

KES: Knowledge Enabled Services for better EO Information Use



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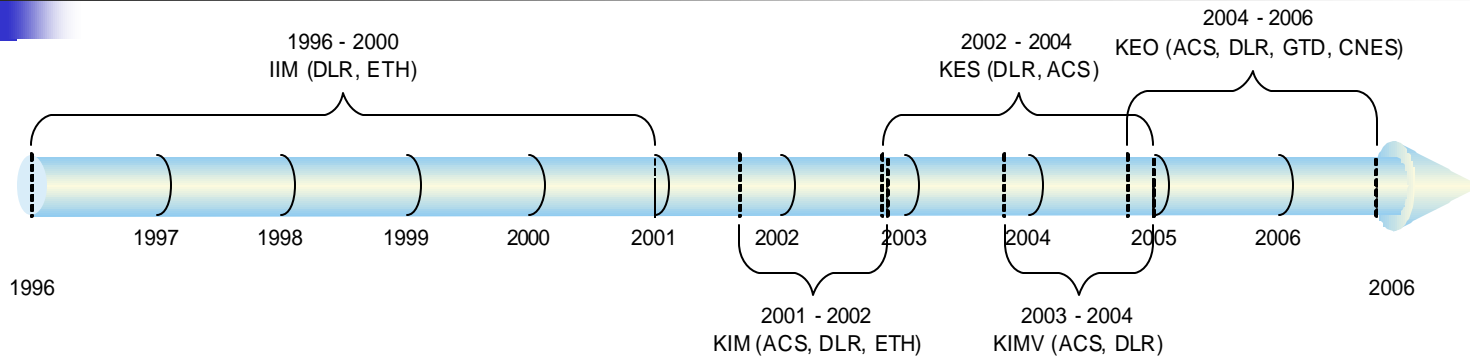
The problem

- During the last decades, the satellite image catalogues have stored huge quantity of data
- State of the art catalogues permit only to specify location, time of interest, metadata like platform, sensor, acquisition mode...

The interpretation task

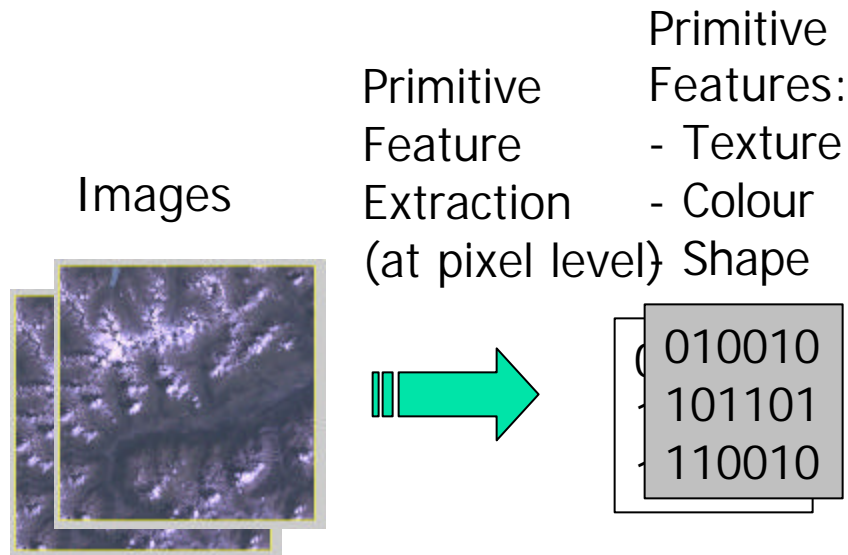
- The interpretation of EO images requires
 - Fusion of data/information for better understanding of structures
 - Aggregation with existing knowledge specific to the application fields (at higher level)

A little bit of history..

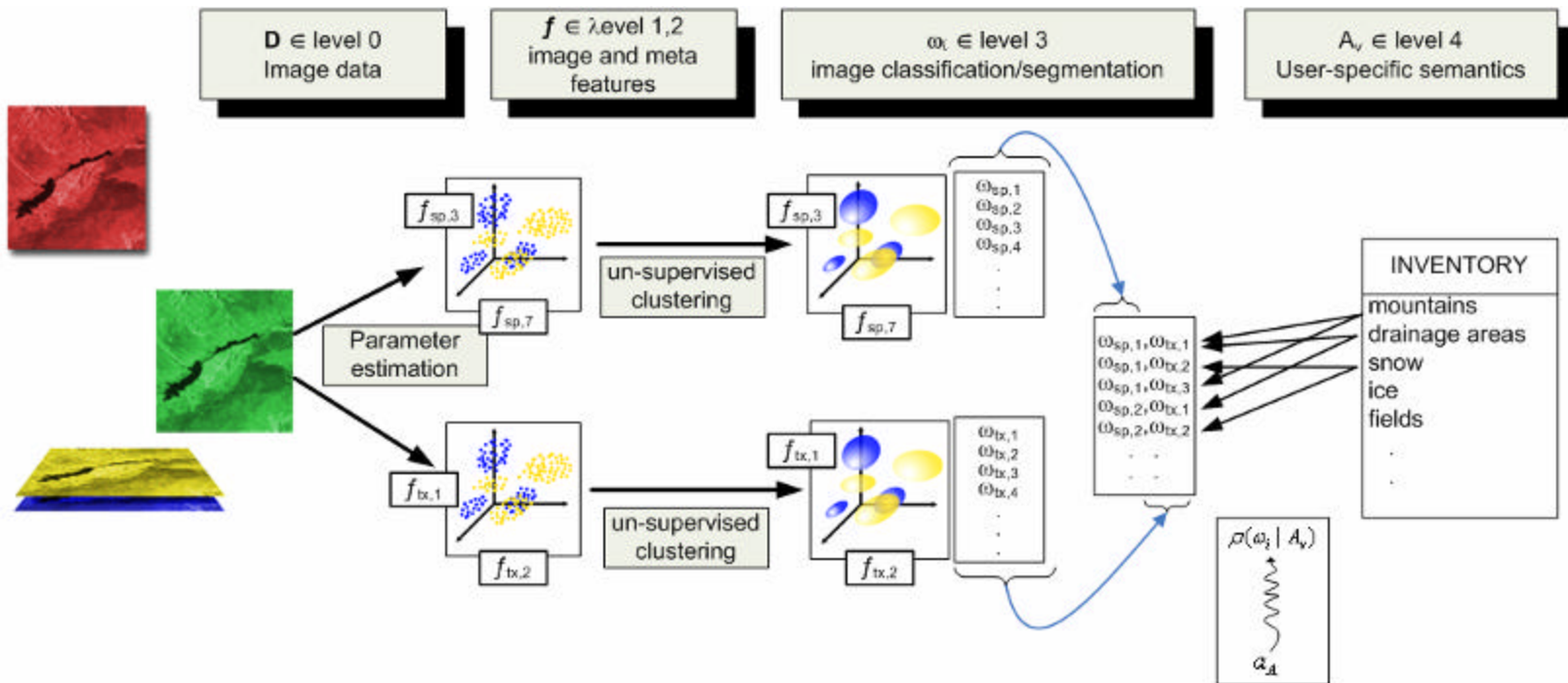


- 1996-2000 IIM (Image Information Mining) (<http://isis.dlr.de/mining>)
- 2001: KIM (Knowledge Information Mining) (<http://www.acsys.it:8080/kim>)
- 2002: KES (Knowledge Enabled Services)
- 2003: KIMV (KIM Validation)
- 2004: KEO (Knowledge-centred Earth Observation)

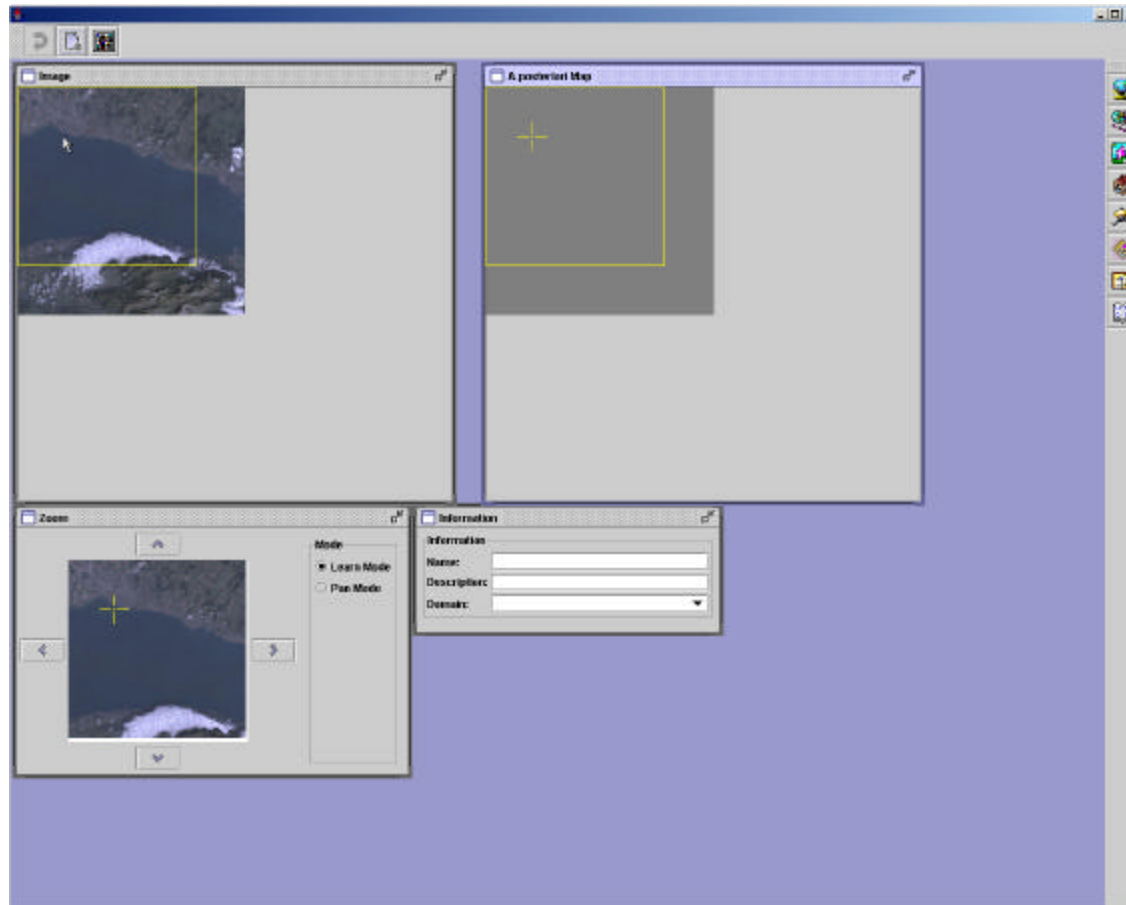
KIM: Knowledge Driven Information Mining



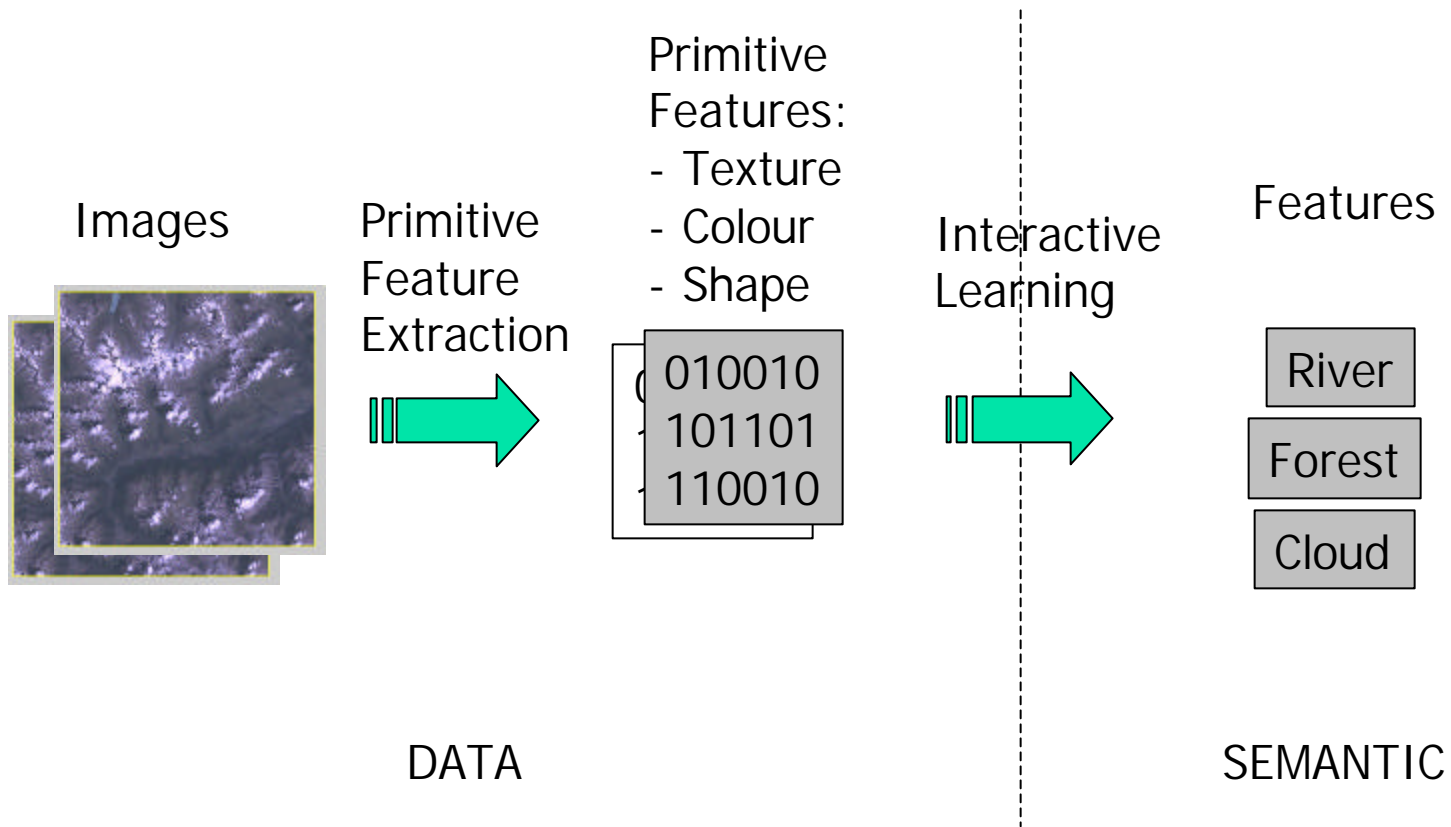
More in detail



KIM Interactive learning



From data to semantic

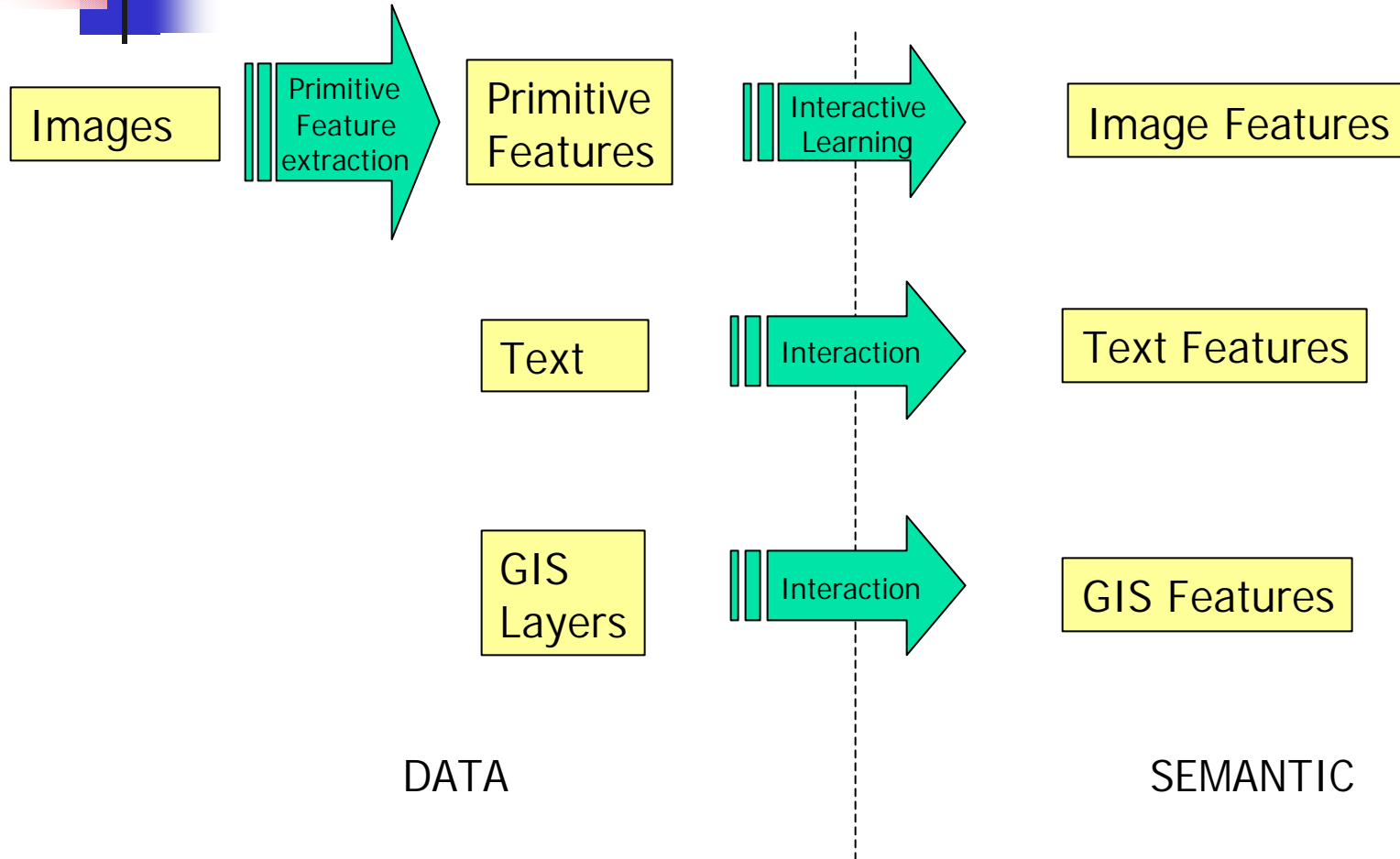




From KIM to KES (Knowledge Enabled Services)

- Image interpretation is not a simple task. Each user needs a set of accessory data, as for example GIS layers or texts obtained through Internet.
- Yet, the amount of available information makes searches a demanding and expensive task.
- An environment where images are at the focal point, and where each user can navigate through a taxonomically structured knowledge, could be of extreme value.

Other semantic



KES: New interface

The screenshot displays the KES Client 1.0 interface. The main window is titled "KES Client 1.0" and contains several panels:

- Set Features or Category:** Includes radio buttons for "Probability", "Separability", and "Coverage".
- Advanced Area:**
 - Set Collection:** A list of collection types including "All collections", "Image", "Presence", "Sentinel", "Icons", "Smart", "MicroImage", and "Text".
 - Set Satellites and/or Sensors:** Checkboxes for "Landsat", "Hellas", "Providence", "ERS", and "Smart".
 - Other sensors:** Checkboxes for "Radar" and "Optical".
- Date:** Fields for "From:" (1970 01 01 01:12:00 PM CET) and "To:" (2004 05 11 01:12:00 PM CET).
- Bounding box:** Fields for "Upper left bound (Lat, Lon)" (00.00, 100.00) and "Lower right bound (Lat, Lon)" (92.00, 103.00).
- Search results:** A table with columns: Name, Collection ID, Insertion Date, Lat Center, Lat Corner, Lat/Down, Lon, and Lon/Down. The table lists various "Ingao" entries from Switzerland.
- Map panel:** Includes "Zoom" (Zoom out, Zoom in), "Refresh" (Refresh), "Layers", and "Map navigation" (Map navigation, ROI selection) controls. A map of Europe is shown with a bounding box over Switzerland.
- Search results table:**

Name	Collection ID	Insertion Date	Lat Center	Lat Corner	Lat/Down	Lon	Lon/Down
Ingao_202_1_0	Switzerland	28-mae-2002	47.820	46.907	46.907	47.820	47.820
Ingao_202_1_1	Switzerland	28-mae-2002	48.186	48.073	48.073	48.186	48.186
Ingao_202_2_2	Switzerland	28-mae-2002	47.883	47.844	47.844	47.883	47.883
Ingao_202_2_3	Switzerland	28-mae-2002	47.735	47.696	47.696	47.735	47.735
Ingao_202_2_4	Switzerland	28-mae-2002	47.486	47.373	47.373	47.486	47.486
Ingao_202_2_5	Switzerland	28-mae-2002	47.238	47.114	47.114	47.238	47.238
Ingao_202_2_6	Switzerland	28-mae-2002	47.010	46.907	46.907	47.010	47.010
Ingao_202_3_1	Switzerland	28-mae-2002	48.186	48.073	48.073	48.186	48.186
Ingao_202_3_2	Switzerland	28-mae-2002	47.883	47.844	47.844	47.883	47.883
Ingao_202_3_3	Switzerland	28-mae-2002	47.735	47.696	47.696	47.735	47.735
Ingao_202_3_4	Switzerland	28-mae-2002	47.486	47.373	47.373	47.486	47.486
Ingao_202_3_5	Switzerland	28-mae-2002	47.238	47.114	47.114	47.238	47.238
Ingao_202_3_6	Switzerland	28-mae-2002	47.010	46.907	46.907	47.010	47.010
Ingao_202_4_1	Switzerland	28-mae-2002	48.186	48.073	48.073	48.186	48.186
Ingao_202_4_2	Switzerland	28-mae-2002	47.883	47.844	47.844	47.883	47.883
Ingao_202_4_3	Switzerland	28-mae-2002	47.735	47.696	47.696	47.735	47.735
Ingao_202_4_4	Switzerland	28-mae-2002	47.486	47.373	47.373	47.486	47.486
Ingao_202_4_5	Switzerland	28-mae-2002	47.238	47.114	47.114	47.238	47.238
Ingao_202_4_6	Switzerland	28-mae-2002	47.010	46.907	46.907	47.010	47.010
Ingao_202_5_2	Switzerland	28-mae-2002	47.883	47.844	47.844	47.883	47.883
Ingao_202_5_3	Switzerland	28-mae-2002	47.735	47.696	47.696	47.735	47.735
Ingao_202_5_4	Switzerland	28-mae-2002	47.486	47.373	47.373	47.486	47.486
Ingao_202_5_5	Switzerland	28-mae-2002	47.238	47.114	47.114	47.238	47.238
Ingao_202_5_6	Switzerland	28-mae-2002	47.010	46.907	46.907	47.010	47.010
Ingao_202_5_7	Switzerland	28-mae-2002	48.186	48.073	48.073	48.186	48.186
Ingao_202_6_2	Switzerland	28-mae-2002	47.883	47.844	47.844	47.883	47.883
Ingao_202_6_3	Switzerland	28-mae-2002	47.735	47.696	47.696	47.735	47.735
Ingao_202_6_4	Switzerland	28-mae-2002	47.486	47.373	47.373	47.486	47.486

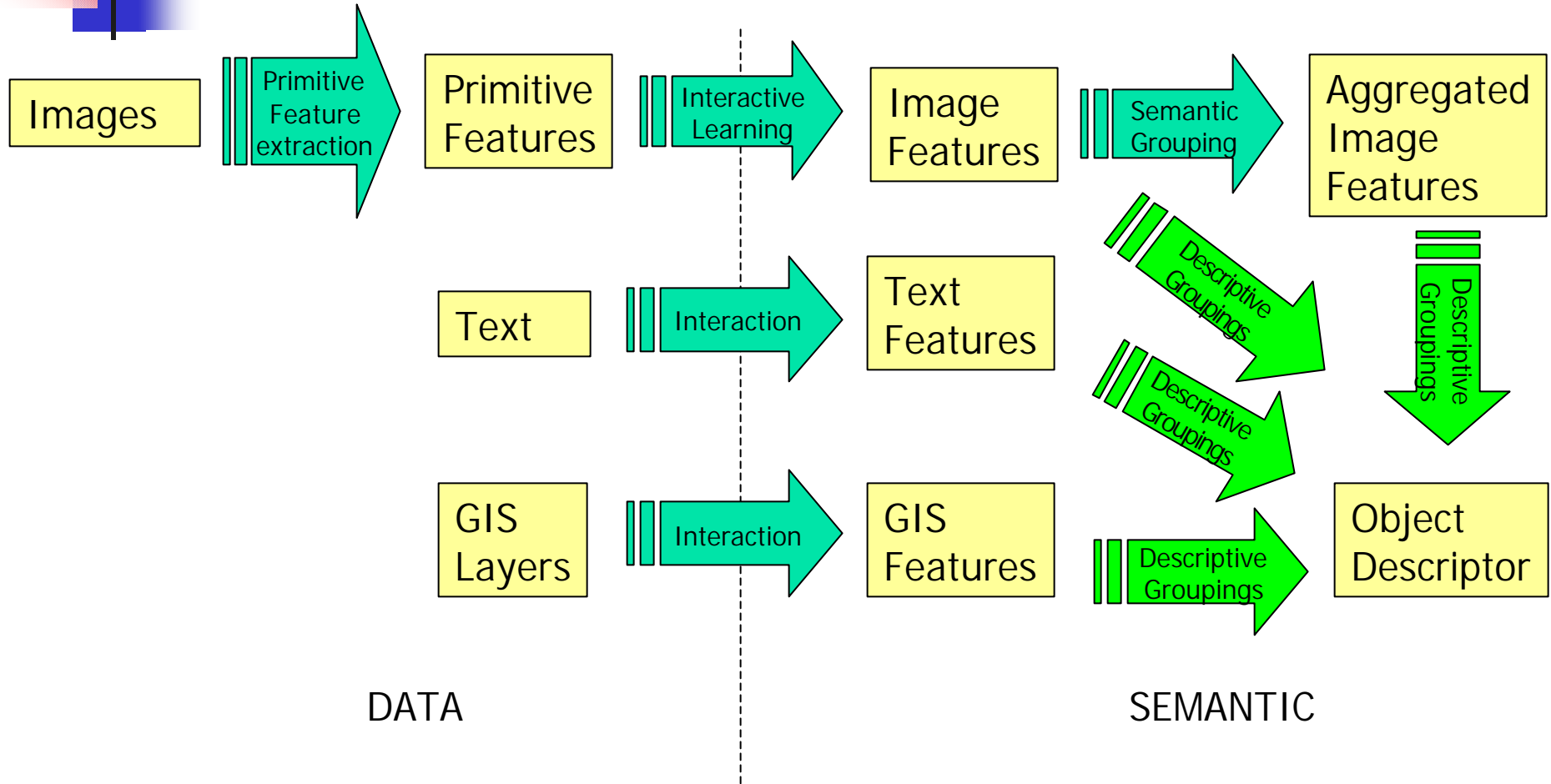
Semantic Grouping

- In KIM it is simple to define a feature by identifying a river through positive and negative examples.
- However, the "river" might become part of a wider concept (e.g.: water). This should be implemented without retraining the system for all possible water types.

Aggregated Features

- In KES a new kind of grouping, called “aggregated features”, has been introduced.
- In a similar way as in defining positive and negative examples on the image, it will be possible to define the concept “water” as:
 - Positive examples:
 - sea + river + lake + water reservoir
 - Negative examples:
 - streets + houses + mountains

Semantic Grouping





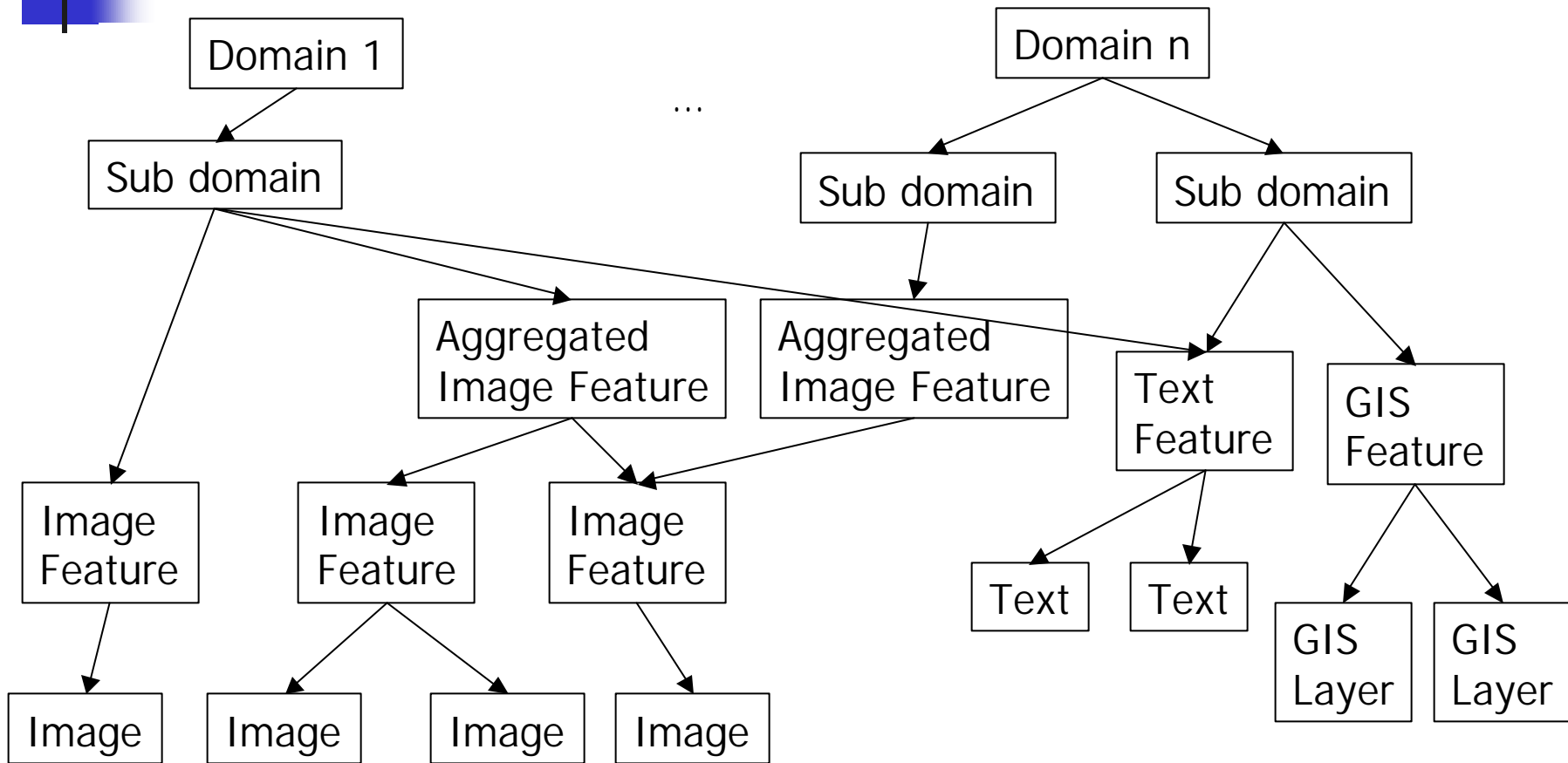
Ontology

- Ontology is the specification of a conceptualisation. It can be related to a system (System Ontology, which can be domain independent and reused for different domains) or to a domain (Domain Ontology, specific for that domain).

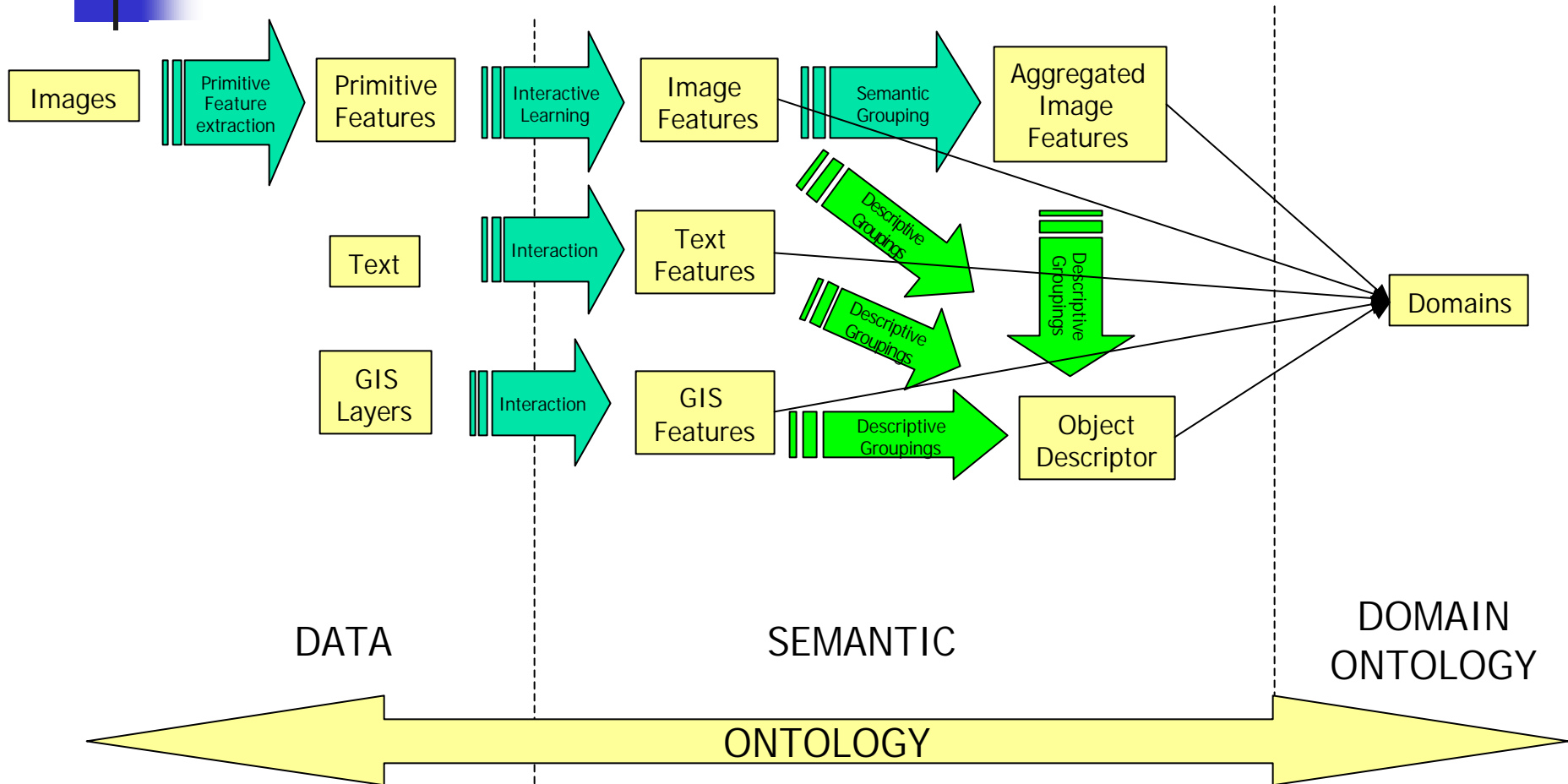
Domain Ontology

- Domain ontology is the set of definitions and concepts pertaining and belonging to a specific domain (and shared by concerned people).
- Different domains have generally different ontologies. As an example, a climatology expert could have a different vision of (and terms to describe) water compared to that of an oceanography expert.

Taxonomy



Data / Semantic / Ontology

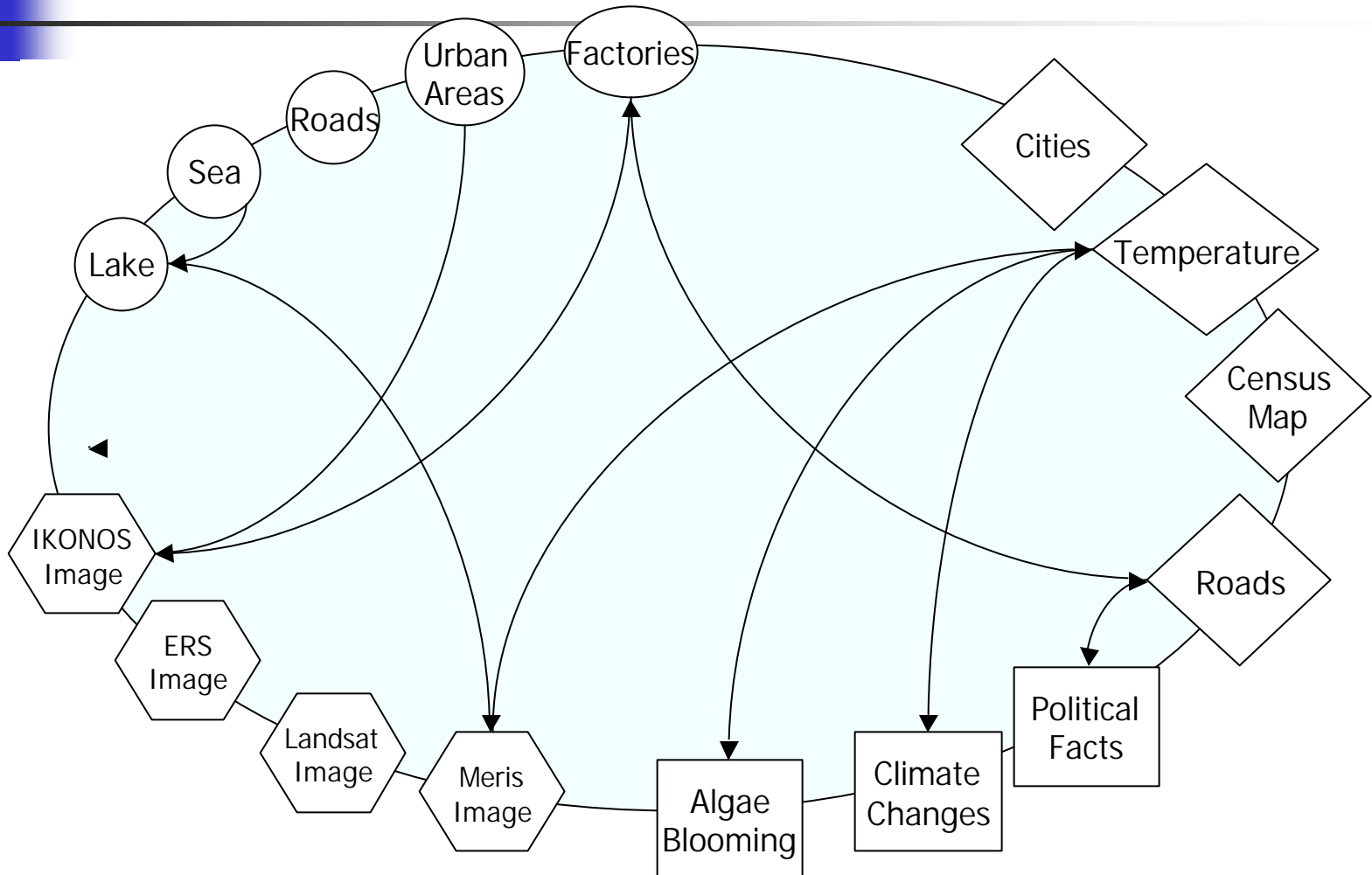




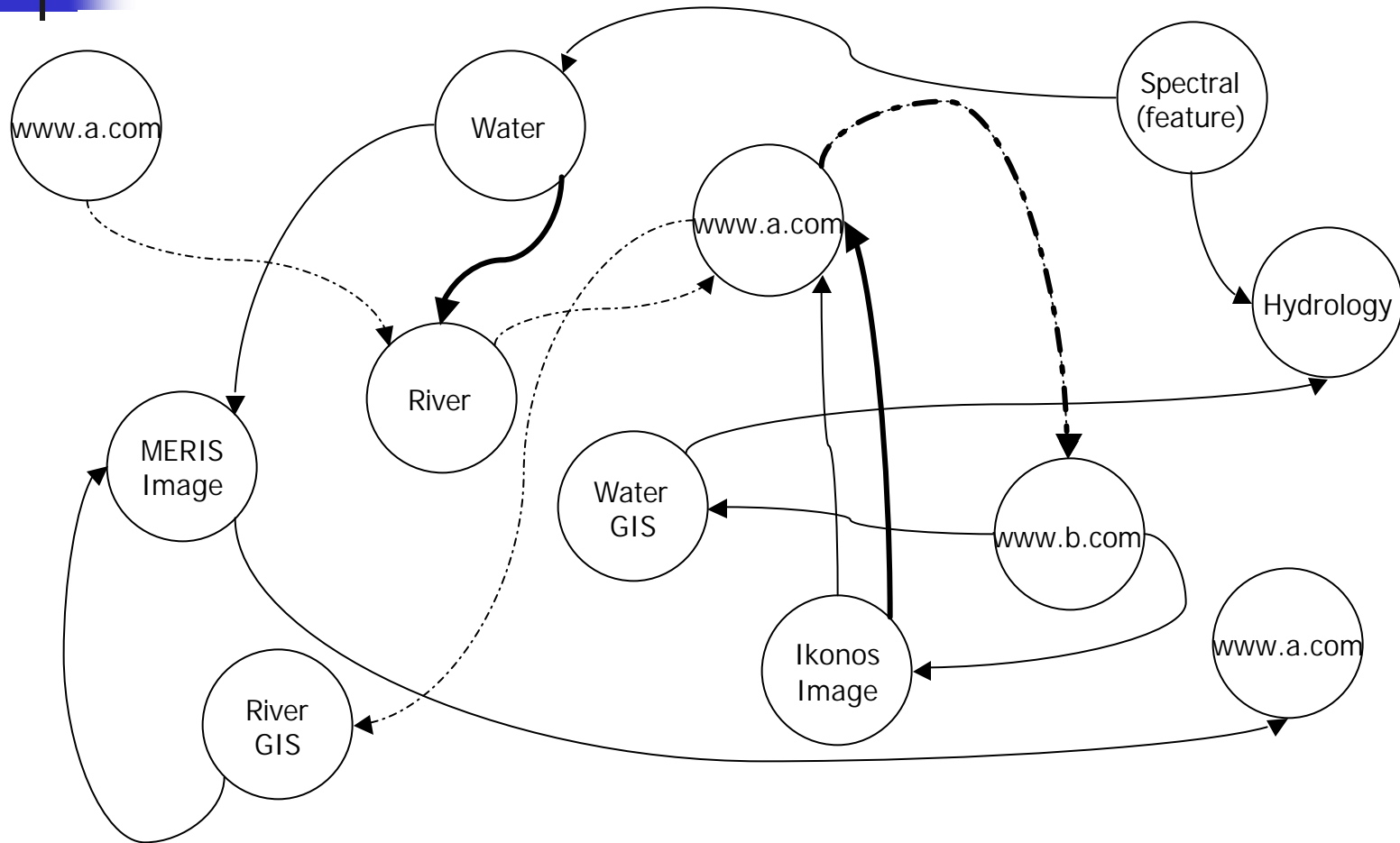
Implicit and explicit knowledge transfer

- The KIM prototype permits to associate weighted combinations of primitive features to image features. While defining features, the user explicitly transfers knowledge to the system, which is stored and made available to the same or other users.
- In addition there is a further type of knowledge (implicit) that could be discovered: if the user domain of interest is known, by observing the user interactions with the system during search and browsing, it is possible to infer the data of likely user interest and link it with the pertinence domain.

Knowledge transfer



Knowledge Graph





Knowledge Discovery

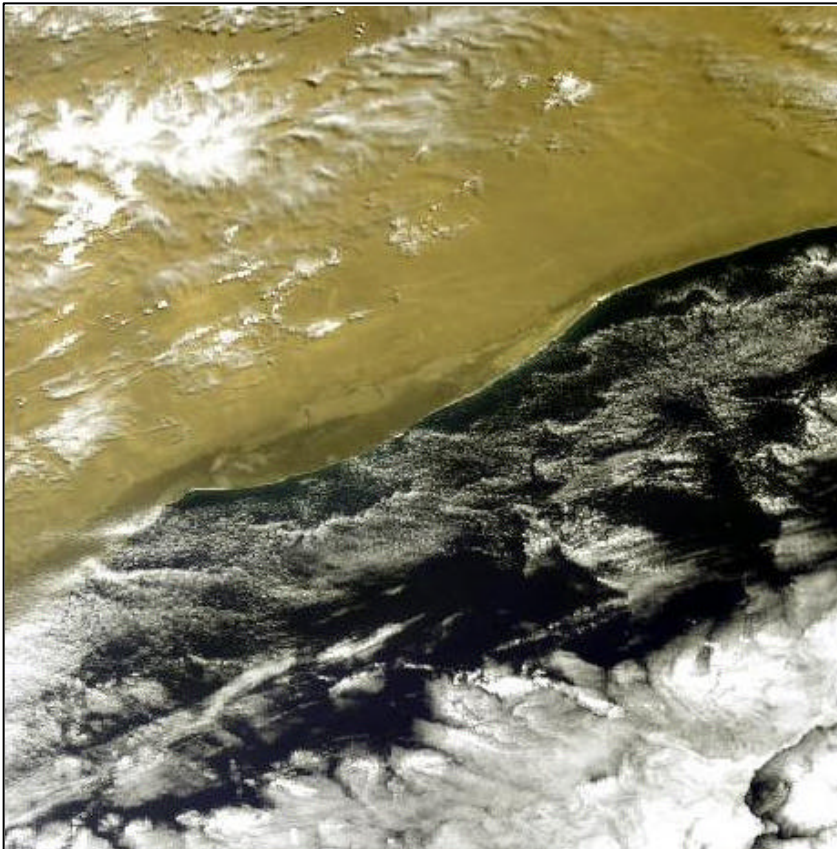
Exploring this graph means
discovering the user's knowledge



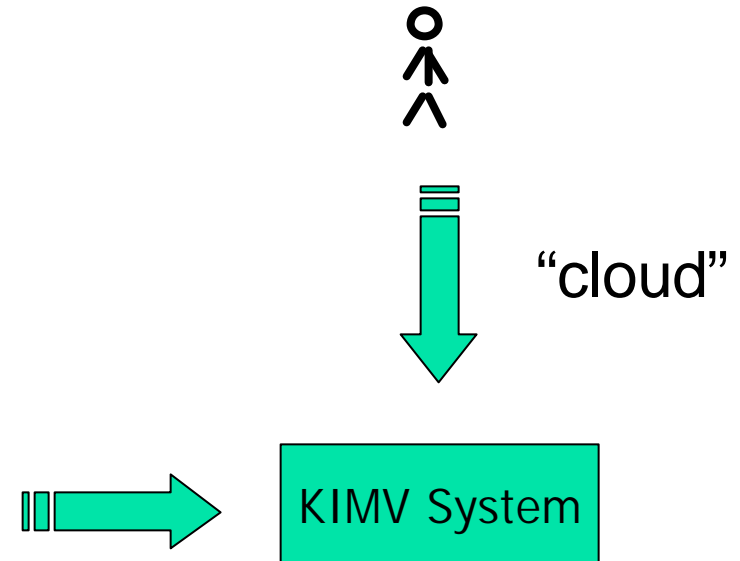
KIMV (KIM Validation)

A practical case study:
Automatic cloud classification in
MERIS images

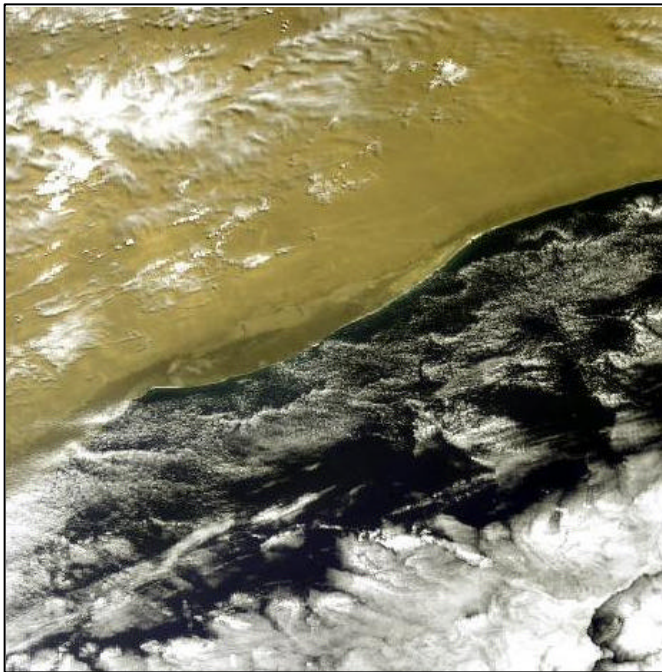
Cloud Cover Characterization



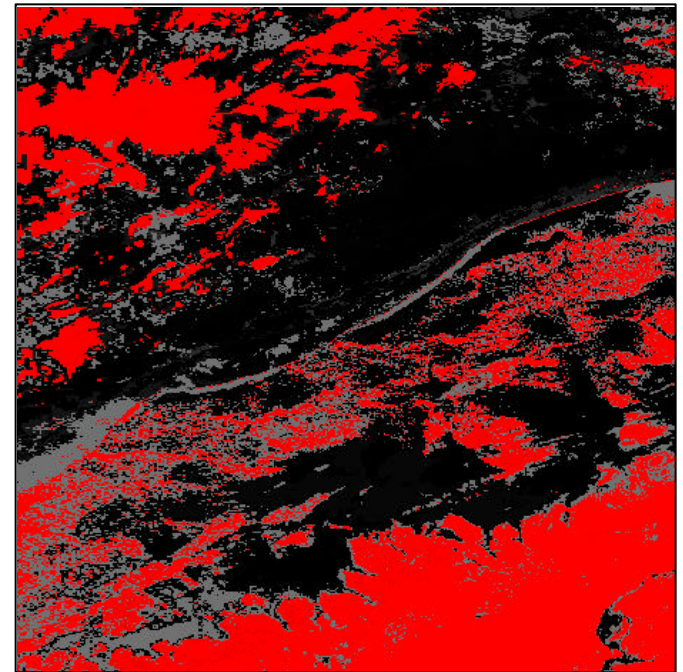
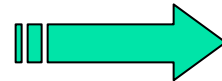
MERIS Level 1 – Reduced Resolution



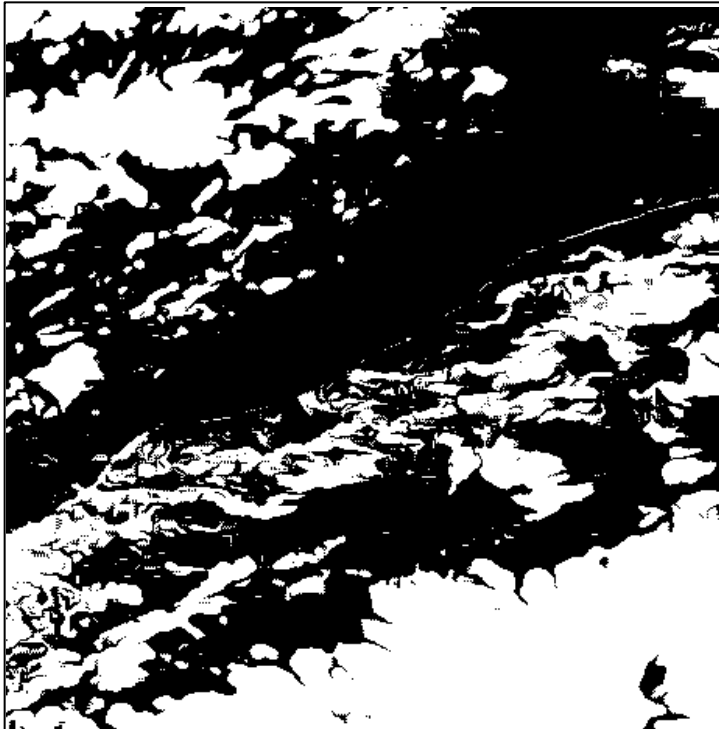
Cloud cover characterization



Map of
Cloud
object

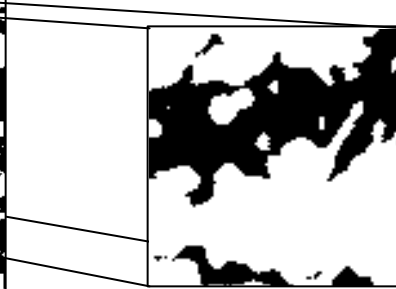
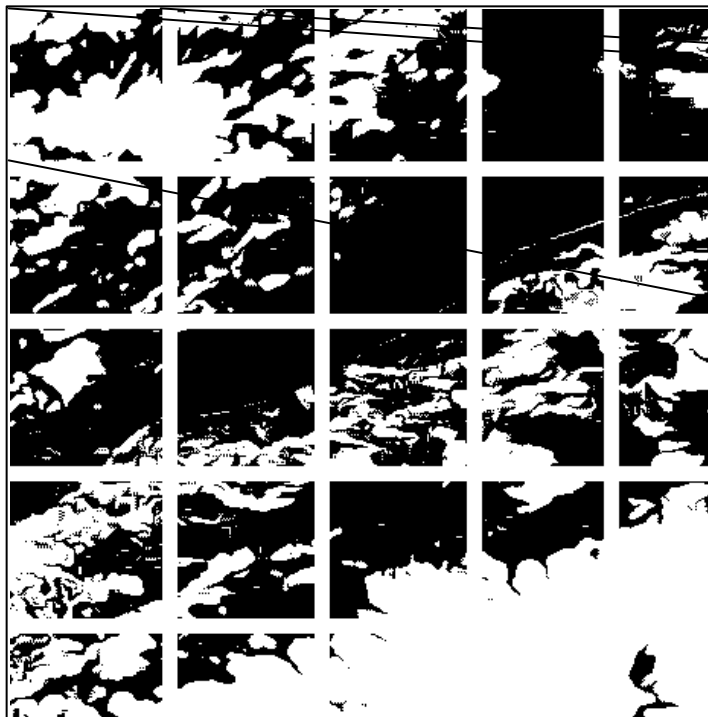


MAP Object Extraction



Binarized, closed
MAP of “cloud” label

Tiling



IMG	Vote	Shape
12345	60	(x1,y1)-(x2,y2)....
12345	20	(x1, y1)-(x2,y2)...

MASS

Mass Portal

Home Register Log in

Catalogue Search

Collections:
 ACS.MERIS.CLOUD
 ESA.ENVISAT.ASA_GMI_1S
 ESA.ENVISAT.ASA_WVX_xC
 ESA.ENVISAT.ASA_IM_xS
 ESA.ENVISAT.ASA_APH_0S
 ESA.ENVISAT.ASA_APV_0S
 ESA.ENVISAT.ASA_APC_0S
 ESA.ENVISAT.ASA_WSK_xS

WMS Services:
 (Click here to add a WMS...)
 Demis World Map [1.1.0]

WMS Layers:
 [Empty]

WMS Styles:
 [Empty]

Date:
 From: 2003 Jan 01
 To: 2004 Jan 01

Cloud Cover Percentage:
 50

Retrieve 10 metadata

Starting from 1

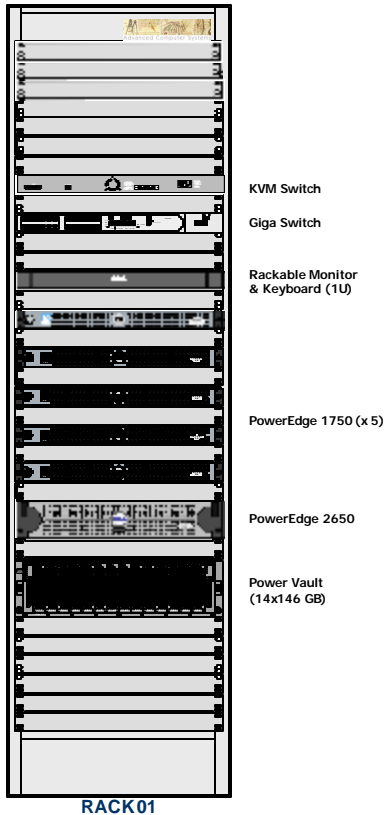
Update map
 Clear map
 Scale: 250 km

Search Next

Product Identifier	Collection	Platform	Acquisition Date/Time	Satellite Domain	Graphical Overview
EN1-03031109214865-31700.RR1	ACS.MERIS.CLOUD	Envisat-1	2003-03-11T09:21:48.65Z	Orbit: 5372 Orbit Direction: descending Frame: 100 Track: 308	
EN1-03052009205776-31799.RR1	ACS.MERIS.CLOUD	Envisat-1	2003-05-20T09:20:57.76Z	Orbit: 6374 Orbit Direction: descending Frame: 5605 Track: 308	
EN1-03090209213176-31799.RR1	ACS.MERIS.CLOUD	Envisat-1	2003-09-02T09:21:31.76Z	Orbit: 7877 Orbit Direction: descending Frame: 4484 Track: 308	

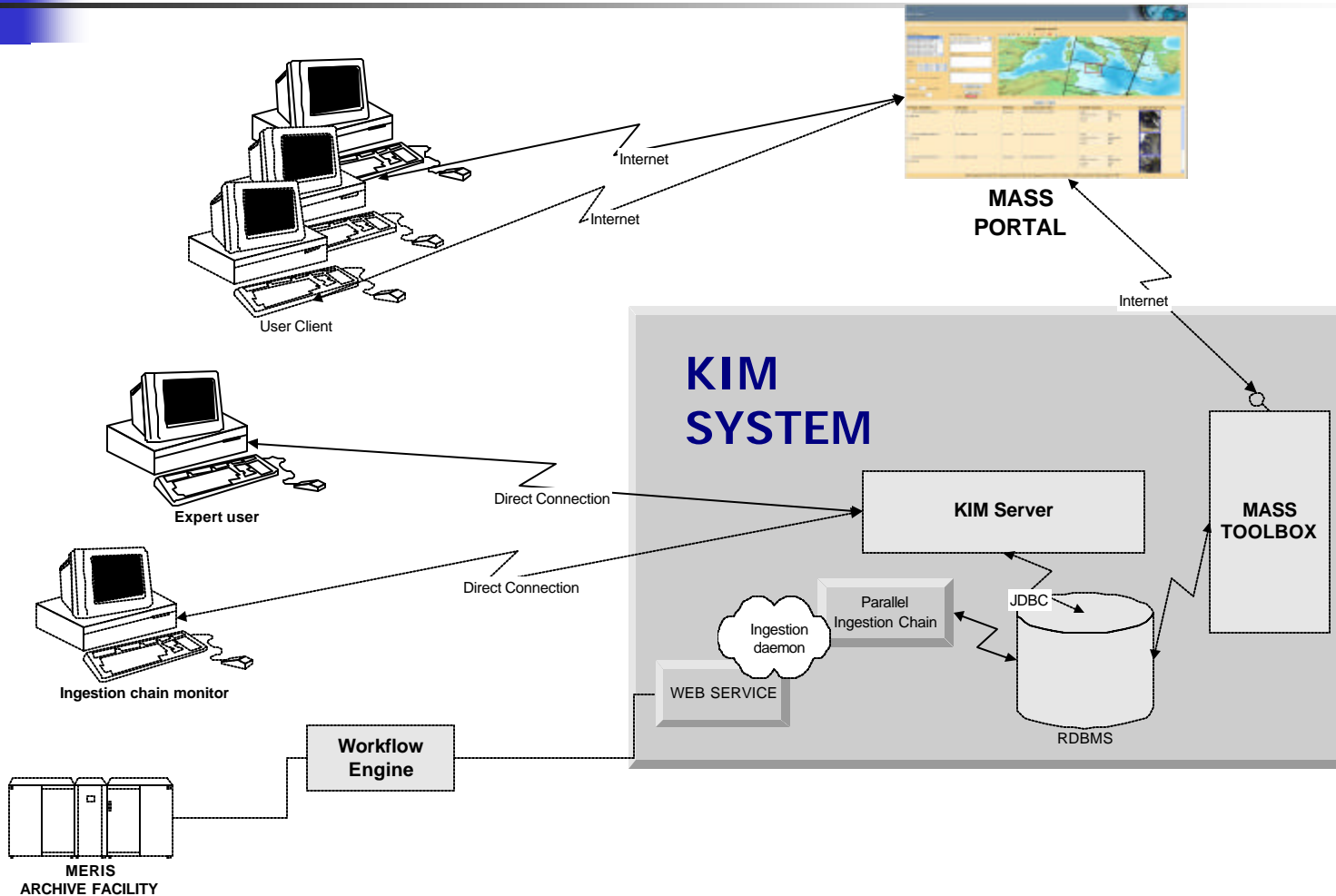
Start Request 12:12:6.187, Saved AOI 12:12:6.453, End Request 12:12:9.234, Total dur.: 3.047, Save AOI: 0.266, Search: 2.781

Linux Cluster



- Cluster nodes: 10 Dell 1750, dual Xeon 3 GHz
- Database and Application Server: Dell 6600, 4 Xeon 2.8 GHz

System Context





KIM prototype

- <http://www.acsys.it:8080/kim>
- Andrea Colapicchioni
 - a.colapicchioni@acsys.it

**Visit the ACS stand for a
demo**