Future Land-Use Patterns

- ISIMIP2 Workshop-

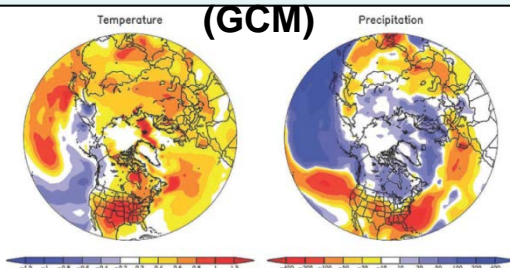**Miodrag Stevanović**

23 June 2016

Introduction

- Consistent land-use patterns projections for the ISIMIP 2nd phase
- Contribution to 1.5 degree Celsius IPCC report

- Goals:
  - Land-use patterns as a representation of **climate change** induced impacts in agricultural and other land-use sector
  - Land-use patterns as a representation of **mitigation** trade-offs from large-scale land-based mitigation policies (bioenergy production and avoided deforestation).

MAgPIE – **M**odel of **Ag**ricultural **P**roduction and its **I**mpact on **E**nvironment

Biophysical inputs

Global Circulation Models (GCM)

Temperature   Precipitation

Temperature
Precipitation

Vegetation Hydology Model *LPJmL*

Crop yields, Water, Carbon & Residues

Global Land Database

based on FAO, IUCN and WRI

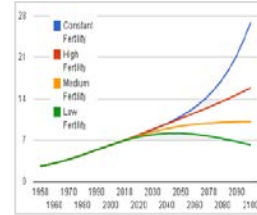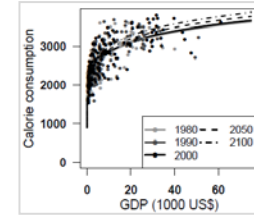Cropland, Pasture, Forest, Scrub, …

Socioeconomic inputs (regions)

Income (GDP)

Population

- GTAP
- OECD
- World Bank
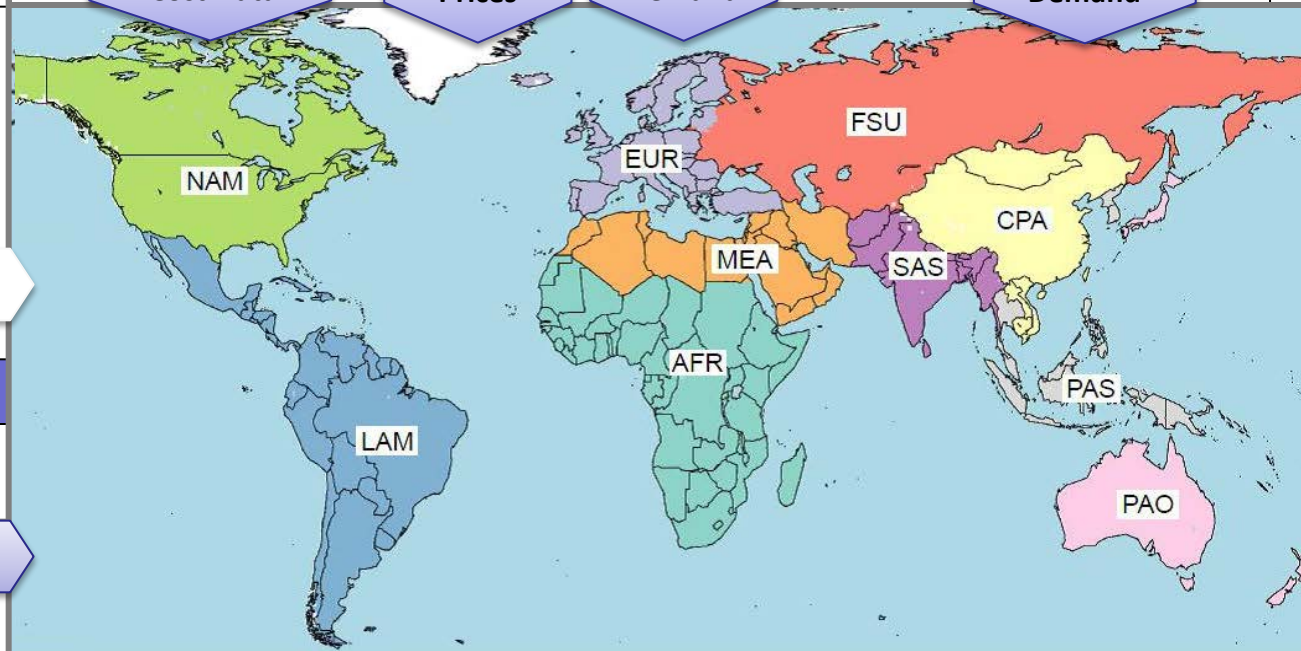- IFPRI

Energy System Model *ReMind*

kcal/capita

Investment and Cost Data

CO_2 Prices

Bioenergy Demand

Food + Feed Demand
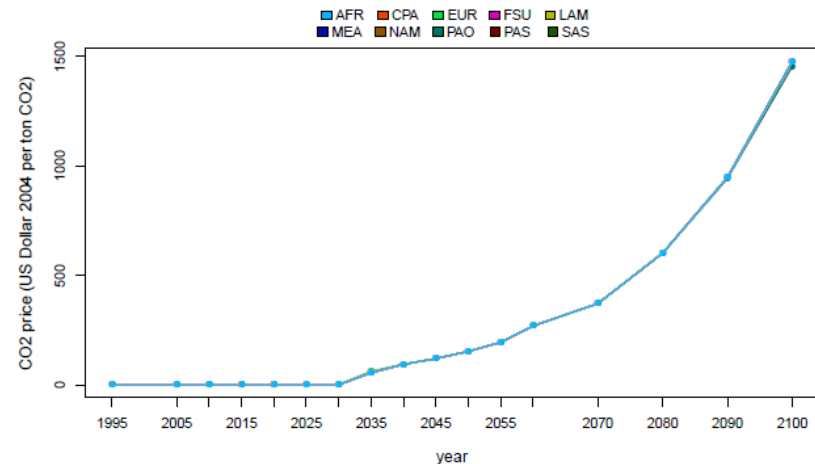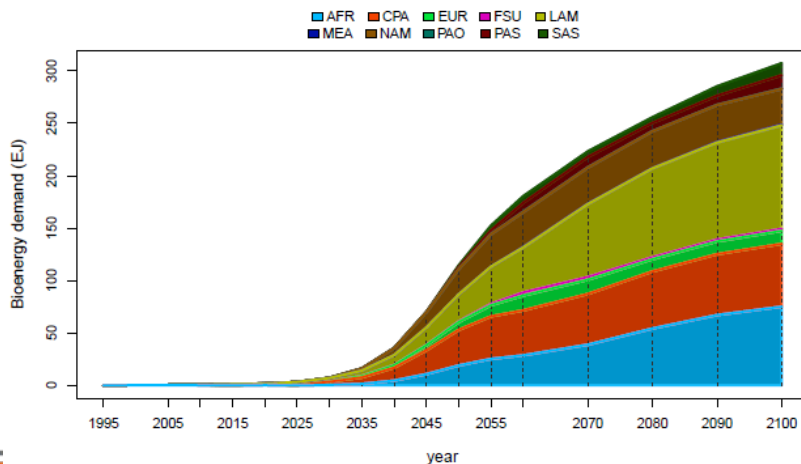
FSU
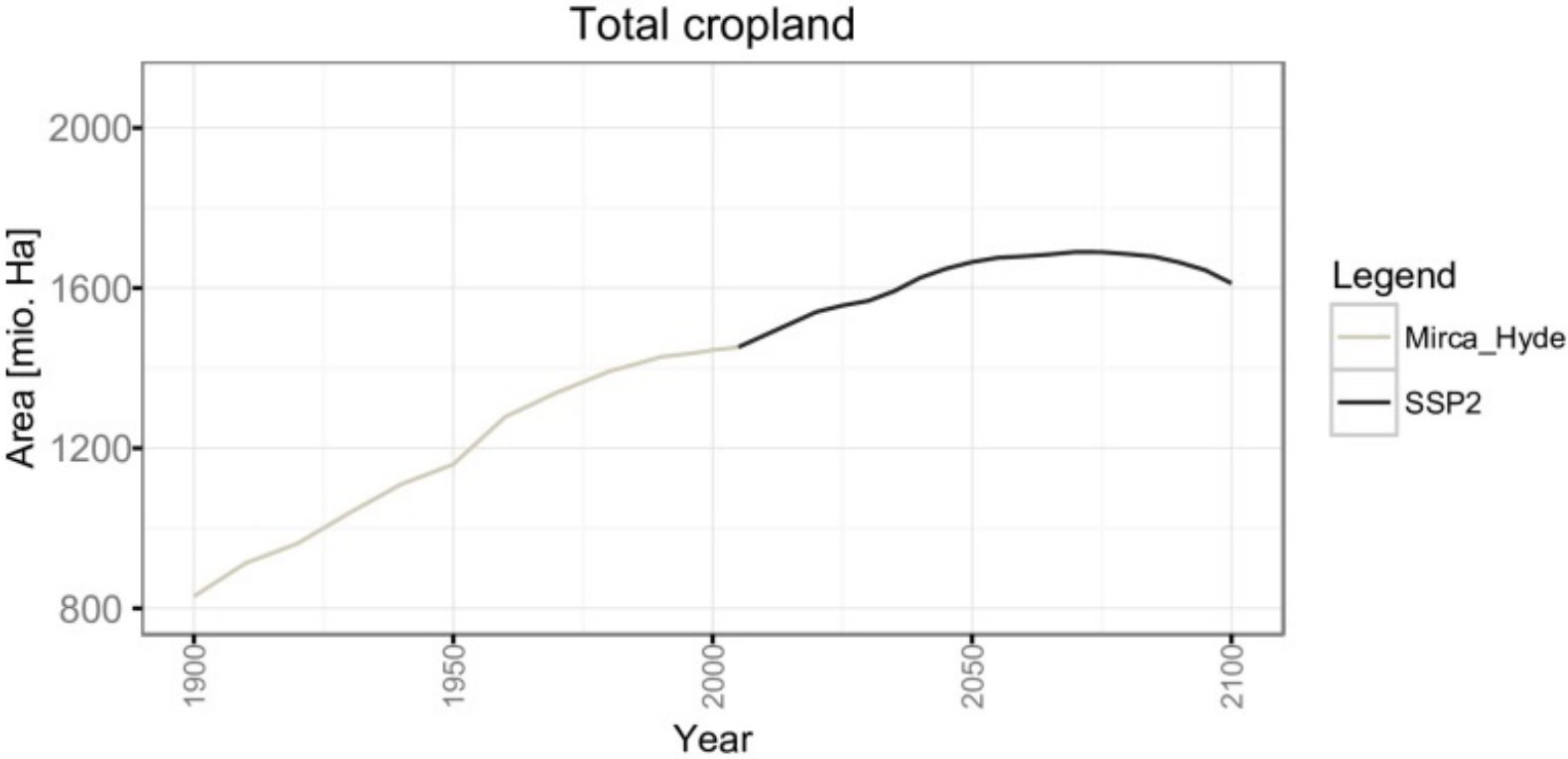EUR
NAM
CPA
MEA
SAS
AFR
PAS
LAM
PAO

MAgPIE

- **Output**: optimal land-use patterns (spatially explicit land- and water use)

- **Endogenous** interplay of:
  - Cropland expansion
  - Irrigation expansion
  - Yield-increasing technological change
  - Transport and trade opportunities

- **Caveats** that influence spatial representation:
  - Clustering of spatial data
  - Disaggregation procedures
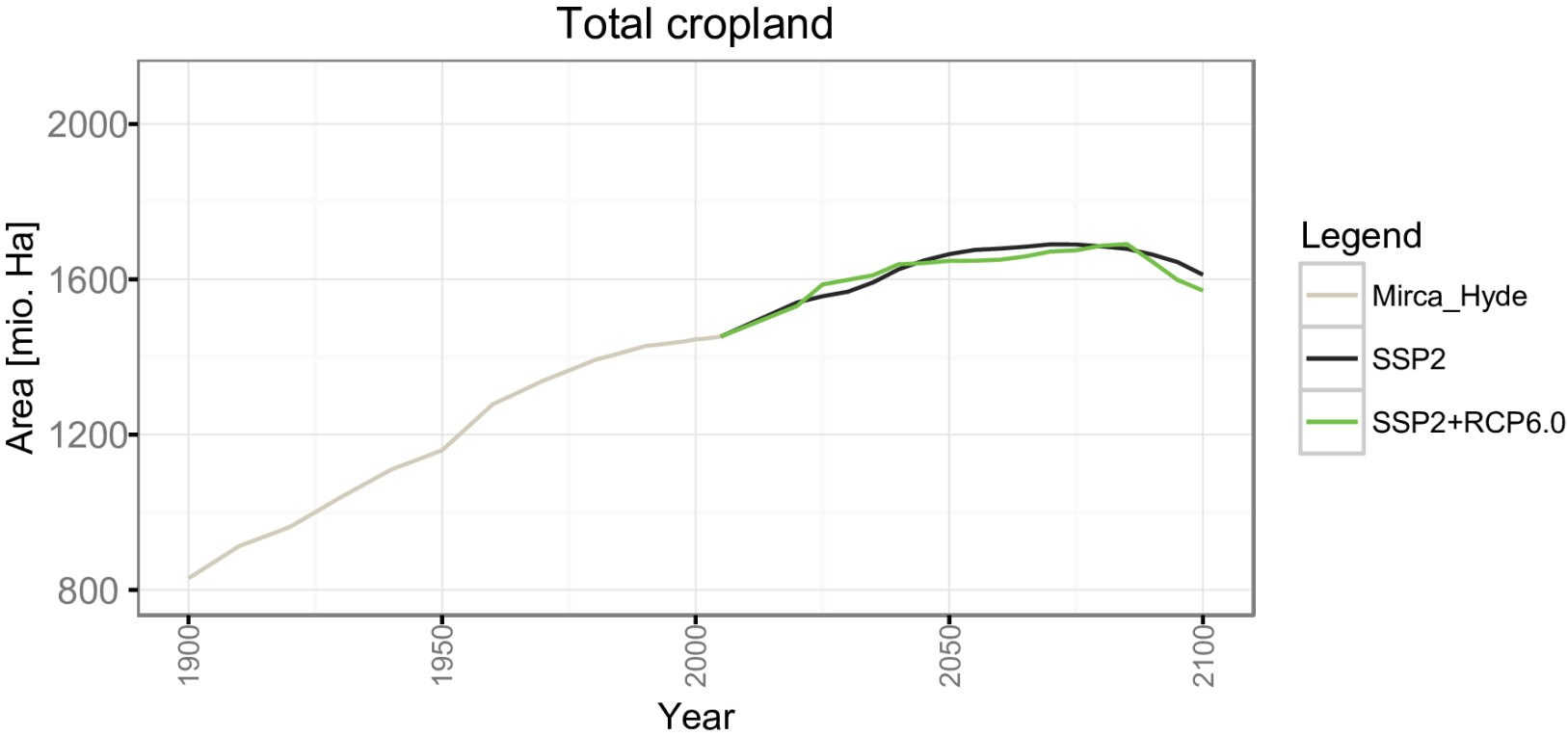 - Regional decision making

Scenarios

- **SSP2** "middle of the road" scenario parametrization
  - Business as usual (BAU) but no climate change effects
  - Calibrated to Mirca regional cropland and pastureland levels

- **SSP2+RCP6.0**
  - Climate change impacts on crop yields and water availability
  - ⬆ CO_2 fertilization effect on crop yields

- **SSP2+RCP2.6**
  - Mitigation scenario
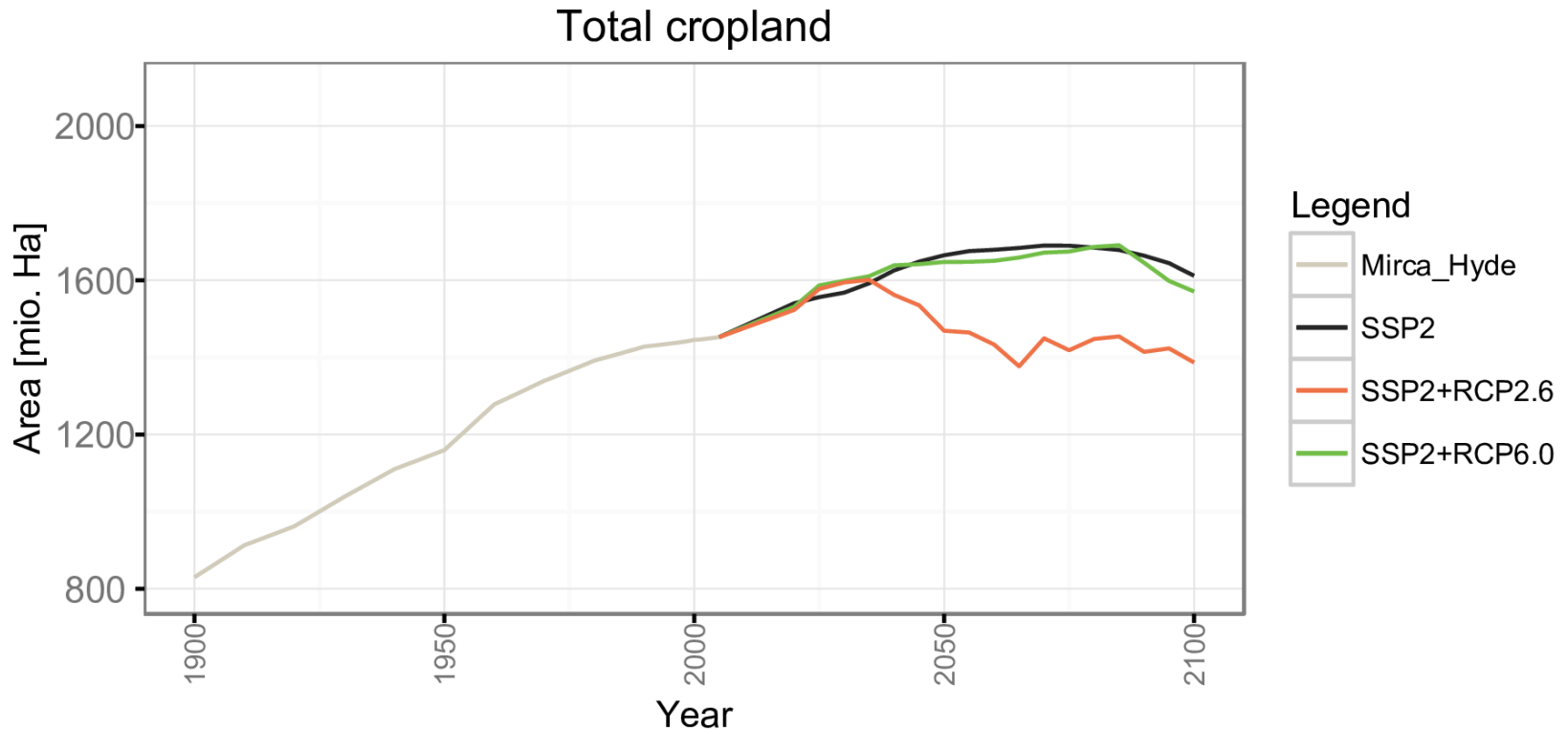 - Carbon price and bioenergy demand from ReMIND/MAgPIE IAM framework

Results: Total cropland projections - Preliminary
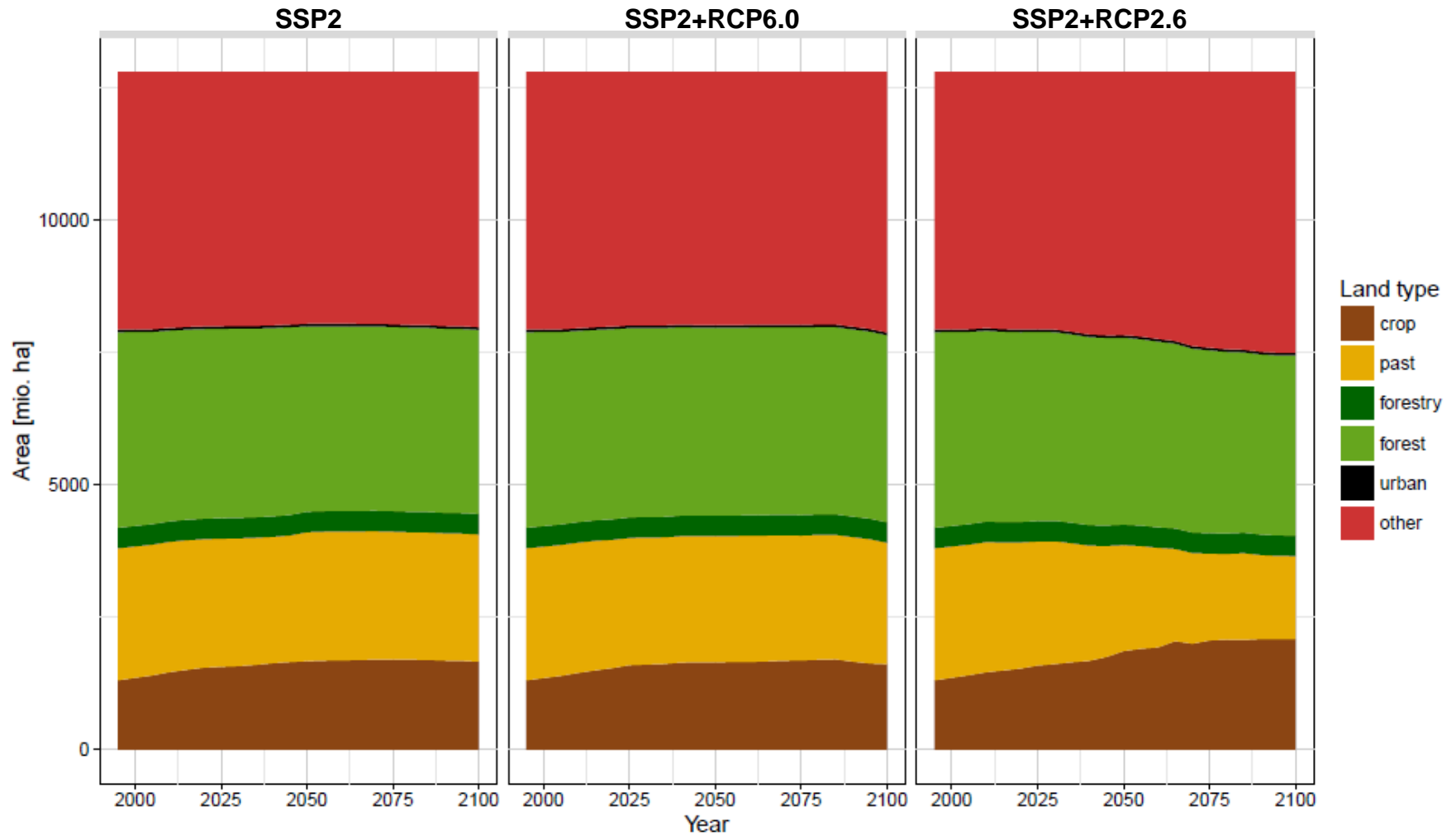
Results: Total cropland projections - Preliminary

Total cropland

Results: Total cropland projections - Preliminary (w/o bioenergy)
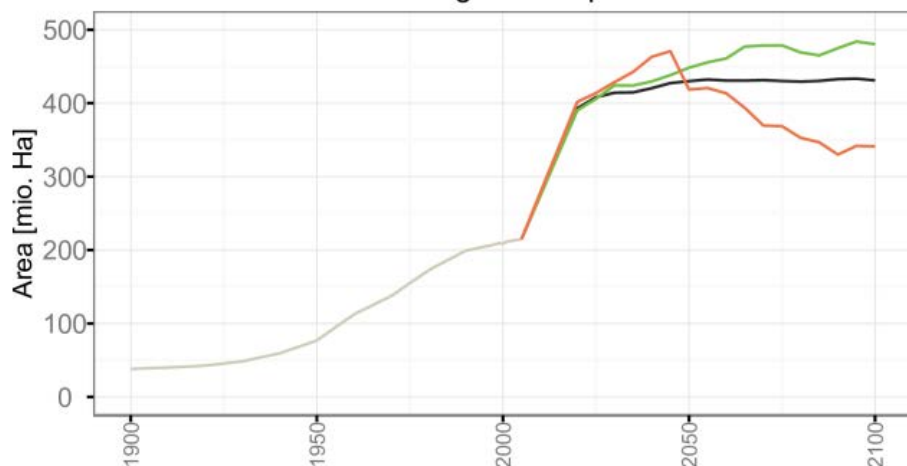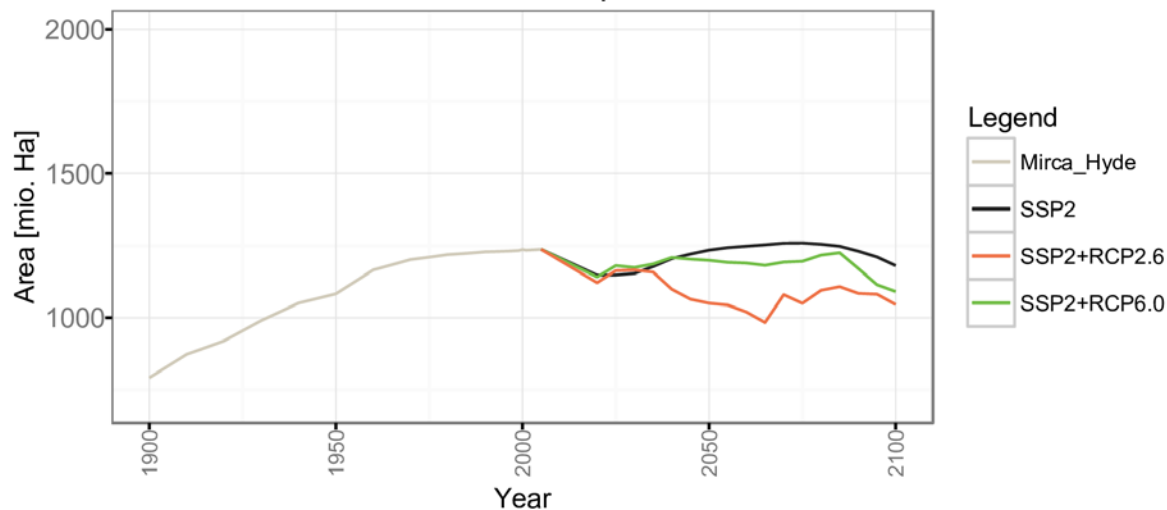

Total cropland

Global Land-Use Overview - Preliminary

Total cropland projections: irrigated and rainfed - Preliminary

Total irrigated cropland

Total rainfed cropland
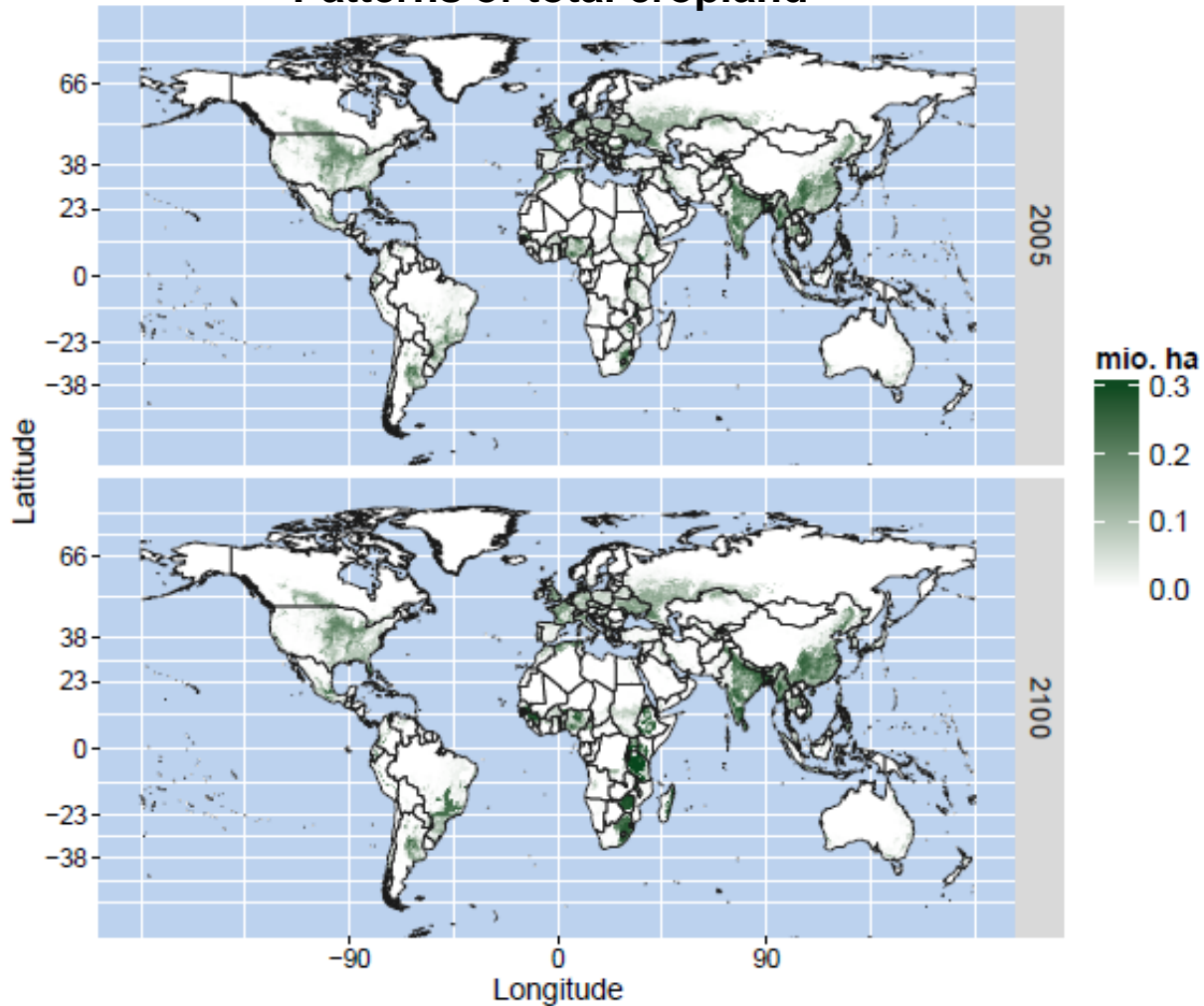
Legend
- Mirca_Hyde
- SSP2
- SSP2+RCP2.6
- SSP2+RCP6.0

Total gridded cropland projections - Preliminary
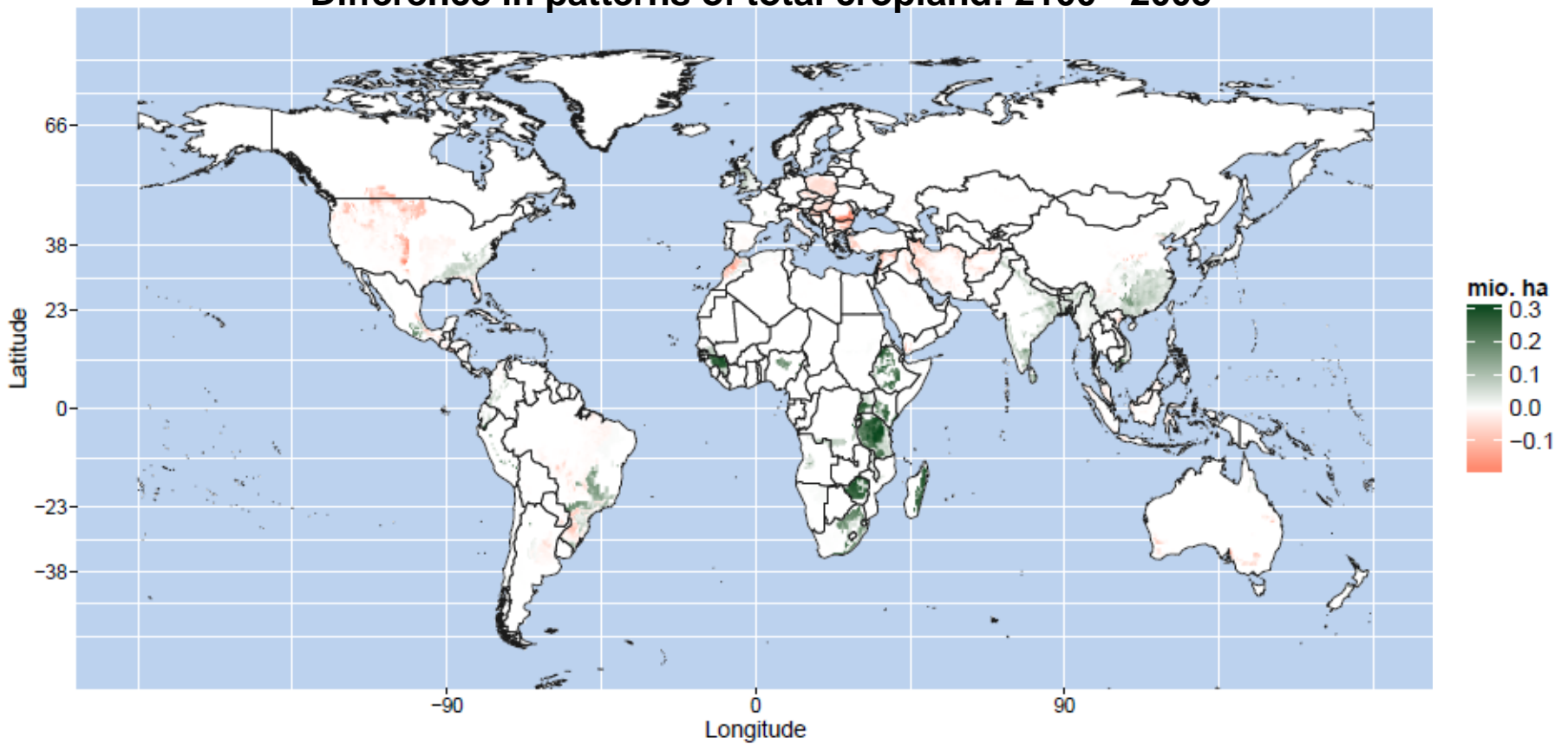
Patterns of total cropland

SSP2 scenario

Total gridded cropland projections - Preliminary
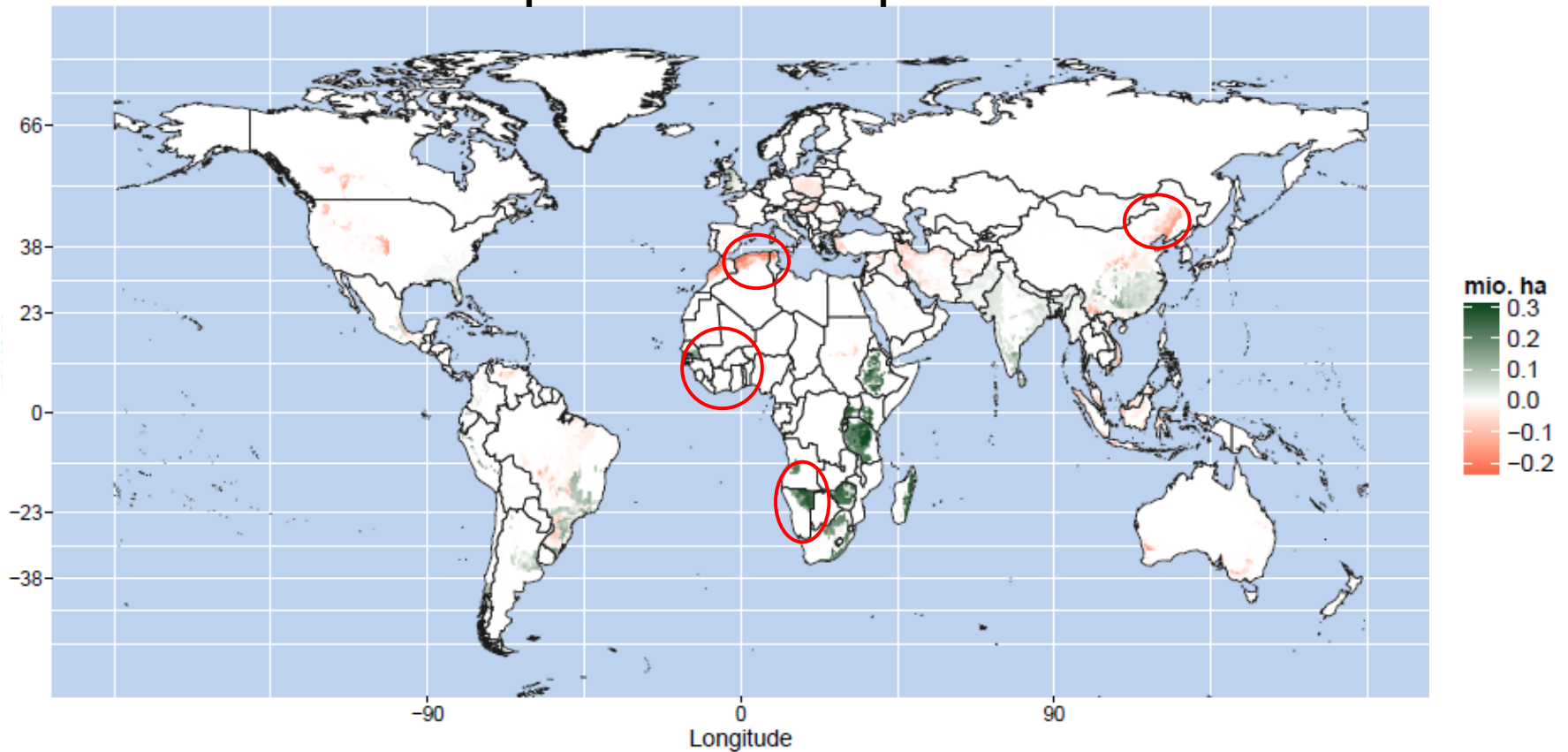
SSP2 scenario:

Difference in patterns of total cropland: 2100 - 2005

Total gridded cropland projections - Preliminary
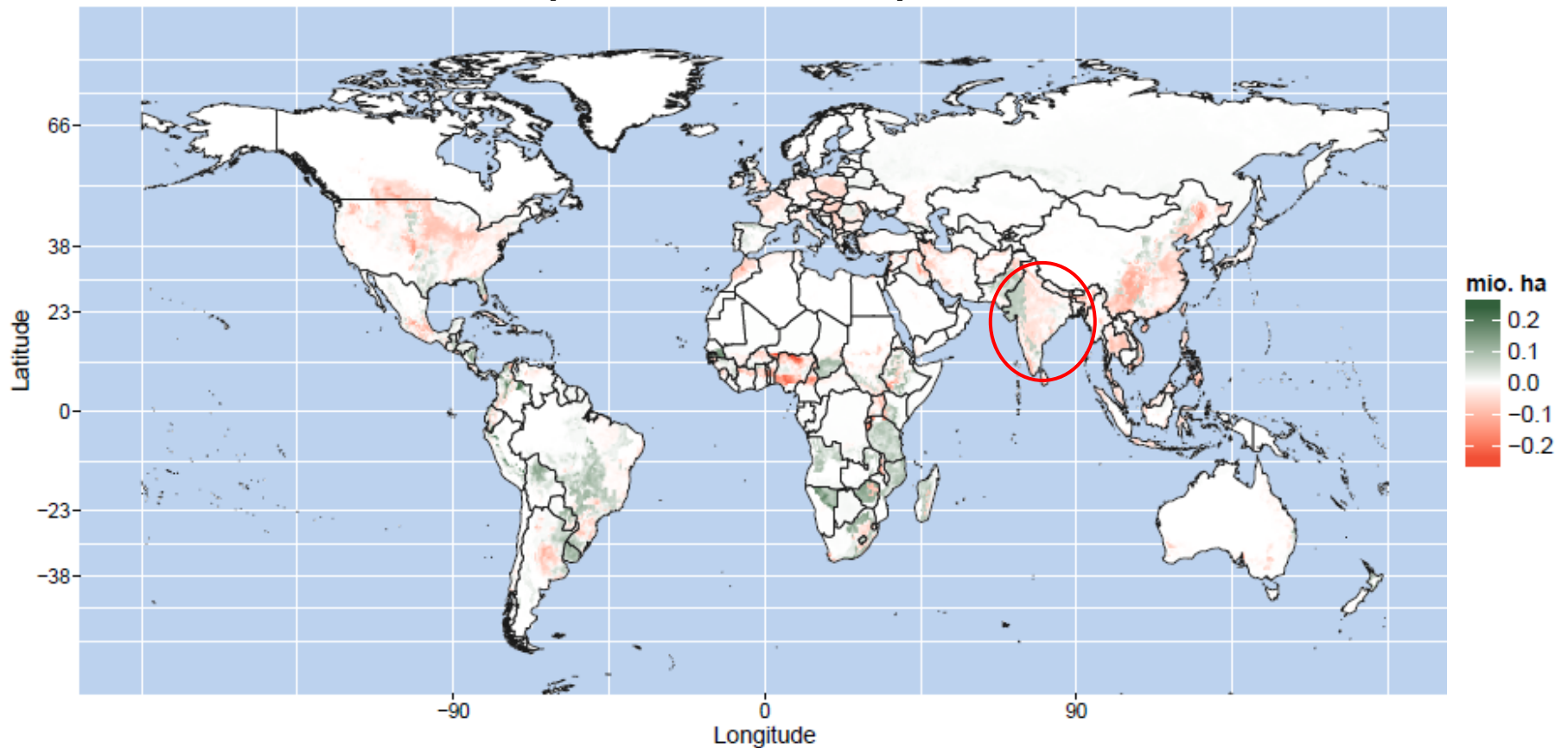
SSP2+RCP6.0 scenario:

Difference in patterns of total cropland: 2100 - 2005

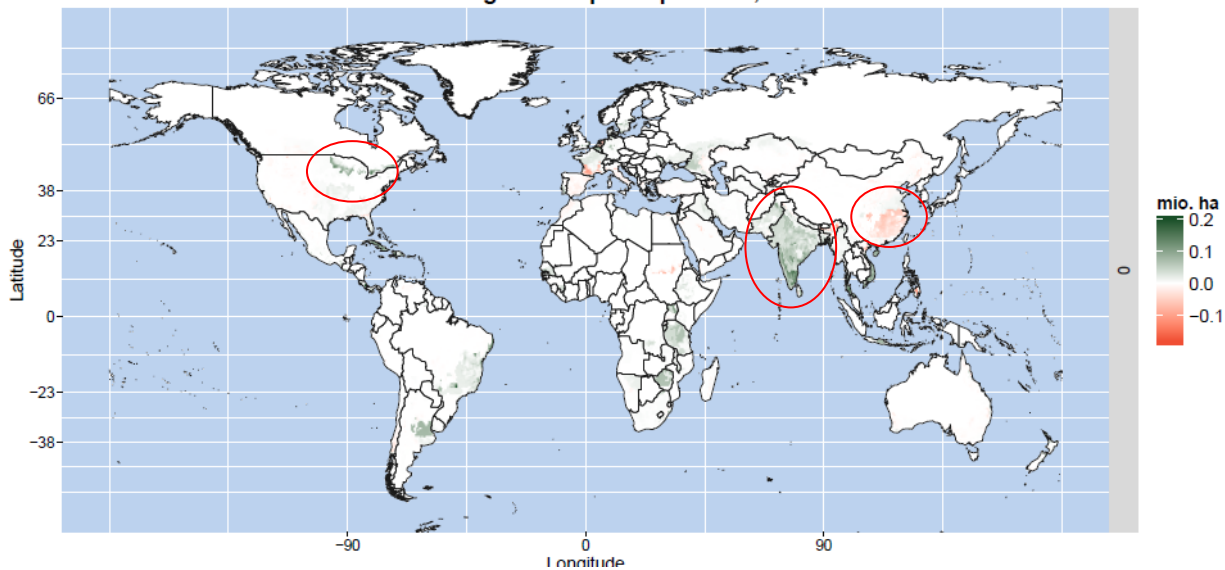# Total gridded cropland projections - Preliminary

SSP2+RCP2.6 scenario:

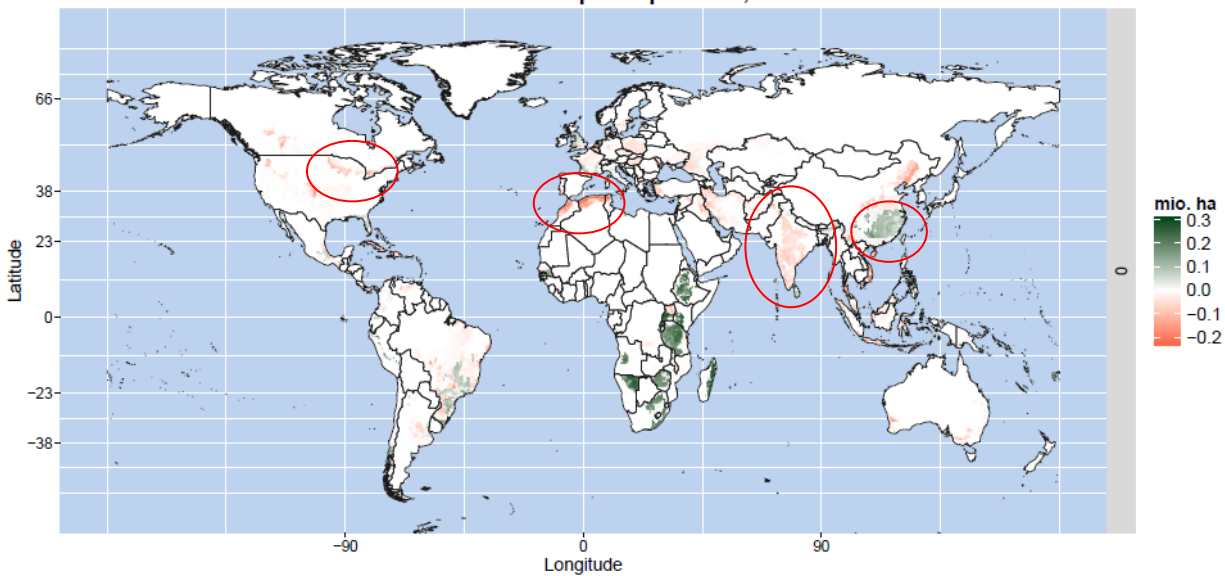**Difference in patterns of total cropland: 2100 - 2005**

Gridded irrigated and rainfed cropland - Preliminary

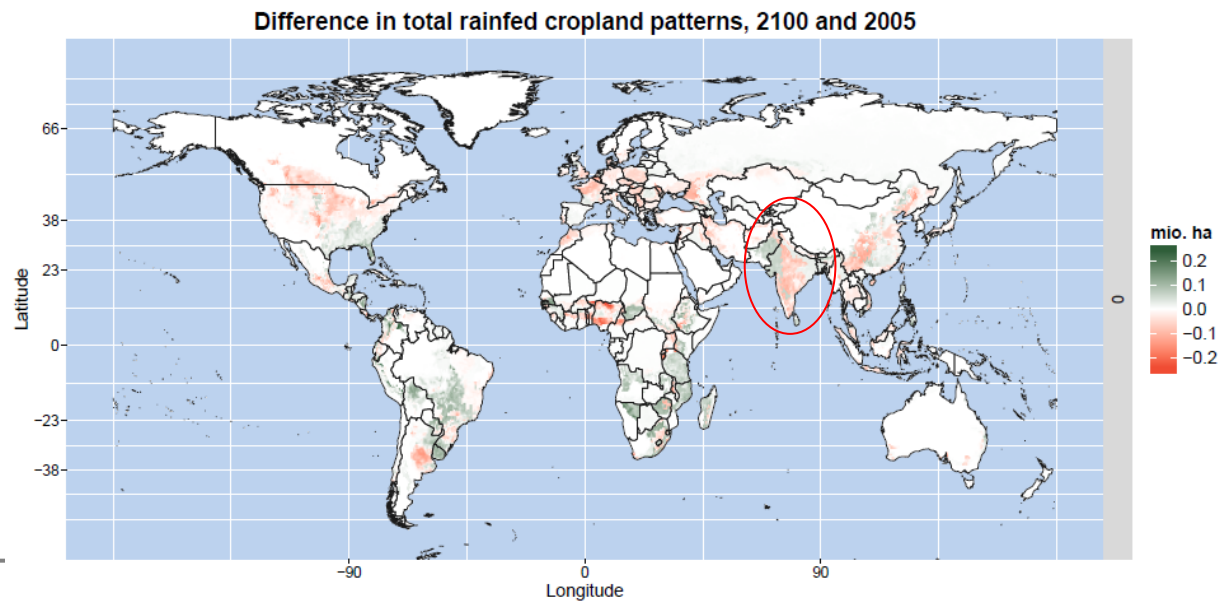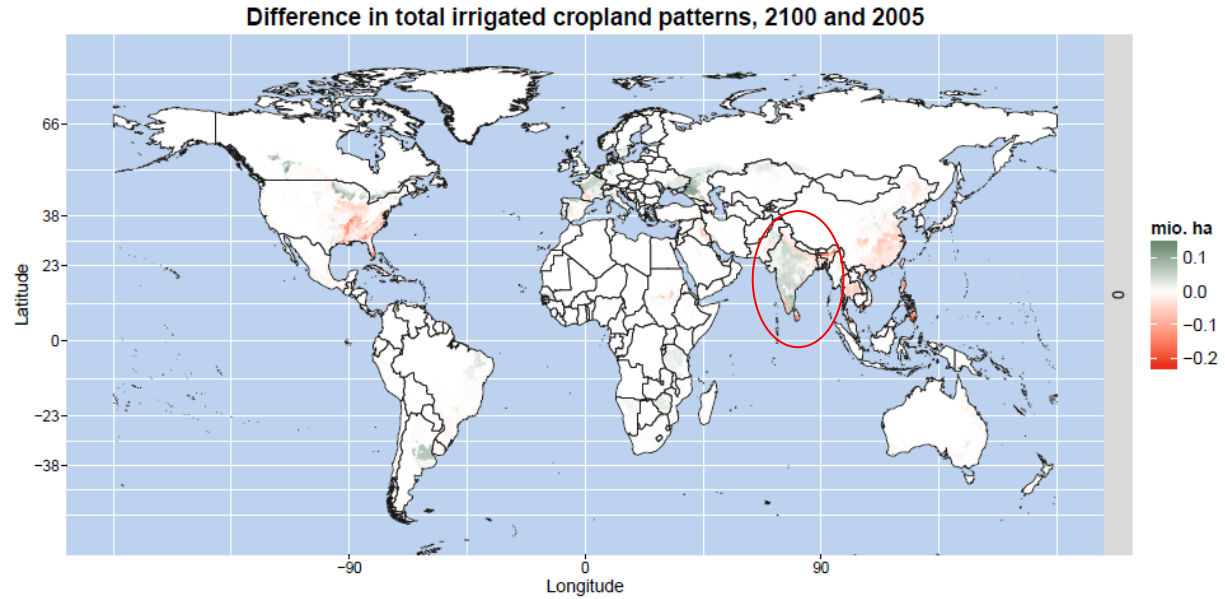Difference in total irrigated cropland patterns, 2100 and 2005

Difference in total rainfed cropland patterns, 2100 and 2005

SSP2+RCP6.0 scenario:

Gridded irrigated and rainfed cropland - Preliminary

SSP2+RCP2.6 scenario:

Difference in total irrigated cropland patterns, 2100 and 2005

Difference in total rainfed cropland patterns, 2100 and 2005

Synthesis & Outlook

- Land-use projections depend greatly on different **socio-economic** future:
  - SSP1, SSP2 & SSP5 scenario are available
- There is significant change in LU-patterns if a **climate change mitigation** policy is considered, with large-scale bioenergy production.
- **Other uncertainties**:
  - Climate projections //5 GCMs
  - Crop modeling // CO_2 fertilization effect
  - LU models //

- Delivering of the LU-data:
  - Aggregation level?
    - Total cropland, pastures; irrigation areas; single crops; bundled crop types.
  - Scenarios choice?

Thank you for your attention!