

Ulysses URAP Active Sounding Sequence List

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The Ulysses Unified Radio and Plasma Wave (URAP) sounder sequence occurrence list provided to the Planetary Data System for archival with the Ulysses DUST data is briefly described here. The URAP sounder (described in Stone et al., 1992) was operated with a low duty cycle to serve as an alternate calibration for other Ulysses solar wind density determinations and to gain experience with sounding in the solar wind. Because of the low duty cycle, every 15 to 180 minutes, depending on the phase of the mission and the spacecraft data rate, the sounder data were not suitable for routine study of solar wind density. An example of their use in cross-calibration is found in Maksimovic et al., 1995.

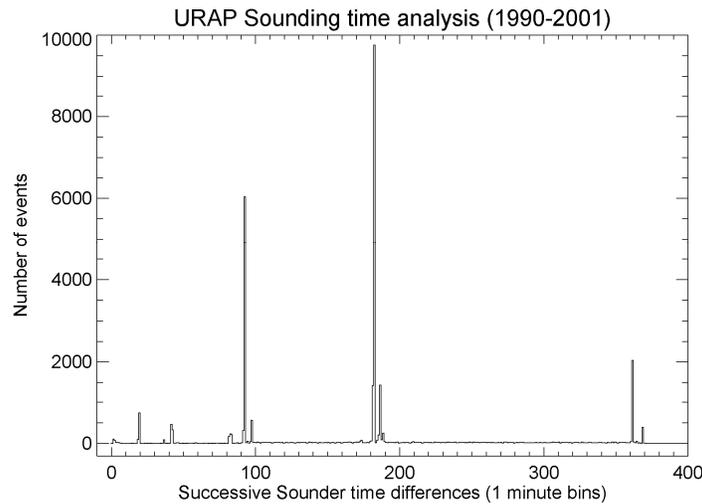


Figure 1. – Histogram of time differences between successive URAP sounding sequences.

The DUST instrument detects the soundings as noise which increases the background level for detection of dust events (e.g., Kruger et al., 1999, and references therein). For that reason, a list of sounding occurrences has been created for inclusion with the DUST archival data. The format of the URAP sounder occurrence data files is one ASCII text file per calendar year containing the start and end times of each sounding in PDS date/time format as one “event” per line. As shown in figure 1, the vast majority of sounding occurrences are separated by ~19, 40, 90, 180, or 360 minutes, depending on both the commanded duration of spacecraft clock time between successive sounding sequences and the data acquisition rate (bit rate). A few successive soundings occur at random time separations because the interval between them crosses a transition in spacecraft data rate, which affects the interval between soundings. Other intervals with higher rates of sounder activity occur during the first several months of the mission when

the instrument was being qualified. After November 8, 2001, the sounder was stopped, in part to reduce the URAP instrument's power requirement, except for two short intervals of soundings on June 30, 2003 and May 2, 2007, occurring when the radio instrument was turned on and the sounder was not yet disabled. Note that this list does not attempt to reconstruct sounding occurrence times that occurred during telemetry gaps.

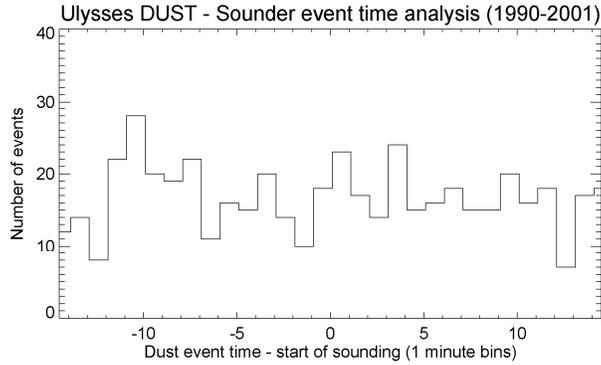


Fig. 2 – Histogram of dust event times relative to sounding sequence start times. Only ± 15 minutes lags are shown.

In figure 2, we show the time distribution (superposed epoch analysis) for all dust events in the file dpf90-05.out obtained from the ESA Ulysses Data System web site on 20 September 2007. There is no evidence of a statistically-significant decrease (or increase) in dust events at zero time lag relative to the start of a sounding. To confirm that our software was functioning properly, we created a test data file in the DUST archival format for which a pseudo dust event time was generated for each sounder sequence. As seen in Figure 3, the test data perform as expected when passed through the same sounder-dust correlation software, i.e., there is a zero lag test event for every sounding sequence (with a precision of one minute).

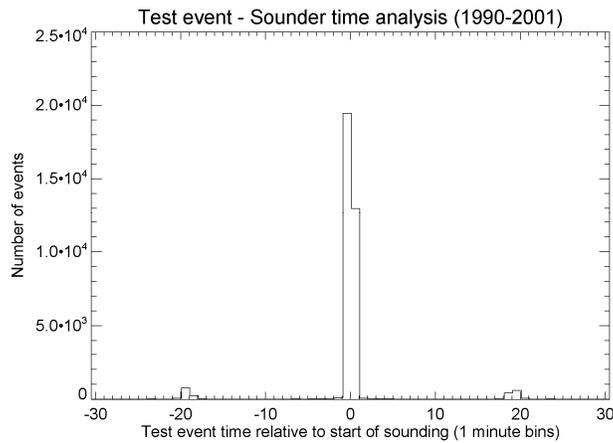


Fig. 3 – Histogram of test event times relative to sounding start times. Small increases in the histogram occur at ± 19 minute lags result from successive sounding separated by 19 minutes, as would be expected (see Figure 1).

We are lead to conclude from this study that the DUST event occurrence in the DUST archival data set is not biased by the Ulysses sounder in a statistically significant way.

Additional comments on Sounder sequence occurrence list: It may be seen in the sounder occurrence list that the sequence durations are multiples of 32 s, the duration of one “format” of Ulysses URAP data at the 1024 bps spacecraft data rate. A single sweep through the full sounder frequency range (1.25-48.5 kHz) requires 128 s. For most of the mission (starting in Jan 23, 1992), the standard sounder operation was 1 ½ sweeps, which scans the lower half of the spectrum twice, focusing on the region where the electron plasma frequency would typically occur; the duration of these soundings is 192 s. We refer to the continuous operation of the sounder (in active mode) for 128 or 192 sec as a sequence. During testing, there are sometimes sequences of longer duration. In a typical mode, the sounder would transmit a short duration signal three times for each frequency channel. With 64 frequency channels covering the full frequency range, this yields 192 (288) transmissions in 128 (192) seconds. There is also a passive mode, in which the Sounder performs the same high frequency spectral analysis, without active sounding. Sounder passive mode sequences are not included in the list because they do not impact the DUST detector or other instruments that might respond to the transmissions.

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References:

Krüger, H., E. Grün, M.Landgraf, et al. “Three years of Ulysses dust data: 1993–1995”, *Planetary and Space Science*, **47**, 363-383, 1999.

Maksimovic M., S. Hoang, N. Meyer-Vernet, et al., "The solar wind electron parameters from quasi-thermal noise spectroscopy and comparison with other measurements on Ulysses", *J. Geophys. Res.* **100**, 19881-19891, 1995.

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