Future Direction of AMBER: Inner-Magnetospheric Array for Geospace Science (iMAGS)

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Team Members: M. Moldwin (UM); E. Zesta (NASA); A. Boudouridis (SSI); and AMBER team members around the world!
Objectives: To investigate

→ the processes governing electrodynamics of the equatorial ionosphere as a function of local time, longitude, magnetic activity, and season, and

→ ULF pulsation strength and its connection with equatorial electrojet strength at low/mid-latitude regions.
Instrument & its Setup at the site

- Belkin UPS
- Magnetometer
- BeagleBoard
- GPS
- Sensor

Sensitivity: 0.01 nT
Resolution: 0.5 sec
Objectives: To investigate the longitudinal variability of dayside electrodynamics
Is equatorial electrodynamics longitudinal dependent?

Scherliess and Fejer, JGR, 1996

→ Is the drift at Jicamarca the same at different meridians?
→ AMBER monitors dayside electrodynamics at different longitudes
AMBER provides longitudinal variability of dayside electrodynamics

\[ J_X = \left( \sigma_P + \frac{\sigma_H^2}{\sigma_P} \right) E_X = \sigma_C E_X \]

**Magnetometer at off the equator**

\[ B_{\text{Obs}} = B_{\text{main}} + B_{\text{SQ}} + B_{\text{FAC}} + B_{\text{RC}} + B_{\text{MP}} \]

**Magnetometer at the equator**

\[ B_{\text{Obs}} = B_{\text{main}} + B_{\text{SQ}} + B_{\text{FAC}} + B_{\text{RC}} + B_{\text{EEJ}} + B_{\text{MP}} \]
Longitudinal and Seasonal Variability of Equatorial Electrodynamics and Ionospheric Irregularities!

Dayside and evening side drifts

If not the drift, then what controls the longitudinal variability of bubbles?

Bubbles or Scintillations
Solar Wind-Magnetosphere-Ionosphere impact on technological systems!

- AMBER contribute in tracking Solar Wind-magnetosphere-ionosphere coupling impact on ionospheric disturbance

ULF wave penetration to low-latitudes

ULF wave associated E-field fluctuation and its impact on ionospheric density
Longitudinal and Seasonal Variability of Lunar Tide Effect on Equatorial Electrodynamics

Yizengaw and Carter., AG, 2017
So far AMBER have

✈ Supported 2 senior and mid-career researchers

✈ Graduated students (2 PhD in Ethiopia, 1 PhD in Algeria, 1 MSc in Nigeria)

✈ Currently Students (2 PhD in Ethiopia, 1 PhD in Nigeria, 1 PhD in Cameroon, 1 PhD in Ivory Coast, 1 PhD in Chile, 1 PhD in Thailand)

Postdocs

✈ Edigardo Pacheco (BC, now at Jicamarca), Brett Carter (BC, now at RMIT).

✈ Produced about 40 peer-reviewed publications and over 50 conference presentations

✈ We are ripe for more dense future output
AMBER – iMAGS (NSF - operation)

iMAGS (Inner-Magnetospheric Array for Geospace Science)

Merging AMBER, SAMBA, MEASURE Networks

Team members: E. Yizengaw (PI, BC), M. Moldwin (Co-I, UM), E. Zesta (Co-I, NASA), A. Boudouridis (SSI); M. Magoun (BC)
Objective of iMAGS magnetometer Array

- To understand the processes governing electrodynamics of the equatorial ionosphere as a function of local time, longitude, magnetic activity, and season.
- To understand the Solar Wind – Magnetosphere – Ionosphere coupling impact on the equatorial density distributions that important for the communication and navigation systems.
- To estimate the plasmasphere mass density.
- To monitor the GIC currents not only at high latitudes but also at the equatorial region where the GIC get amplified by EEJ in the same way it gets amplified by AE at high latitudes.
Data returning procedures

- Tunnel Server
- GMAG Server
- GMAG Viewer

SSH, Port 22
UDP, Port 9604

@ Site

SSH, Port 100xx

Map it to WWW

UDP, Port 9605
You can search by day numbers or by station name

You can download ASCII data (1 min, 1 sec, and half sec resolution)

You can download summary plots for a quick look!

You can download Electrojet data (daily plots and ASCII data)!
Two prominent grand challenge problems

- **Power fluctuation issue:** Lack of funding to augment with solar panel
- **Internet Connectivity issue:** Expensive to use other alternative options

The collaborative agreement signed with different international agencies may help improve these grand challenges!
<table>
<thead>
<tr>
<th>Year</th>
<th>Evolution of Instrumentation in Africa and Its Significant Outputs!</th>
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<tbody>
<tr>
<td>2007</td>
<td><img src="image1" alt="Map of Space Science Instruments in Africa: 5 years ago" /></td>
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<tr>
<td>2015</td>
<td><img src="image2" alt="Map of Space Science Instruments in Africa: Now" /></td>
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**Significant Legacy!**

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Thank You!