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GLADYSCALE: A STRATEGIC TOOL FOR ASSESSING SATELLITE IMPACT ON GROUND-BASED ASTROPHYSICS AND PLANNING FUTURE ASTROPHYSICS MISSIONS

Abstract

In the past 400 years, ground-based astronomy has dominated as the data source for probes into the cosmos and has uniquely excelled in major scientific areas, including exoplanetary science, multi-messenger astronomy, and galactic archeology.

Now, the proliferation of satellites has dramatically altered ground-based astronomy. Satellites cause streaks on images, block out precious photons, and lower the signal-to-noise ratio of observations. This is particularly concerning for the 30-meter, billion-dollar class telescopes proposed as the next generation of observatories and expected to come online in the next decade–the same timeframe as approximately 200,000 more satellites. The potential rapid deterioration of the ability to use ground-based observatories will leave a significant void, with hundreds of high-priority research projects impacted and researchers scrambling to find new ways to complete their science.

To preempt this potential future, we need to understand which regimes of ground-based astronomy are most at risk and determine possible future paths. The first step in this research, which has already been completed, is to create a predictive model of the effects of satellite constellations based on planned launches in the next ten years, focusing specifically on the impact on astrophysics goals. The next step in this research, which is underway, is to create a rating metric that assesses the risk posed to each astronomical case by satellites. This metric will be called the GLADYSCALE, after the developer of GPS, Gladys West.

GLADYSCALE ranks ground-based astronomical cases based on three factors: threat level, timescale, and importance to the scientific community. The threat level and timescale come from orbital track analysis, and the importance comes from the 2020 Decadal Survey, the guiding document for U.S. astrophysics priorities. This study identifies which goals can be achieved on the ground, which is most likely to require a transition to space-based modes, and when the inflection point for each sub-regime of astronomy is expected to occur. The inflection points mark when a science case is impossible from the ground due to satellite-induced data deterioration. Using GLADYSCALE, the community can proactively and strategically plan for future space missions in exoplanets, astronomy, and space physics.

This presentation will provide an overview of the results of GLADYSCALE under different future satellite environmental conditions. It will also discuss the scientific and time-dependent rationale for rethinking how we prioritize telescope design and the applications of GLADYSCALE for space science mission planning.