Analysing the Effects of Different Land Cover Datasets on Modeling Deforestation and GHG Emissions Associated with Land Use Changes

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INTRODUCTION

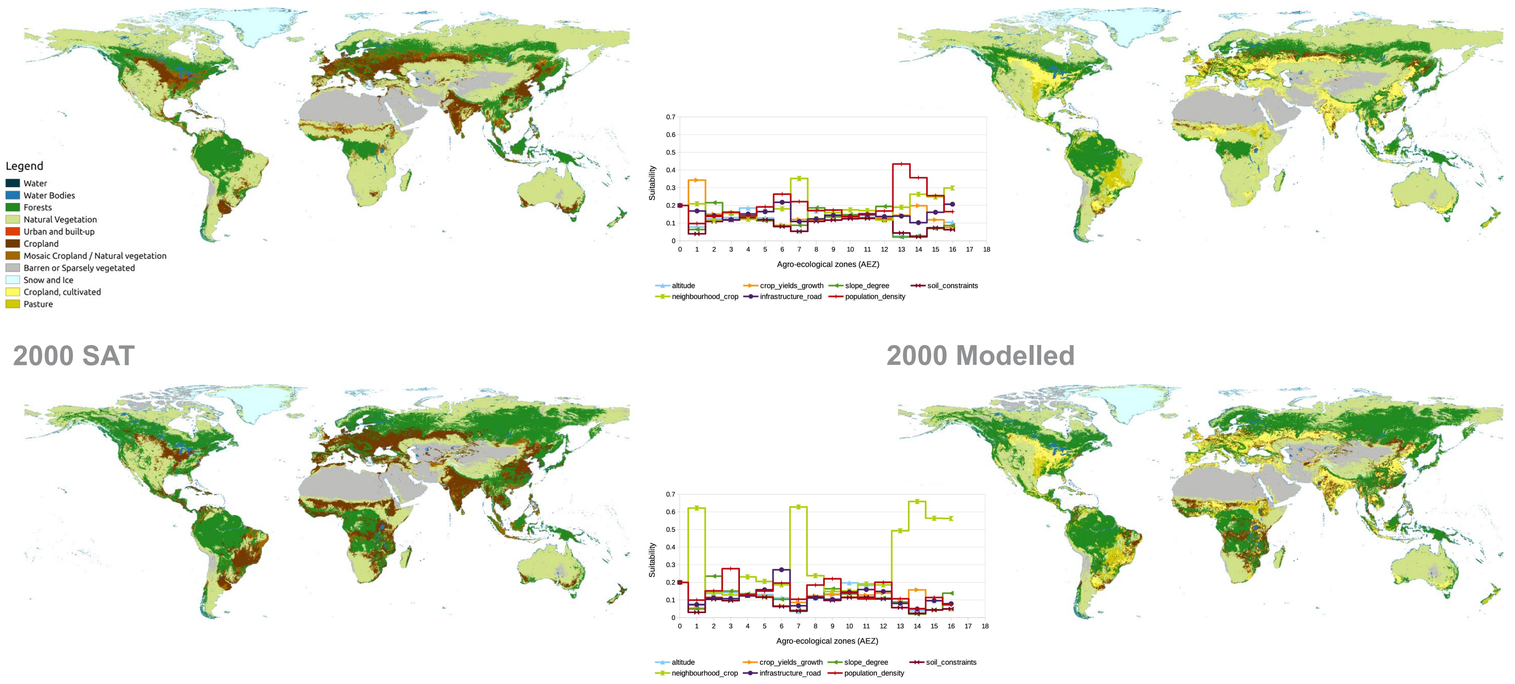
Human induced land use changes have strong impacts on the Earth System. To evaluate future impacts of agriculture on land use changes, models like LandSHIFT have been developed. These models require different external information like geophysical, socio-economic and climate data, as well as land-cover data derived by remote sensing satellites. All these types of information affect modeling results.

While uncertainty in socio-economic and climate data are considered in different scenario pathways, uncertainty in geophysical and land cover data are usually not assessed. Land cover datasets have considerable discrepancies due to different sensor technologies and processing methodologies. Therefore they affect results such as land use change modeling as well as follow-up analysis.

METHODOLOGY

MODIS

CCI-LC



(1) Parameter Estimation

determines the spatial correlation between **socio-economic data** (population, road network), **bio-geophysical data** (altitude, soil constraint, terrain slope, crop yields (climate), cropland neighbourhood) and the occurrence of arable land changes. It is based on the concept of **agro-ecological zones** (AEZ).

(2) Initialization

uses a **multi-criterial-analysis** (MCA) to allocate country specific

$$\psi_k = \underbrace{\sum_{i=1}^{n} w_i p_{i,k}}_{suitability} \times \underbrace{\prod_{j=1}^{m} c_{j,k}}_{constraint}, \quad with \sum_i w_i = 1 \quad and \quad p_{i,k}, c_{j,k} \in [0,1]$$

ψ	:	*preference factor*
n	:	*number of suitability factors*
m	:	*number of constraint factors*
w_i	:	*weight of factor i*
$p_{i,k}$	:	*suitability value of factor i*
$j_{i,k}$	:	*constraint value of factor j*

croptype area statistics from FAO on the land cover dataset. The parametersets from the prior step is used to calculate preference values for the allocation on a **5_arc-min scale**.

(3) Validation

contains a comparison of frequency distributions that confirms the median **suitability of cropland cells (MODIS: 0.56; CCI-LC: 0.55)** is higher than that of **non-cropland cells (MODIS: 0.05; CCI-LC: 0.03)** and a ROC analysis shows that the most suitable cells are cropland cells **(AUC of MODIS: 0.978; AUC of CCI-LC: 0.982).** This indicates cropland cells can predominantly be found at locations with higher suitability values and so the model has the ability to simulate these, an important factor determining the location of cropland.

(4) Scenario

calculations with the LandSHIFT model are based on the land use maps generated in the previous step as well as **statistical production data** from the FAO **for the years 2000 to 2010**. LandSHIFT uses a multi-criterial-analysis (MCA) and the estimated parameters again to allocate these production data in a spatial explicit way.

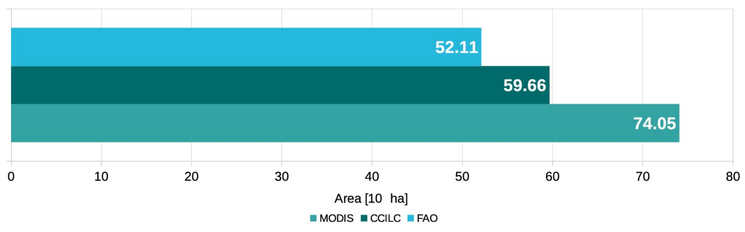
The resulting maps are used to analyse landuse changes, deforestation and the associated greenhouse gas emissions.

RESULTS

Deforestation

for the years 2000 to 2010 is based on the land use change maps from the scenario calculation.

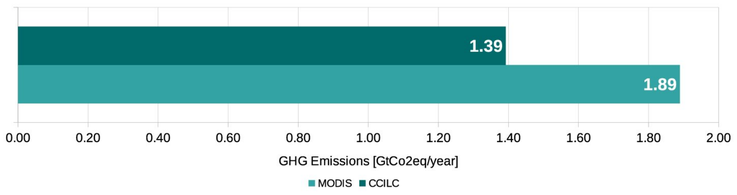
Results show that **deforestation is higher in both scenarios compared to FAO statistics**. The main reason for the discrepancies are the varying land use type classification of forest.

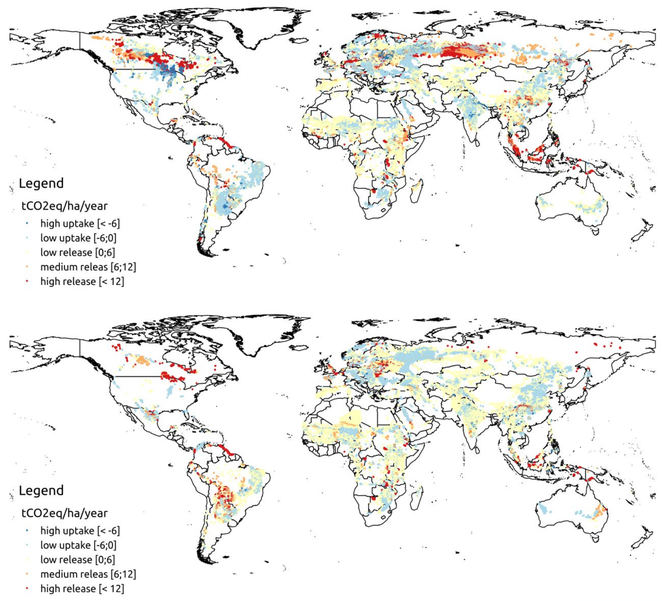


GHG emissions

for the years 2000 to 2010 are also calculated based on land use changes. The calculation of carbon stock change in soil and vegetation due to land-use changes is based on the approach of the EU Renewable Energy Directive (RED).

Results show that both products **differ greatly in quantitative and spatial distribution.**





MODIS

CCI-LC

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