Reply

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[1] The author is pleased to reply to by *Lean*, [2002]. For readers who may be unfamiliar with the details or purpose of the SOLAR2000 project, we appreciate the opportunity to clarify any misunderstandings as may be highlighted in the comment. Although the topic of the comment, i.e., a concern about the description of total solar irradiance (TSI) variability, is not the focus of this paper, we agree that it is important to clarify misunderstandings on this topic.

[2] *Tobiska*'s [2001] is the second paper in a series that describes the derivation and validation of the E10.7 proxy. It discusses the daily E10.7 compared to the daily F10.7, a subject that is only briefly mentioned by Tobiska *et al.* [2000]. We demonstrate in this paper that improvements in the daily representation of extreme ultraviolet (EUV) solar irradiances are obtained by using E10.7 compared to the 10.7-cm radio flux, F10.7, in atmospheric density applications. E10.7 is the integrated EUV from 1.8 – 105.0 nm and is reported in F10.7 units.

[3] Since this paper is one of several E10.7 validation papers, it was not our original intent to discuss the solar constant or total solar irradiance variability. However, *Lean* [2002] refers to the variable *S(t)* in Table 3 and Figure 1 of the original paper, which is an output of SOLAR2000 v1.05 in the case of this paper and also of the current release, version 1.15. A description of the absolute value and variation of *S(t)* in SOLAR2000 is found in Tobiska *et al*. [2000], Tobiska [2000, 2002] and in the SOLAR2000 model "Readme" file. It's variability comes only from the solar spectrum between 1 and 122 nm after it has been summed with a static, non-varying solar reference spectrum. It is not intended to represent the variable total solar irradiance in the early versions of the model (version 1.yz). The variability comes from the 1-122 nm wavelength range alone and is included in the model output for a specific group of users who have requested this spectral range's variability relative to a reference, full solar spectrum.

[4] Longward of 122 nm, SOLAR2000 version 1.15 uses the non-varying American Society for Testing and Materials (ASTM) E490 reference spectrum. This spectrum is extremely useful for space systems' users who desire a general spectral shape of the Sun's irradiance. In the course of planned upgrades beyond the version v1.yz (EUV variability) of SOLAR2000, we will replace this spectrum with time-varying spectral models. Our scheduled upgrades include ultraviolet, visible/infrared, and theoretical spectral variability in versions 2.yz, 3.yz, and 4.yz, respectively, during the next 3 years.

[5] We realized in the early development of version 1.05 that there was a possibility of misunderstanding what the value *S(t)* represents and, using recommendations such as those by J. Lean, we revised subsequent versions of SOLAR2000 to more fully describe this quantity and avoid confusion. It was unambiguous from the beginning that the model's *S(t)* variation does not account for most of the total irradiance variation. Faced with this, we had the options of ignoring user requests for a full spectrum or providing a placeholder, reference spectrum with an appropriate explanation for its use. We choose the latter route, knowing that this would force us to make a series of improvements in subsequent versions. With these improvements, the variability in the UV, VIS, and IR spectral regions will increasingly be reflected within the *S(t)* variable in SOLAR2000.

[6] It should be noted that SOLAR2000 embodies an archive of information from multiple instruments, captured across many spacecraft and rockets, spectral bands, and periods of time, and this aspect of the empirical model is a unique contribution of SOLAR2000. This aspect fulfills two primary purposes of the model, i.e., to preserve a knowledge-bridge from historical measurements to eventual first principles' representation of solar irradiances and to provide operational solar irradiances.

[7] The absolute magnitude and relative variations of *S(t)* in SOLAR2000 are consis-

tent with *Fröhlich and Lean*'s [1998] 1366.1 W m^{-2} value to the degree by which we formulate this variable, as discussed above, and to the degree in which we absolutely know the average total solar irradiance. The values are at the +2σ uncertainty of the absolute magnitude of historical total solar irradiance measurements although they are not centered on the present TSI mean. In version 1.15, we have incorporated the 1366.1 value as the baseline since it is the ASTM E490 normalization value. However, there are at least four separate empirical wavelength range scale factors applied in the derivation of ASTM E490, including an overall factor of 0.99745 applied to the composite data set to force a match with the 1366.1 W m^{-2} value. Because ASTM E490 does not report irradiances shortward of 119.5 though it is normalized to the TSI (a suggested improvement for a future ASTM reference spectrum), and because we have extended the spectrum shortward of 119.5 nm, we take a first order approach in early model, version 1.yz, development. We sum the EUV irradiances to this value through the process of extending the spectrum. We recognize that this approach results in a higher *S(t)* mean value, 1367.28 W m^{-2}, even though this +2σ level is within the minimum-maximum range of ASTM E490, 1363-1368 W m^{-2}, where 1σ is 425 ppm. As we develop spectral variability beyond the EUV, we will, of course, revisit the method of ASTM E490 normalization in conjunction with our independently derived variable irradiance reporting.

[8] Our objective is to provide the best possible representation of spectral variability that is consistent with overall TSI variability and magnitude. We believe we have done this for the 1–122 nm wavelength range variability by using historical solar measurements to derive SOLAR2000. In this light, we appreciate J. Lean's comments, which we take in the spirit of clarifying the use of the term *S(t)*, and we will consider those comments as we continue to evolve SOLAR2000 into a full spectrum model that is variable across all wavelength regions.

References

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