VOLUME 3
ISSUE 2

February
2011

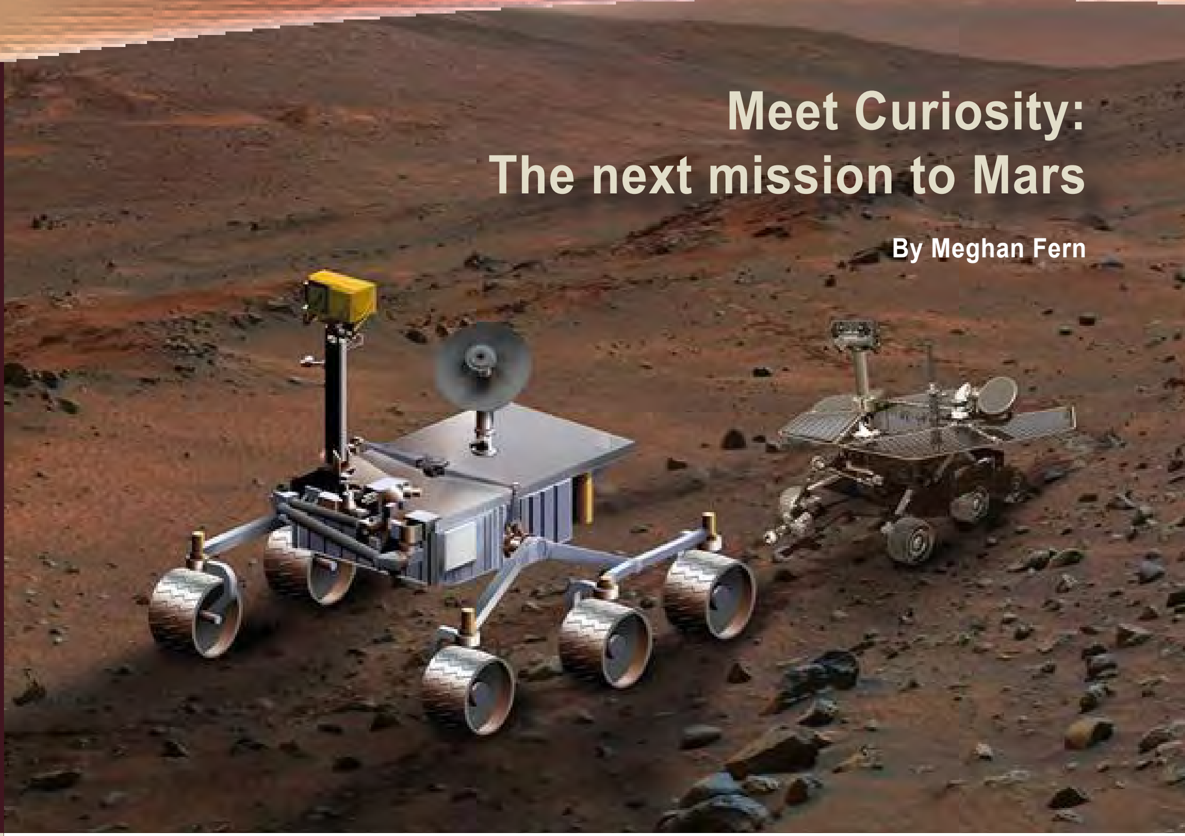
NEWSLETTER OF THE SCHOOL OF EARTH AND SPACE EXPLORATION

SESE Source

THIS ISSUE

Meet Curiosity: The next mission to Mars

By Meghan Fern



An artist's concept of NASA's Mars Science Laboratory (left) serves to compare it with Spirit, one of NASA's twin Mars Exploration Rovers. Weighing in at 1,875 pounds, Curiosity will carry the biggest, most advanced suite of instruments for scientific studies ever sent to Mars. Image Credit: NASA/JPL-Caltech

REMINDER

The Robert S. Dietz Memorial Public Lecture will be held on Thursday, February 24 at 5 p.m. This free lecture series brings distinguished speakers to ASU for an annual lecture to the general public by leading scientists.

Robert S. Dietz was a leading researcher in plate tectonics, planetary sciences, and science in the public interest. This year's lecture will be delivered by John Grotzinger (Caltech) in the Physical Sciences Building's F-wing (PSF), room 166, on the Tempe campus.

The R. S. Dietz Museum of Geology, located on the first floor of PSF, will be open before and after the lecture.

The Mars Science Laboratory (MSL) mission, scheduled to launch in the fall of 2011, will be the largest rover to land on Mars. With advanced capabilities and instrumentation living inside, MSL will examine the austere but stunning Martian surface for evidence of past and present habitability.

Determining an appropriate landing site for analysis is a fundamental aspect of the MSL mission. "The landing sites that we're picking all have some morphological, chemical and mineralogical [evidence of water]," stated Michelle Minitti, an ASU research associate and assistant director of the Center for Meteorite Studies.

The indication that liquid water, regarded as a basic element for life, has been present on the surface is a commonality amongst all candidate landing sites. The presence of water is detected from orbit, using high-resolution remote sensing data, particularly from the Mars Reconnaissance Orbiter (MRO). The MRO provides insight into the presence of geomorphic characteristics relevant to water, such as channels and deltas.

Minitti is a co-investigator on the MSL camera team, specifically working with the Mars Hand Lens Imager (MAHLI). MAHLI, one of MSL's 10 instruments, is mounted on the robotic arm of the MSL and will acquire close-range images of Martian rocks for observation. MAHLI produces images with the same color capability as that of consumer digital cameras. The images provided by MAHLI will enable a greater understanding of the mineralogy written in the rock record. The close examination of the materials is essential for determining the past environmental conditions that have acted on them. Kenneth Edgett, a SESE alum (MS 1990, Ph.D. 1994), is the principal investigator on the MAHLI team.

continued on page 2

continued from page 1

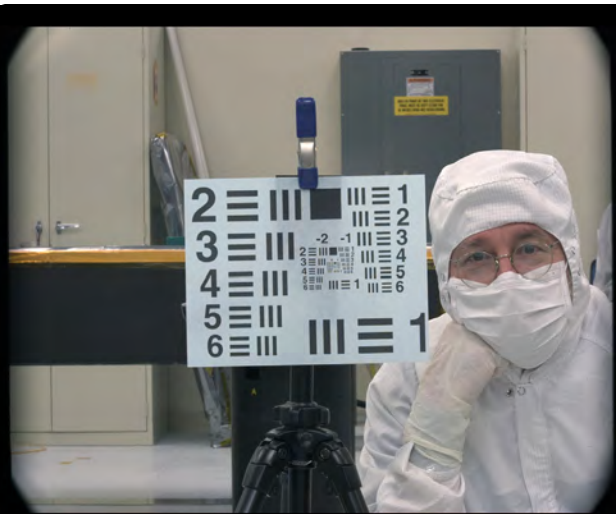
MAHLI was created by Malin Space Science Systems, a company started and operated by former SESE professor Michael Malin (1979-1991). Malin is the principal investigator for two other MSL cameras, the Mars Descent Imager (MARDI) and Mastcam. Professor Jim Bell, who joined SESE in December 2010, is yet another SESE member involved with MSL. He also serves on the Mastcam team led by Malin.

The Mars Exploration Rovers (Spirit and Opportunity) could scratch the Martian surface and try to get a sense of things, but Curiosity can retrieve a sample and put it in various analytic chambers.

The instrument for examining the chemical and mineralogical properties on Mars is called CheMin. CheMin will perform determinative mineralogy using x-ray diffraction, a standard lab technique used for determining the mineralogy of rocks and soils. The acquired samples will be powdered and placed in CheMin. An x-ray beam will be sent through the material. The beam is diffracted when it encounters the sample according to the internal structure of the material. This pattern of diffraction is essentially a mineralogical fingerprint that can provide definitive evidence of water during Mars' formation, a key feature for assessing habitability. Additional information gained from determining the composition of the minerals is the discovery of nutrients and potential sources of energy that life also requires.

Jack Farmer is a professor in SESE, and a member of the CheMin science team. He explained the importance of understanding the mineral composition of the Martian surface, stating, "Mineralogy provides our best indicator for environmental conditions that prevailed during the formation of a rock. Also, living things require nutrients in the form of elemental building blocks and sources of energy. We can learn about all those things through an understanding of mineralogy. If you can get a really clear indication of what that composition is, you can begin to track the requirements for life and perhaps get an answer to the question, were habitable environments present at the time this rock formed?"

The past and present habitability of Mars will also be addressed by an instrument known as the Sample Analysis at Mars (SAM), which consists of a group of three instruments: a Quadrupole Mass Spectrometer, a Gas Chromatograph, and a Tunable Laser Spectrometer. SAM, essentially an analytical chemistry system, will perform chemical and isotopic analyses of the atmosphere, as well as rocks and soils that are processed through SAM. It will be searching for traces of organic compounds and isotopic indicators of climactic change. Meenakshi Wadhwa, director of the Center for Meteorite Studies at ASU, is a co-investigator on the SAM team.



Malin Space Science Systems delivered the two cameras for MSL's Mast Camera (Mastcam) instrument. During post-transportation instrument checkout in a cleanroom at JPL, Mastcam 34 was used to take this picture of Mastcam Principal Investigator Michael Malin. In this image, the camera is demonstrating a resolution of about 9 pixels per millimeter at a distance of 2 meters (6.6 feet). Image Credit: NASA/JPL/Malin Space Science Systems

The current Mars atmosphere is thin and cold, primarily carbon dioxide and with surface temperatures and pressures typically below the triple point of water (the point where all three phases of water, liquid, gas and vapor can coexist). In addition to discovering water, it is important to establish if a denser atmosphere once existed on Mars than today. The presence of minerals formed in water suggests that in the past the Martian atmosphere was denser and warmer so that liquid water was abundant at the surface. Although exactly how dense and warm the atmosphere may have been is debatable.

So, where did the Martin atmosphere go?

There is no single agreed upon cause for the atmospheric depletion. Undoubtedly, Mars lost water through the process of photo dissociation occurring in the upper atmosphere. But carbon dioxide and other atmospheric components of the atmosphere are dissolved in water and constantly react with crustal rocks where they are removed as weathering products. On Earth, these weathering products are recycled back to the atmosphere by plate tectonics and associated volcanism. However, Mars lacks plate tectonics which means that the weathering products are not recycled.

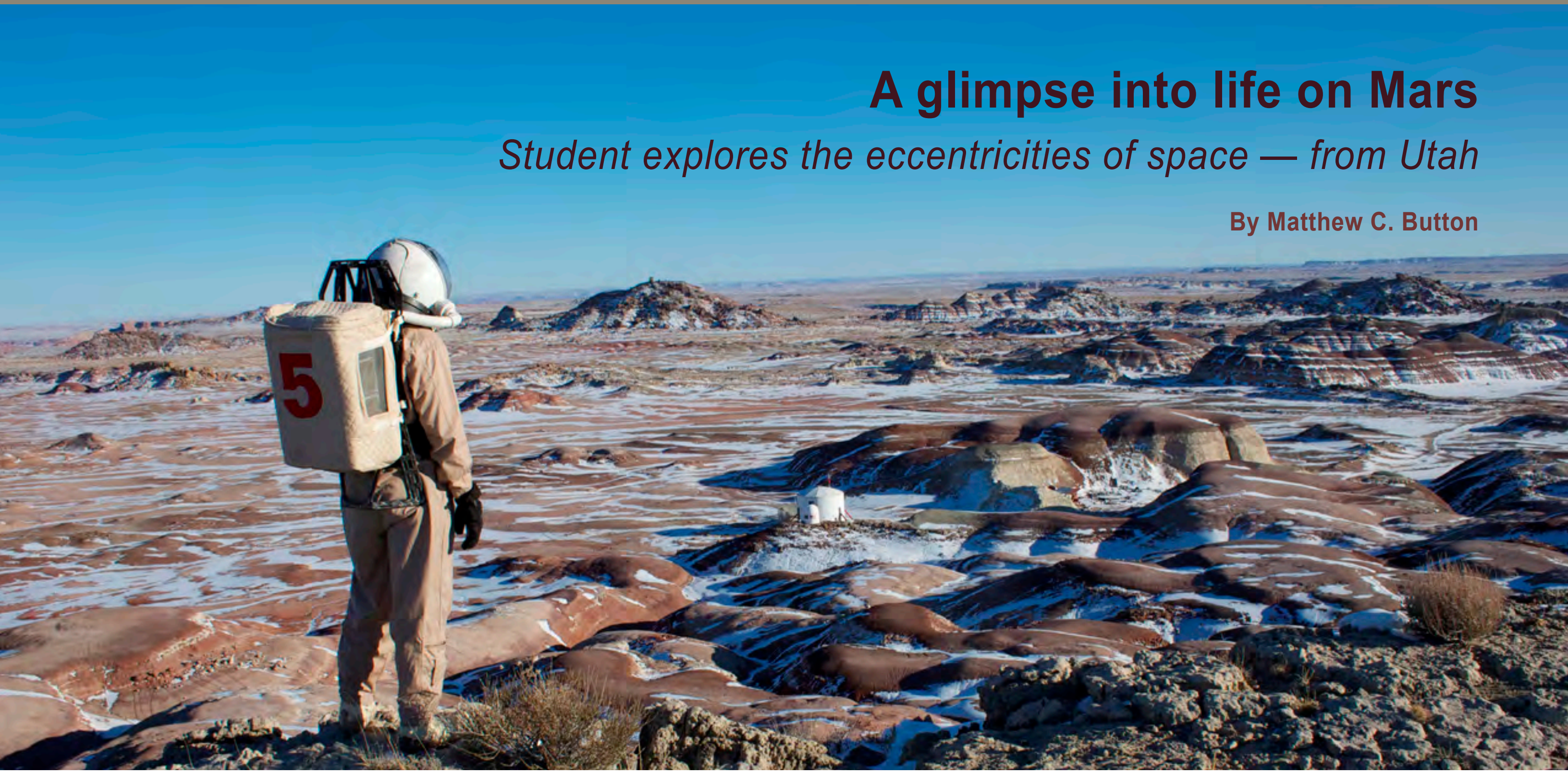
Without plate tectonics, atmosphere can be lost over time. Although Mars is home to the largest volcano in the solar system, there is no evidence for plate tectonics, suggesting atmosphere may have been lost to the crust and never recycled.

The Martian atmosphere is inhospitable for life at the surface today. The suggestion of earlier Earth-like surface conditions supports the notion that life could have gotten started there. But, could life still persist on Mars? If there is existent life on Mars today, the likelihood that it exists at the surface is minimal partly due to the lack of surface water and presence of high radiation.

"If there is present life there, it is probably underground," stated Amy McAdam, a SESE alum (Ph.D. 2008) who has worked on MSL's SAM instrument. The existence of life meters below the surface is more plausible as a result of being better protected from exposure to radiation; also, it will have access to water that it would be denied on surface.

Although MSL lacks the ability to drill deep into the subsurface, where extant life might be present, it will be able to sample the interiors of ancient sedimentary rocks formed at a time when water was present at the surface of Mars.

"The fact that on Earth we routinely find evidence for past habitability and life preserved in ancient rocks, from a time when our biosphere was still young, gives us hope that we will discover such evidence preserved in the ancient sedimentary rocks on Mars," said Farmer.



A glimpse into life on Mars

Student explores the eccentricities of space — from Utah

By Matthew C. Button

Spacesuits can be cumbersome things, and while their awkward size may be a spacebound necessity, some earthbound scientists are perusing the surface of our own earth within these air-tight outfits. Such activity might seem outlandish but for extraordinary young ASU scientists such as Jim Crowell working at the Mars Research Desert Station (MDRS) recalibrates his research methods to fit future environments like Mars. Crowell, a junior undergraduate student, represents the younger face of SESE's students with their gazes fixed toward the heavens.

MDRS is funded by the Mars Society, an organization promoting human exploration and innovation in the direction of Mars, and a group any aspiring astronaut would be keen to be a part of. Each fall, the Mars Society puts out a call for applications and based on experience and qualifications, research scientists are selected to join the three-week simulation. Other institutions, such as NASA's Ames, often send teams of researchers who want to gain a more extraterrestrial glimpse at experimental procedures in Mars environments.

While Winter Break for many brings back memories of snow and ice, family time and home-cooked meals, for Crowell it meant travelling to the San Rafael Swell in Utah, a landscape with red-brown sands, limestone valleys, and dust stained skies, exuding an undeniable Martian feel. Set alone in the desert, the simulated Mars habitat was Crowell's project for the month. During the first week he and five other crew members worked to repair the habitat so that it could be ready for simulation.

"The water lines had to be unfrozen, we had to restart the greenhab and bring in plants, and work on just little maintenance things," Crowell recounts.

The habitat itself consists of three buildings: a habitat, greenhab, and observatory. The habitat looks very much like a giant cylinder; beyond its air lock double doors the crew does most of its work during the two-week research period. Large batteries and two generators power the heating, hot water, and appliances the mock astronauts use during their stay. Even more curious than the habitat is the greenhab which serves not only as a greenhouse, but as a water filtration system. Water starts off in a massive tank outside the habitat, and then gets pumped manually into faucets for drinking and showering. The dirty water drains down through the greenhab where the vegetation can cleanse the water and re-route it to flush toilets. This level of resource efficiency would be a high priority millions of miles away from earth. The third component is the observatory, which is a telescope that can be accessed from the habitat and controlled via the internet.

Once the simulation was set to go, he lived and worked as though he was on Mars. Part of crew 97, Crowell was officially the "Executive Officer and Human Factors Researcher." In the habitat with him were four other scientists: geoscientist Judah Epstein, morphology expert Amanda Damptz, Mars Society Executive Director Lucinda Land, human habitat enthusiast Tonya Thompson, and engineering mechanic specialist Nathan Wong. Communicating was only by radio outside the habitat, dealing with broken equipment and routine research was done as though Utah's climate was that of the red planet. Crowell's research compared panorama photographs he took from the ground with satellite images.

"I haven't processed all of it yet, but I've attached GPS coordinates to all of the panoramas so I can relate them to the satellite images and when I see a line or a circle on the satellite image, I can confirm that it is a mountain or a cliff from these ground shots." Crowell explains. Crowell can then run the pictures through a program to measure distance and depth creating a kind of map, with satellite data being constantly checked and precisely focused by his panoramas. Oftentimes a satellite cannot reveal all the geographic details, as in the scenario Crowell describes:

"Actually the hills in the area (around MDRS) are really sloped, and even though they did show

continued on page 4

continued from page 3

up on the satellite they didn't look that high. But when you actually get to the hills you realize they are a lot higher than you originally anticipated."

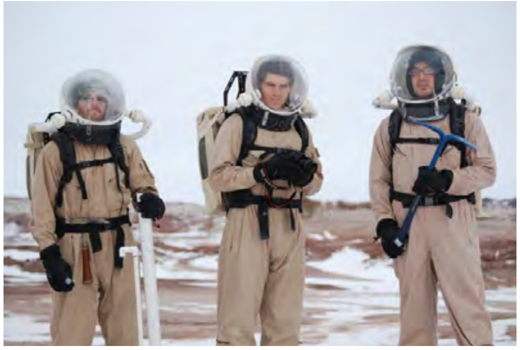
But it was not all Crowell's research. Since there was just the small crew living in the habitat, crew-members had to often lend a hand in other initiatives. Experiments with sand storm rovers, extracting rocks for signs of life, and psychophysiological tests that looked at senses in the isolation of the habitat were part of the entirety of the mission.

Crowell was a little annoyed by the air locks, the unreliable radio communication, and the spacesuits, but these things were expected. Unexpectedly bothersome was the fact he was stuck with five strangers for the better part of three weeks.

Crowell doesn't just spend his vacations endeavoring to explore, and his research at the MDRS is by no means the extent of his interest in the stars. He has worked with Professor Phil Christensen using the Mars Odyssey thermal emission imaging system (THEMIS) to photograph and map areas of the Martian surface, a task similar in nature to his MDRS research. He helped develop a simulation that set up a network of seismometers across the lunar surface to detect subsurface structure of Earth's moon.

He is also the founder of the ASU chapter of Students for the Exploration and Development of Space (SEDS). The group dabbles in the massive subject that is space, doing community outreach, researching, observing meteor showers, etc. Crowell even spoke of collaboration with the ASU's rocketry club Daedalus, where SEDS will be designing a payload in one of their rockets. The first meeting was Feb. 2, however, this semester's meetings continue through April and the group is always looking for new members.

"We also go to conferences like Space Vision and International Space Development Conference, where professionals speak and you can get some great contacts," mentions Crowell. More information on SEDS can be requested



by emailing james.crowell@asu.edu.

Crowell feels his ultimate career aspiration is a NASA astronaut. He is currently employed at the Lunar Reconnaissance Orbiter Camera facility looking at images of the Moon for specific geological features. Congress in 2010 projected a manned NASA initiative to Mars for 2030, and while that leaves less room for exploration in the present, it provides boundless potential for future exploration —exploration that will be done by SESE's accomplished youth ... people like Jim Crowell.

Community News

Meet Meghan, the newest member of the SESE Source. *She is an intern from the English department.*

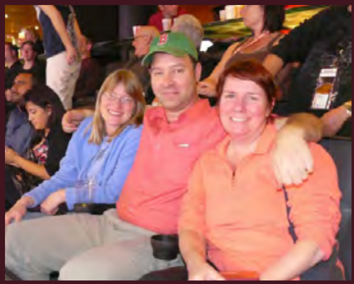
I was born in Fairfax, Virginia and moved to Scottsdale, Arizona when I was four. Currently I live in Tempe and am a senior majoring in English Literature. I changed my area of studies upon transfer after my sophomore year at the University of Arizona, where my major had been Nutritional Sciences with a minor in Chemistry.

I love to read, particularly short stories. I love animals and had been volunteering at the Arizona Animal Welfare League. I am unsure about what I want to do for a career and hopefully, one day, that light bulb in my head will ignite. Although, I often think it is important to have many careers, and as long as someday I look back and say, 'I made a difference somewhere and gave my best,' I'll be content.

I want to go to a graduate school on the east coast, specifically Washington D.C. Although I say I am unsure about what career path I want to take, I know I enjoy writing and researching areas that aren't frequently explored. I would love to be a freelance writer, but at the moment I think it's most important that I gain experience and get involved with different organizations that emphasize media relations or magazines focused on promoting literature.

Our recent Phoenix Suns fundraiser ended on a great note. The Suns won against the Boston Celtics. It was a wonderful game. Thank you to those of you who so generously participated in the event. We raised $1,630 for the Colloquium Series Fund. For those of you who didn't buy a ticket but would still like to contribute to the SESE Colloquium fund, you can help us grow the fund by giving online.

On behalf of SESE, thank you again for helping to make this fundraiser a success!



Cosmic house of mirrors

By Nicole A. Cassis

Looking deep into space, and literally peering back in time, is like experiencing the universe in a house of mirrors where everything is distorted through a phenomenon called gravitational lensing. Gravitational lensing occurs when light from a distant object is distorted by a massive object that is in the foreground. Astronomers have started to apply this concept in a new way to determine the number of very distant galaxies and to measure dark matter in the universe. Though recent progress has been made in extending the use of gravitational lensing, a letter published in *Nature* Jan. 13 makes the case that the tool may be even more necessary than originally thought when looking at distant galaxies.

Albert Einstein showed that gravity will cause light to bend. The effect is normally extremely small, but when light passes close to a very massive object such as a massive galaxy, a galaxy cluster, or a supermassive black hole, the bending of the light rays becomes more easily noticeable.

When light from a very distant object passes a galaxy much closer to us, it can detour around the foreground object. Typically, the light bends around the object in one of two, or four different routes, thus magnifying the light from the more distant galaxy directly behind it. This natural telescope, called a gravitational lens, provides a larger and brighter – though also distorted – view of the distant galaxy. These distortions, which stretch beyond the limits of the Hubble Space Telescope, can be effectively handled by a new space telescope on the drawing boards – the James Webb Space Telescope (JWST).

A very massive object – or collection of objects – distorts the view of faint objects beyond it so much that the distant images are smeared into multiple arc-shaped images around the foreground object. According to Rogier Windhorst, one of the letter's authors and a SESE professor, this effect is analogous to looking through a glass coke bottle at a light on a balcony and noticing how it is distorted as it passes through the bottle. Cosmologists such as Windhorst believe that gravitational lensing likely distorted the measurements of the flux and number density of the most distant galaxies seen in the recent deep near-IR surveys with Hubble's Wide Field Camera 3.

When you look back to when the universe was young, you are seeing extremely early objects (known as "First Light" objects) that are very far away. The older and farther away the object, the more foreground universe there is to look through, which means the greater the chance that there will be something heavy in the foreground to distort the background image. This research suggests that gravitational lensing dominates the observed properties of very early galaxies, those that are at most 650-480 million years old (now seen with Hubble at redshifts of z > 8-10, respectively). The halos of foreground galaxies when the universe was in its heydays of star formation (about 3-6 billion years old and at a lower redshift of z=1-2) will gravitationally distort most of these very early objects.

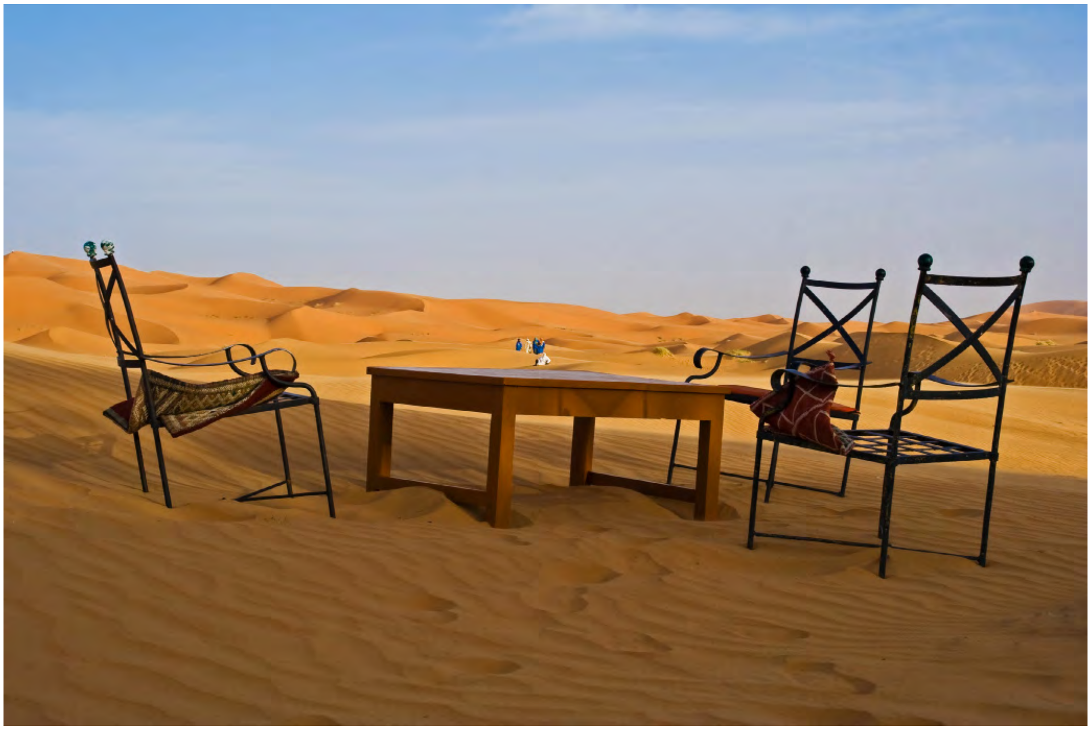
"We show that gravitational lensing by foreground galaxies will lead to a higher number of galaxies to be counted at redshifts z>8-10. This number may be boosted significantly, by as much as an order of magnitude. If there existed only three galaxies above the detection threshold at redshifts z>10 in the Hubble field-of-view without the presence of lensing, the bias from gravitational lensing may make as many as 10-30 of them visible in the Hubble images," explains Windhorst. "In this sense, the very distant universe is like a house of mirrors that you visit at the State Fair – there may be fewer direct lines-of-sight to a very distant object, and their images may reach us more often via a gravitationally-bent path. What you see is not what you've got!"

Future surveys will need to account for a significant gravitational lensing bias in high-redshift galaxy samples. Only the JWST – if it gets finished as designed – can make sense of this gravitationally biased distant universe because it will have exquisite resolution and sensitivity at longer wavelengths to disentangle these very distant objects from the foreground lensing galaxies. This work is too hard to do with Hubble's Wide Field Camera 3 at redshifts z >= 10, because at Hubble's resolution one literally can no longer see the forest for the trees at these extreme distances.

"Our suggestion of the possibility of large gravitational lensing biases in high redshift samples is of crucial importance to the optimal design of surveys for the first galaxies, which represent a central part of JWST's mission," says Windhorst. "This work clearly shows that we need JWST – and its superb infrared resolution, dynamic range, and sensitivity – more than ever to disentangle the First Light forest from the foreground trees. We will also need a next generation of object finding algorithms, since the current software is simply not designed to find these rare background objects behind such dense foregrounds. It's like finding a few "nano-needles" in the mother-of-all-haystacks."

Decidedly dryer days?

By Matthew C. Button



Water is not something we think about too often, in fact we have come to take this basic necessity for granted. Water is no mystery in Arizona; we know summer heat waves will mean careful hydration, smelly sweat, and commercialized sports drinks. But what remains a mystery is the direction of this thing we depend on — just where is all the water going? Scientists like SESE's Enrique Vivoni and those in his Surface Hydrology Research Group, are trying to chart the slow movements of water and model the massive systems that harbor this substance we need to survive. From regional geology, to vegetation, urbanization, and yearly rainfall Vivoni, and his numerous collaborators are trying to paint a more accurate picture of water in the Southwest.

"We have an arsenal of instrument networks that we can deploy with the purpose of understanding watershed processes," says Vivoni.

A large component of what Vivoni does involves environmental monitoring. He and many other researchers diligently record data from arrays of instruments in the field to see where water goes. From rain gauges to water content devices the measuring tools are limitless; there are even tools that can measure the velocity of sap within trees to see how much water they consume. Autonomous platforms such as helicopters and aircraft that can map watersheds are just a few of the more eccentric technologies that aid scientists in their quest to know water.

One way Vivoni has tried to track water in the Southwest is by charting vegetation. Yes, mapping plants.

"Ecosystems of the Southwest respond to summer rainfall. You might see, if say you're driving out in the Sonora Desert, things flowering up; you'll see saguaro bulge. We're interested in understanding and studying that process: when water arrives what happens to the desert," Vivoni explains. The large amount of water used by these plants has long been acknowledged, but what wasn't known was how much water they actually pump back into the atmosphere.

"We found this linkage between the plants that are living there and the subsequent daily rainfall that constitutes a future water supply," says Vivoni.

Even small details like the humidity plants release back into the air can provide more information for the massive computer modeling programs that Vivoni uses. Combined with information about topography, climate trends, and all the raw data that the massive instrument network provides, the modeling programs can determine where evaporation will be, where run off will occur, and where soil moisture will be. Model simulations can predict where the water is, and where it may be in the future.

But why? We do not appear to be having any shortages of the liquid variety. Water today may be bottled up into the SESE vending machines of tomorrow. Vivoni sees these models as more than just locating the water, but as being able to predict and strategically use water more effectively: "We want to be able to forecast. If I could forecast the current system I could give you a prediction for a scenario you come up with for society—what if we urbanize here, what happens to the crops ten years from now, what happens if we get fifty percent less or more rainfall? The model could be a way for predicting, and making better decisions."

The numerical model extends Vivoni's research from simply learning of past watersheds to a broader indication for the future of watersheds. But what kind of future is that? A recent History Channel documentary Prophets of Doom, threw scientific critics into imbroglios of controversy when a hydrologist claimed (with the certainty of Y2K) that global fresh water shortages could be some untimely end for mankind. Vivoni doesn't share this view.

"Some areas have plenty of water, in fact, certain areas are going to get more water as a

continued on page 7

continued from page 6

result of climate change, because it's not going to be a uniform response everywhere," he says.

Arizona, for example, has a variable climate system. Though it is considered to be dry here, the humidity fluctuates from year to year, unlike areas such as Saudi Arabia where models would show consistent dryness. Vivoni explains "…the 1980s here were very wet. People did things thinking they were going to be able to get that amount of water supply every year. The 2000s have been very dry, and institutions that we've created—assuming there was going to be a lot of water—might not work as well."

Dryness in our region is nothing extraordinary; Vivoni believes, however, that impending climate impacts in the Arizona region may have new consequences that our institutions may not be ready for. Many considerable changes are emerging. Evidence of significant temperature rise will undoubtedly affect water, but just how it affects water is a partial mystery.

Vivoni's models can offer glimpses into what the future may hold. For example, higher temperatures are leading to an earlier snow melt. And for anyone who knows the water cycle, it won't be just the skiers that are disappointed in the decreased powder, but anyone (or anything) who uses the water that would trickle down the mountain for a season. Many papers have been published and the scientific community seems to forecast a dryer more arid Arizona, but the forecast is not certain. It is difficult to know what the summer season will be like, and models can only foresee tidbits.

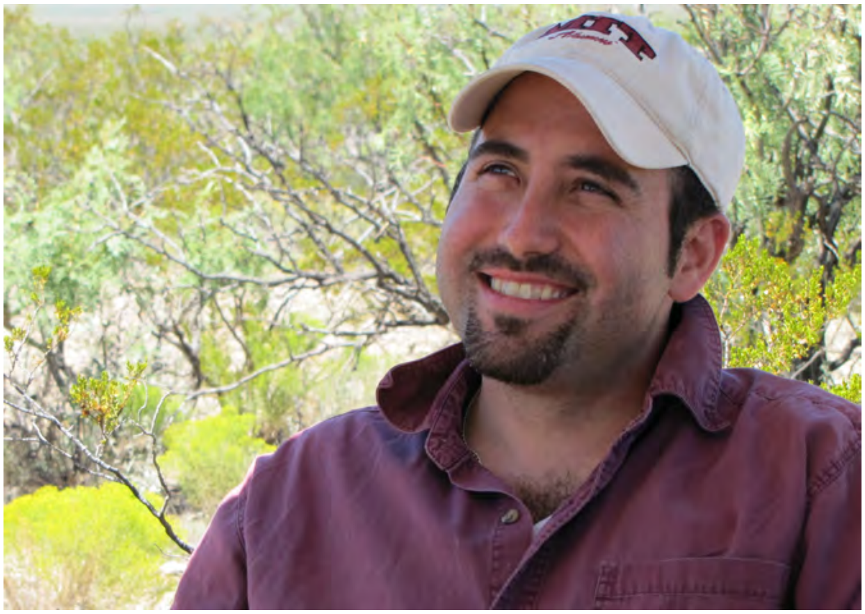
Vivoni sees that though water supplies may be in flux in the Southwest, these climate implications represent a slow danger, with the even more threatening to situation being the lack of public and institutional impetus to use water more efficiently.

"In the west, we live in a water scarce area where water is very important. While we may be paying attention, the next step of investing in how to adapt or mitigate climate change is what is really needed," Vivoni says.

In the mean time and in the academic setting Vivoni and his collaborators will continue to sharpen these simulated hydrologic predictions and teach others about water. Vivoni is the only hydrologist in SESE, but there are several other scientists focusing on hydrology throughout ASU.

> "Anyone who understands the water cycle knows it won't be just the skiers that will be disappointed by the decreased powder."

"Water is a topic that spans from the social sciences to the physical sciences and every flavor in between. For students interested in water, there are classes that cover this whole range of disciplines," says Vivoni.



Though ASU does not have an over-arcing major or structured curriculum designed for hydrologist wannabes focusing on water is still a possibility. At present, most student hydrologists at ASU are either geology or civil engineering majors.

Vivoni himself became interested in desert hydrology as a specialization from experiences as a high school student. Wondering about mechanisms of the environment, hydrology was the way he could look creatively at the physics behind nature's operation.

"Why the desert? Why water? If you want to matter go to where the resource is lacking. In the Southwest the supply of water is scarce, water controls other things. I'm especially interested in where hydrology intersects other disciplines but also just look at the implications of living in a large desert city," Vivoni says.

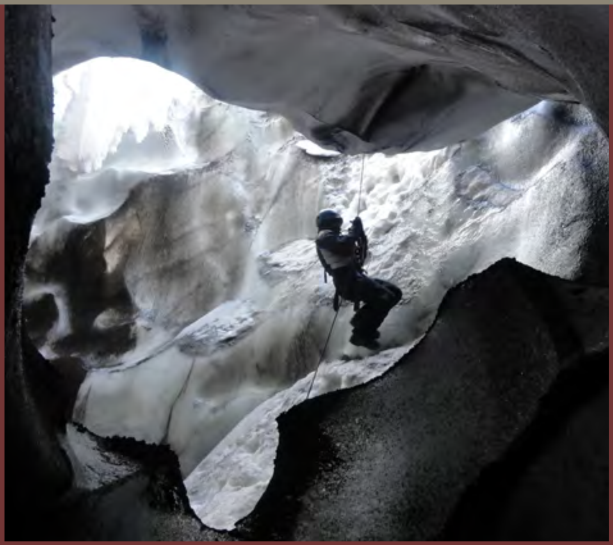
Tempe for example has in many ways engineered its ecosystem. Its rearranged natural channels, shaped rooftops and gutters to move rainfall effectively, and built parks as man-made retention basins. Many palm trees and other plants on ASU's campus have irrigation systems that allow greenery drink in the mornings. The very fact that 175,523 fully hydrated human bodies amble through Tempe each and every day is a feat with unknowable consequences.

"Everyone has a day to day experience with water; people don't know where it's coming from or where it goes after you use it. You're used to it. It isn't something out of the ordinary like new life on Mars or a man on the Moon. Public attention on water will increase when water as a resource dwindles," Vivoni explains.

When exactly this vital resource will run dry remains unknown but the work of Vivoni will aid human decision making and hopefully prevent any ensuing slurp sounds that signal water has run out. Though a forecast for rain may be a dreary thought compared to a sunny day, even darker is the thought of unquenchable thirst, devastated ecosystems… and un-flushable toilets.

ALUMNI PROFILE
Kayla Iacovino

By Meghan Fern



Kayla Iacovino graduated from ASU in 2010 with a bachelor's degree in Geological Sciences. She is currently a Ph.D. student at University of Cambridge with an anticipated graduation date of 2014.

Iacovino spent over a month exploring the frozen tundra of Antarctica, where sheets of ice are smooth like glass and lie in stark contrast atop crystalline structures. Antarctica contains over two thirds of Earth's fresh water, and yet it is one of the driest deserts on the planet, windy and laden with ice. The arctic summer occurs during the winter of the northern hemisphere, and December of 2010 is when Iacovino observed Mt. Erebus, the most active volcano on the continent, located near the McMurdo Station.

"Looking down, you see pools of magma," said Iacovino, "connected to deep Earth."

The observations made at Mt. Erebus are key elements in her dissertation, which will focus on activity occurring several kilometers below Earth's surface. Rock samples collected by Iacovino from the Antarctic desert have been brought back to Cambridge. These samples will be thoroughly experimented on, altered and retested several times. The assessment will aim to determine the activity occurring several kilometers below Earth's surface, creating what is seen atop it. Iacovino is specifically interested in examining the manner in which carbon dioxide, water and sulfur interact with magma deep inside Earth, and the activity that transpires in that space below the surface. She hopes to gain knowledge about ways in which gasses are released from volcanoes and factors to determine the nature of their explosions.

Iacovino entered ASU as a freshman, and like many students, she was undecided about a specific area of study. "I have always been interested in science," she said, "but I was going to focus on film."

Iacovino became invested in geology after taking a course that combined both astronomical and geological sciences (SES 101: Earth, Solar System, and Universe), co-taught by professors Ed Stump and Jeff Hester. "Geology was more hands on," she said. The concept of readily tangible materials was exciting, giving her an outlet to express creativity in a way that was personally appealing.

While at ASU, Iacovino gained valuable research opportunities through the NASA Space Grant College and Fellowship Program. Her depth of understanding and intrigue were intensified by gaining additional time in the lab, experimenting and getting hands on knowledge. She worked in ASU's experimental petrology lab under Dr. Gordon Moore studying the chemical properties of volcanoes and what makes them erupt. The prospect of applying the theories taught in lecture to physical materials provoked greater enthusiasm in Iacovino. "Research experience is invaluable," she said.

The research opportunities afforded Iacovino the chance to attend national conferences, including presenting research results to the American Geophysical Union conference. It was through these events that she became introduced to her mentor, Dr. Clive Oppenheimer, a coordinator for the Cambridge Volcanology Group.

Iacovino's undergraduate experience is complemented by the University of Cambridge on a global level. "It's so international," said Iacovino, an Arizona native, "and culturally diverse…everyone is from out of town." Studying abroad has given her the opportunity to utilize the proximity of other countries to her advantage. She will be taking rock samples from Antarctica to France, utilizing access to different tools to test her findings. The exposure to scholars on a global level has additionally introduced Iacovino to a wide range of various perspectives on geological theories.

Unlike many people who too often abandon old passions while they follow their career, Iacovino has combined her studies with her enthusiasm for cinema, becoming a science editor for trekmovie.com, a website devoted to informing fans about news that relates to Star Trek.

In addition to research, Iacovino is a blog contributor for Science Friday, a website focused on a weekly Friday talk show that is part of NPR's "Talk of the Nation," which airs scientific discussions with scholars in the field. She also manages a personal website, kaylaiacovino.com, where she incorporates her research updates, photography, and information regarding other scientific news.

When asked about future plans or anticipated pursuits following graduation from Cambridge, Iacovino expressed interest in public outreach, stating, "Science is important and needs to be communicated with the public."

Iacovino sees importance in creating an outlet for popular science, and facilitating the understanding of scientific discoveries and ongoing research with the public is something she is passionate about.