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To: ECGVM Workshop
From: Arthur Niell

Subject: What should we do for surface meteorology values?

1. Surface met sensitivity

From a previous memo the sensitivity of height estimate to surface pressure error is approximately -0.7 mm/hPa. This says that the apriori pressure should be good to on a few tenths of a hPa (millibar) for the pressure to be a negligible contribution to the height error at the 1 mm uncertainty level. How do we get pressures anywhere near that good? I am assuming that the need to locate the pressure sensor to an accuracy of two meters is not a problem.

The accuracy of the temperature measurements depends on the use: antenna structural deformation, other? I will concentrate on pressure for this memo, although the temperature requirements may be more complex since the antenna structure is distributed.

2. Surface met accuracy

For each observation a pressure and temperature are needed. The pressure should be the value at the intersection of axes (this is probably true for the current level of accuracy). The temperature may need to be measured more than one place. For example, the temperature difference due to solar heating on one side may produce a horizontal change in position, and the temperature of the pedestal is likely to vary with height.

Each sensor needs to be calibrated at some interval of time, and an uncertainty of the calibration must be associated with the measurements, not just the uncertainty of each measured value.

Several issues need to be considered:

If the calibration changes, how are the data to be corrected between the calibration measurements?

How can the instruments be calibrated when no accurate calibration has been done for a long time, or when the new calibration differs significantly from the previous?

Can a Numerical Weather Product, such as ECMWF or NCEP, be used to calibrate the instruments with sufficient accuracy?

Since the met sensors are not likely to be mounted at the desired location, and the location may (will) change with time, how is the correction made and with what accuracy?

In memo ECGVM_aen4 I illustrated a new problem with surface data observed at Westford: bad time-tags. However, the agreement between two pressure sensors after correction to a common height and adjustment of the time difference was very good (almost too good to be believed): <0.1 hPa. Unfortunately, the only way I could tell which of the sensors had the bad time was by referring to a third sensor in the vicinity (at the Haystack

antenna, approximately 1.x km from Westford). How can this or other unanticipated error be caught and corrected, retroactively?

3. RECOMMENDATIONS:

1) Since many sites have more than one geodetic technique (VLBI, GPS, SLR, DORIS, other?), the met data should be independent of any technique. Similarly, no technique configuration file need have any reference to the met data since the relative position correction can be made at the analysis stage.

2) The raw data and calibration information (with uncertainties for both) should be permanently archived in one continuous file for each site.

3) Correction for calibration and position difference should be done at the time of analysis when the position of the antenna is known. This means either a good apriori position must be provided or an iterative procedure used if the initial position is poor (worse than 2 meters for pressure).

4) I think the RINEX form of the met data is awkward since a) the header interrupts the data sequence; b) calibration information is restricted to the location of the headers; and c) there is no provision for measurement uncertainty. All of the information could be provided in a file with one line per surface met measurement:

time, sensor reading/uncertainty, calibration error/uncertainty, sensor geocentric XYZ

5) Not a recommendation, but another question: Should temperature and pressure (and humidity) be in separate files? Not desirable in my view, but the lines become rather long if calibration is included and if sensors are at different locations. Since calibration occurs irregularly, can it be inserted as a separate but recognizable line?