

# Probabilistic Orbit Lifetime Assessment with OSCAR

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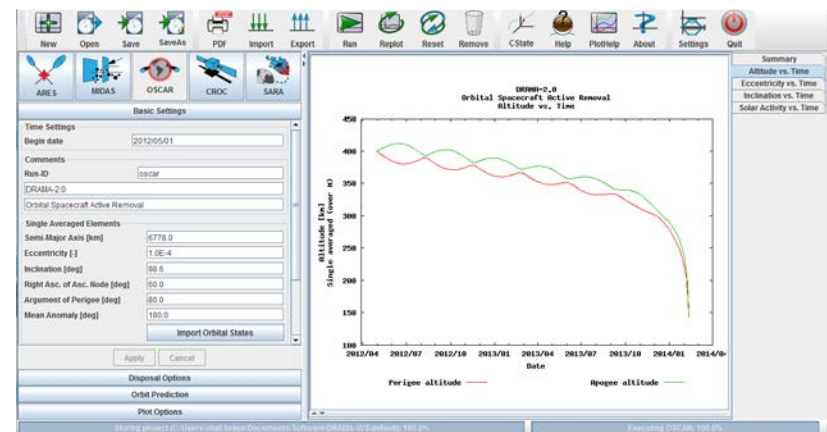
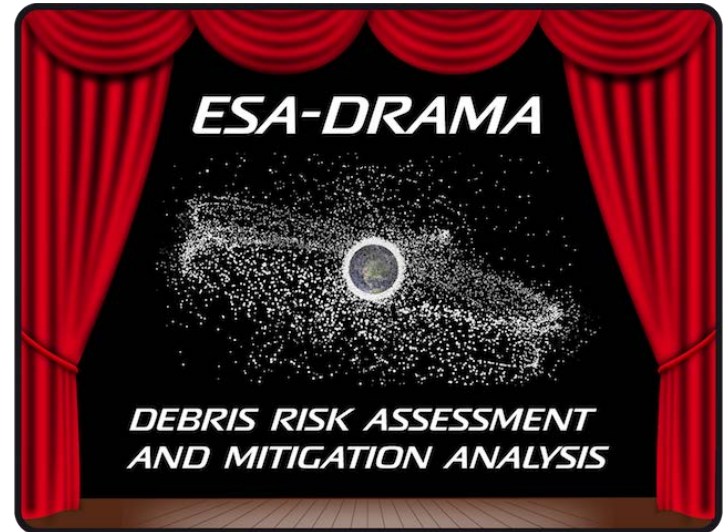
Issue/Revision: 1.0

Reference:

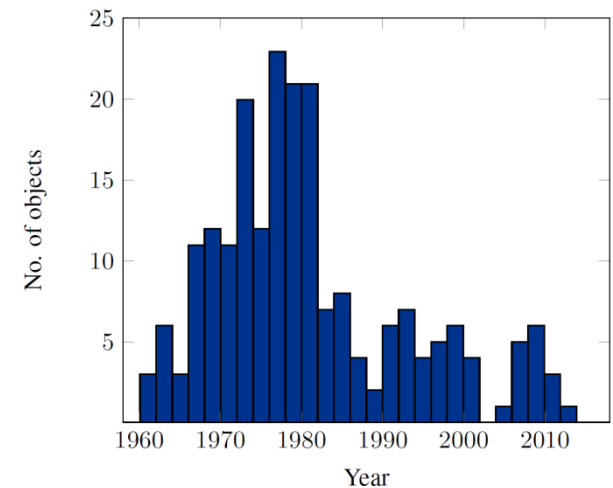
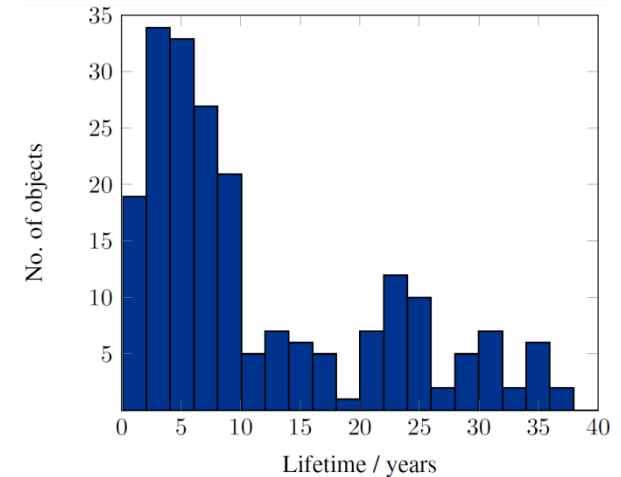
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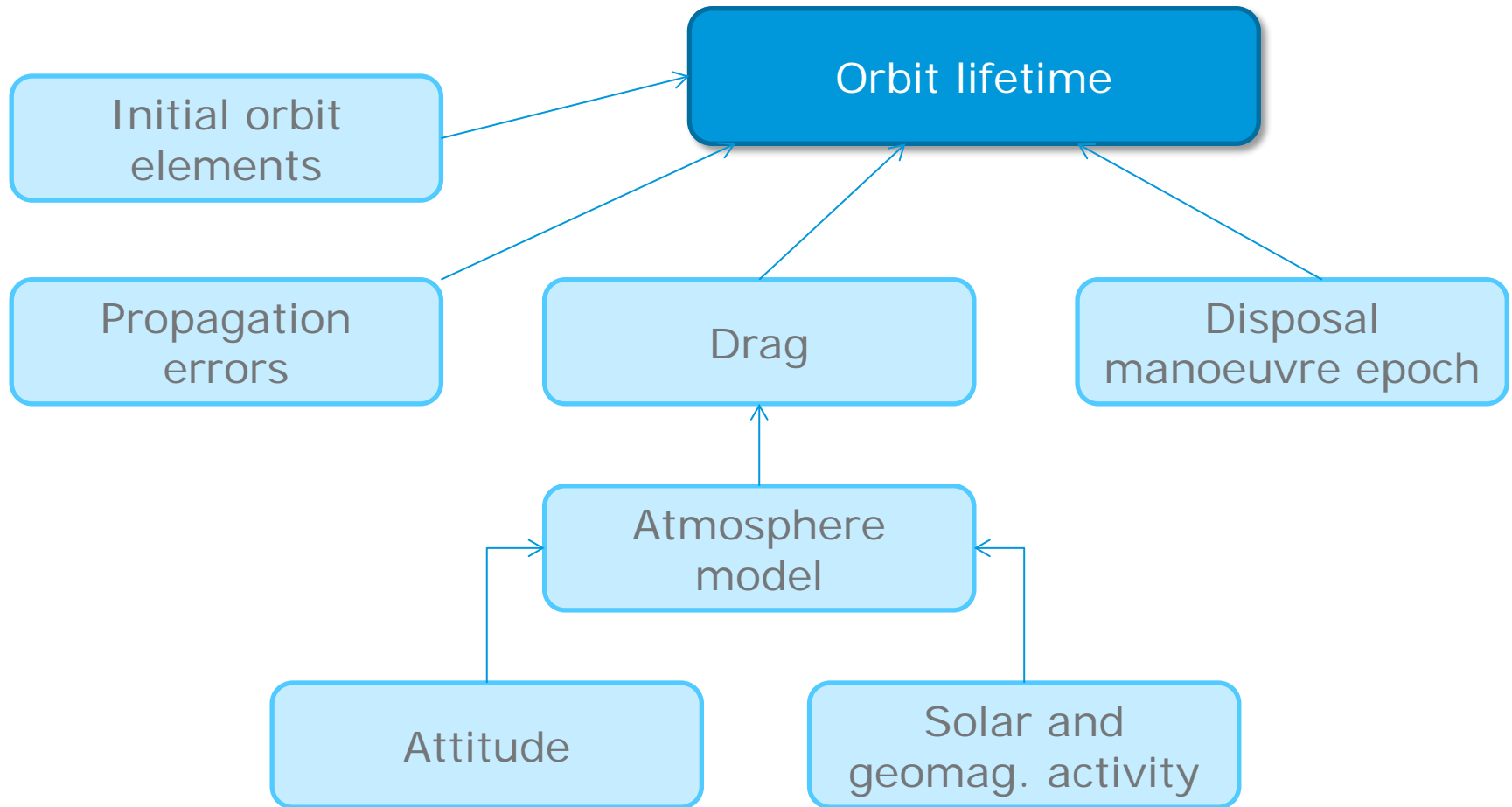
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- **Assessing orbit lifetime**  
compliance in LEO is required  
(e.g. through ESA's space debris mitigation policy)
- **ESA's DRAMA OSCAR** tool to estimate orbit lifetime
- Forecasting orbits over decades **associated with uncertainties**
  - Important information that should be considered in the assessment!

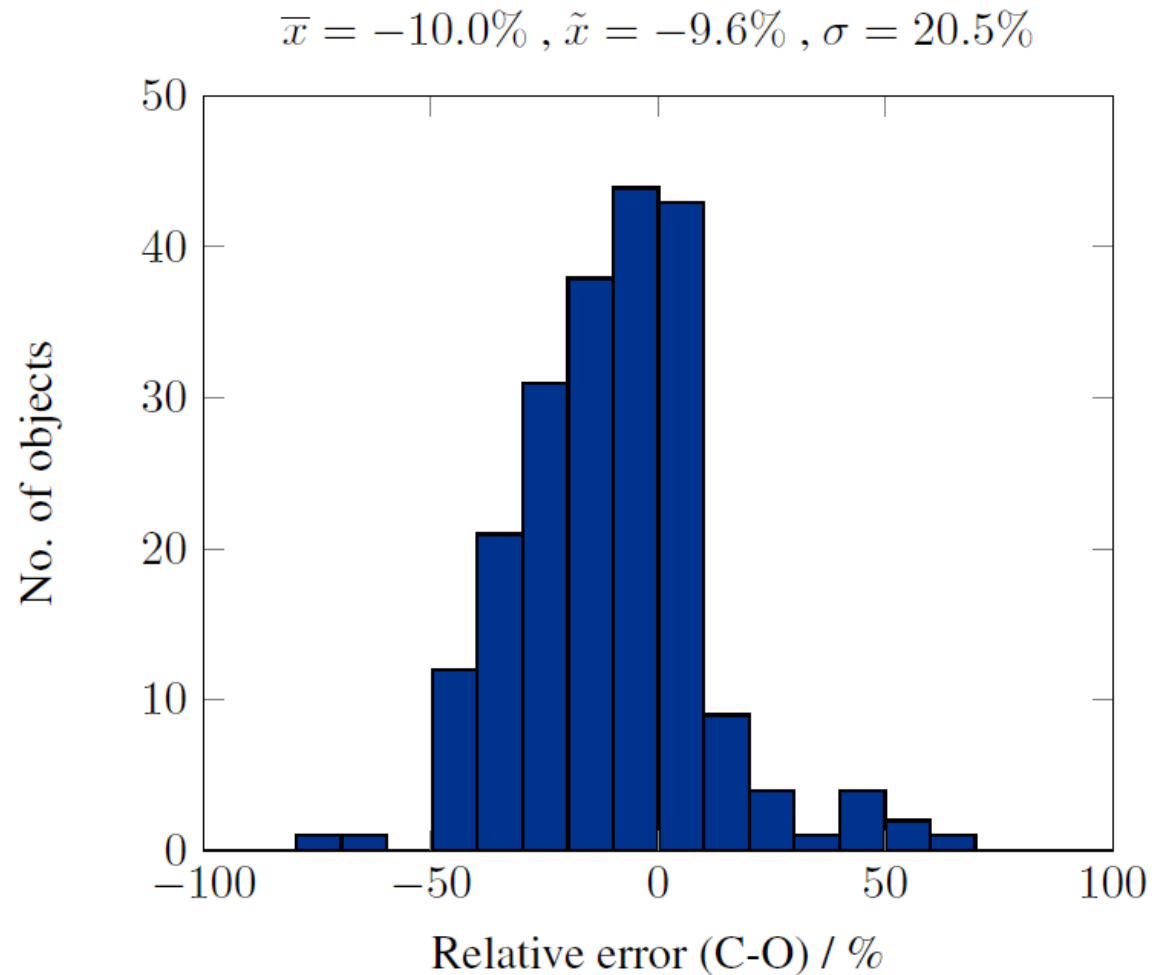


1. Identify objects for which true orbit lifetime can be obtained for a comparison with predictions
  - a. 207 rocket bodies in LEO selected
  - b. Orbit information from TLE
  - c. Dimensions from DISCOS
2. Address uncertainties in disposal manoeuvre epoch
3. Sensitivity analysis for initial orbit elements



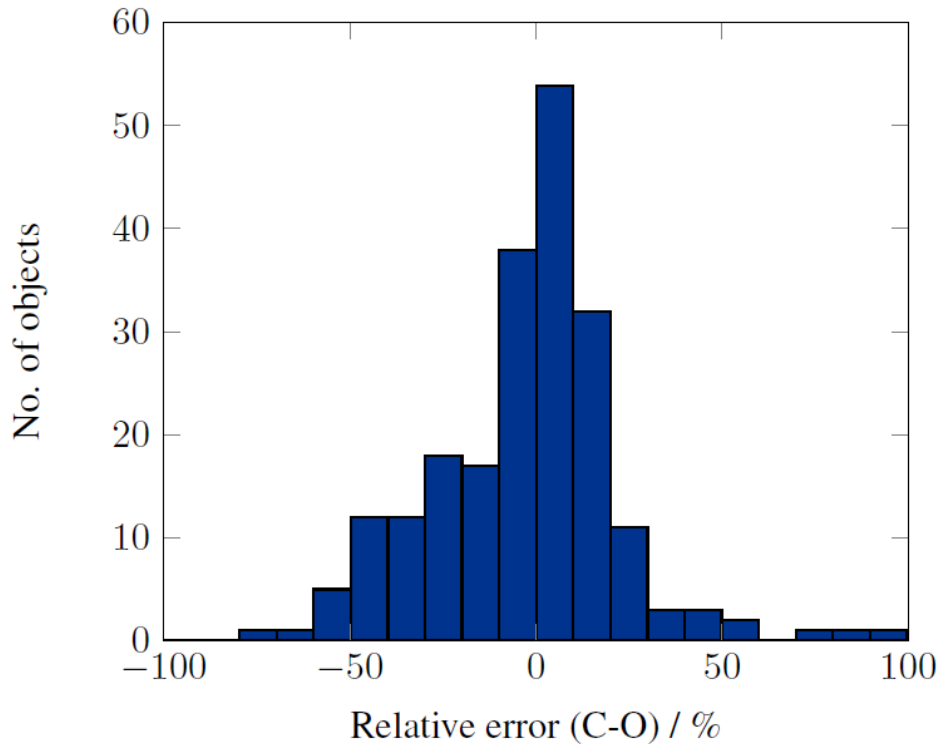


# Model uncertainties: the nominal case



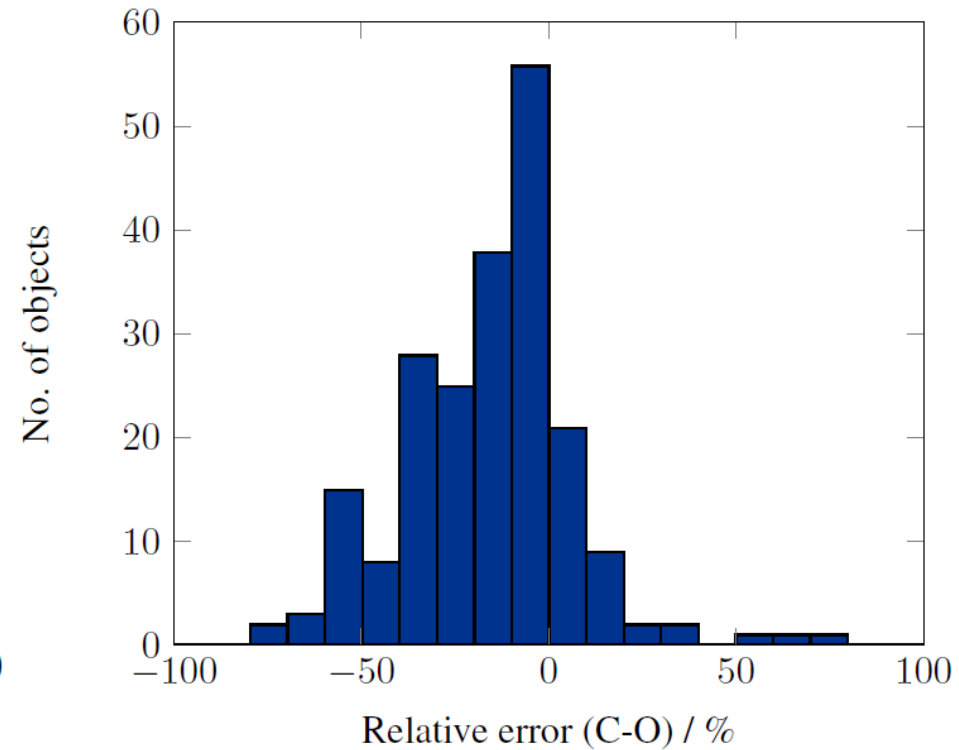
- ECSS repeated cycle:

$$\bar{x} = -3.1\%, \tilde{x} = 0.3\%, \sigma = 24.8\%$$



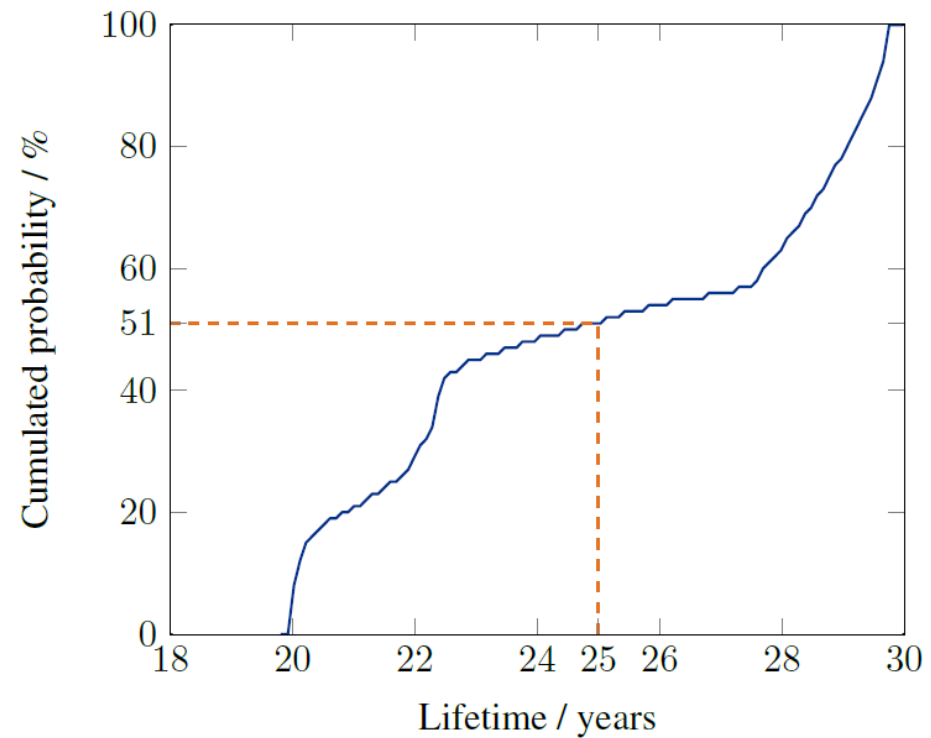
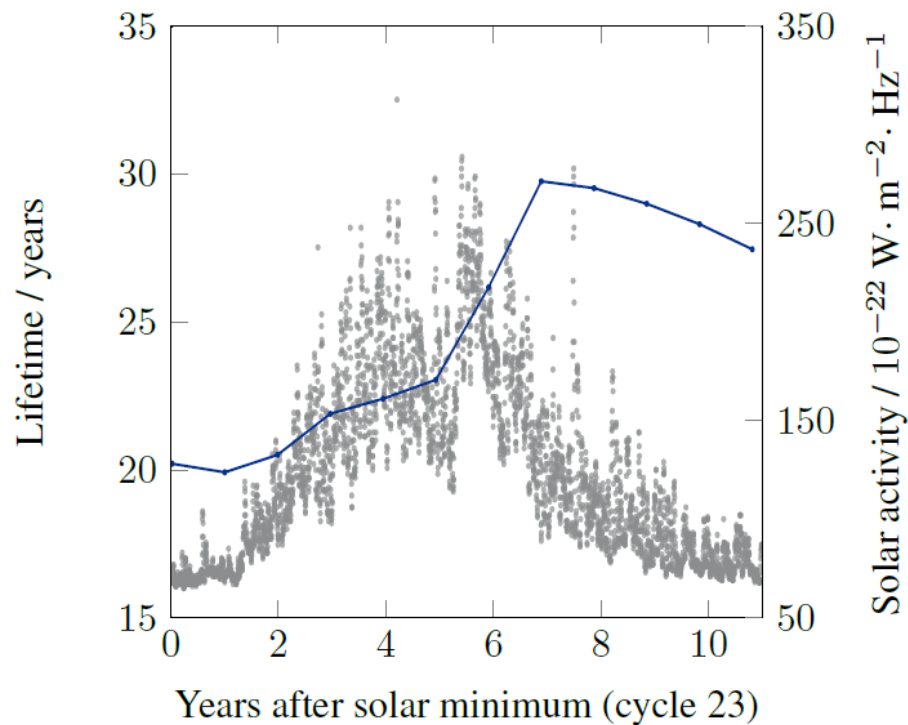
- ISO-MC cycle:

$$\bar{x} = -16.6\%, \tilde{x} = -14.4\%, \sigma = 22.1\%$$



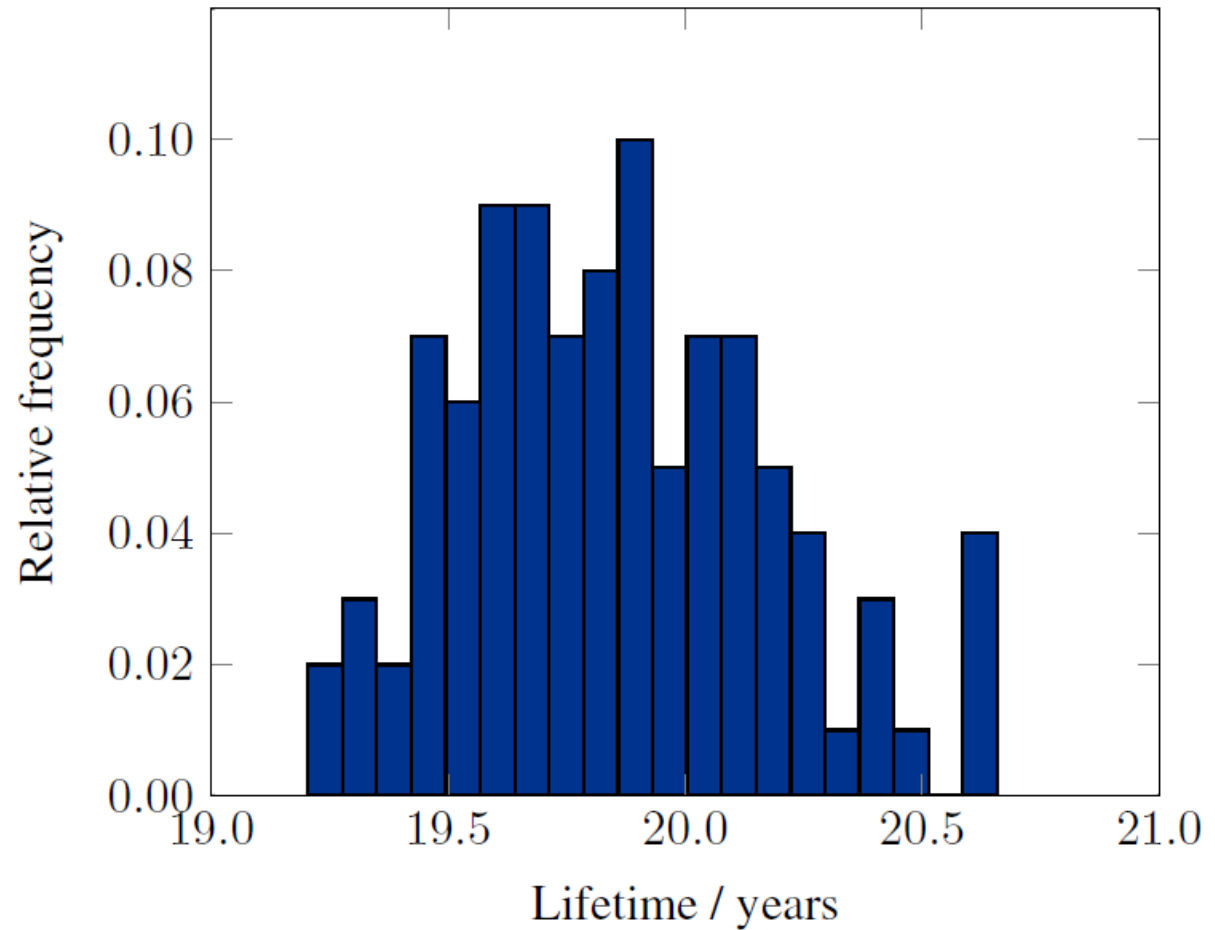
# Disposal epoch uncertainty

- Typical Cubesat orbit at 610 km, sun-synchronous



# Sensitivity in initial orbit elements

- Initial orbit at 610 km
- Uncertainty in semi-major axis of 3 km (normally distributed)





- **OSCAR** is ESA's recommended tool to be used for assessing compliance, for example, with the 25-year-rule
- Uncertainties associated with lifetime estimate were missing so far
- This study addressed several of the uncertainty sources
- An upgrade of OSCAR is envisaged to provide a probabilistic lifetime estimate in the near future

Thank you for your attention!

<https://sdup.esoc.esa.int>