COLOURS TOOL · PERCEIVE LEGACY

Light Damage Estimator (LDE)

Predicting and mitigating light-induced colour changes in sensitive art.

Light-Induced Damage Prediction | Colour Fading Simulation | Preventive Conservation | Spectral Analysis | Risk Assessment for Cultural Heritage

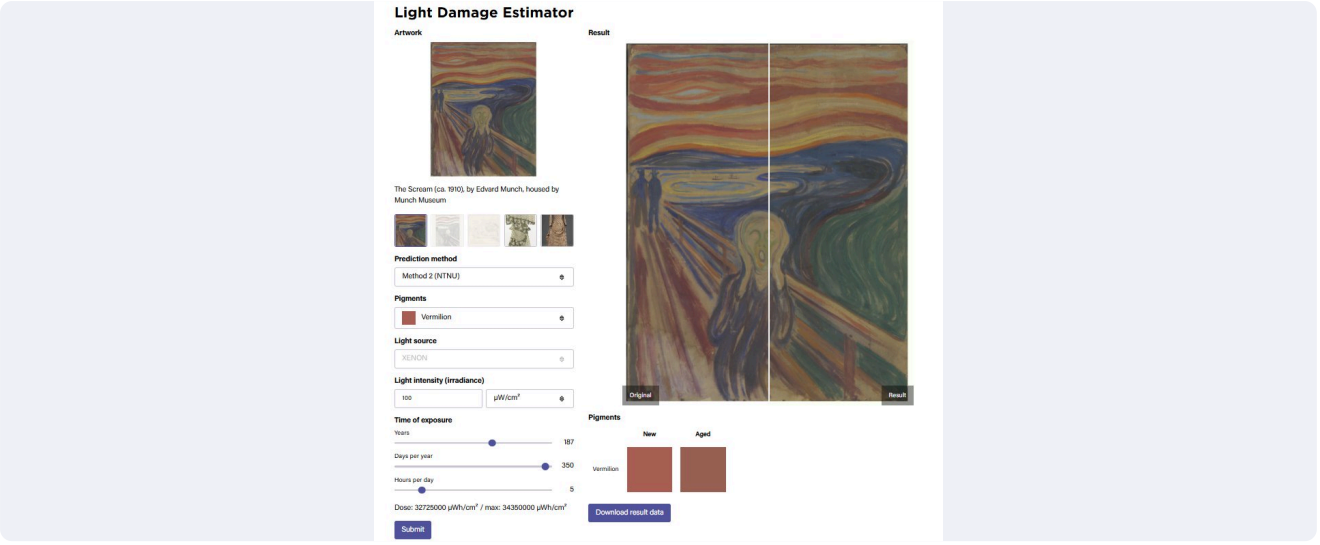


Fig. 1: Main dashboard of the LDE.

OVERVIEW

The Light Damage Estimator is a decision-support tool developed within the framework of the PERCEIVE project and currently under improvement in the COLOURS project. It addresses a critical challenge in cultural heritage preservation: predicting and mitigating light-induced colour change in sensitive artworks.

Designed for researchers, conservator-restorers, and museum professionals, LDE estimates how pigments and materials may fade or alter when exposed to specific lighting conditions over time. By combining the spectral power distribution of a selected light source with scientific datasets describing pigment sensitivity and fading behaviour, the tool simulates potential long-term visual changes.

LDE enables users to define exposure durations, compare lighting scenarios, and establish safe display thresholds. Rather than reacting to irreversible damage, professionals can proactively assess risk and optimize exhibition strategies. The tool supports both preservation and presentation, helping institutions balance conservation requirements with public access.

KEY FEATURES

- Simulation of pigment fading based on spectral light profiles
- Integration of scientific datasets on material sensitivity
- Customisable lighting configurations (LED, halogen, daylight, etc.)
- Exposure time modelling and cumulative dose calculation
- Definition of safe display thresholds and risk levels
- Visualisation of predicted colour change over time
- Comparative scenario analysis (multiple lighting setups)
- Cloud-based data storage and traceability of assessments
- Interoperability with digital twins hosted in ECCCH

IN PRACTICE: A USER STORY

Maria is a conservation scientist at a national museum preparing an exhibition of 19th-century watercolours, highly sensitive to light exposure. Before installation, she wants to ensure that the display lighting will not accelerate fading.

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She logs into the Cloud platform and opens the LDE. The digital twin of the artwork, previously uploaded to the Cloud, is already available. Maria selects the specific LED lighting system planned for the exhibition and imports its spectral profile. She then defines the expected daily exposure time and overall exhibition duration.

Using embedded pigment sensitivity data, LDE calculates the cumulative light dose and predicts potential colour shifts in different areas of the painting. A visual overlay highlights zones at higher risk. Maria adjusts the lighting intensity and tests an alternative filter. The simulation updates instantly, showing a significantly reduced predicted colour change.

Later, she shares the assessment report with the exhibition curator and lighting designer through the Cloud environment. Together, they compare multiple scenarios, balancing visitor experience with conservation constraints. The final setup uses a slightly warmer light with reduced intensity, maintaining visual quality while staying within safe exposure limits.

Months later, the documented simulation remains archived in the Cloud, linked to the object's conservation record. Future professionals can review the decision-making process, ensuring transparency and long-term preservation planning.

Through LDE, Maria moves from reactive conservation to preventive, data-driven risk management.

WHY ON THE CULTURAL HERITAGE CLOUD?

Deploying LDE on the ECCCH ensures direct access to high-quality digital twins, spectral datasets, and conservation documentation.

From a technical standpoint, ECCCH provides secure storage, version control, authentication services, and shared metadata standards. LDE can retrieve object-specific information (materials, prior restoration history) and store risk assessment results as structured, traceable records. Cloud deployment also enables collaborative scenario testing among geographically distributed teams, supporting interdisciplinary decision-making.

WHO CAN USE IT

LDE primarily serves conservator-restorers, conservation scientists, and preventive conservation specialists responsible for managing light-sensitive collections. Museum curators and exhibition designers benefit from scenario-based lighting optimization. Heritage scientists and university researchers can use the tool for studying material degradation and validating predictive models.

The tool also supports policy-makers and collection managers by providing standardized, data-driven risk documentation. In the long term, LDE may be adopted by galleries, archives, and libraries, expanding its relevance across the broader cultural heritage ecosystem.

EXPECTED TIMELINE

Alpha 2026
Spectral engine and exposure modelling

Beta 2027
Visualisation, scenario comparison, pilots

Release 2028
Production-ready on the ECCCH

During 2026, an alpha version will focus on implementing the core spectral calculation engine and exposure modelling, with internal testing by consortium partners and initial integration with ECCCH data storage services. In 2027, a beta version will introduce advanced visualisation modules, scenario comparison tools, and pilot testing with selected heritage institutions. By 2028, before project completion, LDE is expected to reach a stable, production-ready release fully interoperable with ECCCH infrastructure.

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MORE IMAGES

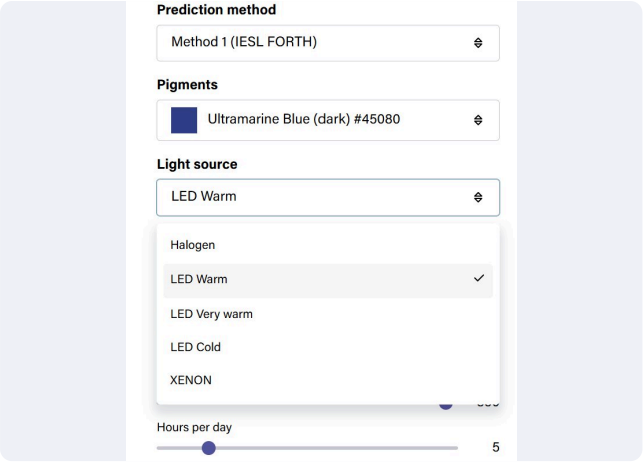


Fig. 2: Selection of a light source with specific spectral characteristics, to ensure accurate colour change estimation.

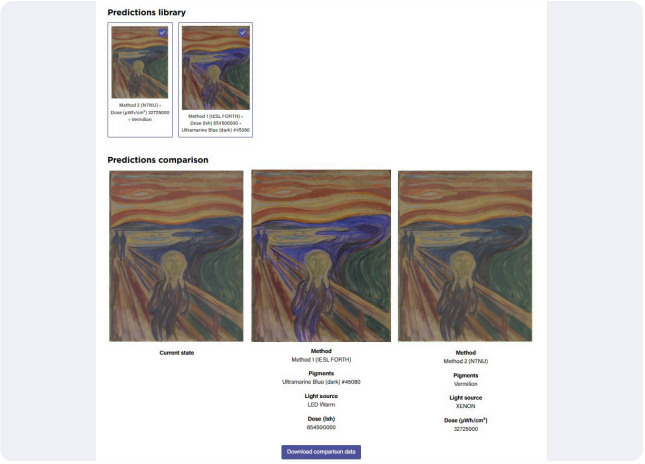


Fig. 3: Comparison of predicted colour changes across different lighting set-ups, with downloadable results to guide conservation decisions.

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