Joint Research Centre (JRC)

Integrated use of Capri and Europe-DNDC: a modeling framework to assess the Cross-Compliance effects on European agricultural environment

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Summary

1) **General overview**
- ✓ Payments for environmental services
- ✓ 2003 CAP revision and Cross Compliance

2) **CAPRI/Europe-DNDC modeling approach into CCAT**
- ✓ CAPRI
- ✓ Europe-DNDC
- ✓ HSMU support

3) **Scenario conceptualization and implementation**
- ✓ No-tillage scenario
- ✓ Max-manure scenario (170 kg/ha y)
- ✓ Catch-crop scenario

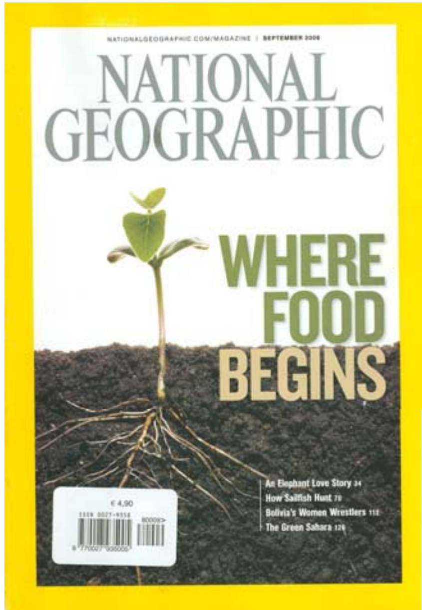
4) **Results**

5) **Conclusions-Comments**

More than one billion people are undernourished worldwide [FAO 09]

✓Lower incomes due to economic crisis
✓Persisting high food prices
✓Lowered access to food for poor people

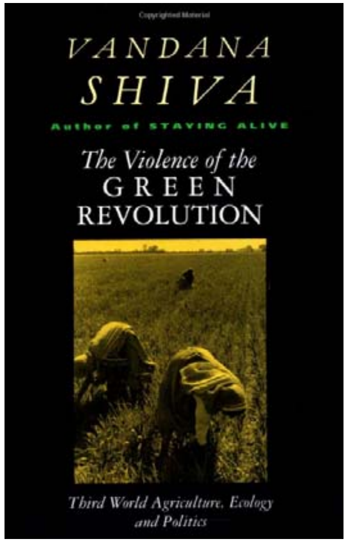
The agriculture back on top of agenda of policymakers to fight against the food crisis and for alleviating poverty



The future challenge will be to double the food production by 2030 [Food summit, Rome 08]

Future growth in food output must derive largely from crops already in use by preserving their productivity / great hopes in genetic engineering [FAO 07]

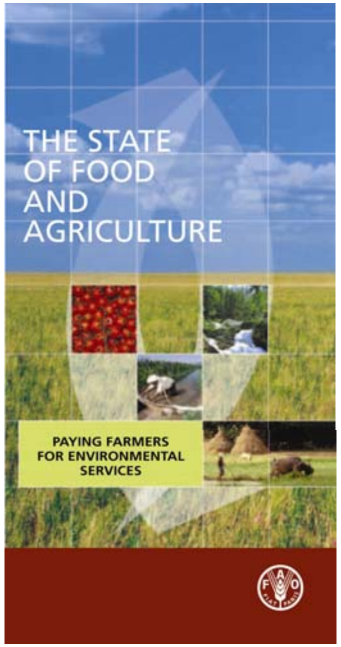
General Overview



The development of intensive farming practices caused a degradation of other ecosystem services essential for human survival (climate, water quality, etc.)

The relationships between poverty, hunger and degraded environment are becoming even clearer, as well as the possible feedback on our society

The agriculture is the main driving force in LUCC at world scale



It's necessary to promote global political measures to push the farmers into adopting more sustainable farming practices while continuing to address the society's changing needs

<u>Payments for environmental services</u>: help the farmer to afford the additional costs for adopting more conservative practices and produce environmental benefits (natural habitats preservation, enhanced air and water quality, soil productivity recovery, etc.)

Cross Compliance (CAP)

The 2003 reform of CAP introduced the Cross-Compliance (CC) tool, to check up the respect of several environmental, food safety, animal welfare, etc. (SMRs) standards as well as the maintenance of farmlands in good agricultural and environmental conditions (GAECs) as prerequisite to receive direct payments.

Cross-compliance

It is difficult to quantify the real effects of these measures at EU25 scale

Simulation based model play an important role in describing the relationships of physical events and socio-economical development

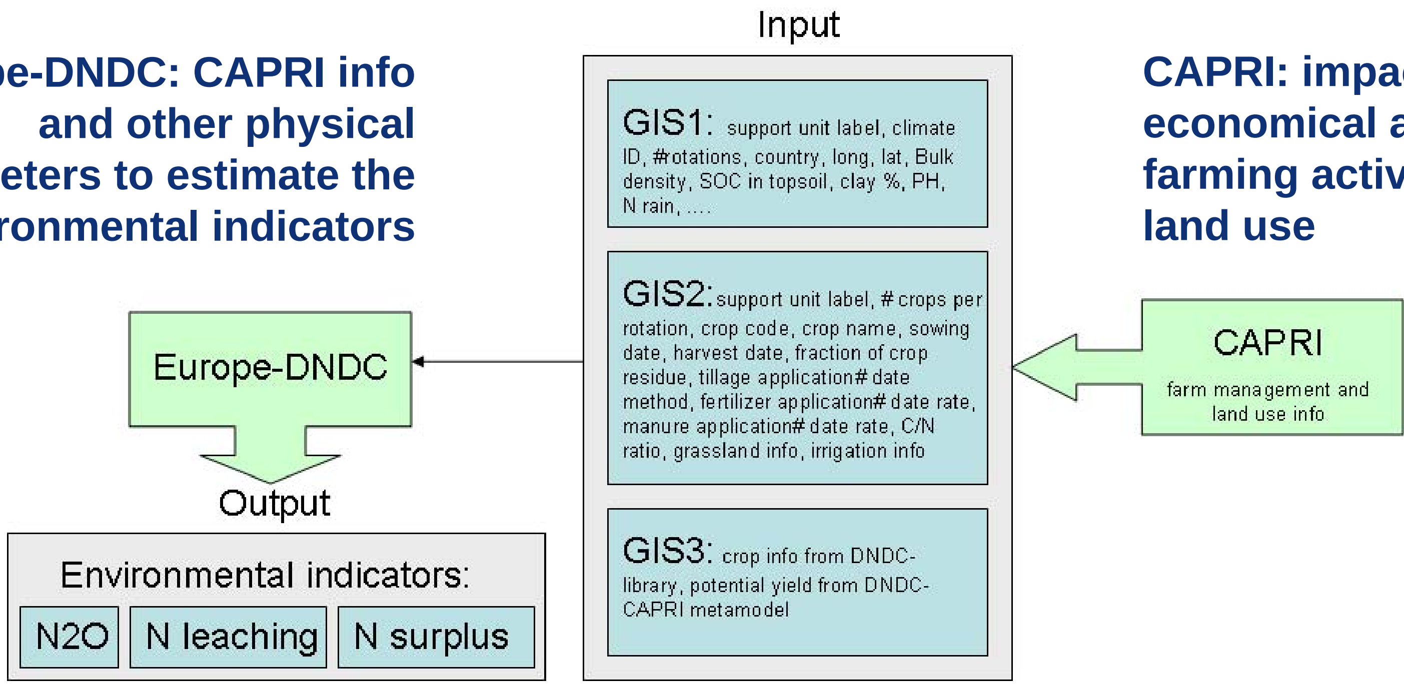
The CC Assessment Tool (CCAT) project aims to develop a simulation platform integrating different models in order to provide a quantitative analysis of CC effects at European scale by means of environmental indicators.

CAPRI/Europe DNDC model

Our modeling approach integrates the agro-environmental CAPRI model with the biogeochemical model DNDC

Europe-DNDC: CAPRI info and other physical parameters to estimate the environmental indicators

CAPRI: impact of socio-economical aspects on farming activities and land use

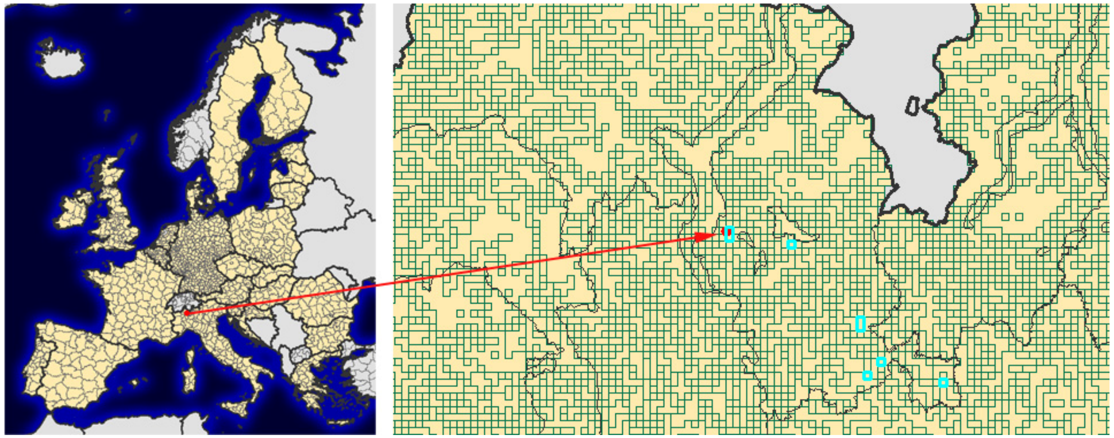


Europe-DNDC allows more flexible simulation of large number of spatial-agricultural units, selecting up to ten crops to be simulated into each unit

The HSMU (Homogeneous Spatial Mapping Unit) is the minimal geographical unit used for the spatial simulation.

The Europe of 25 Member States is composed by 207439 HSMUs which are multipart polygons derived from the overlay of four different datasets:

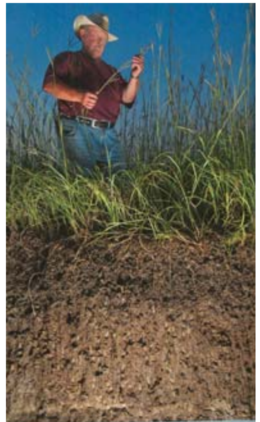
- ✓**administrative boundaries (Gisco NUTS2 e NUTS3)**
- ✓**land cover (CORINE level 3)**
- ✓**soil (SGDB classification)**
- ✓**slope data (CCM DEM 250 divided in five classes)**



CC scenarios implementation

HSMU subset selection: about 20000 HSMUs among the entire EU25 set, min threshold in land use (corn>10% of HSMU agricultural land).
Period: 1990-1999. Corn Monoculture

We want to compare the agricultural practices' effects under CC vs. conventional practices (baseline).



<u>Baseline scenario</u> S1:

VS.

<u>Alternative management</u>

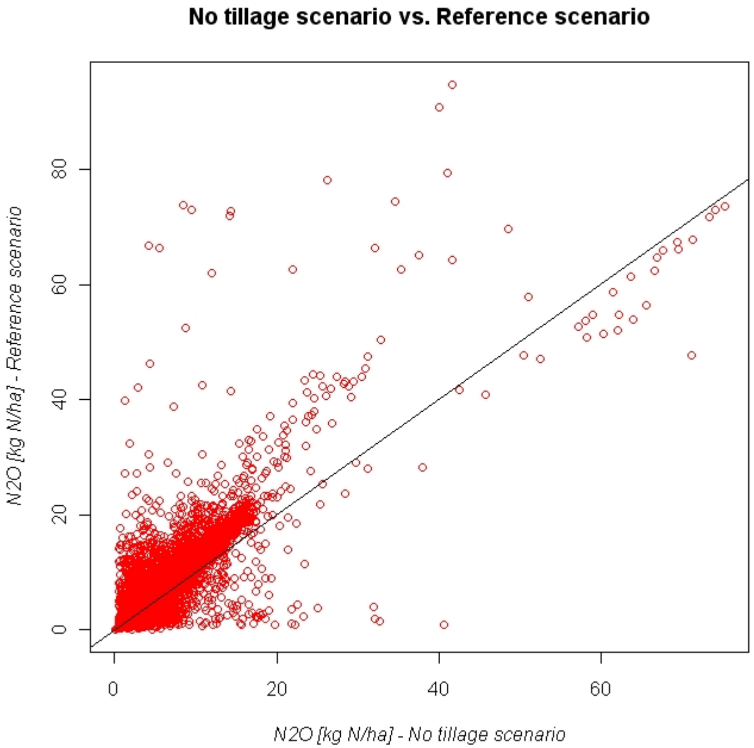
No till scenario S2
Max Manure scenario S3
Catch crops scenario S4

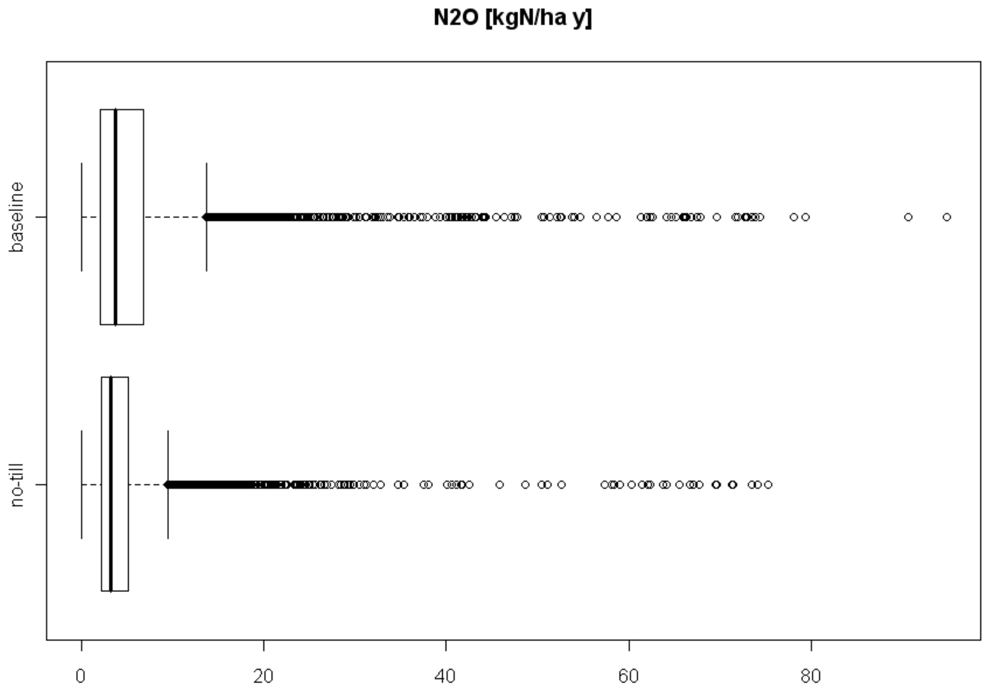
CC scenarios implementation

CC standard	Description	Implementation
--	Reference scenario Monoculture corn 20000 HSMU	S1: Tillage 20 cm 1 fertilizer N input 2 manure N input
GAEC 02	Tillage reduction Soil organic matter recovery	S2: like S1 without tillage
SMR 2	Max Manure is 170 kgN/ha Y	S3: like S1 max manure amendment 170 kgN/ha y
SMR8 GAEC 02-03-04	Surface protection; standard crop rotation; catch crops	S4: 2xcycles corn (2y)-alfalfa (3y). Corn like S1, alfalfa no-till, 1 manure appl.

RESULTS S2 vs.S1

N2O - No till scenario vs. Baseline scenario





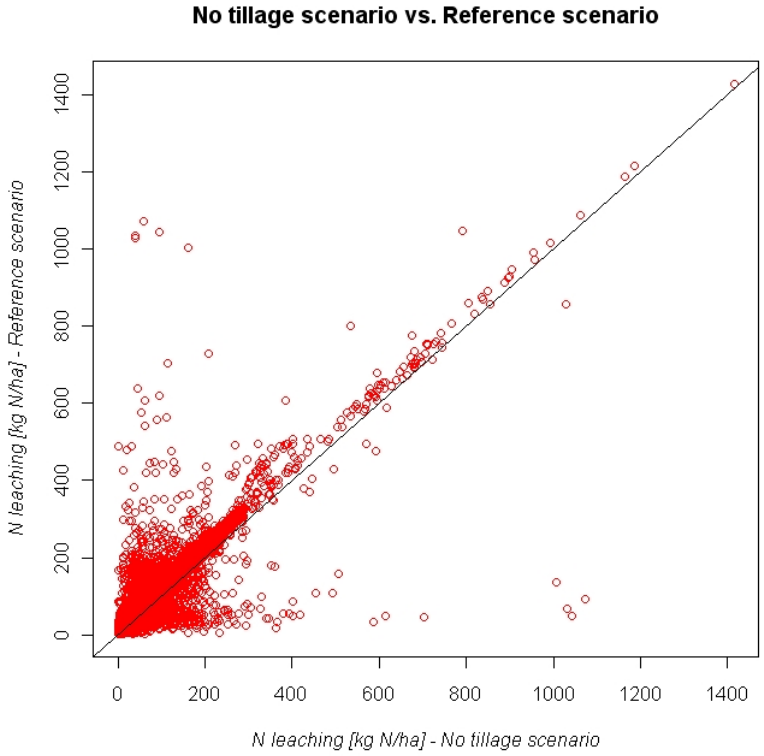
Paired T test (95%): t=34.85, p-value<2.2 E-16

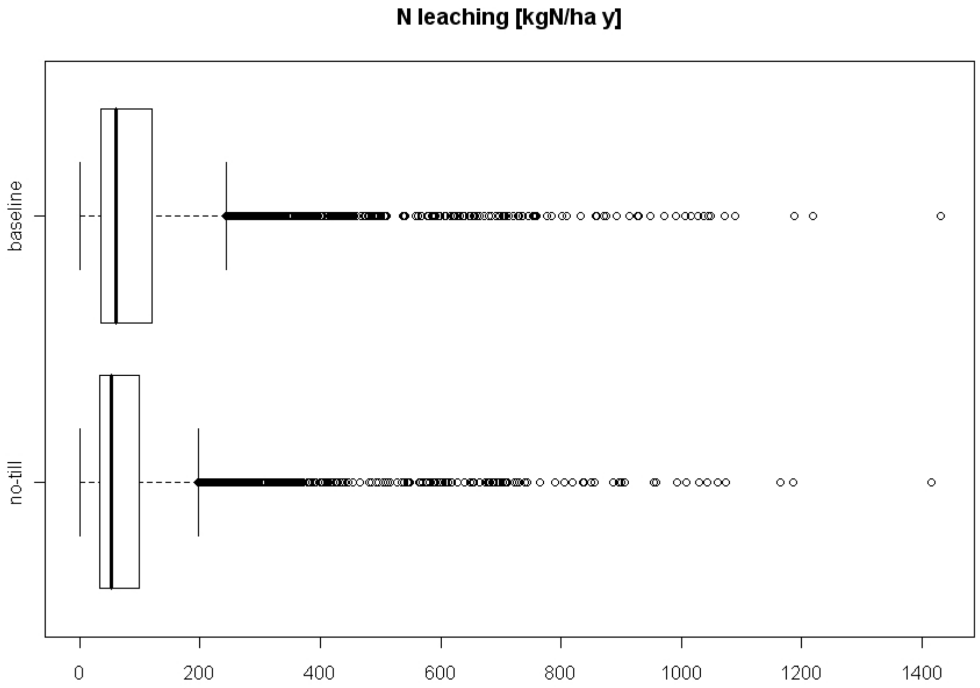
-20% N2O Emission

No till increase N2O in poor aerated soils or soils with high water content (reduced air-filled porosity)

No till decrease N2O in well aerated soils

N leaching - No till scenario vs. Baseline scenario



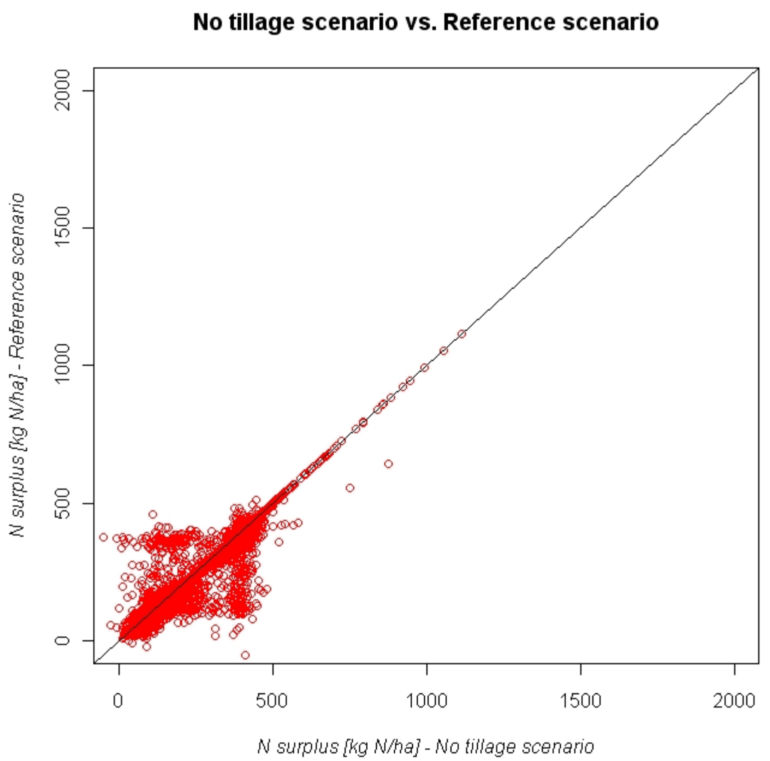


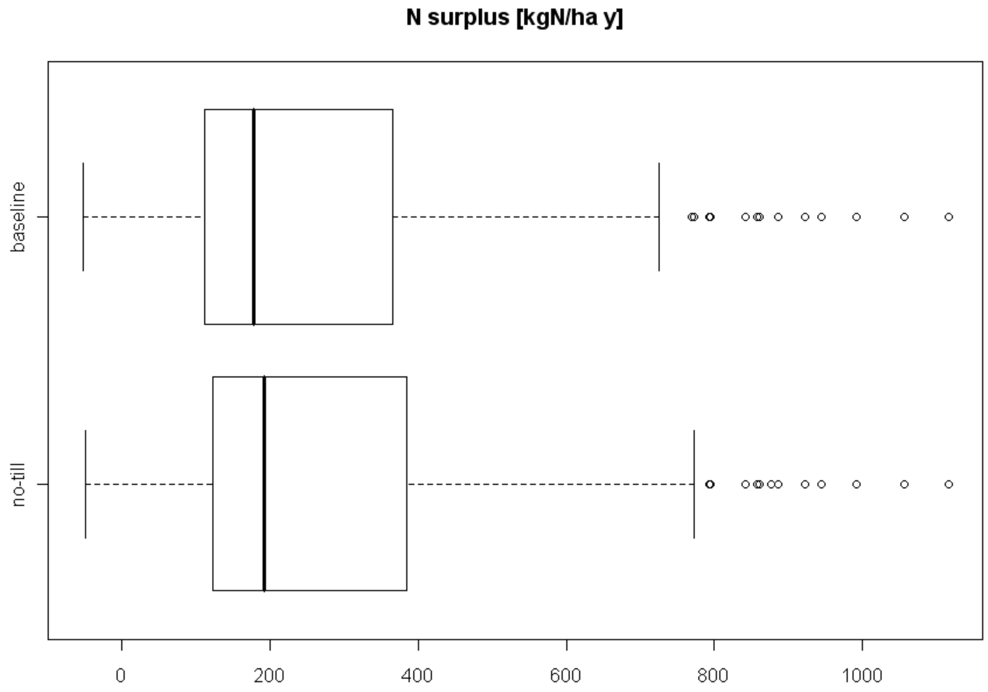
Paired T test (95%): t=29.3, p-value<2.2 E-16

-13% N leaching

Mineralization reduction-increased SOC and less inorganic N for leaching

N surplus - No till scenario vs. Baseline scenario



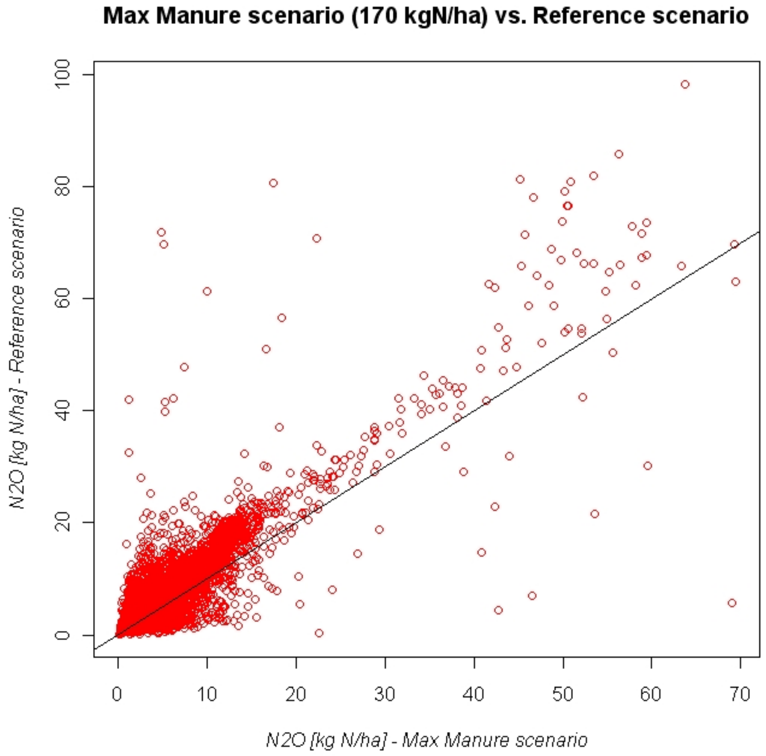


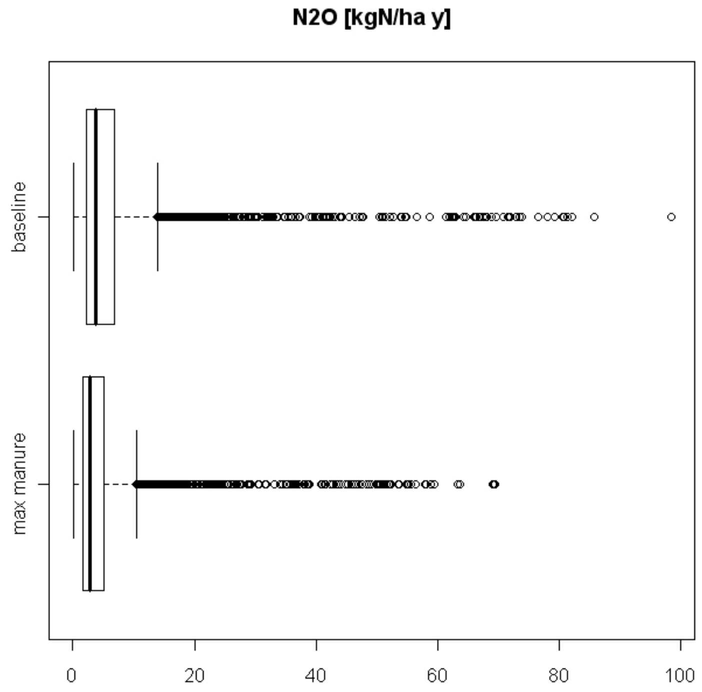
Paired T test (95%): t=69.26, p-value<2.2 E-16

+6% N surplus

Reduction of plant uptake and N input from root residue-increase in N fixation

N2O – Max manure scenario vs. Baseline scenario





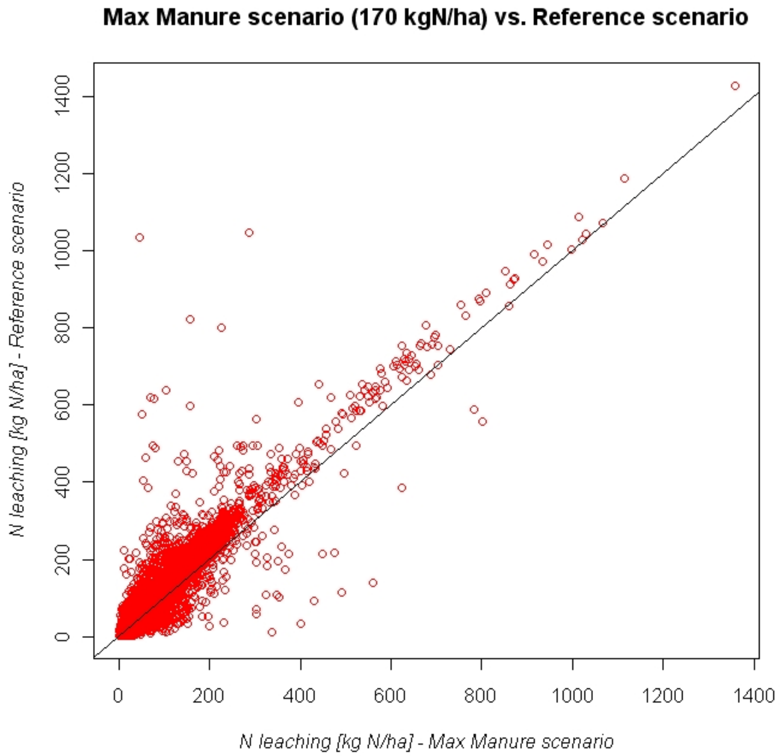
Paired T test (95%): t=50.45, p-value<2.2 E-16

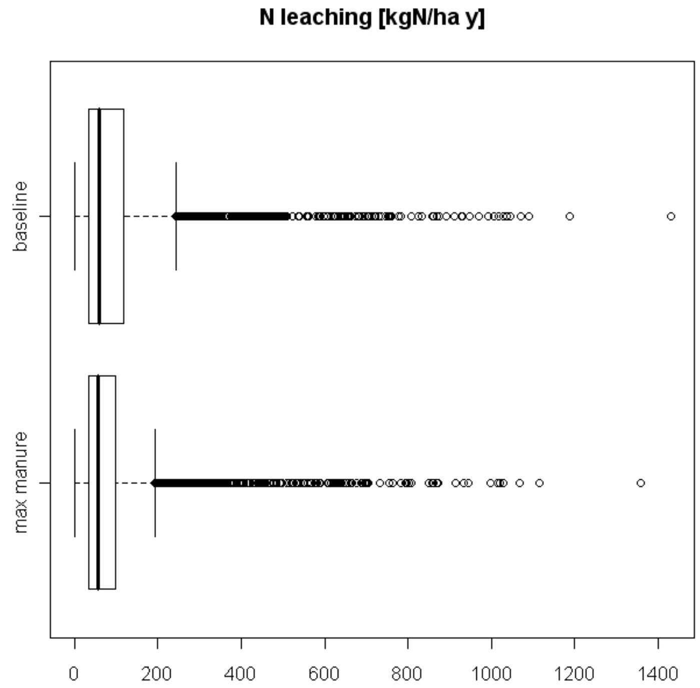
-24% N2O Emission

Addition cost for enlarging the place to store manure

RESULTS S3 vs.S1

N leaching – Max manure scenario vs. Baseline scenario



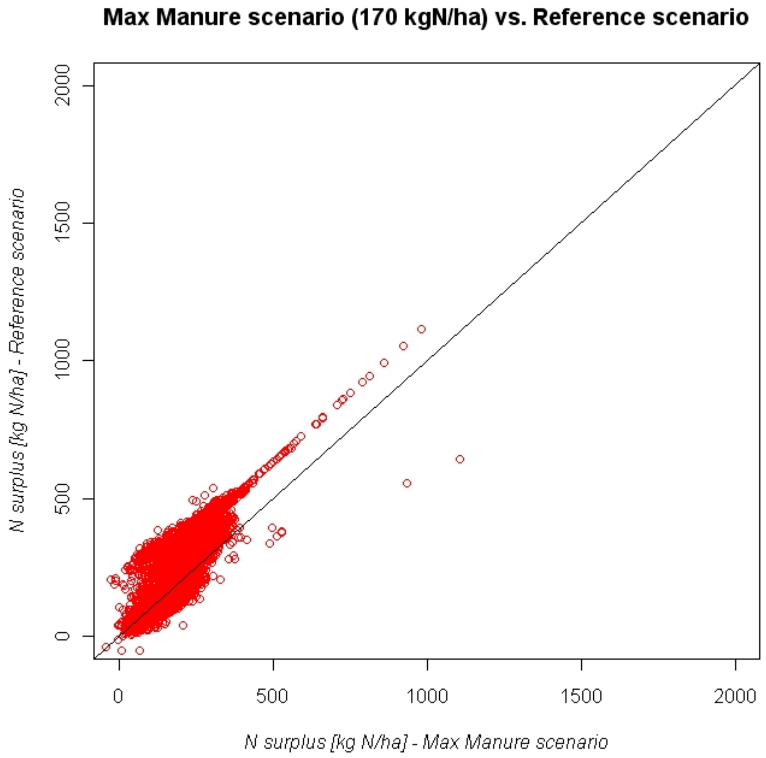


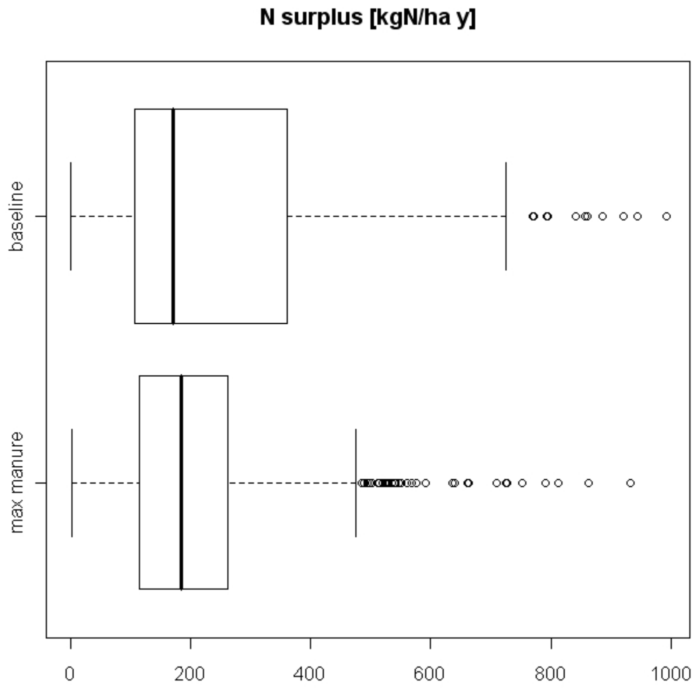
Paired T test (95%): t=39.88, p-value<2.2 E-16

-14% N leaching

RESULTS S3 vs.S1

N surplus – Max manure scenario vs. Baseline scenario



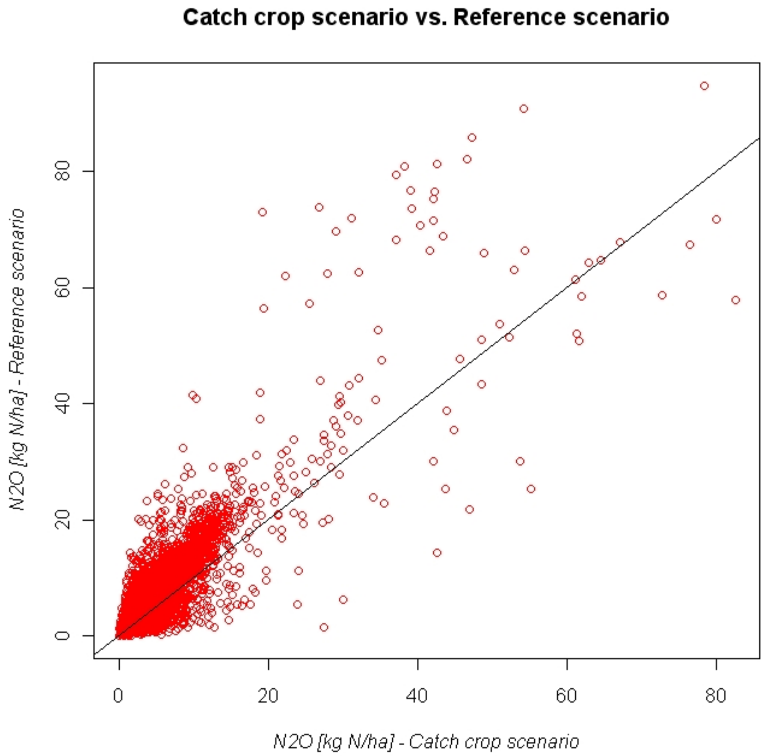


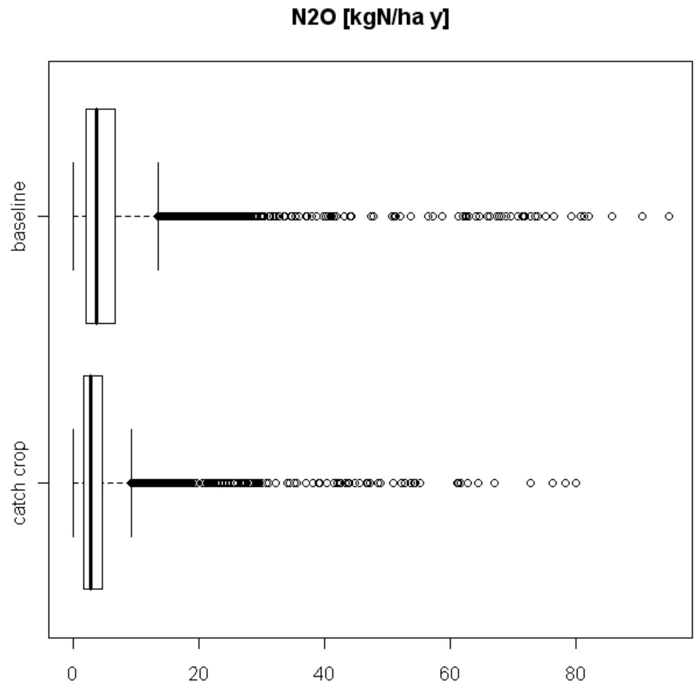
Paired T test (95%): t=55.36, p-value<2.2 E-16

-15% N surplus

RESULTS S4 vs.S1

N2O – Catch crop scenario vs. Baseline scenario



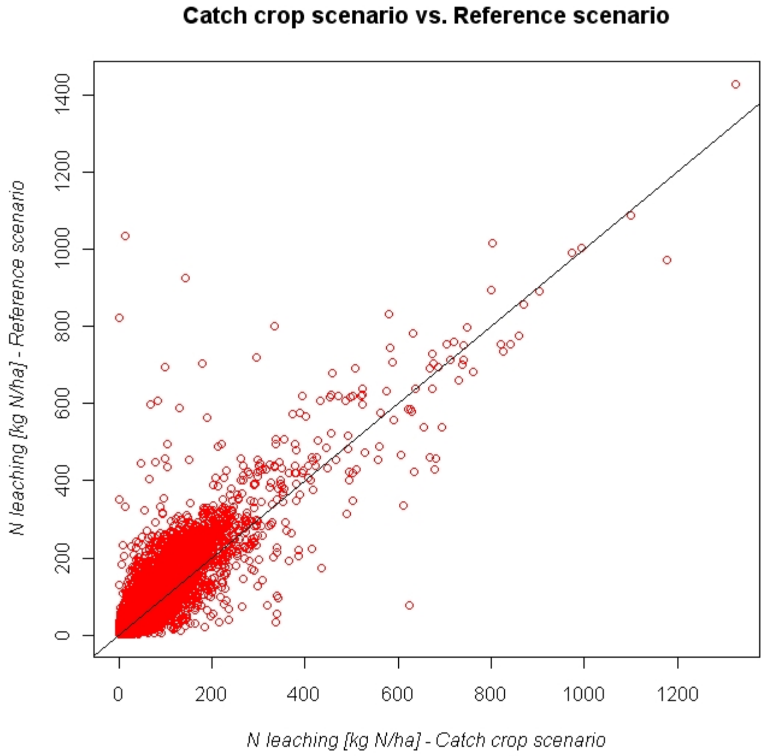


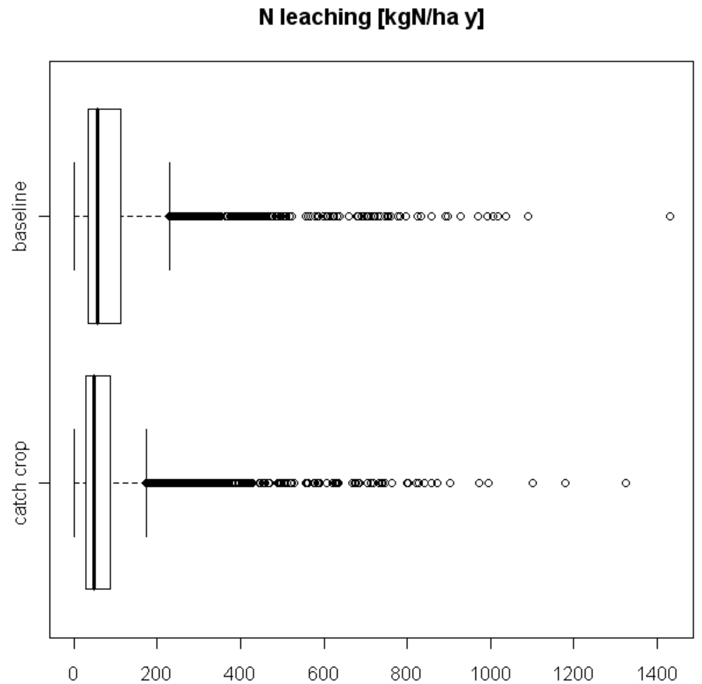
Paired T test (95%): t=48.35, p-value<2.2 E-16

-27% N2O Emission

Reduced N input (only 1 manure amendment on alfalfa) - increased N fixation - cover crop against wind erosion and water runoff - more efficient use of water - organic matter recovery

N leaching – Catch crop scenario vs. Baseline scenario

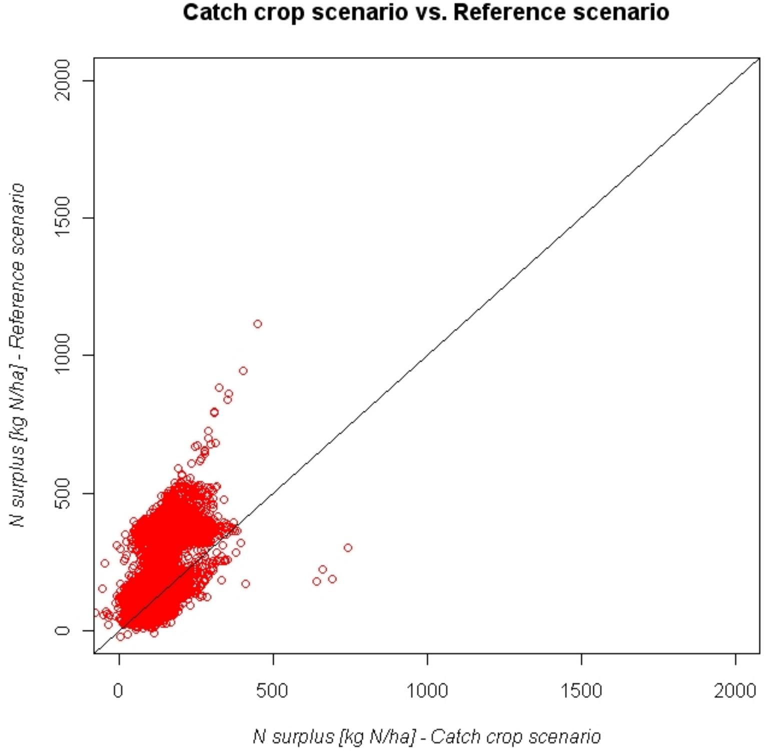


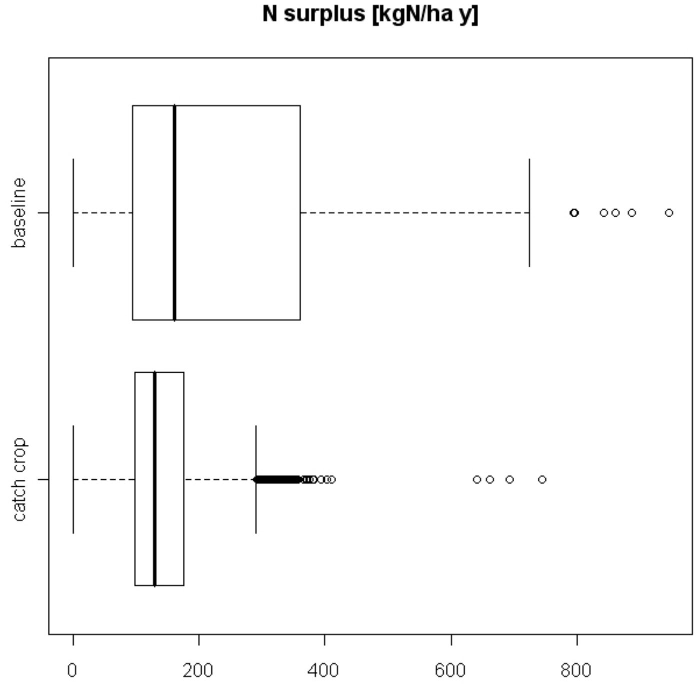


Paired T test (95%): t=40.47, p-value<2.2 E-16

-20% N leaching

N surplus – Catch crop scenario vs. Baseline scenario





Paired T test (95%): t=69.26, p-value<2.2 E-16

-34% N surplus

CONCLUSIONS

The intensive farming systems are accelerating the GHG emissions and undermining the ecosystems services upon which long term crops production depends

Extensive policy actions are needed to influence this current trend and to guarantee long term food production in the face of climate change and environmental degradation.
Cross Compliance (CAP) and payments for environmental services aim to push the farmers into adopting more sustainable activities

Simulation based model and their integrated use (CCAT) allow studying the effects of CC measure on air, soil and water quality by means of environmental indicators.

We designed a series of scenarios to be implemented into CAPRI/Europe-DNDC model by varying 3 alternative management practices:

✓No till: N2O (-20%), N leaching (-13%), N surplus (+6%)
✓Max manure: N2O (-24%), N leaching (-14%), N surplus (-15%)
✓Catch crop: N2O (-27%), N leaching (-20%), N surplus (-34%)

Questions

Thank you!