A3: A User-Friendly Web Tool for Predicting Mould Growth in Moisture Safety Design

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About the conference
The following abstract is from the 3rd International Conference on Moisture in Buildings (https://ukcmb.org/icmb25) held in UM Guimarães, Portugal, on the 23-24 Oct 2025. All abstracts published here underwent single blind review by the Conference Scientific Committee.

Abstract

Mould growth depends on relative humidity (RH), temperature and material susceptibility. The MOGLI (MOuld Growth LImit) model predicts risk based on the material parameter critical moisture level (RH_{crit}), determined in laboratory tests, and the expected climate conditions in the building. We present MOGLI 2.0, an improved version of the model, implemented in a user-friendly web application. Key innovations include explicit uncertainty intervals for RH_{crit}, a risk accumulation method that considers both how long and how far RH exceeds RH_{crit}, and the use of threshold times derived from laboratory observations. Validation with field data from attics and crawl spaces demonstrated good agreement between predicted and observed mould growth. The tool supports early-stage design decisions for moisture-safe buildings and is currently available as a beta version.

Keywords: moisture safety; mould growth prediction; risk classification; critical moisture level; design tool

1. Introduction

Mould growth in buildings is determined by local microclimate conditions, primarily relative humidity (RH) and temperature, and the susceptibility of building materials. A key concept in assessing this risk is the critical moisture level (RH_{crit}), defined as the lowest RH at which mould growth occurs on a specific material. RH_{crit} is determined through standardised laboratory testing, the CML method [1], and varies between products and with temperature. If RH_{crit} is exceeded, there is a risk of mould growth.

To support moisture-safe design, the MOGLI (MOuld Growth LImit) model, originally described as the PJ model [2], was developed to predict mould growth risk based on RH_{crit}. Earlier versions successfully predicted mould growth [3] but lacked dynamic treatment of time and uncertainty. This extended abstract presents MOGLI 2.0, an improved version of the model, and its implementation in a user-friendly web tool designed to assist practitioners in evaluating mould risks during design and renovation.

2. The MOGLI model

MOGLI version 2.0 was developed to address key limitations of the original model. It retains the use of product-specific RH_{crit} values, classified into five classes, and temperature-dependent RHcrit curves (isopletes). It introduces an explicit uncertainty interval (±U) for RH_{crit}. This enables the model to distinguish between conditions where risk can be confidently excluded, confirmed, or remains uncertain. Figure 1 illustrates the RH_{crit} curve and its uncertainty bounds, together with sample climate data.

Additionally, MOGLI 2.0 accounts for both the duration and the magnitude of exceedance above RH_{crit}. Each timestep of exposure above RH_{crit} is weighted by how far RH exceeds the critical level, reflecting the accelerated rate of mould growth under more humid conditions. The accumulated exposure time is then compared to threshold times derived from laboratory tests, ensuring that predictions are biologically meaningful rather than triggered by single events.

3. The MOGLI web tool

To facilitate practical use, MOGLI 2.0 has been implemented in a web-based application, the MOGLI Tool Version 0.1 (beta). It enables practitioners or researchers to evaluate mould growth risks based on their own climate data and selected building materials following the MOGLI 2.0 logic. The beta version is available at: https://mogli.shinyapps.io/MOGLIapp/. While fully functional, the tool is under active development, with ongoing improvements to usability and output, and results should be interpreted with caution.

The user interface consists of a sidebar for input and a main panel for graphical and numerical output. Users upload climate data (temperature and RH) in Excel (.xlsx) format and specify the columns for date/time, temperature, and relative humidity. Example data are also provided for demonstration purposes.

A central step is defining the appropriate RH_{crit} for the material. Users can either select one of five predefined material classes (A–E) or choose from a list of example materials with RH_{crit} values determined in previous research using the CML method. These examples are for illustration only and cannot be assumed to represent other products in the same category. However, they may be used as guidance early in the moisture safety design process when specific products have not yet been selected. Verified test data from the material manufacturer should be used whenever possible. The user can also include additional measurement uncertainty from their own data or calculations, in line with the Guide to the Expression of Uncertainty in Measurement (GUM, ISO/IEC Guide 98-3:2008).

The tool uses default threshold times derived from laboratory testing according to the method, representing the median value for several products within the same material class (A–E). Users can override these defaults with product-specific threshold times for greater precision, as such data are provided when a specific product is tested according to the CML method.

After setting parameters and clicking ‘Run’, the application calculates the accumulated exposure time above RHcrit (i.e., the total time and degree by which RH exceeds the critical threshold). The result is presented as one of four risk levels: No Risk, Low Risk, Possible Risk, or Risk. Interactive plots display temperature and RH time series, differences from RHcrit ± U, and accumulated exposure, providing a clear overview of risk.

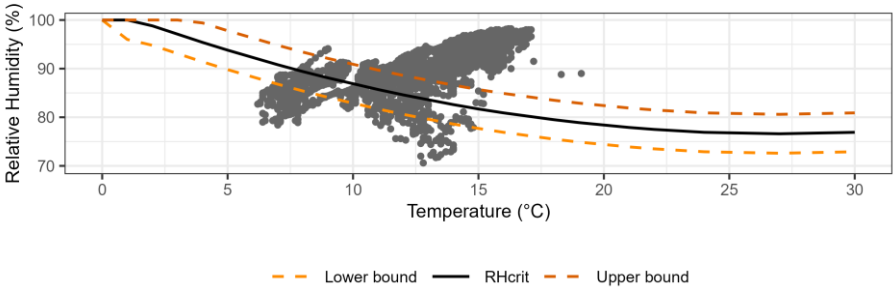

Figure 1. Temperature (°C) and RH (%) from a sample dataset together with the RHcrit curve and its uncertainty bounds (± U).

4. Empirical validation

Validation against 2.5 years of field data in attics and crawlspaces demonstrated the reliability of the model. No growth was observed in cases classified as “No Risk,” and all “Risk” cases corresponded to observed growth, indicating no false negatives or positives in these categories. “Possible Risk” closely matched actual growth (17 of 18 cases), highlighting the model’s conservative and useful warning function. “Low Risk” showed mixed outcomes, with growth in 4 of 16 cases, indicating this category represents a transitional zone rather than complete safety.

5. Future work

Future work will focus on usability testing with practitioners, expanding supported input formats (e.g. CSV and simulation outputs), and developing clearer guidance for interpretation. Integration with building regulations and expansion of RH_{crit} values provided by manufacturers are also planned. Further model refinement and validation, including adjustment of key parameters and additional laboratory and field studies, may also be conducted to improve risk classification across all categories. These efforts aim to foster adoption of the MOGLI tool in design workflows and strengthen moisture-safe building practices.

References

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