# AEROSOL PROPERTIES OBSERVED IN THE GLOBAL ATMOSPHERIC WATCH PROGRAM OF IZAÑA OBSERVATORY (TENERIFE): CHEMICAL COMPOSITION AND SIZE DISTRIBUTION

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**Izaña Atmospheric Research Centre (IARC)**; La Marina 20, 6ª, Santa Cruz de Tenerife

**Project:** "Aerosol in-situ characterization program in the framework of the Global Atmospheric Watch: training in techniques of sampling for chemical analysis, size distribution measurements, data validation and analysis "

# CONTENTS

## CONTENTS



# 1. INTRODUCTION

**Atmospheric Aerosol → (Particulate Matter, Suspended Particles) :**

- A suspension of fine solid or liquid material in a gas.
- Diameter Size : 1 nm - 100 µm.
- Mixture of natural matter with anthropogenic substances.

**Matter of concern for several reasons:**

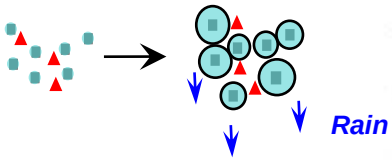
1. Air Quality Impairment: cardiovascular and respiratory diseases

   $PM_{10}$
   $PM_{2.5}$
   Ultrafine Particles
   Chemical Composition

2. Influence on Climate → *IPCC (2007)*

   a) Interaction of aerosols with incoming sun light.

   b) Involved in cloud formation and cloud properties: influence on rain pattern and hydrological cycle



# CONTENTS




http://www.wmo.int/pages/prog/arep/gaw/gaw_home_en.html


***GAW objectives:***

*Long term monitoring of aerosol properties that affects air quality, radiative forcing and climate*

**1. Particle Size Distribution**

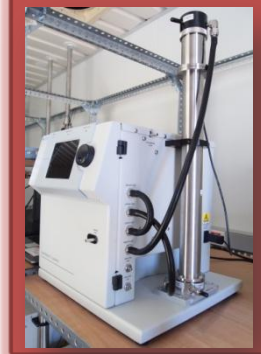
**2. Chemical Composition**

3. Optical Properties

# CONTENTS



**SMPS**
(**S**canning **M**obility **P**article **S**izer)



**OPC**
(**O**ptic **P**article **C**ounter)

**APS**
(**A**erodynamic **P**article **S**izer)

**UCPC**
(**U**ltrafine **C**ondensation **P**article **C**ounter)

**Integrating Nephelometer**

**2 x MAAP**
(**M**ulti**A**ngle **A**bsorption **P**hotometer)

**HVS**
(**H**igh **V**olume **S**amplers)

**Aethalometer**

**2 x CPC**

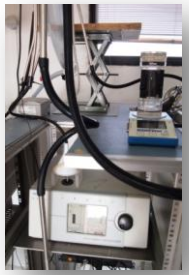
# CONTENTS



## 2. REGULAR ACTIVITIES

### 2.1 Instrumentation → SMPS, CPC, PMx, samplers

a) Principle of Measurement
b) Calibration
c) Maintenance
d) Troubleshooting

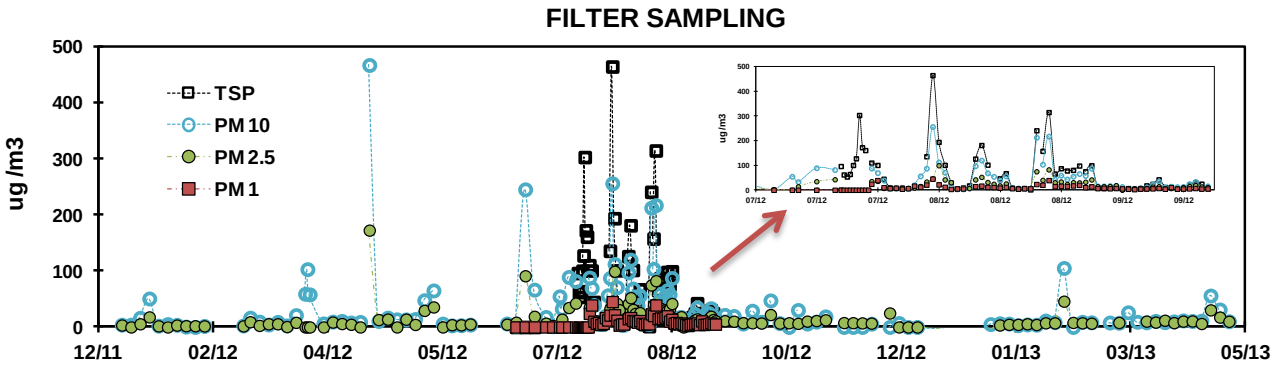



### 2.2 Filter Sampling

a) PM10
b) PM2.5
c) TSP
d) PM1

### 2.3 Data Analysis

a) Validation of Data
b) Evaluation of Data



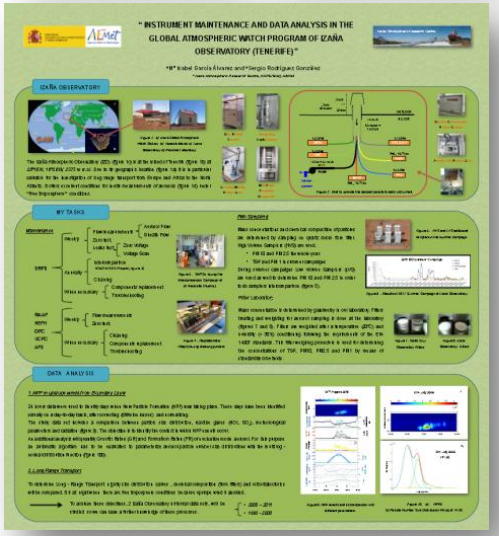
# CONTENTS



## 3. COMPLEMENTARY ACTIVITIES

### 3.1 Campaigns

- ✓ Izaña Summer Campaign
- ✓ OC/ EC Artefacts
- ✓ SMPS Huelva Campaign *(November 2012)*
- ✓ POPs Campaign *(each 3 month)*
- ✓ PM10 LVS *(daily samples)*




### 3.2 Courses

**8th Summer School on Atmospheric Aerosol Physics, Measurement, and Sampling**

**Hyytiälä, Finland, May 5-11, 2012**

## CONTENTS



# 4. RESULTS

**Ph - D**

**Director** : Dr. D.Sergio Rodríguez
(*Atmospheric Research Centre of Izaña*)

**Co-Directors:** Dr. D.Andrés Alastuey
*(Institute of Environmental Assessment and Water Research(IDÆA-CSIC) ).*
Dr. D.Barend L. Van Drooge.
*(Institute of Environmental Assessment and Water Research(IDÆA-CSIC) ).*

**Tutor** : Dr. D.Luis Galindo
*(Department of Analytical Chemistry, Nutrition and Bromatology, La Laguna University).*

## 4.1 Climatology of new particle formation events in the subtropical North Atlantic free troposphere at Izaña GAW observatory


## 4.2 Filter Sampling chemical composition

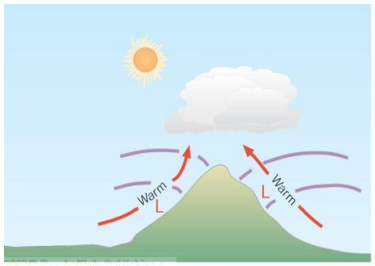
# CONTENTS

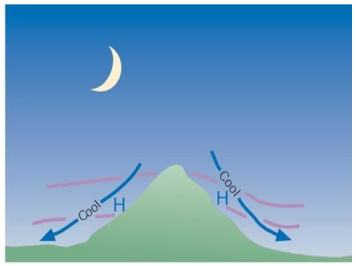


## 4.1 Climatology of new particle formation events in the subtropical North Atlantic free troposphere at Izaña GAW observatory

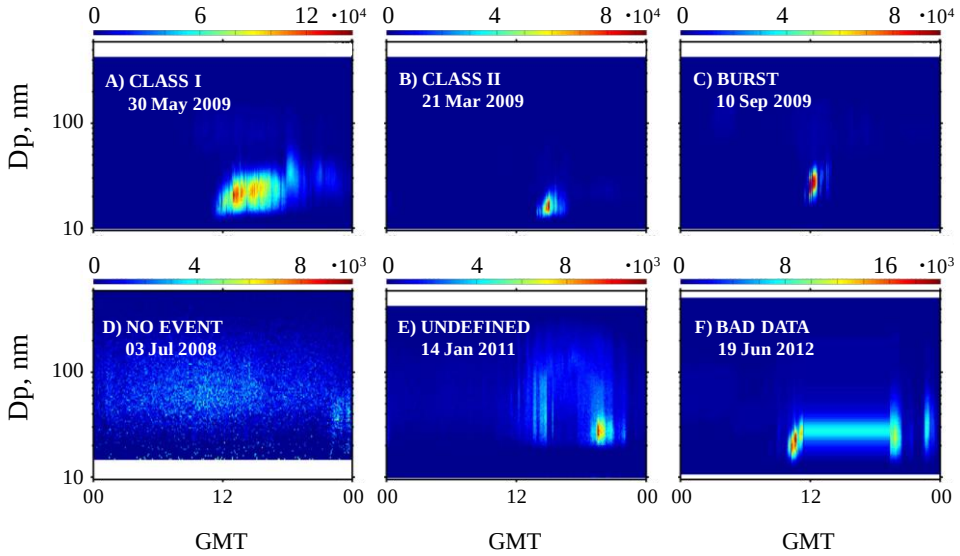
**Nucleation :**

Formation of new aerosol particles, detected at sizes greater than 3 nm, and their subsequent growth up to 100 nm.



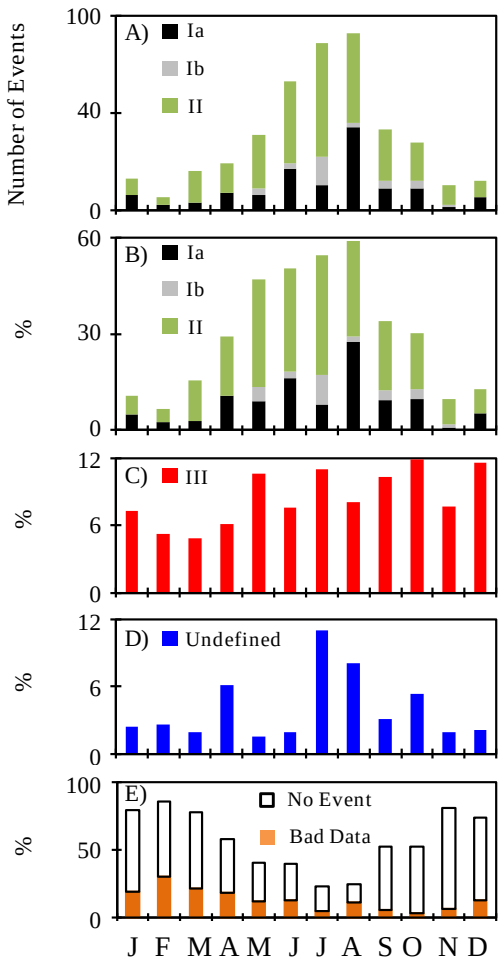

**STUDY PERIOD : June 2008 – June 2012**

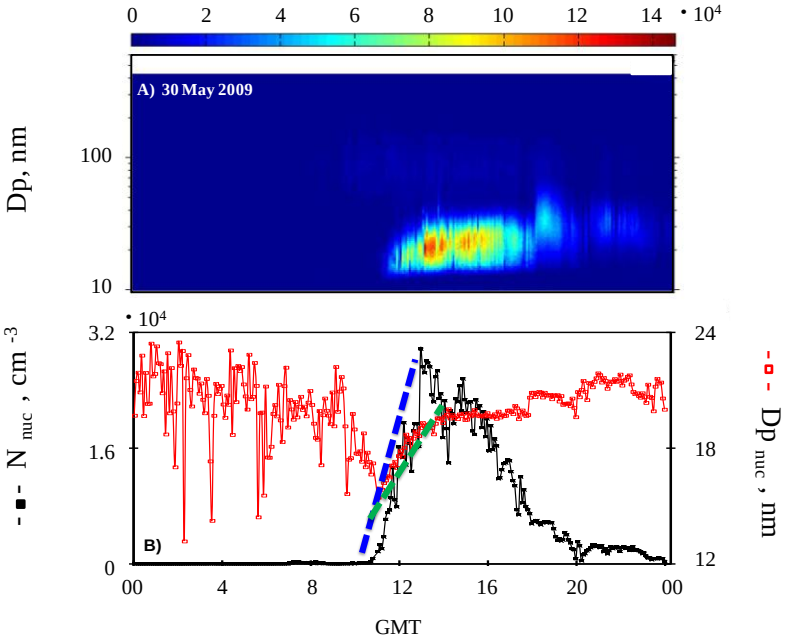



| Event type | Number | % |
|---|---|---|
| **Class Ia** | **109** | **9.25** |
| **Class Ib** | 26 | 2.21 |
| **Class II** | 227 | 19.27 |
| Class III | 101 | 8.57 |
| Non- Event | 514 | 43.63 |
| Undefined | 50 | 4.24 |
| Bad Data | 151 | 12.82 |
| **Total days** | **1178** | **100** |

# CONTENTS





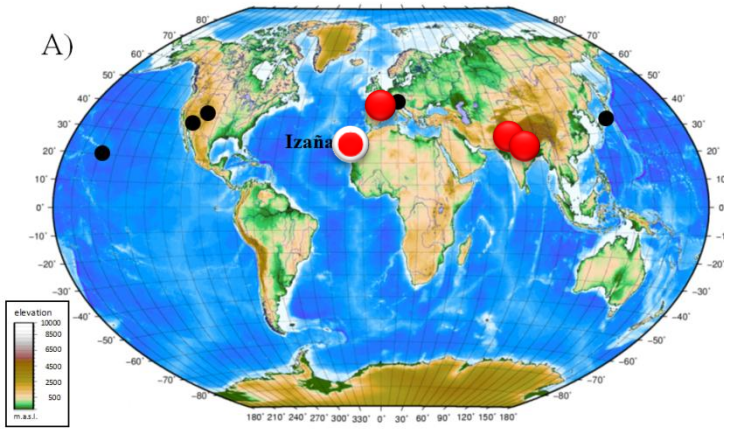

Atmospheric aerosol formation events are usually characterized by two quantities:

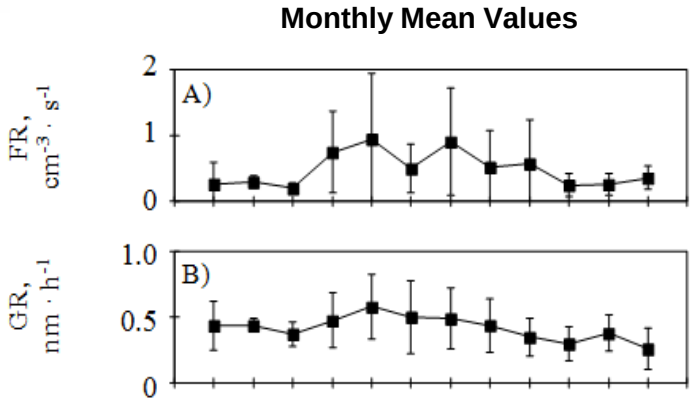
- aerosol ***formation rate***
- aerosol ***growth rate***

The **mean GR** during the study period was **0. 42 nm·h$^{-1}$** and the **mean FR 0. 49 cm$^{-3}$·s$^{-1}$**

# CONTENTS



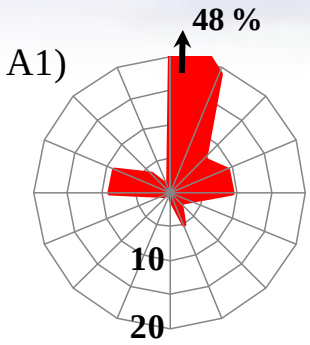


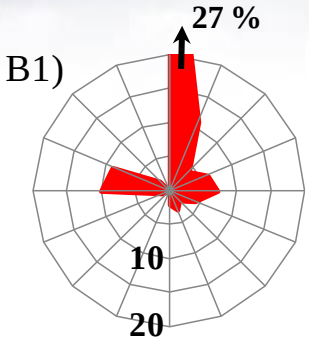

| Mount /Observatory | Study Duration | Altitude, m.a.s.l | Region | FR, $cm^{-3} \cdot s^{-1}$ | GR, $nm \cdot h^{-1}$ |
|---|---|---|---|---|---|
| **Izaña** | **4 Years** | **2400** | ***Atlantic Ocean*** | **0.49 ± 0.57** | **0.42 ± 0.21** |
| Mauna Loa | 2 Months | 3400 | *Pacific Ocean* | 0.50 ± 0.57 | 0.40 ± N/A |
| Jungfraujoch | 1 Year | 3580 | *Europe* | 0.90 ± N/A | 6.00 ± N/A |
| Puy de Dôme | **5 Years** | 1465 | *Europe* | | 5.00 ± 3.50 |
| Pyramide | **16 Months** | 5079 | *Asia, Everest* | 0.17 ± N/A | 1.80 ± 0.70 |
| Mukteshwar | **5 Years** | 2180 | *Asia, Himalaya* | 0.40 ± N/A | 2.43 ± 0.70 |
| Norikura | 1 Year | 2770 | *Asia, Japan* | | 2.85 ± N/A |
| Lemmon | 4 Months | 2790 | *North America* | | 16.50 ± N/A |
| Rocky | 1 Month | 2900 | *North America* | | 3.96 ± N/A |

# CONTENTS

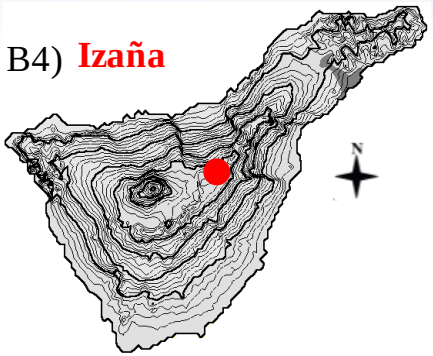





F Step , frequency %




G Step , frequency %




## Context during NPF events

| | |
|---|---|
| Ozone (ppb) | T (ºC) |
| $SO_2$ (ppt) | Relative Humidity (%) |
| $NO_x$ (ppt) | Water Vapour ($g \cdot cm^{-3}$) |
| Global ($w \cdot m^{-2}$) | Wind speed ($m \cdot s^{-1}$) |
| Diffuse ($w \cdot m^{-2}$) | Wind X- Component ($m \cdot s^{-1}$) |
| Direct ($w \cdot m^{-2}$) | Wind Y- Component ($m \cdot s^{-1}$) |
| UV-B ($w \cdot m^{-2}$) | Vertical Wind ($m \cdot s^{-1}$) |
| UV-A ($w \cdot m^{-2}$) | Dust |

✓ **Type Ia events**

↑ $SO_2$, Global, UV-A, UV-B ***//*** ↓ WS

✓ **Type Ia versus other type events**

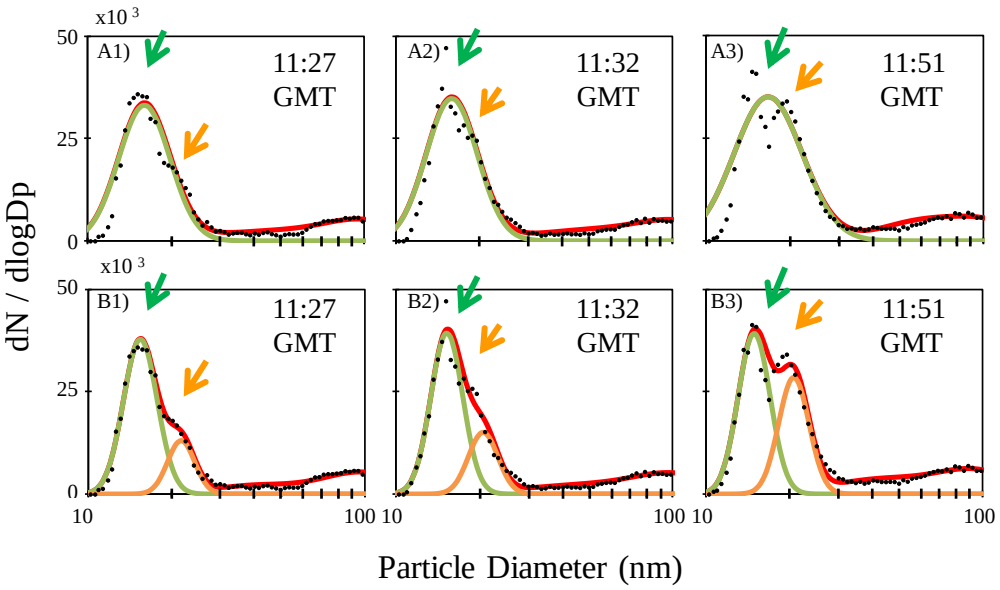
$SO_2$, → Length Banana // T ↑ and RH ↓

✓ **Year to year variability**

Influenced by dust concentration.

# CONTENTS






| Method / Day | GR, nm·h$^{-1}$ SMPS data | GR, nm·h$^{-1}$ 1 nuc. mode fitting | GR, nm·h$^{-1}$ 2 nuc. mode fitting (nuc. mode 1) | GR, nm·h$^{-1}$ 2 nuc. mode fitting (nuc. mode 2) |
|---|---|---|---|---|
| 30 May 2009 | 0.98 | 1.40 | 0.27 | 0.58 |
| 5 Jul. 2009 | 0.46 | 1.74 | 1.01 | 0.55 |
| 16 Aug. 2010 | 0.39 | 1.40 | 0.83 | 0.56 |
| 20 Aug. 2010 | 0.90 | 3.44 | 0.59 | 1.59 |

# CONTENTS



## 4.2 Filter Sampling chemical composition

(Management entrustment, IDAEA-CSIC; Barcelona)

**STUDY PERIOD : 2008 - 2011**

Chemical Composition

→ OC / EC validation

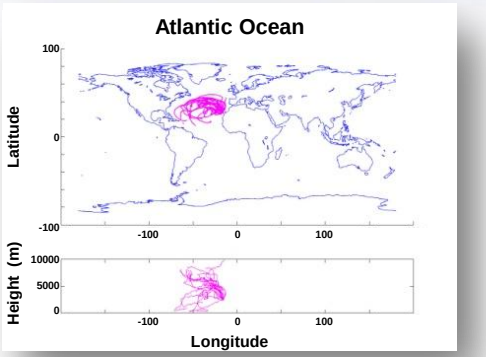
| | | | |
|---|---|---|---|
| $Al_2O_3$ | Ca | K | Mg |
| Fe | Ti | P | Na |
| $CO_3^{2-}$ | ind. Ca | | $NH_4^+$ |
| $SiO_2$ | ind. Al | | $SO_4^{2-}$ |
| $SO_4^{2-}$ | ind. Na | | $Cl^-$ |
| | | | $NO_3^-$ |

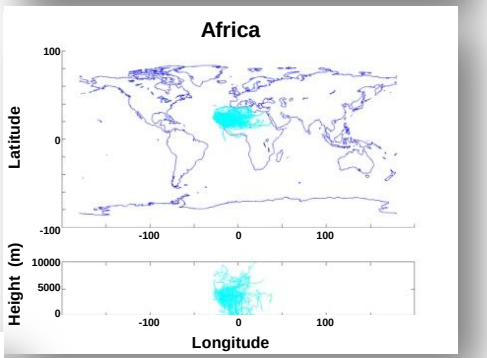
As, Ba, Bi, Cd, Ce, Co, Cr, Cs, Cu, Dy, Er, Ga, Gd, Ge, Hf, La, Li, Mn, Mo, Nd, Ni, Pb, Pr, Rb, Sb, Sc, Se, Sm, Sn, Sr, Ta, Th, Ti, Tl, U, V, W, Yb, Zn, Zr

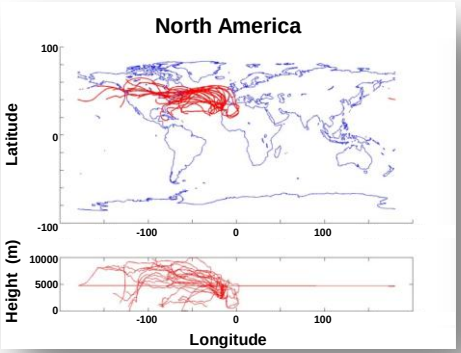
- SMPS Size Distribution
- Reactive gases
- Radiation
- Meteorological parameters

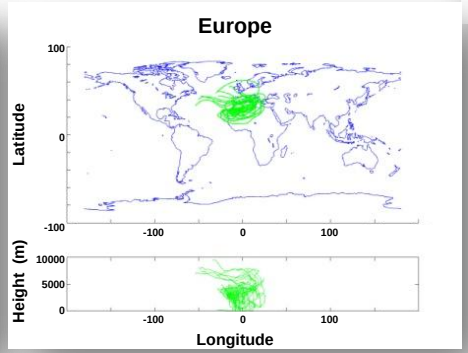
- APS Size Distribution

- Back-trajectories




**Different origin → Different concentration of chemical species and pollutants ?**

# CONTENTS



# 5. CONGRESSES AND PUBLICATIONS

## 5.1 Congresses

**Characterization of new particles formation events at Izaña Mountain Observatory (Tenerife, Canary Islands): formation, growth rates and influencing atmospheric parameters**

M.I. García[1], S. Rodríguez[1], R.D García[1] and Y. González[1]

**Calibration and intercomparison results in the Spanish network on environmental DMAs**

F. J. Gómez-Moreno[1], B. Artíñano[1], V. Juncal Bello[2], M. Piñeiro Iglesias[2], P. López Mahía[2], N. Pérez[3], J. Pey[3], A. Alastuey[3], M. Sorribas[4], B. A. de la Morena[4], M.I. García[5], S. Rodríguez[5], G. Titos[6,7], H. Lyamani[6,7] and L. Alados-Arboledas[6,7]

**The Spanish network on environmental DMAs: the 2012 SMPS+UFP intercomparison campaign and study on particle losses in dryers**

F. J. Gómez-Moreno[1], E. Alonso[1], B. Artíñano[1], V. Juncal Bello[2], M. Piñeiro Iglesias[2], P. López Mahía[2], N. Pérez[3], J. Pey[3], A. Alastuey[3], B. A. de la Morena[4], M. I. García[5], S. Rodríguez[5], M. Sorribas[6,7], G. Titos[6,7], H. Lyamani[6,7] and L. Alados-Arboledas[6,7]

**The REDMAAS 2012 SMPS+UFP intercomparison campaign**

F. J. Gómez-Moreno[1], E. Alonso[1], B. Artíñano[1], V. Juncal Bello[2], M. Piñeiro Iglesias[2], P. López Mahía[2], N. Pérez[3], J. Pey[3], A. Alastuey[3], B. A. de la Morena[4], M. I. García[5], S. Rodríguez[5], M. Sorribas[6,7], G. Titos[6,7], H. Lyamani[6,7] and L. Alados-Arboledas[6,7]

# CONTENTS



## 5.2 Publications

**Climatology of new particle formation events in the subtropical North Atlantic free troposphere at Izaña GAW observatory**

M.I. García[1,2], S. Rodríguez[1], Y. González[1], R.D. García[1,3]

**INTERCOMPARACIONES DE LA RED ESPAÑOLA DE DMAs (REDMAAS) EN LA ESTACION DE SONDEOS ATMOSFÉRICOS DEL INTA EN EL ARENOSILLO**

**Editores Científicos:** M. Sorribas, B.A. de la Morena y F.J. Gómez-Moreno

**Autores:** F.J. Gómez-Moreno[1], M. Sorribas[2,3], E. Alonso[1], B. Artíñano[1], V. Juncal Bello[4], M. Piñeiro Iglesias[4], P. López Mahía[4], N. Pérez[5], J. Pey[5], A. Alastuey[5], M. I. García[6], S. Rodríguez[6], G. Titos[2,3], H. Lyamani[2,3], L. Alados-Arboledas[2,3] y B.A. de la Morena[7]

# THANKS FOR

# YOUR ATTENTION