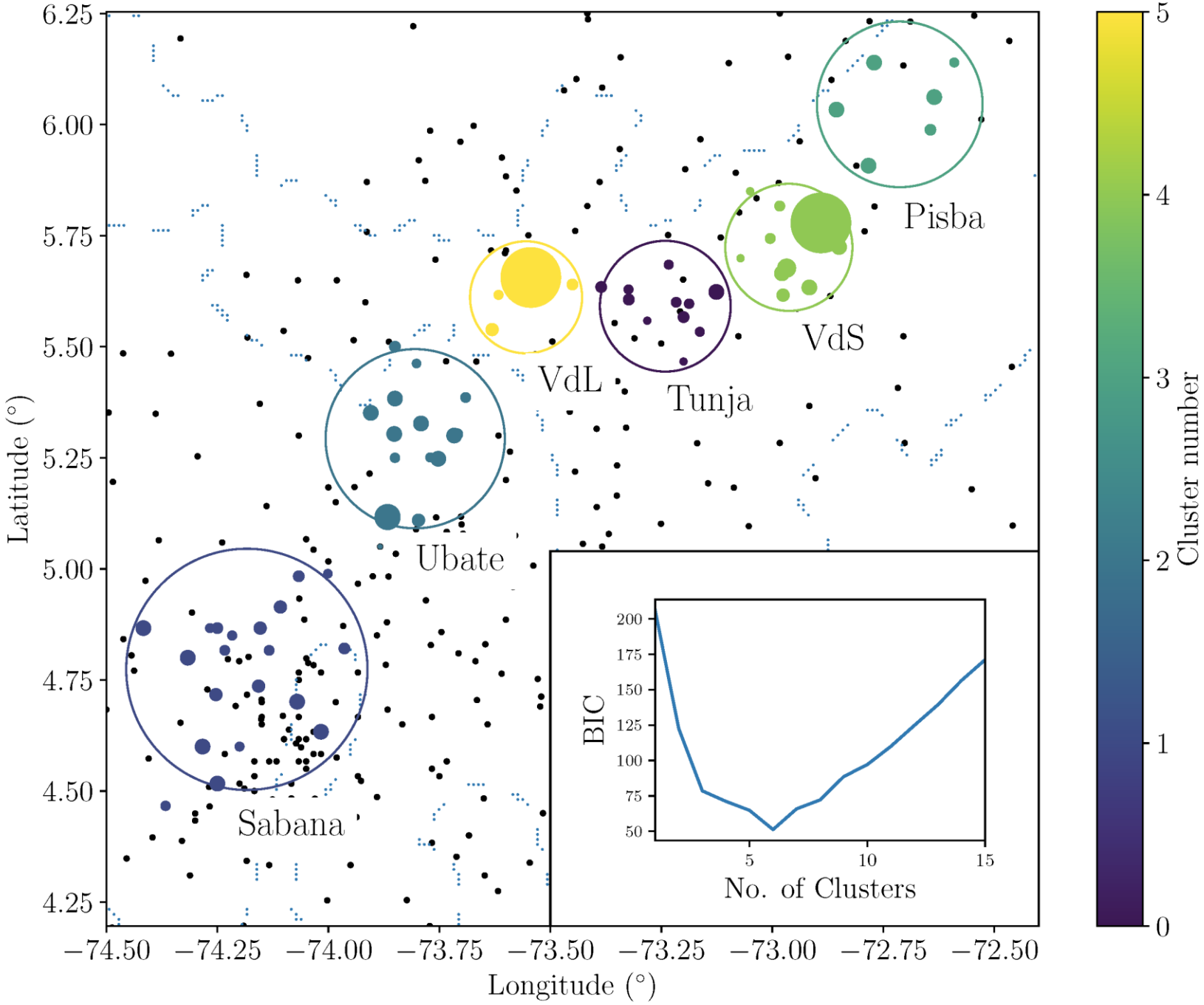

COMUNIDAD UNIVERSITARIA
TE INVITAMOS A PARTICIPAR EN EL
WORKSHOP
RADIOASTRONOMÍA
EN COLOMBIA
VIGILADA MINEDUCACIÓN
Universidad ECCI
Auditorio Sede P Calle 51 No. 19-12 Bogotá.
FEBRERO 16 Y 17 DE 2018

Radio Astronomy @ UECCI

- 3 undergraduate projects
- 1 MEng student
- 2 PhD Scholarships @ Universidad de Chile (RAIG) (2017+)
  - MARI-II: Antenna prototype 50-150 MHz for EOR
  - 1 m sub-mm dish at Cerro Calán– receiver refurbishment
- Research and Universities Coordination (TF1)

  Andean Regional Office of Astro4Dev, IAU


Pisba
VdS
VdL
Tunja
Ubate
Sabana
Latitude (°)
Longitude (°)
Cluster number
BIC
No. of Clusters
6.25
6.00
5.75
5.50
5.25
5.00
4.75
4.50
4.25
−74.50
−74.25
−74.00
−73.75
−73.50
−73.25
−73.00
−72.75
−72.50
0
1
2
3
4
5
200
175
150
125
100
75
50
5
10
15

Radio Astronomía @ UECCI

- 3 trabajos de pregrado
- 1 estudiante de MEng
- 2 becas doctorales para dos estudiantes @ Universidad de Chile (RAIG) (2017+)
  - MARI-II: Prototipo antena 50-150 MHz para EOR
  - Antena Sub-mm de 1 m – modernización

- Coordinación de Investigación y Universidades

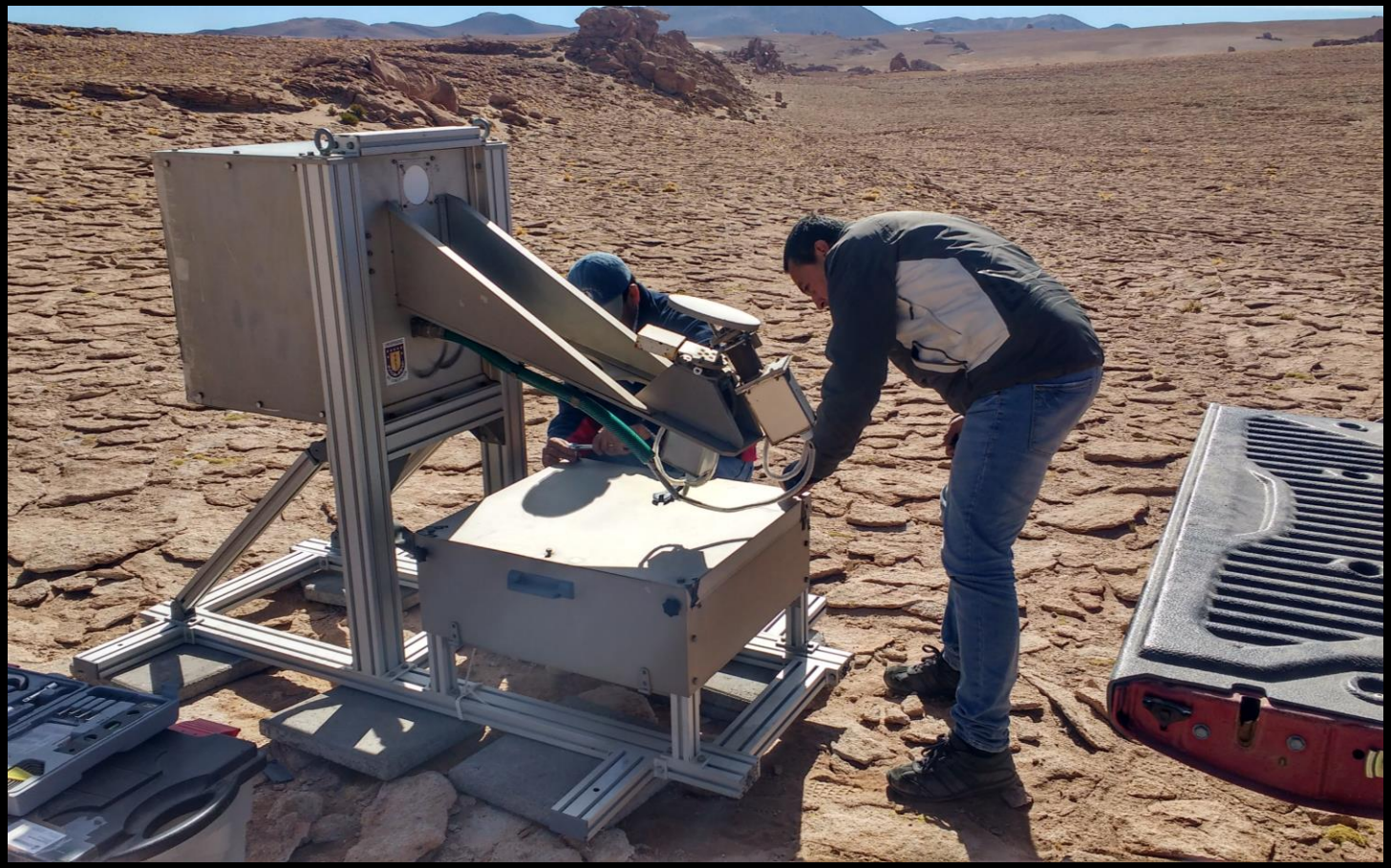
  Andean Regional Office of Astro4Dev, IAU
- Coordinación Grupo de Trabajo en Radioastronomía


SEGUNDO WORKSHOP DE ASTRONOMÍA EN LOS ANDES
23 - 30 DE JULIO DE 2015
Universidad de Los Andes
Bogotá, Colombia
Fecha límite
Recepción de trabajos
29 DE MAYO
Invitados
Lydia Cidale
Instituto Astrofísica de La Plata, Argentina
Farid Char
U. de Antofagasta, Chile
Kevin Govender
Oficina de Astronomía para el Desarrollo-IAU, Suráfrica
José Ishitsuka
Instituto Geofísico del Perú
Kathy Vieira
Centro de Investigaciones Astronómicas, Venezuela
Matias Gómez
U. de Chile
Comité Organizador local
Jaime Forero-Romero (Uniandes, Colombia)
Germán Chaparro Molano (UECCI, Colombia)
Alejandro García (Uniandes, Colombia)
Beatriz Sabogal (Uniandes, Colombia)
Comité Organizador Científico
Dennis Cazar (U. San Francisco de Quito, Ecuador)
Juan Carlos Muñoz-Cuartas (U. de Antioquia, Colombia)
Fausto Mena (U. de Chile)
Luis Nuñez (U. Industrial de Santander, Colombia)
Cecilia Scorza (Haus der Astronomie, Alemania)
Nobar Baella (Instituto Geofísico del Perú)
Temas
Astropartículas
Radioastronomía
Financiación de proyectos
Astronomía para el público
Educación en escuelas
Educación superior
Más información sobre la programación del workshop en:
http://andeanroad.github.io/WorkshopAstronomiaAndes2/
http://bit.ly/1PjJ4Ad
Contacto:
gchaparrom@ecci.edu.co
je.forero@uniandes.edu.co
Organizadores:
IAU
ECCI
Universidad de los Andes

MARI: Medidor Autónomo de Radio Interferencia

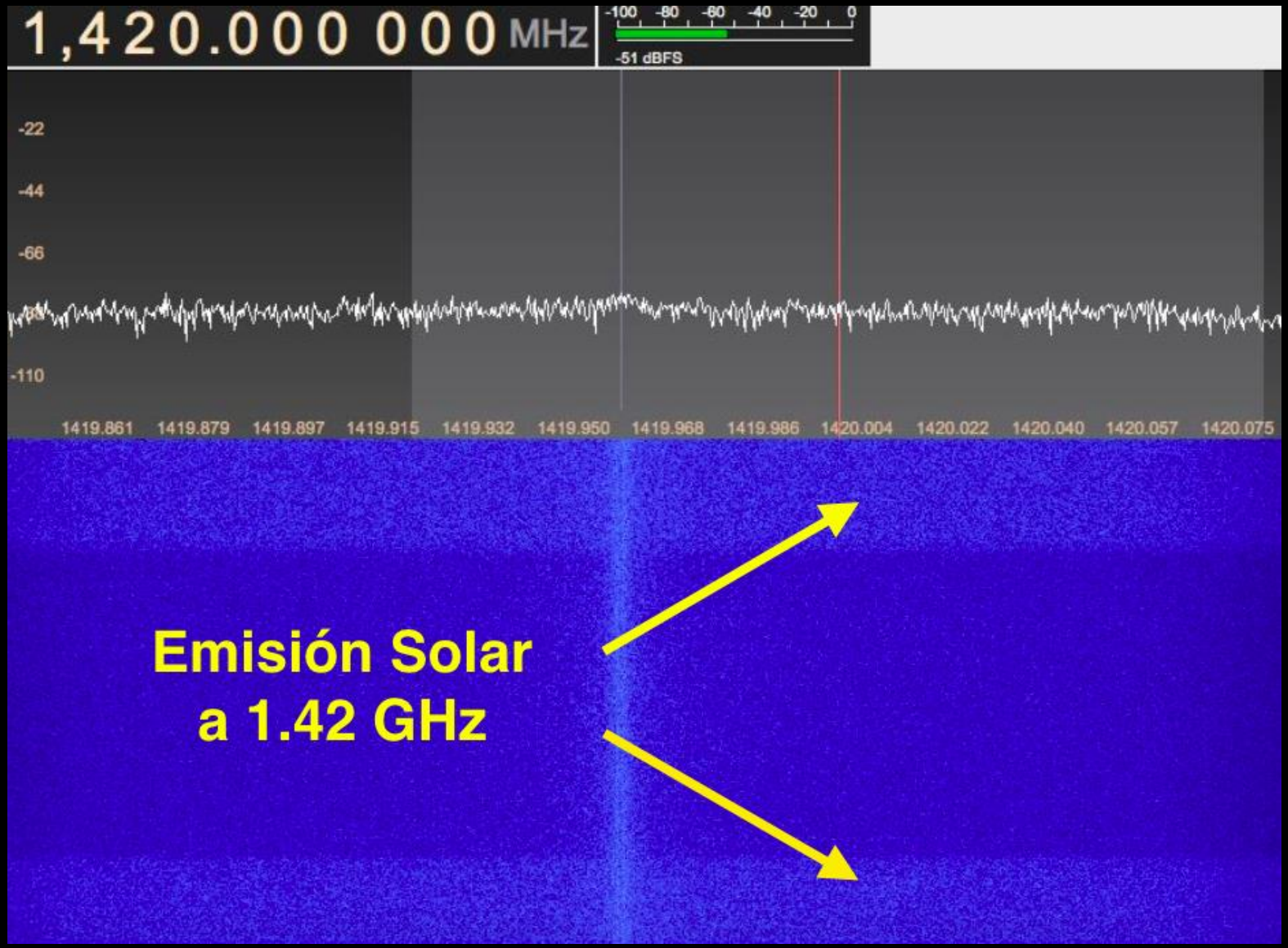
(Pathfinder for redshifted 21 cm line arrays – EOR)

MARI-II



Southern Millimeter-Wave Telescope

Dish conversion
4 m radio telescope @ 1.4 GHz (21 cm) UECCI


1,420.000 000 MHz
-100 -80 -60 -40 -20 0
-51 dBFS
-22
-44
-66
-110
1419.861 1419.879 1419.897 1419.915 1419.932 1419.950 1419.968 1419.986 1420.004 1420.022 1420.040 1420.057 1420.075
Emisión Solar
a 1.42 GHz

saint-germain / **ControlAntena**

Unwatch 1 | Star 0 | Fork 0

Code | Issues 0 | Pull requests 0 | Projects 0 | Wiki | Insights | Settings

Calculations for antenna pointing

Edit

Add topics

23 commits | 1 branch | 0 releases | 1 contributor

Branch: master | New pull request | Create new file | Upload files | Find file | Clone or download

Germán Chaparro Molano and **Germán Chaparro Molano** working for osx :D — Latest commit 6db8759 on 18 Nov 2016

MPU6050_DMP6	elevation sketch	a year ago
arduino_cmps11_serial	serial stuff ok in ubuntu	a year ago
sketch_oct21b	azimuth sketch	a year ago
.gitignore	working for osx :D	a year ago
README.md	Initial commit	3 years ago
arduino_comm.ipynb	serial stuff ok in ubuntu	a year ago
azimuth.pdf	Upload file	3 years ago

Estudio de Sitio

- Estudios de viabilidad para observaciones milimétricas

Publications of the Astronomical Society of the Pacific, 129:105002 (20pp), 2017 October https://doi.org/10.1088/1538-3873/aa83fe

CrossMark

Low Dimensional Embedding of Climate Data for Radio Astronomical Site Testing in the Colombian Andes

Germán Chaparro Molano[1], Oscar Leonardo Ramírez Suárez[1], Oscar Alberto Restrepo Gaitán[1,2], and Alexander Marcial Martínez Mercado[1,3,4,5]

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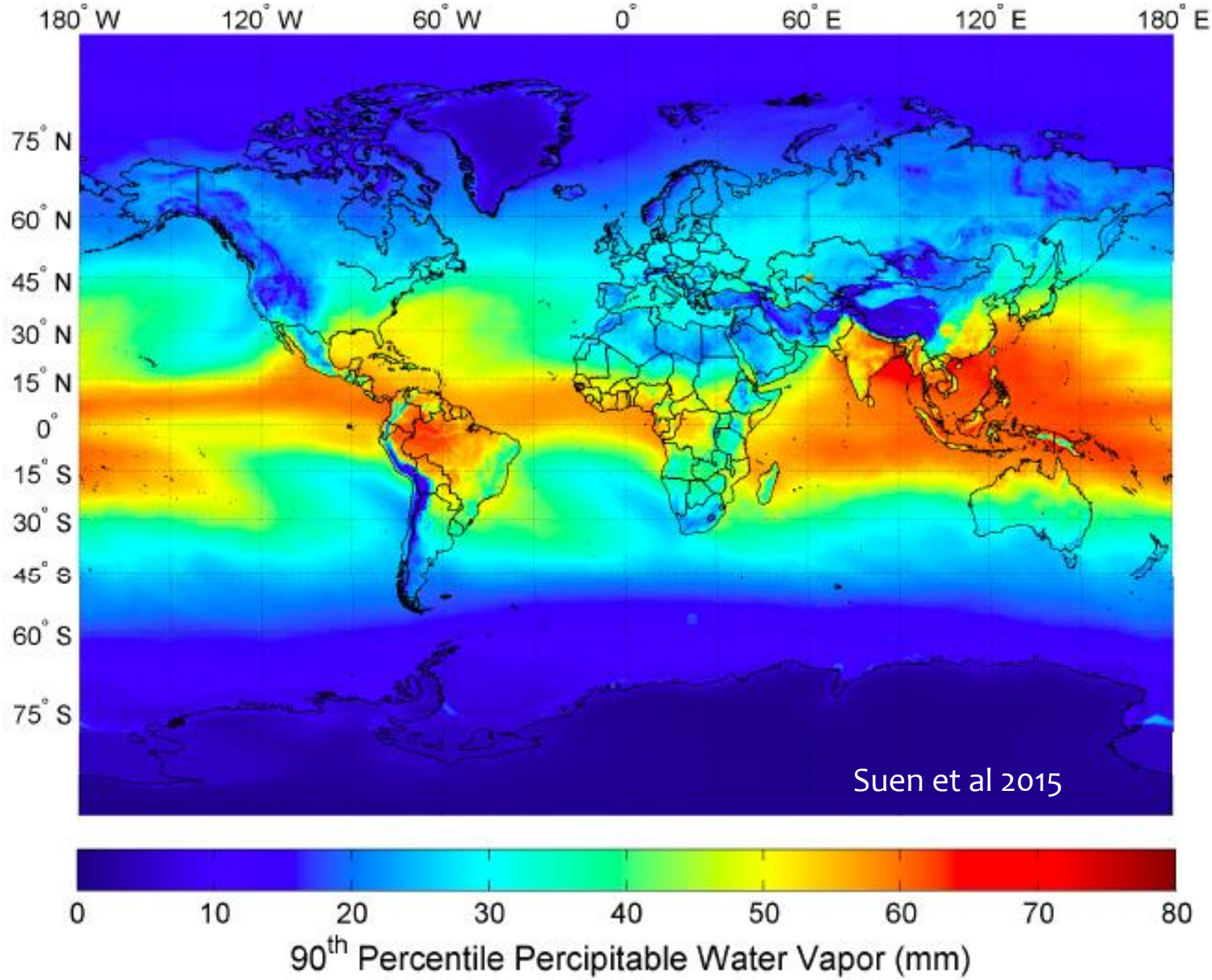
Received 2017 May 25; accepted 2017 July 31; published 2017 September 1


180° W
120° W
60° W
0°
60° E
120° E
180° E
75° N
60° N
45° N
30° N
15° N
0°
15° S
30° S
45° S
60° S
75° S
Suen et al 2015
0
10
20
30
40
50
60
70
80
90th Percentile Percipitable Water Vapor (mm)


IRAM 30 m

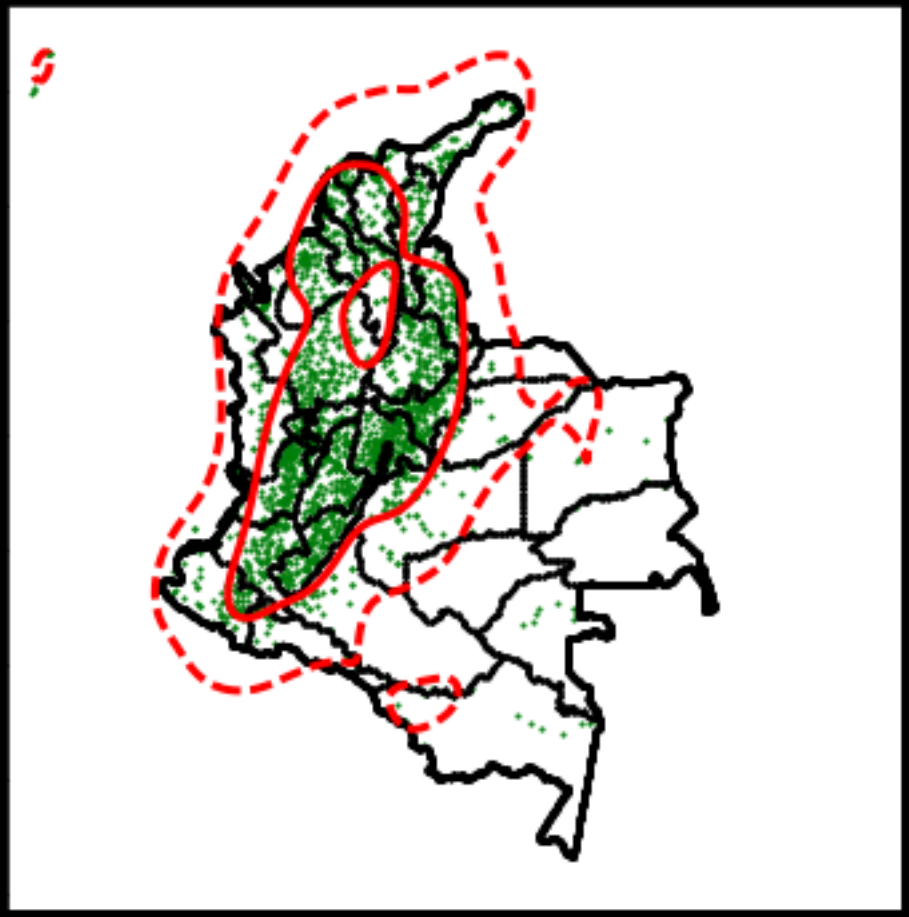

Plateau de Bure


LMT


ALMA

IDEAM Climate Data (1980-2010)

- 2046 weather stations
- Precipitation, Rain Days, Relative Humidity, Sunshine
- Multi-annual Monthly Averages (Jan, Feb,…)
- 12-dimensional data
- Selection criteria –Machine Learning



Climate data for National Meteorological Observatory, Bogotá (1971–2000)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	26.4 (79.5)	25.2 (77.4)	26.6 (79.9)	24.4 (75.9)	25.0 (77)	28.6 (83.5)	25.0 (77)	23.3 (73.9)	26.0 (78.8)	25.1 (77.2)	25.6 (78.1)	24.4 (75.9)	28.6 (83.5)
Average high °C (°F)	20.2 (68.4)	20.3 (68.5)	19.4 (66.9)	20.1 (68.2)	19.0 (66.2)	19.2 (66.6)	18.6 (65.5)	18.8 (65.8)	19.2 (66.6)	19.5 (67.1)	19.6 (67.3)	19.9 (67.8)	19.6 (67.3)
Daily mean °C (°F)	14.3 (57.7)	14.5 (58.1)	14.9 (58.8)	14.9 (58.8)	15.0 (59)	14.5 (58.1)	14.6 (58.3)	14.1 (57.4)	14.3 (57.7)	14.3 (57.7)	14.4 (57.9)	14.6 (58.3)	14.4 (57.9)
Average low °C (°F)	7.6 (45.7)	8.4 (47.1)	9.5 (49.1)	9.7 (49.5)	9.7 (49.5)	9.5 (49.1)	9.2 (48.6)	8.9 (48)	8.7 (47.7)	9.0 (48.2)	9.2 (48.6)	8.0 (46.4)	9.0 (48.2)
Record low °C (°F)	−1.5 (29.3)	−5.2 (22.6)	−0.4 (31.3)	0.2 (32.4)	0.2 (32.4)	1.1 (34)	0.4 (32.7)	0.4 (32.7)	0.3 (32.5)	1.8 (35.2)	0.5 (32.9)	−1.1 (30)	−5.2 (22.6)
Average precipitation mm (inches)	50 (1.97)	68 (2.68)	91 (3.58)	135 (5.31)	120 (4.72)	54 (2.13)	35 (1.38)	45 (1.77)	70 (2.76)	137 (5.39)	127 (5)	81 (3.19)	1,012 (39.84)
Average rainy days (≥ 1 mm)	9	12	14	18	19	17	15	14	16	21	16	11	181
Average relative humidity (%)	75	76	75	77	77	75	74	74	75	76	77	76	76
Mean monthly sunshine hours	156	128	107	88	83	94	114	117	109	96	103	138	1,328
Source: Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM)[33]													

Reducción de Dimensionalidad

- Análisis de Componentes Principales (Eigenvalores y Eigenvectores de la matriz de covarianza)
- Preservamos 2-sigma de la varianza de los datos
- Reducimos la dimensionalidad de los vectores (datos) de 12 a 3(2)

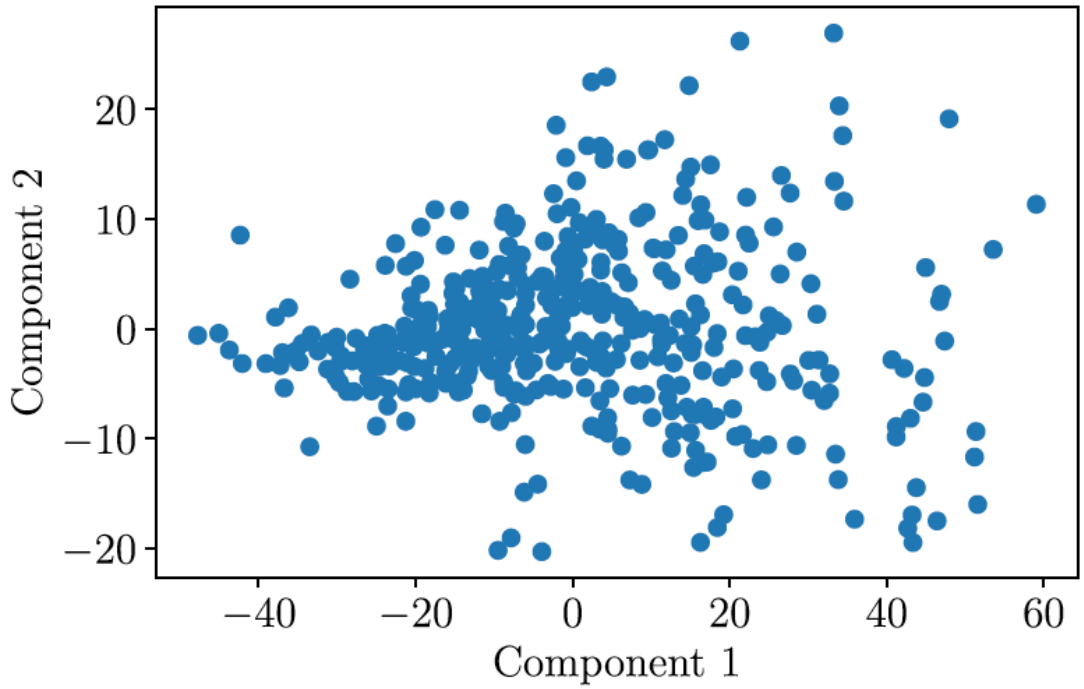
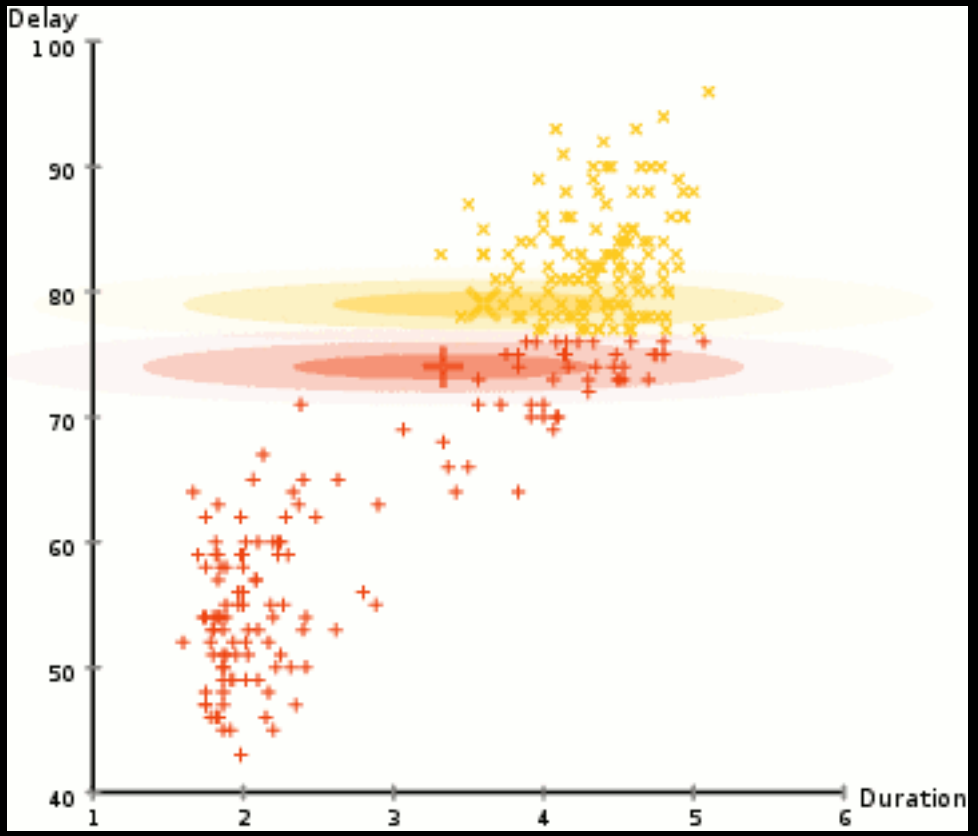


Figure 3. Relative humidity data projected across two principal components. The dimensionality of the data has been reduced from 12 to two while covering 95% of the variance of the data.

Modelos de Mixtura Gaussiana



Modelos de Mixtura Gaussiana

$$p(\mathbf{x}) = \frac{1}{(2\pi)^{D/2}|\boldsymbol{\Sigma}|^{1/2}} \exp\left[-\frac{1}{2}(\mathbf{x}-\boldsymbol{\mu})^{\mathrm{T}}\boldsymbol{\Sigma}^{-1}(\mathbf{x}-\boldsymbol{\mu})\right] \doteq \mathcal{N}(\mathbf{x};\boldsymbol{\mu},\boldsymbol{\Sigma})$$

$$p(\mathbf{x}) = \sum_{m=1}^{M} \frac{c_m}{(2\pi)^{D/2}|\boldsymbol{\Sigma}_m|^{1/2}} \exp\left[-\frac{1}{2}(\mathbf{x}-\boldsymbol{\mu}_m)^{\mathrm{T}}\boldsymbol{\Sigma}_m^{-1}(\mathbf{x}-\boldsymbol{\mu}_m)\right]$$

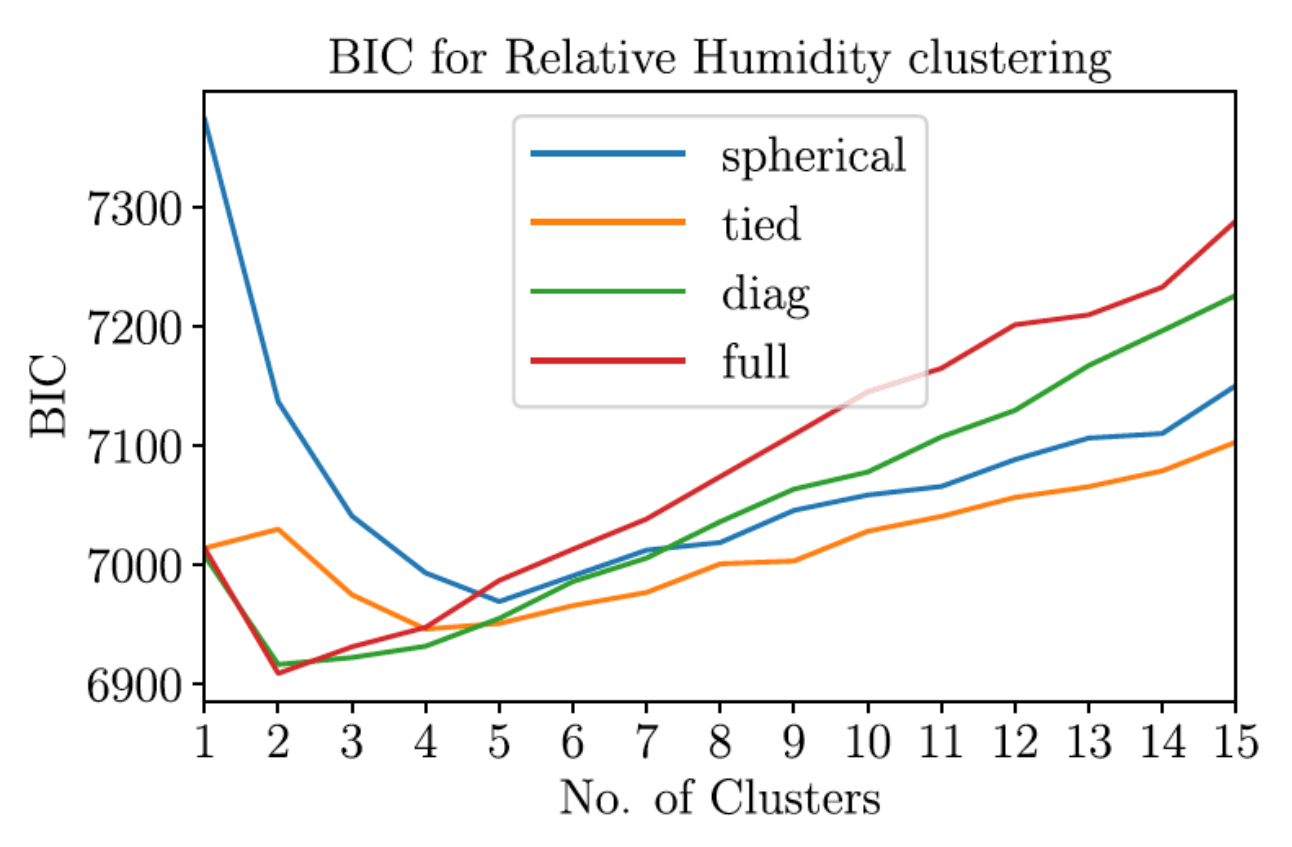
$$= \sum_{m=1}^{M} c_m \mathcal{N}(\mathbf{x};\boldsymbol{\mu}_m,\boldsymbol{\Sigma}_m), \qquad (c_m > 0).$$

$$\boldsymbol{\Theta} = \{c_m, \boldsymbol{\mu}_m, \boldsymbol{\Sigma}_m\}$$

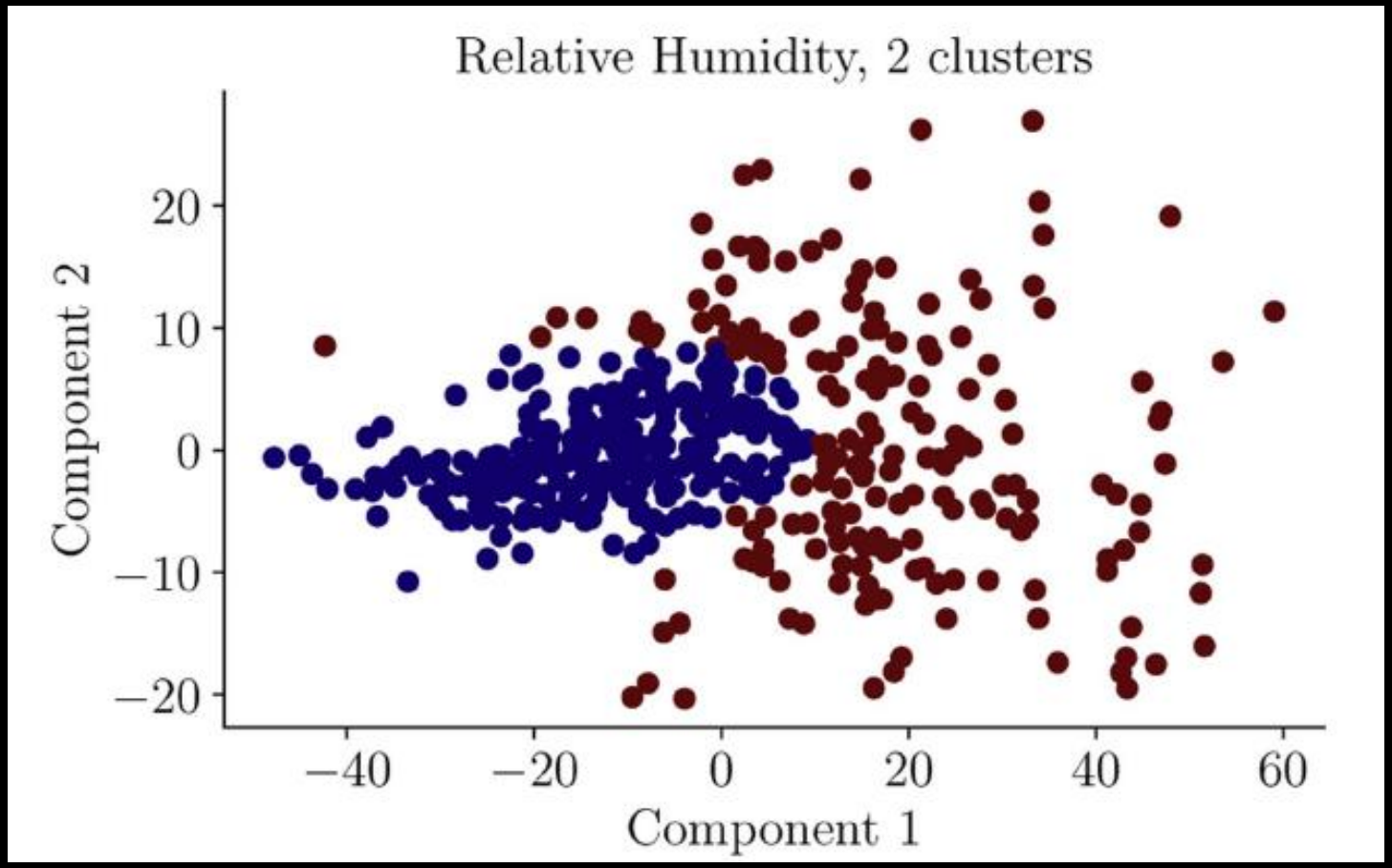
$$\mathcal{L} = \prod_i p_i(\mathbf{x};\boldsymbol{\Theta})$$

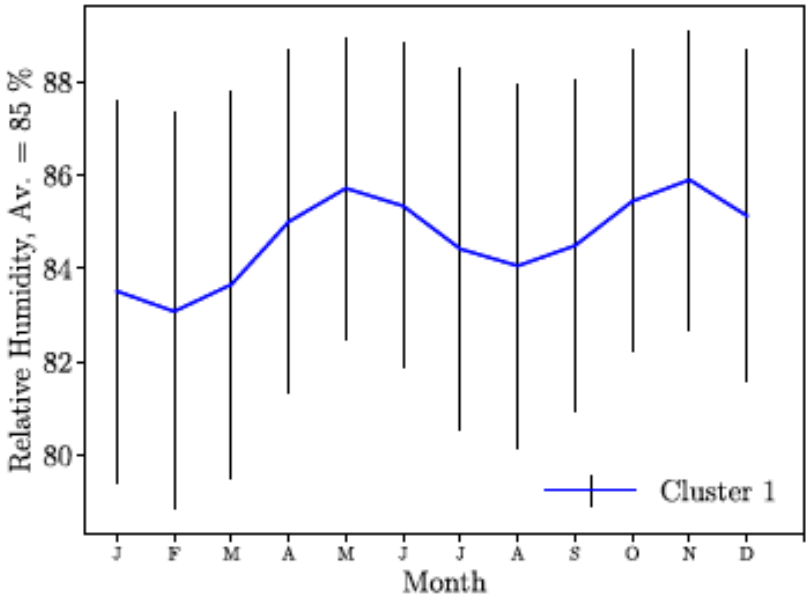
Criterio de Información Bayesiano

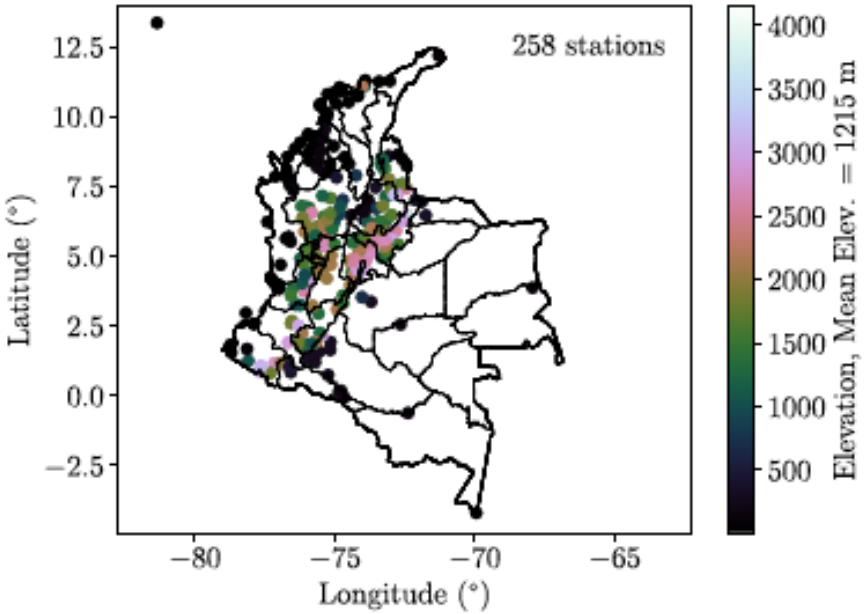
$$\mathrm{BIC} = \ln(n)k - 2\ln(\hat{L})$$

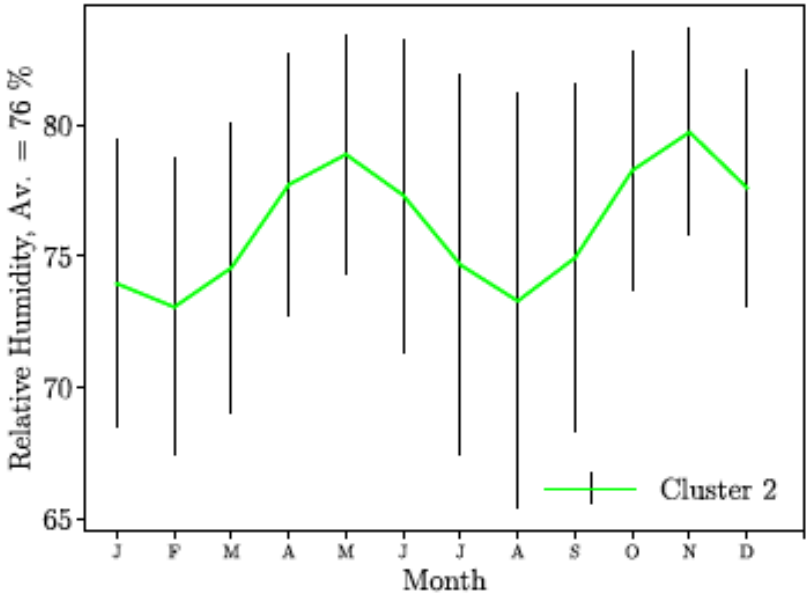


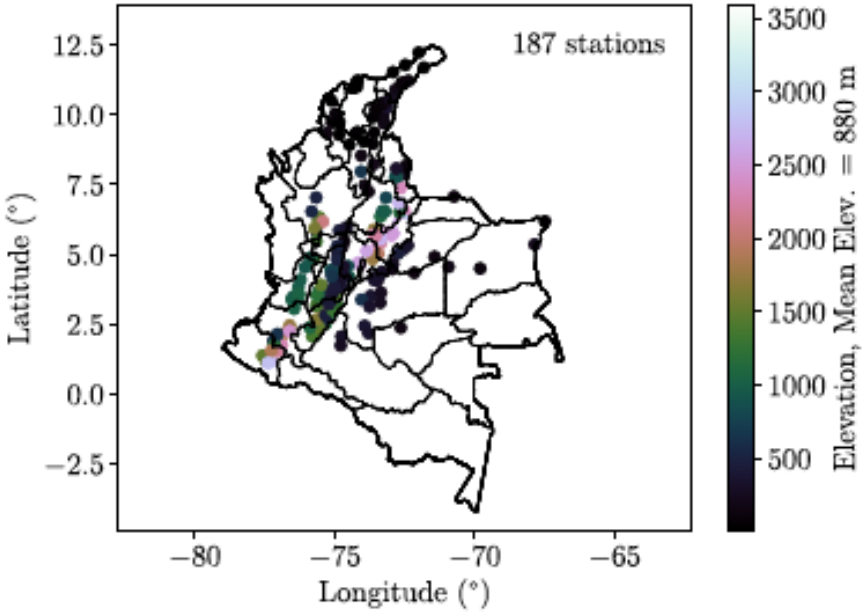
Low Dimensional Embedding



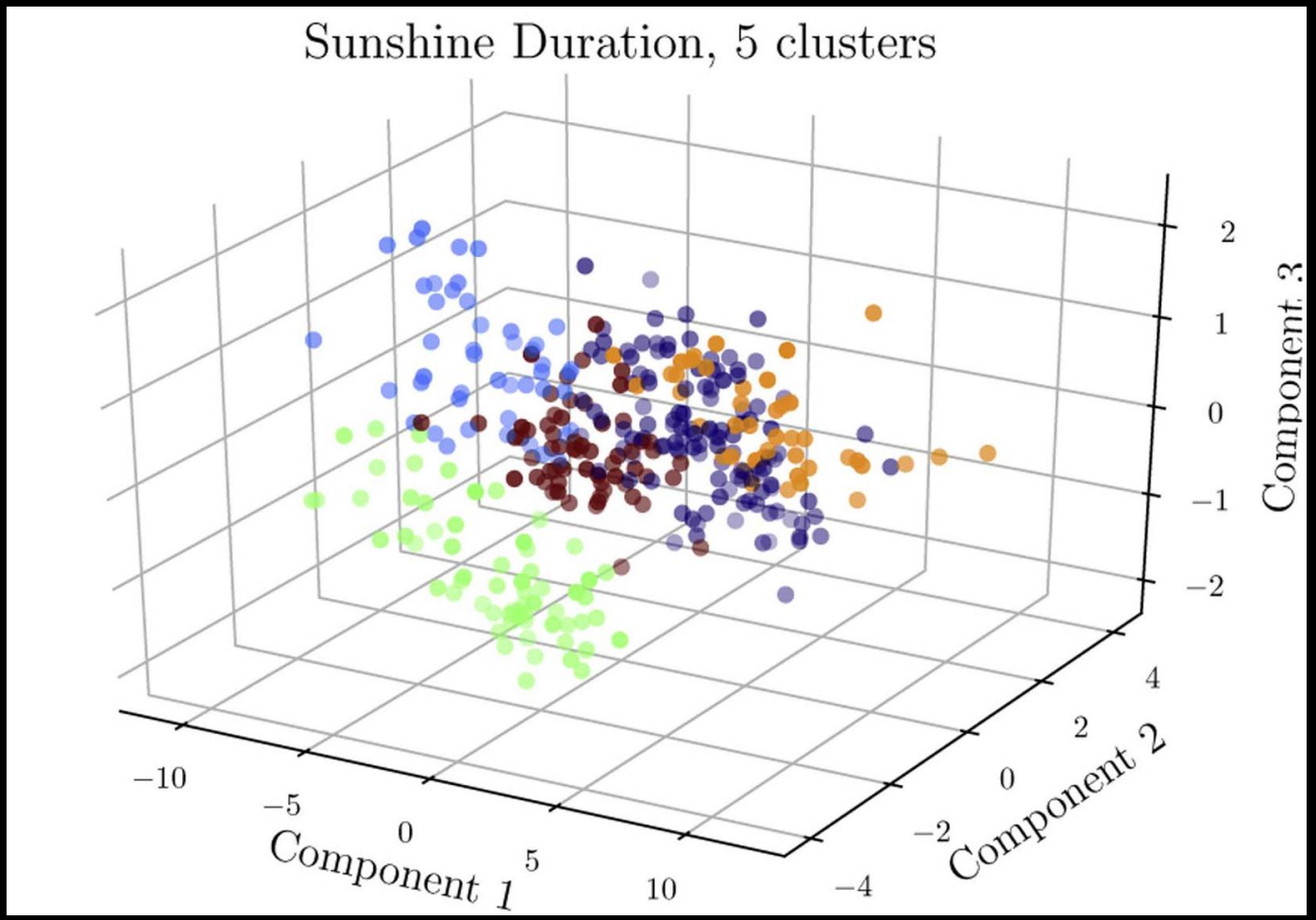

Relative Humidity, Av. = 85 %
88
86
84
82
80
Cluster 1
J F M A M J J A S O N D
Month


258 stations
Latitude (°)
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
−80 −75 −70 −65
Longitude (°)
Elevation, Mean Elev. = 1215 m
4000
3500
3000
2500
2000
1500
1000
500


Relative Humidity, Av. = 76 %
80
75
70
65
Cluster 2
J F M A M J J A S O N D
Month


187 stations
Latitude (°)
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
−80 −75 −70 −65
Longitude (°)
Elevation, Mean Elev. = 880 m
3500
3000
2500
2000
1500
1000
500

Low Dimensional Embedding



Bayesian Quality Index

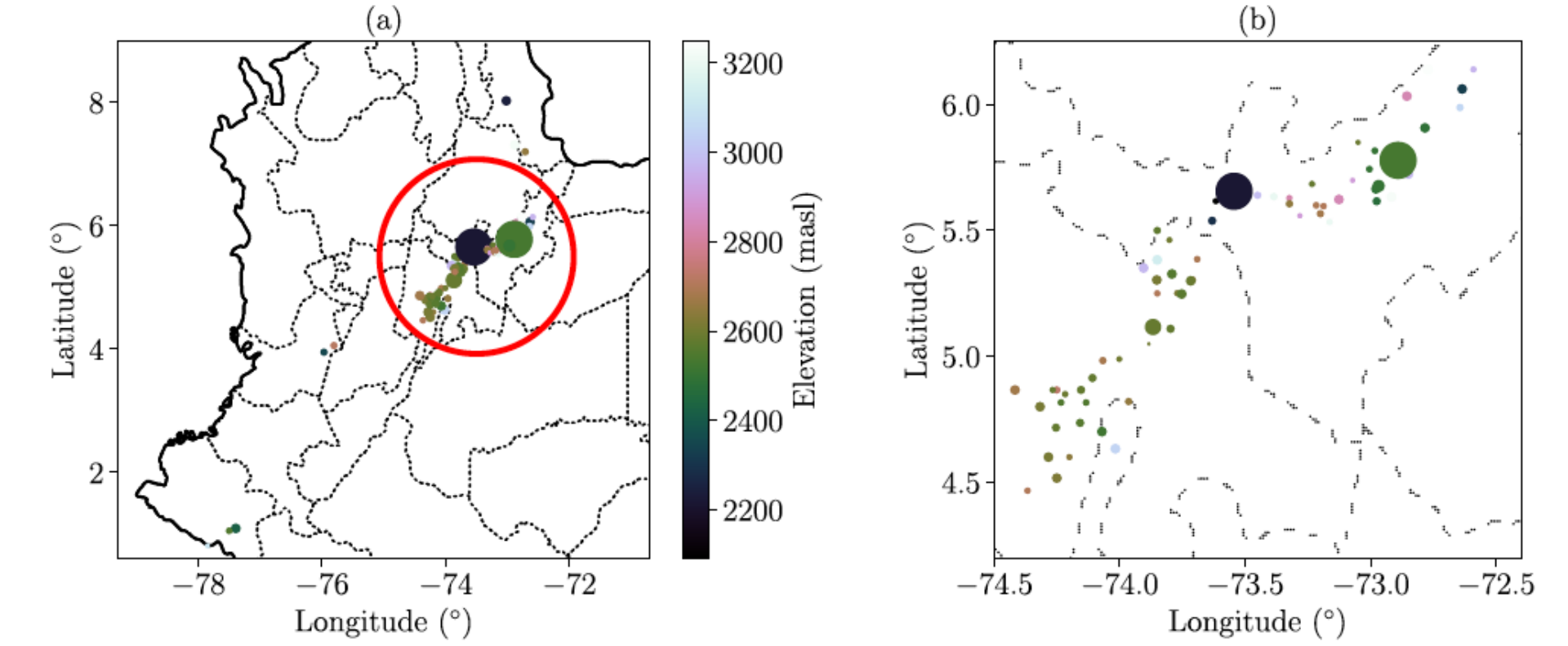
$$P_j = P(C \cap A \cap T_i \mid h)$$

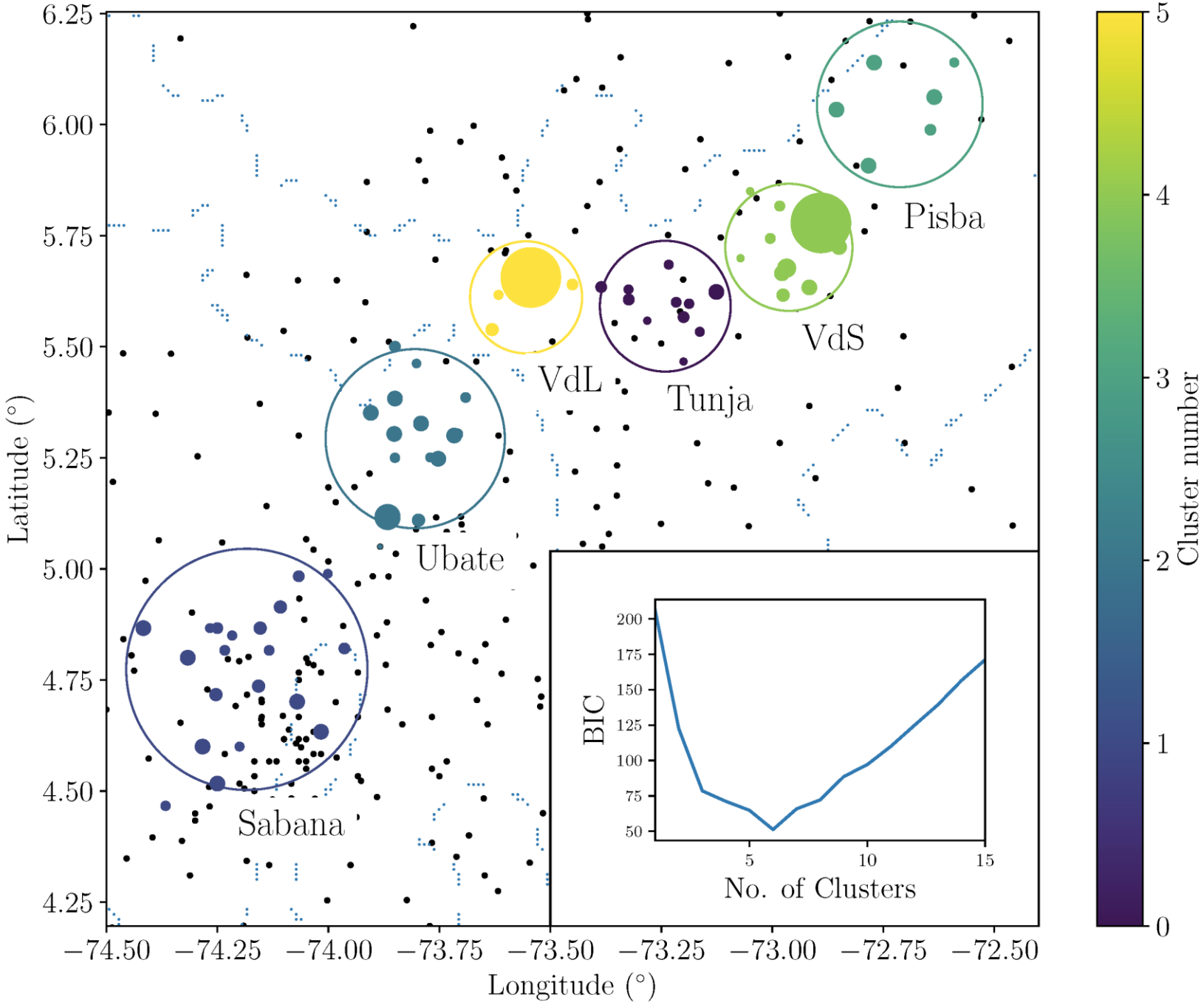
$$P_j = \frac{P(h \mid C \cap A \cap T_i)}{P(h)} P(C \mid A \cap T_i) P(A \mid T_i) P(T_i), \quad (3)$$

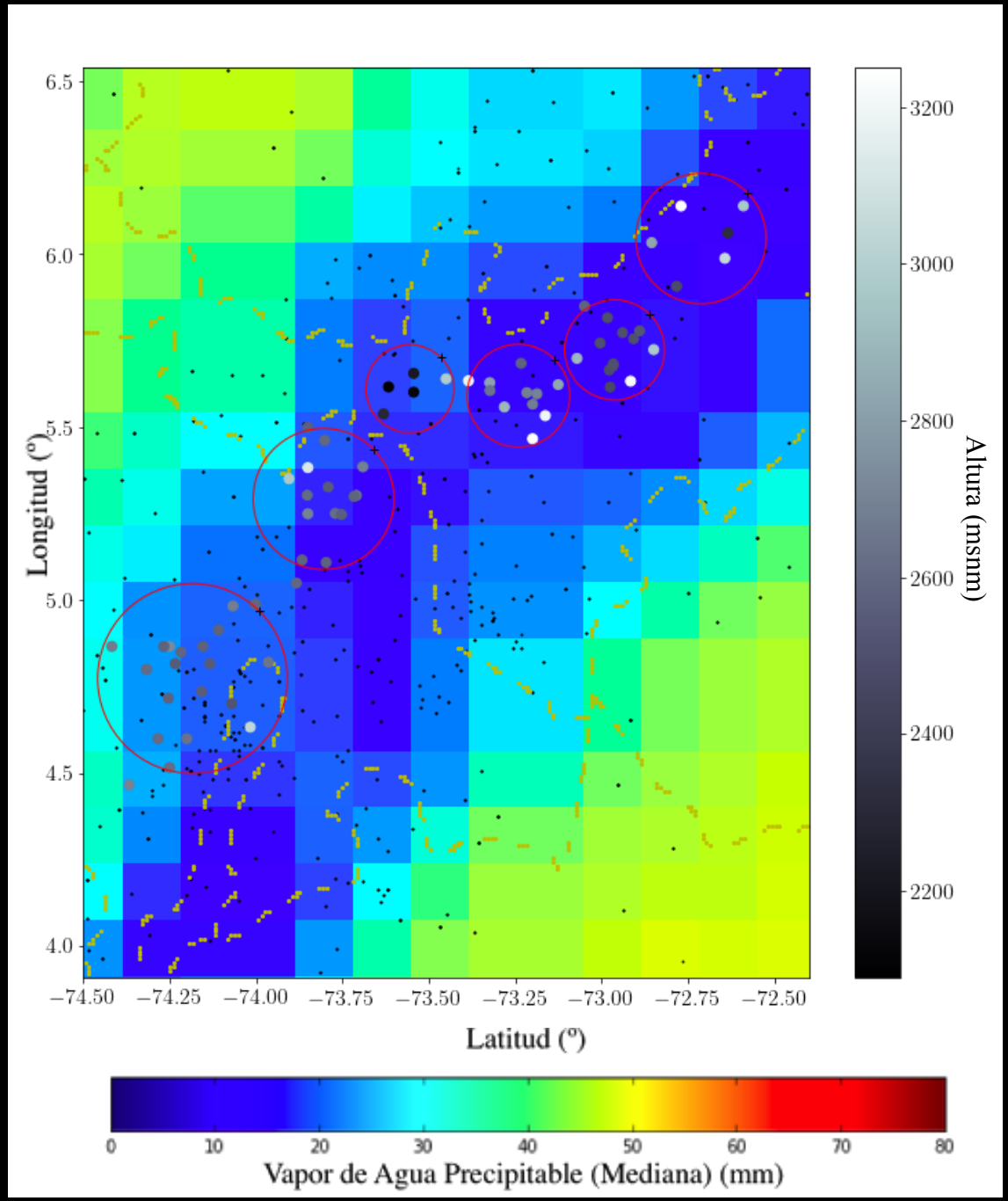
where

1. $P(h \mid C \cap A \cap T_i)$ is the distribution of elevations for a station type (T_i) on our shortlist ($C \cap A$),
2. $P(A \mid T_i)$ is the probability that a station of type T_i is in our shortlist,
3. $P(T_i)$ is the probability that a station type is T_i, and
4. $P(C \mid A \cap T_i)$ is the probability that a station meets all four criteria (C) given that it is in our shortlist (A) and is of type T_i.

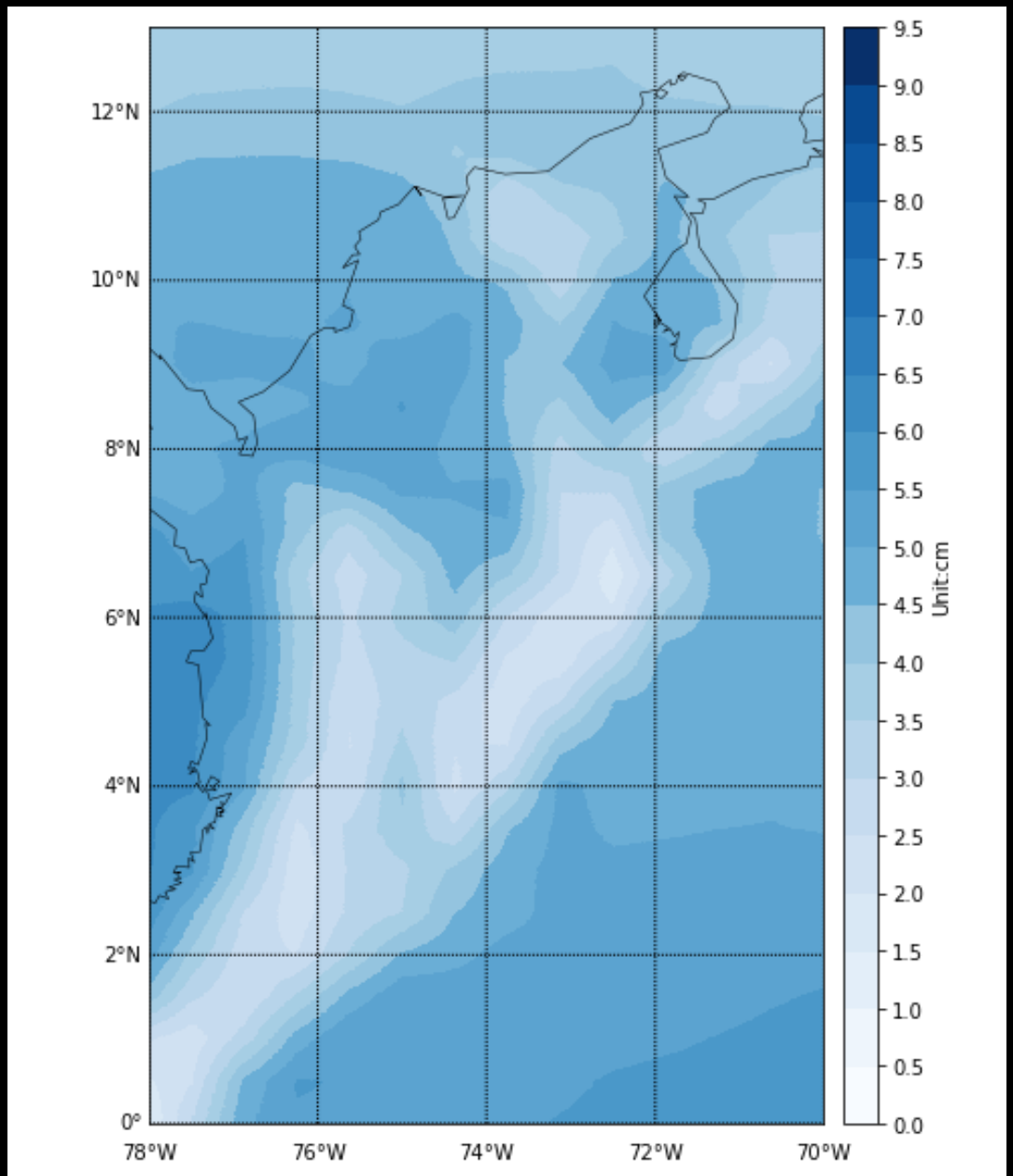
Estaciones candidatas situadas por encima de 2000 msnm




Pisba
VdS
VdL
Tunja
Ubate
Sabana
Latitude (°)
Longitude (°)
Cluster number
BIC
No. of Clusters
6.25
6.00
5.75
5.50
5.25
5.00
4.75
4.50
4.25
−74.50
−74.25
−74.00
−73.75
−73.50
−73.25
−73.00
−72.75
−72.50
0
1
2
3
4
5
200
175
150
125
100
75
50
5
10
15


6.5
6.0
5.5
5.0
4.5
4.0
Longitud (°)
−74.50
−74.25
−74.00
−73.75
−73.50
−73.25
−73.00
−72.75
−72.50
Latitud (°)
3200
3000
2800
2600
2400
2200
Altura (msnm)
0
10
20
30
40
50
60
70
80
Vapor de Agua Precipitable (Mediana) (mm)

MODIS – satellite Water Vapor measurements



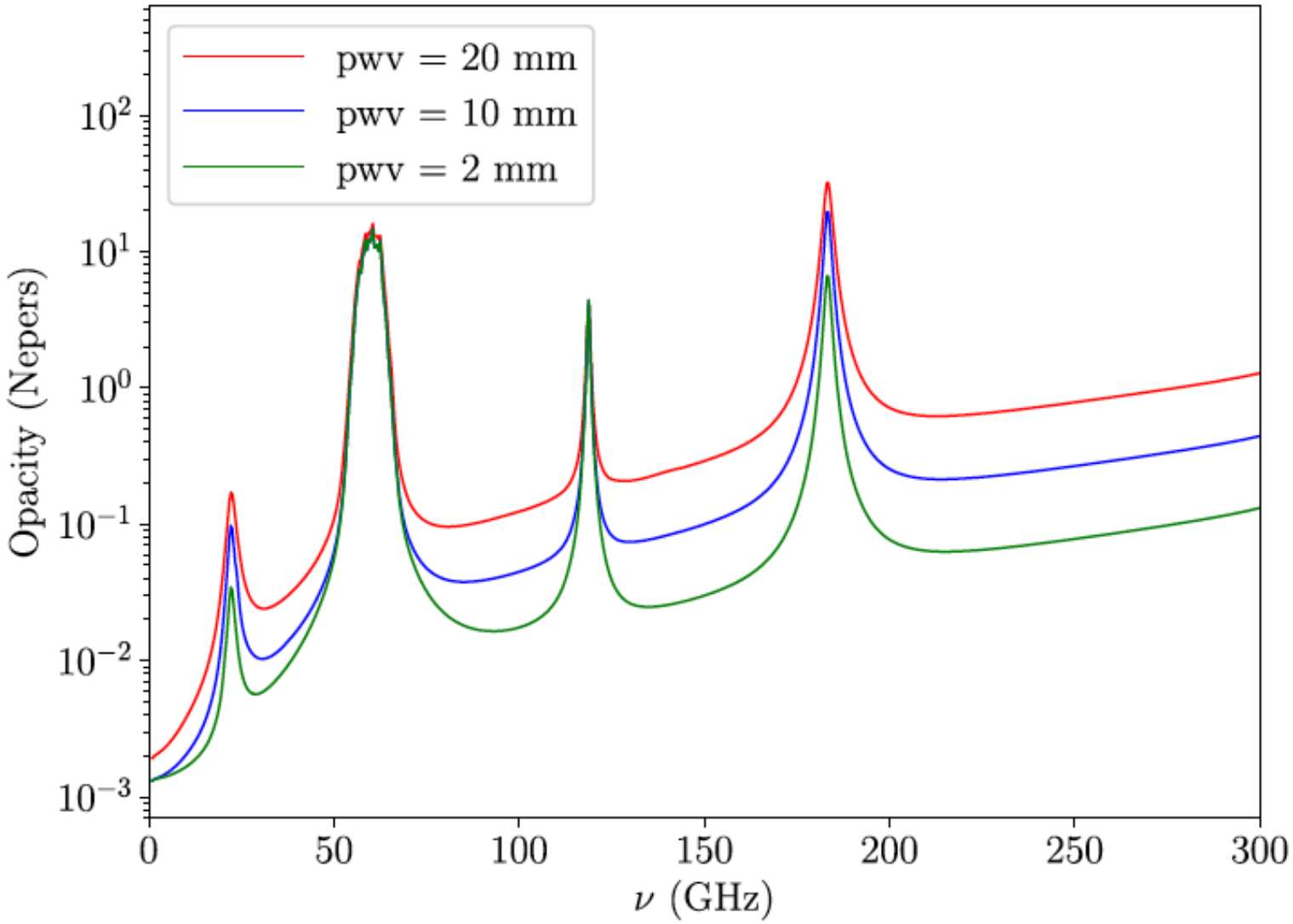


Figure 1. Atmospheric opacity models for the Colombian Andes for different precipitable water vapor (pwv) values corresponding to three scenarios for a 3400 masl site: red line (20 mm pwv) 90% relative humidity at 15°C, blue line (10 mm pwv) 90% relative humidity at 0°C, and green line (2 mm pwv) 30% relative humidity at 0°C.

Site Testing preliminary results

- 4 candidate regions for sites above 3400 msnm for mm-wave radio astronomy
  - Valle del Sol
  - Valle de Ubaté
  - Páramo de Pisba (*)
  - Cantón de Tunja (*)
  - Cocuy - East
- Observing bands:
  - 70-115 GHz
  - 120-170 GHz
  - 120-130 GHz

GitHub

Estudio de Sitio:
saint-germain/ideam

Control por astropy+arduino
saint-germain/ControlAntena