SEALING ATMOSPHERIC LANDSCAPES IN RESONANT SIMULATIONS

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PLANETARY
PACKAGING
ATMOSPHERE
WORLD-BUILDING
SIMULATION

The desire to seal skies within confined spaces crosses disciplines and ages. From food packaging to planetary climate engineering through poetry and painting, atmosphere is continuously portrayed in recurrent simulations reminiscent of a Russian Doll structure. Structuring the notion of "*planetary packaging*" as an interpretative paradigm—and growing around it—this text depicts atmospheres across opposite—but mirroring—scales and contexts. In a system of echoes and reflections, contained atmospheres and atmospheric containers blur and shape each other. By counterposing modified atmosphere packaging—provocatively landscapes of built worlds gazing toward planetary processes—with climate engineering strategies—systematically reminiscent of procedures employed in modified atmosphere packaging—the research bridges tension between planetary non-linear and complex mechanisms, and the everyday immediate-reachable dimension. Tracing but modeling and speculating its attributes, the smaller atmospheric doll can observe and imitate the largest, while the latter drawing on the smaller omits fundamental elements, offering a reductive, simplified human-graspable understanding of it.

SIMULATION AND WORLD-BUILDING INSIDE A PACKAGING

Being on Earth also means inhabiting and being inhabited by its atmosphere. A gaseous mixture closely connected to the concept of the planet and in a state of interdependence with it, the atmosphere is an elusive and mutable phenomenon, interpreted on a planetary scale as a container but at the same time containable. The artist and author Andreas Philippopoulos-Mihalopoulos (2022) describes atmospheres as "Russian Dolls, one fractally nested into the next" (p. 43). I adopted this Matryoshka pattern, interpreting it as a system of echoing simulations where content and container merge and confuse by shaping and adapting the connotations of the adjacent dolls. From the planetary to the packaging, this text unravels the opposing—yet intertwined—layers of this atmospheric Matryoshka. Introducing the "*planetary packaging*" notion as an interpretive paradigm, it explores atmospheres across scales and contexts, revealing their shifting boundaries and entangled simulations.

If you think about astronauts, they never leave the planet Earth; they are embraced by the simulation of an atmosphere inspired by the Terrestrial one. The astronauts never come into direct contact with other planetary realities; rather, sheathed in spacesuits and ships, they carry with them a simulation of what they know, a capsule of the Terrestrial world that isolates them from the unknown. Hermetically packaged in a modified atmosphere that protects, preserves, and extends their lives, they are not visitors to other planets but the custodians of a simulation of their own.

In an analogous but opposite manner, it is possible to artificially simulate atmospheres by generating worlds within our own. A concrete example is the Martian atmospheric simulation at the Astrobiology Centre Laboratories in Madrid. An accurate replica of Mars' environmental conditions, where data collected on the red planet are performed and operationalised in a controlled chamber where specific hypotheses and phenomena can be tested.

The simulation achieves such a genuine precision that it is chemically indistinguishable from the records collected on the planet itself. The physicists working on "Marte, Mars on Earth" emulate a planetary atmosphere, evoking in a quasi-alchemical way a planet superimposed on the Terrestrial world.

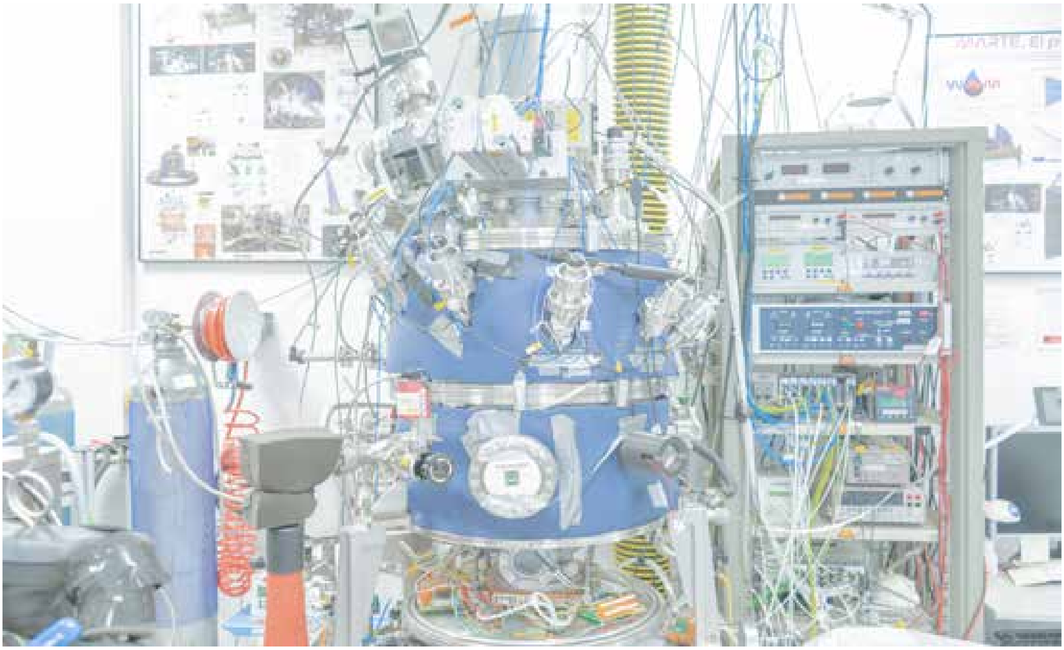

Fig. 1 Mars simulation chamber at Centro de Astrobiologia Madrid Credit: Christian Scenini.

Other technologies act on the atmosphere with similar techniques, although applied in very different contexts and scales. In this section, I discuss MAP, an acronym for "Modified Atmosphere Packaging," a technology widely used in the food industry to preserve products.

In most food containers there's an empty space between the product and the packaging. This apparently useless area that consumers often perceive as a form of waste, a space that could have held a few more drops, candies, or salad leaves. Known as headspace or ullage, in MAP this "empty" space is filled by replacing the Earth's atmosphere with an artificial one. An interstitial environment—a liminal space—is placed between the product and the Earth's atmosphere with the aim of extending the shelf life of each specific product.

One of the techniques used in MAP to extend product life is to drastically lower the air oxygen levels inside the packaging. More precisely the oxygen concentration is lowered to 1–10 percent instead of its usual 21 percent of Earth's atmosphere. Lowering the oxygen level also involves increasing carbon dioxide concentration above the usual 0.03 percent of the terrestrial atmosphere, reaching for example 80 percent concentration of carbon dioxide in the atmospheres that host parmesan cheese. As the microbiologist Malathi Vakkalanka (2012) explain, "the combination of reduced oxygen and elevated carbon dioxide levels reduces the respiration rates of the cheese, [...] thus extending the life of the product." (p. 109)

After their generation, despite their artificiality, these atmospheres begin to live on their own. By this I do not want to say that after the packaging is sealed, what happens inside is uncontrolled and unpredictable, but of course changes and reactions are not performed with controllers connected to the packaging. Every possible reaction between the inner environment and the product is taken into account during the atmosphere engineering phase; the changes that take place inside the packaging are therefore predicted but not performed on-site.

Fig. 2 Atmosphere quality control inside a potato packaging Credit: Campden BRI.

Considering the act of creating these artificial and unprecedented atmospheres, we can find an interesting analogy with Ian Cheng (2022) notion of Worldbuilding. In his work, Cheng describes Worldbuilding as the art of creating worlds, designed to evolve through autonomous interaction between their constitutive elements. In the book "Emissary's Guide To Worlding", he identifies autonomy and vitality as the two fundamental characteristics that define a world, emphasising on how it is "a living thing, artificial, but also still alive" (p. 21). The atmosphere within the packaging is designed with precision, but as we have seen, it is also designed to evolve together with the product, embodying precisely these characteristics. It does not merely contain and preserve, but becomes an active part of a system that like Cheng's worlds, self-regulates and transforms over time.

These confined systems are configured as atmospheric landscapes, as worlds, as artificial ecosystems in which the interactions between atmosphere and product lead to self-regulating processes similar to those that characterise the Earth planet. We can recognise within them patterns and mechanisms that provocatively echo planetary dynamics but which are also simulated, thus playing with their own set of rules. The ecologist Paul Colinvaux (1973), referring to the processes that alter the Earth's atmosphere wrote: "Nitrogen, oxygen and carbon dioxide are all manipulated by organisms in ecosystems. [...] the concentration of all three of these gases has been determined or at least drastically altered by life" (p. 24). The same alteration —on a compressed scale— of atmospheric composition is performed by product respiration. A tangible example can be observed in the atmospheres designed to host lettuce. At the time of its genesis, it consists in most cases of 5% Oxygen, 5% Carbon Dioxide, and 90% Nitrogen. After 10 days, the breath of the lettuce has altered the environment composition bringing the Oxygen to 1%, Carbon Dioxide to 15%, and Nitrogen to 84%, making it no longer a place to host that world.

These artificial atmospheres are thus configured as optimised habitats, engineered microcosms that do not exist independently of what they encapsulate but co-evolve with it. They are artificial ecologies superimposed on pre-existing ones, atmospheric landscapes that, as long as they are sealed inside the packaging, exclude but mimic the outside world.

Food Products	N_2 (%)	CO_2 (%)	O_2 (%)	Air (%)
Oily fish	60–40	40–60	<1	
White fish		60	40	0–20
Crustaceans		80–100		
Red meat		15–30	70–85	
Poultry	70–80	20–30	1–2	
Bakery and pasta	20–50	50–80		
Cheese	30–100	0–70		
Vegetables		0–15		
Fruit		0–20		
Coffee	100			
Potato chips	100			

Fig. 3 Recommended gas mixtures for different food products Credit: Cambridge University Press.

Product	Temp. (°C)	Atmosphere	Shelf Life (d)	Ref.
Beef	4	20% CO_2, 80% O_2	>15	1
Pork	4	100% CO_2	>24	2
Chicken	1.5	50–80% CO_2	≥23	3
Trout	1.7	80% CO_2, 20% N_2	~20	4
Dungeness crab	1.7	80% CO_2, 20% air	≥25	5
Submarine sandwich	4	30% CO_2, 70% N_2	30	6
Cheeseburger	4	20% CO_2, 80% N_2	30	6
Broccoli	4	10% CO_2, 11% O_2 79% N_2	21	7

Fig. 4 Typical shelf life of MAP products Credit_Cambridge University Press

The protective films of packaging act like the membranes that the philosopher Peter Sloterdijk (1998) describes as “materialised entities for differentiating between inside and outside” (p. 327). Determining what is part of a world and what is excluded from it "membranes act as media amid border traffic" (p. 327). Opening these films, the atmosphere comes out and encounters another reality. Time on Earth world flows differently; the product loses the protection and privileges that the modified atmosphere offered it and must be consumed in a few days. The world originated inside the packaging and the Terrestrial one mix, the parameters equalise, as they come into contact, they stretch towards uniformity. The smaller atmosphere dissolves into the larger world; gas, pressure and temperature reconfigure and compensate.

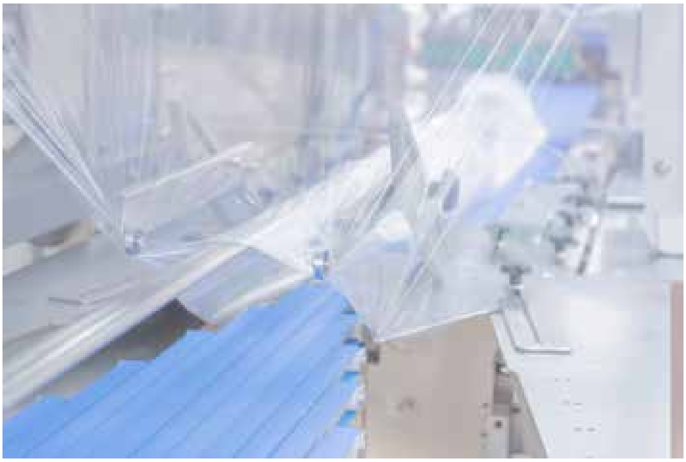

Fig. 5 Packaging machine Credit: Christian Scenini.

EXPIRY DATE AND CLIMATE ENGINEERING

Up to this point I have identified features that echo planetary dynamics within packagings, offering therefore an understanding of the term *planetary packaging* where *packaging* is the subject and *planetary* is the interpretative key subjected to it. From now on, this reading is meant to be reversed, *planetary* becomes the subject and *packaging* the speculative attribute.

To do this, I will start with a fundamental aspect of all modified atmosphere packagings: the expiry date. The product, together with the engineered atmosphere that preserves it, is subject to a degradation process. Over time, biochemical interactions between the product and surrounding gases alter the atmospheric equilibrium until a critical point where the engineered world changes, assuming other forms no longer useful for its initial purpose. The atmosphere, initially designed to protect and extend the life of the product becomes a toxic space. This is the non-return threshold: beyond it, entropy takes over and the system collapses. From the moment an atmosphere is generated, a countdown begins. The aim is to artificially suspend time and prolong the existence of a controlled ecosystem as long as possible before its inevitable collapse. However, as Parisi's first law stipulates, the tension towards degradation is inevitable; it can be slowed down and controlled, but it is still looming. This process is accelerated and the point of no return moves closer in a directly proportional way to the processing level of the product; the more a system is sectioned, altered and thus artificialised compared to its natural state, the closer its expiry date will be.

A speculatively similar estimated date is recognisable and identifiable on a planetary scale with the one given by the Climate Clock. Indicating the First January of 2028 as the date of the point of no return, it estimates the achievement of +1.5°C in atmospheric temperature compared to pre-industrial levels. This alteration indicates the point of no return, an expected date that —as in the packaging— sets the deadline for the world as we know it. It has moved closer to the present because of anthropogenic and therefore artificial operations that have altered the environment. Returning to packaging, we have seen how an artificial response to the same issue has slowed down this process. The philosopher of technology Benjamin Bratton (2019), in "Terraforming" argues that "The responses to anthropogenic climate change must be equally anthropogenic" (p. 9); this statement is in line with and echoes the strategies of MAP, where an artificial atmosphere slows down the looming degradation countdown in processed food.

Atmospheric engineering procedures on a planetary scale are identified by the term "Climate engineering," which refers to a set of deliberate, large-scale interventions aimed at altering the Earth's atmospheric system to counteract the effects of climate change. In both MAP and climate engineering, the atmosphere is seen as a system that can be designed and modified to accomplish certain requirements. In agreement with what has been discussed so far, the media theorist Jussi Parikka (2022) states: “Modern science comes to see weather as a contemporary machine of management of the environment, a project for optimisation” (p. 36). The illusion of being able to control the atmosphere is based on the capacity to obtain ever more accurate simulations, turning them into the reality of reference. To do so, technoscientific solutionism reduces the Earth’s planetary complexity to a system that can be modelled and optimised. Like a packaging where the atmosphere is engineered, the Earth’s atmosphere is objectivised and given into the hands of design. The idea of an optimised planet leads us to the notion of Earth as packaging or a chamber in which the engineered atmosphere is continuously recalibrated.

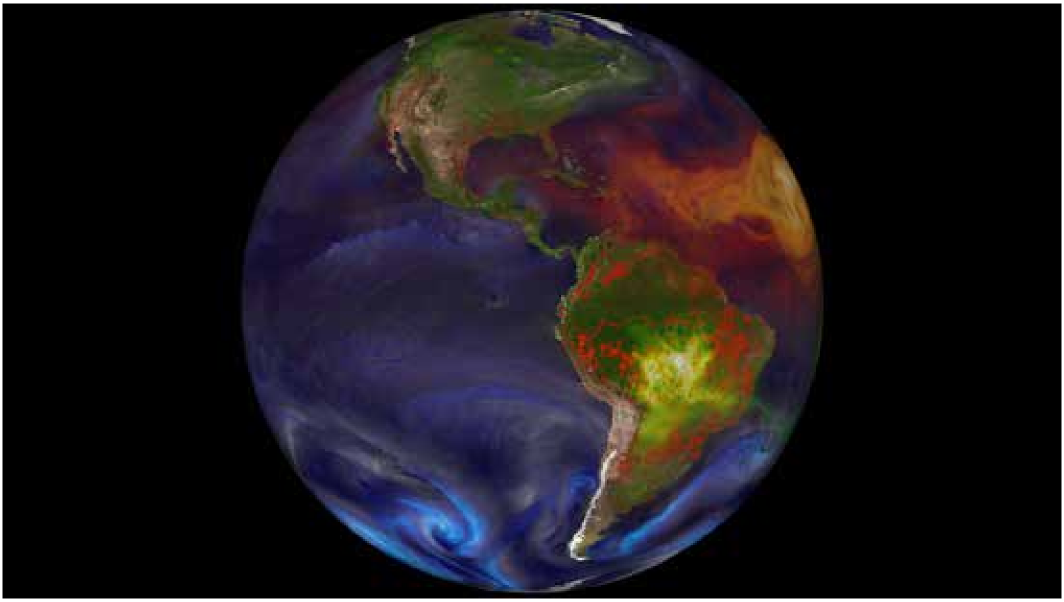

Fig. 6 GEOS-5 simulation Credit: NASA.

This technocratic approach, however, clashes with the physical limits and non-linear loops of a planetary system, revealing the illusion of total control over atmospheric complexity. The overview and actions one believes to perform over the planet are actually over the simulation of it, and therefore atmospheric alterations and adjustments work on the simulation itself because the rules of it are human-established. But at the moment they are scaled up and applied on a planetary level, they will act in a world with other derived laws, making it impossible to impartially predict all the consequences due to these operations, leading therefore "to chain reactions with unpredictable effects on our ecosystem" (Kugler and Longfellow, 2022, p. 36).

Fig. 7 iOS 16 iPhone wallpaper
Credit: Apple.

As Benjamin Bratton (2024) has observed, "Planetary Computation reveals and constructs the planetary as a humanist category": the planet is not only observed but is constructed as a human-readable and manageable concept. It is reduced to a unified vision, ubiquitous and accessible to anyone with a screen. Proposed in its forviating totality, it comes down to the banality and massive diffusion of smartphone wallpapers. Turning on the phone screen, I no longer even pay attention to the simulated planet in the background. I am so familiar with the concreteness of such a depiction that the planet ceases to be an imaginary and becomes just an image. Satellite pictures, climate projections, and computational simulations create an observable planet reduced to an interface that is paradoxically distance because it is too accessible. I have the feeling I have every single aspect of the planet at my fingertips—that I can turn it off and put it back in my pocket with a click.

This detached and concrete familiarity experienced on a massive scale further feeds the techno-optimism that relies on atmospheric engineering strategies. The understanding of the planet performed through planetary computation translates the complexity of nonlinear processes into a packaging of data. The resulting interpretation of "planetary packaging" is therefore a reductive and clarifying interpretive lens through which to observe the entire planet.

CONCLUSION

The understanding of "planetary packaging" that I have unfolded in this text is an interpretive paradigm that depicts atmospheres across different scales and contexts: planets superimposed on planets, worlds excluding worlds, and atmospheres containing atmospheres. Container and content merge and confuse as in a Russian doll. We have seen how the smallest figure can observe and imitate the largest, tracing but modelling and speculating its attributes. While for the larger one, drawing on the smaller means omitting fundamental elements and offering a reductive and simplified understanding of it.

In MAPs the atmosphere is conceived as a protective interstitial space designed to extend the life of the product confined in it. Within these packages, however, we have recognised processes that echo Terrestrial dynamics at a planetary scale. Ceasing to be a liminal space that looks "empty" from the outside, the interior of those packages is transformed into an optimised world that evolves an artificial ecology, simulated and superimposed on pre-existing ecosystems. The expiry date of worlds within the MAP is postponed by atmospheric engineering processes reminiscent of climate engineering strategies deployed at a planetary scale. The interpretation of planetary packaging in the last section is reversed. Packaging becomes the key to understanding a measured and calculated planetary system, reduced to a package

Fig. 8 Cheese in a Modified Atmosphere Packaging Credit_ Christian Scenini.

of data translated into simulations and images that offer a clarified but distorted understanding of it.

By entering the pockets of much of the Earth's population, the planet is reduced to an agglomeration of pixels that makes it as close as it is detached—an image, a packaging of data paradoxically distant because it is too accessible. The planet dissolves among its own echoing and redundant representations, entering into the common imaginary with the same effortlessness and immediacy as cheese packaging.

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