New Horizons REX Data Set Review – KEM 1

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1. Executive Summary

Four data sets from the New Horizons Radio Science Experiment (REX) were provided and reviewed:

- nh-x-rex-2-kemcruise1-v2.0
- nh-x-rex-3-kemcruise1-v2.0
- nh-x-rex-2-kem1-v1.0
- nh-x-rex-3-kem1-v1.0

The first two are an updated version of the KEM cruise 1 data sets reviewed last year in October 2018 and delta-reviewed in June 2019. The KEM cruise 1 datasets are well-documented and contain all relevant data to interpret and use the data contained within.

The second two are new data from the KEM1 encounter period for MU69 flyby. These datasets contain no REX data at all, only DSN uplink data from what I think are a few tests and the MU69 encounter itself. I do not understand the purpose of archiving such a dataset at this time, as there is very little scientific information contained within the dataset. If the dataset is going to be archived, it needs some level of explanation or disclaimer why it is archived at this time without any REX data, either within a readme file in the "data" folder or a more detailed explanation in the dataset.cat file. I also recommend updating the "rex_activities" and "seq_rex_kem1.tab" documents with a complete sequence of activities.

2. KEM Cruise 1 Datasets

Data

This is the version 2 data from what has previously been reviewed. I re-examined the Solar Conjunction data (Jan 2-6, 2017) and Bistatic Dry Run data (Dec 1, 2017) from the Side-A data ("0x7b1"). All results matched my expectations based on previous reviews.

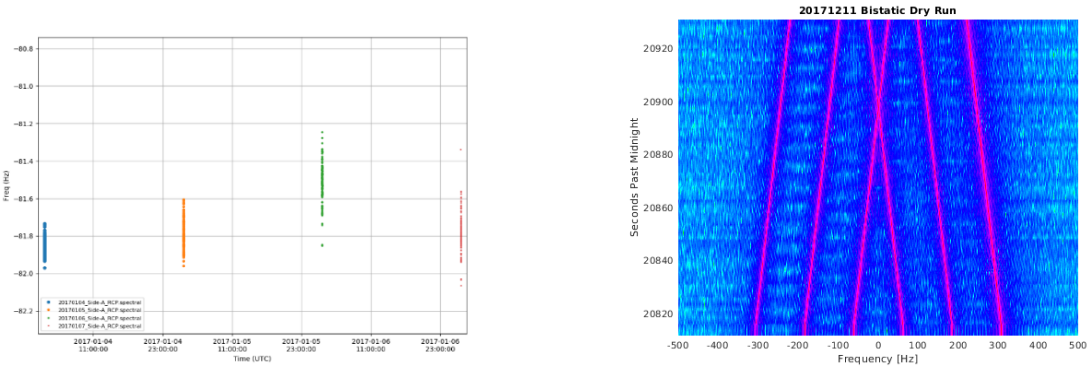

Figure 1. Data extracted from the KEM1 Cruise datasets for Solar conjunction (left) and Bistatic Dry Run (right), which match expectations based on the documentation ("rex_activities_kemcruise1.pdf")

The DSN uplink data ("data/tnf/" folder) appropriately cover each activity in the KEM1 dataset. I was able to reproduce the *tab files from the raw *tnf files.

New data are included in the year (June 18, July 1, August 1). The documentation describes these as SNR verification and radio path delay tests. I performed the same analysis as done on the solar conjunction data for the July 1, 2018 test and was able to extract frequency observables in-line with expectations.

Documentation
This dataset is well-documented and the documentation reflects comments from the previous peer reviews.

3. KEM Encounter Datasets

Data
This dataset contains no REX data. It only contains the DSN uplink data from Sept 8-9, 2018, October 19-20, 2018 and December 31, 2019. The MU69 encounter occurred Jan 1, 2019 but due to the large one-way light-time from Earth to the spacecraft the ground uplink needed to begin the previous day on December 31. The other data are likely from tests prior to the encounter.

I examined the DSN uplink data for the encounter and found it in-line with my expectations, with some level of Doppler compensation. Each station is slightly offset from the others as I expect based on the dry run data from the other dataset. Additionally, the *tab files match the binary data within the *tnf files exactly.

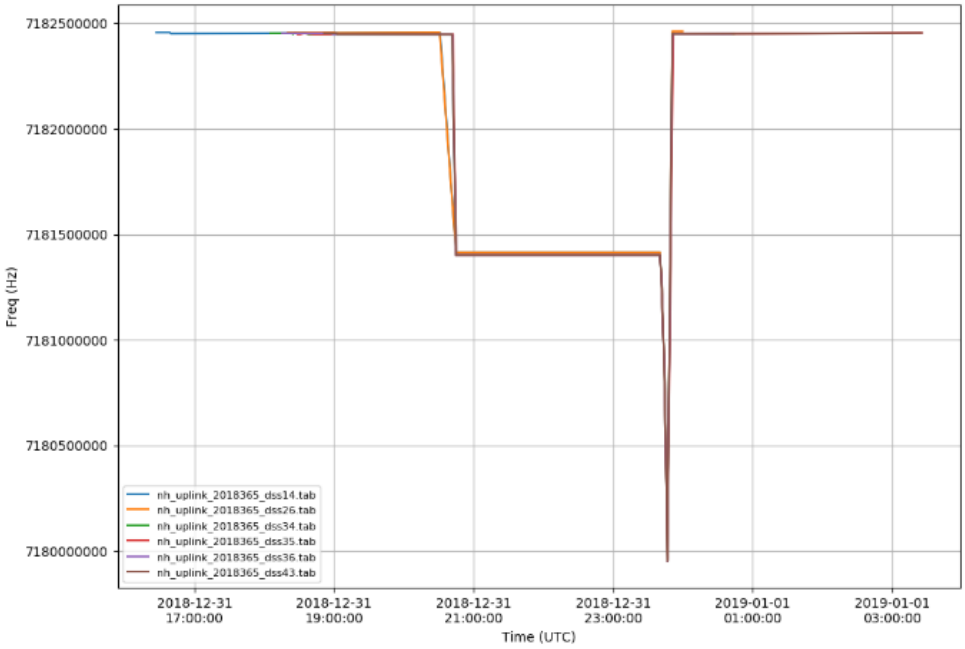

Figure 2. DSN Uplink data from December 31, 2018 (DOY 365)

Documentation

dataset.cat – Under the "Version" header, it states that "Version 1 contains no REX data". This needs to be very clear throughout the dataset and perhaps even an aareadme.txt in the "data" folder itself.

seq_rex_kem1.tab – contains the sequence of events for REX for the dataset. It shows the September and October activities which I can correlate with the TNF files. It lists activities on December 24, 2018 but there are no corresponding files associated with this. It is missing the KEM encounter activities.

rex_activities_kemcruise1.pdf – It is unclear to me why this document is included in this dataset, when the activities described within occurred in the KEM Cruise 1 datasets. It should be replaced with a version that covers this dataset.

The dataset needs some documentation or disclaimer why it is being archived without any REX data, as without the REX data, there is no scientific purpose for this dataset to be archived.