Reconstructing Historical Solar Activity with the Advective Flux Transport Model

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Historical reconstructions of total solar irradiance (TSI) rely on calculations of flux emergence and transport based primarily on sunspot-number records. In 2015, the Sunspot Indices and Long-term Solar Observations (SILSO) released version 2.0 of the sunspot-number time series, including monthly sunspot numbers from 1749 to the present. These revisions produce a sunspot record that differs notably from prior versions and are thus expected to significantly impact estimates of solar open and closed magnetic flux and historical TSI reconstructions. We are using the Advective Flux Transport (AFT) model estimate the impacts of sunspot number revisions on extant historical reconstructions of TSI based on the empirical, proxy-based NRLTSI2 model. AFT is, a realistic surface flux transport model that has demonstrated its predictive capability on both short (active-region evolution) and long (solar-cycle) timescales. We present our method for generating synthetic active-region databases based on the revised sunspot-number record. These synthetic databases include the timing, position, and strength of solar active regions, which are then used as the magnetic input sources to AFT to create simulations of the evolution of the Sun's magnetic fields, from which historical TSI variations (since 1749) will be estimated. We also show examples of AFT-generated historical and recent solar cycles, the latter of which we use to validate the model's ability to generate realistic solar cycles.