The FUND model

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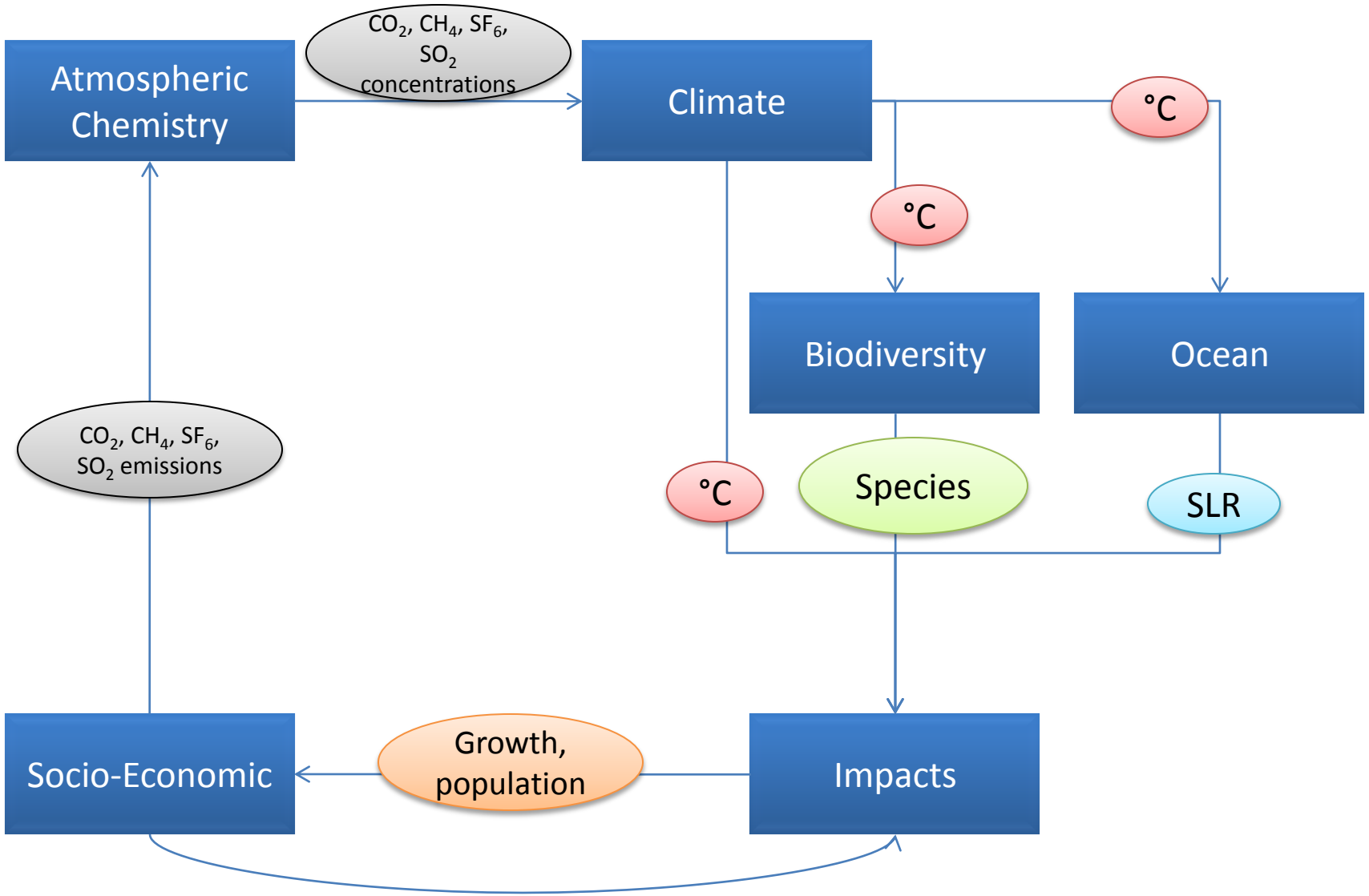
Outline

- FUND model
  - Basic structure
  - Impacts
  - Planed model developments
- Catastrophes
- Social Cost of Carbon – WG

FUND


Atmospheric Chemistry
CO_2, CH_4, SF_6, SO_2 concentrations
Climate
°C
°C
Biodiversity
Ocean
CO_2, CH_4, SF_6, SO_2 emissions
°C
Species
SLR
Socio-Economic
Growth, population
Impacts

Scenario

Exogenous

- GDP
- Population
- Energy and carbon intensity
- Land use change and deforestation CO_2 emissions
- CH_4 emissions
- NO_2 emissions

Endogenous

- CO_2 emissions
- CO_2 emissions from "dynamic biosphere"
- SF_6 emissions
- SO_2 emissions

Physical Components

- All gas cycles explicitly modeled (CO_2, CH_4, N_2O, SO_2)
- RF for each gas explicitly modeled

- Climate Sensitivity Uncertain
- Adjust transient climate response properly!

Health Impacts

Mortality (#)

Vector born diseases
- Dengue fever
- Malaria
- Schistosomiasis

Diarrhoea

Cardiovascular
- Cold
- Heat

Respiratory

Extratropical storms

Tropical storms

Value of a Statistical Life

Morbidity (years)

Vector born diseases
- Dengue fever
- Malaria
- Schistosomiasis

Diarrhoea

Cardiovascular
- Cold
- Heat

Respiratory

WTP

Sea-level Rise

- Based on Fankhauser (1994), updated

- Cost of protection
- Value of lost dryland
- Value of lost wetland
- Cost of Emigration
- Cost of Imigration

More Impacts

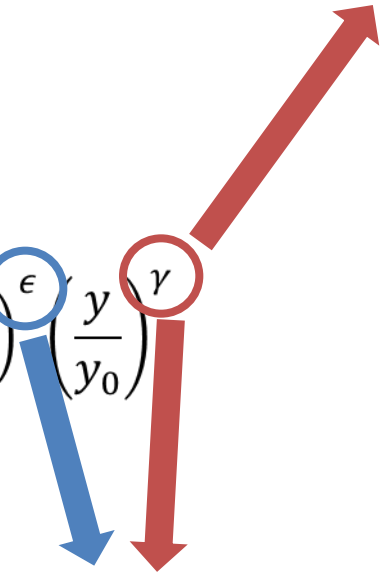
- Agriculture
- Tropical Storms
- Extratropical Storms
- Forestry
- Heating Energy
- Cooling Energy
- Water Resources
- Species Loss

Damages

$$D_{tr} = \sum_s D_s(T_{tr}, y_{tr}, \dots)$$

$$\begin{cases} \gamma = 0 & \text{additive damage} \\ \gamma = 1 & \text{multiplicative damage} \\ \gamma > 1 & \text{"luxury good" type damage} \\ \gamma < 0 & \text{"Schelling" type damage} \end{cases}$$

$$D_s(T, y, \dots) = \alpha \left(\frac{T}{1.0}\right)^{\epsilon} \left(\frac{y}{y_0}\right)^{\gamma}$$



Uncertain in Monte Carlo mode

Future Plans on Impacts

- Ocean Acidification
  - Corral reefs
  - Shell fish
- Tourism
- River floods
- Update energy consumption

Catastrophes

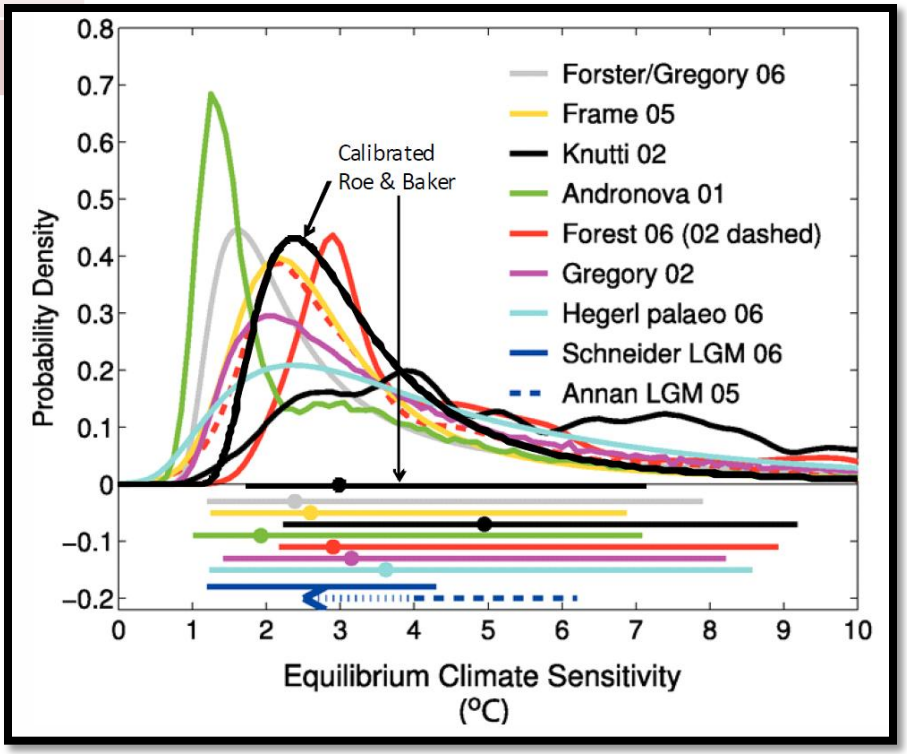
Ceronsky et al. (~~2005~~2010 hopefully!) „Checking the price tag on catastrophe: The social cost of carbon under non-linear climate response," *FNU Working Paper* 87

- Thermohaline circulation collapse
- Marine methane hydrate destabilization
- High Climate Sensitivities

Social Cost of Carbon - WG

Scenario Uncertainty

Scenario	YpC in thousand $	Probability
IMAGE	43.4	20%
MERGE	27.8	20%
MESSAGE	32.1	20%
MiniCAM	42.6	20%
5th Scenario	35.7	20%



Discounting

Distribution

Case 1

Country	Damage
Italy	0.9%
Rwanda	13.2%

Case 2

Country	Damage
Italy	1.0%
Rwanda	1.0%

=

Country	Damage
World Average	1.0%

Anthoff, D. and R. S. J. Tol (2009). "The Impact of Climate Change on the Balanced Growth Equivalent: An Application of FUND." *Environmental and Resource Economics* **43**(3): 351-367

Anthoff, D. and R. S. J. Tol (2010). "On international equity weights and national decision making on climate change." *Journal of Environmental Economics and Management* **60**(1): 14-20

Thank you!

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