SHORT TERM SCIENTIFIC MISSION (STSM)
SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: CA 51211
STSM title: Health Cities, biometeorological Indexes and respiration diseases
STSM start and end date: 14/04/2019 to 19/4/2019
Grantee name: KASSOMENOS PAVLOS

PURPOSE OF THE STSM:

(max.200 words)
The purpose of this STSM was the collaboration between the scientific group GeoBioMet of University of Cantabria directed by Professor Pablo Fdez-Arroyabe and me from the Univeristy of Ioannina, Greece (Prof. Pavlos Kassomenos) in order to find possible connections between charged nanoparticles meausered in Santander area and the prevailing weather types in Santander, as well as, the air masses affecting the area. The air masses affecting Santander may be responsible for carrying charged nanoparticles from either the sea (Cantabrian Sea) or the continental areas of both the Iberian peninsula and France.below I present (fig1) the area in which we made the Weather type Analysis.

Figure 1. The location of the measurements (Universityof Cantabria) and the geographical coordinates in which the backtrajectory analysis was made.

It must be noted that the measurements of charged nanoparticles were made by the group of Cantabria University for one month (July 2018) every second and in 14 bands. For the same period the analysis of Weather types were made through backtrajectories in a six hourly basis every day.
Also we are trying to find possible connections between oppressive health and certain weather types in terms of the electrical properties of the nanoparticles.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

(max.500 words)

During the STSM we debugged the collected charged nanoparticle data during July 2018 by the Scientific group of Prof Pablo Fdez-Arroyabe in 14 different bands according to the dimensions of nanoparticles from 6nm to 10 μm. The electricity data were collected every second and integrated to 10 minutes time intervals and finally to 6 hourly values per day (e.g. at 00, 6, 12, 18 GMT).
For the same time period we adopted two weather type classifications.
The first one was an objective weather type classification based on gridded surface pressure data and for the wider area of Northern Spain and the Gulf of Cantabria and it is consisted from 18 different synoptic weather categories based on the prevailing weather systems over Northern Spain (Low, High or combinations of them).
The second one is a subjective method to compute the Weather Type based on the air masses arriving in Santander.
Specifically we compute the air masses back trajectories arriving in the area of the measuring point at 500 m above the ground. This height was chosen to avoid possible turbulent phenomena that may affect the correlation between the recorded “electrical” data and the air masses arriving. A typical figure (Figure2) follows:

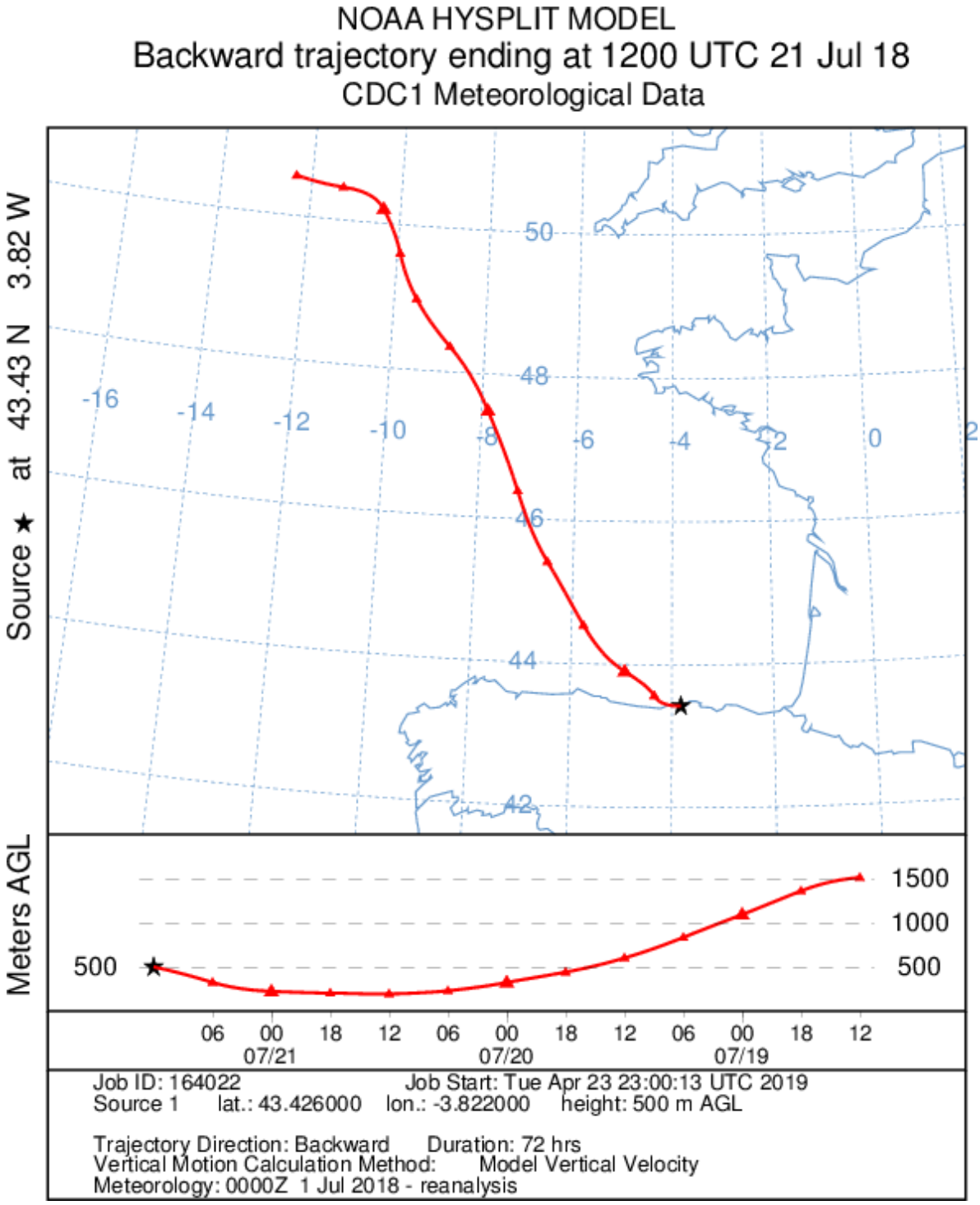
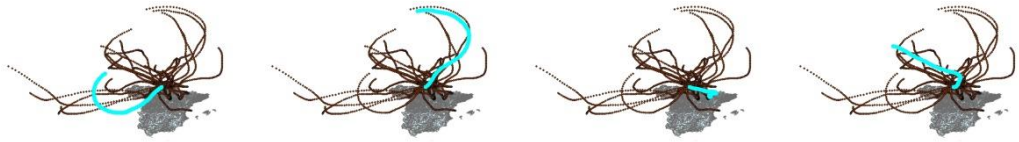


Figure 2. A typical example of backtrajectory affecting Santander at 12 UTC July 21, 2018.

The back trajectories were computed for 72 hours before the hour of arriving in Santander hour by hour.
Specifically we found the coordinates (latitude and longtitude), temperature, rain and relative humidity hour by hour (in total 72 hours).
We computed these back trajectories using the HYSPILT model of NOAA that it is in public domain and we used archive data for July 2018 in an analysis of 2.5ºX2.5º (reanalysis data).
The back trajectories were estimated 4 times per day e.g. the UTC (GMT) 00, 06, 12, 18.
After that we plotted these back trajectories in an ARCGIS system and we categorized them using SPSS Statistical package, version 20. From the clustering, we found 5 air mass types per each one of the 6h periods. A typical figure (Figure 3) follows.



(a) (b) (c) (d)

Figure 3. We present the main air mass types affecting Santander during July 2018 (a) from SW, (b) from NE, (c) Local circulations, (d) NW

For each one of the weather type found we estimated the meteorological fields (temperature, relative humidity and rain) and their origin.
Figure 4 shows temperature evolution during backtrajectory route.

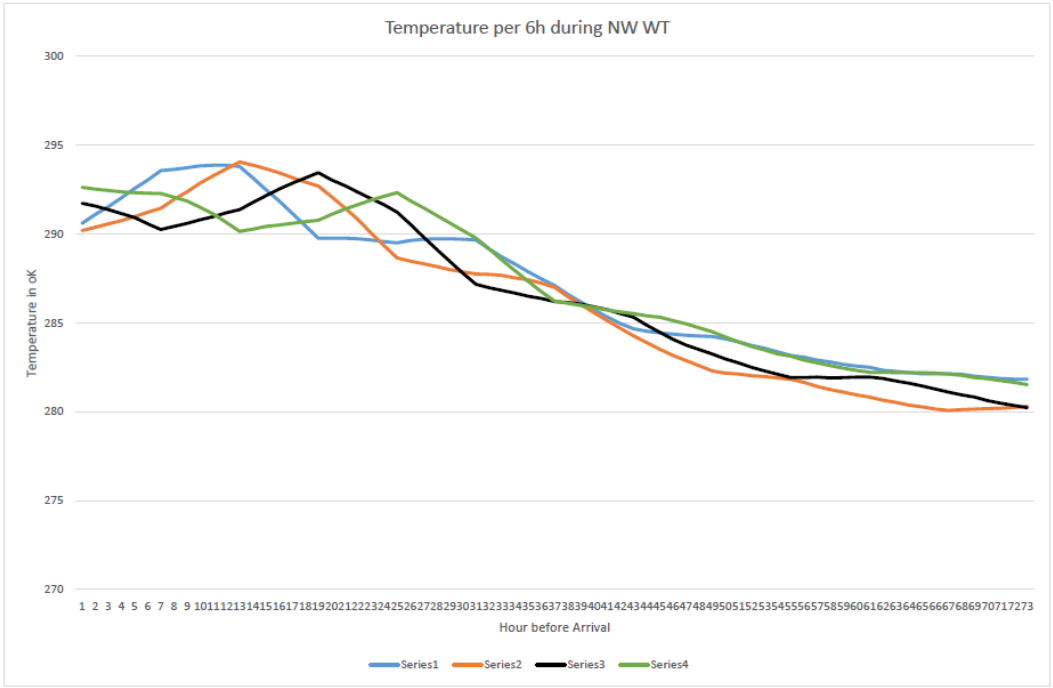


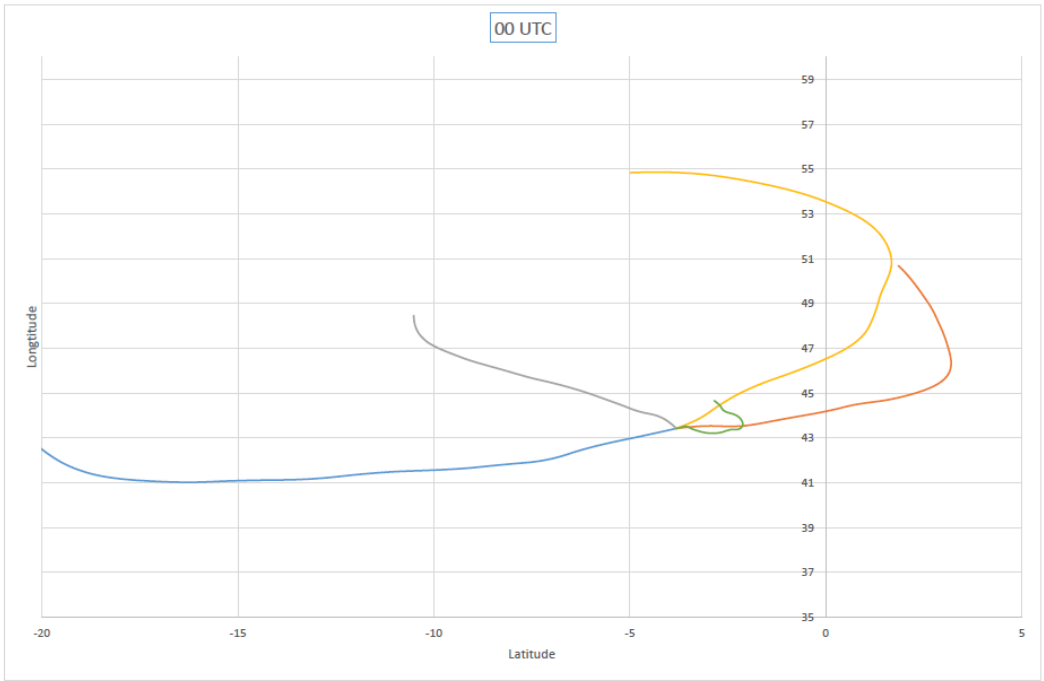
Figure 4. Temperature during the route of NW WT at 06.00 UTC.

We found, in the majority of the cases, that the air masses affecting Santander during July 2018 are coming from W-SW and NE-N directions. Also a significant number of cases could be characterized as local with short travelling routes around the city of Santander and the nearby Cantabrian sea and continental areas surrounding the city.
Finally we estimated the electrical charge in the nanoparticles during these categories mainly in two of the 14 different classes having dimensions around 2.5 μm and 40 nm respectively.

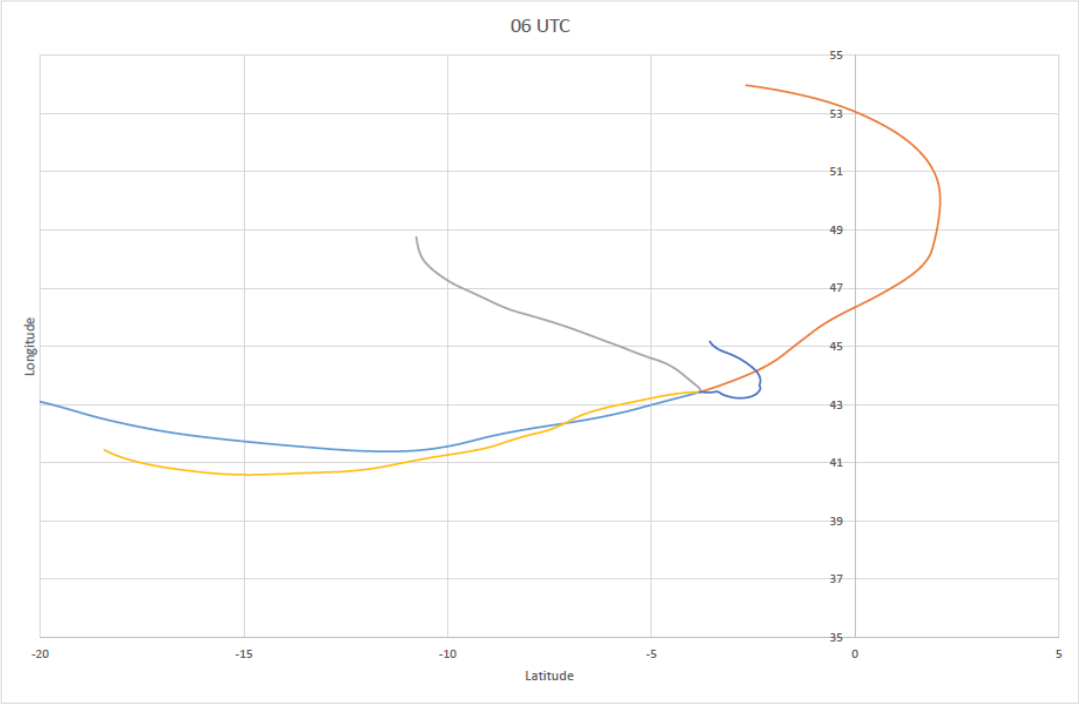
DESCRIPTION OF THE MAIN RESULTS OBTAINED

The work made in Santander during my STS Mission would be prepared as a scientific methodological paper that we would like to submit in a peer review scientific journal in the coming months, preferably in the Special issue of STOTEN concerning COST 15211.

Looking in the existing bibliography about the correlation between air mass types, electrical properties of nanoparticles and biometeorological indices we suppose that our work is innovative. The work made correlates electrical properties of nanoparticles and the weather types affecting an area, as Santander, Spain.
This paper is designed to propose a methodology how to handle and compare the electrical properties of nanoparticles and the weather types in terms of the origin of the nanoparticles.
It was also planned to study the daily evolution of the electrical properties of nanoparticles in comparison with the meteorological parameters per Weather type found from the air mass analysis.
It was also tried to find connections between the weather type and the human health in terms of positive/negative charge of nanoparticles.
From the analysis of the weather types affecting the area of Santander we found that there are five classes of air masses.
The first class is the air mass coming from SW and is a rather short trajectory originated over the Atlantic Ocean near the coasts of Portugal. These air masses are warm and wet.
The second class refers to air masses coming from the continental France and there are dry and cold.
The third category is the air masses originated in the West of Santander in the Atlantic Ocean. Their trajectories are long and they mainly wet.
Fourth category consists of air masses originated around Santander and could be characterized as local circulation. This category contains about 35% of the 31 days of July 2018.
Finally there is also one more category. This category refer to air masses originated in the Cantabrian Sea and are of course wet but they are slow moving.
The last two categories are mainly the most possible to combine with high concentration of charged nanoparticles in the area.
Below we present in figure 5 the figures showing the mean trajectory of each weather type per 6 h.



(a)


06 UTC
Longitude
Latitude
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41
39
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-20
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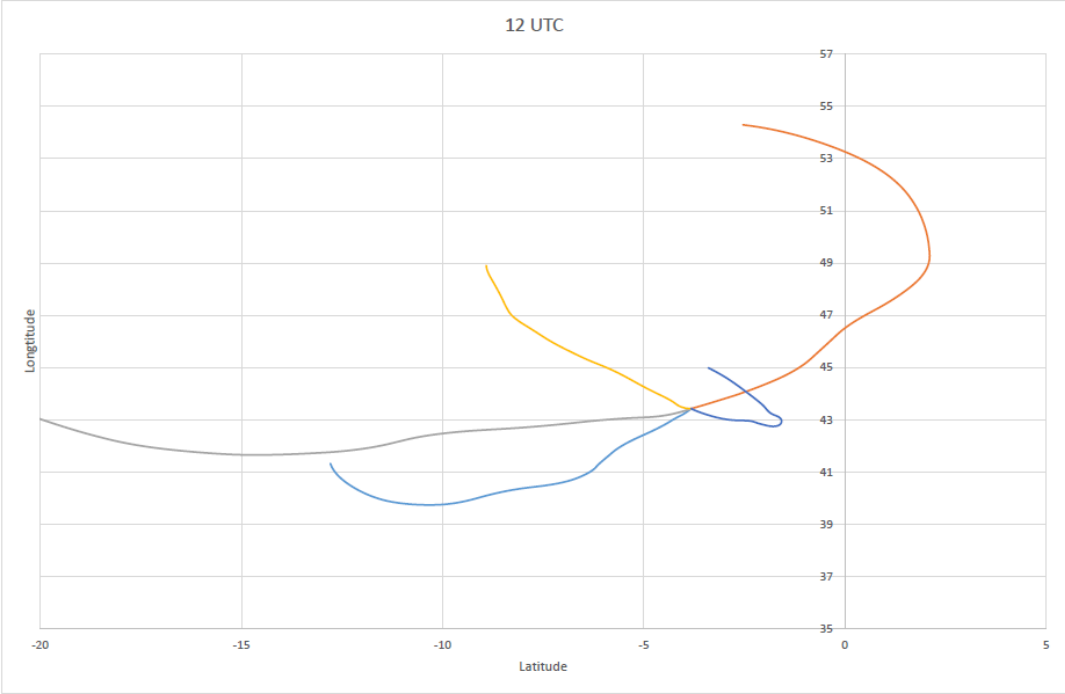
5

(b)


12 UTC
Longitude
Latitude
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-15
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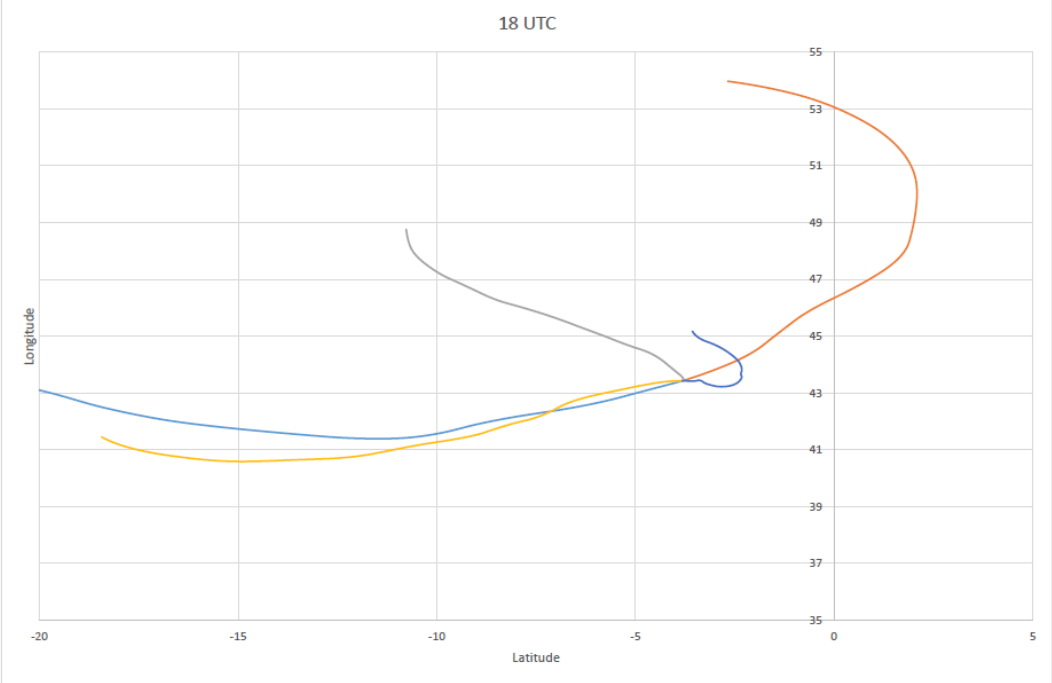
(c)



(d)

Figure 5. The mean back trajectories of the five air mass categories per 6h time interval during July 2018 in Santander (a) 00 UTC, (b) 06 UTC, (c) 12 UTC and (d) 18 UTC.

As it is already stated the majority of days was characterized by local circulations. In the following figure 6 we can see the temperature evolution during backtrajectory route but for the local circulations and the four 6h intervals.

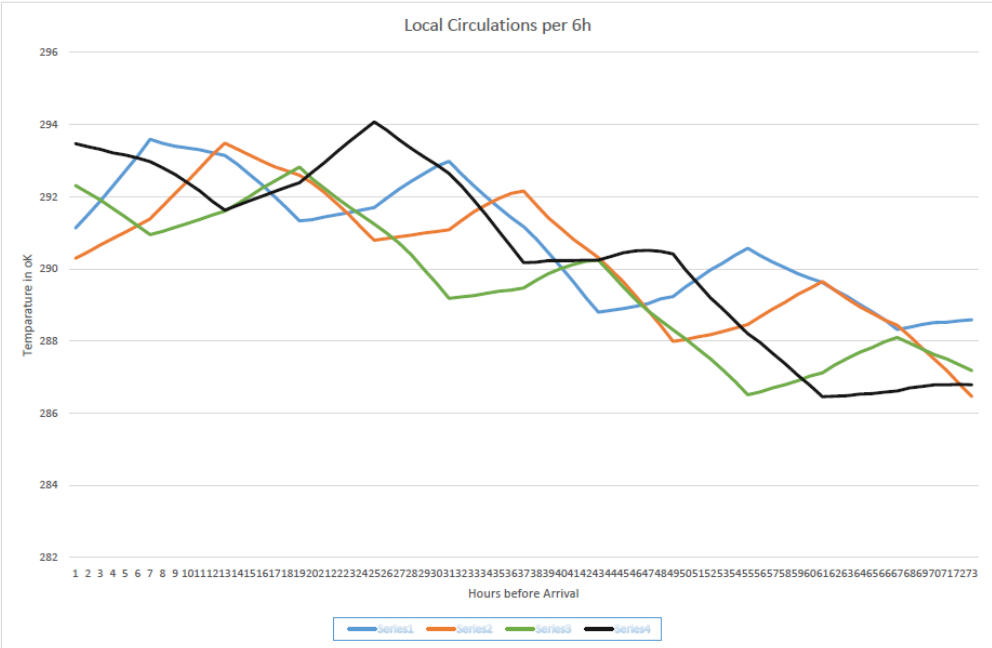


Figure 6. Temperature during the route of WT referring to Local circulations per 6h interval.

Finally another preliminary result is the following Table showing the air mass types at 00 UTC and the main meteorological parameters for its one of them.

Table 1. WT and the main meteorological parameters (temperature, atmospheric pressure, rain, RH) during July 2018 in Santander.

00 UTC	No of Cases	Temparature (oK)	Atmospheric Pressure (hPas at 500m above ground)	Rain in mm during the whole trajectory route (72h)	RH (%) in 500 meters above ground
SW	5	289,84	906,32	1,86	81,08
NE	3	290,6	908,4	0,166667	74,46667
W	2	292,1	910,5	6,3	70,8
N_NW Atlantic Short	8	288,4	908,725	2,9875	84,6125
Local	10	291,13	907,04	9,17	78,7

In the table we can see that the most wet category is N-NW Atlantic short while the most dry is W. The most warm category is W with the coldest one is N-NW Atlantic.Local circulations are combined with the higher rain, whlile Local circulations and N_NW Atlantic Short and the most frequent weather types appearing totally in the about 65% of the days.

FUTURE COLLABORATIONS (if applicable)

The mission was an excellent opportunity for me to meet and exchange ideas with the scientific group of Cantabria University (Geobiomet) and to transfer and receive knowledge in a wide range of disciplines concerning nanoparticles, their electrical properties and air mass types in general and those affecting the area of Santander and Northern Spain.
The collaboration established between the Universities of Ioannina, Greece and Cantabria, Spain will continue exchanging knowledge, measurements, ideas, statistical tools, writing papers and proposals, etc. in our common fields.
We also aggred to continue and enhance our collaboration with visits to Santander and Ioannina, not only for the lead scientists of the two scientific groups (me and Prof Pablo Fdez-Arroyabe) but also for members of their groups as PhDs students, Mcs people, collaborating scientists etc., in the fields of electrical properties of nanoparticles, weather types, their relation, as well as, their effect in human health and well being in the direction of defining new biometeorological indices closely related to atmospheric electrical properties in order to protect human health.

Acknowledgments
STSM Committee
Cost 15211