INVESTIGATION OF METHODOLOGIES FOR ATMOSPHERIC RETRIEVAL FOR THE CPTEC OPERATIONAL SYSTEM

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ATMOSPHERIC RETRIEVAL

The Center for Weather Forecasting and Climate Studies (CPTEC) is responsible for producing weather maps for the numerical prediction in Brazil. One key issue for numerical prediction is related to provide good estimation of the initial conditions for the atmospheric simulation code. One procedure consists of retrieving vertical atmospheric profiles for temperature and moisture profiles. The CPTEC operationally uses the Inversion Coupled with Imager (ICI-3) software in dynamic mode (CPTEC analysis) with the ATOVS/NOAA-16 system to supply such vertical profiles. However, CPTEC is also investigating new retrieval schemes that have been developed at INPE. One of these schemes retrieves the profiles by means of a generalized least square problem, where a new regularization operator is employed. Such regularization operator is based on maximum entropy of second order [1, 2]. An Artificial Neural Network (ANN) is another scheme for retrieving the atmospheric profiles. The ANN is the Multi-layer Perceptron, with backpropagation learning strategy [3]. The goal here is to compare different methods, focusing on the operational procedures. The comparison is carried out by using two different databases: TIGR and NESDISPR. About 500 profiles from the TIGR and 400 profiles from the NESDISPR, and associated radiances, are selected for testing the three strategies. The average error over profiles is used to perform the comparison among the inversion methodologies, and these analyses will be shown here.

ENTROPIC REGULARIZATION

Higher order of the entropic regularization represents a generalization of the standard MaxEnt regularization method, allowing a greater flexibility for introducing any prior information about the expected structure of the true physical model, or its derivatives, into the inversion procedure [1, 2].

The Second Order entropic regularization:

\[
\Omega(t) = -\sum_{i=1}^{N} s_i \ln(s_i)
\]

min \[ |Kt - y|_2^2 - \alpha \Omega(t) \] (1)

DATABASES

Two different database for temperature profiles were used: TIGR (Thermodynamic Initial Guess Retrieval) and NESDISPR worldwide climatological profile - a file created by the NOAA-NESDIS. The data sets were divided: training, validation, and generalization data set. The training set is used for training the Artificial Neural Network, and the generalization test, obtained with the ANN trained with TIGR database. The Figure 9 (a-b) were obtained by the ANN trained with TIGR database. The Figure 10 (a-b) was obtained with second order entropic regularization.

ARTIFICIAL NEURAL NETWORKS

Artificial Neural Networks (ANN) have become important tools for information processing. Properties of ANNs make them suitable for application in pattern recognition, signal processing, image processing, financing, computer vision, and so on. There are several ANN different architectures. Here a Multilayer Perceptron (MLP) with backpropagation learning is employed.

RETRIEVAL USING ANN

ENTROPIC REGULARIZATION RESULTS

Entropic regularized solution is obtained by choosing the function \( \sigma \) that minimizes the functional (1). The optimization problem is solved by the quasi-Newtonian optimizer routine from the NAG Fortran Library [4].

INVERSE PROBLEM

\[
q = \frac{1}{\sigma} \left( \sum_{j=1}^{N} w_j y_j f_j + b_0 \right)
\]

REFERENCES


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