Status of RCP 8.5
Spatial land and emissions projections

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Integrated Scenario Analysis

- Explore uncertainty of long-term development under climate constraints through limited set of scenarios (3): A2R, B2, B1
- Scenario taxonomy (H/M/L) based on:
  -- emissions,
  -- vulnerability,
  -- stabilization levels,
- Integration: energy – agriculture – forestry sectors
- Assessment of implications of stabilization:
  -- technology choice (e.g. efficiency vs. supply)
  -- sectorial measures (which gas, when, where)
  -- economics (costs and investments)
- Focus of this talk - A2R (RCP 8.5):
  - Land-use and land-cover change
  - Emissions (pollutant emissions – downscaling)
IIASA Integrated Assessment Framework

Scenario storyline:
- Economic development
- Demographic change
- Technological change
- Policies

Global and regional scenarios:
- Population
- Economy

Downscaling tools:
- Spatially explicit and national scenarios

Feedbacks:

Spatially explicit socio-economic drivers

DIMA
Forest management model

National, regional & spatially explicit socio-economic drivers

AEZ-BLS
Agricultural modeling framework

Consistency of land-cover changes (spatially explicit maps of agricultural, urban, and forest land)

MESSAGE-MACRO
Systems engineering/ macro-economic modeling framework (all GHGs and all sectors)

Carbon and biomass price

Potential and costs of forest bioenergy sinks

Endogenous climate model

Drivers for land-use related non-CO₂ emissions

Agricultural bioenergy potentials and costs

CLIMATE & ACIDIFICATION IMPACT MODELS

NATIONAL POLICY MODELS (GAINS)

Emissions & abatement costs

Deforestation & Afforestation (modeled on 0.5 x 0.5)

GHG Emissions
Industry, Energy, and Land-based Mitigation

Riahi, et al. 2007
Scenario Comparison with Literature
(● baselines vs. ○ energy and ○ all-C mitigation)
Spatial Land Cover Projections (pre RCP stage)

• Spatial land cover information for broad land use categories (0.5 x 0.5):
  – built-up land (residential plus infrastructure)
  – cultivated land (arable and permanent crops, irrigated vs non-irrigated)
  – forest (managed vs unmanaged)
  – grassland/shrubland/woodland
  – other land (=water, desert, rocks, ice)
Note: calibration of GLC2000 class weights starts from estimated reference weights and is based on an iterative scheme to match national / sub-national statistics of year 2000 (FAO AT2015/2030 adjusted cultivated land).
Arable Land (A2R)

- Strongest expansion across all IIASA-GGI scenarios (but small compared to changes of other factors)

Fischer et al., 2007

Areas of intensive joint production
ESM/CM Needs (Land)

• Aim: assessment of climate implications of land-cover change, including climate-carbon feedbacks (albedo, terrestrial sinks)

• Explicit characterization of managed vs natural land-cover (spatially explicit)

• Smooth transition from past to future land use/cover
  – Different land representation across IAMs and UNCERTAINTY
  – Harmonization of land for base year (one consistent history with alternative RCPs into the future)

• Development of new land categories according to their role in biogeophysical and biogeochemical processes:
  – Grassland (natural vs pasture + grazing intensity)
  – Harvested areas in forests (primary forests vs timber & bioenergy + tC implications)
  – Trade-off between internal consistency of RCP and the need of “harmonized” base year
HYDE 3.0 (Pasture in 2000)
Total Grass & Wood Land (2000)  
IIASA

Split between pasture and natural grassland needed.

G. Fischer, 2008
Ruminants, 2000 - 2100

- Base year from FAO
- Projections based on regional/spatial feed/energy balances:
  - Available crop feed, agricultural residues, and grass land productivity
  - Population density

G. Fischer, 2008
Grazing intensity, 2000

G. Fischer, 2008
Note: calibration of GLC2000 class weights starts from estimated reference weights and is based on an iterative scheme to match national / sub-national statistics of year 2000 (FRA2000 and FRA2005).
• Forest land-cover is decreasing
• However, deforestation is slowing down
  (increasing affluence - trend is more rapid in other scenarios)
Downscaling of SO2 from 11 regions to grid-cells

- Two approaches for testing of pattern differences
  - Proportional scaling (per source)
  - Exposure driven
    - Emissions increase: proportional to economic growth
    - Pollution control exposure driven

- Base year
  - Sectoral patterns from EDGAR 3.2 (1x1)
  - EDGAR scaled regionally to fit A2R base year

- Calculation resolution 0.5x0.5
2030

Proportional scaling

Sulfur emissions, 2030 (I)
kt SO2 / cell
- 0 - 1
- 1 - 10
- 10 - 50
- 50 - 100
- 100 - 200
- 200 - 500

Exposure driven

Sulfur emissions, 2030 (II)
kt SO2 / cell
- 0 - 1
- 1 - 10
- 10 - 50
- 50 - 100
- 100 - 200
- 200 - 500
Proportional scaling

sulfur emissions, 2050 (I)
kt SO2 / cell
- 0 - 1
- 1 - 10
- 10 - 50
- 50 - 100
- 100 - 200
- 200 - 500

Exposure driven

sulfur emissions, 2050 (II)
kt SO2 / cell
- 0 - 1
- 1 - 10
- 10 - 50
- 50 - 100
- 100 - 200
- 200 - 500
Difference in Spatial Pattern
(2070, A2R)

Red: higher in case of proportional scaling
Blue: higher in case of exposure method
East China (2030)

Exposure / GDP

Proportional
East China (2050)

Exposure / GDP

Proportional
RCP 8.5 / Status

✓ Full spatial information on land cover/use
✓ Extension to new emissions sectors and sources (e.g., forest and savannah fires, NH3)
✓ Methodology for downscaling of emissions

• Next Step: Harmonization to same base year across IA-models (regional & spatial)
  – Land-use: New Hampshire (George Hurtt, Steve Frolking, Louise Parsons Chini)
  – Emissions: smooth transition from inventory base year pattern to the scenario (re-gridding or transition algorithm)
  – Spatial emissions inventories not available yet