Deep Learning for Remote Sensing Big Data Analytics

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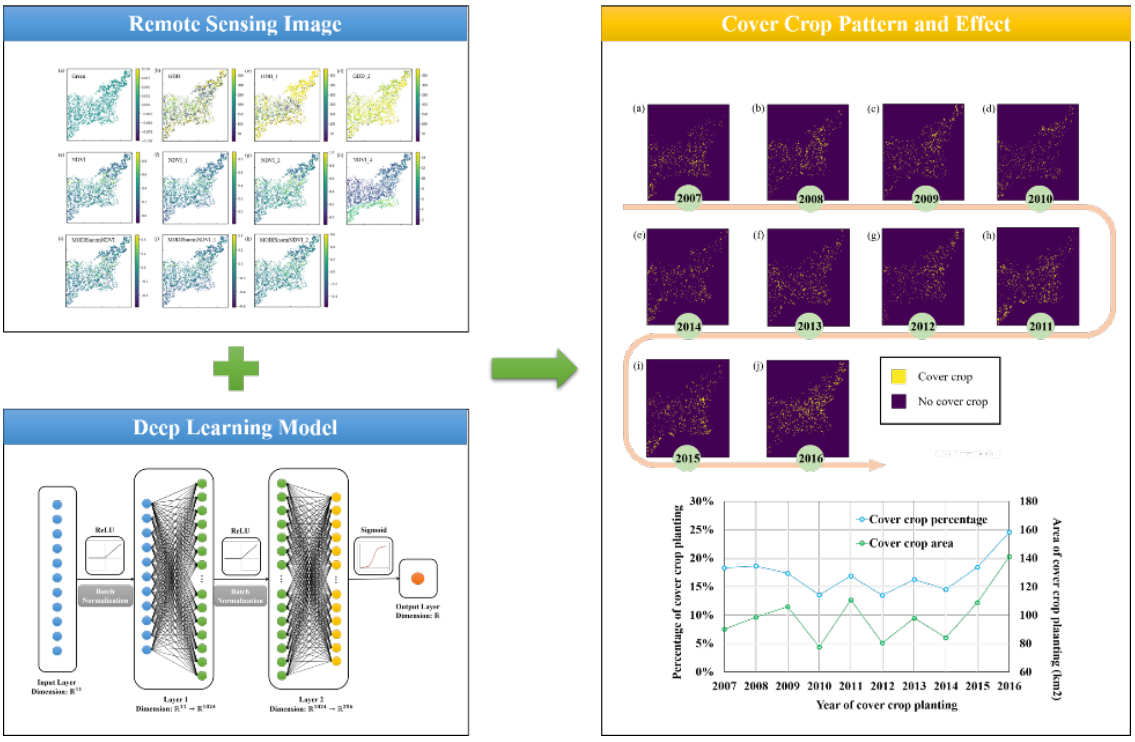
According to the Food and Agriculture Organization (FAO) of the United Nations, there has been a rise in world hunger since 2014. The population of undernourished people has increased from around 804 million in 2016 to approximately 821 million in 2017. Severe undernourishment happens mainly in Africa, Asia and the Latin America. Therefore, the current progresses undertaken are insufficient to achieve the Global Nutrition Targets by 2025. One of the reasons causing the severe food crisis is the climate change. In order to mitigate risks from climate variability that directly cause damage to soil and water quality and agricultural productivity, human management is required to develop resilience for climate changes. Addition of cover crop to bare soil left by annual crops in winter serves as an approach to improve water infiltration, retain soil water and prevent runoff and erosion. However, cover cropping has not been commonly adopted by land operators. Moreover, there remains agronomic, operational and economic challenges. Therefore, it is important to quantify the potential benefits of cover cropping and ability of preventing runoff and eutrophication. The traditional way is to undergo field trials, but there are several limitations associated with this approach exists: (1) huge labor and cost investment; (2) inability to cover large area; (3) variabilities in site-specific weather and soil qualities; and (4) inconsistent management practices.



To tackle this challenge, we will quantify the yield effects of cover cropping by analyzing and processing the remote sensing data that are publically accessible and abundant. By making use of the remote sensing data, we will develop deep learning models, such as Convolutional Neural Network (CNN) and Long Short-term Mmemory (LSTM), to identify the existence and amount of cover crop planting for pixels within the Mid-West U.S. Next, we will compare the performance of deep learning models and select the optimal one. After prediction of cover crop patterns using the deep learning model, we will also investigate the cover crop's environmental and economic impacts. The challenge in addressing these problems lies in the high-dimensional and unstructured nature of remote sensing data. We study this specific problem and generalize this method to the global cover crop investigation issue.