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The Need for Atmospheric and Climate Research Infrastructures

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The need to routinely monitor and understand the state of the atmosphere and the Earth System has been recognized since the late 19th century when international coordination of observations began. A sophisticated global network for classic meteorological variables such as wind, temperature, pressure, water vapour, cloud cover and type, precipitation and solar radiation has evolved within a framework maintained by the World Meteorological Organization, other international organizations and national partners. It has been driven by the many different users needing weather and climate information from such diverse sectors as marine transport and shipping, energy, agriculture, water management, aviation and defense. Originally, it was confined to mostly surface-based observations but in the mid 20th century, vertical balloon profiling was added to meet the needs of aviation and an emerging interest in numerical weather forecasting. In the late 20th century, two major changes took place. First, the chemical variables- greenhouse gases, aerosols, ozone and their precursors- that influence weather, climate, ecosystems and the air we breathe were added mainly as surface-based *in situ* and remote sensing networks. Second, the mainly two-dimensional surface-based network of classic meteorological variables was transformed into a comprehensive three-dimensional global system integrated using atmospheric models and data assimilation techniques. This was done by greatly enhancing observations from surface-based and satellite remote sensing instruments and commercial aircraft.

With the possible exception of stratospheric ozone, global observation systems for chemical variables have not yet made the same jump from surface-based two dimensional networks to comprehensive integrated three dimensional networks. Unlike classic meteorological variables that have institutionally stable infrastructures dedicated to their long term measurements, chemical variables have been measured through a patchwork of international, national or regional research efforts with short term funding whose longevity cannot be assured for the longer period of time that is essential for environmental security. Today in Europe and indeed the World, there is an opportunity to fill a gap in medium to long term infra-structure support for chemical observation systems.

Atmospheric and climate research infrastructure initiatives are needed to assure long term three dimensional atmospheric observations as a solid foundation for shorter term process and model development research activities within the European Research Framework programme. This presentation reviews emerging atmospheric and climate research infrastructure initiatives that, when implemented within a global context, will strengthen the environmental security of Europe. Observations of atmospheric greenhouse gases and their regional or global budgets as well as enhanced vertical profiling of the atmospheric using aircraft and surface-based systems are a priority. Infrastructures that achieve this or that enable the atmospheric and climate process research required for prediction and analysis will represent a swing of the pendulum back from the extreme of short term project funding. This will help to place Europe solidly amongst the leaders of Earth System studies of the 21st century.