SOLERES — A Spatio-Temporal Environmental Management Information System based on Neural-Networks, Agents and Software Components

(TIN2007-61497)

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MINISTERIO DE CIENCIA E INNOVACIÓN

Jornada de Seguimiento de Proyectos, 2010

CONTENT

SOLERES

Environmental
Management
Information
System

Neural-Networks
Knowledge

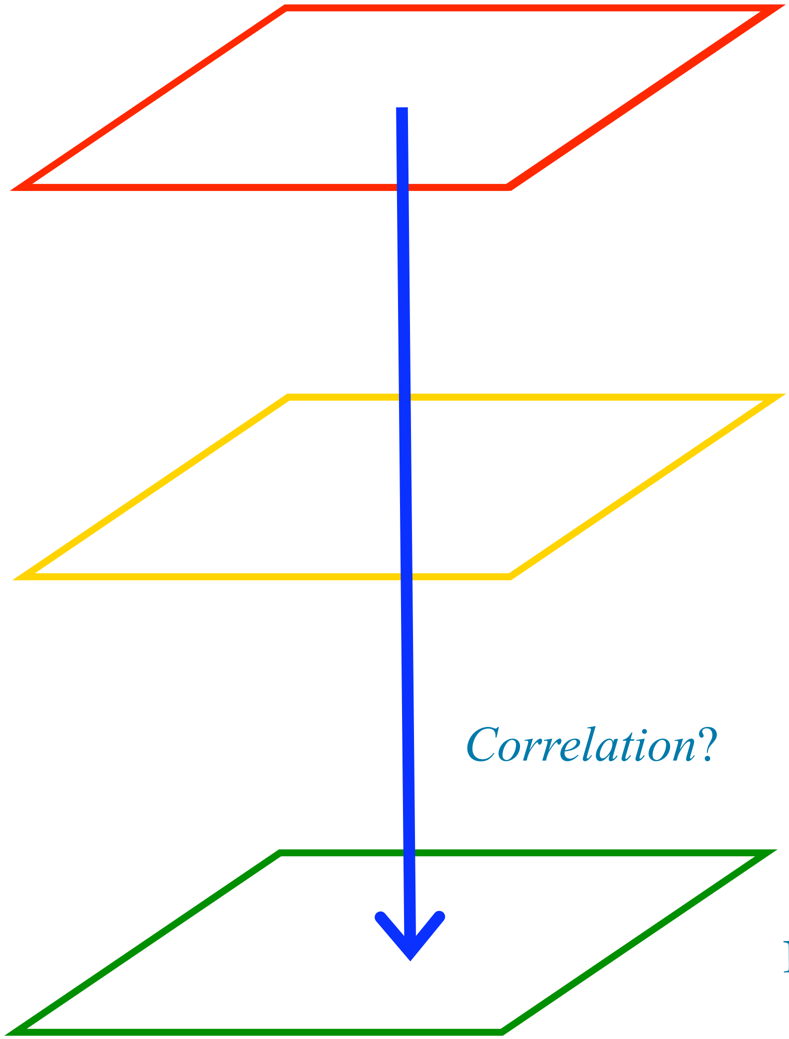
Environmental Info
Ontologies

Cooperative Systems
Multi-Agents

Satellite Images
AC-based clasif.

Component-based systems
Trading agents

"application, integration and development of multidisciplinary works"



Cartography (map #1)

Advan., a lot of info for decision purposes

Disadvan., difficult to obtain (years & fieldwork)

Satellite Images (map #2)

Advan., real-time info for decision (but limited)

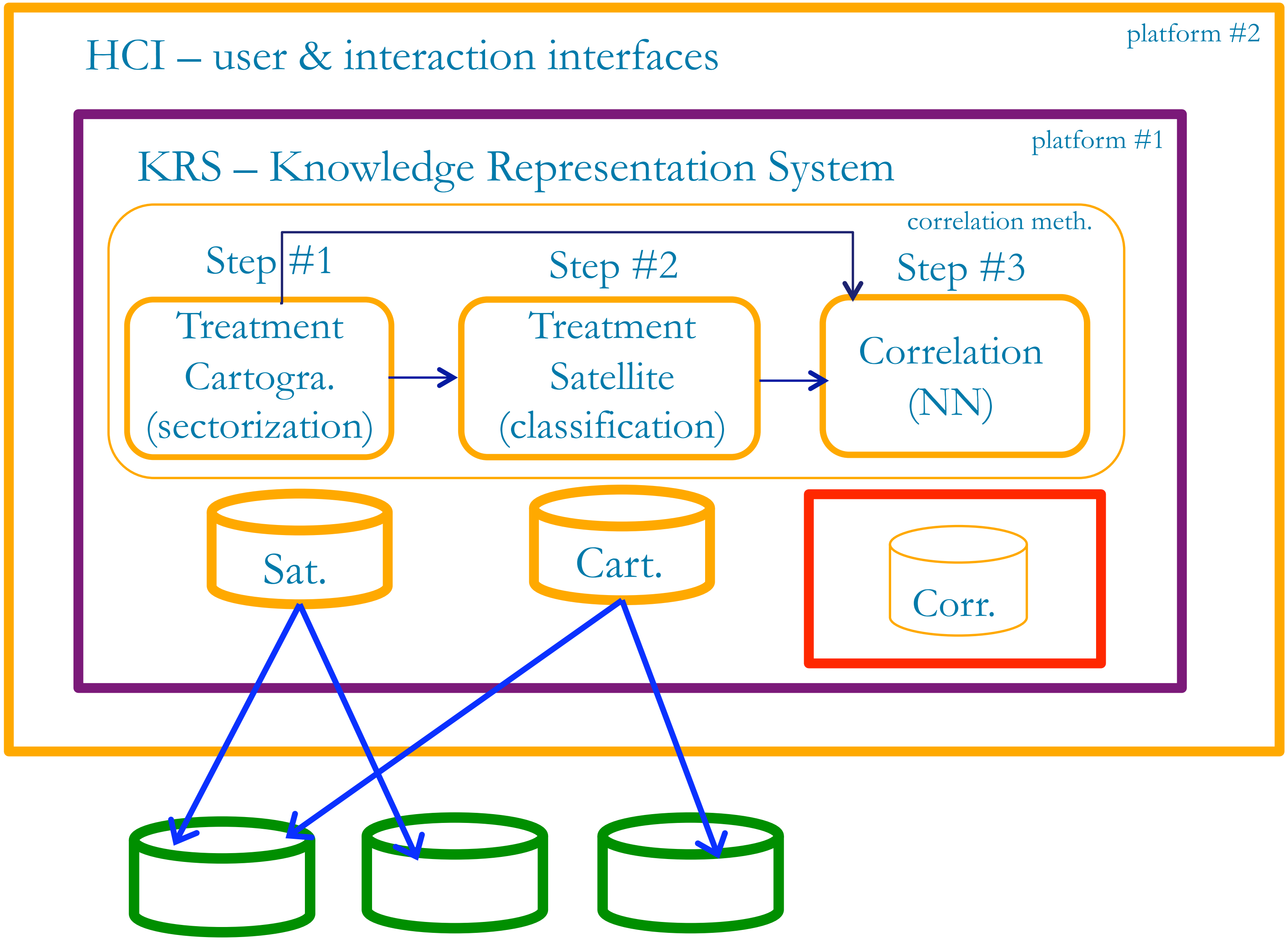
Low cost (in the develpoment).

Disadvan., some fieldwork info is not interpreted

Environmental map

New map obtained from the correspondence m1 & m2

Framework, Platform & Methodology - EMIS

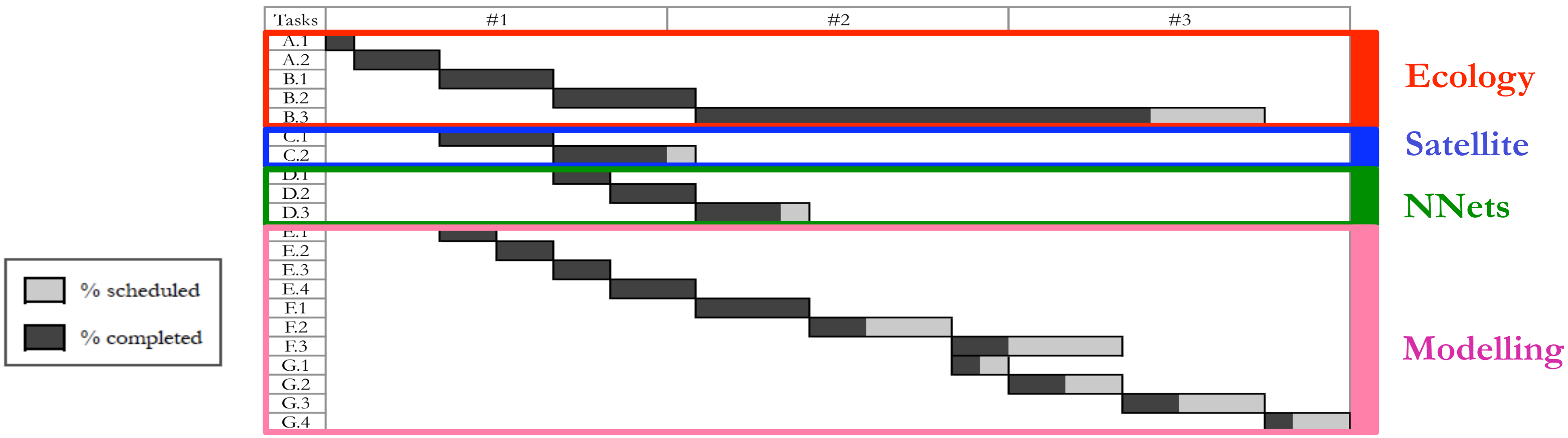


CONTENTS

We estimated the following objectives:

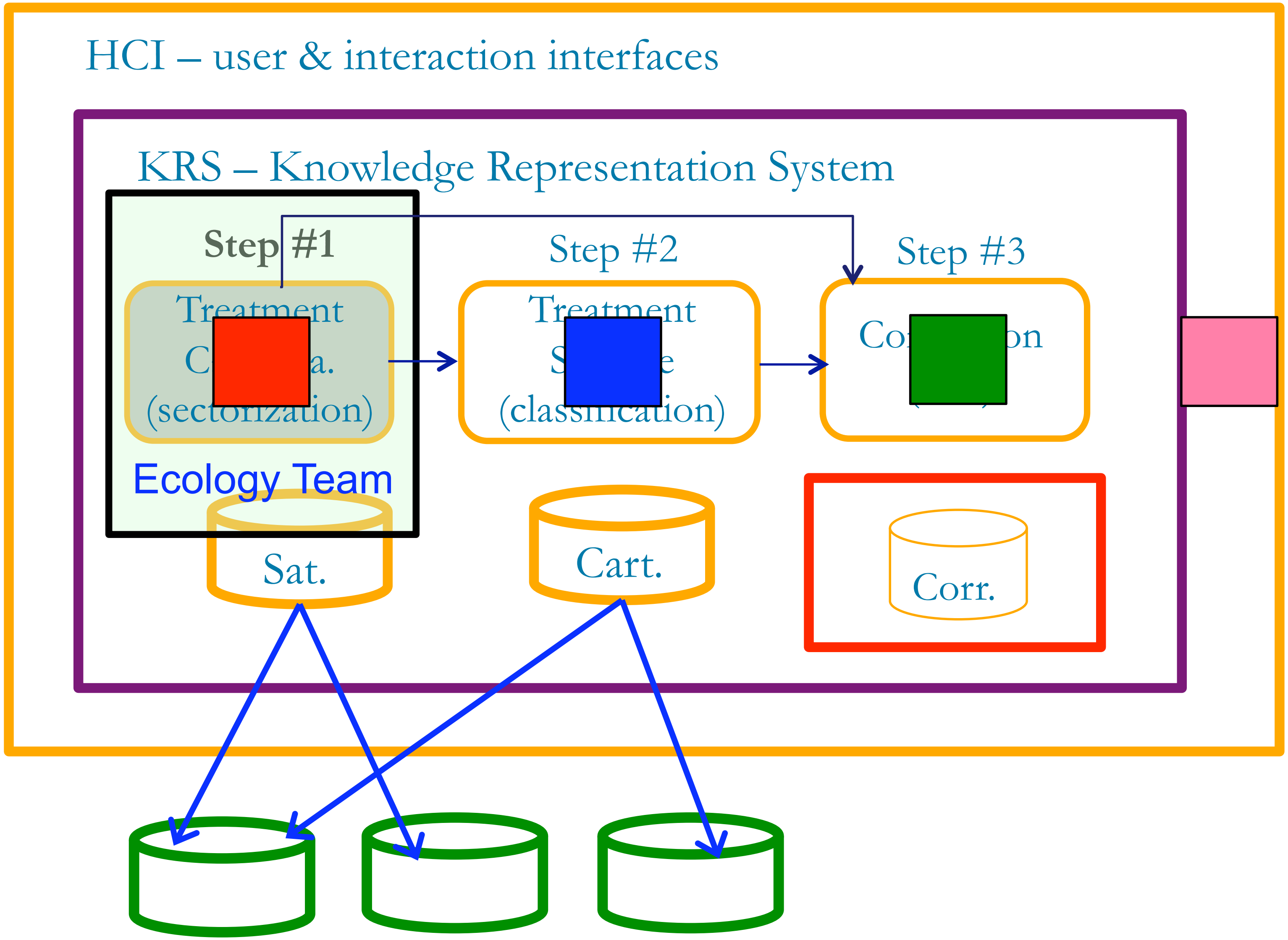
Reached or will be reached in this year

- **(a)** Study the correspondence ecological & satellite info.
- **(b)** Develop a new language for specifying environmental maps.
- **(c)** Study and demonstrating viability of neural-networks in ecology.
- **(d)** Define a hierarchical trading model for information retrieval in EMIS.
- **(e)** Study the intelligent user interfaces design.
- **(f)** Carry out research in CBD and MDD.
- **(g)** Research on neural-networks with SE techniques in CBD and MDD.
- **(h)** Study dinamical composition algorithms of COTS based on trading.
- **(i)** Reduce techniques & practices gap in Soft & Knowledge Eng.

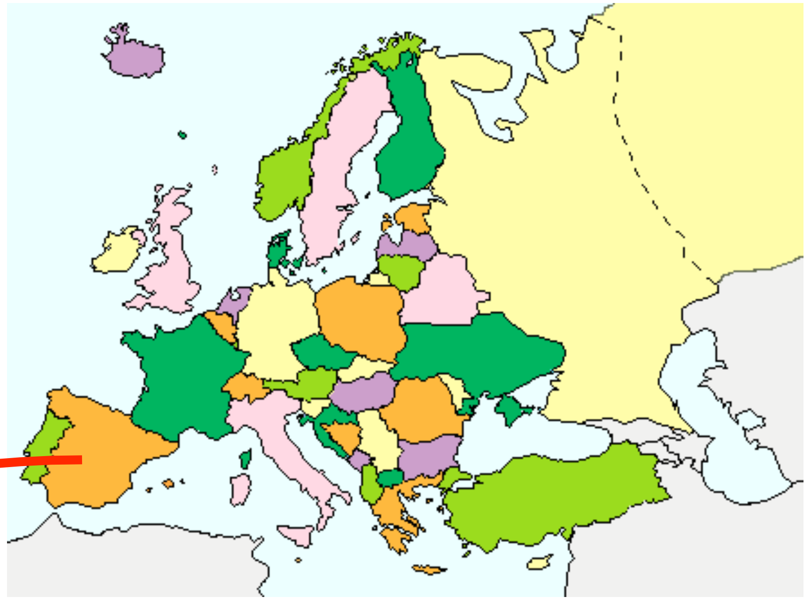


CONTENTS

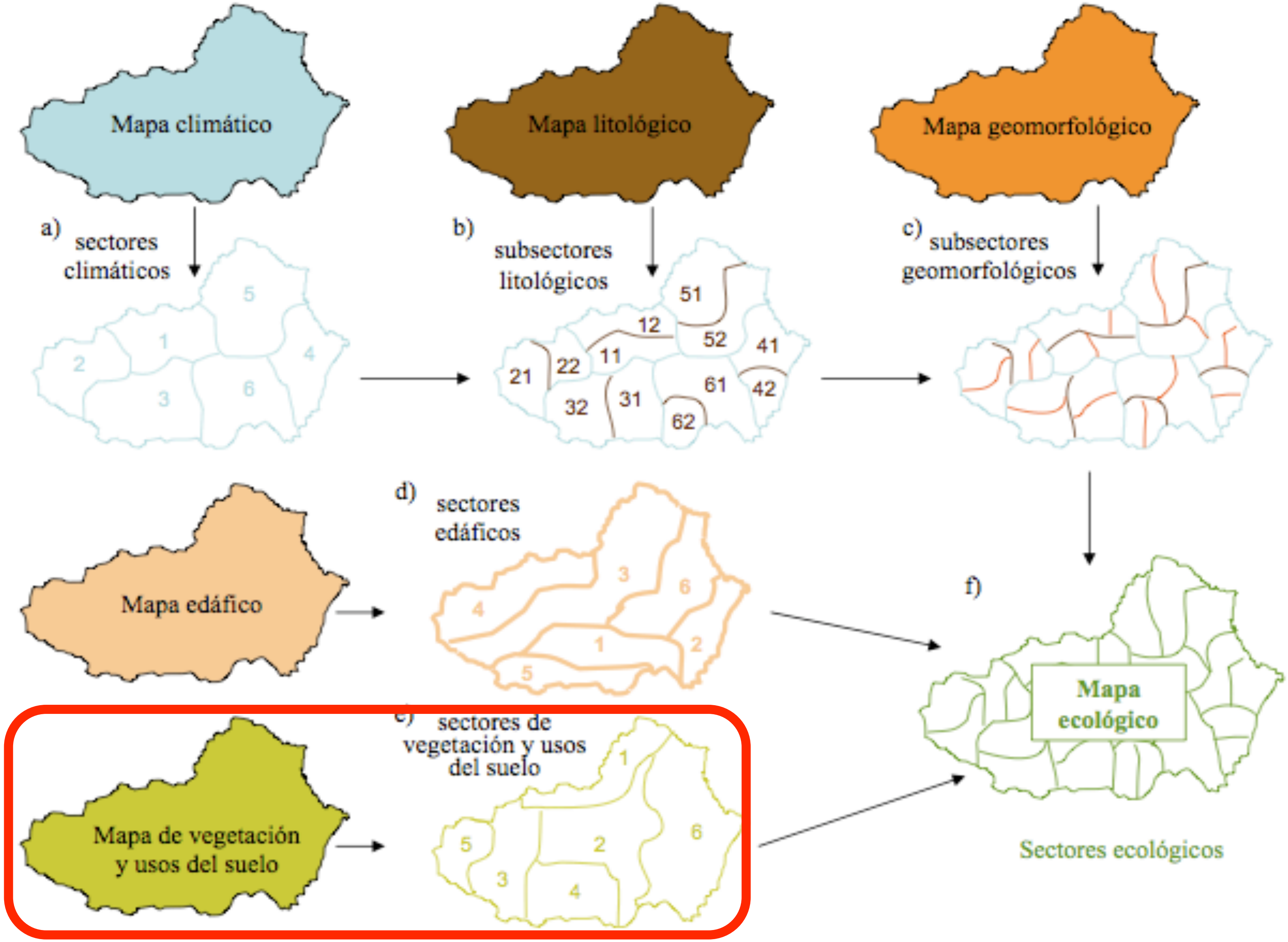
Framework, Platform & Methodology - EMIS



Study Area



Granada + Almeria

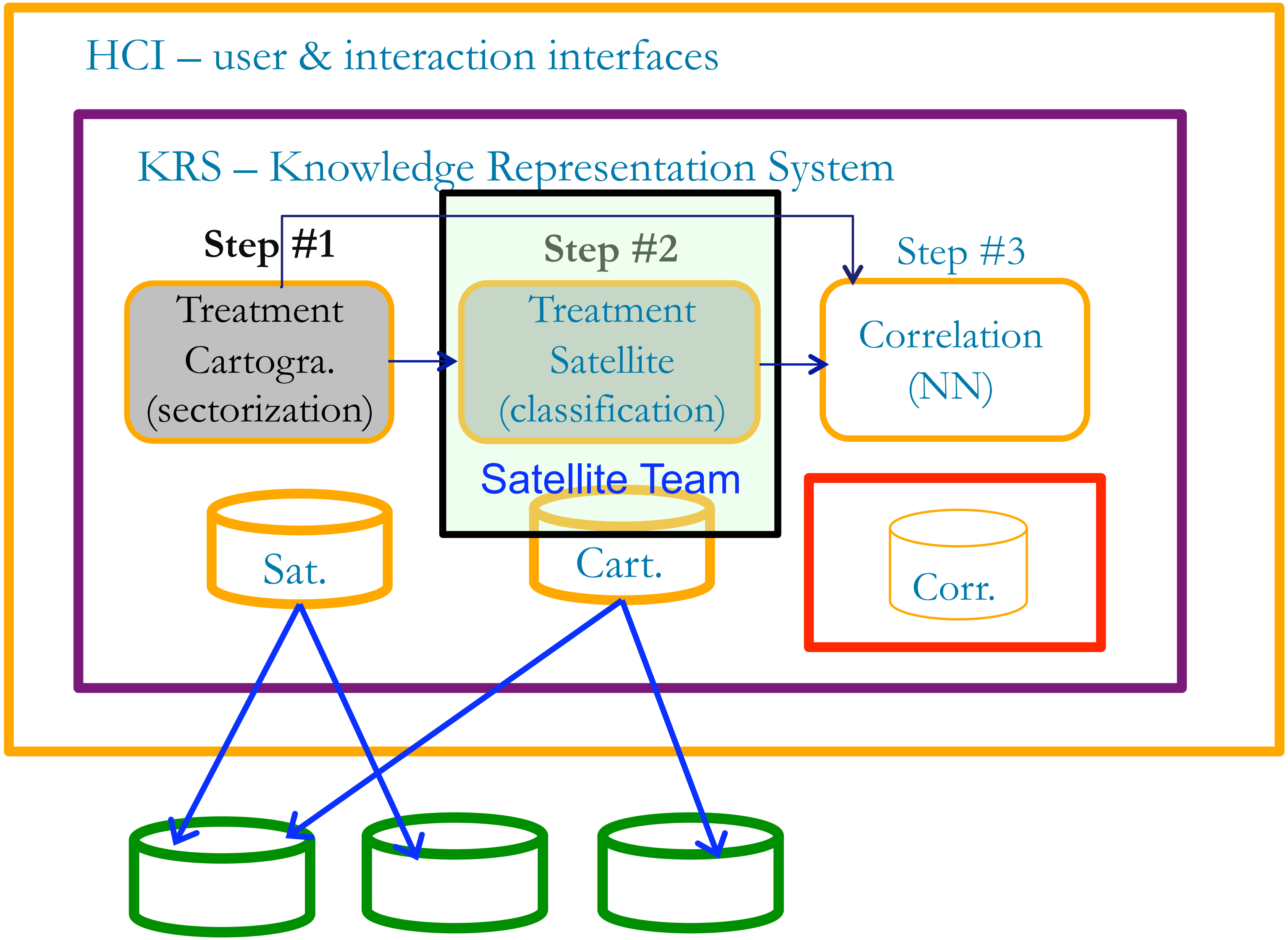


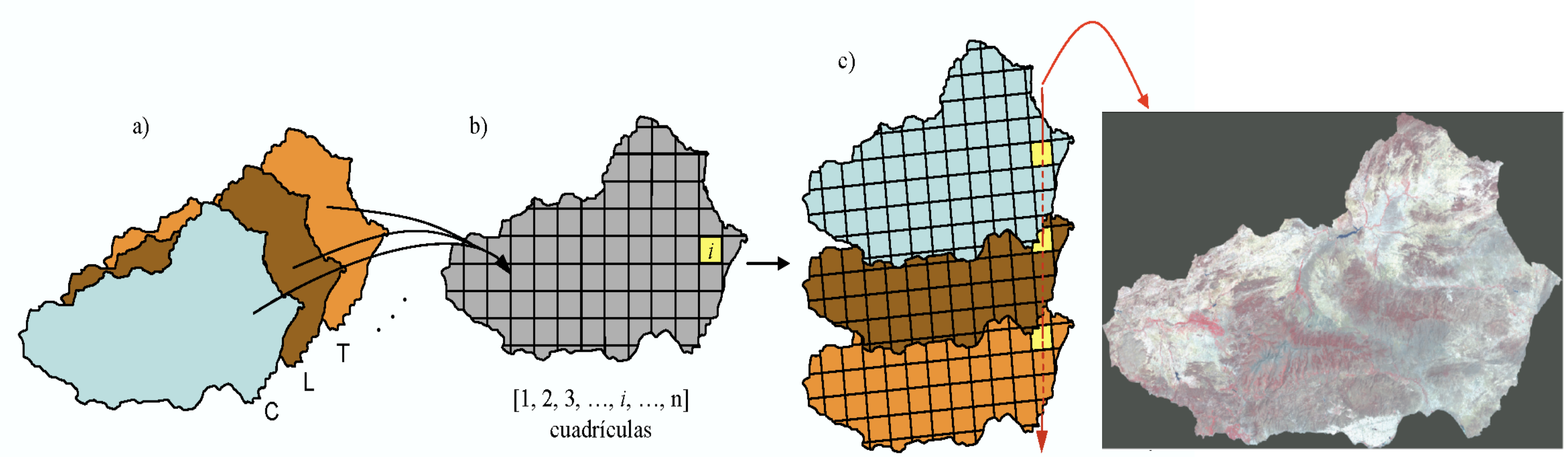
Due to the variability

http://www.ual.es/acg/soleres/ecology.html

Tools: ArcGIS, ArcView, ArcInfo

Framework, Platform & Methodology - EMIS





Satellite treatment:

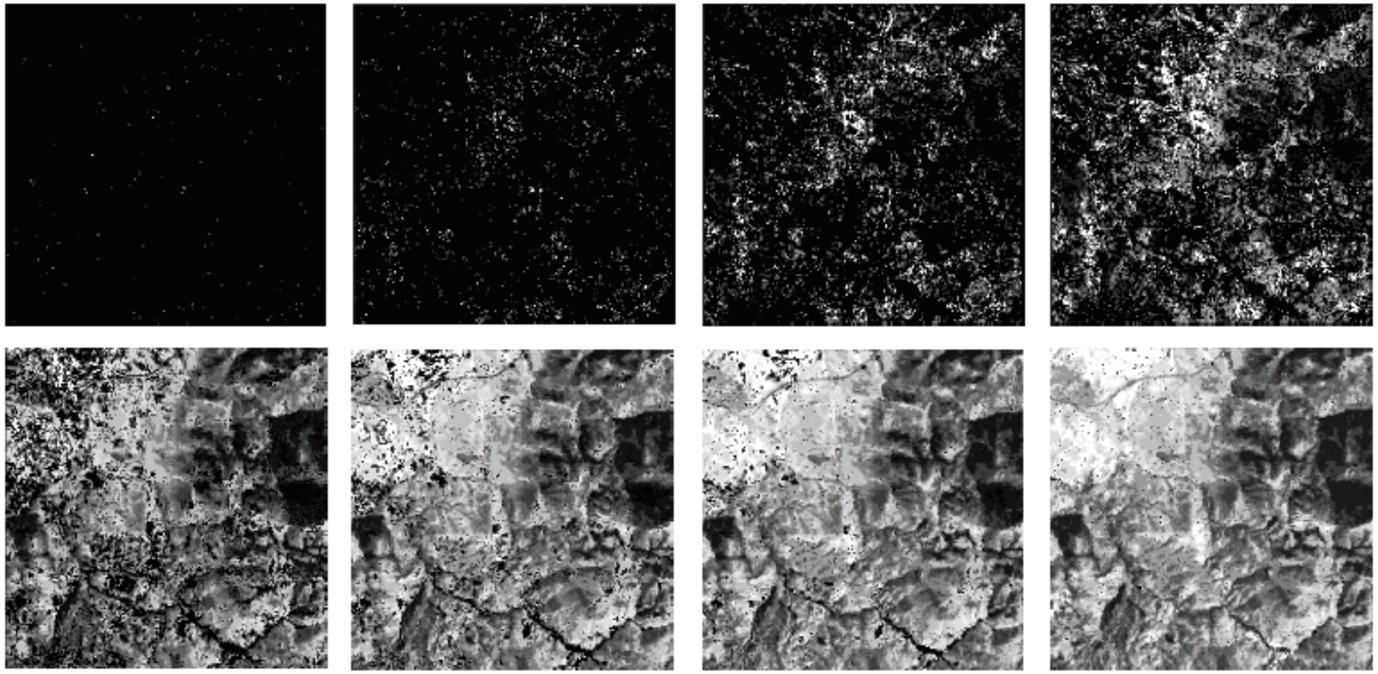
1.- Composition of satellite images: 7981x5195 Landsat, 30x30m.

2.- Adaptation of the spatial resolution to ecological map: 1km2.

3.- Calculation of the cells (matrix): 21905 cells

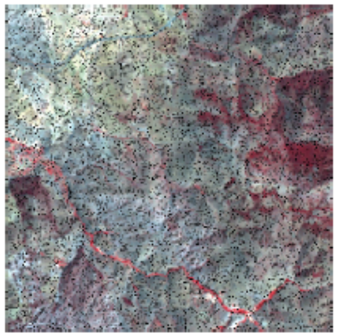
4.- Calculation of the mean, media and #30 percentile.

Development of a new classification algorithm based on Cellular Automata

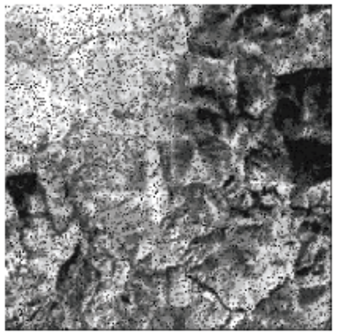


Example – Result after the iteration #8

original



traditional



72.974 / 90.601
80%

CA

75.899 / 90.601
84%

+4%

Well classified

Development of a new classification algorithm based on Cellular Automata

The satellite subteam is preparing some publications with the results

We have a previous publication with preliminary studies:

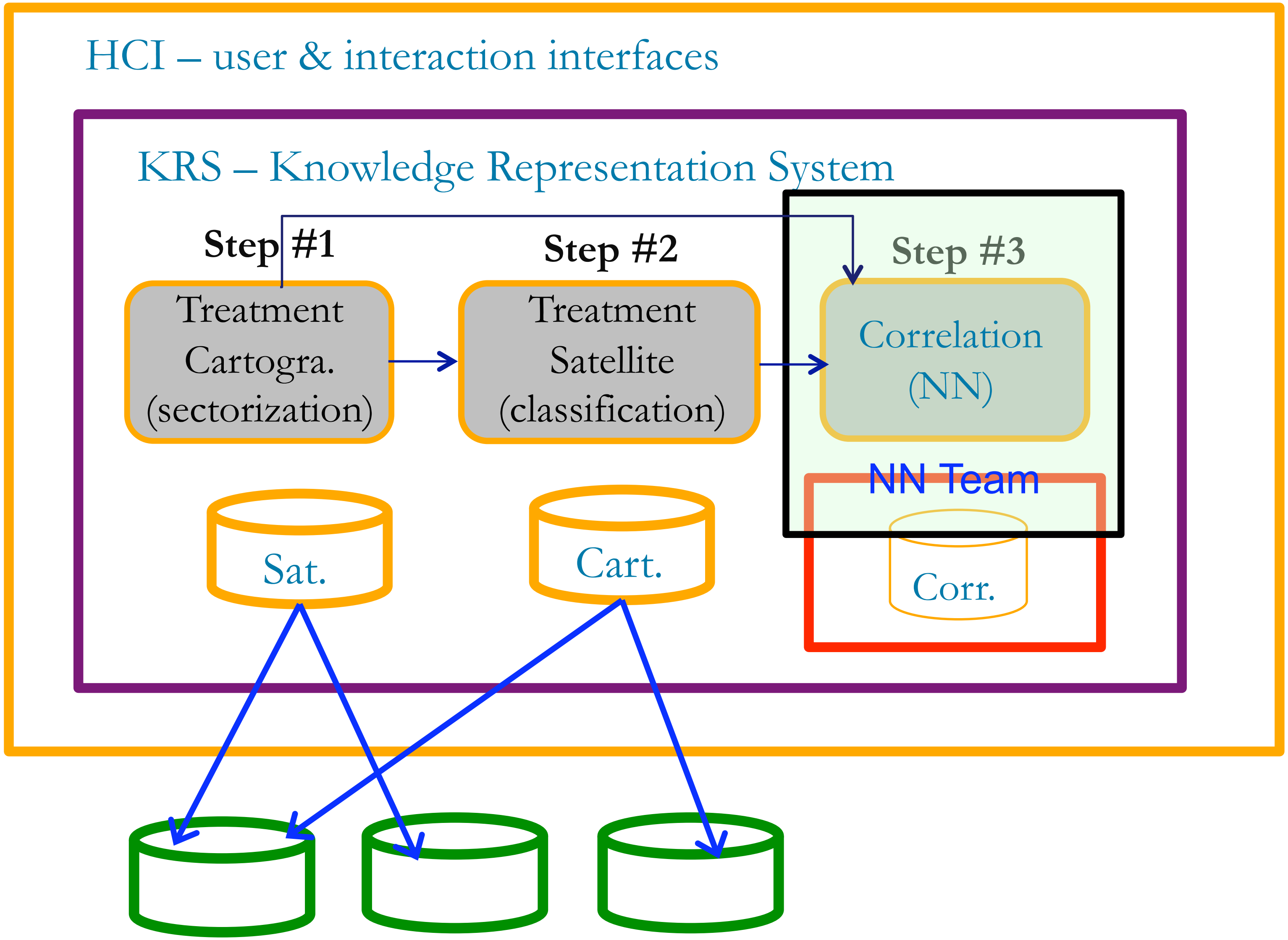
Espinola M, Ayala R, Leguizamón S, and Menenti M. Classification of Satellite Images Using the Cellular Automata Approach. WSKS 2008. 24-28 Sept., Athens (Greece), Springer CCIS 19, pp. 320-327, 2008.

Future: extend CA algorithm to agent architectures

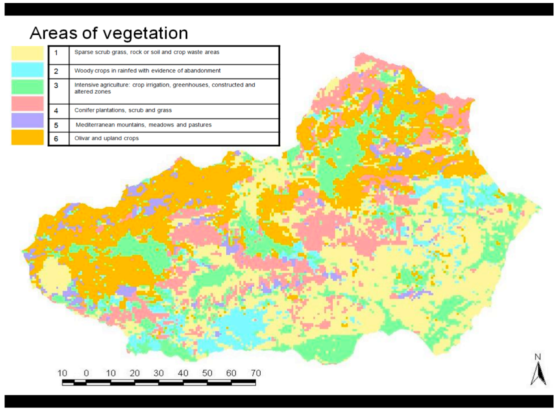
Doctoral Thesis, 2010-2011

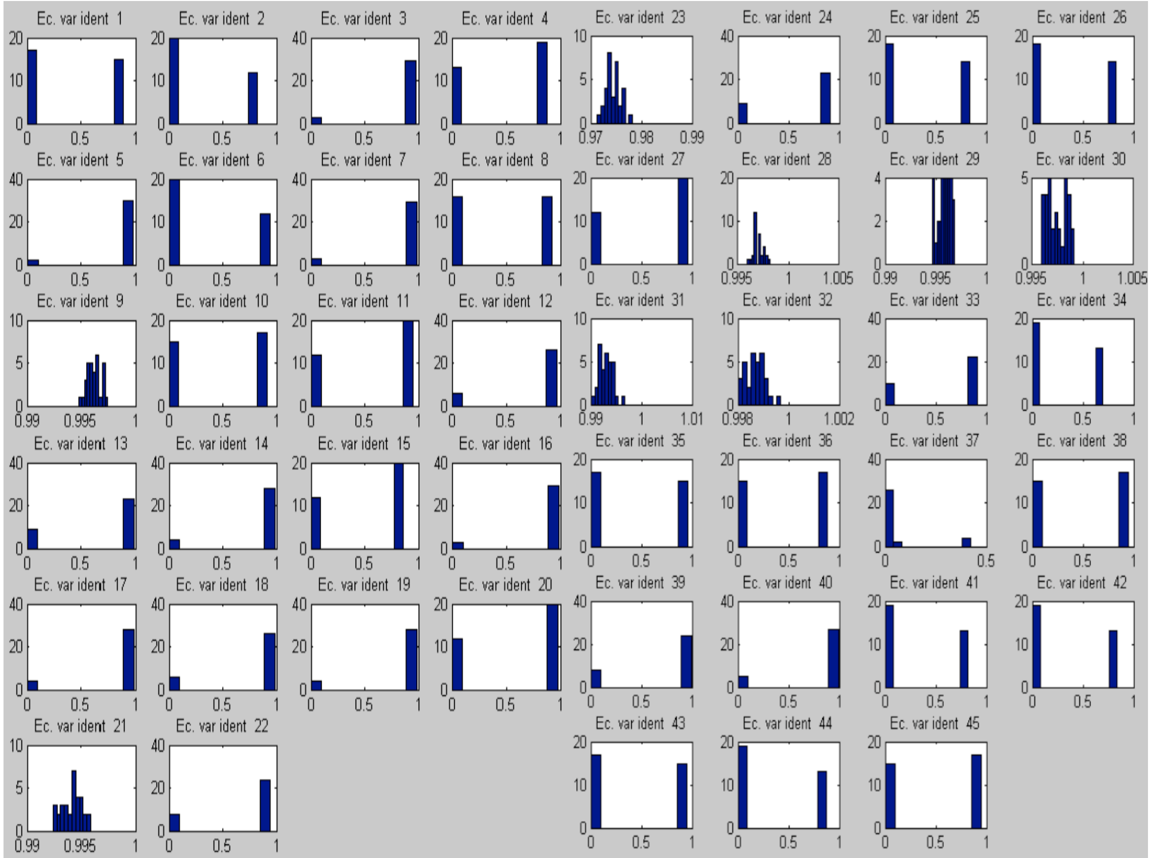
Tools: ERDAS and *Toolkit*.

Framework, Platform & Methodology - EMIS



Neural-networks based on Radial Basis Function (RBF) networks





- 45 variables (vegetation)
- Set of NN m(c,s)
- 32 times the experiment
- 48 days of calculation

metrics:

(a) the precision

(b) the variance

mapping(veg)(carto,sate) → 42/45 (95%)

NN team is preparing publications with the results

Tools: Matlab on a 3-Core NVIDIA GPUs, 256 cores each one

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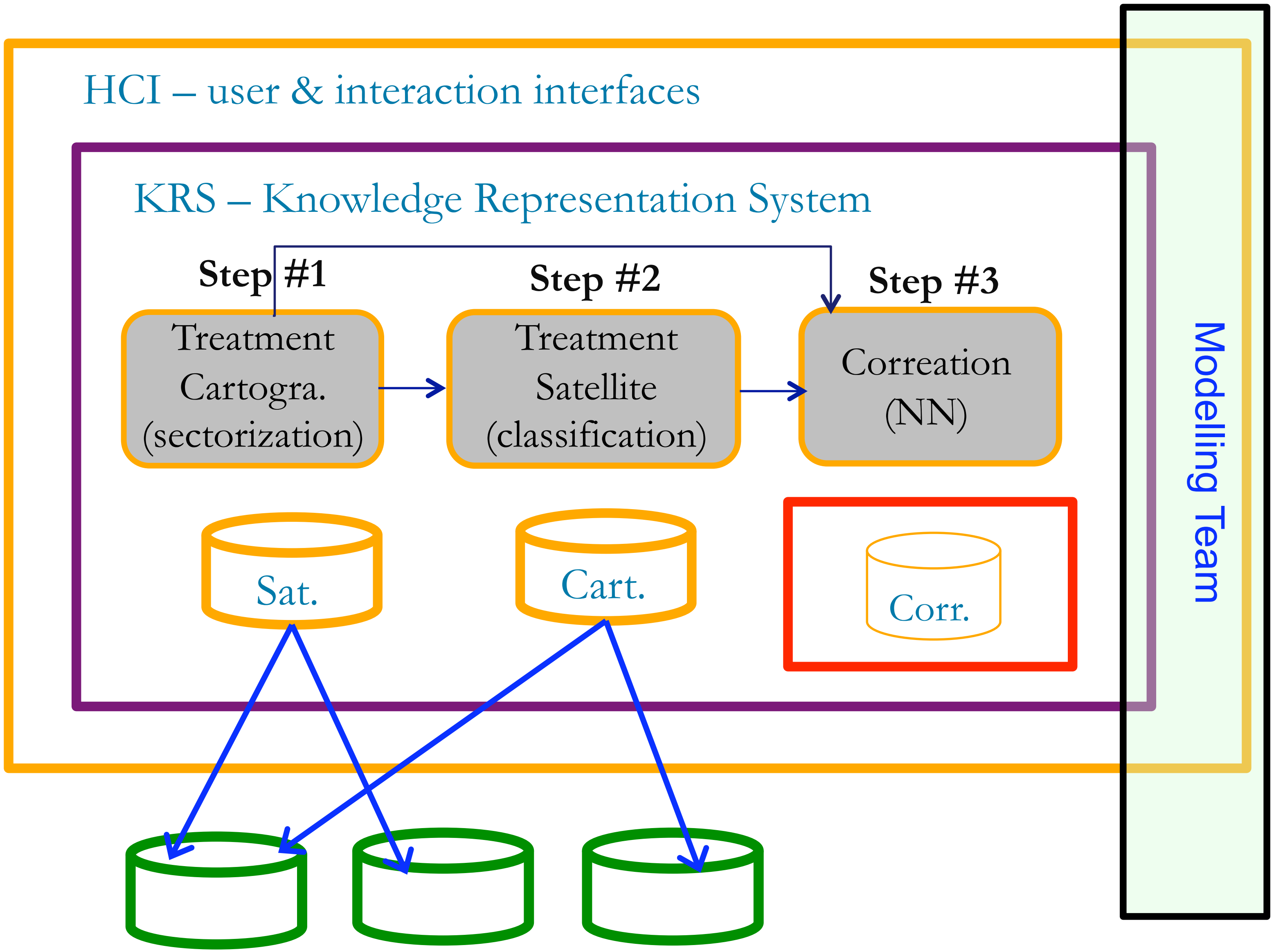
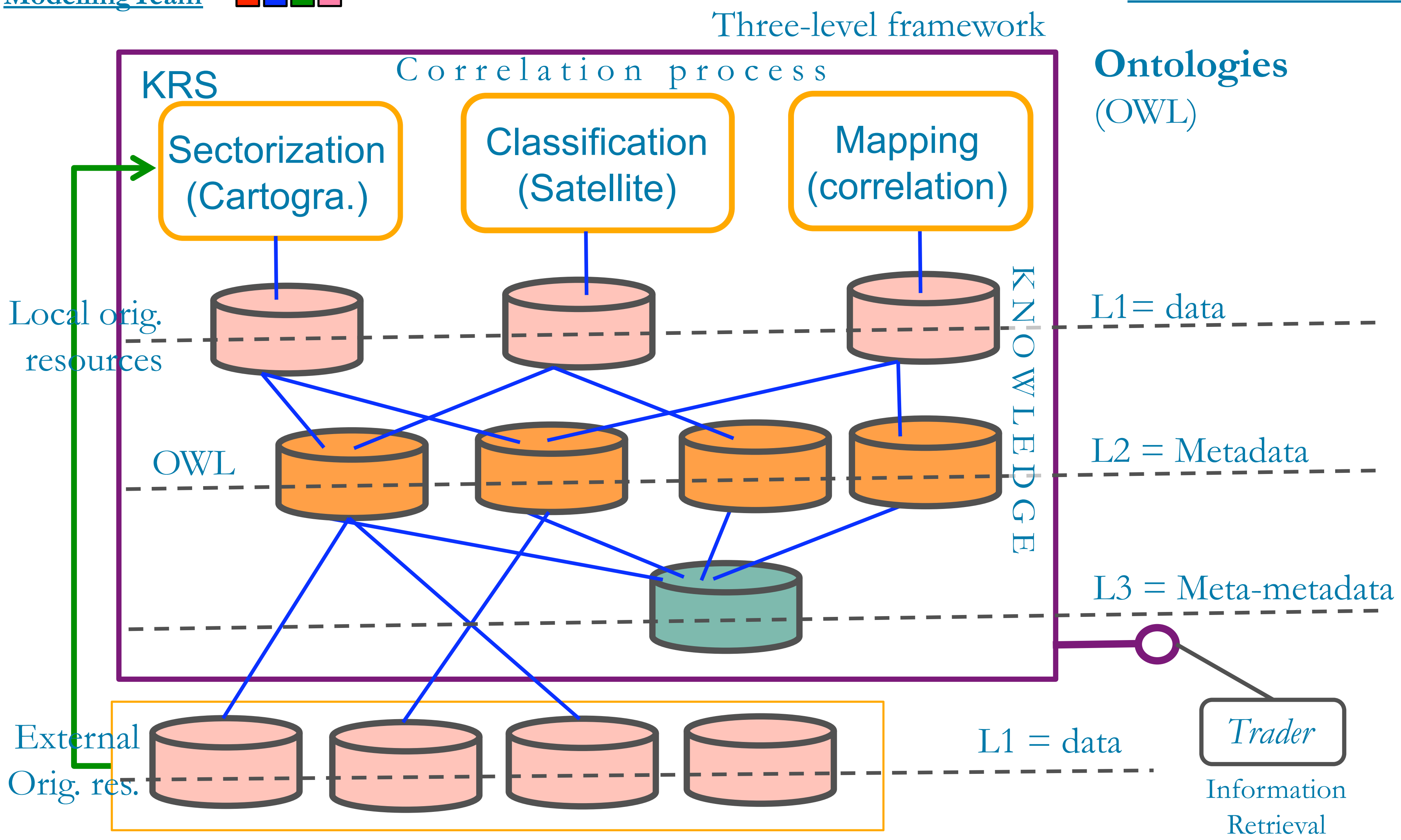
Framework, Platform & Methodology - EMIS

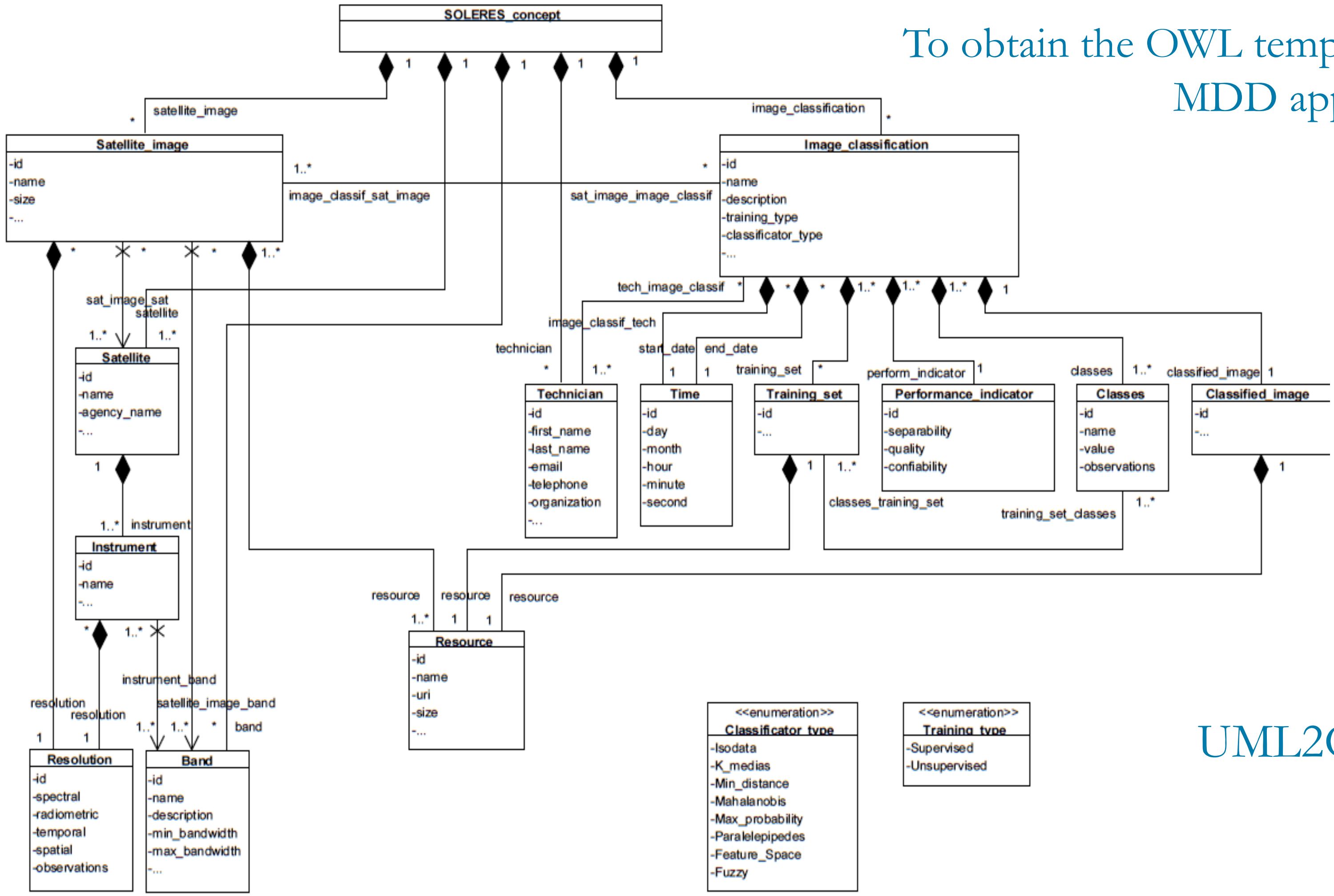




Padilla N, Iribarne L, Asensio JA, Muoz FJ, and Ayala R. Modelling an Environmental Knowledge-Representation System. LNCS-5288, pp. 70--78, 2008.

Asensio JA, Iribarne L, Padilla N, Muoz FJ , Ayala R, Cruz M, and Menenti M. A MDE-based Satellite Ontology for Environmental Management Systems. 2010, Information Technology, Info. Systems and Know. Manag. Springer book. ISBN: 978-0-387-88750-0.

To obtain the OWL templantes: MDD approach



UML2OWL

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Iribarne L, Padilla N, Asensio JA, Muñoz FJ, Ayala R, Cruz M, Almendros J, and Menenti M. An Open-Environmental Ontology Modeling. IEEE Trans. Syst. Man Cybern. Part A-Syst. Hum. (In 3rd revision).

formalization of the ontology (a piece)

FOL (First Order Logic)

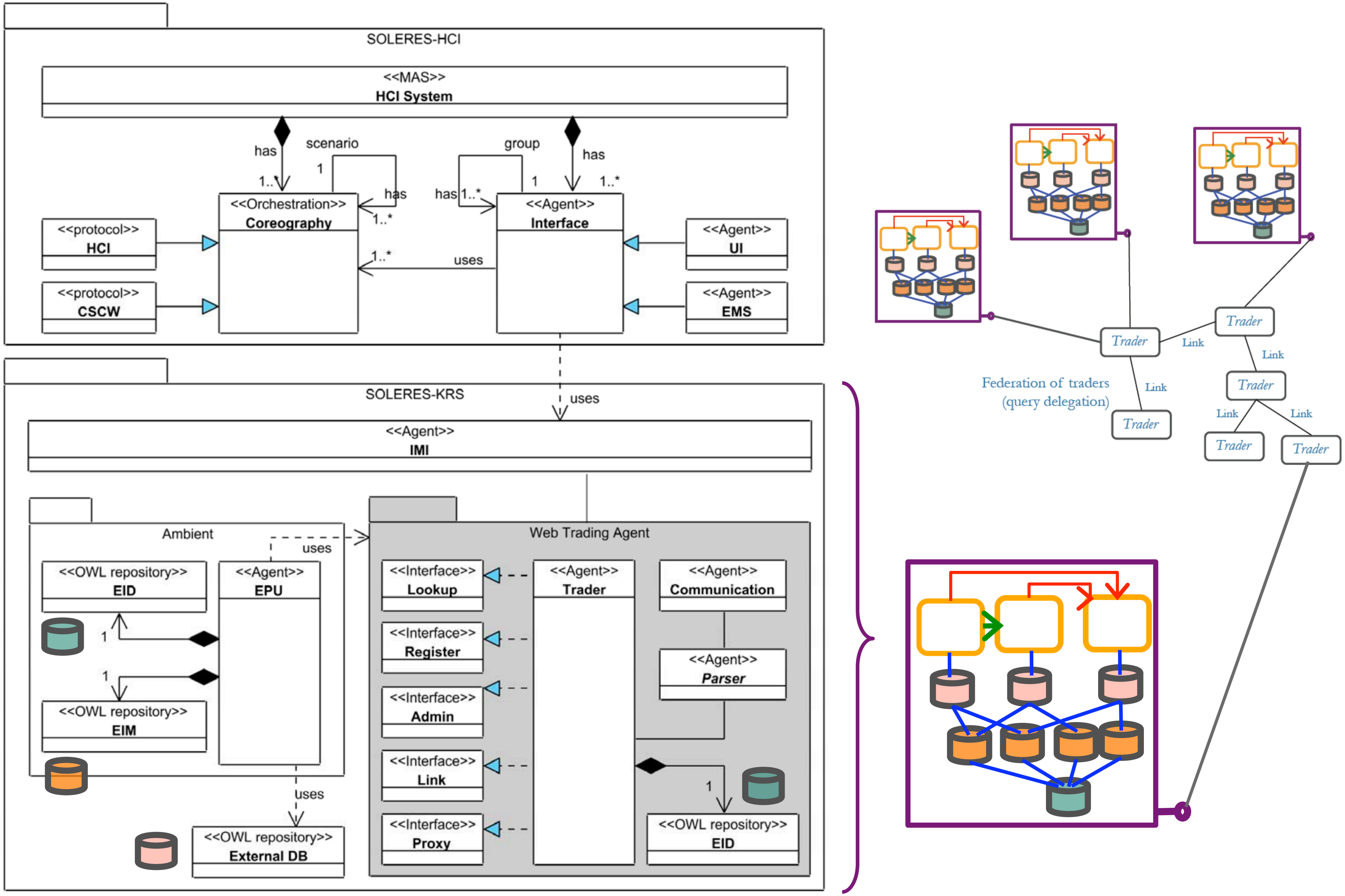
TABLE VI
FOL FORMALIZATION OF SATELLITE MAPS (FIG. 6)

$\forall x, y.satellite\_image(x,y) \rightarrow Soleres(x) \wedge Satellite\_image(y)$
$\forall y.Soleres(y) \rightarrow (\sharp\{x|satellite\_image(y,x)\} = 1)$
$\forall x, y.resolution(x,y) \rightarrow Resolution(x) \wedge Satellite\_image(y)$
$\forall y.Resolution(y) \rightarrow (\sharp\{x|resolution(y,x)\} = 1)$
$\forall x, y.sat\_image\_sat(x,y) \rightarrow Satellite\_image(x) \wedge Satellite(y)$
$\forall y.Satellite(y) \rightarrow (\sharp\{x|sat\_image\_sat(y,x)\} = 1)$
$\forall x, y.instrument(x,y) \rightarrow Satellite(x) \wedge Instrument(y)$
$\forall y.Satellite(y) \rightarrow (\sharp\{x|instrument(y,x)\} = 1)$
$\forall y.Instrument(y) \rightarrow (\sharp\{x|instrument(y,x)\} \geq 1)$
$\forall x, y.resolution(x,y) \rightarrow Resolution(x) \wedge Instrument(y)$
$\forall y.Resolution(y) \rightarrow (\sharp\{x|resolution(y,x)\} = 1)$
$\forall x, y.instrument\_band(x,y) \rightarrow Instrument(x) \wedge Band(y)$
$\forall y.Instrument(y) \rightarrow (\sharp\{x|instrument\_band(y,x)\} \geq 1)$
$\forall y.Band(y) \rightarrow (\sharp\{x|instrument\_band(y,x)\} \geq 1)$
$\forall x, y.satellite\_image\_band(x,y) \rightarrow Satellite\_image(x) \wedge Band(y)$
$\forall y.Band(y) \rightarrow (\sharp\{x|satellite\_image\_band(y,x)\} = 1)$
$\forall x, y.satellite(x,y) \rightarrow Soleres(x) \wedge Satellite(y)$
$\forall y.Soleres(y) \rightarrow (\sharp\{x|satellite(y,x)\} = 1)$
$\forall y.Satellite(y) \rightarrow (\sharp\{x|satellite(y,x)\} \geq 1)$
$\forall x, y.band(x,y) \rightarrow Soleres(x) \wedge Band(y)$
$\forall y.Soleres(y) \rightarrow (\sharp\{x|band(y,x)\} = 1)$
$\forall x, y.resource(x,y) \rightarrow Satellite\_image(x) \wedge Resource(y)$
$\forall y.Satellite\_image(y) \rightarrow (\sharp\{x|resource(y,x)\} \geq 1)$
$\forall y.Resource(y) \rightarrow (\sharp\{x|resource(y,x)\} \geq 1)$

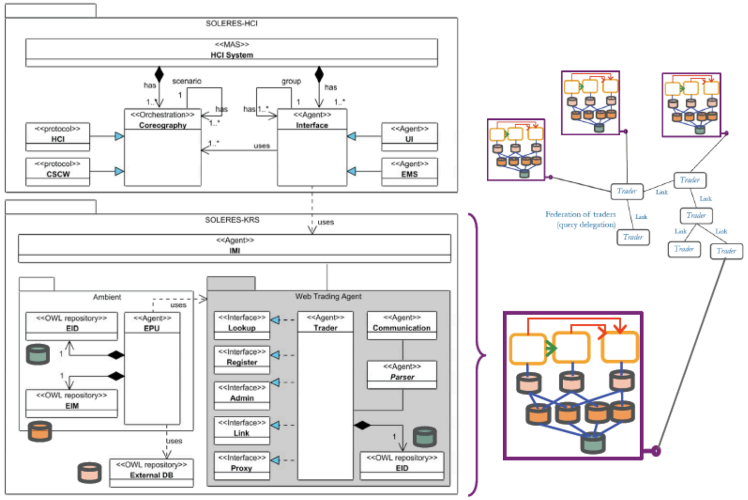
DL (Description Logic)

TABLE VII
DL FORMALIZATION OF SATELLITE MAPS (FIG. 6)

$\top \sqsubseteq \forall satellite\_image.Soleres \sqcap \forall satellite\_image^{-}.Satellite\_image$
$Soleres \sqsubseteq (\geq 1.satellite\_image) \sqcap (\leq 1.satellite\_image)$
$\top \sqsubseteq \forall resolution.Resolution \sqcap \forall resolution^{-}.Satellite\_image$
$Satellite\_image \sqsubseteq (\geq 1.resolution) \sqcap (\leq 1.resolution)$
$\top \sqsubseteq \forall sat\_image\_sat.Satellite\_image \sqcap \forall sat\_image\_sat^{-}.Satellite$
$Satellite \sqsubseteq (\geq 1.sat\_image\_sat)$
$\top \sqsubseteq \forall instrument.Satellite \sqcap \forall instrument^{-}.Instrument$
$Satellite \sqsubseteq (\geq 1.instrument) \sqcap (\leq 1.instrument)$
$Instrument \sqsubseteq (\geq 1.instrument)$
$\top \sqsubseteq \forall resolution.Resolution \sqcap \forall resolution^{-}.Instrument$
$Instrument \sqsubseteq (\geq 1.resolution) \sqcap (\leq 1.resolution)$
$\top \sqsubseteq \forall instrument\_band.Instrument \sqcap \forall instrument\_band^{-}.Band$
$\top \sqsubseteq \forall instrument\_band.Band \sqcap \forall instrument\_band^{-}.Instrument$
$\top \sqsubseteq \forall satellite\_image\_band.Satellite\_image \sqcap \forall satellite\_image\_band^{-}.Band$
$Band \sqsubseteq (\geq 1.satellite\_image\_band)$
$\top \sqsubseteq \forall satellite.Soleres \sqcap \forall satellite^{-}.Satellite$
$Soleres \sqsubseteq (\geq 1.satellite) \sqcap (\leq 1.satellite)$
$Satellite \sqsubseteq (\geq 1.satellite)$
$\top \sqsubseteq \forall band.Soleres \sqcap \forall band^{-}.Band$
$Soleres \sqsubseteq (\geq 1.band) \sqcap (\leq 1.band)$
$\top \sqsubseteq \forall resource.Satellite\_image \sqcap \forall resource^{-}.Resource$
$\top \sqsubseteq \forall resource.Resource \sqcap \forall resource^{-}.Satellite\_image$



Agent architecture based on trading



Prototype of the system

Tools:

- JADE
- SPARQL
- Protegè (OWL)
- Visual Paradigm for Eclipse (UML)
- ATL for MT (uml2owl)
- COTStrader (team's product)

Iribarne L, Padilla N, Asensio JA, Muñoz FJ, Criado J. Involving Web-Trading Agents & MAS. An implementation for searching and recovering environmental information. Proc. Int. Conf. on Agents and Artificial Intelligence (ICAART'2010). Vol. 2, pp. 268--273, 2010.

Criado J, Padilla N, Iribarne L, Asensio JA, Muñoz FJ. Ontological Trading in a Multi-Agent System. Proc. Int. Conf. on Practical Applications of Agents and Multi-Agent Systems. (PAAMS'2010). 26-28 Apr., Salamanca (Spain).

Iribarne L, Padilla N, Asensio JA, Muñoz FJ, Ayala R, and Criado J. An Ontological Web-Trading agent approach for information retrieval. World Wide Web Journal. In 3rd revision.

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User & Interaction Interfaces (HCI)

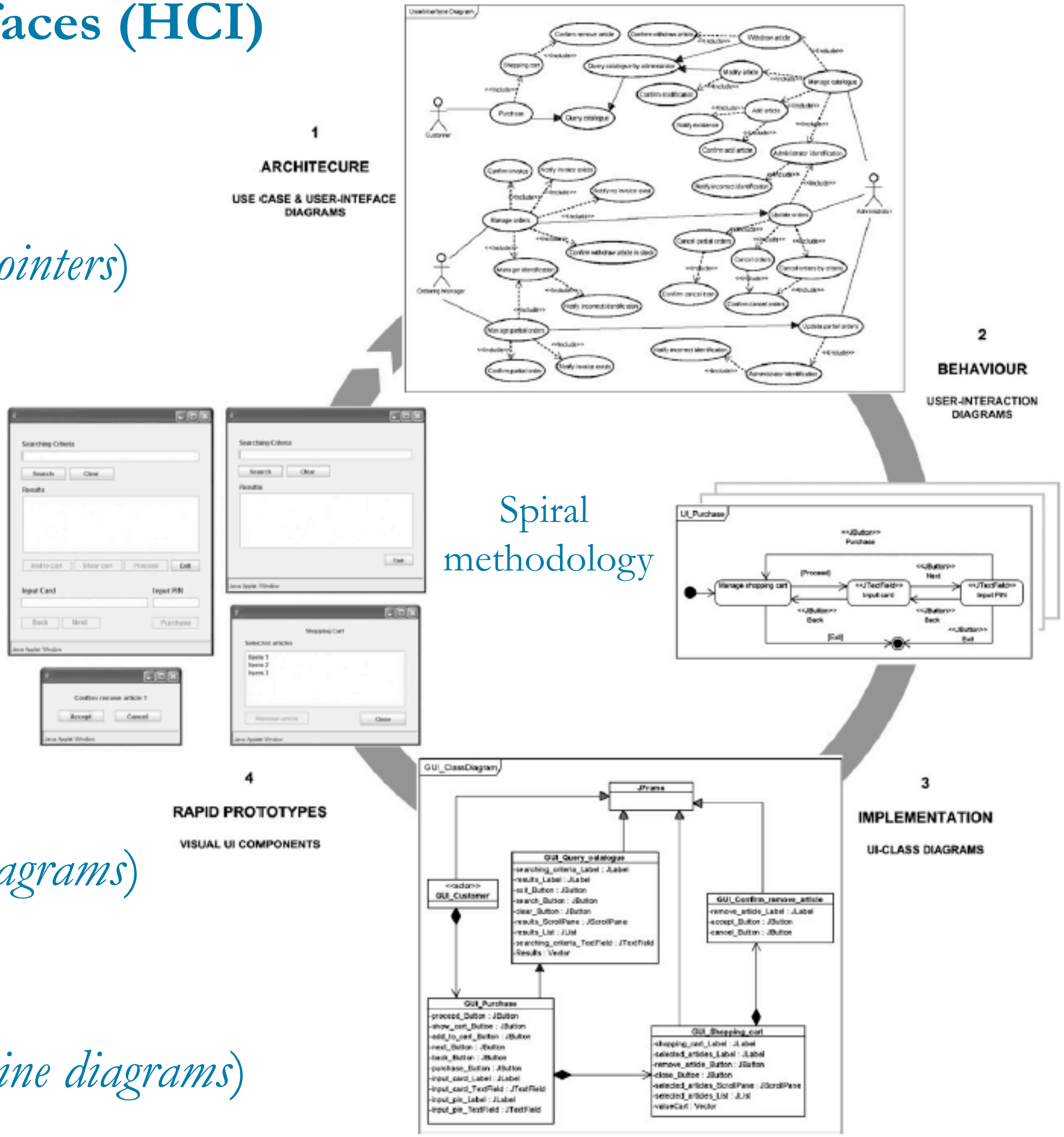
WIMP Interfaces
(Windows, Icons, Menus and Pointers)

Useful for WIS
(Web-based Info. Systems)

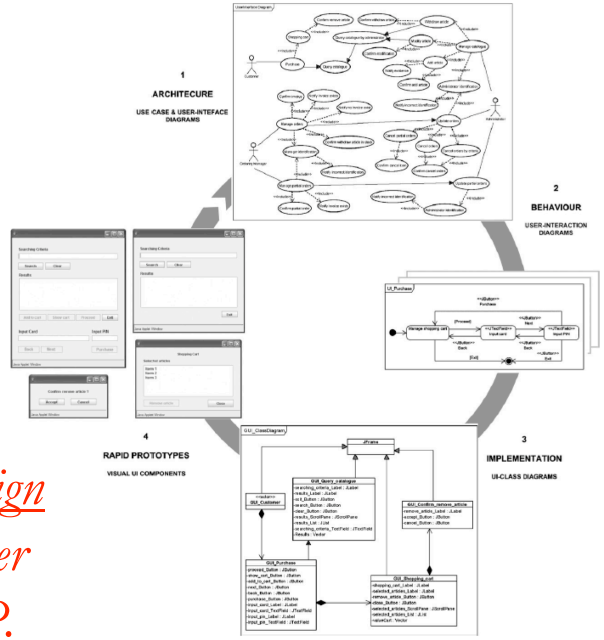
MDD perspective
(Model-Driven Develpment)

User-Inteface Diagrams
(extension of UML use-case diagrams)

User-Interaction Diagrams
(extension of UML state-machine diagrams)



User & Interaction Interfaces (HCI)



Almendros J, and Iribarne L. An extension of UML for the modeling of WIMP user interfaces. Journal of Visual Languages and Computing, 19(6):695–720, 2008.

Code generation

Almendros J and Iribarne L. User interaction and interface design with UML. Chapter XXXVIII in the book Human Computer Interaction: Concepts, Methodologies, Tools, and Applications. P. Zaphiris and C. S. Ang (eds.), IGI Global. 404–431, 2009.

User-Interaction and connection to DB: sequence diagrams

Almendros J and Iribarne L. UML modeling of user and database interaction. The Computer Journal, 52(3):348–367, 2009.

User & Interaction Interfaces (HCI)

Eclipse GMF tool to "draw" user-interaction for modelling UI.

Almendros J, Iribarne L, Asensio JA, Padilla N, and Vicente-Chicote C. An Eclipse GMF Tool for Modelling User Interaction. LNCS/LNAI 5736, pp., 405–416. 2009

(Goal of the project in MDD) Model transformation (MT):

Almendros J and Iribarne L. A Framework for Model Transformation in Logic Programming. PROLE'2008. 7-10 Oct, Gijón, Asturias (Spain), pp. 29–39, 2008.

Almendros J and Iribarne L. A Prolog-based Approach for Model Transformation. IEEE Trans. Knowl. Data Eng. (TKDE). In 2nd revision.

User & Interaction Interfaces (HCI)

General HCI model for SOLERES

Iribarne L, Asensio JA, Padilla N, and Ayala R. SOLERES-HCI. Modelling a human-computer interaction framework for open EMS. Springer CCIS 19, pp. 320–327, 2008.

Adaptation of traders for modelling HCI

Asensio JA, Iribarne L, Padilla N, and Ayala R. Implementing trading agents for adaptable and evolutive UI-COTS components architectures. ICE-B'2008. 26-29 July, Porto (Portugal), pp. 259–262, 2008.

Cooperative Systems and intelligence issues for HCI.

In progress & results throughout 2010.

CONTENTS

Results & Discussion

#1: 85% of the project executed.

#2: new classification process for Sat. based on CA: + 4%.

#3: mapping cartographic & satellite is possible (success 95%: 43/45).

#4: mapping will allow the interpretation of new satellite image info.

#5: mapping is possible for other env. variables (+vegetation).

#6: ontology-driven framework: standardization procedure for EMIS.

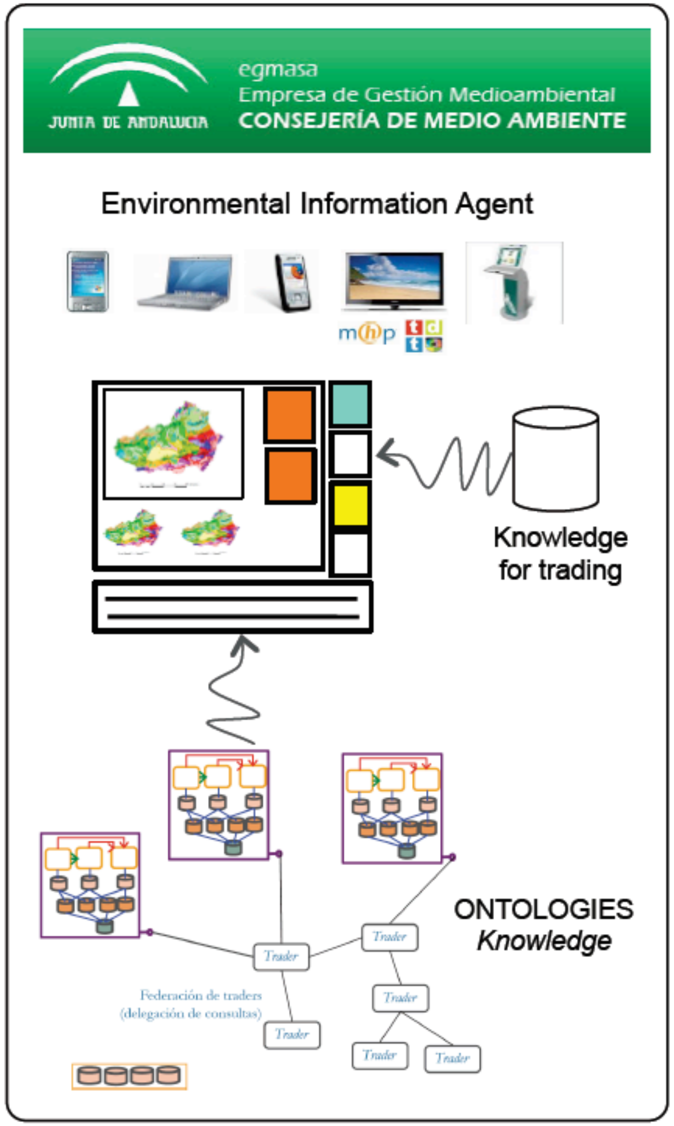
Results & Discussion

#7: modelling/framework can be extended to other info (sat & carto).

#8: SE advances for UI & interaction through UML and MDD

Call-for-Project (Andalusian) + EGMASA: "Development of an intelligent Web agent for environmental information"

EGMASA is a partner of the project
Public company on EM & GIS
Government of the Region of Andalusian



Publications & Works

14 scientific and technological publications:

- 9 in proceedings of conferences (7 international)
- 3 journal articles (JCR)
- 1 book chapter (IGI Global Publisher)
- 1 scientific and technical book

3 journal articles in revision (3rd and 2nd)

1 collateral research line (JCR): application of UML modelling experiences in SOLERES (MICINN cited):

Iribarne L, Ayala R and Torres JA. A DPS-based system modelling method for 3D structures simu- lation in manufacturing processes. Simulation Modelling, Practice and Theory J., 17(5):935–954, 2009.

Publications & Works

4 open lines of research that will lead to doctoral thesis works:

(2010/2011 deadline)

1 ontology-driven multiagent architecture applied to EMIS.

1 methodology for sat. classification using cellular automata and agents.

(2009, in progress)

1 automatic generation of UI through intelligent MT

1 trading service for building UI based on i-COTS composition.

→ A solution in evolutive and cooperative user interfaces.

New proposal sent to the MICINN in the last *Call-for-Projects* 2010

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