Introduction

The project focuses on the modeling and forecast of snowmelt runoff, from small and mid-size basins during the winter period. Special consideration will be given to the prediction of "rain on snow" (ROS) events in intermediate mountain regions, as these events have been shown to frequently produce potentially dangerous floods in such basins. The forecast of ROS events is of critical importance for the safety and welfare of the population, as they can lead to significant damage to infrastructure and property. The development of a comprehensive understanding of the processes involved is crucial for improving the accuracy of these forecasts.

Methodology

The sensors used are off-the-shelf stand-alone systems with a built-in datalogger. The distance between the sensor and the receiver is measured with an accuracy of ±0.5%. The distance readings are corrected for the height and the size of the sensor is recorded by the software, and for the air temperature at which they are recorded. Recordings are triggered by solar radiation and external noise or snowfall. A number of innovative methods exist to fill these gaps, ranging from simple sensor extrapolation to the use of satellite imagery.

The Study Basins

Sensor networks will be set up in three basins over the next two winters. The chosen basins differ in their size and topographical and vegetation characteristics. The first basin selected for the study is the "Bregen" catchment, located approximately 10 km to the south of the Black Forest. The basin is about 40 km² in area and has a fairly steep relief. The elevation ranges from 300 m to 1500 m, and the basin is located in the foothills of the Northern Black Forest. The basin is characterized by steep slopes and rugged terrain, with a maximum slope of 60%. The second basin selected is the "Freschen" basin, located in the foothills of the Jura mountain range. The basin is about 10 km² in area and has a moderately steep relief, with a maximum slope of 40%. The third basin selected is the "Bregen" basin, located in the foothills of the Northern Black Forest. The basin is about 10 km² in area and has a steep relief, with a maximum slope of 50%.

Vegetation Influence

The figure shows hourly snow depth measured at three stations, each representing a different aspect. The station selected is one in an open pasture, one on a forested area, and one on a forested area with a high tree density. The snow depth data is used to evaluate the influence of vegetation on snow accumulation and snowmelt processes, including snowmelt runoff resulting from topography and vegetation effects.

Time Lapse Photography

The above figure shows some examples of the kind of information that can be gained from time lapse photography. The pictures from cameras 1-5 show the development of snow cover over the course of the winter season. Camera 1 provides a general view of the area, while camera 2 focuses on a specific location. Camera 3 captures a close-up view of a small patch of snow, while camera 4 shows the entire area, including the surrounding landscape. Camera 5 provides a detailed view of the snow cover, including the presence of small snowdrifts and the movement of snow on the ground.

Future Work

The research data will be augmented by observations of soil moisture, ground water levels, and runoff in smaller streams to gain a better understanding of the spatially variable response of basins to snowmelt and rain-on-snow events. The data will be collected using a range of sensors, including soil moisture sensors, ground water level sensors, and runoff meters. The data will be analyzed using statistical and geospatial methods to understand the relationships between the different variables and to identify potential areas for further research.