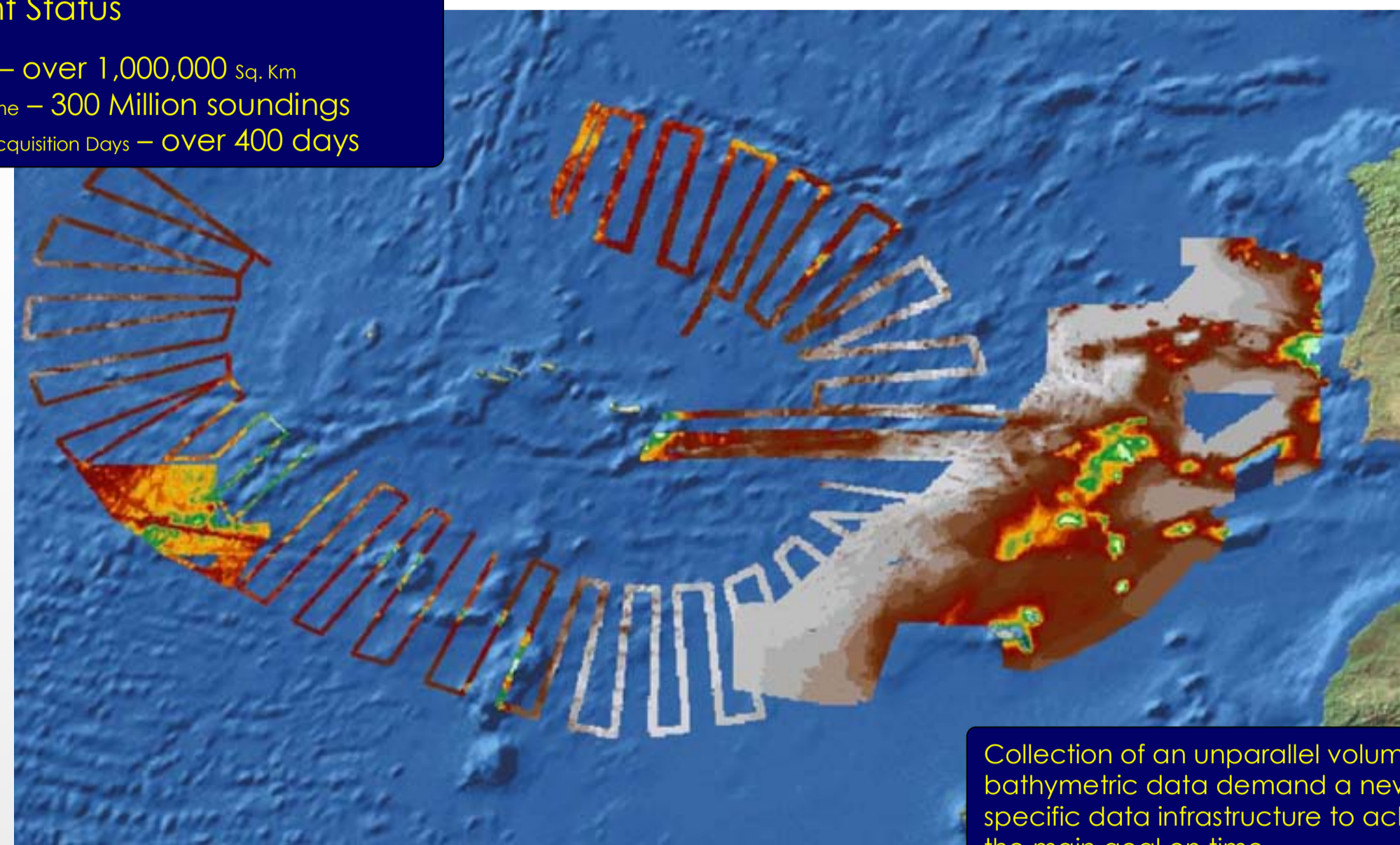# FoSMiner
An added value tool for UNCLOS article 76 implementation

Aldino Campos[1], Manuel Pinto de Abreu[1], Fernando Pimentel[1] and EMEPC team

The ratification of the United Nations Convention on the Law of the Sea (UNCLOS) by Portugal, on November 3rd, 1997, was the first step to engage in the largest systematic hydrographic survey operation in the Portuguese history. From this ongoing mission, a huge amount of high resolution bathymetric data has resulted. To efficiently manage these data, fully optimizing the available resources and making the process possible within the time frame constraints, incorporating the provisions described by article 76, a dedicated Spatial Data Infrastructure was established. Built on top of a commercial off-the-shelf Database Management System, with spatial capabilities (Oracle 10g Spatial), this infrastructure solves two major challenges. The first one is related to the data management, mainly to its high volume and geodetic related computations. The second relates to an appropriate methodology to extract the most positive sets of deliverables to support the Portuguese sustained submission. This poster describes the data flow process, within this infrastructure, from the data acquisition to the final analysis stage. It also presents a detailed composition of all FoSMiner modules in order to extract the desired knowledge in an automated approach.

Present Status

Total Area – over 1,000,000 Sq. Km
Data Volume – 300 Million soundings
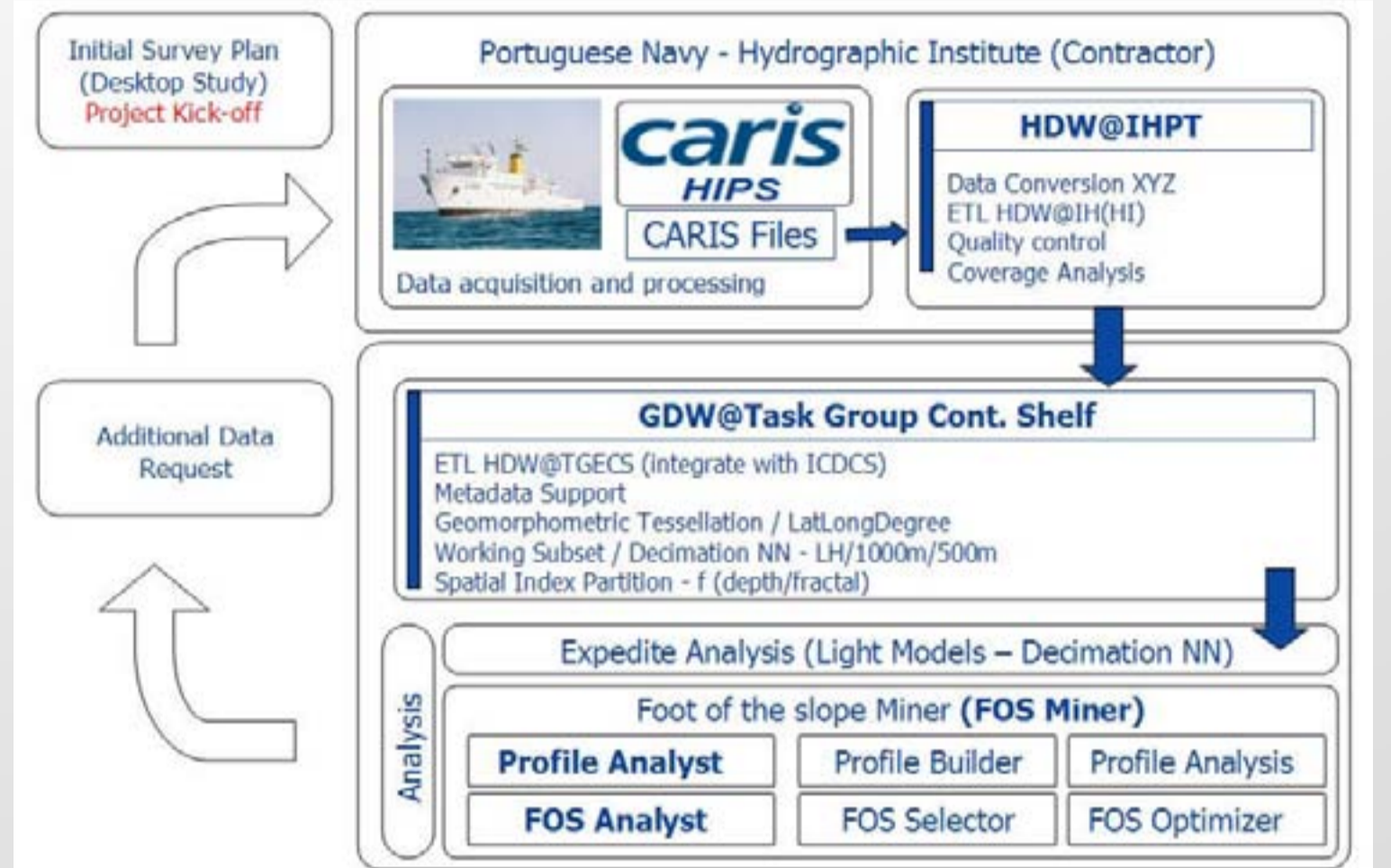Effective Acquisition Days – over 400 days

Task Group Mission

- Prepare the Portuguese proposal for the extension of the Continental Shelf, beyond the 200 NM under Art.º 76 of the UNCLOS.

- Follow up its submission to the CLCS (Commission on the Limits of the Continental Shelf.

Resolution of the Portuguese Council of Ministers 9/2005, January 17th

Collection of an unparallel volume of bathymetric data demand a new specific data infrastructure to achieve the main goal on time.

Data Flow

Initial Survey Plan (Desktop Study) Project Kick-off

Portuguese Navy - Hydrographic Institute (Contractor)

CARIS HIPS / CARIS Files — Data acquisition and processing

HDW@IHPT — Data Conversion XYZ / ETL HDW@IH(HI) / Quality control / Coverage Analysis

Additional Data Request

GDW@Task Group Cont. Shelf
ETL HDW@TGECS (integrate with ICDCS) / Metadata Support / Geomorphometric Tessellation / LatLongDegree / Working Subset / Decimation NN - LH/1000m/500m / Spatial Index Partition - f (depth/fractal)

Expedite Analysis (Light Models - Decimation NN)

Foot of the slope Miner (FOS Miner)

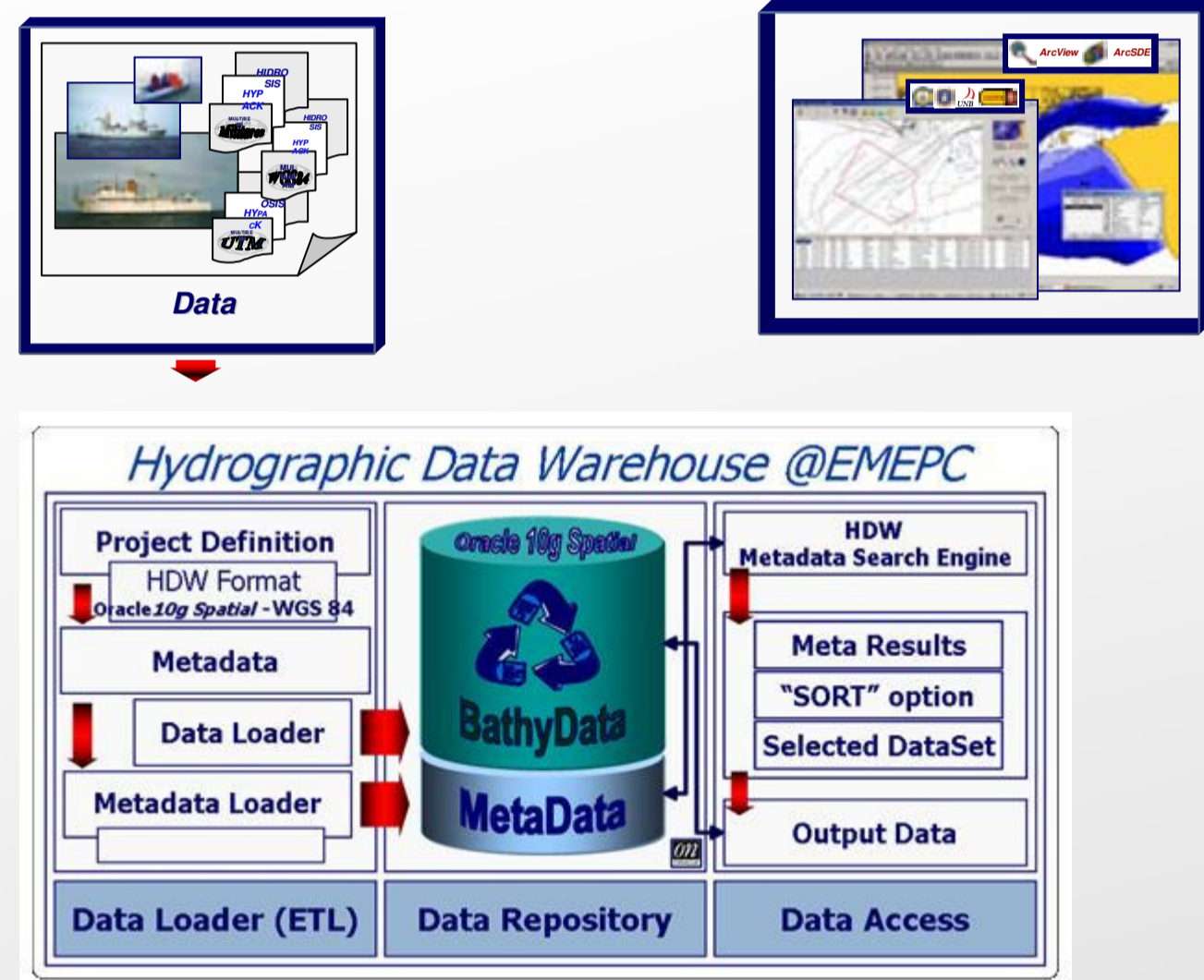| Profile Analyst | Profile Builder | Profile Analysis |
| FOS Analyst | FOS Selector | FOS Optimizer |

More than 300 million soundings acquired, using two Kongsberg EM120 and one EM710 Swath bathymetry systems. The surveys cover an area of 1 million km2, distributed along:
1) A roughly north-south stripe comprising the Continental Portugal margins, the Azores-Gibraltar Fracture Zone, the Madeira-Tore Rise and the Madeira Plateau; and
2) A set of radials joining the 200 and 350 NM limits in the Azores region.

## Geomorphometric Data Warehouse

GDW Features:

Built on top of a Commercial off-the-shelf DBMS Oracle 10g;

Enable Spatial functions and operations;

Allow multi-survey integration;

Provides Metadata to sustain a reliable proposal;

Optimizes data output on several formats end spatial references;

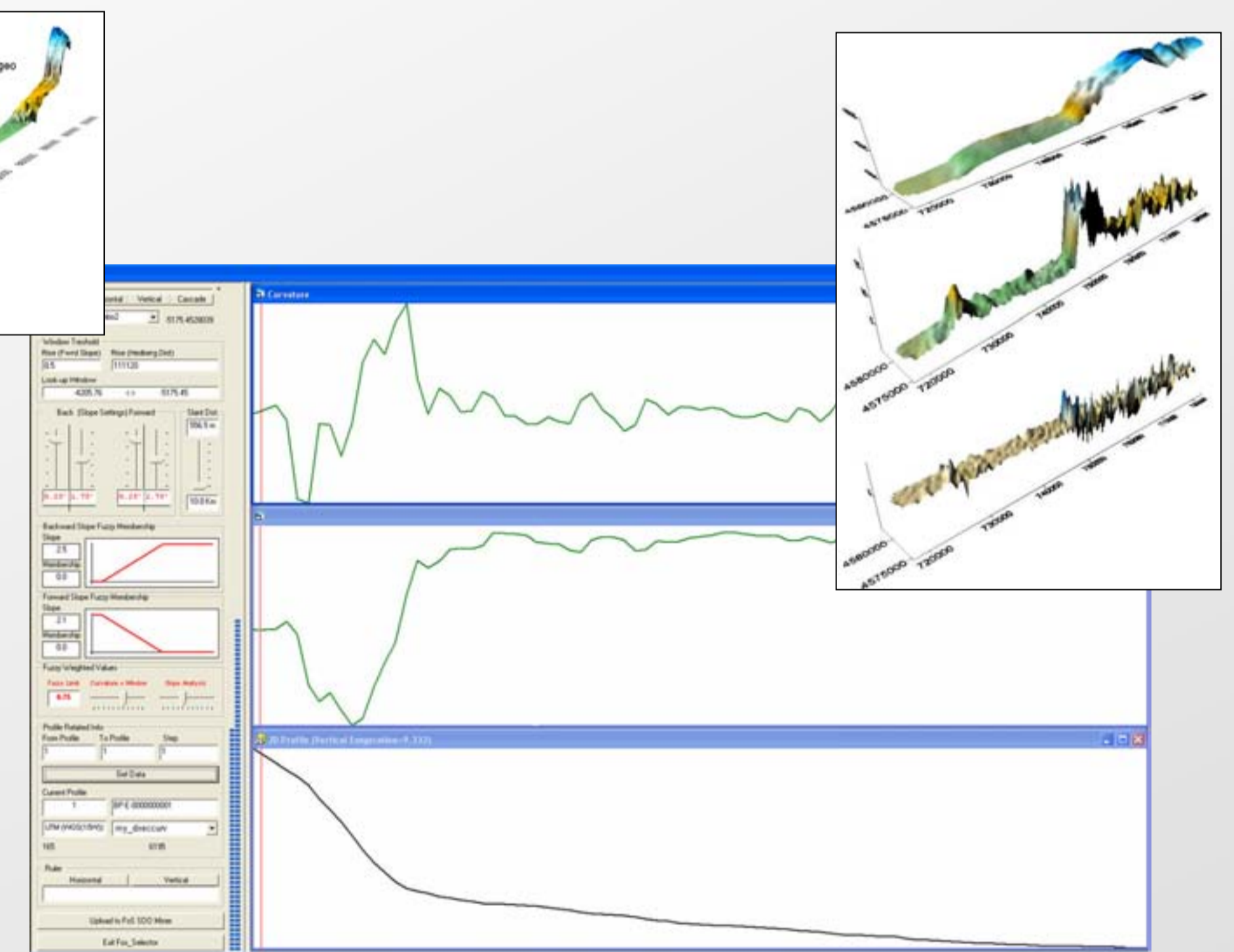**A**llow direct connection with several commercial GIS.

Data

Hydrographic Data Warehouse @EMEPC

Project Definition / HDW Format / Oracle 10g Spatial - WGS 84 — HDW Metadata Search Engine
Metadata — Meta Results
Data Loader — "SORT" option
Metadata Loader — Selected DataSet
BathyData / MetaData — Output Data
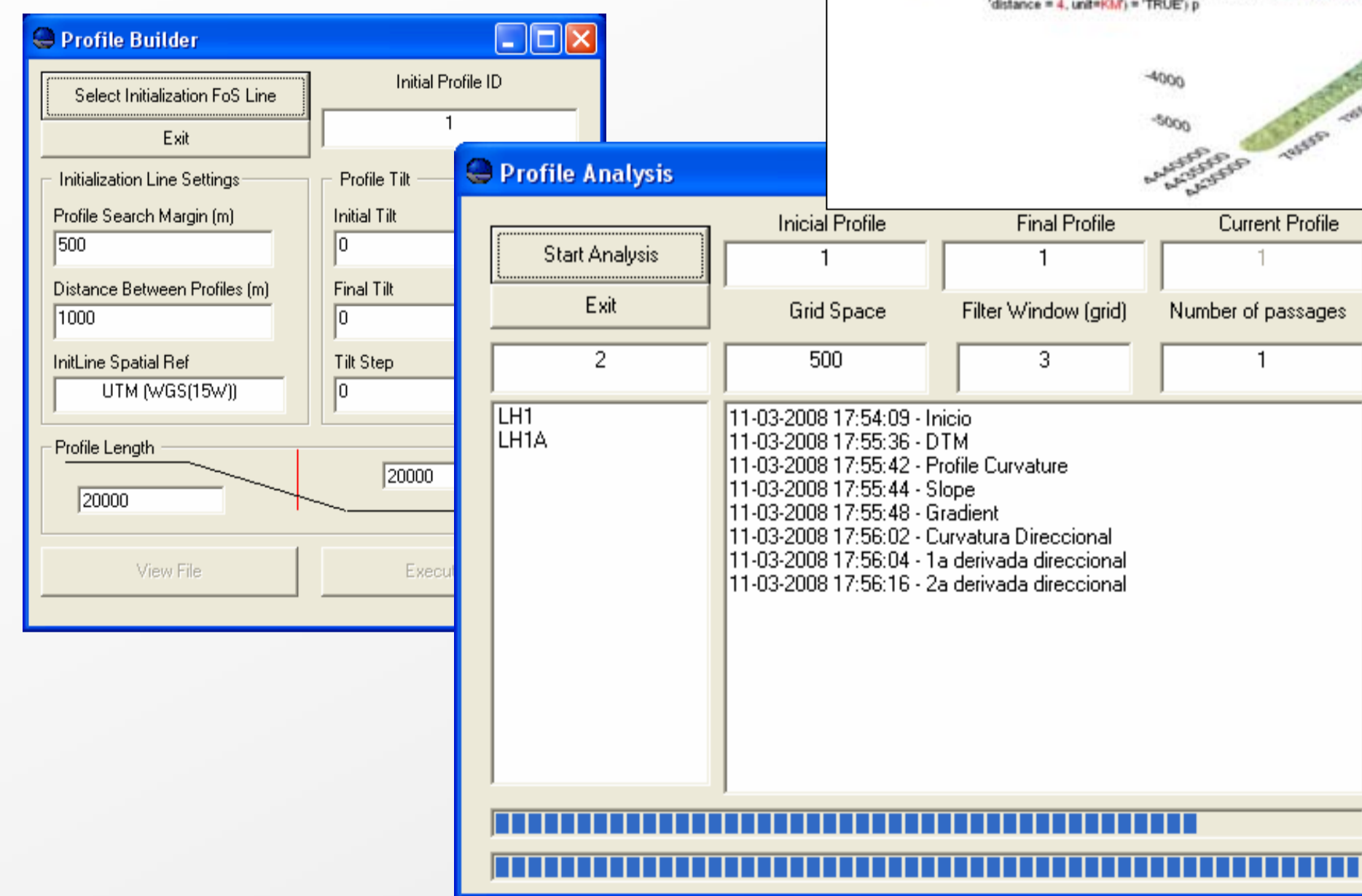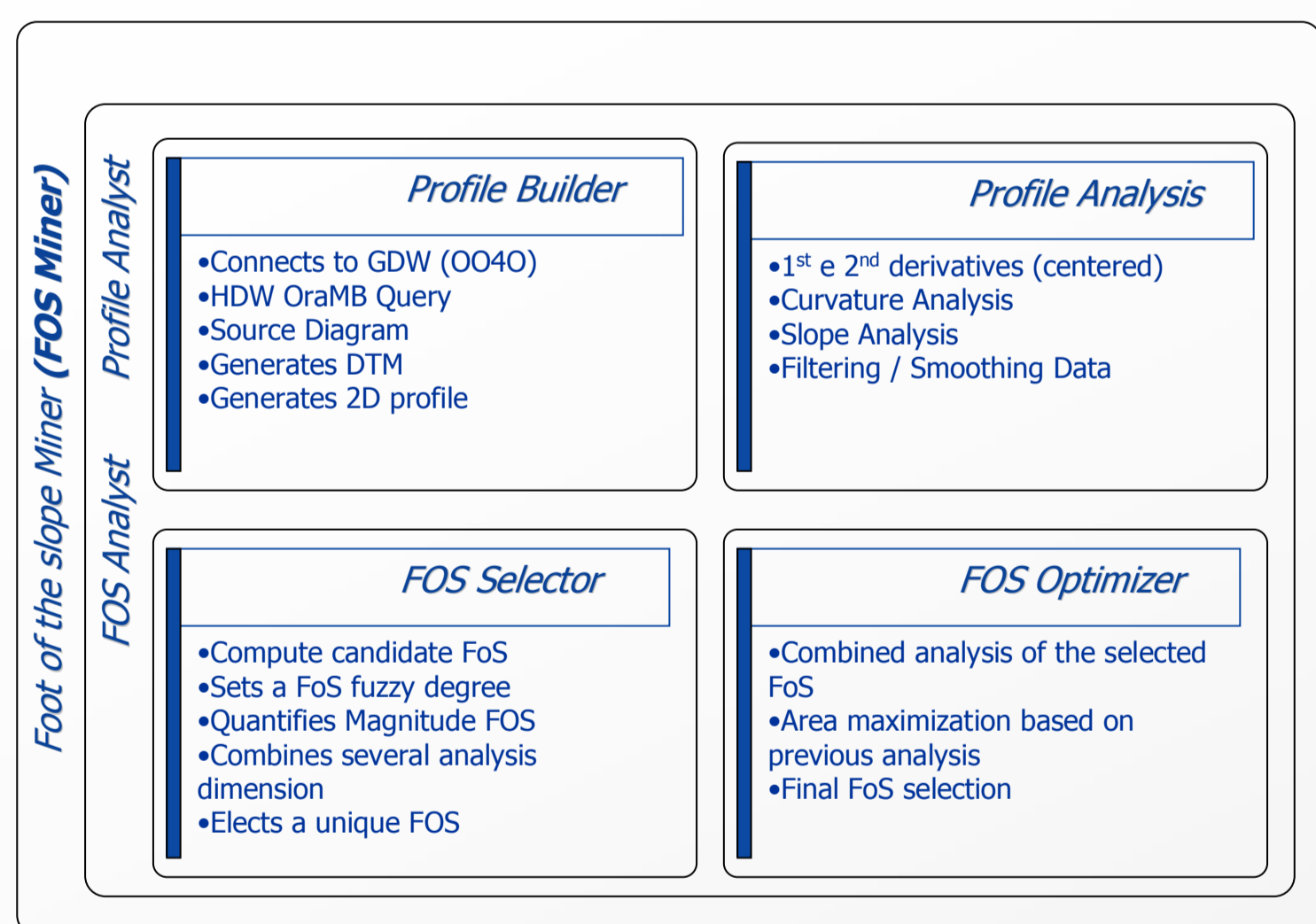Data Loader (ETL) | Data Repository | Data Access
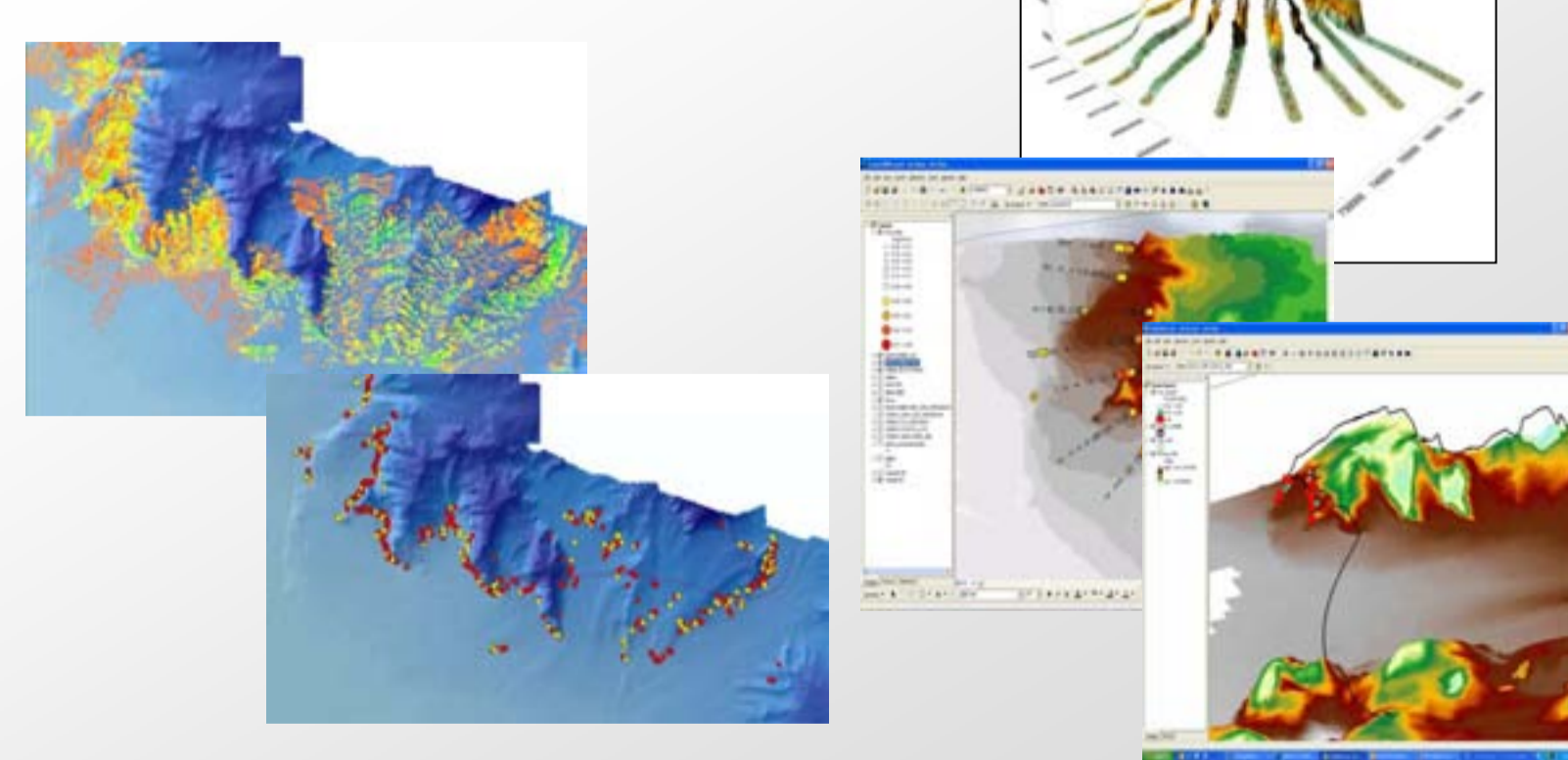
Optimizing Spatial Data:

Resample survey datasets (original data) based on a specific distance (NN on grid), allowing fast visualization at several display scales;

Spatial Data partition (tessellation) based on survey extend, allowing fast query response;

Spatial Index partition based on data density / fractal dimension.
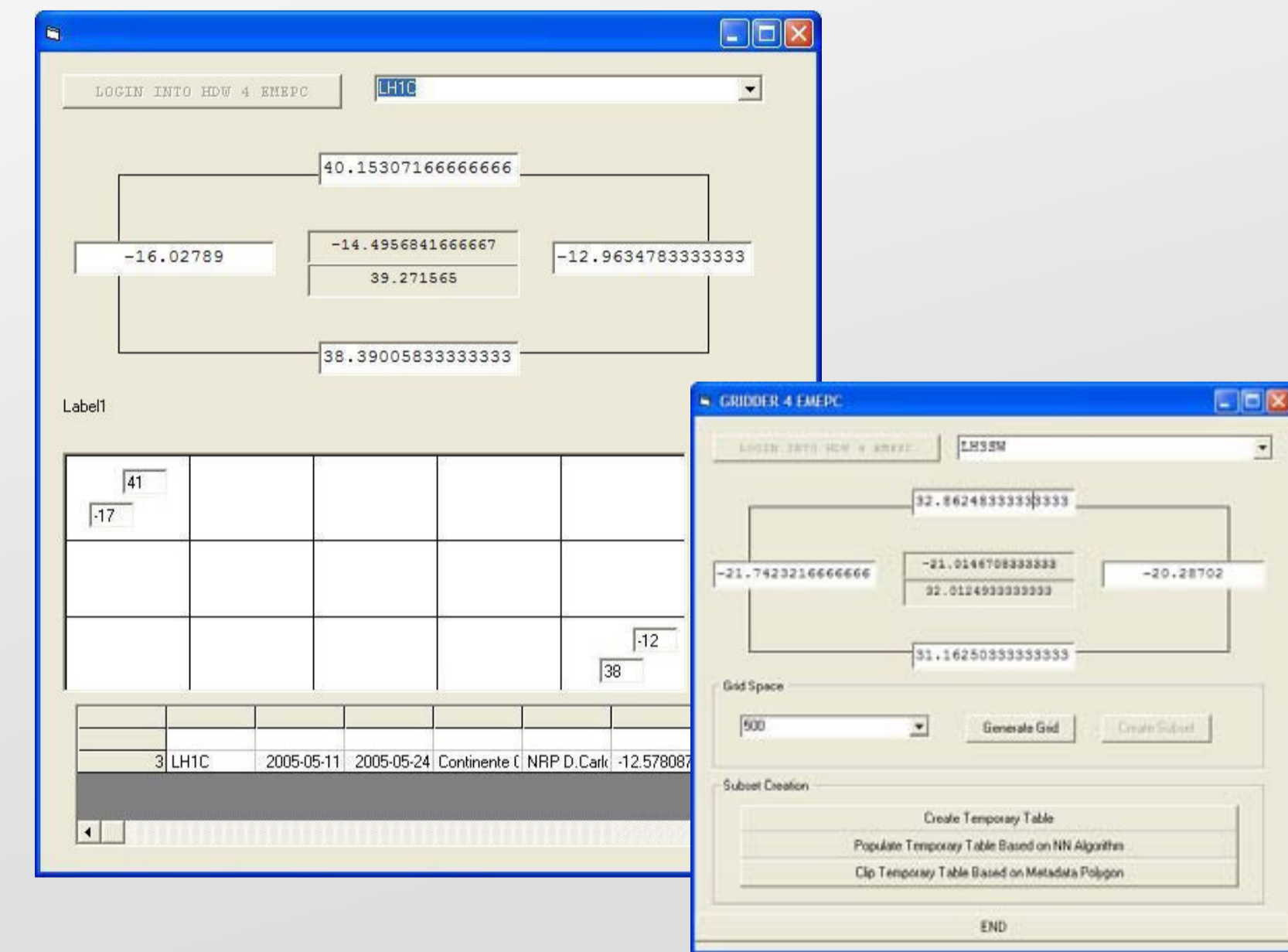
Foot of the Slope Extraction and Qualifier Engine

Foot of the slope Miner (FOS Miner)

Profile Analyst

Profile Builder	Profile Analysis
•Connects to GDW (OO4O) •HDW OraMB Query •Source Diagram •Generates DTM •Generates 2D profile	•1st e 2nd derivatives (centered) •Curvature Analysis •Slope Analysis •Filtering / Smoothing Data

FOS Analyst

| FOS Selector	FOS Optimizer
•Compute candidate FoS •Sets a FoS fuzzy degree •Quantifies Magnitude FOS •Combines several analysis dimension •Elects a unique FOS	•Combined analysis of the selected FoS •Area maximization based on previous analysis •Final FoS selection

GIS Integration

Profile Analyst
(Profile Builder + Profile Analysis)

Access spatial data from GDW (through OO4O data provider);

Storage Procedure to provide data built on server side;

Terrain model and spatial analysis built on the client side;

Store derived data (implicit dimensions) as number array on the GDW.

FoS Analyst
(FoS Selector + FoS Optimizer)

Access profile analysis data through OO4O data provider;

Order the Local Maxima Curvature;

Sets a search window as base of the continental slope;

Combines all data and sets a FoS fuzzy membership degree;

**F**inds the optimal combination of all selected FoS to maximize the extended area.
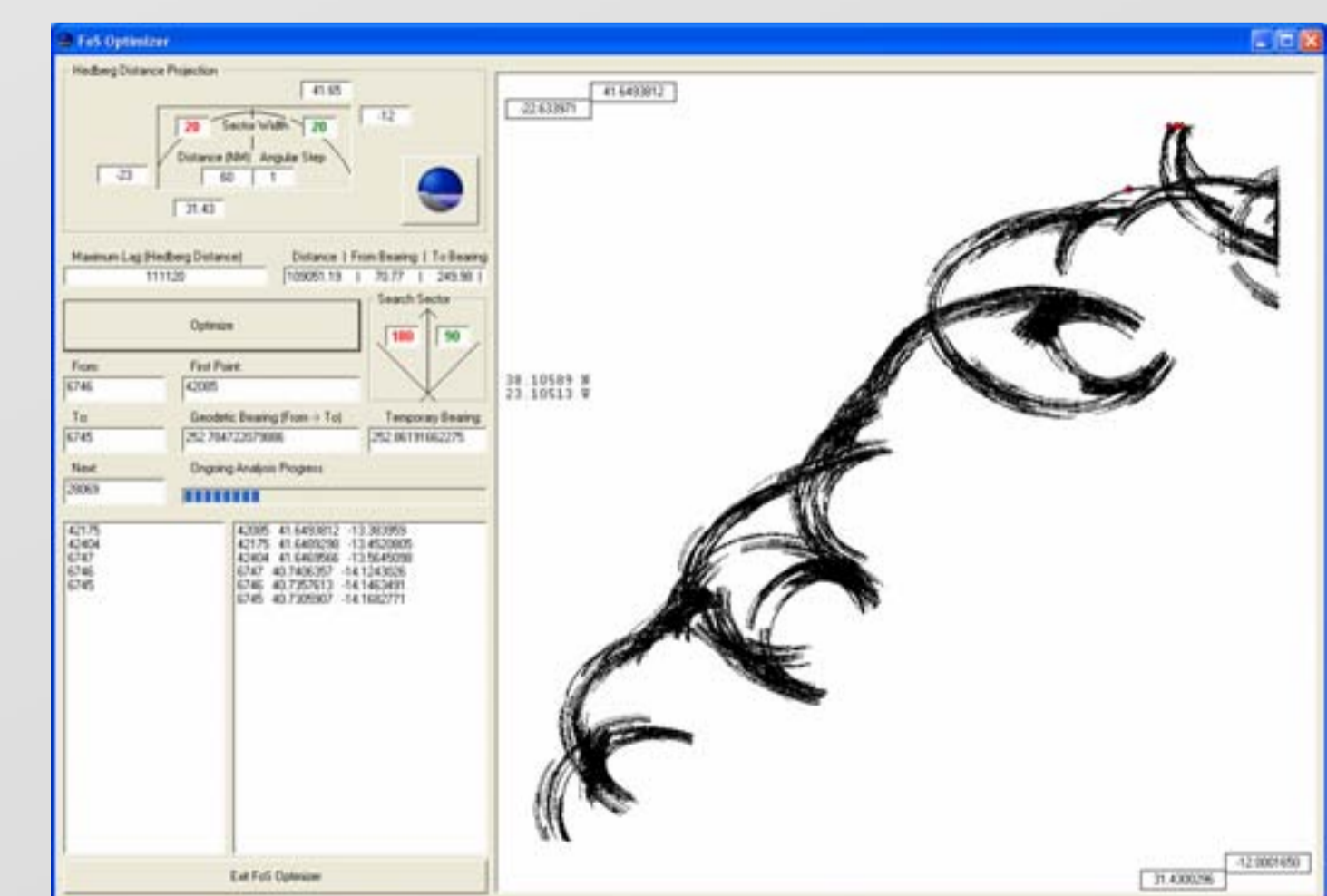
Aldino Campos graduated in 1993 from the Portuguese Naval Academy. He worked at the Portuguese Hydrographic Institute as hydrographic surveyor and as Spatial data analyst. Presently he is a PhD candidate on Territory Engineering and works as technician (Spatial Database Developer) at the Portuguese Task Group for the extension of the Continental Shelf.

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Fernando Maia Pimentel holds a MSc in Physical Oceanography - Underwater Acoustics (Naval Postgraduate School, Monterey, USA) and a Hydrographic Engineering (Hydrographic Office, Portugal). He is the Technical Coordinator of the Portuguese Task Group for the Extension of the Continental Shelf (EMEPC) and its areas of expertise are hydrographic surveying, nautical charting and maritime GIS.
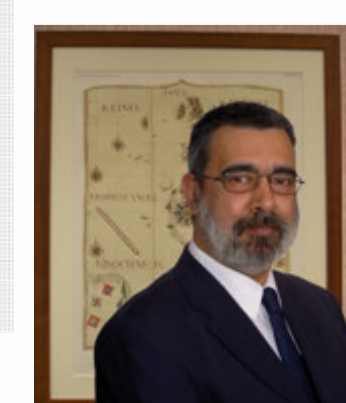
EMEPC team is a multi disciplinary working group that has as main mission the preparation of the Portuguese proposal for the extension of the Continental Shelf, beyond the 200 NM under Art.º 76 of the UNCLOS. This team works under the direct dependence of the Secretary of State for the Defense and Maritime affairs.

1. EMEPC (Estrutura de Missão para a Extensão da Plataforma Continental)