Section Sciences et Ingénierie de l'environnement
Design Project 2024 (semestre de printemps)

Proposition n°6

Novel remote sensing methodology to detect irrigated crops from satellite imagery

Partenaire externe ou laboratoire IIE
Kilian Vos
kilian.vos@dpie.nsw.gov.au *Téléphone +61410758630
Water Division, Department of Planning and Environment, NSW government, Australia
Taille de l'entreprise (nbre de collaborateurs) : 7 scientists in the Remote Sensing Team
Adresse Sydney, NSW
Site Web https://www.dpie.nsw.gov.au/water

Encadrant EPFL
Laurent Jospin
laurent.jospin@epfl.ch
EPFL ENAC IIE CRYOS
021 693 44 90
https://www.epfl.ch/labs/topo/

Descriptif du projet

Freshwater is a limited ressource in many parts of the world, and this is especially the case on the arid Australian continent. Freshwater ressources are critical for agricultural activies, mining and natural environments such as wetlands amongst many other uses. Government agencies are tasked with managing the water ressources and ensuring that water is shared equitably amongst all users. The key to develop **sustainable water management strategies** is adequate monitoring of the water ressources over large spatial and temporal scales. This is the realm of **satellite remote sensing**.

In this Design Project, we invite the students to **develop novel remote sensing methodologies to monitor water ressources from space**. In the state of New South Wales (almost twice as big as France), where the climate is predominantly arid, farmers must rely on irrigation to supplement rainfall and cultivate crops like cotton, cereals and various fruits and vegetables. One important feature that can be observed from satellite imagery and provides an estimate of how much water is being used for agricultural activities is **the extent of irrigated areas** in the catchment. Areas where crops are being irrigated during the growing season are generally greener than the surrounding vegetation. This signal can exploited on the satellite imagery (**Landsat and Sentinel-2**) to automatically detect irrigated areas, for example by calculating the Normalised Difference Vegetation Index (NDVI), as shown in Fig 1. However, this is a challenging problem as NDVI alone is not enough to discriminate irrigated crops as the surrounding vegetation can also display high levels of greenness after rain events, as

shown in Fig 1.It is therefore necessary to rely on additional datasets (e.g., evapotranspiration, rainfall data) and **innovative image processing techniques** to achieve this task.

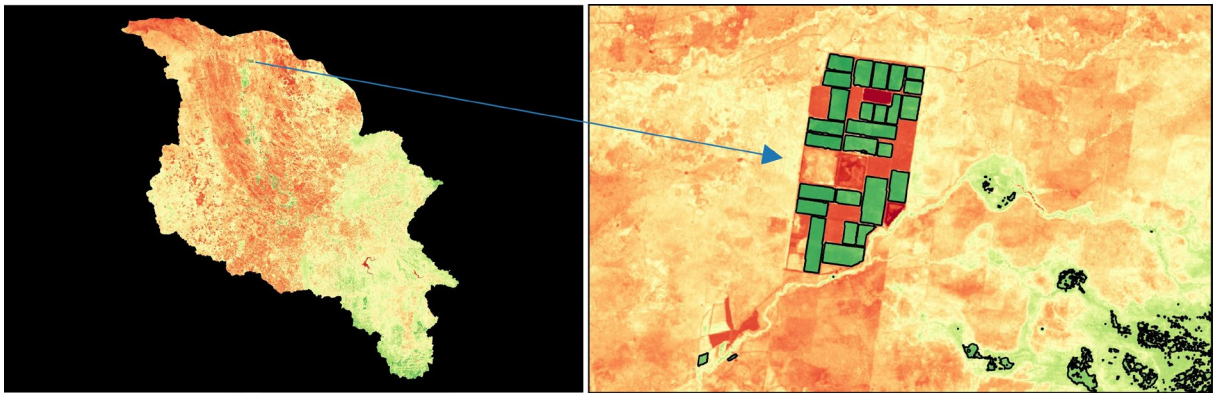

Figure 1. NDVI composite image from Landsat 5 for one of the NSW catchments, the right panel is zooming into a section where irrigated paddocks are detected together with surrounding vegetation.

Objectif et buts

1. Develop an automated methodology to map irrigated crops from satellite imagery
    a. Write a Python script that can load input data (a satellite image and associated evapotranspiration and climate datasets) and output a vector layer with the extent of irrigated areas.
    b. Experiment with various image processing and pattern recognition techniques to find the optimal methodology to robustly extract irrigated areas and exclude the surrounding vegetation.
    c. Perform a validation of the methodology by comparing the satellite-derived irrigated areas with groundtruth datasets available at the Department.

Descriptif tâches

- This project is 100% computer-based and will involve programming and GIS software to process geospatial data (ideally Python and QGIS).

- The first step of the workflow will be to load satellite imagery (from Google Earth Engine), evapotranspiration data and climate data for an area of interest (we can provide starting scripts for this).

- Then the more creative part of the project will start, where the students can link the biophysical characteristics of irrigated crops during the growing season with the remote sensing signals observed. Understanding these relationships spatially and temporally is the key to detecting the presence of irrigated crops and discriminating the surrounding non-irrigated vegetation.

Divers

Prerequisites:

- Interests in remote sensing and image processing
- Use of GIS software
- Python/Matlab programming