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Facing critical decisions on climate change in 2015

Summary

This statement has three main purposes: firstly, to provide scientific background to some issues with particular media misconceptions; secondly, to highlight some recent science (since the Fifth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC AR5)) that has improved our understanding of the pace at which the climate is changing; and thirdly, to emphasise issues of particular importance to European Union (EU) policy makers.

We start with a brief overview of current trends in emissions of carbon dioxide (CO_2). We go on to consider the importance of shorter-lived greenhouse gases (including methane) and the response of natural ecosystems to global warming. We highlight the importance of adaptation and resilience in parallel with mitigation. On new scientific evidence, we provide a detailed explanation of why the media meme of a 'warming pause' is incorrect. We provide updated information on the rate of melting in the cryosphere (Arctic, Antarctic and Greenland), and local effects on the Gulf Stream.

Our conclusion is that recent evidence suggests that climate model predictions are in some respects (particularly the cryosphere) overly conservative about the pace at which climate change is proceeding. This emphasizes the urgency for the 2015 United Nations Climate Change Conference in Paris (COP21) to produce an agreement that can deliver not just the target of a 2 °C limit but **to limit warming below that figure**. This has major implications for the world's use of fossil fuels in the coming decades, the majority of whose reserves must remain unused this century if there is to be a 50% chance of limiting warming to 2 °C.

We note that the EU's Climate and Energy policy framework for 2030 puts the EU in a position of leadership through its target of reducing emissions by at least 40% below 1990 levels. We thus recommend that, for COP21, the EU should:

- negotiate energetically for an agreement that is capable of reducing emissions sufficient to limit global warming to less than 2 °C;
- independently of the outcome of COP21, strengthen its leading position by implementing its commitment to reduce emissions by 30% by 2020;
- emphasise the importance of parallel efforts to increase resilience to the risks posed by unavoidable climate change.

1 Introduction

The European Academies' Science Advisory Council (EASAC), which is formed by the national science academies of the EU Member States, provides independent and objective advice to European institutions on science-based policy issues. Global warming and climate change is one such issue, and EASAC issued aides memoire to policymakers ahead of both the Durban (EASAC, 2011) and Doha (EASAC, 2012) meetings of the United Nations Framework Convention on Climate Change (UNFCCC) Conferences of the Parties (COP). In late 2013, EASAC published an analysis of the role of climate change in extreme weather in Europe (EASAC, 2013). In preparation for the Paris meeting of the contracting parties this year (COP21), EASAC has prepared this statement based on recent findings from the continuous stream of new knowledge from research and environmental monitoring activities across the globe.

A previous aide memoire (EASAC, 2011) focused on the importance of the agreement at COP15 in 2009 to limit global warming to 2 °C above pre-industrial levels and noted that, despite the 1992 Rio Conference, the Kyoto Protocol and the boom in renewable energy technologies over the past decade, CO_2 emissions had continued to rise. Global emissions of CO_2 from fossil fuel combustion and cement production have continued to grow by approximately 2.5% per year over the past decade; and the International Energy Agency Energy Sector Carbon Intensity Index (ESCII) has shown little reduction as a result of global changes in supply technologies because of the continued dominance of fossil fuels (of which the most substantial sources of greenhouse gases are coal and lignite) in the energy mix (International Energy Agency, 2013).

However, the most recent interim figures suggest that CO_2 emissions from the energy sector (International Energy Agency, 2015) in 2014 stabilised in a time of continued economic growth—the first time in 40 years there was a halt or reduction in emissions of greenhouse gases (GHG) that was not tied to an economic downturn. This has been attributed by the International Energy Agency to efforts to mitigate climate change having a more pronounced effect than had previously been thought. EASAC believes such progress should **encourage world leaders to aim for an ambitious outcome at the Paris Summit**, in order to accelerate progress and implement urgently measures that will ensure global warming remains within the 2 °C limit.

The science of climate change reported by the IPCC Fourth Assessment (2007) and Fifth Assessment (2014a) have been thoroughly evaluated by numerous national academies (e.g. Royal Society/National Academy of Sciences, 2014; Royal Swedish Academy of Sciences, 2015) and by international bodies. Advances in science and technology have increased our knowledge of how to mitigate climate change, uncertainties in the scientific analysis continue to be addressed, co-benefits of mitigation to health have been revealed, and new business opportunities have been found. **EASAC remains concerned, however, that progress in turning this substantial evidence base into an international policy response has so far failed to match the full magnitude and urgency of the problem**. This note highlights some of the many issues that EASAC considers relevant to the forthcoming negotiations involving the EU and the national governments of Europe.

2 Shorter-lived climate pollutants

Most debate centres on the key greenhouse gas CO_2 and its long-term effects, but other major contributors include methane, nitrous oxide (from agricultural use of fertilisers) and hydrofluorocarbons. Within these other forcing agents, some work over shorter timescales than CO_2, including methane, tropospheric ozone, black carbon[1] and some hydrofluorocarbons—some of which contribute both to degraded air quality and to global warming. UNEP's Climate and Clean Air Coalition focuses on the reduction of such shorter-lived pollutants.

Using current technology and experience on controlling emissions, Shindell et al. (2012) identified 14 measures targeting methane and black carbon emissions that could reduce projected global mean warming by about 0.5 °C by 2050. This research estimated additional benefits of avoiding 0.7 million to 4.7 million annual premature deaths from outdoor air pollution, and increasing annual crop yields by 30 million to 135 million metric tonnes because of surface ozone reductions in 2030 and beyond.

After CO_2, methane makes the second largest contribution to the forcing of global warming. Its potential for reducing emissions from electrical plants by replacing coal can be increased further with co-generation, but it is important to eliminate

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[1] Black carbon (EASAC, 2012) comes primarily from forest fires, inefficient burning of biomass during cooking, from land clearance on a global scale, and diesel engines on a European scale.

emissions and leakage for two reasons. Firstly, methane's global warming potential (GWP) has been revised upwards in the latest IPCC assessment. Secondly, there is debate over the appropriate timescale to be used for the GWP[2]. Currently the GWP for methane used in calculations is 25 (100-year GWP), based on the 2007 IPCC 4th Assessment Report. EASAC considers that **methane's importance as a contributor to overall warming is underestimated and recommends** at the minimum that the figures used in EU emissions calculations should be updated and negotiated into UNFCCC methodologies. EASAC also agrees with the comments in IPCC AR5 that '*there is no scientific argument for selecting 100 years*' and that, with an atmospheric lifetime of approximately 10 years, a shorter period would be appropriate. Discoveries of high levels of methane in the atmosphere (well in excess of those expected from known emissions) also show that there is inadequate knowledge on the sources and sinks of this important greenhouse gas (see EASAC, 2014).

3 Natural ecosystems

Previous aides memoire have emphasised the role of natural ecosystems in capturing CO_2 from the atmosphere and storing it in the world's oceans, forests and other terrestrial ecosystems. Pressure from human activities and growing populations puts these benefits at risk. Directly, deforestation leads to the loss of carbon storage and releases greenhouse gases back into the atmosphere. There are also indirect effects from rising temperatures. Specifically, these increase the risk of transfer of greenhouse gases to the atmosphere from regions where they are stored in permafrost, from methane hydrates in the Arctic shelf, and from an increase in forest fires with consequent deforestation.

If global warming continues at the present rate, there are also potential risks for many natural and managed ecosystems especially through rising sea levels, storm surges, floods, drought and heat waves (EASAC, 2013). Shifts in weather patterns will have an impact on agricultural production including reduced yield (Asseng et al., 2014); they will distort the balance of ecosystems, rendering them sensitive to even moderate climate change (Kroel-Dulay et al., 2015); they will accelerate biodiversity loss and species extinctions (Urban, 2015); and they will damage marine systems, including corals that will continue to be bleached or degraded in warmer and more acidic oceans (Pandolfi et al., 2011).

4 Adaptation to climate change

Even if emissions of GHG stopped altogether, existing concentrations of GHG in the atmosphere would continue to exert a warming effect for a long time. Whatever measures are put in place to reduce the intensity of global human-induced climate forcing, **building resilience through adaptation** will be necessary to provide more resilience to the risks already emerging as a result of climate change. This will require major effort as emphasised in EASAC (2013) and Royal Society (2015), and will need to be factored into sustainable development goals. Measures will involve adaptation of infrastructure and human habitation to changes in hydrological cycles (floods and droughts), rising sea levels (abandonment of low-lying areas), and extreme weather events (e.g. heat waves and wind storms[3]).

5 Recent scientific evidence and issues

Direct challenges to the underlying evidence and science of climate change continue to be funded on a large scale (e.g. Dunlap and McCright, 2011; Goeminne, 2012; Brulle, 2013). Associated media coverage places policymakers in the difficult position of judging between 'claims' and 'counter claims' on key aspects. In the next paragraphs, therefore, we provide some comment on two areas of media controversy (the basic trends in warming and the adequacy of a 2 °C limit), before pointing to some **recent scientific results** that illuminate underlying processes and other factors relevant to the challenges being addressed in Paris.

5.1 Recent warming trends

Much emphasis has been given to the observation that the extremely warm surface temperature record in 1998 (because of an exceptionally strong El Niño) has been exceeded only rarely in the subsequent 16 years (in 2005, 2007 and 2014). This has allowed the assertion that **if** 1998 is taken as the baseline for a 16-year trend, there has been little change. This ignores the fact that in systems with natural variability, such statistical 'cherry-picking' is arbitrary and unscientific[4], but this has nevertheless been

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[2] The GWP for methane is 34 when assessed over a 100-year period, but when considering a 20-year period it rises to 86, and is 108 over a 10-year period.

[3] Fischer and Knutti (2015) concluded that 75% of extreme hot days and 18% of days with heavy rainfall worldwide can be explained by anthropogenic warming. In a world with 2 °C warming above pre-industrial levels, almost all extreme hot days and 40% of heavy rainfall days would be attributable to rising temperatures.

[4] If, instead of 1998, the years 1992, 1993 or 1996 were taken as the starting point, the direct opposite and equally erroneous conclusion (an acceleration in the rate of warming) would be drawn.

widely used to promote the view that global warming has 'paused', or is encountering a 'hiatus'. It has also been used to argue that the climate is far less sensitive to increasing GHG concentrations than the climate models suggest and that therefore the risks posed by global warming have been overstated.

Possible contributors to short-term slowing in the warming trend include an increase in volcanically induced cooling over the early 21st century (Santer et al., 2015) and cooler phases of the El Niño cycle. However, even though such short-term factors may be influencing surface temperatures from year to year, latest data suggest that **no significant change in the rate of warming between the immediate pre-1998 and post-1998 periods occurred**.

Firstly, the global surface temperature is only one indicator of the rate of warming. Increased radiative forcing from rising GHG concentrations is distributed throughout the climate system (including atmosphere, oceans, cryosphere and biosphere). The atmosphere accounts for only about 1% of the extra heat, and ocean warming dominates as the heat sink[5]. Studies on the distribution of heat in the oceans (Chen and Tung, 2014) have found that, since the turn of the century, **more heat has been moving into deeper oceans, and the deep ocean appears to be heating at a higher rate than previously thought** (see also World Meteorological Organization, 2015).

Secondly, Karl et al. (2015) refined the corrections in temperature records necessary to reflect changes in methodology over the years in measuring sea surface temperatures, together with an improved analysis of key land regions that may be warming faster or slower than the global average. This new analysis shows **the trend over the period 1950–1999** was a warming of 0.113 °C per decade, which is **virtually indistinguishable with the trend over the period 2000–2014** of 0.116 °C per decade.

Thirdly, a recent statistical analysis has also cast doubt over the existence of a real 'hiatus'. One way of identifying changes in trends is a statistical technique known as change point analysis, which subdivides a time series into sections with different linear trends. When this is applied to the four major global temperature data sets, the results suggest only three change points from 1880 to 2014 (Cahill et al., 2015)—all before 1979. **No statistically significant shift in trend can be identified around 1998** so that the apparent hiatus is not outside what is expected from natural variability.

Following a new record warm temperature for 2014 and the likelihood that 2015 will be the warmest year on record, there is the opposite danger of oversimplification in the media that 'the warming pause is over'. That is also a false assertion. Firstly, there never was a significant pause (for the reasons above); secondly, trends in global warming cannot be determined from a single year, or even a couple of years, because natural variability within the climate system means that long-term forced changes such as global warming will not proceed smoothly with each year being warmer than its predecessor.

5.2 The 2 °C target (upper limit)

A second challenge has been to the logic underlying the 2 °C target (Victor and Kennel, 2014). **EASAC considers this a fundamental issue because climate policy needs a long-term global goal that is consistent with the outcome of 'preventing dangerous climate change'**. Such a goal requires a single indicator that covers the multitude of risks set out in IPCC reports. Global temperature is one obvious choice because it is a single metric that is directly linked to the increased radiative forcing from increasing GHG concentrations, and is the main driver of the associated impacts and risks (Figure 1). (The only risk that is not directly influenced by global temperature on the basis of current knowledge is ocean acidification, which is a direct impact of rising CO_2 levels in the atmosphere.) Alternative indicators might be to limit the concentration of GHG in the atmosphere, or to limit the imbalance in the Earth's incoming and outgoing radiation, but these would be two and one steps, respectively, removed from the actual impacts and risks shown in Figure 1.

IPCC also concluded that the current goal is achievable at limited cost (the best estimate of the annual cost of limiting warming to 2 °C is a 0.06% reduction in the growth rate of global gross domestic product (IPCC 2014b)). Although some questions have been raised over whether this target is still achievable (e.g. Geden, 2015), the United Nations structured expert dialogue (UNFCCC, 2015) noted that '*science has provided a wealth of information to support the use of that goal*' and that concern about ocean acidification and sea level rise, '***only reinforces the basic finding*** *emerging from the analysis of the temperature limit,*

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[5] IPCC (2014a) states that full ocean depth warming accounts for about 93% and warming of the upper (0–700 metres) ocean about 64% of the total heat input.

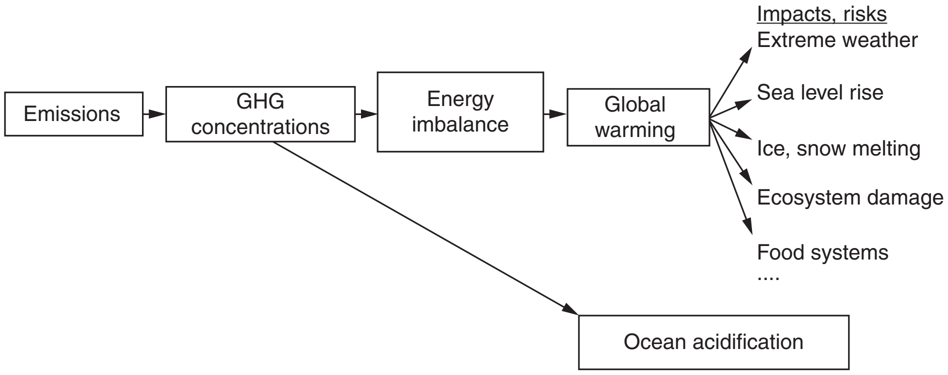

Figure 1 From emissions to impacts and risks.

namely that we need to take urgent and strong action to reduce GHG emissions'.

A key question is whether 2 °C is in reality a safe level. The IPCC reports consider that several major risks are considered 'high' already for 2 °C warming, and such risks have tended to increase between assessments. In particular, one of the rationales behind 2 °C was the AR4 assessment that above 1.9 °C there is a risk of triggering the irreversible loss of the Greenland Ice Sheet, eventually leading to a global sea-level rise of 7 metres. In IPCC AR5 (IPCC, 2014a), this risk is reassessed to start already at 1 °C, and since AR5 was published, new science is pointing to higher risks of irreversible melting in Antarctica (see below). Moreover, the expert dialogue concluded that '*The 2 °C limit should be seen as a defence line … that needs to be stringently defended, while less warming would be preferable*.' **EASAC thus strongly supports the conclusions of the expert dialogue cited above that 2 °C should be a firm target for mitigation strategies at COP21, and that this be seen as an upper limit to the UNFCCC's target to avoid dangerous anthropogenic climate change**.

5.3 Changes in the cryosphere

The **Arctic sea ice** is part of the cryosphere where the effects of global warming on melt are easiest to see through a reduction in surface area. In September 2015, the minimum surface area was the fourth lowest on the satellite record (Figure 2a), and the statistical trend shows a mean annual reduction in area of about 13% per decade; or about a 40% reduction in extent since 1979 (National Snow and Ice Data Center, 2014). The seasonal maximum reached on February 25 2015 (14.54 million square kilometres) was the lowest in the satellite record (National Snow and Ice Data Center, 2015). Arctic ice extent is affected by seasonal variations in the climate system, weather patterns, as well as underlying temperature trends; moreover reductions in ice cover have also been associated with a thinning and loss of mature ice, **so the volume decrease is in fact greater than the decrease in area, with the statistical trends showing an approximate 66% decline in the minimum volume since 1979** (Figure 2b).

In Antarctica, melt losses in West Antarctica have increased by about 70% in the past decade, and earlier volume gains recorded in East Antarctic ice shelves have ceased (Paolo et al., 2015). Melting processes are also better understood: warming oceans are causing melting below the ice shelves in West Antarctica where six glaciers studied are partly supported by land and partly float (Rignot et al., 2014). Study of the retreat of the grounding line[6] shows that it has retreated by tens of kilometres, is crossing a retrograde bedrock slope and is probably engaged in an unstable 40 kilometre retreat. One of the glaciers studied (the Pine Island Glacier) has thinned at an accelerating rate and is now the largest single contributor to sea-level rise in Antarctica (Shepherd et al., 2012). The loss of the ice shelves would speed the complete collapse of the West Antarctic Ice Sheet, which would eventually cause up to 3.5 metres of sea level rise (Favier et al., 2014).

Comparable trends have now been observed in East Antarctica (Greenbaum et al., 2015) where similarly large amounts of water are involved. Other recent studies show accelerating melt rates in other parts of Antarctica (including the Southern Antarctic Peninsula (Wouters et al., 2015)). **Such acceleration in melting raises concerns over feedback mechanisms in the melting processes and nonlinearity in ice sheet disintegration[7], which are still insufficiently understood and not included in IPCC models.**

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[6] The dividing line between land and water underneath a glacier.

[7] For instance Pollard et al. (2015) found that including the mechanisms of hydro-fracture and ice-cliff failure in models accelerates the expected collapse of the West Antarctic Ice Sheet to decadal timescales.

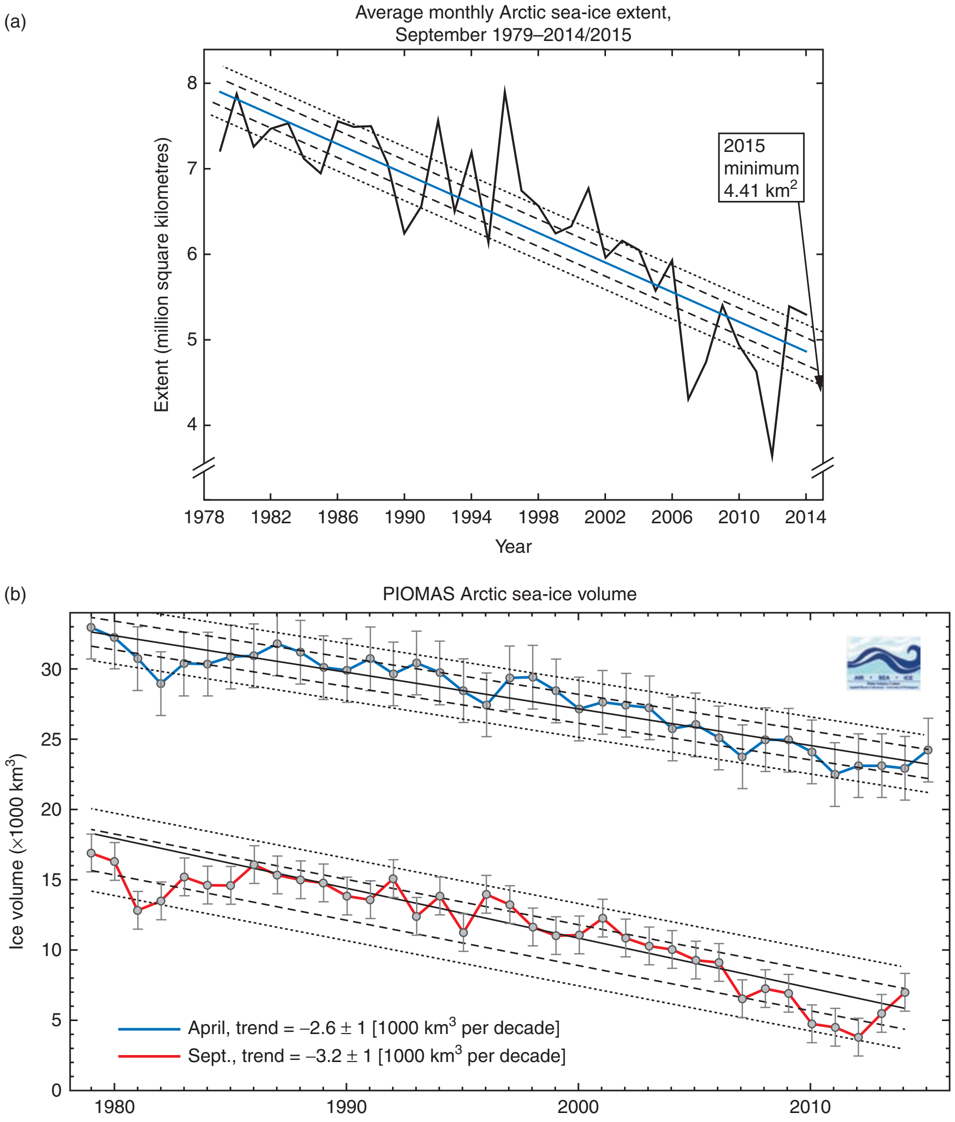

Figure 2 (a) Arctic ice extent at summer minimum areas. Source: National Snow and Ice Data Center. (b) Arctic sea-ice volume. The trend for the maximum volume is shown in the top line, and the minimum volume is shown in the bottom line. Source: Polar Science Center.

Trends in Antarctic **glacier** melting (which contributes to sea level rise) contrast with the area of Antarctic **sea ice** extent, which has increased in recent years with a record area in 2014. Such increases have been cited as providing contrary evidence to global warming. However, they are probably due in part to the melting of land ice reducing the salinity of adjoining seawater, making it less dense, and so able to freeze at slightly higher temperatures than the underlying denser seawater. Thus, even though expanding winter Antarctic sea ice may appear counterintuitive in a warming planet, it may nevertheless be another manifestation of recent warming. Moreover, changes in the extent of sea ice do not affect sea level.

Globally, some **glaciers** have been extensively monitored nationally and regionally. Since 1894, this has been internationally coordinated through the World Glacier Monitoring Service. Data from many areas are available before those of the World Glacier Monitoring Service, and add to the period during which net gains or losses of glaciers have been measured. Glacier loss is one of the most visible manifestations of warming, but intermittent re-advances reflecting local changes in the balance between snowfall and melt can be seen in some glacier subsamples at regional and decadal scales. To obtain a global picture, Zemp et al. (2015) have reviewed approximately 42,000 data sets acquired since 1600 and shown that the monitored glaciers in the early 21st century are losing mass at a rate unmatched since the start of the World Glacier Monitoring Service, or seen in available historical records. Moreover this rate has been accelerating over recent decades, and loss rates in the first decade of the 21st century were double the average observed during the period 1951–2000.

Specifically in **Greenland**, analysis of the extreme melt in 2012 (Nghiem et al., 2012) revealed that melt occurred at or near the surface of the Greenland Ice Sheet across 98.6% of its entire extent on 12 July 2012, coinciding with an anomalous ridge of warm air that became stagnant over Greenland. Such a melt event is very rare, with the last significant one occurring in 1889. Global warming alone is not enough to account for the increasingly rapid melting of this ice sheet. Other factors include darkening of the ice sheet surface, which results in greater rates of melting. In addition to black carbon from forest fires and other sources (Colgan et al., 2014), research is starting into the role of microbes that can bloom on melting snow and ice surfaces, darken the ice sheet surface (Stibal et al., 2015) and thus amplify the basic impact of rising temperatures. In addition, new findings on the role of 'supraglacial' lakes formed as the Arctic warms suggest these accelerate the rate of melt and that **previous estimates of the rate of melt may be too low** (Leeson et al., 2015). With an area of 1.71 million square kilometres and volume of 2.85 million cubic kilometres, the Greenland ice sheet is the second largest glacial ice mass, with a sea-level equivalent of 7.4 metres.

5.4 The Gulf Stream

A regional consequence of warming, through its effect on melting in Greenland, has long been postulated to be a weakening of the Atlantic Meridional Overturning Circulation, commonly known as the Gulf Stream. Atlantic overturning is driven by differences in the density of warm ocean water from the south and cold, salty water from the north. The warm and fresher water is lighter and flows north, while the cold water is denser and sinks to deeper ocean layers and flows south. Fresh water released from the melting Greenland Ice Sheet dilutes the saline ocean water and makes it less dense, and thus less likely to sink and be carried south. Consistent with the deep density changes, the strength of the Atlantic Meridional Overturning Circulation derived from ocean measurements at 26° N (Smeed et al., 2014) has shown a persistent decrease since 2004. While the magnitude of the decline is uncertain over such a short period, the median estimate corresponds to a reduction in strength of about 20%. This implies reduced heat transport that should lead to cooling of the North Atlantic over several years.

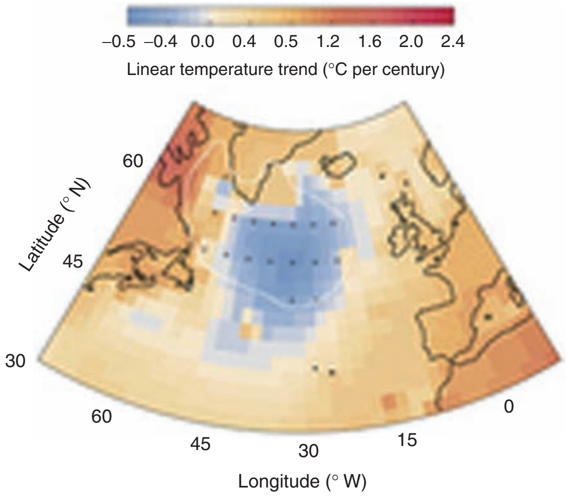

Figure 3 Cooling in the sub-polar North Atlantic. Source: Rahmstorf et al. (2015).

The North Atlantic between Newfoundland and Ireland is practically the only region of the world that has defied the trend of global warming and even cooled (Figure 3). A recent study (Rahmstorf et al., 2015) attributes this to a weakening of the Gulf Stream system after 1975—an unprecedented event in the past millennium. Further melting in Greenland could contribute to further weakening of the Atlantic Meridional Overturning Circulation with **uncertain implications for the climate of northern Europe and northeastern USA and Canada**.

5.5 Carbon budget

Because CO_2 remains in the atmosphere for more than 100 years, there is a substantial lag between any reduction in emissions, atmospheric concentrations and mitigating effects. Assessments of the impact of global warming thus require consideration of the cumulative impact of carbon already in the system as well as annual emissions. In this context, the IPCC AR5 provided a scientific link between **cumulative carbon emissions** and global warming, enabling a robust conclusion about the urgency of undertaking major mitigation efforts within the next two decades to have any realistic chance of avoiding 2 °C warming (IPCC, 2014b). Friedlingstein et al. (2014) have also compared IPCC estimates with annual emissions and concluded that the remaining emissions quota (from 2015 onwards) associated with a 66% probability of keeping warming below 2 °C (estimated to be 1,200 (900–1,600) gigatonnes (Gt) of CO_2) would be exhausted in about 30 (22–40) years at the 2014 emission level of 40.3 Gt of CO_2 per year.

With such fundamental limits now better understood, it is possible to calculate how much of the available fossil fuel reserves would have to remain unburnt to have a 50% chance of limiting warming to 2 °C. McGlade and Ekin (2015) calculate that cumulative carbon emissions between 2011 and 2050 would need to be limited to around 1100 Gt of CO_2, which would be exceeded if more than one-third of present estimates of global fossil fuel reserves were used. To be compatible with a warming limit of 2 °C therefore, **a third of global oil reserves, half of gas reserves and over 80% of current coal reserves should remain unused** from 2010 to 2050. Moreover, development of resources in the Arctic and any increase in unconventional oil production (e.g. tar sands and oil shales) are not compatible with efforts to limit average global warming to 2 °C.

Such basic scientific limits have substantial implications both at industry and at national levels, and other studies are starting to examine the financial and political implications of potential wasted capital and stranded assets associated with climate change (Grantham Research Institute, 2015). A first step towards addressing this issue was taken at the G7 summit in Germany in 2015, when it was agreed to aim to phase out fossil fuel use by the end of the century. EASAC recognises the challenges involved in making the transition from current fossil fuels to new sources of energy, but notes that a clear outcome to COP21, which sets agreed pathways for GHG emission reductions over the next 30 years, would reduce the risk of stranded assets by providing a stable framework to conduct research in science and technology and facilitate industry's orderly transition to a lower carbon economy[8].

6 Concluding comment; the role of the EU

No short document can cover all of the many aspects of climate change. However, the overview of some recent science suggests that climate model predictions are in some respects (particularly the cryosphere) overly conservative about the pace at which climate change is proceeding. This emphasises the urgency for the Paris Conference to produce an agreement that can deliver the target of 2°C and, **if possible, aim to limit warming below that figure**.

Recent calculations of the insufficiency of 'intended nationally determined contributions' to limit warming to 2°C emphasize **the need for a strong agreement that incorporates procedures for future further reductions**. Moreover, this underlines the importance of **countries avoiding locking in high carbon infrastructures** (e.g. fossil fuel generation, buildings and transport) in their development plans (Boyd et al., 2015).

Accordingly, EASAC recommends that, for COP21, the EU should:

- negotiate energetically for an agreement that is capable of reducing emissions sufficiently to limit global warming to less than 2°C;
- whether or not an agreement is reached at COP21, implement its commitment to reduce emissions by 30% by 2020;
- emphasise the importance of parallel efforts to increase resilience to the risks posed by unavoidable climate change.

This is in line with the Climate and Energy policy framework for 2030, whereby the EU has set itself a target of reducing emissions by at least 40% below 1990 levels and in line with the scientific conclusion of AR4 that developed countries should reduce their emissions by 2050 by 80–95% (a figure already endorsed by EU leaders).

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[8] In this context, six major European oil and energy companies have advocated a global price on carbon, to provide a stable market mechanism.

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