Desenvolvimento Tecnológico e Sensoriamento Remoto: Perspectivas e Desafios

Previsão de Safras e Segurança Alimentar

Jansle V. Rocha
Operational Agriculture Monitoring

AGRIFISH Unit of DG Joint Research Center

MARS-STAT & MARS-FOOD
Indicators from low resolution satellite data (since 1981)

Indicators from meteo data sets (since 1975)

Indicators from agro-meteo parameters

Statistical analyses: time series, tendency analyses, etc.

Yield forecasts
MCYFS: Methodological approach
Final results are published in the MARS-STAT bulletins about 20 times a year distributed as:
- Printed issues
- By E-mail and on the Web

http://agrifish.jrc.it/marsstat/Bulletins/2006.htm
MARS-STAT Bulletin types

Analyses by Countries

Climatic updates and forecasts updates

Rice Bulletins

Special issues
MARS FOOD ACTIVITIES

**Missions**

Adequate alerts on food security for world-wide regions at risk

**Activities**

- Development of Crop yield monitoring for food security
- Building of networks and partnerships and a pool of expertise in Food Security

**Customers**

- DG DEV
- DG AIDCO
- DG RELEX
- ECHO
- DG AGRI

**Objective**: Contribute to the EU external aid and development policy, in particular to the EU Food Aid and Food Security policy,

**How**: by the improvement of the information on crop yield and production in regions of the world affected by food shortages

- Avoid food shortage or market disruption
- Better calibrate and direct European Food Aid

Could also contribute indirectly to the Agriculture and Trade policies by providing crop prospects information on Russia, Mercosur, etc, …
In partnership with United-Nations Food and Agriculture Organization (FAO)

System based on the use of global remote sensing and meteorological data and on the development of agrometeorological models

Data coverage of the world

Data analysis on 4 Regions of interest

Russia & Central Asia

South America

Eastern Africa

Mediterranean Basin

A general view of the MARS-FOOD Crop Monitoring system
Ten-daily Bulletins, Somalia example

Approach based on C-NDVI profiles and rainfall
C-NDVI : Weighted NDVI “Unmixing NDVI”

CNDVI with CORINE Land cover + NOAA/AVHRR
AFRICNDVI with AFRICOVER + VEGETATION

\[ w_j = \frac{P_j}{\sum_j P_j} \]

\[ \bar{\mu} = \sum_{j} m_{j} C_{NDVI_j} \cdot w_j \]

Goal : Extract the crop component of 1 km VGT NDVI product
MARS project experience in Europe with CNDVI
Forecast for Sorghum Deyr 2005: expected yield is better than average and previous season.
Forecast for Sorghum Deyr 2006: expected yield is below than average and previous season.
Conclusion: no need for high resolution agriculture map but resolution similar to NDVI profile resolution recommended
Quantitative approach

Three steps: Trend, Similarity, Regression

Final expert assessment
Key information

4 Ten-daily Bulletins: Somalia, Sudan, Ethiopia and Eritrea

Link with local statistics (must be reliable) for the calibration of NDVI / Rainfall information – Support FAO-AGROMAPS & SALB-GAUL initiatives
Approach based on Water Satisfaction Index and C-NDVI
An elaborate crop specific water balance model outputs directly usable by food security administrators. As shown in the MARSMARS-FOOD Bulletin (East Africa 2005), a drop in sorghum production was observed in 2005 as compared to the normal condition, affecting 11 million people. The Water Satisfaction Index (WSI) for the sorghum crop in October 2005 was calculated, showing a difference from the average of the last 6 years.
Key information needed to run the FAO Water Balance Model

- **Planting decade** – Under improvement: AGHRYMET rainfall rules, NDVI Phenology product of GEOLAND-VGT4AFRICA, …
- **Current rainfall by decade** – ECMWF model, Must be improved, thru Crop Rangeland Monitoring Network, Rainfall data assessment WG (?): ECMWF, RFE, …
- Current PET – ECMWF model
- Length of the Crop cycle
- Soil water holding capacity (soil data)
Qualitative crop yield assessment using the WSI

WSI for Maize

Kenya

Uganda

IGAD

Percentage of maize area in each class

0% 20% 40% 60% 80% 100%

2001 2002

Qualitative crop yield assessment using the Water Satisfaction Index (WSI)

IGAD

Percentage of maize area in each class

0% 20% 40% 60% 80% 100%

2001 2002

Kenya

Uganda

IGAD

Percentage of maize area in each class

0% 20% 40% 60% 80% 100%

2001 2002

Qualitative crop yield assessment using the Water Satisfaction Index (WSI)
Quantitative crop yield assessment (t/ha)

Based on years of reference and potential yield, Under Calibration
Global Crop Specific Water Balance Model (GCSWB) under implementation / “automatic” version

Under development in collaboration with FAO
2 Bulletins based on WSI and/or C-NDVI: East Africa and South America

Data dissemination: thru EUMETCAST – VGT4AFRICA and in collaboration with GMFS

Data exchange policy: VGT and ECMWF requests, under discussion
Monthly & Bi-monthly Bulletins, Russia and Central Asia example

Approach based on CGMS* and C-NDVI
Current Russia and Central Asia Bulletin structure

Crop monitoring

Data preparation

- Meteo data
- Remote sensing data
- Other data

Analysis of indicators

- Crop Growth Indicators
  - Temperature and Radiation
  - Moisture regime
  - Dry Matter Production modeling
- Crop Status Indicators
  - NDVI

Synthesis and conclusion

Qualitative approach based on indicators before an operational CGMS under calibration
Two families of indicators (Crop Growth – Meteo and Crop Status – NDVI-DMP)
Radiation and Temperature

Climatic Water Balance

Rainfall

Crop Status NDVI - DMP

Current indicators compared with last year and 15 years average
Expert GIS based mapping analysis

Quantitative / Regression approach
MARSOP Site for information dissemination

Main METEO and satellite base indicators

On-the-fly sub-national data analysis

Main GWSI indicators available
MARS-FOOD Pool of Expertise

- Support to national / regional institutions capacity building (training, information exchange, …)

- FAO Collaboration Agreement

- Participation in United-Nations FAO - WFP Crop and Food Supply Assessment Missions

- Coordination role for the EU : European Space Agency (GMFS), World Food Program (Emergency Needs Assessment) , …

- Scientific Networks (CRAM, South America) and Regional conferences

- Technical support to EU Delegation under the newly signed Administrative Arrangement with DG AIDCO

- Support to Vulnerability and need assessment
Crop Monitoring in South America

Jansle Rocha

MARS-FOOD Action / AGRIFISH Unit

Institute for Protection and Security of the Citizen
Crop Monitoring in South America

Objectives

• generate frequent bulletins

• to establish a Scientific Network with local institutions for data, technology and knowledge exchange

• to develop methodologies on crop monitoring for the region
  - data integration
  - modelling
CROP MONITORING IN SOUTH AMERICA

Bulletins

(http://agrifish.jrc.it/marsfood/Bulletins/southamerica)

• NDVI and Rain (actual, differences and profiles)

• + WSI difference for wheat, maize and soybean

• +cumulated rainfall (from oct/1 or apr/1) + WSI difference for soybean and maize (summer crops) and wheat and maize (winter crops)

• + Mask for Annual Crops (summer) + planting dates (?)
Monitoring Regions - Argentina
Monitoring Regions - Brasil

Legend:
- Red: >25% Large Decrease
- Orange: 25% to 10% Small Decrease
- Yellow: -10% to 10% No Change
- Green: 10% to 25% Small Increase
- Dark Green: >25% Large Increase
- Gray: No data

\[ \text{Legend} \]

\[ \text{Monitoring Regions - Brasil} \]
Monitoring Regions – Brasil
food insecurity areas
Monitoring Regions - Paraguay
Monitoring Regions - Uruguay
Bulletin Data
10 days
The CNDVI technique
- CNDVI is a method to extract crop specific NDVI profiles for mixed pixels
- Developed by MARS for the use of NOAA AVHRR images with CORINE land cover

Advantages
- More information than average NDVI profiles for physical units
- Easy to use with different images and land cover maps
CNDVI with CORINE Land cover + NOAA/AVHRR

AFRICNDVI with AFRICOVER + VEGETATION

\[ w_j = \frac{P_j}{\sum P_j} \]

\[ \hat{\mu} = \sum_{j=1}^{n} m_{j} c_{j} \text{NDVI} w_j = AFRICNDVI \]
Crop monitoring outputs: 10-daily country reports
Somalia status 10/01/2005

Forecast for Sorghum 2004/2005: expected yield is better than average and previous season.
SCIENTIFIC NETWORK

Objectives

• data comparison/calibration
• methodology development
• crop mask
• crop monitoring information system for the region