30th IADC Meeting, May 22-25, 2012

Montreal, Canada

Updated results of 8 years of GEO region surveys

Presentation of the Roscosmos delegation to the IADC WG1

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Instruments for GEO Surveys

- Typical 22 cm and 25 cm aperture telescopes
  FOV – from 2.8°x2.8° to 5.5°x5.5°

- Facilities having survey instruments

  Blagoveshchensk, Collepardo, Milkovo, Nauchny, Pulkovo, Tarija, Ussuriysk

- New instruments with 40 and 50 cm aperture

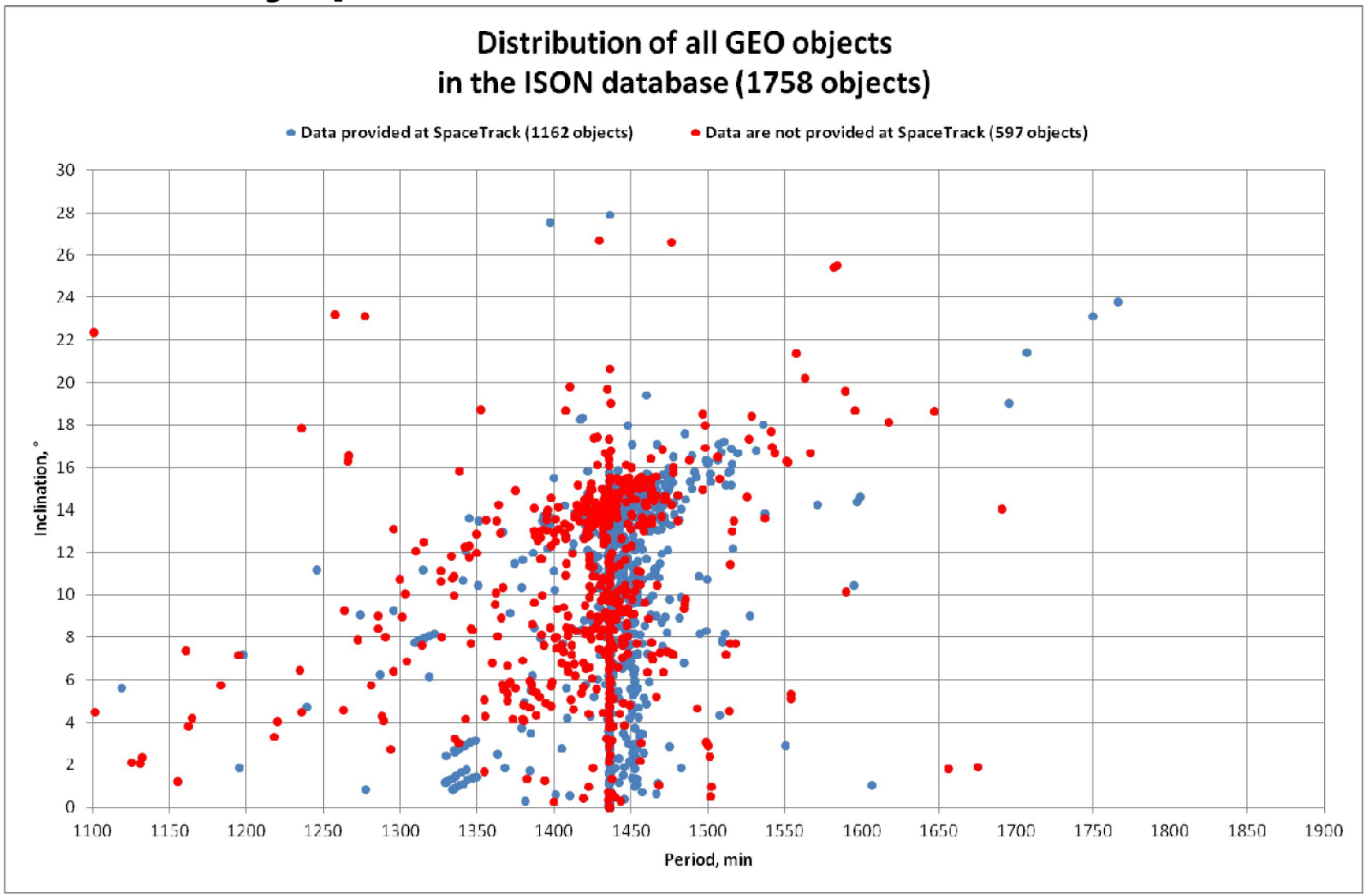
ISON Monitored GEO Region Objects

- 1557 GEO region objects were tracked by ISON early 2011 (compare to 1016 objects of the same region for which orbital data were providing at SpaceTrack), including
  - spacecraft – 922
    404 – active
    518 – non-active
  - upper stages and AKMs – 257
    of more than 15 different types (modifications)
  - fragments and objects of undetermined type – 378
    (only 20 GEO fragments are officially catalogued at SpaceTrack)

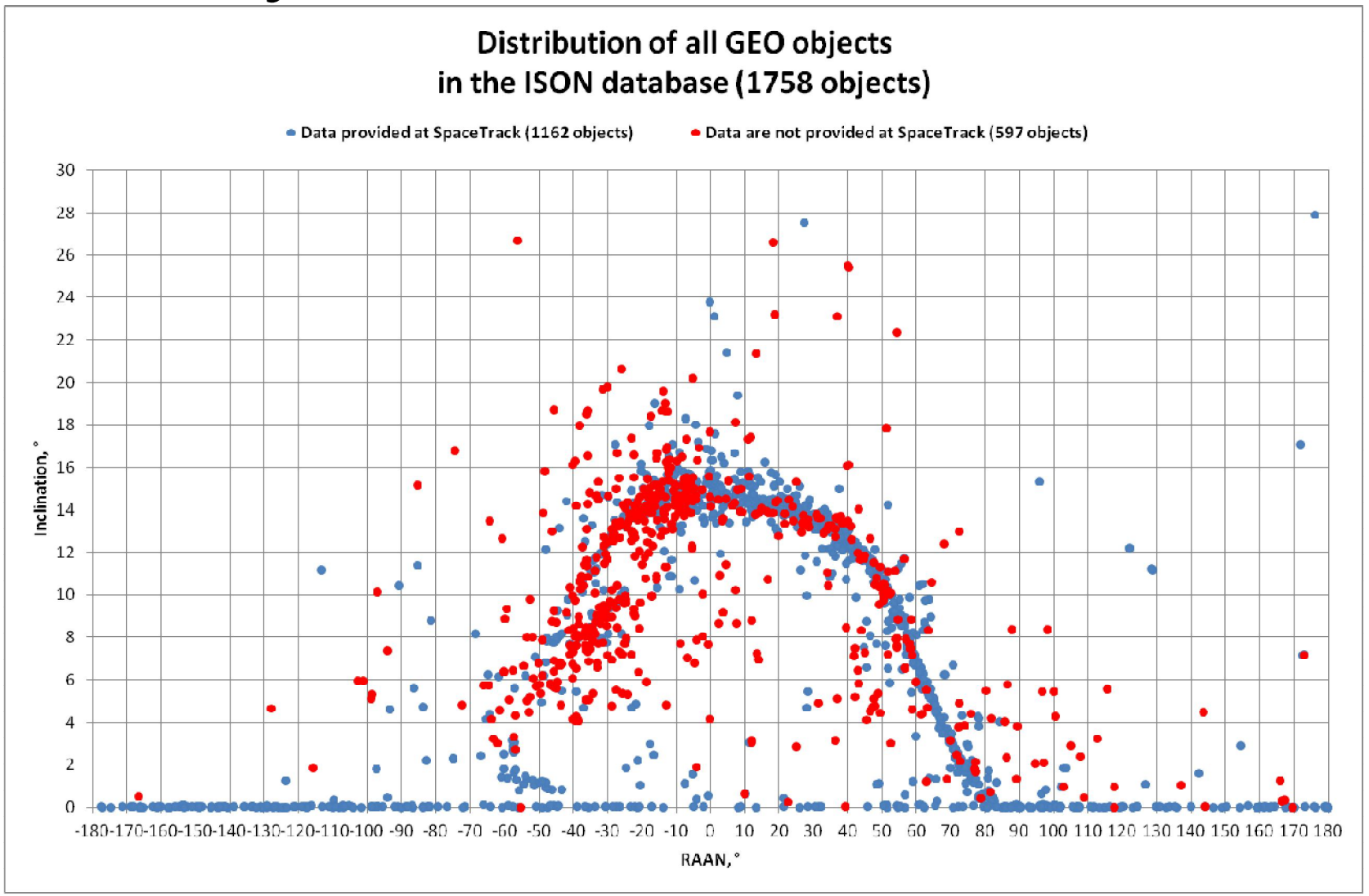
- 147 new GEO objects are discovered and added to the ISON database in 2011

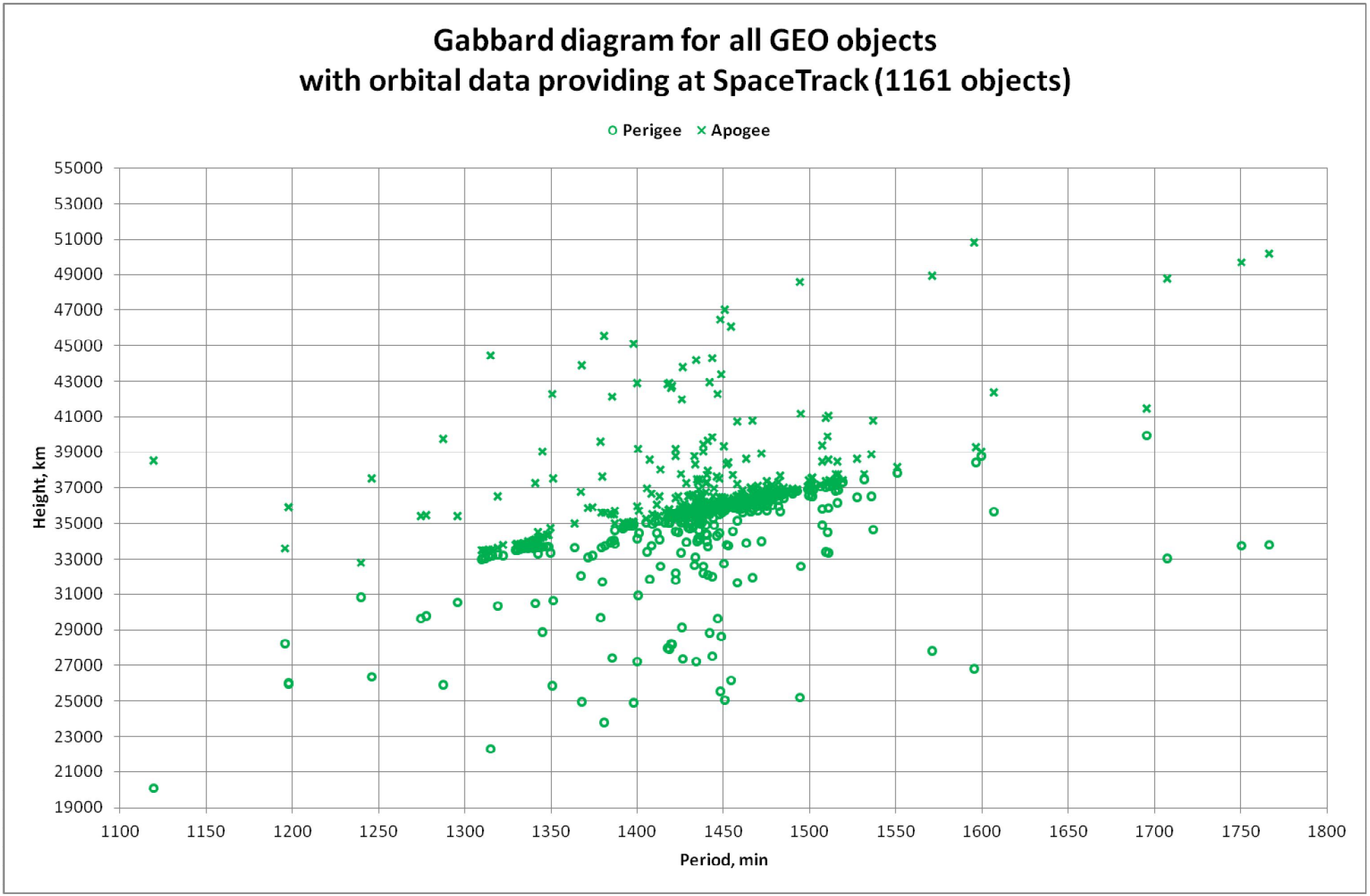
- 1704 GEO region objects are in the ISON database as of 31.12.2011, 54 new GEO region fragments are discovered in 2012

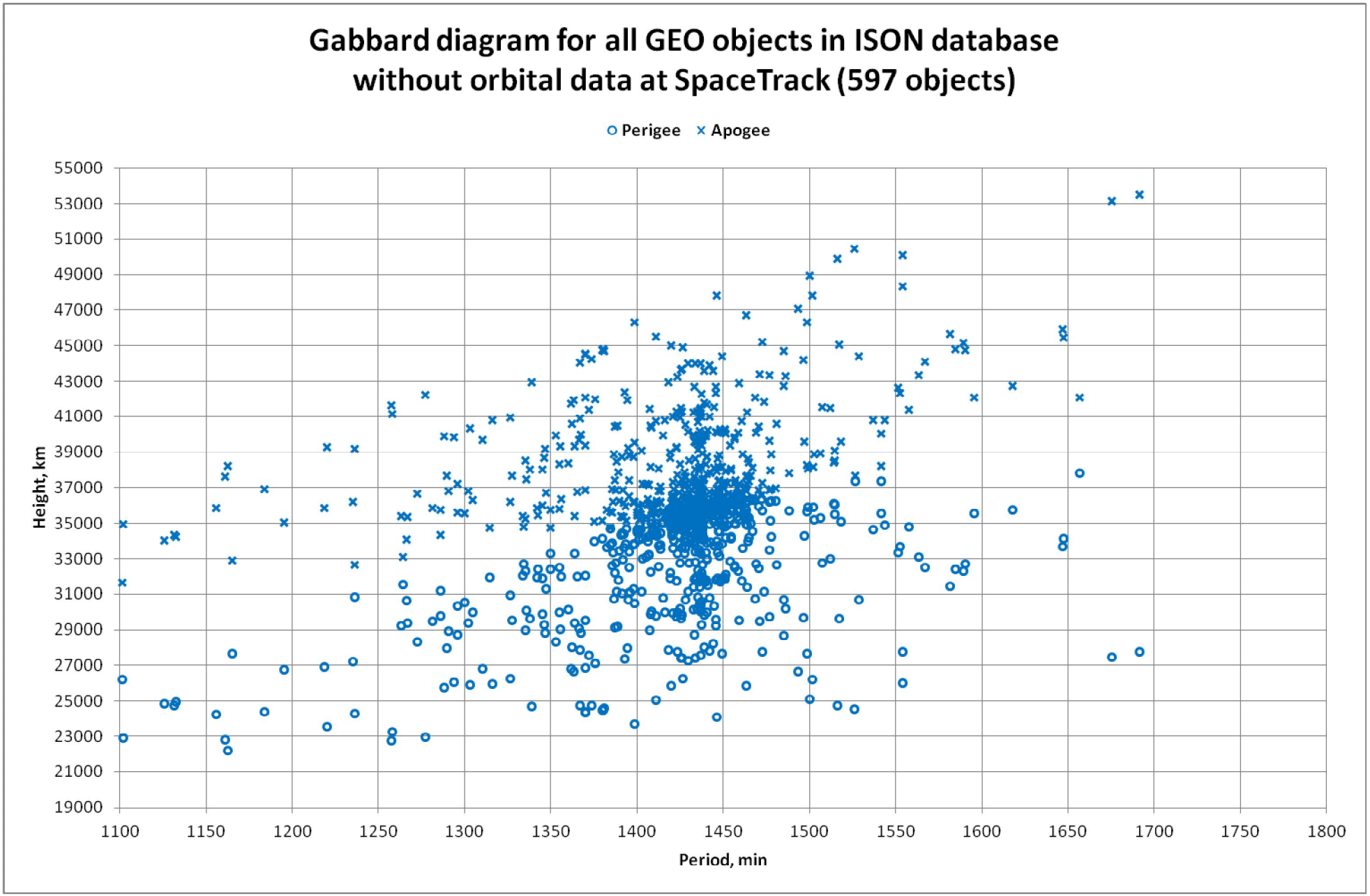
Distribution of observing GEO objects by period and inclination

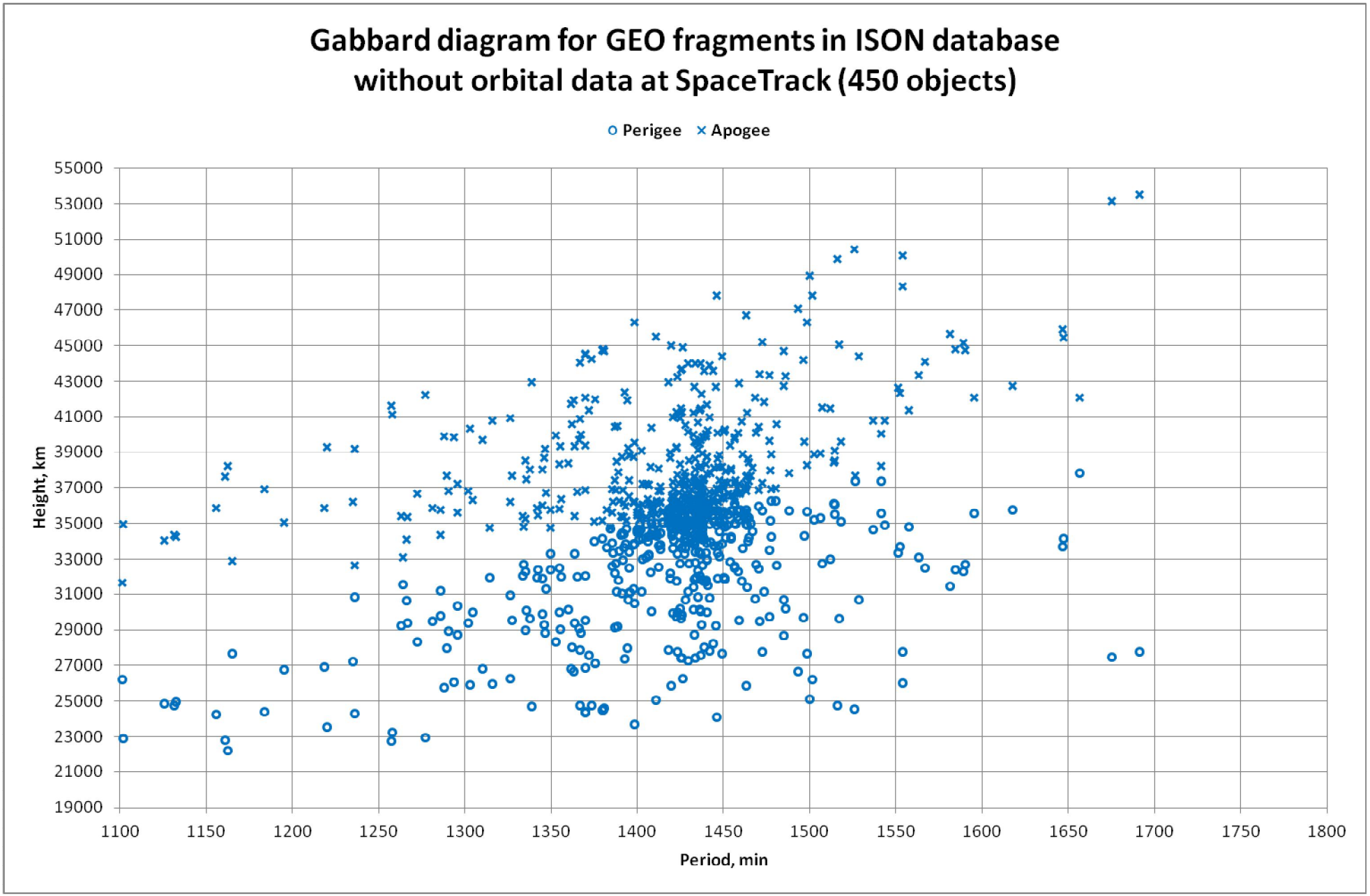


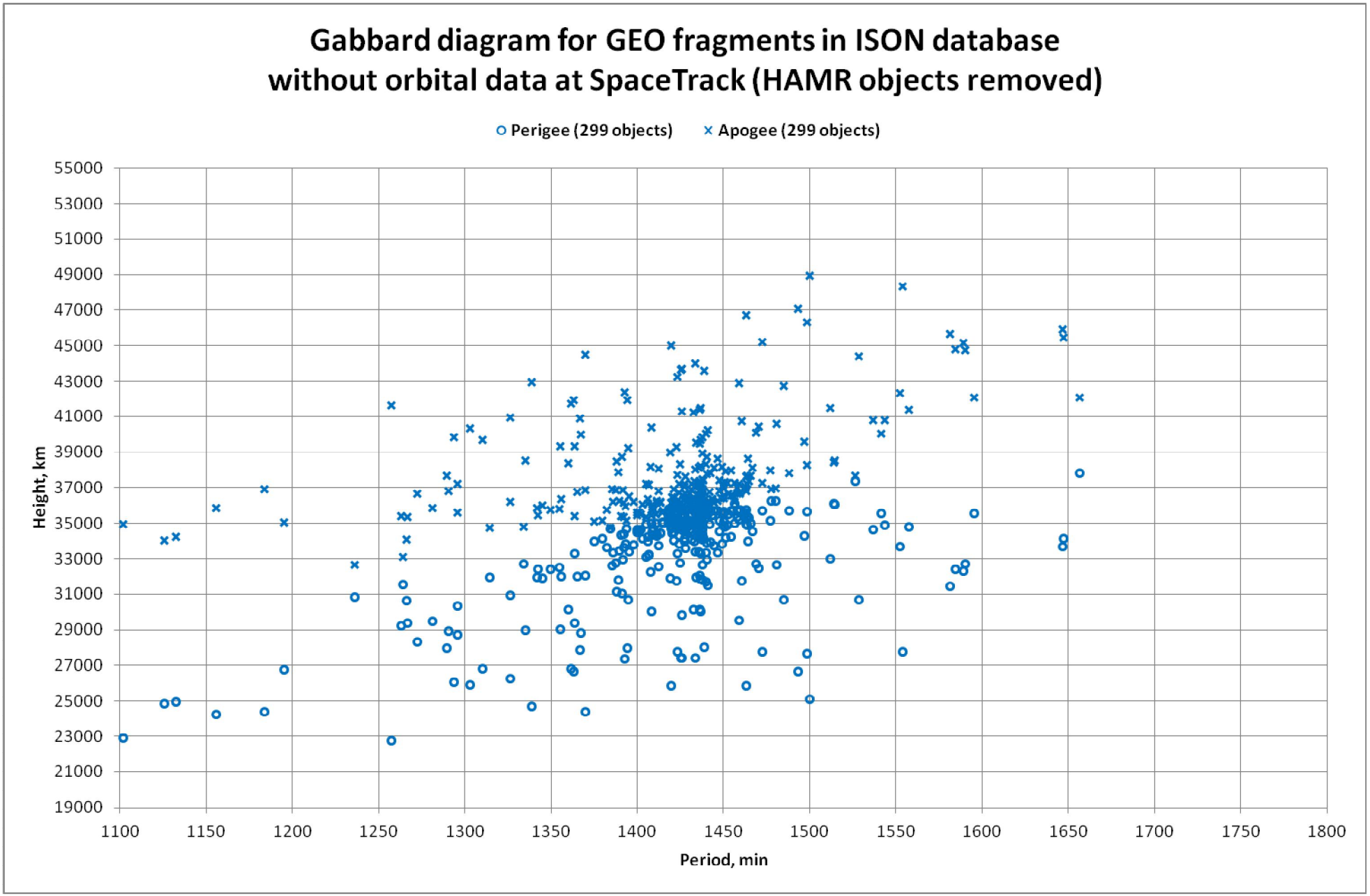
Distribution of observing GEO objects by RAAN and inclination




Gabbard diagram for all GEO objects
with orbital data providing at SpaceTrack (1161 objects)
Perigee
Apogee
Height, km
55000
53000
51000
49000
47000
45000
43000
41000
39000
37000
35000
33000
31000
29000
27000
25000
23000
21000
19000
1100
1150
1200
1250
1300
1350
1400
1450
1500
1550
1600
1650
1700
1750
1800
Period, min


Gabbard diagram for all GEO objects in ISON database without orbital data at SpaceTrack (597 objects)
Perigee
Apogee
Height, km
55000
53000
51000
49000
47000
45000
43000
41000
39000
37000
35000
33000
31000
29000
27000
25000
23000
21000
19000
1100
1150
1200
1250
1300
1350
1400
1450
1500
1550
1600
1650
1700
1750
1800
Period, min

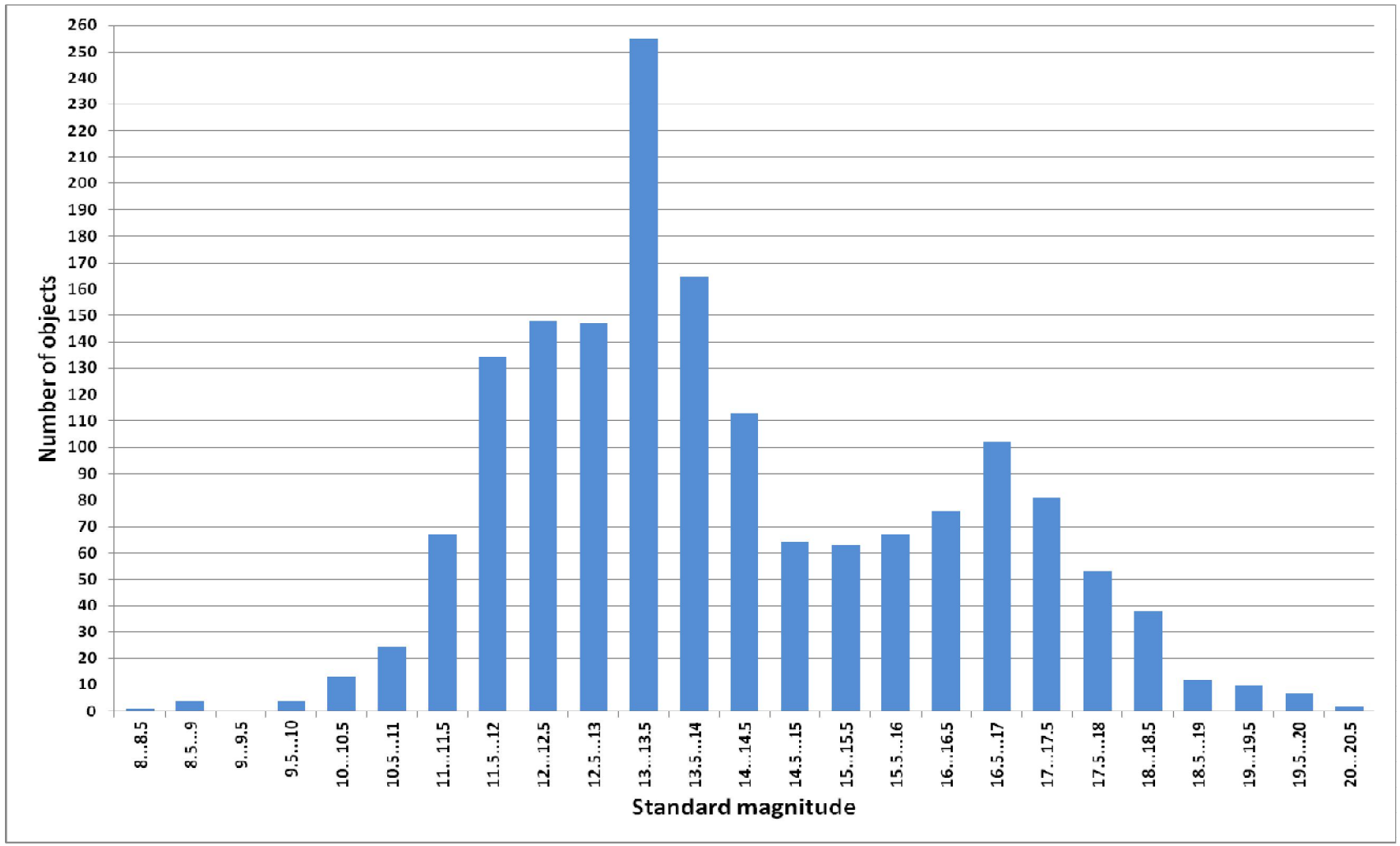

Gabbard diagram for GEO fragments in ISON database without orbital data at SpaceTrack (450 objects)
Perigee
Apogee
Height, km
55000
53000
51000
49000
47000
45000
43000
41000
39000
37000
35000
33000
31000
29000
27000
25000
23000
21000
19000
1100
1150
1200
1250
1300
1350
1400
1450
1500
1550
1600
1650
1700
1750
1800
Period, min


Gabbard diagram for GEO fragments in ISON database
without orbital data at SpaceTrack (HAMR objects removed)
Perigee (299 objects)
Apogee (299 objects)
Height, km
55000
53000
51000
49000
47000
45000
43000
41000
39000
37000
35000
33000
31000
29000
27000
25000
23000
21000
19000
1100
1150
1200
1250
1300
1350
1400
1450
1500
1550
1600
1650
1700
1750
1800
Period, min

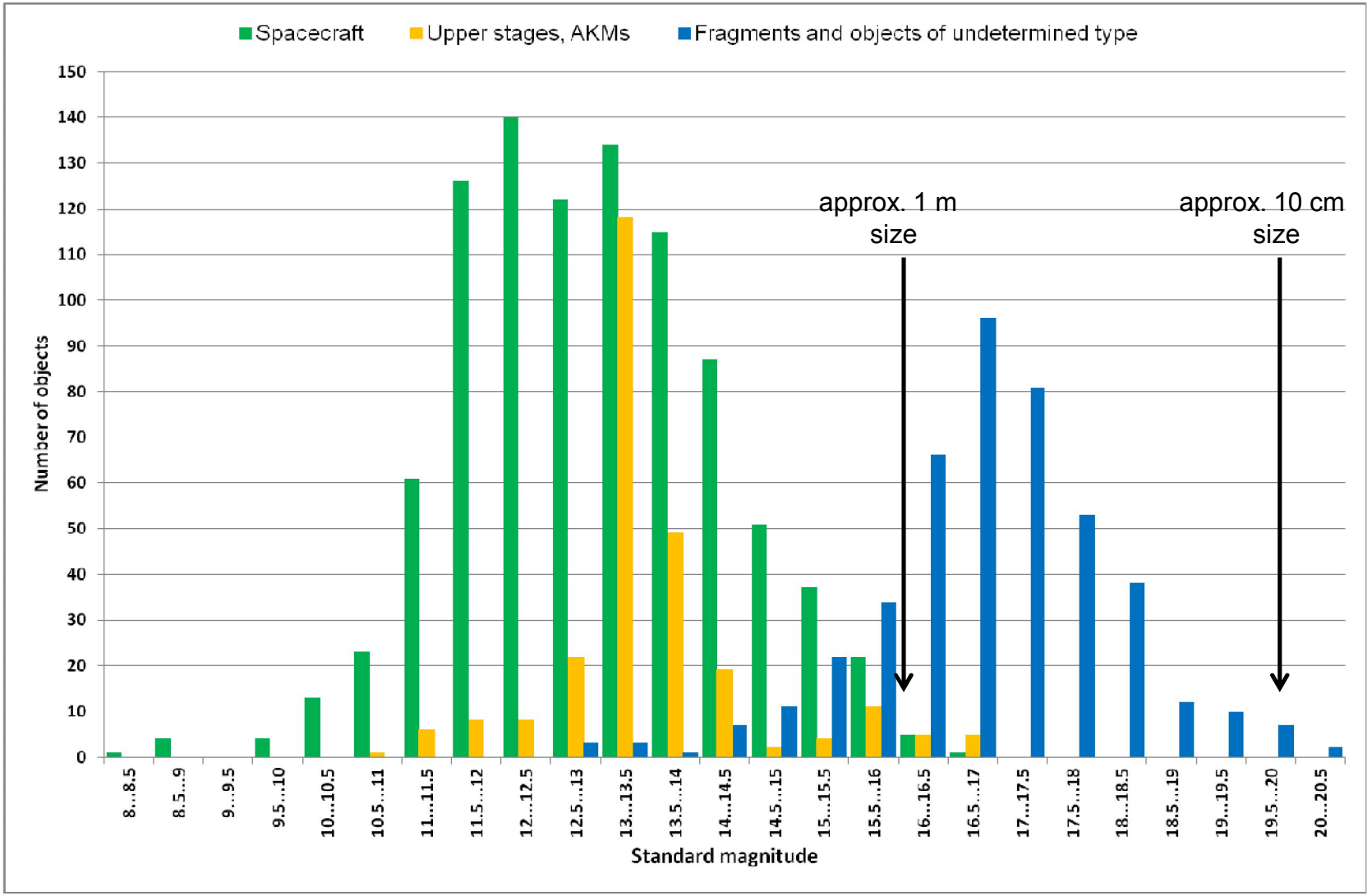
Brightness distribution of observing GEO objects

- Each object is assumed as a diffuse sphere with albedo of 0.15
- Differences between diffuse sphere phase function and real phase function for particular object are ignored
- Standard brightness (referring to a zero phase angle and 40000 km distance) is calculated for each object based on all collected measurements to the date
- Objects are split into 3 groups:
  - spacecraft,
  - rocket bodies (upper stages, AKMs),
  - fragments and objects of undetermined type

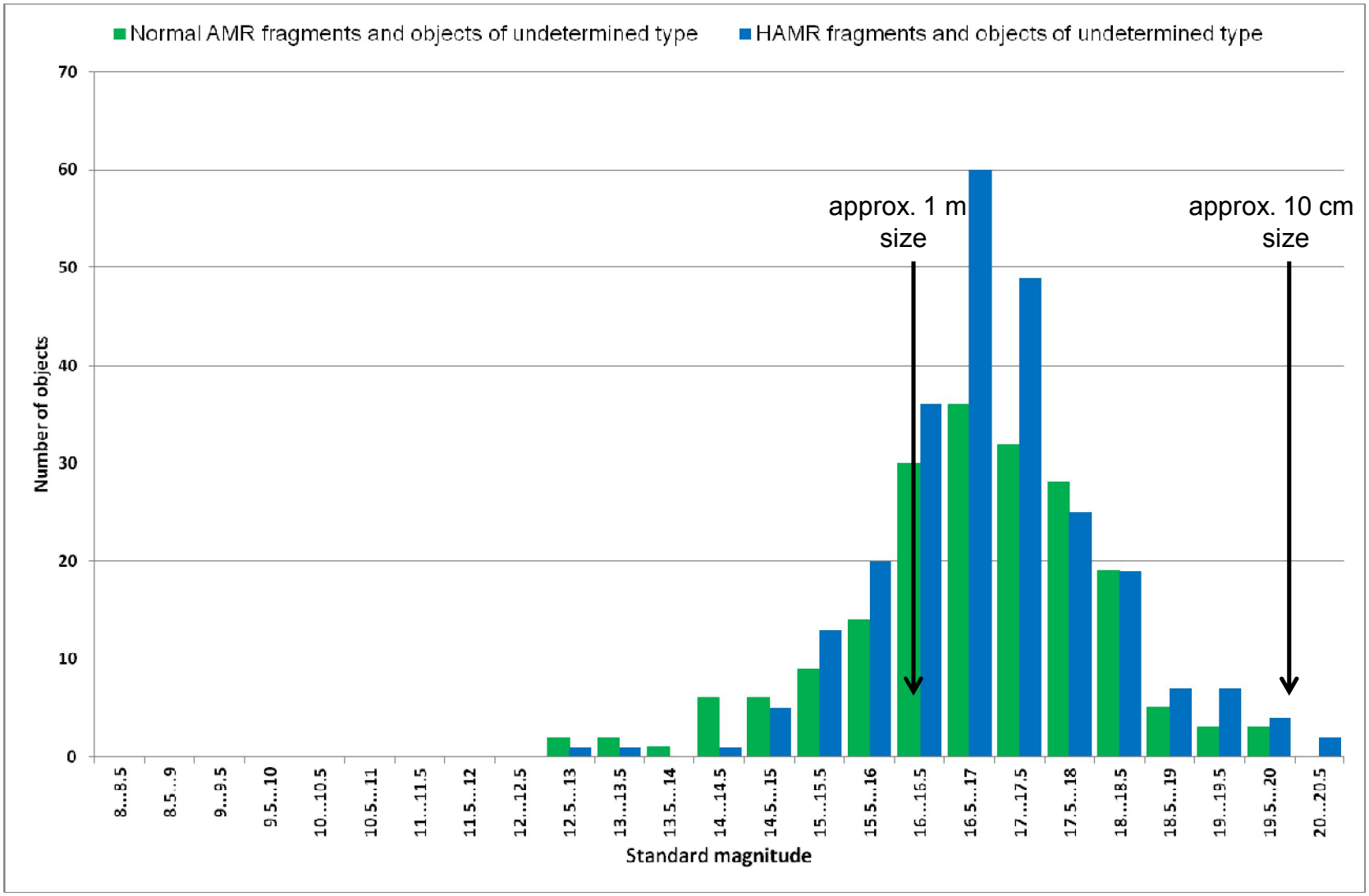
ISON Tracked GEO Objects Distribution by Standard Magnitude – 1704 objects



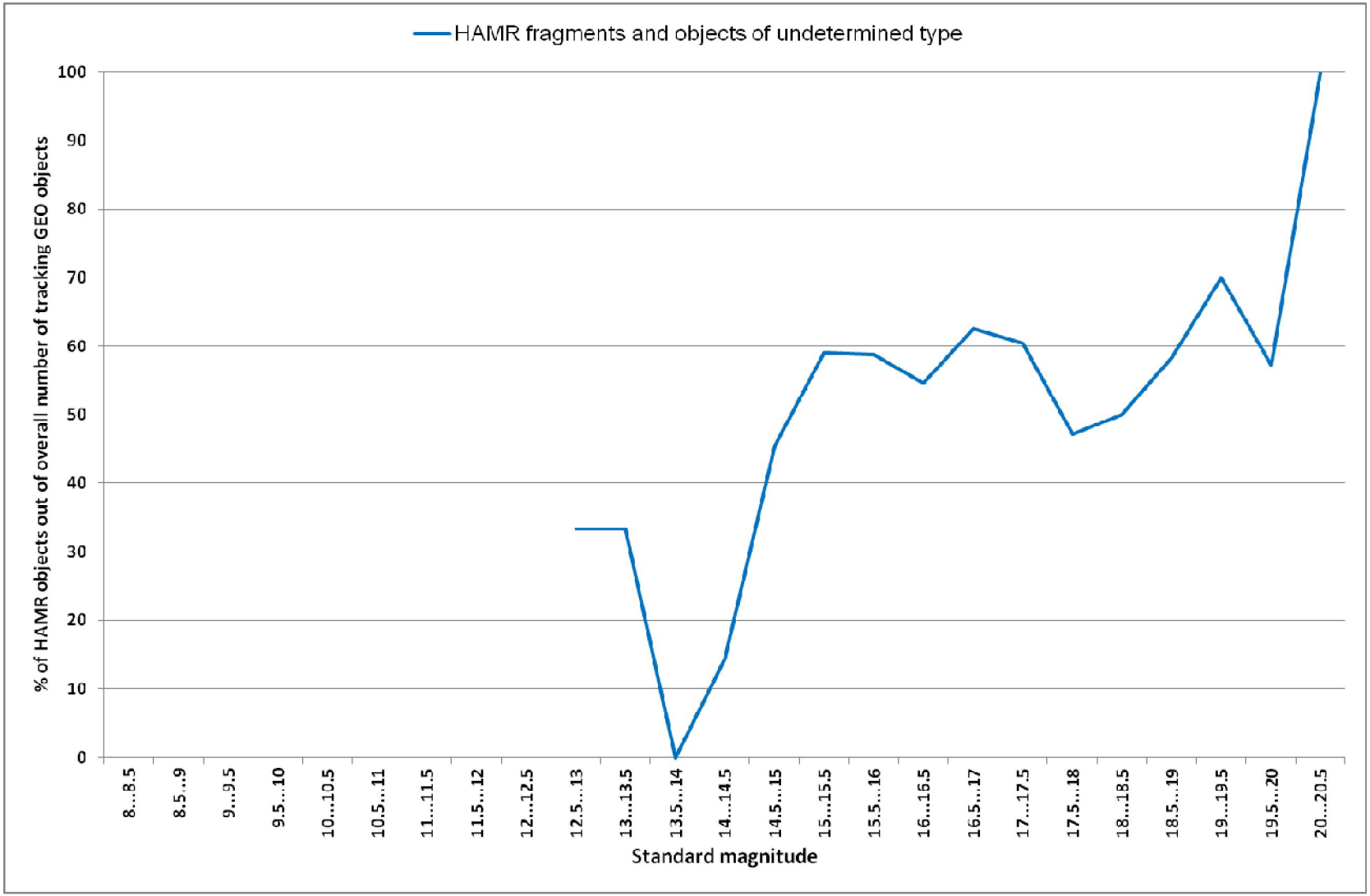
ISON Tracked GEO Objects Distribution by Standard Magnitude – 1704 objects



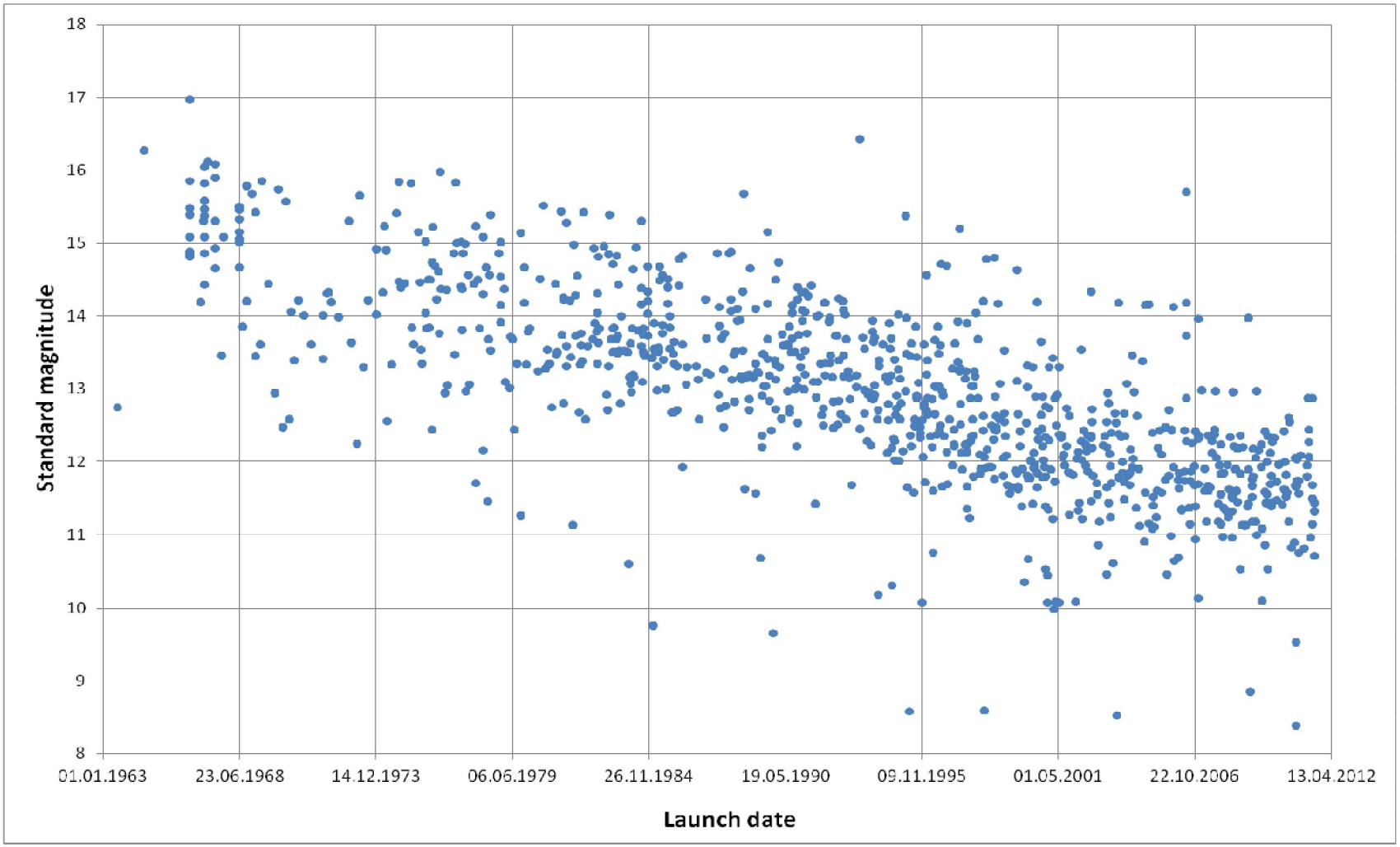
ISON Tracked GEO Fragments and Objects of Undetermined Type



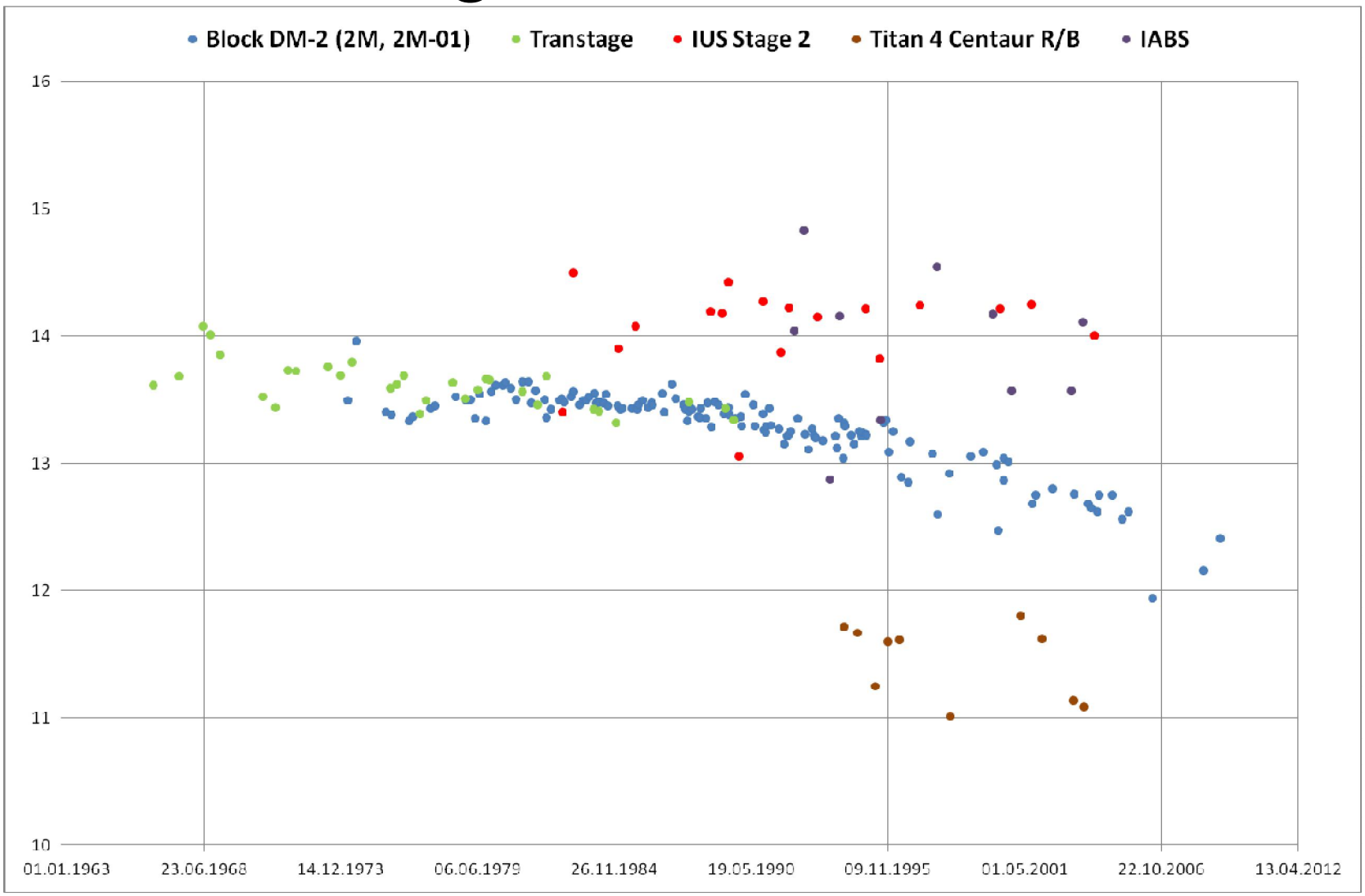
GEO HAMR Objects. How many?



ISON Tracked GEO Spacecraft Standard Magnitude vs. Launch Date



ISON Tracked GEO Upper Stages Standard Magnitude vs. Launch Date



Conclusions

More than 9 millions of measurements (RA, DECL) are collected within the ISON project since 2003

1758 GEO objects are tracked by ISON as of May 2012, including 597 ones without orbital data at SpaceTrack

Large population of HAMR objects is discovered and studied

Brightness properties of tracking objects are studied in a different way

Acknowledgements

Great thanks to all ISON observers and engineers

Special thanks to the AIUB team for support of continuing multiyear cooperative GEO and HEO debris research especially HAMR ones