Abstract Project VorratAktuell

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Project Summary

In an era of rapid environmental change, the necessity for up-to-date and comprehensive forest information is increasingly recognized by all stakeholders involved in forest management and conservation. In the context of sustainable forest management, the evaluation of growing stock plays a central role in the monitoring and planning of forestry actors. The aim of the project "VorratAktuell" is to publish a wall-to-wall and annually updatable growing stock map for the state of Baden-Württemberg, which can then be used both in forestry practice and for further research or by environmental actors. The project is a collaboration between the Forest Research Institute Baden-Württemberg and the Regierungspräsidium Freiburg. The project represents the second consecutive follow-up initiative aimed at developing the growing stock map and is scheduled to run from 2024 to 2026.

The applied model is undergoing a transformation, as it was previously linear regression models and is now being switched to a Random Forest and / or a XGBoost model, as new runs have predicted more promising results. Other models, as well as an AI based approach are possible within the future of the project. The model is trained using the operational inventory data from the State Forest Administration (LFV) and incorporates the annual aerial survey data from the LGL. The use of operational inventory data provides a substantial training dataset that expands annually. This growing pool of data allows for a refined selection process of filtered data over the years, enabling the model to be improved incrementally.

Focus of this project is not only the selection of one or more suitable models but also on the practicality of calculations to ensure rapid usability, as new maps are usually requested at the beginning of the year. Additionally, it emphasizes the selection of further training parameters to address the complexities of forest growth and stock development. Those parameters have been partially developed in-house or are sourced from other departments within our research institute. Key parameters include climate, topography, soil characteristics and parameters on an individual tree basis, such as competition indices. The model also gets an update of the tree species map, as the new map will be derived from the Future Forest project, which has generated a map using artificial intelligence based on Sentinel-2 time series data.

The innovative potential of this project lies in the creation of a comprehensive growing stock map with potentially unprecedented accuracy and coverage, which has not been available before. The advancement is attributed to the extensive amount of training data and the variety of parameters that have been tested and partially implemented. However, it is important to note that the model is limited to the state of Baden-Württemberg, both due to the location of the training data and the available aerial images. Furthermore, the direct feedback from our practical partners leads to highly applicable

research outcomes. The collaboration ensures that the findings are relevant and can be effectively implemented in real-world forest management practices, enhancing the overall impact of the project.

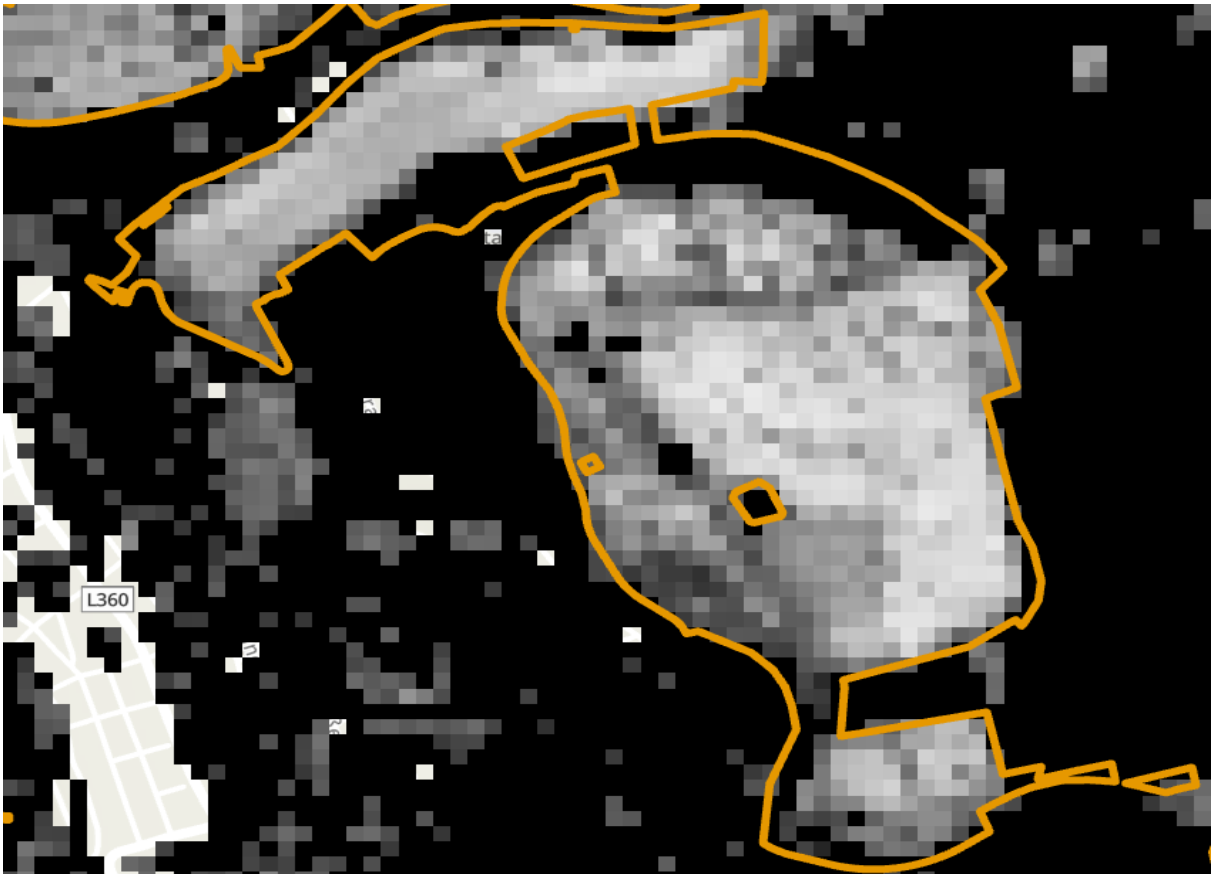

Figure 1: The figure shows the growing stock map with stock boundaries marked (yellow). Dark values are low stock values, light values are high stock values. The second figure is the growing stock map of a very

A validation method is scheduled to be implemented at the beginning of 2025. The approach will employ a combination of terrestrial full calipering, terrestrial laser scans and drone-based LiDAR surveys. This methodology allows for the evaluation of larger areas without the need for manual measurements of tree height and DBH for numerous individual trees. As our objective is to provide accurate stock estimates at the stand level, validation will also be conducted at this scale. Consequently, stand-wide validation data will be collected. The process will incorporate the refined automated stand delineation methodology developed in this project, which facilitates stock estimation for relatively homogeneous stands.

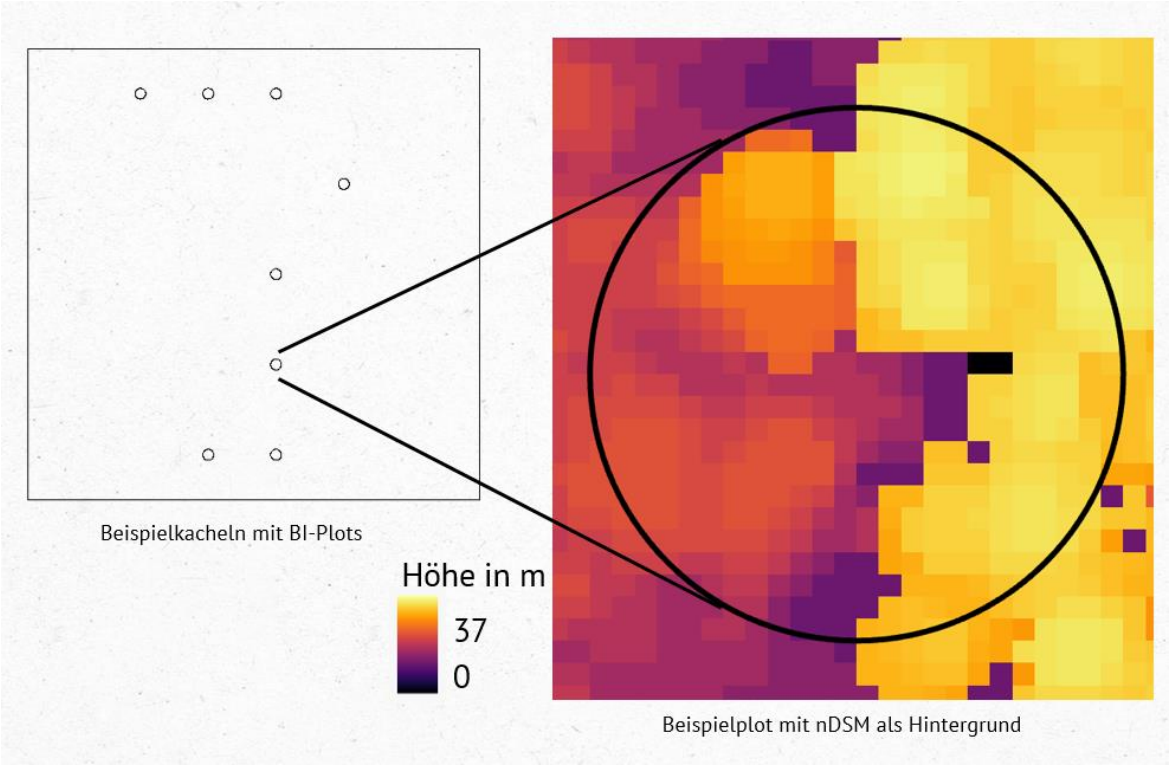

Figure 2: The figure is an example of the connection of inventory data and remote sensing data. The inventory plots within a tiff-tile are used to extract various derived values from the normalized digital elevation model.

Conclusion

This project has made significant strides in enhancing the practical utility of forestry maps, both through the improvement of the map itself, as well as focusing on the collaboration with practitioners. This ensures that the project's outcomes are highly relevant and applicable in real-world scenarios. Despite the challenge of producing a wall to wall map with an annually updated version on a relatively large area, the growing stock map is a reliable product, which is already applied in practice. The advancements in the accuracy of the map are primarily made because of new models and the implementation of new parameters. Preliminary results are known, but not yet official. The first values will be available by March. The validation will also be well advanced by the time of the conference and will enable preliminary assessments of the validation methods.

The project combines practical relevance with the scientific freedom to implement innovative ideas and integrate other research findings. Open questions still remain, e.g. the number of specific tree species models to include, the accurate inclusion of wood volume beneath the canopy or the assessment of the inclusion of single tree parameters.

At the upcoming conference, we anticipate receiving constructive feedback on our current approach, seeking to engage with experts in modelling, remote sensing and forestry who can provide critical insights, spark innovative ideas and propose new directions, which can improve the work within the project. Additionally, there is an opportunity for professional exchange with new colleagues, which can facilitate the establishment and deepening of potential collaborations.