COST ES1404 MC and WG meetings, Grenoble 18-20 March 2015
Summary of WG1-WG2 discussions

18 March : plenary session

The contribution of WG1 and WG2 to the plenary session on 18 March consisted of introductory talks and a few review or overview talks.

WG1 :
- Introductory talk by M. Schneebeli (CH ; WSL-SLF Davos)
- Talk "Applications of Terrestrial Laser Scanner for snow studies" by J. I Lopez-Moreno (SP ; CSIC Zaragoza)
- Talk "A review and outlook of snow property measurements at different scales" by M. Schneebeli (CH ; WSL-SLF Davos)

WG2 :
- Introductory talk by S. Morin (FR ; Météo-France – CNRS Grenoble)
- Talk "Overview of the WMO-SPICE project" by R. Nitu (Environment Canada)

19 March : Following the discussions held on March 18, the fact that many of the tasks in WG1 and WG2 overlap in practice, and that many participants of the meeting could be willing to participate to both WG1 and WG2 activities, it was proposed that WG1 and WG2 work jointly during this first COST ES1404 face-to-face scientific meeting.

The work was carried out in three sessions. The first session allowed participants to illustrate their activities relevant to WG1 and WG2 and are listed below. After a few more presentations, the second session focussed on the identification of the best method to work towards delivering the deliverables of the WG1 and WG2. The third session was carried out mostly in three subgroups addressing various components of the tasks of WG1 and WG2.

Session 1 and 2 :
Roberta Pirazzini (FMI, Helsinki) showed activities related to snow observations especially in polar areas, addressing spectral albedo, roughness, snowpit observations, remote sensing using a quadrocopter for broadband albedo, spectral albedo, downward looking camera and recent developments towards continuous monitoring of snow spectral albedo (dual spheres system).
Roberta Pirazzini (FMI, Helsinki) showed the result of previous work carried out in Finland towards the onset of a WG1-WG2 questionnaire. Various input from the participants was recorded, such as the relevance of contacting WMO-RSX (European regional), but also considering existing questionnaires such as the GCW questionnaire ; pre-SPICE questionnaire available on WMO website (Rodica Nitu to be contacted for individual replies) + other communities (avalanches, roads etc.).

Achim Drebs (FMI, Helsinki) showed a method employed in Finland to measure snow on the ground by means of bi-annual snow course around 15 January and 15 March every year every around 1200 km2. Current efforts to sustain measurements are to engage secondary schools, globe-schools, scout movement etc. (science/society projects which could be very relevant for snow monitoring).

Craig Smith (Environment Canada) provided a summary of the Snow-on-the-Ground component of SPICE, showing in particular in terms of snow depth and SWE the differences between automated and manual measurements at the SPICE around the world.

Giovanni Macellonni (CNR) provided an Italian perspective to COST ES1404 with a summary of snow activities by Italian teams in terms of remote sensing, in situ observation etc..

Michele Citterio (DK, GEUS) reported on the Greenland monitoring programme PROMICE and the difficulties to deploy and maintain weather stations in Greenland. Open call to community for installing sensors on PROMICE weather stations.

Ghislain Picard (FR, Univ. Grenoble – CNRS) shared thoughts about several items of WG1 and WG2 : WG1 could aim at making recommendations about the definition of snow variables, and WG2 could address instrument accuracy for various quantities, in particular for spectral albedo. Specific work on data format should be engaged (SYNOP, CAAML etc.)

A. Seres (Hungary) presented recent development towards 10 m resolution avalanche hazard maps using various observational inputs together with a snow model.

Arda Sorman (Turkey) provided a summary of snow studies in Turkey, including instrumentation such as the Snowpack analyzer.

Session 3 :

The work was split in three subgroups. The goal of these subgroups was to identify key elements for a) snow property variables, b) instruments c) snow depth and SWE. The results presented below are a first step toward this goal, and need additional consolidation.

A. Kontu, M. Sandells, A. Nadir Arslan, F. Naaim, M. Citterio, Külli worked on a list of snow variables that would need to be addressed. The preliminary list which came out of this group is given below :

Snow parameters on the ground:
Snow extent,
Snow depth,
SWE, -profile, -bulk
Density: - profile, -bulk
Temperature: -surface, -profile, -bulk
Wetness: -profile, -bulk
Surface roughness
Surface albedo: -broadband, -spectral
Surface directional reflectance
BRDF
Impurity (concentration and type): -BC, -Algae, -Microbial activity
Brightness temperature
Backscatter
Hardness
Thermal conductivity
Electrical conductivity
Stickiness factor
Stratigraphy
Permeability
e-folding depth
shear resistance
polarization
Solid precipitation:
Precipitation intensity
Drifting snow: -occurrence, -flux

Microstructure:
grain size (ref to Fierz et al., 2009),
SSA,

correlation function,
correlation length,
grain shape,
tortuosity,
Porosity,
Snow isotopes
Name of the instrument (or of the method)
Location of the measurements (country, land cover type)

Task 2.1 Review of instruments

M. Schneebeli, S. Kaasalainen, G. Macelloni, G. Picard, M. Rothmüller worked on establishing a list of instruments used to measure snow in-situ (i.e. not including remote sensing) that could deserve standardizationn.

The list below is provisional, additional criteria to be added could by (instrumental) robustness, method, availability, precision and others.

** What are the basic instrument necessary at the basic level (i.e. International Classification) ?

- Magnifying glasses
- Density cutter + scale (many different device)
- Sticks / ruler / stakes
- SWE tube (an issue : diameter, size depending on)
- Temperature probe 'pt100' (an issues : calibration, accuracy, solar radiation)
- Rammsonde. Mechanical properties in general is an issue (no established standard procedures)
- Stability test

** Middle level, National Meteorological Service, Harmonization, Interest by companies

- Broadband albedometers
(- Long wave)

** Advanced level,
- Dielectric or TDR, Snow fork for snow wetness.
- Webcam / time-lapse photography
- Acoustic and laser -snow depth meters.
- Stratigraphy by NIR-photography, and translucent profile
- IR Sensor for surface snow temperature (WMO?)

- magnaprobe
- Needle probe and heat flux plate (thermal conductivity)
- microCT
- method/protocole : casting
- High resolution micro-penetrometer (SMP)
- Laserscans
- Photogrammetry
- Optical SSA devices / IceCube / NIR-photography / ASSSAP / Spectro,...
- CH4 adsorption
- Instrument to measure impurities (ion chromatography, « Sunset », SP2, ...)
- Lysimeter (runoff)
- Snow pillow (SWE)
- Gamma and cosmic rays sensors (SWE)
- Lagrangian densification disk monitor
- direct air permeability measurement

- neutron probe

- Spectro-radiometers
    - Ground-based Microwave radiometers
    - Ground-based radar and SAR
    - Optical field-spectrometer.

- Wetness automatic probes
- GPR

- Direct numerical simulation of snow properties based on snow tomography

Interface to atmosphere :
- drifting snow flux (snow particle counter, flowcap, disdrometer, …)
- precipitation gauges

Space-borne instruments? not discussed in this session

todo :
- Make a table with information : Manual / automatic, robust/difficult, …, price, compagny list, reference papers
- Table to be linked to the variable list/table.

- Suggestion to set up a web site (integrated with HarmoSnow (?) with database of « advanced » instruments in Europe).

S. Morin, Nacho Lopez-Moreno, Marc Pons, Carlo Carmagnola, Achim Drebs, Anna Seres worked specifically on items relevant to snow depth and SWE, as the two latter are the variables which are always relevant regardless of the snow application that relies on in-situ observation data. The main messages from this group are that :
- It is relevant to virtually all snow applications (NWP, climate, hydrology, avalanche warning, road/traffic/trains, energy lines, airports, hydropower, industry, tourism (ski), environment (biology, contaminants), agriculture, buildings (snow load) …
- Geographic scales are a concern (Representativeness of point/series of measurements with respect to subgrid variability (with respect to chosen grid : « available » digital elevation model, NWP/hydro/climate models) ; Accounting for land cover : canopy vs. open ? topography (slope/aspect) ? altitude ? (impact of underlying soil properties)
- the two are linked together by bulk snow density SWE/SD : bulk density variability (tie to modelling/assimilation) could help reduce measurement requirements to only one variable (SD)
- SD is much easier to measure automatically than SWE. However it is questionable whether automated measurements of SD under canopy exist operationally ?– Sodankyla, other station from Finland (Roberta) ?
measurements of interception on trees (research question ?) Measurements under canopy (requires characterization – LAI, SVF, other ?) vs. open areas (more or less variability)
- depending on the application, the time resolution is variable WMO for SD : 24 hours or less SWE ?(of course depends on the application)

All the the information above could be organized, together with the WG3 questionnaire, into a living document on the COST ES1404 wiki (restricted to WG members during the initial document preparation phase).