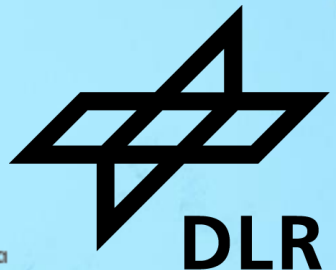


IADC MOLNIYA TRACKING CAMPAIGN

Status: 06/2023

Current Agencies Involved: ASI, DLR, ESA



Sensors



ASI

- Radar Birales
- Medicina, Italy
- Accuracy: Range < 50 m, Range-rate < 4 m/s
- Field of View: $6^\circ \times 6^\circ$, steerable along local meridian

ASI



ESA

- 0.8m, 1m Telescope
- Zimmerwald, Switzerland
- Accuracy Ra/Dec: $0.8''$ (0.8m), $0.6''$ (1m)
- Field of View: $0.63^\circ \times 0.63^\circ$ (0.8m), $0.41^\circ \times 0.45^\circ$ (1m)

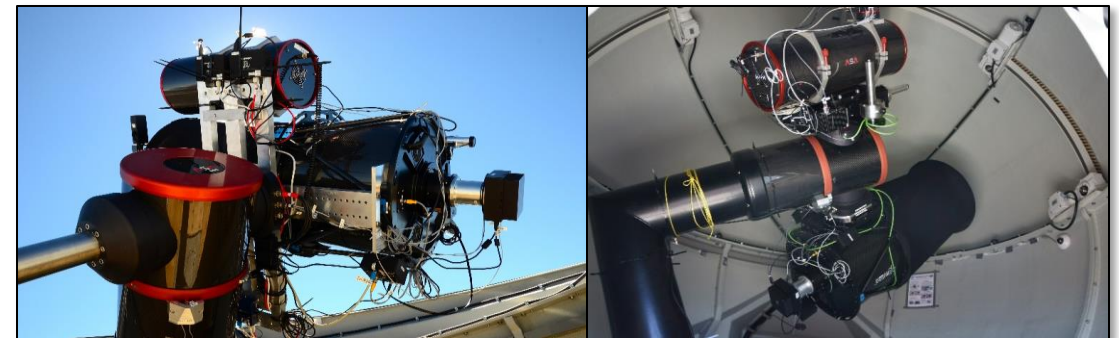
ESA



DLR

- 20cm, 25cm, 50cm Telescope
- South Africa, Australia, Germany
- Accuracy Ra/Dec: $1.5''$ (20/25cm), $\sim 1''$ (50cm, seeing limited)
- Field of View: $13^\circ \times 15^\circ$ (20cm), $3.6^\circ \times 3.6^\circ$ (20cm), $2.9^\circ \times 2.9^\circ$ (25cm), $0.6^\circ \times 0.6^\circ$ (50cm)

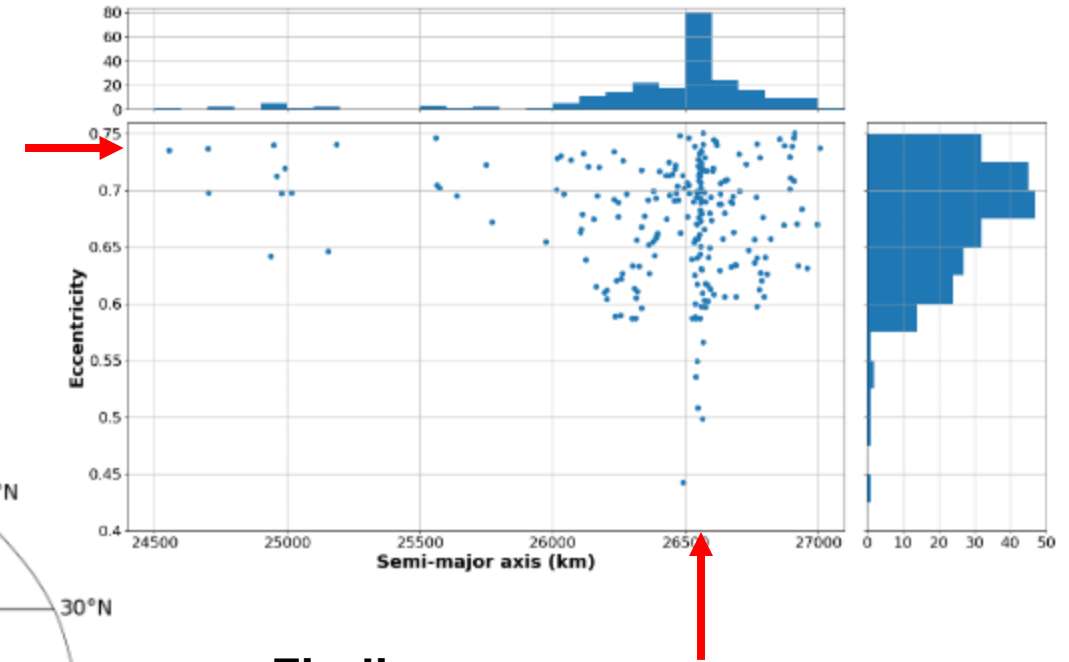
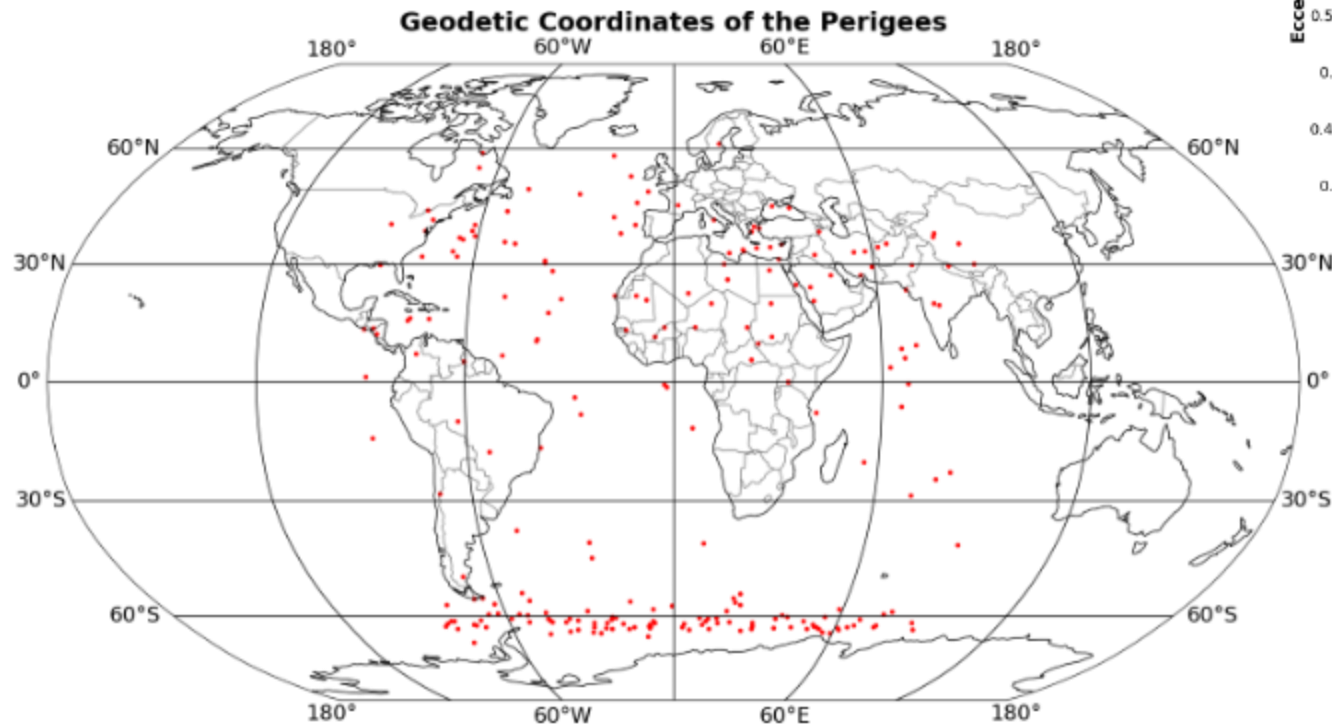
DLR



Public Catalogue: Data

Molniya-like objects

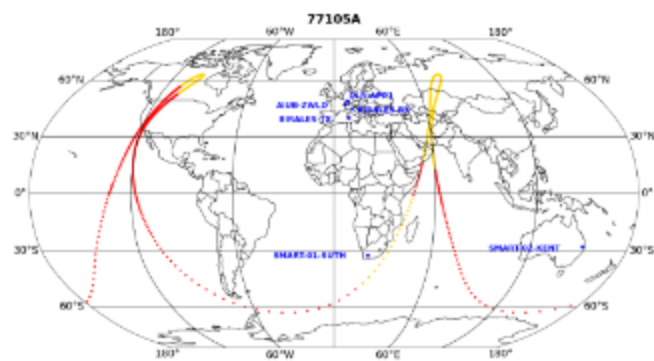
- Eccentricity $e = 0.737 \pm 0.15$
- Semi-major axis $a = 26,553 \pm 2,000$
- Inclination $i = 63.4 \pm 10$
- 229 objects from space-track.org



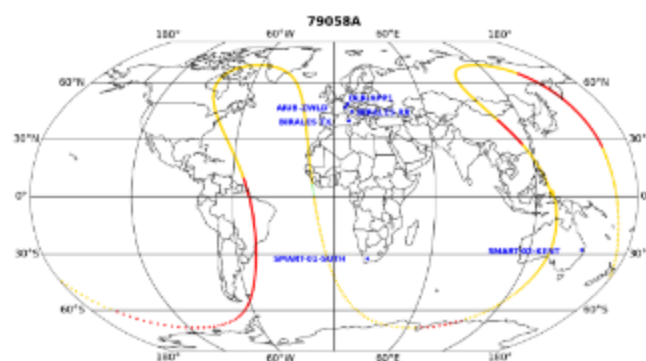
Findings

- Elements distributed
- Perigee distributed → categorize
- Possible to observe?

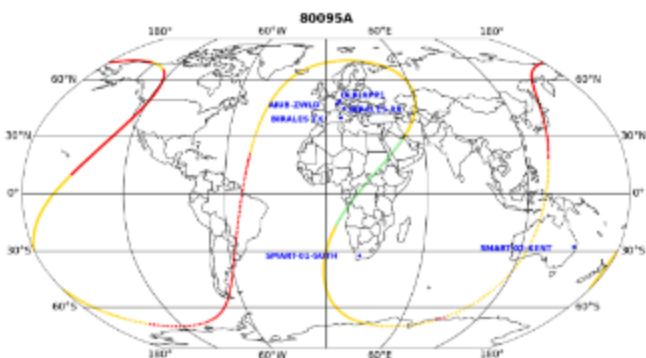
Public Catalogue: Data



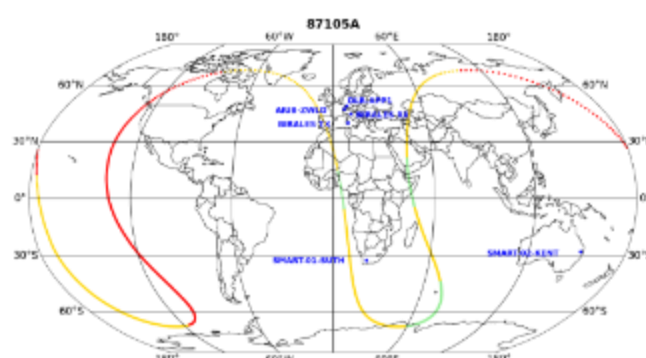
Classical Molniya



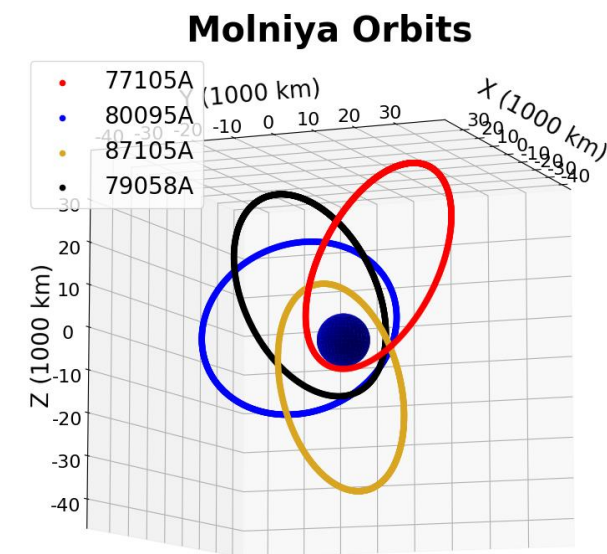
Perigee < -30°



Perigee -30°...+30°



Perigee > +30°



Objects

- Categories: [-90;-30], [-30,30], [30,90]
- Visibility check
- Selection of object
- Objectives:
 - tracking possible from station x?
 - OD with acquired data possible?

No visibility – visible from one station – visible from two stations

Public Catalogue: Visibility



Object selection criteria:

- objects shall be visible from stations with individual specifications (night length, fixed field of view, horizon mask, ...)
- enough objects identified which are visible from all stations (25, mainly perigee $> +30^\circ$)
- enough objects identified which are visible from all telescope station (40, all three categories)

Observation Campaigns



Observation campaigns

- Telescopes only: 15.05.2023 – 26.05.2023
 - South Africa / Australia: 194 tracklets, including few tracklets near simultaneously tracking the same object)
 - Switzerland: 15.05.2023 – 07.06.2023 239 tracklets
 - Germany: ~ 1,000 images
- All sensors: 01.06.2023 – 09.06.2023
 - Ongoing at time of preparation of slides 😊

Data Processed



ASI

- Few observable passes. No data generated with BIRALES so far. New attempts planned after IADC, including OD processes

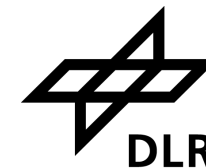
DLR

- Tracklets converted to TDM
- In preparation for OD, results expected after IADC

ESA

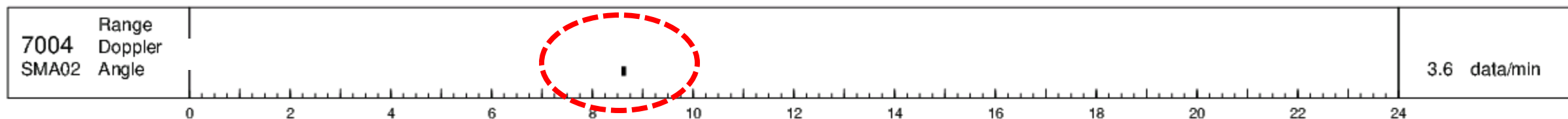
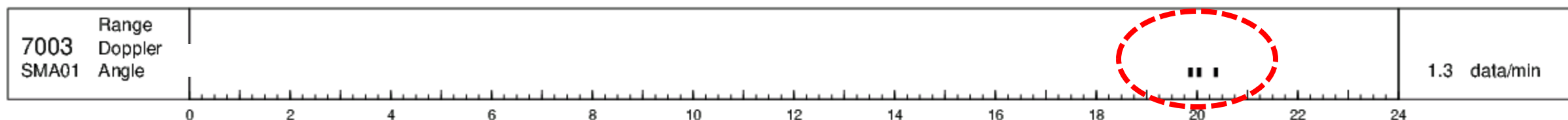
- Tracklets to be converted to TDM (for data exchange),
- OD to be done after IADC

Processing Example DLR



Int. Desig.	NORAD	Name	#Obs South Africa	#Obs Australia	Campaign Start
1997-015A	24761	COSMOS 2340	22	21	2023/05/18 18:17:02

- State from TLE OD
- TLE from SpaceTrack or CelesTrak
- OD from state and observations



Next Steps



Preparation of OD

- Exchange station coordinates (done)
- Exchange tracklets (partly done)
- perform OD of known objects

Preparation of next observation campaign

- ASI, DLR, ESA, ...
- New selection of objects
 - to cover all categories of perigee
 - check for capability of data acquisition

How to track Space Debris in this regime without any prior knowledge?

- Staring experiment?
- Track-while-scan (possible, telescopes are set up, ...)???
- Pseudo-object-tracking?
- Any other idea?

Anyone wants to join?