OTES Data Caveats V1.0 (05/21/2018)

The primary caveat associated with EGA data is the “ringing” that occurs as the Earth (or Moon) comes into or leaves our field of view. This is a known and expected effect; the transition from a very hot target (e.g., Earth) to a cold one (space) or vice versa produces a slope in the OTES interferogram that cannot be instantaneously accommodated by the DC-correction electronics. The transform of the interferogram results in high-frequency “ringing” in the spectrum that usually appears in a few sequential observations. A correction algorithm has been written and refined by the OTES team using the EGA data and will be implemented in a future update.

Update: V2.0 2019-05-30

EGA and Approach calibrated radiance spectra were observed to exhibit “ringing” that occurs as the target (Earth, Moon, Bennu) comes into or leaves the OTES field of view (FOV). This is a known and expected effect; the transition from a very hot target (e.g., Earth) to a cold one (space) or vice versa produces a slope in the OTES interferogram that cannot be instantaneously accommodated by the DC-correction electronics. The transform of the interferogram results in high-frequency “ringing” in the spectral region of interest (resulting from a step function that occurs when the interferogram is folded) that usually appears in a few sequential observations. A correction algorithm has been written and implemented by the OTES team to equalize the ends of each interferogram, thus removing any ringing from the data. The algorithm identifies the values at the ends of each interferogram, calculates the linear slope between them and then removes the slope to force the ends of the interferogram to zero. This can impart a low frequency sine wave on the interferogram but the frequency/power of this wave is at such low wavenumbers that any distortion of the spectrum occurs outside the spectral region of interest for science. The algorithm is applied to all interferograms, with the most strongly affected spectra typically being where the FOV_fill_factor changes from 0 to 1 or 1 to 0 over the span of a few spectra.

An important caveat accompanying OTES data is associated with observing sequences in which the OTES field of view (FOV) was not filled by the target (e.g., Earth, Moon, Bennu). The standard calibration of OTES data uses views of space and an internal calibration target that fill the FOV; when the target does not fill the FOV, wavelength-dependent, off-axis modulation of energy through the interferometer results in an apparent low signal at short wavelengths. Correcting this effect requires a substantially more complex calibration approach, which is under consideration. These data may be used for relative comparisons of, for example, one channel’s radiance throughout the sequence, but the spectral data should not be used for absolute radiance or emissivity science.

Update: V3.0 2019-07-20

Spatially-resolved data acquired in December 2019 (at the end of the Approach phase and during the Preliminary Survey phase) were obtained as “ride-along” observations during imaging-optimized campaigns and, as a result, some of the OTES sequences did not include an ideal cadence of space calibration observations. To improve the resulting calibration, the OTES team developed an approach that uses trends in instrument radiance as a function of temperature over time to better predict and remove instrument effects in the calibrated radiance data. The method of calculating calibrated radiance that was used (method 1 vs. method 2) is indicated by the calrad_used attribute found in the calibrated data product Mission Area/data_processing_information portion of the label.

Update: 2019-11-20

The OTES data have been augmented with a quality word having separate bits that are assigned specific values to provide a quick means of searching for data that meet the user's quality constraints. The quality word is defined as follows:

1) Bits 1-2. These two bits are used to assess the quality of the radiometric quality which currently has values from 0 to 3:
    a. 0. Space observations spaced less than 400 seconds apart
    b. 1. Space observations spaced more than 400 seconds but less than 800 apart
    c. 2. Space observations spaced more than 800 seconds apart
    d. 3. No space observations in the sequence
2) Bit 3. This bit is used to assess the quality of the derived Brightness Temperature (BT).
    a. 0. Brightness Temperature has valid values
    b. 1. A phase inversion was present in the spectrum and the Brightness Temperature is not valid.
3) Bits 4-16. Unassigned.

Bit															
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	Unassigned	BT	Space gap	

Update: 2020-04-20

The 2019-07-20 update above contains an error in the date of the spatially-resolved data – it should read December 2018 (for the end of the Approach phase).

Update: 2020-10-27

During analysis of the highest resolution Reconnaissance data, the science team determined that the geometry values calculated for the OTES spots do not take into account the location of the instrument near the edge of the spacecraft deck. At the spatial resolution of the Detailed Survey and early Reconnaissance data sets, the effect of this offset is negligible, but it becomes more significant with increasing spatial resolution. In addition, small increases in rotation error also were not taken into account. Users should be aware of these sources of geometric error until such time as recalculated geometries can be provided to the PDS.

Update: 2021-05-03

Data collected immediately following the Touch-and-Go sampling event, while the nadir deck was still pointed at Bennu, observe the dust cloud produced by contact with Bennu and are not properly calibrated using the standard processing pipeline for OTES data. Data for the Encounter 9 delivery (8/17/2020 – 11/17/2020) have been produced using a corrected geometry calculation to account for the location of OTES on the spacecraft deck and other sources of geometric error.

Update: 2022-02-01

Encounter 10 data products (11/17/2020 to 05/10/2021) have been added to the archive. Encounter 10 products were produced using the updated geometry calculation. Data products from

07/01/2019 through 8/17/2020 have been updated with re-calculated geometries that use the latest spacecraft clock kernels for time conversions. The updated geometric calculation includes the location of the OTES instrument near the edge of the spacecraft deck. Additionally, a higher-spatial resolution shape model was used for the calculations to account for the OTES footprint size versus the shape model facet size. The consequence of the geometry update (with final spacecraft clock kernels) is a slight difference in geometric quantities and in some cases small differences in calculated times. The small differences in calculated times can result in a single engineering record moving from one file to another. Changes in a single engineering record are not significant, in that these records are used for data trending. Additionally, slight changes in timing/geometry may introduce small (on the order of e^{-11}) differences in calibrated data values. These differences are not scientifically significant. Finally, it is possible that the UTC time string in the filename will be slightly different than the start_date_time in the XML label.

The geometry values provided with OVIRS and OTES data are for the intersection of the instrument boresight with a single facet of the v20 Shape Model [Barnouin, 2019]. Users for whom geometric values (e.g., incidence and emission angle) are important to their analysis of OVIRS and OTES data should be aware that this shape model has significantly higher spatial resolution than either spectrometer. As such, the values calculated may not be representative of the integrated area within the instrument observation spots, especially in areas with significant topographic or slope variations. The choice to report instrument boresight values was made because this method of calculation imposes the fewest assumptions on the data. Users desiring more precise or more representative values would have a subjective choice of shape model resolutions.

Re-delivered, updated products have a product label version_id of 2.0.

Calibration data acquired approximately one month after the TAG event (11-18-2020) reveal the presence of dust on the OTES optics. The degree of contamination is not quantified at this time, nor is the location(s) of the dust (primary mirror, secondary mirror, etc.) known with certainty. The standard pipeline processing is insufficient to properly calibrate these best-effort data. Data acquired during the Farewell Observations (04-07-2021) also display the effects of dust contamination on the OTES instrument and the standard pipeline processing is not equipped to properly calibrate these data.