**Report Regarding International Cloud Data, for ASHRAE TC 4.2, 01/27/2019, Neal Lott**

**Data Findings**

Following information is based on initially checking 4 stations’ Integrated Surface Data (ISD) for 2013 and 2017, downloaded from NCEI’s FTP site. Joe Huang provided an inventory of cloud data for these and other locations during his research regarding the decline in total cloud cover reports. Data checked are in standard ISD format, so data field names as noted below are based on ISD format (eg, the GF1 field). This was followed by checking of additional stations.

* 476620 data for 2017: Synoptic report type (FM-12). Total cloud cover (GF1) and cloud layer data (GA1, etc) reported every 3 hours. Very similar pattern found for 2013. Cloud cover data every 3 hours is adequate for climatology purposes.
* 476710, 476860, 476870 data for 2017: METAR report type (FM-15). Cloud layer data (GA1, GA2, etc data) in every observation (except when clear sky) but total cloud cover not reported. For 2013 prior to August, cloud layer data and total cloud cover were found in the data (see below for further details).
* Other international stations: Very similar pattern found as above.

Derivation of GF1/cloud cover from cloud layer data ceased in August 2013. Note that cloud layer data provides the low, middle, and high cloud details. Total cloud cover is an overall summation of the portion of the sky obscured by clouds – generally expressed in 1/8’s units or in terms such as “SCT” for scattered clouds.

Prior to August 2013, data processing at the operational center level (ie, by the Air Force and NOAA) derived the total cloud cover value (if possible) if it wasn't reported.  Since that time, the derivation is no longer done.  There has been a general shift away from deriving values for an archived dataset - ie, stick to what's reported and quality control those data.

Bottom line is that this is global in nature, with variations by country and station.  Depending on the type of weather report/observation (eg, Synoptic vs METAR), the data may include:  A) cloud layer data along with total cloud cover, B) cloud layer data but no total cloud cover report, or C) no cloud information.

**Derivation of Total Cloud Cover from Cloud Layer Data**

Total cloud cover can be derived from cloud layer data. Please note that I haven’t received any feedback yet from recent inquiries submitted to NCEI and USAF, so the algorithm provided below is subject to change and improvements.

* 1) If total cloud cover (GF1 field in ISD) is available, then use the total coverage code field for the total cloud cover. No need to proceed further. Key point: Do not interpret a missing value (99) as 0/clear, or initialize software to 0/clear for total cloud amount.
* 2) If the total cloud cover (GF1 field in ISD) is not available or shown as missing, then proceed as follows by checking cloud layer data:
  + 2A) Interrogate the GD1/2/3/4 field in ISD. Note that generally from one to three or four cloud layers are reported. Determine the cloud layer field with the largest value for cloud cover. Assign that value for total cloud amount. There are two coverage codes that may be reported in the GD field. Coverage code field #2 (in octas) should be used as primary, with coverage code field #1 (few, scattered, broken, overcast, obscured) as secondary.
  + 2B) If a GD field is not available, interrogate the GA1/2/3/4 field in ISD. Note that generally from one to three or four cloud layers are reported. Determine the cloud layer field with the largest value for cloud cover. Assign that value for total cloud amount.
* 3) If total cloud cover is not available and cloud layer data are also not available, then assign a value of missing for total cloud cover. Note: There are stations which report cloud layer data, but do not report clear skies (00 coverage). For those locations, you can interpret no cloud data report in the observation as clear skies, provided that the station routinely provides cloud data.

As an example, if a value for total cloud cover is not available, and cloud layer data is available (GD or GA, above) – GD1 reports a low cloud amount of 2, GD2 - a middle cloud amount of 4, and GD3 - a high cloud amount of 7. In this case, assign a value of 7 for the total cloud cover.