Two fast forward radiative transfer models dedicated to the AIRS instrument and comparison to AIRS observations.

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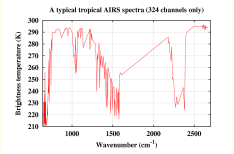
Introduction

With its 2378 infrared channels with a spectral resolution ranging from 0.35 cm^{-1} to 1.5 cm^{-1}, the high spectral resolution Advanced Infrared Sounder (AIRS), recently launched on board of EOS-Aqua, opens promising perspectives for remote sensing applications as the improvement of temperature and water vapor profile retrieval or retrieval of greenhouse gases (CO_2, N_2O , CO and CH_4 for example). In order to reduce the amount of data and calculation time needed by these applications, a subset of 324 channels has been extracted and is distributed by the NESDIS.

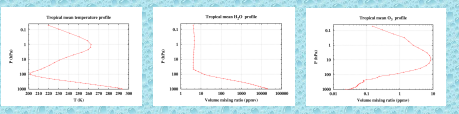


The key for all these applications is the availability of a fast forward radiative transfer model, much faster than the line by line models. Two such models are presented here.

Thermodynamic Initial Guess Retrieval (TIGR) climatological database :

2311 thermodynamic profiles (T, H_2O ,O_3)

Mean thermodynamic profiles of the 872 tropical TIGR situations



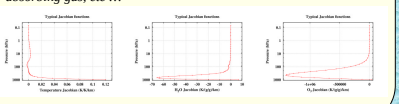
Automatized Atmospheric Absorption Atlas (4A)

fast line by line model

based upon the GEISA spectroscopic database

Jacobian definition

The Jacobian function is simply the first partial derivative $\left(\frac{\partial T_B}{\partial q}\right)$ of the brightness temperature T_B calculated by the forward radiative transfer model with respect to one input thermodynamical parameter q like temperature, surface emissivity, mixing ratio of an absorbing gas, etc …



Examples of Jacobian functions for the AIRS channel located at 1008.3 cm^{-1}

Radiative database :

Transmission functions

Temperature Jacobian

Mixing ratio (H_2O, CO_2, O_3, N_2O, CH_4 and CO) Jacobians

Emissivity Jacobian

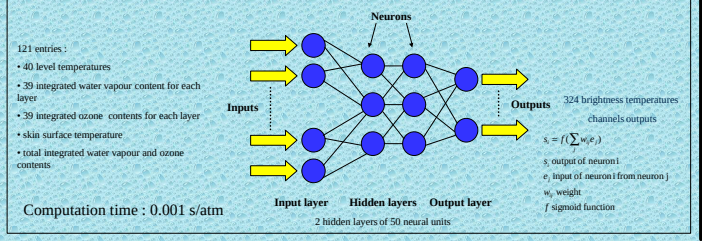
AIRS brightness temperatures

Neuronal model

- **Multilayer Perceptron (two hidden layers)**
- **Supervised Learning on the TIGR database**

Inputs :temperature and mixing ratio (H_2O, O_3) profiles
(1 network for each viewing angle)

Outputs : 324 AIRS channels brightness temperatures



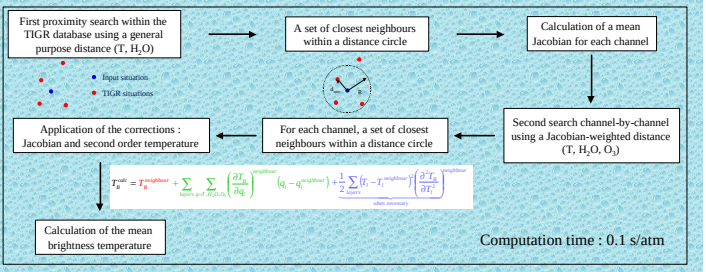
Jacobian model

- **Pattern recognition within the TIGR thermodynamical database**
- **Linearization of the radiative tranfer equation Þ use of Jacobians**

Inputs : emissivity, viewing angle, temperature and mixing ratio (H_2O, O_3, CO_2, CH_4, N_2O, CO) profiles

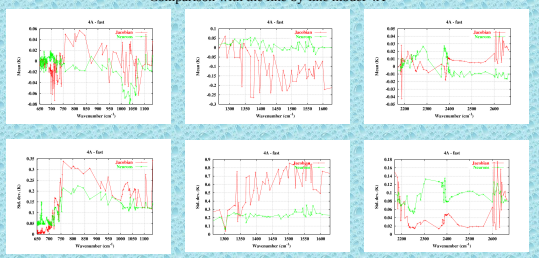
Outputs : - 324 AIRS channels brightness temperatures

- Jacobian functions



Statistics on the TIGR database

Comparison with the line-by-line model 4A

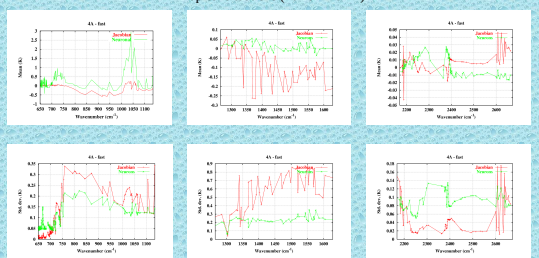


Statistics on an independent database

Comparison with the line-by-line model 4A

ECMWF analyses 19 September, 2003

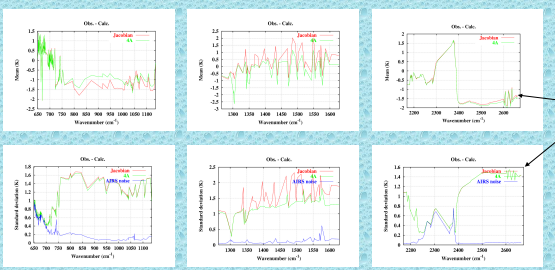
Tropical situations (20° S – 20° N)



Comparison with observations using ECMWF analyses

19 September, 2003

Comparison with clear night AIRS observations above sea



Conclusion

Jacobian Model	***Neuronal Model***
• Computation of Jacobian functions available	*•Computation of Jacobian functions still difficult*
•Relatively fast	*•Extremely fast*
•No learning process	*•Long learning process (50000 iterations at least)*
•Good treatment of the CO_2 channels	*•Appropriate treatment of the CO_2 channels*
•Poor treatment of the H_2O channels (would require high order corrections or better sampling of the database)	*•Good treatment of the H_2O channels*
•Able to take into account greenhouse gases profiles	*•Unable to take into account greenhouse gases profiles*