Conference of the International Journal of Arts & Sciences,
CD-ROM. ISSN: 1943-6114 :: 11(03):85–90 (2018)

IR RADIOMETER FOR THE MEASUREMENT OF ATMOSPHERIC IR RAYS, TESTING AND ANALYSIS OF DATA, PART I

Nuri Emrahoglu

University Cukurova, Turkey

IR spectrum measurement is required for many reasons. The most important of these is global warming caused by CO_2 and CH_4 gases. In addition, water vapor, NO molecule groups, H_2S and other molecules cause contamination of the atmosphere and change of structure.

This study consists of two parts. Construction of measurement system in Section I and II. the section consists of calibration and atmospheric data acquisition. In section I, IR sensors are used for the radiometer construction, based on semiconductor technology for UV, visible and IR measurement. The measurement range is 6 sensor with 300nm-8μm and PT1000 temperature sensor is used to control the ambient temperature. The sensors are protected by an IR-permeable half-spherical glass. In addition, in order to minimize the temperature effect of sensors, the electrical power of the peltier cooler, which is the environment thermoelectric module with sensors, is supported by the DC battery supplied by the photo voltaic battery. In the first part of the study, the initial data from the sensors confirmed that the system was running smoothly.

Keywords: CO2 Global Warming IR Radiometer.

Introduction

In this study, IR radiometer based on semiconductor technology was designed to understand the effect of greenhouse gases on climate and to determine the abundance of greenhouse gases. The study consists of two parts. The first one is the construction of the IR radiometer, the second one is the calibration process of the IR radiometer, the realization and analysis of the data acquisition. The first part was completed and the sensors were tested with 40W / m^2 tungsten lamp and outdoors solar radiation. As a result of the test, it was determined that the IR radiometer produced data.

Literature Review

As it is known, since the industrial revolution, the atmosphere is constantly contaminated by the use of fossil fuels. There are many studies on this subject.

In 1990, the Curtis-Godson approach was used to determine the CO_2 and O_3 parameters by IR radiation measured in the middle and sub-atmospheres in the Infrared Radiation Parameters in Ming-Dah Chou Digital Climate Models. The same approach was studied in N_2O and CH_4 [1].

In 2015, D. R. Feldman1 et al. Reported a study of the observations of surface radiation with CO_2 from 2000 to 2010, which confirmed the theoretical predictions of the atmospheric greenhouse effect for anthropogenic reasons [3].

Hyo-Seok Park et al. In 2015, the study of the effect of the North Pole Winter Infrared Radiation on Early Summer Sea Ice was investigated [4].

Gaby Radel and colleagues in 2015 In visible and near-infrared wavelengths, in the studies of global irradiance and climate effect of water vapor continuity, the solar radiation component of water vapor feedback increases by about 4% and 9%; 18 are more negative and the global average precipitation response is reduced by 1% and 4%, and especially at atmospheric temperatures and wavelengths below 2 µm, there is a need for improved continuous measurements [5].

In 2016, Thomas R. Anderson and his colleagues predicted that global warming would increase between 1-3 ° C with increasing CO_2 emissions [6].

In his work by Thomas Allmendinger in 2018, he argues in contrast to the fact that the atmospheric temperature in the mountains is lower than in low areas, despite the increasing density of sunlight, in contrast to its work in Thermal Radiation and its Role in Greenhouse Effect. On top of that, greenhouse gases such as carbon dioxide have no effect [7].

I. M. Nasrtdinov et al in their study in 2018 Siberian Summer Conditions IR Spectral Area and Smoke Aerosol Effects of the Direct Radiation Effects have examined. The DRE value at atmospheric boundaries in the thermal spectral region has been shown to be about 3% [8].

Materials and Methods

As known, IR radiometers measure the IR region of the spectrum from the sun, the excited gas molecules in the atmosphere, and the radiation reflected from the surface to the atmosphere and reflected by the greenhouse gases. Previous studies have identified solar radiation from IR (Duffie, John A., Beckman, William, 2013) [2]. The remaining greenhouse gases have an IR spectrum. IR radiation is divided into three regions, NR IR, M IR , F IR.

The world standard Eppley PIR radiometer measures the thermal radiation value. It measures only 0.3-3µ of atmospheric radiation. Within this wavelength range it includes near and medium IR radiation that passes through the atmosphere and is reflected. The IR radiometer is designed to measure the IR radiation in three parts: near middle and far. These objectives cover areas where greenhouse gases are heavily irradiated.

Selection of Sensors

In Figure 1-7, the intensity of the greenhouse gases in the atmosphere is given. As it can be seen from the figures, the sensors sensitive to these wavelengths were selected as the radiation intensity of sample molecules such as CO_2, N_2O, CH_4, H_2S. Two of these sensors measure CO_2 and CH_4 directly. Other molecules are measured in total. Thus, the ratio of greenhouse gases measured directly to CO_2 and CH_4 was determined and it was thought that other greenhouse gases could be detected [9].

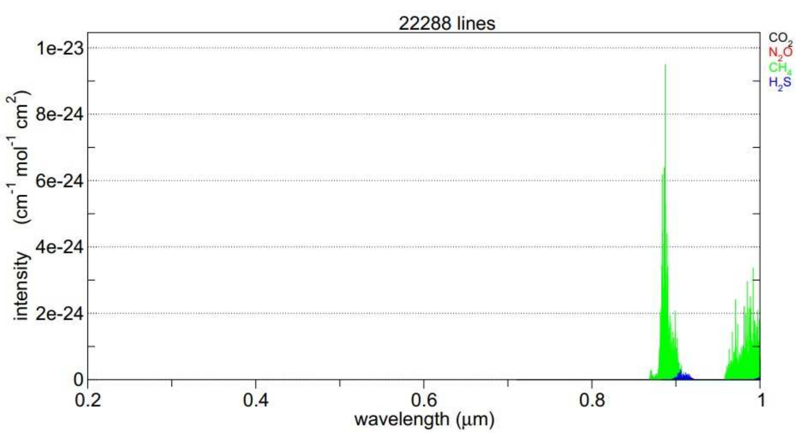

Figure 1. Radiation intensity of CO_2,N_2O,CH_4,H_2S greenhouse gases between 0.2-1 µm

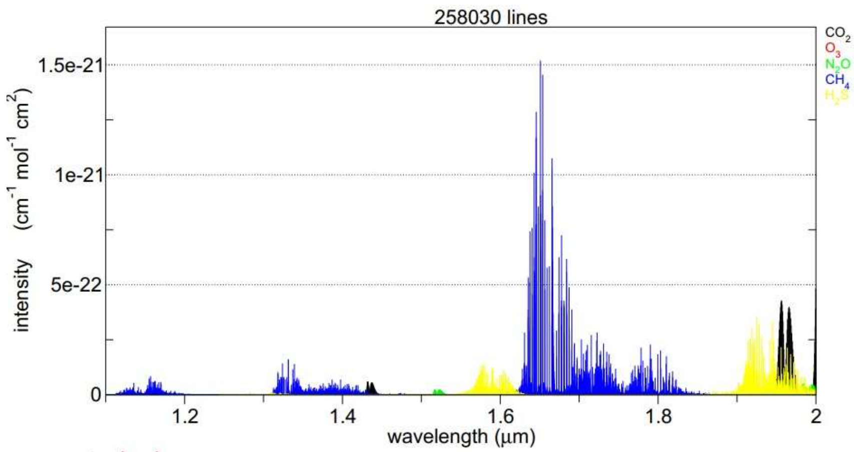

Figure 2. Radiation intensity of CO_2,N_2O,CH_4,H_2S greenhouse gases between 1-2µm

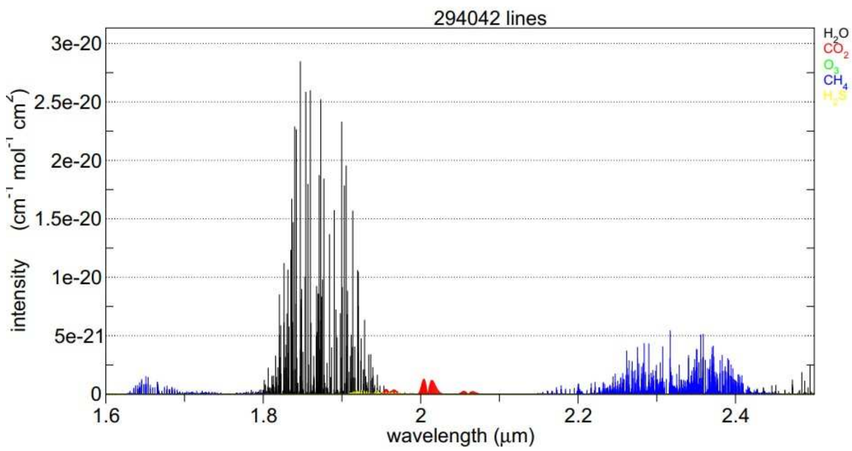

Figure 3. Radiation intensity of CO_2,N_2O,CH_4,H_2S greenhouse gases between 1.6-2.5µm

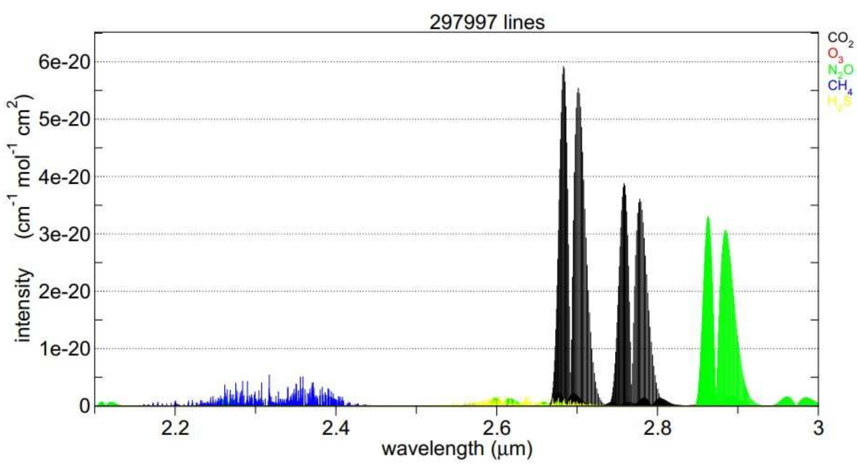

Figure 4. Radiation intensity of CO_2,N_2O,CH_4,H_2S greenhouse gases between 2-3µm

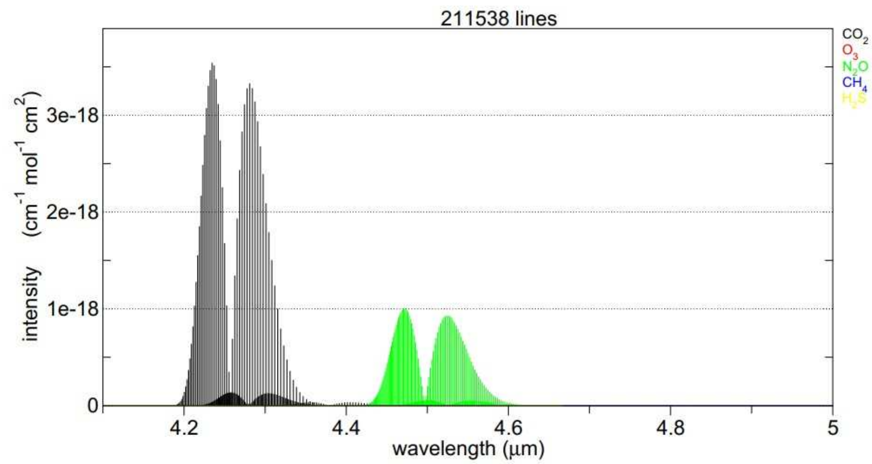

Figure 5. Radiation intensity of CO_2,N_2O,CH_4,H_2S greenhouse gases between 4-6μm

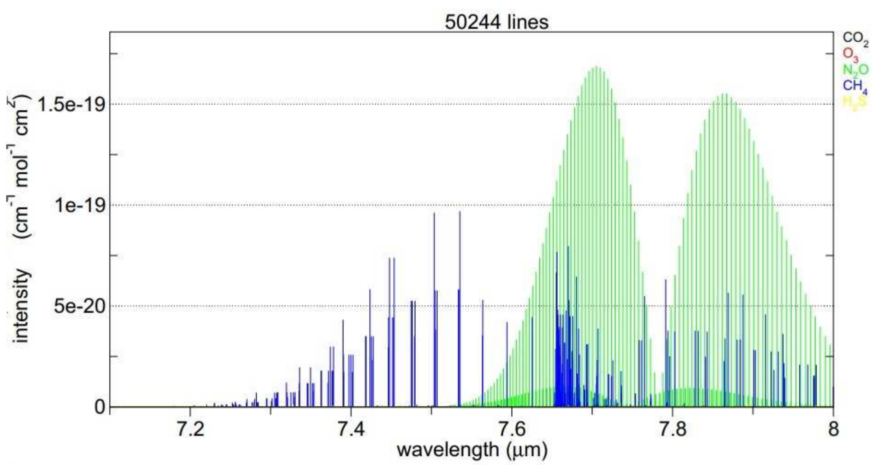

Figure 6. Radiation intensity of CO_2,N_2O,CH_4,H_2S greenhouse gases between 7-8μm

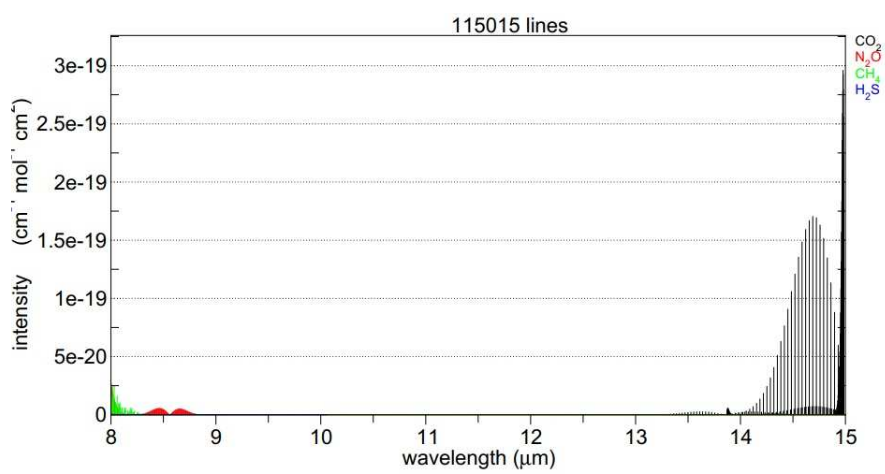

Figure 7. Radiation intensity of CO_2,N_2O,CH_4,H_2S greenhouse gases between 8-15μm

The sensors used for the above mentioned greenhouse gases (Si and InGaAs based semiconductor sensors) are used. These sensors are UV-Vis, NIR, MIR, FIR sensitive.

Sensors attached to the board are shown in figure 8. Sensors on board are respectively; ; 3-4.5µm CO_2, 300-1000 nm UV-Vis, 800-900 nm CH_4, 800-1.7 µm CH_4, H_2S, 8-15 N_2O, CH_4, CO_2 measures greenhouse gases.

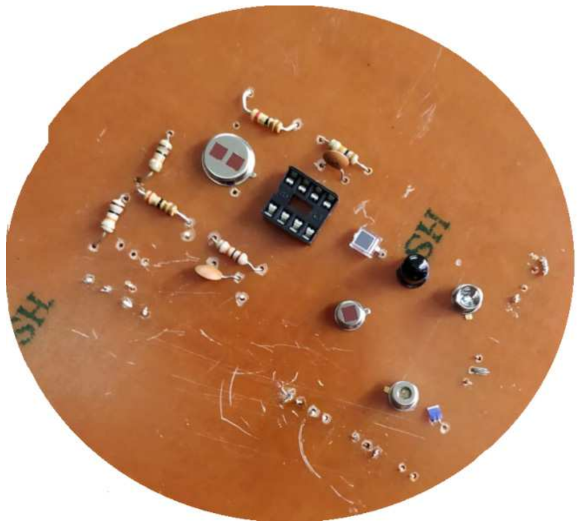

Figure 8. IR sensors measuring CO_2, CH_4, N_2O, H_2S greenhouse gases between 300nm-15µm.

Conclusion and Discussion

After mounting of IR sensors, the values taken under dark and tungsten radiation are given in table 1. As can be seen from this table, the sensors were operated under a 40 W / m^2 radiation. This shows us that we are on the right track.

Table 1. IR Radiometer and initial measurements

Sensör	mV (40 W/m^2)
3-4.5µm CO_2	0.4
300-1000 nm UV-Vis	500000
800-900 nm CH_4	0.13
800-1.7µm CH_4,H_2S	71
400-1100µm	550
8-15µm N_2O,CH_4, CO_2	0.14

When the table values were examined, the test was completed and the IR Radiometer was achieved. Part I of this study was completed and II. test measurements will be started for section calibration, CO_2, CH_4,N_2O,H_2S molecular gas values will be tested in the laboratory condition with the radiation values and calibration will be completed. Afterwards, analysis will be made with the data to be taken under atmospheric conditions and will be concluded with an article.

Acknowledgement

This work was supported by Research Fund of the Cukurova University. Project Number: FBA-2018-10304

References

1. Ming-Dah Chou, David P. Kratz and William Ridgway, 1990. Infrared Radiation Parameterizations in Numerical Climate Models. Journal of Climate , 4, 424 – 437
2. Duffie, John A., Beckman, William, (2013). Solar Engineering of Thermal Processes Willey Fourth Edition. 54-64
3. D. R. Feldman, W. D. Collins1, P. J. Gero, M. S. Torn1,4, E. J. Mlawer & T. R. Shippert. (2015). Observational determination of surface radiative forcing by CO2 from 2000 to 2010. N a t u r e 5 1 9 , 339-442
4. Hyo-Seok Park , Sukyoung Lee , Yu Kosaka ,Seok-Woo Son And Sang-Woo Kım, (2015). The Impact of Arctic Winter Infrared Radiation on Early Summer Sea Ice. J o u r n a l o f C l ı m a t e, 28, 6281- 6296.
5. Gaby Radel, Keith P. Shinea and Igor V. Ptashnika, (2015). Global radiative and climate effect of the water vapour continuum at visible and near-infrared wavelengths. Q. J. R. Meteorol. Soc. 141, 727–738
6. Thomas R. Anderson, Ed Hawkins and Philip D. Jonesc,(2016). CO2, the greenhouse effect and global warming: from the pioneering work of Arrhenius and Callendar to today's Earth System Models. Endeavour, 40 No.3
7. Thomas Allmendinger, (2018). The Thermal Radiation of the Atmosphere and Its Role in the So-Called Greenhouse Effect. Atmospheric and Climate Sciences. 8, 212-234.
8. I. M. Nasrtdinov, T. B. Zhuravleva., and T. Yu. Chesnokova, 2018). Estimation of Direct Radiative Effects of Background and Smoke Aerosol in the IR Spectral Region for Siberian Summer Conditions. Atmospheric and Oceanic Optics, 31, No. 3, pp. 317–323
9. http://www.spectralcalc.com/spectral_browser/db_intensity.php