HadISDH.land Update Document

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General Notes:

The HadISDH.land.4.6.0.2023f contains all 12 months of 2023. It is a minor new version (Y element + 1) because a new formula is used to calculate the wet bulb temperature from dewpoint temperature and air temperature and a bug fix in the parent dataset HadISD has resulted in a generally higher rate of error flagging (https://hadisd.blogspot.com/2023/10/bug-in-buddy-checks.html, https://hadisd.blogspot.com/2024/01/hadisd-v3402023f-future-look.html).

Although only last year we implemented a new algorithm (Stull, 2011) to remove the large errors at high temperature/low humidity in the previous Jensen et al., (1990) method, a new method is now available which reduces moist bias errors at high temperature/low humidity (reaching +1.3 °C) and dry bias errors at low temperature/high humidity (approaching -1 °C). The new Non-iterative Evaluation of Wet-bulb Temperature (NEWT) method has been developed by Rob Warren at the Bureau of Meteorology and coded in python. Its errors are far smaller at ± 0.01 °C. Rogers and Warren (2024) introduce the new method and compare it against the Stull (2011) and other methods (https://essopenarchive.org/users/714325/articles/698601-fast-and-accurate-calculation-of-wet-bulb-temperature-for-humid-heat-extremes). Here we use their python code to calculate adiabatic wet-bulb temperatures using polynomial fits from surface pressure, air temperature and specific humidity. This change only affects the wet-bulb temperature fields and differences are negligible in large-scale means and far less than 1 °C for the most part. Differences are largest over hot/dry and cold/humid air conditions. We still use the Stull (2011) method to decide whether to calculate vapour pressure with respect to ice or water because it is faster to implement so there is no change to other variables.

The HadISD bug fix was to correct the application of the buddy check which hasn't been working since the 2017f versions but was only detected late last year. The buddy check compares quality controlled neighbouring stations and can remove error flags where neighbouring stations support the candidate value. The bug resulted in more flagged observations being unflagged than should be. The correction has resulted in a higher flagged error removal rate. This, and the slight change to station network historically, as various updates are applied to the source dataset ISD, results directly in small changes to coverage and indirectly through influencing the homogenization process, which for HadISDH.extremes can result in changes when using the HQscore to select the higher quality data.

All other processing steps for HadISDH.extremes remain identical. The new version of HadISD (3.4.0.2023f) has pulled through some historical changes to stations which are passed on to HadISDH.land resulting in 9667 compared to 9555 initial stations. The end station count is further reduced after completeness checks and homogenisation. The homogeneity adjustments differ slightly due to sensitivity to the addition and loss of stations, historical changes to stations previously included and the additional 12 months of data. More information can be found at https://hadisdh.blogspot.com/2024/04/2023-update-from-hadisdhland4602023f.html.

Rogers, C.D.W. and Warren, R.A. (2024). Fast and Accurate Calculation of Wet-bulb Temperature for Humid-Heat Extremes. ESS Open Archive. January 18, 2024. DOI: 10.22541/essoar.170560423.39769387/v1

Stull, R., 2011: Wet-Bulb Temperature from Relative Humidity and Air Temperature. J. Appl. Meteor. Climatol., 50, 2267–2269, https://doi.org/10.1175/JAMC-D-11-0143.1.

Version Number X.Y.Z.0000p/f:
4.6.0.2023f

Major changes X:

- None

Bug fixes and minor changes Y:

- Change of wet-bulb temperature formula from Stull (2011) to the Non-iterative Evaluation of Wet-bulb Temperature (NEWT) method - https://essopenarchive.org/users/714325/articles/698601-fast-and-accurate-calculation-of-wet-bulb-temperature-for-humid-heat-extremes.
- Bug fix in HadISD (parent dataset) buddy check, resulting in a greater number of observations being flagged as errors and removed - https://hadisd.blogspot.com/2023/10/bug-in-buddy-checks.html, https://hadisd.blogspot.com/2024/01/hadisd-v3402023f-future-look.html.

Minor bug fixes / historical data updates Z:

- 9667 compared to 9555 initial selection stations last year.
- Use of HadISD.3.4.0.2023f as the basis which includes retrospective improvements (to correct data, add or remove data sections) to the historical data in NCEI's ISD archive are ongoing. These are not documented.

Start Date DD.MM.YYYY: 1973-01-01
End Date DD.MM.YYYY: 2023-12-31
Hadisdh Data Format (Baseline documentation): https://zenodo.org/record/7963175
Reference: No change

- Willett, K. M., Dunn, R. J. H., Thorne, P. W., Bell, S., de Podesta, M., Parker, D. E., Jones, P. D., and Williams Jr., C. N.: HadISDH land surface multi-variable humidity and temperature record for climate monitoring, Clim. Past, 10, 1983-2006, doi:10.5194/cp-10-1983-2014, 2014.
- Willett, K. M., Williams Jr., C. N., Dunn, R. J. H., Thorne, P. W., Bell, S., de Podesta, M., Jones, P. D., and Parker D. E., 2013: HadISDH: An updated land surface specific humidity product for climate monitoring. Climate of the Past, 9, 657-677, doi:10.5194/cp-9-657-2013.
- Smith, A., N. Lott, and R. Vose, 2011: The Integrated Surface Database: Recent Developments and Partnerships. Bulletin of the American Meteorological Society, 92, 704\u2013708, doi:10.1175/2011BAMS3015.1.

Other notes: The update blog post is here: https://hadisdh.blogspot.com/2024/04/2023-update-from-hadisdhland4602023f.html