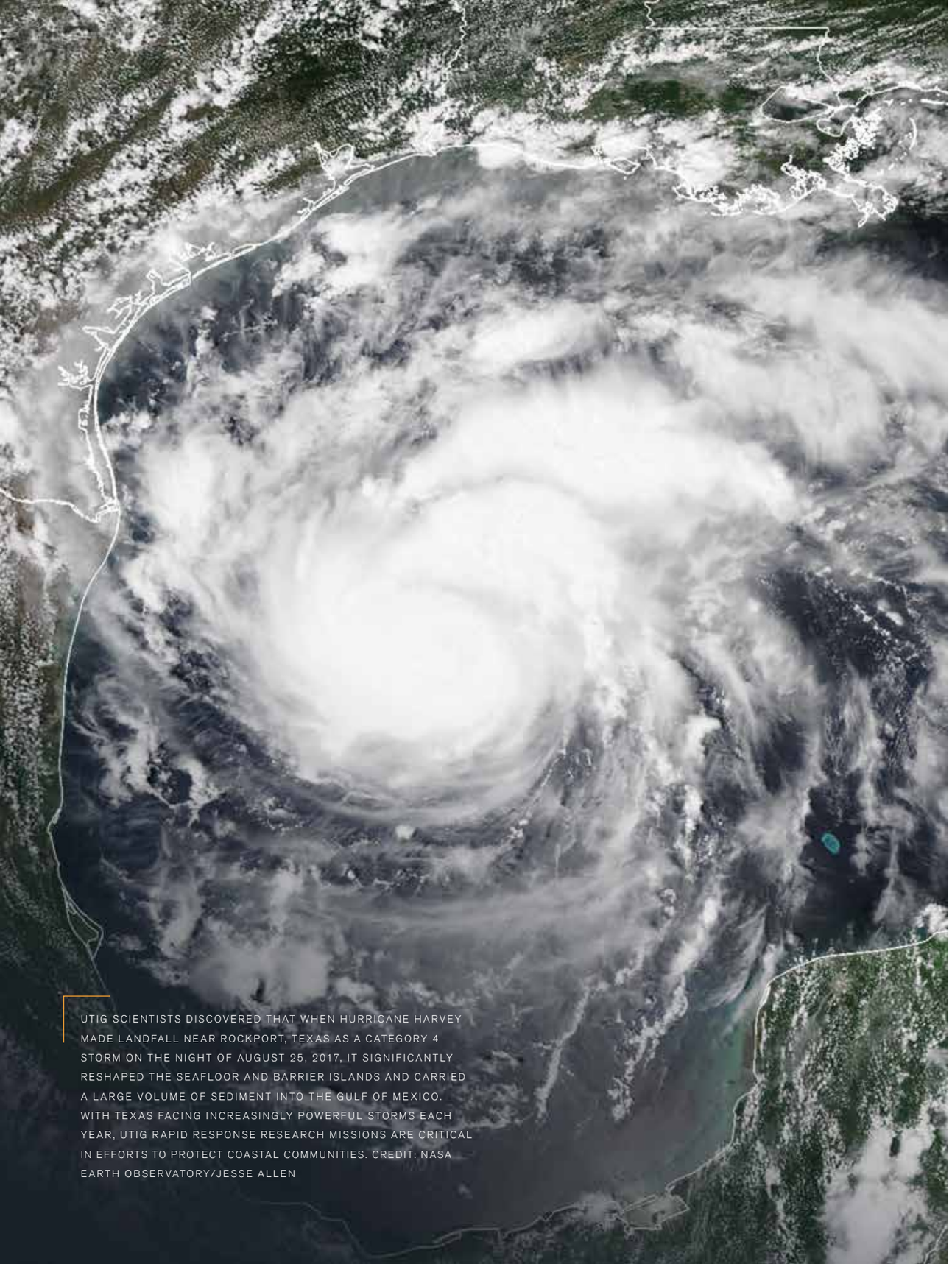
Understanding How Worlds Work



UTIG SCIENTISTS DISCOVERED THAT WHEN HURRICANE HARVEY MADE LANDFALL NEAR ROCKPORT, TEXAS AS A CATEGORY 4 STORM ON THE NIGHT OF AUGUST 25, 2017, IT SIGNIFICANTLY RESHAPED THE SEAFLOOR AND BARRIER ISLANDS AND CARRIED A LARGE VOLUME OF SEDIMENT INTO THE GULF OF MEXICO. WITH TEXAS FACING INCREASINGLY POWERFUL STORMS EACH YEAR, UTIG RAPID RESPONSE RESEARCH MISSIONS ARE CRITICAL IN EFFORTS TO PROTECT COASTAL COMMUNITIES. CREDIT: NASA EARTH OBSERVATORY/JESSE ALLEN

The UT Institute for Geophysics (UTIG) is a world leader in expeditionary-scale geophysical research on land, at sea, and in the air. Its wide-ranging expertise includes energy, polar, marine, climate, and planetary geosciences. Whether responding to natural disasters, imaging the deep earth, or searching space for signs of life, UTIG is at the forefront of cutting edge research at home and abroad.

UTIG scientists are dedicated to understanding how worlds work. Home to 50 doctorate-level scientists—research entrepreneurs—UTIG scientists provide a broad range of geoscience expertise. For example, our staff advises and conducts international scientific ocean drilling projects, performs Rapid Response surveys following natural disasters, investigates conventional and unconventional natural resources in the Gulf of Mexico, leads airborne radar studies of ice sheets on Earth and on other planets, researches earthquake and tsunami risks, and models past and future climate. UTIG scientists supplement their fieldwork with computer analysis, modeling, and laboratory work. ¶ UTIG seeks state, national, and international opportunities to leverage its proven geophysical proficiency addressing leading issues in resource development and environmental management. When society faces critical environmental problems that cause controversy among citizens and confusion among government policymakers, UTIG scientists engage the parties, plan an appropriate and effective response, and collect data that leads to responsible solutions. For such issues, UTIG scientists don't take sides; they find answers.

Lean and Agile

UTIG receives only $2 million per year from the state and UT, but it pumps $48 million into the Texas economy. Academic, government, and industry partners help us to leverage funding all while uncovering new knowledge that helps us understand and improve our world. This combination of support is critical to maintain the staff and infrastructure required for complex, field-based research programs and for training the next generation of geoscientists.

UTIG by the Numbers

STATE AND UNIVERSITY PER YEAR	$2 million
DIRECT EXPENDITURES PER YEAR	$22 million
INDIRECT ECONOMIC ACTIVITY	$26 million
ECONOMIC IMPACT ON TEXAS	$48 million
FOUNDED	1976
SCIENTISTS ON STAFF	50
GRADUATE STUDENTS	45
PEER-REVIEWED SCIENTIFIC PAPERS (2017–2018)	200
PAPERS WITH STUDENT CO-AUTHORS (2017–2018)	44

UTIG MILESTONES

1972 — Established lunar seismology program at UT

1974 — Conducted first academic marine multichannel seismic program

1984 — Established PLATES Program, an ongoing academic-industry partnership

1987 — First academic 3D marine multichannel seismic program

1993 — Established aerogeophysical polar research program at UT

1995 — Established Gulf Basin Depositional Synthesis Program, an ongoing academic-industry partnership in the Gulf of Mexico

2000 — Established first comprehensive climate research program at UT

2007 — Developed and initiated Rapid Response program to investigate earthquakes, hurricane, and tsunami hazards

2008 — Established pioneering field course in marine geology and geophysics

Established teacher development academies for teaching earth and space science in Texas public schools

Geophysical survey reveals extent of Hurricane Ike's underwater damage to Galveston

2010 — Discover Magazine cites two UTIG science stories among top 100 of the year: Haiti Earthquake response and Mars Polar Ice Cap

Rapid Response team investigated Haiti earthquake, building on a long history of UTIG's research in the area

2011 — Research investigates links between earthquakes, tsunamis, and ancient civilizations in eastern Mediterranean region

2012 — Study provides insights for shoring up Louisiana's vanishing wetlands

Helped design space probe to Jupiter's icy moons

2013 — Demonstrated the cause of 2004 major tsunami-generating earthquake in Sumatra

Found Evidence for a "Great Lake" on Jupiter's moon, Europa

Helped install a subsurface observatory at the fault that caused the great Japanese earthquake and tsunami

2015 — Study reveals abrupt climate change in northern latitudes 12,000 years ago

Pioneer method to track water flowing through glaciers

2016 — Study finds humans causing earthquakes in Texas since the 1920s

Drilled into the Chicxulub impact crater

2017 — Led mission to drill for methane hydrate in Gulf of Mexico

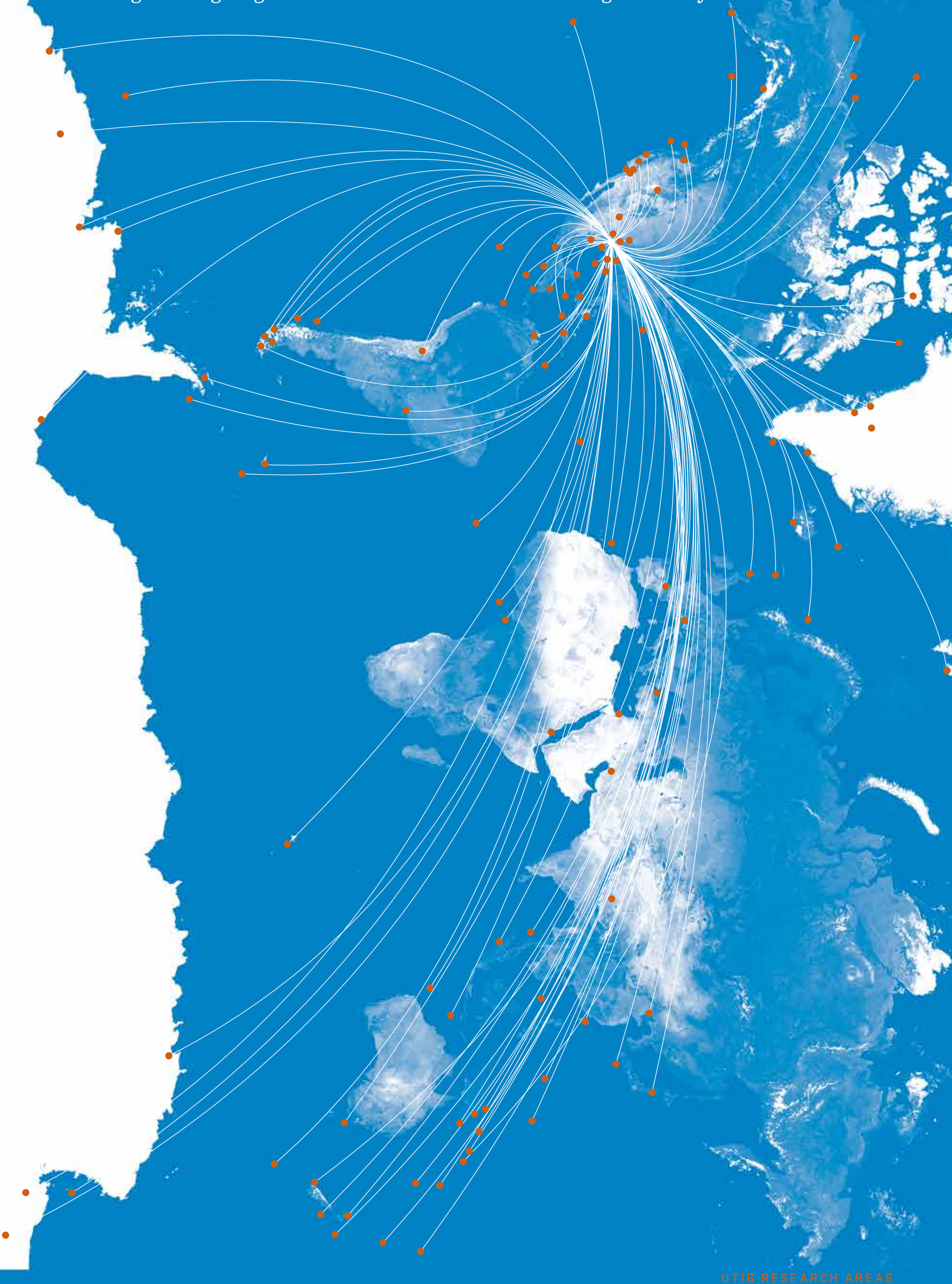
Rapid Response team investigates seafloor after Hurricane Harvey

Led mission to find sand resources in the Gulf of Mexico

Studies aid La Niña weather predictions

2018 — Study finds link between Western Hemisphere rainfall and Atlantic Ocean circulation patterns in past and present

From the ends of the earth to the bottom of the sea to other planets, UTIG is there, making cutting-edge scientific discoveries that change the way we live and work.



UTIG RESEARCH AREAS

A Better Future for Texas and the Gulf of Mexico

UTIG scientists study a number of issues important to Texas including earthquakes, climate, natural resources, and energy. Their research in and near Texas and the Gulf of Mexico in partnership with major stakeholders ensures a better Texas into the future.

TEXAS PANHANDLE EARTHQUAKES

UTIG scientists are evaluating the history and causes of a recent increase in Texas earthquakes, including more than three thousand earthquakes detected in the "Pecos hotspot" and a magnitude 4.0 earthquake which struck Amarillo in the Texas Panhandle, possibly induced by the region's oil and gas production. UTIG scientists are working with the Bureau of Economic Geology's TexNet program, which deployed seismic stations across the Texas Panhandle, to assess whether these earthquakes are influenced by human activity.

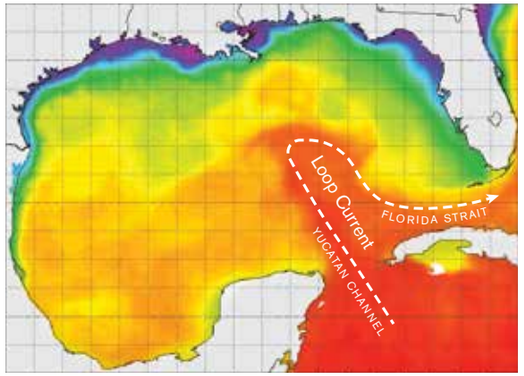
PECOS & AMARILLO, TX

WHITE WELL LOCATIONS AND PETROLEUM DRILLING STRUCTURES MARK THE YATES OIL FIELD IN THE LAYERED SEDIMENTARY ROCKS OF THE PERMIAN BASIN. ACTIVITIES RELATED TO OIL AND GAS PRODUCTION IN THIS AREA OF WEST TEXAS MAY HAVE CONTRIBUTED TO THREE THOUSAND EARTHQUAKES DETECTED NEAR PECOS THROUGHOUT 2018. CREDIT: EARTH SCIENCE AND REMOTE SENSING UNIT, NASA JOHNSON SPACE CENTER

UNDERSTANDING CLIMATE IN THE GULF OF MEXICO

UTIG scientists will reconstruct the history of the Loop Current through the Florida and Yucatan Straits; the Loop Current is an important control on Gulf of Mexico climate and oceanography, both of which influence hurricane development and impact human endeavors such as oil drilling and fishing operations.

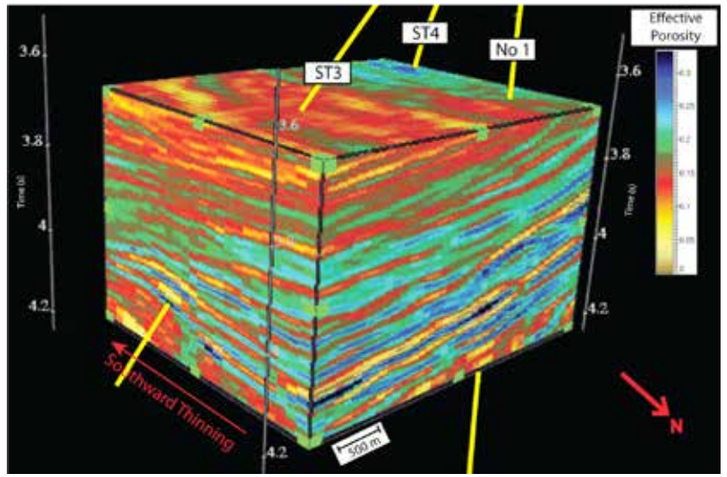
GULF OF MEXICO



THE LOOP CURRENT STUDY WILL INVESTIGATE HOW WATER FLOW INTO AND OUT OF THE GULF OF MEXICO HAS CHANGED THROUGH TIME AND HOW IT RELATES TO REGIONAL CLIMATE. CREDIT: CHRIS LOWERY

PUSHING THE LIMITS OF SEISMIC RESOLUTION

UTIG scientists and students are developing innovative mathematical and numerical models capable of resolving small scale features from seismic data including subsurface fractures. These are extremely useful for accurate description of hydrocarbon reservoirs, aquifers and mineral bearing zones, all of which have a direct impact on the economics of resource exploitation in Texas.



POROSITY ESTIMATION FROM 3D SEISMIC AND WELL LOG DATA AIDS IN LOCATING AND PREDICTING THE NATURE OF UNDERGROUND RESOURCES. THE EXAMPLE SHOWN HERE IS FROM THE MARCO POLO FIELD, GULF OF MEXICO. CREDIT: G. RUSSEL YOUNG AND MRINAL SEN

MAKING AN IMPACT AT CHICXULUB CRATER

An international research mission, co-led by UTIG researchers, has discovered how the Chicxulub Crater impact caused billions of tons of rock to move like liquid. The study, which is part of the International Ocean Discovery Program, offers insights into how impacts resurface planets, how vaporized ocean sediments were a key cause of global mass extinction 66 million years ago, and how life recovered following impact.

CHICXULUB CRATER, MEXICO

THE CHICXULUB IMPACT CRATER LIES BENEATH THE YUCATAN PENINSULA. UTIG RESEARCH UNCOVERED HOW LARGE IMPACTS AFFECT A PLANET'S SURFACE. CREDIT: NASA/ DON DAVIS

Building Bridges: Academia, Industry, and Government

UTIG scientists have a long history of partnerships with industry and government through geophysical investigations around the globe. Research conducted by UTIG scientists aids industry scientists in identification and development of energy resources in the deep water Gulf and other resource-rich deep basins around the globe.

MEETING FUTURE ENERGY NEEDS

UTIG leads two landmark projects geared toward meeting future national energy needs. The GOM^2 project links scientists and engineers on a frontier problem with economic impact for Texas: the study of methane hydrates, the cleanest of hydrocarbon fuels and a potential source for natural gas. The project is the first in the United States to acquire and directly study methane hydrates in reservoirs from the deep water oceans.

UT GeoFluids is a research consortium managed by UTIG and supported by eleven energy companies. The group designs and develops safe and effective drilling programs to access energy reserves. The project's next ten year phase, which begins in 2020, will focus on technologies to improve seismic imaging and well design.

GULF OF MEXICO

UTIG USES NOVEL TECHNOLOGY TO EXTRACT PRESSURIZED ROCK CORES FROM A MILE BENEATH THE OCEAN. INSIGHTS GAINED BY STUDYING THEIR ENERGY CONCENTRATION, MECHANICAL PROPERTIES AND FLUID FLOW MAY SOON ALLOW FOR PRODUCTION IN AN ECONOMICALLY VIABLE AND ENVIRONMENTALLY SAFE MANNER. CREDIT: ANTON CAPUTO

BUILDING A NATIONAL OFFSHORE SAND INVENTORY

UTIG is working with the Bureau of Ocean Energy Management to develop an inventory of offshore sand resources in the Gulf of Mexico. Understanding the location, character and quantity of sand resources around our coastline is playing an increasingly significant role in protecting our coastal communities from erosion, sea level rise and the impact of major storms.

STUDENTS REEL IN A SEISMIC STREAMER DURING A CLASS RESEARCH PROJECT THAT STUDIED SAND RESOURCES IN THE GULF OF MEXICO IN SUPPORT OF THE INVENTORY PROJECT. CREDIT: JOHN GOFF

EXPLORING THE GULF OF MEXICO THROUGH TIME

UTIG maintains several long-standing academia-industry partnerships focused on understanding the geologic history of the Gulf of Mexico. For more than three decades, the PLATES Project has been dedicated to creating accurate, high-resolution models of tectonic plate movement. These models and associated databases are especially useful to groups engaged in hydrocarbon or mineral exploration on both regional and global scales.

The Gulf Basin Depositional Synthesis Project is an ongoing industry-supported program that seeks to understand the depositional history and framework of the Gulf of Mexico. Deliverables include a GIS database, an extensive supporting bibliography and detailed maps and cross sections that provide a comprehensive picture of Gulf-wide sedimentary history.

IN COLLABORATION WITH THE BUREAU OF ECONOMIC GEOLOGY, THE DEPARTMENT OF GEOLOGICAL SCIENCES, AND THE COCKRELL SCHOOL OF ENGINEERING, UTIG IS PARTNERING WITH THE MEXICAN INSTITUTE OF PETROLEUM TO BRING UTIG'S RESEARCH STRENGTH TO EXPLORATION IN THE SOUTHERN GULF OF MEXICO. THE PROJECT AIMS TO BOOST HYDROCARBON PRODUCTION AND FIND NEW RESERVES. CREDIT: MIKE MAREEN/ADOBE STOCK

Engaging the Next Generation of Geoscientists

UTIG's programs with Texas K–12 students and teachers ensure that pioneering geophysics work will continue for generations. UTIG's work with undergraduate students, graduate students and postdoctoral fellows helps prepare tomorrow's workforce.

MARINE GEOLOGY AND GEOPHYSICS FIELD COURSE

UTIG offers a three-week, hands-on field course for graduate and upper-level undergraduate students with instruction in the collection, processing, interpretation and presentation of marine geological and geophysical data. Alumni note the course's applicability to energy, environmental, and geotechnical industries as well as coastal restoration and management fields.

STUDENTS READY A PISTON CORER FOR OFFSHORE SEDIMENT SAMPLING NEAR GALVESTON. CREDIT: RODRIGO FERNANDEZ

GEOFORCE

UTIG houses the Jackson School of Geosciences GeoFORCE program, an experiential outreach program that prepares Texas high school students to become part of the geosciences workforce. This nationally recognized program that engages more than 640 high school students each summer.

UTIG SCIENTISTS REGULARLY PARTICIPATE IN GEOFORCE SUMMER FIELD EXCURSIONS. RESEARCHERS SHARE THEIR KNOWLEDGE OF EARTH SYSTEMS WITH YOUNG STUDENTS AT SITES THROUGHOUT THE COUNTRY. CREDIT: GEOFORCE

UT AUSTIN SCIENCE OLYMPIAD

Each year UTIG students and scientists organize and create assessments for the UT Austin Science Olympiad Invitational and Regional tournaments. The tournaments are among the largest and best known science competitions for middle and high school students in Texas, with nearly 2,000 students competing in rigorous, standards-based challenges in all STEM (science, technology, engineering, mathematics) disciplines.

MIDDLE SCHOOL STUDENTS TAKE PART IN A CRIME BUSTERS FORENSIC CHEMISTRY COMPETITION DURING A SCIENCE OLYMPIAD INVITATIONAL TOURNAMENT HELD AT UT, AUSTIN. CREDIT: SAMIKSHA RAY

What Makes Earth Shake?

UTIG scientists bring their expertise around the world to better understand how earthquakes work and identify potential hazards. They undertake several major seagoing campaigns each year during which a variety of geophysical techniques are used to examine processes associated with earthquake generation.

EXPERTISE WORLDWIDE

UTIG scientists routinely lead interdisciplinary groundbreaking research missions from research vessels, including the scientific drilling ship, JOIDES Resolution (JR). Several UTIG scientists hold leadership roles in the International Ocean Discovery Program, an international collaboration that uses ocean-going platforms, including the JR, in the study of past Earth and climate history through the retrieval of ocean floor rocks and sediments.

UTIG SCIENTISTS OFTEN WORK ABOARD THE JOIDES RESOLUTION WHICH IS PART OF THE INTERNATIONAL OCEAN DISCOVERY PROGRAM AND IS FUNDED BY THE NATIONAL SCIENCE FOUNDATION. CREDIT: BILL CRAWFORD, IODP

UNDERSTANDING THE TOHOKU-OKI EARTHQUAKE, JAPAN

UTIG is leading an international research collaboration network whose aim is to understand the processes driving earthquakes at subduction zones around the world. UTIG studies of the earthquake that struck Japan in 2011 are contributing to this highly collaborative research community that hopes to improve forecasting models of when and where such earthquakes might strike.

THE MARCH, 2011 EARTHQUAKE AND TSUNAMI OFF THE COAST OF JAPAN KILLED MORE THAN 15,000 PEOPLE. UTIG IS LEADING EFFORTS TO PROVIDE INSIGHTS ABOUT POWERFUL QUAKES. CREDIT: ROB KAYEN, PACIFIC COASTAL AND MARINE SCIENCE CENTER.

CHARACTERIZING DANGEROUS PLATE MARGINS

UTIG scientists are working in an international collaboration on a multi-year, multi-platform study of the New Zealand tectonic plate boundary—a major boundary that generates destructive volcanoes, earthquakes and tsunamis. The team will evaluate the geometry, movement and deep structure of the region. The study will help characterize convergent plate boundaries and the risks they pose to citizens around the world.

OCEAN BOTTOM SEISMOMETERS AWAIT DEPLOYMENT ON THE DECK OF A RESEARCH VESSEL NEAR NORTHEAST NEW ZEALAND. THE INSTRUMENTS AID UTIG SCIENTISTS IN UNDERSTANDING EARTH'S CRUSTAL STRUCTURE. CREDIT: HARM VAN AVENDONK

Understanding Climate: Past, Present, Future

UTIG scientists investigate Earth's climate change on timescales from seasons to millennia. With a focus on key regions such as monsoon belts and the polar oceans, and phenomenon such as El Niño, researchers can attribute change to natural or man-made factors as well as predict their future evolution.

PREDICTING EL NIÑO AND LA NIÑA

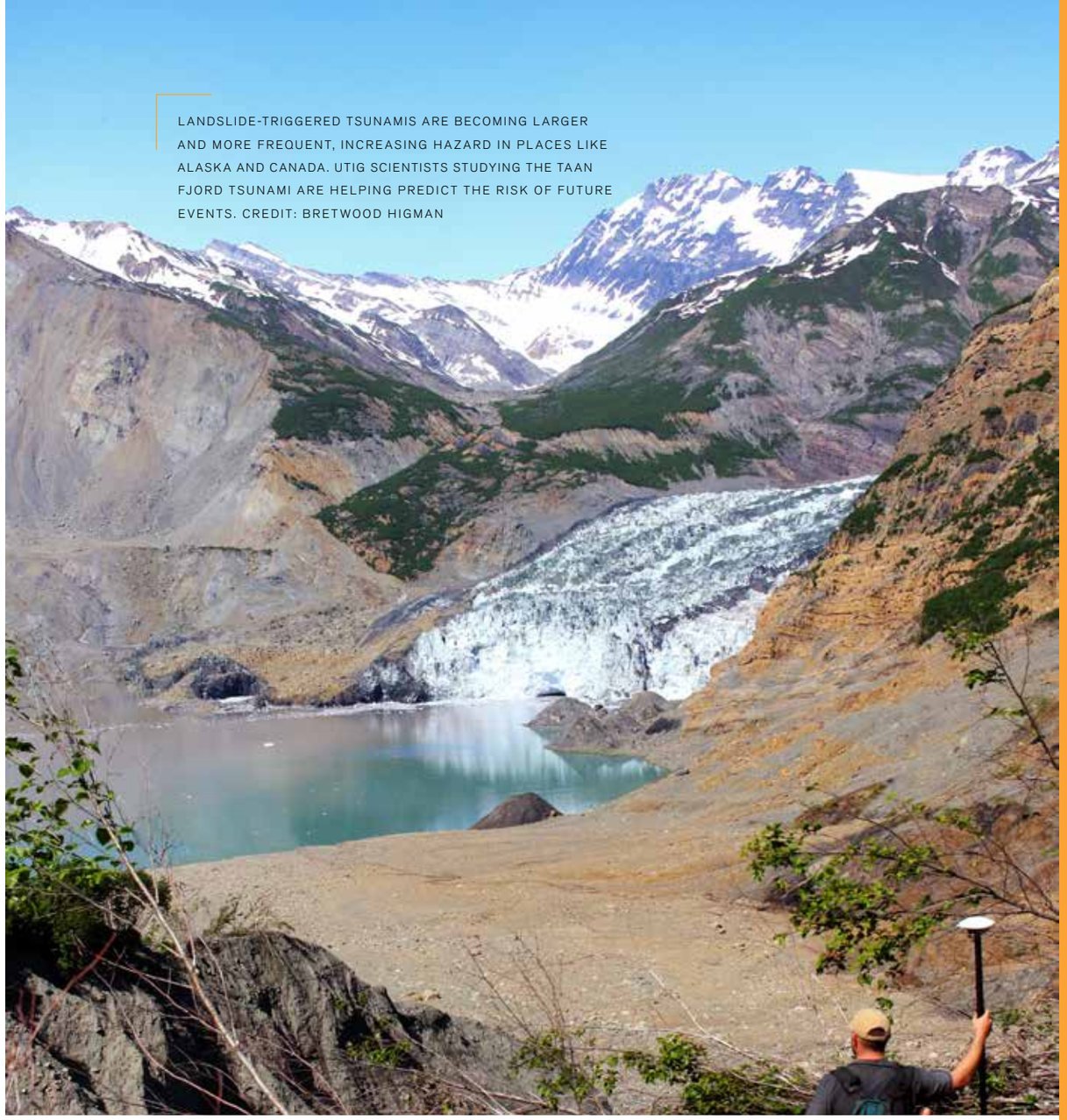
Climate scientists at UTIG have significantly improved our ability to predict drought over North America caused by La Niña—a cooling pattern in the tropical Pacific. By studying La Niña's historical records and combining them with computer models, UTIG scientist discovered subtle differences in ocean signals that helped them successfully predict the duration of the La Niña event during the winters of 2017 and 2018.

LA NIÑA MAY CAUSE DROUGHTS IN THE SOUTHERN UNITED STATES, INCLUDING PARTS OF TEXAS. UTIG RESEARCH IS HELPING PREDICT THE STRENGTH AND DURATION OF SUCH CLIMATE EVENTS. CREDIT: BOB NICHOLS, USDA

BENCHMARKING CLIMATE CHANGE PREDICTIONS

UTIG climate scientists refine their theories of future climate change by contrasting them with records of past climate changes stored in geological archives. Their research is transforming our ability to anticipate extreme climatic events that have not yet been observed, but could become the norm in the future.

UTIG SCIENTISTS STUDY FOSSIL CORALS SUCH AS THESE IN VANUATU IN THE SOUTHWEST PACIFIC TO UNCOVER NEW FEATURES OF OUR CHANGING CLIMATE. CREDIT: JUD PARTIN.



LANDSLIDE-TRIGGERED TSUNAMIS ARE BECOMING LARGER AND MORE FREQUENT, INCREASING HAZARD IN PLACES LIKE ALASKA AND CANADA. UTIG SCIENTISTS STUDYING THE TAAN FJORD TSUNAMI ARE HELPING PREDICT THE RISK OF FUTURE EVENTS. CREDIT: BRETWOOD HIGMAN

LANDSLIDE-TRIGGERED TSUNAMIS

UTIG scientists found that a 2015 landslide-triggered tsunami in Taan Fjord, southeast Alaska, was three times taller than the earthquake-triggered tsunamis that razed parts of Indonesia, Sri Lanka, India, and Thailand in 2004 and nearly four times taller than the 2011 Japanese tsunami that damaged the Fukushima nuclear plant in Japan. The study's findings will help predict the risk of landslide-triggered tsunamis around the world, particularly in higher latitude regions where a warming climate melts glaciers that stabilize mountain slopes.

TAAN FJORD, ALASKA

UNDERSTANDING ICE-OCEAN INTERACTIONS IN WEST GREENLAND

UTIG is part of an interdisciplinary, multi-institutional team of geophysicists, geologists, glaciologists and oceanographers who are working to understand how marine-terminating glaciers in Greenland respond to climate. Detailed maps of submarine glacier faces and associated fjords, oceanographic measurements, satellite-based observations, and models help build a comprehensive understanding of the potential impact on sea level and changes to large-scale ocean circulation as the climate warms.

WEST GREENLAND

A UTIG SCIENTIST INSTALLS A PRESSURE SENSOR DURING A STUDY TO UNDERSTAND THE PATH OF SURFACE WATER TO THE BOTTOM OF THE GLACIER WHERE IT CAUSES SLIDING ON A VARIETY OF TIMESCALES, PARTICULARLY IN THE MARINE-TERMINATING GLACIERS OF WEST GREENLAND. CREDIT: JASON GULLEY

UTIG SCIENTISTS ARE USING AN AIRBORNE ICE-PENETRATING RADAR ARRAY TO CREATE A DETAILED MAP OF EAST ANTARCTICA ICE SHEETS AND WHAT LIES BENEATH THEM. CREDIT: LUCAS BEEM

ANTARCTICA: TRACKING A NEW GLOBAL THREAT

UTIG is part of an international collaboration to study ice-buried lowland basins in East Antarctica which hold enough ice to raise global sea levels at least 3.5 meters (about 10–13 feet). To better understand how these ice sheets are evolving, scientists are using airborne ice-penetrating radar arrays and ice core drilling to aid in evaluating both the topography and interior of the ice covering these lowlands. This novel approach will help computer modelers improve their simulations of the past and future Antarctic ice sheet and its potential impact on global sea level.

JANG BOGO STATION, ANTARCTICA

Exploring Other Worlds

UTIG scientists are building the scientific and technical foundations to lead the next generation of geophysical planetary missions, instruments, and discoveries. UTIG researchers study planetary systems via the tools of terrestrial analog field programs, geophysical modeling, and mission science. UTIG specializes in research related to Mars, icy satellites, and giant planets.

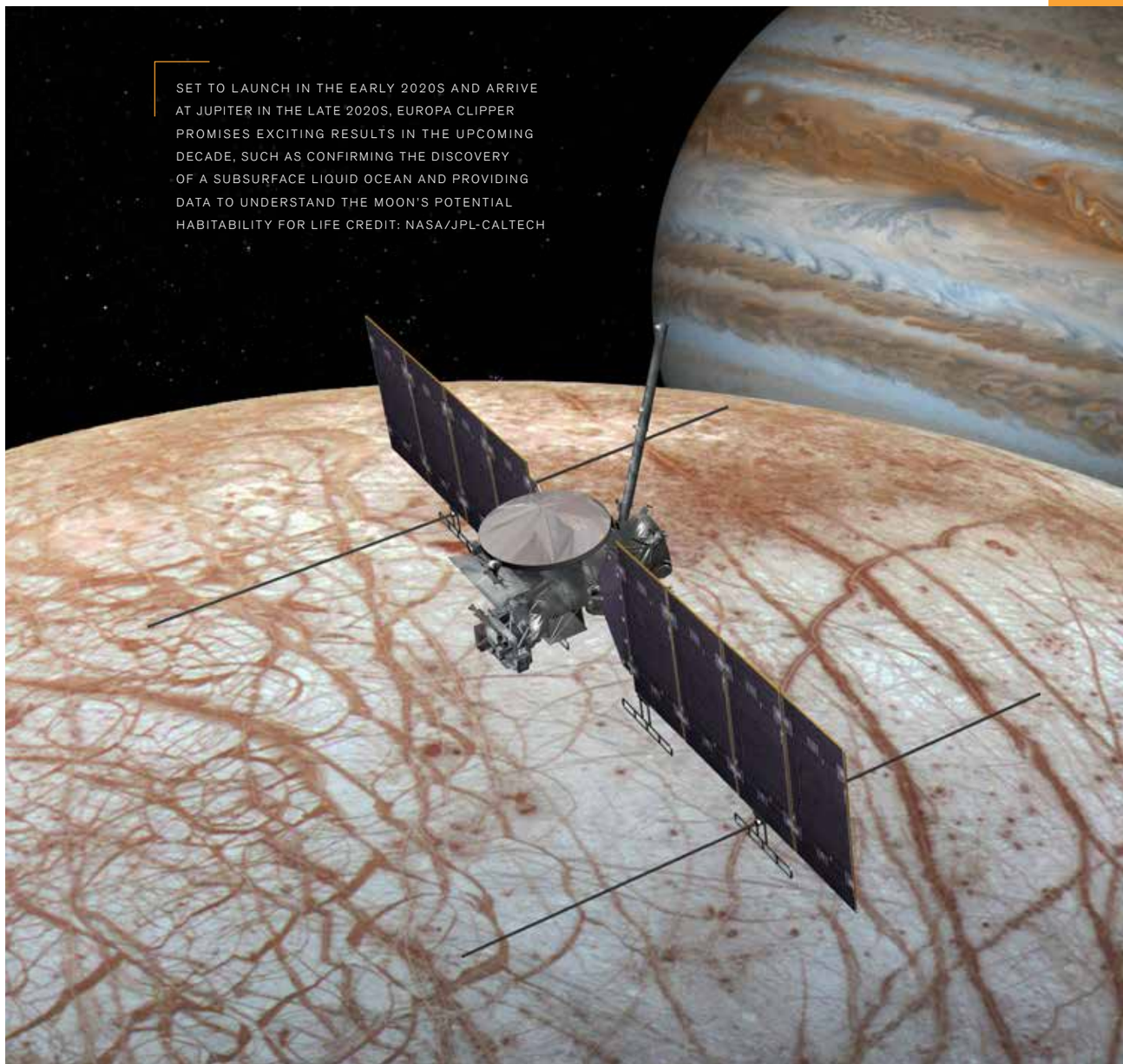
BULLSEYE ON WATER ICE

UTIG researchers prospect for glacial ice hidden beneath rock and soil on Mars. Future human explorers will need access to near-surface water supplies. Warm, wet oases like those on Mars are not just a potential resource for future explorers, but may be the kinds of habitable zones that have supported past Martian life.

CONCENTRIC RINGS MARK THE SITE WHERE VOLCANIC HEAT MAY HAVE MELTED OR EVAPORATED GLACIER ICE NEAR THE MARS SURFACE, SIMILAR TO THE WAY VOLCANOES MELT OUT GIANT PITS CALLED "CAULDRONS" IN ICELAND. THIS CAULDRON IS ABOUT 2.5 KM (1.6 MI) WIDE. CREDIT: JOSEPH LEVY/NASA/UNIVERSITY OF ARIZONA

SEARCHING OUR SOLAR SYSTEM TO FIND POTENTIAL HABITATS FOR LIFE

Scientists from UTIG are working with NASA on the Europa Clipper mission to explore whether Jupiter's icy moon Europa could harbor conditions suitable for life. The Radar for Europa Assessment and Sounding: Ocean to Near-surface (REASON) instrument on Europa Clipper will revolutionize our understanding of Europa's ice shell by providing the first direct measurements of its subsurface structure using techniques developed at UTIG to study ice sheets on Earth. REASON continues Texas's long history of leading space exploration efforts.



SET TO LAUNCH IN THE EARLY 2020S AND ARRIVE AT JUPITER IN THE LATE 2020S, EUROPA CLIPPER PROMISES EXCITING RESULTS IN THE UPCOMING DECADE, SUCH AS CONFIRMING THE DISCOVERY OF A SUBSURFACE LIQUID OCEAN AND PROVIDING DATA TO UNDERSTAND THE MOON'S POTENTIAL HABITABILITY FOR LIFE CREDIT: NASA/JPL-CALTECH

PLANETARY

TEXAS Geosciences

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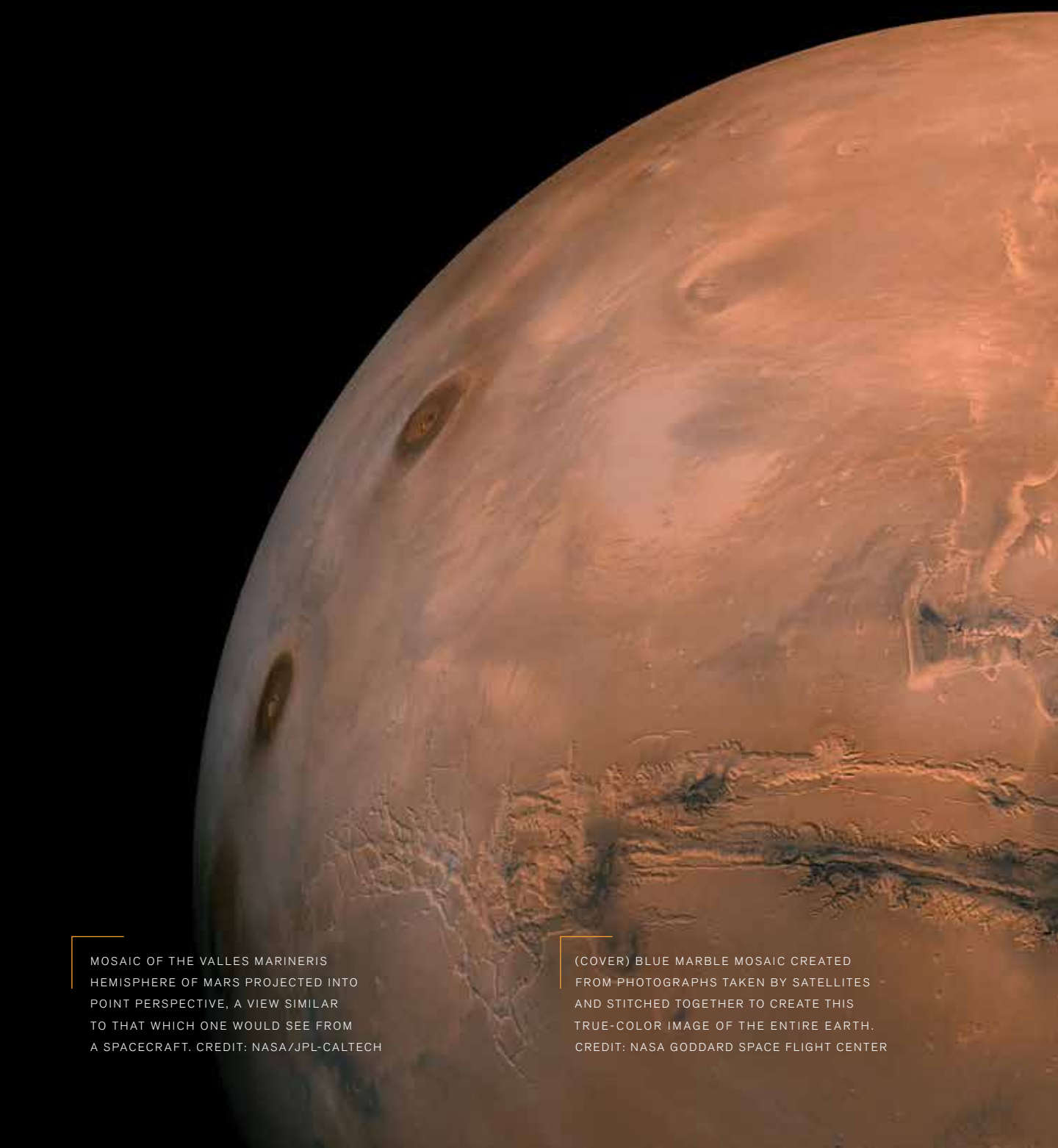

MOSAIC OF THE VALLES MARINERIS HEMISPHERE OF MARS PROJECTED INTO POINT PERSPECTIVE, A VIEW SIMILAR TO THAT WHICH ONE WOULD SEE FROM A SPACECRAFT. CREDIT: NASA/JPL-CALTECH

(COVER) BLUE MARBLE MOSAIC CREATED FROM PHOTOGRAPHS TAKEN BY SATELLITES AND STITCHED TOGETHER TO CREATE THIS TRUE-COLOR IMAGE OF THE ENTIRE EARTH. CREDIT: NASA GODDARD SPACE FLIGHT CENTER