Update on all-sky camera analysis

Canon camera (R,G,B pixels).

Has been operating at LSST site for ~1 year. 32s exposure time. ~4 arcmin pixels

Equal-area projection fisheye lens (i.e., no sophisticated image reduction required!)

Things we'd like to do with the data

- Verify sky brightness model, build twilight sky model (done)
- Test weather predictions (do clouds roll in when predicted?)
    - Still looking for a forecast archive from Gemini and/or proprietary forecasts
- Cloud statistics. How often do we need to use the camera to inform LSST pointing?
    - DES claims it's usually "all clear" or "all cloudy"
    - Stubbs points out there should be several contrails per night
- If there are sufficient partly-cloudy times, work out how to return a cloud and/or transparency map, and predict future cloud map for the LSST scheduler

Original pipeline

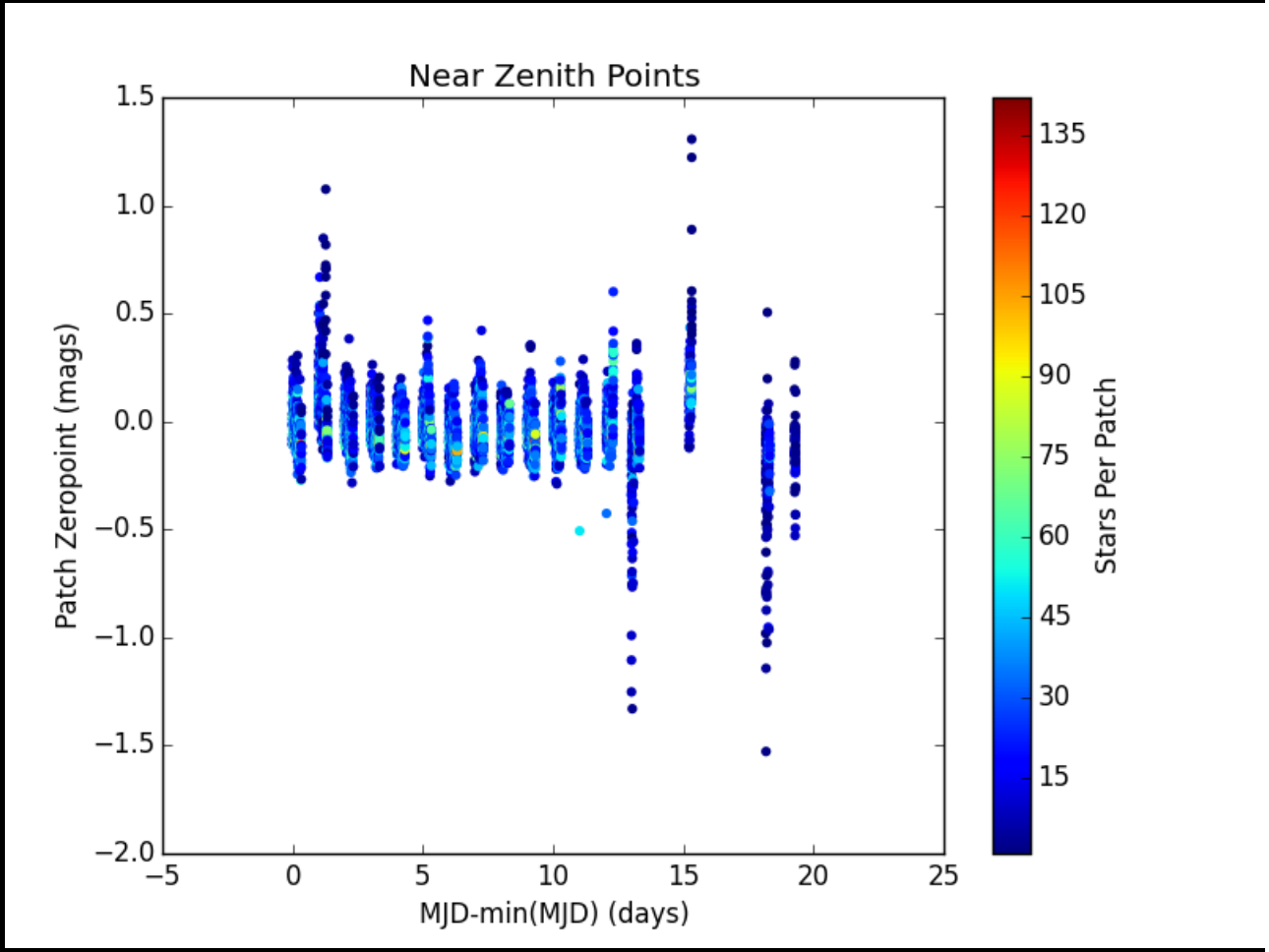
- Solve astrometry every frame
- Do photometry from a list of ~4000 known stars and record mags and background values

This breaks down in light clouds—faint stars drop below detection and astrometry solution gets bad (not a problem for background measures, but stellar mags get matched to wrong star ID).

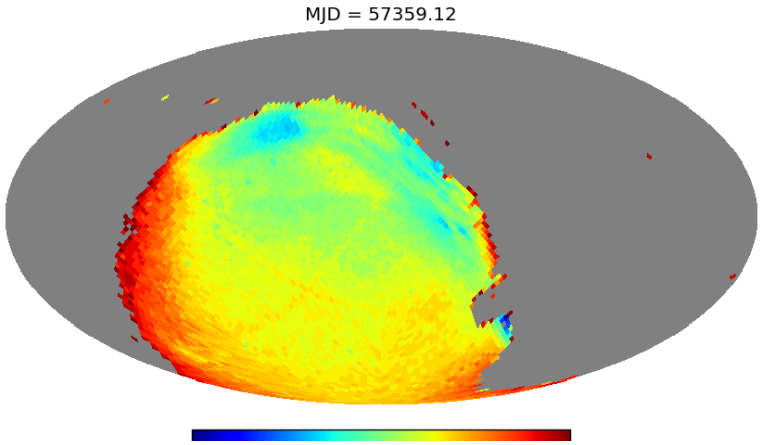
All sky camera section near MW plane

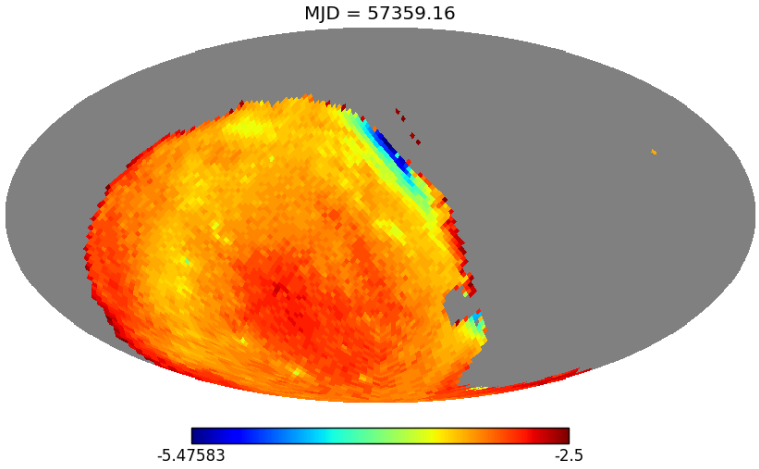
Running ubercal

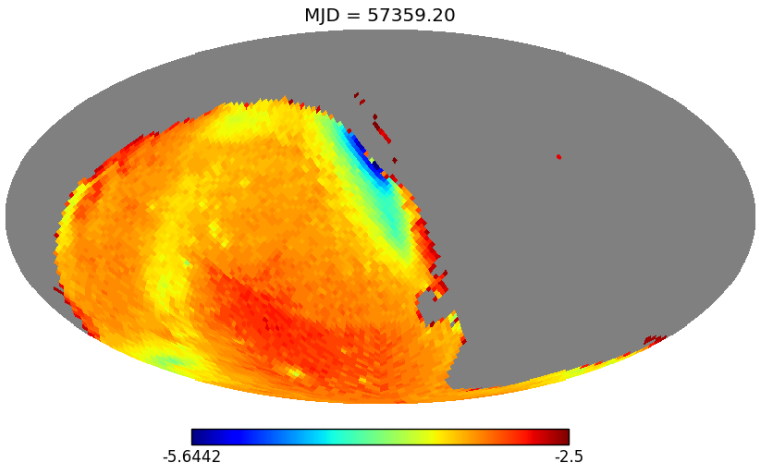
- Very few stars per patch, even at low resolution
- Fails in clouds b/c stars are mis-identified
- Non-Gaussian residuals

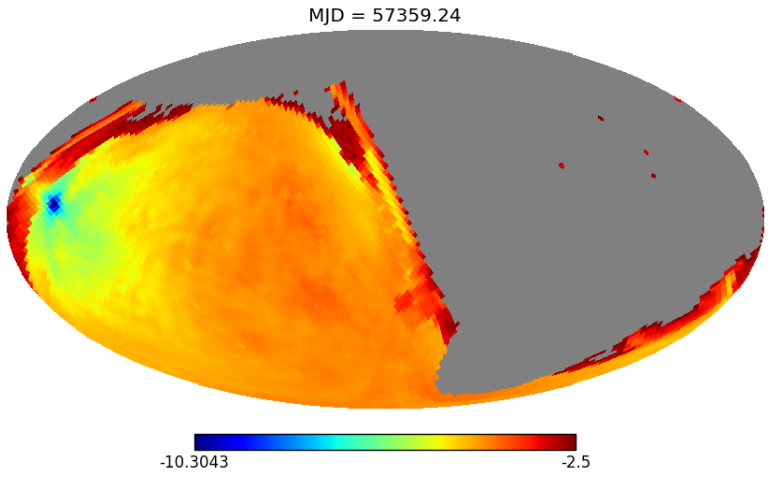


Even if we fix the photometry, the resolution will be very low (~7+ degrees, every 15 minutes) when it's cloudy if we use stars to measure transparency. A Canon camera is small, and there are few bright stars.







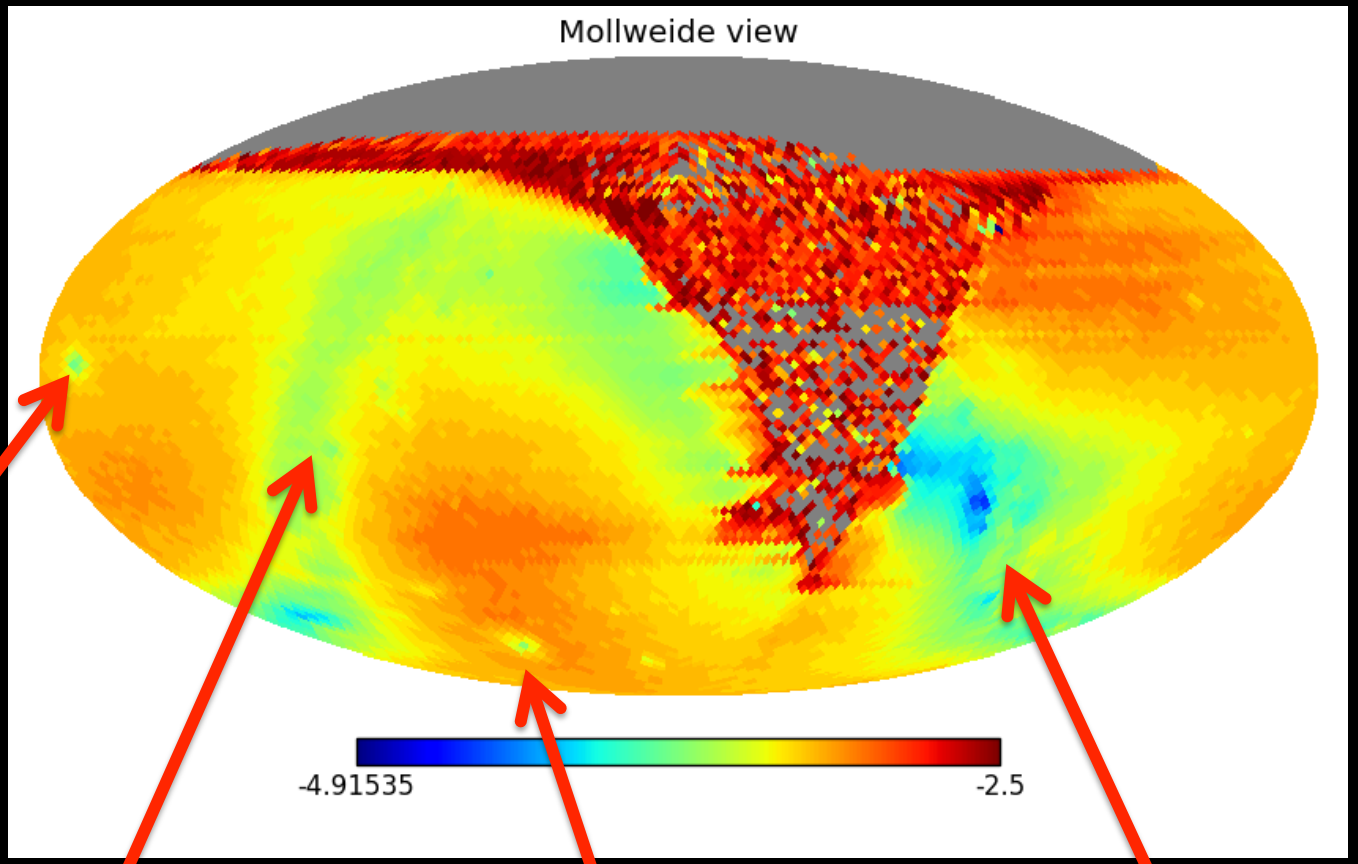


~1 hr steps

New pipeline

- Use a fixed alt-az solution for the images
- Use MJD to calc RA,Dec of each pixel in an exposure
- Median bin into healpixels at 2 degree resolution (eliminates all the point sources)
- 66 nights so far → 20 GB database

Dark-time Median map of median healpixels (get's rid of clouds)

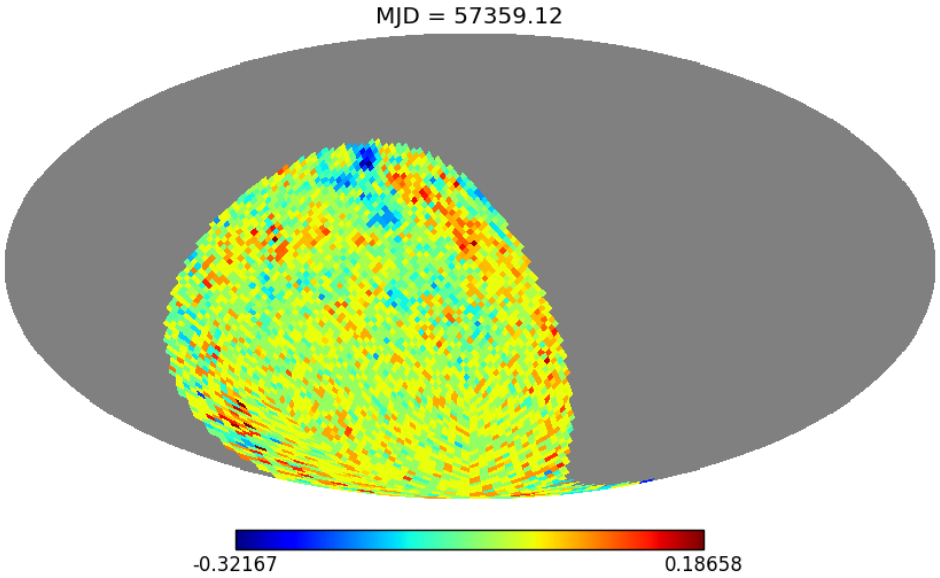


Planet?
Jupiter?

MW

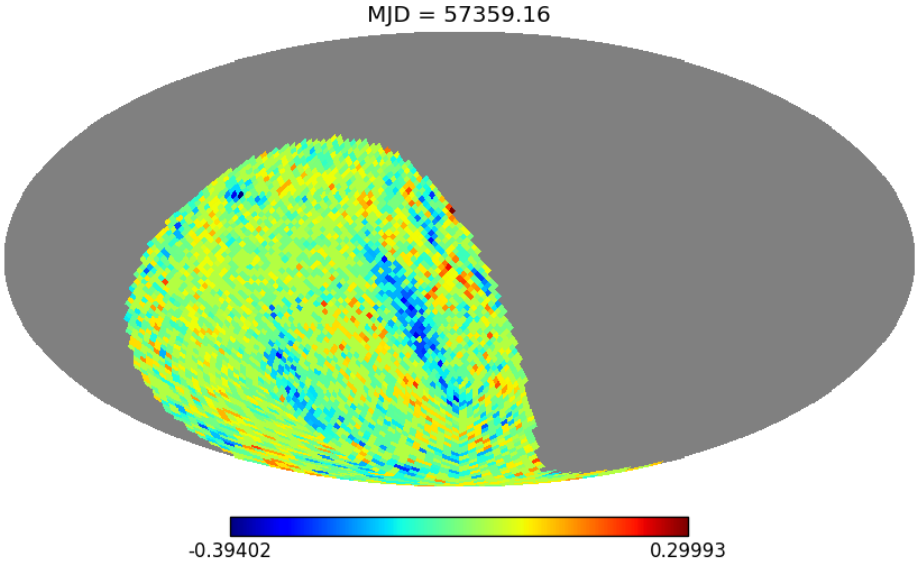
LMC

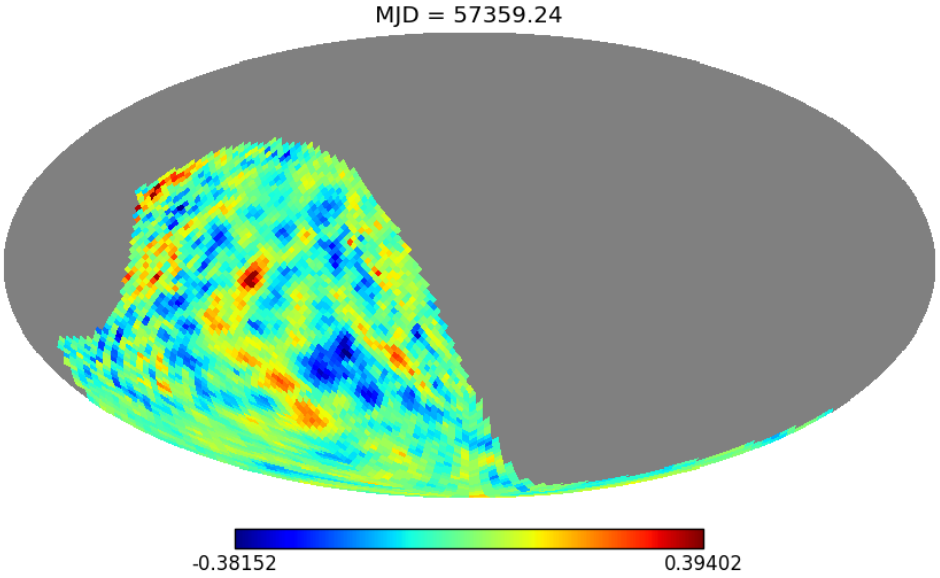
GC



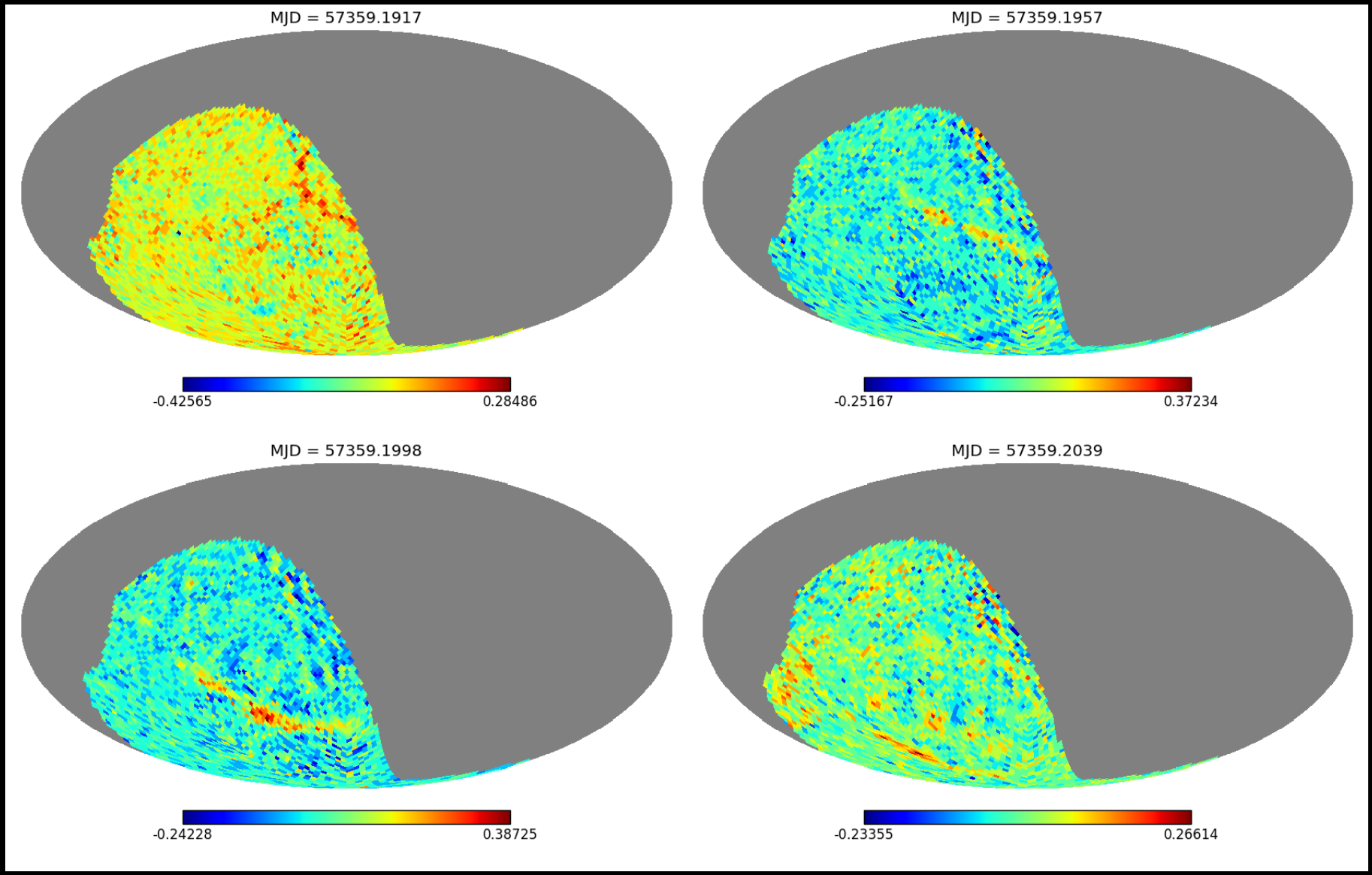
2 ways to look for clouds

- Compare to sky model
- Subtract consecutive exposures





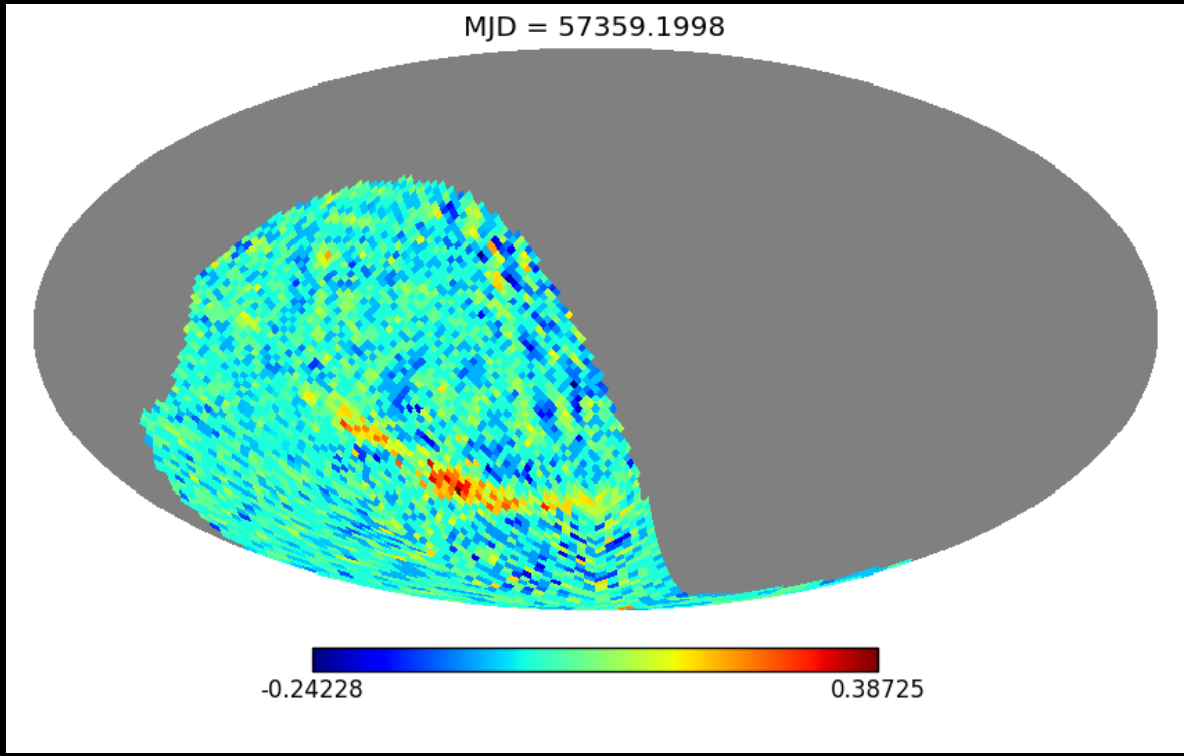
Sequence of difference images (6 min steps)



Human eye picks out the cloud easily. Stubbs has demonstrated some nice filtering to do it automatically.

Note: Easy to say where the cloud is, hard to say what the transparency is. Clouds can make sky brighter or fainter at night.

So we can make ***cloud masks***, but not full ***transparency maps*** unless we do a massive overhaul on the photometry pipeline (and even then, there's not much dynamic range to work with, we lose a lot of stars in light clouds).



Working out which statistics give a good approximation of the cloudiness.