

AN INTEROPERABLE CLIMATE SERVICE FOR DROUGHT MONITORING

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THE CONTEXT

Advances in ICT, as high-performance computing, processing and storing, new coding standards, the availability of open and costless data, and the strong impulse of the geoinformation technology foster the development of self-sustained monitoring and forecasting systems and allow the upgrade of a timely, ready-to-use and user-specific early-warning communication, especially in climate and environmental fields.

Despite the availability of huge amount of data from different sources and at different spatial scales, information is frequently scattered and not enough integrated to increase preparedness and planning. Moreover, to be effective operational systems should respond to different priorities and users' needs, and have some main requirements: information continuously updated and timely delivered, expandable platform and on-demand services, products adequate to the different users' competencies and technical skills and respond to **Open Innovation** (Open Access, Open Data and Open Source), **Open Science** and **FAIR** (Findable, Accessible, Interoperable and Reusable) paradigms. Following this approach, the Institute of BioEconomy (IBE-CNR), developed the Drought Observatory (DO), a Climate Service providing automatic, detailed and timely information on drought events at national level or for defined geographical windows (<https://drought.climateservices.it/>).

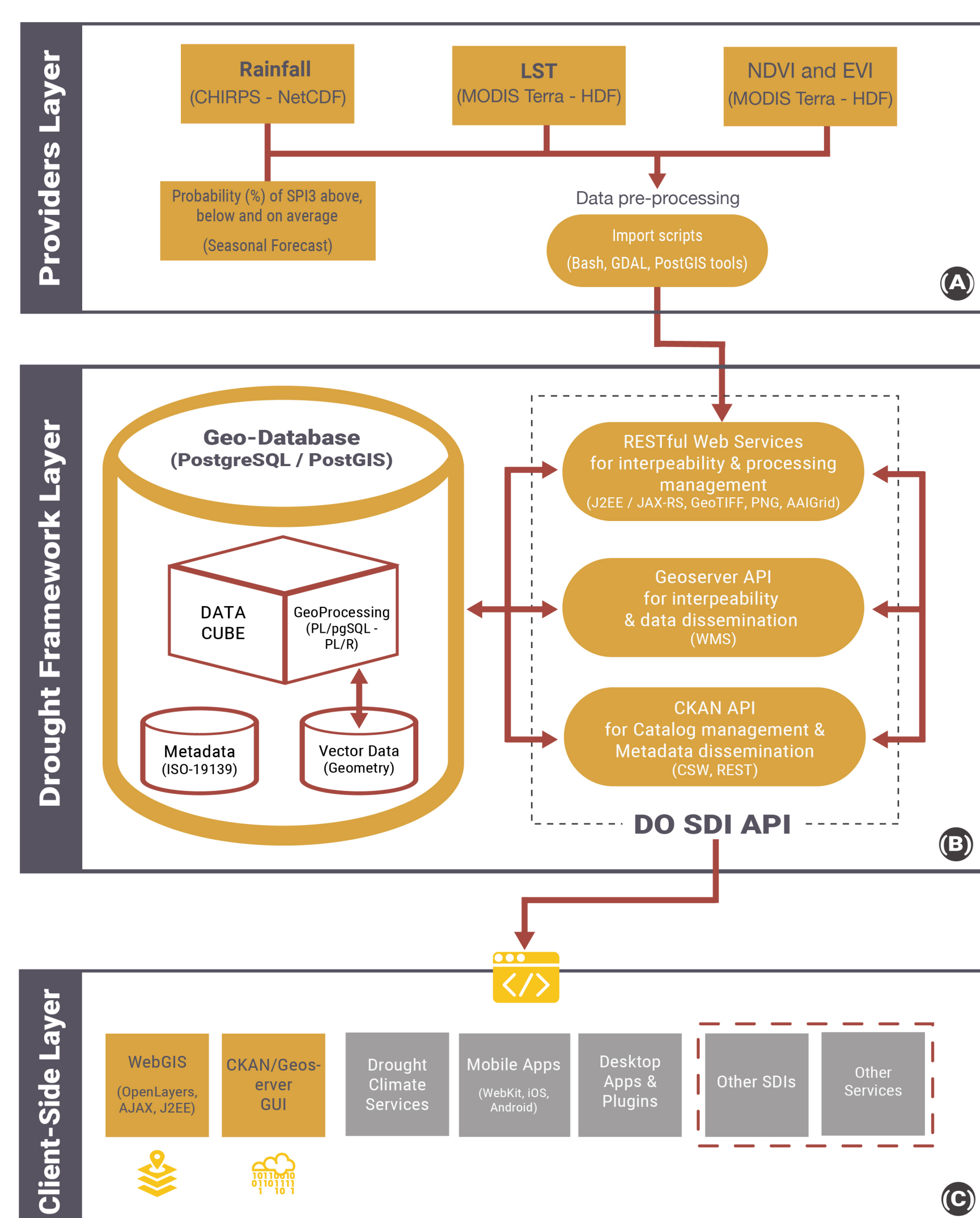
THE SYSTEM ARCHITECTURE

Thanks to the DO interoperable Spatial Data Infrastructure (SDI), we are able to improve the dissemination of an updated and customizable information, thus facilitating the transfer of research know-how to operational applications. The new geospatial **Data Cube** multi-dimensional approach allows the download, storage, access, analysis, geoprocessing, and use of remote sensing and climatic data. The Service-Oriented Architecture, based on Open Geospatial Consortium (OGC) standards, is a database-centered architecture, with PostgreSQL as DataBase Management System. Moreover, advanced statistical procedures integrate R Procedural Language into PostgreSQL (PL/pgSQL) through PL/R wrapper.

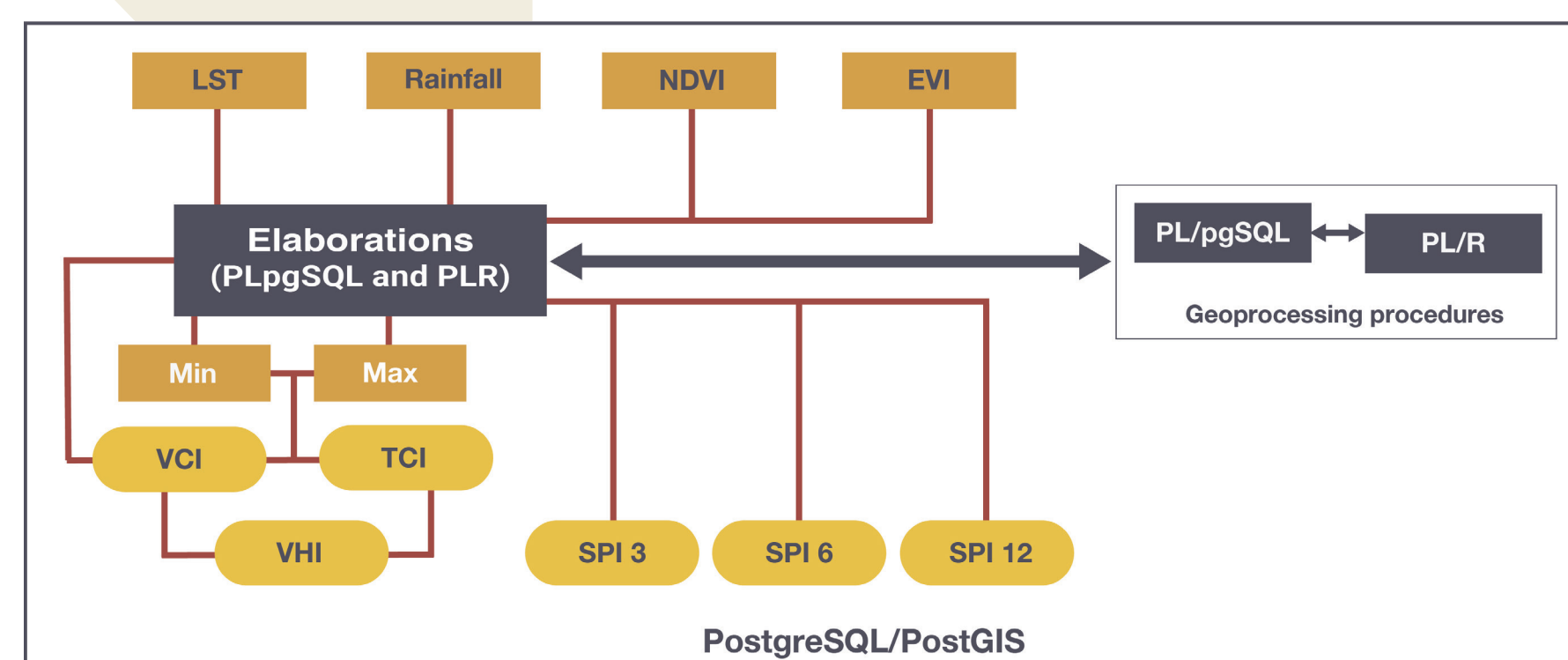
The architecture, designed for the Drought Observatory (DO) monitoring framework optimization, is composed of three layers:

- Providers Layer for retrieving input data,
- Drought Framework Layer for managing metadata and processing stored data,
- Client-side Layer for results dissemination.

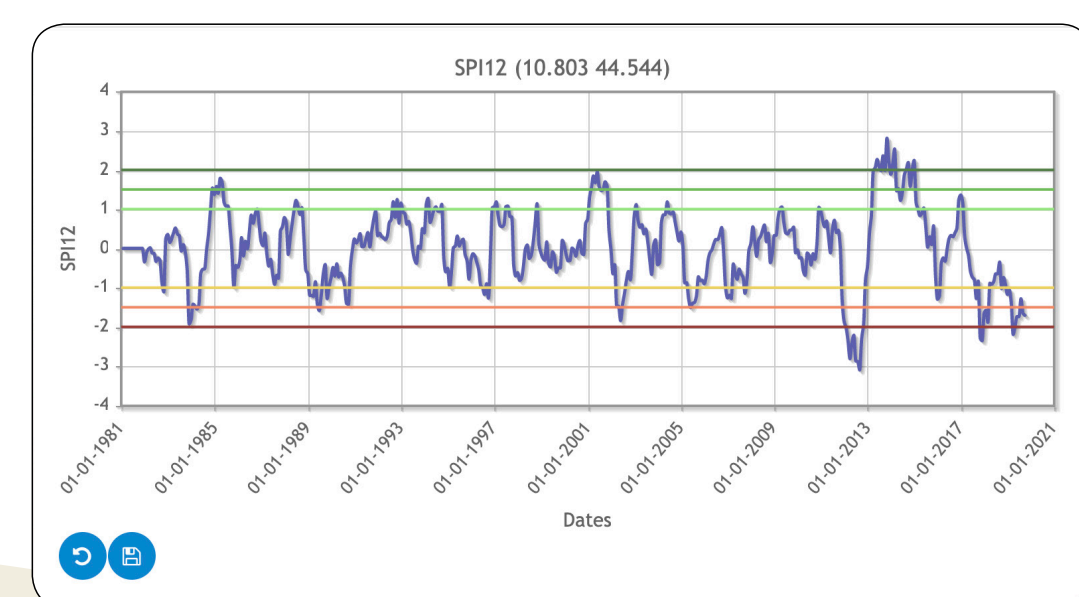
The three Layers communicate through specific Representational State Transfer (REST) web services, following the SOA paradigm.



DROUGHT INDICES: OCCURRENCES AND TRENDS



Key feature of this Open Source and Interoperable SDI is the integration of ground-based, satellite data and models to monitor and forecast drought occurrences and trends. The Data Cube supplies vegetation and precipitation information in the form of maps, graphs and stats.



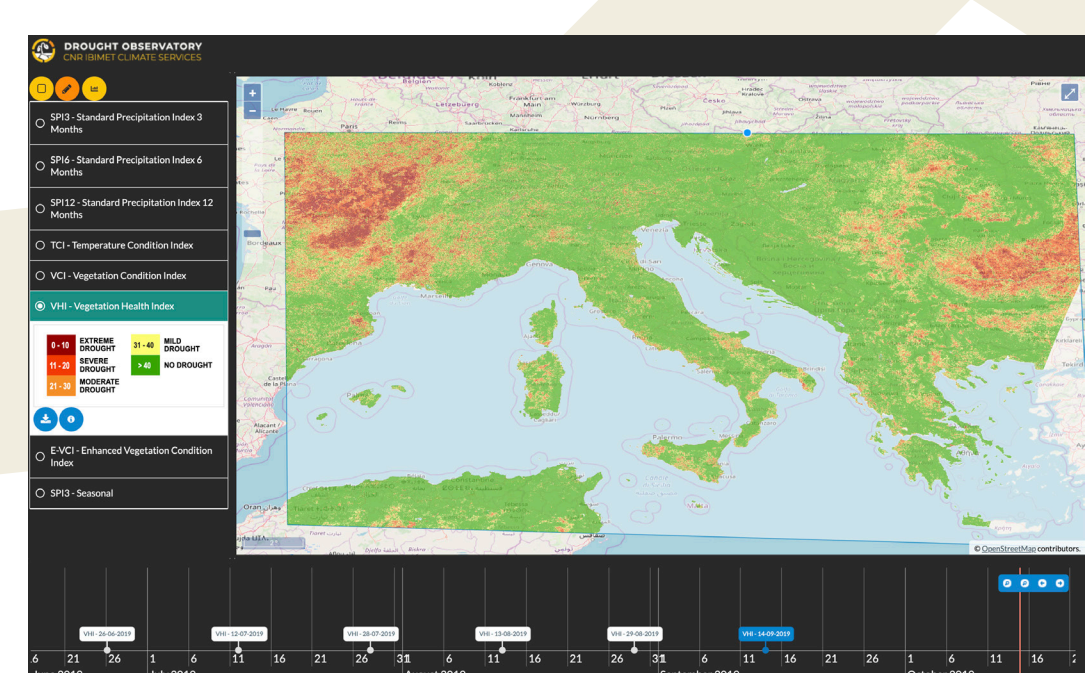
A webGIS tool allows to visualize trends of the active drought index (SPI12 in the example) for a selected pixel.

INFORMATION TO SUPPORT DECISIONS

The Drought Observatory website is structured to offer drought information, data and services responding to different users' needs and technical skills.

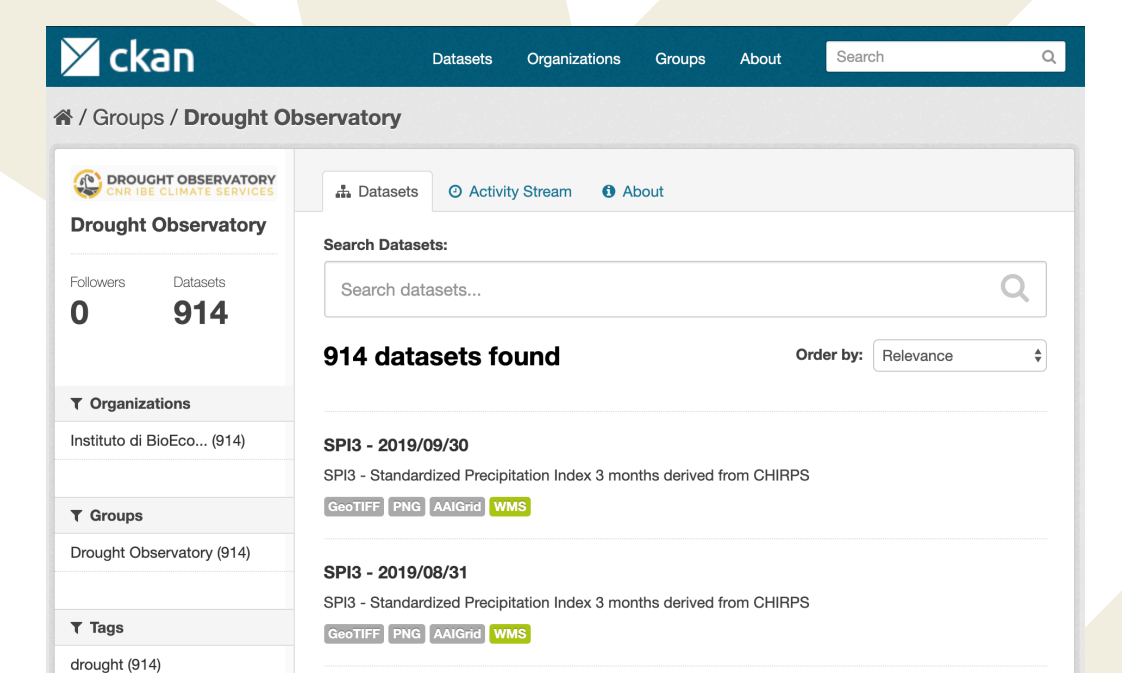
WEB GIS

A customized Open Source WebGIS application to integrate different datasets and share maps of drought indices.



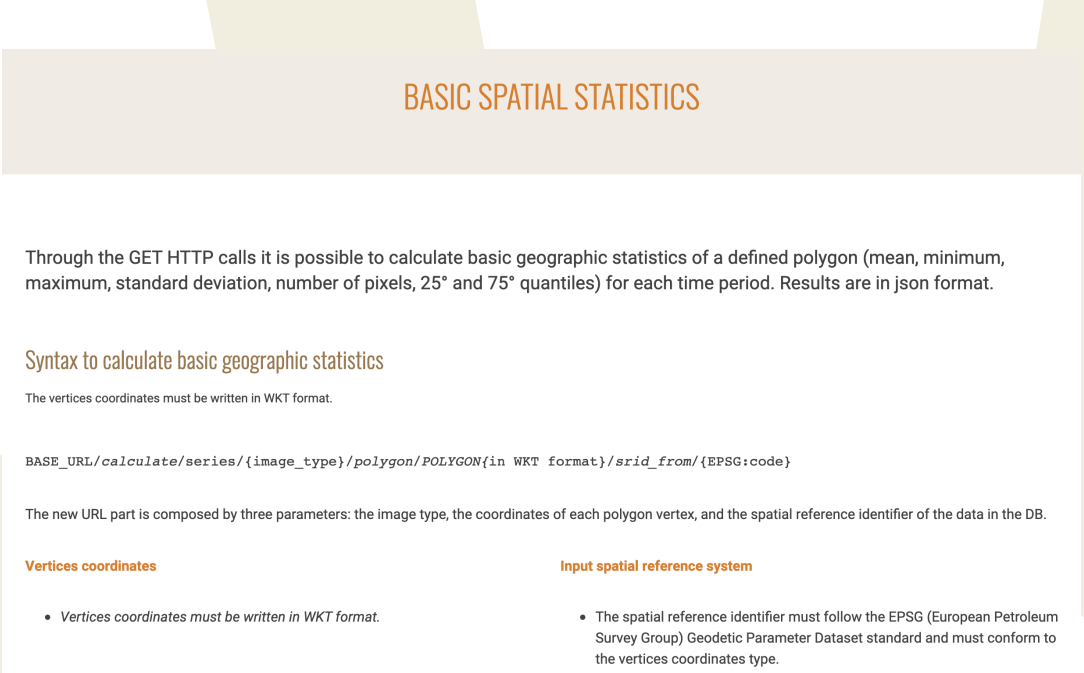
OPEN DATA

A CKAN GeoServer and PostgreSQL catalogue with data and metadata in different formats and standard protocols.



RESTFUL API

The Drought Observatory RESTFUL APIs for data download, clipping and basic stats ensure a complete interoperability.



MONTHLY BULLETIN

The Bulletin is a custom service for Tuscany region that provides monthly updates on Tuscan drought current and future conditions and local impacts.



References in R. Magno, T. De Filippis, E. Di Giuseppe, M. Pasqui, L. Rocchi, B. Gozzini. (2018) Semi-automatic Operational Service for Drought Monitoring and Forecasting in the Tuscany Region. *Geosciences*. 8(2), 48: 1-25. doi: 10.3390/geosciences8020049

