EU COST Action 720
Integrated Ground-Based Remote-Sensing Stations for Atmospheric Profiling: An overview

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Abstract

In 2001, the European Research Action COST-720, "Integrated Ground-based Remote-Sensing Stations for Atmospheric Profiling" was installed as a five-year project in order to contribute to improvements in vertical profiling using active and passive ground-based remote-sensing techniques. The major scientific objectives to this research action were:

(1) Assessment of new or improved profiling systems,
(2) initiation and stimulation of improvements to basic techniques as well as basic algorithms for ground-based remote-sensing systems,
(3) assessment of algorithms using combinations of different techniques for improved profiling of atmospheric parameters (integrated profiling), and
(4) realisation of field campaigns for data provision to OSE experiments in NWP modelling (*see contribution on LAUNCH-2005*).

The paper gives an overview on COST-720 in general and shows selected results to the different scientific objectives of the action. Special emphasis will here be laid on results from evaluations of the integrated profiling objective. As an example, an impression on the capabilities of cloud profiling using integrated systems and algorithms is given. As cloud profiling particularly enables validation of NWP output as well as improvements of model parameterizations, the contribution will exemplify results of integrated cloud profiling to the output of various NWP models.

1. The COST framework

Founded in 1971, COST is an intergovernmental framework for European Co-operation in the field of Scientific and Technical Research, allowing the co-ordination of nationally funded research on a European level. COST Actions cover basic and pre-competitive research as well as activities of public utility.
COST has clearly shown its strength in non-competitive research, in pre-normative co-operation and in solving environmental and cross-border problems and problems of public utility. It has been successfully used to maximise European synergy and added value in research co-operation.
The member countries participate on an “à la carte” principle and activities are launched on a “bottom-up” approach. One of its main features is its built-in flexibility. This concept clearly meets a growing demand and in addition, it complements the other Community programmes.
COST has developed into one of the largest frameworks for research co-operation in Europe and is a valuable mechanism co-ordinating national research activities in Europe. Today it has almost 200 Actions and involves nearly 30,000 scientists from 34 European member countries and more than 80 participating institutions from 11 non-member countries and Non Governmental Organisations.

2. COST Action 720, objectives, organisation

Aim: The development of integrated ground-based remote-sensing stations for atmospheric profiling. 12 EU and 2 non-EU countries participate in this Action, which ends in June 2006. A Final Report is in preparation.
Working Group 1, Basic techniques and algorithms. Tasks are the assessment of the state of the art of individual techniques in view of their potential for integration. Where necessary and possible work has been done on improvements, especially with respect to algorithms. Considered measurement systems are in particular: Microwave and Infrared Radiometer, Lidar, Wind profiling radar, Cloud radar and C-Band weather radar.
Working Group 2, Integration. Tasks are the derivation of profiles of temperature, humidity and clouds.
Additional activities on data use: Assessment of assimilation techniques for humidity and cloud profiles; impact studies on ground-based networks of high-resolution profiling stations, proposal for a BUFR code for integrated profiling stations.

3. Key field experiments

3.1. TUC (Temperature, Humidity and Cloud Profiling), Payerne (Switzerland), Nov. 2003 - Feb. 2004. This was a COST-720 initiative, broadened into weather forecasting and automatic cloud cover detection. TUC was designed to test single ground-based temperature profiling systems and humidity profiling systems and to assess automatic cloud detection systems. The dataset enabled further studies on system integration for temperature and humidity profiling and the detection of PBL phenomena.

3.2. International Radiosonde Intercomparison, Mauritius, February 2005. Participation with GPS water vapour, cloud radar and laser ceilometer was considered beneficial for WMO and COST-720.

3.3. Convective Storms Initiation Project (CSIP), Central Southers England, (UK Universities), June - August 2005. A microwave radiometer and laser ceilometer, deployed alongside a 1290 MHz windprofiler at Linkenholt, Hampshire, UK, were supplemented by radiosondes and Chilbolton radar scanning's across the top of the site, allowing integration studies for summertime boundary conditions. This completed other field work and high resolution NWP modelling.

3.4. LAUNCH [1] field experiment, DWD Richard Aßmann Observatory, Lindenberg (Germany), Sept. - Oct. 2005: The first objective is directed to improvements in NWP modelling (validation of model output, improvements of physical parameterisations), using data of individual remote-sensing systems and two integrated stations for monitoring wind, temperature, water vapour and clouds. The second objective is the assessment of water-vapour lidar and microwave systems providing input for mesoscale NWP assimilation experiments in Eastern Germany and middle and Southern Italy. The data will also be used for an assessment of a new single-photon-counting ceilometer and an FTIR spectrometer for atmospheric temperature and humidity sounding.

3.5. Helsinki Testbed. August 2005 meteorological measurement campaigns started in Southern Finland. Aim is to provide input and experience for mesoscale weather research, forecast and dispersion model development and verification, information systems integration, end-user product development and data distribution for public and research community. The Finnish weather observation network has been supplemented with nearly 60 stations equipped with Vaisala WXT510 weather transmitters, of which 42 are cell-phone base-station masts. New ground-based remote-sensing instruments in the Testbed domain are a 1,3 GHz wind profiler/RASS, a dual-polarization weather radar in Helsinki, and five laser ceilometers.

4. Research topics on integration

4.1. Cloud geometry and structure: Instruments = Radar (estimation of radar reflectivity), Lidar, (extinction profile), Microwave radiometer and first guess.

4.2. Fog, low level clouds, Cloud top and cloud base: Instruments = Ceilometer, FM CW Radar, Present Weather Sensor.

4.3. Humidity profile. Instruments: Microwave radiometer, Wind profiler (S/N ratio, spectral width), Cloud radar, Ceilometer, GPS, ASMUWARA (All-sky multiwavelength radiometer, Uni-Bern).

4.4. Temperature profile 1: Instruments = Microwave radiometer, Infrared radiometer, Cloud radar, Ceilometer, Wind profiler. A variational method has been developed to integrate observations from these instruments with *a priori* information from an NWP model. The required forward models and error characteristics have been developed and validated for some of these observations. The same technique can be applied to the retrieval of humidity profiles (4.3).

4.5. Temperature profile 2: Instruments = Wind profiler (VHF), RASS.

5. Future

A proposal for a new COST Action is being developed. It will aim at the development and implementation of ground-based remote-sensing systems that will serve both the needs of weather forecasting and climate monitoring in Europe, contributing to EUCOS an GCOS, and contributing to operations as well as research. Furthermore, it is agreed to prepare a proposal for a new EUMETNET programme, focussing on the implementation of a network of operational integrated observing sites and the development of algorithms for the validation of NWP model output using their data.

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[1] International Lindenberg campaign for assessment of humidity and cloud profiling systems and its impact on high-resolution modelling