Status of the Meteorological Data Format Working Group

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Outline

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Background

- The Meteorological Data Transfer Format (MDTF) was developed to be used by NASA, the Air Force, and others for the Space Shuttle program. After this program ended, use of MDTF was maintained.

- MDTF offers a unique format including units and character formatting for each data source:
  - Wind Towers
  - Low Resolution Flight Element balloons (LR)
  - Winds only balloons [Low Resolution Flight Element balloon (LW), High Resolution Flight Element balloons (HR), and Jimsphere balloons (JS)]
  - 48 MHz Tropospheric Doppler Radar Wind Profiler (TDRWP)
  - 915 MHz DRWP

- Additionally, MDTF was designed so that files would be readable to users (ASCII) and easy to analyze with the FORTRAN programming language.

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Background

- Limitations of the MDTF format include:
  - 80 character limit per line. Lines of data can be difficult to read due to lack of delimiters and some data being separated across two or more lines.
  - No data values are sometimes denoted with white space and other times as "-999".
  - LR balloon data uses multiple termination lines and headers to separate interpolated data, mandatory data, and significant levels.
  - Meta data in TDRWP and DRWP files can be difficult to read or understand.
  - There exist data recorded by balloons that aren't included in this format.

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Motivation

- Conversations arose from the Range Commander's Council Meteorology Group (RCC MG) discussing the limitations of MDTF, which come from MDTF being designed for older technologies. Further discussion was held at the Spring 2016 NEDOLWG and was met with general agreement that many users convert data from MDTF to another format before performing any analysis.

- As a new program begins, Space Launch System (SLS), an opportunity arises for the community of users to discuss, decide upon, and develop a new meteorological data format to replace MDTF.

- The Meteorological Support Interface Control Working Group (MSICWG) was formed to give meteorological data users from the Eastern Range (ER), Kennedy Space Center (KSC), Johnson Space Center (JSC), and Marshall Space Flight Center (MSFC) a forum to discuss the status of instruments, networks, and data in support of the Space Shuttle program and has been carried over to support SLS.

- A team was formed as part of the MSICWG over the summer of 2016 to begin developing new formats and discuss methods of implementation. This presentation presents the initial formats developed by the working group.

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Team Background

- The team consists of members of the MSICWG; data users from MSFC, JSC, KSC, and ER.

- Team members were selected for their experience with data and for using data in unique applications.

- For example:
  - MSFC users: Aid in vehicle design, Build climatologies for future engineering needs, Provide Day-of-Launch (DOL) support
  - JSC users: Provide operational forecasts for DOL and landing, Provide weather data to Mission Control for engineering purposes
  - KSC/ER: Provide operational forecasts for NASA, Air Force, and commercial space vehicle launches, Meteorological analysis of local weather for Ground Systems Development and Operations (GSDO) support

- By putting together a group from multiple centers/programs, with multiple unique interests in the data, new formats can be created with all users in mind.

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Team Goals

- Develop new formats to improve upon the currently used MDTF formats.
  - All members of the working group agree upon the new formats.
  - Proposed formats are presented to users across the community supporting SLS for discussion.
- Write documentation outlining and describing the new formats.
  - Will be based on the current MDTF documentation the describes the format.
  - Find proper ownership and support for new documentation.
- Develop methods to implement new formats.
  - As instruments, networks, and requirements are updated, the new formats can be integrated into the data dissemination process.

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Current Work

- Three new formats have been discussed:
    - LR
    - TDRWP
    - Wind Tower
- The team is seeking feedback from the community on these new formats as well as other discussed changes, such as:
    - Units
    - Missing data flags
    - Additional data to include in formats

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Current Work: LR Format

- All data from the current format is retained in the proposed format.
- Data is space delimited.
- A character at the beginning of each line identifies the source of the data: Interpolated, Mandatory, and Significant levels.
- All data fields from Interpolated data, Mandatory levels, and Significant levels are included on each line.
- Additional data included in the proposed format:
    - Longitude and Latitude
    - Ascent rate

Current Work: LR Format

```
LR012722350 201509292350 CCAFS
RAWINSONDE AMP/LR TEST NBR A1806 WS1
ID    ALT     ALT   DIR    SPD    SHR ASCENT   TEMP    DPT    PRESS   RH  ABHUM DENSITY   I/R  V/S    VPS   PW  LATITUDE LONGITUDE
      GEOMFT GEOPFT DEG    KTS /SEC    F/S    DEGC   DEGC     MBS   PCT  G/M3    G/M3     N  KTS    MBS   MM   DEGREES   DEGREES
I       16   -999   210    4.0 -999   -999    27.5   25.9 1008.80   91  24.09 1154.28   398  680  33.42    0   34.9286 -117.9033
I     1000   -999   246   16.4 .023   -999    25.3   22.0  975.32   82  19.16 1126.81   364  677  26.39    6 -999.0000 -999.0000
I     2000   -999   270   15.6 .011   -999    23.2   20.9  942.16   87  18.03 1096.59   351  674  24.66   12 -999.0000 -999.0000
I     3000   -999   276   16.8 .004   -999    21.3   19.6  909.92   90  16.84 1066.31   338  672  22.88   17 -999.0000 -999.0000
I     4000   -999   290   18.2 .007   -999    19.6   18.1  878.55   91  15.35 1036.14   323  670  20.74   22 -999.0000 -999.0000
I     5000   -999   284   19.8 .004   -999    18.0   17.2  848.10   95  14.61 1005.90   312  668  19.63   27 -999.0000 -999.0000
...
M     -999    758     8    9.0 -999   -999    16.8    7.3 1000.00   54 -999.00 -999.00  -999 -999 -999.00 -999 -999.0000 -999.0000
M     -999   2182    79   10.0 -999   -999    12.6    5.6  950.00   62 -999.00 -999.00  -999 -999 -999.00 -999 -999.0000 -999.0000

M     -999   2915    94   12.0 -999   -999    10.8    4.9  925.00   67 -999.00 -999.00  -999 -999 -999.00 -999 -999.0000 -999.0000
...
S      800   -999     8    8.0 -999   -999    16.6    7.2  998.50   54 -999.00 -999.00   313 -999 -999.00 -999 -999.0000 -999.0000
S     3900   -999   103   15.0 -999   -999     8.2    4.2  892.40   76 -999.00 -999.00   285 -999 -999.00 -999 -999.0000 -999.0000

S     4100   -999   103   14.0 -999   -999     7.6    3.8  885.80   77 -999.00 -999.00   283 -999 -999.00 -999 -999.0000 -999.0000

...
NNNN
```

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Current Work: PS Format

- All data from the current TDRWP format is kept in the proposed format.

- Extra blank lines in between lines of data are removed.

- Data values are space delimited.

- The data that was in the footer has been moved to the header. Descriptive text and units are included with the new header data.

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Current Work: PS Format

```
PS072731210 201509301209 CCAFS/KSC
TROPOSPHERIC PROFILER
        E AZI        N AZI      V AZI      E ELE       N ELE        V ELE         #FFT E TMEDOMAVG N TMEDOMAVG V TMEDOMAVG
          DEG          DEG        DEG        DEG         DEG          DEG           NA          NA            NA          NA
        135.0         45.0        0.0       75.3        75.3         90.0          096          30            30          30
     E SPECAVG   N SPECAVG V SPECAVG   E PULREP    N PULREP     V PULREP E VERTGTSPC N VERTGTSPC V VERTGTSPC E VERTGTWID
           NA          NA        NA   MICROSEC    MICROSEC     MICROSEC       METER       METER        METER       METER
            3           3         3      153.8       153.8        153.8         149         149          149         149
  N VERTGTWID V VERTGTWID MAXACVOLT MINACVOLT TRANSPOWER   NOISETEMP  REFLECTPWR   DRVROUTPWR    DRVRINPWR    TRANSTEMP
        METER       METER     VOLTS     VOLTS         KW       DEG K       WATTS        WATTS        WATTS       DEG K
          149         149       640         0        187          20        2919            0            0           0
   ENCLOSTEMP   FLOODALRM   ACSALRM  CODEBITS ETPMDFLTCD N TPMDFLTCD V TPMDFLTCD E RUNMEANCD N RUNMEANCD V RUNMEANCD
        DEG K          NA        NA        NA         NA          NA          NA          NA           NA          NA
           47           4         0         5          3           3           3           0            0           5
   ALT   DIR   SPD   SHR      WW    S1      S2     S3     N1     N2     N3   WID1    WID2    WID3  G  G  QC
   GEOM  DEG   M/S  /SEC     M/S    DB      DB     DB     DB     DB     DB   M/S     M/S     M/S   1  2  NN
   1798  234  14.0  .000   -0.12  111.5  109.9  110.8  62.0   62.6   62.3   0.8     0.5    0.64  0  0  64
   1948  233  14.0  .001   -0.06  115.0  114.6  114.8  62.1   62.7   62.4   0.9     0.5    0.70  0  0  64
   2098  238  14.3  .008   -0.19  117.7  117.3  117.5  60.5   61.2   60.9   0.9     0.5    0.68  0  0  64
   2247  242  14.4  .006   -0.18  118.0  113.5  116.3  61.3   61.9   61.6   0.7     0.5    0.60  0  0  64
   2397  244  14.4  .004   -0.09  118.7  117.2  118.0  62.2   62.6   62.4   0.9     0.5    0.70  0  0  64
...
NNNN
```

Current Work: WT Format

- All data from the current Wind Tower format is kept in the proposed format.

- Additional fields of data are included for location of tower (latitude and longitude) and future instruments (direct/diffuse solar radiation, soil moisture, soil temperature).

- Fields of data are space delimited.

- If no data is available, a value of "-999" is given instead of the blank space.

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Current Work: WT Format

- Options for Wind Tower data:
  1. One file contains all towers for each 1 or 5 minute interval. Each tower height has its own line of data.
     - Pros: Easy to update format as new instruments are added.
     - Cons: Difficult to read data.
  2. One file per tower for each 1 or 5 minute interval. Each tower height has its own line of data.
     - Pros: Easy to update format as new instruments are added. Easy to read since there is only one tower per file.
     - Cons: Puts a strain on the servers to produce 60,480 files daily compared to the 1,728 currently created.

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Current Work: WT Format Option 1

```
WT010711602 201603111602 CCAFS/KSC
WIND TOWER DATA
                   01 MIN    01 MIN    10 MIN
                   AVERAGE   PEAK      PEAK              TMP
TOWER      HGT  AV DIR  SPD  DIR  SPD  DIR  SPD  DEV  TMP    DIF     DP     RH   PRE   DIFRAD  REFRAD  SLTEMP  SLMOIST   LAT    LON
           FT  MIN DEG  KTS  DEG  KTS  DEG  KTS  DEG   F      F      F      %    MB    W/M2    W/M2      F       MM     DEG    DEG
0108       06   01 -999 -999 -999 -999 -999 -999 -999 77.4 -999.0 -999.0 -999 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
0108       12   01  139    7  151   15  140   19  022 -999.0 -999.0 -999.0 -999 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
0108       54   01  141   14  141   19  142   23  011 75.0   -2.4 -999.0 -999 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   132   01  157   21  157   25  157   26  004 73.7 -999.0   62.8   69 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   133   01  145   17  137   23  157   25  004 74.2 -999.0   61.2   64 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   134   01  153   12  153   17  155   21  003 73.7 -999.0   59.8   62 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   257   01  156   22  153   24  153   26  003 72.7 -999.0   59.8   64 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   258   01  140   19  145   23  144   25  004 73.1 -999.0   61.1   66 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   259   01  152   12  153   17  154   19  002 72.8 -999.0   60.0   64 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   382   01  161   22  154   24  159   26  002 72.0 -999.0   57.4   60 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   383   01  144   19  136   23  149   26  003 72.3 -999.0   60.6   67 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   384   01  154    8  160   12  147   13  003 72.2 -999.0   59.9   65 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   457   01  158   22  153   24  157   26  002 71.6 -999.0   60.3   68 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   458   01  146   19  149   23  145   26  003 71.9 -999.0   60.4   67 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   459   01  192    1  193    7  165    9  047 72.0 -999.0   59.5   65 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
```

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Current Work: WT Format Option 2

```
WT010711602 201603111602 CCAFS/KSC
WIND TOWER DATA 0108
                 01 MIN    01 MIN    10 MIN
                 AVERAGE   PEAK      PEAK               TMP
TOWER      HGT  AV  DIR  SPD  DIR  SPD  DIR  SPD  DEV   TMP    DIF     DP    RH    PRE   DIFRAD  REFRAD  SLTEMP  SLMOIST    LAT     LON
           FT  MIN  DEG  KTS  DEG  KTS  DEG  KTS  DEG    F      F      F     %     MB    W/M2    W/M2      F      MM       DEG     DEG
0108       06   01 -999 -999 -999 -999 -999 -999 -999   77.4 -999.0 -999.0 -999 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
0108       12   01  139    7  151   15  140   19  022 -999.0 -999.0 -999.0 -999 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
0108       54   01  141   14  141   19  142   23  011   75.0   -2.4 -999.0 -999 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0


WT010711602 201603111602 CCAFS/KSC
WIND TOWER DATA 39 B NW
                 01 MIN    01 MIN    10 MIN
                 AVERAGE   PEAK      PEAK               TMP
TOWER      HGT  AV  DIR  SPD  DIR  SPD  DIR  SPD  DEV   TMP    DIF     DP    RH    PRE   DIFRAD  REFRAD  SLTEMP  SLMOIST    LAT     LON
           FT  MIN  DEG  KTS  DEG  KTS  DEG  KTS  DEG    F      F      F     %     MB    W/M2    W/M2      F      MM       DEG     DEG
39 B NW   132   01  157   21  157   25  157   26  004   73.7 -999.0   62.8   69 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   133   01  145   17  137   23  157   25  004   74.2 -999.0   61.2   64 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   134   01  153   12  153   17  155   21  003   73.7 -999.0   59.8   62 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   257   01  156   22  153   24  153   26  003   72.7 -999.0   59.8   64 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   258   01  140   19  145   23  144   25  004   73.1 -999.0   61.1   66 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   259   01  152   12  153   17  154   19  002   72.8 -999.0   60.0   64 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   382   01  161   22  154   24  159   26  002   72.0 -999.0   57.4   60 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   383   01  144   19  136   23  149   26  003   72.3 -999.0   60.6   67 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   384   01  154    8  160   12  147   13  003   72.2 -999.0   59.9   65 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   457   01  158   22  153   24  157   26  002   71.6 -999.0   60.3   68 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   458   01  146   19  149   23  145   26  003   71.9 -999.0   60.4   67 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
39 B NW   459   01  192    1  193    7  165    9  047   72.0 -999.0   59.5   65 -999.0 -999.0  -999.0  -999.0  -999.0 -999.0 -999.0
```

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Future Work

- JS/HR/LW and RW formats need to be discussed and agreed upon.
- A document describing the new formats needs to be finalized.
- Methods of implementation need to be decided upon.

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