



Starting to partner with NASA in space and Earth science

Marc S. Allen^{*}, Paul L. Hertz

Science Mission Directorate, National Aeronautics and Space Administration, 300 E Street SW, Washington, DC 20546, USA

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Abstract

NASA research programs offer many opportunities for productive partnerships with investigators in other countries. While spacecraft projects are complex and very expensive, there are other, lower-cost partnerships that can yield important scientific results and offer excellent opportunities for building up new space and Earth science programs and for training new researchers.

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1. Introduction

Few areas of human activity have inspired people as much as the exploration of space and few fields of scientific exploration have delivered such rapid and exciting discoveries as space science and observation of the Earth from space. It has been decades since the first detailed space images of the Earth and pictures of the outer planets and of the remotest Universe were obtained. But even now, new results on space astronomy, solar physics and solar system exploration, and the Earth environment capture the imaginations of people all over the world.

Participation in space research is technically challenging and can be very expensive. Like many challenges, the hardest steps to take may be the first ones. Fortunately, the peaceful exploration and use of space is today truly global. Major space-faring nations welcome the cooperation of new and established partners, so there are many entry points for collaboration and development leading to increasing capabilities. The United States is one of these nations, and NASA offers a rich menu of opportunities for new partnerships.

Collaboration in space science offers many benefits. It stimulates technical education, workforce development,

and industrial capabilities, as well as the advancement of useful technologies. It also enables access to special skills and industrial capabilities on a global scale while it spreads the costs and risks of expensive undertakings. One especially valuable side effect is the impetus that collaboration provides to participants for international relationship-building and for diffusion of a philosophy of open access to scientific data.

International collaboration does, however, pose some special challenges. Principal among these is synchronization of decision-making and funding cycles between partners. International partnerships can introduce a degree of extra management complexity to research and space system development. Cultural and language differences must be overcome and all parties must adapt to export control regulations where they apply. At the same time, formal international partnerships can help stabilize the partners' project funding. The rich history of international space science illustrates that the challenges can be, and have been, overcome, by advance planning, diligent consultation during execution, and accumulated experience. Beginning with less complex undertakings, like those described below, promotes the maturation of relationships and technical capabilities that can lead to more ambitious partnerships.

This paper describes NASA's policies for cooperation in space research, including space science and environmental science, and selected options for new partners to work with

^{*} Corresponding author. Tel.: +1 202 358 0733; fax: +1 202 358 3992.
E-mail address: marc.allen@nasa.gov (M.S. Allen).

NASA data and to get involved in a wide variety of lower-cost flight programs. A table of web sites is included to aid those who are interested in accessing these data or learning more about cooperative research opportunities.

2. NASA History and Policy for International Cooperation

NASA was chartered for international cooperation in space from the very beginning. The legislation that created NASA, the National Aeronautics and Space Act of 1958, provided nine general goals for the new space agency; two of these lay the foundation for US science cooperation in space as it is today:

- The expansion of human knowledge of the Earth and of phenomena in the atmosphere and space; and
- Cooperation by the United States with other nations and groups of nations in work done pursuant to the Act and in the peaceful application of the results thereof.

As a result of the international orientation of the new US space program, key principles were established very early, in 1958 at the second meeting of COSPAR in The Hague:

- Designation by each participating government of a central agency for the negotiation and supervision of joint efforts;
- Agreement upon specific projects rather than generalized programs;
- Acceptance of financial responsibility by each participating country for its own contributions to joint projects;
- Projects of mutual scientific interest; and
- General publication of scientific results.

The US commitment to collaboration with foreign partners in space has recently been strongly reaffirmed by the new US National Space Policy, released in June 2010.

Expand international cooperation on mutually beneficial space activities to: broaden and extend the benefits of space; further the peaceful use of space; and enhance collection and partnership in sharing of space-derived information.

During the intervening years, international cooperation on NASA's programs expanded enormously. As of August 2011, NASA had nearly 500 active agreements with over 100 countries around the world; fully 2/3 of these are for NASA science activities. The remaining third encompasses comparable numbers of agreements in space operations (including human space flight), aeronautics, exploration systems, as well as framework agreements. One half of all agreements are with partners in Europe; alternatively, eight partners account today for half of the total: France, Germany, the European Space Agency, Japan, the United Kingdom, Italy, Canada, and Russia. But this means there are very numerous agreements with other partners as well,

fully 50% of all agreements being with countries not on this list. In all, over the 50 years of NASA's existence, it has established over 3000 agreements with foreign partners.

3. Partnership opportunities

How can a new partner get started with NASA, especially without immediately facing the enormous costs and technology challenges of building, launching, and operating spacecraft? Or, how can a current partner with NASA extend collaborations into new areas?

The basic key to partnership on NASA programs lies in team formation, Scientist-to-Scientist, with US or non-US investigators who are already involved. A menu of ready approaches to beginning to develop relationships and joint activities would include:

- Scientist-to-Scientist Research Collaboration;
- Multilateral Forums and Science-based Organizations;
- Space Data Sharing for Research;
- Earth applications;
- Ground-based measurements in Earth science;
- Suborbital investigations; and
- GLOBE education program.

The remainder of this article explores these approaches. At the end is provided a table of useful web sites for access to US space and space-related science. Entries in this table are indicated by numbers like this (#1) in the text below.

3.1. Scientist-to-Scientist Collaboration

A look at any scientific journal will illustrate a fundamental fact: science today is international. Collaborative relationships between investigators of different nationalities are the rule, not the exception. Further, recent developments in telecommunications and data transmission make geography essentially irrelevant, once a relationship has been established. Many non-US scientists have studied in the US and start their careers with contacts there.

Studying abroad and teaching abroad are avenues to establish relationships. Another way is short or longer term visits at US research institutions; one competitive program that brings foreign investigators to work at a NASA research center is the NASA Postdoctoral Program (#1). Investigators with the right skills can also get involved as Participating Scientists on space mission teams.

The goal and basic mechanism of collaboration are coauthorship of papers in the peer-reviewed literature. Becoming part of a team of researchers that includes investigators already part of the NASA-supported science system is the gateway to more complex and ambitious partnerships.

3.2. Multilateral Forums and Science-Based Organizations

A good way to build scientific relationships is by exchanging information and ideas at international scientific

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