Sixth Framework Programme

CICCAT

Cross Compliance Assessment Tool

Integrated approach to assess impacts of cross compliance measures on environment

Partners

- Alterra, The Netherlands
- CEET, Estonia
- IfLS, Germany
- JRC-Ispra (IES-RWER-CC Units)
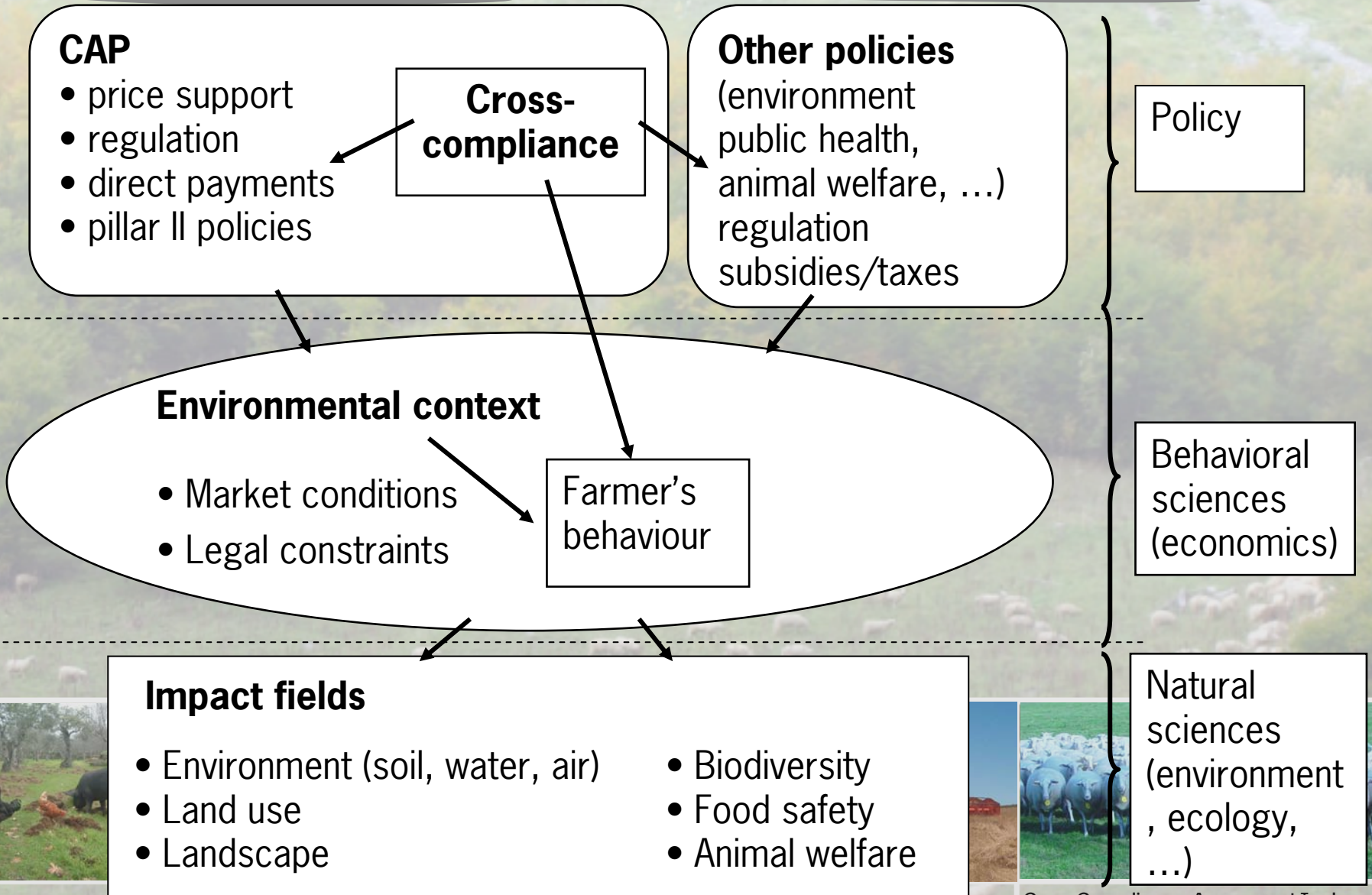- LEI, The Netherlands
- UBonn-ILR, Germany
- UAM, Spain

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Outline presentation

1. **Overall framework of CCAT and the role of environmental impacts**

2. **Objectives and approach Task 4.2**

3. **Models and tools for assessment of impacts**

   - **CAPRI model**

   - **MITERRA, EPIC and DNDC models**

4. **Evaluation, conclusions and discussion aspects**

5. **Milestones and deliverables**

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Conceptual relationship CC, farmers response and effects

CC AT
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CAP
- price support
- regulation
- direct payments
- pillar II policies

Cross-compliance

Other policies
(environment public health, animal welfare, …) regulation subsidies/taxes

Policy

Environmental context
- Market conditions
- Legal constraints

Farmer's behaviour

Behavioral sciences (economics)

Impact fields
- Environment (soil, water, air)
- Land use
- Landscape
- Biodiversity
- Food safety
- Animal welfare

Natural sciences (environment, ecology, …)

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SMRs and fields of impact

SMRs	Agricultural markets and producer's income		Environment							Land use	Biodiversity				Landscape	Animal welfare and health		Food safety
	Agricultural markets	Producer's income	Ground water quality	Surface water quality	Water quantity	Air quality	Climate	Physical soil quality	Chemical soil quality	Land use	Birds	Mammals	Invertebrates	Plants	Landscape diversity	Animal welfare and health	Animal health	Food safety
Wild birds Directive	X	X		X		X	X		X	X	X	X	X	X	X			
Groundwater protection Directive	X	X	X	X				X		X	X	X	X	X				
Habitats Directive	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Sewage Sludge Directive	X	X	X	X		X	X		X	X	X	X	X	X			X	X	X
Animal welfare Directives	X	X	X	X						X	X	X	X	X	X	X	X	X
Food safety Directives	X	X	X	X						X	X	X	X	X	X	X	X	X

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GAECs and fields of impact

GAECs	Agricultural markets and producer's income		Environment							Land use	Biodiversity				Landscape
	Agricultural markets	Producer's income	Ground water quality	Surface water quality	Water quantity	Air quality	Climate	Physical soil quality	Chemical soil quality	Land use	Birds	Mammals	Invertebrates	Plants	Landscape diversity
Soil erosion		X	X	X		X	X	X	X	X	X	X	X	X	X
Soil organic matter		X	X	X		X	X	X	X	X	X	X	X	X	X
Soil structure	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Minimum level of maintenance		X	X	X	X	X	X	X	X	X	X	X	X	X	X

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Objectives

- Assessment or impacts of cross compliance measures on air-, soil-, and water quality in terms of:
  - Atmospheric emission of ammonia and green house gases (air quality/climate)
  - Soil accumulation or release of carbon (organic matter), nitrogen, phosphorous and heavy metals (chemical soil quality); pesticide use in a qualitative way
  - Soil erosion (physical soil quality); compaction in a qualitative way
  - Leaching and runoff of nitrogen (water quality)

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General approach

- To develop an integrated knowledge tool for the assessment of the impacts of CC on air, soil and water quality indicators on a European scale (based on Miterra Europe, INITIATOR2, CAPRI models)

- 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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Models available

Main models:

- CAPRI (market response model)
- MITERRA EUROPE Extended (simple integrated N model)
- EPIC (detailed soil-crop-hydrological model)
- DNDC (detailed biogeochemical model)

Complementary tools, mainly for use in MITERRA

- INTEGRATOR (Integrated multi-component model on N for Europe): relevant formulations to be used in MITRRA
- INITIATOR2 (Integrated model including all major element fluxes for NL): relevant for extending MITERRA with carbon, phosphate and metals.
- RAINS-GAINS (used for delivering excretion (animals) and emission factors (housing) in MITERRA
- DYNASPAT-SEAMLESS spatial disaggregation tools

Main environmental fluxes in agriculture
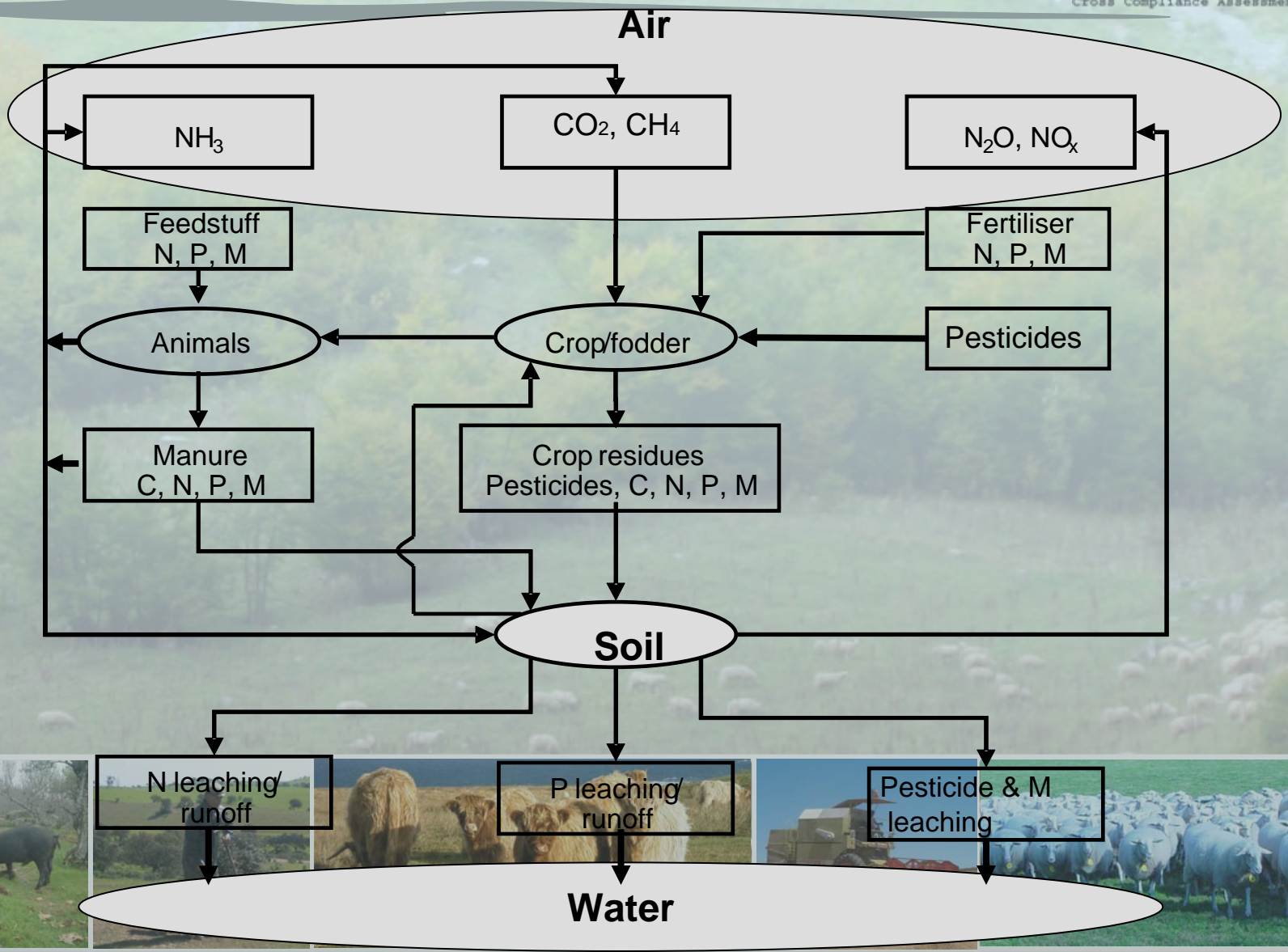
Indicators predicted by core environmental models

Compartment	Indicator	MITERRA Europe extended	DNDC	EPIC
Air/Climate	NH_3 emission	X	X	X
	GHG emission (CO_2, N_2O, CH_4)	X	X	-
Soil	Nitrogen balance	X	X	X
	Carbon balance	X	X	X
	Phosphorous balance	X	-	X
	Metal balance	X		
	Erosion	-	-	X
Water	Nitrogen leaching	X	X	X
	Phosphorous leaching	(X)	-	(X)
	Metal leaching	(X)		

Approach to predict air, soil & water indicators
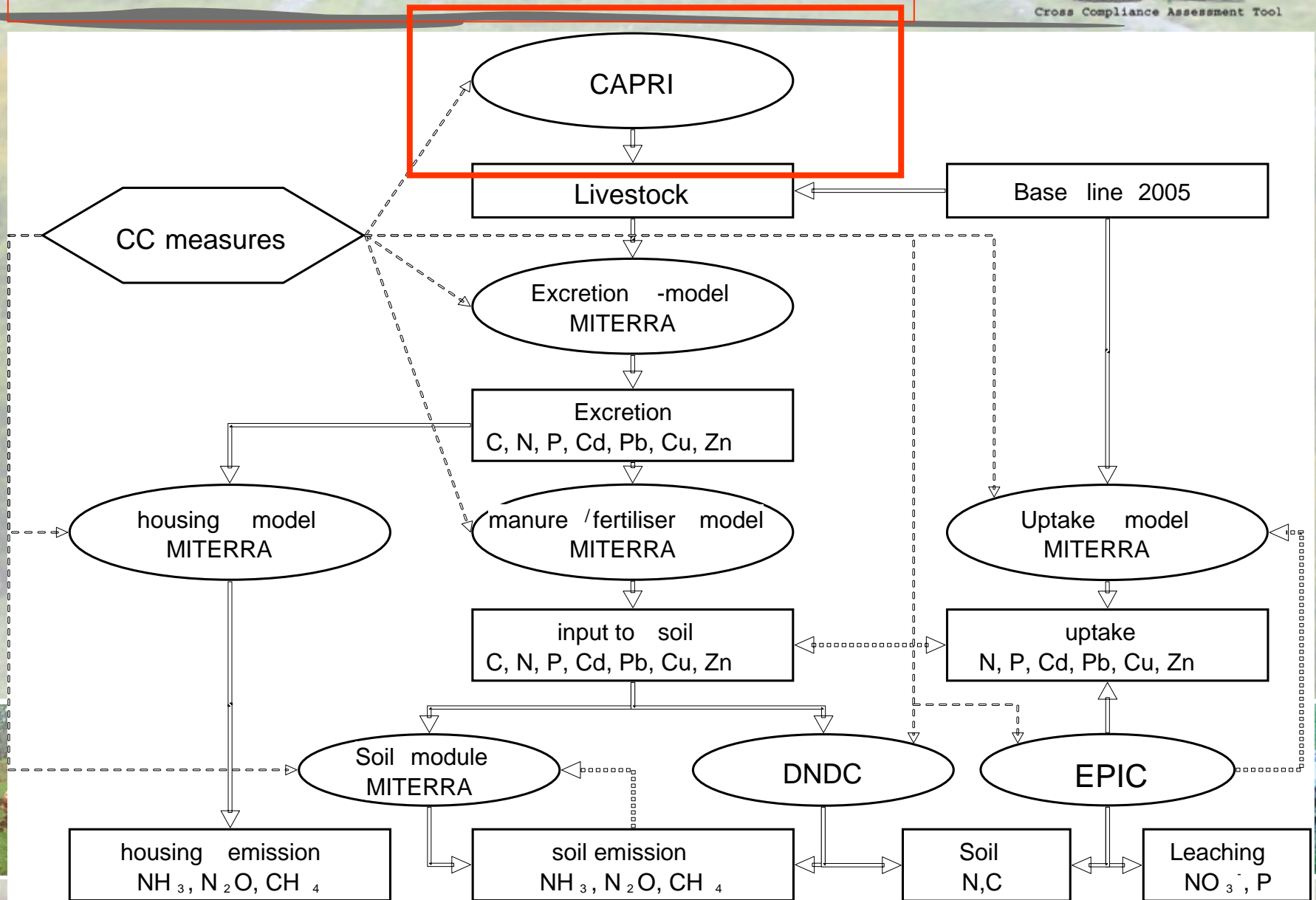
CAPRI output used as input in environmental models

- Level of (additional) compliance in % of farms, % of farm type, % of farm land (if modelled endogenously)
- Farmers response to compliance in terms of changes in farm practice (SMRs, GAECs)
- Market response: Changes in land use per farm type per region
- Market response: Changes in livestock numbers+mix per farm type per region
- Environmental indicator (N- and P- balance, GHG emissions)

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Specialization of CAPRI and MITERRA results

To spatially allocate land use and individual farm information to a specific environmental context (soil, climate, slope)

To facilitate the model linking, as this requires relating different scales to each other, just as different domains (market (administrative) and environment (environmental regions)).

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Specialization of CAPRI and MITERRA results

- Creation of the Homogeneous Spatial Mapping Units (HSMUs)

- Statistical allocation of land use to HSMU

- Statistical allocation of farm types (using detailed land use allocation) to HSMU

Spatial allocation of farm types

Definition of HSMUs
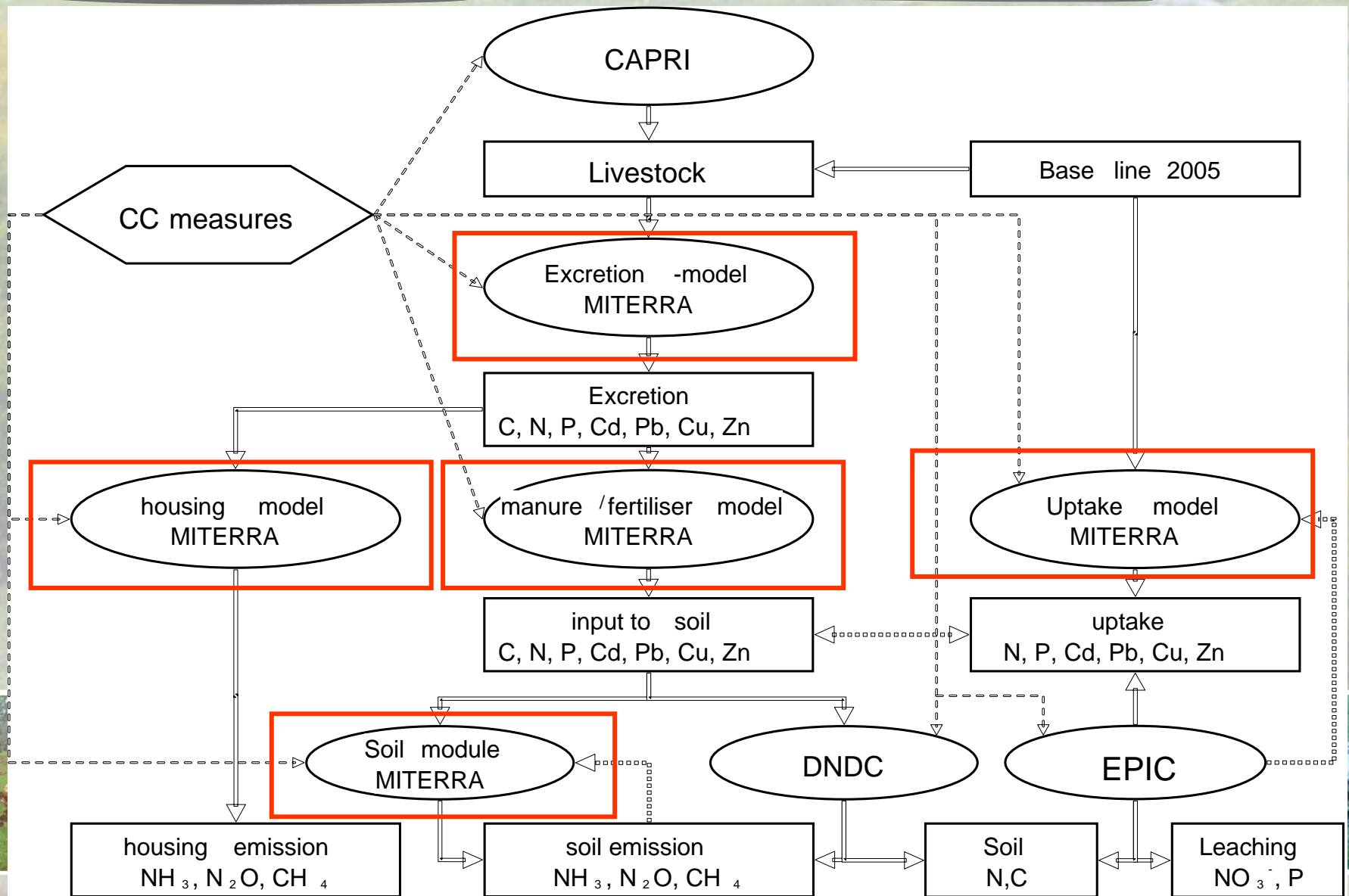
NUTS3 Regions

CORINE Land Cover

Soil Mapping Unit

Slope

degrees
- 0
- 1
- 2 - 3
- 4 - 7
- >= 8

Approach to predict air, soil & water indicators

MITERRA-EUROPE

- Ammonia, nitrous oxide and methane emissions from housing, storage and soils
- Nitrate leaching
- Interactions between N flows housing and soils (consistent N budget)
- Measures to mitigate ammonia and nitrate emissions

MITERRA-EUROPE

- Idea is to use MITERRA Europe as a basis for CCAT and further expand this tool by:
  - Including C and metal balances (Including ideas from INITIATOR2)
  - Refine spatial scale (from MUTS2 to HSMU including data from CAPRI Dynaspat and developments in the Nitro Europe project in developing the model INTEGRATOR
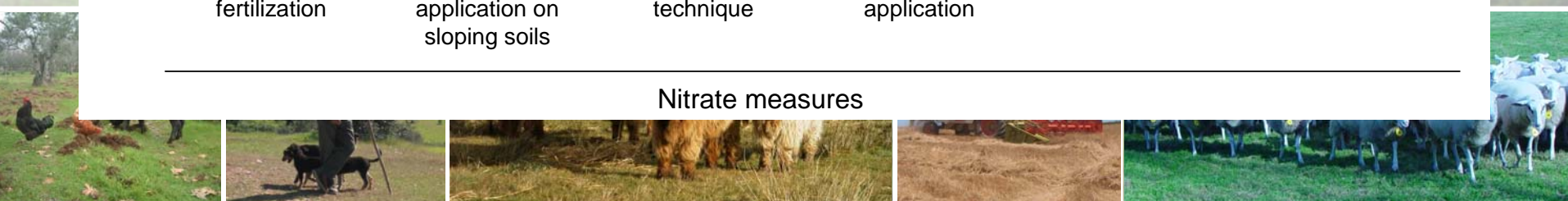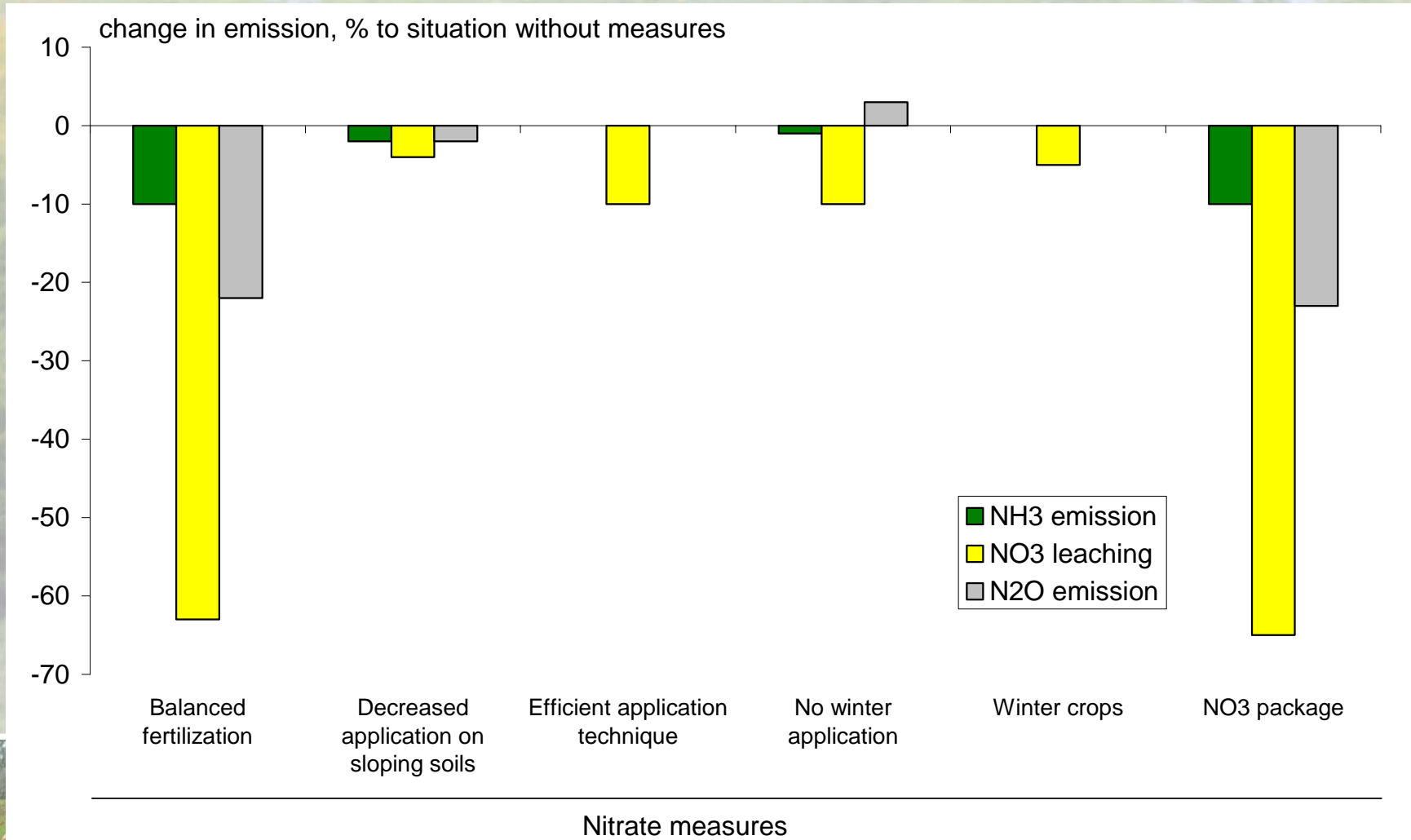
Cross Compliance Assessment Tool

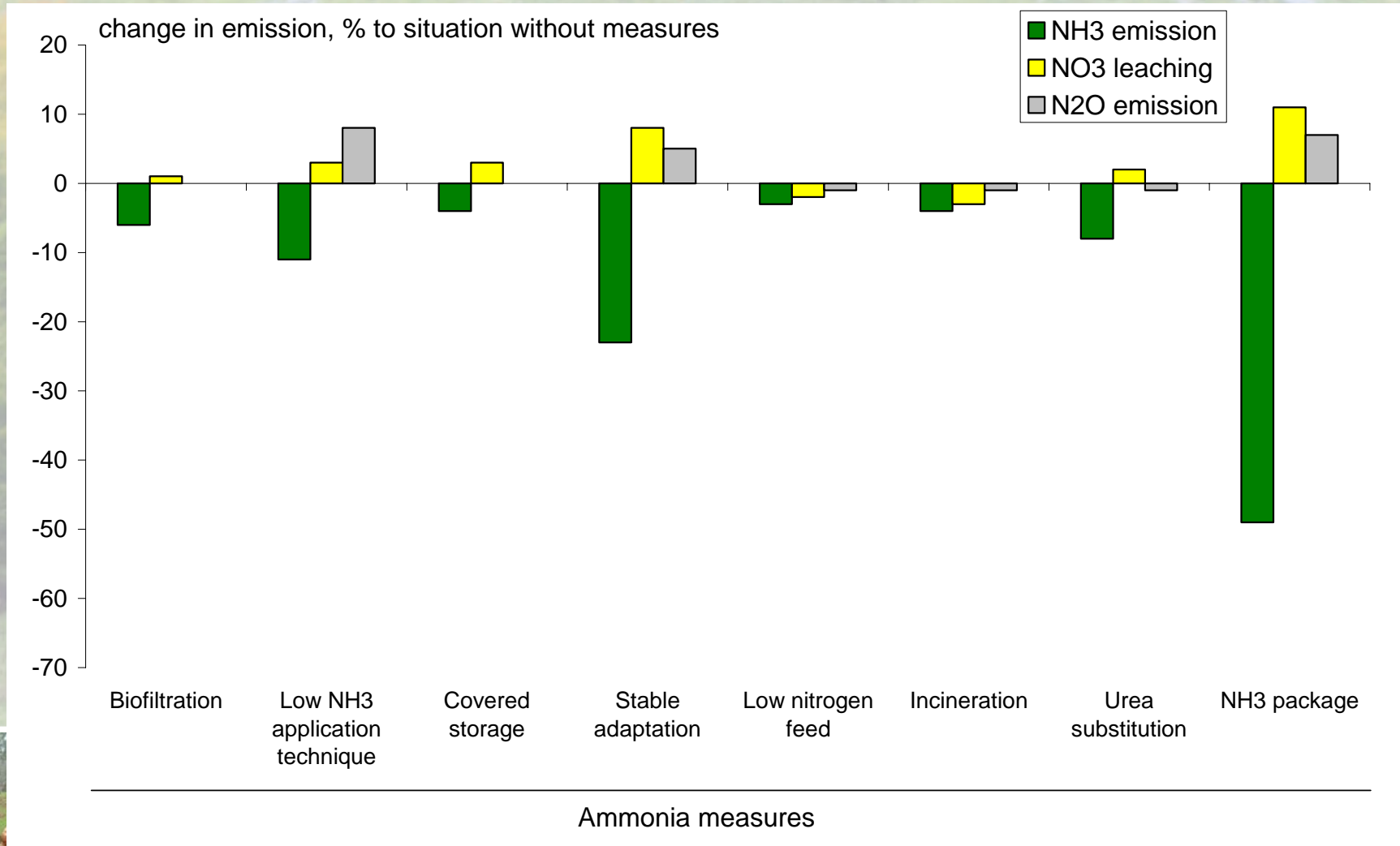# MITERRA: Selected nitrate measures from Nitrate Directive

- balanced N fertilizer application
- maximum manure N application rate
- no fertilizer and manure application in winter and wet periods
- limitation to fertilizer application on sloping grounds
- manure storage with minimum risk on runoff/seepage
- appropriate fertilizer and manure application techniques
- growing winter crops
- buffer strips near water courses

MITERRA: Effect of nitrate measures

change in emission, % to situation without measures

Legend:
- NH3 emission
- NO3 leaching
- N2O emission

Categories: Balanced fertilization, Decreased application on sloping soils, Efficient application technique, No winter application, Winter crops, NO3 package

Nitrate measures

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MITERRA: Effect of NH3 measures

change in emission, % to situation without measures

Legend:
- NH3 emission
- NO3 leaching
- N2O emission

Y-axis: 20, 10, 0, -10, -20, -30, -40, -50, -60, -70

Categories: Biofiltration, Low NH3 application technique, Covered storage, Stable adaptation, Low nitrogen feed, Incineration, Urea substitution, NH3 package
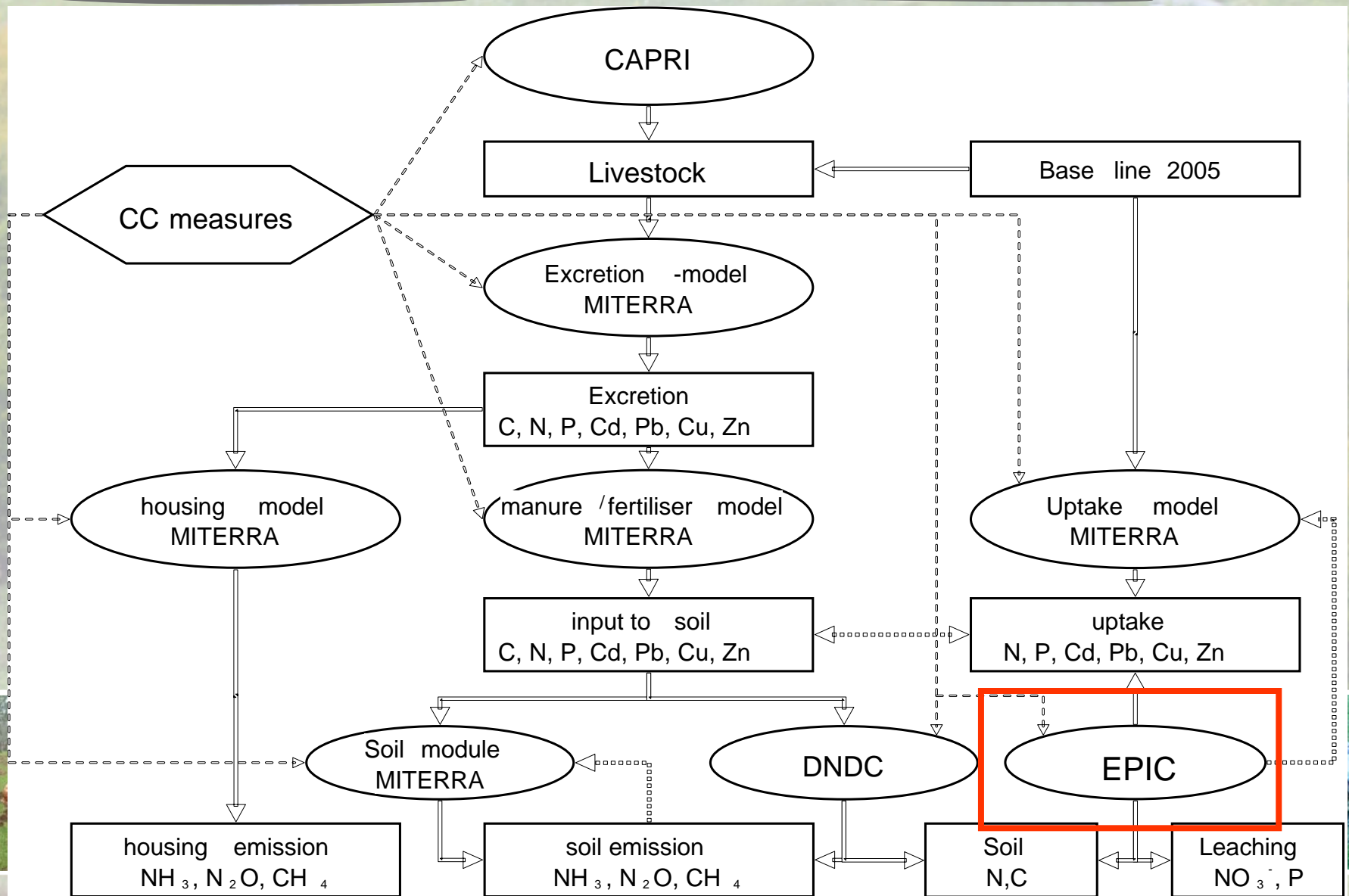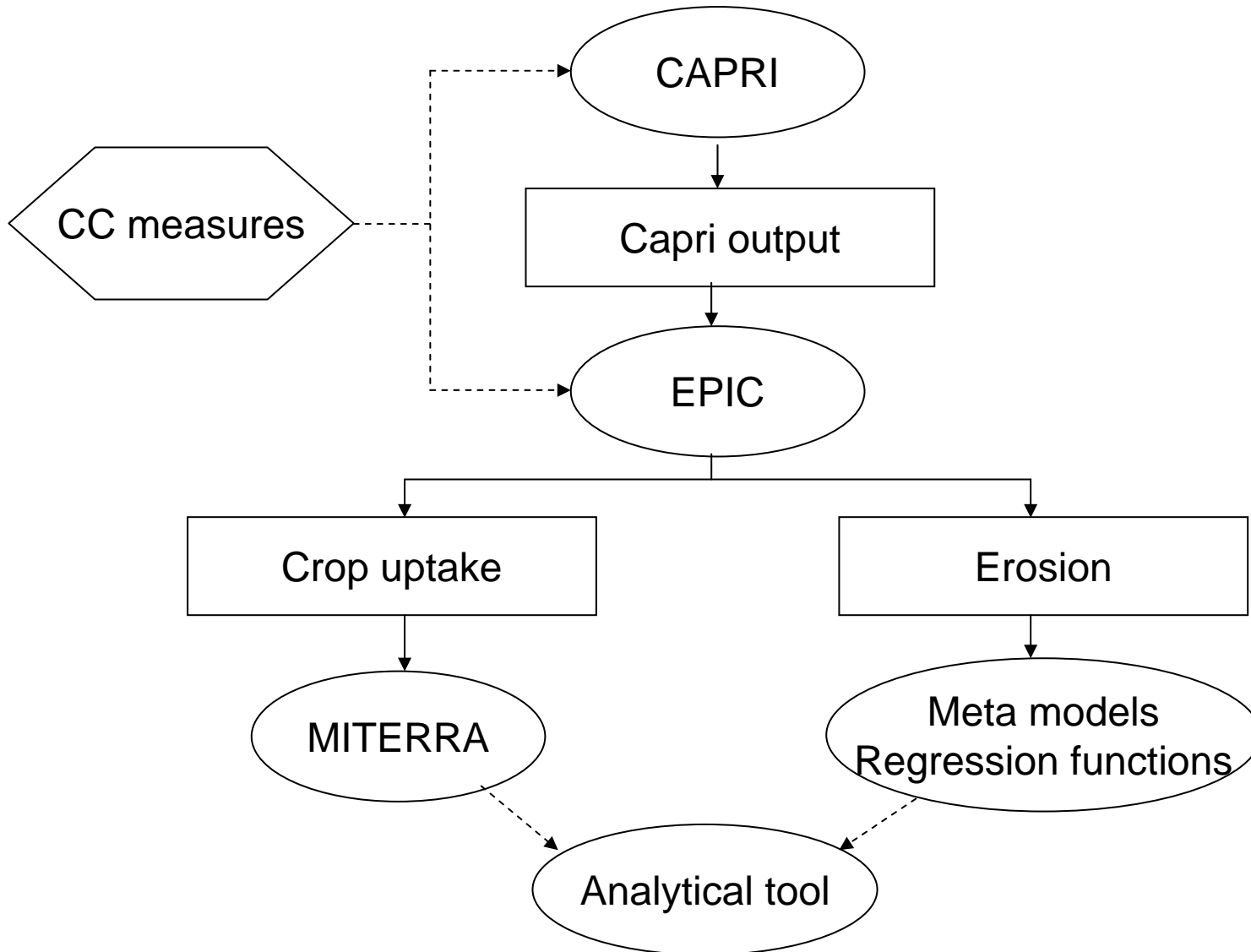
Ammonia measures

Mechanistic detailed models

- Detailed chemical and hydrological soil models, for use at the field level
  - DNDC: focused at greenhouse gas emissions (specifically N_2O)
  - EPIC: focused on element balances and physical soil quality
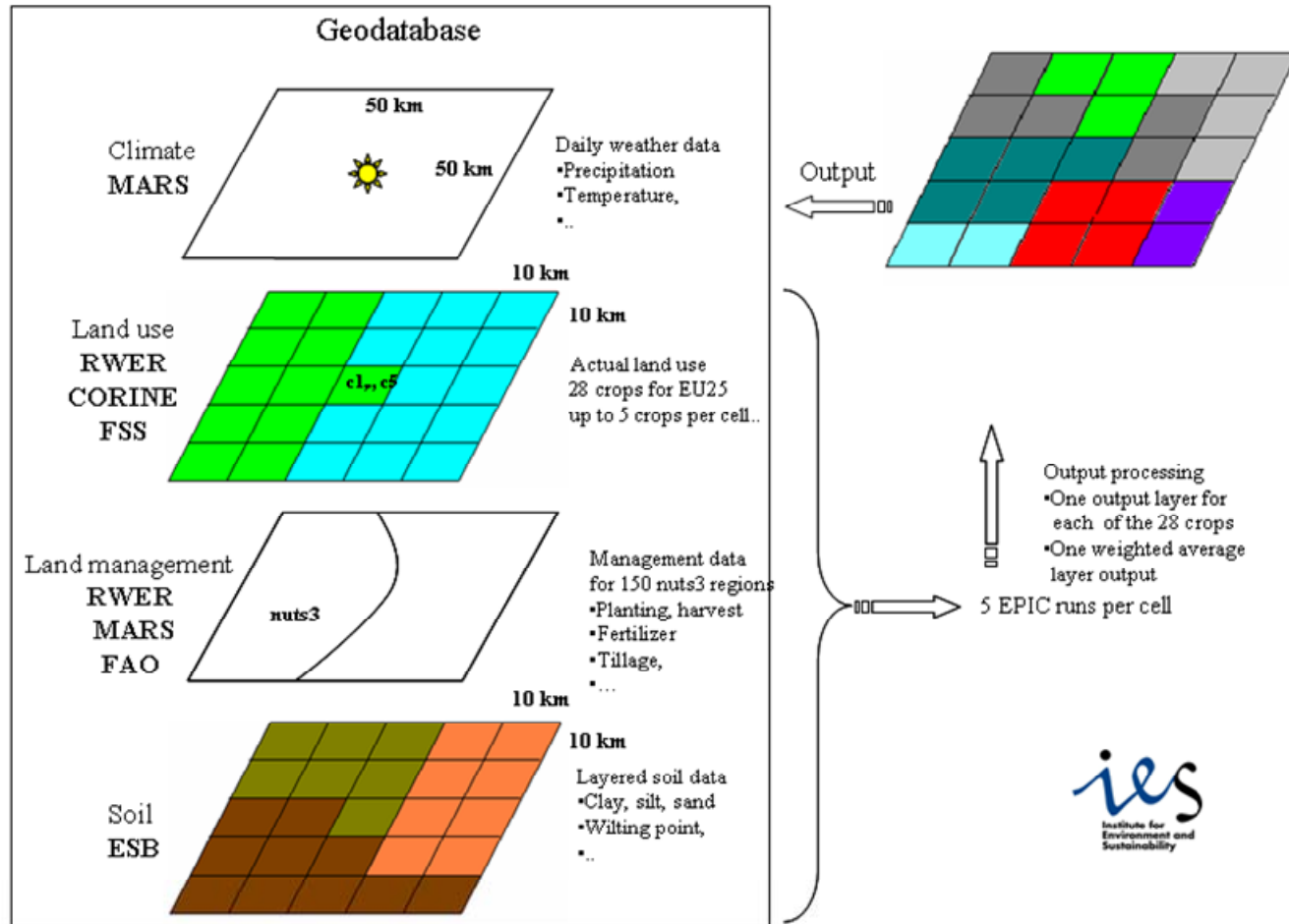
Approach to predict air, soil & water indicators

EPIC-EAGLE: GIS link (Bouraoui & Aloe)

Modelling framework of CAPRI-DNDC modelling for Europe

Socio-economic database

- European national and international statistics
- Policy framework
- Global trade framework
- Regional statistics

DNDC-EUROPE

CAPRI
- National market/trade
- Regional agricultural system + economic and environmental indicators
- Production level and farm input estimation at spatial calculation units

DNDC
- Definition of environmental scenario
- Aggregation to modeling spatial units
- Simulation at modeling spatial unit

GIS environmental database
- Geographic data
- Climate data and N deposition
- Soil information
- Farm Management
- Agricultural land use map

Environmental indicators
- N2O, N2
- NOx
- CH4
- NH3
- Nitrate leaching
- Carbon Stocks
- Livestock density
- …

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Environmental indicators to be modeled

Environmental field of impact	Indicator	Model	Level of measurement				
			farm	group of farms	region	country	EU
Water	Nitrogen leaching	MITERRA (EPIC-DNDC)			X	X	X
	Phoperous leaching	MITERRA (EPIC-DNDC)			X	X	X
	Metal leaching	MITERRA (EPIC-DNDC)			X	X	X
	Pesticides leaching	EPIC			X		
Air quality	Ammonia NH3 emission	MITERRA (EPIC-DNDC)			X	X	X
	Contribution of agriculture to total emissions of ammonia (NH3)	INTEGRATOR				X	X
Climate	Gross total GHG emission from agriculture (CO$_2$, CH$_4$, and N$_2$O)	MITERRA (EPIC-DNDC)					
	Contribution of the agriculture to total emissions of greenhouse gases CO$_2$, CH$_4$, and N$_2$O.	INTEGRATOR				X	X
Soil	Annual soil erosion risk by water	EPIC			X		
	Area and share of agricultural land affected by water erosion	EPIC			X		
	Gross Nitrogen balance	MITERRA (EPIC-DNDC)			X	X	X
	Gross phosphorus balance	MITERRA (EPIC-DNDC)			X	X	X
	Carbon balance	MITERRA (EPIC-DNDC)			X	X	X
	Pesticide soil contamination	EPIC			X		

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Conclusions

- CCAT proposes an integrated approach to assessing impacts of CC.
  - Direct effects of SMRs & GEACs on income, market by CAPRI
  - Link between economic responses and environmental effects

- In CCAT we will use CAPRI and MITERRA/EPIC/DNDC for assessing economic and environmental impacts on a quantitative EU wide scale

- CCAT aims at providing a regionally explicit overview of CC impacts requiring up- and downscaling of input and output data.This requires:
  - Understanding of the different regional implementation pathways of SMRs and GAECs (CIFAS database)
  - Linking modelled CAPRI and MITERRA output to HSMUs
  - Using spatially detailed data sources and incorporating the range in environmental circumstances in the modelling approaches

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Discussion points

- Finalization on "indicators to be included": pesticides yes or no etc
- Linkage DNDC and EPIC vs MITERRA Europe: e.g using elaborated uptake calculation of EPIC or results of EPIC in MITERRA Europe
- Spatial approach DNDC and EPIC results: all HSMUs or ?

- Linkage of cross compliance measures to the modelling tools. Can they directly be analyzed or need the CC measures first be analyzed with the CAPRI model?

Deliverables Month 1-18

- D4.2.1 Report on design and development of the environmental impact generator of CC, including (i) the selection of CC measures to be analyzed and an outline of the implementation strategy with detailed mechanistic tools and the integrated model (month 7).

- D4.2.2 The environmental impact generator for prototype 1, consisting of (a set of detailed mechanistic tools ??) MITERRA2 and a simplified EPIC version to assess the impact of selected CC measures on air, soil and water quality indictators at the European scale (Month 18).

Milestones Month 1-18

- M3: Agreement on general approach by Integrated tool and detailed models

- M3 Overview of potential CC measures to be analyzed

- M 5: Selection of measures to be analyzed and draft report on methodology

- M 6: Meeting between JRC, Ubonn and Alterra on approaches and the linkage between detailed and simple model approaches (linked with CCAT meeting: 13 June)

Milestones Month 1-18

- M12: MITERRA version available for testing CC measures
- M 12: First applications of specific CC measures by DNDC and EPIC
- M18: Spatial databases containing preliminary information of DNDC to assess results of the impacts of CC for whole EU
- M18 First ideas about a simplified EPIC version (metamodel) to assess CC impacts on erosion, compaction and pesticide leaching.

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Deliverables and milestones Month 19-36

- M 24: Simplified calculation rules for the regional impact of CC implementation on water, soil, air, and climate at the regional scale for incorporation in the final analytical tool.

- D4.2.3: Report on the sensitivity analysis of the mechanistic tools DNDC and EPIC related to various parameters and the methodology to calculate selected CC measures by MITERRA Europe (Month 24).

- D4.2.5 Final version of MITERRA Europe as a component for the final analytical tool of WP5 (month 28).

Deliverables and milestones
Month 19-36

- M30: Quantification of CC implementation on water, soil, air, and climate at the regional scale

- D4.2.4 Spatial databases containing assessment results of the impacts of CC on air, soil and water quality indicators at the European scale (month 33).

- D4.2.6 Report on quantification of CC impacts on environment, including recommendations on the spatial variability of the cost/benefit for selected measures and implementation pathways (Month 35).

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Thank you for your attention!