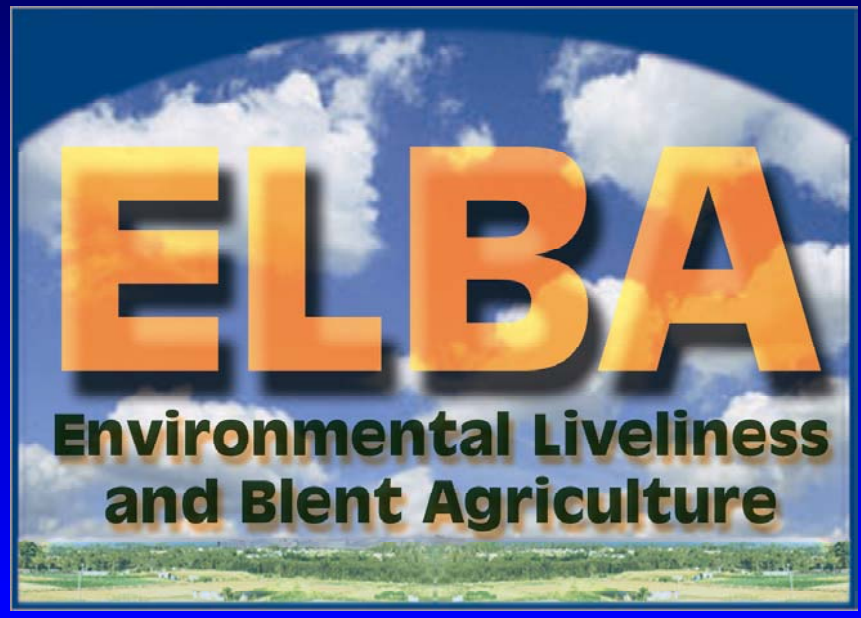


ANALISI INTEGRATA DEI SISTEMI AGRO-AMBIENTALI

Palladino Giuseppe

ALMA MATER STUDIORUM – UNIVERSITA' DI BOLOGNA

DIPROVAL – SEZ. ECONOMIA

Un modello integrato per l'analisi dei sistemi agro-ambientali

integrato

COMPONENTE ECONOMICA

COMPONENTE FISICO - ECOLOGICA

MODELLO ECONOMICO-AMBIENTALE

Un modello integrato per l'analisi dei sistemi agro-ambientali

analisi

- **DESCRITTIVA** → **SERIE STORICHE 1990 - 2000**
- **PREVISIONALE** → **MEDIO TERMINE 2005**

Un modello integrato per l'analisi dei sistemi agro-ambientali

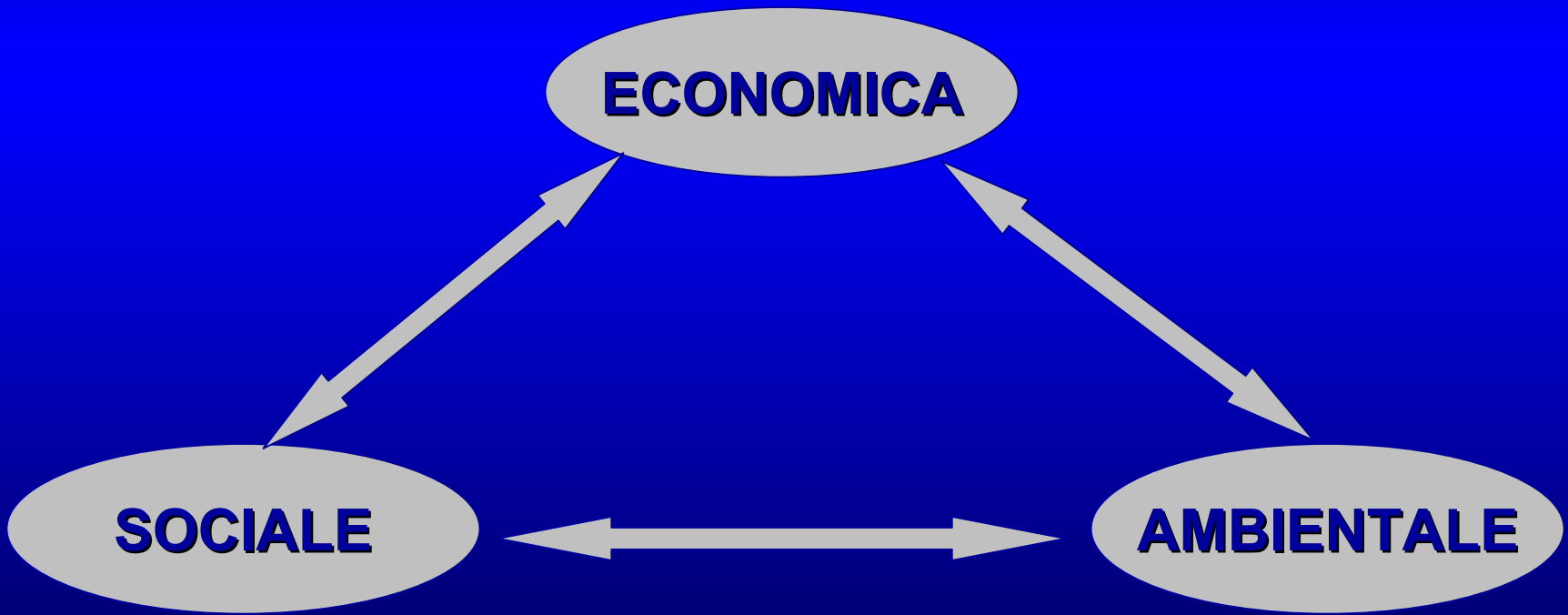
sistemi

COMPARTI di PRODUZIONE PRIMARIA

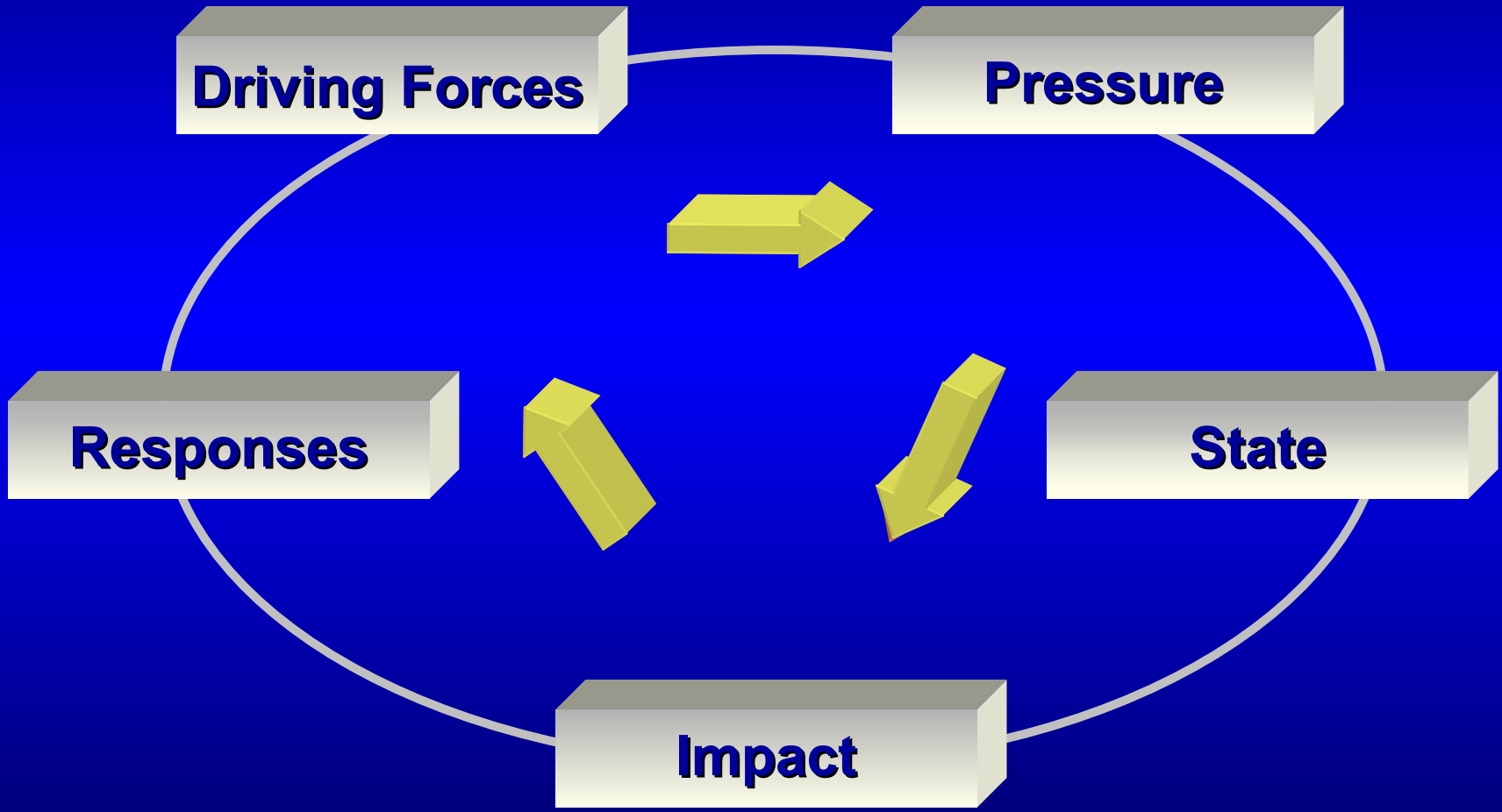
TERRITORIO RURALE

ELBA
Environmental Liveliness and Blent Agriculture

Un modello integrato per l'analisi dei sistemi agro-ambientali



SCHEMA DI ANALISI



ELBA - Componente economica: struttura modulare

MODELLO DI EQUILIBRIO PARZIALE e STATICO COMPARATO

Modulo offerta: modelli multi-prodotto provinciali e regionali

Modulo mercato: modello multi-prodotto nazionale

Metodologia: ottimizzazione vincolata

ELBA - Componente economica

MODELLO SETTORIALE: 54 attività di produzione primaria

Tecnologia
Condizioni di mercato
Condizioni politiche
Comportamento economico dei produttori

MODELLO NAZIONALE: 20 regioni e 103 province italiane

MODELLI ELBA e CAPRI

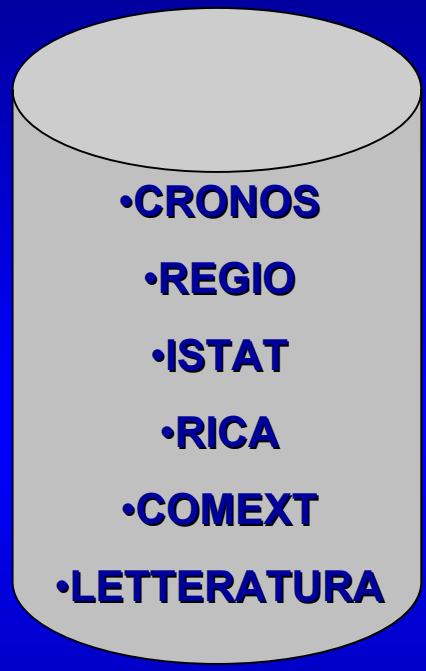
ELBA - Componente economica: metodologia

- Programmazione quadratica (PMP)
- Entropia incrociata

- Calibrazione dei livelli di attività:
  produzioni vegetali ed animali
  reimpiego produzioni (alimentazione, rimonta)

- Proiezioni in funzione delle condizioni economiche e politiche attese

ELBA - Data Base



Geo-referenziazione

Completezza
Congruenza

ELBA - Componente economica: data base

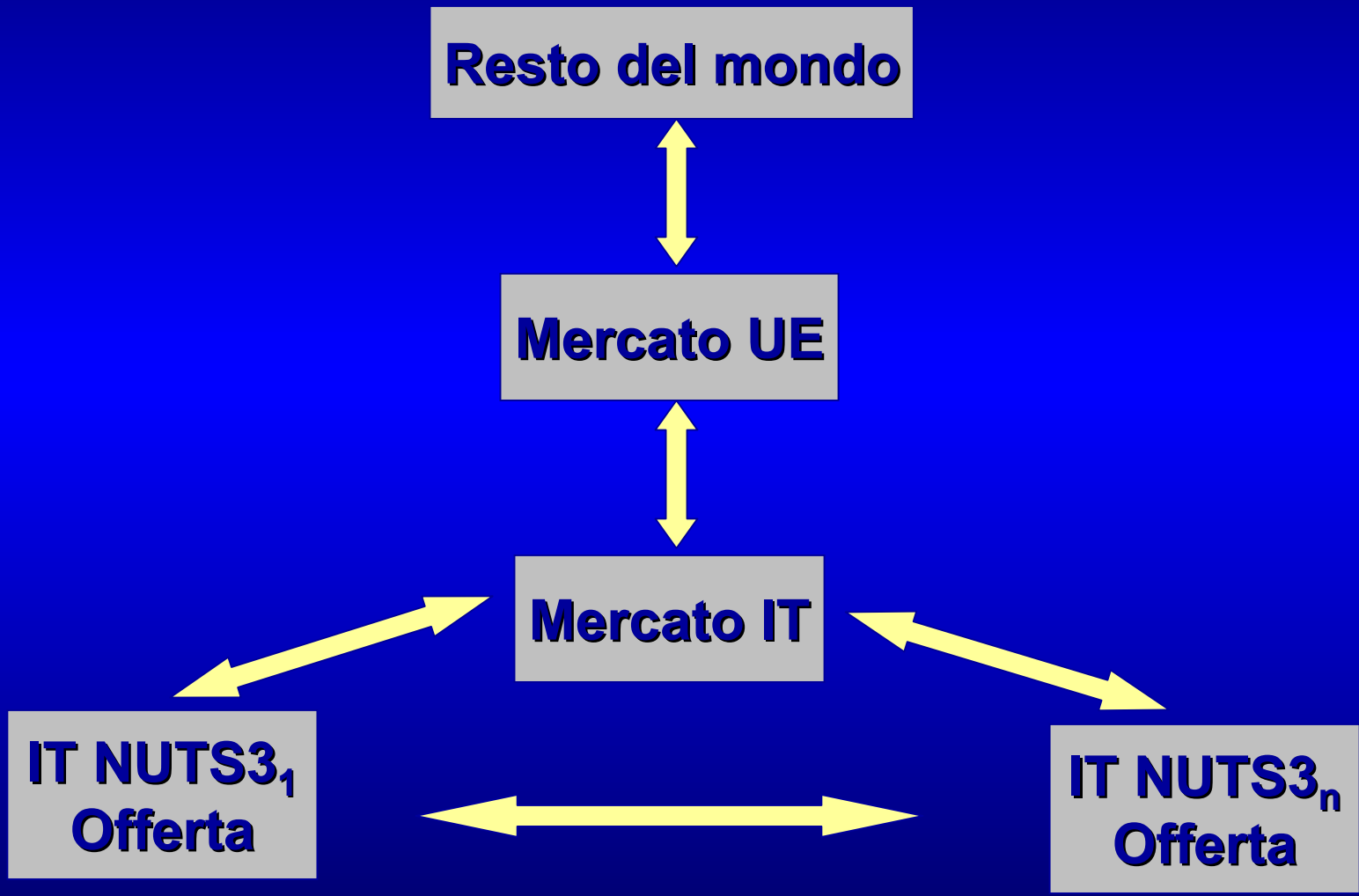
Variabili

- Fisiche: superfici e mandrie, coefficienti input ed output, consumi intermedi e finali, commercio, ...
- Economiche: prezzi, costi, redditi, ...
- Politiche: sussidi, quote, set-aside, tariffe, ...

Serie storiche (ottobre 2002)

- Livello nazionale: 1973 - 1999
- Livello regionale: 1986 - 1999
- Livello provinciale: 1990 - 2000
- Previsioni: 2005

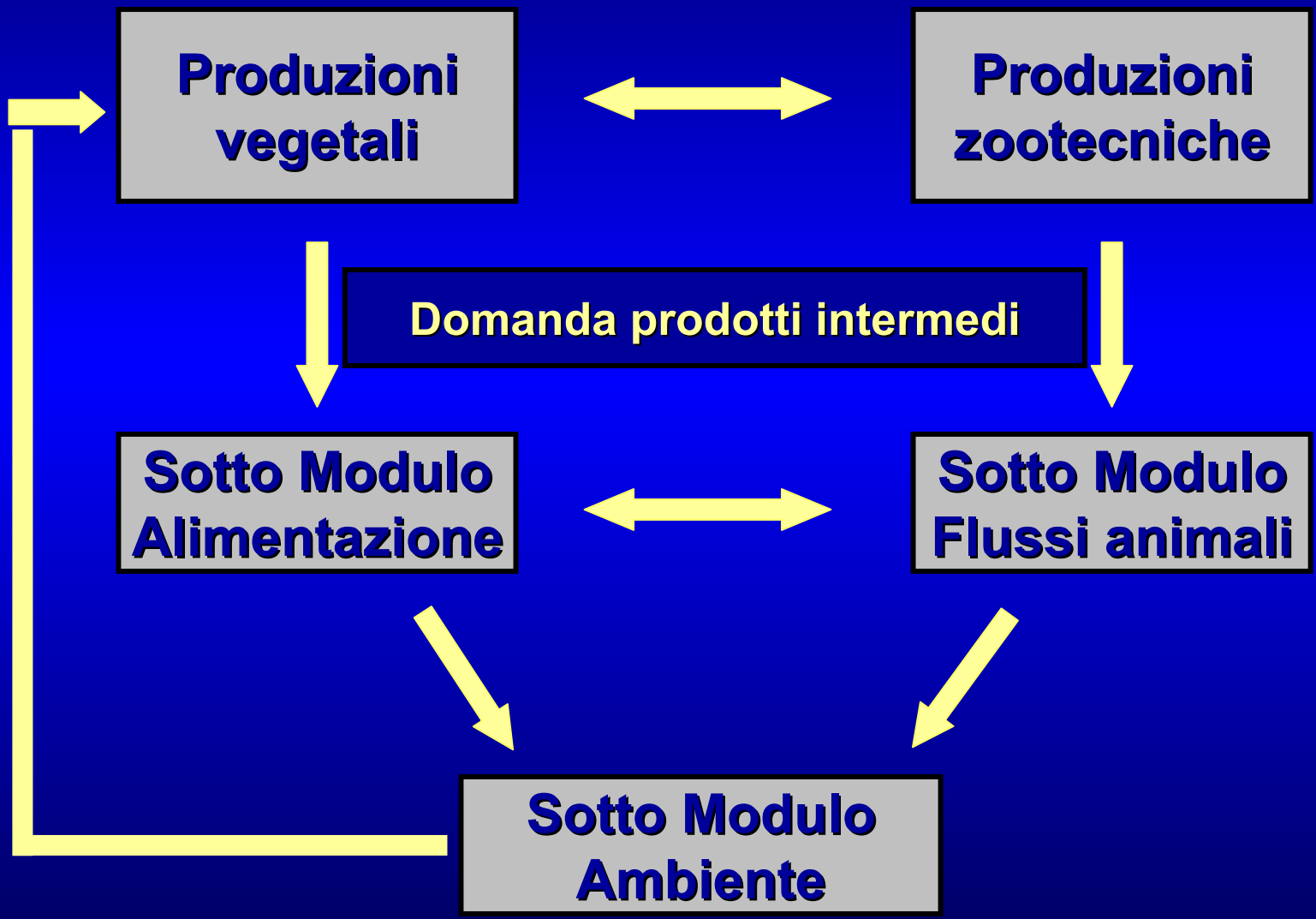
ELBA - Componente economica: modulo mercato



ELBA - Componente economica: modulo offerta

- Funzione obiettivo massimizza il reddito lordo provinciale / regionale
- Reddito lordo:
    - ricavo dalla vendita dei prodotti
    - più premi
    - meno acquisti di fattori variabili
- Ridotto numero di vincoli (superficie agraria, pascoli, set-aside, quote, fabbisogni nutritivi)

ELBA - Componente economica: modulo offerta



ELBA - Componente economica: sotto-modulo alimentazione

- Modelli regionali

- Definizione sistemi di produzione

- Calcolo fabbisogni alimentari: fase fisiologica, lunghezza ciclo produttivo, rese, IPG,....

- Vincoli di razionamento: capacità di ingestione - ruminanti, ingestione ottimale di energia - monogastrici, capacità di ingombro materie prime, rapporto foraggi-concentrati, fibra lunga, elementi essenziali, disponibilità di foraggi regionale,....

CONSUMO INTERMEDIO MATERIE PRIME E DERIVATI

ELBA - Componente economica: sotto-modulo flussi animali

- Modelli provinciali

- Definizione sistemi di produzione

- Descrizione dell'evoluzione della mandria e delle relazioni esistenti tra le diverse fasi dell'allevamento

- Incremento del grado di informazione offerto dalle statistiche ufficiali (consistenze e macellazione): definizione del numero di capi allevati (flusso)

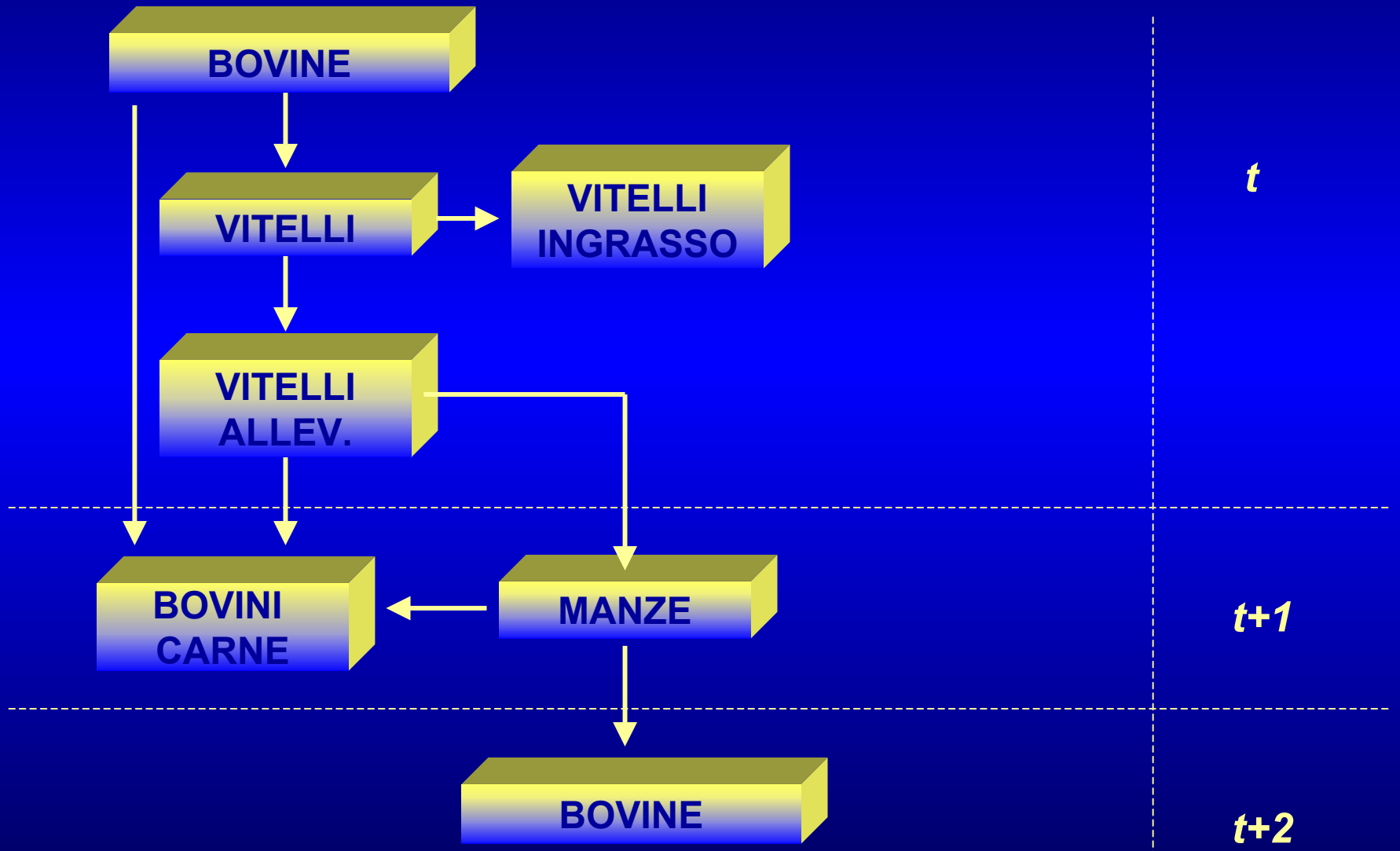
ELBA - Componente economica: sotto-modulo flussi animali

- Stima del commercio interregionale (netto) di animali

- Stima del commercio tra le regioni ed i paesi UE (import/export nazionale) in funzione delle caratteristiche degli animali importati o esportati.

LIVELLO DI ATTIVITA' PRODUTTIVA
REIMPIEGO DI GIOVANI ANIMALI

ELBA - Componente economica: sotto-modulo flussi animali



ELBA - Modulo ambiente

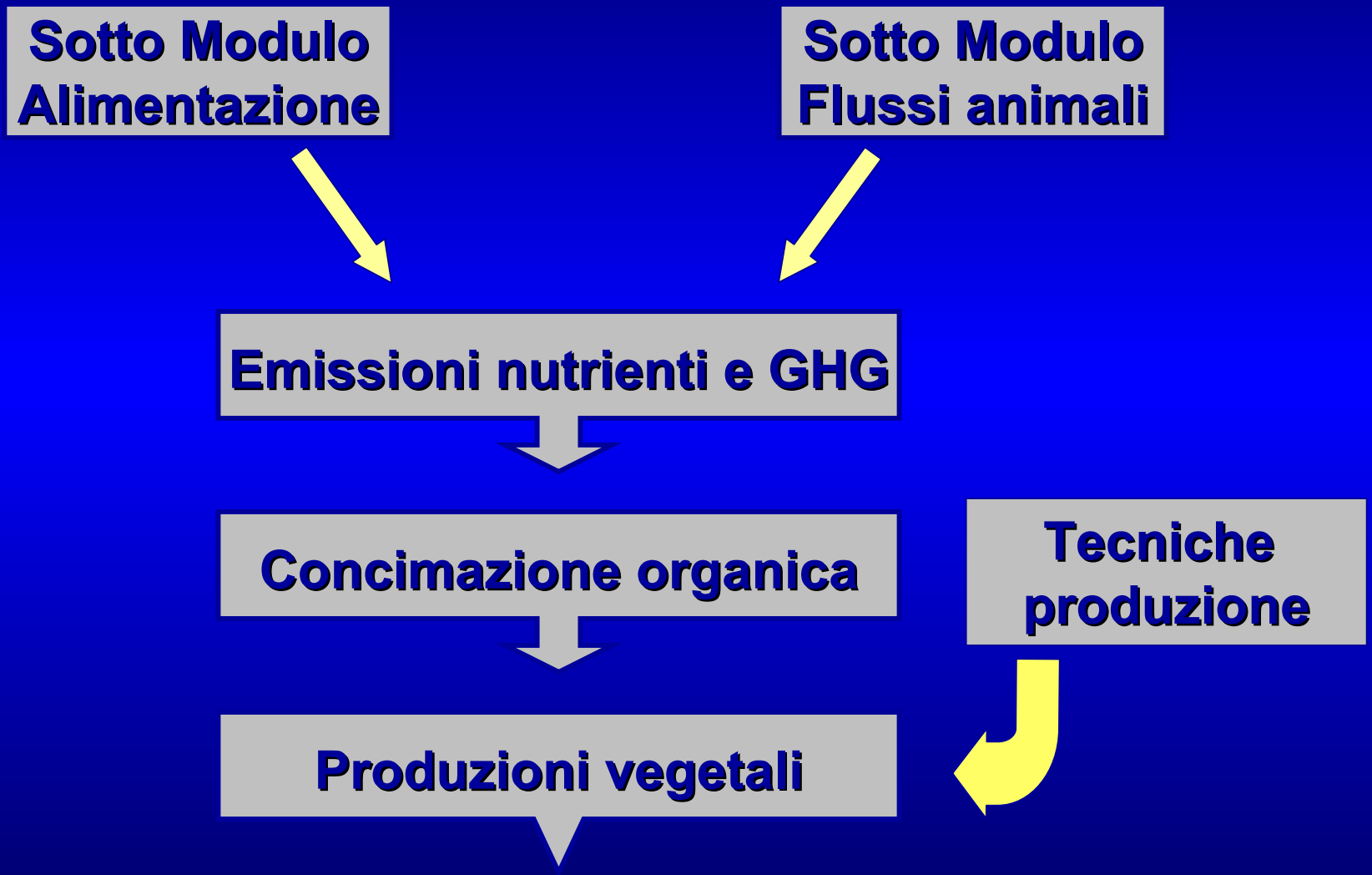
- Modelli per areali di 1 Km^2

- Calcolo coefficienti I/O

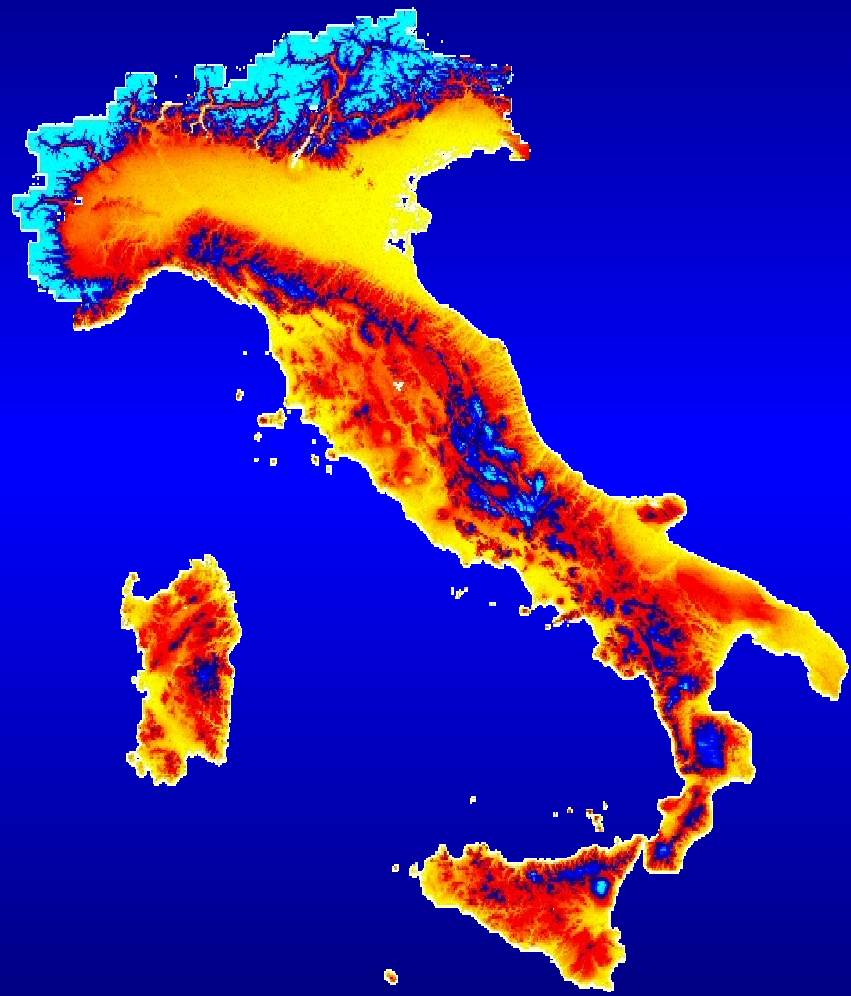
- Stima la pressione ambientale con coefficienti variabili

- Consente di effettuare scenari modificando i sistemi produttivi agro-zootecnici

ELBA – Integrazione modulo economico modulo ambiente



ELBA - Modulo GIS

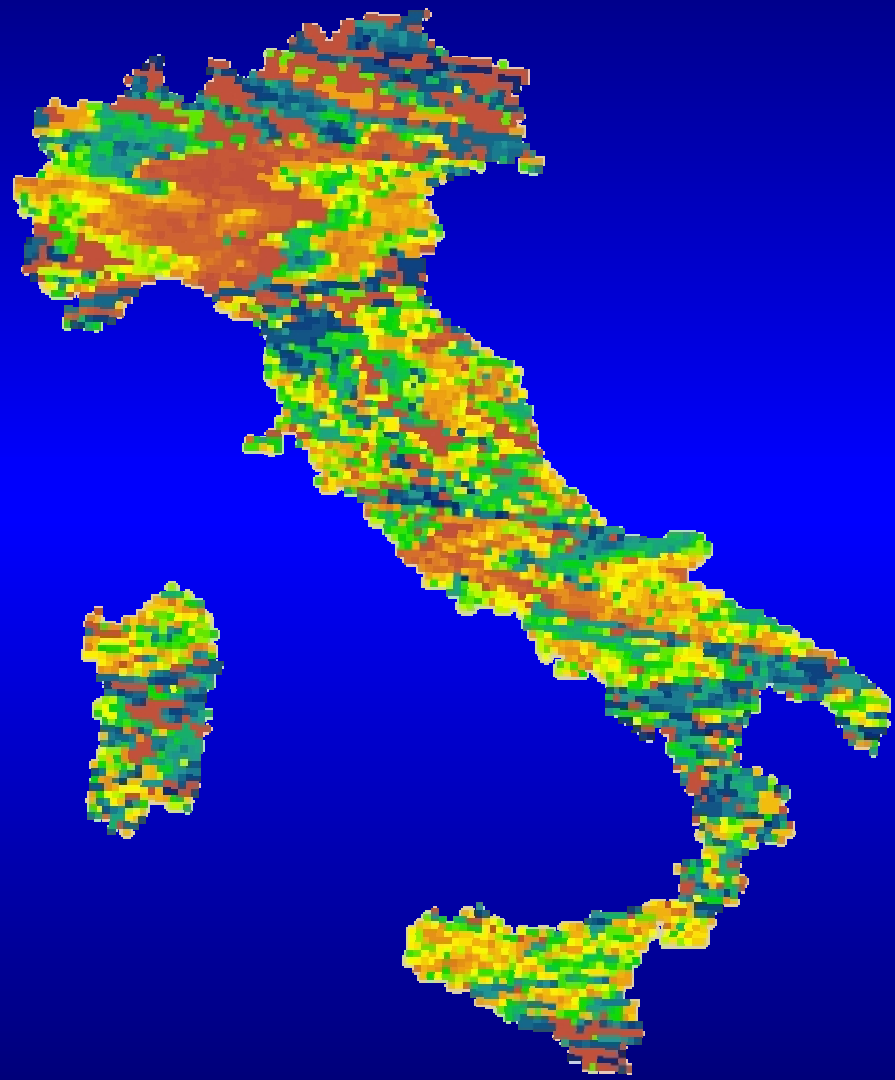


DEM

ELBA - Modulo GIS

Suolo

DEM



ELBA - Modulo GIS

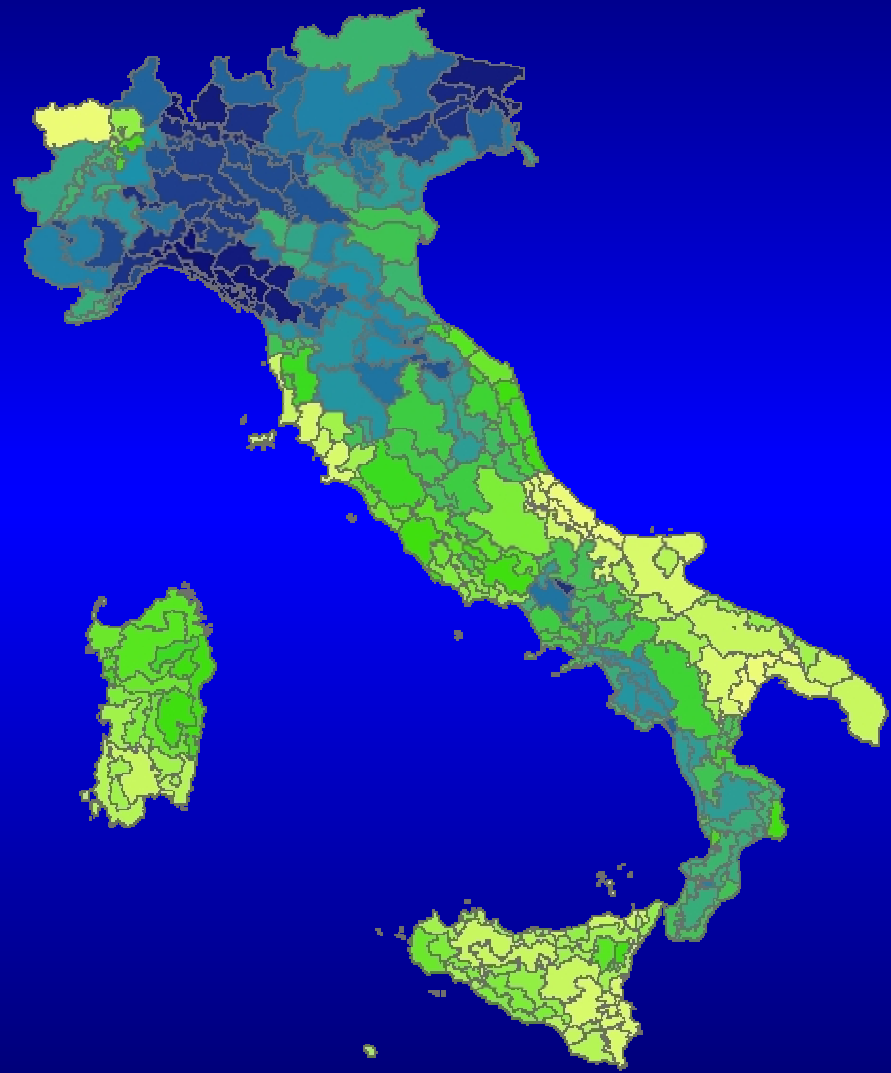
Uso del suolo

Suolo

DEM

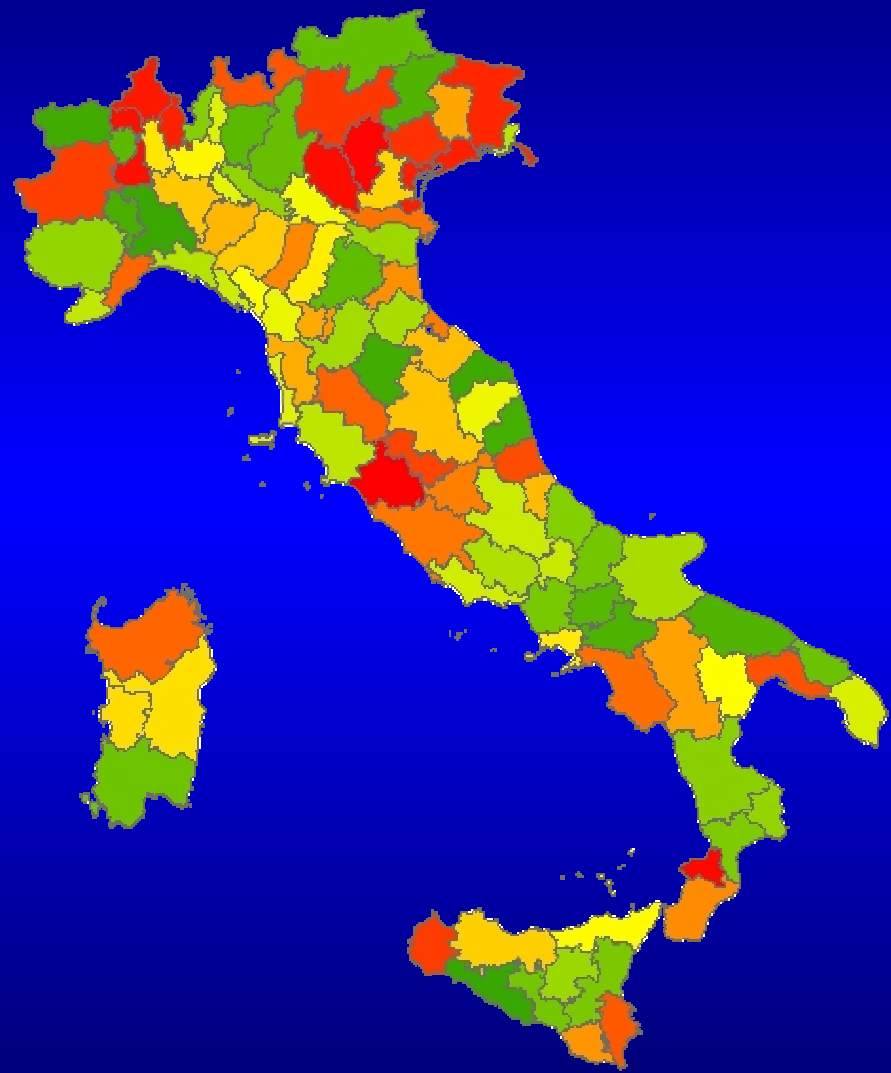
ELBA - Modulo GIS

- Clima
- Uso del suolo
- Suolo
- DEM



ELBA - Modulo GIS

- Sist. produzione
- Clima
- Uso del suolo
- Suolo
- DEM



ELBA - Modulo GIS

- Sist. produzione
- Clima
- Uso del suolo
- Suolo
- DEM

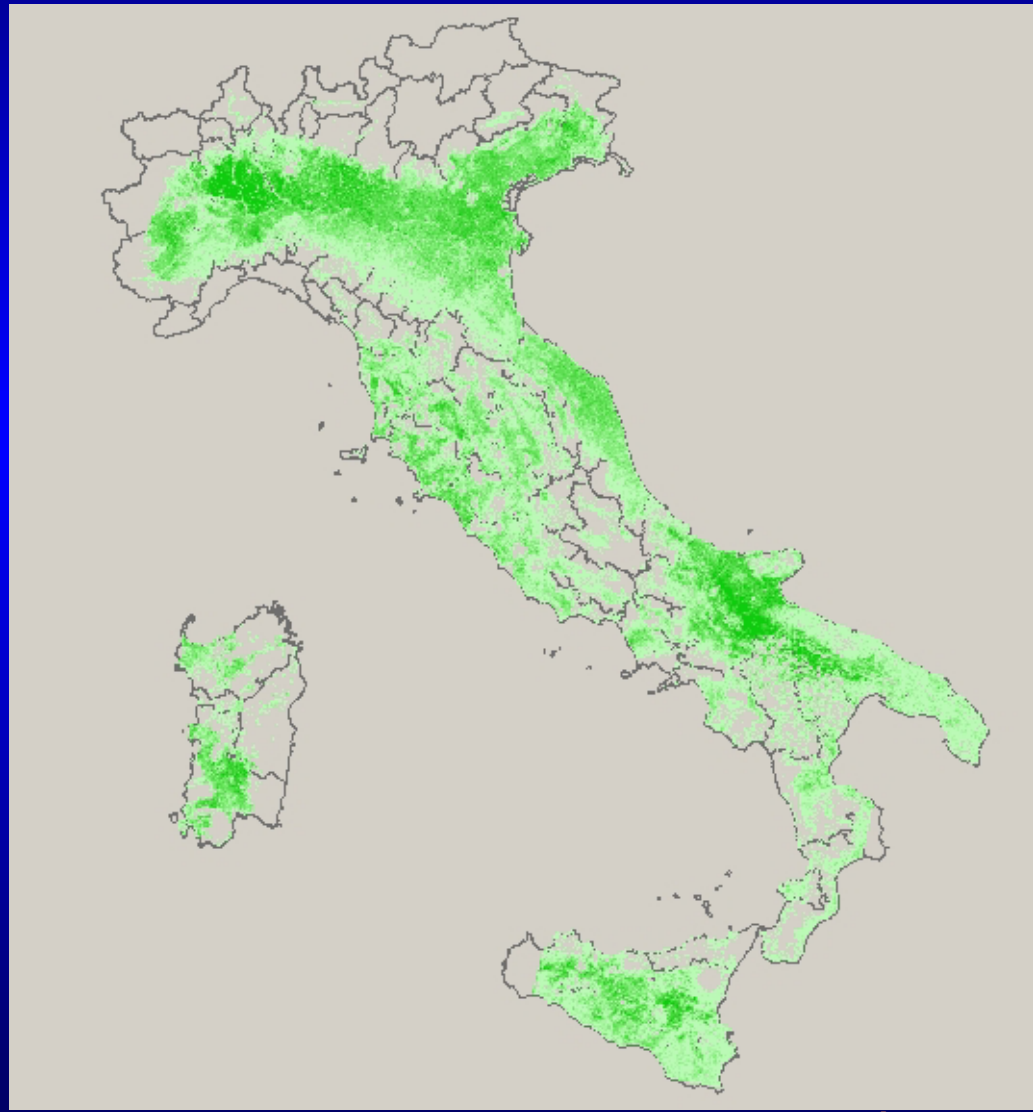
1km² - DB

ELBA - Uso Suolo

Cereali	Cereali invernali Mais Riso
Oleaginose	Colza Girasole Soia
Altre estive	Barbabietola Tabacco Pomodoro
Altri seminativi e foragg.	
Arboree	Vigneti Olivo Frutteti
Altro entro area frame	
Altro fuori area frame	

ELBA - Uso Suolo

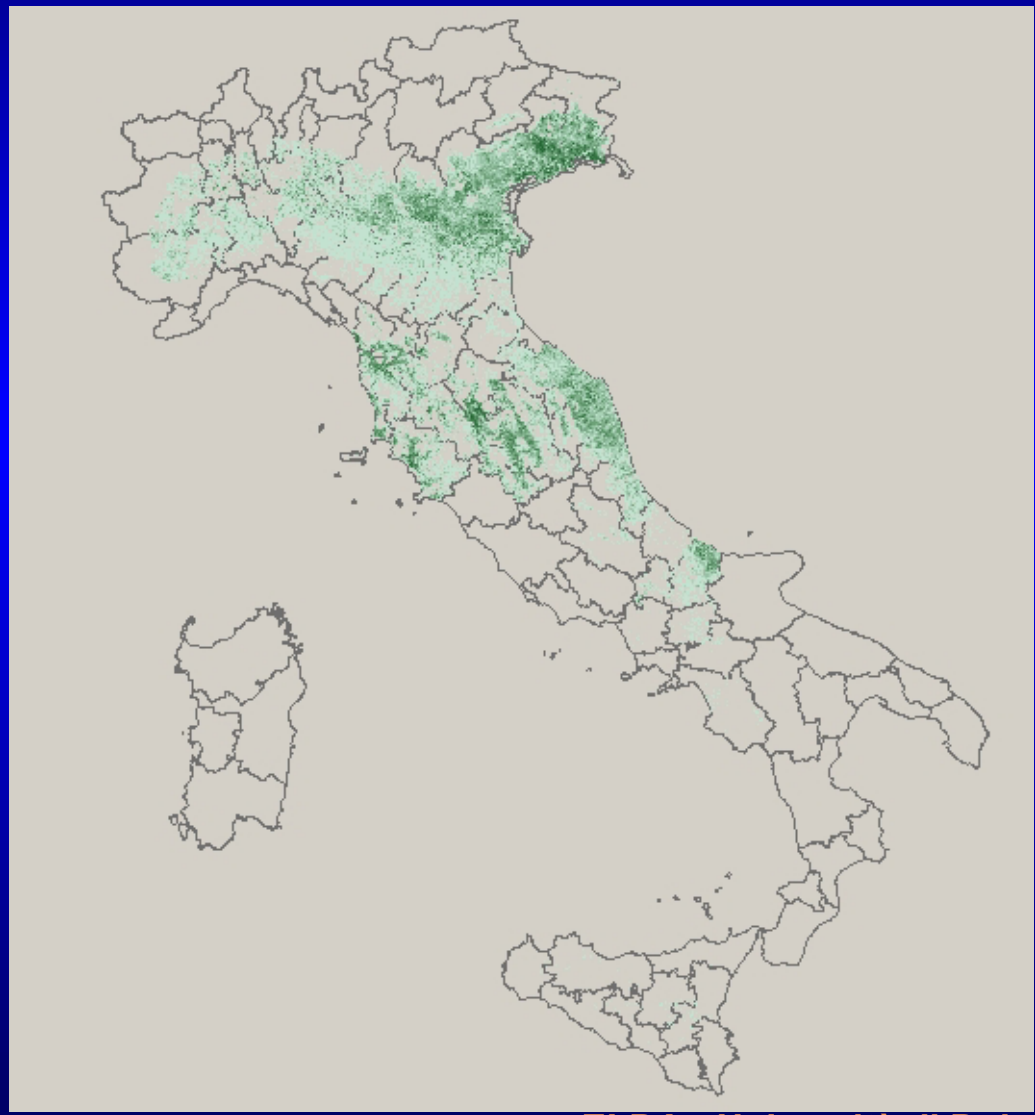
CEREALI



ELBA - Uso Suolo

CEREALI

OLEAGINOSE

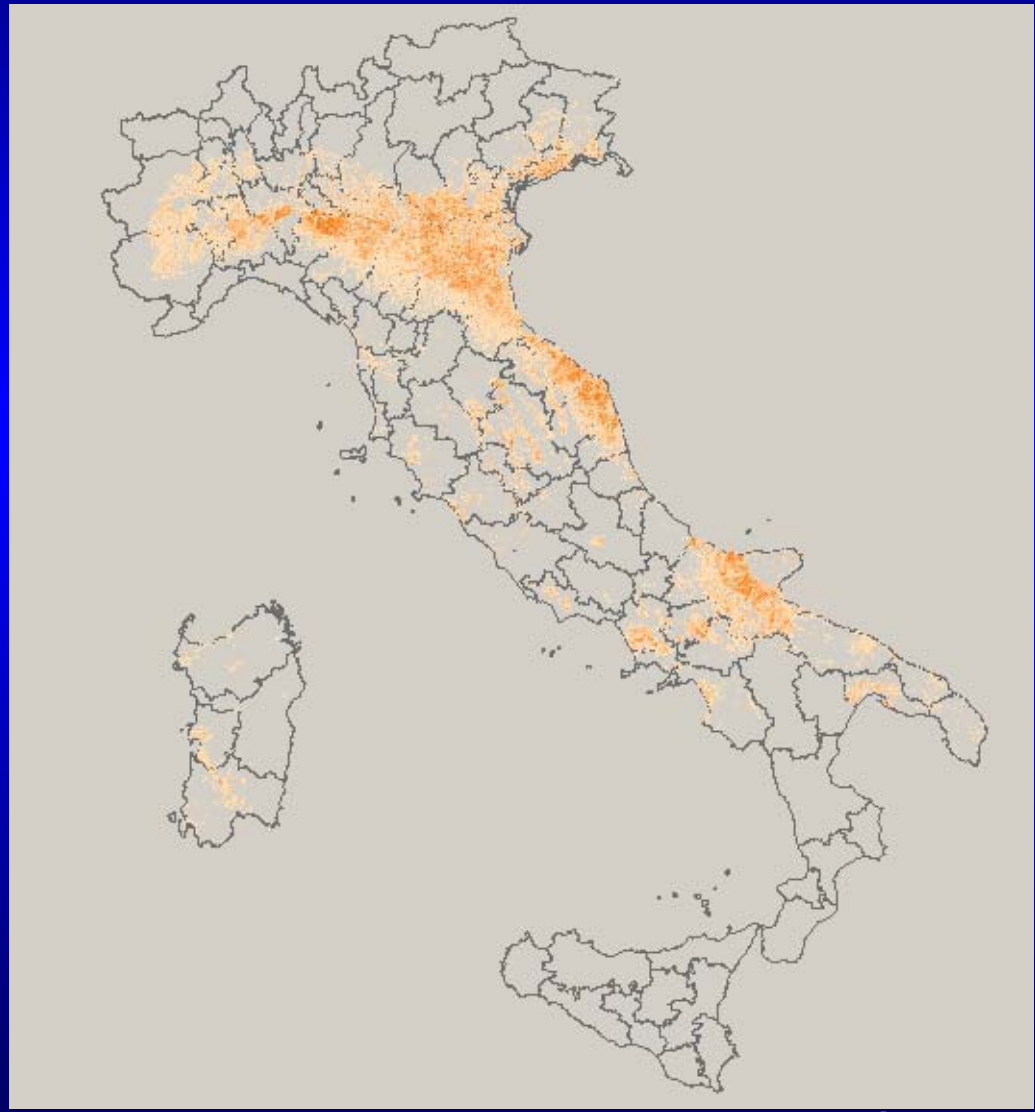


ELBA - Uso Suolo

CEREALI

OLEAGINOSE

ALTRE ESTIVE



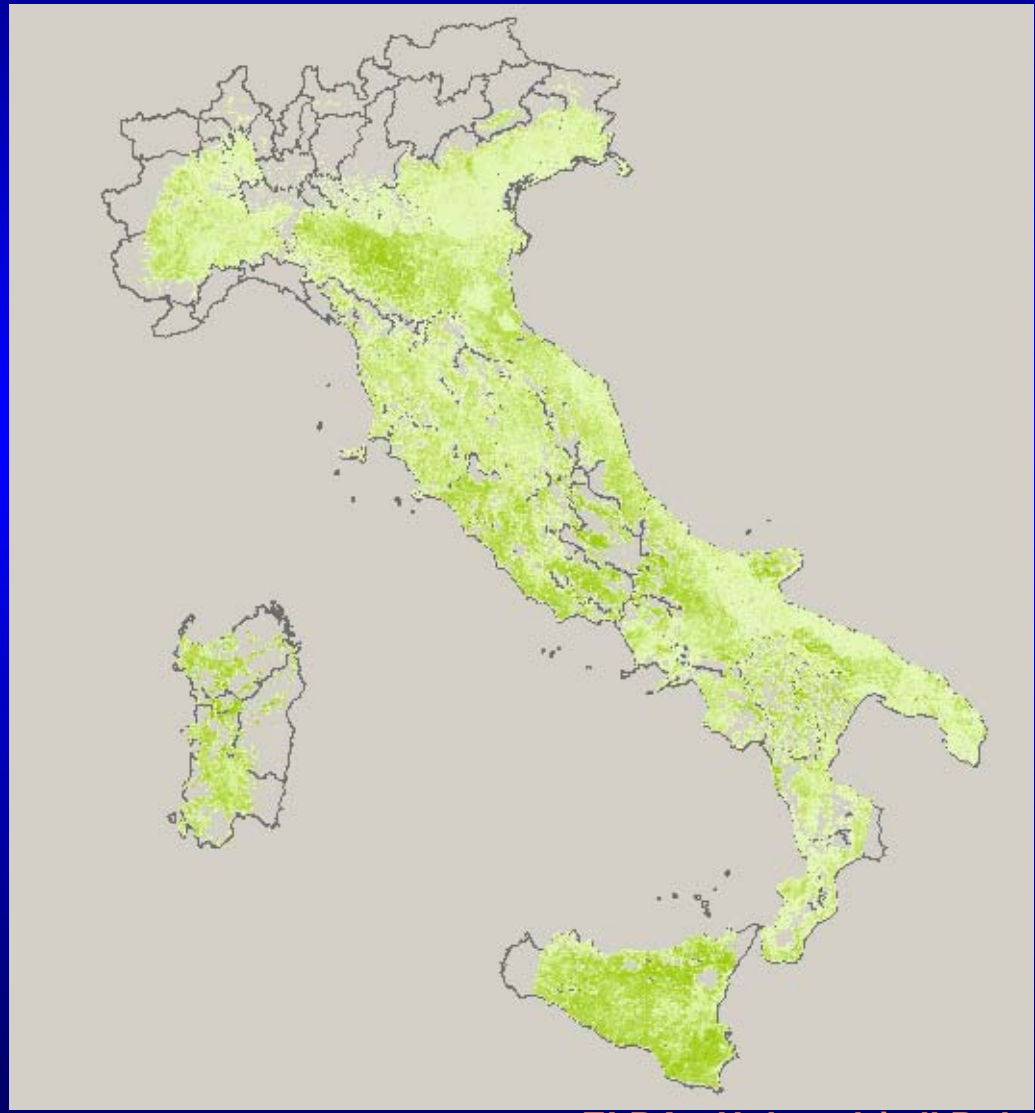
ELBA - Uso Suolo

CEREALI

OLEAGINOSE

ALTRE ESTIVE

FORAGG.-ALTRO



ELBA - Uso Suolo

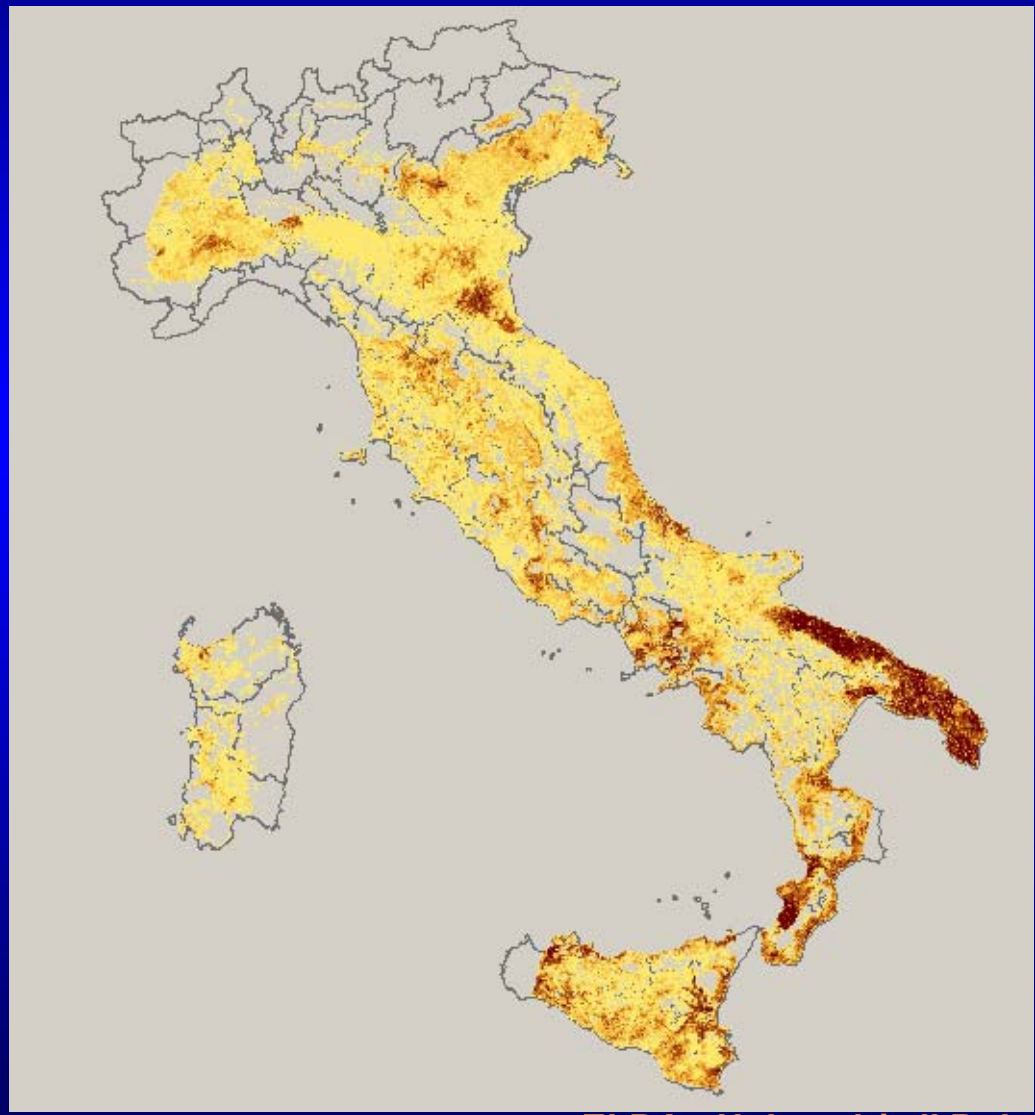
CEREALI

OLEAGINOSE

ALTRE ESTIVE

FORAGG.-ALTRO

ARBOREE

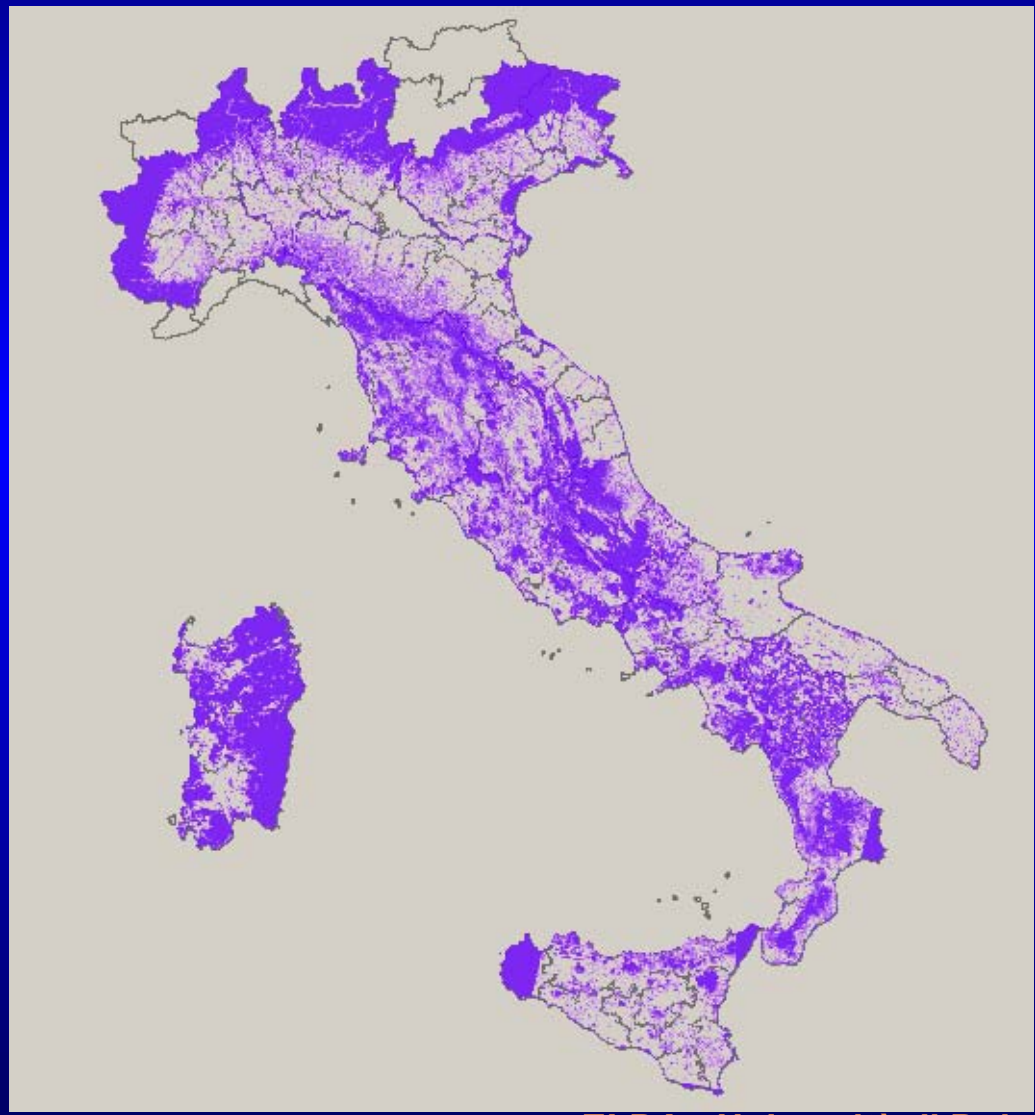


ELBA - Uso Suolo

- CEREALI
- OLEAGINOSE
- ALTRE ESTIVE
- FORAGG.-ALTRO
- ARBOREE
- ALTRO AGR.

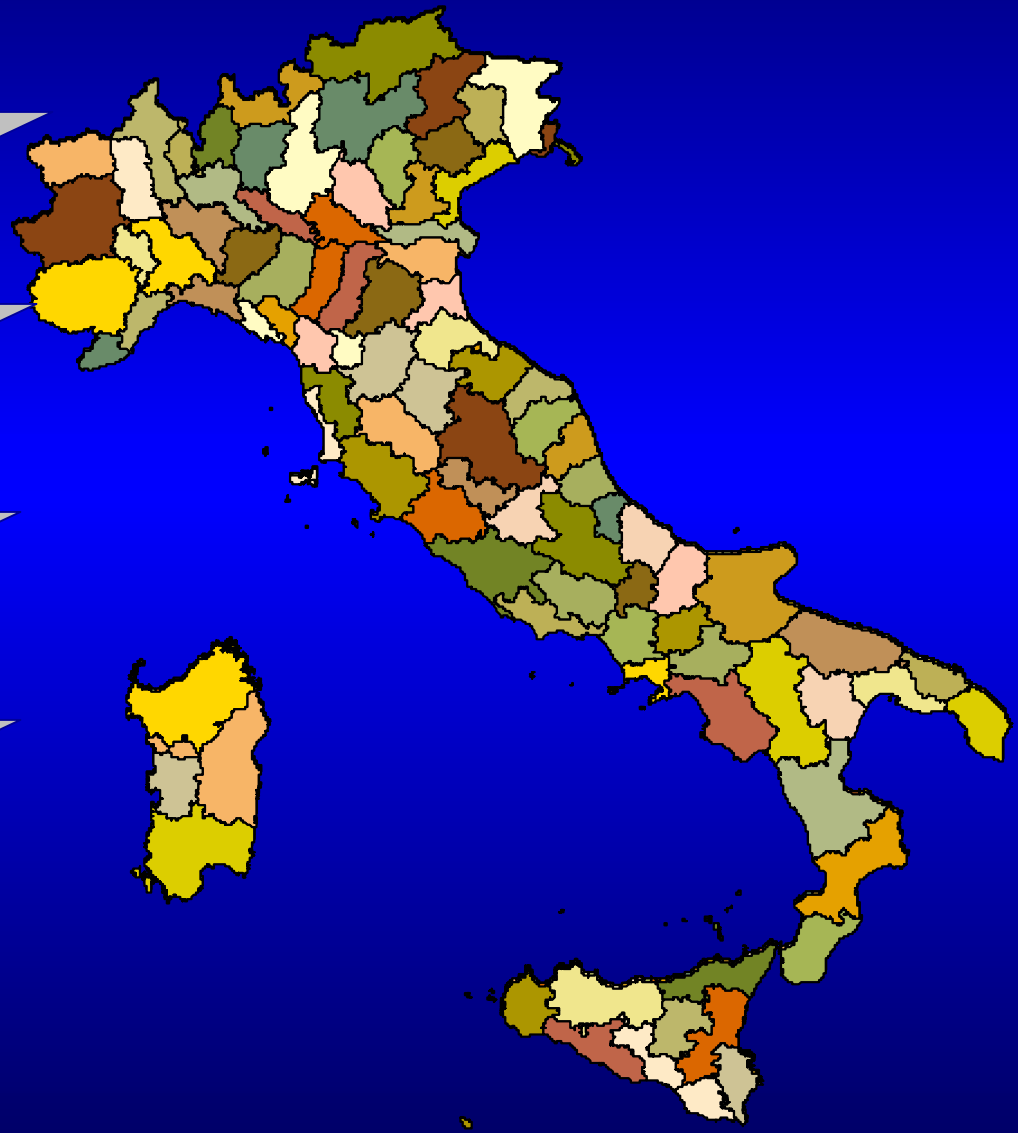
ELBA - Uso Suolo

- CEREALI
- OLEAGINOSE
- ALTRE ESTIVE
- FORAGG.-ALTRO
- ARBOREE
- ALTRO AGR.
- NO AGR.



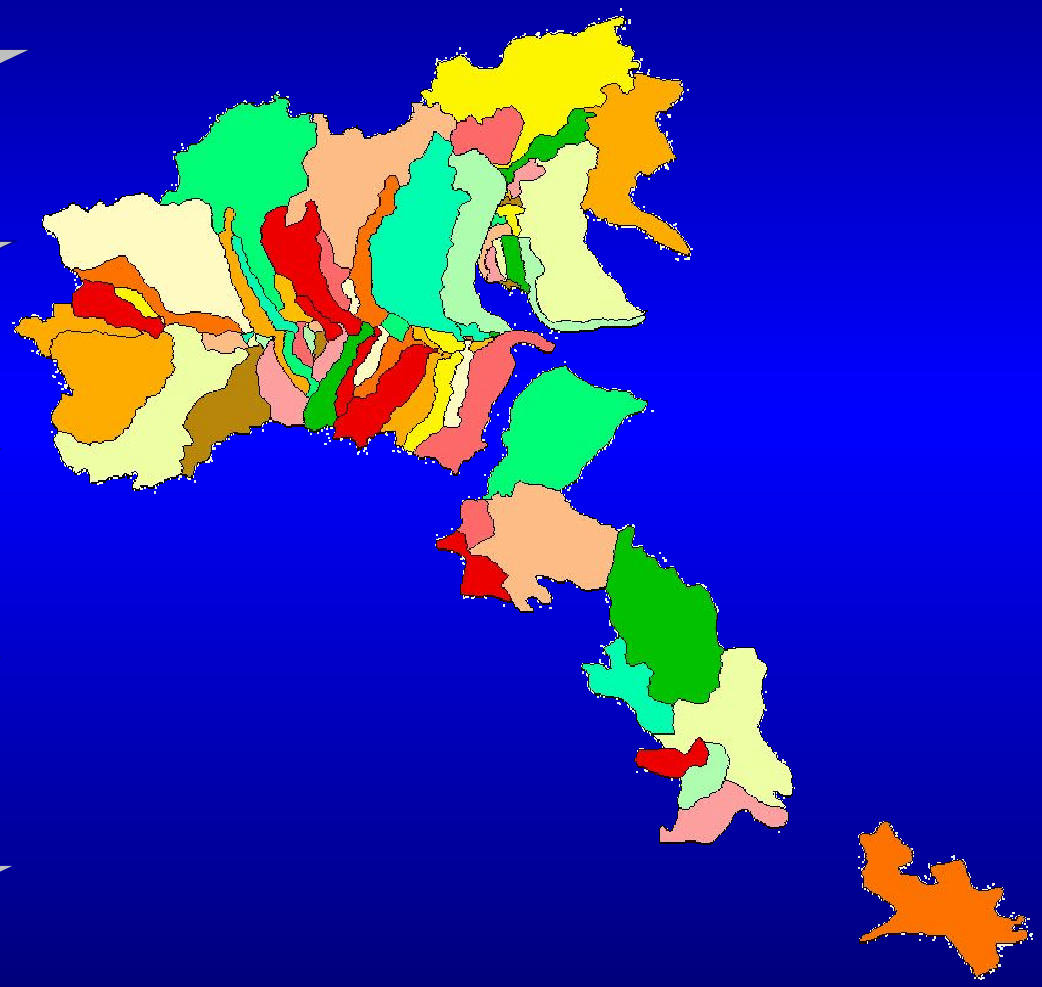
UNITA' TERRITORIALE

- Regioni
- Province
- 290000 Areali
- Aree vulnerabili

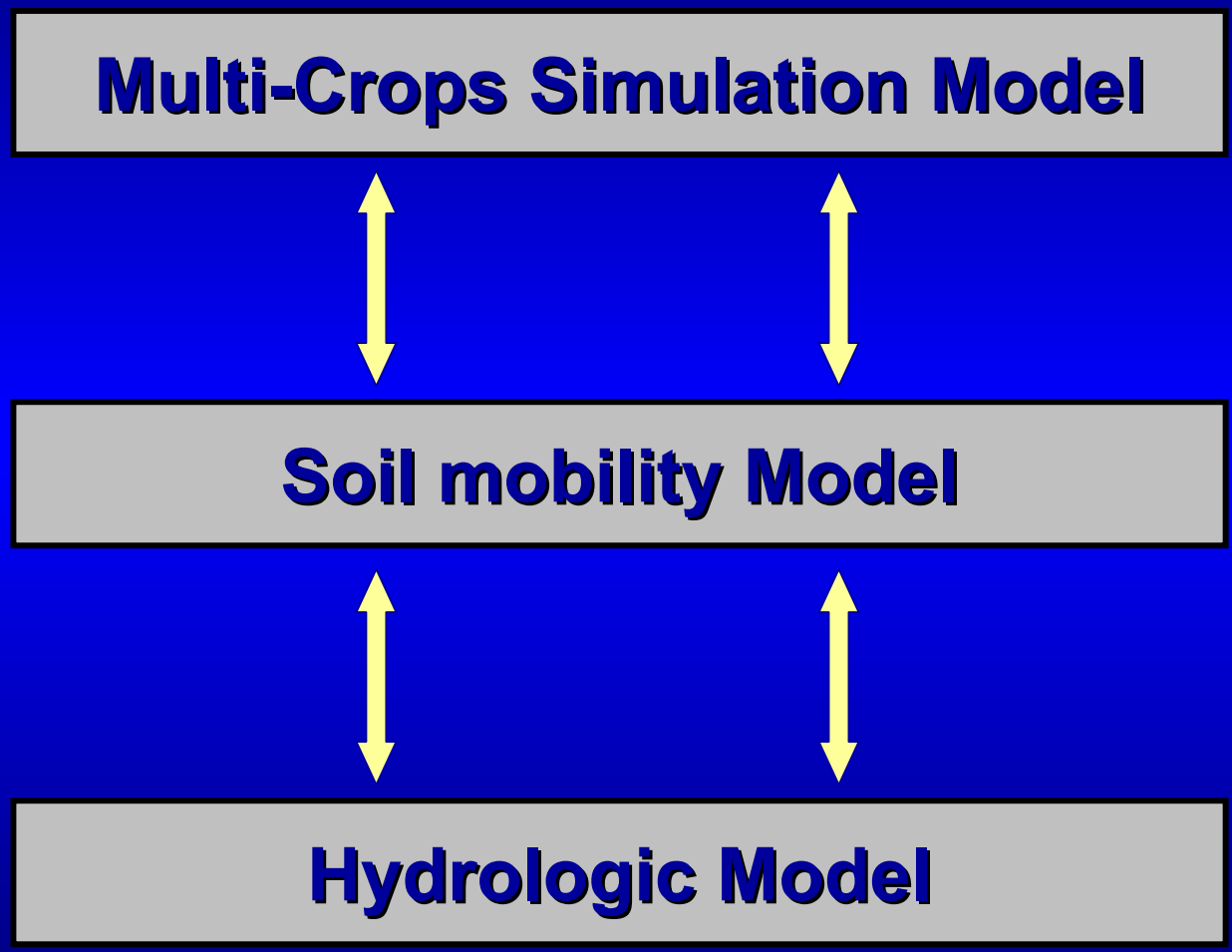


UNITA' TERRITORIALE

- Regioni
- Province
- 320000 Areali
- Aree vulnerabili
- Sottobacini



LAND USE - SOIL - WATER MODEL



LAND USE - SOIL - WATER MODEL

SWAT - Soil and Water Assessment Tool

a river basin, or watershed, scale model developed by Dr. Jeff Arnold for the USDA Agricultural Research Service (ARS)

LAND USE - SOIL - WATER MODEL

SWAT - Soil and Water Assessment Tool

-CREAMS (Chemicals, Runoff,Erosion from Agricultural Management Systems)

-EPIC (Erosion-Productivity Impact Calculator)

-GLEAMS (Groundwater Loading Effects of Agricultural Management System).

LAND USE - SOIL - WATER MODEL

SWAT requires specific information about weather, soil properties, topography, vegetation, and land management practices occurring in the watershed. The physical processes associated with water movement, sediment movement, crop growth, nutrient cycling, etc. are directly modeled.

LAND USE - SOIL - WATER MODEL

SWAT was developed to predict the impact of land management practices on water, sediment and agricultural chemical yields in large complex watersheds with varying soils, land use and management conditions over long periods of time.

SWAT - Soil and Water Assessment Tool

MODEL OBJECTIVE

Predict the effect of management decisions on water, sediment, nutrient and pesticide yields with reasonable accuracy on large, ungaged river basins.

SWAT - Soil and Water Assessment Tool

MODEL COMPONENTS

Weather, surface runoff, return flow, percolation, ET, transmission losses, pond & reservoir storage, crop growth & irrigation, groundwater flow, reach routing, nutrient & pesticide loading, water transfer

SWAT - Soil and Water Assessment Tool

MODEL OPERATION

- Daily time step-long term simulations
- Groundwater flow model
- Areas subdivided to account for differences in soils, land use, crops, topography, weather, etc.
- Areas of several thousand square miles can be studied
- Soil profile can be divided into ten layers

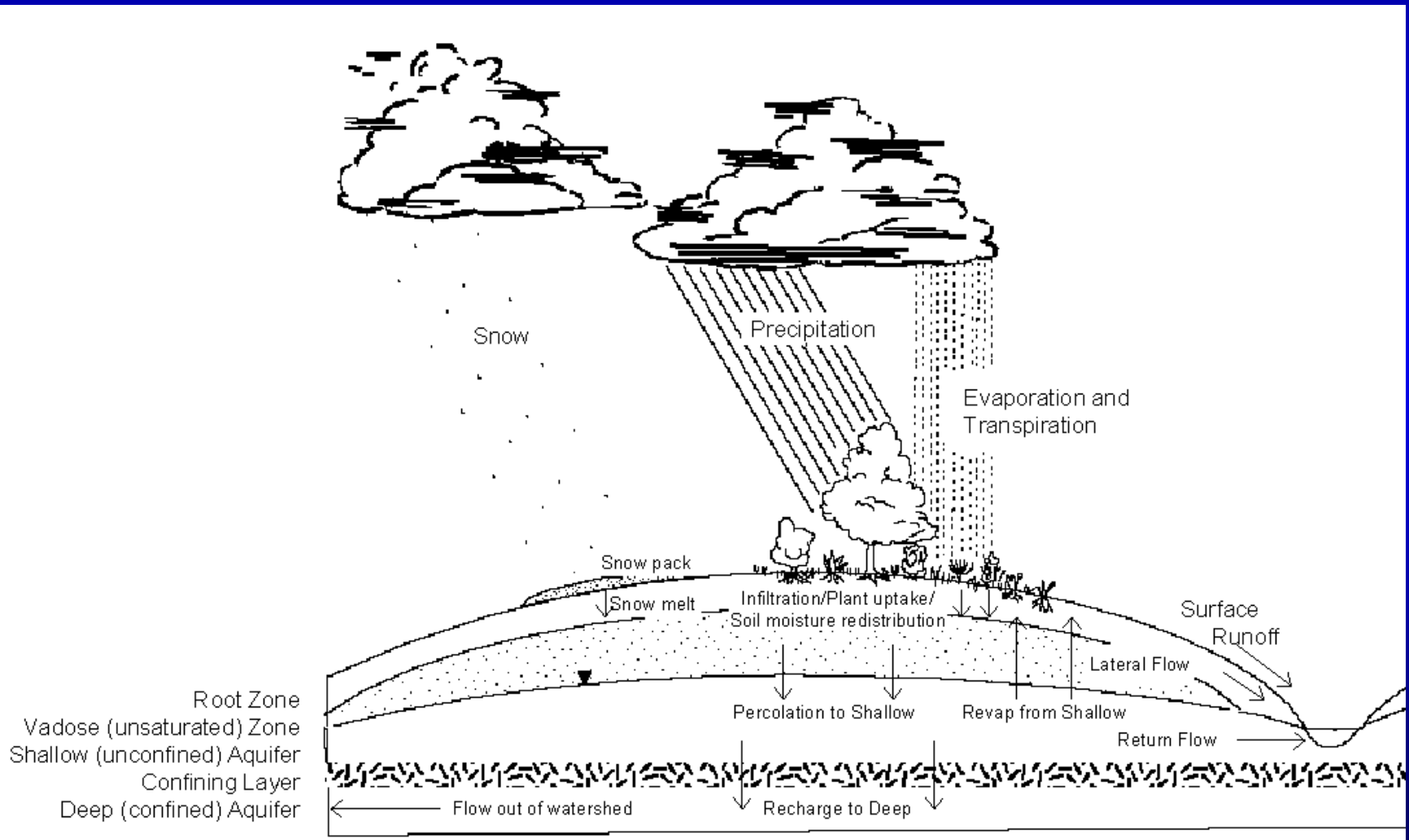
SWAT – Land Phase

The hydrologic cycle as simulated by SWAT is based on water balance Equation:

- the soil water content available for plant uptake
- the amount of precipitation
- the amount of surface runoff
- the amount of evapotranspiration
- the amount of percolation

ELBA

Environmental Liveliness and Blent Agriculture



SWAT – Land Phase

Major Processes/Inputs in Land Phase of Hydrologic Cycle:

- Climate
- Land Cover/Plant Growth
- Management
- Nutrients
- Pesticides
- Erosion

SWAT – CLIMATE

The climatic variables required by SWAT consist of daily precipitation, maximum/minimum air temperature, solar radiation, wind speed and relative humidity.

Values for daily precipitation and maximum/minimum air temperatures to be input

Solar radiation, wind speed and relative humidity are always generated by the model.

SWAT – Land Cover/Plant Growth

SWAT utilizes a single plant growth model to simulate all types of land covers. The model is able to differentiate between annual and perennial plants.

Annual plants grow from the planting date to the harvest date.

Perennial plants maintain their root systems throughout the year.

Potential Growth	**Potential and Actual Transpiration**
Nutrient Uptake	**Growth contraints**

SWAT – MANAGEMENT

SWAT allows the user to define management practices taking place in every areas. The user may define the beginning and the ending of the growing season, specify timing and amounts of fertilizer, pesticide and irrigation applications as well as timing of tillage operations.

SWAT – NUTRIENTS

SWAT tracks the movement and transformation of several forms of nitrogen and phosphorus.

In the soil, transformation of nitrogen from one form to another is governed by the nitrogen cycle.

The transformation of phosphorus in the soil is controlled by the phosphorus cycle .

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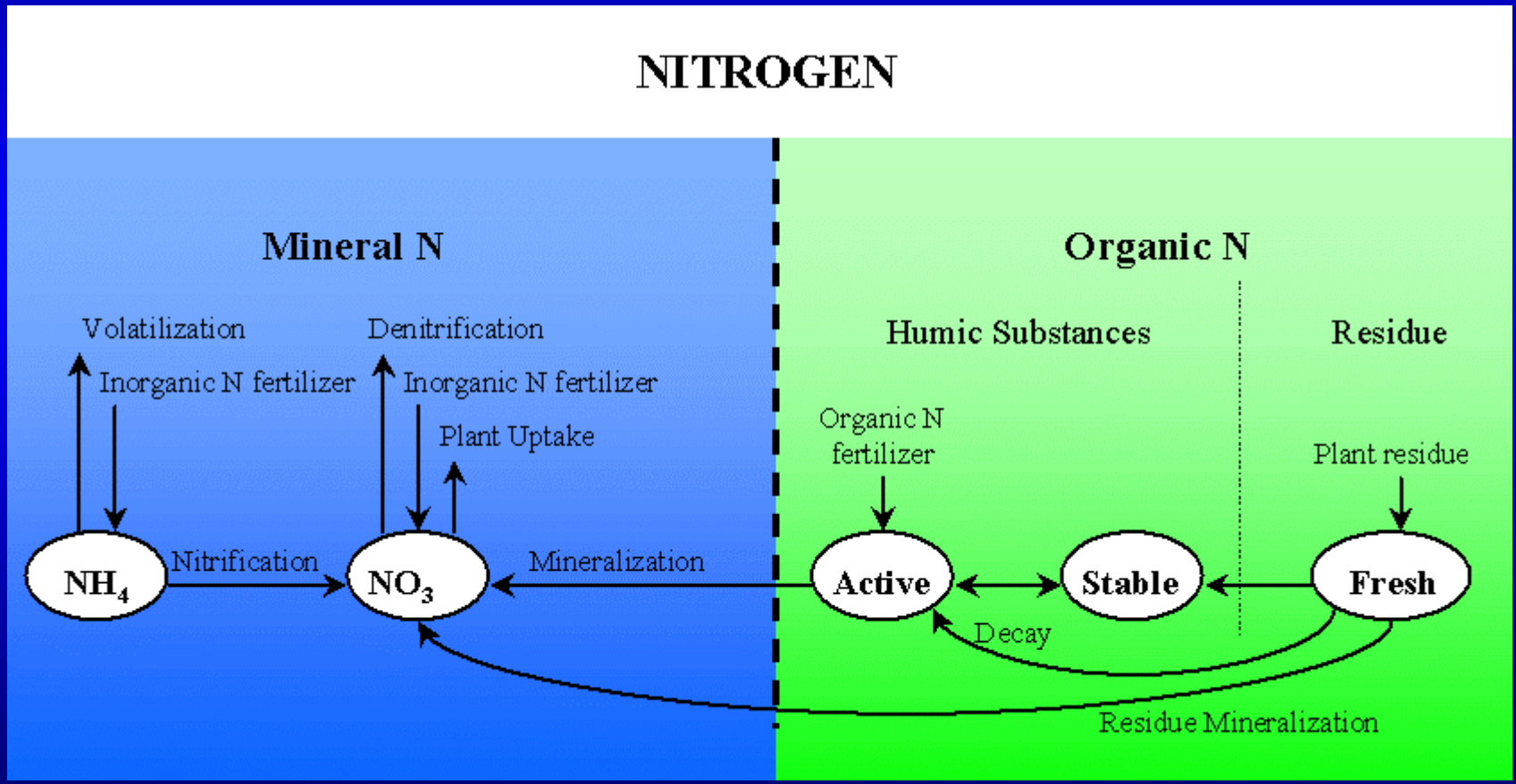
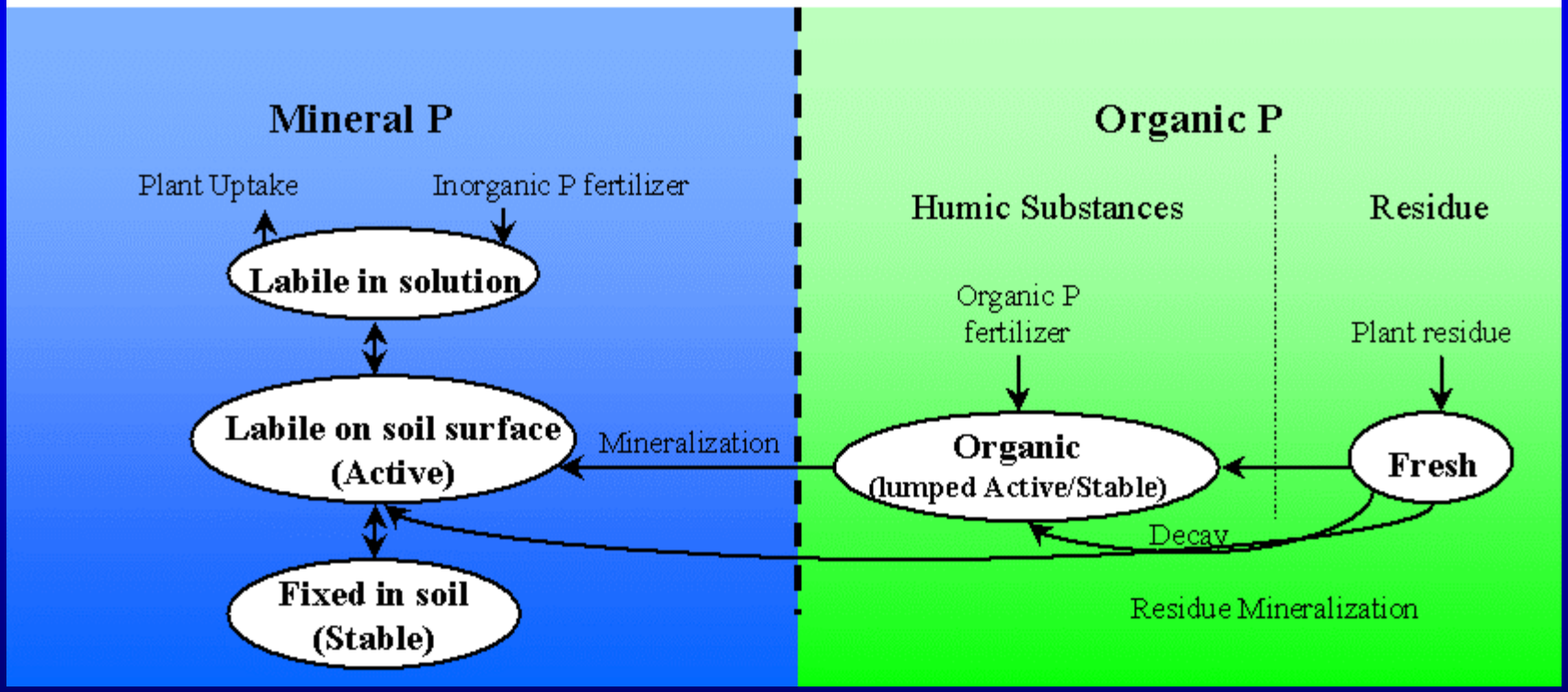
Environmental Liveliness and Blent Agriculture



ELBA
Environmental Liveliness and Blent Agriculture

PHOSPHORUS

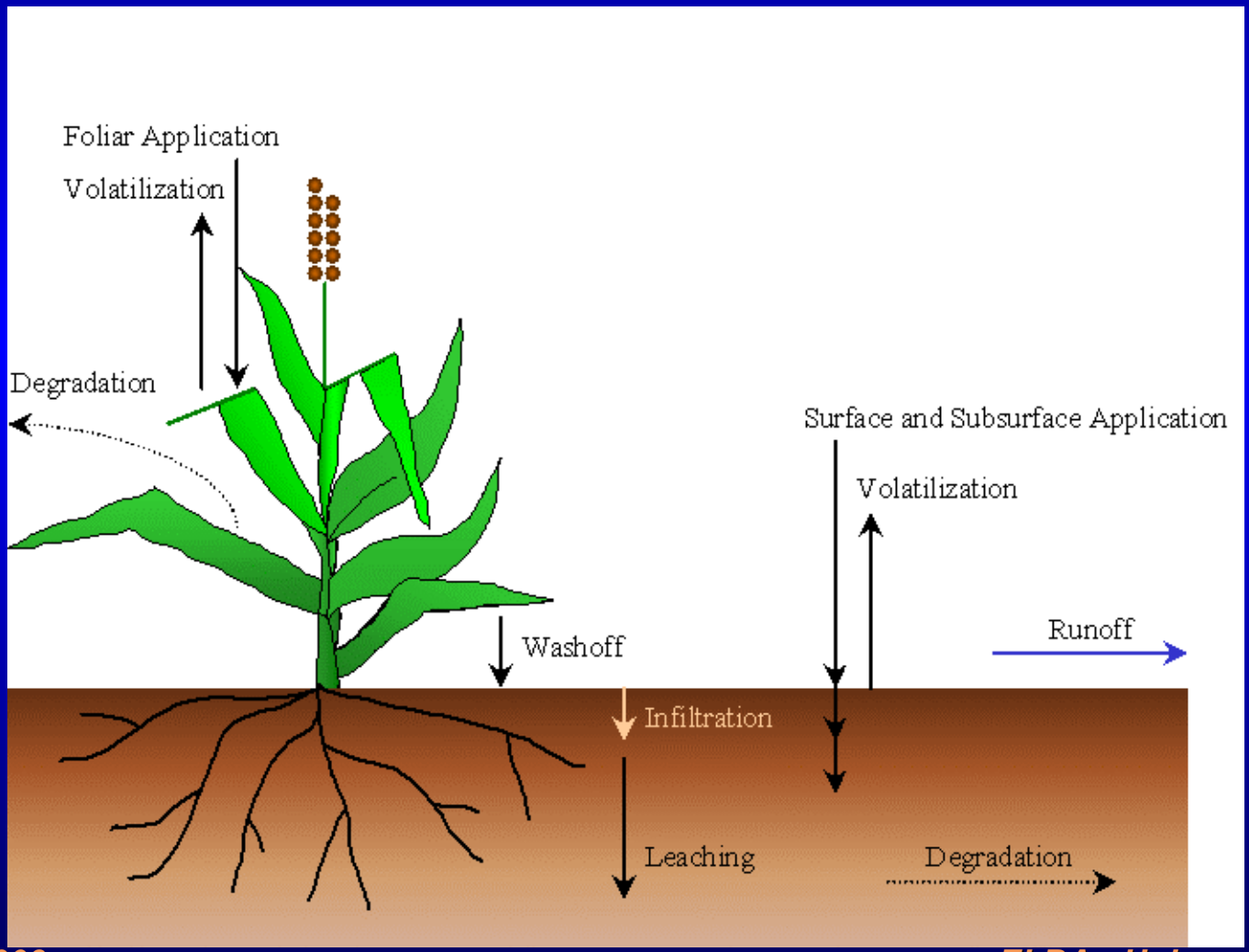


SWAT – PESTICIDES

SWAT simulates pesticide movement

- into the stream network via surface runoff (in solution and sorbed to sediment transported by the runoff)
- into the soil profile and aquifer by percolation (in solution)
- into the atmosphere through volatilization.

ELBA
Environmental Liveliness and Blent Agriculture



SWAT – EROSION

Erosion and sediment yield are estimated for each areas with the Modified Universal Soil Loss Equation (MUSLE) .

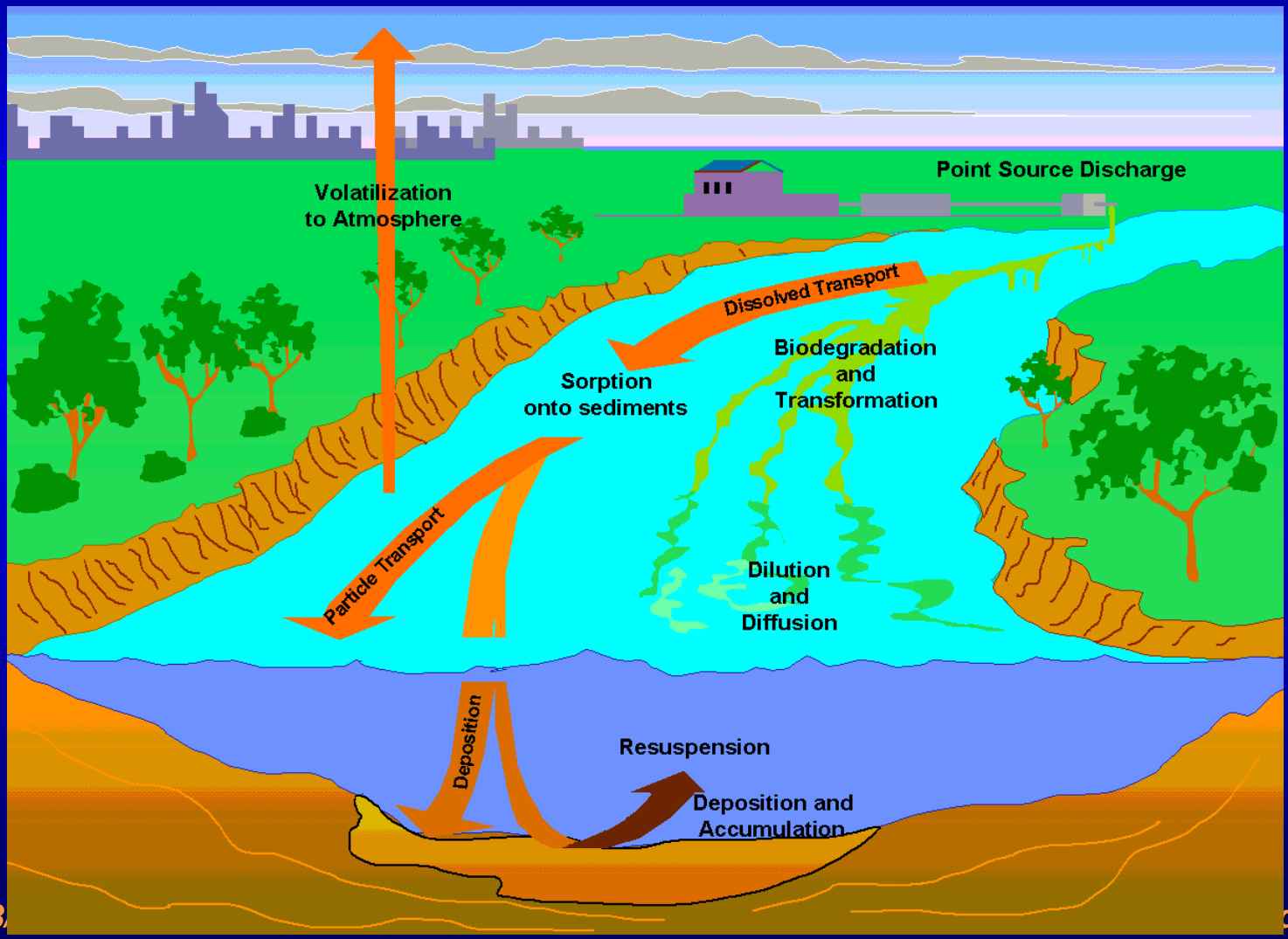
While the USLE uses rainfall as an indicator of erosive energy, MUSLE uses the amount of runoff to simulate erosion .

SWAT – Routing Phase

Once SWAT determines the loadings of water, sediment, nutrients and pesticides to the main channel, the loadings are routed through the stream network of the watershed

ELBA

Environmental Liveliness and Blent Agriculture



ELBA - Output

Analisi politico-economica

- Intero territorio nazionale
- Diversi livelli aggreg. spaziale
- Bilancio economico per attività produttiva
- Bilancio di mercato e flussi comm.
- Misure di politica economica ed ambientali

Analisi ambientale

- Nutrienti: N, P, NH3
- GHG: CH4, N2O, CO2
- Indicatori DPSIR
- Lisciviazione, percolamento

ELBA - Applicazioni

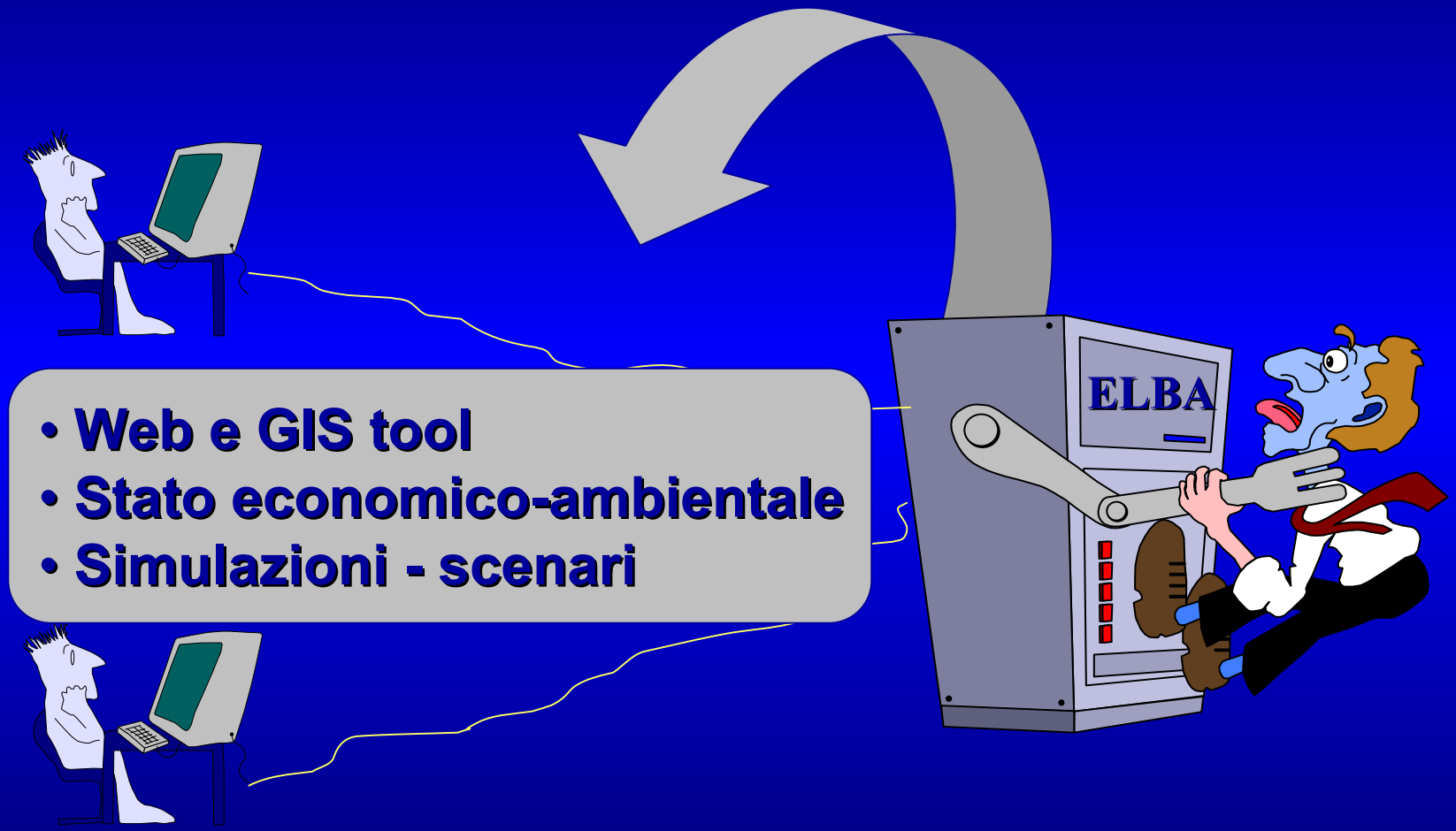
- Cross-compliance

- Agenda21

- Contabilità ambientale

- I.S.E.W. agricolo

ELBA - Connessione remota



- Web e GIS tool
- Stato economico-ambientale
- Simulazioni - scenari