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Retrieving of the CO_2 total content from GOSAT measuring data with help of neural network technique

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For control over the content of greenhouse gases (CO_2 and CH4) the Japanese Aerospace Exploration Agency (JAXA) was developed and launched January 23, 2009 satellite Ibuki. The satellite is equipped with a Fourier transform spectrometer (TANSO-FTS), which monitors radiation in the near-IR (3 channels: 0.7, 1.6 and 2.06 microns, as well as IR (one channel)) to measure CO_2 and CH4 [http://www.jaxa.jp]. There are many approaches to solving the inverse problem of recovering the total gas content from satellite measurements, which are parametric. Nonparametric approaches such as neural networks, random forests regression or empirical orthogonal functions, support vector regression and other, apply to the data rarely. This is due to the fact that important in these methods is the stage of learning. For training it is necessary to generate sample data (signal-to-response) so as to attain the corresponding accuracy of the inverse problem.

The paper characterizes the solving algorithm of forward task for signals modeling of GOSAT with maximum taking into account of relief features and atmosphere changes, and also the solving of inverse task, by means of neural-network technique. Important quality of solving algorithm forward task is the calculating speed and the accuracy. The speed is needed in order to maximally the fast time to compile the base of model signals that allow for manifold changes of satellite feed in time, for data of geographic point. When neural network learning the recalculation need or endorsement of this base arises that desirably carry to out fast. It is clear that the solution precision of inverse task is determined by the good accordance of model and real signals of satellite device.

When solving the inverse problem by the method of neural-network they is necessary to select the neural network architecture (the number of layers and the neuron number in layer, activation functions) in such a manner as to retrieving error was minor. As of quality criterion formation of network architecture, by us the rate of learning (the steps amount training, required to reach given error level For training and test by us the sample of concentration profiles 2 for one of geographic points, on the territory of Western Siberia has been prepared. The sample size is 2190 profiles, of which 365 were chosen for test. The profile consists of 15 altitude levels (0-30 km). For anyone profile spectrum reflected solar radiation for different corners of sun declination. The spectrum keeps data for frequencies of CO_2 absorption region (6160-6260 cm-1). The type of neural network was chosen the multilayer perceptron.

In the report the calculation results of forward and inverse tasks of retrieving of CO_2 total content 2 for model situation, and also the processing of real satellites data are given.