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# Space Situational Awareness: Building an Essential Tool for Treaty Implementation

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# Space Situational Awareness (SSA)

## Key Issues To Consider In Treaty

### The Earth orbital population

- objects characterization
- events characterization (launch and orbital events as sources of orbital objects)

### Threats to the orbital/ground assets by the orbital population

- close encounters (potential collisions)
- orbital fragmentation events
- natural re-entry (intentional de-orbit) of the large objects or objects containing dangerous materials
- radio frequency interference

# Challenges Of Treaty Implementation To Support SSA Tasks

- Data collection
- Data processing and analysis
- Data sharing

# Challenges Of Treaty Implementation To Support SSA Tasks. Data Collection

Need of the internationally recognized source(s) of verified information on:

- updating trajectory data for orbital objects
- objects characterization and identification with the originating source to enable the assumption on responsibility
- orbital events

# Challenges Of Treaty Implementation To Support SSA Tasks. Data Processing And Analysis

Need of the international data center(s) for:

- close encounters (potential collisions) and re-entry analysis and liability assessment, producing of warnings
- analysis of data to identify non-compliance with Treaty and other relevant international treaties and recommendations

# Challenges Of Treaty Implementation To Support SSA Tasks. Data Sharing

Need of the new international data sharing policy for orbital objects and events

- definition of required data to share
- rules on data representation completeness, timeline etc.
- standardization issues for data contents and representation
- data access and dissemination policy

# International Orbital Objects Trajectory Data Service – Basement and Essential Tool for Treaty Implementation

Trajectory data for all individually searchable and trackable orbital objects is a key element of the SSA.

***No trajectory data – no threats analysis – no results supporting SSA tasks – no way for Treaty implementation for SSA purposes***

Measurement network supporting implementation of Treaty for SSA should be international

- geographical distribution of sensors is required
- building of such network is expensive for one State but can be performed for little cost for each State if many involved

# The UN General Assembly Resolution 62/217

*The General Assembly,*

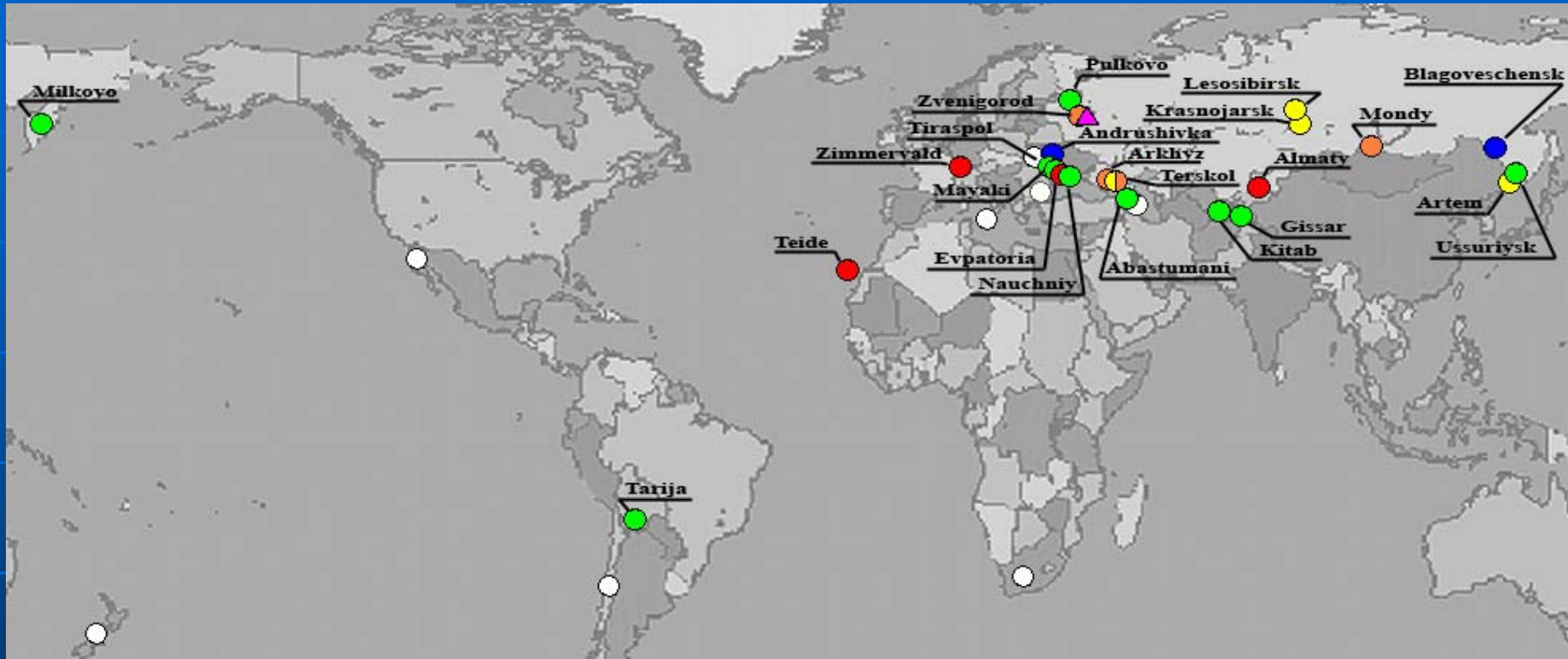
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*Considering,* that space debris is an issue of concern to all nations,

.....

28. *Considers* that it is essential that Member States pay more attention to the problem of collisions of space objects, including those with nuclear power sources, with space debris, and other aspects of space debris, **calls** for the continuation of national research on this question, **for the development of improved technology for the monitoring of space debris and for the compilation and dissemination of data on space debris**, also considers that, to the extent possible, information thereon should be provided to the Scientific and Technical Subcommittee, and agrees that international cooperation is needed to expand appropriate and affordable strategies to minimize the impact of space debris on future space missions;

# International Scientific Optical Network



**Green** circles – ISON observatories working in the project during a few years

**Blue** circles – ISON observatories working in the project the first year

**Yellow** circles – ISON observatories where preparatory work is carrying out

**Red** circles – observatories – foreign partners of ISON

**Orange** circles – observatories – Russian partners of ISON

**White** circles – potential facilities for placement of new instruments

# ISON Project

ISON can be considered as implementation of one of possible concepts of organization of international network for the near-Earth space monitoring, data exchange, processing and analysis.

The project principal coordinator is KIAM RAS.

## ISON joins:

- 18 scientific institutions in 9 States , including partners from ESOC, AIUB (Switzerland), astronomical organizations of Bolivia, Georgia, Moldova, Russia, Tajikistan, Ukraine, Uzbekistan. Partners from Italy, Mongolia and Chile will join ISON soon
- 18 observatories and observation facilities
- 25 optical instruments
- coordination and data processing and analysis center
- more than 60 observers and researchers

# ISON Current Primary Goals

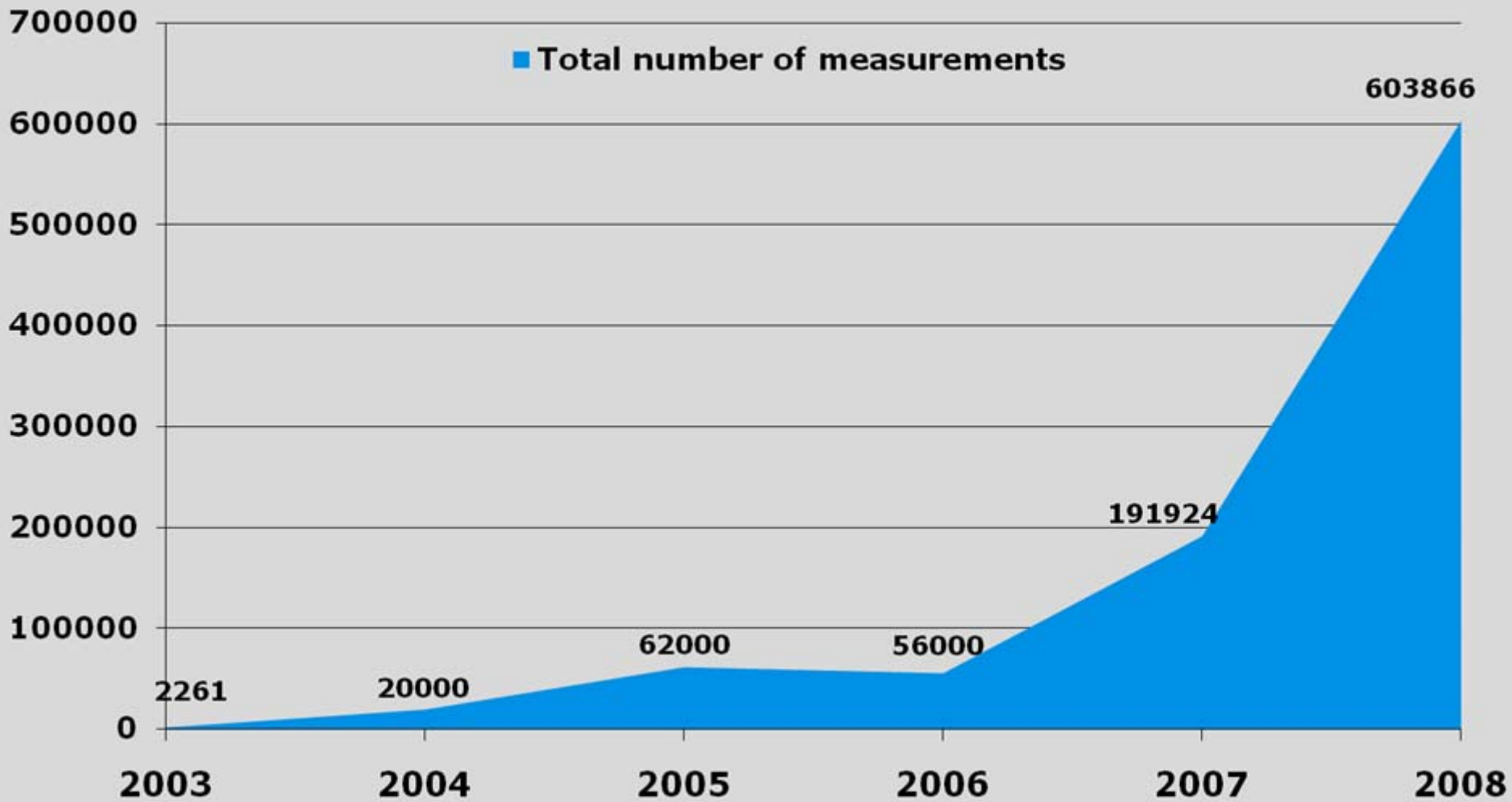
GEO region (one of the most important in the near-Earth space; limited natural resource):

- regular monitoring
- new objects discovering and tracking
- maintenance as complete GEO objects database as possible

HEO orbits (significant lack of our knowledge on real situation on these orbits):

- new objects on GTO and other HEO regimes discovering and individual tracking
- dedicated HEO surveys will start soon

# ISON increasing output



# GEO region study results obtained in 2005-2008

## COVERAGE

- Global GEO coverage capability is achieved that is important for continuous studying of space debris situation in that region
- Since Jun 2007 wide GEO survey mode is implemented for longitudes 31.5W to 90E in a zone  $\pm 16^\circ$  with respect to the "true" GEO ring. Partial GEO survey mode is implemented for other longitudes

## OBSERVATION OUTPUT

- Overall number of obtained measurements exceeded 950000

## TRACKED OBJECTS

- Number of continuously tracked objects in GEO is 1428, including 152 unknown bright GEO objects (brighter than  $15^m$ ) orbital data for which publishes annually in «ESOC Classification of Geosynchronous Objects» (the last one – Issue 11, Feb 2009)
- Nearly 439 faint (fainter than  $15^m$ ) GEO and GTO objects are discovered in GEO region surveys during the last 4 years, including objects with high AMR. Of this number 203 GEO objects are tracked continuously.
- Thus **population of known and constantly observing objects in GEO region is increased more than 35 per cent**. New discoveries continue<sub>13</sub>

# Known GEO Population

- Spacecraft – 869  
339 are controlled
- Upper stages – 256  
more than 15 different types
- Fragments – 303  
only 20 are officially catalogued still

ISON data are more complete and precise than publicly available information providing by the US SSN

# Example of efficient international cooperation

- Defunct INSAT-1B satellite was predicted with SOCRATES-GEO software (developed by CSSI, AGI) to pass within 100 m of ASTRA 1F on 4 Feb 2009 using publicly available data on INSAT-1B
- ISON was able to provide more accurate data to CSSI who confirmed a close approach within 3 km but still with significant risk
- SES-ASTRA was able to use the data and analysis to perform appropriate collision avoidance maneuver to increase miss distance to just over 14 km

# Summary

- Treaty-based SSA requires support from international tracking network. Implementation of Treaty is not possible without establishing of continuous international monitoring of the near-Earth space, obtained data processing, analysis and dissemination.
- Success of the ISON project proved feasibility of creation of international observation network and data center (similar to the Minor Planet Center) on space debris information for high altitude (GEO, MEO, GTO and other HEO) objects in full compliance with the UN General Assembly Resolution 62/217
- Quantity and quality of obtaining information permit to perform analysis of threats in GEO region (close encounters of non-cooperating operational spacecraft as well as space debris approaches to functioning satellites) and produce reliable results.
- ISON project can be considered as implementation of one of possible concepts of the international network for orbital objects monitoring, obtained data processing, analysis and exchange to support Treaty.