

Short Summary of the Master Thesis “Agricultural Change Detection Under Military Conflict Using the Example of Ukraine War” by Torge Brunhorn

The Ukraine conflict is a daily headline in the news. There are reports of casualties, injuries, and destruction, often accompanied by remarks that the reported numbers cannot be independently verified. However, facts and reliable information are crucial for assessing a situation accurately. As a geoinformatician, this has always bothered me, which is why I used the opportunity of my master's thesis to examine the Ukraine conflict more closely. One particularly affected sector, if we believe the media reports, is agriculture. Therefore, I wondered if I could use remote sensing methods to investigate how agriculture has changed over the years due to the war. Specifically, it's interesting to determine which of the spheres of influence in Ukraine is most affected: Is it the areas that have been under separatist occupation since 2014, those occupied by the Russian army, or perhaps the areas under the influence of the Ukrainian armed forces? To investigate this, three study areas were designated within their respective zones of influence.

First, the question arises whether changes in agriculture are due to the war or rather to changes in the weather. For instance, if 2022 was an unusually dry year in Ukraine, it would also impact crop yields. Therefore, changes in agriculture would only be partially attributed to the conflict. To verify this, it is important to analyze climate data from recent years, considering possible fluctuations in temperature and precipitation. The next challenge is to determine the relevant agricultural fields for this study. Other land cover types such as forests or water bodies are not relevant to my research question and are therefore disregarded. The next step is to measure changes in the previously identified agricultural fields. Of particular interest are the state of vegetation and fallow lands.

The analysis of weather data initially promises interesting outcomes. It is evident that there were no exceptional weather conditions in 2022. The data suggests that the year of the Russian military incursion was relatively average compared to previous years. This is also reflected in the analyzed satellite images. The classification of agricultural field areas worked excellently, with an accuracy rate of over 91%. It is evident that highly healthy vegetation decreased by up to 94% from 2021 to 2022. Interestingly fallow lands did not decrease but rather increased. Therefore, after the Russian military incursion, there were fewer fallow lands. In addition, the chlorophyll content in vegetation dramatically declined in 2022.

It is presumed that the fields were largely left to themselves. Vital vegetation declined because the fields were barely cultivated with crops. The fields were not tilled or fertilized during this time. Hence, weeds and smaller vegetation settled on the fields. This explains why most fields are mostly overgrown. The decline in chlorophyll is likely related to a decrease in fertilizers. Nitrates have a significant impact on chlorophyll formation. Thus, it can be assumed that there was a war-related reduction in fertilizers. The fields were probably not adequately sown, plowed, or fertilized since the beginning of 2022. The area that has been under separatist control for a longer period is the most affected. The area under Ukrainian control is the least affected. It can be concluded that the war has had a significant impact on the supposedly "peaceful" areas under Russian control. In summary, agriculture has been heavily influenced since the beginning of the war. It is not only the areas under Ukrainian control but particularly the areas under the control of the aggressors that are affected.