Dodging Satellites with the Rubin Observatory Scheduler

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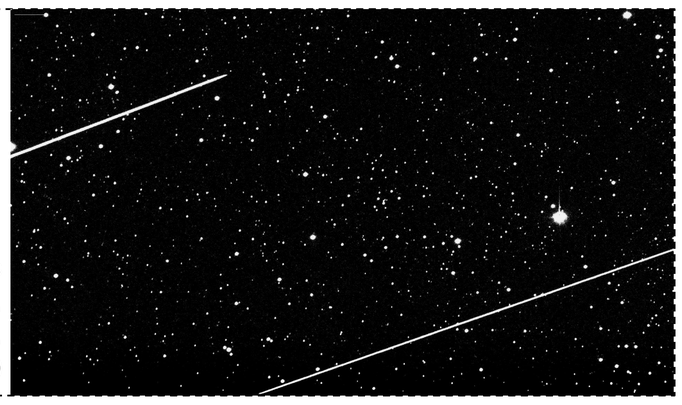
- An increasing number of commercial low-Earth-orbit satellites will leave bright streaks in many Rubin LSST pointings
- Can we avoid some streaks in pointings while ensuring enough survey depth and exposure time?

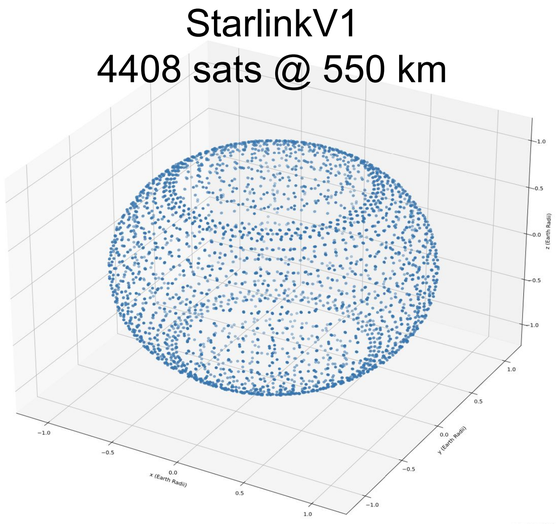


Two Starlink satellites (Jeremy Tregloan-Reed, Calar Alto Observatory, September 2020)

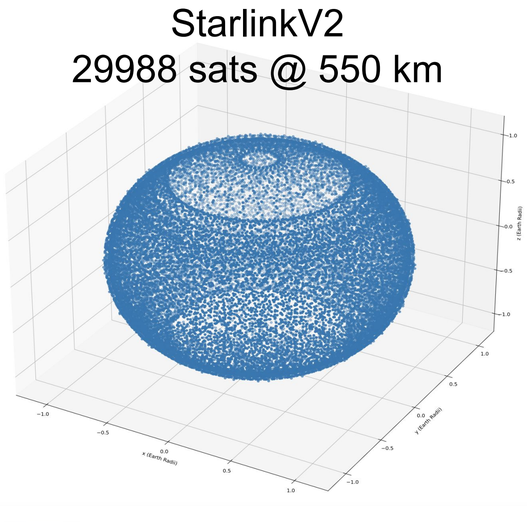
Three Simulated Satellite Constellations

- Based on FCC filings for operators with existing satellites in orbit

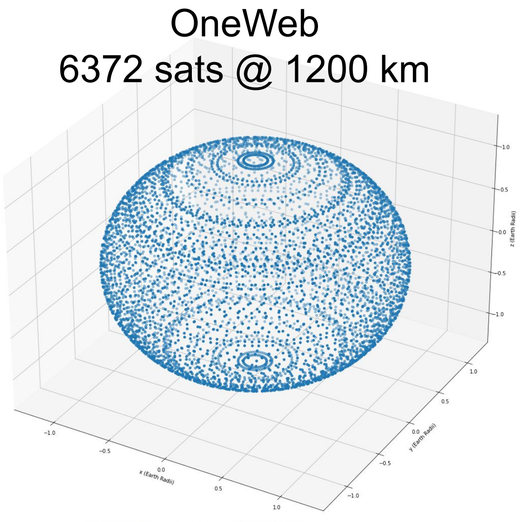
StarlinkV1
4408 sats @ 550 km



StarlinkV2
29988 sats @ 550 km

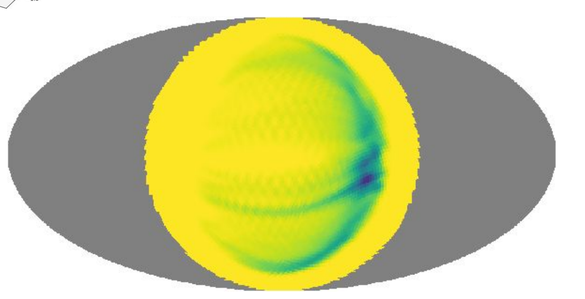


OneWeb
6372 sats @ 1200 km

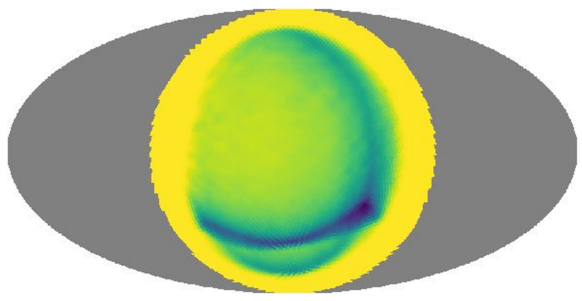


Adding Dodging to the Rubin Scheduler

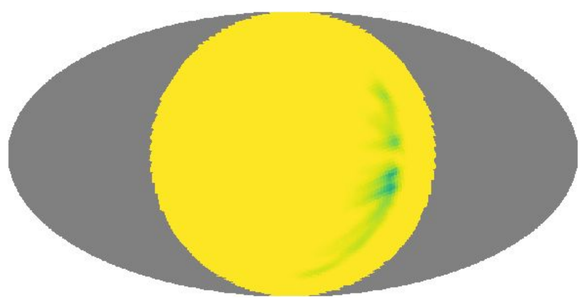
- Predicted satellite maps over 90 min (gray areas are below the horizon)
- Scheduler already considers slew time, image depth, and footprint uniformity — **we add a new weight to "reward" satellite avoidance**
- OneWeb has fewer satellites than Starlink, but they are illuminated longer due to higher orbital altitudes



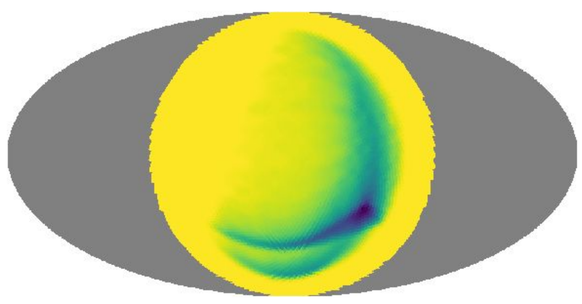
StarlinkV2, Sun altitude –17.1 degrees



OneWeb, Sun altitude –17.1 degrees



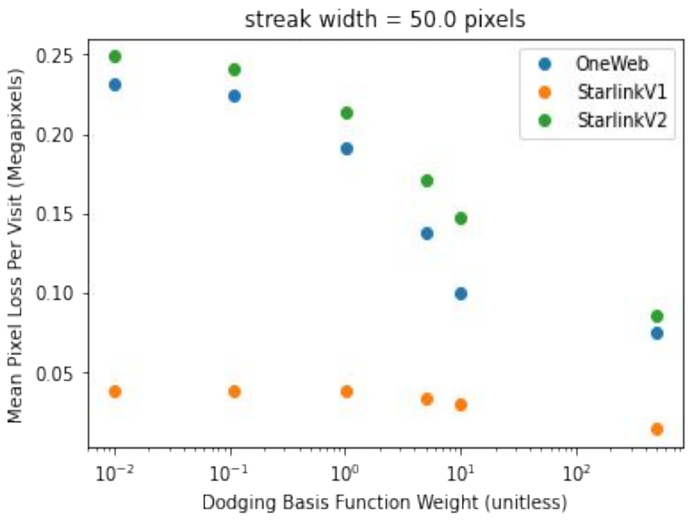
StarlinkV2, Sun altitude –26 degrees



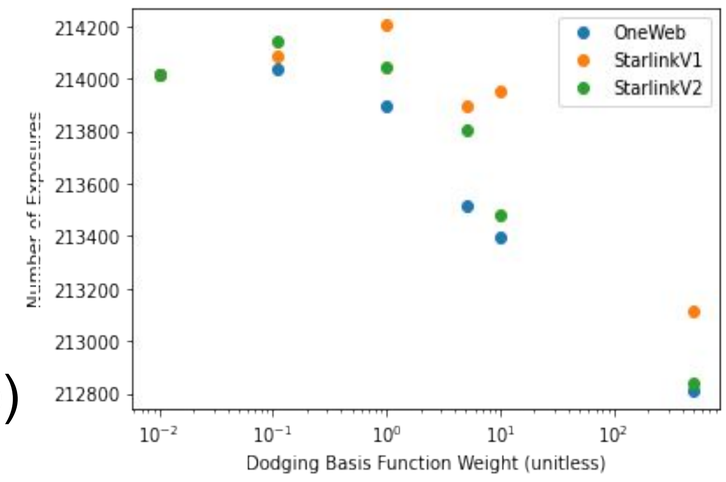
OneWeb, Sun altitude –26 degrees

We modify the scheduler to avoid areas of the sky with more satellite streaks in the next 90 minutes

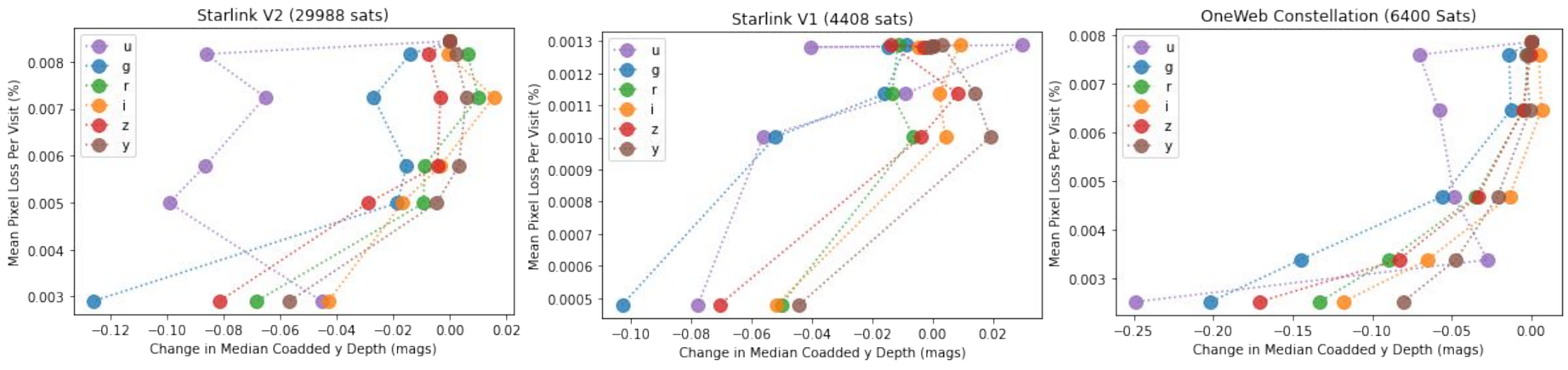
Higher dodging weight and a smaller satellite population reduces pixel loss



Higher dodging weight and a larger satellite population yields fewer exposures (due to increased slew time)



Trade-off between pixel loss and coadded depth (depth loss due to fewer exposures & less desirable conditions)



We ***can*** dodge satellites effectively with the Rubin Scheduler, but the penalty in survey depth makes it ***overwhelmingly not worth it***

Caveat: this needs to be revisited if satellite streaks are bright enough to saturate detectors

Participant in the LSST Corporation's program for student researchers at the 2022 Rubin PCW