

Systems of the ISDSS

MAROCCO	
MIVAD	**Efficient water distribution in the Drâa valley**
AGROSIM	**Agricultural strategies against water scarcity in the Drâa Oasis**
ISII	**Information system of institutional interdependencies**
HYDRAA	**Hydrologic model for the Drâa Catchment**
IWEGS	**Interaction between water use and groundwater and soil conditions in the middle Drâa Valley**
PRO-RES	**Prognosis of snowmelt runoff for a water reservoir**
IDEP-DRAA	**Possible future developments of evaporation and precipitation for the Drâa Catchment**
LUD-HA	**Local land use desisions - High Atlas**
PADRAA	**Decision Support System for Sustainable Pastures in the Drâa Catchment**
PLANT	**High Atlas plants**
Veg-Sat	**Decision Support System of vegetation and their spatio-temporal distribution**
SEDRAA	**Scenarios of soil erosion in the Drâa region**
SGMHydraa	**Statistical model for the generation of meteorological data for hydrological modelling in Drâa region**

Summary & Conclusions

Motivation

- **Is there a demand for SDS in ERM?** ✓

- **Are we ready for SDS for ERM?** ✓ ✗

Objective

- **Combination of latest developments in:**

    GIS, RS, SE, MI ✓

ISDSS

- **Complex but easy to use!**

- **Flexible and extendable!**

- **Available & open source software!**

To Dos

- **Quality of models!**

- **Regional Input Data!**

- **Error propagation!**

**SDSS-Concepts
and -Approaches:
GIS- and RS-Based
Spatial Decision Support**

Please try the ISDSS systems at our expo!

Thank you for your attention!