README: NOAA 6-14 SEM MEPED Omnidirectional Detector Response Functions

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The Space Environment Monitor (SEM) Medium-Energy Proton and Electron Detectors (MEPED) that flew on TIROS-N and NOAA 6-8, 10, 12 and 14 included three Omnidirectional detectors. The channels from these detectors were referred to as P6, P7 and P8 and were nominally sensitive to >16, >36 and >80 MeV protons. See three NOAA documents on the NCEI website for more details (Hill et al. 1985; Seale and Bushnell 1987; Raben et al. 1995). Though designed to measure energetic proton fluxes, these channels proved also to be sensitive to energetic electrons (e.g., Boscher et al. 2018). The thoroughly redesigned second-generation SEM(-2) (including Omnidirectional detectors that were much less sensitive to electrons) first launched on NOAA-15. The last NOAA-14 SEM data file is from December 31, 2004. The first-generation SEM is sometimes referred to as SEM-1.

Many years ago, electron and proton response functions for channels P6, P7, and P8 of NOAA 6-8, 10, 12, and 14 were evaluated by Monte Carlo methods. These simulations used the deposited-energy threshold measured for each flight unit (approximately 0.2 MeV). See Cayton (2007a) for details.

The modeled proton responses are significantly different from the nominal responses (Cayton 2007b). This can be attributed to inclusion of the effects of the shroud (a dust cover and thermal control surface) in the modeling. In order to accurately simulate an instrument's performance, it is essential to include details like the thin thermal shroud in the model.

ASCII files of the tabulated response functions are provided by NCEI for the SEM user community. In each file, the incident energy is given in MeV; the response function value, in cm^2-sr.

There is one file for the electron response of each channel (P6, P7, P8) on each satellite. In each electron file, the 1st column contains the electron energies and the 2nd column contains the response functions. The electron responses are total responses due to isotropic electron fluxes incident from above and below.

In contrast, the proton responses of all six flight models are contained in two files per channel (P6, P7, P8). The top proton response and back proton response are contained in separate files (protons can penetrate the spacecraft and the back of the instrument). The model shielding behind the sensors is the same. In each proton file, the 1st column contains the proton energies and the 2nd-7th columns contain the response functions in satellite numerical order, i.e. 6, 7, 8, 10, 12, and 14.

Thus there is a total of 6 electron response files and 2 proton response files per channel, for a total of 24 response files. The filenames use the following templates:

sem1_omni_pN_electron_noaaS.txt, where N = 6, 7 or 8 and S = 06, 07, 08, 10, 12, or 14
sem1_omni_pN_proton_top.txt, where N = 6, 7 or 8
sem1_omni_pN_proton_back.txt, where N = 6, 7 or 8

The simulated top low-energy proton responses without the thermal shroud included are also provided. The purpose of these simulations is to illustrate the effect of the shroud through comparisons with the simulations that include the shroud. See Figure 1 for the NOAA-14 example of this comparison. These files are <u>not</u> recommended for modeling of the instrument response and are provided for illustrative purposes only.

sem1_omni_pN_proton_top_noshroud.txt, where N = 6, 7 or 8

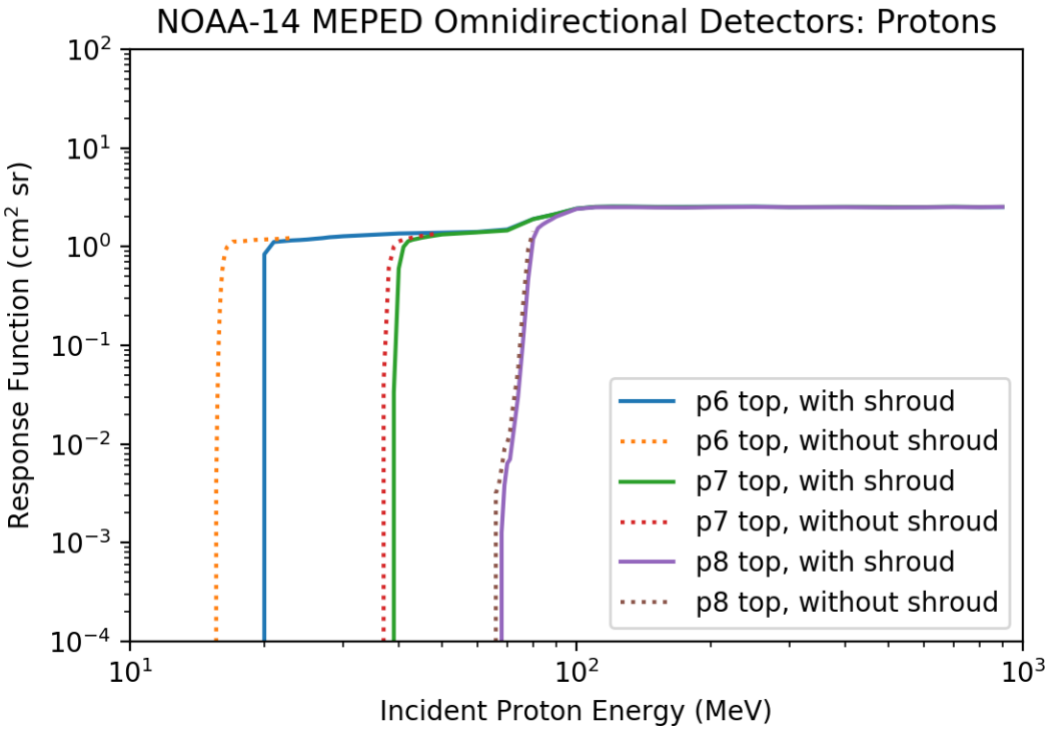

Figure 1. Comparison of the NOAA-14 SEM-1 Omnidirectional detector responses to isotropic protons incident on the top hemisphere, with and without the thermal shroud, to illustrate the importance of including the shroud in instrument calibrations and simulations.

References

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