

Satellite Mega Constellations

(Dated: May 3, 2023)

ABSTRACT

Updates on how satellite mega constellations could impact observations of solar system objects and the overall fraction of pixels that could be lost to satellite streaks

1. INTRODUCTION

Throughout this paper we consider a Gen 2 Starlink satellite constellation as in [Hu et al. \(2022\)](#). This constellation has 30,000 satellites in altitudes ranging from 340 to 614 km.

This is the LSST overview paper: [Ivezić et al. \(2019\)](#).

2. PIXEL IMPACT

After year 1, 8% of all images would have at least one streak from the constellation. Per image, the mean streak length comes to 15.3 arcmin, so a 1 arcmin streak mask would result in 0.04% of pixels being lost (assuming 0.2 arcsec per pixel and 3.2 Gpixels per visit).

Some of the most impacted observations are the high airmass observations taken in twilight to detect inner solar system objects. These visits consist of single 15s snaps. Table 2 breaks down the impact of streaks for twilight and non-twilight NEO visits.

2.1. *Toss a Snap*

We can consider a “worst-case” scenario that if a visit contains a satellite streak, then that snap with the streak is discarded and a visit is reduced to a single 15s exposure rather than two 15s exposures. This would result in the 5- σ limiting depth being 0.37 mags shallower than if there was no streak.

In Figure 1, we show the result for rejecting snaps with streaks for the first year of the baseline v3.0 survey in r .

visits	N visits	streaked	pixels lost
all	216120	8.4%	0.043%
non-twilight	210679	7.4%	0.039%
twilight NEO	5441	45.7%	0.19%

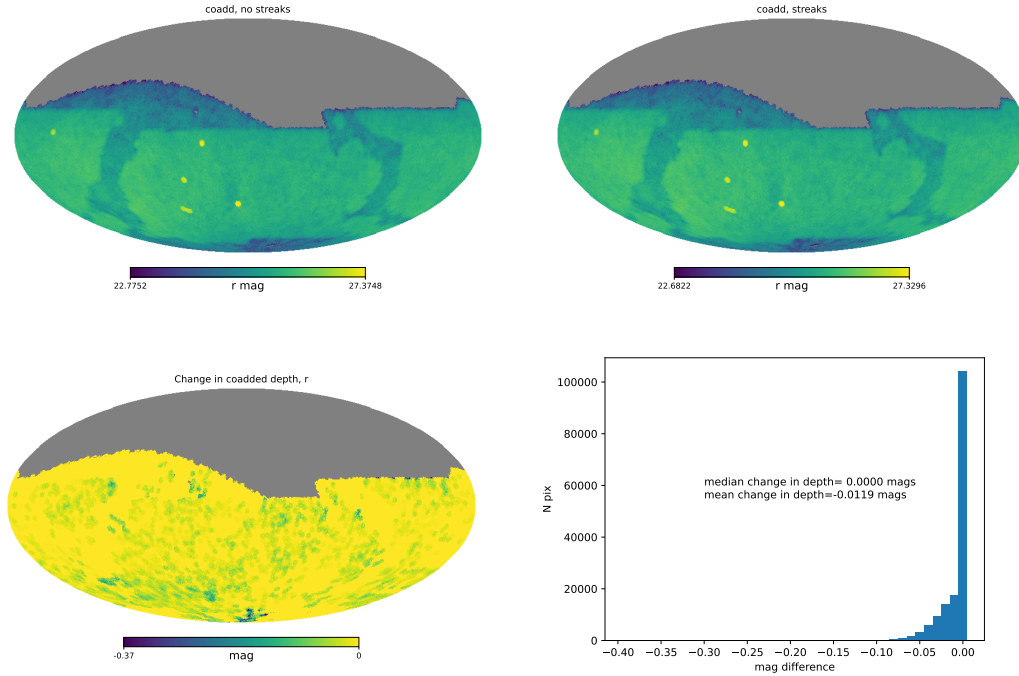


Figure 1.

For this subset of exposures (r band in the first year, only 30s visits so no twilight NEO observations), we find that of the 44,000 visits, 5% would be streaked by an illuminated satellite. A large portion of the sky would be unaffected, with the mean change in coadded depth being 0.011 mags.

3. SOLAR SYSTEM IMPACT

We can check how satellites could impact discovery of solar system objects.

APPENDIX

A. REFERENCES

REFERENCES

Hu, J. A., Rawls, M. L., Yoachim, P., & Ivezic, Ž. 2022, *ApJL*, 941, L15

Ivezic, Ž., Kahn, S. M., Tyson, J. A., et al. 2019, *ApJ*, 873, 111

B. ACRONYMS

Acronym	Description
LSST	Legacy Survey of Space and Time (formerly Large Synoptic Survey Telescope)
NEO	Near-Earth Object
arcmin	arcminute minute of arc (unit of angle)
arcsec	arcsecond second of arc (unit of angle)