

The Undefined Foundation: Why "Global Temperature" Has No Scientific Definition

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Abstract

Despite being the central statistic in climate science and policy, "global temperature" and its variants lack any standardized scientific definition from major standards organizations. This article examines why ISO, WMO, IPCC, and other bodies have avoided defining this ubiquitous term, concluding that the concept violates fundamental thermodynamic principles and represents an arbitrary statistical construct rather than a measurable physical quantity.

Introduction

The term "global temperature" appears in thousands of scientific papers, media reports, and policy documents. The Paris Agreement aims to limit "the increase in the global average temperature," yet remarkably, "the Paris Agreement does not specify precisely what is meant by 'global average temperature'" according to the IPCC itself. This investigation reveals that no standards organization has ever provided a rigorous scientific definition for this central concept.

The Conspicuous Absence

The International Organization for Standardization (ISO) has developed comprehensive standards for climate science, including:

- ISO 14090: Adaptation to climate change
- ISO 14091: Climate risk assessment
- ISO 80000-5: Thermodynamic quantities and units

Yet conspicuously absent is any definition of "global temperature." This is not an oversight. ISO has standardized virtually every scientific quantity imaginable, from fundamental units to complex atmospheric models (ISO 2533 for the International Standard Atmosphere).

What makes this omission particularly egregious is that ISO extensively USES terms like "global temperature," "global warming," and "global average temperature" throughout their climate-related standards, while refusing to define what these terms mean. For example, ISO Guide 84:2020 addresses climate change in standards and refers to "global warming" and temperature changes, yet nowhere does ISO provide a standardized definition of the global temperature they reference. This

represents the height of scientific irresponsibility - building entire frameworks around an undefined concept while having the authority and obligation to define it.

Similarly, the World Meteorological Organization (WMO) provides detailed standards for local temperature measurements and climate normals but offers no definition for global temperature. The WMO states that "the global surface temperature assessment is based on the instrumental records of the air temperature measured at 1.25 to 2 metres above the surface level on the land" combined with sea surface temperatures, but critically, WMO never defines what "based on" means. This vague language - "based on" - exemplifies the problem: it provides no specification of how measurements are combined, what mathematical operations are performed, what weighting schemes are used, or how the "assessment" is actually calculated. Without these specifications, the statement is meaningless - a circular non-definition masquerading as an explanation.

The Thermodynamic Problem

Temperature is an intensive thermodynamic property - it exists at a point or in a system at thermodynamic equilibrium. The Earth is neither homogeneous nor in thermodynamic equilibrium. When temperatures from different locations are averaged, the result is a statistical construct - a number - but that number is NOT itself a temperature. It doesn't represent the temperature of anything physical.

This is why standards organizations cannot define "global temperature" - doing so would require making arbitrary choices about:

- Which averaging method to use (arithmetic mean, weighted average, geometric mean, harmonic mean, etc.)
- What to measure (air temperature at what height? ocean temperature at what depth?)
- How to weight different regions
- Whether to use actual temperatures or anomalies

The critical point is that there are infinite possible averaging methods, and each produces different results - not just different numbers, but potentially different trends. An arithmetic mean might show warming while a geometric mean shows cooling for the same data. If the averaging method is undefined and arbitrary, the resulting statistic cannot possibly have any physical meaning. It becomes merely a mathematical artifact of the chosen calculation method, not a representation of any real-world phenomenon.

The Definitional Chaos

The absence of a standard definition has led to methodological chaos among organizations attempting to calculate "global temperature." According to a Wikipedia article on temperature anomalies, "Different meteorological organizations have used respective base periods for global mean surface temperature datasets, such as 1951–1980 (NASA GISS and Berkeley Earth), 1961–1990 (HadCRUT U.K.), 1901–2000 (NCDC/NOAA), and 1991–2020 (Japan Met)" [4]. These organizations not only use different baselines but different methodologies entirely, producing different numbers for what is supposedly the same quantity.

Even the IPCC, which might be expected to provide clarity, offers only a circular definition. The IPCC Sixth Assessment Report defines global mean surface temperature (GMST) as the "estimated global average of near-surface air temperatures over land and sea ice, and sea surface temperature (SST) over ice-free ocean regions" [3]. Note the revealing use of the word "estimated" - even the IPCC acknowledges this is not a measurement of any actual physical quantity but a constructed estimate. The definition fails to specify how this "average" is calculated, weighted, or standardized.

The Implications

The absence of a standardized definition has profound implications:

1. **Scientific Integrity:** The foundation of climate science rests on tracking changes in an undefined quantity
2. **Policy Decisions:** Trillions of dollars in economic decisions are based on "limiting global temperature rise" without defining what that means
3. **Public Trust:** The public is not informed that "global temperature" is an arbitrary statistical calculation that does not measure or represent any physical property

Conclusion

After extensive research into standards documentation and scientific literature, the universal avoidance of defining "global temperature" by standards organizations represents a fundamental issue in climate science communication. These organizations have not forgotten or overlooked this term - they have deliberately avoided defining it because it is physically meaningless and definitionally impossible.

The climate science community has built an entire framework around tracking changes in a quantity that:

- Has no standardized scientific definition
- Violates basic thermodynamic principles
- Represents different things to different organizations
- Cannot be defined without arbitrary choices lacking physical justification

This represents, at minimum, a failure of scientific transparency. The public and policymakers deserve to know that when they hear about "global temperature" changes, they are not hearing about a temperature at all, but about an undefined statistical calculation that does not correspond to any physical property and varies depending on who calculates it and how.

References

1. IPCC Special Report on 1.5°C of Global Warming, Chapter 1
2. ISO 80000-5:2019 - Quantities and units — Part 5: Thermodynamics
3. Wikipedia: Global surface temperature
4. Wikipedia: Temperature anomaly
5. WMO Global surface temperature data sets
6. NASA GISS: The Elusive Absolute Surface Air Temperature

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