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Metrological challenges in earth observation

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Abstract- Abstract- The talk presents an overview on relevant climate observation needs. The main focus is on the role of remote sensing methods in the context of the United Nations Framework Convention on Climate Change (UNFCCC) Kyoto protocol [1]. In particular, the metrological challenges of a reliable earth observation for climate change detection and verification are discussed.

I. Climate change, earth observation, remote sensing, traceability.

There is unequivocal evidence that climate change and global warming are real and having significant effects on the earth and human being. Last decade, the issue of climate change has arrived at the top of the global political agenda. However, still many aspects of the global climate system are not yet completely understood and, therefore, disputed both by the public, the politics and the economy. Relevant key uncertainties involve the role of the clouds, the sea-level rise, the carbon cycle and the impact of human-caused aerosols. Reducing these knowledge lacks and uncertainties will assist governments and international organizations to adopt more effective policies for mitigating, and adapting to climate change.
The agreement of the latest UN Climate Change Conference in 2009 (COP15) recognize the scientific view that the increase in global temperature should be kept below two degrees Celsius to avoid dramatic problems in adapting our life to a fast changing environment. It also calls for a review of the accord by 2015, along with a consideration of strengthening the long-term goal "in relation to a temperature rise of 1.5 degrees Celsius."[2] A reliable scientific research input is really critical for implementing international commitments of states and for their willingness to address the challenges related to the above objectives.
The need for accurately interpreting small changes in the state of the environment on a climatic time scale requires internationally accepted traceable measurement standards with lower uncertainties and monitored and maintained stability. Many of the challenges faced by climate change forecast are measurement challenges, such as, for example assessing the sinks and sources of greenhouse gases, assessing the spectral absorption effect of these gases, and the resulting changes in surface and atmospheric temperature. Main areas which require the support of metrology are long term stable monitoring of trends in the overall atmospheric composition , standards and calibration methods for the measurement of greenhouse gases (GHG) and atmospheric species and the support of earth-system science. The latter includes earth observation and remote sensing of land and ocean parameters.
The establishment of pre-launch as well as in-flight calibration which is traceable to interna-tionally agreed reference standards is one of the most urgent metrological challenge. Novel calibration systems providing traceability will allow the comparison between various national/regional monitoring systems, measurement techniques and data acquisition systems operated worldwide. Novel in-flight calibration strategies allowing traceability to the SI from space are a fascinating vision of the metrology community. International attempts to tackle this goal are discussed. One example is the Quality Assurance Framework of Earth Observation (QA4EO) which has been endorsed by the Committee on Earth Observation Satellites (CEOS) as a contribution to facilitate the Group on Earth Observations (GEO) efforts for a Global Earth Observation System of Systems (GEOSS). The core principle of the quality framework established by QA4EO is the use of quality indicators and establishing traceability of measurement results [4]. To set up GEOSS [5] is part of the ten years implementation plan of the Global Climate Observation Service Implementation Plan for the period from 2005 through 2015. Climate is one of the driving forces of this plan.
Recognizing the demand of getting SI-traceable measurement results obtained by global observing systems, in Spring 2010 the World Meteorological Organization (WMO) and the BIPM jointly hosted an international workshop on Measurement Challenges for Global Observation Systems for Climate Change Monitoring.[3] During this workshop, a WMO-CIPM MRA was signed "…to ensure that data, related in particular to measurements of state and composition of atmosphere and water resources… are poorly based on units traceable to the SI…"
Important objectives and conclusions of this workshop apply for examples to remote sensing technologies. At present, remote sensing technologies are used in the observation of about one third of the essential climate

variables (ECVs) of the International Climate Observation System (GECOS).
The provision of new measurement technologies and standards that support the capability to monitor the environment and to mitigate the and adapt to climate change requires a multi-disciplinary and collaborative approach. The 2010 Call on Metrology for Environment of the European Metrology Research Program (EMRP) opens the possibility for the European metrological community to strengthen its efforts in developing the necessary metrological infrastructure. Through the EMRP, the European National Metrology Institutes and Designated Institutes will be empowered to coordinate and collaborate with each other for achieving maximum impact of modern metrology. This will enable them to underpin the international effort in defining environmental objectives and standard within the post-Kyoto process.

References

[1] Rosenquist A et al, A review of remote sensing technology in support of the Kyoto Protocol, Enviromental Science &Policy 6(2003) 441-455
[2] http://www.pewclimate.org/international/copenhagen-climate-summit-summary
[3] http://www.bipm.org/en/events/wmo-bipm_workshop/
[4] http://www.qa4eo.org/docs/GSICS_QA4EO.pdf
[5] http://www.earthobservation.org