SOUTH EAST EUROPE
Transnational Cooperation Programme

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

Drought Monitoring Process

and DMCSEE solutions

Gregor Gregorič
Slovenian Environmental Agency

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DMCSEE Final Conference
14 – 15 May 2012

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Contents

- Concept of drought monitoring
- DMCSEE - Implemented drought indices and indicators
- Application of Numerical Weather Prediction models
- Future directions

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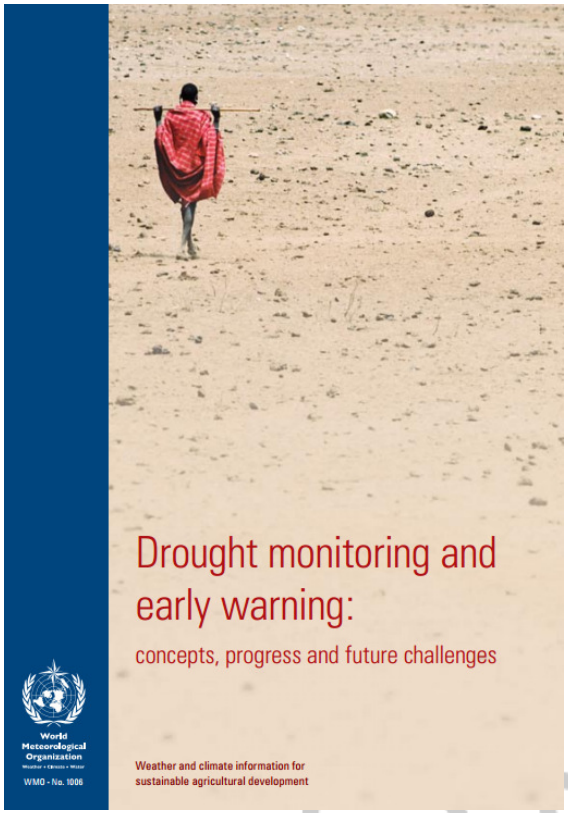
Drought and drought monitoring

" …Drought by itself is not a disaster. Whether it becomes a disaster depends on its impact on local people, economies and the environment and their ability to cope with and recover from it."

" … comprehensive drought monitoring system that can provide early warning of drought's onset and end, determine its severity and deliver that information to a broad clientele in many climate- and water-sensitive sectors in a timely manner. With this information, the impacts of drought can be reduced or avoided in many cases. "



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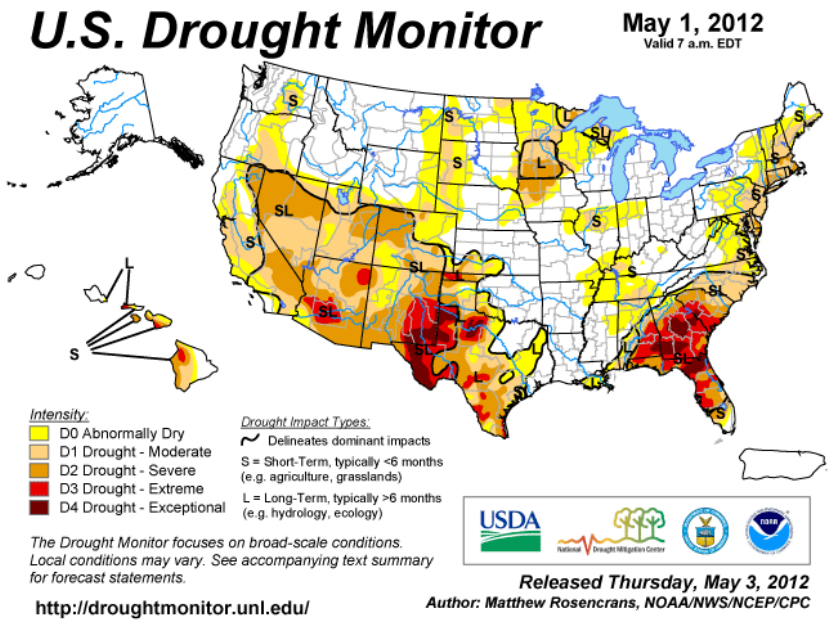
Example of drought monitoring system

US Drought Monitor:

- Blend of indicators (PDSI, SPI, streamflow and soil moisture percentiles)
- Impact oriented (drought type distinction, “reality check”)



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DMCSEE – implemented drought indices

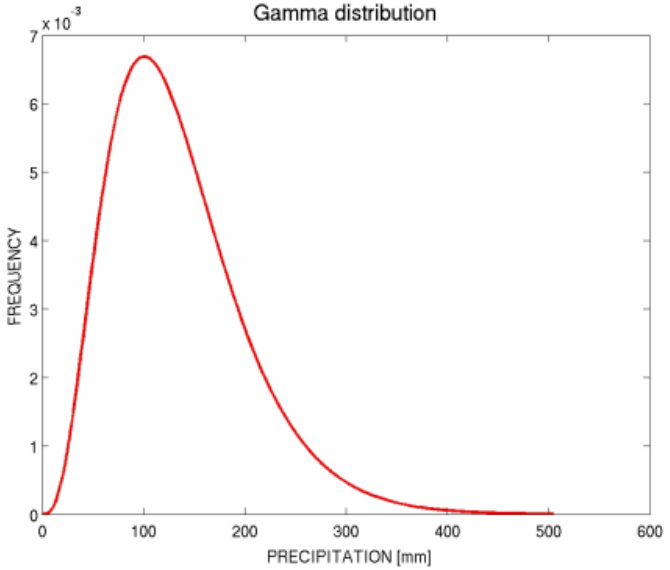
Meteorological drought: **Standardized precipitation index**
Application of NWP models

Agricultural drought: **Palfai drought index**
Application of irrigation scheduling software

Dissemination of products

Standardized precipitation index

- Standardized departure of precipitation amount in chosen time period from “normal” conditions:
  - Transformation to standardized normal distribution (0 mean and 1 std. deviation)
  - Special treatment of case when precipitation amount is zero -> limitation of accumulation length!



Gamma distribution for august precipitation (Ljubljana, 1850 -2005)

Standardized precipitation index

SPI value is "measure of departure of precipitation amount from "normal" conditions in unit of std. deviations"

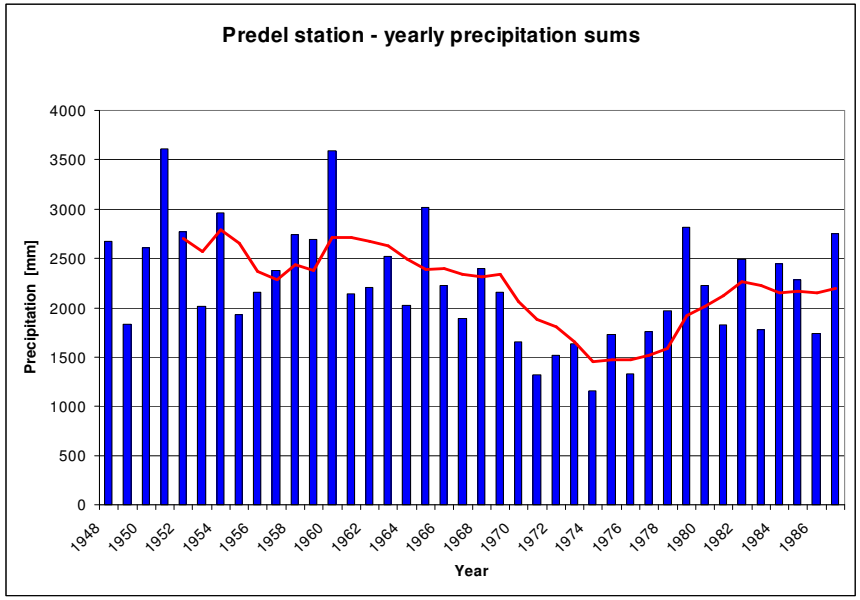
SPI	Classification	Probability (%)
2.00 >	Extremely wet	2.3
1.50 to 1.99	Very wet	4.4
1.00 to 1.49	Moderately wet	9.2
0 to 0.99	Mildly wet	34.1
0 to -0.99	Mild drought	34.1
-1 to -1.49	Moderate drought	9.2
-1.50 to -1.99	Severe drought	4.4
-2.00 <	Extreme drought	2.3

- **SPI advantages:**
  - Simplicity (only rainfall data required)
  - Variable time scale
  - Standardized value (can be applied in different climate regimes -> WMO "Lincoln" declaration!)
- **SPI disadvantages:**
  - "Forced-fitting" of theoretical probability distribution
  - Extreme droughts (over longer period) occur with same frequency on all locations – SPI can't identify drought prone regions
  - Problems with small values

Standardized precipitation index

Implementation within DMCSEE project:

- **Preparation of calibration precipitation data**
  - Choice of calibration period
  - Digitalization and QC
  - Homogenization



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Standardized precipitation index

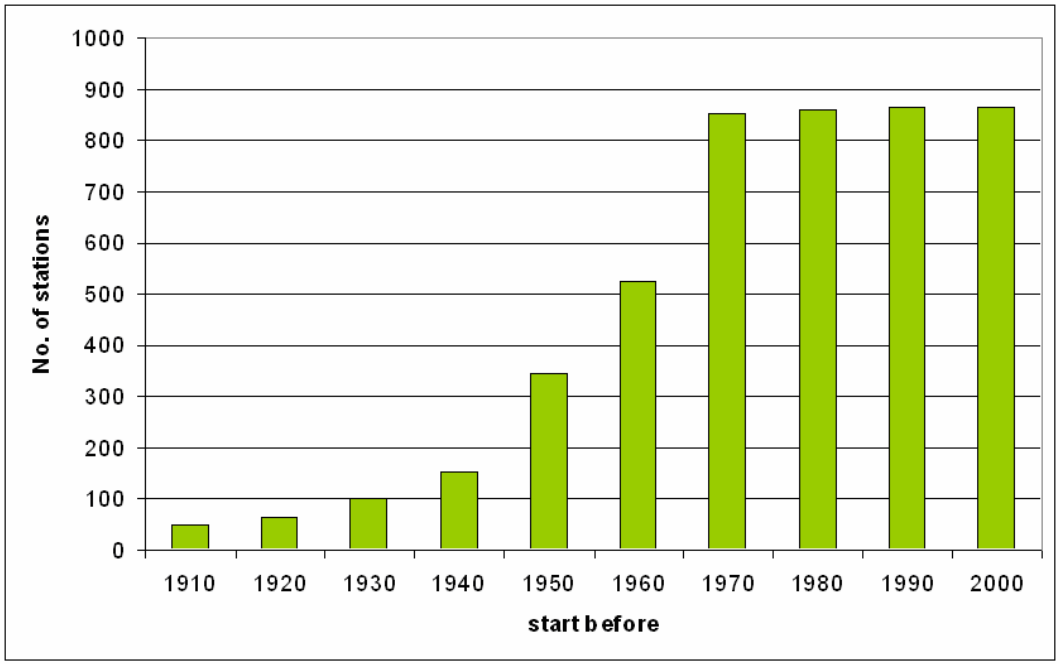
Implementation within DMCSEE project:

- **Preparation of software**
  - Program in C: possibility of daily update
  - Bug found!!
- **Training on climatological mapping**
  - MISH software for spatial interpolation
  - Use of GIS software for preparation of georeferenced maps

Standardized precipitation index

Implementation within DMCSEE project:

- **Decision on calibration period: 1971-2000**



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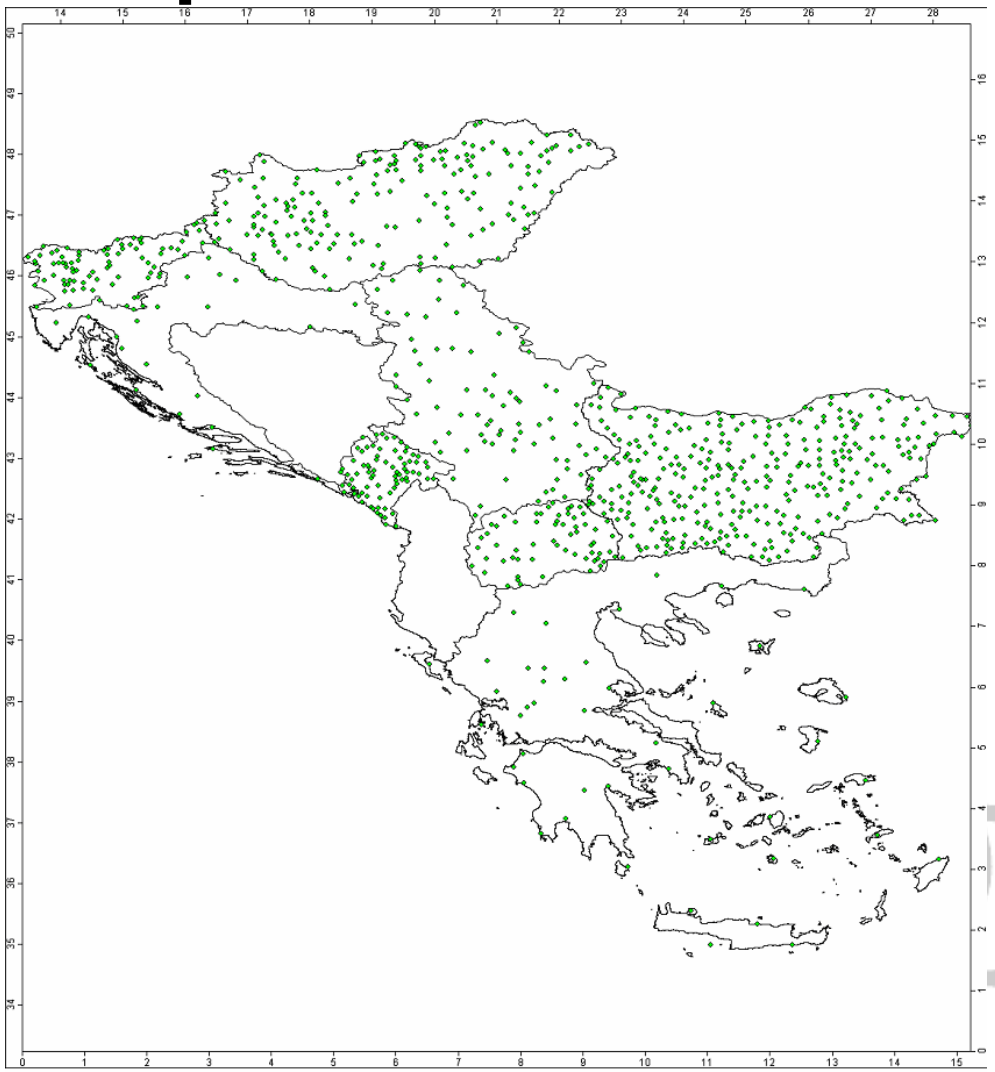
Standardized precipitation index

Implementation within DMCSEE project:

- **Decision on calibration period: 1971-2000**
- **860 stations in partner countries are now prepared for SPI calculations**

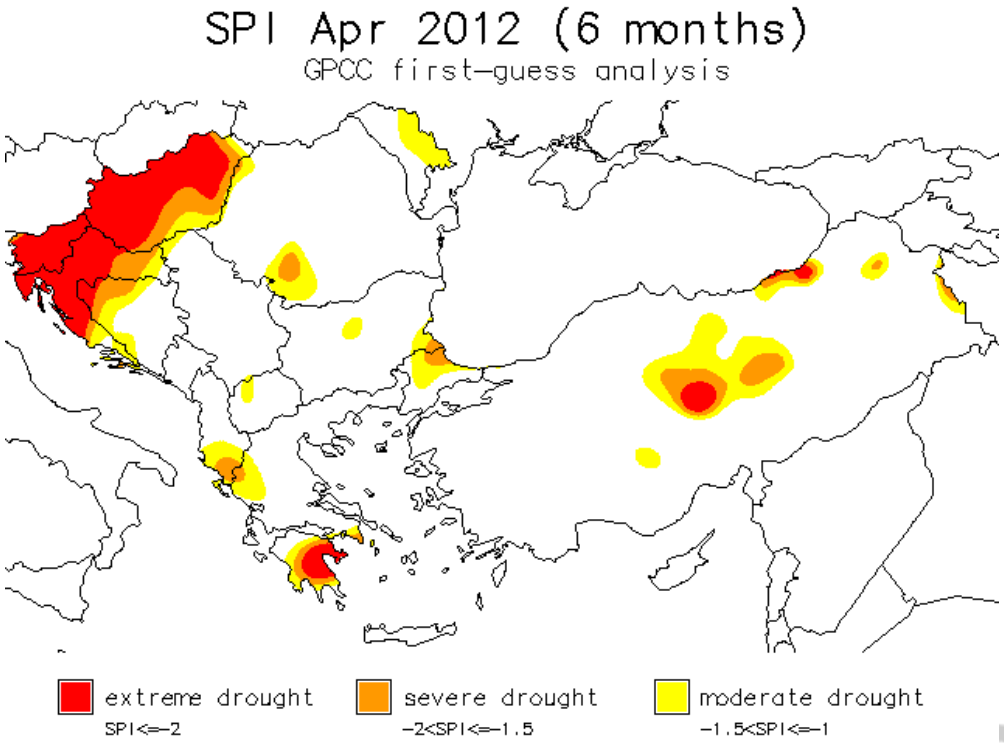


SPI maps

Regional SPI maps are based on Global precipitation climate center (GPCC) data.

First-guess maps are available after 5th day of the next month.

For the period 1951-2000 maps are available on **www.dmcsee.org**



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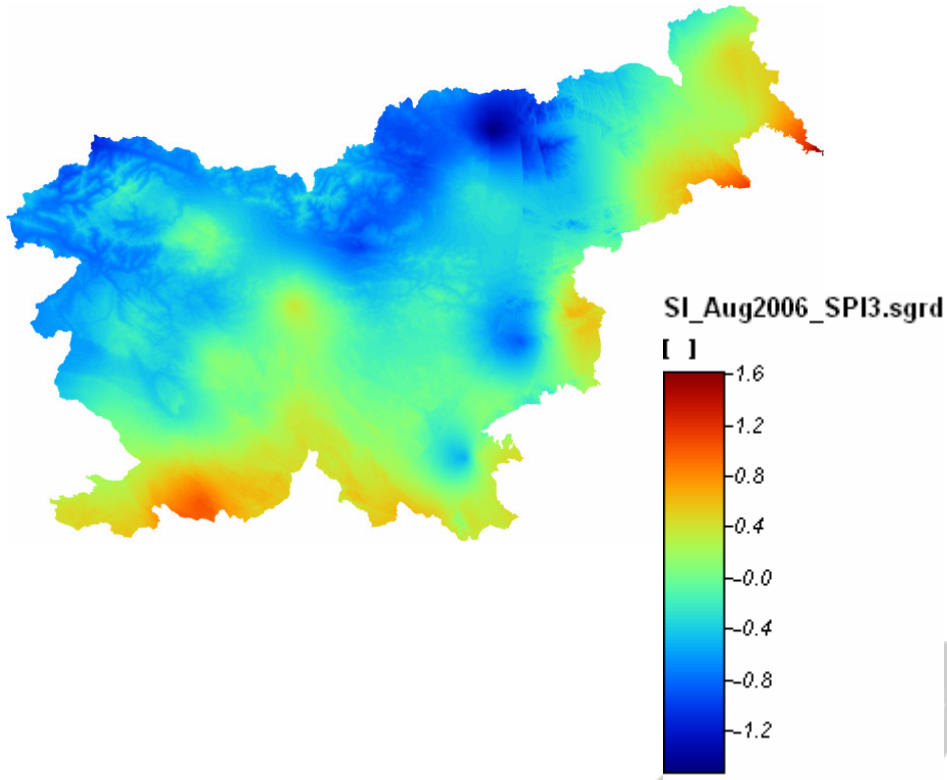
SPI maps

National maps prepared by partners by spatial interpolation (kriging / optimal interpolation)

Output: rasters in georeferenced format

Reached agreement on resolution, size and projection for each partner country



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Agricultural drought

- **Irrigation scheduling optimization tool used for drought monitoring**
  - Water deficit for non-irrigated plants / water needed to avoid unacceptable loses
  - Implemented software: WinISAREG model (-> next presentation!)

- **Agriculture-specific drought index**
  - Weighting according to water needs of most sensible crops (maize)
  - Palfai drought index (-> next presentation!)

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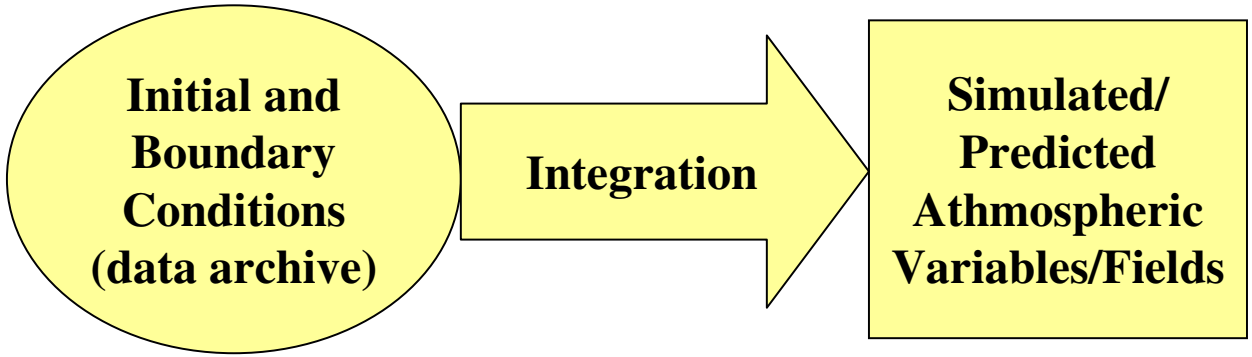
Application of NWP models



What is NWP?

Numerical resolving of mathematical equations describing development of atmospheric variables in time

Air Pressure
Wind
Temperature
Humidity
Cloudiness
Precipitation
Evaporation
Soil Moisture

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Application of NWP models

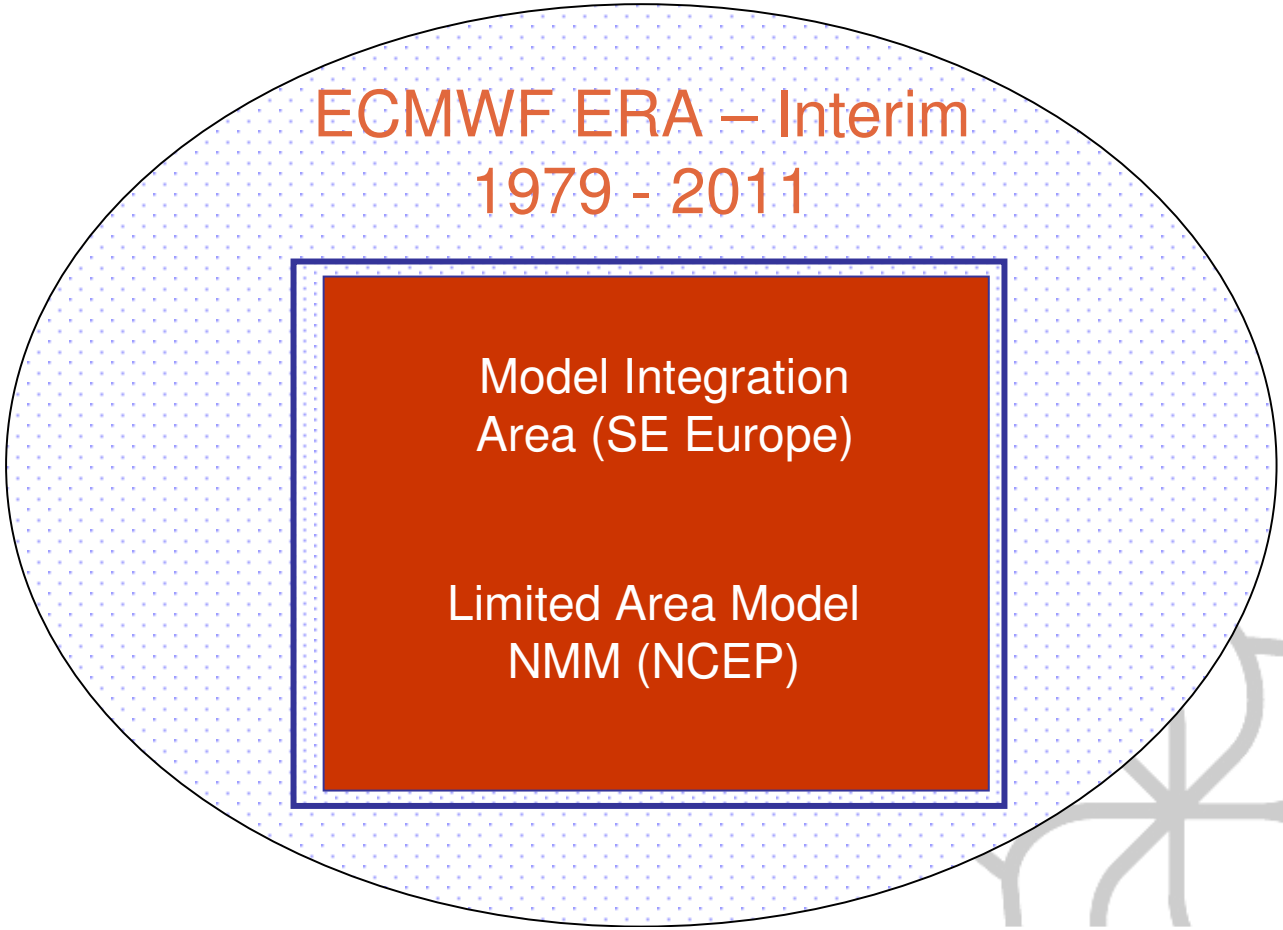
"Normal" application of NWP models – weather forecasting.

Application of NWP for drought management:

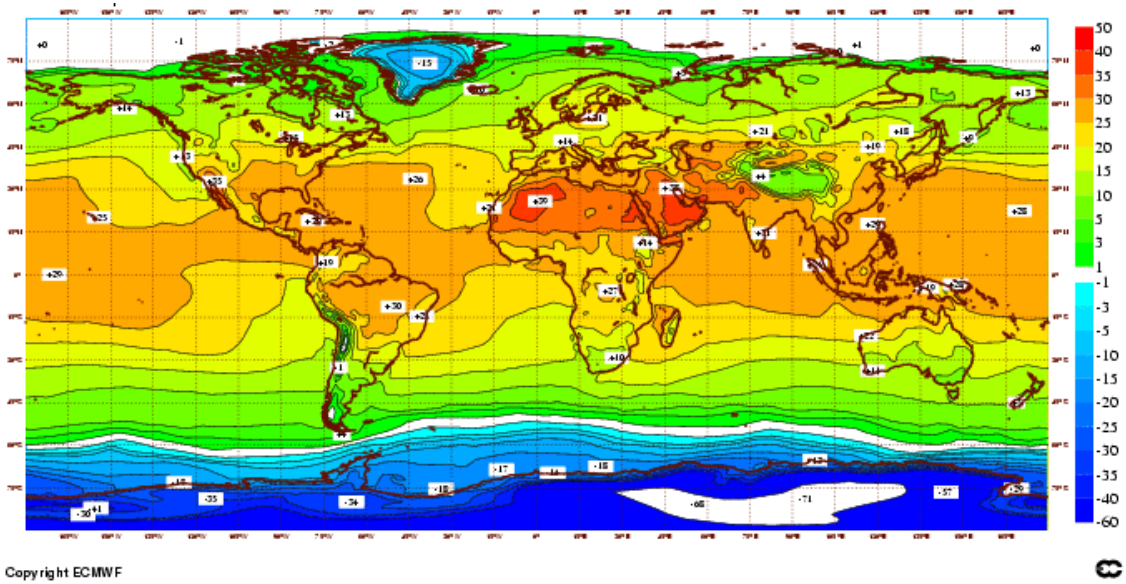
- analysis (monitoring)
- long-term forecast

<u>(Re)analysis goal</u>:

To re-compute reanalyses data over SE Europe in dense grid (~8.5 km resolution) to obtain "model climatology" or „model statistics" for drought situations interpretation



Application of NWP models



Copyright ECMWF

Reanalysis

Set of global analyses describing the state of the atmosphere and land and ocean wave conditions.

Example left: Monthly mean of 2m temperature for August 2002

Available sets at ECMWF
ERA-40 - 1957 - 2002
ERA – Interim - 1979 – present
see: http://www.ecmwf.int/research/era/do/get/index

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Application of NWP models

DROUGHT RELATED VARIABLES

Surface water balance

Soil moisture anomaly

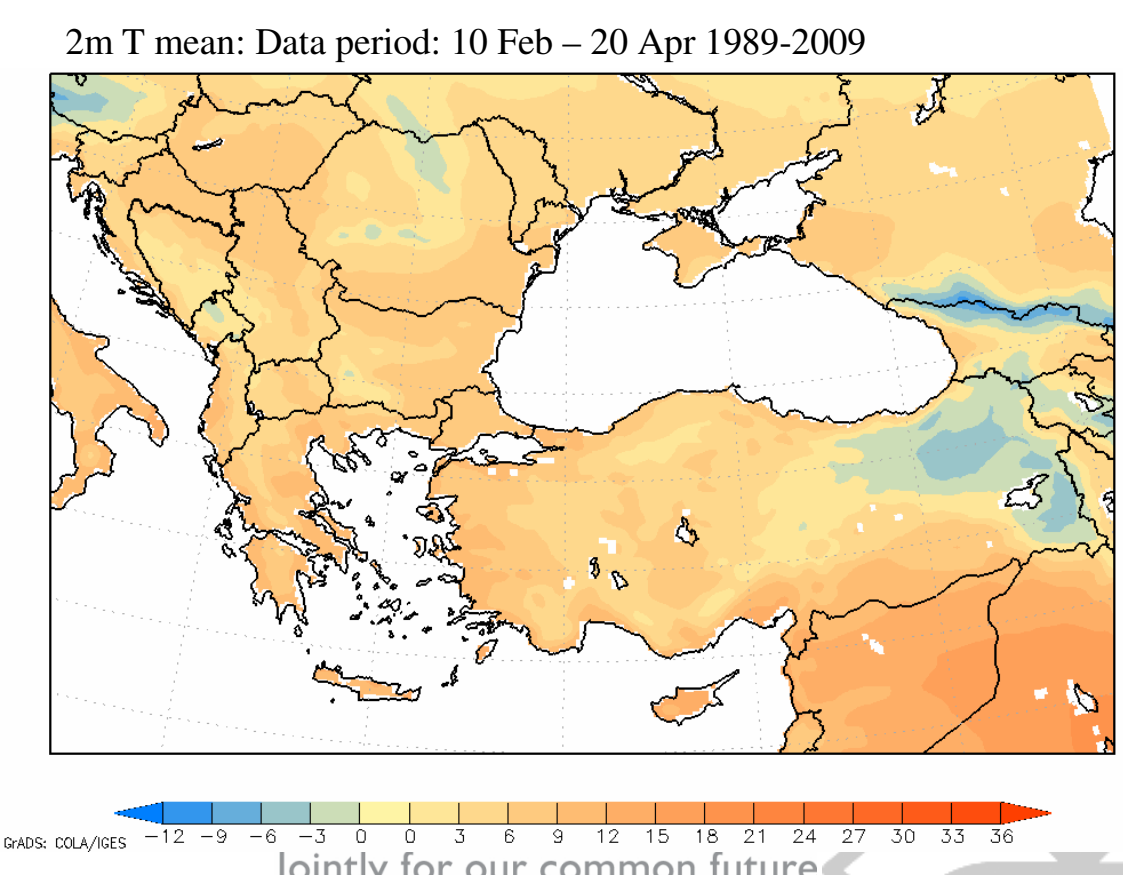
Temperature sums

DROUGHT RELATED TIME SCALE

10-day aggregation

DROUGHT RELATED INTERPRETATION

Not absolute values, deviation from normals, percentiles



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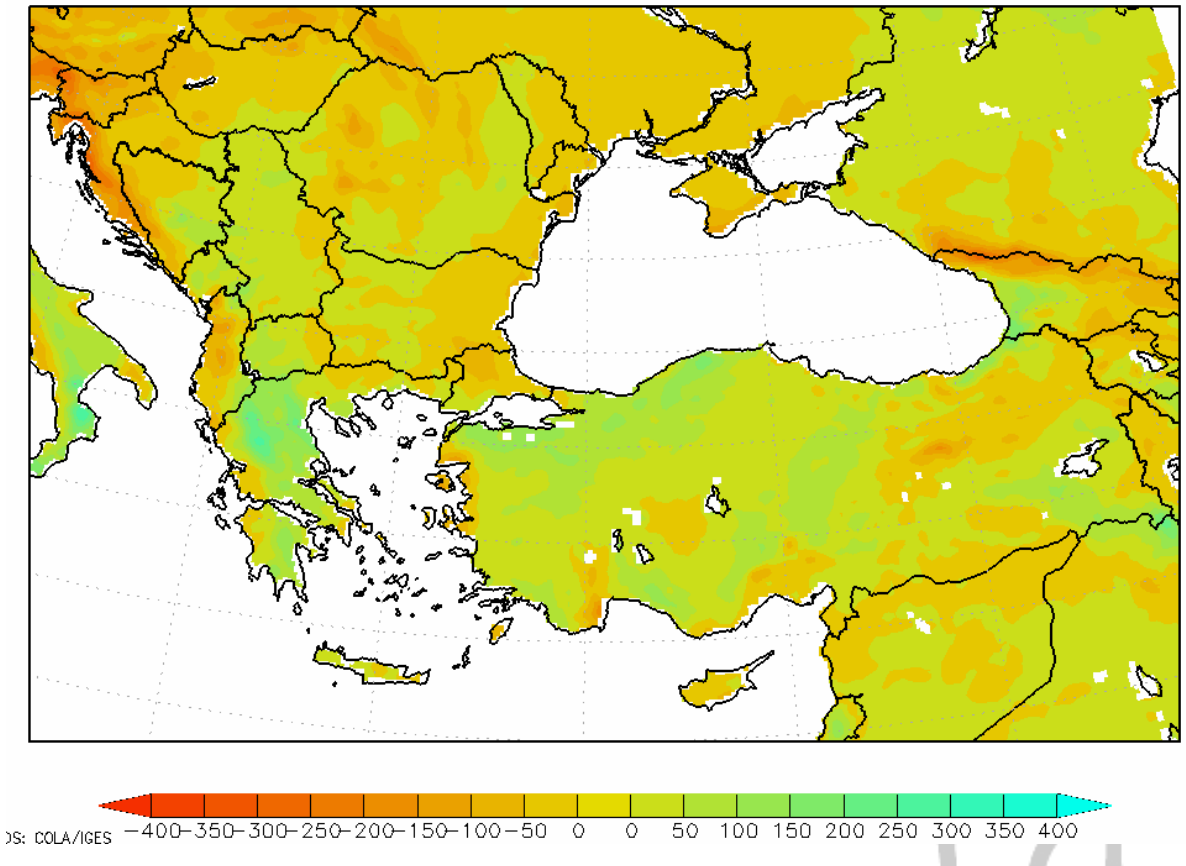
Application of NWP models

Examples of products

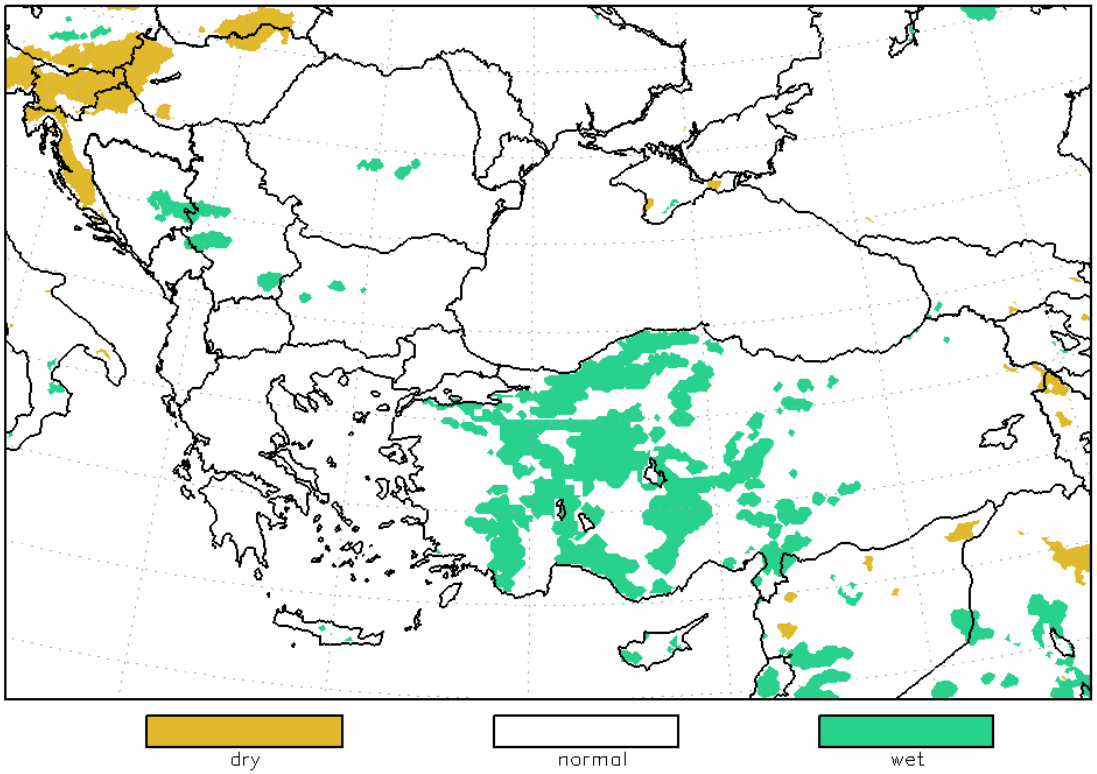
60 – day accumulation of surface water balance anomaly
31. Jan – 31. Mar 2012



Application of NWP models

Examples of products

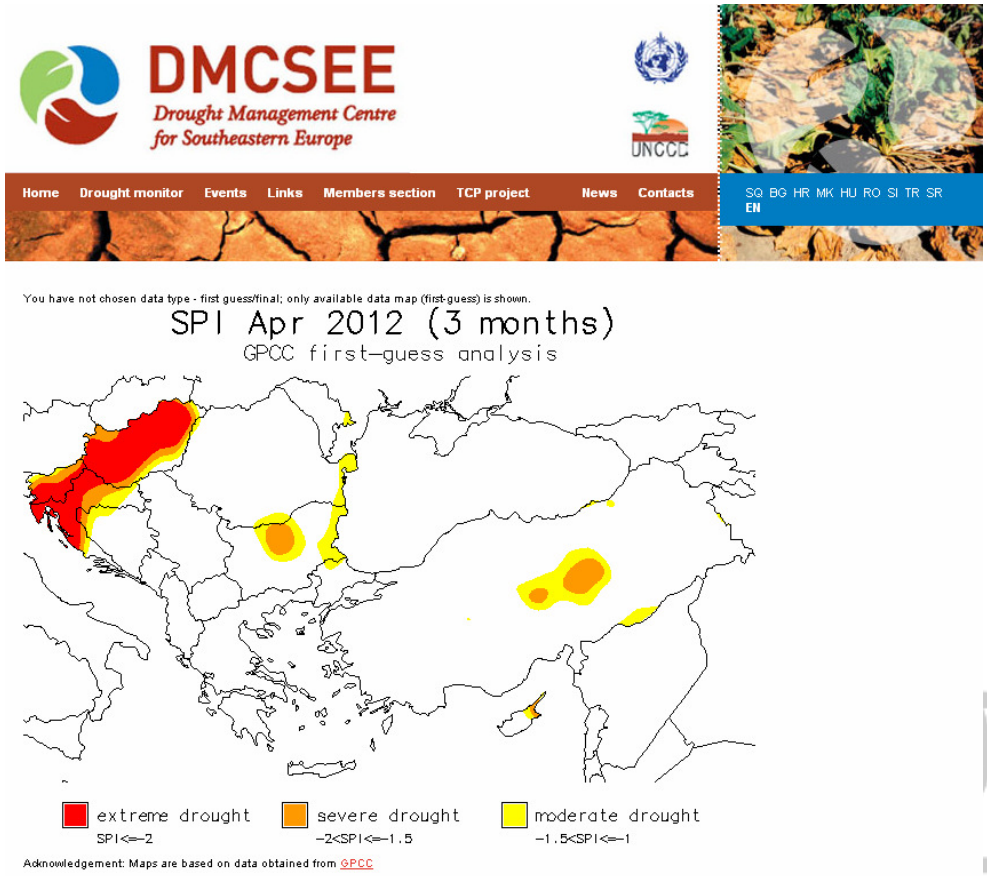
Accumulated water balance (1. Jan – 31. Mar 2012)
Driest and wettest 5% in comparison to reanalysis archive



Dissemination

- **Bulletins and web pages**
  www.dmcsee.org

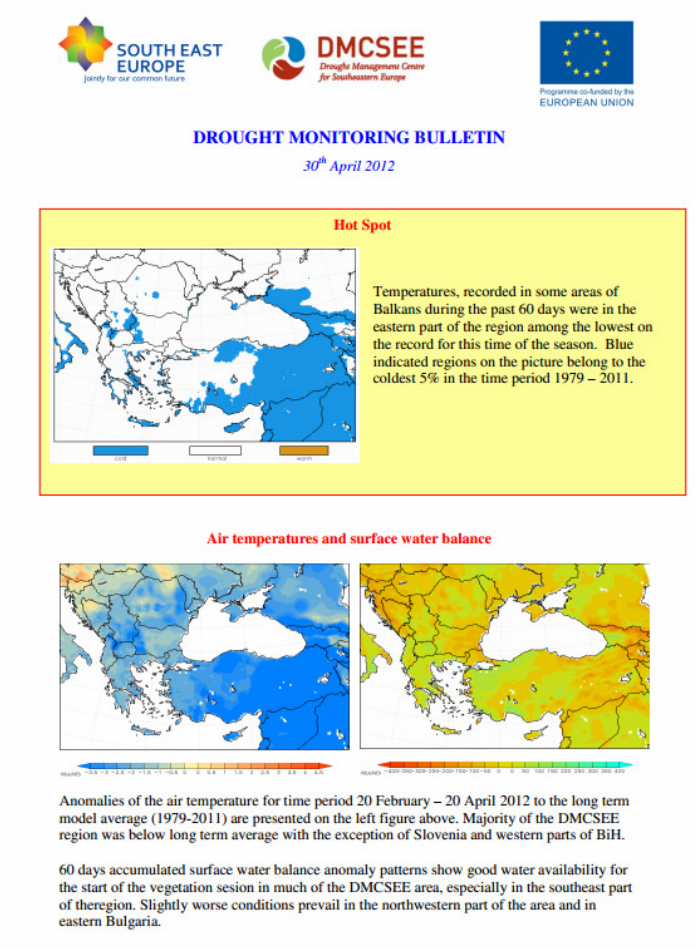
  Archive of SPI1, SPI3 SPI6 and SPI12 maps is available under “drought monitor”



Dissemination

- **Bulletins and web pages**
  www.dmcsee.org

  Monthly drought monitoring bulletin is issued in warm season (vegetation period) containing relevant maps and records of drought impacts



DROUGHT MONITORING BULLETIN

30th April 2012

Hot Spot

Temperatures, recorded in some areas of Balkans during the past 60 days were in the eastern part of the region among the lowest on the record for this time of the season. Blue indicated regions on the picture belong to the coldest 5% in the time period 1979 – 2011.

Air temperatures and surface water balance

Anomalies of the air temperature for time period 20 February – 20 April 2012 to the long term model average (1979-2011) are presented on the left figure above. Majority of the DMCSEE region was below long term average with the exception of Slovenia and western parts of BiH.

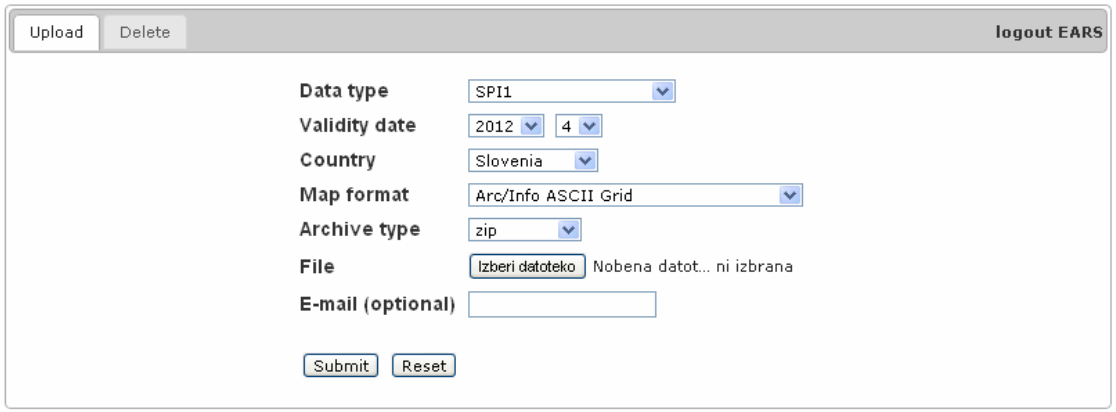
60 days accumulated surface water balance anomaly patterns show good water availability for the start of the vegetation sesion in much of the DMCSEE area, especially in the southeast part of theregion. Slightly worse conditions prevail in the northwestern part of the area and in eastern Bulgaria.

Jointly

Dissemination

GIS application

Enables partners to upload through simple password authentication products in agreed size and format



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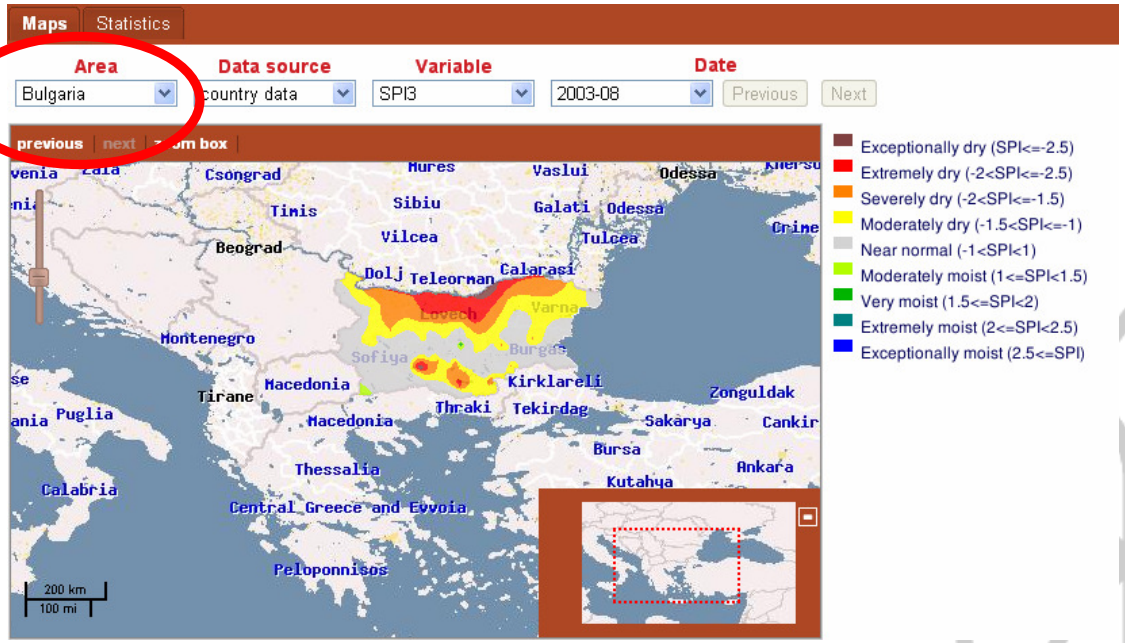
Dissemination

GIS application

Maps of partners' countries are accesible through simple navigation



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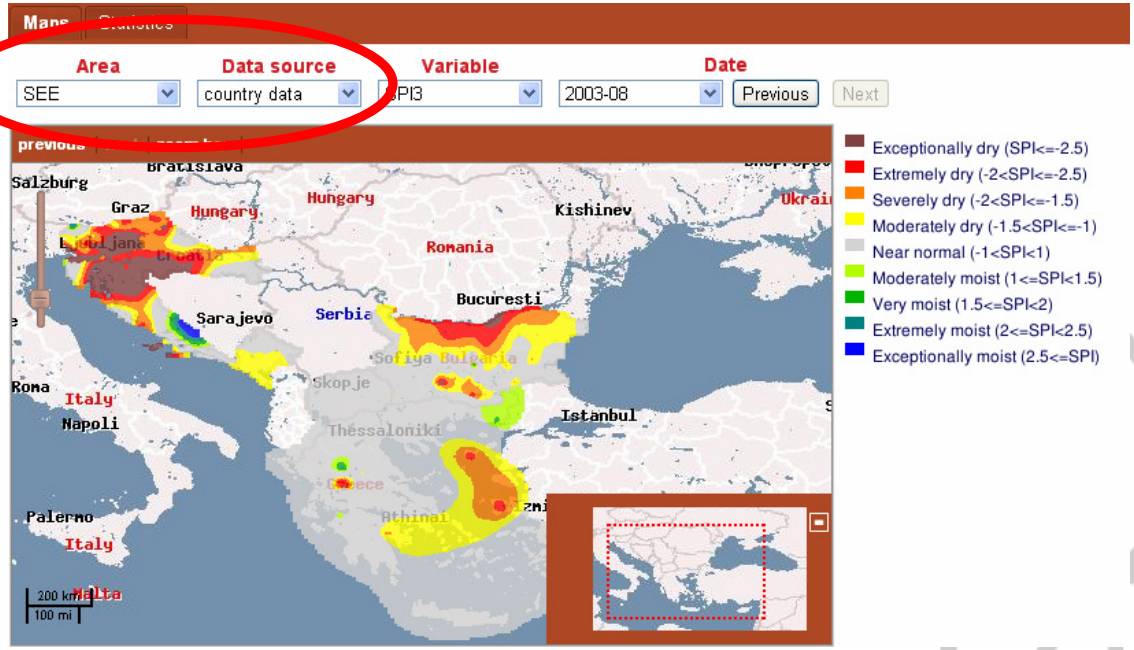
GIS application

Selection of whole region as area and country data as source results in regional composite



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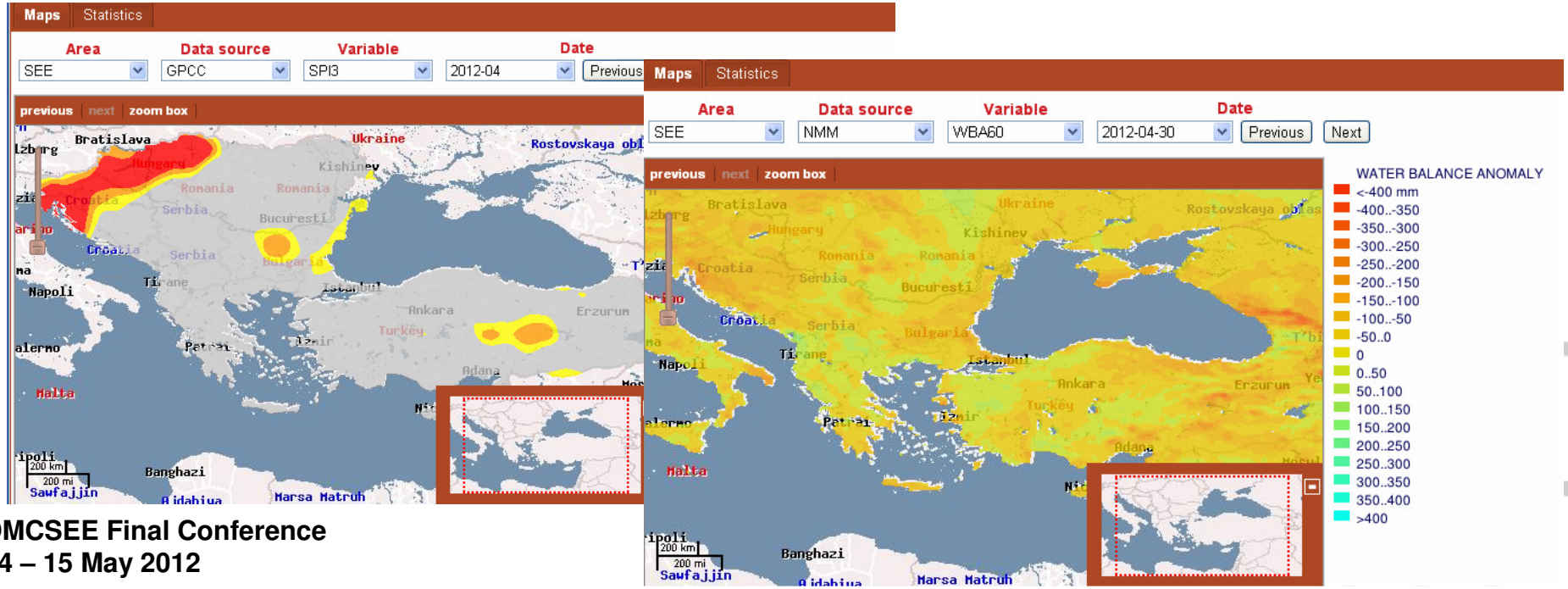
GIS application

Regional products (“global” data sources) are also available



Early warning

Early warning system is proposed to be based on SPI

- **Systematically following situation**
  - Preparation of regional/composite maps
  - Interpretation of maps
- **Application of long term forecasts**
  - Contribution of project partner - Republic Hydrometeorological Service of Serbia and its Virtual Climate Change Center

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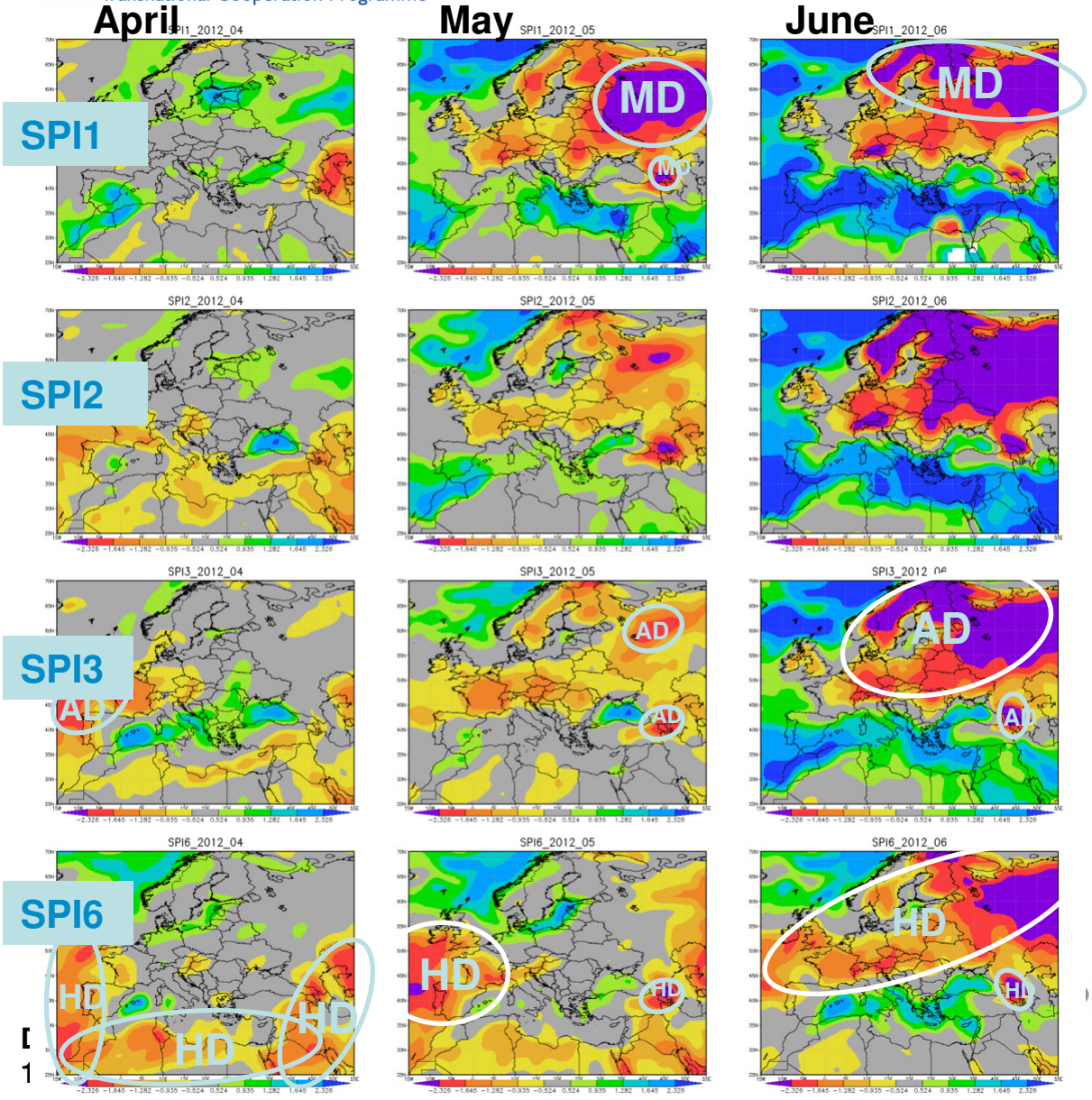

Early warning

VCCC regional seasonal forecast

Based on dowscaling of ECMWF seasonal forecast (41 ensemble members)

anomalies computed from model climatology

Proposed tresholds for meteorological (MD), agricultural (AD) and hydrological (HD) drought

MD – SPI1 < -2.3
AD – SPI3 < -1.6
HD – SPI6 < -1.3

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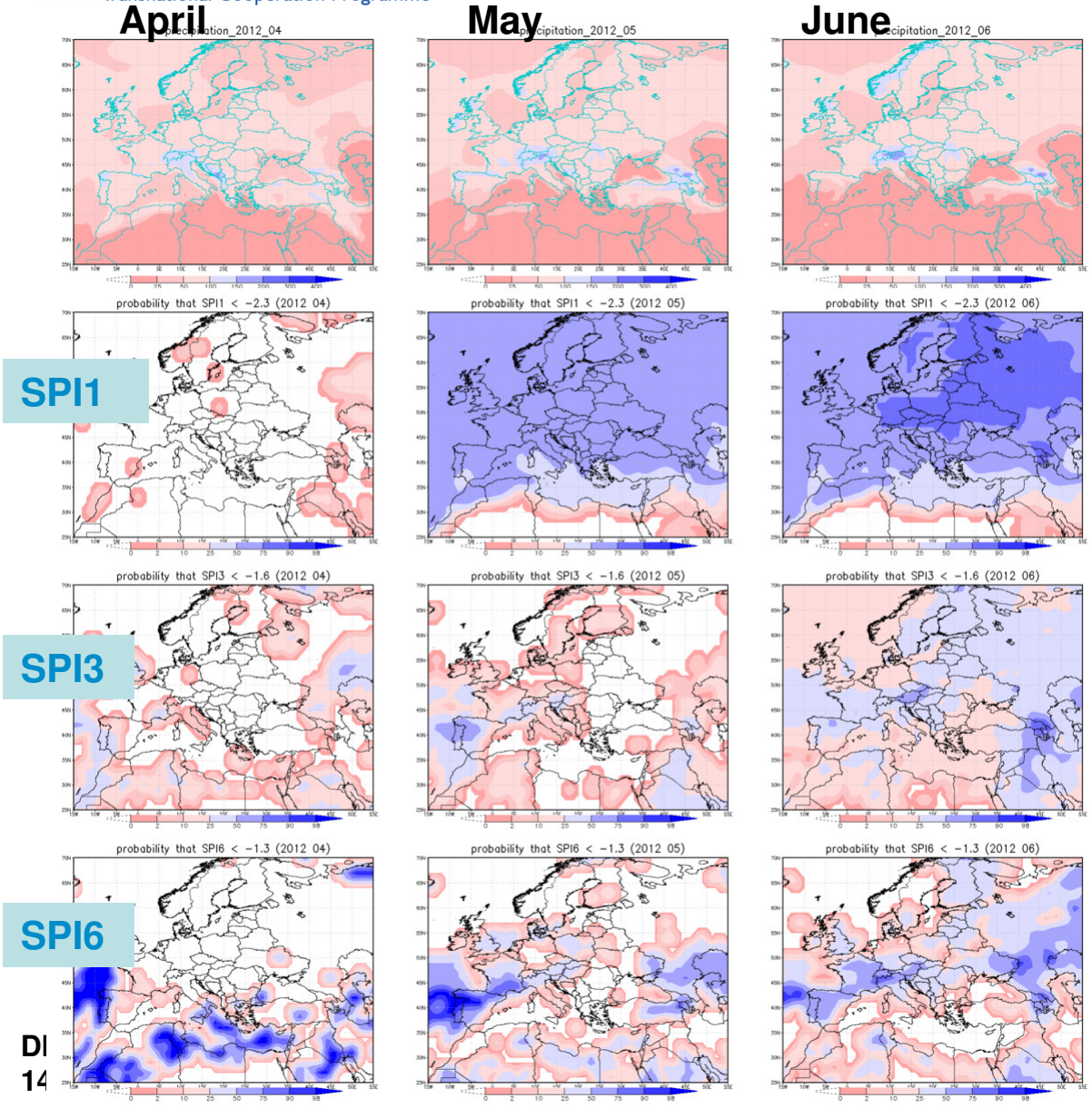
Early warning



VCCC regional seasonal forecast

Based on forecast of precipitation amount, probabilities of SPI exceeding tresholds can be plotted

MD – SPI1 < -2.3
AD – SPI3 < -1.6
HD – SPI6 < -1.3

ır common future

Future work

- **Maintenance and further development of the GIS application**
  - Arrangements with national meteorological services for regular updates
  - Acquisition of available monitoring and forecasting products
- **Application of remote sensing data**
  - “Round table provocation”

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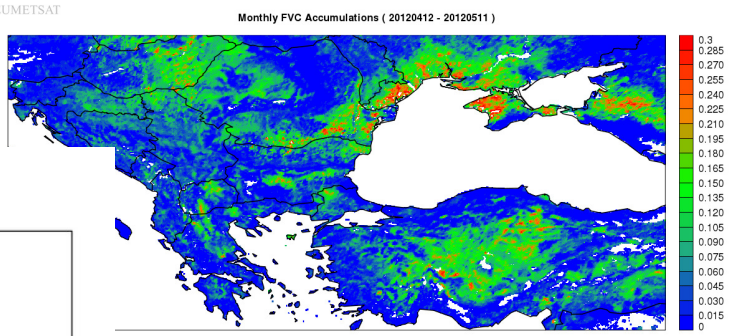
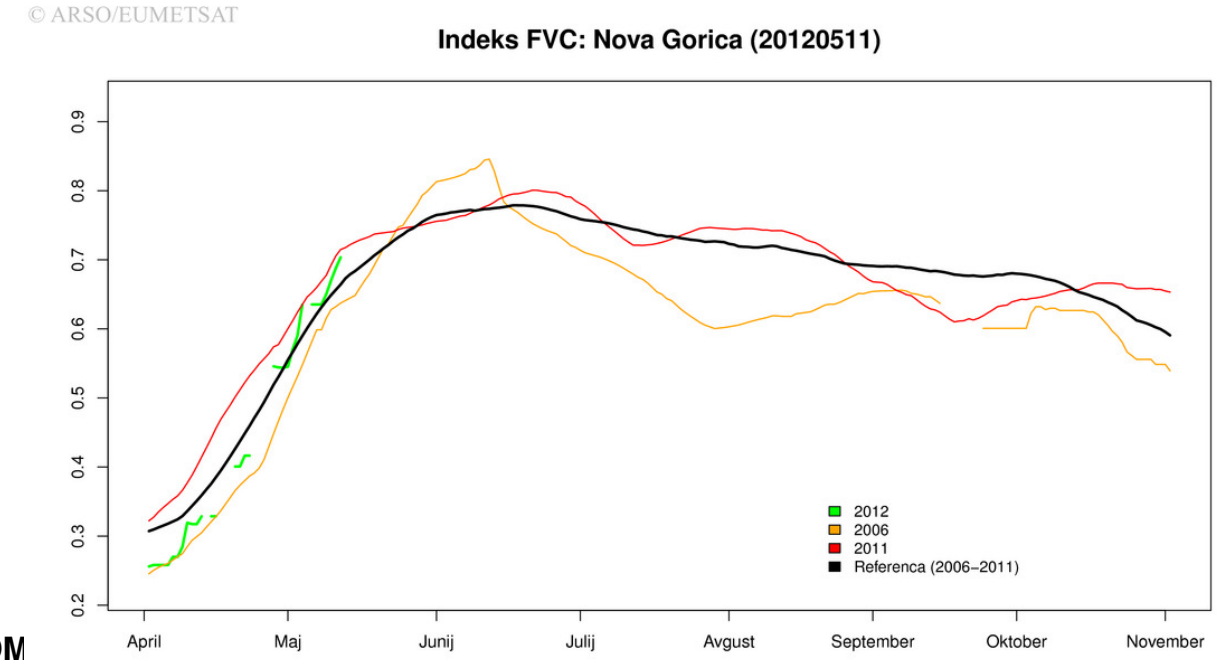
Future work

- **Application of EUMETSAT LANDSAF product for SEE Europe**
  Anomaly of Fraction of vegetation cover





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