STØTTET AF
Promilleafgiftsfonden for landbrug

SatHub 1.4 contribution to project "5178 - Markens dræningstilstand; effektiv kortlægning"

SatHub

Af Peter Fogh, Christian Schou Oxvig og Donjeta Runjeva

Exported on 08/28/2019

Table of Contents

This documentation describes version 1.4. SatHub and how it contributes to the project "5178 - Markens dræningstilstand; effektiv kortlægning".

1 Executive summary

Version 1.4 of SatHub has been released. The purpose of SatHub version 1.4 is to enable the collection of high-quality, cloud free satellite images, specifically normalized difference water index (NDWI) and RGB images, using state-of-art cloud detectors like the Braaten-Cohen-Yang cloud detector and S2Cloudless. Such collected high-quality satellite image-data is a necessity for completing the analyses in the project "5178 - Markens dræningstilstand; effektiv kortlægning".

2 State-of-art cloud detectors

One often-used cloud detector is the Braaten-Cohen-Yang cloud detector, e.g. it is used in CropManager. CropManager currently (i.e. 19 Aug 2019) uses the Braaten-Cohen-Yang cloud detector, also called MSS clearview-mask (MSScvm), [1, 2] for removal of Sentinel-2 images containing clouds. The implemented algorithm (i.e. SentinelHub custom-script) is seen below.

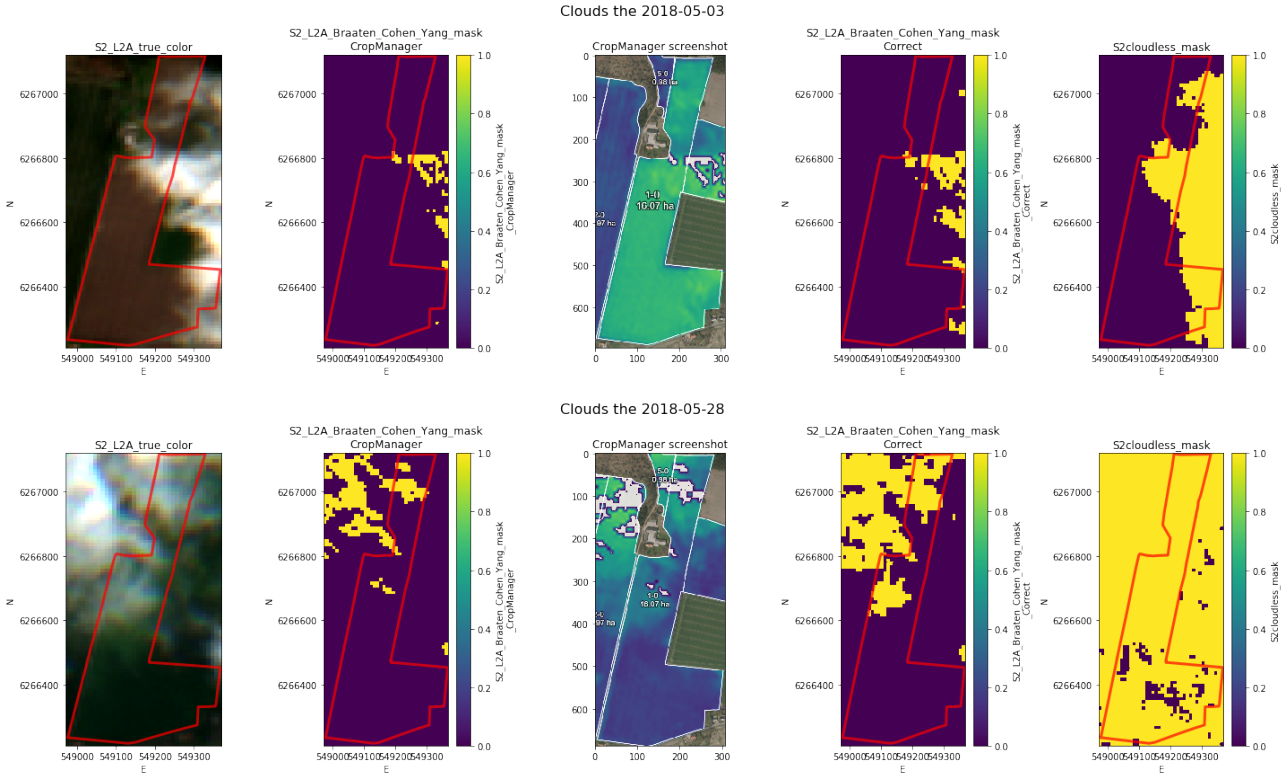
SentinelHub custom-script used by CropManager

```
//Cloud detection: BCY_MASK
var bRatio = (B02 - 0.175) / (0.39 - 0.175);
var NGDR = (B02 - B03) / (B02 + B03);

function clip(a) {
  return Math.max(0, Math.min(1, a));
}

//if cloud, return 1
if (bRatio > 1) { //cloud
  return [1,1,1];
}

if (bRatio > 0 && NGDR>0) { //cloud
  return [1,1,1];
}

//NDVI if no cloud
var ndvi = (B08-B04)/(B08+B04);
var ndre =  (B08-B05)/(B08+B05);
return [ndvi,ndre,0];
```

However, this implementation is not up-to-date, as the producer of the implementation, Sinergise, has updated it to use the Sentinel-2 bands B03 and B04 instead of B02 and B03 [3], thus CropManager is using an incorrect implementation of MSScvm. The error was due to an incorrect bandwidth comparison of Landsat satellite bands [4], which MSScvm is based on, and the Sentinel-2 satellite bands [5], which Sinergise offers. The correction is reported to the CropManager team, which will implement the updated cloud mask algorithm for images after 01 Aug 2019

2.1 Cloud detector visual comparison

The images and conclusion below are from our analysis of the different cloud masks and how they differ.



The plots above for the 2018-05-03 and 2018-05-28 visualizes from left to right: the red-green-blue (RBG) image, the incorrect (i.e. using band 2 and 3) Braaten-Cohen-Yang cloud mask currently (2019-08-20) utilized by CropManager, a screenshot of CropManager' biomass analyses visualization, the correct (i.e. using band 3 and 4) Braaten-Cohen-Yang cloud mask, and the S2cloudless [6] cloud mask currently used by SatHub. The red line visualizes the field polygon border.

The conclusions based on the visualizations is a follow:

- As seen both the 2018-05-03 and 2018-05-28 the incorrect Braaten-Cohen-Yang cloud mask and the screenshot of CropManager' biomass analyses is identical, thus we conclude the implementation is equivalent.
- As seen both the 2018-05-03 and 2018-05-28 the incorrect Braaten-Cohen-Yang cloud mask classify fewer pixels to contain a cloud than the correct Braaten-Cohen-Yang cloud mask, thus implementing the correction of the cloud mask in CropManager could improve the biomass-benchmark, as more clouds should be detected and more cloudy images should be removed from the benchmark.
- Comparing the S2cloudless cloud mask to the correct Braaten-Cohen-Yang cloud mask and the RGB image, it can be seen for the 2018-05-03 that S2cloudless better detects the cloud in its entirety, where the Braaten-Cohen-Yang cloud mask only detects the core of the cloud, i.e. the brightest parts. However, for the 2018-05-03 S2cloudless seem to detect too many pixels as cloudy, whereas the Braaten-Cohen-Yang cloud mask better detects the cloud in its entirety.

2.2 MSScvm added to SatHub

SatHub has been extended with both the old and the new MSScvm implementation, as the MSScvm correction in CropManager only will effect images after 01 Aug 2019. Thus, users of SatHub can download satellite images from any date using any of the cloud masks. The new MSScvm implementation is selected as the default cloud mask to use. The command-line argument "--remove_clouds_using" can be used for changing the utilized cloud mask for removing cloudy images.

Thus, SatHub now enables high-quality NDWI images for the project "5178 - Markens dræningstilstand; effektiv kortlægning", as the Braaten-Cohen-Yang cloud mask will remove cloudy images.

3 Other SatHub improvements

- Added NDWI output channel based on near-infrared (NIR) and short-wave infrared (SWIR) frequency bands such that SatHub now offers both NIR/SWIR NDWI and G/NIR NDWI output channels.
- Bug-fix such that SatHub can save RGB GeoTIFF images.
- Warning message if there are no cloud-free images to save

4 References

1. Braaten J, Cohen WB, Yang Z. 2015. *Automated cloud and cloud shadow identification in Landsat MSS imagery for temperate ecosystems*. Remote Sensing of Environment. 169:128-138.
2. Sinergise, SentinelHub custom-scripts, Braaten-Cohen-Yang cloud detector, https://custom-scripts.sentinel-hub.com/custom-scripts/sentinel-2/cby_cloud_detection/, visited 19 Aug 2019 .
3. SentinelHub custom-scripts Github update, https://github.com/sentinel-hub/custom-scripts/commit/c9e3e51cbc56565b82f87b9df1da8bf5beec2c2f, visited 19 Aug 2019 .
4. Landsat 4 specifications, https://www.usgs.gov/land-resources/nli/landsat/landsat-4?qt-science_support_page_related_con=0#qt-science_support_page_related_con, visited 19 Aug 2019 .
5. Sentinel-2 specifications, https://en.wikipedia.org/wiki/Sentinel-2#Instruments, visited 19 Aug 2019 .
6. Sentinel Hub Cloud Detector for Sentinel-2 images in Python,https://github.com/sentinel-hub/sentinel2-cloud-detector, visited 19 Aug 2019 .