National Aeronautics and Space Administration

New Opportunities: International Collaboration – Understanding Climate Change

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10 February 2009

OVERARCHING PRINCIPLES and OBJECTIVES

- The Earth is an integral, complex system
  - Many processes, with varying time and spatial scales
  - Quantitatively describing the ***interactions between processes*** is key
- ***Measurements*** must span all important variables, and all important scales
- ***Research*** leads to greater understanding, which is codified in numerical models – ***prediction***
- Societal benefits result when ***understanding*** is combined with ***measurements*** so that ***useful information products*** are generated and actually used
- ***The problem of understanding and predicting climate change is too large for any single agency or even any single nation – efficient , effective collaborations are essential***

OUTLINE

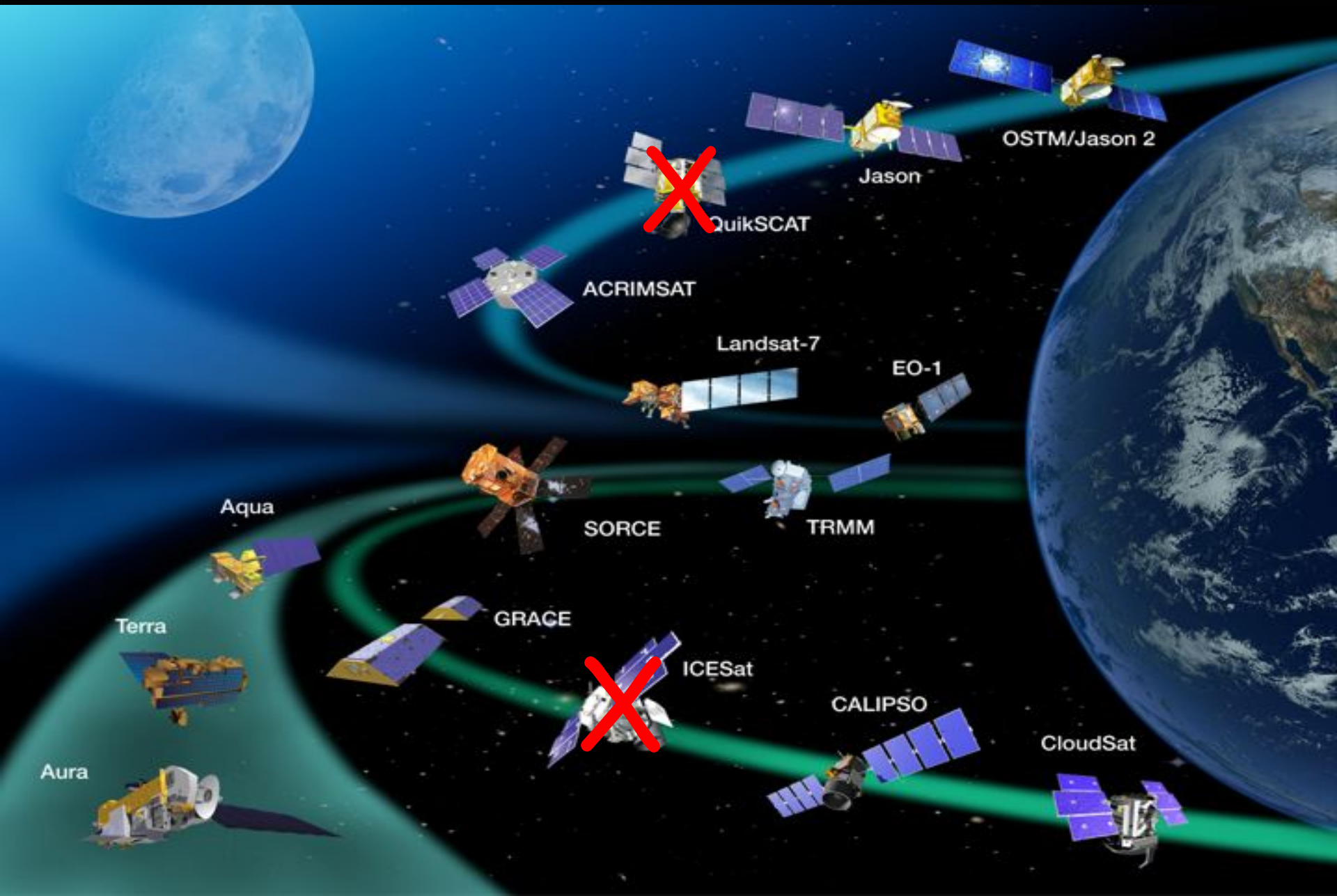
- Brief overview of NASA Earth Science and Applications

- **Key issues in Earth System Science collaboration**
  - Need for rapid, transparent, free and open data exchange
  - Plethora of potential partners
    - Many nations
    - Research and operational agencies
  - Scope (measure new quantities) vs. continuity
  - Collaborative ***missions*** or collaborative ***programs?***
    - Differences in program structures and approaches between different international space agencies
  - Role(s) of (multiple) international coordination entities
    - CEOS, WMO, GEOSS, ...
  - Societal impacts/benefits lead to increased national leadership visibility

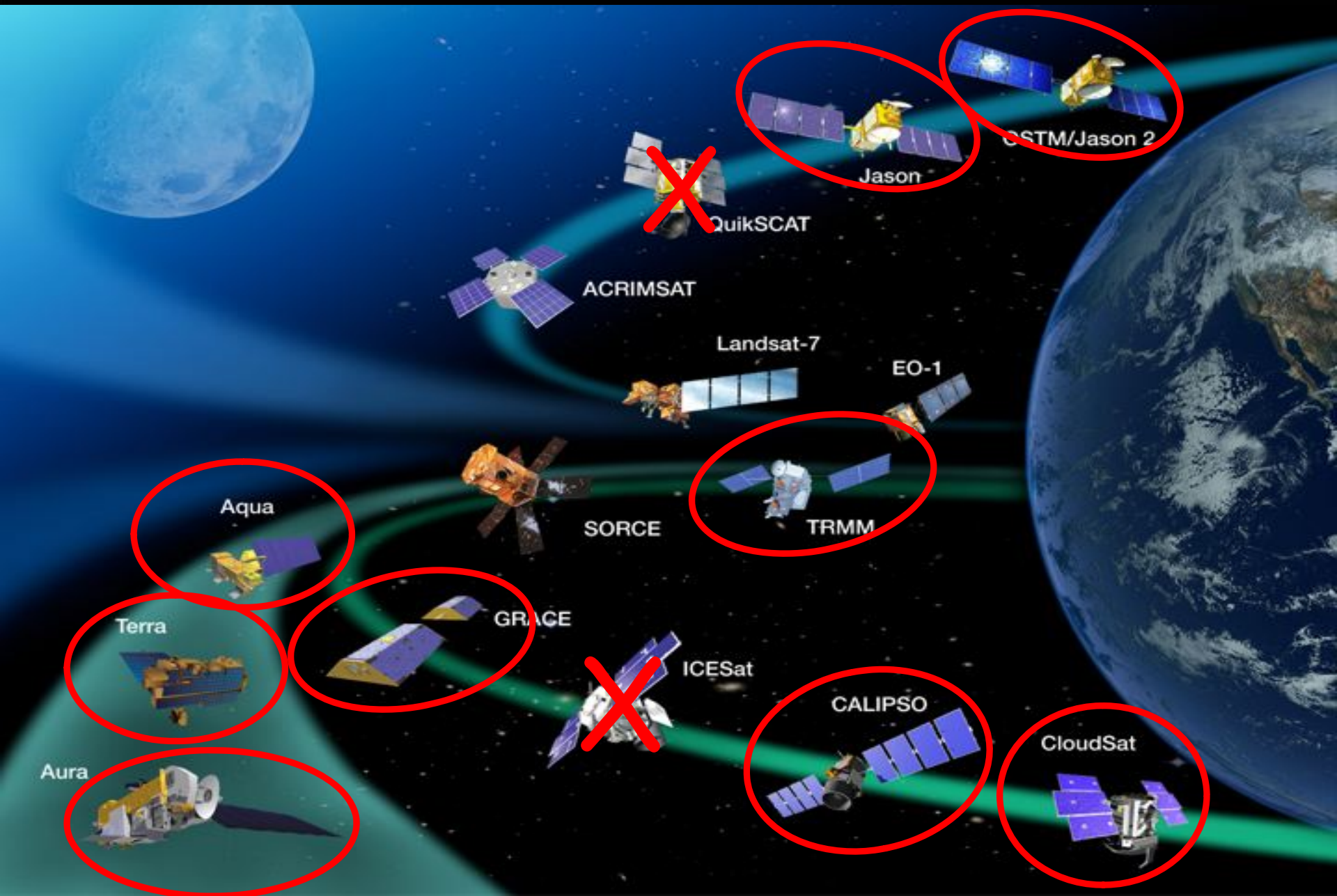
Earth Science Division Overview

- Overarching goal: to advance Earth System science, including climate studies, through spaceborne data acquisition, research and analysis, and predictive modeling
- Six major activities:
  - Building and operating Earth observing satellite missions, many with international and interagency partners
  - Making high-quality data products available to the broad science community
  - **Conducting and sponsoring cutting-edge research**
    - Field campaigns to complement satellite measurements
    - Analyses of non-NASA mission data
    - Modeling
  - Applied Science
  - Developing technologies to improve Earth observation capabilities
  - Education and Public Outreach
- ***NASA's Earth Science Program is unique: Space program with a comprehensive, broad-based research and applications element, and a research science/applications program with expertise and access to space***

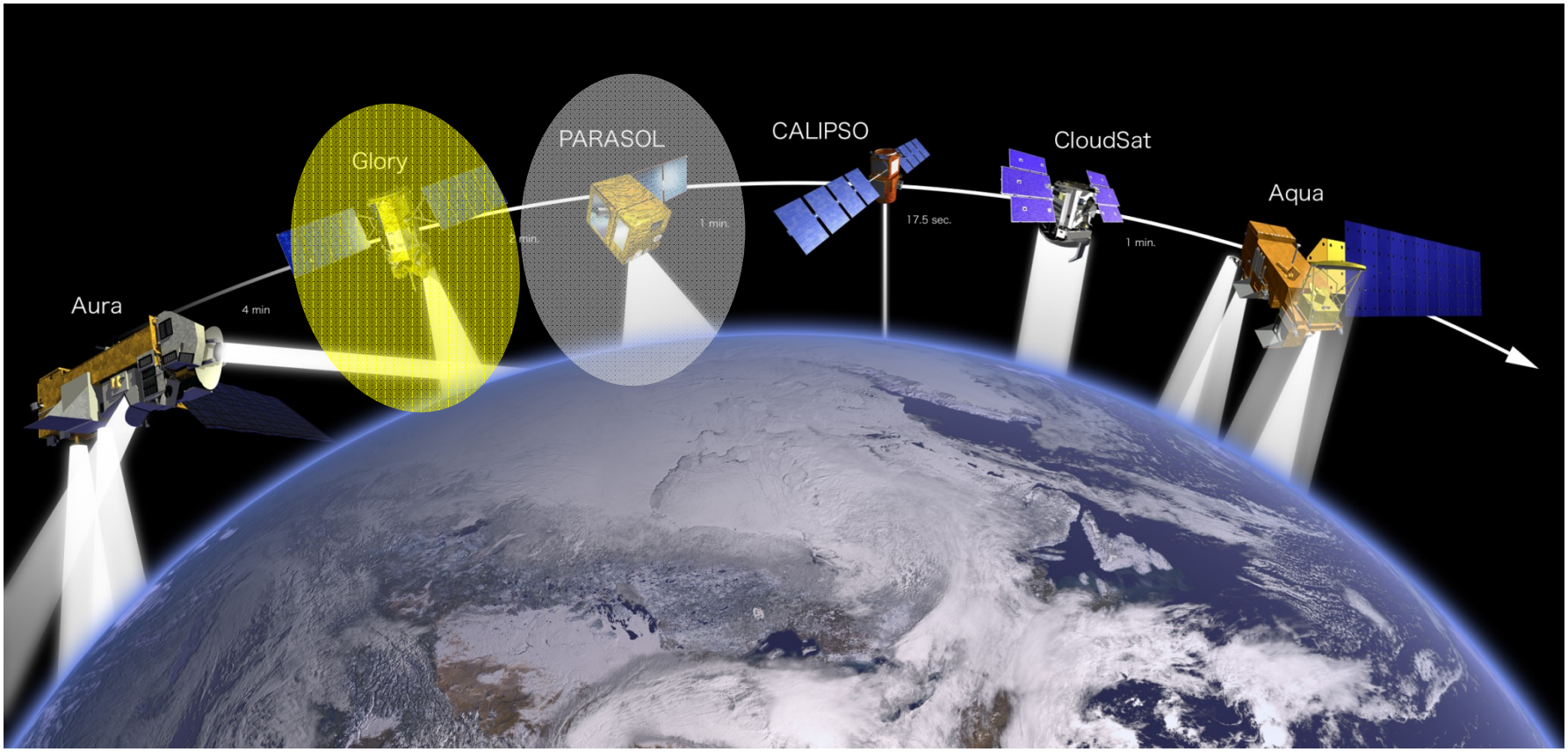
NASA Operating Missions – January 2010



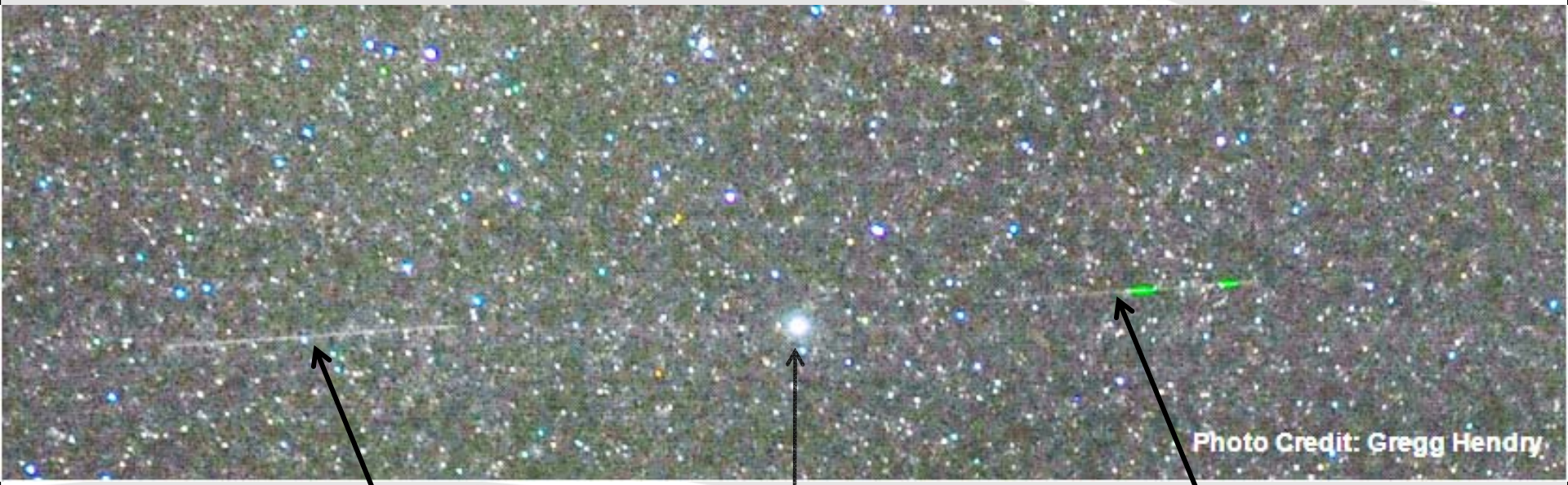
NASA Operating Missions – International Collaborations



International A-Train (end of CY2010)



CloudSat and Calipso in the A-Train



Vega

CloudSat track

CALIPSO track;
CALIOP laser

Taken at 5/28/09, 3am local, 6 sec exposure; track visible because satellites illuminated while surface still in darkness

8

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FOUNDATIONAL PRINCIPLES OF EARTH SCIENCE AND APPLICATIONS

- The Earth is an integral, complex system
  - Many processes, with varying time and spatial scales
  - Quantitatively describing the interactions between processes is key
  - Measurements must span all important variables and all important scales
  - ***Open, timely data exchange/availability is essential***

- Understanding the integrated system requires coupled, coordinated activities ("end-to-end" approach)
  - Measurements are important but not sufficient
  - Research combines measurements, develops understanding
  - Models codify knowledge, extend data, and can be used for prediction when coupled with measurements
  - ***Open, timely data exchange/availability is essential***

- Societal benefits result from useful ***information products*** based on research
  - Accurate, focused, ***timely***
  - ***Predictably available***
  - Understandable (product + user)

Data Sharing/Availability Policy

- NASA commits to the **full and open sharing** of Earth science data obtained from NASA Earth observing satellites, sub-orbital platforms and field campaigns with all users as soon as such data become available.
- NASA recognizes **no period of exclusive access** to NASA Earth science data.
- NASA makes available all NASA-generated standard products along with the source code for algorithm software, coefficients, and ancillary data used to generate these products.
- All NASA Earth science missions, projects, and grants and cooperative agreements include data management plans to facilitate the implementation of these data principles.
- NASA enforces a principle of non-discriminatory data access so that all users will be treated equally. For data products supplied from an international partner or another agency, NASA restricts access only to the extent required by the appropriate MOU.
- NASA charges for distribution of data are no more than the cost of dissemination (OMB Circular A-130).
- NASA promotes an open data sharing policy in national and international fora including GEO and US GEO. NASA is vice-chair of the CEOS Strategic Implementation Team, and is also a contributing member of the Interagency Working Group on Digital Data.

http://nasascience.nasa.gov/earth-science/earth-science-data-centers/data-and-information-policy

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Diverse Range of Potential Partners/Participants

- In contrast with Space Science (Planetary, Astrophysics), many different agencies/nations, with differing resources and aspirations, have the desire and the capability (and accomplishments) to contribute to Earth observations from space
  - NASA, ESA, JAXA, CSA, CNES, CONAE, Korea, ISRO, Brazil, Thailand, ASI, …
- Interests and foci often overlap or compete
- Sampling considerations ***can*** justify some coordinated multiple measurements of the same quantity, but unnecessary duplication or low quality is not helpful
- Data product quality, transparency, and timeliness often vary between research vs. “operational” organizations

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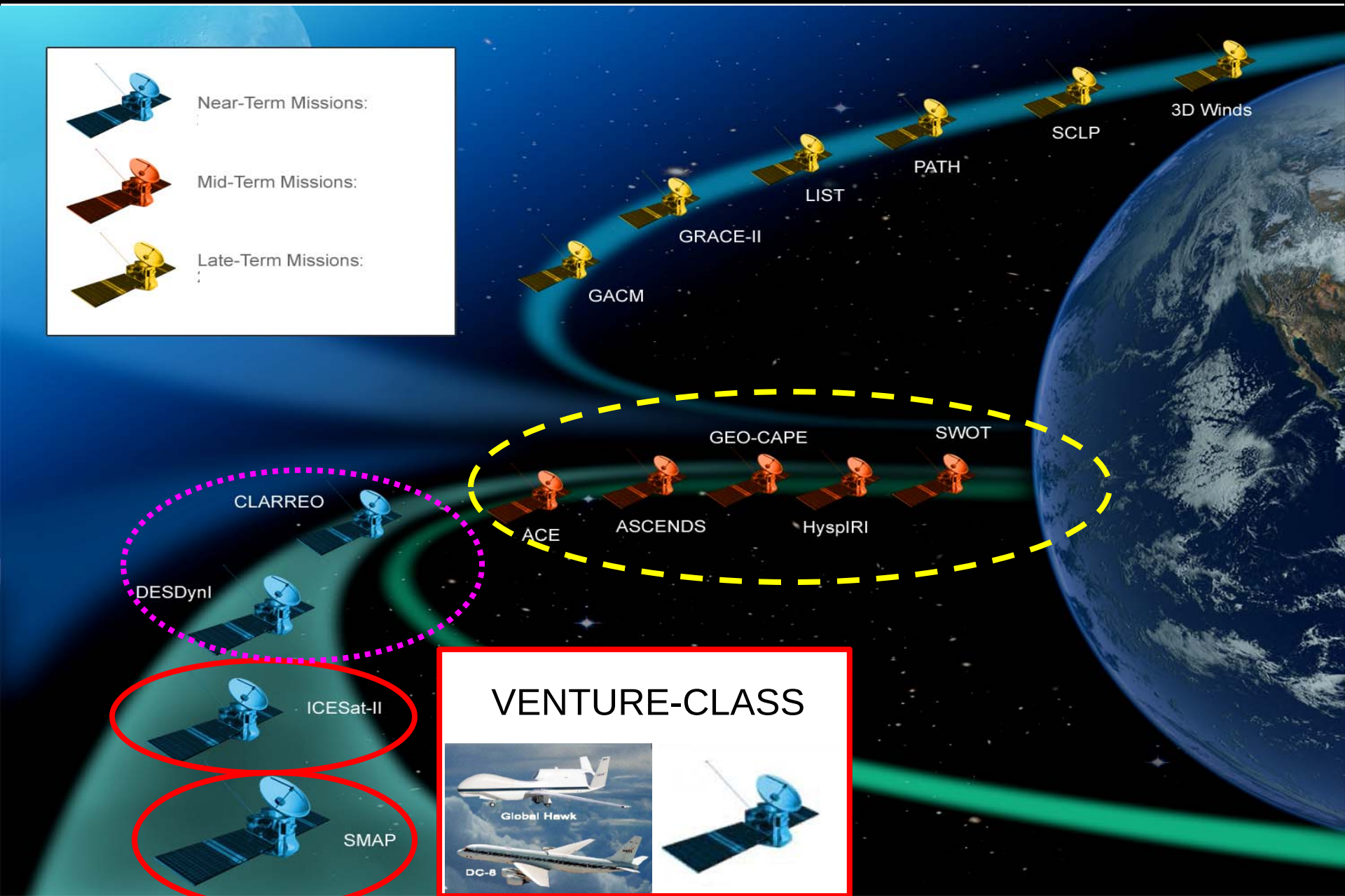
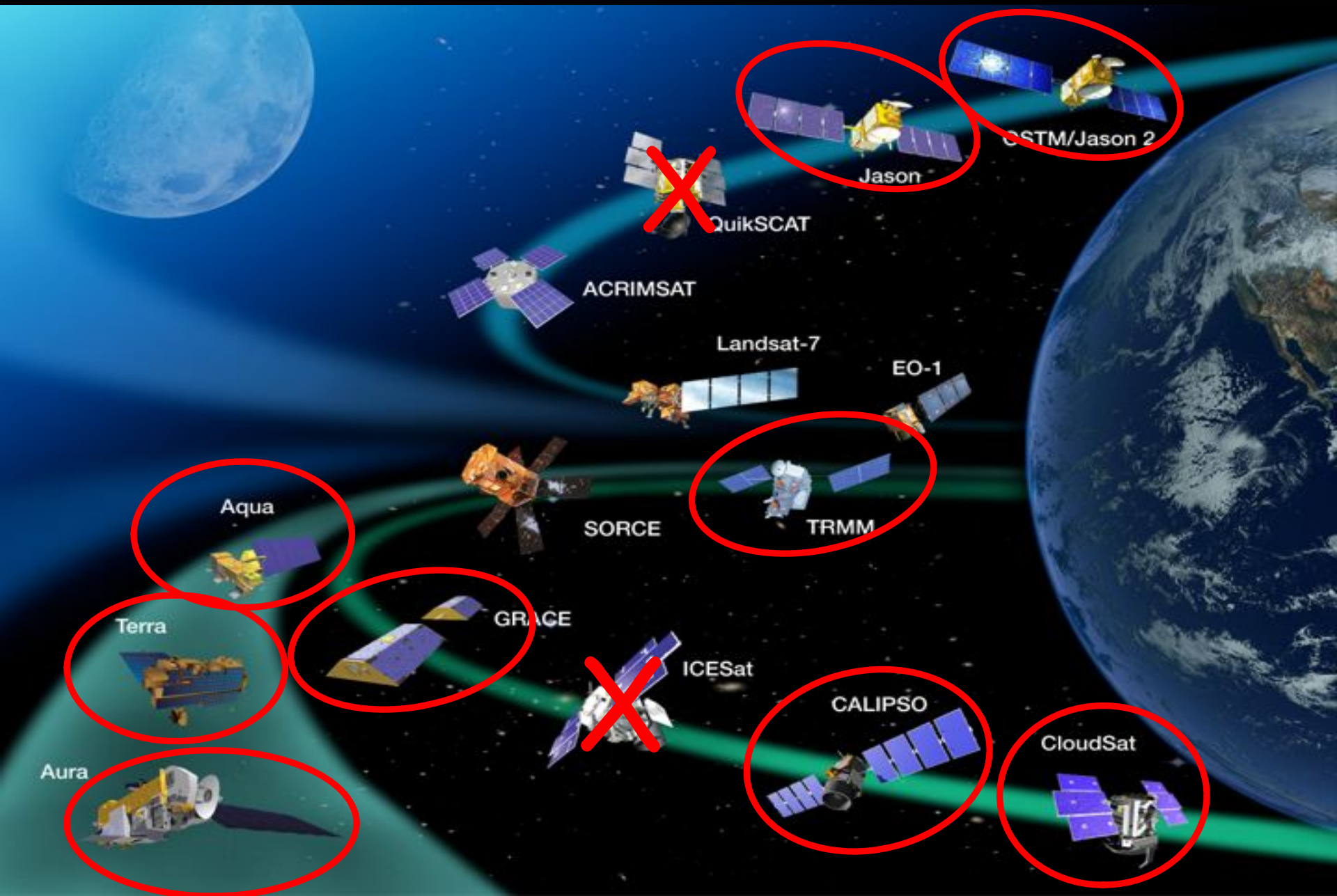
Joint Missions, or Collaborative Programs?

- *Joint missions* are typical collaborations
  - Multiple contributions of hardware and services to a single mission
  - Both research and operational organizations
  - Must manage for *schedule* to be successful
- *Collaborative programs* involve complementary ***missions*** divided among agencies
  - More common among operational agencies (NOAA does PM polar met orbit, EUMETSAT covers mid-morning; GEO met sats, etc.)
  - Absolutely requires transparent, full data exchange
- Mission selection/definition approaches must be compatible
  - Mission vision/definition (e.g. Decadal Survey) vs. competitive mission focus selection (e.g. Earth Explorer, Venture-Class)

Decadal Survey Missions Next Generation



NASA Operating Missions – International Collaborations



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