Study and improvement of altimeter and radiometer data analysis and processing

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Jason-1 will carry an altimeter and a microwave radiometer, like its predecessors TOPEX/POSEIDON and ERS-1/2. We propose to participate in data processing and in-flight calibration/validation activities, on the basis of our previous work on ERS-1/2 [Bernard et al, 1993, Eymard et al, 1994] extended to the altimeter. Our study is therefore divided into two main parts: improvements in geophysical parameter retrieval algorithms and calibration/ validation/long-term survey of the JMR radiometer.

Retrieval algorithms for integrated water vapor content (equivalent to wet tropospheric correction), integrated liquid water content and sea surface wind speed will be improved. "Statistical" retrieval algorithms are formulated using a large data set at latitudes lower than 60° North and South over the oceans [Bourras, 1999], containing surface parameters and atmospheric profiles, and corresponding simulated brightness temperatures and backscattering cross-sections.
The source of meteorological data is 12-hour predictions derived from the meteorological model developed by the European Center for Medium-range Weather Forecasts (ECMWF). Relationships between satellite measurements and geophysical parameters are formulated using a classical multilinear regression. Improvement in retrieval algorithms depends therefore on the representativity of the database, the accuracy of the radiative transfer model, and finally on the quality of the inversion model. First, the database will be built using the latest version of the ECMWF forecast model, which has been operational since November, 2000. The 60 levels in the model enable a complete description of the troposphere/ stratosphere profiles and the horizontal resolution is now one-half a degree. Second, we will study the impact of a better sea surface model (at long and short scales), using assessed parameterizations of the atmospheric forcing (surface fluxes) [Smith, 1980, and Dupuis et al, 1997], then of a consistent description of the sea surface spectrum and the foam coverage. We use the emissivity model from the Université Catholique de Louvain [Lemaire, 1998], coupled with an atmospheric model [Liebe et al, 1993] for gazeous absorption.
A systematic comparison between measurements and simulations (active and passive) will be performed over coincident meteorological fields in Jason configuration and also in TMR, ERS-2/MWR, Envisat/MWR, SSM/I and TMI configurations, allowing a direct comparison between different measurements. Finally, for the inversion, we will compare performance of neural network inversion with the classical regression.

In-flight calibration will consist first of all in evaluating the calibration by comparison of measurements with simulations, using the same radiative transfer model and ECMWF global meteorological fields at coincident locations with the satellite. Although such a method only provides the relative discrepancy with respect to the simulation chain, the results, obtained simultaneously for several radiometers, can be used to detect significant calibration problems (more than 2-3 K). Before applying the inversion algorithms, the calibration will be fitted to the model used for inversion, leading to no significant bias in the retrieval. The validation of retrieved products will be performed by comparison with in-situ measurements from shipborne radiosoundings for water vapor and ship or buoy measurements for surface wind speed. Finally, for the long-term drift control, we will compare the method used for the long-term survey of the TMR [Keihm et al, 2000], which consists in surveying the colder sea points of the brightness temperature distribution, and continental areas where the atmosphere variability is much less than over open oceans. Using this last method, the stability of brightness temperatures can be checked using hot targets (Amazonian forest and Sahara desert) or cold targets (Greenland glacier).

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