Mapping LAI measurements at different scales for the validation of large swath satellite sensors
First results for the VALERI project

M. Weiss[1], L. de Beaufort[2], F. Baret[3], D. Allard[2], N. Bruguier[3], O. Marloie[3]

[1] NOVELTIS/INRA, [2] INRA Biométrie, [3] INRA Bioclimatologie

BACKGROUND

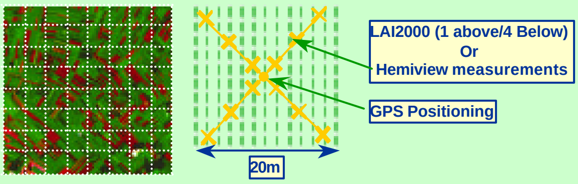
- **Many large swath sensors**

  VEGETATION, POLDER, MSG, MERIS, AATSR, AVHRR, SeaWifs, MODIS, MISR

- **Need for:**
  - **Validation of the biophysical products (LAI, fCover, fAPAR, Albedo)**
  - **Inter-comparison between sensors and algorithms to ensure**
    - **Continuity of observation**
    - **Improved accuracy of estimates**

= VALERI project

OBJECTIVE = Deriving LAI maps at low spatial resolution from few Ground measurements



The Romilly site (France): 10kmx10km agricultural area

Area divided in 49 square cells

- **At least one field per cell, characterizing the main crop in the cell**
- **Proportion of the considered crop within the whole area respected**

3 KRIGING METHODS CONSIDERED

Ordinary kriging

$$LAI^*(x_o)=\sum_{a=1}^{49} w_a LAI(x_a)$$

$LAI(x_a)$ is the measured LAI at x_a
$LAI^*(x_o)$ is the estimated LAI at x_o

Minimizing the estimation variance ($\sigma^2=f(\gamma_{LAI,LAI})$, $\gamma_{LAI,LAI}$ is the LAI variogram) and

$$\sum w_a = 1$$

Collocated kriging

$$LAI^*(x_o)=\sum_{a=1}^{49} w_a LAI(x_a)+d\;LAIreg(x_o)$$

$LAI_{reg}(x_o)$ is the LAI estimated value using high spatial resolution image (20m) And a multi linear relationship between reflectances and measured LAI

Minimizing the estimation variance ($\sigma^2=f(\gamma_{LAI,LAI}, \gamma_{LAI,LAIreg}, \gamma_{LAIreg,LAIreg})$,

$$\sum w_a + d = 1$$

Kriging the residual

$$\varepsilon(x_a)=LAI(x_a)-LAIreg(x_a)$$

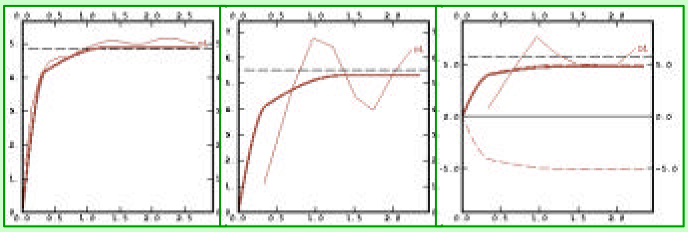
ε is the residual error between measured LAI and estimated LAI using a regression that may be not necessary multi linear

Ordinary kriging of ε

Assuming that $LAI(x_o)$ the mean LAI value over the measured cross at x_o

RESULTS

- **VARIOGRAM computation**

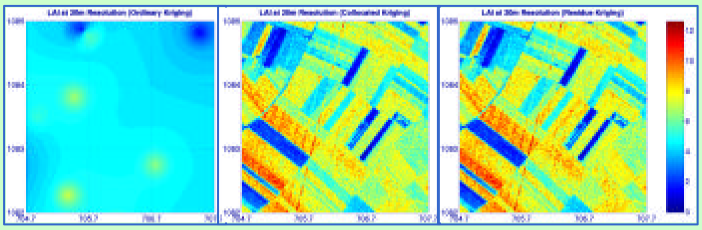


$\gamma(LAI, LAI)$ $\quad$ $\gamma(LAI_{reg}, LAI_{reg})$ $\quad$ $\gamma(LAI, LAI_{reg})$

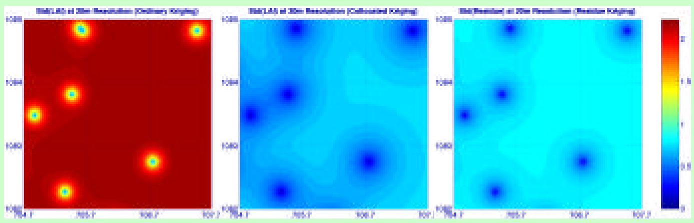
2 spherical models S_1 (range=357m) and S_2 (range = 1335m)

$$\begin{pmatrix}\gamma(LAI,LAI) & \gamma(LAI,LAIreg)\\ \gamma(LAIreg,LAI) & \gamma(LAIreg,LAIreg)\end{pmatrix}=\begin{pmatrix}3.73 & 3.53\\ 3.53 & 3.38\end{pmatrix}(1-S_1)+\begin{pmatrix}1.17 & 1.28\\ 1.28 & 1.93\end{pmatrix}(1-S_2)$$

- **LAI MAPS (3km x 3km) at 20m resolution**

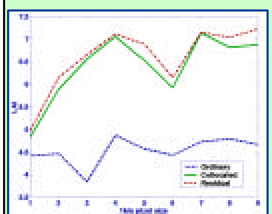


- **Ordinary kriging : few measurements, no actual spatial information**
- **Collocated kriging: spatial information provided by SPOT image prevalent (reflectance/LAI) relationship must be linear**
- **Residual kriging : spatial information provided by SPOT image prevalent**



Using spatial information reduces kriging variance

CONCLUSIONS



Estimated LAI for 9 pixels at 1km resolution

- **Collocated kriging kept as the best method**
- **Methods will be tested on forest and sparse vegetation**
- **Next campaigns = new sampling strategy**
  - **Improve variogram computation**
  - **Improve LAI/Reflectance regression**