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Determination of Cloud Properties and the Complete Net Surface Radiative Cloud Forcing from Surface Radiation Measurements

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One constraint in determining the effect of clouds on the net surface radiative energy budget (termed cloud forcing by many) using model calculations for cloudless sky irradiances is the availability of information needed as model inputs such as temperature and humidity profiles, aerosol optical depths, column ozone amounts, etc. The availability of these quantities is limited in many locations, and using climatological or spatially/temporally interpolated values increases the uncertainty of the model calculations and thus the resultant net cloud effect estimations. The Flux Analysis methodology has been developed to use time series of surface radiation and standard meteorological measurements to produce continuous cloudless sky irradiances and infer cloud macro-physical properties such as cloud amount, cloud optical depth and effective transmissivity, and cloud radiating temperature all without the need for ancillary information such as model calculations require. Thus, particularly in situations where the model inputs need to be interpolated or climatological values used, the Flux Analysis methodology permits cloud effect determinations that are perhaps less uncertain than otherwise possible, and additionally provides cloud property estimations not otherwise available. We will present a brief outline of the Flux Analysis methodology, and examples of climatological analyses of surface radiation budget and net cloud forcing, and cloud properties, using data from US Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) Program and the international Baseline Surface Radiation Network (BSRN) sites.