

# EXPERIENCING MATHEMATICS



MMACA is a Spanish association born with the aim to create a museum of mathematics in Catalonia. Whereas a physical museum is a main goal, at the moment MMACA has no stable place, but has done intense work with temporary exhibitions. More than 68.000 visitors, 3,000 m<sup>2</sup> of exhibition accumulated during more of two years of continued exhibitions in more of 20 cities, and more than 40 actions of dissemination. All the materials and modules are self-manufactured and have been conceived to allow the public experiencing mathematics through the senses. Favoring math learning at different educational levels is another priority and thus, MMACA has specific didactic projects and is supported both by FEEMCAT (Federation of Catalan Math Teachers Associations) and SCM (Catalan Mathematics Society).

**mmaca**

Museu  
de Matemàtiques  
de Catalunya

## Why sharing mathematics?

Museums and expositions of mathematics generally do not possess or rely on historical heritage, nor on extremely advanced and expensive machinery. Rather, they rely on objects and modules specially designed to exhibit and visualize an abstract concept. These objects include puzzles, jigsaws, sculptures, software on computers, audio and video media, etc. Most part of this material is easily reproducible, and can potentially be shared and multiplied without detriment. This openness paradigm reflects the nature of mathematics, of free knowledge and collaborative community.

The main value of a well designed module is the way of transmitting the idea or concept, the key point one must focus on, the difficulties and distracting issues for the understanding. The kind of highly valuable knowledge achieved by experience. Sharing this know-how is essential to replicate activities and create feedback.



We make a proposal of collaboration between science museums and centers in order to improve the presence of mathematics in their exhibitions, to analyze the perception of mathematics by the public, to exchange experience and ideas for a mutual benefit.

## Why experiencing mathematics?

Mathematics is still today the big unknown science, identified by most people with mere computations or simply with a necessary tool to perform other science and works. Indeed, mathematics is often a big absence in science fairs, museums and expositions. However, mathematics are indirectly gaining an increasing relevance on the public, induced by technology advances, economic effects, statistics, involvement, biology and medicine models, polls and elections, complexity... And beyond all its applications, there is a great beauty on the study of abstract problems, just for an intellectual pleasure. It's a good moment for a renewal of mathematic popularization, both on the pure and the applied sides of maths. And nowadays mathematics can be shown as an experience the same way that superconductivity can be shown in an experiment.



# THE SPHERE OF THE EARTH

## What is a map?

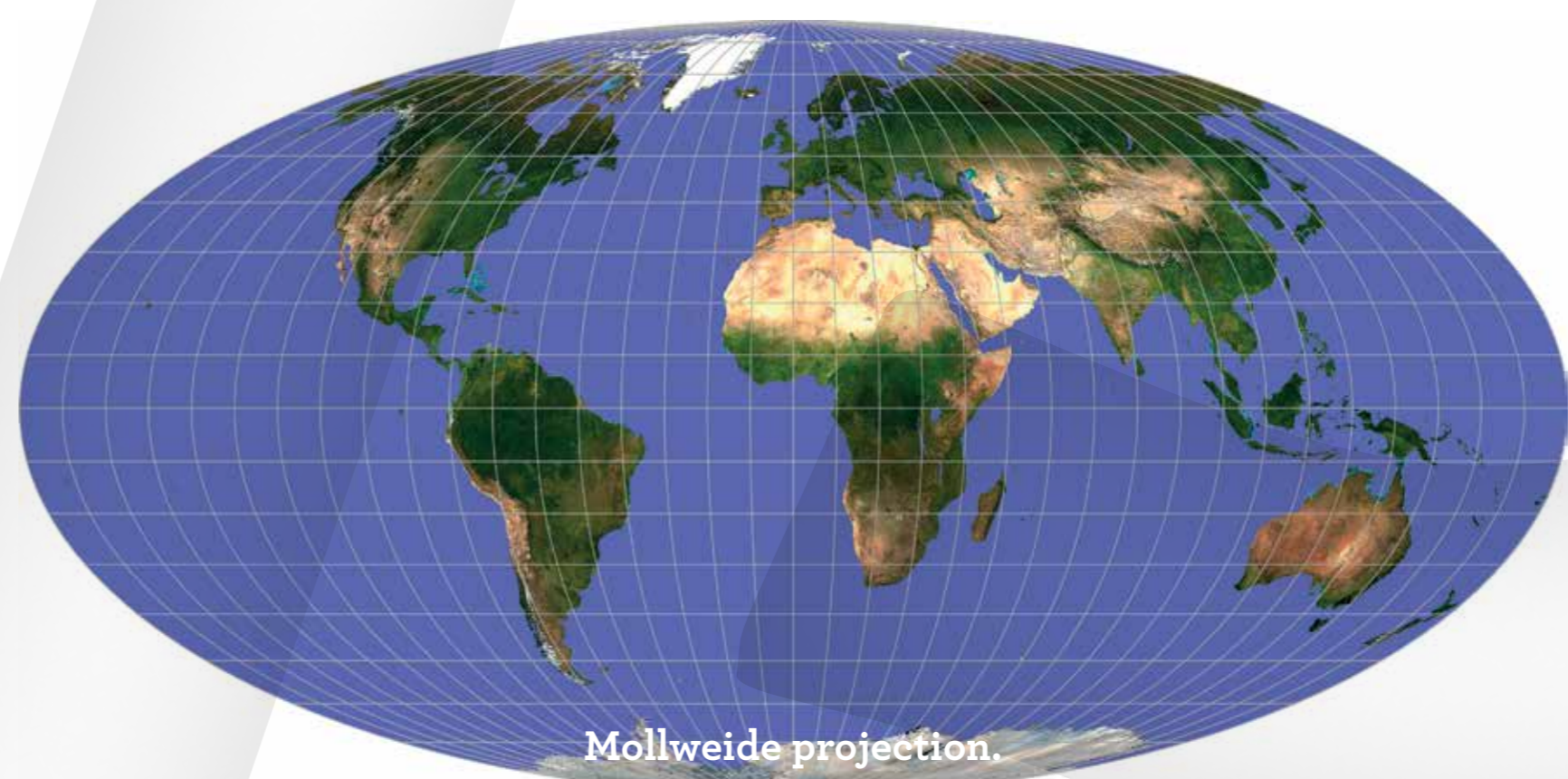
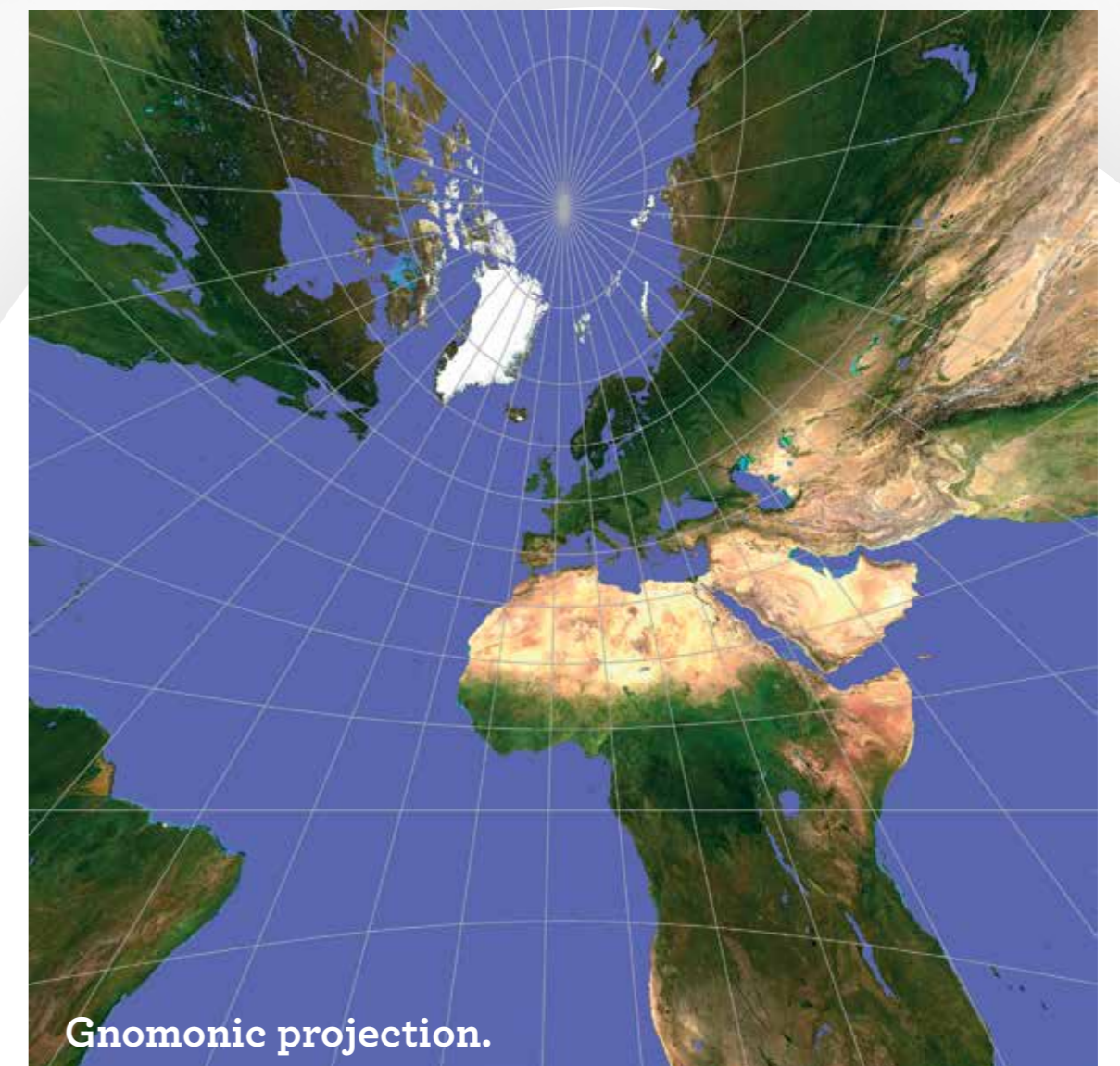
A map projection is a flat representation of the surface of the Earth. There are infinitely many ways of doing these maps; some of them will represent faithfully the angles with the North (navigation), others will preserve areas, others straight paths... but all of them will distort the true appearance of the Earth in one way or another. Gauss' Egregium Theorem ensures that there is no perfect map, that is, there is no way of representing the Earth keeping distances at scale. This is exactly what makes cartography a discipline: developing several different maps that try to solve well enough the problem of representing the Earth.

## Can we measure the distortion?

The French mathematician Nicolas Auguste Tissot invented in 1859 a graphical method to display the distortion produced at any point on a map.

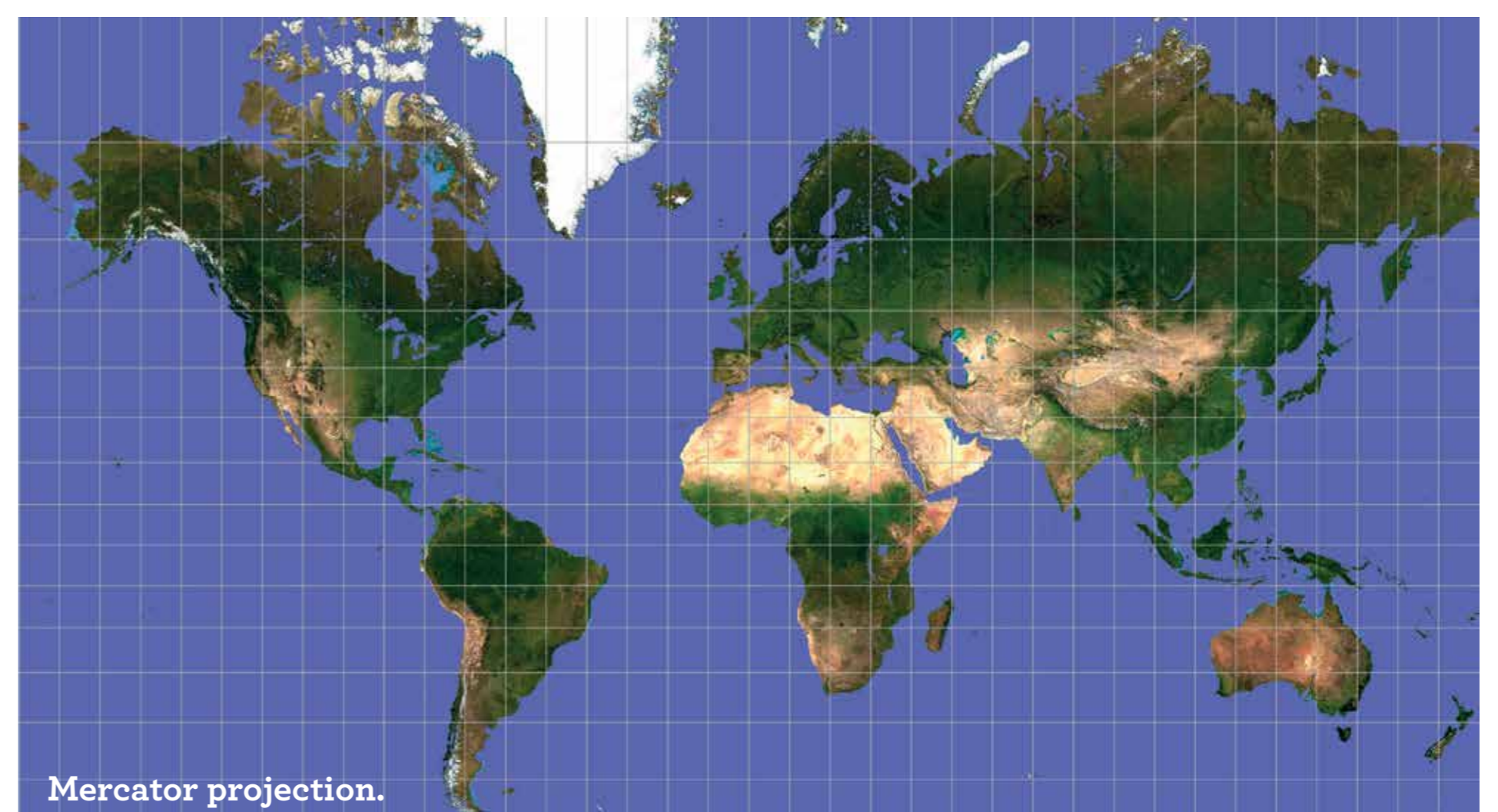
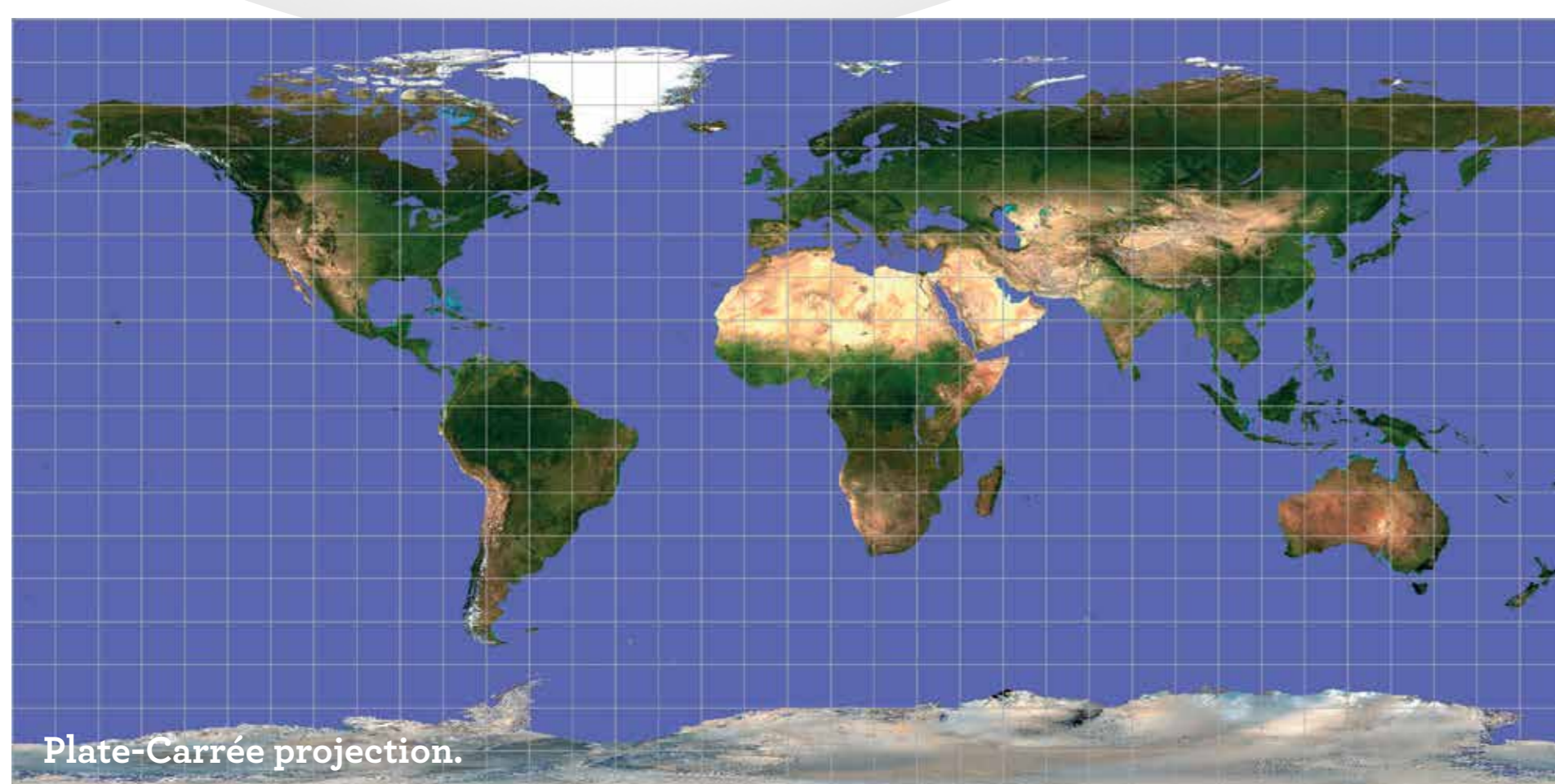
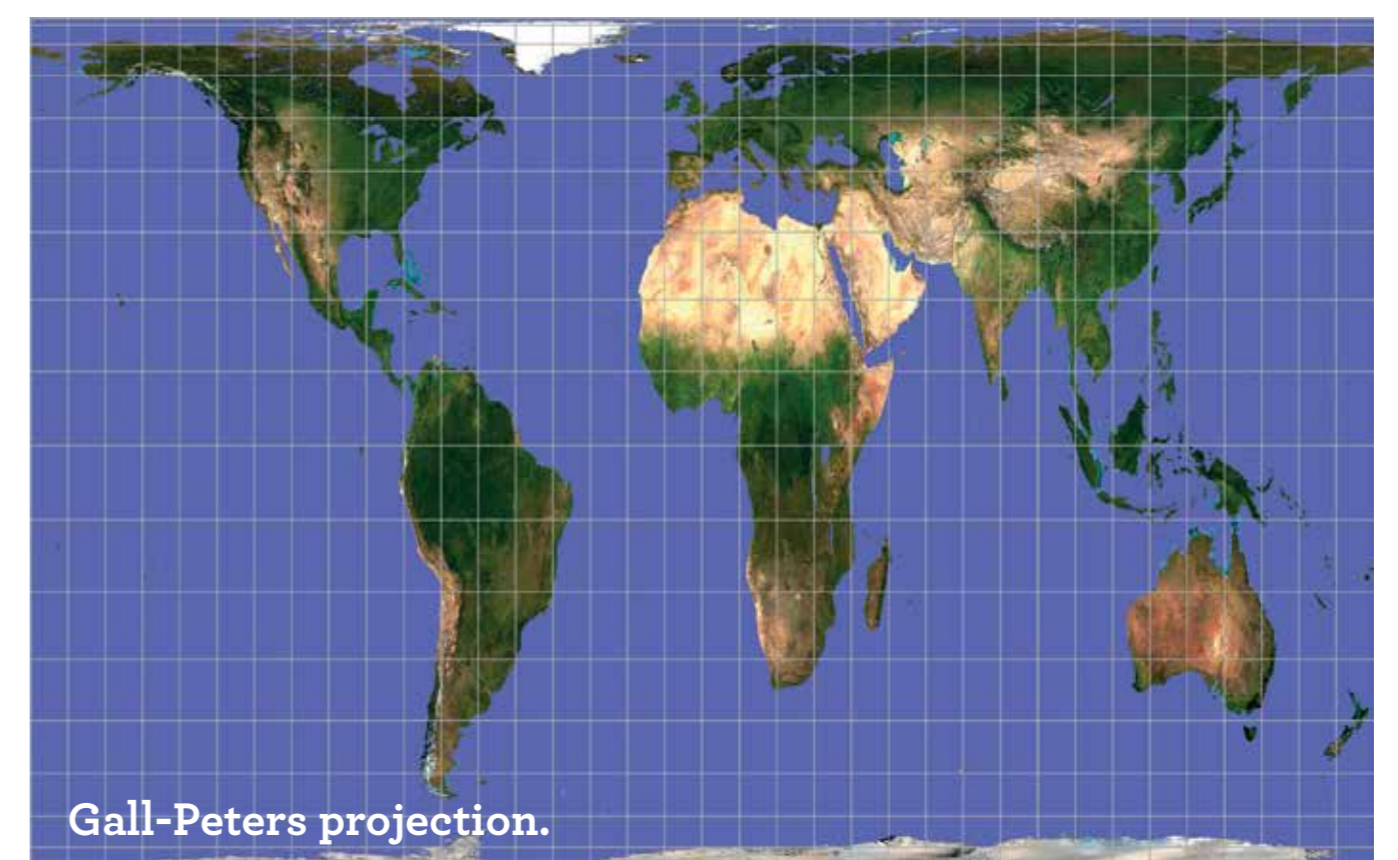
Imagine a small circle around a point on the Earth. If we project this circle onto the map, it will no longer appear as a circle, because of the distortion. If the circle is small enough, it will be projected onto an ellipse (infinitesimally). We can display this ellipse magnified so we can see it on the map. This ellipse is called a Tissot's indicatrix for the map, and its properties give us a variety of information about the distortion.

Our computer program visualizes dynamically Tissot's ellipses.



## Credits

The exhibit "The Sphere of the Earth" was awarded first prize in the Mathematics for Planet Earth 2013 competition, organized by UNESCO-IMU. It is distributed under a Creative Commons license and it is freely available at <http://imaginary.org/program/the-sphere-of-the-earth>.

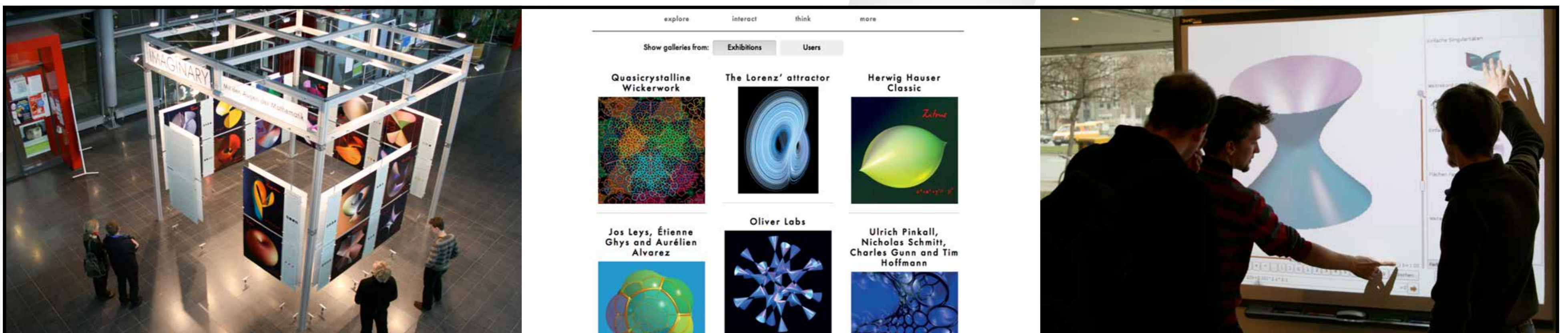


Author: Daniel Ramos (MMACA - Museu de Matemàtiques de Catalunya).

# IMAGINARY

open mathematics

**IMAGINARY is an open source platform for interactive and participative maths communication where everybody can share maths exhibits and exhibitions.**

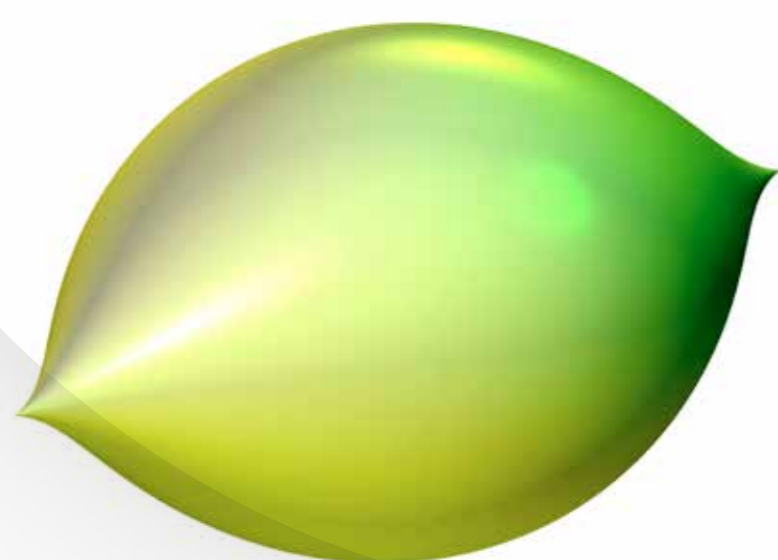


The platform currently hosts two exhibitions: the original travelling exhibition “IMAGINARY – through the eyes of mathematics” and “Mathematics of Planet Earth” that was developed by the community for the project Mathematics of Planet Earth 2013. The exhibitions have been shown in more than 80 cities in 20 countries and attracted more than 1 million visitors.

IMAGINARY contents include image galleries, mathematical films, interactive programs and hands-on exhibits. All material is made available to museums, schools and a broad audience under a free licence and can thus be reproduced and used for individual exhibitions and events.

Moreover, IMAGINARY provides an opportunity for all users to contribute with their own material and serves as a hub for exchange of ideas in the field of maths communication.

The platform consists of an explore section where the material of the various exhibitions can be found, an interact section where users can share their ideas with the community and a think section with interesting mathematical background material.



Zitrus  $x^2+z^2=y^3(1-y)^3$



**IMAGINARY is a project by the Mathematisches Forschungsinstitut Oberwolfach and supported by the Klaus Tschira Stiftung.**



**Join us!** [www.imaginary.org](http://www.imaginary.org)