Discussion paper on the calculation of the standard Climate normals: a proposal for a dual system

By
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1 Introduction and need for change

The Standard Climate Normals underpin many climate services and applications, including climatologies, and also comprise the reference period for the evaluation of anomalies in climate variability and change monitoring. The current method for calculation of these normals is to average station data over a 30 year period, and update the normals every 30 years. This might be referred to as the "30/30 model". The current Standard normals period is 1961-90, and under current methodology, the next update will be in 2021, when the 1991-2020 period will become the new standard.

The question arises about the representativeness of a period such as 1961-90 after 15, 20, 25 years in a non-stationary climate. Many climate applications need to base fundamental planning decisions on average and extreme climate conditions, and it is plain that, for instance, an orchardist in 2015 trying to assess whether the climatic conditions in a region suit a particular variety of fruit, is not going to be receiving optimal guidance from 1961-90 Normals when the base climate is changing. At the same time, a set of Climate Normals that is stable over a long period is still required to anchor time-series of temperature, rainfall etc for climate monitoring purposes. Recognising these differing needs, the Commission for Climatology (CCl) wishes to propose the adoption of a dual system of normals, as described below.

In so doing, the CCl recognises that such a change to long-standing practice may result in considerable extra work for some NMHSs in amending products, and the possibility of other unintended consequences arising. For these reasons, we invite comment on the proposal from climate services and other Technical Commissions.

2 The proposal

The CCl proposes that the standard period of climatological normals be redefined as a dual standard:

1. Retain the 30/30 model, i.e., a base period of 30 year normals, updated every 30 years, i.e retain 1961-90 as the base period until 2021, when 1991-2020 will become the new base period; AND

2. Define a "rolling" set of 30 year Normals updated every 10 years (hereafter the 30/10 model), such that 1981-2010 becomes the current base-period, until 2021, when 1991-2020 will become the new base period, and in 2031, that 2001-2030 become the base period.

A refinement of this dual standard is to retain for (1) a fixed base period in perpetuity, i.e., the 30/30 part of the model is replaced by a single 30 year set of normals that is held constant. That is, the period 1961-90 (or other 30 year period) remains constant, thereby providing a permanent reference for climate monitoring purposes, while to accommodate other climate applications the 30/10 model applies.

The various options are summarised in Section 5 below.

3 Other considerations:

Trewin (2007)[1] conducted an in-depth analysis of the representativeness of climate normals, and concluded among other things that for many purposes and variables shorter periods, based on as few as 10-15 years of data, could be used. This might enable normals to be calculated for more stations than would be the case with a 30 year Normal. However it was felt by CCl that a consistent standard should apply for all variables, and that rainfall, at least, required at least 30 years of data to establish a reasonably stable average.

It is anticipated that CLIMAT and CLIMAT SHIP messages compiled for GCOS (see annex A) would continue to use the 30/30 model; however this requires discussion.

Considerations for and against the above proposal are summarised below.

4 Arguments for and against adopting the dual standard for climate normals.

The Case for changing the methodology:

- The use of more up-to-date Normals under the 30/10 model provides a more realistic base period for climate services. For instance, design standards and climatologies would be based on a more representative standard that better reflects possible changes in climate. By contrast, basing design standards etc on climate Normals that are up to 30 years out of date might raise significant credibility problems with the users of services and products ("can't we get more recent data that this?")

- The latter point is accentuated if we consider the possibility that, under a changing climate, some kind of tipping point could be passed, leading to a sudden, large and sustained change in one or more fundamental climate variables. Such tipping point changes have arguably already occurred (e.g., step-change decreases in rainfall in southwestern Australia, and more recently, in southeastern Australia).

- Some NMHSs already employ a 30/10 model, for instance NCDC in the United States.

- More common updates mitigate the effects of technological change. For instance, the period 1961-90 averages were based largely on conventional observations, whereas by 1981-2010 (or 1991-2020), many observational systems were largely automated, and 1981-2010 corresponds roughly with the widespread adoption of satellite products. Thus comparisons of averages between periods (useful for some purposes) might reflect at least partially technological change as well as actual climatic differences.

- Similarly, a number of new products, including satellite products, have been introduced since 1981, hence the 1981-2010 period is the first opportunity to present normals for these products.

[1] Trewin, B (2007): The role of climatological normals in a changing climate. World Climate Data and Monitoring Program No 61, WMO-TD No 1377. 46pp

- Adopting the dual standard, so that one version of the Normals is kept constant for a lengthy period (the 30/30 model), provides the stability needed for referencing climate variability and change. To do otherwise would make the problem of communicating climate variability and change to the public harder. If we replaced the 1961-90 base period for climate anomalies with the warmer 1981-2010 standard, and continued to do this every ten years, the appearance of time-series would keep fluctuating, making it harder to demonstrate, for instance, a warming trend. In particular, at the current time global debate and negotiations on climate change mitigation and adaptation are at a sensitive stage: many climate change scientists believe that failure to take immediate action could lead to irreversible, dangerous climate change. If only the 1981-2010 standard were adopted, time-series would suddenly start to show negative anomalies in some years, whereas previously anomalies were nearly all positive. This would make it harder to demonstrate a warming trend. Although an illusion, countering this illusion in the face of organised climate change scepticism would be a major communication challenge for NMHSs the world over, as well as for the IPCC and related bodies.

  A variation on this is to retain a fixed period normal in perpetuity, for instance 1961-90 be retained as a permanent reference period for climate monitoring applications. Alternatively, a different fixed period could be employed for this purpose (e.g., 1971-2000, since more data were available over this compared with the earlier period). This approach avoids the communication difficulties that might arise in 2021 (and 2051) when the 30 years reference normal is updated, as would occur under the 30/30 model.

- Modern technologies such as enhanced computing capability and increasingly, modernised database systems (e.g, CCl's initiative of implementing Climate Database Management Systems) and the provision of specialised software (e.g., RClimDex) make updating normals much easier than previously.

The case against changing the methodology:

- Some NMHSs could face large increases in workload to revise products and services currently based on the 1961-90 period. Knowing that the base period will need to be updated in 2020 (status quo) is a very different proposition to having to update within perhaps the next two to three years, and then (depending on what base period model is selected) having to face regular updates thereafter. This problem might be mitigated if, for instance, WMO provided software to regularly update normals (based on agreed common standards with regard to, e.g., missing data). Such software is likely to become a recommended feature of Climate Data Management Systems. Alternatively, the normals could be calculated centrally by global agencies such as NCDC.

- There is a risk that more frequent changes of normals could lead to instability, with climate-linked design standards, for instance, varying too much between update periods.

- The use of two standards raises the prospect of confusion, and perhaps the inappropriate use of Normals for specific purposes. A communication strategy for NMHSs, including guidance on the most appropriate model for certain climate applications, would be needed.

5 Summary of options.

1. Retain the status quo, i.e., the 30/30 model alone. Under this scenario, 1961-90 remains the preferred option until 2021 when the 1991-2020 period becomes the new standard normal period.

2. Retain the status quo, but keep the normals period fixed in perpetuity, i.e 1961-90 (or some other reference period) is retained as the standard in perpetuity.

3. Adopt the 30/10 model only, i.e. 1981-2010 would become the standard normals period until 2021, when 1991-2020 would become the new standard. This would take effect following ratification by Cg-XVII in 2015 (refer below)

4. Adopt the 30/30 and 30/10 dual standard, i.e., 1961-90 remains the standard for climate monitoring applications until 2021, then gets updated as in (1) above; while for other climate applications 30 year normals are updated every ten years. Under this approach, the 1961-90 period and the 1981-2010 period would become dual normals, and this could be applied (if required) from 1 January 2013.

5. As (4), but retain the 1961-90 (or other 30 year period) in perpetuity and apply the 30/10 updates model.

The recommended options are (4) or (5).

6 The process:

1. The substance of this document, and the options, will be circulated to other stakeholders - Technical Commissions, other programs and groups, for review and comment.

2. On the basis of feedback from stakeholders, finalise the paper as a WMO Technical document, making a recommendation to adopt the new dual normals paradigm (assuming there is a suitable level of agreement to do so), and communicate this formally to Members. This would enable quick implementation of the new paradigm, and those Members who choose to do so could adopt the 1981-2010 normals for their non-monitoring applications as soon as possible.

3. Update the Guide to Climatological Practices accordingly.

4. Develop a communications strategy to explain to Members about the new paradigm and how it can be applied.

5. Finally, the WMO Technical regulations (Annex A) should be amended to reflect the new dual standard definition of the Climate Normals. This amendment should be formally approved at Cg-XVII in 2015.

Annex A: WMO technical regulations and recommended practices relevant to computing, coding and disseminating Normals**.**

Compiled by the secretariat

Definitions (WMO, Technical Regulations WMO No 49 Vol. I)

Period averages. Averages of climatological data computed for any period of at least ten years starting on 1 January of a year ending with the digit 1.

Normals. Period averages computed for a uniform and relatively long period comprising at least three consecutive ten-year periods.

Climatological standard normals. Averages of climatological data computed for the following consecutive periods of 30 years: 1 January 1901 to 31 December 1930, 1 January 1931 to 31 December 1960, etc.
N O T E: When data are not continuous, adjusted normals may be computed.

Distribution of Climate data (CLIMAT reports) (WMO, Technical Regulations WMO No 49 Vol. I

Each Member **shall** arrange for the distribution of the climatological data for a selection of its stations, in accordance with the provisions of Annex II *(Manual on Codes* (Publication No. 306)) and Annex III (Manual on the Global Telecommunication System (Publication No. 386)). The data shall be available as soon as possible after the end of the month.

Normals in the WMO Manual on Code (WMO No306)

FM 71–XII CLIMAT Report of monthly values from a land station

The CLIMAT code form consists of five sections:
0 — Code name and groups MMJJJ IIiii
1 111 Monthly data of the month referred to in MMJJJ including number of days missing from the records. This section is mandatory
2 222 Monthly normals corresponding to the month referred to in MMJJJ including number of years missing from the calculation
3 333 Number of days in the month with parameters beyond certain thresholds during the month referred to in MMJJJ
4 444 Extreme values during the month referred to in MMJJJ and occurrence of thunderstorms and hail

71.4.1 Meteorological Services **shall submit** to the Secretariat, for distribution to the Members, **complete normal data** of the elements for stations to be included in CLIMAT bulletins. CLIMAT reports for the two months following the submission of such complete normal data to the Secretariat shall include the normals for the months in question, in the form given in Section 2. The same procedure shall be followed when Services consider it necessary to make amendments to previously published normal values.
Note: When normal data are included in the bulletins, the number of stations per bulletin may be reduced if necessary.
71.4.2 The normal data reported shall be deduced from observations made over a specific period defined by *Technical Regulations*.
Note: Section 2 of the code supplies the means to specify the start and finish years, and those years missing from the calculations where it is not possible to supply data for the full recommended period.