ASTROBIOLOGY – A BRIDGE BETWEEN EARTH SCIENCE AND SPACE EXPLORATION. P. Ehrenfreund, S. Chung, J. Rummel, N. Peter, Space Policy Institute, Elliott School of International Affairs, Washington DC, USA (pehren@gwu.edu), Institute for Coastal Science and Policy, East Carolina University, Greenville NC, USA, European Space Agency, Paris, France

Introduction: Planet Earth is currently the only habitable world we know. Although life may have existed as early as 3.5 billion years ago, humans have lived for only a rather short time on Earth—about 2 million years. Nonetheless, we are (unfortunately) making up for lost time as a major factor affecting the habitability of the planet. In the last 200 years humans have changed the Earth dramatically, calling into question how long the Earth and its natural systems can balance its limited energy and material resources against the effects of human-caused pollution.

Astrobiology, the study of life in the universe, addresses, as an interdisciplinary science field, many questions that are relevant for sustaining life on planet Earth—and in particular, the relationships between a planet and life, and how each affects the other [1]. Astrobiology provides both the knowledge and perspective to inform us about how to maintain the Earth as a long-term habitable home for humanity.

Increasingly, it has been shown that space technology can be applied to address problems on Earth. While the “Mission to Planet Earth” enabled by Earth observation satellites has been recognized in the past decades, the role and potential contribution of space exploration activities to understanding and protecting our home planet has not been accepted to the same degree. Nonetheless, some of the space activities involved in investigating our solar system have equally significant implications for understanding the evolution of life on Earth, and how Earth has become—and remains—habitable. In particular, studies of the Sun and of the potential for life on other planets in our solar system provide examples of the linkages between space exploration and Earth science.

Where Space meets Earth. Synergies between space exploration and the preservation of our habitat exist, and protecting life on Earth requires similar concepts and information as do investigations of life beyond the Earth, including the expansion of human presence in space [2,3]. Instrumentation and data handling to observe both planetary objects and planet Earth are based on similar techniques. Moreover, while planetary surface operations are conducted under different conditions, the requirement to probe the surface and subsurface of both the Earth and other planets has yielded similar tools and technologies, such as radar, seismometers, and drilling devices. The Earth observation community has developed some exemplary tools and has featured successful international cooperation in data handling and sharing that could be equally well applied to robotic planetary exploration.

Integrating Astrobiology research as a bridge between Earth and Space Science: Information on both biodiversity and extreme life can help to provide concepts (based on recent scientific data) of how ecosystems respond to rapid rates of change, and may help determine possible directions by which the Earth and its biosphere (including humans) can survive and co-evolve in the future. This approach requires an application of the principles and perspectives of astrobiology to identify options that might allow humanity to halt the destruction of its own habitat, as well as the decline of biodiversity on Earth, while addressing a variety of related economic and energy-related scenarios associated with those options [4].

Astrobiologists should guide and support the exploitation of synergies between the Earth and space communities—and synergies can arise on technical, managerial, and political levels. Technical synergies can result from sharing scientific knowledge, data, and experiences, as well as common infrastructures, technologies, and skills. Managerial synergies can arise from sharing institutions, governance structures, and by learning from the management-knowledge and skills of the other community. On the political front, coalitions can be formed to address common policy goals and strategies that could be shared to address common obstacles and pitfalls. And, too, it should be noted that the education and awareness of society can benefit tremendously from a knowledge of the overall habitability of our solar system, and the new worlds, beyond.

References: