SPACE AND *IN SITU* INFRASTRUCTURE

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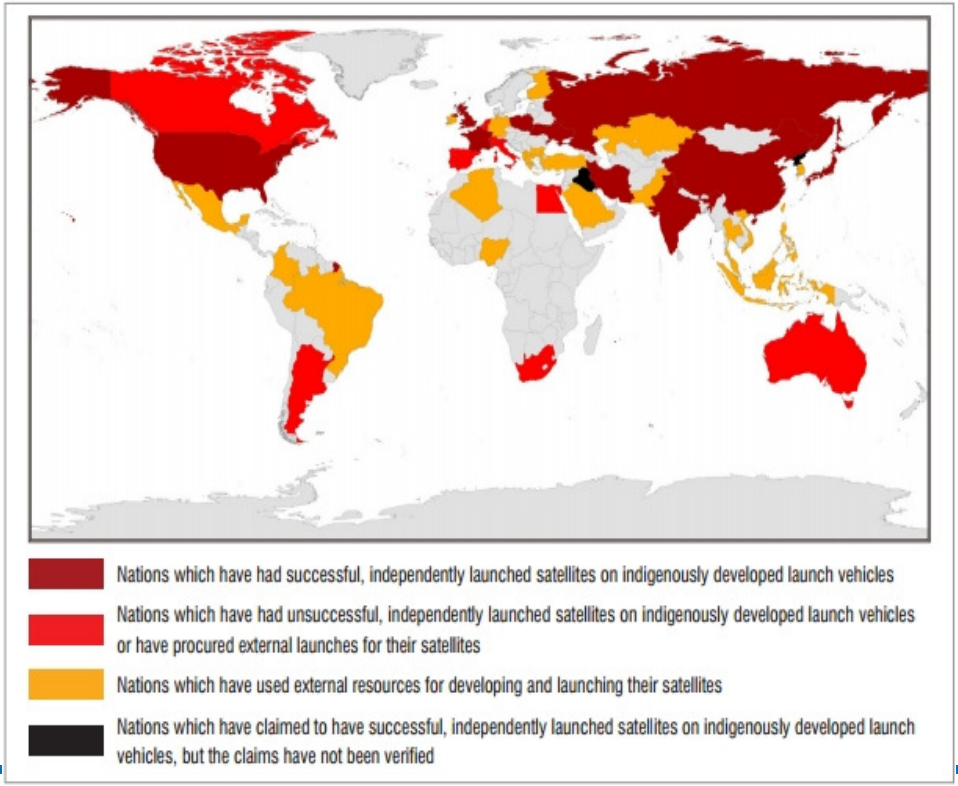
The present scientific, technological and organisational capacity of Africa is not enough to ensure regularly full assessment and efficient monitoring of the continent's environment and natural resources

Status of African Space Activities (source: Ngcofe L, Gottschalk K, 2013)



[1] The original table is attached to this report as Annex B

Overview of the present Space component of the EO Infrastructure in Africa

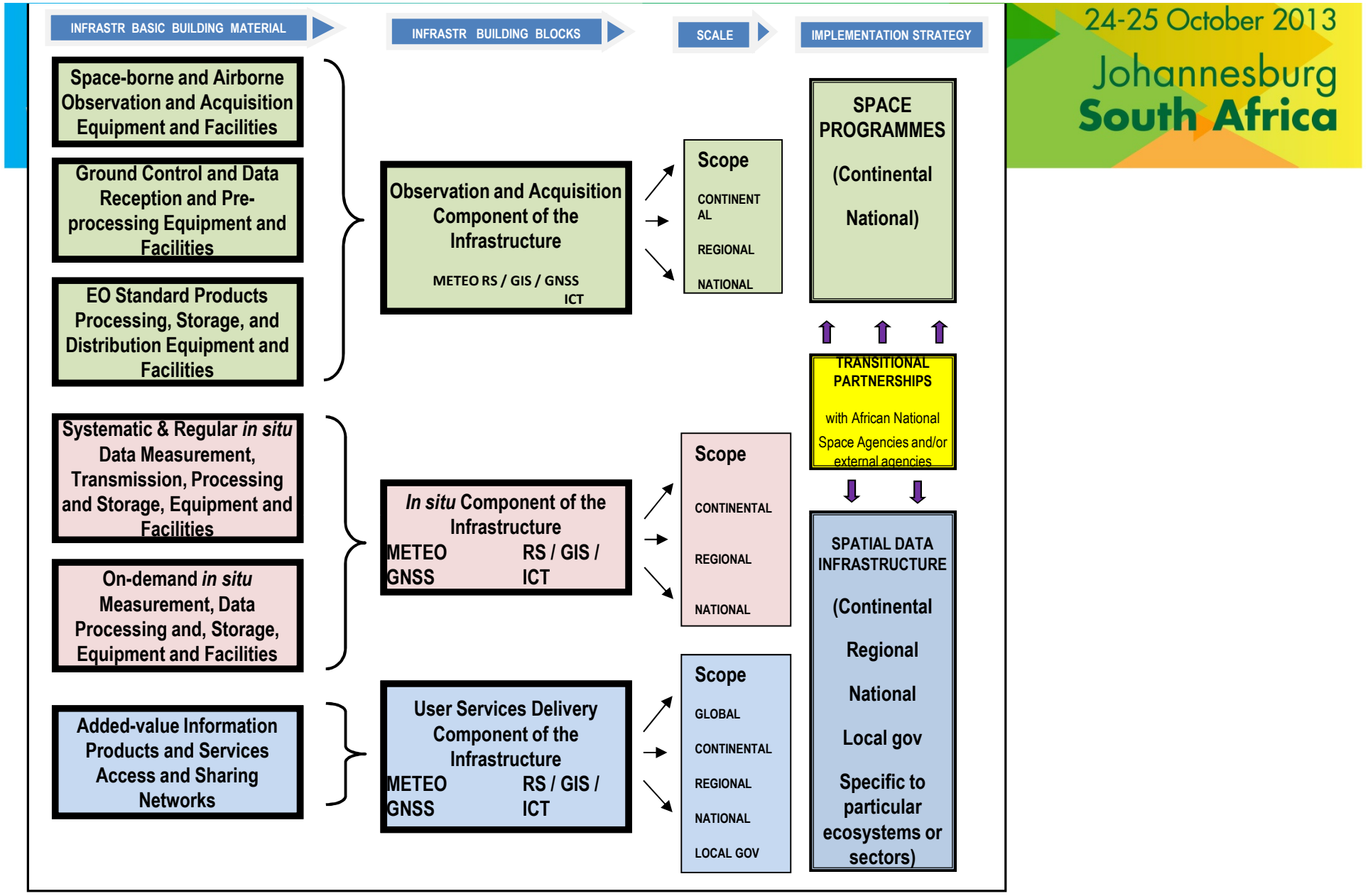
Country or Organization	*Satellites*	*Ground support facilities*
Egypt	Four (4) satellites launched between 1998 and 2010	Two (2) Satellite Operations Centres;
South Africa	Four (4) satellites launched between 1999 and 2011	Three (3) satellite ground stations
Nigeria	Three (3) satellites launched between 2001 and 2011	One (1) satellite ground station
Algeria	Three (3) satellites launched between 2002 and 2010	Two (2) rocket launch sites
Reg African Satellite Comm Organisation (RASCOM)	Two (2) satellites launched between 2007 and 2010	Two (2) Satellite Operations Centres
Namibia		One (1) satellite ground station; one (1) telescope
Democratic Rep of Congo		One (1) Sounding rocket launch site
Kenya		One (1) Orbital launch pad; one (1) satellite ground station
Mauritius		One (1) telescope
South Afr – Botswana – Ghana – Kenya – Madagascar – Mauritius – Mozambique – Namibia - Zambia		One (1) Square kilometre Array radio telescope
Libya		One (1) Sounding rocket launch site

The present Space segment of the African Space Infrastructure is the logical consequence of a continent with

- a little more than a decade of Space activity, and
- only 7% of the countries implementing a national space program in operational terms.

However, coordinated efforts are underway under the aegis of the AMCOST, with the recent development of an African Space Policy and an African Space Strategy

NEEDS AND GAPS ANALYSIS



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SEVENTH FRAMEWORK PROGRAMME

Category of Data	Components of the Space and in situ Infrastructure			Identification of gaps
	Acquisition and Observation	*In situ*	*Services delivery*	
Long Term Management of Natural Resources				
1 Coarse Resolution (300m-1km)	MSG NOAA SPOT-VGT MERIS MODIS ASAR	Daily coverage • Ground receiving stations • processing capability for standard products in 53 African Countries	• Fully functional meteo, hydrology and RS networks (acquisition, transmission, storage and standard products dissemination) • Location-based network	• Robust Internet connectivity • Fully functional e-government with G2G, G2P and G2C facilities	Active regional institutions include AGRHYMET (Niger) RSAU (Botswana) ICPAC (Kenya) RCMRD (Kenya) CSE (Senegal) UCTC (South Africa), but no awareness of forming a continent level community

2	Medium Resolution (10-50m)	LANDSAT SPOT CBERS IRS ASTER NigeriaSat-1 & X EgyptSat-2	Complete coverage yearly Same as above	Same as above	Same as above With availability of online resources at National Mapping Agencies such as 3m DEM, historical LC/LU layers, CORS postcast data, etc.	Maspalomas (Canary) SANSA (South Africa) NARSS, Cairo & Aswan (Egypt) Abuja & Jos (Nigeria) Malindi (Kenya) Lack of receiving stations in large key regions (Central Africa, West Africa…)
3	High resolution (2-5m)	SPOT NigeriaSat-2	Complete coverage every 3-5 years Coverage on-going	Same as in 1 above with Aircraft equipped for local areas surveying (aerial photography – radar imagery – etc. precision location-based networks accessible to the public and surveying/mapping companies	Same as above With availability of privately operated EO portals providing online access to information resources such as localised 70 cm DEM, localised and historical LC/LU layers, hydrology and weather products, etc..	Murzuq (Lybia) SANSA (South Africa) Maspalomas (Canary) Abuja (Nigeria) NARSS, Aswan (Egypt) Few sensors are acquiring information but rarely on the African continent; lack of receiving stations or on-board recording

4	Very High resolution (<1m)	Ikonos GeoEye Pleiades (to come)	Sampling for statistical applications and validation	Same as in 3 above	Same as in 3 above, but With availability of privately operated EO portals providing online access to information resources such as localised 20 cm DEM, localised and historical LU / LC layers. etc	As part of e-Gov strategies, G2G, G2P and G2C facilities should be put in place to create opportunities for the private sector to develop end-user oriented applications, while Gov play their role of referee and control
5	Radar high resolution (1-50m)	RadarSat 2 EnviSat COSMO-SkyMed TerraSAR-X	Complete coverage yearly	Radar Survey Aircraft and equipped terrestrial vehicles Radar imagery processing equipment (hard and software)		Lack of receiving stations in large key regions (Central Africa, West Africa…) Lack of fully validated procedures Low level of expertise in radar imagery processing

6	Geodetic data	GNSS GPS GLONASS Operational Galileo Constellation (2014) CORS Georeferencing data Gravimetry field data	Permanent Core Service Permanent end-user service • Gravimetry anomalies detection	Receivers for professional applications and for positioning and navigation purposes Post-processing information dissemination	SANSA (South Africa) EMA (Ethiopia) ECA-SROWA (Niger) CICOS (DRC) Kilimanjaro (Tanzania)	Africa Reference Framework (AFREF) not operational, particularly inactive in West Africa Africa not engaged in the ground reception segment (Receiver industry) Technology consumer and not solution builder
7	Data and AVIPS Dissemination	EUMETCAST Earth Observation Portal VGT4Africa ftp GeoNetwork	• Data dissemination • AVIPS distribution	Regular & Occasional *in situ* data dissemination	53 African Countries RICs Programme / Project	ftp transfer rate is very low in many countries lack of data policies resistance to data sharing and re-use lack of high-speed ICT infrastructure

Marine and Coastal areas							
1	Coarse Resolution (300m-1km)	MSG NOAA SPOT-VGT MERIS MODIS ASAR	Daily coverage • Ground receiving stations • processing capability for standard products African Marine and coastal areas	• Fully functional meteo, hydrology and RS networks (acquisition, transmission, storage and standard products dissemination) • Location-based networks	• Robust Internet connectivity • Regional weather forecast systems 5 to 7 day horizon • Real-time Disaster Warning Systems	GMES and Africa Network of Marine Remote Sensing Centres to form an African Marine Remote Sensing Core Service
2	Medium Resolution (10-50m)	LANDSAT SPOT CBERS IRS ASTER NigeriaSat-1 & X EgyptSat-2	Complete coverage yearly • Same as above	Same as above	• Coastal sensitivity and vulnerability atlases and state of the environment reporting • A GMES and Africa Network of coastal observatories	

3	High resolution (2-5m)	SPOT NigeriaSat-2	Complete coverage every 3-5 years • Coverage on-going	Aircraft equipped for local areas surveying (aerial photography – radar imagery – etc. precision location-based networks accessible to the public and surveying/mapping companies	• Coastal sea level, • Coastal circulation, • Coastal sea state data, analyses, imagery and mapping • Ship traffic situation and maps
4	Very High resolution (<1m)	Ikonos GeoEye Pleiades (to come)	• Sampling for statistical applications and validation	Aircraft equipped for local areas surveying (aerial photography – radar imagery – etc. precision location-based networks accessible to the public and surveying/mapping companies	• Biological productivity data, analyses, imagery and mapping from long term ecosystem research observational networks • A GMES and Africa Capacity Dev Network of Higher Education Institutions

5	Radar high resolution (1-50m)	RadarSat 2 EnviSat COSMO-SkyMed TerraSAR-X	• Complete coverage yearly	Radar Survey Aircraft and equipped terrestrial vehicles Radar imagery processing equipment (hard and software)	• Cloud cover areas coastal sea level, • Coastal circulation, • Coastal sea state data, analyses, imagery and mapping • Ship traffic situation and maps	Lack of fully validated procedures Low level of expertise in radar imagery processing
6	Geodetic data	GNSS GPS GLONASS Operational Galileo Constellation (2014) CORS Georeferencing data Gravimetry field data	Permanent Core Service Permanent end-user service • Gravimetry anomalies detection	Receivers for professional applications and for positioning and navigation purposes Post-processing information dissemination	• Sea Navigation core Service • Early Warning services for disaster management	

7	Data and AVIPS Dissemination	EUMETCAST Earth Observation Portal VGT4Africa ftp GeoNetwork	• Data dissemination AVIPS distribution	Regular & Occasional *in situ* data dissemination	African Coastal and Marine areas

Water Resources Management

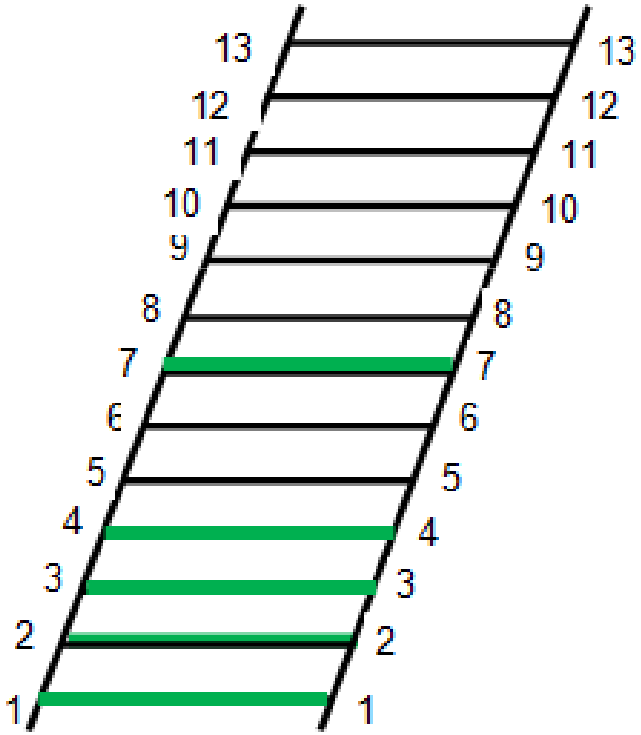
1	Coarse Resolution (300m-1km)	MSG NOAA SPOT-VGT MERIS MODIS ASAR	Continental level • Ground receiving stations • processing capability for standard products	• Fully functional meteo, hydrology and RS networks (acquisition, transmission, storage and standard products disseminatio n) • Location-based networks	• Robust Internet connectivity Core set of continental scale products covering different components of the water cycle: e.g. • Precipitation; • Evapotranspiration ; • Soil moisture; • Water quality; • Surface and ground water levels; • (short / long range) forecasting products

2	Medium Resolution (10-50m)	LANDSAT SPOT CBERS IRS ASTER NigeriaSat-1 & X EgyptSat-2	Regional level, transboundary river basins and national level	Meteo and Hydrology *in situ* measurement networks Transmission network Data Distribution / dissemination networks	Availability of online resources at National Integrated Water Resources Management Agencies - such as 3m DEM, historical LC/LU layers, CORS post-processing data, etc.
3	High resolution (2-5m)	SPOT NigeriaSat-2	National level	Aircraft equipped for local areas surveying (aerial photography – radar imagery – etc. precision location-based networks accessible to the public and surveying/mapping companies	• Base mapping for water supply and sanitation; • Irrigation areas, crop mapping; • Ephemeral water bodies; flooding; • Mapping groundwater aquifers; • EIA for hydro power, water • Diversions and impoundment or other water related engineering – diversion plans. • Availability of privately

4	Very High resolution (<1m)	Ikonos GeoEye Pleiades (to come)	Localized assistance to farmers in decision making through the crop production cycle, IWRM Administration and Planning, and urban sanitation	• Availability of privately operated EO portals providing online access to information resources such as localised 20 cm DEM, localised and historical LU / LC layers. Etc • Specific *in situ* data mandatory for EO-based service calibration and validation

Table 2 shows that the needs for an African Space and *in situ* Infrastructure, as a support to the delivery of categories of core services and end-user services, are diverse and overlap considerably from a thematic point of view

Figure 2 : Position of African nations on the Space Technology Ladder (Adapted from D. Woods, A. Weigel, 2012)



Level on the Ladder	*Requirement*	*number of African countries fulfilling the requirement*
13 - Launch Capability	Satellite to GEO	
12 - Launch Capability	Satellite to LEO	
11 - GST Satellite	Build locally	
10 - GST Satellite	Build through mutual int collaboration	
9 - GST Satellite	Buid locally with outside assistance	
8 - GST Satellite	Procure	
7 - LEO Satellite	Build locally	1
6 - LEO Satellite	Build through mutual int'l collaboration	
5 - LEO Satellite	Build locally with outside assistance	
4 - LEO Satellite	Build with support in partners facility	1
3 - LEO Satellite	Procure with Training Services	3
2 - Space Agency	Establish Current Agency	7
1 – Space Agency	Establish First National Office	3

AN ACTION-ORIENTED SOLUTION TO THE SPACE AND *IN SITU* INFRASTRUCTURE DEVELOPMENT IN AFRICA

Infrastructure development is not an end *per se*, but a means to offer the possibility :

- to provide GMES core services to a variety of communities in Africa;
- to deliver a series of end-user services (Added-value Information products and services – AVIPS) as a result of the provision of these core services

On this basis the following actions are proposed to target the Space and *in situ* Infrastructure development as components necessary to fill the gaps in the three groups of GMES Core Services in the areas of :

- Coastal and Marine Areas management;
- Water Resources Management
- Long Term Management of Natural resources,

and in the other sustainable development sectors and the remaining priority thematic and cross-cutting areas (6+4) defined by the GMES and Africa Initiative

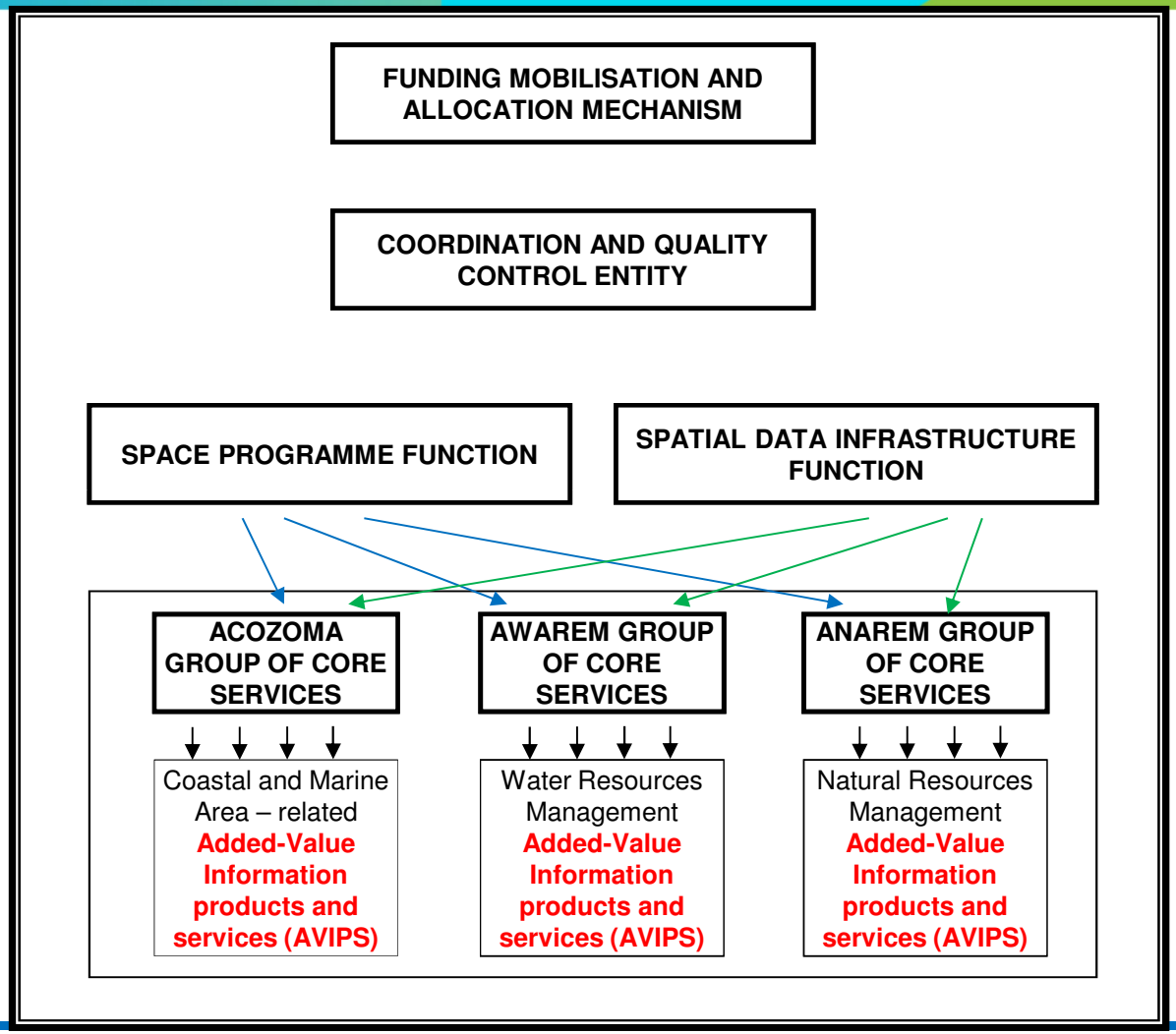
In this regard three priority groups of GMES core services are proposed, as a basis for developing the Space and *in situ* Infrastructure in Africa. They are inspired from the available three consensus-based chapters:

- An Africa Coastal Zones and Marine Areas (ACOZOMA) Group of GMES Core Services;
- An Africa Water Resources Management (AWAREN) group of GMES Core Services;
- An Africa natural resources Management (ANAREM) Group of GMES Core Services

A full concept note on this approach is proposed, with the following principles for organisation and management

- no duplication of institutions, but the strengthening of existing ones to fulfill the necessary functions, except where there exists a real and evidenced vacuum
- one coordination entity playing also the key role of quality assurance, with the necessary assistance
- A Space Programme function, separate from the Spatial Data Infrastructure function, but with functional links between the two

- A separate entity in charge of financial resources mobilization and allocation
- An overall Monitoring and Evaluation mechanism to ensure efficiency and performance of the whole implementation process


FUNDING MOBILISATION AND ALLOCATION MECHANISM
COORDINATION AND QUALITY CONTROL ENTITY
SPACE PROGRAMME FUNCTION
SPATIAL DATA INFRASTRUCTURE FUNCTION
ACOZOMA GROUP OF CORE SERVICES
AWAREM GROUP OF CORE SERVICES
ANAREM GROUP OF CORE SERVICES
Coastal and Marine Area – related Added-Value Information products and services (AVIPS)
Water Resources Management Added-Value Information products and services (AVIPS)
Natural Resources Management Added-Value Information products and services (AVIPS)

Thank you for your attention