UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION
SERVICE CENTER FOR SATELLITE APPLICATIONS AND RESEARCH
College Park, MD 20740

April 25, 2022

MEMORANDUM FOR: Vanessa Griffin - NESDIS/OSAAP Director
Mitch Goldberg, NESDIS Senior Scientist
Ajay Mehta, NESDIS/OSGS Director
Kathryn Shontz, NESDIS/OSGS Deputy Director
Mark Paese, NESDIS/STAR (Acting) Director
Ian J. Zelo, NESDIS/STAR (Acting) Deputy Director

FROM: Sid Boukabara, SAT chair, NESDIS, OSAAP BOUKABARA.SID.AHMED.1369422622 Digitally signed by BOUKABARA.SID.AHMED.1369422622 Date: 2022.04.25 15:37:14 -04'00'

Frank Gallagher, SAT co-chair, NESDIS, OSAAP GALLAGHER.FRANK.WOOLSEY.1264444663 Digitally signed by GALLAGHER.FRANK.WOOLSEY.1264444663 Date: 2022.04.26 10:40:21 -04'00'

SUBJECT: Recommendations Regarding the Planning of Future Satellite Data Ground Processing - *Complementary Alternatives to Enhance Open Science and Processing Resilience*

Scope: This memo provides background information and recommendations on aspects related to potential options that NESDIS should consider for the next-generation ground architecture planning and implementation. This option might be of particular interest to the handling of the SNPP data when this sensor becomes tertiary after the launch and commissioning of the JPSS-2 satellite.

Important note: *This memo was developed based on the deliberations and discussions among the core-SAT (federal employees only), following fact-finding and discussions of results and scientific facts with the general SAT.*

Executive Summary:

The core-SAT looked at many aspects and features of the Community Satellite Processing Package (CSPP) presented during the SAT discussion, and based on the core-SAT discussion, linking this to the overall objective of supporting the advanced planning of the NESDIS ground processing, here are the highlights of the main findings and recommendations that resulted from that discussion:

- *Fact:* The CSPP software package is a well-established and world-recognized distributed system to process satellite data (all levels) from NOAA and non-NOAA space assets. It could be used to process data retroactively, but, if combined with an ingest system to acquire data real time, it may become a powerful way to process data with very low latency. The recommendations below refer not necessarily to the CSPP

system itself, but to the distributed processing model of a CSPP-like implementation (*referred to as CSPP-style.*)

- We recommend NESDIS include a CSPP-style processing system in its planning of the next-generation ground architecture. Such a system could serve at a minimum (1) as an alternative processing system for users to process data, (2) provides an overall increase in the resilience of the ground architecture (as opposed to highly centralized processing of all data), (3) allows the combination and leveraging of Government owned algorithms to co-exist with open science from academia, other agencies, and the private sector, therefore helping both users with testing new data and products. It could also provide NESDIS an alternate pathway for research-to-operations transitions.

- We recommend that this CSPP-style model/approach be considered in the context of the NCCF and the NESDIS move to a cloud-based architecture. Since users will likely have to pay to egress data, it might be beneficial to offer them a cloud-based CSPP-style package to select, process, and tailor the data users need instead of downloading data from the cloud and processing it on a local platform. We understand this approach is already planned for the NCCF, but might not be available until five years from now. The CSPP-style package could potentially fill the gap.

- We recommend expanding the CSPP-style processing to include all LEO, GEO, SWO, and partner data.

Background:

There are multiple flavors to satellite data processing and dissemination currently implemented, or being investigated, by NESDIS. The most important one is the operational processing performed in OSPO using a ground architecture that is highly reliable and has high levels of mission assurance. The large majority of the disseminated data is generally obtained by a small set of operational users. There are, however, resources and hardware constraints on this infrastructure that limit its ability to process multiple satellites simultaneously. In addition, NESDIS is moving to a flexible cloud-based infrastructure (the NESDIS Common Cloud Framework - NCCF) with OSGS and OSPO working on the development of, and transition to, this framework in the next few years. This cloud-based implementation presents open questions regarding its availability to satisfactorily process new satellite data. There are also concerns that users who are not necessarily ready (or able/resourced) to access data from the cloud may become disenfranchised. The SAT team has had a thorough discussion on an alternative option to allow the processing of satellite data. This discussion was centered around the Community Satellite Processing Package (CSPP) that the University of Wisconsin has developed with NOAA funding. The core-SAT determined that this option is viable, cost-effective, and should be considered as a complementary option for inclusion in the NESDIS future ground processing planning. In addition, it presents a few noticeable advantages over the current processing techniques, one of which is an increase in our ground processing system resilience. Also, the ease by which one could leverage open science, citizen and IoT data, and other community investments would be enhanced by the addition of a CSPP-like data processing package

Information about the CSPP: Historically, NOAA has developed a number of data sharing and processing packages that have often been tied to specific missions or programs. The CSPP incorporates NOAA's goal of sharing meteorological satellite data processing software and would further complement the future NESDIS Ground Enterprise. The CSPP is a community effort with contributions from NOAA, NASA, international meteorological agencies, and academia.

Facts, Results and Findings:

The SAT discussion centered around the CSPP as developed at the University of Wisconsin, but it was clear that the idea behind CSPP is what may be more interesting to a future NESDIS ground system: a flexible, distributed, *open-source and open-access community* ground processing system. CSPP is an efficient and flexible software package that is freely distributed and includes validated science algorithms from NOAA. It also accommodates open science algorithms and has the ability to feed the processed data into a Global Telecommunications System (GTS)-based distribution system at low latency.

- The CSPP is a set of algorithms to process NOAA and NASA satellite data (RDR, SDR, EDR, etc.) into user-ready products. These products incorporate a wide variety of geophysical domains, including atmosphere, cloud, ocean, and cryosphere. The CSPP has the flexibility to not only process operational NOAA data using algorithms developed by NOAA subject matter experts, but also to include tailored algorithms. There are approximately 2900 current users of CSPP located in over 100 countries.
- Users can receive data from NOAA or directly from the satellite and use CSPP to process real-time or historical data using their own algorithms integrated into CSPP. CSPP is available for current NOAA LEO and for GEO satellites and includes the capability to process some data from space weather sensors as well. Users currently process most of the JPSS and GOES-R sensor data in CSPP, with the exception of OMPS, which will be included once upgrades are completed. The CSPP package also contains tools to visualize and analyze the data.
- The CSPP software packages are publicly available and free of charge. They are self-contained and complete with no need for compilation or third party software. They are easy to install and run, as the package includes clear documentation and easy to use tools for visualization and assessment. Test datasets are also provided to aid the user in setting up the system.
- The CSPP GEO software is used at half of all GOES Rebroadcast (GRB) receiving stations around the world. Users include those from NOAA, NASA, international meteorological agencies, receiving station vendors, weather service providers, and university and research communities. The University of Wisconsin provides 8x5 support for CSPP under contract to the NWS at sites receiving GRB and HimawariCast data.
- CSPP software allows users to run NOAA-developed software using NOAA data. Direct broadcast (DB) readout stations allow for real-time acquisition of data, and the use of CSPP at these stations helps to improve data collection and processing latency. The data from some of the users is then provided globally through the GTS system with latency on the order of 20 minutes. CSPP allows for the introduction of new algorithms and data sets to more rapidly address user needs. For example, flood mapping products were first tested using CSPP before being transitioned to an operational environment.
- New CSPP releases are announced to users through email and the website describes new features and provides updated documentation. Comprehensive tests of CSPP are completed to compare and validate against official data sources before any new packages are released. Data is also verified and its quality validated by external reputable centers such as UKMET and EUMETSAT (NWP-SAF).
- The CSPP-style concept is being employed by other entities, including the private sector, and is complemented by other capabilities. As long as users have the data from any source, they can employ the CSPP package to process their data of interest. Users can also port the CSPP framework to cloud-based services such as Google and Amazon.

- A CSPP-style system could offer a formal complement/alternative to NOAA processing in the case of legacy satellites processing.

- A CSPP-style package could be an excellent approach to serve as a testbed to new applications, new products, and new services. Users can be provided access to the system in order to experiment with new data sets. NOAA should reiterate (if and when appropriate) the value of open source. A CSPP-style approach is an excellent way to act on that.

- The CSPP-style approach is likely to be appropriate for some users, but not all. It is recommended that NESDIS adopts a policy (similar to the IDSS policy) of those who are the "deep core" users of NESDIS data, the core-users, the external users, and, perhaps, international users, as a way to cleary identify what users could benefit from the CSPP-like approach. Indeed, the SPP-style approach is likely not appropriate for those users who do not have access to enough computing capability fr example.

Recommendations:

- NESDIS should incorporate a CSPP-style processing system in its planning of the future ground architecture. It serves at a minimum (1) as a backup processing system, (2) provides an overall increase in the resilience of the ground architecture (as opposed to highly centralized processing), (3) allows for the combination and leveraging of Government-owned algorithms to co-exist with open science from academia, other agencies, and private sector.

- We recommend this CSPP-style model/approach should also be considered in the context of the NCCF as NESDIS moves to a cloud-based architecture. Since users will likely have to pay to egress data, it might be beneficial to offer them a CSPP-style package to process, tailor, and select the data they want to be downloaded instead of processing and downloading (egressing) all the data.

- In order to be comprehensive, and to assess the state of the *market*, it recommended that NESDIS issue a wide call to the community to assess whether there are other CSPP-style systems in existence that NESDIS could possibly incorporate into an enterprise ground system.

- We recommend expanding the CSPP-style processing to include all LEO, GEO, SWO, and select partner satellite data when appropriate.

- We recommend NESDIS should consider using a CSPP-style approach beyond DB users, for example, including NCCF users.

CC: Jim Yoe (NWS), Mitch Goldberg (NESDIS), Flavio Iturbide-Sanchez (NESDIS), Andy Heidinger (NESDIS), Walter Wolf (NESDIS, OSGS)