NOAA ROSES Semi-Annual Report

Reporting Period: March 2021 – August 2021 (2nd report)

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Project Title: Development of a Next-Generation Science-Quality Geostationary Satellite Active Fire Product

Executive Summary

Our focus during this second reporting period was on 1) conducting more-extensive machine learning experiments and 2) surveying and reviewing the research-grade and operational FDC production software recently made available to our team.

Progress toward FY20 Milestones and Relevant Findings

Software and Algorithm Refinement

We obtained from collaborator C. Schmidt the most recent versions of the “master”, research-grade FDC algorithm software (Fortran), which is executed as a module within Geocat, and the corresponding ATT operational implementation (C++). Having conducted a thorough survey and review of the source code, we began developing a software “wrapper” that will permit us to run and test the Geocart-based Fortran implementation outside the full Geocart environment.

Data Quality Assessment + GOFC/GOLD Networking Activities

We performed an intercomparison using data from other operational GOES-16/ABI fire products being generated by the European Space Agency (ESA) and the Brazilian Institute for Space Research (INPE). This activity was facilitated through networking activities with members of the Global Observation of Forest Cover and Land-Use Dynamics (GOFC/GOLD). We used the two previously generated 24 h training data samples coinciding with Winter (1 January) and Summer (14 July) seasons in 2020 as reference information to estimate omission and commission error rates for all three products. Overall FDC error rates (Figure 1) were comparable to the ESA and INPE products. The low confidence fire detection pixels produced by FDC were found to substantially increase commission errors, while contributing little to reduce omission errors.

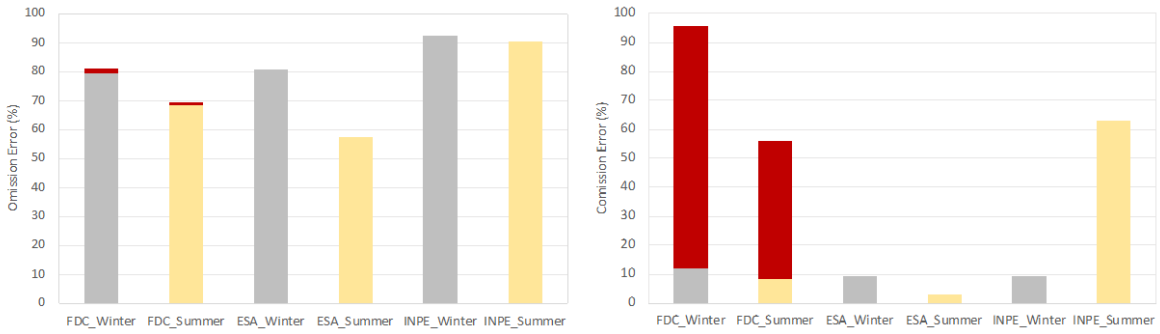

Figure 1: Omission and commission error rates calculated for winter (1 January) and summer (14 July) 2020 using NOAA's GOES-16 FDC operational fire product and those being generated by the European Space Agency (ESA) and the Brazilian Institute for Space Research (INPE). Fraction of FDC data highlighted in red indicated increase (decrease) in omission (commission) errors by after removal (addition) of low confidence fire pixel classes. Reference data was derived from visual interpretation of GOES-16/ABI imagery.

Machine Learning Analysis

Labelled training data (Figure 2) were used to train a multi-layer perceptron (MLP) model using top-of-atmosphere reflectance and brightness temperatures as features. These features were extracted on a per-pixel basis for both the current and previous frame (-10 mins) to account for the temporal dimension. Non-fire labels were randomly sampled from non-fire regions: for each frame 2000 non-fire pixels were sampled (90% over land and 10% over water). Training was done on January data and independent testing was performed on July data. While the performance of the model was high on testing data (fire producer's accuracy ~94%, user's accuracy ~90%), the mapping of fires for the whole disk revealed areas of fire over-detection, related to areas where training data were not sampled. Therefore, next steps will be undertaken to improve sampling of non-fire pixels. Additional features related to solar zenith angle will be added as well.

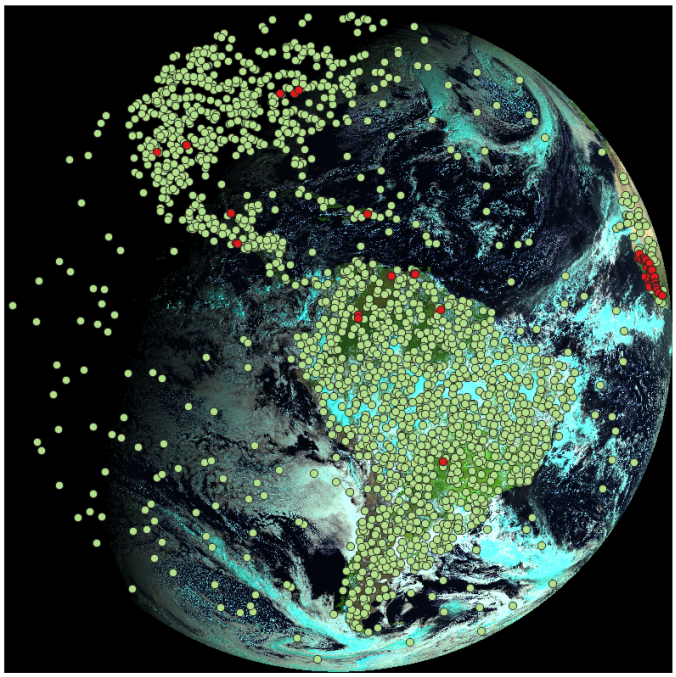

Figure 2: Distribution of training samples from the GOES-16 ABI full-disk frame acquired on 1 January 2020 at 13:10. Red dots represent fires, while green dots represent non-fire samples.

Plans for Next Reporting Period

1. Make targeted additions to our training data set to support the machine-learning component of the project.
2. Complete implementation of a software “wrapper” environment in which we can run and test the Geocart-based FDC software module outside the full Geocart environment.
3. Incorporate general code improvements and targeted algorithm refinements into the research-grade FDC software.
4. Finalize the first planned revision of the FDC project in collaboration with existing NOAA/NESDIS efforts toward this goal.
5. Commence GOFC regional coordination as part of the first post-covid GOFC Fire Implementation Team meeting (now deferred to spring 2022).