

A field experiment for the observation of alpine precipitation

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Abstract—A field experiment devoted to the observation and the quantification of alpine precipitation will be set up in Davos from Fall 2009 to Spring 2010. In particular, a dual-polarization Doppler weather radar will be involved, as well as ground instruments (disdrometers, weather stations) for validation.

I. INTRODUCTION

WATER resources of many countries all over the world solely depend on the amount of liquid and solid water stored in mountains. Being the only source, precipitation determines water input in mountainous regions. In these regions, the variability of precipitation in space and time is amplified by the complex interactions between the atmospheric dynamics, the microphysical processes controlling precipitation and the rugged topography. This strong variability is a key issue for the monitoring, the modeling and the forecasting of precipitation. Because of the harsh conditions, accurate and reliable measurements of precipitation in mountainous regions remains a challenge that has major consequences on water resources, natural hazards and ecosystem functioning. Polarimetric weather radar systems can provide crucial high-resolution information about precipitation in mountainous regions. This is essential in order to close the energy and water budgets as well as to improve the current capabilities of weather and climate numerical models to better assess the potential impact of climate change in these sensitive regions. In addition, the possibility to determine if precipitation are solid or liquid using polarimetric radar measurements is of particular interest to study the dynamics of the transition between snow and rain.

In order to advance our understanding of the hydrometeorology of mountainous regions, a field campaign has been set up in Davos (CH). The main objective of this field campaign is to better understand the small-scale dynamics of precipitation in a mountainous environment, by collecting reliable high-resolution measurements from the polarimetric X-band weather radar recently acquired by EPFL-LTE and by developing appropriate techniques for the estimation of liquid and solid precipitation.

In addition to the radar, other instruments will be deployed. In particular, a video disdrometer from EPFL-LTE will be installed at the experimental site of the SLF on the Weissflujoch. This sensor will provide crucial information about the size and shape of hydrometeors. The other instruments run by SLF at the Weissflujoch and Wannengrat sites will be useful for comparison between radar estimates

and ground-based measurements. This field campaign is part of the Swiss Experiment.

II. THE FIELD EXPERIMENT

The field experiment (described in this section) will be conducted from September 2009 to Spring 2010, in order to collect a large data set representative of the diversity of alpine precipitation, with a focus on solid precipitation.

A. Site

As previously mentioned in the introduction, the field experiment will be set up in Davos (CH). This particular site has been chosen because the Swiss Federal Institute for Snow and Avalanche (SLF, part of WSL) is located in Davos. Researchers at SLF have studied issues related to snow for decades. In particular, two sites have been instrumented for the observation of snow (see <http://www.slf.ch/ueber/standorte>): (1) The Weissflujoch site, a research field at about 2600 m of altitude with many instruments (in particular weather stations, precipitation gauges, and daily manual observations of snow height and density during winter), and (2) the Wannengrat site, a more remote site at about 2500 m of altitude where about 10 weather stations (including radiation measurement) have been deployed. A map of the area is shown in Figure 1. Therefore, the significant experience and knowledge about snow measurement that can be found at SLF will be useful for the interpretation and the evaluation of the measurements collected by the polarimetric weather radar (deployed at about 2100 m of altitude so that both sites will be covered).

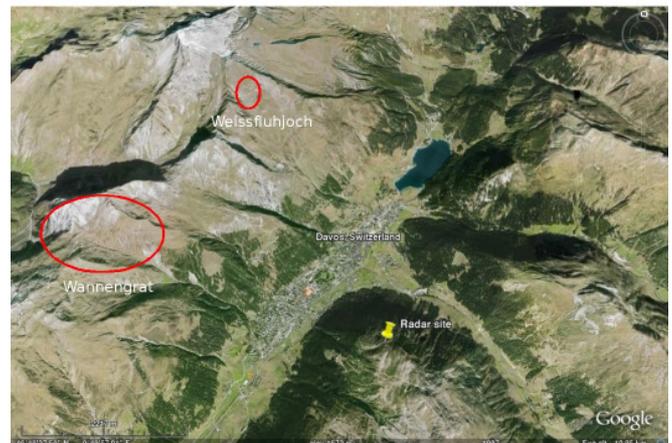


Fig. 1. Main instrumented sites for the field campaign in the Davos area.

B. Instruments

In this section, the main instruments that will be deployed/used during this field experiment are listed:

1. A dual-polarization Doppler (or polarimetric) weather radar transmitting at 9.41 GHz (X-band). This is a mobile radar system recently acquired by EPFL-LTE. Using the different polarimetric signatures of the different types of hydrometeors, the type of precipitation can be identified. A picture of the system is presented in Figure 2.
2. Optical and video disdrometers to measure the number and the size of the hydrometeors, in order to estimate the drop/particle size distribution, a critical information for radar data interpretation and for the validation of numerical weather model. Figure 3 shows the 2 optical disdrometers already deployed at the Weissfluhjoch site.
3. Weather stations from SLF at both sites, to collect standard meteorological variables (temperature, humidity, wind speed and direction, radiation among others). A picture of a weather station deployed at the Wannengrat site is shown in Figure 4.



Fig. 2. The mobile X-band polarimetric radar system.



Fig. 3. The 2 Parsivel optical disdrometers deployed at the Weissfluhjoch site (and other instruments).



Fig. 4. Weather station on the Wannengrat site (courtesy SLF).