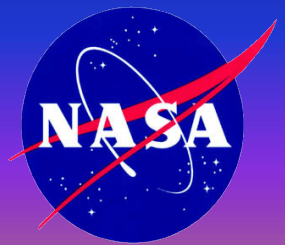
Ethiopian Space Science

Endawoke Yizengaw

Institute for Scientific Research, Boston College



From Tracking the Cattle to Tracking the Satellites!!

Endawoke Yizengaw

Institute for Scientific Research, Boston College

Four degrees from four continents

Where does the journey started?

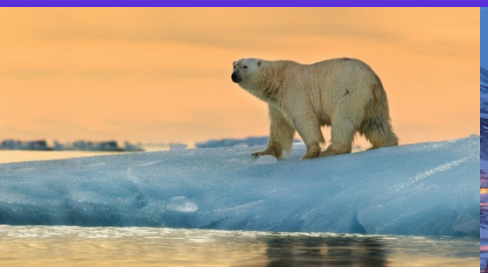
The forced educational journey

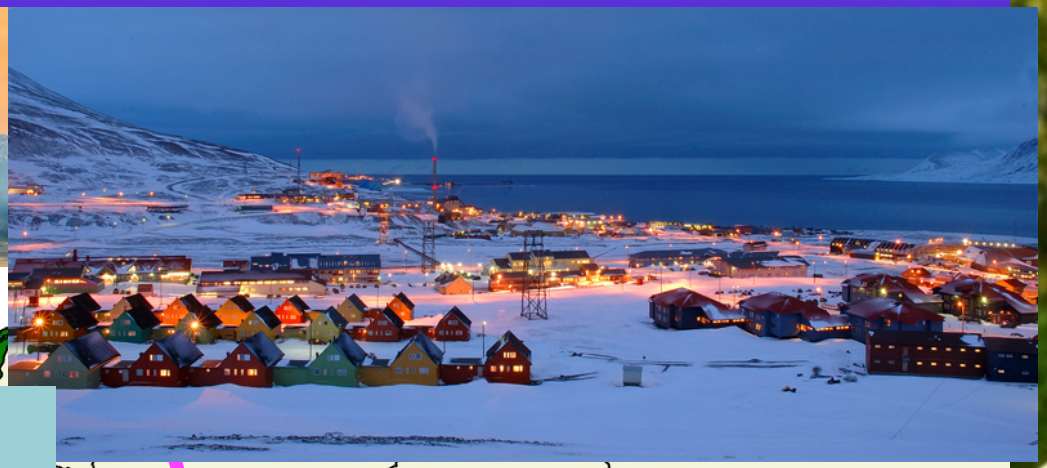
Un planned profession: Joined vocational school and received diploma in Auto-mechanics!

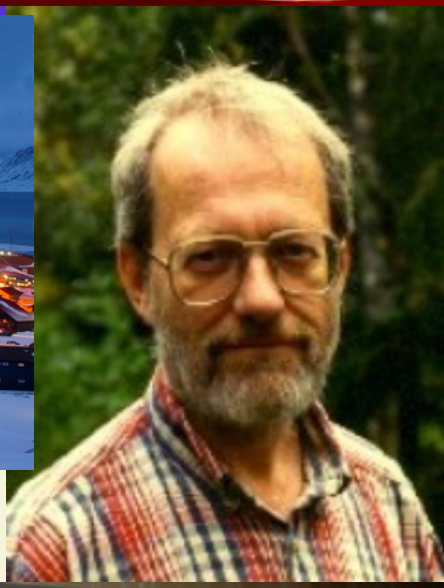
Start acting a real academician: Joined AAU and received Bachelor degree in Applied Physics!

The adventures educational journey

The real adventures educational journey







UNIS

The University Centre in Svalbard

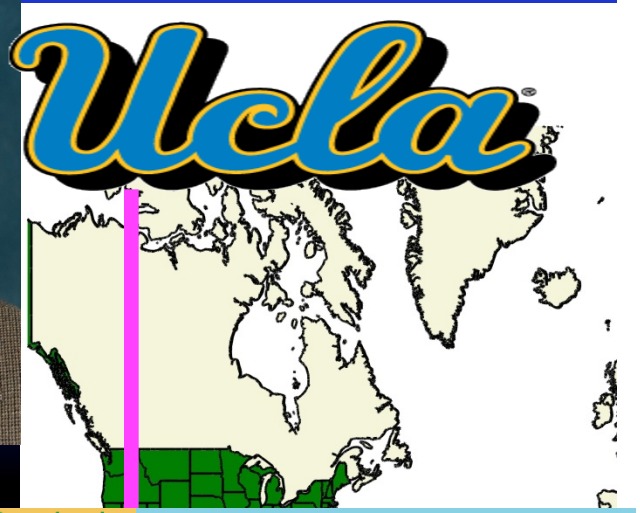
The unforgettable life in Svalbard

The unforgettable life in Svalbard

The adventures educational journey to the south

LA TROBE UNIVERSITY
AUSTRALIA

Real Academic Career started here



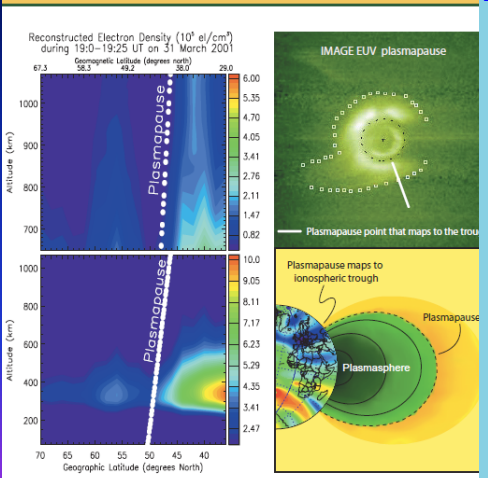
Postdocs Rock

The UCLA Postdoctoral Scholars Reception was established in 1998 to recognize the important contributions that postdoctoral scholars make to the interrelated missions of research, teaching, and public service at UCLA. At this ceremony, the Chancellor's Award for Postdoctoral Research is conferred on particularly accomplished individuals. The nominees come from virtually every discipline at UCLA, from the basic and applied sciences to the professional schools, the social sciences, and the humanities. This year's ceremony, held on March 22, 2006, honored the work of five outstanding scholars.

Yizengaw and Moldwin, 2005

Geophysical Research Letters

16 MAY 200
Volume 32 Number
American Geophysical Unio

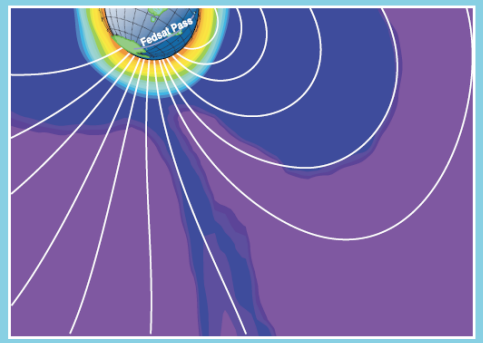


Connecting outer space to the edge of Earth's atmosphere • Tsunami warning system for the Indian Ocean • Saharan dust gives clues to weather patterns

Yizengaw et al, 2006

Geophysical Research Letters

28 OCTOBER 2006
Volume 33 Number 20
American Geophysical Union

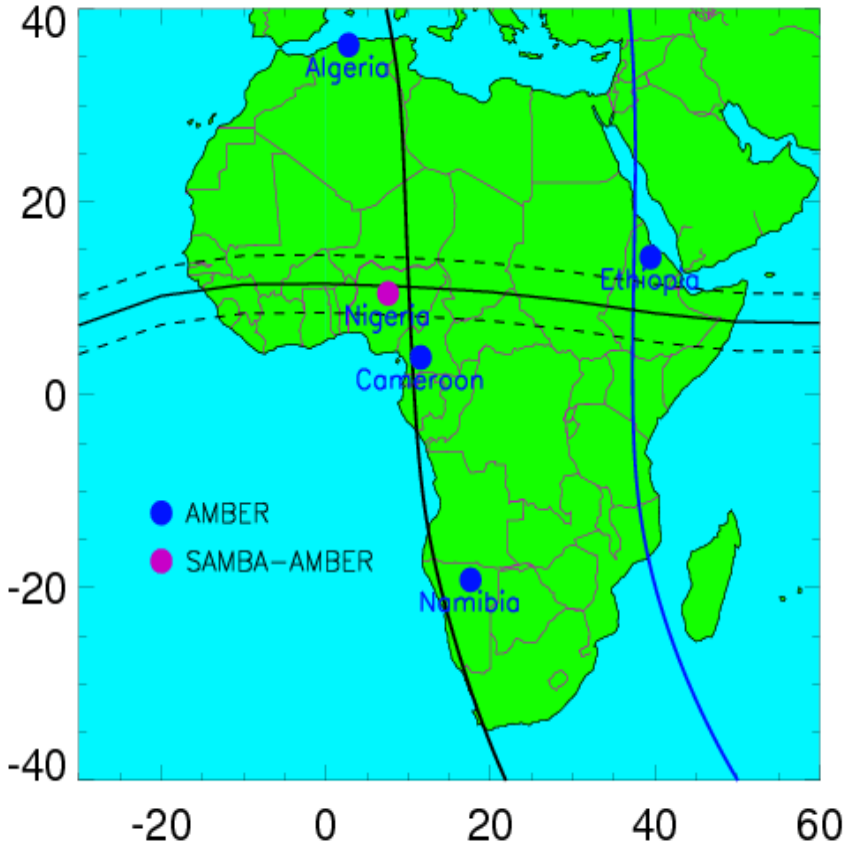


First tomographic image of ionospheric outflows • Detailed analyses of the October 2005 Pakistan earthquake • China's surface temperatures to increase despite decrease in insolation

Became PI for many grants, including AMBER magnetometer network

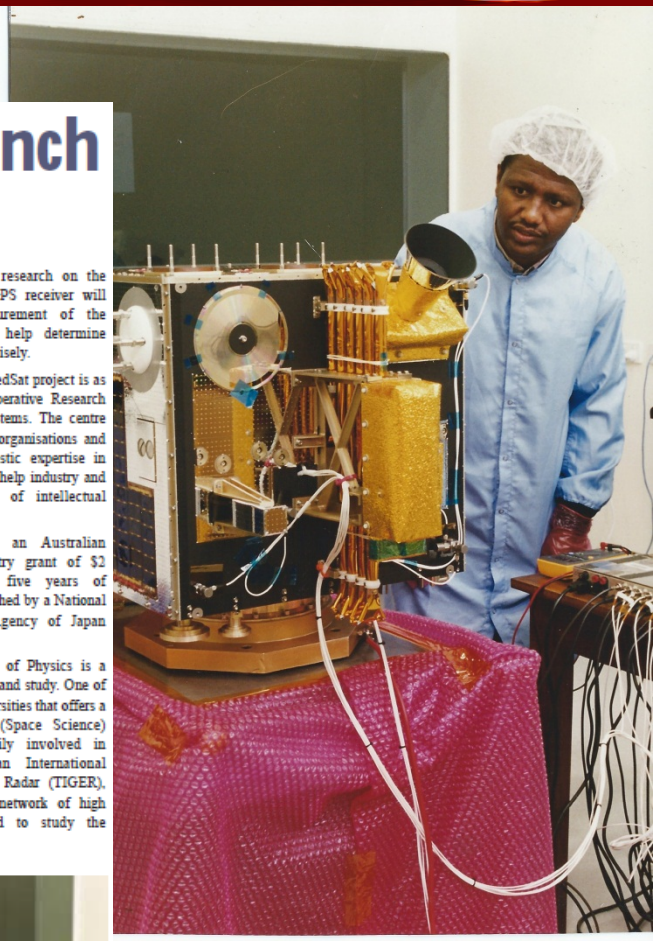
AMBER (African Meridian B-field Education and Research)

E. Yizengaw (PI) and M. Moldwin (Co-I)



- 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.

First time I saw what satellite looks like



LA TROBE UNIVERSITY
Bulletin
AUGUST 2002

NEW PRECINCT FOR
language and
culture

Pregnancy &
BODY
IMAGE

LIME LIGHT
on local lizard

Countdown to FedSat launch

for La Trobe space researchers

Navigation, timing and other technologies could become more accurate thanks to La Trobe University's participation in FedSat – Australia's first scientific satellite in three decades.

The FedSat 'micro-satellite' – a 50 cm cube weighing about 55 kg – will go into orbit from a rocket scheduled to be launched from Japan on 1 November 2002.

La Trobe University senior lecturer and space physicist, Dr Elizabeth Essex, is project leader for one of four major scientific studies using FedSat when it orbits from pole to pole 800 km above the earth. Her project will investigate applications of satellite communications, GPS technologies and the earth's magnetic field.

Originally developed for American defence, the GPS (Global Positioning System) is now widely used for navigation, – from berthing a passenger liner to finding a street in an on-board automobile location system – as well as for timing and other scientific purposes.

Working with a team that includes Doctoral student, Endawoke Yizengaw, and Master's student, Rudy Birsa, Dr Essex will investigate aspects of GPS signal distortion.

Signals transmitted from 30 GPS satellites orbiting at an altitude of 20,000 km have to pass through the ionosphere en route to earth where the density of electrons and other factors distort the signals. This affects the accuracy of the information used for navigation and other precision applications.

GPS satellite range signals are delayed according to the density of electrons in different parts of the ionosphere.

'It is vital that we devise means to correct these errors and we can only do this once we understand more about the ionisation distribution and its effect on the signals as they pass through the ionosphere,' Dr Essex says.

Her team is using the first FedSat project to look at different aspects of this problem. Mr Yizengaw, who graduated in physics from the University of Addis Ababa and as a Master of Atmospheric Physics from Tromso University in Norway, will study the total electron content in the ionosphere.

His objective is to calculate the density of electrons and use this information to correct errors in the GPS signals.

Mr Birsa is researching scintillation – amplitude and phase variations – as a factor in signal irregularities that occur as GPS signals traverse the ionosphere. Pinpointing the volume of scintillation helps to understand irregularities in the low latitude ionosphere, he says.

FedSat will permit the recording of 'GPS slices' of the ionosphere, enabling a 3D moving picture to be constructed.

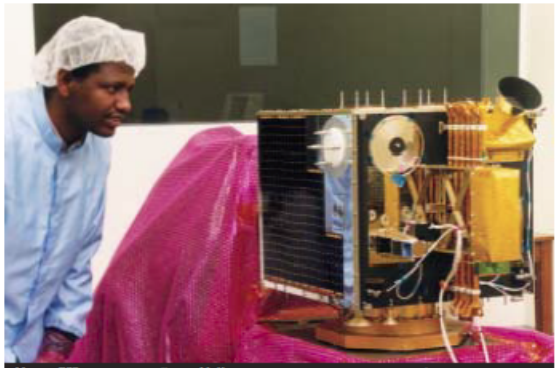
Dr Essex says FedSat will also help alleviate a problem with GPS satellite transmitting systems in the southern hemisphere. 'Because most of our hemisphere is water, there are fewer ground receiving stations. FedSat will act as a receiving station, thereby providing information on the Southern Hemisphere ionosphere.'

As well as scientific research on the ionosphere, FedSat's GPS receiver will allow accurate measurement of the satellite's position to help determine satellite orbits more precisely.

La Trobe's role in the FedSat project is as a member of the Cooperative Research Centre for Satellite Systems. The centre includes 12 Australian organisations and aims to develop domestic expertise in satellite technologies to help industry and the commercialisation of intellectual property.

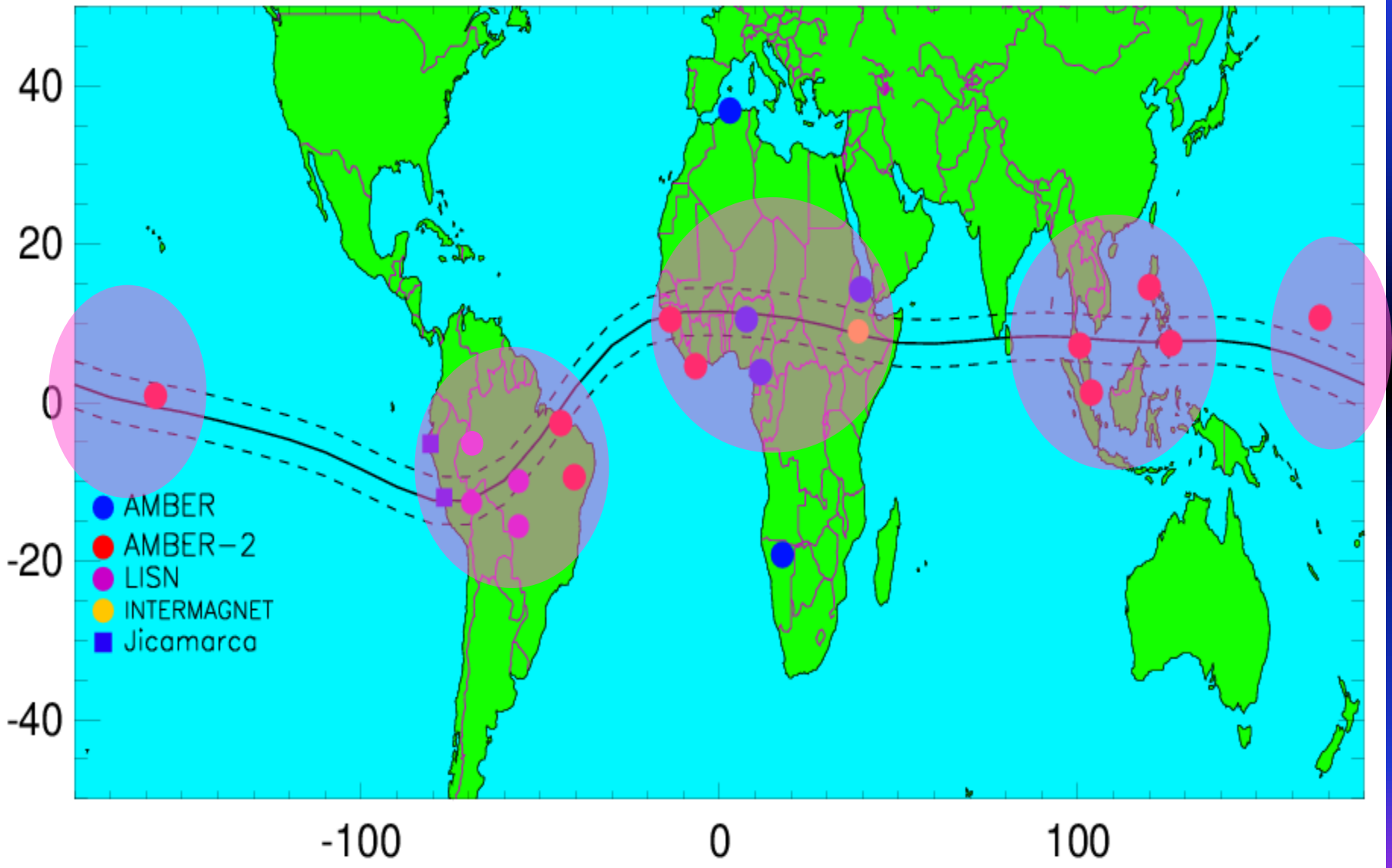
FedSat has received an Australian Government AusIndustry grant of $2 million. Culminating five years of planning it will be launched by a National Space Development Agency of Japan rocket.

La Trobe's Department of Physics is a leader in space research and study. One of the few Australian universities that offers a Bachelor of Science (Space Science) degree, it also heavily involved in managing the Tasman International Geospace Environment Radar (TIGER), part of SuperDarn, a network of high frequency radars used to study the ionosphere.■



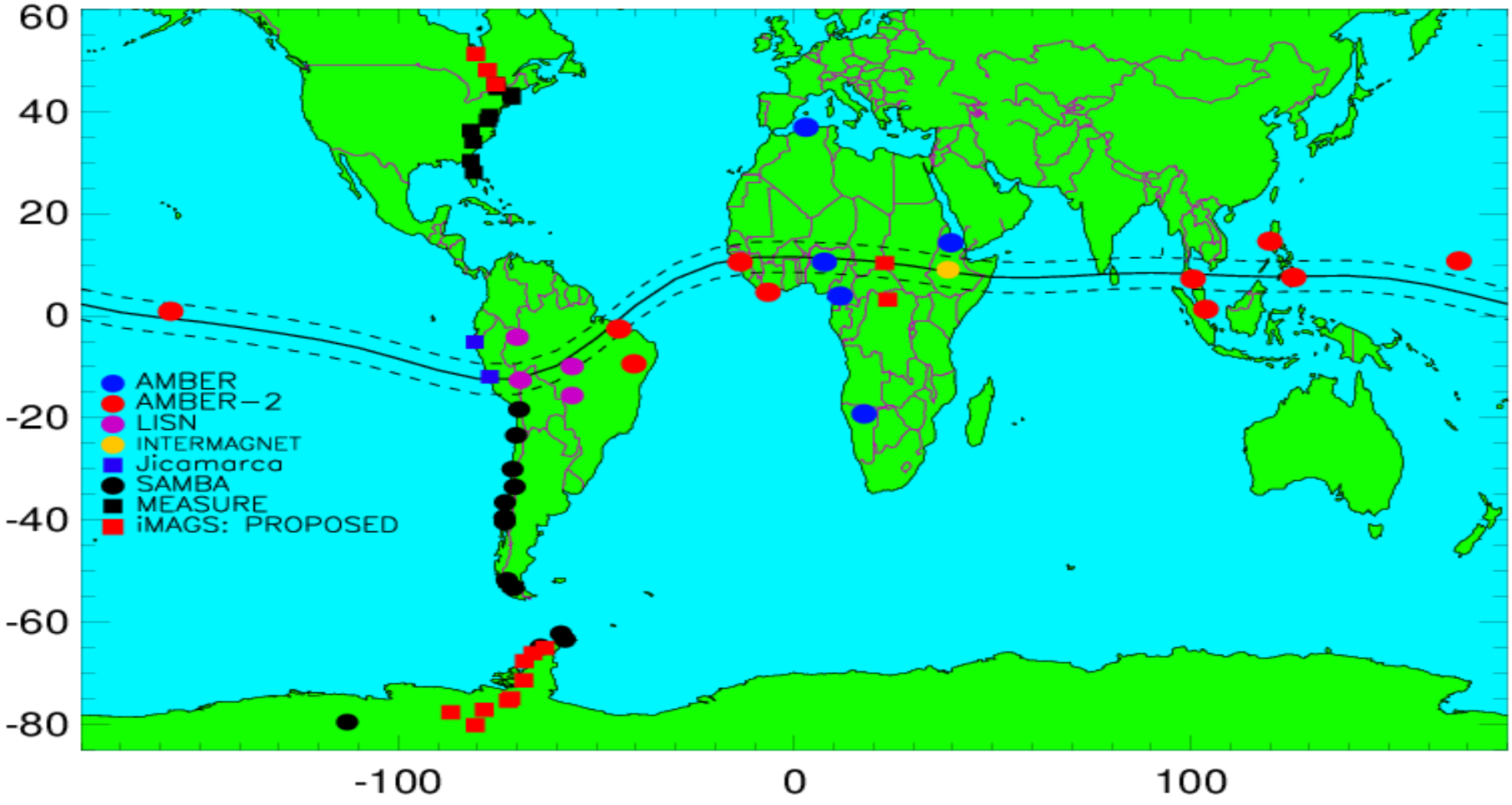
Making GPS systems more efficient: Mr Yizengaw and the satellite during recent final tests in Melbourne before the launch later this year.

Expansion of AMBER networks



iMAGs (SAMBA-AMBER-MEASURE)

Team Members: M. Moldwin (UM); E. Zesta (NASA); E. Yizengaw (BC); A. Boudouridis (SSI)

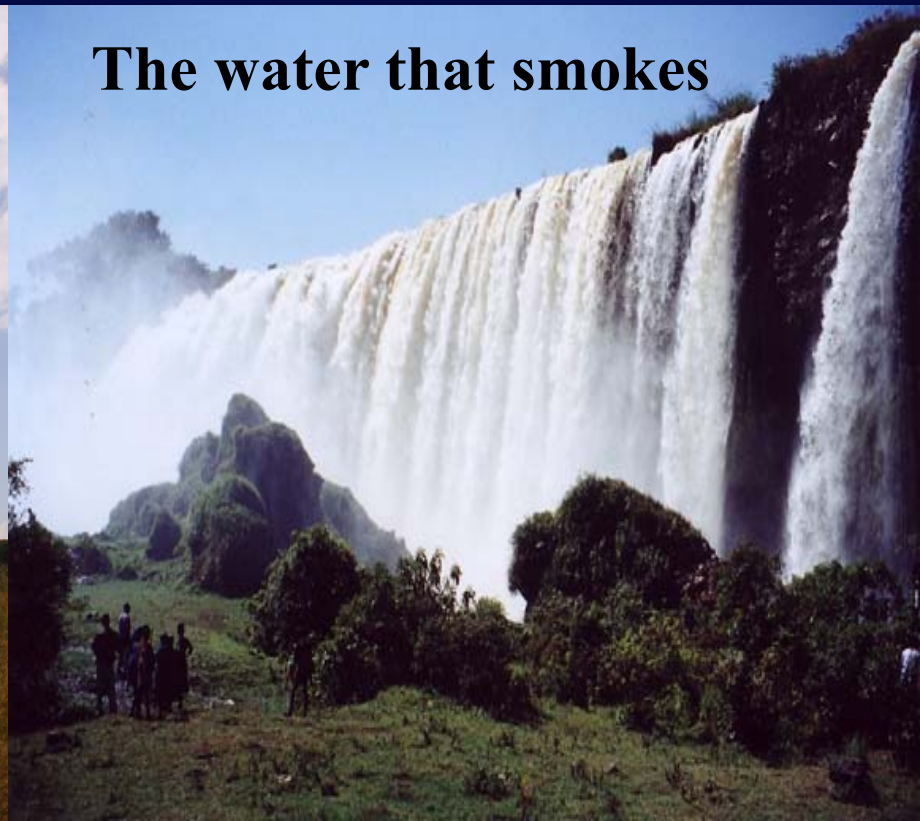


Some of iMAGs objectives

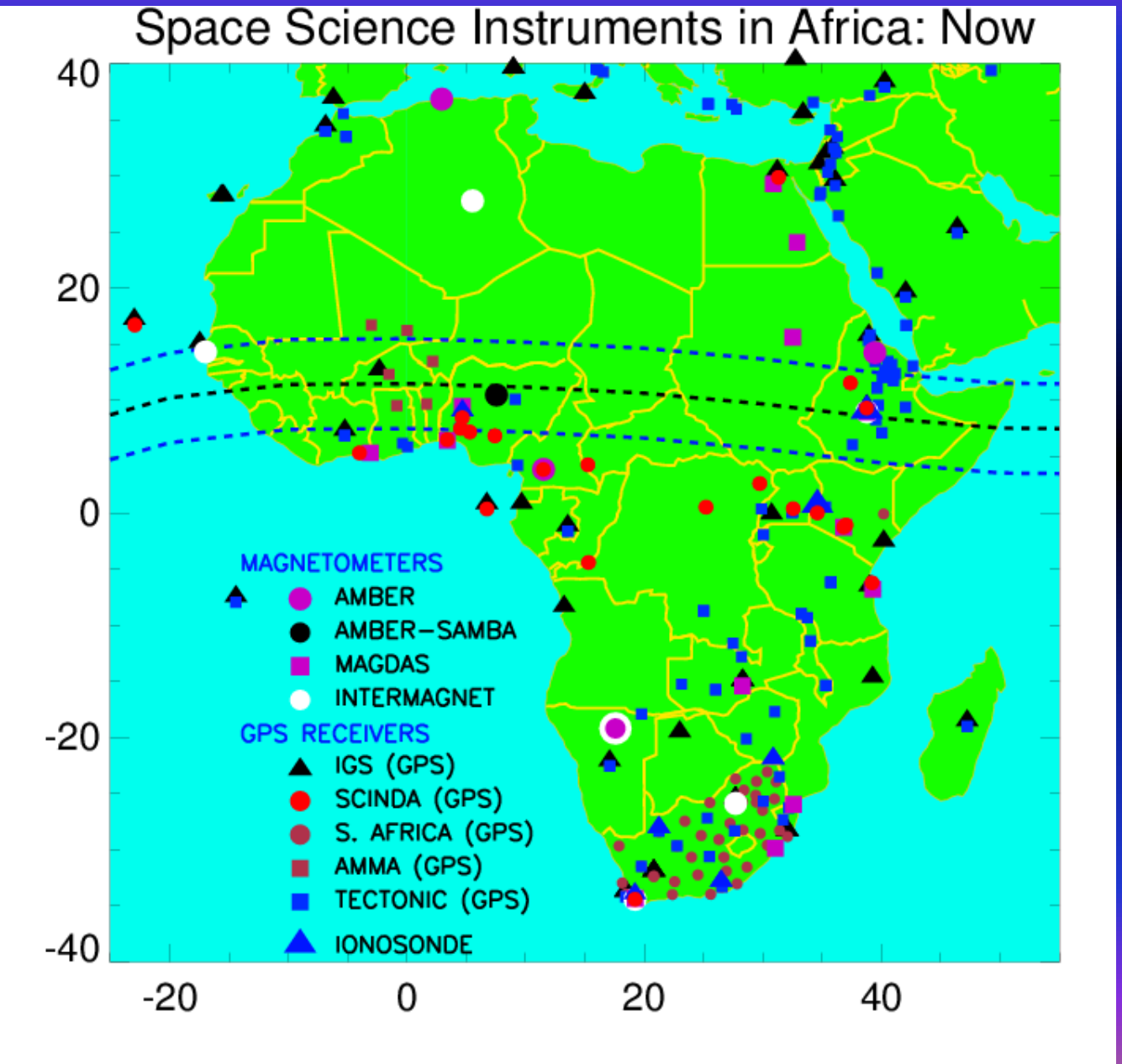
- **To understand the structure and dynamics of plasmaspheric mass and number density, and to contineously monitor the plasmapause location**
  - ***Field Line Resonances (FLR)***
  - ***Identify the plasmapause location from*** **spectral cross-phase reversal of two mag. stations** ***and using GPS TEC and Tomography Technique***
- **To continue filling the gaps of equatorial region and study EEJ dynamics and the penetrating ULF waves and its possible relationship to scintillation at different longitudes.**
  - ***Investigating the connection between ULF waves and scintillation using combination of mag. And GPS observations***
  - ***To understand the interhemispheric asymmetries of ULF wave power and the state of the ionosphere***

AMISR in Africa

Team Members: Endawoke Yizengaw (BC), Anthea Coster (MIT), Mark Moldwin (UM), and David Hysell (CU)



General Instrumentation in Africa



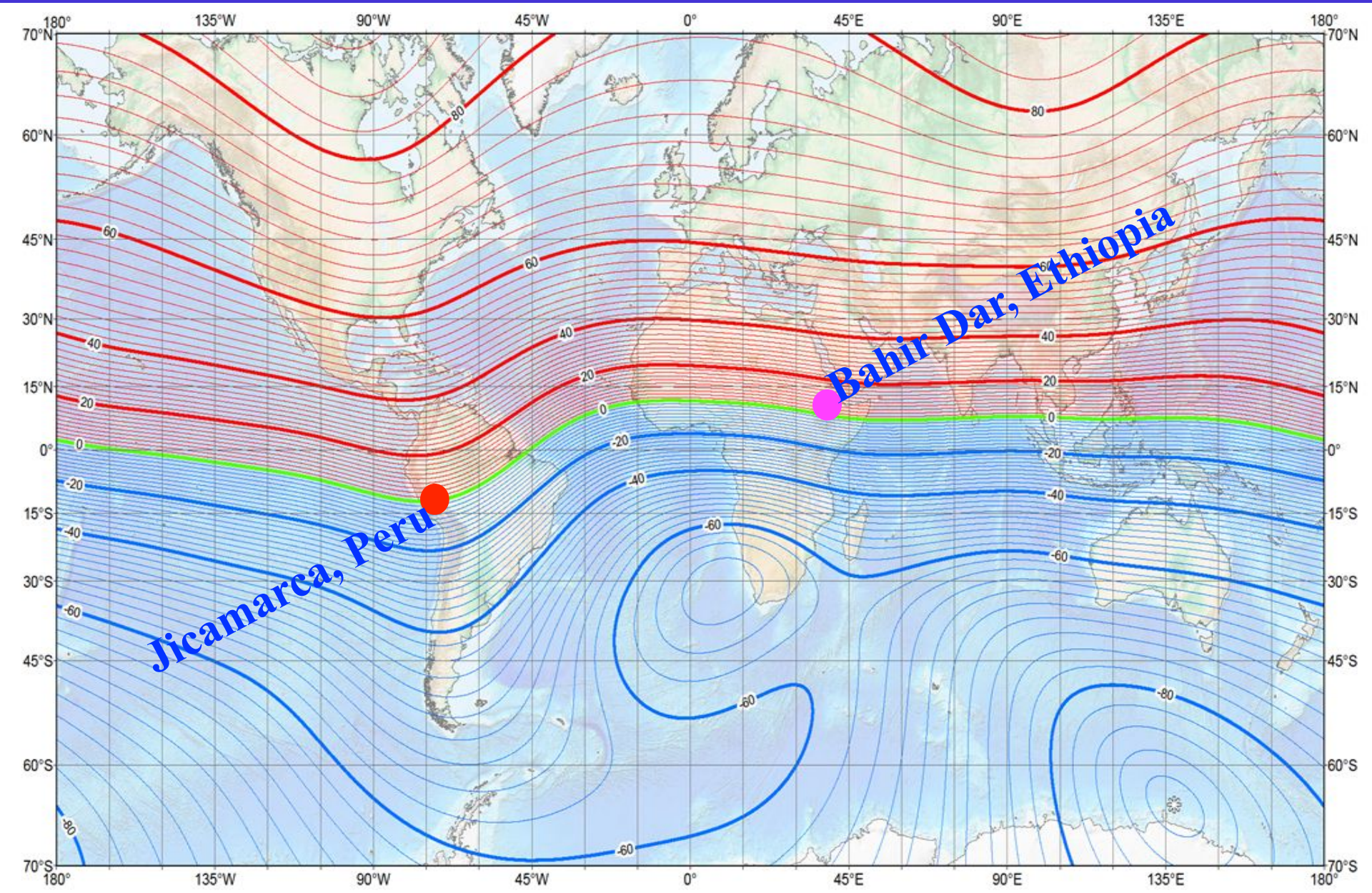
Five Years ago

Now

Why do we need ISR?

- ISR provide more accurate information than any ground-based instrument does
- ISR can provide electron density information both bottom and topside
- It can infer ion composition, and ion neutral collision frequency
- It measures electron and ion temperature, velocity
- It can infer atomic constituents, electric field
- It can infer neutral temperature and winds

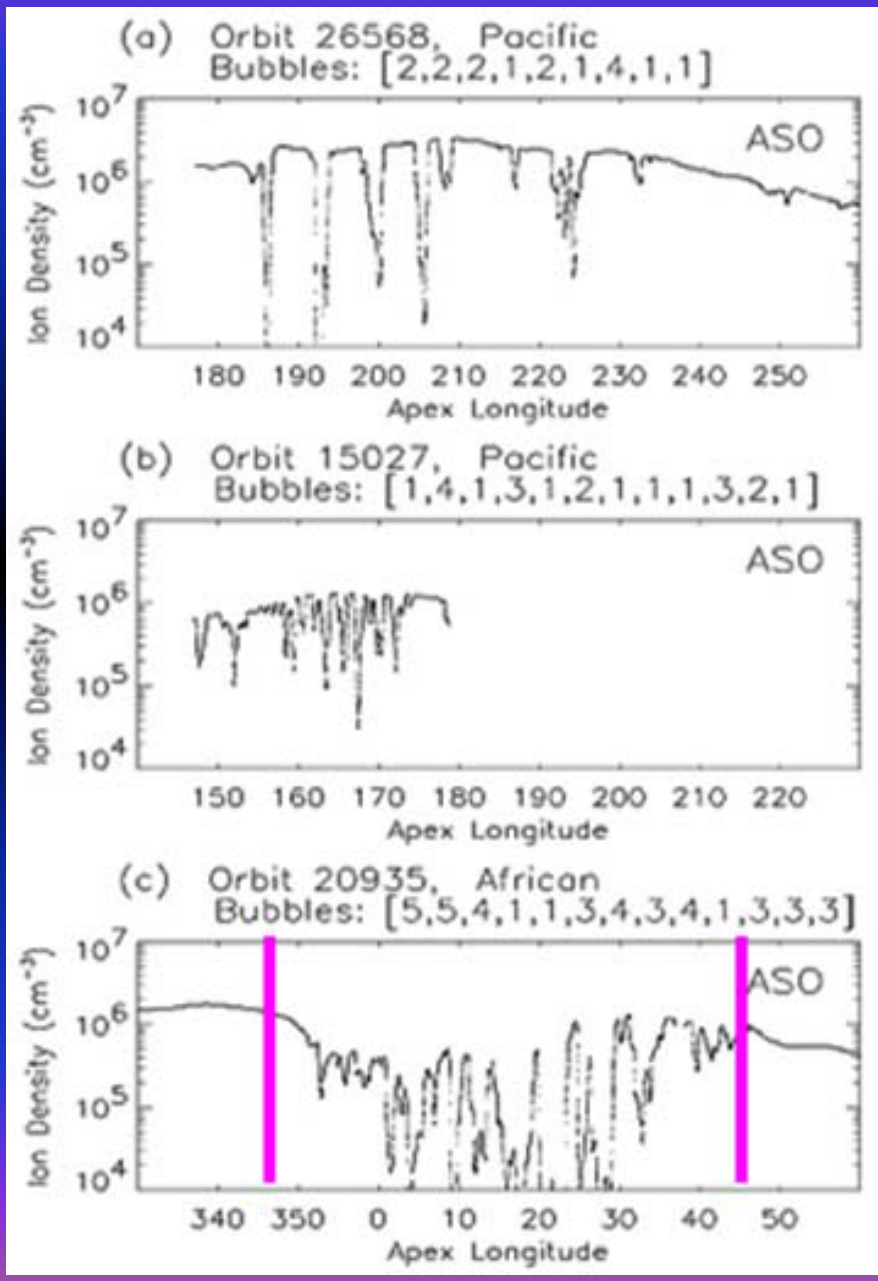
Why the location is important??



Why in Africa? (AEE Obsr.)

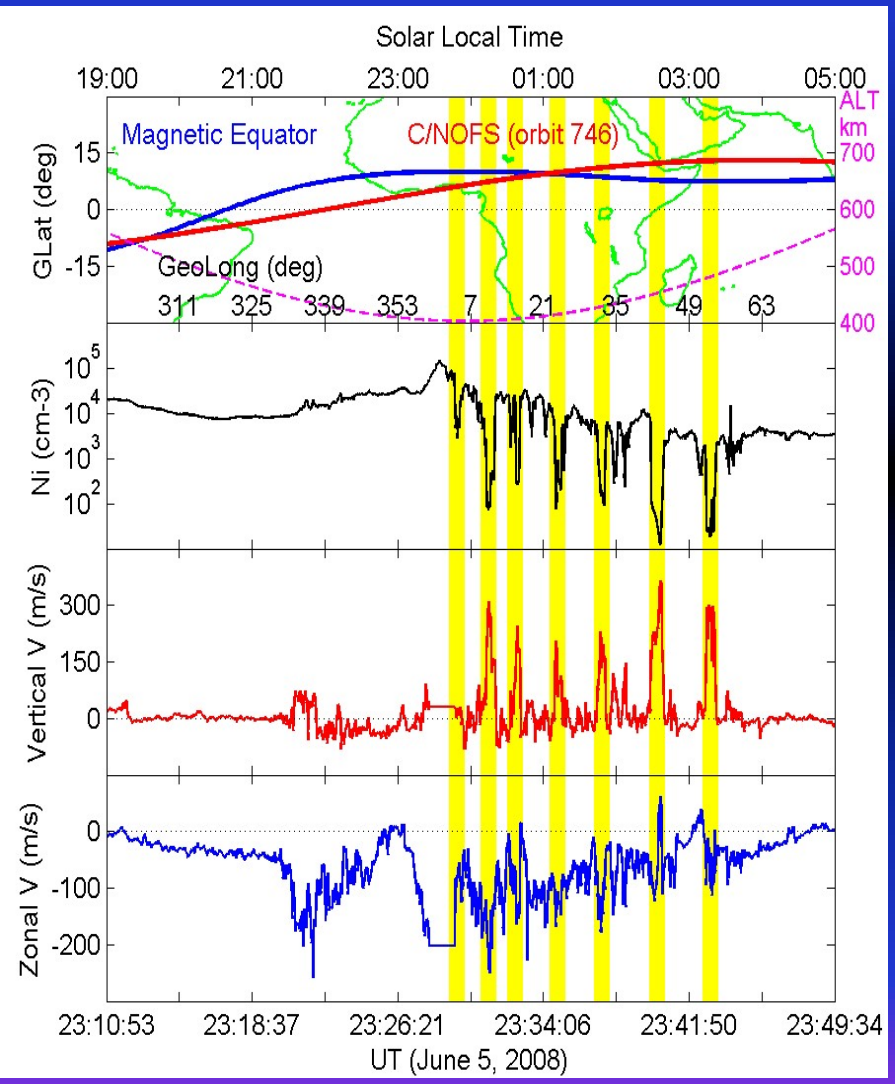
- Satellite observations exhibit unique bubble characteristics
- Bubble envelope frequently shows very large deep and wider longitudinal extent in the African sector compared to other longitude sectors?
- That is why we need ground-based instruments in Africa to understand the physics behind this unique structures

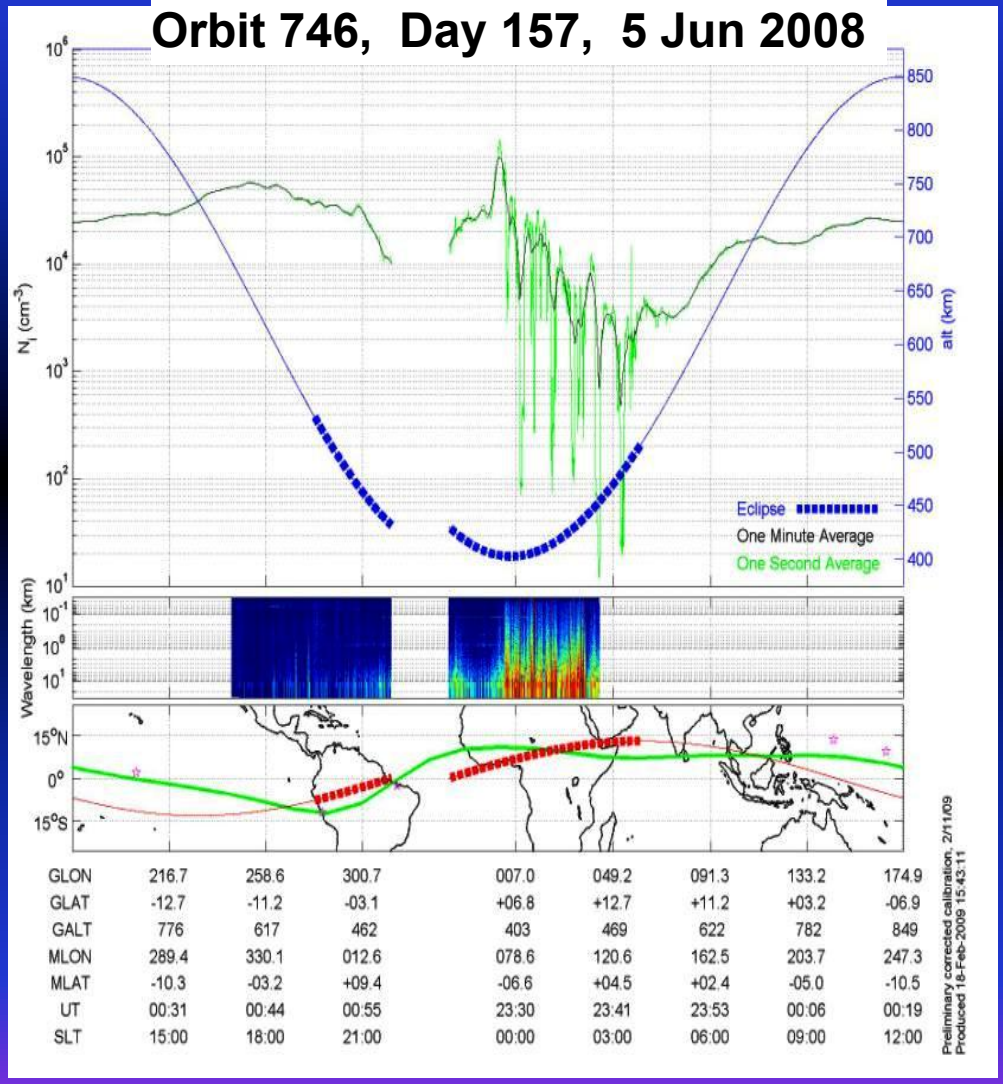
Hei et al., 2005



Why in Africa? (C/NOFS Obsr.)

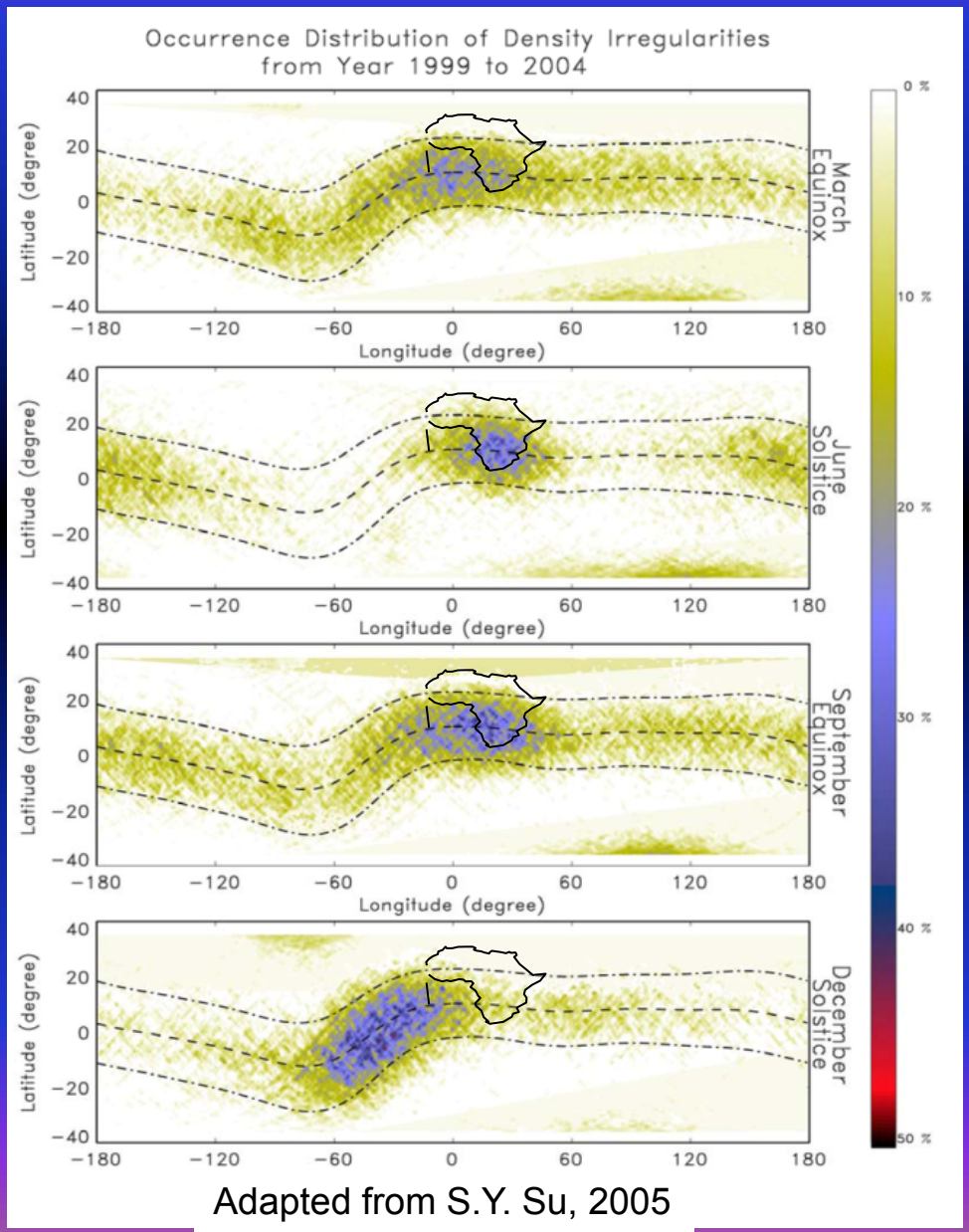
Equidistant Equatorial Plasma Bubbles (C/NOFS)



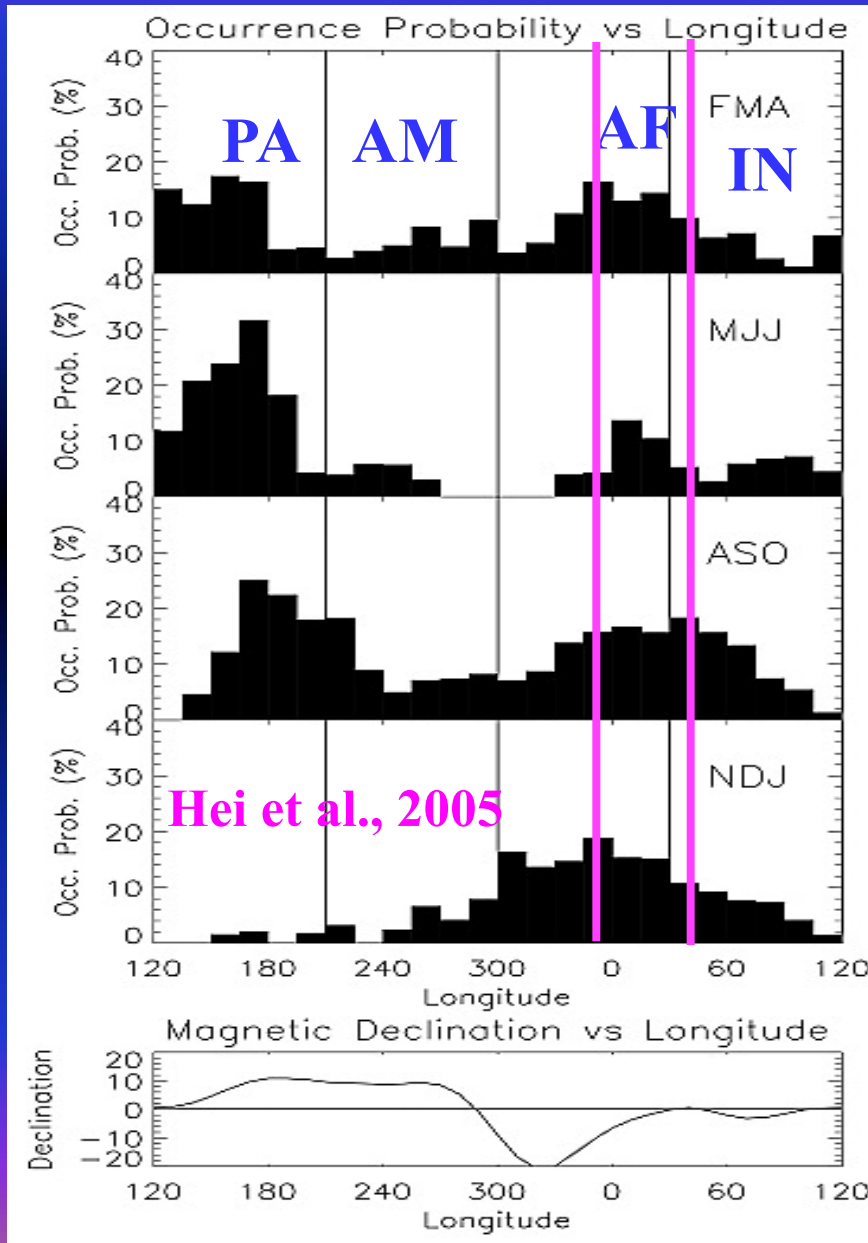


Courtesy of Odile

Why in Africa? (ROCSAT & AEE Obsr.)



Adapted from S.Y. Su, 2005



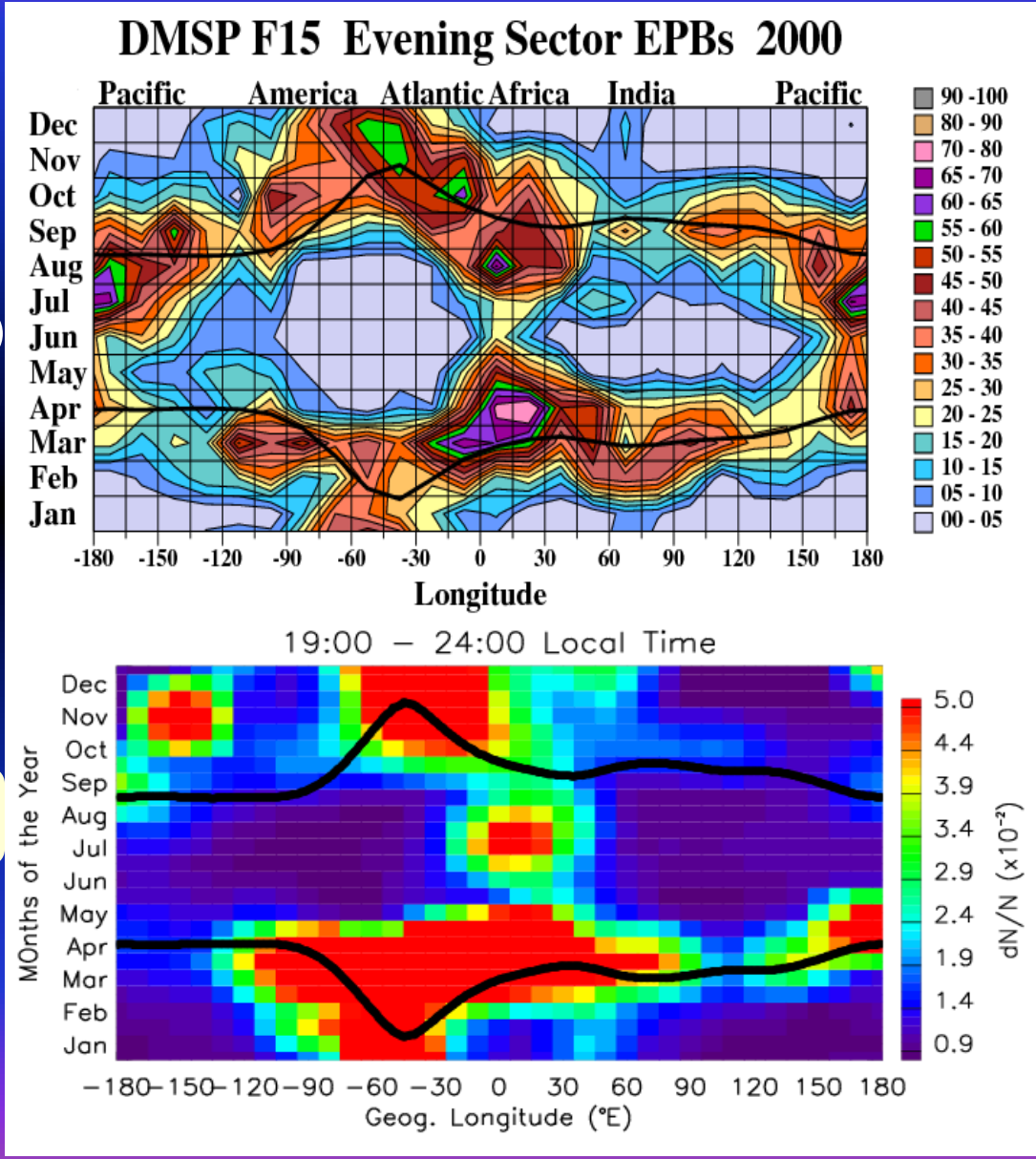
Why in Africa? (DMSP Obsr.)

DMSP Observations:

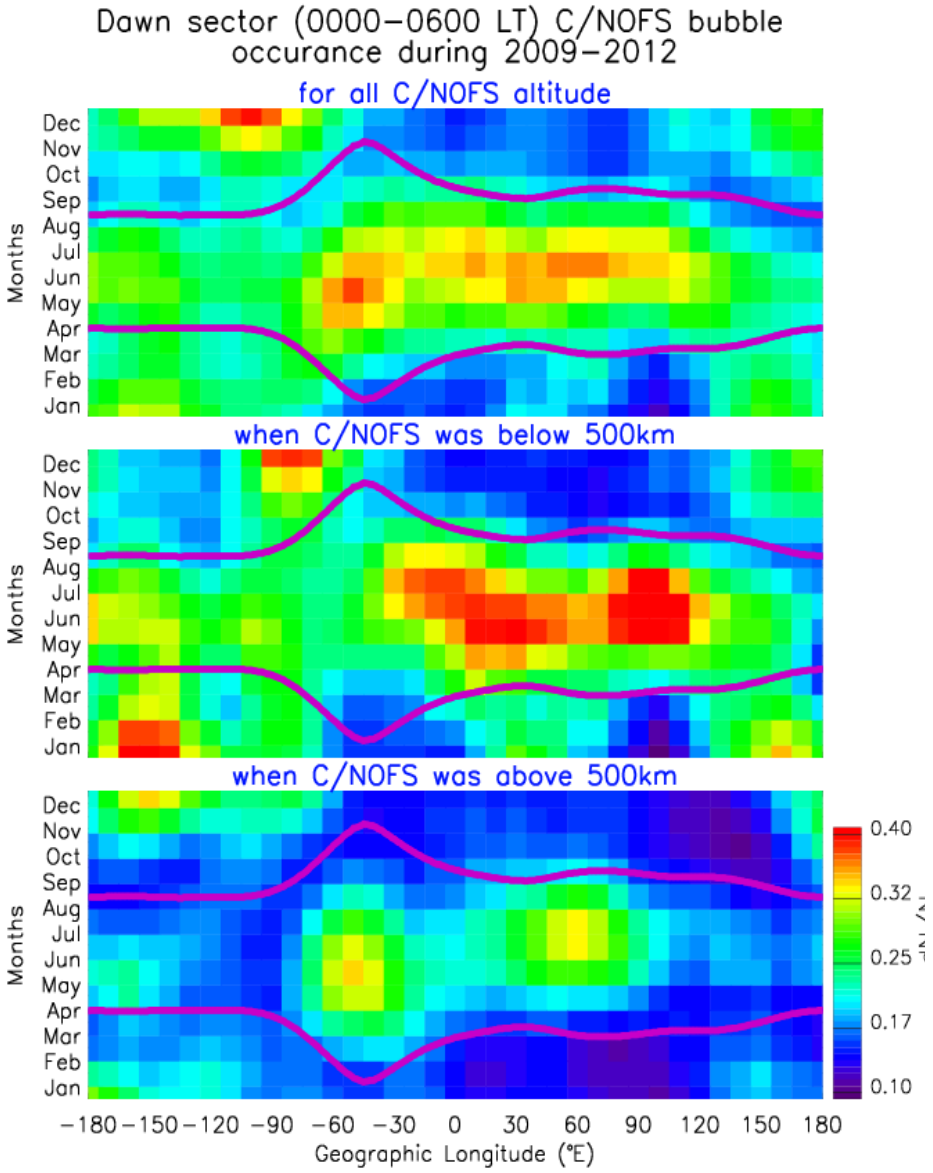
Gentile et al., 2011

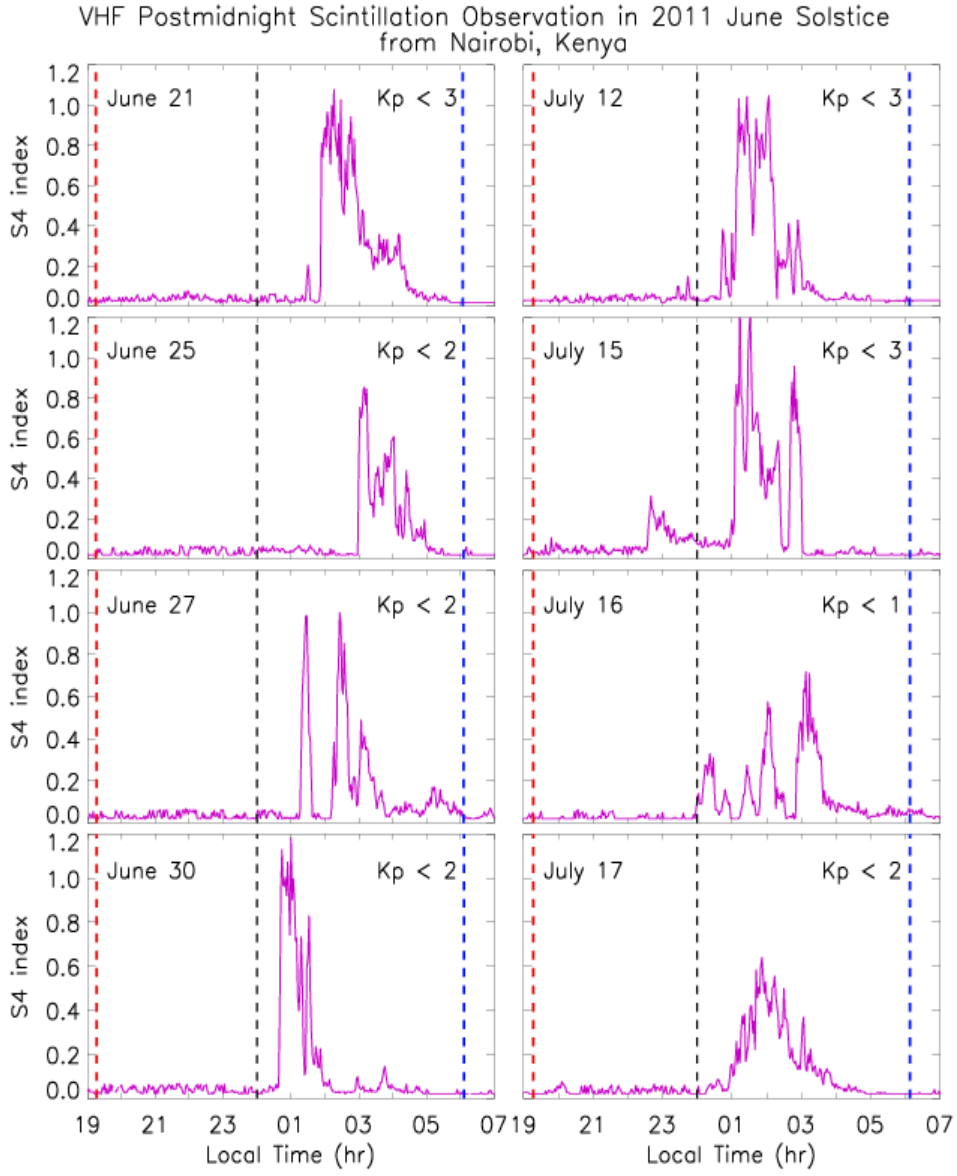
In Africa (Long ~ -20° to 52°) dusk sector irregularities are active almost all seasons during solar max.

C/NOFS Observations



Is African sector behave nicely even during quiet time post-midnight local time?





Questions that need to be answered by AMISR

- Why are ionospheric irregularities in Africa unique? More frequent, large scale bubble properties (zonal width, depletion level, and spacing)?
- Why depleted plasma regions (or bubbles) penetrate to higher altitudes in the African sector? .
- Why is the ESF phenomenon much deeper and more active throughout the year in the African region as compared to other longitude sectors?
- Why a very intense and widely separated equatorial ionospheric anomaly (EIA) often observed in the African sector?
- What is the role of the neutral atmosphere, including winds, tides and waves, in creating the unique equatorial electrodynamics of the African ionosphere?

Anticipated potential new science that was not possible with Jicamarca

- What does the E-region density profile look like? How severe it is for the navigation communication systems?
- What does the E-region wind profile look like and what is its contribution for the equatorial density irregularities, bubbles, and spread F region?
- Does the bubbles extended outside the EEJ region, what does its vertical structure looks like? Does it have identical feature as the one at the equator?
- What is the role of the E-region winds, atmospheric tides and waves at off the equator, in creating the unique equatorial electrodynamics of the African ionosphere?

AMISR in Africa Societal Benefits

- Placing the AMISR in Africa will attract scientists worldwide and rapidly position Africa at the top of global ionospheric research, creating strong international collaborations, recognition and opportunities for the African Space Science Community
- AMISR in Africa has also direct impact in advancing space science research into Africa by establishing and furthering sustainable research/training infrastructure within Africa so that more young scientists will be educated in their own country.
- It will also play a vital role in the future socioeconomic development of Africa.
- It will spark interest into the young African generation and encourage them to do science and technology, which is the back bone for the economic development of any country.

Why Ethiopia is chosen as home for AMISR in Africa?

- **Its geographic location:** Bahir Dar is located approximately the same geomagnetic latitude as Jicamarca but the two locations has different excursions between the geomagnetic and geographic equator. Thus, placing AMISR in Bahir Dar will provide great opportunities to the scientific community for new science investigations.
- **Operational sustainability:** Operating AMISR sustainably requires well trained local personnel, and Bahir Dar University has already ISR specialized scientist (Dr Baylie Damtie).
- **Space Science research activity:** Bahir Dar University is also one of the two universities, next to Addis Ababa University, in the country that has space science research and education activities.
- **More importantly AMISR in African is not only Ethiopian but it is for the entire world and are welcome to take part.**

Where are we right now?

- Identify a scientifically compelling location. (Done)
- Convene a workshop or other venue for soliciting broad community input. (Done)
- Prepare a document describing the scientific rationale for the location. (Done)
- Prepare proposals for different funding agencies. (MRI proposal submitted to NSF on 02/21/13)
- Conduct a site survey to investigate logistical aspects. (Done last November, with team includes NSF's AGS director)
- Work with NSF throughout, particularly with regard to funding strategies and partnering opportunities. (on going task)

AMISR in Africa Workshop

Boston College, 1-3 March 2012

Objective: The prime objective of the workshop is to discuss and identify the scientific and societal benefits of developing a new international upper atmospheric facility, Advanced Modular Incoherent Scatter Radar (AMISR), in Ethiopia.

ORGANIZERS

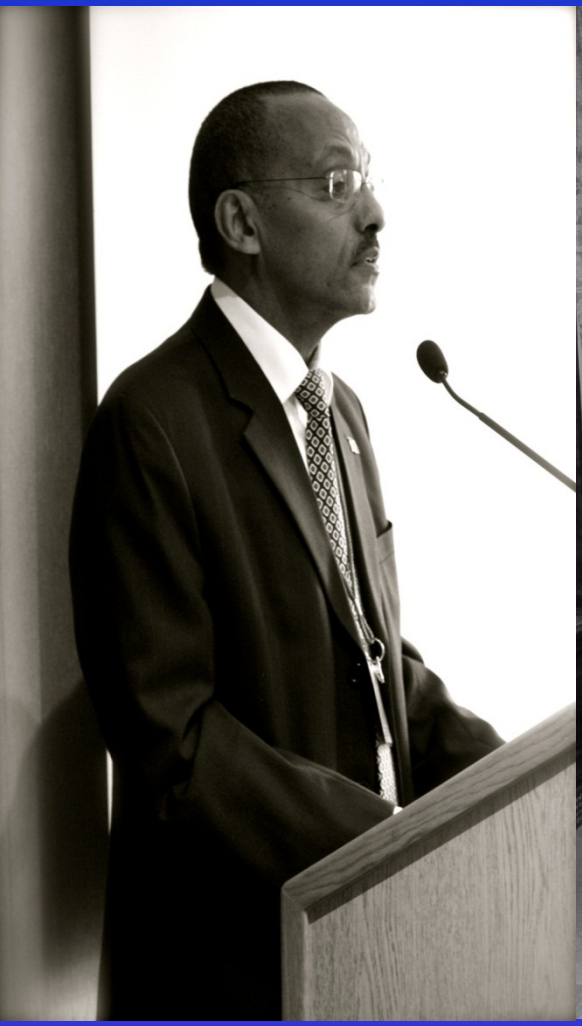
Endawoke Yizengaw, Boston College
Anthea Coster, Massachusetts Inst. of Technology
Mark Moldwin, University of Michigan

SPONSORS

National Science Foundation

Boston College

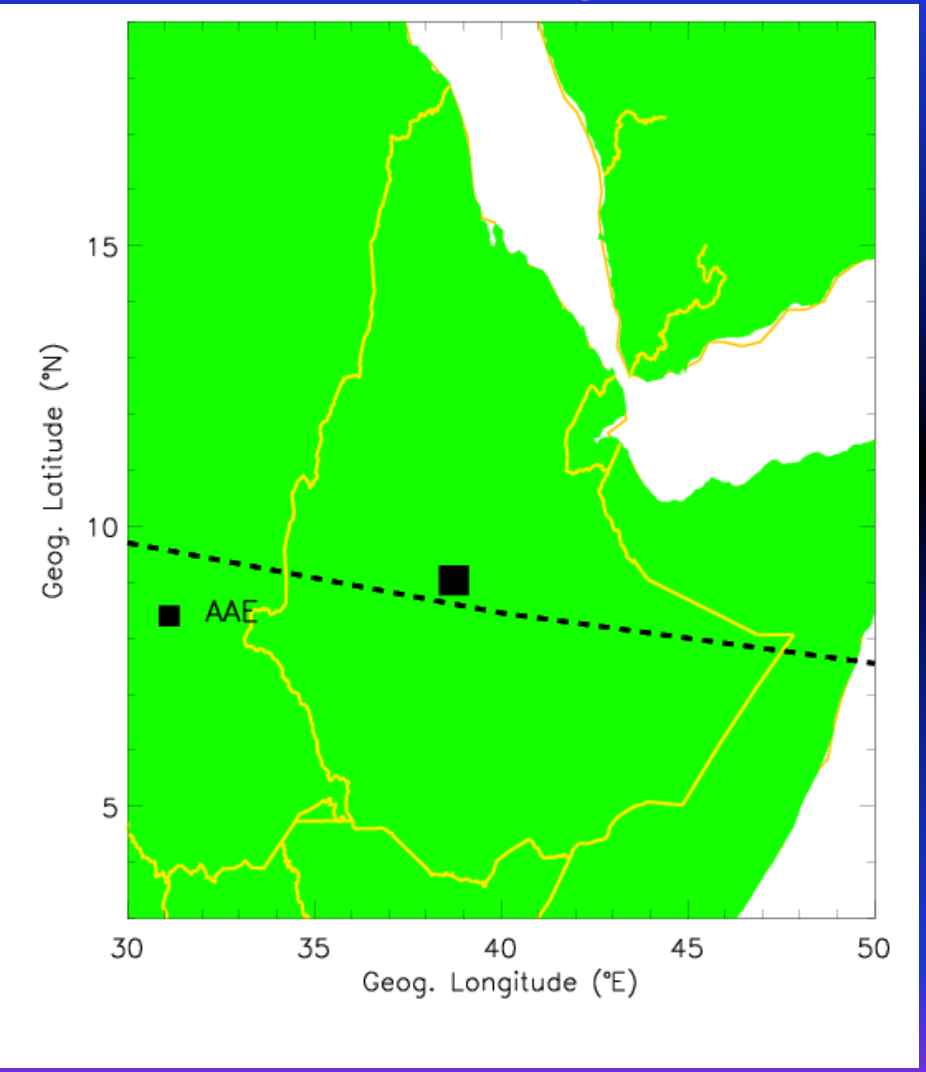
Workshop Participants



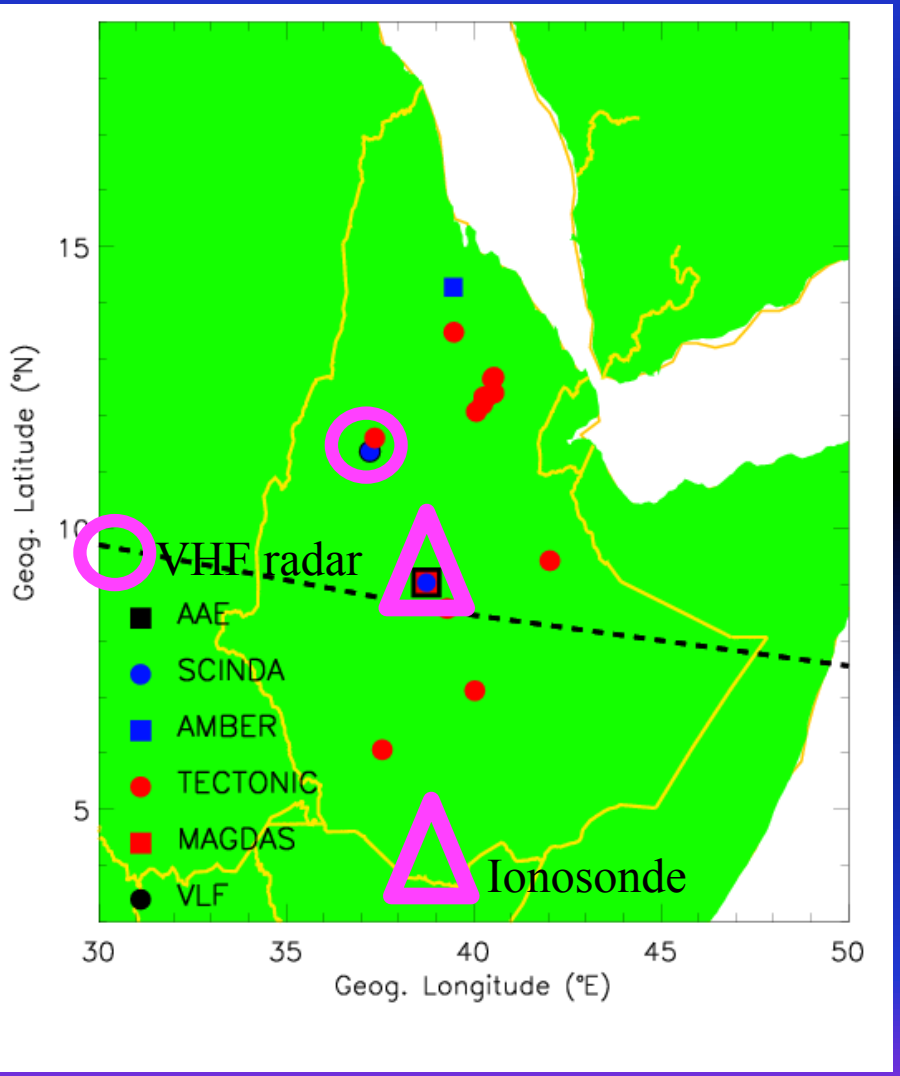
More information, including all slides presented at the workshop can be found http://www.bc.edu/sites/amisr

Instrumentation in Ethiopia

Six Years ago



At Present



Last week we heard from AFOSR that two FPI instruments get funded.

Research Facilities in Ethiopia

Washera Geospace and Radar Science Laboratory at Bahir Dar University

Washera Geospace and Radar Science Laboratory

- Radar waveform design
- Inverse problems (tomography, decoding)
- East African region ionosphere specification

Oulu University
Boston College
AFRL
ICTP
World Bank

Unexpected results from Norwegian government scholarship program

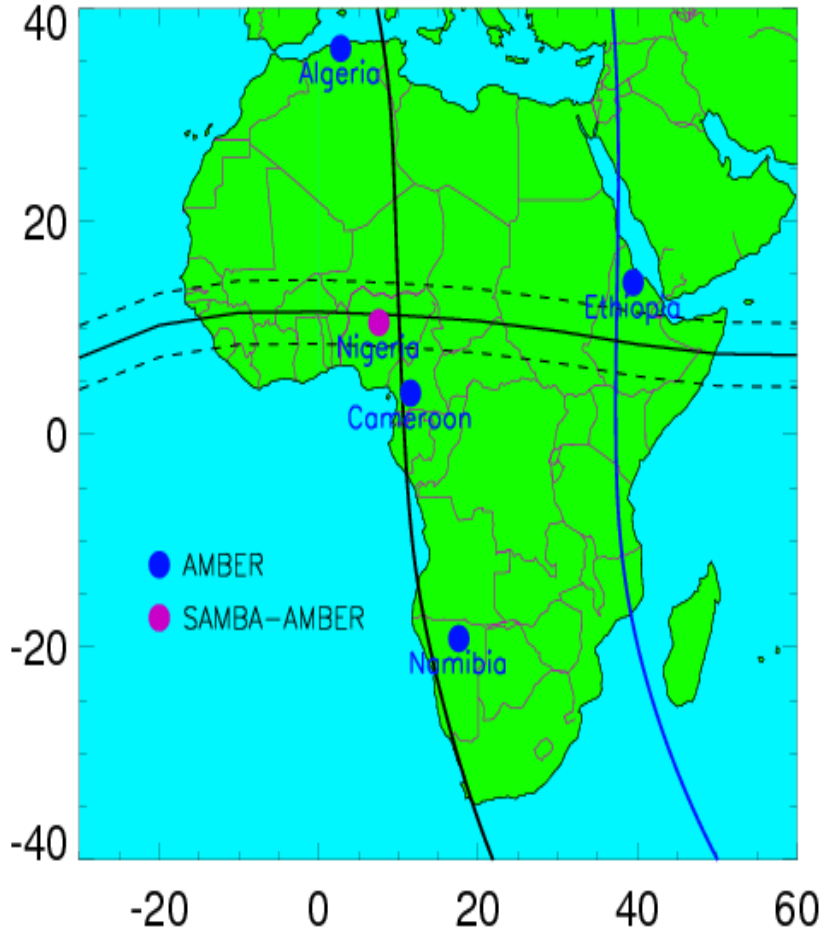
- ~10 PhD's (of these 3 PhD in Space Science)
- 30 MSc or more
- Brings Space science culture to Ethiopia
- Brings Instrumentation
- Space Science program (now ~6 PhD and ~15 MSc or more graduate students at BDU and AAU)
- Produced Global citizenship

- The question is, if few scholarships by the Norwegian tax payers can bring such results, what will an AMISR at Bahir Dar does for Ethiopia, Africa, and the world?

Not sure for the copy right issue?

From the name of small village to the name of science project, and now become the name of Beer company!

Join AMBER team for possible free AMBER beer!



2005

2012

Conclusion

If you convince yourself that you can do it, anything is possible, just keep moving forward!!!!

Thank You