

# Research Collaboration on Ionospheric Irregularities in Low-Latitude Region and Effects on Positioning and Navigation System

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Ionospheric irregularities in low-latitude regions such as sporadic E and equatorial plasma bubbles (EPB) cause degradation in communication, positioning and aeronautical navigation systems. Since the sporadic E affects VHF communication across border, whereas EPBs originate at the magnetic equator and propagates to higher latitudes, research collaboration in this area is important for the study on their characteristics as well as the effects on modern technology.

**Key Words:** Equatorial Plasma Bubbles, Positioning, Navigation

## 1. Introduction

Ionosphere is an important medium in which the radio signals in communication, positioning navigation pass through. At low-latitude region, irregularities in the ionosphere come in several forms such sporadic E, equatorial plasma bubbles (EPBs) [1-3]. Recently, we have embarked on international projects in EPB study, Sporadic E study, effects of EPBs on positioning and aeronautical navigation such as ground-based augmentation system (GBAS) and in the near future, on satellite-based augmentation system (SBAS).

## 2. Results

First, we show the activities of ASEAN IVO project on EPB study and effects on precise positioning. GNSS receivers have been installed in Yangon Technological University (YTU) in Myanmar, Institute of Technology Cambodia (ITC) and Cambodian Academy of Digital Technology (CADT) in Cambodia, National University of Laos (NUOL) in Laos and Institute of Geophysics in Vietnam. Several training workshops on total electron content (TEC) and RTK positioning were given to locals in these countries. We will show the results of TEC maps, rate of TEC change index (ROTI) maps from these stations. The movement of EPBs are analyzed in terms of horizontal speed and vertical drift velocity. In addition, the performances of cm-level positioning at these stations are displayed. For example, during On March 20<sup>th</sup>, 2020, the ionosphere is in a quiet state with the Kp index of 3. During equinoctial months (March, April, September, October), local ionospheric irregularities such as EPBs are often seen. (IPPs). West to East.

Next, we describe the delay gradient analysis project supported by Electronic Navigation Research Institute (ENRI), Japan, since 2011. The statistics of delay gradients have been studied during both quiet and disturbed periods. The short and long baselines are focused. Consequently, in 2019-2023, the GBAS demo project at the Suvarnabhumi airport was carried out by Japanese and Thai side. The references GNSS stations were installed near the runway of the airport, then the VHF transmitters and receivers were also set up. Multiple flight tests were implemented. In addition, the Ionospheric Monitoring Front (IMF) detector was also installed on the campus of KMITL.

Finally, we will overview ongoing research collaboration projects such as SouthEast Asia Low-latitude Ionospheric Observation Network (SEALION) since 2004 and Sporadic E detection project since 2023.

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