Inter-Agency Space Debris Coordination Committee

The Inter-Agency Space Debris Coordination Committee (IADC)

– An overview of IADC's annual activities

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IADC Chair

www.iadc-online.org

55th Session of the Scientific and Technical Subcommittee
United Nations Committee on the Peaceful Uses of Outer Space

29 January to 9 February 2018

Overview of IADC

- IADC is an international forum of national and international space agencies for the worldwide technical/scientific coordination of activities related to space debris in Earth orbit issues and provides technical recommendations.
- The 13 IADC member agencies are:
  - ASI (Agenzia Spaziale Italiana)
  - CNES (Centre National d'Etudes Spatiales)
  - CNSA (China National Space Administration)
  - CSA (Canadian Space Agency)
  - DLR (German Aerospace Center)
  - ESA (European Space Agency)
  - ISRO (Indian Space Research Organisation)
  - JAXA (Japan Aerospace Exploration Agency)
  - KARI (Korea Aerospace Research Institute)
  - NASA (National Aeronautics and Space Administration)
  - ROSCOSMOS (State Space Corporation “ROSCOSMOS”)
  - SSAU (State Space Agency of Ukraine)
  - UKSA (United Kingdom Space Agency)

Inter-Agency Space Debris Coordination Committee

Membership

- IADC members are national or international space and state organizations that carry out space activities through planning, designing, launching, or operating space objects.

- IADC members should actively undertake space debris research activities and contribute to an increased understanding of space debris issues for the preservation of the orbital environment

Structure and Purposes of IADC

- IADC consists of a Steering Group and four specified Working Groups (WGs) covering measurements (WG1), environment and database (WG2), protection (WG3), and mitigation (WG4).
- The primary purpose of the IADC is to
  - exchange information on space debris research activities between member space agencies.
  - facilitate opportunities for cooperation in space debris research.
  - review the progress of ongoing cooperative activities.
  - identify debris mitigation options.

(IADC Terms of Reference, see http://www.iadc-online.org)

- IADC provides technical recommendations to the world space communities. It is not a regulatory organization

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Annual Meetings

- More than 100 technical experts from member agencies participate in the annual meetings to share information, address issues, and define and conduct studies on all aspects of space debris: measurements, modeling, protection, and mitigation.
  - UKSA hosted the meeting in Harwell Oxford, UK in 2016
  - ESA hosted the meeting in Darmstadt, Germany in 2017
  - JAXA will host the next meeting in Tsukuba, Japan in June 2018

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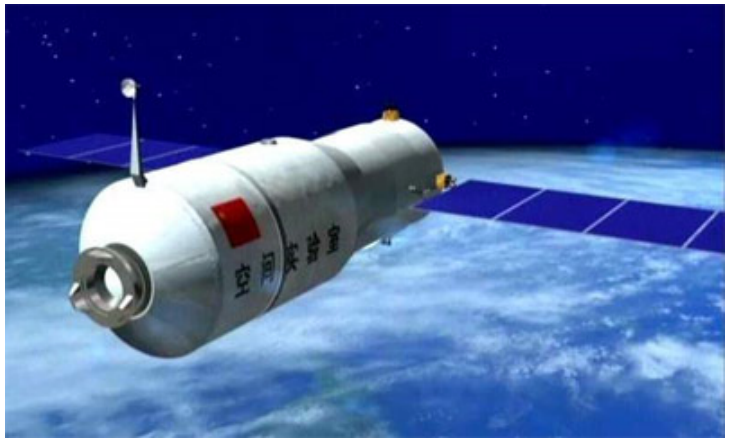
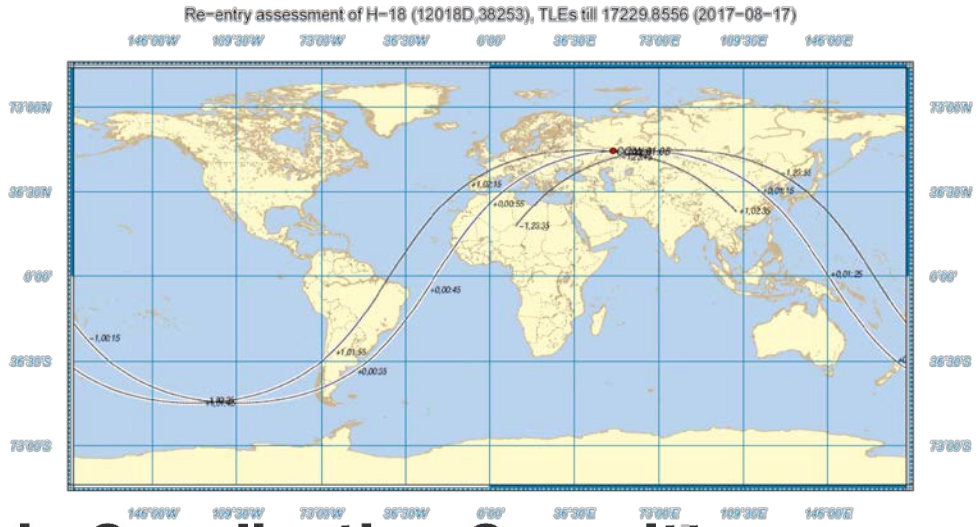
Re-entry Prediction Campaigns

- To prepare for and respond to high risk re-entry events, the IADC members conduct annual object re-entry prediction campaigns for data sharing exercises and improvement of the prediction techniques.
  - 21 campaigns have been conducted since 1998, including a Long March 3B upper-stage in 2017.
  - The campaign for Tiangong-1 will be conducted on this March or April.

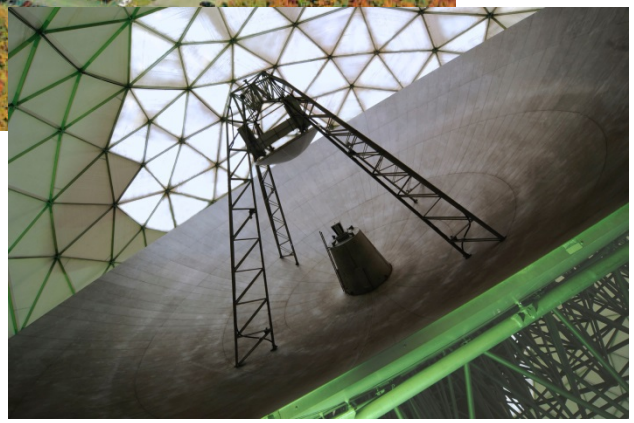




WG1: Measurements

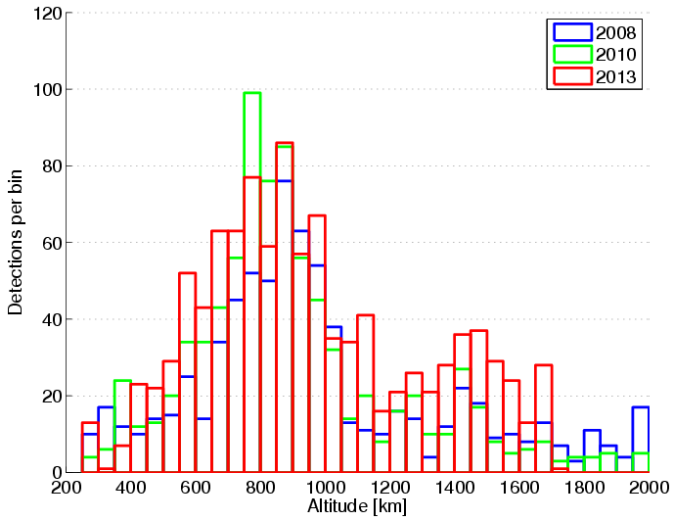
Objective: identify, evaluate and recommend opportunities for cooperation

Haystack radar

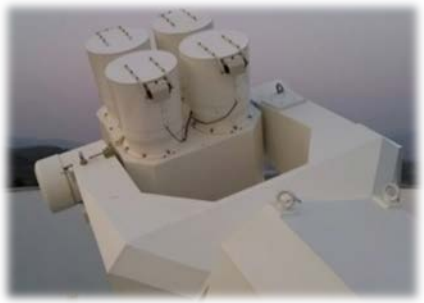
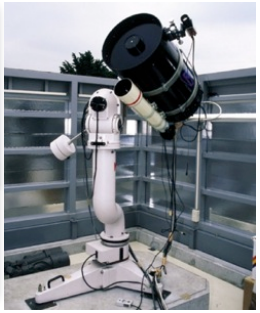


TIRA radar

- 24 hour LEO radar beampark campaign
  - regular 24-hour radar survey of LEO population
  - snapshot of population > ~ 1 cm
  - monitor evolution of population

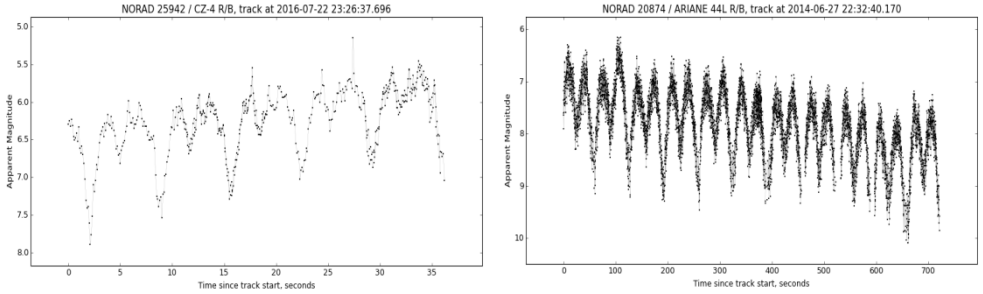


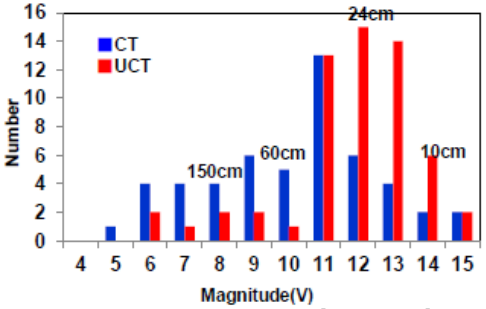
Altitude distributions of detected objects

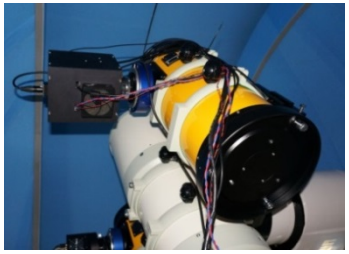



Sensors used for the lightcurve observations. CNSA(upper left), JAXA(upper right), ESA(bottom left) and Roscosmos(bottom right)

- Optical lightcurves of massive LEO objects
  - Objective: understand the motion of ADR targets for long duration
  - Campaign observations were carried out (ESA, CNSA, NASA, JAXA,Roscosmos)
  - Some insights were revealed
  - Further analysis is needed

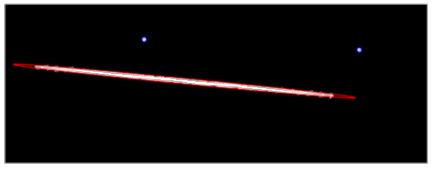
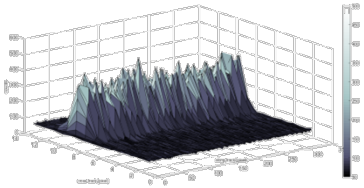






LEO survey observation using the large CMOS

- Information exchange of current status of each delegation
  - Roscosmos started regular operation of Automated Warning System on Hazardous Situations in Outer Space(ASPOS OKP)
  - JAXA carried out LEO survey test observation using the large CMOS sensor.
  - ASI developed the software to extract lightcurve

New software for lightcurve of ASI

WG2: Environment and Database

- Study to quantify the benefits of active debris removal initiated as a result of 2013 LEO stability report
- Companion studies in progress to extend and clarify main study results
  - Characterise the uncertainties in future environment projections from propagation, solar activity, fragmentation
  - Quantify the effect of differences/unknowns in the future launch traffic such as small satellite proliferation and increases in launch rates
- Consideration of space sustainability effects from deploying large constellations of satellites

WG3: Protection

- **Document status**
  - Spacecraft Component Vulnerability for Space Debris Impact
    - Unique collection of hypervelocity impact test data and numerical simulation results of space vehicle components such as batteries, cables, etc.
    - Updated to version 0.7 September 2017
    - Will be ready for IADC Steering Group review by IADC36 in 2018
  - Protection Manual (IADC-04-03) version 7.0
    - Compendium of meteoroid and orbital debris risk assessment methodology
    - Edits for version 7.1 to be completed by IADC36 in 2018

WG3: Protection

- **Upcoming Action Items**
  - New Shielding Methods and Materials
    - CSA, CNSA, JAXA and NASA agreed to describe approach/methodology for development of advanced meteoroid and orbital debris shielding and provide examples
  - Projectile Shape Effects
    - Orbital debris environment definitions continue to improve
    - Implications to spacecraft shield performance from non-spherical projectiles needs additional investigation
    - Discussion will continue at IADC36 in 2018

WG4 : Mitigation

- WG4 discussed the proposed the revisions in the IADC Space Debris Mitigation Guidelines based on AI 33.2 “Update of the IADC space debris mitigation guidelines and of the support document”
- Modified the Guidelines to provide numerical figures and rationale for several key points such as and referred to SG for approval:
    - On-ground casualty expectation for re-entry events
    - Maximum long-term presence tolerated in GEO region
    - Probability of success for post mission disposal
    - Probability of break-up during operational phase
- Large Constellation:
  - Potential Additional Mitigation Measures to Address the Proliferation of Small Satellites and Large Constellations
  - Reached consensus on study scenarios with WG2. Expected study results from WG2 by next annual meeting
- WG4 reviewed and revised IADC Statement and First Recommendations on Large Constellations of Satellites in Low Earth Orbit
- Studies progressing on the action item Guidelines to aid orbit and attitude determination.
- Other topics:
  - Commercial launches, attitude / orbit determination help, MEO objects…

Current Adherence to Mitigation Guidelines

- Members of the IADC use surveillance data to analyse global trends in the adherence to mitigation guidelines:
- GEO:

  IADC guidelines request a disposal of the space object into a graveyard orbit after completion of the mission

  ➢ a trend towards satisfactory levels of successful re-orbiting activities has been observed over the past years

- LEO:

  IADC guidelines request to dispose the space object such that it limits the orbital lifetime to 25 years in the LEO region

  ➢ the current implementation level is considered insufficient and no apparent trend towards a better implementation is observed

New Activities for WG4

- One new Action Item proposed on
  Geosynchronous Satellite Disposal
- Proposed two internal tasks
  1. Various uncertainties in natural re-entry analysis
     – JAXA lead
  2. Casualty risk procedure assessment
     – ESA lead

Large constellation statement

- IADC issued the first statement in 2015
- IADC updated the statement in late 2017 with additional recommendations for considerations by large constellation operators to mitigate the risk to other operational spacecraft and to the environment

Conclusions

- IADC is the internationally recognized technical/scientific authority on space debris.
- IADC participates in and contributes to the UN space debris activities via the Scientific and Technical Subcommittee (STSC) of the Committee on the Peaceful Uses of Outer Space (COPUOS).
- IADC will continue to advance the knowledge of space debris and to develop environment management strategies to preserve the near-Earth space for future generations
  - http://www.iadc-online.org/index.cgi?item=docs_pub