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TROPOSPHERIC PROPAGATION STUDIES CARRIED OUT BY CNES AND ONERA FOR SATELLITE COMMUNICATION SYSTEMS AT KA AND Q/V BANDS

Abstract

CNES and ONERA have been collaborating for more than 20 years in the domain of tropospheric propagation for the design of high frequency satellite communication systems. In order to provide attractive access to the Internet satellite systems have to cope with more bandwidth to deliver high data rates required by the end users. These wide bandwidths are not available in conventional frequency bands such as C-band or Ku-band and operators are migrating to higher frequency bands such as Ka-band (20/30 GHz) and Q/V band (40/50 GHz) for future GEO Very High Throughput Satellite (VHTS) systems. The main limitation of frequencies higher than 20 GHz is their sensitivity to propagation impairments, it is therefore needed to better characterise and model tropospheric propagation. To achieve this goal, CNES and ONERA have launched a research work programme on the one hand through propagation experiments carried out both in temperate and in tropical and equatorial areas and on the other hand propagation model development in terms of statistical prediction methods and channel models. The objective of this paper will be first of all to present results from propagation experiments carried out by CNES and ONERA in Toulouse (France), Kourou (French Guiana), Shillong and Hassan (India) in collaboration with ISRO, and in Svalbard in cooperation with NASA and ESA. Future plans for new experiments in other locations in the World will be given. Then, development of propagation models performed by ONERA and CNES will be addressed, focusing on statistical prediction methods of rain rate, rain attenuation and site diversity, as well as on channel models allowing the space-time behaviour of the propagation channel to be represented. Examples of testing activity realized with these propagation models will be presented. Then future trends for research in the tropospheric propagation will be outline with the use of new frequency bands, and propagation issues for non-GSO systems and more particularly for mega-constellations.