Biogenic emissions of NO

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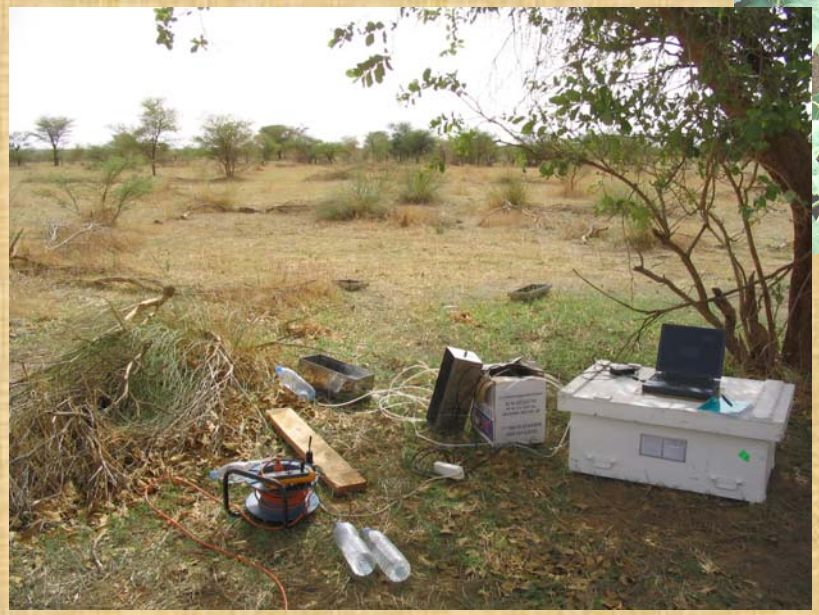
Biogenic emissions of NO

- NO emitted at the surface is rapidly oxidized into NO_2 and contributes to O_3 formation in the lower troposphere.
- NO emission inventories are better represented for anthropogenic sources.
- Biogenic emission inventories are scarce and given at low resolution (monthly, 1°/1° for Yienger and Levy 95, Davidson and Kingerlee 97, Potter et al. 96).
- Biogenic emissions over West Africa are not documented.
- Our proposal: provide biogenic NO inventory at high resolution in the region of interest for AMMA.

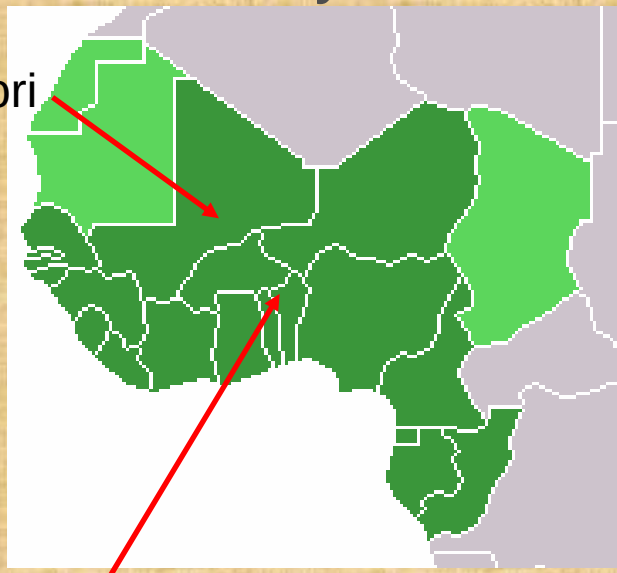
Biogenic emissions of NOx



Methodology:
Manual and/or automatic dynamic chambers connected to NO/NOx analyzer.

Sites:

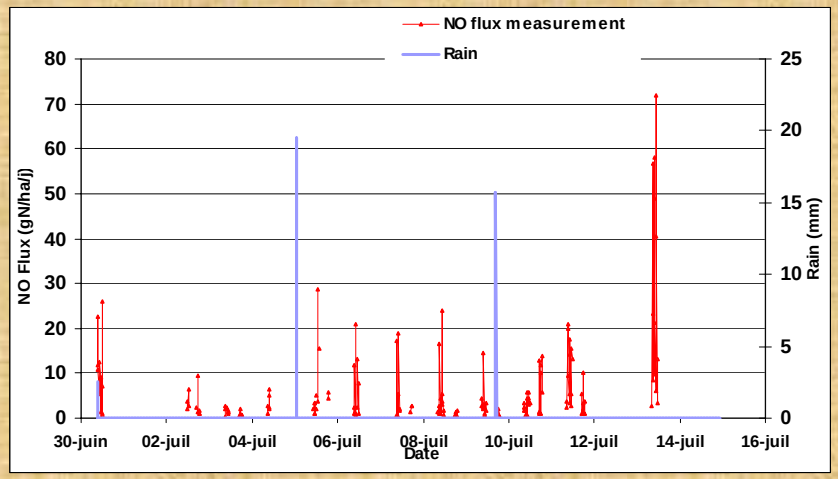
-Djougou (Bénin): 1 field experiment in June 2005 (rainy season)
-Hombori (Mali): 2 field experiments in July 2004 (transition) and August 2005 (rainy season).

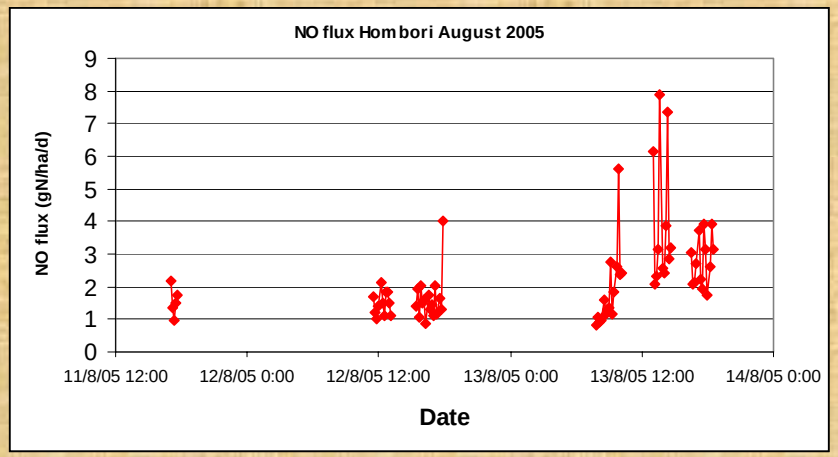


Results from field experiments: Hombori

- **2004**: 180 fluxes in 10 different configurations (sandy or loamy soils, far from or close to acacia trees, with or without vegetation inside the chamber, with or without faecal matter).

- **2005**: 70 fluxes in sandy soil (site 17 Agoufou super site). Rainy season.





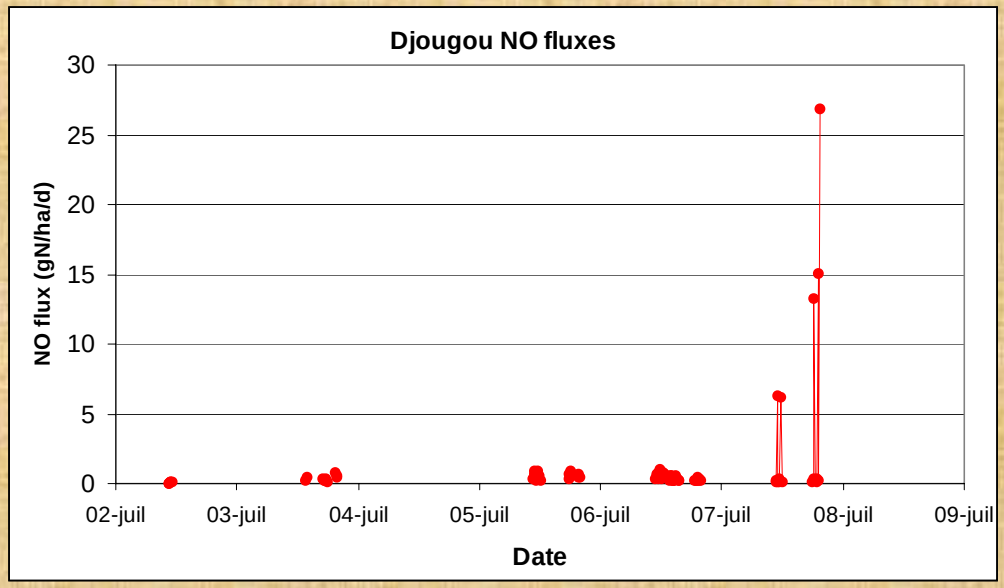
Lower fluxes during wet than during transition season.

=> Soil moisture and pulse effect

Results from field experiments: Djougou 2005 (2 - 9 July)

85 fluxes, in 5 different sites (yam field, teak plantation, savanna, Karite forest, termite mounds)

- Fluxes in the lower range (below 1.5 gN/ha/d), excepted above termite mounds.
- Rain event on July 5th has no real effect on emissions (measurements near limit detection).



=> Emissions present a high spatial heterogeneity, at small scale (differences between fields and termites mounds) and at larger scale (difference for the same season between Mali and Benin

Mali: pasture, grazing, C/N more active. No fertilization in Benin.

Parameterisations

Existing work:

YL95 is the most widely used in parameterisations, considering usual influent parameters, as soil temperature and moisture at surface, fertilization rate, type of biome.

Our work:

Parameterisations are built from neural network calculations, both with temperate and tropical data $\Rightarrow$ general parameterisations defined with usual variables (same as YL95, except biome) and new variables such as soil temperature at depth, pH, texture and wind speed.

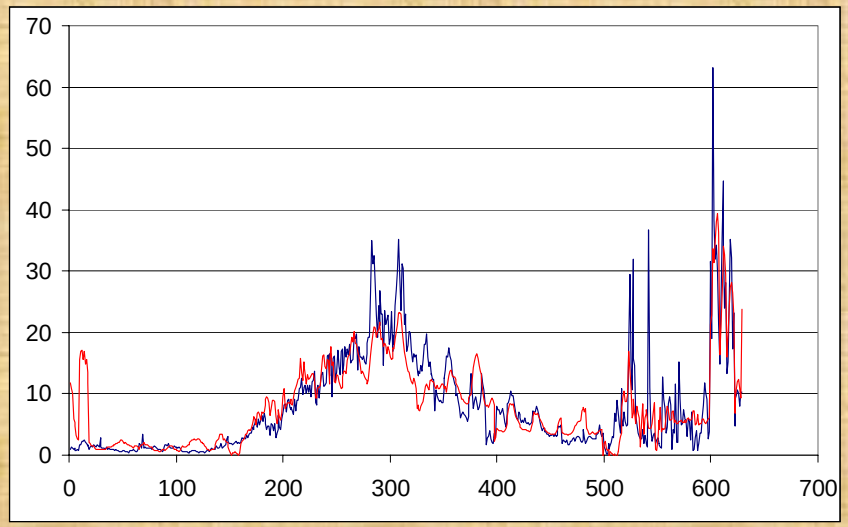
Equations are non linear.

Validation of these equations :

Network results and experimental fluxes are compared, then the equation is included in a SVAT model.

Parameterisations

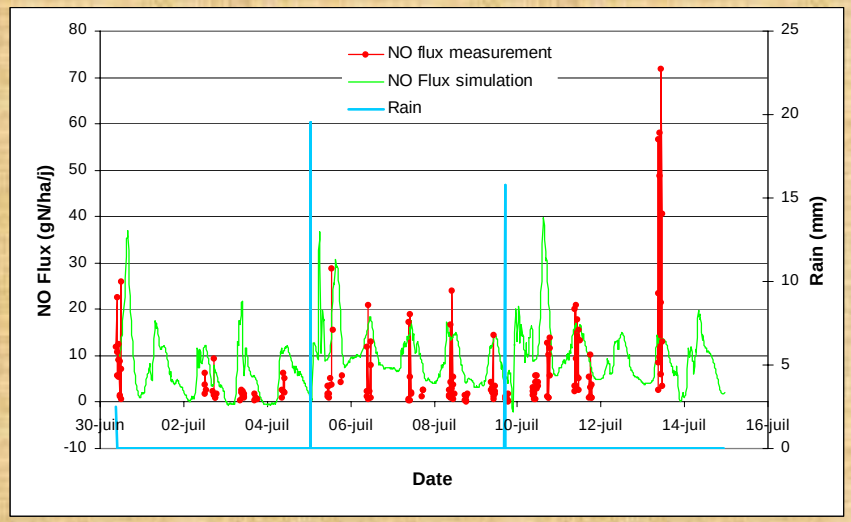
Network results



Blue plot: experimental fluxes (tropical and temperate data).Red plot: network result

Network performance is determined according to quality indexes.

SVAT model validation in Hombori



Green plot: modelled fluxes. Red plot: experimental fluxes. Blue plot: rain events.

Network parameterisation in SVAT reproduces the diurnal temperature cycle, as well as the lower time scale variation due to soil moisture changes (pulse effect).

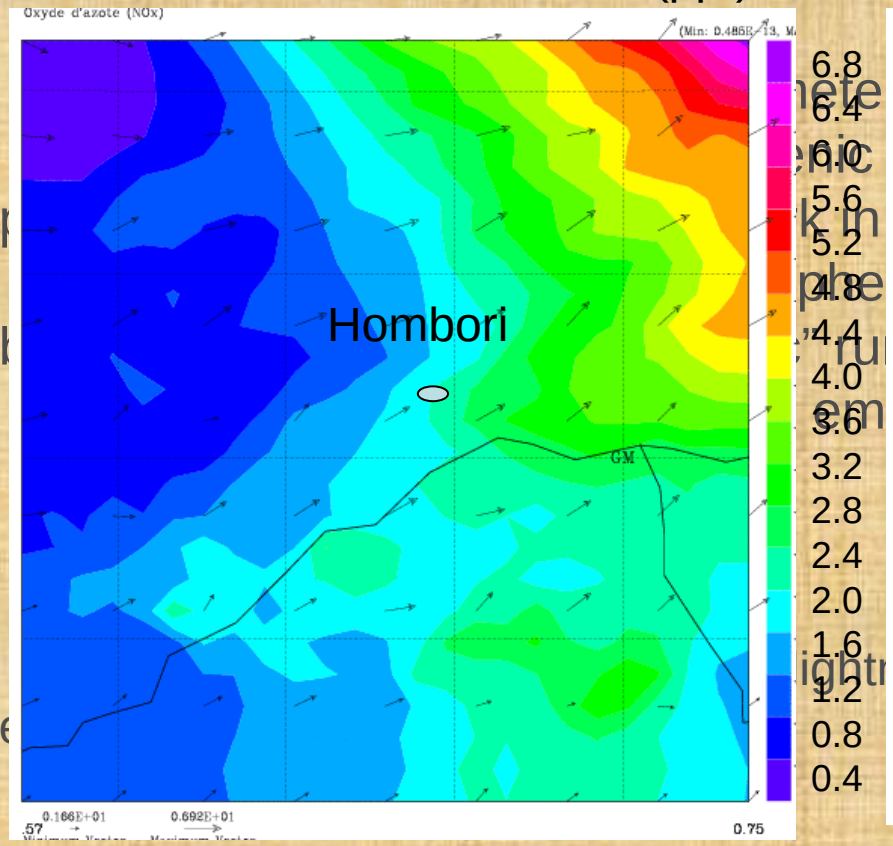
3D modelling

- Work in progress:

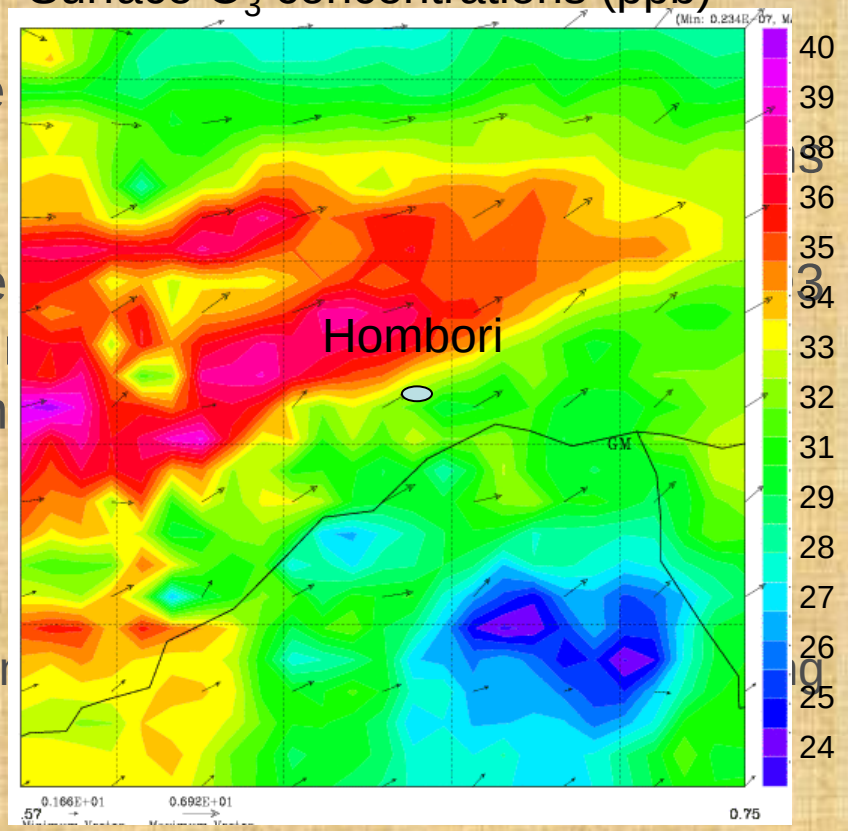
  - Control run with GEIA emissions including anthropogenic emissions + YL95 parameterisation for biogenic emissions.

  Example for NOx and O_3 surface fields after a 36h simulation with MNHC.

Surface NOx concentrations (ppt)



Surface O_3 concentrations (ppb)



3D modelling validation

- Validation of atmospheric concentrations:

  - with soil measurements (NOx and O_3 in Djougou, NO in Hombori and Djougou)

  - with aircraft NOx concentrations

  $\Rightarrow$ discussion about flight positions and trajectories, about chemical measurements on board, abour periods of measurements.

  - with satellite data for NO_2 concentration integrated over the tropospheric column (ex: GOME measurements in Jeagle et al., 2004)

Emission inventory

- Emission inventory will be constructed from 3D modelling mentioned above.
- Spatial scale: meso scale around super sites of Hombori and Djougou, 500km/500km (approx).
- Temporal scale: Seasonal variation, as dry, wet and transition seasons will be documented through field experiments, 1 year round (2005-2006).

Schedule

- Next field campaigns in Djougou: January, May, August 2006
- Next field campaign in Hombori: July 2006 (December 2006 during SOP A'?)
- 3D model validation available for 18 month-report.
- Emission inventory available for the period 2005-2006 at the end of SOP measurements.