SAS Developments at XMM SOC

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Overview

1. SAS releases
2. Public SAS code release. Status and goal
3. ESAS inclusion -- bring this in as part of SAS and using CCF calibrations. Less monolithic
4. Python -- removing PGPlot --> maintenance. Some PERL removal too. Grace expected to be removed from prerequisites?
5. In general, SAS can be run in Python now -- more docs and scripts to be made available with next SAS release later this year.
6. Also producing VM version and docker version
7. Docker usage within the ESA Datalabs (remote collaborative system) being tested -- looks good.
8. Remote Interactive Science Analysis (RISA)

Half an eye on ATHENA science software needs.

SAS Releases

- Fully validated code releases once a year.
- Occasional patches.
  - Last major release v20.0 in November 2021
  - Next release v21.0 in November 2022
  - No major functionality changes but CAL and DAL interfaces updated

Public SAS code release

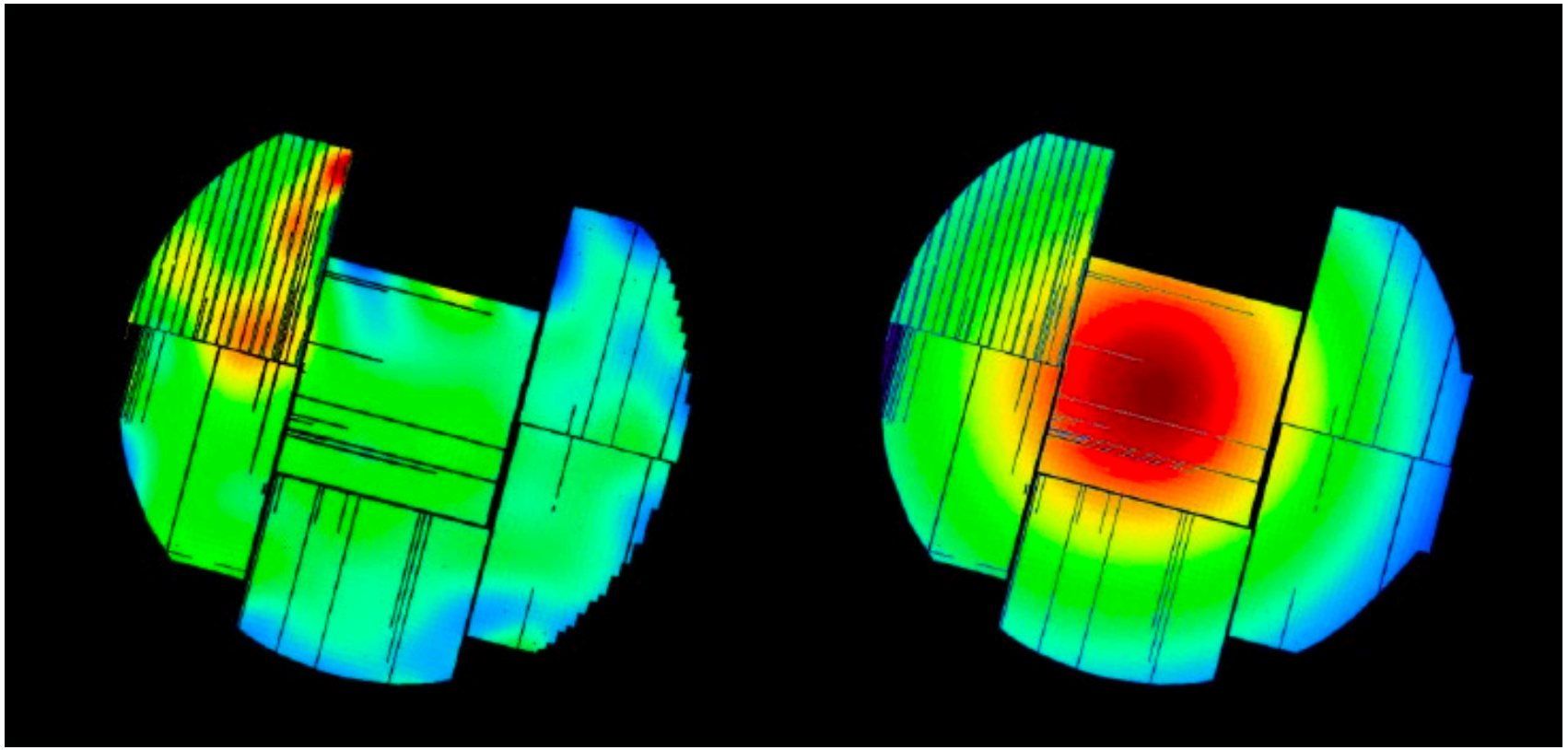
- Goal is to release SAS code publicly for users.
- Problem is some code was originally run with copyrighted code
  - notably from Numerical Recipes code (this is not available as public code)
- Currently removing/replacing copyrighted code with publicly available code e.g. SLATEC library
  - Test output values consistent and test harnesses established
- Onto a second stage where code replacements from GNU Science Library (GSL) to be used to finish 23 affected routine changes.
- Following this update, ESA will need to assess the code releasability before final code release can occur.

- Aiming for public code release updates to be done by the end of the year

ESAS inclusion in SAS release

- For a number of years the extended source analysis package has been developed by the XMM-Newton group at the Goddard Space Flight Center (originally lead by Steve Snowden – now retired).
- The package can
  - Create source and model particle background spectra and exposure-corrected, background-subtracted (particle, soft proton, and solar wind charge exchange) images
  - Allow spectra and images to be produced for user-defined regions within an observation field of view
  - The package can handle mosaicked data.
- GSFC has fully updated the code so that
  - It is compatible with the rest of SAS and to be distributed with SAS from version 21 onwards
  - This includes the use of XMM-Newton CCF calibration files, sams as the rest of SAS – as opposed to previously requiring its own database of background data.
  - Has become more modularised (last version more monolithic). User can pick and choose parts wanted
  - Complete documentation update.
- Still requires full testing before release

Example Background and Exposure maps



SAS in Python

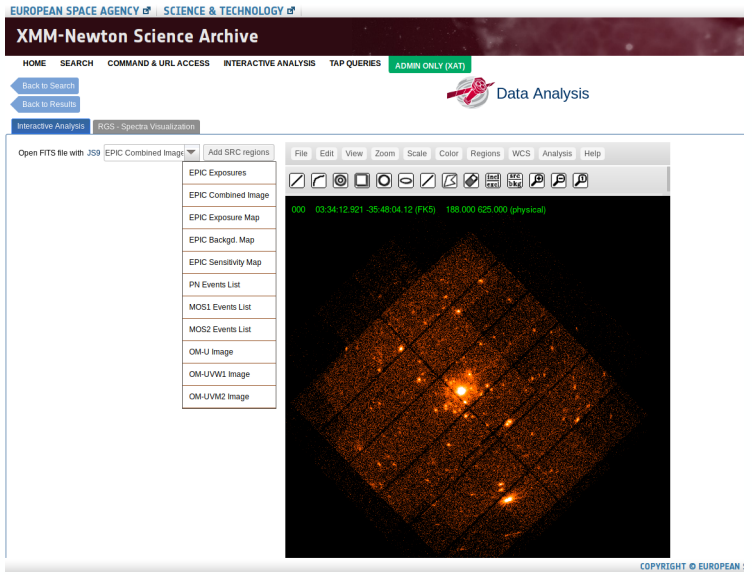
- As of SAS 20, SAS commanding can be done within a Python environment
  - Fully operational Python infrastructure pysas .
  - This enables SAS use within Jupyter notebooks and/or JupyterLab.
    - Makes software available to use with the very wide range of features and capabilities of such packages as *Astropy*.
    - *Astroquery* access to XMM-Newton archival data is already available – allows scripted rather than UI access to XMM-Newton data.
  - Python also being used to remove *PGplot graphical* routines. Part of attempt to reduce complexity of packages that make up SAS and provide adaptable code for users.
- Looking at replacement/reduction of use of PERL and HEASARC packages by Python.
- More documentation and sample scripts/threads are expected to be available with the next SAS release

Virtual Machine and Docker versions of SAS

- **Both VM and Docker versions are created for each SAS version release.**
  - *VM4SAS20.0 available in two VM formats, VMware and Vbox*
  - *First public SAS Docker image based on the Ubuntu 20.04 base image used with SAS release 20.0*
- **These do require extra software to run either the VM or docker engine. But make SAS able to be simply installed and run on most systems.**
- **Docker version being developed for *ESA's online Datalabs (a cloud environment).***
  - **The XMM-Newton docker in Datalabs could in principle include the whole range of software wanted in an astronomer's 'X-ray environment', e.g. Xspec**
  - **Please see XMM-Newton Datalabs demo by E. Ojero.**

Remote Interactive Science Analysis (RISA)

- RISA can be run by users who want to run interactive analysis on (typically) a few observations
- It can be accessed online via the XMM-Newton science archive (XSA).
  - Allows reprocessing using the latest SW version and CCFs
  - EPIC spectra, light curve and image generation



- RISA statistics for 2021:

  Number of jobs submitted: 1084

  Number of unique users (not SOC): 70

- Recent successful study on running RISA in the cloud. Likely to move to this (or Datalbas) soon