

Customizable Drought Climate Service for supporting different end users' needs

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(IBIMET-CNR; LaMMA Consortium)

DROUGHT IMPACTS

✓ **2011-2012:** one of the longest dry period since 1955 in Tuscany.

Water shortage in several areas of the region.

Cost of 2012 drought event in Florence Province: over 50 Millions Euro of losses in crop productions and forest fires (source: Florence Province).

✓ **2016-2017:** over 10 Italian regions declared the water crisis.

Cost of drought in Tuscany: 430 Millions Euro of damages estimated by Tuscany Region.



WHY

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TEMPORAL GAP AND PROACTIVE SOLUTIONS

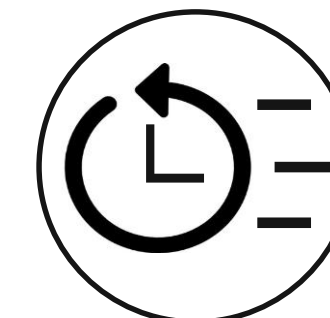
DROUGHT PREPAREDNESS

Drought development



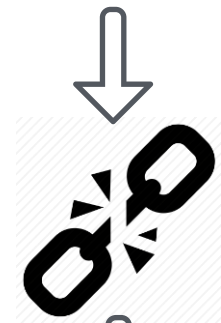
How can we improve
readiness??

(Measures which enable
governments, communities and
individuals to respond rapidly and
effectively to disaster situation)



Proactive solution

...temporal gap ...



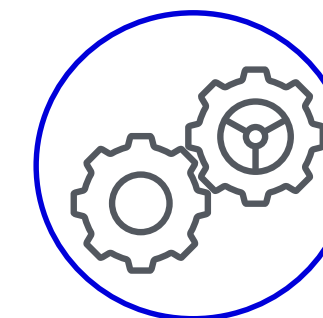
Drought emergency management



...to support decision making
process and to reduce impacts



Providing simple and timely
information on current and expected
drought conditions ...





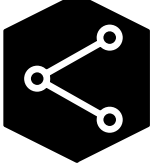

Implementing an integrated
system of monitoring and
forecasting drought status and
water resource availability



COPING DROUGHT

One of the main gaps is that **information** on physical states and impacts is **not optimally integrated to support different users' needs**.

To cope with and mitigate drought, is essential:

- To rely on **formal and informal cooperation** among national, regional and local partners that *share data and drought-related products and technologies* 
- To determine drought severity and its spatial extent, **observing current and future conditions** (precipitation, temperature, soil moisture, vegetation health, streamflow, reservoirs levels, etc.) 
- To **share no-cost and ready-to-use data and tools** between research institutions, government agencies, water authorities and general users (**open-data and interoperability**) 
- To **communicate the information** to decision makers and other stakeholders in a **timely** manner and **appropriate formats** 

TO WHOM

.....

MULTI-USER OPERATIONAL SERVICE

Water authorities



Decision makers



**Drought
Climate Service**



Farmers



Researchers



Stakeholders

- ✓ Continuously updated information / Timely Dissemination
- ✓ Expandable and on-demand service
- ✓ Appropriate products / instruments supply (not simple data sharing!)

PRIORITIES AND USER NEEDS

.....

PARTICIPATORY APPROACH

Local, regional, national and international users can ask at any time updated information more useful for their assessments or their further investigations, and even in other geographical areas covered by the available datasets.

HOW

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IMPLEMENTATION OF CLIMATE SERVICE

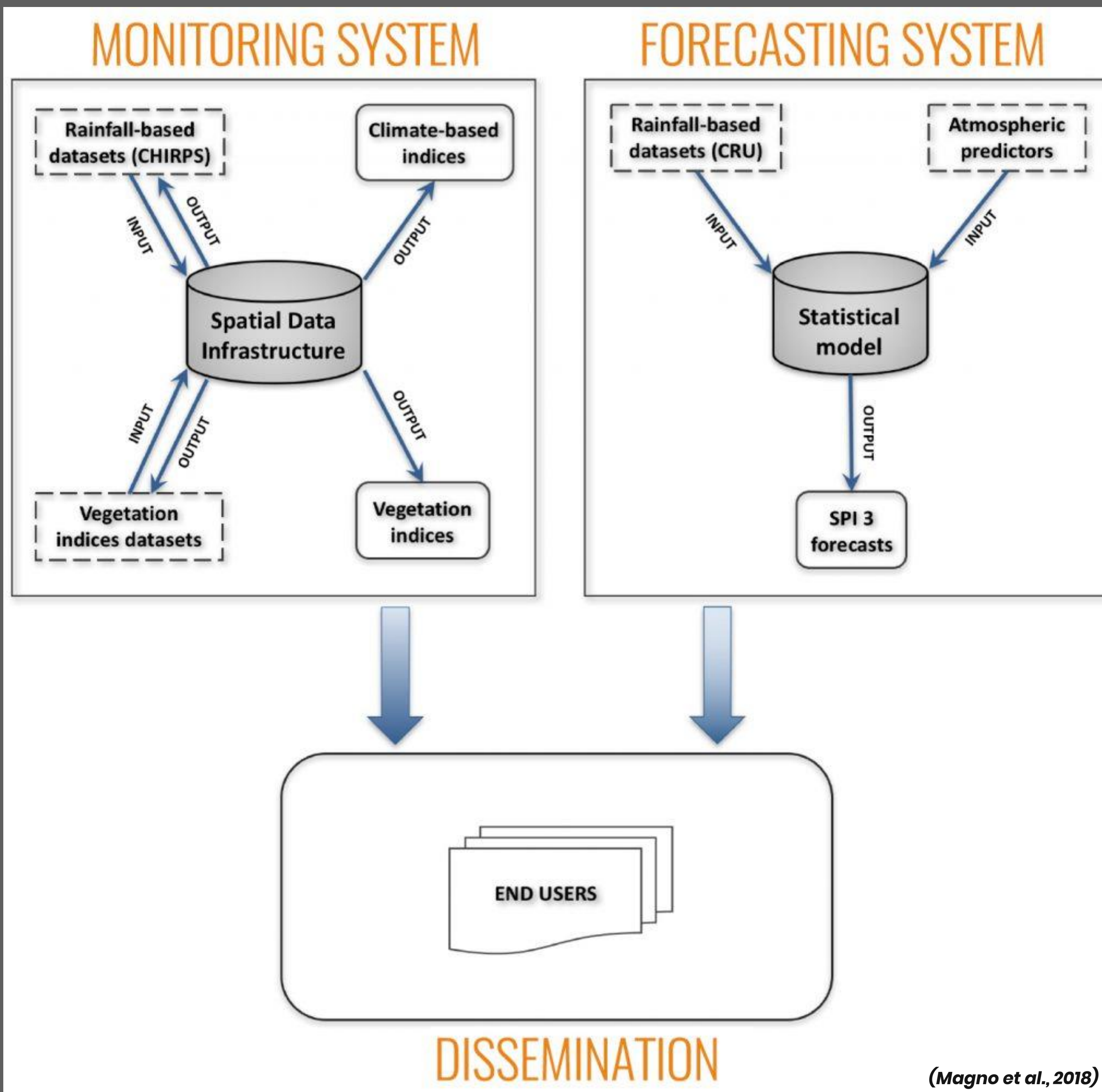
- **Spatial Data Infrastructure**
- Open Data
- Open Source
- Interoperability
- Standardization
- Customization
- Semi-automatic / automatic updating and elaboration

OPERATIONAL CHAIN

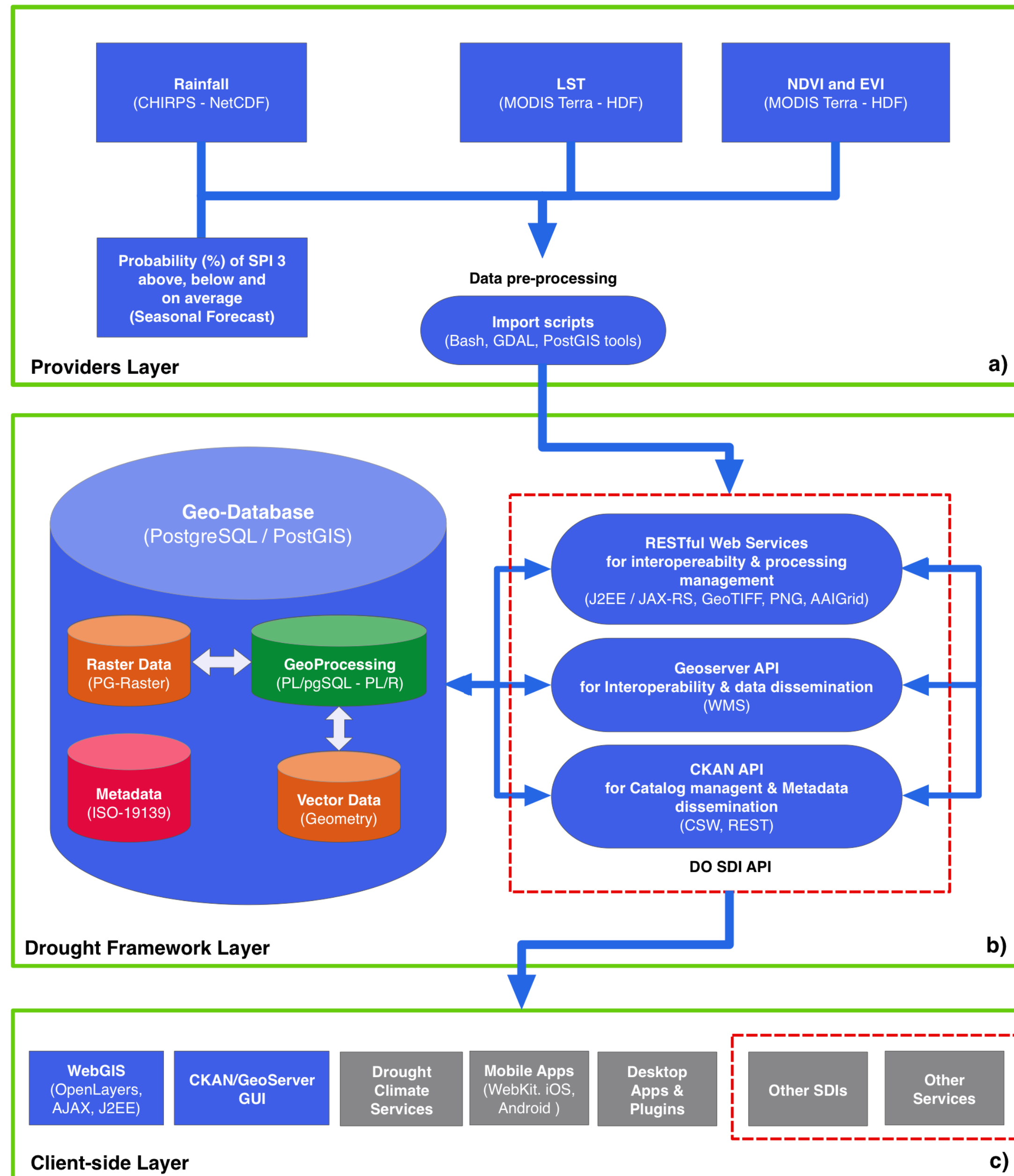
.....

Components of the Drought Climate
Service operational chain.

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



SDI – Spatial Data Infrastructure



Geoinformatic developer: l.rocchi@ibimet.cnr.it

SPATIAL DATA INFRASTRUCTURE


.....

- ✓ The **SDI** built to support the DCS responds to some fundamentals **requirements**: research data openness, interoperability, standardization, flexibility/customization, scalability, responsiveness and specific user needs.
- ✓ Our user-oriented and process-based DCS SDI is focused on the **best use of** climate and environmental **data** for drought assessment and **their translation in information**, instead of simple data sharing.

- ✓ Open
- ✓ Interoperable
- ✓ Customizable

DROUGHT OBSERVATORY

(Magno et al., 2018)



DROUGHT OBSERVATORY
CNR IBIMET CLIMATE SERVICES

THE SYSTEM

SDI ARCHITECTURE

SERVICES

CONTRIBUTIONS


Clear URL Cache


Clear Cache

Ciao, Ramona Magno

DROUGHT TEAM

CONTACT






OPEN DATA

Through CKAN and GeoServer, a complete catalog is supplied to publish data and metadata in several formats and standard protocols. Spatial data are discovered and ready to be reused by any third-party client applications, guaranteeing the integration of this climate data with other information types.


Click here



WEB GIS

A WebGIS application based on open source solutions has been customized in order to integrate different datasets and share maps of drought indices with researchers, decision makers and other stakeholders.


Click here



MONTHLY UPDATES

On the LaMMA Website monthly updates on Tuscan drought current and future conditions and local impacts are available, including press release. From the web page is also possible to access to the archive of monthly bulletins.


Click here



RESTful APIs

The RESTful web service allows to integrate any client application data from the Drought Observatory Spatial Data Infrastructure. The RESTful APIs developed are made available on the GitHub platform.


Click here



USER SURVEY

A survey is available to collect suggestions and needs from different users and to improve the effectiveness of operational services.

Click here



GLOSSARY

A selected list of drought related keywords taken from acknowledged glossaries: EarthLabs, Intergovernmental Panel on Climate Change (IPCC), National Drought Mitigation Center (NDMC).

Click here

- ✓ Web Services
- ✓ Standard catalog CKAN
- ✓ WebGIS Application
- ✓ Bullettins

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

<https://drought.climateservices.it/>

DOWNLOADING

The downloading is possible through GET HTTP calls that get back data from the geoDB, using a URL composed by a fixed part and a variable one.

The fixed part (BASE_URL)

`http://149.139.16.84:8080/dgws/api/download`

The variable part is composed by three different parameters: image format, image type, period.

Image format	Image type (parameter or index)	Period
<ul style="list-style-type: none">• <i>png</i>• <i>gtiff</i>• <i>aaigrid [coming soon]</i>• <i>wms [coming soon]</i>	<ul style="list-style-type: none">• <i>tci</i>• <i>vci</i>• <i>vhi</i>• <i>evhi [coming soon]</i>• <i>spi3</i>• <i>spi6</i>• <i>spi12</i>	<ul style="list-style-type: none">• <i>year</i> (year of reference)• <i>month</i> (month of reference)• <i>day</i> (day of reference)• <i>doy</i> (Julian day)

Syntax to download the whole image

The *day* specification is compulsory, even if we want to download monthly, weekly and two-weekly indices. The PNG images are classified, whereas the GTIFF images are saved in real.

`BASE_URL/j_get_whole_{image_format}/{image_type}/{year}/{doy}`

`BASE_URL/ j_get_whole_{image_format}/{image_type}/{year}/{month}/{day}`

- ✓ Open
- ✓ Interoperable
- ✓ Customizable


DROUGHT
OBSERVATORY

(Magno et al., 2018)

- ✓ Web Services

https://drought.climateservices.it/


- ✓ Open
- ✓ Interoperable
- ✓ Customizable



DROUGHT OBSERVATORY
CNR IBIMET CLIMATE SERVICES

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Vegetation

Followers

0

Datasets

312

Organizations

CNR - IBIMET (312)

Groups

Remote Sensing (312)

Vegetation (312)

VCI (208)

VHI (104)

Tags

drought (312)

Datasets

Activity Stream

About

312 datasets found

Order by: Relevance

VHI - 2017/10/16

VHI - Vegetation Health Index derived from the combination of VCI and TCI Indices

GeoTIFF

PNG

AAIGrid

WMS

VHI - 2017/09/30

VHI - Vegetation Health Index derived from the combination of VCI and TCI Indices

GeoTIFF

PNG

AAIGrid

WMS

VHI - 2017/09/14

VHI - Vegetation Health Index derived from the combination of VCI and TCI Indices

GeoTIFF

PNG

AAIGrid

WMS

VHI - 2017/08/29

VHI - Vegetation Health Index derived from the combination of VCI and TCI Indices

GeoTIFF

PNG

AAIGrid

WMS

DROUGHT OBSERVATORY

(Magno et al., 2018)

- ✓ Standard catalog CKAN

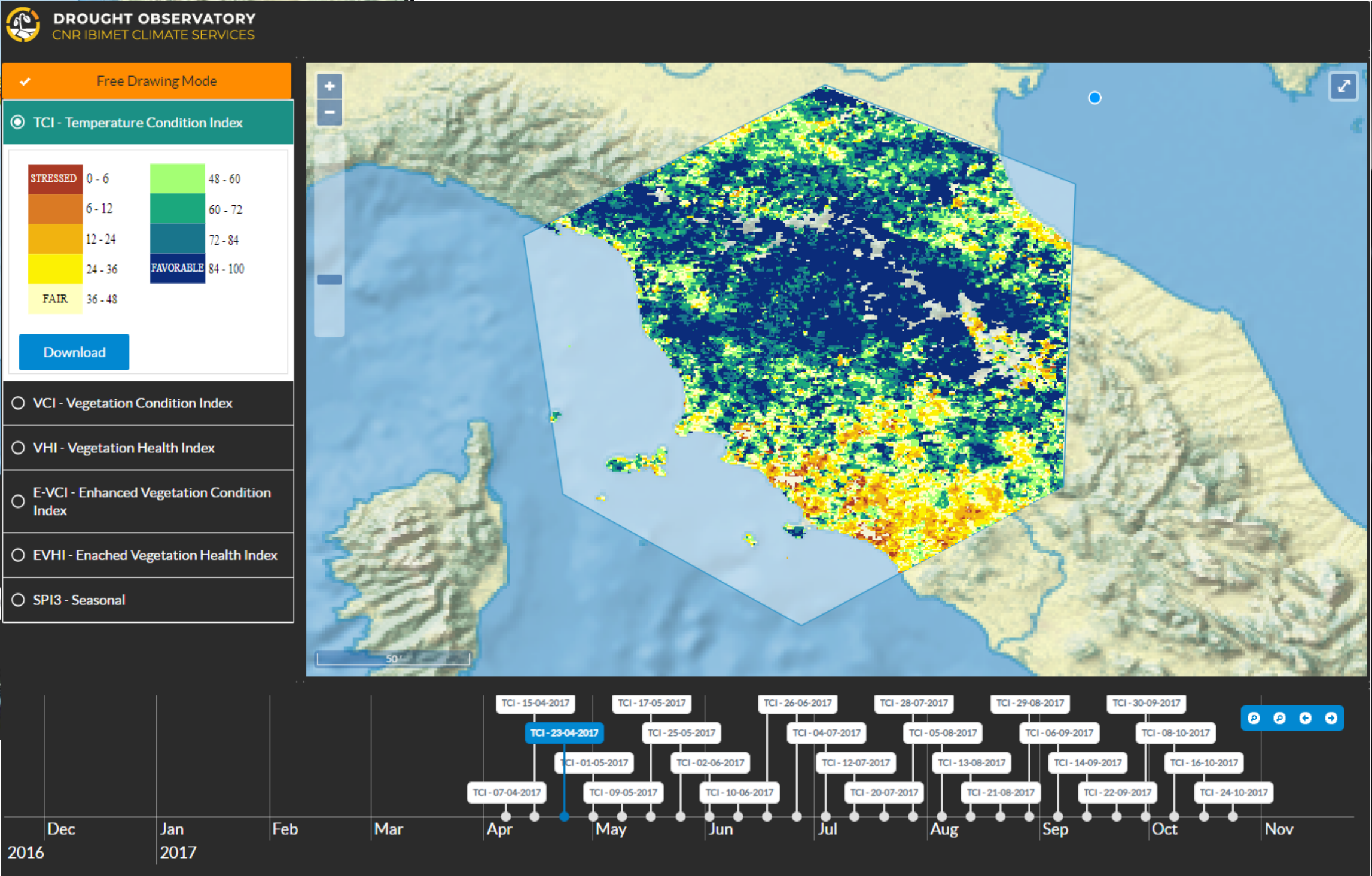
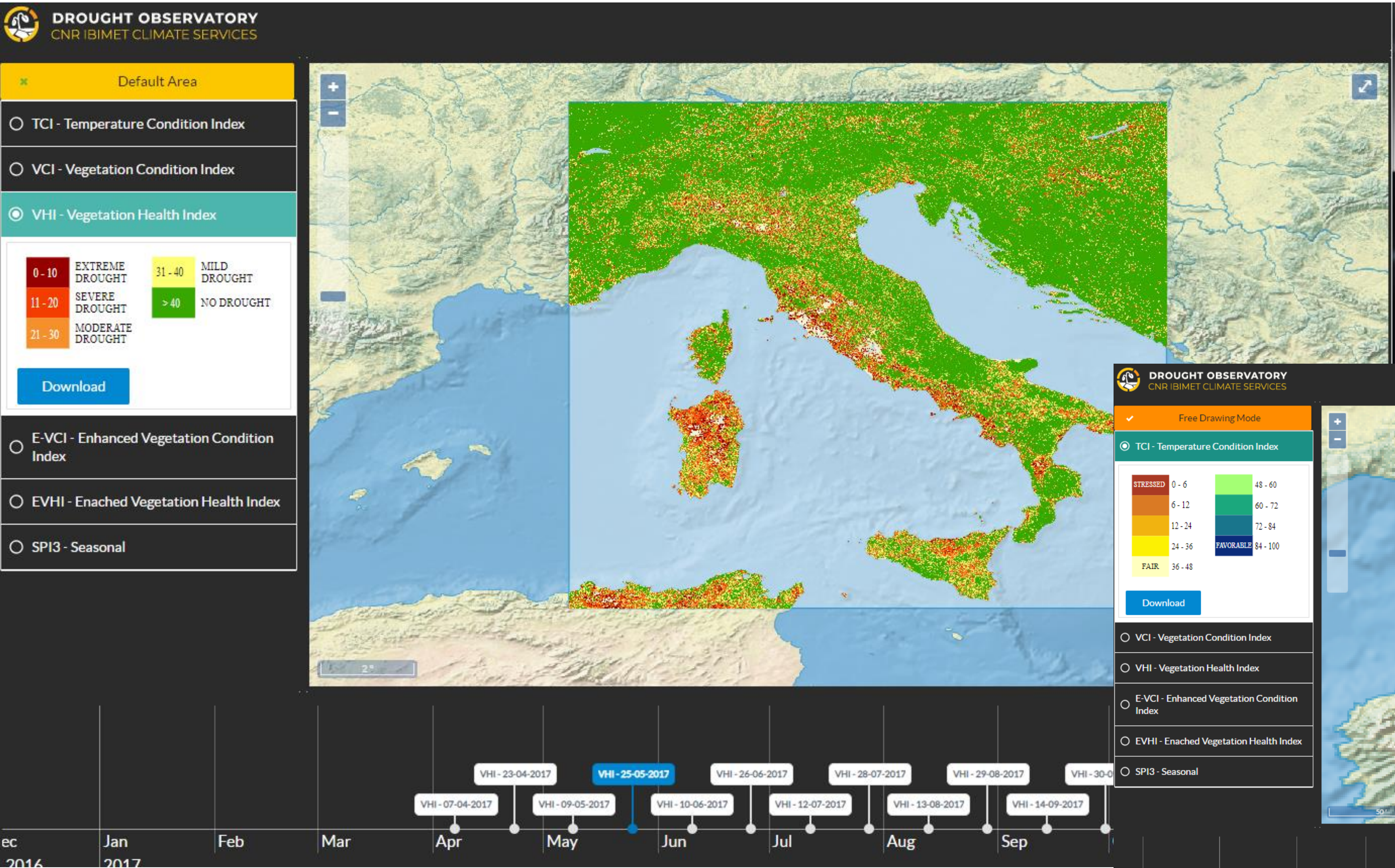
<https://drought.climateservices.it/>

- ✓ Open
- ✓ Interoperable
- ✓ Customizable

DROUGHT OBSERVATORY

(Magno et al., 2018)

✓ WebGIS Application



<https://drought.climateservices.it/>

- ✓ Open
- ✓ Interoperable
- ✓ Customizable

DROUGHT OBSERVATORY

(Magno et al., 2018)

- ## Bullettins

bollettino siccità per la TOSCANA

Sett.
2012

situazione attuale

Dal punto di vista climatico Settembre è stato un mese di transizione, grazie agli eventi precipitativi più o meno abbondanti occorsi nei primi giorni e nella parte centrale e finale ed alle temperature più miti dell'ultima settimana (dal 21 al 28 Settembre).

Una parte della vegetazione forestale ed agricola arborea è stata in grado di sfruttare questo break e ridurre lo stato di stress nella seconda metà del mese, mentre le formazioni che presentavano le criticità più elevate, continuano ancora a soffrire della prolungata carenza idrica.

Nonostante i miglioramenti, però, la siccità di lungo periodo, che ha raggiunto il culmine a fine Agosto e che tutt'ora

continua come mostrano gli indicatori utilizzati, ha costretto la Regione Toscana a dichiarare il 17 Settembre lo stato di crisi per eccezionali avversità atmosferiche.

Le ultime stime, infatti, indicano che i danni da siccità ed incendi ad essa collegati sarebbero di alcune centinaia di milioni di euro, stime che devono ancora considerare le perdite dei comparti viticolo e olivicolo, ma che indicano una contrazione della produttività dei cereali intorno al 40%, fra il 40 e 50% per le orticole, dal 30 al 40% per la frutta e perdite nel settore zootecnico del 40-50%, imputabili alla mancanza di foraggio fresco.

Il bollettino descrive la situazione del mese appena trascorso, analizzando alcuni indicatori per monitorare la siccità in Toscana. I dati utilizzati per gli indici derivano sia da stazioni meteorologiche a terra (Servizio idrologico regionale, Aeronautica e reti LaMMA), sia da immagini satellitari MODIS.

www - siccità

Per l'aggiornamento quindicinale e per maggiori informazioni sugli indicatori utilizzati visitate le pagine dedicate alla siccità sul sito del Consorzio LaMMA.

Settembre 2012 - sommario

Indici di pioggia pp 2-5

Anomale di pioggia; indice SPI; indice di pioggia efficace (EDI)

Indici da satellite pp 6-7

Anomale indice di attività fotosintetica (NDVI); Stato di salute della vegetazione (VHI)

Focus pp 8-9

Agricoltura: vigneti e oliveti; Foreste

Previsioni 3 mesi pp 10-11

Temperature, piogge e indice SPI

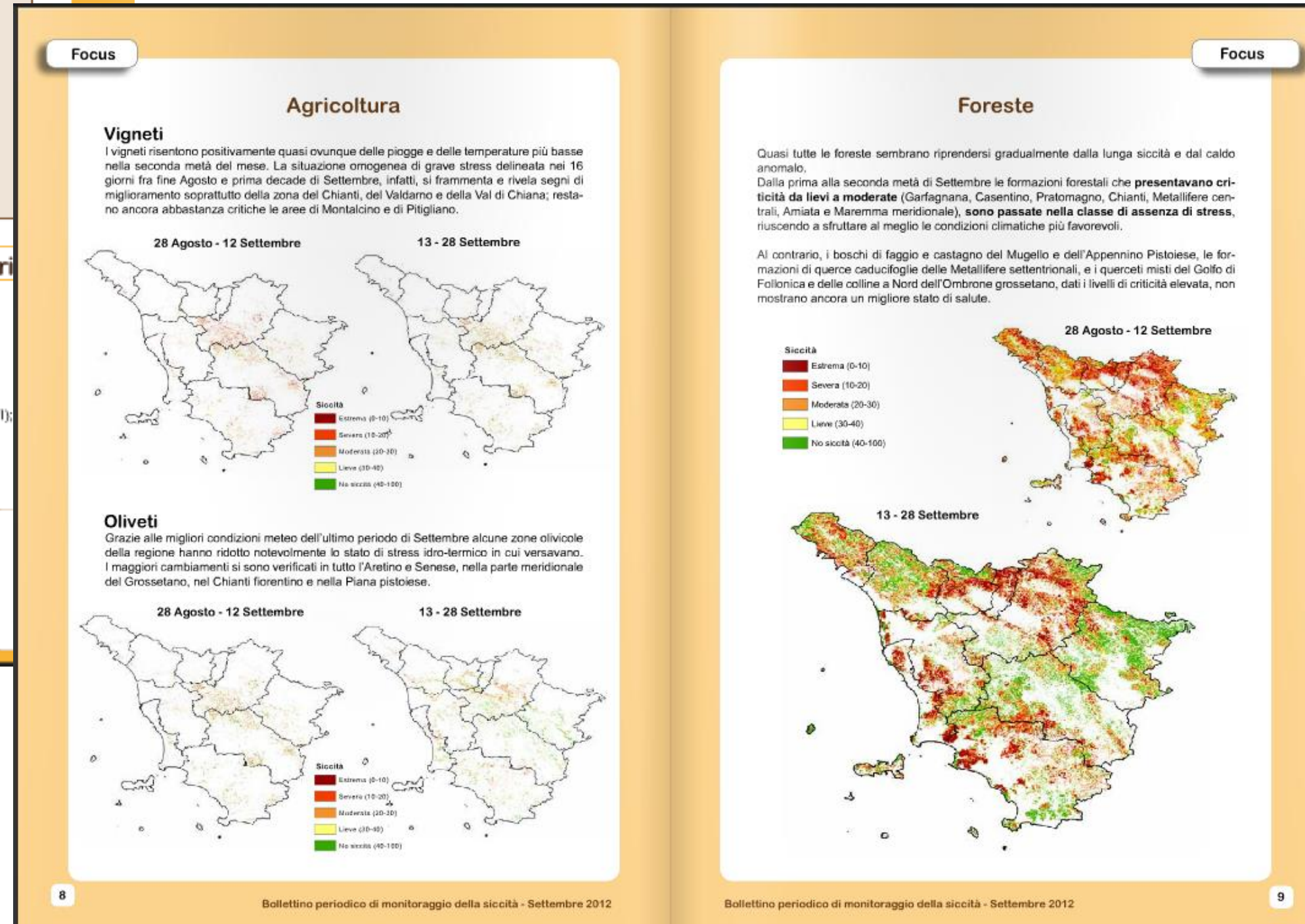
Focus

Vig
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Previous month
recap and
forecasts of next
months.

Analysis of forests and main crops condition (spring/summer).



On-line visualization
and downloadable version

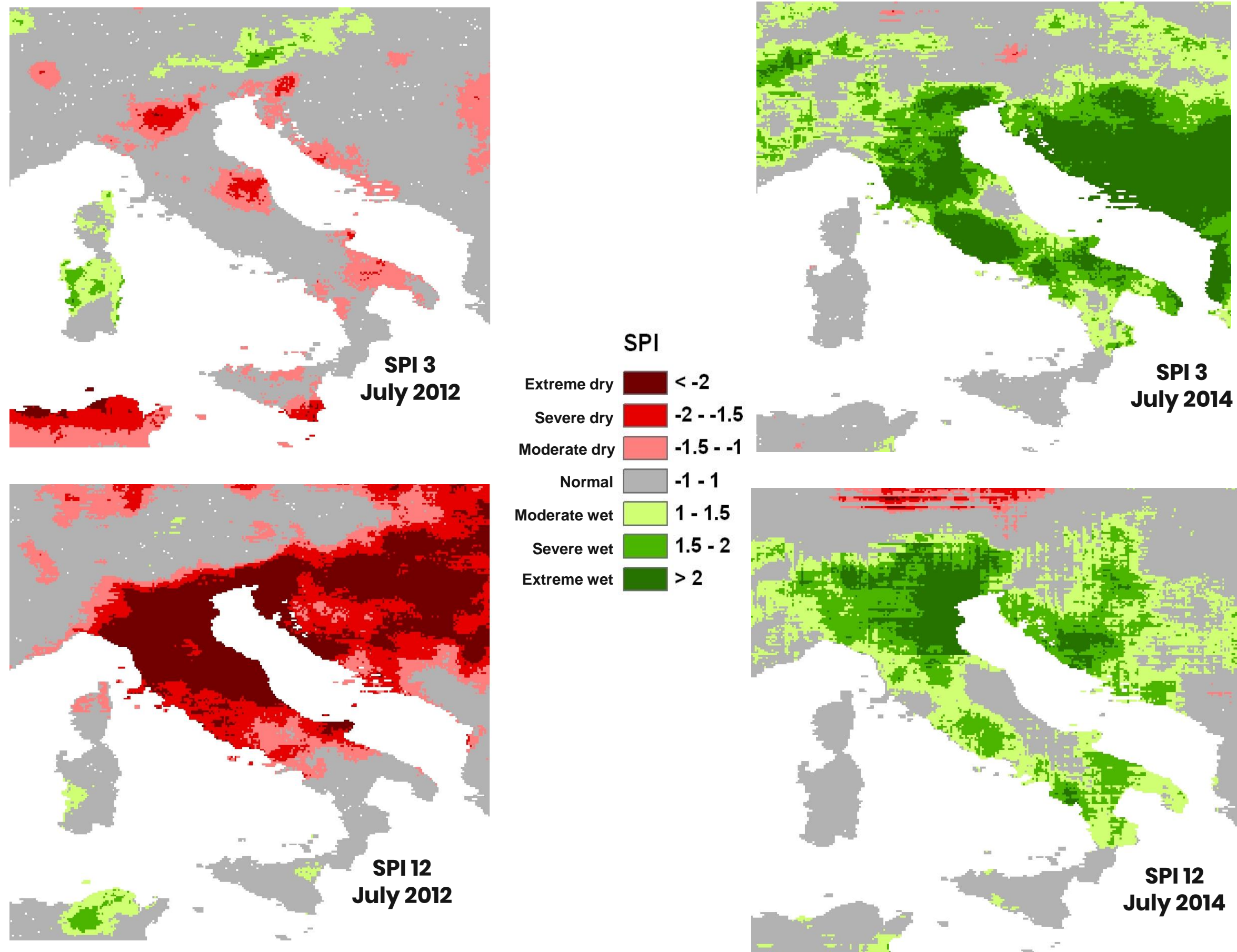
<https://issuu.com/consorziolamma>

WHAT

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MONITORING AND FORECASTING

- Remote sensing
- Precipitation & Vegetation
- Multiple indices
- Near-real time computation
- Long and continuous time series of main parameters



CHIRPS (*Climate Hazards Group InfraRed Precipitation with Stations*) (Funk et al., 2014)

From daily to annual data; resolution 0.05° ; from 50N to 50S; available from January 1981.

Three main types of information :

- (1) global 0.05° precipitation climatologies (datasets: GHCN, GSOD, GTS, national, regional)
- (2) time-varying grids of satellite-based precipitation estimates,
- (3) in situ precipitation observations.

MONITORING



RAINFALL-BASED INDICES

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SPI – Standardized precipitation Index

Monthly dataset;

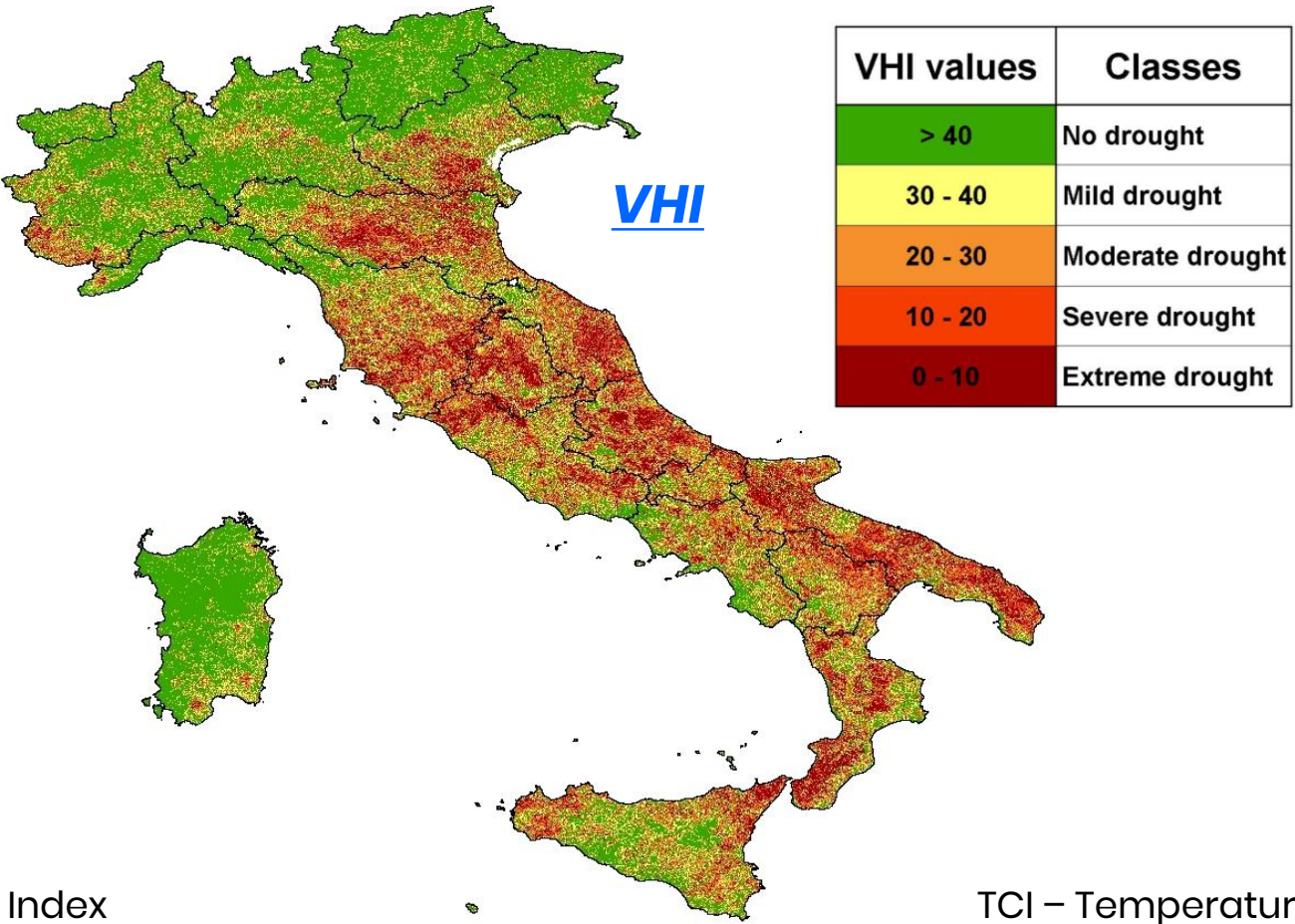
Multi-temporal index (3,6, 12 months);

Long and up-to-date rainfall time series;

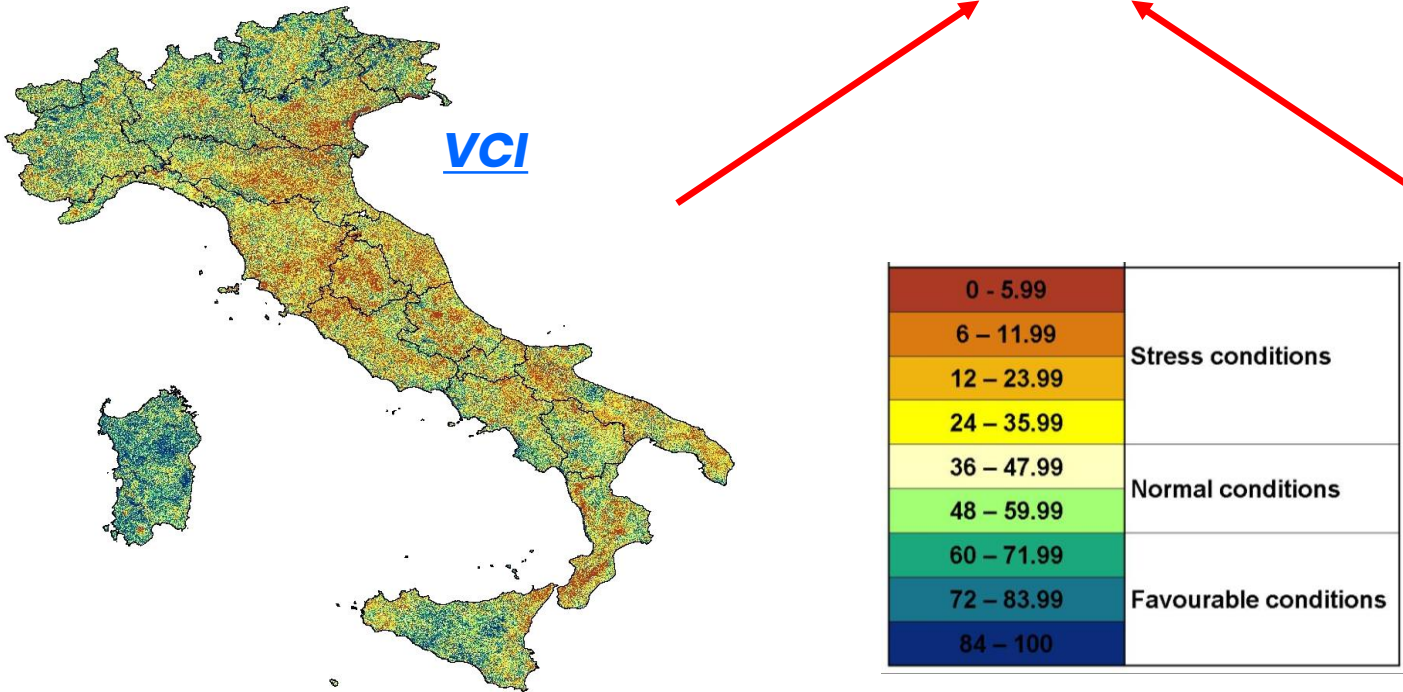
Standardized.

VHI – Vegetation Health Index

$VHI = a * VCI + b * TCI$



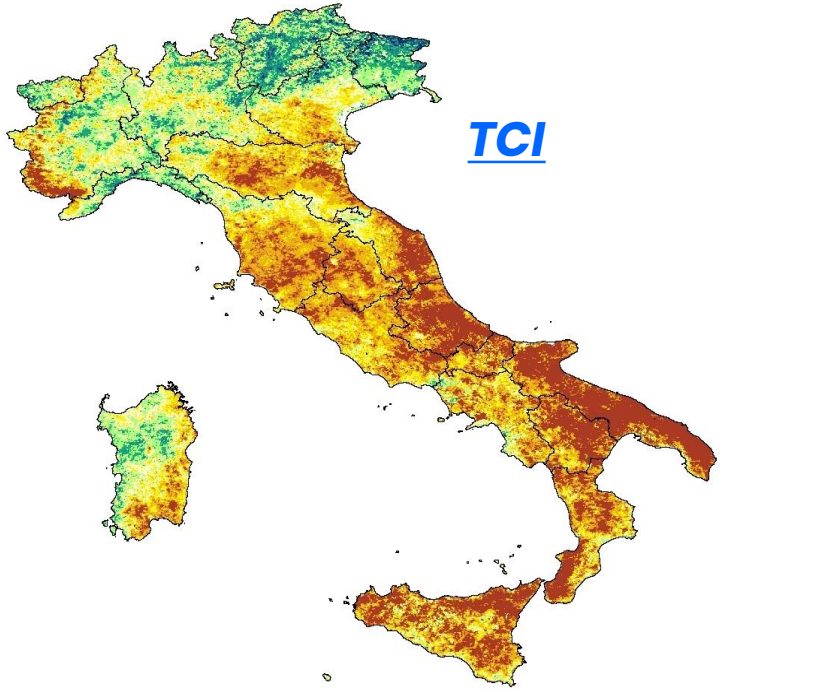
VCI – Vegetation Condition Index



$VCI_i = ((NDVI_i - NDVI_{min}) / (NDVI_{max} - NDVI_{min})) * 100$
(Kogan, 1995)

Terra MODIS 16-day smoothed EVI & NDVI products, 250m resolution (MOD13Q1)

TCI – Temperature Condition Index



$TCI_i = ((LST_{max} - LST_i) / (LST_{max} - LST_{min})) * 100$
(Kogan, 1995)

Terra MODIS 8-day smoothed LST images, 1 km resolution (MOD11A2)

MONITORING



REMOTE SENSING INDICES

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VHI – Vegetation Health Index

Combination of two indices (TCI and VCI) that monitor temperature and moisture impacts on vegetation.



Frequent and detailed spatial information



Application in periods with less cloud cover

October 2018

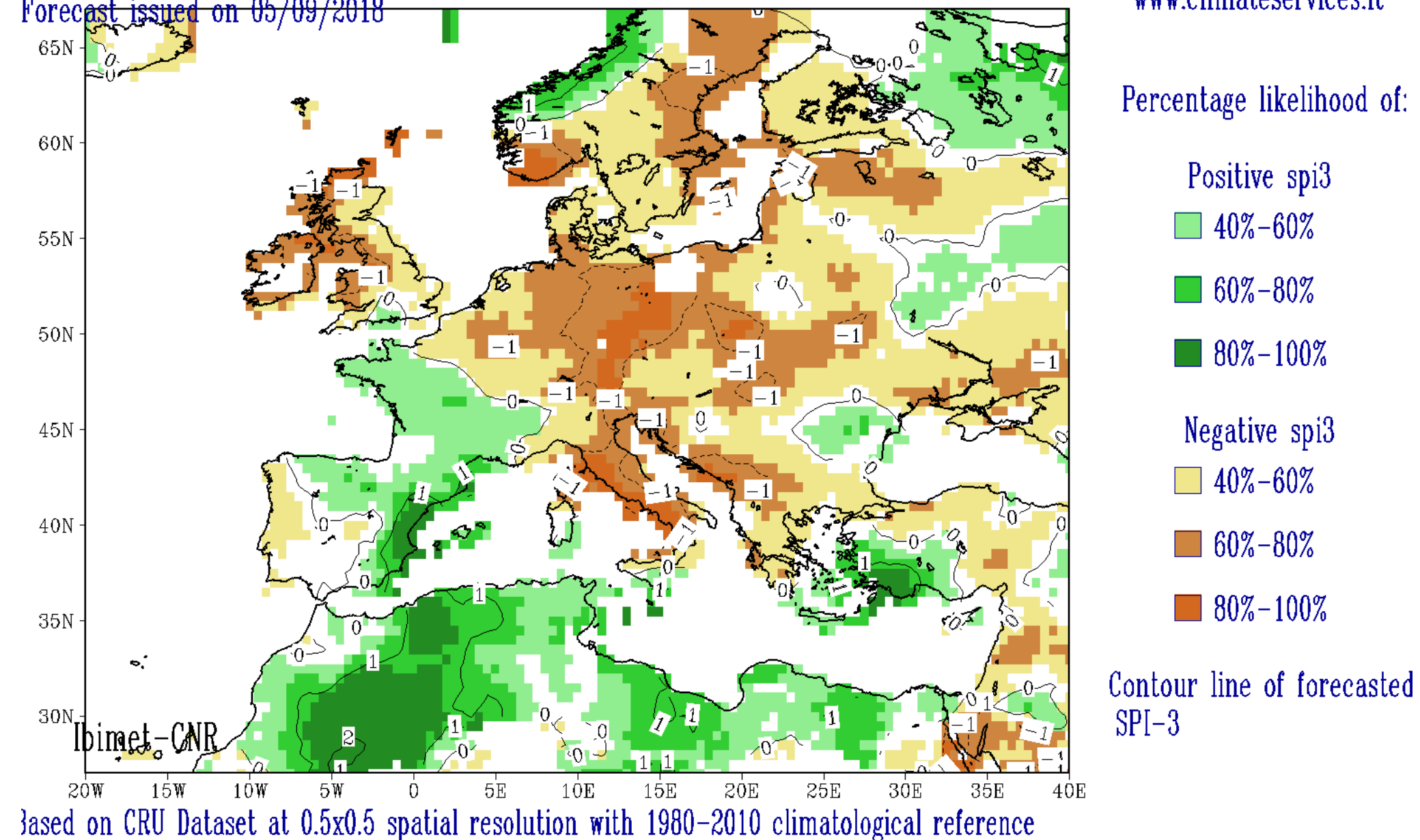
Most likely category for SPI-3months [CRU Dataset]

Forecast issued on 05/09/2018

Ibimet-CNR Seasonal Forecast

multi-regressive model

www.climateservices.it



Authors: m.pasqui@ibimet.cnr.it

e.di.giuseppe@ibimet.cnr.it

- First phase (***selection of predictors***): double step procedure to select the best MR model in terms of predictive performance, i.e. which are the large scale atmospheric drivers (and their lags) to use as predictors for SPI3.
- Second phase (***estimation of parameters***): estimate the value of MR parameters that reproduce the linear relation between SPI3 and each driver selected at 1).
- Third phase (***extrapolation***): use the parameter estimates obtained at 2) to predict future SPI3 anomaly.

CRU (*Climatic Research Unit – University of Est Anglia*) (Harris & Jones, 2017)

CRU TS v. 4.00: monthly long data series (1901-2015) of several parameters (min and max temperature, precipitation, etc.); 0.5° spatial resolution.

SEASONAL FORECASTS

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SPI – 3 months forecast (Magno et al., 2018)

Empirical physically-based approach (Multivariate Regression Model) to predict meteorological drought using the SPI 3 index.

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

NEXT STEPS

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NEW INDICES, NEW IMPROVEMENTS

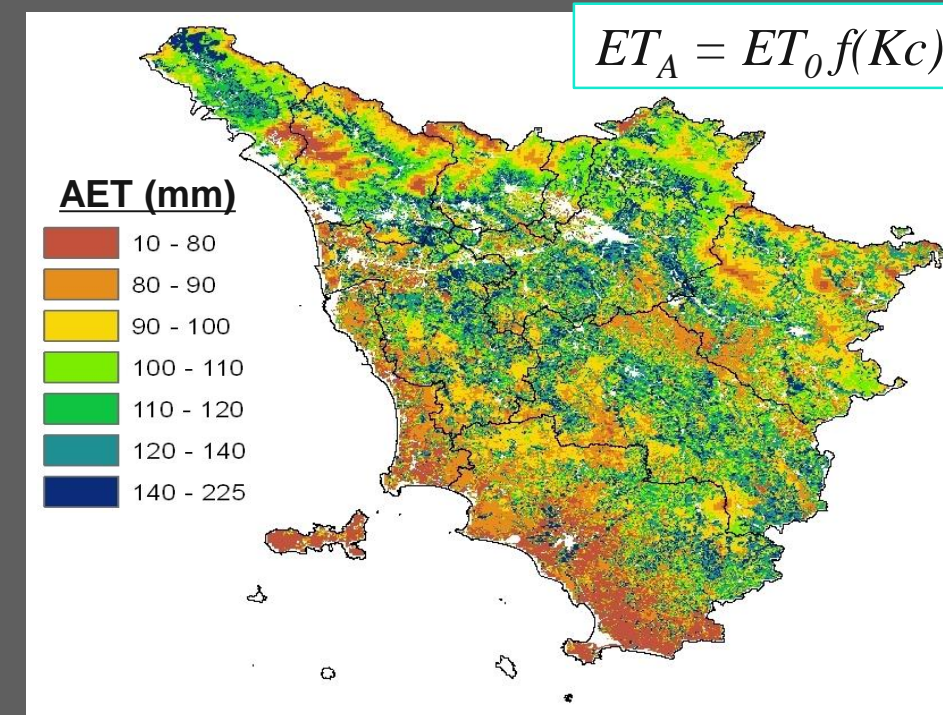
- AET – Actual Evapotranspiration
- Soil Moisture

 Soil moisture

 AET – Actual Evapotranspiration

Separation of Evaporation and Transpiration processes.

Inclusion of short term water stress (Cws & AW).



$$AET = ET_0 (FVC * Kc_{veg} * Cws + (1 - FVC) * Kc_{soil} * AW)$$

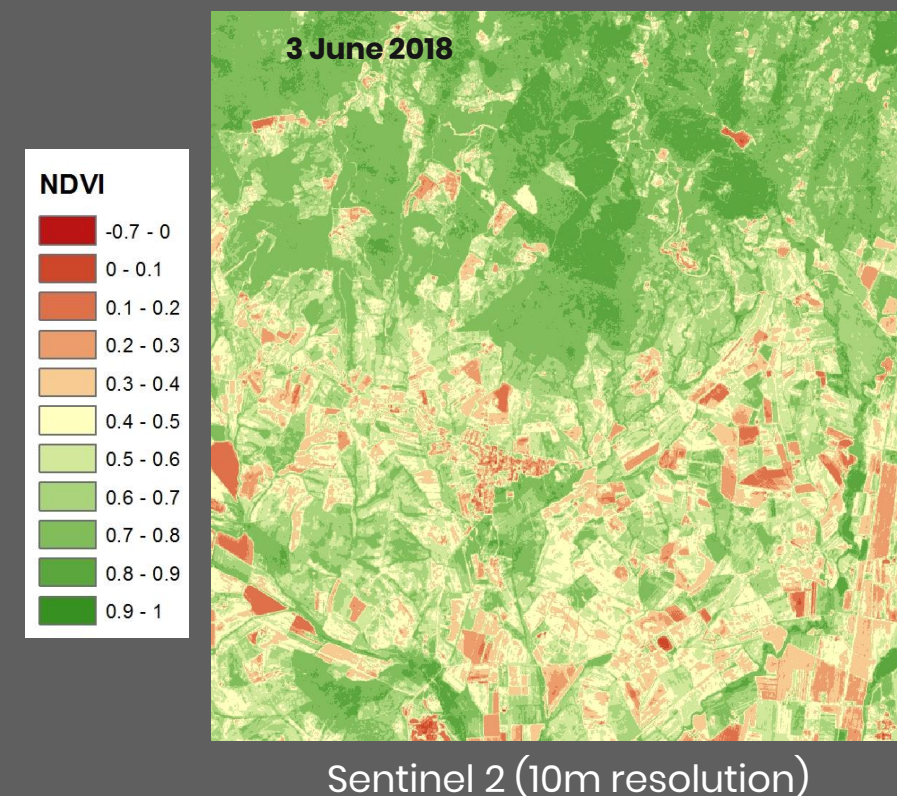
(Chiesi et al., 2013; Maselli et al., 2014)



Downscaling for on-demand analysis at local level



Implementation of new indices based on high resolution satellite data



NEW INFORMATION

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Ongoing collaborations for sharing information at different levels and for specific needs (from precision agriculture to regional/national drought monitoring).

Help us to improve the Drought Observatory for Climate Services:

<https://drought.climateservices.it/survey/>

Get Connected

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