

**Joint NASA LCLUC Science Team Meeting and  
GOF-C-GOLD/NERIN, NEESPI, MAIRS**

**Monitoring land cover, land use and fire in Northern Eurasia  
September 16-19, 2009 - NCRST, Almaty, KAZAKHSTAN**

# **The MARS project: Remote sensing in support of European Agriculture Policies**

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# Outline

- **MARS Unit and JRC**
- **Managing EU Policy**
  - Controls with Remote sensing
  - >Land parcel identification system
- **Monitoring Agriculture**
  - Crop monitoring and Yield forecast
  - Area estimates
- **Conclusions**

## JRC's Mission Statement

*"... to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies.*

*the JRC functions as a centre of science and technology reference for the EU, independent of special interests, private and national".*

## MARS Project

- Started 20 years ago to provide more timely objective pan-european information and forecast on agriculture production (MARS STAT)
- Extended in 93 to the management and control of the Common Agriculture Policy (Direct Aids) MARSPAC
- Since 2000 development of Early Warning for Food Security MARSFOOD
- Since 2005 : A global strategy

## 58 Staff in total

48 paid by JRC,  
10 paid by other DG's

27 permanent officials,  
31 temporary: 3 Years CA, Post Doc, VS -SNE  
+ circa 15 persons outsourced ( MARS OP)

## Budget

JRC credits:	1.1 Mio Euro
Admin Arrangements:	1.7 Mio Euro

AGRI Sub delegations: 6.5 + 1.9 Mio Euro

## Main costumers / working relations

EC Directorates: AGRI, ENLARG, AIDCO,  
RELEX ENTR, RTD, INFSO...

### Core expertise

- Agronomy
- Remote Sensing / Image analysis
- Geomatics, GNSS, GIS
- Crop modeling, Agro-meteorology
- Statistics
- ICT

### Additional Expertise

Agricultural insurances  
Vulnerability assess.

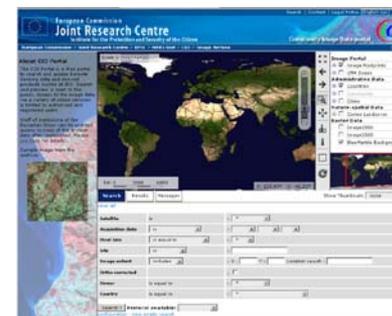
## 4 institutional Projects

### **GEOCAP – Geo-Information Management and Control Methods**

Support and addresses new information and controls needs for European Policies related to Common Agriculture, such as Cross Compliance, Farm Advisory System, traceability...

### **CID – Community Image Data Portal**

Satellite (and aerial) remote sensing data management for DG AGRI and within the JRC.  
30 TB on-line archive of HR+VHR imagery



### **AGRI4CAST - Crop/Production Forecasts/Estimates and Climate Change Impact on Agriculture**

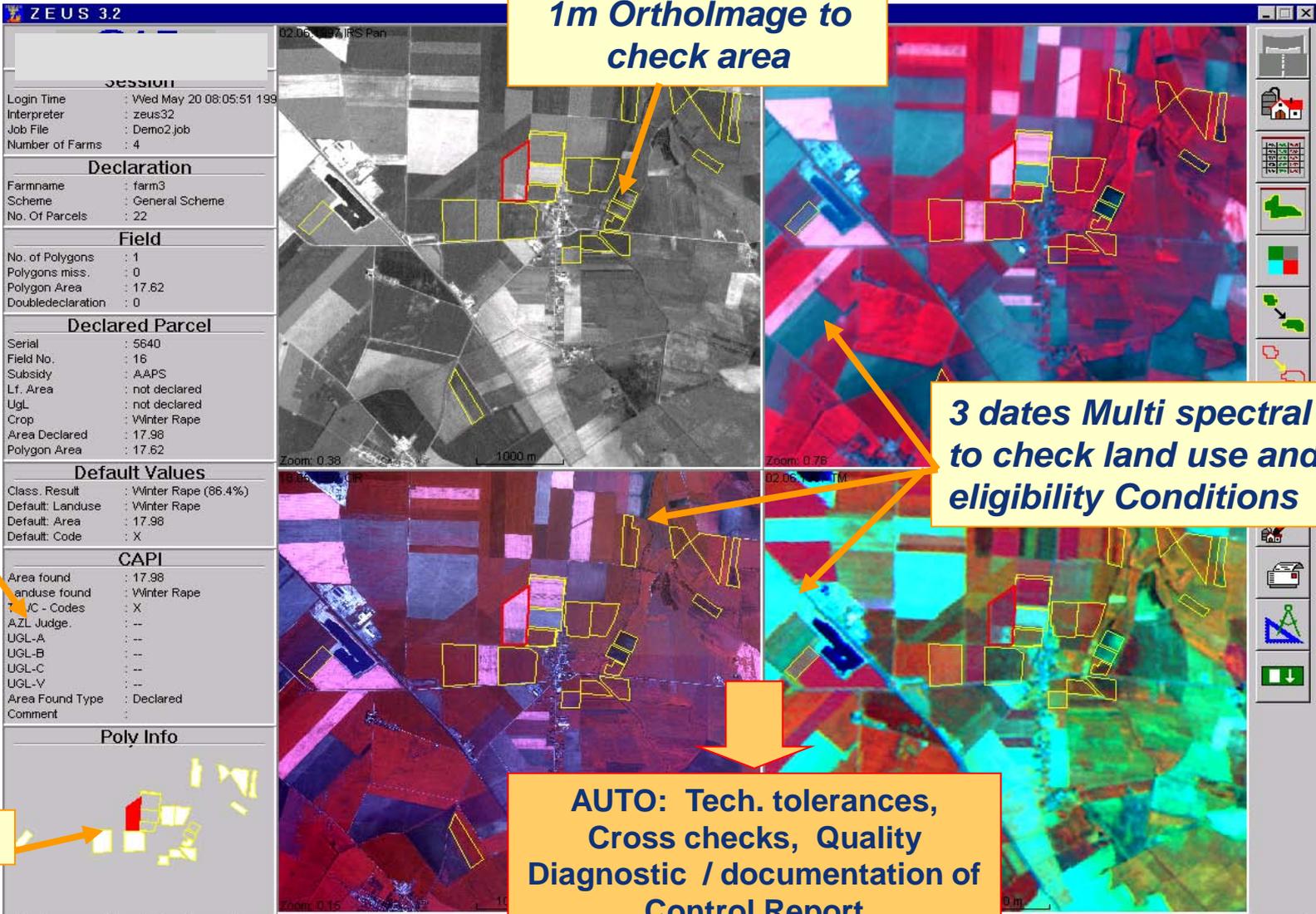
European activities & world wide activities related to Global trade in support to DG AGRI. Research & development related to crop insurance and climate change impact on Agriculture.

### **FOODSEC - Food Security Assessment**

World wide activities related to Food Security, Focus on Sub Saharan Africa- in support to DG RELEX DEV, ECHO & direct links with UN FAO and WFP.  
Research & dev on Vulnerability assessment , post harvest losses, etc

- Direct Aids for farmers
  - Total budget of 53 Bio Euros (41 % of 2008 EC budget)
  - area based payments and since 2004, mainly decoupled
    - Single payment scheme
    - conditioned by Cross compliance (respects of EC Rules + maintenance in good conditions)
  - Declarative system and integrated control system (IACS)
    - 100 % administrative checks / risk analysis
    - 5 % minimum On the Spot checks
- Statistics 2008
    - 8.3 Mio applications (27 Member-States)
    - 629,000 OTS checks (7.6%)
    - 338,000 farms controlled with RS (55% of OTS)

## CAPI = Computer assisted Photo interpretation



**Farmers declaration data**

**Inputs of observation + anomaly codes**

**1m Orthoimage to check area**

**3 dates Multi spectral to check land use and eligibility Conditions**

**GIS navigation**

**AUTO: Tech. tolerances, Cross checks, Quality Diagnostic / documentation of Control Report**

Session	
Login Time	: Wed May 20 08:05:51 199
Interpreter	: zeus32
Job File	: Demo2.job
Number of Farms	: 4

Declaration	
Farmname	: farm3
Scheme	: General Scheme
No. Of Parcels	: 22

Field	
No. of Polygons	: 1
Polygons miss.	: 0
Polygon Area	: 17.62
Doubleddeclaration	: 0

Declared Parcel	
Serial	: 5640
Field No.	: 16
Subsidy	: AAPS
Lf. Area	: not declared
UgL	: not declared
Crop	: Winter Rape
Area Declared	: 17.98
Polygon Area	: 17.62

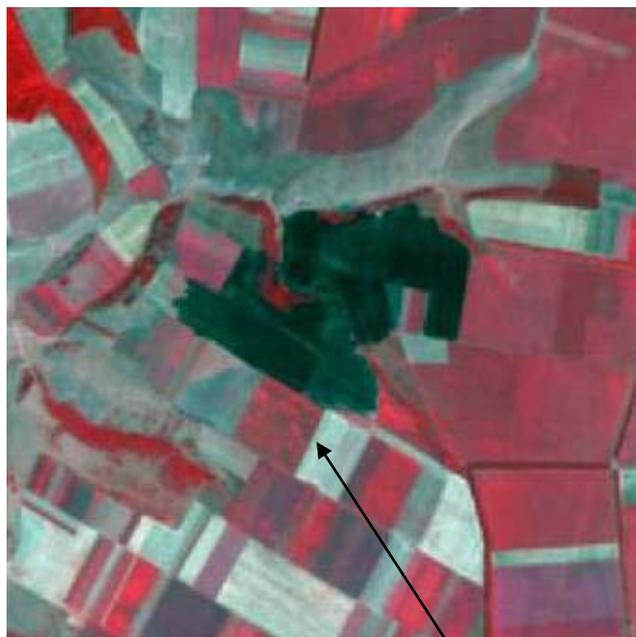
Default Values	
Class. Result	: Winter Rape (86.4%)
Default: Landuse	: Winter Rape
Default: Area	: 17.98
Default: Code	: X

CAPI	
Area found	: 17.98
Landuse found	: Winter Rape
TJC - Codes	: X
AZL Judge.	: --
UGL-A	: --
UGL-B	: --
UGL-C	: --
UGL-V	: --
Area Found Type	: Declared
Comment	: --

Poly Info	
[Map view of polygons]	

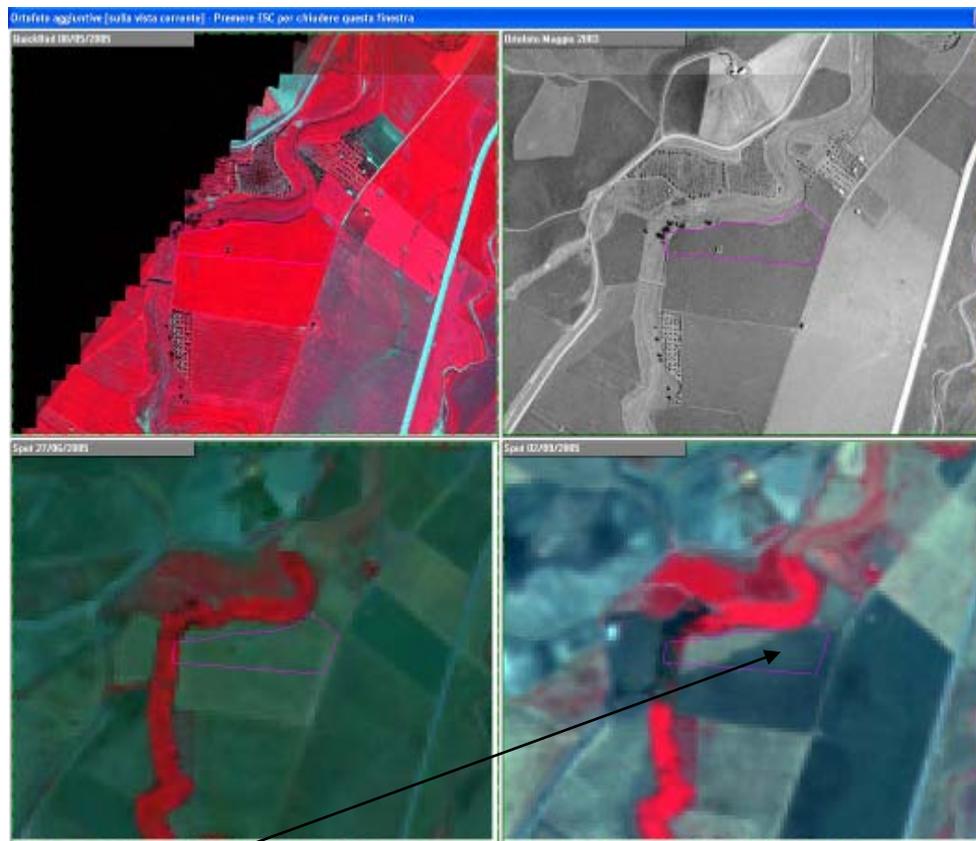
Select parcel by clicking the polygon - Zoom by pushing right mouse butt

## GAECS: Good agricultural and environmental conditions



**SPOT HR**  
**July 2007**  
**(Bulgaria)**

Stubble burnt



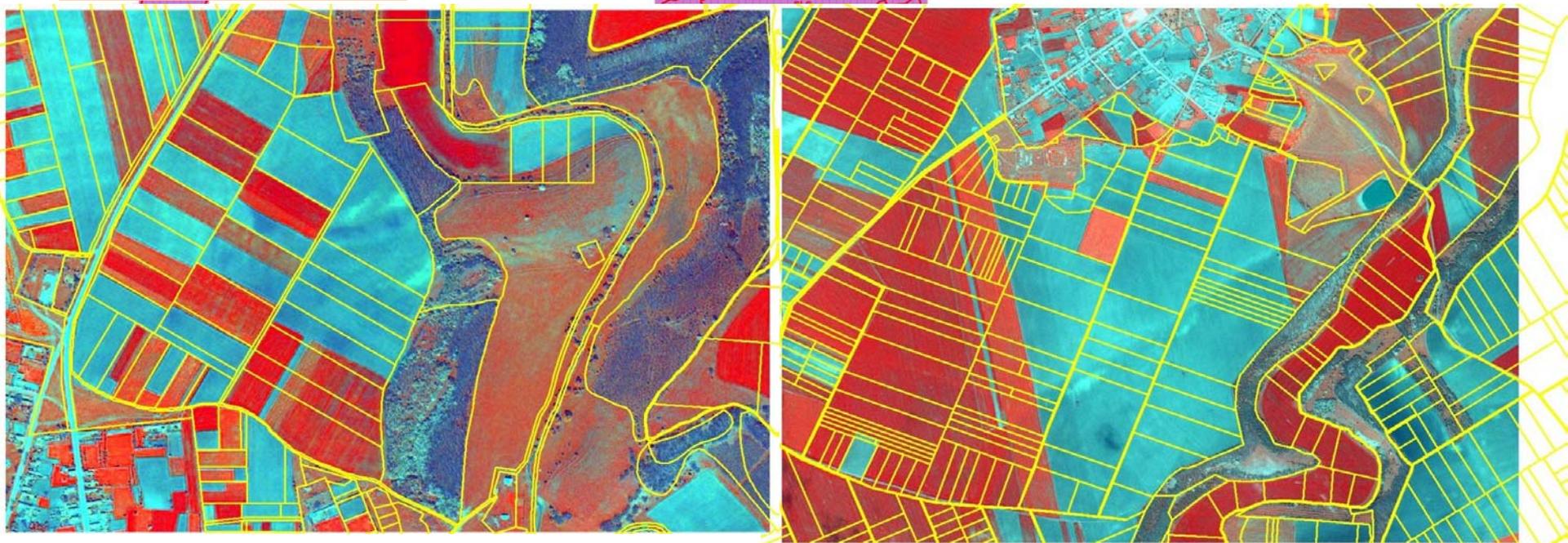
**(Italy)**

**SPOT HR**  
**September 2005**

**Physical blocks and location of farmers as 27.11.2006 : 105 221 km<sup>2</sup> – 95%**

Physical Block: 322 500 (without family gardens) -Mean area of the Physical Block : 15 ha

## Existing Cadastre

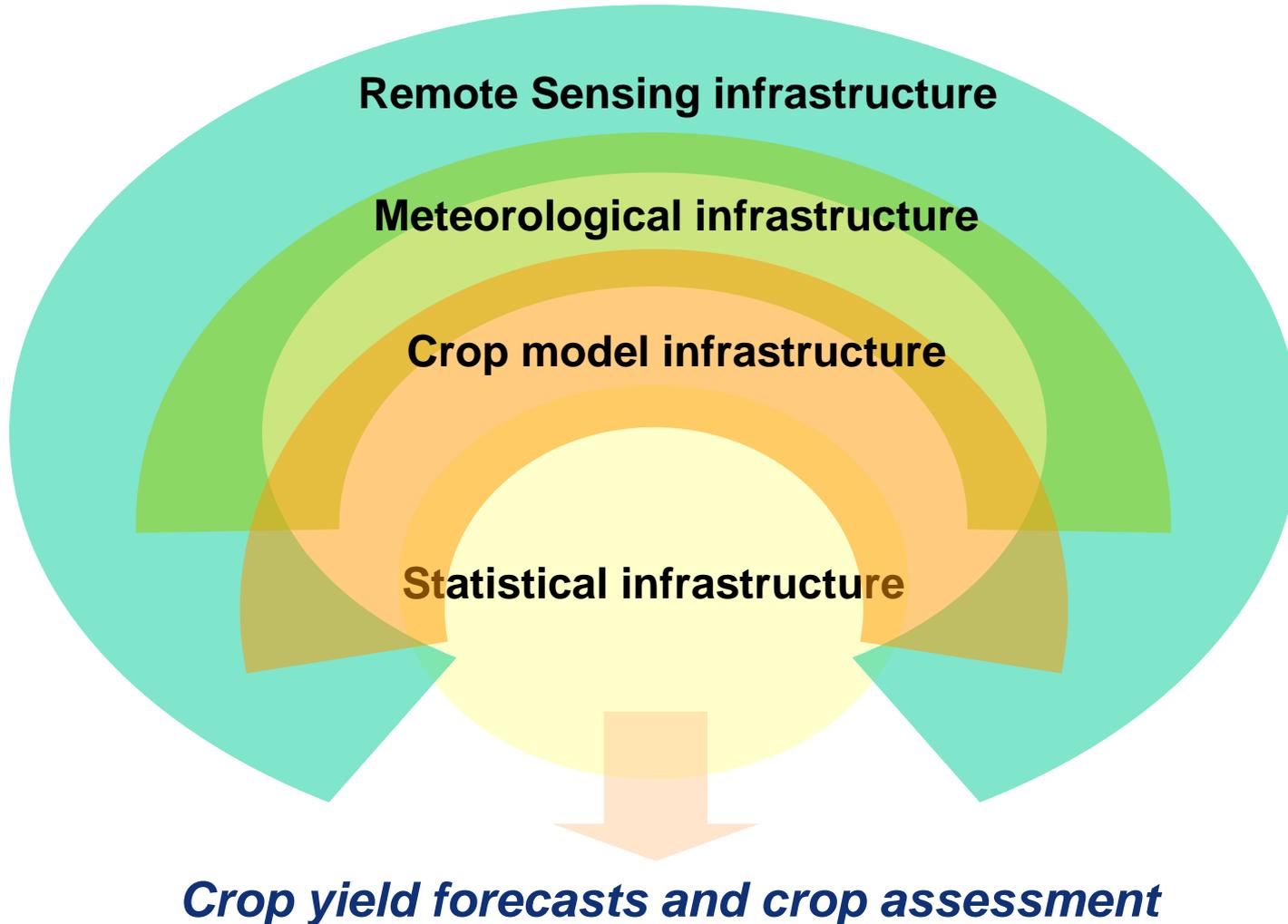


Recent archive Satellite 1m ortho were produced for 30% of the area to allow block creation << 2007

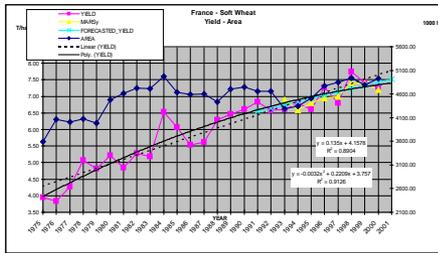
Complete 50cm color orthophoto cover in 08



## MARS general system design

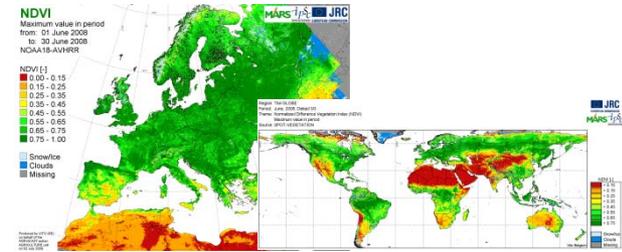


## Statistical infrastructure



time series regression,  
similarity analyses

## Remote Sensing infrastructure



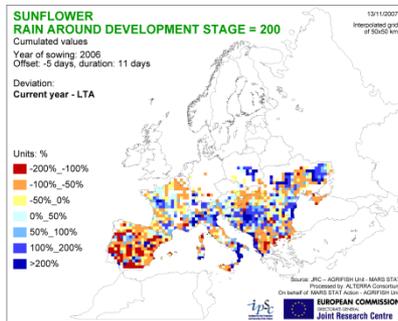
Vegetation state & meteo indicators  
since 1981 Europe, 1998 worldwide

MARS Yield Forecasts at national level - End of August 2007

COUNTRY	CEREALS YIELD (t/ha)				
	SOFT WHEAT	HARD WHEAT	BARLEY	MAIZE	GRAIN
FR	5.2	5.2	5.2	5.2	5.2
IT	5.2	5.2	5.2	5.2	5.2
ES	5.2	5.2	5.2	5.2	5.2
PT	5.2	5.2	5.2	5.2	5.2
GR	5.2	5.2	5.2	5.2	5.2
TR	5.2	5.2	5.2	5.2	5.2
UK	5.2	5.2	5.2	5.2	5.2
PL	5.2	5.2	5.2	5.2	5.2
CZ	5.2	5.2	5.2	5.2	5.2
SK	5.2	5.2	5.2	5.2	5.2
RO	5.2	5.2	5.2	5.2	5.2
BE	5.2	5.2	5.2	5.2	5.2
LU	5.2	5.2	5.2	5.2	5.2
DE	5.2	5.2	5.2	5.2	5.2
AT	5.2	5.2	5.2	5.2	5.2
SE	5.2	5.2	5.2	5.2	5.2
NO	5.2	5.2	5.2	5.2	5.2
DK	5.2	5.2	5.2	5.2	5.2
FI	5.2	5.2	5.2	5.2	5.2
EE	5.2	5.2	5.2	5.2	5.2
LV	5.2	5.2	5.2	5.2	5.2
LT	5.2	5.2	5.2	5.2	5.2
SI	5.2	5.2	5.2	5.2	5.2
SK	5.2	5.2	5.2	5.2	5.2
HR	5.2	5.2	5.2	5.2	5.2
CY	5.2	5.2	5.2	5.2	5.2
MT	5.2	5.2	5.2	5.2	5.2
GR	5.2	5.2	5.2	5.2	5.2
TR	5.2	5.2	5.2	5.2	5.2
RU	5.2	5.2	5.2	5.2	5.2
UA	5.2	5.2	5.2	5.2	5.2
BY	5.2	5.2	5.2	5.2	5.2
PL	5.2	5.2	5.2	5.2	5.2
CZ	5.2	5.2	5.2	5.2	5.2
SK	5.2	5.2	5.2	5.2	5.2
RO	5.2	5.2	5.2	5.2	5.2
BE	5.2	5.2	5.2	5.2	5.2
LU	5.2	5.2	5.2	5.2	5.2
DE	5.2	5.2	5.2	5.2	5.2
AT	5.2	5.2	5.2	5.2	5.2
SE	5.2	5.2	5.2	5.2	5.2
NO	5.2	5.2	5.2	5.2	5.2
DK	5.2	5.2	5.2	5.2	5.2
FI	5.2	5.2	5.2	5.2	5.2
EE	5.2	5.2	5.2	5.2	5.2
LV	5.2	5.2	5.2	5.2	5.2
LT	5.2	5.2	5.2	5.2	5.2
SI	5.2	5.2	5.2	5.2	5.2
SK	5.2	5.2	5.2	5.2	5.2
HR	5.2	5.2	5.2	5.2	5.2
CY	5.2	5.2	5.2	5.2	5.2
MT	5.2	5.2	5.2	5.2	5.2
GR	5.2	5.2	5.2	5.2	5.2
TR	5.2	5.2	5.2	5.2	5.2
RU	5.2	5.2	5.2	5.2	5.2
UA	5.2	5.2	5.2	5.2	5.2
BY	5.2	5.2	5.2	5.2	5.2

# Yield forecasts Crop assessment

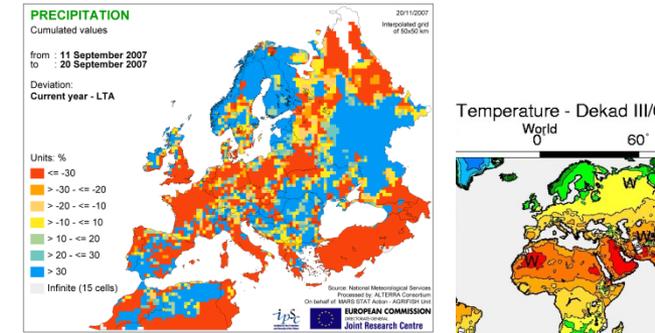
## Crop Model infrastructure



Agrometeo indicators derived from crop growth  
model – WOFOST / LINGRA / WARM and GWSI



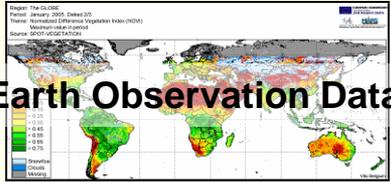
## Meteorological infrastructure



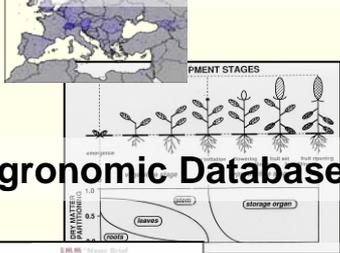
observed data since 1975 Europe  
under construction for Africa  
worldwide ECMWF data + archive

## NRI, monthly / ad hoc monitoring

### Data collection & retrieval



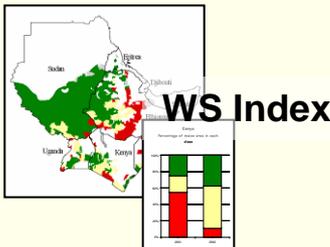
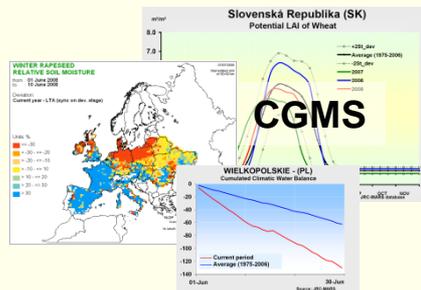
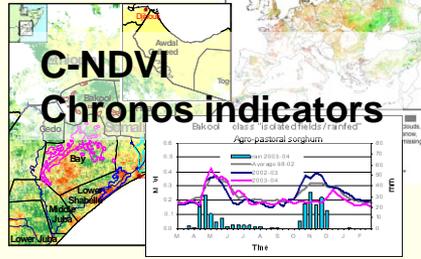
### Meteorological Data



### WEB Information Media Monitor Magazines

### Agro-phenological network

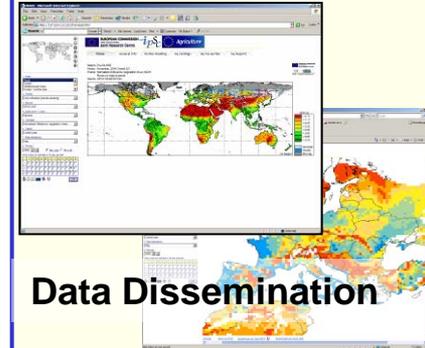
### Processing & Analysis



### Reporting

**Reporting**

### Dissemination



**Bulletin Dissemination**

- DG AGRI
- DG RELEX
- DG EUROSTAT
- EU Delegations
- Member States
- National Agencies
- Int. Institutions (FAO, ...)

## End of campaign evaluation & feed backs

- European Window
- 35 countries covered
- 11 crops of interest
- 30 years of meteo and agrometeo data
- 21 years of low resolution satellite information
- 20 crop's indicators are daily simulated

**RICE BULLETIN**  
Second part of 2008 campaign  
EU is experiencing a decrease in production, mainly because of a reduced rice-cropped area

**CLIMATIC UPDATE**  
Situation between 16 April - 30 April 2007  
Forecast until 11 May 2007

**MARS forecast**

Country	2007	2008	2009
France	1.00	0.98	0.94
Spain	0.75	0.80	0.80
Italy	1.00	0.95	0.95
Poland	0.80	0.80	0.80

**PASTURE BULLETIN**  
Situation 01 April - 30 April 2007  
Forecast until 11 May 2007

**PURE AND RAINFALL**  
period the thermal conditions (+20% from LTA) for the second half of April in Benelux and western Germany as well as northern France, Denmark, Central Europe, and the Balkans. The rest of the period was negative (-10% from LTA). In the north, the simulated wheat crops for these areas had a positive water balance and a surplus of solar radiation in April.

**Diseases risk (Blatt)**  
The map is showing the estimated risk of infection for wheat and maize (EU) under current conditions (mean forecast) for 2008.

**MAP REPRESENTING THE VEGETATION CONDITIONS OF THE MAIN FARMING FACTORS AND GRAZING AREAS OF EUROPE**  
The analysis refers to the distribution of satellite data and the identification of those areas from the deviation of the vegetation index from the long term average.

**CLIMATIC WATER BALANCE**  
The map shows the climatic water balance for the period between 16 April and 30 April 2007. The balance is positive in most of the area, indicating a surplus of water.

**PERMANENT FORAGE**  
Over most of the pasture and permanent grassland areas of the EU the combined effect of mild temperatures and sufficient rainfall during the period of spring are consistent with the availability of good grazing and an early first cut.

**PERMANENT FORAGE**  
However, in late March, dry conditions established and the extended cold early May were particularly significant. These conditions were consistent over most of continental Europe, with the exception of the UK and Ireland. Conditions were more favourable than average in homogeneity and on a national good weather for pasture in southern and central parts of the EU.

**CLIMATIC WATER BALANCE**  
The map shows the climatic water balance for the period between 16 April and 30 April 2007. The balance is positive in most of the area, indicating a surplus of water.

**MARS Crop Monitoring in Europe**  
1st April 2007 to 10th May 2007  
Vol. 15, No 3  
ISSN 1725-5813  
EUR 22748 EN

**Temperatures boosting crop growth**

1. Agrometeorological overview  
Continuing unseasonably mild and dry conditions over most of the continent; the worst conditions were in the central and northern EU, whilst more favourable conditions occurred in the western and southern Mediterranean. Brief but threatening late frosts in May over north-east Europe.

2. Temperatures and evapotranspiration  
Thermal anomalies continued in April. Warmer-than-seasonal temperatures occurred mainly in the central and northern EU, Italy and Norway.

3. Contents  
1. Agrometeorological overview 1  
2. Temperatures and evapotranspiration 1  
3. Cereals 1  
4. Forage 1  
5. Pests 1

4. Cereals  
Cereal harvest is revised downward according to a drying June mainly in France with an effect expected on late winter varieties and spring/summer cereals.

5. Forage  
EU25 wheat production is expected at almost 122 Mt, this includes about 12% increase in soft wheat and about 19% in durum wheat as compared to 2003. Maize figures are revised downward in EU25 (France, Italy) giving a final expected production at about 30.3 Mt (+16.4% than 2003). The total cereal harvest for EU25 is now about 210 Mt, which is about 12 Mt more than 2003 (about +5.2%).

CROPS	European Union 27 Yield (Mt)				
	2006	2007	Average 2003-2007	% Diff 2007	% 2007 Average
TOTAL CEREALS	4.7	4.8	4.8	+1.4	+1.0
Soft wheat	5.4	5.5	5.4	+2.4	+1.0
Durum wheat	3.0	2.9	2.7	-1.8	-1.7
Total wheat	8.1	8.2	8.0	+1.8	+2.7
Spring barley	3.4	3.7	3.7	+6.7	+18.0
Winter barley	6.1	6.2	6.0	+5.0	+4.0
Total barley	4.1	4.3	4.2	+4.9	+2.7
Grain maize	6.5	6.6	6.5	+1.6	+2.4
Other cereals <sup>(1)</sup>	2.9	3.0	3.2	+1.1	+1.4
Rape seed <sup>(2)</sup>	3.0	3.0	3.0	+1.5	+1.7

All MARS bulletins can be downloaded from <http://mars.jrc.it/marsstat/Bulletins/2008.htm>

## 2003 - 2009 Focus on the Horn of AFRICA

### MARS-FOOD

#### Crop monitoring in Somalia

September 2007

Date of issue: 10 October 2007 Vol. 15 - 2007

#### Above normal crop conditions in Northern Somalia

Some rainfall for September is visible in Awdal Galbeed and in the coastal areas of Southern Somalia, with slightly above average values in parts of Lower Shabelle and Juba.

Vegetation in Northern Somalia appears generally greater than normal both for agricultural and pastoral areas. In Southern Somalia vegetation conditions are slightly below average, but this is generally of low impact in the current dry season.

Total Gu 2007 season rainfall was generally below average for central Somalia with a clear negative impact on crop yield for Lower Shabelle, parts of Bay, Bakool and Gedo.

Conflict and alarming humanitarian conditions continue to deteriorate the critical food security situation, especially for IDP and poor households in Southern Somalia.

EUROPEAN COMMISSION  
Joint Research Centre

Overall Good Sorghum Yield

In general the climate conditions were favourable for maize and sorghum development for most of the countries in Eastern Africa during the main crop season of 2006. The main climatic concern during this crop season was the negative impact of flash floods on food security, mainly in Ethiopia, South Sudan and more recently in Somalia.

Figure 1. NDVI Monthly difference with the long term average (1958-2006) for September

### MARS-FOOD

#### Crop monitoring in Eritrea

August 2007

Date of issue: 7 September 2007 Vol. 06 - 2007

#### Good crop conditions and above normal rainfall in western Eritrea

During the month of August, below average rainfalls have been observed in the western and the central highlands of Ethiopia. These conditions are also clearly below last year in Amhara. The Vegetation Condition Index map on the right of this page indicates that most of the country is now close to the average conditions of the last eight years. South of low VCI values appear nevertheless again in the main cereal production areas of Western Oromiya. On the contrary, in the eastern part of the region, and especially in the production zones of Afar and Biale, vegetation profiles are above average and close to last year. In Tigray, the vegetation condition are good, with vegetation profiles appearing above last year and above average.

Figure 1. NDVI Monthly difference with the long term average (1958-2006) for September

### MARS-FOOD

#### Crop monitoring in Ethiopia

August 2007

Date of issue: 12 September 2007 Vol. 02 - 2007

#### Normal crop conditions but below average rainfall in Central Highlands

During the month of August, below average rainfalls have been observed in the western and the central highlands of Ethiopia. These conditions are also clearly below last year in Amhara. The Vegetation Condition Index map on the right of this page indicates that most of the country is now close to the average conditions of the last eight years. South of low VCI values appear nevertheless again in the main cereal production areas of Western Oromiya. On the contrary, in the eastern part of the region, and especially in the production zones of Afar and Biale, vegetation profiles are above average and close to last year. In Tigray, the vegetation condition are good, with vegetation profiles appearing above last year and above average.

Figure 1. NDVI Monthly difference with the long term average (1958-2006) for September

### MARS-FOOD

#### Maize and Pasture monitoring in Kenya

July 2007

Date of issue: 13 August 2007 Vol. 04 - 2007

#### Very Good Yield for Maize and Fairly Good Situation of Pasture

The maize cycle is already completed in most provinces of the country (Figure 1), except for some important areas in Rift Valley (start flowering stage - half of the cycle) and Central provinces (final maturation > 85% of the cycle).

Our water balance model confirms the very good maize yield already announced in June for 2007 (Figures 2 and 6).

The temporal profiles of vegetation index provide now a complete picture of the cropping season, which is more relevant than the index difference for July (Figure 7). The analysis of these temporal profiles confirms a favourable season for the main maize growing Highlands, Rift Valley and West Provinces and exceptional conditions Central and Coast provinces.

Availability of pasture is generally good at the end of the long rains. Rerestoring (Figures 10 and 11) indicates normal for most pastoral areas, no good condition for the recovery after 2006 drought (especially in Turkana and coast province).

Figure 1. Vegetation Condition Index in relation to the historical average of the period

### WFSAU Climate Data Update

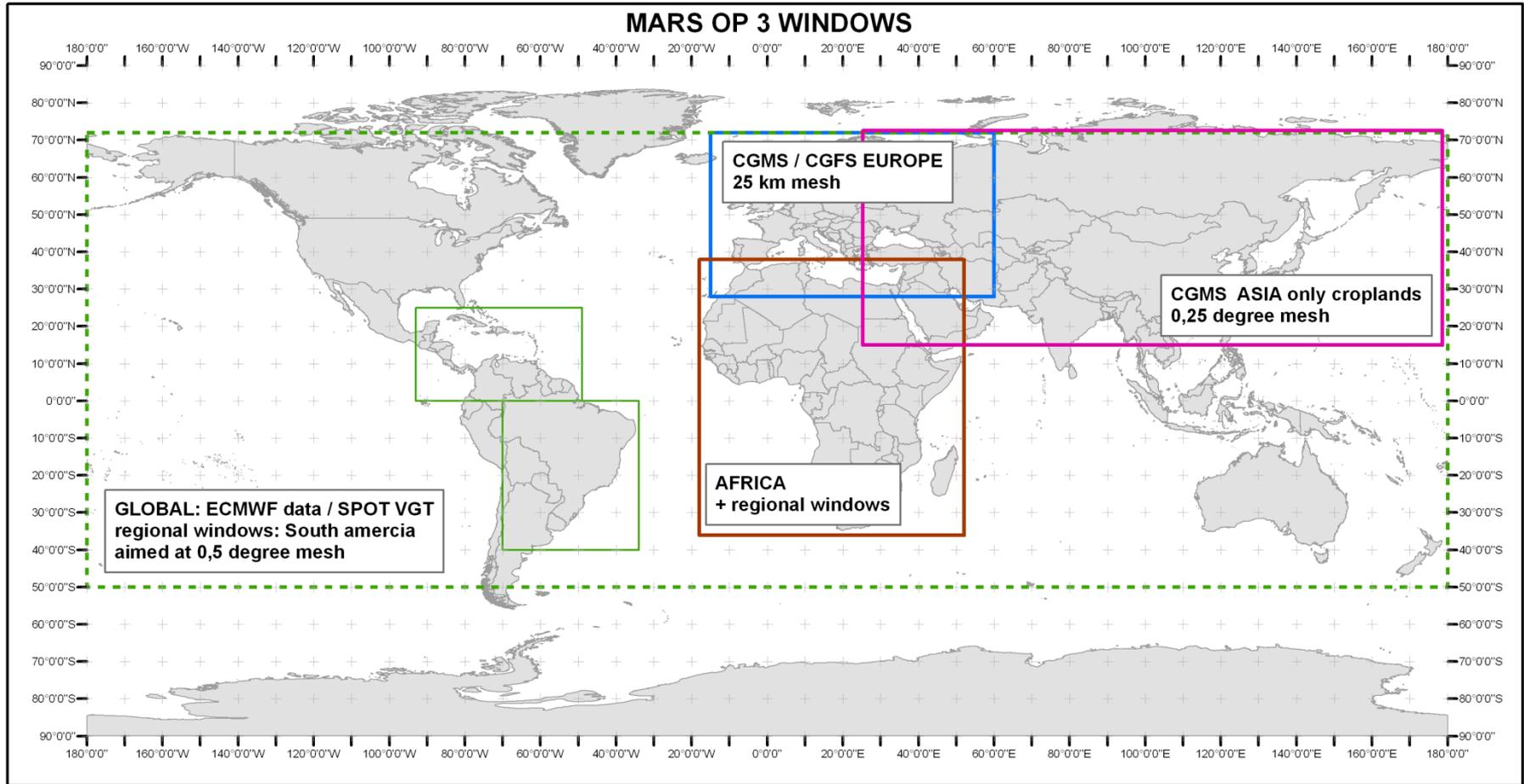
July, 2009

Current Rainfall and NDVI

The report is a compilation of the data on Current Rainfall and NDVI (Vegetation Condition Index) for the month of July 2009. It is intended to provide a quick overview of the current situation in the region.

Maps and graphs in this bulletin are presented for reference purposes.

1. Current Rainfall (mm) for July 2009. The map shows the current rainfall for July 2009. The legend indicates the following categories: 0-10, 10-20, 20-30, 30-40, 40-50, 50-60, 60-70, 70-80, 80-90, 90-100, 100-110, 110-120, 120-130, 130-140, 140-150, 150-160, 160-170, 170-180, 180-190, 190-200, 200-210, 210-220, 220-230, 230-240, 240-250, 250-260, 260-270, 270-280, 280-290, 290-300, 300-310, 310-320, 320-330, 330-340, 340-350, 350-360, 360-370, 370-380, 380-390, 390-400, 400-410, 410-420, 420-430, 430-440, 440-450, 450-460, 460-470, 470-480, 480-490, 490-500, 500-510, 510-520, 520-530, 530-540, 540-550, 550-560, 560-570, 570-580, 580-590, 590-600, 600-610, 610-620, 620-630, 630-640, 640-650, 650-660, 660-670, 670-680, 680-690, 690-700, 700-710, 710-720, 720-730, 730-740, 740-750, 750-760, 760-770, 770-780, 780-790, 790-800, 800-810, 810-820, 820-830, 830-840, 840-850, 850-860, 860-870, 870-880, 880-890, 890-900, 900-910, 910-920, 920-930, 930-940, 940-950, 950-960, 960-970, 970-980, 980-990, 990-1000, 1000-1010, 1010-1020, 1020-1030, 1030-1040, 1040-1050, 1050-1060, 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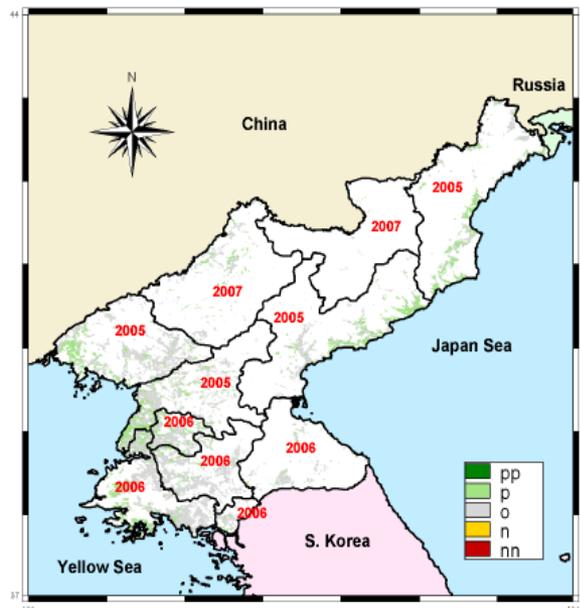
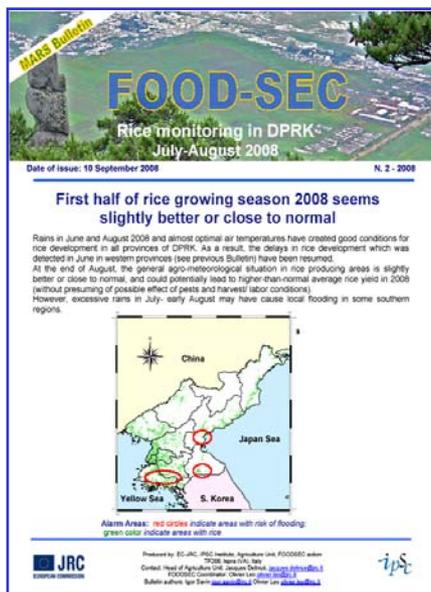


 GLOBAL window  
+ regional RS windows  
data: ECMWF  
SPOT VGT  
model: GWSI,  
CGMS level 1

 EUROPEAN window  
data: meteo station data  
ECMWF  
NOAA - AVHRR,  
MODIS, MSG, SPOT VGT  
model: CGMS  
CGFS

 ASIAN window  
+ regional RS window  
data: ECMWF  
SPOT-VGT  
model: CGMS

 AFRICAN window  
+ regional windows  
data: meteo station  
ECMWF  
MODIS, MSG  
SPOT VGT



Deviation of NDVI of 2<sup>nd</sup> dekad of August 2008 from long-term average (SPOT-VGT)  
pp – higher than average, p – slightly higher than average, o – close to average, n – slightly lower than average, nn – lower than average; Red figures indicate for each province, the most similar past year in term of NDVI time profile

**DPRK** Close to average Rice crop performance (2<sup>nd</sup> dekad August 2008) in nearly all rice zones

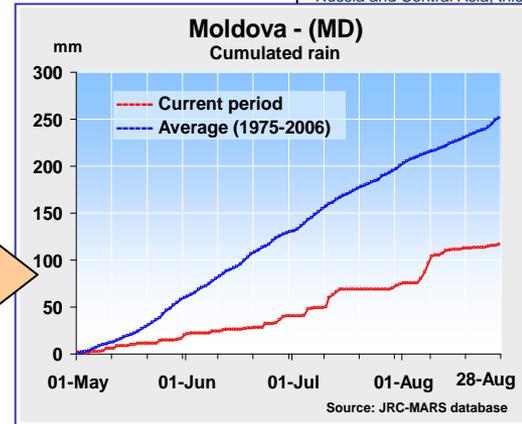
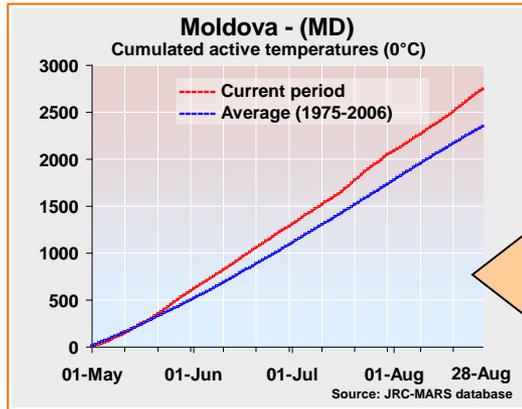
## MOLDOVA:

- 2007 Specific report / assessment Drought and Heat stress
- 2009 Drought \_ Repport and yield forecast provided to FAO GIEWS

## A request from AIDCO –A (6/08/07)

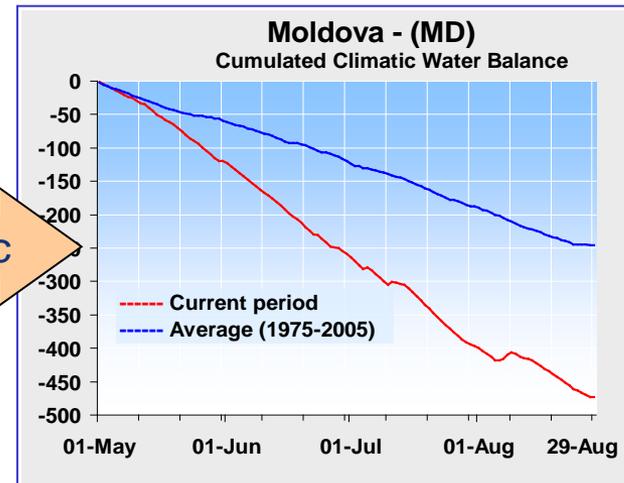
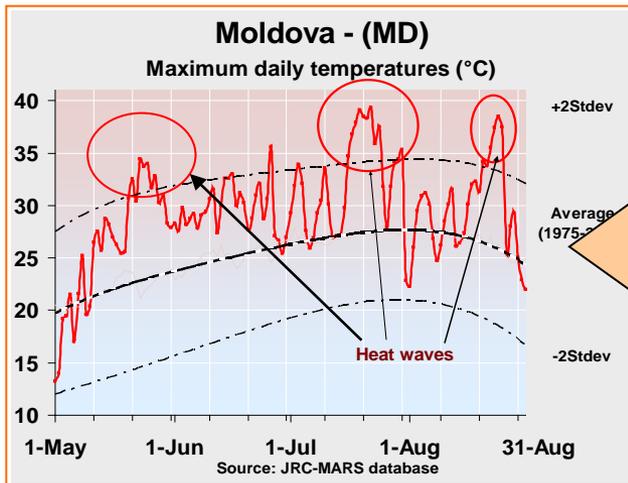
From: GIORGI Sergio (AIDCO)  
[mailto:Sergio.GIORGI@ec.europa.eu]  
Sent: 06 August 2007 16:52  
To: GENOVESE Giampiero (JRC)  
Subject: FW: Agro-meteorological Bulletin for Russia and Central Asian Countries (2007-3)

Dear Mr Genovese,  
being somewhat familiar with the JRC bulletins produced for Russia and Central Asia, this is to kindly request your assistance in providing information concerning the agro-meteorological situation in the last few days (such as this year's situation) in the ENP countries and Yemen for the period of the year (AIDCO) under the coordination & supervision for



Quick analysis

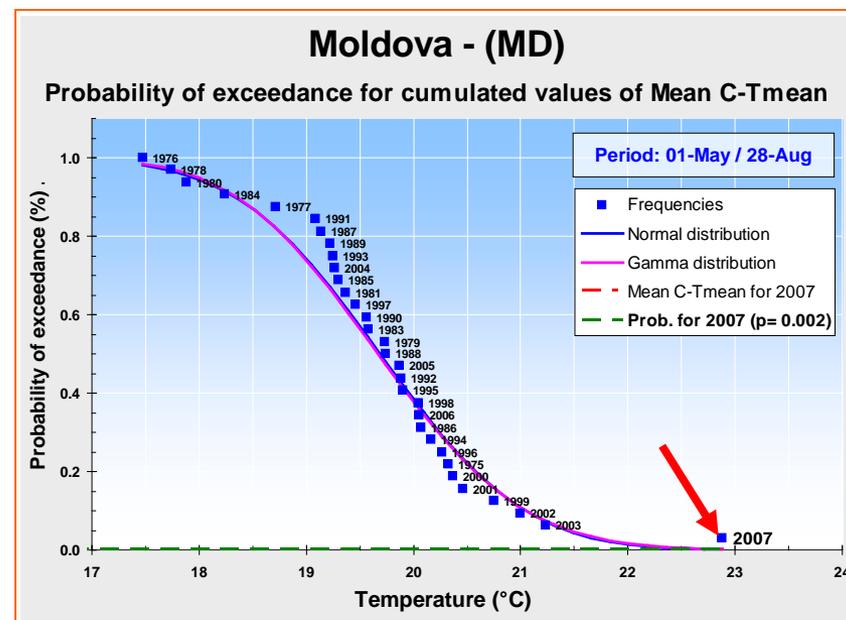
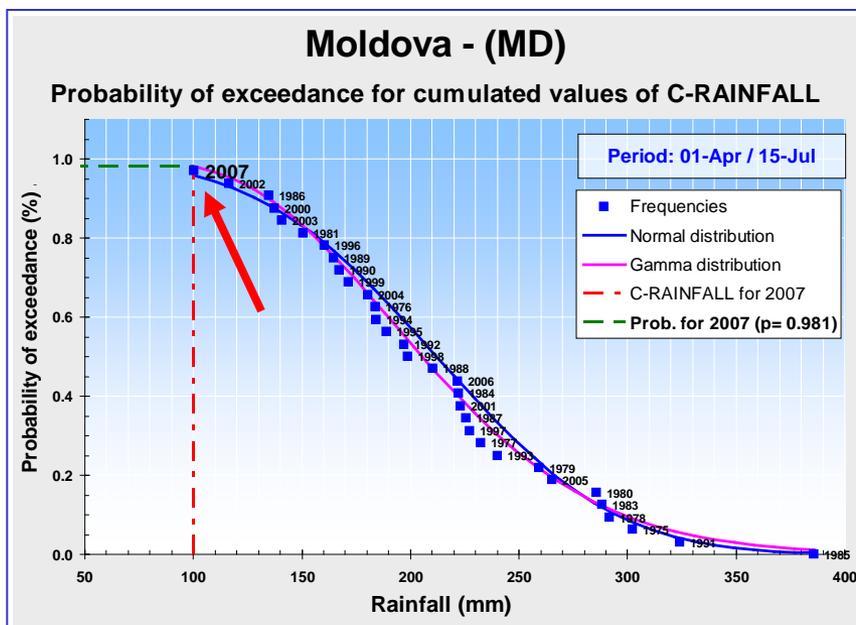
A rapid analysis of the meteo data confirms the gravity of situation



Agro climatic

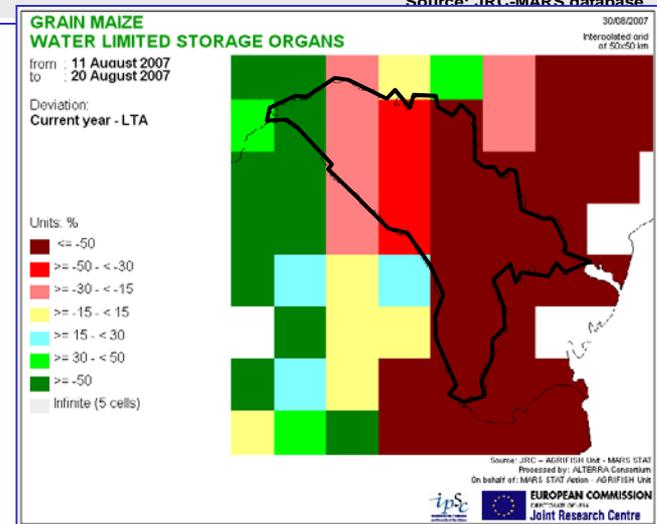
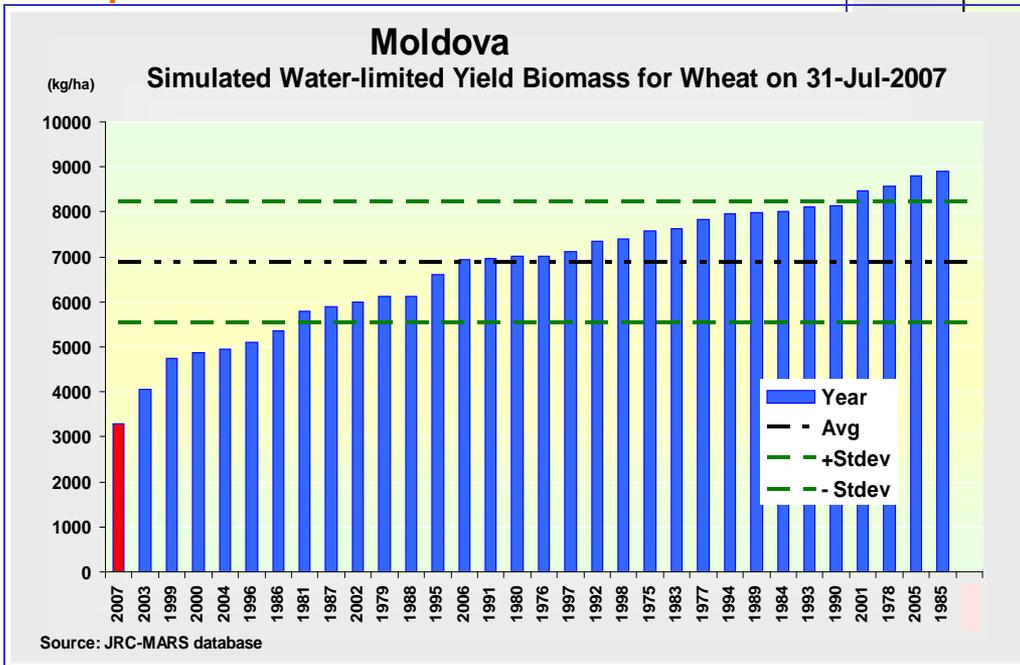
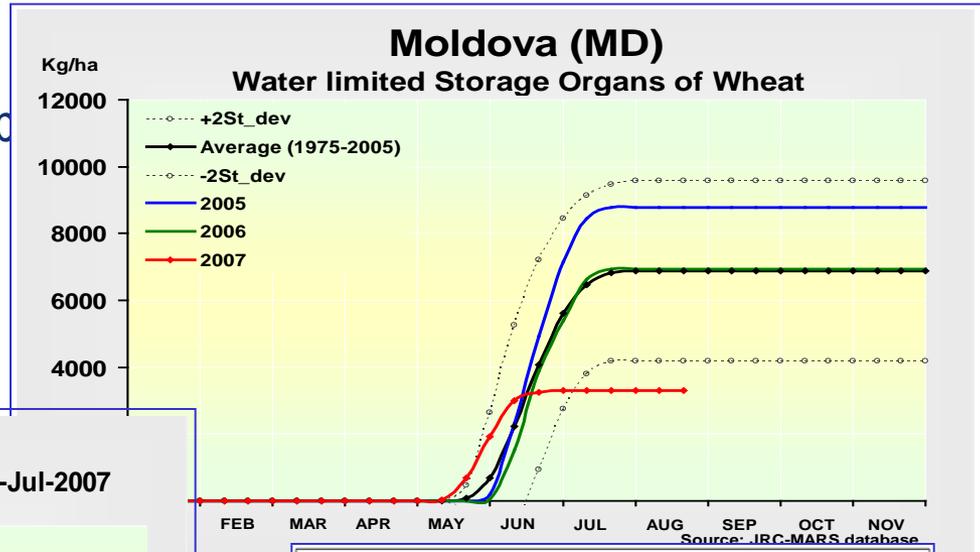
## 2007 Drought and heat-stress in Moldova

Frequency analysis on 32 years confirms a series of extreme events of Drought and Heat wave occurring at key development stages for both winter and summer crops

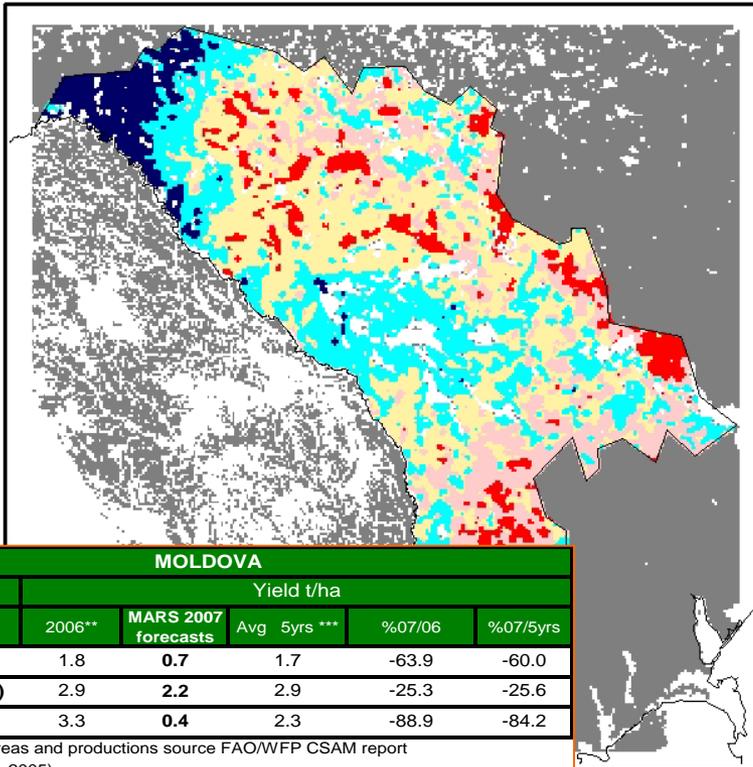


## 2007 Drought and heat-stress in Moldova

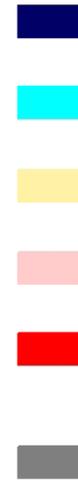
Crop Simulations (Wheat, rapeseed, sp Barley, Sunflower) by WOFOST model (CGMS) indicated an **exceptional damage to both winter and summer crops.**



## TEN DAY NDVI CLUSTER ANALYSIS OF SPOT VEGETATION DATA FOR ARABLE LAND - DIFFERENCE BETWEEN CURRENT YEAR (2007) AND LONG TERM AVERAGE (1999 - 2006)

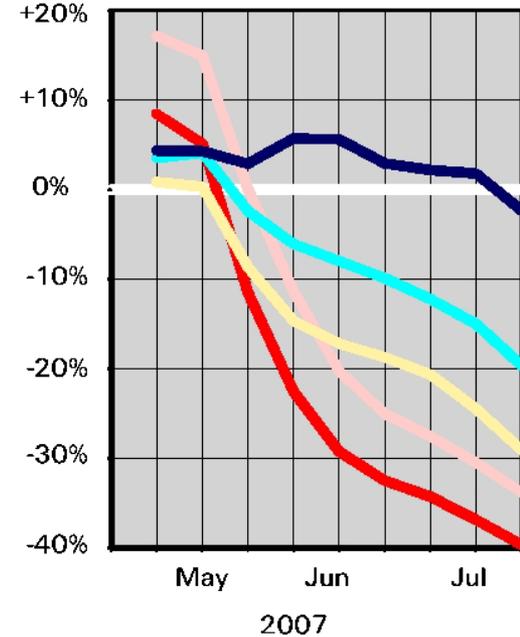


Comparison current year with LTA profile classes



clouds, snow, missing, excluded

## TEN DAY NDVI DIFFERENCES in Percent



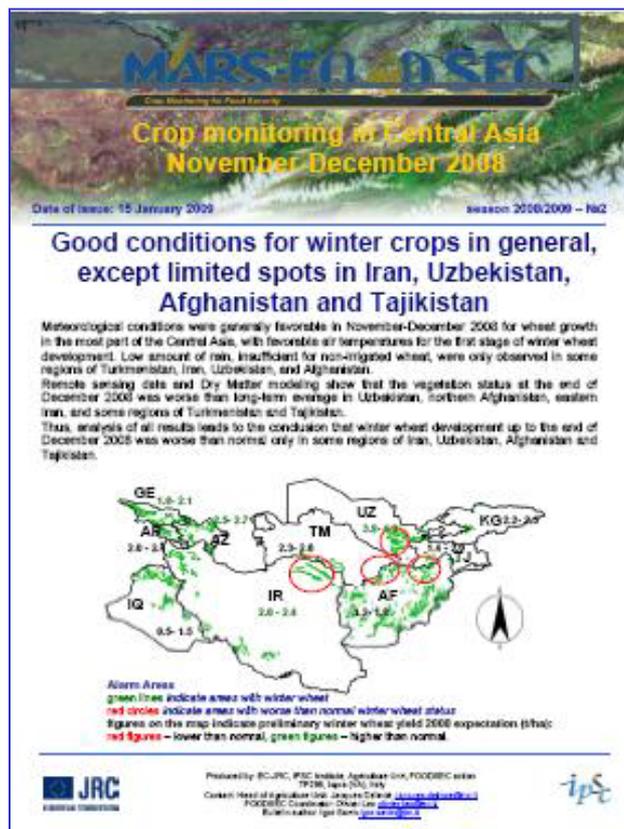
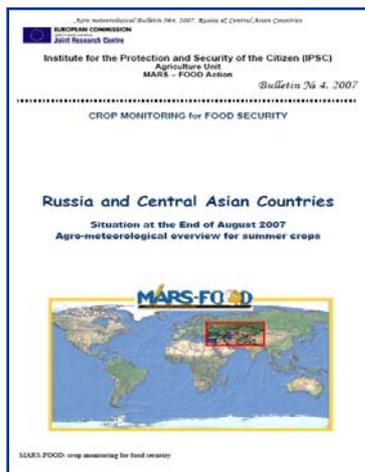
MOLDOVA					
	Yield t/ha				
	2006**	MARS 2007 forecasts	Avg 5yrs ***	%07/06	%07/5yrs
barley	1.8	0.7	1.7	-63.9	-60.0
grain maize (SI)	2.9	2.2	2.9	-25.3	-25.6
wheat	3.3	0.4	2.3	-88.9	-84.2

\*\* based on 2006 areas and productions source FAO/WFP CSAM report  
 \*\*\* FAOSTAT (2001-2005)  
 (SI) only surving and/or irrigated fields

At least a quarter of the total crop areas are seriously affected (crop failure)

## • Transition period between redefinition of windows // Bulletins

- 2007 Russia and Central Asia
- 2008 Russia and Ukraine covered in “European Window” + Specific Central Asia Bulletin , Disrupted early 2009
- in 2010 Kazakhstan and Central Asia. in a large CGMS ASIA Window ( incl. India, China)



**MARS-FL D SEC**  
Crop monitoring in Central Asia  
November-December 2008

Date of Issue: 19 January 2009 Version: 20082009 - 002

Good conditions for winter crops in general, except limited spots in Iran, Uzbekistan, Afghanistan and Tajikistan

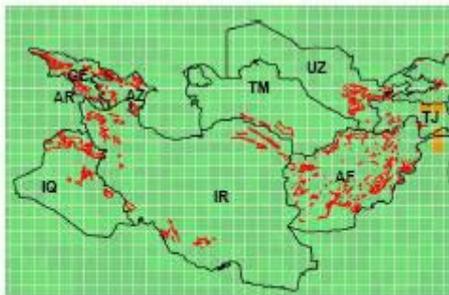
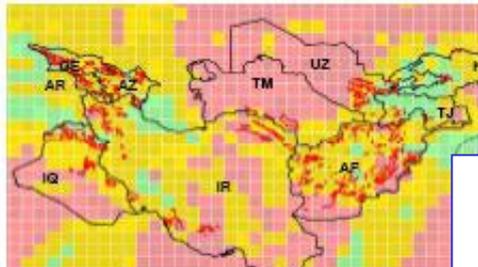
Meteo conditions were generally favorable in November-December 2008 for wheat growth in the most part of the Central Asia, with favorable at temperatures for the first stage of wheat development. Low amount of rain, insufficient for precipitation annual, were only observed in some regions of Kazakhstan, Iran, Uzbekistan and Afghanistan.

Climate average rate and Dry Matter content show that the irrigation status at the end of December 2008 was worse than long-term average in Uzbekistan, northern Afghanistan, western Iran, and some regions of Turkmenistan and Tajikistan.

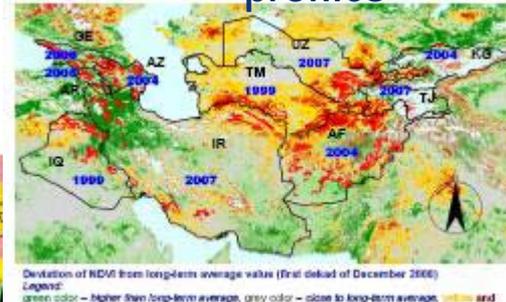
This analysis of the results which is the conditions for winter wheat development up to the end of December 2008 was worse than normal only in some regions of Iran, Uzbekistan, Afghanistan and Tajikistan.

**JRC**

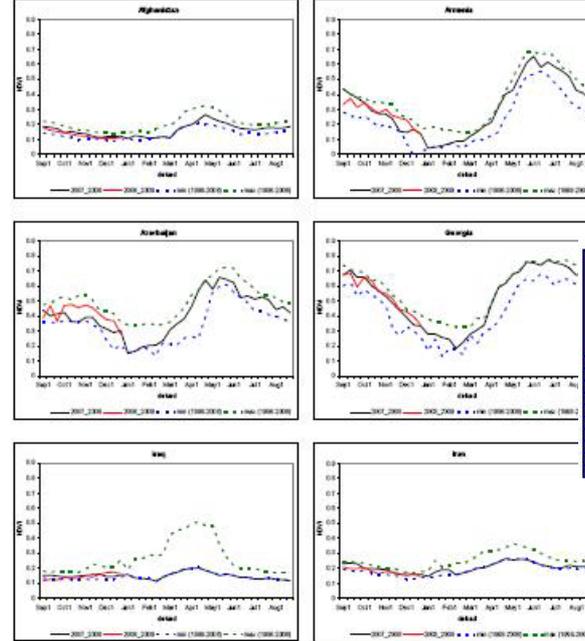
## Meteo conditions



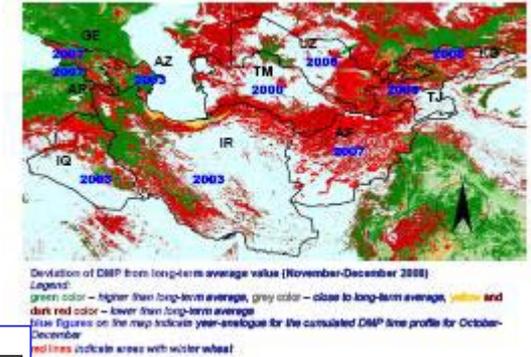
## NDVI conditions & profiles



Annex 3. NDVI time series for winter wheat zones



## DMP



country code	crop growth indicator & winter wheat yield expectation (t/ha)								
	precipitation sum for the period from October to June (based on regression analysis, and year-analogue definition)			NDVI curve (based on regression analysis, and year-analogue definition)		DMP curve (based on regression analysis, and year-analogue definition)			
	yield	R <sup>2</sup>	yield for year-analogue	yield	R <sup>2</sup>	yield for year-analogue			
AF	-	-	1.5	-	-	1.9	-	1.7	1.2-1.8
AR	-	-	2.3	-	-	2.1	-	1.3	2.0-2.4
AZ	-	-	2.6	-	-	2.6	-	2.6	2.6-2.7
GE	-	-	1.9	-	-	2.0	-	1.5	1.8-2.1
IR	-	-	2.1	-	-	2.3	-	2.1	2.0-2.4
IQ	-	-	-	-	-	0.6	-	1.4	0.6-1.5
KG	-	-	2.3	-	-	2.4	-	-	2.2-2.6
TJ	-	-	1.5	-	-	1.9	-	-	1.4-2.0
TM	-	-	-	-	-	2.5	-	2.4	2.3-2.8
UZ	-	-	3.9	-	-	4.2	-	-	3.8-4.5

## Preliminary Forecasts

## Sensor

## Preprocessing

## Indicators

## Info extraction over space and time

**MSG**  
since 2005

**NOAA AVHRR**  
since 1981

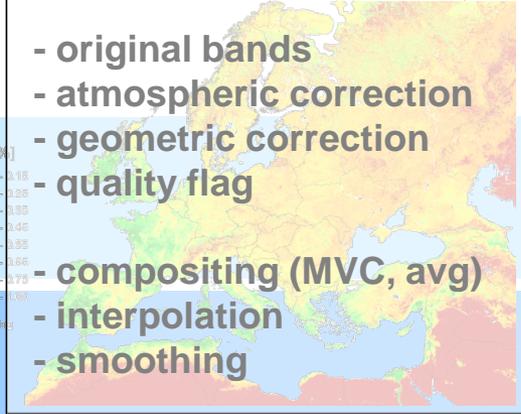
**METOP AVHRR**  
from 2008

**SPOT VGT**  
since 1998

**MODIS TERRA**  
since 2000

**Pan-European**  
Daily, 10- daily, monthly,  
long term average

- original bands
- atmospheric correction
- geometric correction
- quality flag
- compositing (MVC, avg)
- interpolation
- smoothing

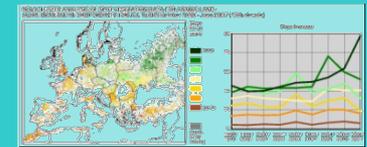


**Land surface temp.**  
**Radiation (DSSF)**  
**Sunshine duration**  
**Snow cover**

**NDVI**  
**fAPAR**  
**DMP**

**NDVI**  
**fAPAR**  
**DMP**

**Difference analysis**  
**Time profile analysis**  
**Cluster analysis**  
**Similarity analysis**  
**Rank analysis**  
**Probability analysis**

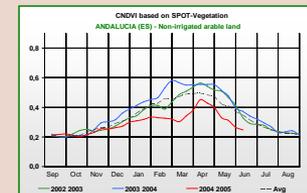


**Intra annual & full series**

### C- indicator

Weighted mean according to land use within the unit of interest

**Administrative unit**  
**Agri-ecological zonation**  
**Grid (25 km \* 25 km)**



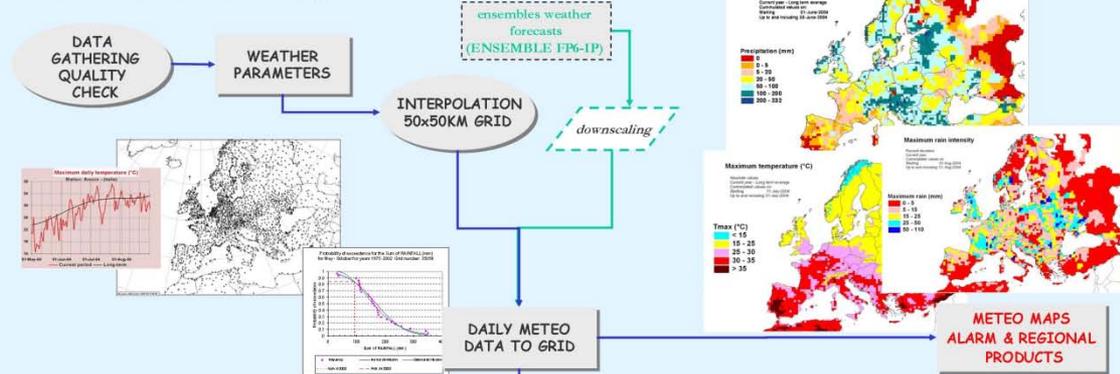
**Asian Window defined**  
**with same characteristic**

## Complement station network

Enhance, fill gaps, increased density, cross-checking

Parameter: LST, radiation, snow cover

### Level1: Weather Monitoring



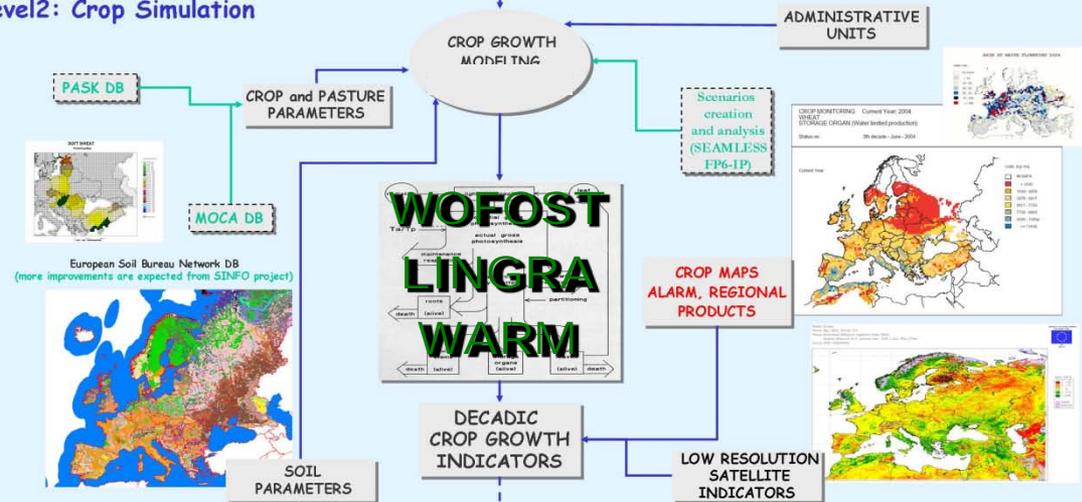
## Alternative source for CGMS data as direct input for crop models

Meteo: radiation, sunshine duration, snow cover

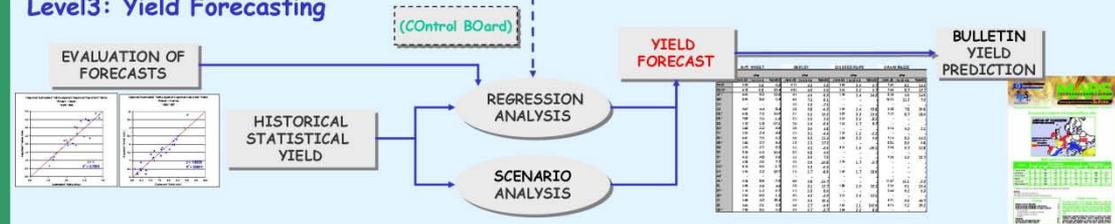
Vegetation state: NDVI, fAPAR, DMP to derive phenology or biomass

Input/calibration/update of CGMS

### Level2: Crop Simulation



### Level3: Yield Forecasting

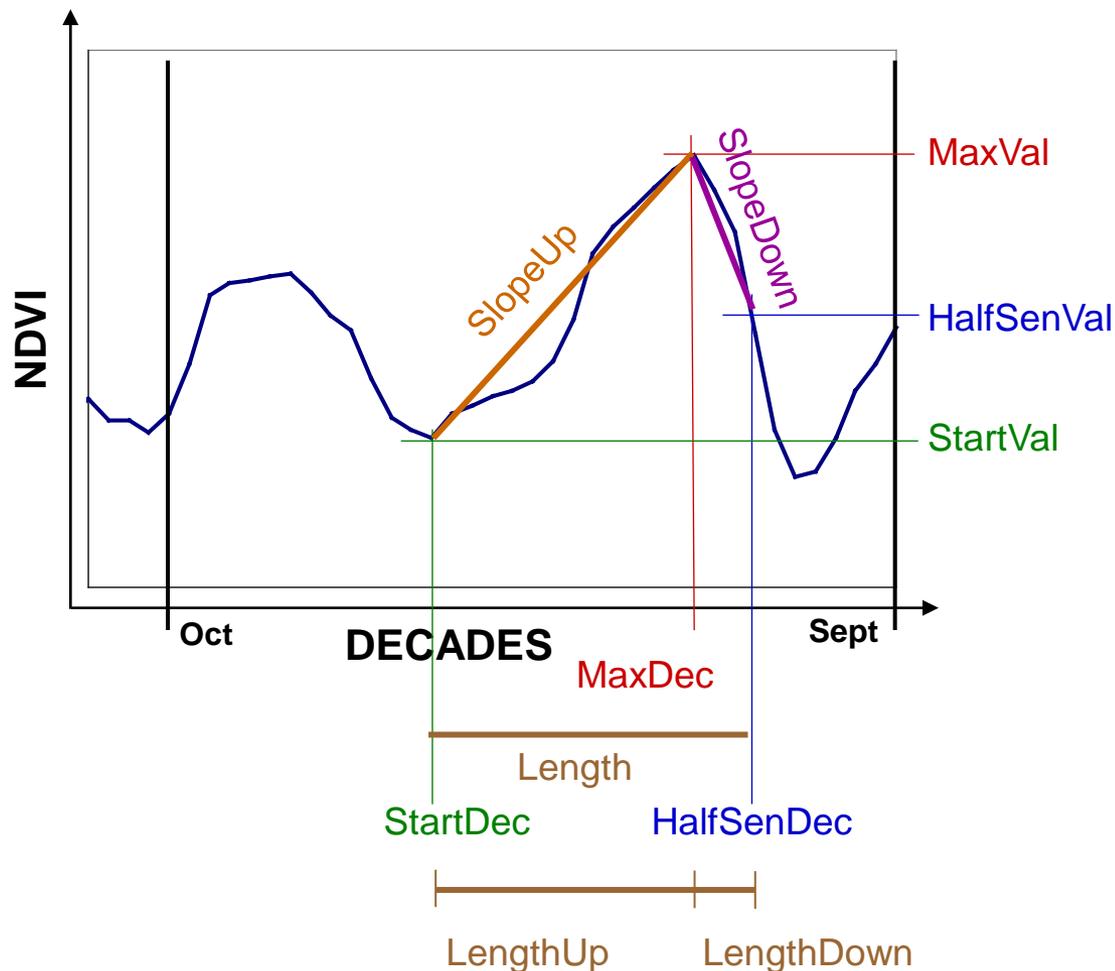


## Regression indicator & scenario

Chronos indicators derived from NDVI, fAPAR

Similarity analysis

- Radiation most promising parameter for direct ingestion by crop development model level I
- RS vegetation state parameters very efficient in semi arid but CGMS 10 daily crop growth parameters are better predictors in non water limited situations
- **Vegetation state parameters – link between Chronos** indicators and crop phenology further to be established
  - Collection of observed phenol data is crucial (agro-phenological network)
- Good crop masks for the extraction are needed, as regional / local statistics (weighting)



**Chronos phasing indicators:**

- StartDec
- MaxDec
- HalfSenDec

**Chronos intensity indicators:**

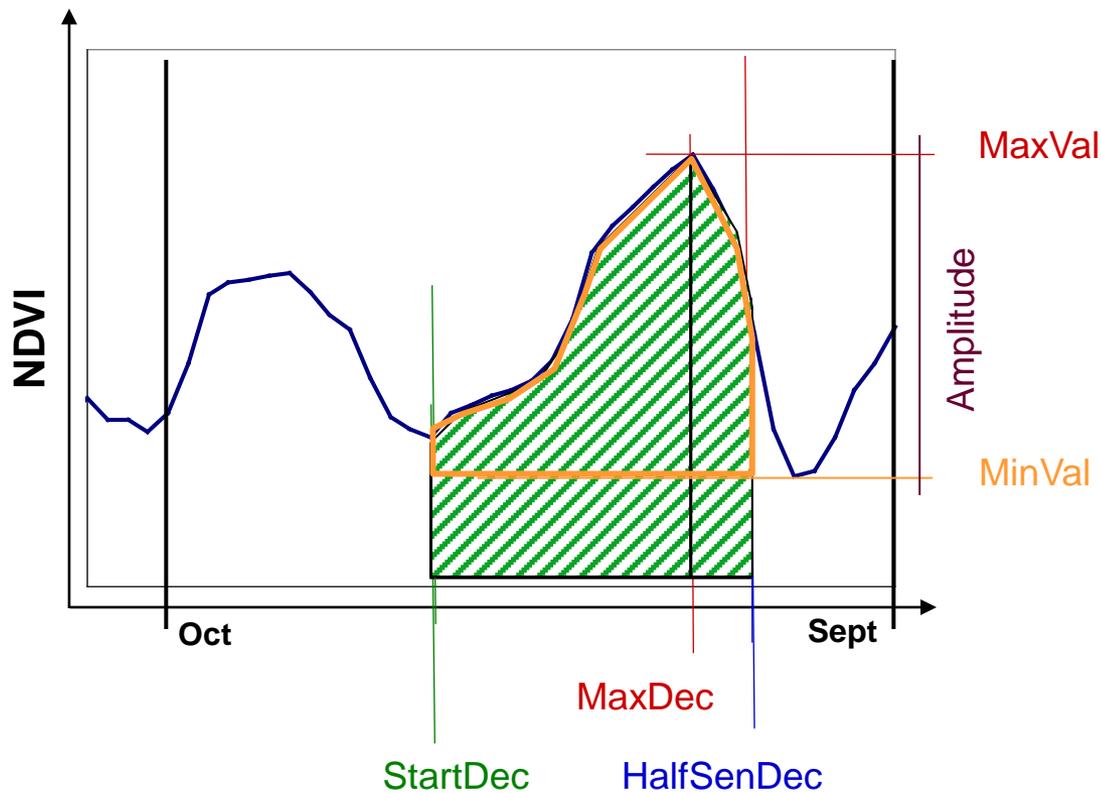
- StartVal
- MaxVal
- HalfSenVal

**Chronos duration indicators:**

- Length
- LengthUp
- LengthDown

**Chronos cumulative indicators I:**

- SlopeUp
- SlopeDown



### Chronos cumulative indicators II:



Cum\_StartMax



Cum\_MaxHalf



Cum\_StartHalf



Cum\_StartHalf\_min

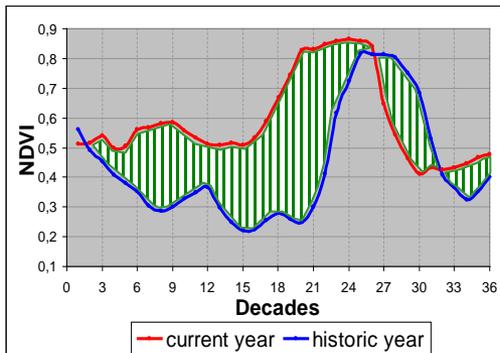
Amplitude

# Potential Use of Most Similar Year of the Time Series to Current Year

## DISTANCE



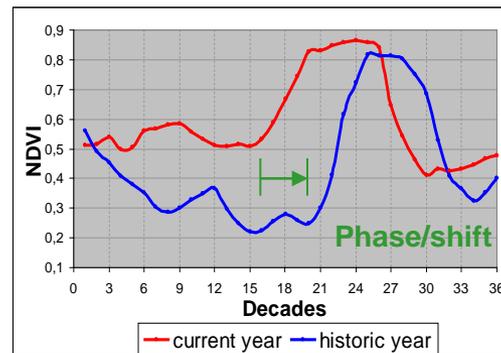
Overall similarity dependent from phase and intensity



## CORRELATION



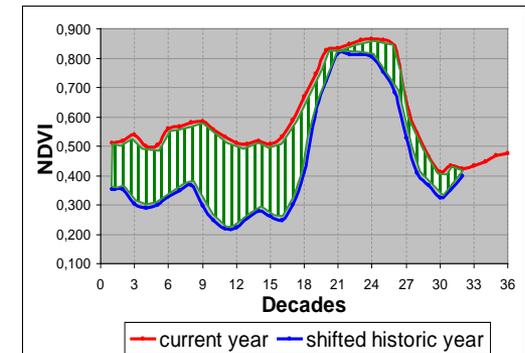
Shift in crop cycle independent from intensity



## CORRELATION + DISTANCE



Cycle similarity independent from the date



$$ABSdiff_k = \sum_{i=1}^n ABS(NDVI_{current,i} - NDVI_{k,i})$$

$$simyear = MIN(ABSdiff_k)$$

k = year, i = decades

$$corr\_coeff1_k = \frac{\sum_{i=1}^n (NDVI_{current,i} - \overline{NDVI}_{current}) \cdot (NDVI_{k,i} - \overline{NDVI}_k)}{\sqrt{\sum_{i=1}^n (NDVI_{current,i} - \overline{NDVI}_{current})^2 \cdot \sum_{i=1}^n (NDVI_{k,i} - \overline{NDVI}_k)^2}}$$

$$simyear = MAX(corr\_coeff1_k)$$

$$ABSdiff_k = \sum_{i=1}^n ABS(NDVI_{current,i} - NDVI_{k,i})$$

$$simyear = MIN(ABSdiff_k)$$

## Crop monitoring focusing on Yield

- Areas estimates provided by survey or trend analysis

## Mapping information crucial for crop masks

- Extraction of cleaner low resolution indicators (agric / crop specific)
- In Europe use of Corine Land cover (1:200 000, 5 years Updating)
- Low - medium resolution classification 1-5 years updating.

## Area Estimates with Remote sensing ?

## Area Estimates ?

### MARS Regional Inventories in EU 1988- 1995

- AFS Field Surveys (Regular grid, square segments - 500 m 1km )
- Regression estimates with 1 date (wall to wall) High Resolution images
  - Small or very small parcel in most of old Europe
  - poor cost-efficiency

### New contexts and drivers:

- Decoupled policies, Development of biofuels
- Low cost wide Swath Satellites with high or Medium resolution
- Important to test new approaches in Europe and “emerging” countries

### But

- Target accuracy very high: << expected inter-annual variation Pixel counting doesn't provide an unbiased statistical estimates

➤ *necessity of robust validation protocols*

## Pilot activities foreseen in Central Asia

### Ukraine:

#### AREA ESTIMATES

Region: 1- 2 oblasts 40 ~ 60,000 km<sup>2</sup> + 1Mio ha of cereals (Wheat)

Images: 2 types of tests: Multi-date classification using AWIFS and MODIS

Ground data: >1000 points by AFS or randomly collected “along the road”

Special attention to the validation protocols

On going call for proposal → Campaign 2010

YIELD FORECASTING: Collaboration agreement with the “Leonid Pogorilyy Ukrainian Scientific Research Institute”

### Kazakhstan:

Collaboration Agreement being signed with NCRST

- Crop Monitoring and Yield forecast systems
- Similar pilots on Area Estimates to be defined and carried out in 2010 - 2011 (GEOLAND2 Project)

MARS data infrastructures, Statistical tools + crop development models are open and ready to share with nat. or reg. organizations

- Implement operational monitoring system
- Carry out specific development or research in similar fields (ex desertification, drought...)
- Simulate Climate change impact and adaptation strategies...

We are interested in integrating user's feed backs, calibration / validation... geo-localized ground data (phenology, yields, pests)

Contact us or participate to a CGMS workshop and training course (ISPRA 2010) !

***Thanks for your attention !***

**Olivier Léo - Bettina Baruth**