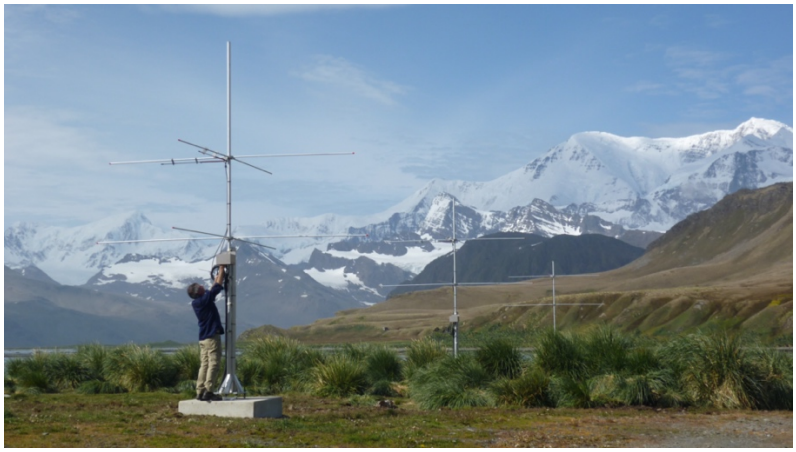

HWD Files from the SkiYmet VHF Meteor Radars

INTRODUCTION

The HWD files ("Horizontal Wind Data") record, in ASCII, the zonal and meridional hourly-mean winds estimated by a SkiYmet meteor radar for one day of recording. The winds are calculated in eight non-overlapping height gates. This document describes the file format and the method used to calculate the winds. All of the Bath/BAS SkiYmet radars use an identical analysis and data format.

1 Filename & Data Format

Filenames

The filename identifies the radar site and the day of recording in a self-explanatory format. For example, the file,

bath-skiyment-meteor-radar_king-edward-point_20190720_daily-winds.hwd

is for the radar at King Edward Point on South Georgia. The date format is YYYYMMDD and all times/dates are UT.

File Contents

The HWD file presents hourly winds in height/time bins as rows of ASCII data. For example,

```
k, ht =  2  85.
times   .5  1.5  2.5  3.5  4.5  5.5  6.5  7.5  8.5  9.5 10.5 11.5 12.5 13.5 14.5 15.5 16.5 17.5 18.5 19.5 20.5 21.5 22.5 23.5
zonal   -2   -3  -13   -5    1    8   -1  -11   30   46   45   51   57   44   57   58   62   47   48   27   42   26   10   28
merid   38   39   34    6    6    6    7    7   -9  -25  -26  -17  -18  -22   -7  -12   -2   13   13   28   27   45   55   52
# pts   60   38   42   43   69   50   65   68   67   89   54   47   48   39   41   43   40   41   37   32   34   27   42   27
```

The information in each row is,

k	the *number* of the height gate, where 1 is the lowest in height
ht	the *central height* of that height gate in km
times	the *time* in hours (UT) at the centre of that height/time bin
zonal	*zonal wind* in that height/time bin in ms^{-1}, positive values eastwards
merid	*meridional wind* in that height/time bin in ms^{-1}, positive values northwards
# pts	*the total number of meteors* used to calculate winds in that height/time bin

The final row in the file is an estimate of the daily-mean atmospheric temperature given in the format, *Temp. = 168.7 K +/- 3.5 for day = 2019/07/20* etc. This is calculated on the basis of the variation of ambipolar diffusion coefficient with height using the procedure described in Hocking (1999) and Hocking *et al*. (2001).

Notes -

1. The depth of the height gates are 3, 3, 3, 3, 4, 5, 6 and 12 km for height gates number 1 to 8, respectively
2. Although the HWD files include height gates 7 and 8 (103 km and 109 km), in practice there are always too few meteors at these heights to calculate a reliable wind. The distribution of meteors in height usually allows wind estimates from ~ 80 – 100 km only.

2 HOW THE WINDS ARE CALCULATED

The method used to calculate the winds from the individual meteors recoded in the corresponding mpd file is described by Hocking *et al*. (2001). In brief, this considers the individual unambiguous meteors recorded (i.e., those of ambiguity = 1 in the mpd file). The software suite running in real-time on the radar applies a least-squares fitting routine to the meteors in a height/time bin to determine the best-fit uniform wind, **u** = (u, v, w), in the meteor collecting volume. Here, **u** is a vector wind that can be resolved into zonal, meridional and vertical components u, v and w, respectively.

The fitting routine minimises the quantity,

$$\sum_i [\{\mathbf{u} \cdot \mathbf{r}_i^u\} - v_{\mathrm{r}i}]^2,$$

Where i refers to the meteor number in a particular height/time bin. The vector $\mathbf{r}_i^u$ is a unit vector from the radar to that meteor, $v_{\mathrm{r}i}$ is the radial velocity measured for that meteor and $\mathbf{u} \cdot \mathbf{r}_i^u$ is the vector dot product. Mesospheric winds on the scale of the meteor collecting volume (a diameter of ~ 400 km) have u, v >> w, so here w is set equal to 0.

An additional step is used to reject individual meteors with anomalous velocities that are "outliers" in the distribution. This is a second iteration of the above equation. In this process, the fitting is first applied to all individual meteors in the height/time bin to Estimate u and v. Then, for each meteor, the radial velocity which would correspond to that wind field is determined and compared to the actual individual value. If they are different by 30 – 40 ms^{-1}, then the meteor velocity is rejected as an outlier. This process provides protection against the small number of spurious meteor detections that may have been recorded.

REFERENCES

Hocking, W. K., *Temperatures using radar-meteor decay times*, Geophys. Res. Lett., 26, 21, 3297-3300, DOI: 10.1029/1999GL003618, 1999.

Hocking, W. K., *et al*., *Real-time determination of meteor-related parameters utilizing modern digital technology*, J. Atmos. Solar-Terr. Phys. 63, 155 – 169, DOI: 10.1016/S1364-6826(00)00138-3, 2001.

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