A Spatial Agent-based Model for Assessment and Prediction of Woodchips Availability for Heating Plants in Austria

Johannes Scholz[1], Peter Mandl[2], Christian Kogler[2], Michael Müller[2]

[1]Research Studios Austria – Studio iSPACE, Salzburg
johannes.scholz@researchstudio.at

[2]Department of Geography and Regional Studies, University Klagenfurt, peter.mandl@aau.at, chris@edu.uni-klu.ac.at, m9muelle@edu.uni-klu.ac.at

Poster and Paper

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https://giscience.aau.at/content/poster-giscience-2014

Framework

By **cooperation** of Geography, Geoinformatics, GIScience, Spatial Analytics

What: **Potentials** of Renewable Energy Ressources

How: **Modelling** using different methods of a „Spatial Data Science“ and

Geosimulation for sensitivity analysis, hypotheses testing, scenario building, prediction, prescription

For: **Answering** urgent **questions** and **decision support**

Motivation

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- Energy from renewable sources to reduce greenhouse gases (Kyoto Protocol)
- Availability (potential) of resources in space and time
- Simulation of the change of availability (potential)
- What can and should be done?
- What consequences have different actions?

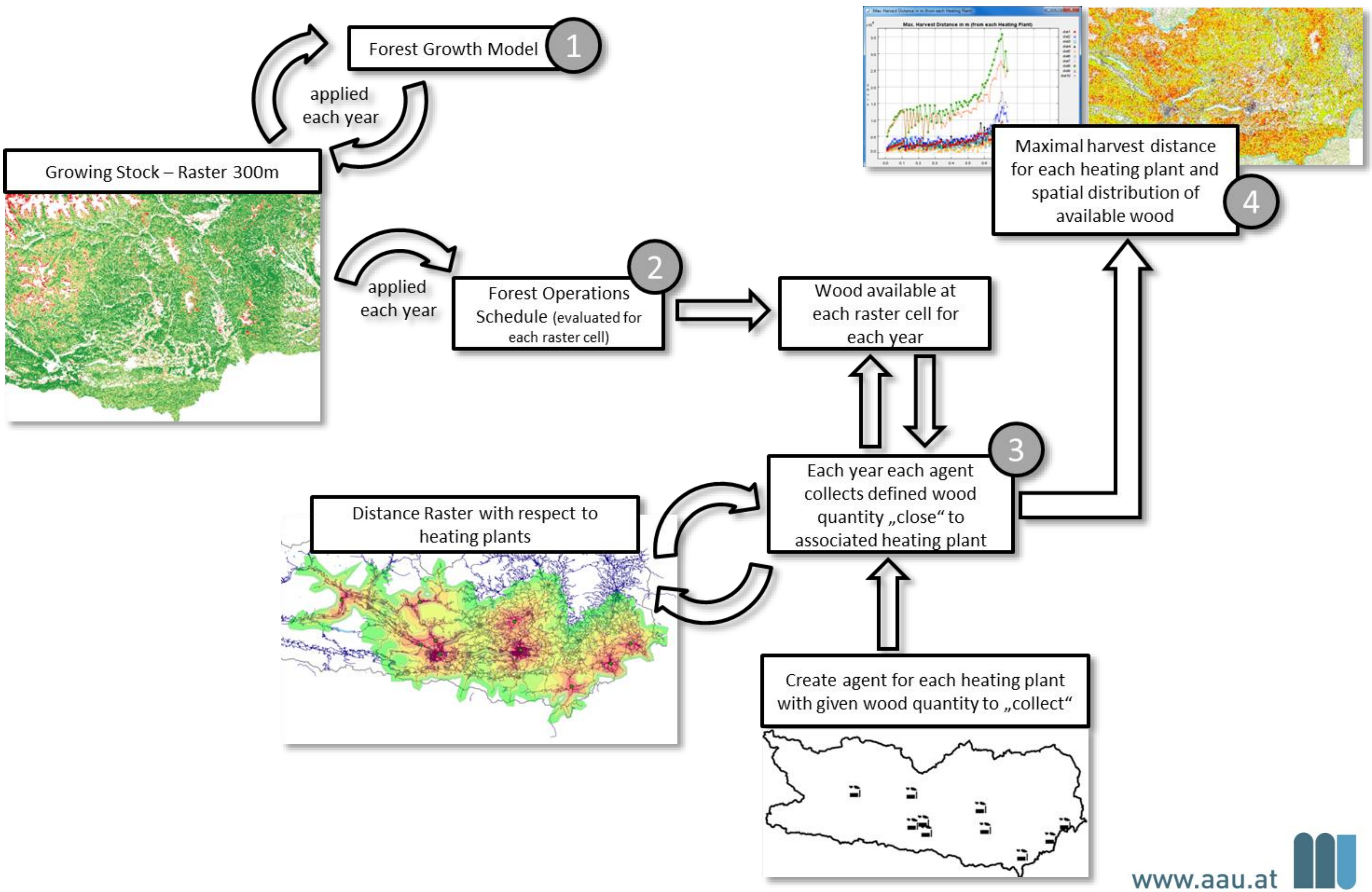
Scientific Question

Which **spatio-temporal and economic effects exist on the wood chips availability** as renewable energy source for heating power plants in a closed market (Carinthia and Austria) over the next 50 years?

Innovations of this model:

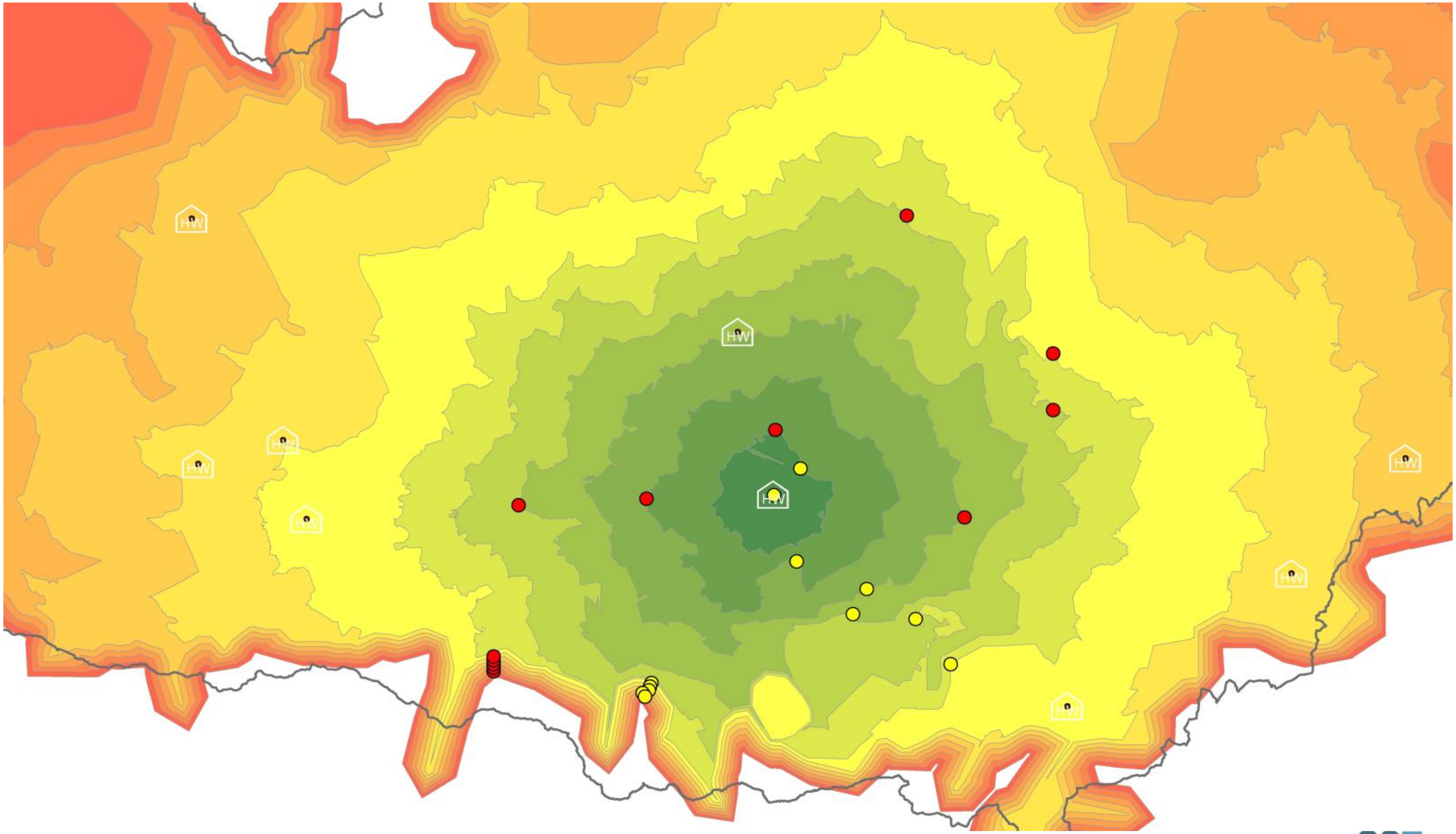
- Very **high spatial resolution** using **real data**
- **Coupling** of a GIS and an agent-based modelling environment (Agent Analyst of ArcGIS)
- **Hypothesis testing** if the support of wood chips as fuel for heating plants is a sustainable solution for renewable energy source projects in Central Europe

Approach

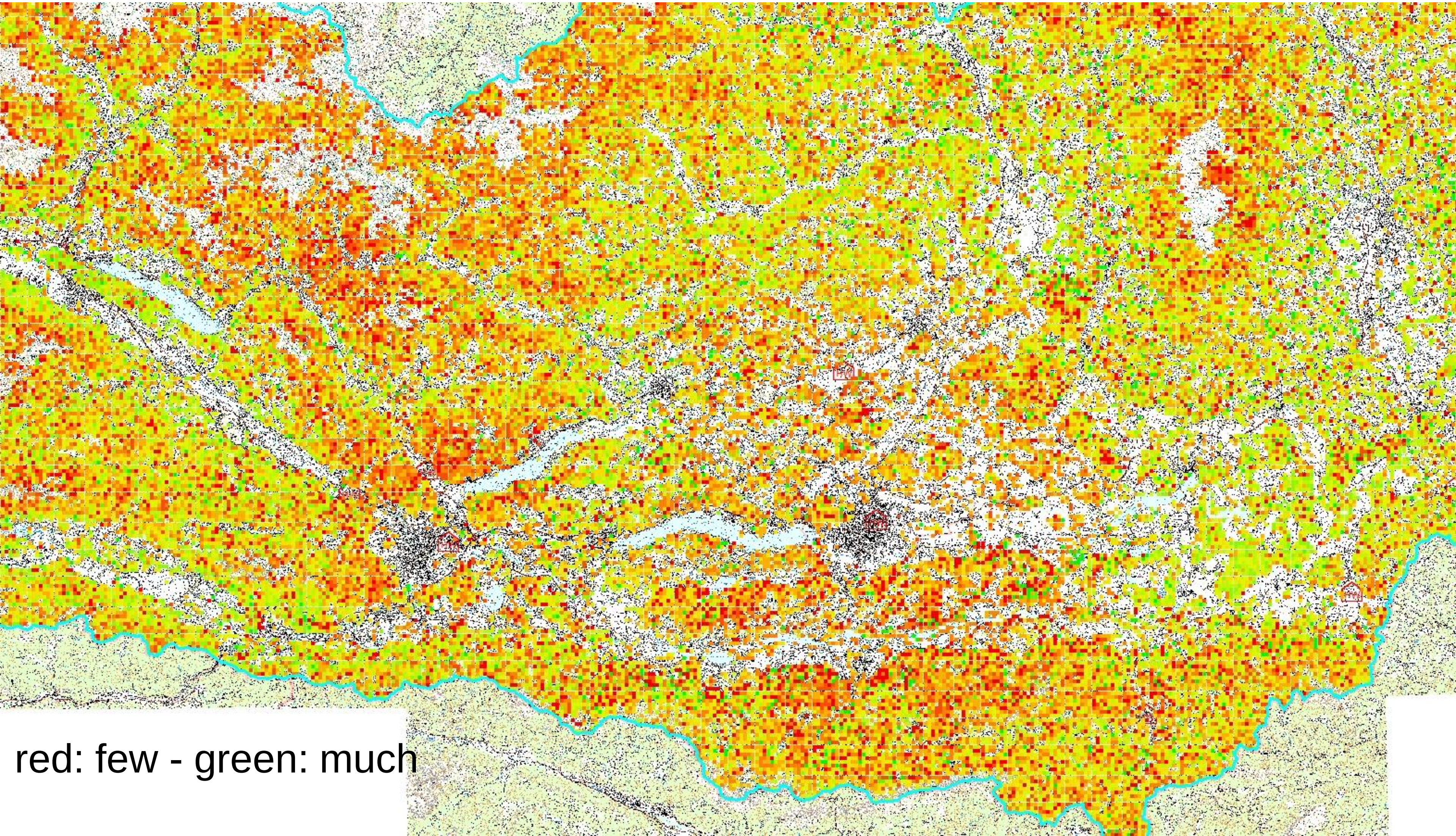


Forest Growth Model
1
applied
each year
Growing Stock – Raster 300m
applied
each year
Forest Operations Schedule (evaluated for each raster cell)
2
Wood available at each raster cell for each year
Maximal harvest distance for each heating plant and spatial distribution of available wood
4
Each year each agent collects defined wood quantity „close“ to associated heating plant
3
Distance Raster with respect to heating plants
Create agent for each heating plant with given wood quantity to „collect“

Distance zones from Power Plant



Available woodchips within the first 10 years



red: few - green: much

Results

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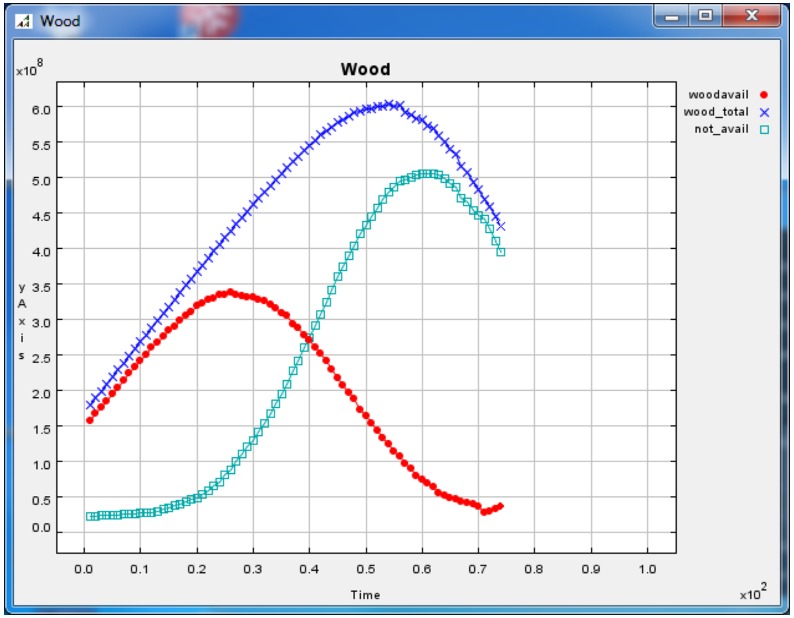
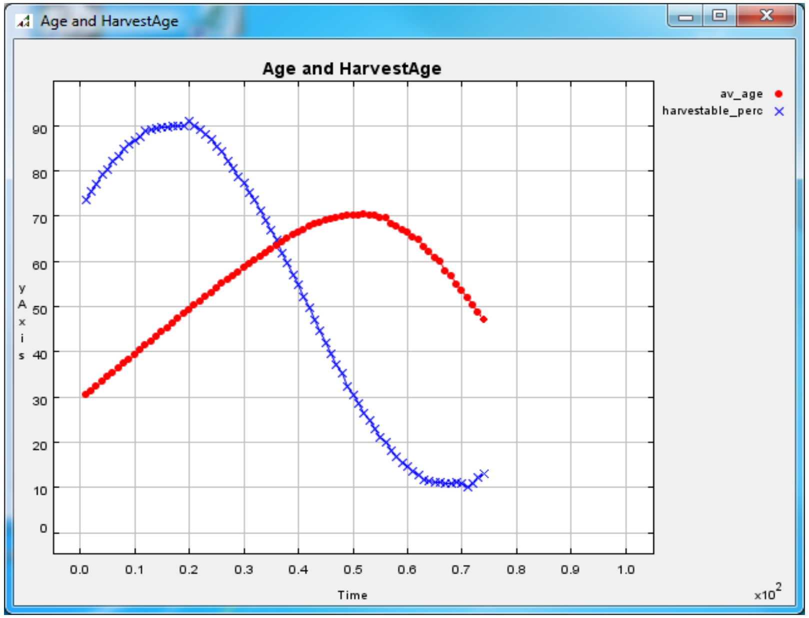
- The **left figure** shows the amount of the total (blue), the available (red) and the not available wood (lightblue) for all of Carinthia.
- The **right figure** shows the average age (red) and the total percentage of the harvestable forest stands (blue). **In these figures the proposition that the age of the stands is the main reason for a massive decrease in wood chips availability during the next decades is confirmed.**

Results

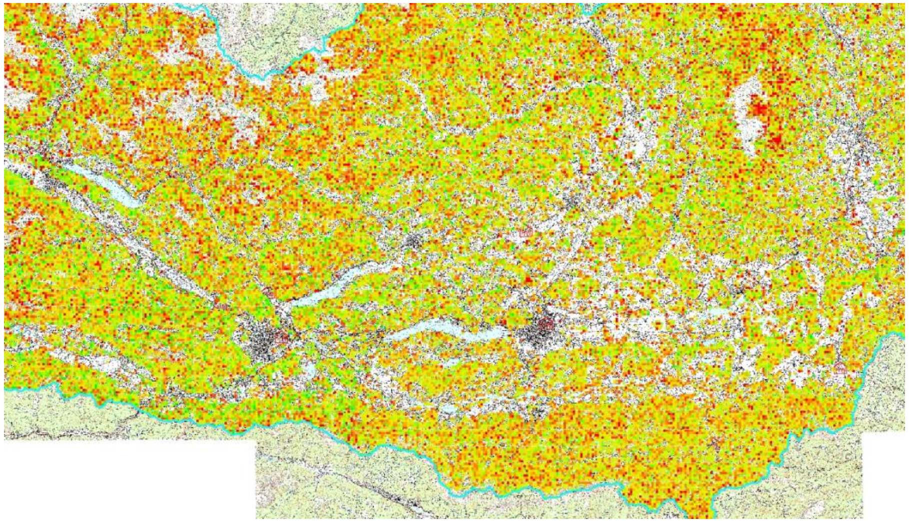


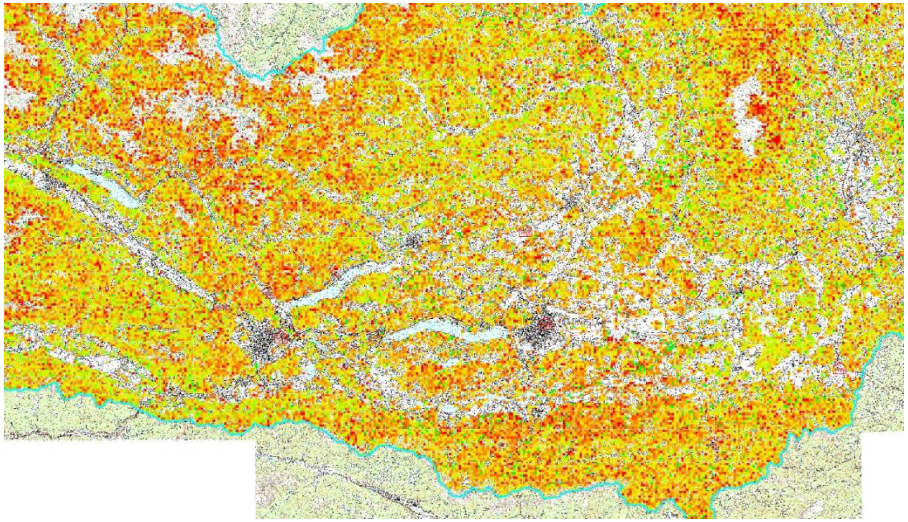


The amount of the total (blue), the available (red) and the not available wood (lightblue) for all of Carinthia is shown.

The average age (red) and the total percentage of the harvestable forest stands (blue) is shown.

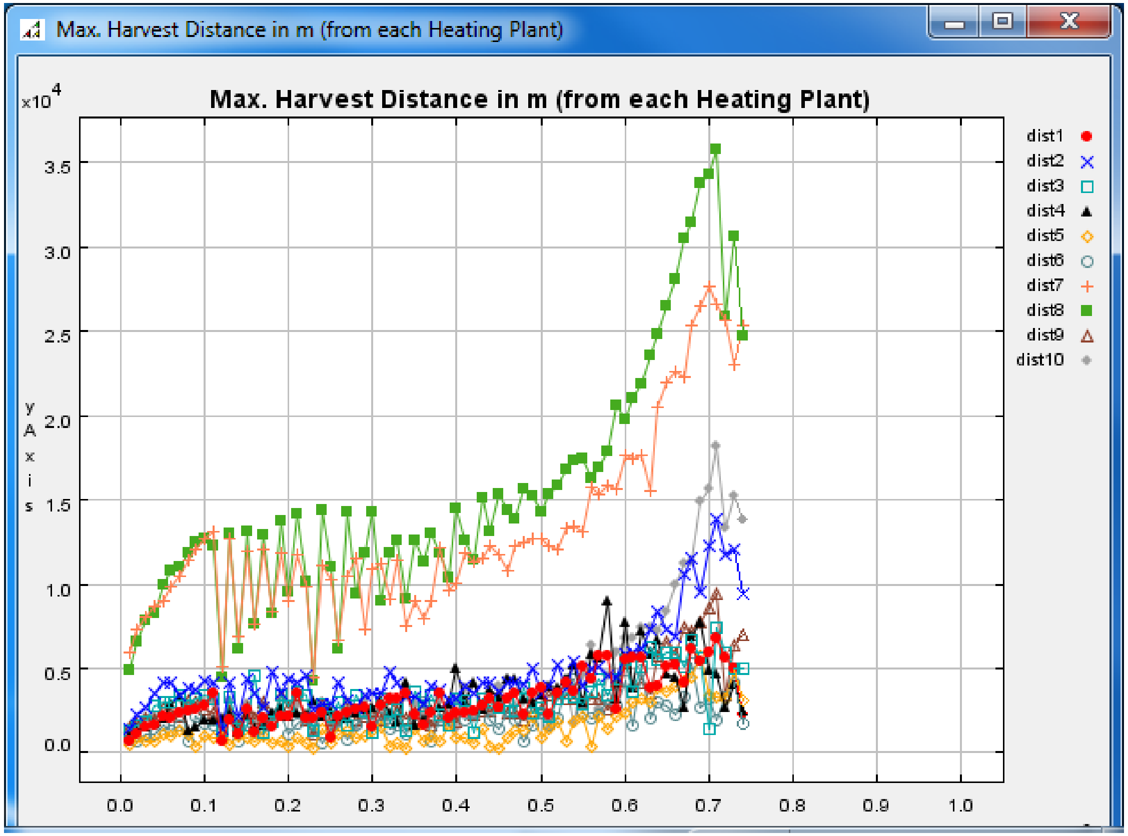
Results





Change of the spatial distributions of much available (green) and few available wood (red) in Carinthia within a time span of 10 years.

Results



The **maximum transport distance** from the forest to every heating plant for each simulation year.

Conclusions

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- **High age of the stands** > main reason for a massive decrease in wood chips availability during the next decades.
- **Decrease of available wood in the vicinity of the power plants** and in the higher regions in general can be seen.
- **Maximum transport distance increases the longer the simulation runs** > Wood chips have to be imported over longer distances.
- It is indicated that, within Carinthia, **one cannot fully rely on wood chips from local forests** in order to fulfil the heating energy demand.

Further Work

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- Simulation of additional scenarios
- Change of the types of forest operations and their timing
- Influence of wood chip imports from other countries on the model results
- Optimum of the number and the location of power stations according to the available amount of timber in Carinthia
- Combination of the biomass power plants with other renewable energy sources.
- Development of a simulation methodology supporting the Energy Master Plan for Carinthia (http://www.energie.ktn.gv.at/)