Evolution of the JPSS Ground Project Calibration and Validation System
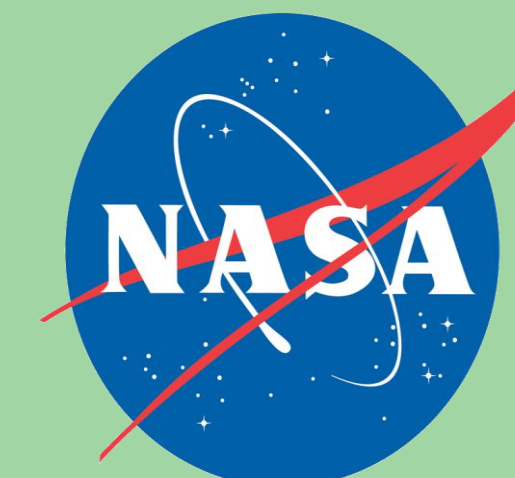
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JPSS Introduction

- The Joint Polar Satellite System (JPSS) is the NOAA's next-generation operational Earth observation Program that acquires and distributes global environmental data from multiple polar-orbiting satellites

- The JPSS Program plays a critical role to NOAA's mission to understand and predict changes in weather, climate, oceans, and coasts environments, which supports the nation's economy and protects lives and property

- The NASA is acquiring and implementing the JPSS, comprised of flight and ground systems on behalf of NOAA

- The JPSS satellites are planned to fly in afternoon orbit and will provide operational continuity of satellite-based observations and products for NOAA Polar-orbiting Operational Environmental Satellites (POES) and the Suomi National Polar-orbiting Partnership (SNPP) satellite

GRAVITE Overview

- GRAVITE stands for "Government Resource for Algorithm Verification, Independent Test, and Evaluation"

- GRAVITE is a mature NOAA system developed and deployed by JPSS Ground Project that supports SNPP mission and has been in operations since SNPP launch

- GRAVITE is:
  - ✓ NOAA system 5048
  - ✓ Assessed as "moderate" security impact as per NIST 199
  - ✓ A mission data support system; Class "C" under NASA Procedural Requirements (NPR) 7150.2A
  - ✓ Data center class hardware housed at the NOAA Satellite Operations Facility

- ✓ GRAVITE Services facilitate:
  - ✓ Algorithm Integration and Checkout
  - ✓ Algorithm and Product Operational Tuning
  - ✓ Instrument Calibration
  - ✓ Product Validation
  - ✓ Algorithm Investigation
  - ✓ Data Quality Support and Monitoring

GRAVITE Evolution

- **GRAVITE Version 1.0 (GV1.0):** Evolved from NPOESS GRAVITE; originally not intended for formal Cal/Val but "play ground" for scientists

- **GRAVITE Version 2.0 (GV2.0):** Self-directed analysis of GRAVITE capabilities, design, and performance. Initiated and led improvements in storage design, defect correction, and performance

- **GRAVITE Version 3.0 (GV3.0):** Major re-architecture that incorporated SNPP lessons learned. Addressed a number of issues related to data rights conflicts, performance issues (multiple databases, multiple file copies, redundant data storage), direct application access to database without validation, scale and maintenance, and multiple distribution mechanisms

- **GRAVITE Version 4.0 (GV4.0):** Requirement updates and minor enhancements that do not impact the overall design. Host Data Quality Assurance (DQA) Offline tool suite on GRAVITE
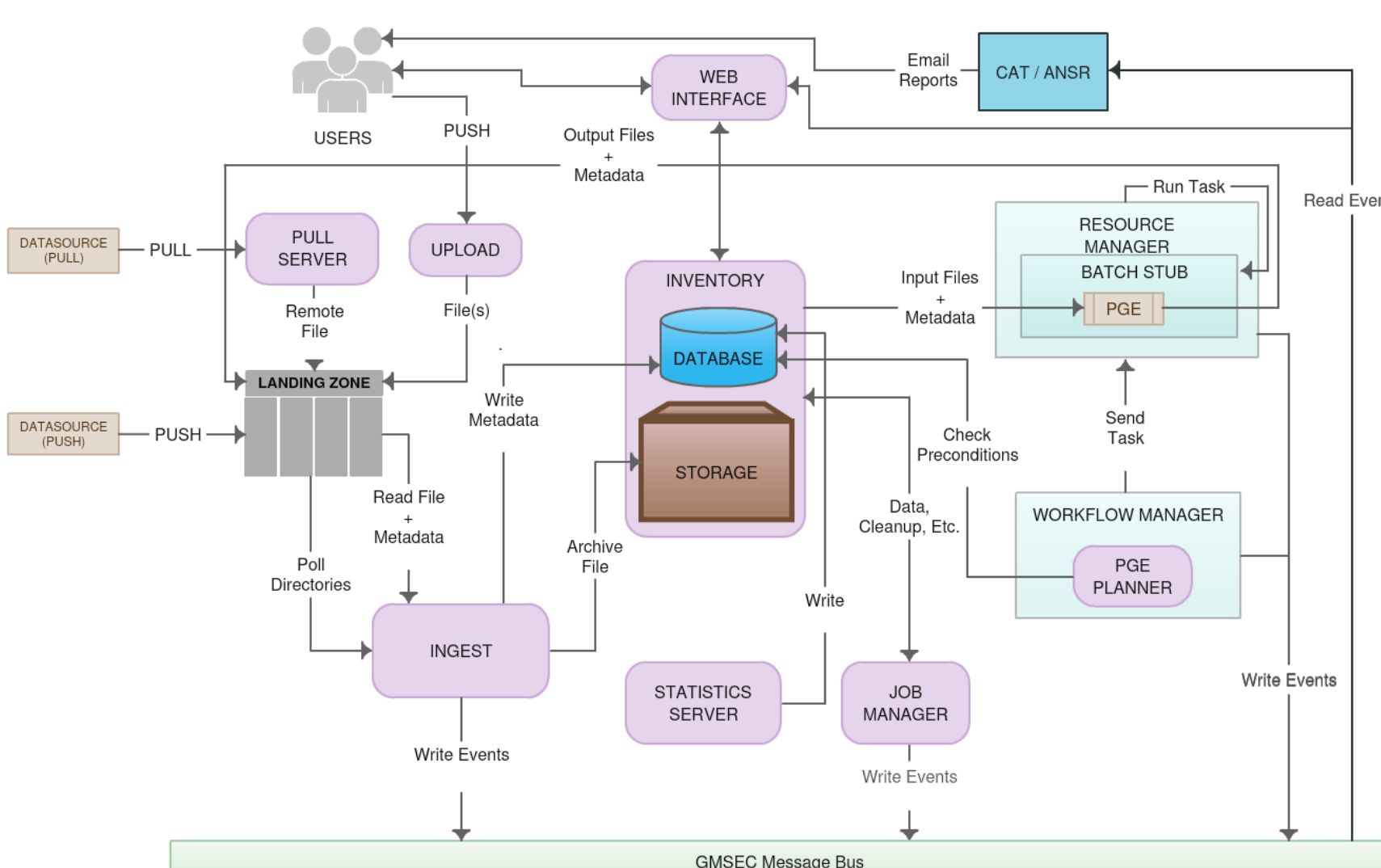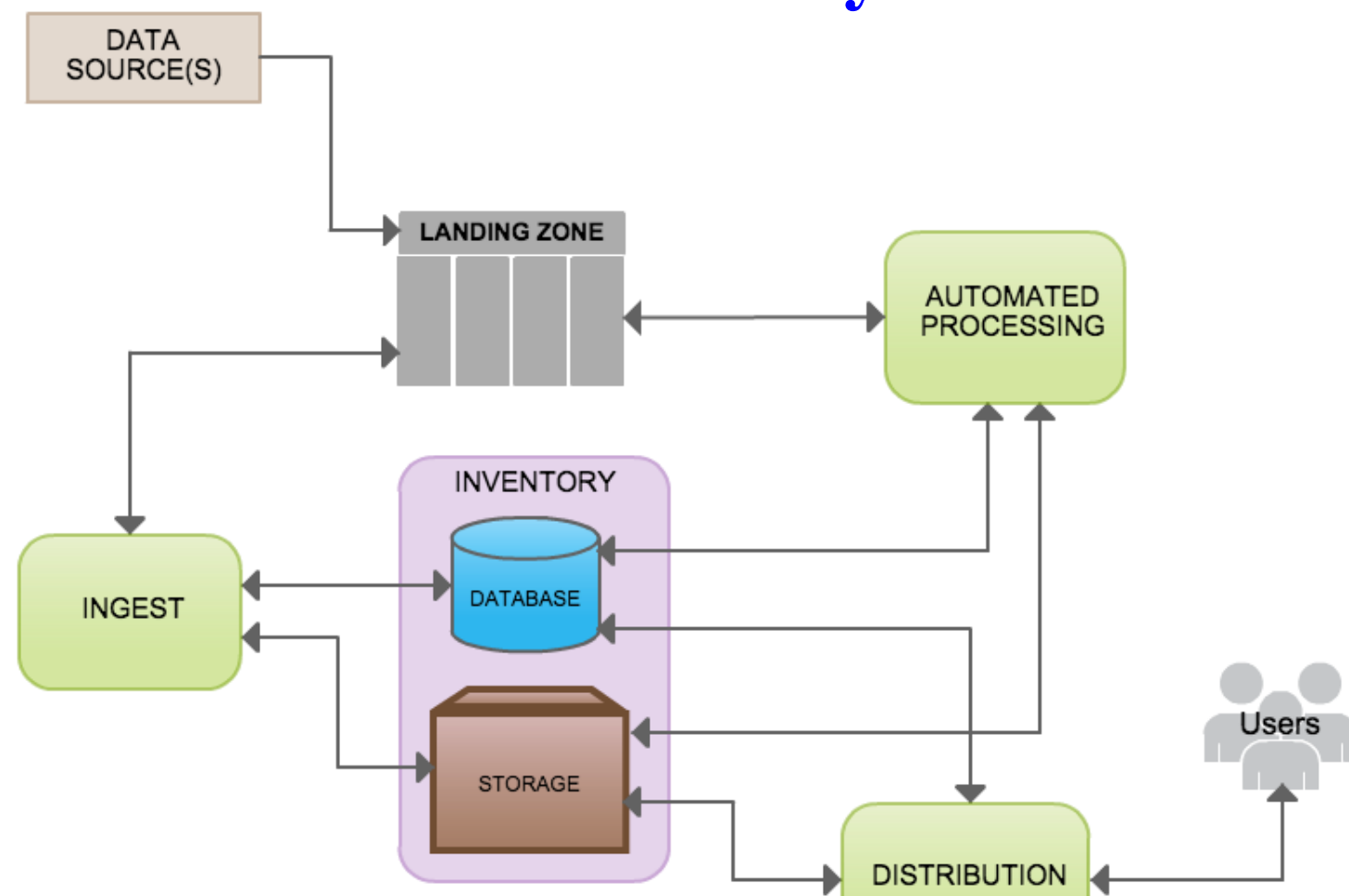
GRAVITE Subsystems

Figure 1. Investigator-led Processing System (IPS). In-house developed. Production system, operator managed. Consists of Ingest, Automated Processing, and Distribution components. Runs Product Generation Executable (PGEs) for Cal/Val and Data Quality Monitoring
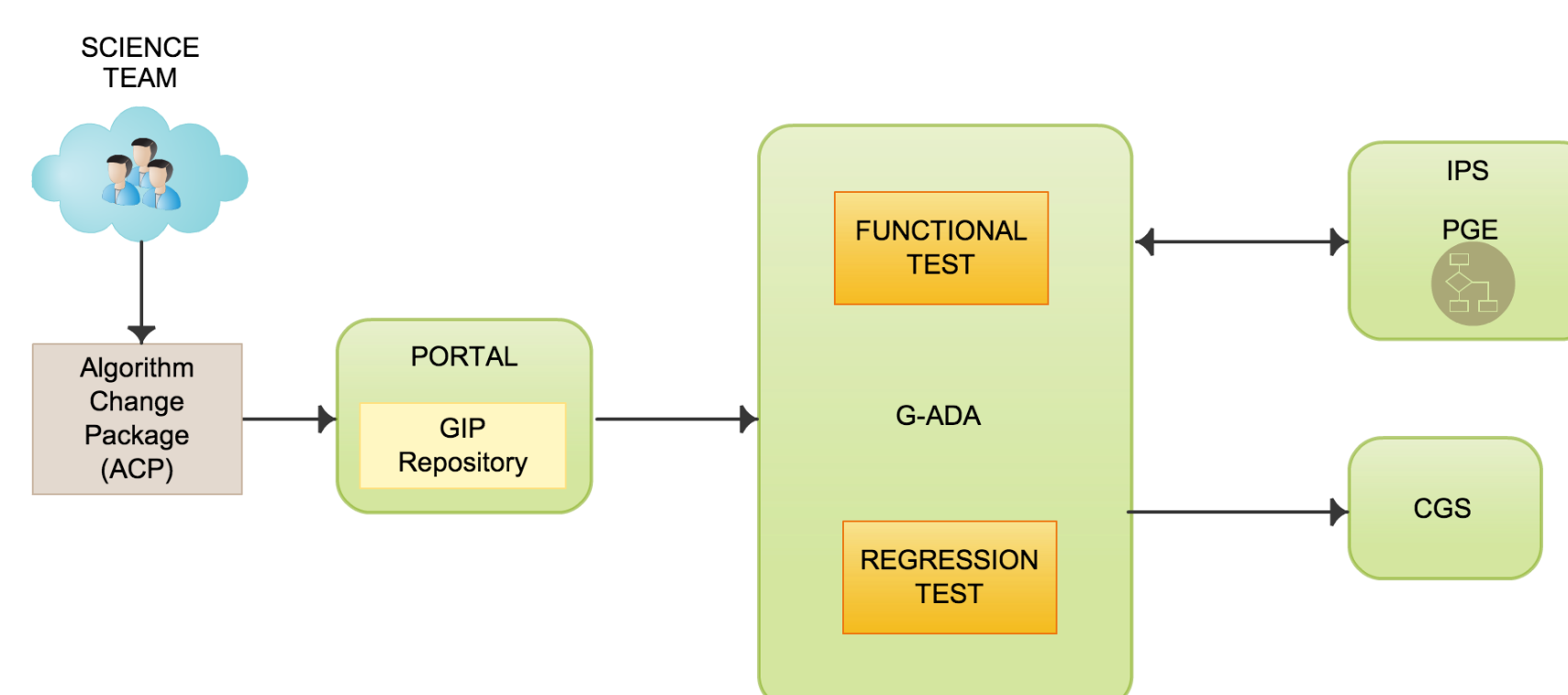

Figure 2. GRAVITE Algorithm Development Area (G-ADA). Interface Data Processing Segment (IDPS) compliant development and testing platform for JPSS algorithms and Look-Up-Tables. After verification, proposed changes are sent to Common Ground System (CGS) as Algorithm Change Packages (ACP) for integration
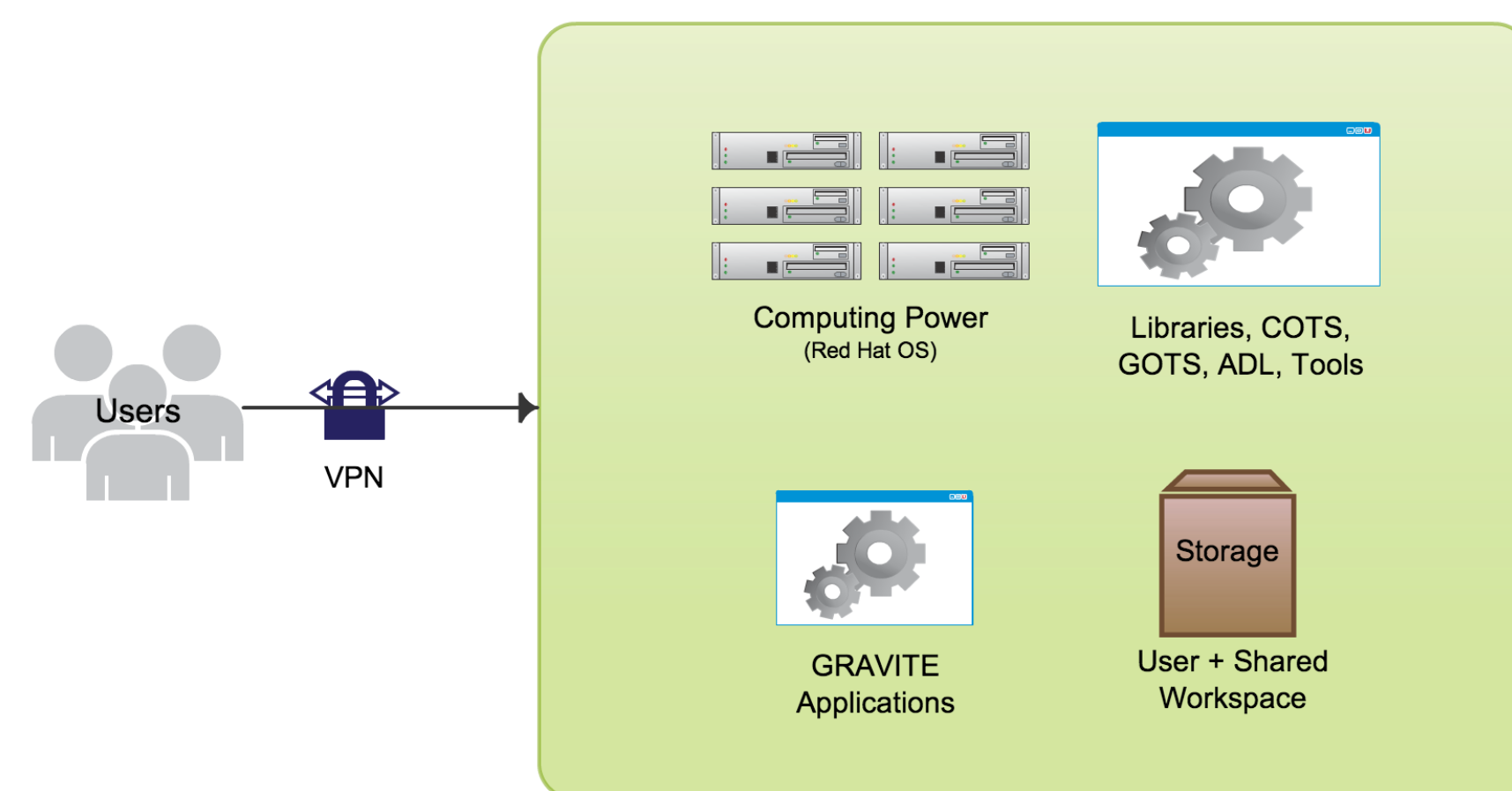

Figure 3. Investigator Computing Facility (ICF). Science tools and libraries, personal user space, access to data, computing power are provided to run CPU and memory intensive applications.
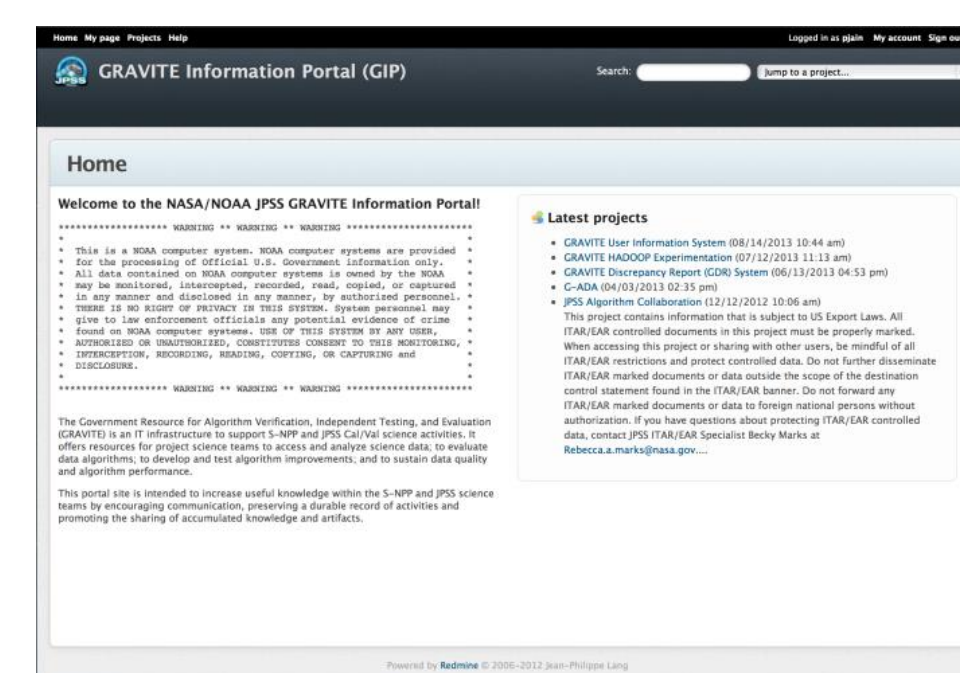

Figure 4. GRAVITE Information Portal (GIP). Coordination and knowledge sharing for GRAVITE projects through Blogs, Wikis, Action trackers, etc.
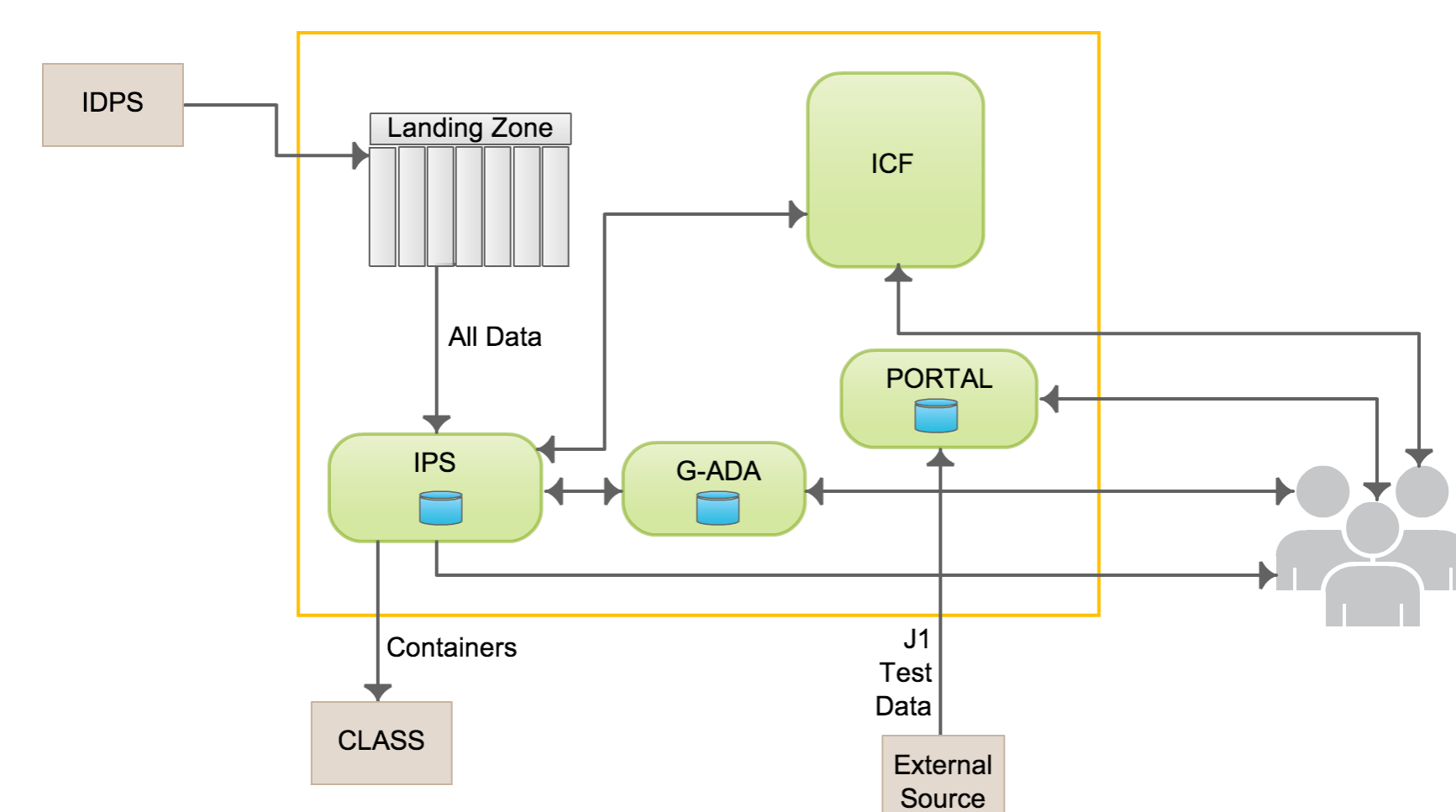
GRAVITE Functions

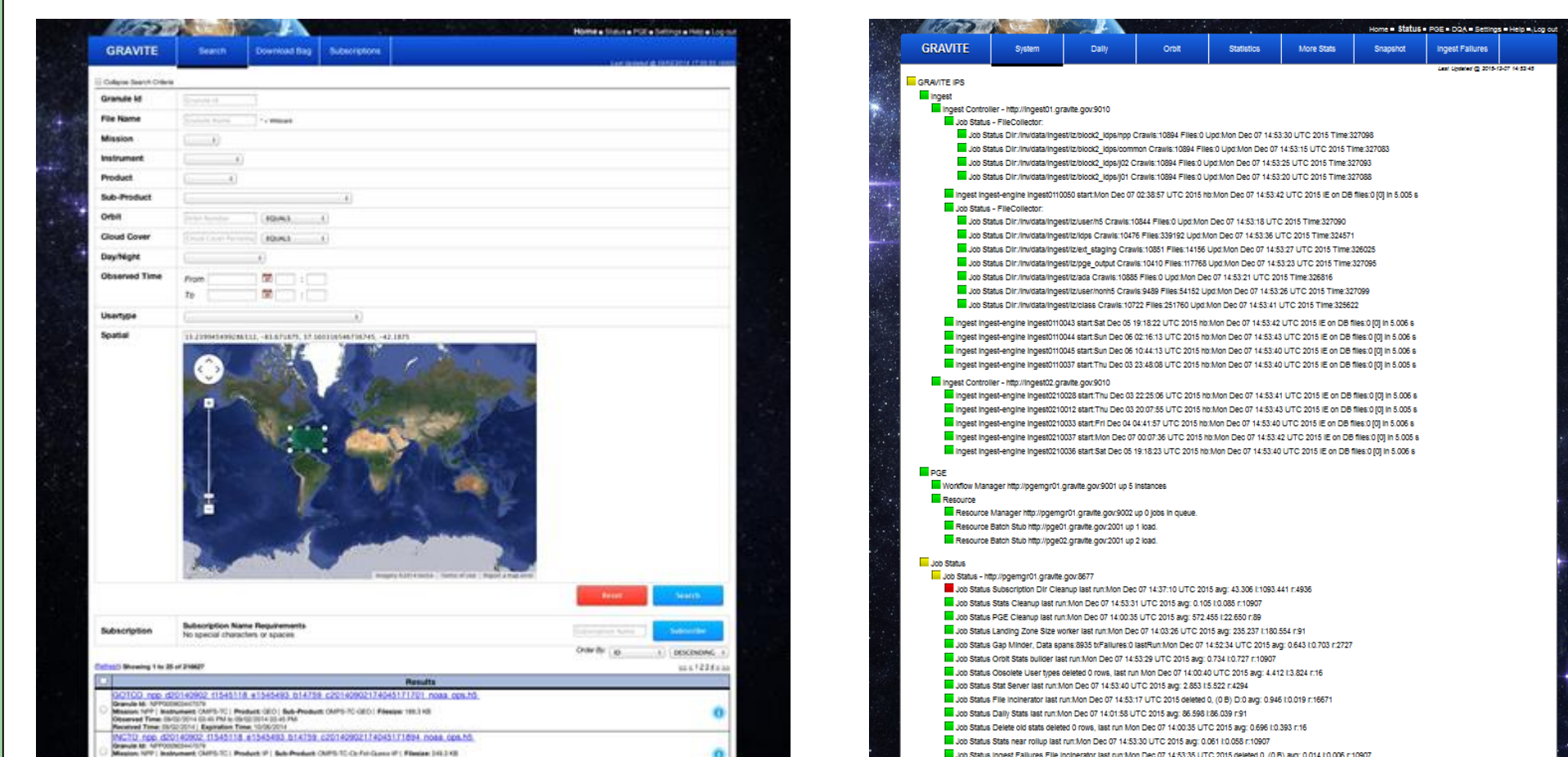
Figure 6. GRAVITE Version 4.0 (GV4.0)

Figure 7. GRAVITE Search Interface and System Status

Figure 7. GRAVITE Ingest and Orbital Statistics

GRAVITE Purpose and Unique Features

Category	Description	Unique Feature(s)
Distribution	Fast access to IDPS created data products (anticipated to be on the order of minutes in Block 2.0)	Direct interfaces to IDPS and STAR
Cal/Val tools	Automated and ad-hoc tools that cal/val users use for algorithm analysis and update	Product Generated Executables and Algorithm Support Functions
IDPS "Clone"	The G-ADA provides an instance of the IDPS available for algorithm change testing, science investigation, and data quality investigation	Installation of latest IDPS code in identical SW environment on similar hardware
Access to baselined data	Access to the latest baselined Processing Coefficient Tables (PCTs) and Look Up Tables (LUTs)	Access to ICF with the latest updated tables provided to IDPS
DQA offline	Data Quality Assurance Offline Tools	DQA offline in GRAVITE takes advantage of the performance features as well as proximity to near-real time data flows

GRAVITE Data Flow

Figure 5. GRAVITE Version 4.0 (GV4.0) Data Flow

- **Landing Zone**: Data sources either push files to the Landing Zone or Pull Server pulls remote files and place them on the Landing Zone

- **Ingest:** Looks for new files on Landing Zone; Reads file metadata; writes metadata related entries to the database ; Archives files in GPFS storage

- **Workflow Manager:** Sends PGE information to the Planner. Planner checks to see if all pre-conditions are met for running a PGE. If conditions are met, Workflow Manager sends a task to Resource Manager

- **Resource Manager:** Executes task on available machine. Outputs are sent to the Landing Zone for ingest

- **Job Manager:** Executes repetitive task on available machine

- **Goddard Mission Services Evolution Center (GMSEC):** Events are written to and read from Message Bus

- **GRAVITE Inventory:** Includes Database and GPFS storage

Summary

- GRAVITE is currently in operations and has been successfully supporting SNPP since its launch in Oct 2011
  - ✓ Exceeds GV3.0 ingest requirements of 5TB/day. Observed ingest rates up to 16TB/day
  - ✓ Largest implementation of Apache OODT

- GRAVITE has evolved as a system with increased performance:
  - ✓ Robust, stable, reliable, maintainable, scalable, and secure
  - ✓ Supports development, test, and production strings
  - ✓ Replaces proprietary and custom software
  - ✓ Uses open source software
  - ✓ Compliant with NASA and NOAA standards

- GV4.0 adds enhancements to GV3.0 to support JPSS
  - ✓ Minor architecture updates are anticipated as a result of these requirements changes/additions
  - ✓ Necessary interfaces and documents are baselined
  - ✓ GRAVITE is on schedule to support JPSS Lanuch