Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

University of Ljubljana

UNIVERSITY of STIRLING

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APPLIED REMOTE SENSING TRAINING PROGRAM
TRAIN - EMPOWER - ADVANCE

Crop Mapping using Synthetic Aperture Radar (SAR) and Optical Remote Sensing

April 4, 2023

NASA's Applied Remote Sensing Training Program (ARSET)

https://appliedsciences.nasa.gov/what-we-do/capacity-building/arset/about-arset

- Part of NASA's Applied Sciences Capacity Building Program
- Empowering the global community through online and in-person remote sensing training
- Topics for trainings include:
  - Water Resources
  - Air Quality
  - Disasters
  - Land
  - Climate & Energy (recently added)

NASA's Applied Remote Sensing Training Program (ARSET)

https://appliedsciences.nasa.gov/what-we-do/capacity-building/arset

- ARSET's goal is to increase the use of Earth science remote sensing and model data in decision-making through training for:
  - Professionals in the public and private sector
  - Environmental managers
  - Policy makers

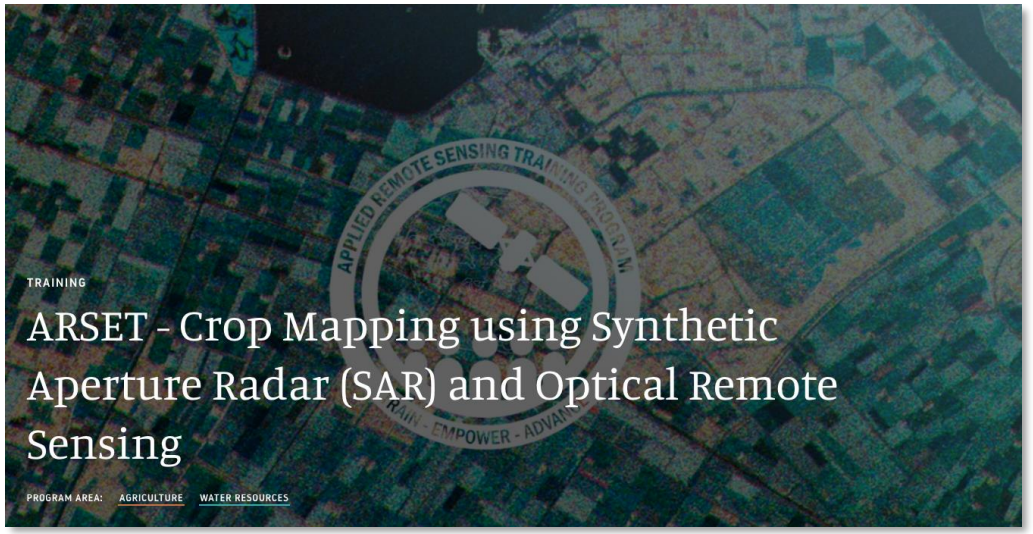
All ARSET materials are freely available to use and adapt for your curriculum. If you use the methods and data presented in ARSET trainings, please acknowledge the NASA Applied Remote Sensing Training (ARSET) program.

Training Format

- Three 2.5-hour sessions including presentations, demonstrations, and question and answer sessions
- The same content will be presented at two different times each day.
- Session A will be presented in **English.**
- Session B will be presented in **Spanish.**
  - Session A: 10:00-12:30 EST (UTC-4)
  - Session B: 13:00-15:30 EST (UTC-4)

- Training materials and recordings will be available from:

  https://appliedsciences.nasa.gov/join-mission/training/english/arset-crop-mapping-using-synthetic-aperture-radar-sar-and-optical-0



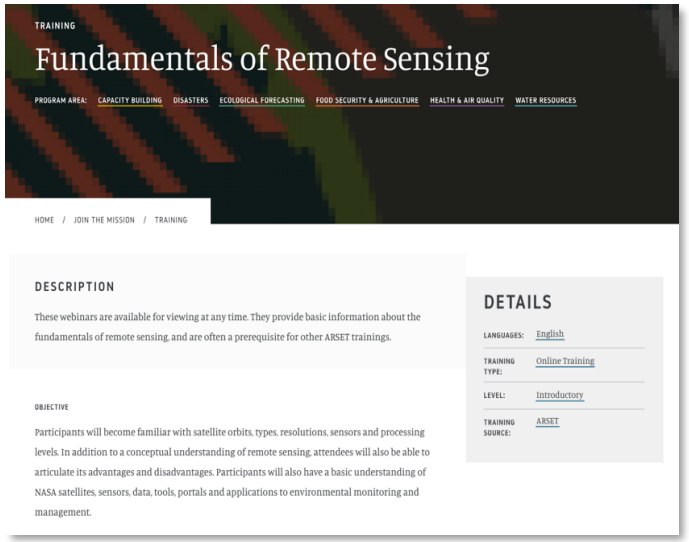
Homework and Certificate

- Homework Assignment:
  - Answers must be submitted via Google Form
  - Due Date: April 25, 2023
- A certificate of completion will be awarded to those who:
  - Attend all live webinars
  - Complete the homework assignment by the deadline (access from website)
  - You will receive a certificate approximately two months after the completion of the course from: marines.martins@ssaihq.com

Prerequisites

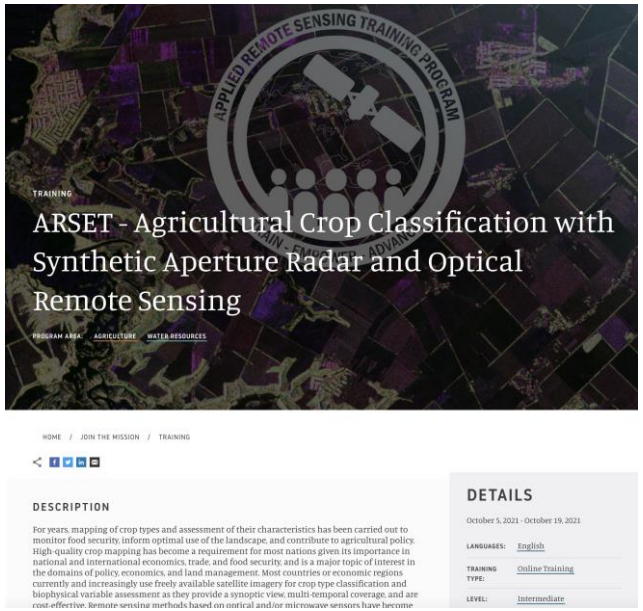
Fundamentals of Remote Sensing:

https://appliedsciences.nasa.gov/join-mission/training/english/fundamentals-remote-sensing



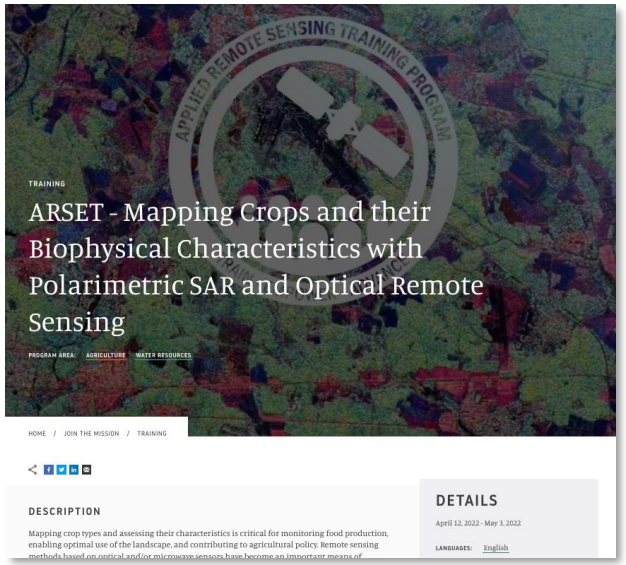
Agricultural Crop Classification with Synthetic Aperture Radar and Optical Remote Sensing:

https://appliedsciences.nasa.gov/join-mission/training/english/arset-agricultural-crop-classification-synthetic-aperture-radar-and

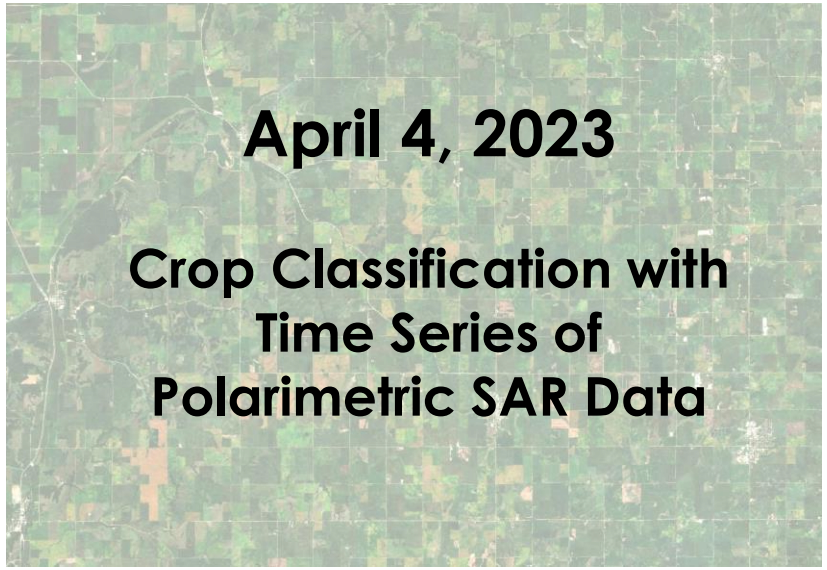


Mapping Crops and their Biophysical Characteristics with Polarimetric SAR and Optical Remote Sensing:

https://appliedsciences.nasa.gov/join-mission/training/english/arset-mapping-crops-and-their-biophysical-characteristics

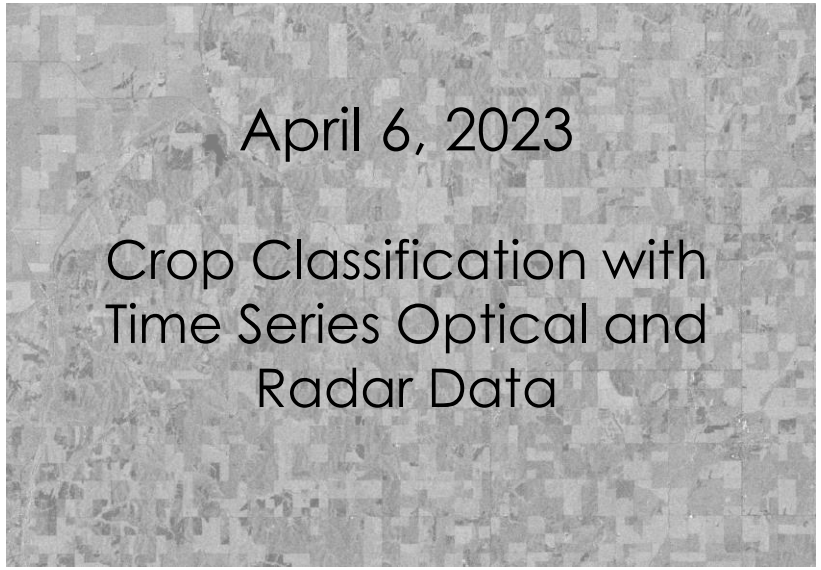


Training Outline



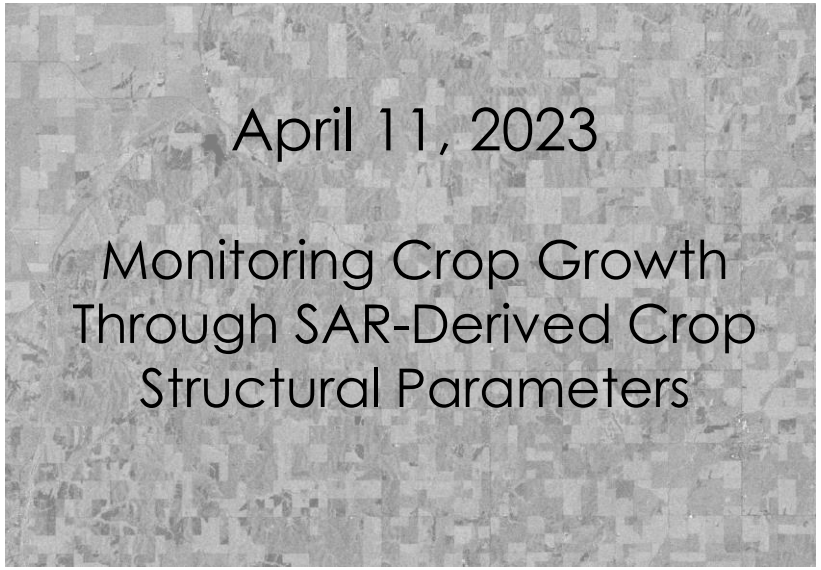
April 4, 2023

Crop Classification with Time Series of Polarimetric SAR Data



April 6, 2023

Crop Classification with Time Series Optical and Radar Data



April 11, 2023

Monitoring Crop Growth Through SAR-Derived Crop Structural Parameters

Training Objectives

After participating in this 3-part training, attendees will be able to:

- Explain how polarimetric parameters are used for crop condition assessment
- Demonstrate how to perform Sentinel-1 SAR preprocessing to derive quasi polarimetric parameters
- Perform a calibration of a SAR-based vegetation index to NDVI
- Monitor crop growth with multitemporal polarimetric SAR (PolSAR) data from Sentinel-1
- Examine crop growth using a canopy structure dynamic model and time series of Sentinel-1 imagery
- Classify crop type using a time series of radar and optical imagery (Sentinel-1 & Sentinel-2)

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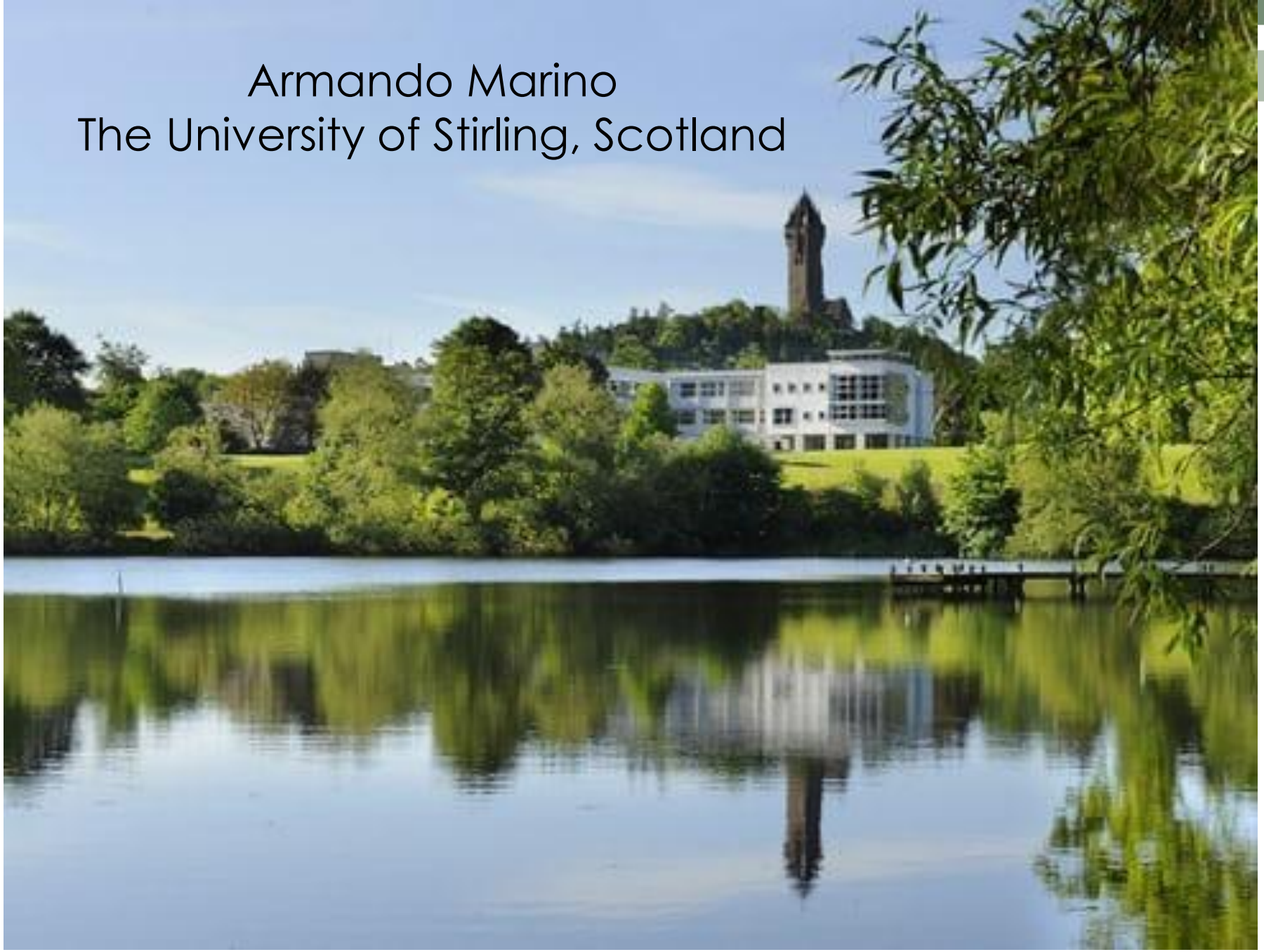
Crop Classification with Time Series of Polarimetric SAR Data

Armando Marino

April 4, 2023

Introduction



Credit: Armando Marino

Learning outcomes:

By the end of this practical you will learn how to:

- Run Python code for machine learning of multitemporal PolSAR data
- Pre-process PolSAR data for using machine learning
- Format the data in feature vectors
- Run random forest and K-Means classifiers
- Evaluate the accuracy of your classifiers

Before you start:

- This practical builds on skills from a previous ARSET training: *Mapping Crops and their Biophysical Characteristics with Polarimetric SAR and Optical Remote Sensing* https://appliedsciences.nasa.gov/join-mission/training/english/arset-mapping-crops-and-their-biophysical-characteristics

- If you are not very familiar with Pythion, you may want to go through the materials from the previous training before you attempt this training.

- In the training folder, you will find files with and without solutions. My suggestion is to try to solve the coding exercises on your own before you listen to the training or look at the solutions.

Python

"Python is a programming language that lets you work quickly and integrate systems more effectively."
https://www.python.org/

You can find many tutorials or books on the web. The one I use is the following:
https://docs.python.org/3/tutorial/

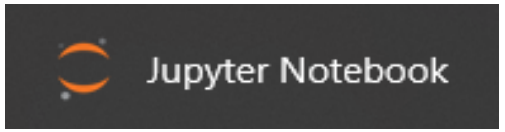
Downloading/Installing: Anaconda

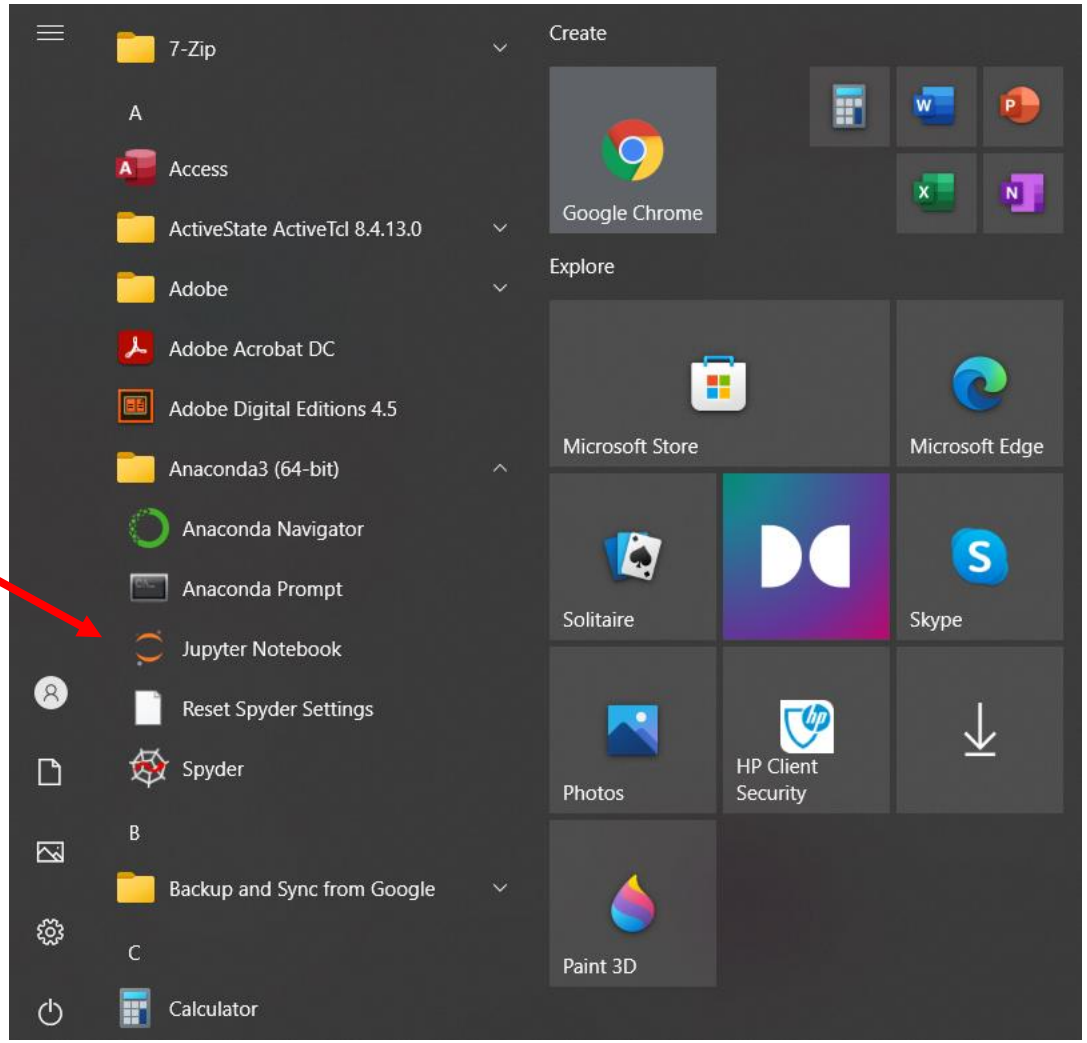
My suggestion is to use the *Anaconda installer*, because it comes with most of the common libraries: https://www.anaconda.com/products/individual?modal=nucleus

If you do not want to use Anaconda, please make sure you use Python 3.x version (3.6+ will be fine), but **NOT 2.7**, since some functions have changed!
The 2.7 version will NOT run with the code I am sharing!

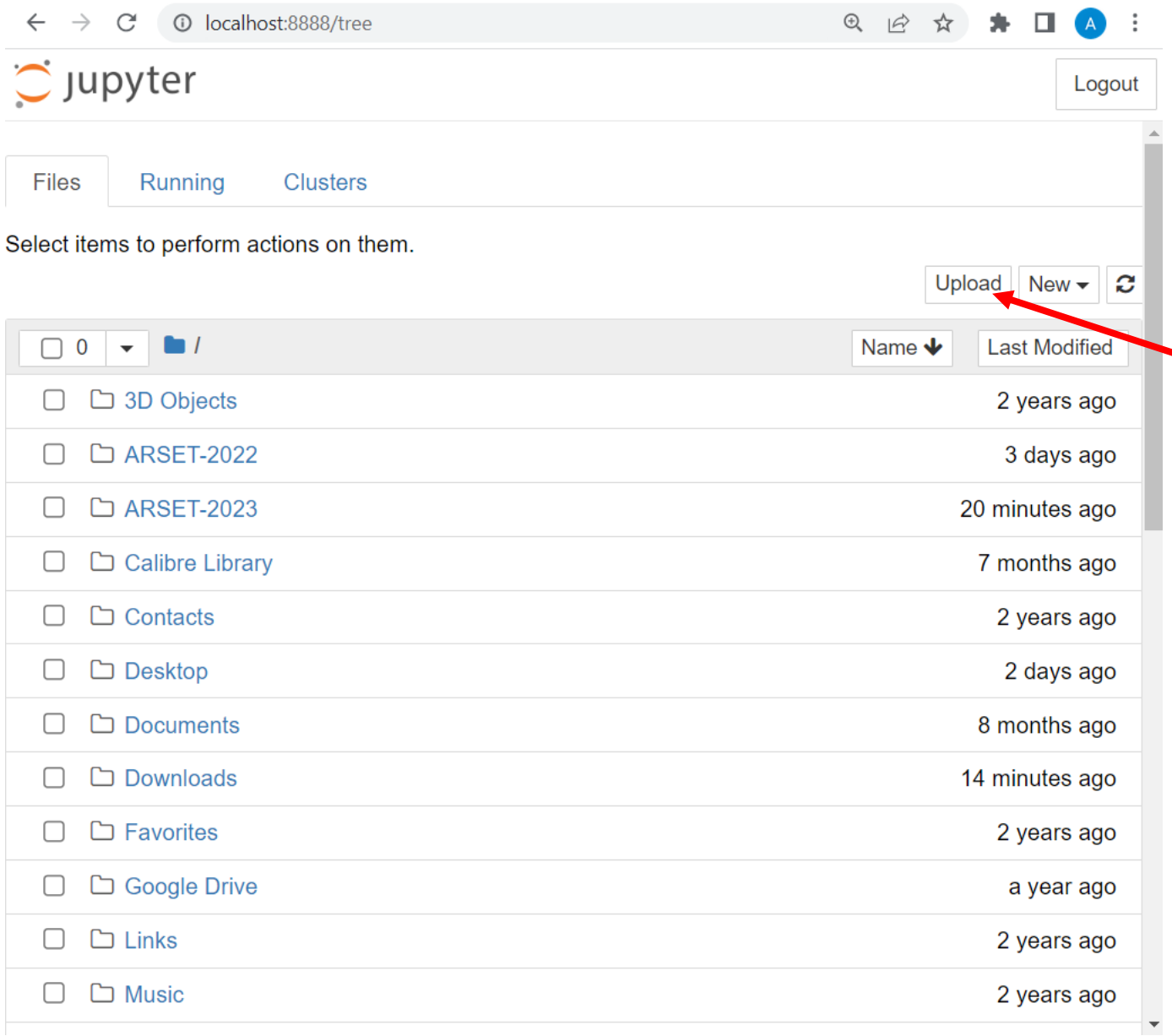
Jupyter Notebook

Anaconda will install Jupyter Notebook and you should see its icon in the Start menu (Windows OS).





Jupyter Notebook

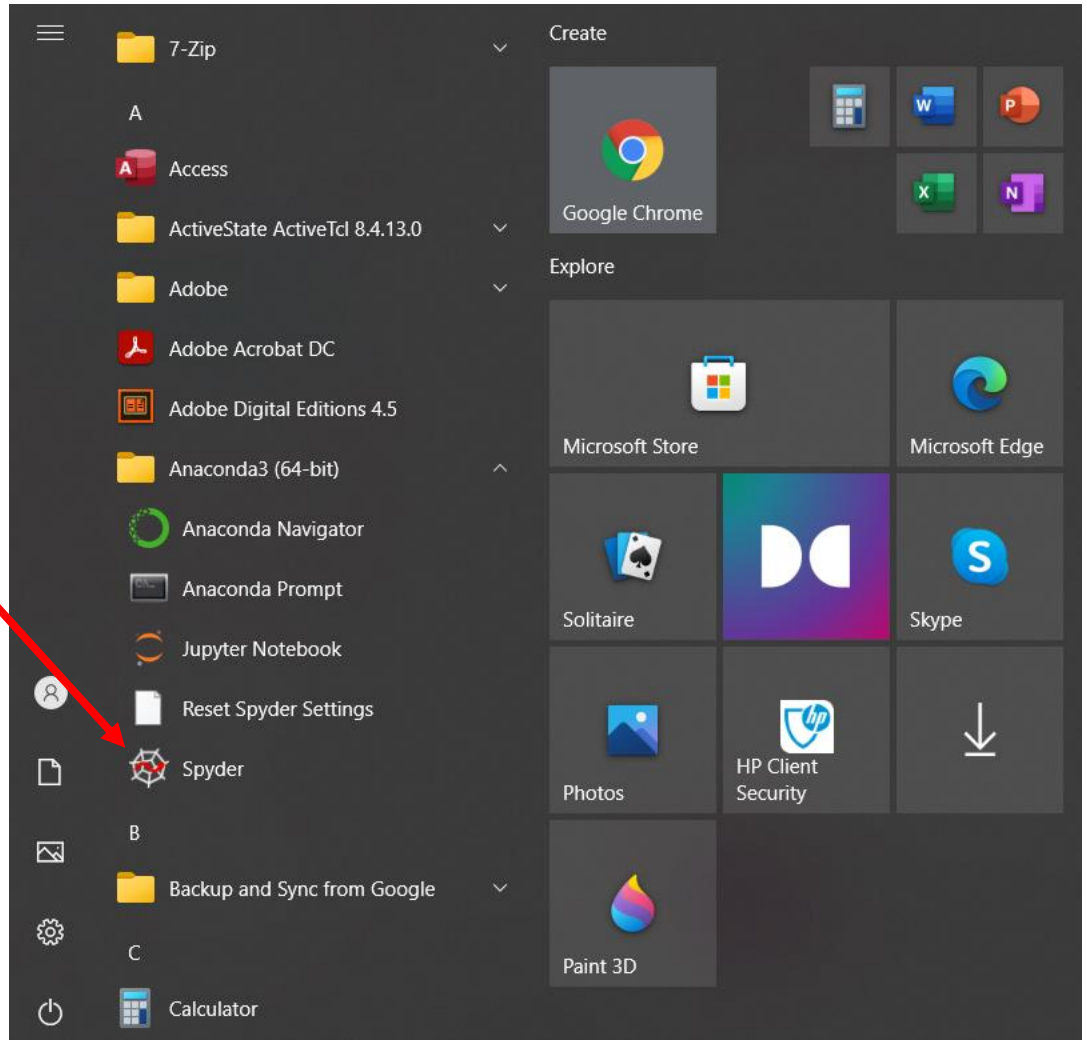


Jupyter opens in a web browser, and you can upload scripts using the **Upload** button.

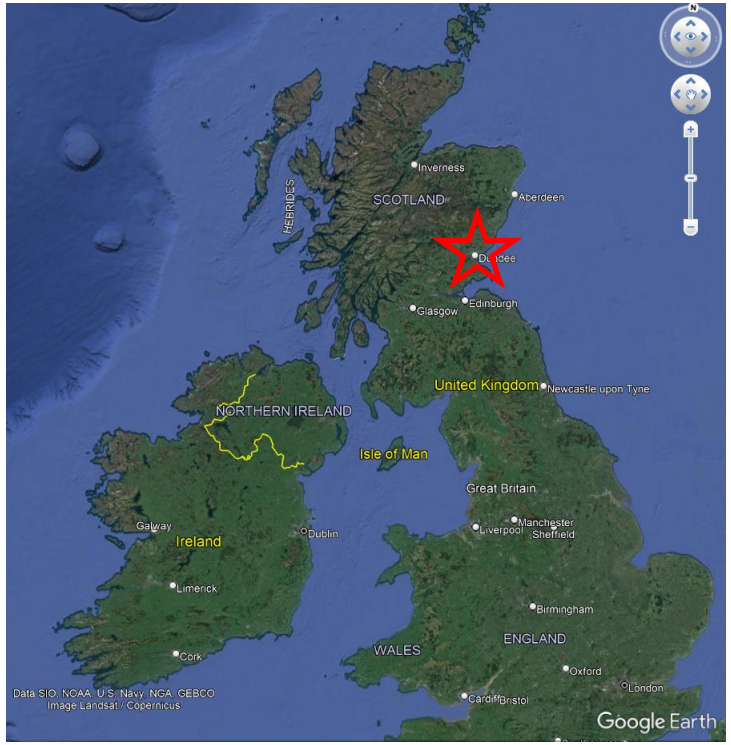
Spyder

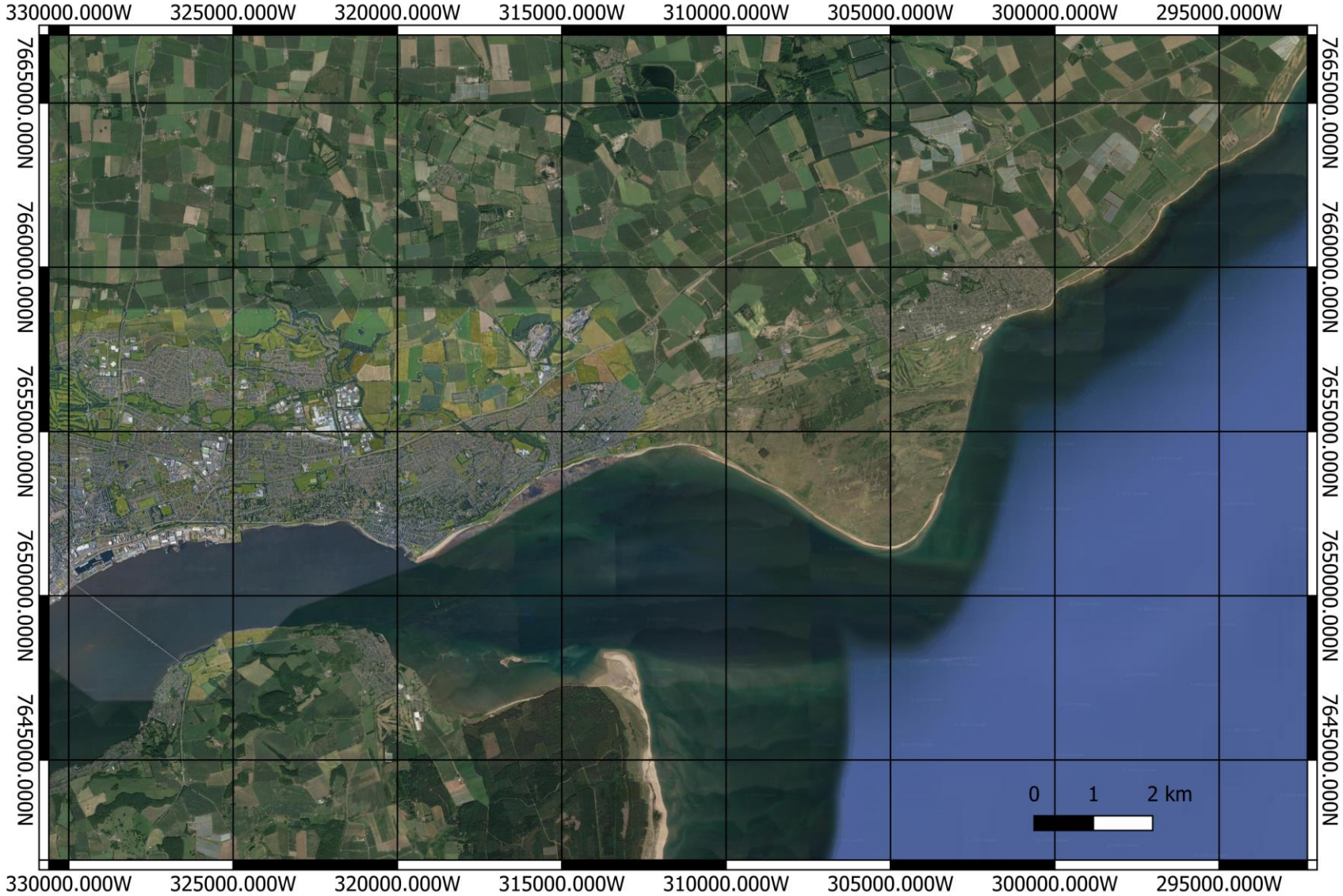
Anaconda will install the Python editor **Spyder** and you should see the icon below.

Spyder is a handy editor, and you may want to use it when you are scripting **operational/automatic processing stacks**.



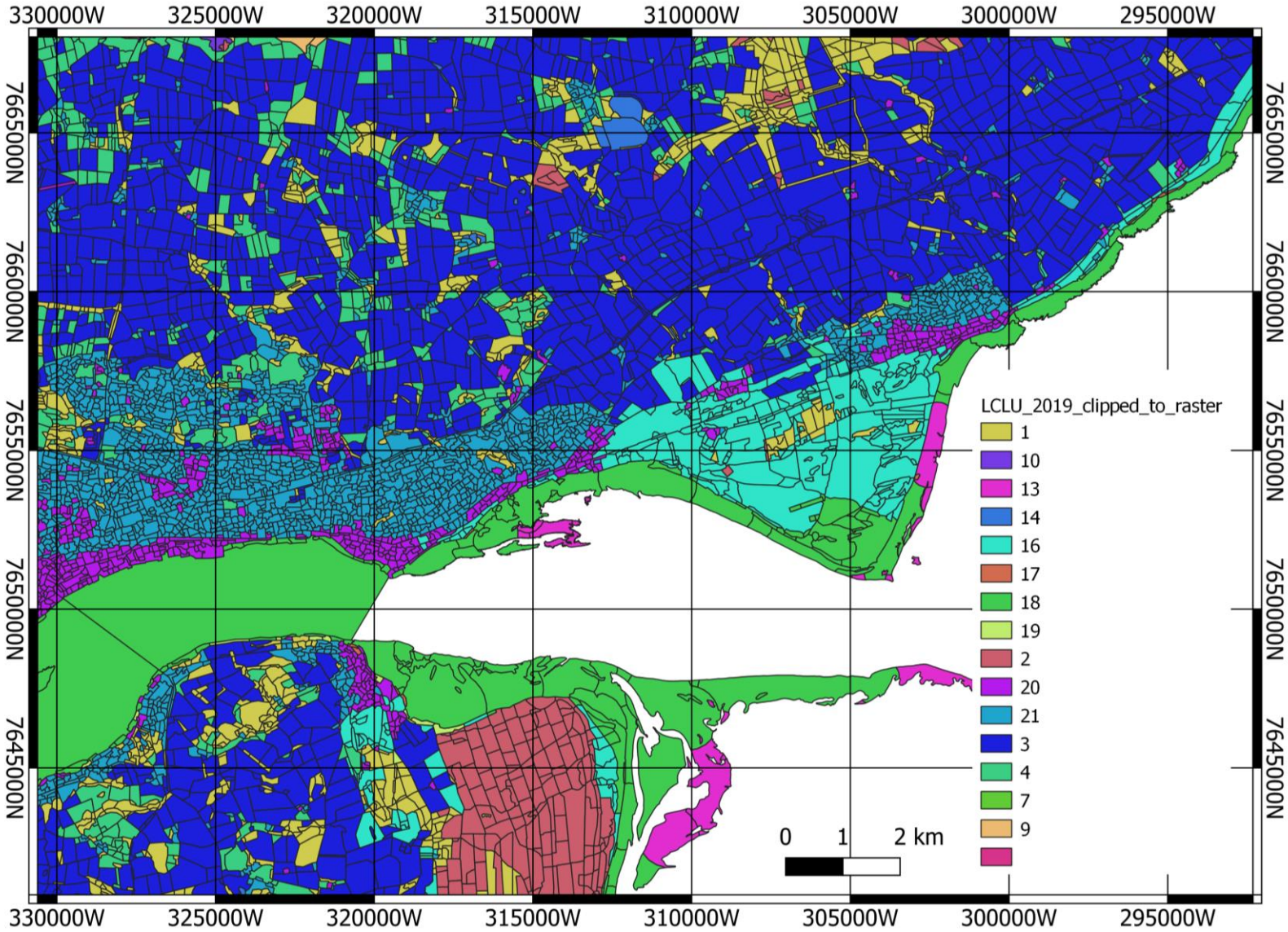
Data: Sentinel-1 ESA; Location: Angus, Scotland



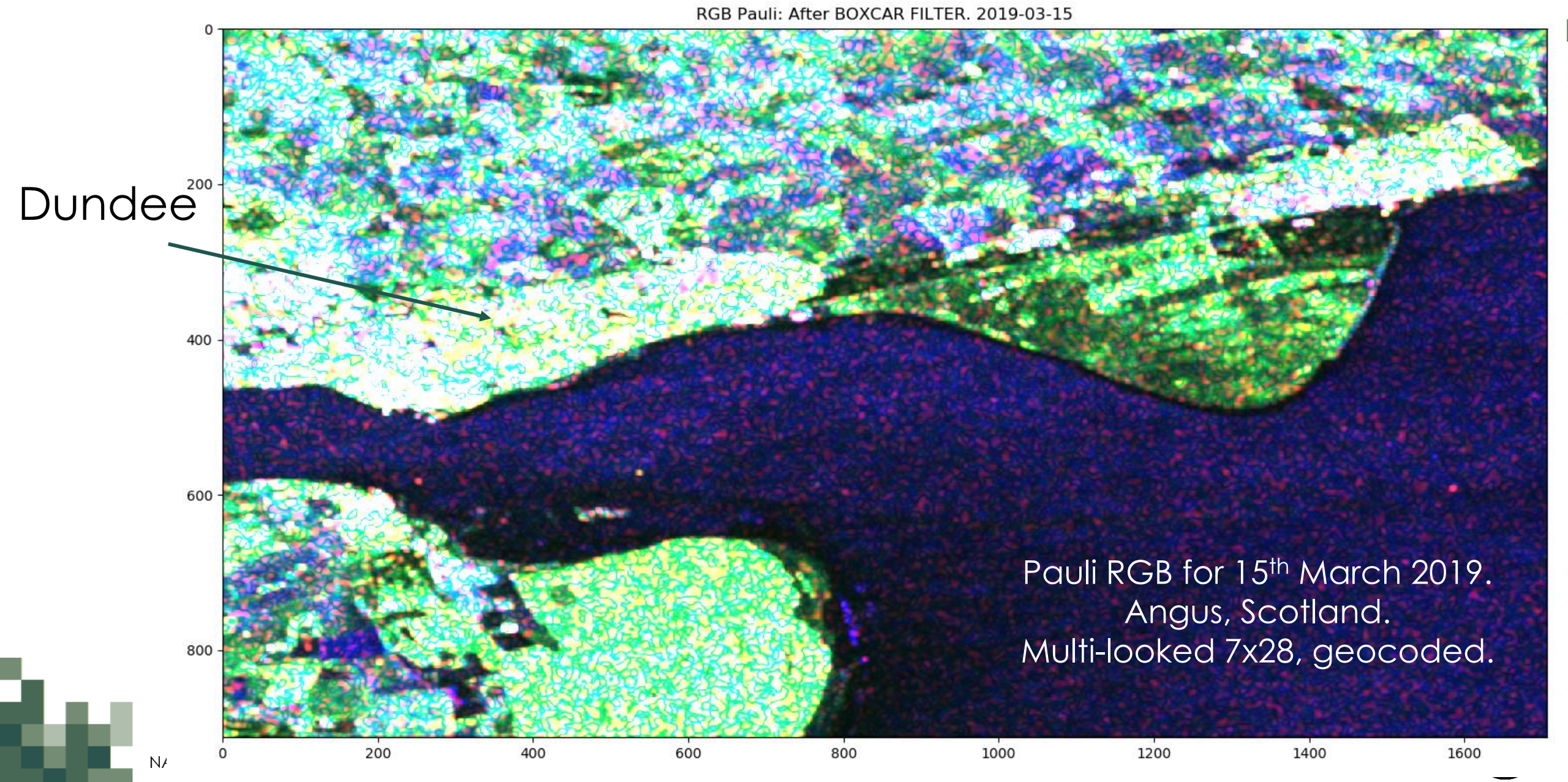


Data: Sentinel-1 ESA; Location: Angus, Scotland

The **crops** are mostly cereals, potatoes, and rapeseed oil.



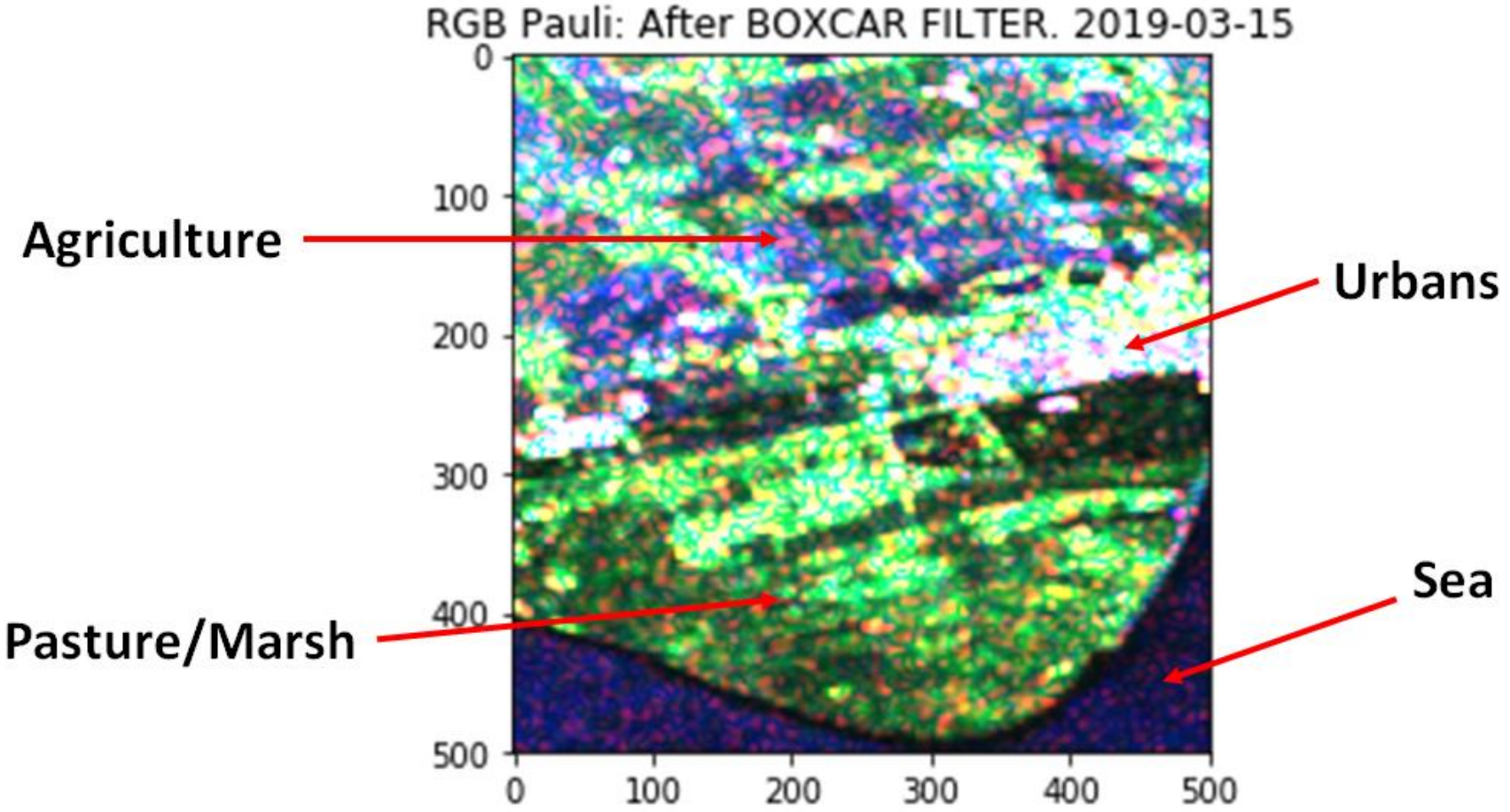
Data: Sentinel-1 ESA; Location: Angus, Scotland



Data: Sentinel-1 ESA; Location: Angus, Scotland

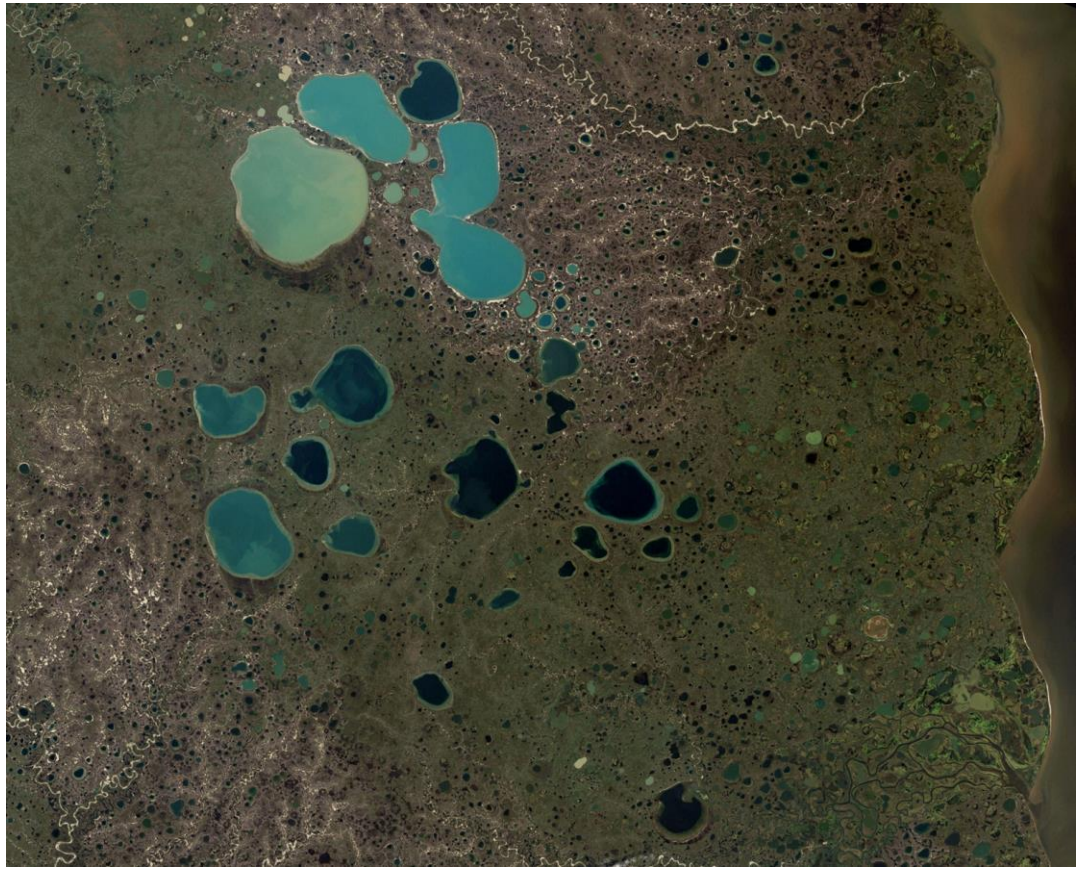
Pauli RGB for 15th March 2019. Angus, Scotland. Multi-looked 7x28, geocoded.

This is the small area we will initially concentrate on in this practical.



Questions?

- Please enter your questions in the Q&A box. We will answer them in the order they were received.
- We will post the Q&A to the training website following the conclusion of the webinar.



https://earthobservatory.nasa.gov/images/6034/pothole-lakes-in-siberia

Contacts

- Trainer:
  - Armando Marino: armando.marino@stir.ac.uk
- Training Webpage:
  - https://appliedsciences.nasa.gov/join-mission/training/english/arset-crop-mapping-using-synthetic-aperture-radar-sar-and-optical-0
- ARSET Website:
  - https://appliedsciences.nasa.gov/arset
- Twitter: @NASAARSET

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Thank You!