Analysis of Record for Calibration (AORC) Temperature and Precipitation Records

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FTP Location:

ftp://hydrology.nws.noaa.gov/pub/aorc-historic/AORC_??RFC_4km/ for temperature zip files
ftp://hydrology.nws.noaa.gov/pub/aorc-historic/AORC_??RFC_4km/ ??RFC_precip_partition/ for precipitation zip files

Content:

Instantaneous 2-m above ground temperature valid at nominal file time, and 1-h precipitation accumulation ending at the nominal file time. The period covered is 5 January 1979 to 31 December 2017. Data are stored at a precision of 0.1K and 0.1mm. Data are unprojected, that is, defined by a latitude/longitude grid. File collections on the ftp server are from a thinned AORC grid at a spacing of 0.032 degrees, approximately 4-km mesh.

Format is netcdf, with one field per file per hour. All hours for a given month are in a zip collection with the month yyyymm indicated in the filename.

Spatial extents:

Data for each RFC were subset from the full domain such that each RFC's contributing area is covered with 0.25 to 0.5 degree latitude/longitude buffer outside the greatest east-west-north-south extents.

Synopsis of AORC temperature methodology:

For 1979-2015:

Long-term means of maximum and minimum temperature are from a combination of PRISM 1981-2010 means over the conterminous United States and British Columbia; from an NCEI-published dataset over the remainder of Canada up to 53 degrees N; and from 1981-2010 station normals published by Servicio Meteorológico Nacional (2018), interpolated via Anusplin over Mexico (Fig. 1 shows the spatial blending of these sources).

Daily max/min temperatures are from the dataset of Livneh et al. (2015), which features continuous coverage from central Mexico to southern Canada. The max/min time series was adjusted with monthly correction factors so that the mean monthly temperature (for each of the

12 months) matches PRISM climatology during the 1981-2010 period. The same factors were applied to the original Livneh data during 1979-2010 and 2009-2015. This effectively downscales the temperatures to account for climatic/elevation effects.

The daily max/min values at all grid points were distributed temporally via the NLDAS2 (Cosgrove et al. 2003) 3-h temperature time series. As shown schematically in Fig. 2, two potential adjustments are calculated for the original NLDAS2 temperature. A range adjustment (Fig. 2a) constrains the original temperature toward the Livneh maximum/minimum range. A mean adjustment (Fig. 2b) constrains a running mean temperature toward that of the Livneh mean. A final adjustment is based on one of these two adjustment, or a weighted average of the two. The range adjustment is applied if the 3-day daily max/min correlation between the NLDAS2 and Livneh values is at least 0.8; the mean adjustment is applied if the correlation is less than 0.5. A linearly-varying weight is applied if the correlation is within the range 0.5 to 0.8. An example of the original NLDAS2 and final AORC temperature time series, for Bismarck ND during March 1979 (Fig. 3), illustrates how the application of the two corrections varies over time, with the range correction being applied on most days, but the mean correction being applied when the diurnal range is very small.

For 2016-present:

The update portion of the AORC temperature record is based on the Unrestricted Real-time Mesoscale Analysis (extended) (URMA). This operational analysis has sufficient spatial coverage and the advantage of application of a high-resolution terrain. However, its archive was too short for incorporation with the earlier AORC. The original ~2.5km grid mesh Lambert projection data has been downscaled based on coincident data from NLDAS2 and the AORC from the 2010-2015 period, in an attempt to maintain temporal continuity. However, the data should ultimately be re-constrained with a new 30-year climatology, when such data become available.

Synopsis of AORC precipitation methodology

For 1979-2009:

Similar to temperature, long-term means of monthly total precipitation are from a combination of PRISM 1981-2010 means over the conterminous United States and British Columbia; from an NCEI-published dataset over the remainder of Canada up to 53 degrees N; and from 1981-2010 station normals published by Servicio Meteorológico Nacional, interpolated via Anusplin, over Mexico (Fig. 1 shows spatial blending of these sources). The monthly climatology was used as a long-term constraint on the 1981-2010 Livneh et al. accumulations. In most of the conterminous United States and Canada, this resulted in changes of only 0 to 2% from the original, which also incorporated PRISM and NCEI climatology. However over western Canada and Mexico, the application of British Columbia PRISM and new Anusplin climatology did result in appreciable differences from the original Livneh data.

After extensive examination of the Livneh et al. daily precipitation record as compared with NLDAS2, RFC/NCEP StageIV, and other sources, we determined to apply the Livneh monthly total precipitation, rather than daily. These monthly accumulations were used to adjust NLDAS2 daily (ending 1200UTC) accumulations and after 2010, StageIV daily accumulations.

Following a logic similar to that of the NLDAS2 (Cosgrove et al. 2003, NASA 2018) the daily accumulations were disaggregated to hourly according to available sources. The list shown in Fig. 4 is in the preference order for radar hourly precipitation inputs, namely StageIV after 2001, Stage II and/or NOWrad after 1995, and Manually Digitized Radar (MDR) for 1979-1994.

When/where radar hourly precipitation does not cover observed nonzero daily amounts, hourly estimates are based on information from CMORPH microwave/infrared satellite (1998+) or Climate Forecast System Reanalysis hourly simulations. Where no nonzero hourly estimate appears, the daily precipitation is distributed equally across the 24-h period. In practice, this approximation is fairly rare.

For 2010-present:

Examination of StageIV daily precipitation and other, gauge-based precipitation sources from 2002 to approximately 2009 showed that in some areas the StageIV was consistently biased low during the winter months. This statistical behavior, likely due to reliance on radar for precipitation detection, substantially improved during/after 2010. Therefore, in order to incorporate heavy precipitation events as detected in StageIV, while retaining long-term consistency with the gauge-based Livneh data, the AORC daily precipitation during and after 2010 is based on StageIV where available, with a bias correction factor, varying by month, being applied. The bias correction is set by the ratio of the 6-year accumulations for the Livneh data and StageIV during 2010-2015. Outside StageIV coverage areas, the NLDAS2 daily precipitation is used.

REFERENCES

Cosgrove, B., and Coauthors. 2003. “Real-time and retrospective forcing in the North American Land Data Assimilation System (NLDAS) project.” *J. Geophys. Res*., 108, 8842.

Livneh B., T.J. Bohn, D.S. Pierce, F. Munoz-Ariola, B. Nijssen, R. Vose, D. Cayan, and L.D. Brekke, 2015: A spatially comprehensive, hydrometeorological data set for Mexico, the U.S., and southern Canada 1950-2013, *Nature Scientific Data*, 5:150042, doi:10.1038/sdata.2015.42.

NASA, (accessed November 2018): Land Data Assimilation Systems. [https://ldas.gsfc.nasa.gov/nldas/NLDAS2forcing.php]

Servicio Meteorológico Nacional (accessed November 2018): Información Climatológica. [http://smn.conagua.mx/es/climatologia/informacion-climatologica]

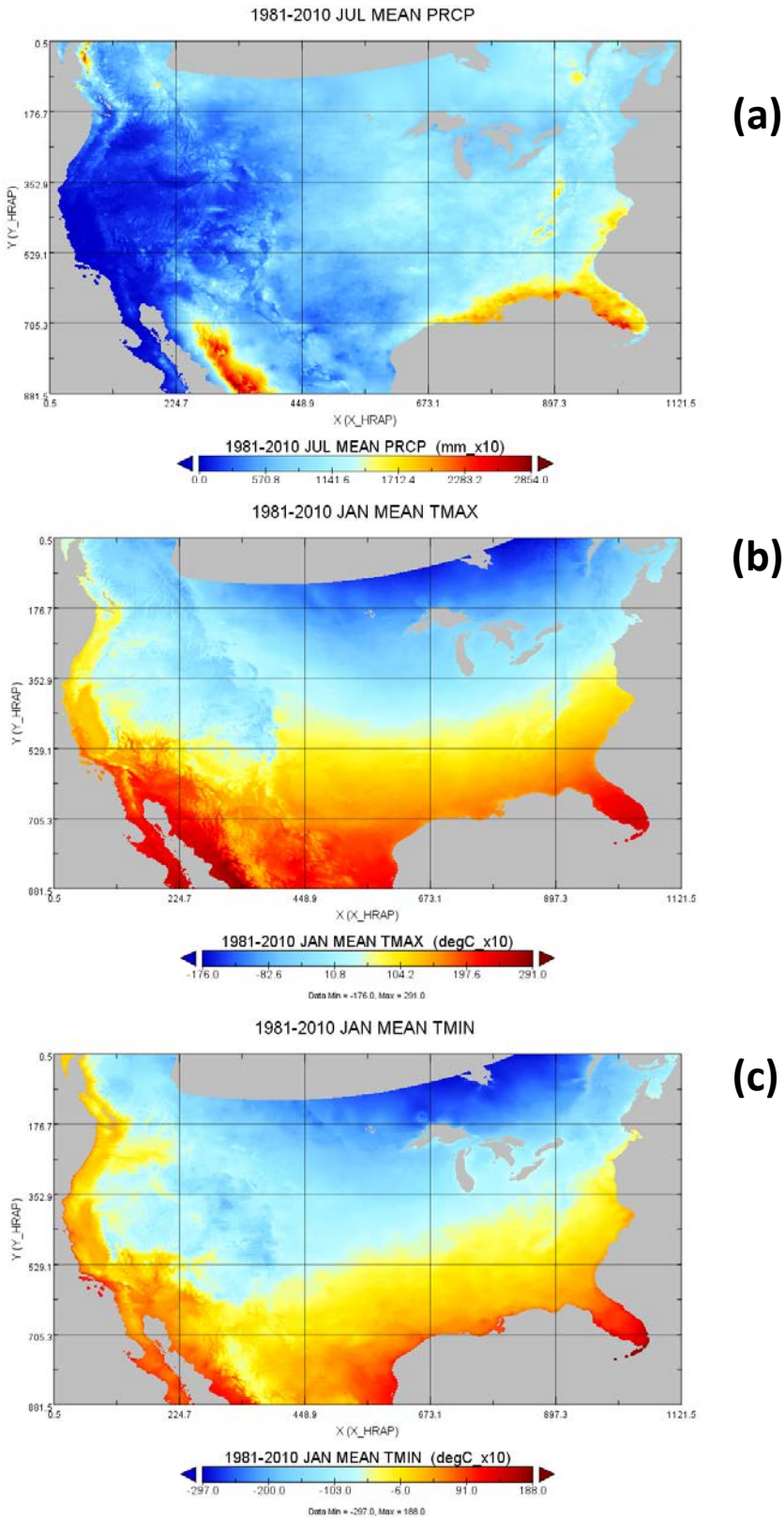

Figure 1. Spatial merge of PRISM, NCEI, and SMN/Anusplin monthly climatic fields, for (a) July total precipitation, (b) January maximum temperature, (c) January minimum temperature.

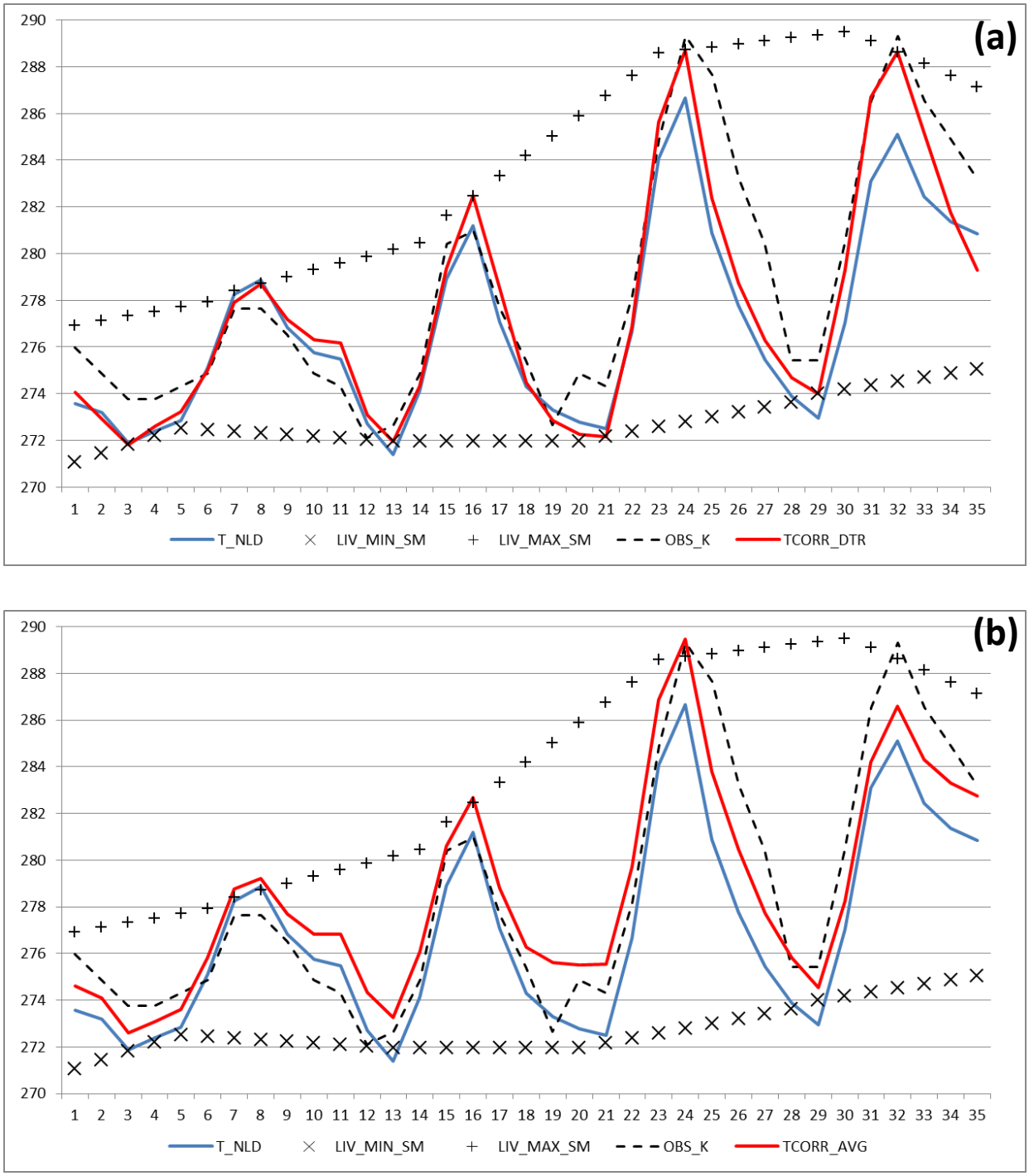

Figure 2. Temperature traces for St. Louis, MO, 6-10 February 2002 (a) is for diurnal range correction, (b) is for running mean correction. Livneh daily maximum smoothed rrace indicated by (+), minimum trace by (X), site observations by black dashed line, NLDAS2 Trace by blue line, initial correction by red lines.

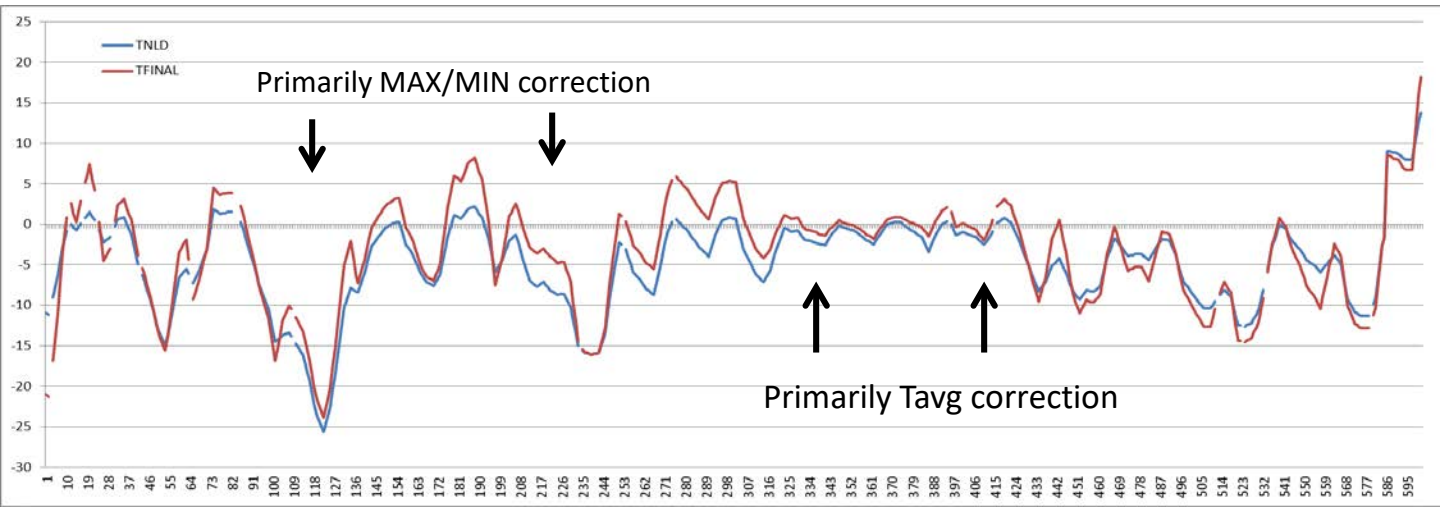

Figure 3. NLDAS2 (blue) and AORC (red) temperature traces for Bismarck ND, 5-29 March 1979.

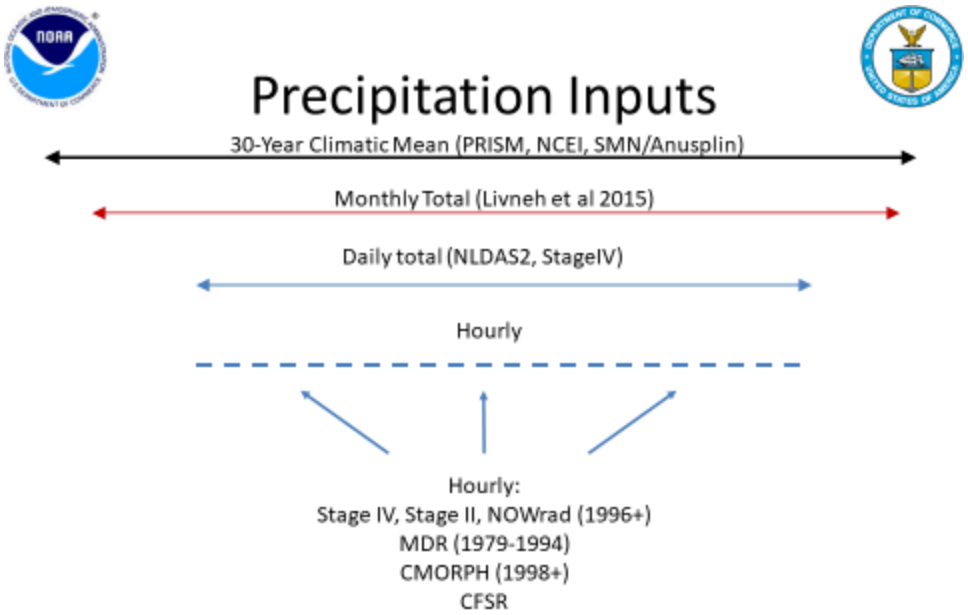

Figure 4. Schematic illustrating relationship between constraints of 30-year climatology (top), monthly and daily total precipitation (middle) and final hourly AORC precipitation (bottom), estimated by disaggregation of daily totals.