PRELIMINARY STUDIES OF THE GNSS APPLICATION TO PRECIPITATION NOWCASTING

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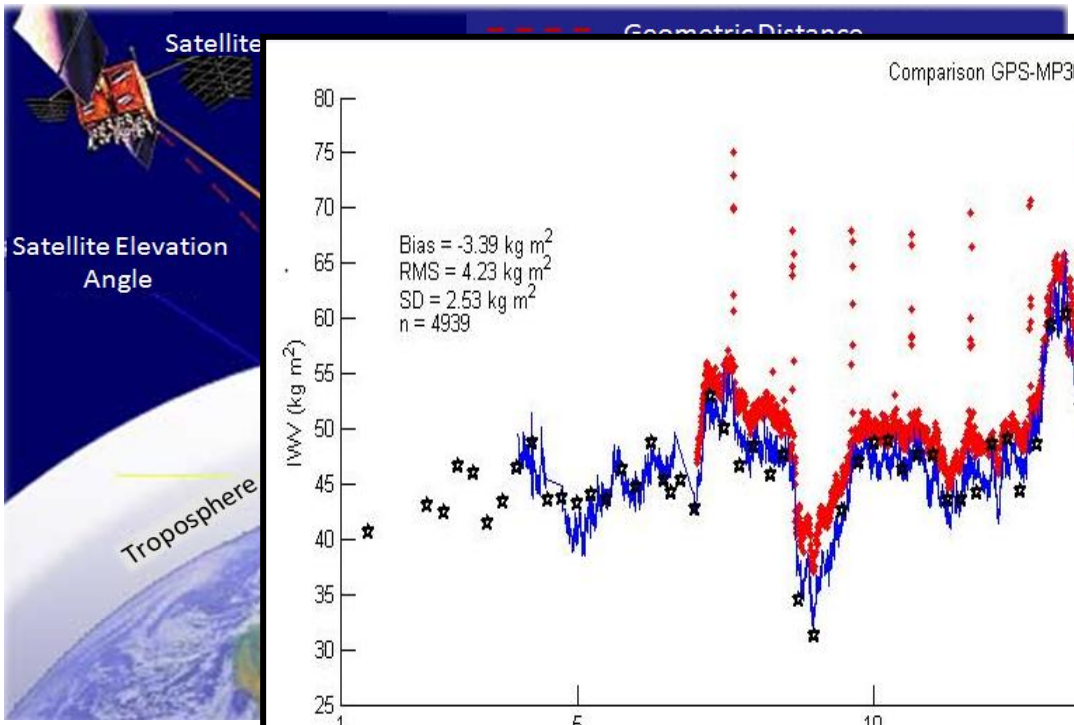
Integrated water vapor from Global Navigation Satellite System (GNSS) observations

- **The influence of water vapor in the signal GNSS propagation generates a delay called Zenithal Tropospheric delay, which can be estimated with relative precision and converted into Integrated Water Vapor (IWV) values.**

The most important characteristics of these values are:



Objective of this research

- It is to study of the application of GNSS to precipitation nowcasting in very short-term (smaller than 1 hour).

- This new GNSS application is based on the assumption that the IWV-GNSS series contain a signature in the signal that can be used to predict the occurrence of strong precipitation.

- There are some previous works that have investigated this assumption, but nobody had success to obtain conclusive results, yet.

- The first question is:

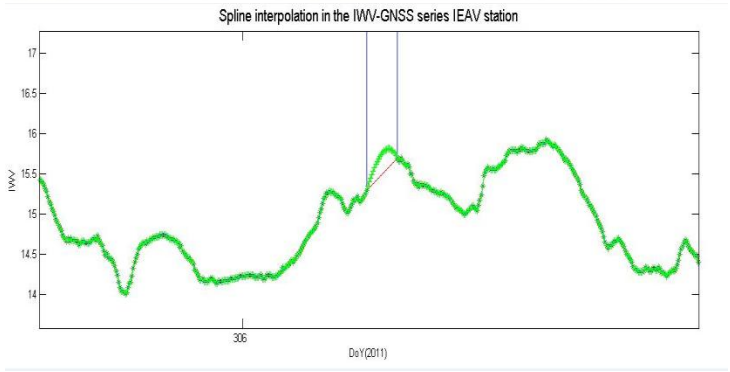
Are IWV-GNSS values with high resolution (5 minutes) information about atmospheric water vapor or only noise????

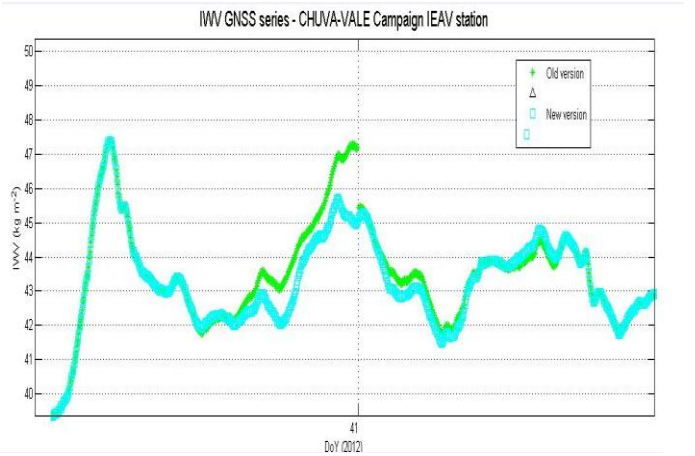
- The GNSS data collected during CHUVA campaigns in different regimes of precipitation has made possible this study appropriately.

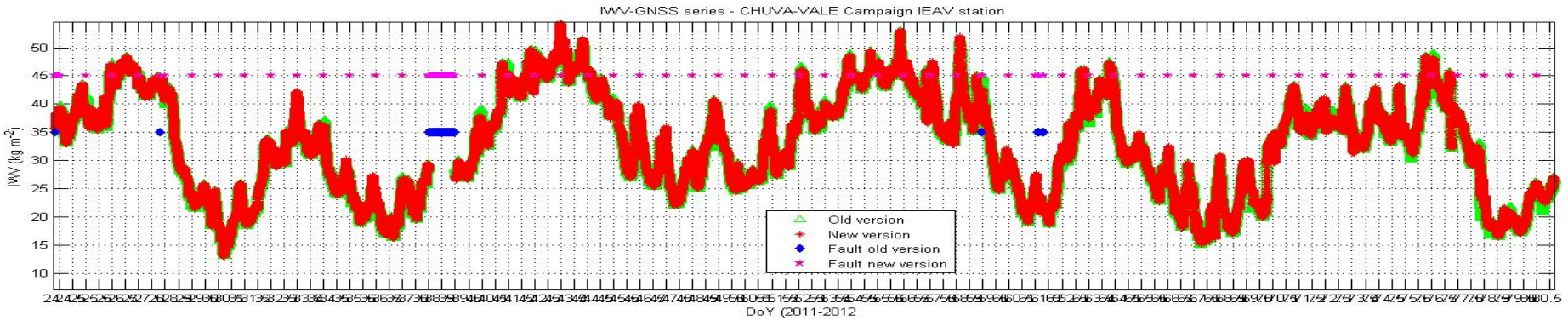
Correction and improvement in the IWV-GNSS series

The software used is GOA-II from JPL (NASA)
Some new methodologies were used in this process, such as:

- suitable model of Ocean tide loading deformations effect;
- coefficient upgraded of the antenna phase center;
- station coordinate well-determined and correctly fixed;
- Suitable combination of different processing to minimizing the faults and erroneous jump in the series;
- Splines are been used to complete the series



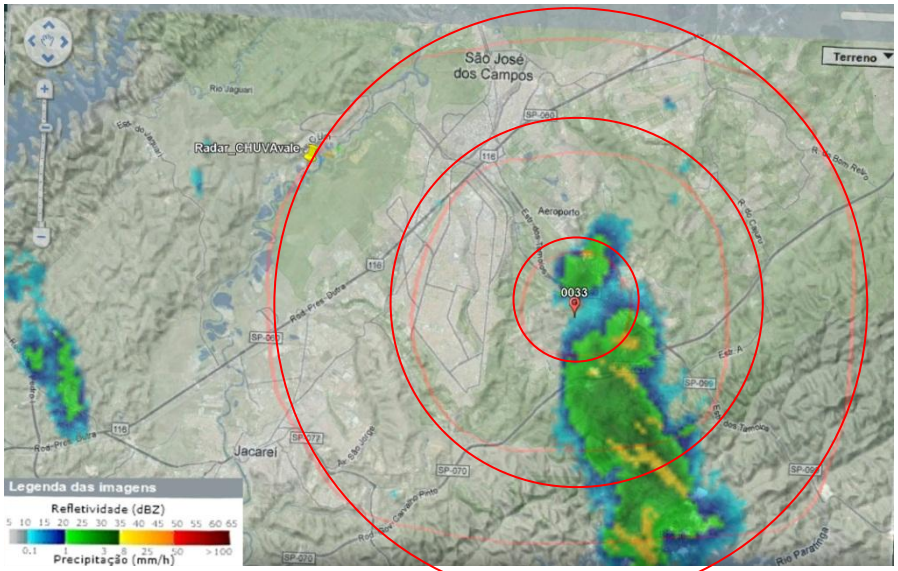


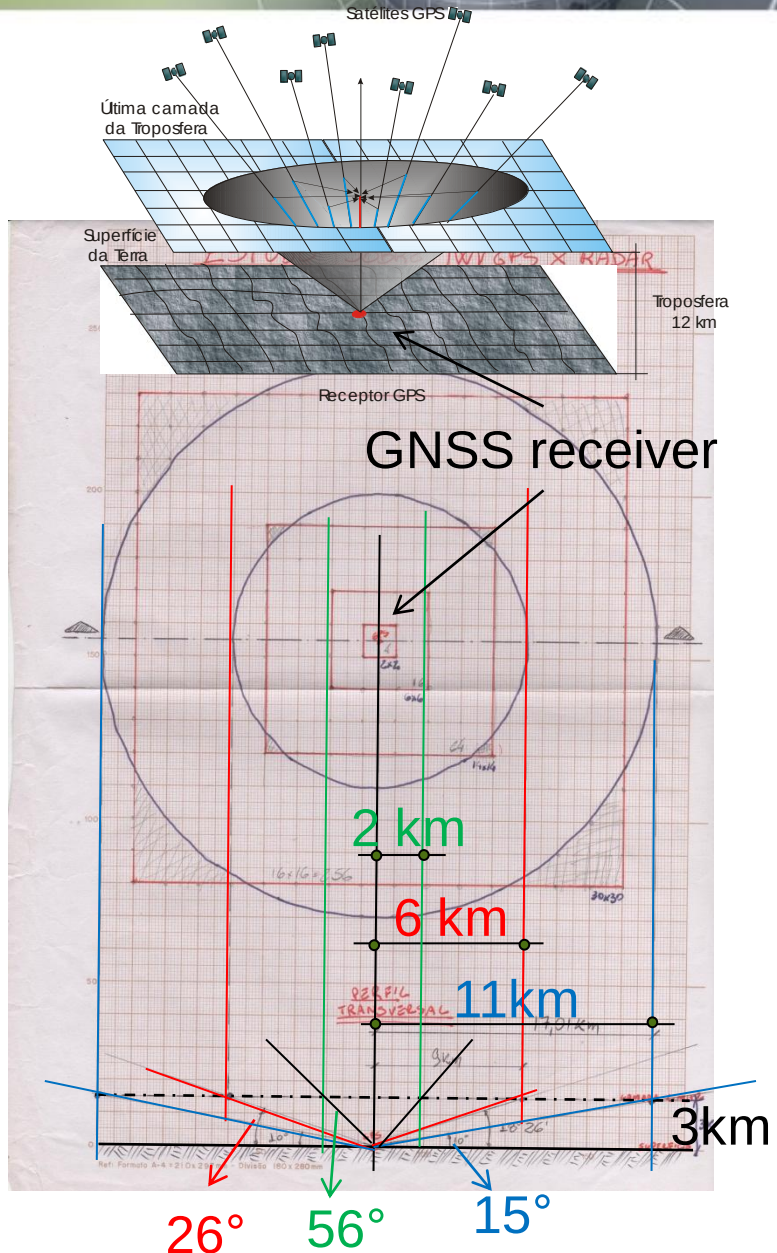


Precipitation series from Radar data

Taking into consideration different configurations:

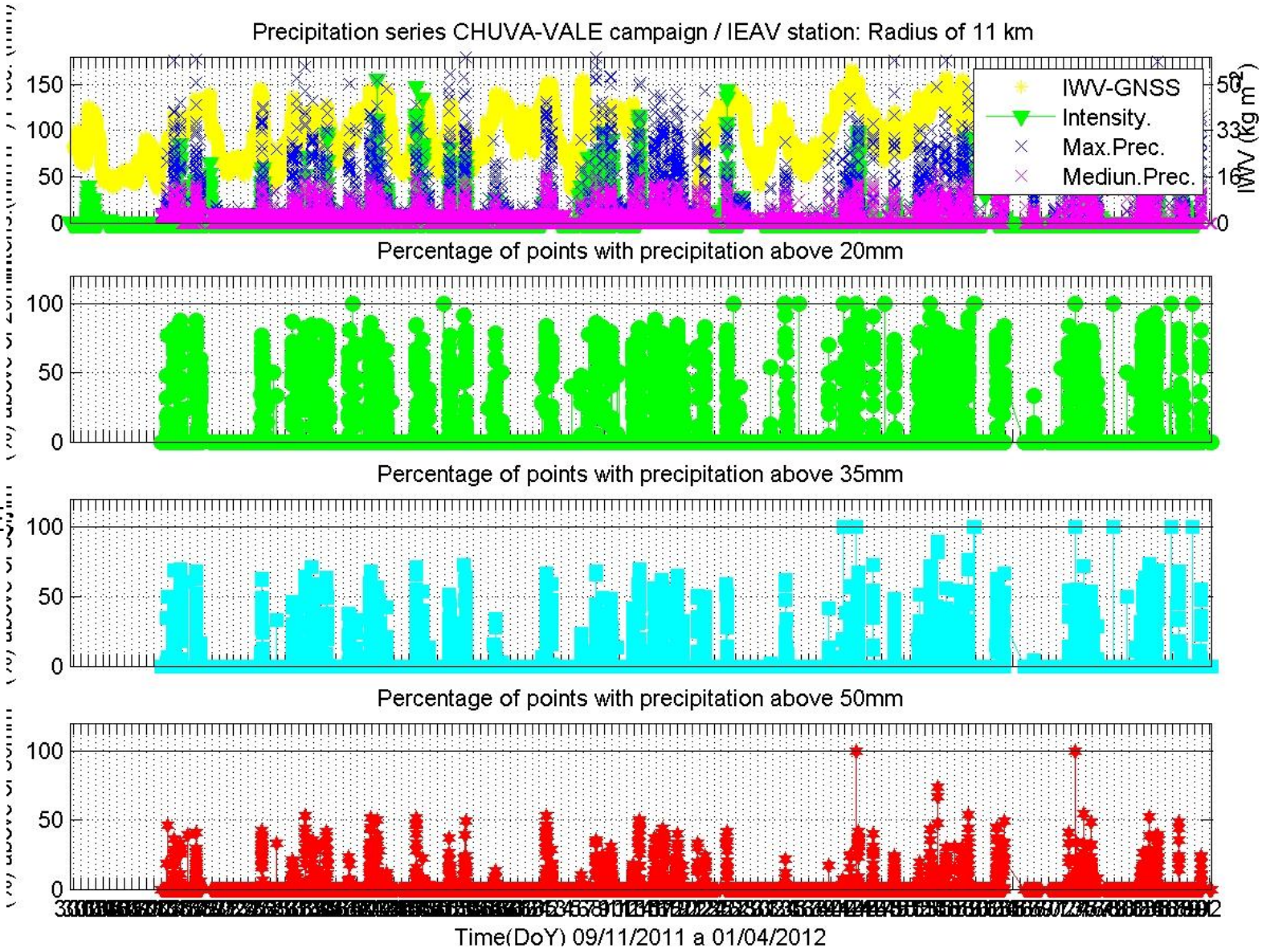
- Circle of radius of 2, 6 and 11 km around of GNSS receiver;
  - Maximum precipitation;
  - Medium values of precipitation;
  - Total precipitation;
  - Percentage of the points above of 20mm; 35mm and 50mm;





IWV-GNSS and precipitation series

- Fortaleza
  - DEFESA;
  - Eusébio;
- Belem:
  - Outero;
  - DTCEA;
  - MOSQUE;
- Vale:
  - IEAV
  - UNIVAP
  - Pousada;
  - INPE.



Analysis of results: proposed methodology

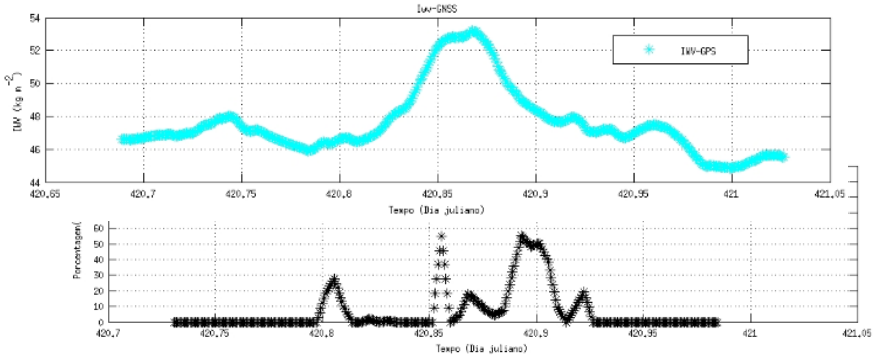
Nowadays 3 ways are used to analysis of results:

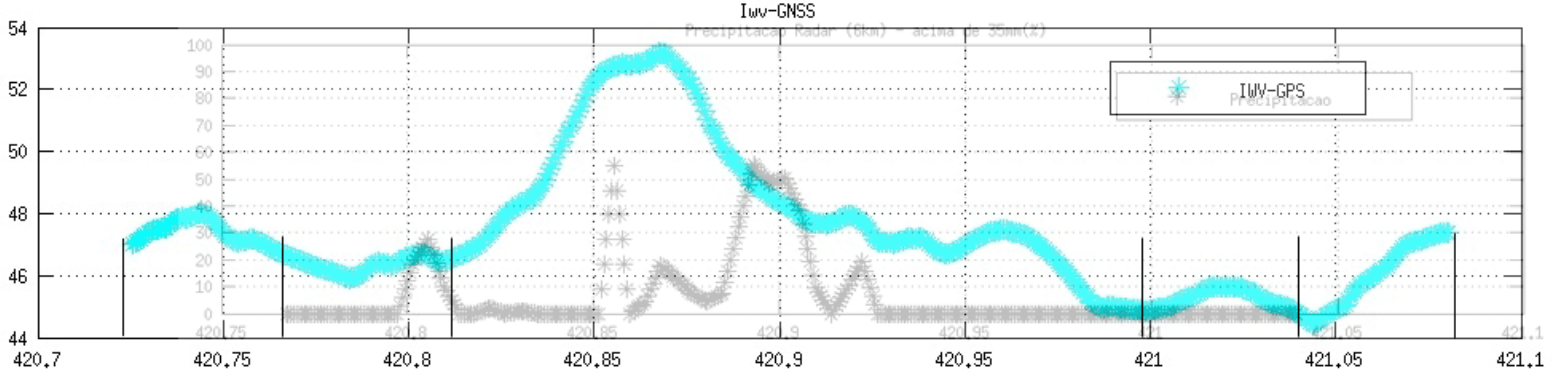
- Lag correlation using sliding window of data;
- Variation rate of IWV before the precipitation events;
- IWV Wavelet power spectrum;

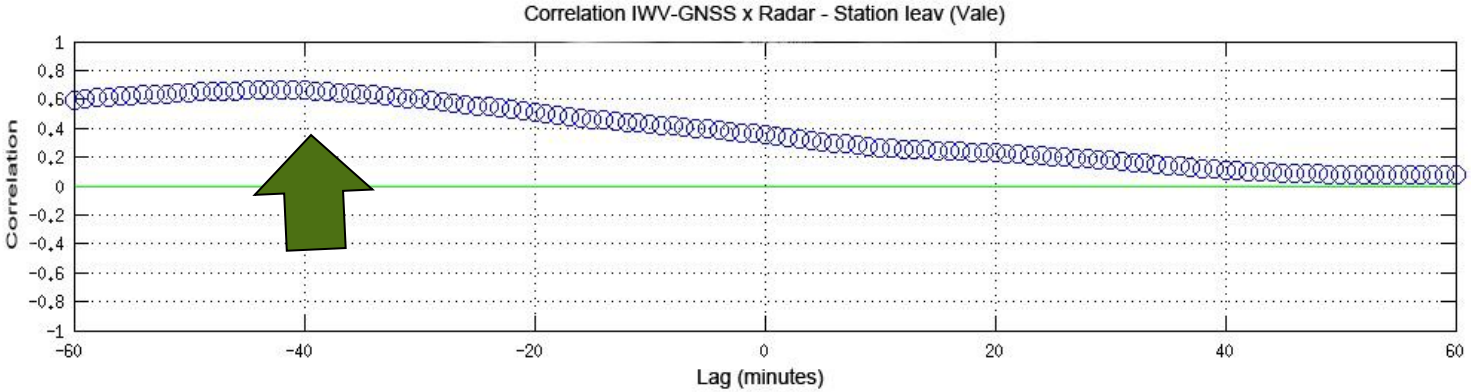
Preliminary results are presented in the next slides in case study to illustrate the ideas:

Lag correlation

IWV values present the excessive increase during periods that precede strong precipitation and a temporal unconformity can be observed in the correlation coefficient between the series.



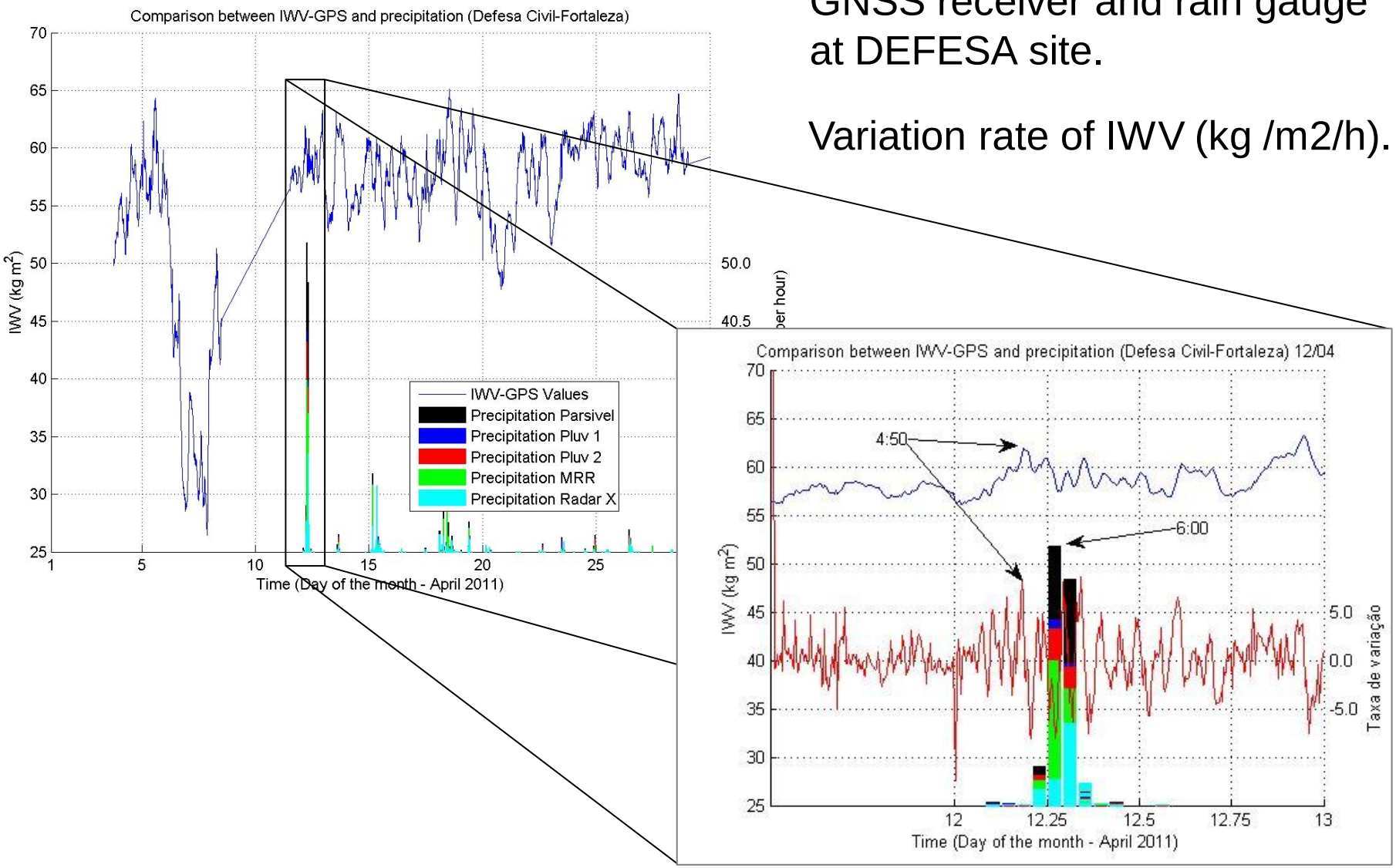




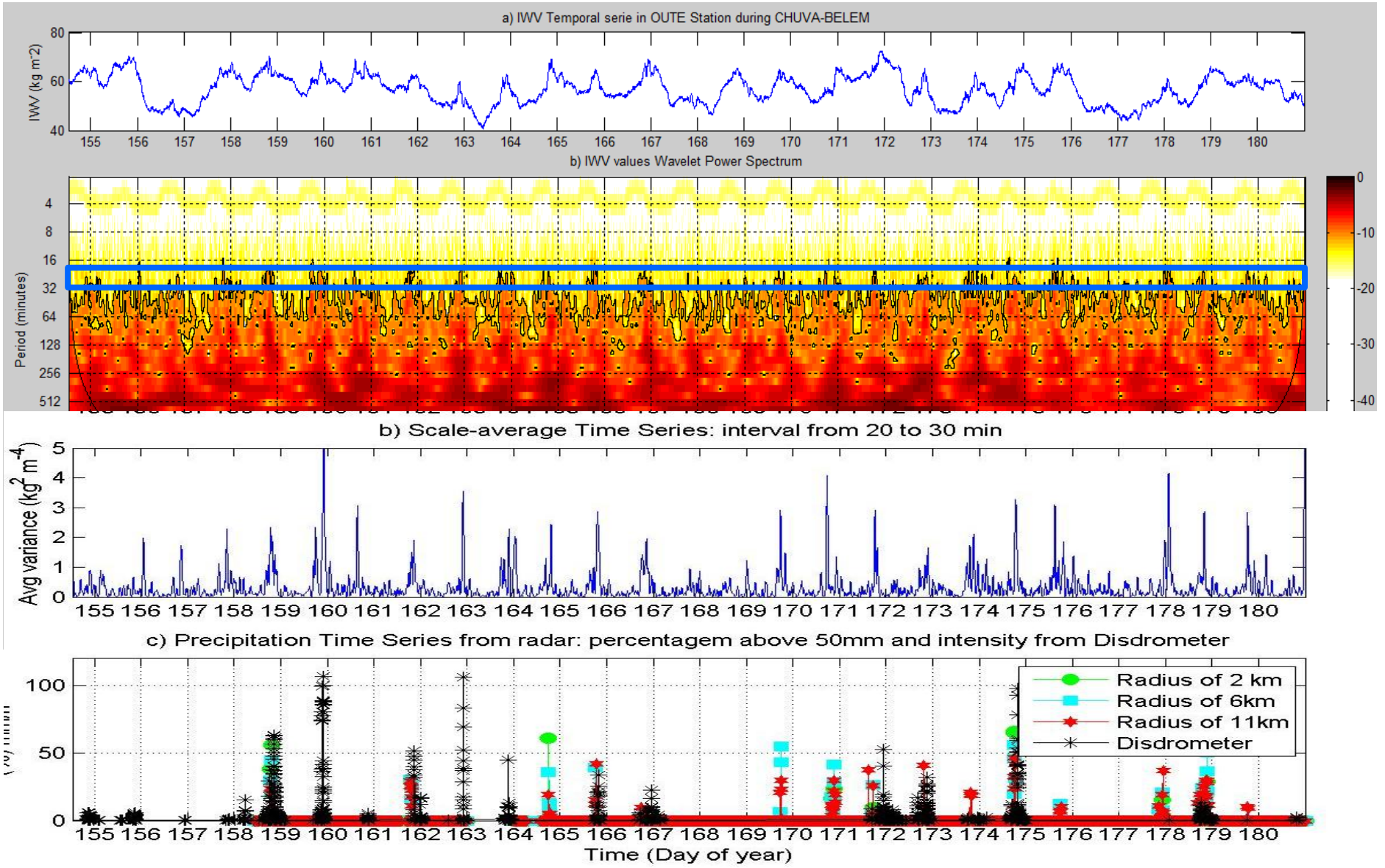
CHUVA Fortaleza: case study

GNSS receiver and rain gauge at DEFESA site.

Variation rate of IWV (kg /m2/h).



Wavelet power spectrum



Necessity and next steps

Necessity:

- Classification of each precipitation event in all CHUVA campaigns;

Next steps:

Selection of precipitation events in different patterns and position (close or distant) of the receiver
to continue the analysis of the results using:

- Correlation with sliding window of data;
- Wavelet power spectrum;
- Variation rate of IWV in function of time (dIWV/dt) and its relationship with precipitation events;
- And other….

Goal main:

Determination of a pattern of the temporal variation of the IWV, which signalizes the storm occurrence and associate it with a probability function.

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Thank you for your attention.

Discussions
Suggestion
Comments

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