

# INPs in Argentina: performed measurements and perspectives

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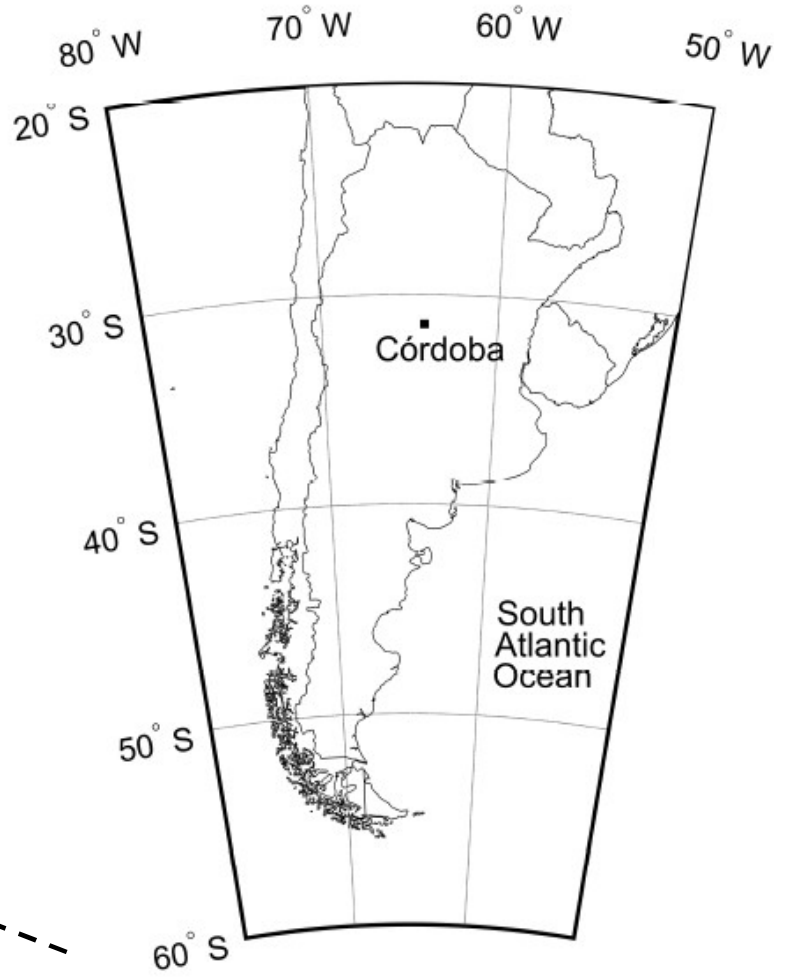
Consejo Nacional de Investigaciones Científicas y Tecnológicas  
National Council for Scientific and Technological Research



Universidad Nacional de Córdoba  
National University of Córdoba

# Location

<https://www.mapas-del-mundo.net/>



- Molecular dynamics
- Polar ice
- Lightning activity
- Thunderstorm electrification
- Cloud microphysical processes
- INPs measurements: since 2013



Temperature control up to  $-50^{\circ}\text{C}$ .



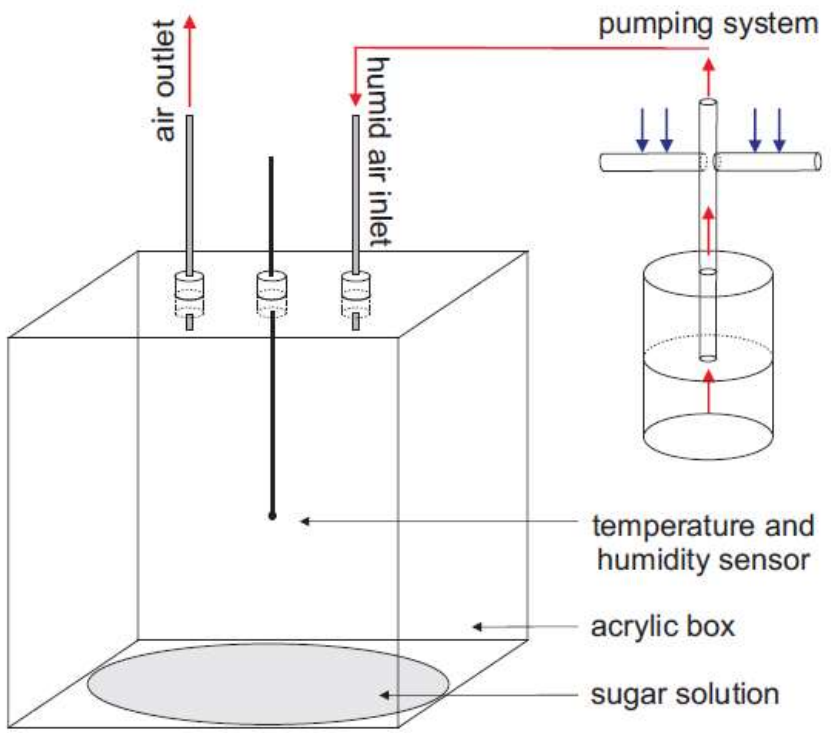
Temperature control up to  $-35^{\circ}\text{C}$ .

- INPs concentration by deposition mode
- INPs concentration (four modes)
- INPs by immersion freezing
- Perspectives

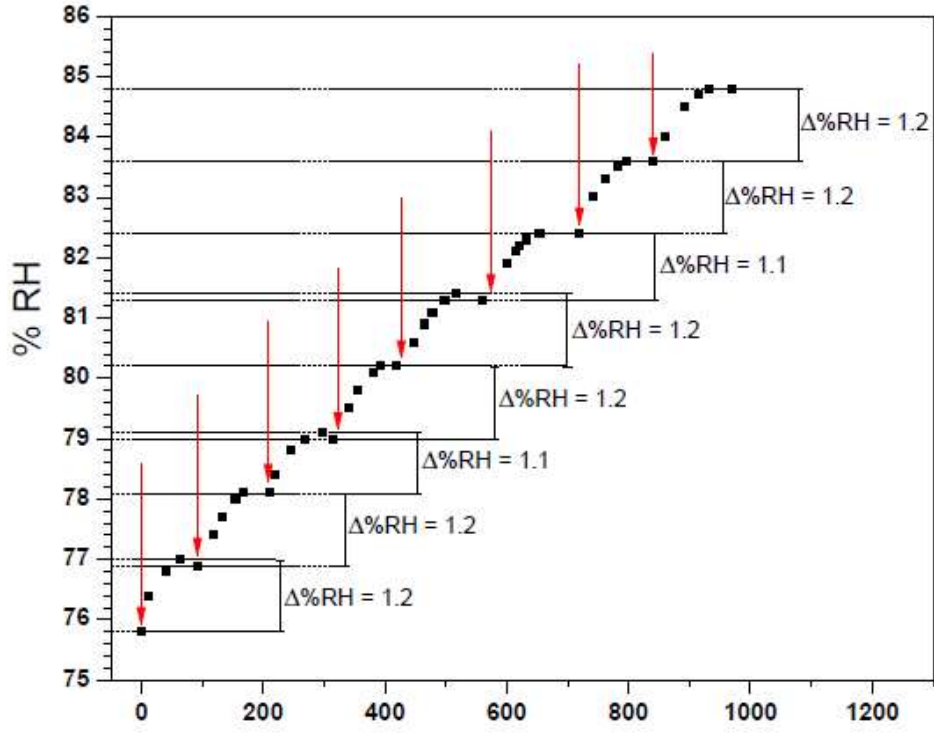
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# INPs concentration by deposition mode

Site of study: Córdoba city.  $-15^{\circ}\text{C} < T < -35^{\circ}\text{C}$



Cloud chamber



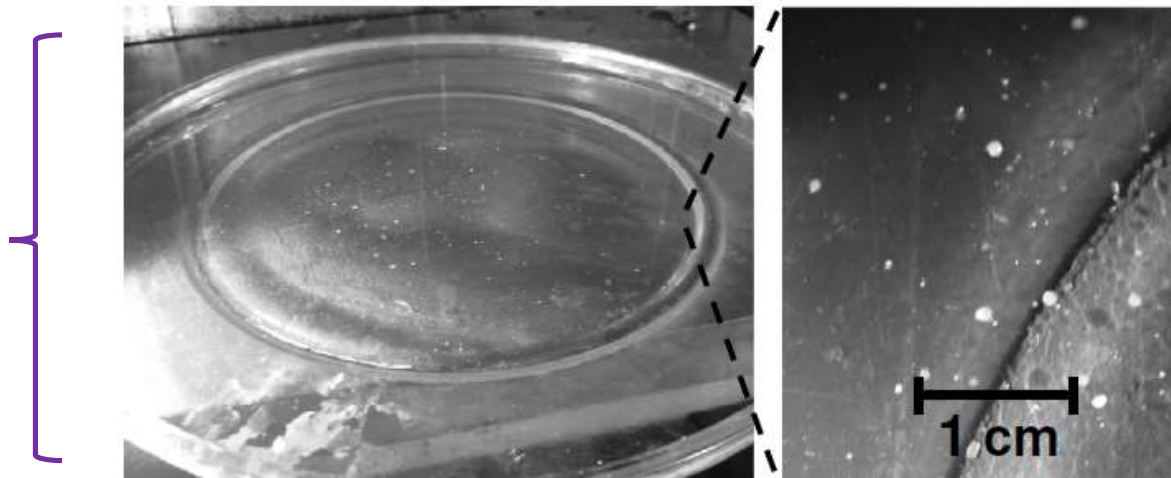
Calibration



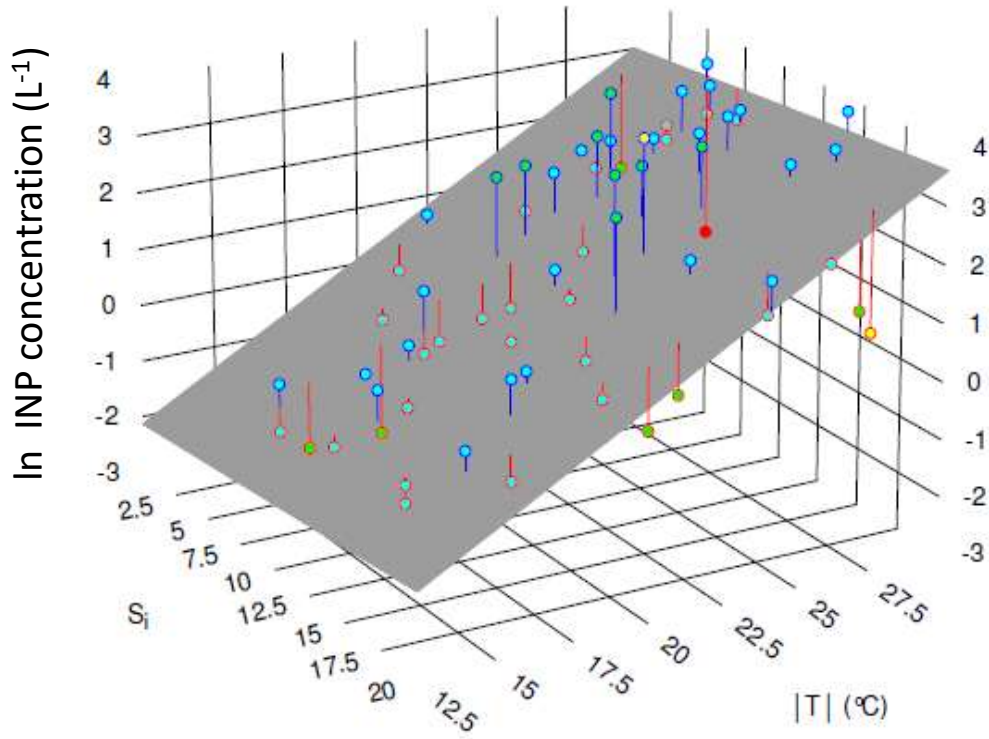
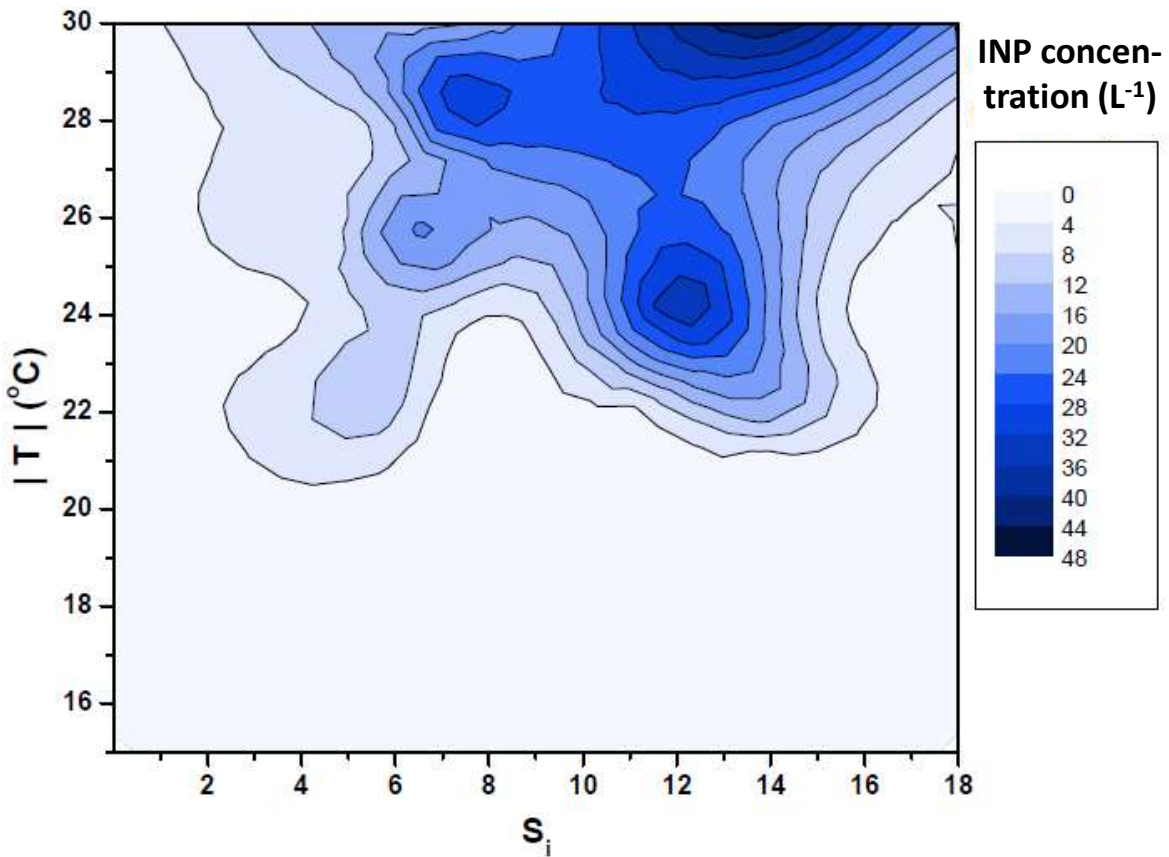
López, M. L. and Ávila, E. E.: **Measurements of natural deposition ice nuclei in Córdoba, Argentina**, Atmos. Chem. Phys., 13, 3111–3119, <https://doi.org/10.5194/acp-13-3111-2013>, 2013

Quantification method: Bigg (1957)

Solution:  
Water, sugar,  
glycerol



# INPs concentration by deposition mode

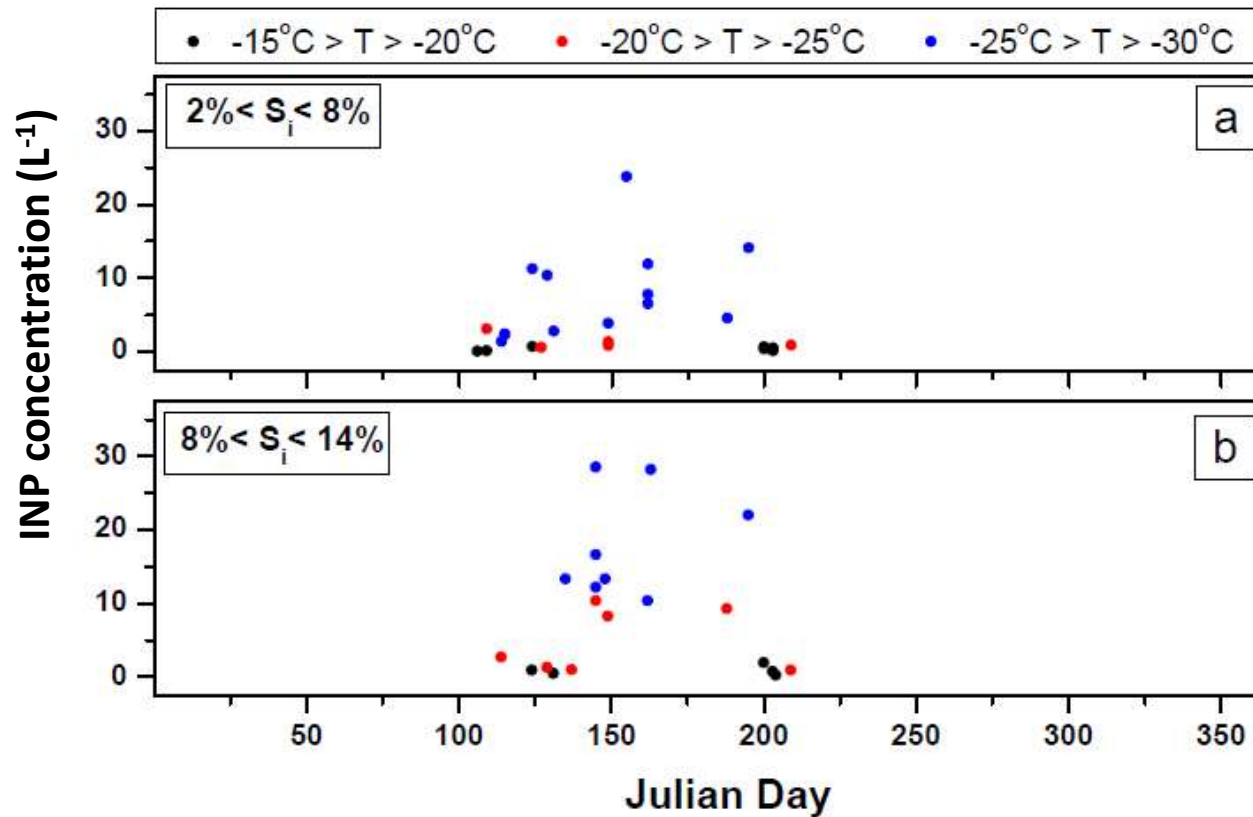


$$INP = C \exp(a|T| + bS_i)$$

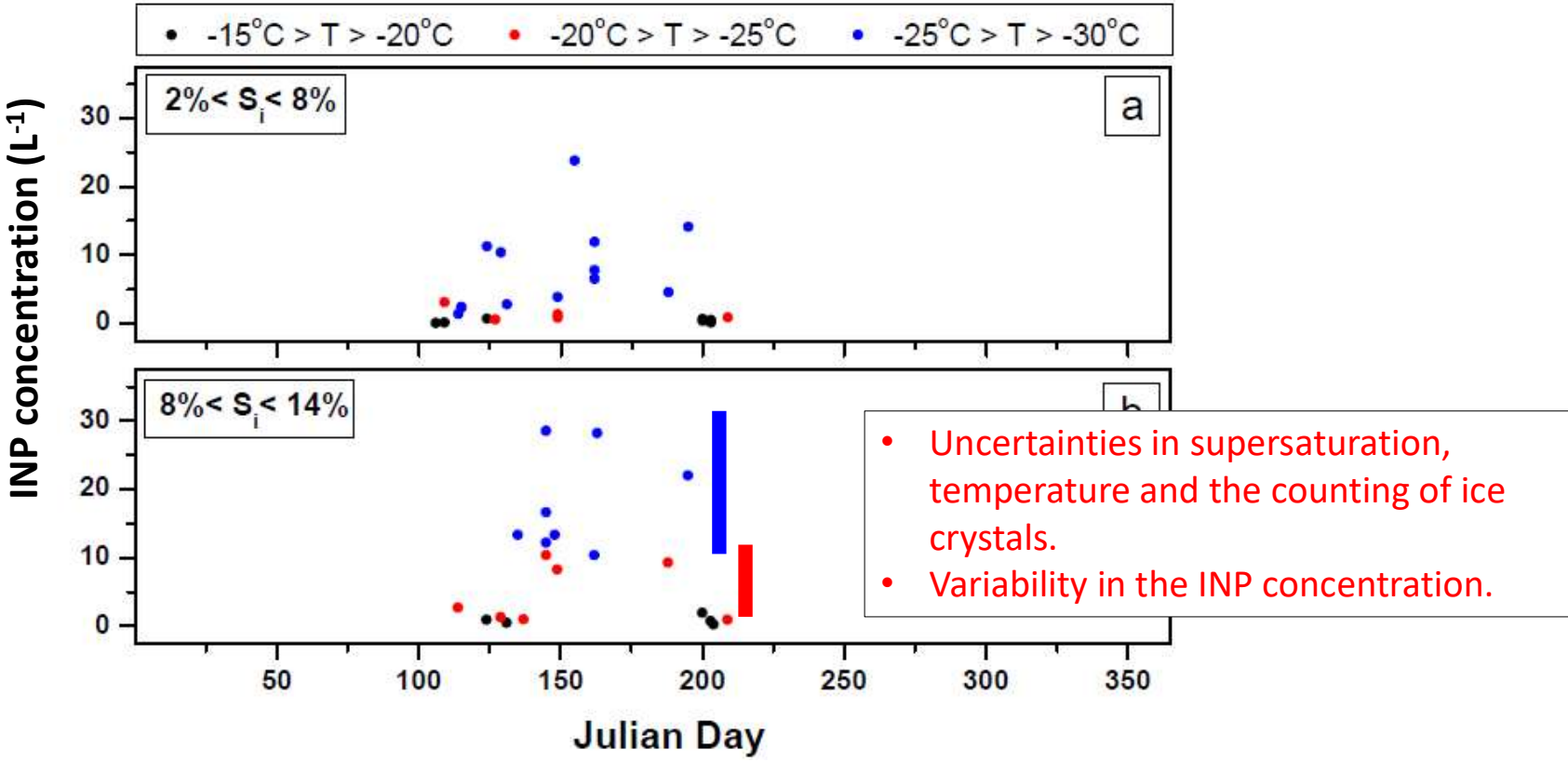


López, M. L. and Ávila, E. E.: **Measurements of natural deposition ice nuclei in Córdoba, Argentina**, Atmos. Chem. Phys., 13, 3111–3119, <https://doi.org/10.5194/acp-13-3111-2013>, 2013





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# INPs concentration by deposition mode

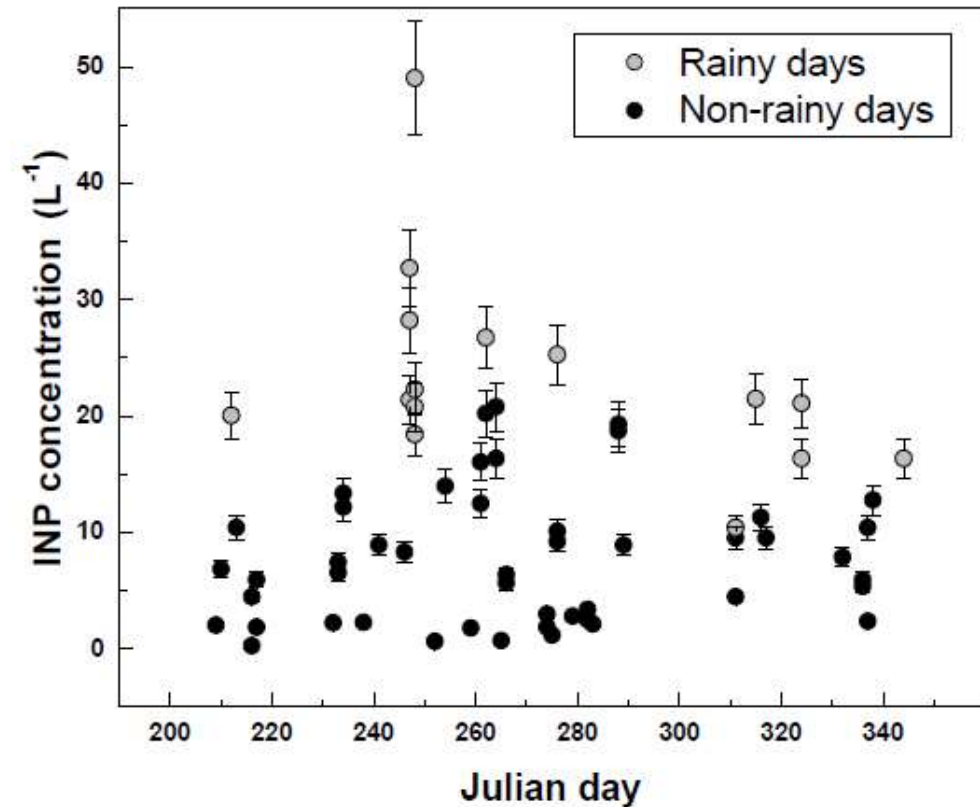
10

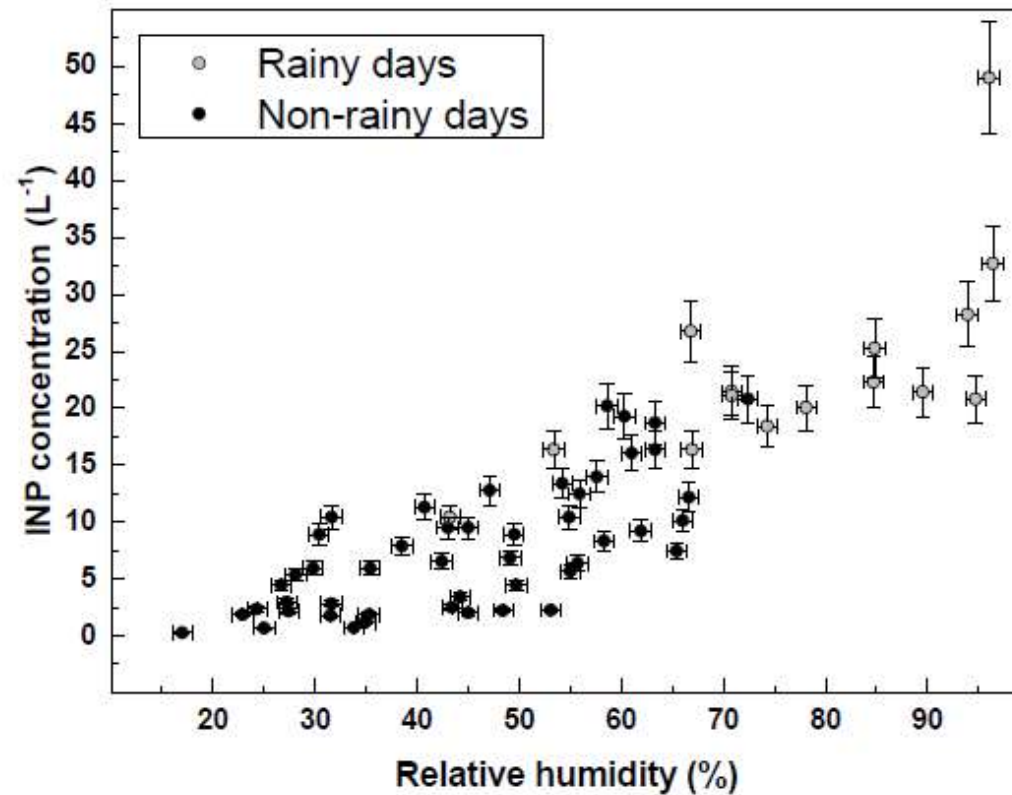
Site of study: Córdoba city

Quantification method: Bigg (1957)

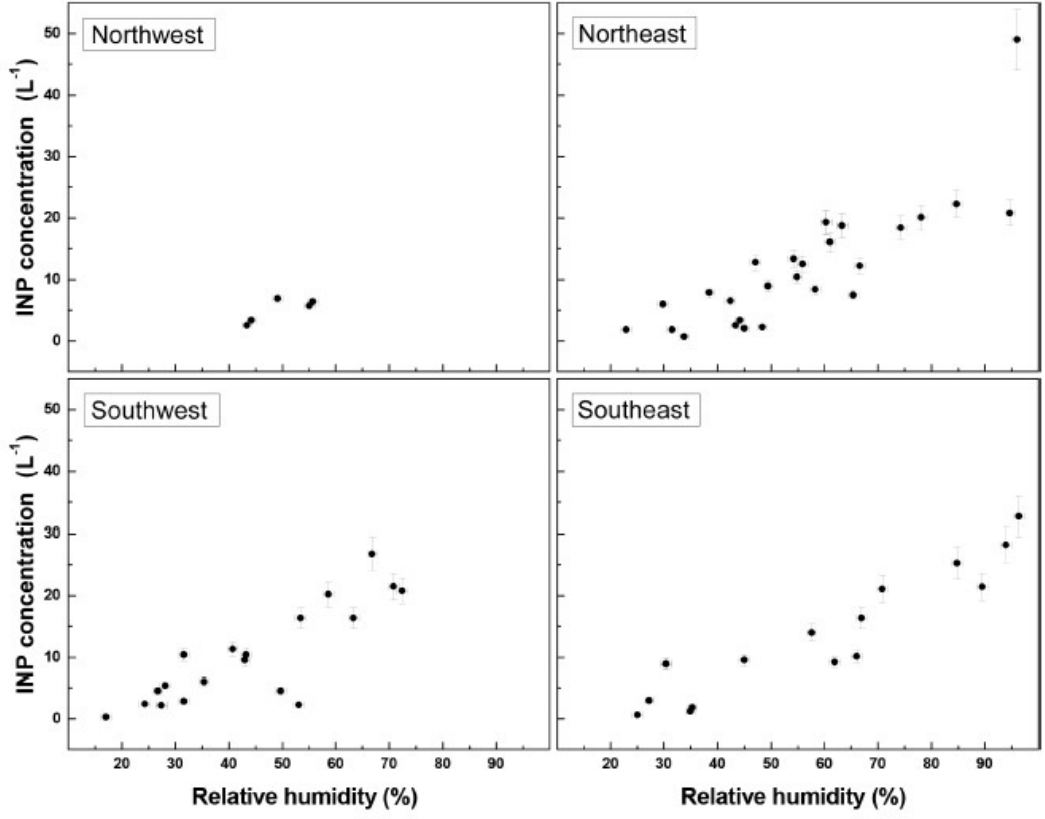
$T = -25^{\circ}\text{C}$

$S_i = 15\%$





# INPs concentration by deposition mode



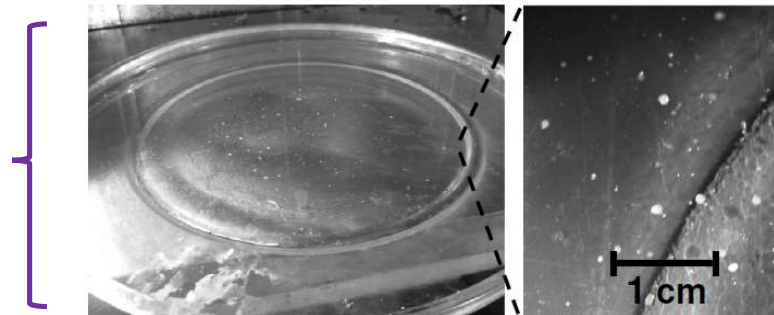
López, M. L. and Ávila, E. E.: Influence of the ambient humidity on the concentration of natural deposition-mode ice-nucleating particles, Atmos. Chem. Phys., 16, 927–932, <https://doi.org/10.5194/acp-16-927-2016>, 2016.



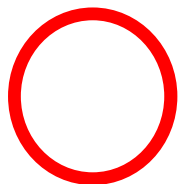
Quantification method: Bigg (1957)

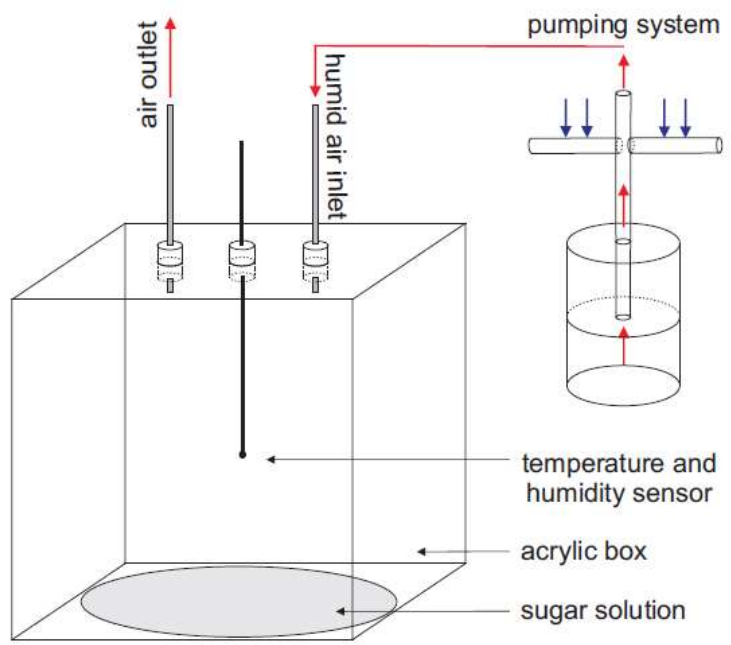


Solution:  
Water, sugar,  
glycerol ( $\downarrow T_c$ )

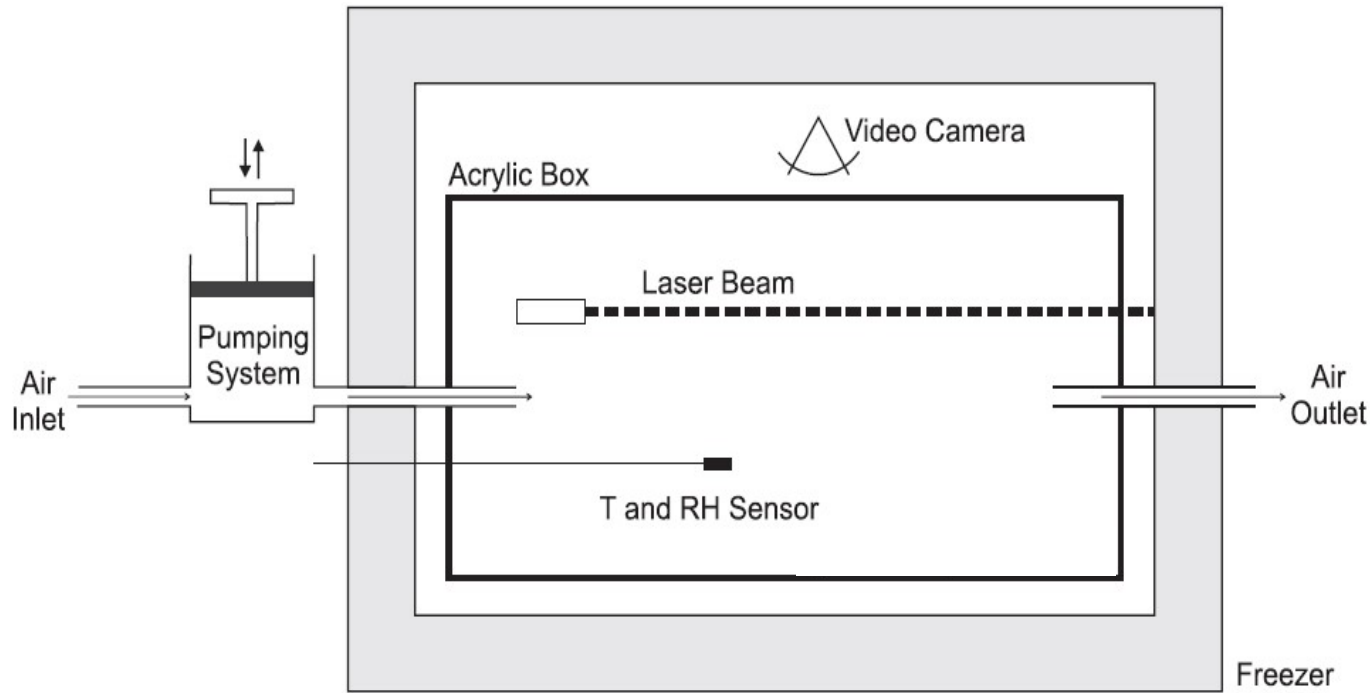


Quantification by sparkles





Cloud chamber in the previous papers

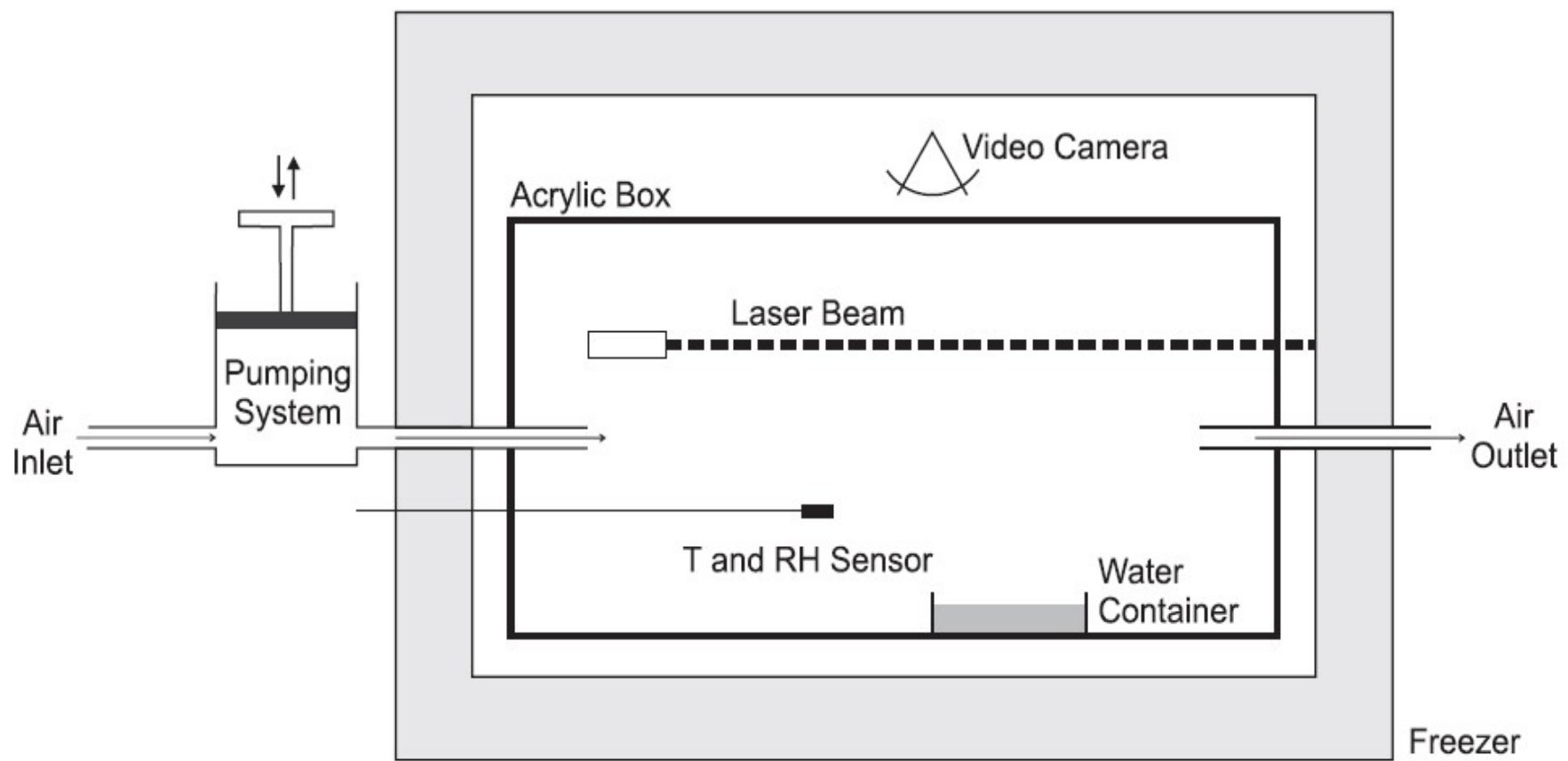


Cloud chamber in the present work

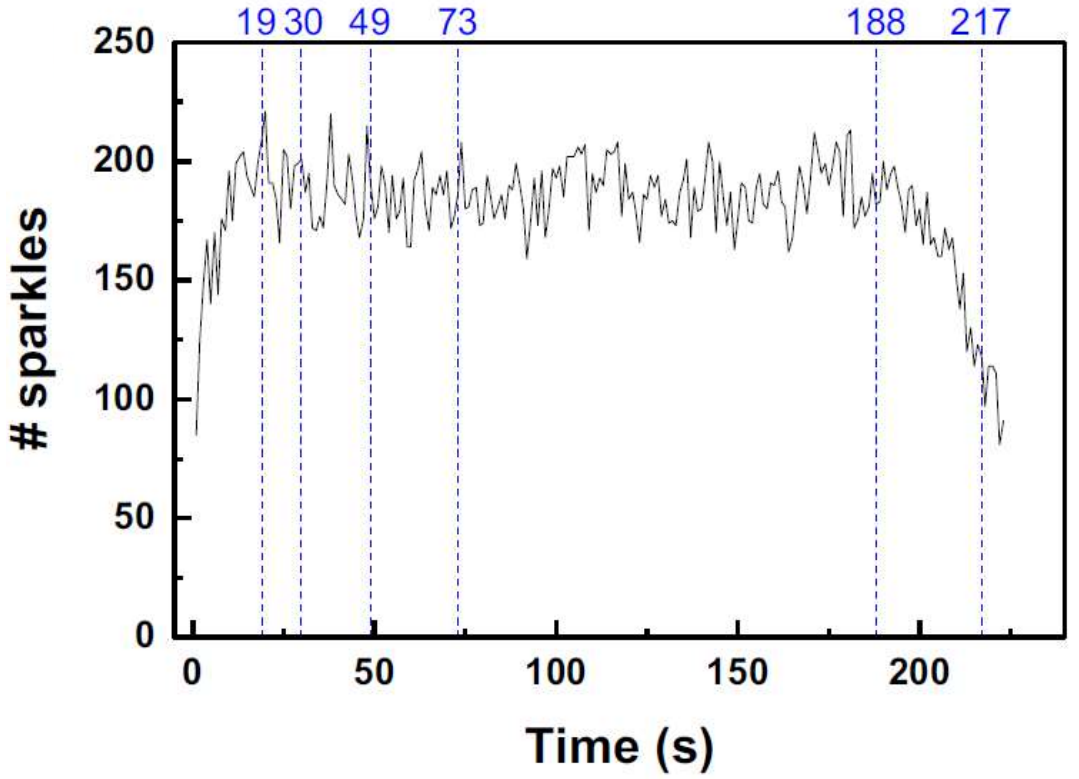
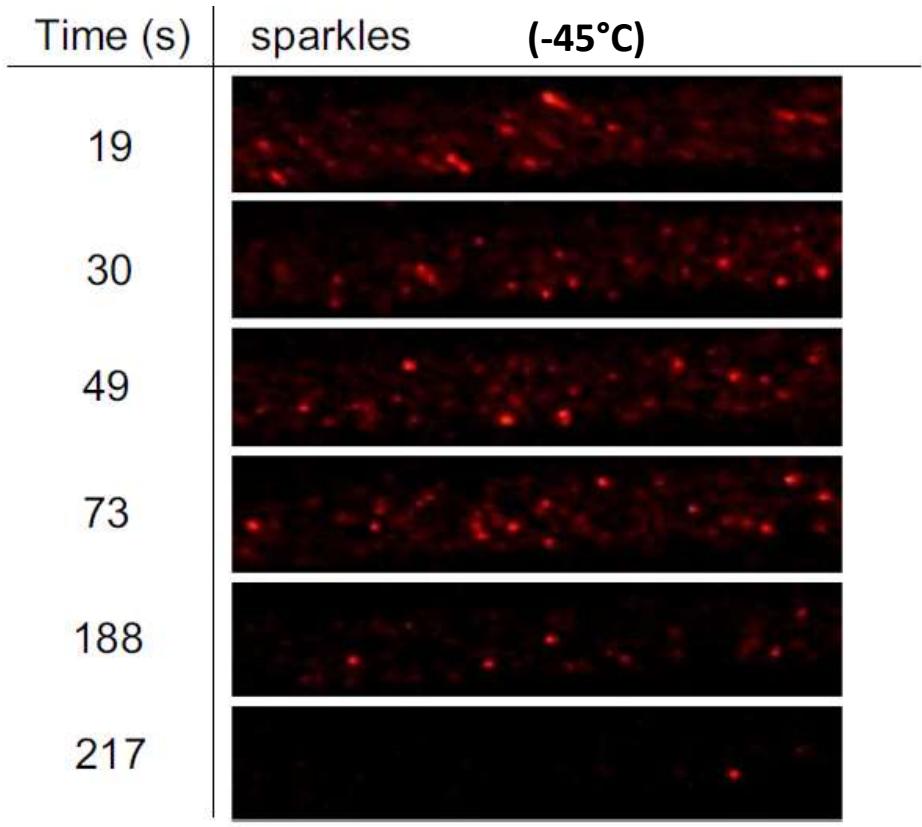


- INPs concentration by deposition mode
- INPs concentration (four modes)
- INPs by immersion freezing
- Perspectives

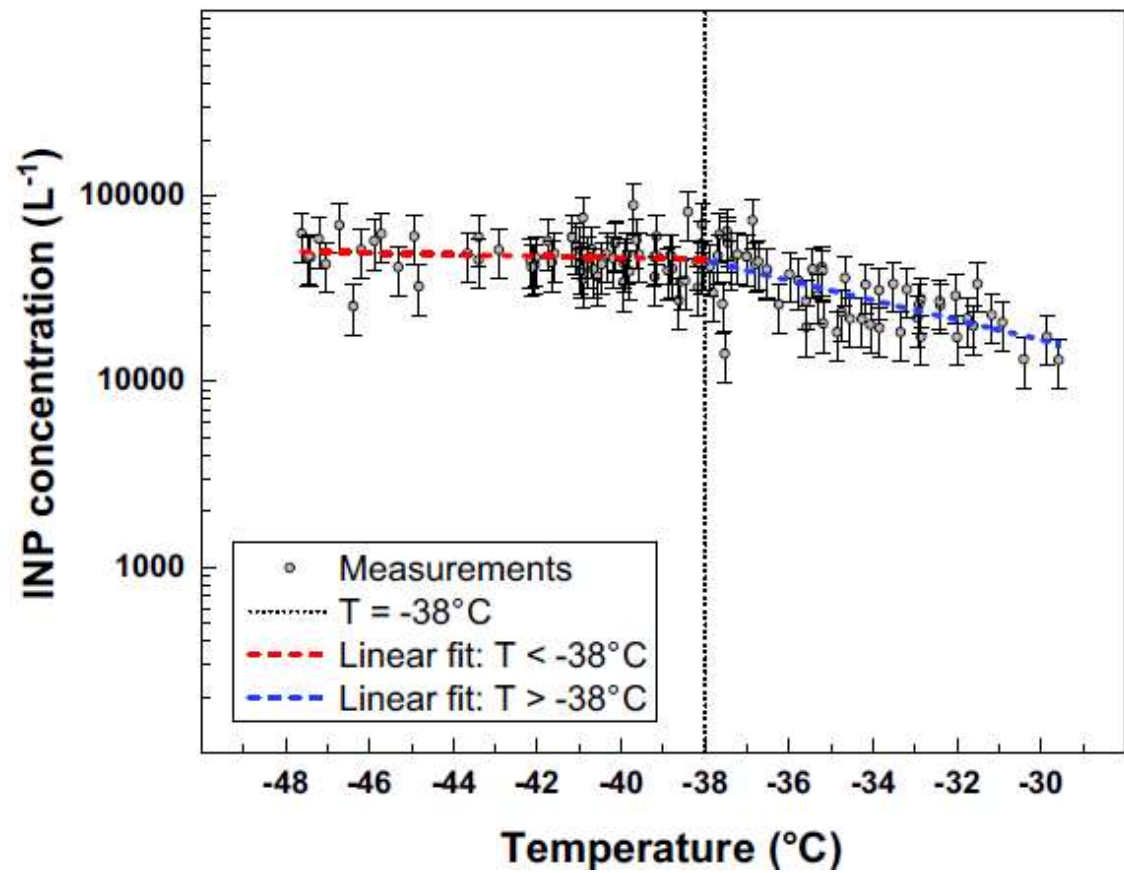
# INPs concentration (four modes)



# INPs concentration (four modes)

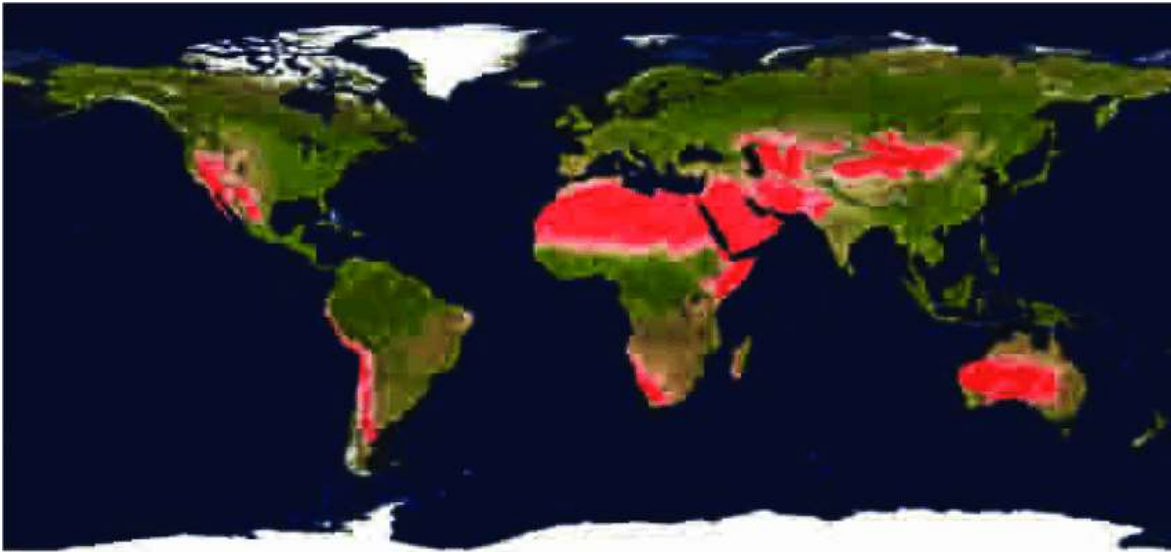


López, M. L. and Bürgesser, R. E.: **Laboratory measurements of ice nuclei particle concentration in the range of -29°C to -48 °C**, Atmos. Res., 251, 105433, <https://doi.org/10.1016/j.atmosres.2020.105433>, 2021.

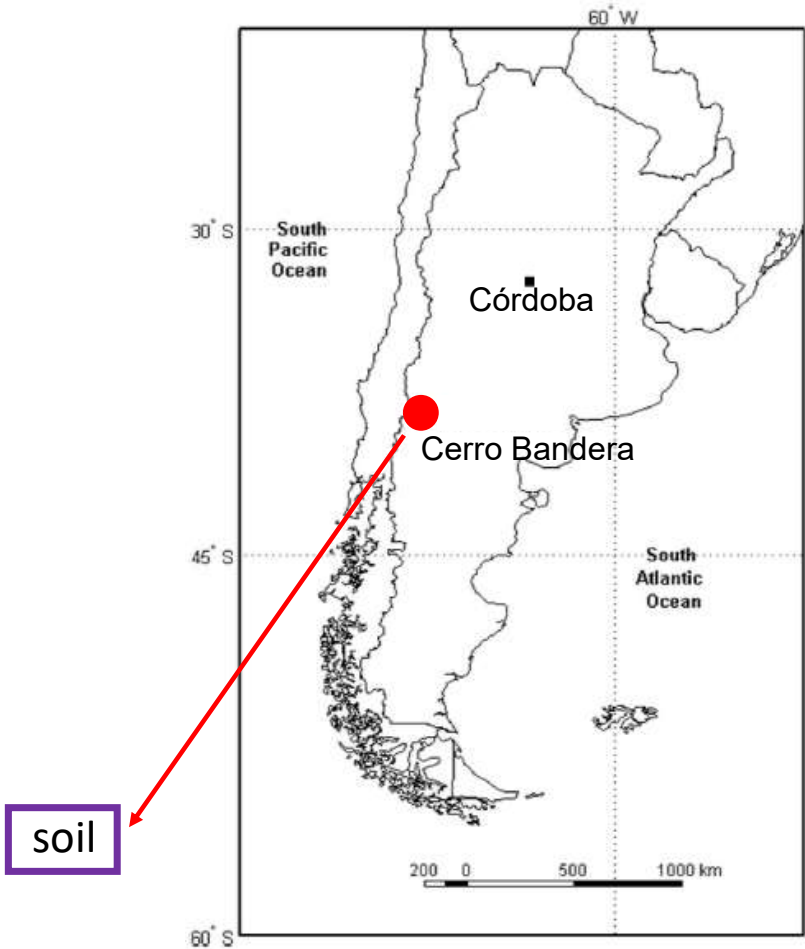


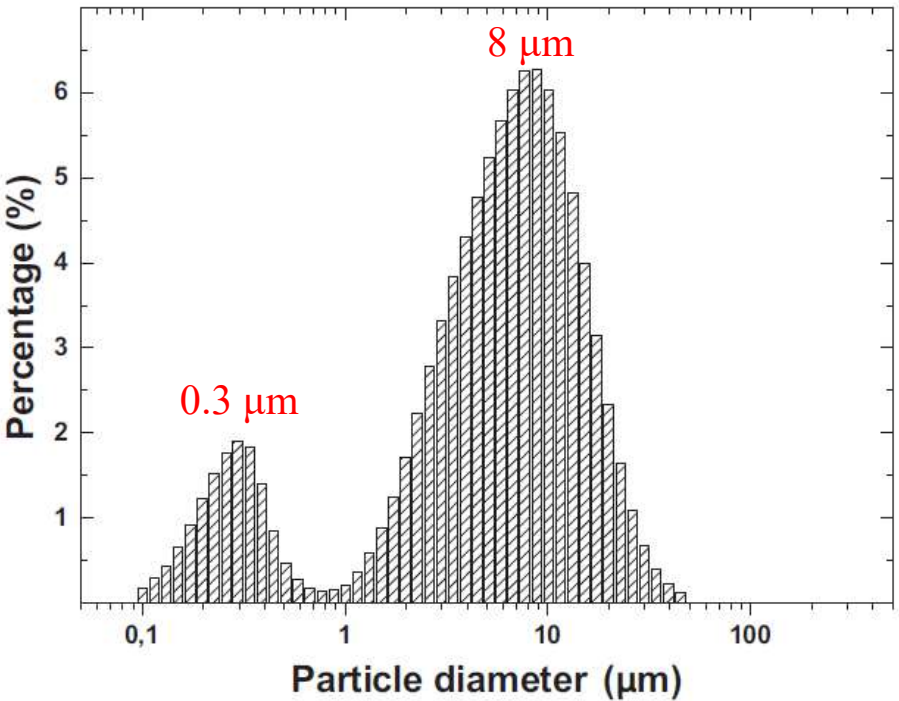
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# INPs by immersion freezing

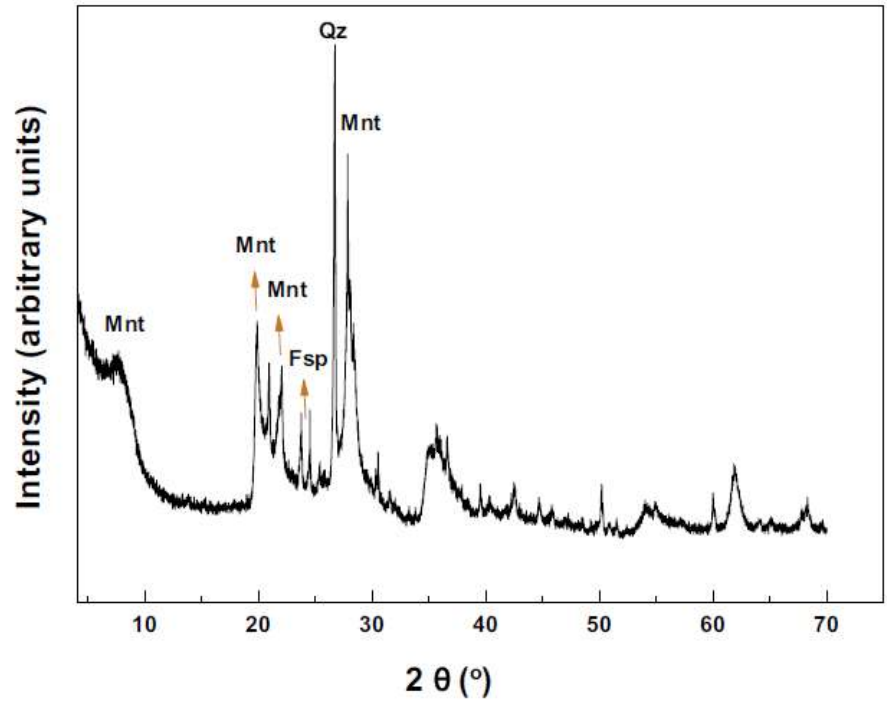


Source: Global Deserts Outlook (2006), UNEP, Ed. Ezcurra, E.





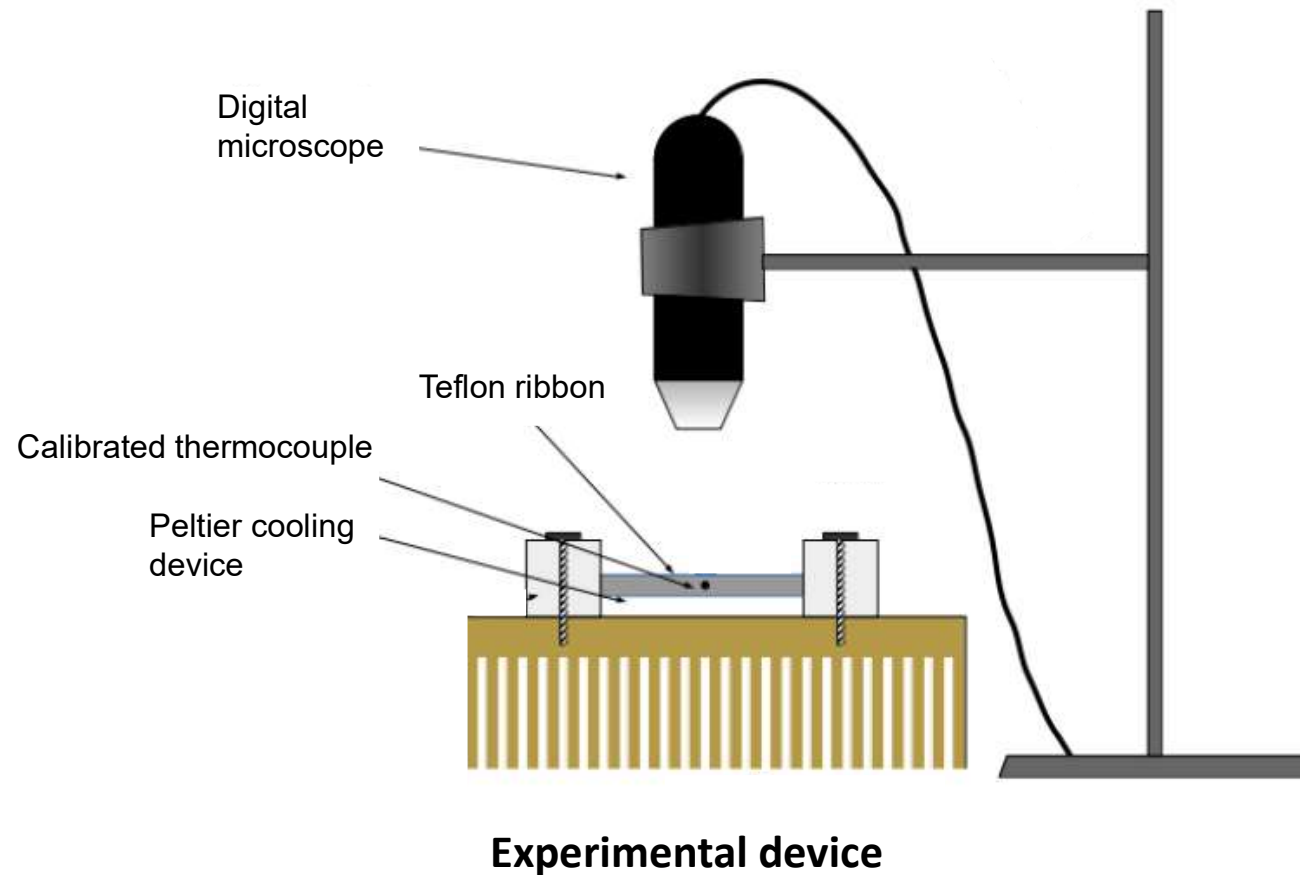
Particle size distribution



XRD spectrum



López, M. L. et al.: **The role of natural mineral particles collected at one site in Patagonia as immersion freezing ice nuclei**, *Atmos. Res.*, 204, 91-101, <https://doi.org/10.1016/j.atmosres.2018.01.013>, 2018.

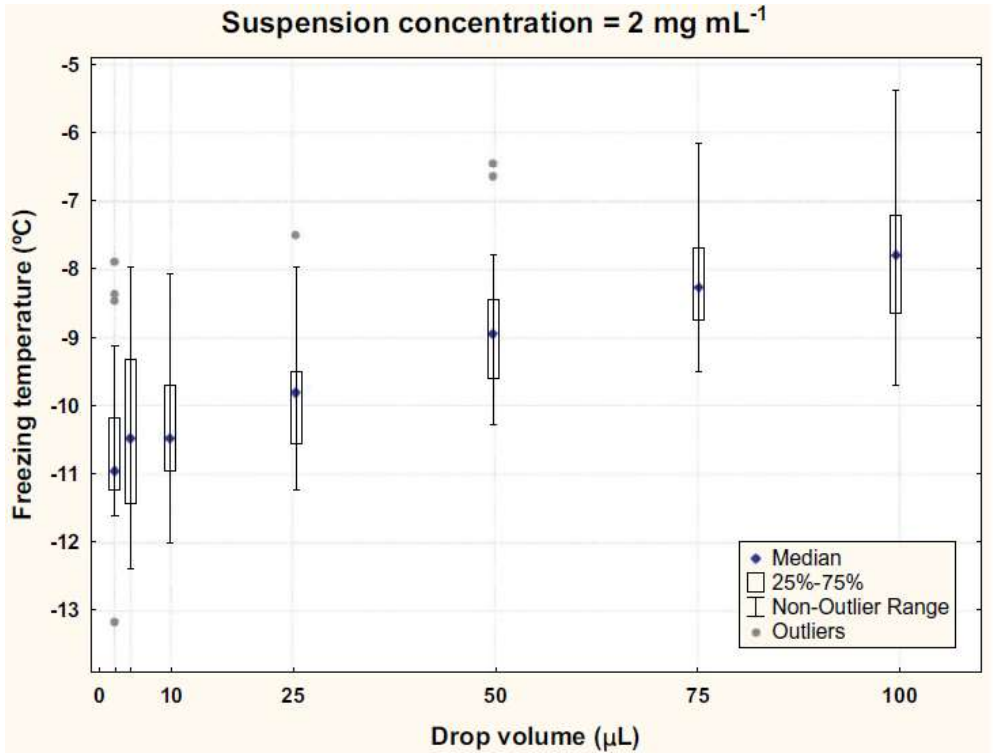
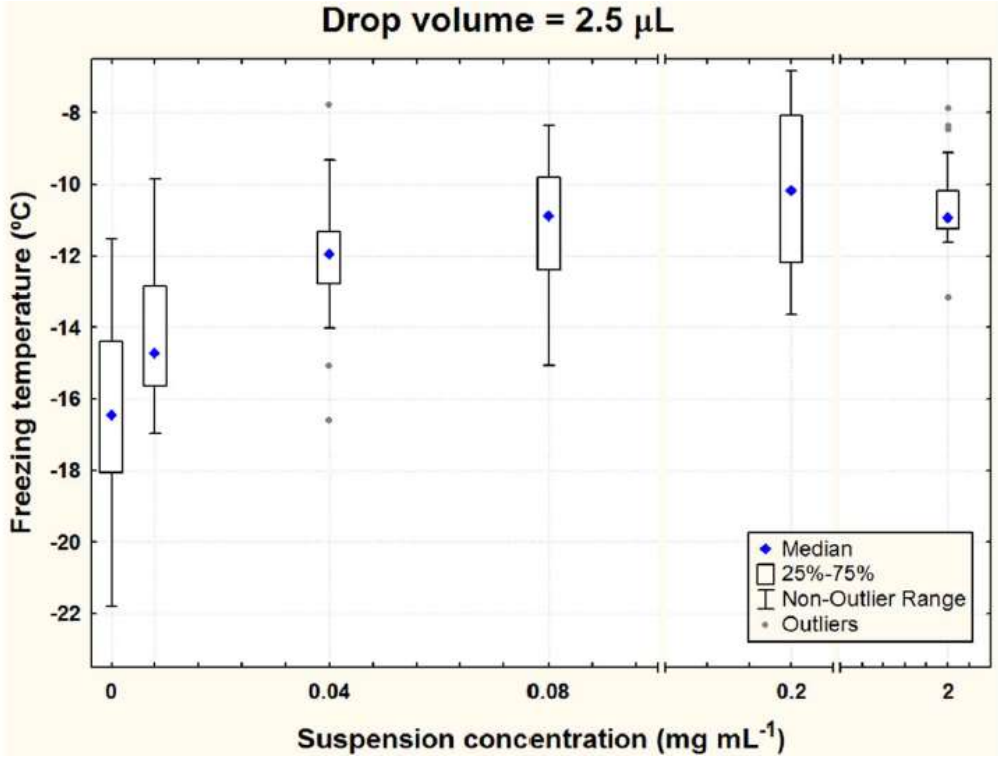


**Drop: before and after freezing**

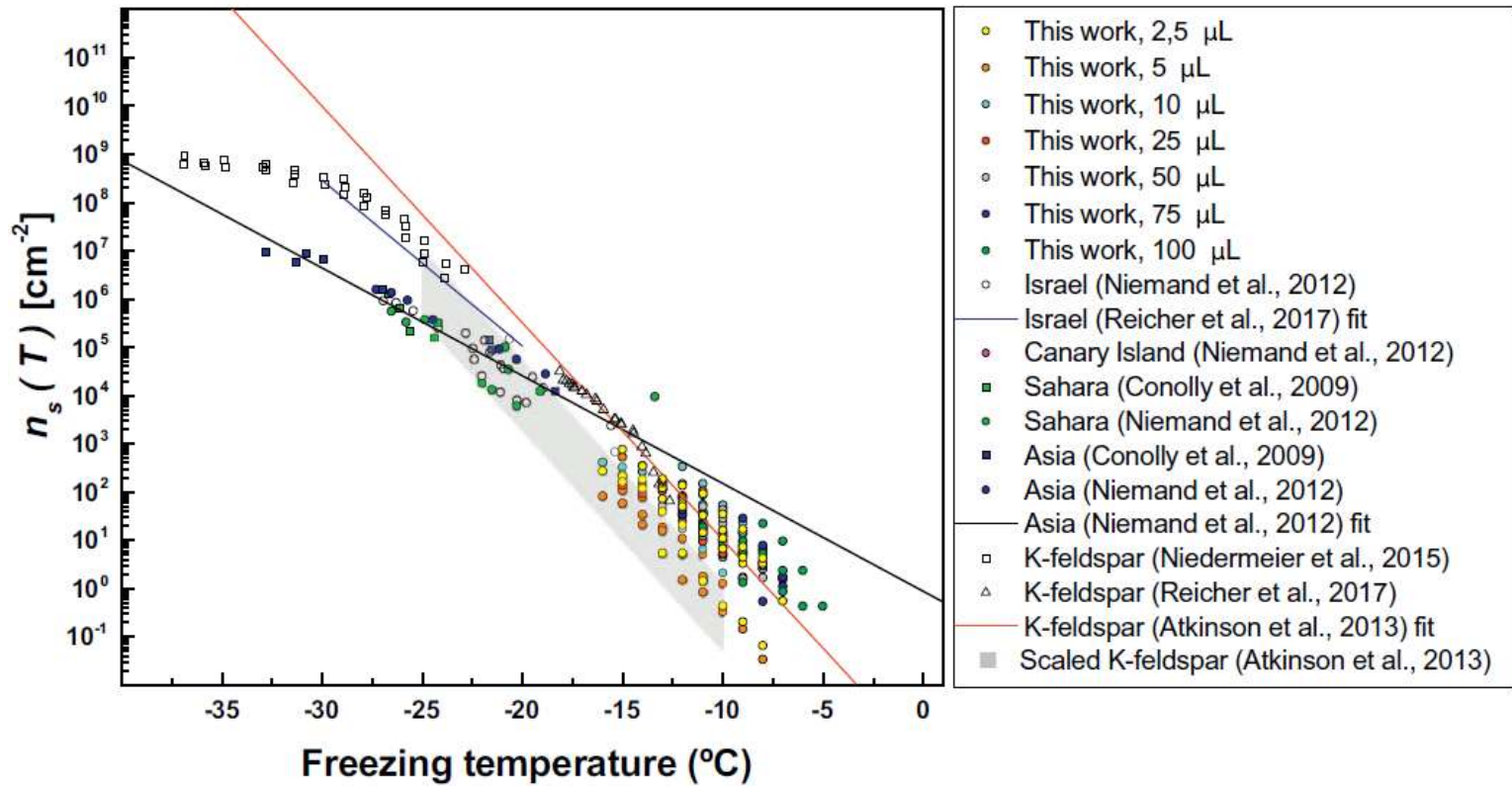
- Different volume:  
2.5, 5, 10, 25, 50, 75 and 100  $\mu\text{L}$ .
- Different concentration:  
2, 0.2, 0.08, 0.04 and 0.008  $\text{mg mL}^{-1}$ .



# INPs by immersion freezing



López, M. L. et al.: **The role of natural mineral particles collected at one site in Patagonia as immersion freezing ice nuclei**, *Atmos. Res.*, 204, 91-101, <https://doi.org/10.1016/j.atmosres.2018.01.013>, 2018.



Density of ice nucleation active sites at different temperatures



López, M. L. et al.: The role of natural mineral particles collected at one site in Patagonia as immersion freezing ice nuclei, Atmos. Res., 204, 91-101, <https://doi.org/10.1016/j.atmosres.2018.01.013>, 2018.

Characteristics of the main accessories minerals of the collected sample, obtained by comparison from powder diffraction patterns.

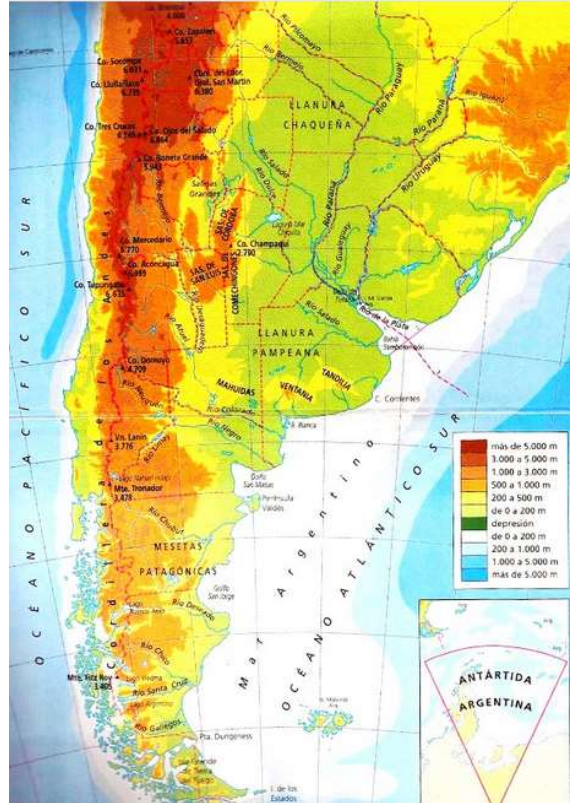
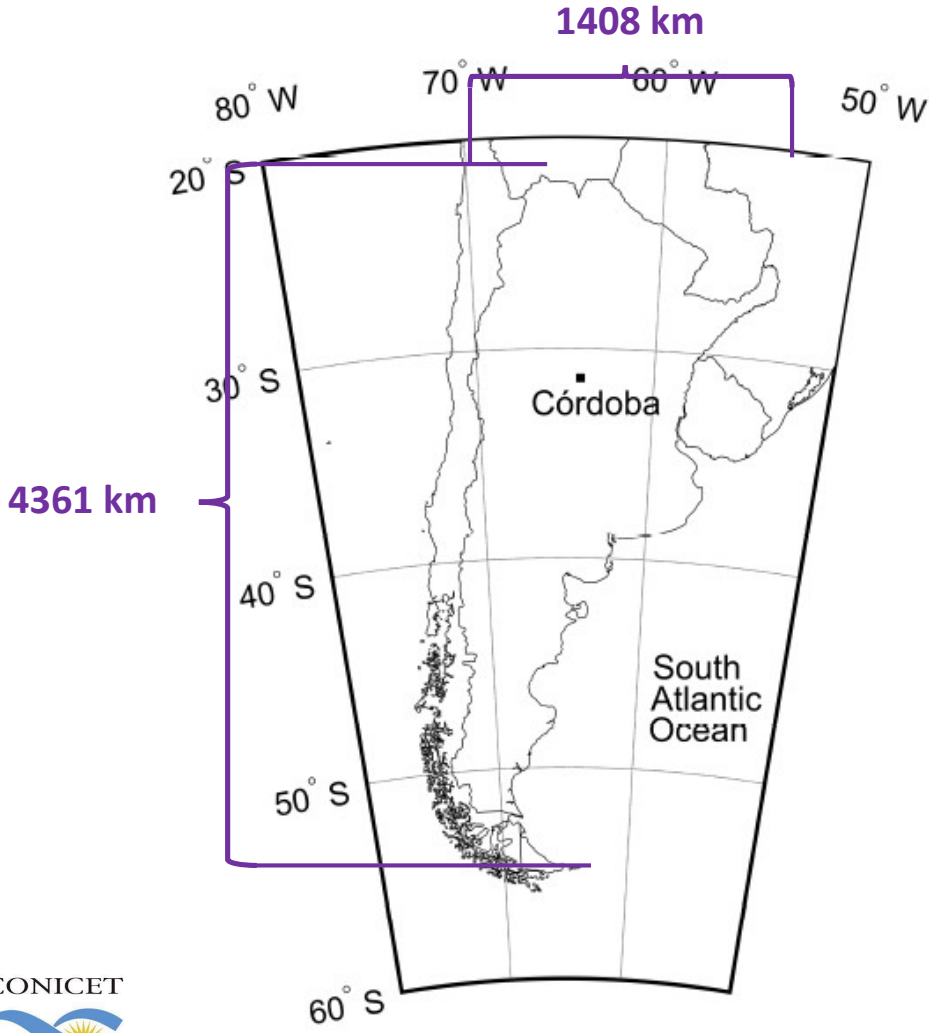
Compound name	Mineral name	Chemical formula	Crystal system	Reference code
Silicon oxide	Quartz	SiO <sub>2</sub>	Hexagonal	01-089-8934
K-Al silicate hydroxide	Muscovite	KAl <sub>2</sub> Si <sub>3</sub> AlO <sub>10</sub> (OH) <sub>2</sub>	Monoclinic	00-007-0025
K-Al silicate	Orthoclase	KAlSi <sub>3</sub> O <sub>8</sub>	Monoclinic	00-019-0931
Na-Ca-Al silicate	Anorthite	(Ca,Na) (Si,Al) <sub>4</sub> O <sub>8</sub>	Anorthic	00-018-1202



López, M. L. et al.: **The role of natural mineral particles collected at one site in Patagonia as immersion freezing ice nuclei**, *Atmos. Res.*, 204, 91-101, <https://doi.org/10.1016/j.atmosres.2018.01.013>, 2018.

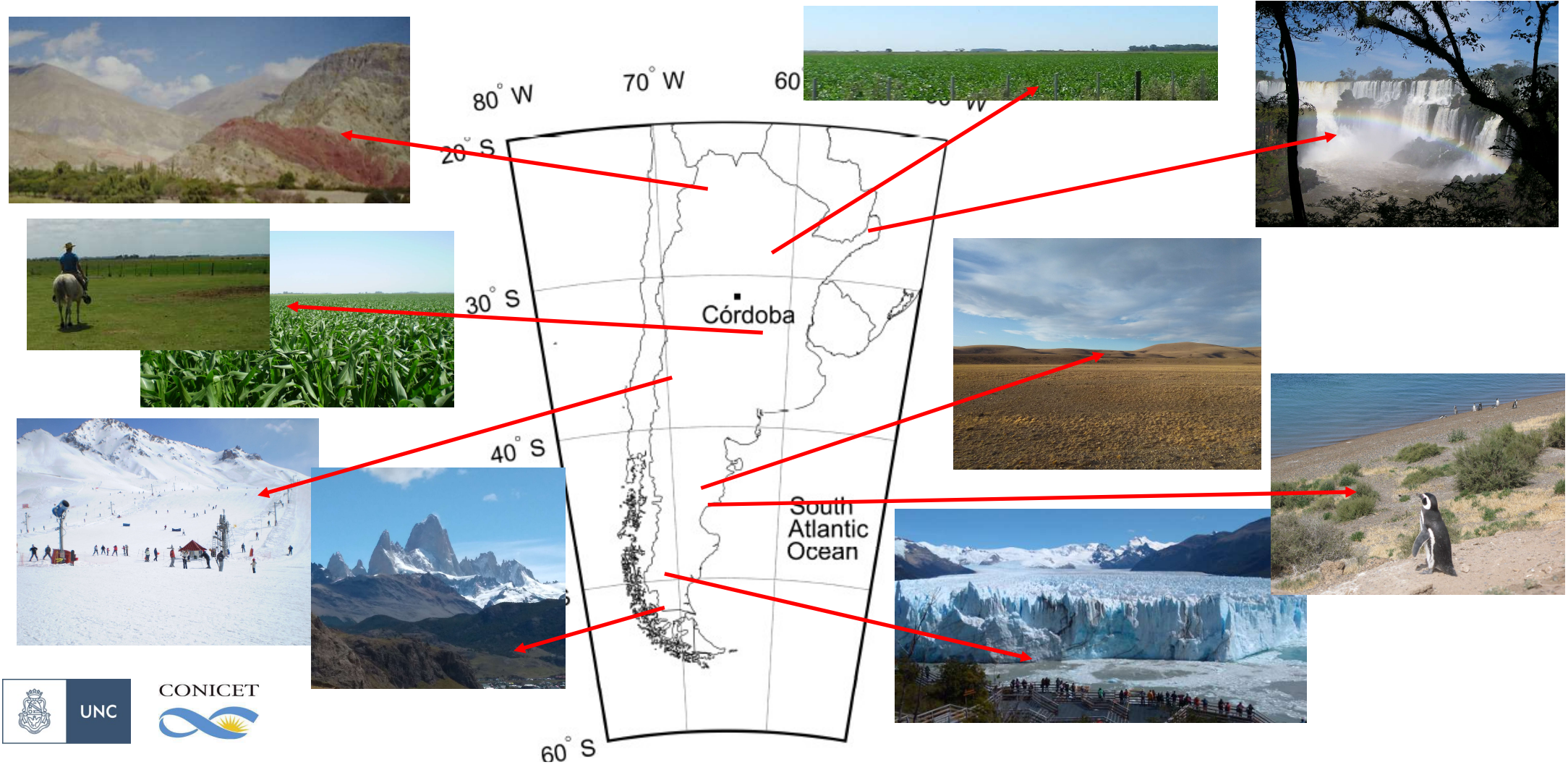
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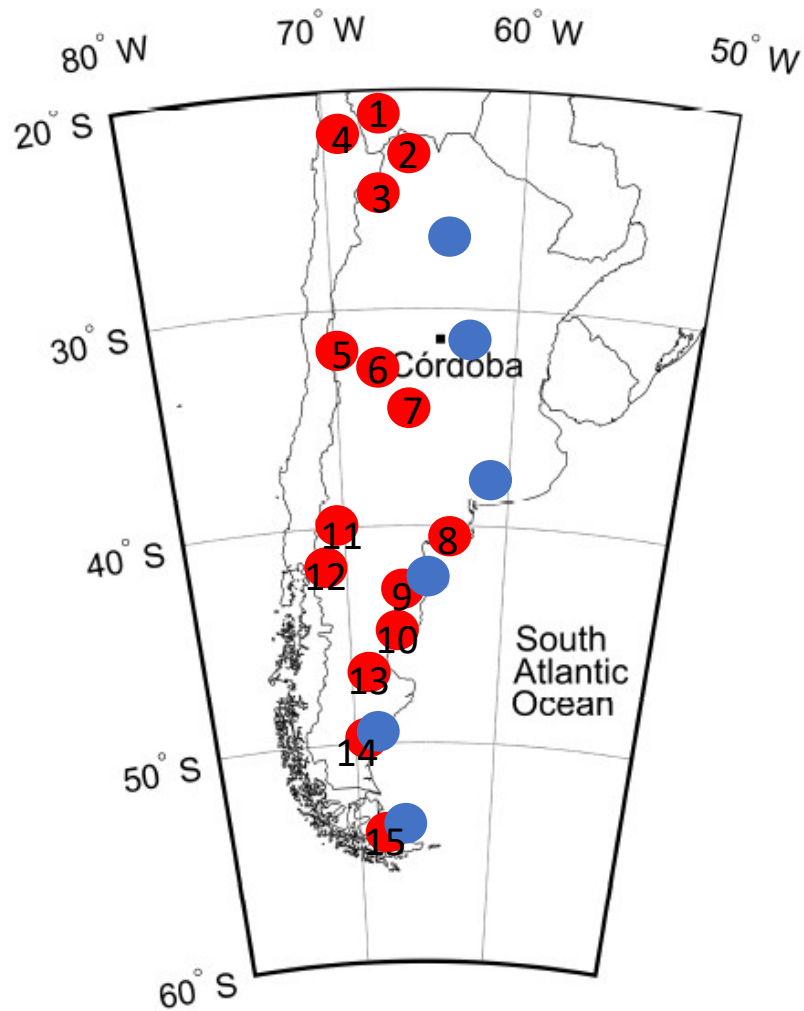
# Perspectives: regarding immersion freezing...



<https://elmapadeargentina.com/mapa-fisico-de-argentina>

# Perspectives: regarding immersion freezing...





● Soil samples

● Aerosol samples

- 1: Uyuni
- 2- Puna norte
- 3- Punta sur
- 4- Atacama
- 5- Cahucete
- 6- Río Bermejo
- 7- Salina del Bebedero
- 8- San Antonio Oeste
- 9- Lago seco
- 10- Fitz Roy
- 11- Plottier
- 12- Volcán Puyehue
- 13- Gran Laguna Salada Guarrayalde
- 14- San Julián
- 15- Río Grande

- Temporal variability in INPs concentration.
- Relation between INPs concentration and size particles.



Model 212

<https://metone.com/>



## Team:



Dr. María Laura López



Dr. Rodrigo E. Bürgesser



Ph.D. student  
Verónica Tur

## Collaborators:



Dr. Nesvit Castellano



Dr. Beatriz Toselli



Dr. Gustavo G. Palancar



Dr. Diego Gaiero

# Thank you

