GEWEX - WMO Agriculture

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

Summary

- GEWEX / WMO overviews
- Role of agriculture in hydrological and atmospheric gases cycles
- Drought Management, Climate Smart Agriculture or how to take command of our environment

World Meteorological Organization

- United Nations agency for weather, climate, hydrology and water resources and related environmental issues.

- 191 Members from National Meteorological and Hydrological Services (NMHS) – New Member – South Sudan (Dec 2012)

- 10 major scientific & technical programmes (Secretariat)
- 8 Technical Commissions advise & guide activities of programmes (Experts)
- 6 Regional Associations involved in implementation

WMO Technical Commissions

- Commission for Aeronautical Meteorology (CAeM)
- Commission for Agricultural Meteorology (CAgM)
- Commission for Atmospheric Sciences (CAS)
- Commission for Basic Systems (CBS)
- Commission for Climatology (CCl)
- Commission for Hydrology (CHy)
- Commission for Instruments and Methods of Observation (CIMO)
- Joint WMO-IOC Commission for Oceanography and Marine Meteorology (JCOMM)

COMMISSION FOR AGRICULTURAL METEOROLOGY

President: Byong Lee, Vice-President: Federica Rossi

Management Group (MG)

FOCUS AREAS (FA)

FA 1
Operational Agricultural Meteorology

FA 2
Science and Technology for Agricultural Meteorology

FA 3
Natural Hazards and Climate Change/Variability In Agriculture

FA 4
Capacity Development in Agricultural Meteorology

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GEWEX

Focus areas:

- Water and Energy Cycles and Processes

- Observations and Predictions of Precipitation

- Global Water Resource Systems

- Changes in Climate and Weather Extremes

The Global Energy and Water Cycle Exchanges Project (GEWEX) is an integrated program of research, observations, and science activities that focuses on the atmospheric, terrestrial, radiative, hydrological, coupled processes, and interactions that determine the global and regional hydrological cycle, radiation and energy transitions, and their involvement in climate change.

GEWEX

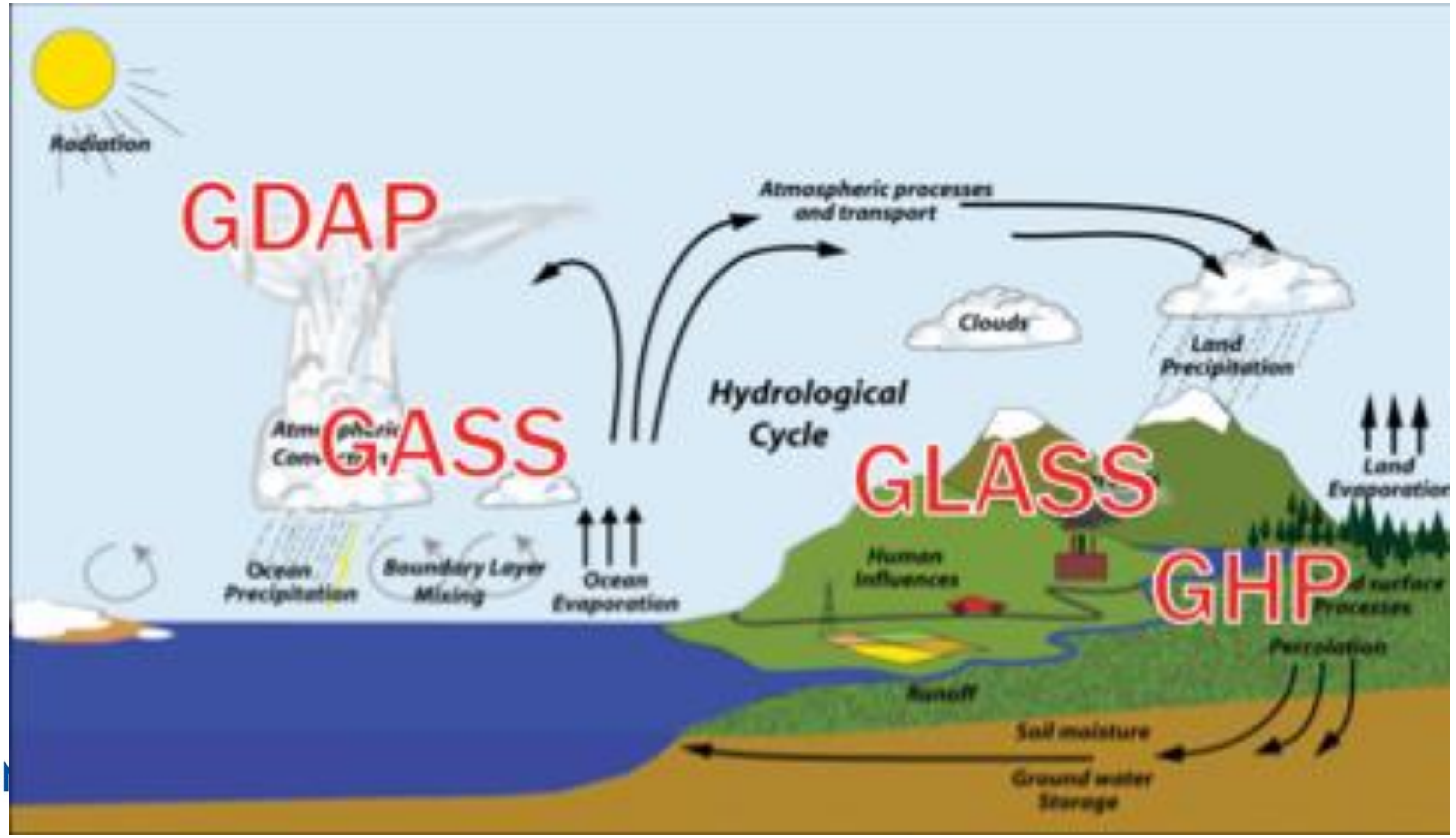
Global Land/Atmosphere System Study Panel

Global Atmospheric System Studies Panel

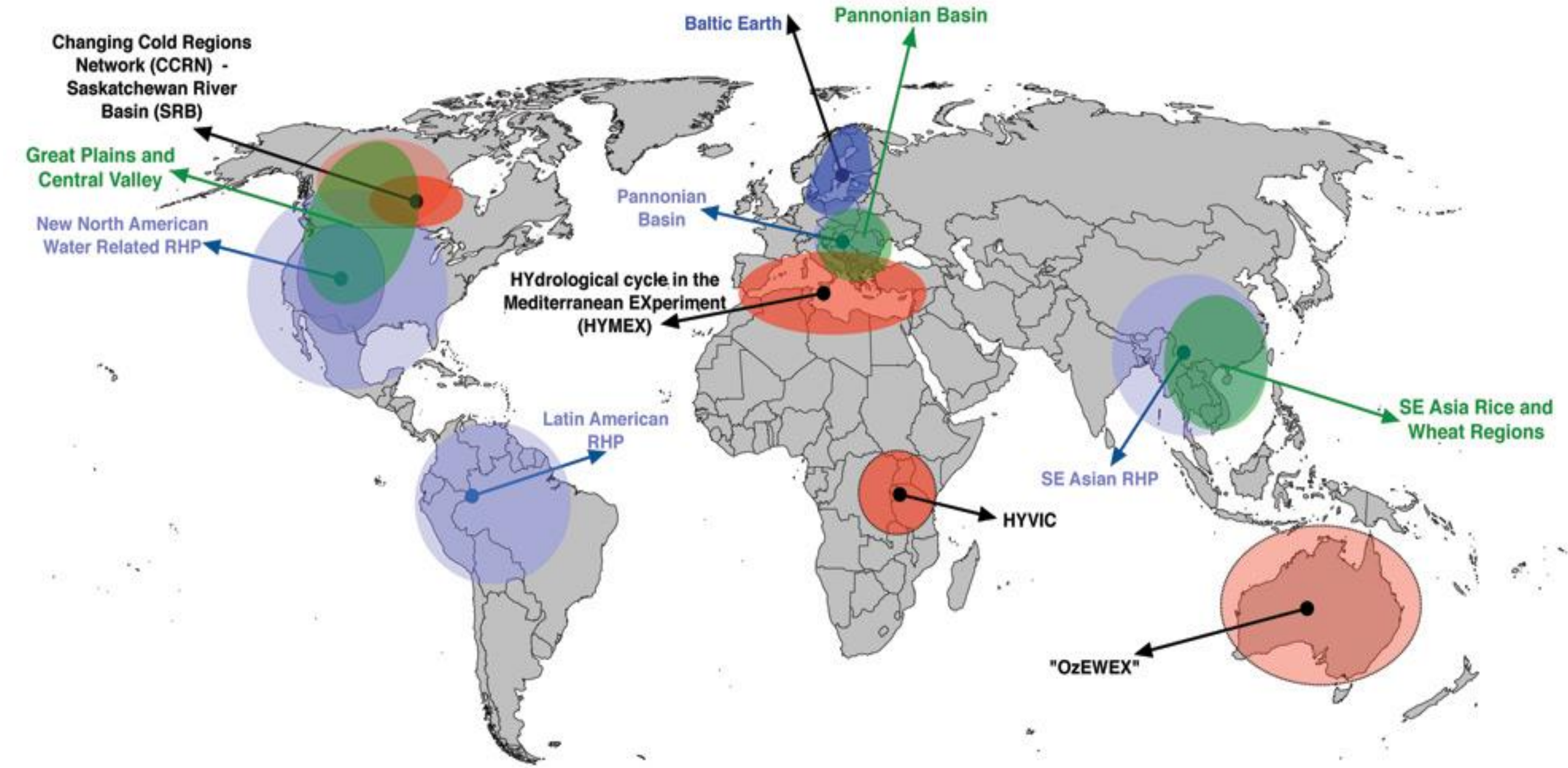
GEWEX Hydroclimatology Panel

GEWEX Data and Assessments Panel

GEWEX panels:



Regional Hydroclimate Projects



Fully working: HyMeX, CCRN
Initiating: HYVIC, OzEWEX
Prospective: PannEx, Baltic Earth
First contacts: Asia, USA, South America

Role of agriculture in water and gases cycles

Water use in agriculture in Africa (source FAO)

Water withdrawal refer to the gross quantity of water withdrawn annually for a given use including the three large water-consuming sectors: agriculture (irrigation and livestock watering), water supply (domestic/municipal use), and industry.

Total water withdrawal per year for Africa is 215 km^3, or barely 5.5 percent of the renewable water resources on the continent and less than 6 percent of world withdrawals . On a continental scale, 86 percent of inventoried withdrawals are used for agriculture, a value higher than the global agricultural water withdrawal (70 percent).

However, this figure varies substantially at regional level. The Sudano-Sahelian and the Indian Ocean Islands Regions have the highest levels of agricultural withdrawals (95 and 94 percent, respectively, of the total regional water withdrawal), while the Central Region uses only 56 percent of its withdrawals for agriculture.

The annual precipitation in this region allows rainfed agriculture, which is not feasible in the dry countries. Generally speaking, as in 1995, these are the countries that withdraw the highest volumes of water. Indeed, about 70 percent of Africa’s total water withdrawal is concentrated in the Northern and the Sudano-Sahelian Regions. These two regions cover nearly half of the continent (48 percent) and account for two-thirds of the irrigated areas (67 percent).

Water withdrawals per inhabitant are 247 m^3/year, but this average conceals significant variations both between and within regions. They range from 21 m^3/inhabitant/year in the Central Region to 786 m^3/inhabitant/year in the Indian Ocean Islands Region . The region whose rate of water withdrawal (as a function of internal renewable water resources) is the lowest is the Central Region (0.1 percent), while the region with the highest rate of water withdrawal is the Northern Region (200 percent) (Figure 11). This latter rate is induced by the contribution and the use of water resources from outside the region (water from the Nile River in Egypt), and to a lesser extent by the use of non-renewable water resources (in Algeria and Libyan Arab Jamahiriya).

Water use in agriculture in SE Asia (source FAO)

Total annual water withdrawal for the Southern and Eastern Asia region is almost 1 981 km3, which is around 50 percent of world withdrawals . It should be noted here that the total population of the region is more than half the world population. About 82 percent of inventoried withdrawals are by agriculture, which is higher than the value for global agricultural water withdrawal (70 percent). However, this figure varies by country. In 14 out of 22 countries in the region agricultural withdrawal accounts for more than 80 percent of the total water withdrawal, with more than 95 percent in Viet Nam and Nepal, while in Malaysia and Mongolia it represents less than 50 percent, and in the Maldives and Papua New Guinea 0 percent. The Mainland Southeast Asia and South Asia countries use on average 92 and 91 percent respectively of their withdrawal for agriculture while Maritime Southeast Asia countries use 79 percent and East Asia countries use only 65 percent.

India and China with a water withdrawal of 761 km3 and 554 km3 respectively cover the highest withdrawals in the world, accounting for 19 percent and 14 percent of the total respectively, while in the Southern and Eastern Asia region they represent 38 and 28 percent respectively of total withdrawal. Water withdrawal per inhabitant is 560 m3/year, but this average conceals significant variations between countries. The figure ranges from 10 and 60 m3/inhabitant in the Maldives and Papua New Guinea respectively to 1 037 m3/inhabitant in Pakistan and 1 232 m3/inhabitant in Timor-Leste (Figure 10).

Agricultural water withdrawal expressed in m3 per hectare of irrigated land: Gross average for the region is 8 960 m3/ha/year. Figures for China and India, which together represent 64 percent of the region's agricultural water withdrawal, are: 5 700 and 10 400 m3/ha of irrigated land respectively. However, other countries show much higher values, as for Viet Nam, Republic of Korea, Sri Lanka, Timor-Leste and the Philippines where agricultural water withdrawal is between 15 000 and 35 000 m3/ha/year.

Considering the 13 countries out of 22 in the region, for which data on surface water and groundwater withdrawal is available, surface water withdrawal represents 75 percent of the freshwater withdrawal and groundwater 25 percent.

Water use in Eastern Europe (source FAO)

Total annual water withdrawal for the Eastern Europe region is 81 024 million m^3, which is 2.0 percent of world withdrawals. The Russian Federation, with 61 000 million m^3, has the highest withdrawal, accounting for 75 percent of the total. Latvia and Lithuania have the lowest withdrawal with 248 million m^3, or 0.3 percent, and 631 million m^3, or 6 percent, respectively of the total withdrawals in the region. Water withdrawal per inhabitant is 387 m^3 per year, ranging from 126 m^3 in Latvia to 1 310 m^3 in Estonia.

About 58 percent of inventoried withdrawal is water withdrawn by the industrial sector, which is much higher than the value for global industrial water withdrawal (19 percent). Industrial withdrawal accounts for the higher percentage of total water withdrawal in all countries except Belarus, where it represents 32 percent, and Latvia, where it represents 21 percent of the total. The high figure for Estonia is related to the high figure for cooling of thermoelectric power plants (accounting for almost 90 percent of the industrial water withdrawal), provided by Estonia.

Agricultural water withdrawal accounts for 21 percent of total water withdrawal in the region. At country level it is relatively more significant in Belarus and Ukraine, accounting for 32 percent and 30 percent respectively of the total withdrawal in the country. In the other five countries agricultural water withdrawal varies from 20 percent in the Russian Federation to less than 1 percent in Estonia.

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Water use for agriculture in Hungary

(source Hungarian Central Statistical Office)

4.1.11. Water use in agriculture (2000–2014)

Denomination	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Water sales for irrigation, million cu. m.	215.8	110.7	157.7	189.2	109.0	56.8	69.9	162.7	143.3	161.1	55.0	105.2	192.0	282.3	173.0
Of which:															
for the production of rice	35.8	32.7	30.5	28.0	22.0	18.2	24.5	35.5	32.9	21.4	13.0	31.0	35.0	32.1	29.0
Water sales for fishponds, million cu. m	351.3	335.3	315.6	314.0	272.0	302.3	244.7	265.7	297.8	305.1	206.2	281.8	239.0	275.5	320.4
Area with irrigation licence, thousand hectares	235.5	231.2	225.1	225.8	226.0	223.1	199.7	188.8	208.1	202.1	173.8	182.5	190.6	168.3	222.8
Of which:															
irrigated	125.3	105.3	123.4	126.9	93.0	68.4	68.4	82.1	93.7	99.7	54.6	72.7	106.5	95.8	130.4
Area of fishponds with licence, thousand hectares	31.5	31.1	31.1	30.0	29.0	33.9	33.0	28.3	32.1	33.9	37.6	50.2	38.5	30.2	36.2
Area of operating fishponds, thousand hectares	28.1	27.5	26.5	26.6	20.0	28.3	25.3	24.5	25.9	28.6	27.4	26.4	31.8	26.1	32.5

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Cereal production in Hungary

(source Hungarian Central Statistical Office)

4.1.13. Production and use of main cereals (2013–2015)

Denomination	Cereals, total			Wheat			Maize		
	2013	2014	2015	2013	2014	2015	2013	2014	2015
Characteristics of production									
Harvested area, hectare	2,816,936	2,817,265	2,697,704	1,090,480	1,112,730	1,029,318	1,242,605	1,191,420	1,146,127
Total harvested production, ton	13,609,908	16,613,380	14,145,172	5,058,301	5,261,890	5,331,426	6,756,435	9,315,104	6,632,783
Average yield, kilogram/hectare	4,830	5,900	5,240	4,640	4,730	5,180	5,440	7,820	5,790
Average procurement price, HUF per ton	–	–	–	47,752	48,389	48,652	48,792	41,498	42,494
seed for sowing	–	–	–	74,383	56,388	61,743	387,243	257,151	271,816
for human consumption and for industrial purposes	–	–	–	48,266	49,876	53,319	48,933	39,113	42,729
fodder	–	–	–	46,253	45,533	45,625	45,455	39,431	41,609
Value of gross production, million HUF									
at current prices	680,757	742,209	651,420	250,119	256,290	263,960	342,856	392,623	289,492
at constant prices	812,462	835,885	635,491	309,154	260,022	261,588	398,418	474,718	273,970
$Consolidated balance sheet, tons									
Initial stock	6,621,092	7,666,055	11,535,164	2,366,214	2,171,034	2,488,179	3,524,258	4,732,830	8,135,650
Total harvested production	13,609,908	16,613,380	14,145,172	5,058,301	5,261,890	5,331,426	6,756,435	9,315,104	6,652,783
Imports	340,478	524,106	487,550	95,339	169,978	213,779	165,996	270,368	151,357
Other sources	–	–	–	–	–	–	–	–	–
Total resource	**20,571,478**	**24,803,541**	**26,187,886**	**7,519,854**	**7,602,902**	**8,033,384**	**10,446,689**	**14,318,303**	**14,939,790**

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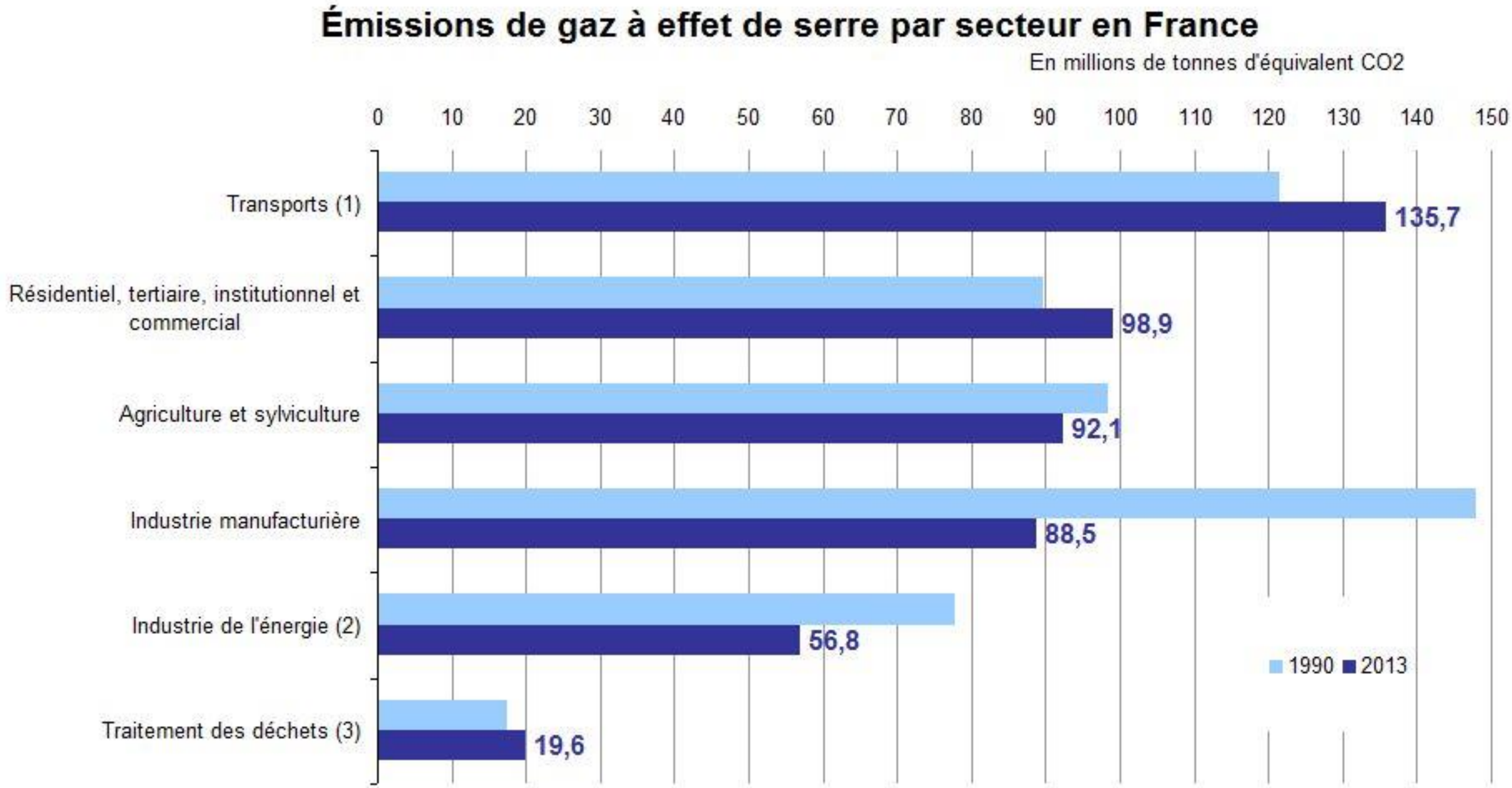
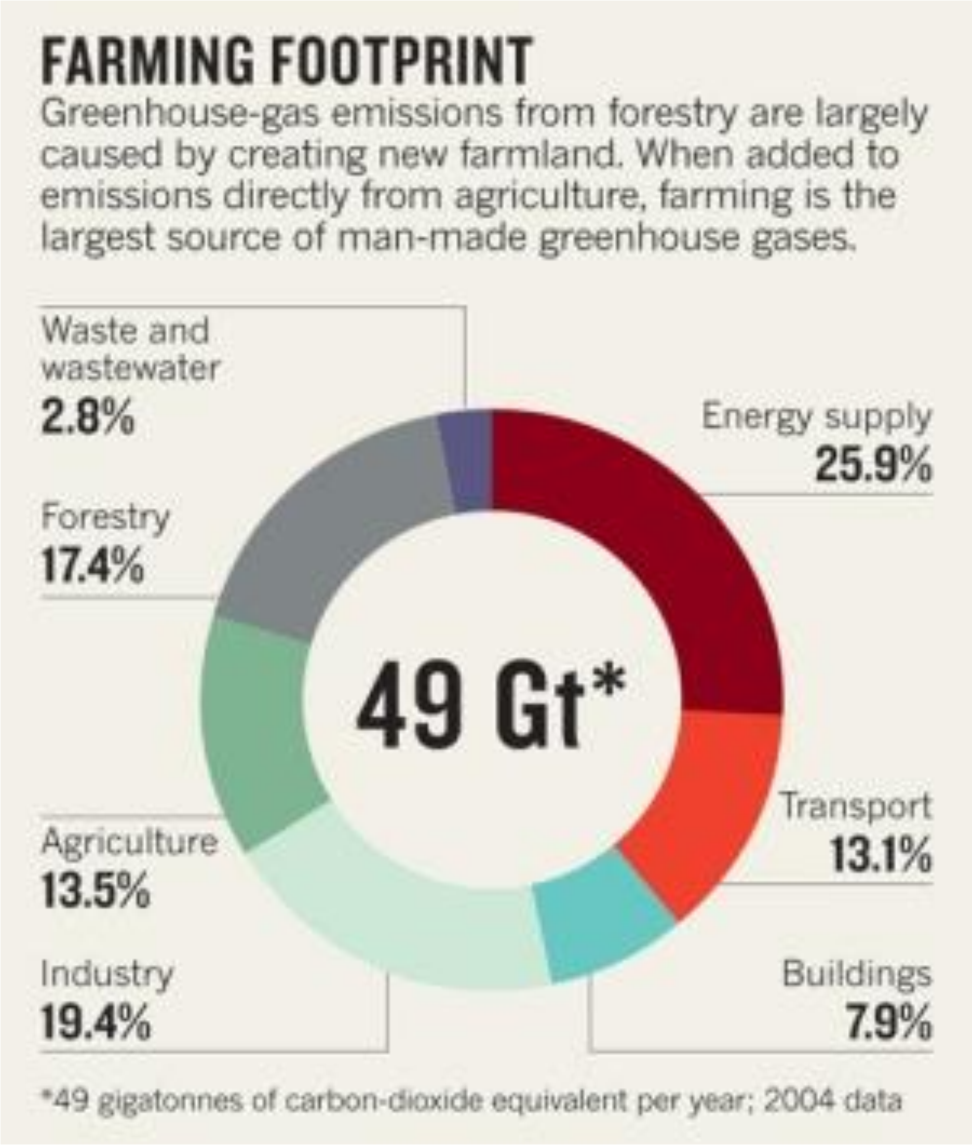
GHG emissions



Notes : hors UTCF (utilisation des terres, leurs changements et la forêt) ; (1) aérien et maritime : trafic domestique uniquement ; (2) y compris incinération des déchets avec récupération d'énergie ; (3) hors incinération des déchets avec récupération d'énergie, et hors captage de biogaz.
Champ : France métropolitaine, départements d'Outre-mer, Saint Martin (périmètre Protocole de Kyoto).
Source : Citepa (inventaire CCNUCC, format "Plan Climat"), juin 2015.

GHG emissions



Summary of GHG Emissions for Hungary

Base year (Convention) = 1985-87

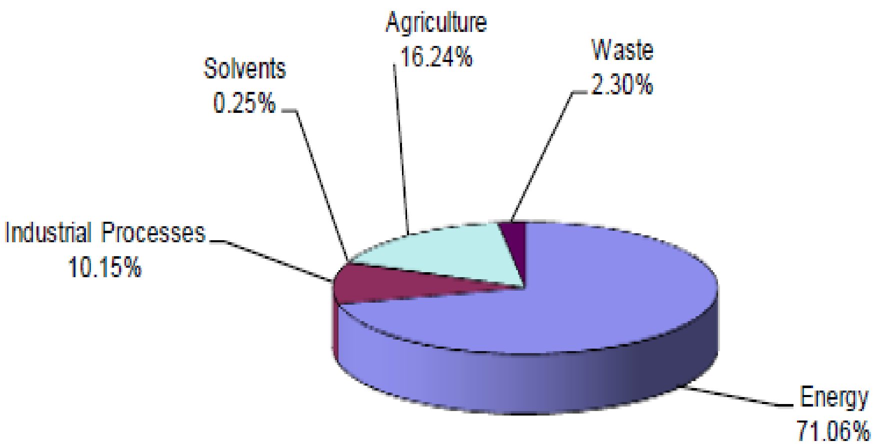
	Emissions, in Gg CO_2 equivalent		
	1985-87	2000	2012
CO_2 emissions without LULUCF	84,378.2	58,080.6	46,072.4
CO_2 net emissions/removals by LULUCF	-2,594.5	-686.1	-4,483.5
CO_2 net emissions/removals with LULUCF	81,783.7	57,394.5	41,588.9
GHG emissions without LULUCF	114,447.1	76,504.3	61,980.7
GHG net emissions/removals by LULUCF	-2,555.4	-609.3	-4,407.1
GHG net emissions/removals with LULUCF	111,891.7	75,895.0	57,573.5

	Changes in emissions, in per cent		
	From 1985-87 to 2000	From 2000 to 2012	From 1985-87 to 2012
CO_2 emissions without LULUCF	-31.2	-20.7	-45.4
CO_2 net emissions/removals by LULUCF	-73.6	553.5	72.8
CO_2 net emissions/removals with LULUCF	-29.8	-27.5	-49.1
GHG emissions without LULUCF	-33.2	-19.0	-45.8
GHG net emissions/removals by LULUCF	-76.2	623.3	72.5
GHG net emissions/removals with LULUCF	-32.2	-24.1	-48.5

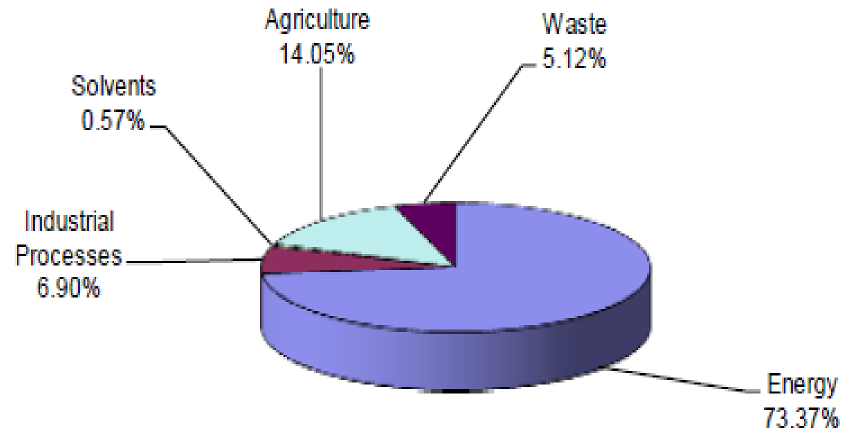
	Average annual growth rates, in per cent per year		
	From 1985-87 to 2000	From 2000 to 2012	From 1985-87 to 2012
CO_2 emissions without LULUCF	-2.6	-1.9	-2.3
CO_2 net emissions/removals by LULUCF	-9.1	16.9	2.1
CO_2 net emissions/removals with LULUCF	-2.5	-2.6	-2.6
GHG emissions without LULUCF	-2.8	-1.7	-2.3
GHG net emissions/removals by LULUCF	-9.7	17.9	2.1
GHG net emissions/removals with LULUCF	-2.7	-2.3	-2.5

GHG emission/sector (source UNCCD)

1985-87



2012



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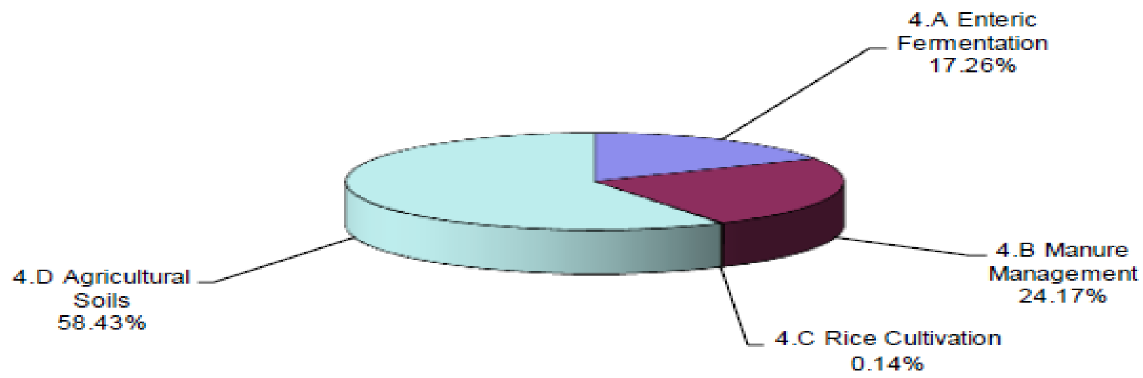
Sources of GHG in agriculture

a) enteric fermentation (flatulence) by ruminant animals such as cattle, sheep and goats, which produce methane (CH_4) emissions; enteric fermentation is a natural part of the digestive process for many ruminants as anaerobic microbes, decompose and ferment food in the rumen that are then absorbed by the ruminant; this digestion process is not 100 % efficient, so some of the food energy is lost in the form of methane; measures to mitigate enteric fermentation would not only reduce emissions, they may also raise animal productivity by increasing digestive efficiency;

b) soil nitrification and denitrification, which produces nitrous oxide (N_2O) emissions; nitrification is the aerobic microbial oxidation of ammonium (NH_4) to nitrates (NO_3), whereas denitrification is the anaerobic microbial reduction of nitrates to nitrogen gas (N_2);

c) manure decomposition, which produces methane and nitrous oxide emissions.

Hungary - 2012



Drought associated losses in agriculture

Drought Takes $2.7 Billion Toll on California Agriculture

•June 2nd, 2015   By Andrea Thompson

The record-breaking drought in California — brought about by a severe lack of precipitation, especially mountain snows — has exacted a $2.7 billion toll on the state's economy because of agricultural losses, researchers said Tuesday. During a briefing for the California Department of Food & Agriculture, scientists from the University of California, Davis, told officials that based on their preliminary research and modeling, the drought is resulting in a harder economic pinch this year than it was in 2014.

Drought Impact	Loss Quantity
Water Supply	
Surface water reduction	8.7 million acre-feet
Groundwater pumping increase	6.2 million acre-feet
Net water shortage	2.5 million acre-feet
Statewide Costs	
Crop revenue loss	$856 million
Additional groundwater pumping cost	$595 million
Livestock revenue loss	$100 million
Dairy revenue loss	$250 million
Total direct agricultural costs	**$1.8 billion**
Total statewide economic cost	**$2.7 billion**
Total job losses	**18,600**

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Drought Management, Climate Smart Agriculture or how to take command of our environment

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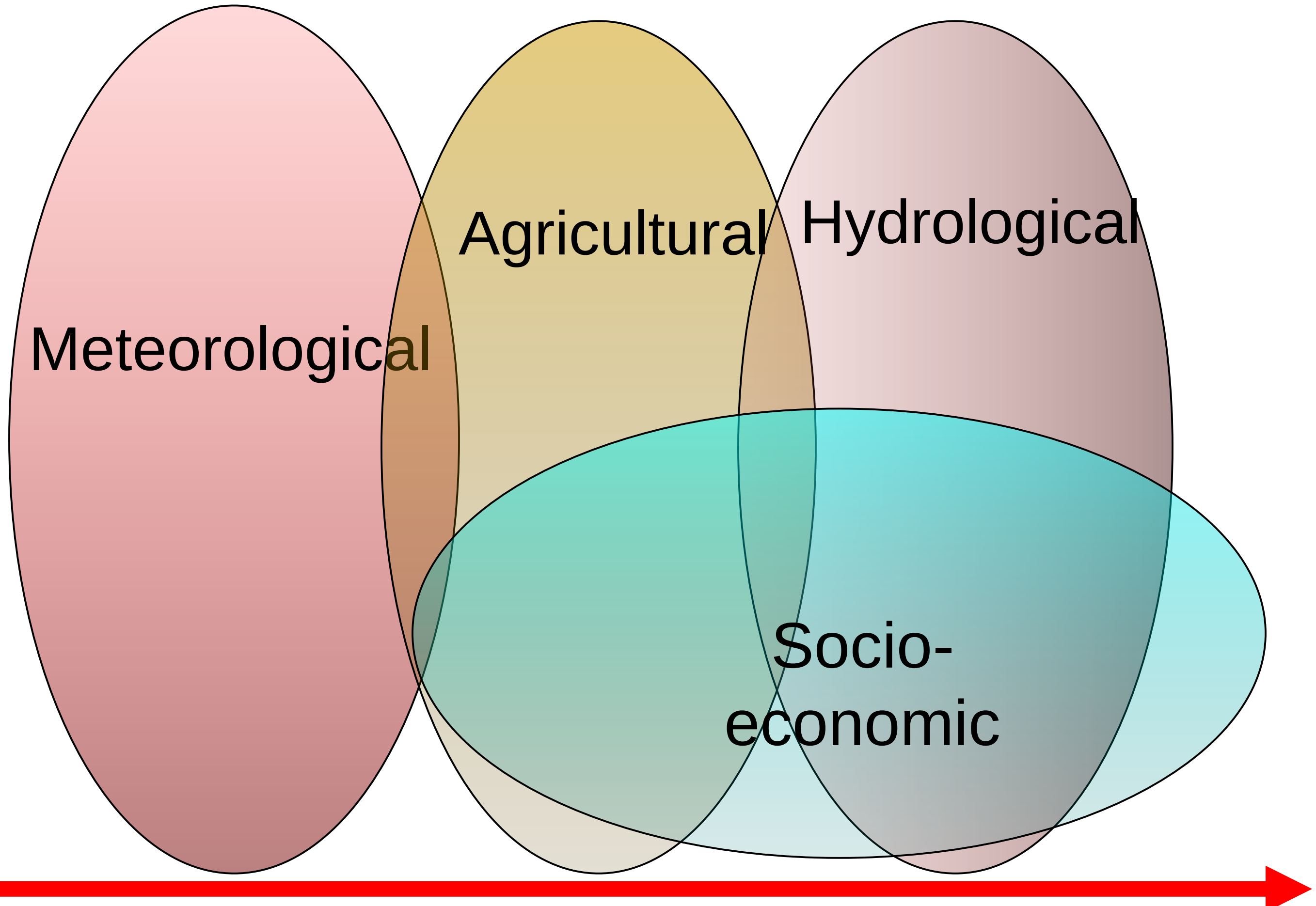
Natural and Social Dimensions of Drought

Decreasing emphasis on just precipitation deficiencies

Increasing emphasis on water/natural resource management

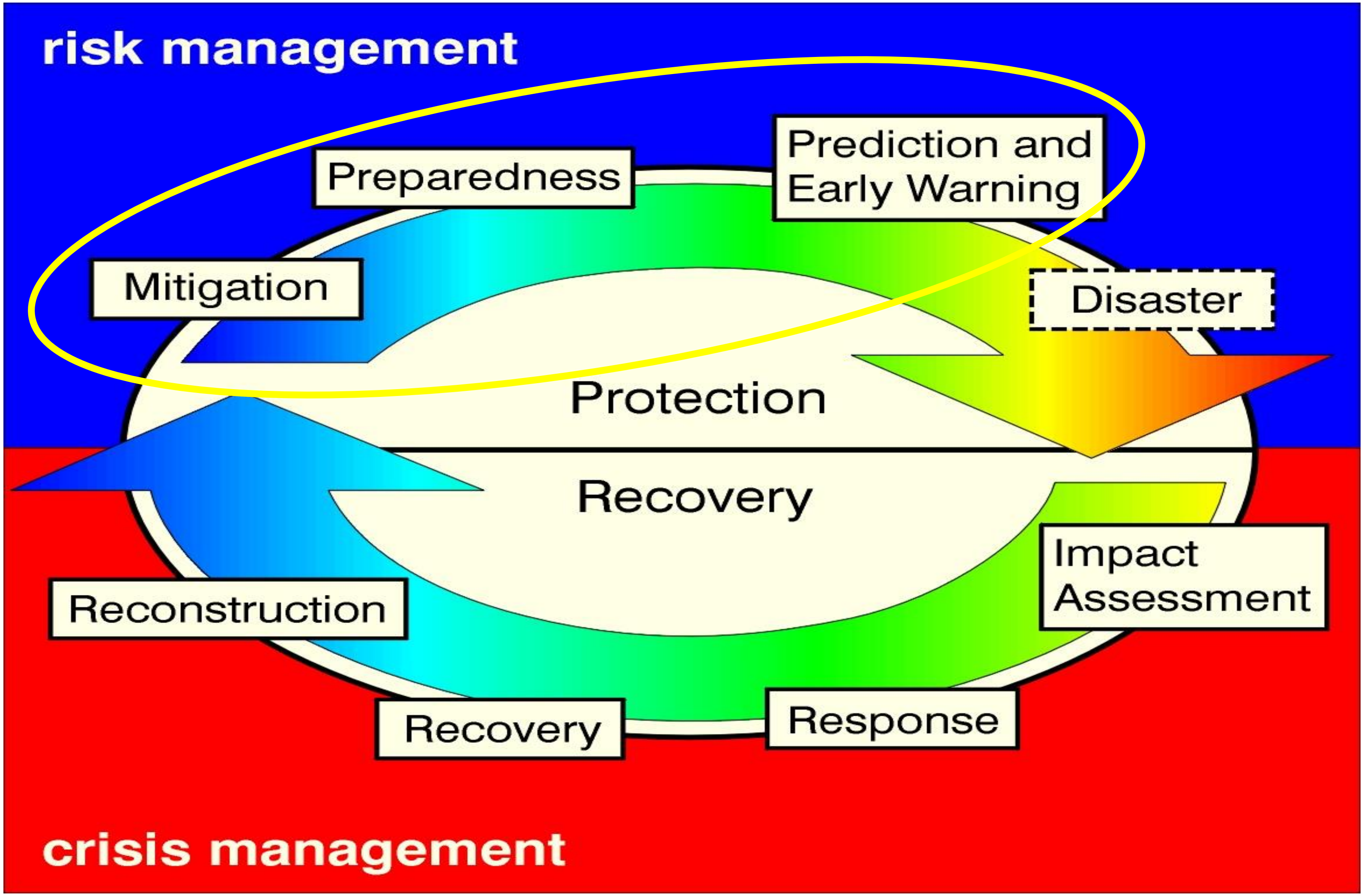
Increasing complexity of impacts and conflicts



Time/Duration of the event

Source: Wilhite 2006

The Cycle of Disaster Management



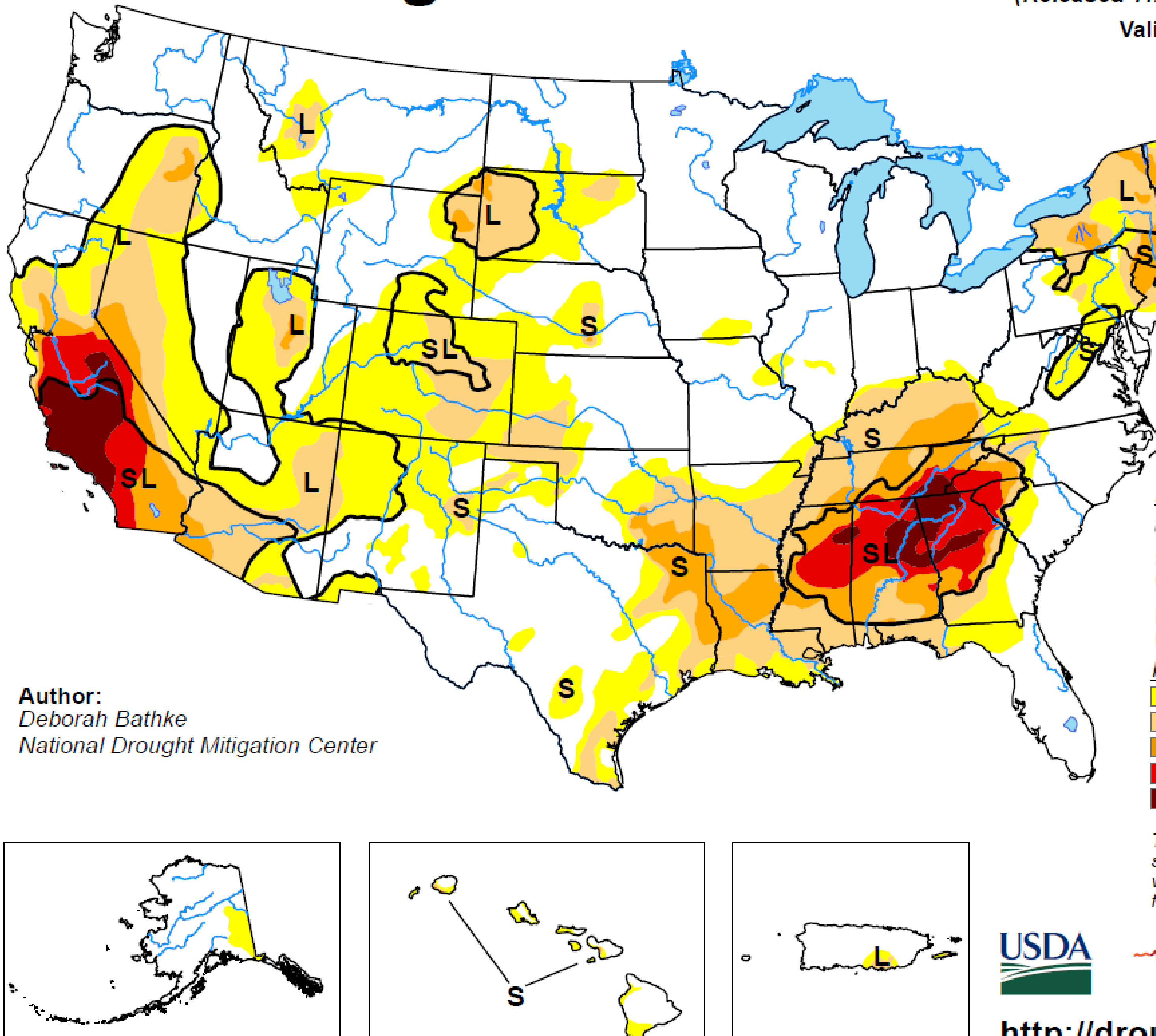
Source: Wilhite 2006

U.S. Drought Monitor

November 8, 2016

(Released Thursday, Nov. 10, 2016)

Valid 7 a.m. EST



Drought Impact Types:

Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Deborah Bathke
National Drought Mitigation Center

http://droughtmonitor.unl.edu/

Drought Management and Agriculture

Impacts list

Burn ban across most of Louisiana Duration: 11-06-2016 - unknown

Outdoor burning banned in 25 counties of Western North Carolina
Duration: 11-07-2016 - unknown

Additional water conservation requested for customers of South Central Connecticut Regional Water Authority Duration: 10-11-2016 - 11-07-2016

Outdoor burn ban in Floyd County, Georgia. Duration: 11-08-2016 - unknown

Tennessee hunters, outdoor enthusiasts to take special precautions with fire
Duration: 11-09-2016 - unknown

Trees, some pastures not coping well with dry fall in Jefferson County, Texas
Duration: 11-07-2016 - unknown

Rancher in Buna, Texas switched cattle to hay early. Duration: 11-07-2016 - unknown

Ranchers concerned about grass production, cattle rotation in Jefferson County, Texas

Some Examples of Decision Making Using the Drought Monitor

- USDA Dried Milk Program 2002-03
- USDA CRP Release hot spot trigger
- Numerous states use as a drought trigger (Governor’s declarations)
- 2006-07 USDA Livestock Assistance
- 2006-07 IRS (tax deferral on livestock losses)
- 2008 Farm Bill
- NWS Drought Information Statements

Source: Svoboda, 2009

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Climate Services and Agriculture

- **Historical climate data series**
- **Crop characteristics**
- **Soil characteristics and conditions**

Simple crop models

Advices for farmers and decision making

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Approaches to Drought Monitoring

- **Single index or parameter**
- **Multiple indices or parameters**
- ***Composite* index**

Source: Svoboda, 2009

Indicators & Triggers Definitions

- **Indicators: Variables to describe drought conditions.**

  Examples: precipitation, streamflows, groundwater, reservoir levels, soil moisture, Palmer indices, …

- **Triggers: Specific values of the indicator that initiate and terminate each level of a drought plan, and associated management responses.**

  Example: precipitation below the 5th percentile for two consecutive months is a Level 4 Drought.

Source: Svoboda, 2009

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Importance of Drought Indices

- ***Simplify*** complex relationships and provide a good communication tool for diverse audiences
- ***Quantitative*** assessment of anomalous climatic conditions
  - Intensity
  - Duration
  - Spatial extent
- ***Historical*** reference (probability of recurrence)
  - Planning and design applications

Source: Svoboda, 2009

Considerations in Choosing Indicators / Triggers

- Proper and Timely Detection of Drought
- Spatial and Temporal Sensitivity
- Supplies and Demands
- Drought In / Drought Out
- Composite and Multiple Indicators
- Data Availability, Validity, and Clarity
- Ease of Implementation

Source: Svoboda, 2009

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Key Variables for Monitoring Drought

- climate data
- soil moisture
- stream flow / ground water
- reservoir and lake levels
- snow pack
- short, medium, and long range forecasts
- vegetation health/stress and fire danger
- remote sensing products
- **relations with impacts**

Source: Svoboda, 2009

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Agricultural Drought Outcome

- **No consensus (17 indices)**

Conclusions

- **Water Balance models are quite good since they take into account soil and crop growth**

- **NDVI is very useful and is comparable with hydrological balance**

- **For all indices, a temperature component is important**

DMCSEE

Drought Management Centre for Southeastern Europe

UNCCD

Home · Drought monitor · Links · Members section · News · Contacts

SQ BG HR MK HU RO SI TR SR **EN**

Drought Management Centre for Southeastern Europe - DMCSEE

Drought is a normal part of climate in virtually all regions of the world. South Eastern Europe is no exception; in past decades the drought-related damages have had large impact on the economy and welfare. Therefore the need to establish a Drought Center for SE Europe to alleviate the problems caused by drought in the area became evident at the end of the past century. The idea was further elaborated by International Commission on Irrigation and Drainage (ICID) and UN Convention to Combat Desertification (UNCCD). The UNCCD national focal points and national permanent representatives with the World Meteorological Organization have agreed upon the core tasks of the Drought Management Center for South Eastern Europe (DMCSEE) and the proposed project document.

The mission of the proposed DMCSEE is **to coordinate and facilitate the development, assessment, and application of drought risk management tools and policies in South-Eastern Europe with the goal of improving drought preparedness and reducing drought impacts.** Therefore DMCSEE will focus its work on monitoring and assessing drought and assessing risks and vulnerability connected to drought.

Founding countries:

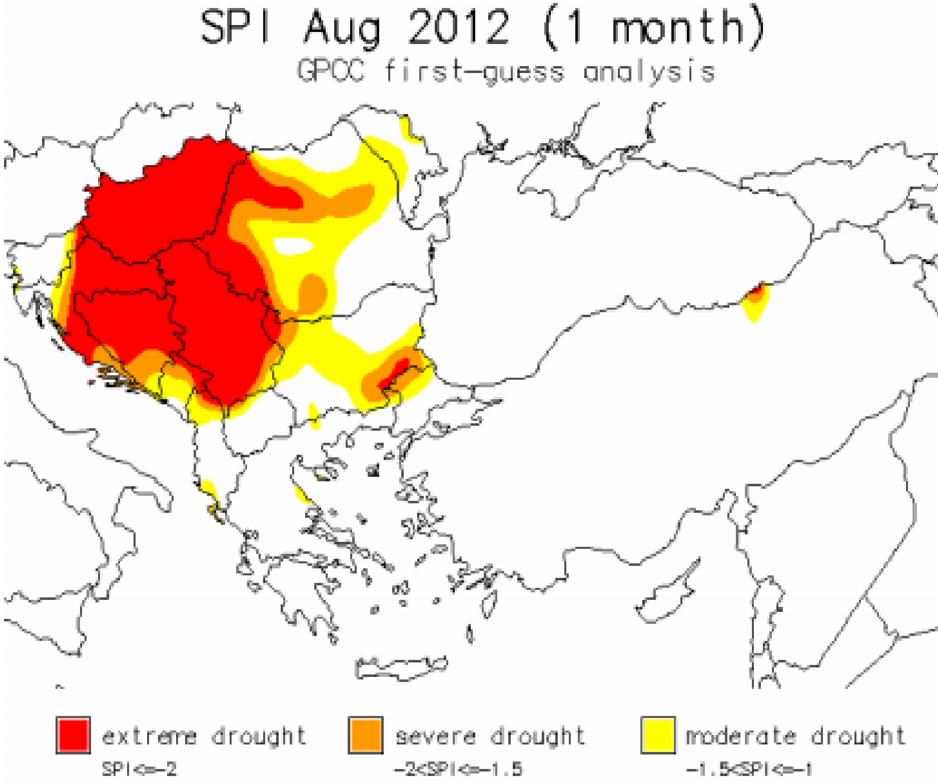
- Albania
- Bosnia and Herzegovina
- Bulgaria
- Croatia
- FYROM
- Greece
- Hungary
- Moldova
- Romania
- Slovenia
- Turkey
- Montenegro
- Serbia

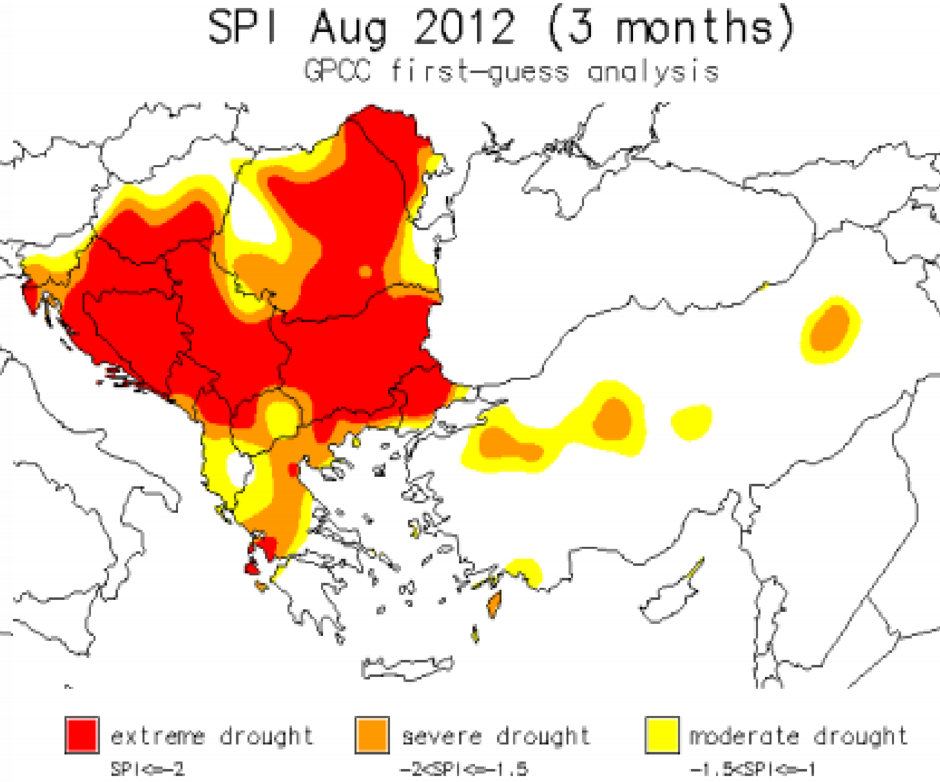
Founding agencies:

- WMO
- UNCCD

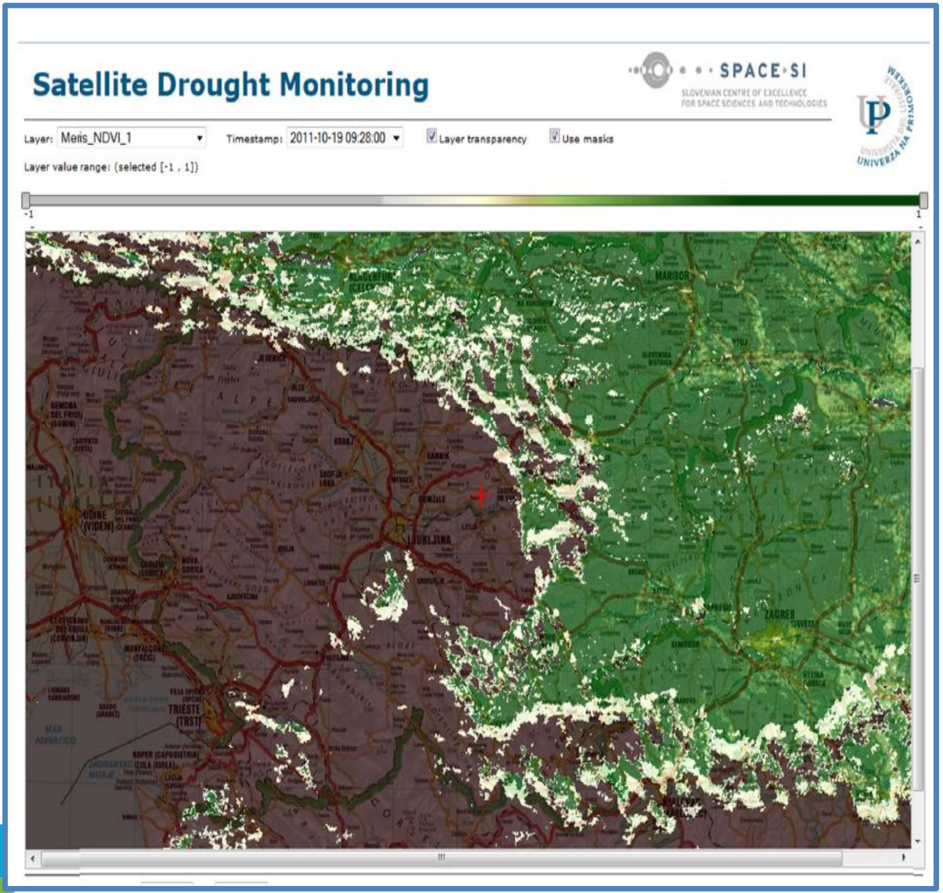
www.dmcsee.org

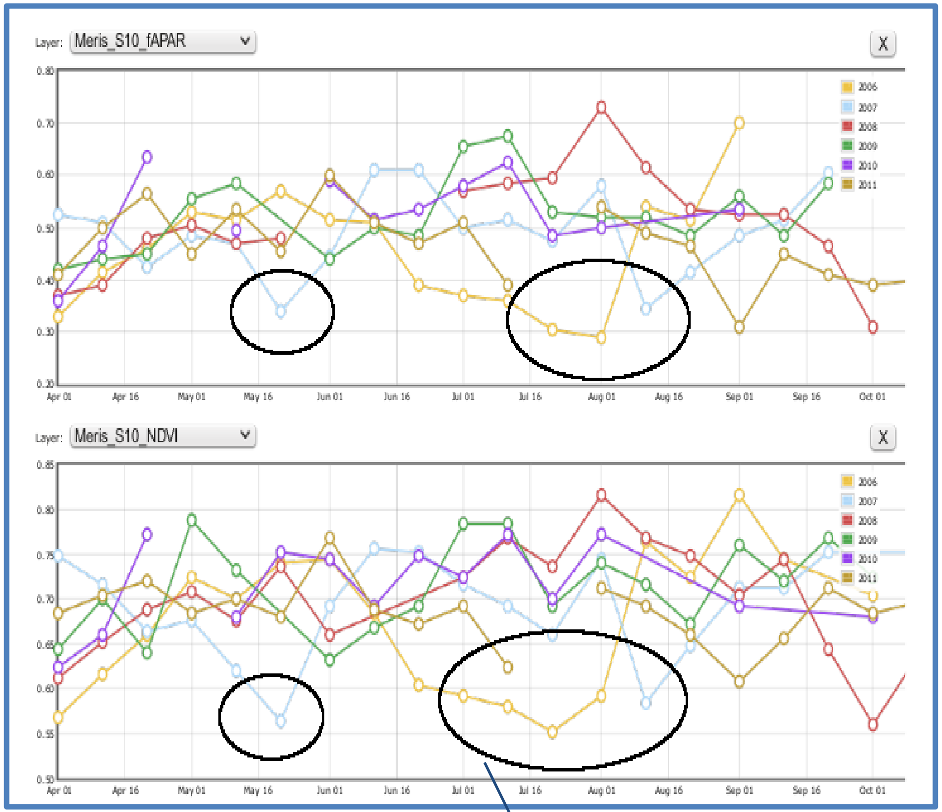
SPI Index


SPI Aug 2012 (1 month)
GPCC first-guess analysis
extreme drought
SPI<=-2
severe drought
-2<SPI<=-1.5
moderate drought
-1.5<SPI<=-1


SPI Aug 2012 (3 months)
GPCC first-guess analysis
extreme drought
SPI<=-2
severe drought
-2<SPI<=-1.5
moderate drought
-1.5<SPI<=-1

Web application graphical interface





Drought detection

Satellite data:

✓MERIS full resolution 250 m (usually one image daily)

✓VITO/VEGETATION in 2006-2012

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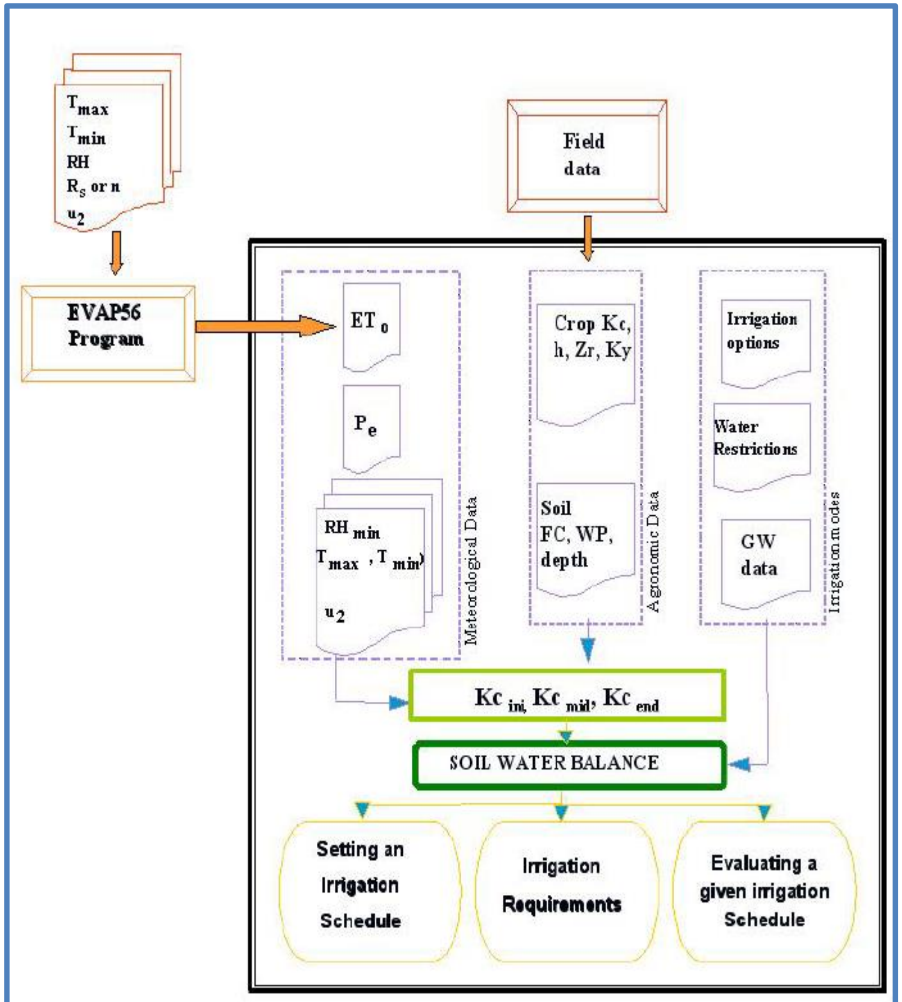
Numerical crop models



WinISAREG model, Irrigation needs SARRA-H water balance, carbon balance and phenology for cereals

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Climate Smart Agriculture

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Challenges

•**Ensure creation of knowledge in collaboration with institutions, organizations, universities and other stakeholders in order to reduce Knowledge gaps that hinder decision making/policy setting, adoption and implementation of climate-smart agriculture (**Best practices in sectors, i.e. weather insurance)

• **Linking research to implementation to improve approaches.** (Develop guides)

•**Strengthening extension and support tools for climate-smart agriculture, reflecting the perspectives knowledge and experience of producers.** Case study on Climate Smart Farming Extension and Decision Tools , Review of index-based insurance case studies (FAO), …

Challenges (II)

- **Stimulating research and investment in climate-smart agriculture and food systems, drawing on indigenous knowledge systems and expertise where feasible** (What about our traditional knowledge in Europe?)
- **Developing or identifying metrics that can be useful for measuring progress in climate-smart agriculture** (through crop models)
- **Ensure sharing of information and knowledge through a number of communication, capacity building and extension channels, in particular linking with universities, technical institutions and national and local entities** (Webinars)
- **Ensure collaboration with other action groups**

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WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Thank you
Köszönöm

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