JPL

Jet Propulsion Laboratory

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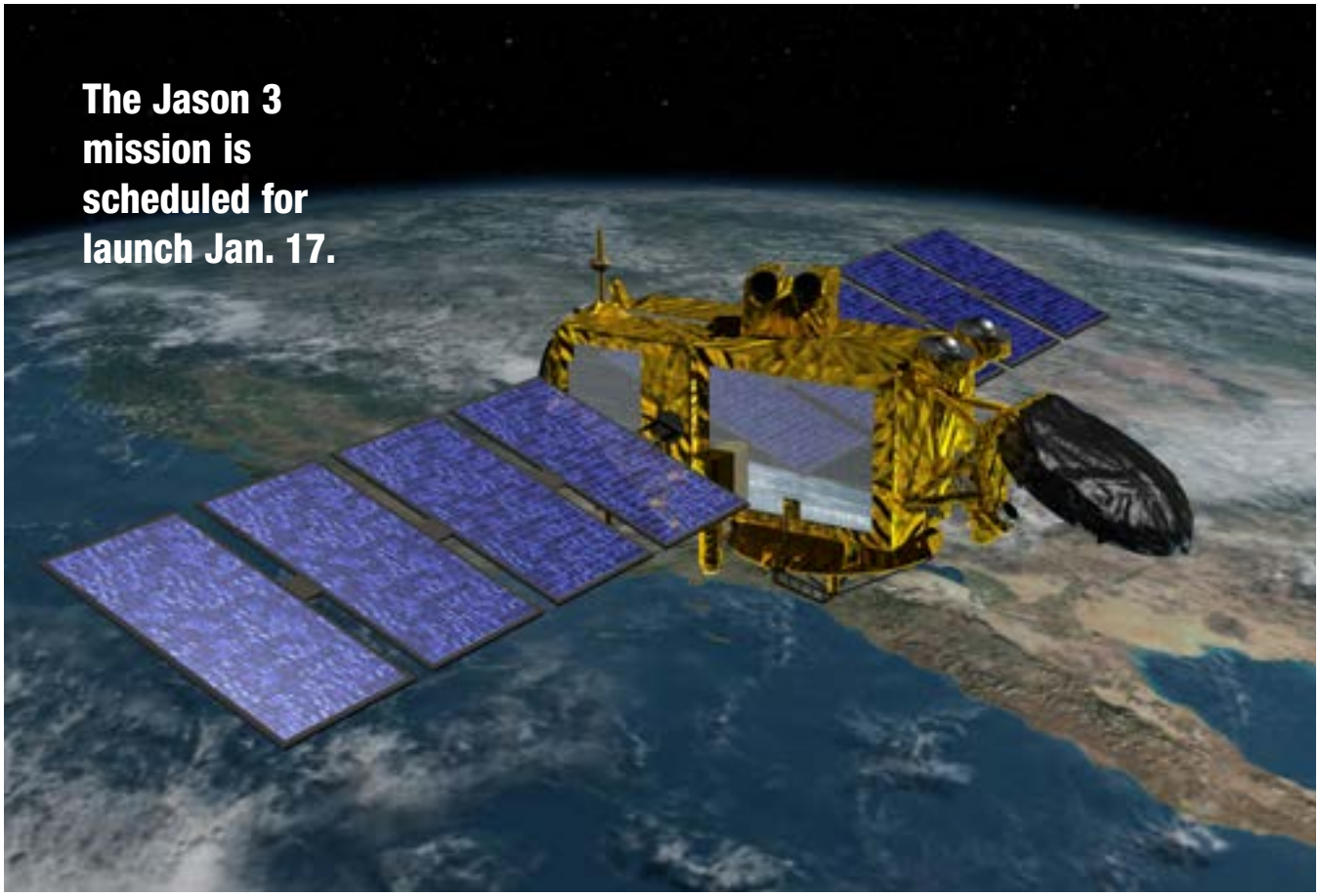
What to expect in 2016



The Jason 3 mission is scheduled for launch Jan. 17.

With almost 40 missions or major spacecraft instruments in flight under JPL's control, two launches to Earth orbit this year will add to the Lab's busy portfolio.

The first launch, Jason 3, will continue a critical series of surveys on sea-surface heights begun in 1992 (please see the article on page 4). Also going skyward will be a demonstration of a new ultra-precise clock for deep-space navigation.

Following are some highlights of what's coming up in 2016.

MARS

The Curiosity rover will continue reading chapters of Mars' environmental history by investigating layers of Mount Sharp in 2016, once it completes an unprecedented close-up study of active sand dunes along its route. Curiosity's prime mission

Continued on page 2

2016 LOOK FORWARD *Continued from page 1*

established that ancient Mars offered wet environmental conditions with all the basic requirements for supporting microbial life. The current extended mission is examining how those conditions changed.

As the Opportunity rover passes the 12th anniversary of its landing, and for several months ahead, it will be examining outcrops in "Marathon Valley." Here, clay-mineral deposits have been mapped from orbit, and the rover's work is deciphering the geological context for those water-related clues.

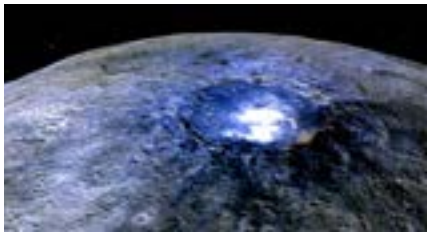
Mars Reconnaissance Orbiter, which in March will mark 10 years at the Red Planet, will continue to examine candidate landing sites for future robotic and crewed missions. It is also continuing research into how Mars has changed over time.

The Odyssey orbiter, the longevity champion of all Mars missions, will note the 15th anniversaries of its launch on April 7 and of its Mars arrival on Oct. 24. A focus for 2016 will be observing Mars during early morning daylight hours.

Preparations for future studies of Mars will keep many JPLers busy this year. The InSight mission's plans for a 2016 launch were suspended in December 2015 due to further work needed on its key instrument.

InSight will be returned from Vandenberg Air Force Base to spacecraft builder Lockheed Martin's facility in Denver. The next period of planetary positions favorable for a launch from Earth to Mars will be in spring 2018.

For NASA's 2020 Mars rover mission, JPL is building the spacecraft and three instruments.

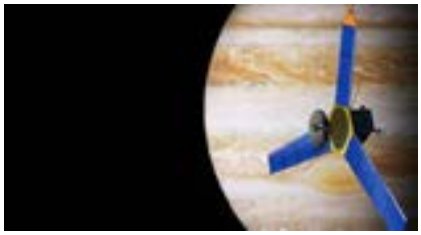


DAWN

The Dawn spacecraft is in its fourth and final science orbit at dwarf planet Ceres. Of particular interest during this low-altitude mapping orbit is Occator crater, home to Ceres' bright spots.

As in the higher orbits, Dawn will scrutinize Ceres with all of its scientific instruments. The camera and visible and infrared mapping spectrometer will reveal greater detail than ever before on the appearance and the mineralogical composition of the strange landscape.

Dawn is the first mission to visit a dwarf planet, and the first mission outside the Earth-moon system to orbit two distinct solar system targets. It orbited protoplanet Vesta for 14 months in 2011 and 2012, and arrived at Ceres on March 6, 2015. Dawn's prime mission is scheduled to end in June.



JUNO

The Juno spacecraft will arrive at Jupiter July 4, almost five years after launch. The Discovery mission's primary goal is a better understanding of the planet's formation and evolution. From an elliptical polar orbit, Juno will observe Jupiter's gravity and magnetic fields as well as atmospheric dynamics and composition. Juno will achieve the first-ever look below Jupiter's dense cover of clouds to answer questions about the gas giant and the origins of our solar system.

Amateur astronomers will serve as a virtual imaging team by identifying features of interest from Juno's color camera, JunoCam. The mission has kicked off the first stage of JunoCam activity with the launch of a new Web platform at https://www.missionjuno.swri.edu/junocam.

Juno is slated to complete 37 orbits of Jupiter during its 20-month orbital period, which will be followed by a deorbit into Jupiter to end the mission in 2018.

DEEP SPACE ATOMIC CLOCK

The project will fly and validate a miniaturized, ultra-precise, mercury-ion atomic clock that is orders of magnitude more stable than today's best navigation clocks, revolutioning the way deep-space navigation is conducted.

JPL is completing development of a demonstration unit and payload to operate for at least a year to validate its functionality and utility for one-way-based navigation. In February the payload will begin integration to an orbital testbed, with launch to Earth orbit scheduled for September. Surrey Satellite Technologies of Englewood, Colo. is providing the spacecraft.

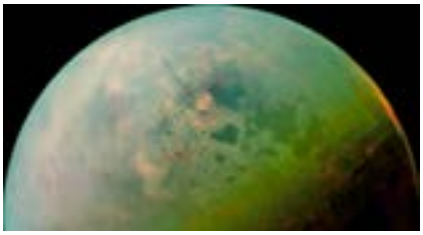
Continued on page 3

CORAL

The COral Reef Airborne Laboratory will work to provide critical data and new models to analyze the status of coral reefs and to predict their future.

Acquiring spectral image data via the Portable Remote Imaging Spectrometer instrument installed in a commercial Gulfstream-IV plane, the mission will provide the most extensive picture to date of the condition of a large portion of the world's coral reefs.

CORAL science will focus on key reef areas in the Pacific Ocean: Hawaii, the Mariana Islands, Palau and the Great Barrier Reef. Data acquisition is currently planned for 2016-17, with science analysis in following years.



CASSINI

In 2016 Cassini will check off a number of "lasts" in its long-term study of Saturn's largest moon, Titan, including the final opportunities to probe Titan's interior using gravity science, look for sparkling reflections caused by wind and waves, and bounce a radio signal off the frozen surface to learn about its properties.

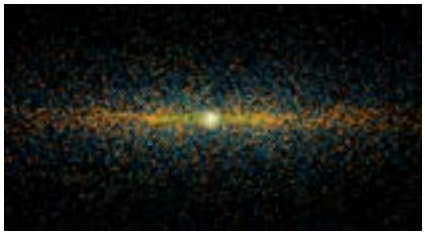
On Nov. 30, from a a highly inclined orbit, Cassini will begin its F-ring orbits, where the spacecraft will repeatedly pass very close to the outer edge of the main rings. The team expects some spectacular views and new insights about the rings.

Cassini will execute its closest flyby of the small moon Pandora (altitude 9,000 miles) Dec. 18.

ASTROPHYSICS

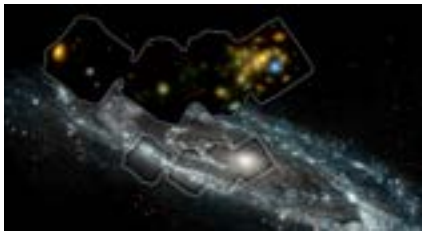
JPL's missions outside of the solar system have busy campaigns in 2016.

Using the repurposed Wide-field Infrared Survey Explorer spacecraft,



NEOWISE continues its hunt for asteroids and comets. NEOWISE has measured the size and brightness of about 20 percent of the known asteroid population.

A JPL-led Discovery-class proposal for a new asteroid-hunting spacecraft, the Near-Earth Object Camera (NEOCam), has been funded for further study by NASA.



With its X-ray vision, NuSTAR recently captured the best high-energy X-ray view yet of a portion of our nearest large, neighboring galaxy, Andromeda.

The JPL-developed Kepler mission has an active schedule coming up after having confirmed 1,030 exoplanets to date. Kepler has now discovered more than 100 of the extrasolar bodies during its K2 mission, which revived the spacecraft from a technical malfunction in 2013.

The Spitzer Space Telescope can help narrow down the sizes of exoplanets too, and in 2015 confirmed the closest known rocky planet to Earth, HD 219134b. The infrared observatory also worked in tandem with the Hubble Space Telescope in finding the faintest

object ever seen in the early universe, about 400 million years after the Big Bang, 13.8 billion years ago.

The optical module of the James Webb Space Telescope's Mid-Infrared Instrument, or MIRI, is undergoing testing at Goddard Space Flight Center as part of the integrated science instrument module's final cryogenic performance test. The module will be mated with the optical telescope element later this year. The instrument's cooling subsystem has entered its final performance testing as part of acceptance test program at JPL. In August, major components of the cooler will unite with the spacecraft, now being assembled at Northrop Grumman Aerospace Systems in Redondo Beach, Calif.

Looking to the future, JPL is working with Goddard Space Flight Center on Wide-Field Infrared Survey Telescope-Astrophysics Focused Telescope Asset (WFIRST-AFTA), a NASA observatory designed to settle essential questions in both exoplanet and dark energy research. JPL's role includes developing a telescope and coronagraph for the mission. JPL is also conducting technology-development research for a starshade that could be used for exoplanet studies.

Smooth transition

By Mark Whalen

Jason 3 will continue surveys that have revolutionized climate science

With scientists' projections of a major El Niño event drenching the southern half of North America already coming true, the timing for the launch of JPL's Jason 3 mission couldn't be better.

Jason 3's predecessor, Jason 2, designed for a five-year mission to track sea-level rise, ocean circulation and climate change—as well as data on such climate phenomena as El Niño and La Niña—has delivered solid service for seven-plus years.

But Jason 2 isn't done just yet. The mission recently provided a new image that appears very similar to one from December 1997 by Topex/Poseidon, during the last large El Niño event.

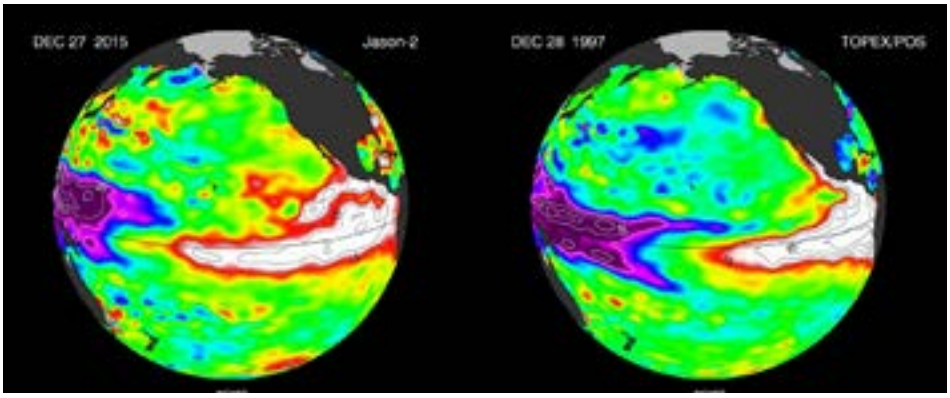
To kick off the next stage of ocean topography surveys, Jasons 2 and 3 will fly in tandem during a six-month calibration phase, said Jason 3 Project Scientist Josh Willis.

"We did this same kind of mission between Topex/Poseidon and Jason 1, and between Jason 1 and 2," said Willis. "Our ability to do this is why we have an unbroken record of data going all the way back to 1992, which has revolutionized how we do oceanography and climate science."

With possibly the biggest El Niño of the past 50 years on its way, Willis is expecting to continue measuring the event's evolution with Jason 3. "This one started at the beginning of 2015—winter and then spring—and really took off over the last three or four months," he said. "It will continue until March or April 2016."

Although the sea-surface height signal in 1997 was more intense and peaked in November of that year, in 2015, the area of high sea levels is larger. "This could mean we have not yet seen the peak of this El Niño in the Pacific," added Willis. "This El Niño is interesting because it causes such extremes in sea level, and in rainfall in some places, and storm patterns change all over the planet. This variety of conditions is good for cross-calibrating the two missions."

Beyond El Niño, Jason 3 will continue providing critical data on the impacts of climate change.



Images of El Nino storms taken in December 2015 by Jason 2 and in 1997 by TOPEX/Poseidon look strikingly similar.

"We live in a time of global warming and a climate that's changing in new ways every decade," said Willis. "The successive missions are each looking at a new climate. They give us, one mission after the next, an additional five years of the climate record. The climate we live in today is significantly different than in 1992, when we launched Topex."

One of the simplest but most important measurements Jason 3 will make is how high the ocean is.

"The oceans cover two-thirds of our planet, and measuring their height tells us how currents are changing—when there's a current in the ocean, it tilts the surface," said Willis. "These satellites are designed to measure that tilt."

In addition, warmer water also stands taller. "When El Niño causes warming in the eastern Pacific, we see that as about one foot of extra sea-level rise there," added Willis. "Water expands when it warms up, causing sea levels to rise. But the oceans are also getting bigger because the ice is melting and adding extra water to them.

"Our satellites measure global sea-level rise more accurately than any other observing system in the world," he said. "And that is a yardstick for climate change."

Jason 3 is scheduled for liftoff from Vandenberg Air Force Base aboard a SpaceX Falcon 9 rocket Sunday, Jan. 17 at 10:42 a.m. PST, at the opening of a 30-second launch window. If needed, a backup launch opportunity is available at 10:41 a.m. PST on Jan. 18.

Jason-3 is a four-agency international partnership consisting of the National Oceanic and Atmospheric Administration, NASA, France's space agency (Centre national d'études spatiales) and the European Organization for the Exploitation of Meteorological Satellites. JPL provides NASA project management, three instruments and instrument mission operations. Thales Alenia Space of France built the spacecraft. The mission is planned to last at least three years, with a goal of five years.

Launch coverage and prelaunch briefings will be available at http://www.nasa.gov/nasatv.

News Briefs

Theisinger honored for leadership


Pete Theisinger

Peter Theisinger, former project manager for the Mars Exploration Rovers and Mars Science Laboratory missions and former Engineering and Science Director, has been selected to receive the American Astronautical Society's Space Technology Award for 2015.

Theisinger was cited "for leadership in advancing the United States' planetary exploration capabilities, including its continuously evolving spacecraft reaching planetary bodies and roving across their surfaces; in the process directly enhancing human knowledge of both the solar system and Mars in particular."

The Space Technology Award, established last year to recognize outstanding achievements in space technology, will be presented in March at an organization symposium.

Public engagement kudos to Willis


Josh Willis

Josh Willis, project scientist for the upcoming Jason 3 ocean-surface topography mission, has been appointed a Public Engagement Fellow of the American Association for the Advancement of Science.

Willis is one of 15 climate-change researchers nationwide chosen for the honor. The fellows will convene in June 2016 at AAAS headquarters in Washington for public engagement and science communication training, networking and plan development.

Willis is also the principal investigator for the Oceans Melting Greenland airborne campaign that in 2016 will observe changing water temperatures on the continental shelf surrounding Greenland.

Long involved in public engagement, Willis in 2014 co-wrote, produced and starred in a sketch comedy for kids about climate change called The Lollygaggers.

Earth-observation honors for Reager

JPL research scientist JT Reager has been selected by the National Oceanic and Atmospheric Administration as winner of the David Johnson Award for outstanding innovative use of Earth observation satellite data.

Reager, who joined JPL in 2014 and works in the Surface Hydrology Group, was nominated based on his pioneering use of Gravity Recovery and Climate Experiment (GRACE) data to better characterize the hydrologic extremes of flooding and drought.


JT Reager

The award, honoring NOAA's first administrator, is given to young professionals who have developed an innovative application of Earth observation satellite data that is, or could be, used for operational purposes to assess and/or predict atmospheric, oceanic or terrestrial conditions.

French early-career award to Chahat


Nacer Chahat

Nacer Chahat of the Spacecraft Antennas Group was recently awarded a French early-career award for scientists and engineers. The "Prix Bretagne Jeune Chercheur" rewards researchers in the early stages of their careers for outstanding contributions in their fields.

Chahat, who joined JPL in 2013, was also recently elected as a senior member of the Institute of Electrical and Electronics Engineers' Antenna and Propagation Society.

Ridesharing efforts paying off

JPL has received a certificate of appreciation from the South Coast Air Quality Management District for achieving an average vehicle ridership of 1.57 persons, which exceeds the target of 1.50 for the area.

The Laboratory was also recognized by the Los Angeles County Metropolitan Transportation Authority with a Diamond Award for being one of the employers in the county to meet its assigned average vehicle ridership goal. It's the sixth Diamond Award won by JPL in either the Employer or Individual categories.

Retirees

The following employee retired in November:
Andres Huertas, 13 years, Section 347J.

Letters

Many thanks to my co-workers and friends for the kind and generous outreach upon the passing of my father. Your words brought me much peace in this time of loss. My dad was always so proud that both myself and Steve work at JPL, and I too am proud to call this amazing place my work home. Thank you all again for your compassion.
Deborah Watson

My brother and I would like to thank our co-workers and the JPL community for their support over the last several months during the illness and subsequent passing our mother, Bonnie D. Storms. The condolences and lovely plants have brought us comfort and are greatly appreciated.
Laura Thompson and James Storms

Classifieds

Ads submitted Dec. 19–31. To submit an ad, e-mail *universe@jpl.*nasa.gov.

For Sale

BIKES: mountain bike, custom built unique giant prototype, Shimano 3 x 10 drive train with Deore LX and XT components, BB7 mechanical discs & Suntour wheels, Rock shox Monarch for rear shock and Dart II for front, green, great condition, $600; pistachio green beach cruiser, big saddle, fenders and girly style decals, brand-new tires, like new; $75; purple 21 speed 3 x 7 with twisting handle grips that shift, tires like new, great condition. $85. 626-399-7817.

SCUBA equipment: all in excellent condition; Scubapro MK25/s550 BC, Scubapro Ultra Console w/ compass, Aqualung regulator bag, Scubapro Razor fins, wet suit vest w/hood sz. XL, 2 dive bags, weights, Nikon Coolpix L5 dive camera w/waterproof case, misc. other items. 626-303-6317.

MISC.: Schwinn men's hybrid bike, bought by mistake, never used, brand new, white 18 inch, lifetime warranty through manufacturer, lightweight tubing model S4026B, $175/obo; LG washer dryer, red, HE energy saver, like new, only used randomly for 2 years; $800 for both. 626-354-4176.

Vehicles / Accessories

'09 HARLEY-DAVIDSON Street Glide touring bike, low mileage (5,000), Screaming Eagle pipes, customized seat, saddlebags, fairing with LED lights across front, custom paint, flat black and beautiful; financing if you need it. $15,500. 626-482-1444.

Wanted

SPACE INFO/memorabilia from U.S. & other countries, past & present, for personal use (see http://www.youtube.com/watch?v=S7PvjGp7mCU). mrayman@alumni.princeton.edu, 818-790-8523, Marc Rayman.

For Rent

LA CRESCENTA, 3 bedrm., 1.5 bath, mountain-view house above Foothill Blvd.; living rm. w/fireplace, walk-in closets in all 3 bedrms, formal dining rm., remodeled kitchen w/granite countertop, stainless steel sink & brand-name appliances, breakfast nook in kitchen, brand-new bathroom w/ granite countertop & 2 side mirrors, laundry rm. w/ hook-ups, 2-car detached garage, front and fenced backyard, brand-new copper pipes, drainage syst. & electrical wires, ~1,400 sq. ft.; exc. blue ribbon school district, walking dist. to elementary, high school, library and shops; no pets; $2,700/mo + $2,700 deposit. Text 818-636-1727 or yuehsinc@gmail.com.

PASADENA townhouse, 2 bedrooms, 1.5 baths, master walk-in closet, 2-car garage, new washer/dryer in unit, stainless steel appliances, central air/heat; walking distance to PCC, Caltech, Gold Line, Rose Parade route; 6 miles to JPL, minutes to 210 freeway; water and trash included; available mid-January; $2,100/month + security deposit, one-year lease. 626-429-6096, glor1an@aol.com.

PASADENA, two furnished rooms in a lovely 4-bd./2-bath house, big backyard, hardwood floor, big closet, shared bathroom, kitchen and laundry privileges; 2 miles to JPL, close to public transportation; short- or long-term lease available; must like dogs and be very clean; $800 and $850 + $800 deposit. 818-960-8654.

Vacation Rentals

BIG BEAR lakefront, luxury townhome, 2 decks, tennis, pool/spa, beautiful master bedrm. suite. 949-786-6548.

JACKSON HOLE, WY: Luxurious bed and breakfast on 3 acres of solitude on Snake River near Jackson Hole Mountain Resort and south entrance to Grand Teton Natl. Park; see http://www.bentwoodinn.com/; mention JPL for discount. info@bentwoodinn.com, 307-739-1411.

MAMMOTH, Snowcreek, 2 bd., 2 ba. + loft, sleeps 6-8, fully equip'd kitchen incl. microwave, D/W, cable TV, VCR, phone, balcony w/mtn. vw., Jacz., sauna, streams, fishponds, close to Mammoth Creek, JPL discount, no pets. 626-798-9222, 626-794-0455 or valeriee@caltech.edu.

MAMMOTH, Snowcreek, beautiful updated condo, 2 bd., 2 ba. + loft (sleeps 6-8), great location by pond/meadow, new appliances, TVs, DVD players, free wireless Internet and washer/dryer, no pets. 818-952-2696 or BigMtnPrettySky@gmail.com.

MAMMOTH, remodeled 2 bed/2 bath + loft, short walk to Canyon Lodge; Courchevel 6 features full kitchen, cable and Internet TV, DVD & Blu-Ray, wireless high-speed Internet, 2-car garage, Jacuzzis, summertime grill and pool; no pets. http://Courchevel6.com.

OCEANSIDE condo, on the sand, watch the beautiful sunsets, charming, 1 bedroom, panoramic view, walk to pier or harbor, pool/spa, game room, sleeps 4 max, all amenities. 949-786-6548.

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Universe

Editor
Mark Whalen

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