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Unforced trends and variability of surface solar radiation in CMIP5

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We examine annual mean all sky surface solar radiation (SSR) in 43 pre-industrial control (piControl) experiments of the Coupled Model Intercomparison Project Phase 5 (CMIP5). We find that internal SSR variability and unforced SSR trends over 10 to 50 years are closely linked. The finding is not trivial as internal variability comprises a range of time scales (e.g., weather, El Nino, Atlantic Meridional Oscillation) that potentially leave an imprint on unforced SSR trends. An analytical relation is given that expresses, as a function of SSR variability, the likelihood of occurrence of an unforced SSR trend of a specific length and strength. SSR variability, and thus SSR trends, we find to depend strongly on geographical region and on whether they are quantified in absolute units or relative to the long term mean SSR. Two corresponding maps are given. Depending on geographical region, we estimate that a positive unforced 30 year trend with at least a 25% chance of occurrence has a magnitude between 0.15 and 1.7 W/m2/decade or 0.11 and 1.4 percent of long term mean SSR per decade. Comparison with present-day observations and inter-model spread suggests for these estimates an average uncertainty of about 30%, and a regional uncertainty up two three times larger or smaller. We illustrate how these results may be used to get statistical estimates of how (un-)likely it is that observed SSR trends or part thereof are due to internal variability alone.

Reference: Folini, D. et al., "Trends of surface solar radiation in unforced CMIP5 simulations", JGR 2017, doi:10.1002/2016JD025869