

CMB-S4 Transient Pipeline Development and Evaluation

Felipe Menanteau (*he/him*)

CMB-S4 Collaboration

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Objective

- Detect and report transients events for CMB-S4
- Evaluate the SPT-3G software and SPT-3G Transient pipeline for this
(https://github.com/SouthPoleTelescope/spt3g_software)
- Use CMB-S4 DC0 Simulations for this task
- Follow the path of Whitehorn (2016) SPTPol and Guns et al (2021) SPT-3G for transient detection

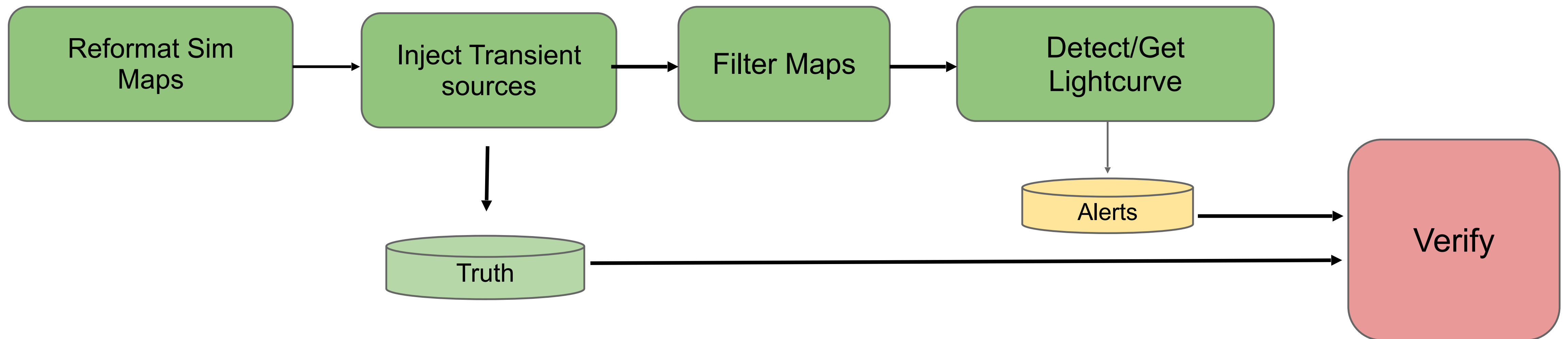
Thanks:

- Sam Guns
- Allen Foster
- Tom Crawford
- Sasha Rahlin
- Nathan Whitehorn

DC0 Simulations

- 5711 CHLAT SCAN maps (RISING & SETTING) transferred to from NERSC to the Illinois Campus Cluster (ICC) at the National Center for Supercomputing Applications (NCSA).
- All 5711 CHLAT noise maps in HDF5 format were transformed into Healpix (FITS) all-sky maps using toast (i.e. `toast_healpix_coadd`) on the ICC.
- We tiled the sky in 36 ~20deg x 20deg tiles and use these tiles for our analysis.
- Tiles use a ZEA projection
- We used the Singularity Containers (based of docker) for the batch jobs at the ICC
- Code repo for CMB-S4 Transient Pipeline: <https://github.com/CMB-S4/s4trans/>

Processing workflow



DC0 Simulations

RISING SCAN 40-150-10

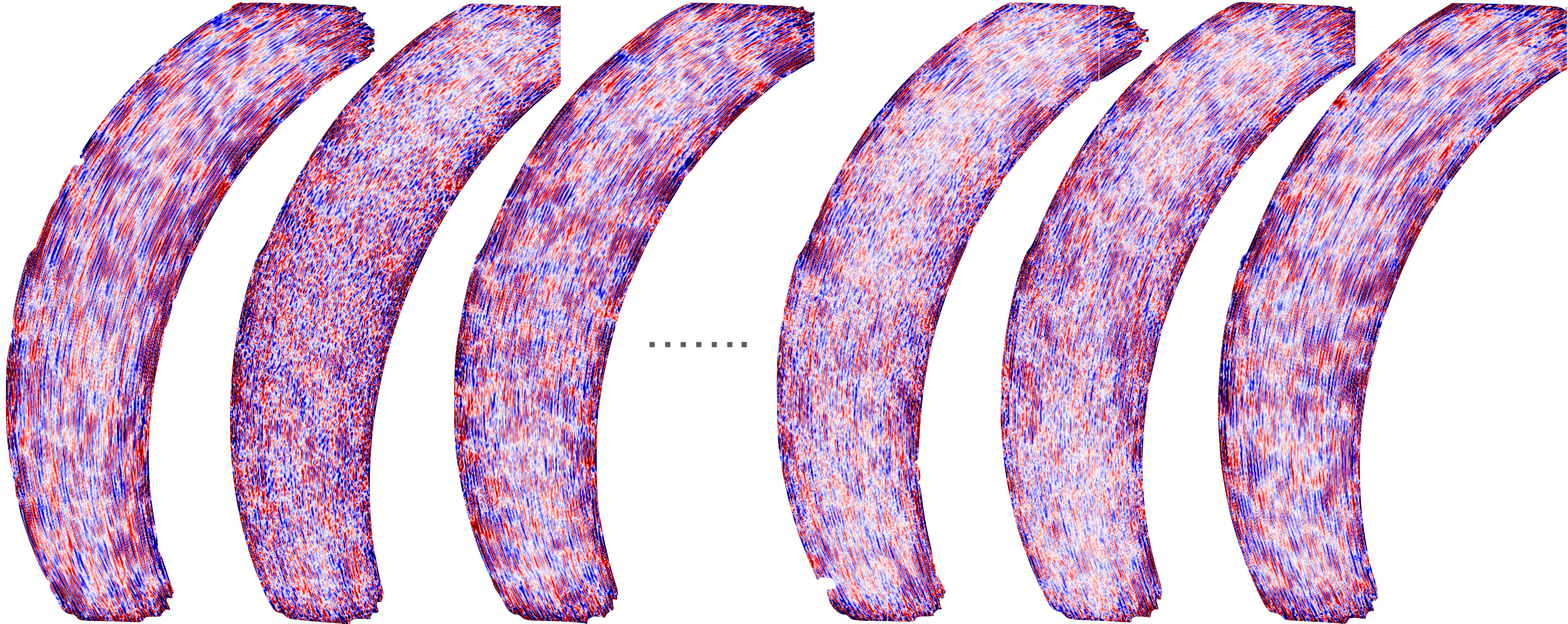
RISING SCAN 40-157-9

RISING SCAN 40-162-9

RISING SCAN 40-163-9

RISING SCAN 40-161-9

RISING SCAN 40-160-9



DC0 Simulations (Tiling)

RISING SCAN 40-150-10

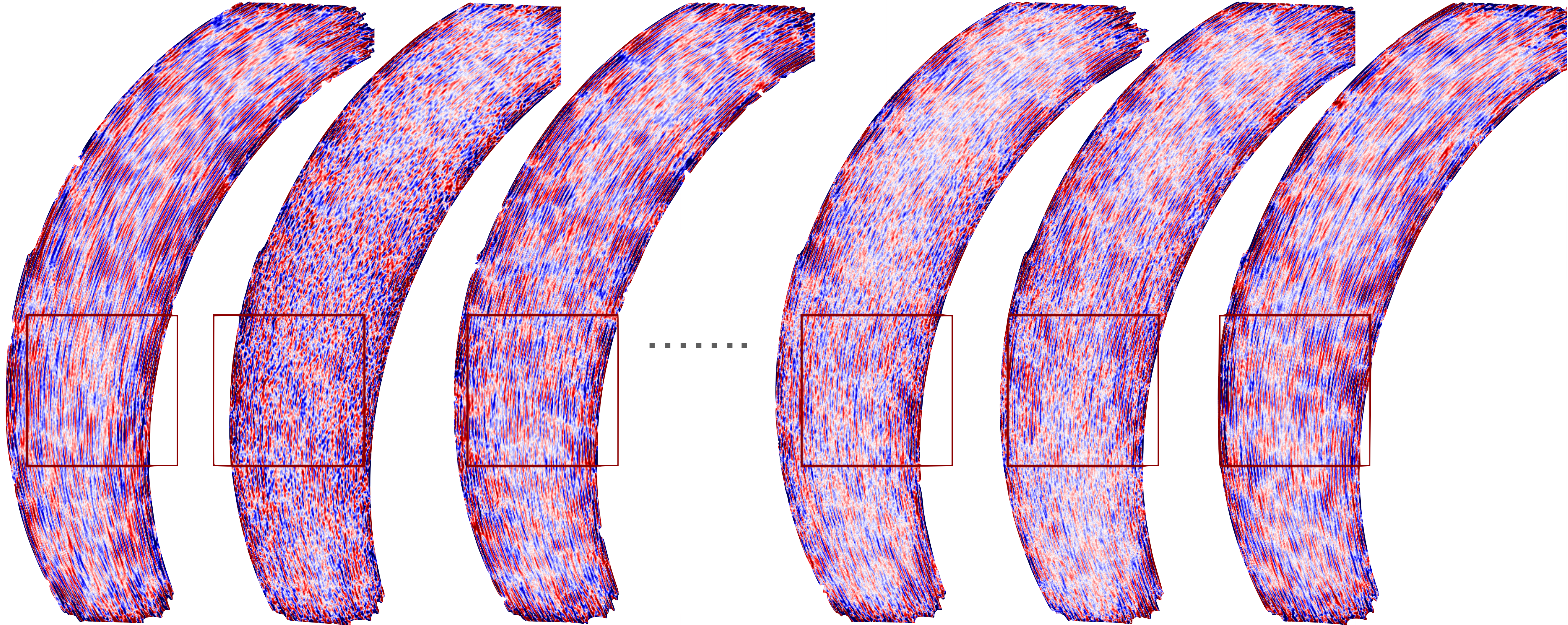
RISING SCAN 40-157-9

RISING SCAN 40-162-9

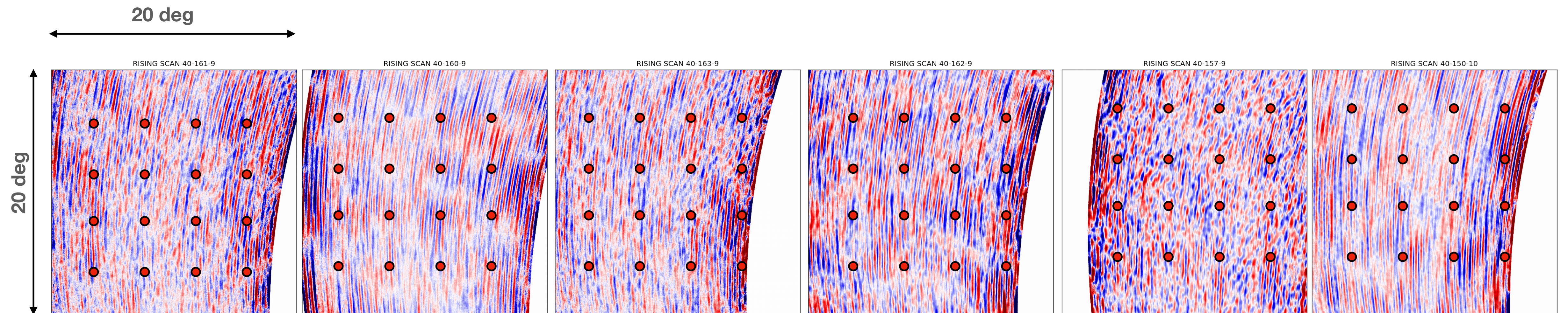
RISING SCAN 40-163-9

RISING SCAN 40-161-9

RISING SCAN 40-160-9

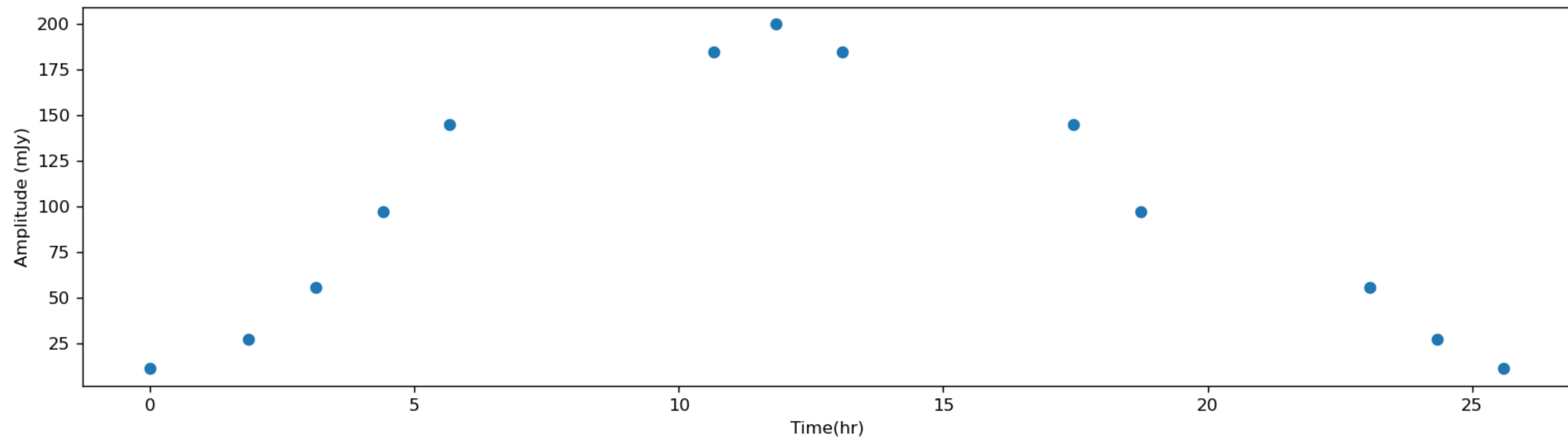
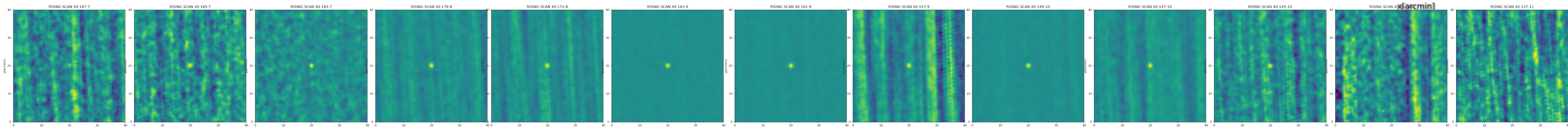


Sky Tiling on DC0 Scans (Arbitrary)



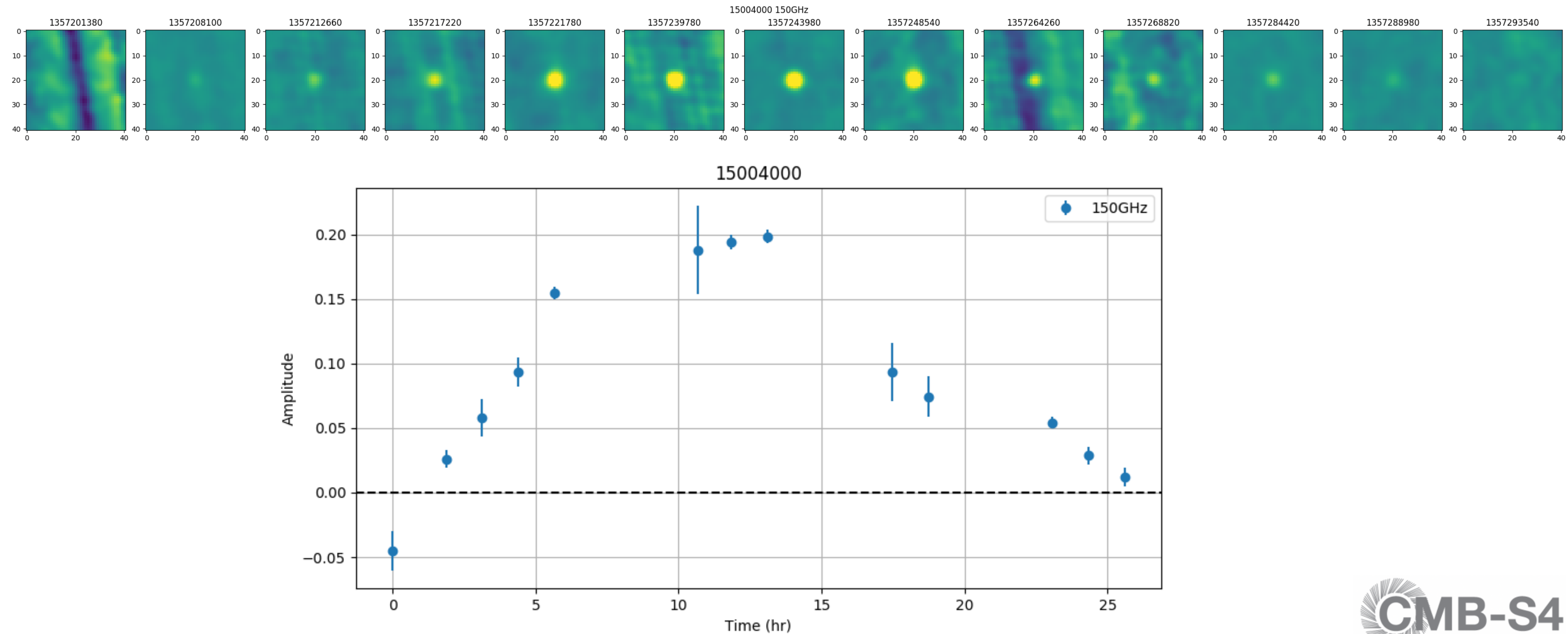
Injection of transient sources (inputs)

- Projection + Injection + Filtering takes ~12 min over 1 tile per scan/observation on ICC running x40 wide



Source Detection and Light Curve Recovery

Using the SPT-3G Transient Pipeline



Future Work

- Run Source injection and LightCurve extraction at scale (all sky?) at ICC
- Inject sources at various time-scales and fluxes
- Verify/Distribute/Asses DC0 results — How??
- Follow steps of SPT-3G collaboration and develop a cutout/lightcurve server for transients like the “SPT-3G Cutout Web App”

- Home
- Cutout
- Status

Single Observation Section

Use Single Observation maps

Select Date range for Single Observation maps only

Acceptable range: 2019-01-01 to 2022-06-22

Start Date
01/01/2019

End Date
11/30/2021

Filetype Section

Select filetypes for Single Observation maps, winter_2020 and rawmap_v1_2019_2020

- passthrough
- filtered

Select at least one filetype.

Coadd Section

Select Coadd ID for coadds only

- winter_2020
- rawmap_v1_2019_2020
- cleanbeammap_v1_2019_2020

Select frequency bands

- 90GHz
- 150GHz
- 220GHz

Select at least one frequency band.

Input a CSV-formatted table of cutout positions, (RA,DEC) in decimal degrees, (XSIZE,YSIZE) in arcmin. Optional column with unique id/names can be added so columns are OBJID, RA, DEC, XSIZE, YSIZE

Cutout Positions

RA,DEC,XSIZE,YSIZE
358.3406816, -58.9660379, 10, 10
354.3406815, -58.9660379, 10, 10
357.3466815, -58.9660379, 10, 10

UPLOAD CSV FILE

- Get lightcurves for input positions
- Do not make FITS thumbnails
- Select uniform coverage
- Send email notification

GENERATE CUTOUTS

SPT-3G Cutout Web App

- Built on DES experience
- K8s deployment on NCSA radiant (open stack)
- K8s for job management an resources
- Web front-end is React JS
- CILogin for authentication
- Retrieve files using wget
- 100% open source deployment
- We have python REST API**

Full k8s deployment repo home:
<https://gitlab.com/spt3g/kubernetes>

South Pole Telescope (SPT) at NCSA

Launch app

Learn more

Conclusions

- We have demonstrated that we can use the SPT-3G software to load, project and filter DC0 scan maps
- Starting point for SPT-3G software are Healpix maps.
- We have developed code to insert transient sources of arbitrary flux/times
- We have used SPT-3G software to project (ZEA) and filter the DC0 scans over ~40 observations. Run times are about 15 min/tile.
- Can run over all tiles in 15hrs
- We have demonstrated that we can successfully run the SPT-3G transient pipeline to recover the injected sources.