Tenerife GRUAN

Potential super-site

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GOBIERNO DE ESPAÑA

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MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

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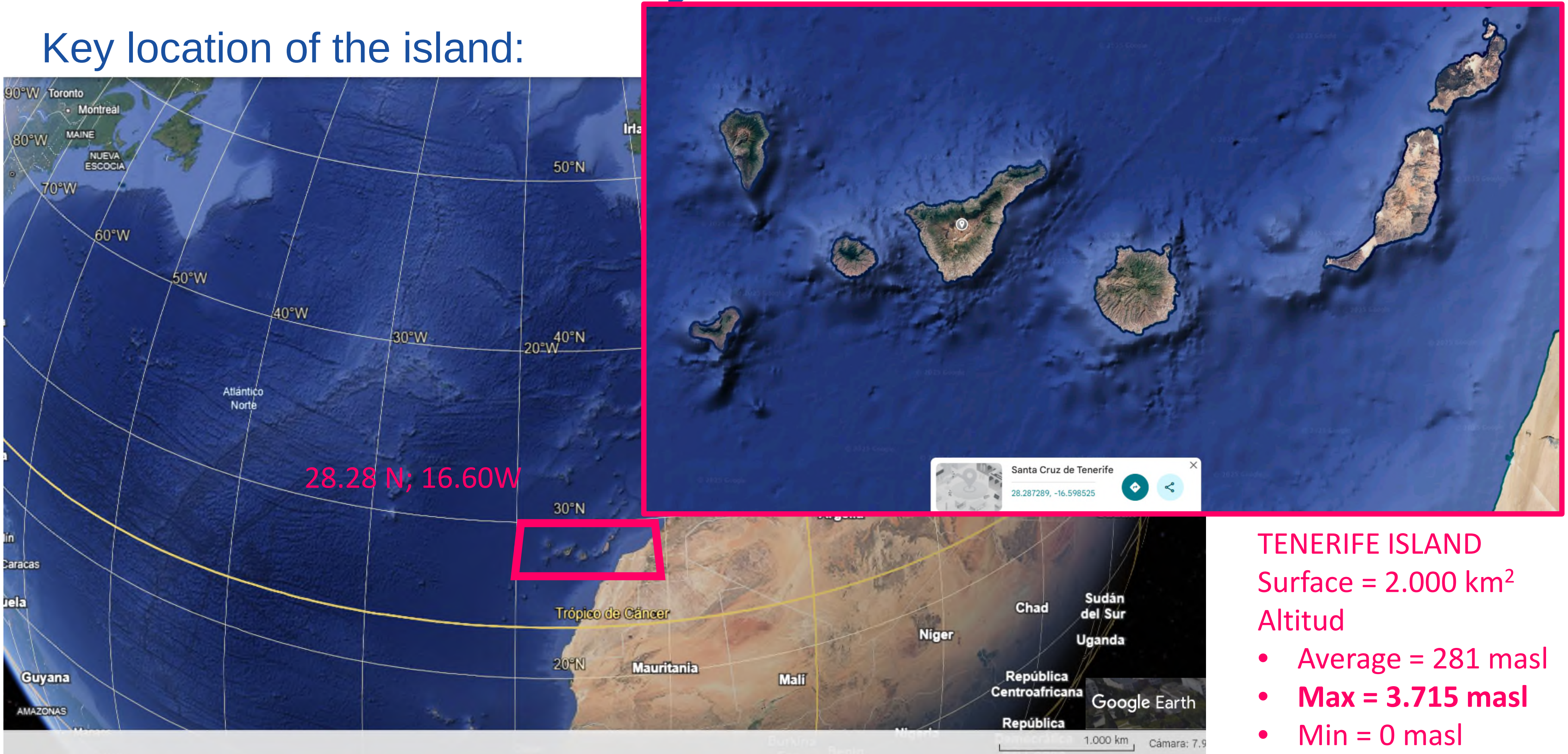
Tenerife as an atmospheric research laboratory

Key location of the island:



TENERIFE ISLAND

Surface = 2.000 km^2

Altitud

- Average = 281 masl
- **Max = 3.715 masl**
- Min = 0 masl

Tenerife as an atmospheric research laboratory

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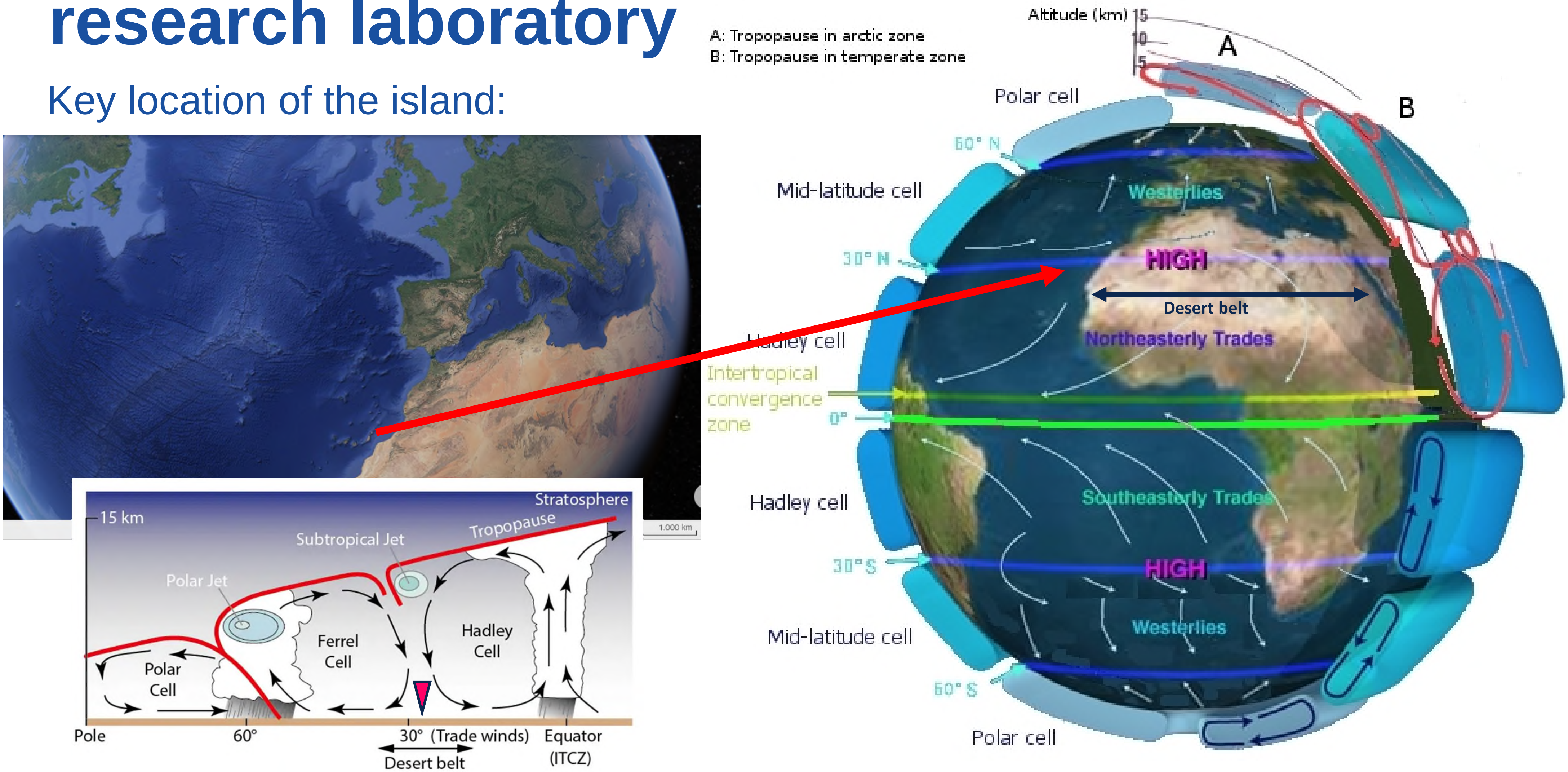

Tenerife as an atmospheric research laboratory

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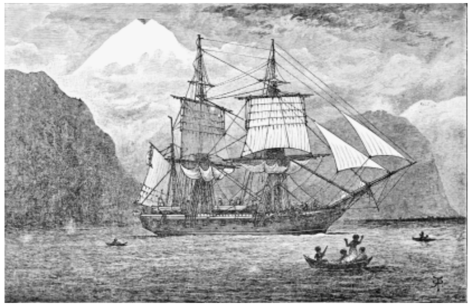
FIRST AEROLOGICAL OBSERVATIONS…

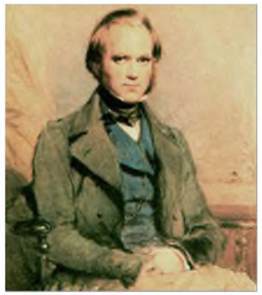
- 1643 Royal Society of London “measure the weight of the air and the height of the atmosphere”

Edmond Halley, who published the “First Wind Chart” 1686

- 1799 – A. Von Humbolt “measure of air T and P, flor and fauna observations at diferente altitudes”
- 1832 – C. Darwin “measure the diameter of dust particles in suspension” on board of the BEAGLE



HMS Beagle, a brig of the British Royal Navy, in the Strait of Magellan



Charles Darwin

Alexander Von Humbolt

Main source: “Ciencia y presencia extranjera en las islas canaraias: de la ilustración a la primera guerra mundial” F. De Ory
Science and foreign presence in the Canary Islands: from the Enlightenment to the First World War http://hdl.handle.net/20.500.11765/2043

Tenerife as an atmospheric research laboratory

FIRST AEROLOGICAL OBSERVATIONS…

- 1856 C. Piazzi Smyth "first **systematic** meteorological and astronomical observations"

C. Piazzi Smyth

- 1873 First meteorological observations in Santa Cruz de Tenerife carried out by Francisco Aguilar y Fuentes —a public works assistant, painter, poet, and astronomy enthusiast— from a small rooftop weather station at his home.

F. Aguilar y Fuentes

- 1904-1905 Hergestell "first balloon-sonde campaigns"

Professor Hugo Hergesell conducting balloon and kite surveys aboard Prince Albert of Monaco's yacht "Princesse Alice"

- 1909 **R. Wenger** and **A. Stark** "first aerological and solar radiation observations in the "high" atmosphere at la Cañada de la Grieta".

Main source: "Ciencia y presencia extranjera en las islas canaraias: de la ilustración a la primera guerra mundial" F. De Ory

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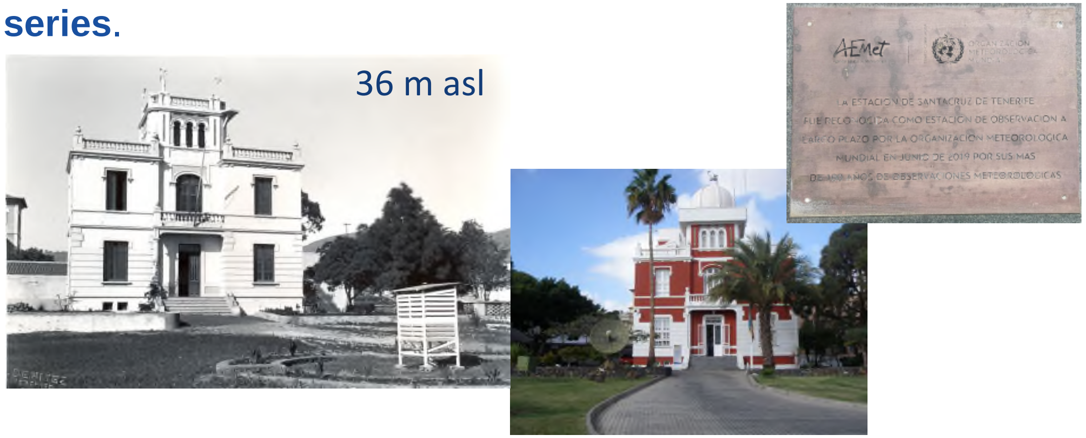
Tenerife as an atmospheric research laboratory

Izaña Observatory

… and following the history, the 1st of January 1916 the Izaña Atmospheric Observatory was inaugurated.

Santa Cruz Observatory

• Meteorological observations in Santa Cruz de Tenerife began in **1873** (different locations but same surrounding as a convent, the town hall, etc.).
• Since **1924**, the station has been located at the Tenerife Meteorological Centre, built for that purpose.
• Proximity of earlier sites and consistency of precipitation data allow for a **continuous, homogeneous climate series**.



In both places, record has remained **uninterrupted**, even during the Spanish Civil War and World War II
→ Both recognized as **Centenial Observatories by the WMO**.

Tenerife and GRUAN

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Four key locations on Tenerife are described as part of a potential larger GRUAN site.

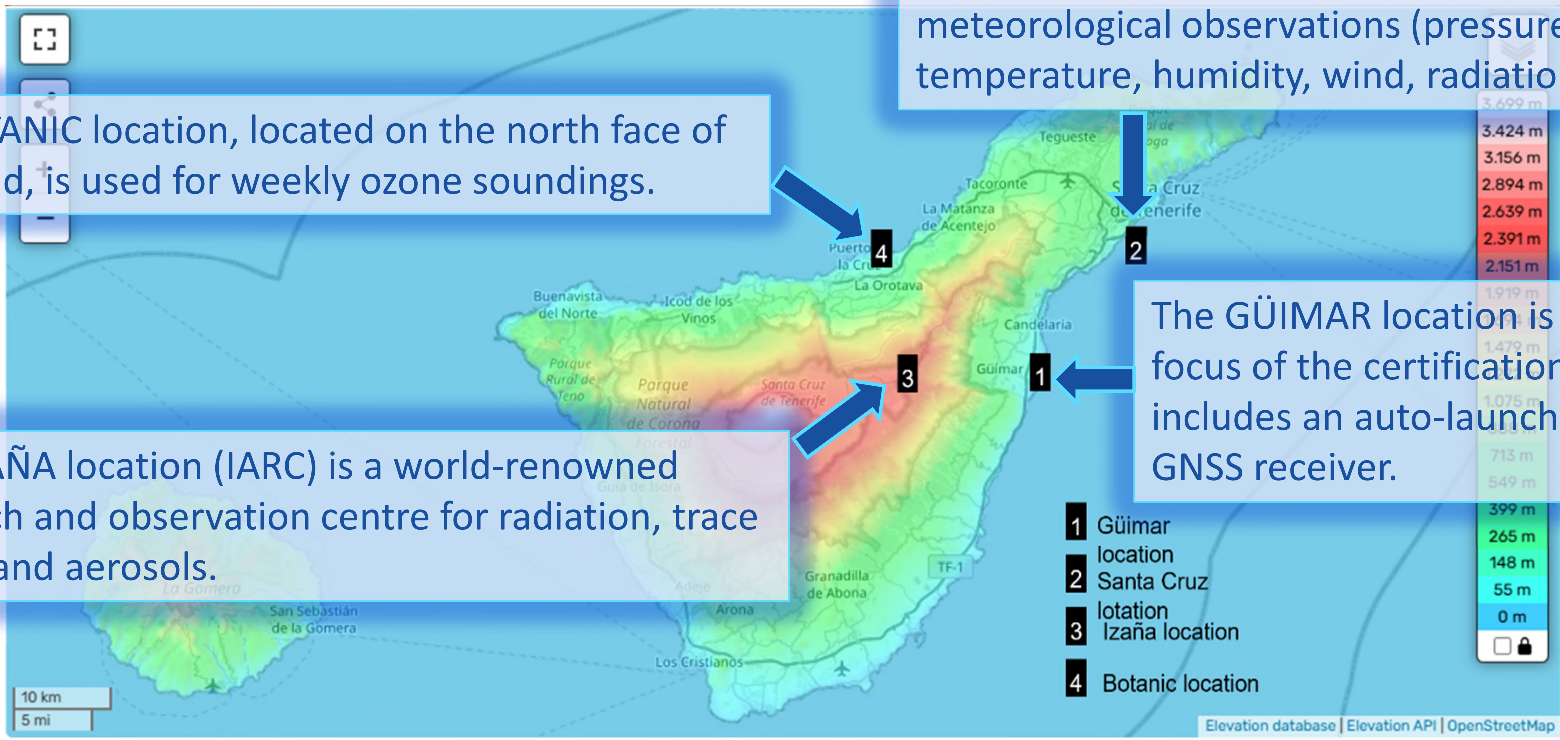
Izaña Atmospheric Research Center

The SANTA CRUZ location, in an urban area, holds a long historical record of surface meteorological observations (pressure, temperature, humidity, wind, radiation, etc.).

The BOTANIC location, located on the north face of the island, is used for weekly ozone soundings.

The GÜIMAR location is the main focus of the certification process — includes an auto-launcher and GNSS receiver.

The IZAÑA location (IARC) is a world-renowned research and observation centre for radiation, trace gases, and aerosols.

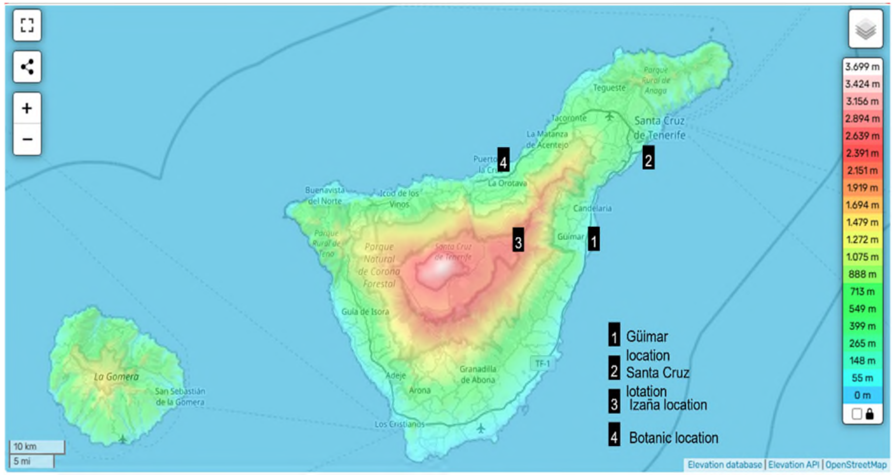


Tenerife Regional Meteorological Center

Operational managment with separate teams/departments

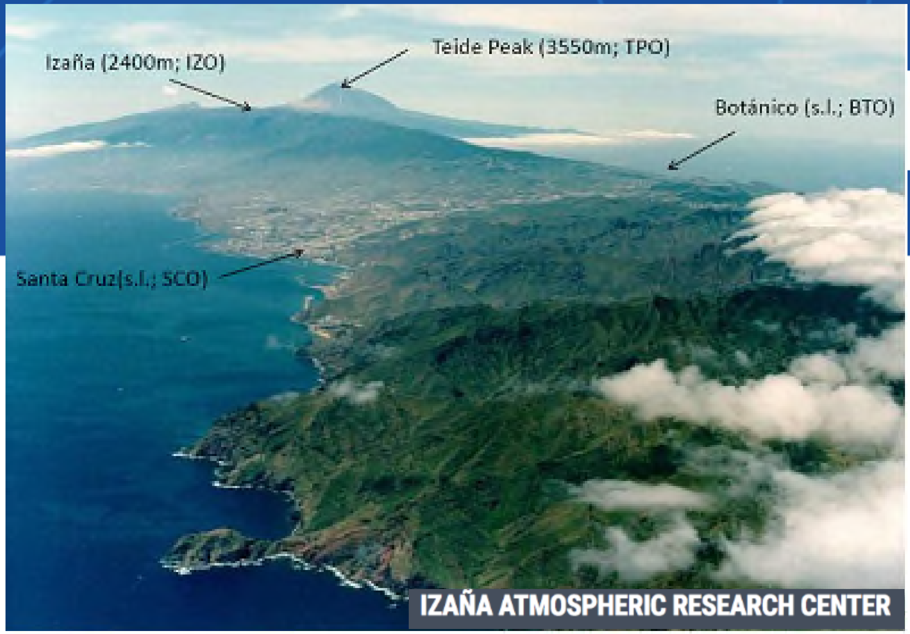
Tenerife and GRUAN

To understand atmospheric features around Tenerife…

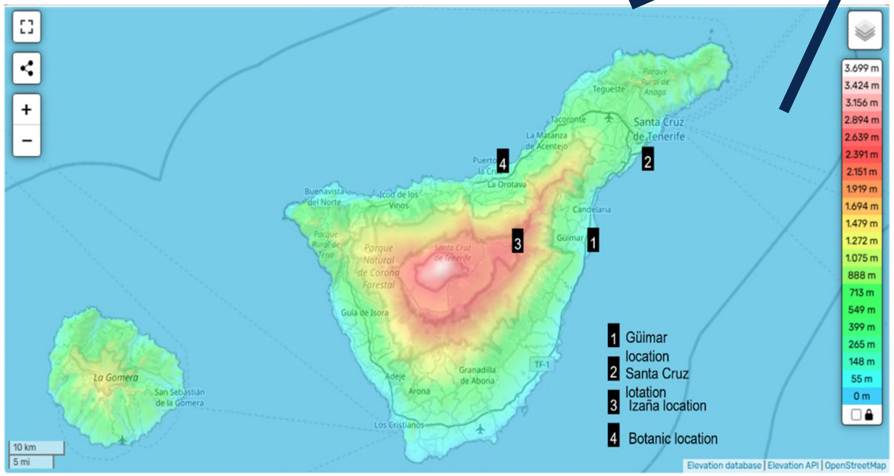


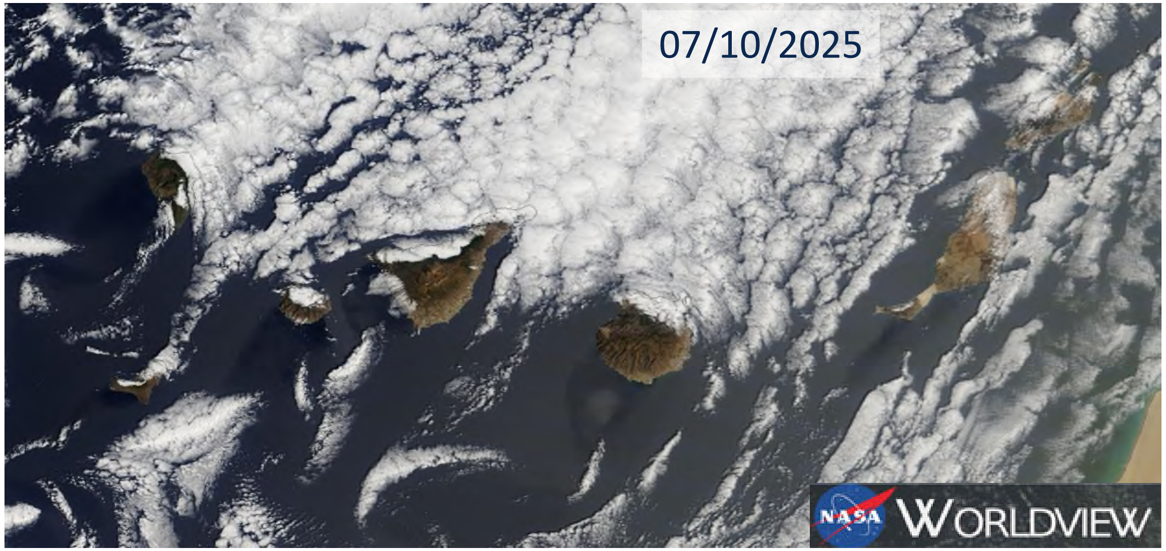
Tenerife from a satellite view
https://www.youtube.com/watch?v=vP-Q9iX3j0A

Tenerife and GRUAN



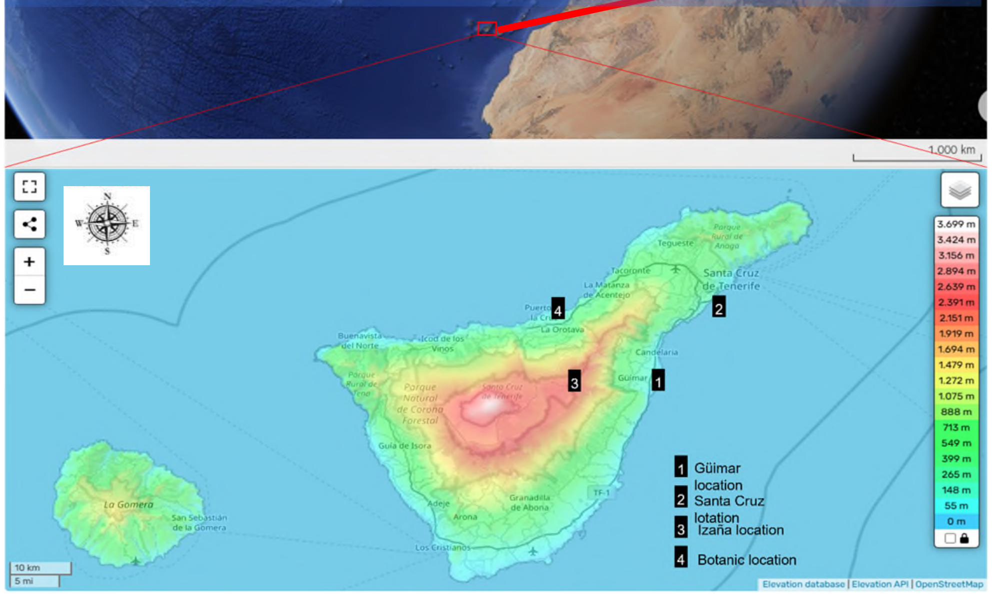
To understand atmospheric features around Tenerife…

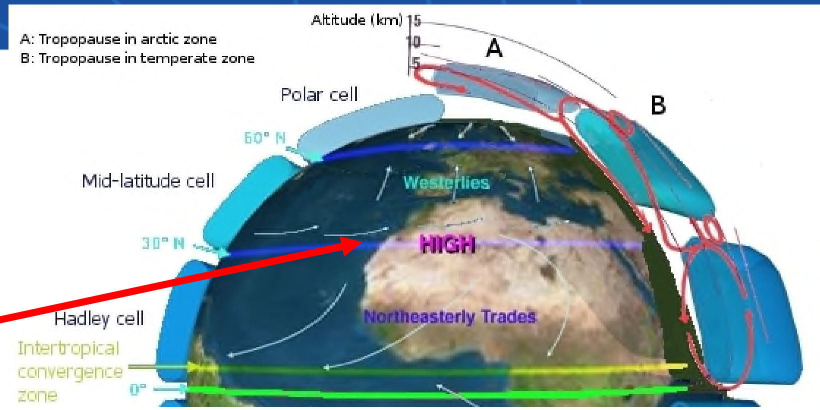


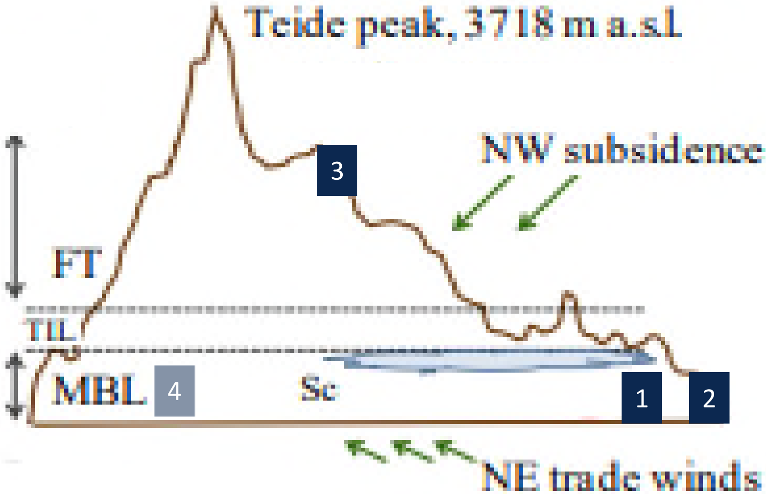


Tenerife and GRUAN

- **Marine Stratocumulus Clouds**
  - Common in regions with stratiform cloudiness
  - Formed by **NE trade winds** bringing moisture from the ocean
- **North vs. South Slopes**
  - **Northern slope**: humid conditions due to sea clouds
  - **Southern slope**: dry conditions
- **Dust Intrusions**
  - Episodes of Saharan dust transport affecting the free troposphere
- **Stratospheric Ozone Intrusions**
  - Linked to **tropopause folds**, injecting ozone into the upper troposphere



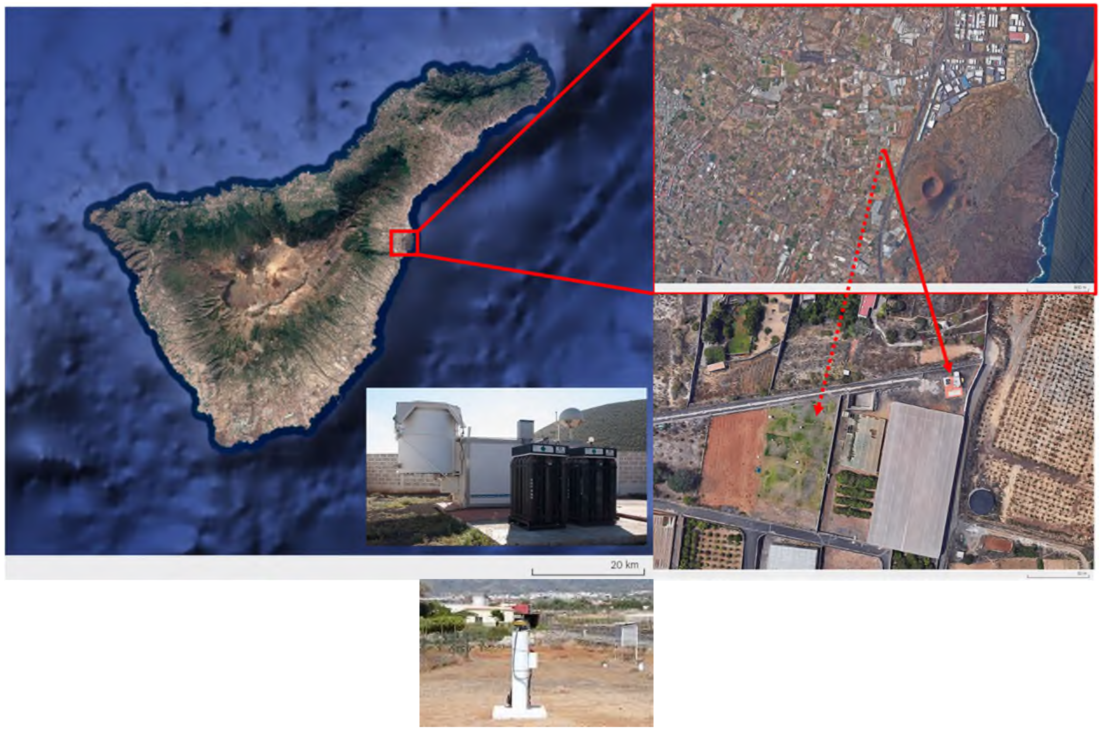




From PhD García-Álvarez, M.I. "Origin of atmospheric aerosols transported across the North Atlantic free troposphere"

GÜIMAR location

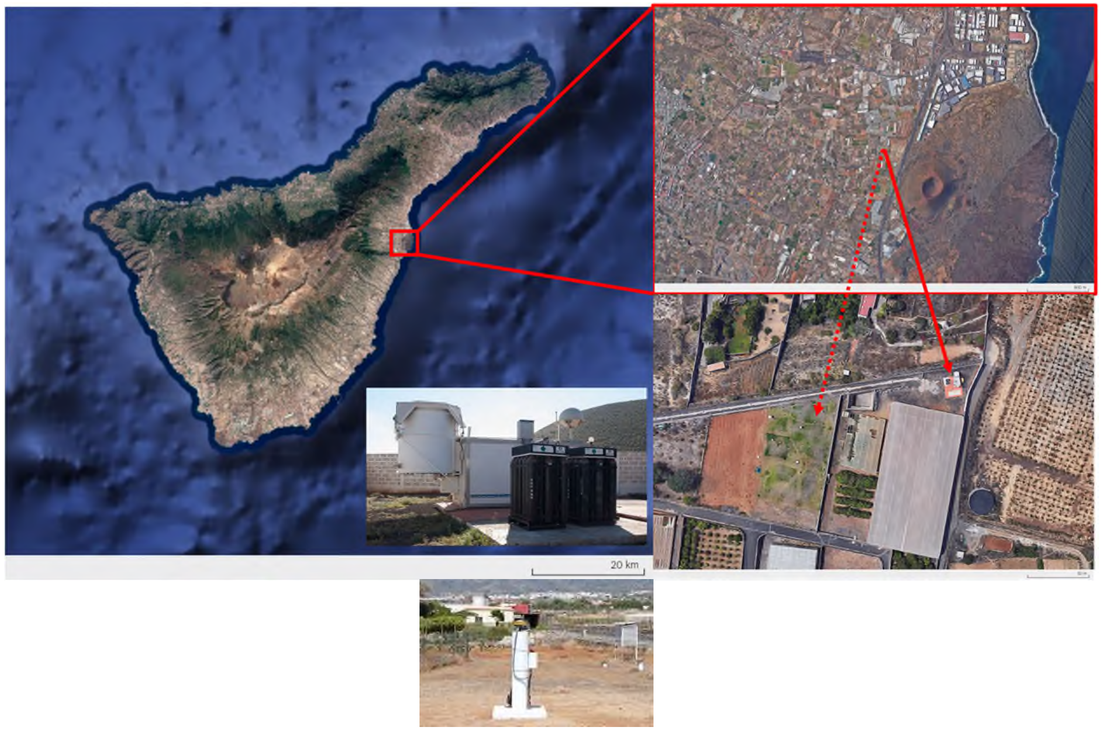
Tenerife Regional Meteorological Center



- **Vaisala Autolauncher AS15** (operational since 2003, first in Spain), provides upper-air data for NWP; complemented by a VAISALA MAWS 110 weather station.
- Data transmitted in near real time to GTS, part of AEMET’s Thermodynamics Sounding Network and GUAN network (GCOS).
- **GNSS station** (Javad RingAnt-G5T antenna + DeltaS-3S receiver) recently installed to retrieve integrated water vapor.
- Both instruments **proposed for GRUAN certification**, providing required redundancy for water vapor observations.
- In addition, an **Automatic Weather Station (AWS)** provides ancillary surface measurements (P, T, RH and Wind).

GÜIMAR location

Tenerife Regional Meteorological Center



Importance of the Güimar Location for GRUAN

- **Unique subtropical Northern Hemisphere location**, providing coverage near **North Africa**, a region with scarce GRUAN data.
- **Well-established and reliable infrastructure**, with long-term operation, regular maintenance, and capacity for future expansion.
- **High-quality twice-daily soundings** reaching 10 hPa, essential for long-term **climate monitoring** and for studying **short-term atmospheric dynamics** (e.g., jet stream intrusions, Saharan air masses).

Joined GRUAN in 2016 [GRUAN code TEN-Tenerife]:

Currently submits:

upper-air radiosonde (2/day)

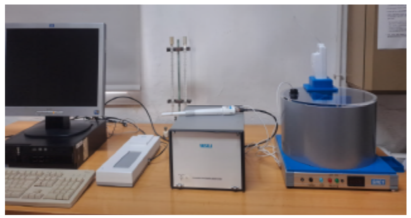
GNSS data [IGS code TFEG]

SANTA CRUZ location

Tenerife Regional Meteorological Center

Santa Cruz Observatory & GRUAN Staff Base

- GRUAN site staff and **logistics for Güimar** are managed from this facility.
- **Dedicated laboratory** for radiosonde testing and verification (humidity chamber, reference T-probe). Working in TT4 GRUAN Experiment.
- Regular **surface, radiation, and total ozone** observations.
- **Centennial WMO station (code 60020)** with continuous meteorological records since 1924 (and before since 1873 in the surrounding).



SANTA CRUZ location

Tenerife Regional Meteorological Center

Santa Cruz Observatory & GRUAN Staff Base

- Since 1975 balloon soundings, even earlier but difficult to trace.
- Measurement of T, P, RH and wind components atmospheric profile (since 1995 with high resolution).
- Manually performed, daily, 00 UTC and 12 UTC, before autolauncher was established.

Also O3S launched from here 1/week, since 1992 until 2011 → moved becuase technical and operational issues

IZAÑA location

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Izaña Atmospheric Research Center

Izaña Atmospheric Observatory (IARC-AEMET)

- **WMO Centennial Station (code 60010)**, operating since **1916**, focused on **trace gases, aerosols, and climate-related atmospheric research**.
- Contributes to multiple international networks, fostering strong **synergies with GRUAN**, including:
  - **BSRN**, **NDACC**, **Aeronet**, **GAW**, **GCOS**, **E-PROFILE**, and **E-GVAP**.
- A key reference site for **long-term atmospheric monitoring** and **climate-quality observations**.

(an extended presentation will come later today…)

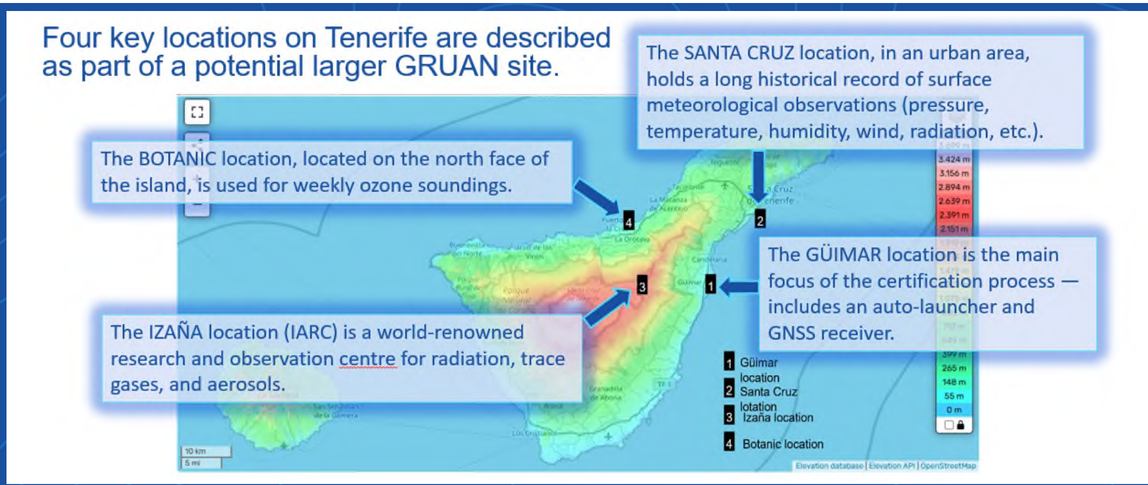
BOTANIC location

Izaña Atmospheric Research Center

Ozone Sounding Station (IARC-AEMET)

- Performs **weekly ozone soundings** with **ECC sensors** using a **Vaisala Digicora MW41** system (manual operation).
- Continuous **surface observations** (temperature, humidity, pressure, wind, precipitation) since **1992 (Santa Cruz) – 2011 (Botanic)***.
- Meteorological data supports the **ozone sounding program** (used internally, not distributed).

*** Note:** The ozone sounding program was moved from *Santa Cruz* to *Puerto de la Cruz* in **2011** to reduce local pollution effects, avoid interference from nearby power lines, and improve operational management with separate teams.



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THANKS FOR YOUR ATTENTION!!