TDP: Retrieval of snow cover area and snow physical parameters over North Western Himalayan mountains using optical and microwave remote sensing, April 2007-March 2012.

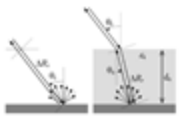
1. Quantification of the terrain and SAR imaging effects on parameter retrieval in mountainous terrain.

2. Retrieval of Snow Cover Area (SCA), Snow Density (SD), Snow Water Equivalent (SWE), and Snow Wetness (SW) using SAR data.

PENETRATION DEPTH & DIELECTRIC PROPERTIES OF SNOW/ICE

PENETRATION DEPTH d_p

$$d_p = \frac{\lambda_0 \sqrt{\varepsilon'}}{2\pi\varepsilon''}$$



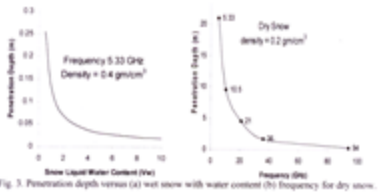


Fig. 3. Penetration depth versus (a) wet snow with water content (b) frequency for dry snow.

DIELECTRIC CONSTANT (ε) = $\varepsilon' + i\,\varepsilon''$ $\quad$ ε' (pure ice)=3.15

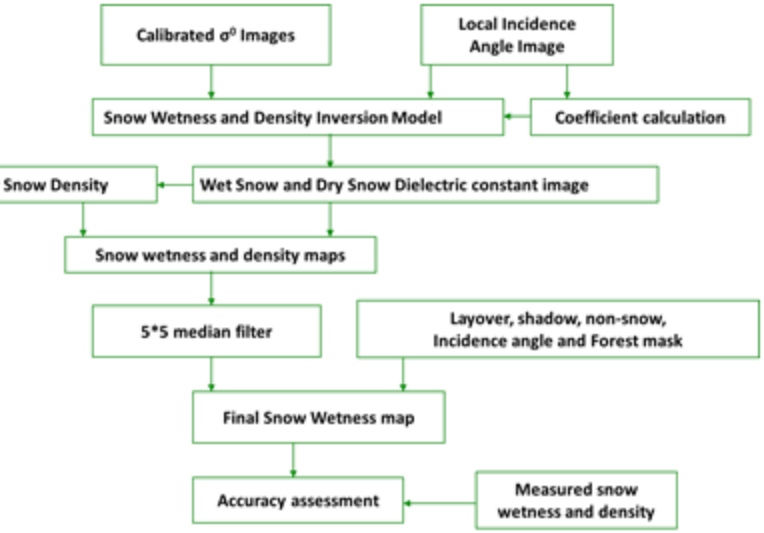
Dry Snow: Real part (ε') $\quad \varepsilon' = 1 + 1.60\rho + 1.86\rho^3$

Dry Snow: Imaginary part (ε'') $\quad \varepsilon'' = \varepsilon_{ice}''(0.52\rho_s + 0.62\rho_s^2)$

ε'' of *dry snow* at C- and L-band is of the order of 0.001 to 0.0001.

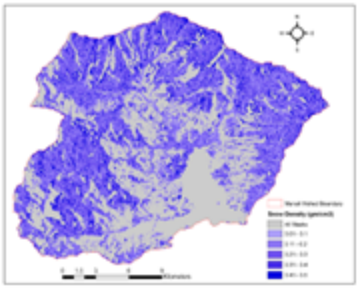
Wet Snow: Real part (ε') $\quad$ Wet Snow: Imaginary part (ε'')

$$\varepsilon'_{ws} = \varepsilon'_{ds} + \frac{23 V_w f_0^2}{f_0^2 + f^2} \qquad \text{Where, } f_0 = 10\ GHz;\ 1GHz<f<30GHz \qquad \varepsilon''_{ws} = \varepsilon''_{ds} + \frac{23 V_w f_0}{f_0^2 + f^2} f$$

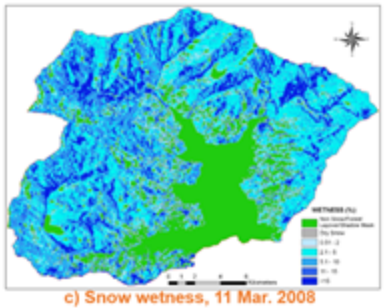


Results of snow density & wetness retrieval using SAR based inversion models

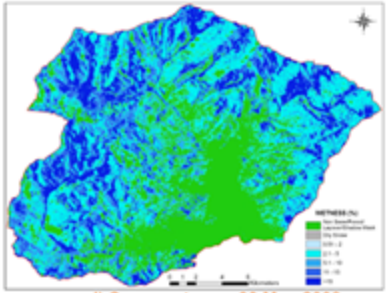
a) 20 Jan 08 Snow density map of study area



b) 20 Jan 09 Snow density map of study area

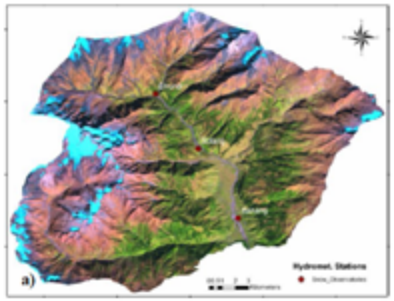


c) Snow wetness, 11 Mar. 2008

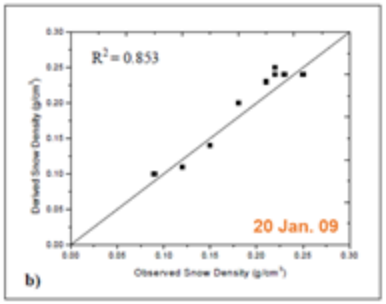


d) Snow wetness, 30 Mar. 2008

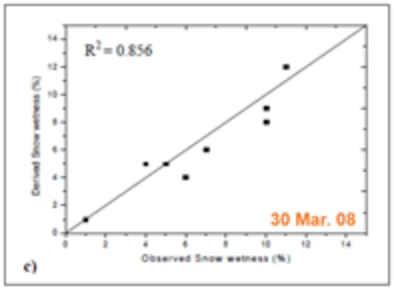
ACCURACY OF INVERSION MODELS W. R. T. GROUND OBSERVATIONS



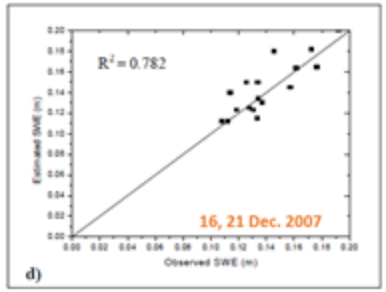
a)



b)



c)



d)