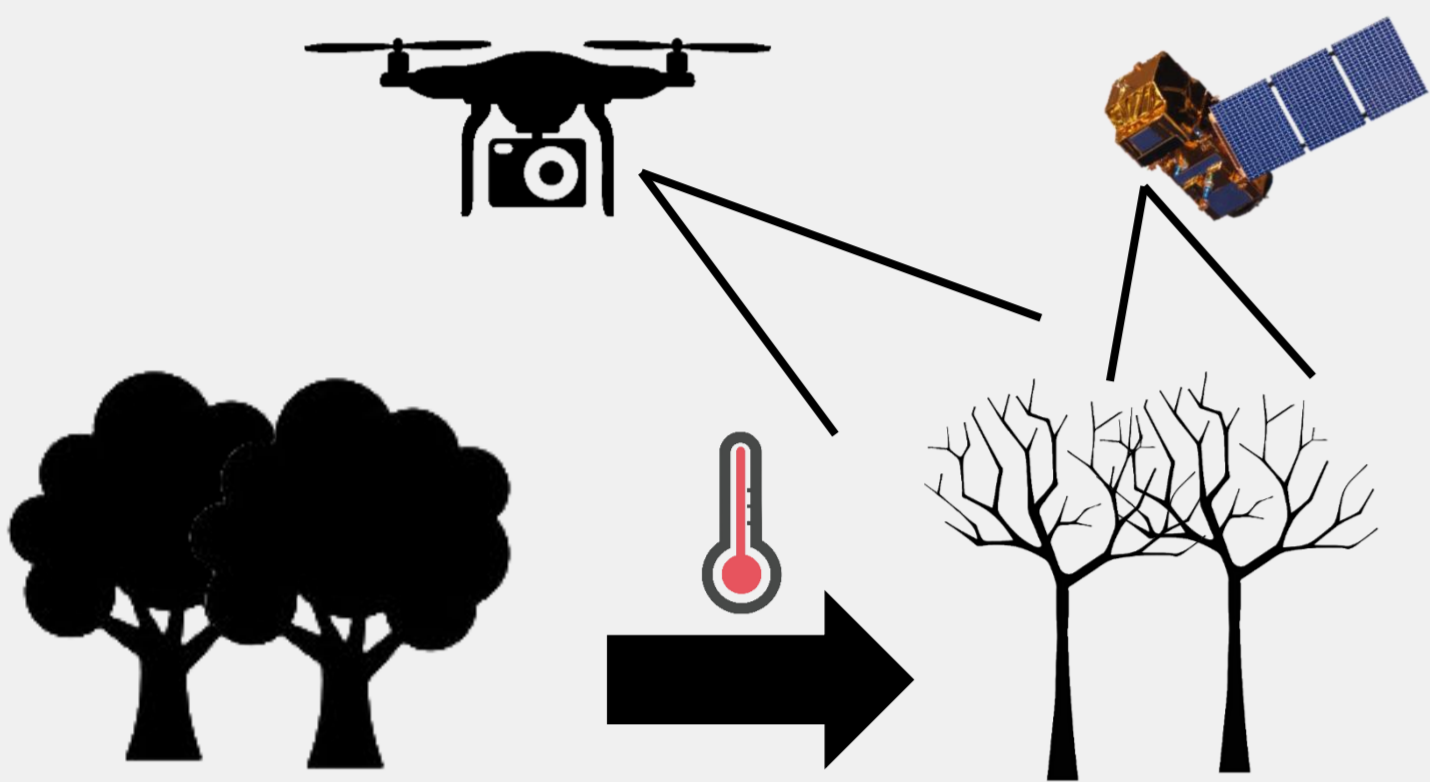


Future Forest Project - *FF.ai*

AI to Obtain Tree Species and Forest Condition Information from Remotely Sensed Data

By **Christopher Schiller**¹, **Jonathan Költzow**¹, **Tamalika Chakraborty**¹ and **Fabian Ewald Faßnacht**¹

Background

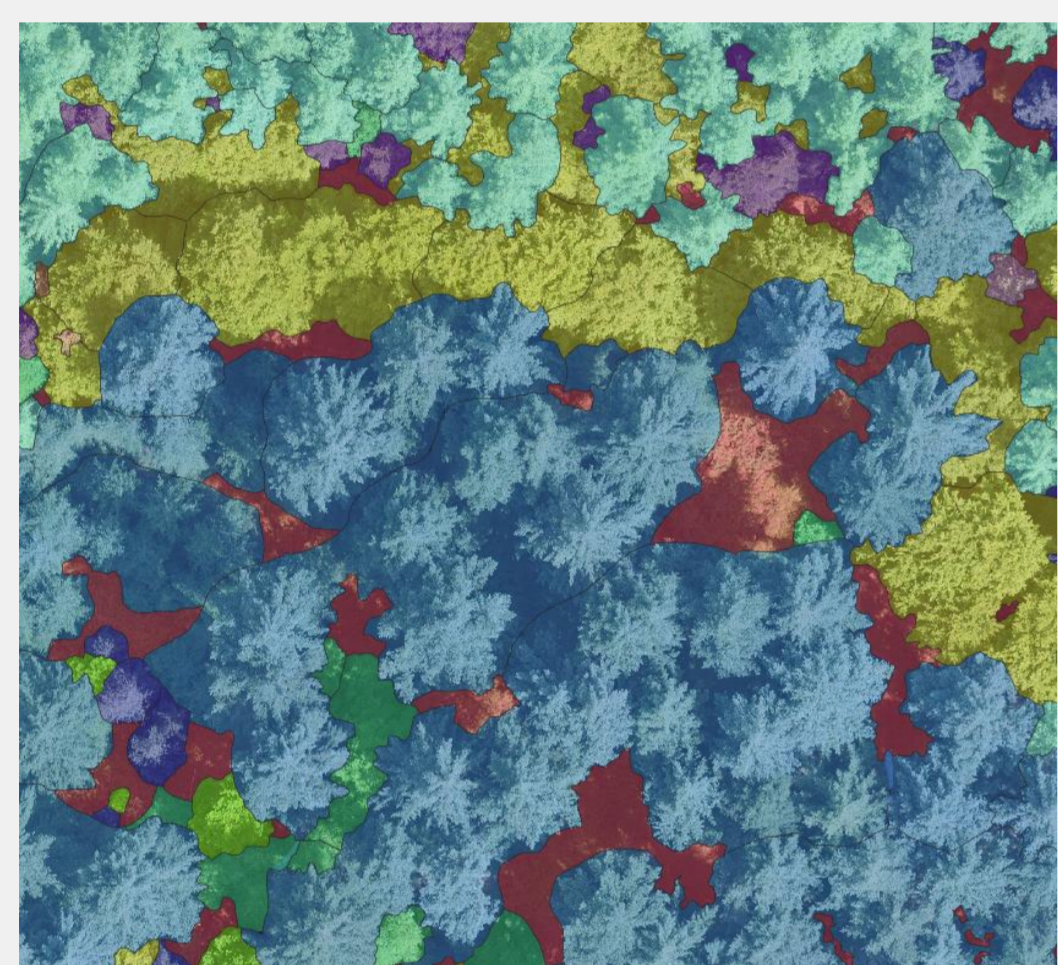


- nearly 79% of German forests are damaged* due to an increasing number of extreme weather events in the context of climate change (droughts, storms, etc.)
- Planning of urgently needed conversion of forests can be assisted by remote sensing (airborne and spaceborne)
- Deep Neural Networks may enable new and advanced ways of extracting information from high spatial and temporal resolution remote sensing data
- *Future Forest* aims at: 1) predicting tree species by combining both aerial imagery and satellite time series
2) establishing a near-real-time forest condition monitoring tool based on satellite time series

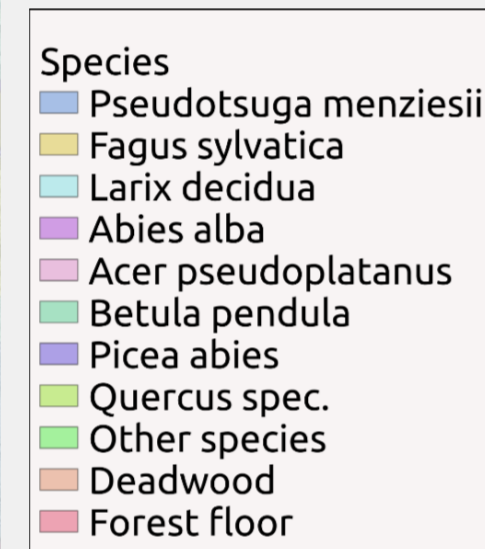
*<https://www.bmel.de/DE/themen/wald/wald-in-deutschland/waldzustandserhebung.html?jsessionid=4BCDC9202DE3E8BBD9A68CE63EA6BA29.internet2831#doc14554bodyText1> (German), last access on July 28th, 2022

1. Tree Species Mapping

High spatial resolution aerial imagery

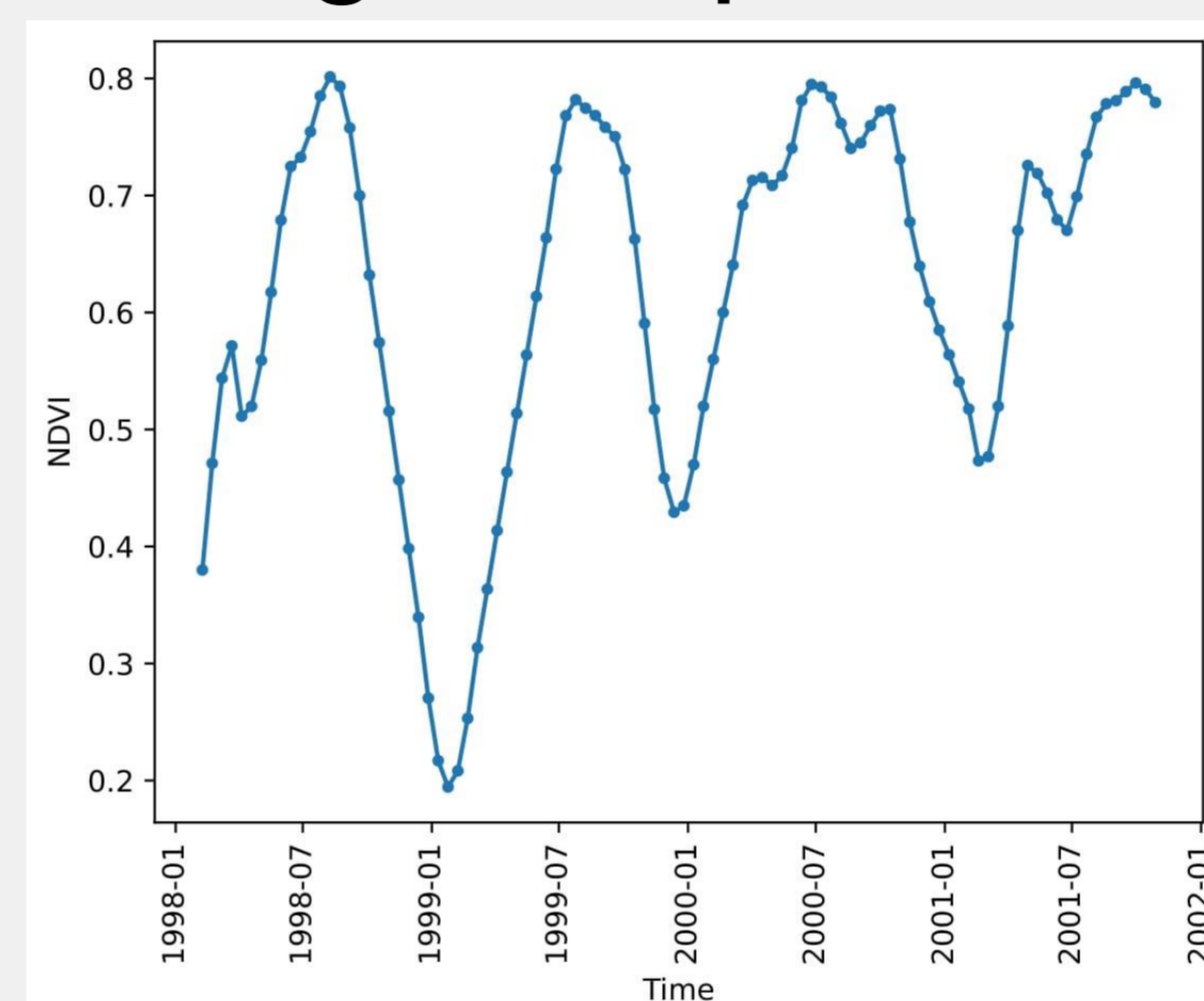


- Delineated species
- Targets: 8 most abundant species in Germany



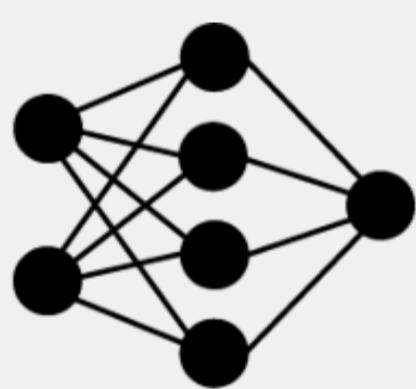
2. Near-Real-Time Forest Decline Monitoring

High temporal resolution satellite time series

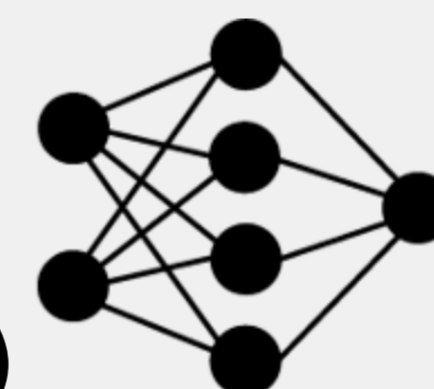


- Compilation of multiple reference data sets about forest condition
- 4-years satellite time series: all spectral bands + vegetation indices
- Quality control and smoothing of time series

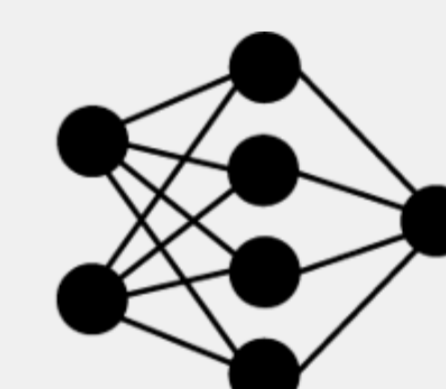
Model training



Fusing two Deep Learning models: Convolutional Neural Networks (CNN; images) + Recursive Neural Networks (RNN; time series)

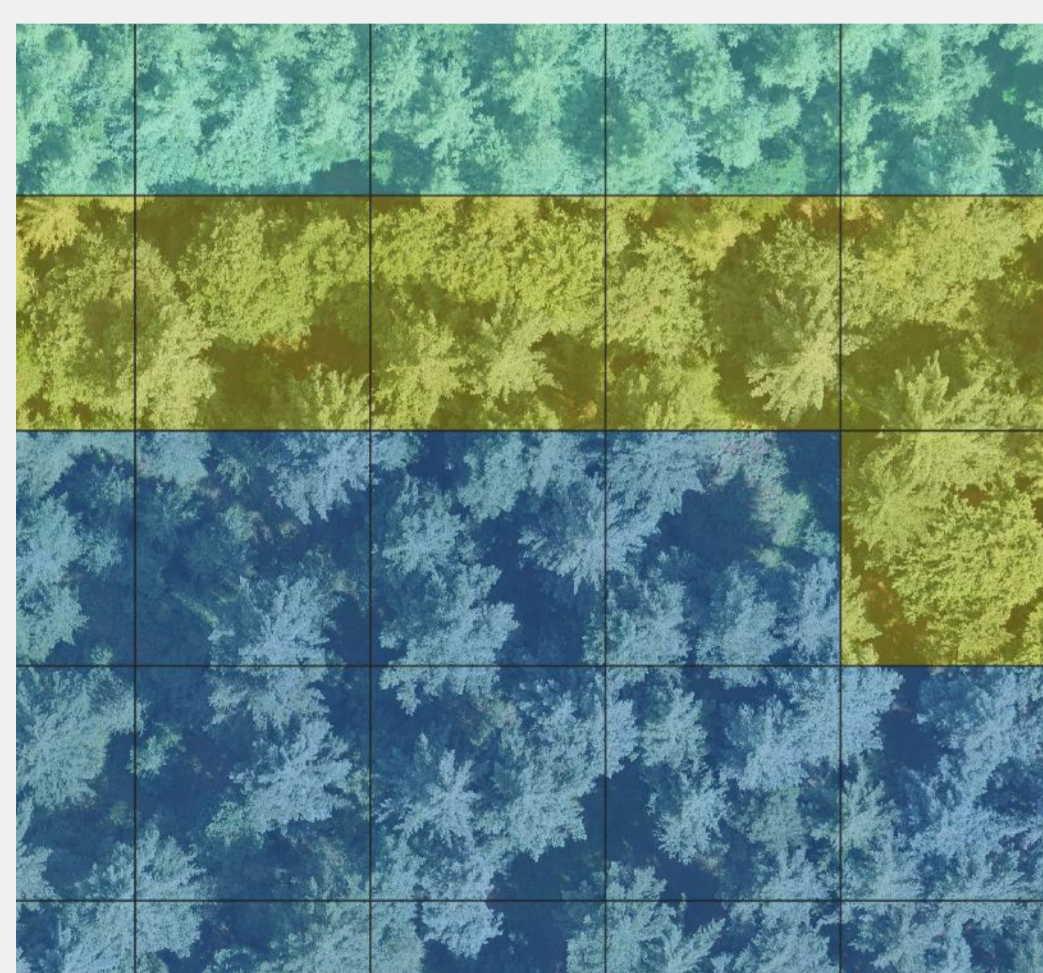


Model training

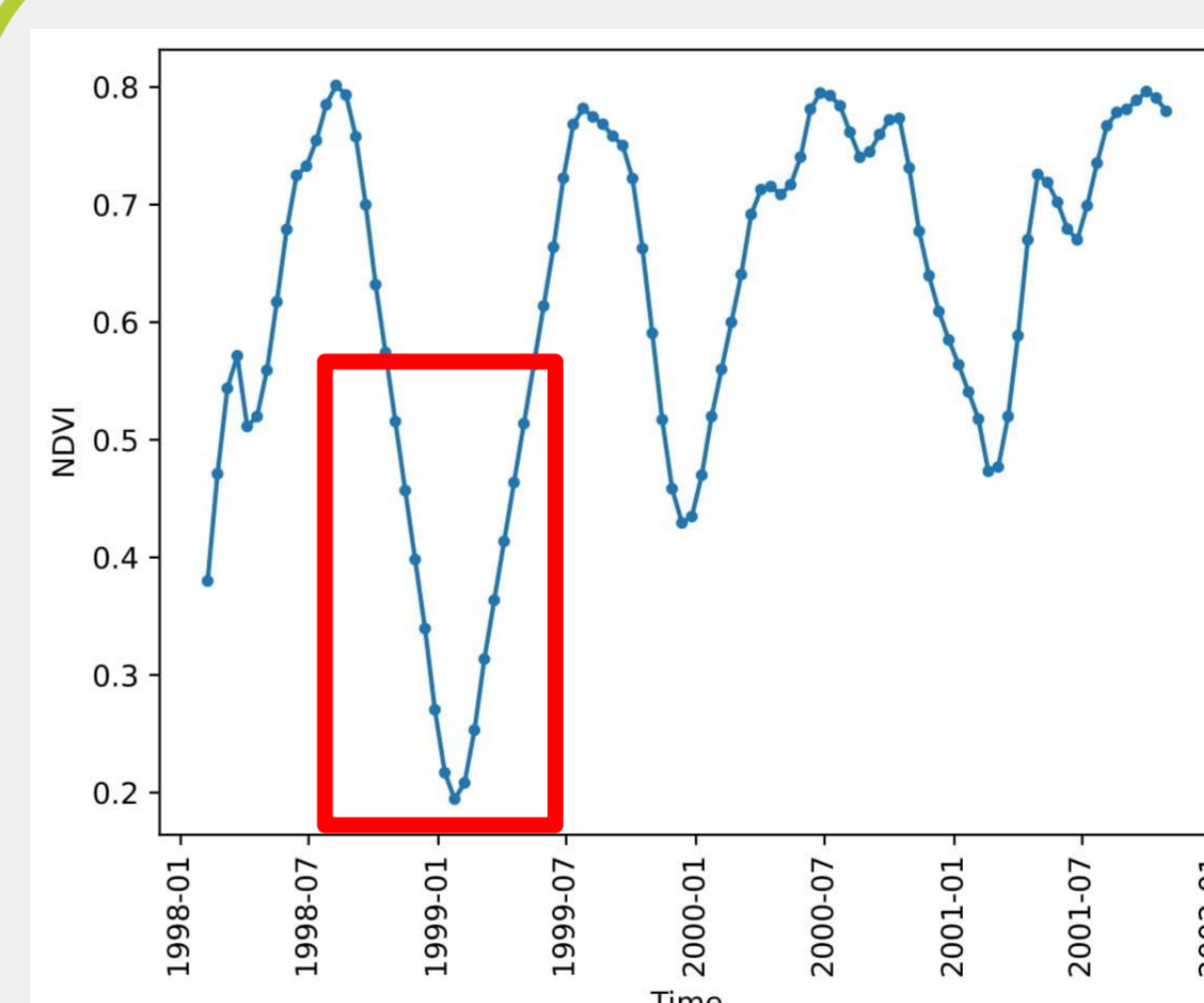
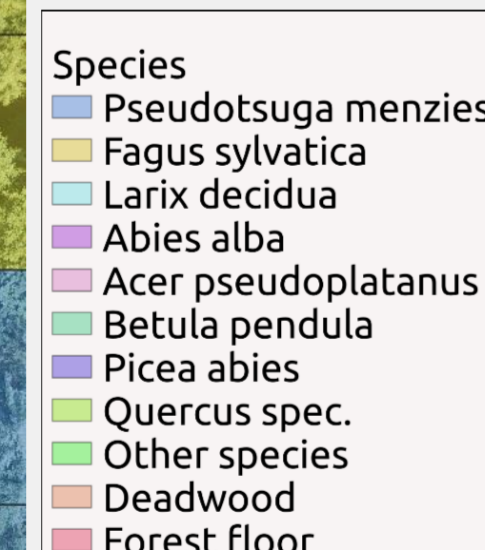


Recursive Neural Network (RNN)

Resulting product



- Map of most abundant tree species in 20*20m pixel
- Validation on very-high resolution UAV imagery
- Investigation of effect of understory (e.g. co-dominant layer)



Explainable AI

- Detect reason for model prediction
- Gain trust in the model by *understanding* it

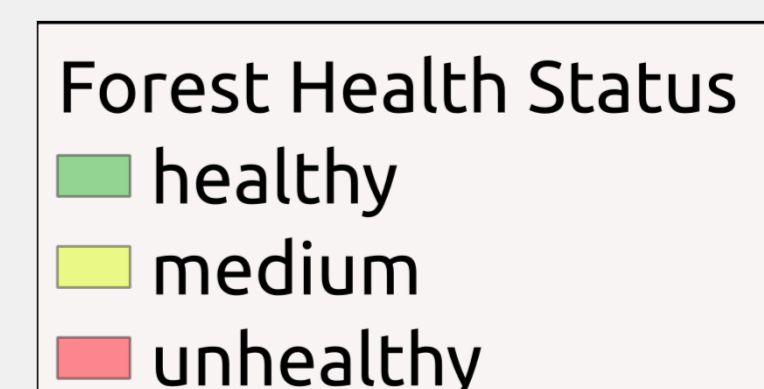
3. Forest Development: Conversion Scenarios

- Developed by TU Munich
- Based on results of tree mapping and forest decline monitoring
- Providing conversion scenarios for the following decades depending on desires of forest practitioners, including biodiversity, wood yield, etc.

Resulting product



- Develop a method to compare newly ingested satellite signal with expected one
- Provide forest condition info in near real-time



Nationwide application