

# 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

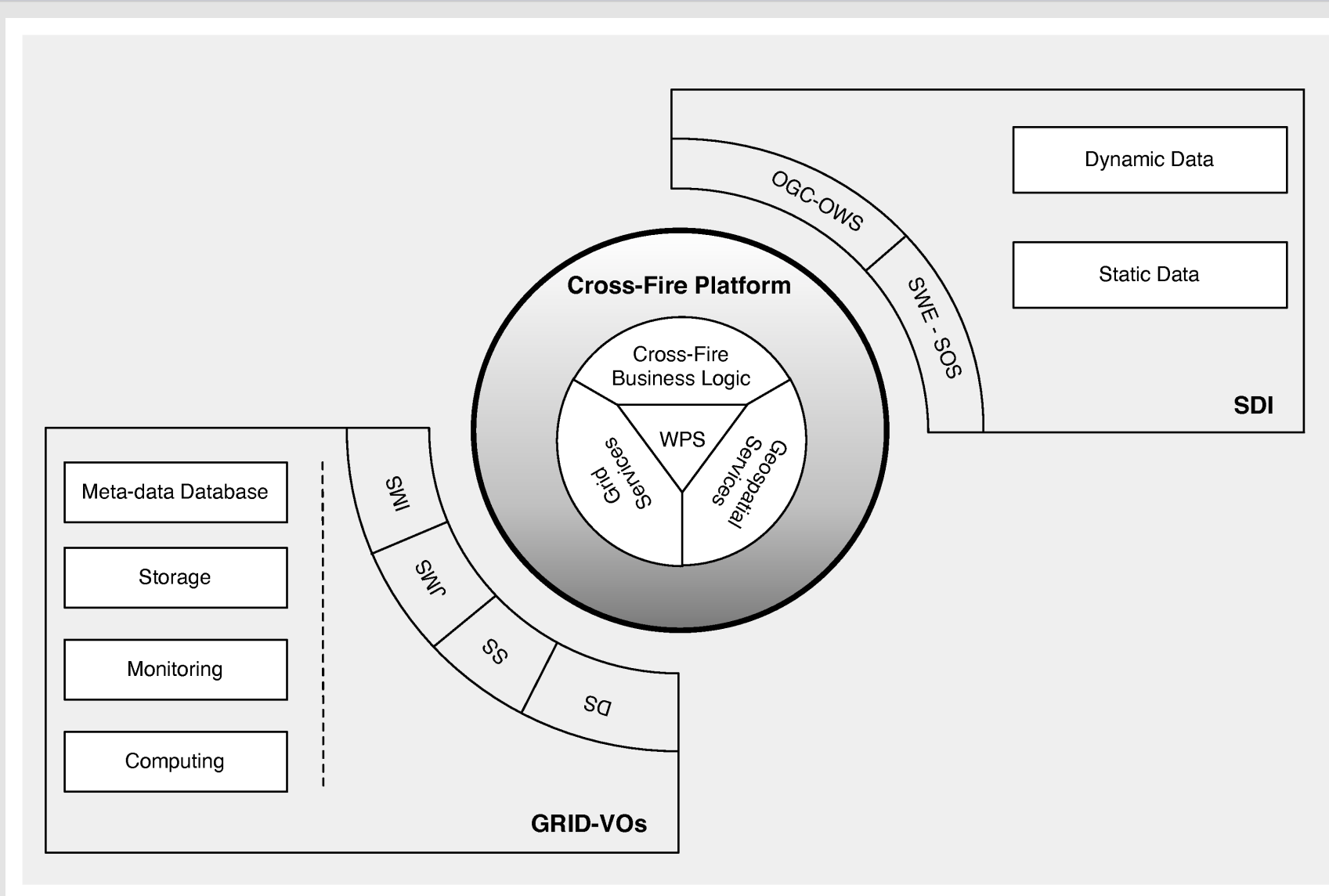
Spotting distance  
Probability of ignition  
Height of dead crown  
Area, perimeter ...



# 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.

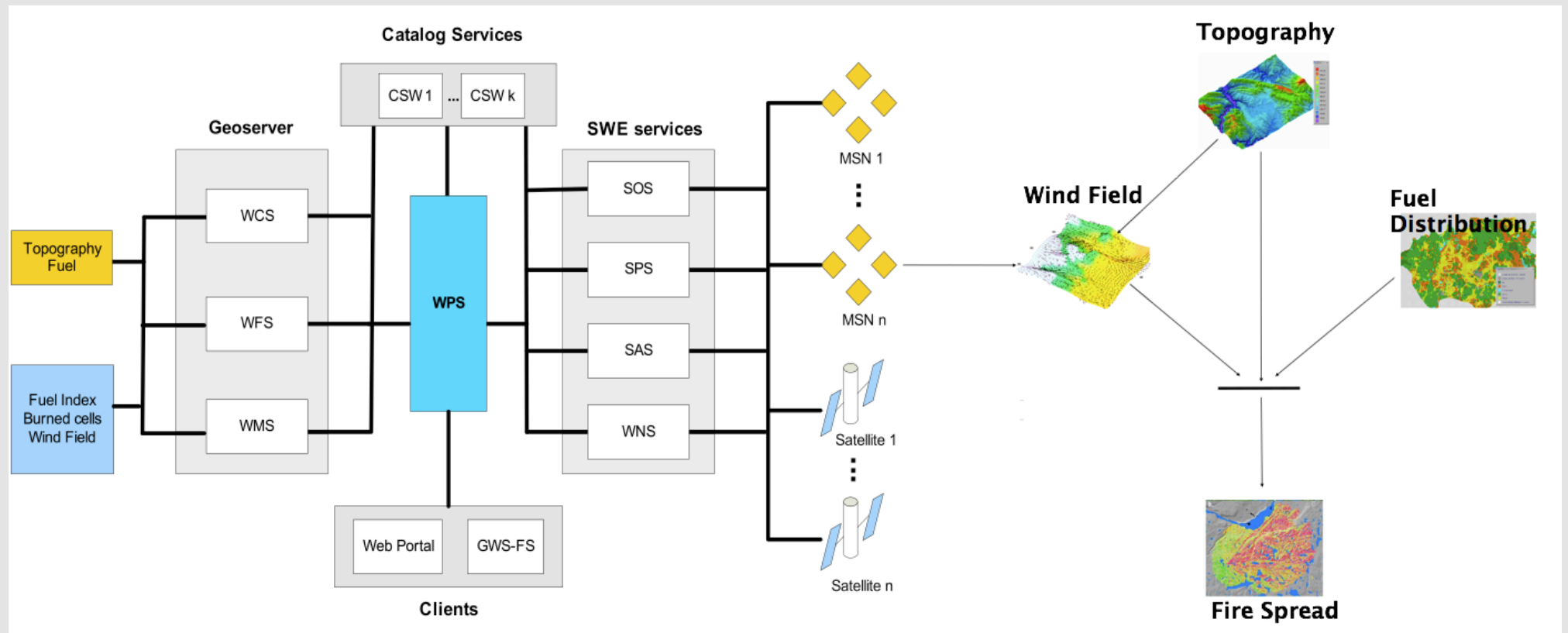
# OGC SDI (2)

- 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

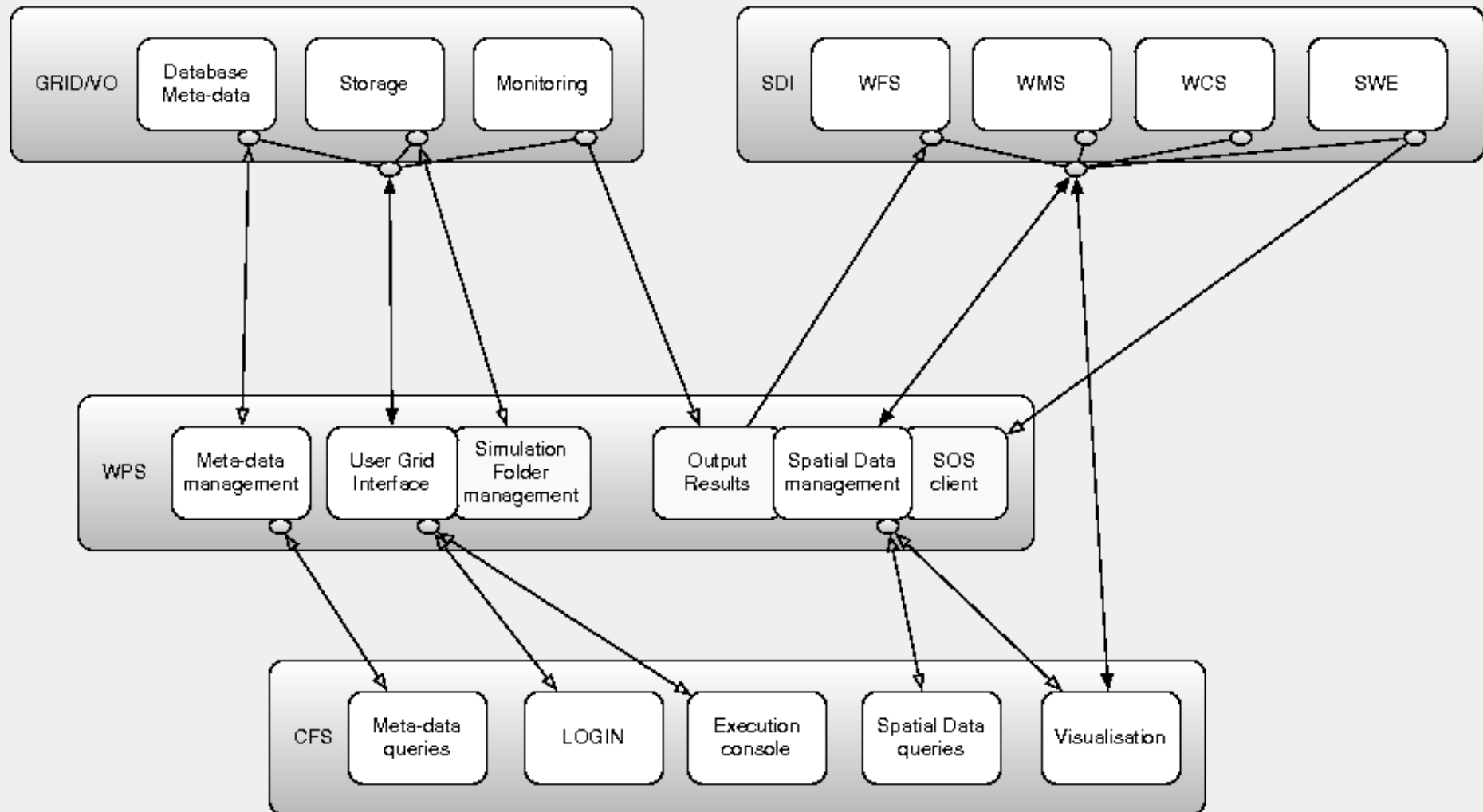




# SDI Implementation

- 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

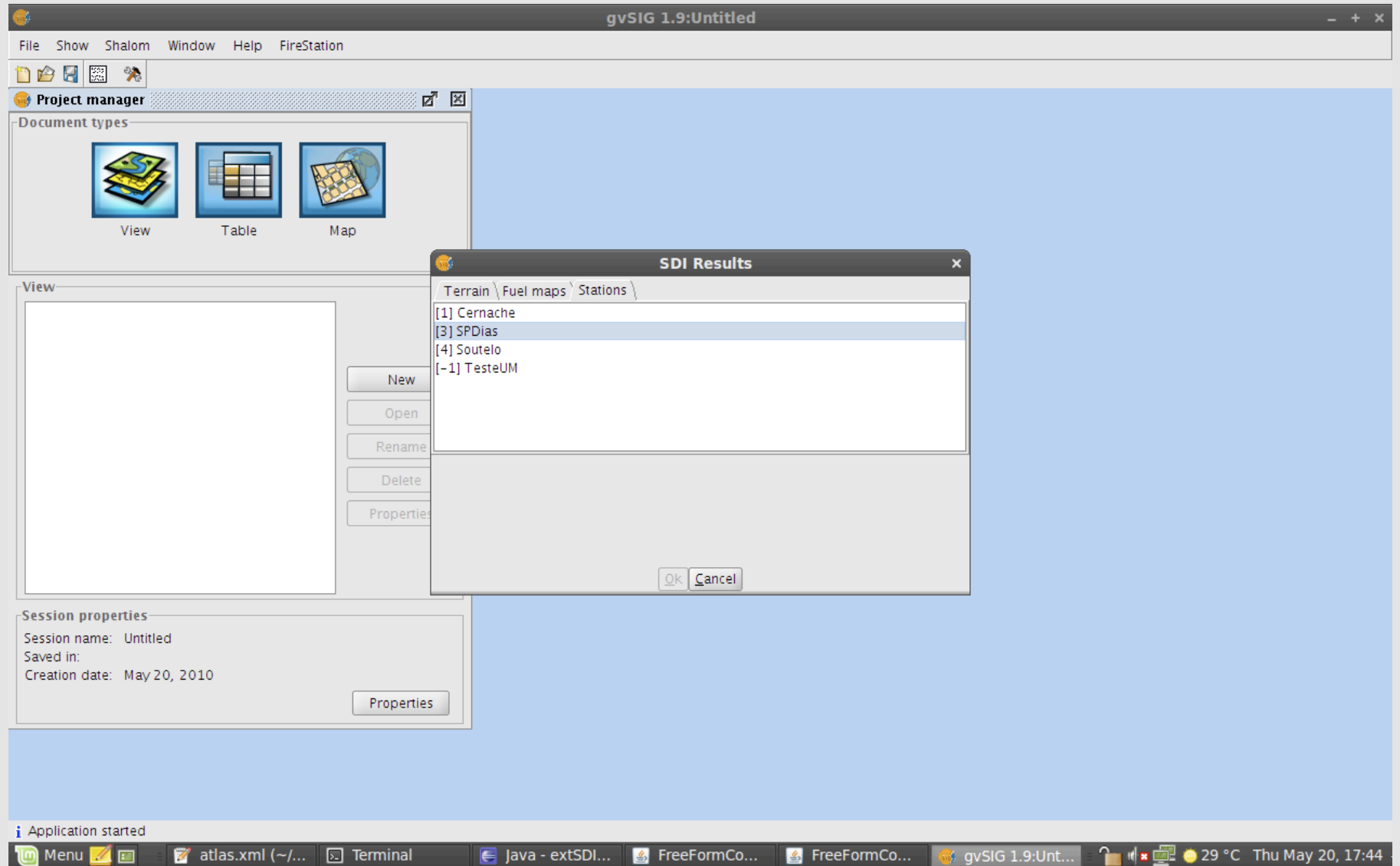
# CFS Client

- 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.

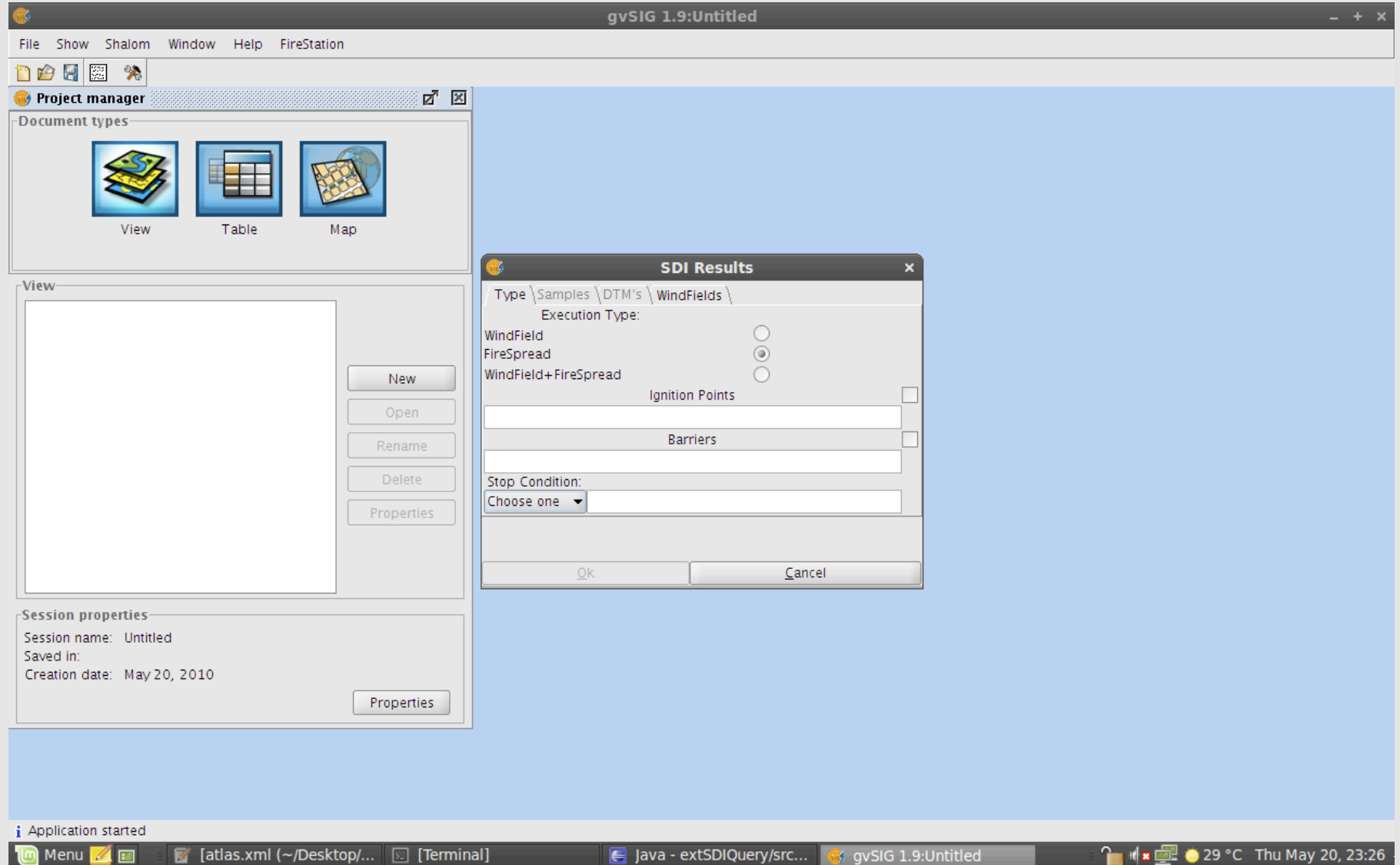
# CFS Client

- 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

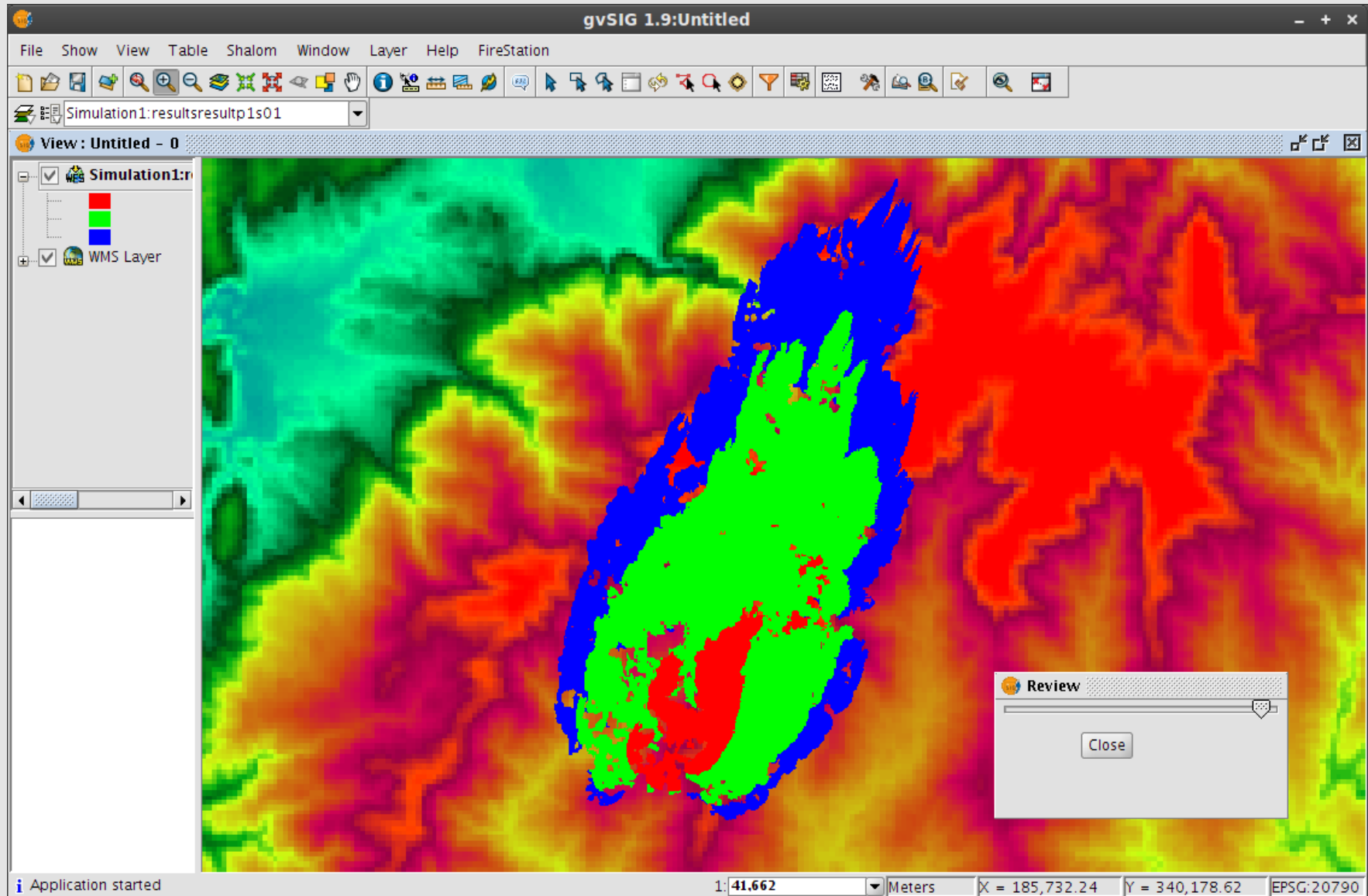
# CFS Client (Spatial Data Queries)



# CFS Client (Execution Console)



# CFS Client (Visualization)

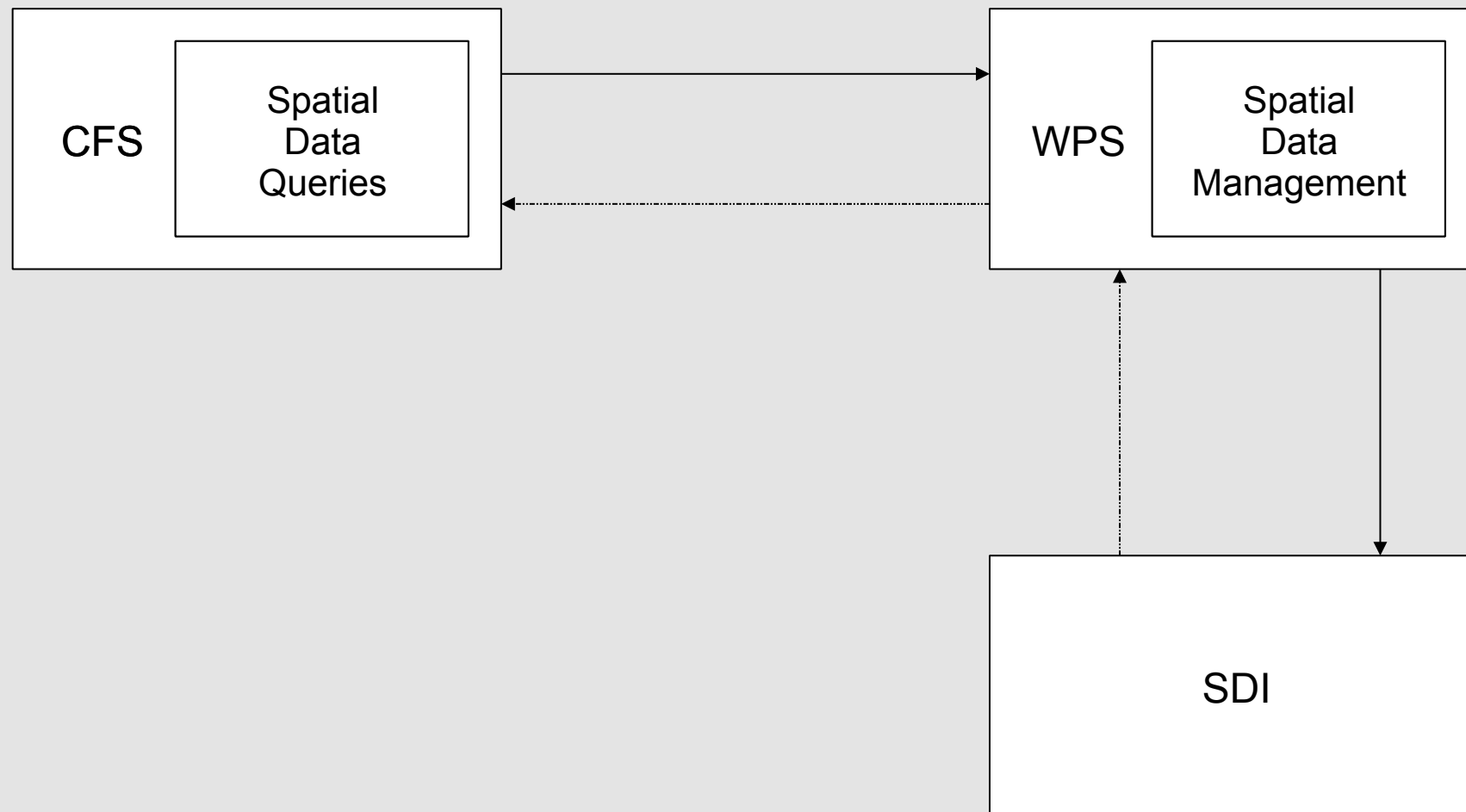




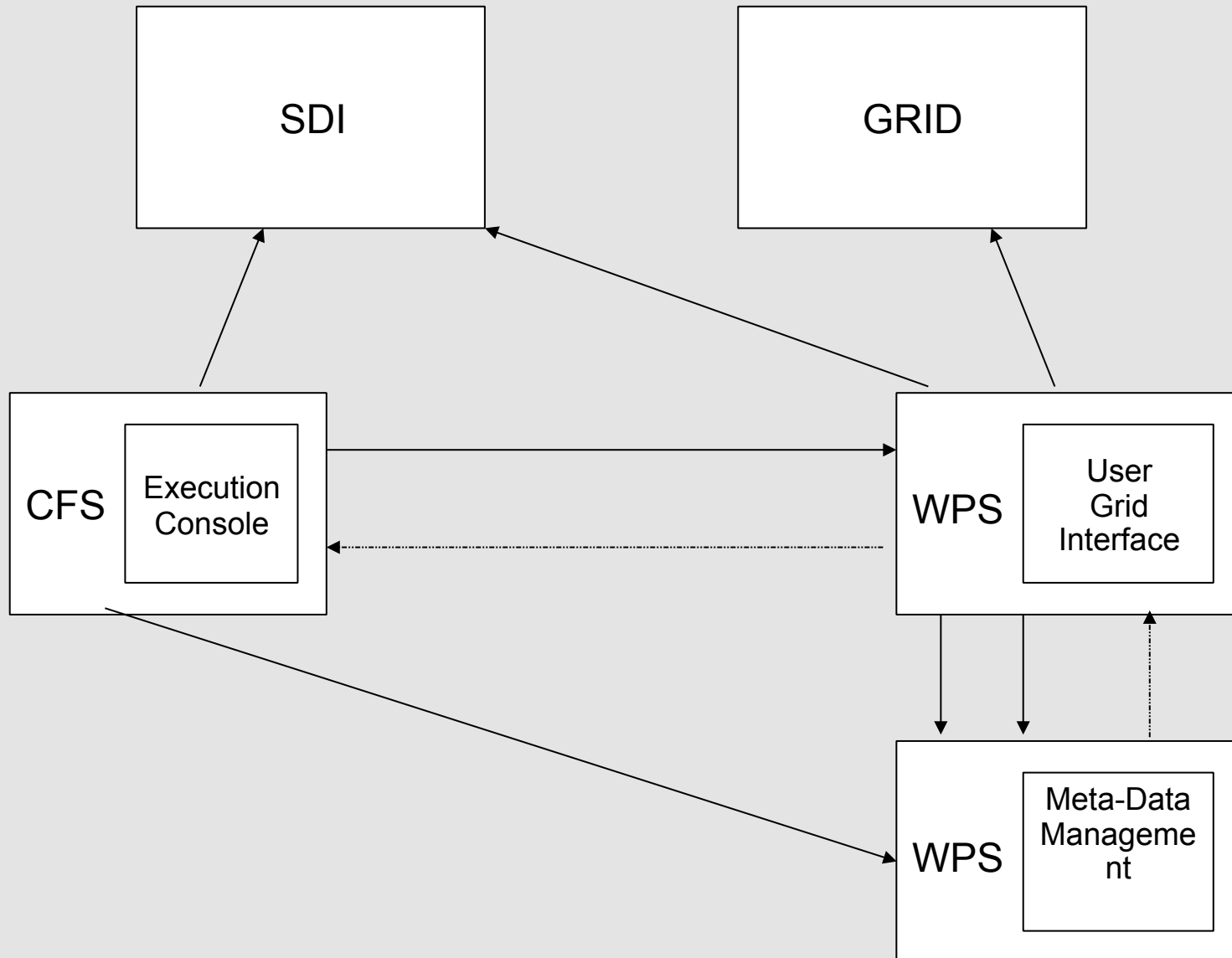
# WPS Workflow

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**