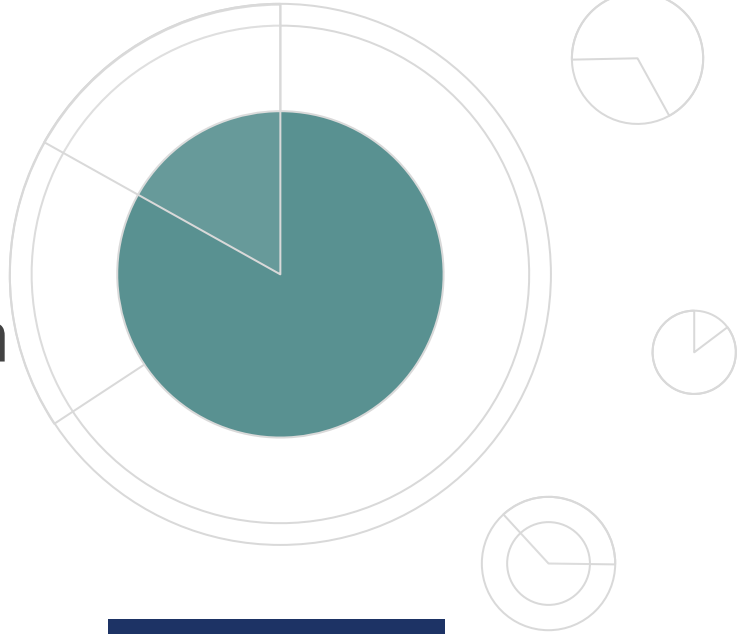

Analytics and visualisation of UCS satellite data

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Roadmap

- Motivation and Aim
- Dataset
- Glossary of Scientific Terms
- Related work
- Design ideas and alternatives
- Final design choice
- Evaluation of solution showing interesting results
- Implementation process

Motivation and Aim

Motivation

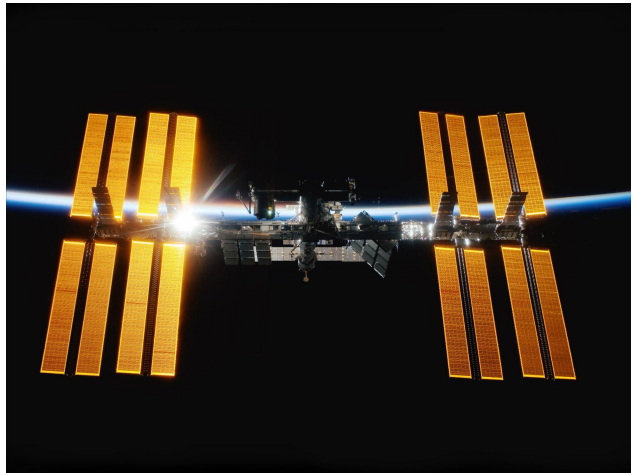
Growing interest in what is above our heads BUT lack of current visualisations for the data

Data: Union of Concerned Scientists (UCS) Satellite Database

- Research tool for specialists and non-specialists (school children/journalists)
- Open-source information on operational satellites
- Easily manipulated for research and analysis
- First published in 2005, updated in 2022
- Only UN-registered satellites (no early USSR data)

Aim

- Keep the first version as wide as possible
- Collect usage data
- Refine in line with user requirements



The International Space Station

Dataset - https://www.ucsusa.org/resources/satellite-database

- Large dataset contains 28 attributes for each satellite, and >5000 entries
- Cleaned data by removing entries with blank fields, and missing formulae updated
- 12 attributes selected to make it more manageable
- Mix of all three data types

Satellite Information

- Name/Country/Launch Site - Categorical
- Launch Date - Ordered
- Users - Civil/Military/Government etc - Categorical
- Purpose - Earth Observation/Communication etc - Categorical

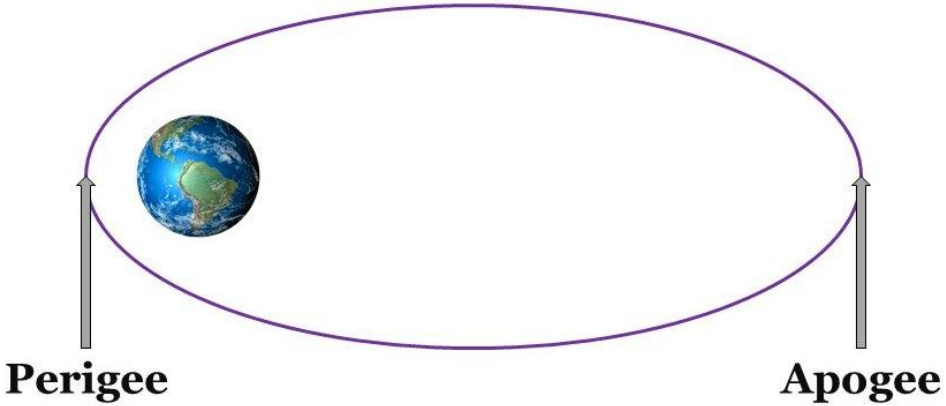
Orbit Information

- Class - Elliptical/GEO/LEO/MEO - Categorical
- Period/Eccentricity/Perigee/Apogee/Longitude of GEO - Continuous

Here's the Science-y Bit...

- Period: Time it takes to complete one orbit, in minutes
- Eccentricity: for our data, 0 is a circular orbit, 0 to 1 is elliptical

Elliptical Orbits



https://clipartcraft.com/explore/earth-clipart-real-6/

- Perigee: Point closest to the earth, in km
- Apogee: Point farthest from the earth, in km

Here's the Science-y Bit…

Circular Orbits

https://www.esa.int/Enabling_Support/Space_Transportation/Types_of_orbits

- GEO: Geostationary orbit - altitude of 35,786 km designed to match the rotation of the earth so it stays in one place above the equator
- Longitude: defines where that place is relative to the earth, in degrees
- LEO: Low Earth orbit - Geocentric (circular) orbit - altitudes <2,000 km
- MEO: Medium Earth orbit - anywhere between LEO & GEO, but usually ~ 20,000 km

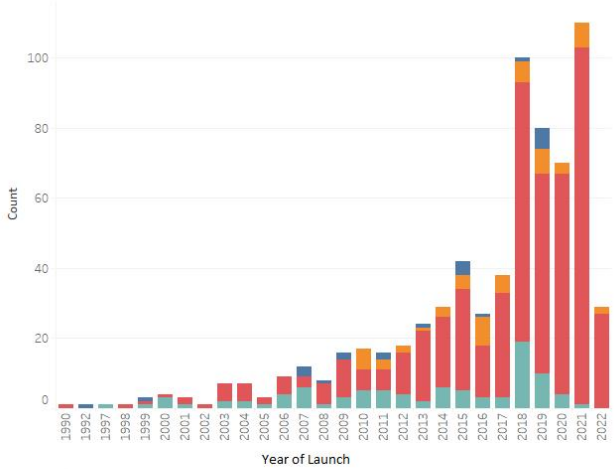
Related Work

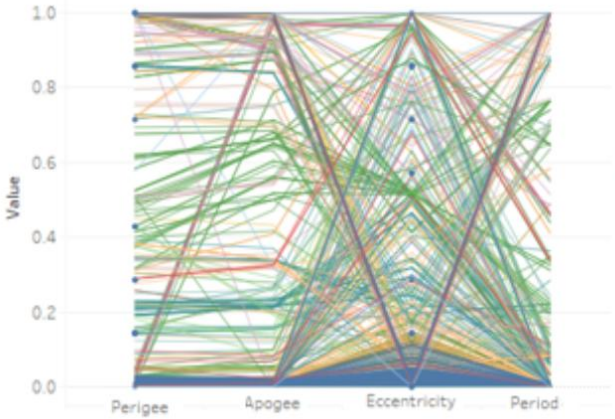
- Visual capital website published an article visualising the same dataset aiming to draw results about who owns the Earth’s Orbit :Wood, T. (2020) Visualizing all of Earth's satellites: Who owns our orbit?, Visual Capitalist. Available at: https://www.visualcapitalist.com/visualizing-all-of-earths-satellites

- The dataset was also explored in Emiliani, L. (2022) Exploring the UCS satellite database, Kaggle. Kaggle. Available at: https://www.kaggle.com/code/luisemiliani/exploring-the-ucs-satellite-database/notebook

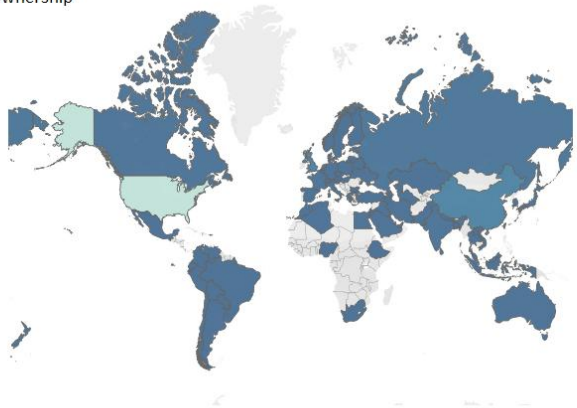
Proposed solution

Sats & Orbits

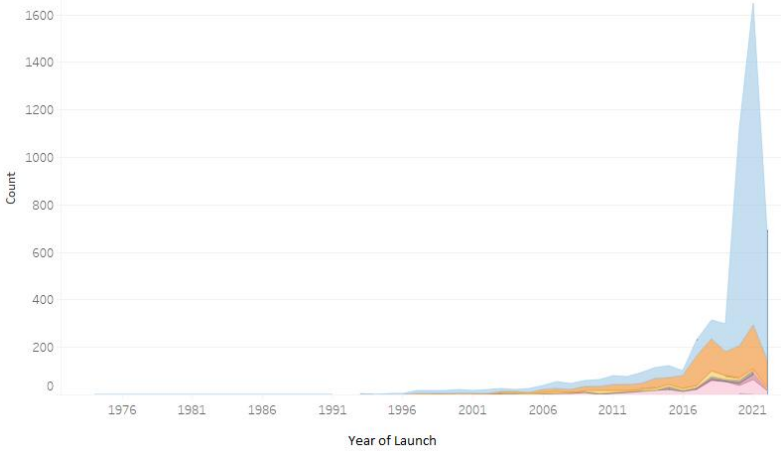




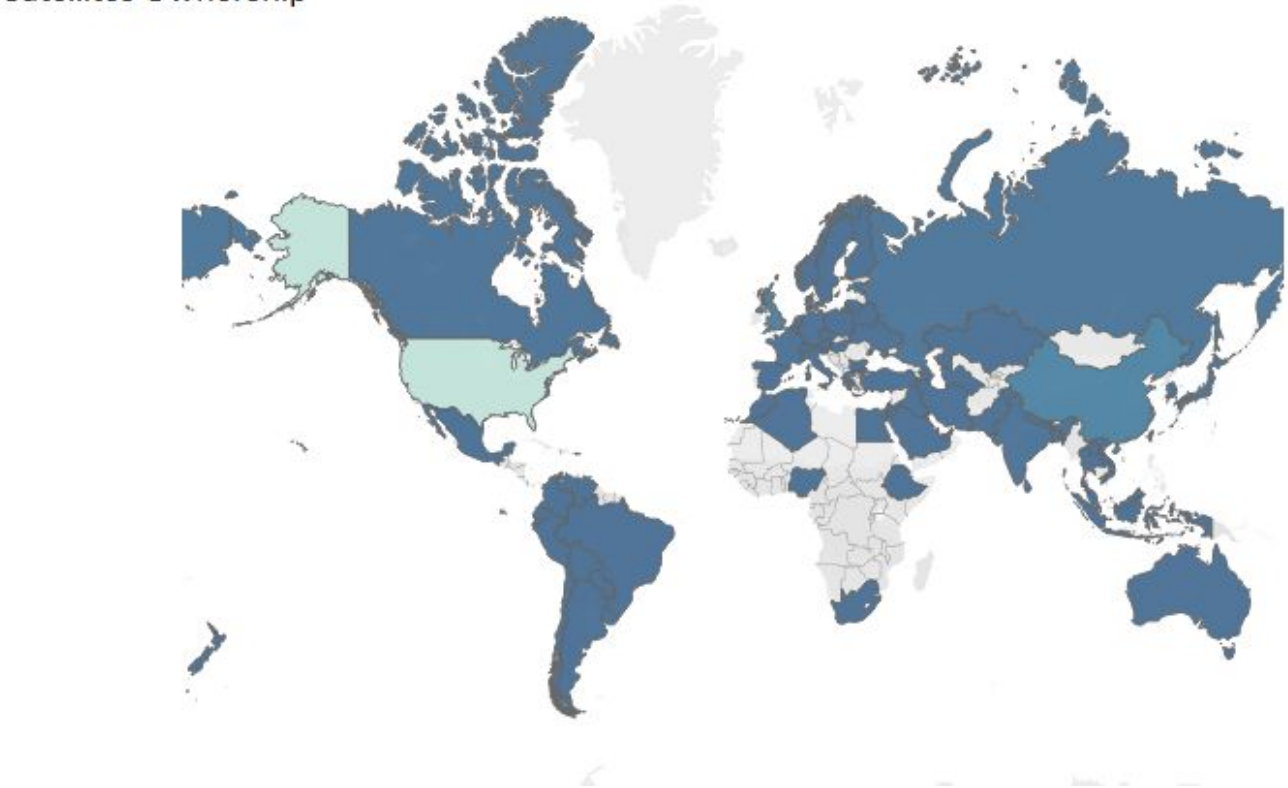
Satellites Ownership



Purposes of Satellites



Satellites Ownership



Count of Sats

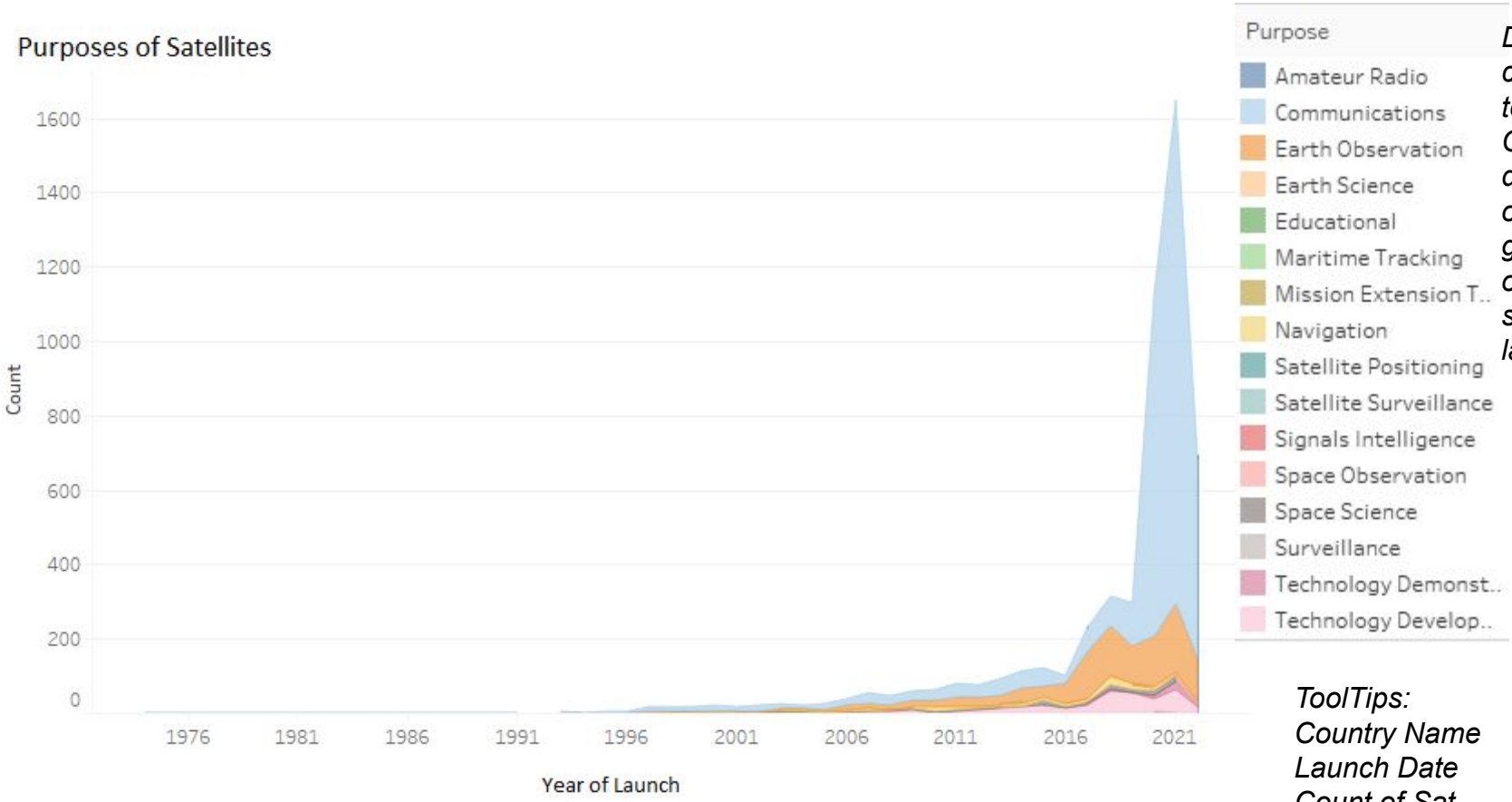
1 3,388

Reverse Saturation was used

ToolTips:
Country Name
Region
Number of Active Sat owned

Currently active satellites by country.

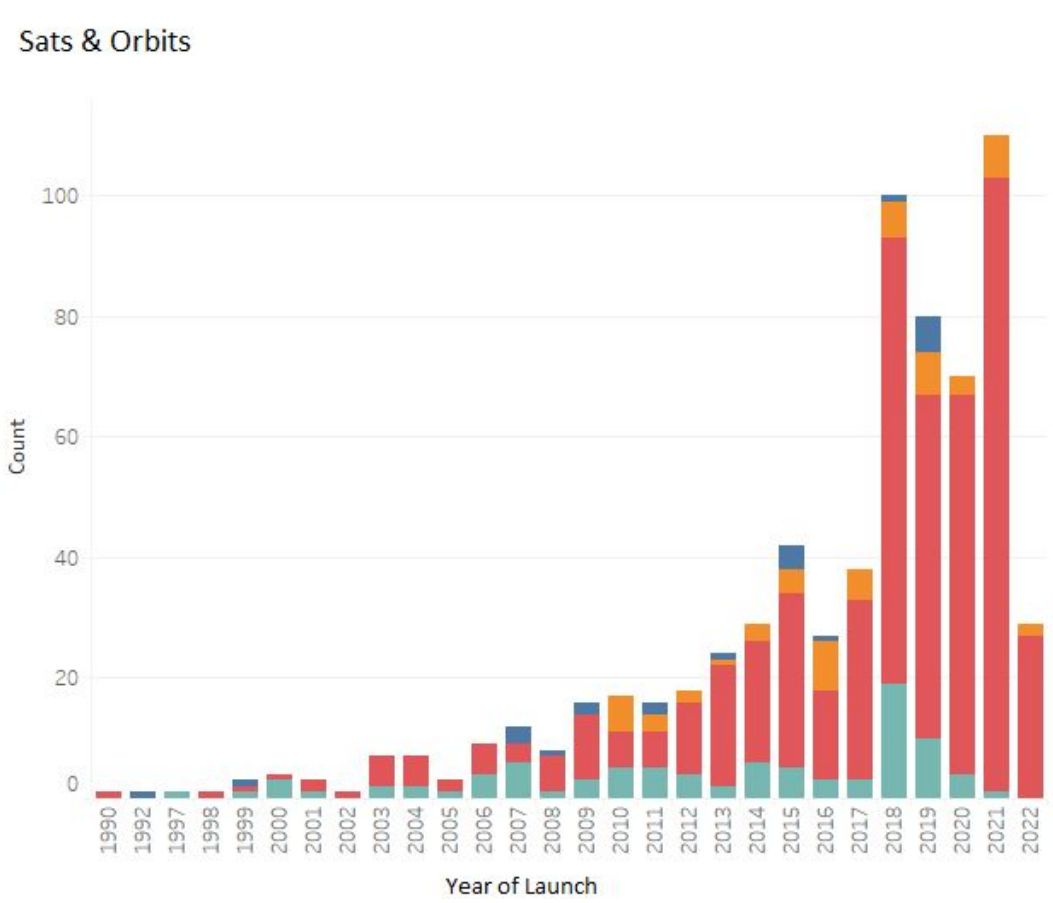
Enhancement Suggestion:
Add Time Scale
Add Orbits to tooltips



Distinct colors(Hue) to represent Categorical data. to avoid overlap, the graph is ordered from smallest to largest

ToolTips:
Country Name
Launch Date
Count of Sat
Purpose

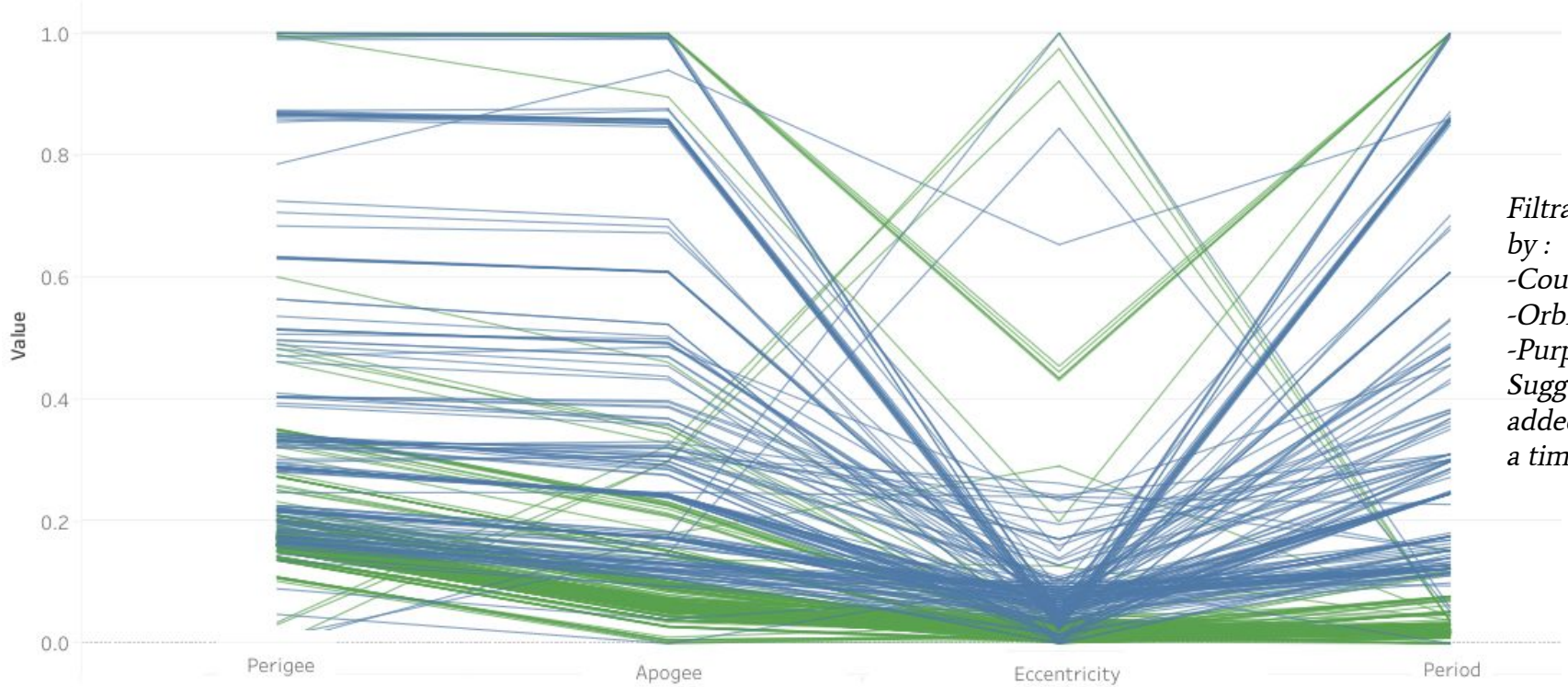
Intended Purposes of currently active satellites plotted over time.



Distinct colors(Hue) to represent Categorical data.

ToolTips:
Country Name
Launch Date
Count of Sat
Purpose

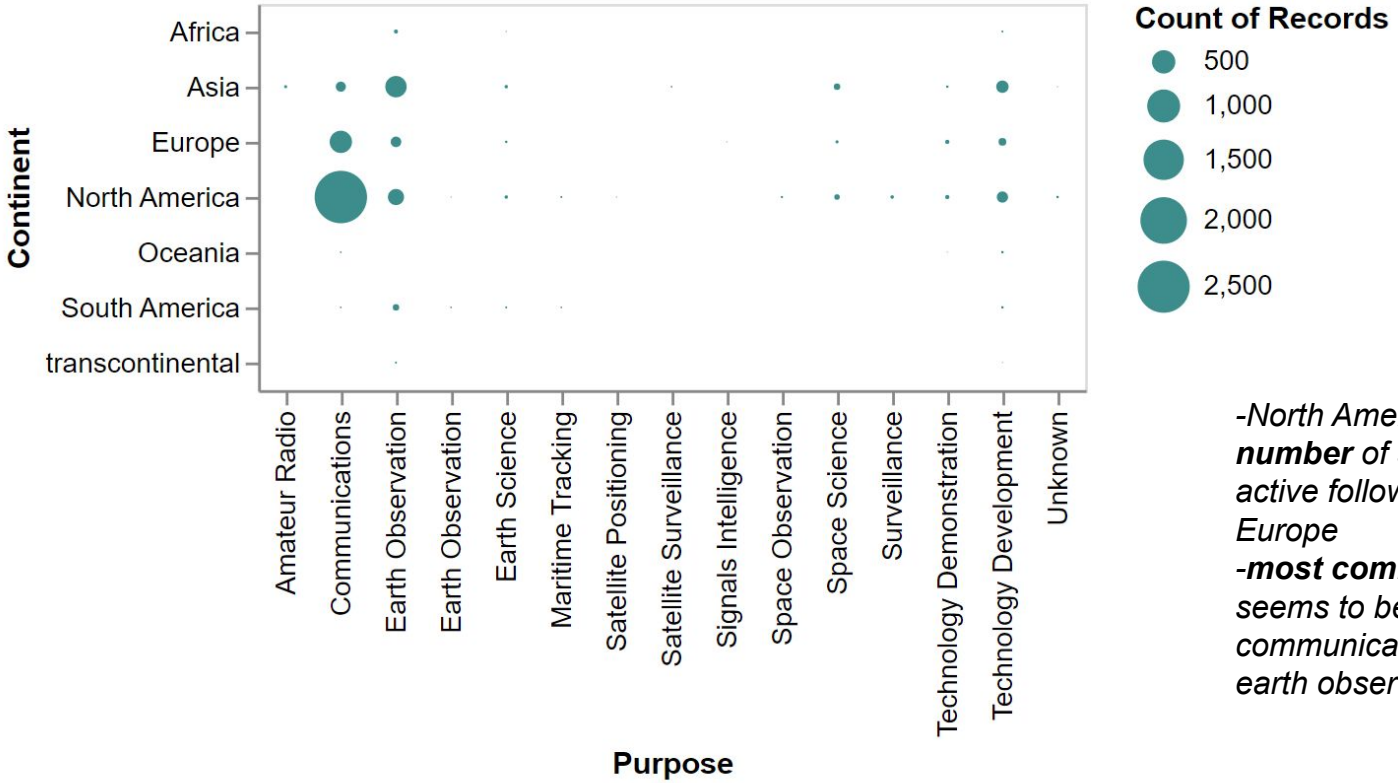
Purpose of currently active satellites split into the four types of orbit, plotted over time.



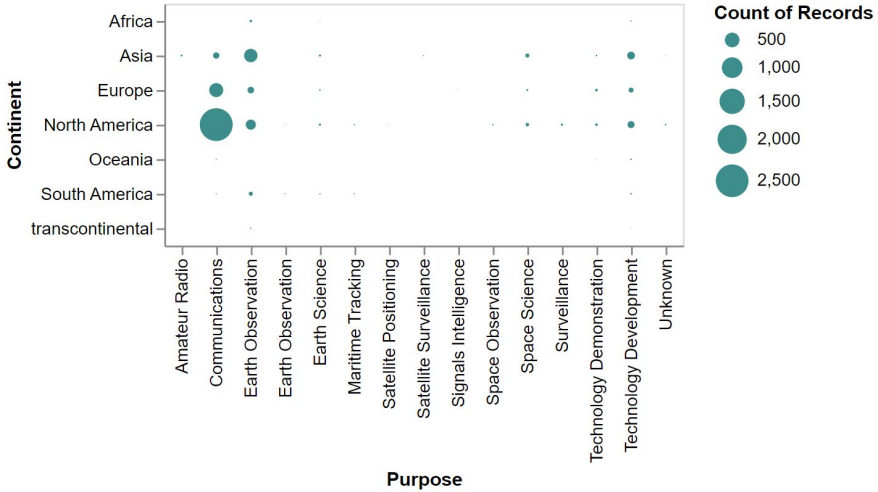
Filtration for all by :
-Country
-Orbit
-Purpose
Suggestion: added filtration is a time scale

Design Alternatives

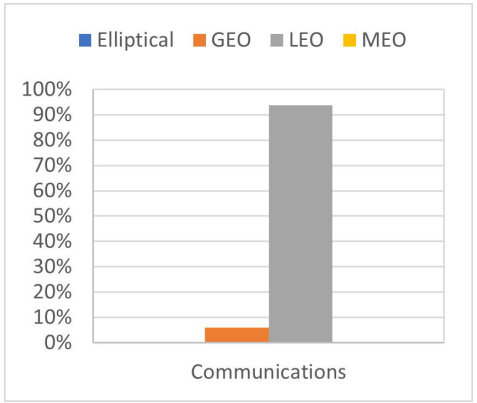
1. Multiple coordinated views

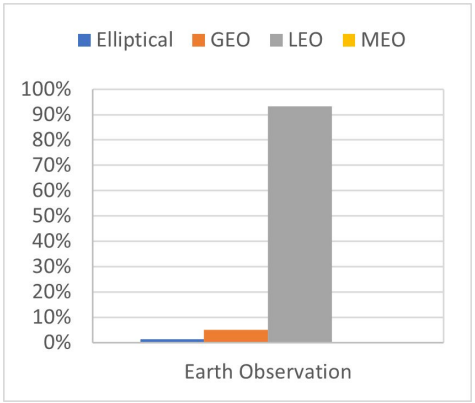


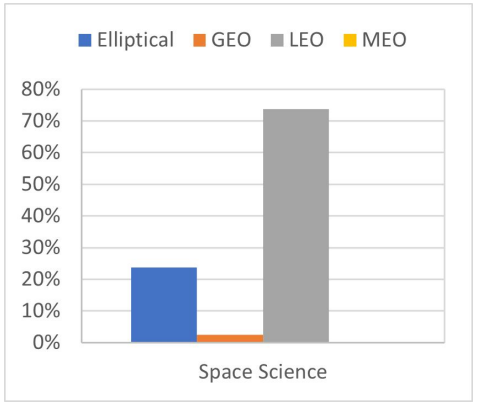
*-North America owns **most number** of satellites currently active followed by Asia and Europe*
*-**most common use** of satellite seems to be to support communications, followed by earth observations*



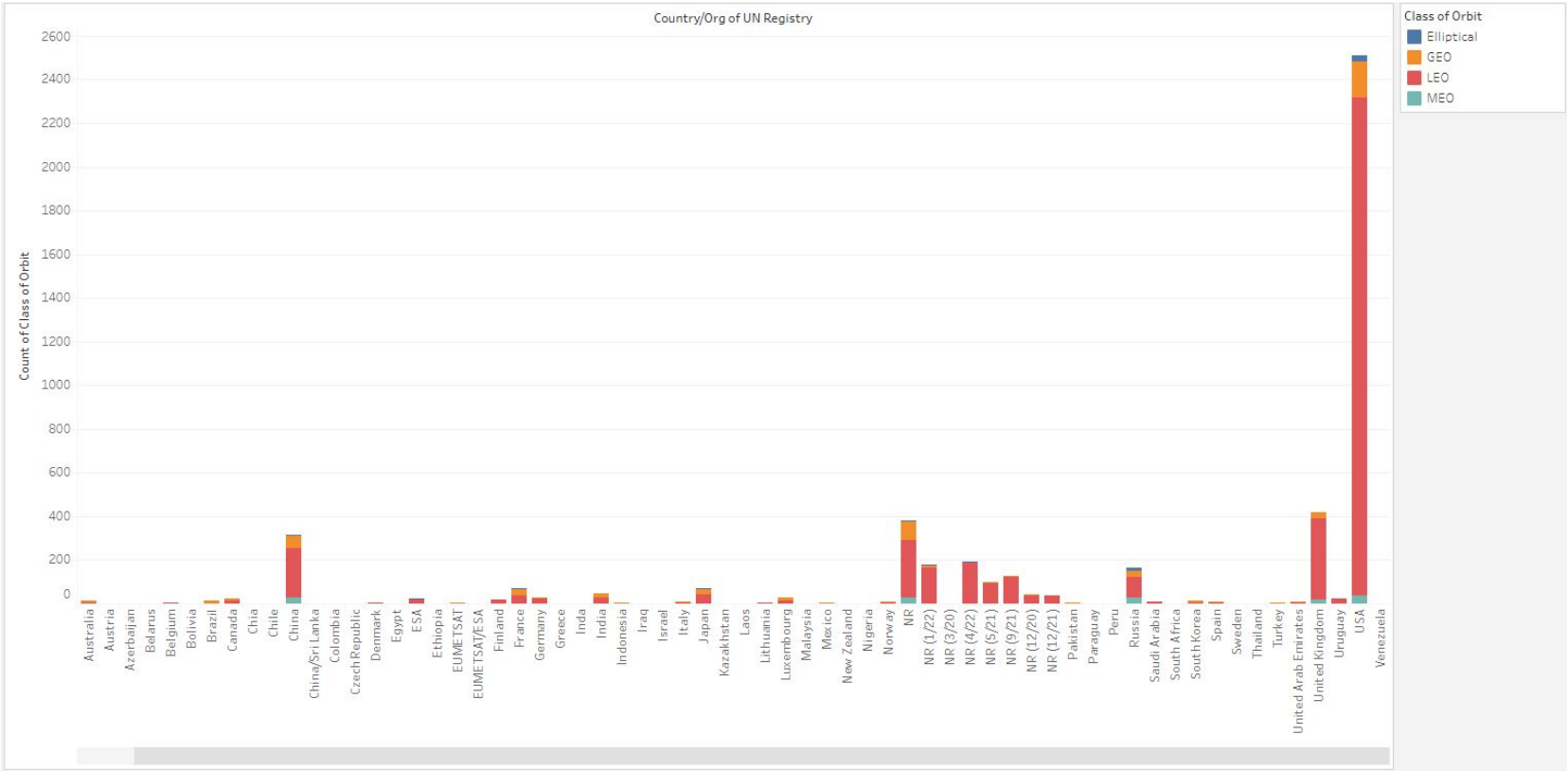
-In North America: most common orbit is LEO, except in case of Space science

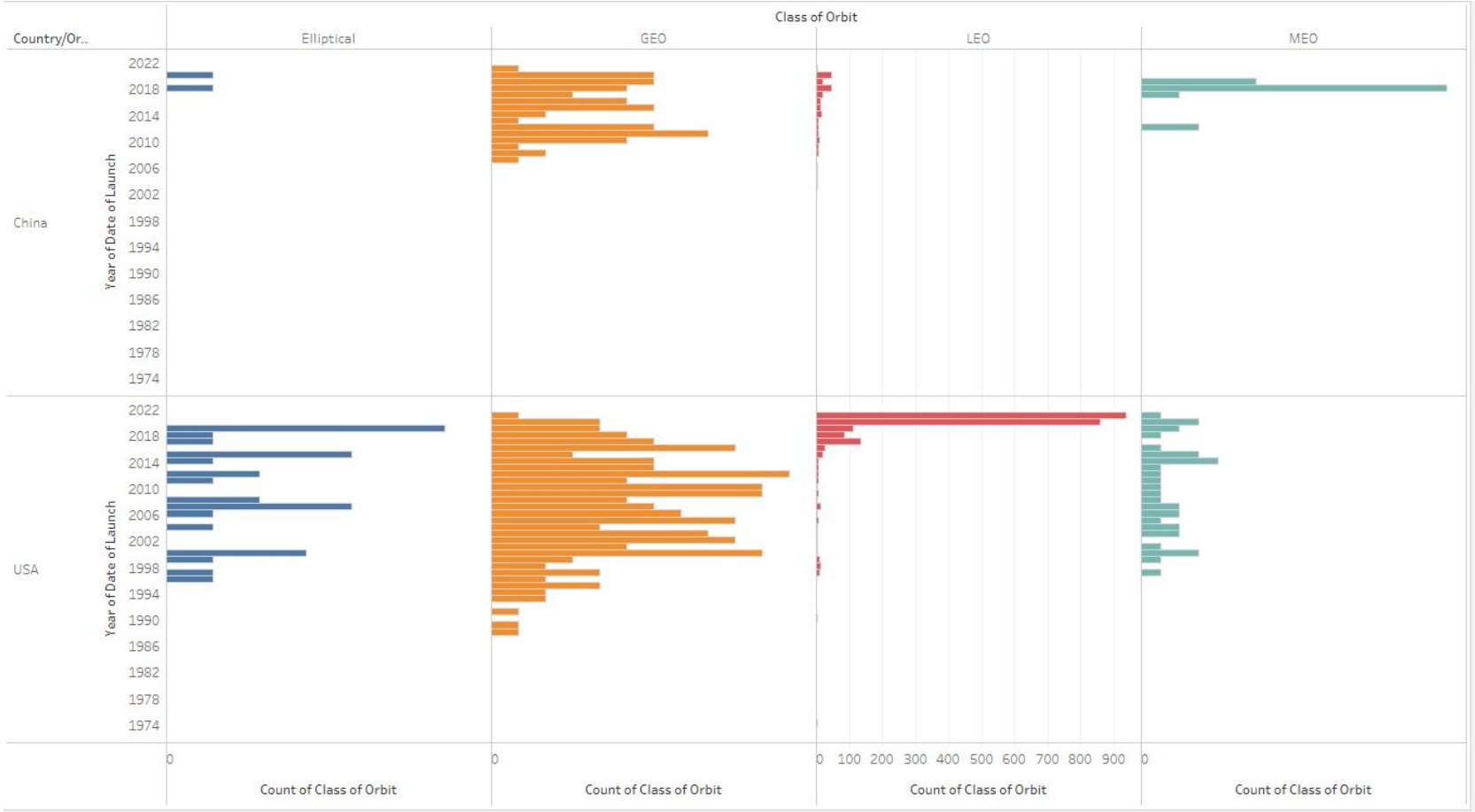




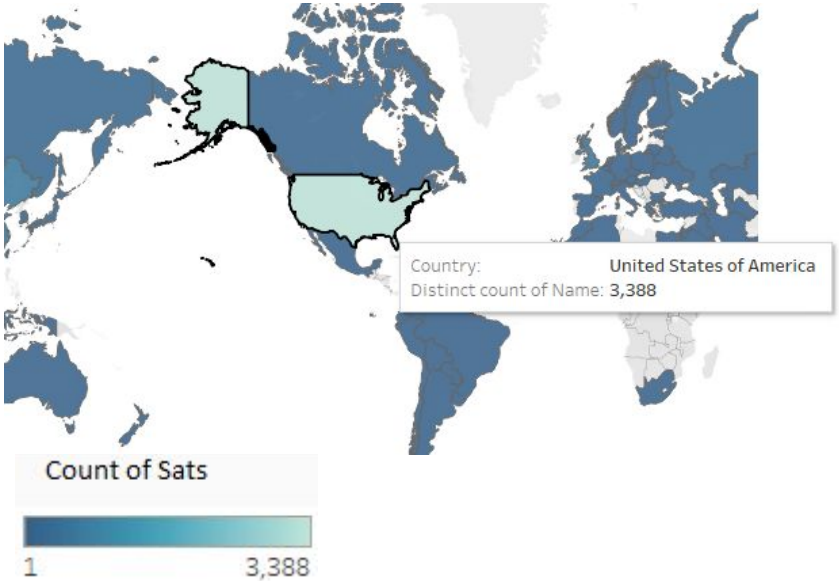


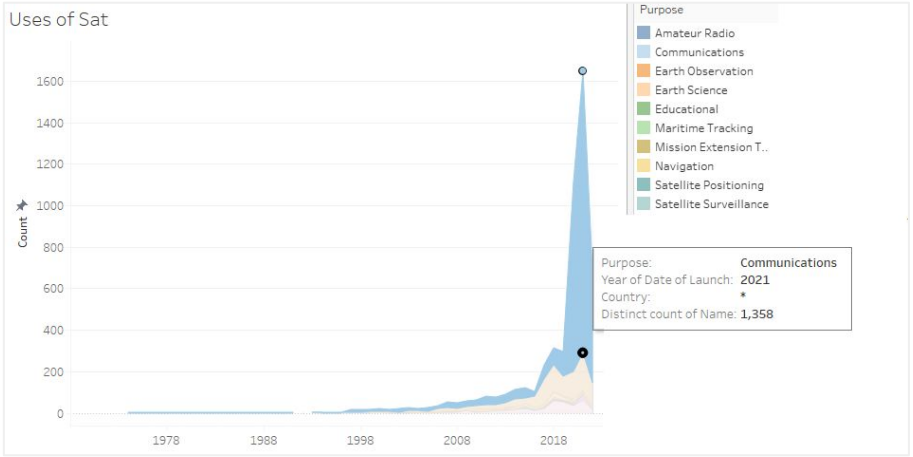
2. Overview – partial zoom




Class of Orbit
Country/Or..
Elliptical
GEO
LEO
MEO
China
USA
Year of Date of Launch
2022
2018
2014
2010
2006
2002
1998
1994
1990
1986
1982
1978
1974
0
0
0 100 200 300 400 500 600 700 800 900
0
Count of Class of Orbit
Count of Class of Orbit
Count of Class of Orbit
Count of Class of Orbit
Country/Org of UN Regis...
(All)
Null
Algeria
Argentina
Australia
Austria
Azerbaijan
Belarus
Belgium
Bolivia
Brazil
Canada
Chia
Chile
China
China/Sri Lanka
Colombia
Czech Republic
Denmark
Egypt
ESA
Ethiopia
EUMETSAT
EUMETSAT/ESA
Finland
France
Germany
Greece
Inda
India
Class of Orbit
Elliptical
GEO
LEO
MEO

Initial Results from exploring the data and prototypes





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7. Dataset Link
   UCS Satellite Database. Union of Concerned Scientists. Retrieved December 8, 2022, from https://www.ucsusa.org/resources/satellite-database

8.

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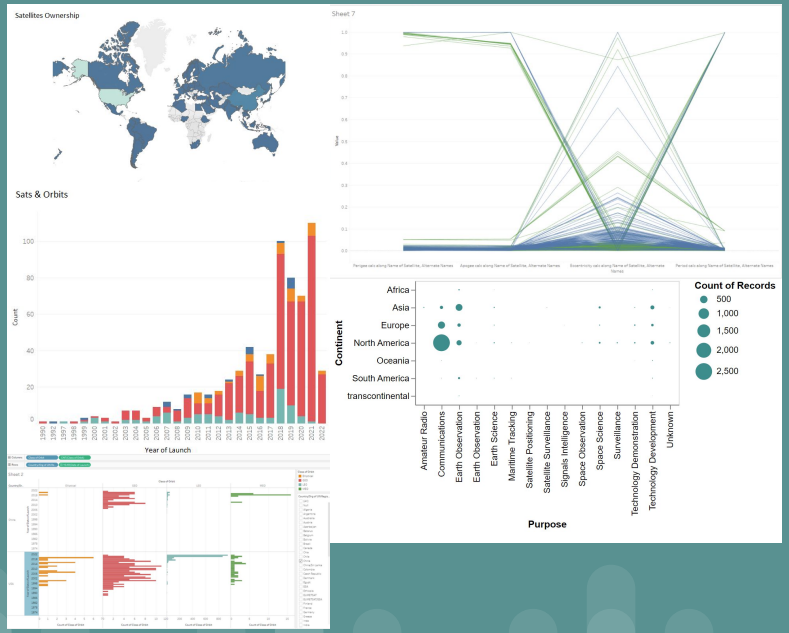

Thank You

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