Scientific report of STSM AvalMap Andorra – data review and field observation

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Name of the host institute
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- **Purpose of the STSM**

This STSM was the first of a two part Short Term Scientific Mission. The purpose of this two part mission is to run the snowpack model AvalMap, developed by Anna Seres for the Low Tatras in Slovakia (Fig.1.), for an area in the Andorran Pyrenees and see if it is applicable to such different input data and geographical conditions and to what extent. If it is found to produce sufficient results, the model could be implemented for that area for further use. AvalMap is a complex, multi-layer snowpack model, which beside calculating the most important snowpack processes and parameters (depth, density, crystal size and shape, bonding strength between layers, weak layers), also gives an estimate about the avalanche danger for each pixel of the input DEM.

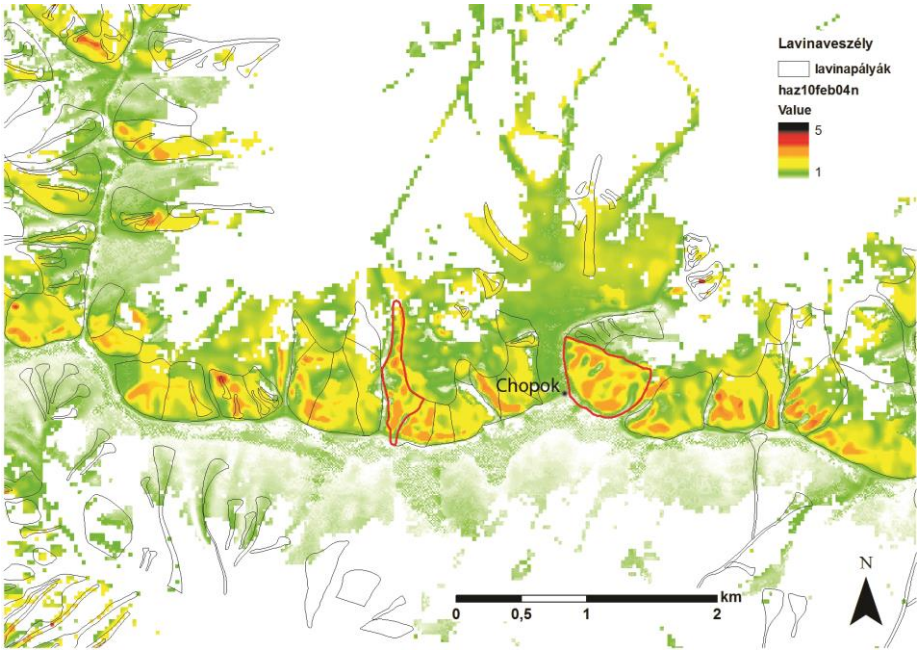

Fig.1. Final result of the model AvalMap, showing the avalanche danger for the Chopok group of the Low Tatras in Slovakia. This model will be implemented to the Andorran Pyrenees.

- **Description of the work carried out during the STSM**

During the STSM the following work was carried out:

- 2 days of field observations:
  - 1.day: Visiting the area of Ordino-Arcalis, Font Blanca and the Area of Seturia, where a boarder view could be obtained from the study area, the characteristic landforms, the location of the meteorological stations, ski slopes, popular ski touring sites (Fig.2.).
  - 2. day: Visiting the meteo station at Sorteny Natural Park, which will be one of the main data supply stations (Fig.3,4.).
- 2 discussion days:
  - 1 office day: Giving a presentation about AvalMap, introducing it to some of the staff at CENMA. Discussing what type of nivo-meteorological data are needed to run the model, in what format and which would be the best stations to use for which variable with Dr. Laura Trapero and Dr. Marc Pons. Discussing what raster data are needed to run the model, checking the available and most suited date with Marc Pons and Roger Caritg.
  - 1 discussion day: Discussing how the work could be carried out in practice, how frequent and what type of validation data are needed. Transferring the raster data. Design of the 2015-2016 winter measurement campaign data generate the data needed for the validation process.

Fig.2.: View of the Ordino-Arcalis area, Andorra.

Fig.3.: Dr Laura Trapero looking for the reason of missing snow depth data at the Sorteny meteorological station

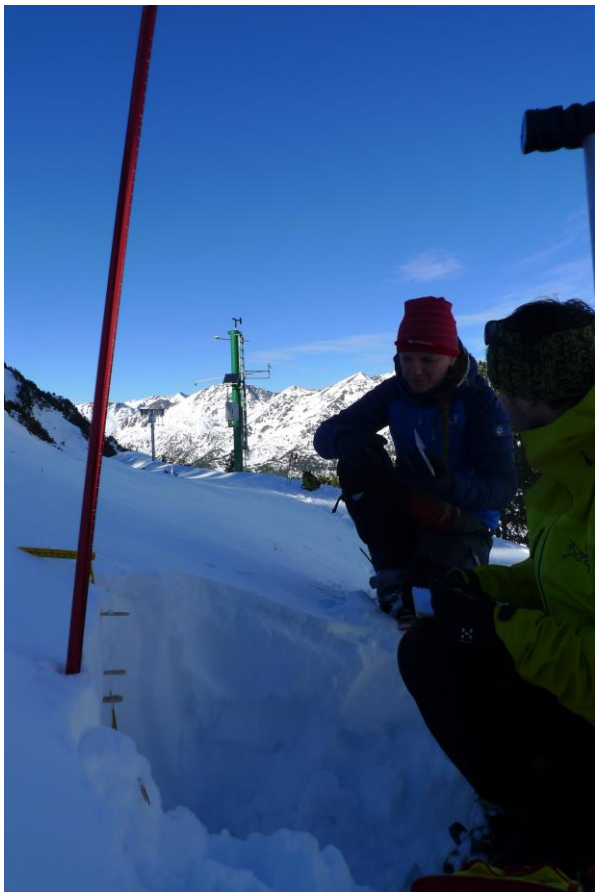

Fig.4.: Dr Marc Pons and Dr Anna Seres doing snow pit analysis at Sorteny National Park

- **Description of the main results obtained**:

Deciding what type of data will be used from which station. Wind input data will be used from Maia weather station, with the other wind measurements used for validation. Temperature will be used from all available stations (Fig.5.). The same interpolation technique will be used as is in the model, but completing it with variables typical for the area, like distance from the sea and distance to the north (latitude). Determining what type of precipitation was falling and where by crossing the interpolated precipitation map with the interpolated temperature map or by considering 3 vertical bands (representing 3 different climatic behaviours inside the country) with 3 input data (Perafita, Bony, Sorteny weather stations).

By checking the available raster data, it was found that the existing land cover data is not really sufficient for the model as many times it indicates forest in new the avalanche paths. A new land cover data should be made either by the classification or the simple drawing of the available orthophotos. The following changes should be made in the model: Using rhododendron instead of the category dwarf pine, with reduced snowpack depth limit (1m) to allow avalanches to slide down. Add category sparse forest with the limit of 0,5m snowpack limit to the land cover categories.

Deciding that the model would be run for the past two years first, roughly adjusting it based on the available validation data, then it would be run for the actual season, taking frequent validation data (weekly snow pits and stability test at several sites) fine calibrating the model.

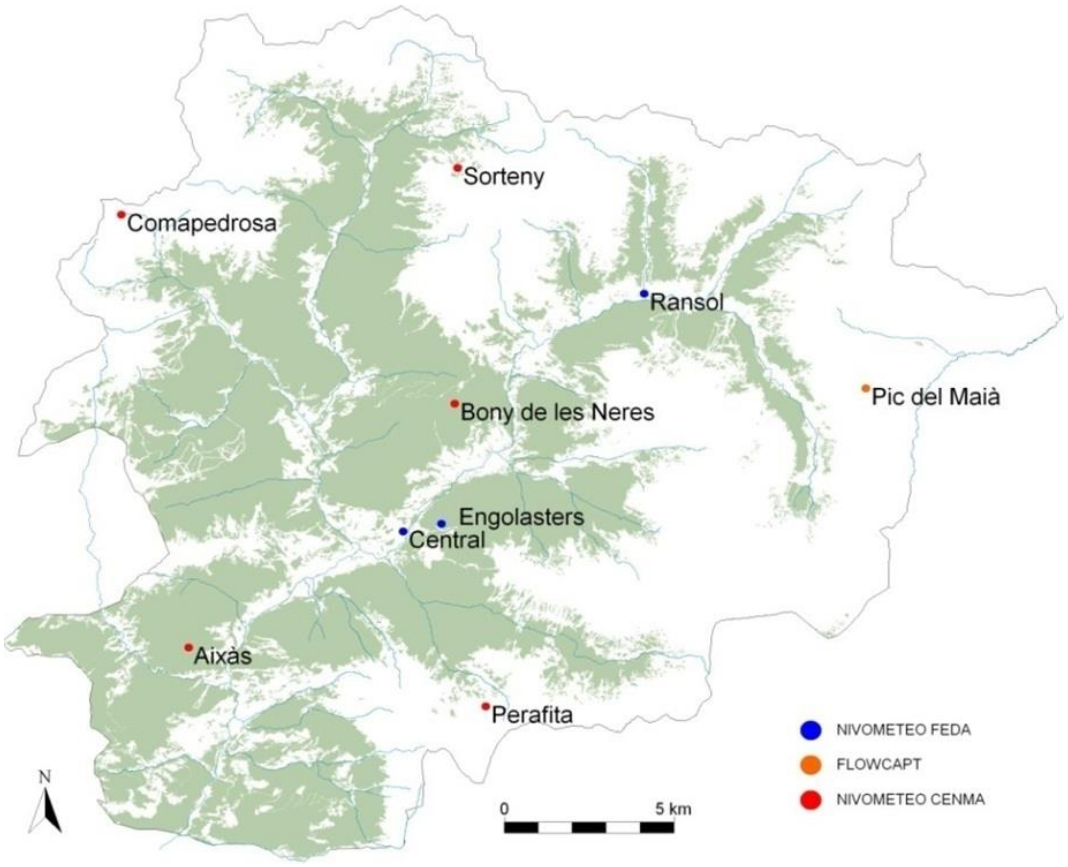

Fig.5. Meteorological stations of Andorra that will be used for the model AvalMap

- **Future collaboration with the host institution**

As a result of this mission, the model will be run for Andorra for the whole season and validation data will be taken. In 2016 the calibration of the model will be carried out within the framework of another STSM. If the model is found to produce sufficient results, the model could be implemented for Andorra for further use.

- **Foreseen publications/articles resulting from the STSM**

Publications/articles are not foreseen as the result of this STSM, but a publication is planned after the validation, the second STSM.

- **Confirmation by the host institution of the successful execution of the STSM**

A letter from the host institution has been attached to this report in order to confirm the successful execution of the STSM.