# Status of RCP 8.5
# Spatial land and emissions projections

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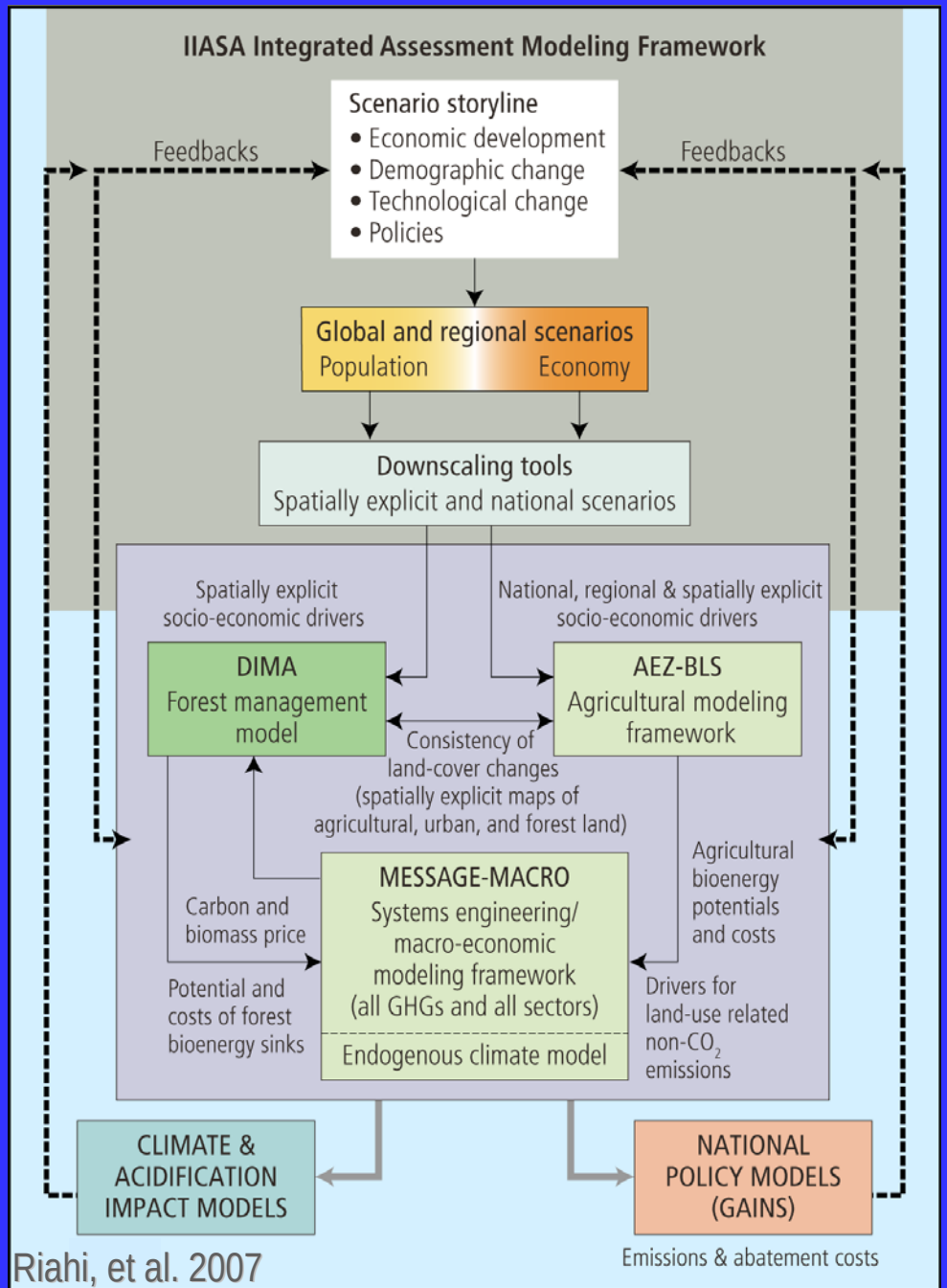
# Integrated Scenario Analysis

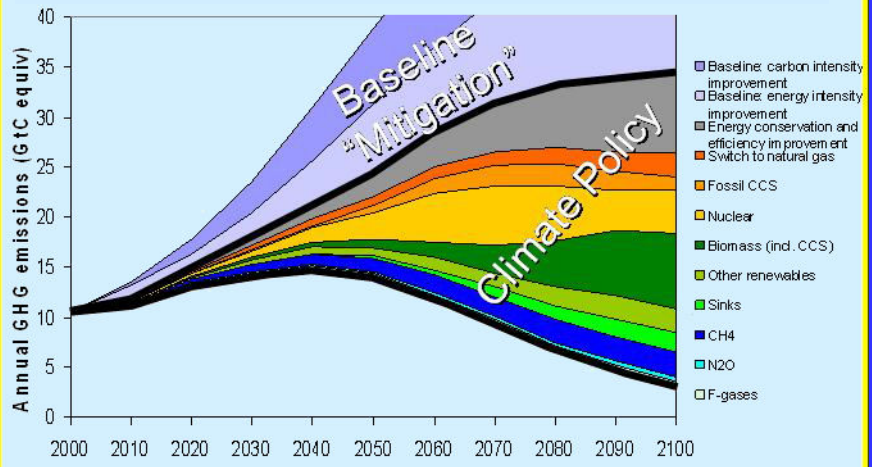
- Explore uncertainty of long-term development under climate constraints through limited set of scenarios (3): A2R, B2, B1
- Scenario taxonomy (H/M/L) based on:
  -- emissions,
  -- vulnerability,
  -- stabilization levels,
- Integration: energy – agriculture – forestry sectors
- Assessment of implications 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

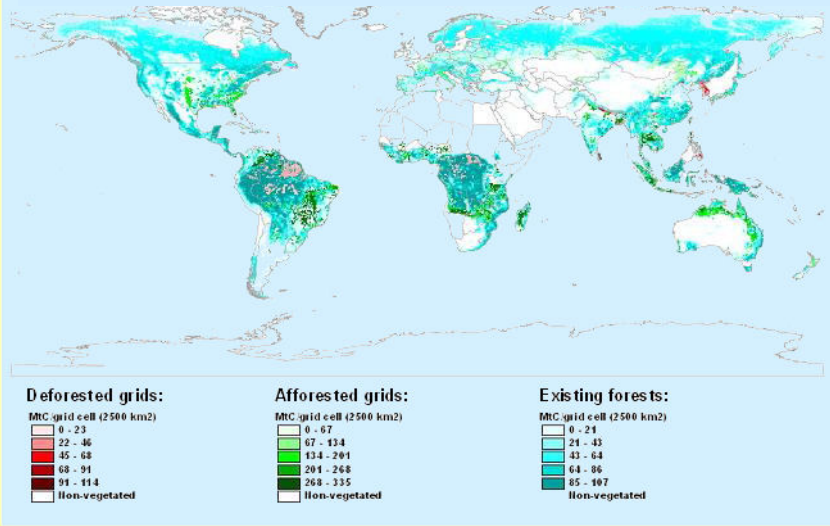



Riahi, et al. 2007

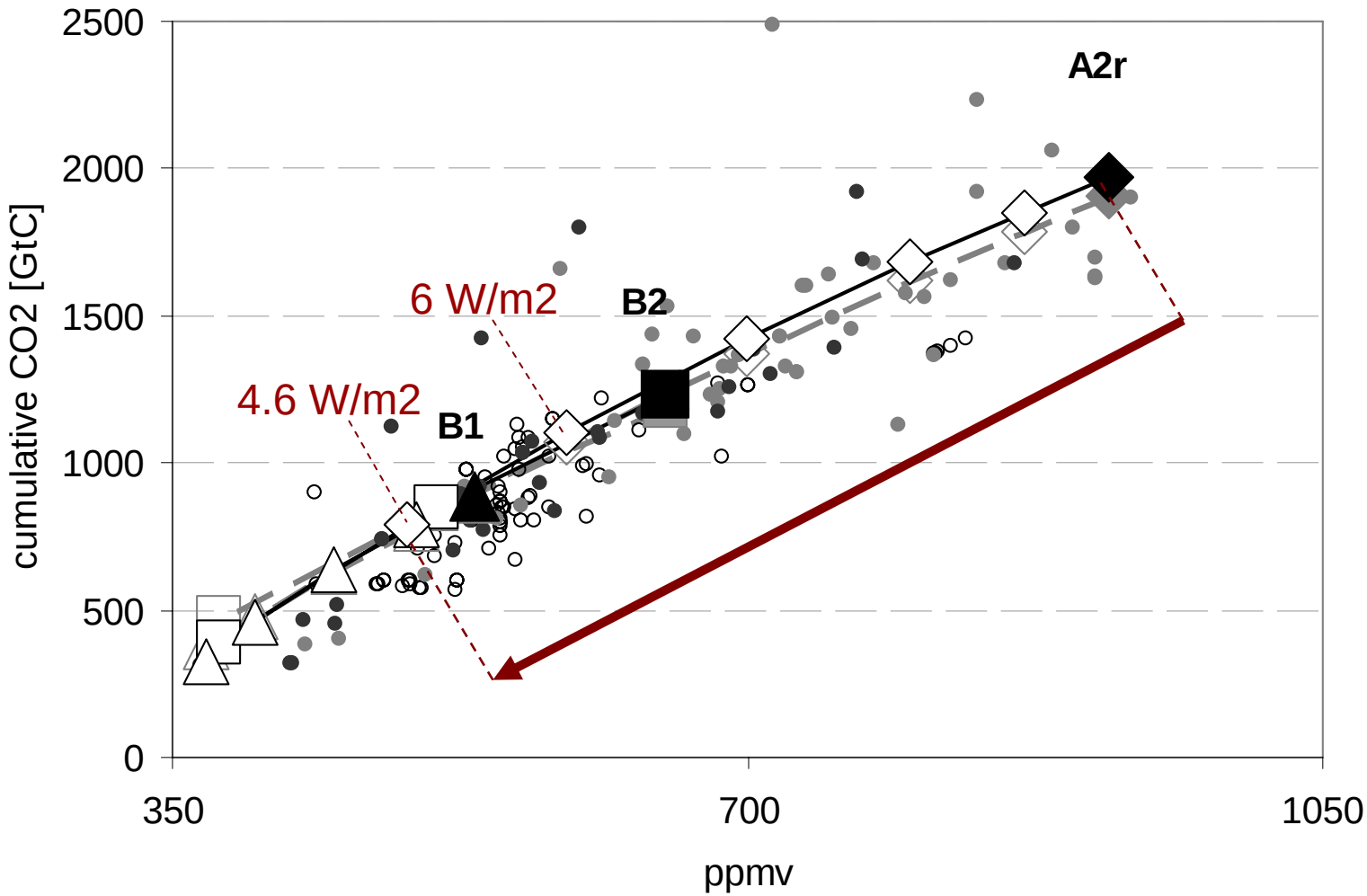
## GHG Emissions
## Industry, Energy, and Land-based Mitigation




## Deforestation & Afforestation
## (modeled on 0.5 x 0.5)



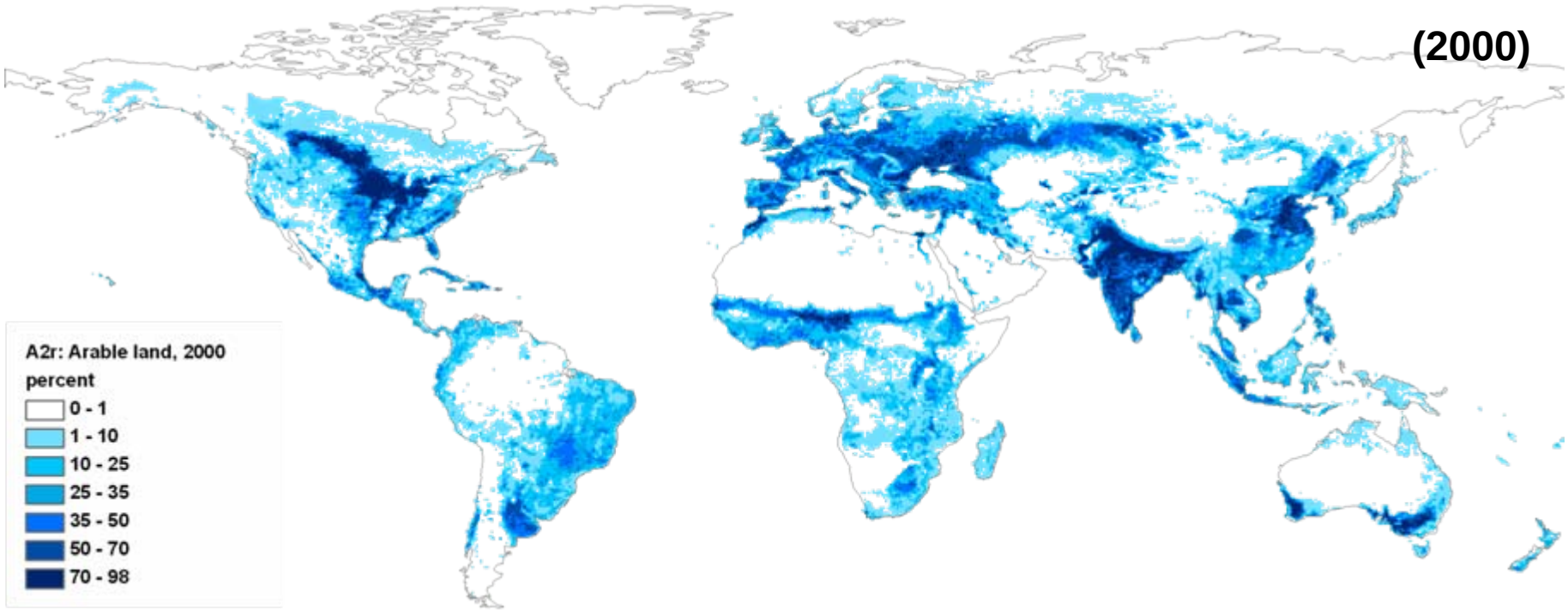
# Scenario Comparison with Literature
# (● baselines vs. ● energy and ○ all-C mitigation)



# 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)

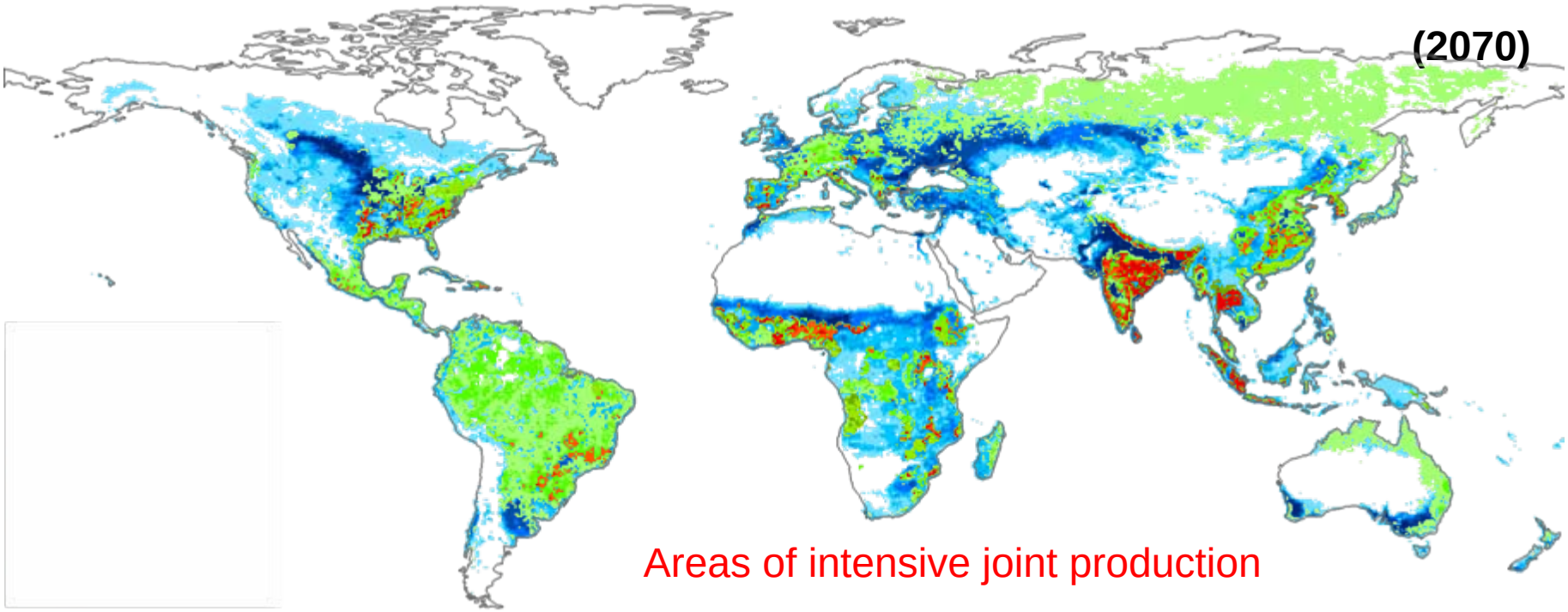
# Arable Land (2000)




Fischer et al., 2007

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)



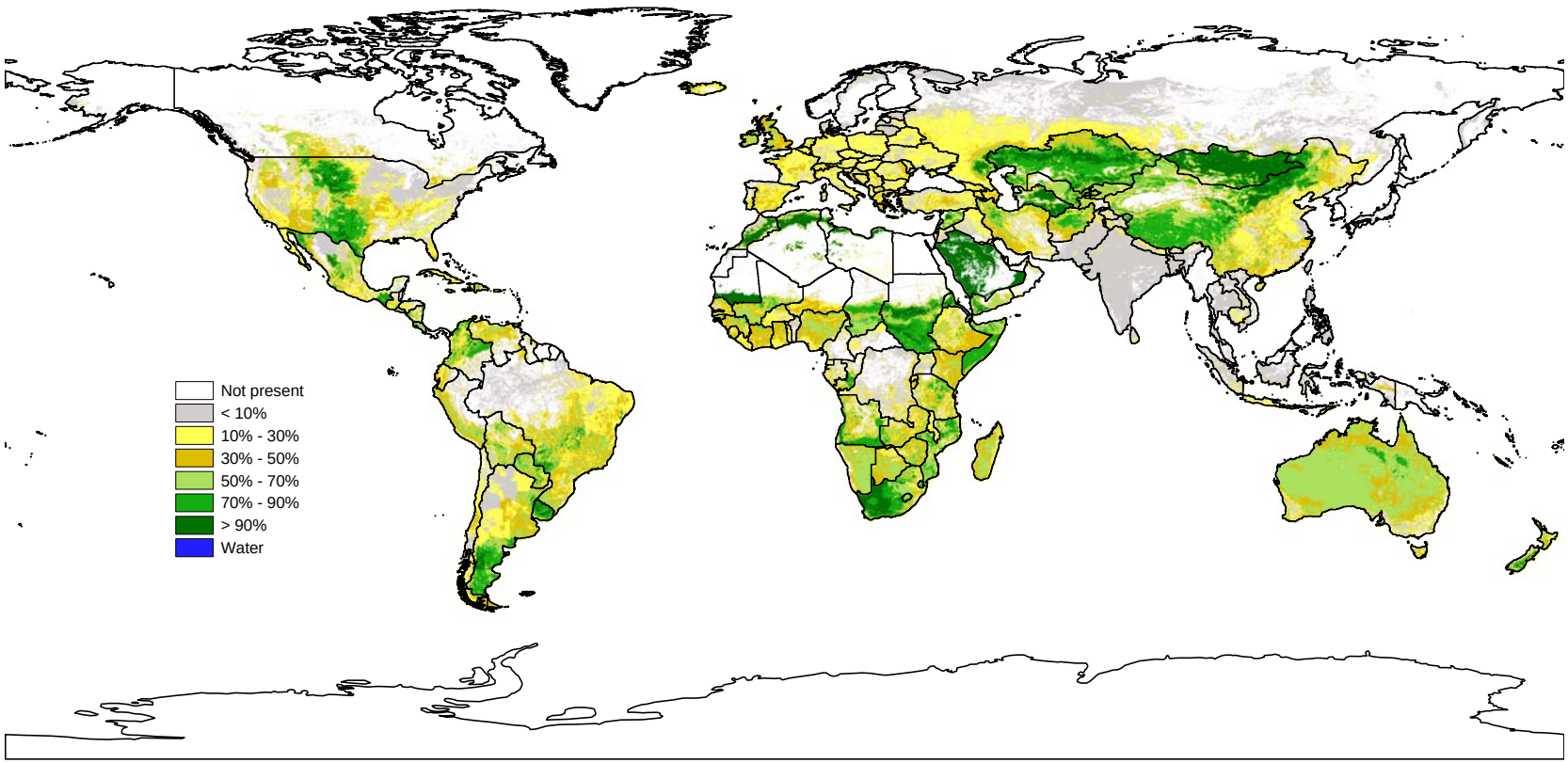

Fischer et al., 2007

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

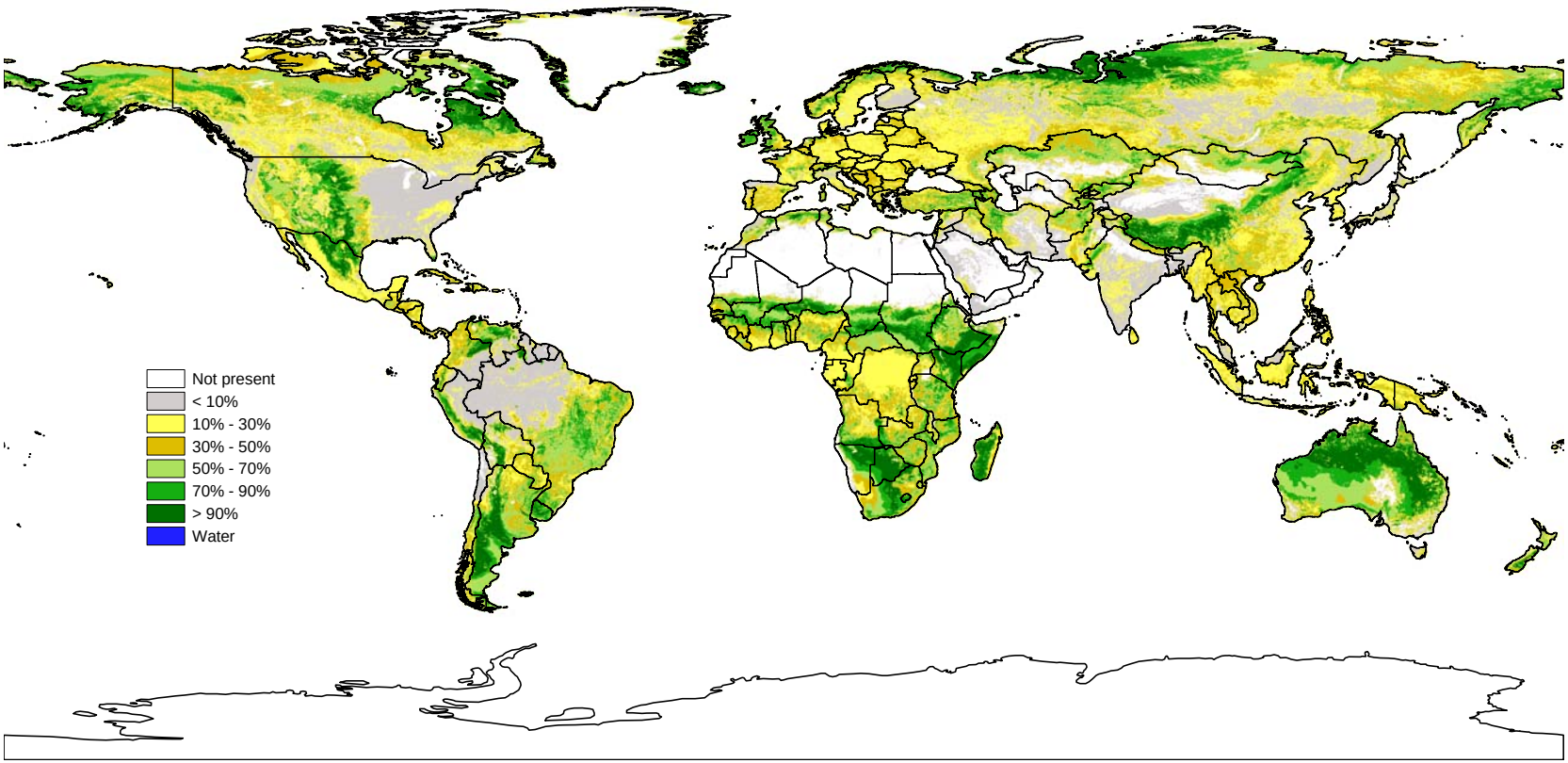
# ESM/CM Needs (Land)

- Aim: assessment of climate implications of land-cover change, including climate-carbon feedbacks (albido, 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)



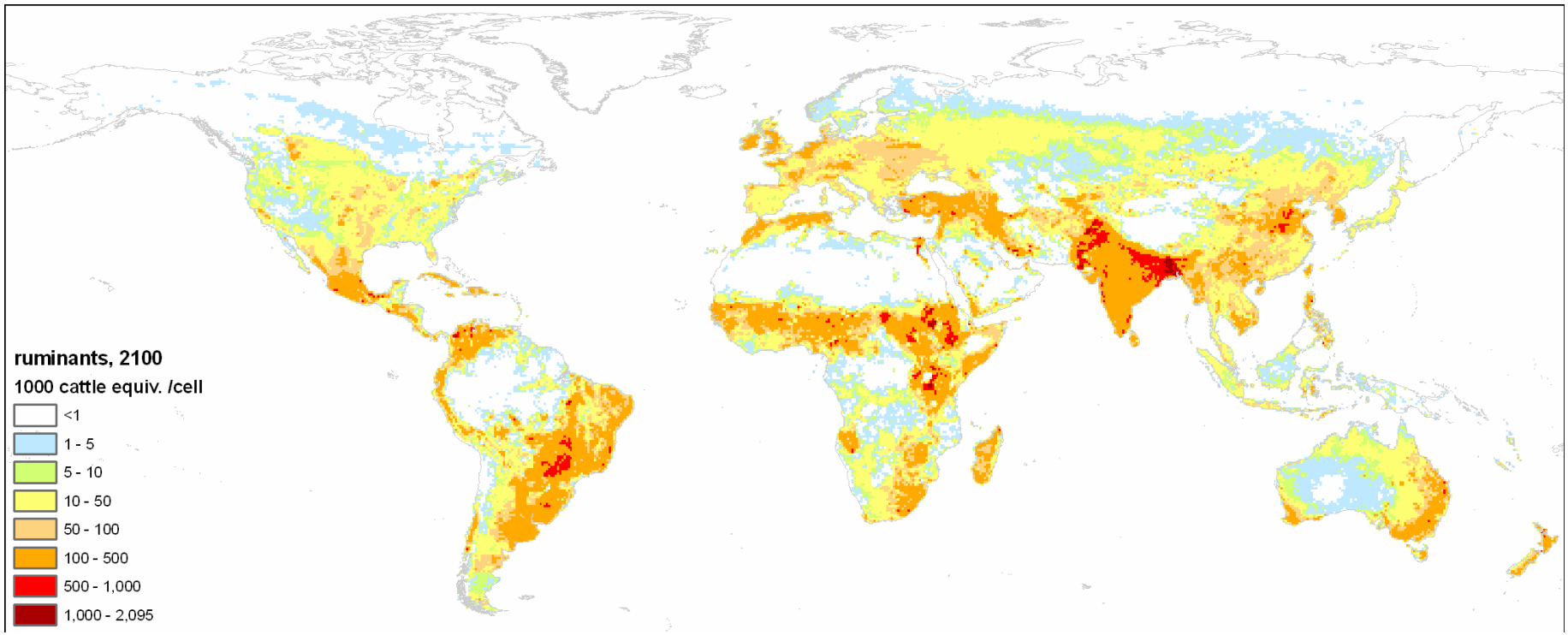
# Total Grass & Wood Land (2000) IIASA




Split between pasture and natural grassland needed.

G. Fischer, 2008

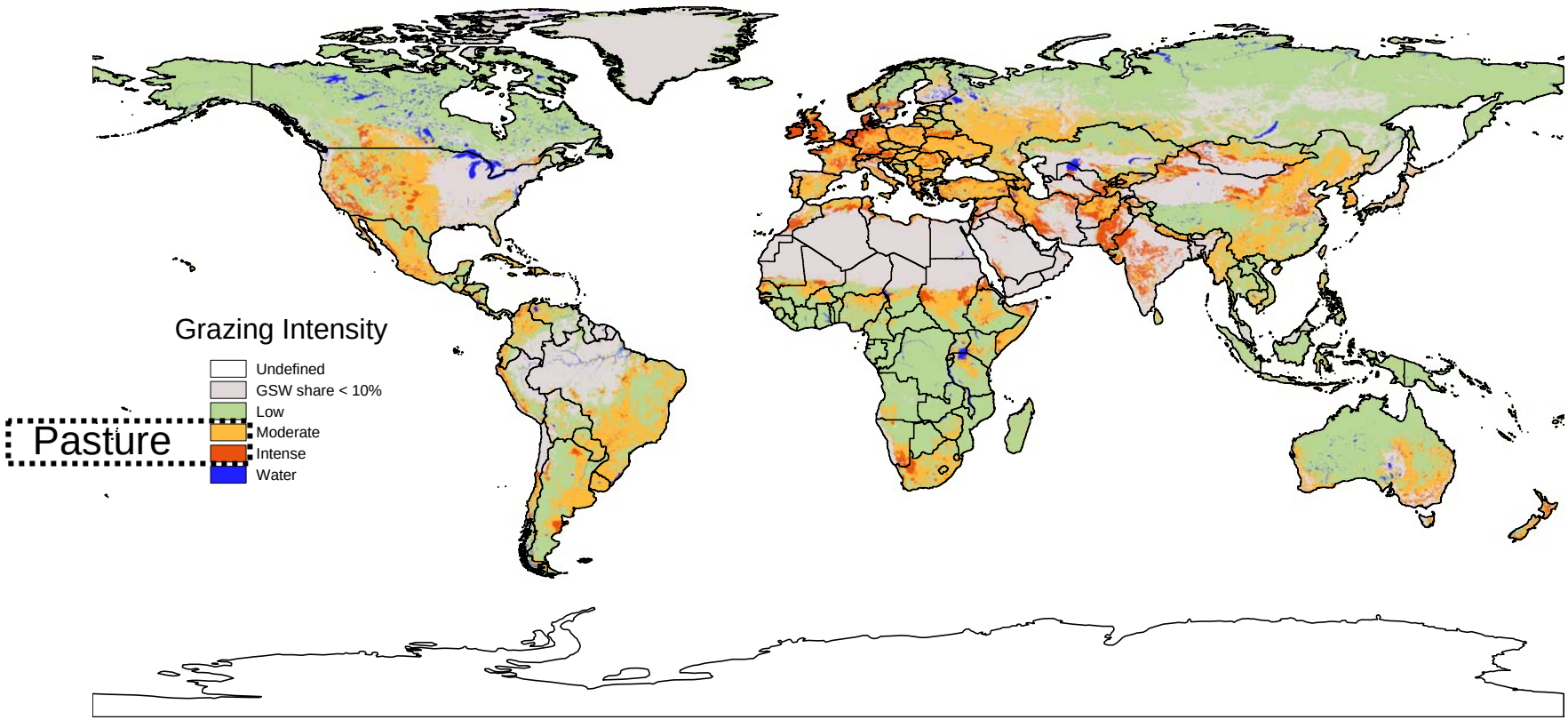
# Ruminants, 2000 - 2100




G. Fischer, 2008

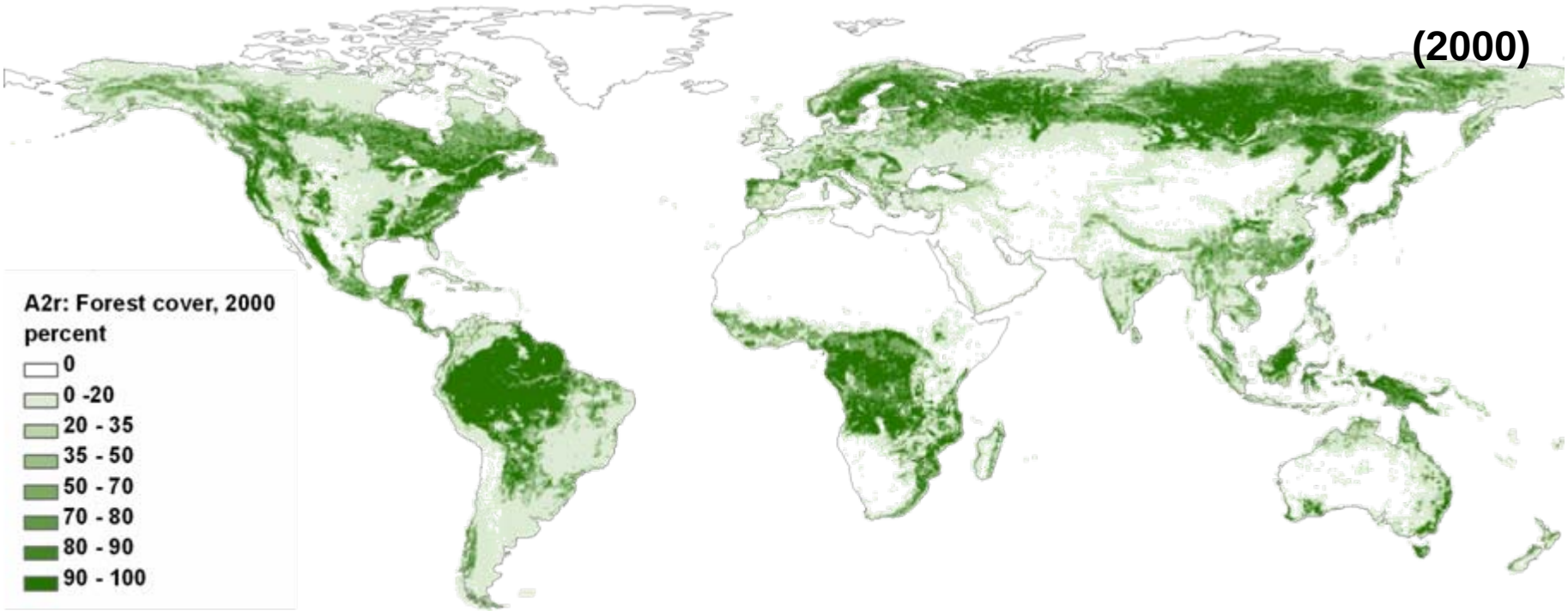
- Base year from FAO
- Projections based on regional/spatial feed/energy balances:
  - Available crop feed, agricultural residues, and grass land productivity
  - Population density

# Grazing intensity, 2000




G. Fischer, 2008

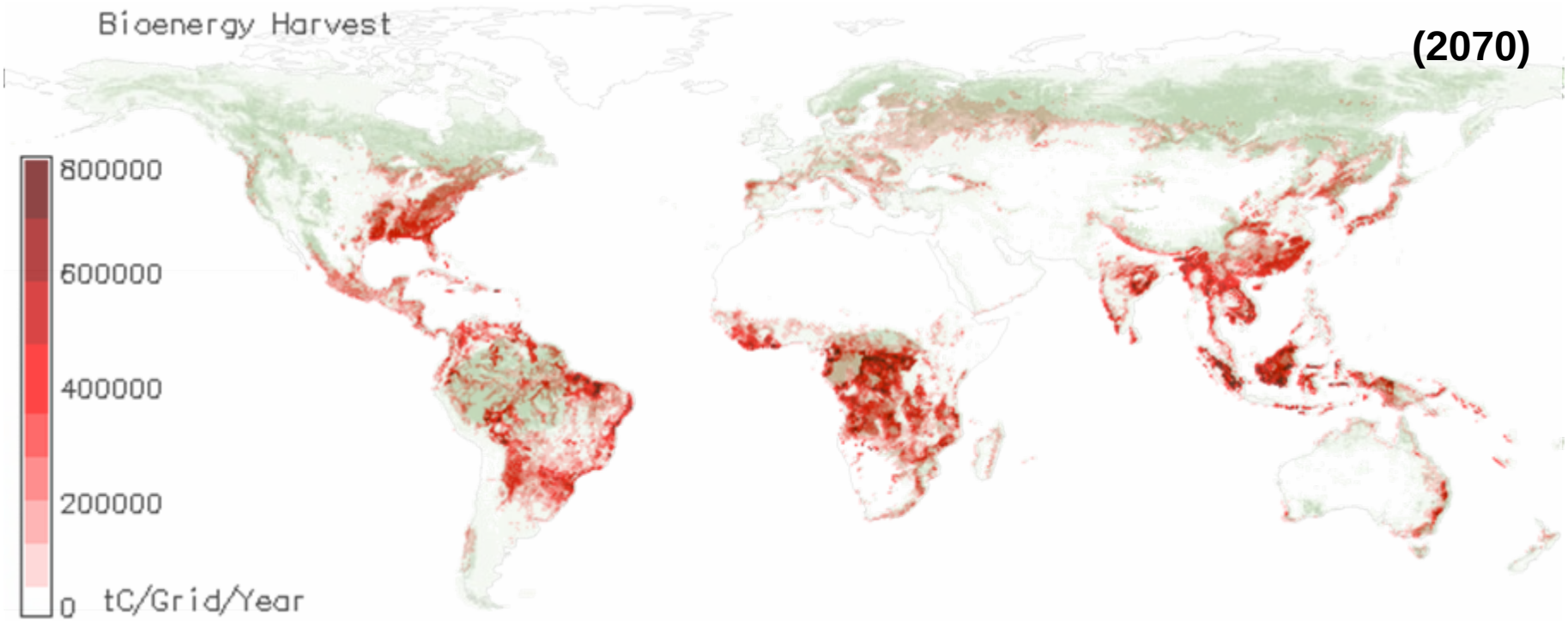
# Forest cover (2000)




Kindermann et al.

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 cover (A2R)



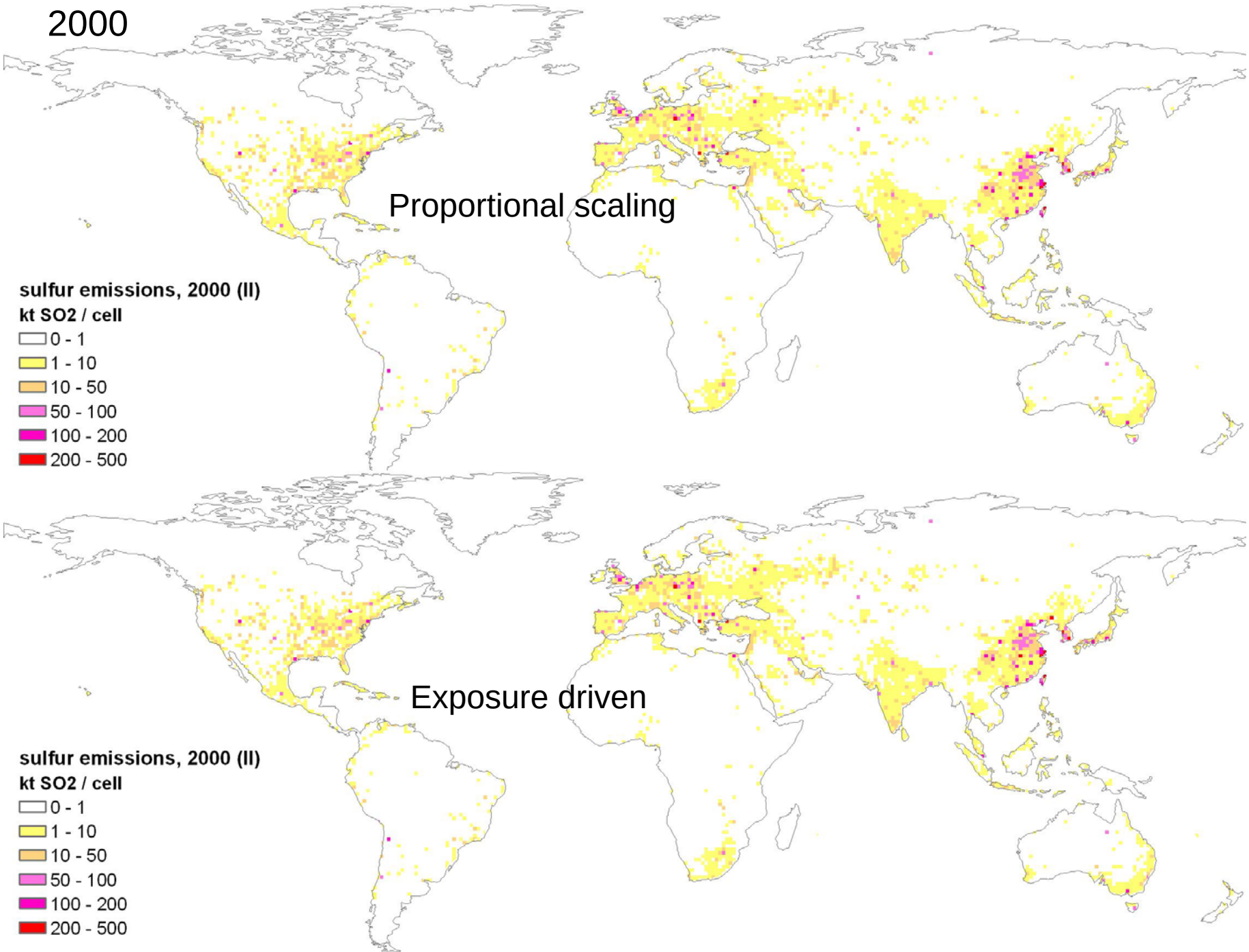

Kindermann et al.

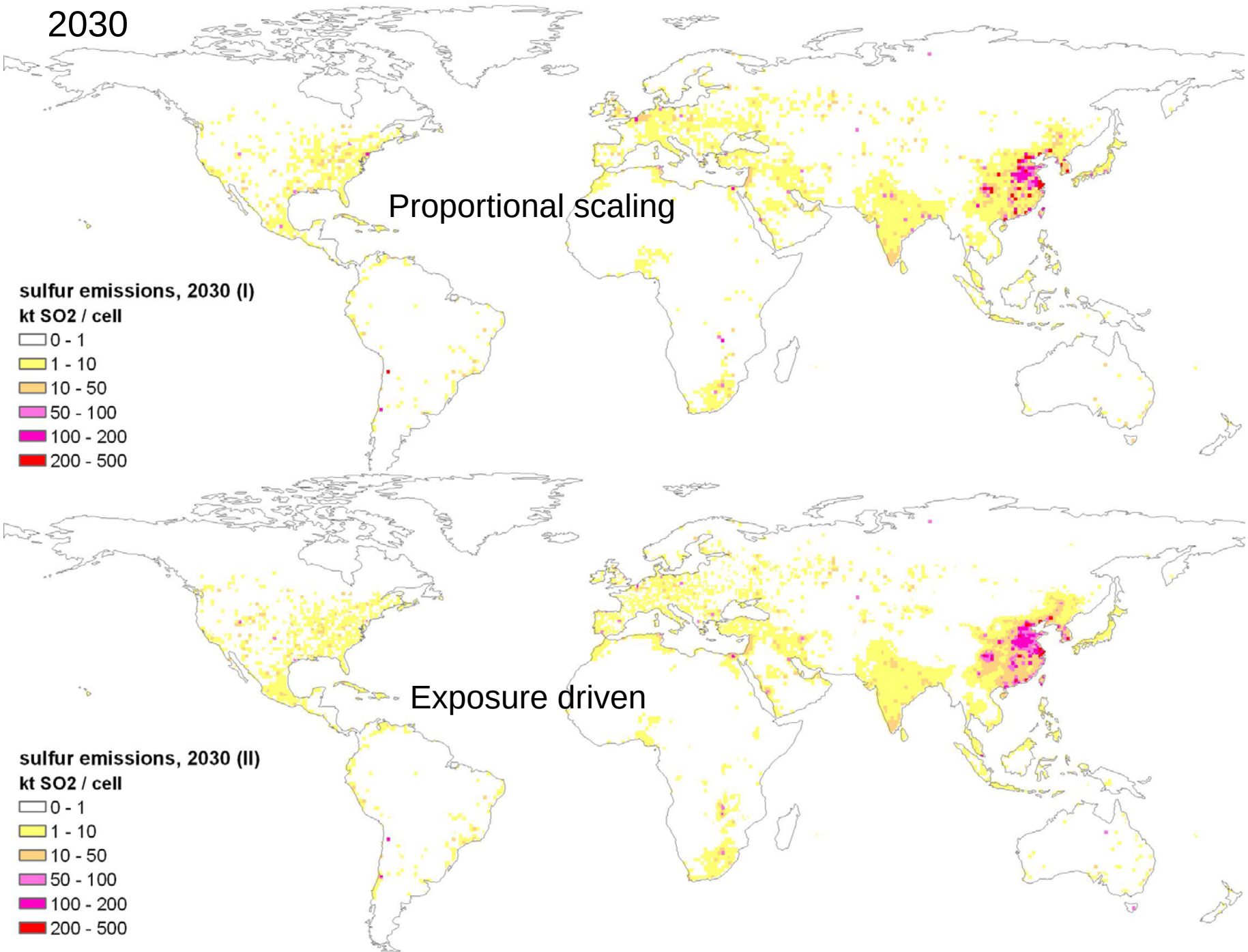
- Forest land-cover is decreasing
- However, deforestation is slowing down
  (increasing affluence - trend is more rapid in other scenarios)

# Downscaling of SO2 from 11 regions to grid-cells

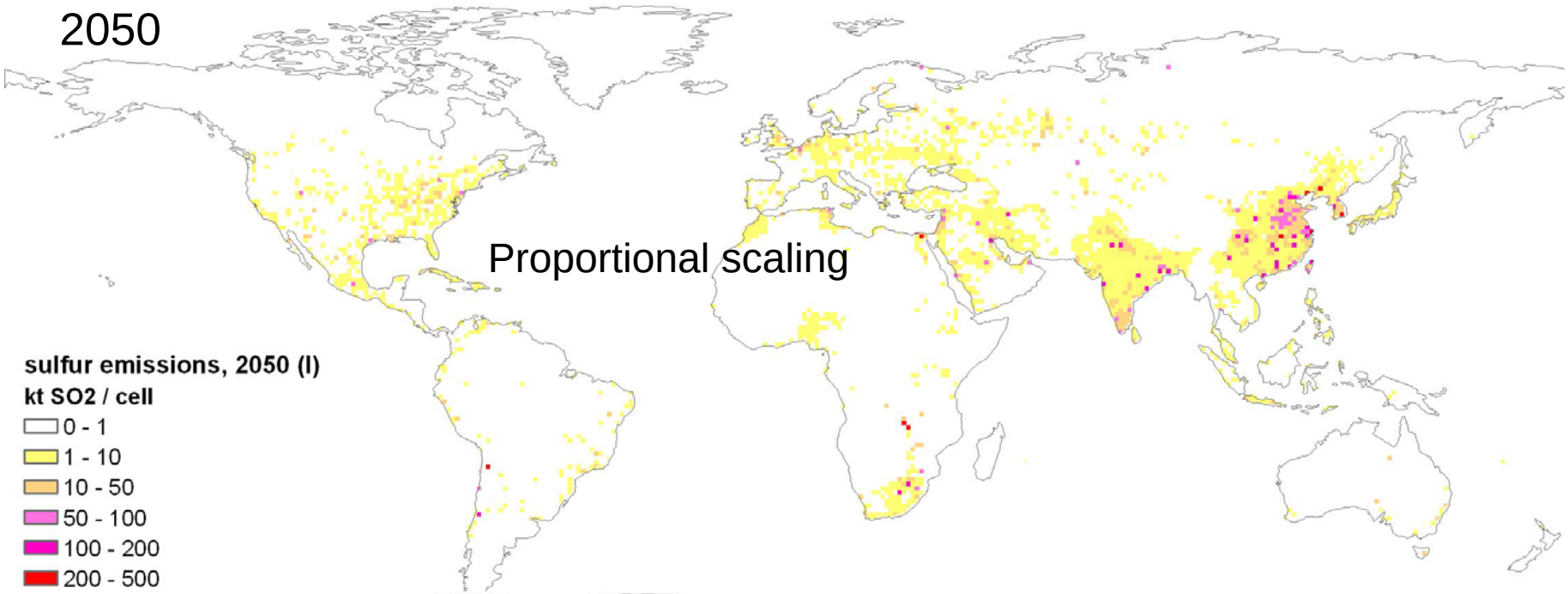
- Two approaches for testing of pattern differences
  - Proportional scaling (per source)
  - Exposure driven
    - Emissions increase: proportional to economic growth
    - Pollution control exposure driven
- Base year
  - Sectoral patterns from EDGAR 3.2 (1x1)
  - EDGAR scaled regionally to fit A2R base year
- Calculation resolution 0.5x0.5

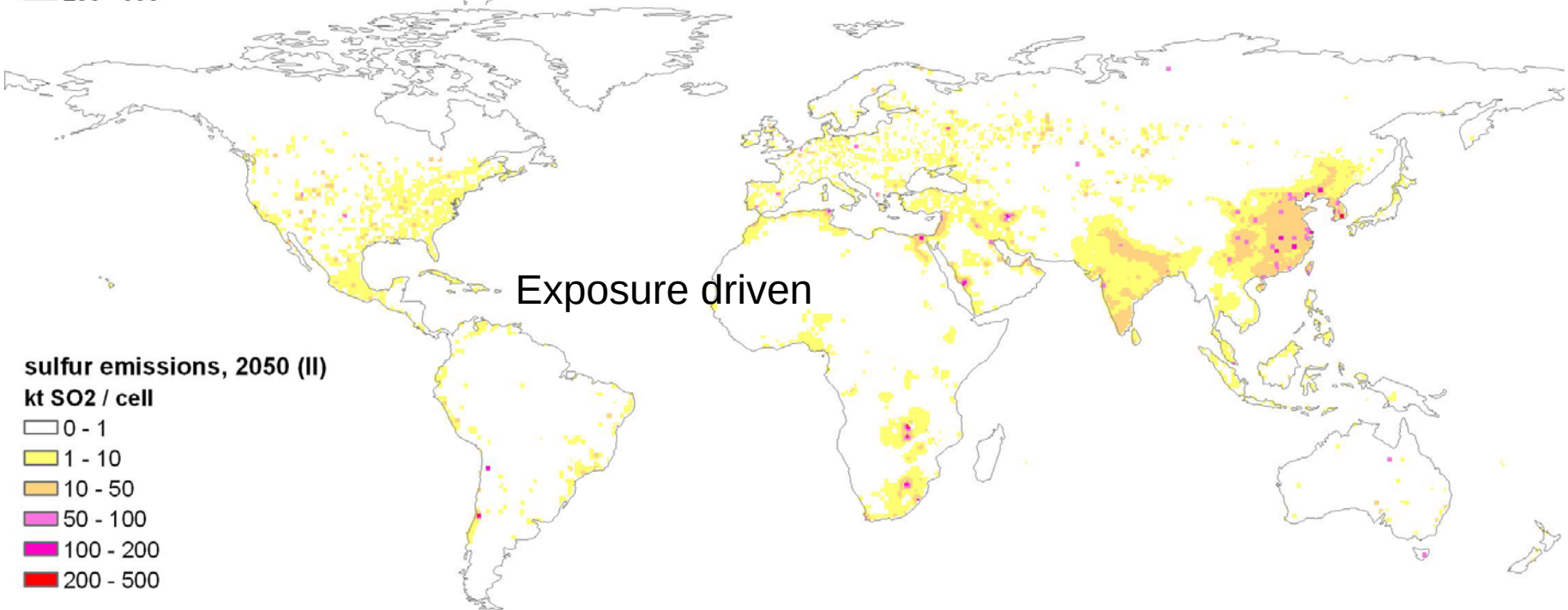
2000


Proportional scaling
sulfur emissions, 2000 (II)
kt SO2 / cell
0 - 1
1 - 10
10 - 50
50 - 100
100 - 200
200 - 500
Exposure driven
sulfur emissions, 2000 (II)
kt SO2 / cell
0 - 1
1 - 10
10 - 50
50 - 100
100 - 200
200 - 500

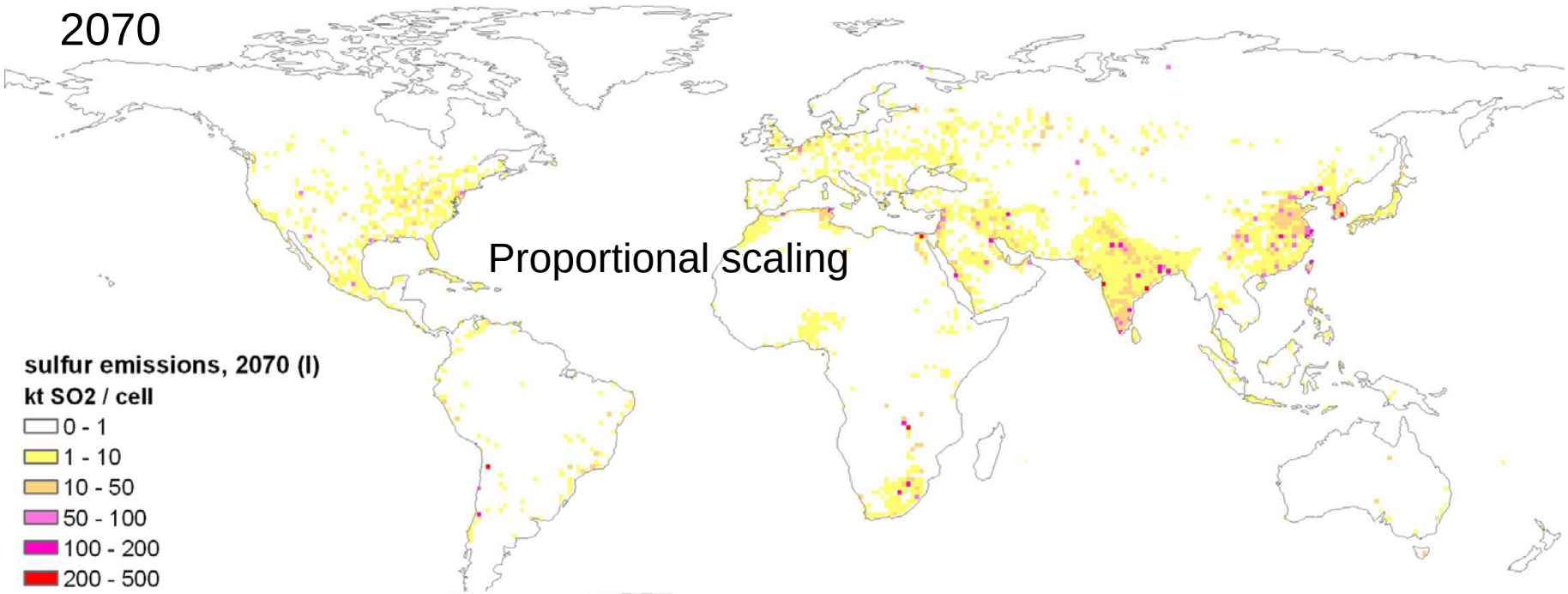

2030
Proportional scaling
sulfur emissions, 2030 (I)
kt SO2 / cell
0 - 1
1 - 10
10 - 50
50 - 100
100 - 200
200 - 500
Exposure driven
sulfur emissions, 2030 (II)
kt SO2 / cell
0 - 1
1 - 10
10 - 50
50 - 100
100 - 200
200 - 500

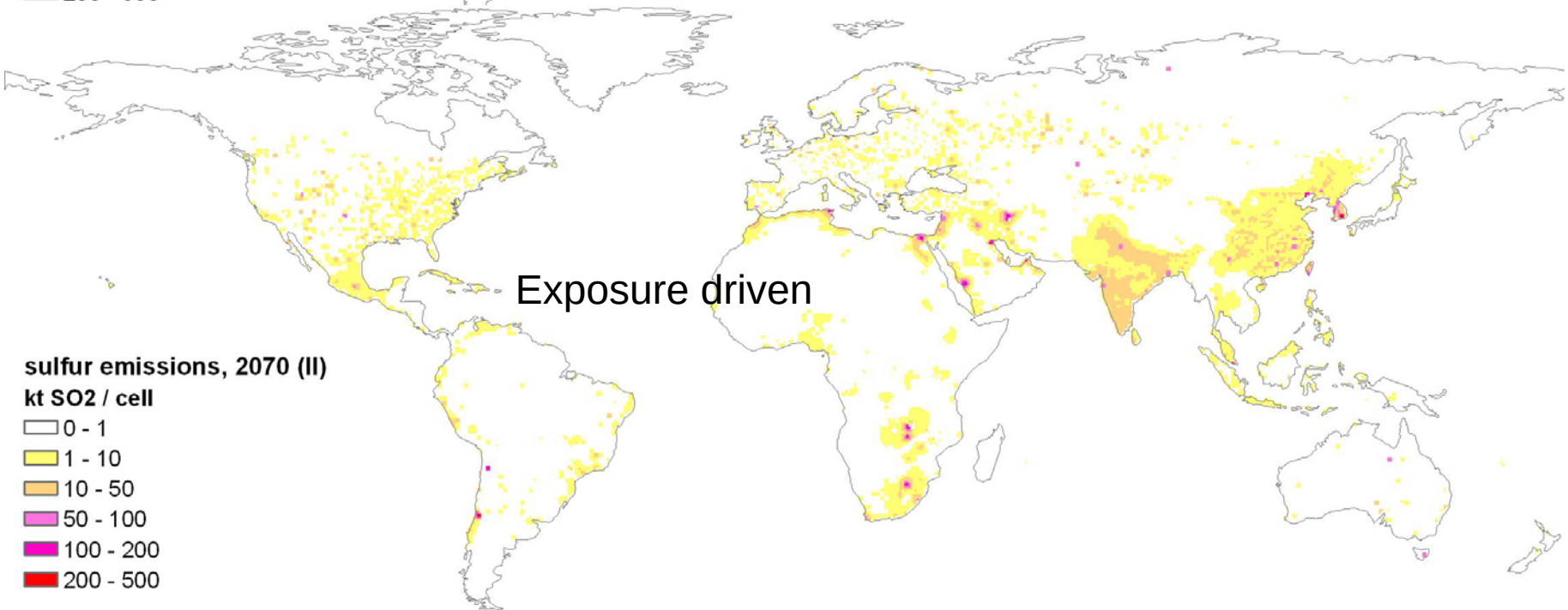
2050

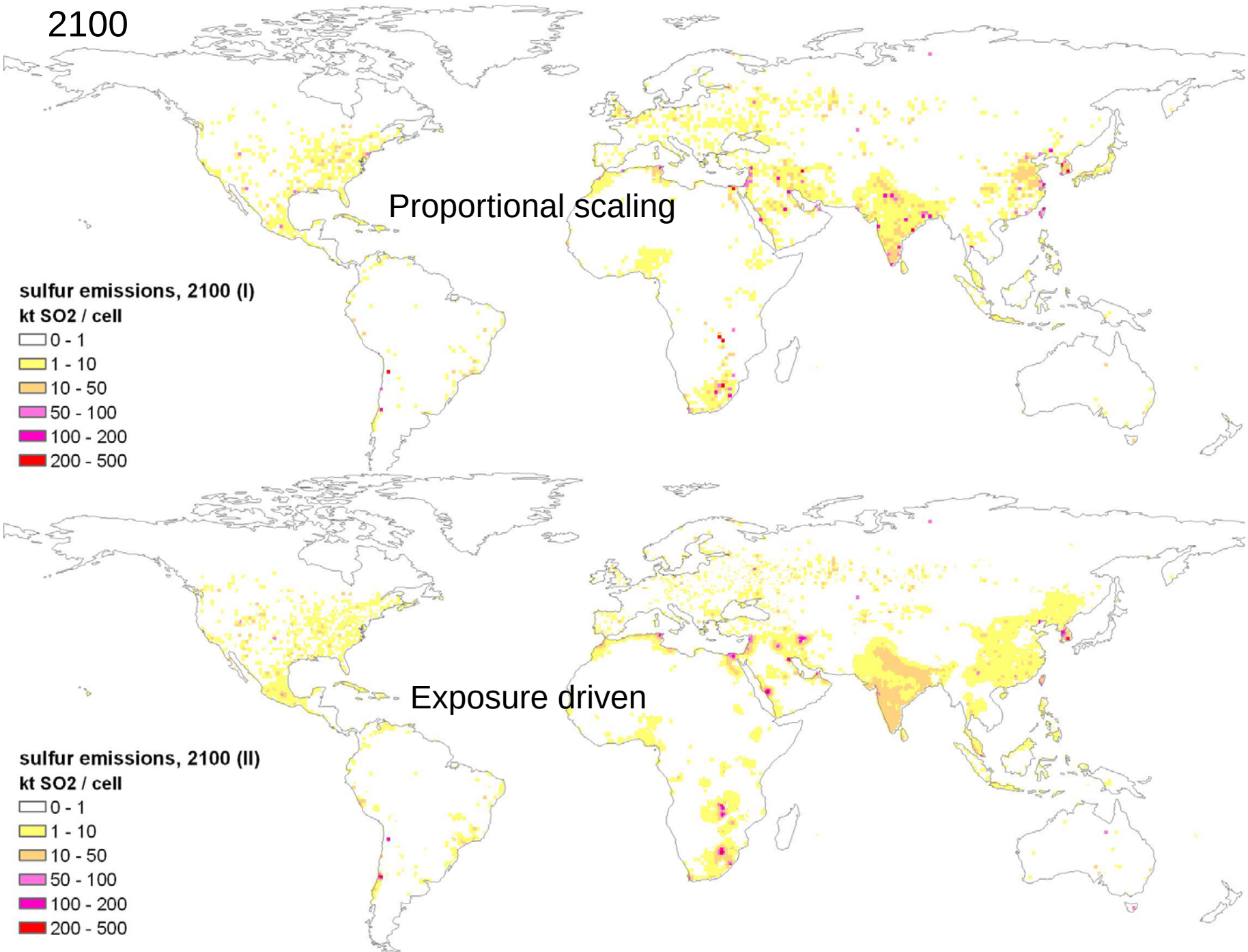

Proportional scaling
sulfur emissions, 2050 (I)
kt SO2 / cell
0 - 1
1 - 10
10 - 50
50 - 100
100 - 200
200 - 500


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

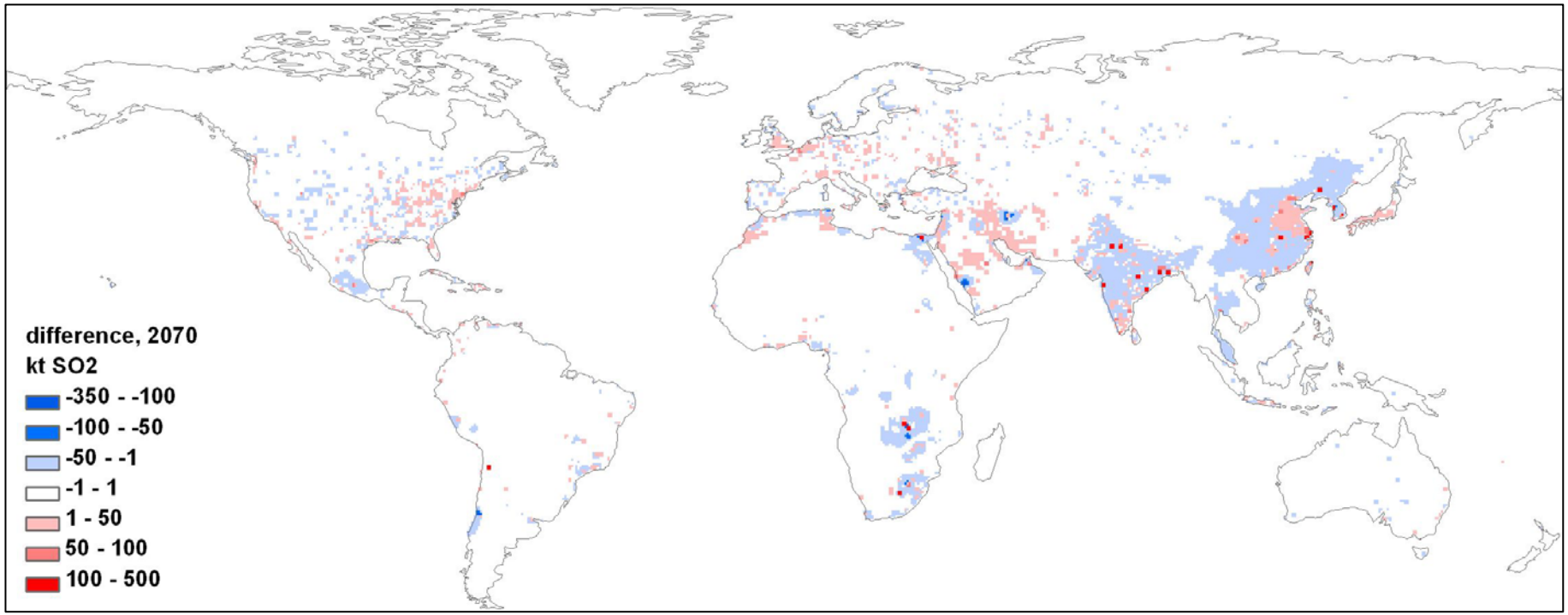
2070


Proportional scaling
sulfur emissions, 2070 (I)
kt SO2 / cell
0 - 1
1 - 10
10 - 50
50 - 100
100 - 200
200 - 500


Exposure driven
sulfur emissions, 2070 (II)
kt SO2 / cell
0 - 1
1 - 10
10 - 50
50 - 100
100 - 200
200 - 500


2100
Proportional scaling
sulfur emissions, 2100 (I)
kt SO2 / cell
0 - 1
1 - 10
10 - 50
50 - 100
100 - 200
200 - 500
Exposure driven
sulfur emissions, 2100 (II)
kt SO2 / cell
0 - 1
1 - 10
10 - 50
50 - 100
100 - 200
200 - 500

# Difference in Spatial Pattern (2070, A2R)

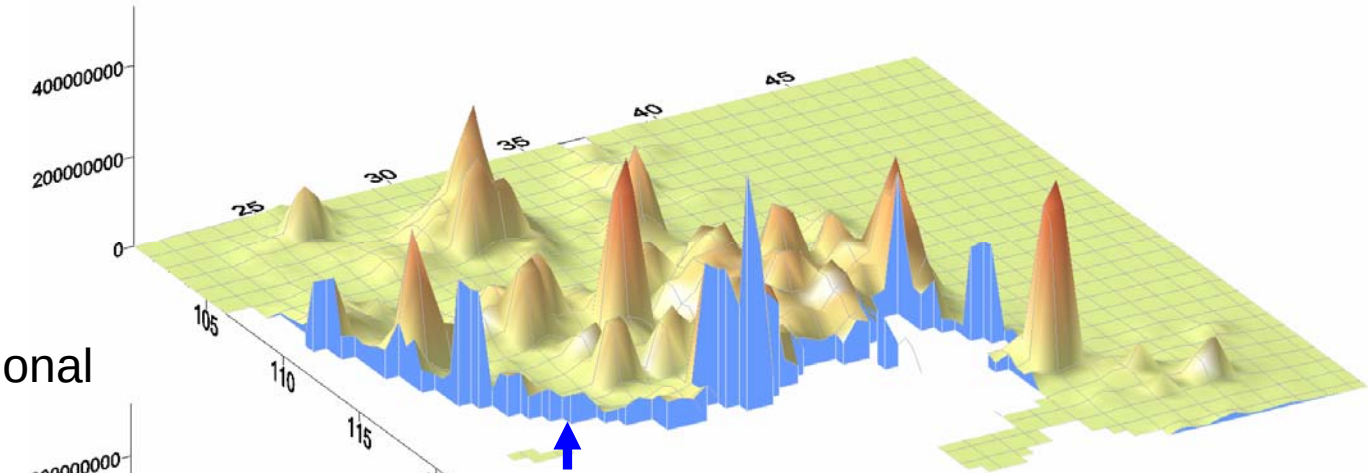



Red: higher in case of proportional scaling

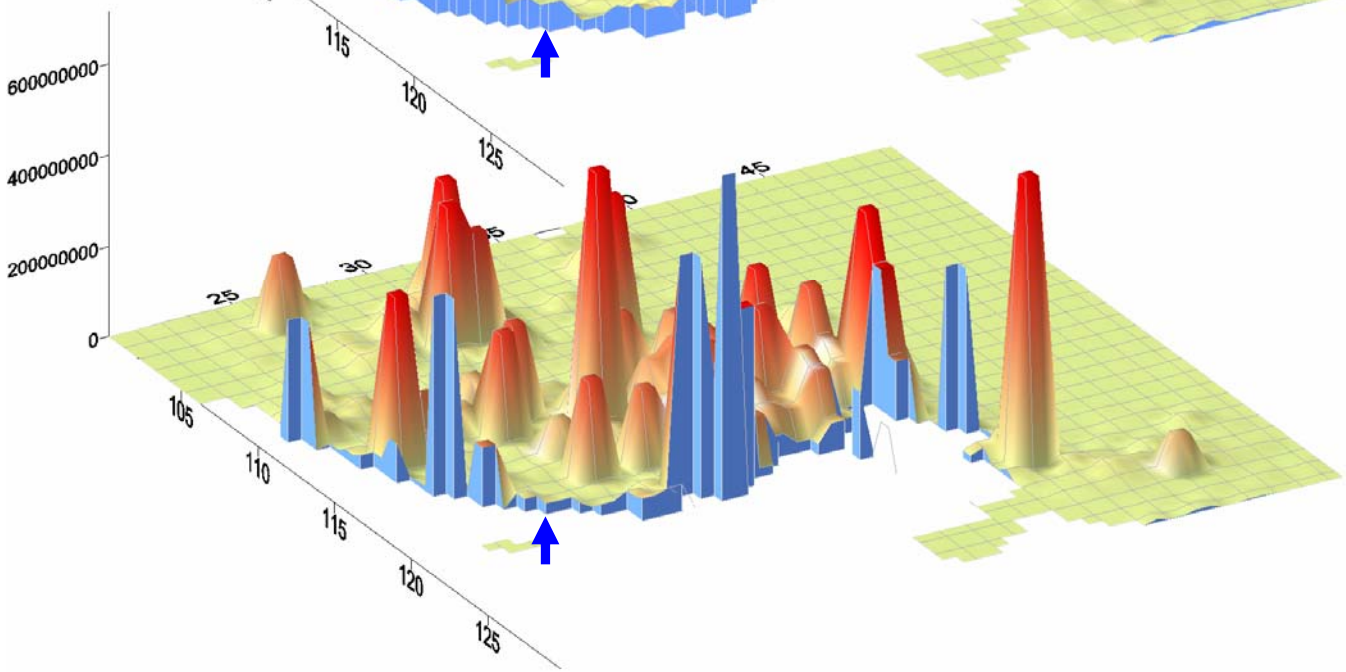
Blue: higher in case of exposure method

# East China (2030)

Exposure / GDP



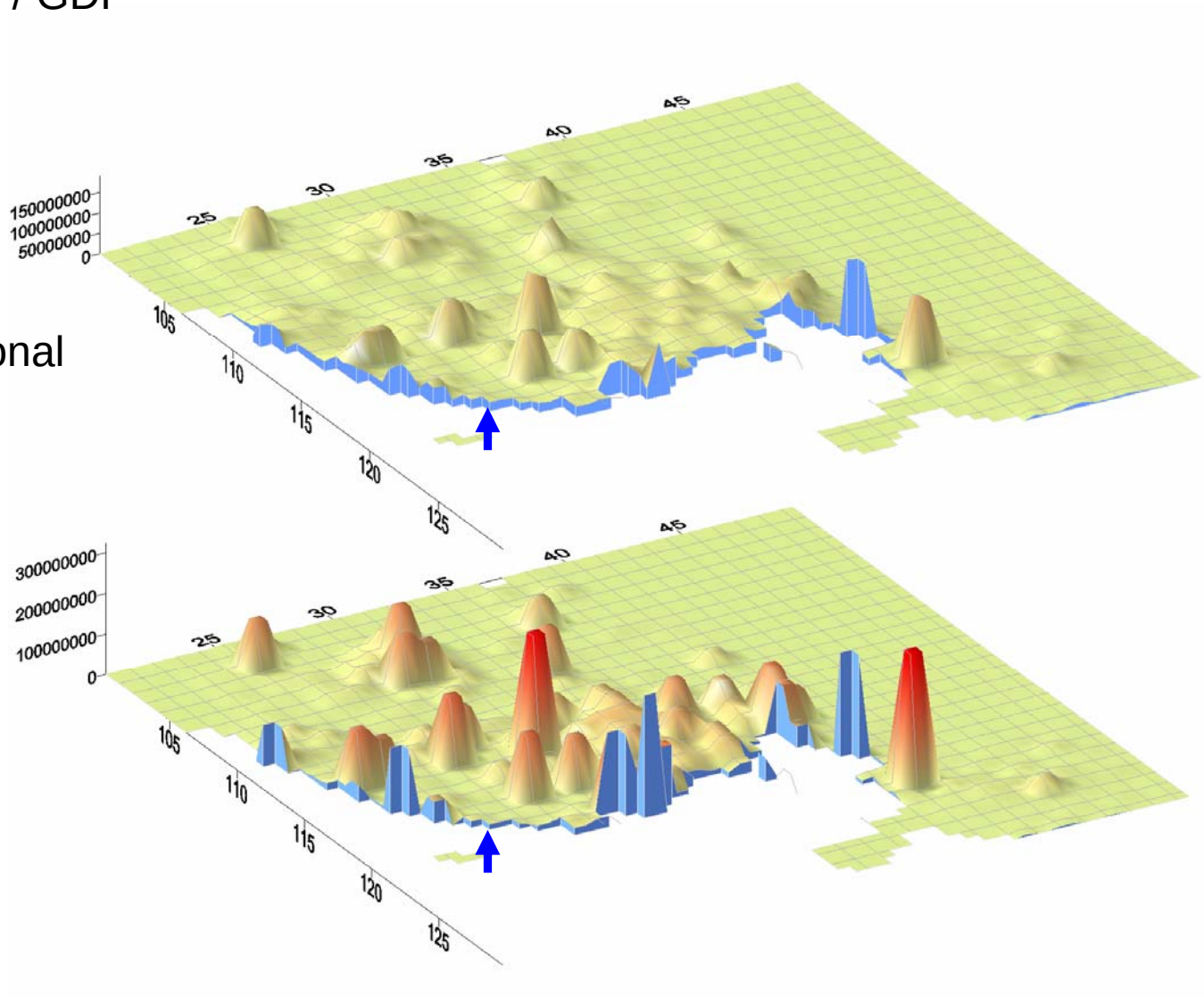

Proportional



# East China (2050)

Exposure / GDP

Proportional



# RCP 8.5 / Status

- ✓ Full spatial information on land cover/use
- ✓ Extension to new emissions sectors and sources (eg forest and savannah fires, NH3)
- ✓ Methodology for downsclaling 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