LUNA: A Space-Based Sustainable Agricultural and Thermal Stress Detection for Crops in the Philippines

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Motivation

The Philippines' **tropical climate** is suitable for **agricultural production**, and to improve the crop harvest is to increase the **economic growth**. Some of the top crops exported by the Philippines are rice, corn, and banana. Every crop must be properly managed to maintain its health and benefits. A major factor influencing crop quality and quantity is climate change. The United States Environmental Protection Agency states that crops can suffer damage and decreased production because of sudden fluctuations in temperatures. With this, we plan to combine the technological advancements in both land and space satellites to gather reliable data that can **improve** not only the **harvest of crops** but also the **agriculture ecosystem.**

Objectives

- To develop a CubeSat that can gather and transmit data using **Albedo sensor and In-situ land satellite support.**
- To detect the **Thermal Stress** in **Palay (unmilled rice), Corn (maize), and Banana** in the Philippines.
- To provide **real-time information on crop yields, soil and water conditions, as well as weather patterns** for making informed decisions related to water conservation, crop rotation, and various other agricultural operations.

Methodology

- We will adapt the **thermal imaging sensor** of albedo satellite constellations for the space satellite data gathering and combine this with the in-situ land satellite to gather the **soil moisture or quantitatively volumetric soil water content (SWC)**.
  The data gathering is divided into two (2) parts:
  1. In-situ land satellite for soil moisture.
  2. (CubeSat) Albedo satellite constellations for thermal stress, carbon, and methane mapping.

- To detect **soil moisture**, we use **in-situ land satellites**: The soil moisture or quantitatively volumetric soil water content (SWC) plays a vital role in partitioning the flux of incoming radiation into latent and sensible heat between the earth's surface and the atmosphere and partitioning precipitation between runoff and infiltration. To establish more reliable data gathered by the space satellite (CubeSat), we use land satellite buried in-situ sensors that infer SWC from an electromagnetic response.

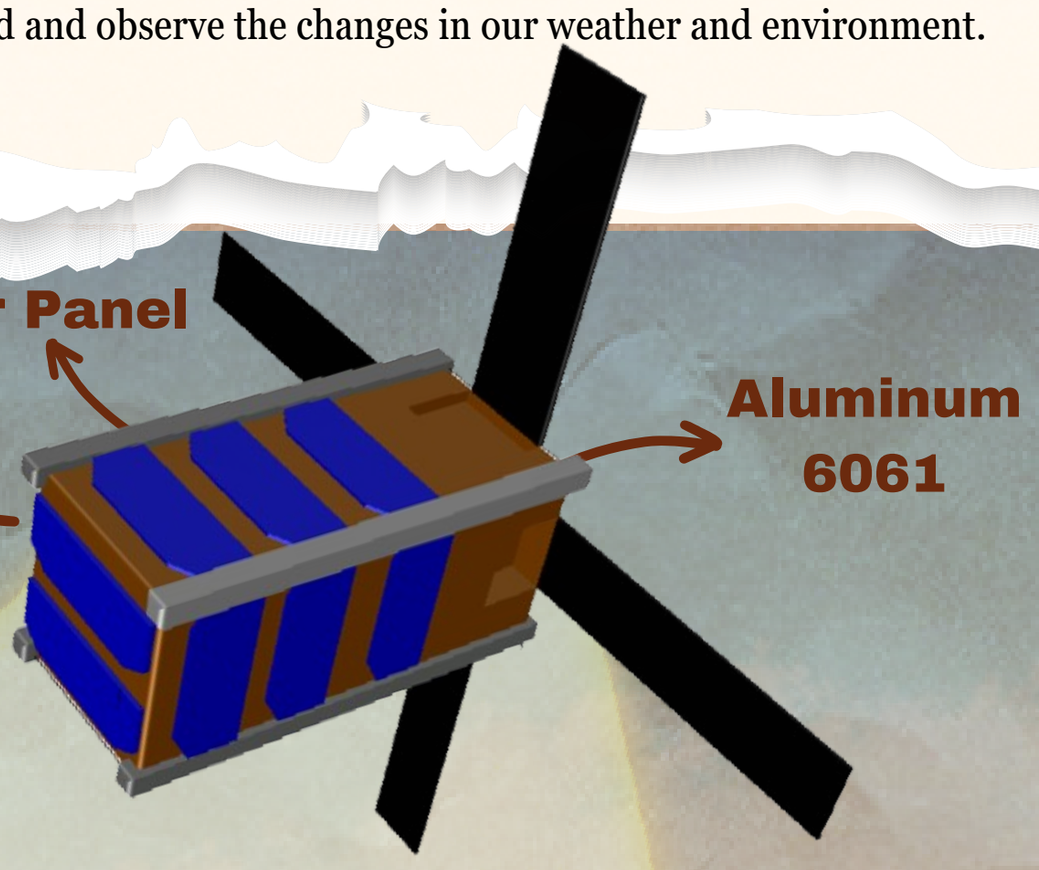
- To detect **thermal stress**, carbon, and methane mapping, we use space satellites: (**Albedo satellite constellations**) Albedo satellite can collect 10-centimeter commercial satellite imagery from the National Oceanic and Atmospheric Administration (NOAA), 40-centimeter multispectral imagery, and 4m Thermal imagery with a spectral range from 7.5 μm and 13.5 μm (microns). With Albedo satellite constellations, covering a spectral range of 0.4 μm to 13.5 μm, and the availability of Artificial Intelligence (AI), Machine Learning (ML), Computer Vision (CV) algorithms, and management systems, industrial and natural emissions can be detected to monitor climate change to understand and observe the changes in our weather and environment.

TOP EXPORTED Crops affected by Thermal Stress

Temperature that can cause Thermal Stress on crops	
Corn	30 °C
Banana	31 °C
Rice	42-45 °C

Effects of Thermal Stress

-Reduces grain yield
-Reduces net photosynthesis
-Withered leaves
-Impaired seedling
-Peel pitting
-Discoloration
-Nutrient imbalances



Conclusion

The result of the LUNA CubeSat mission detects the thermal stress and soil moisture for crops in the Philippines which will increase the exportation rate and the economic significance of crops.

By combining the data-gathering capabilities of Albedo satellite sensors and the in-situ land satellites the thermal stress, and soil moisture can be detected, and correspondingly carbon and methane mapping. Finally, this data will help not only the increased exportation rate of crops in the Philippines but also the advancement of agricultural ecosystems.

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References