**Goals:**

The main objective of this project was to develop an algorithmic solution that can help local communities detect and prevent bark beetle attacks, by utilising the knowledge gained here at The University of Edinburgh throughout my four years. \\

To clarify further, the aim of this project was to provide the local communities with a tool that would analyse large areas of forest quicker, and spot the regions that have changed through time, and provide communities with their locations. This way the local communities can prioritise which regions of forest they should inspect first, and hence cut down the time needed to find the regions that are damaged. For that, it was important that the solution is using the publicly available satellite networks and can be accessed regardless of the available budget.

**Introduction**

***Debrief***

Global warming is becoming an ever more serious problem humanity is, and is yet to face, in the 21st century. In the last decade we have seen the previously unimaginable consequences of our actions in various forms of natural disasters. We have been observing immense temperature change, from having much warmer summers, to having very cold winters. These changes in temperature came with other natural catastrophes that have put us and our surroundings under more constraints. From extreme droughts to unpredictable hailstorms. But what is even more absurd is the fact that these various weather conditions occur relatively close to each other in terms of time. And as it has affected humans directly, it already had a very negative effect on the nature and trees. Just like us, the trees are not used to such extreme weather conditions, and the consequences can be easily seen.

***Bark beetles***

One such example was the fall and winter of 2015 and 2016 in the Southern region of Slovenia. Intense hailstorms and extreme temperature shift on daily basis, sub-zero during the night and around ten Celsius during the day, have created one of the biggest catastrophes Slovenia has ever faced. For many trees this was too much, and the consequences could be seen in larger areas of forest being filled with broken trees. And so, the perfect breeding grounds for bark beetles were created. Bark beetles is a family of beetles that live of trees by penetrating through the bark and into the wood, where they lay their eggs. The trees would usually defend by by producing sap but in case of week trees or large numbers of bark beetles, the trees can easily become overwhelmed. This can result in bark beetles successfully cutting the tree’s water supply which eventually kills the tree. In ever green trees this can be seen in the change of colour of their crown, from green to orange/brown, and the eventually to grey.

It is important to note, that majority of the bark beetles are rarely or danger, and that it is only certain groups within the family that can cause great damage. Moreover, the bark beetle population has previously been controlled in numbers, but due to global warming we have seen incredible increase in their numbers. Firstly, due to the temperature change, the bark beetle was able to move further away from the equator and higher in terms of altitude. These are the regions predominantly covered with pine trees and conifers. These trees are especially vulnerable to bark beetle attacks, as their structure is much weaker and hence makes it easier for the beetle to penetrate. Secondly, the extreme weather conditions that have put an extra strain on the forests, have created large regions of damaged trees, which are of course not as strong in defending against the beetles and this provided the beetles with an ideal breeding condition. Therefore, their population has grown in numbers which increased their power resulting in successful attacks even on strong and healthy trees, as they simply over-whelmed the tree’s immune system and brought it to its knees.

In recent years we have seen some fo the biggest bark beetle attacks  
Xxxxxxx

Xxxxxxxx

Xxxxx

Xxxxxxx

xxxxxx

***Solutions used***

As it was explained above, the bark beetles are incredibly small organisms and are quite hard to spot with a naked eye, which makes them incredibly hard to fight against. To date there has not been any successful development of chemicals that could eradicate the beetles which makes them especially dangerous and it comes as no surprise that the lumber industry is really considering the beetle as one of their biggest enemies. There is an interesting say: “a lumber-jacks biggest fear is smaller than a coin!”.

Therefore, it is important to try and prevent the spread of bark beetles by monitoring the state of the forest and making sure that weakened trees are removed on time and that forests are frequently being sampled and tested so as to spot any potential attack on time. This however, has been done in a very inefficient way. Many organisations resort to hiring rangers and forest managers that monitor the health of forest manually, by walking through the forest and spotting potential problems and damages. This method is of course very inefficient because it is sometimes unfeasible to expect the whole region to be thoroughly checked on time. Another potential way of monitoring the state of forests is by using the airplanes to fly over the forest and take high-resolution images and try spot the regions that need further examination on ground. However, this is an incredibly expensive method which many communities cannot afford. Moreover, when it comes to large territories of forest, such as in Canada and Asia, even this method becomes inefficient.

Look around you, these trees are dying

A lumber-jacks biggest fear is smaller than a coin!