INTEGRATOR: a tool to assess greenhouse gas emissions and nitrogen fluxes in Europe

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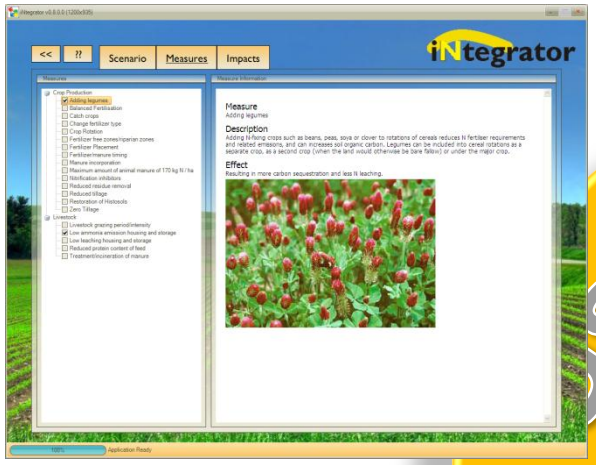
Introduction

- We developed and applied an integrated tool (INTEGRATOR) for the European scale to:
  - Examine past (1970-2000) and future (2000-2030) changes in land cover and land management (livestock and N fertilizer use) in response to IPCC scenarios.
  - Predict past and future N (NH_3, NO_x) and GHG (CO_2, N_2O, CH_4) exchange in response to these changes.
  - While including interactions between agricultural and non-agricultural systems by N emissions and related N deposition.

Integrator setup

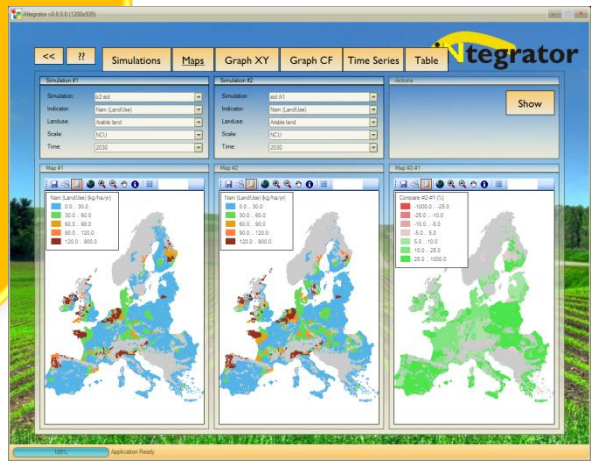


User Interface

Core model

Computing

N fluxes



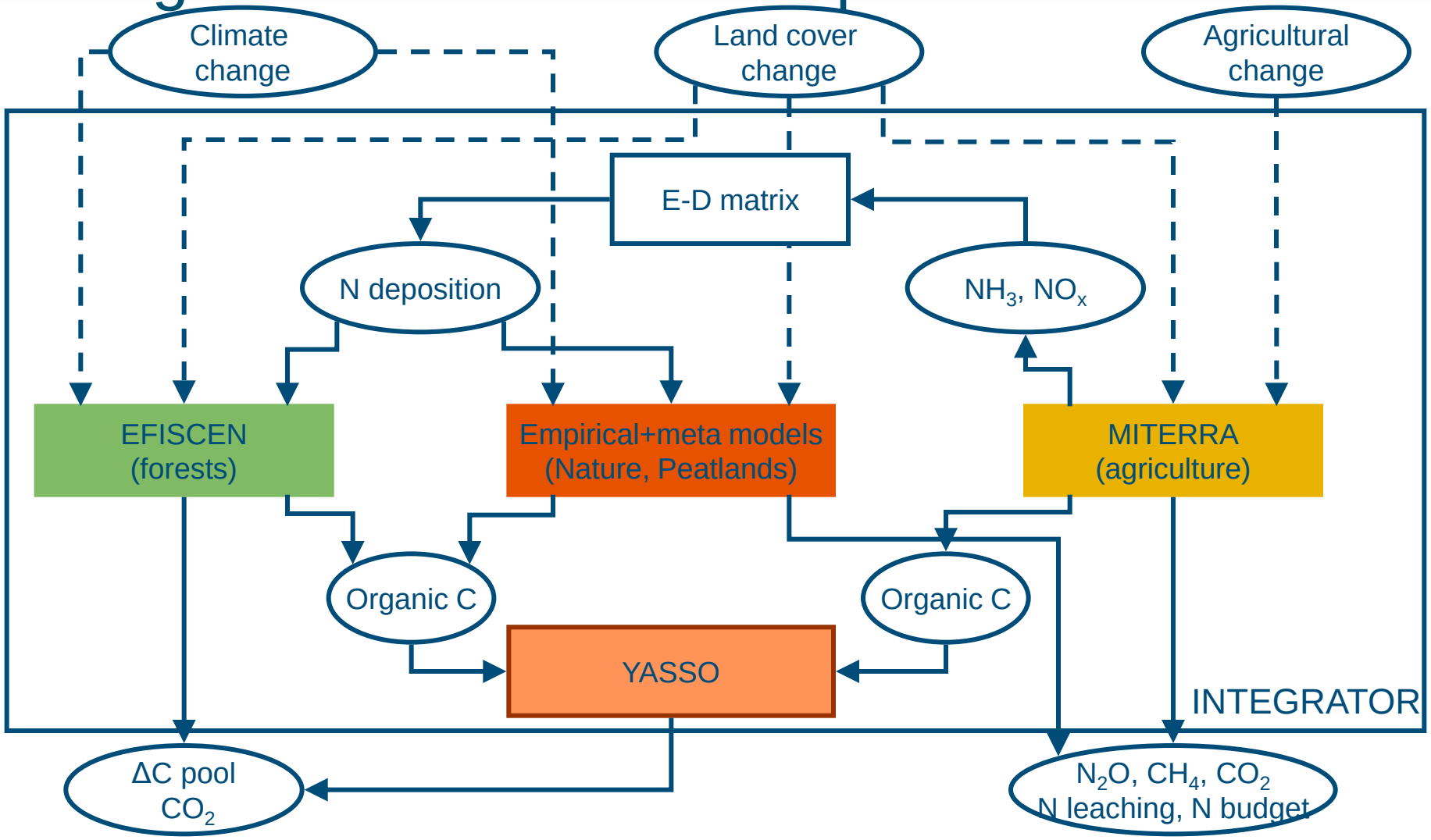
Model-GUI interface

- The INTEGRATOR core model was made OpenMI compliant

- The graphical user interface obtains most information dynamically from the model (which output parameters are available, which time-period will be simulated) or from XML files (map legend, available measures, info on measures):

- Hard coding in the interface is minimized, giving the core model developer maximum flexibility

Integrator: core model setup



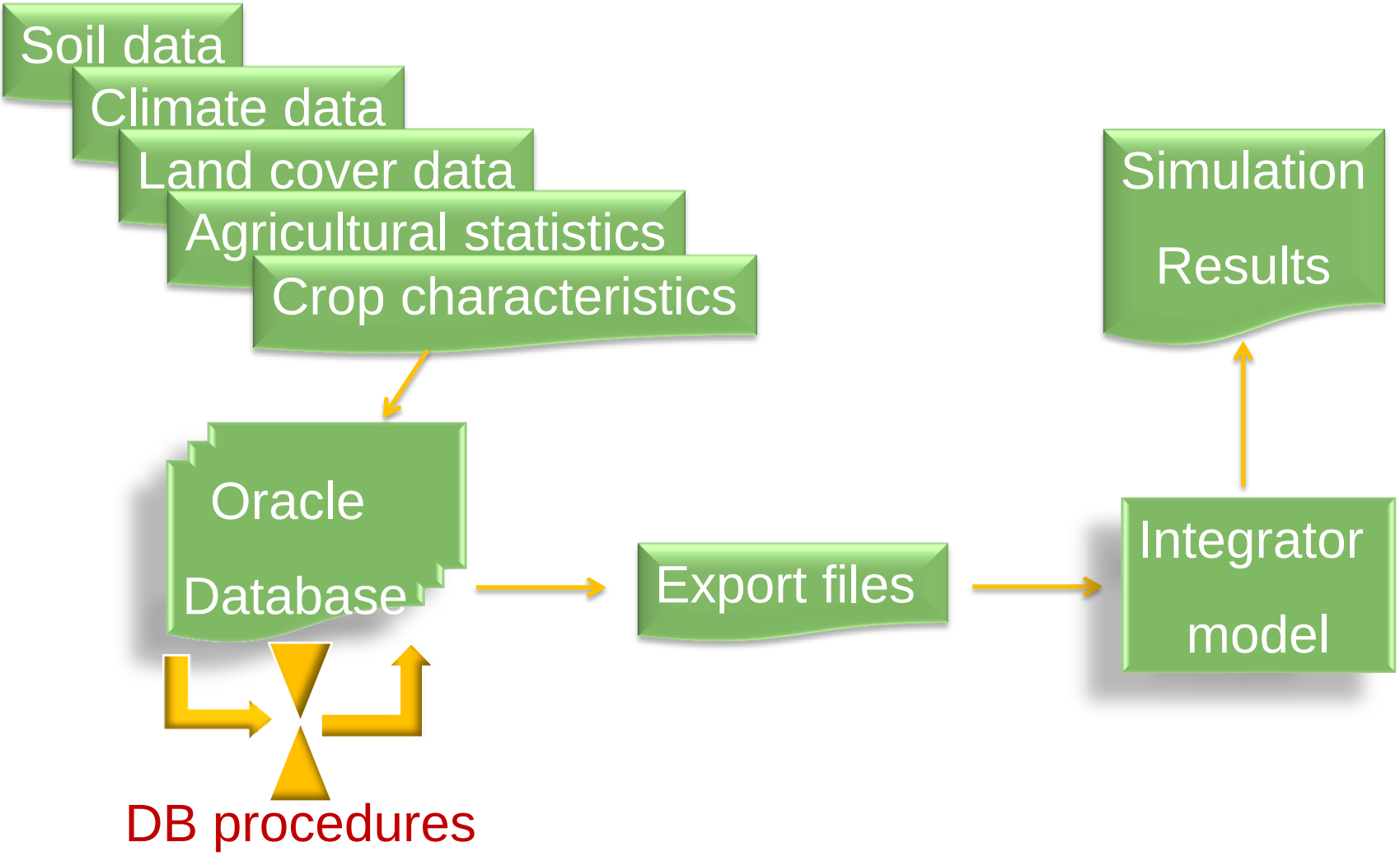
Models in INTEGRATOR

System	Outputs				
	CO_2	CH_4	N_2O	NH_3	Nbudget
Housing	–	←	MITERRA	→	–
Agriculture					
- Grassland	(YASSO)	←	MITERRA	→	
- Arable land	(YASSO)	←	MITERRA	→	
Nature					
- Forests	EFISCEN/ YASSO	Empirical models		–	(YASSO)
- "Heathlands"	X	Empirical models		–	X
- Peatlands	←	Empirical models	→	–	X

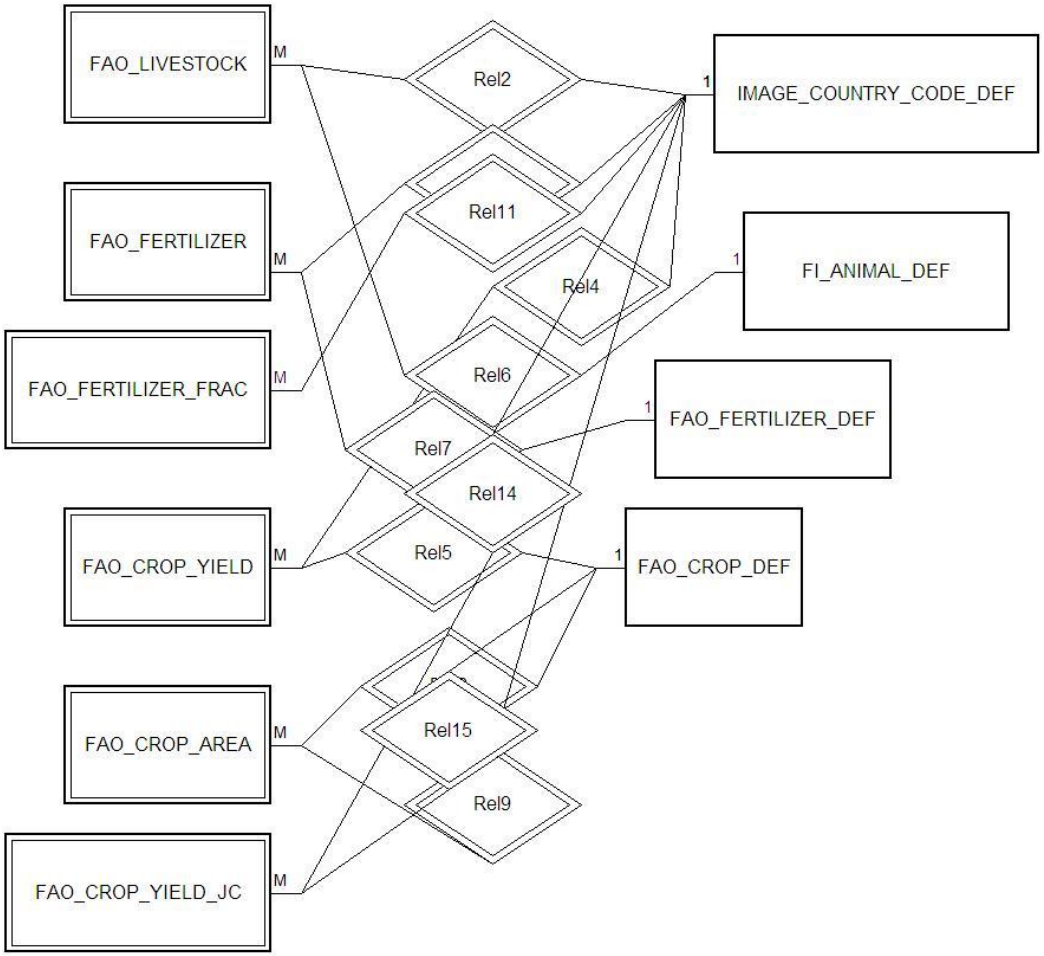
Data

- Data sources included are, for example:
  - Soil map and soil data
  - Land cover maps
  - Climatic data
  - Agricultural statistics and projections
  - Crop characteristics
  - Results from other model (e.g. RAINS)

Data flow


Soil data
Climate data
Land cover data
Agricultural statistics
Crop characteristics
Oracle Database
DB procedures
Export files
Integrator model
Simulation Results

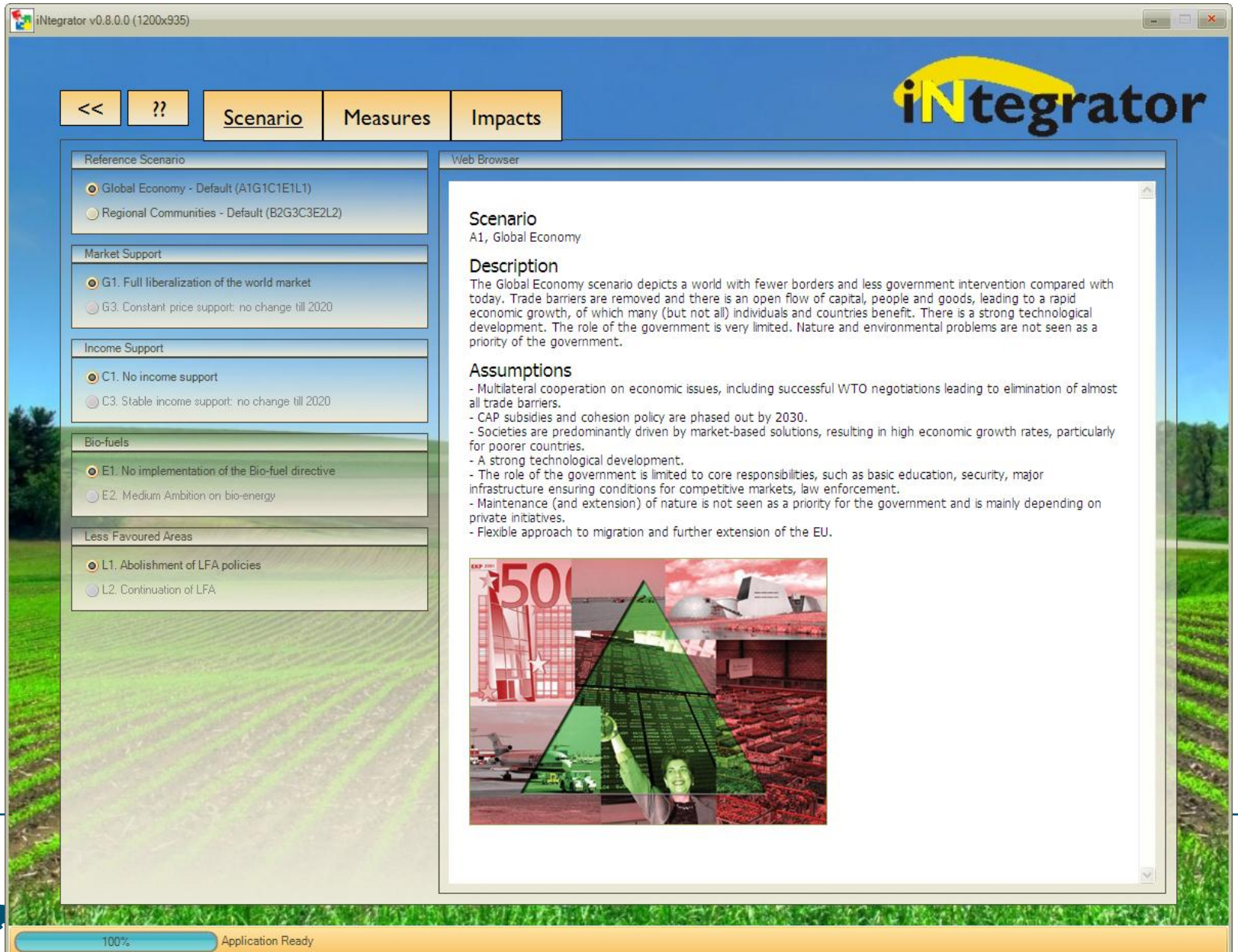
Data base


FAO_LIVESTOCK
FAO_FERTILIZER
FAO_FERTILIZER_FRAC
FAO_CROP_YIELD
FAO_CROP_AREA
FAO_CROP_YIELD_JC
M
Rel2
Rel11
Rel4
Rel6
Rel7
Rel14
Rel5
Rel15
Rel9
1
IMAGE_COUNTRY_CODE_DEF
FI_ANIMAL_DEF
FAO_FERTILIZER_DEF
FAO_CROP_DEF

Interface

- The graphical user interface provides options to:
  - Define scenarios
  - Define measures
  - Run the model
  - Examine model results
  - Compare simulations

Scenarios


iNtegrator v0.8.0.0 (1200x935)
<<
??
Scenario
Measures
Impacts
iNtegrator
Reference Scenario
Global Economy - Default (A1G1C1E1L1)
Regional Communities - Default (B2G3C3E2L2)
Market Support
G1. Full liberalization of the world market
G3. Constant price support: no change till 2020
Income Support
C1. No income support
C3. Stable income support: no change till 2020
Bio-fuels
E1. No implementation of the Bio-fuel directive
E2. Medium Ambition on bio-energy
Less Favoured Areas
L1. Abolishment of LFA policies
L2. Continuation of LFA
Web Browser
Scenario
A1, Global Economy
Description
The Global Economy scenario depicts a world with fewer borders and less government intervention compared with today. Trade barriers are removed and there is an open flow of capital, people and goods, leading to a rapid economic growth, of which many (but not all) individuals and countries benefit. There is a strong technological development. The role of the government is very limited. Nature and environmental problems are not seen as a priority of the government.
Assumptions
- Multilateral cooperation on economic issues, including successful WTO negotiations leading to elimination of almost all trade barriers.
- CAP subsidies and cohesion policy are phased out by 2030.
- Societies are predominantly driven by market-based solutions, resulting in high economic growth rates, particularly for poorer countries.
- A strong technological development.
- The role of the government is limited to core responsibilities, such as basic education, security, major infrastructure ensuring conditions for competitive markets, law enforcement.
- Maintenance (and extension) of nature is not seen as a priority for the government and is mainly depending on private initiatives.
- Flexible approach to migration and further extension of the EU.
100%
Application Ready

Measures

iNtegrator v0.8.0.0 (1200x935)

<< | ?? | Scenario | Measures | Impacts

iNtegrator

Measures

- Crop Production
  - Adding legumes
  - Balanced Fertilisation
  - Catch crops
  - Change fertilizer type
  - Crop Rotation
  - Fertilizer free zones/riparian zones
  - Fertilizer Placement
  - Fertilizer/manure timing
  - Manure incorporation
  - Maximum amount of animal manure of 170 kg N / ha
  - Nitrification inhibitors
  - Reduced residue removal
  - Reduced tillage
  - Restoration of Histosols
  - Zero Tillage
- Livestock
  - Livestock grazing period/intensity
  - Low ammonia emission housing and storage
  - Low leaching housing and storage
  - Reduced protein content of feed
  - Treatment/incineration of manure

Measure Information

Measure

Low ammonia emission housing and storage.

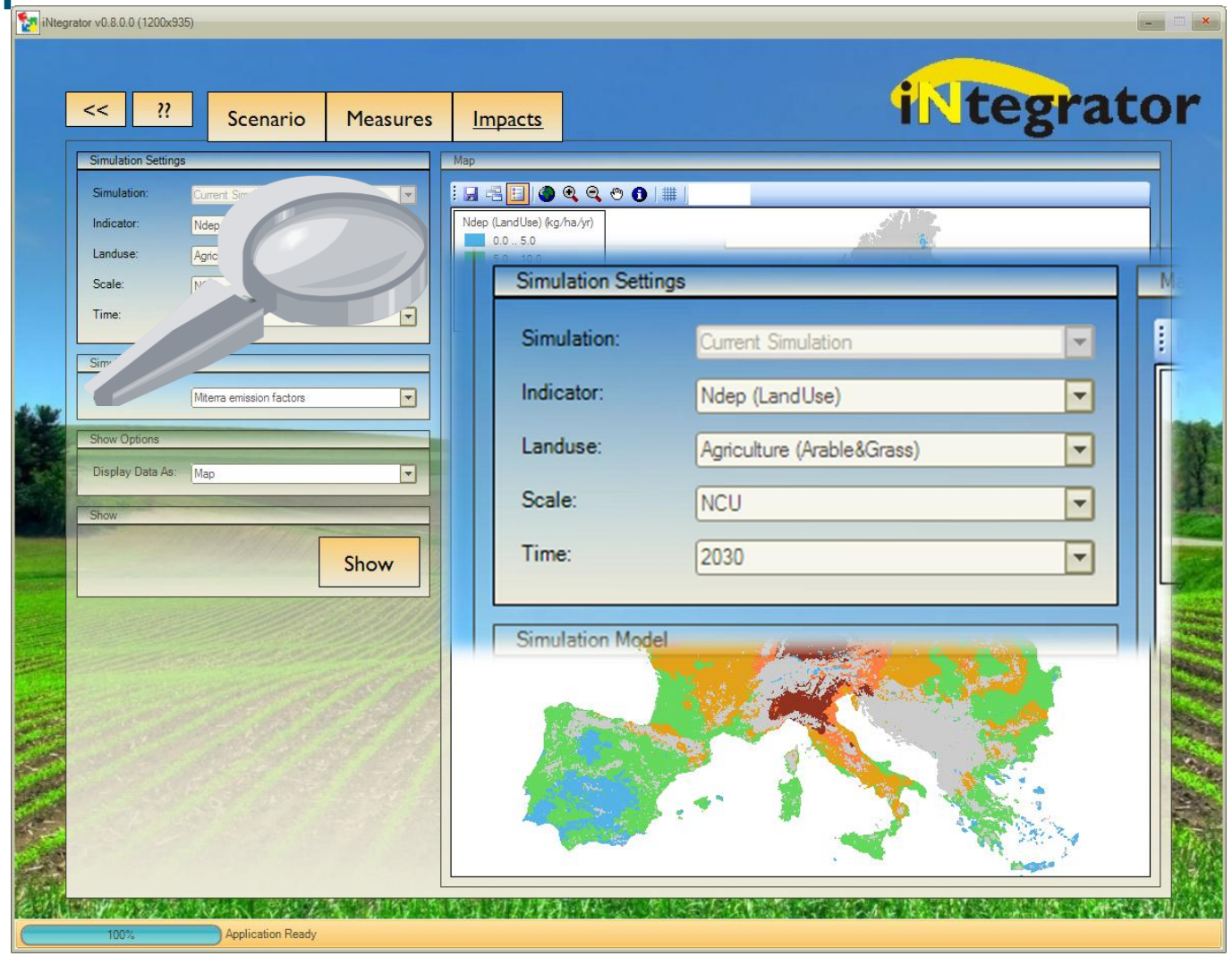
Description

Housing adaptation by improved design and construction. Lower NH_3 emission fractions from stables and manure storages by improved de-sign and construction. For the effect of this measure we assume a redaction of 50% for dairy cattle, 25% for other cattle, 40% for pigs, 65% for lay hens and 40% for other poultry

Effect

Resulting in lower NH_3 emissions

Impacts


iNtegrator v0.8.0.0 (1200x935)
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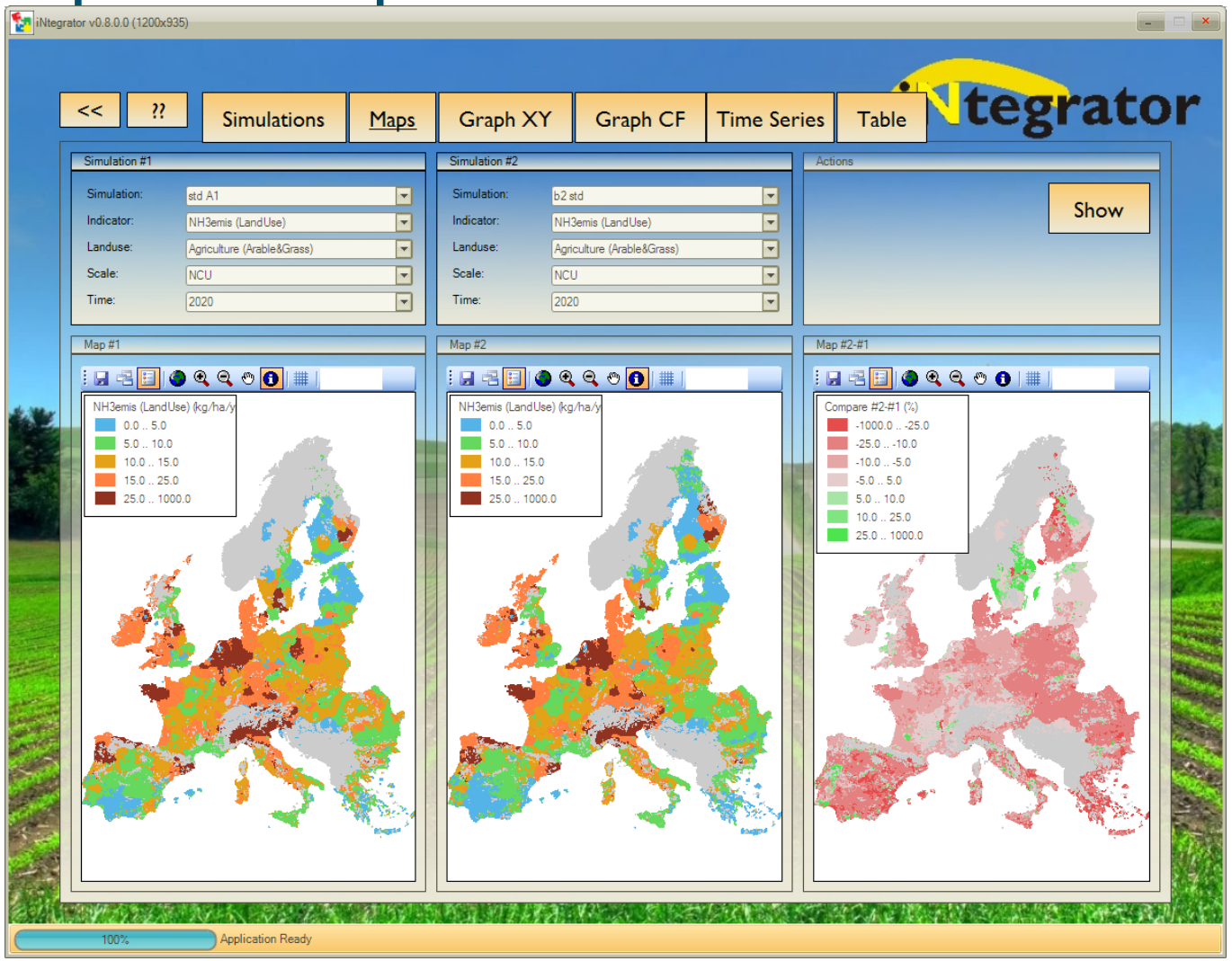
Scenario
Measures
Impacts
iNtegrator
Simulation Settings
Simulation:
Indicator:
Landuse:
Scale:
Time:
Map
Ndep (LandUse) (kg/ha/yr)
0.0 .. 5.0
Simulation Settings
Simulation:
Current Simulation
Indicator:
Ndep (LandUse)
Landuse:
Agriculture (Arable&Grass)
Scale:
NCU
Time:
2030
Simulation Model
Mitema emission factors
Show Options
Display Data As:
Map
Show
Show
100%
Application Ready

Compare: maps



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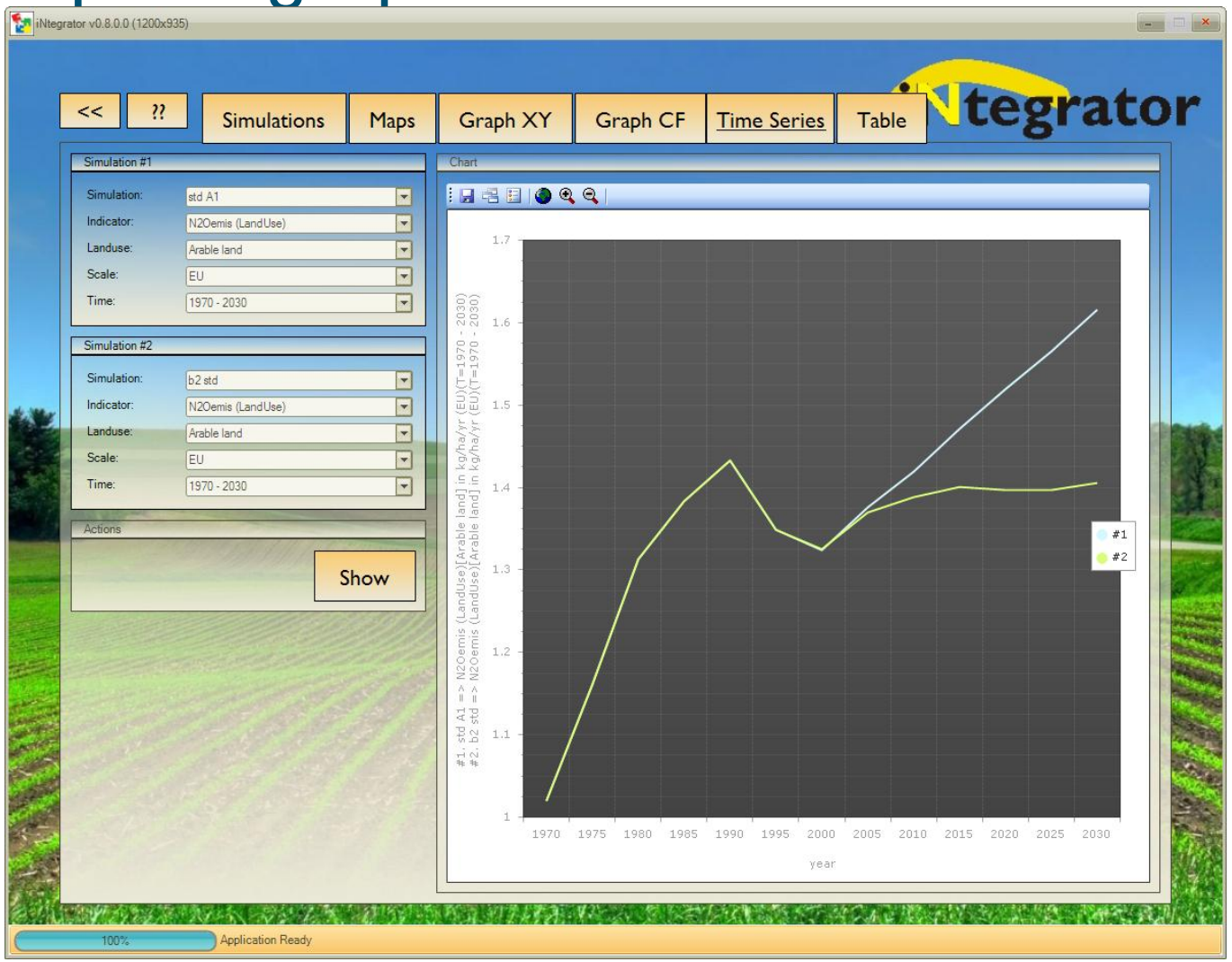
Compare: graphs



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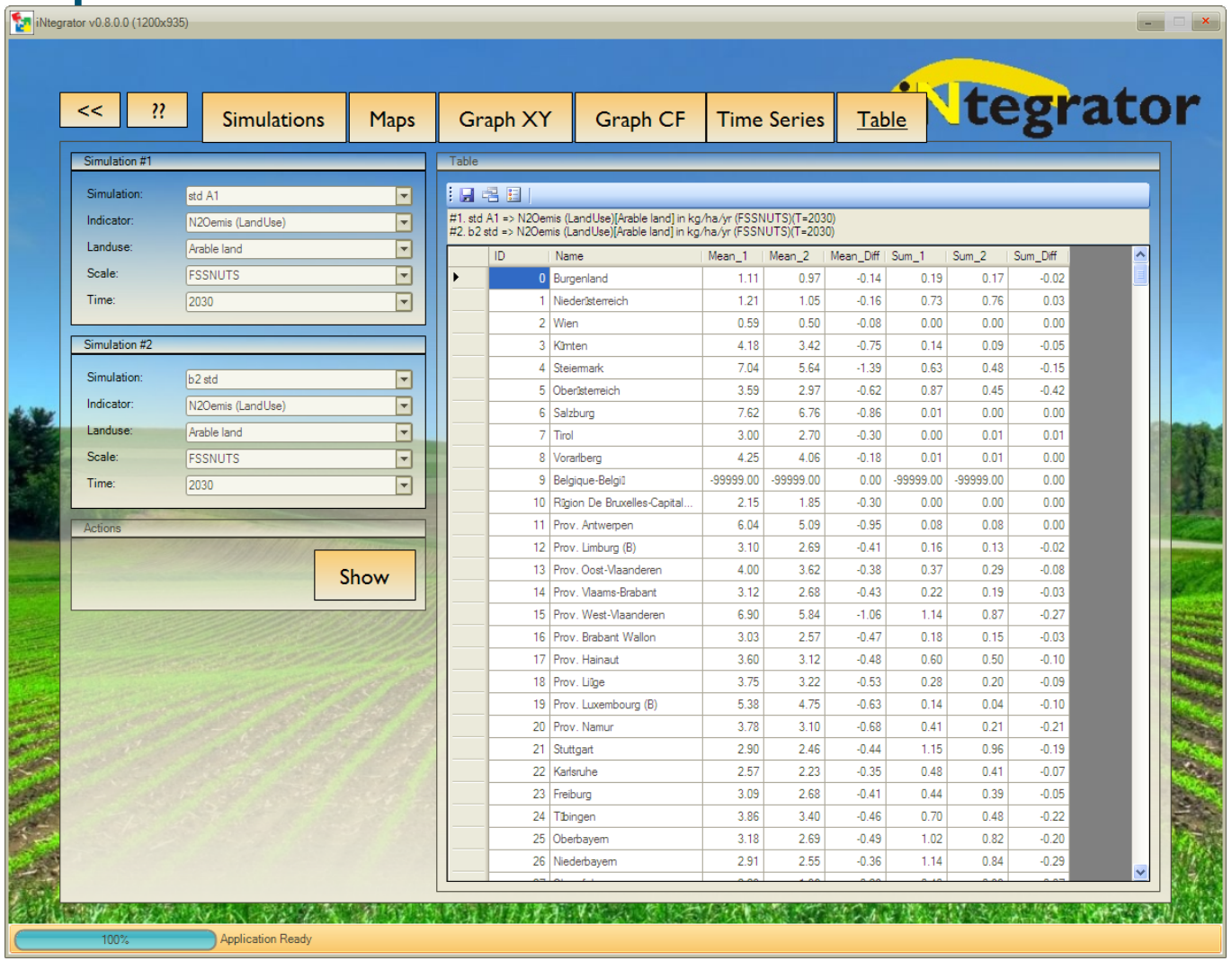
Compare: tables



Summary and conclusions

- With INTEGRATOR European wide assessments can be made on N fluxes and GHG emissions
- The model integrates existing models, knowledge and data
- The user interface provides easy use
- Although the integrated models are simple, the integrator core is complex due to the vast amount of data that need to be processed
- Some final testing and improvements are still needed

End

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