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A new Fundamental Climate Data Record (FCDR) for almost 40 years of measurements from the polar-orbiting High resolution Infrared Radiation Sounder (HIRS) based on a metrologically traceable uncertainty analysis.

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As part of the Horizon 2020 FIDUCEO project, we present a new Fundamental Climate Data Record (FCDR) for the High resolution Infrared Radiation Sounder (HIRS), with pixel-level metrologically traceable uncertainties and error covariance estimates. HIRS has flown on 16 EUMETSAT and NOAA polar-orbiting satellites between 1978 and present. It is a 20-channel radiometer with one visible channel and 19 infrared channels, the latter covering a range from 3.7 to 15 μm. The instrument will soon turn 40 years old, but as it was designed to make measurements for weather forecasting, it cannot be immediately applied in climate science. Rather, usage for climate measurements requires (1) a thorough metrological uncertainty analysis for each instrument, and (2) harmonisation to bring all instruments to a common reference. In this paper, we present a detailed metrological analysis and the resulting FCDR.

We have identified 17 distinct physical effects that cause an error in calibrated HIRS radiances. Starting with the measurement equation, which relates the calibrated radiances to measurands and calibration parameters, we explore the magnitude and correlation structures of some of those effects. The correlation structure affects how errors propagate upon the calculation of averages and other statistics, so this information is critically important for climate applications. The correlation structure for identified effects includes fully random, fully systematic, and locally systematic.

The result is a new publicly available FCDR designed for appropriately produced Climate Data Records (CDRs) spanning nearly 40 years.