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How much CO_2 really contributes to global warming? Spectroscopic studies and modelling of the influence of H_2O, CO_2 and CH_4 on our climate

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Based on the actual *HITRAN'2008* database [1] detailed spectroscopic studies on the absorbance of the greenhouse gases water, carbon dioxide and methane in the atmosphere are presented. The objective of these investigations was to examine and to quantify with these newly available data the influence of these gases on our climate.

The line-by-line calculations for sun light from *0.1 – 8* μm (short wavelength radiation) as well as those for the emitted earth radiation from *3 – 60* μm (long wavelength radiation) show, that due to the strong overlap of the CO_2 and CH_4 spectra with the water vapour lines the influence of these gases is significantly reducing with increasing water vapour pressure, and that with increasing CO_2-concentration well noticeable saturation effects are observed limiting substantially the impact of CO_2 on the warm-up of the atmosphere.

For the water vapour, which in its concentration is considerably varying with the altitude above ground as well as with the climate zone, separate distributions for the tropes, the moderate zones and the polar regions are presented. They are based on actual *GPS*-measurements of the water content in these zones [2] and are applied for calculating the absorbance in the respective regions. The vertical variation in humidity and temperature, in the partial gas pressures and the total pressure is considered for each zone separately by computing individual absorption spectra for up to 228 atmospheric layers from ground level up to *86 km* height.

The propagation length of the sun light in these layers, which depends on the angle of incidence to the atmosphere and therefore on the geographic latitude, is included by considering the earth as a truncated icosahedron (bucky ball) consisting of 32 surfaces with well defined angles to the incoming radiation and assigning each of the areas to one of the three climate zones.

To identify the influence of the absorbing gases on the climate and particularly the effect of an increasing CO_2-concentration on the warming of the earth, a two-layer climate model was developed, which describes the atmosphere and the ground as two layers acting simultaneously as absorbers and Planck radiators. Also heat transfer by convection between these layers and horizontally by winds or oceanic currents between the climate zones is considered. At equilibrium each, the atmosphere as well as the ground, delivers as much power as it sucks up from the sun and the neighbouring layer or climate zone. With this model for each climate zone the temperature progression of the earth and the atmosphere is calculated as a function of the CO_2-concentration and several other parameters like ozone and cloud absorption, short- and long-wavelength scattering at clouds as well as the reflection at the earth's surface.

The simulations for the terrestrial and atmospheric warm-up show well attenuating and saturating progressions with increasing CO_2-concentration, mainly caused by the strongly saturating absorption of the intensive CO_2 bands and the interference with water lines. The climate sensitivity C_S as a measure for the temperature increase found, when the actual CO_2-concentration is doubled, assumes$C_S = 0.41^\circ C$ for the tropical zone, $C_S = 0.40^\circ C$ for the moderate zones and $C_S = 0.92^\circ C$ for the polar zones. The weighted average over all regions as the global climate sensitivity is found to be $C_S = 0.45^\circ C$ with an estimated uncertainty of *30%*, which mostly results from the lack of more precise data for the convection between the ground and atmosphere as well as the atmospheric backscattering. The values for the global climate sensitivity published by the *IPCC* [3] cover a range from *2.1˚C – 4.4˚C* with an average value of *3.2˚C*, which is seven times larger than that predicted here.

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