# Deep Learning for classification and segmentation for understanding clouds from satellite images


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# The problem

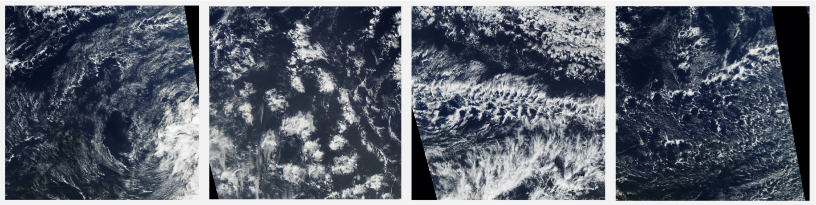
**Task :** With a given satellite image, we predict segmentation masks for four cloud organization patterns : **Sugar**, **Flower**, **Fish**, and **Gravel**.

**Motivation :** Shallow clouds play a large role in the Earth's radiation balance and yet they are poorly represented in **climate models**.

**Dataset :** Gathered by the scientists of two meteorologic institutions and later was used to host a Data Science **competition on Kaggle**.

**Problematics :** The ground-truth masks presented in the **dataset** are quite **noisy** meaning they include a lot of areas that actually do not contain clouds at all. Also, the masks of different classes can overlap. These two facts significantly increase **problem complexity**.

**Metric :** **Mean Dice coefficient** is chosen as the metric to measure the model performance.



(a) Sugar (b) Flower (c) Fish (d) Gravel

FIGURE – Canonical examples of the four cloud organization patterns.

# Research

## Several aspects for studying :

- How training on **different image sizes** affects the final results ?
- What is an **optimal threshold** value for pseudo-labels generation ?
- Which **encoder** should be used with **U-Net** architecture ?

## What we propose :

➔ **Two-stage segmentation** pipeline with **progressive resizing** & **pseudo-labelling**.

➔ **Post-processing** procedure after the model generates predictions, namely, drop all the masks which **pixel size** [1] is less than some **parameter *k*** (can be optimized).

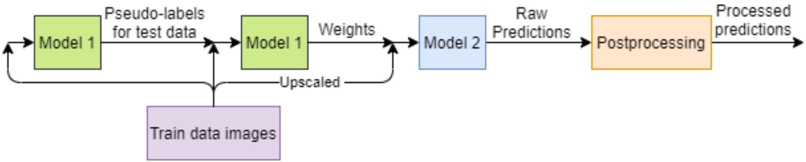



FIGURE – Pipeline.

1. Pixel size is defined as a number of pixels which belong to the same connected component

# Summary

## Results :

- Dice score : 0.658 [2].
- Position : Top 6.2% [95th].
- Final leaderbord ranking by Dice coefficient differs
  by no more than $\sim$1,5% between the 1st and the 100th positions.

## Ways to improve :

- Specific pre-processing which tackles the problem of noisy dataset.
- Training on bigger image sizes.
- Better post-processing threshold selection.

2. Perfect model achieves an accuracy of 1.