CSPP GEO and LEO at the National Laboratory for Earth Observation (LANOT)

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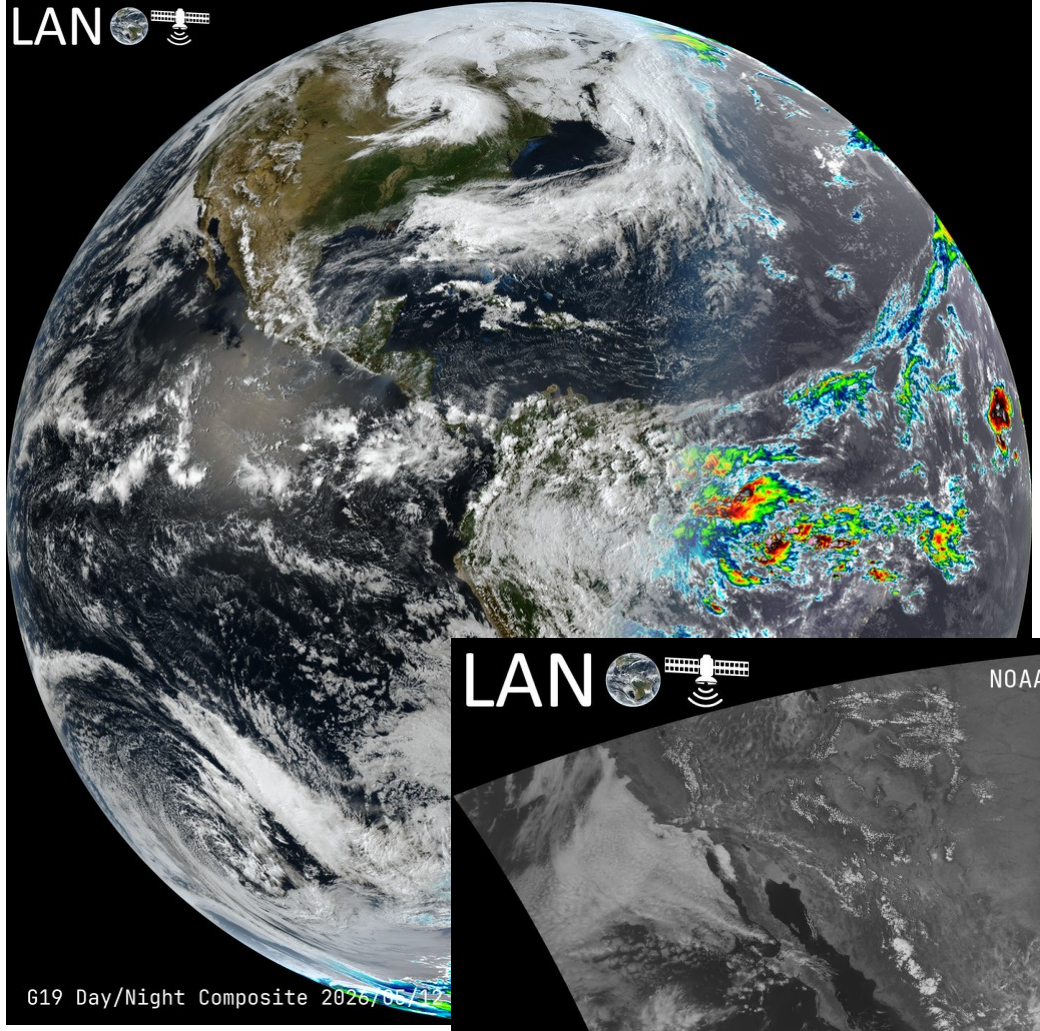
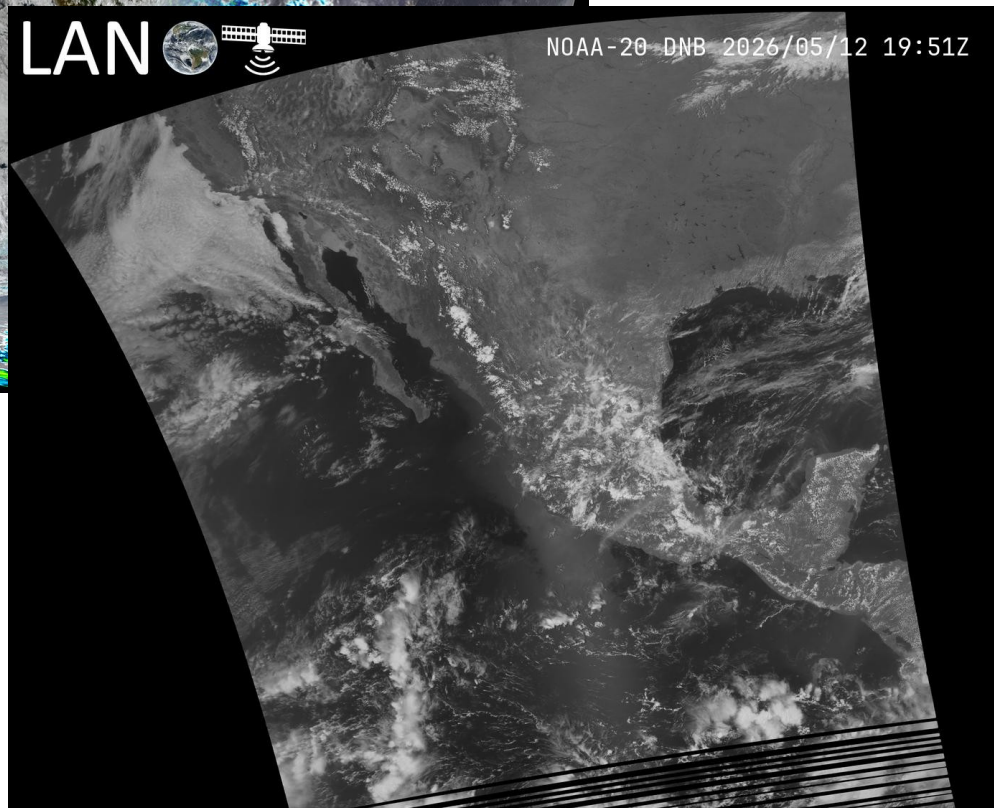
and Víctor Jiménez Escudero





2026 CSPP Users' Group Meeting

Laboratorio Nacional de Observación de la Tierra (LANOT)

Goals: Receive, process, store and distribute remote sensing data and images for issuing early alerts on storms, wild fires, volcanic emissions as well as continuous surface and atmospheric monitoring and studies.

Antennas on our roof

LANOT processing cluster

Processing nodes (datawork partition)

Node	Role	Key specs
cirrus, stratus	CSPP LEO / GEO processing	Rocky Linux 9 · NFS/Lustre client
cuatrillizos (×4)	AI / GPU acceleration	NVIDIA Tesla T4 · 16 GB VRAM · 256 GB RAM · Debian 13
Sea Space nodes	Data ingestion	GRB + Direct Broadcast reception

Storage & distribution (dataservice partition)

Node	Role	Storage
tren1 / tren2	Working storage (/datawork) · HA via Keepalived	RAID5 · 44 TB + 33 TB
darwin / humboldt	Distribution (/dataservice) · FTP, WWW	RAID5 · 21.8 TB each
kawak	Distribution overflow · WWW	RAID5 · 20 TB

Cluster modernization in progress — Slurm and MinIO deployment underway

Networking

10 GbE internal (172.16.x.x)
MTU 9000 for bulk data transfer
VLANs: admin / data isolation
Public: 132.247.103.x (SFTP, FTPS, HTTPS)

Orchestration

Slurm workload manager
datawork · dataservice partitions
Singularity/Apptainer containers
.sif recipes on GitHub (LANOT-UNAM)

Operating systems

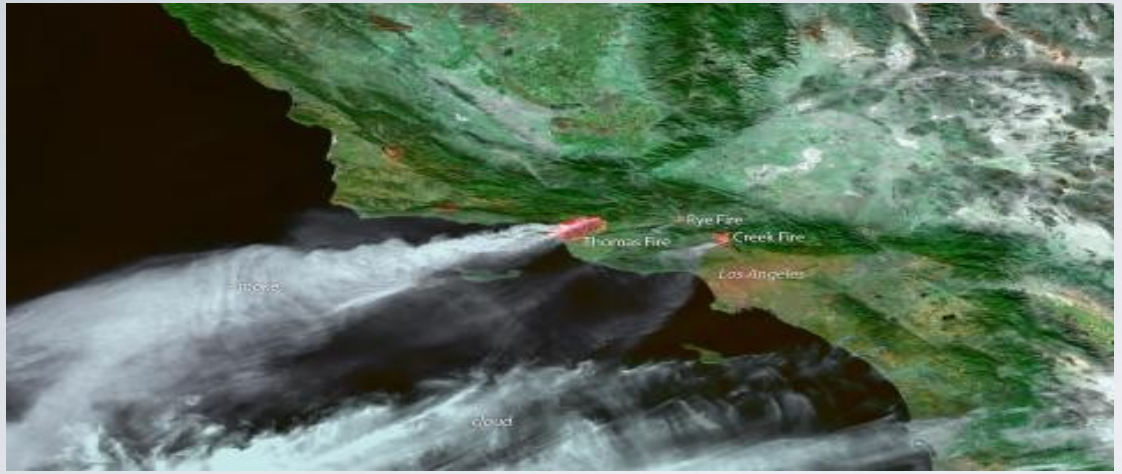
Rocky Linux 9 — processing + storage nodes
Debian 13 — GPU + publication nodes

Monitoring

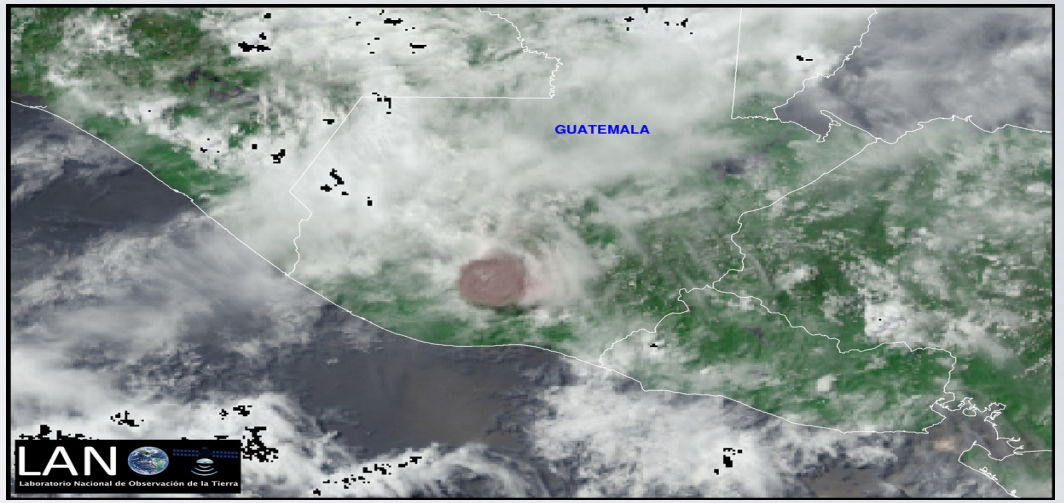
Prometheus + Grafana dashboards

IN-HOUSE DEVELOPED ALGORITHMS

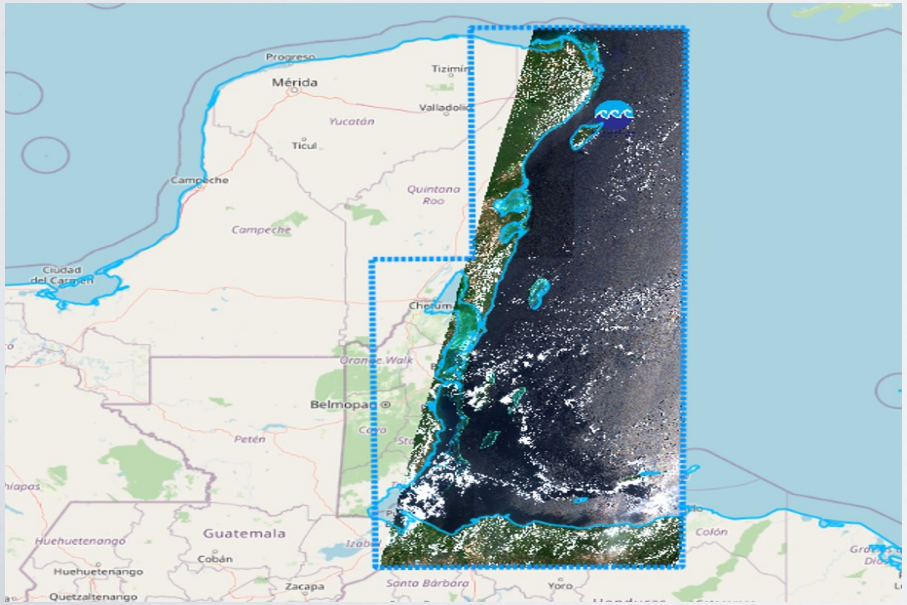
Hot Spots from ABI imagery



Volcanic Ash Detection

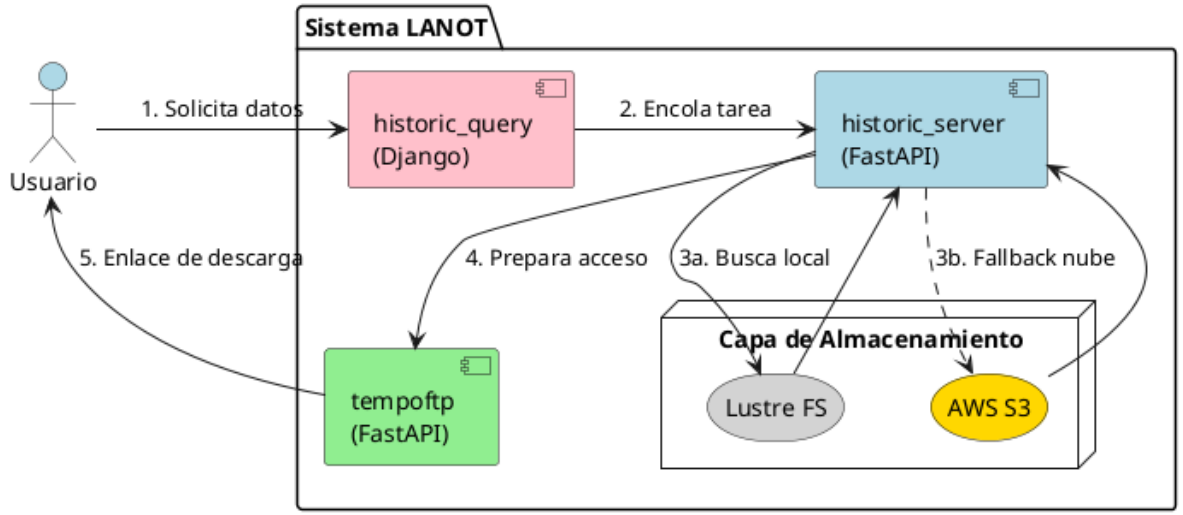


Sargassum Monitoring



- Historic Data Retrieval System
- High Performance Satellite Views
- MapDrawer

Historic Data Retrieval System



Automated Microservices Architecture

We eliminated operational bottlenecks by transforming manual email requests into a fully automated, self-service data pipeline.

historic_query: Self-service web interface for researchers to filter by satellite, sensor, and time range.

historic_server: Asynchronous high-performance API (FastAPI) for physical volume retrieval with automated AWS S3 fallback.

tempoftp: Secure, isolated delivery via ephemeral FTP accounts with a 72-hour TTL.

A flexible user interface allows to create complex queries to get thousands of files

```
fechas = {
"20190115":  ['00:30-04:30', '10:00-13:30'] ,
"20190116":  ['09:30-13:30', '18:00-22:50'] ,
"20190216":  ['06:30-09:30', '12:00-15:00', '22:00-23:55'] ,
"20190217":  ['00:00-01:00', '03:00-06:00', '10:00-19:00', '22:00-23:55'],
```

Fechas y horarios

Seleccione las fechas de su interés. Por cada fecha puede seleccionar uno o varios intervalos de horas. Optativamente puede seleccionar una segunda fecha para indicar un intervalo de fechas. Los botones (+) permiten agregar intervalos de horas para una misma fecha y más fechas con sus respectivos conjuntos de intervalos de horas. Los botones (-) permiten borrar.

Fechas inicial y final (optativa)			Hora inicial y final		
15 / 01 / 2019	dd / mm / aaaa	(+)	00 : 30 a.m.	04 : 30 p.m.	(+)
			10 : 00 a.m.	01 : 39 p.m.	(-)
16 / 01 / 2019	dd / mm / aaaa	(-)	09 : 30 a.m.	01 : 30 p.m.	(+)
			06 : 00 p.m.	10 : 50 p.m.	(-)
16 / 02 / 2019	dd / mm / aaaa	(-)	06 : 30 a.m.	09 : 30 a.m.	(+)
			12 : 00 p.m.	03 : 00 p.m.	(-)
			10 : 00 p.m.	11 : 55 p.m.	(-)
17 / 02 / 2019	dd / mm / aaaa	(-)	00 : 00 a.m.	01 : 00 a.m.	(+)
			03 : 00 a.m.	06 : 00 a.m.	(-)
			10 : 00 a.m.	07 : 00 p.m.	(-)
			10 : 00 p.m.	11 : 55 p.m.	(-)

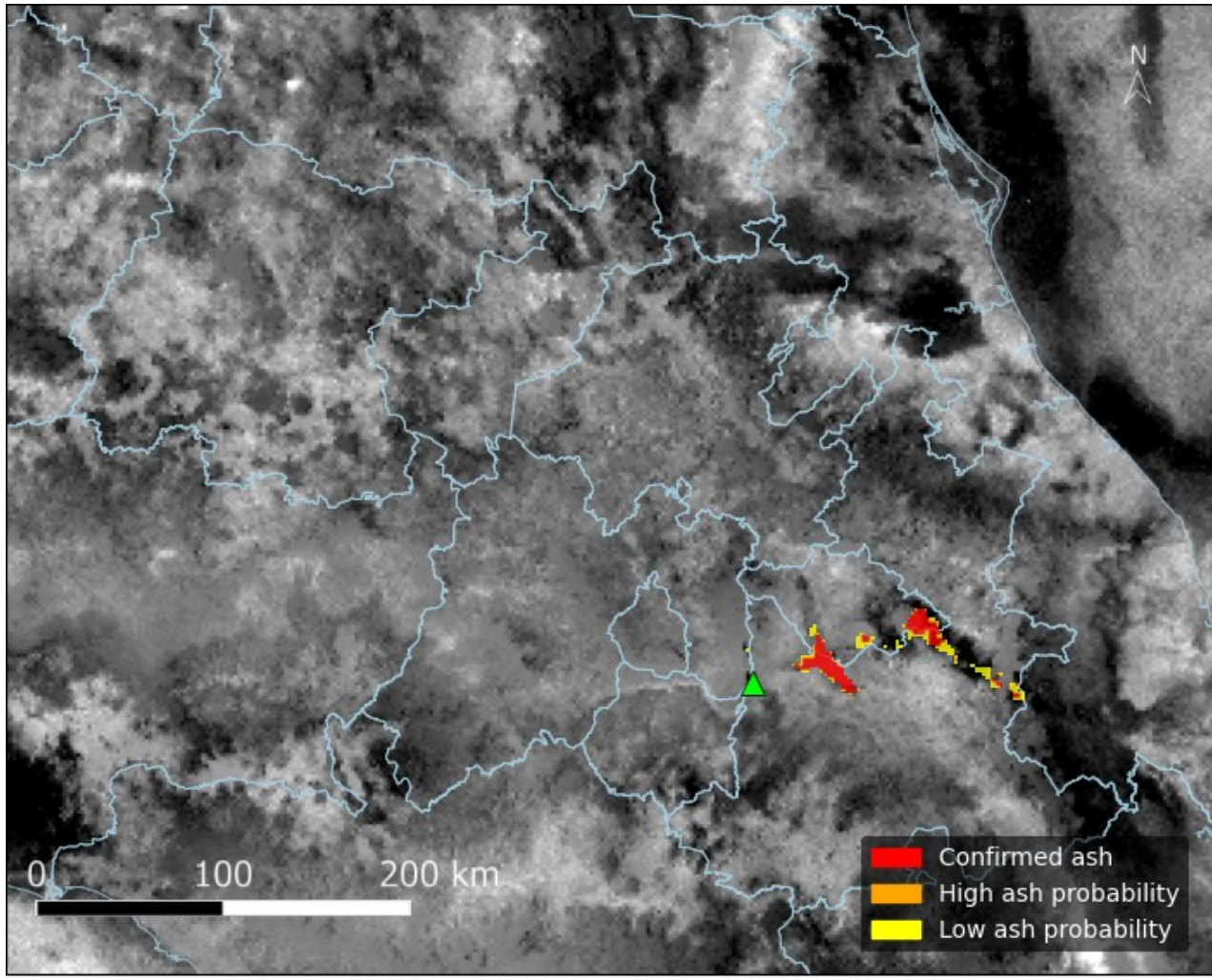
Generar JSON

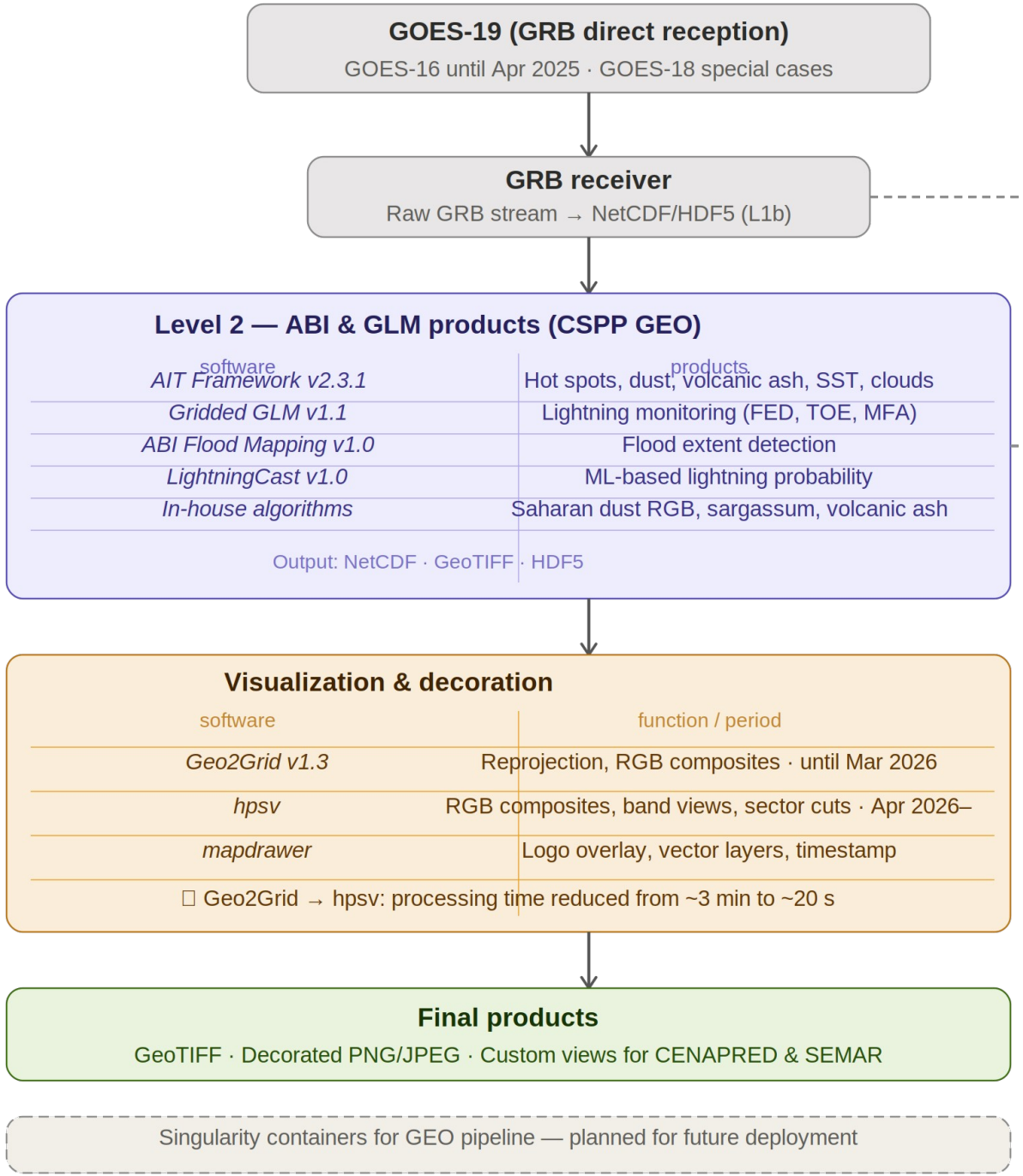
Popocatépetl Ash Detection Project

We extend our sincere gratitude to the CSPP team at the Space Science and Engineering Center (SSEC) at the University of Wisconsin–Madison for their invaluable support providing *critical Ancillary Data* to run CSPP Geo AIT framework for historical 2019 data ().

Their contribution directly enabled the generation of Level 2 products, including Derived Motion Winds and our own Ash Detection algorithm, from over 20,000 GOES-16 ABI L1b datasets (recovered with our historic retrieval data system; paper already submitted to Journal of Applied Volcanology).

Thank You





LANOT has operated a real-time GOES GRB direct broadcast system since 2018, processing ABI and GLM data through CSPP GEO. Since April 2026, in-house visualization tools (hpsv, mapdrawer) have replaced Geo2Grid, cutting image generation time from ~3 min to ~20 s.

HPSATVIEWS (hpsv)
High-performance satellite visualization

Developed at LANOT to meet real-time operational needs, hpsv is a lightweight C11/OpenMP tool that generates GOES-R visualization products in seconds, with full metadata traceability for reproducibility.

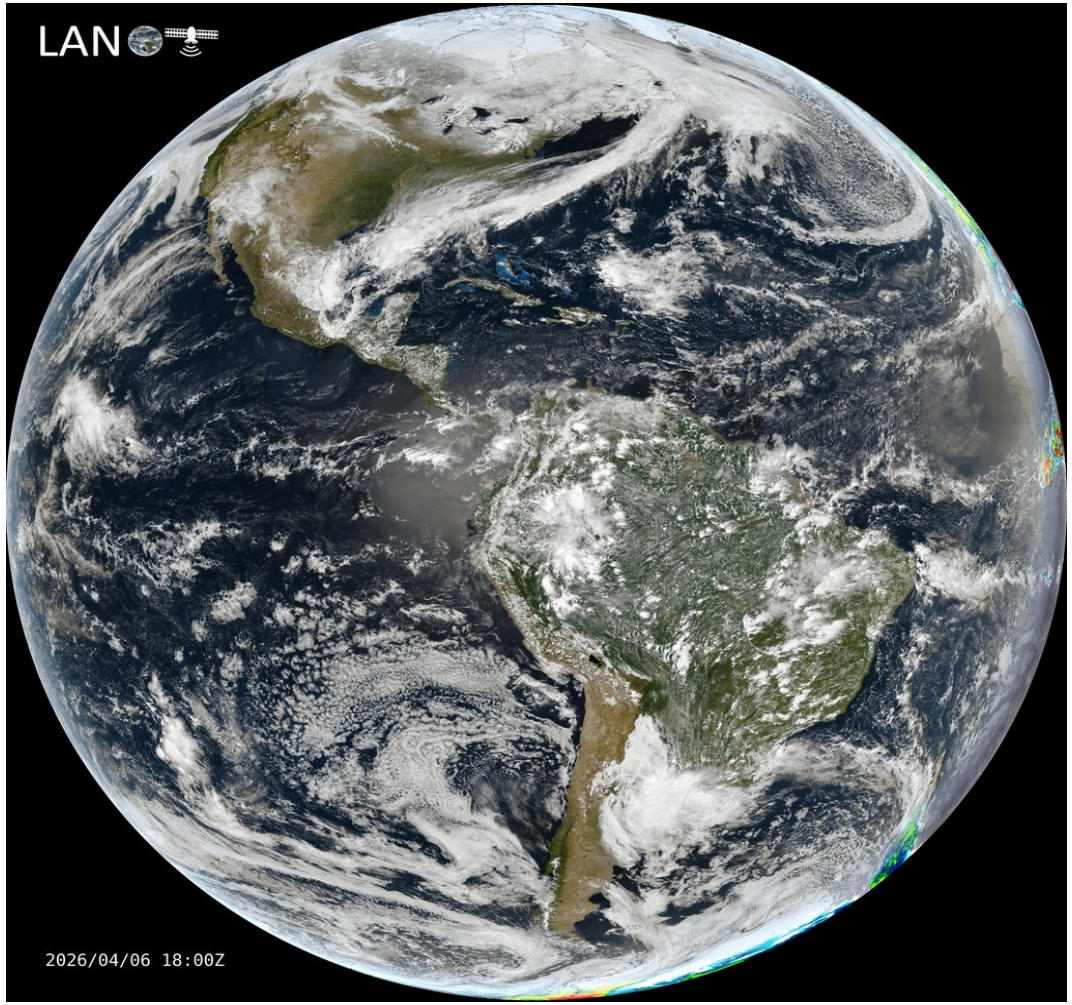
Key capabilities: true color, day/night composite, ash, air mass and custom RGB modes · Rayleigh correction · Cloud-Optimized GeoTIFF · band algebra

Performance (Full Disk): ~22 s vs. ~3 min with Geo2Grid + GDAL — saving ~2,300 processing hours/year at LANOT

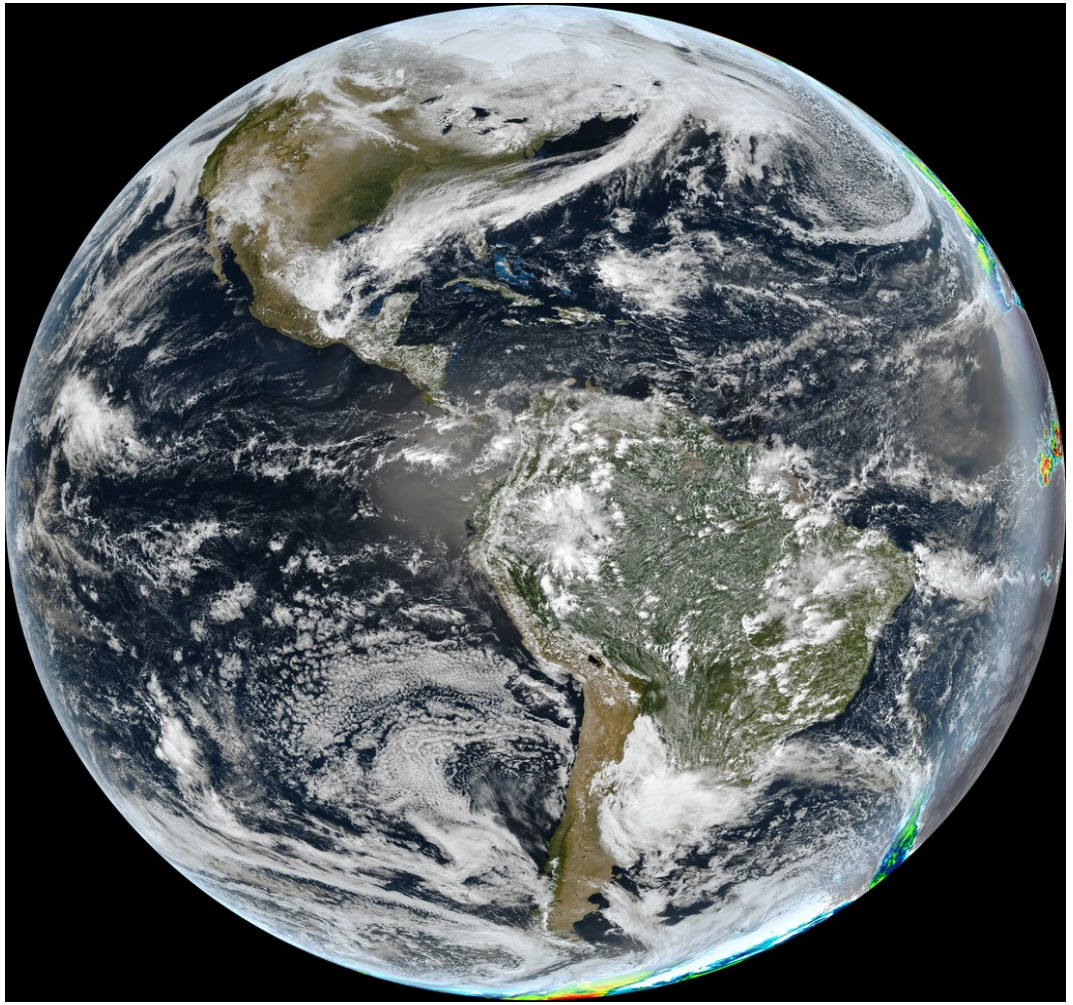
Note: hpsv is purpose-built for fast operational visualization. It complements, not replaces, general-purpose tools like Geo2Grid or satpy.

github.com/asierra/hpsatviews · C11 · GPL v3

Can you notice the difference?



geo2grid



hpsv

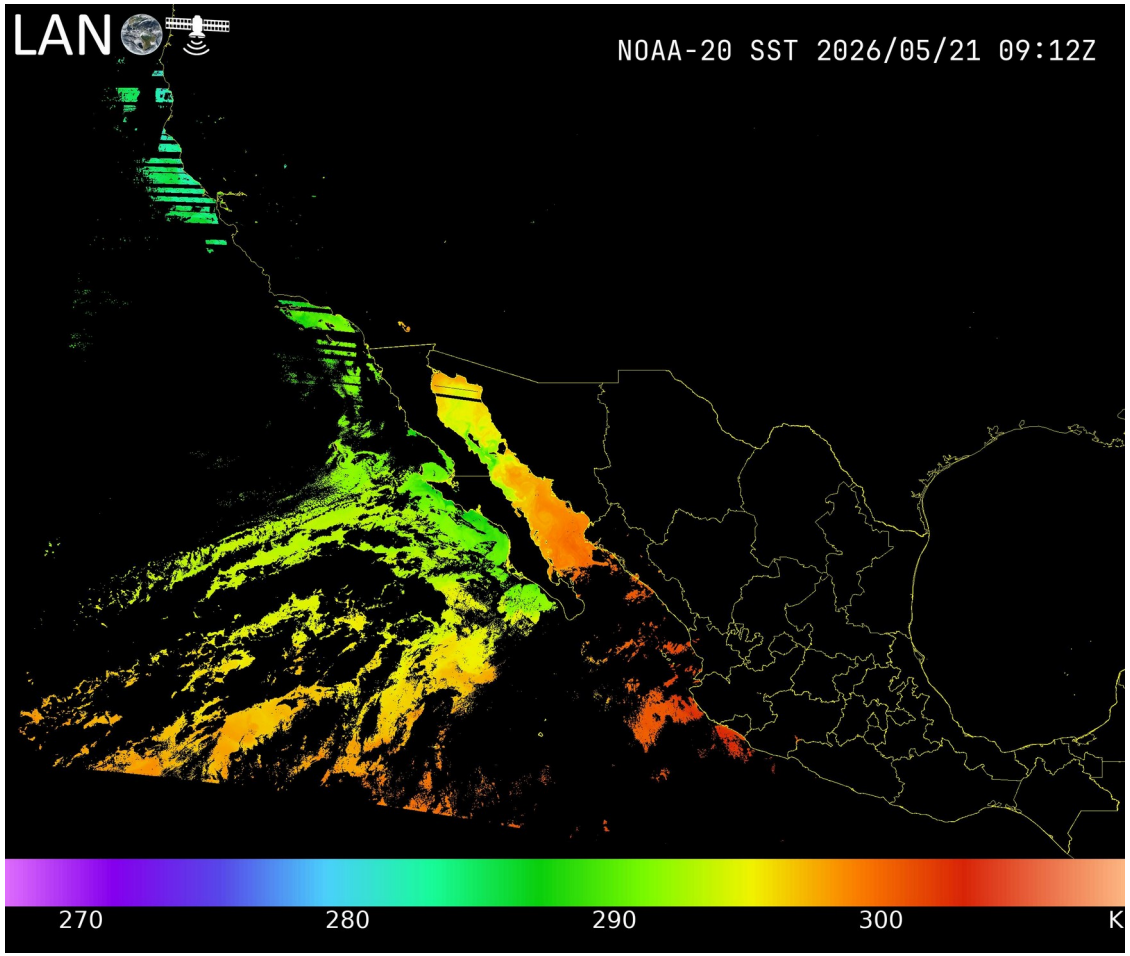
MapDrawer: Geospatial Metadata & Overlay Automation

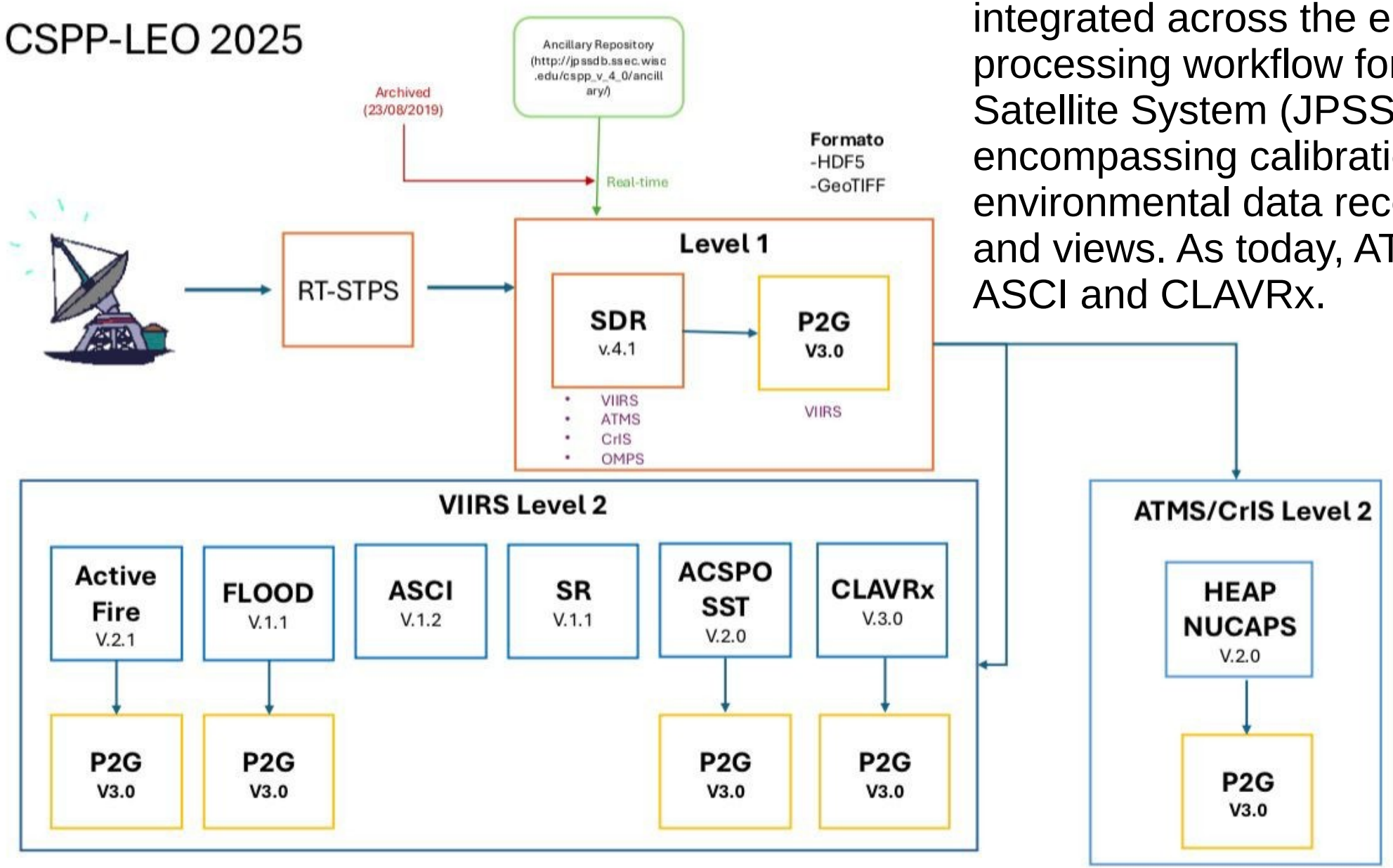
Purpose: Custom in-house tool for dynamic rendering of logos, geographical context, administrative borders, and custom overlays on satellite imagery.

Core Technology: Developed for high-performance spatial operations utilizing Python, C++, GDAL, Rasterio, and NumPy.

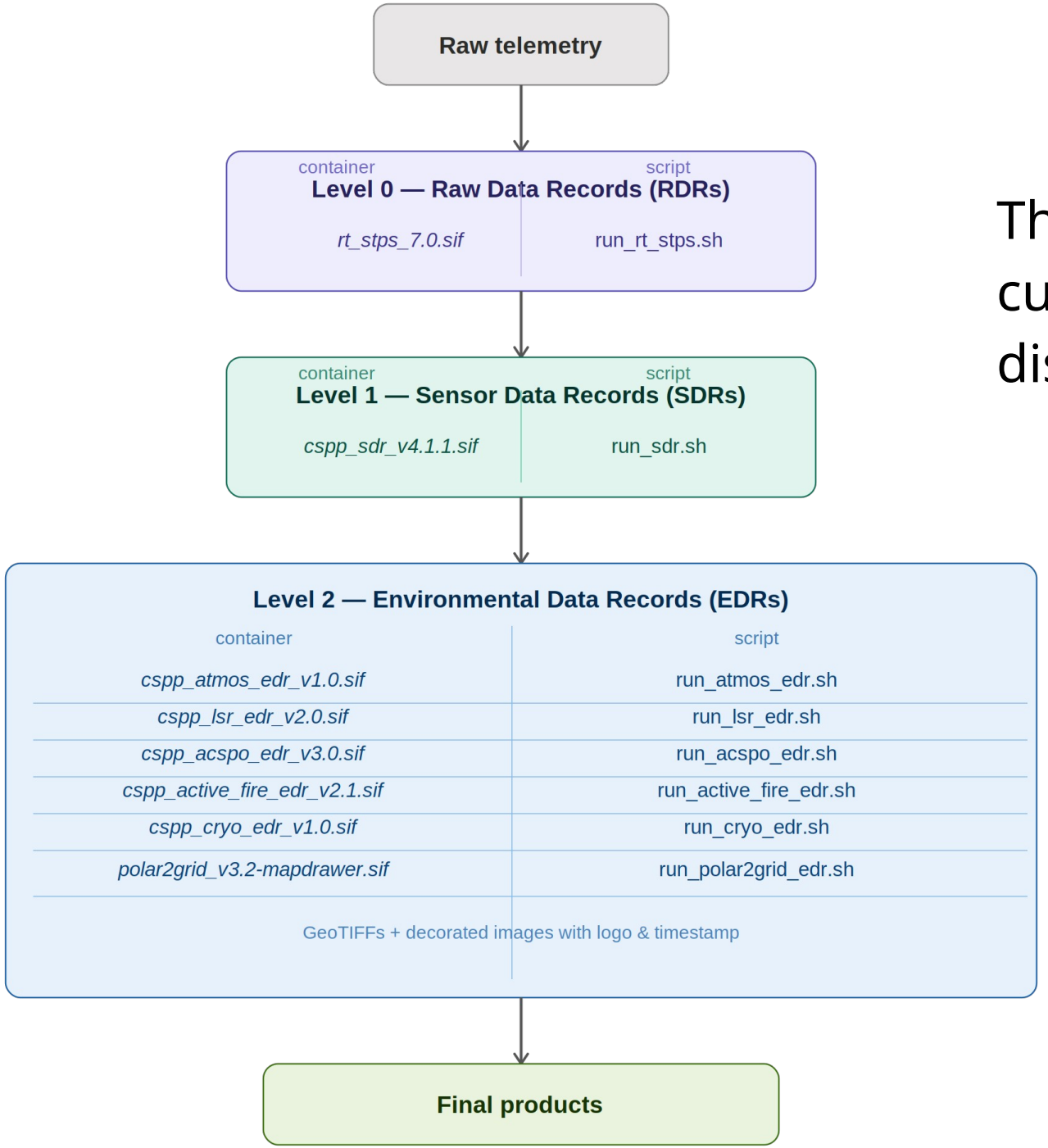
Pipeline Integration: Seamlessly complements `hpsv` and `Geo2Grid` pipelines by automating map generation, metadata and logo overlays.

Operational Impact: Eliminates the overhead of heavy desktop GIS software or heavy Python libraries (matplotlib), enabling instant geographical reference for critical events (e.g., active fires, hurricane tracks).



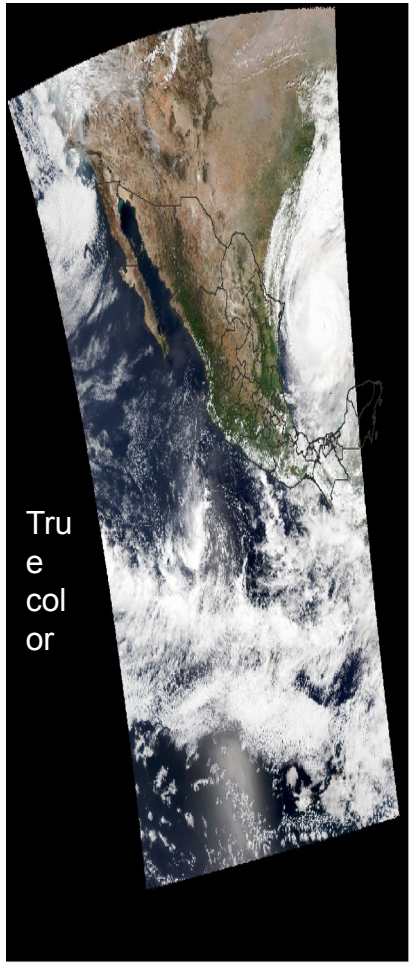


Since 2025, we are using CSPP integrated across the entire data processing workflow for the Joint Polar Satellite System (JPSS), encompassing calibration, geolocation, environmental data record generation and views. As today, ATMOS instead of ASCI and CLAVRx.



These containerized workflows are currently being deployed across our distributed processing cluster.

Atmosphere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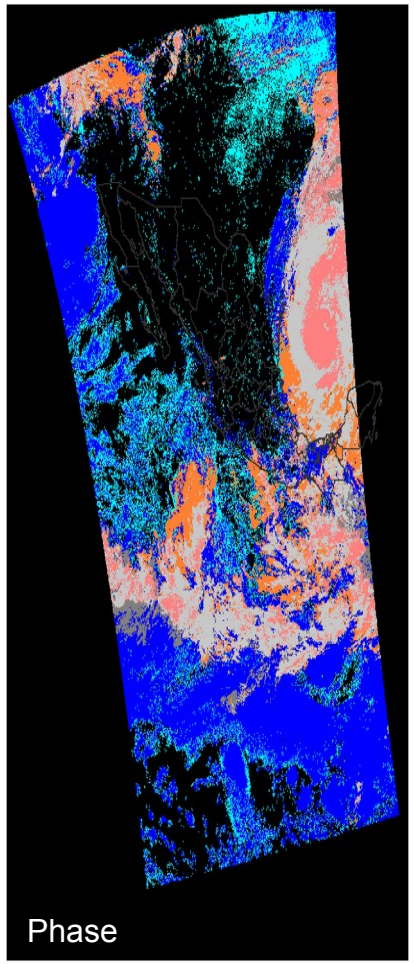
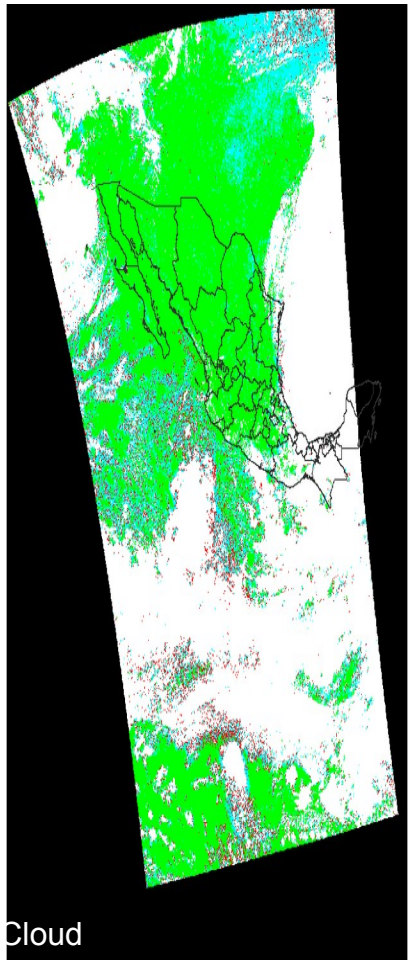
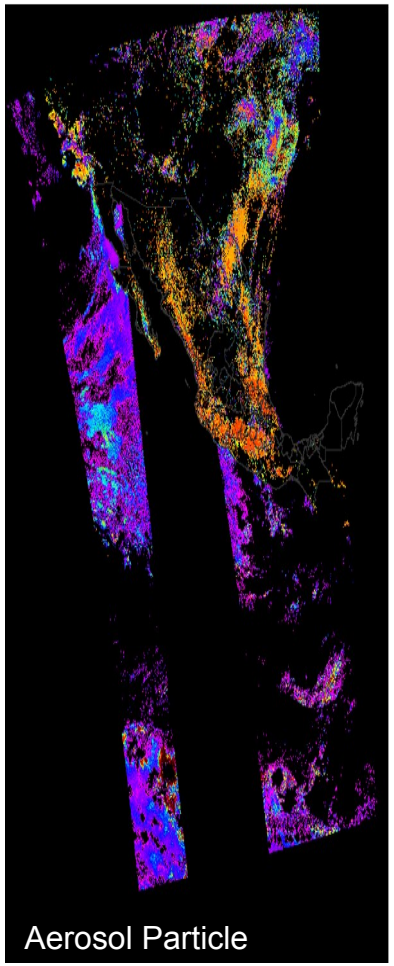
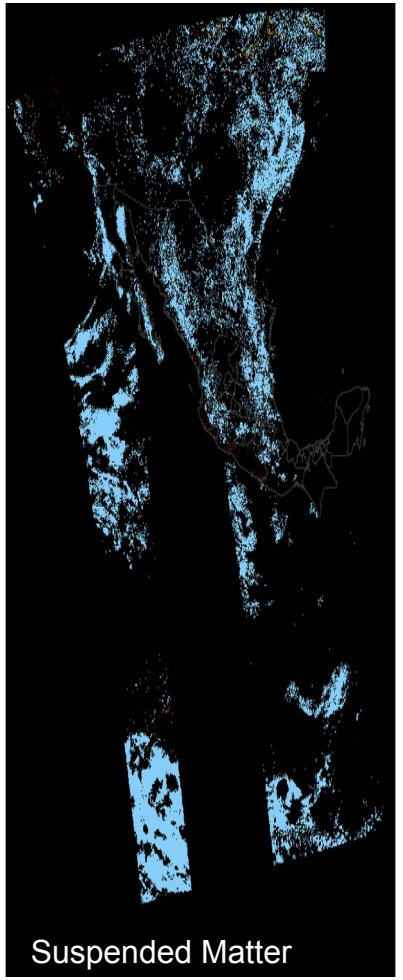
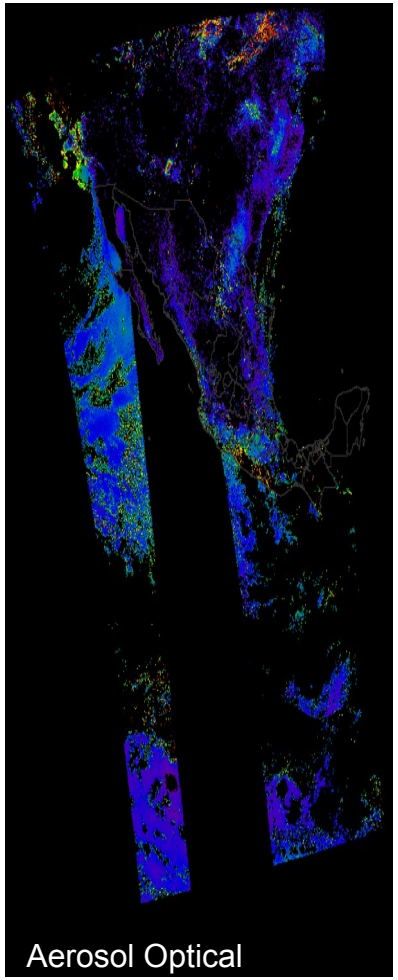

Phase

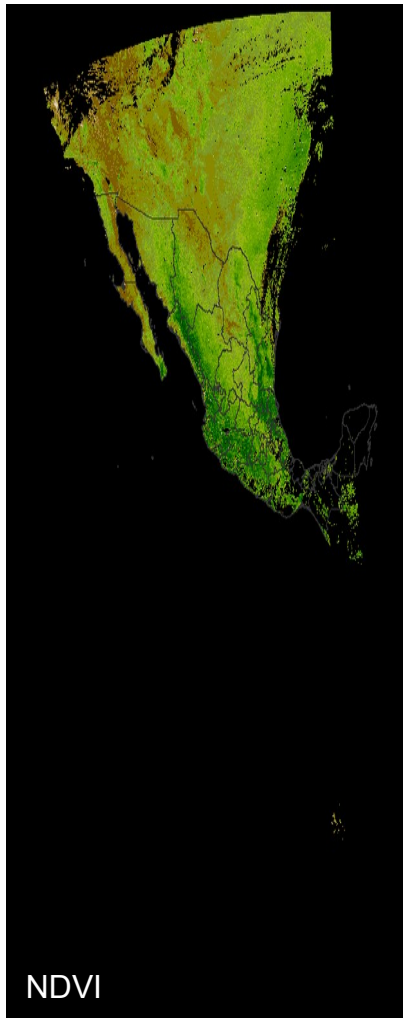

Cloud

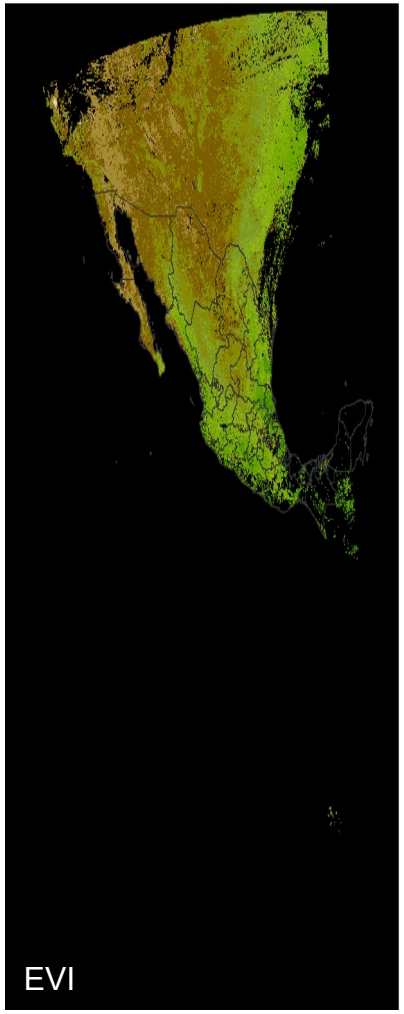

Aerosol Particle

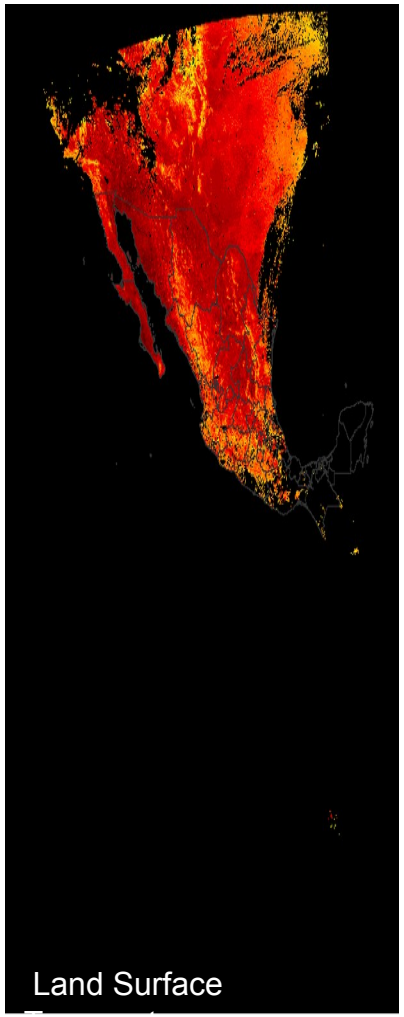

Suspended Matter

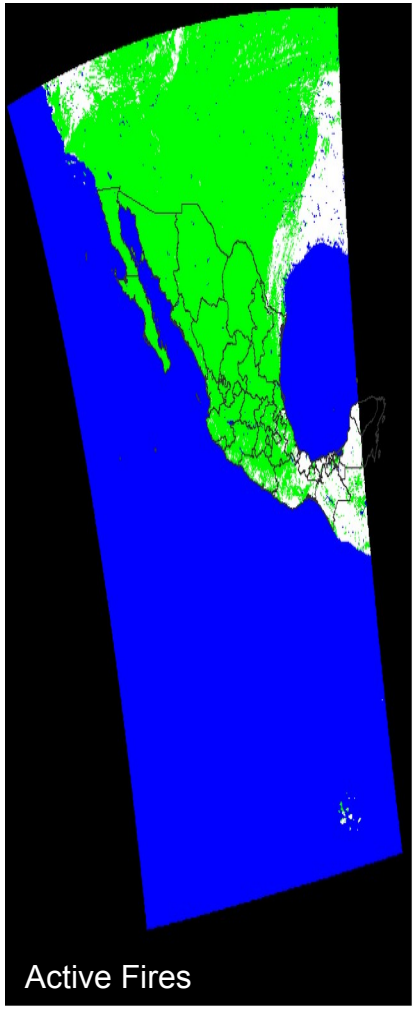

Aerosol Optical

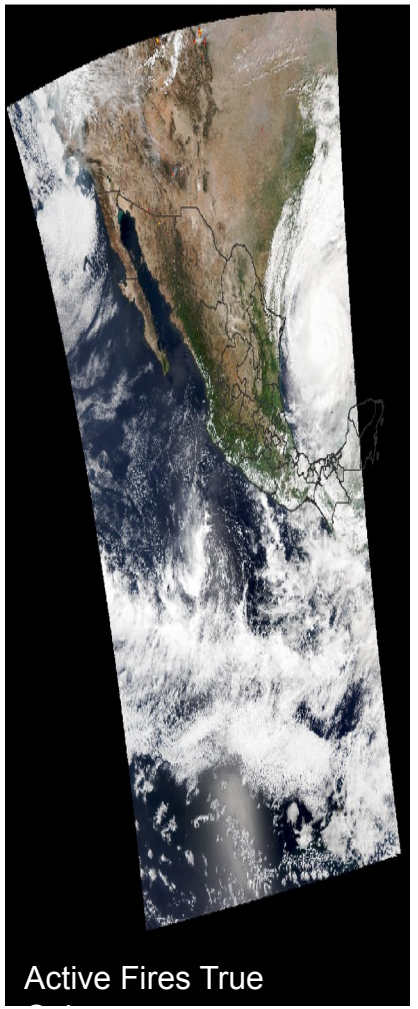
Surface

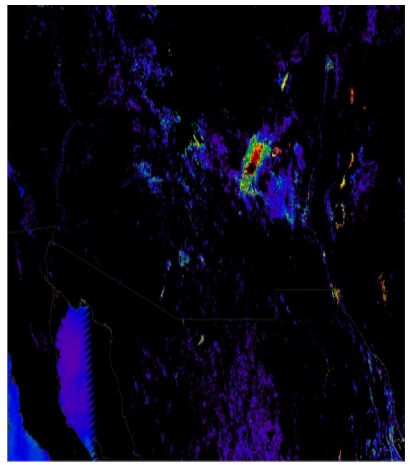


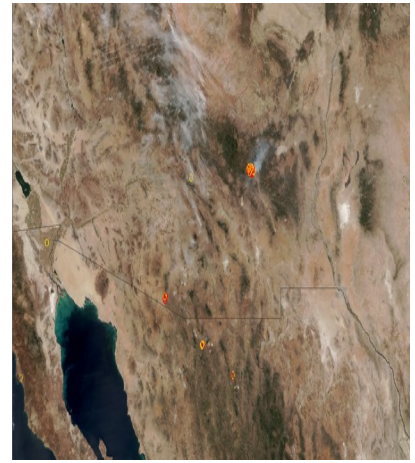




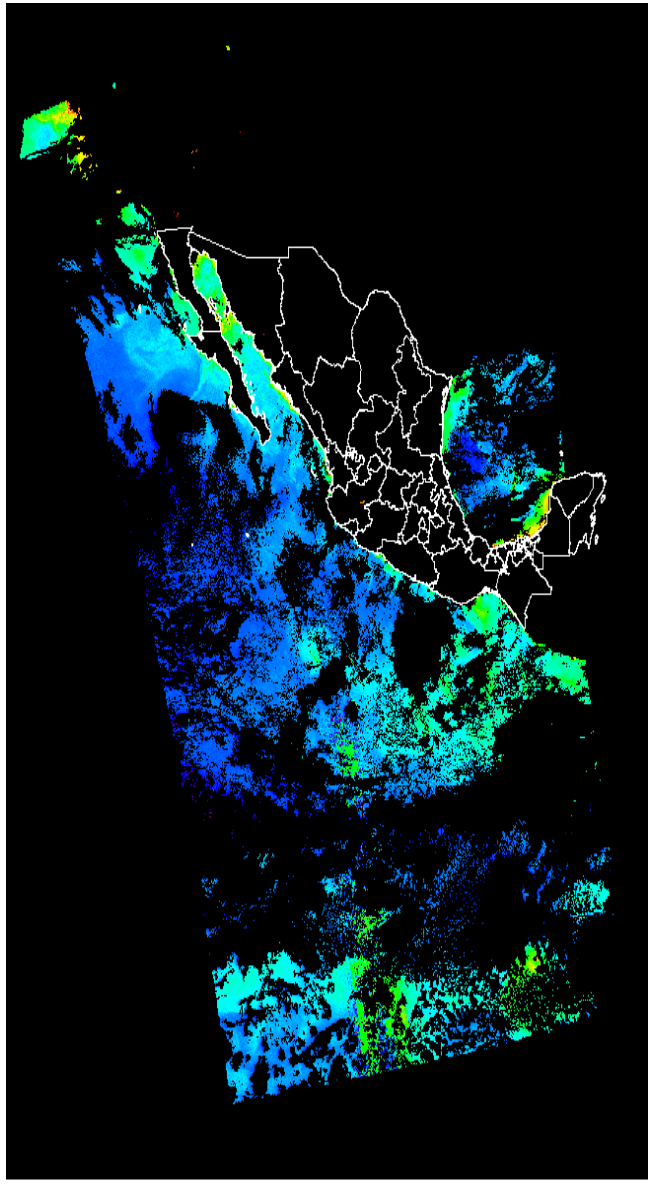


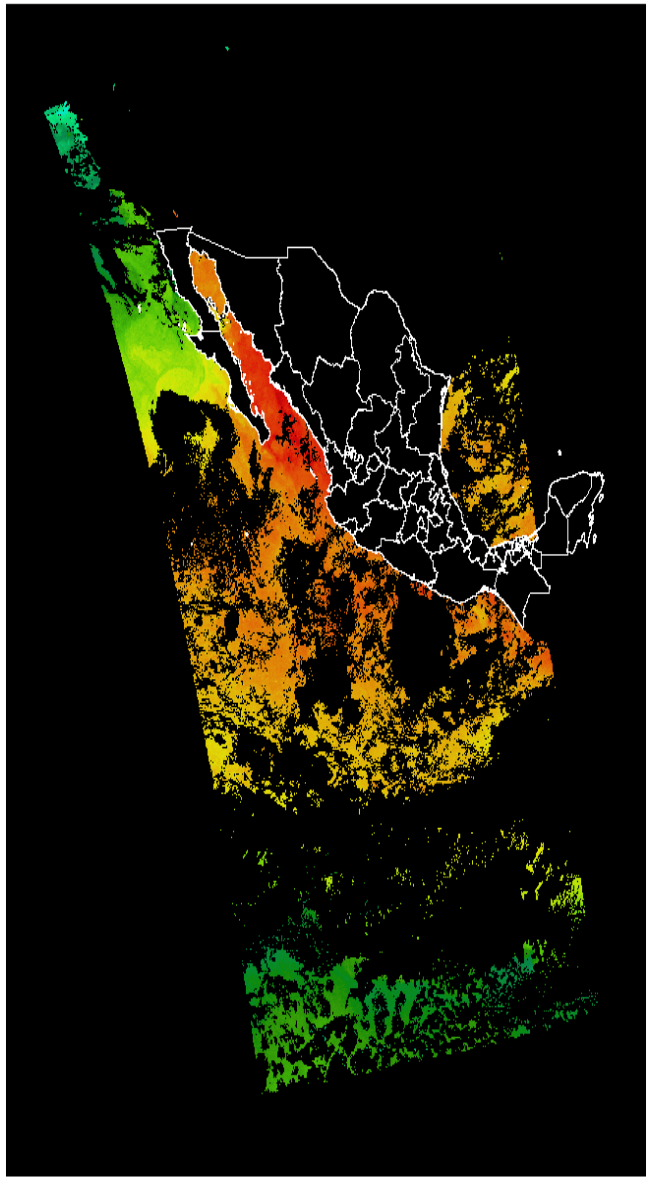


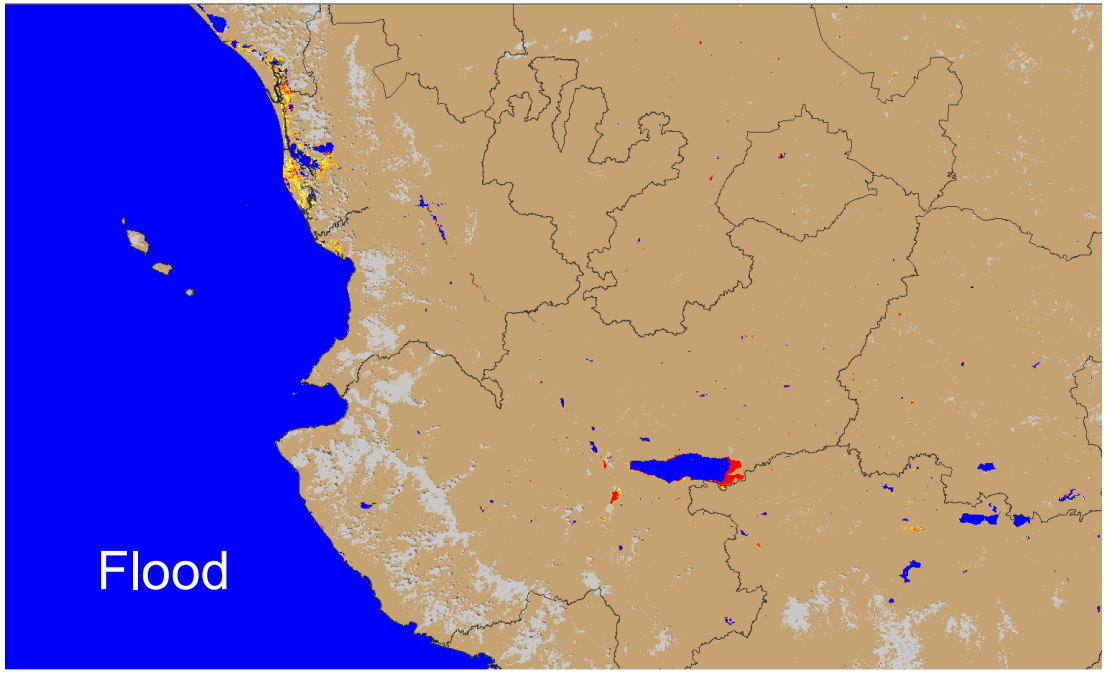




Ocean and lakes







Next steps at LANOT

Infrastructure modernization

- Migrate processing cluster to Slurm workload manager (replacing manual bash scripts) with dedicated datawork and dataservice partitions
- Deploy high-availability storage: Keepalived/NFS for /datawork, MinIO (S3-compatible) for /dataservice
- Prometheus + Grafana monitoring dashboards for cluster health and service status

Containerization roadmap (Singularity/Apptainer)

- CSPP LEO pipeline: containers operational since 2025 ✓
- CSPP GEO pipeline: containerization in progress
- METOP (AAPP + CSPP-NOAA): containerization planned
- All container recipes managed via GitHub (LANOT-UNAM)

AI and new products

- GPU nodes (NVIDIA Tesla T4) being integrated into the cluster for ML-based products
- First use case: sargassum detection model (ongoing M.Sc. thesis)

Conclusions

- LANOT has fully integrated CSPP LEO and GEO into a containerized, reproducible processing pipeline covering the complete data chain from raw telemetry to operational products — serving national users including SEMAR, CENAPRED, and SMN.
- The in-house development of hpsv demonstrates that targeted, lightweight tools can dramatically reduce operational latency (~3 min → ~20 s) while improving image quality and maintaining full scientific traceability.
- LANOT's ongoing cluster modernization — Slurm scheduling, high-availability storage, and Singularity containers — positions the lab for scalable, fault-tolerant satellite data processing.
- We remain committed to the CSPP community: container recipes are openly available, and planned containerization of CSPP GEO and METOP pipelines will further align our infrastructure with reproducible science standards.

Questions?

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Thank you!