Methods and Tools for Algorithm Quality Maintenance in the Joint Polar Satellite System (JPSS) Common Ground System (CGS)

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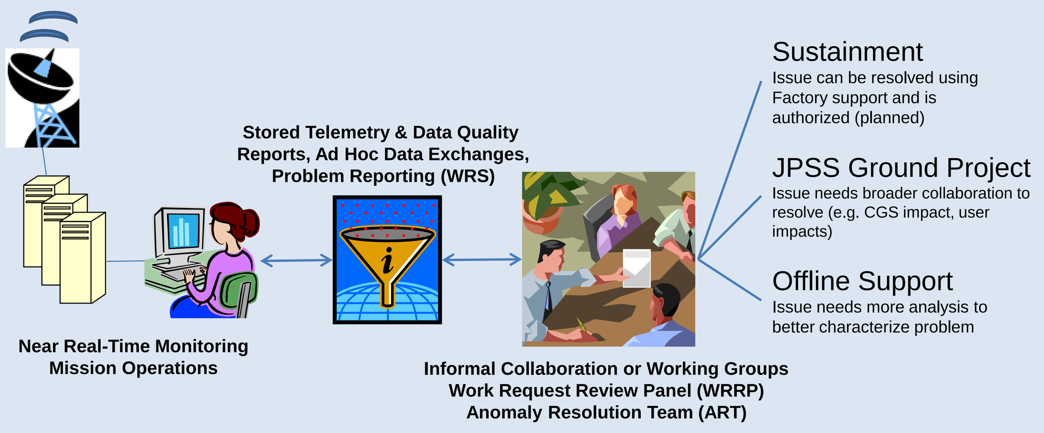
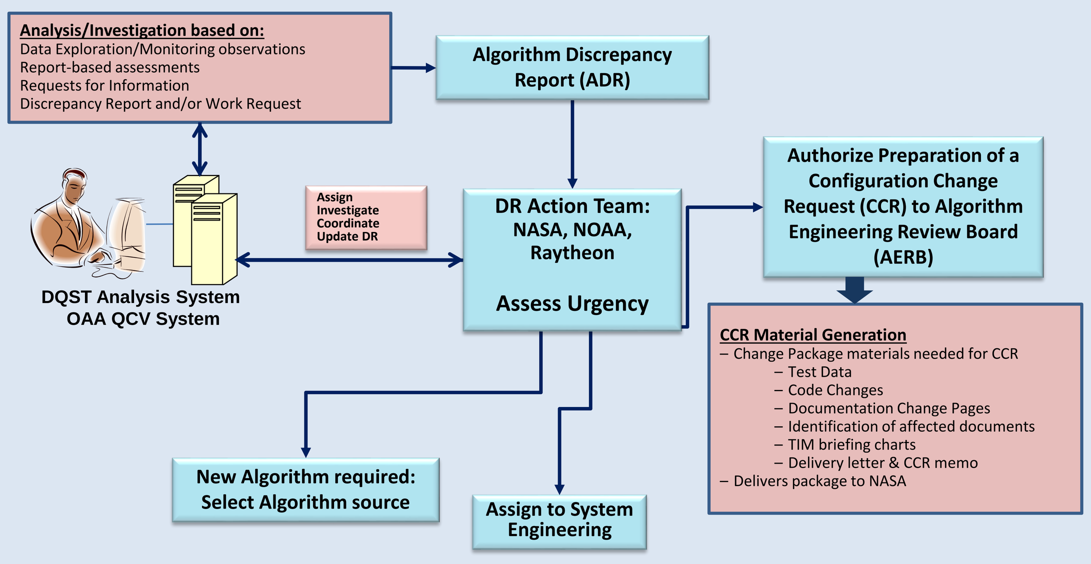
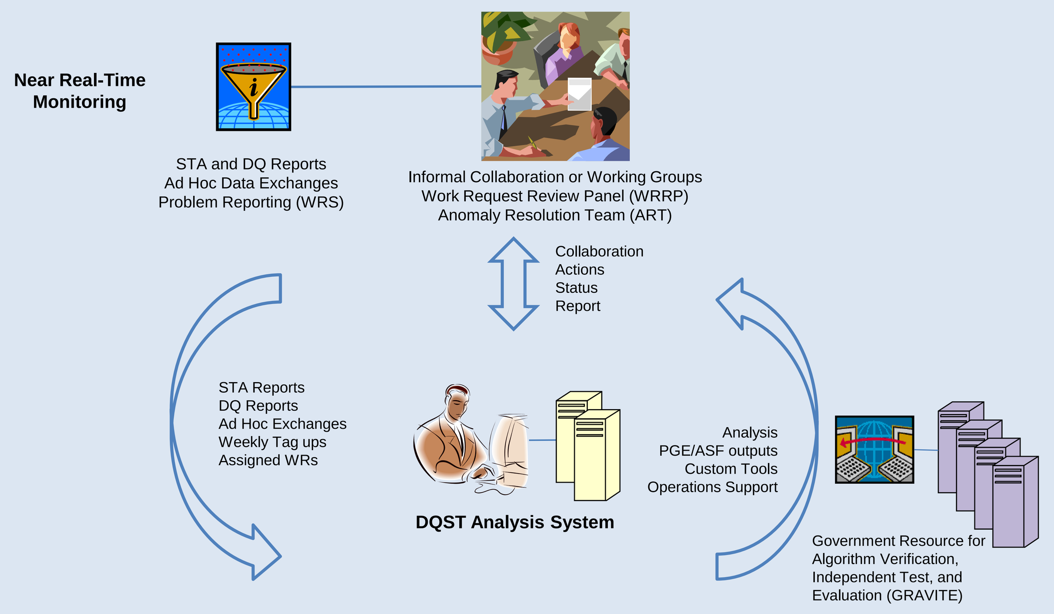
The first satellite in the JPSS constellation, known as the Suomi National Polar-orbiting Partnership (S-NPP) satellite, was launched on 28 October 2011. CGS is currently processing and delivering Sensor Data Records (SDRs) and Environmental Data Records (EDRs) for S-NPP and will continue through the lifetime of the Joint Polar Satellite System programs. The EDRs for Suomi NPP are currently undergoing an extensive Calibration and Validation (Cal/Val) campaign. As Cal/Val changes migrate into the operational system, long term monitoring activities will begin to track product quality and stability. In conjunction with NOAA's Office of Satellite and Product Operations (OSPO) and the NASA JPSS Ground Project, Raytheon is supporting this effort through the development and use of tools, techniques, and processes designed to detect changes in product quality, identify root causes, and rapidly implement changes to the operational system to bring suspect products back into specification. Figure 1 outlines the processes in place to detect and analyze quality issues, and initiate the change process. Maintaining a strong provenance to validated science is critical as the system evolves in response to both resolution of product quality issues and incorporation of new science. Establishing the provenance requires rigorous test, analyses, and comparison activities, the maintenance of controlled test data sets and expected results, and the ability to update test inputs and outputs based on evolving needs. Figure 2 illustrates a data mining tool that allows investigators find and select specific scene conditions needed for a new test data set. It uses the VIIRS Cloud Mask (VCM) Intermediate Product (IP) as a characterizing gateway to identify and extract sub-orbit granules of interest based on geophysical characteristics of interest . This greatly reduces the time spent sorting through very high volume data sets for the necessary test conditions. Figure 3 outlines the steps in maintaining the science provenance as the baseline evolves. This process includes comparing outputs, ensuring changes in outputs are the results of the new science and not unanticipated responses or errors, and the selection and verification of new test data sets.



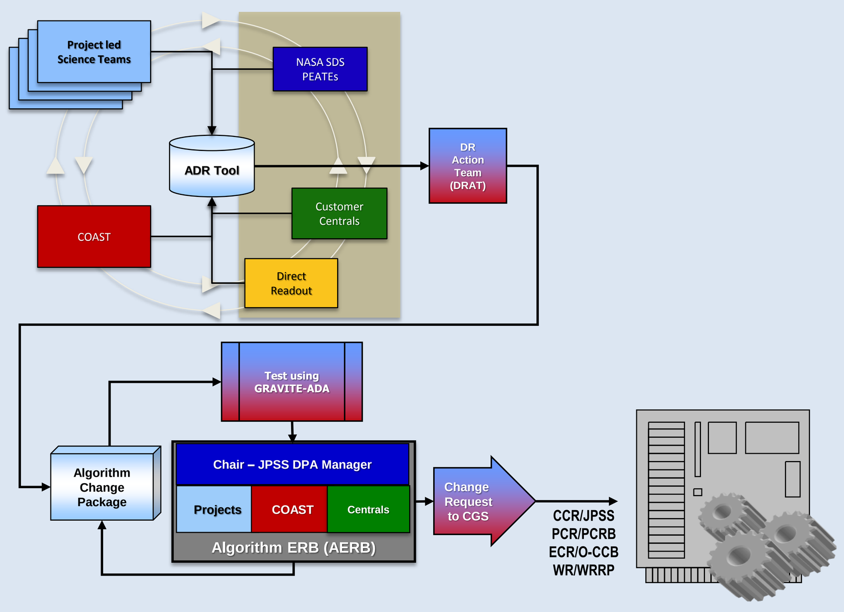
Mission Operations Support staff provide near real-time monitoring during day-to-day operations



Raytheon science data and engineering experts support Program Analysis efforts using the DQST Analysis and Operational Algorithm Assessment (OAA) Quality Characterization and Visualization (QCV) Tool Suite. Some problems require a change, and need formal review. In some cases, information gathering may be all that is needed.

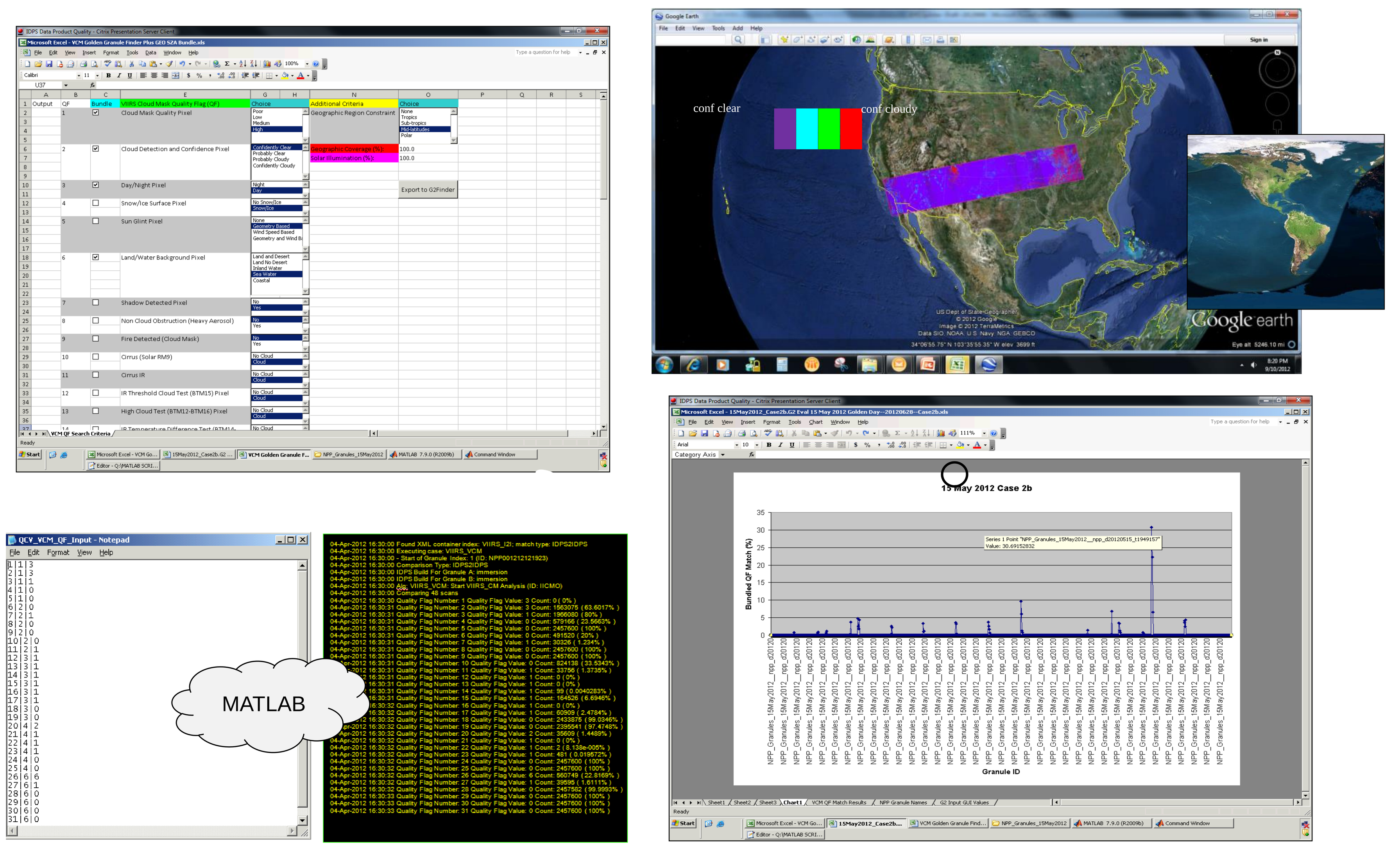


Data Quality Support Team (DQST) science data experts collect information from OPS and GRAVITE for assessments using DQST Analysis System. The DQST collaborate closely with Mission Operations and the JPSS Mission Partners.



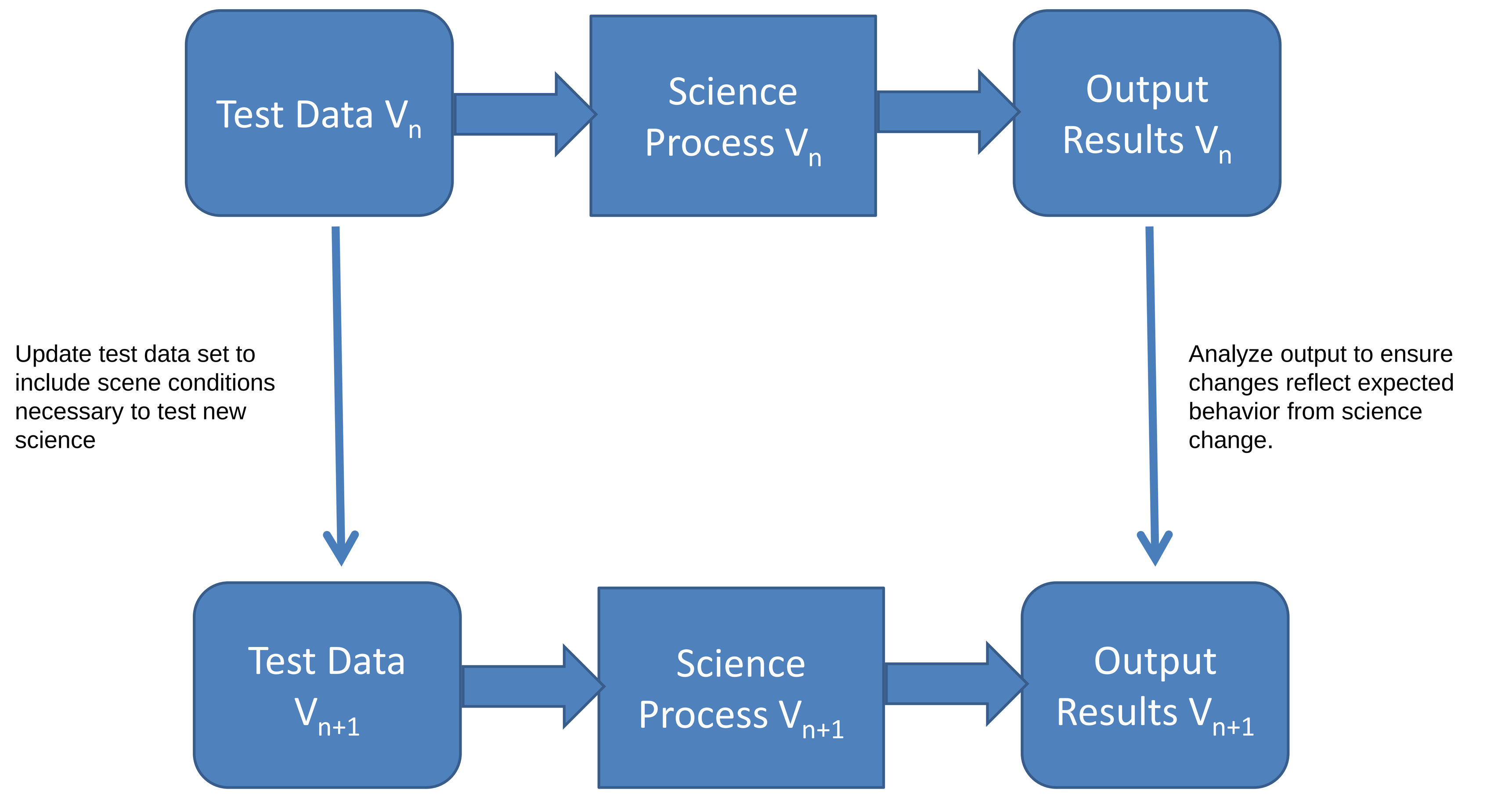
Discrepancies are reported using the Algorithm DR Tool, reviewed by the DR Action Team (DRAT). Formal changes are proposed via algorithm change packages via Configuration Change Requests (CCRs), which are reviewed at the AERB.

Figure 1 – Detecting and Analyzing Quality Issues



A tailored graphical user interface combining user-defined VIIRS Cloud Mask Quality Flag (QF) values, QF bundling logic, as well as geographic and solar/geophysical constraints enables quantitative analysis and identification of a "best match" from multiple-day, multi-orbit datasets for either cloud-or-downstream algorithm processing

Figure 2 – Targeted Data Mining



The framework consists of two data categories – benchmark and experimental– and two analysis variation categories – principle and non-principle. Experimental data advances to benchmark data iteratively as the operational algorithm baseline evolves. Here, updates to Test Data V_n to include the necessary new scene conditions provide the new experimental Test Data V_{n+1} set. Analysis of output results ensure only variations due to known external variables are present (principle variations). Non-principle variations (e.g., errors in software code, requirements, or interfaces) are identified and removed through rigorous software or systems engineering processes. Once principle variations are confirmed, the Test Data V_{n+1} set becomes the new benchmark.

Figure 3 – Analysis Framework