Synergistic use of active and passive microwave measurements for sea/atmosphere parameters retrieval

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ABSTRACT

Several satellites as ERS1-2 and TOPEX-POSEIDON carry both active and passive microwave sensors. In particular, on these platforms, a microwave radiometer has been specially designed to provide the tropospheric path delay due to humidity, in order to correct the altimeter path measurement. Both instrument signals are sensitive to the sea surface and the atmosphere properties (surface wind, cloud, absorption,....). However, the altimeter and radiometer data processing has always been performed independently. Because emissivity and reflectivity are not really independent parameters, we know that the measurements from active and passive microwave modes are related to each other, therefore the coupling of these two types of microwave measurements should improve the retrieval of all the geophysical parameters obtained separately with no any interaction. We have undertaken to examine the feasibility and performances of a coupled retrieval of surface and atmosphere parameters of both instrument couples.

A double scattering model has been developed at Louvain-La-Neuve university (Belgium), taking into account the idea of coupling active and passive modes. A first step of this work is the validation of direct results of this model (brightness temperatures and scattering coefficients). This is done using comparisons with several satellite measurements (ERS1-2, TOPEX-POSEIDON, SSM/I) and ECMWF meteorological coincident fields over which we apply the model. Improvements are being introduced and tested in this model. The atmosphere modelisation is based on the Liebe atmosphere absorption model. It also contains Monahan & Lu foam coverage model and Droppleman foam emissivity model. A new dielectric constant model has been developed in order to improve the surface model. Comparisons with other surface models used in radiometry have been undertaken. Verification is done using satellites measurements: ERS1-2, T/P, SSM/I.

The retrieval process is done by iterations in this model. Surface effect is detected first, then used as a first guess for the atmosphere parameters processing, the results are then used again in order to determine with more accuracy the surface parameters. The iteration is repeated until we reach convergence of the results. The iteration method is compared to a statistical coupling method, where the geophysical parameters are expressed as a function of all the active and passive measurements together. An important database of active and passive data (scattering coefficients and brightness temperatures) is simulated using the double model. Then, a multilinear regression fit is applied to this database in order to retrieve the surface/atmosphere parameters that served for the direct simulation. This leads to a statistical algorithm that we compare the performances to the iteration method.

The geophysical products so obtained are compared to the standard geophysical products, derived separately. An other comparison is done with meteorological ECMWF coincident measurements (2hours in time and 0.5 in latitude and longitude). They are also compared to in-situ and radiosounding measurements and this constitutes the final validation.