

A platform to support Civil Protection applications on the GRID

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Project Crossfire

• **Collaborative Resources Online to Support Simulations on Forest Fires (Crossfire)**

• Support

- Portuguese NGI (Ingrid)
 - FCT grant GRID/GRI/81795/2006
- JRU Portugal
 - EELA2: *E-science grid facility for Europe and Latin America:*
 - *FP 7, INFRA-2007-1.2.3:*

Goals

- To scale from the desktop towards a service-oriented information system
- To benefit from Grid Infrastructure
- To provide decision-makers with a persistent set of independent high-level services
- To share geospatial information.

FireStation

- Integrated system
 - Three Modules
 - Wind field (Canyon, Nuatmos)
 - Fire Weather Index of the Canadian System
 - Fire propagation over a complex topography
 - Demands
 - high computing power
 - large data set
 - Developed under CAD MicroStation
(*proprietary*)

Wind Field Module

- **Nuatmos**
 - Analytic Model developed by Ross et al., 1988
- **Canyon**
 - Navier-stokes solver for a 3D generalized coordinate system

Fire Weather Index Module

- Canadian Fire Weather Index (FWI)
 - a daily fire risk rating system
 - how weather/fuel affects fire potential
- The module allows
 - assess fire potential over the considered territory, in absence of any extinguishing action
 - estimate moisture content of dead/live fuels

Fire Propagation Module

- Based on
 - Static information concerning the vegetation cover and topography of the terrain
 - Wind Field information provided by the Wind Field Module
 - The module used (Nuatmos or Canyon) influences the quality of the estimated fire spread, the overall computation time of the simulation and the amount of input/output data required

Simulation

Meteorology

Wind speed & direction
Temperature
Relative humidity
Fuel moisture

Topography

Slope
Orientation
Altitude

Fuels

Fuel models

FIRE BEHAVIOUR MODEL

Primary Outputs

Rate of spread
Fire line intensity
Flame height/width

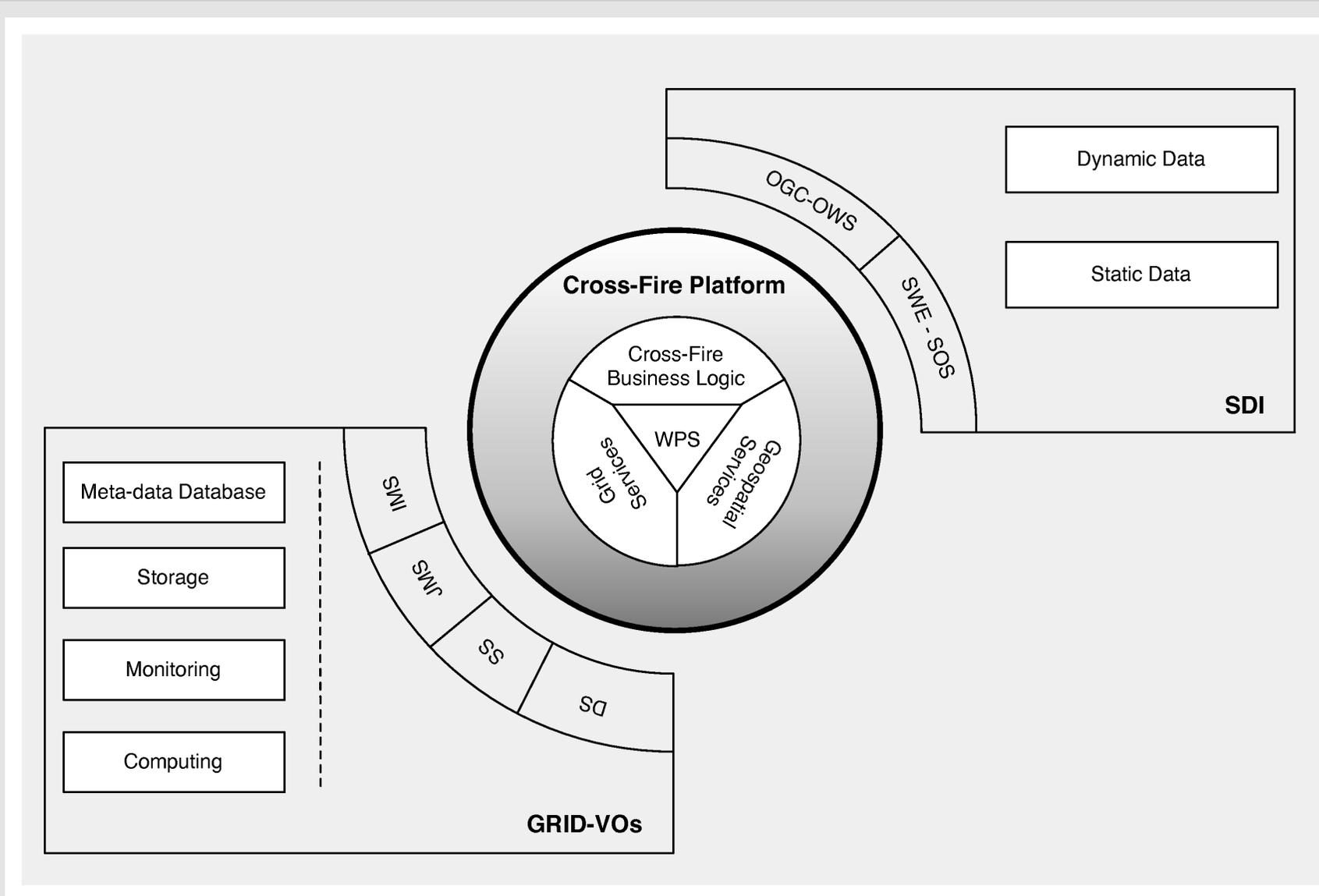
Secondary Outputs

Spotting distance
Probability of ignition
Height of dead crown
Area, perimeter ...

Crossfire

- Using Grid tools and services
- Manage large data input/output files;
- Maintain a data-base of past simulation
 - avoid repeated simulations;
 - evaluate simulations under different conditions
- Monitoring of the fire growth
 - near real-time

Crossfire Architecture Overview



Crossfire Platform

- Business Logic
 - Handles the algorithms that provide all system functionalities (Wind Field, Fire Spread, FWI)
- Grid Services
 - Information and Monitoring Services (IMS)
 - Job Management Services (JMS)
 - Security Services (SS)
 - Data Services (DS)
- Geospatial Services

OGC

- The Open Geospatial Consortium (OGC) is an international voluntary consensus organization that creates standards for geospatial content and services, GIS data processing and data sharing.

OGC SDI (1)

- WMS (Web Map Services) - standardizes the access to georeferenced map images;
- WCS (Web Coverage Services) - standardizes access to geospatial data as coverages representing space-varying phenomena;
- WFS (Web Feature Services)- standardizes the retrieval and update of digital representations of real-world entities referenced to the Earths surface.

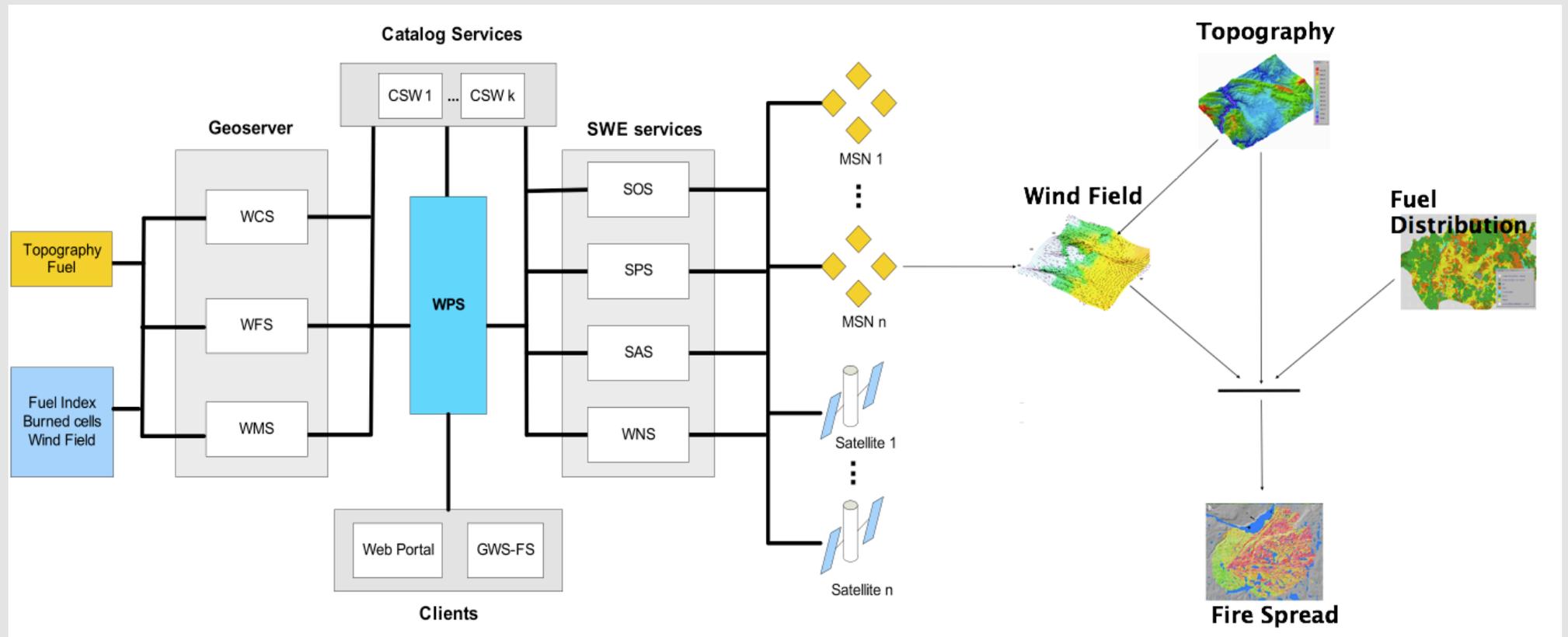
OGC SDI (2)

- WPS (Web Processing Service) - defines basic request-response interaction for remote execution of a service, which can include any algorithm, calculation, or model that operates on spatially referenced data;
- CSW (Catalog Service-Web) – one of the Web Catalogue Services profile used to discover, browse, and query metadata about geographical services, data and resources.

OGC-SWE

- The OGC Sensor Web Enablement (SWE) initiative makes all types of sensors, instruments, and imaging devices accessible and, where applicable, controllable via the Web, through a common interface and encodings.

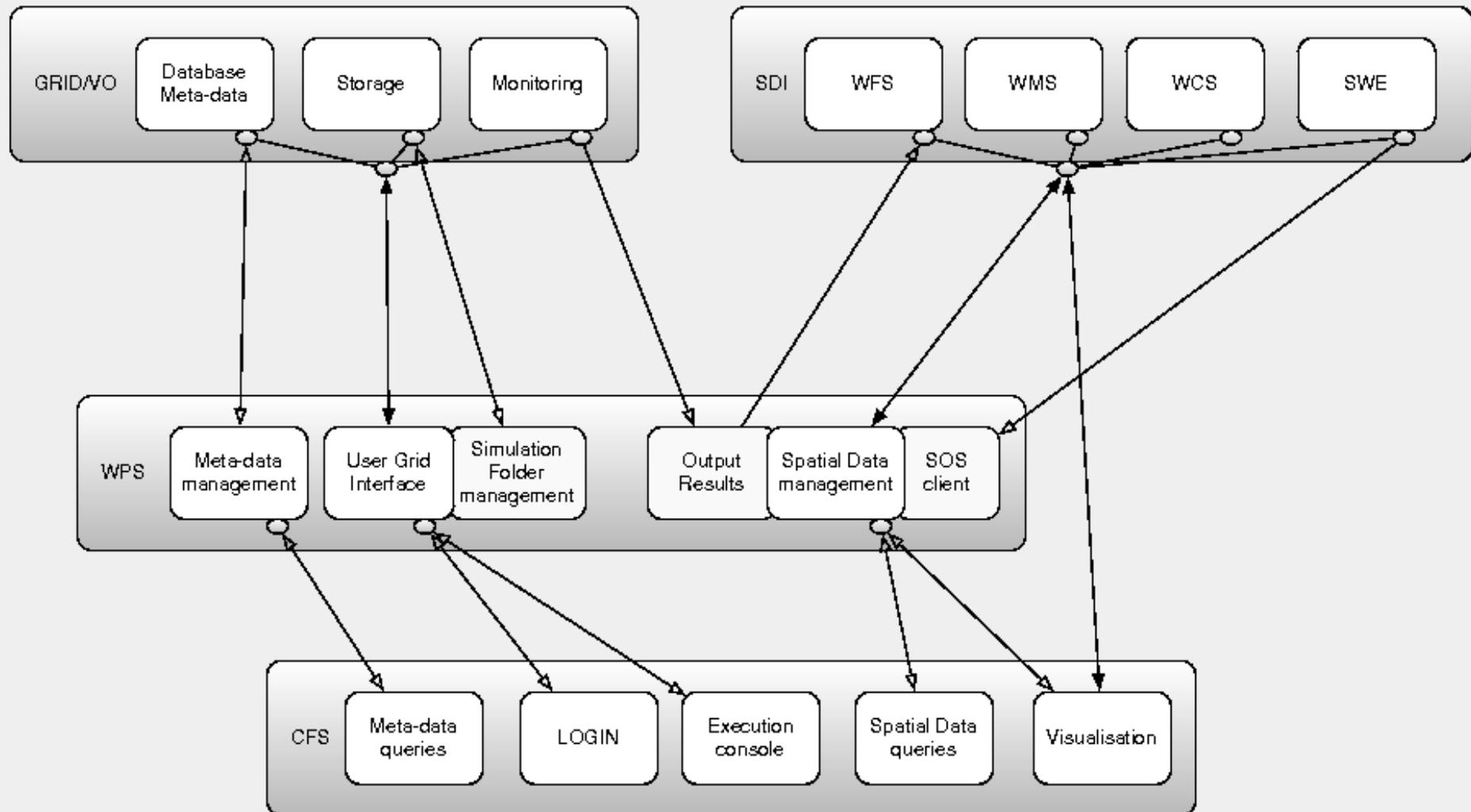
OGC-SDI Integration



SDI Implementation

- Geoserver
 - Open Source software that implements the WCS, WFS and WMS standards
 - Connected to a Postgres database enhanced with the Postgis extension
- 52n SOS
 - Open Source software that implements de sos standard

WPS Algorithms



WPS Algorithms

- Developed on top of WPS 52 North.
 - 52 North WPS is a framework developed in Java that allows the adding of modules (called algorithms) that can be provided to users through the WPS standard

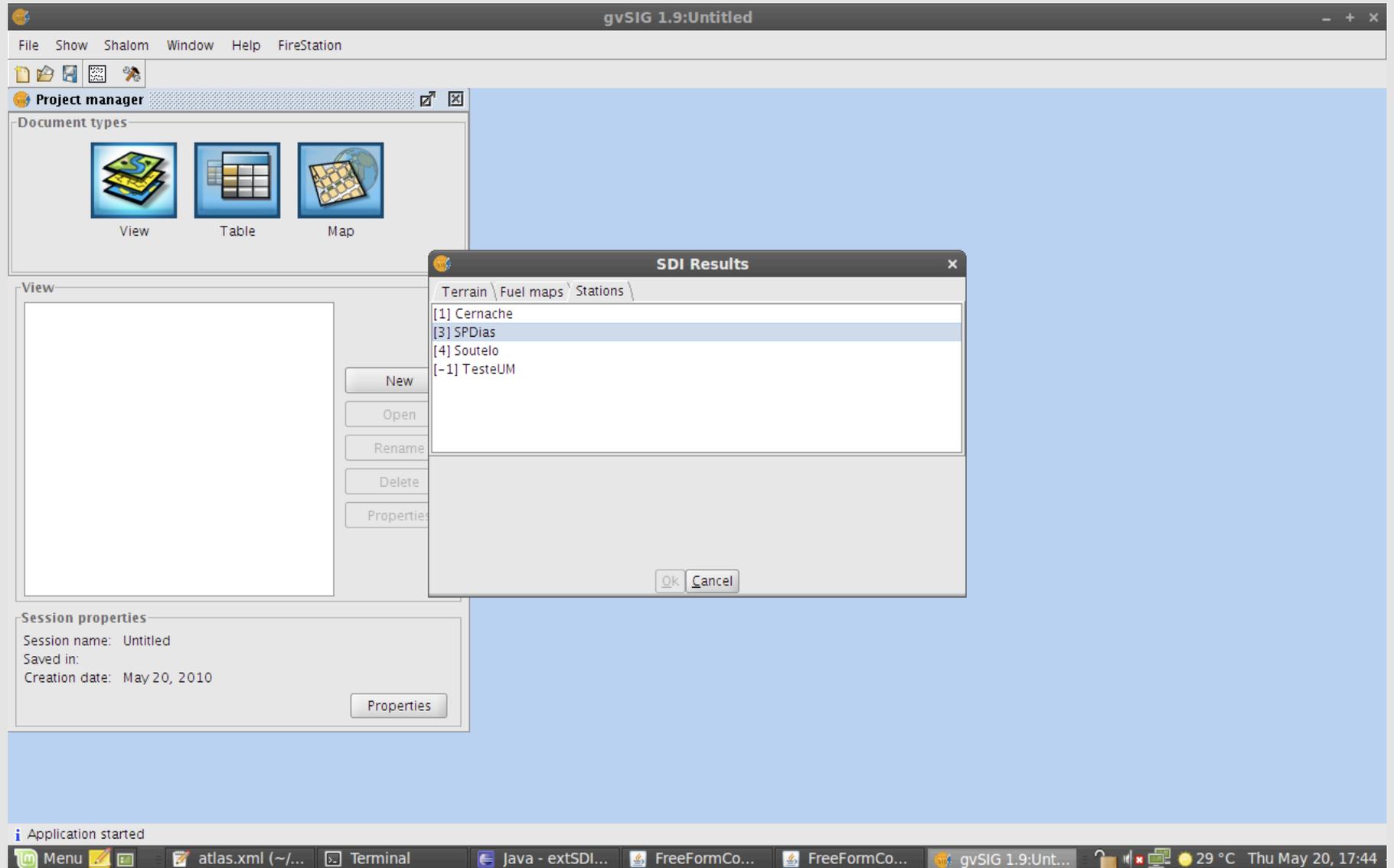
CFS Client

- The Console FireStation (CFS) is based on gvSIG, a full feature Open Source GIS desktop solution, funded by EC, which conforms to INSPIRE for managing geospatial information.

CFS Client

- Execution Console
 - Responsible for the authentication and proxy generation, through our WPS layer
 - Responsible for the gathering of data necessary to different steps of the simulation
- Visualization
- Meta-Data Queries
- Spatial Data Queries

CFS Client (Spatial Data Queries)



CFS Client (Execution Console)

The screenshot displays the gvSIG 1.9:Untitled application window. The main interface includes a menu bar (File, Show, Shalom, Window, Help, FireStation), a toolbar, and a Project manager panel on the left. The Project manager panel shows document types (View, Table, Map) and a View area with buttons for New, Open, Rename, Delete, and Properties. Below the View area is the Session properties section, showing session name (Untitled), saved in location, and creation date (May 20, 2010).

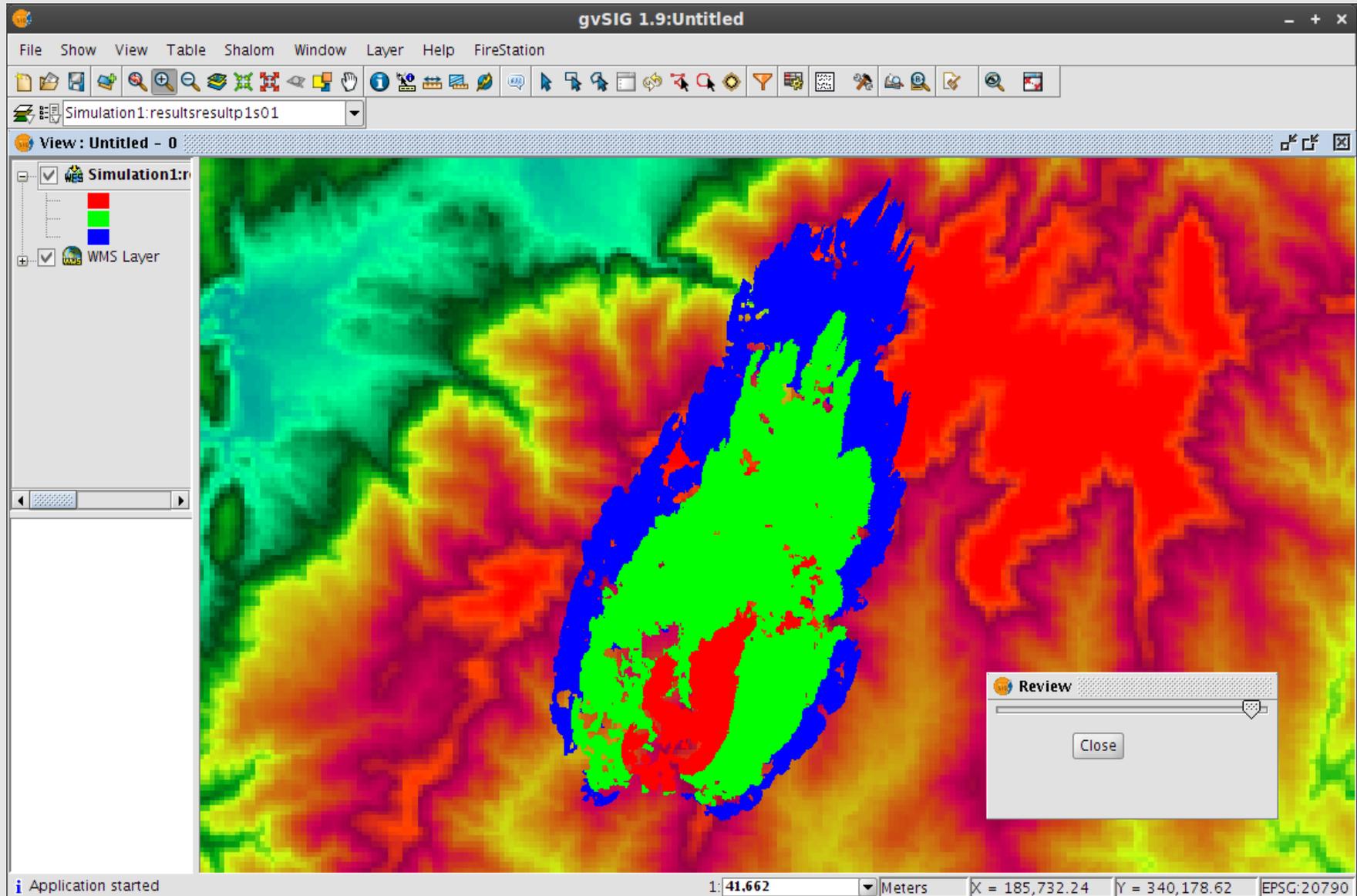
An SDI Results dialog box is open in the foreground, showing the following configuration:

- Type: Samples \ DTM's \ WindFields \
- Execution Type:
 - WindField:
 - FireSpread:
 - WindField+ FireSpread:
- Ignition Points:
- Barriers:
- Stop Condition: Choose one (dropdown menu)

The dialog box has OK and Cancel buttons at the bottom.

At the bottom of the screen, the system tray shows the application started message, a menu icon, and the taskbar with open windows: [atlas.xml (~/Desktop/...), [Terminal], Java - extSDIQuery/src..., and gvSIG 1.9:Untitled. The system clock shows 29 °C and Thu May 20, 23:26.

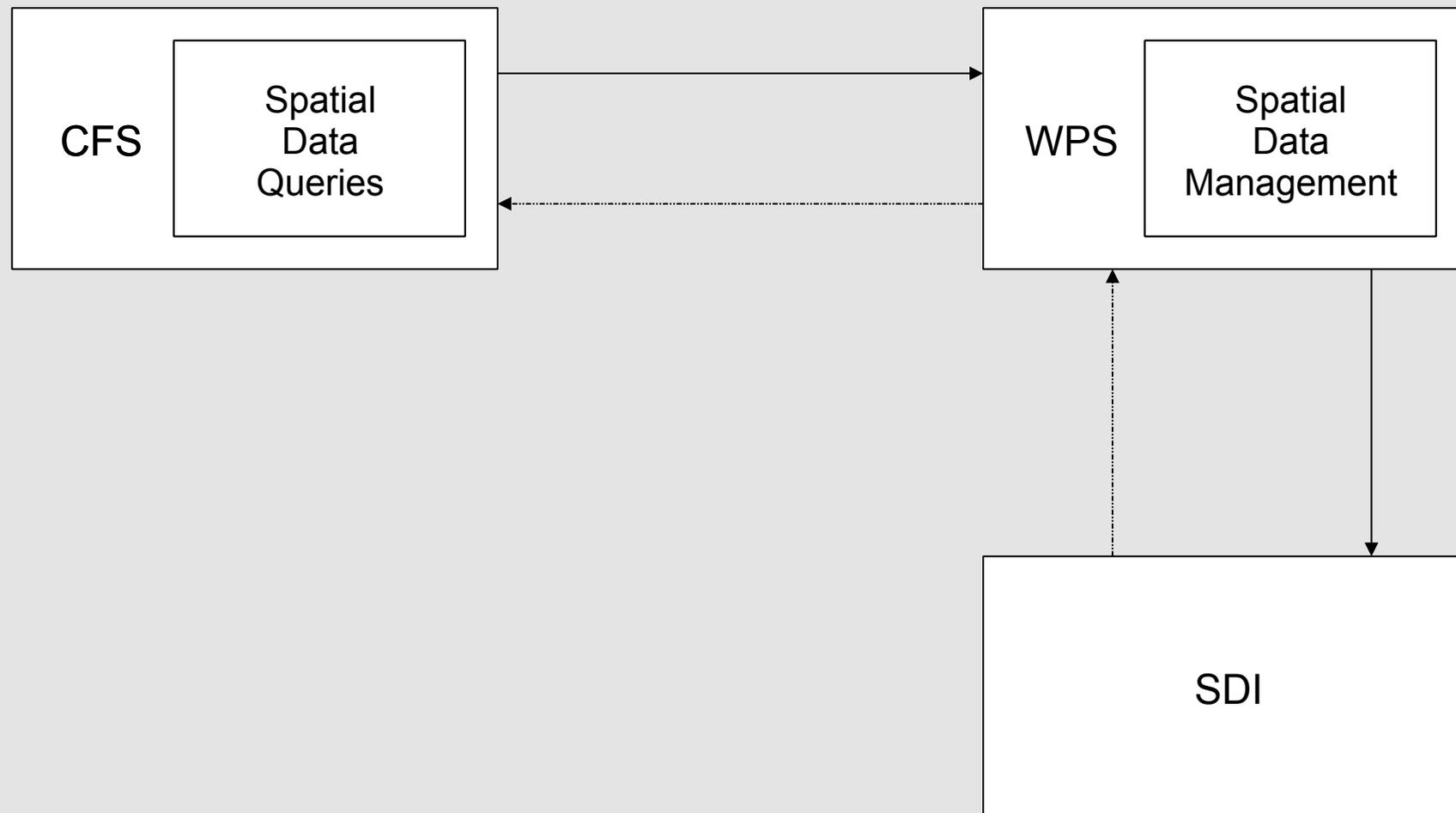
CFS Client (Visualization)



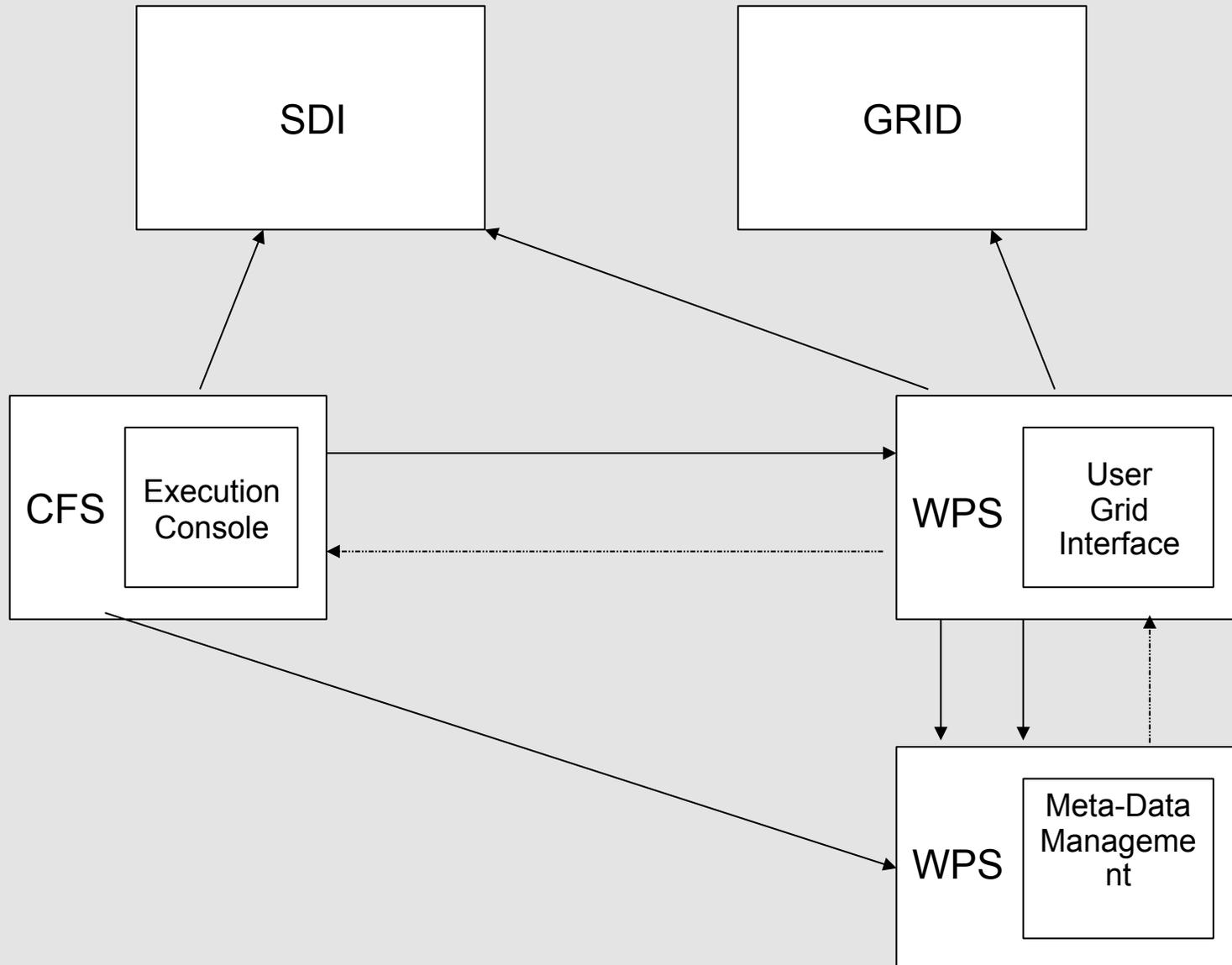
WPS Workflow

1. Data Acquisition
2. Simulation request (Wind Field and/or Fire Spread)

Data Acquisition



Simulation Request



Work in Progress and Future Work

- Parallel implementation of CANYON wind simulation model to reduce the time of overall fire spread simulation;
- WPS-server X509 based module for a One Sign Authentication Management, to allow a consistent integrating of user access to both the GRID and the SDI;
- Decision-support system based on a web portal where many players can connect, to request services through the core WPS layer.

Thank You

QUESTIONS