Space Traffic Management

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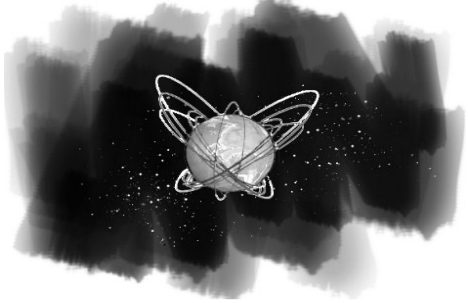
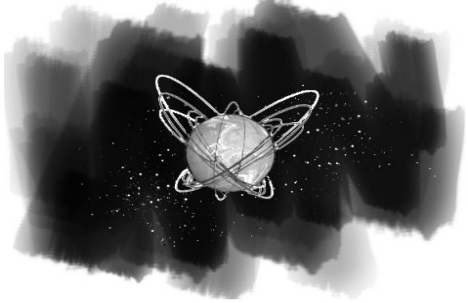


Overview

- The Problem
- ISU Report Conclusions and Recommendations
- Future Developments



International Space University

- International, Interdisciplinary, Intercultural
  - Post-graduate-level curriculum
  - 2500+ alumni from 96 countries
- 2007 Space Studies Program – Beijing, China
  - 117 students from 27 countries
- Report Sponsors
  - NASA Ames
  - Arsenault Family Foundation
  - International Association for the Advancement of Space Safety (IAASS)

Team Traffic

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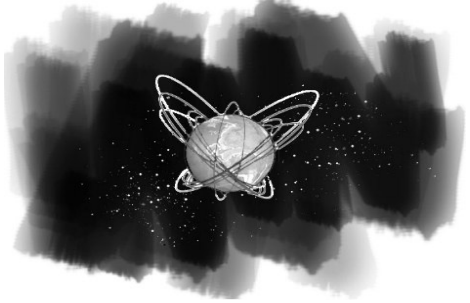

The Problem

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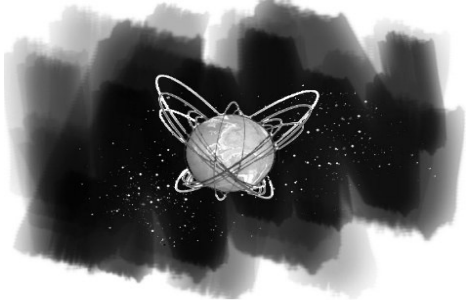


The Problem

- Space debris persists
- Space traffic is increasing
  - Certain orbits have specific utility, creating concentrated areas of space traffic
  - Increased use of space resources by all States will only increase traffic further
- Potential for collision and debris-generation feedback loop that destroys the utility of key orbits
- Sustainability of space is key to global development

Current Debris Situation

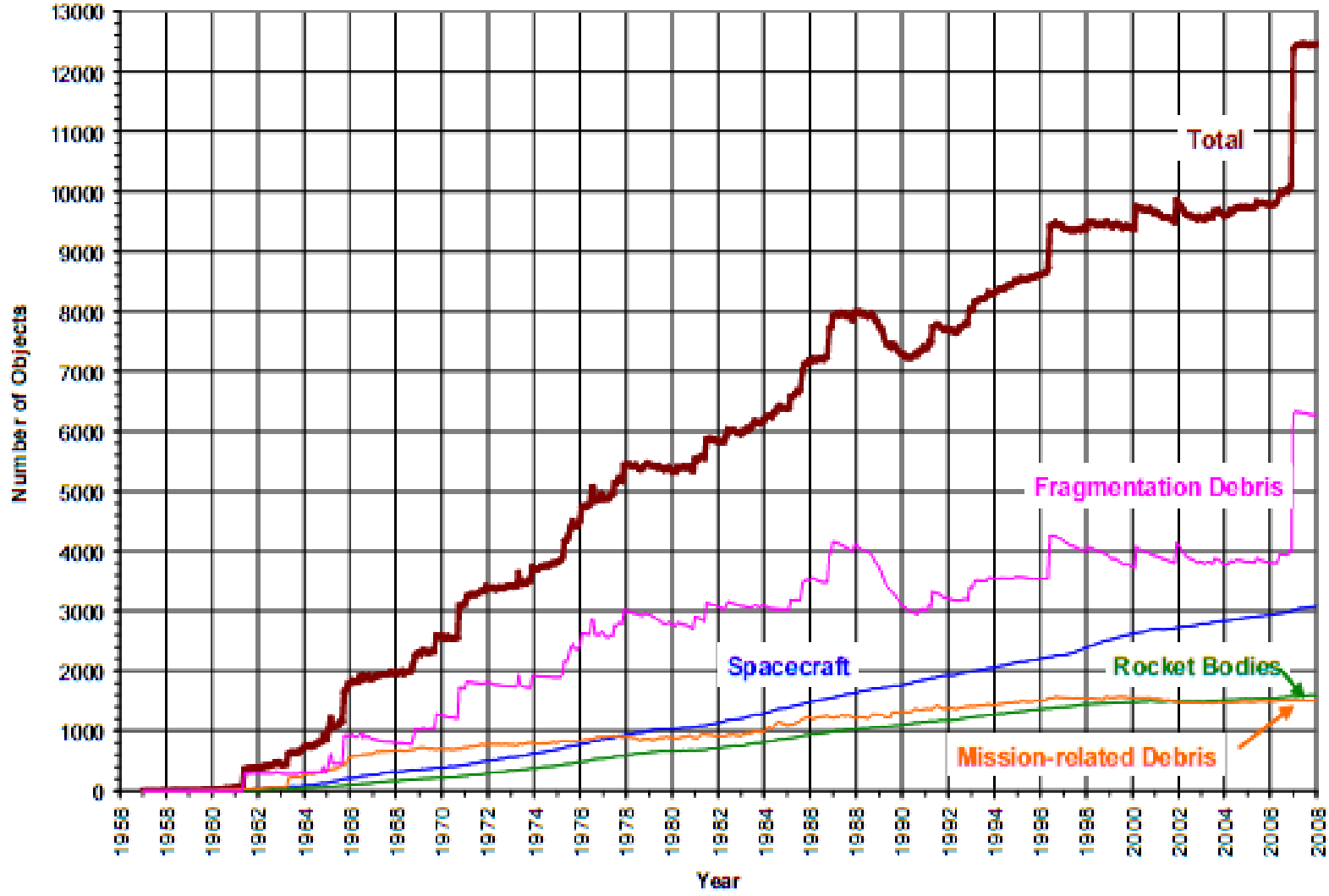
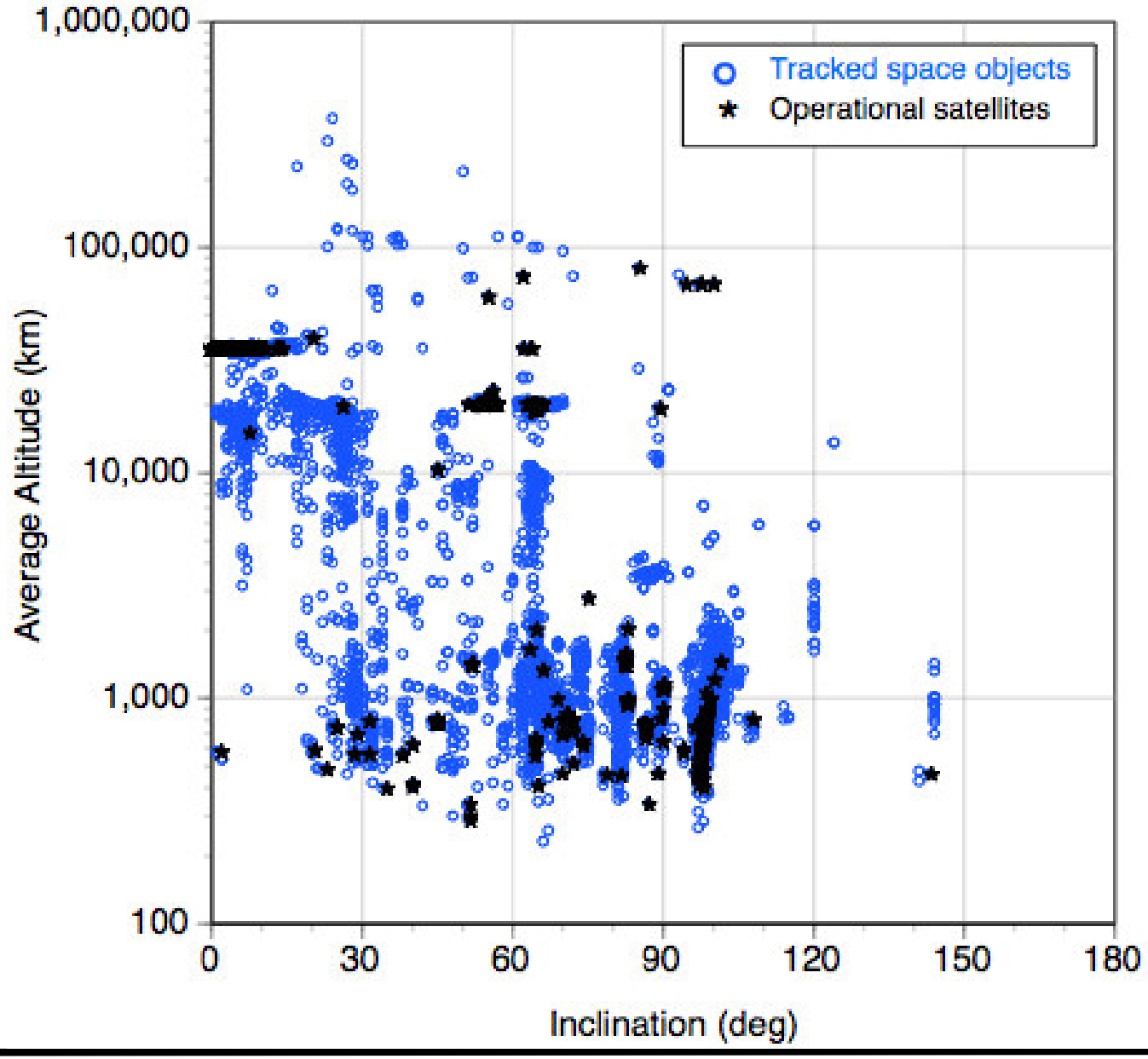


Chart courtesy of NASA Orbital Debris Quarterly, January 2008

Space Object Concentrations

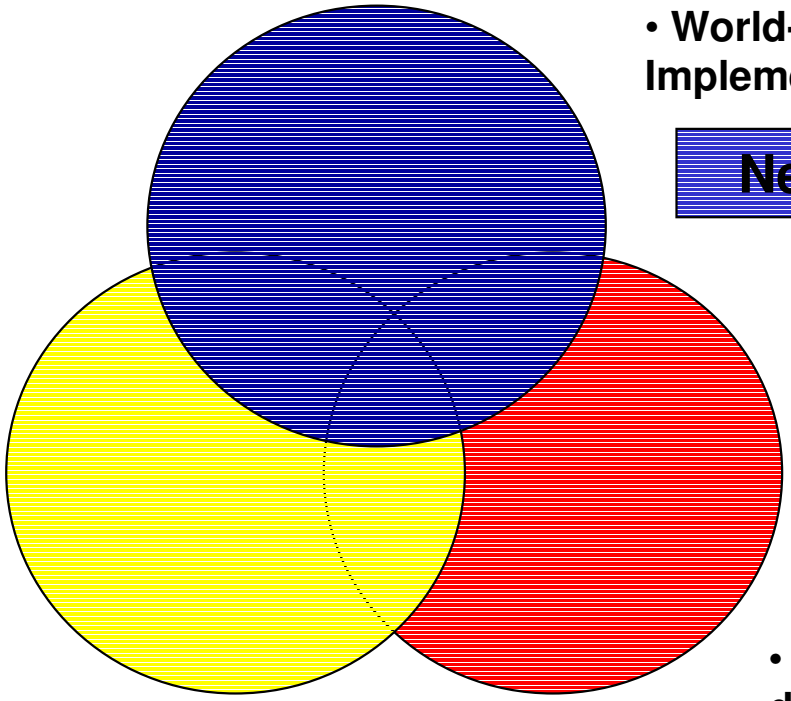


Sustainability of Space

Debris Mitigation

- Minimizes creation of future debris
- IADC success
- World-wide Implementation starting

Near-Term



Debris Removal

- Removes existing debris from orbit
- IAA study on-going, results due mid 2009

Long-Term

Space Traffic Management

- Minimizes effects of debris on spacecraft

Mid-Term

ISU Report Conclusions and Recommendations

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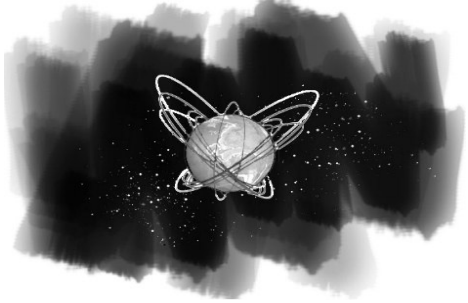
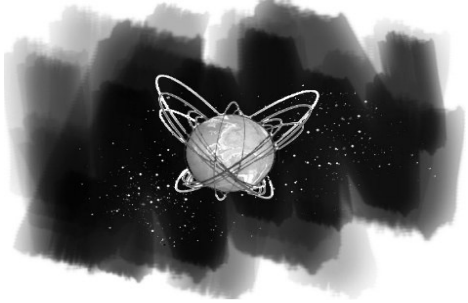


Proposed Solution

- **A set of Space Traffic Management (STM) measures providing a strong foundation for further research covering four areas of immediate concern.**
  - **Collision avoidance**
  - **Improved utility of geo-synchronous orbit**
  - **Sun-synchronous orbit (SSO) congestion**
  - **Dangers to human-rated craft**

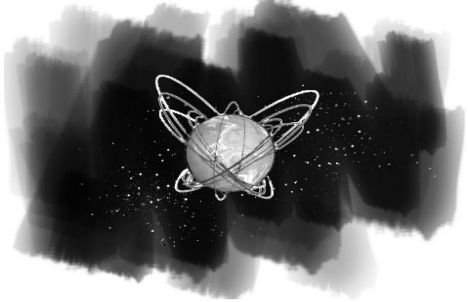
  These measures:
    - **Are not focused on debris mitigation**
    - **Allow more efficient use of crowded orbits**
    - **Give owner-operators the tools to protect their spacecraft**



Collision Avoidance

- **STM provides standard data set, warnings, and recommendations of avoidance maneuvers to help owner-operators that might not have the tracking or analytical ability in-house**
- **Gives owner/operator flexibility to maneuver based on internal cost/benefit analysis unless inaction could threaten other spacecrafts**

Rules provide the spacecraft owner-operators with the information and tools to help make educated choices and to improve satellite safety



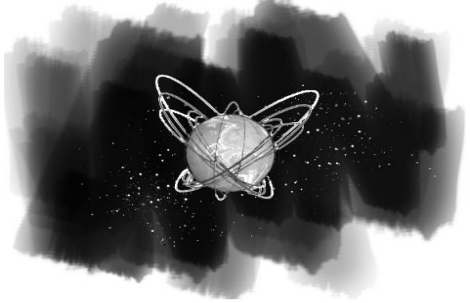
Geosynchronous Data Sharing

- More accurate conjunction assessment predictions and more efficient collision avoidance maneuver planning
  - Public data error: 20-50 km
  - Owner-Operator data error: 7 km
- Clear separation between station-keeping spacecraft and maneuvering satellites
- Allows for more efficient planning for station-keeping maneuvers

Rules increase efficiency of existing GEO slotting and operations and reduce energy costs

Potential STM Organizations

Managing Body	Phase I: Rule Development	Phase II: Consensus	Phase III: Implementation of the System (1)	Phase III: Arbitration Procedures (2)
UNCOPUOS		✓		✓
ITU		✓		
IADC	✓			
ICAO			✓	✓
New Agency	✓		✓	✓



Future Developments

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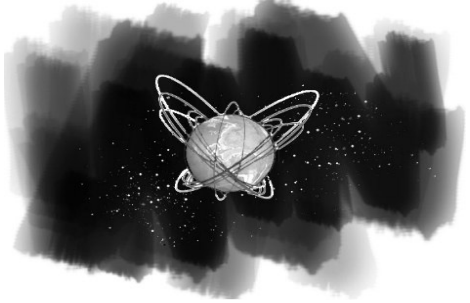
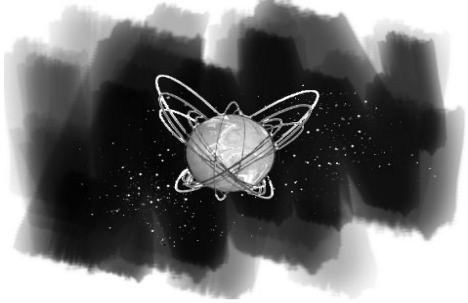


Future Developments: Key Questions

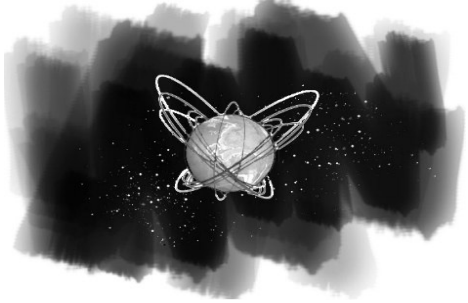
- When STM will be needed
- The effects of varying a timescale of implementation
- Investigating whether it really is beneficial for key actors to engage with STM
- When is it most beneficial for them to do so

Our Goal: To develop a technically sound and politically viable STM system



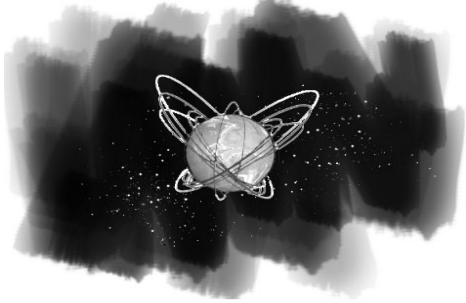
Future Developments: Next Steps

- **Problem definition**
- **Accurate knowledge base of space objects**
- **Analysis of key technical requirements**



International Data Gathering Issues

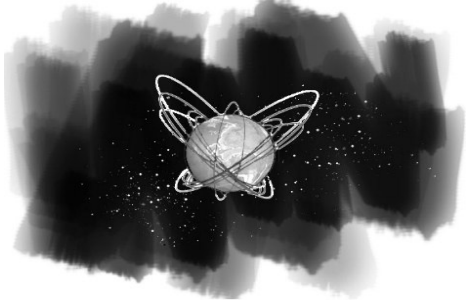
- No State, including the US, has capability to monitor current space traffic to the required extent
- World-wide network of data gathering sensors needed. An amalgamation of the current international sensor capabilities would be a first start
- First Step: Geosynchronous owner/operator data disseminated on a voluntary basis

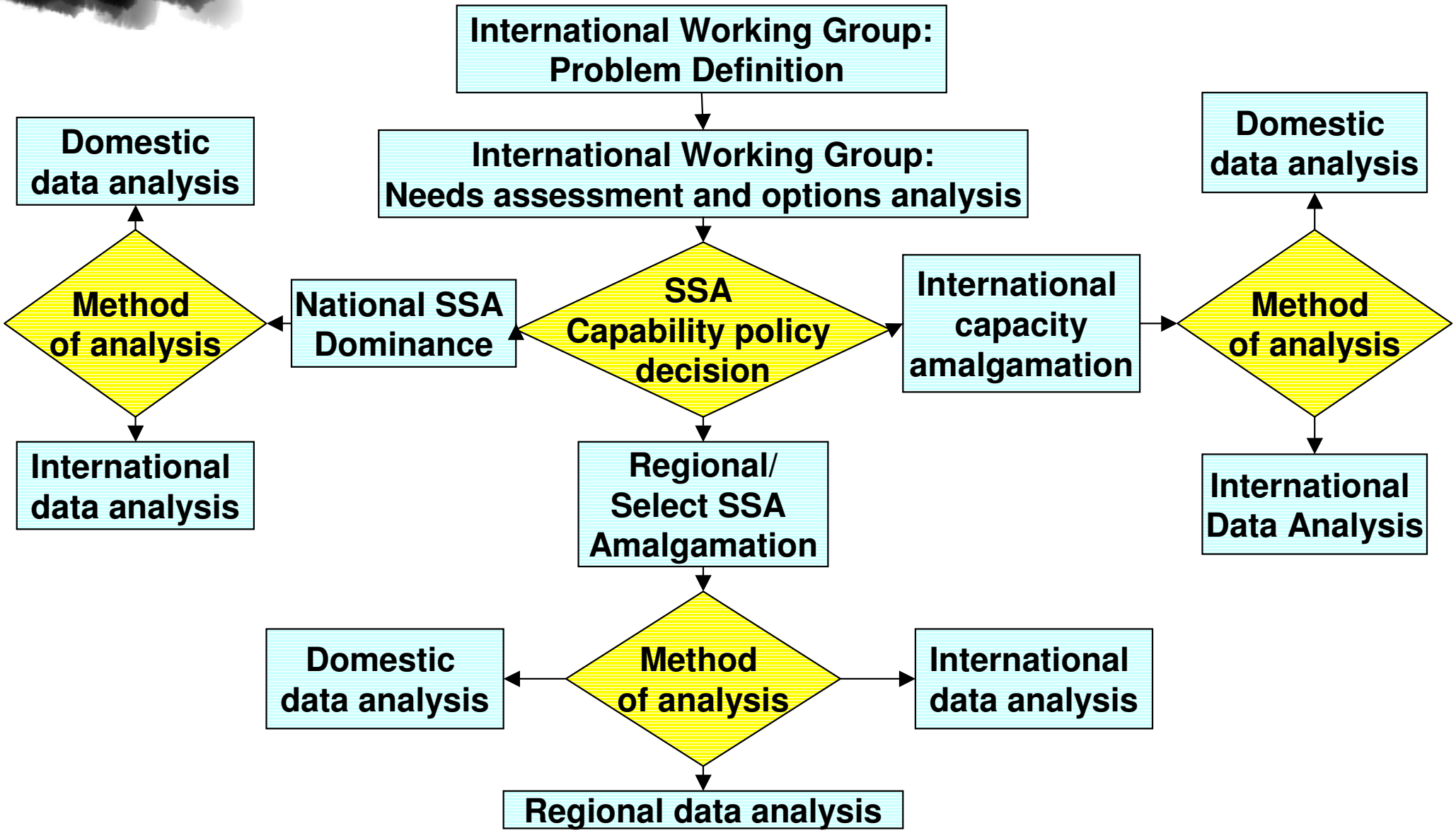


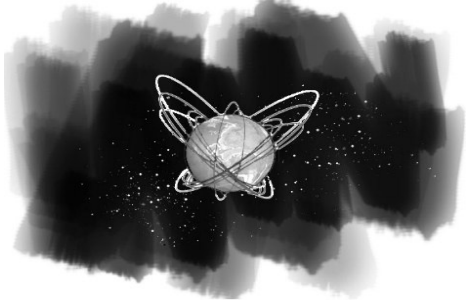
Data Sharing and Analysis Issues

- **Geo-political issues affecting willingness to share data**
  - **Potential of bilateral data-sharing agreements?**
- **Analysis**
  - **Multi-lateral collection, bi-lateral distribution domestic analysis?**
    - **Human capacity issues**
  - **Multilateral collection, multi-lateral distribution, domestic analysis?**
    - **Geo-political concerns**
  - **Multi-lateral collection, international analysis**
    - **Organizational legitimacy and organizational proliferation issues**

Roadmap for SSA



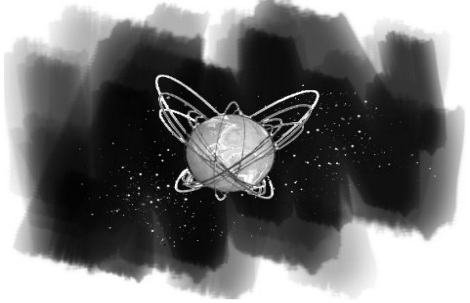




Key Recommendation:

Inter-Agency Working Group

- Following the IADC model
- Representative group of key space actors focusing on science to define the space traffic problem
  - Advantages:
    - Low cost
    - Proven track record
    - As apolitical as is realistic
    - Output of a clearly defined initial problem to present to the international community



Questions?

If you would like a copy of the ISU report this can be obtained by emailing:

info@swfound.org

or
downloading it from:
http://www.isunet.edu/index.php?option=com_docman&task=doc_download&gid=371

Thank you for your time