Agrometerological study of semi-arid areas : an experiment for analysing the potential of FORMOSAT-2 time series of images in the Marrakech plain

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Summary. The design of tools for the regional monitoring of land-use/land-cover, water balance and crop yield is necessary to ensure a sustainable development of semi-arid regions. As part of the SudMed project, a time series of FORMOSAT-2 images has been acquired over the Al Haouz/Marrakech plain, from November 2005 to now with a time step of 4 days. This communication aims at presenting the associated experiment as well as a first analysis of the potential of FORMOSAT-2 for agrometerological study.

The authors acknowledge NSPO, SPOT-Image & CNES for FORMOSAT-2 images, and the AERONET network.

Space Time Characteristics of FORMOSAT Acquisitions over the Al Haouz/Marrakech plain

➢ Tawainese satellite (NSPO)
Data are sold by SPOT-Image.

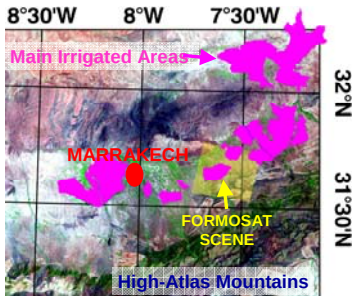
➢ 24 x 24 km² scene at **8m resolution**, acquisition centred on 7°35'W x 31°40'N, with **constant viewing angle (~17°),** 4 spectral bands (blue/green/red/nir)

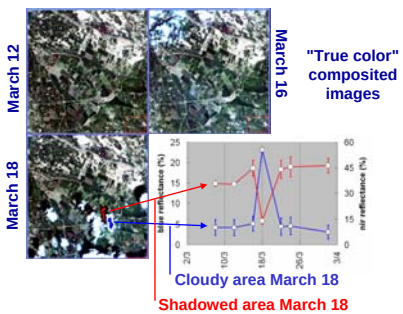
➢~ **4-day repeatitivity on the region of interest (potentially 1 day):**

- 65 images from Nov. 05 to Aug. 06
- ~ 30 images cloud-free or partially cloudy from Nov. 05 to June 06, corrected with water vapour and aerosol data from a CIMEL sun photometer.

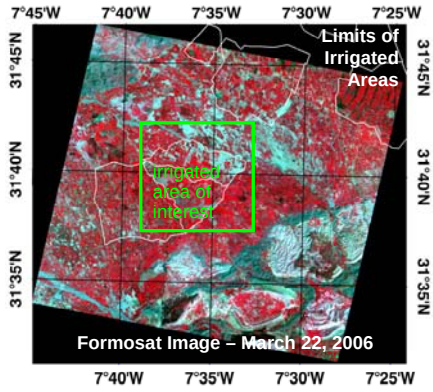
➢ High repeatitivity with constant viewing angle facilitates cloud detection (right figure) and atmospheric correction (see Hagolle et al. this session).

→ smooth reflectances and vegetation indices time series





Region of interest

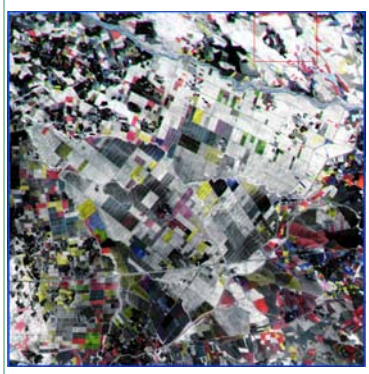


FORMOSAT observes a part of the Al Haouz plain in the centre of the Tensif basin, Central Morocco, 40 km east of Marrakesh city. Dominant land cover classes are cereals, mostly wheat, then fallows, orchards (mainly olive trees) and forages (alfafa). The plain is surrounded by the 'Jbilet' hills (small part in the scene northwest) and High-Atlas mountains (foothills visible in the scene southeast). The Atlas is the region's water bank, supplying several big irrigated areas in the plain. These irrigated areas are managed by a regional public agency (ORMVAH). ORMVAH, together with local farmer associations, is in charge of the dam water distribution. Ground water is also used for irrigation.

At the center of the FORMOSAT scene, the R3 irrigated area covers 2800 ha with dominant wheat crops sown between mid-november to mid-january. It has been intensively studied during the 2005-2006 agricultural season:

Potential for Agrometeorological Studies

➢ High repeatitivity would allow to separate between what is 'natural' (e.g. vegetation growth) and what comes from human

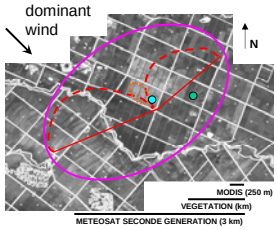


Red reflectances composited image (R: 4/12, G: 8/12, B:12/12). The image highlights cropped areas with important reflectances changes :

- **Yellow - Red : decrease from 4/12 to 8/12 - from 8/12 to 12/12**
- **Blue : increase from 4/12 to 12/12**
- **Green : peak at 8/12**

These changes result from phenomenas that induce a quick response of land surfaces (sowing, irrigation, top-soil drying, harvest…).

[white-grey-dark = no change]



observations of technical practices + surface reflectances (handheld radiometer) + soil and biophysical variables [wheat].

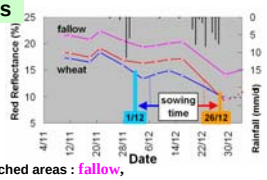
surface heat fluxes with Eddy correlation system [olive trees].

'Regional' sensible heat fluxes with scintillometers [wheat/fallow mixture].

met station **CIMEL sun photometer**

➢ Agricultural Practices

red band R:21/11,G:04/12,B:29/12



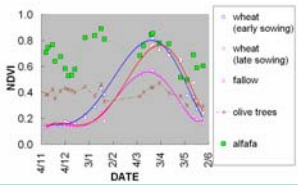
Hatched areas : fallow, early sown wheat, late sown wheat

In this example, we analysed time series of red reflectances for 2 wheat fields with known sowing dates. A direct derivation of quantitative information from the image appears feasible : sowing before 4/12 for red areas or after 4/12 for yellow areas.

➢ Vegetation dynamics / Land-Cover

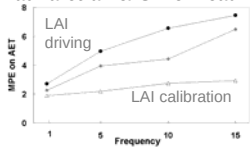
Information on agricultural practices is complementary of what can be derived from more classical analysis of vegetation indices time series. The identification of land cover classes will be facilitated thanks to high repetitivity acquisitions.

FORMOSAT time series will also provide an efficient tool for monitoring the vegetation: phenology, bio-physical variables, dynamics, anomalies etc.



➢ Crop and water balance modelling

An improved identification of agricultural practices and land cover as well as the intensive monitoring of vegetation is useful to control crop and SVAT models (Er-Raki et al., Hadria et al. & Simonneaux et al., this issue). It is expected to gain accuracy in regional estimates of yield and evaporation with FORMOSAT, and to provide a basis for validating results at a coarser spatial resolut° (MODIS, VEGETATION…) .



Error on actual evapotranspiration (%) as a function of satellite data acquisition frequency [obtained with the STICS crop model and simulated data, see Hadria et al. IJRS].