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Report to IASC
3rd Snow Science Winter School

Title, Place and Date of the Meeting:

3rd Snow Science Winter School. Finnish Meteorological Institute Arctic Research Centre, Sodankylä, Finland, 12-18 February 2017.

Theme/Purpose of the Meeting:

Doctoral/post-doctoral level, field-oriented training course (winter school) for teaching snow cover quantification techniques.

Name of Attendees:

Juha Lemmetyinen
Roberta Pirazzini
Florent Domine

Purpose of Attendance:

Acting as lecturer for the SnowSchool. Each lecturer gave 1-2 classroom lectures and assisted daily the student groups in their field work

Report:

The goal of this course was to teach and use the modern field quantification methods for snow cover in a winter school. The modern methods require more experience and know-how to achieve high-quality results, requiring an activity to provide these means to a new generation of young scientists. The focus of this workshop was on field measurements using both quantitative techniques and devices for in situ observations, as well as ground-based remote sensing instrumentation. These were supported by theoretical lessons in the classroom. Field measurements were be done in small groups of four students each.

The premises at Sodankylä of the Finnish Meteorological Institute Arctic Research Centre (FMI-ARC) offered an opportunity to investigate the snow properties of the arctic tundra and taiga. Routine measurements at the site include observations of snow cover with microwave and optical ground based instruments, allowing students at the course a first-hand access to operational research infrastructure. For 2017, an additional focus was on Earth Observing techniques for snow cover.

Specifically, the school began on Monday Feb 13th with an introduction and two classroom lectures. The afternoon was spent on instruction and hands-on practice with snow

measurement equipment, followed by a classroom lecture after dinner. On Tuesday, morning lectures focused on microstructural controls of snow physical properties as well as microwave remote sensing of snow (active and passive). The field work on Tuesday consisted of quantifying snow cover properties in small groups, with each group measuring a snow profile applying all available tools (including a traditional snow profile, snow penetration resistance using a Snow Micropen, and measurement of snow Specific Surface Area). The measurements were done in a forest clearing observed by FMI microwave radiometers (Figure 1). A part of the post-school exercise will be to analyze the observed passive microwave signatures (brightness temperature) based on the collected snow pit information and use of snow emission models.

Figure 1: Field work exercise in small groups on Tuesday, Feb 14th 2017. Microwave radiometry site.

On Wednesday, morning lectures were focused on aspects of optical remote sensing of snow. The following field work in the afternoon was conducted at a nearby open wetland, following a similar protocol to the previous day (figure 2). The site allowed to make non-obstructed optical wavelength measurements of snow reflectance using an ASD field spectrometer. Again, the goal of the exercise was to allow students to relate the snow properties measured in snow pits to the observed quantities in remote sensing (this time the optical reflectance spectrum)

Figure 2: Field work exercise on Wednesday, Feb 15th 2017. Snow Micropenetrometer in action at wetland site.

Thursday Feb 16th consisted of an interactive session in the morning, divided in three parts: in one exercise, students were given an assignment of planning for an extended filed trip on the following day to the Saariselkä tundra site. In a second exercise, groups familiarized themselves with the microwave radiometer data and were given instructions for using the MEMLS microwave emission model. In the third exercise, students were similarly instructed on how to apply the data collected in the field in the online Snow TARTES model, in order to simulate the reflectance spectrum of snow (to be compared to ASD measured spectra in the post-course exercise). The afternoon was used for a safety lecture and independent preparation for the Friday filed trip.

The highlight of the school was an excursion to the Saariselkä fell area (Urho Kekkonen National park). Bus transportation to the site was arranged on Thursday evening. On Friday morning, the winter school set out on skis (or, for those unable to ski, on snowshoes) to reach a site on top of the fells designated as the study area. Once on site, students set out in groups to perform the assignments given on Thursday, including large-scale assessment of snow depth variability, and snow stratification at various altitudes on the fells.

Figure 3: Field work exercise on Friday, Feb 17th at Saariselkä tundra site. Student inside ~2m deep snowpit.

In order to gain their study credits for the school, each group of students will still have to prepare a report describing the methods, results and interpretation of their field work.

The final schedule of the Snow School is summarized in the following table.

Table 1: Schedule of 3rd Snow Science Winter School

Date	Time	Location	Event
Sunday 12.2.	~18:00		Arrival & lodging at guesthouses
	~19:00	Canteen	Dinner
Monday 13.2.	8:00	Canteen	Breakfast
	9:00	Polaria lecture hall	Welcome, presentation of lecturers & site rules etc. setup of small groups
	10:00	Polaria lecture hall	Lecture 1: *Quantifying snow: traditional and emerging methods (M. Schneebeli)*
	11:00	Polaria lecture hall	Lecture 2: *Physical snow models (M. Dumont)*
	12:00	Canteen	Lunch
	13:00	Main building area	Field work 1: *Use of measurement tools, hands-on practice outside in groups*
	17:00	Canteen	Dinner
	18:00	Polaria lecture hall	Lecture 3: *Snow interactions with sea and lake ice (M. Leppäranta)*
	19:00	FMI-ARC spa&sauna center	Icebreaker
Tuesday 14.2.	8:00	Canteen	Breakfast
	8:30	Polaria lecture hall	Lecture 4: *Microstructural controls on snow physical properties (H. Löwe)*
	9:15	Polaria lecture hall	Lecture 5: *Passive microwave remote sensing of snow (J. Lemmetyinen)*
	10:00		Break
	10:15	Polaria lecture hall	Lecture 6: *Active microwave remote sensing of snow (S. Leinss)*
	11:00	Forest clearing site	Field work 2: *Quantification of snow cover & observations using microwave RS instruments. Field lunch*
	17:00	Canteen	Dinner
	18:00	Polaria lecture hall	Wrap-up, data entry & evaluation
	19:00		Free time, shopping possibility
Wednesday 15.2.	8:00	Canteen	Breakfast
	8:30	Polaria lecture hall	Lecture 7: *Why current snow physics models cannot simulate Arctic snowpacks? Consequences (F. Domine)*
	9:15	Polaria lecture hall	Lecture 8: *Optical remote sensing of snow; field work considerations (R. Pirazzini)*
	10:00		Break
	10:15	Polaria lecture hall	Lecture 9: *Optical remote sensing of snow; satellite applications (M. Dumont)*
	11:00	Wetland site	Field work 3: Quantification of snow cover & observations using optical RS instruments. Field lunch
	17:00	Canteen	Dinner
	18:00	Polaria lecture hall	Wrap-up, data entry & evaluation
	19:00	Sodankylä town	Social event
Thursday 16.2.	8:00	Canteen	Breakfast
	9:00	Polaria lecture hall	Interactive session: *Setup of simulations (MEMLS, TARTES) from collected field data*
	12:00	Canteen	Lunch
	13:00	Polaria lecture hall	Safety lecture + independent planning for Friday field trip
	17:00	Canteen	Dinner
	18:00	dep. from Polaria	Bus transportation to Saariselkä
Friday 17.2.	8:00	Kiilopää Fell centre	Breakfast
	9:00	Saariselkä	Field work 4: *Saariselkä field trip*
	17:00	Kiilopää Fell centre	Wrap-up session
	19:00	Restaurant Kammi, Kiilopää	SSWS'17 Official dinner
Saturday 18.2.	8:00	Kiilopää Fell centre	Breakfast
	8:30	dep. from Hostel	Bus transportation to Rovaniemi

Comments and/or Recommendations:

There are very few training courses organized in the specific field of snow science, outside of university courses which are typically aimed at master-level students. As such, we feel that organizing such a course benefits the education of future snow scientists. The high demand for this type of training course has been highlighted by the high number of

applicants for the two previous training schools, held in 2015 in Sodankylä, and 2016 in Preda, Switzerland. A total of 56 students applied for the course in 2017, of which 25 were selected to attend. The majority of feedback from students has been very positive. IASC support for the school lecturers' travel was much appreciated, as with the help of sponsors the course fee for attending students can be kept at a minimum.