Österreichischer Klimatag 2016 Presented by
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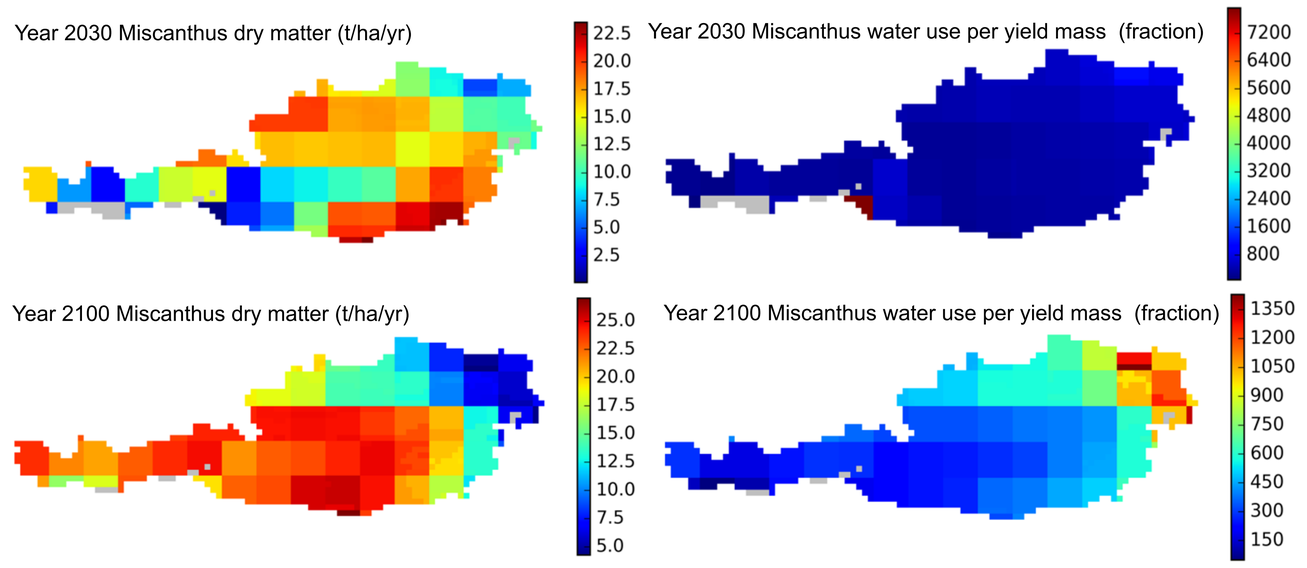
MODELLING IMPACTS OF SECOND GENERATION BIOENERGY CROPS ON ECOSYSTEM SERVICES UNDER CLIMATE CHANGE SCENARIOS

COMBINING BIOGEOCHEMICAL MODELS (ECOSSE, DAYCENT) WITH BIOENERGY CROP MODELS (MISCANFOR, SALIXFOR) AND BIODIVERSITY AND ECOSYSTEM ASSESSMENT AND VALUATION TOOLS (LIFE CYCLE ANALYSIS, FRAMEWORKS, THREAT MATRIXES) TOWARDS AN UNDERSTANDING OF IMPLICATIONS, SYNERGIES, AND TRADE-OFFS UNDER CLIMATE CHANGE. EXCLUSION MAPS DRAWN WITH ARCGIS WILL BE USED FOR A BETTER UNDERSTANDING WHERE BIOENERGY CROPS ARE VALUABLE AND ECONOMICALLY USEFUL. THIS WILL ALLOW TO ESTABLISH AREAS IN AUSTRIA AND EUROPE WHERE THESE CROPS SHOULD BE PLANTED OR AVOIDED OVER THE NEXT DECADES TO MITIGATE IMPACTS OF CLIMATE CHANGE.

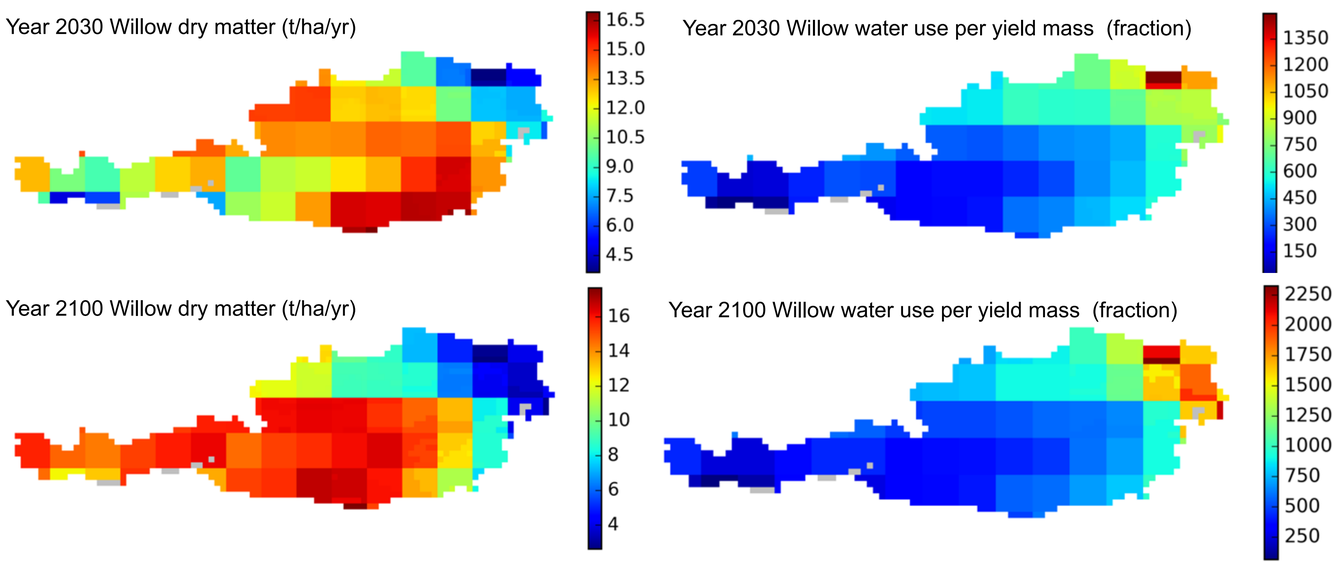
MISCANTHUS in Austria 2030 and 2100

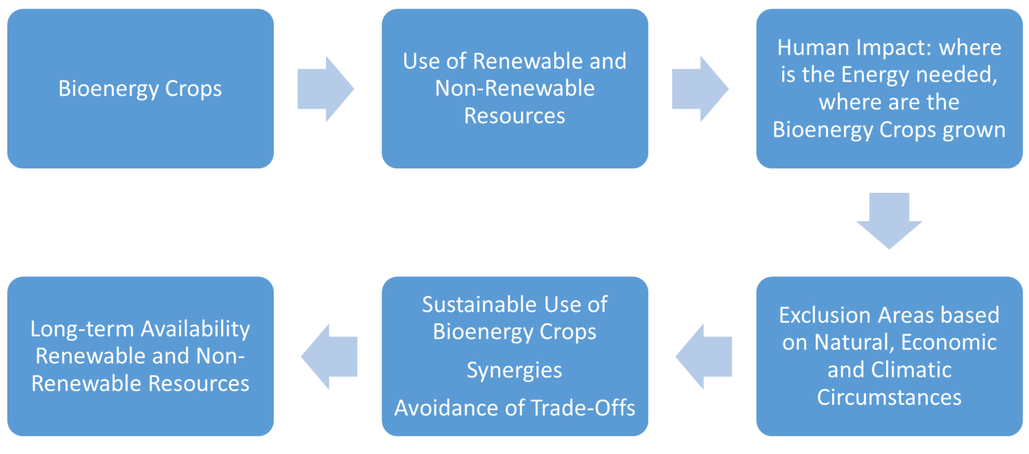
Comparison between the potential dry matter yield (left graphs below) and water per yield mass used (right graphs below). These results were created with the MiscanFor model using IPCC climate scenario from the Special Report on Emissions Scenarios (SRES).



Willow in Austria 2030 and 2100

Comparison between the potential dry matter yield (left graphs below) and water per yield mass used (right graphs below). These results were created with the SalixFor model using IPCC climate scenario from the Special Report on Emissions Scenarios (SRES).





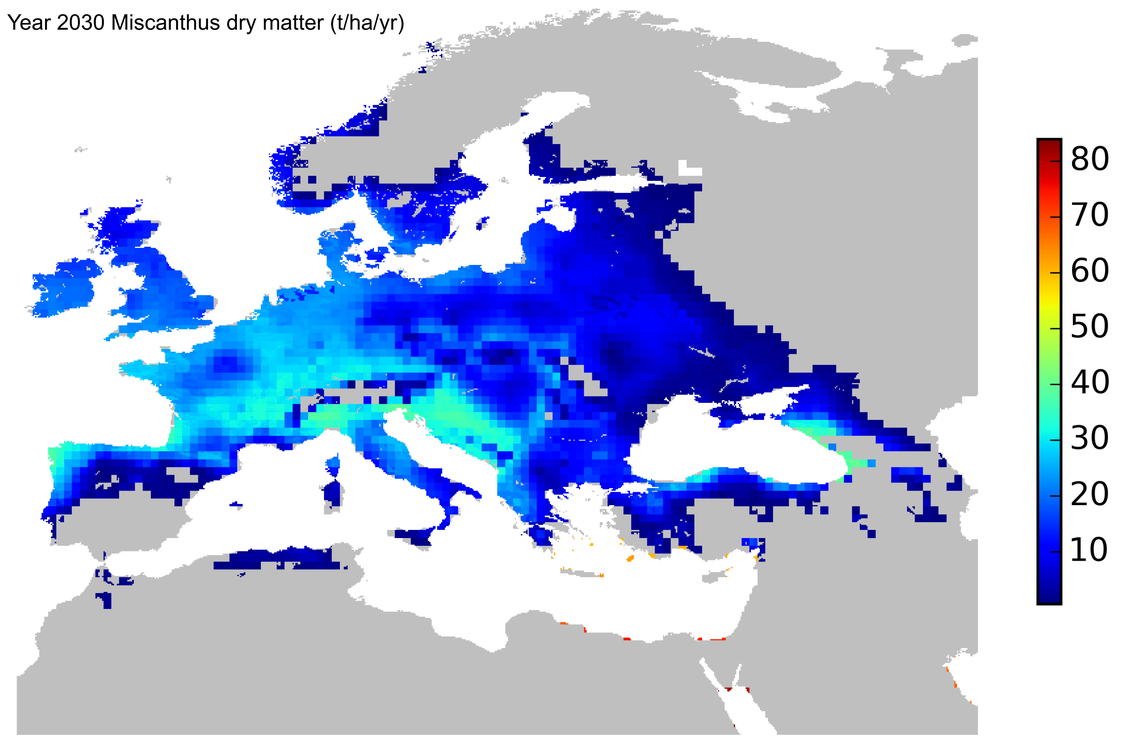
This **Matrix Life Cycle Analysis of Sustainable Bioenergy Crop Use** shows the production chain for a sustainable and trade-off free use of Bioenergy Crops considering all relevant areas.

Ecosystem and Critical Zone Services

Earths permeable near surface layer, Earths Critical Zone, from the tops of the trees to the bottom of actively cycling groundwater is where rock, soil, water, air and living organisms interact. The functioning of this is critical for sustaining services, e.g., water, soil, atmosphere, food, biodiversity. Critical zone services provide context, constraints, and currency that enable more effective management and valuation of ecosystem services. While Ecosystem Services have a “bio”focus and normally look at shorter timescales, Critical Zone Services have a “geo”focus and look at long term intervals. The combination provides us with a useful instrument for evaluation of Ecosystem Services value and adaptation / regeneration capabilities because the ultimate limiting factors are included in the analysis. This instrument provides feedback for policy by adding an expanded currency value to Earths Renewable and Non-Renewable Natural Resources. The Reliability / Security Factor of these recommendations can be enhanced by including Climate Change and Human Impact as well as changing Economic Climate and legislation, e.g., funding, regarding bioenergy crops in the European Union.

(Figure to the right adapted from Critical Zone Services: Expanding Context, Constraints, and Currency beyond Ecosystem Services. Field J.P., Breshears D.D., Law D.J., Villegas J.C., López-Hoffman L., Brooks P.D., Chorover J., Barron-Gafford G.A., Gallery R.E., Litvak M.E., Lybrand R.A., McIntosh J.C., Meixner T., Niu G-Y., Papuga S.A., Pelletier J.D., Rasmussen C.R., and Troch P.A (2015): *Vadose Zone Journal 14(1))*

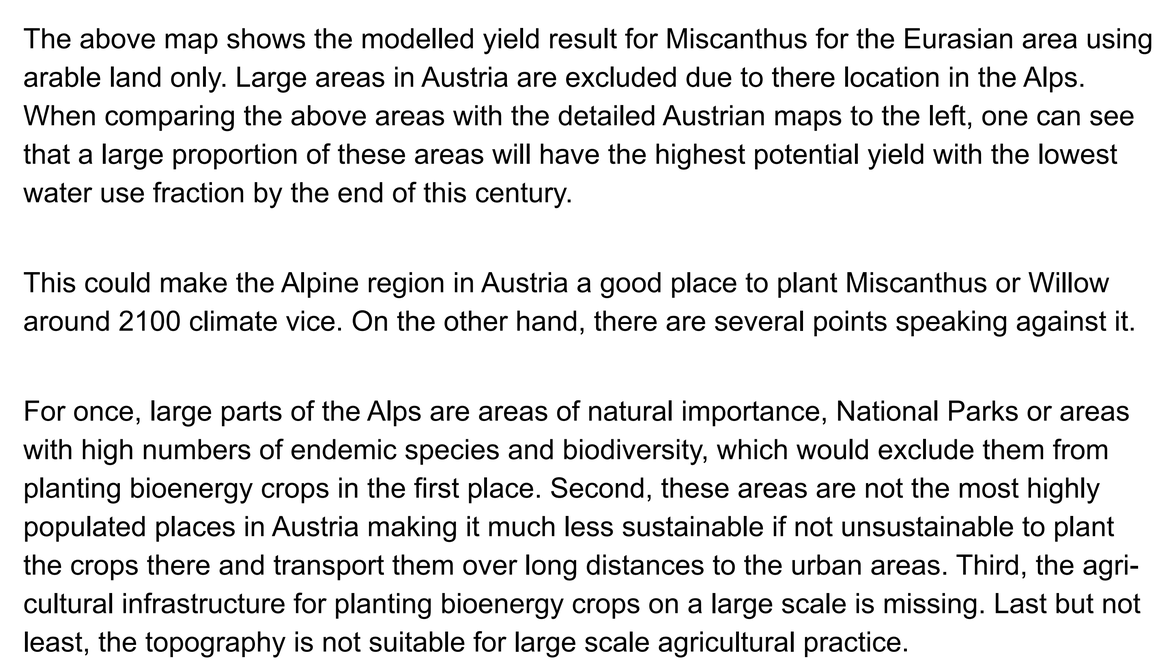
This poster presents several aspects of my approach using the example of Austria. Austria has a very diverse topography and climate which makes it a useful example to visualise impacts. Due to the Alps and the location in the middle of the continent, among other things, it will likely be highly affected by climate change over the next decades.



The above map shows the modelled yield result for Miscanthus for the Eurasian area using arable land only. Large areas in Austria are excluded due to there location in the Alps. When comparing the above areas with the detailed Austrian maps to the left, one can see that a large proportion of these areas will have the highest potential yield with the lowest water use fraction by the end of this century.

This could make the Alpine region in Austria a good place to plant Miscanthus or Willow around 2100 climate vice. On the other hand, there are several points speaking against it.

For once, large parts of the Alps are areas of natural importance, National Parks or areas with high numbers of endemic species and biodiversity, which would exclude them from planting bioenergy crops in the first place. Second, these areas are not the most highly populated places in Austria making it much less sustainable if not unsustainable to plant the crops there and transport them over long distances to the urban areas. Third, the agricultural infrastructure for planting bioenergy crops on a large scale is missing. Last but not least, the topography is not suitable for large scale agricultural practice.



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