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| **Use Case Name** | ***Heat wave health impacts #1 – Heat Early Warning System and Heatwave plan for England*** |
| **Sector** | *Health* |
| **Reference** | ***SEC-HEA-UCT-003*** |
| **Scope of decision-making** | Take preventive action against extreme warm temperatures impacts on health of the population. In this case we focus on the “Heatwave plan for England”. The heat-health watch alert system operates in England from 1 June to 15 September each year. During this period, the Met Office may forecast heatwaves. There are 5 different levels of alert (level 2 to 3 are based on threshold day and night-time temperatures as defined by the Met Office).  https://www.gov.uk/government/publications/heatwave-plan-for-england |
| **Actor** | **Name:** Yolanda Clewlow (1), Rutger Dankers (2), Angie Bone (3)  **Name of organisation:** (1) Met Office, (2) Met Office, (3) Public Health England  **Job title:** (1) Strategic Lead for Health, Weather & Climate, (2) Weather and Impacts Lead and (3) Head of Extreme Events and Health Protection, Public Health England  **Country:** United Kingdom |
| **ECV/CII** | \* Current: Maximum and minimum temperature higher than certain thresholds during two consecutive days.  \* Needs of Public Health England: PHE would like to have impact indicators which take into account the vulnerability of the population exposed to extreme temperatures. Huge need to have higher spatial resolution information for urban heat plans at neighbourhood level.  \* More details on current use of the information: The Met Office's Heat Health Watch Service is designed to alert customers and the general public to the likelihood of heat wave conditions in different administrative regions of England. If there is a high chance (greater than 60%) that these values will be reached on at least two consecutive days and the intervening night, then a level 2 alert will be triggered. The threshold for maximum day and night temperatures are defined for each region (see values in Annex 1 of Heatwave plan for England https://www.gov.uk/government/publications/heatwave-plan-for-england).  The heatwave plan has several levels of alert. The heatwave forecast triggers level 2, and level 3 is reached as soon as is confirmed that the extreme temperatures has been measured. A level 4 alert indicates impacts beyond the health sector (the event is severe or prolonged in time).  The heatwave plan also has an evaluation phase when specific case studies with specific and much more higher data needs could be found. For example, during extreme heat waves it can happen that there is temperature profile inversions which lead to high level of contaminations.  They have considered adding other variables such us humidity but more research is required to answer which one have higher predictive value in the morbidity and mortality.  The Plan is at the moment under external evaluation and may be fundamentally changed in forthcoming years. In order to substantially improve it, retrospective analysis will be needed. |
| **Data source** | Current: Observations and weather forecast.  Potential: to use reanalysis, seasonal forecast and climate projections to improve the plan in future years.  Comments on possibilities of seasonal forecast use: MetOffice says seasonal forecast may be very useful internally. It is unclear how seasonal forecast could be implemented in the heat plan in practice. There is not a big demand of skilled seasonal forecast from PHE. The biggest demand is to have as gradual information as possible as the event approaches, but mainly at weather lead times. Good skill priority over long lead times. |
| **Type of required product** | Raw data, maps, plots, also summary statistics. Key tools would be region depending threshold tools, plots and summary statistics. |
| **Application** | The information is used to set the corresponding level of action of the Heatwave Plan. |
| **Current sources** | MetOffice |
| **Key characteristics of the climate information** | |
| **Timeliness** | As death rates rise soon after temperature increases, with many deaths occurring in the first two days, this is  an important stage to ensure readiness and swift action to reduce harm from a potential heatwave. |
| **Frequency of update** | Mostly daily. Potentially, urban heat plans could be put in practice and then, it would be important to be able to distinguish different parts of the day, which at city level are affected differently by Heat Urban Island effect which is more intense typically at night. |
| **Horizontal spatial resolution** | The data is needed for the current plan at region scale resolution.  But, there is a big need to go to smaller scales, in particular to the city level for big cities.  The requirement from Public Health England is to develop impact based models and indicators that take into account the impacts on society including information about the vulnerability and socio-economic profile of the population. |
| **Horizontal Spatial coverage** | Specific regions from England: London, South East, South West, Eastern, West Midlands, East Midlands, North West, Yorkshire and Humber, North East. |
| **Vertical spatial resolution** | Surface data.  Vertical profiles are sometimes needed for posterior evaluation of heat waves, when temperature inversion may be sometimes observed. |
| **Vertical spatial coverage** | Surface data. |
| **Temporal resolution** | Daily and sub-daily data would be necessary for urban heat plans. |
| **Temporal coverage** | From 1 of June to 15 September each year. |
| **Normal flow of events -** *The typical flow of events from user request, to successfully obtaining the climate data, to using the data. Document the step-by-step chain of activities.* | |
| **Internal or external processing** | For Met Office internally, for PHE and others externally. |
| **Details on data processing / manipulation** | Met Office generate data and check if the heatwave threshold are surpassed. In practice Met Office forecasters will look at a range of data and models, including post-processed model output. The key source at this time range is possibly output from the Met Office Global and Regional Ensemble Prediction System (MOGREPS), supplemented by the ECMWF ensemble, but individual forecasters may prefer to look at deterministic models as well.  If so, after a consultation between Met Office and PHE, the Met Office sends an alert to many agents involved(Public via media, Local Authorities, NHS England and other government departments).  The email alert if that is the case containing the risk per region, among others. |
| **Tools for data processing** | The raw data is generated with the Met Office Unified model, averaged up to the desired regional level and threshold combining two days ahead (heatwave definition). |
| **User requirements in relation to accessibility and visualisation** | |
| **Accessibility** | - |
| **Visualisation capabilities required** | Maps for specific regions of a level of alert. |
| **Quality requirements -** *What information do users require about the quality of climate information in order to use the climate information. Essentially ECMWF wants to know what is the minimum ‘quality’ that is required in order for the user to decide whether or not to use the dataset.* | |
| **Level of skilfulness** | The minimum skill would depend on the specific final end user. The person from Public Health England thinks that a cost-benefit detailed analysis would be required to answer properly this question. Angie Bone says the alerts are not very costly as only behavioural changes can be put in place. There is not the capacity of having extra people working in hospitals due to a Heat wave, for example.  They prefer having higher spatial resolution than more skilful predictions for longer lead times. MetOffice find highly beneficial the use of multi-model approaches. |
| **Validation of data** | - |
| **Meta data** | - |
| **Stability** | *-* |
| **Uncertainty representation** | An alert is only issued if there is a 60% chance of surpassing threshold. The uncertainty information is already incorporated in the decision making process and in the level of alert.  This also would depend on the user and cost of false alarms for each case. For the Met Office this cost could be also in terms of lost of trust. |
| **Other** | - |