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A precision solar spectroradiometer for spectral aerosol optical depth measurements

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The radiative forcing of atmospheric aerosols represents one of the largest uncertainties in the Earth radiative budget. Global networks of surface based sunphotometers such as the GAW-PFR network operated by PMOD/WRC measure the aerosol optical depth at several distinct wavelength channels between the ultraviolet and the infrared. A new generation of solar spectrophotometers, the Precision Solar Spectroradiometer (PSR), is being developed at PMOD/WRC to eventually replace current filter based sunphotometers. It is based on a temperature stabilized grating spectroradiometer with a 1024 pixel Hamamatsu diode-array detector, operated in a hermetically sealed nitrogen flushed enclosure. The spectroradiometer is designed to measure the solar spectrum in the 330 to 1040 nm wavelength range with a spectral resolution of about 1 nm full width at half maximum. The optical bench with the optical elements was optimized to reduce the temperature dependence of the solar measurements to less than 1%K-1 over the whole wavelength range. The design benefits from the experience gained from successive generations of the successful Precision Filter Radiometers (PFR), including: an in-built solar pointing sensor, an ambient pressure sensor and temperature sensors to provide routine quality control information which will allow autonomous operation at remote sites with state-of-the-art data exchange via USB or Ethernet interfaces. The instrument is temperature stabilized to ambient temperatures with a stability of better than 1 K. Initial solar measurements of the PSR beside the PFR-Triad have shown an agreement to within 1% at the common wavelengths 368, 440, 500, and 862 nm.
The PSR prototype will be operated in 2012 next to the PFR-triad of the World Optical Depth Research and Calibration Center (WORCC) to test its performance and long-term stability in view of producing a commercial version of this instrument.