

Analyzing the Contribution of Aerosols to an Observed Increase in Direct Normal Irradiance

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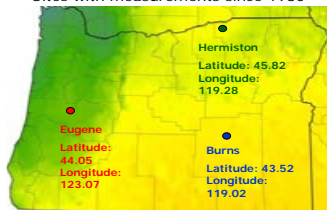
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OBJECTIVE

Determine if increase in surface solar irradiance could be caused by decreasing aerosol concentrations.

1. Irradiance measurements analyzed from 3 stations.

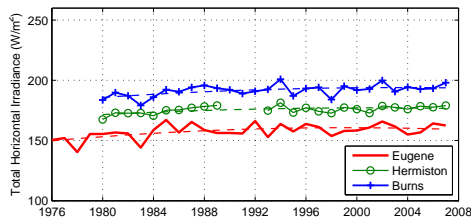
Sites with measurements since 1980



2. All-sky total irradiance increases 1-2% per decade



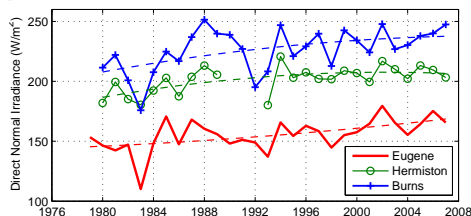
Eppley PSP



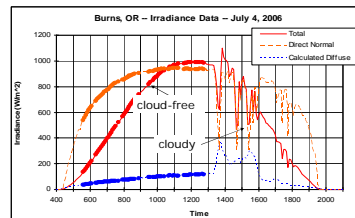
3. All-sky direct normal irradiance increases 5% per decade



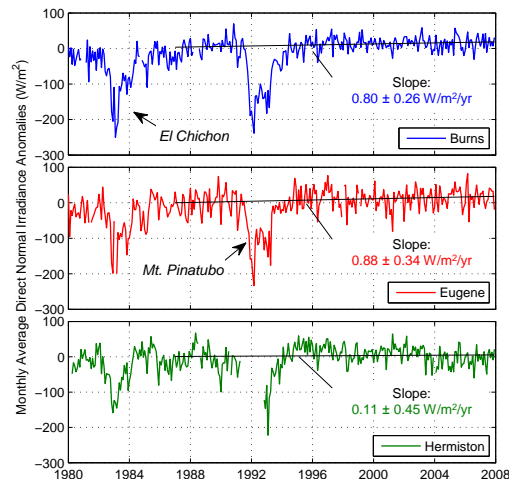
Eppley NIP



4. Clear-sky periods determined with Long and Ackerman SW Flux Analysis^[1,2].



5. Clear-sky direct normal irradiance increases by 1-2% from 1987-2008 (at solar zenith angles of 65-75°).

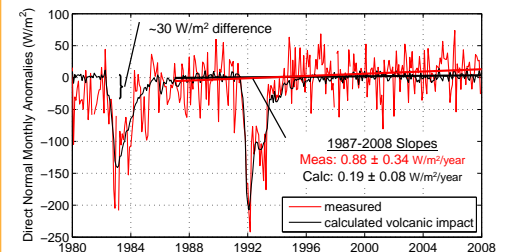


Monthly averages of cloud-free direct normal flux at long atmospheric path lengths (solar zenith angles of 65-75°) are used to look for changes in flux caused by aerosols. A 1-2% increase is seen since 1987 after eliminating years most impacted by volcanic eruptions.

Conclusions

Annual average all-sky total and direct normal irradiance measurements show an overall increase in Oregon between 1980 and 2007. Two measurement sites show statistically significant increases in clear-sky direct normal irradiance in background periods before and after the eruption of Mt. Pinatubo^[6] (1987-2008), consistent with the hypothesis that a reduction in anthropogenic aerosols may contribute to the increase in surface irradiance.

6. Calculated impact of volcanic aerosols does not explain all clear-sky increase.



Radiative Transfer Calculation Details:

- Stratospheric AOD from NASA GISS^[3]
- Average of calc at zenith angles 65, 70, 75°
- DISORT radiative transfer model^[4]
- Temp and humidity profiles from NCEP Reanalysis^[5]
- Constant tropospheric 550 nm AOD of 0.5

References

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4. Stamnes, K., S.-C. Tsay, W. Wiscombe, and K. Jayaweera, 1988: *Appl. Opt.*, **27**, 2502-2509.
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- Stratospheric AOD from NASA Goddard Institute of Space Studies web site: <http://data.giss.nasa.gov/modelforce/strat aer/>
- NCEP Reanalysis from NOAA/OAR/ESRL PSD: <http://www.cdc.noaa.gov/>
- J. Coakley Jr. for Radiative Transfer code and assistance