

Africa – The future space-faring continent Opportunities for African-European cooperation

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Africa is no blind spot on the map of space-faring continents. To cast more light on the conditions for space applications in this emerging space continent and to reveal the points of reference for European actors, this paper presents Africa's social and geographic environment as well as its space-related demand. The findings allow only one statement: Africa needs and is capable of space applications. There is hardly any continent that is more "made for space applications" than Africa. European actors should pool European industry in order to cooperate with African countries and European space agencies should surge ahead and enter into a one-to-one or one-to-x partnership with African space organisations. ESA could assist in the foundation of an African space programme and space organisation

The setting

Space assets have become a precious and useful tools for an increasing number of countries. At the same time, these assets impose a new vulnerability to a nation's economy or security. These two statements are self-evident for many industrial nations and also for the emerging markets of several Asian and South American countries. For a long time, Africa was invisible on the landscape of space-faring countries – the view of many European countries – and this was valid for decades. But today, there are six African-owned satellites¹ orbiting the earth. The latest launch (2007) of a Nigerian communication satellite, built by China, from a Chinese launch site, received much attention. Nigeria is by far the most densely populated country in Africa.

Slowly the eyes of the space-faring nations are turning towards the continent inhabited by about 944 million people². The European Union as the closest geographical neighbour has pointed the way to closer cooperation with Africa in various fields: The African Summit 2005 and the EU-Africa Summit in Lisbon,

2007, opened not only eyes but also minds and doors on both sides. An event preceding the summit was the conference "Space for Development: The case of GMES and Africa" organised by the Portuguese EU Presidency, the JRC and ESA. With this event, the Portuguese Presidency launched a two-year process leading to an Action Plan on a "GMES and Africa" partnership. Europe obviously has committed itself to a close cooperation in the domain of space with Africa and African countries.

A general joint strategy endorsed at the summit by Africa and the EU is described in the 2007 document "The Africa-EU Strategic Partnership"³ and in the Lisbon Declaration on the African-EU summit⁴. The African-EU partnership has shifted from a beneficiary one to a relationship of equal partners. Looking at cooperation in the domain of space, Africa could become a partner in many fields: satellite communication, satellite navigation, environmental monitoring and, last but not least, space security.

¹ One EOSat 2 ComSats for Egypt, 1 EOSat and 1 ComSat for Nigeria, 1 EOSat for Algeria.

² Equals ca. 14% of the world population (2007)
http://www.prb.org/pdf07/07WPDS_Eng.pdf

³ http://www.eu2007.pt/NR/rdonlyres/D449546C-BF42-4CB3-B566-407591845C43/0/071206sapenlogos_formulado.pdf

⁴ http://www.eu2007.pt/NR/rdonlyres/BAC34848-05CC-45E9-8F1D-8E2663079609/0/20071208_LISBONDeclaration_EN.pdf

Sparsely and densely populated at the same time with a “young people” population pyramid, the need for tele-education and primary commodities earmark space applications.

All the same, many question and possible doubts appear in the mind of those in Europe who have the capabilities, the far reaching perspective and the openness for any kind of cooperation with Africa or for direct investments in Africa. But: Where there are chances, there are also risks and fences and bars on the way to seizing the chances.

To thin out the thicket of incoherent information about the topic “Africa and space” and to cast more light on the realities of current and potential space-faring African nations, this issue of “ESPI Perspectives” will point out in brief the state of affairs and the conditions for “Africa and space” as well as potential user needs and the chances and obstacles to an African-European cooperation in the space domain: Because Africa is on the verge of becoming a space-faring continent with ambitions for space utilisation.

The African economic, social and geographic environment – A call for space applications

Before considering Africa as being on the verge of becoming a space-faring continent, one should spend more than one wink in analysing the natural, cultural and economic environment of the continent as a whole. These elements are linked to the potential of Africa’s space-faring activities and socio-economic needs.

At first glance, the African continent appears compact in form, almost uniformly. As form is not content – Africa is a diversely structured continent in terms of the natural, social, and economic environment. 53 countries including Madagascar – plus eight dependant islands⁵ - share a continent that is three times the size of Europe and covers around 20% of the earth’s terrestrial surface area. After Asia, Africa is the most-densely populated continent. The northern-most mountain range, the Atlas Range, is north of the depression of the Sahara desert that separates North Africa from Sahel and Central Africa. South of the Equator, Central Africa’s dense vegetation slowly turns into the Kalahari desert. Because of Africa’s

position almost symmetrically to the Equator, one finds climatic zones in a nearly ideal array.

Often associated with decreasing economic growth, several African states show growth rates that are well above the worldwide average. Mauretania has 19.8%, Angola 17.6% and Mozambique and Malawi both note around 8% annual economic growth⁶. In general, sustainable economic growth is linked to the level of diversification of a state’s economy and, of course, the trade system it is embedded in. Surveys conducted in the last decade have made it clear that economies which traditionally or recently owed much of their growth to primary commodities, especially crude oil, strongly tend to concentrate on the state of their economy instead of investing in the diversification of the market⁷. Those States that are not in the possession of commodities are under much more pressure to diversify their economy. But there are exceptions. Southern Africa, especially the Republic of South Africa (RSA), has the most diversified economies in Africa. In northern Africa, Tunisia clearly shows a horizontal diversification⁸, as well as Mauritius, the island in the Indian Ocean.

The population pyramid for most African countries is a triangle-shaped pyramid: wide at the base and rapidly thinning towards the top: the older the age, the smaller the population. Geographically, the difference in population density is enormous: highly dense in metropolitan area, sparsely populated in rural districts - a status which has inherent social problems that range from maintenance and health care problems to telecommunications and digital gaps in rural areas as well as all social problems related to the population density.

All in all, welfare in many Africa countries is lacking an appropriate level, especially in rural areas. There also is much strain on the African environment due to overpopulation, sporadic high migration rates, climate change and lacking economic development. Space activities in Africa will have enormous impact on everyday life. These will influence water management and crop forecasting, tele-education and rural healthcare, and the financial sector to mention but a few domains where space could lead to substantial benefit

⁶ <http://www.uneca.org/era2007/>

⁷ Angola with its newly exploited crude oil deposits, Nigeria the main oil export nation in Africa.

⁸ Horizontal diversification: A process that occurs when new products not technologically related to current products are introduced to the markets.

for African society. This brief depiction of Africa as a continent should be kept in mind when looking at Africa's space potentials.

Africa's spring time in space and who-is-who in space

The map of Africa is dotted with space centres and regional centres of space and science. Dedicated space centres however are rare. Only Nigeria, Algeria, Egypt, and South Africa⁹ currently have space agencies. Remote-sensing centres are established in many African countries like Libya, Tunisia, Morocco, Ghana, Tunisia, Ethiopia, Mauritius and about 13 more states have centres with links to space sciences.

African EO-Sats and ComSats are operated by a handful of African countries – remote sensing capabilities are however, due to AARSE, abundant.

The earth observation (EO) end-user community e.g. is the most common one of all space disciplines. The African Association of Remote Sensing of the Environment, AARSE¹⁰ has 31 member countries in Africa – a distinct index for African user needs. Together with AARSE, the FAO und UNEP are implementing geospatial, interoperable data standards in Africa that are essential for widely accessible data.

For most of these member countries, satellite data is obtained from sensors not in the ownership of an African country. However, Nigeria, Egypt, Algeria, Morocco have their own EO or communication satellites operating in orbit. Although RSA has by far the most developed space capacity institutions and industry, there is currently¹¹ no country symbol "RSA" on any earth-orbiting satellite – but there soon will be¹² one - and by June 2008¹³, South Africa will have parliamentary approval for the creation of a national space agency (SASA). Turning towards West Africa, the NASRDA (Nigerian National Space Research and Development Agency) has a very ambitious

national space programme¹⁴. It covers the domains of basic science and technology, EO and meteorology, satellite communication and navigation as well as defence and security. Another oil-producing country, Algeria¹⁵, announced in 2007 that it has allocated 900m €¹⁶ for a space programme running from 2006 to 2020. The already orbiting Alsat-1 was a contract work by SSTL¹⁷ for an Algerian EO-Mission. A similar case is found in the land of the pyramids: Egypt has built an EO satellite¹⁸ together with the Ukraine, Egyptsat 1, and its national space authority NARSS¹⁹ is involved in space science and remote sensing. On the commercial side, the Egyptian company Nilesat²⁰ owns and operates two Astrium-made communication satellites.

The telecommunication sector in Africa conforms to the "one-for-all" principle and follows the footsteps of ESA. Africa chose to meet some of its needs for better telecommunications (satellite and terrestrial) capacity with an organisation called RASCOM. A number of 45 countries are members of RASCOM²¹, which is commercially run and whose satellites cover most of Africa. Plans for the coming years involve two Alcatel-manufactured communication satellites dedicated to the whole African continent. RASCOM has a service-provision mandate for all of Africa.

For most of African countries, the national space programmes also stand for socio-economic development supported by space applications. This position brings African countries involved in space very close to the goals of the EU concerning space as established by the European Space Policy²² that also stresses the importance of space for the benefit of citizens. Moreover, the European Council has stressed in its resolution on European Space Policy that in international relations Europe should seriously consider "...making full use of the potential of space systems for sustainable development, namely

¹⁴ http://www.nasrda.org/space_program.php and <http://www.nasrda.org/presentations/mission.doc>

¹⁵ Algeria is third among African oil exploration countries – 2006: <http://www.algerischebotschaft.de/wirtschaft/Industrie.html>

¹⁶ <http://www.animaweb.org/en/actu-detail.php?actu=2271>

¹⁷ SSTL=Surrey Satellite Technology Ltd, UK

¹⁸ Launched 17.04.2007

¹⁹ NARSS = National Authority for Remote Sensing and Space Science <http://www.narss.sci.eg>

²⁰ Nilesat corp.: <http://www.nilesat.com.eg/>

²¹ <http://www.rascom.org/>
²² Communication EU Commission on space policy on 26.04.2008 http://ec.europa.eu/enterprise/space/doc_pdf/esp_comm7_0212_en.pdf

⁹ Parliamentary approval first half of 2008
¹⁰ AARSE=African Association of Remote Sensing of the Environment. <http://www.itc.nl/aarse/>

¹¹ [RSA's first satellite, Sunsat 1, desg. and built at Stellenbosch Univ., start in 1999, operating for 2 years](http://www.dst.gov.za/publications-policies/magazine/m00004/volume-4-5/)

¹² Next RSA satellite for launch: SumbandilaSat: <http://www.sunspace.co.za/programmes/ZA002.htm>

¹³ http://www.engineeringnews.co.za/article.php?a_id=116219

in support of developing countries, in particular, of Africa.²³ African partners are already on the stage of the two big European space initiatives, namely Galileo and GMES. Morocco is the first African country to sign a cooperation agreement on Galileo²⁴. The GMES involvement of Africa has just started. The potential of GMES as a very useful tool for Africa and its nations is evident and also recognised by the EU and African authorities and other stakeholders²⁵.

Communication is one basis of social and economic development. Satellite communication applications can reach the most remote areas.

Another actor in Africa is the United Nations. The Millennium Goals have one focus on Africa. The UN and several of its sub-organisations²⁶ have established programmes to support technical and social development in Africa. Especially the UN Programme on Space Applications²⁷ is aimed at improving space technology use in Africa. Meanwhile, two UN Regional Centres for Space Application and Education – one in Morocco and one in Nigeria – have started offering training courses, workshops and application capacity-building. In cooperation with ECA²⁸, ESA has devoted much effort to the TIGER initiative for Africa. The TIGER initiative will “assist African countries to overcome the problems faced in the collection, analysis and dissemination of water related geo-information by exploiting the advantages of EO technology”²⁹.

Potential user needs and opportunities

One could say that satellites do play a critical role for Africa's sustainable development. The need for managing earth observation satellite resources was almost imperative, and therefore, in 2002 a seed was planted for the

African Resource Management System, ARM³⁰. By now, the system is strongly user-driven and similar to the first steps of the GMES initiative of the ESA and EU. ARM could evolve into a NEPAD³¹ project for the AU³² so that all African countries could benefit from it. Due to global climatic change, the role of weather satellite data is more important than ever. There is a clear demand for harmonising data from weather satellites and for the promotion of a continent-wide application of such data. The EUMETSAT MSG satellites are to provide high quality data and, at the same time, data have to be made available and applicable to a wide range of everyday uses. EUMETSAT with its MSG System contributes significantly to the project AMESD³³, which will – in cooperation with WMO and EU – improve the management of natural resources in Africa. One day, AMESD is meant to be an integral part of GMES and GEOSS³⁴.

Explicitly, the use of satellite data is not only restricted to the role of remote-sensing satellite applications, which are doubtlessly a great benefit for disaster mitigation and forecasting. The latter was already intensely discussed at a workshop organised by UNESCO and the African Union in June 2007³⁵. For earth observation, the definition of user needs is the most advanced.

With much of the African terrain being sparsely populated, and in contrast to the coastal zones, where population density is high, the need is great to connect rural areas to communication means as one base for social and economic development. Satellite communication – only at first glance not directly linked to environment and disaster – could support much of the socio economic development issues in African countries. Compared to the extensive expansion of the terrestrial fibre net satellite communication is a fast way of bringing information to remote areas given a sufficient supply of adequate equipment. There are several examples for this approach. One is

²³ Resolution on space policy by EU Council on 25.05.2008 <http://register.consilium.europa.eu/pdf/en/07/st10/st10037.en07.pdf>

²⁴ EU press release <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/06/1774&format=HTML&aged=0&language=EN&guiLanguage=fr>

²⁵ H.-P. Pisani: “GMES and Africa: A hopeful case for Euro-African cooperation in space development” ESPI ESPI Perspectives No 6 April 2008 http://www.espi.or.at/index.php?option=com_content&task=view&id=22&Itemid=26

²⁶ UN Office for Partnerships, UNIDO, UNOOSA, ECA-UN, FAO, UNEP

²⁷ <http://www.unoosa.org/oosa/sapidx.html>

²⁸ ECA Economic Commission for Africa

²⁹ TIGER project citation: <http://www.tiger.esa.int/about.asp>

³⁰ ARM=Satellite constellation, application infrastructure, information service, public awareness

³¹ NEPAD>New Partnership for Africa's Development. Strategic framework for Africa renewal. Adopted at the 37th Summit of the OAU 2001.

³² AU=African Union, established 1999

³³ AMESD=African Monitoring of Environment for Sustainable Development

³⁴ GEOSS=Global Earth Observation System of Systems

³⁵ <http://portal.unesco.org/ci/en/files/24615/11804347379Agendaupdated.doc/>

Nigeria's NigComSat-1³⁶. NigComSat-1 now has a total of 28 transponders as payload, covering multiple bands for example, for TV and other communication services for private financial companies and oil companies. Egypt also has two ComSats in orbit. This is what African countries have. But the need for more capacities is greater: tele-education in rural areas, tele-medicine, connection to the Internet for SMEs, these are but a few steps towards a more diversified economy in many African states. Currently, the ground infrastructure and the ground equipment for the propagation of satellite services are still in their infancy. With Africa's demands not yet satisfied in the area of tele-education and tele-medicine, a pan-African e-network between India and Africa has found its way into reality. Under the auspices of the EU, organisations such as ESA and WHO also have founded a tele-medicine consortium in order to supply Africa with adequate means. The access to information is important for socio-economic development. This is one major reason why the ITU that organises the World Summit on the Information Society, WSIS, is engaged into promoting technical innovations in a continent like Africa.

Make use of the abundance of young people – educated for space applications with tele-education means – connect rural areas and beware of over-abundance of TV channels of no use.

Of course, satellite communication applications in many domains are closely connected with navigation and positioning services. Navigation services are very much needed in remote and rural areas: For medical, emergency, traffic, forestry and last, but not least tourism purposes.

Africa is also in need of technology development and the transfer of technological know-how as an important base for economic growth.

Opportunities and obstacles

The above mentioned review of African user needs in the space domain, the direct gains for the citizens of African countries is obvious. However, there is the touchy issue of costs and benefits of the space applications that are very closely linked to the development of society and the economy, namely, remote-sensing

applications and satellite communication. It is even more pronounced in the field of space science liked astronautic or other extraterrestrial missions where it is probable that millions of Africans will not see any direct benefit for them – and consequently would not support such space efforts. Public awareness is not to be underestimated. Consequently, for these kinds of missions, uniquely the way of cooperation with non-African space-faring countries may serve to support the sustainable development of space sciences. Space science carries the potential that could lead to innovations in the technology sector for Africa. Without a solid space science base, this innovation opportunity would be cut off. Nevertheless, innovation in space technology is much more likely in sectors that serve societal needs. Satellite communication is a space sector, which African countries should pursue with zest for action. This has several reasons:

- Potential access to remote areas,
- Exploitation of the population pyramid,
- Entails technological innovation,
- Contributes to a diversified economy,
- Strengthens visibility,
- More drive for bundling interests in Africa.

But why? The need to connect people is great. The success of the Indian satellite education programme³⁷ serves as a proof that space technology can bring education to remote and rural areas, because the basis of the population pyramid is young people. There is a huge potential for scientists and engineers in this population group. Once the pyramid has changed shape, as it has in Europe, for example, the abundance of engineers declines with time and the economy suffers under the scarcity of skilled labour and scientists. On the other hand, technological innovation also comes from the pressure that the need for social development imposes on the means (one is SatCom); means which could provide such a development. Providers of satellite communication services and also the design and manufacturing industry will contribute to the diversification of the economy and strengthen the SME sector of African countries. Satellite communication with all its applications will also strengthen the visibility of national and even international societal and technological advancements.

Space technology is very complex and thus for

³⁶ First Nigerian communication satellite NigComSat-1:
<http://www.nasrda.org/docs/slideShow/index.php?idSlide=2>

³⁷ Indian EduSAT since 2004:
<http://www.isro.org/Edusat/Page2.htm>

large space missions it would be wise to pool resources. This could be achieved efficiently by a pan-African institution. Under NEPAD, the vision of an *African Institute of Space Science, AISS*, was already advocated in 2004.

One major obstacle to all of the space opportunities for Africa mentioned is that education will not be allocated the importance it requires. Trained engineers, scientists and skilled workers still often have to be educated abroad – and they often do not come back to exploit their chances in their home countries. Capacity building is a major issue and since 2000, it has also found its way onto the agenda of General Assembly of the UN COPUOS³⁸.

Investments by non-European countries in Africa create many opportunities, but also the potential of possibly critical developments (major workforce of personnel from abroad instead of from the local employment market, skimming of all profits, operating conditions) that should not be neglected. When innovation comes exclusively from non-African states, the effect of innovation from space and space-related industries for other domains will not be long-lasting – hence dependency will develop. This would not be a positive signal for the efforts to obtain the diversification of the economies in African countries.

Last, but not least, the visibility that Africa would gain from satellites and satellite applications “made in Africa” could thwart the willingness of industrialised countries to intensify development aid, as there the attitude still seems to prevail that “space is like a Ferrari – no more is needed”. There also is the thread of the “media society”, leading, e.g., to an over-abundance of TV channels, many of them not of any use for most citizens and not able to bring welfare to those who need it.

Commission assignment for pooling European space industry for sustainable business relation with African countries. European space agencies: Go for a 1:1 or 1:1+n relationship with an African space agency.

What could restrain the endeavour of African countries to pool their space capacities? It is the well-known regime of opinion-gathering and acclamation procedures of a community of states seeking to obtain resolutions, which all members are able to accept – the European

experience *par excellence*. Moreover, major impacts (e.g. regional conflicts) on a country’s society and governance could weaken the ability of states to coordinate their space-related interests aimed at becoming members of a potential new African space agency and an African space policy.

How Europe should contribute to “Space Made in Africa” – The way forward

Africa is not an isolated continent. With regard to many of the above mentioned opportunities, Europe should play an active role: In increasing the chances of a good development as well as in downsizing the obstacles. The cooperation duo Africa/Europe has two sound main pillars.

One main pillar is the collaboration with the EU, consisting of member states, and of the African countries whose representative body, the AU, has begun to broaden its unifying influence in Africa, but does not yet possess a mandate similar to the one of the EU. The EU-Africa collaboration at eye level has just begun and the main pillar resembles more a birch than a beech stem. Many would point out the other main pillar as being the development aid of European countries. Europe and European countries are the main donors in Africa compared to other countries of the earth. No doubt, Africa has benefited from development aid. But the link of development aid and sustainable economic growth in many African countries is quite loose. The causes range from inept strategies of the European countries to African government practices or even to the fragile states in Africa. The real, solid main pillar is not development aid, but the potential of Europe to do business with African states – in a way that does not corrupt European principles of solidarity and good government.

But where are the niches, where is the domain that will best serve Africa’s needs? Beyond GMES and Galileo, Europe should identify SMEs in the member states that are capable of cooperation with emerging organisations and SMEs on the African side – in the field of satellite communication. European funds for SME cooperation with African countries would be one way forward. Even large enterprises like Astrium, could, with reservations, profit from such a fund. Especially satellite communication, which will be one of the driving factors for Africa, is well suited for cooperation although the commercialisation aspect of satellite communication will force partners to clarify the boundaries in order to be able to commit to

³⁸ UNCOPUOS=UN Committee on the Peaceful Uses of Outer Space

bilateral best practise. It is to the address of the European Commission bodies like DG Enterprise or DG Research together with EuropeAid, Trade and External Relations which should pool the actors (industry, agencies) for an African industry programme to create a fund for such activities. Industry representatives should strengthen their awareness of the African potential and of the growing importance of good, reliable and sustainable industrial and technological external relations with Africa with a view to helping Africa develop as an emerging space continent.

ESA, on the one hand, can encourage and even accompany the process of founding an African space agency. The similarity between the member states constellation of Africa and the member states constellation of ESA calls for the application of the principle of “lessons learnt”. No other space organisation on the planet can offer such useful support. On the other hand, the EU should not only avoid enhancing the often cited African stigma “Africa needs bread not satellites”, but rather foster technological collaboration and thereby provide means for sustainable development in African countries.

Space agencies in Europe should reserve more cooperation potential for Africa. ESA members could plan countrywide partnerships where one space agency in Europe has one or more links to partners in Africa. These would accompany them, e.g., in developing a space policy or a space programme. The above mentioned fund should also cover such partnership opportunities in Africa.

Italy's approach, for example, is shown by the agreement signed in the spring of 2008 with Kenya for setting up a centre that will give Kenyan scientist access to EO satellite data and allow them to participate in the development of an EO satellite in Italy, and eventually assist in the creation of a national Kenyan space programme.

Another more concrete, but not yet implemented issue for an international community like the ITU is to assist in the practical application of frequency allocations for African satellite systems.

It is only a question of time when the last step to a space-faring continent will be reached. The development, construction, launch and operation of satellites “made in Africa” is a process which Europe should accompany.



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