Background

A climate tipping point refers to a critical threshold when global or regional climate change causes changes from one stable state to another stable state. Examples include the melting of the Arctic ice sheets leading to sea level rise or rainforest dieback caused by deforestation, which in turn reduces the carbon sink benefits of these tropical forests. Tipping points are also often associated with cascading impacts, where one impact leads to another.

In this webinar, we looked at the latest science on tipping points and considered how mitigation and adaptation can help reduce the likelihood of these events taking place and address the potential impacts.

We were joined by speakers from the University of Exeter, the World Meteorological Organization (WMO) and Climate Sense.

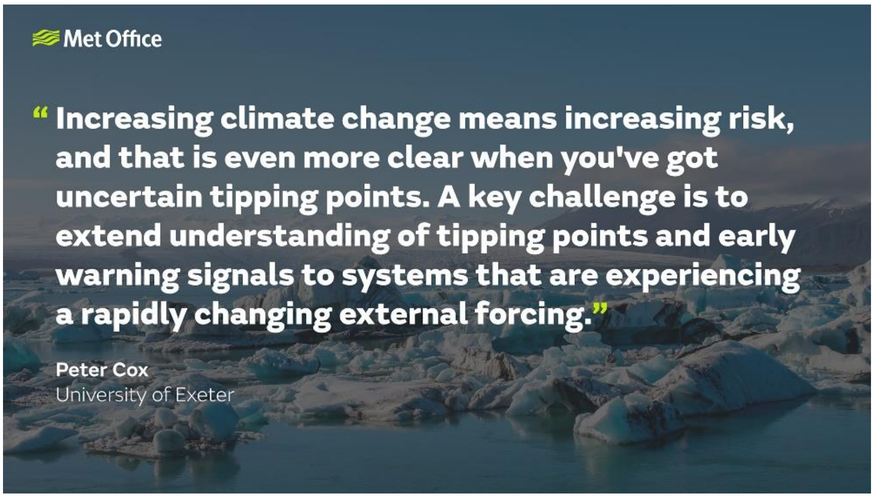
Key webinar talking points

Tipping point thresholds and early warning signals

There is a perception that tipping points indicate a threshold between no risk and a lot of risk. In reality, we don't know exactly where tipping points are, and we're probably not going to know with certainty until some of them are crossed. A more appropriate way to frame tipping points is as a rise in the rate of risk with increasing climate change. Whilst we don't know exactly where tipping point thresholds are, we can say that the chances of crossing a tipping point are inevitably larger if there are high levels of global warming.

It is very difficult to predict deterministically when a tipping point will occur and that is why we're going to see differences between deterministically based models. However, we have a lifeline from mathematics and the natural world. Even though tipping points are difficult to predict, they can have early warning signals that can tell us when they are being approached, i.e., metrics that tell us where system resilience is declining.

Where a tipping point is likely to bring about abrupt change, early warning signals can be quite clear. Where systems take longer to respond, there may be less abrupt change and even an overshoot period during which time a reversal may be possible. The flip side of being able to overshoot, however, is that early warning signals are currently unclear.



Current research and gaps

The World Meteorological Organization’s (WMO) World Climate Research Programme (WCRP) includes a range of core projects that cover a lot of different aspects of climate change including aspects of tipping points. Lighthouse activities are additional research activities designed to facilitate cross cutting climate research that better inform society and climate risk.

Activity examples include:

- Observing modelling of system change with a focus on achieving a tighter integration between global climate observing systems and the climate modelling community, and to identify and quantify uncertainty.
- Integrated attribution prediction and projection, aiming to establish and apply attribution methodologies to help explain multi annual to decadal changes in the climate system design.
- Current and future hazards to understand, quantify and predict changes and the characteristics and statistics of weather and climate hazards.
- Safe Landing Climates explores routes to safe landing spaces for human and natural systems. This includes identifying the sort of risks associated with tipping points, escalating impacts and feedbacks in the earth system.

A Global Tipping Point report is expected at COP28 from Tim Lenton and Johan Rockström which will also include positive tipping points. Thomas Stocker has also put forward a suggestion for a special report on tipping points from the Intergovernmental Panel on Climate Change (IPCC) with an express aim of being a catalyst to advance research in this area.

A key challenge for the research community is the need to push forward understanding of how the climate is changing and early warning signals to ensure that we are prepared for tipping points or regime shifts where regional and global systems could change rapidly. We need to focus on the parts of the world that matter most to humans, and most of them are being affected very rapidly. We need to boost the gap between simple conceptual models and complex models, and we need to ensure those working in observations are working in an integrated way with climate modellers to ensure that the observations can be used in the models and are contributing what's required.

Adaptation pathways

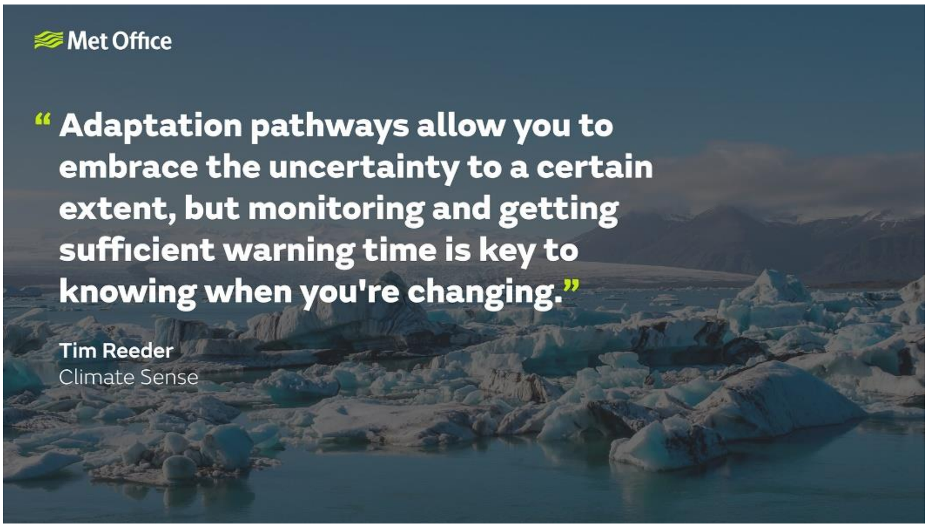
The Thames Estuary 2100 (TE2100) project, which started around 2004, was set up to design a plan for the Thames to protect London for the 21st century. The planning used a concept of adaptation pathways which ensure that, rather than adapting to one scenario, and understanding of the system is developed and ways to adapt it are considered all the way through to a different future.

TE2100 started off with a scenario called High+ which indicated ~2 metres of water level rise, mainly consisting of possible increase in storm surges. Concerns about the impacts of sea level rise due to changes in Antarctica, however, led to consideration of higher worst-case scenarios – High++ - which led to an upper figure of four meters of water level rise.

Adaptation pathways were then developed indicating options for changes to the Thames Barrier moving from today's system to a situation where there were four metres of water level rise. If things change, there is the option to accelerate a pathway or move to a new one.

The learning from this project was taken forward and is currently being used by Network Rail to develop adaptation pathways for train tracks susceptible to the impacts of climate change.

A guide – BSI 8631 – now also exists on adaptation pathways including critical steps around understanding the current system as well as the risks and opportunities from a range of climate change scenarios. Most importantly, this should include the highest climate change scenarios to make sure a big enough envelope is being considered. Monitoring is also essential to validate pathways so that there is an understanding of when to adapt or modify the pathways, and the issue of tipping points is an important part of this.



Final summary

Whilst we don't know exactly where tipping point thresholds are, we can say that the chances of crossing a tipping point are inevitably larger if there are high levels of global warming. Even though tipping points are difficult to predict, they can have early warning signals that can tell us when they are being approached, i.e., metrics that tell us where system resilience is declining.

Better understanding of how the climate is changing and early warning signals is needed to ensure that we are prepared for tipping points or regime shifts where regional and global systems could change rapidly. We need to boost the gap between simple conceptual models and complex models and also develop adaptation pathways which include High++ scenarios. In this way we can manage the risks from climate tipping points, even though not all the necessary information is available.