ERUPCIÓN DEL VOLCÁN DE LA PALMA: CARACTERIZACIÓN DE AEROSOLES VOLCÁNICOS Y EMISIONES DE GAS DESDE UNA PERSPECTIVA SINÉRGICA

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ST-30 Teledetección y sensores ambientales

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AEMet
Agencia Estatal de Meteorología
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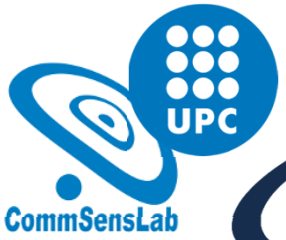
ACTRiS
Exploring the Atmosphere


The Micro Pulse Lidar Network
MPLNET


e-profile
EUMETNET


AEMet
Agencia Estatal de Meteorología


GOA-UVA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Grupo
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THE FRENCH AEROSPACE LAB


Instituto Español de Oceanografía


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Gobierno de Canarias


Sieltec Canarias

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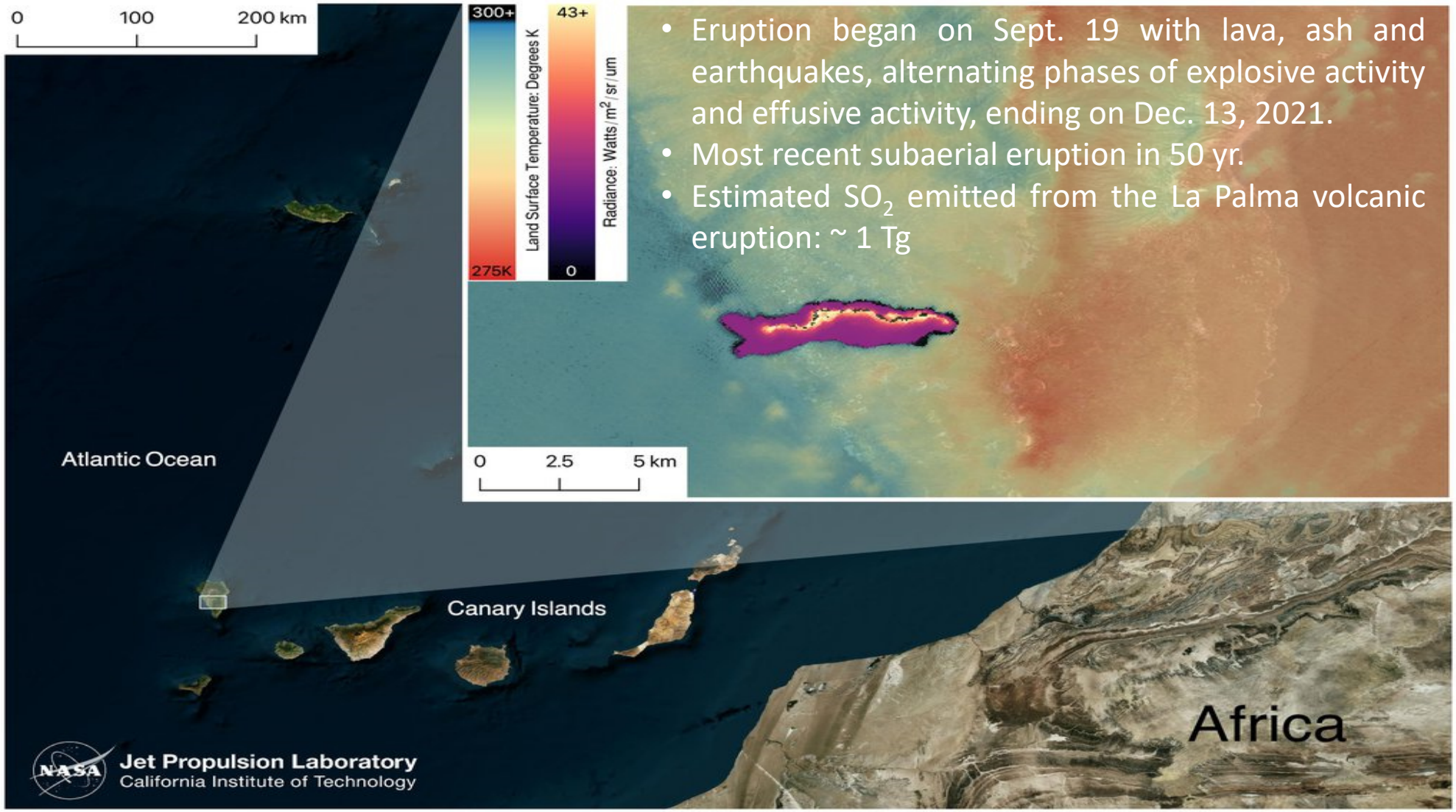
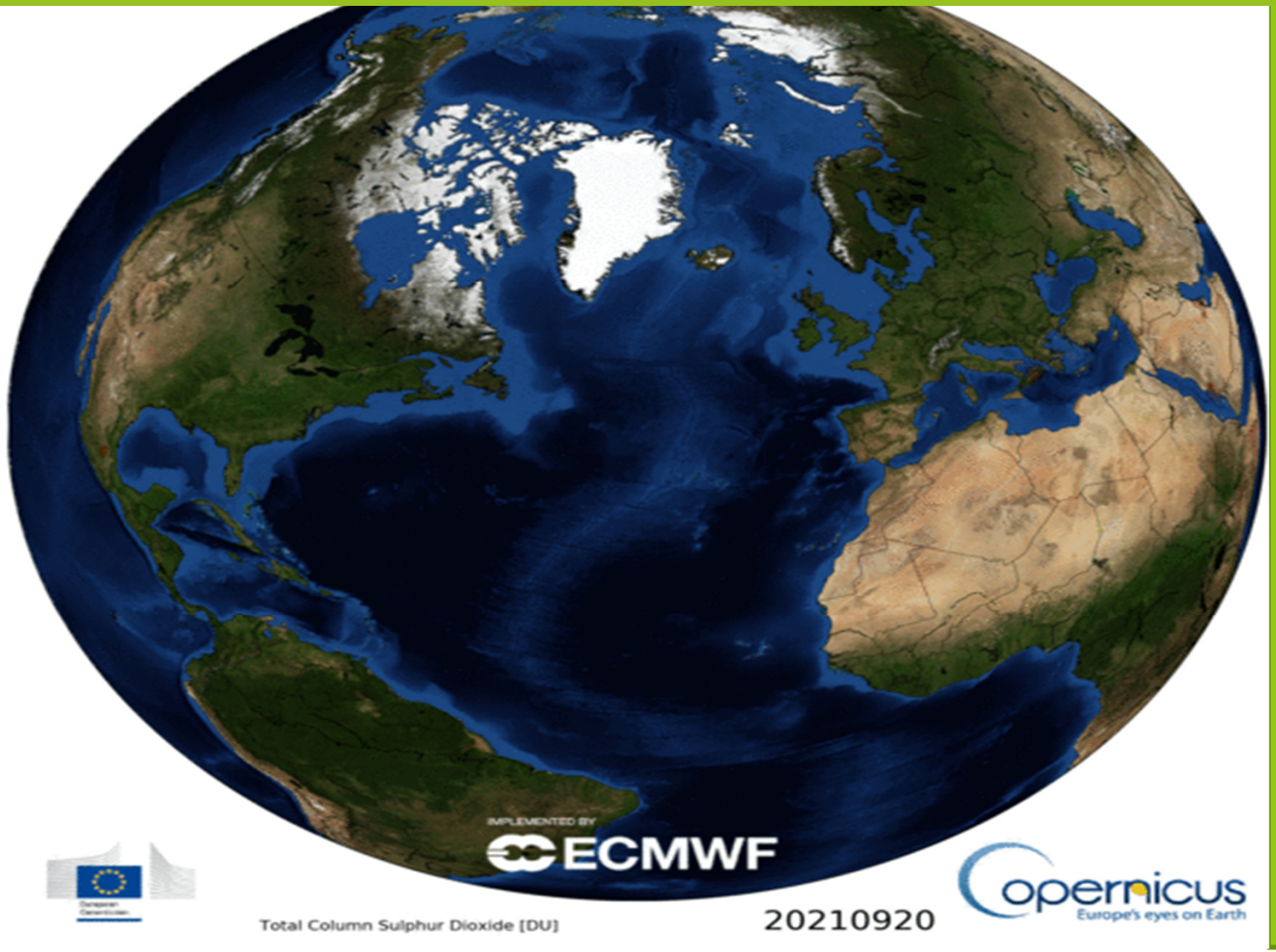
01 LA ERUPCIÓN Y TRANSPORTE ATMOSFÉRICO



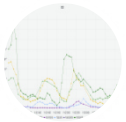
- Eruption began on Sept. 19 with lava, ash and earthquakes, alternating phases of explosive activity and effusive activity, ending on Dec. 13, 2021.
- Most recent subaerial eruption in 50 yr.
- Estimated SO_2 emitted from the La Palma volcanic eruption: ~ 1 Tg

CAMS total column SO_2 20/9 – 29/10/2022



Transport to Europe and America!

Despliegue instrumental y objetivos



Air Quality

Atmospheric profiling

Aerosol profiling

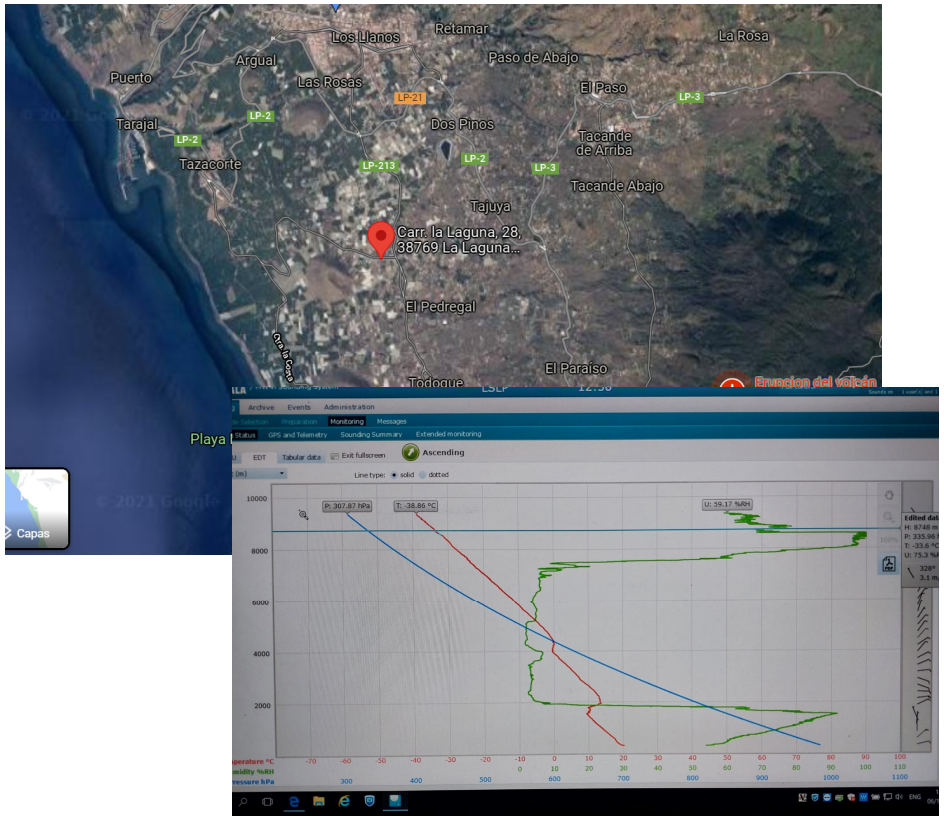
Reseach (SAL, PBL)

IZO-GAW/WMO

02 ESTACIÓN DE OBSERVACIÓN DE LA PALMA

Estación de la Palma: Perfilado atmosférico

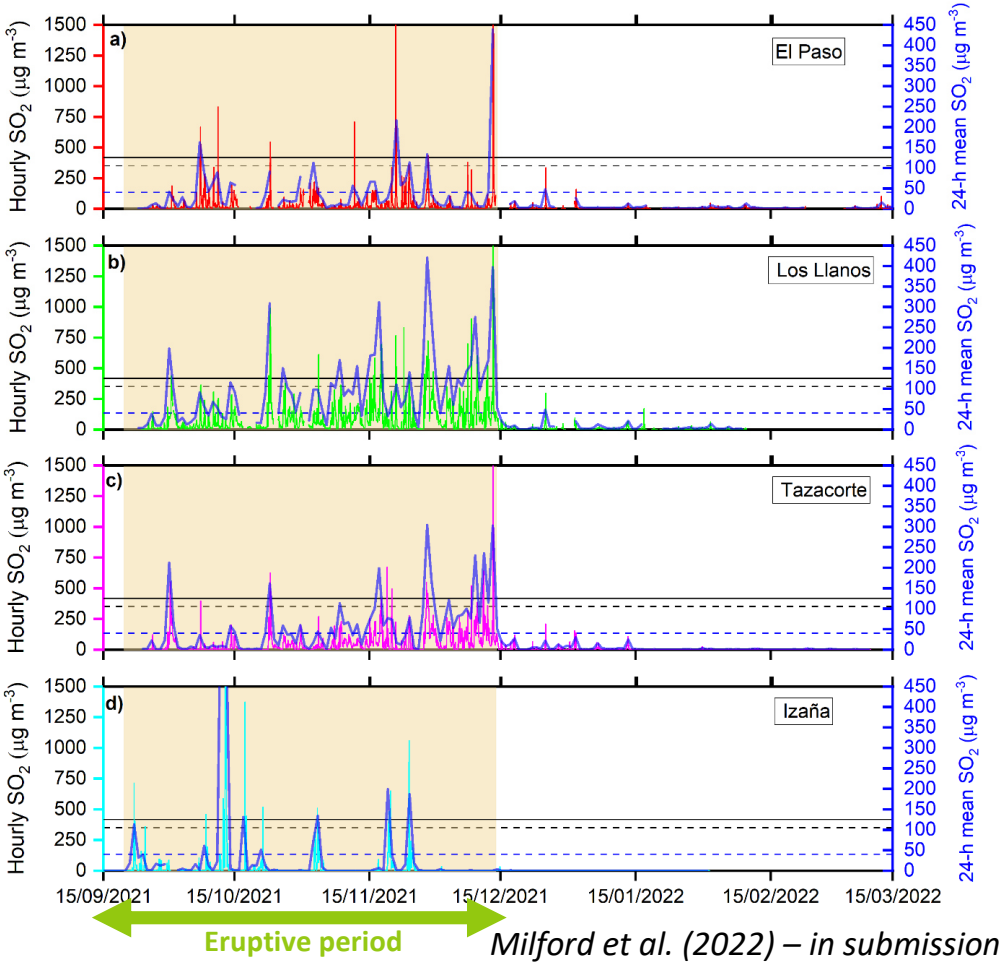
Atmospheric soundings launched daily for the Spanish Emergency Military Unit



Altitude: 295 m

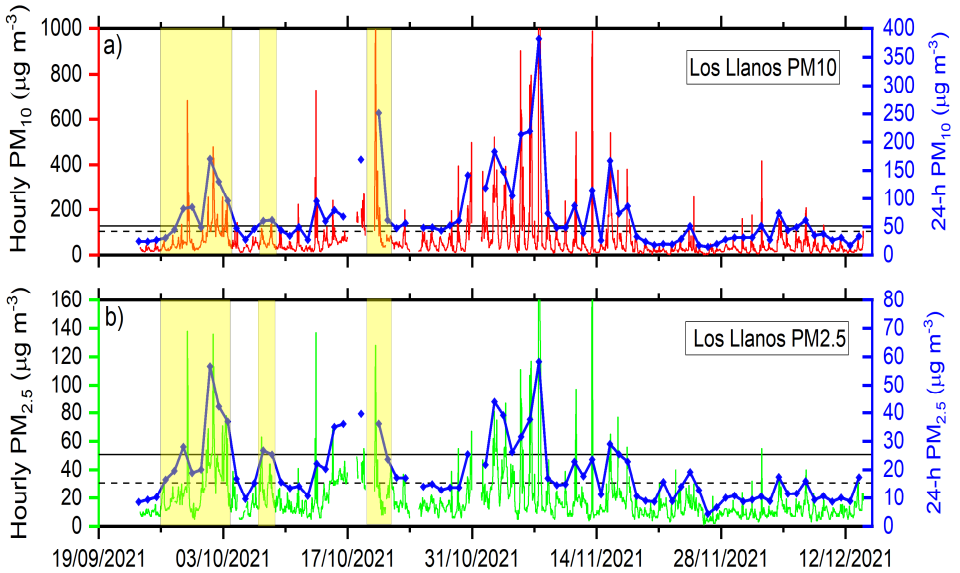
Estación de la Palma: Calidad del aire

Ground-based SO_2 monitoring



Milford et al. (2022) – in submission

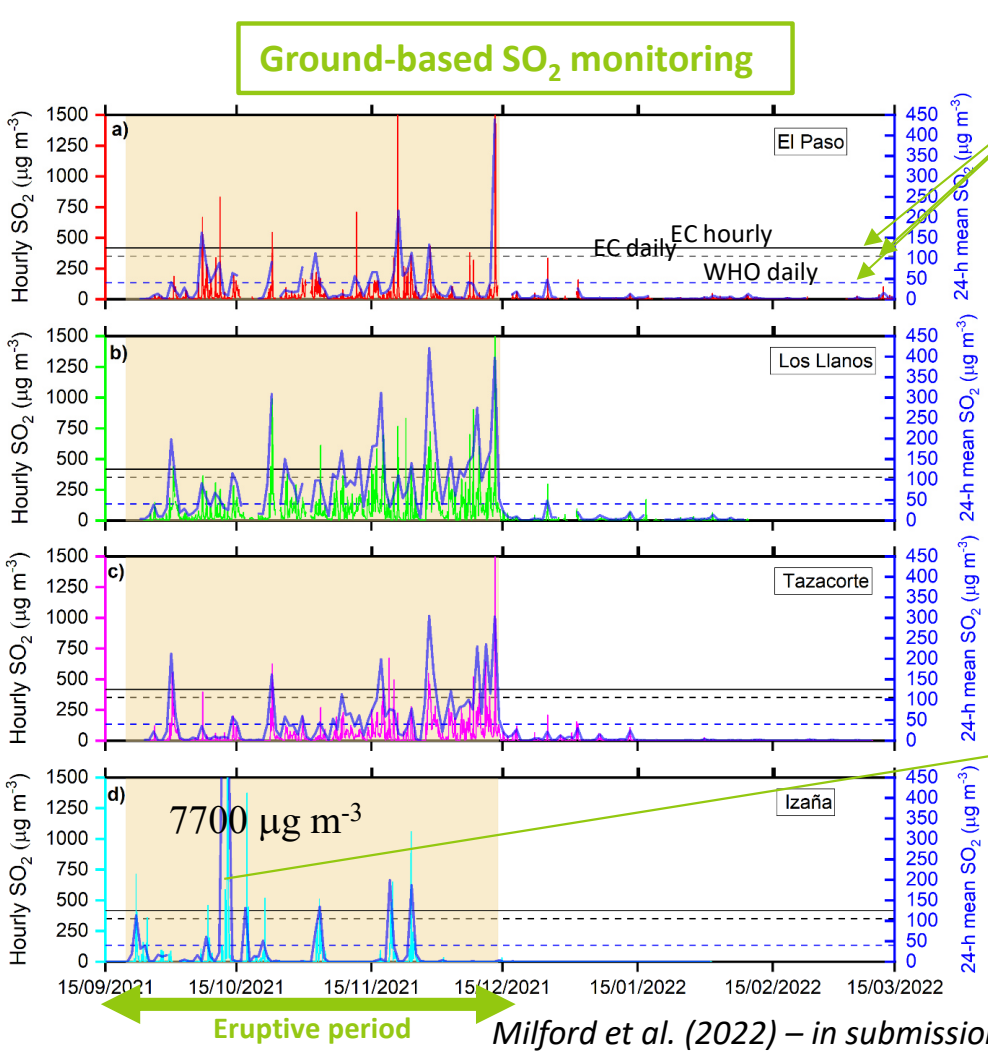
Ground-based PM monitoring



Milford et al. (2022) – in submission

Surface measurements in the Eastern side of La Palma with SO_2: Thermo 43 & Teledyne API; PM: Beta attenuation monitor & PALAS

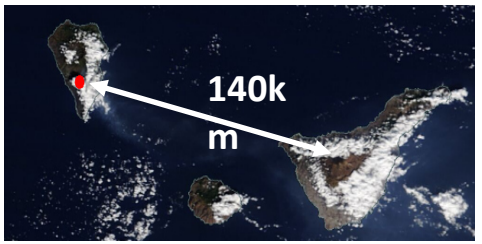
Estación de la Palma: Calidad del aire



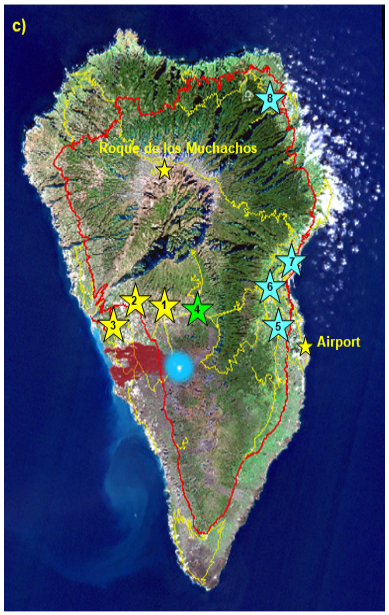
Milford et al. (2022) – in submission

Exceedance from the WHO AQ limit:

- El Paso for 25 days (30% of days of eruption)
- Los Llanos for 56 days (68%)
- Tazacorte for 39 days (48%)
- IZO for 10 days (12%).



maximum hourly mean SO_2 concentration recorded!!!!



Surface measurements in the Eastern side of La Palma with SO_2: Thermo 43 & Teledyne API; PM: Beta attenuation monitor & PALAS

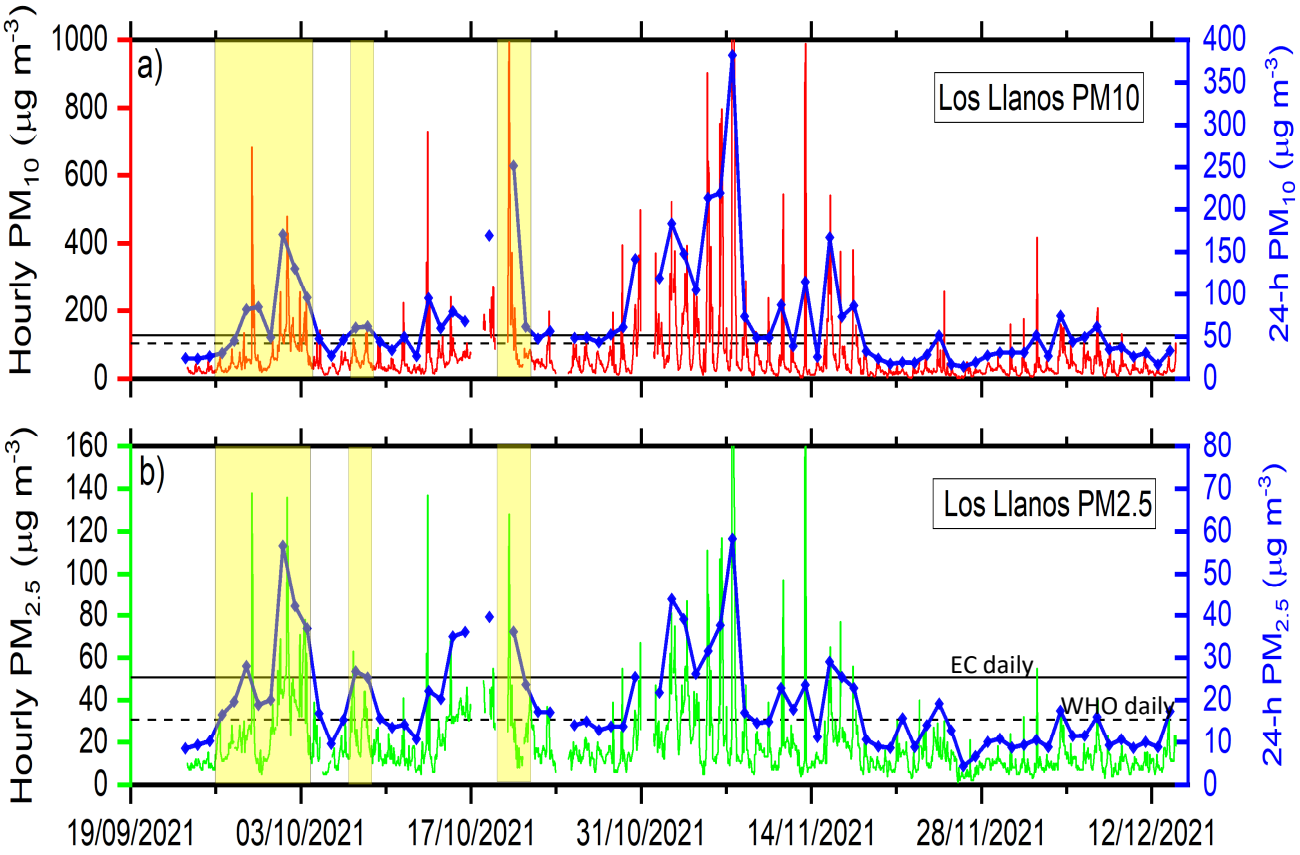
Estación de la Palma: Calidad del aire

Exceedance from the WHO AQ daily limit at Los Llanos:

- PM_{10} - 45 days (55% of days of eruption)
- $PM_{2,5}$ - 42 days (51% of days of eruption)

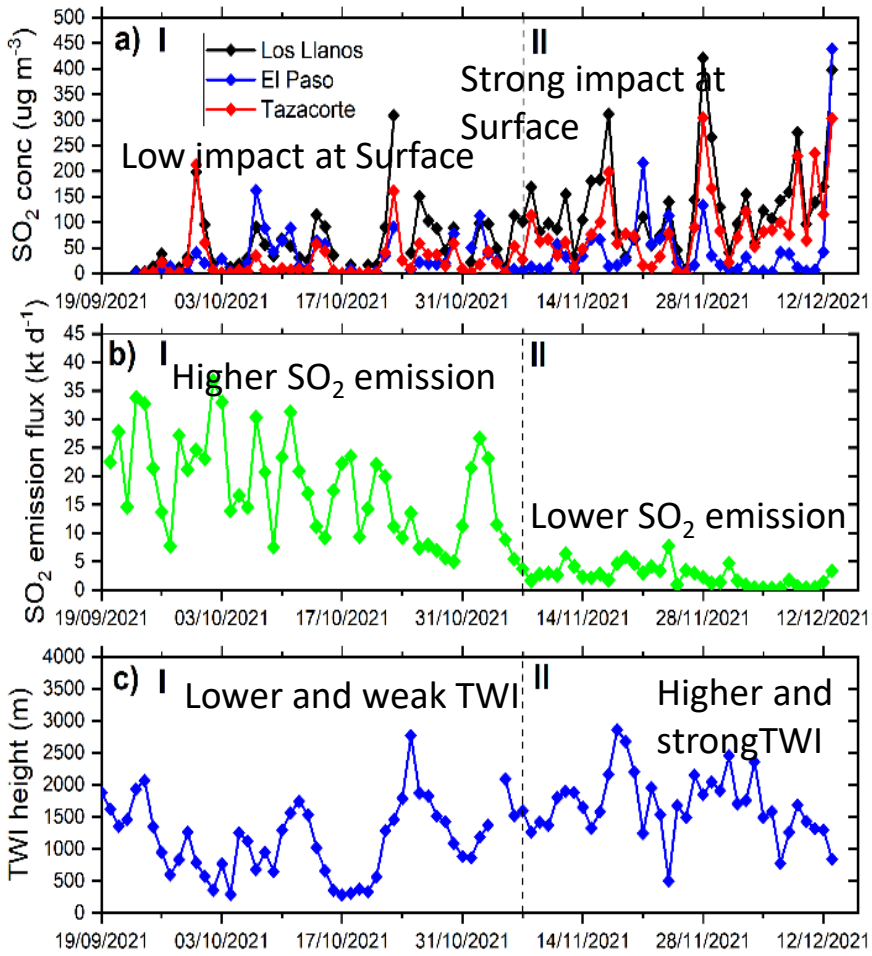
Volcanic enhancement of surface PM concentrations: ΔPM_{10} of 53 μg m^{-3} and 12 μg m^{-3} and for $\Delta PM_{2.5}$

Ground-based PM monitoring



Milford et al. (2022) – in submission

Estación de la Palma: Calidad del aire



Milford et al. (2022) – in submission

Final overview of the eruption from AQ perspective

- **Phase I**: higher SO_2 emission rates (until 7/11/2021) with mean and accumulated SO_2 volcanic emission of 18 kT d^{-1} and 860 kt, TWI height < 2000 m and volcanic emissions injected largely into the FT.
- **Phase II**: lowest mean and accumulated SO_2 emission fluxes (3 kT d^{-1} and 97 kt) but with the largest peaks in SO_2 surface concentrations in La Palma, lower altitude of the volcanic plume and TWI height higher (1330-3000 m) – confinement in the MBL

Important information not only about the eruptive phase or the plume injection height but also other modulating factors

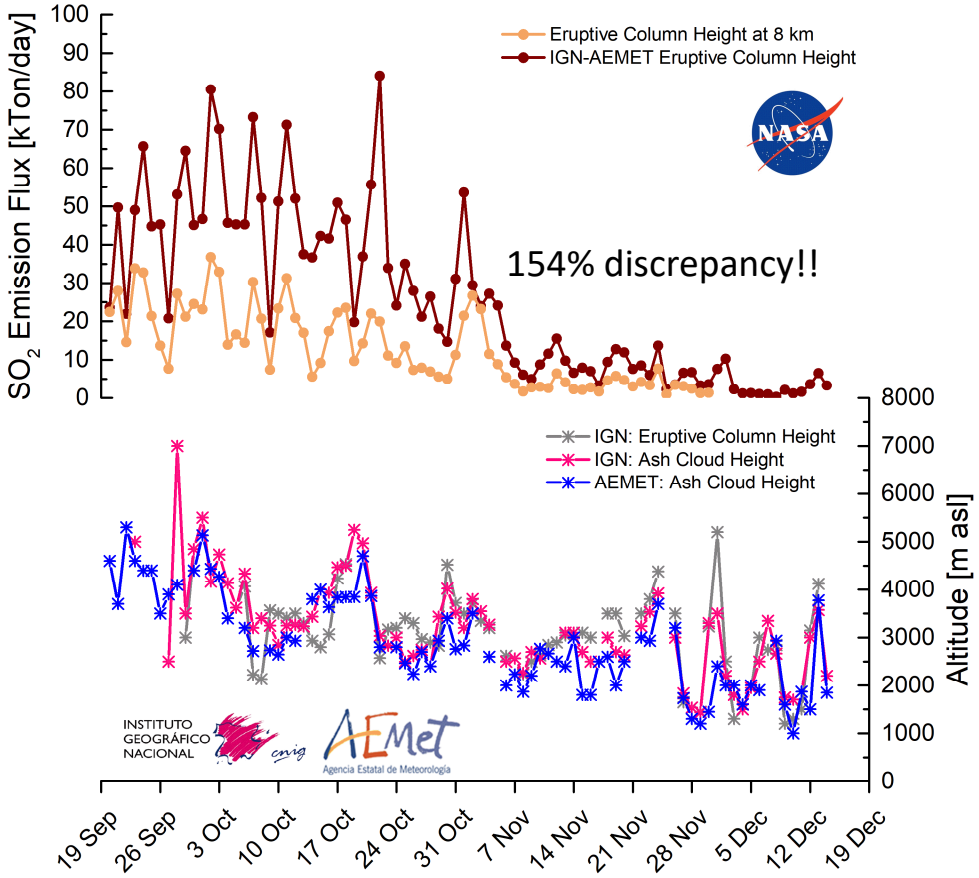
Estación de la Palma: Perfiladores de aerosoles

- **Roque de los Muchachos** (2400 m): ARCADE Raman Lidar at Cherenkov Telescope Array + Sun-Photometer (AERONET)
- **El Paso** (700 m): Prototype CL61D
- **Tazacorte** (140 m): Surface SO_2 and O_3, GRIMM, all-sky camera and MPL (MPLNet + e-profile)
- **Airport** (60 m): CL51 (e-profile)
- **Fuencaliente** (680 m): Sun/lunar photometer (AERONET), all-sky camera, CHM15k Luff (e-profile) + GRASP inversions

Goal: Detect the height and thickness of the volcanic plume (cloud) and the vertical distribution in real time.

- Improve VAAC (Volcanic Ash Advisory Center) predictions
- Validate chemical transport model (MOCAGE)

Estación de la Palma: Perfiladores de aerosoles



Barreto et al. (2022) – in preparation

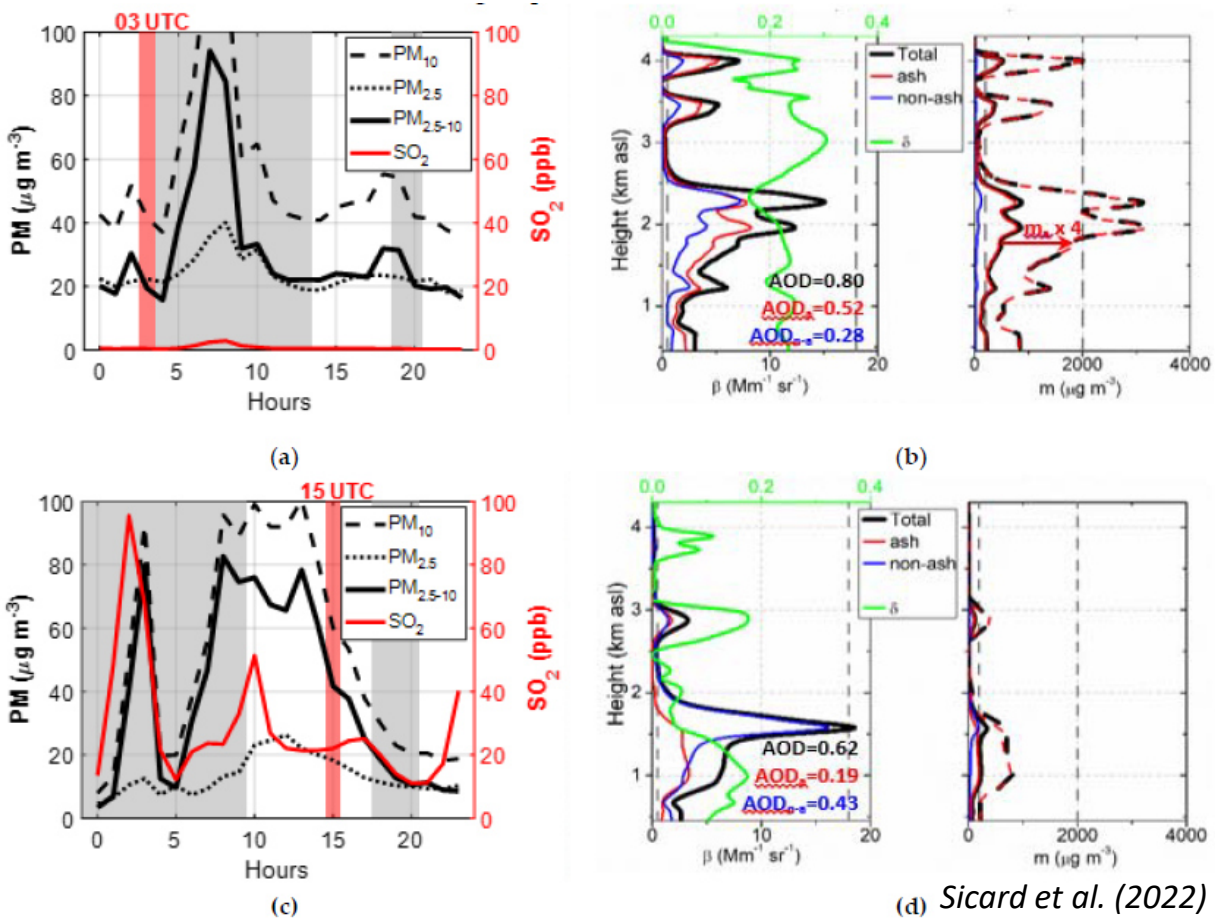
Final overview of the eruption from RR perspective

- Time series of the altitude of the volcanic dispersive plume retrieved using two different and complementary instrumentation: lidars (AEMET) and video-surveillance (IGN). Good agreement between them.
- Decrease in the altitude of the volcanic plume in the second part of the eruption (3-5 km PI; 2-4 km PII).
- The impact of the uncertainty in the estimation of eruptive column height on the SO_2 flux estimated by satellite (**average difference of -154%**).

~3500 m a.s.l. as characteristic altitude in La Palma eruption

Estación de la Palma: Perfiladores de aerosoles

POLIPHON method was applied to separate the fine- and coarse-mode components and estimate their mass concentration using the MPL4 lidar deployed in Tazacorte.

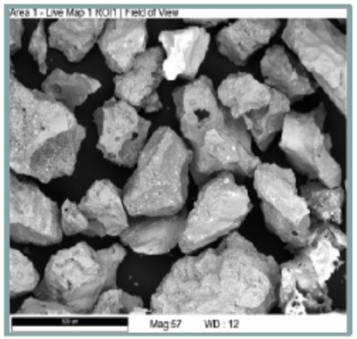


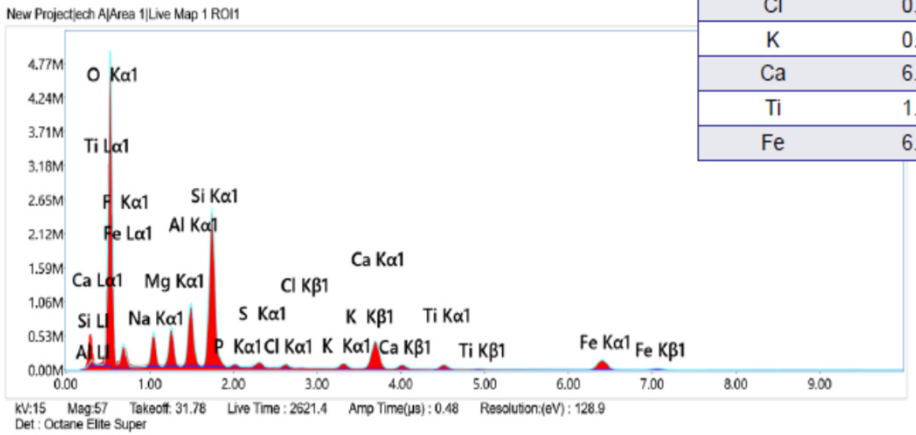
Sicard et al. (2022)

Estación de la Palma: Distribución de tamaño y composición química

Sample A

Main components: O (65%), Si (10%), Al (5%), F-Na-Mg-Ca-Al (~20%)





Element	Weight %	Atomic %
O	50.67	65.30
F	5.06	5.50
Na	4.70	4.21
Mg	3.64	3.09
Al	5.54	4.23
Si	13.58	9.97
P	0.28	0.19
S	0.59	0.38
Cl	0.45	0.26
K	0.86	0.45
Ca	6.51	3.35
Ti	1.26	0.54
Fe	6.87	2.54

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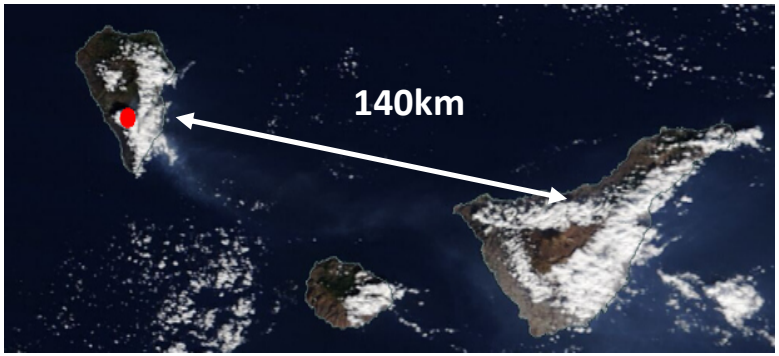
Digital holography & SEM of ash samples

Log-normal distribution with mean diameter of **11 µm**!!

Ceolato et al. (2022) – in preparation

03 ESTACIÓN DE OBSERVACIÓN DE TENERIFE

Estación de Tenerife



GAW

NDACC

NOAA

NASA

PGN

ACTRiS
Exploring the Atmosphere

WRMC-BSRN
World Radiation Monitoring Center - Baseline Surface Radiation Network

ICOS
INTEGRATED CARBON OBSERVATION SYSTEM

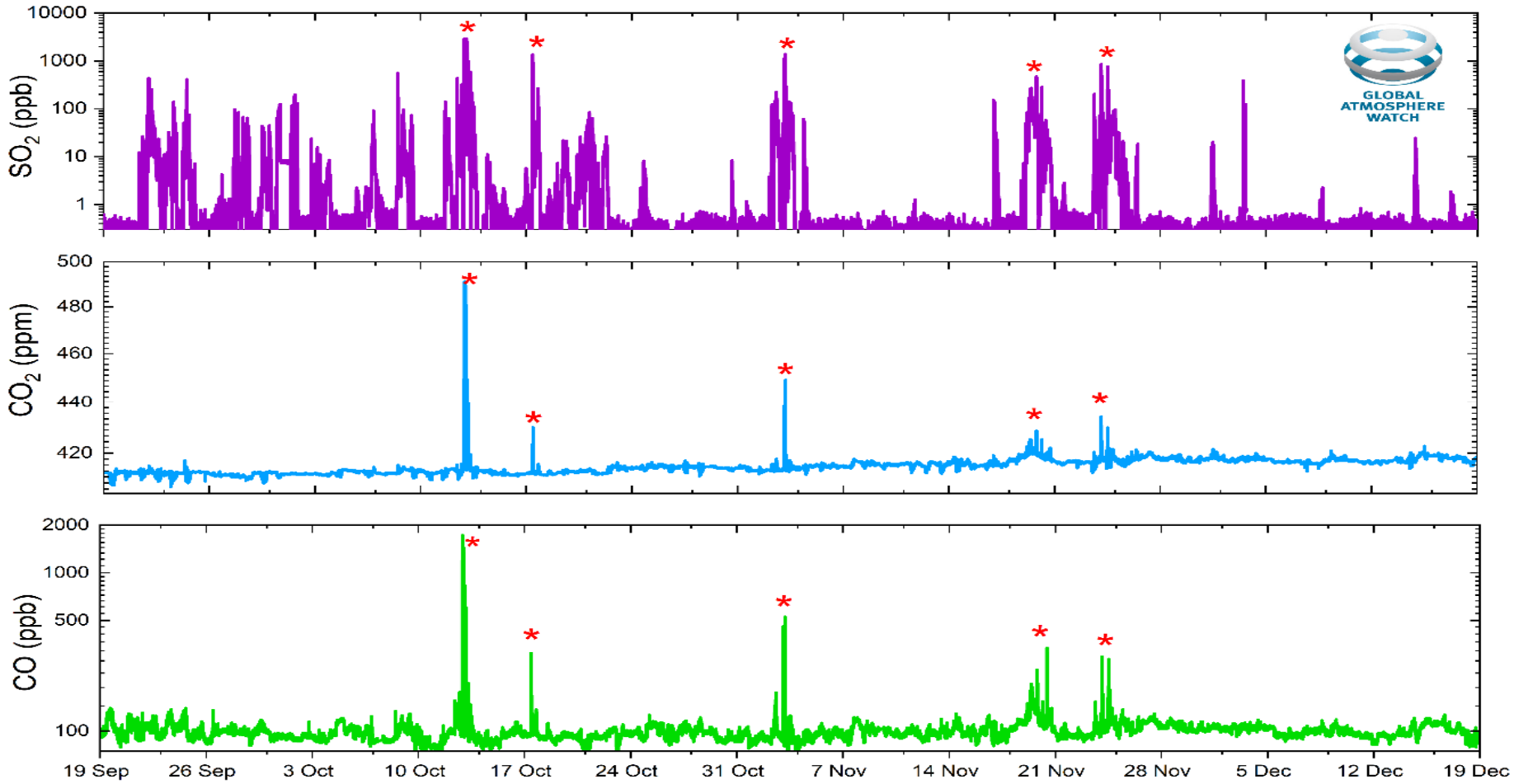
TCCON
total carbon column observing network

The Micro Pulse Lidar Network
MPLNET

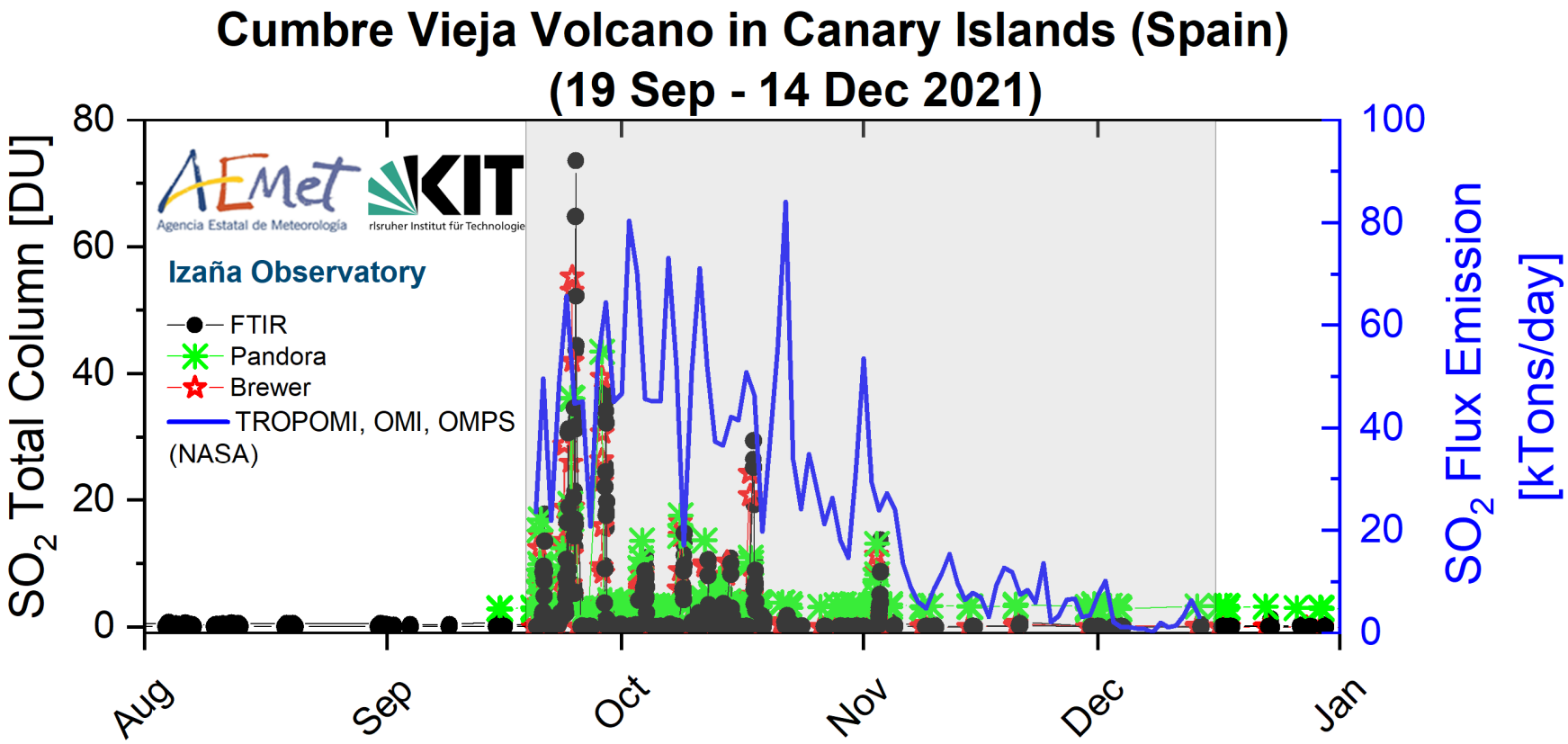
EUBREWNET

e-PROFILE

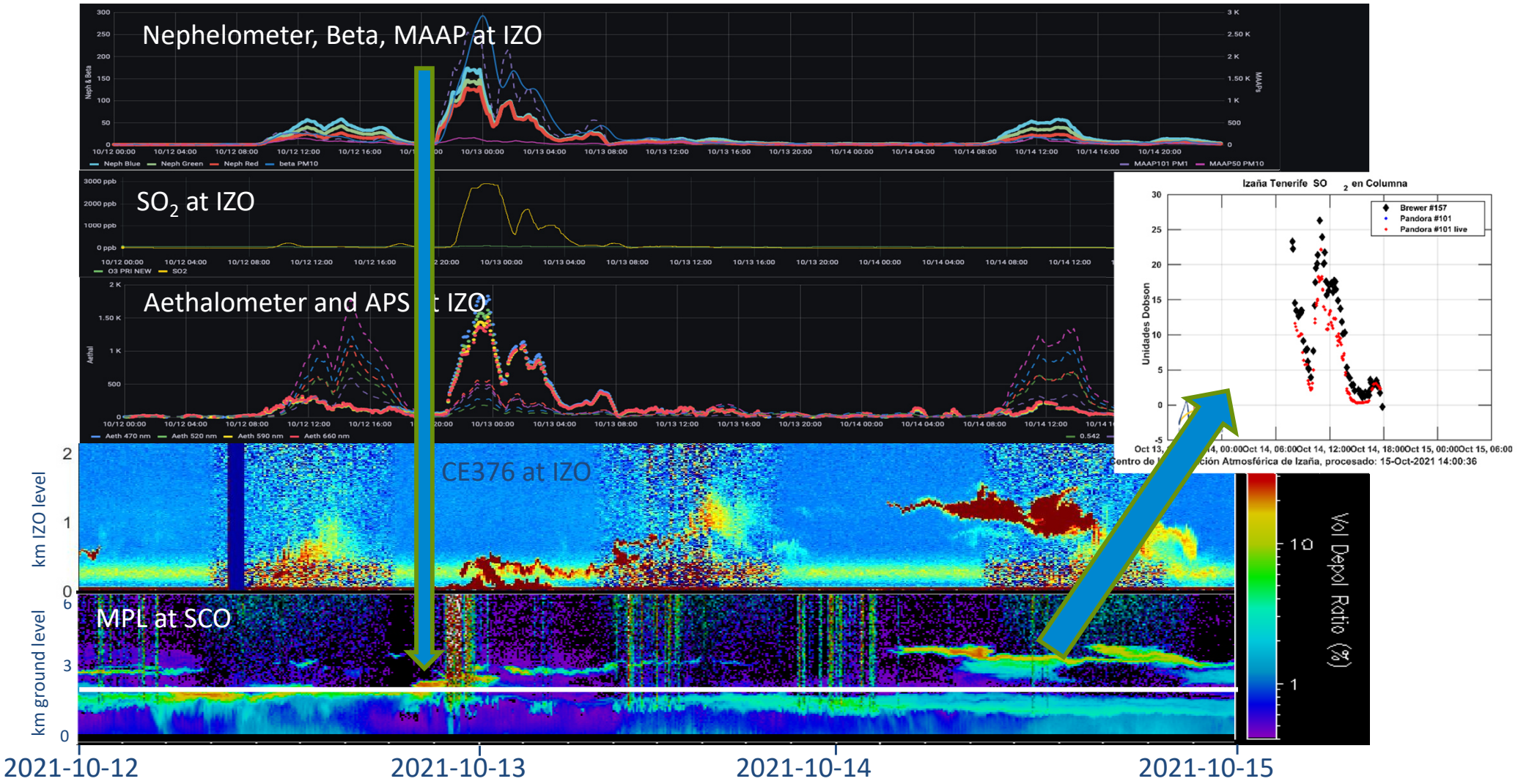
Estación de Tenerife: Monitoreo de gases reactivos y GHG con técnicas in-situ



Estación de Tenerife: Monitoreo de SO_2 con técnicas RS



Estación de Tenerife: Perspectiva sinergética



04 TRABAJOS EN CURSO

Trabajos en curso

Publicados

remote sensing MDPI

Communication

Volcanic Eruption of Cumbre Vieja, La Palma, Spain: A First Insight to the Particulate Matter Injected in the Troposphere

Michaël Sicard [1,2,*], Carmen Córdoba-Jabonero [3], Africa Barreto [4], Ellsworth J. Welton [5], Cristina Gil-Díaz [1], Clara V. Carvajal-Pérez [3], Adolfo Comerón [1], Omaira García [4], Rosa García [6], María-Ángeles López-Cayuela [3], Constantino Muñoz-Porcar [1], Natalia Prats [4], Ramón Ramos [4], Alejandro Rodríguez-Gómez [1], Carlos Toledano [7] and Carlos Torres [4]

remote sensing MDPI

Article

Estimation of the Mass Concentration of Volcanic Ash Using Ceilometers: Study of Fresh and Transported Plumes from La Palma Volcano

Andres E. Bedoya-Velásquez [1], Manuela Hoyos-Restrepo [1], Africa Barreto [2], Rosa D. García [2,3], Pedro Miguel Romero-Campos [2], Omaira García [2], Ramón Ramos [2], Reijo Roininen [4], Carlos Toledano [5], Michaël Sicard [6,7] and Romain Ceolato [1,*]

Enviados

MDPI

Article

Spectral aerosol radiative forcing and efficiency of the La Palma volcanic plume over the Izaña Observatory.

Rosa Delia García[1,2]*, Omaira Elena García [2], Emilio Cuevas [2], África Barreto [2], Victoria Cachorro[3], Carlos Marrero[2], Fernando Almansa [4], Ramón Ramos [2], Mário Pó [5]

Optical properties of volcanic aerosols transported over the Atlantic from the Cumbre Vieja eruption

Y. González Ramos[1,2], B. Sarangi[3], A. Barreto[2], S. Rodríguez[2,4], O.L. Mayol-Bracero[3], C. L. Marrero[2], C. Torres[2], M.F. Sanchez-Barrero[1], I. Popovici[1], L. Pronieswki[1], S. Victori[1], F.A. Almansa[1,2], R. Ramos[2], E. Cuevas[2]

En preparación:

- Milford et al., Air quality impacts of the 2021 volcanic eruption in La Palma (Canary Islands)
- Barreto et al., Volcanic plume height measured during the eruption of the Cumbre Vieja volcano (La Palma) by means of two complementary monitoring methodologies. Implications for satellite SO2 volcanic emission fluxes
- García et al., Sulphur dioxide from ground-based Fourier transform infrared spectroscopy: application to volcanic emissions
- Córdoba-Jabonero et al., Fresh volcanic aerosols injected in the atmosphere during the eruptive activity of the Tajogaite/Cumbre Vieja volcano (La Palma, Canary Islands): Temporal evolution and vertical impact

¡Gracias!

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