Met Office Hadley Centre | Department for Environment Food & Rural Affairs

Climate services for and on behalf of Defra

Food, farming and the natural environment

UK climate-pest risk web tool

Executive summary

- Pests pose risks to many plant species, habitats and ecosystem services[a].
- The **climate-pest risk web tool**, developed by the Met Office Hadley Centre in collaboration with Defra's plant health risk and horizon scanning team, uses up-to-date climate data and models to estimate and map indicators of risk for important plant pests across the UK.
- Defra is using this tool for informing actions to assess, survey, monitor and eradicate plant pests, helping to enhance UK plant biosecurity.

Pests pose risks to a wide range of plant species (including crops), habitats, and the ecosystem services that these provide. Climate (variability and change) can affect these risks by modifying the timing of life cycle events, the distribution and spread of species, and the introduction and establishment of non-native species[1]. Future projections indicate that expanding trade (UK and international) and continued climate change are expected to increase the threat to UK plants from a range of important pest species[2-4].

Scientists from the Met Office Hadley Centre, in collaboration with partners from Defra (Plant health risk and horizon scanning team), Fera Science, University of Exeter and University of Warwick, have developed the climate-pest risk web tool (**https://www.metoffice.gov.uk/hadobs/pests_1km_v1/**) to help pest risk analysts to easily identify the timings and locations across the UK that show highest risk from selected climate-sensitive pests. Indicators of pest risk, such as the timing of adult emergence or number of generations, are estimated using pest life-cycle models together with daily climate data (across the UK at 1 km^2 spatial resolution) from the Met Office Hadley Centre's HadUK-Grid dataset[5].

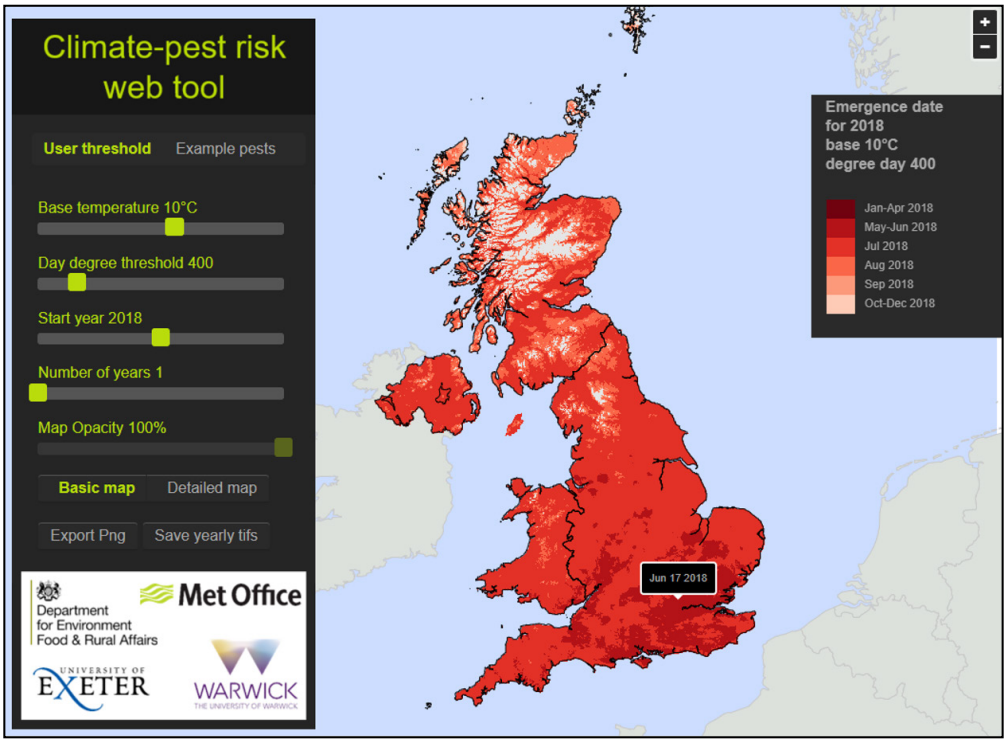
By applying knowledge of known temperature thresholds for different pests, with up-to-date climate observation data, the tool enables users to estimate and compare pest risk indicators across the UK for a range of plant pests and recent years, from 2016 to the present (e.g., emerald ash borer, see box). The latest HadUK-Grid daily climate data are used to update the indicators within two days of real time, providing additional capability for rapid, near-term (current year) forecasts. This was utilised to forecast the possible emergence dates of oak processionary moth and European spruce bark beetle following outbreaks in 2019[6] and 2021[7], respectively. The tool also provides functionality to download the mapped data as geotiffs for use in GIS systems or as images within written reports.

[a] **Ecosystem services** are the benefits people obtain from ecosystems. For the Millennium Ecosystem Assessment these were classified along functional lines, using categories of provisioning, regulating, cultural, and supporting services, and recognising that some of these categories overlap [Millennium Ecosystem Assessment[8]].

[b] **Degree days** are the day-by-day sum of number of degrees by which the temperature exceeds the baseline temperature (the threshold below which the pest is unable to develop), using the minimum, mean and maximum recorded temperatures for that day. Warmer locations such as London will accumulate a higher number of degree days, which will lead to an earlier pest emergence date. Colder locations such as Northern Scotland will have lower rates of degree day accumulation so emergence dates will be later.

Emerald ash borer (*Agrilus planipennis*)

The emerald ash borer (EAB) is a highly damaging pest of ash trees in areas where it has been introduced, including North America and eastern Europe. While there have been no reported findings of EAB in the UK, there is a risk of entry through the trade in firewood. If it arrives, the climate is likely to be suitable for its survival. This figure shows the estimated timing of 10% emergence of EAB across the UK given the climate of 2018 (warmest recent winter) and based on temperature thresholds published in USA and Canada[8]. Emergence dates from mid-June to mid-July are estimated across most of England, with August and early September possible in higher and more northern locations. In cooler climates, e.g., European Russia, a 2-year life cycle is also common. Hovering the pointer over specific map locations displays the estimate for that grid box. The Forestry Commission conduct surveys for EAB in the UK and are evaluating the possibility of using pheromone traps in future years. This web tool can be used to determine the best time of year to put up traps so they could detect the first emerging adults if there was an outbreak.



Future plans

Future developments to the climate-pest risk web tool will continue to be co-designed with pest risk experts and end-users to ensure their relevance and utility. Plans include the addition of new pests, pest risk indicators, climate variables (including humidity and solar radiation), microclimate data and future climate projections, as well as extension of the spatial coverage to include Europe. Extra map layers will be added to identify the location of vulnerable host plant species, and therefore those areas most at risk from specific pests.

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[7] **https://www.gov.uk/government/news/forestry-commission-acts-on-bark-beetle-tree-pest**
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[9] **https://www.millenniumassessment.org/en/index.html**

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