Nano-Satellites as Energy Efficiency Facilitators in Africa

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Outline

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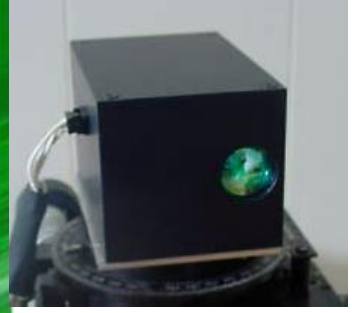
Introduction

- Global energy landscape
  - African energy landscape
    - Slow evolving technological solutions
      - Mostly consumer based economies
    - Inefficient use of available resources
      - Financial, technological and natural

- Small satellites
  - Include **Mini-** (100kg-500kg), **Micro-** (10kg-100kg), **Nano-** (1kg-10kg) and **Pico-** (0.1kg-1kg) satellites
    - Nano-satellites
      - CubeSats
        - » 1 unit (1U) is 10cm X 10cm X 10cm large
        - » A unit is about 1kg heavy
        - » Average development time is 2 years
        - » Relatively ***cheap*** and ***versatile***
        - » Achievable within academic ***platforms*** and ***budgets***

The concept

- Combining earth and space based sensors
- Monitoring of renewable energy sources (sun, wind, water currents etc.)
- Data from the mission can be used to:
  - Identify possible sites where various renewable energy power sites can be built
  - Determine the effects of climate change on the availability of energy from these natural resources
  - Facilitate the establishment of an energy grid and to manage such a grid efficiently



Example instrument: Argus 1000 spectrometer

- About 230g
- 45mm X 50mm X 80mm
- At about 600km orbit, it can detect IR (1523nm) over about 1.57km surface tile length
- Using IR absorption, it can detect H2O, CO2, CO, CH4, HF, and O2 in the atmosphere.

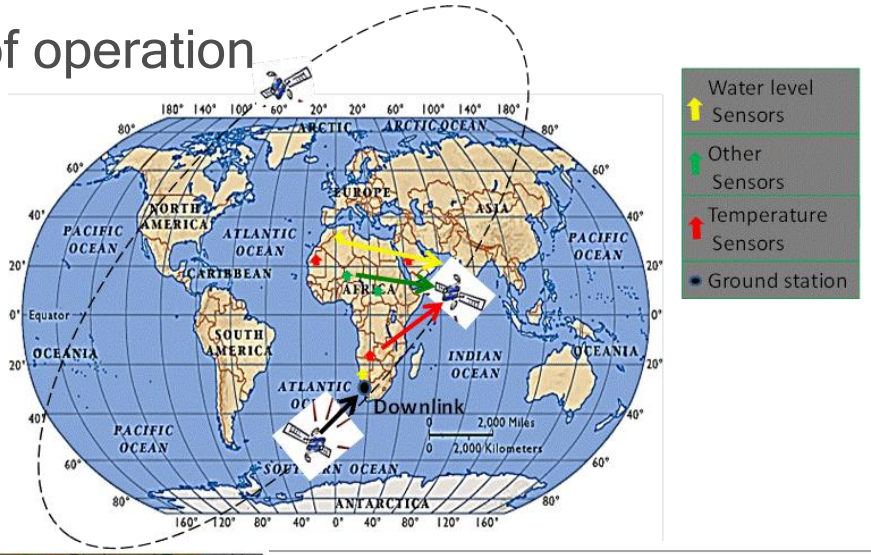
(Thot technology Inc., 2010)

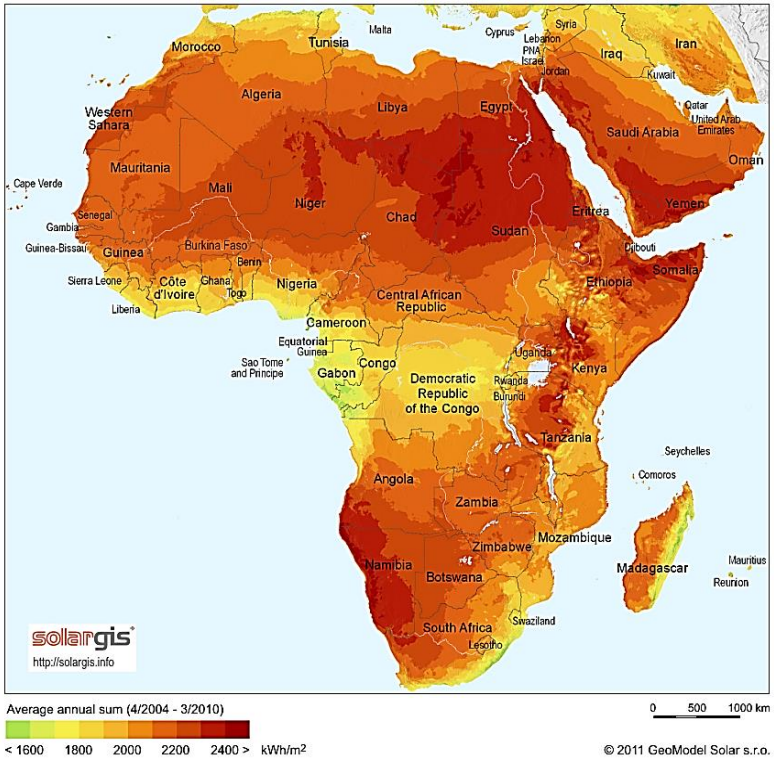
Some African resources

- 1.1 GW of hydropower capacity
- 9000 MW of geothermal potential (about 60MW tapped)
- Abundant biomass, and significant wind potential
- Up to 9KWh/sq.m/day DNI solar capacity in certain areas

(Karekezi and Kithyoma , 2003)

Mission concept of operation





(Solargis, 2013)

Region	Satellite Mission	Nominal Position	Processed Data Period	Max. Resolution	
				Temporal	Spatial (on Equator)
PRIME	MSG Meteosat Second Generation	0°	2005 to present	15-minute	app. 3 km
	MFG Meteosat First Generation	0°	1994 to 2004	30-minute	app. 3 km
IODC	MFG Meteosat First Generation	63°E	1999 to present	30-minute	app. 3 km
GOES-EAST	GOES Geostationary Operational Environmental Satellites	75°W	1999 to present	30-minute to 3 hourly	app. 3 km
PACIFIC	MTSAT Multi-Functional Transport Satellite	145°E	2007 to present	30-minute	app. 3 km

Strengths and weaknesses

- We know how to design space missions
  - 2011 MIC semi-finalists

- We know how to make money from space mission design
  - 2012 MIC business category winners

- We know how to design and build CubeSats
  - ZACUBE1 and ZACUBE2

- Unfortunately, in Africa the space industry is still very young and very few African countries are involved

Conclusion

Although this work is not directly related to energy renewing and/or converting, it shows that nano-satellites are an ***affordable*** and ***very important*** tool for energy management in Africa. In fact, they have the potential to offer a new model in energy management. Such a model would benefit the continent and the world, given the current global energy crisis.

Thanks for your attention

Related bibliography will be made available on request

Questions?