Results and Discussion

**Observatory measurements**

* On 7th February 2012 the temperature is in the range of 3 deg 5 deg over the Dhundhi Observatory.
* The standing snow is around 161 cm.
* The snow has melted from 171 to 161 cm from 06 February evening to 07 February morning
* On 07 February morning to evening the standing snow has melted from 161 cm to 158 cm
* The grain size has also increased to 1-1.5 mm
* The snow condition is a melted freez (wet).
* On 14th February 2012, There was a heavy snow fall
* The standing snow has increased around 32 cm from 13th February 2012 evening to 14th February morning.
* The standing snow fall is 300 cm
* The temperature is around -5 degree during the acquisition.
* The grain size also 1-2 mm
* The snow density is very low 0.08 g/cm3
* The study area is completely covered with the fresh dry snow cover
* On 06th February 2013 the field measurements were conducted synchronize with the ascending pass (6.25 PM) satellite data acquisition around SASE observatory located at **Bhang**.
* The temperature is around 4 degree
* The standing snow is around 66 cm

As per the **Solang** observatory measurements,

* The temperature is around 1.5 degree
* The standing snow is around 170 cm
* There is an 15 cm fresh snow fall recorded within a day

As per the **Dhundhi** Observatory measurements,

* The maximum temperature is 1 degree
* The standing snow is around 249 cm
* On 08th February 2013, the field measurements were conducted around Bhang observatory,
* The satellite data was a descending pass acquisition (6.14 AM)
* The temperature recorded is -3 degree
* The standing snow is around 58 cm

**Solang**

* The temperature is -7.5 degree
* Standing snow is around 140 cm
* There is no fresh snow fall

Dhundhi

* The temperature is -7 Degree
* Standing snow is 227 cm
* On 18th February 2014 the in-situ measurements were collected at Bhang, The satellite data I an ascending pass (6.29 PM)
* The temperature recorded is around 17 degree
* Standing snow is 34 cm
* Within a day around 6 cm snow has melted because of this higher temperature
* Solang
* The temperature recorded is 14 degree
* Standing snow is 106 cm
* Within a day around 11 cm snow has melted
* Dhundhi
* The temperature recorded is 8 degree
* Standing snow is 213 cm
* Around 7 cm snow has melted within a day

On 20th February 2014 measurements collected at Bhang, satellite data pass is descending (6.18 AM)

**Observations from the snow wetness maps by the proposed method**

* The snow wetness map inferred on 14th February 2012 by proposed method is showing almost low wetness values (0-2% by volume). The study area is completely covered with the dry snow cover. Around 32 cm snow fall is recorded from 13th February 2012 evening to 14th February 2012 morning. This descending pass with higher incidence angle (47.4 degree) leads the acquisition over the study area without any geometric distortions.
* The standing snow fall is around 300 cm and the temperature recorded is -5 degree. The snow condition is completely fresh dry snow. The results revealing the field condition and the in-situ estimations were having good agreement with the assessed wetness values by the proposed method.
* Enventhough in the inferred snow wetness map few places wetness is around 2-4% by volume. This may be because of the old snow, which may have been melted and refreeze in the snow pack. Present condition 32 cm fresh snowfall is having a density around 0.08 g/cm3, this low density may allow the c-band data to penetrate more and lead to the small amount of volume scattering.
* The derived wetness map on the same 14 February 2012 by the existing Shi-Dozier method is demonstrating an over estimation of the wetness values comparing with the field in-situ measurements.
* So the proposed snow wetness estimation technique is working exceptionally well at the low wetness conditions as well.
* The effective snow wetness map estimated for 06th Februray 2013 data shows the snow wetness over the Bhang observatory region is around 2-5% and around Solang and Dhundhi observatory regions are 1-3%.
* During this ascending pass (6.25PM) data acquisition day the maximum temperature was recorded at the Bhang observatory is around 4 deg, which may be caused for this amount of wetness (2-5%) over the 66cm standing snowpack. This estimated snow wetness values are much closer to the synchronized in-situ measurements around this observatory region.
* Over the Solang and Dhundhi observatory region, where 15 and 16 cm fresh snowfall were recorded respectievely within a day. During the data acquisition there were no snow fall and the maximum temperature was around 1.5 Deg and 1 Deg over Solang and Dhundhi regions respectively.
* The profile transect over the solang region shows that volume scattering was a bit higher than the surface scattering because of this 15 cm fresh snow fall.

The snow wetness map for 8 February 2013 shows that most of the study area was covered with the snow wetness in the range of 2-4%. During this descending pass data acquisition, the in-situ field measurements were collected around the Bhang observatory and the temperature were recorded around -3 , -7.5 and -7 degrees at the Bhang, Solang and Dhundhi observatories respectively. At the Bhang observatory the maximum temperature recorded on 07 February 2013 was 11 degree , because of this 11cm snowpack has melted within that particular day. This melted water may be percolated to snowpack and make more melt on the snowpack volume. The surface melted snow would may have frozen because of the low temperature (-3). These observations are clearly noticed from the profile plot over this region, which explained clearly that volume scattering power is higher than the surface scattering power.

Over the slop regions the profile transect is showing that volume scattering power is much higher than the surface scattering. This may be because of the water movement inside the snowpack, which caused for more melting in the volume.

The effective snow wetness map estimated for the 18th February 2014 data shows almost melting snow cover (3-6%) over the study area. In Bhang observatory area the maximum temperature was around 17 deg on this ascending pass data acquisition day and it leads to the higher melting over the snow surface. The standing snowpack has melted around 6cm within a day.

Over the solang observatory area The maximum temperature recorded was around 14 Degree and around 11 cm standing snowpack has melted within a day. The surface snow wetness map shows that the snow wetness was around 8-10 % by volume, because of the heavy melting. The profile transect over the Solang observatory area shows thet surface scattering and volume scattering powers were almost equal and some places surface scattering is a bit higher than the volume scattering. The maximum temperature recorded over the Dhundhi region was around 8 degree and 7 cm snow has melted within a day.

The snow wetness map for the 20th February 2014 data shows mostly the wetness in the range of 1-3 %. During this descending pass data acquisition the in-situ measurements were collected around the Bhang observatory area, where the temperature was around 1 degree. On 19 February 2014 the maximum temperature recorded at the Bhang observatory was around 19 degree and 5 cm standing snowpack has melted within a day. This melted water may be percolated to snowpack and make more melt on the snowpack volume. The surface melted snow would may have frozen by the low temperature at night. These observations are clearly noticed from the profile plot over this region, which explained very clearly that volume scattering power is higher than the surface scattering power.

07 February 2012

* The snow wetness map for 07th February 2012 data shows that the wetness is in the range of 1-2% around Bhang observatory region. During this descending pass satellite acquisition, the in-situ measurements were collected around Bhang observatory and the temperature was recorded around -2degree. The estimated wetness values are having a decent concurrence with the near real time field data collected synchronize with the satellite pass.