



## SNOWBALL

### **REMOTE SENSING, MODEL AND IN-SITU DATA FUSION FOR SNOWPACK PARAMETERS AND RELATED HAZARDS IN A CLIMATE CHANGE PERSPECTIVE**

Snow monitoring is essential for prediction of flooding due to rapid snow melt, to provide snow avalanche risk forecasts, and for water resource management, including hydro-power production, agriculture, groundwater and drinking water supply. Three important applications of snow monitoring will be demonstrated: snow-melt induced flash flood warning, snow avalanche warning and hydrogeological modelling of the snow melt water infiltration. The project will also assess the impact of snow under present and future climate conditions on: flash flood statistics due to snow melt contributions, avalanche statistics and groundwater.

The project explores and develops methodologies for developing a future service providing national authorities and general public with real-time snow information and related hazards.

### PROJECT OBJECTIVES

Improve the spatial and temporal resolution of in-situ snowpack parameters measurements.

Development of algorithms and implementation of a prototype snow monitoring system combining Sentinel 1, 2, 3 satellite data, weather station data, and hydrological modelling for snowpack parameters estimation.

Assessment the impact of climate change on the snow-related resources and hazards.

Define and test a reliable methodology for the snowmelt infiltration component of the hydrogeological cycle.

Develop and implement a data assimilation procedure for adjusting the snowpack related state parameters within the snow module of the hydrological forecasting models.

Develop methods for avalanche detection, modelling, and hazard assessment.

# PROGRAM GOAL

The program contributes to the reduction of economic and social disparities in the European Economic Area and to strengthen the bilateral relations by enhancing research cooperation between the scientific communities of Romania, Norway, Iceland and Liechtenstein.

## SNOWBALL PRACTICAL RELEVANCE

SnowBall addresses a problem of national interest, namely the accurate and timely knowledge of the seasonal snow distribution and characteristics. The socio-economic impact of snow is significant, ranging from water management and hydropower, to agriculture, transport, tourism, urbanism and emergency situations management.

The monitoring of ice and snow is very important for the management of natural resources, extreme events prediction such as snowmelt floods, avalanches and the impact of global warming.

Observations of snow pack parameters provide a very important source of information for long term hydrological prediction in spring season; the snow water equivalent observations are essential to update the model simulated snow pack conditions, to ensure that



hydrological forecasts are reliable.

The use of satellite-based snow parameter products will provide more accurate estimates, especially when simulating the hydrologic processes on a national scale or for very large river basins.

A modern approach to avalanche hazards estimation by integrating satellite data, high resolution DEMs and field data and by developing innovative methods like object-based image analysis for automatic detection of the avalanches, delineation of the avalanche release areas, numerical avalanche simulation and change detection of the areas affected by avalanches.

Detailed studies for estimating the magnitude of climate change impacts on snow in Romania.

### Partners:

1. National Meteorological Administration, Romania;
2. Norwegian Computing Center, Norway;
3. Technical University of Civil Engineering, Romania;
4. National Institute of Hydrology and Water Management, Romania;
5. West University of Timisoara, Romania.

**Project Budget:** € 1.199.000

**Project Director:**  
PhD. Gheorghe Stancalie  
gheorghe.stancalie@meteoromania.ro

**Project website:**  
snowball.meteoromania.ro

