CLIMATE DETECTIVES 2020 – 2021

FOREST IN CHANGE

Earth Protctors, "Erdschuetzlinge"
Gymnasium Waidhofen an der Thaya

RESEARCH QUESTION

How big is the spatial distribution of forest damage in the spruce and pine stand by the bark beetle in the Waldviertel region (Waidhofen an der Thaya and Zwettl district, Lower Austria) for the period

SUMMARY OF PROJECT

Climate change is also making a strong impact on bark beetles in the Waldviertel region (NW of Lower Austria). The heat and dryness are optimal for the bark beetle expansion. Secondly there are spruce monocultures in this area, which are not in accordance with the location, where bark beetle can increase rapidly.

In case study areas (Buendlberg, Military Training Area near Alltensteig and the forest NE of Waidhofen an der Thaya) the dissemination of bark beetle in time and space can be investigated by ESA-Sentiel 2 ifrared satellite images. Affected forstest areas show red-brown anomalies.

The Austria Federal Agency for Forest is developing a suitable method in remote sensing to quantify the affected areas by overlaying Ortho Photos and ESA-Sentiel 2 Images. Because of new methods in remote sensing it is possible to quanifiy the damage and forest owners will get financial aid e.g. also to develop the forest monocultures to nature-orientated sustainable forest which can survive in climate change.

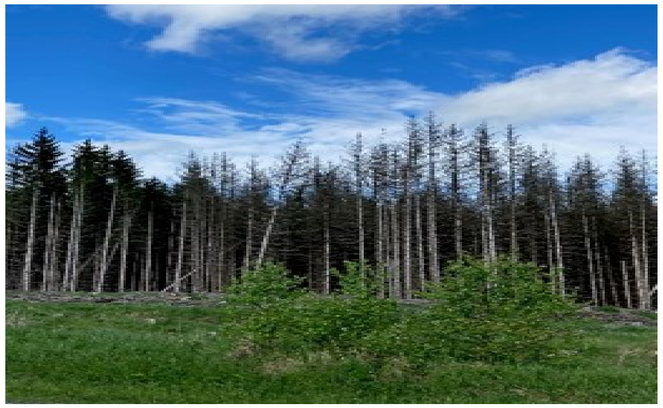


Figure 1: Dry trees that were attacked by barke beetle in the Waldviertel Region (Lower Austria), Photo: Loidolt S.,

MAIN RESULTS

Since 2015, the bark beetle phenomenon has been multiplying rapidly. Another reason for that is, for example, that spruce trees are planted in large areas and the bark beetle has so much attack surface. Particularly, the Waldviertel and the Muehlviertel region (Austria) are strongly affected by the bark beetle plague.

Archaeology offers chronic examinations. In the early Middle Ages there were mainly a mixed natural wood with mostly beeches and fir dominant in the Waldviertel region (Lower Austria).

In the last few years the forests were heavily infested by the bark beetle in the region Waldviertel (Austria). The special 'bark beetle years' were 2018 and 2019, a little weakened in 2020. The tree species mostly infested is the spruce. Also pine trees are often infested. Spruces aren't going to be planted anymore in the Waldviertel region in the future. Instead, larch, marple, oak, European beech and many other species will be used, because deciduous trees are not attacked. It is set to mixed forests.
The damage caused by the insects has fallen since then, but still above average.

The Austrian bark beetle monitoring was initiated in 2005 by the state forestry authorities and the forestry board of the Chamber of Agriculture. The aim of this service is to inform farmers and foresters, who suffer from a bark beetle plague, about the current flight situations of the most stubborn bark beetle species. These can then set up bark beetle traps to prevent the greatest possible damage.

The forest has already mostly been destroyed In the district Waidhofen an der Thaya an Zwettl (NW of Lower Austria). An impressive example is the area of Raabs an der Thaya. Also the forest is destroyed in the military training area near Allentsteig. The spruces and pine trees which are still left are highly threatened.

BRUENDLBERG:

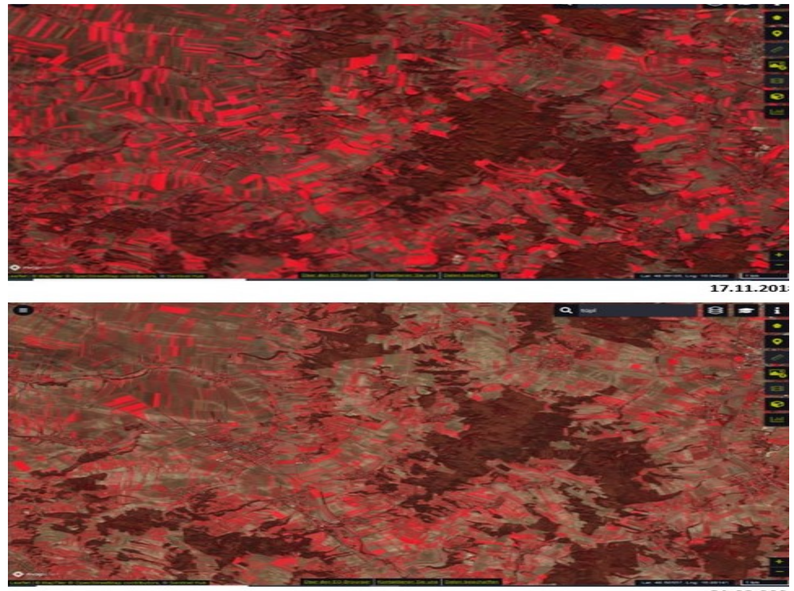


Figure 2: Case Study Bruendlberg: Forest with Bark Beetle Infestation, Eastern of Waidhofen an der Thaya (Austria), ESA-Sentiel 2 Images, IR timelapse animation: 17.11.2018 till 31.03.2021

ACTIONS TO HELP LESSEN TO THE PROBLEM

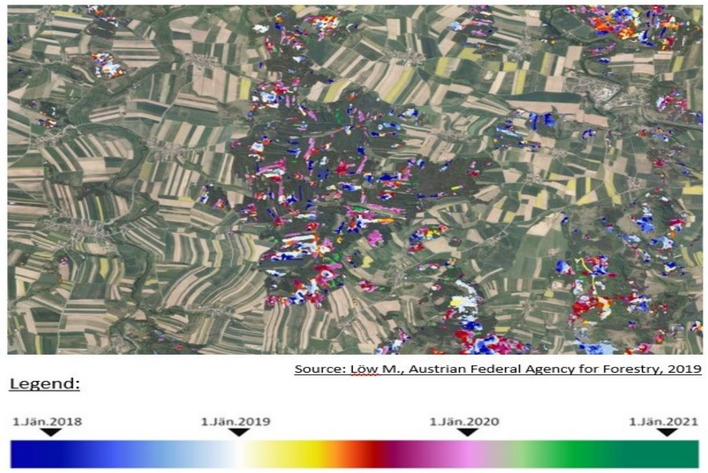


Figure 3: Forest with bark beetle damage NE Waidhofen an der Thaya (Lower Austria), ESA-Sentiel 2 Satellite Image with Ortho Photo Layer, Summer 2019

The Austrian Federal Agency for Forestry is developing a special remote sensing method in combining ESA-Sentiel 2 satellite images and ortho photos for quanitfiying the forest damage because of the barke beetle. Since 2021 there will be paid financial subsidies to forest owners to redevelop the forest to nature-orientated sustainable forest which can survive in climate change.
There is an overview of any actions the team 'Earth Protectors' has taken or plan on taking to help address the climate problem they investigated:

- save water
- make a shopping list before going to shop, don't waste food
- buy organic products
- buy regional products
- rely on a vegetarian diet and no industrial treatment
- buy Fair Trade products
- plant your own vegetable garden
- flowering meadows in the garden instead of a lawn
- later mowing of flowering meadows in the garden
- go by foot more
- more cycling
- use the public transport instead of taking the car
- don't drive unnecessary routes with the car
- use reusable shopping bags

CLIMATE DETECTIVES 2020-2021

Congratulations!

This is to certify that

Earth Protctors, "Erdschuetzlinge"

Gymnasium Waidhofen an der Thaya

participated in Climate Detectives 2020–2021 organised by ESA.

Hugo Marée
Head of Education Office, ESA

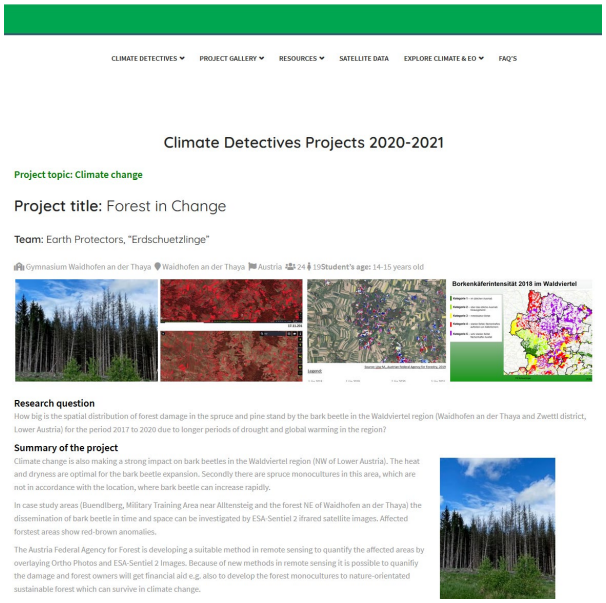
European Space Agency (ESA) Climate Detectives Project 2020-2021

„Forest in Change“

Projekt des Bundesgymnasiums und Bundesrealgymnasiums Waidhofen an der Thaya:
4A Klasse (8. Schulstufe) in Geographie und Wirtschaftskunde, Projektleitung: Prof. Mag. Anita Pöckl

Projektergebnisse:

Link zur Projekthomepage „Forest in Change“:
https://climatedetectives.esa.int/projects-gallery-2021/details/57681/



CLIMATE DETECTIVES PROJECT GALLERY RESOURCES SATELLITE DATA EXPLORE CLIMATE & EO FAQ'S

Climate Detectives Projects 2020-2021

Project topic: Climate change

Project title: Forest in Change

Team: Earth Protectors, "Erdschuetzlinge"

Gymnasium Waidhofen an der Thaya Waidhofen an der Thaya Austria 24 19 Student's age: 14-15 years old

Borkenkäferintensität 2018 im Waldviertel

Research question

How big is the spatial distribution of forest damage in the spruce and pine stand by the bark beetle in the Waldviertel region (Waidhofen an der Thaya and Zwettl district, Lower Austria) for the period 2017 to 2020 due to longer periods of drought and global warming in the region?

Summary of the project

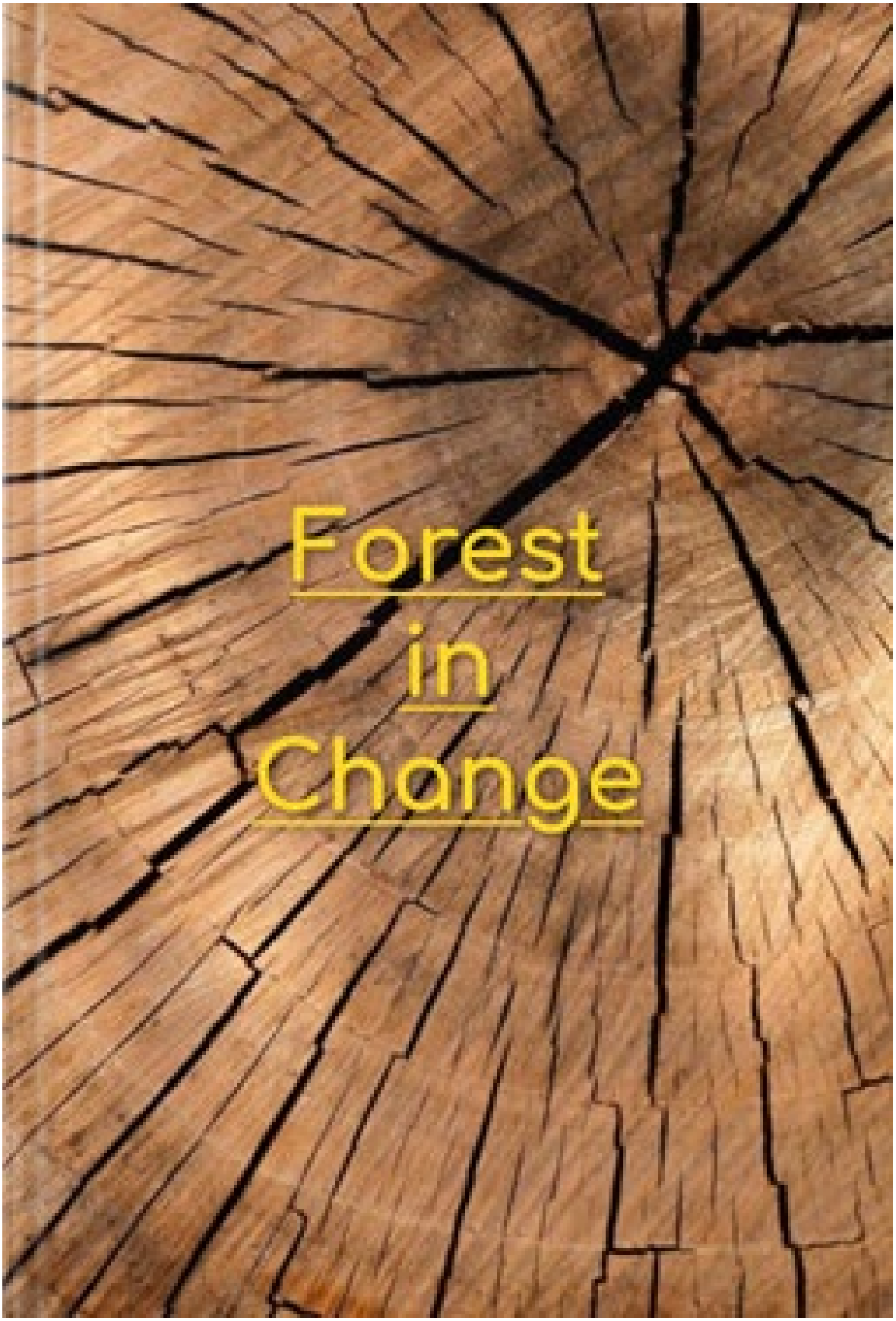
Climate change is also making a strong impact on bark beetles in the Waldviertel region (NW of Lower Austria). The heat and dryness are optimal for the bark beetle expansion. Secondly there are spruce monocultures in this area, which are not in accordance with the location, where bark beetle can increase rapidly.

In case study areas (Buendlberg, Military Training Area near Allentsteig and the forest NE of Waidhofen an der Thaya) the dissemination of bark beetle in time and space can be investigated by ESA-Sentiel 2 ifrared satellite images. Affected forstest areas show red-brown anomalies.

The Austria Federal Agency for Forest is developing a suitable method in remote sensing to quantify the affected areas by overlaying Ortho Photos and ESA-Sentiel 2 Images. Because of new methods in remote sensing it is possible to quanifiy the damage and forest owners will get financial aid e.g. also to develop the forest monocultures to nature-orientated sustainable forest which can survive in climate change.

Link zum E-Book „Forest in Change“:

https://read.bookcreator.com/MnWe-iwxtkPCk0mYB5OscS7s1wH7IrLTskeHnPqbIROZj7AfvUQ1mA/ZHokZY_tTPuSt-Poco6v9A



ESA-Project ‘Forest in Change’

Geography and Economic Education

4A Class, School Year 2020/21

Project Leader: Prof: Mag. Anita Pöckl

Bundesgymnasium and Bundesrealgymnasium Waidhofen an der Thaya (Austria)

Research question

How large is the spatial distribution of forest damage in the spruce and pine stock by the bark beetle in the Waldviertel region (case studies from the district of Waidhofen an der Thaya and Zwettl, Lower Austria) for the period from 2018 to 2020 due to longer periods of drought and global warming in the region?

1. Archaeology

The Waldviertel region (Austria) was only sparsely populated in the early Middle Ages. There were many big settlement-free areas and extensive forests covered the land. The natural wood were mixed in the past. Archaeology offers chronic examinations.

In the early Middle Ages there were mainly mixed forests with mostly beeches and fir dominant.

When was the human intervention the strongest and how did it change the tree population and the ecology of the forest?
In the first half of the 11th century the valley of Horner was settled. That changed the tree population very much. Then step by step the whole region of the Waldviertel was settled.

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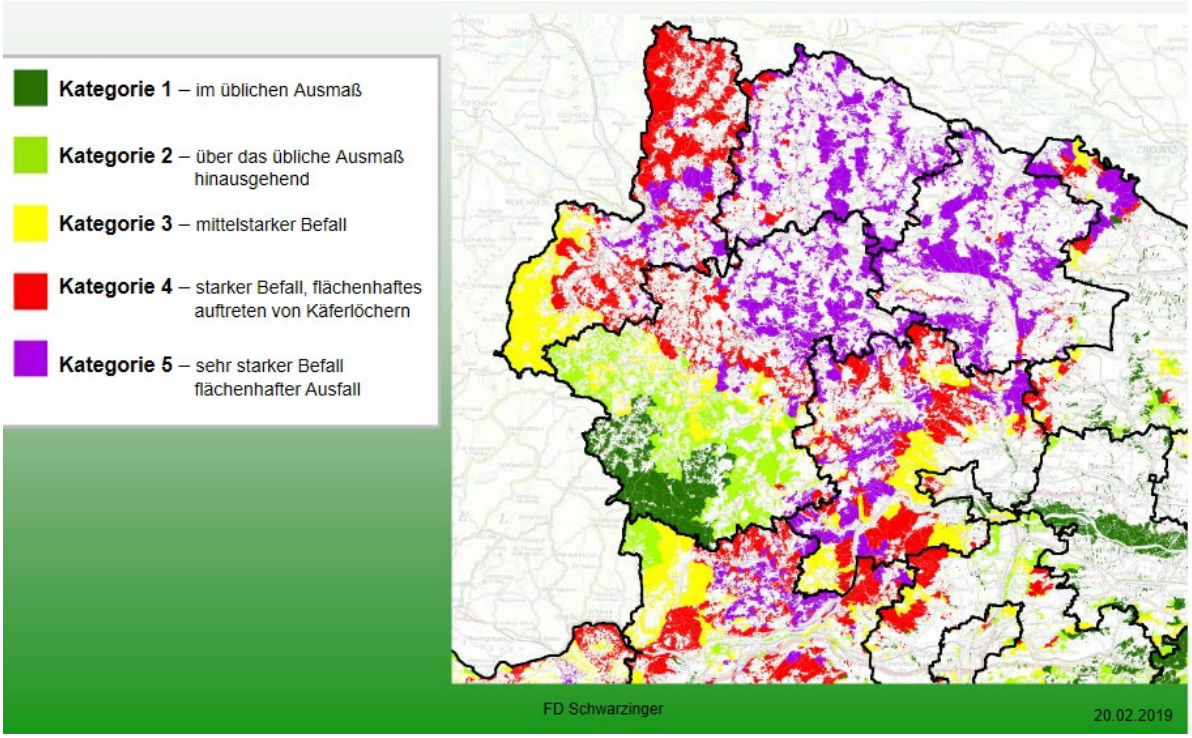
2. The Problem of Bark Beetle Infestation and Forestry Management in the Waldviertel region (district of Waidhofen an der Thaya and Zwettl, Lower Austria)

In the last few years the forests were heavily infested by the bark beetle in the region Waldviertel (Austria). The special ‘bark beetle years’ were 2018 and 2019, a little weakened in 2020. The tree species mostly infested is the spruce. Also pine trees are often infested. Spruces aren’t going to be planted anymore in the Waldviertel region in the future. Instead, larch, marple, oak, European beech and many other species will be used, because deciduous trees are not attacked. It is set to mixed forests.

Spatial distribution of the bark beetle in the region Waldviertel (NW of Lower Austria) in 2018



Source: Government of Lower Austria, Forestry Division, 2018.

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Legend:
Category 5: very heavy infestation
Category 4: heavy infestation
Category 3: medium heavy infestation
Category 1 and 2: to the usual extent

The forest has already mostly been destroyed In the district Waidhofen an der Thaya (north western of Lower Austria). An impressive example is the area of Raabs an der Thaya. Also the forest is destroyed in the military training area near Allentsteig. The spruces and pine trees which are still left are highly threatened.

For advising the forest owners in the district Waidhofen an der Thaya and Gmünd, the employees of the district forest inspection in Waidhofen an der Thaya and the forestry chamber secretary of the local district chamber are available. Since February 2021 there is also financial support from the state for forest owners, whose forest is/was infested.
The answer to the question if there have been mistakes in advising forest owners in the past is probably ‘yes’. It was recommended to plant only spruces. Today we know that the focus on just one tree species is not good.

If the forest is infested by bark beetles, the trees have to be removed as fast as possible. If that is not the case, the forest owner gets a written order from the forest authority to remove the wood within a corresponding period. It can be possible that almost all of the trees have to be cut down if all of the trees except for a small part of them are infested by bark beetles.

3. Bark beetle, Forestry and Forest of the Future

Climate change is also making a strong impact on bark beetles. The heat and dryness it triggers are optimal for the bark beetle. Since 2015, this phenomenon has been multiplying rapidly. Another reason for that is, for example, that spruce trees are planted in large areas and the bark beetle has so much

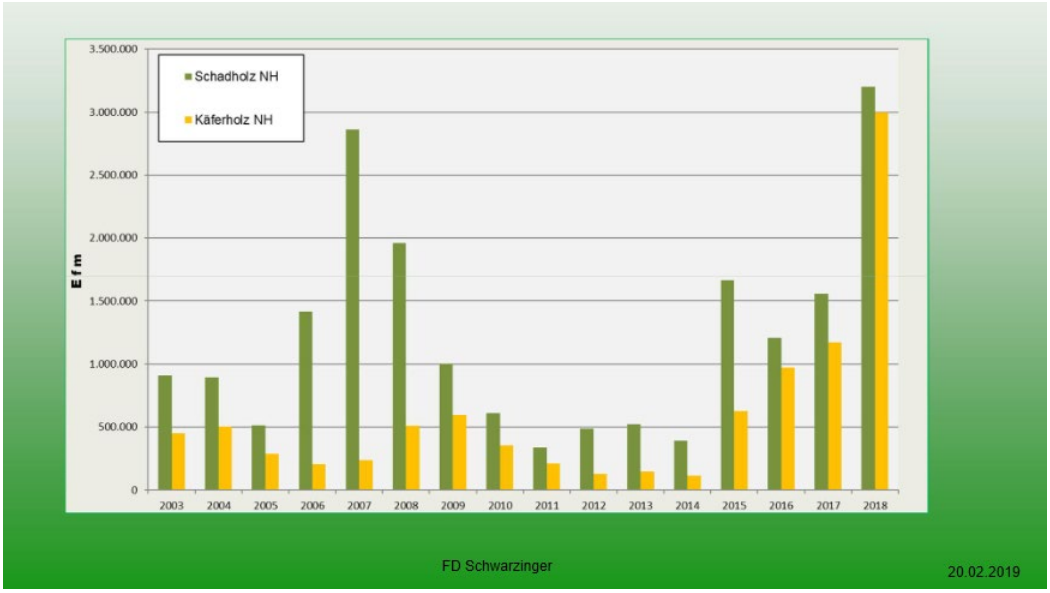
attack surface. Particularly, the Waldviertel and the Muehlviertel region (Austria) are strongly affected by the bark beetle plague.

The damage caused by the insects has fallen since then, but still above average. The foresters are now helping themselves with the so-called stabbing knife for the chainsaw. In this process, grooves are cut into the bark to make it impossible for the beetle larvae to move.

The Austrian bark beetle monitoring was initiated in 2005 by the state forestry authorities and the forestry board of the Chamber of Agriculture. The aim of this service is to inform farmers and foresters, who suffer from a bark beetle plague, about the current flight situations of the most stubborn bark beetle species. These can then set up bark beetle traps to prevent the greatest possible damage.

In January 2020, a team of sniffer dogs was trained for the first time to detect infested trees. This method of fighting against this plague has already been successfully carried out in other beetle species, and it is a great help in the bark beetle plague. The dogs can sniff large and targeted trees so that they can then be removed.

Timber affected by bark beetle damage: 2003-2018



Source: Government of Lower Austria, Forestry Division, 2018.

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4. Case Studies of affected forest areas in the Waldviertel region (Lower Austria) with the EO-Browser

BRUENDLBERG:

In 2018 there were around 50,000 solid cubic meters of firewood in the district of Waidhofen an der Thaya. The federal state of Lower Austria promised 1 million euros for immediate action against the bark beetle.

In December of 2020, over 1,000 trees were planted in the area of the Bruendlberg, for example sweet chestnut, sun linden tree, redwood trees and many more.

Replanted trees

Bare areas

Photos: Pausweg C., Loidolt S., 2021.

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Dry trees that were attacked by the beetle

Cut down trees

Photos: Pausweg C., Loidolt S., 2021.

Case·Study:·Bruendlberg·area·(Eastern·of·Waidhofen·an·der·Thaya,·Lower·Austria)¶

ESA-Sentiel·2·ifrared·satellite·image:·17.11.2018¶

ESA-Sentiel·2·ifrared·satellite·image:·31.03.2021¶

EO-Browser IR Satellite Images: Kainz E., 2021.

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MILITARY TRAINING AREA ALLENTSTEIG:

About 80 percent of the spruce stand is infested or already destroyed. The beetle raged on the 7,900 hectares of forest and entire areas were bare. In 2018 the mark of 200,000 solid cubic meters of timber was reached. That is more than six times the usual annual yield.

In order to transport the wood out of the dud area, forest workers are out and about with the splinter-proof harvester. No classic spruce monocultures are replanted.

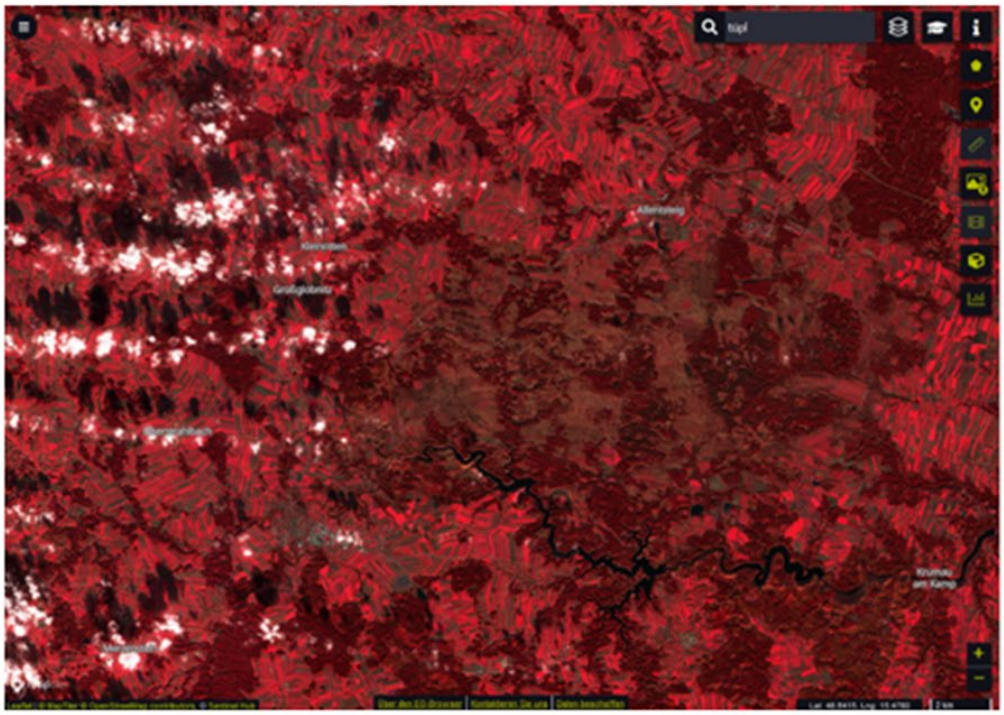
Before the actual work of the harvesters can start, a surface search must be carried out. Not only do duds appear, but around 100 relics are found every year.

To ensure that the dead wood comes out of the forests, around 400 trees are cut and loaded every hour. 150 truckloads left Allentsteig every week.

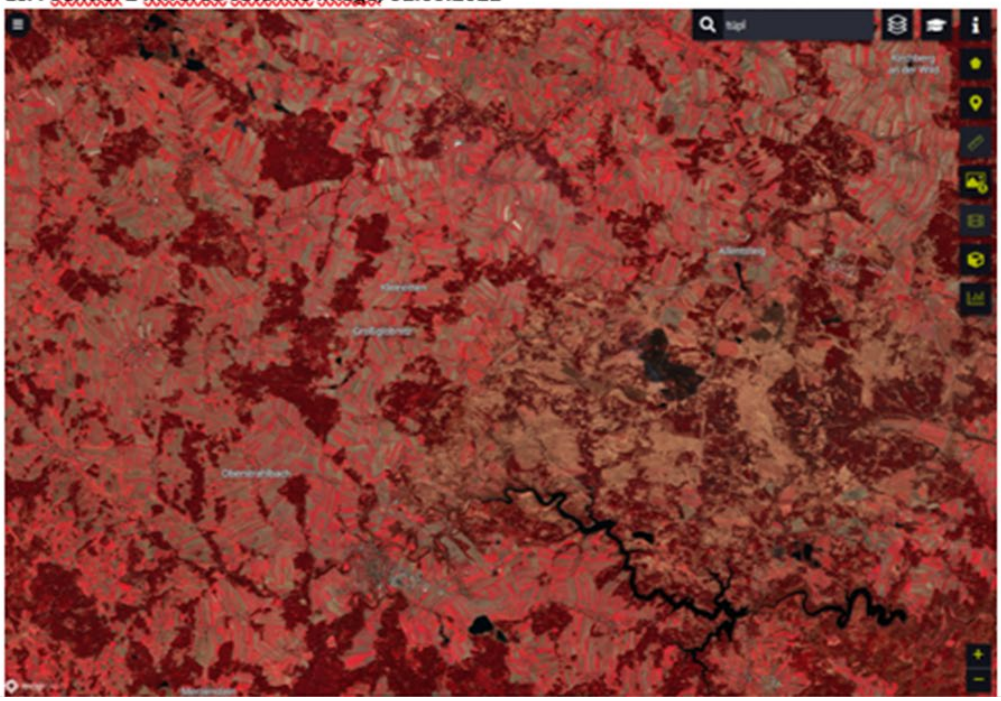
Individual trees stand out that have withstood the bark beetle. Experts want to take a closer look at the genetics of these trees.

Case Study: Military Training Area near Allentsteig

ESA-Sentiel 2 infrared satellite image, 17.11.2018



ESA-Sentiel 2 infrared satellite image, 31.03.2021



EO-Browser IR Satellite Images: Kainz E., 2021.

5. Affected forest owners report bark beetle infestations in their forest areas

A forest owner summarize: 'In the forest, I am going to tell you about, there was for sure bark beetle infestation, but not as much as for example in the area Raabs an der Thaya. You cannot protect the wood from the bark beetle, but if there actually are some affected trees you should cut them down and bring them out of the forest as fast as possible.

The problem of spruce monoculture has its start in the last 50 to 100 years, that's why we want to reforest mixed forests. If the owner of an affected forest does not know what to do, he can turn to the district authority and/or find a company for cutting down bark beetles trees.

Often we can use affected wood normally, but it should not be used for e.g. an important, supporting pillar. Bark beetles brood under the bark, exactly where the power of the tree is transported. That is why the wood has not got holes in it, it just changes the colour. If it is left in the forest for too long before you sell it, it will dry out. Bark beetles are not really beneficial organisms, but they were always there. Just because of the dryness in the last years, they were able to reproduce better, because the trees did not have enough strength for defense.

To improve the species diversity of the trees, there are many very good funding programmes. The owners of a forest can decide by themselves, what kind of trees they want to plant, but a mixed forest is better for the forest climate than monocultures. Spruces are well known as cheap timber. But like everywhere else, it is a question about supply and demand. The price of spruce timber is for example like the price of beech timber, but oak timber costs four times as much. In general hardwood always has a higher price.'

In another forest nearby Riegersburg (Lower Austria), a big part of the trees had be cut down due to the massive bark beetle infestation in 2019. This area is already reforested. The plan is to plant a mixed forest, but the finals selection of different tree species is not clear yet.

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Bark eaten by bark beetles

Bark beetles at work

Greatly reduced tree population

Stored bark beetle timber

Photos: Deyssig F., 2021.

6. Main results and Conclusions

Since 2015, the bark beetle phenomenon has been multiplying rapidly. Another reason for that is, for example, that spruce trees are planted in large areas and the bark beetle has so much attack surface. Particularly, the Waldviertel and the Muehlviertel region (Austria) are strongly affected by the bark beetle plague.

Archaeology offers chronic examinations. In the early Middle Ages there were mainly a mixed natural wood with mostly beeches and fir dominant in the Waldviertel region (Lower Austria).

In the last few years the forests were heavily infested by the bark beetle in the region Waldviertel (Austria). The special 'bark beetle years' were 2018 and 2019, a little weakened in 2020. The tree species mostly infested is the spruce. Also pine trees are often infested. Spruces aren't going to be planted anymore in the Waldviertel region in the future. Instead, larch, marple, oak, European beech and many other species will be used, because deciduous trees are not attacked. It is set to mixed forests.
The damage caused by the insects has fallen since then, but still above average.

The Austrian bark beetle monitoring was initiated in 2005 by the state forestry authorities and the forestry board of the Chamber of Agriculture. The aim of this service is to inform farmers and foresters, who suffer from a bark beetle plague, about the current flight situations of the most stubborn bark beetle species. These can then set up bark beetle traps to prevent the greatest possible damage.

The forest has already mostly been destroyed In the district Waidhofen an der Thaya an Zwettl (NW of Lower Austria). An impressive example is the area of Raabs an der Thaya. Also the forest is destroyed in the military training area near Allentsteig. The spruces and pine trees which are still left are highly threatened.

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7. Summary of the project

Climate change is also making a strong impact on bark beetles in the Waldviertel region (NW of Lower Austria). The heat and dryness are optimal for the bark beetle expansion. Secondly there are spruce monocultures in this area, which are not in accordance with the location, where bark beetle can increase rapidly. In case study areas (Buendlberg, Military Training Area near Alltensteig, forest NE of Waidhofen an der Thaya) the dissemination of bark beetle in time and space can be investigated by ESA-Sentiel 2 ifrared satellite images. Affected forstest areas show red-brown anomalies. The Austria Federal Agency for Forest is developing a suitable method in remote sensing to quantify the affected areas by overlaying Ortho Photos and ESA-Sentiel 2 Images. Because of new methods in remote sensing it is possible to quanifiy the damage and forest owners will get financial aid e.g. also to develop the forest monocultures to nature-orientated sustainable forest which can survive in climate change.

Bark Beetle Infestation in the Waldviertel Region (Lower Austria)

Photo: Deyssig F., 2021.

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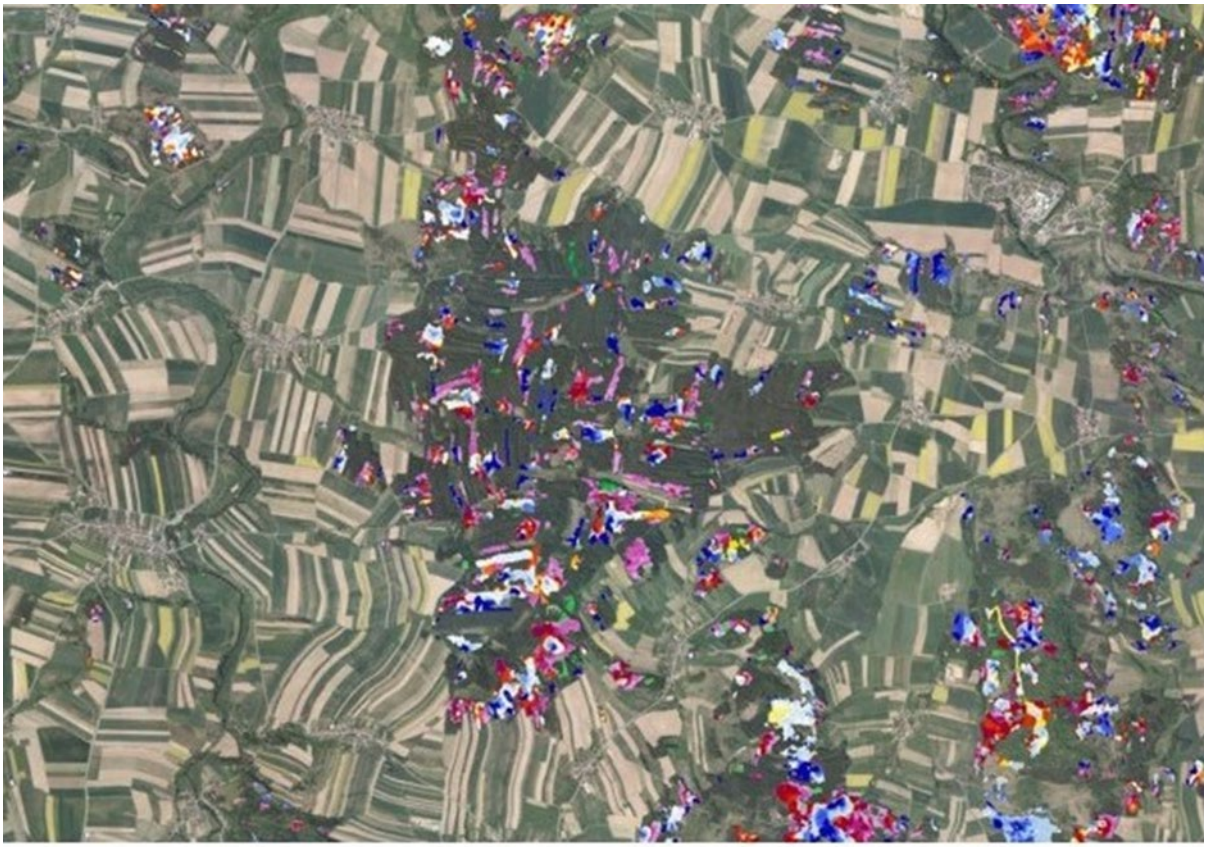
8. What's next - Actions to make a difference and help lessen the problem:

The Austrian Federal Agency for Forestry is developing a special remote sensing method in combining ESA-Sentiel 2 satellite images and Ortho Photos for quantifying the forest damage because of the bark beetle. Since 2021 financial subsidies will be paid to forest owners to redevelop the forest to nature-orientated sustainable forest which can survive in climate change.

Forest with Bark Beetle Infestation NE Waidhofen an der Thaya (Austria)

ESA-Sentiel 2 Images with Ortho Photo Layer, summer 2019 – RGB with anomaly raster

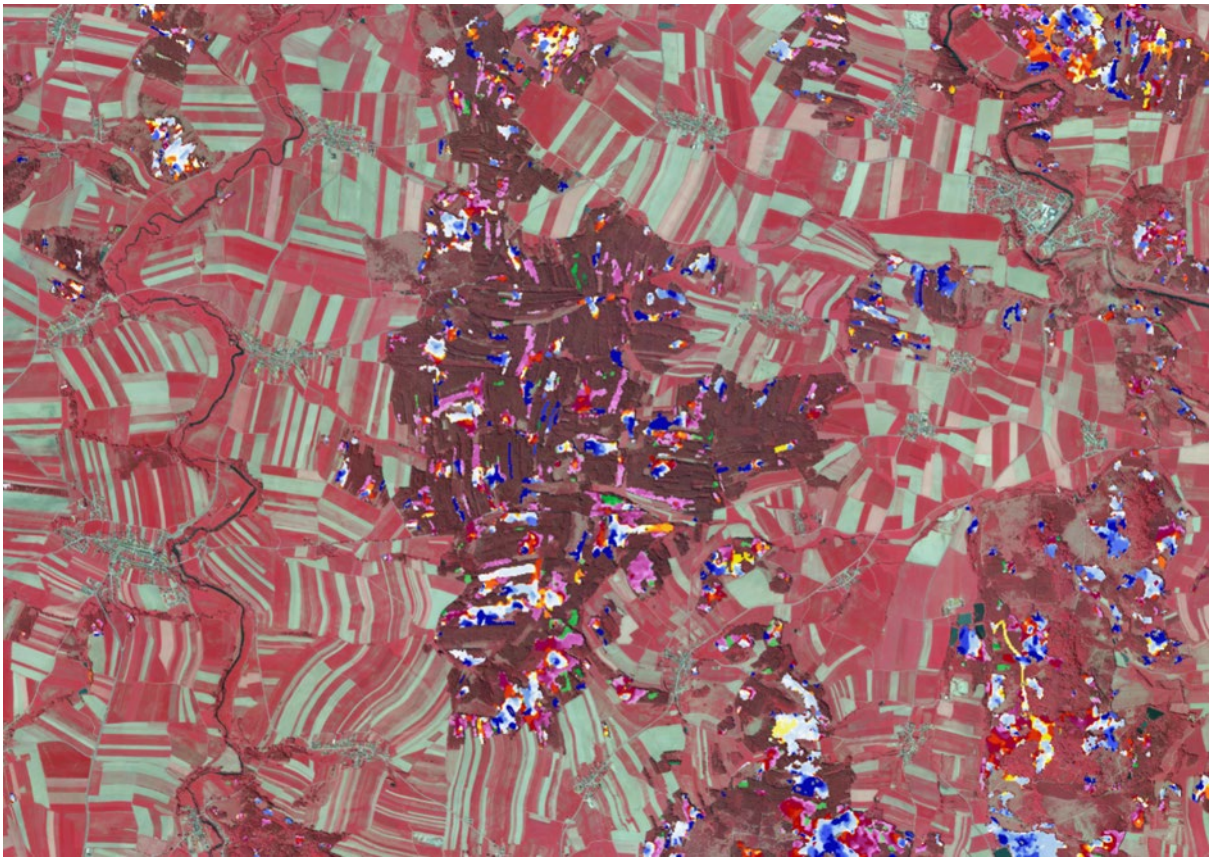


Source: Löw M., Austrian Federal Agency for Forestry, 2019

Legend:

Forest with Bark Beetle Infestation NE Waidhofen an der Thaya (Austria)

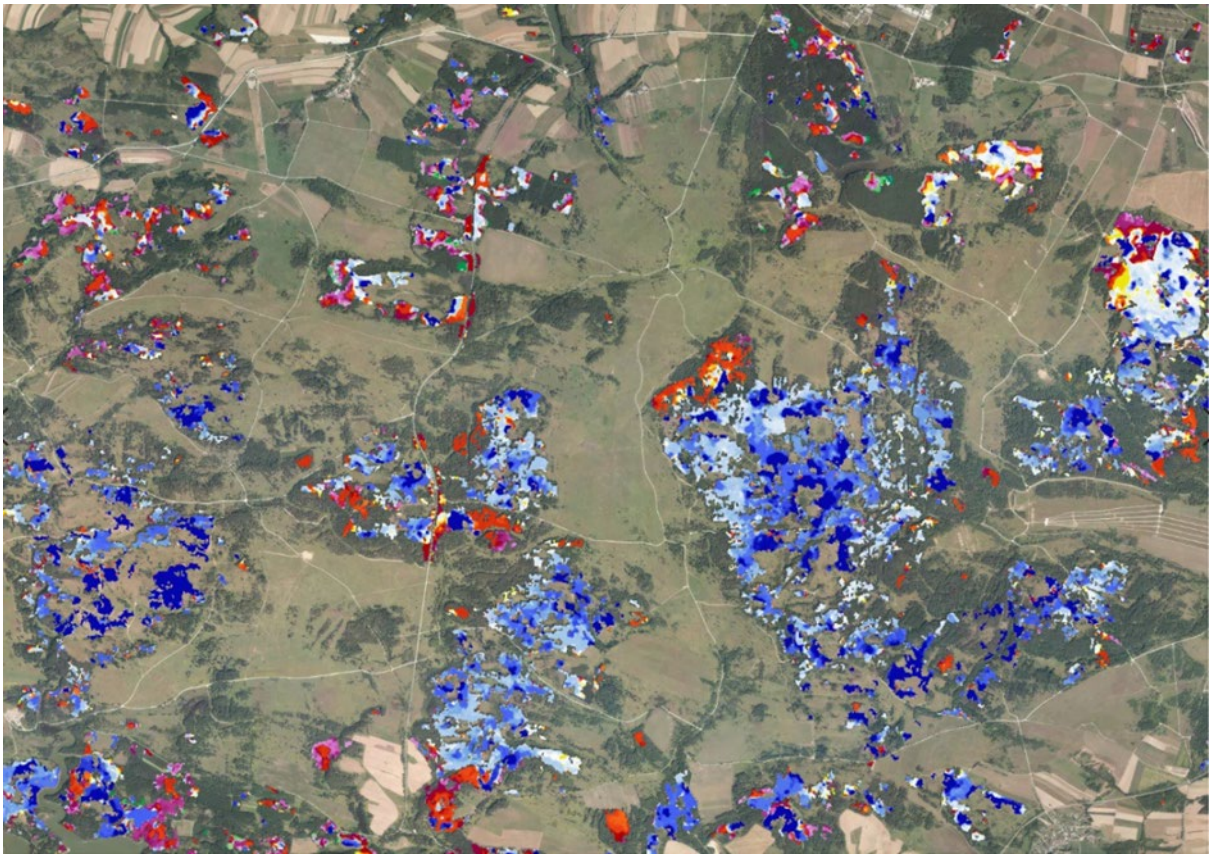
ESA-Sentiel 2 Images with Ortho Photo Layer, summer 2019 – IR with anomaly raster



Source: Loew M., Austrian Federal Agency for Forestry, 2019.

Forest with Bark Beetle Infestation Military Training Area near Allentsteig (Austria)

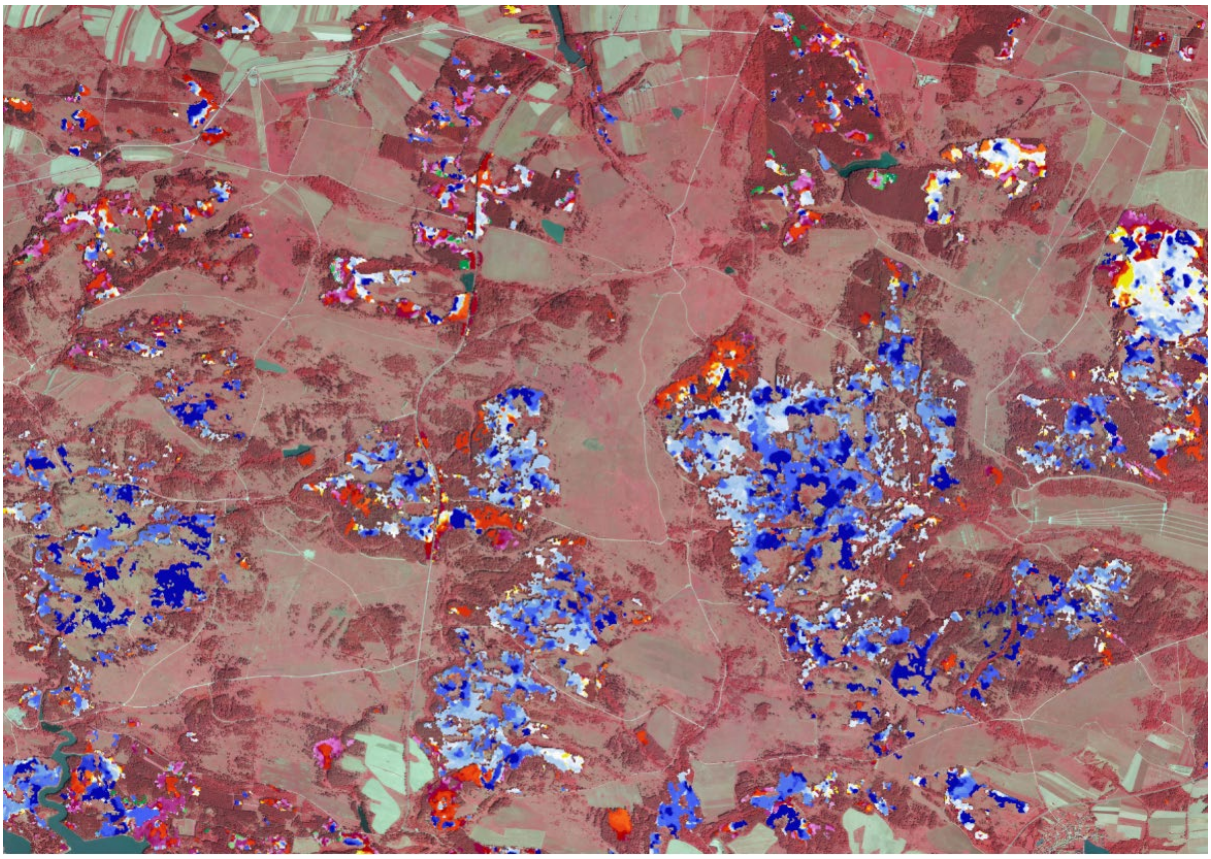
ESA-Sentiel 2 Images with Ortho Photo Layer, summer 2019 – RGB with anomaly raster



Source: Loew M., Austrian Federal Agency for Forestry, 2019.

Forest with Bark Beetle Infestation Military Training Area near Allentsteig (Austria)

ESA-Sentiel 2 Images with Ortho Photo Layer, summer 2019 – IR with anomaly raster



Source: Loew M., Austrian Federal Agency for Forestry, 2019.

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An overview of any actions the team has taken or plan on taking to help address the climate problem they investigated

- save water
- make a shopping list before going to shop, don’t waste food
- buy organic products
- buy regional products
- rely on a vegetarian diet and no industrial treatment
- buy Fair Trade products

- plant your own vegetable garden
- flowering meadows in the garden instead of a lawn
- later mowing of flowering meadows in the garden

- go by foot more
- more cycling
- use the public transport instead of taking the car
- don‘t drive unnecessary routes with the car

- use reusable shopping bags
- buy second hand products
- don’t buy clothes that you don’t need
- donate clothing for second hand
- use less plastic
- don’t buy products with animal testing

- repairing instead of buying new products

- dispose trash appropriately (waste separation)
- use recyclable glass bottles instead of plastic bottles

- rely on renewable energy (in the household)

- stay on the paths in the forest and don’t disturb wild animals

- donate money for environmental protection campaigns

9. Sources and Literature

Homepage der Bundesanstalt für Forstwirtschaft:

https://www.bfw.gv.at/

HomepageWaldwissen:

https://www.waldwissen.net/de/waldwirtschaft/schadensmanagement/insekten/borkenkaefer-monitoring-fuer-oesterreichhttps://bfw.ac.at/rz/bfwcms2.web?dok=5312

HomepageWaldverband:

https://www.waldverband.at/wp-content/uploads/2018/04/Borkenk%C3%A4fer-2018_Web-1.pdf

10. Acknowledgements

DI Christian Lackner, Public Relation
Austrian Federal Agency for Forestry, Vienna (Austria)

Markus Löw, BA, MA, Remote Sensing Department
Austrian Federal Agency for Forestry, Vienna (Austria)

DI Bernhard Nöbauer, Expert in Forestry Management
Government of Lower Austria, Forestry Division at district administration in Waidhofen an der Thaya

Mag. Sandra Sam, Archaeologist
Donau-Universität Krems an der Donau

11. Teams des Projektes „Wald im Wandel"

Team 1: Archaeology

Team members:
Tobias Androsch
Lisa Buchmayer
Marie Louise Steiner

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Team 2: Problem of Bark Beetle Damage in Forest, District of Waidhofen an der Thaya and Zwettl, Article for the school home page

Team members:
Nico Newerkla
Rico Rochla
Achillea Zangl

Team 3: Bark Beetle, Forestry and Forest in Future Time

Team members:
Diana Lazarus
Ines Winklehner

Team 4: Case Studies Areas in the Waldviertel Region: Bruendlberg (Eastern of Waidhofen an der Thaya), Military Training Area near Allentsteig with EO-Browser

Team members:
Eduard Kainz
Sophie Loidolt
Carina Pausweg
Leonhard Waldmann

Team 5: Interviews with Interviews with affected forest owners about bark beetle infestation in their forest areas

Team members:
Lorena Demmer
Flora Deyssig

Team 6: Translation, Article for newspapers, E-Book

Team members:
Lara Armberger
Mona Doppler
Mirjam Eschelmüller
Sara Palmetzhofer
Valentina Pulling

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Team 7: E-Books

Team members:
Laura Dallinger
Omama Elmajdoub
Leonie Huber
Emilia Kohlhofer
Julia Weiss

12. ESA-Project Leader ‘Forest in Change‘

Prof. Mag. Anita Pöckl
Teacher for Geography und Economic Education, History and Social Sciences/Political Sciences
Bundesgymnasium and Bundesrealgymnasium Waidhofen an der Thaya (Austria)

Waidhofen an der Thaya, 26.05.2021