UNIVERSIDAD DE COSTA RICA

Responding to Challenges Beyond the New Normal

SATELLITE METEOROLOGY FROM HOME: LIMITED BANDWIDTH AND PROCESSING POWER

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Challenge

Students may not have enough bandwidth and processing power at home to handle meteorological satellite data and generate products for their university coursework.

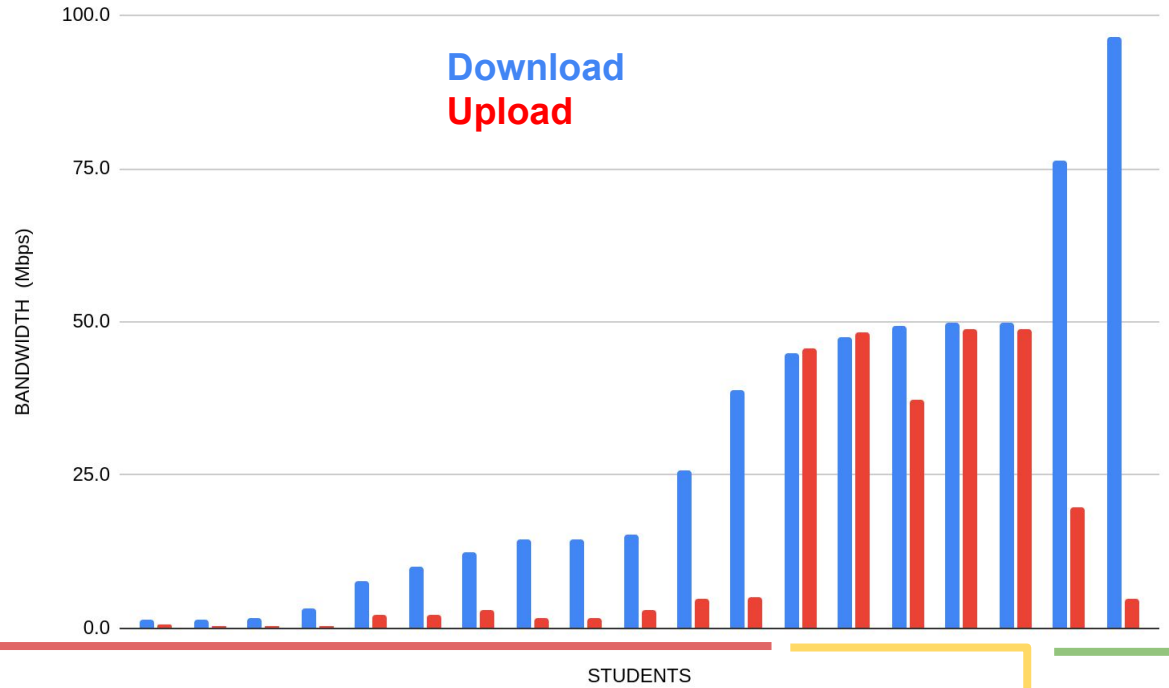
Extra considerations:

- Bandwidth is likely to be shared. Can not be used at 100% capacity for extended periods of time.
- Computer will be running other programs or applications and will likely to be shared. Can not be left calculating or generating products during extended periods of time.

This problem was first identified during the **Meteorological Instruments and Agrometeorology courses** (part of the undergraduate program in Meteorology) during applications of Meteorological Satellites.

At the beginning of the virtual lessons a poll was sent to the students to better understand their situations regarding internet bandwidth availability and processing capabilities in their homes.

Bandwidth available for students at home during 2020

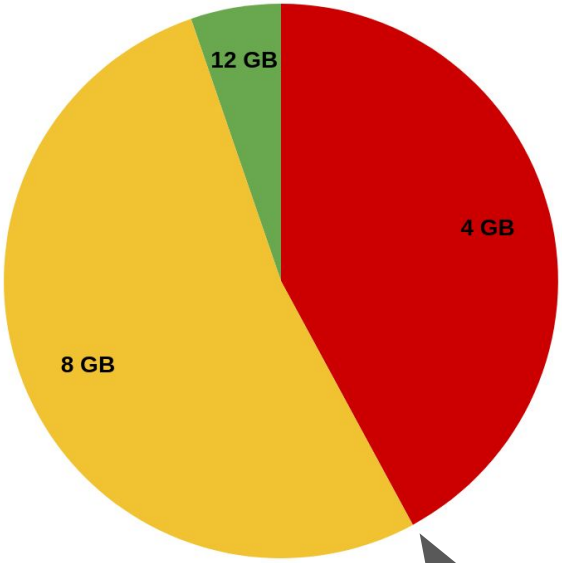


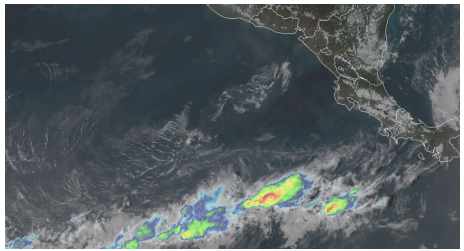
Students can not download data or upload products

Some balance in download/upload available

Good download / Bad upload

Computer memory available for students at home during 2020





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Consider that the memory will be shared with the operating system and part could be reserved for graphics processing depending on the hardware configuration. Only a fraction of this memory will be available for satellite data processing.

Channel 2 of GOES 16 is close to 500 MB meaning that if 2 GB are used by the operating system (could be more) the data that could be accommodated in the student's computer is:

a maximum of 4 images for 4 GB
a maximum of 12 images for 8 GB
a maximum of 20 images for 12 GB

Memory is also needed for the calculations and product generation. This challenge proved to be important when students could not complete even the visualization of a single time of Channel 2 due to these limitations.

Solutions

Mail a memory stick with satellite, radar and automatic weather station data for their coursework.

Pro: Students did not need any bandwidth to obtain data. Even those disconnected from the web had some data to continue the learning process.

Con: This solution served only partially as the limitations in processing power and memory availability were still a big problem during assignments and class activities.

Use a cloud programing environment.

Pro: The bandwidth utilization is minimized and enough processing power and memory is freely available for satellite data processing and product generation (even of RGBs).

Con: The free sessions have limited available resources and if exceeded it stops the process. Even then, the minimum available memory is 12 GB which is the maximum used by the students in their computers representing a big improvement over their local system.

Cloud programming during an international workshop

During October of 2020 a Virtual Training in Satellite Applications for WMO's RA-IV was hosted by the University of Costa Rica. Close to 100 participants attended the sessions that covered topics from technical aspects of satellite meteorology to communicating forecasts.

In the technical sessions on data gathering, basic visualization and product generation the cloud processing (named "Python on the cloud" during the workshop) was introduced as an alternative to those with bandwidth or hardware limitations.

The platform **colab.research.google.com** was used in this case but several others are available online. It is as simple as going into a website and starting to program with a learning curve that is not hard with appropriate guidance.

Download speed simple test using the same command

Household Internet Connection

50 Mbps download / 5 Mbps upload

OR_ABI-L2-CMIPF-M6C02_G16_s2019198120
100%[==================>] 332,58M
1.33MB/s in 4m 51s

Colab.Research.Google.com site

OR_ABI-L2-CMIPF-M6C02_G16_s2019198120
100%[==================>] 332.58M
36.7MB/s in 9.1s

It takes 3.1% of the time to download a 332.58 MB file on the cloud compared to a bandwidth of 50/5 Mbps (above average for the students that took the course).

Follow this link to look into a simple example used in the workshop:

https://github.com/mgarbanzo/UCR_NOAA_2020/blob/main/SatelitesNOAA2020.ipynb

Hint: You can modify and save this example by clicking the icon (

) in that website. A google account is needed to use colab.research.

Results and Conclusions

1. University students can successfully use Python on the cloud for Satellite Meteorology at the undergraduate level. It was implemented successfully during synchronous classes, assignments, and research projects with similar results to those obtained in the University's Computer Laboratories.

2. An international workshop can benefit from cloud services like colab.research to provide high speed internet connection (between data storage and processing units) and large processing power to a wide range of countries while minimizing the bandwidth required per user and obtaining products independently of the utilized hardware on the participant's end.