The Meeting of the Americas

8 to12 August 2010, Foz do Iguassu, Brazil

Development and Availability of a Network-Based Positioning in Brazil

Dr. Daniele Barroca Marra Alves
Dr. João Francisco Galera Monico
Dr. Milton Hirokazu Shimabukuro
Paulo Sérgio de Oliveira Junior
FCT/UNESP – São Paulo, Brazil

PhD. Luiz Fernando Sapucci
CPTEC/INPE – Brazil

FAPESP

unesp

OUTLINE

- Introduction
- Theoretical Considerations
  - Network-Based
  - VRS concept
  - Atmospheric Models
  - SP Network
  - VRS Internet Plataform
- Methodology
- Experiments and Analyses
- Conclusions

INTRODUCTION

GNSS network-based positioning has been widely used by the geodetic community

Several countries have adopted such kind of service

Applying multiple reference station methods one can obtain higher positioning accuracy (cm) in a larger coverage area

In addition to gain in:

- Reliability
- Availability
- Integrity

INTRODUCTION

It can be used in several applications as for example:

- Surveying
- Traffic
- Precise Agriculture
- ...

Data from GNSS Active Network of West of São Paulo State (SP/NET) are being used in Brazil to develop the network-based positioning

The idea is to make available a post-processed service at soon – available on the internet

Later a real time service

NETWORK RTK

Using network-based positioning, it is possible to model the distance dependent errors

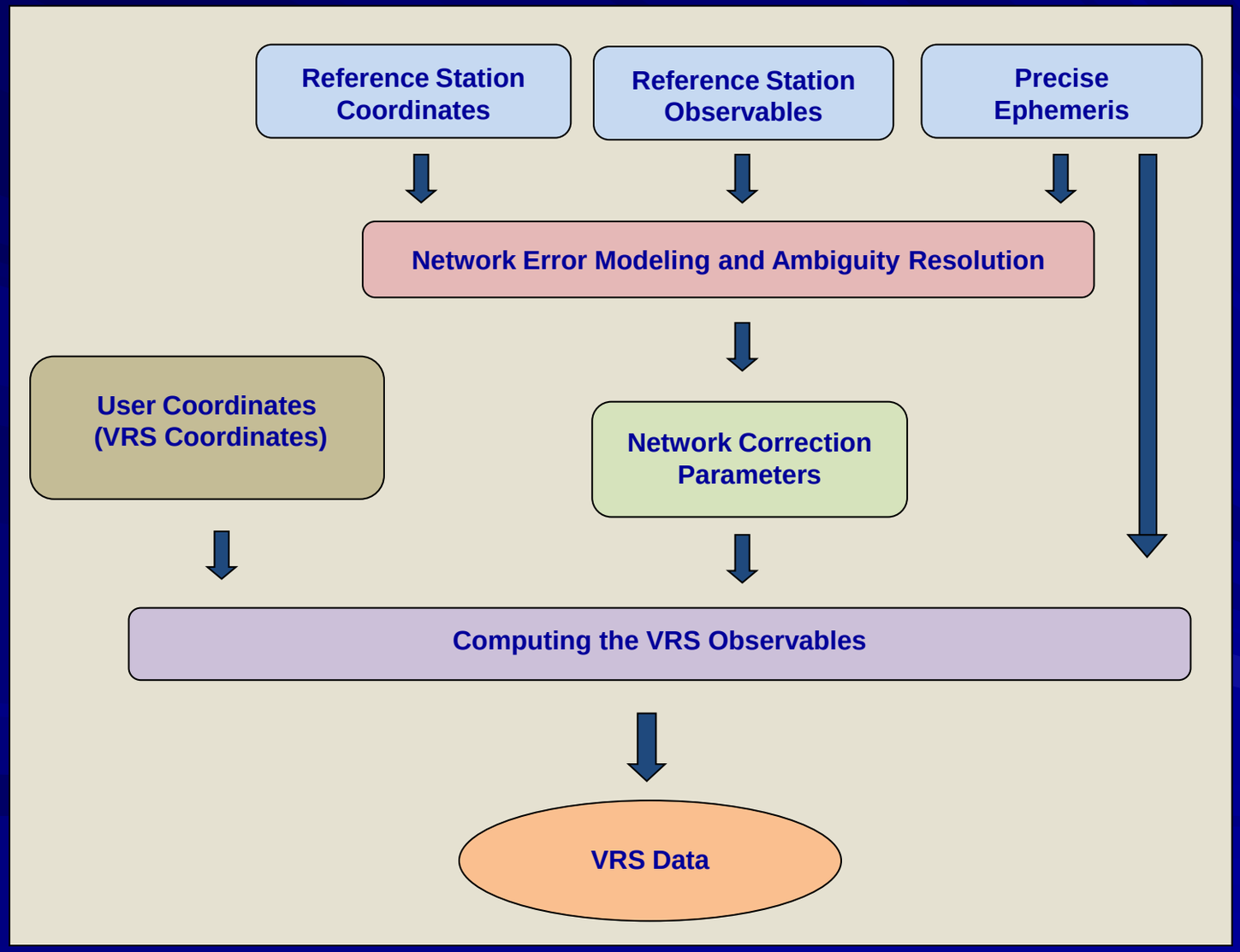
- Ionosphere Effect
- Troposphere Refraction

Several methods have been developed to formulate corrections from a network stations data

In this paper it is used the VRS concept

A reference station is generated close to the user

VRS CONCEPT


Reference Station Coordinates
Reference Station Observables
Precise Ephemeris
Network Error Modeling and Ambiguity Resolution
User Coordinates (VRS Coordinates)
Network Correction Parameters
Computing the VRS Observables
VRS Data

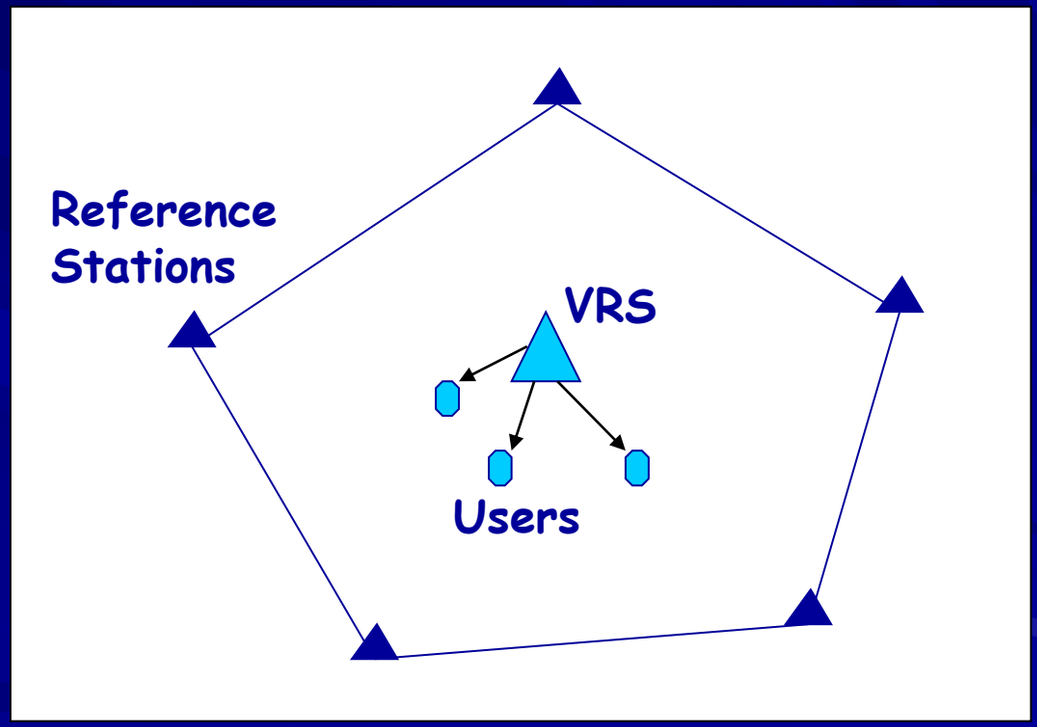
VRS CONCEPT

The VRS data are not provided by a real receiver, but its data are generated from real GPS observations collected by an active multiple reference station network

The idea is that the VRS data resemble as much as possible a real receiver data at the same location

The user has the possibility of using the VRS as if it were a real reference station in your proximities

The user can accomplish the relative positioning using a single frequency receiver



Wanninger (1999)

TROPOSPHERE MODEL

A NWP model was used

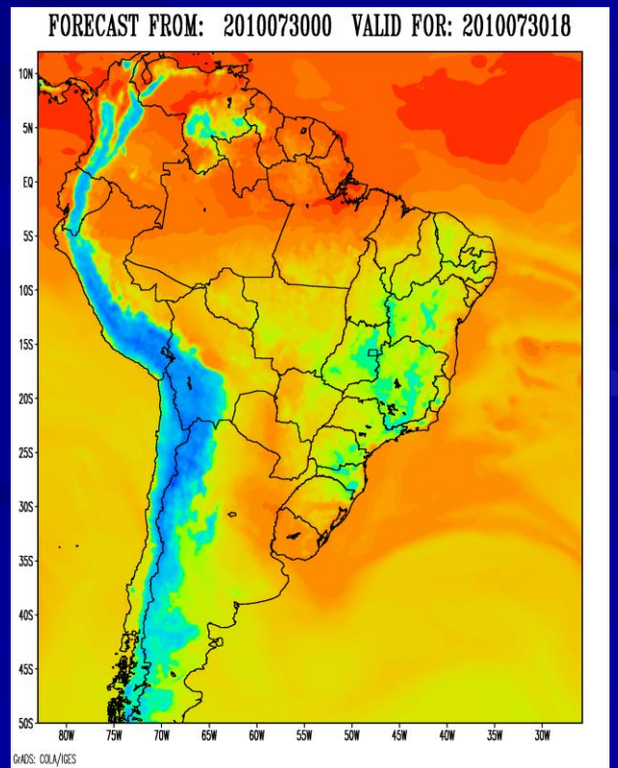
This kind of troposphere modeling has been very used by the scientific community

The procedure used to compute the ZTD by NWP model was jointly developed by UNESP and CPTEC/INPE - Brazil

This model uses:

- ✓ 20x20 km horizontal resolution
- ✓ 19 levels vertical

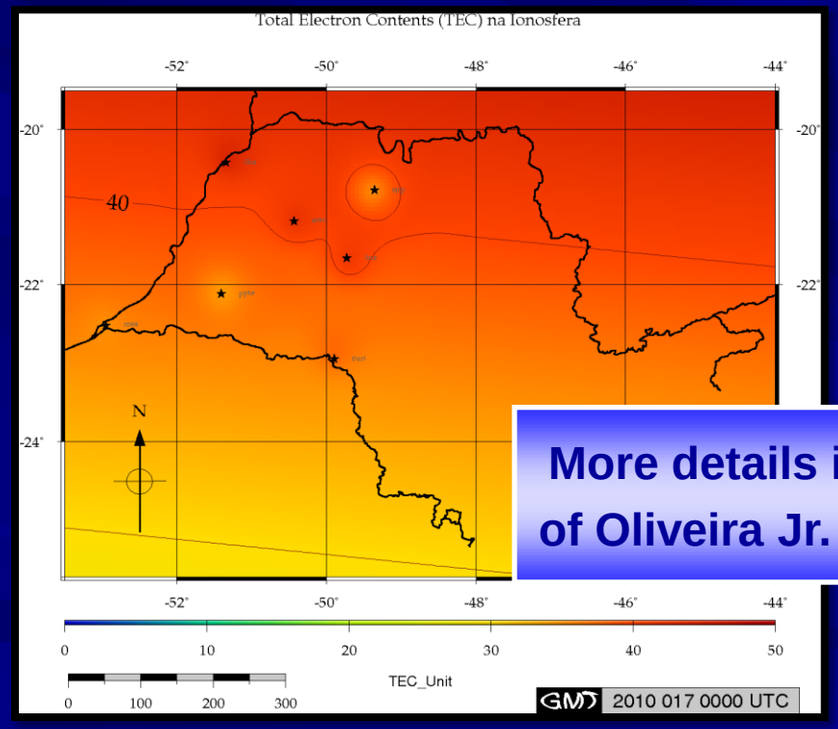
http://satelite.cptec.inpe.br/zenital



IONOSPHERE MODEL

A regional ionosphere model has been developed at UNESP

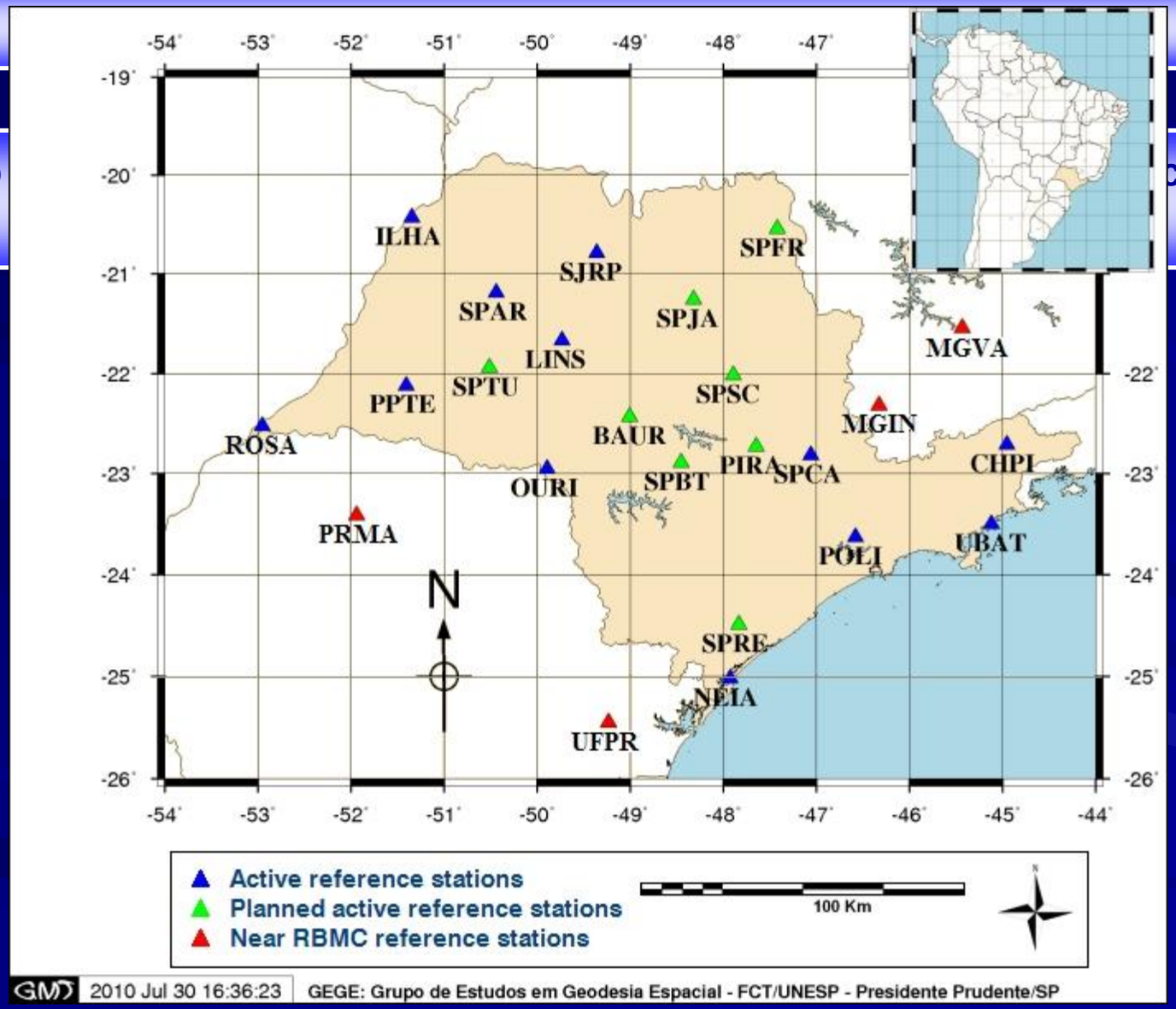
The TEC values are computed directly from SP/Net data



More details in a paper of Oliveira Jr. tomorrow

SÃO PAULO STATE NETWORK

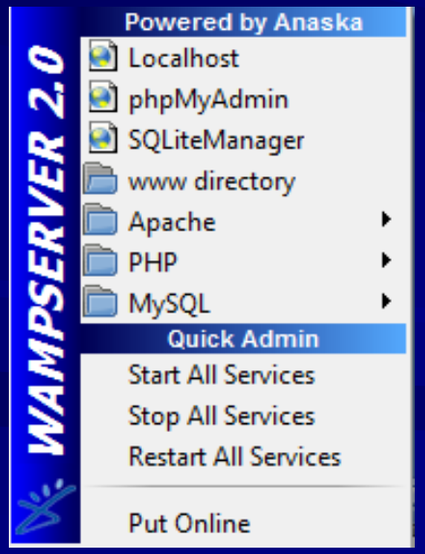
In order to ct.unesp.br>

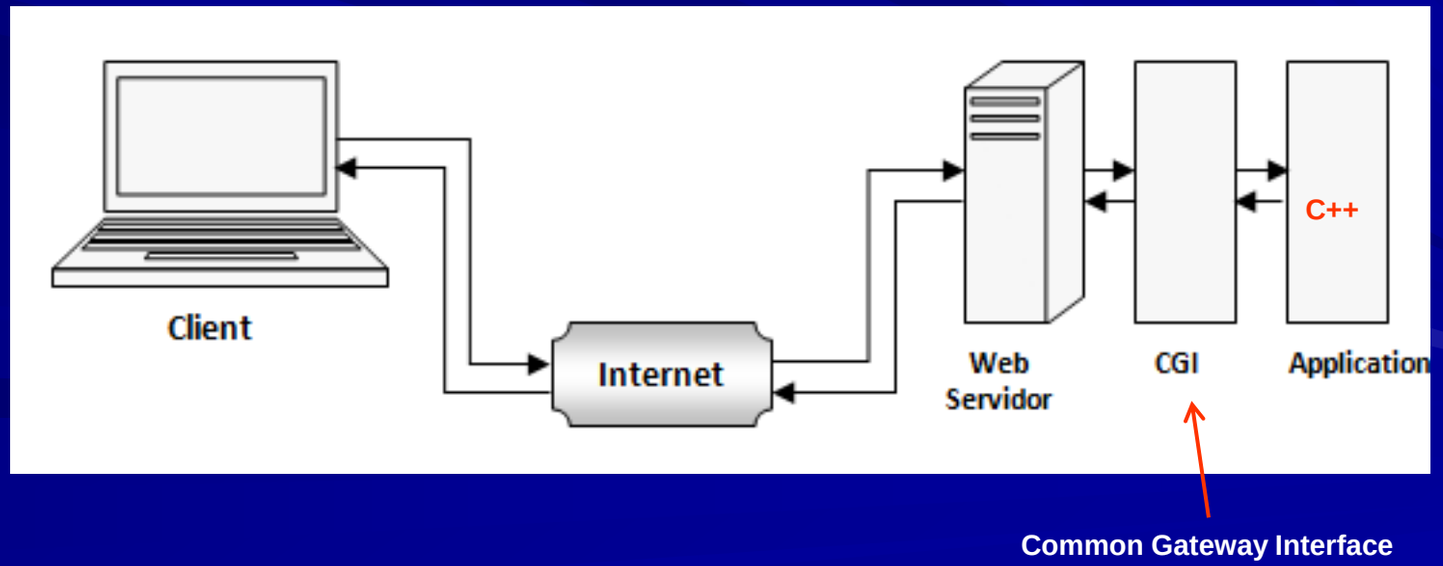


INTERNET PLATAFORM

An Internet plataform has been developed to generate VRS data for users from SP/Net

Post-Processed mode





INTERNET PLATAFORM

VRS METHODOLOGY

The network-based positioning using the VRS concept was applied using a different methodology

- The ambiguity resolution was not performed
- Atmospheric models were used to compute the network corrections
- The experiments were accomplished simulating the real time

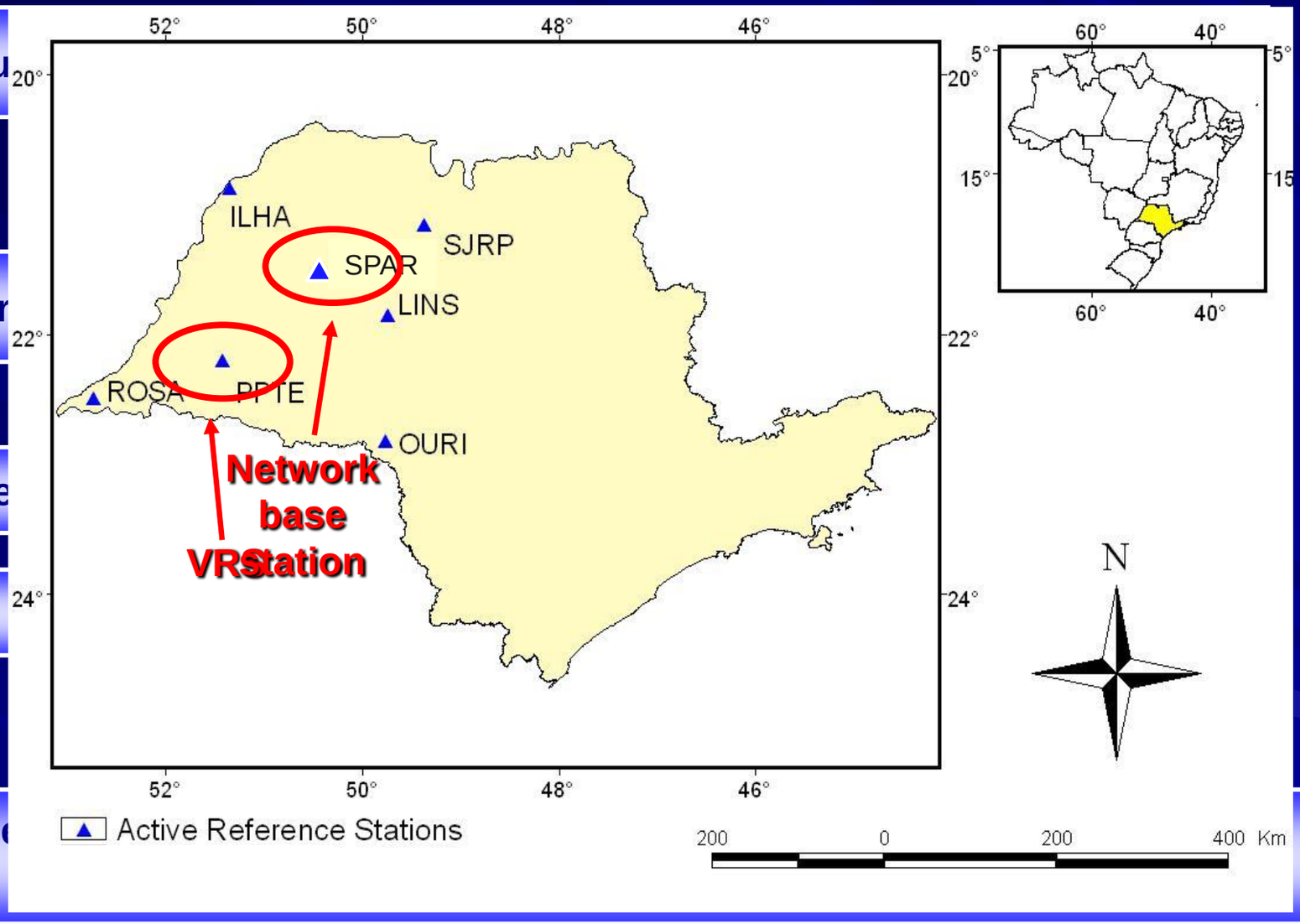
EXPERIMENTS

It was u

The data wer

The

In ord



RAW DATA ANALYSIS – C1

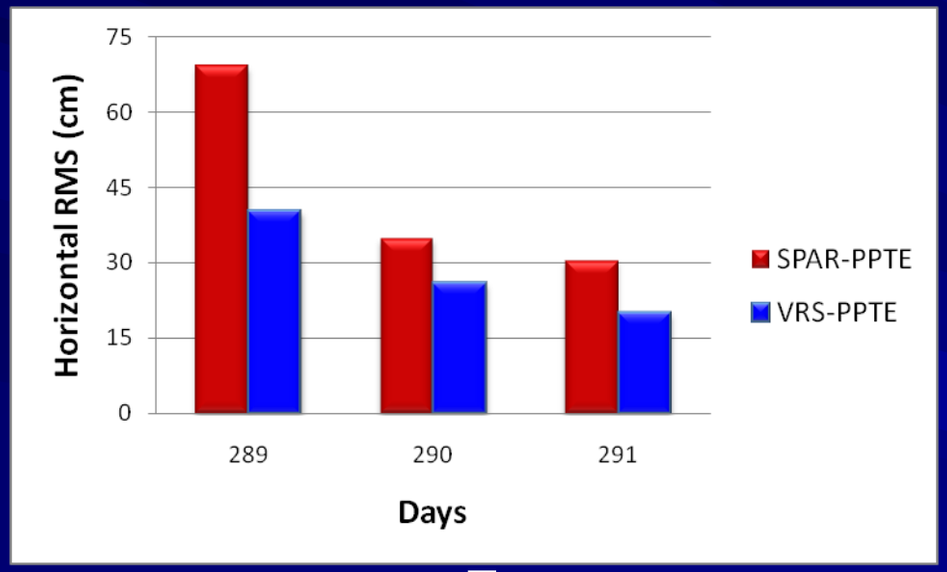
The C1 real file observable was compared with VRS one

RMS(cm)	
Day	C1
289	61
290	63
291	62
Average	62

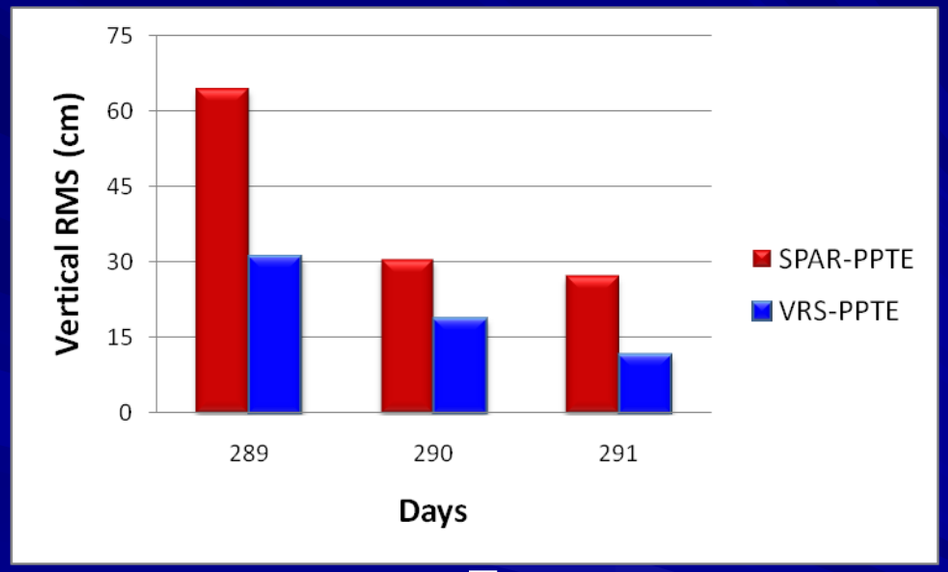
The results agree with the pseudorange accuracy

RELATIVE POSITIONING

Relative positioning VRS-PPTE (real file) and SPAR-PPTE (SPAR is the nearest reference station)



Improvement: 34.2%



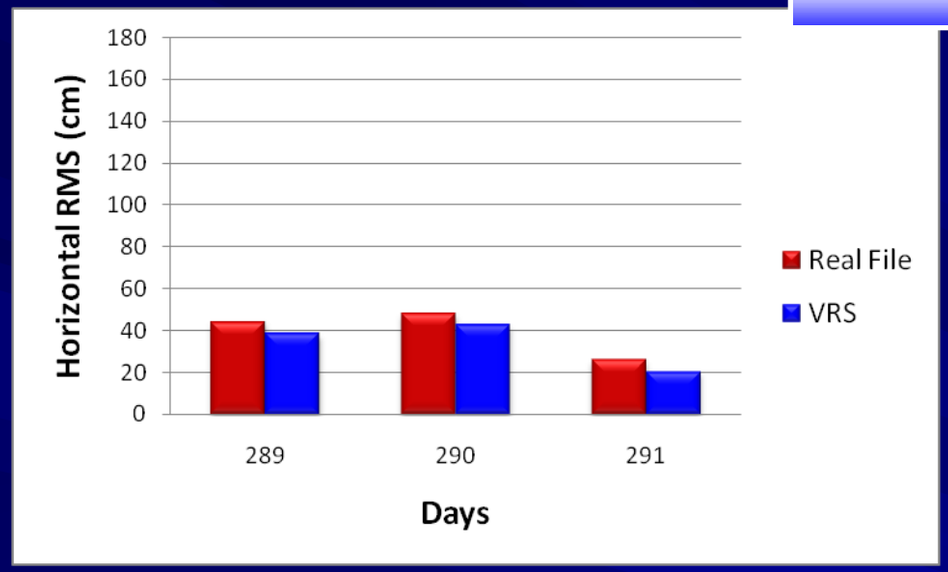
Improvement: 49.5%

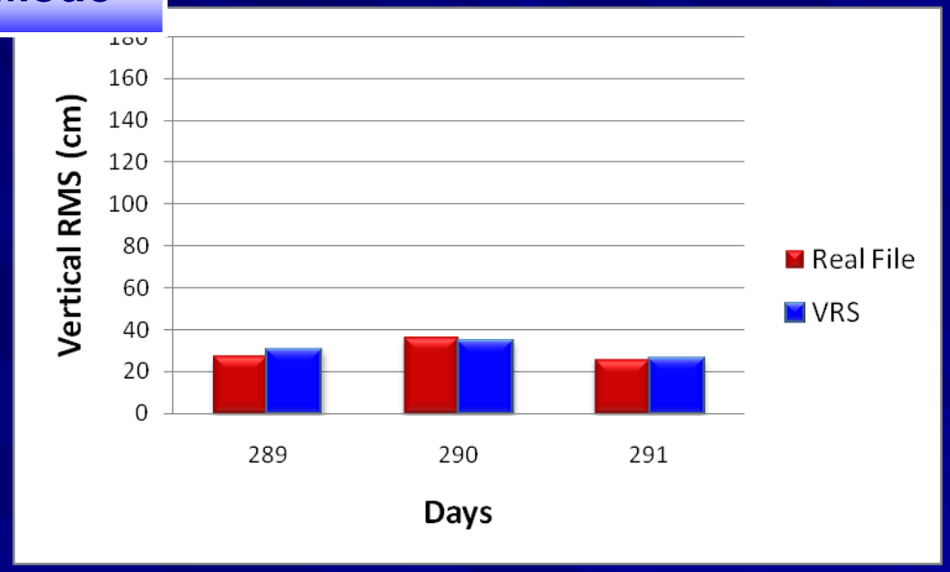
TGO software

PP – COORDINATES ANALYSIS

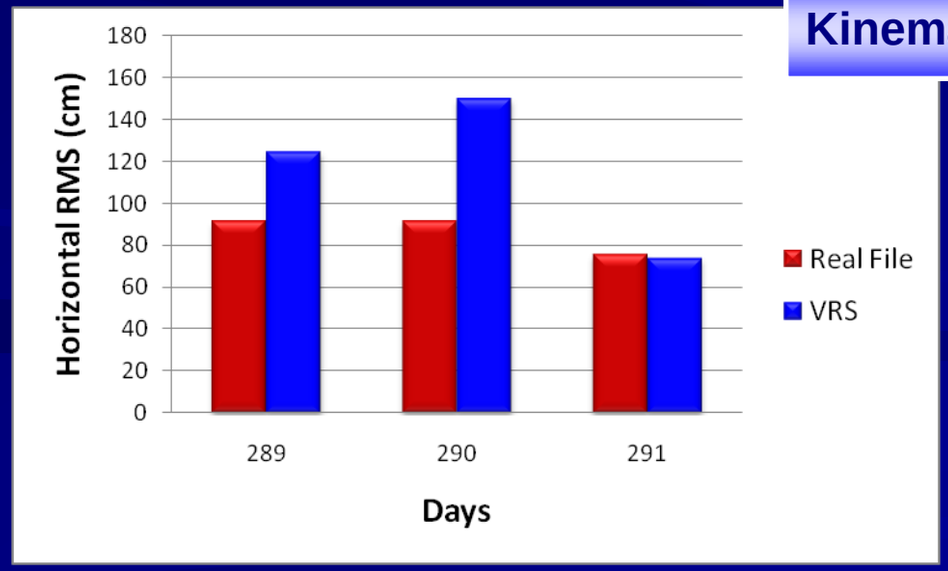
NRCan software

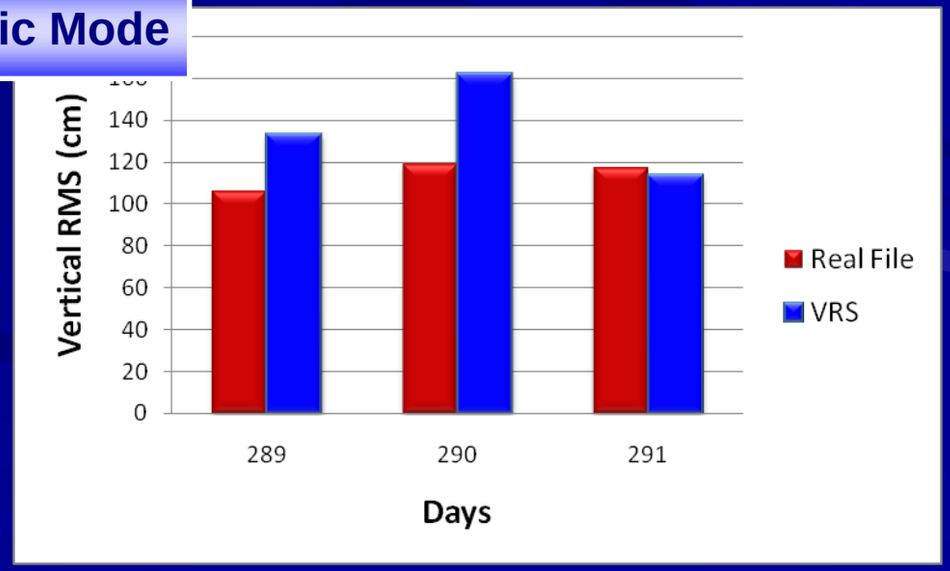
Static Mode





Kinematic Mode

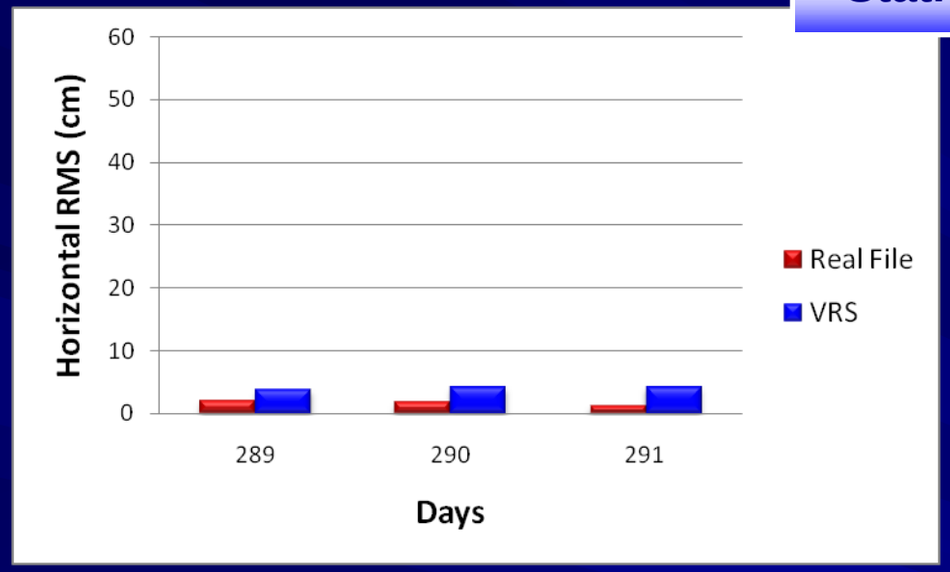


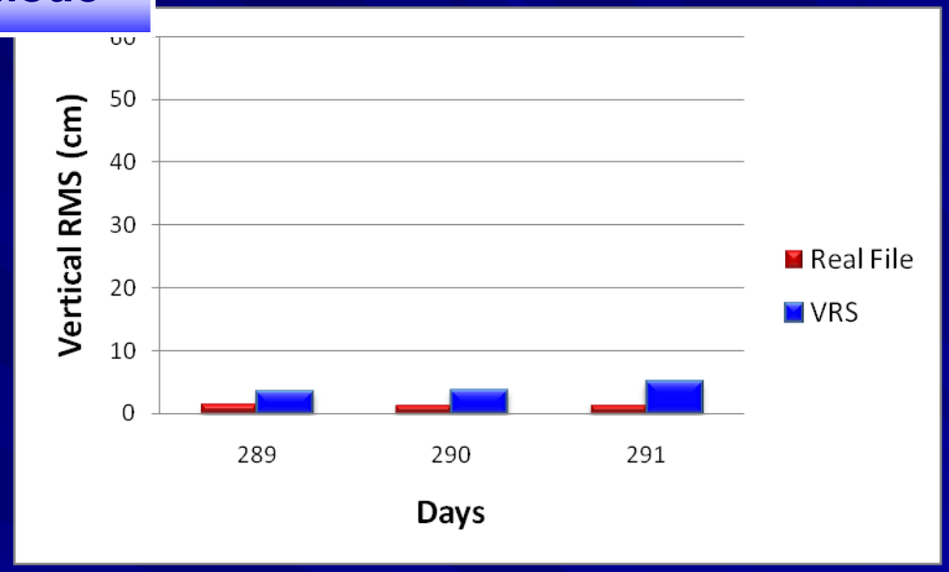


PPP – COORDINATES ANALYSIS

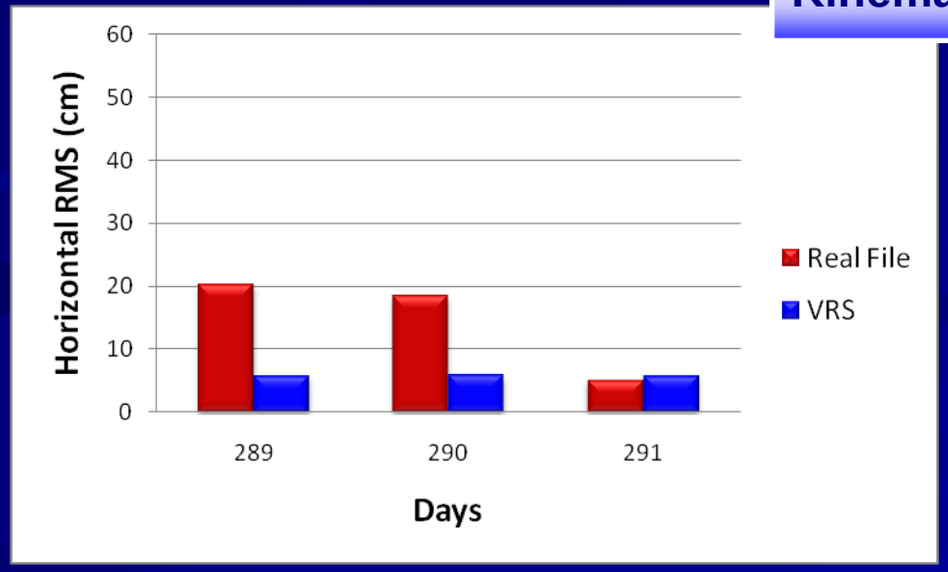
NRCan software

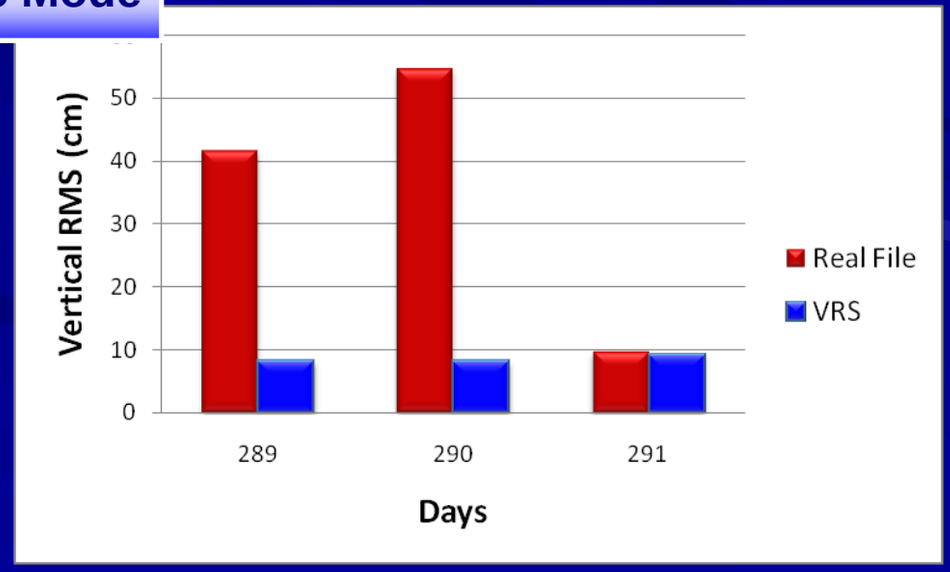
Static Mode





Kinematic Mode





CONCLUSIONS

In this presentation it was showed the performance obtained by a VRS generated using atmospheric models

- The system was developed by FCT/UNESP researchers

The results obtained present evidences that the proposed methodology may be quite efficient

- The results provided by VRS are similar of those obtained by real data (PPTE)
- VRS presented best results than the nearest reference station (SPAR)

CONCLUSIONS

FUTURE works

- **To make available the post-processed network-based on the internet**
- **To develop the real-time network-based positioning (Network RTK)**

Spatial Geodesy Study Group