

# The Search for an Astronomical Site in Kenya

## Brief By

1. Paul Baki- Technical University of Kenya
2. Richard Vaughn- INCA
3. Bitange Ndemo- University of Nairobi
4. Dr. Hashim Nadir, Kenyatta University

## Rationale for the project

Kenya is currently running bachelors programmes in Astronomy and Astrophysics (University of Nairobi) and Masters and Ph.D programmes (Kenyatta University, Technical University of Kenya and University of Nairobi). However, a number of challenges have since been identified namely: inadequate human resource and lack of infrastructure for observational astronomy and astrophysics. The human resource challenge is being addressed through the Square Kilometre Array bursary programme (so far 16 Kenyans sponsored), where they study in South African universities and use South African based infrastructure, the Development in Africa with Radio Astronomy (DARA) programme spearheaded by the University of Leeds, whereby they study in UK universities and use based infrastructure, and lastly training in local universities. Thus, there is currently no Astronomical Observatory, both Radio and Optical Astronomical Observatory to support local training, which has remained largely theoretical.

This state of affairs has occasioned some brain drain, especially as a good number of foreign trained astronomers do not return to the country. However, Kenya hosts some of the best sites for astronomical research on the African continent that are comparable to some of the best sites in the world, especially due to its location on the equator and presence of dark skies. In fact,

- There are several sites within easy reach of motorised vehicles at an altitude of 2,000 metres or more. High altitude affords less atmospheric interference in the observation of the skies.
- Whilst being fairly accessible, such sites are nonetheless far from urban or industrial development. There is thus very little pollution of the sky either by light or effluent.
- Kenya straddles the equator. This affords equal access to both the northern and southern celestial hemispheres, a very rare attribute.

- By the same token, Kenya occupies a longitudinal area that has very few other telescopes in the world. When a Kenyan telescope operates in tandem with observatories in India and the Canary Islands, this confers a huge advantage for researchers who need to monitor astronomical events continuously as the earth rotates.
- At the best sites, the local microclimate allows clear skies for most of the year.

Since 2005, a local working party has managed to attract serious interest – and funding – from National Commission for Science, Technology and Innovation (NACOSTI- Kenya), National Research Foundation (South Africa) and much more recently The Science and Technology Facilities Council (UK). The funding has so far enabled the identification of potential sites for establishment of an optical observatory to the north west of Kenya i.e Samburu and Marsabit counties. At this stage, it is envisaged that a principal telescope with a mirror diameter of 1.4 metres would be sufficient. Observatories of this class generally cost \$1.5 million - \$4 million, depending upon the amount of peripheral infrastructure that has to be established. Such a telescope in Kenya would be the only research-class observatory in the region, providing a focus of interest for the entire continent.

### Justification

The establishment of an Optical Astronomical Observatory , would enable Kenya leverage this project to accomplish the following:

1. **Technology development**- in the area of optical engineering and related technologies
2. **Capacity Building**- in terms of research, training and outreach
3. **Technology transfer**- by working with international partners as possible stakeholders in the construction and running of the facility
4. **International cooperation** – to leverage resources and expertise currently not available in Kenya at the moment.

and also address the issues related to:

- **Brain drain:** The establishment of an observatory would help to reverse the brain drain in this area, bringing in professionals in this discipline from around the world.
- **Economic Uplift:** The sites that have been shortlisted are in economically neglected parts of the country. The construction and maintenance of an observatory would provide some measure of local employment.
- **Tourism:** Once a site is established, one telescope tends to attract others. Several institutions in South Africa and the United States have turned their observatory sites

into significant tourist attractions. For Kenya, this would represent a major diversification in its tourism product.

- **Promotion of STEM:** The skills needed to build and operate astronomical instruments can be readily applied to other areas.
- **Outreach:** The observatory will be used within a broader outreach programme to attract young people into science and engineering. A model for this is the National Schools Observatory (NSO) in the UK, who provide educational materials for schools to a telescope similar to that envisaged for Kenya. The NSO are interested in partnering with Kenyan groups.

### What has been done so far?

Under a grant that was given jointly by NACOSTI in Kenya and the National Research Foundation (NRF) in South Africa, a detailed analysis (see **Dr Edward Graham et al.** was published in March 2015, in *Theoretical and Applied Climatology* ) describing in detail how the shortlist was arrived at, and the techniques that were used of satellite data has provided a shortlist of three mountaintop sites that have the potential to host world class observatories. Of these, two – Mount Kulal and Ol Donyo Nyiro - are off the southern shore of Lake Turkana, with a third - Ololokwe - to the south of Samburu. What remains to be done is to instal ground-based instrumentation at each of these sites to establish which is the most suitable.

A subsequent grant from the Global Challenges Research Fund (GCRF) in the UK has enabled the organisation of three conferences to bring together interested parties. Two have already taken place, one in Edinburgh, UK, and another in Cape Town, South Africa. The third and largest is scheduled to take place in Nairobi from 4<sup>th</sup>-8<sup>th</sup> February 2019. It involves a field trip to the three shortlisted sites so that precise co-ordinates for ground-based instruments can be established.

It has also been suggested that three or four much smaller 'outreach' observatories be established at the premises of Kenyan universities that have active departments in related areas. The cost of each would be a small fraction of that for the main observatory, but would enable students to understand the fundamentals of operation at sites accessible from their campuses.

### Who is involved?

#### *Within Kenya*

The details of institutions and individuals involved are as follows:

Technical University of Kenya – Prof. Paul Baki

Kenyatta University - Dr. Hashim Nadir/Dr. Naftali Kimani

University of Nairobi- Prof. Bitange Ndemo

INCA Africa- Richard Vaughn

NACOSTI- Provided Initial 50% of the initial funding for the project.

### *South Africa*

The National Research Council provided 50% of the funding needed to undertake the initial satellite research, and they have participated actively in the conferences made possible by the GCRF grant. The South African interest has been led by Dr David Buckley, from the South African Astronomical Observatory.

### *United Kingdom*

The Global Challenges Research Fund monies have been channeled through the Science and Technology Facilities Council. Under the leadership of Dr Martyn Wells, they have provided both technical and community outreach expertise that has been gathered in other parts of the world.

The bulk of the atmospheric analysis has been undertaken by Dr Edward Graham, a meteorologist currently based at the University of the Highlands and Islands in Scotland. He has been involved in the siting of several major astronomical observatories around the world.

### **What do we need now?**

The current grant funding from the UK expires at the end of March 2019. By then, we should have ground-based instruments feeding weather data to researchers on the project that will enable us to finalise a site within the next two years.

We need Kenyan Government involvement in the form of official endorsement and funding for the smaller outreach telescopes while this data is being gathered, as well as support for the continuing operation of the local working party. At the same time, we shall be seeking international funding for the construction of the main telescope itself.