

The Director General

Maisons-Alfort, 24 January 2018

OPINION **of the French Agency for Food, Environmental** **and Occupational Health & Safety**

on the “Assessment of the risks to worker health posed by climate change”

ANSES undertakes independent and pluralistic scientific expert assessments.

ANSES’s public health mission involves ensuring environmental, occupational and food safety as well as assessing the potential health risks they may entail.

It also contributes to the protection of the health and welfare of animals, the protection of plant health and the evaluation of the nutritional characteristics of food.

It provides the competent authorities with all necessary information concerning these risks as well as the requisite expertise and scientific and technical support for drafting legislative and statutory provisions and implementing risk management strategies (Article L.1313-1 of the French Public Health Code).

Its opinions are published on its website.

This opinion is a translation of the original French version. In the event of any discrepancy or ambiguity the French language text dated 24 January 2018 shall prevail.

On 28 October 2013, ANSES received a request from the Directorate General for Health (DGS) and the Directorate General for Labour (DGT) to undertake an expert appraisal on the potential impacts of climate change on the health and safety of workers. This formal request was issued as part of efforts to strengthen the management of occupational risks posed by climate change, which is one of the actions set out in the first French National Climate Change Adaptation Plan (PNACC) presented in July 2011.

1. BACKGROUND AND PURPOSE OF THE REQUEST

Climate change, defined as a change in the state of the climate that persists for an extended period¹, is part of “global change”. Sometimes referred to as “global environmental change”, this was defined by the Working Group in charge of the expert appraisal as all major worldwide environmental and societal changes caused by human activities as well as natural factors². Among other things, climate change is likely to affect human health, with specific or compounded effects on the health of certain professionals.

¹ Definition taken from the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), 2013-14.

² “Global change” impacts the physico-chemical and biological characteristics of various types of environmental compartments: atmosphere, hydrosphere, cryosphere, biosphere, soil, etc. It encompasses perceptible global and local environmental changes such as changes in the use of land (deforestation, reforestation, urbanisation, overuse, abandonment, introduction of species, etc.) and aquatic environments. These environmental changes affect all biodiversity levels (biodiversity of genes, species, habitats and landscapes) and all biosphere compartments (pedosphere, hydrosphere and atmosphere).

French Planning Law No 2009-967 of 3 August 2009 on the implementation of the *Grenelle* environmental round table provided for the preparation of a PNACC as part of the State's commitment to climate change adaptation in France³. In 2011, following a broad consultation, France drew up an inter-sector and interministerial PNACC drawing together recommendations translated into action sheets for a five-year period. The sheet relating to health issues included an action on the development of preventive health measures that take into account the consequences of extreme events and the adaptation of vigilance and alert systems. Action 4, Measure 4.2 aimed to strengthen the management of occupational risks posed by climate change.

In this context, ANSES was asked to undertake a scientific expert appraisal to:

- *“compile, through a review of the literature, the potential qualitative effects of climate change on general health;*
- *identify the exceptional or lasting climate hazards most likely to increase in frequency and/or intensity, to study their effects as a priority, in particular considering the numerous potential effects and the uncertainties related to the likelihood of them occurring;*
- *based on a more specific overview for the health and safety of workers, identify the sectors and/or occupations exposed to the effects in question;*
- *assess and classify the risks and estimate the potential impacts in exposed workers;*
- *issue recommendations for eliminating, reducing or preventing the identified risks;*
- *and, where relevant, issue research recommendations”.*

The first two points are being or have been addressed via work undertaken by other organisations more directly involved in these issues than ANSES. The Agency therefore reported and summarised these organisations' conclusions in the expert appraisal report associated with this Opinion, in order to establish the scientific context of climate change in which its work was undertaken.

The initial aims of the expert appraisal work were therefore, before any risk assessment, to identify and prioritise the occupational activities likely to be impacted by climate change. However, in light of the extremely wide variety of occupations and the various exposure conditions that can be associated with the same occupational activity, the objectives of the expert appraisal were redirected, in consultation with the requestors, towards identifying occupational risks likely to be impacted by climate change.

2. ORGANISATION AND METHODOLOGY OF THE EXPERT APPRAISAL

Organisation

The expert appraisal was carried out in accordance with French Standard NF X 50-110 “Quality in Expert Appraisals – General Requirements of Competence for Expert Appraisals (May 2003)”.

ANSES entrusted this expert appraisal to the Working Group (WG) on “Effects of climate change on worker health” supervised by the Expert Committee (CES) on “Assessment of risks related to physical agents, new technologies and development areas”. The methodological and scientific aspects of the expert appraisal work were examined by the CES between 6 October 2014 and 26 September 2017.

³ The French climate change adaptation strategy expresses the State's approach to the issue of climate change adaptation. This strategy was developed as part of a broad consultation, undertaken by the National observatory on the effects of global warming (ONERC), involving various industry sectors and civil society under the responsibility of the Interministerial Delegate for Sustainable Development. It was approved by the Interministerial Committee for Sustainable Development at its meeting of 13 November 2006 convened by the Prime Minister.

ANSES analyses interests declared by experts before they are appointed and throughout their work in order to prevent risks of conflicts of interest in relation to the points addressed in expert appraisals. The experts' declarations of interests are made public via the ANSES website (www.anses.fr).

Methodology

As part of a forward-looking approach, the expert appraisal work focused on the coming decades up to the mid-21st century, after which it seems difficult to anticipate changes in occupations and in the related health risks. Thus, the health effects studied were those related to projected climate changes occurring over the next five years and before 2050.

The review of the scientific literature, in particular the work of the Intergovernmental Panel on Climate Change (IPCC), enabled climate and environmental changes already observed, as well as the most likely climate-change scenarios, to be identified.

The collective expert appraisal sought to characterise the interactions between the climate, the environment and occupational health in order to identify the occupational risks potentially increased by climate change.

There has not been much research or expert appraisal work specifically focusing on the relationship between climate change and worker health. However, institutional reports on the topic have been published by the IRSST (Institut de recherche Robert-Sauvé en santé et en sécurité du travail) in 2012, ONERC and EpE (Entreprises pour l'Environnement) in 2014, and the United Nations in 2016⁴. Therefore, to verify the identified projections and assumptions, the Working Group conducted an extended literature review on the relationship between climate change and human health.

Firstly, an analysis of the various available guidelines and nomenclatures⁵ relating to the organisation of health protection in the workplace enabled occupational risk categories to be defined.

Secondly, in order to link climate change to the occupational risks thus identified, the Working Group compiled knowledge of the mechanisms by which climate change affects health, through an analysis of the available scientific literature. The impact of climate change on occupational risks was assessed by considering knowledge of occupational health, climate change and environmental changes, as well as of the physiological mechanisms of adaptation to hot climate conditions and those related to exposure to ultraviolet radiation and biological agents.

Lastly, some examples of occupational exposure circumstances⁶ were associated with each occupational risk potentially increased by climate changes.

3. ANALYSIS AND CONCLUSIONS OF THE CES

The CES on "Assessment of risks related to physical agents, new technologies and development areas" adopted the collective expertise appraisal work at its meeting on 26 September 2017.

Main findings relating to the effects of climate change on workers

A certainty: climate change is under way

Climate change is currently a reality on which there is broad consensus in the scientific community. Due to the inertia of their response to the increase in greenhouse gases, global warming and other

⁴ Impacts of climate change on occupational health and safety, IRSST, 2012.

Les entreprises et l'adaptation au changement climatique, ONERC and EpE, 2014.

Climate change and labour: impacts of heat in the workplace. Climate change, workplace environmental conditions, occupational health risks, and productivity – an emerging global challenge to decent work, sustainable development and social equity, United Nations/United Nations Development Programme (UNDP), 2016.

⁵ Section 2.1.2 of the expert appraisal report gives a list of the analysed items.

⁶ Work situation leading to exposure to one or more risks.

climate changes are going to accelerate, whatever the future emission scenario for these gases. The environmental effects and consequences for human health are already perceptible, in particular due to the increase in the frequency of certain temperature and precipitation extremes. These climate changes are also affecting other living organisms (micro-organisms, plants and animals), which could in turn impact human health.

A lack of data and few ongoing studies on the topic

Knowledge in climatology now enables precise projections to be made about the future climate with a high level of confidence. However, gaps in knowledge have been identified with regard to the processes by which climate change affects workers' health. For example, the direct physiological effects of heat are relatively well documented, whereas there is less documentation on the effects of heat on vigilance, or more specifically on various cognitive, attentional and motivational processes.

Some indirect effects have a domino effect: the progression of a risk is related to an environmental modification that itself is at least partly the result of climate change. This is true for the colonisation of certain regions by vectors of infectious diseases (mosquitoes of the *Aedes* genus transmitting chikungunya and dengue fever, *Ixodes ricinus* ticks transmitting Lyme disease, etc.) due to the rise in temperatures. Many complex contextual factors can also come into play, such as changes in land use⁷, as well as the transformation of work in response to technological and societal developments.

However, knowledge gaps hinder the characterisation of uncertainties related to the quantification of the identified health effects.

These findings thus confirm the lack of and need for data to be able to assess certain effects of climate and environmental changes on worker health.

A necessary approach based on exposure circumstances

The request received by ANSES proposed the identification of sectors and/or occupations exposed to the effects of climate change. However, workers employed in the same trade can experience very different exposure conditions. Thus, an alternative approach based on "exposure circumstances", enabling professionals to be grouped together according to their actual exposure and not their occupation, was used to undertake the expert appraisal work. This approach relying on exposure circumstances also has the advantage of proposing conclusions relevant to all workers (agricultural employees, retailers, self-employed workers, freelance professionals, public servants, etc.), regardless of their area of activity.

Increased occupational risks

The expert appraisal was organised around occupational risks increased by climate change, with the aim of identifying the related exposure circumstances.

While most of these occupational risks are affected by global warming, some are also influenced by other factors contributing to climate or environmental change, such as climate hazards, biological agents, air quality, or water quality.

Each occupational risk considered was linked to the climate indicators involved, the mechanisms leading to health effects (processes), the factors aggravating the risk, and the corresponding occupational exposure circumstances. Considering the impossibility of an exhaustive identification of all exposure circumstances, particularly for aggravating circumstances, examples were selected for every studied risk. The table in the Annex shows, for each occupational risk studied, the changes in the climate and environmental parameters impacting the risk, the related processes by which health is affected, and examples of exposure circumstances.

⁷ A change in land use can be the result of climate change, decreasing water resources, or changes in cultivation practices.

The expert appraisal highlighted three main climate and environmental changes responsible for increases in the identified occupational risks:

- rising temperatures;
- alterations of the biological and chemical environment;
- changes in the frequency and intensity of certain climate hazards.

Projected global warming will likely be greater in summer than in winter and will be slightly more pronounced in the south-east of metropolitan France. Summer heat waves will become more frequent, longer and more intense, unlike cold waves. The increase in extreme heat events will cause direct physiological disruptions, especially during the acclimatisation period, which will accentuate various occupational risks. This thermal stress can also cause neurological problems described as a “decline in vigilance” in workers, potentially increasing the frequency of several types of work accidents. Lastly, increasing temperatures may also contribute to the exacerbation of psychosocial risks.

Environmental changes induced by climate change, such as changes in ecosystems, their functioning and their populations of organisms, may contribute to the modification of occupational biological risks (immuno-allergic, infectious, toxin-induced or toxic). Moreover, several assumptions suggest there will be an overall increase in exposure to chemical risk, which is nonetheless difficult to quantify.

Certain climate hazards, whose frequency or intensity is expected to increase with climate change (flooding, submersion, increase in rainfall, phases of summer drought, forest fires), may cause occupational risks to increase. However, similar to what has been observed over the past few decades, storm forecasting does not show any noteworthy trends in the frequency or intensity of storms between now and 2050. To supplement this overview of climate change and its role in extreme meteorological and climate events, it is also relevant to address the issue of less common meteorological phenomena that are not necessarily extreme but are potentially dangerous, such as thunderstorms involving hail and lightning as well as mini-tornadoes. In the current state of knowledge, the scale of climate projections remains too coarse to be able to consider this type of phenomenon and therefore no conclusions can be drawn concerning them.

Regarding the issue of risk related to ultraviolet radiation, the literature analysis did not show a clear upward trend in the number of days of full sun, either now or by 2050. However, an increase in risk related to this exposure cannot be ruled out, due for example to changes in people's activities (sports, leisure, etc.) or in the way they dress as a result of climate change (rising temperatures, etc.).

In general, regarding the effects of climate change on worker health, the conclusions of this expert appraisal agree with those of the authors of the reports and publications identified as relevant in the overview of work dealing with the effects of climate change on human health undertaken during the expert appraisal. There seems to be a consensus that climate change leads to an increase in known occupational risks in terms of their prevalence, distribution and severity.

CES proposals and recommendations

Establish:

An observatory for the effects of climate change on worker health (occupational epidemiology and bioclimatology):

This will involve, whenever there is a work accident, providing meteorological data, in addition to specifying the location, time and circumstances of the accident's occurrence. Regarding occupational diseases, a first concrete step would be the identification of relevant data from existing systems (e.g. RNV3P (National Network for Monitoring and Prevention of Occupational Diseases), CARSATs (Occupational Health and Pension Insurance Funds),

CRRMPs (Regional Committees for the Recognition of Occupational Diseases), etc.). A second step, following the identification of existing data sets in various organisations, would involve undertaking reverse analyses of past cases in order to promote multidisciplinary work, create ties between organisations, and validate a work methodology;

A research programme:

This should be developed in collaboration with the CNAMTS (National Health Insurance Fund for Salaried Employees), INRS (National Research and Safety Institute), ANACT (French National Agency for the Improvement of Working Conditions), INERIS (National Institute for Industrial Environment and Risks), Météo France (CNRM, National Centre for Meteorological Research) and ANSES among others, and in keeping with the work undertaken on future climate scenarios in France and their environmental consequences. The programme should focus on the mechanisms of health effects as well as on risk scenarios in the area of occupational health related to climate change and the related uncertainty levels. This research programme could incorporate research methods such as “action research”⁸.

The data from the observatory and research programme would be major inputs for future scientific work on the effects of climate change on worker health, especially for undertaking quantitative risk assessments.

Build awareness and knowledge to better take into account the effects of climate change

It nonetheless seems important, without waiting for the implementation of these two recommendations, to enhance the awareness and knowledge of professionals with regard to the impacts of climate change and their potential consequences for workers’ health. They will thus be better informed and better able to embrace changes in the information they are asked to collect, in particular the integration of criteria of exposure to climate and environmental parameters in the assessment and management of occupational risks.

Incorporate, without delay, climate change into the prevention of heat-related risks

Furthermore, the amplifying effects of heat on occupational risks, which are probably accentuated by global warming, already appear to be recognised. Thus, developing a culture of prevention with regard to hot climate environments currently seems necessary for all occupational activities. These preventive measures should cover technical, organisational and behavioural aspects and be the focus of awareness-raising efforts instigated during initial training.

Innovative solutions should be studied and implemented immediately in order to preserve the health of workers.

4. AGENCY CONCLUSIONS AND RECOMMENDATIONS

ANSES endorses the conclusions and recommendations of its Expert Committee on “Physical agents, new technologies and development areas”, set out in Section 3 of this Opinion.

Climate change is a reality on which there is broad consensus in the scientific community. Because of the inertia of the climate system, changes to the climate related to human activities will continue for many years, regardless of any measures that may be taken today. Combating climate change, which is part of a more global environmental change, is therefore essential to limit its magnitude.

The relationships between climate change and health have been studied for several years now. In a report published in 2016⁹, for example, the WHO stated that the health effects of climate change

⁸ Research method that enables pilot management actions to be tested, through analyses of their results with the support of research protocols and teams.

⁹ Preventing disease through healthy environments - A global assessment of the burden of disease from environmental risks - A Prüss-Ustün, J Wolf, C Corvalán, R Bos and M Neira, WHO, 2016.

could already be estimated in terms of number of deaths and years of life lost, and would affect all population categories. The WHO thus affirms that the “direct and indirect impacts of emerging risks, such as climate change and ecosystem change, need to be tackled urgently, as they are set to become the most challenging risks populations will face in the coming decades”.

Knowledge in climatology now enables precise projections to be made about the future climate with a high level of confidence. However, some of the mechanisms by which changes to the climate affect or may affect human health, either for the general population or for workers, have not yet been thoroughly studied. Moreover, characterising the specific health effects of climate change, within a broader set of environmental changes, is complex and full of uncertainties.

The expert appraisal showed that with the exception of risks associated with noise and artificial radiation, all occupational risks are and will be affected by climate change and environmental changes.

Three main climate and environmental changes are responsible for increases in the identified occupational risks:

- rising temperatures;
- alterations of the biological and chemical environment;
- changes in the frequency and intensity of certain climate hazards.

The rise in temperatures has direct as well as indirect impacts on occupational risks, including risks of accidents related to a decline in vigilance, risks related to the inhalation of chemical substances, and risks associated with biological agents (infectious diseases, pollen, etc.).

Moreover, the increase in occupational risks can be linked, directly or indirectly, to other effects of climate change, such as accident and psychosocial risks due to changes in the frequency and intensity of certain climate hazards, as well as risks related to changes in the biological and chemical environment¹⁰ (infectious diseases, pollen, etc.).

ANSES recommends rapidly strengthening action in the world of work to promote awareness of the health effects of climate change, through the use of information (specific documentation) and training.

The Agency specifically recommends encouraging all occupational-health stakeholders to immediately start integrating the climate change impacts that are already perceptible, or that can be anticipated, in their occupational risk assessment work (identification of people potentially affected, specific assessment of individual work stations and actual exposure depending on the geographical area concerned, etc.).

Noting that some professional organisations are already taking measures to prevent these risks, ANSES recommends integrating the health effects of climate change in their risk prevention approaches (for example by adapting their work environments and organisation) using specific methodological tools that will need to be developed.

In line with the orientations of the work being undertaken to prepare the next PNACC¹¹ and in order to advance knowledge, ANSES also recommends identifying relevant indicators related to the health

¹⁰ Environmental changes induced by climate change, such as changes to ecosystems, their functioning and their populations of organisms, may contribute to the modification of occupational biological risks (immuno-allergic, infectious, toxin-induced or toxic). Moreover, several assumptions suggest there will be an overall increase in exposure to chemical risk, which is difficult to quantify.

¹¹ Especially those orientations produced by the working groups in charge of the “Economic sectors” – with regard to “socio-economic outlook and sectoral awareness” – and “Prevention and resilience” components. (Working groups of the consultation for a new National Climate Change Adaptation Plan (PNACC), which met between the end of June and the end of May 2016).

impacts of climate change, to enable the effects of climate change on occupational risks to be tracked and monitored. This monitoring should include the compilation and storage of data as well as the documentation of occupational exposure situations and feedback from the field regarding climate events and their consequences for worker health.

Lastly, in terms of research, in a context where jobs are evolving, ANSES recommends undertaking more research into the links between climate and environmental parameters and their effects on health (taking into account their changes and mutual interactions), in order to anticipate the development of occupational risks.

Furthermore, efforts should continue to document changes in climate, environmental and bioclimatic indicators and anticipate extreme events.

Moreover, the Agency stresses the need to systematically integrate the issue of climate change and its impacts in future health risk assessments, for both workers and the general population.

ANSES also observes that according to the 2017 survey of the French Radioprotection and Nuclear Safety Institute (IRSN) on perceptions of risks and safety, 42% of the people surveyed in 2016 mentioned global warming as the environmental issue of the greatest concern. However, one out of eight respondents said that climate disruptions are the issue of greatest concern in today's society. ANSES therefore strongly encourages continuing actions aiming to enhance knowledge and awareness of climate change, in particular through education and training.

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KEYWORDS

Effet sanitaire, santé travail, exposition professionnelle, risque professionnel, changement global, climat, changement climatique, réchauffement climatique, changement environnementaux, outil de priorisation.

Health effects, occupational health, occupational exposure, occupational risk, global change, climate, climate change, global warming, environmental change, prioritisation tool.

ANNEX: SUMMARY OF OCCUPATIONAL RISKS LIKELY TO INCREASE AS A FUNCTION OF CLIMATE CHANGE AND EXPOSURE CIRCUMSTANCES

(When reading the table, start with the middle column)

| ANNEX: SUMMARY OF OCCUPATIONAL RISKS LIKELY TO INCREASE AS A FUNCTION OF CLIMATE CHANGE AND EXPOSURE CIRCUMSTANCES | | | | |
|---|--|--|---|---|
| Variables and indices modified by climate change | Processes/mechanisms responsible for the health effect | Type of occupational risk | Necessary exposure circumstances | Examples of secondary, aggravating exposure circumstances, including those that can be limited by prevention measures in the company |
| <p>Variables and indices related to heat and its effects on humans:</p> <ul style="list-style-type: none"> ↑ frequency, duration, intensity of heat waves; ↑ extreme hot temperatures; ↑ high night-time temperatures. | <p>Combination of a physical activity increasing the production of body heat and working conditions preventing the evacuation of this heat, potentially causing:</p> <ul style="list-style-type: none"> - cramps and discomfort; - dehydration; - heat stroke; - death. <p>This health-effect mechanism is combined with all parameters likely to interfere with thermoregulation.</p> <p>Neuropsychological effects, <i>via</i> a decline in vigilance.</p> | <p>Risks related to work in hot thermal environments</p> | <p>Work in a hot thermal environment</p> | <p><i>High air humidity, limited air movement</i></p> <p><i>Artificial heat sources</i></p> <p><i>Wearing of work clothes limiting heat exchange</i></p> <p><i>Lack of hydrating drinks</i></p> <p><i>Intense physical exertion</i></p> <p>Workers living in nocturnal urban heat islands/special zones</p> |
| | | <p>Risks related to physical workload</p> | <p>Work requiring intense, prolonged and/or repeated physical exertion, or uncomfortable/awkward postures</p> | |
| | <p>Like any alteration of working conditions, thermal discomfort is likely to create or aggravate a tense situation:</p> <ul style="list-style-type: none"> - with supervisors; - between colleagues; - with the public. <p>Lack of recovery related to high night-time temperatures can diminish the tolerance and adaptability of workers. The effects of climate variations on the organisation of work (changes to working hours, for example) can generate professional dissatisfaction.</p> | <p>Psychosocial risks</p> | <p>All occupational environments</p> | <p><i>Pre-existing psychosocial risk factors</i></p> <p>Workers living in nocturnal urban heat islands/special zones</p> <p><i>Interference between working hours and private life</i></p> |

| Variables and indices modified by climate change | Processes/mechanisms responsible for the health effect | Type of occupational risk | Necessary exposure circumstances | Examples of secondary, aggravating exposure circumstances, including those that can be limited by prevention measures in the company |
|--|--|---|--|---|
| <p>Variables and indices related to heat and its effects on humans:</p> <p>↑ frequency, duration, intensity of heat waves;</p> <p>↑ extreme hot temperatures;</p> <p>↑ high night-time temperatures.</p> | <p>Increase in the risk of accidents due to neuropsychological effects, causing a decline in vigilance. Physiological effects (e.g. cramps and discomfort).</p> <p>Expected repercussions especially during the acclimatisation phase.</p> | Risk of trips, falls or other disruptions in movement | All occupational environments | <p>Workers living in nocturnal urban heat islands/special zones (lower-quality sleep and lack of night recovery)</p> <p><i>Organisation of work not suited to a climate trend (working hours, work clothes, etc.)</i></p> <p>Intense rainfall, possibly increased by events such as strong wind, hurricane or storm</p> |
| | | Risks related to falls from height | Outdoor and indoor work at height | |
| | | Risks related to collapses and falling objects | Any occupation involving shelving/storage at height | |
| | | Risks related to mechanical handling | | |
| | | Occupational road risks | Workers using vehicles | |
| | | Risks related to internal traffic in companies | All workers if there are flows of vehicles in the company, whether indoors or outdoors | |
| | | Accidents with a chemical product | Any work in the presence of chemical products | |
| | | Work equipment | Work involving the mechanical action of machinery, tools or parts or the projection of materials | |
| | | Risks related to electricity | Any type of activity in the presence of electricity | |

| Variables and indices modified by climate change | Processes/mechanisms responsible for the health effect | Type of occupational risk | Necessary exposure circumstances | Examples of secondary, aggravating exposure circumstances, including those that can be limited by prevention measures in the company |
|---|---|--|---|---|
| <p>Variables and indices related to heat and its effects on chemical products:</p> <p>↑ frequency, duration, intensity of heat waves;</p> <p>↑ extreme hot temperatures;</p> <p>↑ phases of summer drought (Mediterranean region);</p> <p>↑ Fire Weather Index.</p> | <p>Increase in temperatures accentuating phenomena involving the evaporation of volatile chemicals:</p> <ul style="list-style-type: none"> - pressure increase in closed recipients: risk of bursting - risk of reaching the lower explosive or flammable limit: risk of explosion - increase in the risk of inhalation by exposed employees | <p>Risk of fire, explosion</p> <hr/> <p>Risks related to chemical substances and particles</p> | <p>Work with products containing flammable and/or explosive substances</p> <hr/> <p>Work with products containing volatile substances</p> | <p><i>Direct exposure of the substance to solar radiation</i></p> <p><i>Work in closed or confined areas</i></p> <hr/> <p><i>Direct exposure of the substance to solar radiation</i></p> <p><i>Work in closed or confined areas</i></p> <p><i>Physical work causing pulmonary ventilation to increase</i></p> |
| <p>UV index: no current trend and downward trend by 2050;</p> <p>No known trend in the number of days of full sun.</p> | <p>Potentially increased exposure to UV rays, in the spring and summer, or in the mountains, due to adaptive behaviour with milder temperatures.</p> | <p>Risks related to UV radiation</p> | <p>Activities for which workers are exposed to the sun</p> | <p><i>Hot thermal work environment</i></p> <p><i>Wearing of inappropriate clothes with regard to UV protection</i></p> <p><i>Exposure to photo-sensitising products at work or in the sun</i></p> |

| Variables and indices modified by climate change | Processes/mechanisms responsible for the health effect | Type of occupational risk | Necessary exposure circumstances | Examples of secondary, aggravating exposure circumstances, including those that can be limited by prevention measures in the company |
|---|--|--|---|--|
| <p>Variables and indices reflecting average climate change favourable to the development of biological risks:</p> <p>↑ average temperature;</p> <p>↓ cold waves;</p> <p>Lengthening of the window of exposure to pollen, increase in its production and change in its distribution areas.</p> | <p>↑ or ↓ depending on the pathogen in question;</p> <p>↑ in distribution areas for certain existing vectors and establishment of new vectors: emergence or re-emergence;</p> <p>Change in current risks of zoonoses: winter migration, ↑ in forestry land and ↑ in large game, abandonment of exotic pets, etc.;</p> <p>Change in risk following the arrival of climate migrants: tuberculosis, cholera and parasitic diseases.</p> | <p>Risks related to biological agents</p> <p>Risks of infection with respiratory, digestive or dermal transmission</p> | <p>Examples:</p> <p>Work in contact with live or dead people and animals;</p> <p>Laboratory work with micro-organisms or products;</p> <p>Work in natural environments and/or environment-related occupations such as farmers;</p> <p>Collection and treatment of waste and wastewater.</p> | <p>Population displacement.</p> <p>Introduction of new plants, animals and vectors.</p> <p>Climate hazards (storms, floods, submersion, etc.) could cause certain pathogens to spread outside of the areas usually recognised as contaminated.</p> <p><i>Sustained physical work increasing the inhalation of particles (toxic or allergenic).</i></p> |
| | <p>The migration of certain plants and the introduction of new plants could cause changes in the production of allergens and their health consequences.</p> | <p>Risks related to biological agents</p> <p>Immuno-allergic and toxin-induced risks</p> | <p>Examples:</p> <p>Work in natural environments and/or environment-related occupations;</p> <p>Harvesting, storage, transport and processing of contaminated cereals;</p> <p>Harvesting, storage, transport and processing of plant fibres;</p> | <p>Agricultural drought facilitating the dispersal of contaminants (dust, etc.);</p> <p>Limitation of pollen production and, in harvest periods, ↓ in the risk of bringing in wet materials and in mould subsequently developing, and thus exposure to an immuno-allergic or toxin-induced risk during handling.</p> |
| | <p>The risk related to the production of endotoxins could be changed (by climate circumstances more or less favourable to the secretion of these toxins), even though these changes cannot be predicted based on current knowledge.</p> | <p>Toxin-induced (or toxic) risks</p> | <p>Work in mills and bakeries;</p> <p>Work in animal facilities and laboratories using animals;</p> <p>Work in waste treatment and disposal.</p> | |

| Variables and indices modified by climate change | Processes/mechanisms responsible for the health effect | Type of occupational risk | Necessary exposure circumstances | Examples of secondary, aggravating exposure circumstances, including those that can be limited by prevention measures in the company |
|--|---|--|--|---|
| <p>Variables and indices characterising climate hazards:</p> <p>General trend of increasing rainfall during the most extreme episodes, even though the expected changes vary significantly between geographic regions;</p> <p>No noteworthy trend for the risk of wind;</p> <p>↑ risk of submersion: episodes of intense rainfall could cause rivers to overflow;</p> <p>↑ agricultural drought;</p> <p>↑ Fire Weather Index and increase in the risk of fire.</p> | <p>Risk of production interruptions, loss of production tools, company devastation, ↑ unemployment: loss of jobs and mental distress with repercussions on general state of health.</p> <p>Repetition of events over time and physical and mental fatigue/exhaustion for all these employees, with an increase in the risk of accidents.</p> <p>Repetition of climate events, causing physical and mental fatigue or even exhaustion in rescue teams or repair teams with an increase in the risk of accidents.</p> | <p>Risks related to climate hazards associated with climate change</p> | <p>Examples:</p> <p>Rescue activities (professionals, volunteers, company first-aid workers, etc.);</p> <p>Network repair professionals (energy, water, road surfaces, etc.);</p> <p>Fire department staff (professionals, volunteers);</p> <p>Staff of companies located near an area with a high risk of fire.</p> | <p><i>Urban development in flood-prone areas, including coasts, soil sealing;</i></p> <p>Increase in forestry land and in wildland-urban interfaces possibly making fire control more difficult;</p> <p><i>“Landscaping” in small business areas or around companies;</i></p> <p><i>“Mediterranisation” of vegetation near companies (more flammable);</i></p> <p><i>Vegetation losses (highly flammable biomass) that may facilitate the outbreak or rapid spread of a fire;</i></p> <p>Increase in the inaccessibility of certain forest areas making it more difficult to control a fire outbreak.</p> |