How to Convert IVI2 into Aerosol Optical Depth and Total Solar Irradiance

Chaochao Gao and Alan Robock
Department of Environmental Sciences
Rutgers University
New Brunswick, NJ 08901 USA
chaogao08@gmail.com, robock@envsci.rutgers.edu

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Users may convert the stratospheric aerosol loadings (in units of Tg) provided in the Ice Core Volcanic Index 2 [IVI2; *Gao et al.*, 2008] into aerosol optical depth (AOD) by dividing the loadings by 150 Tg [*Stothers*, 1984]. The AOD time series can then be used to calculate the corresponding radiative forcing (in unit of W m^{-2}) by multiplying it by –20 [*Wigley et al.*, 2005]. The conversion to AOD is valid for aerosols with effective radius in the visible spectral range.

References

Gao, Chaochao, Alan Robock, and Caspar Ammann (2008), Volcanic forcing of climate over the past 1500 years: An improved ice-core-based index for climate models. *J. Geophys. Res.*, *113*, D23111, doi:10.1029/2008JD010239. http://climate.envsci.rutgers.edu/IVI2/

Stothers, R. B. (1984), The Great Tambora Eruption in 1815 and its aftermath, *Science*, *224*(4654), 1191 – 1198, doi:10.1126/science.224. 4654.1191.

Wigley, T. M. L., C. M. Ammann, B. D. Santer, and S. C. B. Raper (2005), Effect of climate sensitivity on the response to volcanic forcing, *J. Geophys. Res.*, *110*, D09107, doi:10.1029/2004JD005557.

Here is a sample MATLAB code to calculate the vertical integrated AOD and radiative forcing using IVI2 monthly and spatially dependent data.

```
%Read in the data (Note: the delimiter is blank space)
        D = dlmread ('filename','\t');
        TIME = D(:,1);
        DATA = D(:, 2:end);

% Calculate the vertical integrated aerosol loading
        for t = 1 : 18000
                for i = 1: 18
                        for j = 1 : 43
```

```
                LOAD(t, i, j) = DATA(t, 43*(i-1)+j);
            end
        COLUMNLOAD(t, i) = sum (LOAD(t, i, :));
        end
    end

% Calculate the vertical integrated AOD and radiative forcing
    AOD = COLUMNLOAD / 150;
    F = AOD * -20;

% Write the output
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```