

# 60th European Space Sciences Committee Plenary Meeting

Colleen Hartman

Director, Space Studies Board

Aeronautics Space Engineering Board

November 26, 2020



# Ongoing SSB Studies

- **Lessons-Learned in the Implementation of the EV-M and EV-I Strands of NASA's Earth Venture Class.** Co-Chairs are Christian Kummerow and Mahata Moghaddam.
- **Planetary Science and Astrobiology Decadal Survey 2023-2032** with 6 panels: Panel on Mercury and the Moon, Panel on Venus, Panel on Ocean Worlds and Dwarf Planets, Panel on Giant Planet Systems, Panel on Mars, Panel on Small Solar System Bodies.
- **Astro2020 Decadal Survey** continues with 13 panels, including SOP.
- **Increasing Diversity and Inclusion in the Leadership of Competed Space Missions:** Co-Chairs are Fran Bagenal and Wanda Ward. Committee members to be announced soon.
- **Committee on Planetary Protection** short report underway
- **Future Use of NASA Airborne Platforms to Advance Earth Science Priorities**
- **Space Weather Operations and Research Infrastructure Workshop**

# Achievements: A Sampler

- **Space Nuclear Propulsion Technologies** study is addressing a decades-long question about NEP/NEP enabling space missions.
- **Advancing Aerial Mobility Study**.
- **CoPP**, a new discipline committee, will allow for fast turn-around response to NASA HQ.
- **Decadal Survey on Biological and Physical Sciences Research in Space 2023-2032**: Due to start in early 2021.

# Standing Committees

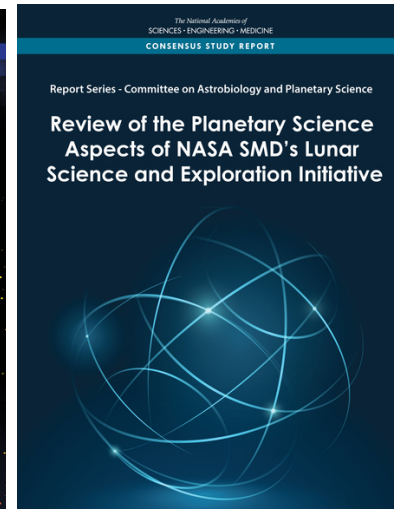
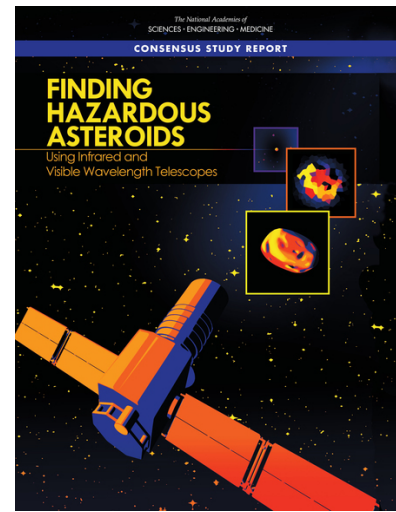
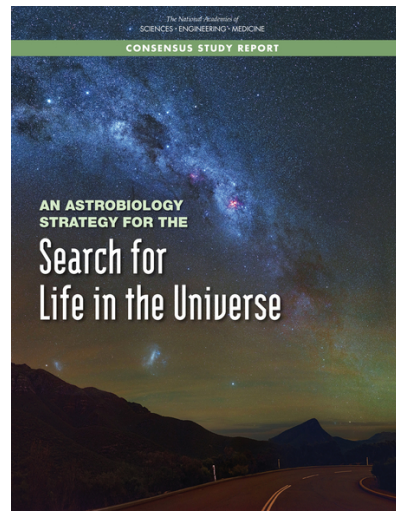
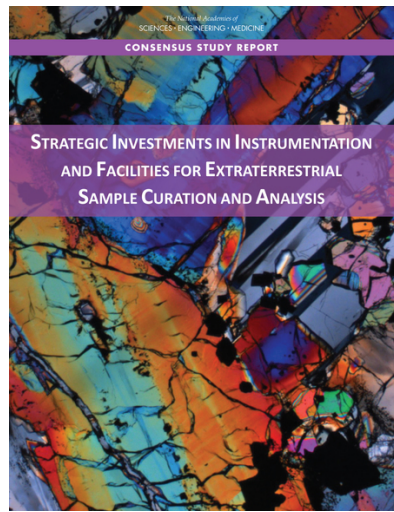
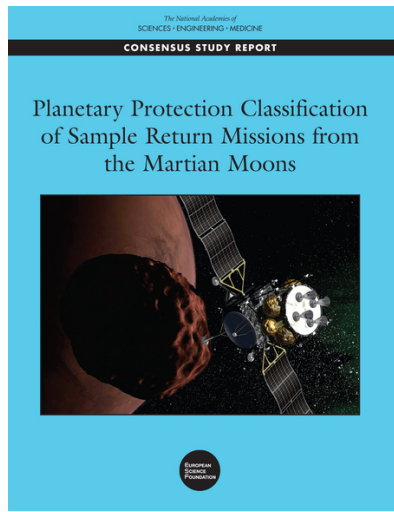
## ASEB:

- Committee on Biological and Physical Sciences in Space (with SSB)
- Committee on Planetary Protection (with SSB and DELS/BLS)

## SSB:

- Committee on Biological and Physical Sciences in Space (with ASEB)
- Committee on Astrobiology and Astrophysics (with BPA)
- Committee on Earth Sciences and Applications from Space
- **Committee on Planetary Protection** (with ASEB and DELS/BLS)
- Committee on Solar and Space Physics
- Committee on Astrobiology and Planetary Science

\* Committee on Space Research (COSPAR) – Charlie Kennel



Prepublication Copy - Subject to Further Editorial Correction

Report Series - Committee on Astrobiology and Planetary Science

Options for the Fifth New Frontiers Announcement of Opportunity

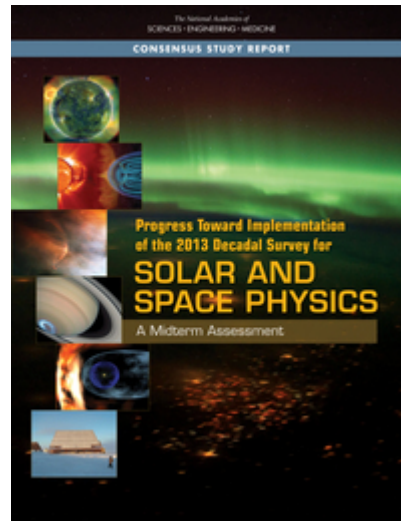
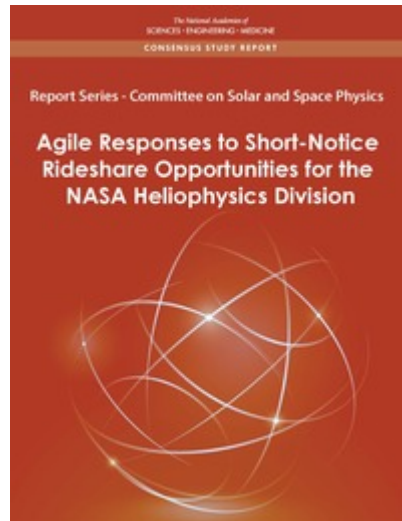
Committee on Astrobiology and Planetary Science  
Space Studies Board  
Division on Engineering and Physical Sciences  
A Consensus Study Report of  
The National Academies of  
SCIENCES • ENGINEERING • MEDICINE

THE NATIONAL ACADEMIES PRESS  
Washington, DC  
www.nap.edu

PREPUBLICATION COPY - SUBJECT TO FURTHER EDITORIAL CORRECTION

The National Academies of SCIENCES • ENGINEERING • MEDICINE  
CONSENSUS STUDY REPORT

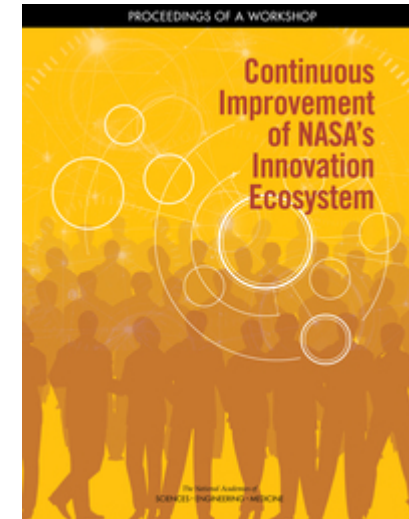
Assessment of the Report of NASA's Planetary Protection Independent Review Board



Review of the Draft 2019 Science Mission Directorate Science Plan

Committee on the 2019 Science Mission Directorate Science Plan  
Space Studies Board  
Division on Engineering and Physical Sciences  
A Consensus Study Report of  
The National Academies of  
SCIENCES • ENGINEERING • MEDICINE

THE NATIONAL ACADEMIES PRESS  
Washington, DC  
www.nap.edu





**PLANETARY SCIENCE AND ASTROBIOLOGY DECADEAL SURVEY 2023-2032**  
**MEMBERSHIP IS ON OUR WEBSITE**

Panel on Mercury and the Moon

Panel on Venus

Panel on Ocean Worlds and Dwarf Planets

Panel on Giant Planet Systems

Panel on Mars

Panel on Small Solar System Bodies

# Astro 2020

A stylized constellation diagram is the background of the entire page. It features a complex network of thin blue lines connecting various points. Some points are highlighted with larger, glowing yellow circles, while others are smaller white dots. The lines form a large, abstract shape that resembles a stylized 'X' or a similar constellation.

Decadal Survey on Astronomy and Astrophysics

*The National  
Academies of*

SCIENCES  
ENGINEERING  
MEDICINE

[nas.edu/astro2020](https://nas.edu/astro2020)



# Survey Structure (Background)

- Steering Committee (20 members)
  - synthesize outputs from the 13 science, program, and state of profession panels into an overall decadal strategy and survey report
  - member serves on each panel to facilitate communication, coordination
- Science Panels (6 panels, 8-11 members each)
  - review all science white papers, review science advances since Astro2010, identify high-priority scientific questions and discovery areas for the coming decade
- Program Panels (6 panels, 12 members each)
  - review relevant project/program APC's, assess proposed projects in terms of science return and priorities, technical readiness, risk, cost
- State of the Profession and Societal Impacts (1 panel, 15 members)
  - review health and demographics of the astronomy and astrophysics community, identify milestones and actions for the coming decade
  - **NOBEL PRIZE IN PHYSICS 2020 for Black Hole work to Andrea M. GHEZ, Penrose & Genzel!**

---

# Status Report

## Science Panels

Astro2020: Panel on Compact Objects and Energetic Phenomena

Astro2020: Panel on Cosmology

Astro2020: Panel on Galaxies

Astro2020: Panel on Exoplanets, Astrobiology, and the Solar System

Astro2020: Panel on the Interstellar Medium and Star and Planet Formation

Astro2020: Panel on Stars, the Sun, and Stellar Populations

## Program Panels

Astro2020: Panel on An Enabling Foundation for Research

Astro2020: Panel on Electromagnetic Observations from Space 1

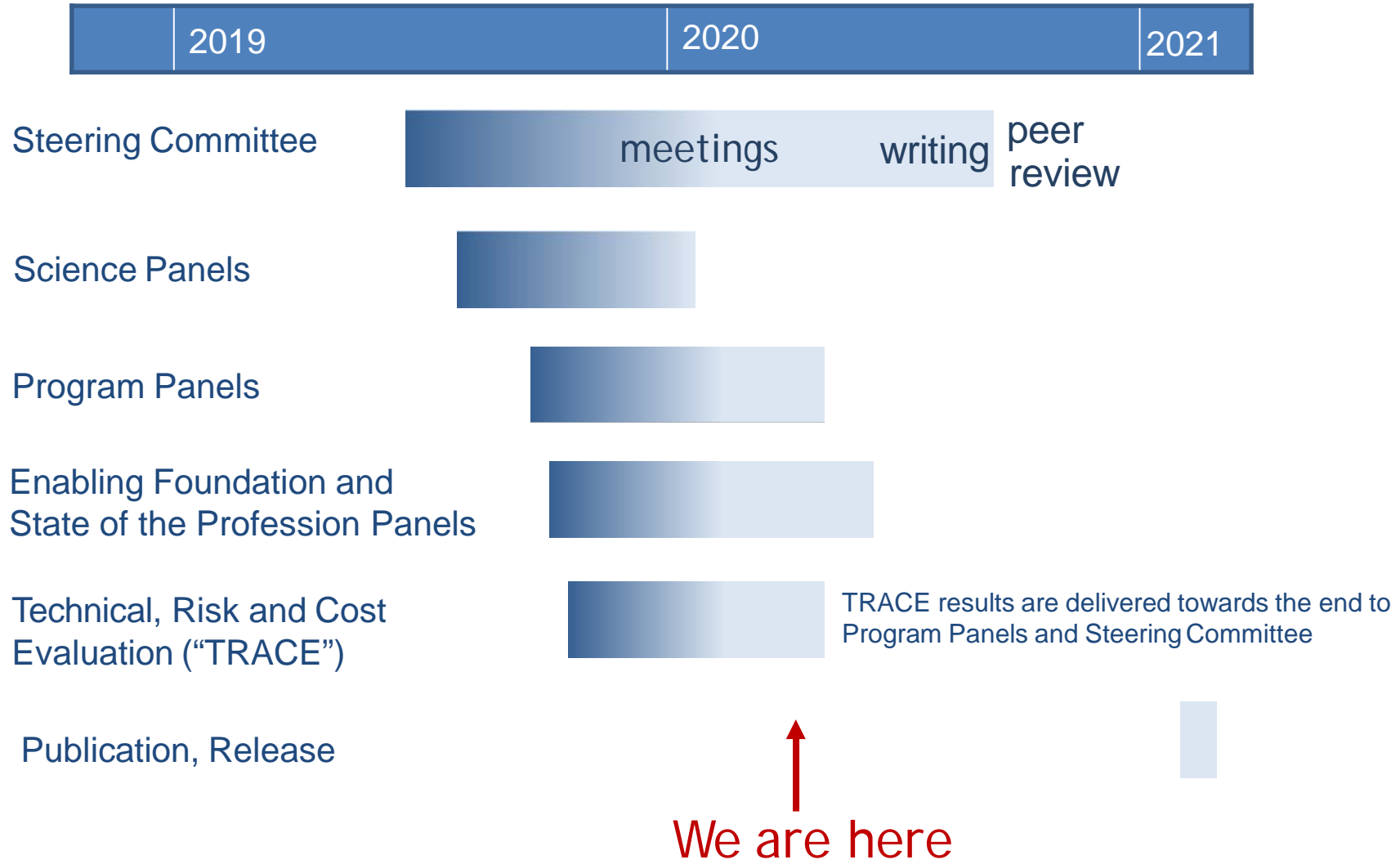
Astro2020: Panel on Electromagnetic Observations from Space 2

Astro2020: Panel on Optical and Infrared Observations from the Ground

Astro2020: Panel on Particle Astrophysics and Gravitation

Astro2020: Panel on Radio, Millimeter and Submillimeter Observations from Ground

# Decadal Survey Timeline (Pre-COVID)



# Planning Forward

- Core Principle: Balance the wish to maintain momentum with consideration for the well-being of survey participants and NAS staff.
- March 24-26 steering committee meeting 1<sup>st</sup> one conducted remotely and every since then, all remote.
  - presentations from international agencies (ESA, ESO, JAXA)
    - reports of working groups and committee planning discussion
- All materials go through extensive NASEM review
- We expect to deliver the report Spring, 2021

# Committee on Planetary Protection

## Background

SSB has been involved in shaping the US planetary protection policy for 60 years.

- NASA has sponsored SSB studies, seeking independent, scientific advice on how to craft their planetary protection policies.
- NASA & NASEM participate in the global space science community to develop consensus international planetary protection policies through the International Council of Science (ICSU)'s Committee on Space Research (COSPAR).

# NASA asks SSB/NASEM to study planetary protection policies

The *2018 Review and Assessment of Planetary Protection Policy Development Processes*, and the *2019 Report of NASA Planetary Protection Independent Review Board* both concluded that there was a need to:

“reestablish an **independent and appropriate advisory body** and process to help guide formulation and implementation of planetary protection adequate to serve the best interests of the public, the NASA program, and the variety of new entrants that may become active in deep space operations in the years ahead.”

→ **CoPP was born**

Relevant points for this group are highlighted

**Statement of Task** The CoPP will also serve the secondary functions of:

1. Providing an independent, authoritative forum for the scientific community, the federal government, [international space agencies](#), relevant private-sector entities and organizations, and the interested public to identify and discuss emerging issues in the scientific, technical, and engineering aspects of planetary protection policies and guidelines;
2. Identifying and prioritizing necessary research and development activities required to advance the development of planetary protection guidelines designed to ensure that the exploration and utilization of extraterrestrial environments is conducted responsibly; and,
3. Providing a forum for interactions with the [International Science Council's Committee on Space Research and other national and international organizations](#) through the addition of international participants when appropriate and in coordination with the SSB.

# CoPP Members

Mr. Joseph K. Alexander, Chair; Alexander Space Policy Consultants

Dr. Angel Abbud-Madrid; Colorado School of Mines

Dr. Anthony Colaprete; NASA Ames Research Center

Dr. Michael J. Daly; Uniformed Services University of the Health Sciences

Mr. David P. Fidler; Council on Foreign Relations

Ms. Sarah A. Gavit; Jet Propulsion Laboratory

Dr. Amanda R. Hendrix; Planetary Science Institute

Dr. Andrew Horchler; Astrobotic Technology

Dr. David M. Karl; NAS; University of Hawaii at Manoa

Dr. Eugene H. Levy; Rice University

Dr. Robert E. Lindberg, Jr.; Independent Consultant

Dr. Margarita M. Marinova; Independent Consultant

Dr. A. Deanne Rogers; Stony Brook University, The State University of New York

Dr. Gerhard H. Schwehm; [European Space Agency](#)

Dr. Trista J. Vick Majors; Michigan Technological University



# CoPP and PPP

## How will we operate?

- The SSB Director and staff will invite the PPP Chair, Vice-Chairs, and members to all open CoPP meetings.
  - For instance, PPP briefed CoPP at one of its first meetings.
- The reports produced by CoPP will be available to PPP members and the public.

# Report Series #1: Planetary Protection for the Study of Lunar Volatiles

....The CoPP shall draft a short report on the impact of human activities on the polar volatiles and the scientific value of protecting the surface and subsurface regions of the Earth's Moon from organic and biological contamination.

1. An overview of the current scientific understanding, value, and potential threat of organic and biological contamination to:

- a. Permanently shadowed regions that have scientific value in the study of the history of the solar system and its associated organic compounds,
- b. Research on the Moon relevant to understanding the process of prebiotic chemical evolution and the origin of life.
- c. Assess the likelihood that spacecraft reaching the lunar surface will transfer volatiles to polar cold traps.

2. An assessment, to the degree possible, of how much and which regions of the Moon's surface and subsurface are of sufficient scientific value to warrant protection from organic and biological contamination.

# Decadal Survey Philosophy

**Science Comes First:** All recommendations must be, first and foremost, science-driven

**Engage the Community :** Solicit community input

**Transparent and Open:** Make the process as open and visible as possible to all interested members

**Situational Awareness of our partner's work is essential. We solicit member nominations for Decadals on our website (self or others).**

TIM DE ZEEUW, Leiden University is a member of Astro2020 SC.



# Who Uses Decadal Surveys

Sponsoring Agencies and Congress use them as the formal statement of priority by the U.S. space science community and give highest priority to the missions identified in the survey whenever possible.



# Big Questions in Space Science

**Astrophysics:** How does the universe work? How did we get here? Are we alone?

**Earth Sciences:** How do we improve weather and air quality forecasts, understand the coupling of the water and energy cycles and ecosystem change, study sea-level rise, surface dynamics, climate uncertainty, and geological disasters?

**Heliophysics:** How do we understand the Sun and its interactions with Earth, the interstellar medium, and space weather?

**Planetary Sciences:** What is the origin and history of the solar system, are we alone, and what hazards and resources lie in space for human exploration?

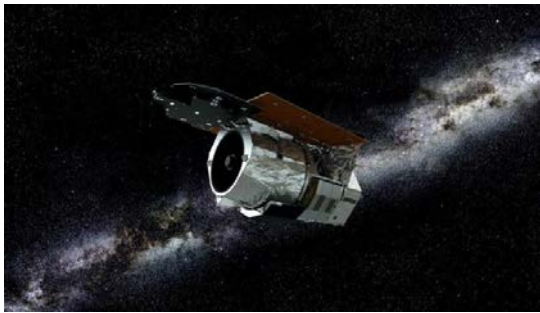
# A Few Past Decadal Recommended Flagships Launched or Being Built

*Astrophysics Decadal*

*Heliophysics Decadal*

*Planetary Science Decadal*

**WFIRST**



Now the Nancy Grace Roman Space Telescope

**Solar Probe**



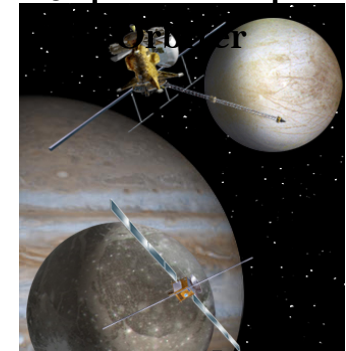
Now the Parker Solar Probe

**Mars Science Laboratory**



Now the Curiosity Rover

**Jupiter Europa**



Now Europa Clipper

**NGST**

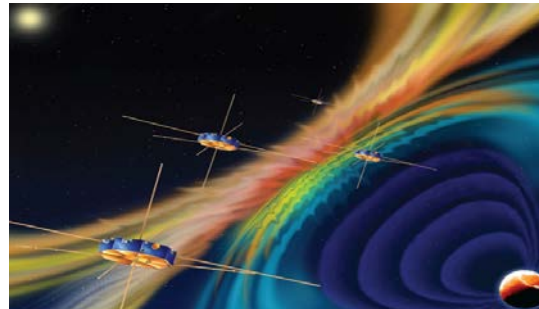
**(Next Generation Space Telescope)**



Now the James Webb Space Telescope

**MMS**

**(Magnetospheric Multiscale Mission)**



*The National Academies of*  
**SCIENCES • ENGINEERING • MEDICINE**

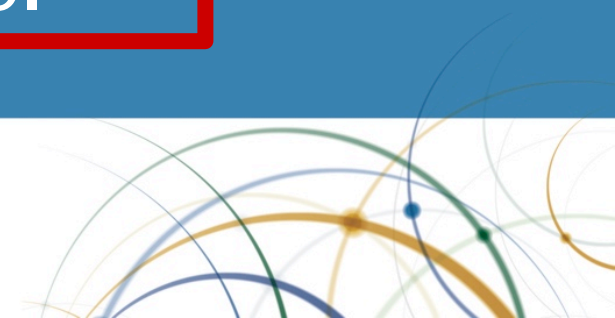
1<sup>st</sup> Step: Perseverance Rover Caching

# How does one estimate the unknown?

## Technical, Risk, and Cost Estimation (TRACE)

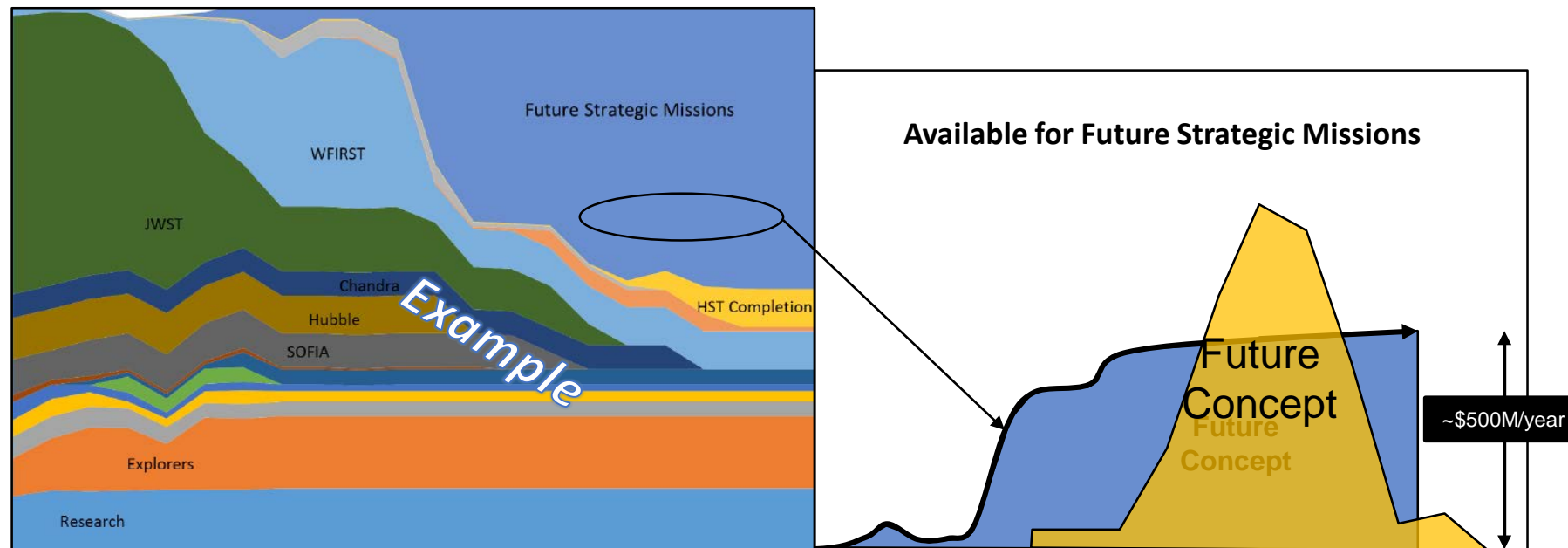
- Independent evaluation of concepts - assuring the analysis is fair, uniform, and tied to historical data to assure accuracy.
- Puts pre-phase A concepts on even footing by evaluating them with whatever information is available and describing the resultant approximation of rough life-cycle cost of a proposed concept.

RISK Box - expand & contract the error box commensurate with available info.



# How does a TRACE work?

- TRACE is a “*look forward*” budget evaluation process with a technical risk assessment
  - Incorporates future cost threats with technical maturity and top 5 risks
- TRACE is an “*interactive*” discussion with the Steering Committee
  - Committees seek a balanced science program within the available budget

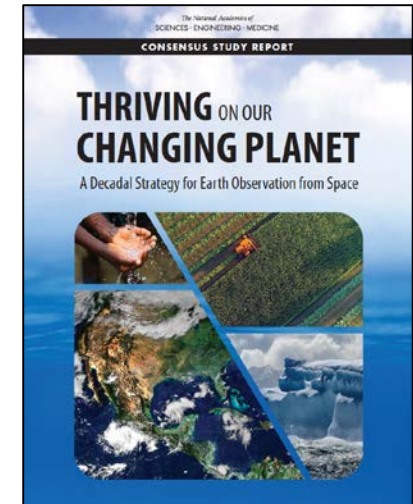
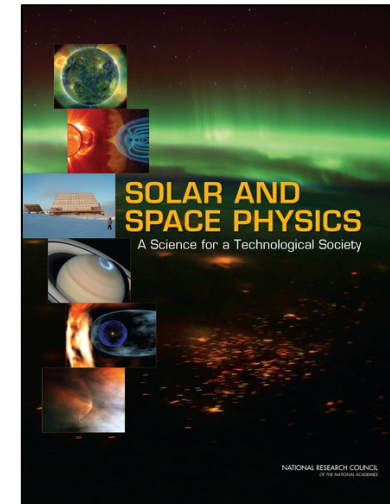
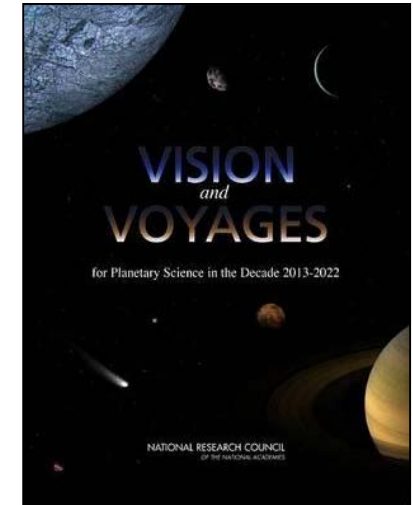
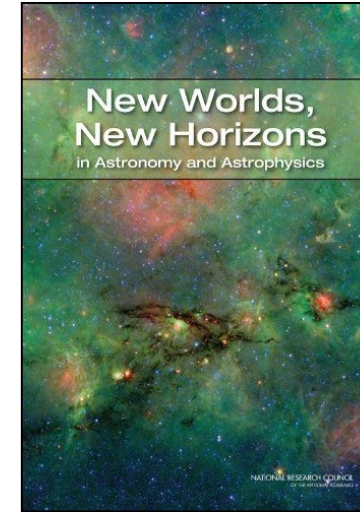




# Do TRACE's over-estimate the price of pre-phas A mission?

## Recent Decadal Survey TRACEs

- **2009 - Astro2010 (Astrophysics)**
  - 8 space-based concepts (\$1B - \$9B)
  - 9 ground-based concepts
  - Concepts chosen from community white papers
- **2010 – Planetary Sciences**
  - 15 space-based concepts (\$1B - \$7B)
  - Concepts generated by panels & NASA Centers
- **2011 – Heliophysics**
  - 6 concepts plus 3 variations (\$0.5 - \$1B)
  - 12 conceptual designs developed by Aerospace
- **2017 – Earth Science and Applications**
  - 3 measurement proof of concepts (\$0.6B - \$1B)
    - “Binning estimates” for 20-30 concepts
    - No real design concepts, minimal definition



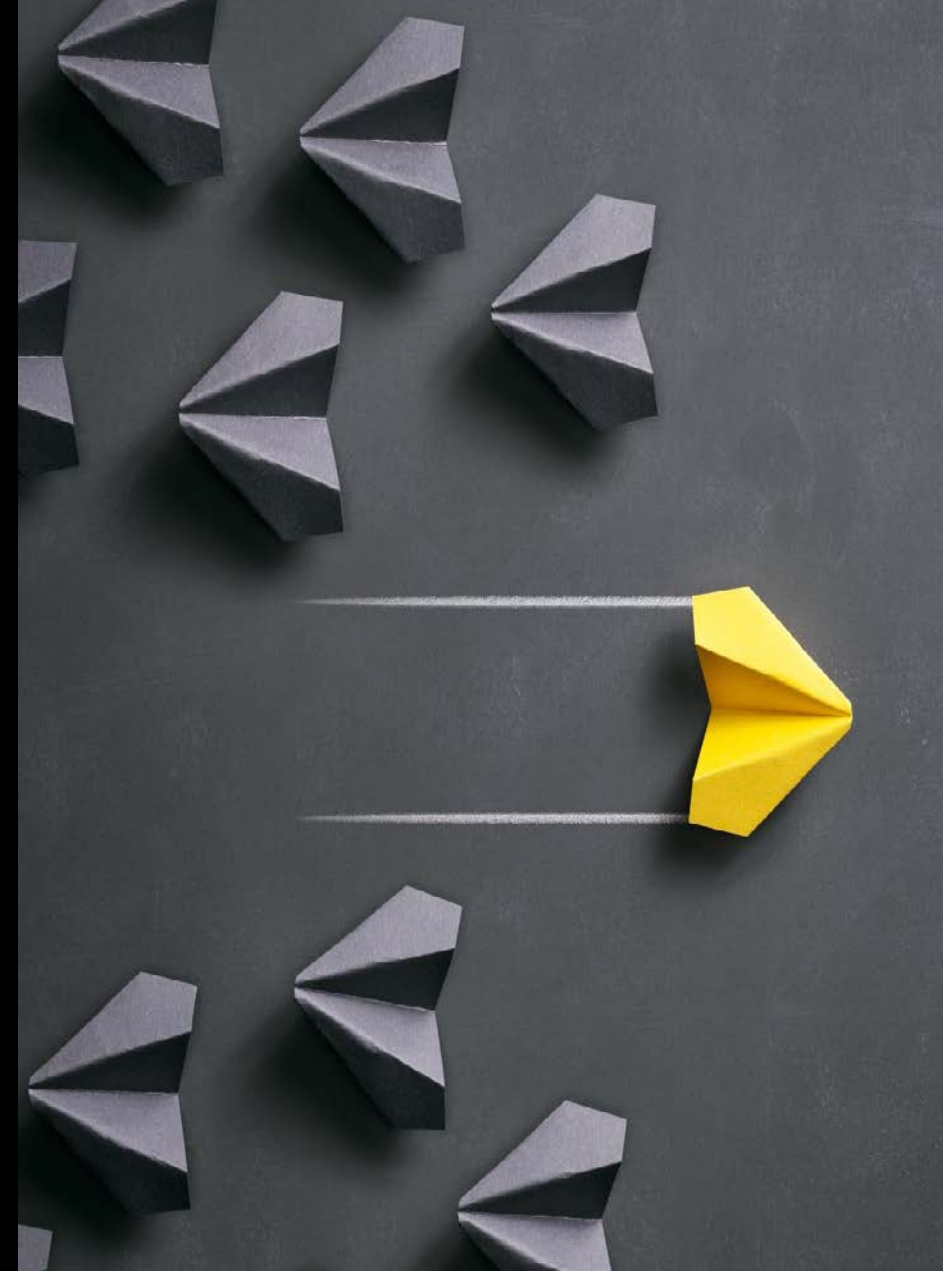
# Decision Rules

*When external priorities shift, scientific or technical advances take place, a plan becomes suboptimal.*

*Decision Rules anticipate changes, and help preserve the relevance of strategic goals.*

*A rigorous TRACE helps, but it is only a ROM: the true cost of a mission cannot be established until Phase C.*

*Decision rules establish caps by triggering reconsideration and possible rescoping of science*



Planetary Sciences Decadal defined strong decision rules Max-C, now Mars 2020:

The committee recommends that NASA should fly the MAX-C mission in the decade 2013-2022 only if it can be conducted for a cost to NASA of no more than approximately **\$2.5 billion**. If a cost of no more than about **\$2.5 billion FY2015 cannot be verified**, the mission (and the subsequent elements of Mars Sample Return) **should be deferred until a subsequent decade or canceled outright**.



# Decision Rules: Heliophysics Example

Decision rules are strategic, not tactical. Implementation should be left to the Agencies. Long-term advice that advances the scientific goals is useful, short-term rules quickly become obsolete or are better determined others.

- HELIOPHYSICS DECADAL EXAMPLE
  - Decision Rule 1. **Missions in the STP and LWS lines should be reduced in scope or delayed to accomplish higher priorities.** Chapter 6 gives explicit triggers for review of Solar Probe Plus.
  - Decision Rule 2. **If further reductions are needed,** the recommended increase in the cadence of **Explorer missions should be scaled back,** with the current cadence maintained as the minimum.
  - Decision Rule 3. **If still further reductions are needed,** the **DRIVE** [Diversify, Realize, Integrate, Venture, Educate initiative] **augmentation profile should be delayed,** with the current level of support for elements in the NASA research line maintained as the minimum.

