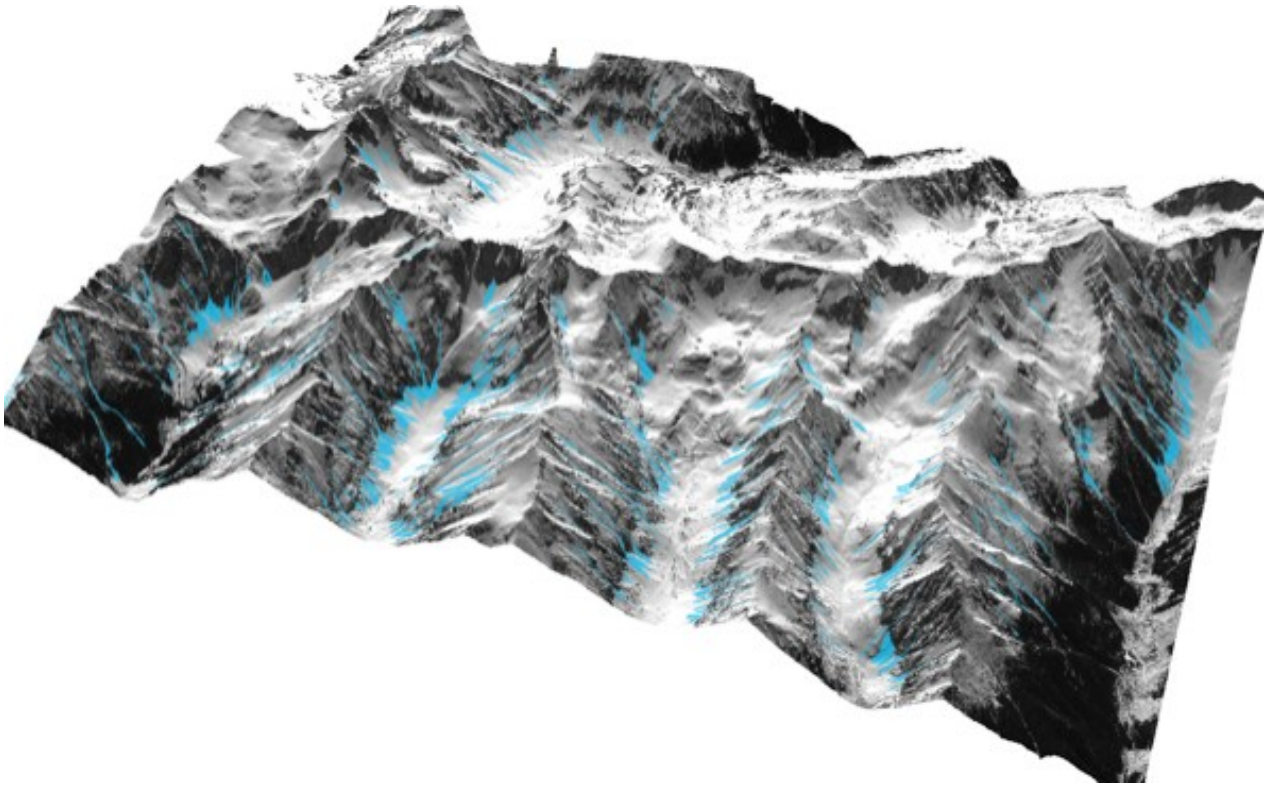
SNOWBALL

Newsletter



Dear readers,

The Snowball team presents the first newsletter dedicated to disseminating the results achieved in the project. The Snowball (Remote sensing, model and in-situ data fusion for snowpack parameters and related hazards in a climate change perspective) is a scientific research project won by the National Meteorological Administration in partnership with the Norwegian Computing Center, Technical University of Civil Engineering of Bucharest, National Institute of Hydrology and Water Management and the West University of Timisoara. The project is funded under the EEA Financial Mechanism 2009 – 2014. The main goal of the project is to develop a new service to provide to national authorities and to general public, consistent information, in quasi real time to monitor the spatiotemporal characteristics of snow cover and the associated hazards (floods caused by the sudden melting snow and avalanches), in the context of present and future climate conditions, based on in-situ and provided by satellites data.

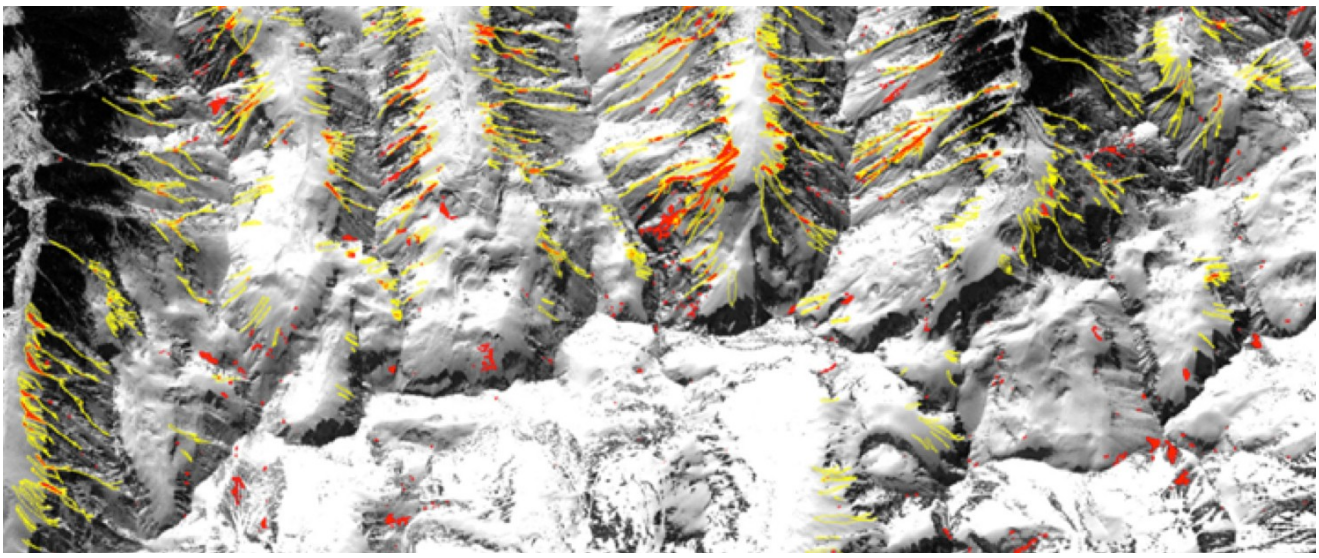
In situ measurements of snow covere parameters

In 2015, this activity was carried out in two directions:

- Design and implementation of new instruments and equipment for measuring snow cover parameters. More specifically, there were designed, tested and implemented the equipment (transducers) for measuring the following meteorological parameters that characterize and influence the evolution of snow cover: soil temperature measured on six levels depth; snow cover temperature pre-set on 5 levels; temperature and snow humidity on discrete levels; snow depth; the temperature at the surface of snow and air temperature.
- The observation and measurement of the snow cover during field campaign, including measurements of the optical properties of snow in the solar spectrum and infrared. Thus, measurements were performed in the study area from Romania, using the spectrometer DSR and spectrometer FieldSpec Pro FR, both by Romanian National Meteorological Administration and Norwegian Computing Center.

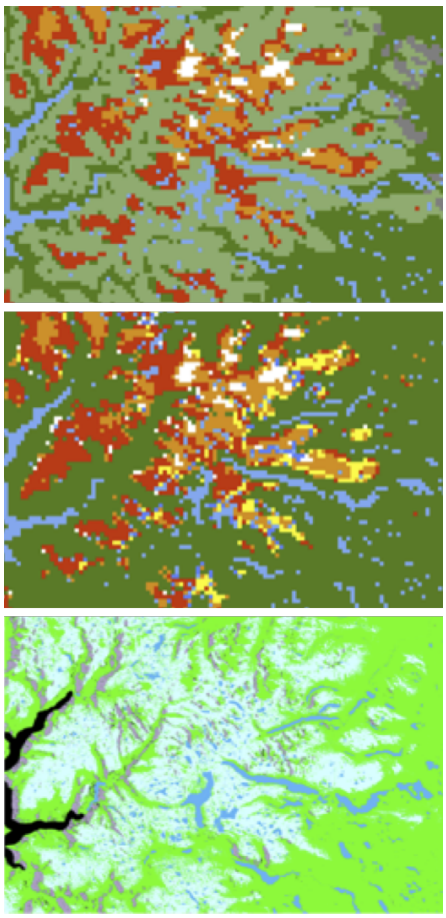
The development of avalanches detection algorithms

To detect quickly and accurately the avalanches and to assess their risk to occur, there were used GIS techniques and very high spatial resolution satellite images (GeoEye-1, QuickBird, Pleiades). So digital maps were developed and were made the statistic analysis of climate data and the main factors of hazard involved in the production of avalanche. In the central glacier sector from Fagaras Mountain (Balea Valea Doamnei, Valea Capra), which is known by the high incidence of avalanches were mapped by field campaigns 34 corridors of avalanches that have been integrated into the GIS database. Areas affected by more than 540 episodes of avalanches have been identified on satellite images of very high spatial resolution. Avalanches inventory represents a premiere for the Romanian Carpathians. In order to achieve the avalanche hazard maps, it has developed a semi-automated method for detection based on the integration avalanche corridors morphometric characteristics extracted from the topographic surface models, digital terrain model derived. It was also performed a preliminary analysis of the capability of avalanches identification based on the algorithm developed by the object oriented analysis, tested on QuickBird satellite images for some mountainous areas in Norway.



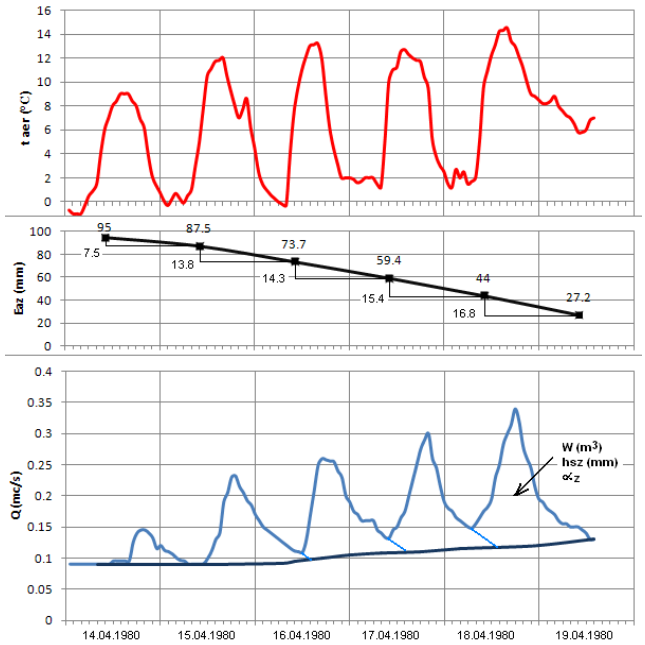
Developement of the estimation of snow cober parameters algorithms from satellite data

To obtain the snow cover parameters from satellite data, in 2015, have developed / used methods and specific algorithms for each spectral domain and parameter. Thus, for optical domain, the snow wetness product is based on the estimation algorithms for wetness at the snow surface using a temporal data analysis: the temperature at the snow surface, the snow grain size and snow coverage. For radar data, the algorithm uses changes detection based on the reports: the area covered with wet snow / without snow (or with dry snow). Radar image processing was done using software application developed in IDL and Python languages, ensuring flexibility in composing processing chains. Currently the algorithms are used for MODIS and RADARSAT images, following to be improved and transferred for the images Sentinel-1 / -3. The results obtained for both study areas from Norway and those from Romania were validated using data recorded by sensors placed at meteorological and hydrological stations or measurements collected within field campaigns. The validation results are very promising and the quality and temporal resolution of the products will increase in 2016 with the launch of European satellites Sentinel-1B and Sentinel-3A.



Improving the water flow forecast resulting from snowmelt

To improve the warnings and forecasts of the water flow resulting from snowmelt, is critical an accurate estimation of snow water equivalent. During 2015 has developed a procedure for data fusion based on simulations made with the hydrological model NOAH, that uses observations of the snow cover parameters measured within national networks of meteorological and hydrometric stations, as well as products satellite relating to snow cover characteristics. A re-configuration of the NOAH forecast model was performed with a simulation snow module through a multilayer representation of it. Configuring the snow module was achieved at the national level to 1 km spatial resolution; the implementation is based on open-source software system for hydrological modelling with distributed parameters WRF-HYDRO.

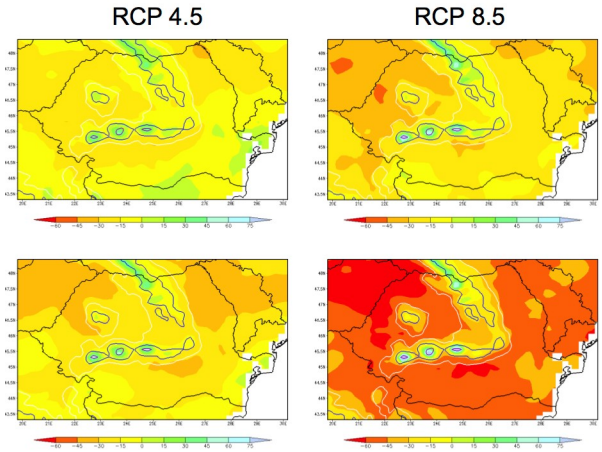


Using the snow module in the multilayer architecture will enable the development of complex data fusion procedures, in particular, a better use of satellite products that relate to the snow cover characteristics.

The influence of variability and climate change over the snow cover and associated hazards

During 2015 was made an analysis of the results of 6 numerical experiments with regional climate models under the two scenarios (RCP 4.5 and RPC 8.5) regarding the changes of snow depth in Romania, from the time horizons 2021-2050 and 2070-2099 time with the reference period 1971-2000. There were found that:

- Decreasing the thickness of snow cover is increasing with the end of XXI century, especially in the scenario RCP 8.5 for that the concentrations of greenhouse gases are higher and the radiative forcing more intense;



- Spatial configurations of change shows the orography impact, such that the location of the Carpathian Arch compared to large scale circulations causes the local specific effects;
- Decreasing snow depth is stronger in the south of Meridional Carpathians, in the west of Apuseni Mountains, and in the north-west part of the country where up to 90% under the worst scenario RCP 8.5;
- In the period between 2021-2050, the regions from north-eastern Romania face in both scenarios with significant decreasing of snow cover of up to 45%.

Assessment of snowmelt water infiltration in unsaturated zone to replenish aquifers

Water resulting from melting snow is an important source contributing to the replenishment of aquifers through infiltrations. The assessment of the water infiltration resulting from snow melting was based on the study of physical processes relating to the freeze-thaw phenomena, the migration of water in soil, the infiltrations of the water from melted snow in the frozen soils, the interaction between snow and frozen soil, the heat from soil and heat transfer at the interface soil - snow cover and the soil degradation through erosion processes. The modelling and prediction infiltration processes of the water resulting from snow melting in the frozen soils can be used in assessing the risks and damage relating to climate change.