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Measuring radiation profiles and the greenhouse effect through the atmosphere

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In spite of many solar shortwave and thermal longwave radiation measurements at the Earth's surface and at the top of the atmosphere, there are few observations documenting how radiation profiles change through the atmosphere - information that is necessary to fully quantify the greenhouse effect of the Earth's atmosphere. Using weather balloons and specific radiometer equipped radiosondes, we measure shortwave and longwave radiation flux profiles from the surface of the Earth up to 35 kilometers in the stratosphere. Radiation profiles measured during nights with different amounts of water vapor, allow determining the greenhouse forcing. We show, that under cloud free conditions, water vapor increases with Clausius-Clapeyron (7% / K), and longwave downward radiation at the surface increases by 8 Watts per square meter per Kelvin. The longwave net radiation however, shows a positive increase (downward) of 2.4 Watts per square meter and Kelvin at the surface, which decreases with height and shows a similar but negative increase (upward) at the tropopause. New flight techniques will be shown using a GPS and autopilot equipped glider to bring the instruments safely back to the launch station.

References: Philipona et al., 2012: Solar and thermal radiation profiles and radiative forcing measured through the atmosphere. Geophys. Res. Lett. 39, L13806, doi: 10.1029/2012GL052087.