An overview on the CAPRI model

Common Agricultural Policy Regionalized Impact Model

Wolfgang Britz, University Bonn

What is CAPRI ?

- A “multi-purpose” modeling system for EU’s agriculture, allows to analyze
  - market policies (administrative prices/tariffs/preferential agreements)
  - Premium systems/quotas/set-aside at regional level
  - Environmental policies (standards/market solutions)
  - Changes in exogenous drivers (population/inflation/exchange rates/consumption behavior/technical progress)
- Regarding
  - supply/demand/trade flows
  - hectares/herd size/yields/input use
  - Producer & consumer prices, income indicators
  - Environmental indicators
  - Welfare effects including the EU budget for the Common Agricultural Policy (CAP)

What is CAPRI ?

- Acronym means “Common Agricultural Policy Regionalised Impact”
- Comprises
  - The underlying “data base”
  - The “economic model”
  - The software tools/code

CAPRI projects and funding

- EU funded project 1997-1999, building upon experience with global trade models and models for Germany
- First version operational 1999
- 2001-2004, new project CAP-STRAT, implementing the new global bi-lateral trade model and new environmental indicators
- 2001/2002, since 2005: work on farm type module
- 2004-2007, work on spatial dis-aggregation and expansion to EU27 and Western Balkans (CAPRI-Dynaspat)
- 2009-2013, work on Rural Development and integration with regional CGEs (CAPRI-RD)

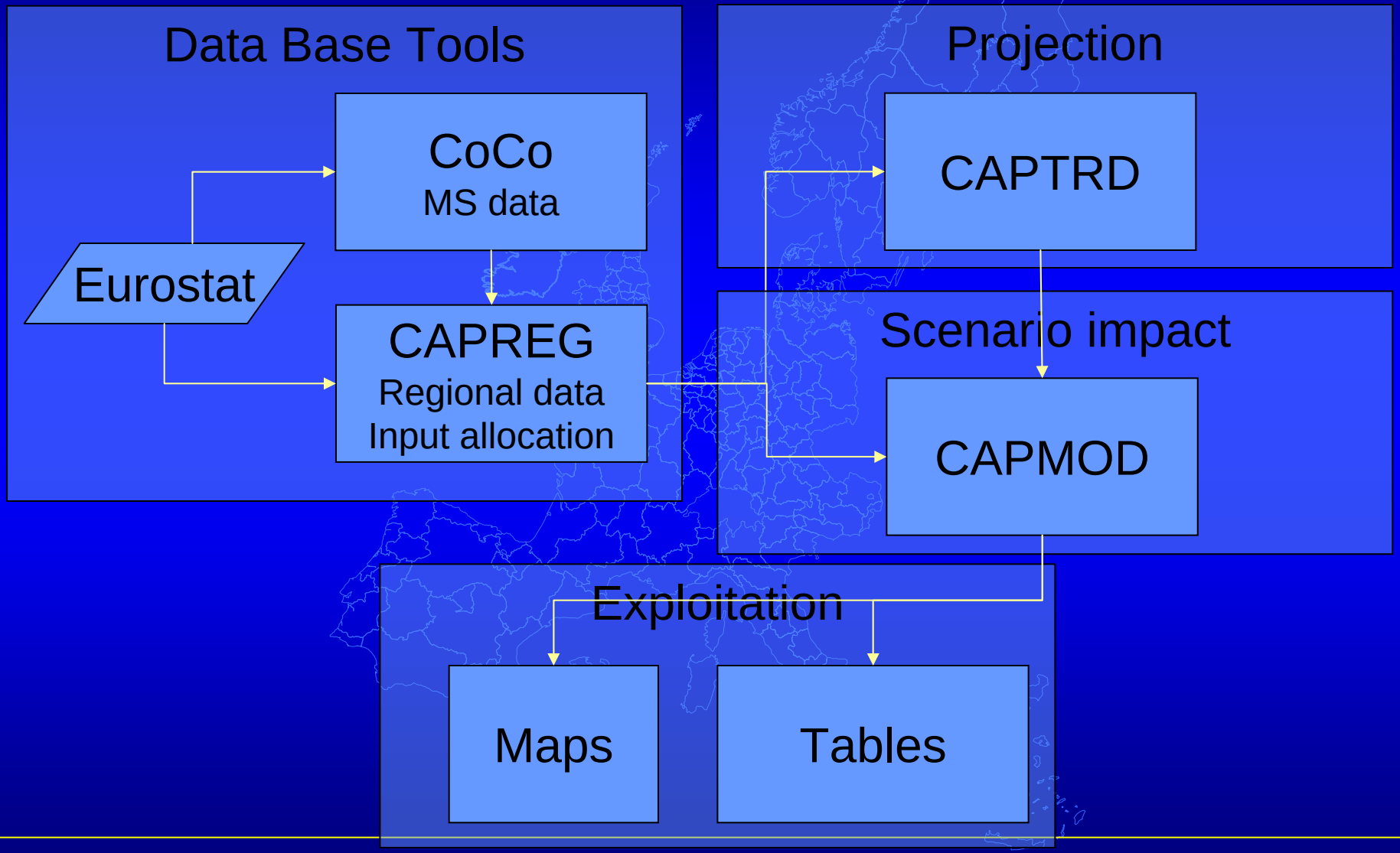
CAPRI projects and funding, continued

- Since around 2002, increasing application of CAPRI in work packages of different research projects such as:
  - SEAMLESS (FP VI)
  - SENSOR (FP VI)
  - EU-Mercopol (FP VI)
  - EU-MedAgPol (FP VI)
  - CCAT (FP VI)
  - CCTAME (FP VII)
  - EC4MACS (EU-Life)
- And application for policy impact assessment (e.g. Agenda 2000, MTR, sugar market reform, dairy market reform)

CAPRI clients and users

- Main client is the EU Commission, directorates general for agriculture and for environment
- Users are research institutions: university, national research institutes and the Joint Research Centre of the EU
- Over time, a rather stable network of core coders/users has developed

Connection between CAPRI tools



Data base tools

- Build up a “suitable” data base for the model:
  - Comprising all the necessary input data
  - Using established and harmonized data sources
  - Without any gaps or inconsistencies
- Main elements:
  - At Member State and regional level:
    - Cropping areas, herd sizes and production
    - Input and output coefficients
    - Farm policy instruments (quotas/set-aside/premiums)
    - Income indicators per activity and region
  - Farm and market balances, Economic Accounts for Agriculture and related prices at Member State level
  - World wide for individual countries or country aggregates: market balances, tariffs, preferential trade agreements, bi-lateral trade flows

Data base tools

- Three “applications”
  - COCO: Member State level
  - CAPREG: regional level, input distribution
  - Global: market balances and trade flows, tariffs
- Code is realized in GAMS
- Application of Bayesian estimators to ensure completeness and consistency

National data base “CoCo”

- Acronym means “Complete and Consistent”
- Builds up time series from 1985-2005 (currently) for EU27, Norway and Western Balkans and Turkey for about 50 activities and products
- Main input source is Eurostat
  (area statistics, farm and market balances, Economic Accounts for Agriculture, Agricultural prices ..)
- Uses constrained estimation techniques to remove data error and fill gaps
- GAMS based
- Handled by Bonn team

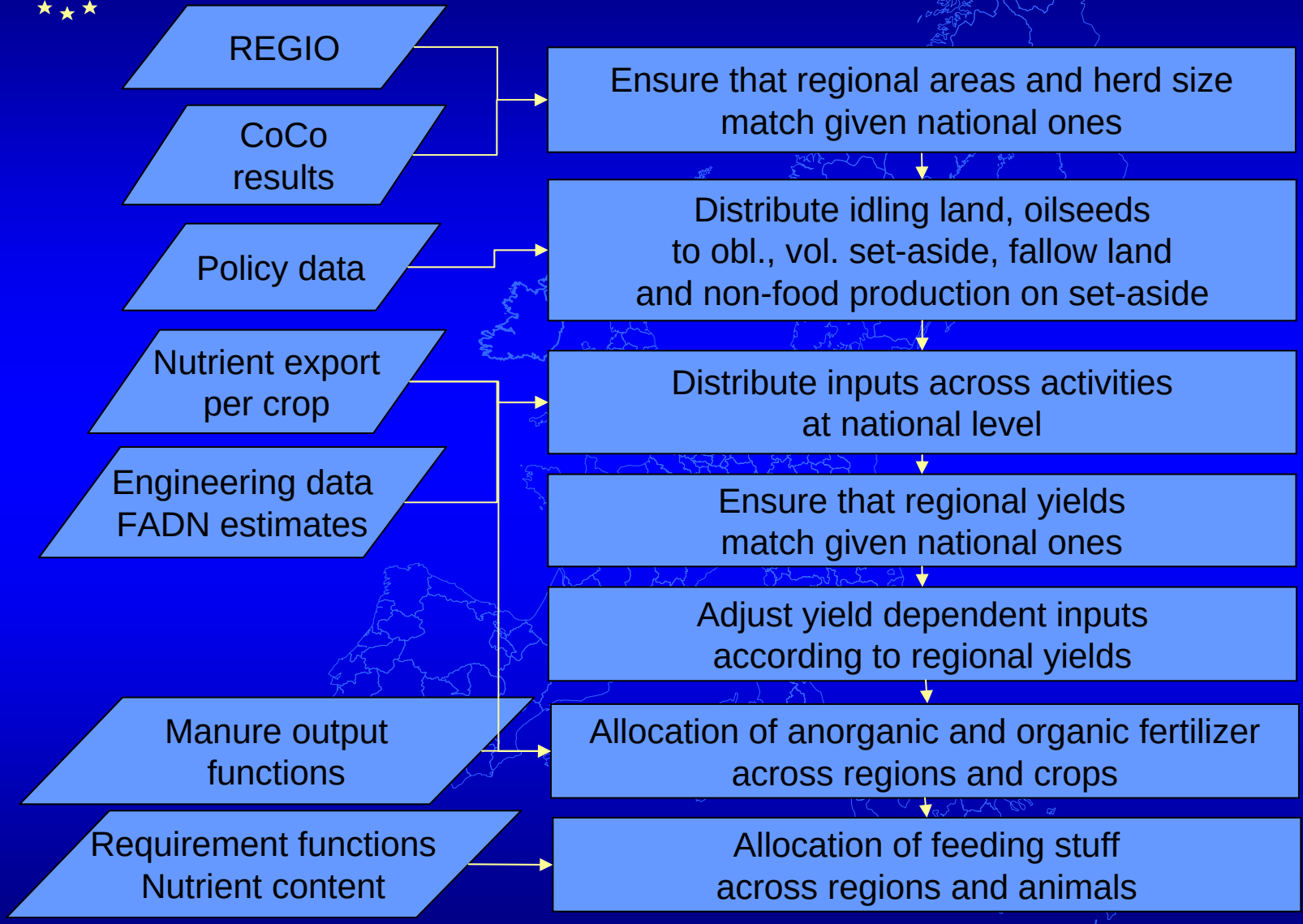
CoCo continued

- Three “packages” inside CoCo:
  - Closed area balances, crop production = yields * area; for all crops simultaneously
  - Animal herds, slaughtered heads, live imports and exports, market balances for meat, balances for young animals, fat and protein balances for dairy products; simultaneously for groups of animals/animal products (cattle, pigs, poultry, sheep and goat, dairy products)
  - Market balances; simultaneously for groups of crops (cereals, oilseeds etc.)

Regional data “CAPREG”

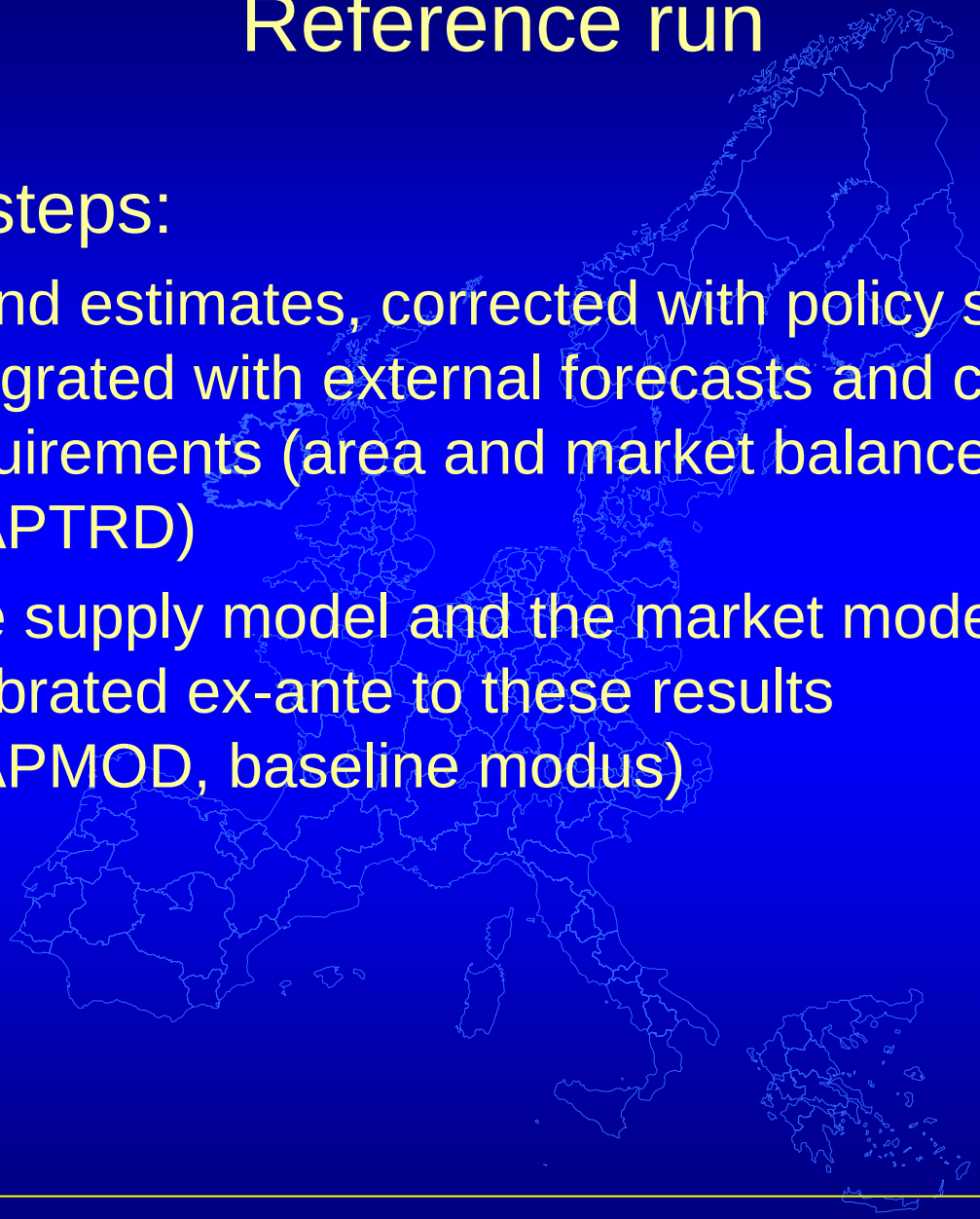
- Introduces input allocation and regional dimension
- Takes data at Member State level (CoCo results) as fix and given
- Main input sources:
  - REGIO domain from Eurostat
  - Data on CAP from DG-AGRI
  - Engineering functions, results from econometric estimation for input/feed/fertilizer allocation
- Uses constrained estimation techniques to determine input allocation, fertilizer and feed distribution

Regional data “CAPREG”



Reference run

- Two steps:
  - Trend estimates, corrected with policy shifts, are integrated with external forecasts and consistency requirements (area and market balances …) (CAPTRD)
  - The supply model and the market model are calibrated ex-ante to these results (CAPMOD, baseline modus)



Scenario impact tool “CAPMOD”

- Designed for counterfactual analysis:
  - what impacts if a different policy would be implemented?
  - Yard stick is the reference run, which covers
    - the current legislation
    - technical progress, population and income growth, changes in consumption patterns
    - for a 7-8 year horizon from the base year
  - CAPMOD combines supply models at NUTS II with an EU wide model for young animal and a global trade model for agricultural commodities

The supply side of CAPMOD

- Each NUTS II region has its own model
- Each model has the same structure (variables and equations), but differs in parameters from model for other regions
- The models are aggregate non-linear programming model, i.e. they maximize an objective function (revenue – costs) under constraints (land balance, set-aside obligations etc.)
- A non-linear cost function as part of the objective, partially based on econometric estimation, dampens over-specialization, allows for calibration to the base year situation and for model behavior based on observed developments

The supply side of CAPMOD cnt.

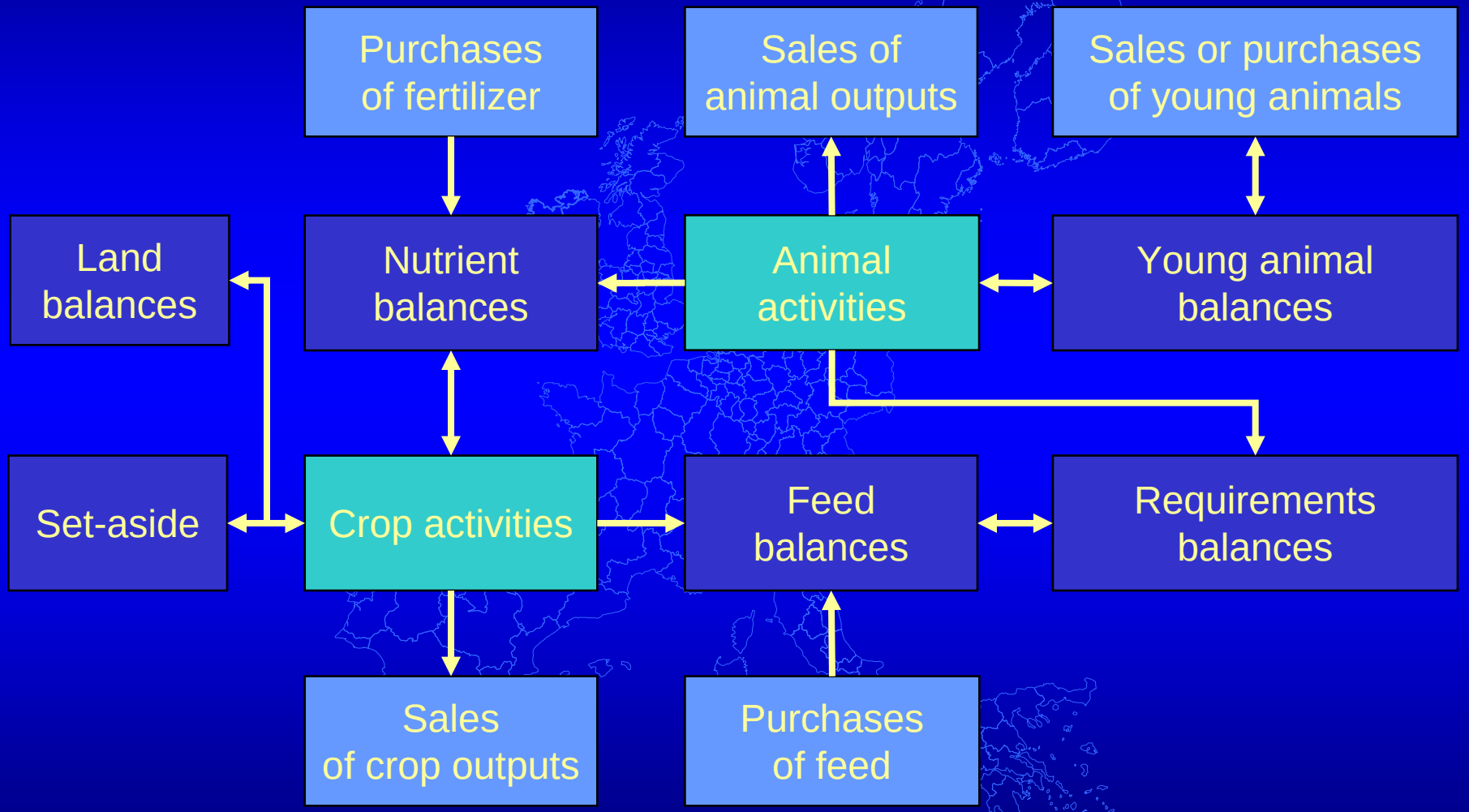
- The constraints comprise:
  - Arable and grass land
  - Feed requirements (energy, protein, fibre, min/max of certain feedingstuff etc.) per animal type
  - N,P,K balances
  - Set-aside obligations
  - Milk quotas

=> Relatively small number of constraints !

The supply side of CAPMOD cnt.

- The objective accounts for:
  - Revenues from selling products
  - Costs from buying variable inputs (fertilizer, plant protection, feed etc.)
  - Costs for other production factors (capital, labor, information) ⇔ the non-linear part
  - A risk component for the A,B,C sugar-beet regime

Relations inside of supply model



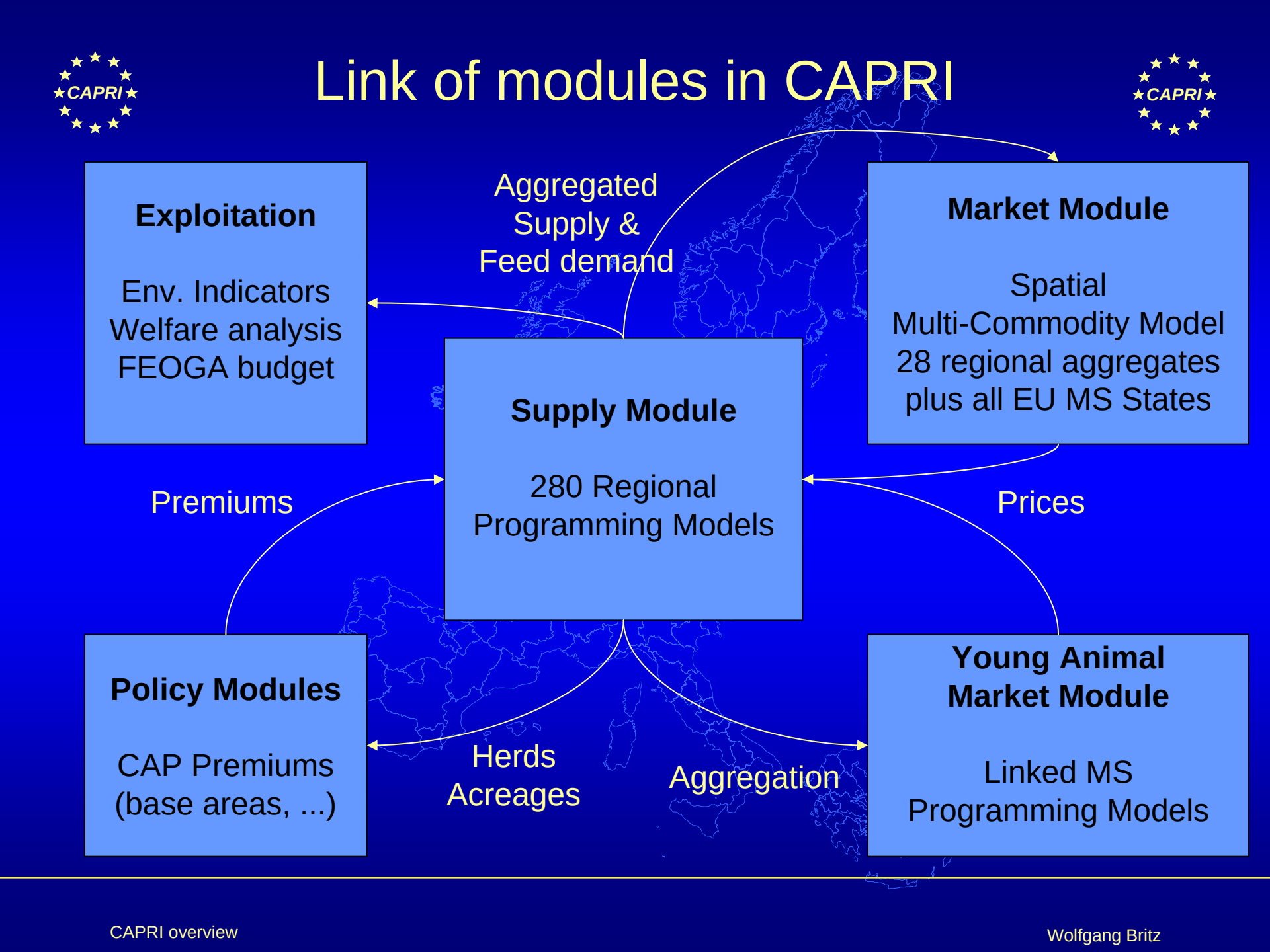
The global trade model of CAPMOD

- Spatial Multi-Commodity Model
- Comprises supply as well as feed, human consumption and processing demand for 47 products and 60 countries/country aggregates in 28 blocks
- Includes bi-lateral trade flows, import tariffs (including Tariff Rate Quotas / preferential agreements)
- And market interventions and export subsidies by the EU

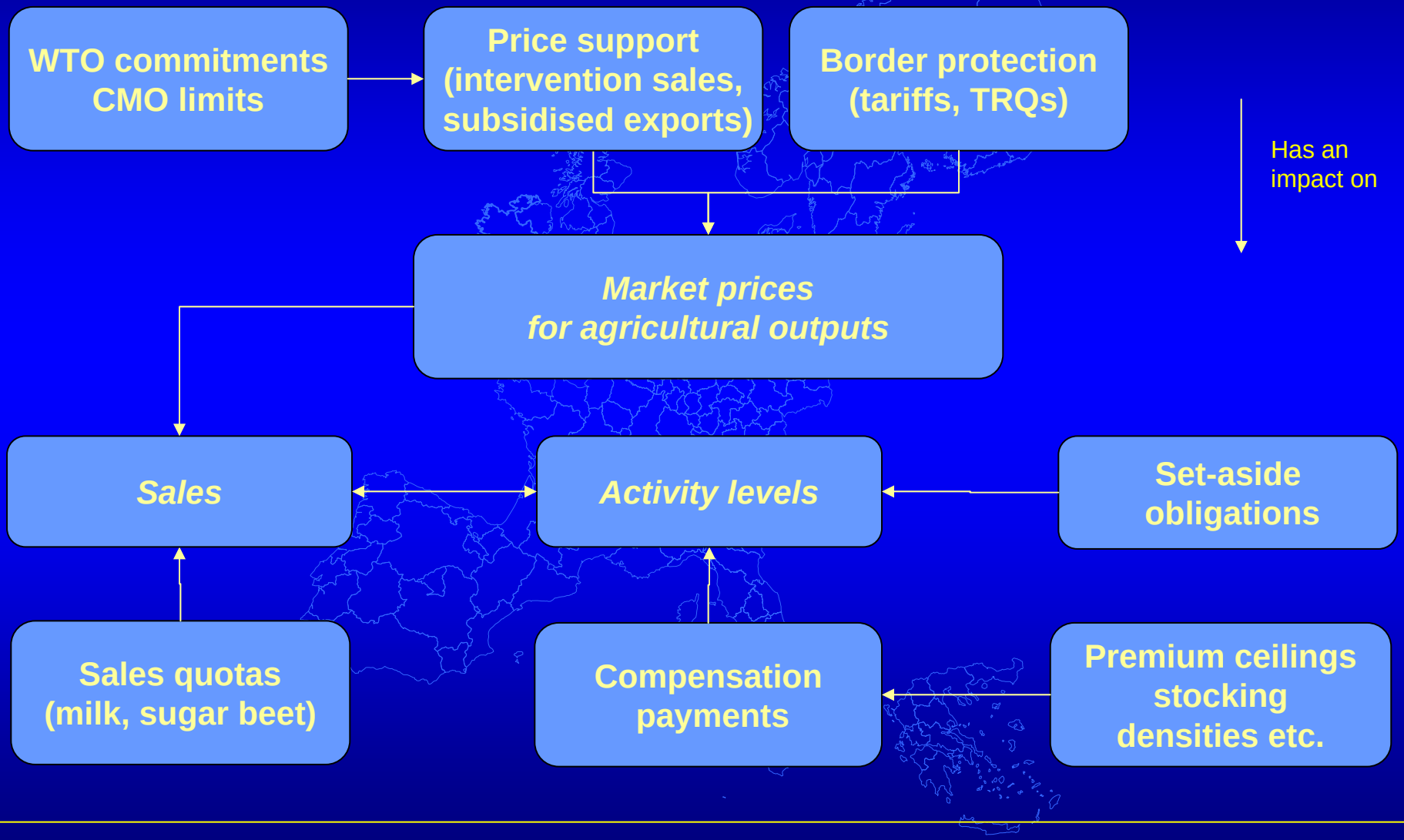
The global trade model of CAPMOD

- Armington approach: quality differences by origin of products => imperfect substitution between imports and domestic sales
- “Well behaved” function ⇔ synthetic parameters are in line with micro-economic theory ⇔ consistent welfare analysis
- Consumer prices are different from producer prices, in most cases fixed processing margin
- Fat and protein balances for milk/dairy products for EU27 Member States

Link of modules in CAPRI



Policy in the model



Spatial Downscaling

- For environmental analysis, local factors as soil, slope, climate or surrounding land use matter
- Spatial Downscaling part in CAPRI distributes consistently major results at regional level for EU27 to ~150.000 clusters of 1x1 km grid cells
- Allows link to bio-physical models and specific analysis e.g. regarding landscape features

Exploitation tools

- Java based Graphical User Interface (GUI):
  - Predefined views as tables, graphs or maps
  - Drill-down tables
  - User may additionally select or pivot
  - Results can be exported to clipboard and different file formats as CSV
- Exploitation can be applied to data base or to scenario results
- GUI covers also steering of the different work step including scenario runs

CAPRI network

- CAPRI handled as “club good”:
  - Code handled as open source
  - but successful application of the model requires training and support
  - the resulting bottle-neck allows the core users/developers to control access
- The core network has a informal agreement about distribution of tasks, tenders together for projects and exploits scientific findings in conference contributions and publications
- Distribution and maintenance of code and data via a Software Version system to allow for distributed development and application

Thanks for your attention