

Hot Air in the Orient

The Middle East and North Africa are currently being rocked by armed conflicts and political crises. But even if these were to be resolved, many people there will likely be forced to leave their homes in the coming decades. **Jos Lelieveld**, Director at the **Max Planck Institute for Chemistry** in Mainz, and his colleagues are predicting that the region will see dramatic climate change and an increase in air pollution, including airborne desert dust.

TEXT **PETER HERGERSBERG**

Heat and drought: Faten, a Syrian farmer, sees these, too, as a contributing factor to the demonstrations that quickly escalated into a civil war in Syria. Speaking with the *New York Times* in 2013, she described what had happened in the years preceding the protests: she and her husband had cultivated grain and vegetables on their land, and thanks to the rainfall, had always had good harvests. “But then suddenly the drought came,” said Faten, who asked not to be quoted with her full name. “The country became a desert.”

Then she angrily explained about how the government ignored her pleas for aid. Her family, like countless other farmers, had no choice but to move to a city and seek work there. Some one million people left their homes during the drought. Particularly young men who had hopes of studying or getting married were hit hard by this. It was also the drought and the unemployment that consequently drove the people to revolution, she says: “When the first calls of ‘Allahu akbar’ then sounded, we all joined the revolution – immediately.”

“Climate factors are probably not the most important aspects in the Syrian conflict,” says Jos Lelieveld, Director at the Max Planck Institute for Chemistry in Mainz. “But the years of drought and the crop failures contributed to the resentment that led to the devastating civil war.” American climate researchers drew the same conclusion in the journal *PNAS* – with all due consideration given to the caution required when analyzing the causes of civil wars. The war in Syria, despite being based primarily on political, ethnic and religious issues, thus became a warning



A reason to go: Rising heat and more frequent sandstorms could force people in many regions of the Middle East and North Africa to leave their homes.

sign for the tragedy that climate change can bring particularly to countries in the Middle East and North Africa. When global warming destroys the foundation on which people build their lives, armed conflicts, migration and displacement are nearly inevitable.

The signs that this is how it will play out are multiplying. Heat records have regularly been broken in the Middle East in recent years. "This past summer, public sector employees in Iraq were sent home because it was just too hot to work," says Lelieveld. And that's just the beginning, as was made alarmingly

clear by a joint study he published in 2013 with researchers at The Cyprus Institute in Nicosia, where he also holds a professorship.

26 CLIMATE MODELS PRODUCED THE SAME FINDINGS

In this study, the researchers used a regional climate model for 18 cities in the eastern Mediterranean and the Middle East – from Athens to Riyadh – to calculate how the extreme temperatures will increase there. They recently substantiated and expanded these

projections to cover the entire Middle East and North African region. They simulated which temperatures can be expected there for the periods from 2046 to 2065 and from 2081 to 2100, in each case once for the summer months June, July and August, and once for the months December, January and February.

All 26 climate models the researchers used for their calculations – the predictions of which also form the basis for the report of the Intergovernmental Panel on Climate Change – produced the same findings: large parts of the



Left Jos Lelieveld hopes that his research will lay the scientific foundation for curbing climate change, or at least attenuating and adapting to its consequences.

Right The Middle East and North Africa are already seeing sandstorms and hot days, such as in Kuwait (top). If global greenhouse gas emissions continue to grow at the current rate, average temperatures in winter will rise by about 2 to 3 degrees Celsius (bottom left) and in summer by about 5 degrees Celsius (bottom right) by mid-century. In the dotted areas, the model calculations are in nearly complete agreement; the crosshatching indicates extensive agreement.

Middle East and North Africa can expect an extremely hot future. Accordingly, from Morocco to Iran and from Turkey to Saudi Arabia, as well as in southern Europe, climate change will have the strongest impact in the months June, July and August, when it is already very hot anyway. In that respect, this region differs from many other parts of the world, where global warming is most noticeable in winter.

According to the calculations, some regions will see an increase in average summer temperatures of about 4 degrees Celsius by mid-century – even if the average global temperature rise is limited to two degrees, in line with the goal set by the community of states at the most recent world climate summits. If humans continue to emit greenhouse gases at the current rate, then between 2081 and 2100, the average temperature will even be more than six degrees higher than at the turn of the last century.

What that means is hardly conveyed in the mere value of the average

temperature increase. Around the year 2000, the daytime temperature was already reaching 43 degrees, but mostly fell to below 30 degrees at night. These temperatures seem downright mild compared with what is yet to come: by mid-century, mean daytime temperatures will reach around 47 degrees and more on particularly hot days, and won't drop below 30 degrees at night.

200 UNUSUALLY HOT DAYS PER YEAR

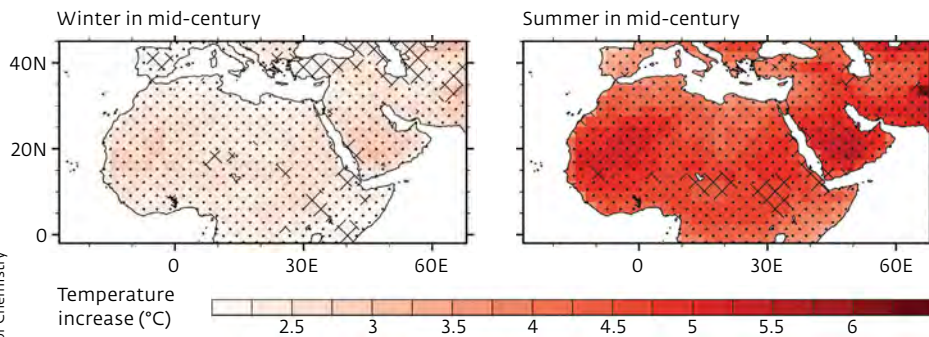
If humans manage to reduce carbon dioxide emissions in the second half of the century, the extreme temperatures will persist at about this level from 2050 on. However, if people continue to release greenhouse gases into the atmosphere unabated, then toward the end of the century we will see temperatures soaring as high as 50 degrees at midday, and still above 34 degrees at night.

Heatwaves will become more frequent. If humans don't curb their carbon dioxide emissions, we will see pe-

riods of extreme heat ten times more frequently than at the start of the 21st century, and they will last much longer. "The people in the Middle East and North Africa will then have to expect about 200 unusually hot days per year toward the end of the 21st century," explains Panos Hadjinicolaou, a climate researcher at The Cyprus Institute. And even if we emit fewer greenhouse gases worldwide from 2040 on, around mid-century, heatwaves will last the entire summer.

Between 1986 and 2005, people didn't have to endure extremely high temperatures for more than about two weeks at a time. However, meteorological data shows that the number of extremely hot days has already more than doubled in recent decades.

Of course, predictions always entail uncertainties. For the predictions the research team made for the Middle East and North Africa, however, the uncertainties are very minor. The researchers tested the reliability of the model calculations by also simulating tempera-



ture development for the Middle East and North Africa for the period from 1986 to 2005. The models reproduced it very accurately.

The development that extreme temperatures will force people to leave their homes also, of course, can't be predicted with absolute certainty. However, the point at which temperatures become unbearable isn't only a matter of personal perception; it is also one of physics: when temperature and humidity rise too severely, the human body can no longer maintain its normal tem-

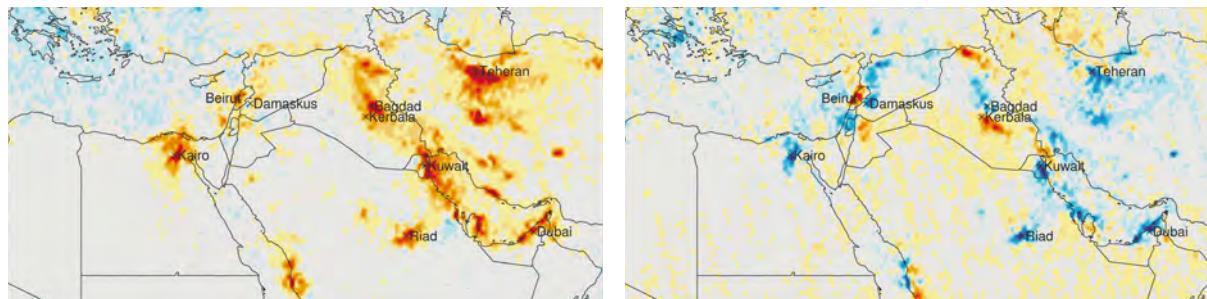
perature of 37 degrees solely through evaporative cooling by perspiration.

As two researchers at Loyola Marymount University in Los Angeles and MIT in Cambridge recently calculated, this will become more and more frequent in the Persian Gulf toward the end of the century. This is because humidity is high near the water, and in addition, according to the calculations of the two US researchers, daily maximum temperatures there will exceed 50 degrees Celsius in some areas. And this prediction isn't just for the distant fu-

ture: a record temperature of 54 degrees was already measured in Kuwait in summer 2016.

Jos Lelieveld is therefore certain: "Climate change will continue to significantly worsen living conditions in the Middle East and North Africa. Protracted heatwaves and sandstorms may make some areas uninhabitable, which will surely increase pressure to migrate."

As a result of increasing heat and drought, strong winds will raise more dust in the future, posing a growing life-threatening danger to people who get caught in a sand and dust storm. In addition, these storms are the most important reason why the concentrations of particulate matter in Saudi Arabia, Iraq and Syria have already risen sharply in recent years: 70 percent between 2000 and 2015. This was confirmed, based on satellite data, by a research team that included scientists from the Max Planck Institute in Mainz and, again, researchers from The Cyprus Institute, as well as from King Abdullah University in Saudi Ara-



Signs of crisis: While nitrogen dioxide emissions rose across nearly the entire Middle East from 2005 to 2010 (left), they fell in many regions between 2010 and 2014 (right). The colors indicate the changes in the concentration of nitrogen dioxide during the period under review – yellow and red signify an increase in the concentration, blue a decrease.

bia. Particulate matter is one of the nastiest air pollutants, because it causes respiratory and cardiovascular diseases and lung cancer.

Heat, drought and air that make breathing a health hazard will make the zone from the southern and eastern Mediterranean to the Gulf region a focal point of climate change. That worries Jos Lelieveld. “The aim of our research is to form the scientific basis for key decisions,” says the Max Planck Director. Only when scientists have thoroughly demonstrated and understood the changes can they provide the information that will allow policy and decision makers to curb climate change or at least attenuate and adapt to its consequences.

His additional position at The Cyprus Institute gives Jos Lelieveld a foothold in a region where global warming is a very hot issue. “Cyprus is part of the European Union, but it is much closer to the Middle East than it is to Europe,” he says. In the past several years, Lelieveld has repeatedly used the location to launch, together with his colleagues in Nicosia, studies on climate change and air pollution in the region. The researchers regularly cooperate with colleagues from other affected countries, such as Jordan, Egypt, Israel, Lebanon and Saudi Arabia. “This ensures that the knowledge and awareness of how severe the changes and their consequences are

will grow in these countries as well,” says Lelieveld.

FEWER NITROGEN OXIDES WHERE PEOPLE HAD TO FLEE

For instance, the staff at the Max Planck Institute in Mainz, together with a researcher from King Abdullah University, analyzed satellite data to investigate how nitrogen oxide concentrations developed in the Middle East between 2005 and 2014. According to their findings, nitrogen oxide emissions rose nearly everywhere in the region up through 2010, in parallel with economic growth.

After 2010, concentrations dropped in many areas, but that was seldom a good sign: it happened primarily in areas where armed conflicts and political crises stalled the economy and people had to flee. Conversely, nitrogen oxide pollution rose sharply in the areas where those who were displaced sought

refuge. “It is tragic that, to some extent, the negative nitrogen oxide emissions trends we observed, although good for air quality, relate to humanitarian disasters,” says Jos Lelieveld. Only in a few exceptional cases, such as in Israel and near the Persian Gulf, did stricter environmental laws lead to a reduction of nitrogen oxides in the air.

Jos Lelieveld hopes that his work will also help other governments develop environmental policies that will allow them to respond to the long-term threats posed by air pollution and climate change. He envisions a future in which the acute crises and conflicts have come to an end: “Of course there are, in some countries in this region, other problems that currently take higher priority.” Hopefully this will not remain the case for much longer – so that opportunities can be pursued to counter the scorching heat and poor air quality. ◀

TO THE POINT

- In the Middle East and North Africa, climate change is already causing longer hot periods and higher extreme temperatures. These effects will intensify in the coming decades.
- Climate change is also causing an increase in air pollution, especially fine particulate matter concentrations.
- Extreme heatwaves and increasing air pollution could compromise habitability in many regions of the Middle East and North Africa.

“Politics must invest in adaptation”

Walter Kälin is Professor Emeritus at the University of Bern Institute of Public Law. He is a dedicated human rights advocate with a particular focus on matters of migration and displacement. He served as Representative of the UN Secretary-General on the human rights of internally displaced persons and as envoy of the chairmanship of the Nansen Initiative for disaster-induced cross-border displacement. We spoke with him about the impact of climate change on migration and the possibilities for protecting people displaced across borders by the effects of climate change.

Professor Kälin, what role do changes in climate currently play as a cause of migration?

Walter Kälin: We know that, since 2008, some 22 million people have had to flee each year, at least temporarily, due to sudden weather events such as storms and floods. However, we don't know how many of those seek refuge abroad. We also don't know how many come to us due to gradual changes in climate, such as droughts and rising sea levels, because no one is going to mention drought as grounds for asylum, as prevailing law grants protection only to war refugees and victims of political persecution.

Should we expect a significant increase in climate refugees from North Africa and the Middle East in the coming decades because it is becoming too hot there?

I would first like to say that the term climate refugee is rarely used any more in the social and legal sciences.

Why?

These people aren't refugees in the legal sense because there is no element of persecution or danger due to human violence. In addition, many of those affected also reject the term. I recently participated in consultations on the Pacific island of Kiribati. There, a representative of an NGO told us very clearly: "We don't want to become refugees! Refugees are marginalized and must rely on humanitarian aid. Therefore, if we have to leave our islands, we want to be able to choose when and where we go." Rather than climate refugees, we speak of disaster-displaced persons.

What exactly is the difference between the two terms?

The term disaster accounts for the human factor – a natural disaster is defined as an event that causes damage that exceeds what a nation or the population can cope with. Displacement in such situations is always multicausal and thus also dependent on human factors.

What does that mean for the question of whether climate change and extreme heatwaves in North Africa and the Middle East will lead to more migration there?

The number of disaster-displaced persons will certainly rise, especially if we do nothing, but exact forecasts are difficult.



Walter Kälin

This is because there are a wide variety of reasons for migration flows. Climate change itself doesn't directly lead to permanent migration. The main issue is how vulnerable people are to climate change and how well they can adapt to it. In the rich Gulf states, where life is already lived largely in air-conditioned spaces, people will be much more capable of adapting to heatwaves than a poor population in remote regions where heat and drought damage health and lead to agricultural problems. The more vulnerable people are, the more likely they are to go away.

So climate change will force poor people to migrate?

Here, too, we have to make a distinction. In order to leave, people have to have a



Lean years: Between 2007 and 2010, Syria suffered a drought that made farmers' lives extremely difficult. Some one million of them eventually gave up their businesses and moved to the cities.

certain amount of means that particularly the poorest of the poor lack. They will stay behind.

What can the countries in North Africa or the Middle East, for instance, and the international community, do to protect people against the consequences of climate change?

If people who are more vulnerable migrate sooner, this will give us the chance to intervene. We can reduce their vulnerability and improve their ability to adapt. I appeal to politics to invest in adaptation. There's a lot that can be done here.

What exactly?

There aren't yet any elaborate plans for skyrocketing temperatures, but it is conceivable to modify houses in such a way that they remain cool inside, and the abundance of solar energy in the affected regions could be used for cooling. The ag-

ricultural sector, too, could prepare for an increase in droughts by using modified irrigation methods and more drought-resistant plants.

But all of that is possible only to a certain degree.

That's undoubtedly correct, and that's why migration must be an adaptation measure. We need possibilities for legal migration. In the long run, rising sea levels will leave people from low-lying Pacific islands no choice but to permanently migrate or relocate. Australia, for instance, is already granting such people temporary work permits so their families can use the money they earn to better cope with the consequences of climate change. In other words, migration can also be circular ...

Which means?

Circular migration is when people migrate for a limited period of time to es-

cape the consequences of a natural disaster, such as a storm, flooding or drought. It can be for months or years. Appropriate programs need to be set up for this, and also for people who have to leave their homes permanently.

Does it make sense to establish similar global provisions for these people to those the Geneva Refugee Convention established for people who flee from armed conflicts?

I don't consider a global convention to be realistic. Also, it's difficult to find provisions that are simultaneously appropriate for the Pacific and North Africa. But 50 countries already have provisions for accepting people following major disasters in their vicinity. It is important to harmonize these provisions to allow action to be taken on a transregional level. They can be built on over time.

Interview: Peter Hergersberg

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