Tools for Climate Change Modeling and Scenario Analysis

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Beijing, China

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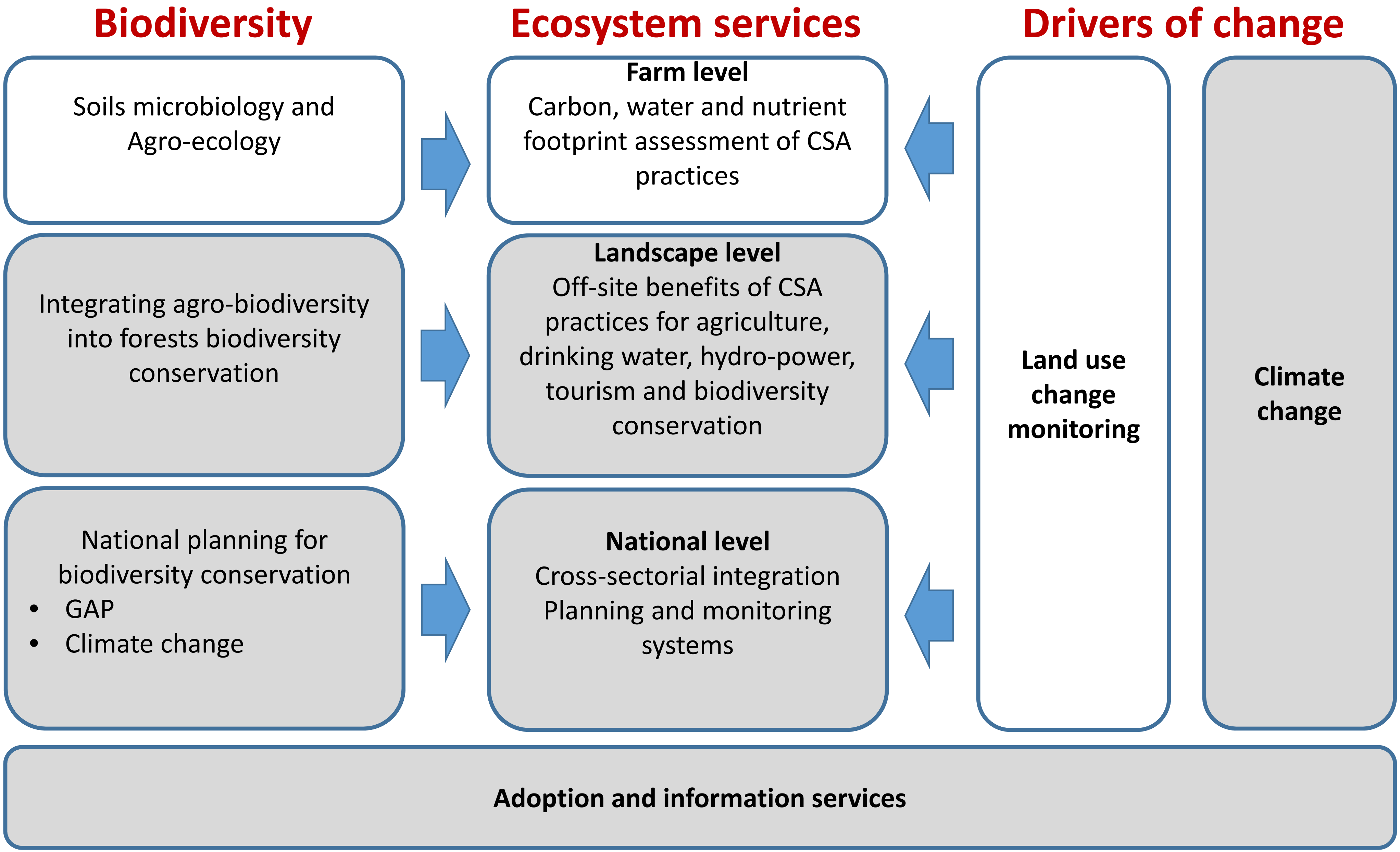
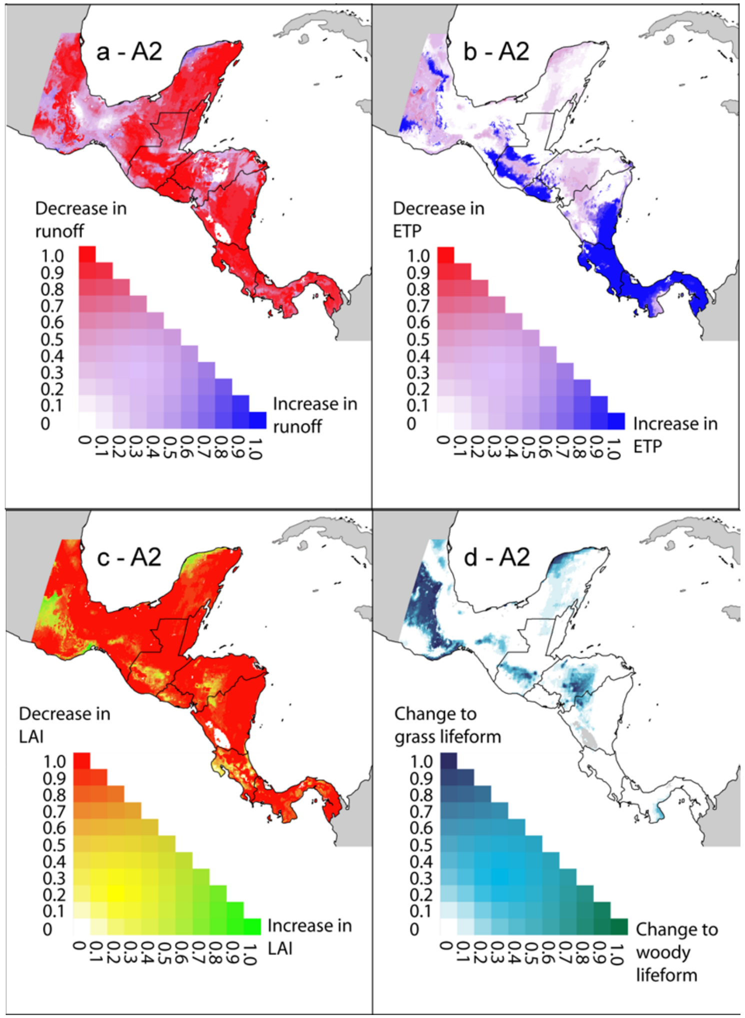

Biodiversity
Ecosystem services
Drivers of change
Soils microbiology and Agro-ecology
Farm level
Carbon, water and nutrient footprint assessment of CSA practices
Integrating agro-biodiversity into forests biodiversity conservation
Landscape level
Off-site benefits of CSA practices for agriculture, drinking water, hydro-power, tourism and biodiversity conservation
National planning for biodiversity conservation
• GAP
• Climate change
National level
Cross-sectorial integration
Planning and monitoring systems
Land use change monitoring
Climate change
Adoption and information services

Land Surface Modeling

- Surface Vegetation Atmosphere (SVAT) models – Equilibrium approach:
  - **Potential** vegetation types that can develop given climate constraints (precipitation, temperature);
  - Comparison between current and future **climate conditions**.
  - Case study: use of MAPSS (Neilson 1995); potential equilibrium states (vegetation, water) in Mesoamerica under Climate Change.

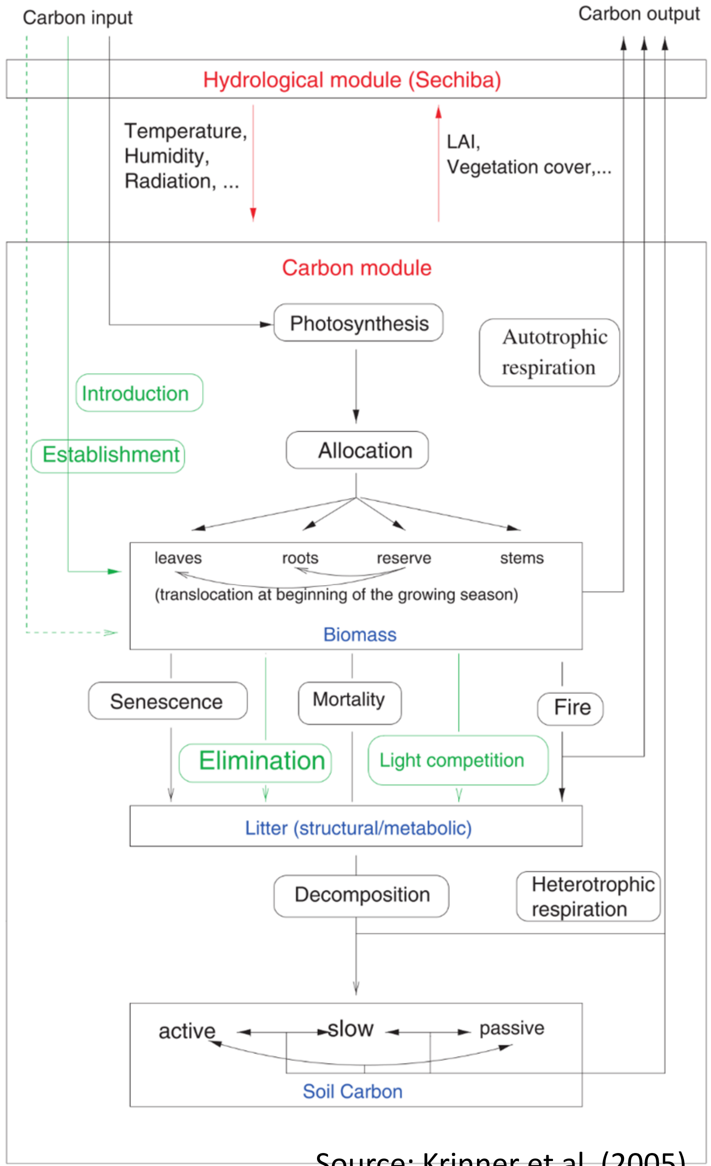
2070 - 2100



Source: Imbach et al. (2012)

Land Surface Modeling

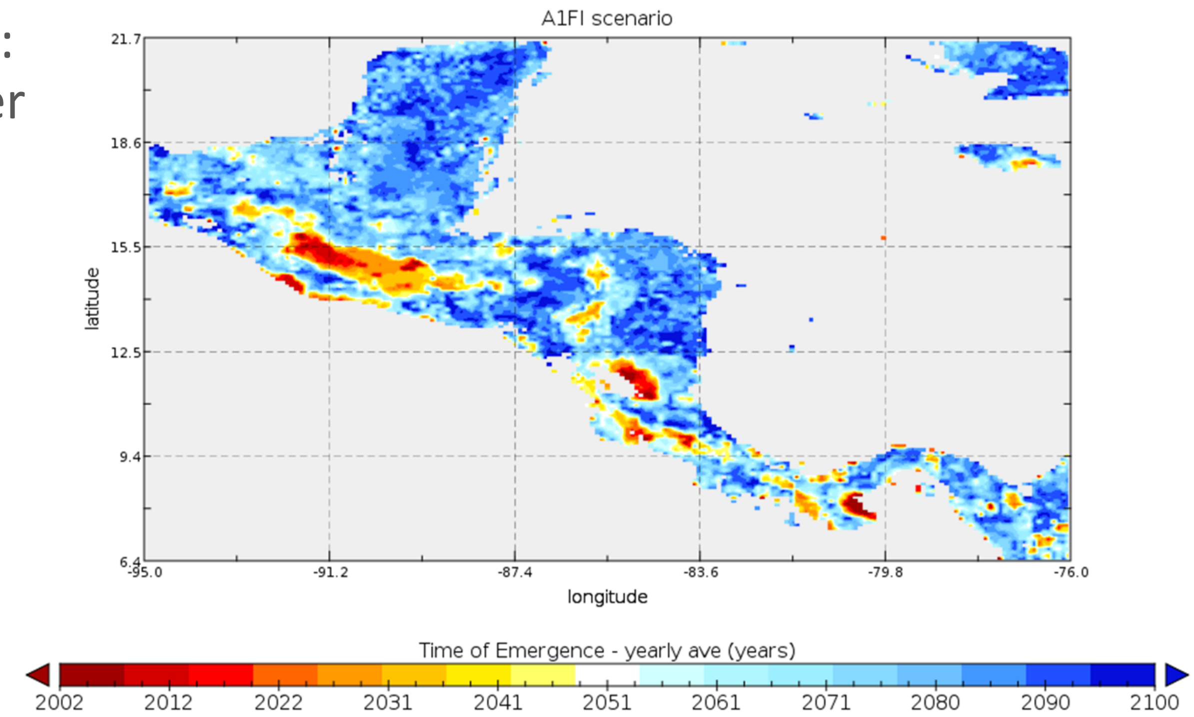
- Dynamic approach: dynamic global vegetation models (DGVMs);
- Study of **inter-annual variability** and **transient changes** in the land biosphere.



Source: Krinner et al. (2005).

Land Surface Modeling

- Case study – application of a DGVM: Use of the model ORCHIDEE (Krinner et al., 2005) to simulate transient changes in runoff in response to climate change in Mesoamerica.

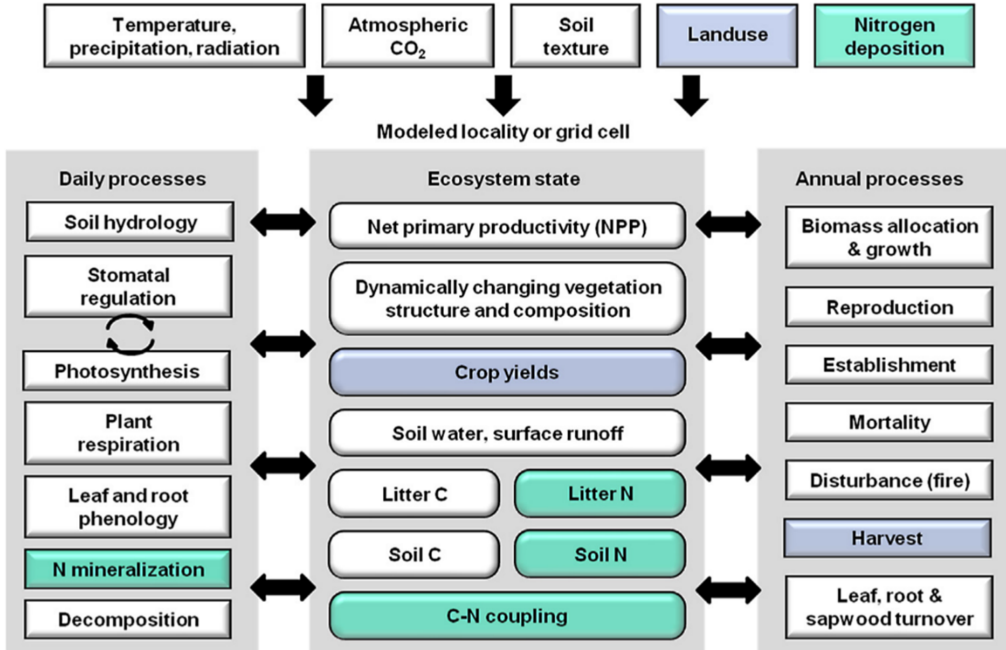


Time of emergence: the year when runoff decreases permanently below the historical minimum (Q_{25}).

Source: Imbach et al. (in prep.)

Land Surface Modeling – Current work

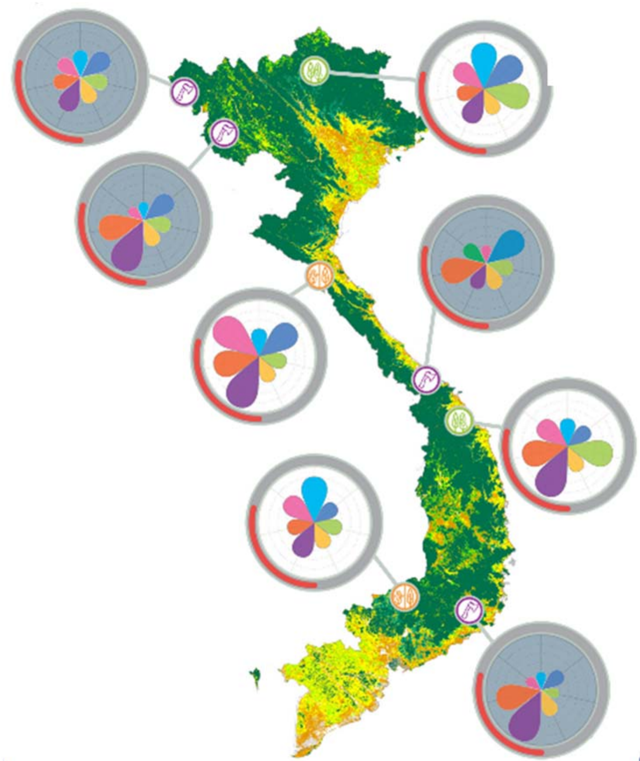
- Crop yields at continental/ regional scale (multi-scale approach along with crop models);
- Monitoring of soil moisture: application to monitoring of agricultural drought;
- Impact of land management practices:
  - Carbon and nutrient cycling;
  - Vegetation changes → biodiversity.



Source: Bayer et al. (2015)

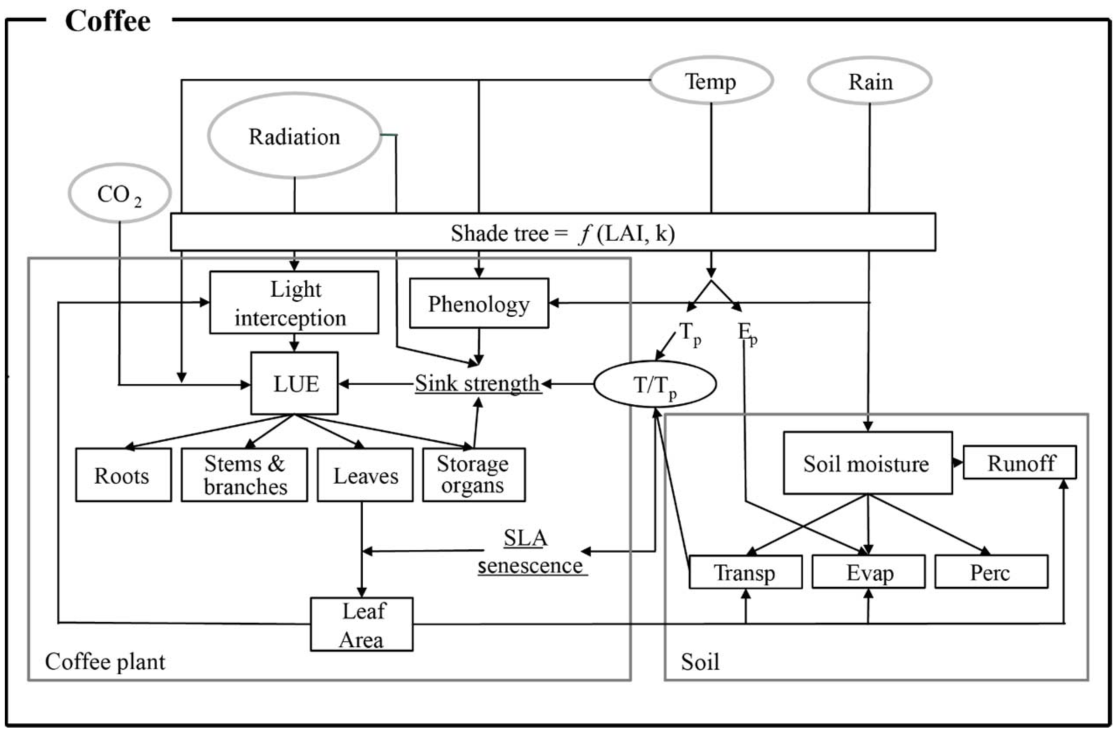
Land Surface Modeling – Current work

- Contribution to identification, quantification and valuation of ES:
    - Historical variability;
    - Effects of climate change and variability;
    - Effect of out-scaling agricultural practices
- Support:
    - Spatial planning;
    - Monitoring systems;
    - Cross-sectoral planning.



Crop Modeling – Climate Change Implications

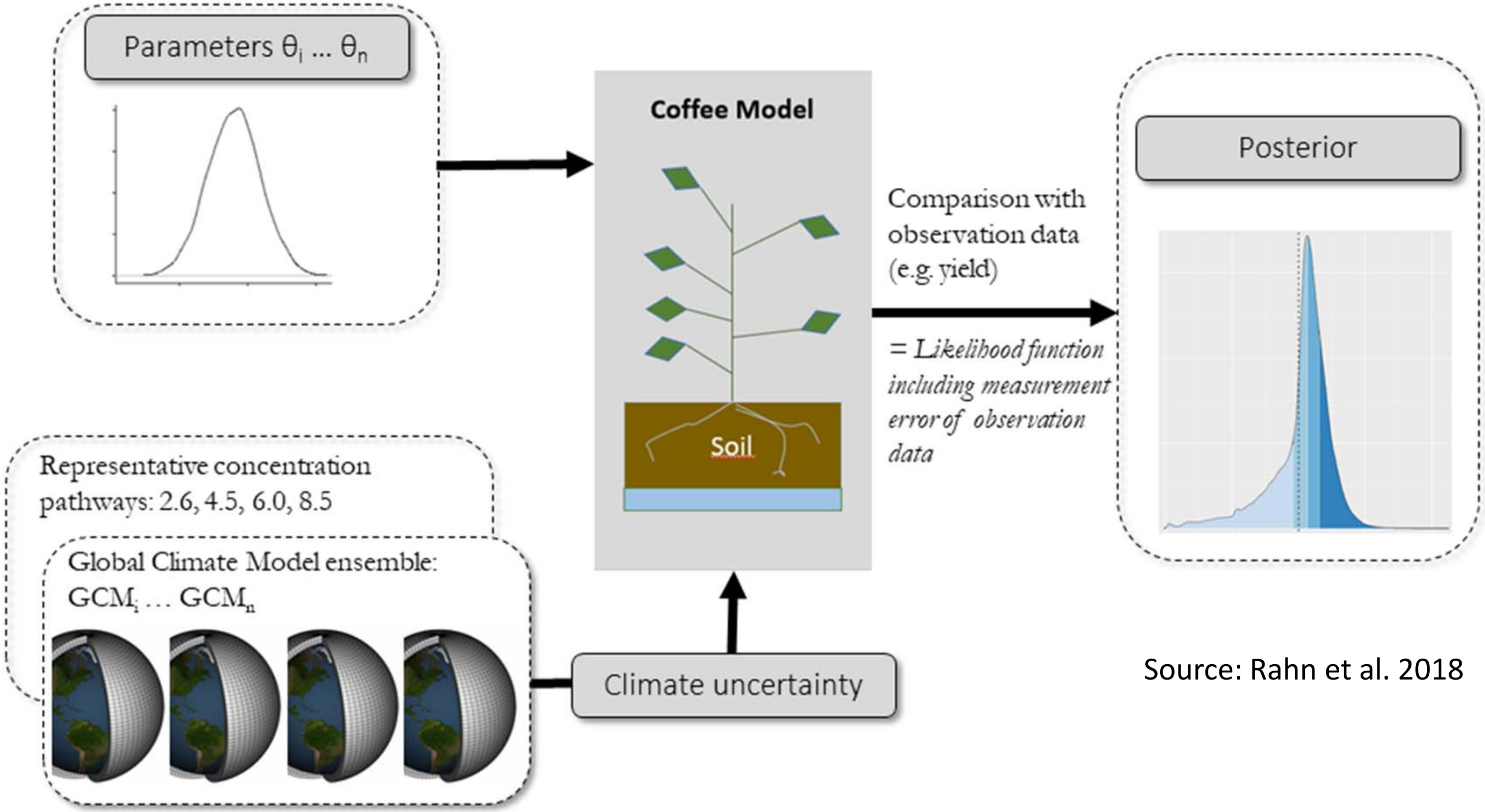
- Process-based yield forecasting;
- Project starting in Vietnam (coffee in Central Highlands).



Source: Rahn et al. 2018

Crop Modeling – Climate Change Implications

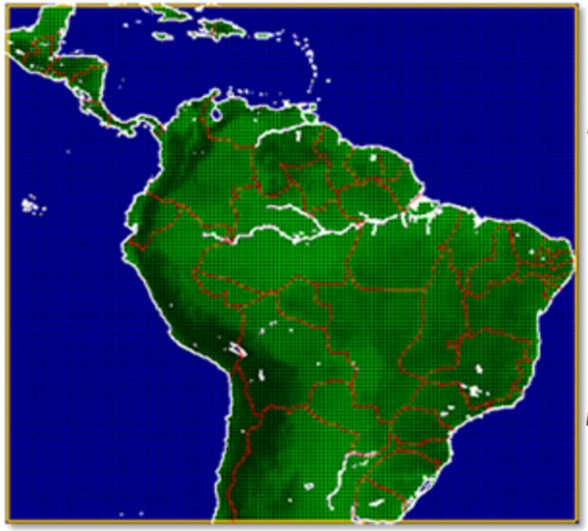
- Data assimilation: bayesian inference to estimate model parameters and uncertainty assessment.



Source: Rahn et al. 2018

Downscaling of Climate Change Projections

- CIAT GCM Data Portal;
- Statistical downscaling of CMIP3 and CMIP5 climate projections at global scale (1 km);
- Dynamical downscaling in Central and South America – models ETA and PRECIS.

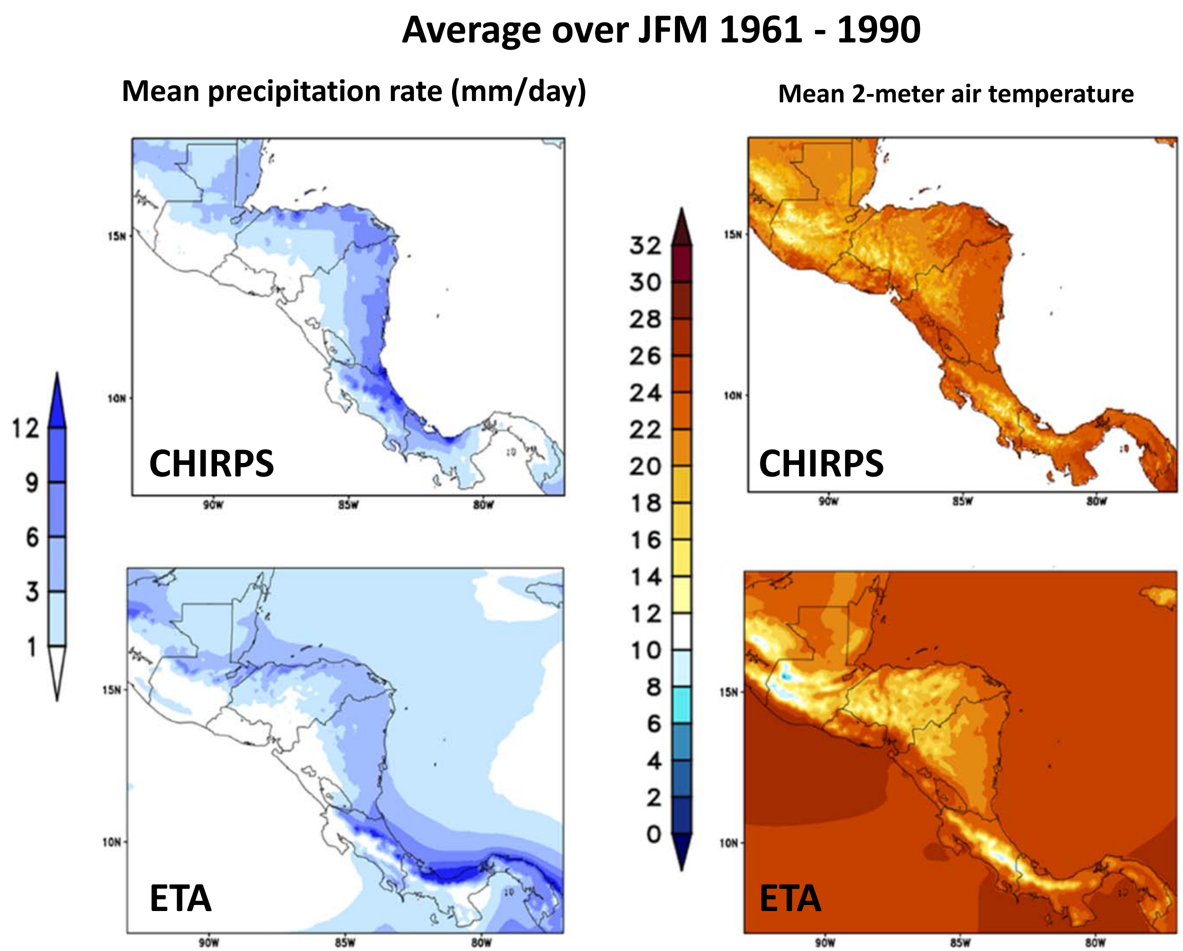


Processing domain with the regional climate model PRECIS (50 km resolution).

GCM	Scenario	Period
HadCM3Q0	SRES A1B	1950 - 2100
HadCM3Q3	SRES A1B	1950 - 2100
HadCM3Q16	SRES A1B	1950 - 2100
ECHAM4	SRES A2	1989 - 2100
ECHAM4	SRES B2	2069 - 2100
ECHAM5	SRES A1B	1950 - 2100
HadAM3P	Baseline	1960 - 1990
HadAM3P	SRES A2	2070 - 2100
HadAM3P	SRES B2	2070 - 2100
ERA40	Reanalisys	1957 - 2000
NCEP:R2	Reanalisys	1979 - 2005
ERA-Interim	Reanalisys	1988 - 1997
ERA15	Reanalisys	1979 - 1993

Downscaling of Climate Change Projections

- Dynamical downscaling:
  - 8 km in Central America;
  - ETA model;
  - GCM HadGEMS2-ES, RCP 4.5.



Source: Imbach et al. (2018)

CIAT

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Perspectives

- Monitoring and analysis of ecosystem services through a coherent framework (DGVMs):
  - Carbon sequestration;
  - Water availability (e.g. human consumption, hydropower);
  - Biodiversity conservation;
  - Nutrient cycling.
- Impact of climate-smart agricultural practices;
- Foresight modeling.

Early warning for deforestation and land cover change

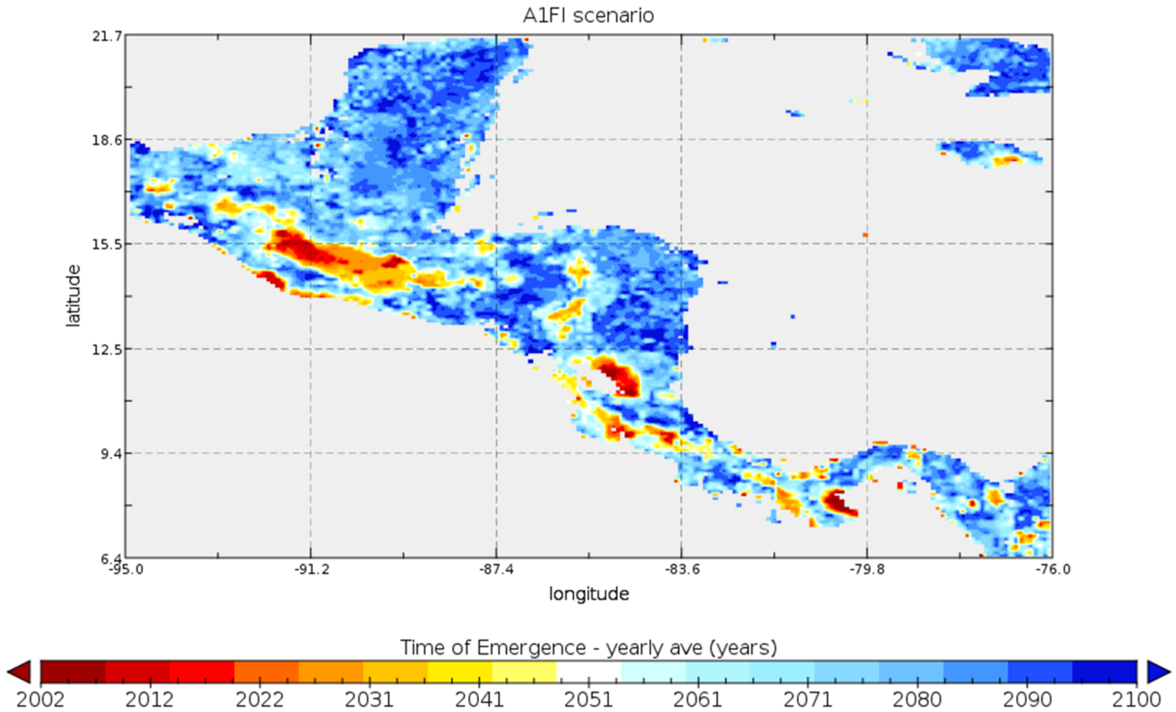
Potential link with:

CAAS Disciplinary Cluster: Agricultural Resources and Environment

CAAS Disciplines:
Agricultural environmental monitoring and evaluation
Agricultural and forestry biomass transformation engineering

Land Surface Modeling

- Dynamic approach: dynamic global vegetation models;
- Study of **inter-annual variability**.



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