NASA Space Apps Challenge

A.I.griculture

Project Report

Agriculture

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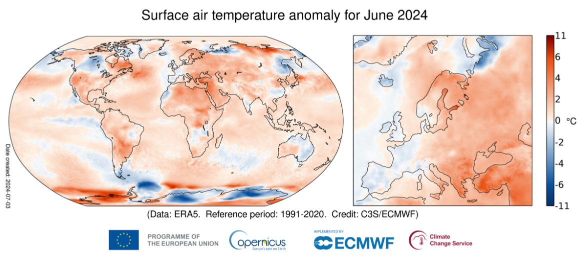
1 Introduction

1.1 Contextualizing the agricultural landscape

Farmers today are navigating an increasingly complex landscape characterized by unpredictable weather patterns, pest infestations, and the proliferation of diseases that threaten crop health. These challenges are compounded by environmental stressors such as climate change, which has resulted in more frequent and severe droughts and floods. The consequences are dire: diminished crop yields, reduced profitability, and heightened food insecurity. As the global population continues to grow, ensuring a stable and sustainable food supply is more critical than ever. Farmers need innovative tools and strategies to manage these water-related challenges effectively, enabling them to adapt to the changing climate and safeguard their livelihoods.

1.2 The Role of Data in Modern Agriculture



To address the myriad challenges that farmers face, harnessing advanced technologies and data-driven insights is essential. NASA's Earth observation datasets provide a wealth of information that can help farmers make informed decisions about water management, crop selection, and resource allocation. With over 50 years of data related to precipitation, soil moisture, vegetation health, and more, NASA's datasets are invaluable for understanding the dynamics of the hydrologic cycle and its impact on agricultural practices. By leveraging this data, farmers can gain actionable insights into weather patterns and soil conditions, allowing them to optimize their operations and mitigate the risks associated with climate variability.

1.3 Focus on Key Crops: Grass, Wheat, and Corn

In this challenge, we focus on three critical crops: grass, wheat, and corn. Grass is essential not only for pastureland but also for various agricultural applications, including soil health and erosion control. Wheat, as a staple food source, plays a crucial role in human diets and animal feed, while corn is vital for both food production and livestock feed.

By analyzing NASA data specifically related to these crops, farmers can better understand their growth requirements, manage water resources more efficiently, and anticipate potential adverse weather conditions that could affect their harvests. This targeted approach allows us to address the unique challenges posed by each crop while emphasizing their importance to food security and sustainability.

1.4 Geographic Focus: The United States

> *"Drought stricken Kansas farmer eyeing reptiles for rain forecast"*
> — *Successful Farming - News*

While our study encompasses global agricultural challenges, this project specifically targets the agricultural landscape of the United States. More specifically it targets Kansas, where droughts have become harsher and more frequent. Farmers are resorting to observing reptiles and reporting their sightings on a Facebook group to predict rainfall.

We are developing a user-friendly website designed to connect farmers with NASA's rich datasets and insights. This localized approach will enhance the relevance and usability of our tool, ensuring that it meets the practical needs of American farmers as they strive to enhance their resilience against water-related challenges. Ultimately, by empowering farmers with a comprehensive web platform that translates complex data into actionable information, we aim to help them thrive in an uncertain agricultural environment.

2 Website description and presentation

Farmers today are navigating an increasingly complex landscape characterized by unpredictable weather patterns, pest infestations, and the proliferation of diseases that threaten crop health. These challenges are compounded by environmental stressors such as climate change, which has resulted in more frequent and severe droughts and floods. The consequences are dire: diminished crop yields, reduced profitability, and heightened food insecurity. Recognizing these challenges, we are developing a user-friendly website that empowers farmers to manage their agricultural practices more effectively.

Our platform allows farmers to enter essential data, such as latitude, longitude, and crop type, which enables them to receive tailored advice, predictions, and timely information regarding ongoing climate-related disasters affecting their region. For example, when a farmer inputs their geographical coordinates and the type of plant they are cultivating—whether it's grass, wheat, or corn—the system can analyze relevant NASA datasets to generate actionable insights.

Additionally, the website will feature a dedicated section providing sources and references, ensuring transparency and credibility in the information provided. The platform utilizes NASA's Earth observation datasets, which are open-source and freely accessible, making them particularly valuable for farmers who may face economic constraints. By leveraging these data resources, farmers can receive guidance on water management, pest control, and crop health, enhancing their ability to adapt to changing environmental conditions.

Ultimately, our website aims to bridge the gap between complex satellite data and practical farming needs, empowering farmers with the knowledge and tools necessary to thrive in an uncertain agricultural environment.

3 Key Factors Influencing Plant Health: Insights for Application Development

To address the myriad challenges that farmers face, understanding the specific needs of crops is essential. Each plant requires a unique set of environmental conditions, including optimal levels of water, sunlight, and temperature, to thrive. By leveraging NASA's Earth observation datasets, farmers can gain insights into these needs and make informed decisions to enhance their agricultural practices.

Several critical parameters can be calculated to assess and improve plant growth, including Evapotranspiration (ET), Growing Degree Days (GDD), Global Photosynthesis (GP), and Daily Light Integral (DLI). Each of these metrics plays a crucial role in determining the health and productivity of crops, allowing farmers to tailor their management strategies accordingly.

3.1 Evapotranspiration (ET)

This parameter quantifies the amount of water transferred from the soil and plant surfaces to the atmosphere, and it can be calculated using the formula:

$$ET = E + T$$

3.2 Growing Degree Days (GDD)

GDD is a heat index that indicates the accumulated warmth available for plant growth, calculated using:

$$GDD = \sum \left(\frac{(T_{\text{max}} + T_{\text{min}})}{2} - T_{\text{base}} \right)$$

Where T_{min} et T_{max} are the maximum and minimum daily temperatures, and T_{base} is the base temperature below which growth does not occur. Datasets from NASA's MODIS and Landsat are used to gather temperature data for GDD computations.

3.2.1 Grow Potential (GP)

3.2.2 Daily Light Integral (DLI)

DLI quantifies the total light available to plants over a 24-hour period, calculated as:

$$DLI = \int_0^{24} \text{PPFD}(t)\, dt$$

Where PPFD(t) is the photosynthetic photon flux density at time tt. NASA's MODIS and VIIRS datasets can be utilized to measure light availability for effective DLI assessments.

By utilizing these formulas and the appropriate datasets, farmers can monitor and optimize the environmental conditions necessary for plant growth. This data-driven approach enables them to manage water resources more effectively and anticipate potential challenges that may arise from climatic fluctuations. In this way, NASA's Earth observation data serves as an invaluable tool in modern agricultural practices, supporting farmers in making informed decisions to ensure sustainable crop production.

4 How It Works: Backend

4.1 Title 1

Hypothèse : On considère que la vitesse que l'on a est à 10m car c'est la norme en météorologie. On calcule donc pour se ramener à 2 mètres.

4.2 Title 2

5 Benefits of the Platform and Aspirations

5.1 Title 1

6 Conclusion & Discussion

7 Annex

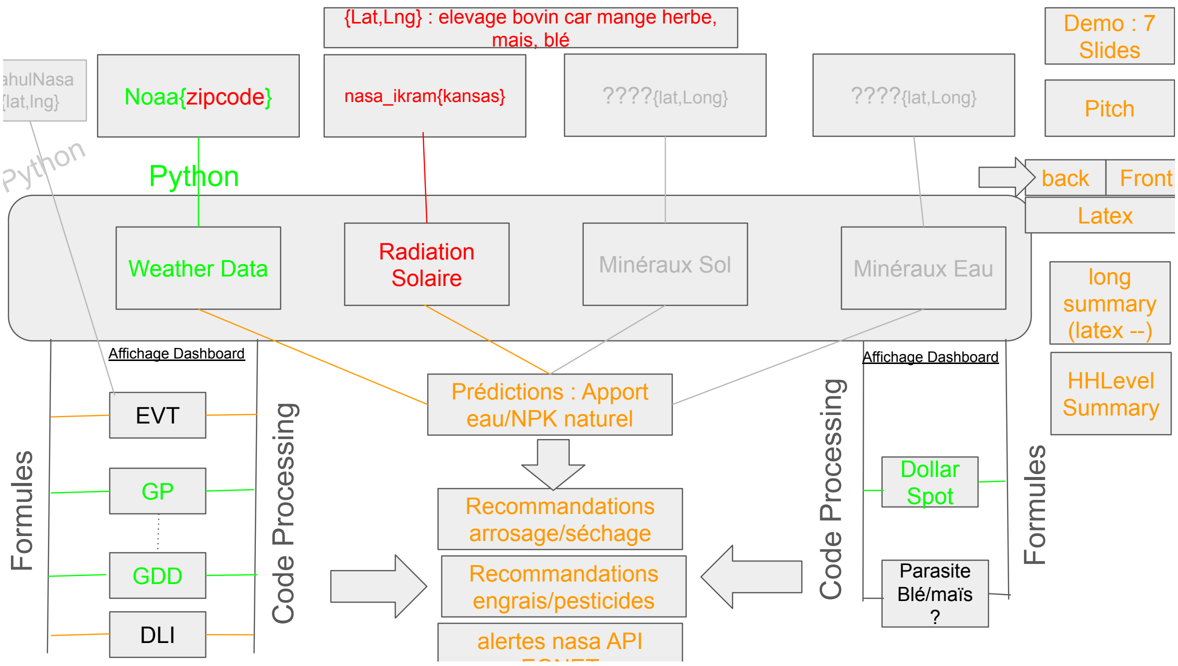


Figure 1: High level Data Flow