Easing the Transition From IPOPP: An Automation Wrapper for CSPP and IMAPP

CSPP Users' Group Meeting
19-21 May 2026
EUMETSAT, Darmstadt, Germany

Richard Wright
Dartcom Systems Ltd.

Introduction – Dartcom Systems Ltd.

- Dartcom founded as a partnership in 1989, making receiver modules and preamps for the APT and WEFAX transmissions in the VHF frequency band, for the emerging amateur market.
- Now a limited company, still based on Dartmoor, in South West England.
- Product range has been continuously developed as new technologies and markets emerged.
- Professional-grade reception hardware and software supplied to customers worldwide, for APT/WEFAX, MDD, PDUS, HRPT, CHRPT, AHRPT, LRIT, HRIT, UHRIT, EUMETCast, HimawariCast and most recently X-Band EOS reception and processing.

Aqua MODIS Sharpened True Colour 2020-06-24 (Received at Dartcom and processed with IPOPP)

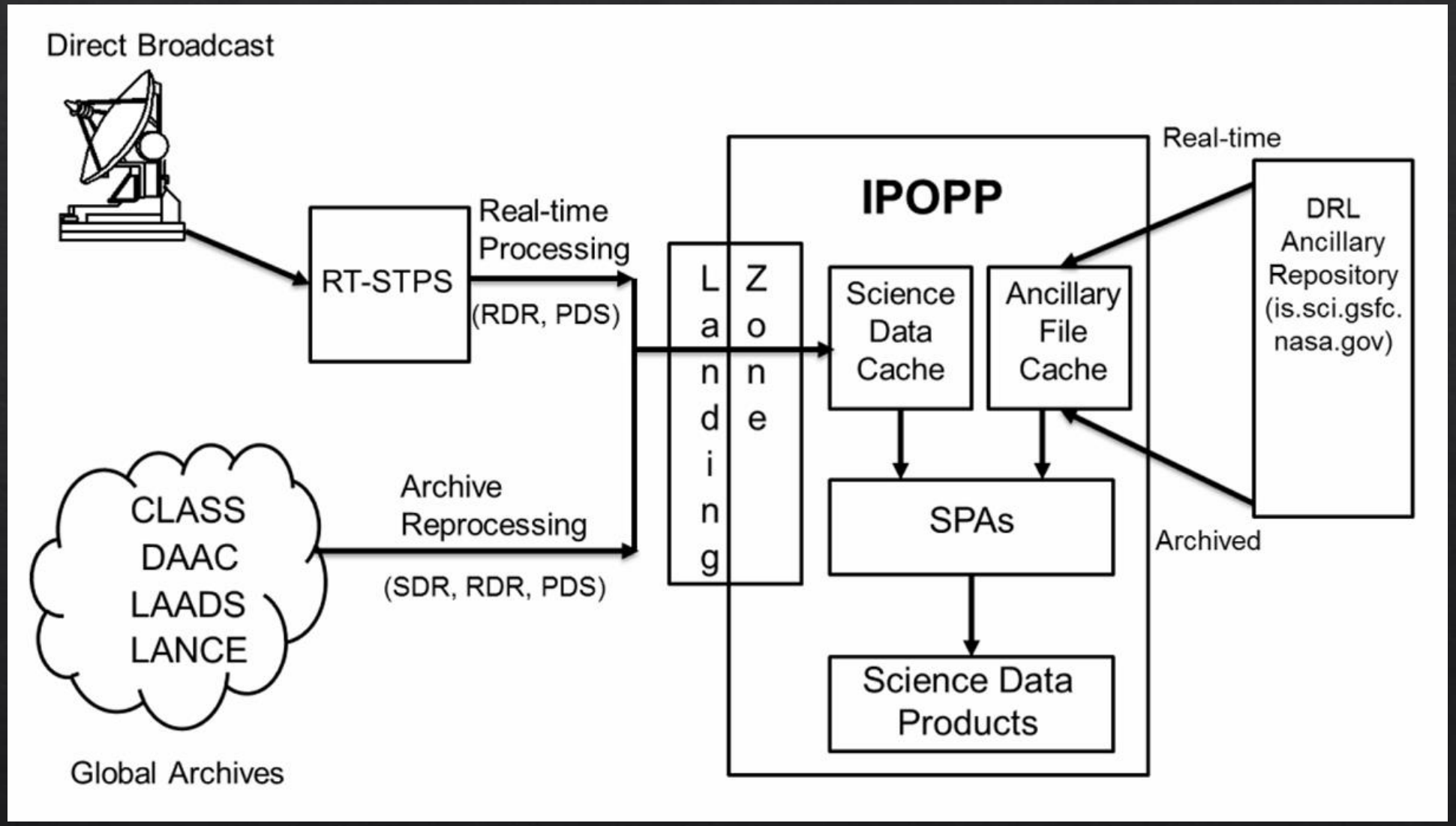
Dartcom X-Band EOS System

- Started developing the X-Band EOS system in 2012.
- Radome-enclosed 1.5m antenna.
- First system delivered to the University of Valladolid, Spain, in 2014.
- Supplied marine, fixed land-based and deployable land-based X- and X/L-Band systems to customers worldwide.
- Majority of hardware and software designed, developed and manufactured in-house, with carefully selected subassemblies from trusted manufacturers integrated into finished systems.

X-Band EOS Processing Software

- Development process included assessment of options for processing X-Band EOS satellite data (Terra, Aqua and NPP).
- Prefer to develop own software in-house, but not viable due to complexity of X-Band processing and established use of scientifically developed algorithms.
- Only two options were IPOPP (NASA DRL) and CSPP (University of Wisconsin CIMSS).
- IPOPP chosen because:
  - Complete, integrated package, designed for automatic end-to-end processing and archiving.
  - Automatic ancillary file management.
  - User-friendly GUI apps for monitoring, control and diagnostics.
  - Supported all current satellites.
- Elected to run IPOPP inside a VM, on a powerful Windows host PC:
  - Allows easy maintenance and deployment of a tried and tested processing system.
  - Familiarity for existing users of Dartcom software (Windows-based).

IPOPP Overview



Source: IPOPP User's Guide 5.0

IPOPP Overview

- IPOPP is an autonomous multi-mission, multi-sensor data processing framework. The framework provides an environment for running plug-and-play Science Processing Algorithms (SPAs). The user only needs to configure IPOPP and place data in the Landing Zone.
- IPOPP supports:
  - real-time processing to meet user operational science data requirements; and
  - archive reprocessing for algorithm evaluation (e.g., multiple versions of an algorithm running in a single processing environment to eliminate ambiguity of measurement).

Source: IPOPP User's Guide 5.0

IPOPP Overview

- IPOPP will autonomously:
  - discover and register raw sensor data;
  - retrieve ancillaries from the DRL's real-time and archived ancillary repositories;
  - register ancillaries in its Ancillary File Cache;
  - schedule SPA executions;
  - fulfil science data/ancillary requests from SPAs;
  - generate science data products; and
  - manage the IPOPP file system.

Source: IPOPP User's Guide 5.0

6th June 2023

[direct-broadcast-users] Imminent changes to DRL support

For many years the Direct Readout Laboratory (DRL) has provided support for the Direct Broadcast community. Time passes, missions launch and end, and people come and go.

As the Terra and Aqua missions approach their end of life, support for them is also ramping down. Continuing support for all NASA and NOAA Direct Broadcast missions (Terra, Aqua, SNPP, and JPSS) will be provided, but not through Direct Readout Laboratory. NOAA has been and will continue to be the principal provider for direct broadcast support going forward.

Therefore, by July, 2023, DRL will be ending development status and beginning archive status. This means the most current software (IPOPP, SPAs, and other) will be frozen and archived. No new users will be accepted. Existing users who need a replacement copy of some software may request it.

Where next?

- IPOPP supports all current satellites, so we have until late 2027 to find a solution (when JPSS-4 is scheduled for launch). *Update: IPOPP ancillary server will be shut down in November 2026 [source: P.7 - Ancillary Data Services for IPOPP and Simulcast].*
- Suggested replacements for IPOPP were CSPP and IMAPP, both developed by University of Wisconsin CIMSS.
  - Neither package is automated, data is not archived and there are no dashboards.
  - Not a drop-in replacement for IPOPP.
- What about using Pytroll to glue everything together?
  - Some parts (eg. runners) are not general enough.
  - CSPP runner only appears to run the SDR processing (no level 2 products generated) so not a complete solution.
  - Won’t enable drop-in replacement for IPOPP.

How hard can it be to make our own wrapper?

- Key requirements:
  - Watch the output folder of the RT-STPS software for new files.
  - Automatically ingest complete level 0 RDR/PDS datasets from RT-STPS and move them to a slot in a data archive, together with a record of the current station position and a snapshot of the current processing configuration.
  - Automatically start processing of each ingested dataset using the appropriate package (CSPP or IMAPP).
  - Automatically create GeoTIFF versions of products using a projection centred on the station position, for import into Dartcom iDAP/MacroPro visualisation and processing software.
  - Automatically manage the data archive, deleting datasets which have exceeded the configured age.
  - Automatically download required ancillary data and manage the ancillary data cache.
  - Provide a simple dashboard showing the datasets in the archive and the status of the relevant processing modules for each dataset.


A FEW
MOMENTS LATER

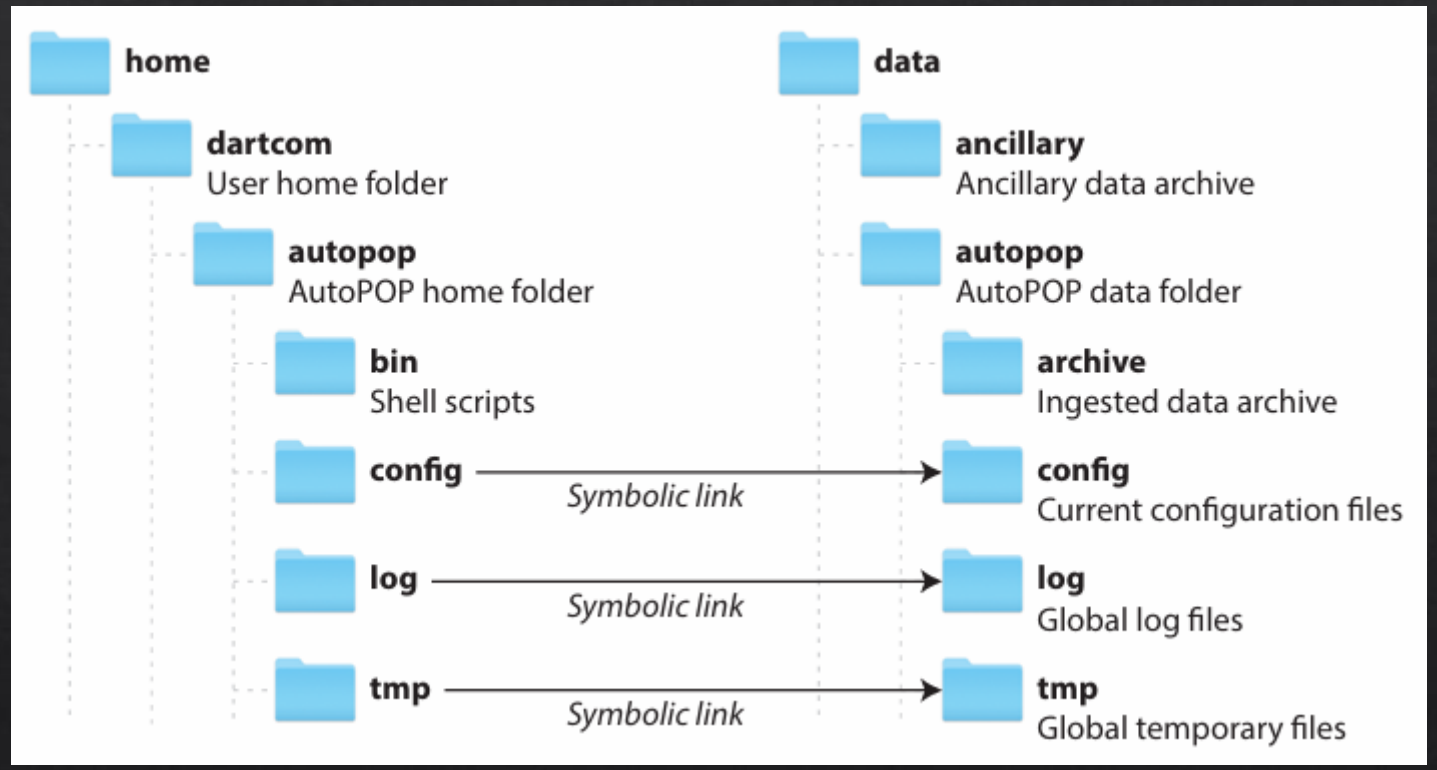
AutoPOP is born!

- AutoPOP = Automatic Polar Orbiter Processor.
- A collection of Bash shell scripts and associated configuration files.
- Designed to allow processing of multiple datasets simultaneously, taking advantage of multiple processor cores to minimise latency.
- Entire processing chain started immediately, with modules waiting for completion of processing by other modules on which they depend.
- Simple file-based signalling system.
- Each dataset can be manually reprocessed if required, for example if an error occurs during processing, or changes to the processing settings are needed.
- Configuration files allow adjustment of global settings such as archive size and GeoTIFF projection, enabling and configuration of the required CSPP and IMAPP modules, and selection of GeoTIFF outputs.
- A browser-based Node-RED dashboard shows the archive contents, with status icons and logs available for each processing module.

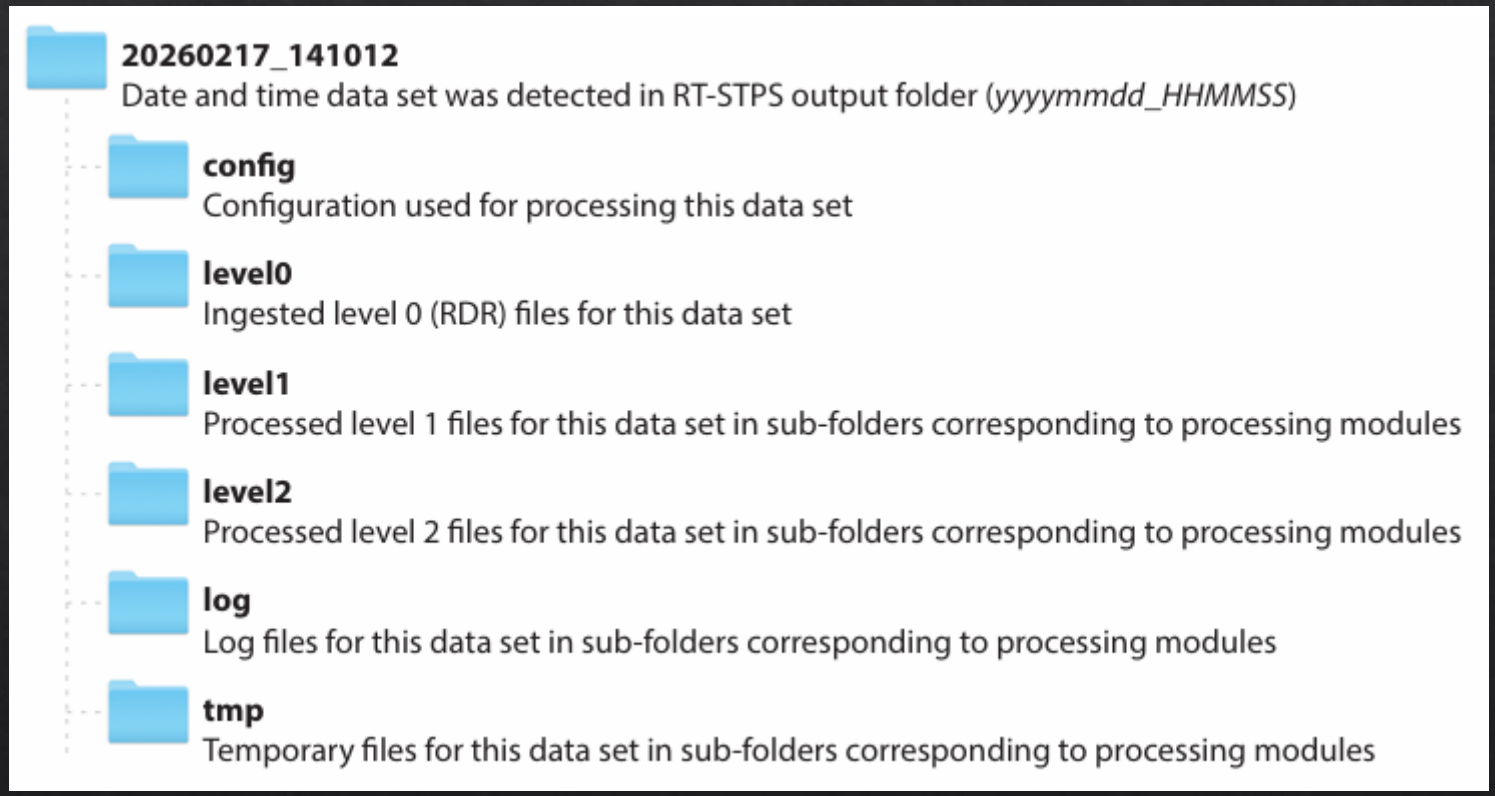
AutoPOP Main Components

- Daemon with associated scripts for starting, restarting and stopping, e.g. autopopd_start.sh
- Ancillary manager cron job (autopop_ancillary.sh).
- Archive manager cron job (autopop_archive.sh).
- Manual reprocessor, e.g. autopop_process.sh – 20260520_114532 (the dash means use the default configuration folder).
- Web-based dashboard (Node-RED).

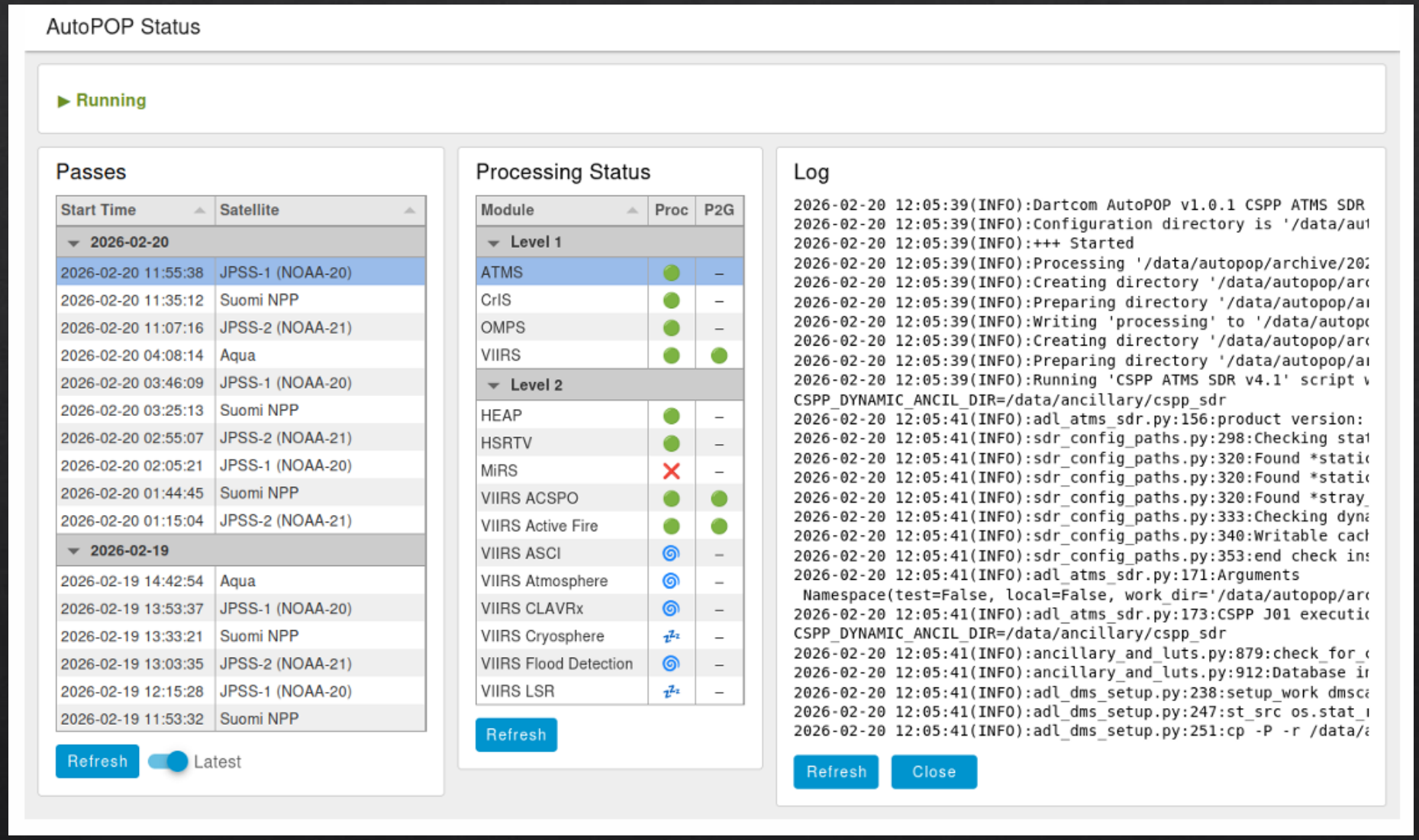
AutoPOP Folder Structure



AutoPOP Archive



AutoPOP Dashboard



AutoPOP Configuration

autopop/config/global.config

```
# Directories
inputDir="$HOME/data"
dataDir='/data/autopop/archive'
logDir='/data/autopop/log'
tmpDir='/data/autopop/tmp'

# Uncomment to enable debug mode
# debugMode=1

# Uncomment to suppress downloading of ancillary data (if internet access unavailable, for example)
# downloadAncillaryData=0

# Uncomment to set maximum age of ancillary data, in days, and adjust as required (default 14 days)
# ancillaryDataMaximumAge=14

# Uncomment to set maximum age of archived data, in days, and adjust as required (default 14 days)
archiveMaximumAge=12

# Uncomment to set number of worker threads to use for Polar2Grid and adjust as required (0=use default)
# p2gWorkerThreads=0

# Uncomment to include alpha channel in Polar2Grid outputs
# p2gNoAlpha=0

# Uncomment to prevent /cos(SZA) being applied to visible band Polar2Grid outputs
# p2gNormalizedRadiances=1

# Uncomment to set PROJ.4 projection to use for Polar2Grid and adjust as required
# 'lcc'=Lambert Conformal Conic, 1 Standard Parallel (EPSG 9801)
# 'merc'=Mercator, Variant C (EPSG 1044)
# 'stere'=Polar Stereographic, Variant B (EPSG 9829)
# 'sterea'=Oblique Stereographic (EPSG 9809)
# If not set, projection will be selected automatically based on station position
p2gProjection='lcc'
```

AutoPOP Configuration

autopop/config/process/cspp/level1/viirs.config

```
# Uncomment to disable CSPP VIIRS SDR processing
# enable=0

# Uncomment to enable debug mode
# debugMode=1

# Uncomment to set number of processor cores to use and adjust as required (0=use default)
processorCores=4

# Uncomment to aggregate output into one file per product type
# aggregateOutput=1

# Uncomment to compress HDF5 output files with transparent internal gzip
# compressHDF5Output=1

# Uncomment to trim specified numbers of granules from beginning and end of pass
# trimGranules=1
# trimGranulesBegin=1
# trimGranulesEnd=1

# Uncomment to retain ellipsoid geolocation products (GMODO and GIMGO files)
# retainEllipsoidGeolocationProducts=1

# Uncomment to disable VIIRS level 1 Polar2Grid outputs
# p2gEnable=0

# Uncomment and adjust to configure Polar2Grid options
# p2gDynamicDNBSaturationCorrection=1

# Uncomment to enable Polar2Grid products
p2gProductI01=1
p2gProductI02=1
.
.
.
```

AutoPOP VM

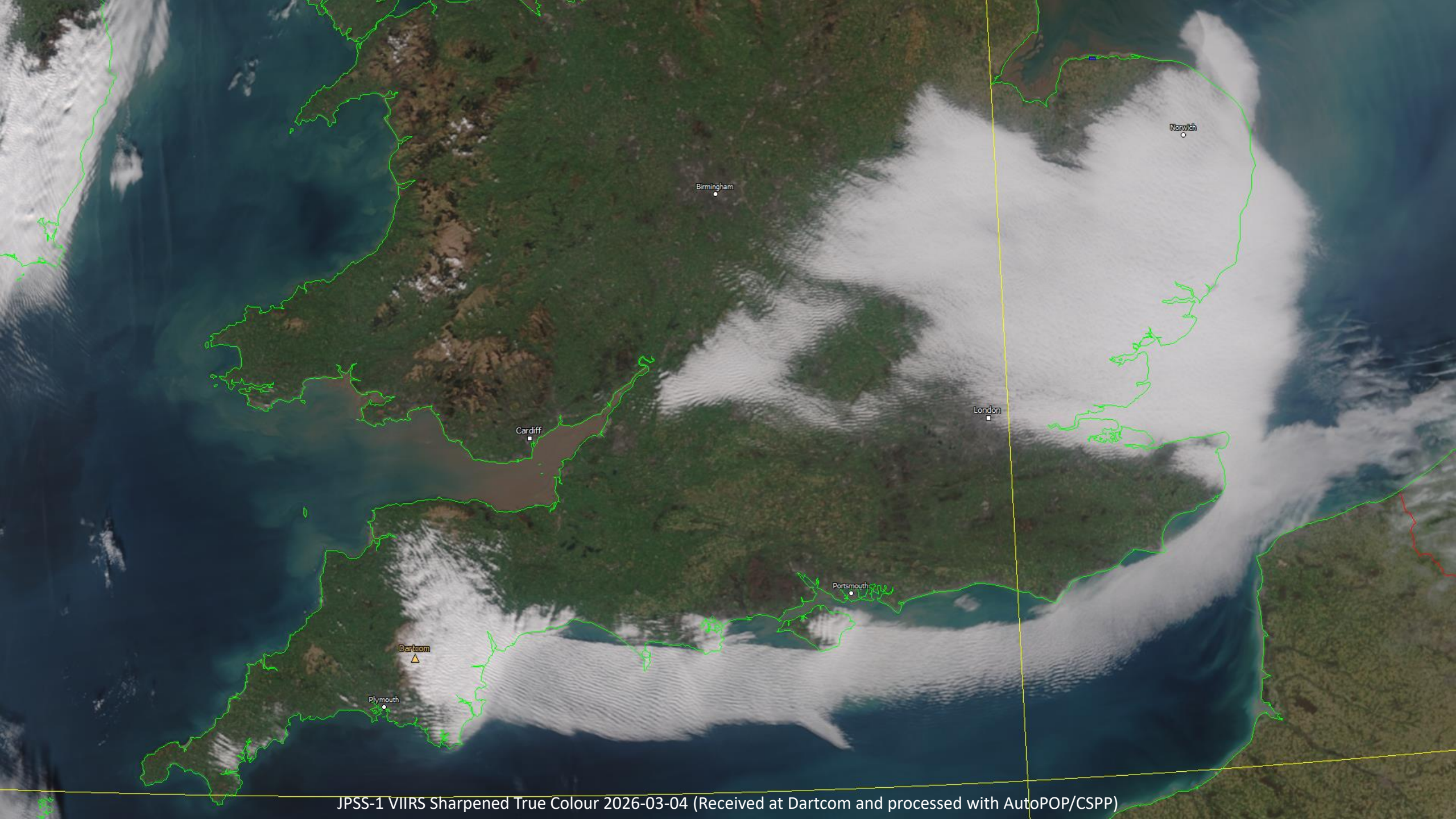
- Hyper-V base VM built using Ubuntu 24 (other flavours are available).
- Our standard processing PC specification:
  - AMD Ryzen 9 9950X 16-core/32-thread CPU (16 cores allocated to VM).
  - 128GB DDR5 RAM (96GB allocated to VM).
  - 2 x 2TB SSDs (1 x OS, 1 x Dartcom iDAP/MacroPro software working drive).
  - 8TB NVMe SSD RAID-0 / PCIe 5.0 NVMe SSD (>12GB/sec read/write).
  - Windows 11 Professional OS.
- RT-STPS, Simulcast, CSPP and IMAPP packages installed on VM in standard locations.
- Conda environment created for each version of each CSPP and IMAPP package, with appropriate environment variables, library versions, etc.

AutoPOP VM

- Points to note:
  - Some CSPP modules share environment variable names and have different library requirements, hence using Conda to mitigate these issues.
  - Some CSPP modules are old and lack support for JPSS-2.
  - CSPP & IMAPP produce a different selection of products to IPOPP.
  - Difficult to work with IPOPP folder structure.

AutoPOP VM – Testing & Use

- Extensively tested and refined over past 6 months.
- Running reliably 24/7, processing data from Aqua, NPP, JPSS-1, JPSS-2 on single PC/VM (also running Dartcom iDAP/MacroPro visualisation/processing software).
- Much faster than IPOPP:
  - VIIRS L1: <5 minutes from pass end (including P2G) [IPOPP took >20 minutes].
  - All L1+L2 products: <17 minutes from pass end.
- Ancillary downloads much reduced compared to IPOPP.
- Gradually deploying on customer systems.



JPSS-1 VIIRS Sharpened True Colour 2026-03-04 (Received at Dartcom and processed with AutoPOP/CSPP)

Where next?

- Ongoing updates as new versions of CSPP modules are released.
- Possible migration of legacy FY-3 processing chain to AutoPOP.
- Test with other Linux distros (including CSPP-recommended Rocky / RHEL).
- Currently developing an AutoPOP module for EPS-SG processing software.
- Gauge wider interest in AutoPOP and potentially make it available to other users.

Conclusion & Final Words

- Many ways to implement a processing chain with CSPP/IMAPP.
- Difficult to make a 100% drop-in replacement for IPOPP.
- Simple, flexible, modular design of AutoPOP is easy to maintain and suitable for other applications (eg. EPS-SG, FY-3).
- VM implementation enables an easily deployable “black box” approach (raw data in, products out).

- Thank you to:
  - Jeremy Jacobsohn and Starry Manoharan at NASA for maintaining the IPOPP ancillary server.
  - CSPP team for their continuing development and support.


FIN

Any questions?

E-Mail: richard@dartcom.co.uk

Web: www.dartcom.co.uk