

Glossary of Key Terms¹

Term	Definition
Scientific Terms	
Attribution [of climate change]	The process of evaluating the relative contributions of multiple causal factors to a change or event with an assignment of statistical significance. ²
Magnitude	The intensity of an event.
Probability	The frequency of an event.
Dynamic	Concerning the motion of bodies under the action of forces. In the context of event attribution, dynamics would include both large-scale circulation patterns, which can modulate temperature and precipitation extremes, and storms. ³
Thermodynamic	Concerning heat and temperature and their relation to energy and work. In the context of event attribution, thermodynamics would include behaviour related to the warming and increased moisture-holding capacity of the atmosphere.
Factual	From the perspective of attribution studies factual refers to the currently observed world as it exists in the context of climate change.
Counterfactual	From the perspective of attribution studies, counterfactual or counterfactual world refers to a hypothetical “control” world that has only been impacted by natural forcings and internal variability. In practice it usually refers to the observed climatic conditions (e.g., a specific SST distribution) as they might have occurred had anthropogenic forcing been absent. ⁴
Causality [counterfactual definition of causality]	An object followed by another, where, if the first object had not been, the second never had existed. ⁵
Necessary causation	X is <i>always</i> required for Y to occur. The event can only occur in the presence of the causal factor, although other factors may also be necessary.
Sufficient causation	If X occurs then Y will occur, but X is <i>not always</i> required for Y to occur. Where the presence of the causal factor alone is sufficient for the event to occur. That is, X always causes Y but Y may also occur for other reasons.
Fraction of Attributable Risk	The fraction of the likelihood of an event that is attributable to a specific causal factor. ⁶
Risk Ratio	The ratio of probabilities under two different conditions or settings; in event attribution this is generally the ratio of the probability under anthropogenic forcing (the factual scenario) to that under the counterfactual scenario. ⁷

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² Hegerl et al, 'Meeting report of the IPCC Expert Meeting on Detection and Attribution of Anthropogenic Climate Change, IPCC Working Group I Technical Support Unit, Bern, 2010.

³ National Academies of Sciences, Engineering, and Medicine. 2016. Attribution of Extreme Weather Events in the Context of Climate Change. Washington, DC: The National Academies Press. doi: 10.17226/21852.

⁴ See note 2.

⁵ Hume, 2004, quoted in Pearl et al 'Causal Counterfactual theory for the attribution of weather and climate-related events' in BAMS, Jan 2016.

⁶ See note 2 at p xviii.

⁷ See note 2 at p xix. The NAS report also notes that while well established in epidemiology, the term is a misnomer because it is a ratio of probabilities and does not involve risk as formally defined to account for both probability and magnitude of impact.

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Natural Variability	Internally (such as El Niño–Southern Oscillation) and externally (e.g., volcanic eruptions or changes in solar radiance) induced natural climate variability that occurs without anthropogenic forcing. ⁸
Legal Terms	
Attribution [of greenhouse gas emissions]	Most often used to refer to the attribution of greenhouse gas emissions to particular state, region or company based on an assumed emissions calculation derived from their fossil fuel production records. ⁹
'But for' test	This is a standard test to prove causation in the UK. To succeed the plaintiff must show (on balance of probability) that the loss would not have occurred but for the defendant's breach of duty. In other jurisdictions, such as US ¹⁰ /Australia ¹¹ , this is defined as "necessary causation".
'Doubling of the risk' test	This is an alternative method of proving causation. To succeed the plaintiff must show (on balance of probability) by means of expert epidemiological evidence that his tortious exposure doubled the risk which he would otherwise have had. ¹² The doubling of risk test does not apply in mesothelioma cases.
Standard of proof	This is the amount of evidence which a plaintiff (or prosecution, in a criminal case) must present in order to succeed. In UK there are two level of standard of proof:- a) Civil proceedings: the standard of proof to succeed is the "balance of probability" test which has been interpreted as greater than 51%. b) Criminal proceedings: the standard of proof to convict is beyond a "reasonable doubt" test, meaning in the certainty range of 98 or 99 percent.
Standard of proof in civil proceedings	The standard of proof to succeed is the "balance of probability" test which has been interpreted as greater than 51%.
Standard of proof in criminal proceedings	The standard of proof to convict is beyond a "reasonable doubt" test, meaning in the certainty range of 98 or 99 percent.
'Material contribution' test	A modification of the "but for" test. To succeed the plaintiff must show (on the balance of probabilities) the defendant's tortious actions materially contributed to the injury. The "material contribution" test allows an injured party to avoid the need to prove "but for" causation and only requires proof that the negligent action materially contributed to the risk of harm. ¹³
'Material contribution to the risk' test	This is a particular method of proving causation. Its application, currently, is limited to mesothelioma (exposure to asbestos dust) cases. To succeed, the plaintiff must prove that defendant's negligence materially contributed to the risk of injury (ie. more than de minimus) to recover damages in full. A distinction is made between indivisible and divisible injuries. ¹⁴

⁸ See note 2 at p xix.

⁹ See Heede R (2014) Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers, 1854–2010 *Climatic Change* 122:229–241; Ekwurzel et al 'The rise in global atmospheric CO₂, surface temperature, and sea level from emissions traced to major carbon producers' *Climatic Change* (2017) 144:579–590 DOI 10.1007/s10584-017-1978-0; Otto et al, 'Assigning historic responsibility for extreme weather events' *Nature Climate Change*, 2017(7).

¹⁰ Third Restatement of Torts.

¹¹ See Civil Liability Act 2003 (Qld).

¹² *XYZ v. Schering Health Care Ltd.* [2002] EWHC 1420, *Novartis Grimsby Ltd v. John Cookson* [2007] EWCA Civ 1261 & *MOD v Abs & Ord* [2010].

¹³ *McGhee v National Coal Board* [1973] 1 WLR 1; *Sido John v Central Manchester and Manchester Children's University Hospitals NHS Foundation Trust* [2016] EWHC 407.

¹⁴ *Sienkiewicz v. Grief (UK) Ltd* [2011].