Prospects for assimilating cloud and precipitation at high latitudes in global weather forecasting

Alan Geer, ECMWF, Reading, UK

A current frontier in all-sky microwave radiance assimilation is the extension to land, snow and sea-ice surfaces: 'all-sky all-surface assimilation'. This is of particular interest in the northern hemisphere winter, where satellite radiances are excluded if they might be sensitive to snow or sea-ice surfaces, which are difficult to model. Initial improvements at the European Centre for Medium-range Weather Forecasts (ECMWF) have focused on better use of window channels over snow-free land and high latitude ocean. These developments depend on improved surface emissivity treatments and a new sea-ice screening. But to go further needs improvements in the radiative transfer modelling of snow and sea-ice surfaces, likely using a mix of empirical and physical approaches. This is currently in development. With good enough surface modelling, the atmospheric signal can be extracted. High-latitude land, snow and sea-ice can be relatively cold, so despite their typically high surface emissivity, rain and cloud emission signals can often be seen at lower frequencies. For example, over sea-ice, the hydrometeor signal can exceed +10 K. Further, at higher microwave frequencies, rain and snow scattering signals are strong, often exceeding -50 K. Hence, an all-sky all-surface assimilation system could extract new information from hydrometeors at high latitudes. Due to the sparsity of other observations in the high latitude winter, these developments could make a significant impact on the quality of weather forecasts.