EMS Annual Conference
Up to date information on the meeting in Budapest 2018

Hot July
What was the cause?

WMO Changes
Is it all change at the top?

Hothose Earth
Is the climate about to flip?

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IABM
INTERNATIONAL ASSOCIATION OF BROADCAST METEOROLOGY

UP FRONT

the magazine of the IABM

Issue 44

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VIEW FROM THE CHAIR

TV-WEATHERCASTERS ARE TRUSTED PEOPLE IN RELATION TO THEIR VIEWERS AND THUS ARE ABLE TO EDUCATE THE VIEWERS ABOUT CLIMATE-CHANGE.

Thoughts to consider

I have to start with weather-headlines, because this year's summer-heat in July and the beginning of August in the entire Northern hemisphere was quite unusual. "Weather" was number 1 headline from Japan to the Arctic. Extreme heat in Germany and other parts of Europe, severe drought conditions in the central and northeastern parts of Germany, devastating floods in Japan, killing at least 220 people, followed by an "unprecedented" heatwave, peaking at 41,1°C, in the US extreme heat in the west with wildfires, forest fires in Sweden and Greece, with a remarkable death-toll of at least 81 people and many more headlines all over the world….

Heat waves are normally not "unusual", but according to the scientist Anders Levermann from the Potsdam Institute for Climate Impacts Research (PIK), stating in several interviews that considering that the last three years have been the warmest on record globally, with unmitigated climate change extreme episodes will likelier occur more frequently. Most of the world's well respected climate-scientists agree with this statement. In an interview with the Guardian, Michael Mann, from Pen State University (See separate report from the Guardian about an interview with Michael Mann, one of the world's leading climate scientists), said that we are now seeing the "Face of climate change".

And this is only the beginning: We all should know by now that as a result of climate-change episodes of extreme weather, be it heat waves or precipitation or droughts, are increasing. Although it is not possible to attribute every single event to climate change, these events fit in the "image" – the long-term trend due to still rising concentrations of greenhouse gases.

Many recent studies have found the relationship between the influences of human activity on extreme events, often not directly but indirectly.

In the Bulletin of the American Meteorological Society, from 135 studies published between 2011 and 2016, 65 % found that the events probability was significantly affected by anthropogenic activities.

In this context I want to mention a study from the George Mason University in Virginia, USA, researching how TV-weather-forecasters are dealing with climate-change. In 2010 the University surveyed 571 weathercasters and only about half believed in global warming. However in 2017 a new survey by the University found that 95 percent saying that they believed that climate was changing.

As TV-weathercasters are trusted people in relation to their viewers and thus are able to educate the viewers about climate-change.

This is supported by the surveys because they found that local TV news remains the top source of

news for Americans. Looking at climate issues, the public trusts their familiar local TV personalities more than anyone other. Supported by Climate Central (non-profit-organization) and a "Climate Matters" project, graphics in conclusion with text about climate change have been produced "ready to use". So the number of stories on global warming by television weather-people has increased 15-fold over 5 years according to the Center for Climate Change Communication at George Mason University. If the trend will continue the number of stories about climate delivered during local weather-casts will raise from 55 in 2012 to more than a thousand in 2018. The next target to talk about in local TV according to Bernadette Woods Placky, Executive director of Climate Central, needs to be "What does climate-change mean to me?"

Everything is fine using "ready-to-use"-graphics accompanied by a "ready-to-use"-text, with one exception: the information needs to be from reliable sources for the one who uses the story but also for the viewers. Reliable sources nowadays are absolutely necessary in times of "fake-news". This task remains to the producers like Climate Central – they need to know their sources and the audience need to know where it comes from.

Most sincere scientists know their trustful sources quite well. But people who are not involved too much with special climate science could run into difficulties in judging "reliable" and "other" publications. A group of trustful investigative journalists in Germany (Süddeutsche Zeitung, public broadcasting Companies – WDR, NDR) together with international media in France and in the US (Le Monde, New Yorker) with best reputation found that there are some so called fake science portals, namely "Waset" and "Omics" in Turkey and India, but also others. They claim to "peer-review" scientific articles, but they don't, they seem to collect a lot of money for frequent fake conferences sometimes with only one or two attendants, where scientists can present their "scientific studies".

The organizers claim that the papers have been peer-reviewed, but were found not to be. The journalists have researched more than 175.000 publications, released by these "fake-portals" and stated that a respectable number of Scientists of well-known Science-Organizations are to be found amongst these publications – most obviously without knowing. The worst thing, these studies are being fed into politics and help interest-groups to release non-scientific results to the public, for economic and political interest, but these publications also find their entry into the science community.

The European Institute for Climate and Energy (EIKE), to some of you probably well-known, is a collector for climate-deniers of man-made climate-change. They work together with the highly controversial "Co^2-Coalition", which is close to Donald Trump. They propagate that a high CO^2-concentration would be perfect for the planet. As proof for their theory EIKE is advertising for peer-reviewed studies published fake-portals.

The journalists had one so-called science report of the press-speaker of EIKE proof-read by a well-known Professor, Jochem Marotzke, Director of the Max-Planck-Institut of Meteorology, in Hamburg. His trial was scathing, the work would not even satisfy the lowest scientific standards.

The current situation opens all doors for publication of: nonsense, obvious untruth about climate change, conspiracy theories (chemtrails) and more..…and this is only the beginning……thoughts to consider!!!

Inge Niedek, August 2018

EMS ANNUAL MEETING: EUROPEAN CONFERENCE FOR APPLIED METEOROLOGY AND CLIMATOLOGY 2018
3rd – 7th September 2018 Budapest, Hungary

Conference theme

Weather and climate: global change and local hazards The challenges for meteorology are growing. Citizens, decision-makers, indeed all of society require information on the consequences of our changing climate, and especially on weather and climate hazards that seem to occur more frequently and to have a significant impact on humans, nature, and infrastructure. The essential role of meteorology since the start of operations remains unchanged – the provision to society of reliable forecasts and trustworthy warnings. However, in the 21st century impact predictions and long-term projections of climate change are also needed to support national strategic decisions aimed at saving lives and reducing the costs of natural hazards. All of these challenges place increasing responsibility on scientists and forecasters, as well as on meteorological companies, institutions, and organisations: the whole "weather and climate enterprise".

Behind these challenges is a need to develop our understanding of the multiple and inter-twined processes of the atmosphere and related environmental components, such as the hydrosphere, the biosphere, the cryosphere, and the anthroposphere. There is a need to innovate tools which facilitate and enable a better service to all sectors of society, from the global through to the national, regional, and local scales. The primary focus of the conference will be to promote and facilitate these essential operational and strategic developments in the European weather and climate enterprise.

The EMS Annual Meeting aims to foster exchange and cross-fertilization of ideas in meteorology and climate science. Among the challenges to be addressed within the EMS2018 theme – Weather and climate: global change and local hazards – are the following:

- Advancing our understanding of how the earth system works
- Weather and climate model development
- Air pollution, weather, and climate; challenges in meteorology, chemistry, and physics
- Challenges in observation, instrumentation, and monitoring
- Developing new applications using big data processing
- Developing new methods for hazard forecasting
- Implementing impact-based forecasts and warnings at the local level
- Communicating uncertainty, especially in the case of high-impact weather events
- Optimising sectoral benefits (e.g. agriculture, energy, transport, urban planning)
- Preparing for adaption and mitigation of global change impacts on the local scale
- Learning how best to reach out to, and communicate with, the general public, stakeholders, and the media

Conference venue

The EMS Annual Meeting 2018 will take place at the Corvinus University of Budapest, Hungary. The Corvinus University is located in the city centre of Budapest.
Corvinus University
Fővám tér 8.
1093 Budapest
Hungary

https://www.ems2018.eu/home.html

THE METEOROLOGIST BEHIND #METSUNITE CAMPAIGN TAKES HIATUS FROM LOCAL TELEVISION

By Stephanie Tsoflias Siegel

WPEC meteorologist Jeff Berardelli is taking a break from TV to educate himself about climate change this fall.

Berardelli, who is also the weather man behind the Twitter hashtag #Metsunite is leaving the West Palm Beach affiliate after 21 years in local news to attend Columbia University's Earth Institute.

Before his move to the Big Apple, Berardelli took some time to talk to TVSpy about his move.

TVSpy: Tell me a little about the #Metsun ite campaign on Twitter. Why did you start it?

Berardelli: #MetsUnite just sort of happened. I'd been spending a lot of time thinking about effective climate communication. But the most important aspect of this idea is empowering TV meteorologists to speak up about one of the most challenging issues of our time. They say if you see something, say something. Most meteorologists today admit they see something, but not nearly enough are saying something.

When are you leaving WPEC, and what are your hopes after you attend Columbia University? Is it to go back into local news?

When I took the main meteorologist job at WPEC the plan was to sail off into the sunset. But being from South Florida, my wife always wanted to experience the seasons and live in a big city. At around the same time I started becoming more focused on the shifting climate. As luck would have it, Columbia University's Earth Institute has one of the best climate programs in the world. Although I am taking a break after 21 years in local TV, I do plan to continue to work in media.

What is your message to young meteorologists and how they can continue to inform viewers about the changing climate?

Open the lines of communication with your viewers. Start small, perhaps on social media or your blog. Be honest. Don't use scare tactics. Do not politicize. Become a trusted authority on climate change. Answer viewer's concerns with openness, honesty and regard for their differing opinions. Most important, be part of the change that is needed. It is an all hands on deck moment and you are an integral voice in our future.

Why It's Worth Leaving My Paycheck Behind

Jeff Berardelli, Meteorologist and Climate Change Communicator Speaking about climate change on CBSN Spring 2018

After 22 years of consistent employment as a TV meteorologist I am stepping away for a moment; it will be the first time since my Junior year at Cornell University. To many it may seem like a risky step. At moments it feels that way for me as well. I'm near the peak of my career and earning years. Who would leave a main meteorologist job in a great place like the Palm Beaches when things are going so well?

But the way I look at it is: the risk is not following my passions and intuition towards the next step. In every step I have taken in my life from career to marriage and everything in between that subtle inner voice has guided me towards a life that is better than I could have conceived. And I honestly feel that I ought to be giving back to a world which has given me so much. So after 5 years as Severe Weather Expert at WPEC I will be heading back to New York City. Starting in September I will be attending Columbia University to get an MA in Climate and Society. The goal is give myself an extra layer of specialty and while doing so, give the Earth and Climate Change another PR agent. Of course as a meteorologist I have a good science background in climate change. But to be

an effective communicator in these challenging times it takes a lot more than science. The MA program at Columbia's Earth Institute offers a multidisciplinary approach with an opportunity to study other key aspects of climate change like sociology, communication, policy, GIS etc… Not to mention it will be an opportunity for me to be in the middle of it all; New York City, a place where the best minds of Climate Change meet the best minds in media.

I also realize, quite vividly as of late, that local news needs to utilize their meteorologists in an expanded way. Just ten years ago everyone needed to watch TV for the local weather forecast. That number is dropping fast due to apps, social media, etc. Thus in my opinion it is necessary for local meteorologists to brand themselves beyond the forecast. Station scientist comes to mind; especially in topics like climate change and the environment. I think having this specialty is not only vital for broadcast meteorologists going forward, but also for the longer term viability of local news. Produce useful, interesting, quality content beyond just the 7 day. This next step in my life will help solidify this expertise for my sake and the station I work at next.

Am I scared? No, not really. I probably should be right? NYC is not cheap and neither is school. Not to mention living in a shoe box. It won't be the most comfortable for my wife and I who are advanced in years (Me, not her. Sorry Honey!). But I have lived in Manhattan before when I worked at WCBS. Plus I have never put much value on "things". I'd say I'm a bit of a minimalist. So with all that said, I am just simply excited to learn again, stop & smell the NYC bagel shops and emerge with new skills and hopefully better suited to contribute to the well-being of the world. I want to be sure, to the best of my ability, that I am making career decisions for the right reasons; not just to accept a paycheck. How I am going to make a positive contribution to society if I am not willing to step off the wheel and think critically about what's right for society's future and how I can live the change I hope to see. If I am ever going to accomplish even half of these lofty goals, I can't just talk, I have to walk. And therein lies the hope. What can I do as one person? Probably not much alone. But what I can I do if I plant enough seeds that blossom? Probably a whole lot more.

While In NYC I plan to continue doing TV weather as a freelancer and finding media opportunities to contribute on climate change. My biggest challenge will be finding creative ways to encourage more media coverage of a planet that is changing rapidly!
You can follow me on Facebook. com/JeffWeather and Twitter. com/WeatherProf. And if you have any questions, suggestions, collaborations to suggest please send me a note on one of those two mediums!

Thank you,
Jeff Berardelli

IABM PRESENTATION TO CBS TECO MARCH 2018

Broadcast Meteorology – what does it need from WMO?

The Commission for Basic Systems (CBS) of the World Meteorological Organisation met in Geneva at the end of March.

As an element of the opening session, a number of guest lectures were provided to members of the Commission from organisations outside the "circle" of National Meteorological and Hydrological Services (NMHSs).

These include presentations from The Weather Company/ IBM, from the International Air Transport Association (IATA) and from the IABM, represented in this instance by Jay Trobec of Keloland TV in South Dakota. As someone long active in affairs of both the IABM and the AMS, where he served as Commissioner for Professional Affairs for six years, Jay was an ideal person to represent our industry at the "top table" of world meteorology.
In his presentation, Jay gave an overview of weather broadcasting as a profession, emphasising the wide spread of backgrounds of those people who end up on-camera in front of a weather chart. Some come from the public sector, some from the private sector. Weather broadcasters are employed by TV stations, by NMHSs, by private sector weather service providers, or as independent contractors. He noted that weather broadcasters come into the profession with a mix of education and training, but increasingly tend to have a professional meteorological background.
Despite this great variety of training, backgrounds and employment, Jay noted that weather broadcasters had common experiences and needs, in attempting to bridge the gap between the worlds of meteorology and media. He emphasised that "knowing your audience" was a crucial skill for weather broadcasters, who would not last long on-air without it. The key skill of weather broadcasters was to assimilate a great amount of essentially scientific information and to weave this into a story that would have meaning for the audience; moreover a story that could be told in just 2 to 3 minutes!

One of the responsibilities of CBS within WMO is for the "Global Observing System" and Jay emphasised that it was fundamental to the work of weather broadcasters to have good access to weather data. Timeliness in access to this data was crucial, especially in cases of severe convective weather. Ease of access was also key; broadcasters did not have the time to look for data in many different places, but needed it all packaged and delivered in easy-to-use formats.

Turning to the question of training, Jay explained that weather broadcasters often work in rather solitary environments, so external support networks for both formal training and informal exchange of ideas and information were crucial. These needs were filled by organisation like the IABM, the AMS Broadcast Meteorology Chapter, the EMS Media Committee, and networks such as Climate without Borders and the Forum International Meteo. The AMS provided a certification process for weather broadcasters which was now

widely accepted within the industry in the USA.

Another development, primarily in the USA but increasingly now in other countries also, is the concept of the weather broadcaster as a "Station Scientist", who is expected to speak authoritatively on many scientific matters, but of course on the issue of climate change in particular. Jay explained that weather broadcasters are typically not trained or experienced in climatology, and so need help and support to properly interpret climate science for their audience. Climate Central are one organisation helping to bridge this gap and are doing a great job – but this is primarily aimed at the US community.

Added to this was the challenge of a rapidly-changing media, with so many new ways to deliver weather information – and weather broadcasters have had to adapt if they want to retain their audience. While TV is still a major source of weather information, and radio is also still very important, especially in the developing countries, the growth of social media and online blogs has greatly increased the number of outlets for, and the work of, the weather broadcaster. Jay emphasised that, despite the growth in online weather, the person who delivers that weather information is still important. People trust the weather broadcasters who they know from routine daily TV, and this trust is an asset when it comes to getting out the message at times of severe weather.

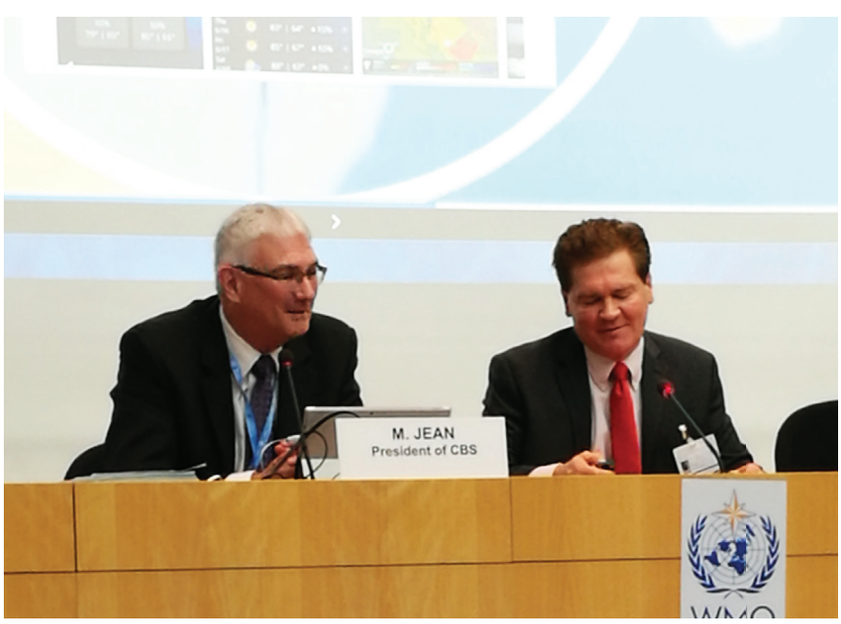
Jay then addressed the relationship between WMO and the weather broadcast community. This was a two-way relationship; weather broadcasters needed support from the WMO community but, in turn, could offer something back. The needs were summarised as:

o Data! Quick, timely, and easy access to weather data so that weather broadcasters can provide a first-class service to our audience
o Global professional standards for weather broadcasters, which can help us all to raise the level of our profession
o Organisation of training opportunities to back up those standards
o Organisation of CPD opportunities, especially those which bring weather broadcasters from different countries and different cultures together
o Clear, concise and digestible information on up-to-date climate science that weather broadcasters can use to inform and educate our audience.

What can the broadcast community offer WMO?
o Engagement with the users – knowing how to reach our audience
o Knowledge of how to work with media. Most weather broadcasters are deeply embedded in the media business and understand media, and the needs of media, thoroughly.
o Communication skill training. Weather broadcasters can help to provide training in communication skills to managers and leaders in meteorology (and have done so in the past through the IABM).
o Advice on where mass-market communication technologies are headed.

As WMO faces major changes and re-organisation, it will be important to keep the perspective of weather broadcasters to the forefront and ensure a continuing voice for our profession at the "WMO table". In making time in his busy schedule to travel to Geneva and address the Commission meeting, Jay has done all of us in our community a significant service.

Report by Gerald Fleming



ALL CHANGE AT THE WMO?

The World Meteorological Organisation has been in existence for almost 70 years; it was founded in 1950 and was itself built on the foundation of the "International Meteorological Organisation" which dated back to the latter decades of the 19th century, and some of the "founding fathers" of international meteorology such as Maury from the US Navy and Buys Ballot from the Netherlands.

While the WMO has changed and evolved over its seven decades, the basic structures established in the middle of the 20th century remain in place.

This looks set to change in the very near future - but before a description of the proposed changes, and the possible implications for the IABM, a brief account of the current WMO structures is in order. They are as follows:

Congress – Meteorology's big bash takes place once every four years in Geneva, and generally lasts for almost four weeks! Each member country of WMO (there are 191) sends a delegation, headed by that country's Permanent Representative (PR) with WMO – normally the head of the national Met Service. Congress-18, the next in a series that stretches back to 1951, will be held next year, in May 2019.

President – Congress elects a President, and three Vice-Presidents, to serve for a four-year term.

Executive Council – Congress also elects an Executive Council (EC) to oversee the affairs of WMO. EC meets annually and has 37 members, which includes the President and Vice Presidents, and also the presidents of the Regional Associations.

Secretary General – Congress also elects a Secretary General for the organisation, who serves as the head of the Secretariat, the body of fulltime WMO employees who are principally responsible for implementing the work of the organisation. The Secretary General serves for a four-year term, and can serve a maximum of two consecutive terms.

Regional Associations – The National Meteorological and Hydrological Services (NMHSs) of the world are divided into six Regions in WMO; Region I is Africa, Region II is Asia etc etc. The PRs of the relevant NMHSs serve as their country's representatives to the Regional Association (RA) meetings,

which themselves take place once every four years. Each Regional Association elects a President and Vice-President; the RA Presidents are ex-officio members of Executive Council.

Technical Commissions – This is where it gets a bit confusing. In addition to the Regional Associations, which divide the world of meteorology in geographical terms, there is a somewhat parallel structure which divides that same world by function. Technical Commissions (TCs) are gatherings of experts in the various fields that comprise meteorology. There are eight TCs in the current WMO structure:

CBS - Commission for Basic Systems
CAS - Commission for Atmospheric Sciences
CIMO - Commission for Instruments and Methods of Observation
CAeM - Commission for Aeronautical Meteorology
CAgM - Commission for Agricultural Meteorology
CCl - Commission for Climatology
CHy - Commission for Hydrology
JCOMM - Joint Commission for Marine Meteorology (with the Intergovernmental Oceanographic Commission)

As is evident, working with WMO requires one to become familiar with an "alphabet soup" of acronyms! The eight TCs together with the RAs coordinate the work of over 4,000 experts who sit on the almost 160 "Expert Teams" devoted to different aspects of WMO work. The work of these experts forms the core of WMOs expertise and authority, as they collectively establish standards and promote good practice and scientific progress across meteorology.

However the organisation and support of the meetings of these experts (there were almost 350 such meetings in 2015) represents a very sizeable cost to WMO, which typically pays the travel and accommodation costs involved.

In what is largely an attempt to contain these costs, the WMO Executive Council has now agreed proposals for Congress next year that amount to the biggest change in the history of the organisation.

The suggestion is to reduce the number of Technical Commissions from eight to just two; effectively one Commission for technical systems and another Commission for applications and services. This proposal is by no means accepted by all Members of the organisation, and the ensuing discussions at Congress next year (Congress will have the final say) will be interesting, to say the least.

In what way is all of this relevant to the IABM?? The principal contact point between the IABM and WMO down through the years has been the Public Weather Services (PWS) programme, which in terms of the current Commission structure relates to CBS, the Commission for Basic Systems (by far the largest Commission).

Under the proposed new TC structures, the PWS programme would relate to the Commission on Applications and Services, where the "public" side of weather forecasting would be joined with the aeronautical meteorologists, the agricultural meteorologists, the flood forecasters and marine forecasters, and the service-oriented elements of climatology. Would this be for the better?? Hard to say; there are many imponderables.

What this does emphasise is that the voice of broadcast meteorology should be heard loud and clear in this debate, and that means that the IABM must make a special effort to be present at Congress next year.

Our observer status with WMO gives us the privilege of a seat at Congress; the chance to air our views to the global meteorological community.

It is a privilege we should value.

Attending Congress is never cheap – Geneva is an expensive city – and that is why the IABM needs the active support of members, both in paying their subscriptions and in getting involved in the debates.

Report by Gerald Fleming

WORLD METEOROLOGICAL ORGANIZATION

WHY ARE ALL MY WEATHER APPS DIFFERENT?

Forecasting is more accurate than ever, but mobile apps can still disagree wildly. What causes the difference – and which one is best?

By Nic Fleming is a freelance science journalist writing in the The Guardian Newspaper

It was a tale of two storms. The first consisted of the rain and thunder forecast for Bournemouth, a holiday resort on the south coast of England, by the BBC weather app on the Saturday spring bank holiday. The second came when the first failed to materialise and a tourism manager in the town complained that visitors who stayed away could have come after all and enjoyed sunshine and blue skies.

This opportunity to rage at inaccurate forecasting, bash the BBC and highlight the grievances of small businesses did not go to waste. For the Sun Newspaper, it was a "blunderstorm". The Mail Newspaper gave voice to furious social media users whose weekend had been ruined by "crap forecasting" and "total incompetence". The Spectator even managed to use the row to take pot shots at climate-change predictions.

So, just another non-storm in a media teacup? Perhaps, yet the story highlights important questions about how technology is transforming both weather forecasting and our relationship with it. Is our ability to predict temperature, precipitation and wind speed improving? If so, how come forecasts can vary so widely depending on which smartphone apps we use? How long have human meteorologists got before supercomputers and artificial intelligence make them redundant? And when can we expect 100% accurate forecasts?

The foundation of modern weather forecasting involves gathering huge amounts of data on the state of the atmosphere and Earth's surface, such as temperature, humidity and wind conditions. Gaps in the data are filled by extrapolating from available observations and past forecasts. Forecast models consisting of sets of equations governing physical and chemical processes use this as a starting point to calculate future conditions.

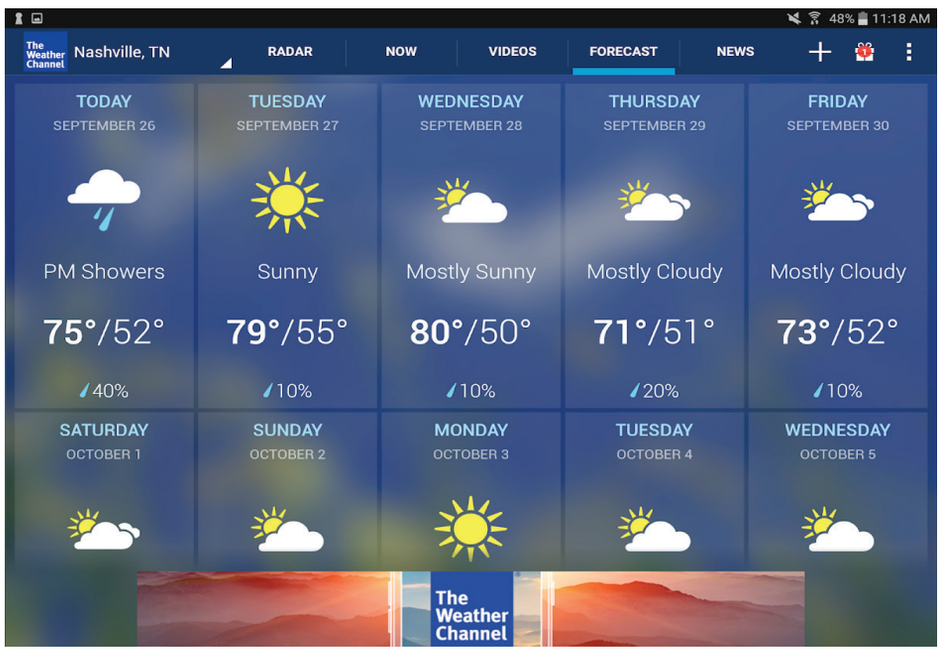
The impact of weather forecasting on human activities is hard to overstate. A 2011 study by the economist Jeffrey Lazo found that US GDP alone could vary by as much as $485bn (£366bn), depending on the weather. No wonder huge sums have been invested in improving predictive capabilities.

Meteorologists' ability to predict atmospheric pressures three to 10 days ahead has improved at a

rate of about one day per decade since 1981.

The number of weather observations has risen dramatically, along with their quality. The UK Met Office, for example, is integrating wind-speed data gathered from transponders carried by large aircraft for navigation purposes into its models. Nasa's GOES-16 satellite, declared operational in December, scans the Earth much more quickly and in greater resolution than previous satellites. In February, the UK completed a £10m upgrade of its rainfall radar network, allowing it to deliver five times more data than before.

All this data is fed into "petaflop" supercomputers capable of doing a thousand trillion calculations per second. These are needed because of the complexity of forecast models that approximate atmospheric processes. These models have become ever more complex as the science has advanced. The extra number-crunching firepower also enables "ensemble forecasting", whereby forecast models are run multiple times using slightly different starting data to explore the probabilities of various outcomes.



This combination of more data, bigger computers and better algorithms has delivered impressive results. A study published in Nature in 2015 found the ability of meteorologists to predict atmospheric pressures three to 10 days ahead had been improving at a rate of about one day per decade since 1981. The Met Office says its four-day air pressure forecasts are now almost as accurate as its one-day forecasts were three decades ago.

The digital revolution has transformed how we get and use weather forecasts. Smartphone apps offer highly localised predictions and wider time frames – from what will happen in the next hour to a fortnight's time. There are 8,000 apps with the word "weather" in their title for Android phones and 2,400 for iPhone users. With so much choice, how can non-experts work out which are most reliable?

Measuring forecasting accuracy is far from simple. What is most important – temperature, rain or wind conditions? Is average overall error most useful, or how often a prediction meets reality? ***"There are many, many ways to measure forecasting accuracy,"*** says Eric Floehr, founder of ForecastWatch, a US company that analyses the performance of weather providers. ***"Different forecasters perform better on different measures, longer or shorter timeframes or in certain geographical regions."***

A ForecastWatch report published last year compared the accuracy of six leading global forecast providers – AccuWeather, the Weather Channel, Weather Underground, Foreca, Intellicast and Dark Sky. The study covered one to five-day forecasts for 1,145 locations, including 29 in the UK, during 2016.

AccuWeather's predictions were best for temperature averages and highs, probability of precipitation and wind speed. The Weather Channel and Weather Underground came top

for low temperature predictions. Dark Sky came last in all these categories.

In the UK, the BBC app has the most users, followed by the Met Office's. In February, the BBC switched from using the Met Office to generate its app forecasts to MeteoGroup, a forecasting company owned by a US private equity group, on grounds, it says, of service quality and value for money.

Floehr provided the Observer with separate data on 12 forecasters covering 29 UK locations during 2017. In a composite measure of accuracy, the Weather Channel and Weather Underground came top, AccuWeather fifth, MeteoGroup (the BBC's new provider) sixth and the BBC ninth (based on Met Office forecasts). On the correct prediction of precipitation, MeteoGroup came fourth overall and the BBC 10th of the 12.

Most regular weather app users will be familiar with the dilemma of trying to decide which to believe when predictions disagree. Given the improved accuracy of forecasting in recent years, why is there still such wide variation between different providers?

Some forecasters can access more observations than others. And they use different algorithms based on different forecast models with different levels of detail. Some apps simply churn out computer models' predictions, others employ meteorologists to supervise and correct these, especially in unusual or extreme weather.

Which weather forecast should you believe?

"We have unique relationships with governments and companies that allow us to obtain the most relevant, real-time data, and use over 125 global, regional, national and local forecast models," says Jonathan Porter, a vice president at AccuWeather. ***"We're constantly integrating new datasets and enhancing our algorithms. Our human meteorologists provide an extra layer of expertise when needed."***

Even if the raw data coming out of algorithms used by different forecasters were identical, there could still be differences by the time their reached our screens. ***"One big difference between apps is what information they choose to show,"*** says Derrick Ryall, head of public weather service at the Met Office. ***"Some choose to simplify things while others put in a lot detail. A lot can come down to perception of accuracy."***

Statistician Nate Silver showed that forecasters' rain predictions tended to be pessimistic. Another source of difference between apps is that, contrary to what some might expect, accuracy is not the sole consideration. In his 2012 book The Signal and the Noise, US statistician Nate Silver highlighted how plotting forecasters' rain predictions against actual weather showed some consistently erred on the pessimistic side, especially at lower and higher probabilities of rain. ***"As a consumer you are going to be a lot more upset with a forecaster if you get rained on and forget your umbrella, than if you don't have to use the umbrella you took," says Floehr. "Because of this, some forecasters tend to over-forecast***

precipitation."

Some leading forecasters are now moving away from this approach. Peter Neilley, a senior vice president at the Weather Company says it stopped having a "wet bias" around three years ago. ***"Rather than trying to make judgments ubiquitously about what's important to people, we pay more attention to the probability of precipitation so people can make their own judgments,"*** he says.

The BBC app has faced widespread accusations of pessimism. It now includes hourly percentage chances of rain, which have caused confusion. ***"If you try to compare the weather symbol with just the probability of rain you won't always see a direct correlation because other elements have an influence on that symbol,"*** said Nikki Berry, a senior meteorologist at MeteoGroup. The BBC app sometimes displays a daily rain icon even when it predicts a less than 50% chance of rain during just one hour of that day. ***"We use the most significant or impactful weather on that day so people aren't caught out,"*** says Berry. She adds that those making important decisions based on forecasts should look beyond weather icons for more detail on the BBC website weather page.

As in many other spheres, advanced computers are increasingly muscling in on roles previously done by meteorologists. As faster processors take over the grunt work, forecasters are shifting towards the more complex aspects of their profession. "There is very little human touch to the forecasts people receive on their smartphones," says Floehr. ***"Meteorologists are increasingly focused on communicating forecasts, and helping people turn them into actionable intelligence. At some point in the next 10-20 years there will no longer be meteorologists in the forecast loop."***

However, those for whom the joy of complaining about the weather is only surpassed by a good moan about forecasters – whether in the media or not – can rest assured. Science tells us there is no such thing as a perfect weather forecast.

"To know everything about the weather you would need to model every single particle in the atmosphere and all interactions between them," says Neilley. ***"That isn't even theoretically possible, because the computer doing the modelling would generate heat and become part of the system, and then need modelling. Putting a thermometer in the air changes conditions a tiny bit. So no, weather forecasts will never be perfect."***

Smartphone data will soon be improving prediction accuracy Satellites have been key in driving better predictions one day and more ahead, but are less useful over shorter time scales. Barometers provide air pressure readings that can help signal imminent changes. Digital barometers have been included in some smartphones since 2011 to assist location tracking, and around 1bn smartphones can now measure air pressure. Prof Cliff Mass at the University of Washington has shown smartphone data can help improve the accuracy of short-term air pressure and rain forecasts. It could also help to predict wind changes. ***"Cellphone data could help us better predict things like thunderstorm initiation, and have a big impact in places where we have less data than we'd like,"*** says Mass, who is also using machine learning to improve the quality of smartphone air-pressure data. He is working with the Weather Company, which collects 250m pressure readings via its Weather Channel app.

Peter Neilley of the Weather Company said this data should be incorporated into its forecasts during 2019. Other forecasters, including Dark Sky, have also been experimenting with using smartphone air-pressure data.

EXTREME WEATHER PERSISTS IN JULY, WITH WIDESPREAD IMPACTS

Extreme weather, including record temperatures and heatwaves, drought and disastrous precipitation, has marked the first half of summer in the northern hemisphere. This has had widespread impacts on human health, agriculture, ecosystems and infrastructure and led to devastating wildfires.

The persistency of high temperatures in some regions – including northern Europe - has been due to a stationary high pressure system. This is common in summer in both Northern and Southern Hemispheres. The jet stream, a core of strong winds around 10 kilometers above the Earth's surface that blow from west to east and which steer weather around the globe – is generally slower in summer and occasionally become weaker than usual, then very settled weather occurs on the surface.

There is much scientific research into whether climate change and substantial changes to sea surface temperature, escalated by high multi-decadal natural variability, are contributing to more profound effect in altering the atmospheric circulation and so leading to more "blocking patterns."

Although it is not possible immediately to attribute individual heatwaves or extreme temperatures to human induced climate change, this is consistent with scientific scenarios (see below).

DROUGHT AND HEAT IN NORTHERN EUROPE

WMO's Regional Association for Europe's Climate Centre on Climate Monitoring, operated by the German Weather Service, DWD, issued a second Climate Watch advisory with guidance on drought and above normal temperatures valid from 19 July until 6 August. The guidance product, used by National Meteorological Services to issue national warnings and forecasts, referred to "a continuation of the drought situation and above-normal temperatures for at least the next two weeks for northern Europe (from Ireland to the Baltic States and southern Scandinavia).

"The weekly temperature anomalies are forecasted with up to +3 to +6°C (in the first week in parts +6 to +10°C). The probability that precipitation will be below the lower tercile is more than 70% in the first week and more than 50% in the second week. This drought may be accompanied by water scarcity, local thunderstorms, risks of wildfires and harvest losses since soil moisture is reduced," it said.

Amid an extended heatwave in Scandinavia, temperatures topped 30°C in the Arctic Circle. Norway saw a record temperature of 33.5°C in Badufoss on 17 July, and it reached 33.4°C in Kevo, Finland. Influenced by a warm wind, the far north of Norway (Makkaur) saw a new record minimum overnight temperature of 25.2°C on 18 July.

The heatwave followed an exceptionally dry and warm May in northern Europe, leading to a a sustained elevated risk of forest fires throughout Scandinavia and the Baltic region. Sweden reported about 50 forest fires burning in mid-July.

Deadly fires fanned by extremely high winds killed dozens of people near Athens on the night of 24 July in one of Greece's worst tragedies for years. The cause was not immediately known. Temperatures on 23 July reached about 38°C and there were strong west winds. Greece, however, has not witnessed below average precipitation so far this summer and so meteorological conditions in Greece cannot be compared to Scandinavia.

Ireland recorded heatwaves at 15 synoptic stations (5 consecutive days or more with maximum temperature over 25°C) and an absolute drought at all its stations.

The UK saw its driest first half of summer on record, with just 47 mm between 1 June and 16 July. The Met Office has said that the heatwave will continue across much of England this week, with temperatures peaking up to 32-34°C in a few places on Thursday or Friday.

The combination of little precipitation and sustained above-average temperatures impacted agricultural production (primarily cereals and hay), while water supply disruptions or restrictions are reported locally. No significant rain is expected until at least mid-July, nor are temperatures forecast to return at normal during the same month, according to the Copernicus European Drought Observatory. http://edo.jrc.ec.europa.eu/

Conversely, southern parts of Europe including parts of Spain, Italy, Greece and Turkey, have been witnessing below average temperatures and above average precipitation for the early part of summer.

The conditions were due to a persistent anticyclone, or high pressure, system blocked over northern Europe. Atmospheric blocking over the northern North Atlantic involves isolation of large regions of air from the westerly circulation for 5-14 days or more.

Atmospheric blocking alters normal climates across Europe and Russia by shifting storm tracks. Typically associated with an anticyclone, the zonal wind pattern known as the jet stream deviates from its mean position and its westerly winds reroute north and south of the anticyclone. Blocking is a typical winter weather phenomena, but it can also influence summer weather patterns as well and it could be linked to extremes such as Russian heat wave in 2010.

Recent analysis suggests that climate change from human activities, also called anthropogenic forcing, might indeed affect the characteristics of blocking events in the Euro-Asia sector, in particular leading to longer blocking episodes.

Another possible player in creating summer atmospheric blocking situations is the interaction between the atmosphere and the Atlantic ocean, which modulates sea surface temperature patterns on decadal time scales. These surface temperature patterns can influence the occurrence probability of summer blocking.

Extreme temperatures

An intense heatwave hit Japan. Within the nationwide observation network deployed by the Japan Meteorological Agency (JMA), 200 out of 927 stations recorded maximum temperature exceeding 35 degrees Celsius on 15 July. On 19 July, JMA issued a warning of very high temperatures from 24 July to 2 August. Kumagaya set a new maximum daily temperature record of 41.1°C, with Oume on 40.8°C on 23 July, according to JMA. Both are near Tokyo. The dangerously high temperatures and humidity came as Japan sought to recover from its worst flooding and landslide disasters in decades (see below)
While issuing warnings of dangerously high temperatures, JMA also produced "Weather Analysis Maps" showing meteorological conditions and temperatures, updated every hour.

The Korean Meteorological Administration issued a severe warning for several days that daily maximum temperatures will be more than 35 degrees, as a number of daily temperature records were broken.

Ouargla, in Algeria's Sahara Desert, reported a maximum temperature of 51.3°C on 5 July. It is likely that this is the highest reliable temperature ever recorded in Algeria. WMO's Weather and Climate Extremes Archive currently lists Kebili, Tunisia, as being Africa's highest temperature with 55°C recorded in July 1931. However, there have been questions about the reliability of colonial era temperature records in Africa.

On June 28, Quriyat, just south of Muscat, on the coast of Oman, recorded a 24-hour minimum temperature of 42.6°C, meaning that the coolest overnight temperature did not drop below that level. Although highest "low" temperature is not currently monitored as a category in the WMO Weather and Climate Extremes Archive, it is believed to be the highest such temperature ever recorded by a thermometer.

Many parts of North Africa saw a heatwave from 3 to 10 July. Morocco saw a new record of 43.4°C at Bouarfa on 3 July. High temperatures are also forecast for the week beginning 23 July.

The station of Furnace Creek in Death Valley national park in California, USA, recorded a temperature of 52.0°C on 8 July. The station holds the record for the highest recorded temperature on Earth at 56.7°C (134°F), on 10 July 1913.

Other parts of California were also gripped by extreme heat. Downtown Los Angeles set a new monthly July minimum overnight record of 26.1°C on 7 July. Chino, near Los Angeles, saw a record temperature of 48.9°C (120°F). Burbank airport set a new absolute record of 45.6°C (114°F) on 6 July, beating 45°C in 1971, and Van Nuys Airport saw a record temperature of 47.2°C (117°C) according to the US National Weather Service.

NWS issued an excessive heat warning for South East California and Southwest and South-Central Arizona, valid through 25 July. It said temperatures in Las Vegas valley may reach up to 46°C and Death Valley National Park 53°C.

In Canada, a heatwave combined with high humidity in the province of Quebec contributed to dozens of deaths, especially among the vulnerable and elderly.

At the same time, parts of Eastern Canada saw a brief return

of wintery weather, with snow in parts of Newfoundland and Cape Breton (Nova Scotia), and temperatures of -1C, in St John's and Halifax. Winter weather this late in the year is rare, this being the first since 1996."

Temperatures were exceptionally high over large parts of northern Siberia in June 2018. That trend continued through the first week of July. The Western Siberian Hydromet Center of Russia issued a storm warning due to temperatures of more than 30°C for more than five days, expected to last between 9 and 16 July. This creates high risks of wildfires as well as of power supply, transportation, and utility services disruptions and drowning of people escaping the heat in water. Krasnoyarsk Region reported daily anomalies of 7°C above average, with fires already impacting about 80,000 hectares of forest.

JUNE ONE OF THE WARMEST ON RECORD

Globally, June was the second warmest on record, according to the European Centre for Medium Range Weather Forecasts Copernicus Climate Change Service. The year to date is the hottest La Niña year on record.

In addition to the exceptionally high over large parts of northern Siberia in June 2018, temperatures were also well above average over much of the USA, central Canada and North Africa, and over the Middle East and northern China.

The contiguous USA had 3rd hottest June on record. But many parts of the country had well above average minimum overnight temperatures, according to the US National Centers for Environmental Information. In 2018 (as of July 9), there have been 6 weather and climate disaster events in the USA, with losses exceeding $1 billion each across the United States. These events included 4 severe storm events and 2 winter storm events. Overall, these events resulted in the deaths of 36 people and had significant economic effects on the areas impacted.

JAPAN HEAVY RAIN EVENT

Japan suffered the worst flooding and landslide in decades, with many daily rainfall records broken between 28 June and 8 July. According to official government figures, more than 200 people lost their lives. Around 10,000 houses have been destroyed and/or inundated.

Japan is one of the world's best prepared countries for disaster risk reduction and disaster management. JMA issued emergency warnings in advance, targeting as many as eleven prefectures in the country to alert people to the significant likelihood of catastrophes. The emergency warning system was launched by JMA in 2013, based on lessons from the major tsunami caused by the 2011 Great East Japan Earthquake. In addition, JMA dispatched its experts as the JMA Emergency Task Team or JETT, to local governments in the region to best support multi-hazard disaster prevention activities. It set up a web portal dedicated to the heavy rain event.

Between 28 June and 8 July, there was extraordinarily heavy rainfall caused by a huge amount of water vapor from a stationary rainy front, in addition to damp air remaining from Typhoon Prapiroon. West Japan and Hokkaido experienced record precipitation during the period, according to the Japan Meteorological Agency (JMA). Total precipitation at many observation sites reached two- to four times the mean monthly precipitation for July. For instance, 1,800 mm of rain fell in Shikoku, 1,200 mm in Tokai, 900 mm in North Kyushu, 600 mm in Kinki, and 500 mm in Chugoku. This triggered a large number of landslide, inundation and flood events.

RELATIONSHIP WITH CLIMATE CHANGE

Episodes of extreme heat and precipitation are increasing as a result of climate change. Although it is not possible to attribute the individual extreme events of June and July to climate change, they are compatible with the general long-term trend due to rising concentrations of greenhouse gases.

Many recent studies have found that the probability of the extreme event has been influenced by human activity, either directly or indirectly.. Of a set of 131 studies published between 2011 and 2016 in the Bulletin of the American Meteorological Society, 65% found that the event's probability was significantly affected by anthropogenic activities. In the case of some extreme high temperatures, the probability increased by a factor of ten or more.

It has been more difficult to identify anthropogenic influence in the attribution of precipitation extremes. Whilst some studies have found that the probability of some extreme precipitation events was increased, most often indirectly, by climate change, for many other studies the results have been inconclusive. This is because the underlying long-term climate signal in extreme precipitation is less clear than it is for temperature and, because

extreme precipitation events typically occur on shorter spatial scales than extreme temperature events. At present, attribution studies are mostly carried out in research mode in peer-reviewed literature.

The IPCC 2012 Special Report on Extreme Events anticipates for example that "it is likely that the frequency of heavy precipitation or the proportion of total rainfall from heavy falls will increase in this century over many areas of the globe" and that "a 1-in-20 year annual maximum daily precipitation amount is likely to become a 1-in-5 to 1-in-15 year event by the end of the 21st century in many regions".

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HEATWAVE MADE MORE THAN TWICE AS LIKELY BY CLIMATE CHANGE, SCIENTISTS FIND

by Damian Carrington Environment editor

Fingerprints of global warming clear, they say, after comparing northern Europe's scorching summer with records and computer models

The heatwave searing northern Europe was made more than twice as likely by climate change, according to a rapid assessment by scientists.

The result is preliminary but they say the signal of climate change is "unambiguous". Scientists have long predicted that global warming is ramping up the number and intensity of heatwaves, with events even worse than current one set to strike every other year by the 2040s.

"The logic that climate change will do this is inescapable – the world is becoming warmer, and so heatwaves like this are becoming more common," said Friederike Otto, at the University of Oxford and part of the World Weather Attribution (WWA) consortium that did the work.

"What was once regarded as unusually warm weather will become commonplace, and in some cases, it already has," she said. "So this is something that society can and should prepare for. But equally there is no doubt

that we can and should constrain the increasing likelihood of all kinds of extreme weather events by restricting greenhouse gas emissions as sharply as possible."

The new analysis is a climate-change attribution study. By comparing extreme weather with historical measurements and with computer models of a climate unaltered by carbon emissions, researchers can find how much global warming is increasing the risk of dangerous weather.

The researchers analysed records of the hottest three-day period at seven weather stations in northern Europe, from Ireland to the Netherlands to Scandinavia, where data was easily accessible.

Why is it so hot?

"We found that for the weather station in the far north, in the Arctic Circle, the current heatwave is just extraordinary – unprecedented in the historical record," said Geert Jan van Oldenborgh, at the Royal Netherlands Meteorological Institute and also part of WWA.

Across northern Europe, the group found global warming more than doubled the risk of scorching temperatures. *"We can can see the fingerprints of climate change on local extremes," he said. "It is amazing now that it is something you can really see at a local level." "Most heatwave studies have been done on large scale averages, so European-wide temperatures,"* said Otto. "In this study, we have looked at individual locations, where people live, to represent the heatwave people are actually experiencing." The analysis is a preliminary study as a full study requires many climate models to be run on high-powered computers, which takes months.

Previous attribution analyses have shown very strong connections between climate change and extreme weather events. The scorching summer in New South Wales, Australia, in 2016-17 was made at least 50 times more likely by global warming, meaning it can be "linked directly to climate change", said the scientists.

The "Lucifer" heatwave across Europe's Mediterranean nations in 2017 summer was made at least 10 times more likely by climate change, while the unprecedented deluge delivered in the US by Hurricane Harvey also in 2017 was made three times more likely by climate change, new research has found. However, other events, such as storms Eleanor and Friederike, which hit western Europe in January, were not made more likely by climate change, according to the scientists.

In Europe, the heatwave has been caused by the stalling of the jet stream wind, which usually funnels cool Atlantic weather over the continent. This has left hot, dry air in place for two months – far longer than than usual. The stalling of the northern hemisphere jet stream is being increasingly firmly linked to global warming, in particular to the rapid heating of the Arctic and resulting loss of sea ice.

The role of climate change in driving extreme weather events may actually be underestimated by these attribution studies, according to Prof Michael E Mann at Penn State University in the US. The work is good, he said, but computer models cannot yet reliably account for the complex jet stream changes caused by global warming, making the attribution studies "inherently conservative".

Serious climate change is *"unfolding before our eyes"*, said Prof Rowan Sutton, director of climate research at the University of Reading. *"No one should be in the slightest surprised that we are seeing very serious heatwaves and associated impacts in many parts of the world."*

The wide geographical spread of the heatwave, right across four continents, points to global warming as the culprit, said Prof Peter Stott, a science fellow at the UK's Met Office: *"That pattern is something we wouldn't be seeing without climate change."*

Why is Europe going through a heatwave?

The heatwave across northern Europe has seen wildfires in the Arctic Circle and prolonged heat across the UK and the European continent. In the south, fierce blazes have devastated parts of Greece, with scores of people killed.

But extreme weather has struck across the globe. Severe floods killed at least 220 people in Japan in early July, with the nation then hit by an "unprecedented" heatwave that peaked at 41.1C and left 35,000 people in hospital. In the US, extreme heat in the west is feeding wildfires, with Yosemite national park being evacuated, while flooding is affecting the east. Temperature records have also fallen in Taiwan, with a temperature of 40.3C in Tianxiang, and in Ouargla in Algeria's Sahara desert, which reported a maximum temperature of 51.3C, the highest temperature ever reliably recorded in Africa. The first six months of the 2018 are the hottest recorded for any year without an El Niño event, a natural climate cycle that raises temperatures.

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ARCTIC CLIMATE RESEARCHER POINTS TO THE RAPIDLY WARMING ARCTIC FOR EXPLANATION OF GLOBAL HEATWAVE

Allison Chandler · © CBC News

IT'S BEEN A HOT JULY.

Wildfires in Greece killed at least 83, Sweden is desperately fighting fires above the Arctic circle, heat waves have struck everywhere from the U.K. to Siberia, and at least 70 deaths in Quebec in July were linked to the heat.

If we want to understand what's driving this heat wave-and if we should expect more of the same, we need to look northward, according to Dr. Jennifer Francis, research professor in Marine and Coastal Sciences at Rutgers University.

Francis has been studying Arctic climate her entire career, and has authored and co-authored dozens of articles in peer-reviewed publications on the subject since the 1990s.

"***The basic story is that because the Arctic is warming so much faster than everywhere else, it's having an effect on mid-latitude weather,***" she told CBC.

According to Francis, weather patterns can stall in certain areas prolonging an intense heat wave, for example - if the jet stream gets too weak.

She describes the jet stream as a fast-moving current of air flowing across the northern hemisphere, passing over mid and northern Canada. It's caused by the collisions between frigid, descending air moving southward from the Arctic, and rising warm air coming from the equator.

"***The temperature difference between the Arctic and areas farther south is what drives the winds of the jet stream,***" Francis said. ***"That jet stream, she said, helps create weather patterns. When the jet stream encounters a mountain range, for example, when the winds are strong, it doesn't really care," she said. "It blows right by just like a strong river of water will tend to go right over a boulder in the stream. But when the winds are weak, it's more easily deflected from its path."***

"***This creates weather patterns on the surface that tend to also get stuck in one place for a long time."***

Given that the Arctic is warming at least twice as fast as anywhere else in the world, Francis says the temperature difference between Arctic and equatorial winds becomes smaller and smaller.

This is "***weakening the winds of the jet stream,***" she said. "***This creates weather patterns on the surface that tend to also get stuck in one place for a long time.***"

Francis says while this research isn't conclusive yet, the science is "***pretty well-settled. We can't finger point directly at the Arctic to say that this summer's crazy weather is directly related to the rapid warming up there, but it certainly fits the story that we've been putting together over the last several years.***"

RUNAWAY WARMING COULD PUSH THE WORLD INTO A 'HOTHOUSE EARTH' STATE AND CAUSE SEA LEVELS TO RISE BY ALMOST 200 FEET IN JUST A MATTER OF DECADES, STUDY WARNS

By PRESS ASSOCIATION

Earth may be decades away from a climatic tipping point that triggers runaway global warming and threatens the future of humanity, scientists have warned.

The threshold will be reached when average global temperatures are only around 2C higher than they were in pre-industrial times, new research suggests. They are already 1C higher, and rising. Feedback mechanisms acting 'like a row of dominoes' will then spin the world into a 'Hothouse Earth' state of uncontrollable climate change.

Long term, the Hothouse Earth climate will stabilize at a global average of 4C-5C above pre-industrial levels, the study shows.

Earth may be decades away from a climatic tipping point that triggers runaway global warming and threatens the future of humanity, scientists have warned. The threshold will be reached when average global temperatures are only around 2C higher than in pre-industrial times If that happened, swathes of the planet around the equator will become uninhabitable, with sea levels up to 60 metres (197ft) higher than they are today threatening coastal cities.

A Hothouse Earth would pose 'severe risks for health, economies, political stability, and ultimately, the habitability of the planet for humans', the international scientists wrote in the journal Proceedings of the National Academy of Sciences.

The research highlighted 10 feedback processes that were predicted to kick in at around 2C of global warming. The 'tipping elements' could turn natural carbon storage systems or 'sinks' into powerful greenhouse gas emitters.

Professor Johan Rockstrom, a leading member of the team from the University of Stockholm, Sweden, said: 'These tipping elements can potentially act like a row of dominoes.

'Once one is pushed over, it pushes Earth towards another. It may be very difficult or impossible to stop the whole row of dominoes from tumbling over. 'Places on Earth will become uninhabitable if Hothouse Earth becomes the reality.' Scientists have warned catastrophic climate change. Feedback mechanisms acting 'like a row of dominoes' will spin the world into a 'Hothouse Earth' state of uncontrollable change

WHAT ARE THE KEY GOALS OF THE PARIS CLIMATE AGREEMENT?

The Paris Agreement on Climate Change has four main goals with regards to reducing emissions:
1) A long-term goal of keeping the increase in global average temperature to well below 2°C above pre-industrial levels
2) To aim to limit the increase to 1.5°C, since this would significantly reduce risks and the impacts of climate change
3) Goverments agreed on the need for global emissions to peak as soon as possible, recognising that this will take longer for developing countries
4) To undertake rapid reductions thereafter in accordance with the best available science

The tipping point dangers were identified as thawing permafrost,

the release of methane trapped on the ocean floor, weakening land and ocean carbon sinks, increased carbon dioxide production by ocean bacteria, Amazon rainforest die-back, coniferous forest die-back, reduced northern hemisphere snow cover, loss of Arctic summer sea ice, reduced Antarctic sea ice and melting polar ice sheets.

The scientists wrote: ***'Our analysis suggests that the Earth system may be approaching a planetary threshold that could lock in a continuing rapid pathway toward much hotter conditions – Hothouse Earth.***

'This pathway would be propelled by strong, intrinsic, biogeophysical feedbacks difficult to influence by human actions, a pathway that could not be reversed, steered or substantially slowed.

'Where such a threshold might be is uncertain, but it could be only decades ahead at a temperature rise of (around) 2C above pre-industrial.' Avoiding a Hothouse Earth would require 'deep cuts' in greenhouse gas emissions as well as concerted efforts to remove carbon dioxide from the atmosphere, both by preserving natural carbon sinks and using technology, said the researchers.

A Hothouse Earth would pose 'severe risks for health, economies, political stability, and ultimately, the habitability of the planet for humans', the international scientists wrote in the journal Proceedings of the National Academy of Sciences

HOW MUCH WILL SEA LEVELS RISE IN THE NEXT FEW CENTURIES?

Global sea levels could rise as much as 1.2 metres (4 feet) by 2300 even if we meet the 2015 Paris climate goals, scientists have warned.

The long-term change will be driven by a thaw of ice from Greenland to Antarctica that is set to re-draw global coastlines.

Sea level rise threatens cities from Shanghai to London, to low-lying swathes of Florida or Bangladesh, and to entire nations such as the Maldives.

It is vital that we curb emissions as soon as possible to avoid an even greater rise, a German-led team of researchers said in a new report. By 2300, the report projected that sea levels would gain by 0.7-1.2 metres, even if almost 200 nations fully meet goals under the 2015 Paris Agreement.

Targets set by the accords include cutting greenhouse gas emissions to net zero in the second half of this century. Ocean levels will rise inexorably because heat-trapping industrial gases already emitted will linger in the atmosphere, melting more ice, it said. In addition, water naturally expands as it warms above four degrees Celsius (39.2°F).

The report also found that every five years of delay beyond 2020 in peaking global emissions would mean an extra 20 centimetres (8 inches) of sea level rise by 2300. 'Sea level is often communicated as a really slow process that you can't do much about ... but the next 30 years really matter,' lead author Dr Matthias Mengel, of the Potsdam Institute for Climate Impact Research, in Potsdam, Germany, told Reuters. None of the nearly 200 governments to sign the Paris Accords are on track to meet its pledges.

Commenting on the findings, climate researcher Dr Phil Williamson, from the University of East Anglia, said: ***'In the context of the summer of 2018, this is definitely not a case of crying wolf, raising a false alarm. The wolves are now in sight.'***

Chris Rapley, Professor of Climate Science at University College London said: 'Previous research has shown that an increase in the mean global temperature of 11-12C would make more than half of the land area currently occupied by humans uninhabitable.

So, a 'runaway' warming to a new and uncontrollable hot state would represent an existential threat to humanity and the majority of existing species.'

THE HEAT IS ON FOR 4 MORE YEARS: EXTREME TEMPERATURES EXPECTED THROUGH 2022

Doyle Rice USA TODAY

A new study predicts global temperatures will be abnormally hot from 2018-2022.
© François Lamidon (flamidon.com)

This summer's heat has shattered records around the Northern Hemisphere, from Algeria to Canada and Japan to California.

New research suggests this could be only the beginning of a four-year global "warm spell."
Using a new forecasting technique, scientists in a study published Tuesday predict that the rest of 2018 through 2022 may be warmer than expected around the world as human-caused global warming and natural factors combine to heat the planet.

"The coming warm period is associated with an increased likelihood of intense to extreme temperatures," the study says.
Scientists say that although the Earth will be warmer than average overall, it may not be hot everywhere for everyone:
"We are not predicting another heat wave – a warmer year doesn't always mean (that)," study lead author Florian Sevellec told Deutsche Welle.
"That's because the forecast only covers global mean temperatures, not regional temperatures in certain parts of the world."

The past four years have been the Earth's four warmest on record (2016, 2017, 2015 and 2014, respectively).
Man-caused climate change, aka global warming, is caused by greenhouse gas emissions from the burning of fossil fuels such as coal, oil and gas.

Though the overall trend is for rising temperatures, warming does not occur in a straight line and can wobble from year to year. ***"Global warming is not a smooth, monotonous process,"*** the study says.

Scientists say the warming trend appeared to lapse in the early 21st century, a phenomenon known as a global warming "hiatus."

The researchers built their forecasting system by statistical "hind-casting," according to The Guardian. This crunches the data from previous climate models to measure which combination was most effective in predicting past temperature trends.

Looking back, the study successfully recreated that so-called hiatus, meaning it has some skill at seeing bumps in the overall warming trend.

More: California had its hottest month on record. Death Valley had world's hottest month ever

More: Hothouse Earth: Runaway global warming threatens 'habitability of the planet for humans'

More: Global heat, fires and floods: How much did climate change fuel that hellish July?

Weather.us meteorologist Ryan Maue, who was not involved in the research, wonders whether the study ***"was really telling us anything new. The methodology is a statistical fit to previous (historical) data and climate model scenarios."***

In addition, he says, ***"there are no physics here – no El Niño or ocean dynamics."***

"The extreme warmth of … 2016 was caused by the strong El Niño, and we have been 'stepped up' at the global temperature level now for two to three years," Maue says. "Thus, to skillfully predict global temperatures, you need to replicate the mechanisms that are actually changing the global temperature (such as El Niño)."

The study's predicted warmth is not a sure thing: The research says there's a 58 percent chance that the world's temperature over the next four years will be unusually warm. There's a 69 percent chance the oceans will be warmer than normal.

Beyond 2022, forecasts are blurry, according to Deutsche Welle. The model simply does not function well when looking further into the future, said Sevellec, a scientist at France's National Center for Scientific Research.

The study was published in the peer-reviewed British journal Nature Communications.

WHEN IS A HEATWAVE A HEATWAVE?

There is no precise definition of a heatwave but it is generally taken to be a period of a few days during which the daytime maximum and night-time minimum temperatures are unusually high for a particular location.

Quite often, as in the recent situation, heatwaves occur because the jetstream (a band of strong winds blowing eastwards high in the atmosphere) weakens and becomes more wavy, or even splits into two.

This can result in the weather systems that it normally drives round the globe getting stuck – as has happened over the past few weeks.

Waves in the northern hemisphere jetstream placed the high pressure, hot and dry weather systems over western Europe, the Middle East, north Asia and North America.

Weather is intrinsically variable - there will always be hotter and cooler periods - so although, by definition, heatwaves sit outside normal conditions, they are nothing new.

A memorable heatwave took place in the United Kingdom during the summer of 1976, which saw exceptionally high temperatures for over two weeks, exacerbating a drought of many months standing.

That year, however, did not see the same conditions occurring over many places in the northern hemisphere, as we have seen in 2018.

Running the IABM

Some of you who receive UP FRONT have, in the past, been active members of the Association, and have contributed membership fees. Others of you have never joined. In recent years the numbers of active members has fallen, as much because of our own administrative weaknesses in dispatching reminders as for any failings among our members.

All of the officers and committee of the Association give of their own time and talents to keep the IABM alive, but there is never enough time for all that has to be done. Costs have been cut to the bone to make sure that every dollar and euro of membership subscription is put to good use.

As you will see in the account of the AMS meeting in Austin elsewhere in this edition, there is a growing engagement, globally, between the different sectors of meteorology – public, private and academic. Both the World Meteorological Organisation and the World Bank are promoting and facilitating this engagement, in an effort to improve partnerships across our industry.

The IABM, as the representative organisation for broadcast meteorology, needs to participate fully in this engagement, to ensure that the perspective of weather broadcasters is fully articulated and understood.

For this reason we are asking all of our readers be they active members, inactive members or others - to contribute by remitting the modest 2018 membership fees for our organisation. Payment is easy via our website, at www.iabm.org

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The American Meteorological Society (AMS) would like to share its free monthly newsletter AMS Soundings with members of the IABM.

Each edition includes news, profiles, awards, special articles, important dates, and other great information about all that's going on with AMS, its work, and the weather, water, and climate community. AMS is committed to strengthening the incredible work being done across the public, private, and academic sectors. Our community knows that collaboration and information sharing are critical to ensuring that society benefits from the best, most current scientific knowledge and understanding available.

To view the latest issue and to find out how to subscribe, visit the AMS Web site at https://www.ametsoc.org/ams/index.cfm/email-subscriptions/ams-soundings-monthly-newsletter/.

The editor of UP FRONT welcomes your contibutions. Please email to secretary@iabm.org. Plain text is fine and any photos you may also have to support your article.