Regional crop & irrigation monitoring:
some examples of (new) opportunities

Belgian workshop 'Space4Food'
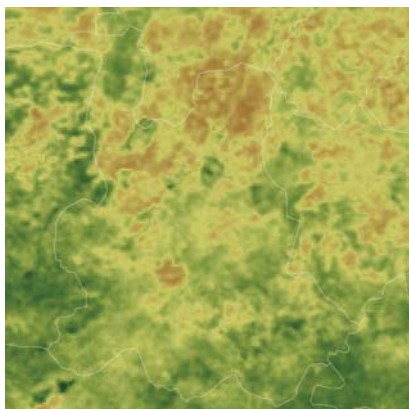*June 11, 2015 - Milan*
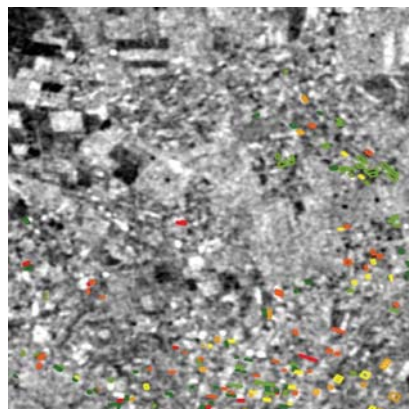Joost WELLENS & Water-Environment-Development unit

belspo   Wallonie - Bruxelles International.be   Belgian Pavilion Milane 2015   EXPO MILANO 2015 FEEDING THE PLANET ENERGY FOR LIFE

Université de Liège Ulg   Arlon campus environnement
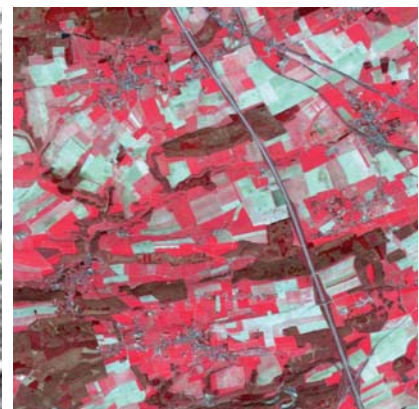

... Monitoring 'space4food'

- applications at ≠ levels -

| 170 km | 10 km | 5 km |

National / regional:
- MODIS (NDVI, GAI, …);
- temporal profiles;
- historic data.

Regional:
- ERS-2;
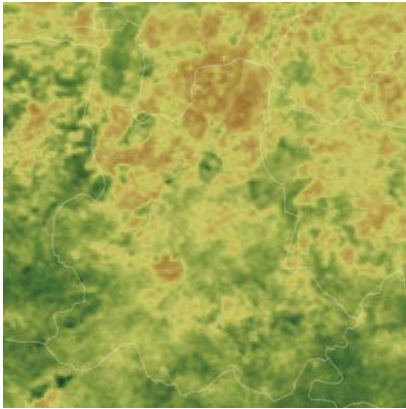- irrigation management database.

Field / Regional / National:
- SPOT-5 Take5;
- time series.
- field observations.

↓   ↓   ↓
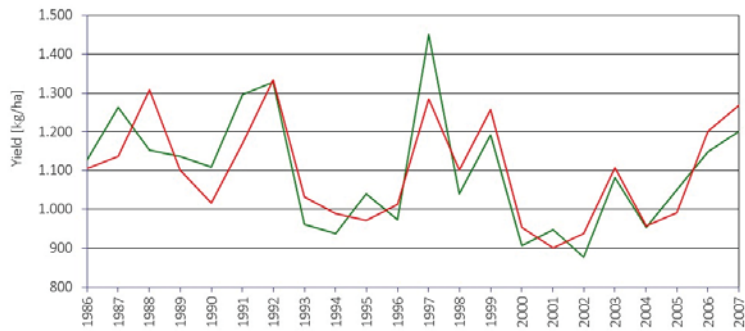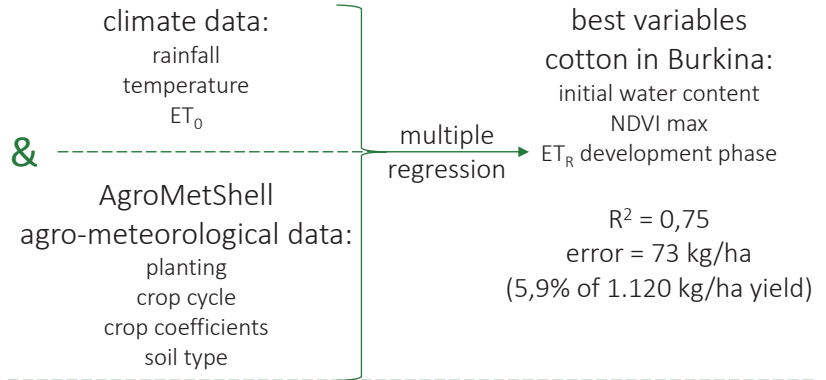Statistical approach   Signal analysis   Assimilation

1.i Regional (coarse) crop monitoring
- Global Monitoring for Food Security -

- MODIS;
- NDVI temporal profiles.

climate data:
rainfall
temperature
ET_0

&

AgroMetShell
agro-meteorological data:
planting
crop cycle
crop coefficients
soil type

multiple
regression

best variables
cotton in Burkina:
initial water content
NDVI max
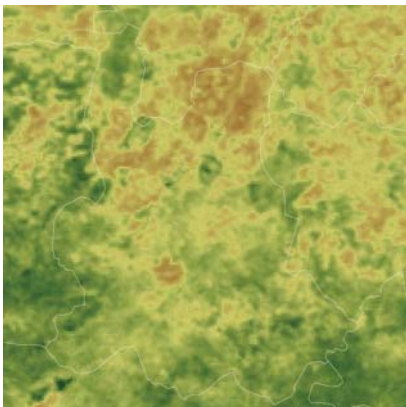ET_R development phase

$R^2 = 0,75$
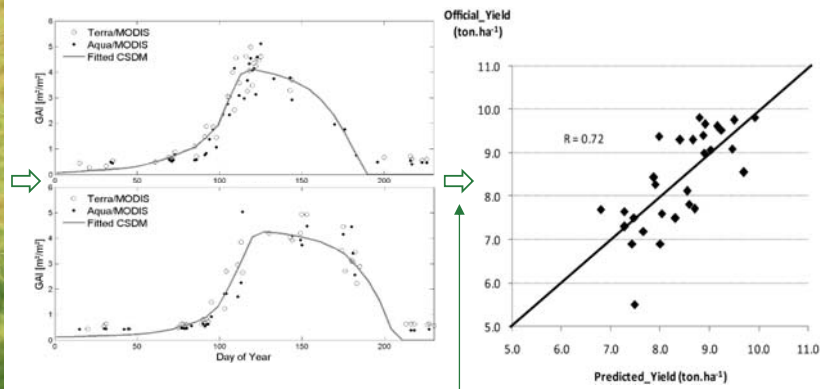error = 73 kg/ha
(5,9% of 1.120 kg/ha yield)

1.ii Regional (coarse) crop monitoring
- 'curve fitting' -
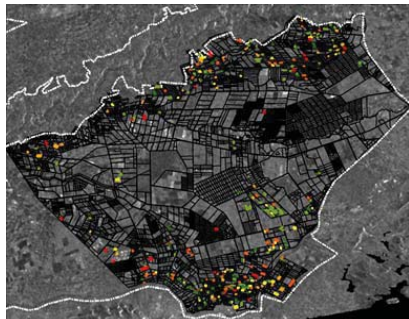

- MODIS;
- GAI temporal profiles.
  (green area index)

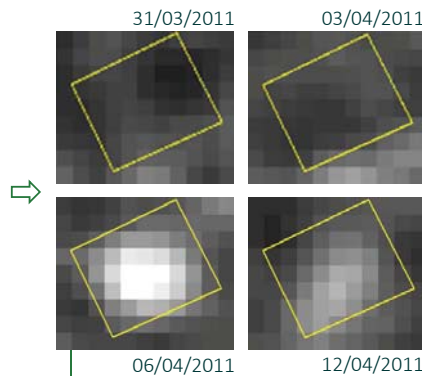Shape of decreasing curves
of green area index
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Regional wheat yield

2 Irrigation monitoring

- using SAR data -

31/03/2011   03/04/2011

06/04/2011   12/04/2011

backscatter

~

soil water content

~

irrigation

+ atmospheric conditions;
+ cost;
+ commercial potential.

- irrigated perimeter of Tadla (center of Morocco);
- 100,000 ha of wheat;
- flood irrigation, 2 to 5 times;
- irrigation water invoices database.

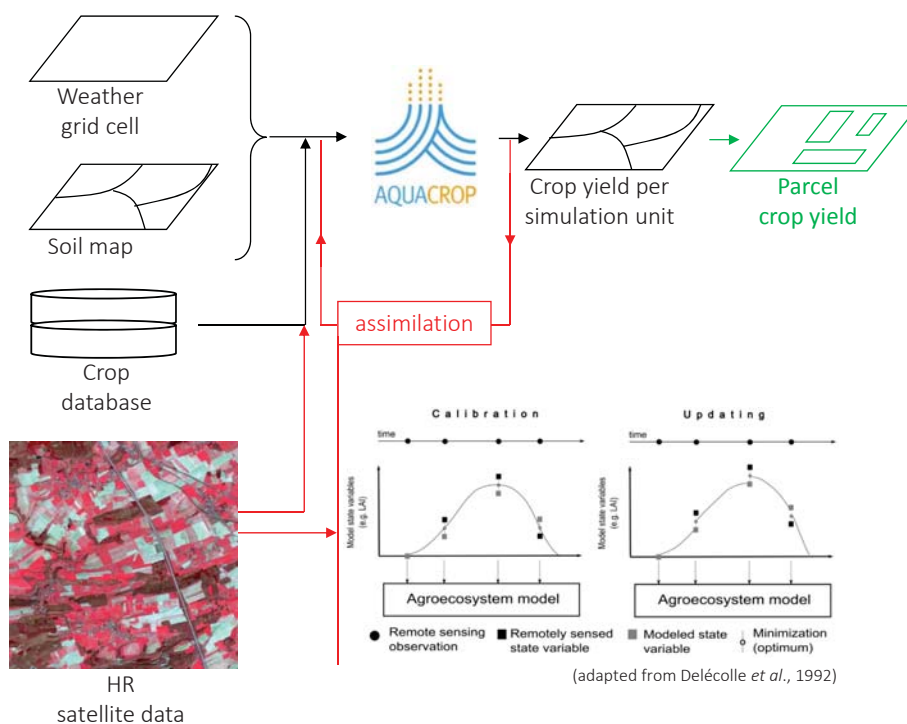- ERS-2;
- C-band;
- dual polarizations (VV);
- 25 m.

3.i Regional (detailed) crop monitoring

- work-flow -

Weather grid cell

Soil map

Crop database

HR satellite data

AQUACROP

Crop yield per simulation unit

Parcel crop yield

assimilation

Calibration   Updating

Agroecosystem model   Agroecosystem model

● Remote sensing observation   ■ Remotely sensed state variable   ▣ Modeled state variable   Minimization (optimum)

(adapted from Delécolle *et al.*, 1992)

3.ii AquaCrop (FAO)

- how does it work? -

simple & solid

$B = WP \cdot \Sigma Tr$ or Biomass = Water productivity · Sum of transpiration

$Y = HI \cdot B$ or Yield = Harvest index · Biomass
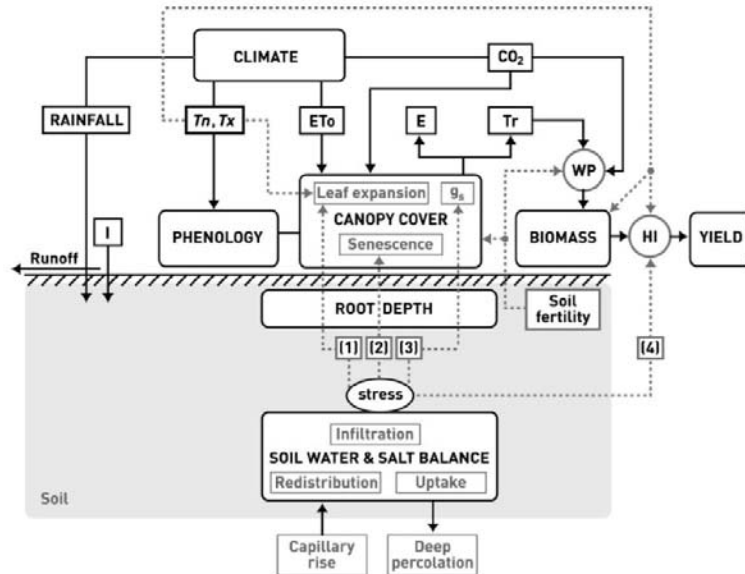
3.iii Crop input

- canopy cover -

08%

44%

85%

88%

① Overhead pictures

② Canopy cover (eCognition)

③ Graph: - crop characteristics;
- canopy growth & decline;
- phenological stages.

Observed vs. simulated soil moisture:

Observed vs. simulated canopy growth cover:

Observed vs. simulated yield:

$R^2 = 0.98;\ nRMSE = 1.17\ ton/ha\ d = 0.99$
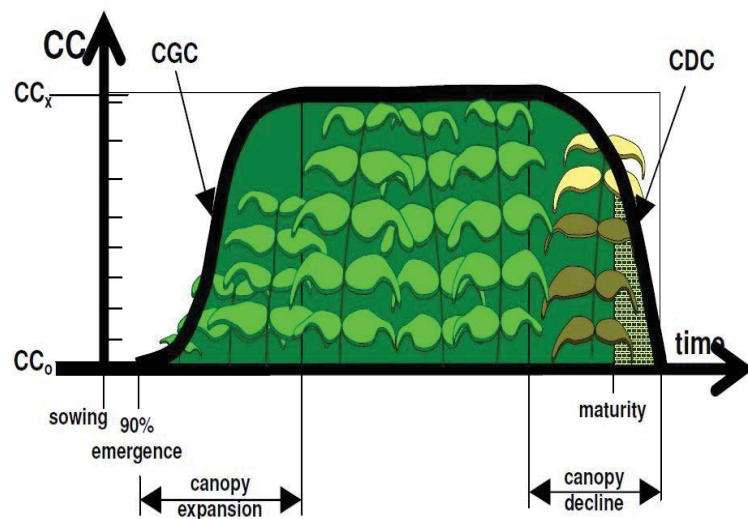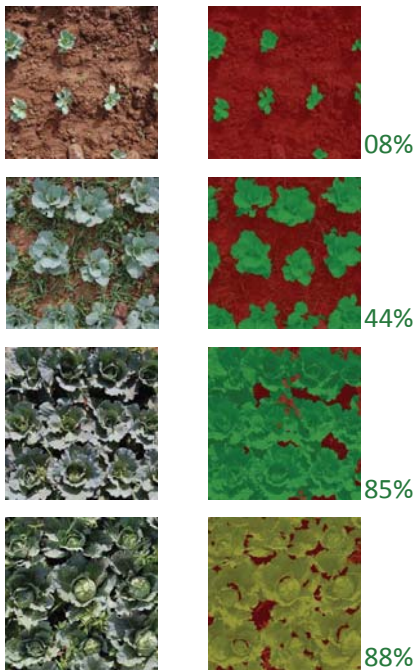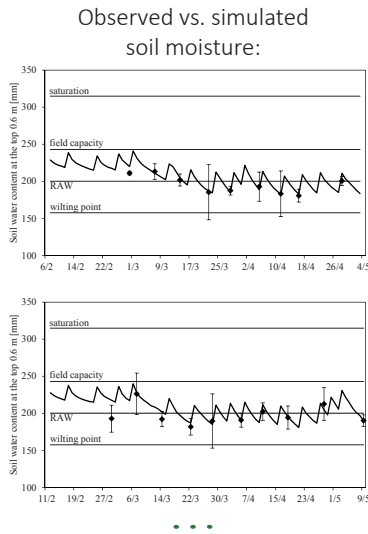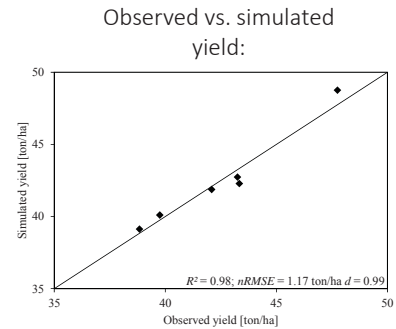
① Soil moisture:
- soil type;
- irrigations;
- ...
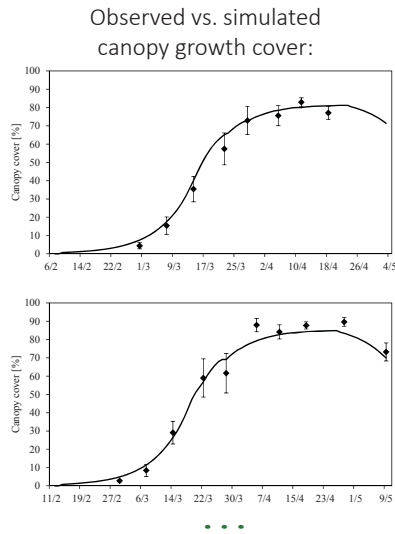
② Canopy cover:
- growth & decline coef.;
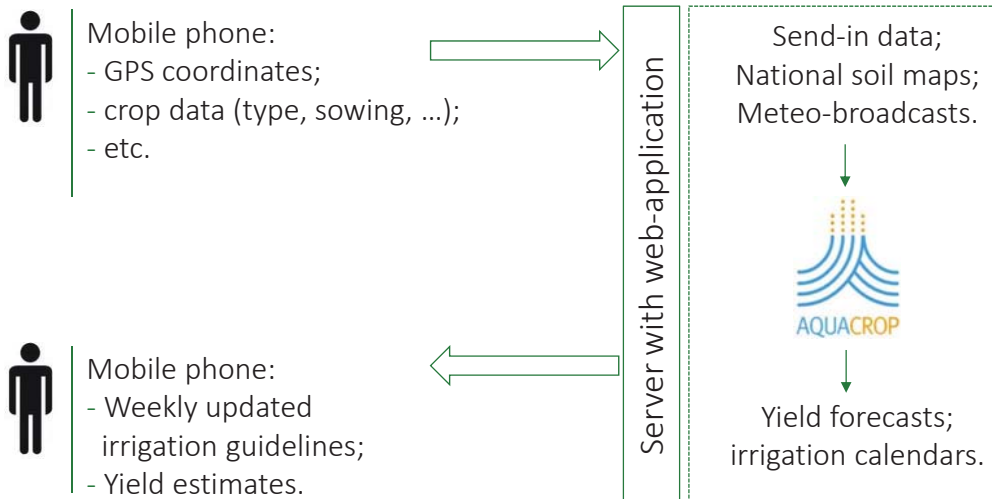- plant densities;
- ...

③ Yield:
- water productivity;
- harvest index.

... Agricultural advice
- 'modelling for the masses' -

Based on the priorly presented knowledge & expertise:

Mobile phone:
- GPS coordinates;
- crop data (type, sowing, …);
- etc.

Server with web-application

Send-in data;
National soil maps;
Meteo-broadcasts.

AQUACROP

Yield forecasts;
irrigation calendars.

Mobile phone:
- Weekly updated irrigation guidelines;
- Yield estimates.

Grazie!