



CLIMATE SERVICE FOR MONITORING AND FORECASTING DROUGHTS

Ramona MAGNO
(LaMMA Consortium; IBIMET-CNR)



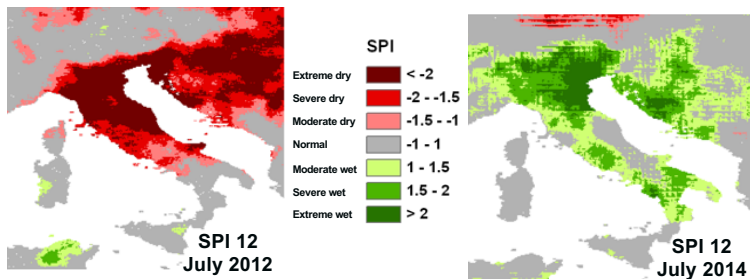
CONSORZIO

LaMMA

RAINFALL-BASED INDICES

✓ SPI – Standardized precipitation Index (McKee *et al.*, 1993)

Monthly dataset (Tuscany rain gauges; CHIRPS (Funk *et al.*, 2014))



✓ EDI – Effective Drought Index (Byun & Wilhite, 1999)

Daily dataset;

Long and up-to-date rainfall time series;

Standardized.



REMOTE SENSING INDICES



Frequent and detailed spatial information



Application in periods with less cloud cover

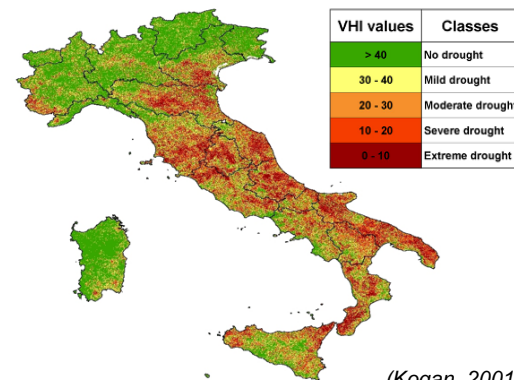


VHI – Vegetation Health Index

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

MODIS_LST: 8 days, 1 km

MODIS_NDVI: 16 days, 250 m



(Kogan, 2001)

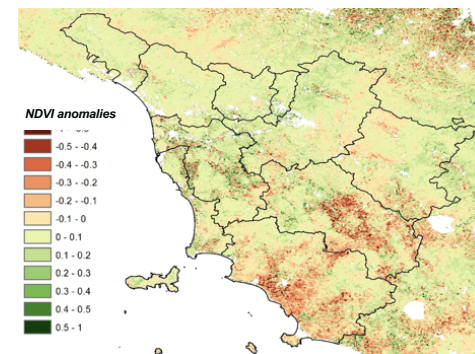
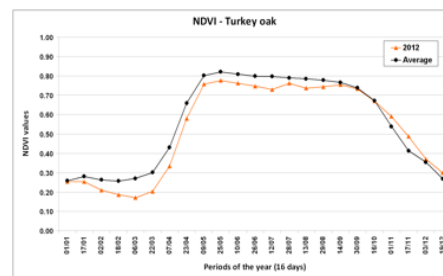
$$VHI = a * VCI + b * TCI$$



NDVI – Normalized Difference Vegetation Index

It characterizes greenness and vigor and, indirectly, the chlorophyll and moisture contents.

Multi-temporal profiles for growing season dynamics/anomalies.





SPI - 3 months (Magno et al., 2018)

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

3 phases replicated for each grid cell of the spatial domain: 1) selection of predictors; 2) estimation of parameters; 3) extrapolation.

- First phase: 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: estimate the value of MR parameters that reproduce the linear relation between SPI3 and each driver selected at 1).
- Third phase: use the parameter estimates obtained at 2) to predict future SPI3 anomaly.

December 2017

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

Forecast issued on 17/10/2017

Ibimet-CNR Seasonal Forecast

multi-regressive model
www.climateservices.it

Percentage likelihood of:

Positive spi3

40%-60%

60%-80%

80%-100%

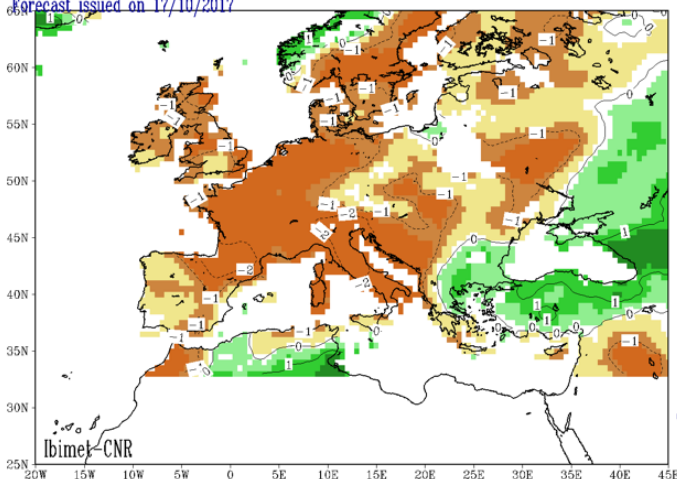
Negative spi3

40%-60%

60%-80%

80%-100%

Contour line of forecasted SPI-3



Based on CRU Dataset at 0.5x0.5 spatial resolution with 1980-2010 climatological reference

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Authors: m.pasqui@ibimet.cnr.it

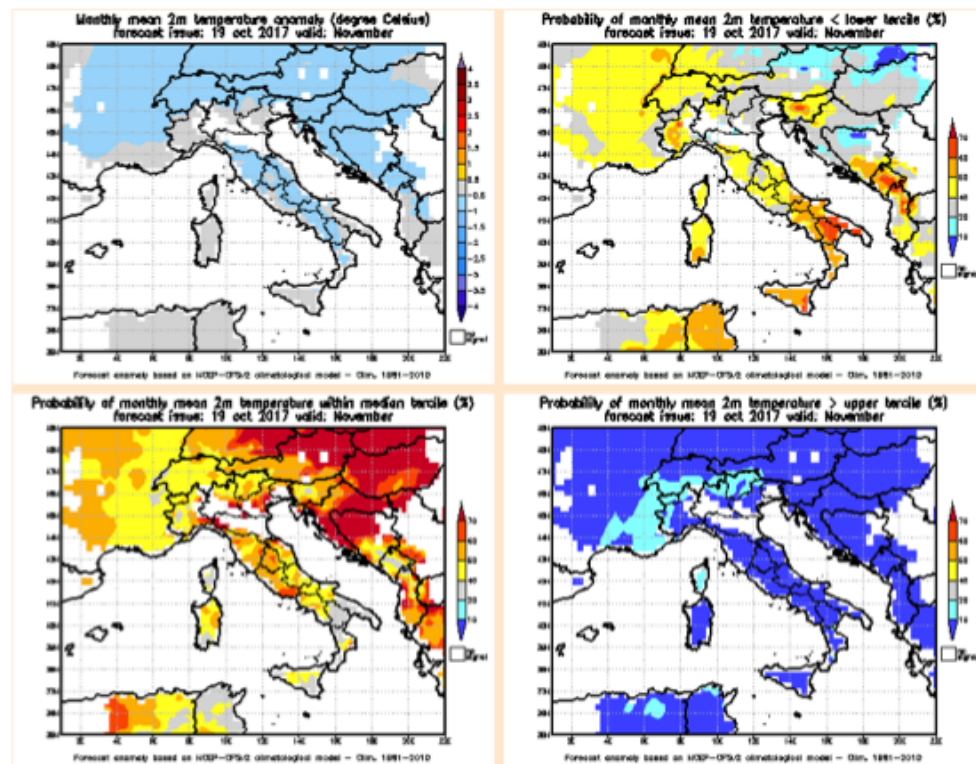
e.di.giuseppe@ibimet.cnr.it



Rainfall and Temperature (Messeri et al., 2017)

Outlook for the next 1-3 months.

Coupled approach: **“Teleconnective” approach**, based on the interpretation of several atmospheric indices; **“Probabilistic” approach** based on circulation type classifications driven by an ensemble global model.



- ✓ Open
- ✓ Interoperable
- ✓ Customizable

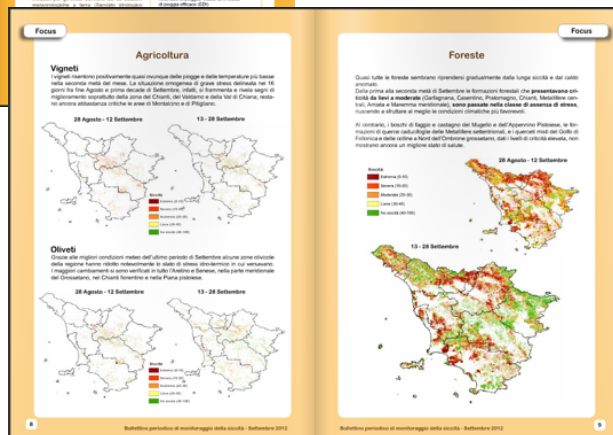
DROUGHT CLIMATE SERVICE

(Magno et al., 2018)

Monthly bulletins - Tuscany


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>


DROUGHT OBSERVATORY
 CNR IBIMET CLIMATE SERVICES

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"> png gtiff aaigrid [coming soon] wms [coming soon] 	<ul style="list-style-type: none"> tci vci vhi evhi [coming soon] spi3 spi6 spi12 	<ul style="list-style-type: none"> year (year of reference) month (month of reference) day (day of reference) doy (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/f_get_whole_{image_format}/{image_type}/{year}/{doy}
```

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

ACTUAL EVAPOTRANSPIRATION

 AET – Actual Evapotranspiration

Estimates based on both in situ and satellite data;

Separation of Evaporation and Transpiration processes;

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

$$AET = ET_0 f(VI)$$

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

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

ET₀ = Estimation by several equations (Jensen and Haise, 1963; Thornthwaite, 1948; FAO paper 56, 1998, etc.)

FVC = Fraction of active vegetation

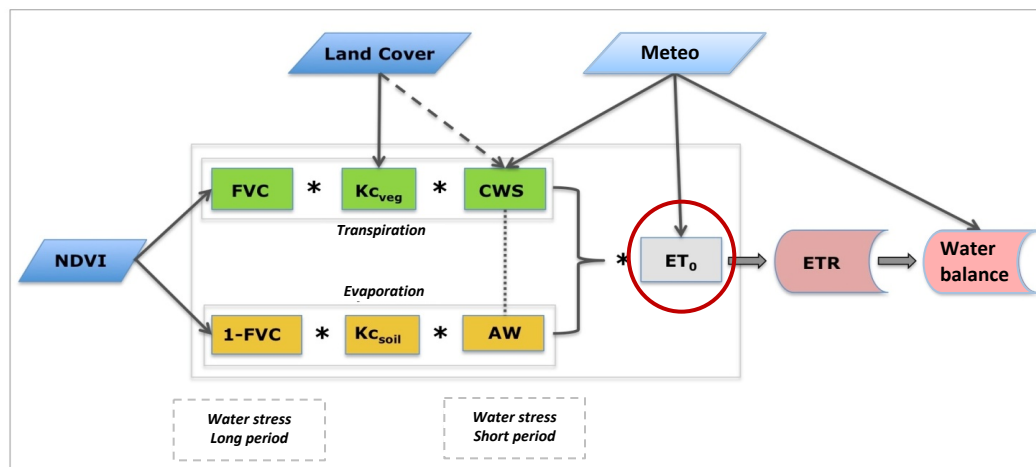
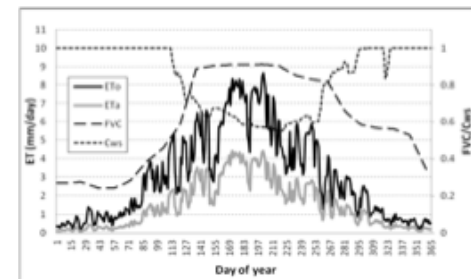
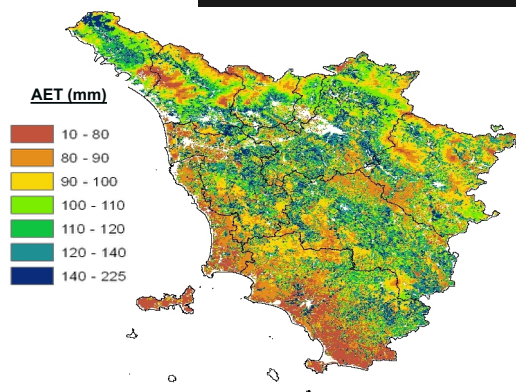
$$FVC = (NDVI - NDVI_{min}) / (NDVI_{max} - NDVI_{min})$$

AW = Available Water (P/ET_0) $AW=1$ per $P > ET_0$

Cws = Coefficient of water stress

$$Cws = 0.5 + 0.5 AW$$

Biome type	K _{Cveg}	Cws, AW
Forest	0.7	Yes (2 months)
Grassland	1.2	Yes (1 month)
Annual crop	1.2	Yes (1 month) during months 1–5 and 10–12. No during months 6–9 if FVC > 0.6 = irrigation
K _{Csoil}	0.2	




Get Connected

Ramona Magno

LaMMA Consortium; IBIMET-CNR

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 +39
4483041

 magno@lamma.rete.toscana.it
r.magno@ibimet.cnr.it

 Via Madonna del Piano, 10
50019 - Sesto Fiorentino (FI) - Italy
<http://www.lamma.rete.toscana.it/siccita-situazione->

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<https://climateservices.it/>