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Tipping Points and Climate Change: Metaphor Between Science and the Media

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ABSTRACT

Over the past decade, scientists and journalists have prominently utilized the metaphor of a tipping point for drastic, irreversible and dangerous climate change. This paper shows how the tipping point metaphor became a multi-purpose bridge between science and the news media, describing how its meaning and use developed and diversified in interaction between these two domains. Within the scientific domain, the metaphor developed from a rhetorical device conveying a warning of drastic, irreversible and dangerous climate change to a theoretical concept driving empirical research. The news media soon picked up the tipping point metaphor for abrupt and dangerous climate change, turning it into a common part of the journalistic lexicon. Moreover, both science and the news media developed another, societal use of the tipping point metaphor, calling for radical societal change to avoid climate change catastrophe. The tipping point metaphor is hence not a monolithic notion but a highly versatile concept and expression, allowing it to be used for various communicative purposes by distinct stakeholders in different contexts.

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1. Introduction

It is by now a familiar proposition that the notable changes in our climate may be so threatening that they may tip our complete ecological system into a qualitatively different state. This possibility of a global climate tipping point has received ample attention in studies of climate change communication (Antilla, 2010; Bellamy & Hulme, 2011; Hulme, 2008; Nuttall, 2012; Risbey, 2008; Russill, 2008, 2015; Russill & Lavin, 2012; Russill & Nyssa, 2009; Skrimshire, 2008; Werners et al., 2013). However, most of this literature does not address the implications of the fact that tipping points involve metaphorical language and thought. Russill (2008) and Russill and Nyssa (2009) are the notable exceptions: they describe the introduction and increasing prominence of tipping point as a metaphor in communication about climate change in the news media (UK and US) and science between 2005 and 2007. Following Schon (1979), Russill and Nyssa (2009) identify the climate change tipping point as a *generative metaphor*, because the term is used in “an effort to solve a policy problem by re-structuring public perceptions in a new and substantive way” (p. 341). In other words, talking about climate change in terms of tipping points illuminates aspects that were not part of the

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debate before, and suggests other responses to climate change than were considered previously—a classic case of metaphorical framing (cf. Burgers, Konijn, & Steen, 2016).

We aim to follow up on Russill and Nyssa (2009) and explore how the meaning and use of the tipping point metaphor in science and the news media developed over a 10-year period, from 2005, when it was first introduced, until 2014. We combine a linguistic and discursive approach to the study of metaphor. This allows us to understand, on the one hand, the use of specific linguistic expressions of the tipping point metaphor, and, on the other, the framing function of the metaphor in climate change discourse (Nisbet, 2009) and as a bridge between climate science and the news media.

In the next section, we give an introduction to the tipping point phrase as a metaphor, including a brief sketch of the use of the phrase over time and in different contexts, and a discussion of (possibly multiple) source domains of the metaphor. Then, we present our theoretical framework, which combines three discourse perspectives on the tipping point metaphor, dealing with its function in science (Boyd, 1993), its function as a boundary object between the domains of science and the news media (Star & Griesemer, 1989), and its function as a discourse metaphor in society (Hellsten, 2002; Zinken, Hellsten, & Nerlich, 2003, 2008). Thereafter, we describe our method of data collection and analysis. The main section of the paper analyses the use of the tipping point metaphor in scientific and news media communication about climate change. The resulting complex picture is finally related to implications for language users in various roles (scientists, journalists and citizens) using the tipping point phrase when communicating about climate change.

2. The tipping point metaphor

Metaphors are sets of mappings between distinct conceptual domains, one functioning as a source domain and the other as a target domain (Gibbs, 2008). The source domain of the tipping point metaphor involves the physical domain in which concrete entities such as a chair or a glass of water can be tipped over and fall, and thus have a tipping point. This is the point at which the object is displaced from a state of stable equilibrium into a new equilibrium state that is qualitatively dissimilar (and typically worse) from the first. An object tips over when its centre of gravity passes the balance point. If this happens with a chair, or a person on a chair, or any other entity or system that is upright and needs to be upright, the consequence is that they are on their back, on the floor. If this happens with a container like a glass, the consequence is that its content spills out and spreads. Things moreover do not tip over of their own accord but it takes a force to tip them over, from people to shakes and earthquakes. This knowledge about the tipping points of concrete entities can then be mapped on to the knowledge of more abstract and complex phenomena, such as the climate system.

This type of cross-domain mapping yields insights about the target domain, in this case the climate system, that are driven by our knowledge of the source domain, in this case concrete objects that are in a state of (im)balance in physical space. If the climate system is like an object with a tipping point, it can tip over when its centre of gravity passes the balance point. What that balance point is, how the centre of gravity of the complete climate system can be conceptualized, what it means for it to tip, how and when this system will tip and with what consequences—all of these then become substantial questions for scientists, journalists, policy-makers and the general public to consider. If the climate system has (been) tipped and is on its back, it cannot function the way it used to, and this in turn raises substantial questions about which functions are invalidated as opposed to which remain in order. If the climate system is spilling the contents it contained, which are then spreading in undesirable ways, the question is which aspects of the climate are involved and how harmful their uncontrolled spreading is. And finally, pressing questions are raised with respect to the forces that are operating at this moment to push the climate system beyond its tipping point, how close in time we have got to the tipping point, and how we can control and contain those forces in order to stop their negative influence on the climate system.

A popular science fiction novel by Kim Stanley Robinson, set in a world threatened by global warming, describes climate change tipping points as follows:

They had passed the point of criticality, they had tipped over the tipping point in the same way a kid running up a seesaw will get past the axis and somewhere beyond and above it plummet down on the falling board. They were in the next mode, and coming into the second winter of abrupt climate change. (Robinson, 2005, p. 645)

Interesting here is the direct metaphorical mapping to a seesaw that tips. Yet, rather than a seesaw that tips back and forth, the paragraph seems to imply that the tipping is of more permanent nature. This potential irreversibility is common for the tipping point metaphor when speaking about climate change. The image that comes to mind—and indeed, an image that is often portrayed in popular articles discussing climate tipping points—is an image of the earth on the edge of a cliff, only inched away from tipping over and falling into the abyss. This image clearly establishes a metaphorical mapping to the physical source domain of *tipping over* into a new, fundamentally different, and undesirable state.

Climate change is not the only nor the first target domain for the tipping point metaphor. In the 1960s, the phrase was used in the sociological literature to refer to abrupt racial changes in neighbourhood residential patterns (Grodzins, 1957). From the 1970s onwards, the phrase became used in mathematical ecology and bifurcation theory (Russill, 2015). Bifurcation theory involves the idea of multiple stable states of a system, also called equilibria. A certain disturbance or perturbation can initiate a positive feedback mechanism that switches a system into an alternative stable state, i.e. it can push the system past the tipping point (Russill, 2015). A more recent and prominent metaphorical mapping connects the source domain of the physical tipping point of a concrete system to a more abstract tipping point of a population with a disease. The Canadian journalist and bestselling author Malcolm Gladwell popularized this interpretation of the tipping point metaphor with his book *The tipping point: How little things can make a big difference* (2000). Gladwell refers to a tipping point as “that magic moment when an idea, trend, or social behavior crosses a threshold, tips, and spreads like wildfire” (2000, p. 12). He extends the at that time already conventionalized epidemiological metaphorical use of the tipping point to the spread of ideas, fashions and trends in society, which, he argued, should be seen as epidemics or viruses. This book became immensely popular in the years immediately before the tipping point phrase was introduced in the climate change debate.

The tipping point phrase hence became defined in the general English lexicon as “a time when important things start happening in a situation, especially things that you cannot change,” the first definition of this term in Macmillan’s English Dictionary (Rundell, 2002; cf. Gladwell, 2000). In the Oxford English Dictionary tipping point is defined as “[t]he point at which a series of small changes or incidents becomes significant enough to cause a larger, more important change” (OED online, www.oed.com). It is quite likely that the success of the tipping point metaphor in the climate change debate is partly due to the linguistic availability and ubiquity of the more general tipping point metaphor in the early 2000s (cf. Russill, 2008). However, other than Gladwell’s “magic moments,” scientists describe climate system tipping points as dangerous, catastrophic and potentially irreversible.

Scholars of environmental communication have criticized this use of the climate tipping point phrase for its connotation of danger, catastrophe and irreversibility (e.g. Hulme, 2008; Nuttall, 2012; Skrimshire, 2008). The main criticism is directed at the alleged tone of alarmism that surrounds the phrase. Hulme (2008), for example, argues that the tipping point concept is used to nourish the discourse of global climate catastrophe, based on fear for an unknown future (Hulme, 2008). Nuttall (2012) sees in the tipping point phrase a revival of determinism, with human agency being left defenceless against the risks of climate change. However, this scholarship does not explicitly consider the metaphorical dimension of the tipping point phrase, forgoing an opportunity to analyse the underlying mappings that may explain different meanings and uses. The aim of our study is hence to enrich the debate on climate change tipping points by a linguistics and discursive analysis of the tipping point metaphor.

3. Theoretical framework

Metaphors play an important role in guiding how we perceive complex issues, both in the public domain of newspapers and in scientific work. Metaphors have been studied in the context of science (e.g. Black, 1962), as common ground for scientific and other discourses (Bono, 1990; Maasen, 1994), and as a crucial part of everyday discourse (Lakoff & Johnson, 1980). We build upon these previous studies, and focus on the metaphor of tipping point. In this paper, we consider three potential, inter-related functions of the climate change tipping point as a metaphor. First, its function within the climate sciences. Boyd (1993) distinguished two common functions of metaphors in science. On the one hand, metaphors can have a pedagogical function, allowing to communicate complex scientific phenomena to a broad audience. At the same time, metaphors may also assist in structuring new conceptual domains within science itself, thus functioning as theory-constitutive devices (Boyd, 1993). We examine this dual scientific function of the tipping point metaphor for climate science, considering whether and when the metaphor has a pedagogical or theory-constitutive function.

Second, we consider the potential function of the tipping point metaphor as a boundary object between science and the news media (Star & Griesemer, 1989). Boundary objects provide a shared understanding around issues. They offer a common ground for multiple discourses by allowing for several interpretations of the meanings of what looks like the same metaphor (cf. Hellsten, 2000; Hellsten & Vasilieadou, 2015). In this sense, the tipping point metaphor can function as a bridge across scientific and public discourses. This, however, may also lead to contestation and variation in its meaning, as we will examine for our materials.

Third, we consider the development of the tipping point metaphor from the perspective of what are called “discourse metaphors” (Zinken et al., 2008). Discourse metaphors are defined as “relatively stable metaphorical projections that function as key framing devices within a particular discourse over a certain period of time” (Zinken et al., 2008, p. 5). We examine whether the tipping point metaphor is also turning into a regular metaphorical expression shaping public discourse around climate change without explicitly calling on the metaphorical meaning of the phrase. An important issue here is whether the predictable career of metaphor (Bowdle & Gentner, 2005), from novel to conventional, has taken place and how it has affected meaning and use of the metaphor. Part of this possible career of a metaphor is the variation between deliberate and non-deliberate use (Steen, 2017). Variation in deliberateness concerns the use of the tipping point phrase *as* a metaphor—a rhetorical device that in fact makes people really think about one thing, the target domain (climate) in terms of something else, the source domain (tipping points)—however briefly. This has to be contrasted with the appropriation of this phrase by the media and the sciences as a conventionalized metaphorical expression to simply denote “a time when important things start happening in a situation, especially things that you cannot change” (cf. Gladwell, 2000). In other words, can the tipping point be seen as an active metaphor today, or should it be understood as a simple conventional expression that happens to be metaphorical but does not restructure our on-going thought in any source domain determined way? Possibly, these different expressions of the phrase persist in different contexts of use.

We hence employ three perspectives on the tipping point metaphor, dealing with (a) its two basic functions in science, (b) its function as a boundary object, providing a shared topic between the domains of science and the news media and (c) its function as a discourse metaphor in society. These approaches can be examined by means of a more detailed analysis of the linguistic, conceptual and communicative aspects of the metaphor involved in its uses in language and discourse.

4. Method

The tipping point metaphor was introduced into the target domain of climate change in 2005. Following Russill and Nyssa (2009), we chose this year as the starting point for our analysis. We collected textual data for a 10-year period, from 2005 to 2014, from news media and scientific

articles. For the domain of the news media, we used LexisNexis to search for publications in major world newspapers. We collected all publications in major world newspapers during the studied period that use the word *climate* and the phrase *tipping point(s)* in the heading or lead (i.e. the title or the first paragraph) of the article. The search query we used is HLEAD (climate AND (tipping point OR tipping points)). We then filtered out duplicates, i.e. articles with a strong similarity, such as articles published under the same title and by the same author. This resulted in a set of 326 articles, distributed over the various years included in our analysis as shown in [Figure 1](#).

We downloaded all articles, including the date of publication, journal of publication and author, for textual analysis. Within this dataset most, but not all, uses of the tipping point metaphor refer to the target domain of climate change. In the year 2005—when the tipping point metaphor was first used by climate scientists to refer to abrupt changes in the climate system—the use of the tipping point metaphor tends to refer to other target domains than climate change (e.g. political tipping points, technological tipping points). We decided not to exclude these articles from our dataset because they indicate that the application of the tipping point metaphor to the climate system target domain was not yet conventionalized. In later years in our dataset, the tipping point metaphor was almost always explicitly linked to the target domain of climate change, in addition to references to tipping points in other systems (e.g. social, political and technical).

For the scientific domain, we collected scientific articles from Thomson Reuters' Web of Science that used the word *climate* and the phrase *tipping point(s)* in the title, abstract or keywords. For the period 2005–2014, this resulted in a total of 301 articles, distributed over time as shown in [Figure 1](#). We downloaded the metadata (date of publication, journal, authors, number of citations, etc.) and abstracts of these articles. Based on a textual analysis of the abstracts and insights from the metadata, we collected the full texts of articles that were of particular interest for our analysis. This included the first five articles that used the term *tipping point* in reference to changes in the climate system, the five most-cited articles, articles by the authors who introduced the tipping point metaphor into climate change research (James Hansen, John Schellnhuber), and articles published in high-impact journals such as *Nature*, *Science* and *PNAS*. We examined this set of articles in more detail, expecting them to be most influential in shaping the meaning of the tipping point metaphor in climate science. Not all articles that we collected refer to climate system tipping points specifically. Yet, all articles link the metaphor to climate change in some way, either by focusing on (ecosystem, societal and technical) changes as a result of climate changes or by discussing larger earth system tipping points (with abrupt climate change being considered one of those).

We closely read the news items and scientific articles in our datasets, analysing the texts on two levels. First, we focused on the use of the tipping point phrase in its context within the text. This approach was chosen to scrutinize the discursive aspects of the metaphor. A focus on the discursive aspects requires taking into account the encompassing textual context in which the metaphor is used. Who uses the phrase? On whose authority? And to refer to which events or phenomena? Second, we zoomed-in on the specific sentence in which the tipping point phrase occurred, focusing on its

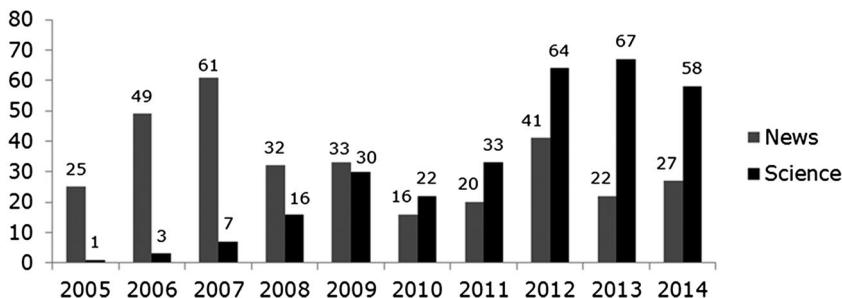


Figure 1. Number of articles published between 2005 and 2014 in major world newspapers (grey) and academic journals (black).

linguistic, conceptual and communicative characteristics (Steen, 2011). We paid attention to the use of the tipping point phrase in combination with particular subjects, verbs, adverbs and adjectives. We also considered the use of quotation marks and other punctuation. Connections with cognitive-linguistic proposals for conceptual metaphors were explored in order to see how expressions related to metaphors in thought such as CHANGE IS MOTION, GOOD IS UP/BAD IS DOWN and so on (cf. Gibbs, 2008). And finally we focused on the question whether metaphors were used deliberately as metaphors, which involves checking whether the addressee's attention is drawn to the notion of a tipping point as a referent in the discourse in its own right (e.g. Steen, 2017); in other words, are addressees asked to really think of climate change as a concrete object or entity that can tip over or be tipped over, exhibiting downward motion in physical space? This dual analysis of textual context (discursive) and language use (linguistic) allowed us to identify and compare the meaning, use and function of the metaphor over time and across the news media and the sciences.

5. Results

Combining insights from our linguistic and discursive analysis, we have found different uses of the tipping point metaphor in science and the news media on climate change. These can be organized in four partly overlapping episodes, characterized by distinct linguistic and discursive uses of the metaphor across science and the news media:

- (1) In the climate sciences, the tipping point metaphor was first introduced from 2005 onwards as a rhetorical device, warning the public and scientific peers for abrupt and possibly irreversible changes in the climate system. This use of the metaphor is characterized by occasionally clearly deliberate metaphorical language use explaining tipping points as motion in space.
- (2) Meanwhile, journalists adopted and employed the notion of a tipping point in climate change as a metaphorical scientific concept with societal implications, also occasionally exhibiting features of deliberate metaphorical use.
- (3) From around 2007, the tipping point phrase becomes popular as a theory-constitutive metaphorical model for research in the climate sciences.
- (4) Finally, from around 2011, notions of tipping points in news media on climate change become used as conventionalized ideas and expressions for important impending change, no longer automatically drawing attention to the metaphorical status of the phrase.

We discuss these four episodes in turn below.

5.1. Scientists introduce climate system tipping points to the public

The notion of climate system tipping points was used for the first time by Professor Hans Joachim Schellnhuber, an internationally renowned climate scientist and founder of the Potsdam Institute for Climate Impact Research, in an interview with BBC reporter Alex Kirby at the 2004 European Open Science Forum in Stockholm (Kirby, 2004). Schellnhuber later recalled that he tried several phrases to explain the notion of abrupt changes in the climate system (such as “switch-and-choke points” and “large scale discontinuities”) (Blaustein, 2015), a process of selection which points to the deliberate nature of his metaphorical speech at the time. It was the metaphor of a tipping point that was picked up by the BBC journalist. Schellnhuber continued using the tipping point metaphor, employing the expression to rephrase existing research into what were then called “critical thresholds” and climate system “hotspots.” The first scientific studies by Schellnhuber and his colleagues that utilized tipping point as a theoretical concept, enabling its use as a theory-constitutive metaphor, were published several years later (e.g. Lenton et al., 2008; Schellnhuber, 2009).

In December 2005, the NASA climate scientist James Hansen stated, in his address to the American Geophysical Union: “we are on the precipice of climate system tipping points beyond which

there is no redemption” (Hansen, 2005, p. 8). In calling attention to the threat posed to humanity by anthropogenic climate change, Hansen used the term *tipping point* in combination with the equally metaphorical but much more dangerous notion of a precipice, which in its literal sense (conventionally) dramatizes the notion of a deep and dangerous fall that is also inherent in tipping point. The combination of the two terms draws attention to the source domain of the tipping point in terms of motion in space. Moreover, given the magnitude of the problem, the religious, conventional metaphor of redemption gets revitalized as a metaphor too, invoking no release from the powers of evil. The ostensible goal was to illustrate in graphic terms of space, motion and values that future changes in the climate system would be bad, rapid and abrupt, and might be irreversible:

- (1) I present multiple lines of evidence indicating that the Earth’s climate is nearing, but has not passed, a tipping point, beyond which it will be impossible to avoid climate change with far ranging undesirable consequences. (Hansen, 2005, p. 1)
- (2) ... , we are on the precipice of climate system tipping points beyond which there is no redemption. (Hansen, 2005, p. 7/8)

Given the sheer scale of the climate problem, it is possible to read the tipping point not just as some abstract moment in time when drastic change may occur, but see it as presented in physical terms as motion towards a place (*nearing, but has not passed, beyond*). Even though this is conventional metaphorical language for time, the metaphor may have been used deliberately as a rhetorical device to make people think about climate change in terms of sudden and (potentially) dangerous motion in space. Whether it was intended as such or taken up as such, neither or both, is impossible to determine. But it clearly is possible that it was meant to persuade the general public of a message about the target domain of climate change by changing their perspective and drawing attention to the source domain of a tipping point, setting up a mapping that points to the dangers of abrupt, and potentially irreversible, climate change.

As the above instances illustrate, experts in the domain of science utilize the media to develop this message. Hansen’s use of the tipping point as a conceptual source domain is considered to be the start of the tipping point trend in climate change communication (Russill & Nyssa, 2009). Other scientists picked up on this metaphor and used it in communication to the media to point out the dangers of abrupt climate change. According to Russill and Nyssa (2009), “[t]he desire to increase public urgency is driving [this] main-streaming of tipping points in climate change communication, not the reporting of peer-reviewed research” (p. 342). Indeed, in the first three years after its introduction (2005–2007), coverage of climate change tipping points in major world newspapers (35 times) far outnumbers peer-reviewed scientific publications (11 times; see Figure 1).

In contrast to the use of the metaphor in direct communication of scientists with the media to convey an image of abrupt and dangerous change in the climate system, we find more meticulous use of the tipping point phrase within the peer-reviewed literature. The first peer-reviewed scientific article on tipping points in the climate system, published in *The Journal of Climate*, introduces the phrase as follows:

- (3) The large changes that began in 1989 suggest that the system had reached a tipping point, a state of the system for which temporary changes in the external forcing (dynamics) created a large internal response that is no longer directly dependent on the external forcing and that is not easily reversed. (Lindsay & Zhang, 2005, p. 4881)
- (4) The late 1980s and early 1990s could be considered a tipping point during which the ice-ocean system began to enter a new era of thinning ice and increasing summer open water because of positive feedbacks. It remains to be seen if this era will persist or if a sustained cooling period can reverse the processes. (Lindsay & Zhang, 2005, p. 4879)

The physical source domain of the metaphor is clearly present in organizing the explanation of a tipping point that is still required at this stage. It involves a *state of a system* (object) when *external forces* (the forces that tip over the object) create a *large internal response* (the tipping over). However, whether this choice of words is in fact driven by attention to the nature of the physical source domain or whether it is simply knowledge about the target domain is not easy to decide. In other words, it is not clear whether the reference to the physical source domain of the tipping point is explicit. Note that it is specifically mentioned that this movement/tipping is not easily reversed, also indicating that it is not in principle impossible to turn a tipped system back to its original, desired state.

Within this first set of scientific articles on climate system tipping points, the metaphor is occasionally extended to the social domain when making policy recommendations, with the claim that socioeconomic tipping is needed to avoid dangerous climate system tipping points:

- (5) International climate policy needs to induce a socioeconomic tipping to a low or no-carbon economy if we are to avoid climate change tipping points. (Lenton & Schellnhuber, 2007, p. 97)
- (6) So, what can we do? The best choice is to avoid tipping events at acceptable social costs. This can be achieved by inducing a fast transition to a low/no-carbon economy [...]. When we say “fast”, we envisage a Third Industrial Revolution in the sense of a socioeconomic tipping event. (Lenton & Schellnhuber, 2007, p. 98)

Note that the language is different, the grammar of *induce a socioeconomic tipping* (5) including an active verb *tipping*. Something similar holds for *socioeconomic tipping event* (6). In these cases, the notion of tipping is not embedded in the conventionalized set phrase *tipping point* and can draw more attention to its basic meaning of caused (downward) movement in space. This may reflect the greater urgency felt by the scientists for undertaking socioeconomic and political action outside their own domain against the dangers of something (climate change) they were already rather familiar with.

Thus, the first use of the metaphor in 2005–2007 in the climate sciences shows a prominent, sometimes deliberate use by climate scientists of the tipping point metaphor as a metaphor recruiting our knowledge of physical motion to convey the prospect of dangerous and abrupt climate change to the public, and at the same time an urgent, occasionally deliberately metaphorical call for action to avoid the doom scenario of crossing climate system tipping points. This is a first demonstration of the tipping point metaphor as an exegetical (pedagogical) metaphor functioning as a boundary object between science and the media, gradually turning into a discourse metaphor structuring the debate on abrupt climate change in society.

5.2. Attention for tipping points in news media

Between 2005 and 2007, climate tipping points received increasing attention in the news media. In 2006, the metaphor even made it to the cover of *Time Magazine*, which stated that “earth is at a tipping point” (Kluger, 2006). In our dataset, we see the number of newspaper articles using the tipping point metaphor when reporting on climate change spike in 2007 with 61 occurrences (see [Figure 1](#)).

Yet most of the news articles from 2005 that combine the terms *climate change* and *tipping point* are in fact not about climate system tipping points. Instead, these articles discuss tipping points that are needed or anticipated in public opinion or in the political response to climate change. Journalists initially used the phrase tipping points to refer to social phenomena, involving radical changes in the attitudes and policies related to climate change challenges. This is in line with the way Malcolm Gladwell used the metaphor in his popular book and indicates that by 2005 the tipping point metaphor was part of the general lexicon of journalists. In other words, the social tipping points referred to in these articles were already conventionalized in use; they did not involve an active recruitment of knowledge about physical motion but simply meant “big change.”

However, in the summer of 2005, journalists also started to report on tipping points in the climate system. Most of these journalistic articles refer to two key events. The first is a study on defrost of Siberian peat ground (permafrost):

- (7) It is a scenario that climate scientists have feared since first identifying “tipping points”—delicate thresholds where a slight rise in the earth’s temperature can cause a dramatic change in the environment, which itself triggers a far greater hike in global temperatures. (Grodzins, 1957)
- (8) Climate scientists warned that a vast expanse of western Siberia has begun an unprecedented thaw, which could cause a “tipping point” in global warming. (Newman, 2005)

The tipping point is placed in adverted commas in both texts, signalling it’s unfamiliar, still strange, scientific use. This suggests that journalist aimed to clearly show that the phrase is used by others, in this case scientists. It potentially also draws attention to the metaphorical status of the phrase, suggesting that we may need our knowledge about physical tipping points to understand what scientists may mean by climate tipping points.

The second set of articles refers to scientific studies of the decline of Arctic sea ice:

- (9) Researchers had long considered Antarctica very cold and, therefore, very stable climatically. But the dramatic disintegration of the Larsen B ice shelf over five weeks that February and March heightened concern that large parts of the frozen continent might be near the tipping point. (Calamai, 2005)
- (10) The greatest fear is that the Arctic has reached a “tipping point” beyond which nothing can reverse the continual loss of sea ice and with it the massive land glaciers of Greenland, which will raise sea levels dramatically. (Connor, 2005)

The physical space and motion terms around these tipping points (*be near* [9], and *reach* and *beyond* [10]) are all regular spatial language use to talk about time and do not necessarily carry deliberately metaphorical force. This may be in line with the fact that tipping point itself had become a conventionalized metaphorical term for big change at that time. The use of the linguistic expression does not necessarily draw people’s attention to the source domain of tipping as motion in space. In other words, in processing these expressions, people may only think of referents from the target domain of time and change instead of from the source domain of space and motion.

Along these lines, many of these newspaper articles refer to scientific warnings for dangerous tipping points in the climate system, but simply in terms of time, not genuine, gravitational, tipping points:

- (11) The world’s ecological clock is ticking. Scientists say unless we dramatically reduce greenhouse gases by 2050 we will reach what they call the “tipping point”, where the damage to the earth’s environment becomes irreversible. (Weekes, 2005)
- (12) Even more concerning are recent warnings from scientists that we might be approaching a tipping point, beyond which major climate change will become irreversible. (“Common-sense solutions can ease impact of global warming,” 2006)
- (13) ... the tipping point is when the exponential rise in Earth’s temperature, already underway, takes off with planet-destroying vengeance. (Zwicker, 2006)

Yet, the above quotations also illustrate that the object at risk of *unprecedented* (8), *dramatic* (7; 9; 10), *irreversible* (10; 11; 12) and *planet-destroying* (13) tipping points is a generalized *we*, *us*, or *humanity* rather than a single individual, city or nation. This involves a change from the social tipping points that were part of the common lexicon of journalists—pointing to individual actors who follow a group process but in principle could act differently—to tipping points as encompassing events in nature without a will of their own, which are subject to inevitable causes explained by

physical laws. The use of the tipping point metaphor in this more explicitly physical sense conveys a lack of human control over potentially detrimental changes in earth's climate.

In sum, in this second phase of using the tipping point metaphor in the climate change debate, we see journalists taking up the tipping point metaphor as a new concept that explicitly comes from science, developing it and explaining it to the public. It is marked off as a specialist, scientific concept by the use of inverted commas, distinguishing it from the conventionalized, generally accepted use of tipping points as moments of social change, which does not seem to carry overt metaphorical force anymore. Especially when it comes to the target of the tipping point we see a difference in language use, with climate tipping point referring to a generalized humanity at risk of tipping (rather than an active individual who follows a group process) and in this way perhaps drawing on the physical source domain of an object that tips over and falls. It is not clear whether, to journalists, the metaphor functions as an exegetical (pedagogical) or theory-constitutive metaphor, even though, as we saw in the previous section, scientists initially explicitly used the metaphor as a pedagogical tool in communicating with the media. Because of this cross-over between domains, the metaphor functions as a boundary object with potentially different functions in the two domains. The meaning conveyed in the news media is one of catastrophic and potentially irreversible climate change threatening humanity, a message that is strengthened in reference to the authority of the scientists that introduce the phrase in public debate.

5.3. Tipping point reaches the mainstream of climate science

While news media attention for climate tipping points decreased after 2007, the number of scientific articles published on the subject increased exponentially at the same time (in our dataset coverage in major world newspapers decreased from 61 to 33 between 2007 and 2009, while the number of scientific publications increased from 7 to 30 publications per year over the same period; see [Figure 1](#)). During this period, the metaphor that had been deliberately introduced by scientists into the public debate in 2005 was given another use, as a conceptually charged technical term, in the scientific climate change literature. In 2008, less than three years after the first scientific article on the topic was published, it was argued in the journal *Science* that the use of the tipping point had moved from a marginalized position to the mainstream of climate science (Kerr, 2008).

As the following quotes illustrate, the focus on abrupt change in the climate system expressed by the tipping point metaphor is itself not new. However, older concepts such as *critical threshold* (metaphorical), *regime shifts* (metaphorical) and *alternative stable states* created a different image than the tipping point phrase.

- (14) We discuss the existence of cryospheric “tipping points” in the Earth’s climate system. Such critical thresholds have been suggested to exist for the disappearance of Arctic sea ice and the retreat of ice sheets: Once these ice masses have shrunk below an anticipated critical extent, the ice–albedo feedback might lead to the irreversible and unstoppable loss of the remaining ice. We here give an overview of our current understanding of such threshold behavior. (Notz, 2009, p. 20590)
- (15) In the Earth’s history, periods of relatively stable climate have often been interrupted by sharp transitions to a contrasting state. One explanation for such events of abrupt change is that they happened when the earth system reached a critical tipping point. However, this remains hard to prove for events in the remote past, and it is even more difficult to predict if and when we might reach a tipping point for abrupt climate change in the future. (Dakos et al., 2008, p. 14308)
- (16) It seems inevitable that the ongoing and rapid changes in the physical environment of the marine Arctic will push components of the region’s existing social ecological systems—small and large—beyond tipping points and into new regime. (Carmack, McLaughlin, Whiteman, & Homer-Dixon, 2012, p. 56)

The tipping point phrase is often used as a synonym for the equally metaphorical notions of *critical thresholds* or *threshold behavior* (14). However, the concept of tipping points focuses in particular on that moment when the threshold is *reached* (15) and when the entity is *pushed* beyond the threshold and into a new regime (16). Thus, other than the term *critical threshold*, the tipping point phrase draws special attention to the moment in real and proximal time when abrupt change may or even will in fact occur (15). This is an idea that is mostly compatible with the notion of crossing a threshold. Moreover, the tipping point phrase, more than *critical threshold*, *regime shifts* and *alternative stable states*, particularly highlights the abrupt change (the *tipping*) that will occur at the tipping point: the entity will be disturbed and end up somewhere else or in a distinctly different state. This abrupt change is also apparent in the visual scientific representation that is generally used in publications to explain the phenomenon: a horizontal movement is followed by a vertical drop, the two core spatial motion concepts illustrating the drastic (negative) change that will take place once a tipping point is passed.

Note how the content and language in (14), (15) and (16) are prominently time oriented. The tipping point is explained in conventionally metaphorical language (*reach*, *passing of critical threshold*) making use of space and motion to talk about change over time. The language might be read as deliberately metaphorical (*push components ... beyond tipping points*) but this reading is not enforced since each of these words can be given a straight conventionalized target domain meaning without needing the detour through caused motion in space. At most, this language is ambiguous between deliberately metaphorical and non-deliberately metaphorical, in the former case requiring thinking via setting up referents from the source domain and projecting on to the target, but in the latter case not—the latter seeming the more likely use of these utterances.

In this third phase, the metaphor is also occasionally extended to the social domain, such as in quote (17), which deliberately bridges the physical meaning of tipping points across the climate system and social domain. Other than in the previous phase (when articles referred to *socioeconomic tipping* as an active verb), the tipping point phrase is now directly mapped onto the social domain, indicating that *virtuous tipping points* can be identified as moments in space or time.

- (17) Tipping points—where a small perturbation triggers a large response— can occur in many complex environmental systems. They produce abrupt and sometimes irreversible change, are inherently difficult to predict, and thus pose considerable challenges to the occupants and managers of those systems. However, tipping points can also represent opportunities. [...] a series of virtuous tipping points are identified, which can help transform the relationships between human societies and the environmental systems we depend upon. (Lenton, 2013, p. 1)

Thus, in this third phase of using the metaphor, we see the exegetical use of the tipping point metaphor by scientists to the general public being complemented by an increase in theory-constitutive use in science itself.

5.4. Renewed/on-going media attention

In the news media, the metaphor (re-)gains attention from 2011 onwards. Warnings from scientists about tipping points in the climate system continue to be reported in the media:

- (18) THE Earth is within decades of reaching an irreversible tipping point that could result in “planetary collapse”, scientists warned yesterday. They called for drastic action, such as rapid curbs on population growth, to prevent food supplies being threatened by major changes to farming caused by climate change. (Dalton, 2012)

Yet, renewed attention is mainly linked to others, such as politicians, picking up the concept to talk about climate change. Warnings about climate tipping points are mainly voiced in the context of various climate conferences, such as the United Nation's Earth Summit in Rio de Janeiro in June 2012, and the climate conference in Durban a year earlier. The news media follow closely such top-level political climate change meetings, and quote the scientists and policy-makers' use of the metaphor to warn about climate change.

- (19) THE greenhouse gas cuts promised around the world will not be enough to avoid the “tipping point” into dangerous climate change, according to a United Nations report released before next week's climate conference in Durban. (Cubby & Wroe, 2011)
- (20) US Secretary of State John Kerry was set to issue a clarion call last night for the world to do to more to combat climate change, warning the planet is being pushed to “a tipping point of no return.” (“Kerry warns Asia on climate ‘tipping point’,” 2014)

Note that the metaphor is again placed in scare quotes, drawing attention to the authority (United Nations report, US Secretary of State) using the phrase to talk about climate change. Tipping points are also identified as abrupt changes in specific, crucial, geographical locations on the Earth, such as the Amazon and the Arctic, thus imagining tipping points as specific *points of change*:

- (21) Billions of trees died in the record drought that struck the Amazon basin in 2010, raising fears that the vast forest is on the verge of a tipping point, where it will stop absorbing greenhouse gas emissions and instead increase them. (Carrington, 2011)
- (22) While the climate system has many tipping points, Superstorm Sandy may have marked one of the more important in terms of public opinion. At the very least, it has blown away the absurd political taboo against talking about a subject we can easily do something about. (“Letters: Superstorm Sandy,” 2012)

In quote (22) creative language is used to make a connection between climate tipping points and human action that can counter this threat, as we have seen also in scientific articles.

In this last phase of use, the tipping point metaphor seems to be employed as a conventional metaphor referring to drastic change instead of the deliberate metaphor that was introduced by scientists in 2005 to call for action to counter climate change. This might reduce its status as a boundary object between science and the media, as the metaphor, in this context, appears to be turning into a generally accepted phrase that happens to be metaphorical about climate change as well as policy change. In this phase, we can see that the tipping point metaphor has developed into a discourse metaphor, providing flexibility for different interpretations of the meanings attached to the metaphor in each of these discourses. This flexibility makes the metaphor vital, able to spread rapidly both within and between domains, yet also controversial, giving rise to different perspectives and entailments.

6. Discussion and conclusion

In this article, we examined the meanings and uses of the tipping point metaphor in the climate change debate. This metaphor suggests a moment in time when a system can be pushed across a balancing point so that it tips over and falls. Our close analysis of the meanings and uses of the tipping point metaphor in the news media and climate sciences revealed subtle variations and developments over time in the two domains (see Table 1 for an overview).

Since 2005, the tipping point metaphor has been used deliberately by climate scientists to convey a warning that abrupt, irreversible and dangerous climate change is imminent. The metaphor was picked up by the news media (prior to the publication of the scientific articles) and developed into a commonly used metaphor about possible, grave dangers of on-going climate change. Here, we observe that the tipping point metaphor functions as a deliberate boundary object between

Table 1. Overview of the main results.

Episodes	Linguistic	Discursive	Theoretical interpretation
Scientists introduce metaphor to the public (2005 onwards)	Draws attention to the source domain of the tipping point in terms of motion in space (<i>nearing, but has not passed, beyond</i>)	Warning the public of abrupt, dangerous and potentially irreversible climate change	Exegetical (pedagogical) metaphor
Attention in news media (2005 onwards)	Use of adverted commas; spatial language to talk about change over time; passive object (<i>we, us, humanity</i>)	Explaining complex phenomenon to the public; conveying scientific warning	Boundary object
Mainstream of climate science (2007 onwards)	Synonym for threshold, but focus on the moment of change (<i>tipping</i>); language is ambiguous between deliberately and non-deliberately metaphorical	Conceptually charged technical term; considered part of “mainstream” climate science	Theory-constitutive metaphor
Renewed/on-going media attention (2011 onwards)	Use of adverted commas; specific location as object (<i>forest; arctic sea ice</i>); no longer drawing attention to the metaphorical status of the phrase	Metaphor picked up by other actors (e.g. politicians); reference to specific locations and events; linking climate change and human action	Discourse metaphor

science and the news media on climate change, on the one hand guiding the conceptual development within the sciences and on the other facilitating communication of abrupt climate change across the sciences and lay audiences. Typical for boundary objects, the tipping point metaphor offers a common ground for different discourses by allowing multiple interpretations of the meanings of the metaphor (Hellsten, 2000). Yet, partly due to these multiple meanings, the tipping point metaphor is also controversial, with critics pointing to the tone of alarmism that surrounds the concept (Hulme, 2008; Skrimshire, 2008), the deterministic language by which human agency appears defenceless against the risks of climate change (Nuttall, 2012), and the overly simplistic extension of the tipping point concept from the climate to the social domain (Russill, 2008; Russill & Nyssa, 2009).

The tipping point phrase represents a less common example of how metaphors generally travel between the sciences and news media. Typically, metaphors between science and the public domain start their journey as new terms in developing scientific theory, and may then be taken up as pedagogical tools to communicate complex phenomena to the public (Deignan, Littlemore, & Semino, 2014, p. 99). The tipping point metaphor is an example of the less common reverse journey, beginning as a rhetorical device to communicate the dangers of abrupt climate change to the public (in 2005–2007) and then developing into a theory-constitutive metaphor in the climate sciences (2007 onwards). While the exegetical function of the metaphor aims at explaining the underlying process to others, in the theory-constitutive phase, the metaphor starts shaping a subdomain of climate science.

Over time, the meanings and uses of the metaphor developed from a vivid illustration of rapid changes in climate (in 2005–2007) to a conventionalized phrase for emphasizing the urgency of actions to counter climate change. Across the sciences and news media, the phrase *tipping point* was used much less frequently as a deliberately metaphorical expression, turning into a more general expression designating moments of great change in any context, accommodating to previously conventionalized uses that had already ended up in various dictionaries as such. This suggests that the specific metaphorical mapping may have bleached and stopped drawing attention to the various properties of the source domain—even though it may be revitalized and used deliberately any time, especially in cartoons portraying the earth on a precipice over a deep ravine. The deliberate function of tipping points as a boundary object, introduced by journalists to describe the complex scientific issue of climate change, diminishes over time. Moreover, this evolution is not just due to developments in the climate change debate but also interacts with other phenomena, including most notably the success of Malcolm Gladwell’s bestselling book *The tipping point*. The use of the phrase *tipping point* in the climate change debate got included in the more general conventionalized

metaphorical expression and simply means “a time when important things start happening in a situation, especially things that you cannot change.”

Whereas tipping points in the climate system are presented as dangerous and beyond our control, tipping points in the societal domain are portrayed as positive and necessary to avoid abrupt climate change. This flexibility allows the metaphor to function as a discourse metaphor, which we particularly observe for the fourth episode studied here. The metaphor has clearly become part of the general lexicon on climate change, being used not just by scientists and journalists, but also, for example, by high-level politicians and in international reports. It is a discourse metaphor that has lost its deliberate origin. It does not seem to function as a framing device very often—in the sense of directing actual interpretation and reasoning about the target domain via aspects of the source domain—which raises questions about the relation between discourse metaphor and framing as well as the evolution from deliberate to less deliberate use of metaphors, which we suggest should be further explore in future research (Burgers et al., 2016; Zinken et al., 2008).

Mapping the tipping point phrase in the climate change debate hence reveals a wide range of crucial target domain implications and questions for both scientists, journalists, decision-makers and the general public. There are many possibilities for varied selection and presentation of these generally hidden aspects of metaphorical conceptualization, and these are used in both deliberate and non-deliberate ways. By explicating the complex ways in which the tipping point phrase in the climate change debate draws upon these metaphorical possibilities, we hope our article can help both scientists and journalists in managing their language use in important public debates.

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