
Управа за хидрометеоролошки работи
на Република Македонија
Hidrometeorological service of Republic of Macedonia

Управа за хидрометеоролошки работи УХМР
National Hydrometeorological Service
Republic of Macedonia

BRIEF INFORMATION ABOUT THE SERVICE

- 1891 -1899: The first meteorological measurements and observations in Macedonia were carried out in Skopje
- 1947: The Hydrometeorological Service in Republic of Macedonia was officially established
- 1978: it becomes Republic Hydrometeorological Institute, a governmental organization of special importance for carrying out work in meteorology and hydrology
- 1992: The Law on Hydrometeorological Matters was delivered
- 1993: as independent country, Republic of Macedonia became a permanent member of the WMO
- 1996 to 2001: The first Automatic weather stations AWS were installed.
  Data were collected manually.
  No maintenance and spear parts.
- 2001: part of Ministry of agriculture, forestry and water economy

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Meteorological department \ main activities

- Meteorological data are managed using CLIDATA software.The available period of digitalized data is from 1951 until now.

- Meteorological information are applied in the field of agriculture, forestry, water management, transportation, urbanism, civil engineering, space planning, tourism, protection of environment and human health;

- Agrometeorological information, forecasts on weather and climate influence over agricultural production especially at adverse weather situations (frost, drought and other weather disasters) etc.

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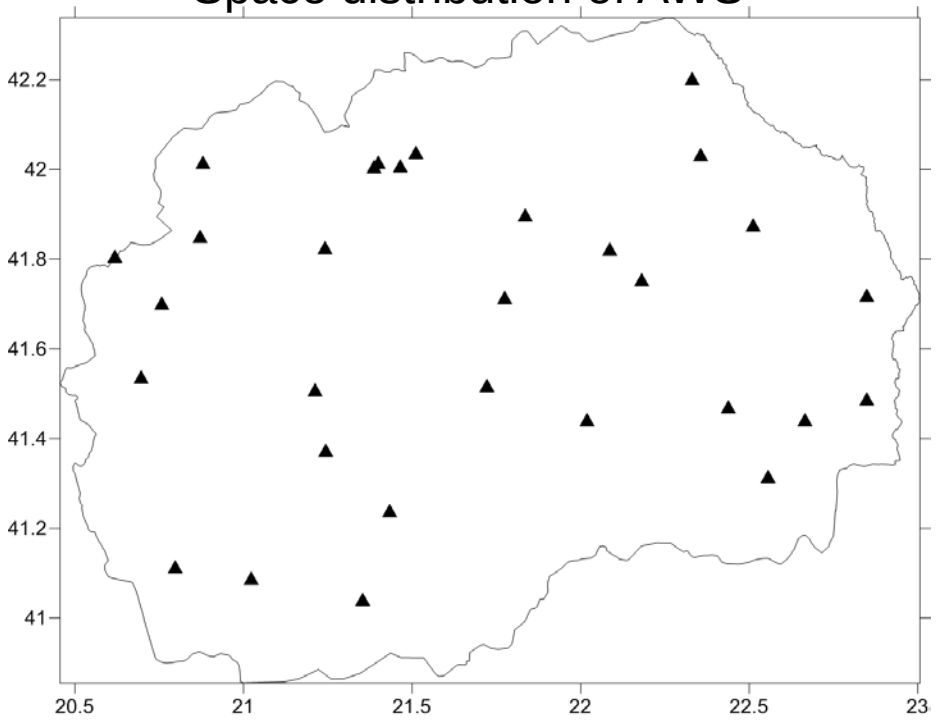
Space distribution of AWS



Meteorological network :

- 19 Main meteorological stations
- (with professional observers)
- 7 Climatological stations
- 24 Phenological stations (3 new)
- 29 AWSs
- 100 Precipitation stations
- 2 Weather radars

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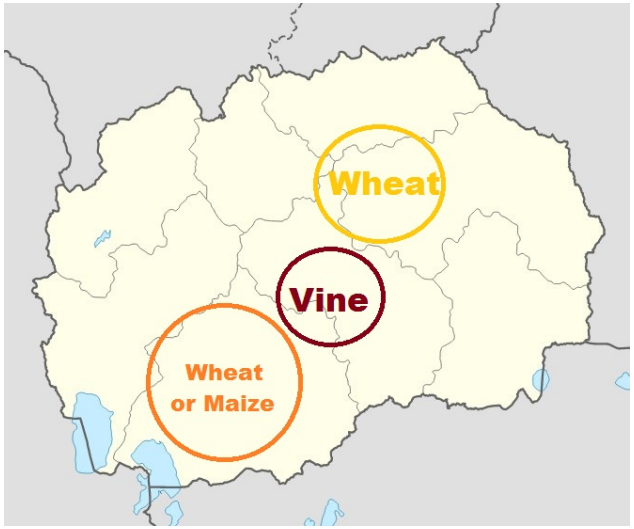
3 regional points for volumetric soil moisture measurement



2 in wheat field
1 in vine field
2 in wheat or maize

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Main characteristics of AWS measurements

Elements	Height of measurement (m)	Sampling (s)	Time averaging/sum (min)
air temperature	2	1	10
air humidity	2	1	10
air pressure	1.5	1	10
ground temp. (-5 cm)	-0.05	1	10
air temperature at 5 cm	0.05	1	10
wind speed	10	1	10
wind directions	10	1	10
wind gust	10	10 minute maximum by moving average with 3 samples	
air t max.	2	10 minute maximum by moving average with 10 samples	
air t min.	2	10 minute minimum by moving average with 10 samples	
rain	1		10
solar radiation	2.5 - 3		10

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Main characteristics of AWS infrastructure

- Data transfer: GPRS, GSM, LAN.
- Data acquisition: every 30 minutes.
- Data archiving: regular import in database (CLIDATA).
- Data export for users: using SQL procedures.
- Distribution data to users: FTP.
- Development of network with standardized sensors and data loggers.

Common problems:

- interruption in communications;
- increased amount of data;
- need of manual control of received data.

System problems:

- lack of spear parts;
- lack of staff;

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Division of Agricultural Meteorology

- Once a week we prepare agrometeorological information about the influence of weather on crops according the general forecast issued by HMS to all media.
- Once a week the agrometeorological information is presented on TV for farmers.
- In case of extraordinary conditions, special warnings are issued
- For insurance companies we provide information on their request
- Students from Faculties for agriculture, forestry and ecology are regular data users
- We prepare decadal agrometeorological bulletins/statistical analysis

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Division of Agricultural Meteorology

- FAO and MAFWE

  Project Title: Reducing Vulnerability of Agriculture to Climate Change

  Goals of the project: To increase institutional capacity of government and other entities to assess climate-change impacts and identify adaptation options and provide improved extension and education materials to farmers.

- **HMS** –Goals of our component: To enhance the technical capacities of the National Hydrometeorological Service (specifically the Agrometeorology Department) to develop climate services tailored to the needs of stakeholders in the agricultural sector and provide early warning.

As part of the Project, three points for installation of AWS are chosen:

- Vine yards – central part
- Rice region – east part
- Organic production – southeastern part of country

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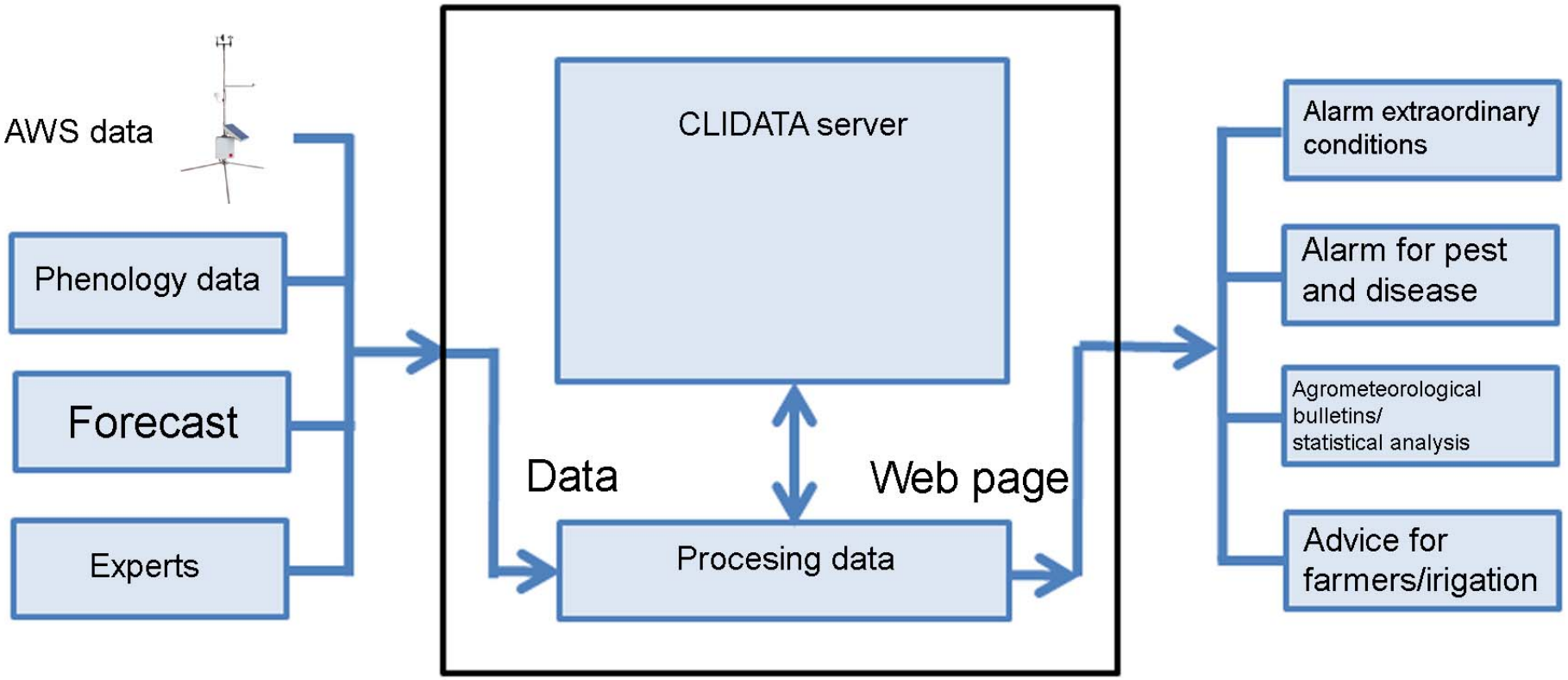

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- Our goal is to provide direct to the users/farmers simple and clear, current and forecasted meteorological information, with tailored information for agro technical field activities.

- Meteo alarms for frost, heat waves, drought, heavy rain, wind and hail, will be issued.

- We plan to have several seminars in order to provide feedback from final users.

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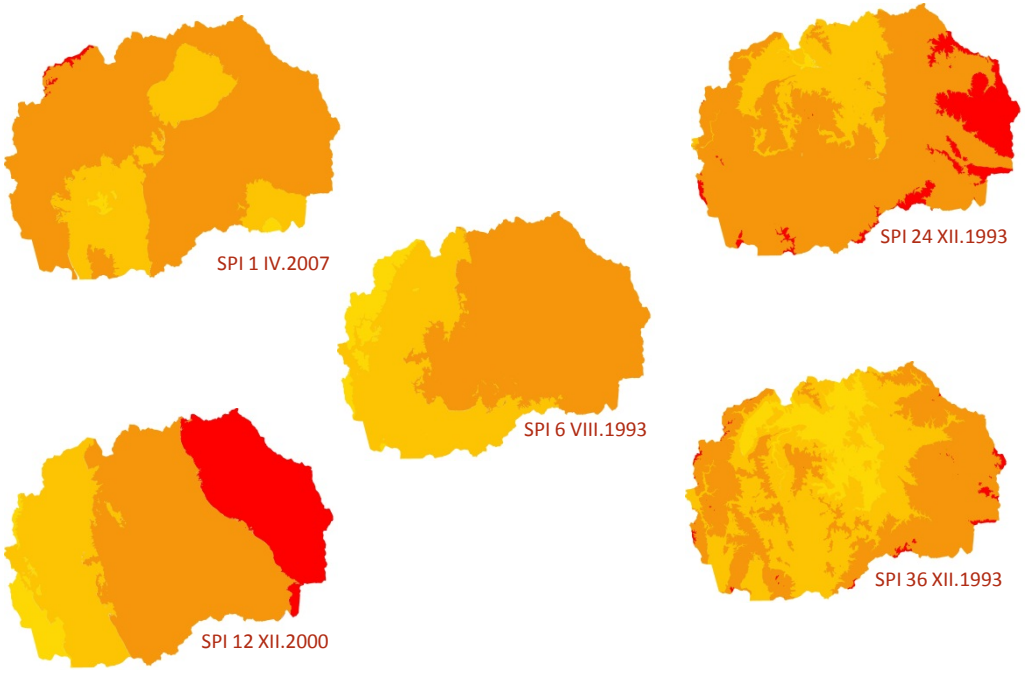
Drought monitoring

SPI Index

SPI values have been calculated for main, climatological and precipitation stations in the Republic of Macedonia (60 stations) for the period 1961-2010 using software provided within the DMCSEE Project. Comparison and analyses have been performed for SPI1, SPI3, SPI6, SPI 12, SPI24 and SPI36.



Category
Exceptional drought
Extreme drought
Severe drought
Moderate drought
Minor drought
Near normal
Slightly increased moisture
Moderately increased moisture
Considerably increased moisture
Extremely wet
Exceptionally wet

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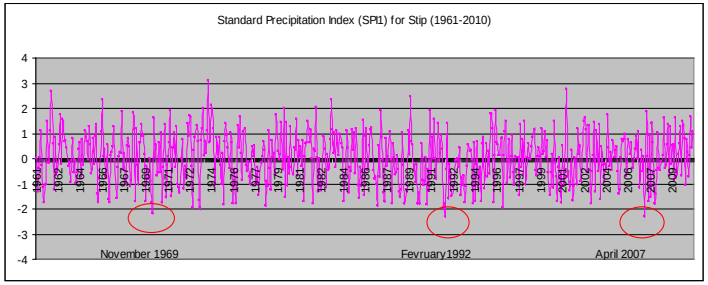
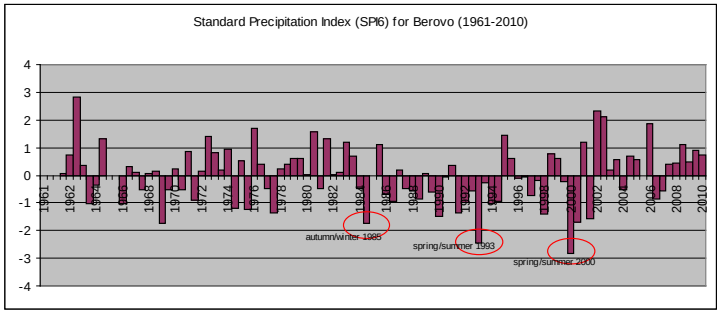
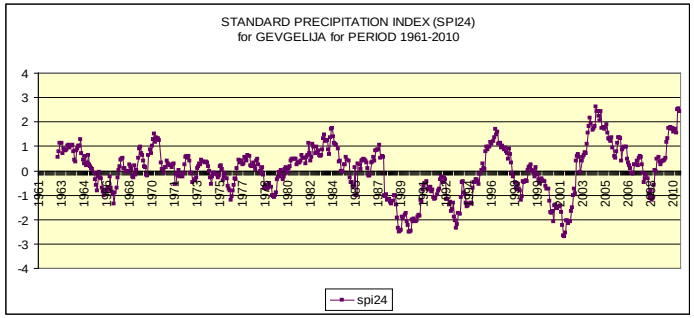
Drought monitoring

- The lowest values for monthly drought (SPI1), showing extreme drought throughout the month are registered in Ovce Pole in April 2007, February 1992 and November 1969.
- Extreme monthly drought was also recorded in December 1992 in Pelagonija, in February 2008 and March 2003 in the Eastern part of the country. April 2004, November 1969 were the driest months in the south part of Macedonia and the western part experienced extreme monthly drought in December 1972.
- SPI 3 values calculated for the annual seasons show that winter 1992, autumn 1969 and spring 2005 the region of Ovce Pole recorded extreme drought.



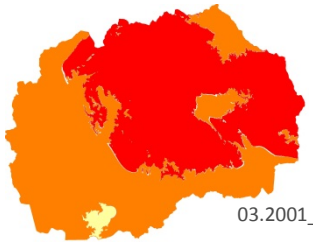




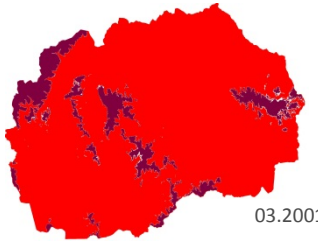
Drought monitoring

Palmer indices

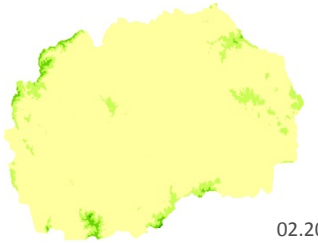
The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The **Palmer Hydrological Drought Index (PHDI)**, another long-term drought index, was developed to quantify these hydrological effects. The PHDI responds more slowly to changing conditions than the PDSI .



03.2001_ZIND

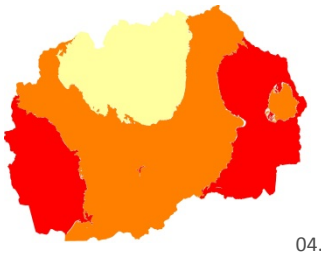


03.2001_PDSI

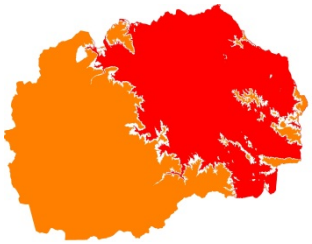


02.2009_PDSI

04.1993_PHDI



04.1993_PDSI



Palmer Indices Legend

- *Extremely moist*
- *Very moist*
- *Moderately moist*
- *Mid-range*
- *Moderate drought*
- *Severe drought*
- *Extreme drought*

	East	East	Northeast	Skopje	Pelagonia	Pelagonia	Southeast	Southeast	Vardar	Southwest	Southwest	Southwest
SPI12	Berovo	Stip	Kriva Palanka	Skopje Petrovec	Bitola	Prilep	Gevgelija	Strumica	Demir Kapija	Lazaropole	Mavrovi Anovi	Ohrid
1963	Exceptionaly wet	Moderately increased moisture	Slightly increased moisture	Exceptionaly wet	Exceptionaly wet	Exceptionaly wet	Considerably increased moisture	Extremely wet	Extremely wet	Exceptionaly wet	Extremely wet	Extremely wet
…												
1990	Extreme drought	Exceptional drought	Exceptional drought	Extreme drought	Extreme drought	Extreme drought	Severe drought	Extreme drought	Exceptional drought	Extreme drought	Moderate drought	Extreme drought
…												
1993	Exceptional drought	Exceptional drought	Exceptional drought	Minor drought	Severe drought	Extreme drought	Extreme drought	Exceptional drought	Extreme drought	Minor drought	Moderate drought	Extreme drought
…												
2000	Extreme drought	Moderate drought	Moderate drought	Minor drought	Minor drought	Severe drought	Severe drought	Minor drought	Moderate drought	Near normal	Minor drought	Near normal
2001	Near normal	Moderate drought	Moderate drought	Severe drought	Severe drought	Minor drought	Minor drought	Severe drought	Minor drought	Severe drought	Severe drought	Minor drought
…												
	Considerably increased moisture	Slightly increased moisture	Extremely wet	Moderately increased moisture	Considerably increased moisture	Moderately increased moisture	Considerably increased moisture	Slightly increased moisture	Near normal	Extremely wet	Exceptionaly wet	Exceptionaly wet

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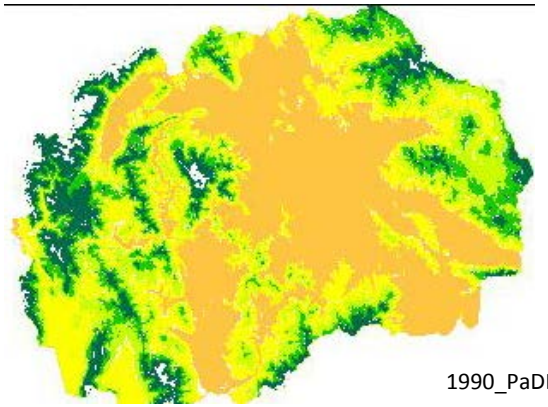
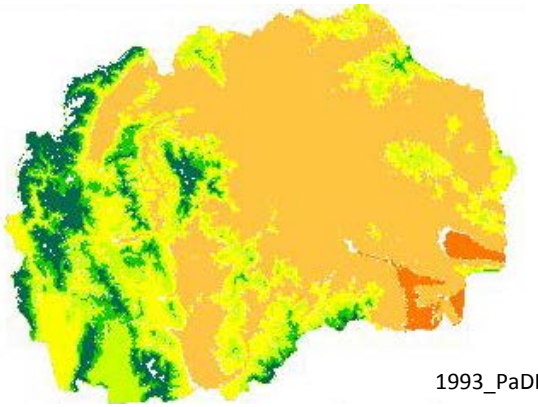
Drought monitoring

Palfai index

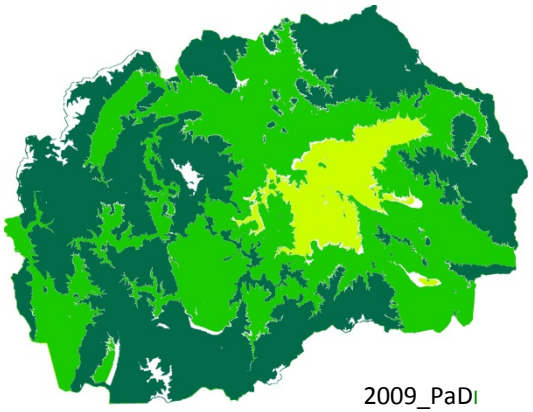
DMCSEE examine the possibility of adaptation of modified PAI for southeast Europe region.
PaDI (Palfai's Drought Index) is a relative indicator, which characterizes the drought with one numerical value in connection with one agricultural year. It expresses the evaporation (temperature) and precipitation relations (the last one with time-varying water demand of plants), and is in consideration of groundwater level state.



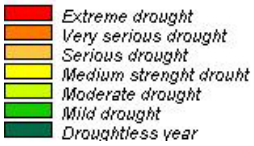
1990_PaDI



1993_PaDI



2009_PaDI



PaDI Index Legend

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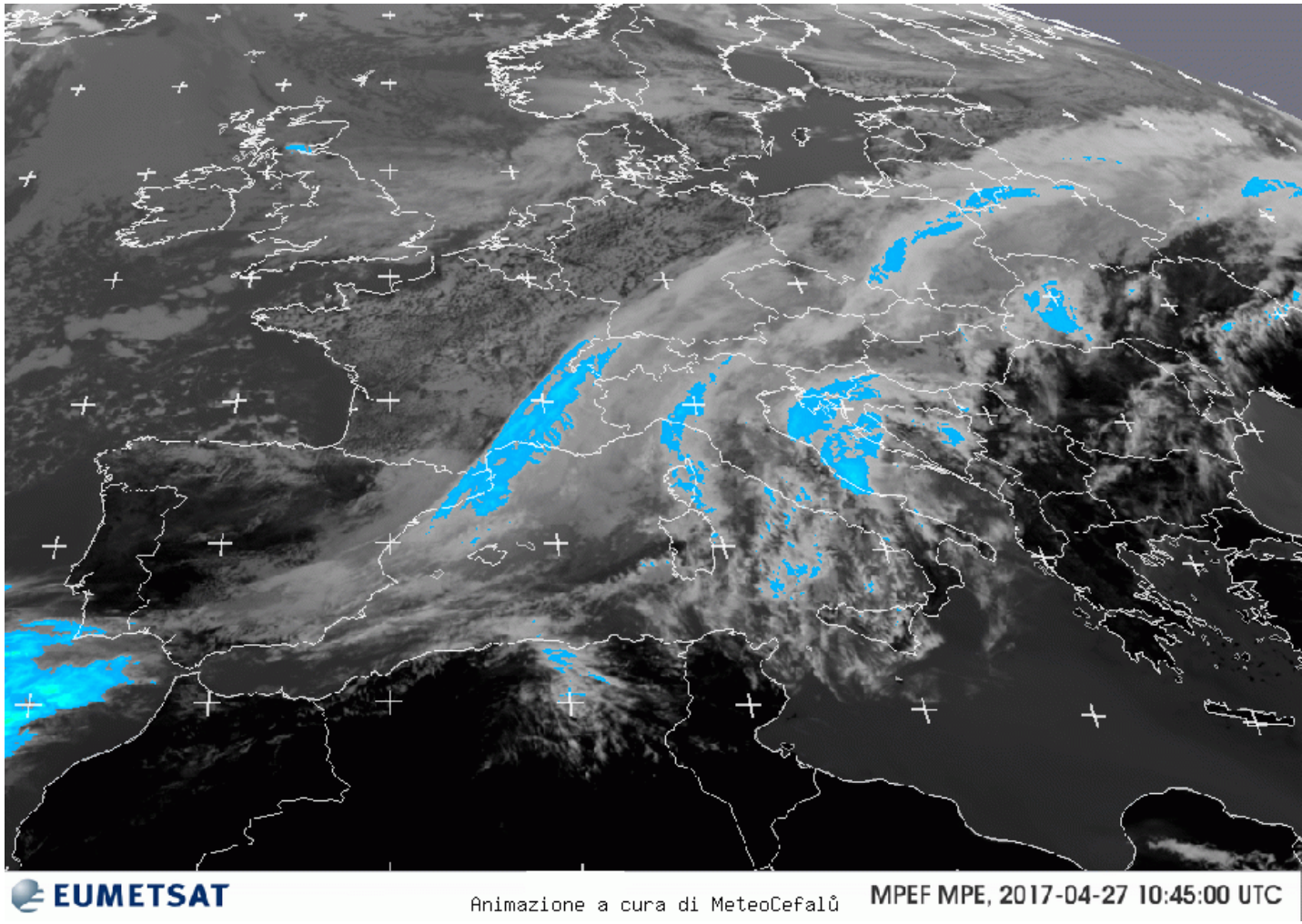
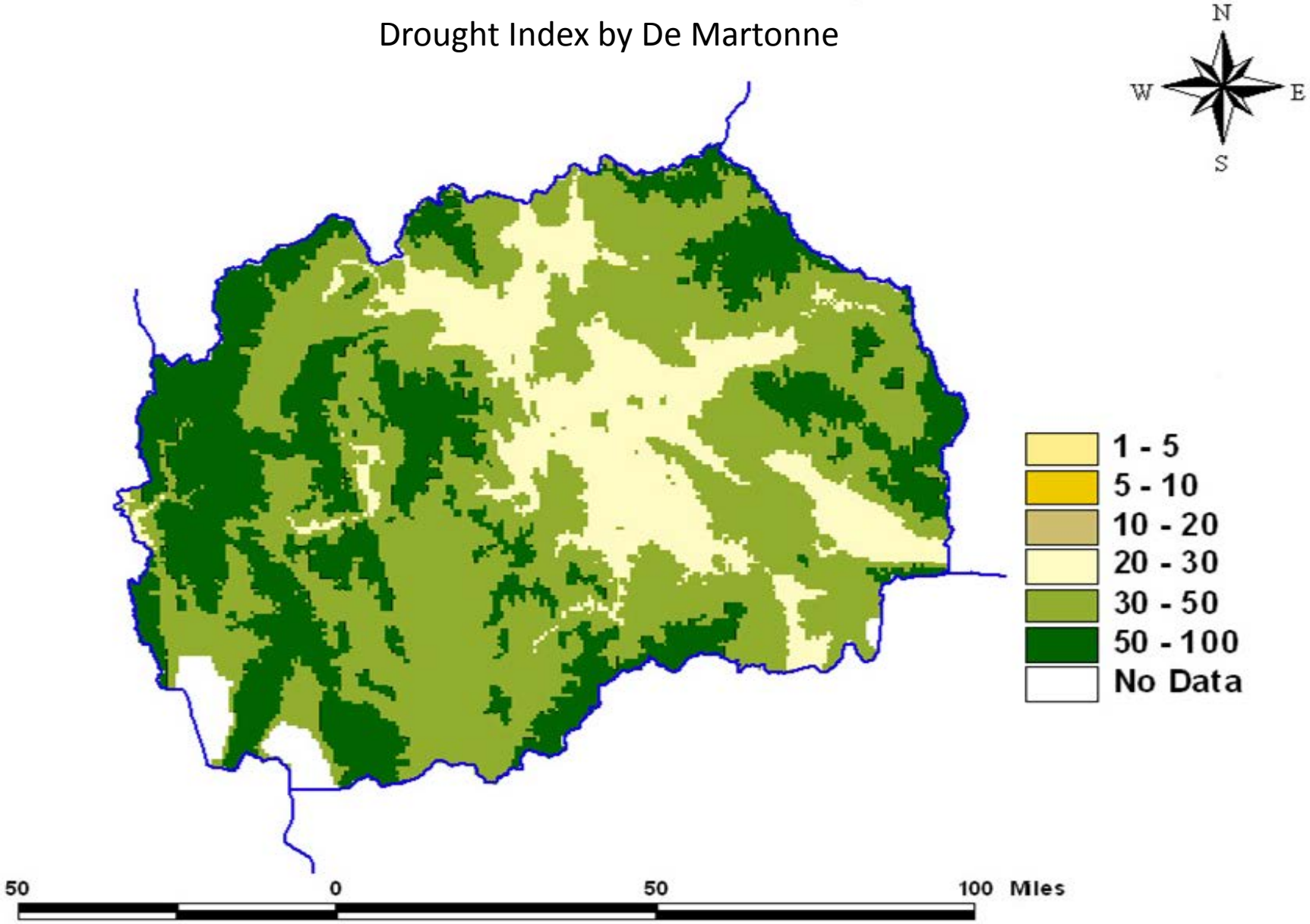
Satellite images from EUMETSAT are used for analyses of weather and nowcasting in the Department for weather forecast.



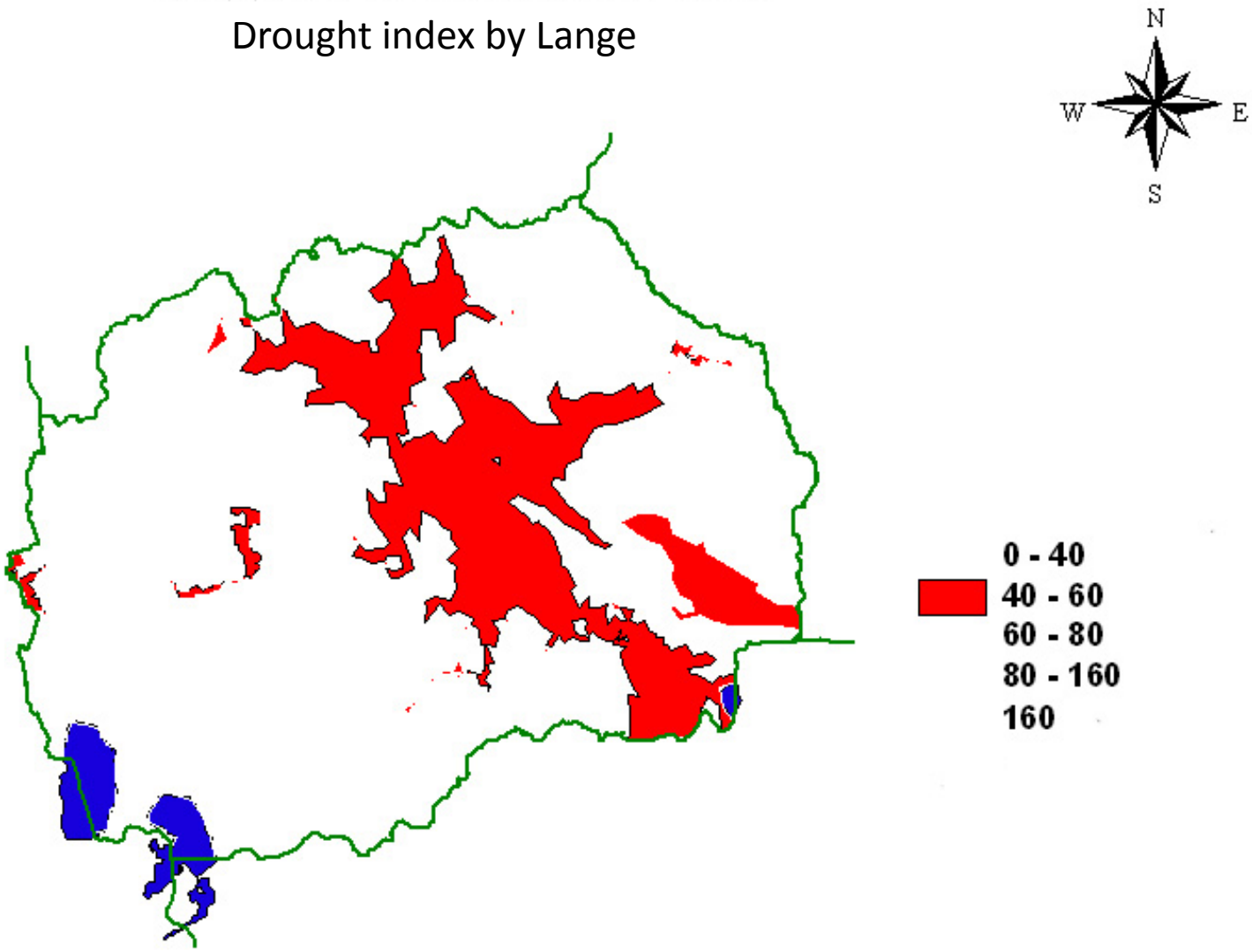
ИНДЕКС НА СУША ПО - Де Мартоне

Drought Index by De Martonne



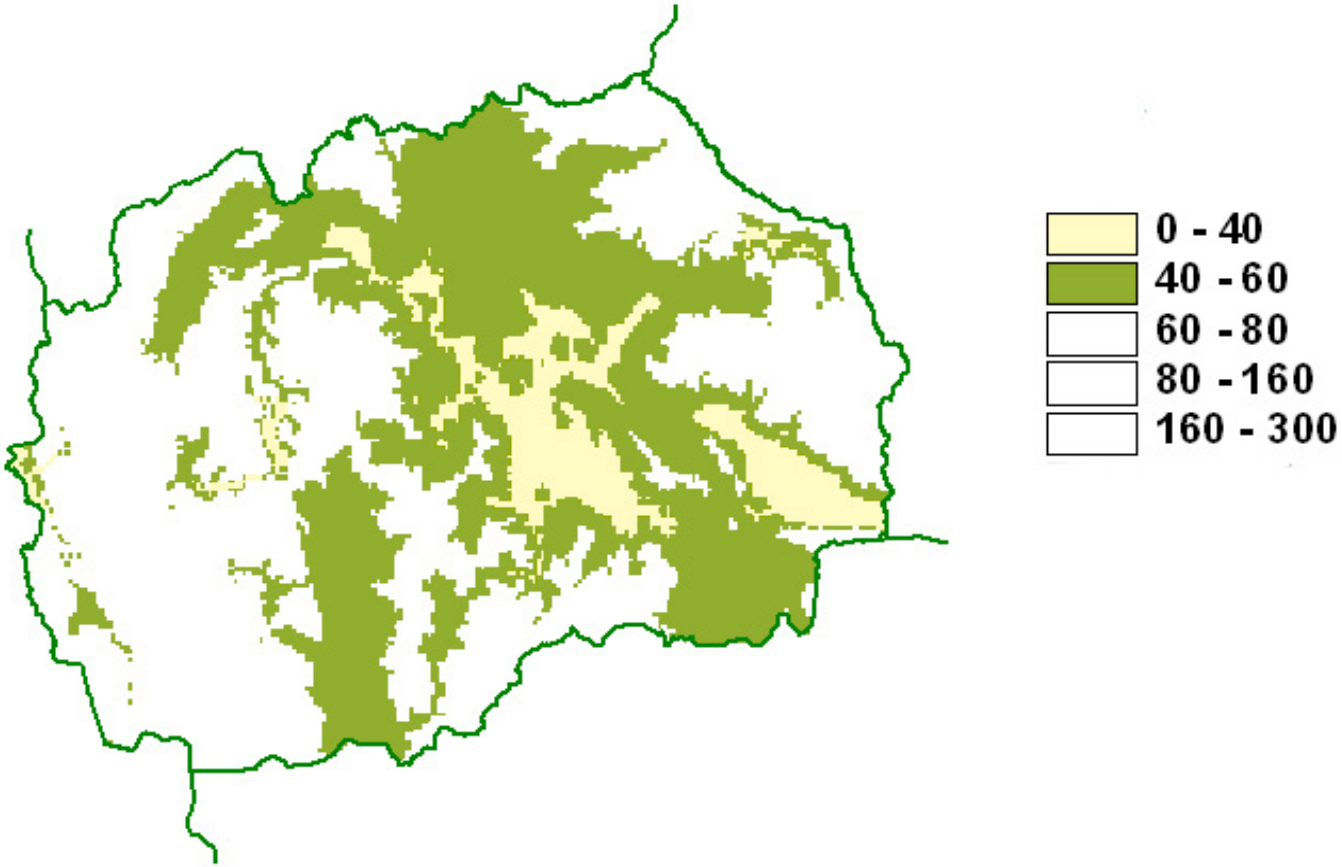
ИНДЕКС НА СУША ПО - Ланг

Drought index by Lange



Региони со сушна и полусушна клима по Ланг
(екстремно сценарио ИС 92а)

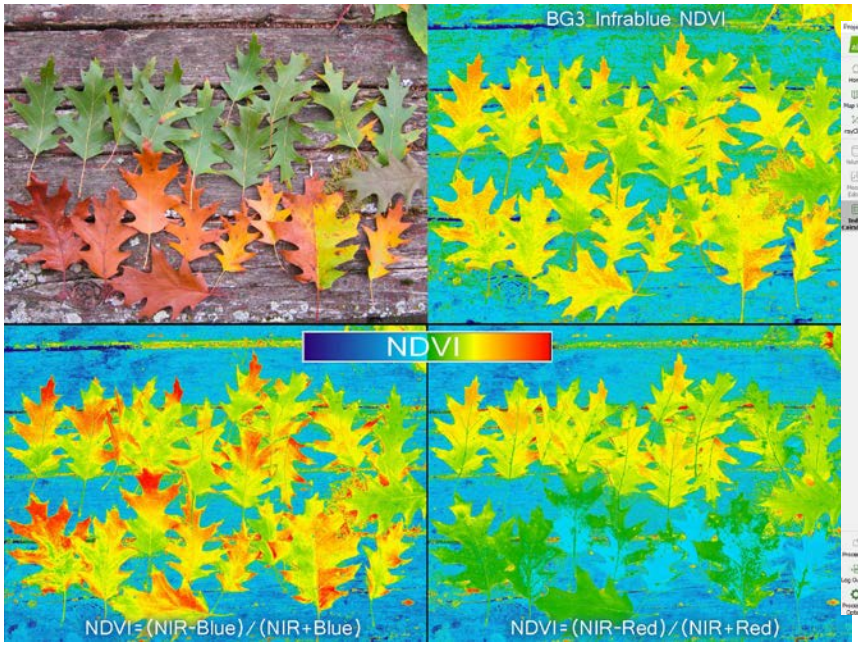
Arid and semi-arid regions by Lange (extreme scenario (IS 92a)

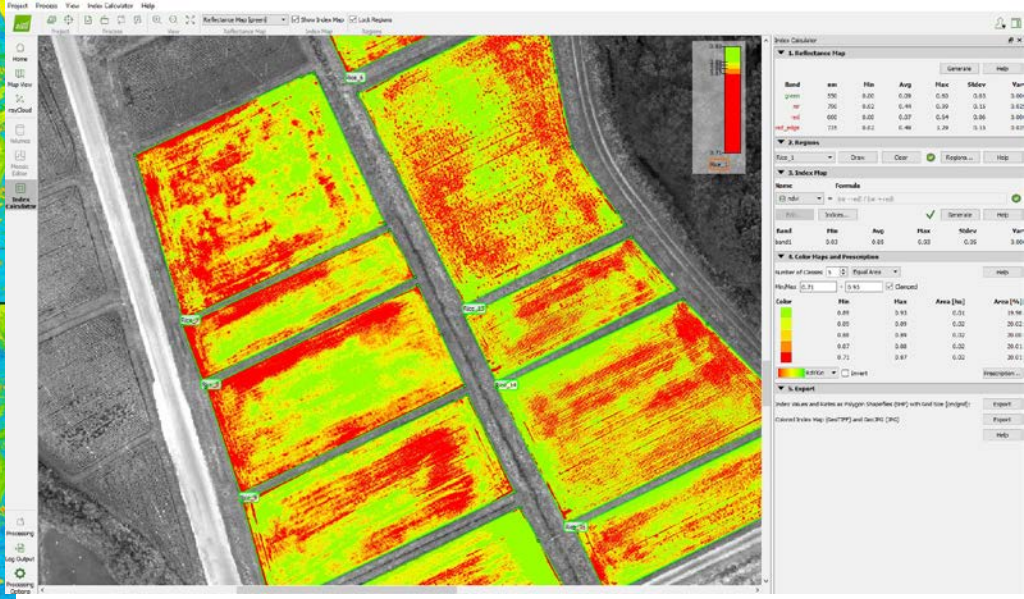


Remote sensing closer look

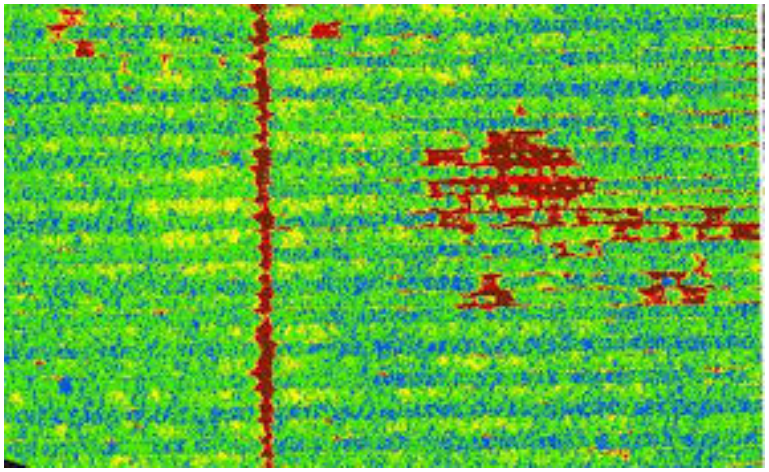
- Small farm size (2ha)
- Small parcel size (0.2 ha)
- Fast development of Unmanned Aerial Vehicles (UAV) – drones
- Easy access to cheap NDVI cameras
- Almost any point and shoot camera can be converted in NDVI camera
- Decreasing of the price of Thermal cameras
- Farmers are interested only in their own parcel
- Hyper spectral cameras and spectral databases on crop protection, soils (type and properties), soil moisture etc.

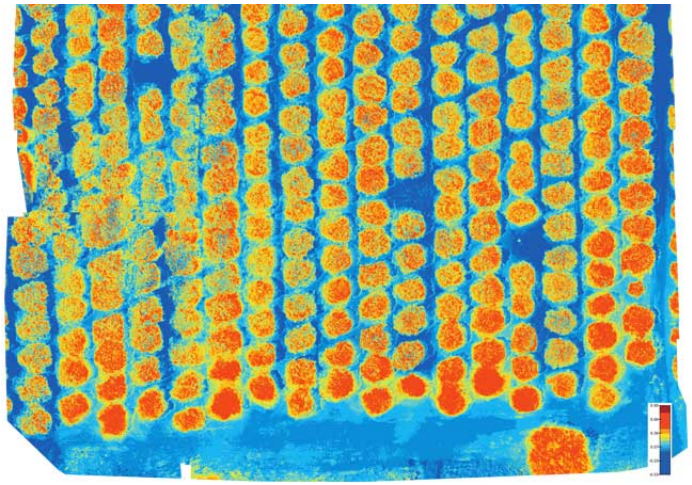
Remote sensing closer look



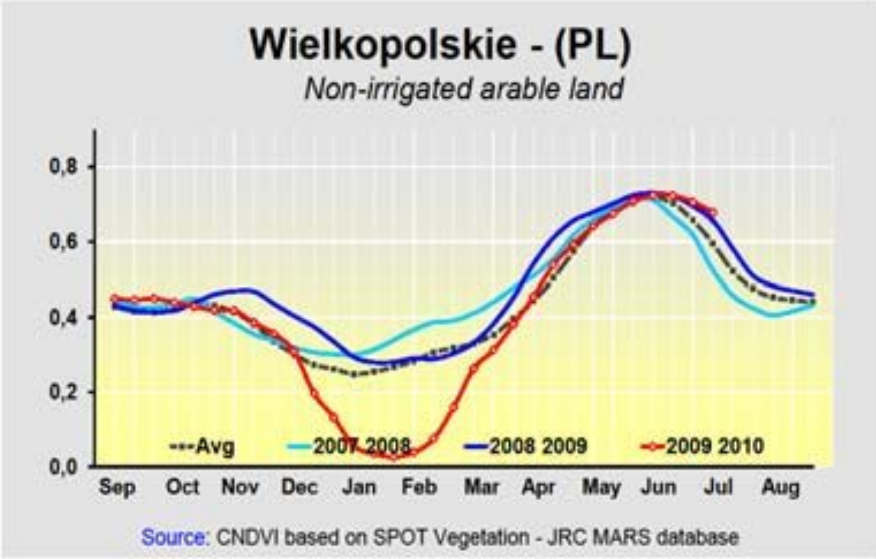


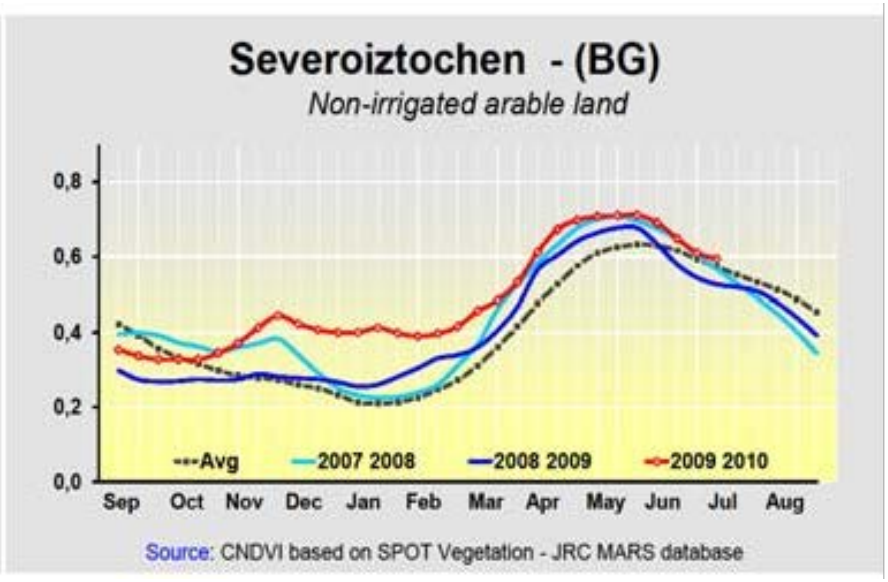
Remote sensing closer look



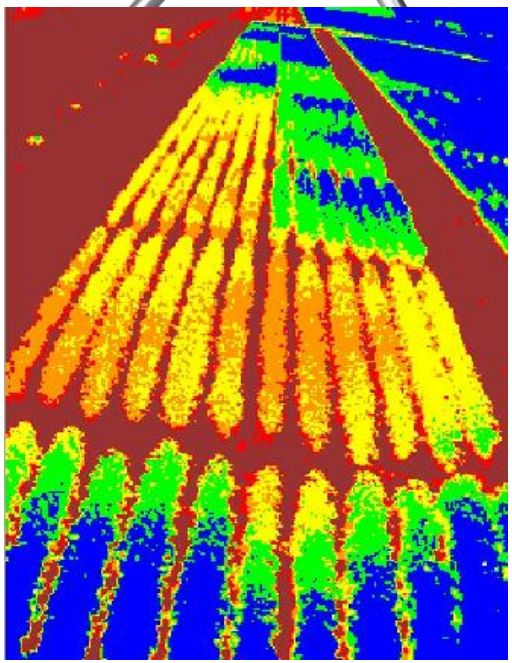


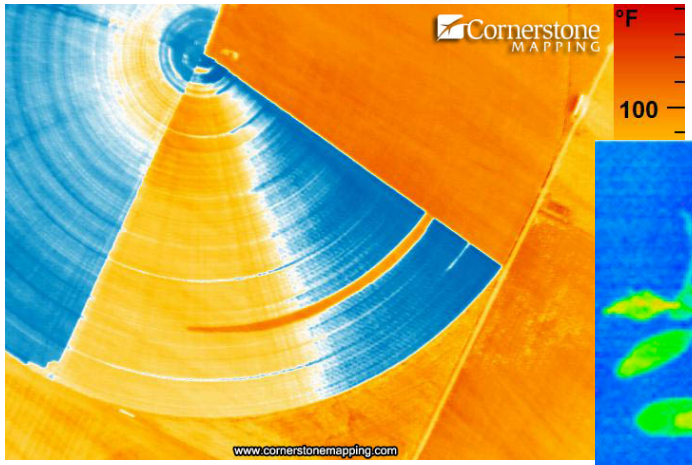
Remote sensing closer look

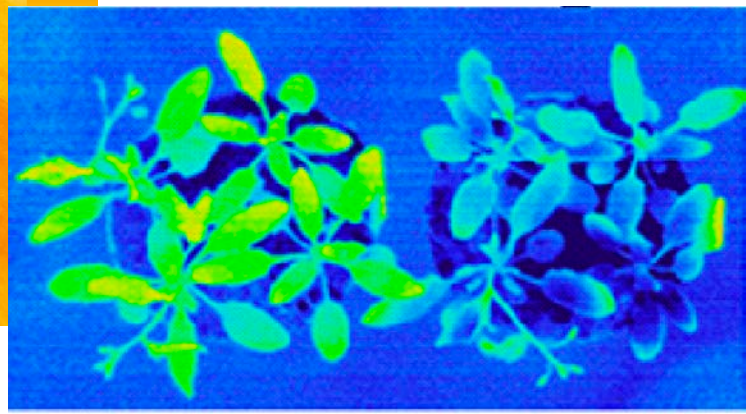




Remote sensing closer look







Remote sensing closer look

- Agriculture need RS, but it should be somehow different for different purposes
- On farm decision making need RS, but also new calibrations, validations, whatever, to become usable for farmers
- NDVI and thermal cameras are already in use, but there is not enough research that can support results
- Hyper spectral cameras are knocking on the agricultural door
- Private companies are developing tools and spectral libraries that will became private property
- Should we join efforts to keep “free data” for agriculture?

Thank you for your attention !