

The summit area is managed by the Office of Mauna Kea Management of the University of Hawaii. Rangers patrol the summit area for conservation purposes and to assist visitors with problems. The larger conservation area surrounding the summit is managed by the Department of Land and Natural Resources of the State of Hawaii.

Each of the telescopes has a sublease from the University of Hawaii. The University of Hawaii has leased the Mauna Kea Science Reserve from the State of Hawaii. The lease expires in 2031.

Case Study 16.5: Canarian Observatories, Spain

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Presentation and analysis of the site

Geographical position: ORM: on the edge of the Caldera de Taburiente National Park, island of La Palma, Canary Islands, Spain. OT: close to the Teide National Park, island of Tenerife, Canary Islands, Spain.

Location: ORM: Latitude 28° 46′ N, longitude 17° 53′ W. Elevation 2396m above mean sea level. OT: Latitude 28° 18′ N, longitude 16° 30′ W. Elevation 2390m above mean sea level.

General description: The two observatories of the Instituto de Astrofísica de Canarias (IAC)—the Roque de los Muchachos Observatory (ORM) on the island of La Palma and the Teide Observatory (OT) on the island of Tenerife—constitute an ‘astronomy reserve’ that has been made available to the international community. The Canary Islands’ sky quality for astronomical observation has long been recognised worldwide. They are near to the equator yet out of the reach of tropical storms. The whole of the Northern Celestial Hemisphere and part of the Southern can be observed from them. The observatories are located 2400 m above sea level, above the temperature-inversion layer produced by the trade winds. This ensures that the installations are always above the so-called ‘sea of clouds’, where the atmosphere, stabilised by the ocean, is clean and turbulence-free.

Inventory: The two observatories currently house telescopes and other instruments belonging to 60 scientific institutions from 19 different countries, together with the scientific and technological resources of the IAC’s Instituto de Astrofísica at La Laguna (Tenerife) and Centro de Astrofísica en La Palma (CALP) at Breña Baja (La Palma). The main telescopes are:

ORM: 10.4m Gran Telescopio CANARIAS (GTC), 4.2m William Herschel Telescope (WHT), 3.5m Telescopio Nazionale GALILEO, 2.56m Nordic Optical Telescope (NOT), 2.5m Isaac Newton Telescope (INT), 2m Liverpool Telescope, 1.2m MERCATOR, 0.45m Dutch Open Telescope (DOT), 1m Solar Telescope (SST), MAGIC I and II (which detect very-high-energy gamma rays), SuperWASP-North (robotic observatory).

OT: 1.55m CARLOS SÁNCHEZ, 1m OGS, 0.8m IAC-80, 0.5m MONS, 0.4m OTA, 1.5 GREGOR (Solar), 0.9m THEMIS (Solar), 0.7m VTT (Solar), 0.3m Bradford Robotic Telescope, 1.2m Robotic telescopes STELLA.

History of the site: As far back as 1856, the Astronomer Royal for Scotland, Charles Piazzi Smyth, conducted astronomical experiments on the mountain summits of the island of Tenerife.



Fig. 16.5.1. The Gran Telescopio Canarias (GTC). Photograph © Pablo Bonet

Cultural and symbolic dimension: The ensemble of observatories on the Canary Islands has played an important role in astronomy, being the place where, for example, the optical counterpart of a Gamma Ray Burst was first observed, the first unequivocal evidence for a stellar-sized black hole in the Galaxy was obtained (something that had been sought for decades), and the first brown dwarf was discovered. The GTC, at present the largest optical and infrared telescope in the world, will ‘see’ the farthest and faintest objects in our Universe, and will help provide answers to many questions about how the known universe was created.

The Canarian observatories form part of a single set of sites in the world with exceptional conditions for observing the Universe. These sites, including their natural and cultural components, are exceptional ‘windows of science and knowledge’.

The Teide mountain is world-renowned for its contribution to science in modern times, especially in the field of geology and the study of the atmosphere. The Teide National Park was inscribed on the World Heritage List in 2007 under natural criteria (vii) and (viii). Its

connection with science is evident: “...the area is a major centre for international research with a long history of influence on geology and geomorphology especially through the work of von Humboldt, von Buch and Lyell, which has made Mount Teide a significant site in the history of volcanology”. Pioneering atmospheric observations were also carried out in this area. Within this context, it seems logical to consider a possible application of cultural criteria in the light of its astronomical values and significance.

Present site management

Present use: The observatory is the site of the telescopes listed above.

Both observatories have, for decades, carried out intensive activity in the dissemination and interpretation of astronomy. Over 30,000 tourists every year visit the Teide National Park at night to see the stars. The ORM receives about 5000 visitors annually. La Palma is now firmly established as a starlight tourist destination.

Protection: The whole area where each observatory is located enjoys a high level of protection. Each of the observatories is located within a European Special Area for Conservation, and lies at the edge of a National Park (see also below).

The astronomical quality of the Canary Islands’ observatories is guaranteed under a specific national ‘Sky Law’ (‘Ley del Cielo’—Law 31/1988) approved in 1988.

Relying upon this regulatory development, a high-sensitivity ‘core area’ has been established around the ORM, extending 9 km in each direction. The rest of the island of La Palma (25 km around the Observatory) is considered a high-protection buffer zone, while the external zone is the area visible from La Palma, 100–160 km around the Observatory, which

includes to the island of Tenerife. The protection also covers radio and atmospheric pollution (prohibiting emission sources above 1500m elevation), and air traffic.

State of conservation: The sky protection law has been in place for 22 years, and has provided good protection for the night sky, especially on the island of de La Palma. The IAC, long aware of the importance of promoting initiatives to protect the ORM and OT, created a Sky Quality Group in the late 1980s and a technical office for sky protection (OTPC) in 1992 to provide advice on the application of the Sky Law. The level of protection has been increasing in recent years, overcoming the initial reluctance of the local population. Better enforcement is expected in the future. The present level of light pollution does not compromise research, maintaining the high level of excellence of the sky quality parameters.

Context and environment: Both observatories are located within areas of the utmost value from an environmental point of view, with exceptional natural scenery. The ORM is located within the core zone of the La Palma Biosphere Reserve and within the buffer zone of the Caldera de Taburiente National Park. The OT is located on a mountain covered in volcanic cinder close to the Teide National Park, with a spectacular view of the Teide stratovolcano itself.

Archaeological/historical/heritage research: Close to the Roque de los Muchachos is the prehistoric cult area of 'Llano de Las Lajitas', part of the astronomical legacy of the Awara, the ancient inhabitants of the island of La Palma.

Main threats or potential threats to the site: The main threat is light pollution, in common with all of the main observation sites in the world.

Management: Both observatory areas are municipality-owned and administrated by the IAC. The IAC is constituted administratively as a Public Consortium, created by statute in 1982, with involvement from the Spanish Government, the Government of the Canary Islands, the University of La Laguna and Spain's Science Research Council (CSIC).



Fig. 16.5.2. The Teide Observatory (OT). Tenerife, Canary Is. © Instituto de Astrofísica de Canarias