Recent Observed Variations in Background Aerosol Optical Depth and Associated Direct Radiative Forcing Estimates

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The direct solar radiative forcing of aerosols is primarily a function of aerosol optical depth (AOD), for which several observational techniques exist. The AOD variations over Mauna Loa Observatory (MLO) have been estimated for the past 55 years from "apparent solar transmission" observations. Because of MLO's unique geographic and topographic location, these AOD estimates have been considered generally representative of variations in the zonal-mean upper-tropospheric plus stratospheric background levels for the Northern Hemisphere lower latitudes. In more recent decades, refined observations of AOD utilizing sunphotometers, lidars and satellites were subsequently implemented. These additional observations now permit more thorough and complete evaluation of changing AOD, although the MLO observations remain a rare long-term record to which the more advanced observations can be compared. Several of these records have been examined and indicate a sufficient increase in background AOD over the past decade (2000s) that, if global, could produce changes in radiative forcing over the decade that are significant but opposite in sign to that of CO_2. However, confident long-term projections of aerosol loadings have not been made and in the last two years some reversal of the previous decade's change is now evident. The actual climatic forcing due to these changes in aerosols is dependent on the complete spatial and temporal extent of the variations, which is the subject of further investigation. The latest data and some speculation as to the origin and impact of the varying aerosols will be presented.

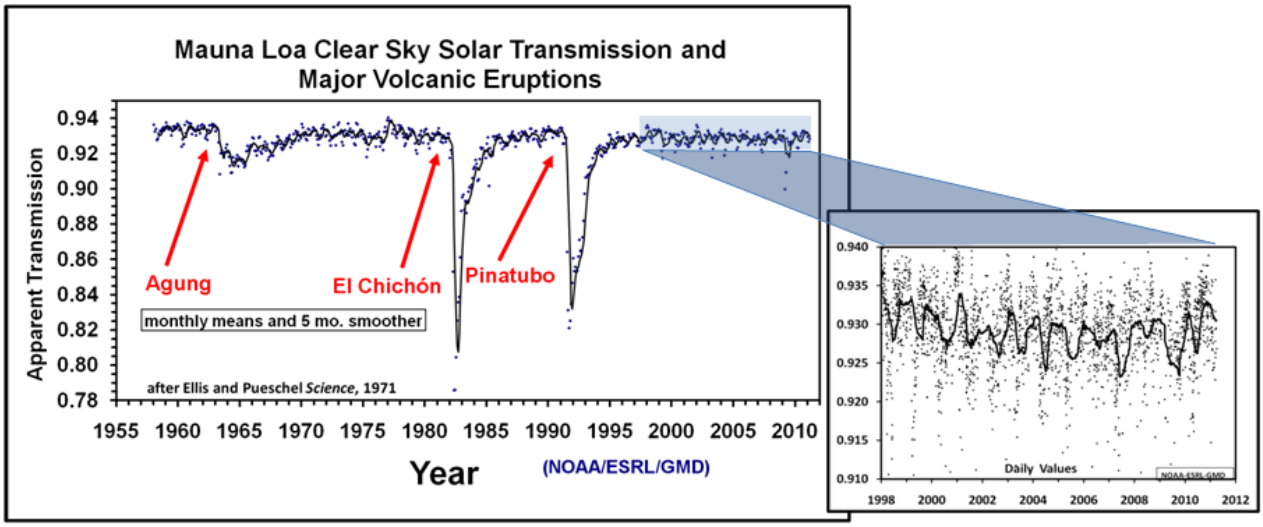

Figure 1. The main (left) plot is monthly average Mauna Loa apparent transmission (points) as computed from the Ellis & Pueschel pyrheliometer ratioing technique. The solid line is a 5-month running smoother. The timing and effect of major volcanic eruptions that injected high amounts of material into the stratosphere are indicated by the volcanoes' names. The annual oscillation in the 5-month smoother is due to seasonal zonal/hemispheric-scale transport from Asia. The expanded plot (right) shows daily apparent transmission for the past 14 years with an 85-point running smoother.