



UNIVERSITÄT HEIDELBERG INSTITUT FÜR UMWELTPHYSIK



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Atmosphäre und
Fernerkundung

Terrestrische Systeme
und Geophysik

Aquatische Systeme
und Stoffkreisläufe

Gasaustausch
und Wellen

Radiometrie und
Altersbestimmung

Master Thesis

Development of a stand-alone atmospheric greenhouse gas spectrometer – deployment on research vessel

Greenhouse gases: Man-made emissions of the greenhouse gases carbon dioxide (CO_2) and methane (CH_4) drive contemporary climate change. While the rising atmospheric CO_2 and CH_4 concentrations in the Earth's atmosphere are evident, our knowledge on how sources and sinks act on regional-to-local scales and how they evolve in the future under climatic and societal change is highly uncertain. To reduce these uncertainties, it requires advanced observation techniques, data reduction methods, and modelling tools that enable attribution of the minute atmospheric concentration gradients to the driving processes of the carbon cycle and human activity.

Project: Here, we propose to further develop a state-of-the-art Fourier Transform Spectrometer (FTS) that is capable of measuring CO_2 and CH_4 (and some other gases such as CO) with high accuracy using molecular absorption spectroscopy in the shortwave infrared spectral range. Developments should focus on making the instrument suitable for autonomous deployments on mobile platforms. The setup will be tried during a cruise of the research vessel Sonne from Mexico to Singapur in May/June/July 2019. The goal is a proof-of-concept for future stand-alone, continuous deployment on freight ships.

Tasks:

- Learn how to operate the greenhouse gas spectrometer EM27/SUN locally e.g. at our roof-top laboratory.
- Setup portable infrastructures that enable stand-alone deployment on mobile platforms, i.e. vibration damping, weather-proof housing, wireless communication, procedure automation.
- Deploy and operate spectrometer on research vessel Sonne during its cruise from Mexico to Singapur in May/June/July 2019.
- Derive highly accurate CO_2 , CH_4 (and CO) concentrations across the Pacific ocean, document achievable accuracy, compare to coincident satellite records (e.g. Sentinel-5 Precursor).

Requirements:

- Keen interest in optics, absorption spectroscopy, atmospheric radiative transfer.
- Hands-on approach to technical developments.
- Capable of 6-weeks ship cruise through the Pacific (seasickness-resistant, medically uncritical record etc.).



Figure. The EM27/SUN (top) during its deployment at Mt. Etna, Italy, and a close-up of the sun-tracker (bottom) during its deployment on research vessel Polarstern.

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Relevant work:

A. Butz, et al., doi:10.5194/amt-10-1-2017, 2017

Klappenbach, F., et al., doi:10.5194/amt-8-5023-2015, 2015