GEOBENE

Improvement in Optimal Forest Management through Earth Observations: A Global Integrated Analysis Considering Fire Risk

Michael Obersteiner[1], Georg Kindermann[1], Ian McCallum[1], Nikolay Khabarov[1],
Jana Szolgayová[1,2], Sabine Fuss[1]

ISRSE-33, May 2009
Stresa, Italy

1) IIASA, Laxenburg, Austria;
2) Comenius University, Bratislava, Slovakia

GEOBENE

Motivation

- Szolgayova et al (2009): optimal rotation at <u>local</u> scale
- Objective: examine impacts at <u>global</u> scale
- Integrated modelling framework:

  (1) stochastic optimization to generate optimal forest management decisions at the local scale for a range of parameterizations

  (2) use output from (1) as "behavioural rules" in the spatially explicit Global Forest Model (G4M)

  (3) impact of EO: difference in management results (i.e. between parameters representing states with and without EO)

GEOBENE

Stochastic Optimization

- For different magnitudes of forest fire risk (assuming wood price & harvesting costs depend on tree size & amount of removed wood volume (and if used during thinning or final cut), planting costs and infrastructure costs) and different discount rates, the yearly decisions maximizing the sum of expected discounted profits in each year are determined.
- Forest fire probability: Poisson-distributed
- Possible decisions: rotation age, thinning (corridors), stocking degree
- Result: “look-up” table for G4M.

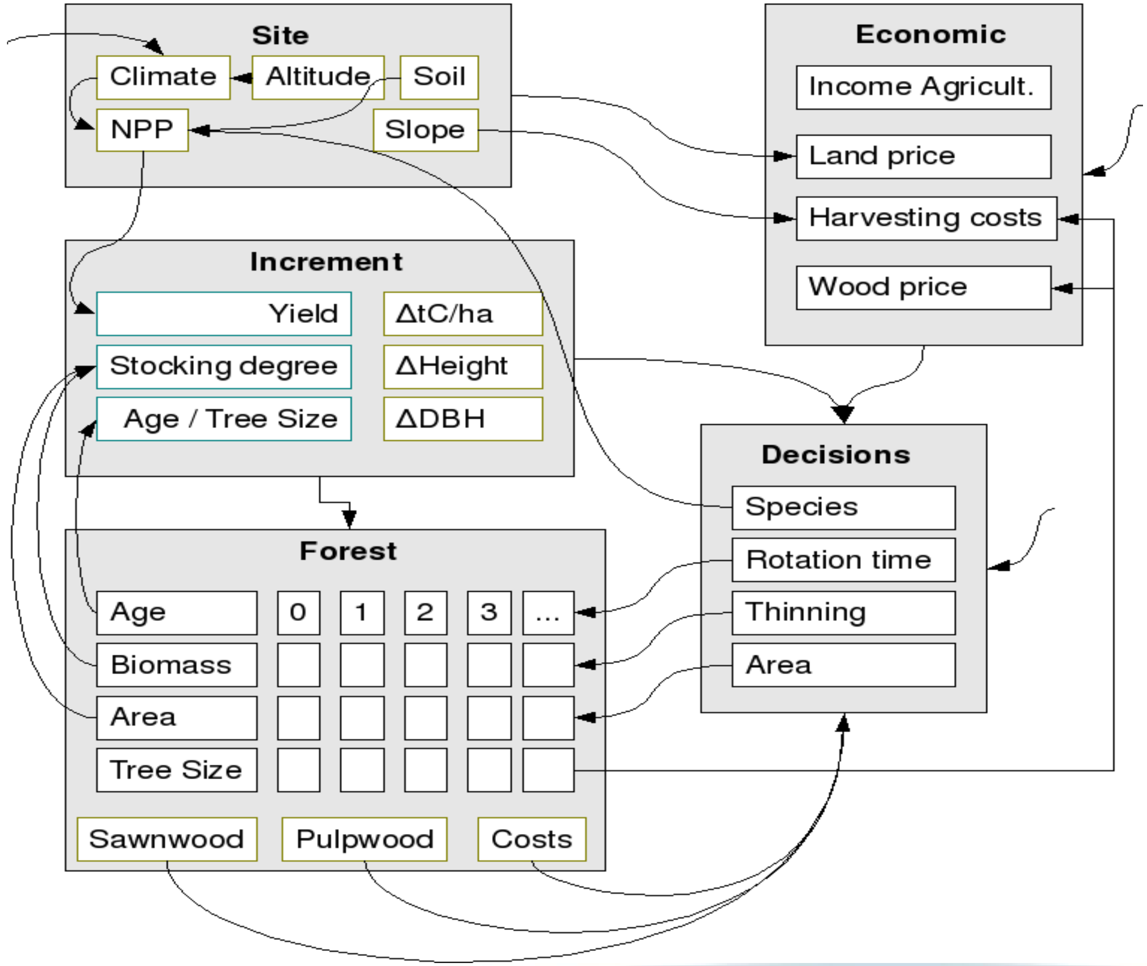
GEOBENE

G4M (G. Kindermann)

Global Forest Model (G4M) ⇒ spatially explicit estimates of:

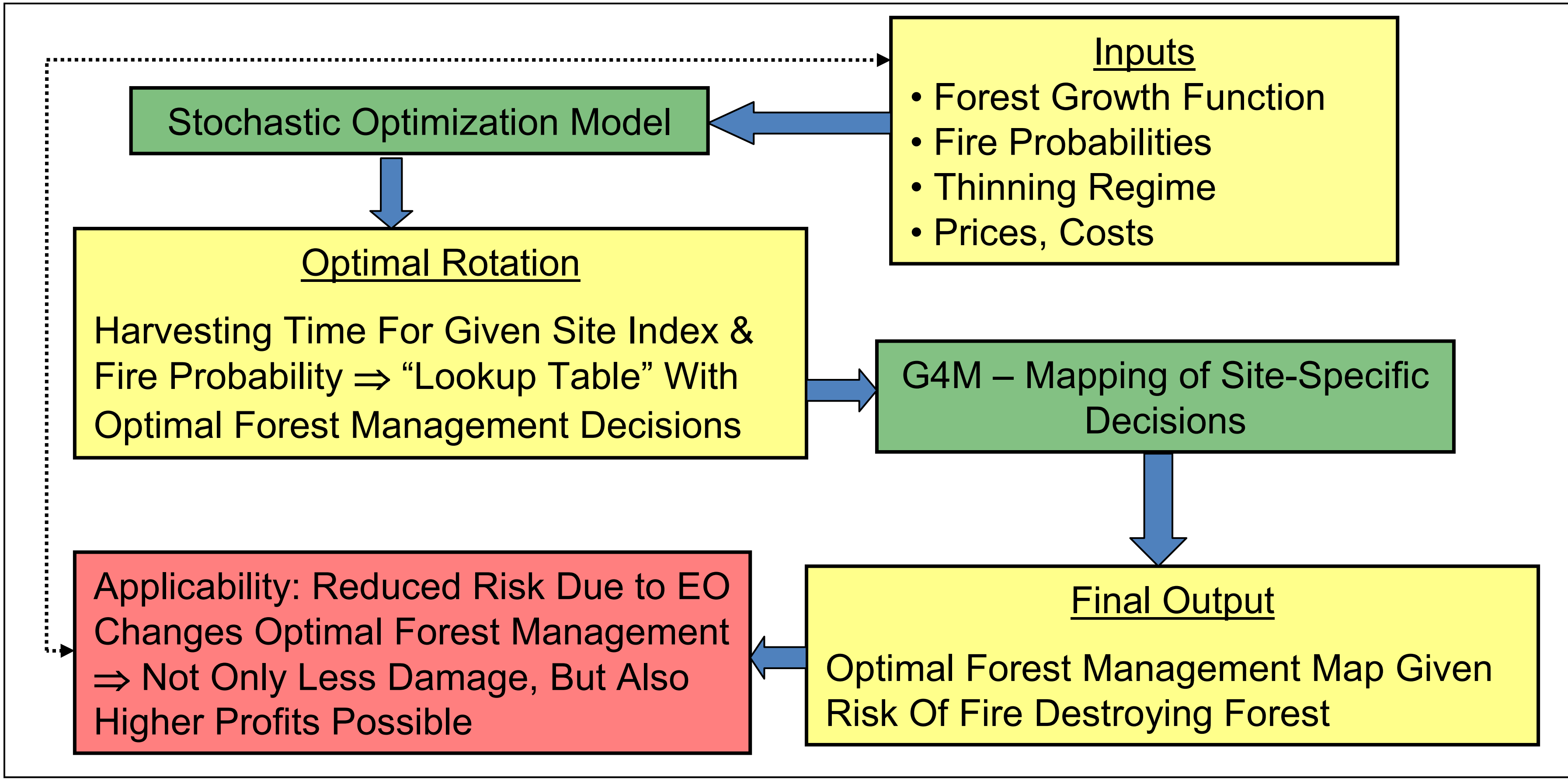
a) annual above-ground wood increment,
b) development of above-ground forest biomass,
c) costs of forestry options (forest management, afforestation & deforestation) through income comparison between alternative land uses

G4M II



Site
Climate
Altitude
Soil
NPP
Slope
Economic
Income Agricult.
Land price
Harvesting costs
Wood price
Increment
Yield
ΔtC/ha
Stocking degree
ΔHeight
Age / Tree Size
ΔDBH
Decisions
Species
Rotation time
Thinning
Area
Forest
Age
0
1
2
3
...
Biomass
Area
Tree Size
Sawnwood
Pulpwood
Costs

Methodology



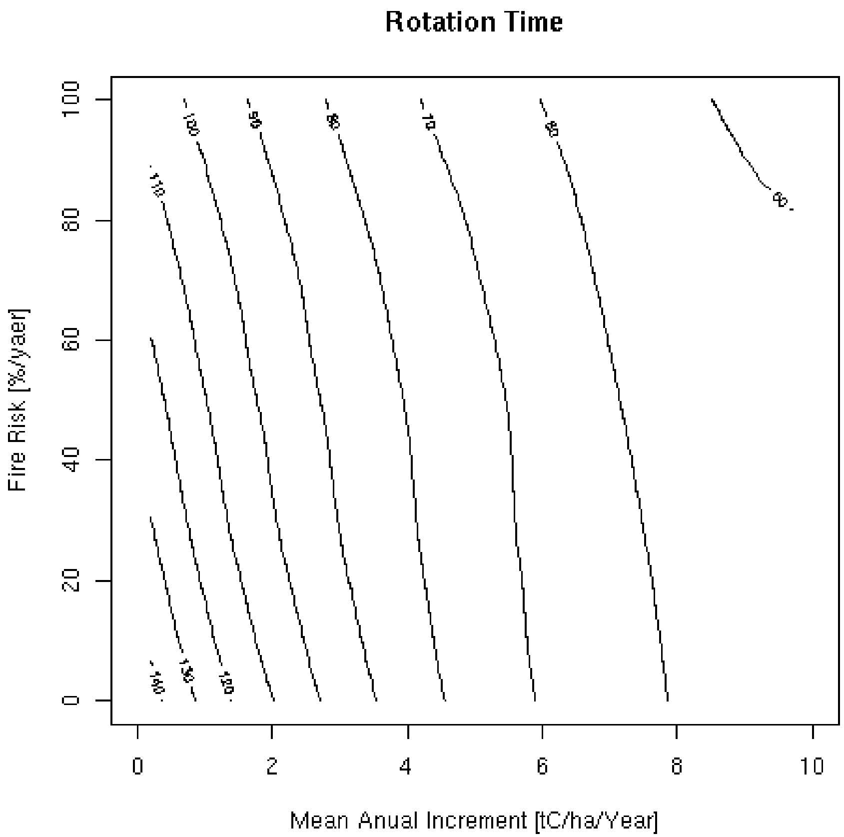
Data

G4M provides combinations of:

- mean annual increment form 0.25-10 tC/ha/year,
- age from 0-400 years,
- yield table stocking degree from 0.1-1 and stocking for unmanaged forests the values
- volume in the forest, diameter, volume removed during thinning

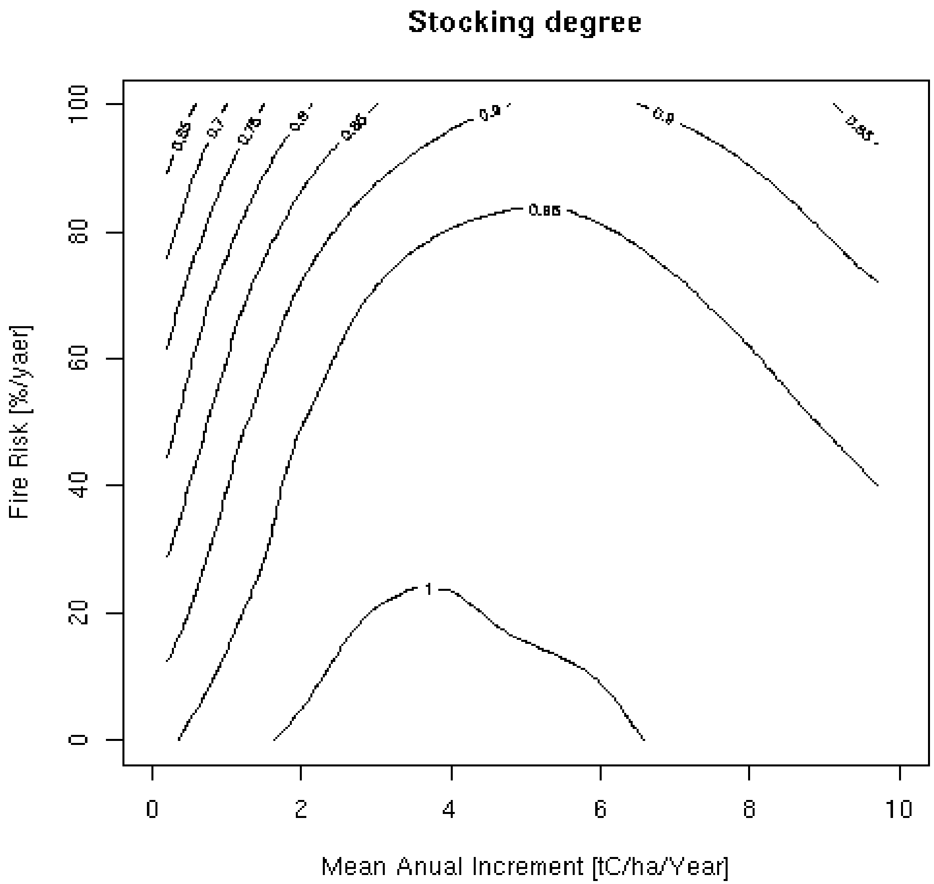
GEOBENE

Results



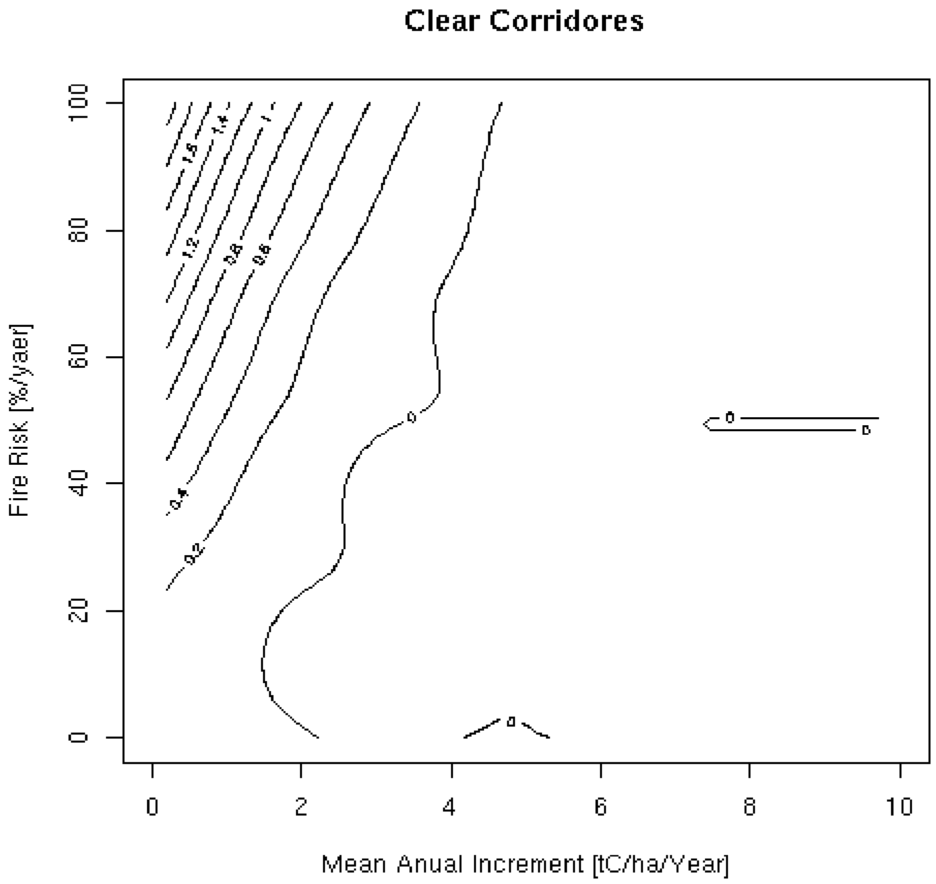
Optimal rotation time for different magnitudes of forest fire risk, mapped for a discount rate of 1%.

Results II



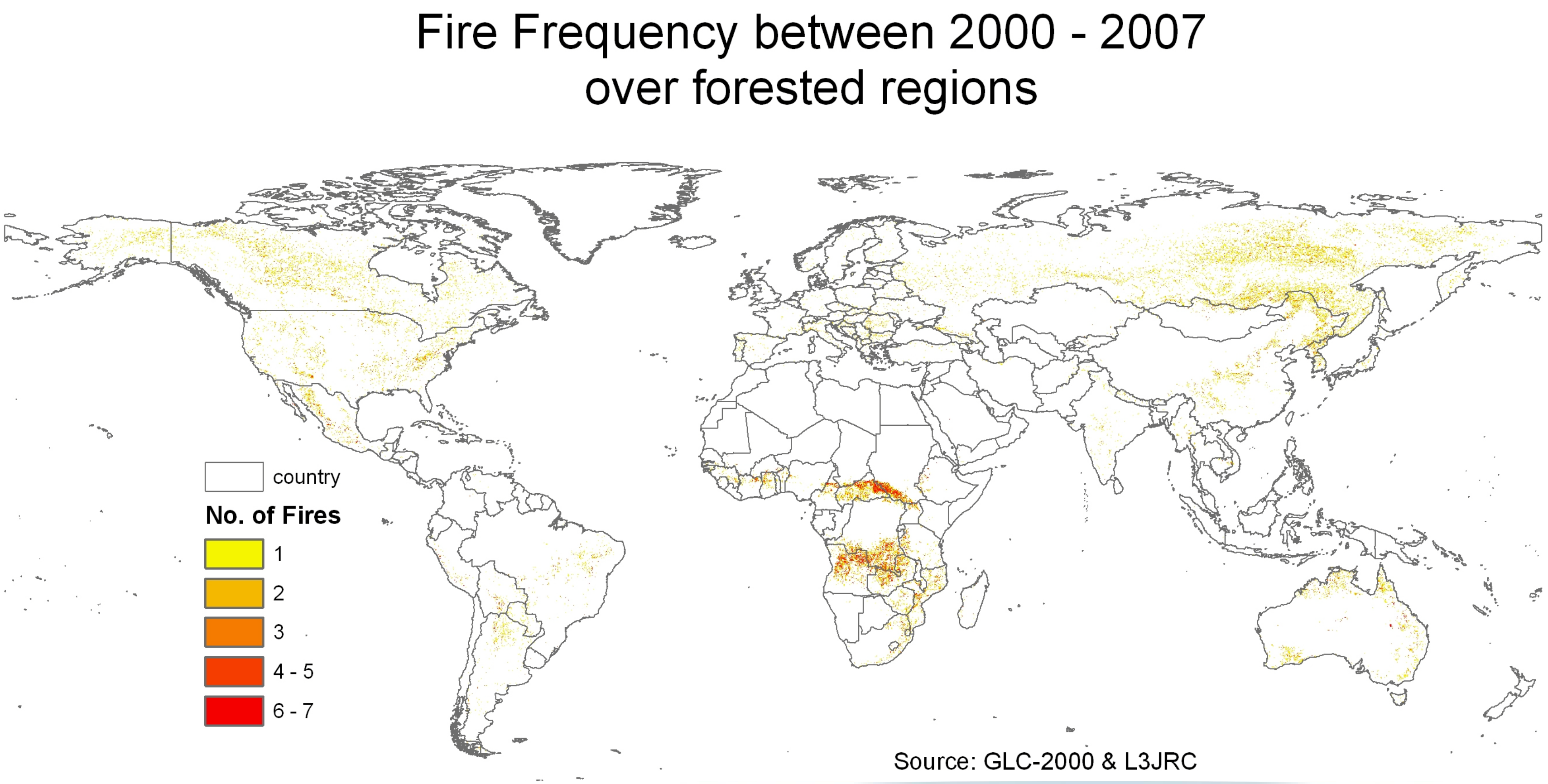
Optimal stocking degree for different magnitudes of forest fire risk, mapped for a discount rate of 1%.

Results III



Optimal size of separating corridors for different magnitudes of forest fire risk, mapped for a discount rate of 1%.

Fire Frequency Map (Burnt Area)



GEOBENE

Fire Frequency

- Global burnt area detected via EO using SPOT VGT S1
- Recorded between 2000 – 2007 by L3JRC consortium
- Pre-processed dataset to remove cloud shadow etc, post-processed to remove over detections
- Assumptions: global fire year starts on April 1st of every year, surface cannot be burned more than once in the same fire season.
- Cell value ~ number of years the cell was identified as burnt area (total cell 1km2) between 2000-2007.
- Improvements/ lengthening of this dataset will greatly improve the quality of estimations based

Conclusions

- Modeling framework enables us to use fire frequency map together with the derived optimal forest management decisions and a site-index map in order to examine the impact of Earth observations. $\Rightarrow$ work in progress
- Higher fire risk leads to shorter rotations to reduce global burnt area, thus EO reducing fire rate would lengthen rotations and increase associated benefits.

GEOBENE

Thank you!

oberstei@iiasa.ac.at