CI/CD approach at EUMETSAT

Transforming Scientific Algorithms into Products that may save your life

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Agenda

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2. Our CI/CD Pipeline Blueprint
3. Case studies and Metrics in EUM
4. Security, Monitoring & Governance
5. Future Roadmap and Next steps

Why CI/CD in Satellite Operations?

The Challenge: *Slow and Manual Release Cycles for stability of service*

- High-risk environment – Near Real-Time (NRT) data must remain always operational
- Validation challenges – Testing and compliance can take weeks
- Security restrictions – Separation of Dev, Validation, and Operational systems
- Growing complexity – More satellites & missions require scalable solutions

EUMETSAT CI/CD Blueprint

- **Version Control & Pipeline Orchestration:** GitLab CI handles commits and runs pipelines.
- **Build & Deployment Automation:** Jenkins & Ansible automate builds, tests, and deployments.
- **Containerization & Scaling:** Docker packages services; Kubernetes scales them.
- **Artifact Repository:** Nexus/Artifactory stores versioned data products.
- **Quality & Security Gates**: SonarQube static analysis and ECSS checks enforce standards

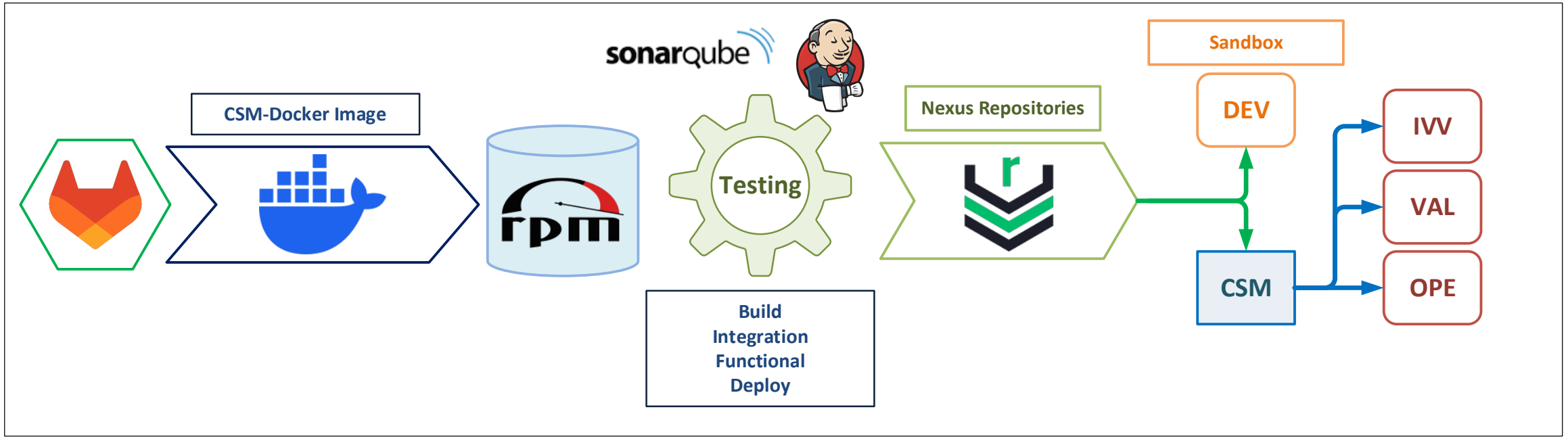
CI/CD at EUMETSAT

Continuous **I**ntegration : With our many tools on several levels we use CI/CD tools like GitLab to integrate with each release or commit.

CI & CD

Continuous **D**elivery : Delivering from external and internal sources we use building tools to deliver the packaged and tested software to the librarians.

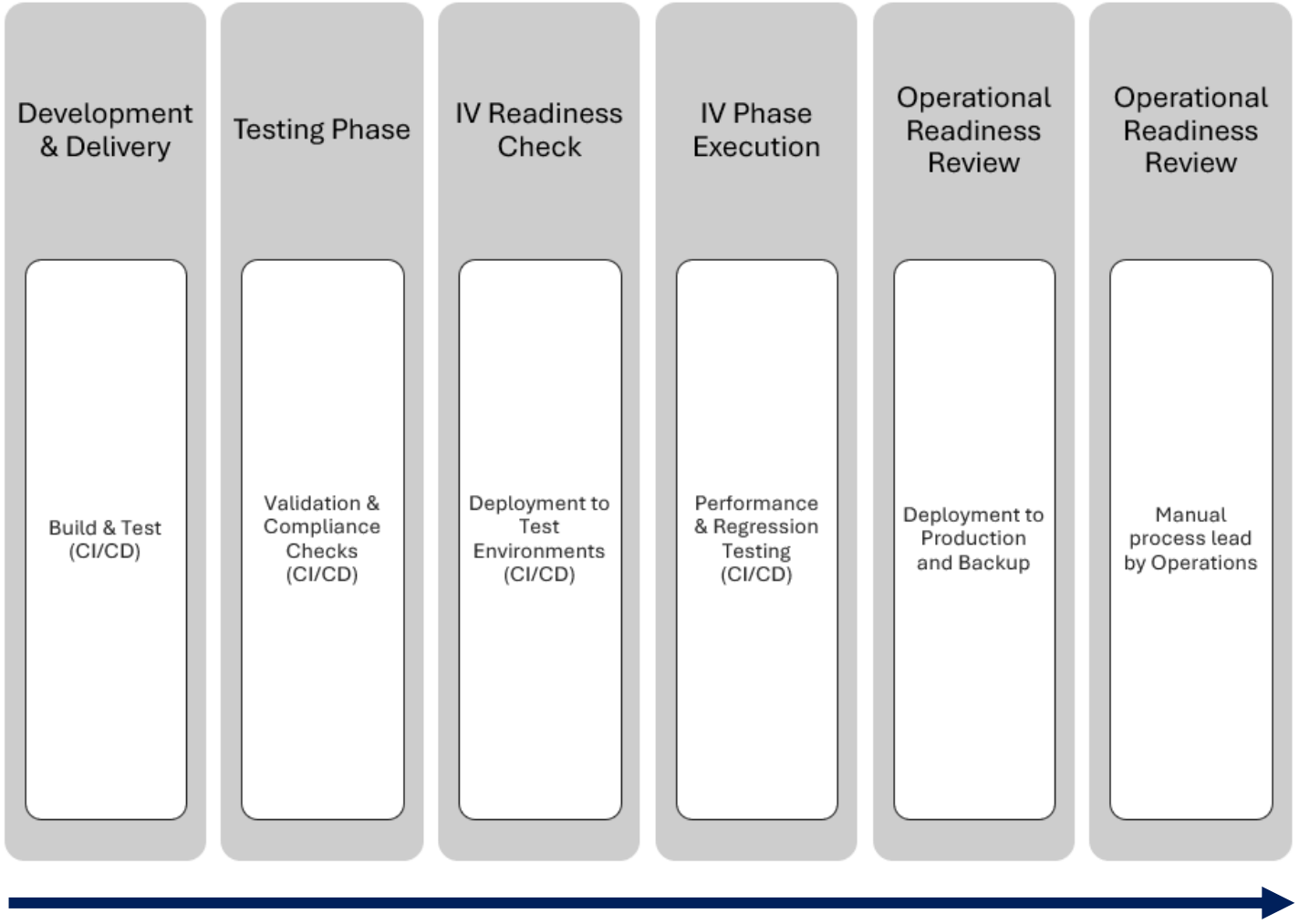
CI/CD Framework at EUMETSAT



The Journey to Operational Readiness

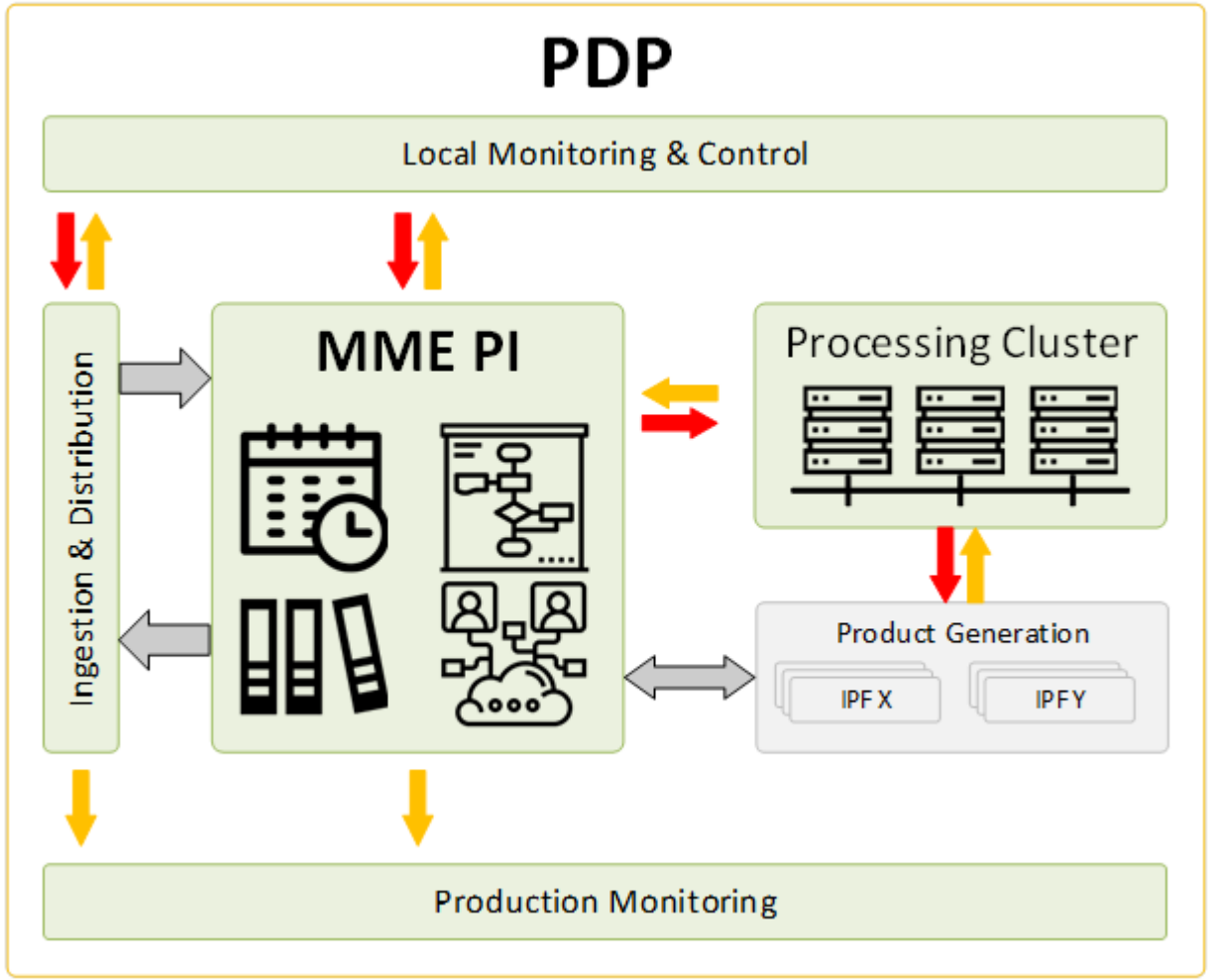
- DEV (Test Readiness Review): Automated testing, unit and static code analysis
- IVV (Test Review Board): Integration tests, security vulnerability scans
- VAL (Product Validation Review Board): ECSS-compliant validation tests
- OPE (Operational Readiness Review): Rollback if needed
- Traceability: All pipeline events are logged to the Product Information Management system

The Journey to Operational Readiness



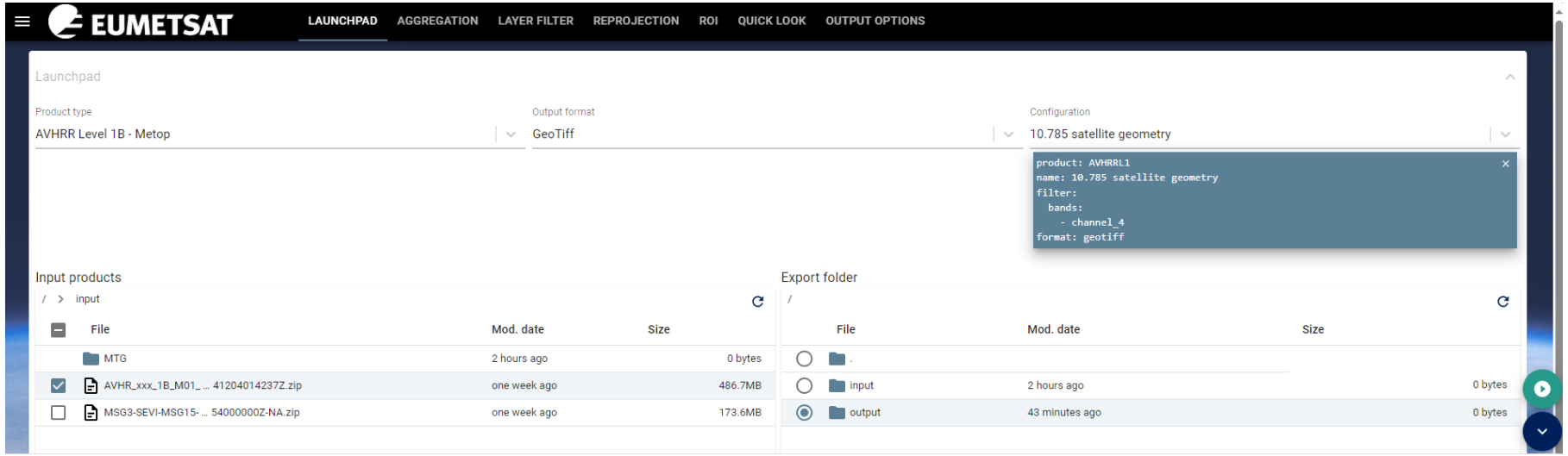
Case Study — Core Payload Data Processing (PDP)

- Modular and mission-agnostic modules convert raw telemetry to Level 1–3 products
- Automated build and test pipelines reduce Integration lead time by 50%.
- Automated monitoring validates data accuracy at each pipeline stage



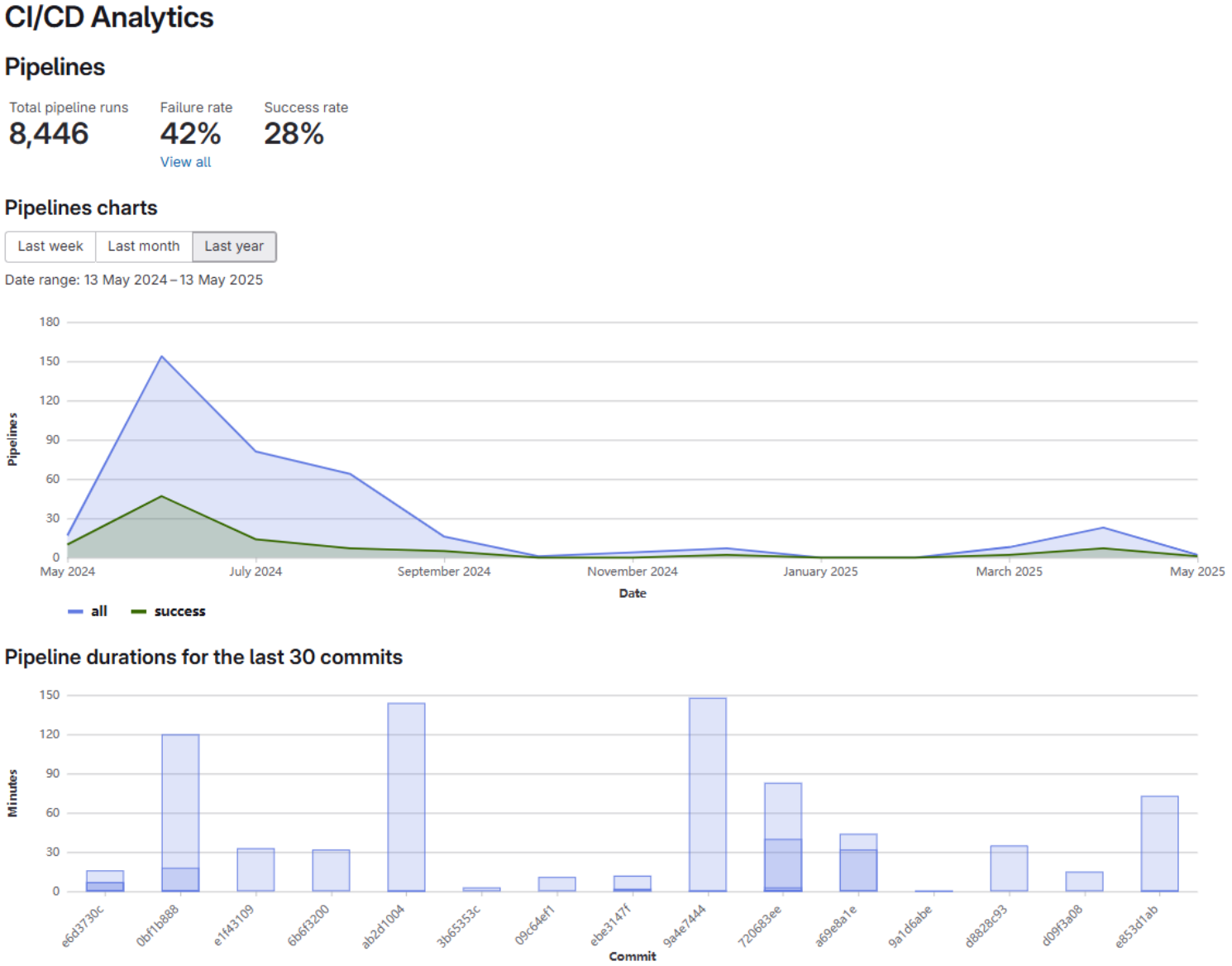
Case Study 2 – Data Tailor

- Over 1,000 automated tests across multiple OS platforms
- Automated validation prevents inconsistencies
- Seamless DEV→PROD deployment pipeline
- Enhancing user experience with zero user-facing errors



Case Study 2 – Data Tailor

- CI/CD and over 1000 automated test cases have helped to reduce operational downtime for new releases to a few minutes and avoided regressions up to 85%.



Case Study 3 – Compact VIIRS (CVIIRS) Data Validation

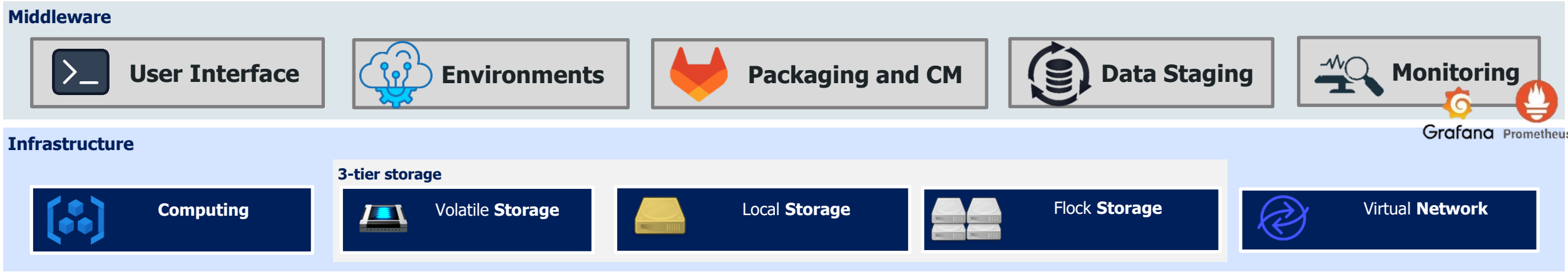
- Automated scientific validation: no data degradation
- Validation plots comparing compressed vs. original data
- Self-detecting anomalies in radiance, reflectance, & brightness temperature

Anomaly detection catches 99.9% of deviations

Human-in-the-loop only for true outliers

Case Study 4 – Multi-Mission Elements Reprocessing (MME REP)

- Automated data reprocessing pipelines using Kubernetes, with no manual steps
- Regression testing aligned with ECSS standards ensures compliance
- Multi-mission consistency and traceable audit logs across long-term datasets



Future of CI/CD at EUMETSAT

- AI-driven anomaly detection & failure prediction
- Common use of CI/CD in container updates
- Full Infrastructure-as-Code (hybrid deployment models) for ground & cloud based environments.
- Automated EUMETSAT and ECSS compliance reporting

Key Takeaways

✓ **Faster deployment cycles** – No long validation bottlenecks

✓ **Less errors & regressions** – Automated tests catch issues early

✓ **Built-in security & quality gates** – Less time to operations

✓ **Scalability for multiple missions** – Standardized pipelines

✓ **AI & cloud integration** – The next evolution in automation

Conclusion & Next Steps

- **Conclusion:** CI/CD adoption is pivotal for future satellite operations
- **Strategic Focus:** EUMETSAT invests in automation and potential AI-driven validation
- **Next Steps:** Roll out CI/CD best practices across additional missions
- **Current discussions:** Where else can automation enhance space data processing IVV?

Thank you!

Questions are welcome.