EUMETSAT
Monitoring weather and climate from space
Surveiller le temps et le climat depuis l'espace

SALGEE

First Experience on D&V Cube applications

Regional application examples

Feedback and suggestions regarding the suitability of the D&V Cube in drought assessments.

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7th SALGEE Virtual Workshop ''Drought & Vegetation Monitoring: Energy–Water Cycle''
24 – 26 Nov 2021

Standpoint: Our study about Drought & Vegetation Monitoring Satellite Applications (Session 5)

- Example 1: Drought & Disease effects on ecosystem resilience
- Example 2: Drought & Crop Productivity (Yield)

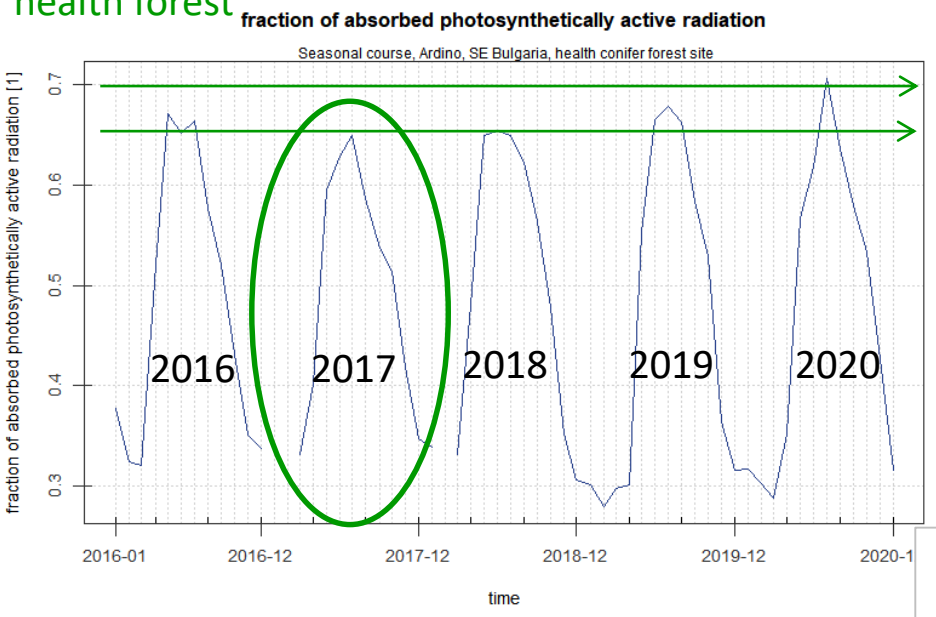
❑ Example 1: Drought & Disease effects on ecosystem resilience

Further using of D&V Cube for regional studies

- LSASAF FAPAR
- LSASAF FVC
- LSASAF NDVI

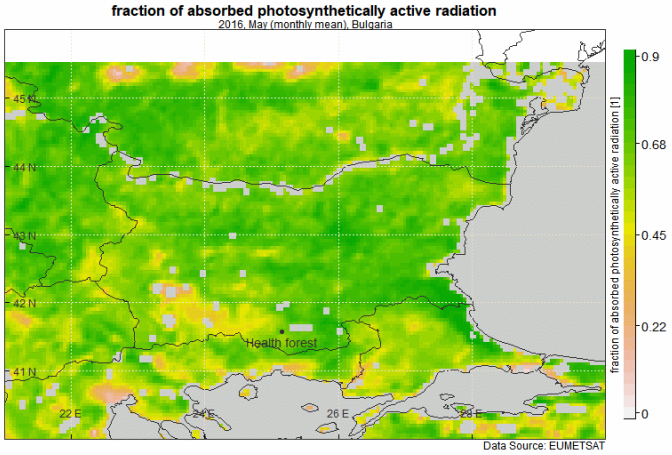
LSASAF FAPAR course 2016-2020

health forest



- Photosynthetic capacity of health-ill forests are similar for 2016 (around 0.65).
- FAPAR becomes lower in ill forest for 2017 and after that do not recover to the initial state, while
- For the health forest FAPAR shows a slow decline in 2017 but after that recovers to even higher than initial capacity to absorb solar radiation.

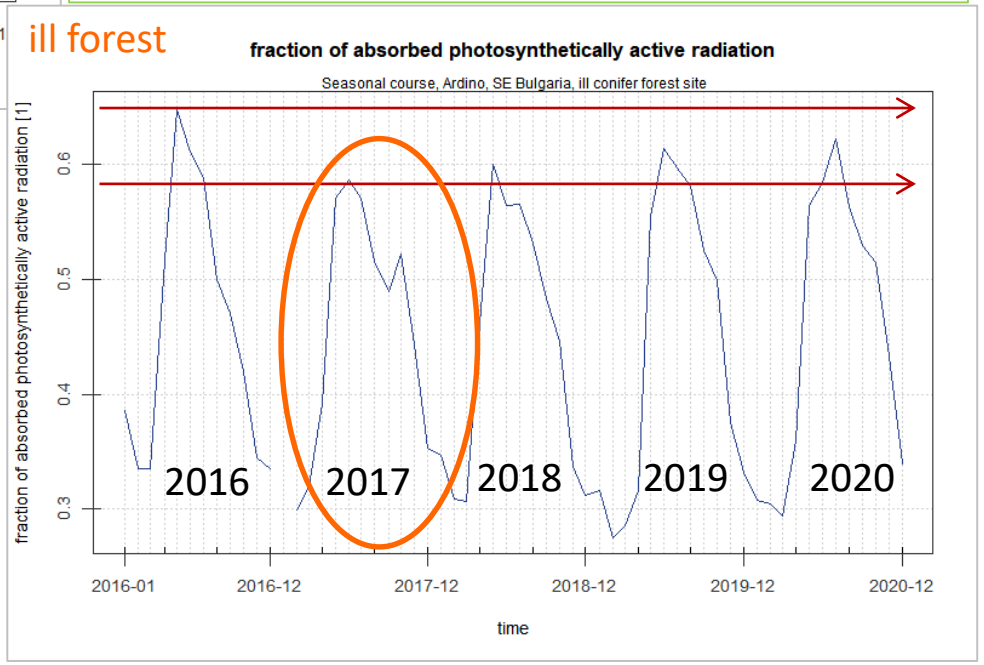
FAPAR (May-Jul) 2016, 2017, 2019 over Bulgaria



FAPAR is higher in May, Jun.

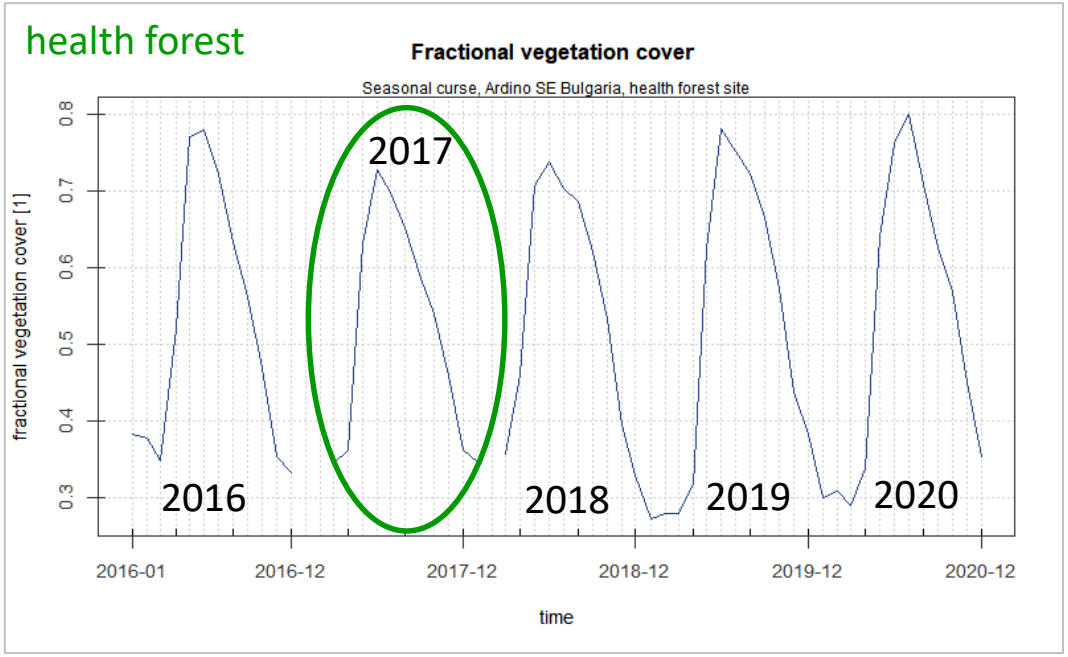
In Jul it declines.

ill forest



LSASAF FVC course 2016-2020

health forest



health forest

- FVC becomes lower for 2017 (*after the snowfall injuries*).
- After that recovers up to higher values around 0.8 (for 2020).

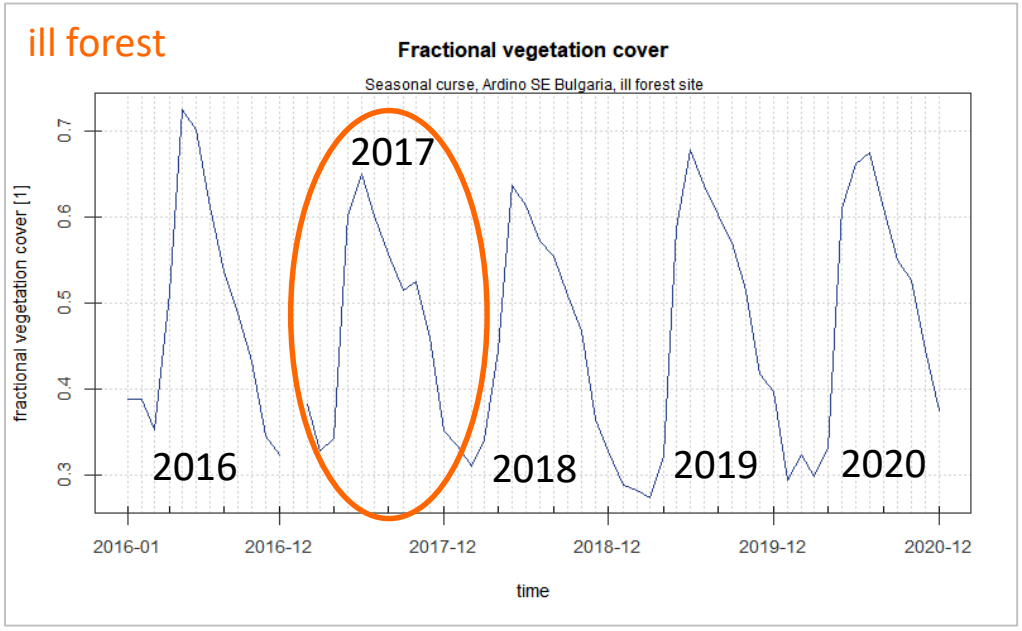
ill forest

- Starting with comparatively close FVC values for 2016, it becomes lower in 2017 and do not recover for subsequent years to initial level.

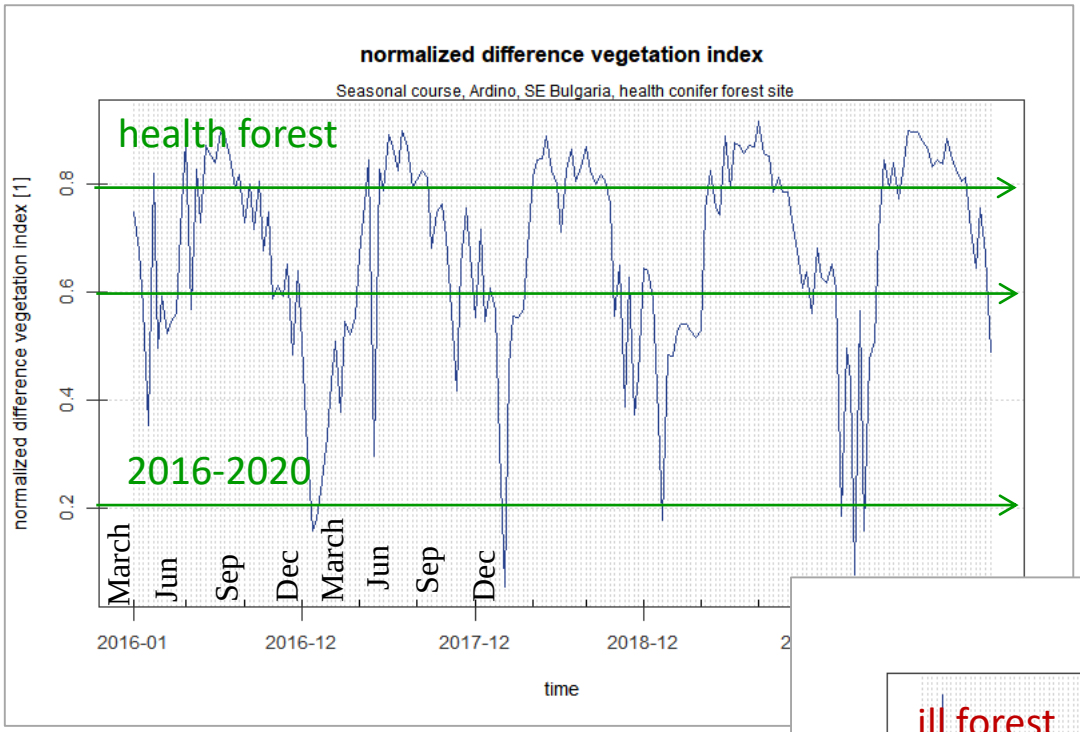
Evaluation of structural capacity of health forest by using D&V Cube.

Analyses of forest drying and decline of related structural characteristics by using D&V Cube.

ill forest



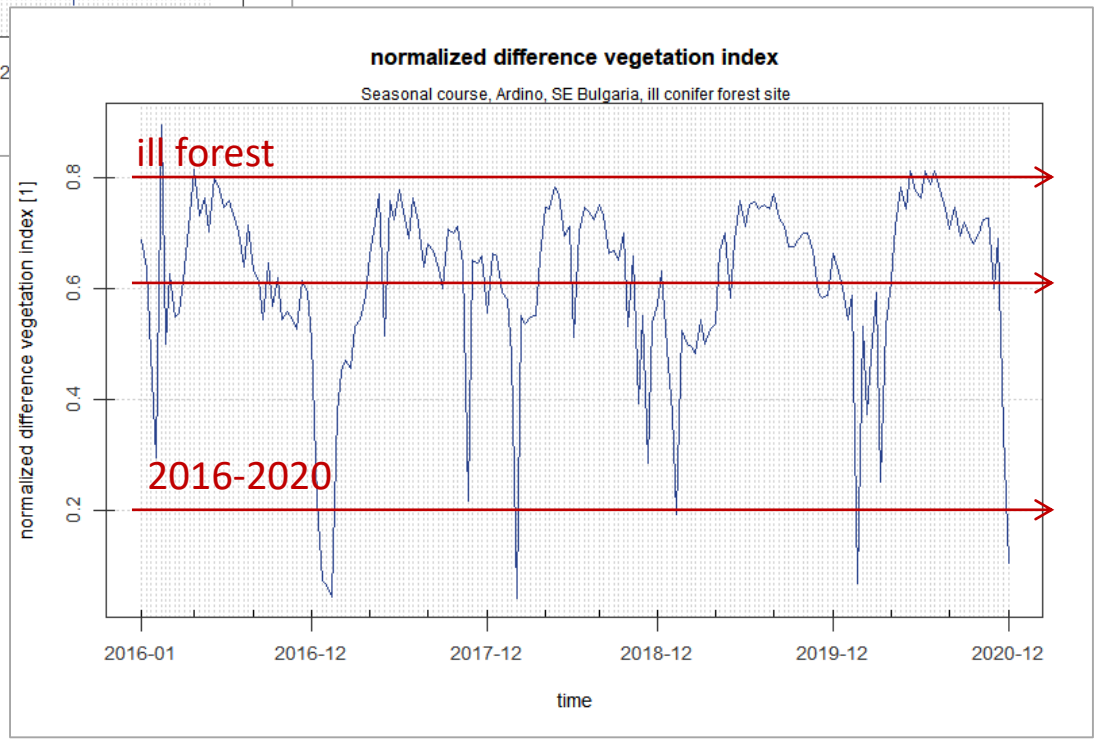
Multy-year monthly means of NDVI at health/ill forest sites



NDVI at the ill forest site has lower values, starting from 0.8 in 2016 and decreasing for 2017, 2018, 2019.

- This implies that the this site is more suseptible to environmental constrains.

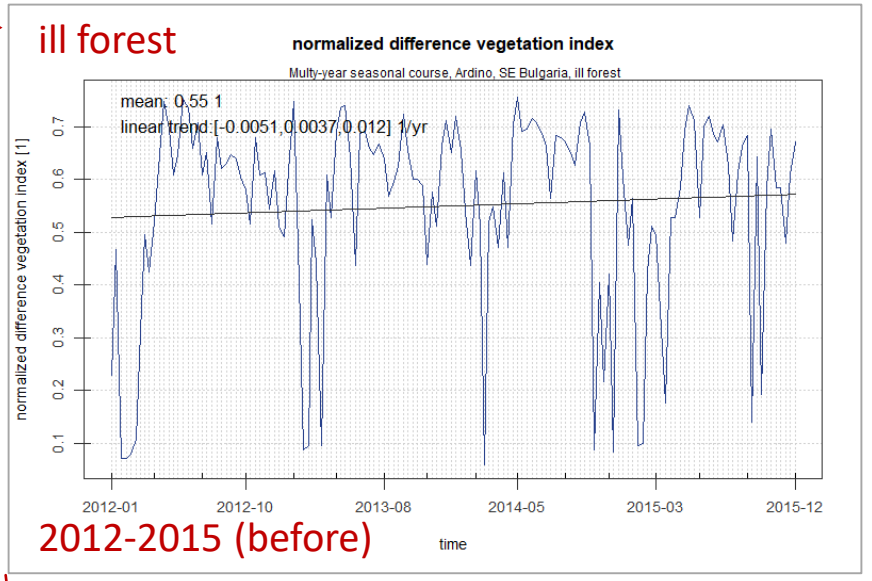
NDVI at health forest site has high values (around 0.9), and remains similar for the whole period 2016-2020.

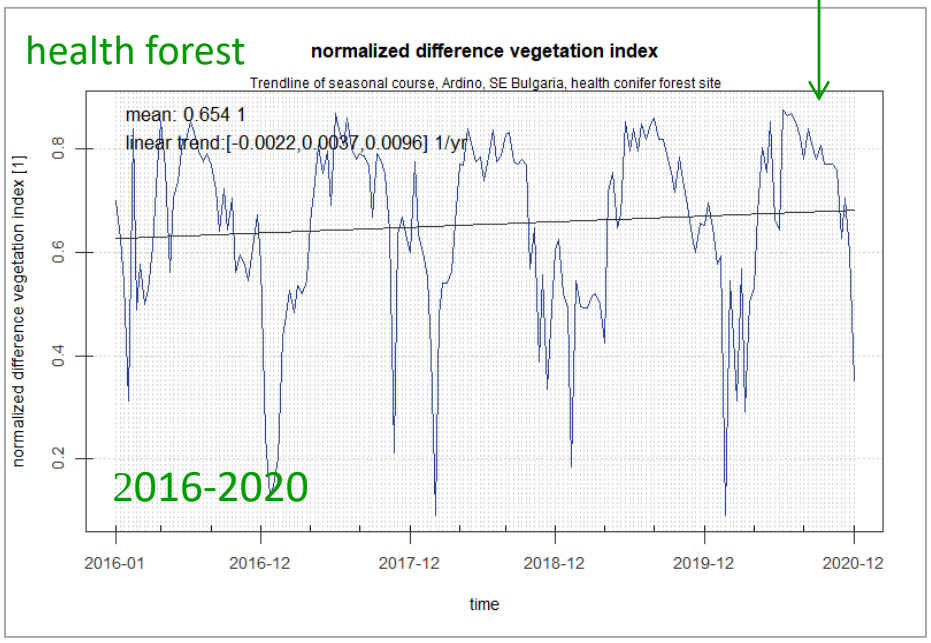


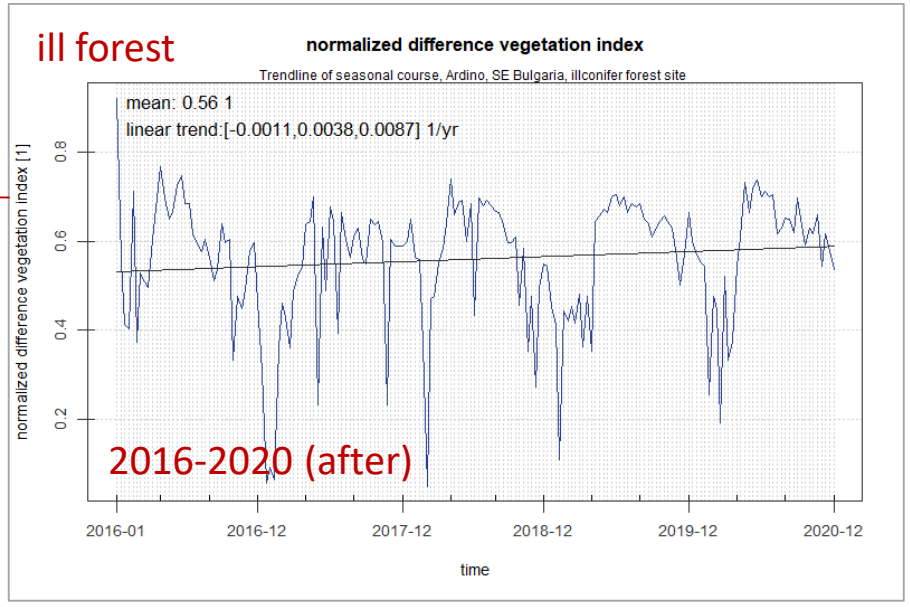
NDVI trend analyses using D&V Cube

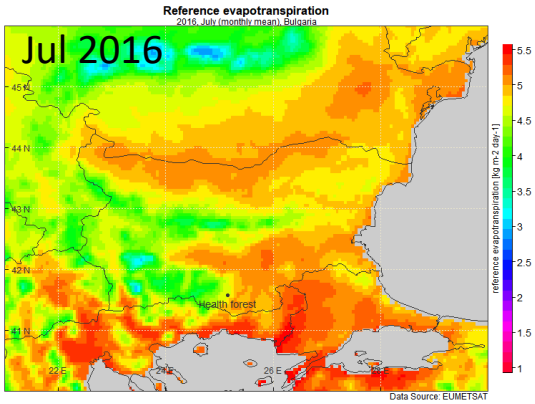
- At ill forest site the NDVI trend analysis before snowfall (2012-2015) is not much differnent from the trend analysis after the snowfall (2016-2020).
- forest injuries are better seen in maximum values of NDVI.

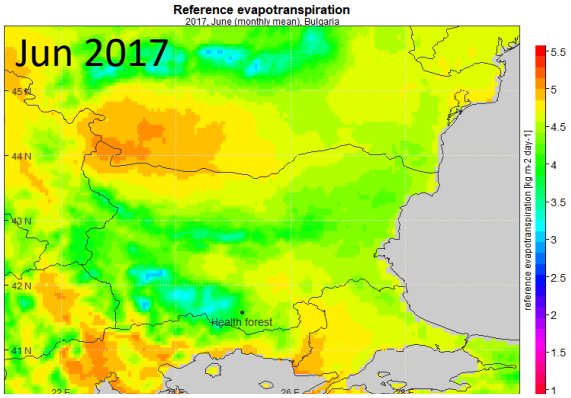
- At health forest site maximum NDVI as well as NDVI positive trend is at much higher level.

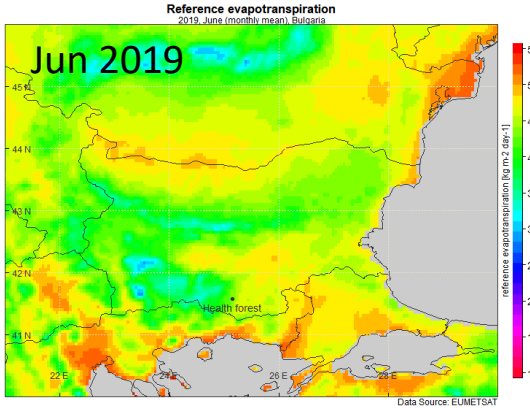


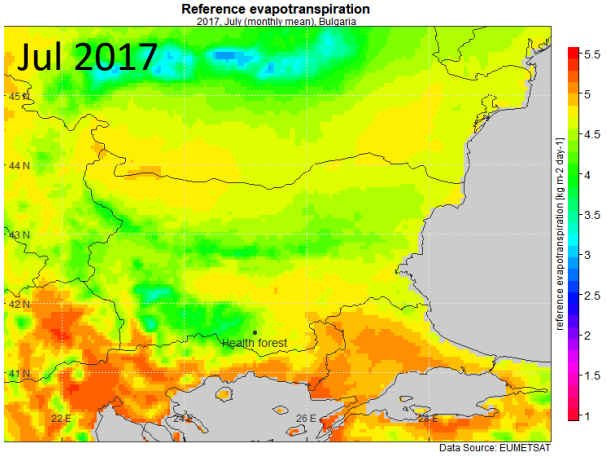


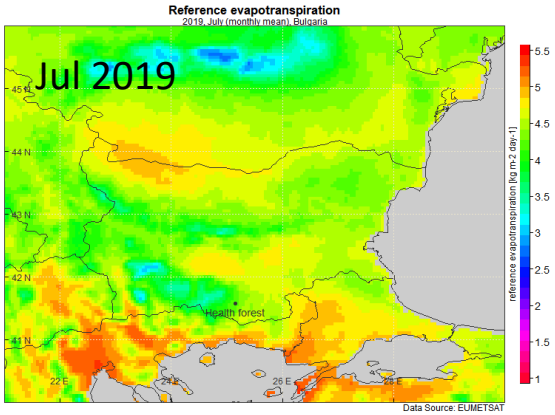












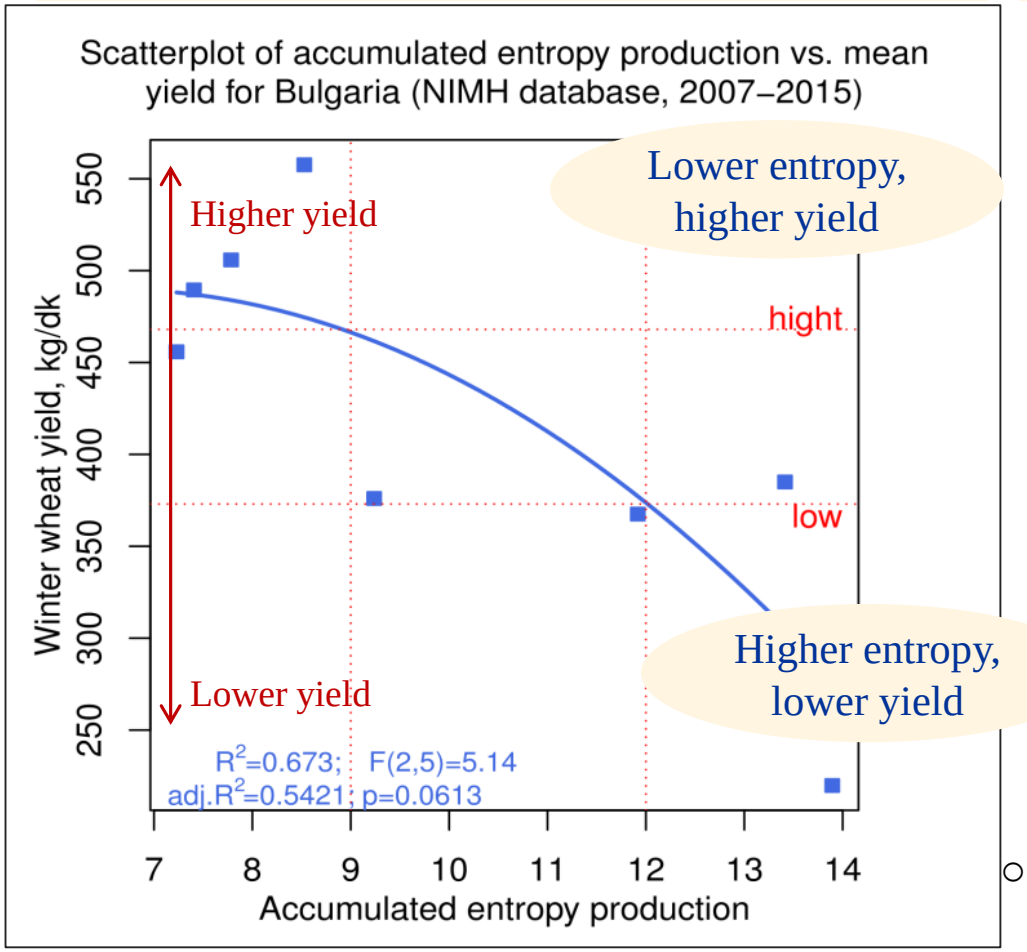
Maps of LSASAF METREF over Bulgaria

D&V Cube applications

- It would be very useful in parallel to METREF to evaluate the water income via precipitation and soil moisture status.
- At this stage DC doesn't provide such possibility because of differences in time/space scale.

❑ Example 2: Drought & Crop Productivity (Yield)

Drought vulnerability and impact assessment

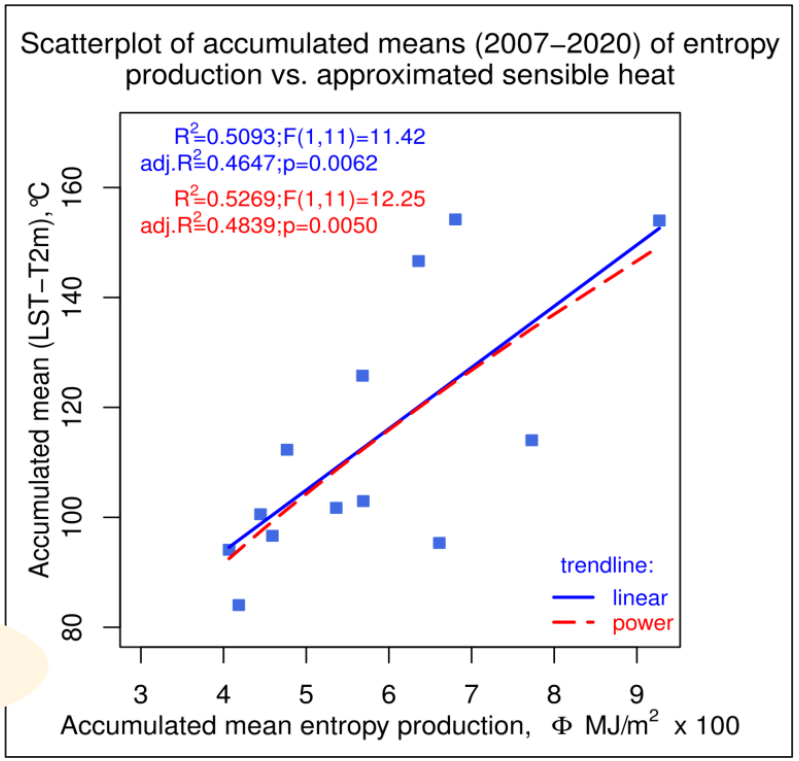


Lower entropy production

Ranking of Entropy production in canopy leaves, Φ – Yield relations

Higher entropy production

Scatterplot of Φ vs. (LSASAF LST-T2m)



Regional (country) level means (2007-2020).

- The surface-air temperature difference (LSASAF LST-T2m) can be used a first order proxy of sensible heat flux, respectively Φ.
- Calculation of (LSASAF LST-T2m) by these parameters from the D&V Cube would be beneficial.

D&V Cube further development

suggestions based on first experience at specific applications

I. Milestones

1. D&V Cube provides data and tools for some climatic analyses and visualization of the results focused on drought problem in its variety of aspects. Allows brief checking of processes, to perform trend analyses, evaluation of site scale processes , complements climatic research techniques.
2. Can provide comprehensive statistical analyses and thus spare time and efforts.
3. Combines information from various sources.
4. Allows an easy and time saving evaluation of a scientific concept prior to more detailed studies.

II. Some Difficulties & Shortcomings

1. We couldn't use the Section Prepare due to the many errors that occurred (*the program gives 'error'* without informative explanations). We start working directly from Analyze Section with data from NetcdfSubset.
2. When selected on a larger dataset, e.g. LST, the system indicates 'time out' and downloading process becomes impossible.

Recomendation: It will be very useful to record a short video tutorial, where the whole process from data downloading to data processing and visualization to be shown. This would allow the process to be repeated by users and to check on the locally built system.

3. Water cycle components - Precipitations and Soil wetness index are not comparable because of different time scale. Precipitation from the Cube has only monthly values; with this space/time resolution it can't be useful in combination with other products?

4. We didn‘t succeed to construct monthly anomalies of some LSASAF products: The system announce ‘error’.

III. Questions/Recommendations

1. Other satellite products and information sources relevant to D&V problem to be included in the Cube
   - AET (LSASAF DMET)
   - The new generated ‘All-weather‘ land surface temperature (LST) product to be considered (*TBD)*.
   - TBD – relevant atmosphere dryness characteristics
   - LSASAF FRP CDR & CO2 Equivalent emissions
   - Gross Primary Productivity is an important climatic parameter (*in the future*)
   - Land Cover map (as ECV)
   - Maps of soil hydrophysical characteristics
2. To have possibility to construct own indexes, e.g.
   - (LSASAF-LST-T2m) is an useful indicator for vegetation stress
   - Some complex climatic indexes for drought assessment, e.g. based on the relations between AET, PET, Soil Moisture to be constructed.
   - Possibilities to construct own LST datasets with different time steps (day/night, daily, monthly…).

3. To improve possibilities for analyses
   - With possibility to overlay on the same plot different parameters/products
   - To compare on the same graphical plot data for more than one selected point for comparison (*plot own location*)
4. To implement improvements in some basic tools to enrich the possible CM SAF R TOOLBOX application.
   - The set of fixed color pallets should be opened for configuration: An option to introduce own user pallet is needed; Each used pallet to be exported in a standard GIS text format; Import of such a standard pallet to be possible.
   - An efficient improvement would be the option of exported GeoTIFF file to be in an extended format by adding to the current 3-colour format additional values with pixel information (coordinates, pixel size) for use in GIS applications.
   - In Rectangular Projection, an option to set the dimension of the image in pixels by Y-axis is needed in addition to the possibility to change the pixel number on X-axis and the ratio.
   - For convenience, Scale Range Min, Scale Range Max, Image Ratio should be saved as user default settings for next applications.
   - To be able to adjust correctly the position of the titles introduced in Subtitle and Scale Caption.

5. To improve the settings options in “Time Series Analysis” of CM SAF R TOOLBOX that will make possible to compare the behavior of the studied parameters.
    - In addition to the dynamic scale applied authomatically on the basis of the variance in the specific parameter, a possibility to set it manually should be develop.
    - there should be a possibility to apply a certain scaling and offset alignment on "y" and "x" to another parameter.
    - In addition to the possibility to adjust the number of major tick it is needed to be able to adjust the number of minor tick marks.
6. To fix problems with some of CM SAF R TOOLBOX applications
    - Impossible to infer monthly anomalies: The Toolbox reports Error in match.arg(units) : 'arg' should be one of “auto”, “secs”, “mins”, “hours”, “days”, “weeks”.
    - In an attempt to avoid this problem trying (anomaly = Actual value – Climatological mean) Toolbox reports Error in arith_wrapper(4, var1, var2, infile1, infile2, outfile, nc34, : Uncompatible time lengths!

Question: How to make reference of output products from the CM SAF R TOOLBOX in papers, presentations, etc.?