Establishing Advanced Modular Incoherent Scatter Radar, Ethiopia

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Outline of the presentation

1. Background information on Ethiopia
2. Bahir Dar University in brief
3. Space science and astronomy education in Ethiopia
4. Space Physics and related research at BDU
5. What we can offer for the success of AMISR project
6. Why we support AMISR project
7. Wish to know when?
8. Conclusions
Background information on Ethiopia
Higher education in Ethiopia

- In 1991 we had two universities (AAU and HU)
- The annual intake of these two universities 3212 students
- 21 years on, we have 31 universities with annual intake of 90,000 students intake
- In total we have about 185,000 students in universities now
Background information on Ethiopia
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Bahir Dar University in brief

Wisdom at the source of the Blue Nile
Bahir Dar University (federation of Colleges)

- 40,000 students
- 3,000 staff
- Largest investor in and employer in Bahir Dar
Bahir Dar University (ICT infrastructure)

Contract Agreement
Between
Information Network Security Agency
And
Bahir Dar University
Bahir Dar University (ICT infrastructure)
Some of BDU’s experience in partnership

- BDU and KTH (Royal Institute of Technology)
  - Sweden (Sweden sponsored lab instruments and logistics like cars (7 million dollars))
  - BDU built whole new campus (buildings, internal road network staff, 60 million dollars), http://ila.edu.et/

- BDU and Cornell University
  - First program of Cornell to be delivered in African soil

CHRONICLE ONLINE
Sept. 12, 2007
CU to offer its first degree program in Africa, with faculty traveling to Ethiopia to teach water management course
By Krishna Ramanujan
In its self-described role as the land-grant university to the world, Cornell has taken a major step in exporting its expertise to African countries, a high priority for Cornell President David Skorton. It is about to offer its first degree program in Africa.

Cornell has signed a memorandum of understanding with Bahir Dar University in Ethiopia to offer its Master of Professional Studies (MPS) degree in international agriculture and rural development, to be taught by Cornell faculty who will travel to Ethiopia.

It will be one of a few Cornell degree programs requiring no period of residence at a Cornell campus.

Five PhD students
At Cornell
New PhD at BDU
MSc run by BDU
http://www.bdu.edu.et/bnwi/
Some of BDU’s experience in partnership

• BDU and Arizona University
  – USAID gave a seed money of 200K to create center of excellence in disaster prevention and risk management at BDU
  – BDU built whole infrastructure and employed staff
  – A unique program established and now fully run by BDU

• BDU and YCF (US company)
  – To create center of excellence in Maritime training (engineers for commercial ships), http://www.emtibdu.edu.et/
  – To employ 4000 Ethiopians a year
  – 44 Ethiopians got employed
  – 91 Ethiopians start working in April
Some of BDU’s experience in partnership

• BDU and YCF (US company)
  – YCF provide staff, lab instruments and employment
  – BDU building the whole infrastructure and staff including capacity building
  – Brought a new sprit
Space science and Astronomy education in Ethiopia

- Addis Ababa University Geophysical Observatory
- Astronomy courses at AAU and public awareness by radio (Dr. Legesse)
- Establishment of Ethiopian Space Science Society (ESSS)
- Space Physics courses at AAU (Esayas, Gizaw and Baylie)
- Space Physics courses at BDU
- Nearly all Universities have started offering elective courses in space and astronomy
- AAU and BDU PhD studies in space physics
- Critical mass of human resource built
Space science and Astronomy in Ethiopia

- ESSS built the Entoto Astronomical Observatory, excellent achievement
- Ethiopia government delegation visited South Africa to share experience
- Roadmap for the future development of Space Science and Astronomy education and research discussed with relevant Ministers
- ESSS together with other stakeholders are preparing the final version of the roadmap for government approval
Instrumentation in Ethiopia

Three Years ago
Now

Map produced by
Endawoke Yizengaw
Space Physics and related research at BDU (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
East African region ionosphere specification (results from receivers at Bahir Dar)

Melsew Negussie (my PhD student)
East African region ionosphere specification (imaging)
Digisonde in Addis, Ethiopia
East African region ionosphere specification (response to storm)

Moges (my MSc student)
Radar waveform design

\[
\langle z^q(t) z^q(t') \rangle = \int \int \langle \mu_q(dr) \mu_q(dr') \rangle \varepsilon^q(t-r) \varepsilon^q(t'-r') + T \delta(t-t') \\
= \int X(r) \varepsilon^q(t-r) \varepsilon^q(t'-r) dr + T \delta(t-t') \\
= \int A_{tt'} X(r) dr + T \delta(t-t'),
\]
Radar waveform design

\[ \mathbf{m} = \mathbf{W}\sigma + \varepsilon, \quad \langle \varepsilon \varepsilon^T \rangle = \Sigma. \]

Here \( \mathbf{m} = \begin{bmatrix} m_1 \\ m_2 \\ \vdots \\ m_N \end{bmatrix}, \quad \sigma = \begin{bmatrix} \sigma_1 \\ \sigma_2 \\ \vdots \\ \sigma_N \end{bmatrix}, \quad \varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_N \end{bmatrix}, \]

\[ \mathbf{W} = \begin{bmatrix} W^1_{ij} & 0 & \ldots & 0 \\ W^2_{ij} & W^1_{ij} & \ldots & \vdots \\ \vdots & \vdots & \ddots & \vdots \\ W^L_{ij} & \vdots & \ldots & W^1_{ij} \\ 0 & W^L_{ij} & \ldots & W^2_{ij} \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \ldots & W^L_{ij} \end{bmatrix}. \]
Possible site for AMISR (the weather radar system project, Bahir Dar)

NOAA Doppler radar from wikimedia
What we can offer for the success of AMISR project

• Tax to import AMISR systems shall be covered by BDU
• Land shall be provided for free
• Utilities (water, power, internet) shall be provided (depending on the location)
• Security
• All necessary logistical support
• Technical maintenance (after building capacity)
Reflections on why we support AMISR project

- Key facility to support education and research in space science
- Springboard to space related technology development in Ethiopia (electronics, software development, data analysis method)
- Crucial facility to understand the physics of the African region equatorial ionosphere
- Its contribution for the development of research universities in Ethiopia
- Big potential to link Ethiopian students and scientists to students and scientists around the world
Unexpected results from AMISR project

- At least 10 PhD
- 30 MSc
- Space science culture
- Instrumentation
- Space Science program
- Global citizen

If few scholarships by the Norwegian tax payers can bring such results, I feel excited on what AMISR at Bahir Dar can do to us and the world!!
Wish to know when?

- Work package one (WP1), get the project document complete
- Work package two (WP2), secure funding for the project
- Work package three (WP3), identify the AMISR site and the associated facilities needed
- Work package four (WP4), assemble the AMISR system and make it ready for shipment
- Work package five (WP5), make the site ready including the necessary buildings
- Work package six (WP6), Transport, installation and testing
- Work package seven (WP7), CELEBRATION (DRINKING BEER)
I wish all of us to meet in Bahir Dar to celebrate AMISR!!

thanks