International Civil Aviation Organization

THE SIXTH MEETING OF IONOSPHERIC STUDIES TASK FORCE (ISTF/6)

Bangkok, Thailand, 19 – 21 January, 2016

Agenda Item 3: Review of status of States' activities and ISTF webconferences

OVERVIEW OF INDIA'S CONTRIBUTION IN IONOSPHERIC STUDIES TASK FORCE

(Presented by India)

SUMMARY

This paper summarizes the contributions made by India in achieving the objectives of Ionospheric Studies Task Force (ISTF).

India is committed to provide continued support to ISTF activities and other GNSS activities under ICAO in Asia Pacific region.

1. Introduction

1.1 The Ionospheric Studies Task Force (ISTF) was established by the CNS/MET Sub-Group of APANPIRG in 2011-12. The objectives are to study the need for development of regional ionospheric threat models for GBAS and SBAS, and to develop them if the need is identified.

1.2 The main activities of ISTF include ionospheric data collection, analysis and sharing in the Asia-Pacific (APAC) region to facilitate the characterization and development of regional model, if needed. Electronic Navigation Research Institute (ENRI), Japan has hosted the data server for this purpose.

1.3 India is actively supporting the ISTF activities owing to its experience in ionospheric studies over equatorial and low latitude region for implementation of SBAS, particularly GAGAN. This paper summarizes the contributions made by India in ISTF so far.

2. Discussion

2.1 India has been actively participating in all the meetings of ISTF- 5 face-to-face meetings and 7 web-conferences so far. India has hosted the 4th meeting of ISTF in New Delhi during 4-7 February 2014. Overall, 7 Information Papers and 10 Working Papers have been presented from India in these meetings.

2.2 For data collection/sharing under ISTF, India has nominated significant number of stations providing ionospheric delay and scintillation measurements. Out of total 37 stations nominated by APAC States as data sources of ionospheric scintillation measurements, 23 are from India. The locations are strategically placed starting from magnetic equator to low mid-latitude region.

2.3 Data from the nominated stations of India have been shared with ISTF and provided to ENRI, Japan to facilitate the data collection, analysis and sharing under ISTF activities. The shared data includes equinox, summer and winter months during low solar activity (2008), medium solar activity (2004) and high solar activity (2012) periods.

2.5 To support the data analysis, India is sharing the relevant and significant results with ISTF. The notable working/information papers from India presented in previous meetings are summarized here:

a) Ionospheric Data Collection and Analysis- Recent Results, IP02 (ISTF/1);

b) Effect of Scintillation on the GAGAN Geo Signals - Challenges in Integrating Geostationary Satellite with Uplink Station, WP11 (ISTF/2);

c) Ionospheric Studies for GAGAN, WP10 (ISTF2);

d) Longitudinal variations in TEC at Low Latitude, WP05 (ISTF/3);

e) Correlation of Scintillation and Loss of Lock for GNSS systems, WP04 (ISTF/4);

f) Space Weather Effects on GAGAN, WP11 (ISTF/4);

g) Development of Ionosphere Prediction Models for Indian Region, WP10 (ISTF/4);

h) Characteristics of TEC over Indian Region, WP09 (ISTF/4);

i) Identification of dates relevant for data Analysis relating to equatorial ionospheric anomalies, WebConf/1; and

j) Development, Testing and Verification of AATR Generation Tools and Results of AATR Analysis Over Indian Region, WP03 (ISTF/5)

2.6 India acquired the Long Term Ionospheric Anomaly Monitoring tool (LTIAM) from FAA through ISTF and has successfully installed it in Windows machine. After minor modifications in consultation with Republic of Korea (Dr. Jiyun Lee), India was successful in running the tool and obtained the initial results. The experience with LTIAM tool as submitted in Webconference#7 (24/9/2015) is provided in Attachment I to this paper.

3. ACTION REQUIRED BY THE MEETING

3.1 The meeting is invited to do the following:

a) note the India’s continued support and contribution in ISTF activities; and

b) discuss any relevant matters as appropriate

– – – – – – – – – – – – –

India's Experience with LTIAM tool

Surendra Sunda
Airports Authority of India

Installation of the LTIAM tool

- Long Term Ionosphere Anomaly Tool (LTIAM) was acquired from FAA for ionosphere gradient analysis for GBAS/SBAS.
- LTIAM tool has been installed in the 64-bit Windows machine.
- MATLAB *R2014a* (8.3 version) is being used to run the LTIAM tool.
- The system is independent and is not connected to internet for any sort of data download.

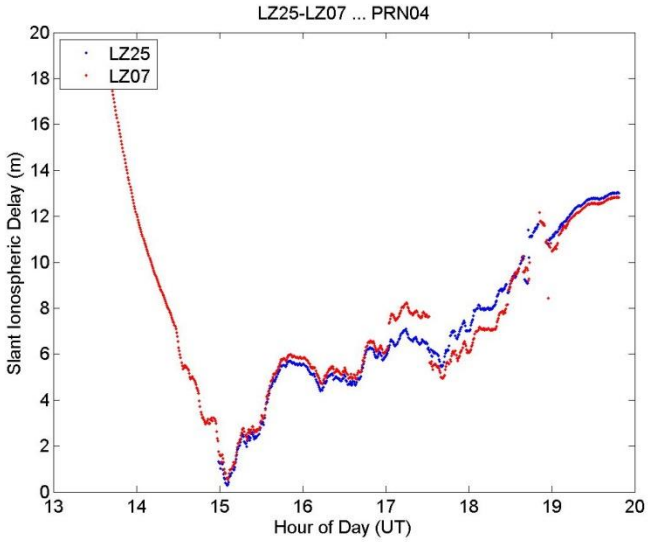
Initial problems

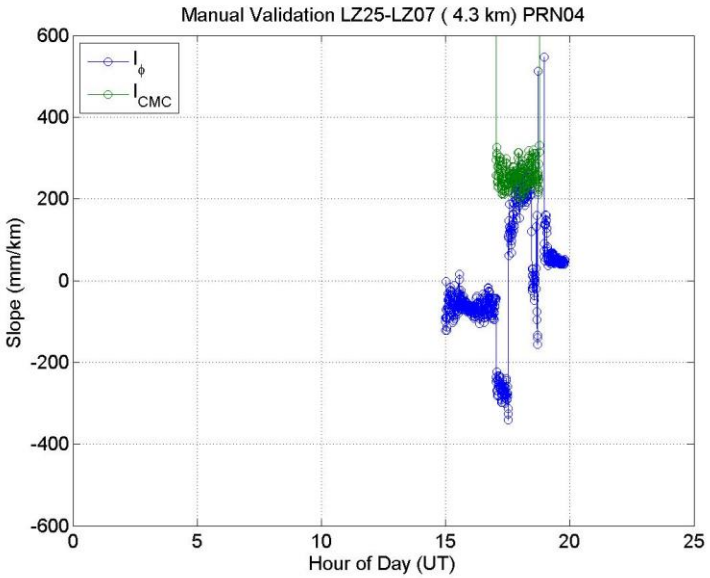
- Since the LTIAM tool is specifically developed to process the US CORS network data and is fully automated to download the data, certain modifications are required for handling the data from other sources.
- For the first trial run, some files(which are created automatically depending on the availability of data from CORS network) were created manually
- All the modules requiring internet connection were switched off/by-passed.
- Program terminating error was encountered while processing the RINEX file in '*LTIAM_rnxread*' module.
- Stepwise debugging reveals that problem lies in the navigation data reading function('ephget') for some particular PRN.
- Code of '*LTIAM_rnxread*' module was modified to handle the error and by-pass the satellite.
- Consulted Dr. Jiyun Lee and her student on this issue and they informed that the particular module is facing problem in this MATLAB 8.3 version only and suggested to use 'MATLAB 2010a' version.
- However due to unavailability of the required version, the trial run was conducted successfully after modifying the code (by-passing the satellite)

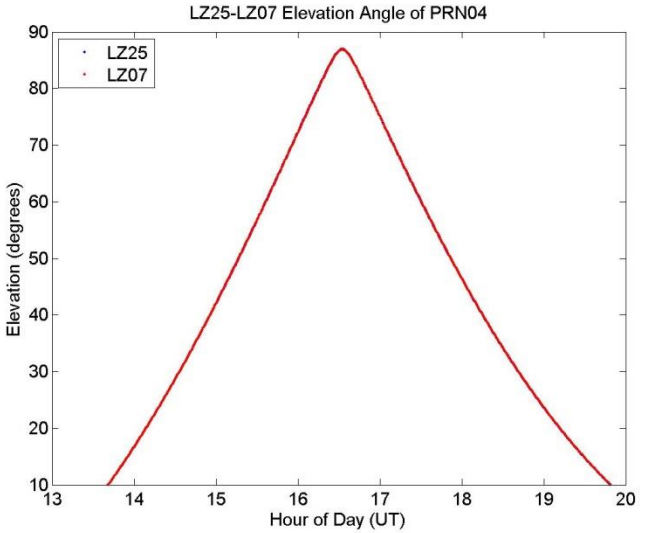
First results of LTIAM

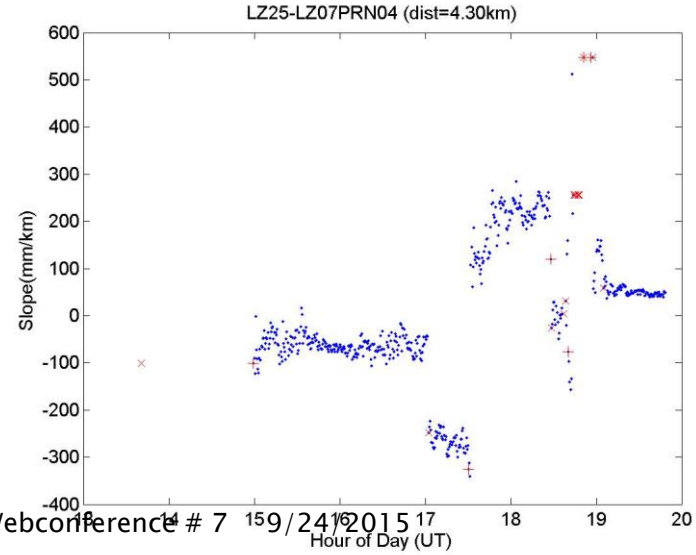
- The RINEX data from two receivers at GBAS site, Chennai were used in the first trial run.
- The baseline of the stations is 4.3 km at Chennai.
- Previously identified date – 2nd April 2014 was chosen for the purpose.
- As known to be ionospheric disturbed day, large gradients were observed for almost all satellites in view in night time.
- The gradients are in the order of 600mm/km to 800mm/km.
- More understanding is required to validate the results and build the data base.

2ND April 2014– PRN 4

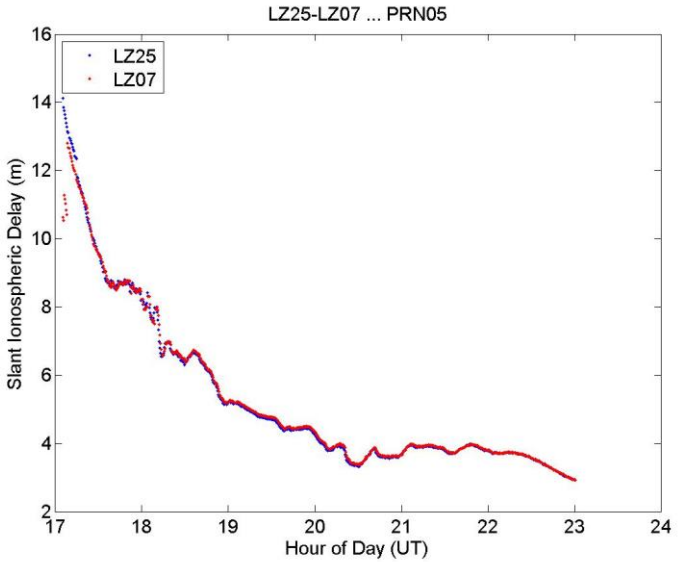


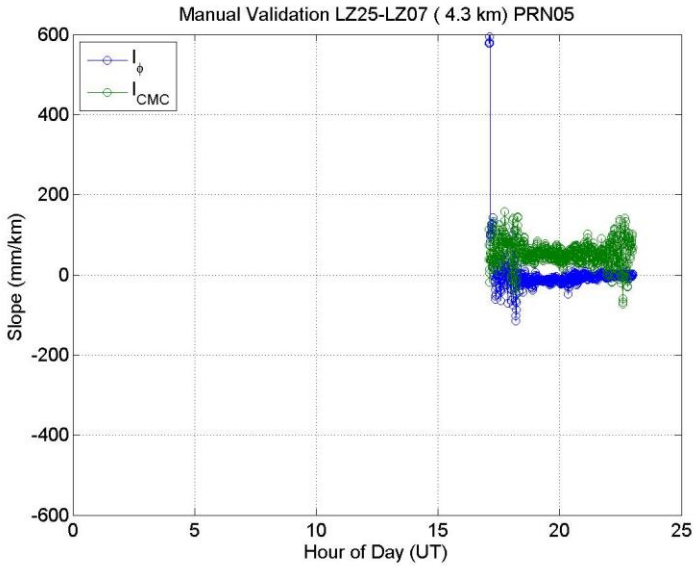


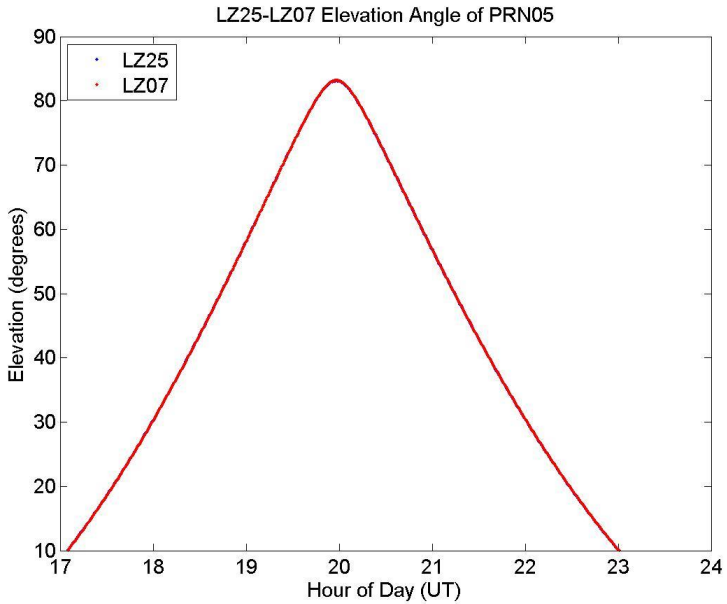


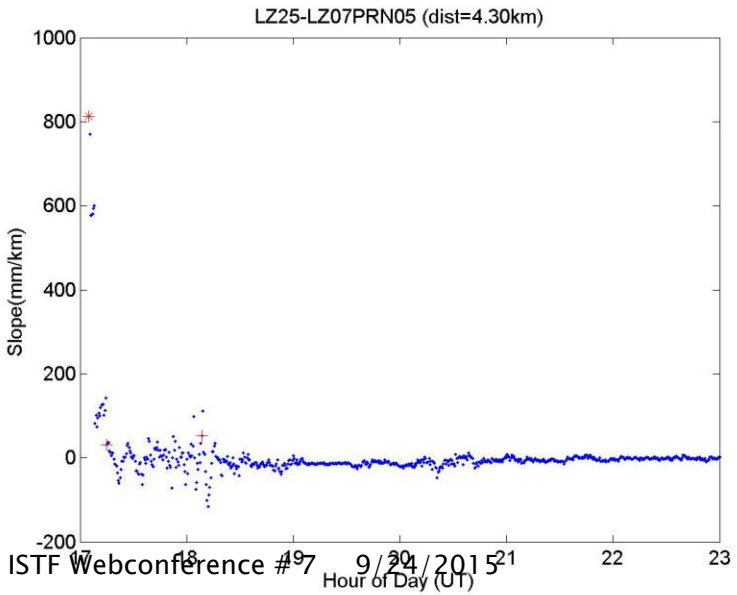


2ND April 2014– PRN 5

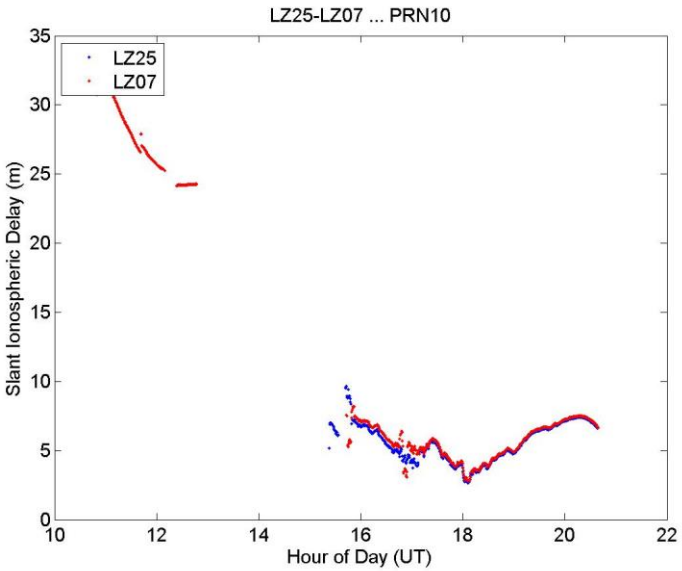


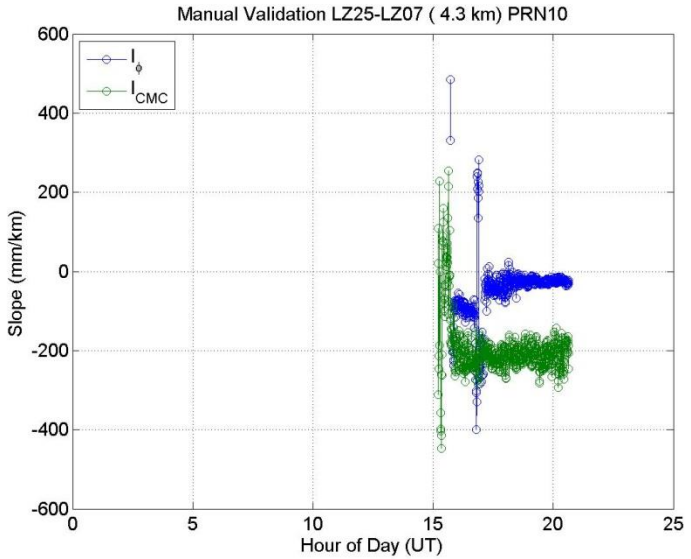


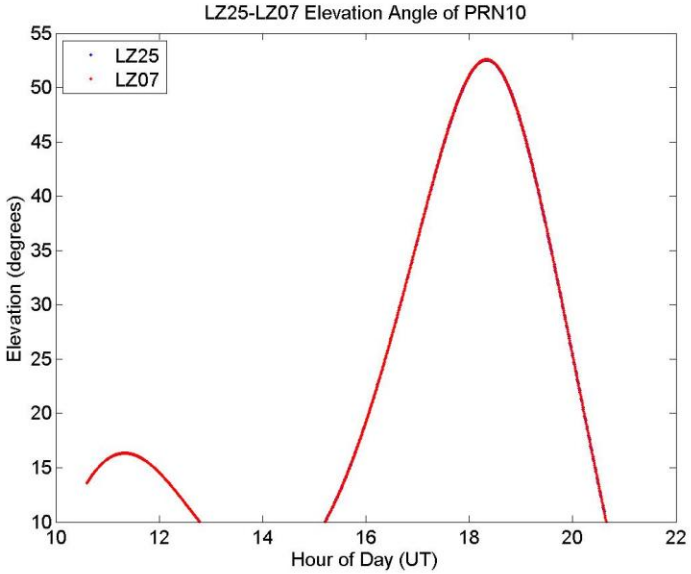


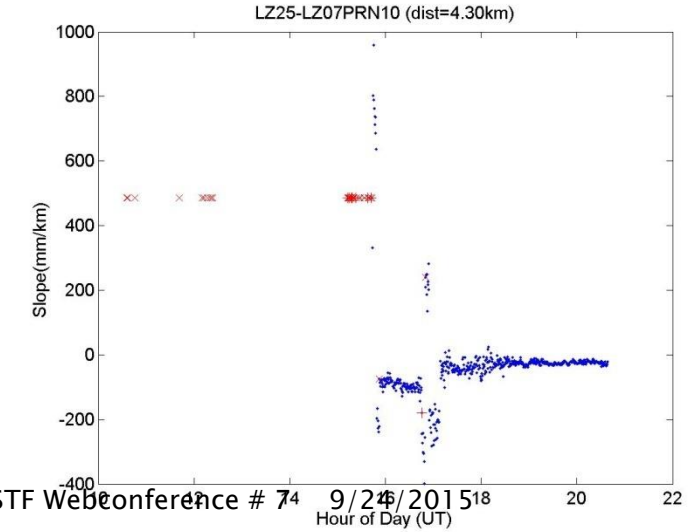


2ND April 2014- PRN 10

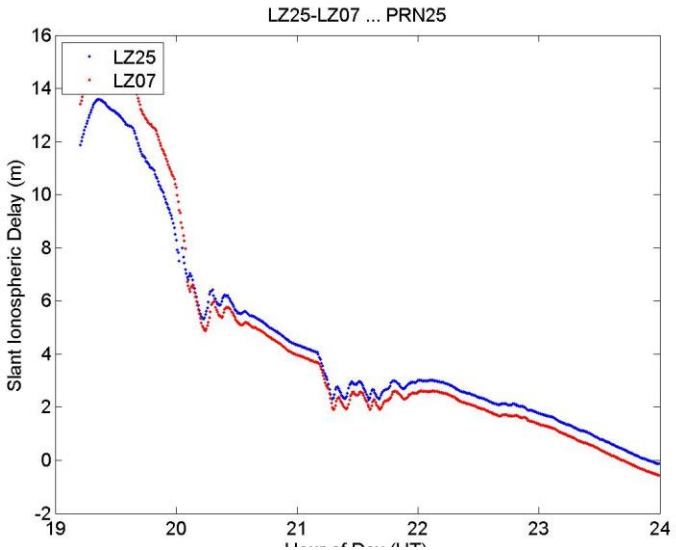


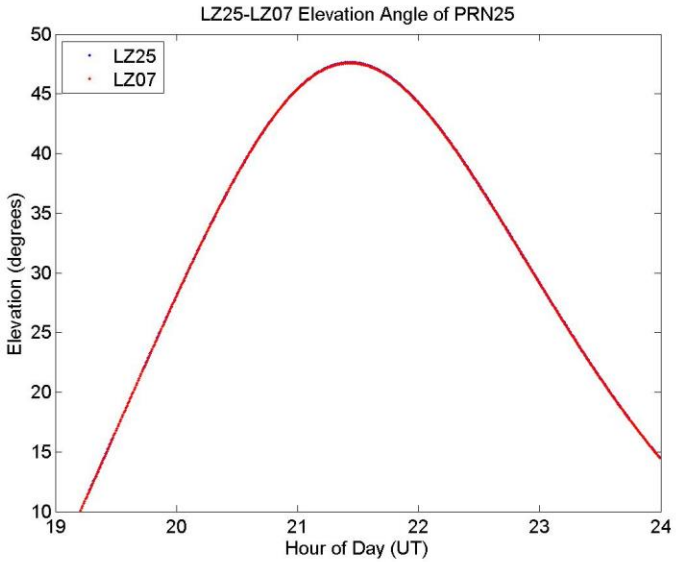


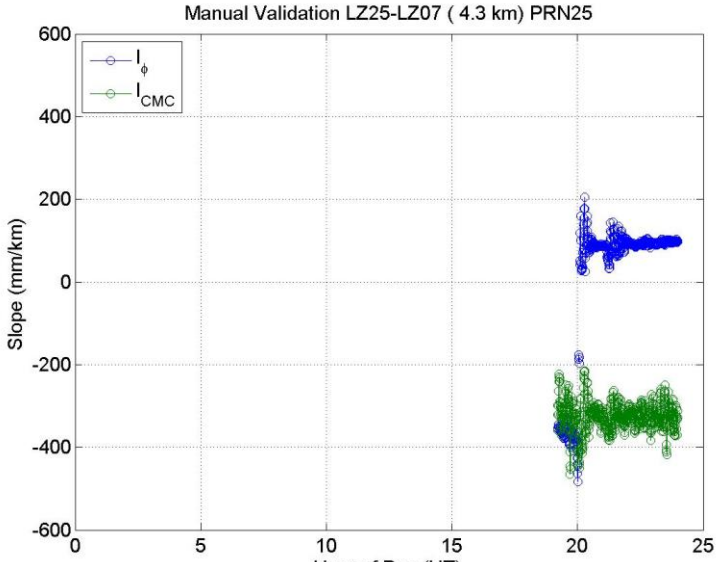


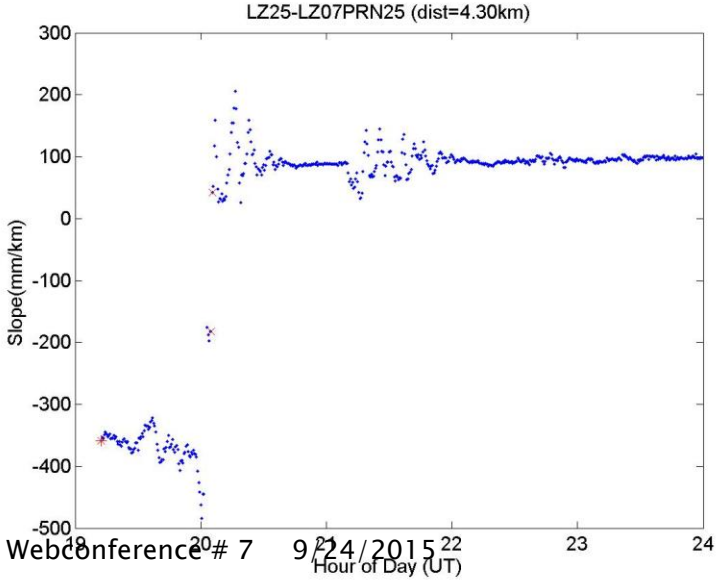


2ND April 2014- PRN 25









Future work

- Modify/edit the RINEX file to merge/split the data day wise.
- Modify the LTIAM data fetching code to read from the particular folder in hard drive.
- Identify the dates based on AATR analysis and Scintillation (S4) analysis.
- Run the LTIAM tool for identified days
- Validate and build the data base (How to do ??)