Ground-based multi-temporal microwave radiometer measurements of snow-covered terrain provide data that are appropriate for developing and validating snow emission models and algorithms for retrieving snow characteristics from space-borne radiometer data. An extensive set of microwave radiometer measurements of snow cover was made at Kirkkonummi, southern Finland, over the whole snow season from January to April in 1985. The radiometer data include brightness temperatures at 1 GHz, 16.5 GHz and 37 GHz, vertical and horizontal polarization. Continuous recording was done at an incidence angle of 50 degrees off nadir. Daily data collection was conducted as a function of incidence angle with 10-degree steps from 10 degrees to 60 degrees. Aluminium sheets covered the ground near the observation tower, thus providing an opportunity to observe microwave emission from snow only (eliminating ground contribution) for small incidence angles. Daily calibration of radiometers consisted of measurements of absorbing sheets and the sky, conducted at least twice (before and after data take). Additionally, results from a sky-measuring 12 GHz precision radiometer at the same site and same elevation angle were obtained.

Ancillary data for snow include water equivalent, depth, temperature, layering, and surface roughness and grain size (photographs). The ground surface temperature was measured regularly and the vertical distribution of near-surface ground temperature was observed occasionally. A special effort was made to characterize the snow medium. Numerous homogeneous snow samples were taken from various depths in the snow pack and measured using free-space systems resulting in dielectric and extinction properties of snow. The free-space systems were operated at 12 (dielectric properties) and 35 GHz (extinction values) and, occasionally, at 18 GHz (dielectric properties). The results were further transformed into extinction coefficients (dry snow) and wetness values (wet snow), thus providing layered information on the whole snow pack. Equations from [1] were used for computing wetness from the complex dielectric constant.

Our earlier IGARSS paper [2] presented the arrangements for and technical details of the campaign and results from radiometer measurements. The effect of an extensive melt/freeze period to the snow grain size and brightness temperature was discussed.

This paper presents more experimental results including measured dielectric, extinction and wetness profiles of snow. Additionally, selected experimental values were compared with results from two snow emission models; the TKK model [3] and the MEMLS model [4] [5]. The TKK model is a single-layer radiative transfer model, which relies on an assumption on scattering being concentrated mostly in the forward direction and on experimental characterization of the snow extinction coefficient [6]. The Microwave Emission Model of Layered Snowpacks (MEMLS) model is a radiative multiple-scattering model, based on experimental characterization of snow over a broad frequency range. In this model snow is assumed to consist of numerous horizontal layers with each layer characterized electrically and physically. The comparison is handicapped to some degree by the fact that the TKK model employs mean snow grain size (measured in the campaign), whereas the MEMLS model employs snow correlation length, as reported in [7] . The first results from the comparison suggest that, in general, both models produce results for dry snow that are in...
satisfactory agreement with experimental values. Work is in progress in order to make further comparisons, including using measured snow dielectric characteristics and wetness values in the models.


