Spatialization of sowing date and nitrogen supplies by combining remote sensed leaf area index and a crop simulation model. The case of durum wheat in the Alpilles test area (South-East of France)

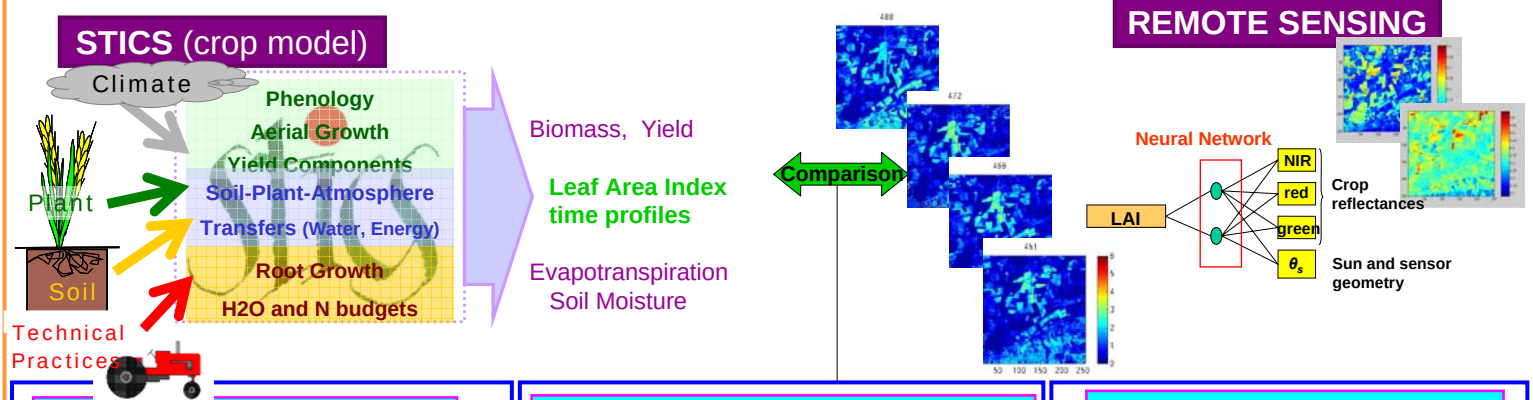
R. HADRIA[1], A. OLIOSO[2], B. DUCHEMIN[3], F. RUGET[2], M. WEISS[4], V. RIVALLAND[2,3], M. GUERIF[2], A. LAHROUNI[1], A. CHEHBOUNI[3], P. LECHARPENTIER[2]

[1]Faculté des Sciences Semlalia (FSSM), Université Cadi Ayyad, Marrakech, Morocco
[2]UMR CSE (Climat, Sol et Environnement), INRA, Avignon, France
[3]Centre d'Etudes Spatiales de la Biosphère (CESBIO), Toulouse, France
[4]NOVELTIS, Ramonville-St-Agne, France

email: olioso@avignon.inra.fr

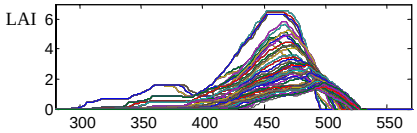
Summary : **In this study, we use remote sensed Leaf Area index (LAI) and crop modelling for deriving spatialized information on sowing date and nitrogen supplies. The method consists in comparing LAI simulated by the STICS crop model to remote sensing estimations in order to choose the best matching agricultural practice scenarios. It is applied to durum wheat in the frame of the Alpilles-ReSeDA experiment (South-East of France) .**

- **After calibration and validation of the STICS model over ground data, a large number of simulations was done by changing the sowing date and the calendar and the level of nitrogen supplies.**
- **Simulated LAI were compared to the remote sensed estimation in order to select the simulation scenarios which were giving the best matches and to determine the most probable date of sowing and nitrogen supply calendar and level for each fields.**
- **The results were very good for the sowing date, with an error lower than one week, while they were more contrasted for nitrogen supplies.**

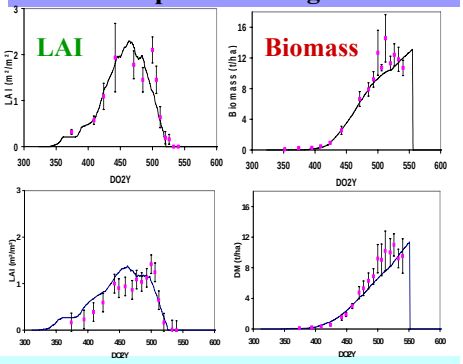


Technical practices scenarios

- **~9000 simulated scenarios combining**:
  - ✓ Sowing date: every 10 days between October and February (14 cases)
  - ✓ Nitrogen supplies: 0, 1, 2, 3 or 4
  - ✓ Nitrogen amount: 40 to 120 kg/ha for each supply (by step of 20 kg)
  - ✓ Initial level of Nitrogen in the soil: 0 to 100 kg/ha by step of 25 kg



Calibration and validation of the STICS crop model using field data



STICS was calibrated over one field (figures on the top) and then validated under 5 other plots (figures in the bottom).

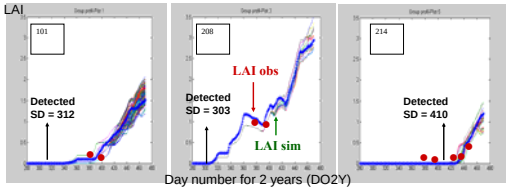
Comparison and scenario selection

- **Simulated LAI profiles are compared to estimated LAI profiles:**
  - ✓ Selection of acceptable scenarios by using a 0.2 RMSD threshold on LAI
  - ✓ Using the 2 first remote sensing acquisition dates for determining the sowing date (LAI is not sensitive to nitrogen at the beginning of the cycle)
  - ✓ Using the following date for determining nitrogen amount and calendar
  - ✓ As several scenarios maybe selected, the most probable is selected as being the most frequent

Alpilles-ReSeDA experiment

- **Collected data (October 1996 to November 1997)**:
  - ✓ Reflectances: POLDER airborne sensor (green, red, nir), 16 dates, 25 km^2
  - ✓ Plant measurements : LAI, Biomass, and repartition by orgarns (6 fields)
  - ✓ Soil : moisture, granulometry.
  - ✓ Climatic data : meteorological station and energy balance stations (3 fields)
  - ✓ Information on technical practices at the field (6 fields) and the farm level (6 farms)

Sowing date (SD) retrieval and mapping

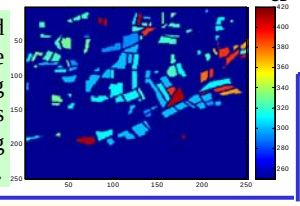


Comparison to observations

Field number	101	120	208	210	214	300
Obs. SD	312	323	297	305	409	315
Est. SD	312	312	303	303	410	303

Farm level	Stated SD	Est. SD
1 (3 fields)	End of Oct. or Feb.	Oct. 30, Oct. 30, Oct. 30
2 (4 fields)	October 26 to 31	Oct. 30, Oct. 30, Oct. 30, Nov. 8
3 (5 fields)	End of October	Oct. 30, Oct. 30, Oct. 30, Oct. 30, Nov. 8
4 (3 fields)	Beginning of Dec. or end of Jan.	Nov. 18, Jan. 25, Feb. 4
5 (3 fields)	November 4 and 5	Nov. 8, Nov. 28, Feb. 14
6 (6 fields)	End of Oct. to beginning of Dec.	Oct. 20, Oct. 20, Oct. 20, Oct. 30, Nov. 8, Nov. 8

Examples of simulated LAI profiles matching the first remote sensing observations for 3 fields and the derived sowing dates and the derived map.



Nitrogen supplies

Retrieved scenarios for N supplies presented discrepancies / field information because of a low sensitivity to the supplied nitrogen until 150kg/ha and because of a time shifting between simulated LAI (o) and remote sensing observation (*) due to the impact of ears and stem surfaces on the measured signals.