









# Integrating the DNDC model into the Indicator **Database for European Agriculture** Adrian Leip<sup>1</sup>, Marco Follador<sup>1</sup>, Berien Elbersen<sup>2</sup>

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#### →What is the Indicator Database for European Agriculture (IDEAg)

#### →Assessment of the impact of "Cross-Compliance"



**DeNitrification DeComposition** 

**DNDC-Model** 

Li et al., 1992, 2000,...





## CAPRI – Common Agricultural Policy Regional Impact Assessment

Enviro





Ca. 40 regions/products including gluten feed & palm oil, CAP, TRQs (bi-lateral and global)

Economic model – production, demand, trade and prices are interacting and simulated simultaneously

Two interlinked modules:

- → A globally closed model for production, demand and trade in primary and secondary agricultural products, including oils and cakes
- → NUTS II simulation models for EU27 which capture in detail farming decisions (crop shares, animal herds, yields, fertilizer use ..)



250 regions for EU27+Norway +Western Balkans, endogenous yields, detailed input coefficients, CAP policy

#### Indicators calculators

GHG budget according IPCC Nitrogen balances from GAINS/MITERRA LCA energy use in agriculture



Geographic layers from CAPRI-disaggregation



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## **Environmental data**





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## The DNDC-CAPRI meta-model.V1

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### DNDC-CAPRI metamodel Nitrogen losses for the cultivation of rape seed

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- → Allows "fast" simulation of large numbers of spatial units/crops combinations
- $\rightarrow$  Allows the calculation of marginal effects giving N-input shocks
- → Improves consistency with process-based model through calibration of yield at HSMU/crop level

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For nitrogen indicators it is important that nitrogen input matches (expected) nitrogen yield and nitrogen surplus



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## Flow of information the CAPRI-DNDC modelling framework







# **Cross-compliance**

Reform of the EU-Common Agricultural Policy 2003 Establishing a link between

- →the granting of income support and
- →compliance with specified requirements of public interest:
  - Maintaining land in good agricultural and environmental condition + maintaining permanent pasture at level at 1.5.2004
  - Compliance with statutory management requirements (environment, food safety, animal health and welfare)



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# The Cross-Compliance Assessment Tool project (CCAT)

→To develop an integrated knowledge tool for the assessment of the impacts of Cross-Compliance on air, soil and water quality indicators on a European scale



Environmental impact

→Apply mechanistic models (DNDC, EPIC) to assess specific impacts of CC on air, soil and water quality indicators.

→To develop simplified functions from the applied mechanistic models to be included in the integrated knowledge tool







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**Nitrate Directive** 

Aims at "to decrease water pollution caused or induced by nitrates from

agricultural sources and prevent further such pollution"

- $\rightarrow$ No more than 50 mg NO3/liter in groundwater
- → Applicable in Nitrate Vulnerable Zones (NVZ)

Nitrate-Directive measures:

- → Balanced N fertilizer application
- $\rightarrow$  Maximum manure N application (170 kg N/ha)
- →Limitation to N application in winter and wet periods
- → Limitation to N application on sloping grounds
- → Manure storage with minimum risk on leaching
- → Appropriate application techniques

CAT Buffer zones

ross Compliance Assessment Growing winter crops







## 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



Cross Compliance Assessment Tool



#### Institute for Environment and Sustainability

# CC scenarios implementation

	CC standard	CC-description	Implementation
<b>Joint Research Centre</b>		<ul> <li>Reference scenario</li> <li>Monoculture corn</li> <li>20000 HSMU</li> </ul>	S1: - Tillage 20 cm - 1 fertilizer N input - 2 manure N input
	GAEC 02 "NO TILL"	<ul> <li>Tillage reduction</li> <li>Soil organic matter recovery</li> </ul>	S2: - like S1 without tillage
	SMR02 "MAX MANURE"	<ul> <li>Max Manure is 170 kgN/ha</li> </ul>	S3: - like S1 max manure amendment 170 kgN/ha
	SMR08 GAEC 02-03-04	<ul> <li>Surface protection; standard</li> <li>Crop rotation; catch crops</li> </ul>	<ul> <li>S4: - 2 cycles corn (2y)-alfalfa</li> <li>(3y). Corn like S1, alfalfa no- till, 1 manure appl.</li> </ul>
Cross Com	Since Assessment Tool	Limitation of N application in winter	S5: - split of fertilizer input into 2 application (at sowing and beginning of winter)

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[kg N/ha yr] - S5

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Cross Compliance Assessment Tool

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Cross-Compliance leads in most cases to a reduced environmental impact for N2O, N-leaching and total N surplus.

• NO-TILLAGE: N2O -20%, N leaching -13%, N surplus +6%

Conclusion

- MAX-MANURE: N2O -24%, N leaching -14%, N surplus -15%
- CATCH CROP: N2O -27%, N leaching -20%, N surplus -34%
- WINTER APPL: N2O +10%, N leaching -11%, N surplus -1%
- → The Indicator Database for European Agriculture is a comprehensive Europe-wide database with consistent data to develop (environmental) indicators for various purposes.
- → Current applications: N-budget (soil/farm/regional); N-losses at watershed; link to sewage N2O emissions; additional sensitivity studies; marginal emission factors (biofuels); biofuel scenarios; LCA assessment of the livestock sector ...