FOR PARTICIPANTS ONLY

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COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE
Scientific and Technical Subcommittee
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Agenda item 6
Implementation of the recommendations of UNISPACE III

Contribution of the Committee to the work of the United Nations Commission on Sustainable Development for thematic cluster 2006-2007: inputs from member States

In paragraph 7 of its resolution A/RES/59/2, the General Assembly requested the Committee on the Peaceful Uses of Outer Space to examine the contribution that could be made by space science and technology and their applications to one or more of the issues selected by the Commission on Sustainable Development as a thematic cluster and to provide substantive inputs for consideration by the Commission.

At its forty-eighth session the Committee agreed that to contribute to the policy year of the thematic areas of the Commission for the period 2006-2007 member States of the Committee should be invited to provide inputs for the development of a concise document to be transmitted to the Commission.

The annex to this document contains the inputs that were received from member States.

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Annex

Contribution of the Committee to the work of the United Nations Commission on Sustainable Development for thematic cluster 2006-2007: inputs from member States

I. Germany

1. Space-based remote sensing of the atmosphere, oceans and land have evolved substantially since the first operational weather satellites went into service. Earth observation space missions have proven their capabilities in monitoring nearly all aspects of the Earth system on a global and regional basis.

2. Space sciences and space applications can contribute specifically to measure air pollution, study the atmosphere and promote climate change research. This is widely being discussed and is well documented in scientific publications and conferences, both nationally and internationally e.g. within the Committee on Earth Observation Satellites (CEOS).

3. Observation of the Earth's atmosphere is focused on three important fields of research and applications: The first relates to the quality of the air and any changes in it, the second relates to changes in the global climate caused by increasing concentrations of greenhouse gases, and the third relates to changes in the ozone layer.

4. One of the most innovative experiments for atmospheric and climate research is the Scanning Imaging Absorption Spectrometer for Atmospheric Chartography (SCIAMACHY), developed in joint German-Dutch-Belgian cooperation. Installed on the Environmental Satellite (Envisat) of the European Space Agency (ESA), the first results of SCIAMACHY clearly demonstrate the potential benefit of its data for global climate and environmental research. For the first time ever, the data allow to determine the spatial distribution of air pollutants like nitrogen dioxide, carbon monoxide, sulphur dioxide and formaldehyde. This in turn allows the quality of the air in individual cities and urban agglomerations to be determined and emission inventories to be verified. It further allows, for the first time, the distribution of two important greenhouse gases, methane and carbon dioxide, to be determined on a global scale.

5. Over the next two years, SCIAMACHY will continue to make a unique contribution to our understanding of the complex system of Earth and its atmosphere, permitting to study the impact of interacting natural and man-made factors on the Earth-atmosphere system. Moreover, SCIAMACHY will provide data for initial applications of the Global Monitoring for Environment and Security (GMES) in atmosphere monitoring.

6. The overall objective of the European initiative GMES is to support Europe's goals regarding sustainable development and governance of the environment by providing timely and quality data, information and Earth observation based services.

7. GMES provides the necessary geo-spatial information services for the European Union (EU) and ESA Member States. GMES also combines European contributions to the international Global Earth Observation Systems of Systems (GEOSS).

8. GMES is comprised of five space missions or "Sentinels": two atmospheric chemistry monitoring missions, one on geostationary and one on low Earth orbit, and three missions covering the following areas: ozone and ultraviolet radiation, climate change and air quality.

9. GMES missions and projects will be implemented through the ESA – GMES Programme and the forthcoming 7th Research Framework Programme of the European Union.

10. The first phase of GMES was approved by ESA Member States at the ESA Ministerial Council in Berlin on 5 and 6 December 2005. Germany has dedicated a large portion of its space budget to remote sensing programmes and is in fact the largest contributor to the GMES Initiative.

II. Nigeria

1. Introduction

11. There is growing international concern about seeking new and deeper understanding of the complex interaction between human society and the environment in view of its Implication for sustainable development — a development which "meets the needs of the present without compromising the ability of the future generations to meet their own needs". Since it is generally recognized that the world's present development path is not sustainable, in spite of substantial efforts to achieve this goal in the last decade, the world community is now focusing attention on the need to develop programmes strategies and agenda in its quest to achieve sustainable development. In addition, the problems of poverty, hunger, disease, ignorance, illiteracy, social and political instability and disaster management must be well addressed, especially in developing countries, in our collective effort towards a sustainable development.

12. Among the issues of sustainable development being addressed as the thematic cluster of the Commission on Sustainable Development for the period 2006-2007 are energy for sustainable development, industrial development, air pollution/ atmosphere and climate change.

2. Energy for sustainable development

13. Energy sustainability requires meeting our energy needs, upon which economic development depends, while protecting the environment and improving social conditions. Energy and development are interdependent factors. Increased energy availability leads to higher development, and higher development generally leads to higher energy use.

14. The fundamentals for future sustainable development in the energy sector are the consideration of the energy needs of future generations. To achieve sustainable development, renewable energy sources should become a larger part of the energy market; however, predictions for the next 25 years show that the increase in the energy market will come mainly from fossil fuels. Marine energy, geothermal energy, solar energy, energy from biomass, wind power and hydropower are all renewable energy sources which should play a more important role in the future.

2.1. Definition Of energy terms

15. The principle of solar thermal energy is to use lenses and reflectors to concentrate the Sun's energy, which will by different means generate electricity and has the advantage of storing heat.

16. Bio-energy (biomass) is a collective term for all non-fossil material of biological origin; this includes all animals and plants by products. They can be broadly classified into three categories: residues/waste, purpose grown energy crops and natural vegetations.

17. Hydropower is the uses of forces and flow of water to produce electric power. The amount of hydropower produced by the plant is related to the amount of water in the upper reservoir, which in turn is related to the amount of rainfall. For marine energy, it includes wave, ocean thermal, tidal energy and marine current energy.

18. Geothermal energy is energy derived from the natural heat from the interior of the Earth. The temperature of the Earth varies widely and geothermal energy devices can be adopted to take advantage of this variation.

2.2. Space contribution to energy for sustainable development

19. Space-based technology continued to demonstrate its contribution to achieving and sustaining better lives for everyone, and had played a crucial role in human development over the years. The impact that space technology might have for the improvement of our current energy situation cannot be over-emphasized. Satellite observations of our planet have shown some of the threats that the sustainable use of non-renewable, and especially carbon-based, fuels pose in this century and beyond. The space age has given us a new perspective on how fragile our precious Earth really is,

and a new understanding of the processes that govern the evolution of its climate with implications on both renewable and non-renewable energy sources.

20. The real prospects for the future of the solar power concept or other ways of using space technology to improve the generation, transmission and use of energy on Earth in the coming years lie in the use of Earth observation satellites for monitoring and analyzing the vegetations and forest, and also for the selection of a suitable and sustainable environment for the biomass plant. For example in solar meteorology, weather forecasting can help in the management of electricity networks during solar storms in terms of spin-offs from space exploration in connection with the improvement of solar cell efficiency, space technology can make a significant contribution. Space and Earth based solar power for the growing energy need of future generations is receiving attention from Nigeria's Federal Ministry of Science and Technology.

21. Similarly, by using Earth observation satellites to analyze weather patterns, we can forecast the amount of precipitation in a given region and also extrapolate from the weather information the approximate quantity of hydroelectricity that can be produced to guide the location of hydropower plants. Nigeria's Federal Ministry of Water Resources is collaborating with the National Space Research and Development Agency to improve energy generation through hydro-electric power projects. Satellite technology plays a vital role in dam site location for such projects.

22. GEOSAT is conducting large scale ocean observations that could be useful for determining more suitable sites for tidal energy plants. Mixed layer remote sensing applications measuring air velocities when the flow is oscillating, can increase the amount of wave energy. For example, Radarsat is useful in measuring sea surface speed and waves prediction. Earth observation satellites are used in the study of ocean temperature. Images from an Advanced Very High Resolution Radiometer (AVHRR) 10.8µm-band were used successfully to demonstrate an experiment related to this in the Netherlands.

23. Many areas have accessible geothermal resources, particularly countries along the pacific "Ring of Fire' spreading centres. Space-based exploratory activities of the "geo hot spots" can be used to improve its energy potentials. This can be achieved through resources positioning via satellite imageries and thermographs. A new generation of high powered ultra spectral infrared satellites, with capabilities to see below the ground or identify volcanic activities, will be deployed for space-based geothermal mapping of the planet.

24. The use of space technology, such as remote sensing and global navigation satellite systems, for the exploration of fossil fuels (oil, gas and coal) cannot be over-emphasized. Images from remote sensing satellites are being used to aid the search for oil reserves and monitor oil spill while navigation systems are used to manage the energy networks. The oil and gas industry in Nigeria, for example, will continue to benefit from the use of space technology for exploration, exploitation and management of that energy sector.

3. Space as a solution to climatic change

25. Climate change is an issue of concern today and will continue to remain on top of the agenda of the international community for years to come. The Kyoto Protocol, which was ratified by 141 countries, and which entered into force in February 2005, is a clear acceptance from politicians around the world that climate changes due to global warming are partially caused by human activities. Fossil fuels are the main emitters of greenhouse gases, which contribute to global warming. Nuclear power plants are often considered to be a clean energy source, but the processing and storage of nuclear waste and the possibilities of accidents are major concerns.

26. Climatic variations in the past, except probably the recent glacier retreat, have been essentially natural, with little or no human influence. However, the present-day concern is that, for the first time in history, the human element has been added to the climatic equation. Thus, emissions of some of the greenhouse gases into the atmosphere from human activities have now modified the concentrations of those gases quite significantly when compared to pre-industrial levels. The anthropogenic gases include carbon dioxide, methane, nitrous oxide and halocarbon compounds. In

recent years, therefore, the major debate worldwide has centered on how real it was that the climate of the Earth was changing, what the climate expectations were, and what measures should be taken by humans to avert the potential climate change and its impacts.

27. Evidence exists to support concern over the state of the global climate. Indeed, since the middle of the late nineteenth century, when a marked increase in carbon dioxide from anthropogenic activities was measured, the observations have shown that over the last 100 years, the Earth's atmosphere has warmed up by about 0.6 °C, while the global sea level has risen by between 10 and 20 cm; spatial and temporal patterns of precipitation are changing; night-time temperatures over land have generally increased by double the increase of day-time temperatures; regional changes such as increased precipitation over land are evident; most of the world's glaciers have been retreating since 1850 while the Arctic ice is thinning, etc.

28. Over the last four decades, since the launch of the first Television Infrared Observation Satellite (TIROS-1), satellite data have progressed from the era of simple "pictures" to high resolution digital renderings from a variety of spectral bands that provide both qualitative and quantitative information about the atmosphere, clouds and land and sea surface properties. Nowadays, environmental satellites are used for a variety of applications that span scales from nowcasting to climate, and include land, ocean, atmosphere and ecological applications. It is well recognized that meteorological satellites provide essential data for weather forecasting to national weather services across the globe. The Government of the Federal Republic of Nigeria, for example, has established a number of institutions, such as the Centre for Climate Change Research and National Meteorological Services Agency, to carry out research and data services related to climate change monitoring/prediction.

29. Indeed, it would be difficult to find an area of operational meteorology that had not come under satellite influence. Simultaneously, new instruments on research satellites are providing insights into future satellite systems to the extent that a variety of environmental applications are growing vigorously. For example, one of the largest Earth observation satellites ever built was the Envisat of ESA. Envisat carries several instruments that will help unravel the mysteries of climate change and global warming. Some of those instruments will assist in creating maps and give an accurate global picture of sea surface temperatures, green house gases in the atmosphere, the ozone levels in the atmosphere and an El Niño event, and unusual ocean currents and changes in its surface temperature.

30. Over the next 25 years, the anticipated development in space-based observing systems, computers, data handling and information and communications technology are expected to further improve on the recent achievements, particularly with the development of very high spatial and spectral sampling systems from ultraviolet to microwave wavelengths, with both active and passive sensors.

4. Space solutions to air pollution/atmospheric monitoring

31. Satellite technology and data have grossly been underutilized for monitoring air pollution and the atmospheric processes, in general. Space technology, which can be referred to as "our eyes from above", is fast becoming an avenue for the monitoring of atmospheric processes and interactions that affect the Earth and also for monitoring the relationships between those processes and human and natural phenomena emanating from the surface of the Earth.

32. Space technology has brought to the fore the fact of a unified system represented by the Earth, in that events that take place in a geographic location have effects on other geographic locations. This is most particularly applicable to events that relate to the atmosphere, such as various forms of atmospheric pollution from volcanic eruptions, biomass burning, dust transportation, effluents from oil installations (point source) etc. The detection, transportation, spread and tracking of those pollutants over large spatial domains and even localized regions can be effectively monitored through satellite technology and remote sensing. Furthermore, the interactions between air pollutants in the atmosphere can also be monitored and studied. Remote and rural regions where

there are no ground-based measurement facilities can be effectively covered by remote sensing, providing the only data source for such regions.

33. Recent developments are being geared towards the integration of meteorological satellites (such as the Defense Meteorological Satellite Program (DMSP), the Polar Operational Environmental Satellites (POES), and the Geostationary Operational Environment Satellites (GOES)) and environmental satellite systems (such as the Earth Observing System (EOS) of the National Aeronautics and Space Administration (NASA) of the United Staets and the future National Polar-orbiting Operational Environmental Satellite System (NPOESS)) into environmental observation systems, which will play an important role in the forecasting and monitoring of air quality. Many space satellites now bear sensors that are specifically designed to monitor atmospheric pollutants. An example is the Measurement of Pollution in the Troposphere (MOPITT) sensor aboard the EOS Terra satellite of NASA, which is specifically designed to measure carbon monoxide profiles and total column methane (a hydrocarbon). The NASA EOS satellite, Aura, is designed to study the Earth's ozone, air quality and climate; it houses one sensor designed specifically to measure trace gases in the troposphere. Also, the Geoscience Laser Altimeter System aboard the NASA Ice, Cloud and land Elevation Satellite (ICESat) measures backscattered light to determine the vertical structure of clouds, pollution and smoke plumes in the atmosphere.

34. In many developing countries, including Nigeria, air pollution is a major issue that needs to be adequately and promptly tackled. The launch and advances being made by Nigeria in space technology and applications are being viewed by many as an avenue to address issues bordering on atmospheric pollution and air quality monitoring and management. This is being carried out through scientific researches and collaboration with other satellite technology developers and users for the acquisition and integration of satellite data. The Nigerian Space Research and Development Agency considers unpolluted air as fundamental to human existence and quality of human life. The Agency is already looking into the acquisition and installation of satellite receiving stations for meteorological satellites and other available environmental observation satellites, which are available through space agencies such as NASA, ESA and the Canadian Space Agency. This will assist in monitoring common issues that cause atmospheric pollution in the country and also assist policy makers in Nigeria in the formulation of laws that will guide the protection of the atmosphere. For example, the African Regional Centre for Space Science and Technology Education – in English Language, which is affiliated to the United Nations and based in Nigeria, has commenced a study on the energy exchange between the surface of the Earth and the atmosphere in a tropical environment. The project is being implemented in collaboration with Uppsala University of Sweden and a micro-metrological research team from the University of Bayreuth in Germany.

5. Role of space in industrial sustainable development

35. The telecommunications satellite industry is leaping to a high level with its commercial viability and enormous social-economic impact on the citizenry as well as on the global economic development.

36. It provides a critical and innovative collaboration for capacity building and the development of satellite technology for transformation in the telecommunication, broadcasting and broadband industry in the world, especially in developed countries, while providing new opportunities and challenging platforms for business and industrial development in moral and remote regions through access to strategic information in the new world economic order.

37. Access to information has become a weapon of mass construction in the sense that information underscores all development efforts, be it in education, provision of health services, marketing, construction, production and even socio-economic activities such as tourism, entertainment industry and defense civil protection.

38. The telecommunication satellite services help in developing such industries as intelligence and security banking, oil and gas sector, commerce and insurance, education, health and medicine, media and broadcasting, telephone and internet services.

39. Other examples are telemedicine (the use of information science and telecommunications to support the delivery of care) and e-health for international medical issues. The use of satellite communications in telemedicine made it possible for quality public health to be shared with underprivileged people in areas of the world with limited health care.

40. It had long been thought that it was an expensive technology upon a strained health budget, but the cost of computing and telecommunications was actually falling, while that of delivering traditional medical care was rising at an alarming rate.

41. Information science and telecommunications offered the promise of making medical care delivery more affordable and accessible. It could be provided by eliminating print media and the use of electronic media and satellites. It is a tool of technology that could span a digital divide in a responsive rather than disruptive way. It could be tailored to most medical requirements. Telemedicine, moreover, need not be expensive and it could allow medical improvement without a repetition of the developmental history of medicine in other countries. Industries that operate in remote areas, such as the petroleum industry with off-shore operation, need telemedicine service.

42. Tele-education projects in several countries were bringing high-quality education to students and educators at all levels in terms of distance learning for capacity building toward achieving the Millennium Development Goals.

43. It is against the foregoing that Nigeria is embarking on a communication satellite project, NigcomSat-1, to be launched in 2006, to meet both Nigerian and African needs for sustainable development in the communication sector.

44. Space can also help the industrial sector in terms of its spin-off effects. For example, the space sector has contributed tremendously to manufacturing, liquefaction, transportation, storage and pipelining in the hydrogen industries. Apart from these, space can also contribute to the instrumentation, design practices, operational use and safety procedure for the storage of hydrogen as a fuel, thus opening an arena for fuel cell research and development with potentials to be used in the near future in transportation, portable devices and residential/commercial establishments .

III. Turkey

45. The specified contributions mostly aim at providing remote sensing data for atmosphere and climate change issues within the framework of sustainable development and the development of satellite-derived rainfall and snow products in contribution to the Satellite Application Facility (SAF) Programme of the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT).

46. The Remote Sensing Division of the Turkish State Meteorological Service has the ground satellite data receiving systems for the meteorological satellites described below.

Meteosat-8 / (MSG-1)

47. This is the first of the "Second Generation" meteorological satellite series of EUMETSAT. Meteosat-8 is a geostationary satellite. It is the successor of the Meteosat First Generation satellites and imaging features such as spectral resolution, spacial resolution and imaging duration have been improved. Meteosat-8 performs a scan of the complete Earth disk in 15 minutes. The Spinning Enhanced Visible and Infrared Imager (SEVIRI) collects data on 12 spectral channels, and the special resolution of the data at the Sub Satellite Point (SSP) is 3x3 km for 11 channels and 1x1 km for the High Resolution Visible (HRV) channel.

48. Following are the SEVIRI channels: visible band centred on 0.6µm - Channel 1 (VIS 0.6); visible band centred on 0.8µm - Channel 2 (VIS 0.8); near-infrared band centred on 1.6µm - Channel 3 (IR 1.6); infrared band centred on 3.9µm - Channel 4 (IR 3.9); water vapour band centred on 6.2µm - Channel 5 (WV 6.2); water vapour band centred on 7.3µm - Channel 6 (WV

7.3); infrared band centred on 8.7μm - Channel 7 (IR 8.7); ozone band centred on 9.7μm - Channel 8 (IR 9.7: O3); infrared band centred on 10.8μm - Channel 9 (IR 10.8); infrared band centred on 12.0μm - Channel 10 (IR 12.0); carbon dioxide band centred on 13.4μm - Channel 11 (IR 13.4: CO2); and broadband high-resolution visible band - Channel 12 (HRV).

Meteosat-7

49. This is the last of the "first generation" meteorological satellite series of EUMETSAT. Meteosat-7 is a geostationary satellite that performs a scan of the complete Earth disk in 30 minutes. This scan consists of the data of the three different spectral channels. Spacial resolution at SSP is 2.5x2.5 km for the visible channel and 5x5 km for the other channels. The High Resolution Imagery (HRI) channels are: visible wavelengths in the range 0.5 to 0.9μm; infrared wavelengths in the range 10.5 to 12.5μm; and WV wavelengths in the range 5.7 to 7.1μm

NOAA L-M-N Series

50. These are the polar orbiting meteorological satellites being operated by the National Oceanic and Atmospheric Administration (NOAA) of the United States. These satellites make nearly polar orbits roughly 14.1 times daily. The High Resolution Picture Transmission (HRPT) Station in Ankara collects data from these satellites about three to four times per day.

51. The satellites carry the following instruments: Advanced Very High Resolution Radiometer (AVHRR/3); Advanced Microwave Sounding Unit-A (AMSU-A); Advanced Microwave Sounding Unit-B (AMSU-B), except NOAA-N; High Resolution Infrared Radiation Sounder (HIRS/3); Space Environment Monitor (SEM/2); Search and Rescue (SAR) Repeater and Processor; Data Collection System (DCS/2); and Microwave Humidity Sounder (MHS) for NOAA-N.

52. The following section describes the EUMETSAT SAF programme and the contribution of Turkey to that programme.

Background

53. In November 1992, EUMETSAT adopted the concept of a distributed Application Ground Segment, including the Central Facility in Darmstadt, Germany, and a network of elements, known as Satellite Application Facilities (SAFs), as specialized development and processing centres. Utilizing the specific expertise available in Member States and Cooperating States of EUMETSAT, the SAF network complements the production of standard meteorological products derived from satellite data at the EUMETSAT Central Facility in Darmstadt and also distributes software packages.

Concept

54. The objective of a SAF is to undertake, on a distributed basis, the necessary research, development and operational activities that can be carried out in a more effective way than at the EUMETSAT Central Facility. The primary role of the SAF is to develop and deliver services and products aimed at enhancing the value and use of satellite data for applications, which are a common need of EUMETSAT Member and Cooperating States.

Rationale

55. When the SAF concept was created, EUMETSAT members aimed to:

(a) improve the ability of EUMETSAT Member States to exploit satellite data;

(b) encourage the utilization of existing skills and infrastructure in Member States for developing geophysical data products and services;

(c) facilitate cost-effective exploitation by ensuring services are distributed in the most appropriate way;

(d) ensure the most cost-effective balance between EUMETSAT central services and distributed services provided by the National Meteorological Services; and

(e) foster the development of cooperation with Cooperating States, non-Member States and other organizations.

Deliverable Benefits of SAFs

56. There are a number of specific benefits arising from the SAFs, including:

(a) improvements to short-range forecasting of severe weather hazards;

(b) benefits to the aviation, agriculture, construction, gas, water and electricity industries;

(c) better understanding of causes and effects of pollution of the upper atmosphere and the depletion of ozone;

(d) early warning of hazards;

(e) better data for climate monitoring;

(f) improved information for land use, ecology, disaster monitoring and agricultural forecasting;

(g) benefits for sea transport, fishing and offshore industries; and

(h) improved data for input to numerical weather prediction and the availability of user software packages for operational applications.

SAF Network Organization

57. Each SAF is led by the National Meteorological Service of a EUMETSAT Member State, working with a consortium of cooperating entities, such as other Meteorological Services, government bodies and research institutes of Member and Cooperating States.

Satellite Data Sources

58. During development, SAFs use data available from any suitable satellite systems, including research missions. In the operational phases, the primary focus is on the exploitation of data provided by operational satellites, and in particular by the EUMETSAT geostationary and polar systems.

SAF Products Distributions

59. Near real time SAF products are distributed by satellite (e.g. the EUMETSAT Broadcast System for Environmental Data (EUMETCast) via the Global Telecommunication System (GTS) / Regional Meteorological Data Communications Network (RMDCN) of the World Meteorological Organization (WMO)) or by other means as appropriate. The SAFs are users of the EUMETCast dissemination capability of EUMETSAT.

Participation of Turkey in SAF

60. Turkey is taking part in the Hydrology SAF (H-SAF) consortium with 11 other countries. Turkey is responsible for precipitation product development (rainfall and snow) using satellite derived data, calibration and validation of the products and impact studies of the products at selected sites. Turkey is represented in the consortium by the Turkish State Meteorological Service, the Middle East Technical University, and Istanbul Technical University.

61. The objectives of the H-SAF are defined as follows:

(a) development of products from existing and future satellites with sufficient time and space resolution to satisfy the needs of operational hydrology;

(b) use of satellite information related to hydrology for monitoring of processes like flooding, drought, snow cover and water exchange between the Earth's surface and the atmosphere; and

(c) development and evaluation of tools for combining spatially distributed information from meteorological satellites, radar and rain-gauge networks and other sources (numerical weather prediction, other satellite systems) to provide quantitative precipitation data for operational hydrology

Satellites to be used for the Development Phase (2005-20010)

62. Satellites and instruments will change during the Development Phase. Considering that a preoperational H-SAF service could be started in mid-2007, the reference coverage could be provided by: Metosat-8 and/or Meteosat-9 equipped with SEVIRI; NOAA-18 equipped with AMSU-A and MHS; DMSP-16 equipped with Special Sensor Microwave Imager/Sounder (SSMIS); DMSP-17 equipped with SSMIS; MetOp-1 equipped with AMSU-A and MHS; and NOAA-17 equipped with AMSU-A and AMSU-B.

63. SAF is divided into the Development and Operational Phases. The Development Phase covers the period 2005-2010. Tables 1 and 2 list satellite products to be developed and satellites and sensors to be used for rainfall and snow parameters.

Table 1: Satellite precipitation products and satellite data sources

Product	Anticipated product quality in the operational phase				Satellites / Sensors	
	Resolution	Accuracy	Cycle	Delay	Development	Operations
Precipitation rate (by microwave (MW) only)	10km (Conical Scanning Microwave Imager/Sounder (CMIS)) 15 km (additional Global Precipitation Measurement (GPM) satellites)	10-20 %(> 10 mm/h) 20-40% (1-10 mm/h) 40-80 % (< 1 mm/h)	6h(CMIS only) 3 h (full GPM)	15 min	Meteosat (Meteosat Visible and Infrared Imager (MVIRI), SEVIRI) + DMSP (SSM/I, SSMIS) + NOAA + MetOp (AMSU-A, AMSU-B/MHS) + EOS/Aqua (AMSR-E, AMSU-A, Humidity Sounder for Brazil (HSB)) + Tropical Rainfall Measuring Mission (TRMM) (TRMM	Meteosat (SEVIRI) + NPOESS (CMIS, Advanced Technology Microwave Sounder (ATMS)) + Further satellites of the GPM (all equipped at least with a MW radiometer, one also with radar)
Precipitation rate (by MW + Infrared (IR))	10 km	Ranging from that of MW to one degraded by an extent TBD	15 min	5 min		

Product	Anticipated product quality in the operational phase				Satellites / Sensors	
	Resolution	Accuracy	Cycle	Delay	Development	Operations
Precipitation phase (by MW only)	10km(CMIS) 15 km (additional GPM satellites)	80 % probability of correct classification	6h(CMIS only) 3 h (full GPM)	15 min		
Cumulate precipitation (by MW + IR)	10 km	Tentative: 10% over 24 h 30 % over 3 h	3h	15 min		

Table 2: Satellite snow products and satellite data sources

<table>
<tr><th rowspan="2">Product</th><th colspan="4">Anticipated product quality in the operational phase</th><th colspan="2">Satellites / Sensors</th></tr>
<tr><th>Resolution</th><th>Accuracy</th><th>Cycle</th><th>Delay</th><th>Development</th><th>Operations</th></tr>
<tr><td>Snow recognition (SR)</td><td>5 km (in MW)
2 km (in VIS/SWIR/TIR)</td><td>95 % probability of correct classification</td><td>6 h (depending on latitude)</td><td>2h</td><td rowspan="4">NOAA (AVHRR)
+
MetOp (AVHRR, Advanced Scaterrometer (ASCAT))
+
Meteosat (SEVIRI)
+
EOS-Terra/Aqua DMSP +
(SSM/I, SSMIS) (AMSR-E)</td><td rowspan="4">MetOp
+
(AVHRR, ASCAT)
+
Meteosat (SEVIRI)
+
NPOESS (Moderate Resolution Imaging Spectroradiometer (MODIS)) (VIIRS, + CMIS)
+
MW
+ radiometers Aqua of the GPM constellation</td></tr>
<tr><td>Snow effective coverage (SCA)</td><td>10km (inMW)
5 km (in VIS/short wave infrared (SWIR)/thermal infrared (TIR))</td><td>15 % (depending on basın size and complexity)</td><td>6 h (depending on latitude)</td><td>2h</td></tr>
<tr><td>Snow status (wet or dry)</td><td>5 km</td><td>80 % probability of correct classification</td><td>6 h (depending on latitude)</td><td>2 h</td></tr>
<tr><td>Snow Water Equivalent (SWE)</td><td>10 km</td><td>20 mm</td><td>6 h (depending on latitude)</td><td>2h</td></tr>
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