Earth Syst. Sci. Data Discuss., 8, C394–C406, 2015
www.earth-syst-sci-data-discuss.net/8/C394/2015/

Earth System Science Data Discussions

Interactive comment on "High-resolution daily gridded datasets of air temperature and wind speed for Europe" *by* S. Brinckmann et al.

S. Brinckmann et al.

sven.brinckmann@web.de

Received and published: 16 December 2015

Anonymous Referee #1

As a general comment it would be extremely useful for the authors to add a few sentences in the conclusions, which provide some guidance to potential users of this dataset. For example, are there regions/sub-regions for which the accuracy is not acceptable and should be treated with caution? Are there best practices, which the authors would recommend to users of the dataset?

changes: p.676,l.17 (sentences added): Concerning the usage of these grid data, we recommend to consider the uncertainty estimates provided in separate files in all analyses. Especially in parts of the North African region the IQR are usually very

high, owing to very sparse observations. To deal with this issue, users could define uncertainty thresholds tolerable for a specific analysis und exclude data with IQR above this level.

Anonymous Referee #2

1: The time in the netcdf files are not correct. When plotting the one for Tmin for Jan 2001, is seems that the days are 2 January 2001 - 1 February 2001 instead of 1-31 January 2001. The probable reason is that the time value should start with 0 instead of 1 (days since 1 January 2001).

response: Thank you for this important remark. We have addressed this problem in the new data version available within a few days under "v002".

2: The coordinates in the netcdf file are wrong. They are given as degrees N and degrees E, but they are not the regular lat/lon coordinates, but the ones from the rotated grid. No projection information is given in the netcdf files to correct for this.

response: We have included the grid information in the new netcdf files available within a few days under "v002".

3: Why are only the IQR values made available and not the total uncertainty values?

response: The IQR data provided in the files include all sources of uncertainties. Instead of upper and lower quartiles the range between these measures are stored as IQR. This strategy is chosen to save disk space for the data sets of high resolution in space and time. It can be justified considering the fact that kriging variance is not very precise and rather gives regional averages of uncertainty estimates.

4: The results section regarding variance and cross validation should be reduced.

response: Section 6.3 is essential for the description of the final uncertainty of the gridded data. For the coordinates of all stations the final interpolation product is simulated without considering target station information. Thus, some of the issues raised in your

next question (5:) are well addressed in this section. The preservation of variance gives information about how extremes are affected. The comparison with station data provides information on the accuracy of the method.

changes: p.670,l.10 (sentence edited to make clear that the quality of the final products is evaluated): For two years, 2001 and 2010, the quality of the final interpolation product is evaluated by applying 'leave one out' cross validation (as defined in Sect. 3.2).

5: What is missing in the manuscript are results regarding the final gridded datasets, such as the effect of the gridding method on extremes and comparison with other existing datasets (e.g. E-OBS, CRU, or even reanalysis in case of wind speed).

response: Concerning the preservation of extremes, see (4:). Concerning a comparison with other datasets, we have to deal with different scales of space (E-OBS, CRU) and time (CRU). As all datasets are mainly based on the same station data, expected differences are mainly due to different reference intervals (consistency problems within E-OBS, see discussion in sect. 2.2 about ECA&D, which are basis for E-OBS) or interpolation schemes. For the interpolation schemes the best way to compare data of different scales is a comparison of cross validation results (RMSE at station coordinates). A direct comparison with E-OBS or CRU is nevertheless interesting, but due to the scale issues beyond the scope of this paper.

changes: p.671,l.4 (new section with comparison of RMSE of other methods): Hofstra et al. (2008) have compared the skill scores for daily temperature interpolation results based on different methods. The RMSE calculated in our study for the same domain are in the same range as found for the best-performing methods tested in Hofstra et al. (2008). For instance, the three-dimensional thin-plate splines method used (in combination with another method) for the E-OBS temperature grid record (Haylock et al., 2008) showed RMSE of 1.12°C and 1.40°C for summer and winter half, respectively. Even though a direct comparison between E-OBS and the temperature data of

our study is not investigated, a discussion on possible differences will be presented in section 8.

6: What is the difference with the current interpolation method compared to other available gridded datasets (except spatial resolution)?

response: Some general information is given in the introduction. Concerning the differences to E-OBS, a section is added to the "Conclusions".

changes: p.676,l.17 (section added): In comparison with the E-OBS temperature data (Haylock et al., 2008) generally similar interpolation accuracies are indicated (section 6.3). Nevertheless, the input data used for the two datasets (mainly ECA&D for E-OBS, mainly SYNOP in our study) refer to partly deviating observation intervals, as described in section 2.2. This can lead to slight differences for certain days and regions. Concerning the usage of predictors, in both datasets temperature changes with altitude are considered in a very similar way. However, slight differences are expected, since in E-OBS these dependencies are calculated locally while in our study the whole data of each subregion are used. A local calculation can potentially better reflect small-scale conditions but may lack robustness in cases of missing representation by local station data. By the consideration of additional predictors for the creation of our datasets more realistic results are expected, on average, for regions with very few station data (e.g., North Africa).

7: Tmin and Tmax from synop are 12h values and not 24h values. In certain conditions, this can result in having not the 'real' daily (=24h) Tmin and Tmax. This should be taken into account when combining with ECA&D data for which Tmin and Tmax are (most of the time) determined over 24h periods. The fact that the Tmin and Tmax grid reflect only 12h extremes should be made more clear (for example in the abstract and/or summary and/or conclusions).

response: It would be most consistent to apply the same 24 hour period for the temperature extremes. But due to the missing availability of corresponding station data in

some countries we chose to use the data of the 12 h observation intervals for the temperature extremes. By using this strategy potential temperature contrasts caused by deviating intervals can be excluded. From our comparison experiments with ECA&D it became clear that for each individual parameter (Tmin, Tmax, Tavg) the observation intervals applied in ECA&D are in some cases different from country to country. For this reason the usage of ECA&D in our study was restricted to cases where a consistency is assured and/or the SYNOP coverage is low (section 2.2).

changes: p.674,l.4 (added to summary): To achieve a high data consistency, temperature extremes are based on the same 12 h intervals of night (18 to 6 UTC) and day (6 to 18 UTC) and a constant 24 h interval starting at 00 UTC is used for the calculation of daily means.

8: Synop values are usually of lower quality than climatological time series such those from e.g. ECA&D, since no quality control is normally applied to synop. What is the reason for not using climatological time series (since these are easily available for 2001-2010 for several parts of Europe) and adding these with synop instead of the other way around (which is used in the manuscript)?

response: see reply to (7): inconsistent observation intervals in ECA&D. We apply profound quality checks to detect erroneous data. Tests with ECA&D in this respect showed, that even these climatological data contain many doubtful values.

changes: p.655,l.3 (section edited): For example, in some countries daily mean temperatures are based on the interval between 00:00 to 00:00 UTC, in other countries between 06:00 UTC and 06:00 UTC (van den Besselaar et al., 2012). Similar differences are found for Tmin and Tmax. This leads to potential discrepancies between SYNOP (using constant intervals as described in section 2) and ECA&D, as our experiments with station data at identical coordinates confirmed. This comparison revealed patterns with differences clearly dependent on the parameter and country. Therefore, an algorithm was designed to carefully include data from the ECA&D archive, ...

9: In the temperature regression, elevation fields of SRTM are used. But these are not available above 60N (according to the given website). No mention of this is given in the manuscript and Fig 5 does show elevation values above 60N so there is an inconsistenty here.

changes: p.659,l.2 (information added): In a first step a multiple linear regression of the monthly means for each station against data fields of altitude (using elevation data from the shuttle radar topography mission (SRTM; see http://dds.cr.usgs.gov/srtm/version2_1/SRTM3/), above 60°N complemented by data from the the United States Geological Survey (USGS ; see http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/gtopo30_info)), continentality (after Gorczynski, 1920) and zonal monthly mean temperature (climatology 1961–1990 based on CRU TS 3.00; Mitchell and Jones, 2005) is applied (see corresponding fields in Fig. 5).

Specific comments:

1: Make clear in the abstract (and summary/results) that the grids are available on a rotated grid and not on a regular lat/lon grid.

changes: p.650,l.9 (sentence changed): By spatial interpolation of these station data grid data in a resolution of 0.044 (5 km) on a rotated grid with virtual North Pole at 39.25 N, 162 W) are derived. changes: p.661,l.27 (changed to): ...final rotated target grid... changes: p.674,l.2 (information added): In this work interpolation schemes for daily station data of minimum, maximum and mean temperature as well as daily mean wind speed in 5 km resolution for Europe (rotated grid with virtual North Pole at 39.25 N, 162 W) are presented.

2: p 652, line 15-16: remove "As contribution...period 1961-2010". Also given 2 paragraphs later.

response: We think, it is important to define the goals of this project here to put it into

context with the investigation of the decadal predictability of regional climate models. Two paragraphs later it is noted that only the results for the latest decade 2001-2010 are presented in the paper.

3: p 653, line 18: put the abbreviations behind the parameters.

changes: p.653,l.18: ...daily mean temperatures (Tavg) as well as daily mean wind speed (Vavg) are derived...

4: p 654, sect 2.1: It is mentioned that the basic uncertainty for wind speed is relatively high and therefore the potential discrepancies are acceptable. But for temperature, the standard deviation is relatively low (0.21 degreesC), but still twice the basic uncertainty given in line 3, but this is not mentioned.

response: We try to compare this averaging uncertainty with general uncertainties of wind speed measurements. It might be useful to add another aspect here, the strong dependency on local roughness conditions. For temperature the averaging uncertainty is low, even for the worst case of measurements every 6 h. So, any further justification is omitted here.

changes: p.654,l.19 (sentence edited): But compared to the relatively high basic uncertainty of 0.5 m s-1 for wind speed data and the strong influence of e.g. local roughness conditions on the measurements, these averaging uncertainties are found acceptable.

5: Fig 1a and b: why not use the same month for comparison?

response: Fig. 1b is shown to demonstrate the functioning of the selection algorithm. The density of data available from SYNOP has increased during the 2001-2010 decade (compare Fig. 3). So, the number of additional data selected by the algorithm from the ECA&D archive is higher in 2001. See also p.655,l.28: ECA&D data contribute especially in these early years.

6: Sect 2.3 (qc and assurance) is not very clear, some rewrite needed: What is meant with "assurance" in the section title? How are the outliers determined for Tmin and

Tmax? How are the thresholds of 7degreesC (line 25) and 0.65 degreesC/m (line 3 p 657) determined? In Sect. 3.1 smaller values than 0.65 degreesC/m are mentioned. Where do the 19 regions come from? How far away are neighbouring stations (p 657 line 29)?

response: Quality assurance is mentioned in the title, as beside the pure quality check additional strategies, as the reconstruction of missing data by other sources, are applied to improve the data quality. Concerning outliers, a desription is given for the hourly data of each day. As noted on p.657, l.9, similar strategies are applied to the daily data of each month, i.e. for Tmin, Tmax and Tavg. A more detailed description is left out here, as the focus of our paper lies on the description of gridded datasets and the related gridding methods. The threshold of 7degC has been determined empirically (see changes explained below). 0.65 C 100m-1 is the lapse rate of the International Standard Atmosphere. This assumption has proven to be adequate for defining regional climatological thresholds in our tests. Concerning the other questions, see changes below.

changes: p.656,l.25 (sentence edited): Corresponding tests with data of several example months indicated clear inhomogeneities for dsdx above 7 C. changes: p.656,l.28 (sentences added): The subregions were defined by combining countries of similar climate. For the Skandinavian countries and Russia an additional separation by latitude is applied. changes: p.657,l.2 (edited): Additionally, an adjustment of temperature with altitude (assuming 0.65 C 100 m-1 according to International Standard Atmosphere) is carried out ... changes: p.657,l.28 (edited): To achieve a more precise estimate of the monthly mean, the missing values are reconstructed by linear regression with neighbouring stations (depending on available stations search radii increased stepwise to 280 km).

7: Eq (1) (and others): what is 'x'? Explain all variables in all equations.

changes: p.659,l.9 (edited): with T(x): temperature at station x, alt: altitude, ...

changes: p.664,l.5 (edited): with V(x): wind speed at station x, exp: exposure or relative altitude, ... changes: p.665,l.6 (edited): with v(z): wind speed at height z, Von Karman constant ...

8: Actually 4 steps are done in the interpolation instead of 3: Monthly regression, daily regression, monthly kriging, daily kriging.

changes: p.658,l.10 (sentence changed): The interpolation is done in four steps: a regression of station monthly means depending on three predictor parameters (elevation, continentality and zonal monthly mean temperatures), followed by interpolation of the regression residuals using kriging to obtain gridded monthly means, a daily adjustment of regression on elevation, and finally, the kriging of daily deviations from station monthly means. changes: p.662,l.3 (edited): In the next step...

9: Sections 3+4: not always clear if stations or gridded fields are used.

changes: p.663,l.1 (edited): ... to the station data ... changes: p.663,l.19 (edited): The ranges, within which station data are correlated, lie between 5 and 8 deg on the rotated grid (around 550 to 900 km).

10: p662, line 5: Why is height correction needed? Observations are already at station height.

response: explanation given in the same sentence. The daily dependency on altitude may be different from the monthly dependency, which is corrected in this daily regression step. changes: p.662,l.5+8: height-corrected -> height-normalized changes: p.662,l.8: height-correction -> height-normalization

11: Fig 7: is this just a schematic are results for a region/month/etc.?

changes: caption edited: Idealized variogram...

12: p 663, line 12-14: How can you decide this for the final setup (ie full 2001-2010 period) when the 2 models are only performed for 4 test months?

response: Two summer and two winter months are used in the tests to consider possible changes as a result of the annual cycle. The mean results showed similar performance than individual variogram fitting. Therefore, usage of this basic null variogram for all analyses is justified.

13: Sect 4.1: coastal distance: what is done with coastal distances >100 km? Is ln(coa+1) used in eq(3) or just coa? Why is 5x5km used and not 10x10km as in Walter et al for the exposure?

response: 5 km radius equivalent to circle filling the square of 10x10km

changes: p.664,l.23 (edited): ...defining maximum coastal distances (higher values are reduced to that constant) between 20 and 100 km. changes: p.664,l.4 (equation refined): V (x) = k0 + k1 Âů exp(x)^0.5 + k2 Âů ln (coa(x)+1) + k3 Âů ln(10/z0(x)) + k4 Âů era(x) + res(x)

14: p 667, line 19: In the regression section, no normalization is mentioned!

response: already explained at p.666,l.27: Therefore, ratios between monthly wind data and the corresponding area mean of the related region are considered.

15: How are IQR determined per day and grid box as there is only 1 uncertainty value per day per grid box.

response: see discussion at (3:) above. Only the differences between lower and upper quartiles are stored.

16: p 668, line 25: It is mentioned that IQR of 1.0 degreesC is high. But almost all areas have values that are even higher. What does that mean?

response: It is mentioned that the quality in this region is very high. Higher IQR in other regions indicate a lower quality.

17: p 669, line 3: why not use 31 July 2010 for wind speed as that day is also used for temperature?

response: We decided to choose a day with partly very high wind speeds to receive stronger contrasts for the daily maps. For July 2010 wind contrasts were very low on all days.

18: p 669, line 10 (and other places): the discussion on nugget in Sect 4.2 is only 1 sentence...

changes: p.669,l.10 (edited): see discussion on the nugget effect in Sect. 3.2

19: p 669, line 13: Fig 11 (instead of 10): are the green grid boxes next to red grid boxes real? These are very large differences over a very small area.

response: strong differences of wind speed due to different exposition and/or surface roughness

20: p 670, line 20-25: are other winter and summer months checked? Difficult to say something using only 1 (or 2) months...

response: Two summer and winter months were checked. In combination with annual cycle of regression residuals shown in Fig. 13, in which the whole period 2001 to 2010 is considered, that statement seems reasonable. Also, similar information can be derived from annual cycles of cross validation results in Fig. 16.

21: p 671, line 5-10: not sure if the high mean wind speed can be a reason. The results shown are differences between cross-validation and original fields, so the higher mean wind speed is already taken into account by taking this type of anomaly.

response: The results show differences between reproduced data (using point interpolation with information from neighbours only) and original data. Higher mean wind speeds produce a broader distribution of data as a result of the characteristics of wind speed (in contrast to temperature). For this reason reproduction using data from neighbours will become less precise.

22: Fig 16: there is a very sharp drop around March/April for Tmin and Tmax, which is

not mentioned at all.

changes: p.671,l.28 (sentence added): The very low RMSE values for Tmin and Tmax in April 2001 are caused by the limited number of data in this month, especially outside of region 4.

Technical corrections:

1: Be consistent in terminology. E.g. altitude and elevation. Subregion and region. When 'statistic' is mentioned, different things are meant. Confusing to use 'explained' as well 'unexplained' variance. 'data' is used when 'stations', 'values' or even 'days' are meant.

response: see changes below. Concerning 'explained' and 'unexplained' variance, both terms are known in statistical modelling and their use in the paper is thus reasonable. p.673,l.2-4: Here, interpolation for coordinates of stations (without using that station data) are compared with measurements at the station. So, 'point data' is used instead of 'station'.

changes: p.656,l.27+28; p.658,l.15+20+23; p.663,l.1+16+24+25+26; p.666,l.12; p.675,l.22+23: subregion -> region fig.4, fig.8, fig.13 (caption changed): subregion -> region p.657,l.3; p.658,l.11; p.659,l.15+16+17: elevation -> altitude p.656,l.12: statistics -> daily values p.657,l.26 (sentences merged): Therefore, only time series containing less than five missing values within a considered month are used. p.661,l.6: ...therefore the values of the whole month are available. p.653,l.19: data -> values p.655,l.13: data -> station data p.655,l.14: -> ... rejecting ECA&D station data ... p.655,l.16: data -> ECA&D station data p.655,l.24: -> total number of station records used p.656,l.9: -> ... of each daily cycle at a target station are substracted ... p.656,l.15: -> number of the daily values p.656,l.22: -> identical values p.657,l.10: data -> values p.657,l.10: -> This quality check is particularly important for the SYNOP extreme values and for all ECA&D data,... p.657,l.22: data series -> time series p.659,l.12: -> only data from stations within the core region p.659,l.14: data -> station data p.659,l.25:

data -> station data p.660,l.2: data -> station data p.660,l.12: data pairs -> mountain stations p.660,l.14: lie between -> are between p.660,l.24: stations -> station measurements p.666,l.23: of the monthly mean wind speed data -> of the data of monthly mean wind speed p.672,l.19: of the data -> of a data value p.672,l.20: data -> values p.673,l.5: points -> locations p.673,l.17: data -> data values p.673,l.25: data -> data values p.675,l.24: gridded data -> grid data p.686 fig.3, y-axis: -> number of stations

2: Several typos exist throughout the manuscript.

response: We will check the spelling before the submission of the revised manuscript. p.656,l.9: -> subtracted

3: Check the order of the Tables and Figures. Table 3 is mentioned earlier than table 2. Same for figures 7 and 6.

4: From p 669 line 13 onwards, the figure numbering is wrong. They should all be 1 higher than the one give

response: These problems will be addressed in the revised manuscript.

Interactive comment on Earth Syst. Sci. Data Discuss., 8, 649, 2015.