1. I'm curious as to what actually is occurring with the generic Bsun file.  I'm guessing it's a coordinate change?

The USAF white light data reports a heliographic latitude (N or S) and a Central meridian distance (longitude E or W). The latitude is then corrected by the Betasun latitude correction, which is a function of date/time.  From the betasun file, it looks like this varies from –7 to +7 (degrees), approximately, over a year.  Is the conversion then to correct from heliographic to Earth centric coordinates, or something similar? (I.e. The reported latitude of the sunspot group is computed from the difference of the heliographic latitude and the beta sun correction).  Is the Betasun an apparent latitude of the sun, from an earth-centric coordinate system.

A line from earth center to the center of the Sun defines the ecliptic plane. The solar disk that Earth sees on any given day does not stay constant with respect to the ecliptic plane. The B0 factor is the change in angle between the perpendicular of the ecliptic plane and the angle of rotation of the Sun. It varies by ~ +/- 7 degrees over a year.

How an observer measures sunspot area: They put a physical map over the Sun and it tells them the heliocentric latitude and longitude of the sunspot, which is how it is reported in the USAF white light sunspot region files. First, the heliocentric latitude needs to be corrected (plus or minus?) for the B0 ecliptic plane correction. Second, an area projection (cosine weighting) factor is computed to determine the irradiance at Earth.

The central meridian longitude: This is the longitude of Sun in the Sun-Earth vertical plane. A correction factor is applied to translate it into the center of the disk (0 UTC).

2. The sunspot blocking function (ps) is computed using a formula that weights the heliographic area by the corrected lat and the lon.  I found a description of this formula in a Lean et al 1998 Astrophysical journal paper (but wouldn't claim to understand all).  Would the following statement work for describing/referencing this formula:

"The bolometric (spectrally integrated) sunspot blocking function is the ratio of the total flux deficit due to sunspots relative to the background solar photosphere.  It is represented by Equation X. [Foukal, 1981, Lean et al., 1998], which incorporates empirical corrections for the additional darkness of larger sunspots than smaller spots [Brandt, Stix, and Weinhart, 1994]. "

Yes, another area for future research/code changes would be evaluating the impacts of different empirical corrections on the time series record. We could track these implementations by version control.

There's a minus sign in the formula in the paper, but not in the code. Is it a coordinate conversion impact?

The sign: This depends on how you are “viewing” the sunspot blocking as a time series. You could consider it as a positive, or as a decrease in irradiance. You just need to be consistent with your definition, and that is why the difference in sign.

3. About the differences in calculations for the uv sunspot blocking function: I think this has to do with the bright magnetic elements around the dark sunspots, and that these bright elements are measured at UV wavelengths.  So, the variation in the UV sunspot blocking formula decreases the sunspot blocking function based on the numbers and intensities of the magnetic elements relative to the quiet sun.  There is also a center-to-limb dependence in this bright intensity contrast, and if I understand the code correctly, this correction is applied relative to the center-to-limb contrast of the bolometric function.  I'm feeling shaky about my understanding of the uv sunspot blocking function, and would like to come up with a similar statement as above to describe the formula and I'd also like to cite it correctly.

Essentially a scaling factor. The sunspot contrast depends on wavelength. The bolometric value is the integral of this wavelength-dependence. If you go only to the uv, you are looking at a slightly different contrast.

Judith, after taking an hour off, this is all I can recollect!

4. I do see nice notes in your code about calculating the bolometric contrast (contrast-1=0.3235), and I will incorporate that into the documentation. I'm guessing the uv contrast (contrast-1=0.464) will have similar description, but with different numbers? I will also include the coefficients (Allen, 1979) for center-to-limb variation at 320 nm and the I/I0 equation.

The Lean (2000, GRL paper) has descriptions of the wavelength dependence of sunspot/facular contrast. One measurement by Allen is compared with estimates by Unruh’s model. In next version of model, Judith will have a wavelength dependence of sunspot contrast that allows the model to better reproduce the SIM short-term variation.