

# Infrared Spectra of Extrasolar Terrestrial Planets with Cloud

# Yumiko Oasa[1]; Nobuhiro Kikuchi[2]

[1] Kobe Univ.; [2] JAXA/EORC

Recent observations reveal that there exist numerous extrasolar planets and our solar system cannot be rare. Because a star is so much brighter than any planet (viewed from outside our solar system, Jupiter would be only one billionth as bright as the sun), the presence of extrasolar worlds around distant stars has so far been inferred only indirectly, by the slight distortion imparted to the star's spectrum. The primary scientific goal of the study for planets outside our solar system is the direct detection and characterization of Earth-like planets that orbit nearby stars and to looking for the chemical signatures of life. For this purpose, the Darwin/TPF projects are proposed and will take the form of either a coronagraph operating at visible and/or infrared wavelengths or a large-baseline interferometer operating in the infrared. In particular, the mid-infrared spectroscopy is the best suited method to directly search for the atmospheric components and conditions attributable to primitive life, such as ozone, carbon dioxide, and methane seen in the Earth's atmosphere.

The detection of such gases on the extrasolar terrestrial planets has been mainly considered on the clear sky conditions, not on the cloudy conditions. Clouds that strongly impact climate through radiative energy redistribution via scattering and absorption constitute the major source of uncertainty in global climate models. Because approximately 60% of the Earth is covered with clouds, most of the extrasolar terrestrial planets would be clouded over. It is needed whether we can detect the atmospheric components from the observed infrared spectra using more realistic climate model.

Here we calculated the synthesized infrared spectra of terrestrial planets and analyzed the Earth's infrared spectra of the Interferometer Monitor of Greenhouse gases (IMG) aboard the Japanese Advanced Earth Observing System (ADEOS) satellite, which is a Fourier Transform Spectrometer (FTS) using a Michelson interferometer. The simulated model spectra is constructed by our radiative transfer model using the general circulation model for climate and cloud. We compared the synthesized spectra with those obtained by IMG. As a result, the infrared spectra of terrestrial planets are sensitive to the radiative properties of clouds for terrestrial radiation, which depend strongly on cloud optical properties and cloud morphology such as cloud top height, cloud distribution, and the observed angle.

In this contribution, we will discuss how the cloud radiation has an influence on the detectability of the atmospheric constituents of extrasolar terrestrial planets.