



Pacific International
Space Center for
Exploration Systems

The background is a collage of images. On the left, a Polynesian man in traditional clothing is shown on a double-hulled canoe. On the right, there are images of the Earth, the Moon, and Mars. In the center, there are several satellite dishes and a satellite in orbit. The bottom half of the image shows a view of Earth from space, with the blue ocean and white clouds of the atmosphere.

***An International
Space Partnership***

**Presented at JUSTSAP 2009
Frank Schowengerdt, Director**



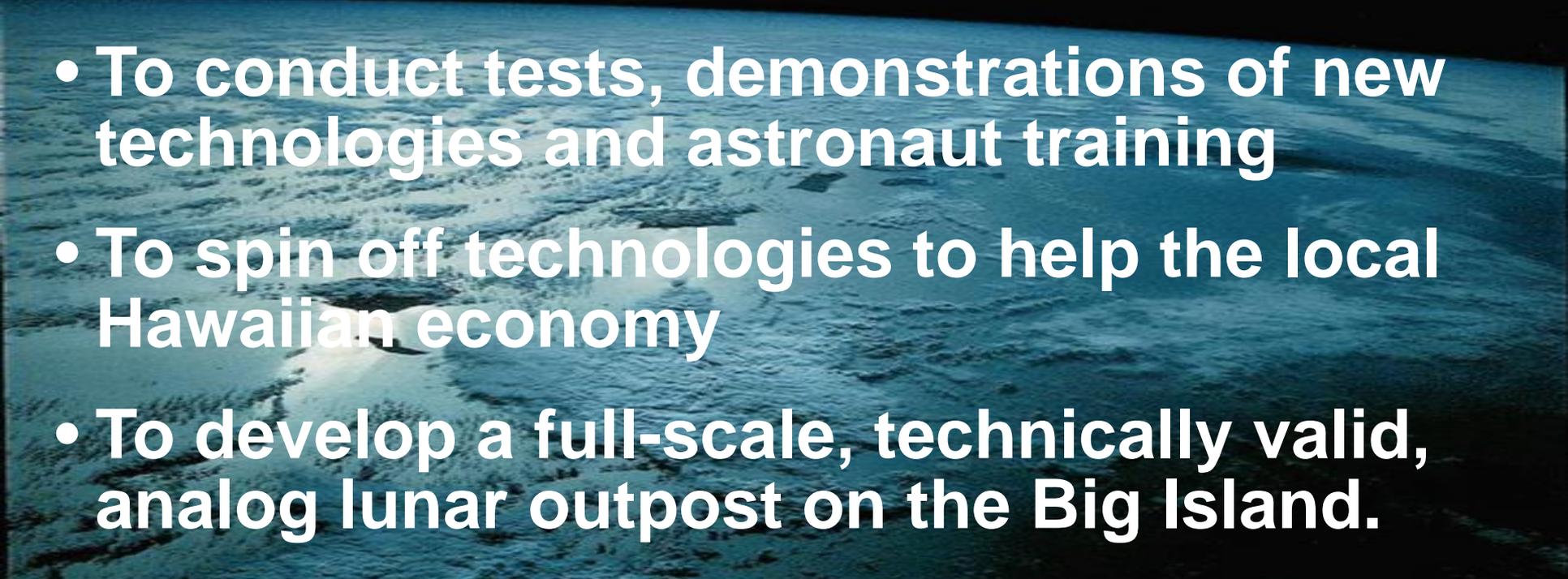
Pacific International
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VISION

***An International Research and Education
Center Dedicated to Sustaining Life on
the Moon and Beyond***



GOALS

- **To become an intellectual leader in human exploration and settlement of space**
 - **To promote STEM education, inspiring students by connecting Hawaiian culture to space exploration and settlement**
 - **To conduct tests, demonstrations of new technologies and astronaut training**
 - **To spin off technologies to help the local Hawaiian economy**
 - **To develop a full-scale, technically valid, analog lunar outpost on the Big Island.**
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The PISCES Team

- **Frank Schowengerdt, Professor of Physics UHH, *Director***
- **Robert Fox, UHH, *Deputy Director***
- **John Hamilton, UHH Physics & Astronomy, *Operations Manager***
- **Christian Anderson, UHH, *Assistant Operations Manager***
- **Dan Bland, President JAMSS America**
- **Rob Carlson, JAMSS America**
- **Larry Clark, ISRU Manager, Lockheed Martin**
- **Jim Crisafulli, Dir. Office of Aerospace Development**
- **Stephen Day, Chair, JUSTSAP**
- **Mike Duke, former Director Center for Space Resources, Colorado School of Mines, Affiliate Professor UHH**
- **Judith Fox-Goldstein, UHH Conf. Ctr.**
- **Alex Ignatiev, Professor of Physics and Director, Center for Advanced Materials, University of Houston**
- **Mark Henley, Boeing Phantom Works**
- **Beth McKnight, McKnight Comm.**
- **Osamu Odawara, Tokyo Inst. of Tech.**

Major Categories from the Strategic Plan

- **Test and Demonstration Program**
- **Student Design Competition**
- **UHH Education Program**
- **Public Outreach**
- **Proposals**
- **Papers**



Tests and Demos

November 2008 Participants

- **NASA: KSC, JSC, GRC, JPL**
 - **Lockheed-Martin**
 - **Michelin**
 - **CSA: NORCAT**
 - **DLR**
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- A photograph showing a view of Earth from space, likely from the International Space Station. The Earth's surface is visible, showing a mix of blue oceans and white clouds. The horizon of the planet is curved, and the background is the blackness of space.

Tests and Demos

Some Views from the Site



Overview



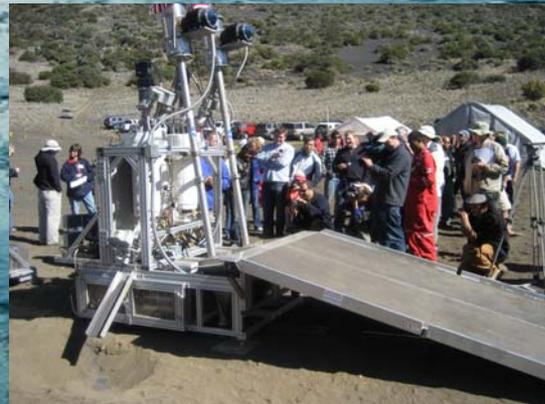
Excavator



Scarab



PILOT



ROxygen



Rover in Crater



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Tests and Demos

Local Outreach



Grades 2-6



Bob Fox Lecturing



Grades 7-12



NASA/PISCES at `Imiloa



Outdoor Exhibits



Scarab at `Imiloa



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Tests and Demos

Media Day



Infirmary



PISCES Crew



Bill Larson
Addresses Reporters



Communications Tent



Larry Clark with PILOT



NORCAT Crew

Tests and Demos

Primary Results

- **First-Ever Demonstration of Pilot-Scale Production of Oxygen and Water from Lunar-Like Regolith**
- **Demonstrations of Robotic Drilling, Excavation, Transport and Traverse, Remote Control from Toronto**
- **Establishment of Viability and Desirability of PISCES Test Site**
- **Successful International Cooperation in Complex Analog Tests Involving Industry, Academia and Government**

Student Competitions

Three Years Running – Thanks Mike Duke!

- **2007**

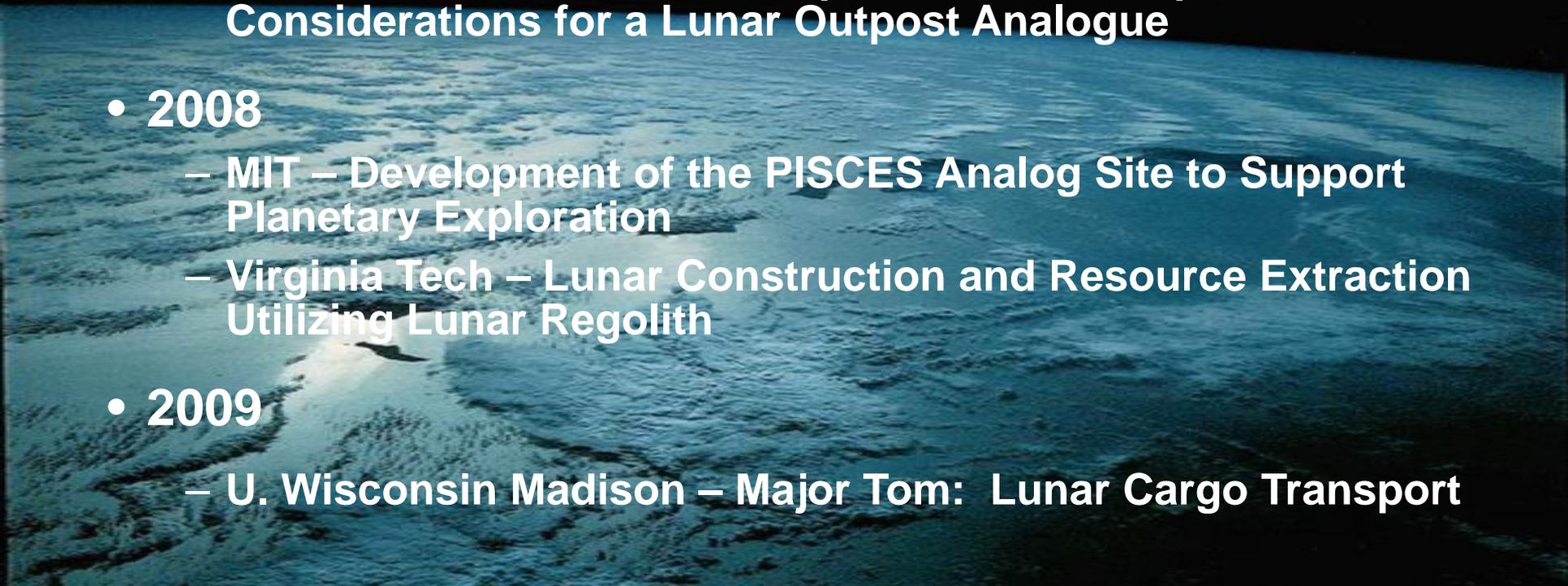
- Honolulu Community College – Lunar Habitat Design
- Colorado School of Mines – Simulated Lunar Habitat
- University of Colorado – Translating Life Support System Functions into Hardware Requirements and Operational Considerations for a Lunar Outpost Analogue

- **2008**

- MIT – Development of the PISCES Analog Site to Support Planetary Exploration
- Virginia Tech – Lunar Construction and Resource Extraction Utilizing Lunar Regolith

- **2009**

- U. Wisconsin Madison – Major Tom: Lunar Cargo Transport



UH Education Program

Thanks Bob Fox!

- Introduction to Space Exploration
- Spaceflight
- National Space Seminar from Hilo
- Human Physiology and Spaceflight
- Embryonic UH System-Wide Space Studies Curriculum





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Public Outreach

***Thanks Bob Fox, John Hamilton
and Beth McKnight!***

- **Local K-12 School Visits**
- **Local Public Space-Related Events (Onizuka Day, Big Island Science Fair, Robotic Competitions, etc.)**
- **PISCES Cultural Advisory Board**
- **Newspaper, Television and Radio Spots from Hilo, Honolulu, Washington and over 160 Outlets Worldwide**

Proposals

November 2008 – October 2009

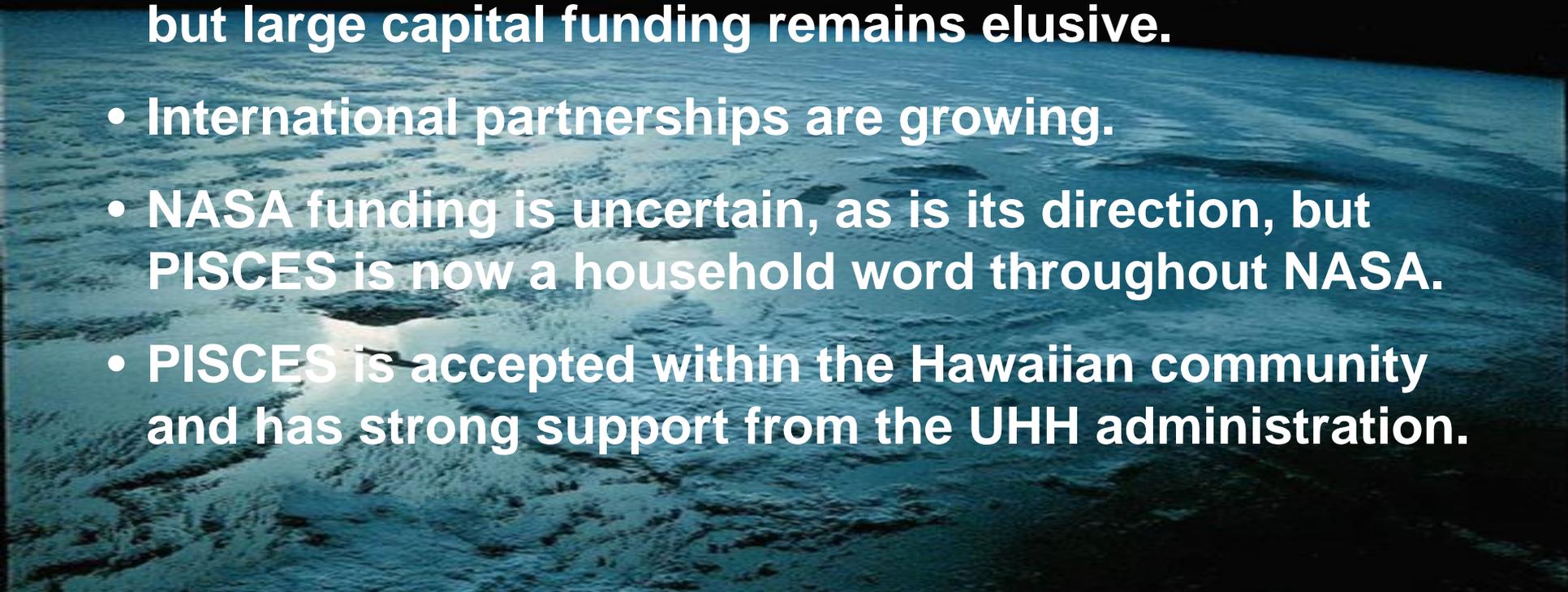
- **PISCES Renewal – State of Hawai`i - Funded at \$300K/Year for Two Years, FY10 and FY11**
- **ISRU Tests and Demonstrations – KSC, JSC, NORCAT (NASA IPP) – Funded at \$191K**
- **Tweel Tests – JPL, Michelin – Funded at \$50K**
- **Unsuccessful**
 - NASA Lunar Science Institute (\$4M)
 - NASA Lunar Science and Exploration Research (\$400K)
 - NASA Steckler Lunar Colonization (\$70K)
- **Successful for 2010**
 - ISRU Tests and Demonstrations – NORCAT, NASA, DLR – Funded at \$155K

Some Examples

- **“Lunar Surface Equipment Testing and Demonstrations at the PISCES Lunar Analog Facilities”, Dan Bland, Robert Carlson, Robert Fox, John Hamilton, Frank Schowengerdt (ISCS 2008)**
- **“Lunar Human Ecology,” Frank Schowengerdt, Robert Fox, Mike Duke, (NLSI 2009)**
- **“An Innovative Approach to Connecting Science and Culture”, Robert Fox, Frank Schowengerdt (IAC 2009)**
- **“Operating A Lunar Analog Test Site: Business and Entrepreneurial Considerations”, Robert Fox, Frank Schowengerdt (IAC 2009)**
- **“Lunar Analog Testing in Hawai'i: An Example of International Collaboration”, Robert A. Fox, Frank Schowengerdt, Dale Boucher, Bill Larson, Lutz Richter (ASCE October 2009)**

Conclusions

PISCES is a Reality

- **Activity at PISCES continues apace.**
 - **Annual state of Hawai`i funding has actually increased in face of most severe economic downturn in decades, but large capital funding remains elusive.**
 - **International partnerships are growing.**
 - **NASA funding is uncertain, as is its direction, but PISCES is now a household word throughout NASA.**
 - **PISCES is accepted within the Hawaiian community and has strong support from the UHH administration.**
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- Aerial view of a coastline with a large bay or inlet, showing the ocean and land.