The following caveats to the use of 3DP data were supplied courtesy of the Wind Deputy Project Scientist Lynn Wilson in January 2015.

OVERALL CAVEATS

OVER-1) The pitch-angles can vary wildly from distribution-to-distribution. For instance, there are times when the lower bound on the zeroth pitch-angle bin can exceed 30 degrees, while other times it is within ~5 degrees. This happens when the detector's look directions do not come close to the magnetic field direction. It does not happen very often, but it does happen often enough to be wary of the any approximate values attached to a specific angular bin. Thus, beware of any long duration plot showing a single pitch-angle range for each bin.

OVER-2) As a general rule, background subtraction was not performed (at least not that I am aware of). The SST data does have some of the look directions removed but other than that the backgrounds are not removed (when this is done, it is typically on a case-by-case basis since it changes over time).

OVER-3) Dataset time resolutions can change and are not necessarily constant, depending on the mode that the instrument happens to be in. Not only does the period/interval between each point change, the duration over which the data were integrated/averaged can change as well.

SST CAVEATS

SST-1) The solid-state telescope (SST) for Wind 3DP electrons (called SST Foil, or SF for short) returns a velocity distribution function containing 7 energy bins and 48 solid-angle bins. The automated CDF routine appears to remove all the following solid-angle bins: [7,8,9,15,31,32,33] = sun/anti-sun look directions, and [20,21,22,23,44,45,46,47] = low geometry factor bins (also correspond to the SST Thick anti-coincidence detector bins). The sun/anti-sun directions are removed to avoid X-ray and EUV contamination, which is often seen during solar flares. If one does not remove these bins, the onset looks exactly like the GOES X-ray observations (which is kind of fun but not what we want to look at). Unfortunately, removal of these look directions can limit the range of available pitch-angles, which can limit the times when we would like to examine aniosotropy in SEP events, for example.

SST-2) Note that SST Open (protons, SO for short) software (i.e., software that produces wi_sopd_3dp_00000000_v01.cdf files) removes the following additional solid-angle bins: [0,1,24,25] = noisy. Additionally, SST Open has 9 energy channels from ~70 keV to ~6.7 MeV (or 7.1 MeV, depending on the mode the instrument is in). It does not appear that the routine mk_sosp_cdf.pro (i.e., software that produces wi_sosp_3dp_00000000_v01.cdf files) removes any of these "bad" look directions, so that should be noted as well.

SST-3) The highest energy channel in both SO and SF is often very noisy and not well calibrated (for instance, you see periods were this channel has a higher flux than a lower energy channel, which it should not in units of number flux). There are other times where these channels are okay, but the user should be aware of such issues.

SST-4) Inside the radiation belts, both SO and SF can saturate and both do suffer effects due to penetrating particles. The instruments are not shielded (as they were not designed to work in the radiation belts), so they can only provide relative changes when in these regions.

SST-5) There may have been no updates to the calibration tables (i.e., lookup tables used to estimate the deadtime and efficiency of a detector, which creates a modified geometry factor for each solid-angle bin) made for either of the SST data sets. The response of the these instruments will decrease over time because the semiconductor materials physically degrade, although this effect will much more important for, e.g., the THEMIS and Van Allen Probes, both of which spend a lot more time in the radiation belts.

SST-6) For Wind/3DP, the variable (INTEG_T) corresponds to the integration time for the entire distribution (it has a slightly different definition for THEMIS ESA distributions, unfortunately). In the 3DP IDL structures, there is a tag for the start (TIME) and one for the end (END_TIME) defined as Unix times (For 3DP, INTEG_T = END_TIME - TIME).

EESA CAVEATS

EESA-1) All the EESA High (i.e., high energy, or ~130 eV to ~30 keV, electrons for an electrostatic analyzer, or EH for short) files are going to be tricky as that instrument has some "bad" bins that might not have been removed before creating the CDF files. It looks like solid angle bins 22-65 (in IDL indexing starting from zero) are used for the wi_ehsp_3dp_*.cdf files. There are generally 88 solid angle bins total for both EESA Low and EESA High.

EESA-2) The onboard electron moments suffer from photoelectron contamination, which can be significant.

EESA-3) Notes to Specific EESA Variables

EESA-3a) In the "wi_elm2_3dp_00000000_v01" dataset:

"MAGT3" is the diagonal elements of the electron "temperature tensor" in a field-aligned coordinate basis. The elements then correspond to: Perp_1, Perp_2, Parallel (with respect to .MAGF). Let V = .VELOCITY, B = .MAGF, then: Perp_1 = (B x V) x B, Perp_2 = (B x V), and T_para = MAGT3[2] and T_perp = (MAGT3[0] + MAGT3[1])/2.

"MASS" is in units of eV/c^2, where c = speed of light in units of km/s. This results is a value of ~5.68566 x 10^(-6) for electrons and ~0.0104389 for protons.

EESA-3b) In the "wi_elpd_3dp_00000000_v01" dataset:

The variables "INTEG_T", "EDENS", "TEMP", "QP", "QM", "QT" and "REDF" are all fill values.

EESA-3c) For the "wi_elsp_3dp_00000000_v01" CDF.

"E_DENS" is the electron number density (not corrected for any s/c potential, that I am aware of). These results cannot take the spacecraft potential into account. Wind does not measure the spacecraft potential actively, so it cannot perform this correction onboard and, thus the results may have many uncertainties.

"E_TENS" is the residual Variance in Electron Velocity (6 components in instrument coords). This is in one of two units. It is calculated as the pressure tensor divided by the number density. In the decommutation source code, they say the units are (km/s)^2. In some of the other moment analysis software, the pressure is in units of [eV cm^(-3)].

"E_Q" is the electron Heat Flux (Q). This is the vector form of the electron heat flux. It should have units of either [(km/s)^3 cm^(-3)] or [eV km/s cm^(-3)]. I am guessing the former due to the units of the .VV tag, since the heat flux is usually given the structure tag .NVVV.

PESA CAVEATS

PESA-1) As a general rule, PESA High is a very cantankerous instrument and really not appropriate for (is not available through) CDAWeb.

It suffers from "UV-contamination" that is not constant in magnitude (Technically, I am not sure that the noise spikes are specifically due to UV-contamination. I only suggest this as the affected bins follow the sun look direction and when I asked Bob Lin, he seemed to find my hypothesis plausible.). To avoid destroying the instrument, UCB intentionally put in ways (electronic and physical) to limit the fluxes for particles near the solar wind beam energies. This is because the instrument had such a large geometry factor and was so sensitive, were it to look at the solar wind it would have burned out the anodes early on. You see this as an apparent inversion of the spectra, where mid-range energies dominate the flux magnitudes. This is unphysical, but it is nearly impossible to automate methods for removal.

There never really was a concerted effort to determine the detector's deadtime and efficiency vs. time. This combined with the low signal-to-noise ratio means that the data can only be used in some contexts that are not, unfortunately, conducive to general public use. One needs to plot each of the full velocity distributions in phase space and estimate one-count levels, etc. before you can trust the data. This is after removing the "bad" bins discussed above that seem to contain UV-contamination or some form of glint .

PESA-2) Notes to Specific PESA Variables

PESA-2a) In the "wi_plsp_3dp_00000000_v01" dataset:

"FLUX" is the proton number flux in 14 energy channels populated from about 0.6 keV to about 10 keV. Channel energies vary with time, keeping the peak flux in channel 10. Channel 15 is the lowest energy channel but is generally unpopulated.

"MOM.P.SC_POT" is defined as the spacecraft potential estimated from proton ONLY measurements but it is not always populated. For most solar wind conditions, the spacecraft potential does not cause significant uncertainties in the ion velocity moments.

"MOM.P.MAGT3"is the proton temperature tensor rotated into a field-aligned coordinate basis and then taking the diagonal elements only. The elements then correspond to: Perp_1, Perp_2, Parallel (with respect to .MAGF). Let V = .VELOCITY, B = .MAGF, then: Perp_1 = (B x V) x B, Perp_2 = (B x V) and Then T_perp = (MAGT3[0] + MAGT3[1])/2.

"MOM.P.TEMP2" is an undocumented temperature correction and should be ignored.

"MOM.A.MAGT3" is the diagonal elements of the alpha-particle "temperature tensor" in a field-aligned coordinate basis (similar to the MAGT3 tag in the "wi_elm2_3dp_00000000_v01" data set). The elements then correspond to: Perp_1, Perp_2, Parallel (with respect to .MAGF). Let V = .VELOCITY, B = .MAGF, then: Perp_1 = (B x V) x B, Perp_2 = (B x V), and T_para = MAGT3[2] and T_perp = (MAGT3[0] + MAGT3[1])/2.