JECAM CFIA-Ottawa

JECAM/GEOGLAM Science Meeting

Ottawa, Canada

21 – 23 July 2014

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Coll.:F. Baret, N. Beaudoin, R. Desjardins, R. Fernandes, I. Jarvis, T Huffman, R. Lacaze, H. McNairn, et al.

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Joint Experiment for Crop Assessment and Monitoring

GEO GROUP ON EARTH OBSERVATIONS

Site Description

- Ottawa, Ontario (CFIA Ottawa Laboratory 3851 Fallowfield Road)
- Level Topography < 0.5% Gradient
- Modified marine sediments with a fine texture and neutral composition. Layers of silty sediments interspersed in the upper 2 meters. Clay loam is the dominant texture.
- Tile Drainage and Precipitation Fed Field
- spring crops: corn soybean, wheat canola
- 15-75 ha fields
- Average of 732 mm of rain yr^{-1} and 236 mm of snow yr^{-1} and temperature averages from 13.4 °C-20.9 °C from May-August (Environment Canada, Government of Canada 2014: http://climate.weather.gc.ca/climate_normals/results_e.html?stnID=4337&lang=e&dCode=1&StationName=OTTAWA&SearchType=Contains&province=ALL&provBut=&month1=0&month2=12)
- Tillage, synthetic fertilizer, seeding, harvest when grains are dry enough

CO_2 , H_2O and sensible heat flux measured in two fields using 3 eddy covariance towers. Nitrous oxide fluxes measured using 2 flux gradient towers. Destructive biomass, LAI, soil sampling, yield mapping. Non-destructive PAI, lCh (Dualex, SPAD), crop cover (nadir photos) soil moisture & T, intercepted PAR, other data from weather station.

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Project Title and Objectives

From fields to regions: Improving crop model predictions, using remote sensing-derived biophysical descriptors and climate data, to evaluate the impact of climate variations on crop production and environmental performance.

Main objectives address the following topics:

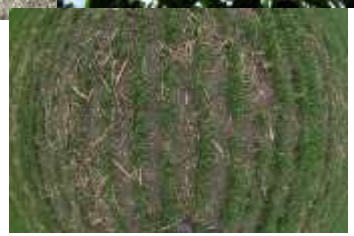
- Validation of LAI and f_{APAR} from Sentinel computation chain
- Assimilation techniques (reinitialization, forcing)
- Yield Prediction
- LAI, evapotranspiration, RUE, N_2O fluxes
- Crop Condition/Stress
- The project needs Crop Cover Mapping and site can serve for training/validation

Earth Observation (EO) Data Received/Used

For each Mission/sensor:

- *Space agency or Supplier* ESA & CSA
- *Optical/SAR:* Chris-Proba, Landsat, MODIS, RapidEye (2010 Formosat & 2013 SPOT products)/RSAT-2
- *Number of scenes:* depends on the years
- *Challenges, if any, in ordering and acquiring the data.* In the past we were not successful to get Chris Proba. RSAT-2 is in high demand too and deconflicting is taken care of by Dr. Jiali Shang.

In situ Data



- Eddy covariance fluxes (ET, sensible heat & CO_2 fluxes)
- Soil respiration (discrete & automated chambers)
- Crop cover (photography)
- PAI (DH photography PASTIS-57 sensors)
- APAR (using 1-m long integrated PAR bars)
- Soil moisture (continuous soil profiles & soil sampling
- Soil fertility sampling
- Destructive biomass & LAI, and yield mapping
- Non-destructive Leaf chlorophyll (SPAD, Dualex)
- Meteorological stations (rain gauge, net radiometers, PAR, anemometers, soil T& moisture profiles)
- Flux gradient N_2O fluxes (using tunable diode lasers)

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Collaborations

- IMAGINES: Roselyne Lacaze, Hygeos and Fred Baret, INRA
  Ferdinand Camacho (EOLAB) with flux data, FAPAR, LAI
- Sentinel-North: Richard Fernandes, CCRS; Olivier Hagolle and Gérard Dedieu, CESBIO (Formosat time series 2010)

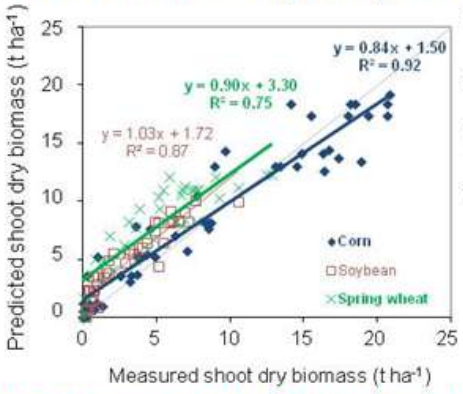
Pending collaboration if GRIP funding

- *Ramata Magagi U of Sherbrooke (RSAT-2)*

2008 Re-Initialization Results (Landsat)

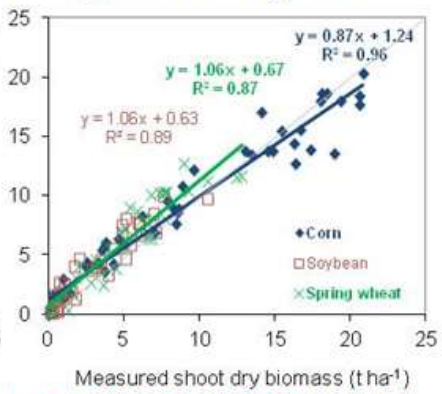
Jégo, G., Pattey E., Liu, J. 2012. Using Leaf Area Index, retrieved from optical imagery, in the STICS crop model for predicting yield and biomass of field crops. Field Crops Res. 131: 63-74.

- No assimilation
- Recommended crop management



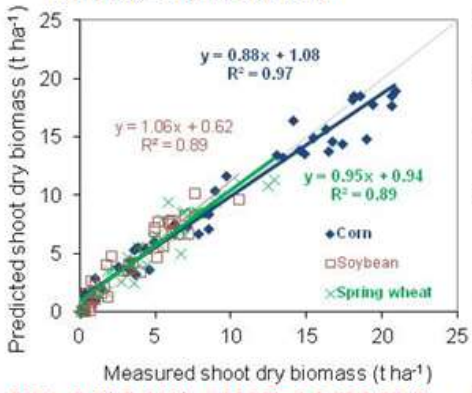
ME=-1.4(-25.0%), RMSE=2.5(43.6%)

- 2 LAI values assimilated
- Optimized seeding date



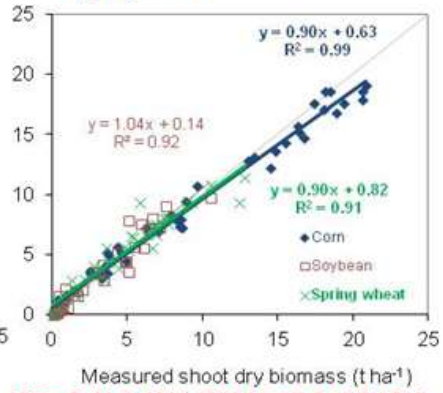
ME=-0.6(-10.1%), RMSE=1.6(26.7%)

- All available LAI values assimilated
- Optimized seeding date, seeding density, & field capacity



ME=-0.5(-8.1%), RMSE=1.3 (22.9%)

- No assimilation
- Actual management & soil properties



ME=-0.1(-1.4%), RMSE=1.0 (17.1%)

We evaluated the performance of STICS in predicting yield and biomass by using LAI retrieved from EO data to re-initialize selected input parameters in 2008 for corn, soybean and spring wheat fields cultivated near Ottawa (Ontario, Canada). Our results indicate that:

- Based on 2008 analyses, the re-initialization of input parameters performed as good as the actual conditions to predict yield.
- For the experimental area, defining simulation units by overlaying field boundaries with soil map delineation was sufficient.

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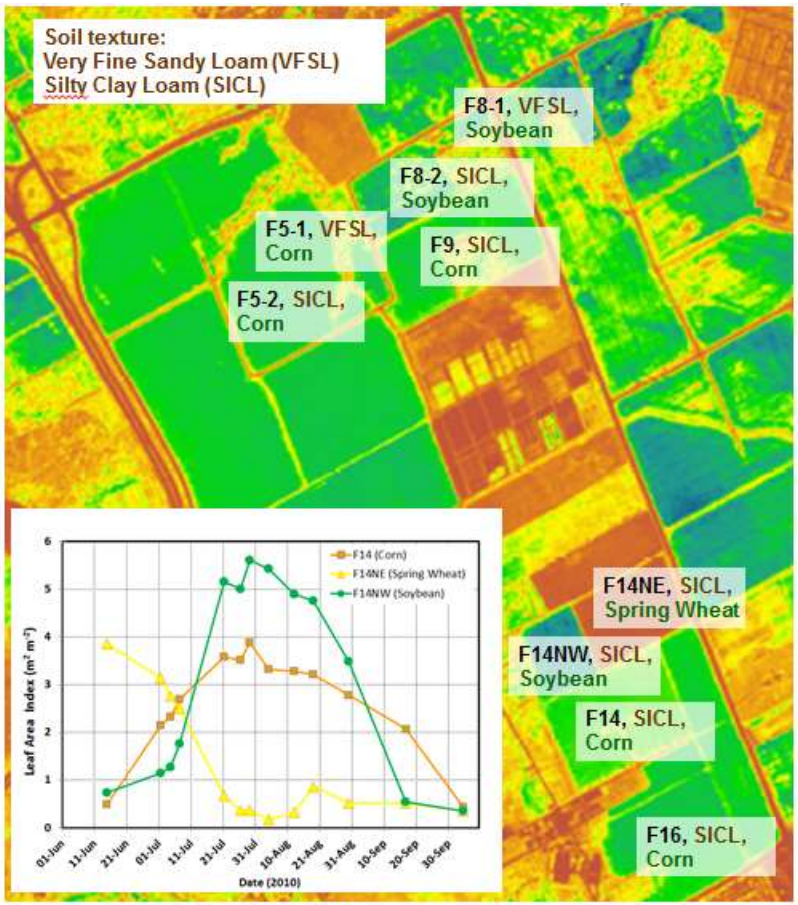
2010 Forcing Results (Formosat)



Maps reporting soil texture, field and crop locations. LAI extracted from Formosat-2 images is also illustrated.

Comparison of measured yield with OptimSTICS predictions

Field	Crop	Yield (t ha^{-1})			
		Recommended management	Forcing with 13 LAI images	Re_initialization with 5 LAI images	Measured
F8-1	Soybean	1.29	1.48	1.71	1.60
F8-2	Soybean	2.39	2.38	2.49	2.60
F14NW	Soybean	2.39	2.38	2.63	2.60
F14NE	Wheat	3.28	2.28	3.55	2.70
F5-1	Corn	7.56	7.23	8.34	7.90
F5-2	Corn	8.03	8.64	9.37	7.80
F16	Corn	8.03	8.64	9.37	8.80
F14	Corn	8.03	8.64	7.40	8.90
F9	Corn	8.03	8.64	8.25	8.60

A t-test on the results shown in the above table indicated that the difference between predicted and measured yield were not significant.

In 2010, forcing LAI in the model was more efficient than re-initialization for corn. Spring weather conditions did not delay seeding, and there was no need to input accurate emergence date.

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Research Plans for Next Growing Season

- In 2014 we were able to instrument 16 sites
- for 2015, we will have 3 flux towers and for the other sites, it depends how many Pastis sensors we get and if we can get the FAPAR ones…
- Do you anticipate ordering the same type/quantity of EO data next year? Y