

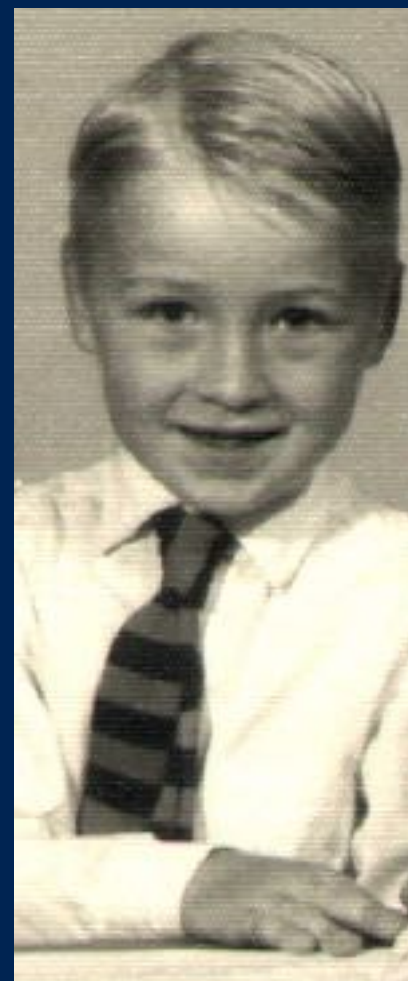
# An introduction to Megaconstellations

Andy Lawrence  
The Challenge of Megaconstellations  
FAS Webinar May 7-8 2022









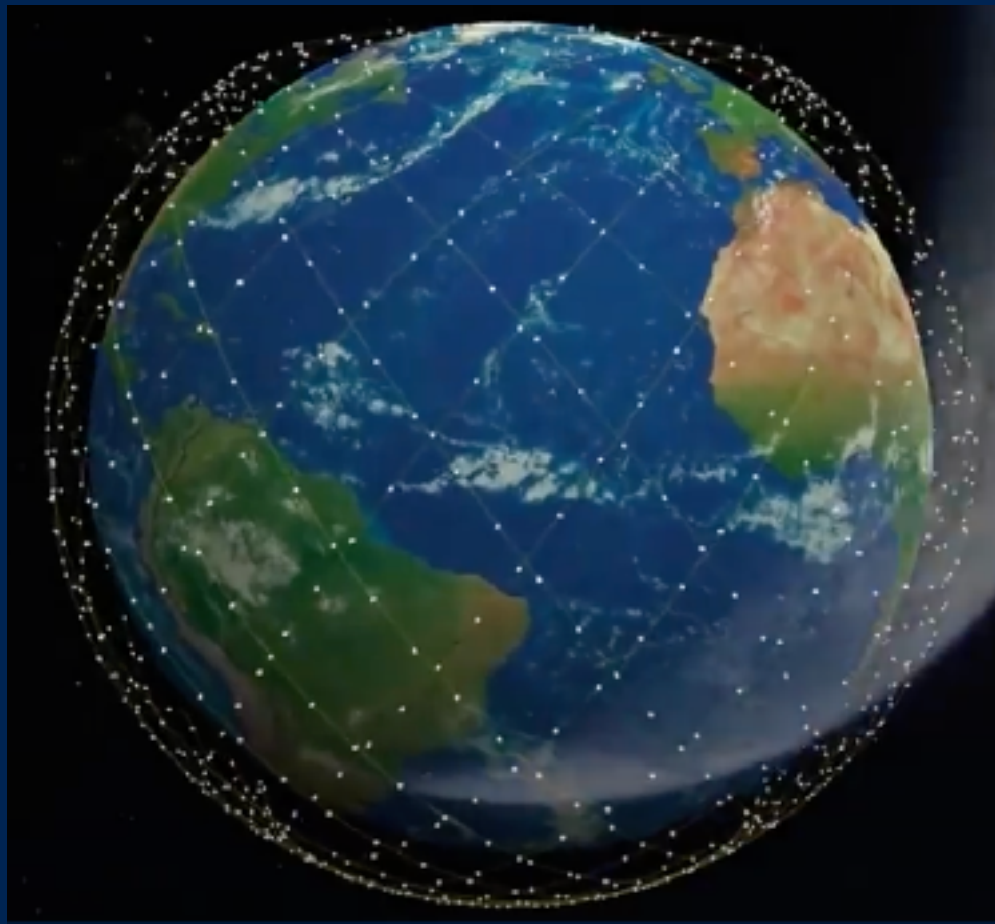


Dark Energy Survey: P.Marenfeld/NOIRLab/AURA





picture  
by Andrew Farrow, ASE



Connecting  
the world!





# Satellite streaks aren't new



UK Schmidt plate, c.1980

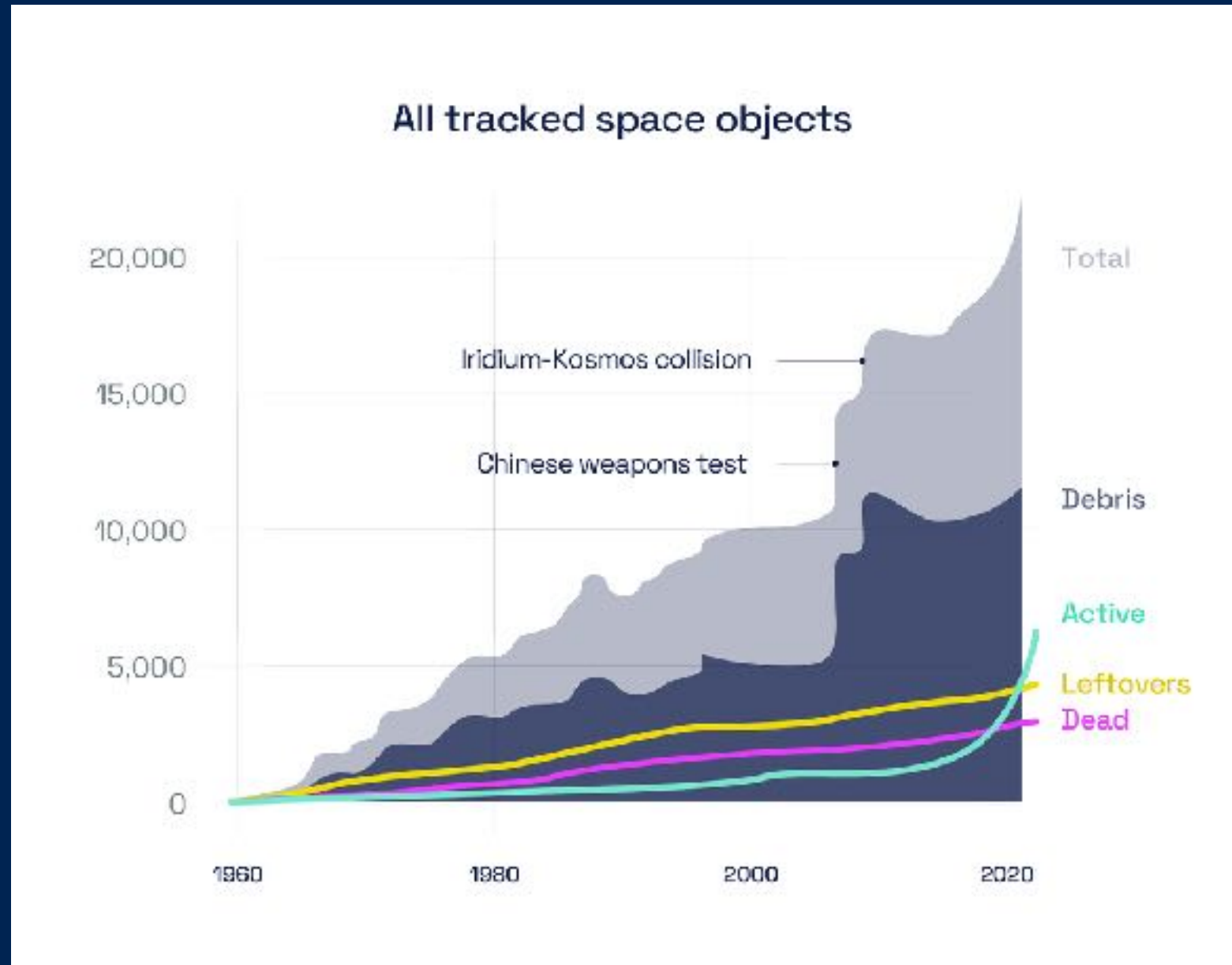


# Satellite internet isn't new



So what's  
new?

The rate  
of change

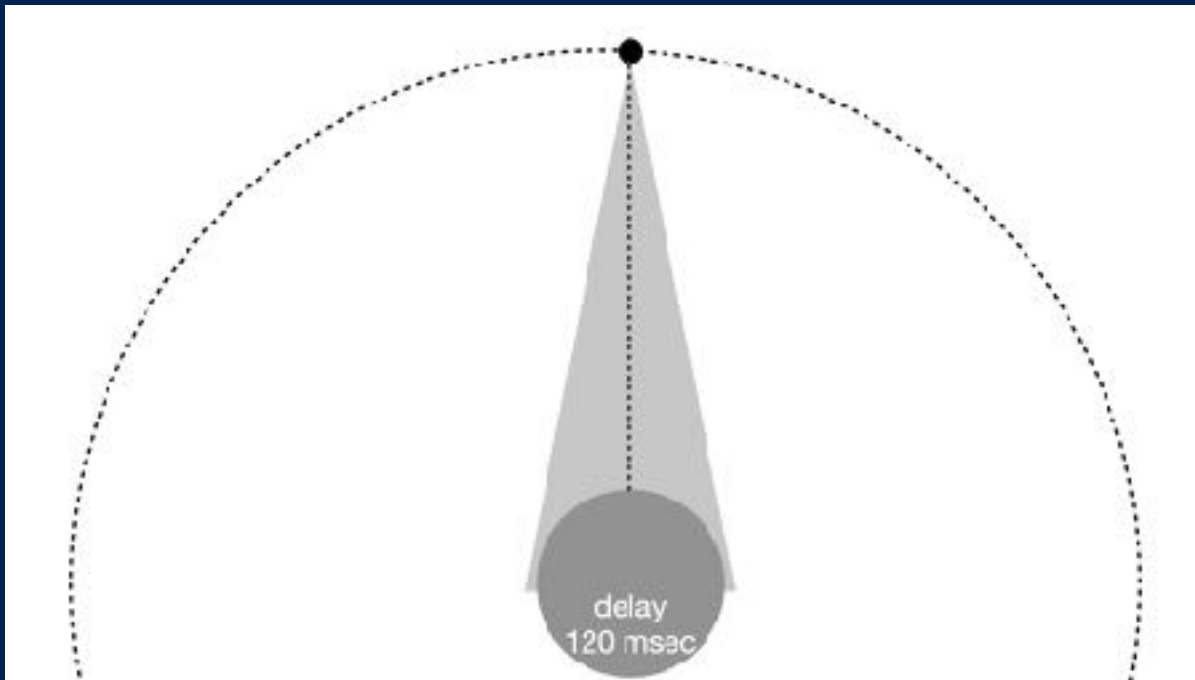




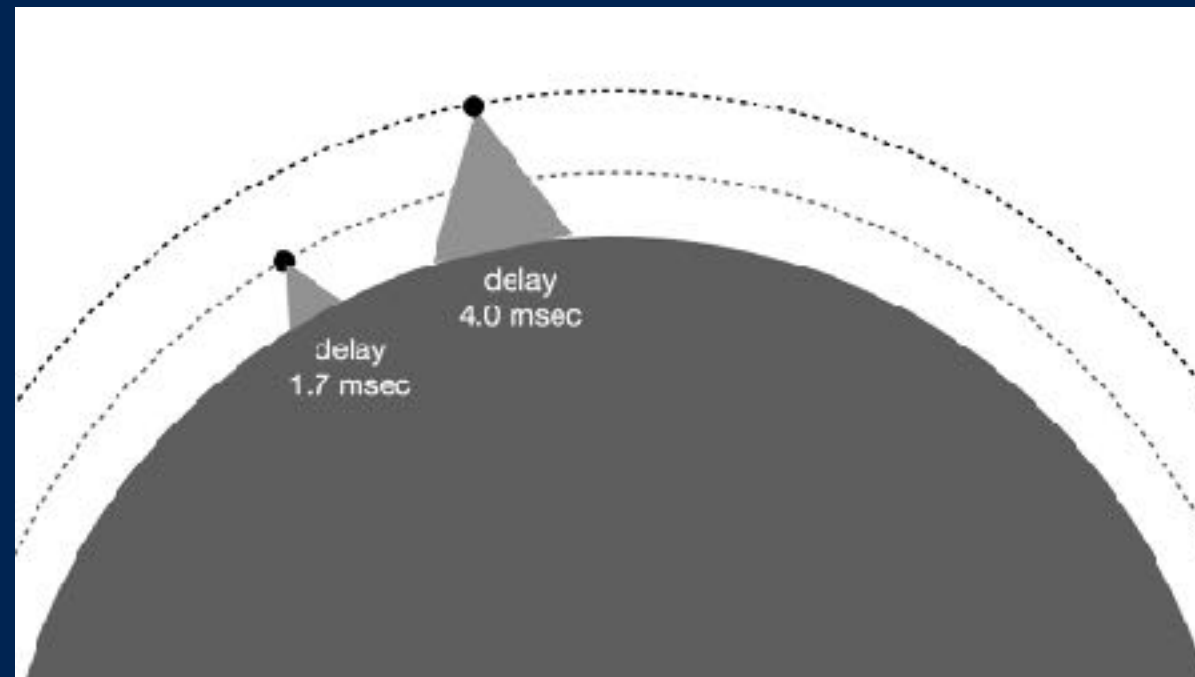


Not just  
Starlink!!

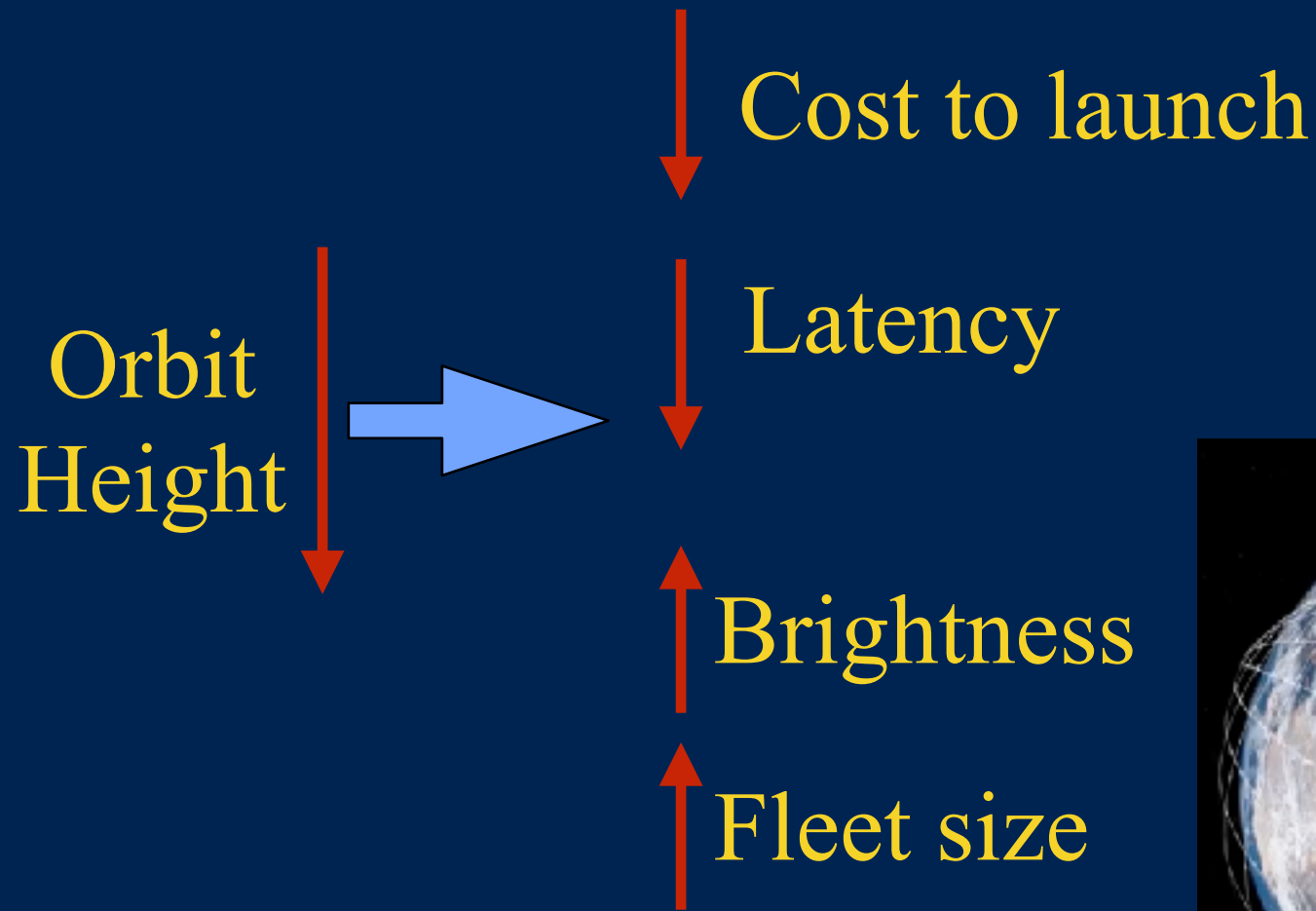
There Will Be More.



Its all about  
latency







ideas from engagement with companies

- Changing albedo
- Predicting glints
- Publishing orbits
- Radio beam re-direction
- Software correction

All takes TIME

All costs MONEY



How bad is it?

How often does  
this really happen?

Is it only serious  
just after twilight?

Can we fix it  
with smart  
software?

What about  
radio astronomy?





Privateer Inc

Reality  
or  
scaremongering?



StartRocket promo

# Types of Light Pollution



Local

Mt Wilson Observatory



Global

Rafael Schmall



# A right to the sky?



# The Space Junk Problem

Getty Images

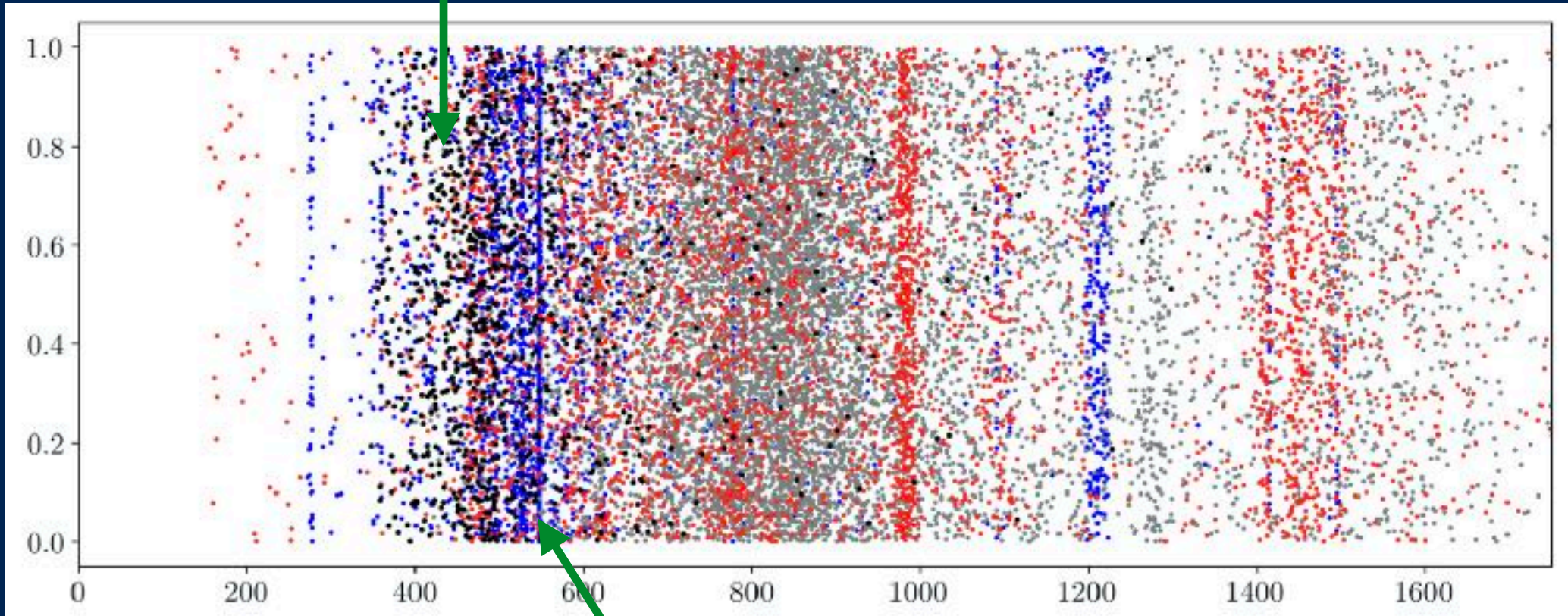




# Space Junk is in shells

Russian  
ASAT  
fragments

OneWeb



height above Earth

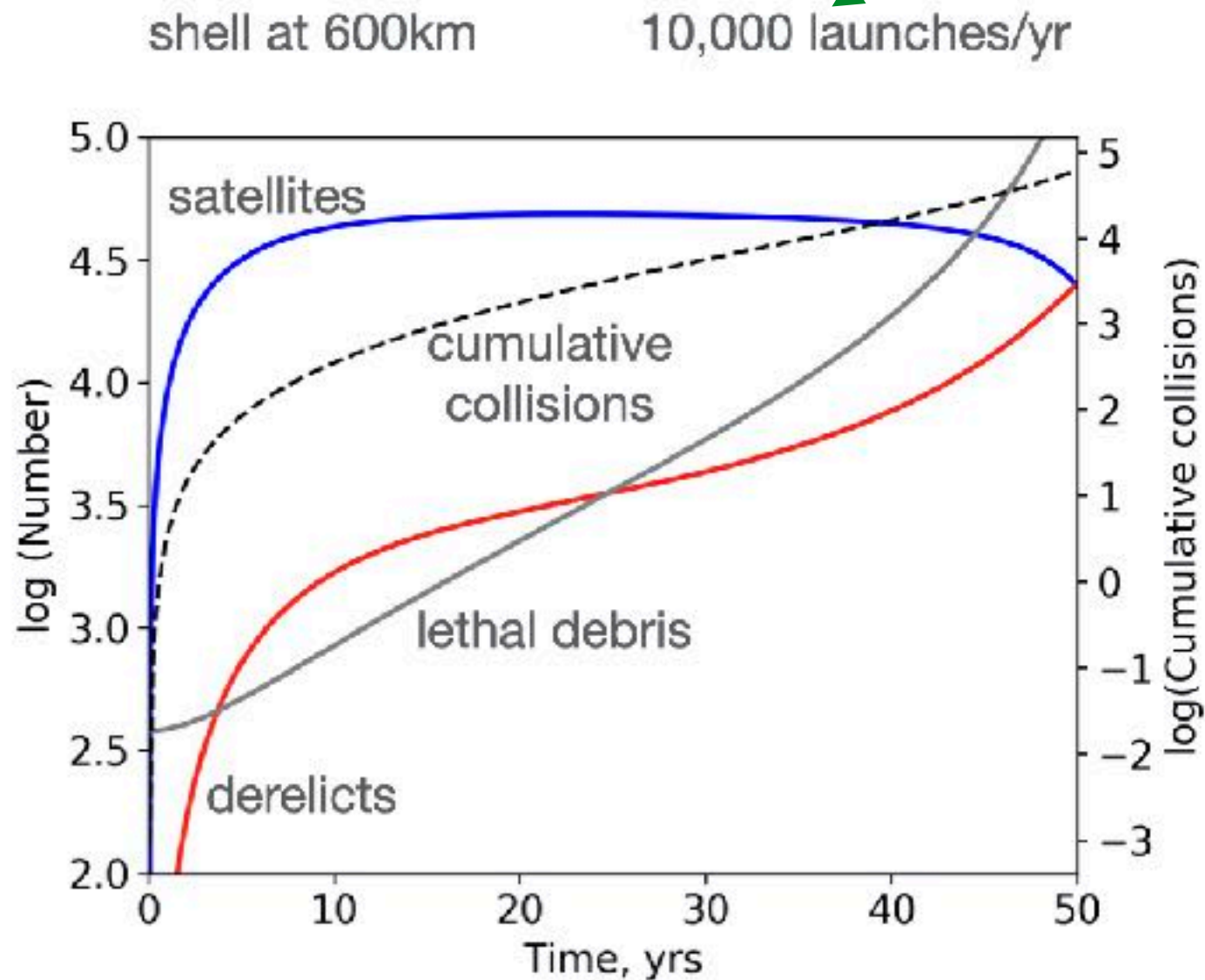
ISS

Starlink



# JASON debris model

aimed at stable  
population of 50,000



Liability  
issues  
will  
grow



# Classic signs of an Environmental Problem

- Your actions have an effect on others
- True costs are externalised
- Problems are incremental and complex



# LOSING THE SKY

Andy Lawrence

Foreword  
by Dr Brian May

ORAL ARGUMENT HAS NOT YET BEEN SCHEDULED

In Re

## United States Court of Appeals For The District of Columbia Circuit

VIASAT, INC.; DISH NETWORK CORPORATION;  
THE BALANCE GROUP,

*Appellants,*

v.

FEDERAL COMMUNICATIONS COMMISSION,  
*Appellee.*

SPACE EXPLORATION HOLDINGS, LLC,

*Intervenor for Respondent*

ON APPEAL FROM THE FEDERAL COMMUNICATIONS COMMISSION  
IBFS FILE NO. SAT-MOD-20200417-00037

BRIEF OF PROFESSOR ANDY LAWRENCE AS *AMICUS CURIAE*  
IN SUPPORT OF VACATUR

## PERSPECTIVE

<https://doi.org/10.1038/s41550-022-01655-6>

nature  
astronomy

Check for updates

## The case for space environmentalism

Andy Lawrence<sup>1,2</sup>, Meredith L. Rawls<sup>3</sup>, Meriba Jah<sup>3,4</sup>, Aaron Booley<sup>5</sup>, Federico Di Vruno<sup>6</sup>,  
Simon Garrington<sup>7</sup>, Michael Kramer<sup>8,9</sup>, Samantha Lawler<sup>10</sup>, James Lowenthal<sup>11</sup>, Jonathan McDowell<sup>12</sup>  
and Mark McCaughrean<sup>13</sup>

Theshell bound by the Karman line at a height of ~80–100 km above the Earth's surface and geosynchronous orbit at ~36,000 km is defined as the orbital space surrounding the Earth. It is within this region, and especially in low Earth orbit, where environmental issues are becoming urgent because of the rapid growth of the anthropogenic space object population, including estel-like 'mega-constellations'. In this Perspective, we summarize the case for considering the orbital space around the Earth as an additional ecosystem, subject to the same care and concerns, and the same broad regulations as the oceans and the atmosphere, for example. We rely on the orbital space environment by looking through it, as well as by working within it. Hence, we should consider damage to professional astronomy, public stargazing, and the cultural importance of the sky, as well as the sustainability of commercial, civic, and military activity in space. Damage to the orbital space environment has problematic features in common with other types of environmental issue. First, the observed and predicted damage is incremental and complex, with many contributors. Second, whether or not space is formally and legally seen as a global commons, the growing commercial exploitation of what may seem to be a 'free' resource is in fact externalizing the true costs.

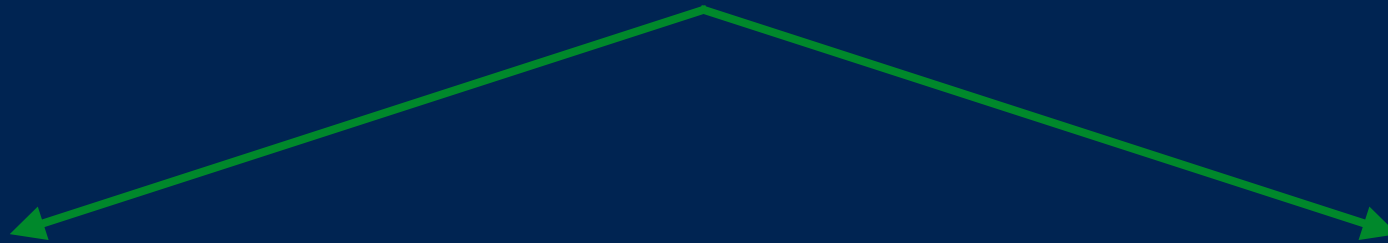


# JASON report quote:

A company who wanted to launch a dump truck full of sand into the same orbit as the International Space Station would have no formal barriers to doing so in many countries around the world.

# Regulation scorecard

Broad Principles	✓	Outer Space Treaty
Competence to launch	✓	in most countries..
Use of radio spectrum	✓	ITU
GSO interference	✓	
Liability	—	“diplomatic channels”
Minimising Debris	—	non-binding guidelines
LEO advertising	— ✗	in some countries..
Atmospheric Pollution	✗	some legal challenges underway
Sky Pollution	✗	
LEO interference	✗	



**International Tribunal  
for the Law of the Sea**



# A Problem of Timescales

Commerce

months

Science

years

Regulations

decades



FIN