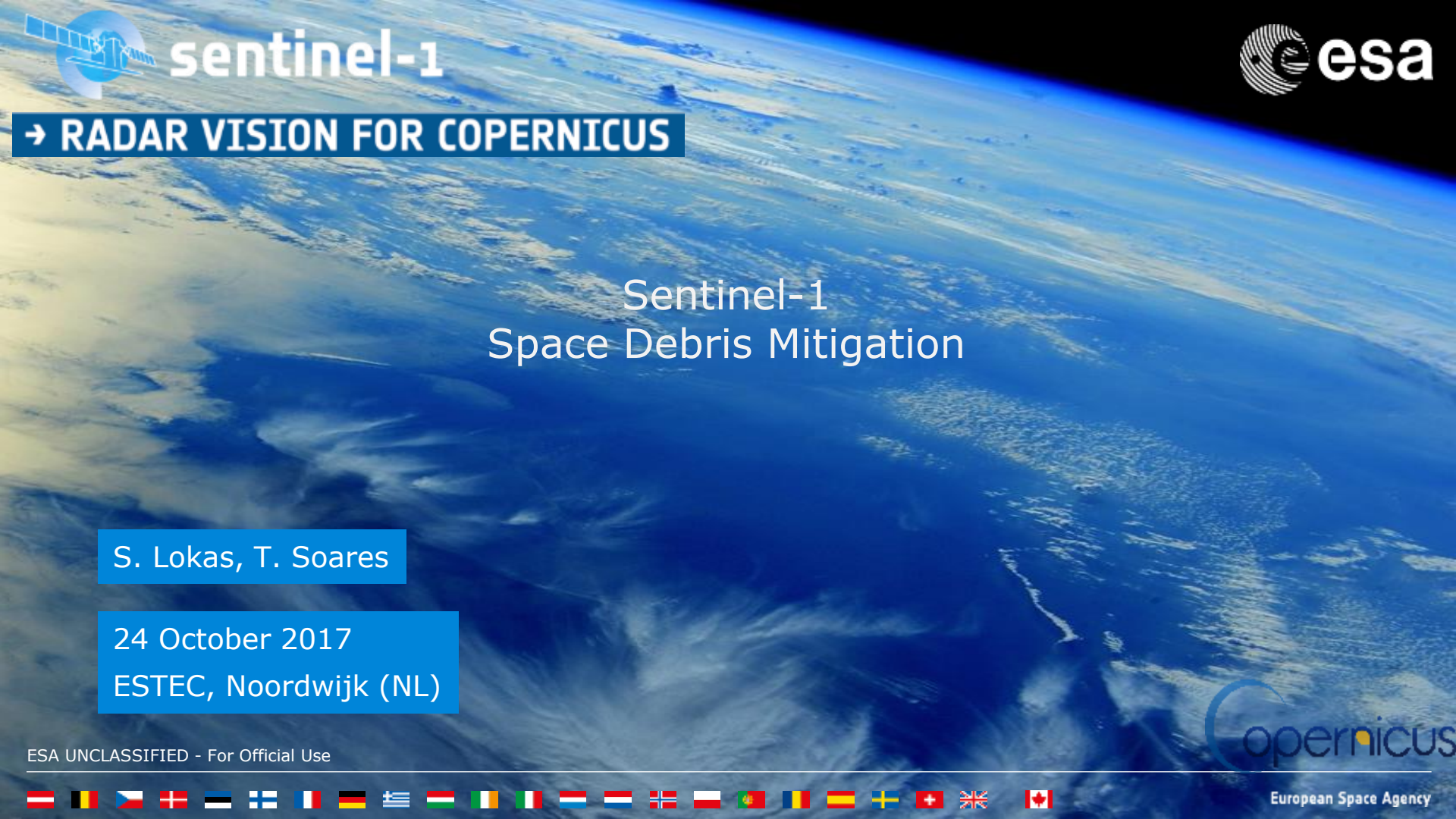

Sentinel-1
Space Debris Mitigation

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ESTEC, Noordwijk (NL)

Outline

- Background
- S-1CD Evolution w.r.t. S-1AB
- S-1 Simulation Results
- Next Steps

Background 1/3

- Sentinel-1 SRR Prior to Entry Into Force of ESA/ADMIN/IPOL(2014)2
  - Sentinel-1AB: Simulations Run under ESA Project Initiative
  - Sentinel-1CD: Nevertheless required by ESA Project to be compliant with the ESA Space Debris requirements
  - Prime Contractor (TAS-I) Lead Activity for Sentinel-1CD
    - Space Debris Mitigation Plan
    - Space Debris Mitigation Report
  - All Simulations Performed by HTG (D) using SCARAB

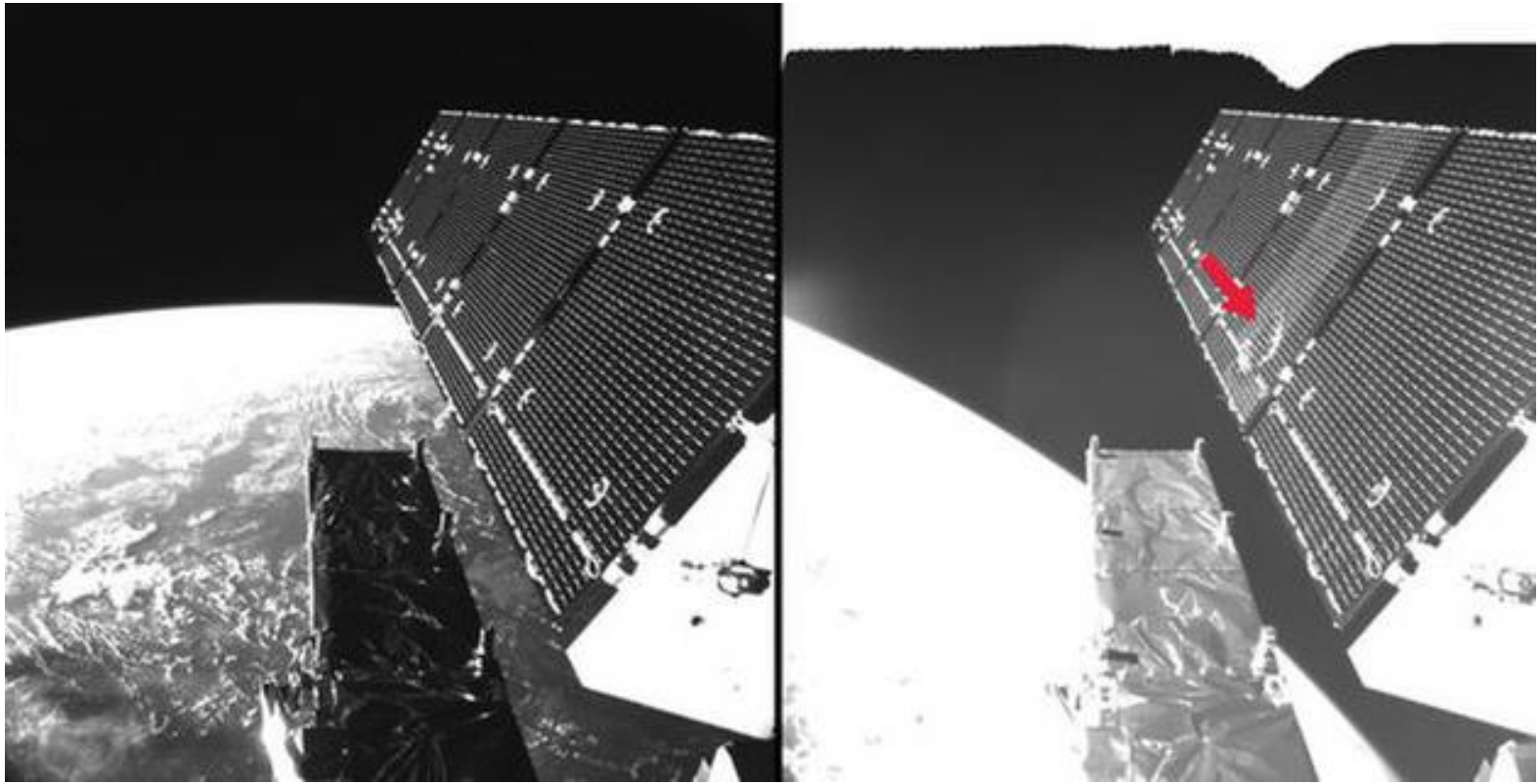
Background 2/3

- Sentinel-1AB Debris Encounters to Date (ref. ESOC, 10 October)

  - Sentinel-1A CAMs: **18**
    - 6 Before Reaching the Reference Orbit
    - 1 During LEOP (Lesson Learned)
  - Sentinel-1A Close Approach (no CAM): **31**

  - Sentinel-1B CAMs: **3**
    - 1 Before Reaching the Reference Orbit
  - Sentinel-1B Close Approach (no CAM): **1**

Background 3/3



http://www.space.com/33920-european-satellite-space-particle-strike.html

Significant Evolution for S-1CD vs. S-1AB

- Automatic Identification System (AIS) Payload: New Feature
- Design for Demise (D4D)
  - Balance Masses
    - Sentinel-1AB (All Steel)
      - 1 Internal Mass (50kg) & 6 External (each 5 kg)
    - Sentinel-1CD Studied 3 Cases (Case 3: All AL6061)
      - Internal Mass 6 Uniform Blocks (each 5.3kg)
      - External Mass 2 Uniform Blocks (each 5kg)
  - C-SAR Antenna Separation during re-entry
    - Designed to ensure separation of whole Antenna at sufficient altitude
    - Based on specific design of the C-SAR Center Panel Brackets that detach at a certain temperature (under Airbus BIPR)

Simulation Results

Scenario	# of Fragments	Tot. mass [kg]	Casualty Area [m²]	Casuality Risk
Sentinel-1AB	37	279,9	25,2	3.33E-04
Sentinel-1CD	**23,1**	**121,0**	**14,8**	**2,00E-04**

Next Steps

- The Sentinel-1 Project Team is cooperating and coordinating with Clean Space.
- The Clean Space Team is supporting Sentinel-1 by:
  - Proposing improvements to the model used in reentry simulations based on current knowledge,
  - Supporting the development and V&V of early break-up brackets,
  - Evaluating technical aspects of the solutions proposed in the Space Debris Mitigation Plan and Report.

- At Sentinel-1CD FAR all these efforts will have been applied and will be presented