The Global Forest and Agricultural Sector Optimization Model

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Why Global FASOM?

- Global Trade
- Pollution Leakage
- Global Externalities

- Heterogeneity
  - Soils
  - Land management

Methodological Developments

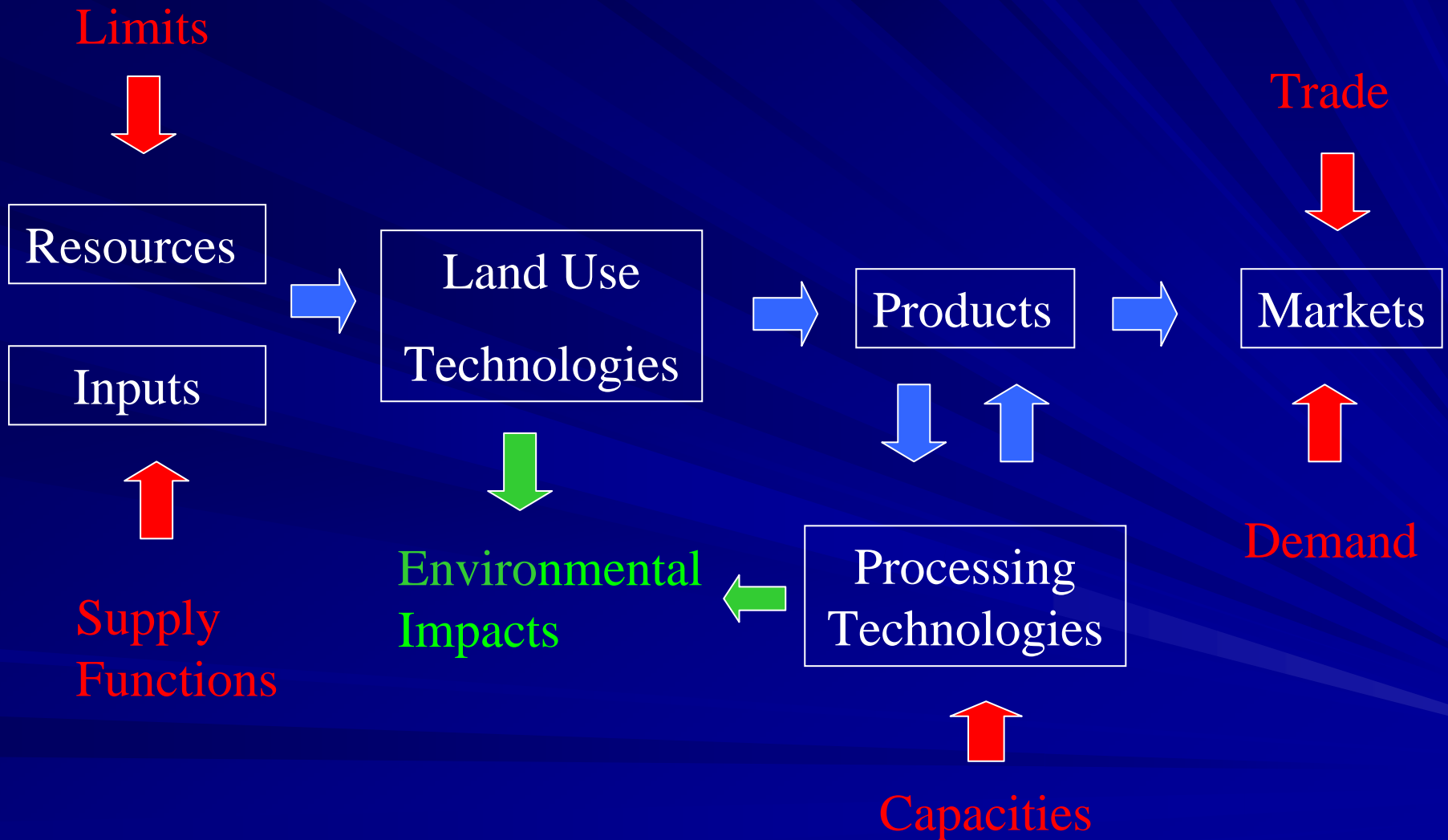1. Regional Expansion (Global FASOM)

2. Soil State Dynamics

3. Biodiversity
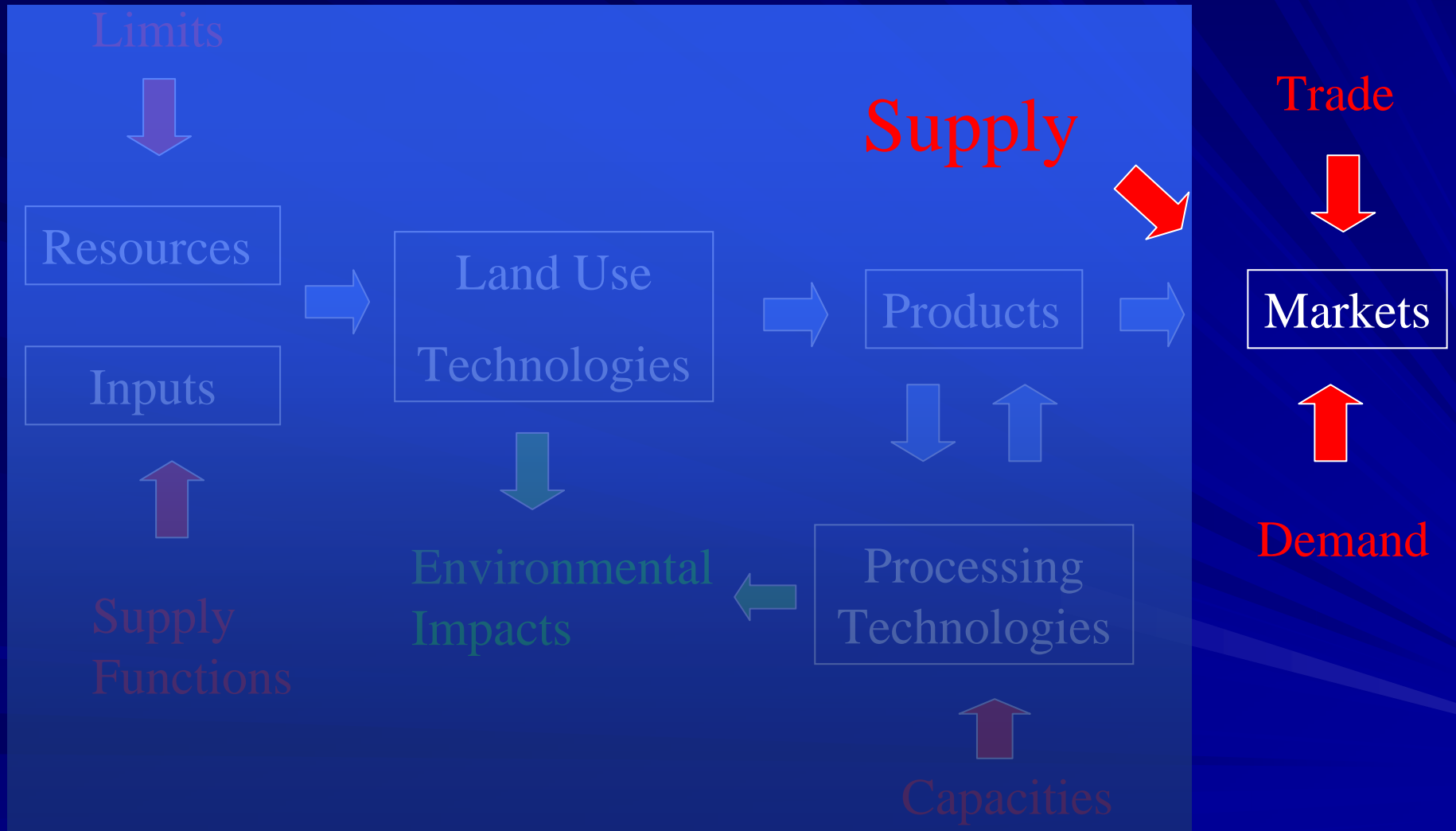
1. Regional Expansion

Global FASOM

FASOM History

- US (1993-)

- EU (2004-)

- Global (2006-)

US/EU Regions

Non-US/EU Regions

Limits

Supply

Trade

Resources

Land Use
Technologies

Products

Markets

Inputs

Supply
Functions

Environmental
Impacts

Processing
Technologies

Demand

Capacities

Tasks

- US + EU FASOM + others

- Balance Regional Resolution

- Land use in non-US / non-EU
  - Microeconomics (Data)
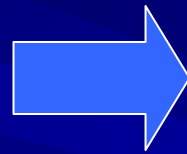 - Environmental impacts (Simulation)

2. Soil State Dynamics

Why Soil State Dynamics?

- **Vulnerability (Humus, Salt)**

- Climate Mitigation
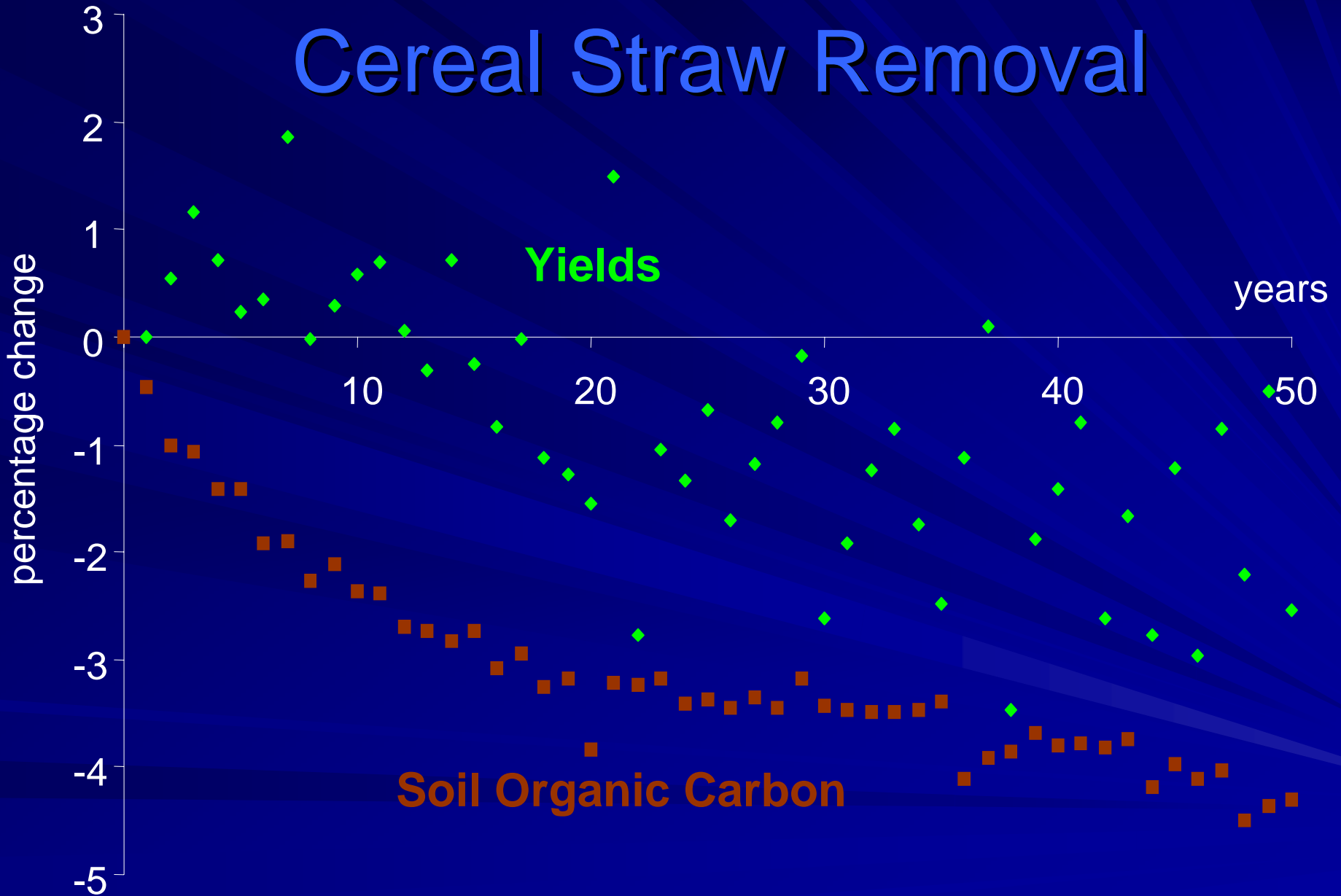
- Productivity

- Desertification, Salinization
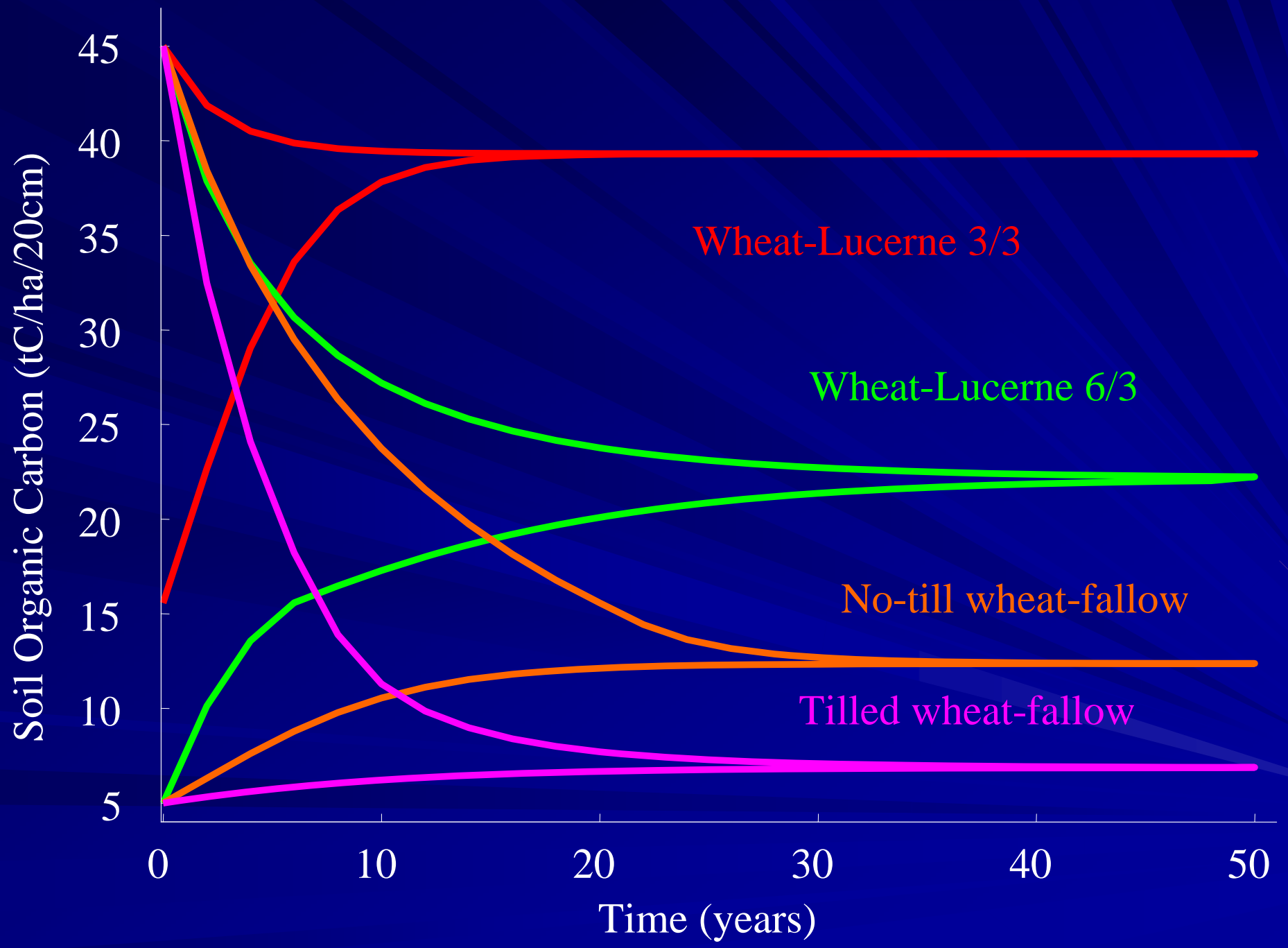
Soil Carbon Determinants

- Crop Choice
- Tillage
- Irrigation
- Fertilization
- Residue Mgt
- Soil Carbon

→ Soil Carbon Change

Wheat-Lucerne 3/3

Wheat-Lucerne 6/3

No-till wheat-fallow

Tilled wheat-fallow

Previous

- Curse of Dimensionality

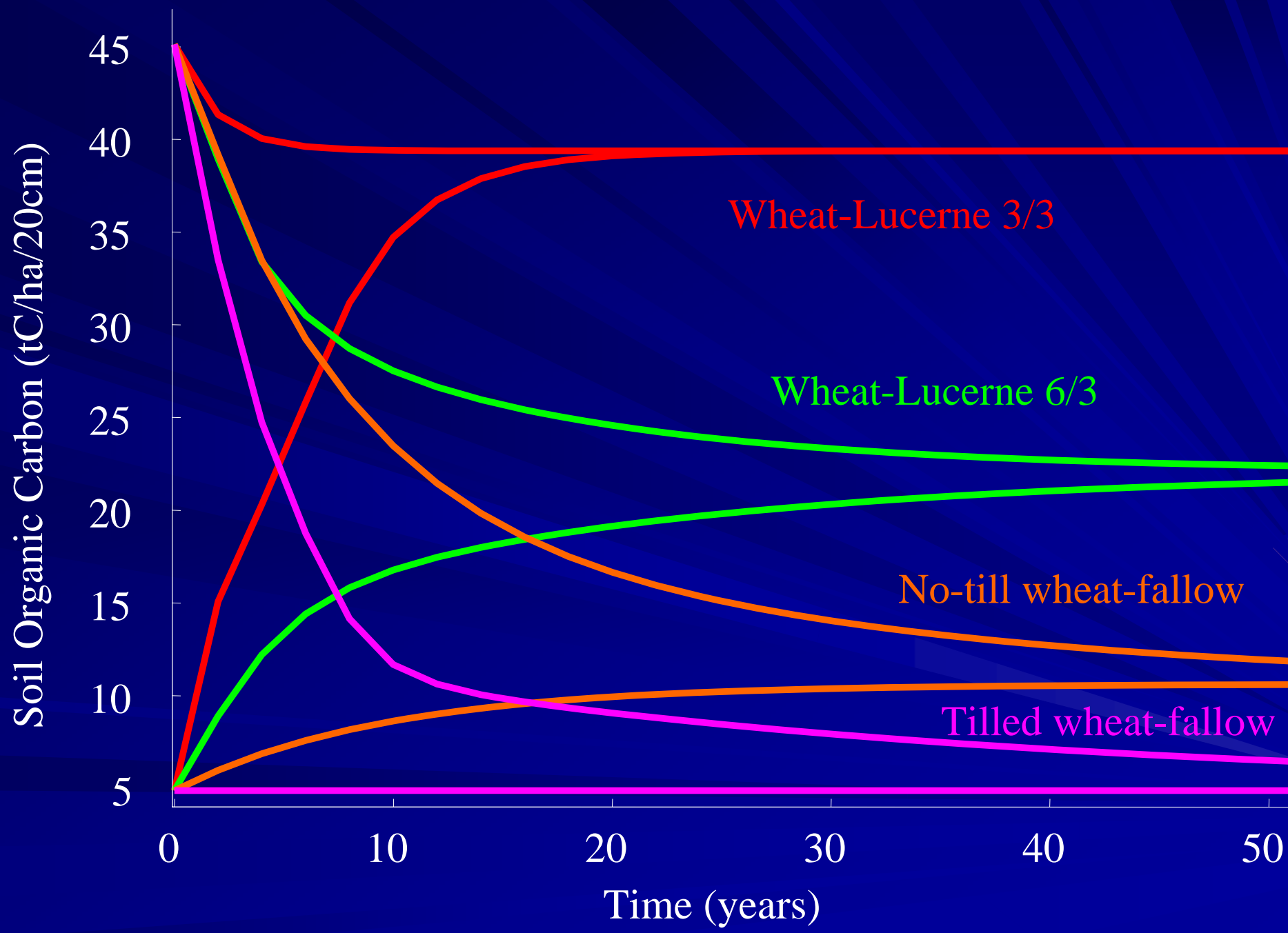- Use of constant emission/sequestration coefficients

New Development

- Markov chain using soil organic carbon as state variable (Schneider, 2007)

Soil Carbon Transition Probabilities

	SOC1	SOC2	SOC3	SOC4	SOC5	SOC6	SOC7	SOC8
SOC1	0.81	0.19						
SOC2		1						
SOC3		0.09	0.91					
SOC4			0.31	0.69				
SOC5				0.5	0.5			
SOC6					0.74	0.26		
SOC7						1		
SOC8						0.04	0.96	

No-till wheat-Fallow

Soil Organic Carbon (tC/ha/20cm) vs Time (years)

Wheat-Lucerne 3/3

Wheat-Lucerne 6/3

No-till wheat-fallow

Tilled wheat-fallow

Extensions

- Soil Carbon Types

- Salt

3. Biodiversity

Previous Treatment

- So far biodiversity is ignored in FASOM
- Comparable models use biodiversity scores

New Development

- Species or habitat requirements
- Habitat supply
- Currently limited to wetlands

Habitat Requirements

■ Vertebrate species as surrogates for biodiversity

– 16 amphibians

– 4 reptiles

– 9 mammals

– 43 birds

72 wetland species of European conservation concern

Habitat Requirements

- Multiple species may require the same habitat

- Eligible habitats must be of minimum size

Habitat Supply

- ■ Ecosystem Type
  - 1. Mires (Bogs, Fens)
  - 2. Wet forests (Alluvial Forests, Swamp Forests)
  - 3. Natural Grasslands
  - 4. Open waters (Running Waters, Standing Waters)
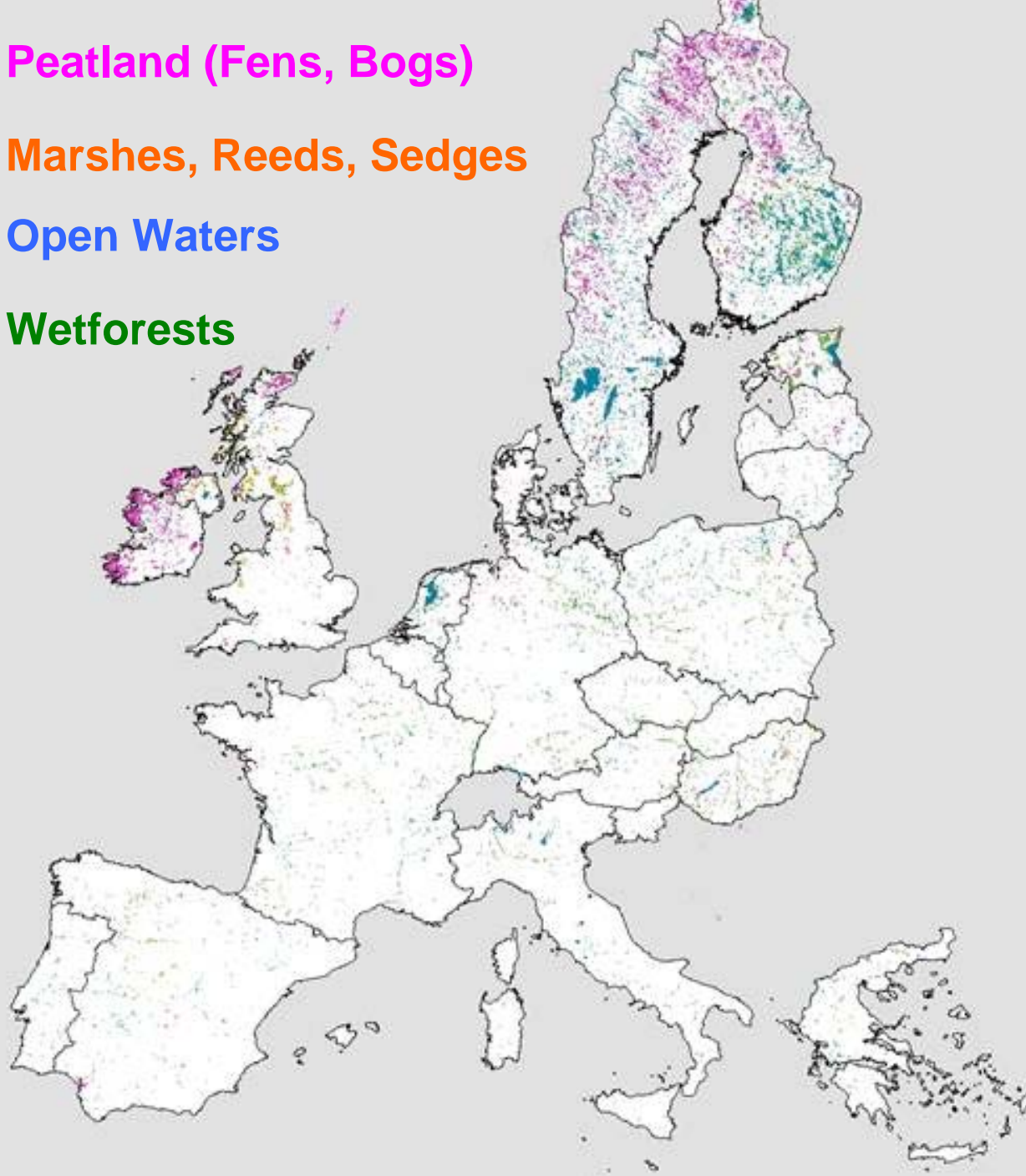- ■ Ecosystem Quality
  1. Existing, Inhabited
  2. Existing, Not inhabited
  3. Potential

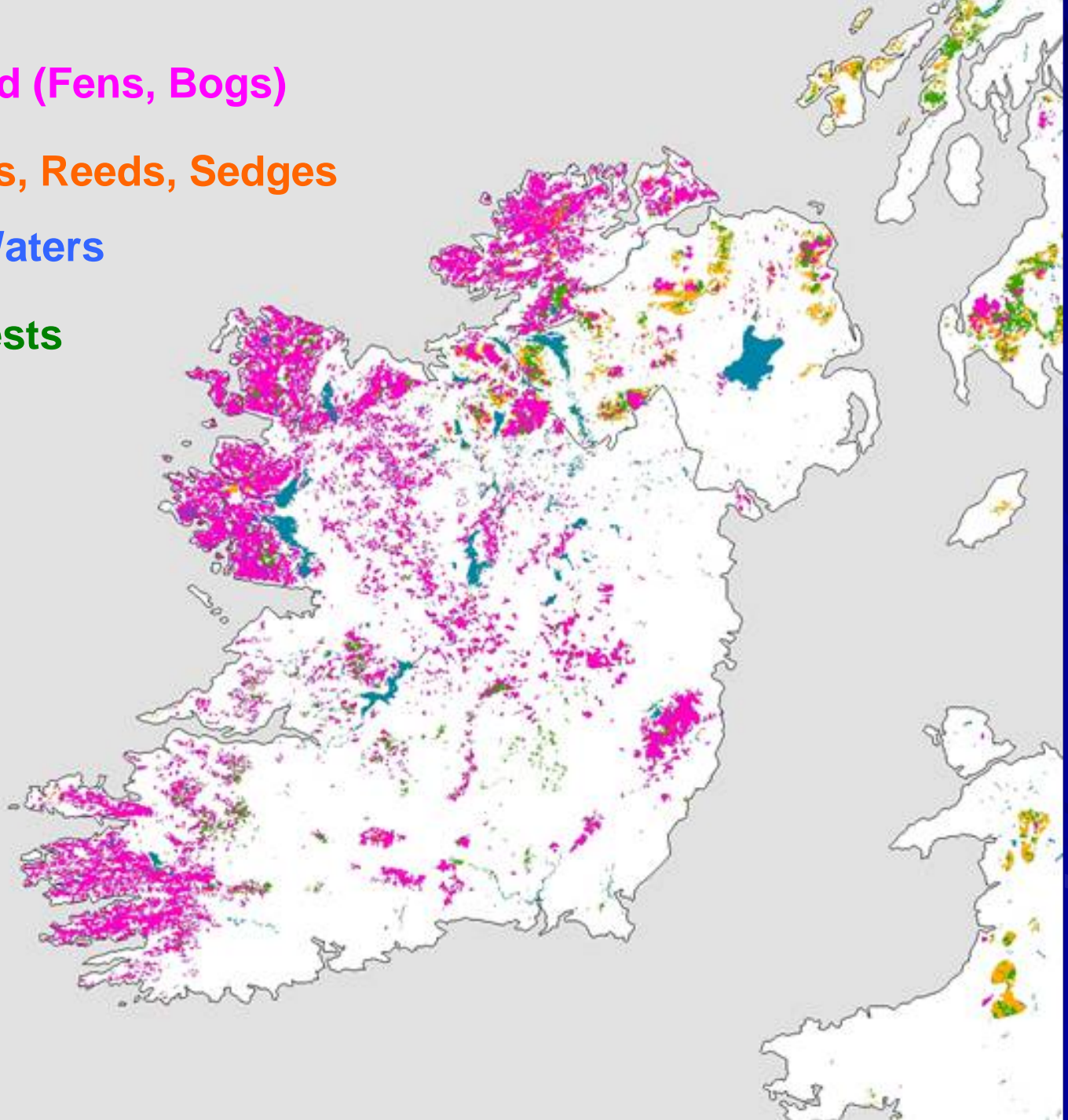**Peatland (Fens, Bogs)**

Marshes, Reeds, Sedges

Open Waters

Wetforests

Peatland (Fens, Bogs)

Marshes, Reeds, Sedges
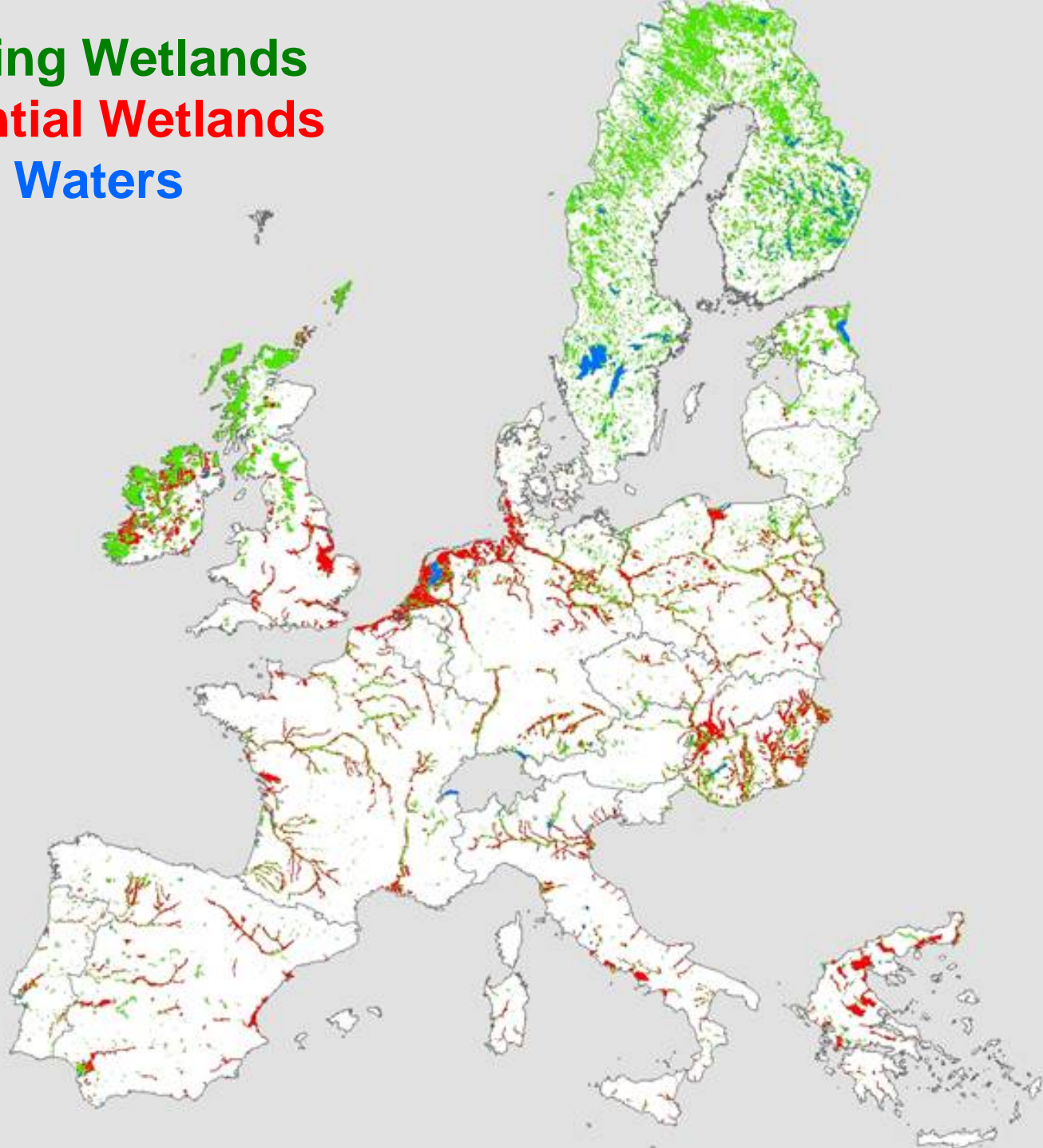
Open Waters

Wetforests

Existing Wetlands
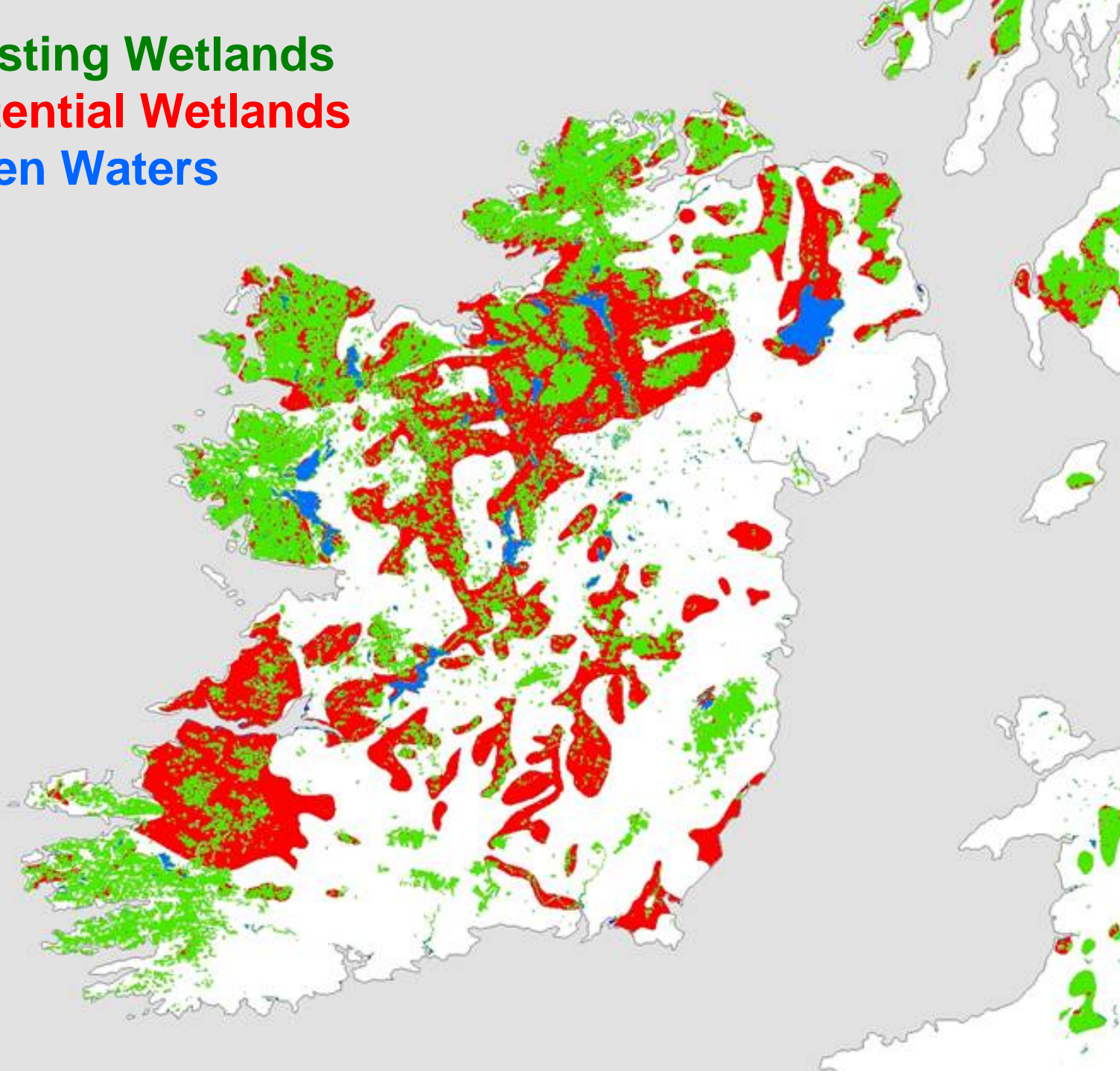Potential Wetlands
Open Waters

Existing Wetlands
Potential Wetlands
Open Waters

Conclusions

- Land use (change) may play an important new role via climate change mitigation
- However, land use impacts are complex and affect multiple non-market goods
- We should not solve today's problem by creating another one tomorrow
- Land use under multiple environmental objectives may be much different than under single (climate) objectives

Global Environmental Treaties

- Framework Convention on Climate Change (UNFCCC, 1992)

- Convention on Biological Diversity (CBD, 1992)

- Convention to Combat Desertification (UNCCD, 1996)

References

Schneider, U. A. (2007). Soil organic carbon changes in dynamic land use decision models. *Agriculture, Ecosystems and Environment*. In print.