Atmospheric total water vapor content retrievals using Aqua AMSR-E data: theoretical and experimental results

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Microwave radiometers measuring radiation from space give us the information about our planet on regular basis. This information appears to be unique in comparison with the one provided by the other instruments due to its regularity, universality, independence on clouds and day time and possibility of operational use. In spite of comparatively low resolution of the microwave radiometric measurements the scientific and practical needs for such data is exceedingly high. Nowadays three such instruments provide this invaluable information: Special Sensor Microwave Imager (SSM/I) on board DMSP satellite, Tropical Rain Measurement Mission Microwave Instrument (TMI) on board TRMM, and (since May 2002) Advanced Microwave Scanning Radiometer (AMSR-E) aboard NASA's Aqua spacecraft. Over the oceans, these radiometers are measuring a number of important geophysical parameters, including sea surface temperature, wind speed, atmospheric water vapor (Q), cloud liquid water, and rain rate. Expansive scientific research studies during the last decades have allowed reasonable interpretation of SSM/I and TMI measurement data: quite a number of geophysical parameter retrieval algorithms have been and are being developed. Various global and regional programs and projects have initiated the organization of the special experiments for obtaining synchronous satellite and in-situ measurement data for the development and validation of those algorithms. On the contrary, AMSR-E data interpretation happens to be at its initial stage: no quite reliable retrieval algorithm exists for any of parameters.In this study the regression algorithm for total atmospheric water vapor content Q retrieval from AMSR-E data is suggested. The algorithm is developed using closed scheme of the numerical experiment and validated by means of its application to collocated in space and time real Aqua AMSR-E and in-situ radiosounding measurements. During algorithm development three various regressions were used: linear, logarithmic and Neural Network. It is shown that in general Neural Network ensure 50 – 200% higher Q retrieval accuracy than the other regressions. The maximum deviations are from several to tens better for Neural Network based algorithms. Under adverse weather conditions (not rainy but cloudy with large cloud liquid water content values) the advantages of Neural Network approach increase dramatically. A complete investigation is conducted concerning radiometer noise and systematic shift in radiometer brightness temperature influence upon the water vapor retrieval errors.