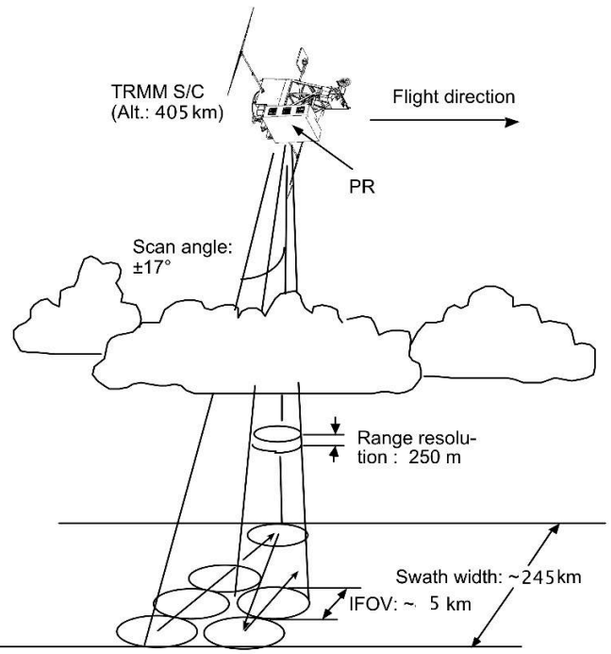
Characterization of Heavy Storms in the Mantaro Valley using remote sensing

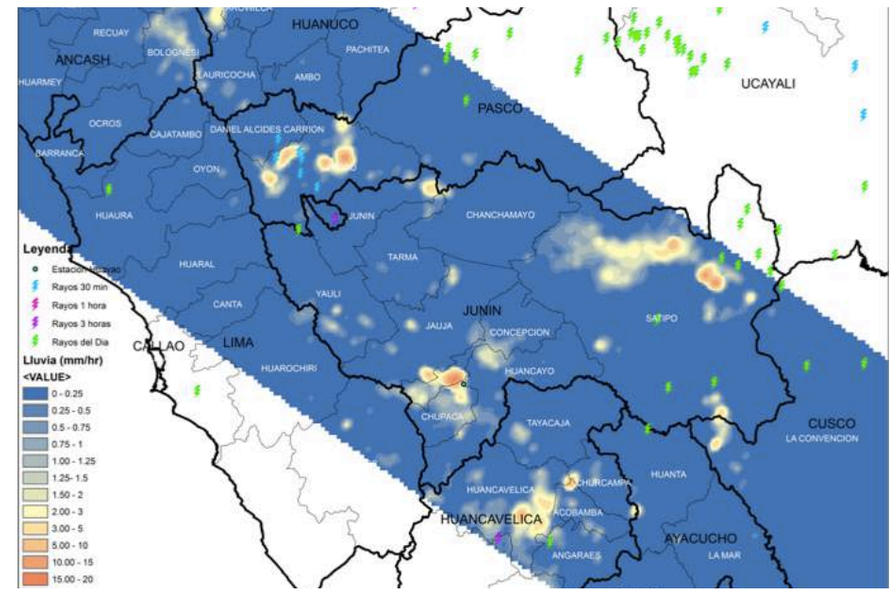
Bach. Steven Chávez
Ph.D. Ken Takahashi

Presentation Outline

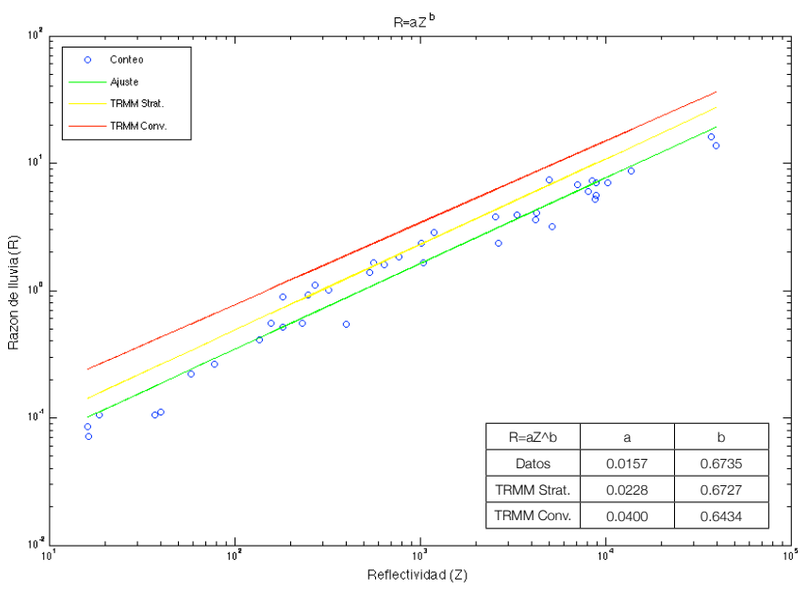
Introduction



Aplications

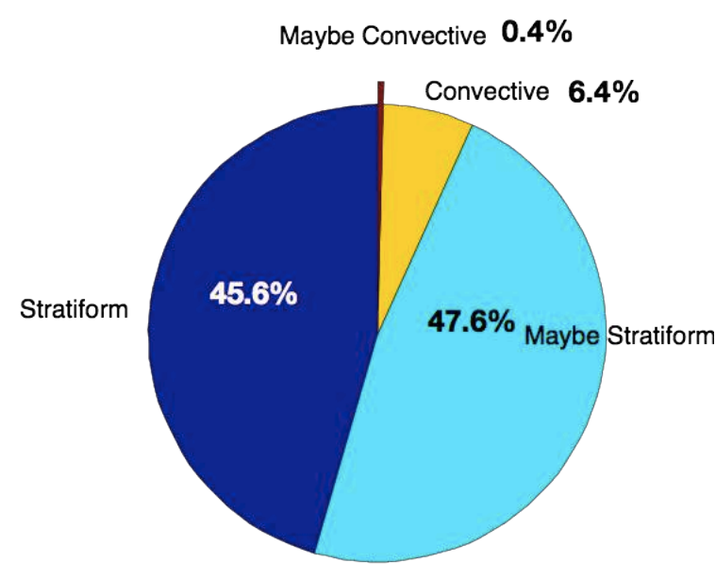


Results

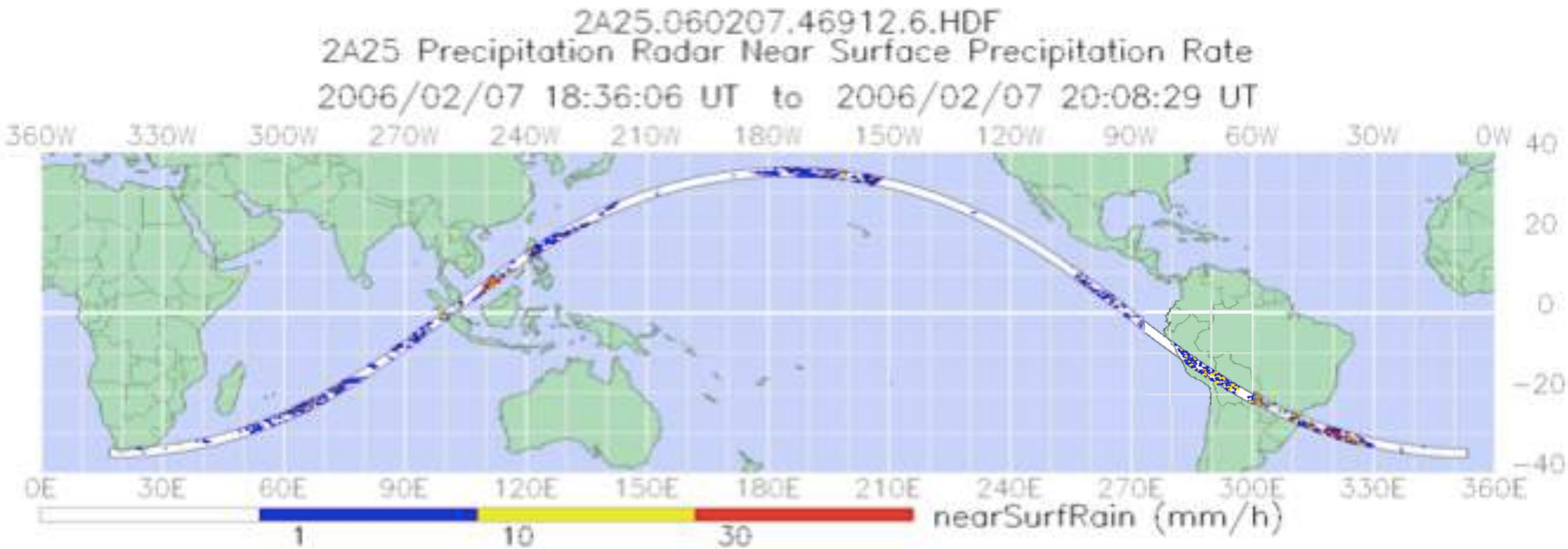


R=aZ^b	a	b
Datos	0.0157	0.6735
TRMM Strat.	0.0228	0.6727
TRMM Conv.	0.0400	0.6434

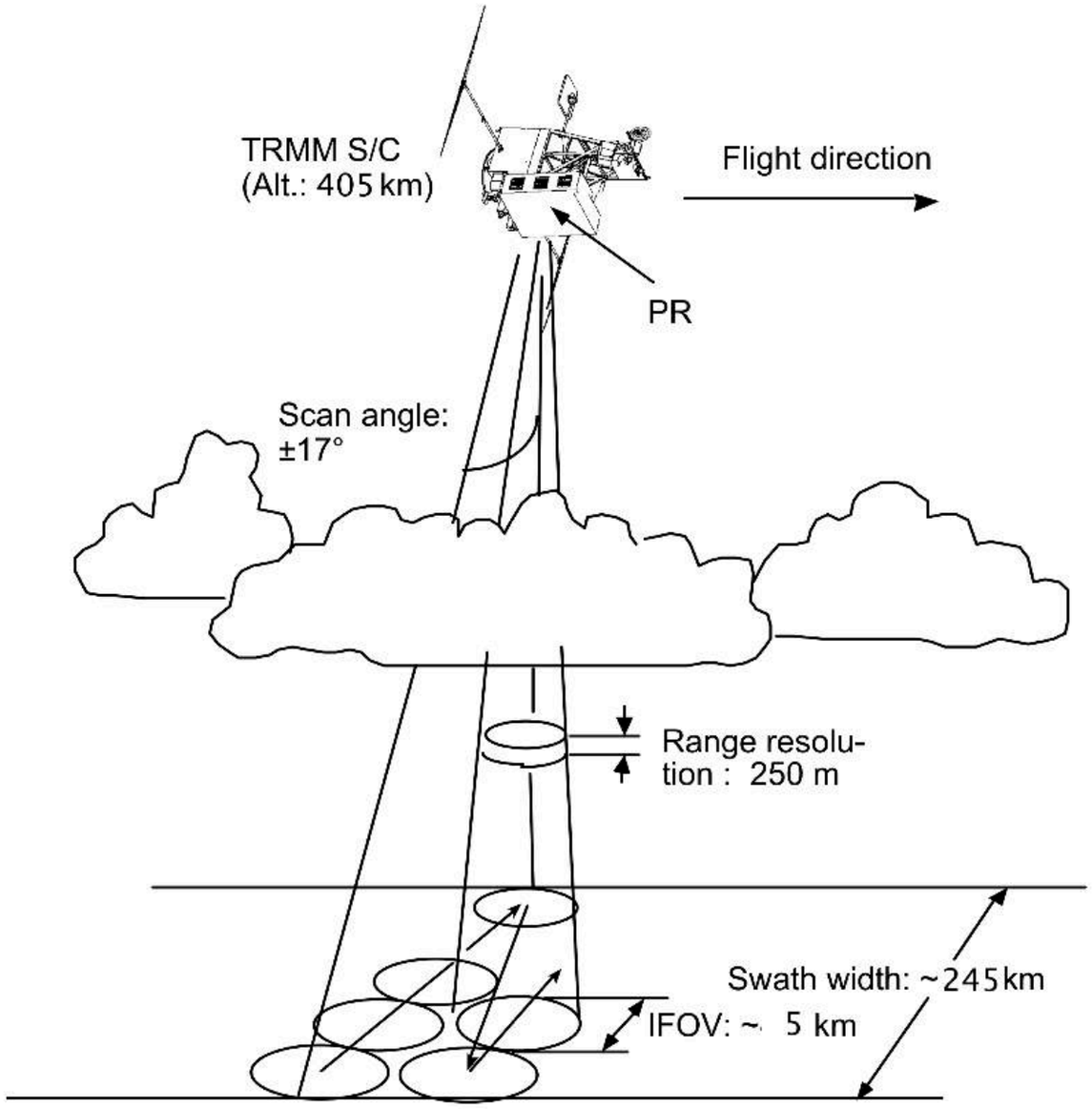
Conclusions



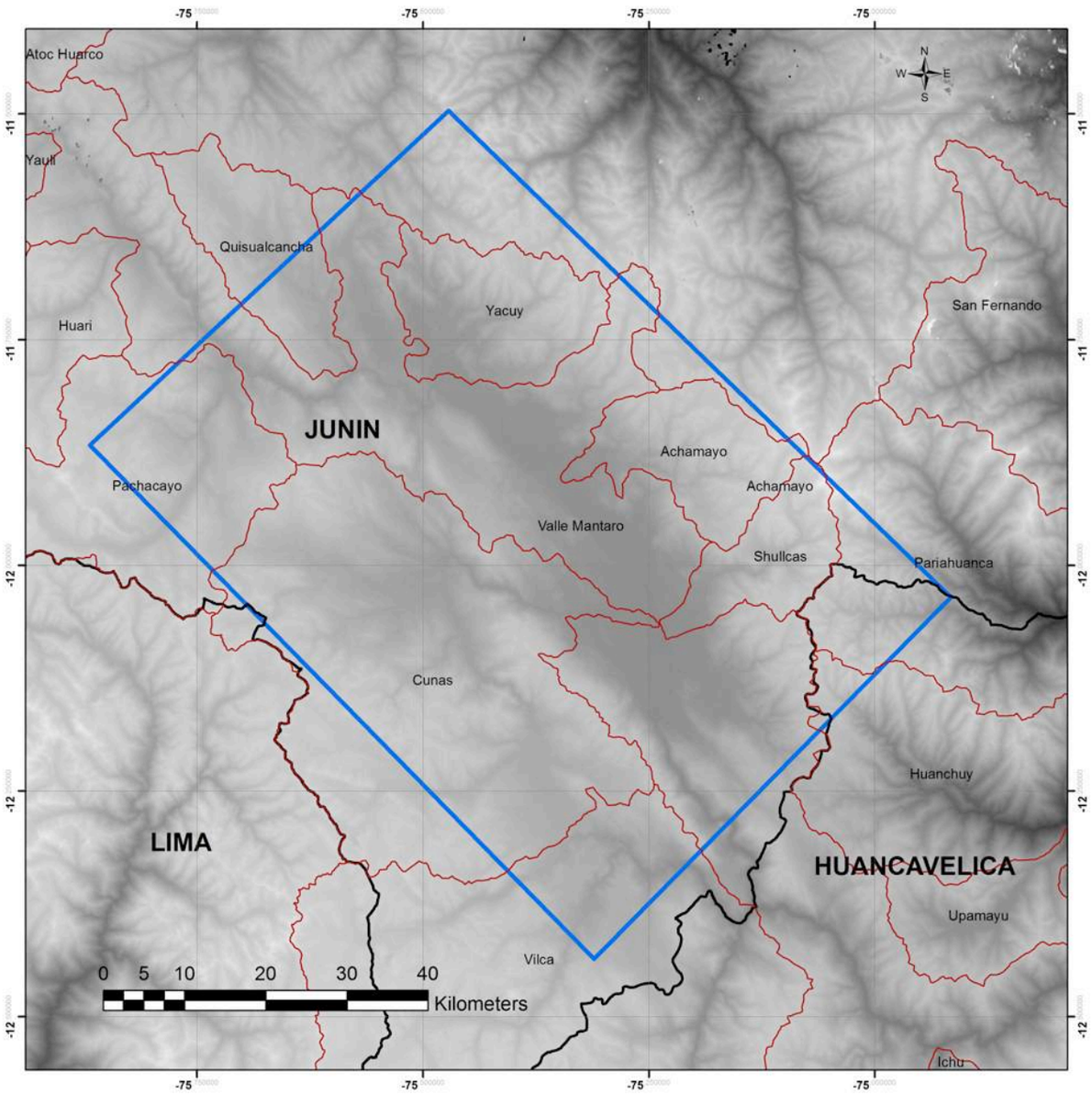
The TRMM Precipitation Radar (PR) 2A25 Product



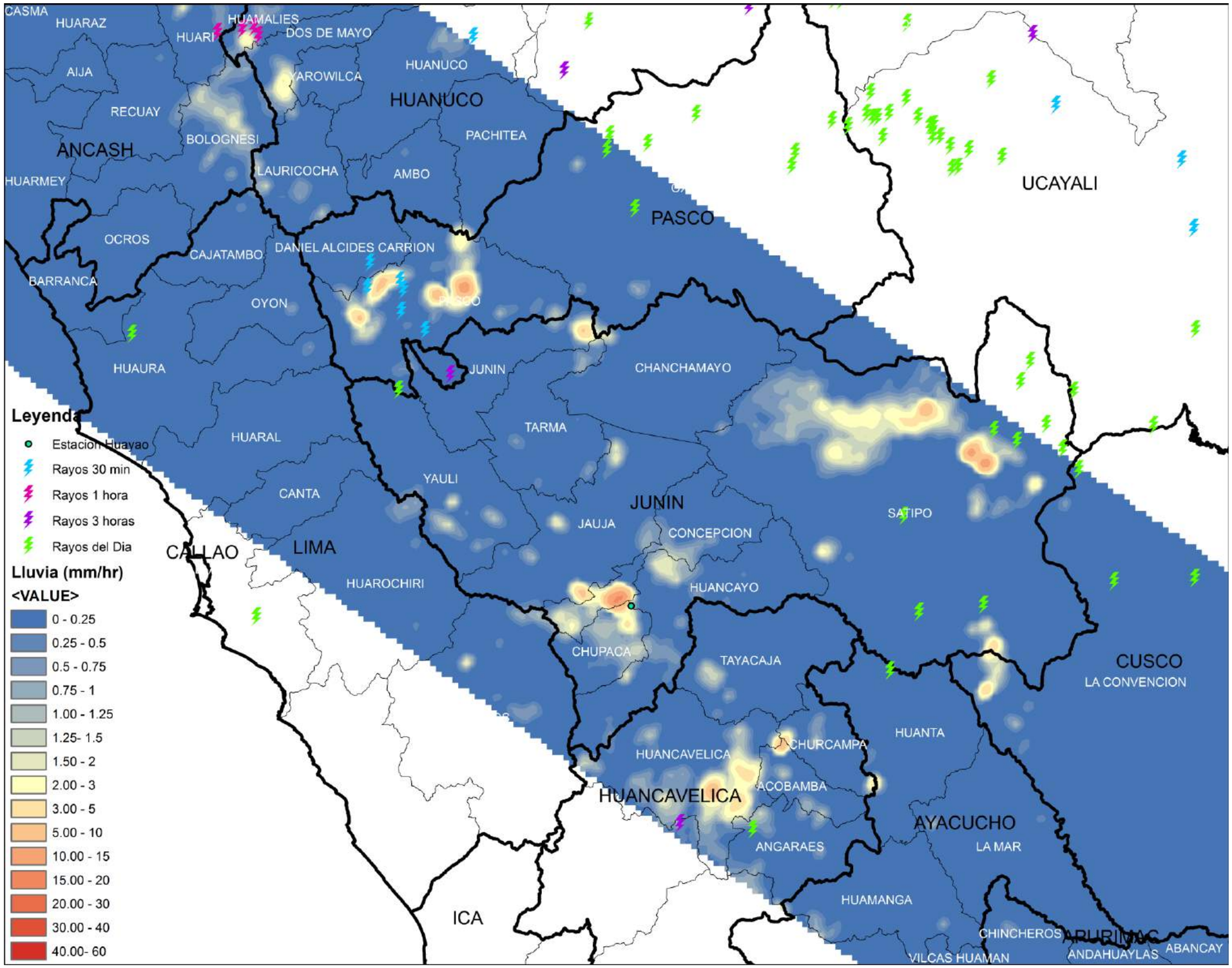
PR Scan Geometry



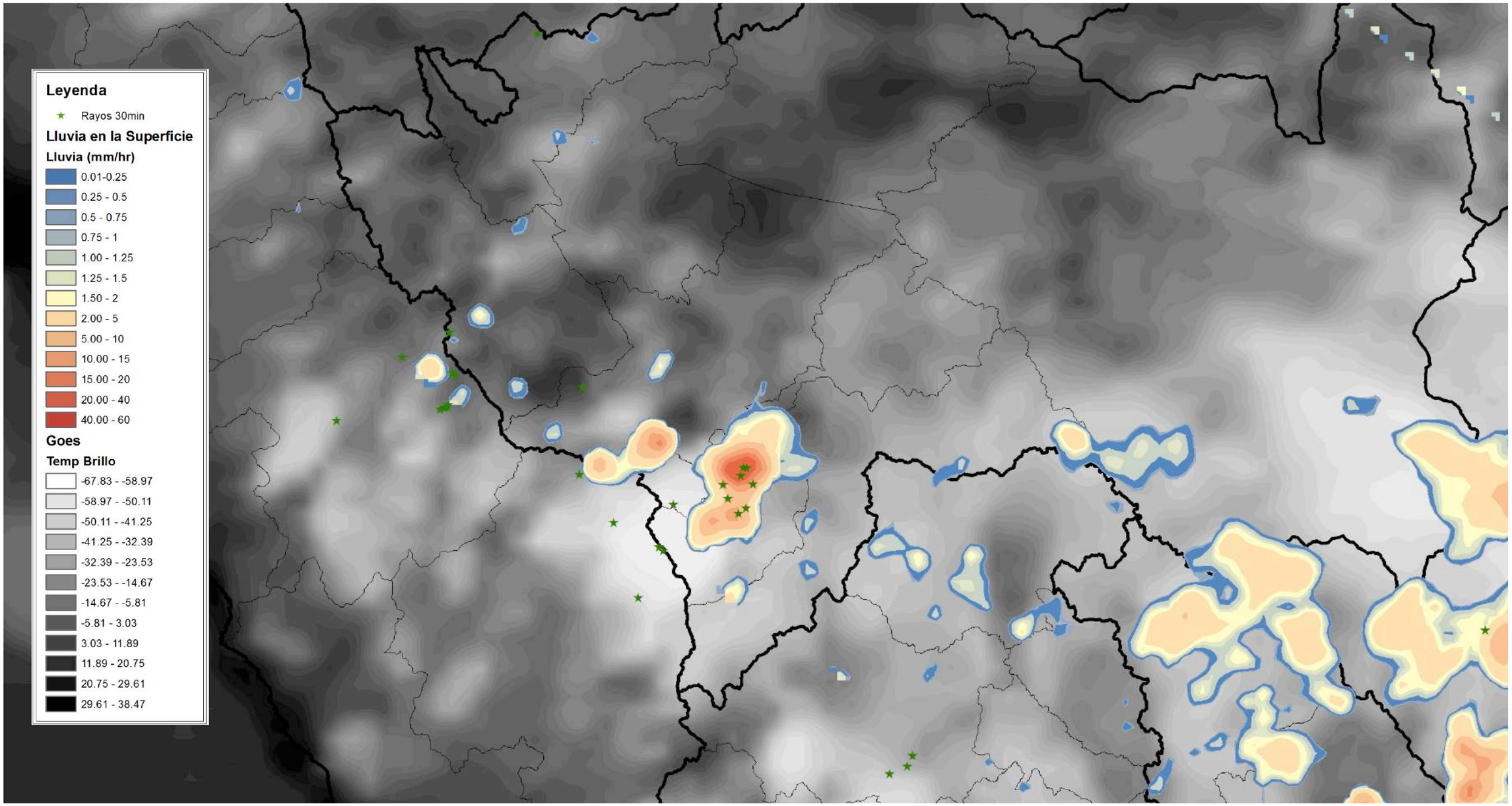
The Area of Study



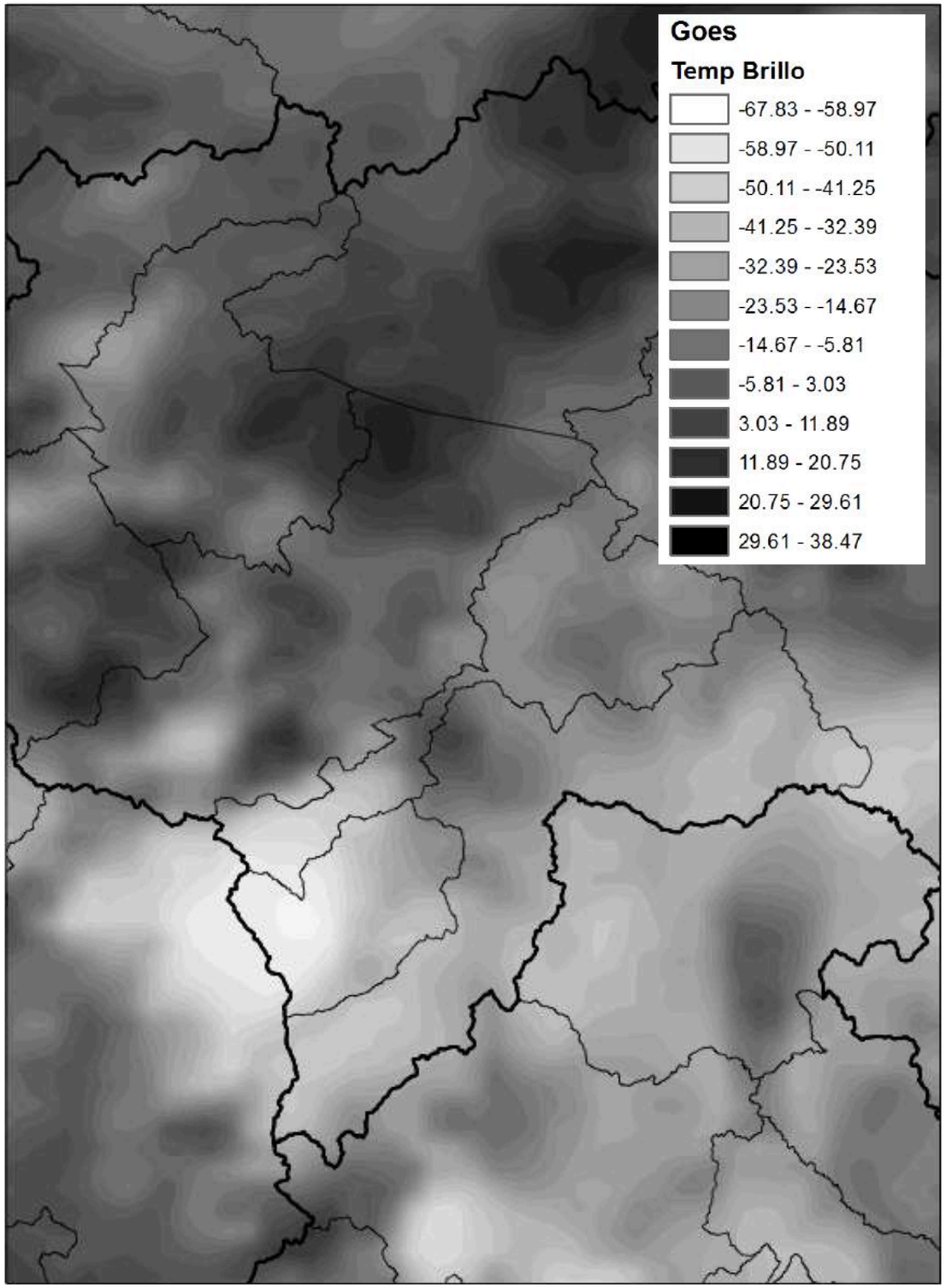
An Aplication

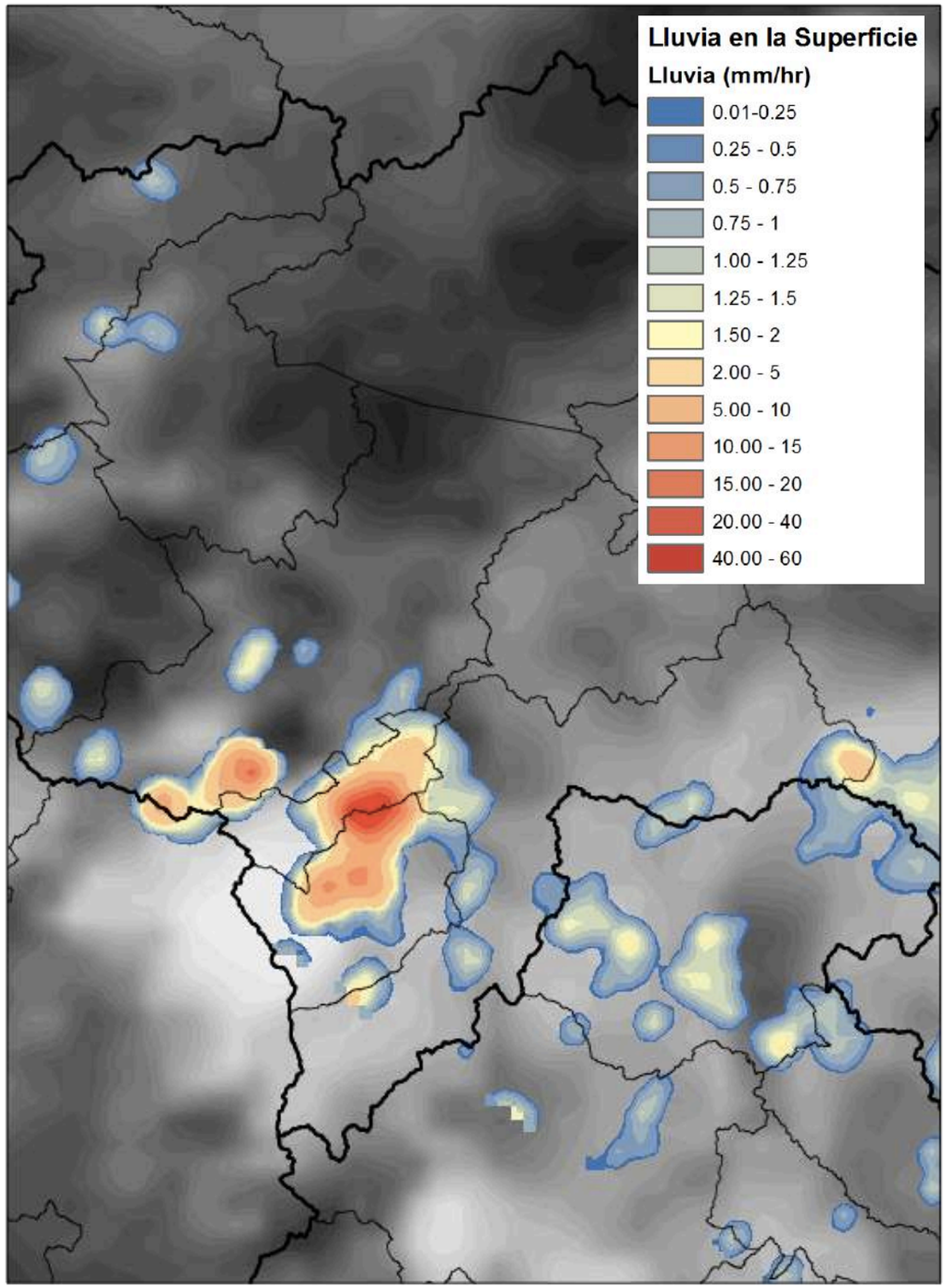


A Storm


Leyenda
Rayos 30min
Lluvia en la Superficie
Lluvia (mm/hr)
0.01-0.25
0.25 - 0.5
0.5 - 0.75
0.75 - 1
1.00 - 1.25
1.25 - 1.5
1.50 - 2
2.00 - 5
5.00 - 10
10.00 - 15
15.00 - 20
20.00 - 40
40.00 - 60
Goes
Temp Brillo
-67.83 - -58.97
-58.97 - -50.11
-50.11 - -41.25
-41.25 - -32.39
-32.39 - -23.53
-23.53 - -14.67
-14.67 - -5.81
-5.81 - 3.03
3.03 - 11.89
11.89 - 20.75
20.75 - 29.61
29.61 - 38.47

Is the bright temperature related to Rain?





First, a summary of how rain is measured.

Understanding PR 2A25.
Radar Reflectivity(Z) and Rain Rate(R)

$$Z \equiv \frac{1}{\mathcal{V}_{\text{res}}} \sum D^6 = \frac{r^2 \overline{P}_r C_R}{|K|^2}$$

$$z = \frac{\sum N_i D_i^6}{v_i A t}$$

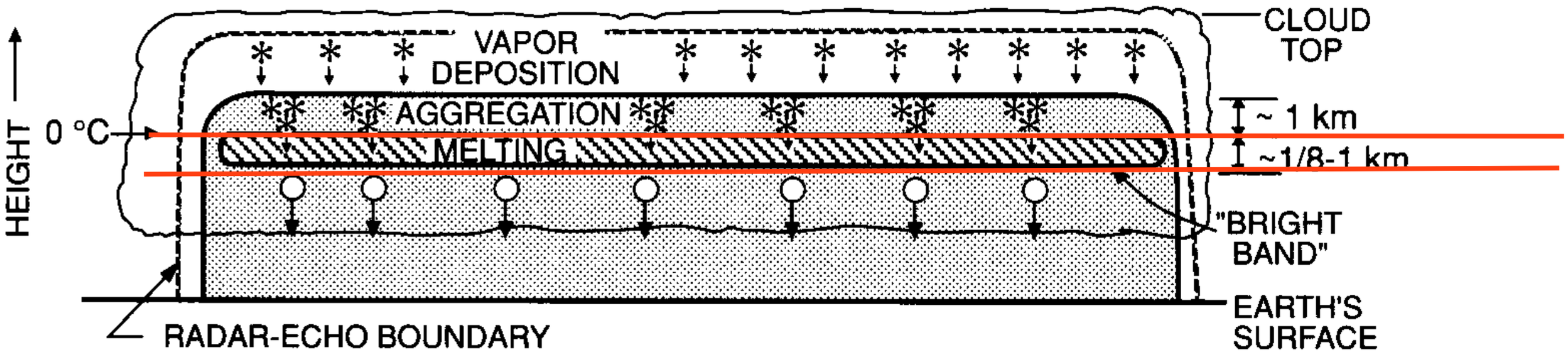
$$R = \frac{\sum \frac{\pi}{6} N_i D_i^3}{A t}$$

Vi = Terminal Velocity
t = Duration of the exposure
A = Area

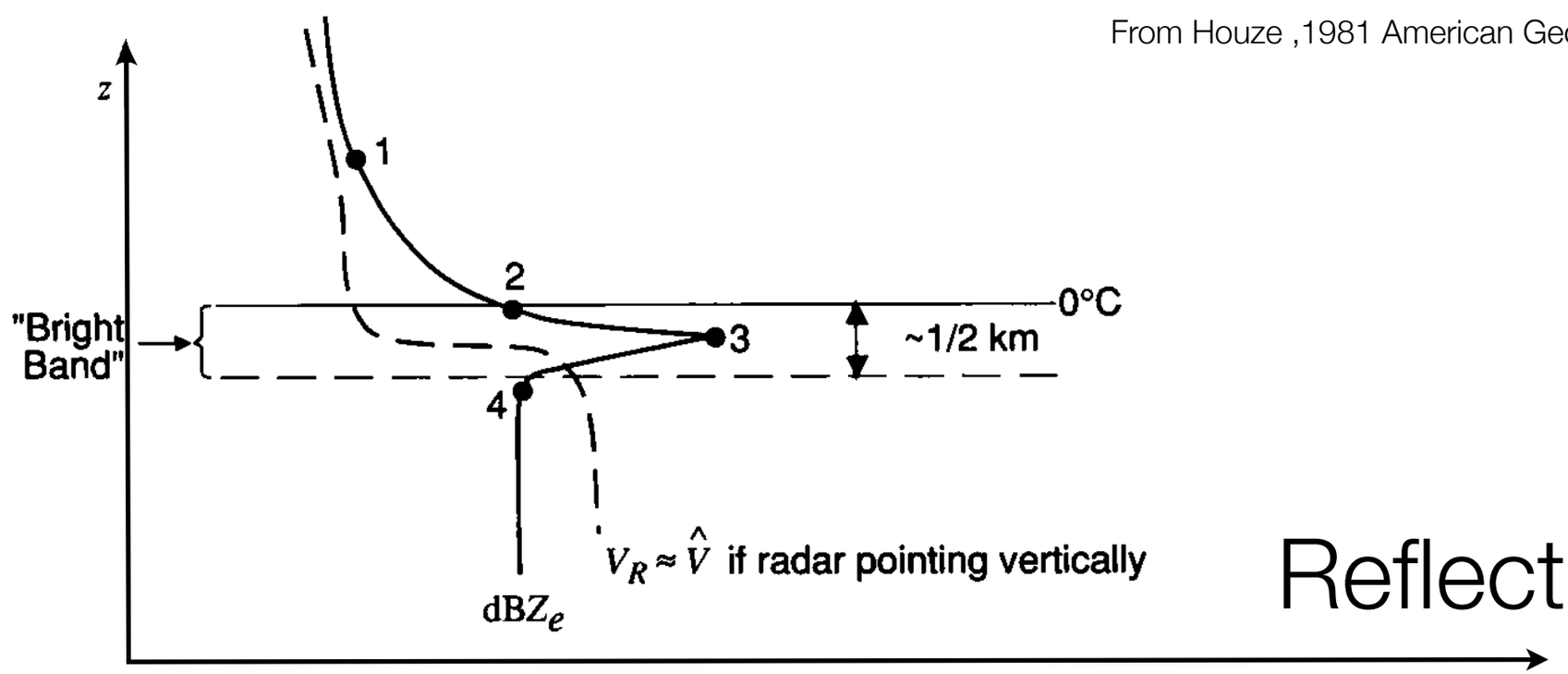
There is an empirical Relation between R and Z that depends of the types of precipitation

$$R = aZ^{b}$$

Stratiform Rain

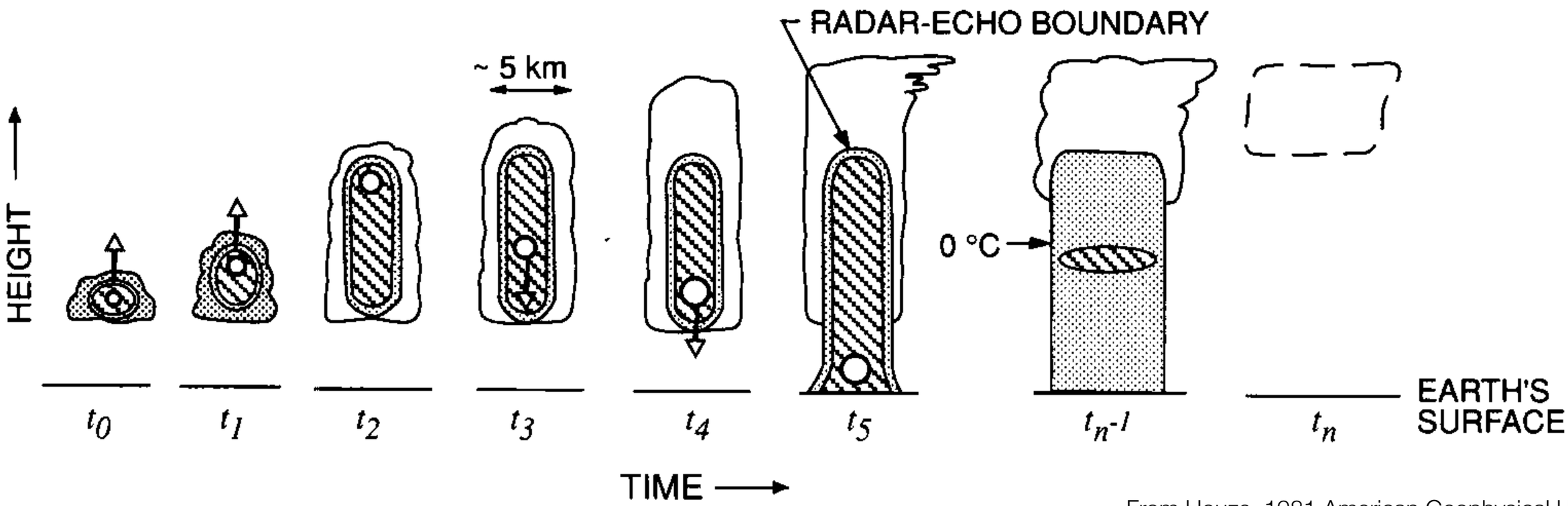


From Houze ,1981 American Geophysical Union



Reflectivity

Convective Rain



From Houze ,1981 American Geophysical Union

The Algorithm 2A23 of PR classifies the Rain in these 2 types and intermediate Types

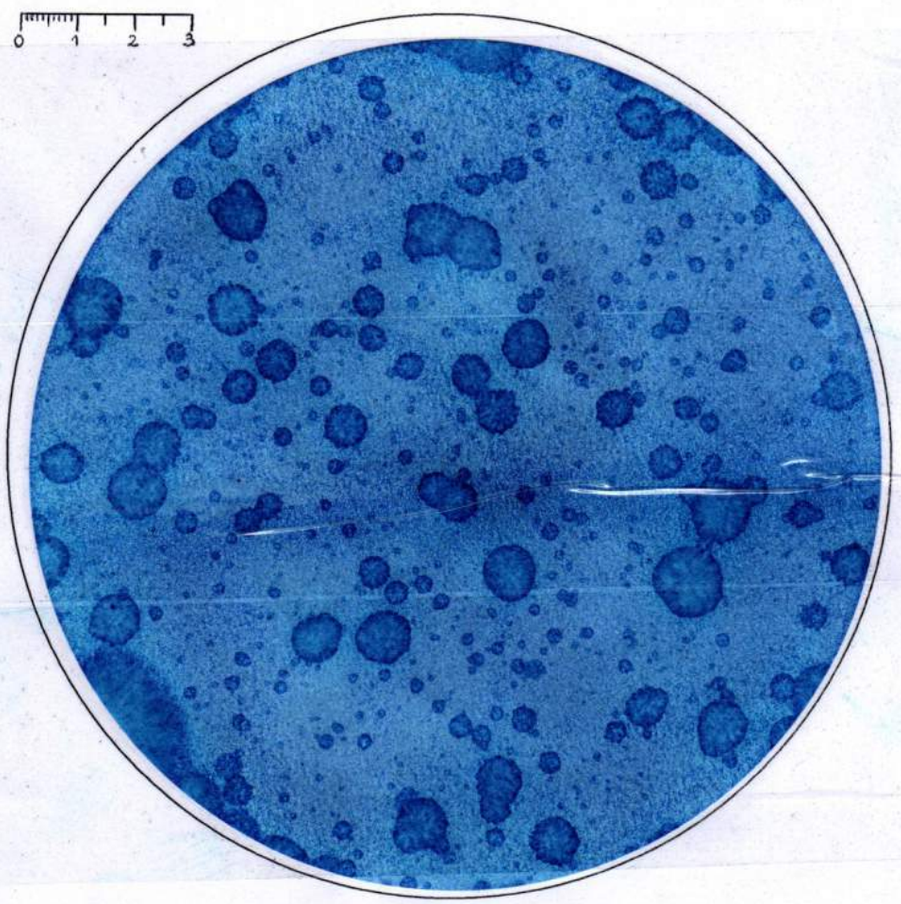
Looking for the Parameters “a” and “b” using the filter paper technique

Ficha N°

Distribución de Tamaño de Gotas

Lugar: Los Girasoles		
Latitud : 0478714	Longitud: 8663097	Altura: 3275
Fecha: 24/01/11	Hora: 15:37	
Tiempo de Exposición: 20 seg		

Anotaciones
Era una lluvia fuerte.

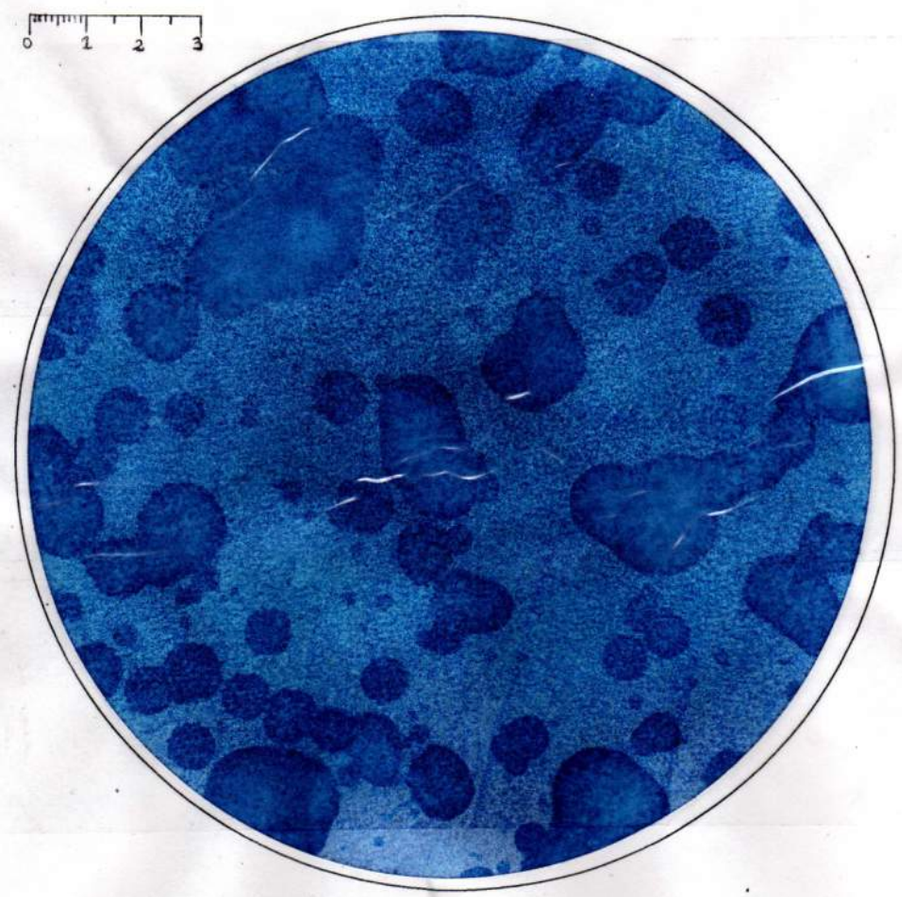


Ficha N°

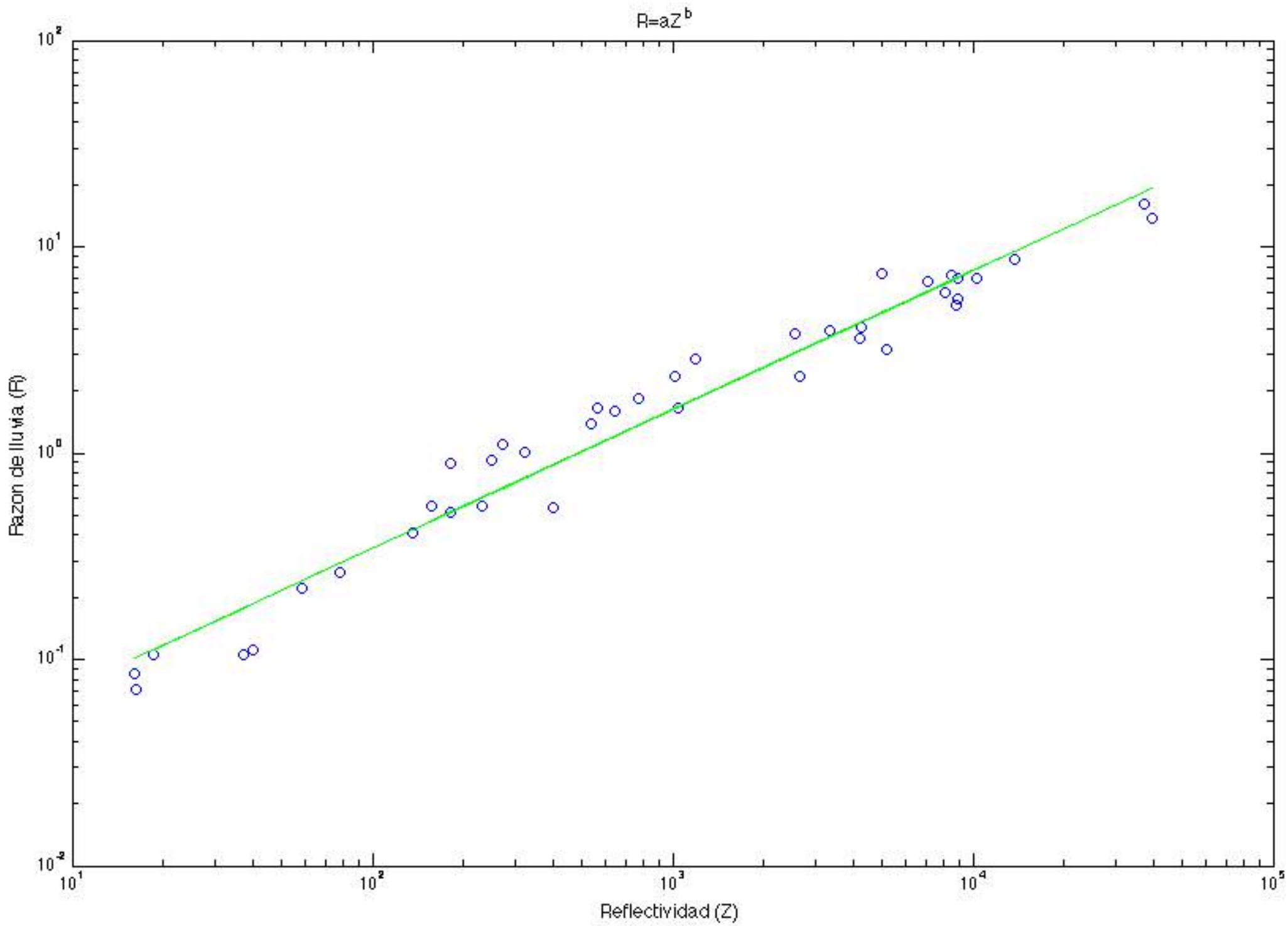
Distribución de Tamaño de Gotas

Lugar: Hotel Balcones		
Latitud : 12°04'47''	Longitud: 75°12'34.4''	Altura: 3286
Fecha: 26/01/11	Hora: 19:37	
Tiempo de Exposición: 5 seg		

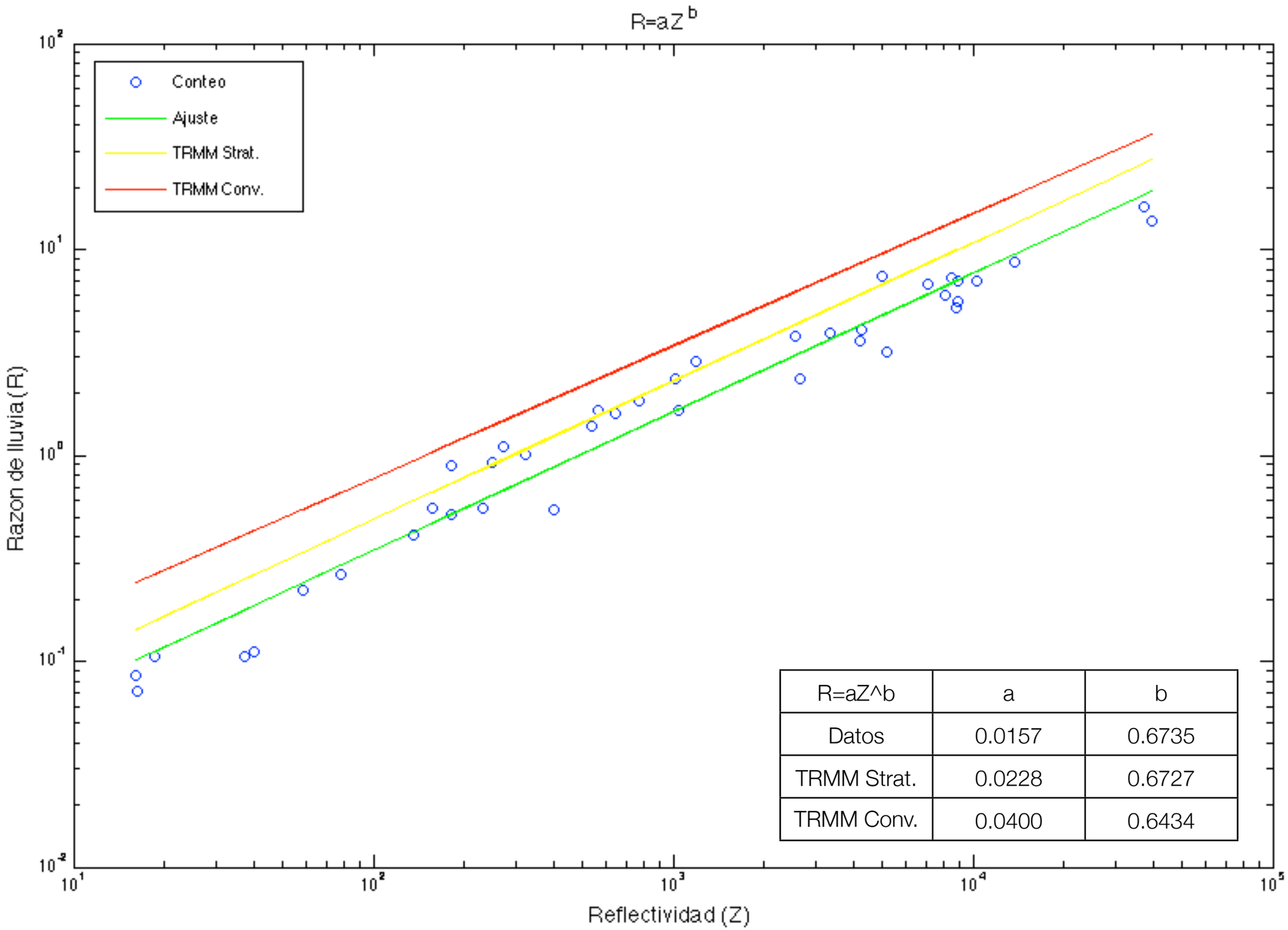
Anotaciones



Data of 40 filter papers



Data and theoretical calculations for TRMM PR

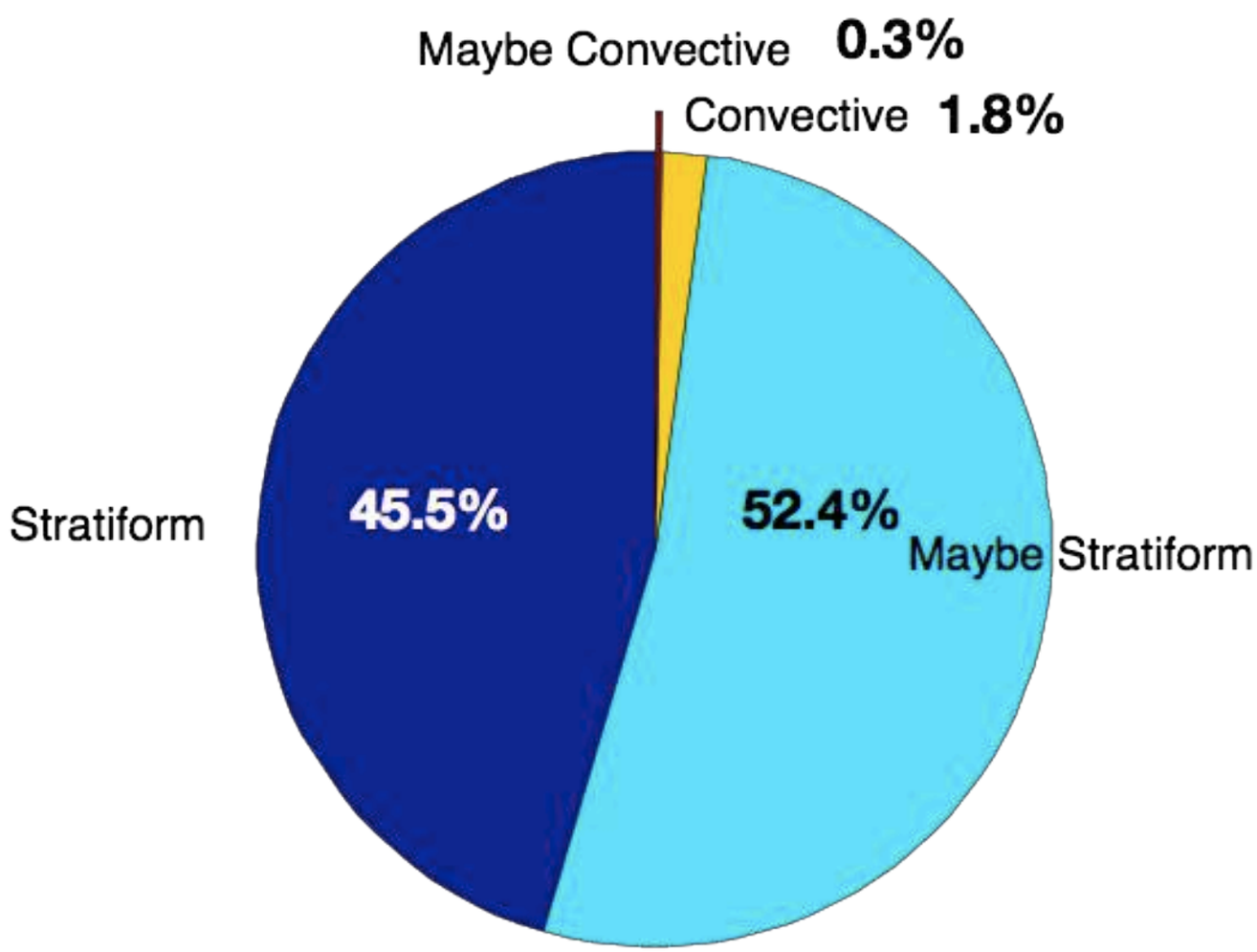


R=aZ^b	a	b
Datos	0.0157	0.6735
TRMM Strat.	0.0228	0.6727
TRMM Conv.	0.0400	0.6434

Results

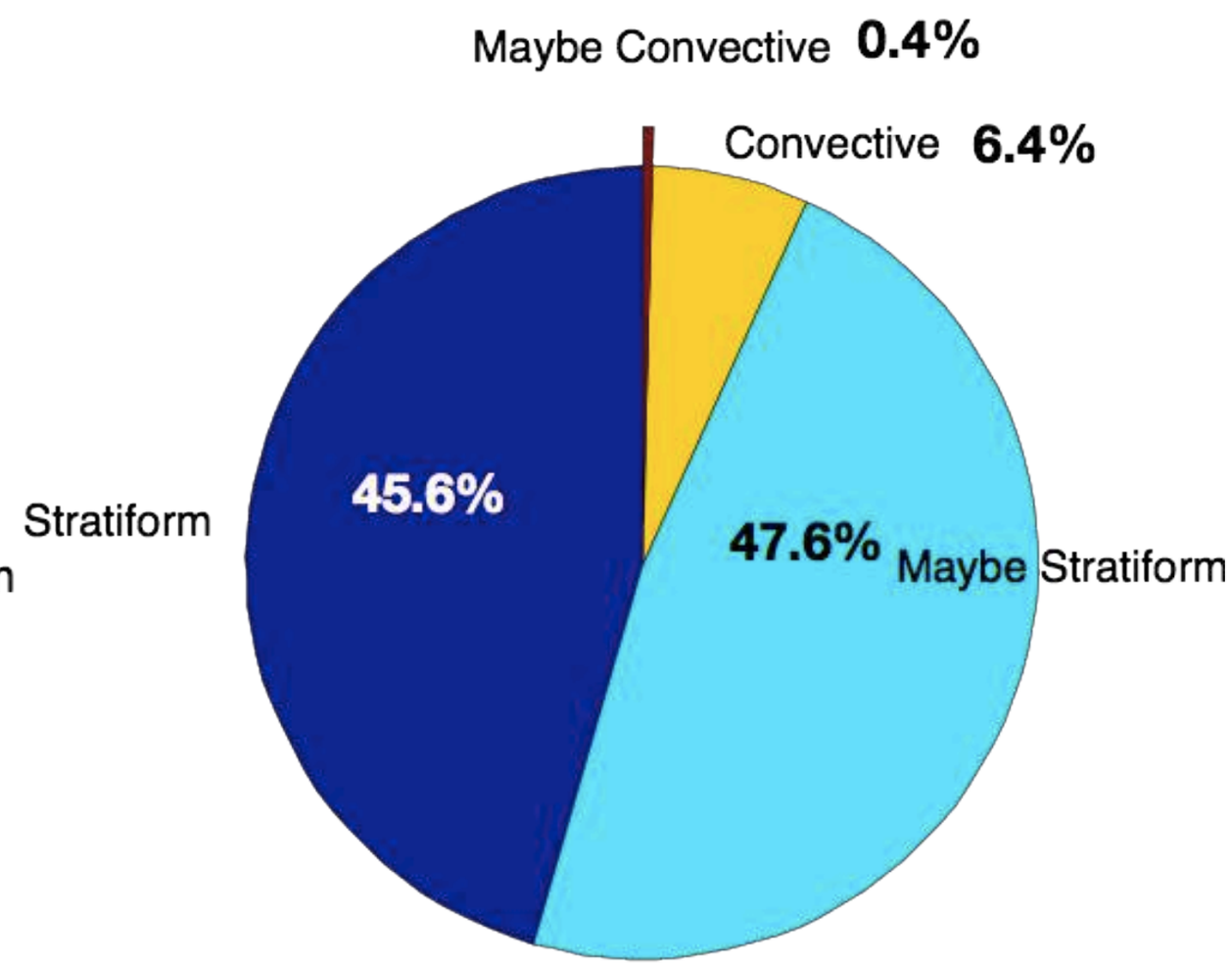
TRMM PR Classification

Pixels

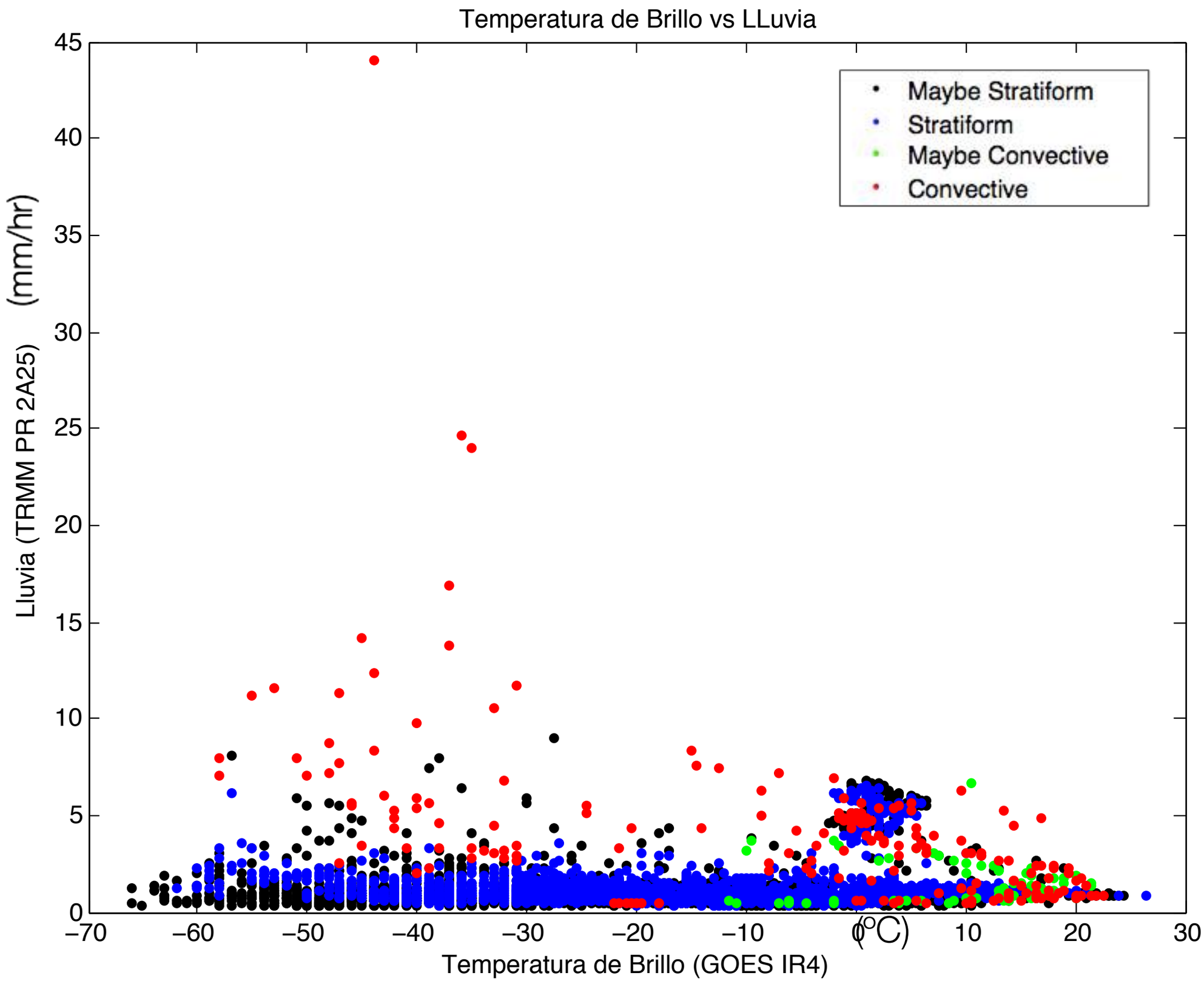


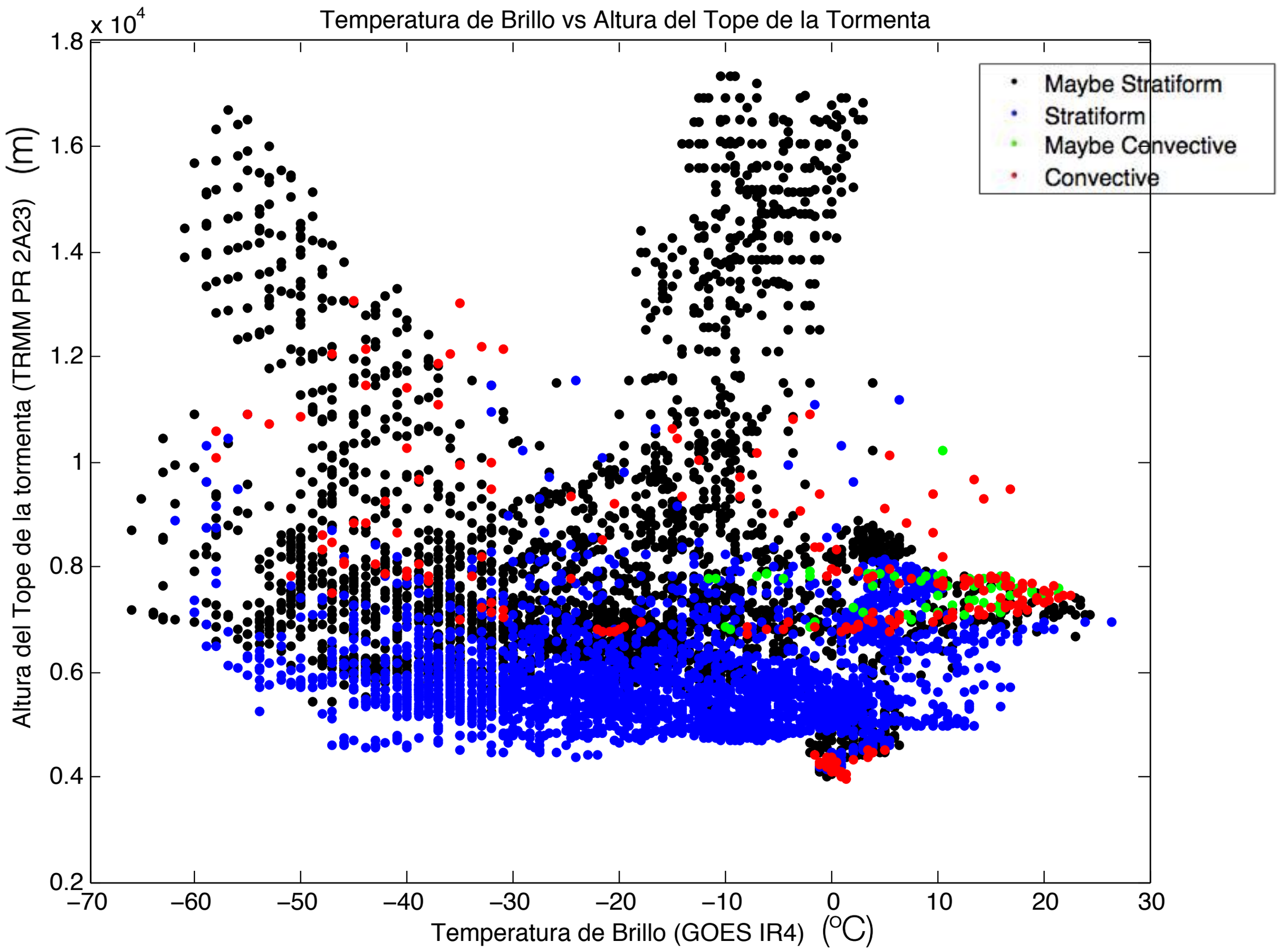
21497 pixels, 5 years

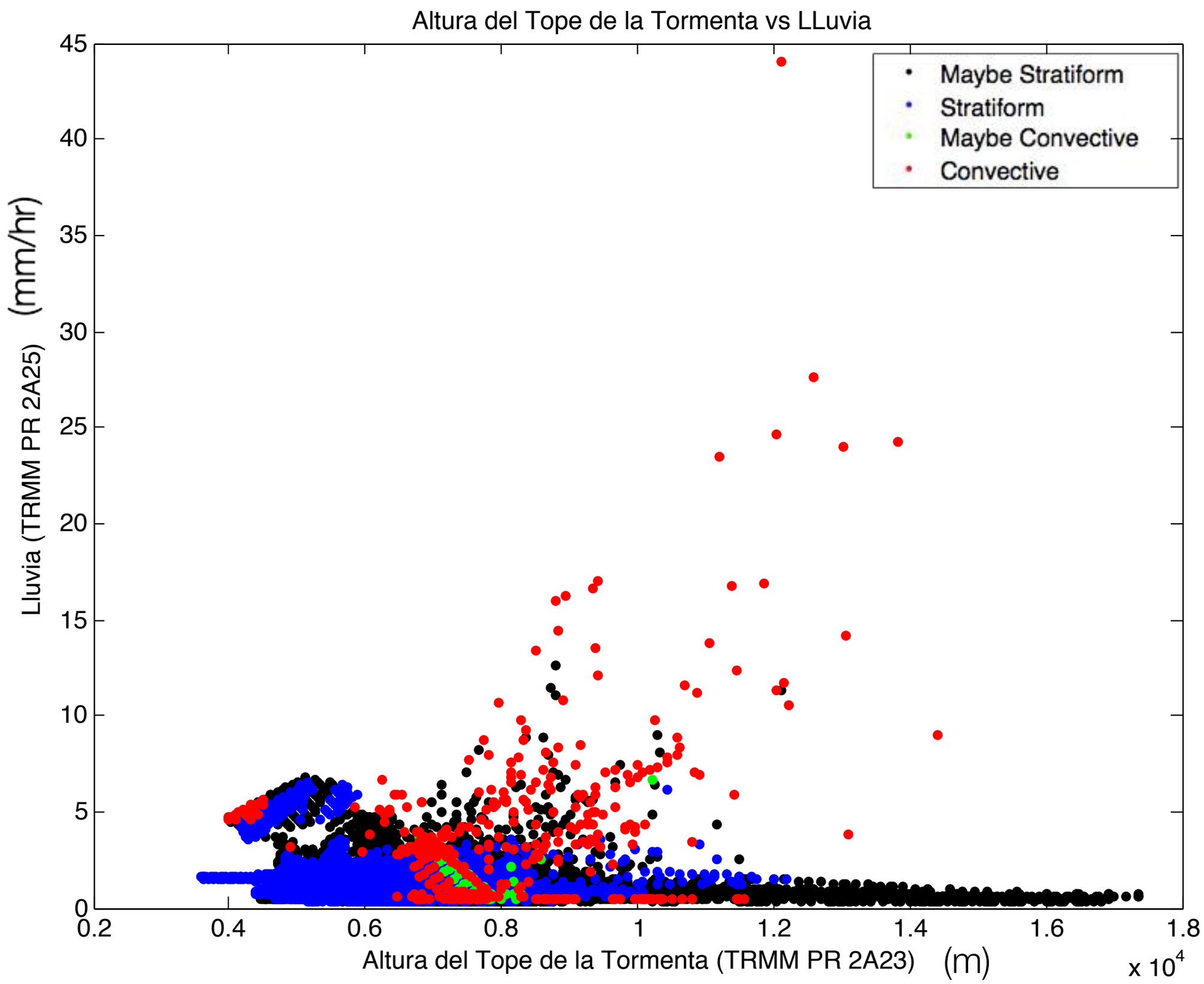
Rain



Is the bright temperature related to Rain?




Temperatura de Brillo vs Altura del Tope de la Tormenta
x 10^4
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
Altura del Tope de la tormenta (TRMM PR 2A23) (m)
−70
−60
−50
−40
−30
−20
−10
0
10
20
30
Temperatura de Brillo (GOES IR4) (°C)
Maybe Stratiform
Stratiform
Maybe Convective
Convective


Altura del Tope de la Tormenta vs LLuvia
Maybe Stratiform
Stratiform
Maybe Convective
Convective
Lluvia (TRMM PR 2A25) (mm/hr)
Altura del Tope de la Tormenta (TRMM PR 2A23) (m)
x 10^4
0
5
10
15
20
25
30
35
40
45
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

Conclusions

- Es posible hacer mapas de precipitación de alta resolución basándonos en la información del producto 2A25 del radar de precipitación.

- No se ha logrado hallar una relación simple entre el tipo de lluvia y la altura del tope de la tormenta, se pueden tener tormentas altas vistas por el PR que sean de tipo tal vez estratiforme con poca lluvia.

- No se ha logrado hallar una relación entre la lluvia medida con el PR 2A25 y la temperatura de brillo.

- La mayor cantidad de precipitación en el aréa de estudio es producto de lluvia estratiforme o tal vez estratiforme.

Gracias