RESONANCE ENERGY EXCHANGE EFFECTS IN ATMOSPHARIC TRANSMISSION DUE TO THE PRESENCE OF POLLUTANTS

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ABSTRACT

Interpretation of the intensity of transmitted solar radiation at any frequency requires information on the extinction coefficient of multicomponent mixtures of gases present in the atmosphere. This is usually obtained by a simple addition of the composition weighted extinction coefficients of the individual components in the mixture. However even in the absence of strongly overapping absorption bands, this has to be corrected if resonant vibrational energy exchange can occur between the components in the gas mixture since such an exchange can alter the number of molecules in the emitting level appreciably. Such is the case e.g. for the 4.3 μ absorption band in CO_2 when pollutants like SO_2, oxides of N_2, unburnt hydrocarbons etc. are present. Many other examples of importance for atmospheric absorption can be given. In view of the large scale pollution of the atmosphere these gases are present in most urban localities in quantities sufficient to effect the transmission of radiation through resonance energy exchange .

As an example, using experimental data on the rate of energy exchange between CO_2 and SO_2 and CO_2 and C_2H_6 mixtures our model calculations show that the change in the net transmission of solar radiation at the 4.3 μ frequency is significant for the expected concentrations of SO_2 and C_2H_6.

This correction is also important in the use of measurements on back scattered laser radiation from smoke plumes in electric power statiions, to measure concentrations of CO_2, SO_2, O_2, N_2 etc.