Snow melt dynamics in snowfall dominated mountain regions in Shonai

*Alexander Brandt[1,3], Muhammad Fraz Ismail[2], Larry Maximo Lopez Caceres[1], Wolfgang Bogacki[2]

1. Yamagata University, 2. Hochschule Koblenz, 3. UGAS

With a total snowfall of 1500 mm, which is the half of the total annual precipitation, Shonai is one of the snowiest regions of the world (*Asaoka et al, 2013*). Snow depth can reach up to 5.2 meters in March before the snow melt finishes in May. The maximum snow depth as 50-year average is 2.7 m in the Yamagata University Research Forest (YURF), southern of the Shonai plains. The relatively warm air in winter (˜ 0˚C) leads to several melting and refreezing processes within the snow column, increasing the snow density to 0.5 g/cm³. This huge amount of snow in Yamagata, Akita and Aomori prefecture is the dominating water source for plants in spring and a good thermal insulation for the soil, which is never freezing in YURF. A change of wind direction in winter is the reason for the high amount of snow. Cold air from Siberia is passing the warm Japanese Sea and faces the central mountains of Tohoku (*Asaoka et al., 2013*). These characteristics are very unique in the world leading to snow accumulations higher than in most areas of the world (*Krasting et al., 2013, Masiokas et al., 2006*).

The thick snow pack with high density results in a high Snow Water Equivalent (SWE). Monitoring and modelling of the snow melt period in spring is essential to confirm river discharges, water infiltration into the soil and to calculate the water balance of Japanese mountain forests. A modelling approach was done with the calculation of Degree-Day Factors (DDF) (*Ismail et al., 2015*). Measurements to determine the snow pack differences of forest covered sites and clear-cut sites are conducted this winter and will be intensified in the snow melting period. We expect results comparable to *Jost et al. (2009)* and *Schelker et al. (2013)*.

Automatic and manual measurements of snow density and snow depth were conducted intensively in the last 7 years in YURF. Together with the DDF we already discovered a significant trend of changing melt dynamics after half of the melting season. Results show furthermore, that the snow cover is not losing water, even in the warm periods during the winter. Soil moisture is measured to identify the start of the snow melt period, river flow discharge measurements will be introduced as soon as the snow melt starts. All these measurements together are parameters for the following calculations of snowmelt runoff. Melting dynamic related to temperature, snow cover and season was discovered and will be compared with river discharge measurements.

Literature:

Asaoka, Yoshihiro, Yuji Kominami (2013): Incorporation of satellite-derived snow-cover area in spatial snowmelt modeling for a large area: determination of a gridded degree-day factor

Ismail, Muhammad Fraz, Habib-ur-Rehman, Wolfgang Bogacki, Noor Muhammad (2015): Degree Day Factor models for forecasting the snowmelt runoff for Naran watershed

Jost, Georg, R. Dan Moore, Markus Weiler, David R. Gluns, Younes Alila (2009): Use of distributed snow measurements to test and improve a snowmelt model for predicting the effect of forest clear-cutting

Krasting, John P., Anthony J. Broccoli, Keith W. Dixon, John R. Lanzante (2013): Future Changes in Northern Hemisphere Snowfall

Masiokas, Mariano H., Ricardo Villalba, Brian H. Luckman, Carlos Le Quesne, Juan Carlos Aravena (2006): Snowpack Variations in the Central Andes of Argentina and Chile, 1951–2005: Large-Scale Atmospheric Influences and Implications for Water Resources in the Region

Schelker, J., L. Kuglerová, K. Eklöf, K. Bishop, H. Laudon (2013): Hydrological effects of clear-cutting in a boreal forest –Snowpack dynamics, snowmelt and streamflow responses

Keywords: Snow Water Equivalent, Degree-Day Factor, soil moisture, snowmelt, climate data, snow accumulation

