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Gridding in situ precipitation data that preserves variance and spatial correlation of the original observations

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The approach targets a specific group of users (ecology and hydrological modelers) who need serially complete gridded fields of daily meteorological variables that preserve (resemble) as close as possible the statistical structure of the station-based point fields (distribution and spatial covariance field). It is known that any interpolation and spatial averaging of the meteorological field affects these characteristics, and some of them (e.g., daily extremes) diverge significantly from the point values. Therefore, some of the steps of the process described below significantly deviate from standard gridding methodologies. The method can be used only in the regions with good spatial data coverage and includes six steps. 1.For each station and month, we estimate three parameters of a mixed gamma-distribution for precipitation. These parameters are: the probability of a day without precipitation, and, for days with precipitation, a two-parameter gamma-distribution function with shape and scale parameters of this distribution. Our analyses show that the shape parameter of daily precipitation distribution is relatively stable geographically and changes little even inside the 5°x 5°boxes. Therefore, we can leave it intact and change only the other two. Thus, if we know that there is a precipitation event inside the cell, then we need only to adjust the scale of the available point measurements within the cell to make them "representative" for the center of the cell and the cell mean elevation. On the contrary, if the most representative observation for the center of the cell site reports no precipitation event, then the task is completed. 2.We calculated the regression equations for the probability of a day without precipitation and for the scale parameter as a function of latitude, longitude, and elevation inside each 5°x 5°box. To secure robustness of the approach, an algorithm that reduces a least absolute deviation from the regression line instead of a least mean square deviation was used. 3.For each 0.5°x 0.5°grid cell, we constructed the list of the N "best" nearby stations for each of two parameters separately, and sorted this list by the proximity to the cell center. Then regression was used to interpolate both parameters into the center of this cell. 4.For each of the grid cells that have at least one station within their boundaries, all appropriate information acquired during the previous steps from the daily data for N "best" stations were used for construction of time series of gridded daily precipitation in this cell. Specifically, all valid station data on this date were sorted in the order of minimal "distance" for this month, cell, and intensity parameter. Then the closest station with the valid datum was selected, and this datum was assigned to the preliminary unadjusted grid time series and a scale corrected datum was assigned to the adjusted grid time series using an intensity parameter interpolated into the same grid cell center. 5.For each grid cell without a valid datum, the conditional probabilities were calculated for the precipitation event absence within this cell using the information whether the nearby cells had or did not have precipitation. 6.A random number generator, previously estimated conditional probabilities (step 5) and parameters of the gamma distribution (step 3) are used to infill missing values of the time series generated at step 4 and to generate the artificial daily precipitation time series for each cell devoid of stations. This approach was tested and used to grid daily precipitation and snowfall time series for the contiguous United States for the past 60 years with a 0.5°lat.x lon. resolution. The resulting gridded precipitation time series are serially complete and cover more than 96% of the land area of

the lower 48 states and 100 percent of the country east of 105°W.

Keywords: precipitation, snowfall, gridding, preserving statistical structure, mixed gamma-distribution