Science for Loss and Damage. Four research contributions to the debate

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The Loss and Damage Network is a network of scientists and practitioners informing the loss and damage debate and includes members from about 20 institutions. This summary paper, written on the occasion of COP22 in Marrakesh, summarizes four recent research contributions to the debate.

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Introduction: A forum for science-society debate

The issue of loss and damage (L&D) has gained enormous traction in international climate policy in recent years, and is seeing strong attention at COP22. With many issues unresolved, the *Loss and Damage Network* is committed to further support dialogue and offer a forum among scientists, negotiators, practitioners and the private sector. As one input, building on recent publications in peer-reviewed academic journals by members of the network, this synthesis paper presents four contributions to further inform the debate. The contributions described will be discussed at a COP22 side event on Loss and Damage and the authors are looking forward to comments and sharing of perspectives.

Contribution #1: Climate attribution research has identified loss and damage all over the world, yet at varying degrees of confidence

Climate change attribution research has been rapidly developing and three main directions relevant to L&D can be distinguished: the first one is rooted in physical climate science where much of the attribution science has been developed over the past decades. IPCC's AR5 provides ample evidence of the fingerprint of anthropogenic emissions in global and regional climates. Anthropogenic influence has not only contributed to increasing mean temperatures but also to changing extremes. The IPCC states in this context that it is very likely that human influence has contributed to temperature extremes since the mid-20th century (IPCC, 2013). In recent years research also made progress towards attribution of single (extreme) events.

A second research direction investigates changes in losses and damages, typically in monetary units, and the drivers responsible for the widely observed increased in loss related to extreme weather events. The main causes of the increase in economic losses over the past decades are attributed to changes in exposure and wealth of assets (IPCC, 2014). A climate change signal could generally not be identified in such studies on economic losses of disasters.

A third direction of research is in principle the missing link between the attribution research for the physical climate system and the disaster loss studies. This has been developed more recently, and examines impacts of climate change on natural and human systems, and to what extent those can be attributed to anthropogenic climate change. IPCC's Working Group II contribution to the 5th assessment report has provided evidence of multiple observed impacts of climate change on natural and human systems across the world (Cramer et al., 2014). Subsequent studies have analysed to what degree the impacts identified in IPCC AR5 can be attributed to anthropogenic climate change (Hansen and Stone, 2016). Huggel et al. (2016) have now analysed which of those impacts can be considered loss and damage (Figures 1 and 2). This most recent research thus indicates that loss and damage has already been observed all over the world, both on land and in the oceans, and can be attributed to anthropogenic climate change with varying degrees of confidence.

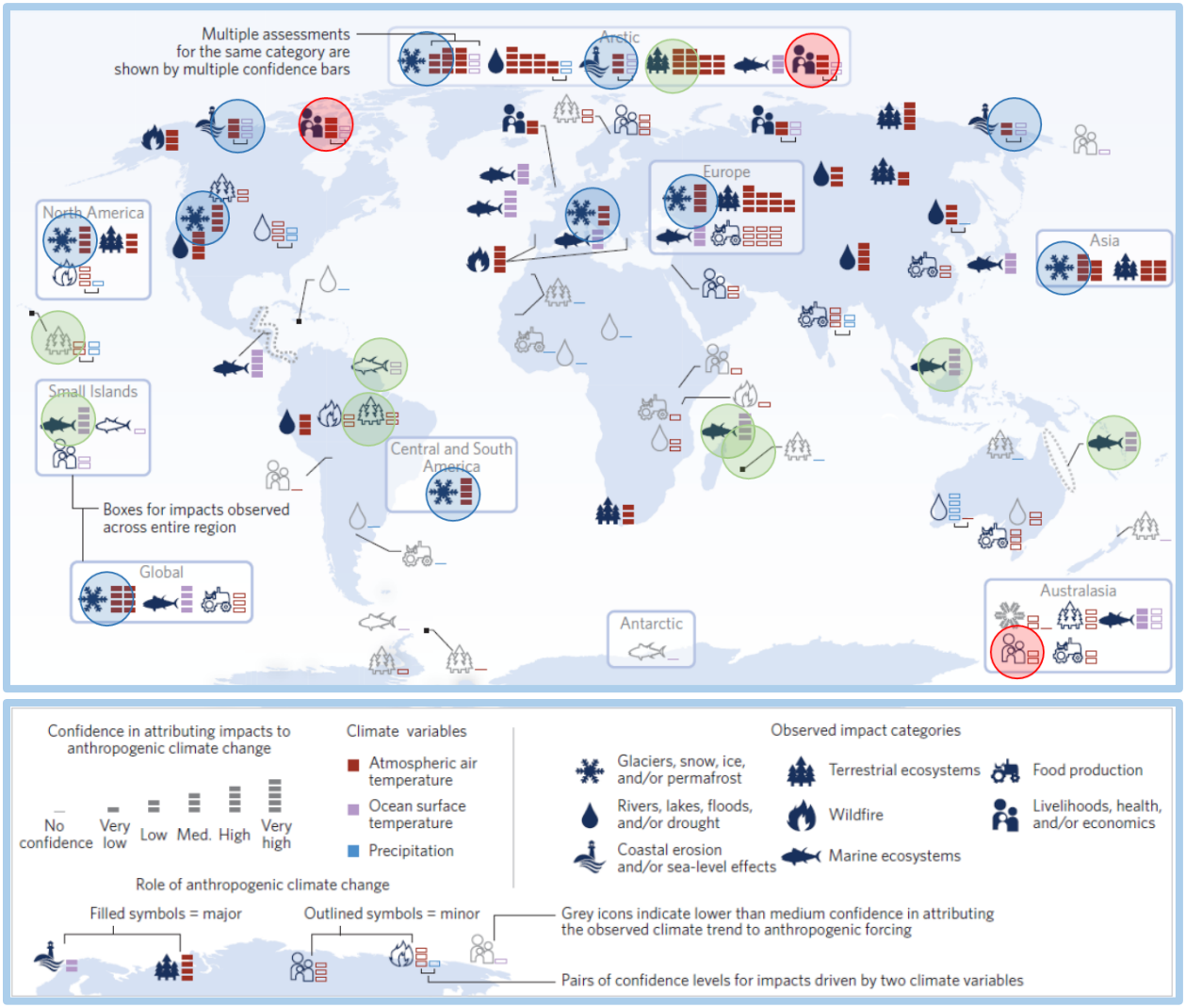

Figure 1 World map showing observed impacts attributed to anthropogenic climate change. Circles indicate observation on loss and damage. Source: modified from Hansen and Stone (2016).

The possible role of attribution in L&D policy has not been clarified so far, and is potentially contested (James et al. 2014; Parker et al., 2016). For instance, it has been suggested that L&D would require consideration of causation (Verheyen and Roderick, 2008), but this has neither been clarified since the WIM has been established, nor has the kind of causation needed been defined. It is important to state that formal attribution studies need to rely on the availability of long-term (environmental and socio-economic) data with appropriate quality, which is a key gap in many countries and regions.

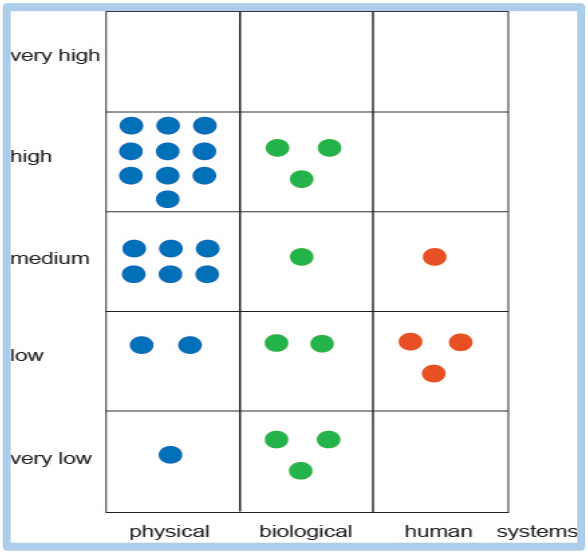

Figure 2 Loss and damage relevant impacts across physical biological and human systems and its attribution to anthropogenic climate change. Each dot represents one observed count of loss and damage. The vertical axis indicated the level of confidence in attribution for each count. Assessment based on Hansen and Stone (2016) and IPCC AR5. Source: Cramer et al. 2014.

Recent L&D Network paper:

Huggel, C., Stone, D., Eicken, H., Hansen, G. (2016). Reconciling justice and attribution research to advance climate policy. Nature Climate Change Change 6: 901-908

Contribution #2: The justice dimension is fundamental and comes in many facets - ethical and philosophical deliberation is critical

Climate justice principles underlie a large part of the climate change policy debate, but often are not revealed explicitly. In case of climate-related L&D it is especially important to be clear about the different justice principles and concepts involved, which are usually of a normative nature suggesting how conditions and distributions *should* be rather than describing how they *are* observed. Disagreement often evolves around different justice principles and concepts. To clarify the different dimensions of justice, it is helpful to clarify the nature and content of these. The three most prominent principles of climate justice in relation to L&D are (Wallimann-Helmer, 2015):

- *Polluter-Pays-Principle (PPP):* This principle differentiates responsibilities relative to the proportion of contribution (emissions) to climate impacts.
- *Beneficiary-Pays-Principle (BPP):* According to this principle it is not only the contributors to climate impacts that are responsible. It is also those solely benefiting from contribution (emissions) of third parties.
- *Ability-to-Pay-Principle (APP):* To differentiate responsibilities, this principle considers economic, scientific or managerial capacities of actors, and thus defines responsibilities according to

capacities. The actual contribution to climate impacts or benefits are not relevant for this principle.

Commonly, PPP and BPP are seen as compensatory, that is backward-looking, principles. Those who have contributed or benefitted from impacts are seen under duty to support either those harmed or at least to shoulder heavier burdens to mitigate factual or projected harms. In contrast, the APP is forward looking and in this sense a distributive principle. The APP can be understood as a principle distributing burdens according to the criteria of economic, scientific or managerial capacities.

The challenge given the Paris Agreement is to clarify what approaches are appropriate to ensure that affected parties are made whole again, i.e. rendering them as well of as before having been inflicted with damage and loss. One important question in this regard is what kind of support is appropriate to remedy a damage or loss. In many cases, financial payments or other measures to repair means damaged and replace means lost are sufficient. In (potential and actual) cases of loss of land or cultural heritage or identity, other means for relieving affected parties are needed.

In common understanding, support has to be provided by those responsible for a damage or loss. As a consequence clarifying how responsibilities are to be distributed is important. The direct link between emissions and impacts (including L&D) established by PPP and BPP and responsibilities to secure finance is not a condition sine qua non. It is possible to differentiate responsibilities to remedy L&D irrespective of the contribution to the problem. To be responsible for an outcome not necessarily means that a party is responsible for remedying the impacts it caused. Against this background, it is furthermore important to distinguish two kinds of responsibilities:

- *Outcome responsibility:* This kind of responsibility concerns ascription of damages and losses to the parties bringing them about (PPP / BPP).
- *Remedial responsibility:* This kind of responsibility differentiates responsibilities for remedying L&D according to the different capacities of the parties (APP).

In the context of L&D, it may be important to have measures in place when climate impacts materialize. This makes immediate action necessary, being as efficient and effective as possible. Hence differentiating responsibilities according to capacity can be considered more urgent than ascribing the responsibility for losses and damages to specific parties. Furthermore, capacities to pay are arguably easier to measure and agree upon than responsibilities for L&D from emissions; therefore, focusing on remedial responsibility could make it easier to identify which parties are responsible for which kind of assistance and measure to tackle L&D.

Recent L&D Network paper:

Wallimann-Helmer, I. (2015). Justice for climate loss and damage. Climatic Change 133:469–480

Contribution #3: A Loss & Damage risk and options space can be identified by building on risk-analytical principles

An important distinction for Loss and Damage differentiates between avoided, unavoided and unavoidable (L&D), whereby *avoided* means L&D avoided due to commensurate adaptation and risk reduction measures put in place. *Unavoided* L&D refers to impacts that could have been avoided had additional, better or more effective adaptation measures been implemented. Consequently, *unavoidable* L&D are impacts that could not been avoided by adaptation (or mitigation) (Verheyen, 2012). We suggest the concept of climate risk can encompass all of these notions, allowing to identify conceptual and operational framework

Risk is defined by IPCC (2014) as "*the potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard".* In principle, the risk concept can be applied to sudden-onset and slow-onset climate-related processes unfolding over timescales from hours to days (landslides, storms, floods) to weeks and months (droughts, heatwaves) to years (sea level risk and impacts) and decades (glacial shrinkage) (see figure 3). In practice, risk analytics have been generally applied to phenomena lasting from hours to months.

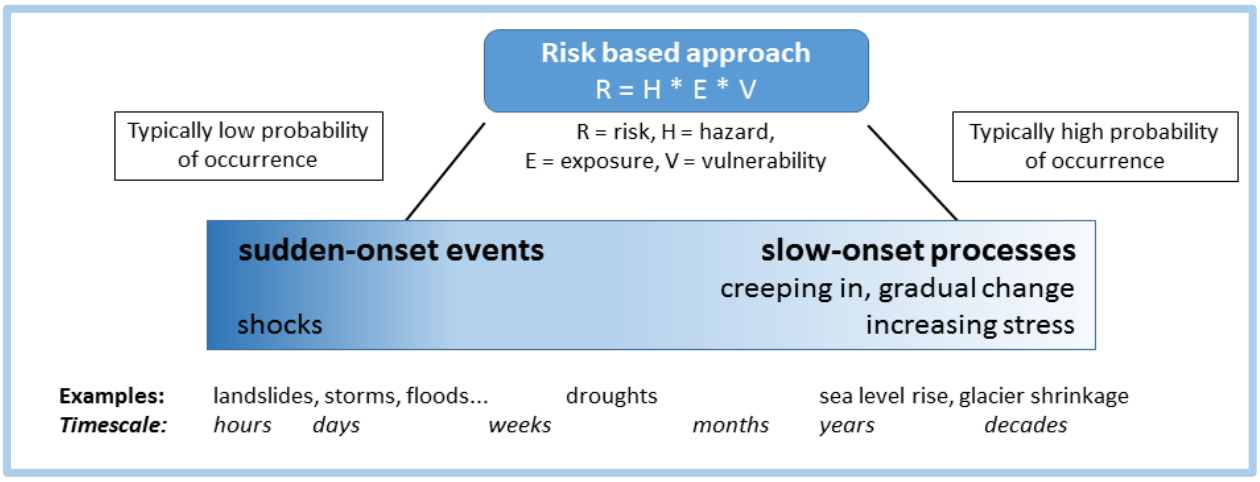

Figure 3 The risk concept as applied to sudden-onset and slow-onset processes. Note that these concepts involve a continuum between each other. Source: Huggel, 2016.

One important point for conceptualizing L&D using risk concepts is the question regarding risk tolerance, which strongly involves a social science perspective and subjective deliberation. Figure 4 (left hand side labelled 'risk space') conceptualizes the L&D risk space across different levels of risks and implications for further action: according to this framing, risk considered acceptable would mean no additional action is necessary, tolerable risk would suggest further action is required considering costs and other constraints; intolerable risk would require action irrespective of any financial or other constraints. It is important to underline that the thresholds between the different levels of risks are i) rather gradual than discrete, and ii) subject to social, cultural, and economic determinants and thus deliberation. Climate change adaptation and DRR would typically address tolerable risks with the objective to reduce risks. The L&D

space is located towards the limits of adaptation and extends into the intolerable risk space. Building on this framework, Mechler and Schinko (2016), using the example of small island states as a case in point, describe the L&D options space as composed of two parts (right side of Figure 4 labelled 'options space')

- *a transformative part,* which relates to options for avoidable L&D ex ante. With climate related risk projected to increase over time, challenges and costs will increase to well-tested climate adaptation (CCA) and disaster risk reduction (DRR) measures. For risks 'beyond adaptation,' novel, transformative measures picking up part of the burden from DRR and CCA domains are needed, such as offering alternative livelihoods, e.g., switching from farming to services, and, at high levels of impacts, assisting with voluntary domestic and international migration.
- *a curative part*, which covers unavoided and unavoidable L&D ex post. While there is scope for DRR/CCA, some further risk is locked in already with serious cost implications (e.g., costs associated with upgrading coastal protection). With risk increased, of which a part cannot be reduced anymore, societally desirable implementation pathways are constrained calling for further support.

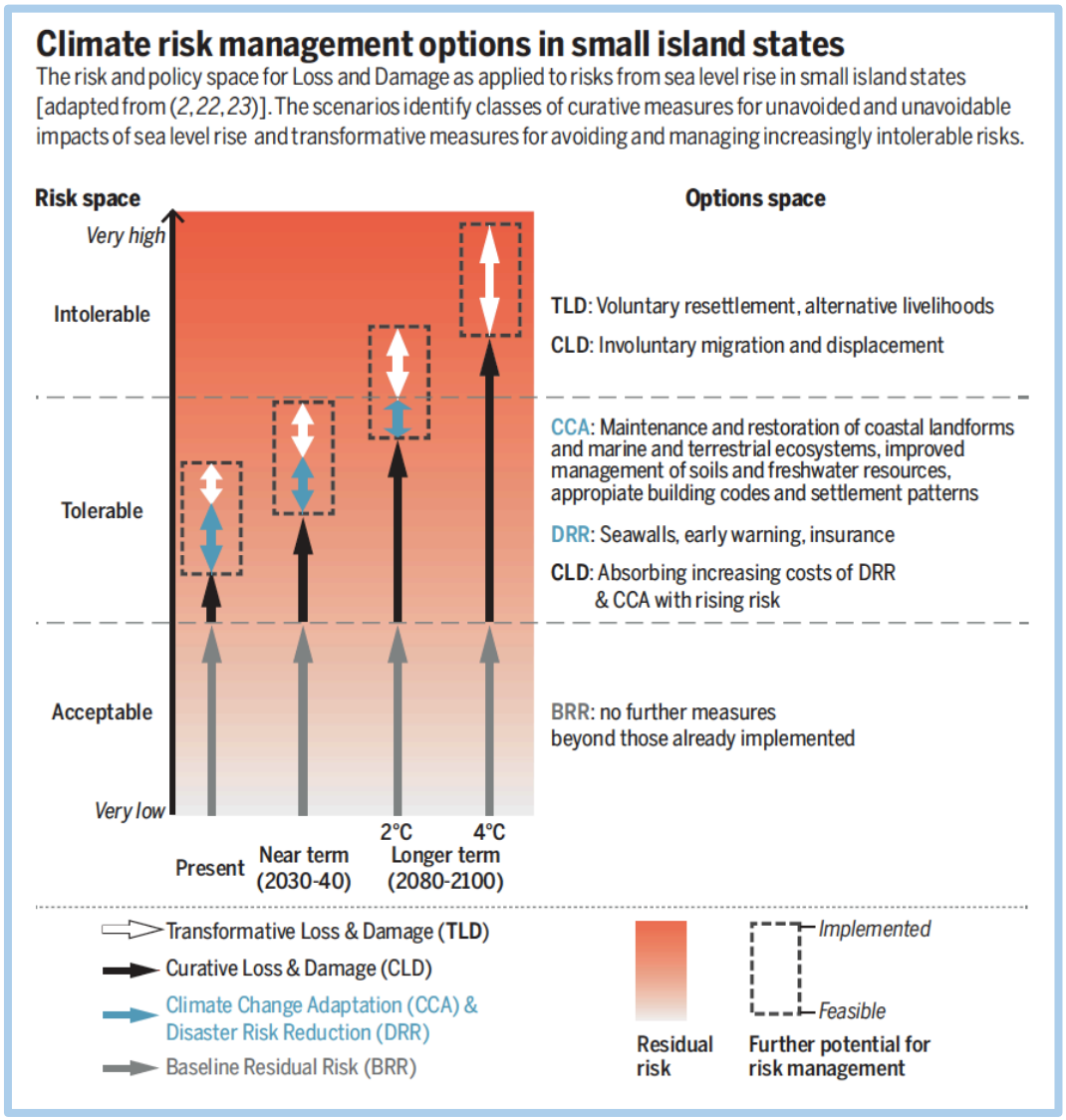

Figure 4 The L&D space as applied to climate- related risk in Small Island States. Source: Mechler and Schinko, 2016

In terms of implications, action on the transformative part can build on tested and innovative DRM and CCA options with the L&D contribution focussed on risks beyond adaptation. Transformative action is, for example, already seeing attention with pledges made by the G7 to support the "climate risk insurance" initiative, which aims to provide insurance cover for climate-related risks to an additional 400 million uninsured people in developing countries. The curative part has so far not seen direct action and will need to build on novel options. One example is the nascent debate on a climate displacement coordination facility, which may deal with planned migration and legal status for involuntary displacement of communities that permanently lost homes or homelands.

Recent L&D Network paper:

Mechler, R. and T. Schinko (2016). Identifying the policy space for climate loss and damage. Science 354 (6310), 290-292

Contribution #4: Insurance has an important role to play if well integrated into comprehensive risk management

'Climate insurance', more broadly termed risk financing, has seen a lot of attention in the instrumental discussion regarding options for tackling L&D. Various mechanisms exist which can help to absorb the economic impact of damages (L&D Action Area 7). These have been applied widely in many countries over past decades, most notably in developed markets. Instruments that are broadly in place in developing countries are listed below (Table 1 as presented by IPCC, 2012). Insurance creates an ex-ante perspective, as it helps to consider the potential damages before disaster strikes, and thus fosters a more strategic approach to risk. If provided by private insurers, insurance can also help shift financial risk from government to international and capital markets.

Table 1: Types of insurance and risk transfer instruments, corresponding target groups and application to weather and climate related events. Source: IPCC 2012; Murray et al., 2012

	Local *Households, Farmers, SMEs*	*National* *Governments*	*International* *Development organizations, donors, NGOs*
Solidarity	Help from neighbors and local organizations	Government post-disaster assistance; government guarantees/bailouts	Bilateral and multilateral assistance, regional solidarity funds
Informal risk transfer (sharing)	Kinship and other reciprocity obligations, semi-formal micro-finance, rotating savings and credit arrangements, remittances		
Savings, credit, and storage (inter-temporal risk spreading)	Savings; micro-savings; fungible assets; food storage; money lenders; micro-credit	Reserve funds; domestic bonds	Contingent credit; emergency liquidity funds
Insurance instruments	Property insurance; crop and livestock insurance; micro-insurance	National insurance programs; sovereign risk transfer	Re-insurance; regional catastrophe insurance pools
Alternative risk transfer	Weather derivatives	Catastrophe bonds	Catastrophe bonds; risk swaps, options, and loss warranties

There is a range of other reported benefits of using insurance to address extreme weather risks, however many of the schemes in developing countries have been applied only recently, and their success still needs to be further evaluated. The use of these mechanisms across developing countries is increasing, yet a range of barriers exists on both the demand and the supply side, such as lack of risk data, limited financial literacy and capacity, low technical capacity, existence of alternative measures including humanitarian assistance, and unsupportive regulatory frameworks.

These instruments are applied most often to cover damages from weather extremes (and other natural hazards, such as earthquakes). They are more difficult to apply to damages from slow-onset processes, defined as the more gradual impacts from climate change, over periods of more than a few years, such as sea-level rise, or ecosystem changes. The slow-onset nature violates the randomness criteria of insurance (same probability in any given year), and the gradual increase in risk can render risks uninsurable. Also adverse selection within (national) populations is an issue, for instance when drought or sea-level rise affects only a part of the country or population. Therefore for slow-onset processes, other finance and funding options need to be considered, including adaptation, or displacement/relocation of populations, which would require financing of another kind.

Recent L&D Network paper:

Surminski, S., Bouwer, L. and J. Linnerooth-Bayer (2015). How insurance can support climate resilience. Nature Climate Change 6: 333-334.

The network and its members stand ready to further provide input to the debate. Please also follow updates on Twitter at @Lossanddamage.

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