



Study and verification of multibeam ability for a new VHF-radar in northern Norway

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The Leibniz-Institute of Atmospheric Physics in Kühlungsborn (IAP) has been operating the ALWIN MST radar system at 53.5 MHz on the North-Norwegian island Andoya for more than 10 years. The antenna array of 144 Yagi antennas has been used to form a 6 degree wide beam on transmission and reception. With this radar, the characteristics of Polar Mesospheric Summer Echoes (PMSE) have been investigated with high time resolution. For future studies of horizontal structures of winds, waves, turbulence and PMSE, the IAP is currently building a new advanced VHF-Radar to replace ALWIN. For this purpose an additional module (Butler matrix) for the receiver of this VHF-Radar has been built which allows the generation of multiple beams in azimuth and zenith angles for simultaneous observations.

In 2009 IAP started to build the successor system of the ALWIN radar, called MAARSY (Middle Atmosphere Alomar Radar SYstem). In the first step this new system will consist of a phased array of 217 individual 3-element Yagi antennas arranged in an equilateral grid structure and the same amount of transceiver modules.

Furthermore 64 Yagi antennas of the former ALWIN antenna array are still available for reception (ALWIN64). On reception the Butler matrix will be used to form simultaneously 16 beams in hardware with the ALWIN64 array, while for transmission an equal illumination with the MAARSY array will be generated.

A Butler matrix is a reciprocal structure composed of half-power 90° hybrid couplers and phase shifters, first described by Butler [1961]. In this structure the total number of available beams is determined by the amount of independent receivers and antenna feeds. A 4-Port Butler matrix simultaneously generates 4 individual in- and outputs. For the current 16 channel radar receiver a 16-Port Butler matrix was built by the concatenation of 8x 4-Port Butler matrices. Using this 16-Port Butler matrix with the ALWIN64 array 16 individual beams with a beam width of approximately 9° are generated. For the height of PMSE-layers the beam width results in a target area of roughly 14km diameter for each single beam.

Since the installation of the 16-Port Butler matrix in November 2009 the ALWIN64 antenna array has been used to sample galactic noise. To verify the functionality of the Butler matrix 6 out of 16 beams have been selected to e.g. monitor the supernova remnant Cassiopeia A. It is furthermore planned to verify the Butler matrix measurements by comparing the data with the AIRIS Riometer which is also located on the Island Andoya.