PNCD ORIZONT 2000
2000-2002

Assimilation of remotely-sensed data of high repetitivity in process models

ICPA Bucharest - ICPPT Fundulea contribution to the ADAM Project (2000-2002 period)

Project manager: Roxana Vintila (ICPA)

RATIONALE

According to a feasability study made in 2000
by the European Remote Sensing Service (ERSIS),
agriculture in relation with the emergence of precision farming
represents the largest share of the Earth Observation (EO)
accessible market,
that is up to 30 % (assessed today at 300 MEUR)

Assuming the availability of new quality data and related services,
the EO accessible market for agriculture is supposed
to increase to 2,000 MEUR in 2015

The "ADAM" PROJECT

Assimilation of Spatial Data by AgroModeling

A French-Romanian co-operation project for 4 years (2000-2004) initiated by the French Space Agency (CNES)

Main Objective

To elaborate a methodology for the assimilation of the remote sensing data of high spatial-temporal resolution within agro-physiological models coupled with radiative models, in order to produce the information needed in a farm (at the "field scale")

The "ADAM" PROJECT

Assimilation of Spatial Data by AgroModeling

Long Term Objective

To produce space systems dedicated to agriculture at the field scale, capable of monitoring and warning, similar to those already operational in meteorology and oceanography

The "ADAM" PROJECT

French Partners

- The French Space Agency (CNES)
- The Institute for Agronomy Research (INRA-Avignon)
- The College of Agriculture Purpan (ESAP-Toulouse)

Responsibility: global co-ordination, satellite data acquisition and pre-processing, research

Romanian Partners

- The Romanian Space Agency (ASR & CRUTA)
- The Institute for Soil Science and Agrochemistry Research (ICPA-Bucharest)
- The Institute for Cereals and Industrial Crops Research (ICCPT-Fundulea)

Responsibility: ground survey, research

- InterGIS srl - private company Responsibility: GPS support

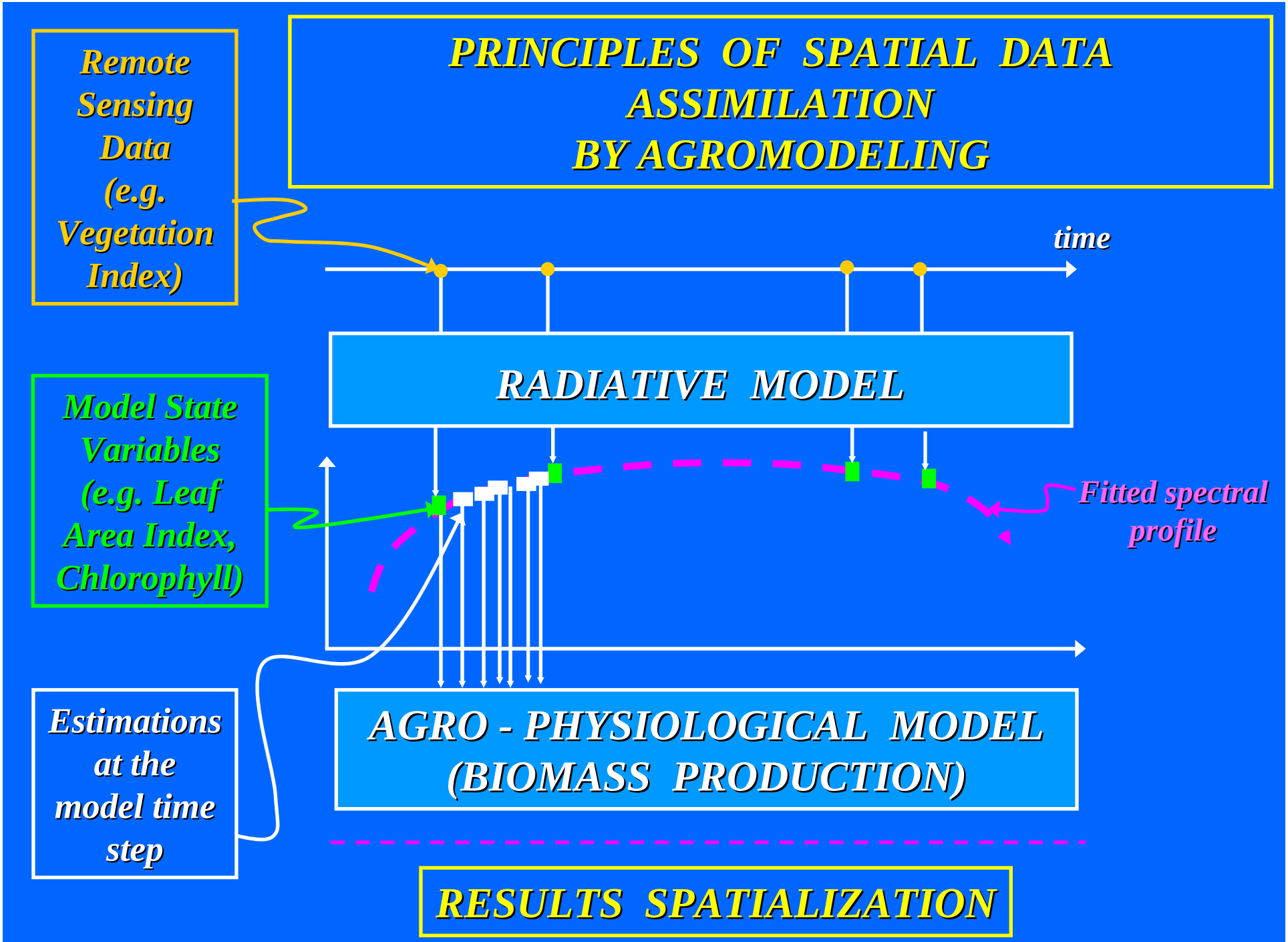
The "ADAM" PROJECT

Specific Objectives of ICPA - ICPPT to be achieved in "ORIZONT 2000" Program

- Contribution to the development and validation of a methodology for the assimilation of the remote sensing data of high spatial-temporal resolution in agro-physiological models coupled with radiative models & the spatialization of the assimilation procedure results

- Development of a processing strategy for the optical and radar remote sensing data in order to extract the maximum of information on soil and vegetation

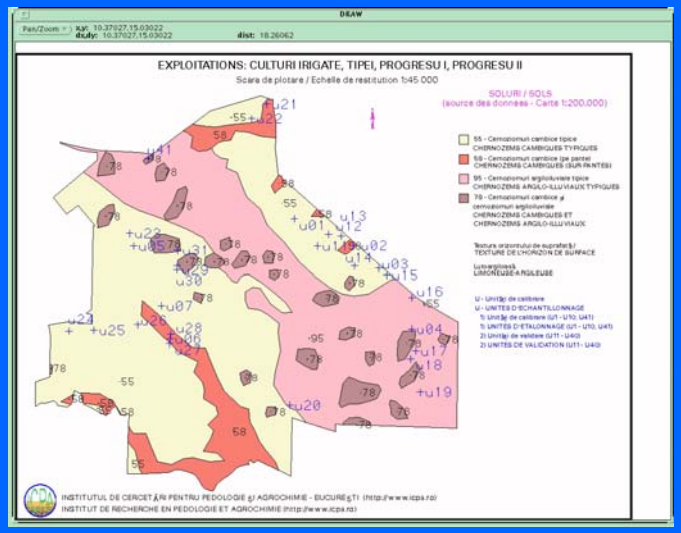
PRINCIPLES OF SPATIAL DATA ASSIMILATION BY AGROMODELING



BASIC INPUT DATA TYPES (I)

(1) meteorological data

(2) soil data



(3) crop data

(4) agricultural practices

(1) meteorological data

- temperature
- rainfall
- global and diffuse radiation
- wind speed
- potential evapotranspiration, ...

(2) soil data

- organic matter
- total Nitrogen, Pa, Ka
- texture
- bulk density
- field capacity
- wilting point
- moisture profiles
- mineral Nitrogen profiles, ...

(3) crop data

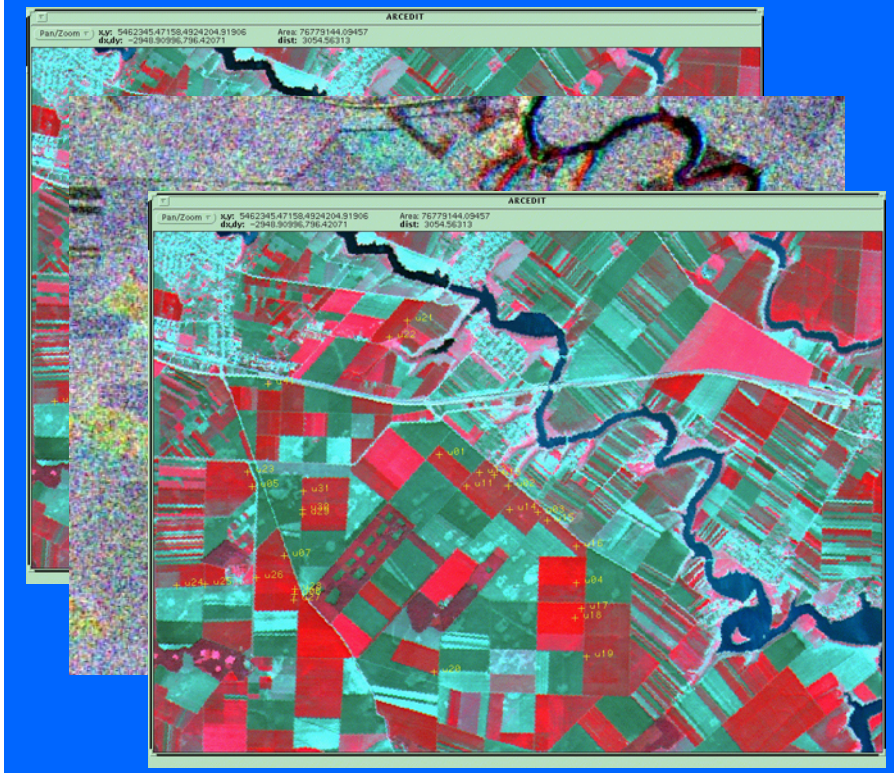
- phenological stages
- leaf area index
- total above biomass
- height
- biomass partitioning (green leaves, senescent leaves, stems, ears)
- yield components
- grain quality
- total Nitrogen in leaves, ...

(4) agricultural practices

- sowing date
- seed treatment
- irrigation
- fertilizers application
- pesticides application
- harvest date, ….

BASIC INPUT DATA TYPES (II)

(5) multitemporal remote sensing data



(6) yield monitoring system data

The frequency of acquisition is related to the crop phenological cycles

SUPPORT INPUT DATA

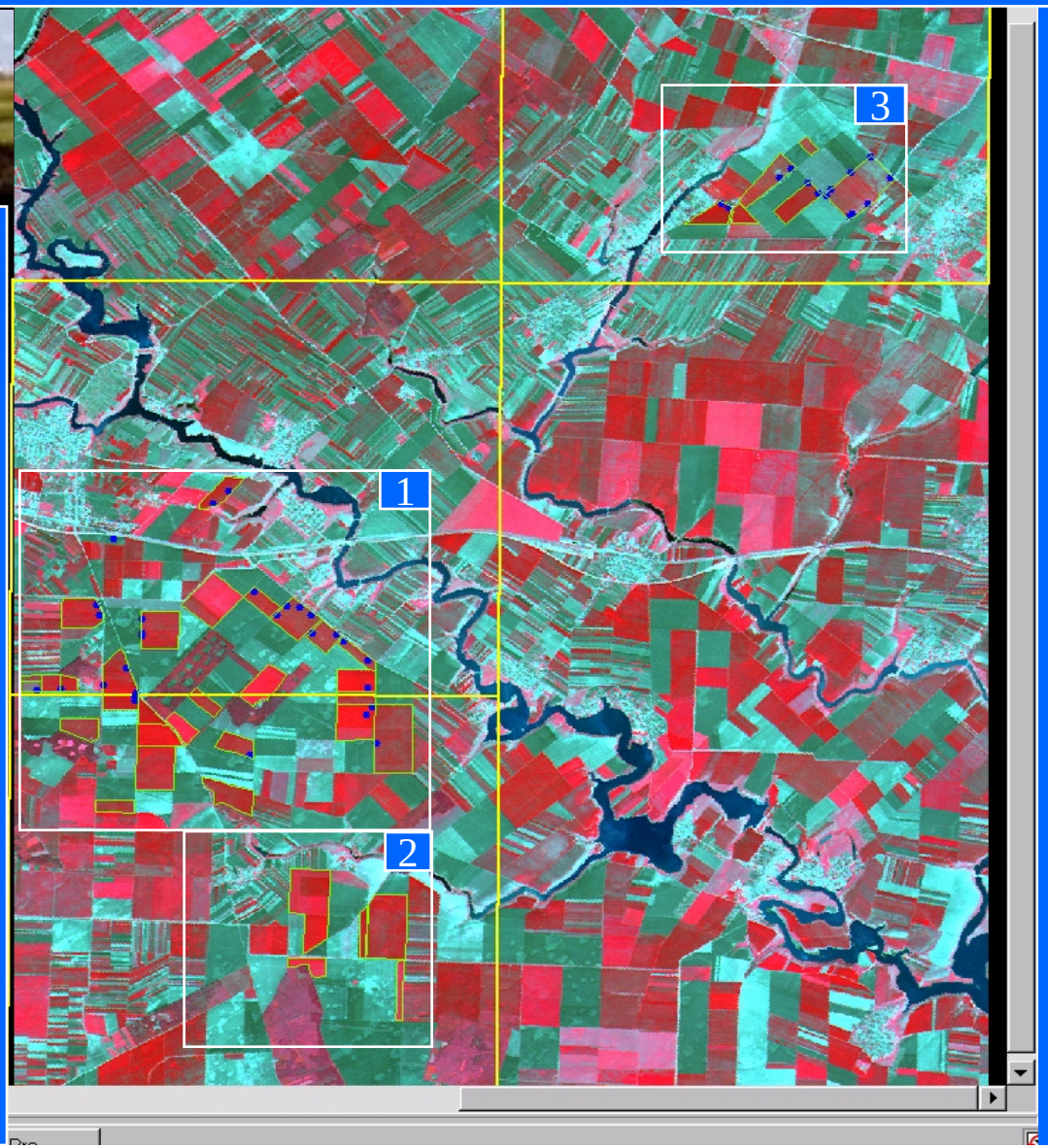
GPS DATA

BASED ON GEOREFERENCING,
INPUT AND PROCESSED DATA
ARE MANAGED WITHIN
A GEOGRAPHIC INFORMATION SYSTEM

THE MONITORING OF THE FIELDS AND OF THE SAMPLING UNITS IN 3 AREAS WITHIN THE FUNDULEA SITE

GPS measurements
1st group:
submetric accuracy
(Odyssey Javad system)

- *Control points for the rectification of the satellite images*
- *Position of the sampling units*
- *Position of the corner reflectors (installed for the calibration of the radar data)*

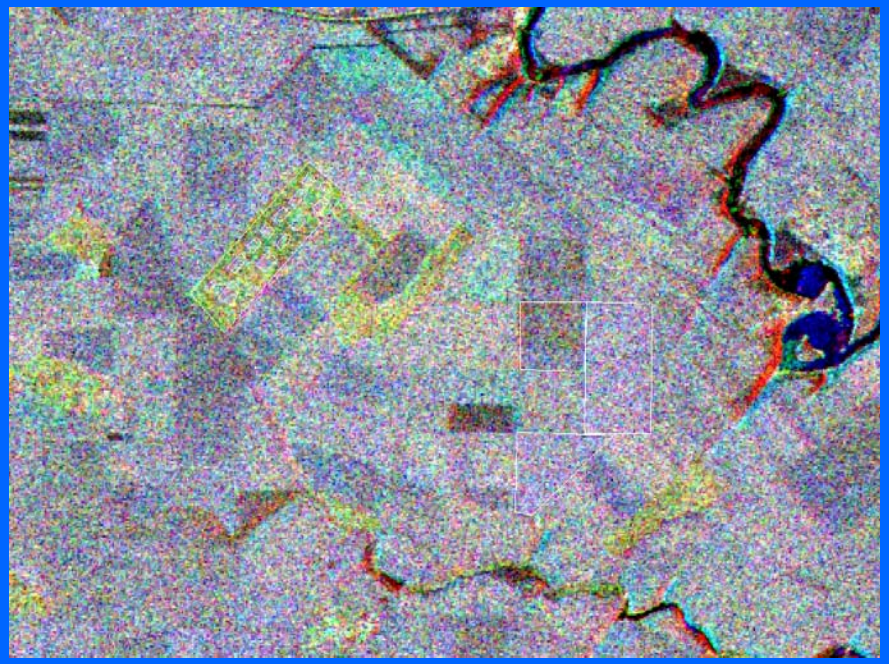


GPS Measurements
1st Group

Accurate location of the corner reflectors (installed on the ICCPT building roof)

GPS Measurements
1st Group

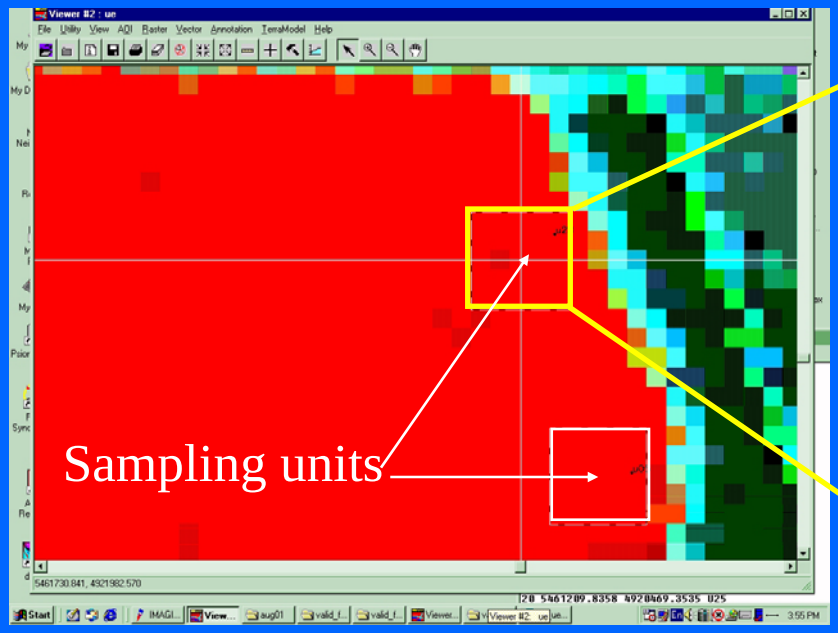
Control points for the rectification of the satellite images



Example of the overlay control
between
an optical image (SPOT XS) and a radar image (ERS 2)

GPS Measurements
1st Group

Location of the sampling units



Example of two sampling units positioned on a SPOT XS image

Example of soil measurements (for moisture and roughness) on a sampling unit

GPS Measurements
2nd Group

Combine machines
equipped with yield monitoring systems (YMS)

- ***LandStar (differential GPS)***
- ***Yield sensor***
- ***Moisture sensor***

The spatial accuracy of the YMS measurements is compatible with the spatial resolution of the multi-temporal remote sensing data

GPS Measurements
2nd Group

Harvest strategy

Harvest the greatest possible number of fields of a minimum area (several hectares) in order to map the variability within fields

Cover the most possible part of the site in order to map the variability among fields

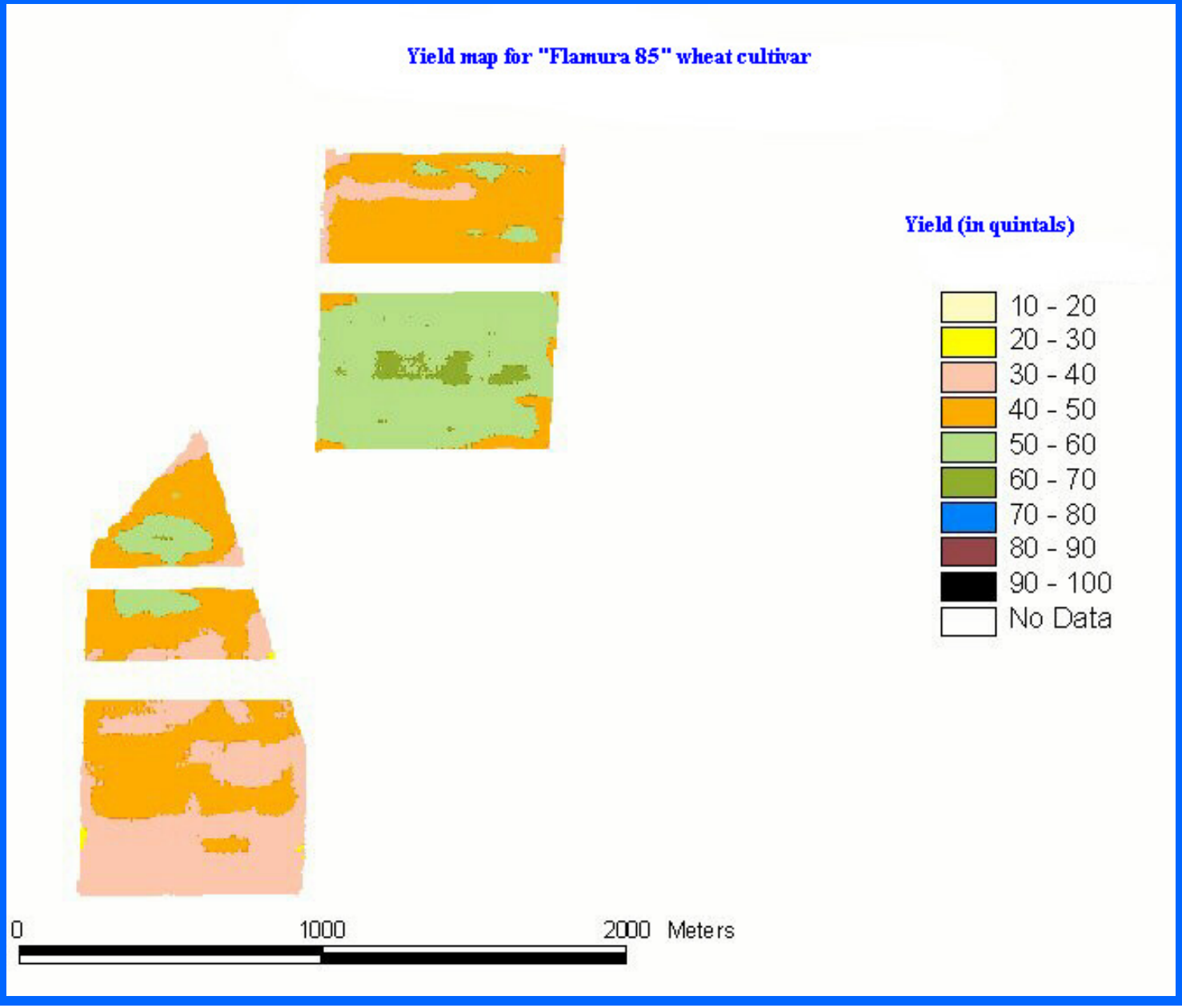
GPS Measurements
2nd Group

During the campaign 2001, about 650 ha of winter wheat have been harvested with 3 equipped combine machines, from a total of 1,500 ha within Fundulea site

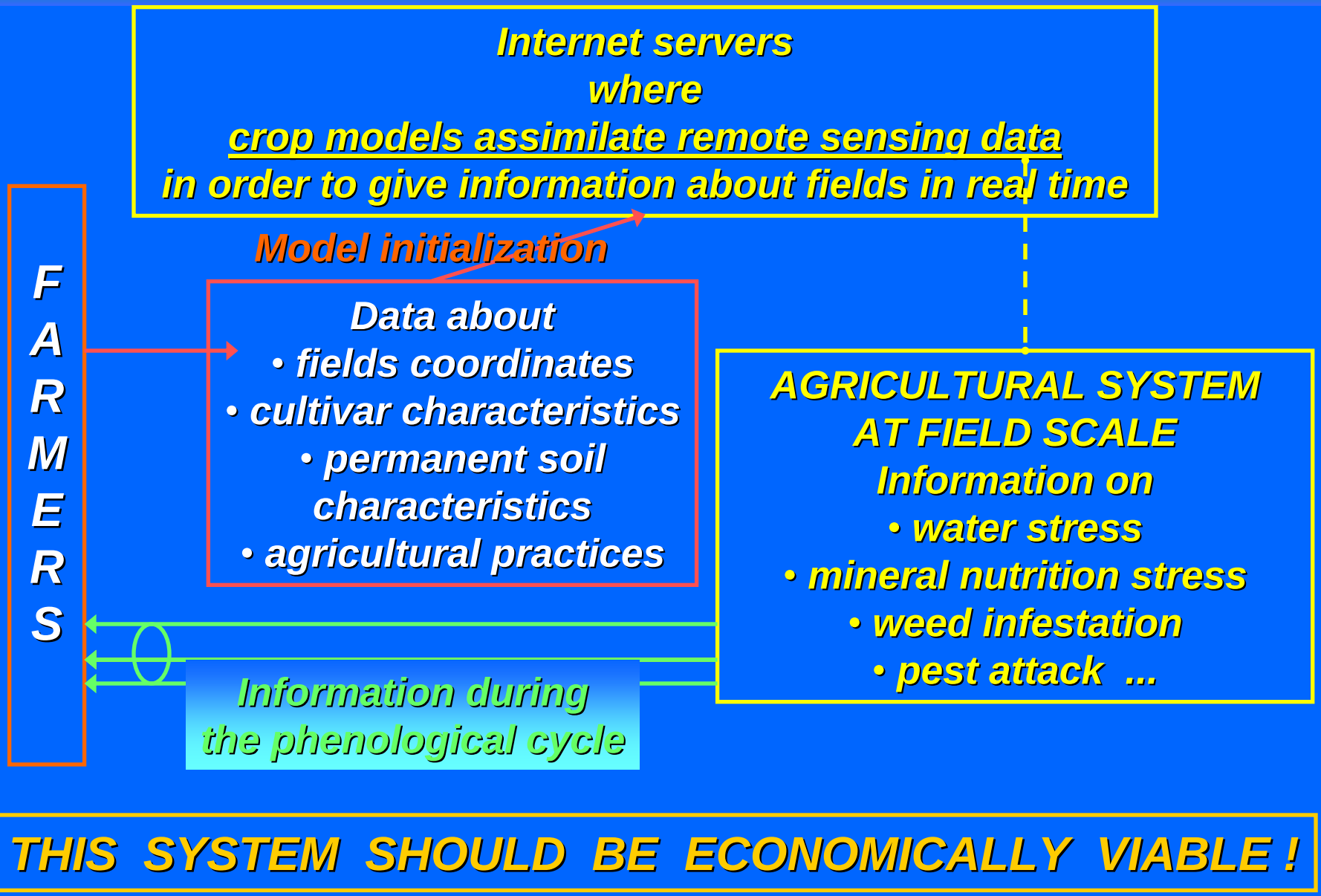
About 80 % of the raw data are of good quality and yield maps have been produced based on them

YMS data are used for the spatialization of the assimilation results and for validation

EXAMPLE OF YIELD MAPS



Challenge for the future



THIS SYSTEM SHOULD BE ECONOMICALLY VIABLE !

DISSEMINATION OF THE PROJECT RESULTS

BARET, F., **VINTILĂ, R., LAZĂR, C**., ROCHDI, N., PREVOT, L., FAVARD, J.-C., DEBOISSEZON, H., LAUVERNET, C., **PETCU, E., PETCU, G., VOICU, P.,** DENUX, J.-P., **POENARU, V**., MARLOIE, O., **SIMOTA, C., RADNEA, C., TURNEA, D.,** CABOT, F. şi HENRY, P., 2001, The ADAM database and its potential to investigate high temporal sampling acquisition at high spatial resolution for the monitoring of agricultural crops. ***Romanian Agricultural Research,*** N. 16, p. 69-80 **(http://www.incda-fundulea.ro/rar/nr16/16.13.pdf)**

LAUVERNET, C., LEDIMET, F.X., BARET, F., DEBOISSEZON, H., FAVARD, J.-C., **VINTILĂ**, **R., LAZĂR, C** şi **BADEA, A.,** 2002, Assimilation of High Temporal Frequency SPOT Data to Describe Canopy Functioning. The Case of Wheat Crops in the ADAM Experiment in Romania. ***Proc. "Recent Advances in Quantitative Remote Sensing"*** (ISBN 84-370-5515-6, ed. J.A. Sobrino, Spain, Universidat de Valencia), p. 921-926