



Multi beam observations of the polar mesosphere using a VHF radar with a Butler matrix for beam forming

Toralf Renkwitz, Werner Singer, and Ralph Latteck

Leibniz-Institute of Atmospheric Physics, Radar Soundings and Sounding Rockets, Germany (renkwitz@iap-kborn.de)

The Leibniz-Institute of Atmospheric Physics (IAP) in Kühlungsborn has been operating the ALWIN MST radar system at 53.5 MHz on the North-Norwegian island Andoya (69.30°N, 16.04°E) for more than 10 years. A phased antenna array consisting of 144 Yagi antennas was used to form 6 degree wide beams on transmission and reception to study the dynamics and structure of the lower and middle atmosphere at polar latitudes. Especially, the characteristics of Polar Mesospheric Summer Echoes (PMSE) have been studied with high time resolution.

In 2009 IAP started to build the successor system of the ALWIN radar. The new Middle Atmosphere Alomar Radar System (MAARSY) consists of a phased array of 433 individual 3-element Yagi antennas arranged in an equilateral grid structure and the same amount of transceiver modules. An initial expansion stage of 196 transceiver modules was installed in spring 2010. In addition 64 Yagi antennas of the former ALWIN antenna array are still available for reception (ALWIN64). A 16-port Butler matrix is used to form simultaneously 16 individual beams of a beam width of 9° in hardware with the ALWIN64 array. It results in a target area of about 14 km diameter at mesopause altitudes for each single beam.

The beam forming capability of the Butler matrix arrangement has been verified observing the galactic cosmic radio noise of the supernova remnant Cassiopeia A. This multi beam configuration has been used in passive experiments to estimate the cosmic noise absorption at 53.5 MHz during events of enhanced solar activity and geomagnetic activity as indicator for enhanced ionization at altitudes below 90 km. These observations are well correlated with simultaneous observations of corresponding beams of the co-located imaging riometer AIRIS (69.14°N, 16.02°E) at 38.2 MHz. In addition, for quiet solar and geomagnetic conditions the diurnal cosmic noise received with individual beams is compared to an appropriate sky noise map.

In active experiments the MAARSY antenna array is used for transmission illuminating the target area of the Butler matrix at mesopause heights. First observations of PMSE in June 2010 are discussed.