REPUBLIC OF SLOVENIA
MINISTRY OF THE ENVIRONMENT AND SPATIAL PLANNING

SLOVENIAN ENVIRONMENT AGENCY

Monitoring the state of vegetation over Slovenia using LSA SAF products

Mateja Iršič Žibert, dr. Gregor Gregorič

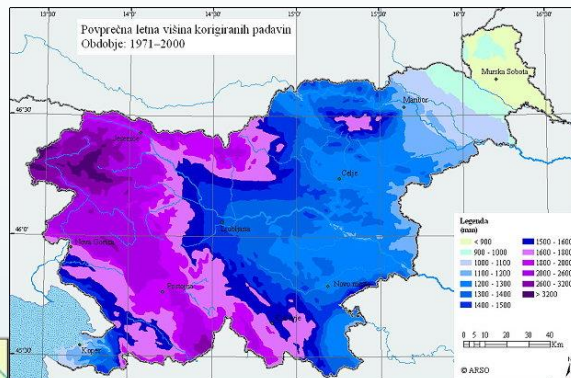Slovenian Environment Agency, Ljubljana, Slovenia

Outline

- Slovenia precipitation potential and frequent droughts in the last years

- DMCSEE – history and cooperation – web – activities

- Important signals from satellite vegetation indexes:

  - LSA SAF in operation since 2011 (Slovenia and SE Europe)

  - Copernicus LAND in operation since 2014

  - Drought (2006, 2013), hail (2011), forest damage after sleet (2014)

- Evapotranspiration: LSA SAF ET and potential (in-situ) ET0

- Advanced methods for detecting drought: ESA SatDroughtMon project

- Conclusions

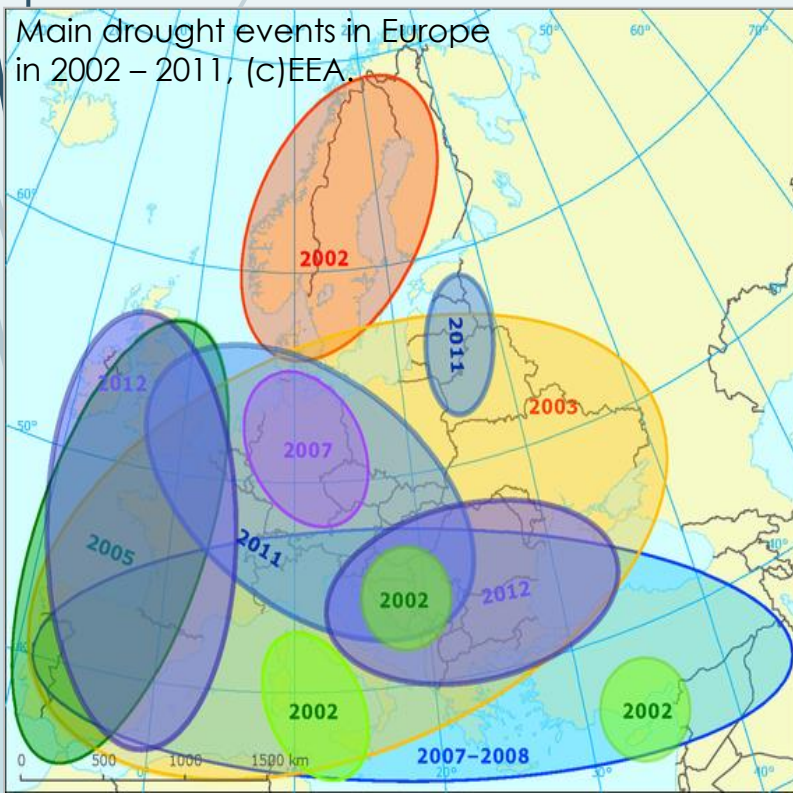# Slovenia: precipitation and frequent droughts in the last years

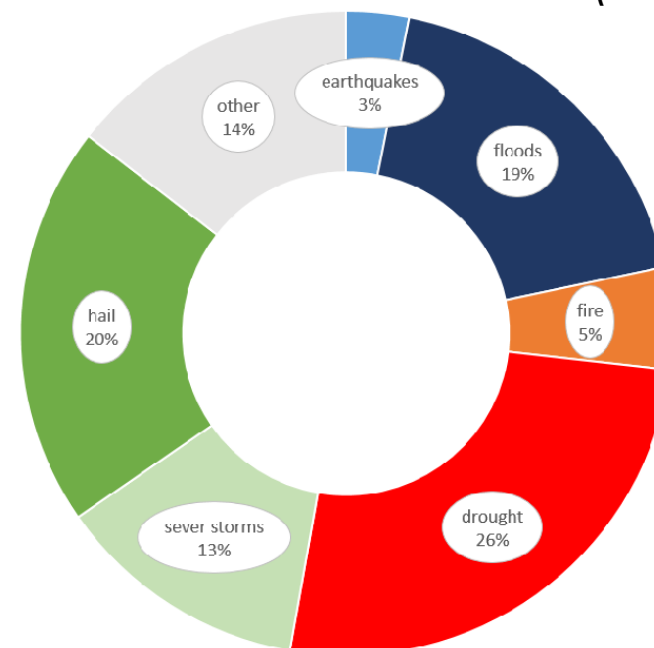High gradient over 200 km:

West > 3200mm/year
East < 900 mm/year

Povprečna letna višina korigiranih padavin
Obdobje: 1971–2000

Very severe drought in Slovenia in last years:
2003, 2006, 2007, 2012, 2013

Damage due to natural disasters (1994-2008)

Main drought events in Europe in 2002 – 2011, (c)EEA

➥ Europe has been affected by several droughts in recent years

➥ Sevirity and frequency of droughts appear to have increased in parts of Europe, in particular in **southern and south-eastern Europe**.

- earthquakes 3%
- floods 19%
- fire 5%
- drought 26%
- sever storms 13%
- hail 20%
- other 14%

(c) Statistical office of Slovenia

Drought Management Center for SouthEastern Europe - DMCSEE

need for Balkan subregional center

1998

Center initiative – "top-down" approach
International Commission on Irrigation and Drainage (ICID) adopted a declaration which expressed the need to establish this centre to alleviate problems caused by drought in the area "Balkan Drought Workshop" in Poiana/Brasov (RO), co-sponsored by the UNCCD

2004

2006

2007

2009

2013

first drought monitoring products, fund raising

Transnational cooperation programme (TCP), cooperation with Eurogeoss project and European Drought Observatory portal

Global water partnership

Integrated drought management programme

triangle approach: UNCCD focal points, permanent representatives with the WMO + observers from UNCCD and WMO)
Workshop for national experts and representatives of National Meteorological and Hydrological Services where they agreed on DMCSEE within context of UNCCD

decision on DMCSEE host institution (procedure led by WMO)

advocacy, management, steering committee, active institutions in consortium

political commitment of Slovenian government (permanent budget for the governance)

GWP project

Drought monitor
www.dmcsee.org

✓ **Implementation of standardized precipitation index (focus set on meteorological drought)**

✓ Maps of SPI, percentiles and precipitation for the SEE region

✓ **Historical maps (record 1951-2000)**

✓ **Data origin: GPCC data/ update once per month**

Drought bulletins and maps

RASTER DATA DOWNLOAD

WCS enables you to download raster data in TIFF and PNG format. These services are useful for performing analyses of drought-related resources in specific software as the functionality of analysing raster maps in a map viewer is limited. You can select SPI on different time scales and WBA (Water balance anomaly) on two months time-scale, provided by NWP.

DROUGHT BULLETINS
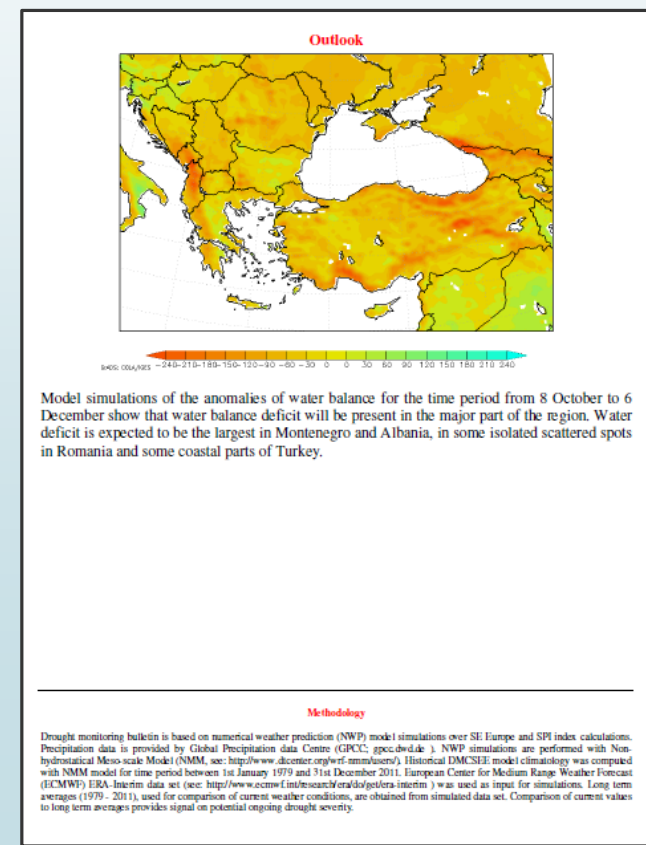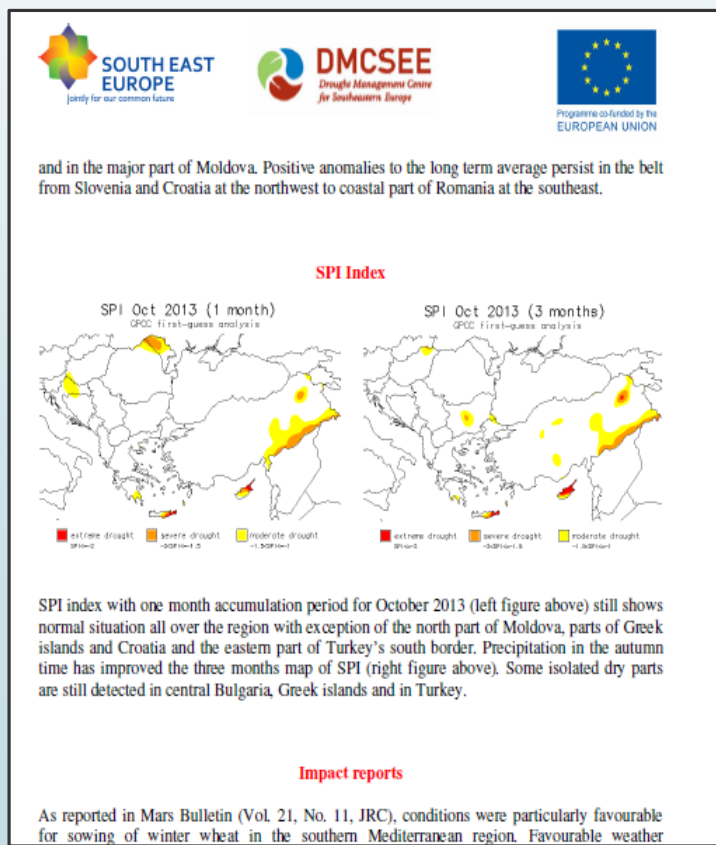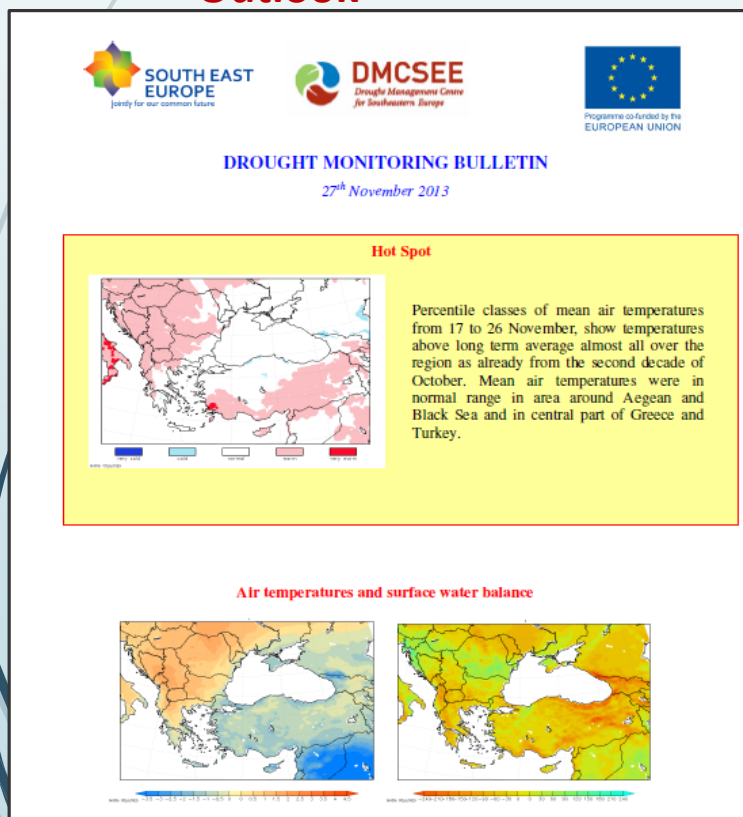
Basic information on drought in the current season are summarized in drought bulletin for SE Europe. Drought bulletin is being published since spring 2010 and can be found by following this link:

Drought Bulletin for SE Europe

DROUGHT MONITORING PRODUCTS

Drought bulletin for SE Europe

✓ **Hot spot** - short summary, short insight of possible circumstances of drought at the time of issue.

✓ Additional and auxiliary information (more detailed information on water balance or temperature situation, additional NWP or RS maps)

✓ **Report on impacts (more about agricultural drought impacts is missing!)**

✓ **Outlook**

LSA SAF vegetation indexes
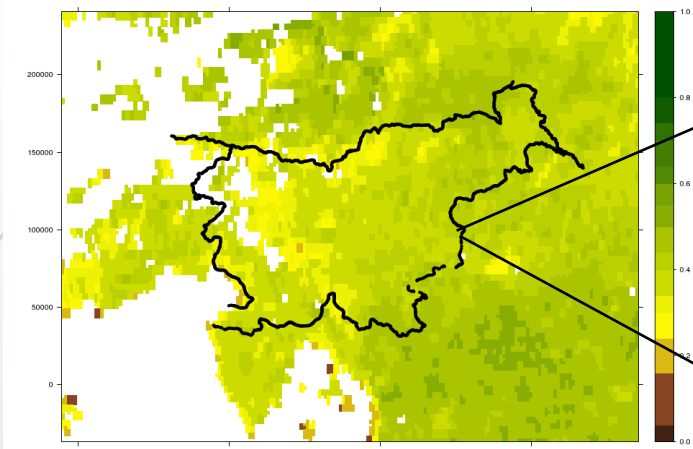
- In operation from **2011**
- **Reference signals** (LAI, FVC, FAPAR, NDVI)
  - for every pixel based on history (from 2006 -2014)
  - dynamic trough the season (April - October)
- Maps over **Slovenia and SE Europe**:
  - Daily maps
  - 10 daily maps
  - Monthly maps
  - end of the season maps (typically June-August)
- **Detailed study** of variation of vegetation signals though the season at **selected locations**:
  - Slovenia (8 locations)
  - DMCSEE area (> 22 locations)
- Combination with **other sources:**
  - models,
  - ground measurements,
  - other satellite data

Monitoring of state of vegetation during vegetative season
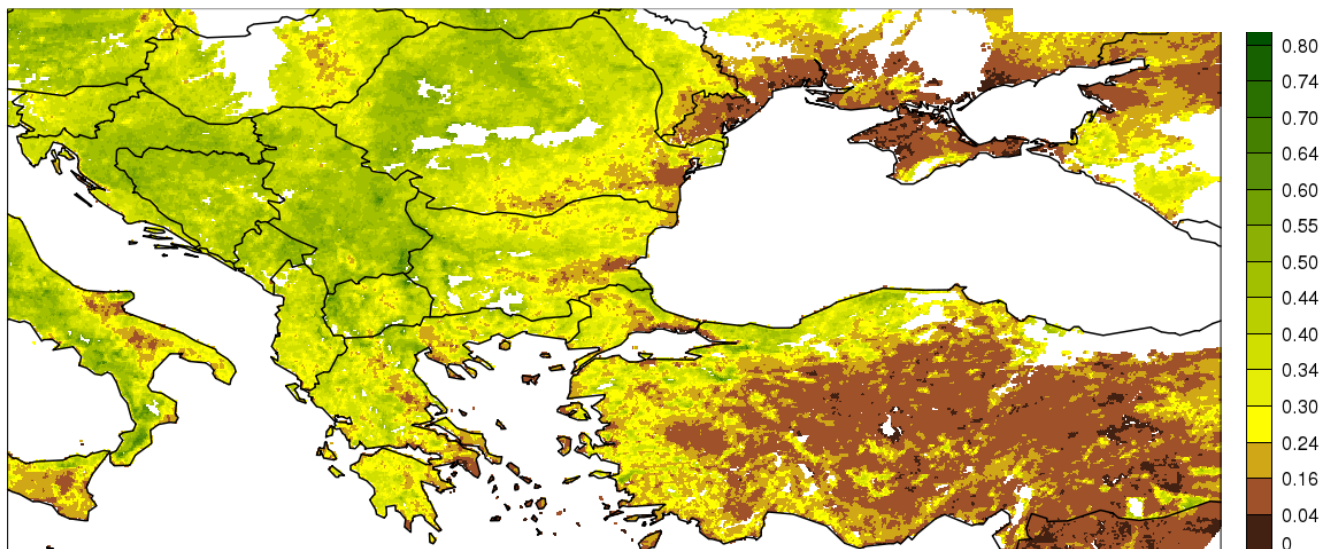

NDVI on 20140810 (Slovenian domain)

© ARSO/EUMETSAT

Indeks FVC: Bizeljsko (20140810)

- 2014
- 2006
- 2013
- Referenca

NDVI on 20140810 (DMCSEE domain)

© ARSO/EUMETSAT

Foto: A. Sušnik
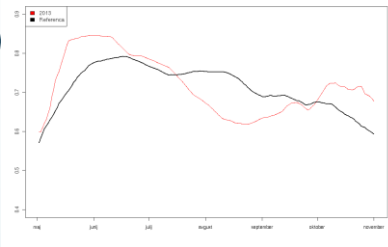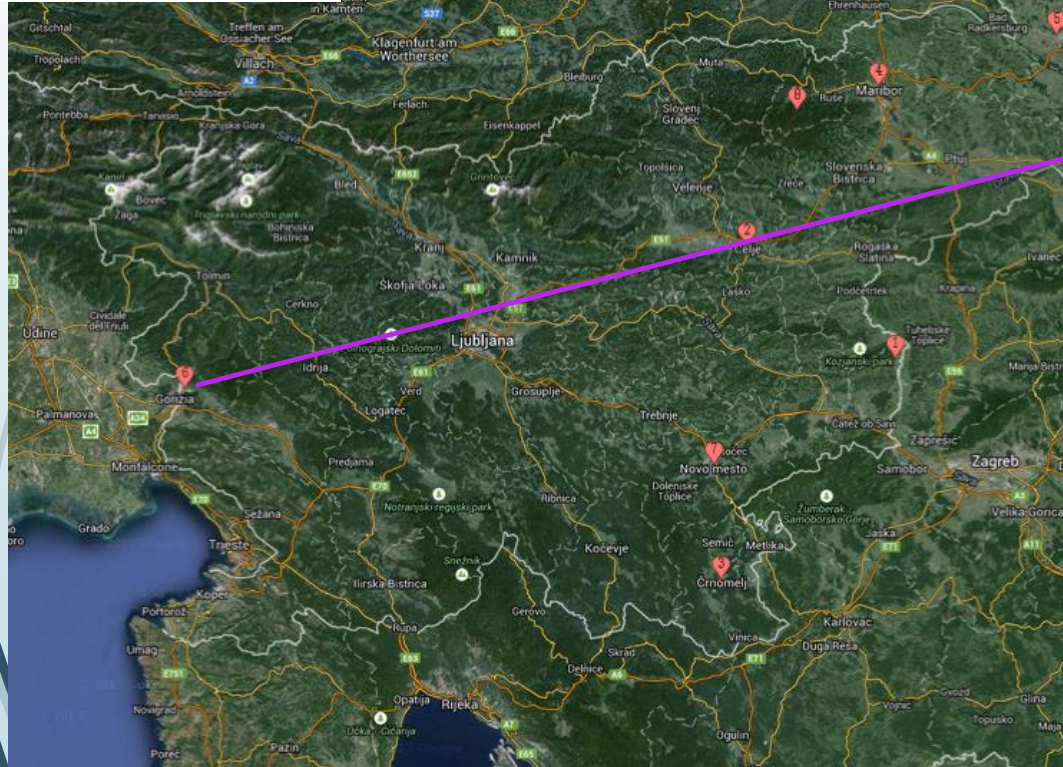
Foto: A. Sušnik

Damage on vegetation

- Drought signal

- Damage on corps due to hail (2011)

- Damage on forest due to sleet (2014)

- Going to finer ground resolution interpertation of the signal is more complicated (5 km -> 1 km, 300 m, 20 m?)

Variation of vegetation signals though the season

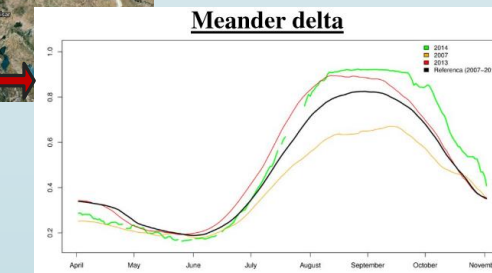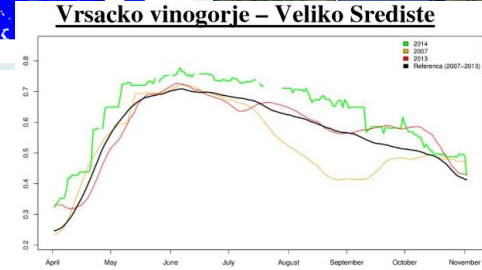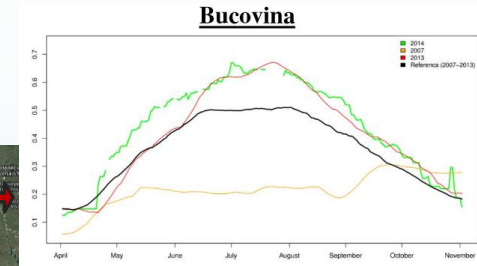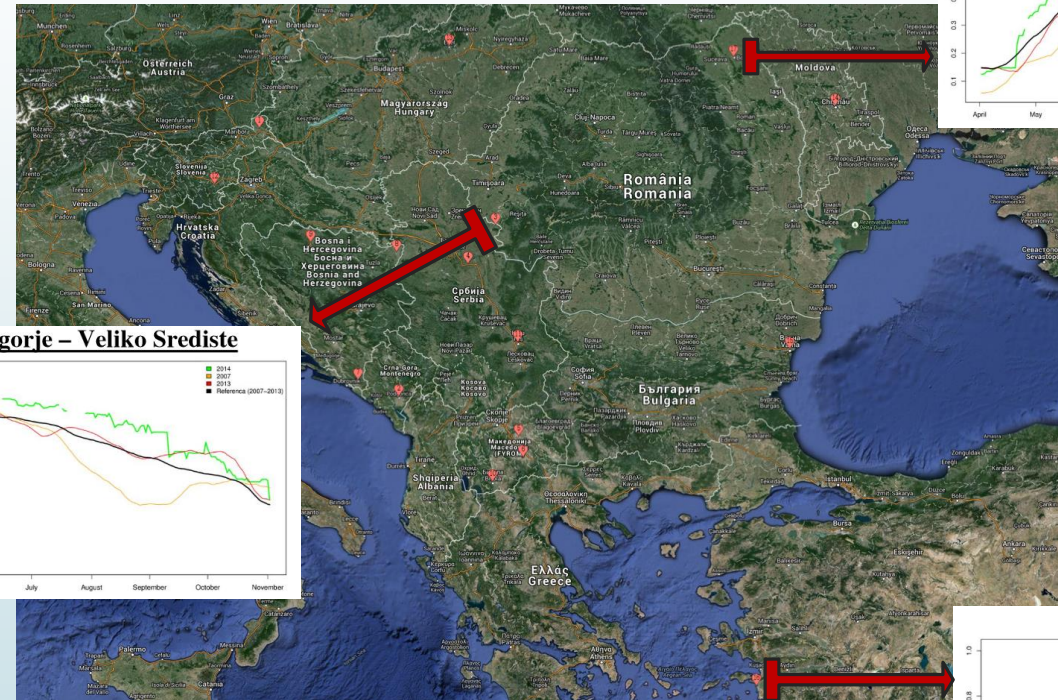- 8 selected locations over Slovenia with homogeneous vegetation over SEVIRI pixel

© ARSO/EUMETSAT

Indeks LAI: Nova Gorica (20141031)

Legend:
- 2014 (green)
- 2006 (orange)
- 2013 (red)
- Referenca (black)

DMCSEE monthly bulletin

http://www.dmcsee.org/en/drought_bulletin/

LSA SAF	Copernicus Global LAND Service
➥ FVC	➥ FCOVER
➥ NDVI	➥ NDVI
➥ FAPAR	➥ FAPAR
➥ LAI	➥ LAI
Ground resolution: 3- 5 km	Ground resolution: 1 km -> 300 m
Every day, based on 15 minutes data (cloud detection very robuste), timeliness 1 day	Every 10 days, timeliness - within 3 days after end of synthesis period Fine scale 300 m (no historical reference at 300 m)

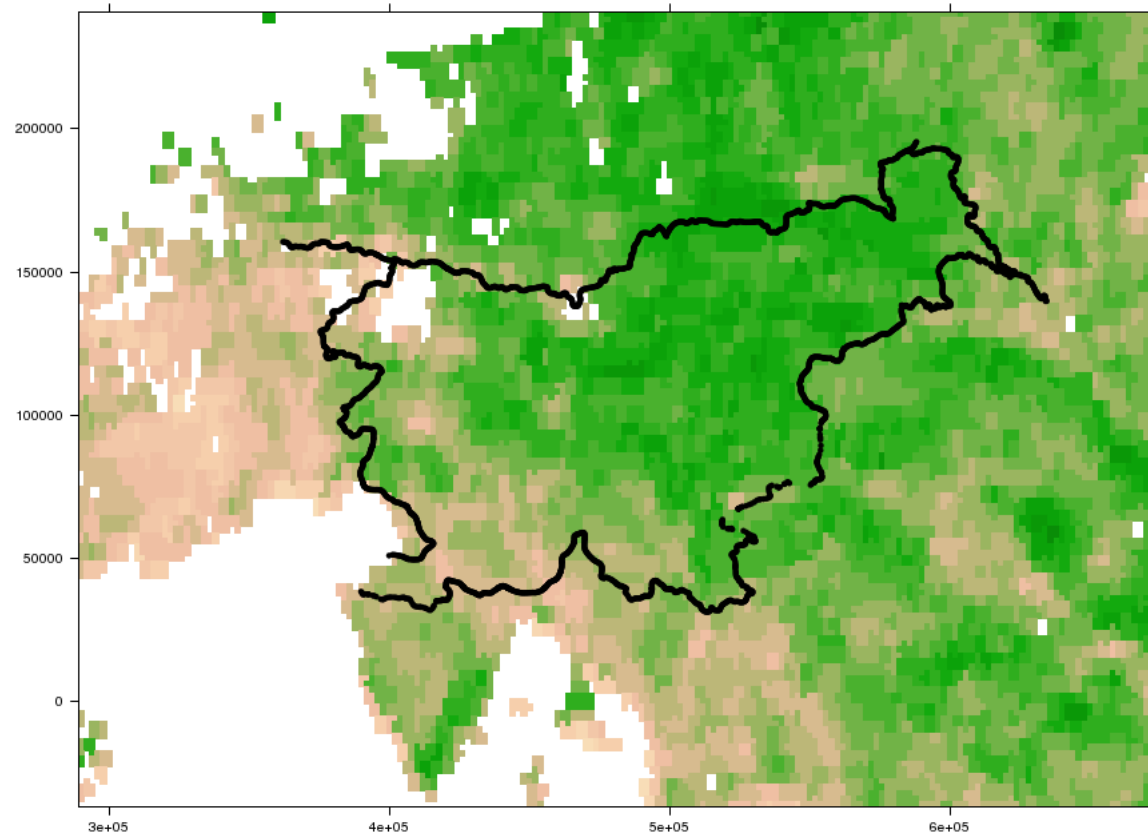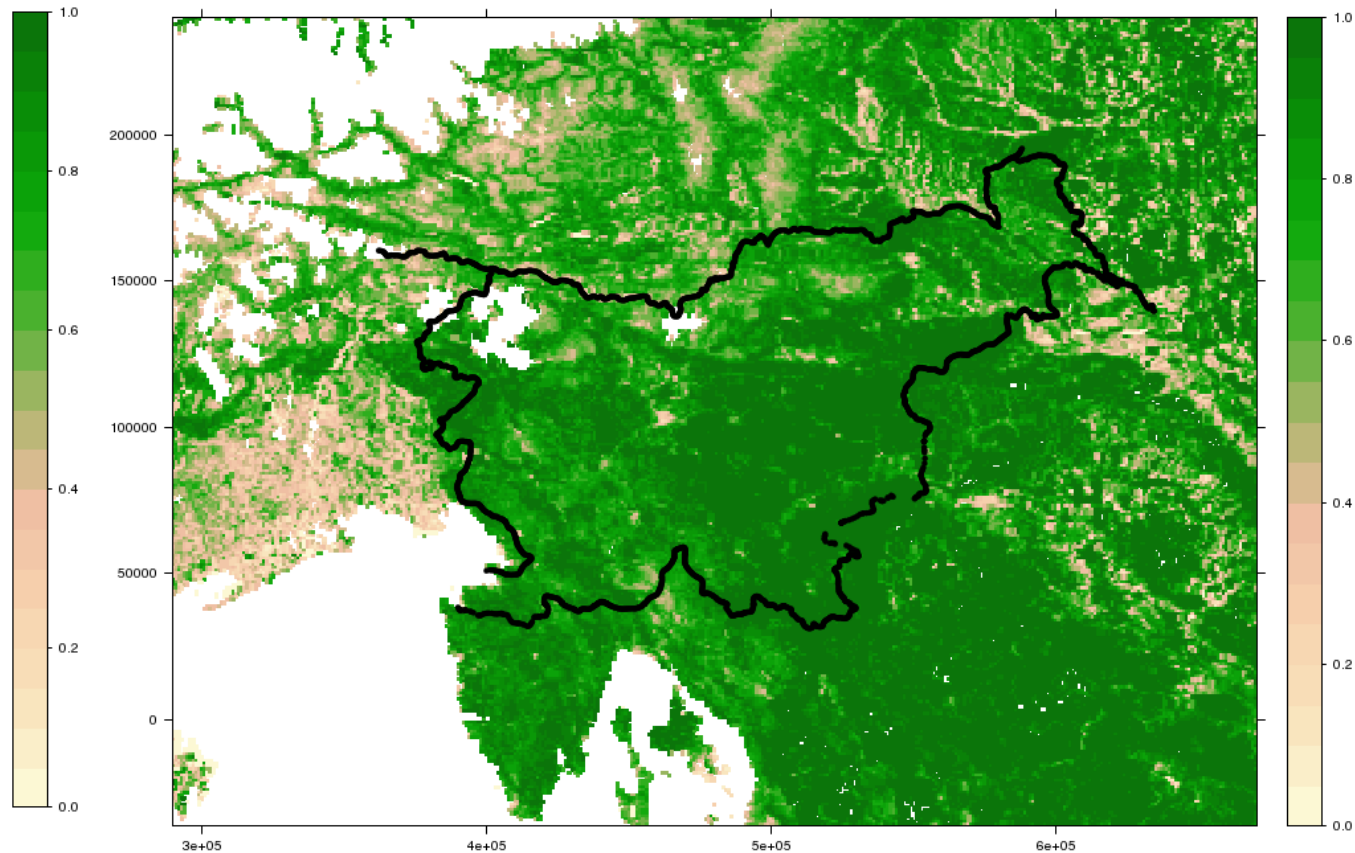(c) ARSO

LSA SAF

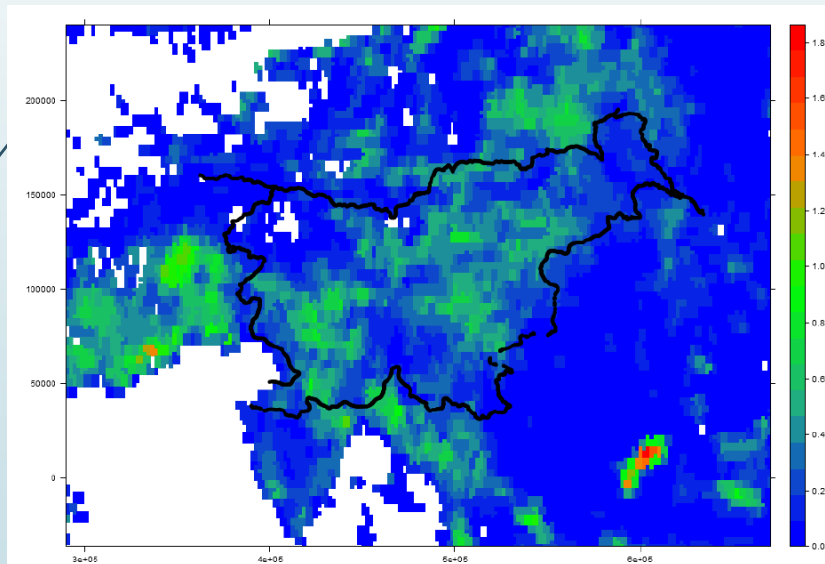Copernicus LAND

FVC on 20150503 (Slovenian domain)

FCOVER on 20150503 (Slovenian domain)

© ARSO/EUMETSAT

© ARSO/Copernicus

(c) ARSO

LSA SAF

Copernicus LAND

Dolenjska Region – Novo mesto

Indeks FCOVER: Novo mesto – 45.9017N 15.3035E (20140824)

© ARSO/Copernicus

(c) ARSO

LSA SAF

Copernicus LAND

Indeks FVC: Nova Gorica (20150519)

Indeks FCOVER: Nova Gorica – 45.9017N 13.6339E (20150503)
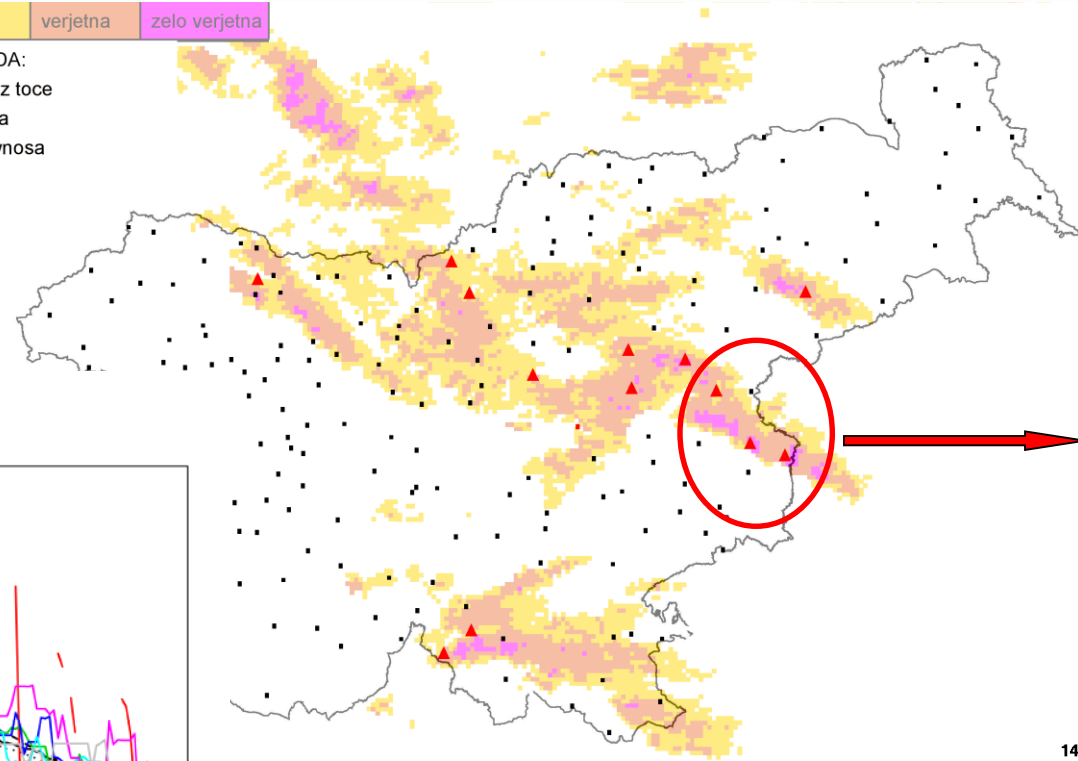
(c) ARSO

Damage on vegetation

- Drought signal

- Damage on corps due to hail (2011)

- Damage on forest due to sleet (2014)

- Going to finer ground resolution interpertation of the signal is more complicated (1 km, 300 m, 20 m)

Damage on vegetation due to severe hail, 11 July 2011

(>20 cm hail layer)

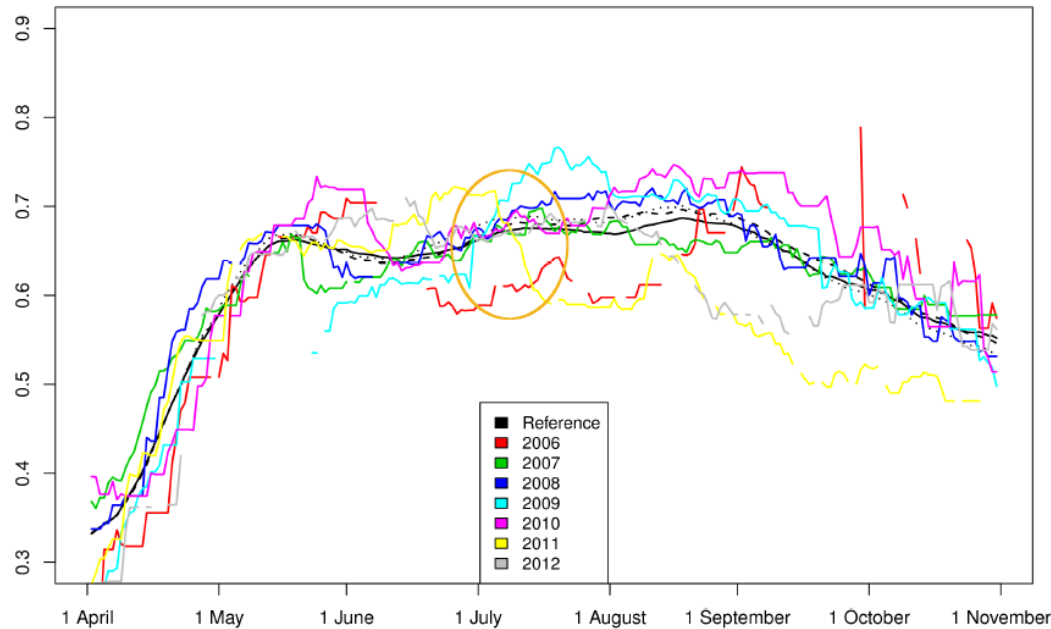# Damage on forest due to heavy sleet in Feb. 2014

© ARSO/EUMETSAT

(c) RTVSLO

Monthly FVC Accumulations (20140725 - 20140823)

Signal was seen through the whole season

Evapotranspiration

© ARSO/EUMETSAT
Daily Evapotranspiration [mm/day] on 20130725 (DMCSEE domain)

LSA SAF ET (blue) with ET0 (red) from ground measurements for the location Maribor in Slovenia from April – November

year 2011

year 2013 – red circle – indication of deviation between ET and potential ET0

ESA PECS SatDroughtMon project

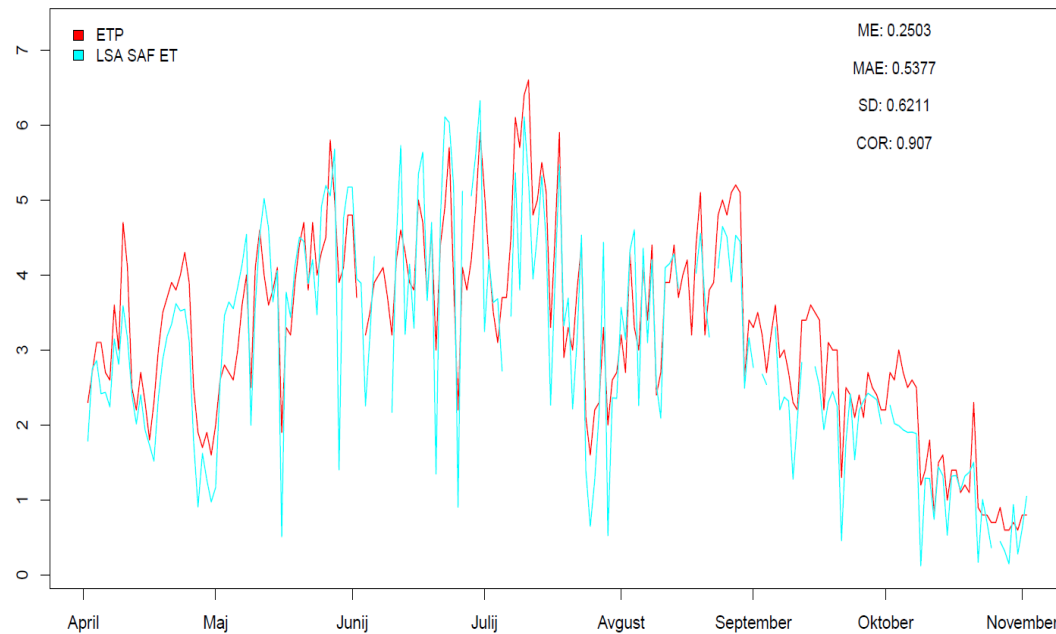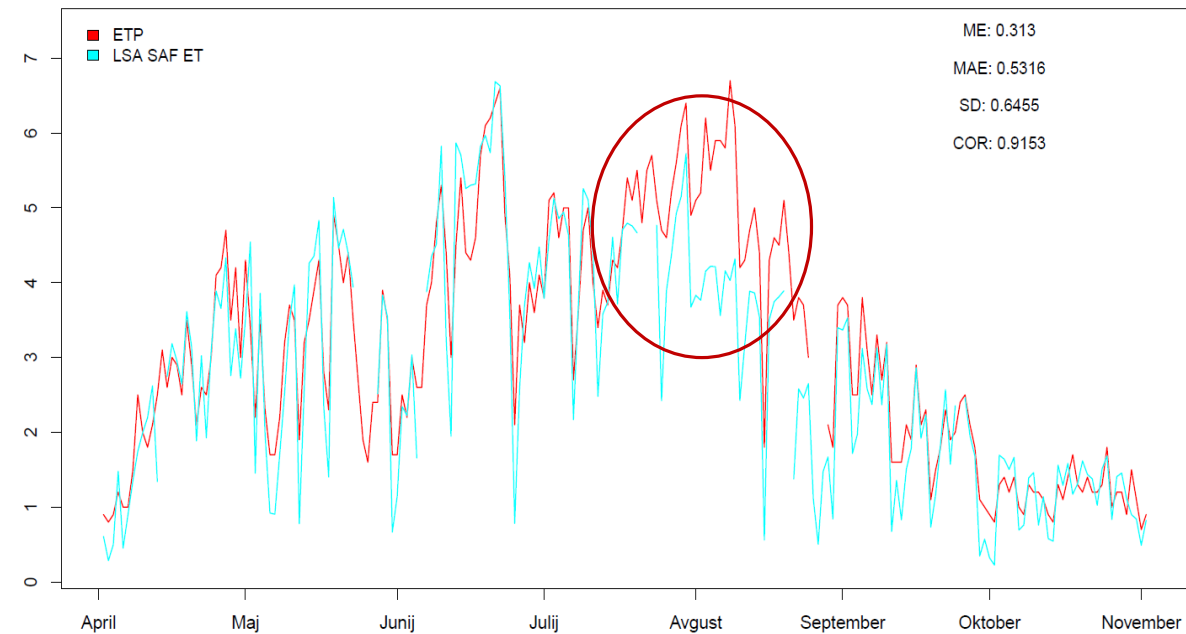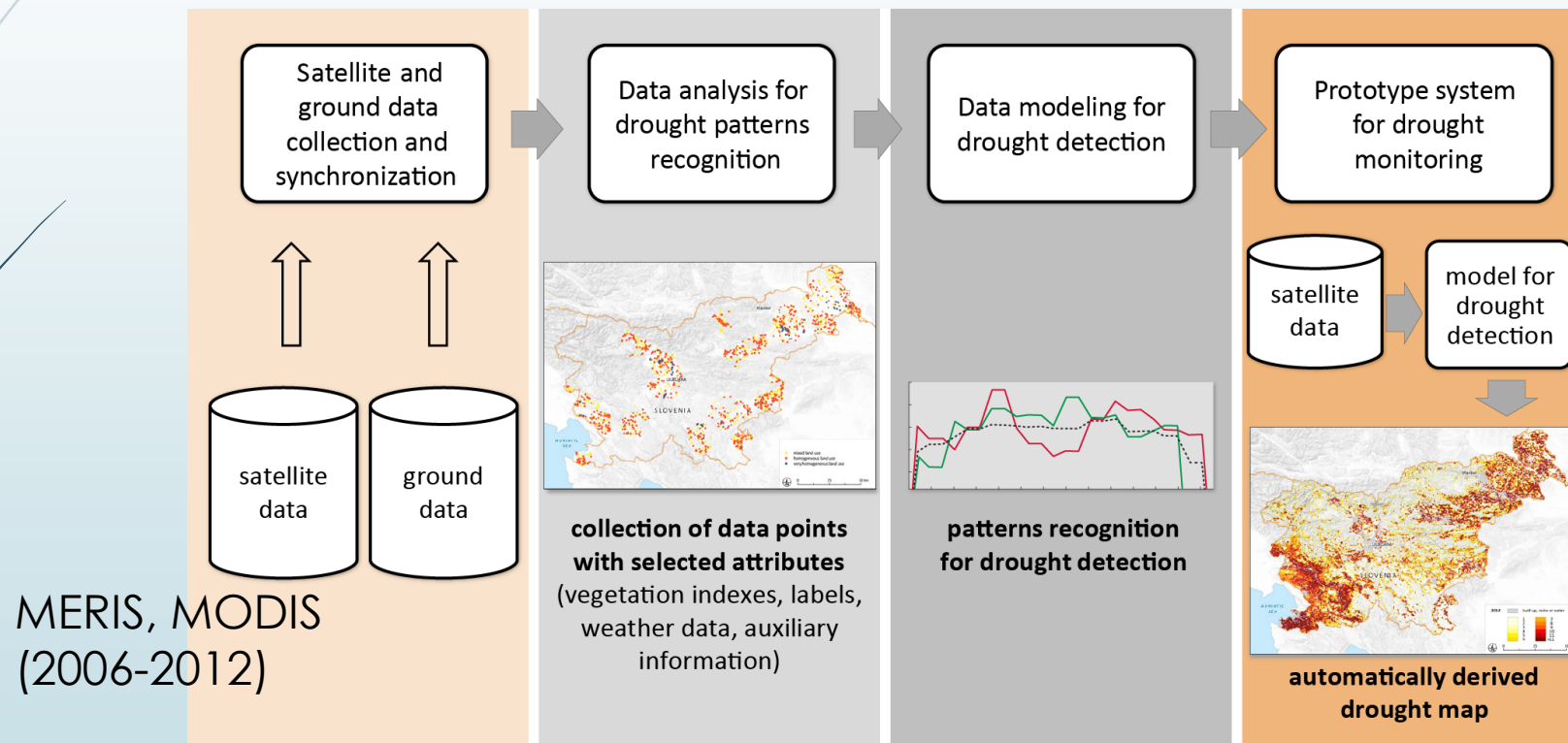Development of Drought Monitoring System Based on Satellite Data and Ground Measurements

MERIS, MODIS
(2006-2012)

Satellite and ground data collection and synchronization

satellite data

ground data

Data analysis for drought patterns recognition

collection of data points with selected attributes
(vegetation indexes, labels, weather data, auxiliary information)

Data modeling for drought detection

patterns recognition for drought detection

Prototype system for drought monitoring

satellite data

model for drought detection

automatically derived drought map

Research Centre of the Slovenian Academy of Sciences and Arts, Slovenian Centre of Excellence for Space Sciences and Technologies,University of Primorska and Slovenian Environment Agency

Conclusions

- LSA SAF vegetation indexes (LAI, FVC) gives very stable signal for drought with good timeliness;

- Fine resolution data (1 km, 300 m, …) gives finer ground resolution, but since the updates are typically every 10 days the interpretation is more delicate (cloud recognition, hail damage, …)

- Going to finer ground resolution interpertation of the signal is more complicated (5 km, 1 km, 300 m, 20 m) -> fusion of GEO and LEO