A decision support system for urban climate change adaptation

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SUDPLAN project

SEVENTH FRAMEWORK PROGRAMME

... and it just works.

Outline

Project overview

Anticipated system architecture

Technical baseline: cids

A 2D predecessor

Project status

Project overview

... and it just works.

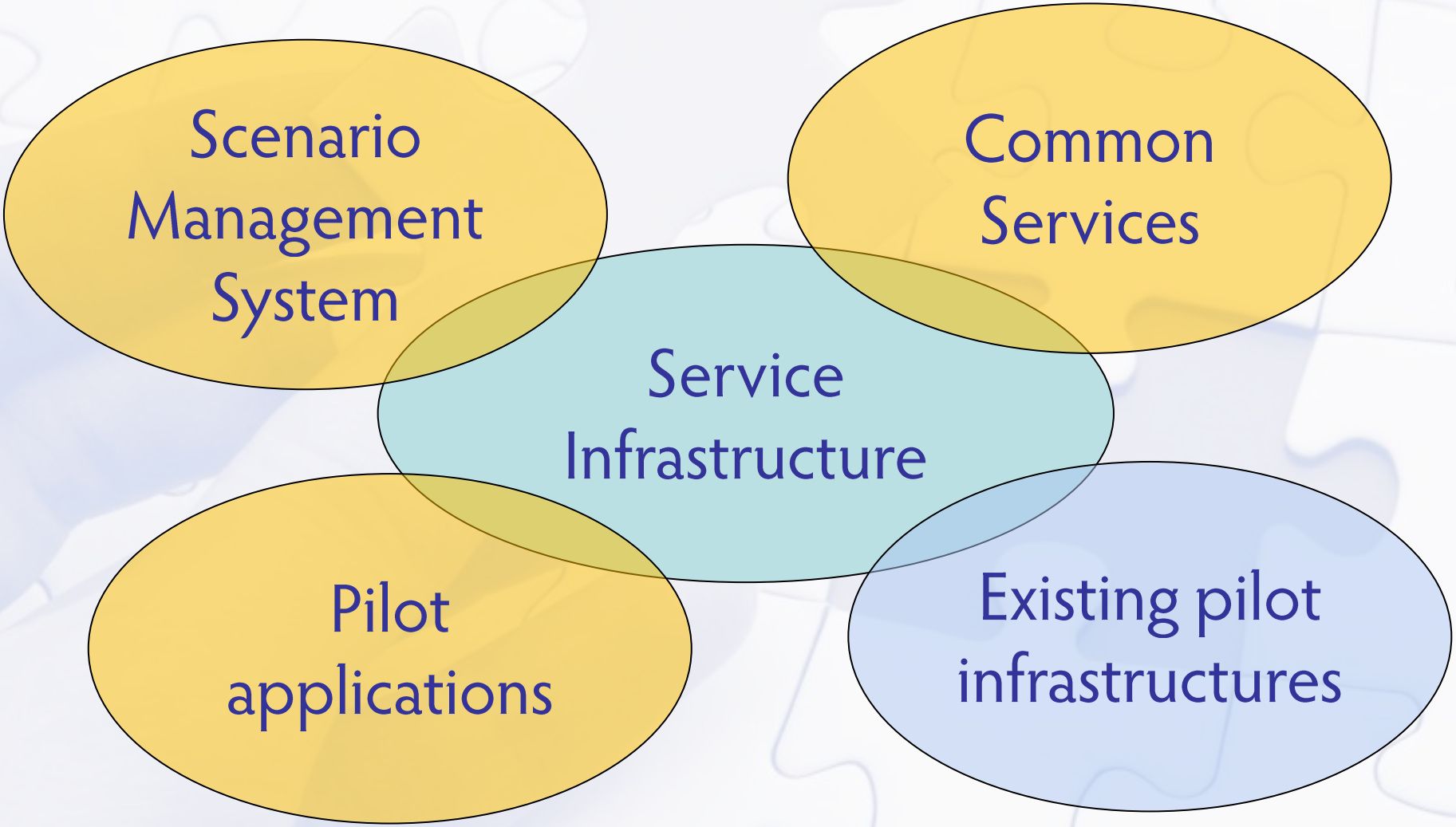
Project objectives

- Development of an easy-to-use web-based planning, prediction, **decision support** and training **tool**
- For users in an **urban context** (city planners) concerned with **climate change issues**
- Based on
  - a **what-if scenario execution environment**
  - an innovative and **visionary capacity to link** existing environmental simulation models, information and sensor infrastructures, spatial data infrastructures and climatic scenario information in a service-oriented approach
- Including **3D/4D** modeling, simulation and visualization

SUDPLAN partners

1. Swedish Meteorological and Hydrological Institute
2. Austrian Institute of Technology
3. cismet GmbH
4. Czech Environmental Information Agency
5. Apertum IT AB
6. Deutsches Forschungszentrum für Künstliche Intelligenz
7. Stockholm Uppsala Air Quality Management Association
8. City of Wuppertal
9. Technische Universität Graz

SUDPLAN project components



SUDPLAN pilot applications

Stockholm: Urban air quality and local scenario emissions, scaled down to individual streets and evaluated against EU directives (**health impact**)

Wuppertal: Heavy, short rainfall events and their impact on the infrastructure, using **high-resolution 3D/4D modelling** of >800 creek sections and 650 km of **drainage channels**.

Linz: Stormwater flooding events and its **impact on waste water treatment plants** and their combined sewer overflows, to avoid polluted drainage water to spill over into the river, using sensor system and runoff models

Prague: Quantifying environmental pressure on Prague and its surroundings (air pollution, heat waves, drying up of soils as well as local floodings due to intense rainfall), **modelling population dynamics** as a response to environmental conditions

Common services

Climate input	CS database	CS models	Local models
Regionally downscaled climate scenarios over Europe	Precalculated European data of - intense rainfall - hydrological data - air quality	Urban downscaling of - intense rainfall - hydrological data - air quality	Pilot-defined models
SMHI's RCA model	CS models over Europe executed by SMHI	CS models over cities executed by end users	City-specific models executed by end users
Input from GCMs	RCA model output used as input	Precalculated CS Europe results as input	CS downscaling results used as input
External projects	**Common services**		**SUDPLAN pilots**

Anticipated architecture

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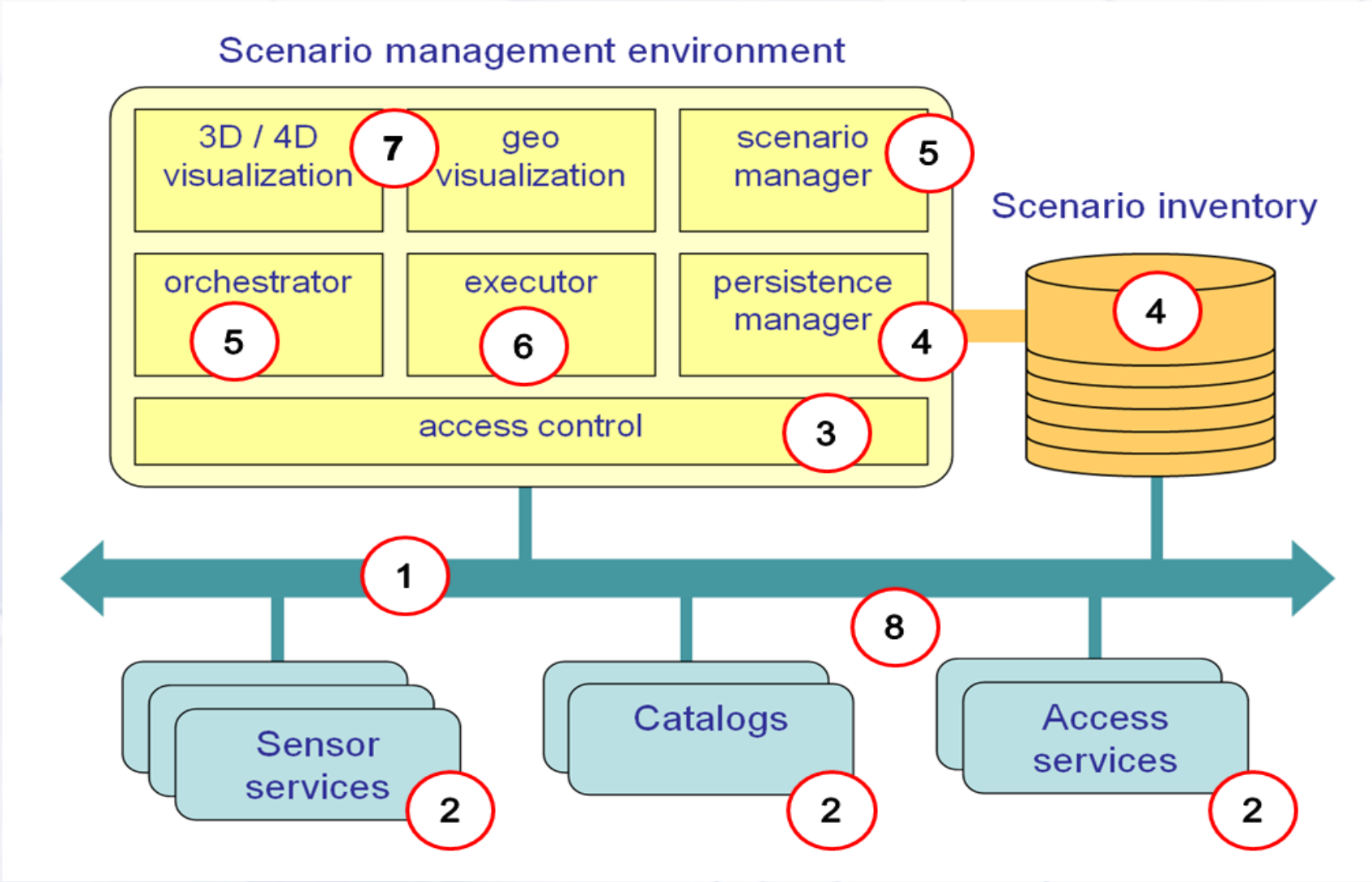
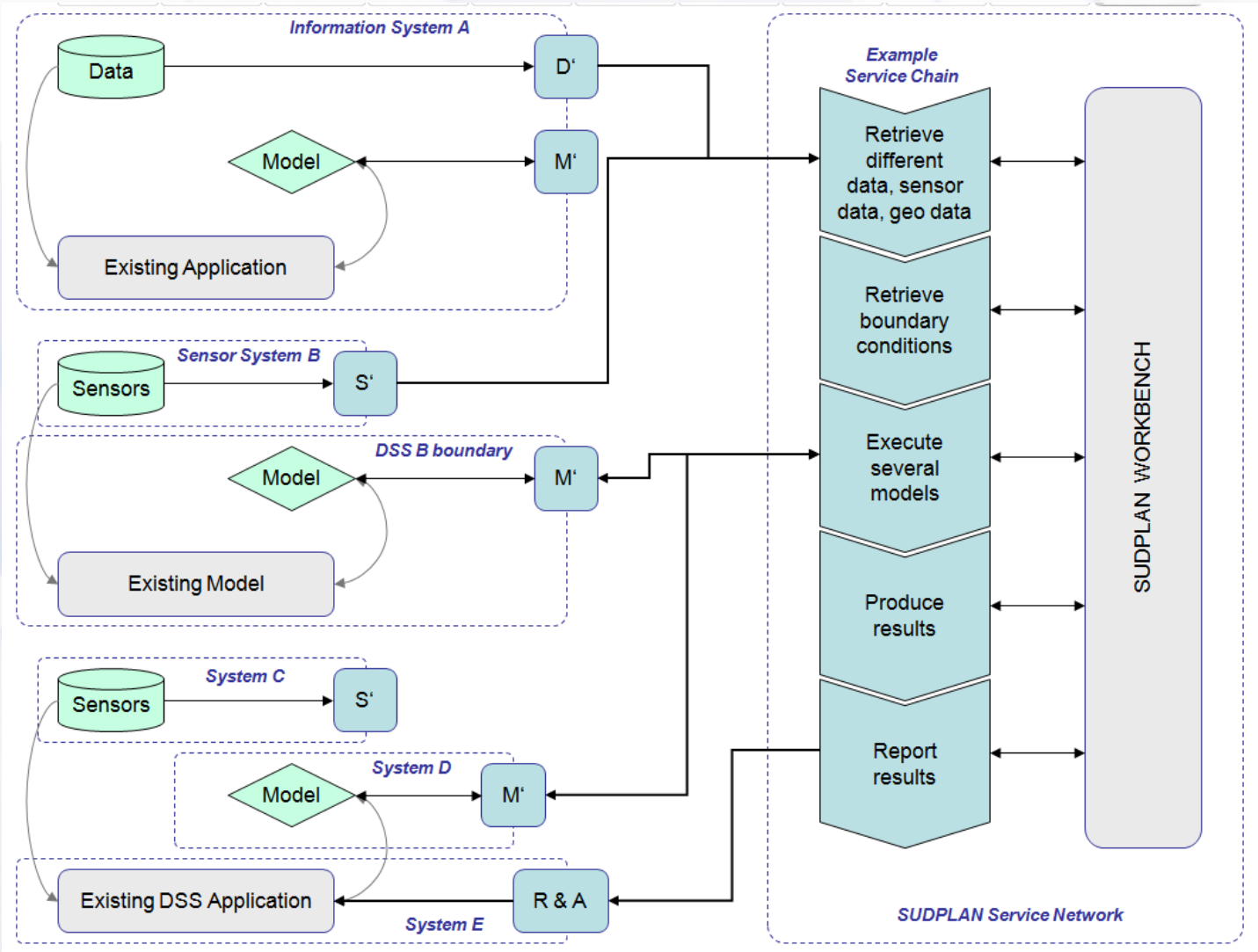
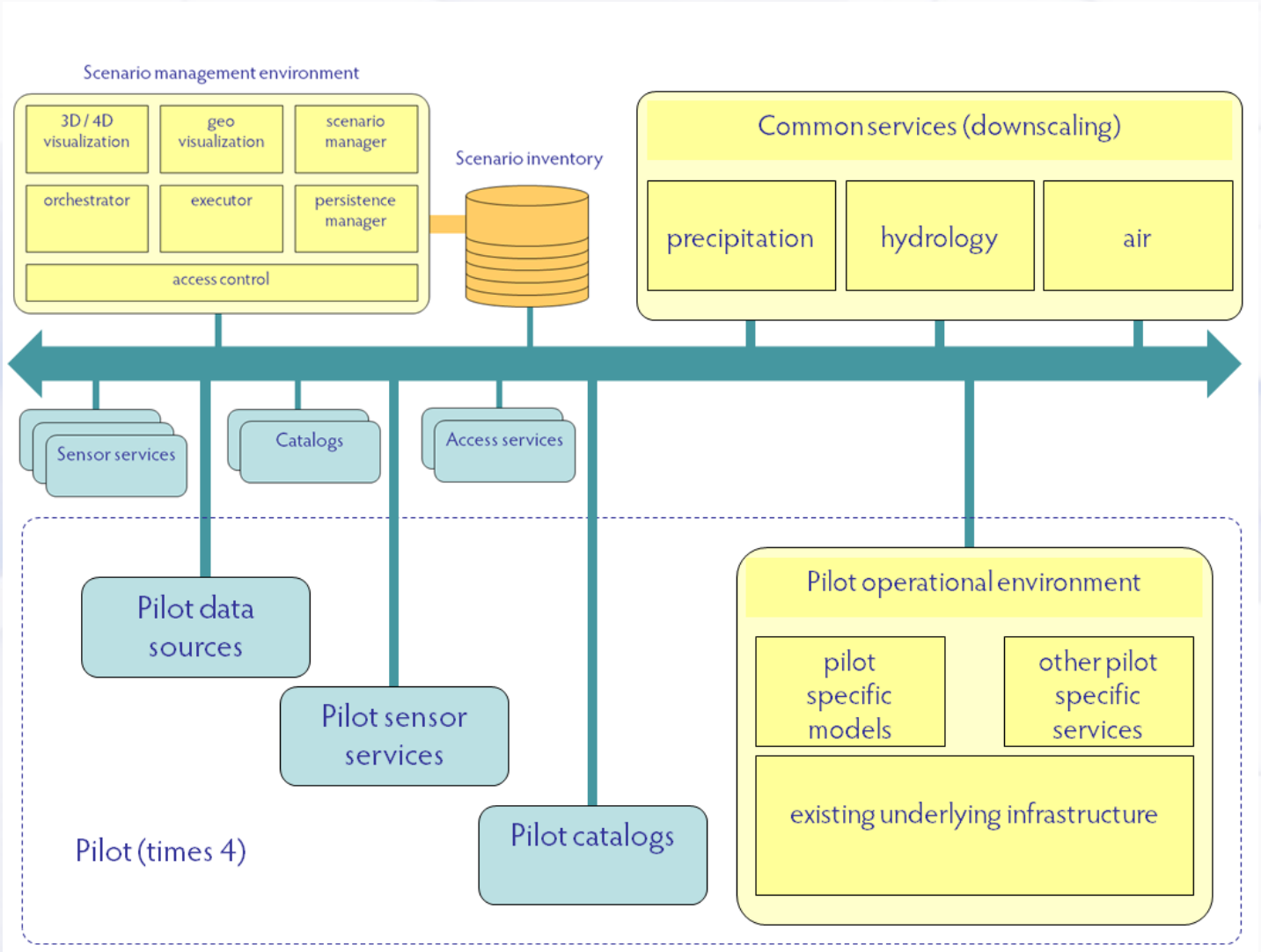
Scenario management system



Typical scenario workflow



Application pilots



Technical baseline: cids infrastructure

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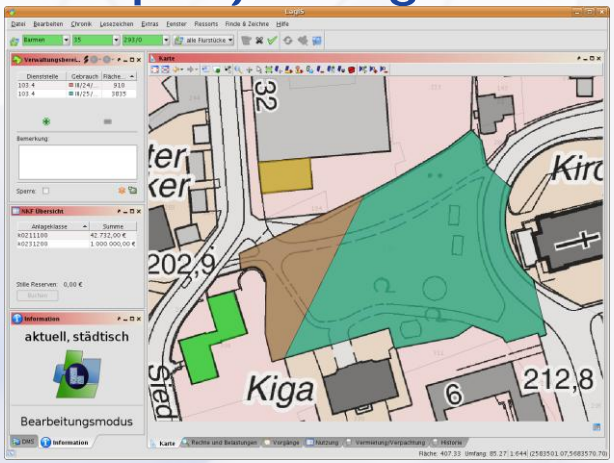
What is cids

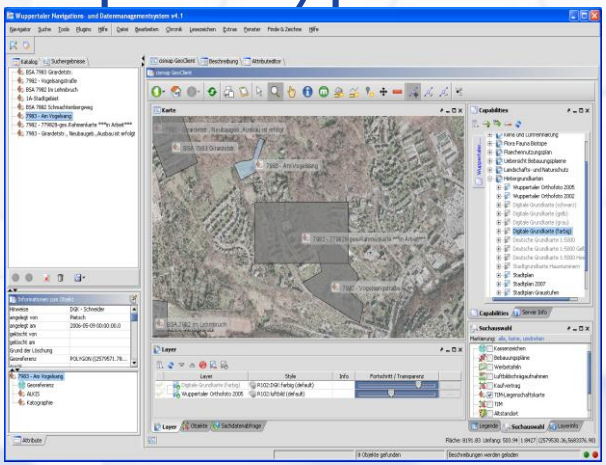
- cids is an integration platform which allows you to overcome system barriers in geo spatial applications
- cids is especially useful for applications which deal with large numbers of real world objects in a spatial context
- unlike traditional GIS and CAD, cids can easily integrate any information type and business process with each other and with the spatial context
- end users see and manage real world objects in their full context

Example applications

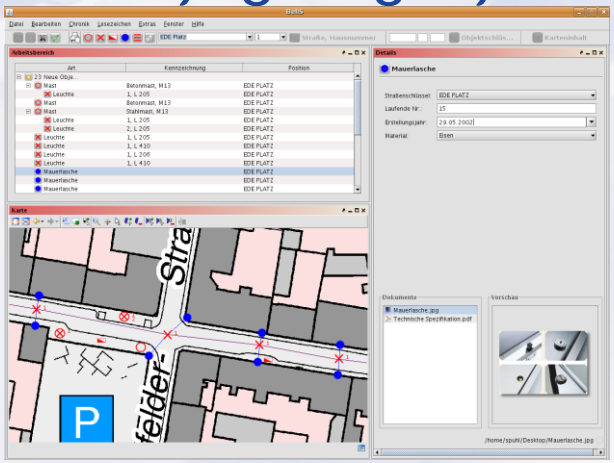
Property management



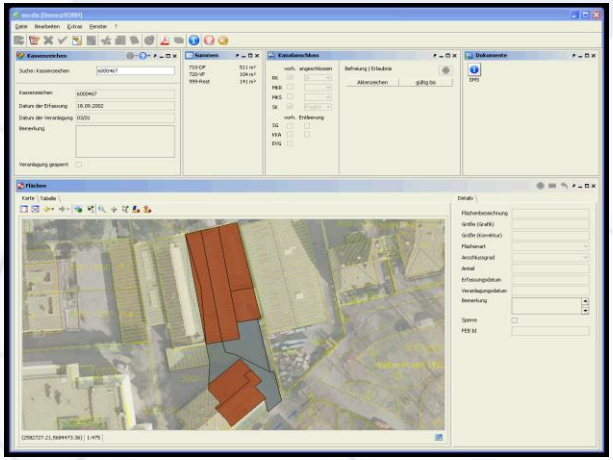
Spatial city platform



City light registry



Waste water taxes



A 2D predecessor

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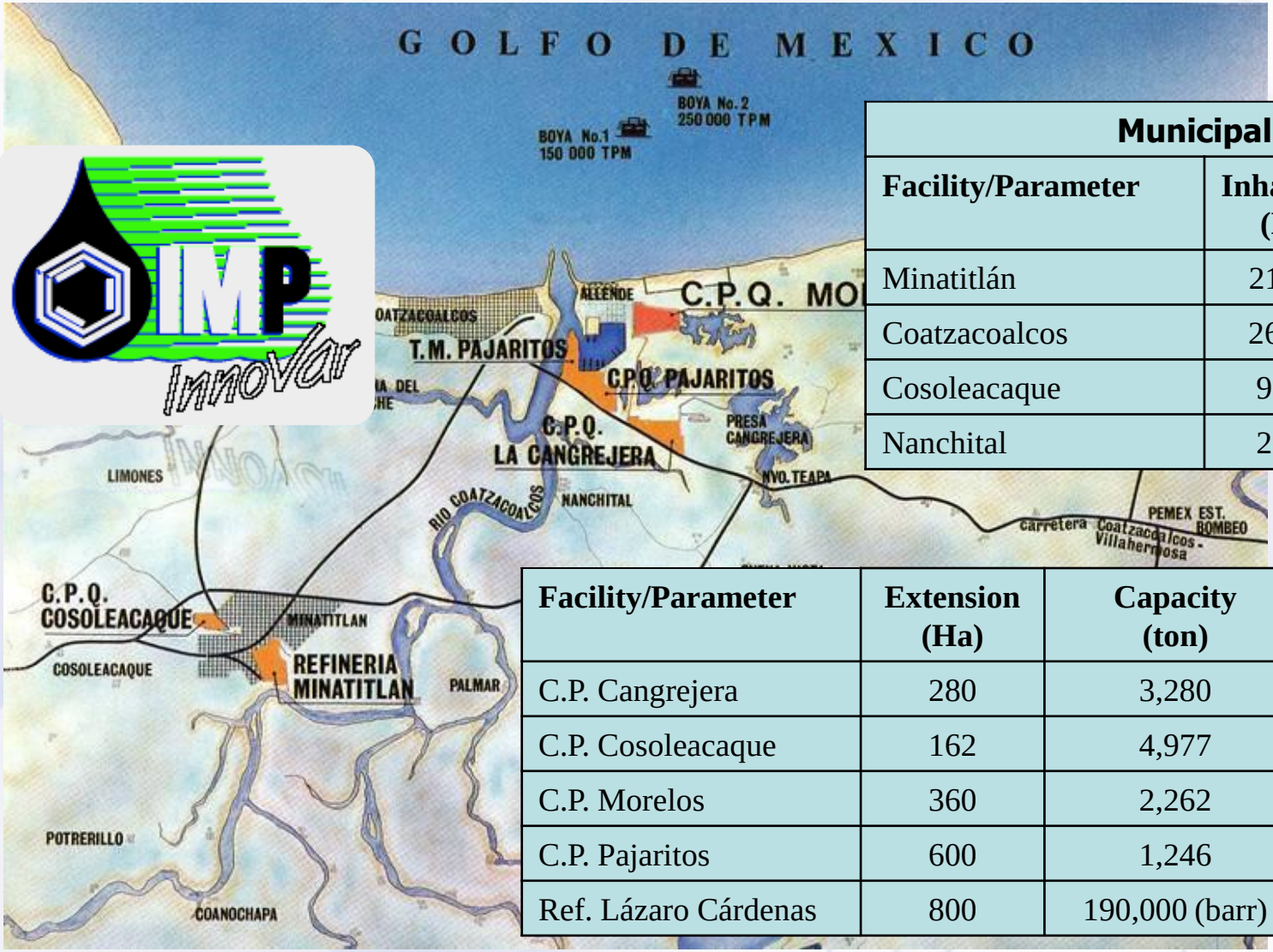
ANAITE system – Coatzacoalcos river basin



Municipalities		
Facility/Parameter	**Inhabitants (Hab)**	**Extension (Km2)**
Minatitlán	211,634	423.91
Coatzacoalcos	267,037	471,16
Cosoleacaque	97,199	234.42
Nanchital	27.166	63.99

Facility/Parameter	Extension (Ha)	Capacity (ton)	Water Discharges (m3/year)
C.P. Cangrejera	280	3,280	7,898,684
C.P. Cosoleacaque	162	4,977	690,806
C.P. Morelos	360	2,262	10,688,282
C.P. Pajaritos	600	1,246	2,540,338
Ref. Lázaro Cárdenas	800	190,000 (barr)	6,475,908

Modelling

Physics parameters

Temp.

$$\frac{dT}{dt} = -K_R(T - T_b)$$

Sal.

$$\frac{dS}{dt} = 0$$

SST

$$\frac{dSS}{dt} = E_r - D_p$$

Phosphorus

PO4

$$\frac{dPO_4}{dt} = D_{P1} apc(1 - f_{op})C_f + k_{83}\theta^{(T-20)}\left(\frac{C_f}{K_{mPc} + C_f}\right)P_{org} - G_{P1} apc C_f$$

P org.

$$\frac{dPorg}{dt} = D_{P1} apc \cdot f_{op} \cdot C_f - k_{83}\theta^{(T-20)}\left(\frac{C_f}{K_{mPc} + C_f}\right)P_{org} - \frac{V_{s3}(1 - f_{D8})}{h}P_{org}$$

Toxics variables

Metals & HAPs

$$\frac{dC_{T1}}{dt} = \frac{K_{f12}}{h}\left(f_{d2}C_{T2}/\phi_2 - f_{d1}C_{T1}\right) - K_{d1}f_{d1}C_{T1} + \frac{K_L}{h}\left(\frac{c_g}{H_e} - f_{d1}C_{T1}\right) - \frac{v_s}{h}f_{p1}C_{T1} + \frac{v_u}{h}f_{p2}C_{T2}$$

WQI

$$ICA_{IMP} = \frac{\sum_{i=1}^{n} I_i \times w_i}{\sum_{i=1}^{n} w_i}$$

Biochemical parameters

DBO

$$\frac{dDBO}{dt} = a_{oc}K_{1D}C_f - K_D\Theta^{(T-20)}\left(\frac{OD}{K_{DBO} + OD}\right)DBO - \frac{V_{s3}(1 - f_{DS})}{h}DBO - \frac{5}{4}\frac{32}{14}K_{2D}\Theta^{(T-20)}\left(\frac{K_{NO3}}{K_{NO3} + OD}\right)NO_3$$

OD

$$\frac{dOD}{dt} = K_2(Cs - OD) - K_d\Theta^{(T-20)}\left(\frac{OD}{K_{DBO} + OD}\right)DBO - \frac{64}{14}K_{12}\Theta^{(T-20)}\left(\frac{OD}{K_{NIT} + OD}\right)NH_3 - \frac{SOD}{D}\Theta^{(T-20)} + G_{PI}\left(\frac{32}{12} + \frac{48}{14}\frac{14}{12}(1 - P_{NH3})\right)C_f - \frac{32}{12}K_{IR}\Theta^{(T-20)}C_f$$

Col. Fec.

$$\frac{dCT}{dt} = -k_{dCF}CF - \alpha_{CF}\frac{I(0)/24}{k_e h}\left(1 - e^{-k_e h}\right)CF - \frac{V_{cf}}{h}CF$$

Nitrogen cycle

NO3

$$\frac{dNO_3}{dt} = K_{12}\theta_{12}^{(T-20)}\left(\frac{OD}{K_{NIT} + OD}\right)NH_3 - GPIanc(1 - P_{NH3})C_f - K_{2D}\theta_{12}^{(T-20)}\left(\frac{K_{N03}}{K_{NO3} + OD}\right)NO_3$$

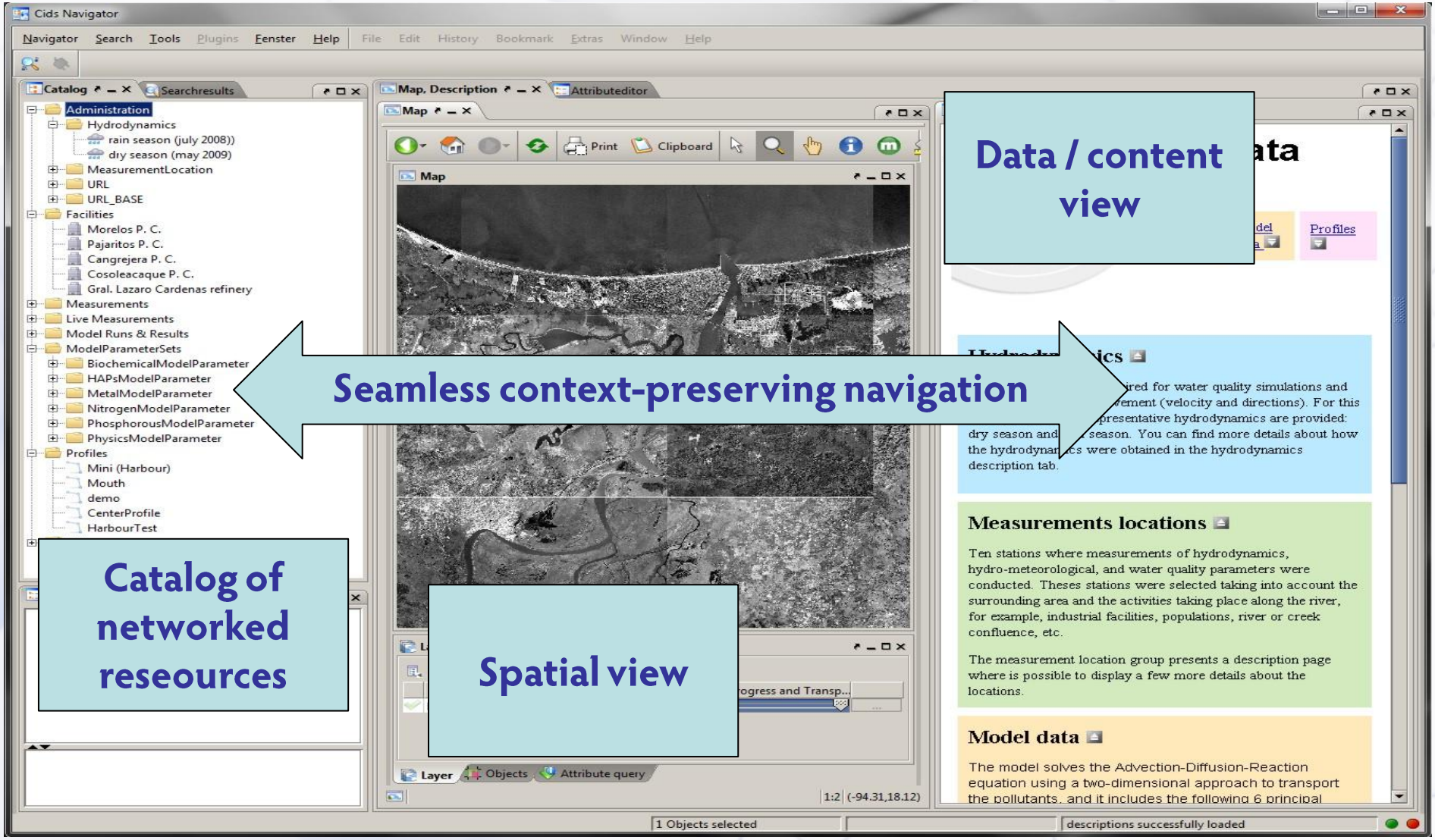
NH3

$$\frac{dNH_3}{dt} = D_{P1} anc(1 - f_{on})C_f + K_{71}\theta_{71}^{(T-20)}\left(\frac{C_f}{KmPc + C_f}\right)N_{org} - GPI \cdot anc \cdot P_{NH3}C_f + K_{12}\theta_{12}^{(T-20)}\left(\frac{OD}{K_{NIT} + OD}\right)NH_3$$

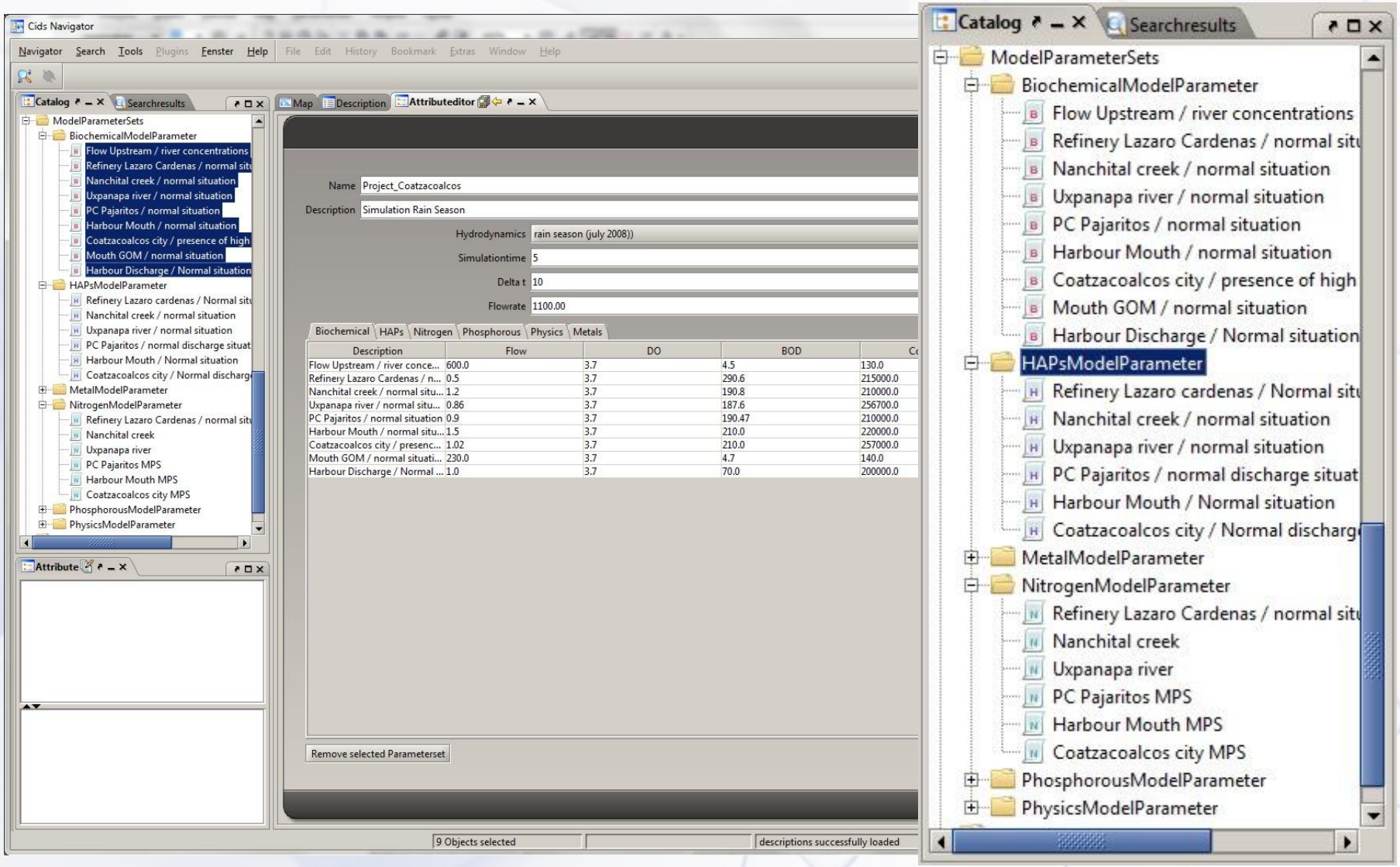
N org.

$$\frac{dN_{org}}{dt} = D_{P1} anc\, f_{on}C_f - K_{71}\theta_{71}^{(T-20)}\left(\frac{C_f}{KmPc + C_f}\right)NH_3 - \frac{V_{s3}(1 - f_{D7})}{h}NH_3$$

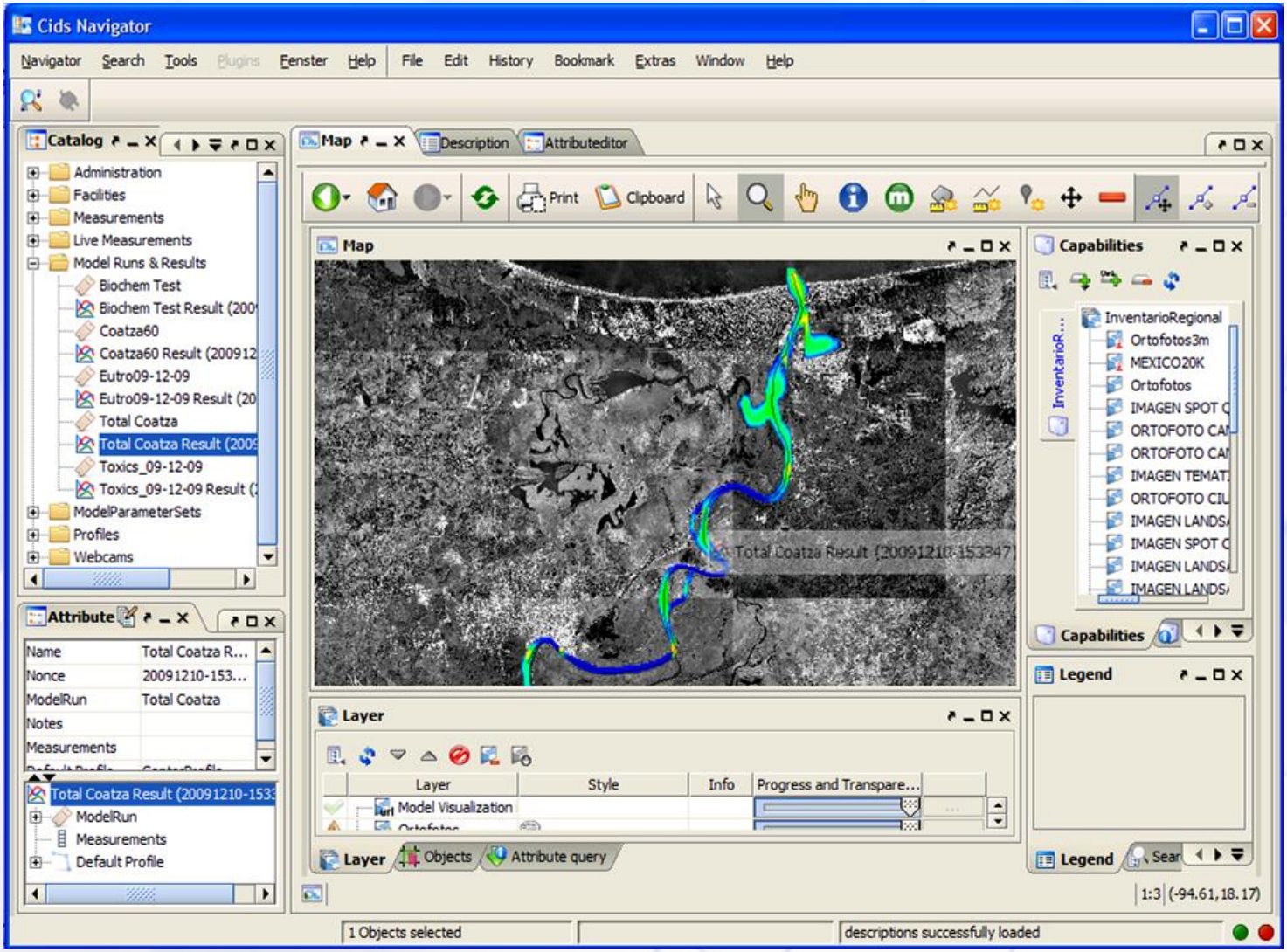
Main screen


Cids Navigator
Navigator Search Tools Plugins Fenster Help
File Edit History Bookmark Extras Window Help
Catalog
Searchresults
Administration
Hydrodynamics
rain season (july 2008))
dry season (may 2009)
MeasurementLocation
URL
URL_BASE
Facilities
Morelos P. C.
Pajaritos P. C.
Cangrejera P. C.
Cosoleacaque P. C.
Gral. Lazaro Cardenas refinery
Measurements
Live Measurements
Model Runs & Results
ModelParameterSets
BiochemicalModelParameter
HAPsModelParameter
MetalModelParameter
NitrogenModelParameter
PhosphorousModelParameter
PhysicsModelParameter
Profiles
Mini (Harbour)
Mouth
demo
CenterProfile
HarbourTest
Map, Description
Attributeditor
Map
Print
Clipboard
Map
Layer
Objects
Attribute query
1:2 (-94.31,18.12)
Data / content view
Seamless context-preserving navigation
Catalog of networked reseources
Spatial view
Profiles
Measurements locations
Ten stations where measurements of hydrodynamics, hydro-meteorological, and water quality parameters were conducted. Theses stations were selected taking into account the surrounding area and the activities taking place along the river, for example, industrial facilities, populations, river or creek confluence, etc.
The measurement location group presents a description page where is possible to display a few more details about the locations.
Model data
The model solves the Advection-Diffusion-Reaction equation using a two-dimensional approach to transport the pollutants, and it includes the following 6 principal
1 Objects selected
descriptions successfully loaded

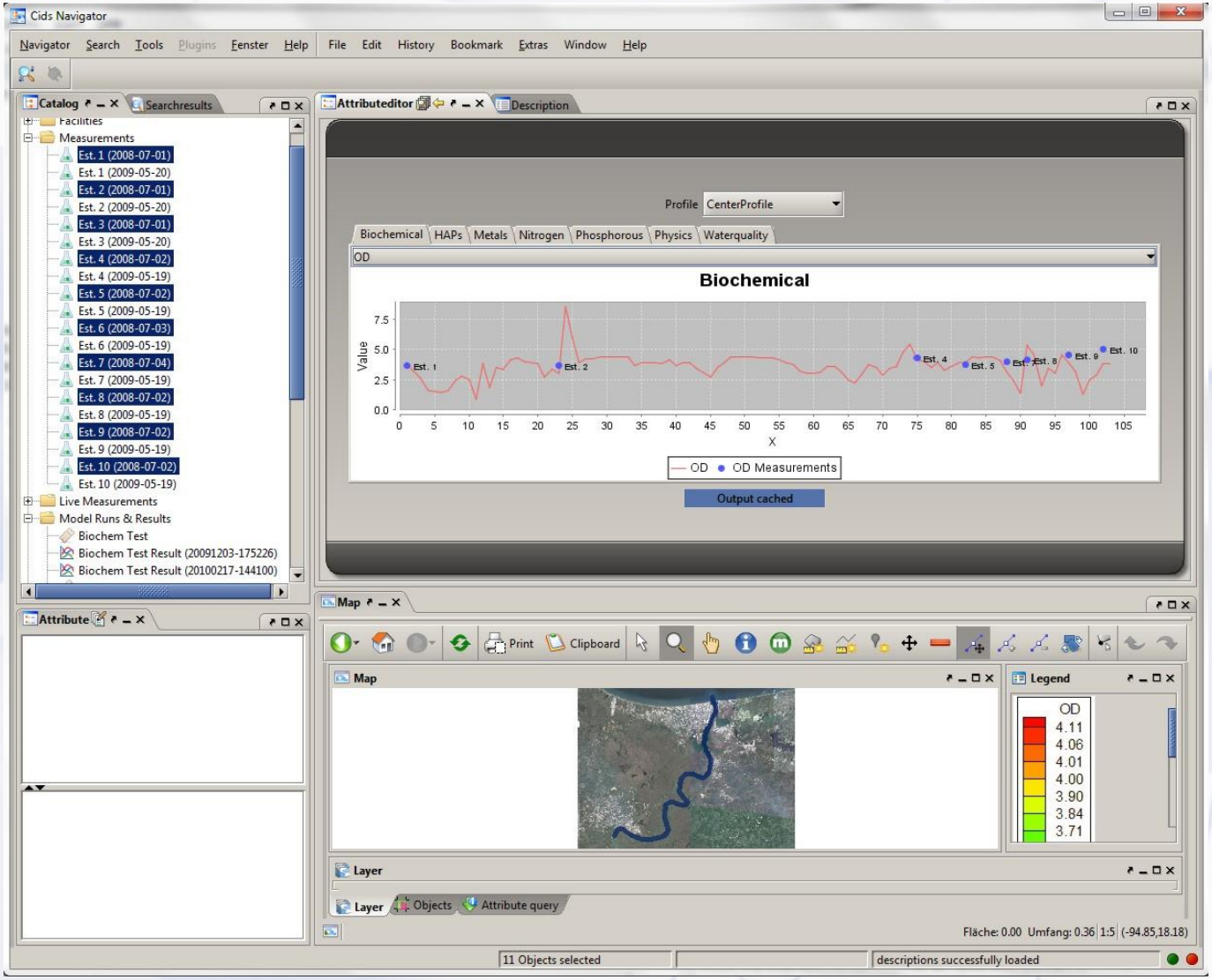
Model parametrisation / automation



Contextual result visualization



Contextual result visualization



Project status

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Activities in year 1

- Building of workbench vision
- Scenario management system requirements specs
- Work on Common Services implementation and integration into the platform
- Pilot application specification (pilot definition plans)

By spring 2011, the first Common Services shall work with the platform and workbench.

And it just works ...

SUDPLAN facts

3.3 Million Euros (EC funding of 2.5 M€)

36 months (since January 2010)

9 Partners

www.sudplan.eu

SUDPLAN is a Collaborative Project (contract number 247708) co-funded by the Information Society and Media DG of the European Commission within the RTD activities of the Thematic Priority Information Society Technologies