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Climates Multiple: Three Baselines, Two Tolerances, One Normal

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Introduction

Today, Friday 1 January 2021, a new World Meteorological Organisation (WMO) climatological standard normal came into effect. The 'present-day' climate will now formally be represented by the meteorological statistics of the period 1991-2020, replacing those from 1961-1990. National Meteorological Agencies in member states are instructed to issue new standard normals for observing stations and for associated climatological products. Climate will 'change', one might say, in an instant; today, the world's climate has 'suddenly' become nearly 0.5°C warmer. It is somewhat equivalent to re-setting Universal Time or adjusting the exact definition of a metre.

But things are not so simple. A few years ago, in 2015, the WMO took the decision to adopt a two-tier system of climatic normals. For operational planning and design purposes, 1991- 2020 would define 'present-day' climate. But 1961-1990 will continue to be used for defining 'historical climate' against which to measure future changes in climate. And 2015 was the same year in which a *third* reference climate was affirmed, namely the 'pre- industrial' climate enshrined in the Paris Agreement on Climate Change (PACC).

This 're-setting' in January 2021 of normal climate is a good moment to offer a brief reflection on the relationship between climatic normals, baselines and tolerances.

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Normals and Baselines

The term 'normal' was first introduced into meteorology in 1840 by the Prussian physicist Heinrich Dove in his monograph on temperature variations around the world (Landsberg, 1955). For Dove, the normal climate of a location was to be described through the averaging of long series of regular meteorological observations. This practice slowly gained acceptance through the later nineteenth century, but it was not until 1935, at their meeting in Warsaw, that the International Meteorological Organisation (IMO) formally agreed that the 30-year period 1901-1930 should be used worldwide for computing climatic normals (IMO, 1937). This 'normal' was superseded in the 1960s by the adoption of 1931-1960 as the standard WMO normal, in turn replaced in the 1990s by the period 1961-1990.

Closely related to the climatic normal is the idea of the *baseline*: a benchmark, point of reference or guideline. The idea of a baseline has been troublesome for environmental thinkers ever since Daniel Pauly introduced the world to the 'shifting baseline syndrome' more than two decades ago (Pauly, 1995). Drawing upon his work in fisheries science, Pauly observed that successive generations of fisheries experts redefined their understanding of what was 'normal' in fish stocks. For Pauly this shifting baseline was troublesome because it relativized the idea of 'the natural' and weakened justifications for policy interventions to restore stocks to some assumed pre-disturbance level (Jackson et al., 2011).

The Functions of a Climate Baseline

Climate baselines perform multiple work in public life—practically, communicatively, analytically and politically. First, a baseline acts as a template that informs and guides long-range strategic design, planning and operational decision-making with regards to weather-sensitive investments. As Guttman (1989: 602) explains, "Planners and policy-makers who use climate as a factor in their decision-making processes require an adequate description or assessment of climate". The conventional 30-year WMO climatic normal is widely used to provide such an assessment. Adopted as a baseline, such normals offer standardised short-hand descriptions of the weather conditions of a place or locality that might reasonably be anticipated and thus be designed and prepared for. Through the designation of 'the normal', the recent past becomes a guide for the future. Arguez and Vose (2011) recommended that climatic baselines be updated as frequently as possible, and at least every decade—which is what the WMO decided to do in 2015.

A second function of the climatic baseline is communicative. In pre-scientific cultures, and still today in popular discourse, the behaviour of the weather is frequently interpreted

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with respect to individual human or collective cultural memories (Endfield & Veale, 2017). However, the standardised statistics introduced by a formal climate baseline offer new ways for establishing the public significance of a climatic or weather anomaly. The responsibility for public meaning-making about the weather is transferred from conditioned human or cultural memories to the standardised achievements of a scientific bureaucracy (cf. Porter, 1995). In contrast to anecdotal claims about past climatic behaviour, a climate baseline allows precise and 'objective' statements to shape the public imagination. As with the design function of climate baselines, the desired length of the baseline period and its frequency of updating need scrutiny if this communicative value of the baseline is to be maintained. What is at issue here is the interplay between the statistical, cultural and psychological constructions of climatic normality and the malleability of individuals' perceptions of stability and change (Hulme et al., 2009).

A third function of climate baselines is analytical. This can apply to numerous fields, such as ecological modelling, scenario construction and climate model evaluation. For example, when undertaking comparative analysis of different climatic datasets, it is frequently necessary to agree a common reference period. The choice of baseline period for analytical applications is usually made on pragmatic grounds. For example, in the construction of global climate observational datasets it is often necessary to reduce climatic time series at multiple locations to anomalies from some common baseline period to enable further calculative work. Thus, in the pioneering work on gridded global land temperature datasets, Jones et al. (1986) adopted a baseline of 1951-1970 since this was the period for which the largest number of meteorological stations had (near) complete data.

Combining Climatic Baselines and Tolerances

A fourth generic function of the climate baseline is more explicitly normative and revolves around the question of "the desirable" climatic state of the planet (Caseldine, 2015). We can trace this function of climatic baselines back to 1975 and Bill Nordhaus' pioneering work on carbon dioxide and climate as "a control problem" (Nordhaus, 1975, 1977). Nordhaus adopted a *baseline* period of 1880-1884 (Nordhaus, 1977), presumably on the pragmatic grounds of it being the earliest period for which reasonably credible estimates of global- mean surface temperature (GMST) were available. But he adopted a climatic *tolerance* on the explicitly normative grounds that "the climatic effects of carbon dioxide should be kept well within the normal range of long-term climatic variation" (Nordhaus, 1975: 23). For Nordhaus, long-term climatic variation was "the last 100,000 years" which he claimed yielded a tolerance of

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2°C[1].

The other influential early study often quoted in the history of the 'two-degree target' (Randalls, 2010) is the German Advisory Council on Global Change's (WBGU) report of 1995. Completed for the first meeting of the Conference of the Parties to the UNFCCC in Berlin in 1995, this study adopted a climate baseline of "today" (by which they likely meant the late twentieth century, although this was not stated) and a tolerance in GMST of 1.3°C (WBGU, 1995). Converting "today's" temperature to 'pre-industrial' added 0.7°C to this tolerance, yielding their eventual normative policy goal of 2°C of warming above the pre-industrial baseline.

'Dangerous climate change' can be defined in either absolute or relative terms. But if defined in relative terms then it matters not just how much deviation from 'normal' is deemed tolerable, but crucially what is deemed 'normal' in the first place. Combining a climatic tolerance of 2°C—or indeed 1.5°C—with a pre-industrial baseline yields a very different climate target than, say, using a 1986-2005 baseline, the period widely adopted by IPCC AR5 Working Group I as their analytical baseline. The choices of both baseline and tolerance are politically charged. They carry significant implications for historic liability for emissions (La Rovere et al., 2002), for policy design (Millar et al., 2017) and for possible reparations (Roberts & Huq, 2015).

What started in the 1970s and 1980s as a pragmatic selection of the late nineteenth century as an *analytical* reference period (Nordhaus, 1977) had, by the twenty-first century, taken on great *policy* significance. Although the 2015 PACC formally adopted pre-industrial climate as its baseline, the precise temporal designation of 'pre-industrial' was left unspecified[2]—whether for strategic political reasons (Geden, 2018), or simply because of a lack of awareness about the significance of the choice. Different 'pre-industrial' baselines have been adopted, either as discursive proxies for a general pre-industrial era or else used analytically to test the sensitivity of the 'pre-industrial' baseline to different definitions (Schurer et al., 2017). Equivalent diversity afflicts the designation of 'present-day' climate. Although often corresponding to a WMO 30-year normal, many other designations of 'present-day climate' have been adopted in different IPCC assessments—such as '1990' (in IPCC AR1 and AR2) or the period 1986-2005 (in AR5)—and more generally by individual scientists. The WMO's decision in 2015 suggests that for the purposes of climate change assessments, the 1961-1990 baseline should continue to be used.

[1] The source of Nordhaus's estimate of 2°C for this geological-scale variation was never stated.

[2] And it is interesting to note that although the earlier Copenhagen Accord of 2009 stated that "the increase in global temperature [i.e., the climatic tolerance] should be below 2 degrees Celsius", no mention in the formal document was made of the baseline climate to which this tolerance should be added.

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Three Baseline Climates

So, what is the significance of the move to a new 1991-2020 WMO normal in January 2021? On the one hand, it is a pragmatic move to redefine 'present-day' climate for operational applications to that of the most recent 30-year period. On the other hand, it puts into play a *third* climatic baseline. Already existing is the 'pre-industrial' climate of the late nineteenth century and the 'historic' climate' of 1961-1990, the latter about 0.3°C warmer than the former. And now there is the new 'present-day' climate of 1991-2020, in turn about 0.5°C warmer than the 'historic climate' of 1961-1990. And in addition to these three climatic baselines, there are the two climatic tolerances enshrined in the PACC of 1.5° and 2°C.

Climatic normals and baselines give precise numerical form to the rather intangible notion of climate: an idea that imposes a degree of imaginative order upon the human experience of atmospheric chaos (Hulme, 2016). While baselines can be either descriptive, predictive and/or normative, climatic tolerances are more explicitly normative. The adoption of particular baselines and tolerances is therefore an overtly political process with geopolitical, ethical and technological consequence. As with the adoption of other universal referential markers—for example the Greenwich Meridian as zero longitude, the metric system, or the formula for water as H2O —these processes entrain historical trajectories, cultural imaginaries, curious serendipities and power dynamics. I will investigate these contingencies at greater length in a subsequent article.

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