Bulletin n°14

Veille thermique
Période : janvier 2024

Objectifs :

L'INRS est de plus en plus sollicité sur des questions concernant les activités en entreprise par forte chaleur : les activités en extérieur, l'été en période de canicule, mais aussi les activités en intérieur, dans des lieux aux conditions thermiques extrêmes. L'objectif de cette veille est de se tenir informé sur ces thématiques, dans une période où la problématique thermique croît avec les changements climatiques.

La bibliographie extraite de la base de données INRS-Biblio, permet la consultation des ressources en version PDF.

Les liens mentionnés dans le bulletin donnent accès aux documents sous réserve d'un abonnement à la ressource.

La validation des informations fournies (exactitude, fiabilité, pertinence par rapport aux principes de prévention, etc.) est du ressort des auteurs des articles signalés dans la veille. Les informations ne sont pas le reflet de la position de l'INRS.

Sommaire :

EPI, matériaux protecteurs/refroidissants

L. Liu, M. H. Zhu, J. B. Feng, H. Peng, Y. Q. Shi, J. F. Gao, L. C. Tang and P. A. Song.

Fire-retardant and high-strength polymeric materials enabled by supramolecular aggregates.

AGGREGATE. 2024.

https://doi.org/10.1002/agt2.494

High-performance polymers have proliferated in modern society across a variety of industries because of their low density, good chemical stability, and superior mechanical properties. However, while polymers are widely applied, frequent fire disasters induced by their intrinsic flammability have caused massive impacts on human beings, the economy, and the environment. Supramolecular chemistry has recently been intensively researched to provide fire retardancy for polymers via the physical barrier and char-catalyzing effects of supramolecular aggregates. In parallel, the noncovalent interactions between supramolecular and polymer chains, such as hydrogen bonding, pi-pi interactions, metal-ligand coordination, and synergistic interactions, can endow the matrix with enhanced mechanical strength. This makes it possible to integrate physical-chemical properties and noncovalent interactions into one supramolecular aggregate-based high-performance polymeric system on demand. However, fulfilling these promises needs more research. Here, we provide an overview of the latest research advances of fire-retardant and high-strength polymer materials based on supramolecular structures and interactions of aggregates. This work reviews their conceptual design, characterization, modification principles, performances, applications, and mechanisms. Finally, development challenges and perspectives on future research are also discussed. This work provides an overview of fire-retardant and high-strength polymer materials based on supramolecular structures and interactions of aggregates, including their conceptual design, characterization, modification principles, performances, applications, mechanisms, challenges, and future perspectives.

Y. J. Xue, T. C. Zhang, H. Peng, Z. W. Ma, M. Zhang, M. Lynch, T. Dinh, Z. Z. Zhou, Y. H. Zhou and P. A. Song.

Fire-retardant, anti-dripping, biodegradable and biobased polyurethane elastomers enabled by hydrogen-bonding with cellulose nanocrystals.

NANO RESEARCH. 2024.

https://doi.org/10.1007/s12274-023-6397-0

Thermoplastic polyurethane (PU) elastomers have attracted significant attention because of their many important industrial applications. However, the creation of fire-retardant and anti-dripping PU elastomers has remained a grant challenge due to the lack of crosslinking and weak interchain interactions. Herein, we report a mechanically robust, biodegradable, fire-retardant, and anti-dripping biobased PU elastomer with excellent biodegradability using an abietic acid-based compound as hard segments and polycaprolactone diol (PCL) as soft segments, followed by physically crosslinking with cellulose nanocrystals (CNC) through dynamic hydrogen-bonding. The resultant elastomer shows the balanced mechanical and fire-retardant properties, e.g., a tensile strength and break strain of 9.1 MPa and 560%, a self-extinguishing ability (V-0 rating in UL-94 testing), and an anti-dripping behavior. Moreover, the as-developed PU can be completely degraded in 1.0 wt.% lipase solution at 37 degrees C in 60 days, arising from the catalytic and wicking effect of CNC on PU chains. This work provides an innovative and versatile strategy for constructing robust, fire-retardant, anti-dripping, and

biodegradable PU elastomers, which hold great promise for practical applications in electronic and automobile sectors.

A. Dabrowska, M. Kobus, P. Sowinski, L. Starzak and B. Pekoslawski.

Integration of Active Clothing with a Personal Cooling System within the NGIoT Architecture for the Improved Comfort of Construction Workers.

APPLIED SCIENCES-BASEL. 2024;14(2).

https://doi.org/10.3390/app14020586

Intense physical activity and high ambient temperature cause construction workers to be exposed to an increased risk of overheating, especially in the summer season. Personal cooling systems have great potential to support workers' thermoregulation and reduce this risk. In particular, solutions based on the thermoelectric effect can provide high cooling effectiveness and ergonomics at the same time. In this paper, a newly developed active clothing solution with flexible thermoelectric modules intended for outdoor activities is presented. The active clothing was subjected to utility tests on a treadmill under laboratory conditions with the participation of potential end users. A comparison of results from cooled and uncooled places indicated a reduction in local skin temperature of as much as 2.7 degrees C. Moreover, a gradual decrease in temperature in the uncooled place during the experiment was observed. Based on the positive results from this evaluation, the personal cooling system was integrated into active clothing within the ASSIST-IoT NGIoT reference architecture. This allows contextual and personalized adjustment of the cooling power to be provided using AI techniques and, additionally, by using data from a weather station and a smartwatch. Training procedures and models for the AI system are proposed, with special attention paid to the privacy aspect.

M. L. Zhang, W. Y. Han, Y. F. He, J. W. Xiong and Y. Zhang.

Natural Ventilation for Cooling Energy Saving: Typical Case of Public Building Design Optimization in Guangzhou, China.

APPLIED SCIENCES-BASEL. 2024;14(2).

https://doi.org/10.3390/app14020610

Heating ventilation and air conditioning systems account for over one-third of building energy usage, especially for public buildings, due to large indoor heat sources and high ventilation and thermal comfort requirements compared to residential buildings. Natural ventilation shows high application potential in public buildings because of its highly efficient ventilation effect and energy-saving potential for indoor heat dissipation. In this paper, a building design is proposed for a science museum with atrium-centered natural ventilation consideration. The floor layout, building orientation, and internal structure are optimized to make full use of natural ventilation for space cooling under local climatic conditions. The natural ventilation model is established through computational fluid dynamics (CFD) for airflow evaluation under indoor and outdoor pressure differences. The preliminary results show that such an atrium-centered architectural design could facilitate an average air exchange rate over 2 h-1 via the natural ventilation effect. Moreover, indoor thermal environment simulation results indicate that the exhaust air temperature can be about 5 degrees C higher than the indoor air mean temperature during the daytime, resulting in about 41.2% air conditioning energy saving ratio due to the free cooling effect of natural ventilation. This work can provide guidance and references for natural ventilation optimization design in public buildings.

H. J. Xu, B. Cao, L. J. Gao, F. M. Wang, G. Y. Jin and Z. J. Liu.

Personal cooling garments with phase change material packages - A critical review of challenges, solutions and recent progress.

BUILDING AND ENVIRONMENT. 2024;250.

https://doi.org/10.1016/j.buildenv.2024.111169

Personal cooling plays a prominent part in alleviating heat stress and improving working efficiency for outdoor workers especially with the increasingly serious global warming. The cooling garments with phase change material (PCM) packages (PPCGs) utilize phase-change latent heat of PCM packs which are embedded in the pockets distributed in different parts of the garment to absorb heat from the body and the micro-environment. Compared to other types of cooling garments, the PPCGs have particular advantages of energy-saving, low-cost, high simplicity and portability. Nevertheless, there are still some critical challenges of this cooling system which obstruct its further development and wide application. This paper provides a detailed review on the challenges and corresponding technological solutions of the PPCGs for personal cooling applications in hot environments. Aiming at the problems of intrinsic drawbacks of PCMs, high humidity in the micro-environment and limited cooling period, the heat-dissipation principle of the human-PPCG-environment system and key factors influencing the cooling performance are analyzed as explanation of the above problems and theoretical basis of the following possible solutions. Subsequently, the corresponding solving strategies are given in view of the three prominent challenges. The solutions of hybrid system integrating PCMs with other cooling technologies and combination of PCMs with different melting temperatures provide innovative ideas for cooling performance improvement and manifest obvious effect on one of these challenges, whereas further research is also needed. Finally, an outlook of the PPCG is presented related to the challenges and developing routes.

Maladies liées à la chaleur

J. Feng, M. Y. Tang, M. T. Gong, F. X. Li, Y. M. Li, B. Huang, F. Feng, X. Wang and H. F. Pei.

A novel indicator for temperature control in heat stroke treatment.

PRECISION MEDICAL SCIENCES. 2024.

https://doi.org/10.1002/prm2.12123

Temperature control plays a pivotal role in patients with heat stroke (HS), but little work has been done sufficiently on the use of temperature control to reflect disease progression. Here, we defined and analyzed the concrete role of controlling time for core temperature to physiological level (CTTP), in order to explore a potential index to guide the treatment of HS.Method: This is a retrospective cohort study. From three hospitals located in Sichuan province, China, we collected a total of 179 HS cases with clinical diagnosis and treatment records. We defined CTTP as the time interval of HS onset to stabilization of core temperature (rectal temperature) below 37.7degree celsius and analyzed the correlation between CTTP and inpatient death of HS patients.Results: Of all the cases, 64.80% were male and 53.07% were exertional heat stroke (EHS). The median (IQR) age was 59 (23.5-73) years old, and the median (IQR) onset temperature was 42 (40.4-42)degree celsius. Multivariable analysis demonstrated significantly high inpatient death in the highest CTTP tertile (>18 h) (hazard ratio: 18.75; 99% confidence interval: 4.06-86.59; p = .0002). In addition, compared with patients in lowest CTTP tertile, patients in highest CTTP tertile were at significantly higher risk of organ damage: 3.48-fold for respiratory failure (95% CI: 1.41-8.59, p = .0069); 3.18-fold for shock (95% CI: 1.37-7.39, p = .0071); 4.09-fold for rhabdomyolysis (95% CI: 1.73-9.64, p = .0013); 4.64-fold for renal damage (95% CI: 2.12-10.14, p = .0001).Conclusion: Long of CTTP predicts inpatient death of HS patients with a CTTP tertile >18 h associated with the highest rate of inpatient death.

Outils et capteurs de mesure

Y. Ahn, C. Tuholske and R. M. Parks.

Comparing Approximated Heat Stress Measures Across the United States.

GEOHEALTH. 2024;8(1).

https://doi.org/10.1029/2023GH000923

Climate change is escalating the threat of heat stress to global public health, with the majority of humans today facing increasingly severe and prolonged heat waves. Accurate weather data reflecting the complexity of measuring heat stress is crucial for reducing the impact of extreme heat on health worldwide. Previous studies have employed Heat Index (HI) and Wet Bulb Globe Temperature (WBGT) metrics to understand extreme heat exposure, forming the basis for heat stress guidelines. However, systematic comparisons of meteorological and climate data sets used for these metrics and the related parameters, like air temperature, humidity, wind speed, and solar radiation crucial for human thermoregulation, are lacking. We compared three heat measures (HImax, WBGTBernard, and WBGTLiljegren) approximated from gridded weather data sets (ERA5-Land, PRISM, Daymet) with ground-based data, revealing strong agreement from HI and WBGTBernard (R2 0.76-0.95, RMSE 1.69-6.64 degrees C). Discrepancies varied by Koppen-Geiger climates (e.g., Adjusted R2 HImax 0.88-0.95, WBGTBernard 0.79-0.97, and WBGTLiljegren 0.80-0.96), and metrological input variables (Adjusted R2 Tmax 0.86-0.94, Tmin 0.91-0.94, Wind 0.33, Solarmax 0.38, Solaravg 0.38, relative humidity 0.51-0.74). Gridded data sets can offer reliable heat exposure assessment, but further research and local networks are vital to reduce measurement errors to fully enhance our understanding of how heat stress measures link to health outcomes. Extreme heat threatens human health. Rising intensity and duration of heat days expose more to hot environments. To understand how extreme heat affects human health, it is important to use accurate weather information and measures that reflect people's actual experience of the heat. Heat Index (HI) and Wet Bulb Globe Temperature (WBGT) are commonly used heat stress metrics that are widely used to set exposure guidelines and policies. However, there have been limited comparisons between daily heat measures and weather variables. In this study, we compared three heat measures (HI, WBGTBernard, and WBGTLiljegren) derived from three widely used gridded weather data sets (ERA5-Land, PRISM, and Daymet) with ground-based weather observations. The heat measures calculated from both the gridded weather data and the station data showed a reasonably strong agreement.

J. R. Buzan.

Implementation and Evaluation of Wet Bulb Globe Temperature Within Non-Urban Environments in the Community Land Model Version 5.

JOURNAL OF ADVANCES IN MODELING EARTH SYSTEMS. 2024;16(2).

https://doi.org/10.1029/2023MS003704

Global heat stress is a phenomenon that impacts the livelihood of humans worldwide. Due to climate change, heatwaves are already increasing negatively impact outdoor laborers and activities. However, calculating heat stress on a global scale is disparaged due to the interplay and treatment of temperature, humidity, and radiation. To help resolve this issue, the Wet Bulb Globe Temperature (WBGT), a standardized heat stress metric, is implemented into the Community Land Model (CLM5), the land surface component of the Community Earth System Model (CESM2). This resolves a long lasting, complex issue within global heat stress: the treatment of solar and thermal radiation. A default

configuration of CLM5 is executed and shows the advantages of simulating the WBGT within multiple environments. Additionally, two commonly used WBGT approximations are implemented for solar exposed (sWBGT) and shaded (FiWBGT) conditions. The 1995 Chicago Heatwave is examined as a case study, focusing on the rural regions impacted by the heatwave. Derivative functions of labor capacity show that assumptions about calculating a non-linear algorithm generate non-negligible biases that can grossly over or underestimate the impact of heat stress on future climate change projections. For example, a difference of 0.5degree celsius from WBGT can result in >10% change in labor capacity. Using a conservative difference of +/- 0.3degree celsius, 100% of land surface extreme sWBGT values and >77% extreme shaded conditions (FiWBGT) differ from WBGT. Therefore, to accurately assess the direct exposure, risk, and damage from climate change on people, it is critical to implement diagnostics directly into Earth system models.

T. Yamakoshi, P. Rolfe and K. Yamakoshi.

A new noninvasive technique for heat-flux-based deep body thermometry together with possible estimation of thermal resistance of the skin tissue.

MEDICAL & BIOLOGICAL ENGINEERING & COMPUTING. 2024.

https://doi.org/10.1007/s11517-023-02991-z

A new noninvasive core-thermometry technique, based on the use of two heat flux sensors with different very low thermal resistances, is proposed. Thermodynamically derived equations, using a pair of skin temperatures and heat fluxes detected from the sensors, can give the estimated deep body temperature (DBT) together with thermal resistance of the skin tissue itself. The validity and accuracy of this method are firstly investigated through in vitro experiments using a tissue phantom model and, secondly, as in vivo comparisons with sublingual (Tsub) or rectal temperature (Trec) measurements in 9 volunteers, attaching the sensors around the upper sternum or the nape. Model experiments showed a good agreement between the measured and estimated temperatures, ranging from approximately 36 to 42 celcius. In vivo experiments demonstrated linear correlations between the estimated DBT and both Tsub and Trec values, though the estimated DBT was 0.13 celcius higher than Tsub and 0.42 celcius lower than Trec on average. The results also strongly suggested the possibility to estimate the tissue thermal resistance; this is discussed herein. Although further in vivo experiments under various environmental conditions are necessary, this method appears highly promising as an accurate, useful and convenient core-thermometry system for medical and healthcare settings.Graphical AbstractOverview drawing of a new deep body thermometry technique from the skin surface using two heat flux sensors with different very low thermal resistances shown in the upper left part. In vivo experiments demonstrated a good agreement between the measured (sublingual and rectal) and estimated temperatures shown in right upper part. The results also strongly suggested the possibility to estimate the skin tissue thermal resistance and this is described in detail in this paper. The present method is highly promising as an accurate, useful and convenient core-thermometry system for medical and healthcare settings and could be used in daily life through further development as shown in the lower right part.

J. Clark and C. E. Konrad.

Observations and Estimates of Wet-Bulb Globe Temperature in Varied Microclimates.

JOURNAL OF APPLIED METEOROLOGY AND CLIMATOLOGY. 2024;63(2):305-19.

https://doi.org/10.1175/JAMC-D-23-0078.1

Wet -bulb globe temperature (WBGT) is used to assess environmental heat stress and accounts for the influ- ences of air temperature, humidity, wind speed, and radiation on heat stress. Measurements of WBGT are highly sensitive to slight changes in environmental conditions and can vary several degrees Celsius across small distances (tens to hundreds of meters). Relative to observations with an International Organization for Standardization (ISO) -compliant WBGT meter, this work assesses the accuracy of WBGT measurements made with a popular handheld meter (the Kestrel 5400 Heat Stress Tracker) and WBGT estimates. Measurements were made during the summers of 2019-21 in a variety of suburban and urban environments in North Carolina, including three high school campuses. WBGT can be estimated from standard weather station variables, and many of these stations report cloud cover in lieu of solar radiation. Therefore, this work also evaluates the accuracy of clear -sky radiation estimates and adjustments to those estimates based on cloud cover. WBGT estimated with the method from Liljegren et al. from a weather station were on average 0.2 degrees C warmer than Observed WBGT, while the Kestrel 5400 WBGT was 0.7 degrees C warmer. Large variations in WBGT were observed across surfaces and shade conditions, with differences of 0.9 degrees C (0.3 degrees-1.4 degrees C) between a tennis court and a neighboring grass field. The method for estimating clear -sky radiation in Ryan and Stolzenbach was most accurate and the clear -sky radiation modified by percentage cloud cover was found to be within 75 W m22of observations on average.

M. Wagih, J. Shi, M. Li, A. Komolafe, T. Whittaker, J. Schneider, S. Kumar, W. Whittow and S. Beeby.

Wide-range soft anisotropic thermistor with a direct wireless radio frequency interface.

Nature Communications. 2024;15(1):452.

https://doi.org/10.1038/s41467-024-44735-z

Temperature sensors are one of the most fundamental sensors and are found in industrial, environmental, and biomedical applications. The traditional approach of reading the resistive response of Positive Temperature Coefficient thermistors at DC hindered their adoption as wide-range temperature sensors. Here, we present a large-area thermistor, based on a flexible and stretchable short carbon fibre incorporated Polydimethylsiloxane composite, enabled by a radio frequency sensing interface. The radio frequency readout overcomes the decades-old sensing range limit of thermistors. The composite exhibits a resistance sensitivity over 1000 °C−1, while maintaining stability against bending (20,000 cycles) and stretching (1000 cycles). Leveraging its large-area processing, the anisotropic composite is used as a substrate for sub-6 GHz radio frequency components, where the thermistor-based microwave resonators achieve a wide temperature sensing range (30 to 205 °C) compared to reported flexible temperature sensors, and high sensitivity (3.2 MHz/°C) compared to radio frequency temperature sensors. Wireless sensing is demonstrated using a microstrip patch antenna based on a thermistor substrate, and a battery-less radio frequency identification tag. This radio frequency-based sensor readout technique could enable functional materials to be directly integrated in wireless sensing applications.

Travail dans une ambiance thermique extrême

C. Thompson, L. Ferrie, S. J. Pearson, B. Highlands and M. J. Matthews.

Do extreme temperatures affect cognition? A short review of the impact of acute heat stress on cognitive performance of firefighters.

FRONTIERS IN PSYCHOLOGY. 2024;14.

https://doi.org/10.3389/fpsyg.2023.1270898

Research shows that exposure to high environmental temperatures can affect task performance. Theoretical explanations outline that heat is a source of stress that competes for limited-capacity resources, therefore if a task is resource-intensive, and/or if heat stress is extreme, performance will suffer. One occupation in which individuals complete demanding tasks and make difficult decisions, often in temperatures exceeding 200 degrees C, is firefighting. Yet very little is currently known about the impact of heat stress on the cognitive functioning of firefighters. This short review summarizes the limited research in this area, focusing on studies that measured cognition of firefighters following a realistic training exercise. The findings are mixed with evidence that heat stress improves, impairs, and has no impact on cognitive functioning. While there are differences in the firefighting activities utilized, and the temperatures that participants were exposed to, it is argued that the varied findings can be attributed to the tasks used to assess cognitive processing, and the cognitive functions being measured. In accordance with the wider field of research, it is concluded that complex functioning, such as sustained attention, vigilance, and working memory is negatively impacted by acute exposure to extreme heat. Greater understanding of factors affecting cognition would inform safety practices and more research is needed to understand how and when heat stress may influence cognition in firefighting scenarios.

A. Ihsan, J. W. Cheng, N. P. Widodo, E. Y. Wang, F. Z. Waly, S. R. Syachran, T. Fadillah and H. N. Khamidah.

Hybrid method for analyzing air thermal conditions in underground mines.

EXPERT SYSTEMS WITH APPLICATIONS. 2024;245.

https://doi.org/10.1016/j.eswa.2023.123026

Thermal prediction of underground mine air is required to develop control measures against heat problems. Researchers have extensively studied this topic using numerical simulations; however, these require long processing times. Recently, researchers have begun using artificial intelligence algorithms; however, the predictive capabilities of the model are still limited because an intelligent system is formed from field measurement data. This study presents a fast and accurate prediction of the Wet Bulb Globe Temperature (WBGT) in underground mines using a hybrid integrated numerical method and an adaptive neuro fuzzy inference system (ANFIS) method. The mine air thermal conditions in various scenarios were analyzed by numerical simulation, and the results were utilized to develop intelligence for ANFIS model -based predictors. A case study was conducted in two underground gold mine areas to demonstrate the effectiveness of this method. The ANFIS model was trained and tested with 81 scenarios generated from numerical simulations. Accurate predictors were obtained, with a coefficient of determination (R2) of 0.98 and 0.97. In addition to predicting the WBGT, the developed ANFIS model optimized the selection of the auxiliary fan power, minimizing the power consumption while simultaneously providing a comfortable WBGT.

Travail par fortes chaleurs et périodes de canicule

G. E. Maline and D. S. Goldfarb.

Climate change and kidney stones.

CURRENT OPINION IN NEPHROLOGY AND HYPERTENSION. 2024;33(1):89-96.

https://doi.org/10.1097/MNH.0000000000000931

Purpose of review : Kidney stones affect an increasing proportion of the population. We suggest that these trends are in part influenced by exposure to higher temperatures as a result of climate change and urbanization. The changing epidemiology of kidney stones is a topic worthy of discussion due to the economic and healthcare burden the condition poses as well as the quality-of-life disruption faced by individuals with kidney stones. Recent findings : The relationship between heat and kidney stones is well supported. Exposure to high temperatures has been shown to increase risk for stone development within a short time frame. Effects are modified by factors such as sex, comorbid conditions, and population vulnerability and adaptability. Urban heat islands (UHIs) likely exaggerate the effect of increasing global surface temperature. The concentration of UHIs often coincides with historic redlining practices in the United States, potentially contributing to observed disparities in kidney health among minoritized populations. As global surface temperature increases and urbanization trends continue, a greater proportion of the world's population is exposed to significant temperature extremes each year, leading to the expectation that kidney stone prevalence will continue to increase. Summary : This work describes the effect of increasing global surface temperature as a result of climate change on kidney stone disease and kidney health. These effects may result in further perpetuation of significant kidney stone related social disparities. We suggest strategies to mitigate the effects of heat exposure on stone formation.

Y. S. Shin, J. B. Ko, D. A. Cha and J. S. Hong.

The Effect of Length of Service in a Thermal Environment on Thermal Comfort and Mental Stress.

BUILDINGS. 2024;14(1).

https://doi.org/10.3390/buildings14010099

An inappropriate thermal environment negatively impacts workers, causing mental stress and safety accidents. Unskilled workers are more vulnerable to industrial accidents and thermal stress compared with skilled workers due to suboptimal and unfamiliar work. Previous studies have focused on individual characteristics (such as gender, age, and race), with limited emphasis on the thermal comfort sensation. This study identified the preferred thermal environment according to work experience and how mental stress differed between unskilled and skilled workers by examining their thermal comfort sensation. Predicted mean vote (PMV) was used as an indicator of the thermal environment, and five environments were constructed for PMV: -2, -1, 0, 1, and 2. Participants were recruited among current workers and the public. Mental stress and thermal comfort sensation were assessed using heart rate variability and thermal comfort vote, respectively. This study demonstrated that the skilled group experienced higher mental stress and a lower thermal comfort sensation. Contrastingly, in the sensitivity analysis, the unskilled group exhibited greater sensitivity to changes in the thermal environment. Through a comprehensive analysis, this study derived an optimal PMV range for each group. The findings can provide a reference for configuring the optimal thermal environment of the workplace.

G. C. Nelson, J. Vanos, G. Havenith, O. Jay, K. L. Ebi and R. J. Hijmans.

Global reductions in manual agricultural work capacity due to climate change.

GLOBAL CHANGE BIOLOGY. 2024;30(1).

https://doi.org/10.1111/gcb.17142

Manual outdoor work is essential in many agricultural systems. Climate change will make such work more stressful in many regions due to heat exposure. The physical work capacity metric (PWC) is a physiologically based approach that estimates an individual's work capacity relative to an environment without any heat stress. We computed PWC under recent past and potential future climate conditions. Daily values were computed from five earth system models for three emission scenarios (SSP1-2.6, SSP3-7.0, and SSP5-8.5) and three time periods: 1991-2010 (recent past), 2041-2060 (mid-century) and 2081-2100 (end-century). Average daily PWC values were aggregated for the entire year, the growing season, and the warmest 90-day period of the year. Under recent past climate conditions, the growing season PWC was below 0.86 (86% of full work capacity) on half the current global cropland. With end-century/SSP5-8.5 thermal conditions this value was reduced to 0.7, with most affected crop-growing regions in Southeast and South Asia, West and Central Africa, and northern South America. Average growing season PWC could falls below 0.4 in some important food production regions such as the Indo-Gangetic plains in Pakistan and India. End-century PWC reductions were substantially greater than mid-century reductions. This paper assesses two potential adaptions-reducing direct solar radiation impacts with shade or working at night and reducing the need for hard physical labor with increased mechanization. Removing the effect of direct solar radiation impacts improved PWC values by 0.05 to 0.10 in the hottest periods and regions. Adding mechanization to increase horsepower (HP) per hectare to levels similar to those in some higher income countries would require a 22% increase in global HP availability with Sub-Saharan Africa needing the most. There may be scope for shifting to less labor-intensive crops or those with labor peaks in cooler periods or shift work to early morning. Average PWCs during the crop growing season and the hottest period (the hottest 90 continuous days in the year) for three time periods: (a, d) recent past (1991-2010); (b, e) with mid-century (2041-2060) with SSP5-8.5; (c, f) end-century (2081-2100) with SSP5-8.5. Areas with no crops at the start of the 21st century are excluded (gray areas). Map lines delineate study areas and do not necessarily depict accepted national boundaries. PWC, Physical work capacity.

D. Enescu.

Heat Transfer Mechanisms and Contributions of Wearable Thermoelectrics to Personal Thermal Management.

ENERGIES. 2024;17(2).

https://doi.org/10.3390/en17020285

Thermoelectricity can assist in creating comfortable thermal environments through wearable solutions and local applications that keep the temperature comfortable around individuals. In the analysis of an indoor environment, thermal comfort depends on the global characteristics of the indoor volume and on the local thermal environment where the individuals develop their activity. This paper addresses the heat transfer mechanisms that refer to individuals, which operate in their working ambient when wearable thermoelectric solutions are used for enhancing heating or cooling within the local environment. After recalling the characteristics of the thermoelectric generators and illustrating the heat transfer mechanisms between the human body and the environment, the interactions between wearable thermoelectric generators and the human skin are discussed, considering the analytical

representations of the thermal phenomena. The wearable solutions with thermoelectric generators for personal thermal management are then categorized by considering active and passive thermal management methods, natural and assisted heat exchange, autonomous and nonautonomous devices, and direct or indirect contact with the human body.

B. Byg and A. D. Shah.

Heating up: climate change and the threat to human health.

CURRENT OPINION IN NEPHROLOGY AND HYPERTENSION. 2024;33(1):78-82.

https://doi.org/10.1097/MNH.0000000000000933

This review discusses the urgency of addressing human-caused climate change and its impacts on health and the environment. Recent findings : The latest evidence shows that current climate changes are primarily attributable to greenhouse gas emissions from human industrial activity. Exceeding 1.5°C of warming above preindustrial levels is projected to increase extreme weather events, increase rates of heat-related morbidity and mortality and vector-borne disease, exacerbate food and water insecurity, harm biodiversity and agriculture, displace communities, and disproportionately impact disadvantaged groups. Summary : Urgent action is required to curb emissions, enact adaptation strategies, and promote climate justice. The healthcare sector must reduce its ecological footprint and prepare systems and workers to address climate change's health effects. Further research should support climate solutions while promoting health equity and environmental justice.

Actualités janvier 2023

- **Travail par fortes chaleurs et périodes de canicule**

As summers grow ever hotter, OSHA appears ready to protect workers. Govexec.com, 29 janvier 2024

- **Outils et capteurs de mesure**

Medtech : le thermomètre encapsulé de Bodycap s'invite aux JO de Paris. Latribune.fr, 9 janvier 2024

The Pixel 8 Pro's Thermometer app can finally record your body temperature. androidauthority.com, 25 janvier 2024