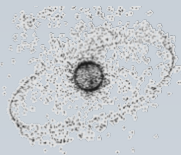


# Scientific Research as a Prerequisite for Space Safety and Sustainability

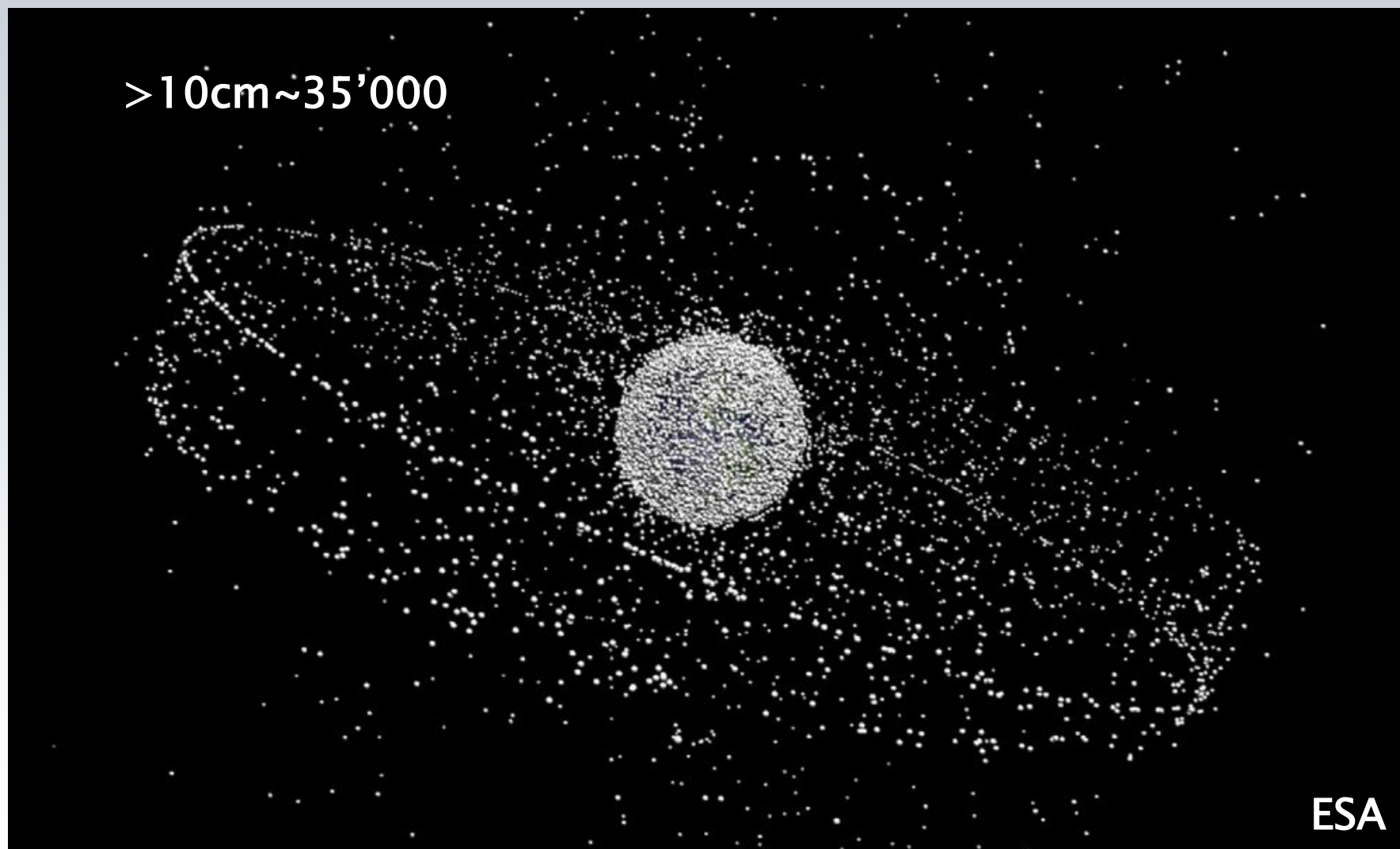
**T. Schildknecht**

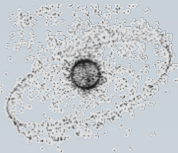
*Astronomical Institute, University of Bern,  
Switzerland*

*Workshop of the Working Group on the  
Long-term Sustainability of Outer Space  
Activities, Feb. 6, 2024*

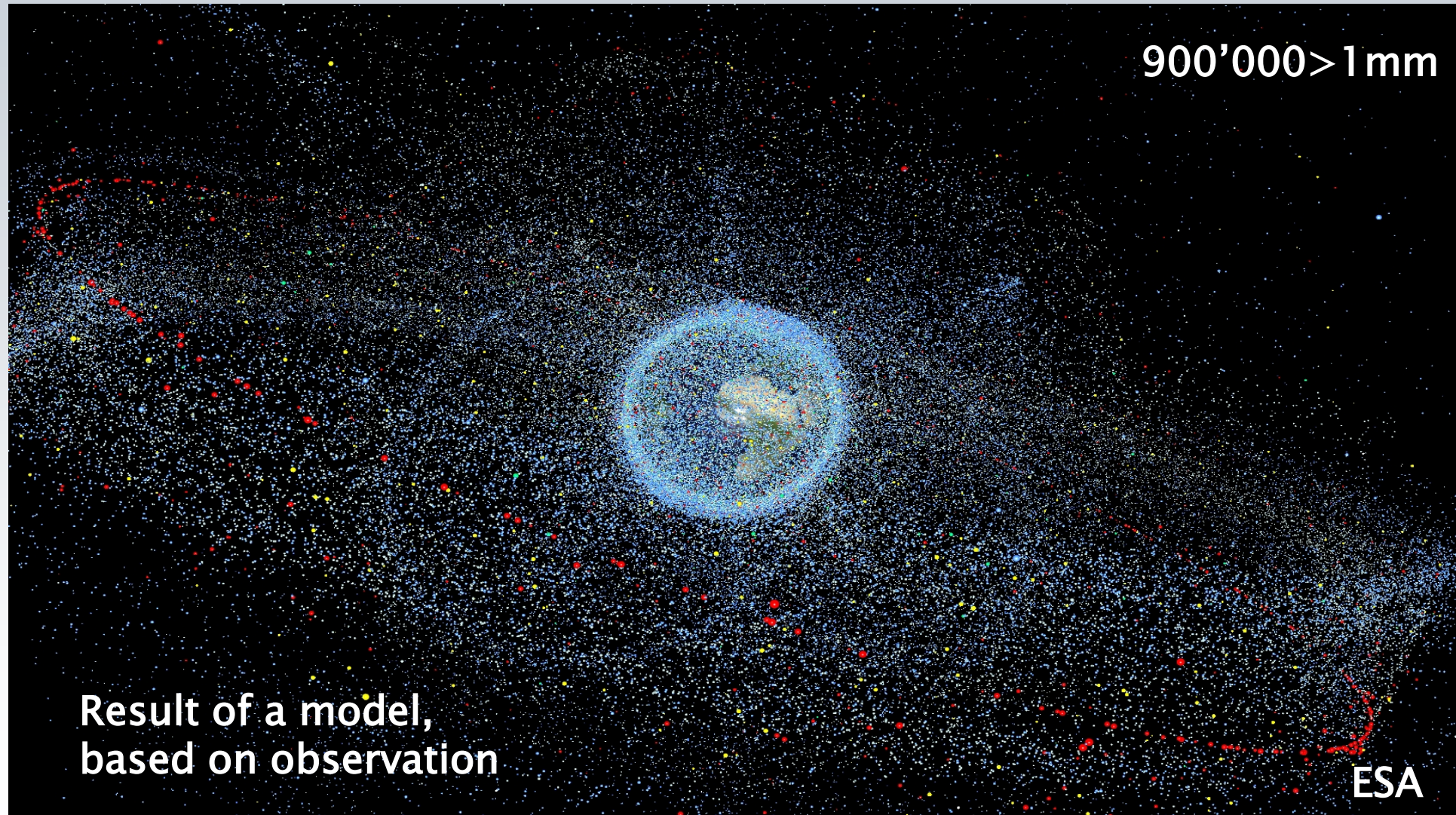


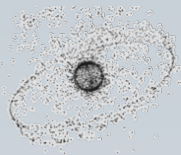
# The Environment – What do we Know?





# The Environment – What do we Know?

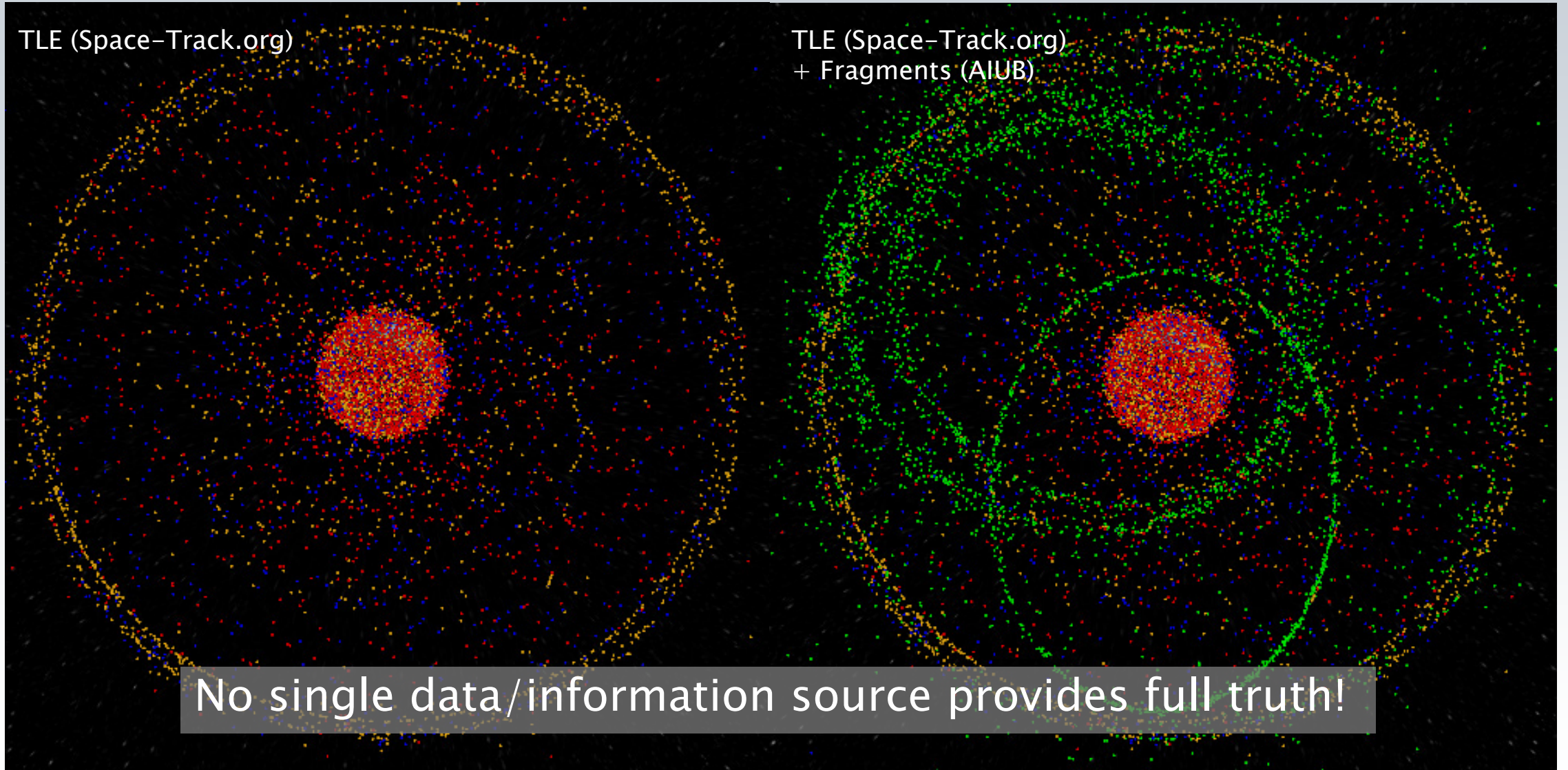




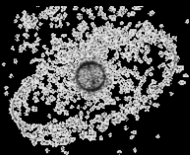
# Data is Foundation (Example Dec. 3. 2019)

TLE (Space-Track.org)

TLE (Space-Track.org)  
+ Fragments (AIUB)

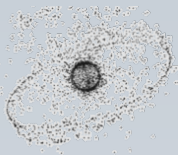


No single data/information source provides full truth!



2009-047B  
Breakup

SwissOGS  
ZimTWIN -20190527  
23:35:00 - 23:50:46  
Exp. Time: 20 sec



# Scientific Research and Observations are Foundational

Need a sound understanding of the space debris (and active spacecraft) environment through observations and modeling

- **current state**

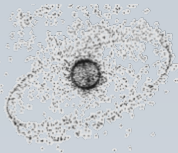
- monitoring of small-size debris population
- nature of objects (size, shape, material, etc.)
- identification of (new) sources (nature of source)

- **physics driving the proliferation**

- identification of debris sources
  - progenitors of debris clouds (breakup/collision events)
  - disintegrations of spacecraft due to aging processes

- **future evolution**

- verification/updating of evolution models



# LTS Guidelines and Recommendations

## Guidelines and Recommendations should be efficient

- need be devised based on
  - best available knowledge of current environment
  - risk models (including orbital capacity)
  - evolution models

## Efficiency of the actual practice in the implementation

- needs to be rated against new observations and updated models

## Rationale for new recommendations

- needs to be based on sound understanding of the current space debris (and active spacecraft) environment and its evolution

# Take Home

Scientific research and observations are foundational to:

*measure the efficiency* of the implementation of existing guidelines, and

*provide the rational* for new recommendations





A dark, black background featuring a prominent diagonal light streak that transitions from a bright cyan at the top left to a white glow at the bottom right. A small, thin crescent moon is visible in the dark space, positioned to the right of the light streak's center. The text "Thank you for your time!" is centered at the bottom in a clean, white, sans-serif font.

Thank you for your time!