Quaderno di METEOROLOGIA APERTA N°4

THE CLIMATE EMERGENCY IN THE DIGITAL AGE

Climate, economy and society

Massimo Crespi

In Padova (Italy),
Summer 2022

Contents

“The cosmos [...] is a sensible god”
Plato, *Timaeus*

CLIMATE EMERGENCY: A NEW WORLDVIEW

1.1. DEFINITION AND EFFECTS

The climate emergency is a phenomenon caused by multiple factors. The anthropogenic component of this phenomenon can be mitigated if governments take appropriate action, guided by suitable economic choices. Some effects, such as the reduced number and complexity of ecosystems — the only engine of biodiversity and thus of species adaptation to the changing conditions of life on earth — can no longer be remedied.

The climate emergency results in the widespread impoverishment of humanity relative to the resources available, as well as increased inequality and conflict.

1.2. CLIMATE AND SOCIETY

The role of climatology in economic, social and cultural processes has changed greatly in recent years. It has itself been subject to significant innovations, reflecting those seen on the technological landscape in general. This impact has been supported by advanced environmental data management policies — which have seen the contribution of all national and international regulatory bodies — promoting increasingly direct spillover into the economy, the market, research, culture and society, ultimately reaching the citizens, the true drivers of growth and resilience in the new climate scenarios.

In the not so distant future, when the climate emergency systematically involves the Western world, it will be advisable to start reconsidering the communication issue; this holds also in light of the evidence that emerged during the COVID-19 outbreak and given the fact that future climate scenarios will affect a larger part of human history, permeating not only time but also space, directly affecting economies, cultures and societies and thus people's lives, their aspirations and ambitions, their happiness and hopes.

An indication of this is *youth disillusionment* [1]. Today young people look far beyond the hedge[2], beyond the events that saddened Jacopo Ortis[3] and all generations of young people who came before and after him, causing them to consider a more distant, if not yet visible, limit. Indeed, generation Z[4] is not the only victim. In the human heart, those ideal certainties, the foundations underpinning the knowledge of one's place within the cosmos[5], those existential, archetypal balances that place humankind in relation to the planet and the universe — as is the case with the depletion or disappearance of certain ecosystems, the rustling of which may no longer be heard — are upset, depriving them of that extremely

---

1 Loss of trust and belief, on the part of young people, in the commitment of any institutional scenario (international bodies, governments, economy, politics) to mitigate the effects of the climate emergency.

2 Giacomo Leopardi, *L'infinito*, 1819.

3 The protagonist of the novel *The Last Letters of Jacopo Ortis* by Ugo Foscolo, 1802.

4 The generation born between 1997 and 2010.

5 Lévi-Strauss, 1962.

complex, balanced and resilient “creation” of which man himself is the fruit, surrounding him with mere weak artificiality.

In the world of governments, dozens of commitments have been undertaken at various UN general assemblies, other intergovernmental *forums* (G7, G8, G20) and in the countless charters and declarations signed over the past 30 years, since Rio '92[6]. And this attention is now extended to all decision-making bodies and organizations. An example of this is the case of NATO which, at its 2021 summit, not only included new scenarios of war, space and cyber space among the critical issues in its “Agenda 2030”, but also those determined or influenced by the climate emergency. Another example is the *World Economic Forum 2021* in Davos which confirmed that the prime cause of global instability is governmental failure to take measures to counter the climate emergency, the second cause being the climate emergency itself. Increasing attention is being paid by Central Banks, including the ECB[7], and other financial supervisory bodies, which have recently established the NGFS[8]. The state of the climate is therefore followed and monitored by many bodies, both governmental and independent, continental, global and national, academic and economic.

However, there is a noticeable disconnect between the substance of what is happening and the way it is represented. The major changes that will affect people's lives, economies, food supplies, and health cannot be mitigated *ex lege*, particularly at a time in history when a deep crisis of legitimacy is undermining institutions and consensus-building mechanisms[9]. Addressing these changes requires a fundamental, long-term commitment, involving society as a whole as well as the intermediate bodies, the elites and gradually involving the individuals themselves, who are increasingly isolated but not necessarily independent. Often they are massed together, imprisoned in their avatars[10], subject to the winds of virtual pseudo-democracies, hostile to any pre-constituted competencies, incapable of reasoning, bound only to a few threads of hope and their own direct interests[11].

1.3. SAVE MAN OR SAVE THE PLANET?

The structural change of an economic system — the key action required for decarbonization — depends on different factors, both endogenous and exogenous[12]; it can be relatively gradual but, when pressed by tight deadlines, risk factors and uncertainties take precedence over any other form of inertia. Today there is a need to further hasten these times, to change

---

6 Rio Declaration on Environment and Development -1992: one of the first international documents to formally acknowledge the climate emergency and call for mitigation measures.

7 European Central Bank: Central bank of the 19 EU countries that use the Euro.

8 The Network for Greening the Financial System was formed by Central Banks and Supervisory Bodies in 2017.

9 Habermas, 1986.

10 Image used to represent oneself in virtual worlds.

11 Floridi, 2020.

12 Piketty, 2014.

the current world-view to one that can deal with horizons that are more uncertain and scenarios that envisage possible physical damage and high transition entropy.

To support this project, all human knowledge must be brought to bear, in particular that which enables a detached look at technology, which can clear away the fog from the digital horizons to provide a destination — even an ideal destination — for consciences and can ensure that the decision-making pathway gradually leads to more open social contexts13 rather than back-pedalling.

This kind of approach is sometimes associated with the re-emergence of a cosmic vision veiled in pantheism, which considers the universe an interconnected *unicum*, a whole where everything depends on everything else, where saving the planet means saving humankind. But this conception relapses into a view that, while ethically acceptable, is functionally disconnected, confusing the cogent problem of reducing the effects the climate emergency has on the human species with the problem of mitigating these effects for the evolution of life and matter in general, as there is no single solution for both. Indeed, the problem is not the same. Nature — organic and inorganic, terrestrial and celestial — is the sphere from which humankind originated. And yet, that it continues to survive is merely an incidental fact in the sense that evolution continues its own selection of those life forms best suited to a given planetary or cosmic homeostatic balance, and this does not necessarily include conditions of life suitable for humans or include the earth *per se* or the life forms that currently inhabit the planet.

Recent experiences in global communication on this theme have deemed the priority to be a clearer, more taxonomically defined narrative of what is happening — or may happen — within a historical horizon, using a form that corresponds to a tested and visible content. This means fewer catastrophic visions that are lost in galactic horizons, and more concrete, ontologically-based visions14 that adequately describe reality in its form and content and its impact on people's lives and the related dynamics. In order to reduce cultural inequalities, which prevent many from contextualizing the different time horizons — economic cycles, human cycles, climate cycles, and cycles of the universe —, the representation of climate and economic transition must be brought back to the human scale as we are the only livings aware that this change of state — death — is a radical, final phenomenon, that our own location within the universe must be limited to the self-conscious 15 Cartesian reflection of "cogito, ergo sum"16 (I think, therefore I am).

CLIMATE AND TRANSITIONS: FROM CARBON TO SILICON

The climatic environment is a mobile scenario, and it is to this which other mobilities, or fluidities17, must be added. Particularly evident among these are the technology-driven or technology-related transitions, a direct expression of a postmodernity in continuous, rapid flux resulting in a steady, progressive evolution of man-made systems, not always correlated with the rhythms of human evolution.

13 Popper, 1973-74.

14 Ferraris, 1998.

15 Floridi, 2014.

16 René Descartes, *Discourse on method*, 1637.

17 Bauman, 2000.

Less visible to the public, on the other hand, are those transitions that affect — and will increasingly affect — the economy. Indeed, such transitions will guide all these shifts, tracing the grooves along which people's lives and their expectations can move. But the weakness and uncertainty of the economic scenarios is so obvious that analysts take the physical damage due to the climate emergency (rising temperatures, extremes, sea levels, etc.) into even less account than the risks associated with the transitions themselves, particularly the risk related to decarbonization.
After decades of steady, orderly technological progress, the digital sciences bring new goals and new possibilities into its own realm, the meta-technological realm.

2.1. THE TECHNOLOGICAL TRANSITION OF METEOCLIMATOLOGY

The first transition is to meteorological and climatological observations and their supporting technologies. The simple on-site 18 weather station (Fig. 1) no longer constitutes the sole site for territorial measurement, although it is still a key element in monitoring, both because of its features, its archives of historical data, and the role it plays in verifying and calibrating other remotely operated instruments.
In fact, a multitude of sensors — which use different measurements to tap into a given point on the planet and interact with each other — is currently used.

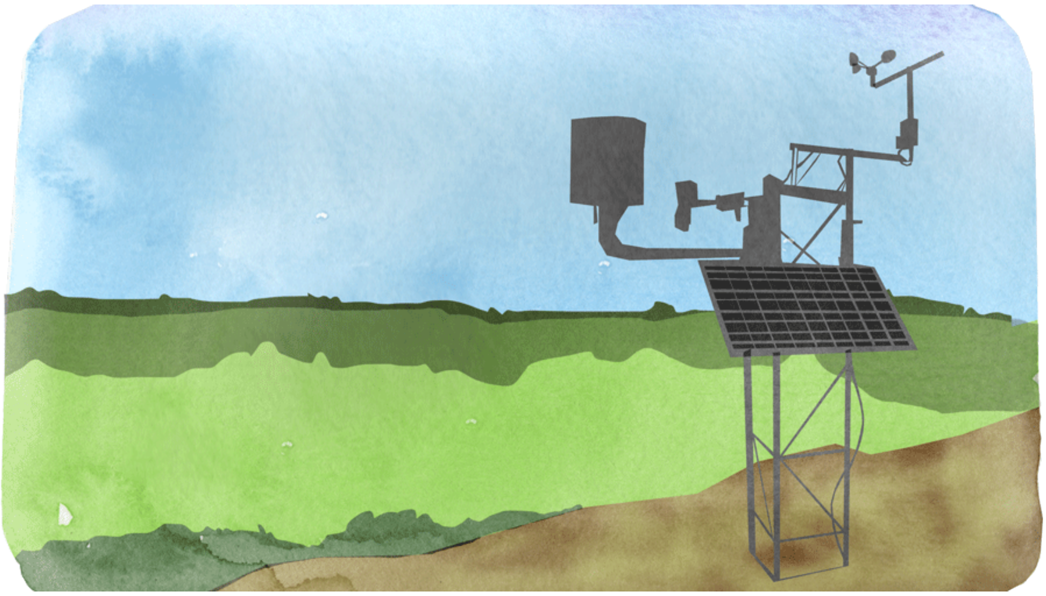

Fig. 1 On-site weather station (ground-based)

to provide a more representative figure. Weather radars operating over various bands, orbiting and geostationary satellites, marine buoys, radiometers19, lightning monitoring networks, wind profilers20, weather balloons. Of different design and technology, these sensors play different roles: conventional and unconventional, on-site or remote, active or

18 Instruments located on the ground that gather data regarding their location (e.g., the conventional weather station).
19 Radiometer: an instrument that stratifies the atmosphere by temperature and humidity.
20 Instrument capable of measuring wind at various altitudes.

passive taking direct or indirect measurements. Collectively they are defined as an "observation set"(Fig. 2).
Moreover, with the processing technology of retrospective data analysis, or meteorological reanalysis, the representativeness of such observations has been pushed ever higher and are now more detailed, statistically robust and digitally mature.

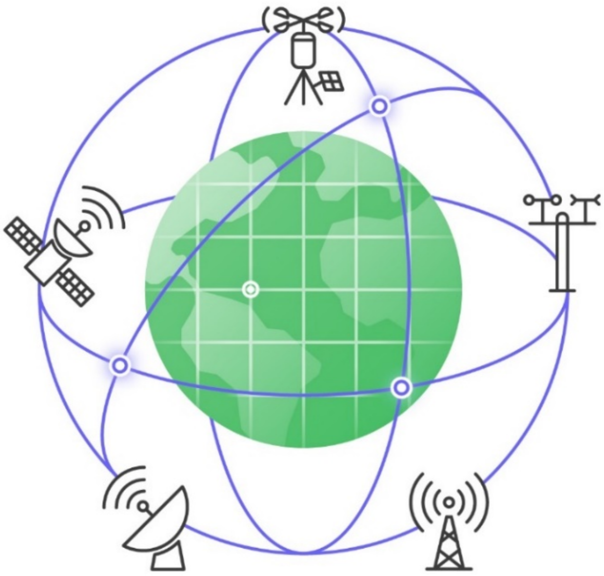

Fig. 2 The "observation set"

With this configuration, meteorology can now participate in all those processes requiring a quantitative contribution and can take on a more prominent role in those contexts requiring it to perform an evidential function. Increasing interactions with society and the economy have also brought substantial experiential feedback that has further fine-tuned these products and services, orienting them toward increasingly specific needs.

2.2. THE ECONOMIC AND SOCIAL TRANSITION

Weather and climate information is no longer the exclusive domain of the narrow sphere of meteorologists. This knowledge has long entered various decision-making processes in the economic, financial, and insurance worlds, often taking on discriminating, discretizing, and evidential functions (Fig. 3).
In general, the contribution of meteorology and climatology to microeconomics — that is, to the lives of businesses and households and thus to the widespread process of decarbonization — carries substantial weight, both in terms of sustainability and effectiveness. For example, in agricultural risk management, it serves as a trigger21 for

21 The minimum weather condition (typically exceeding a rainfall or temperature threshold) that must occur for damages to be liquidated; more generally, the threshold value to activate specific consequential actions.

damage settlements and as an assessment 22 tool for the development of new policy concepts (parametric, index-based). With equally specific functions it supports energy planning, land-use, water resource management, and all *smart*-type activities (city, agriculture, etc.) operating in a digitally mature mode, actions that require, and can enhance, quantitative meteorological information, and indeed emphasizing its role.

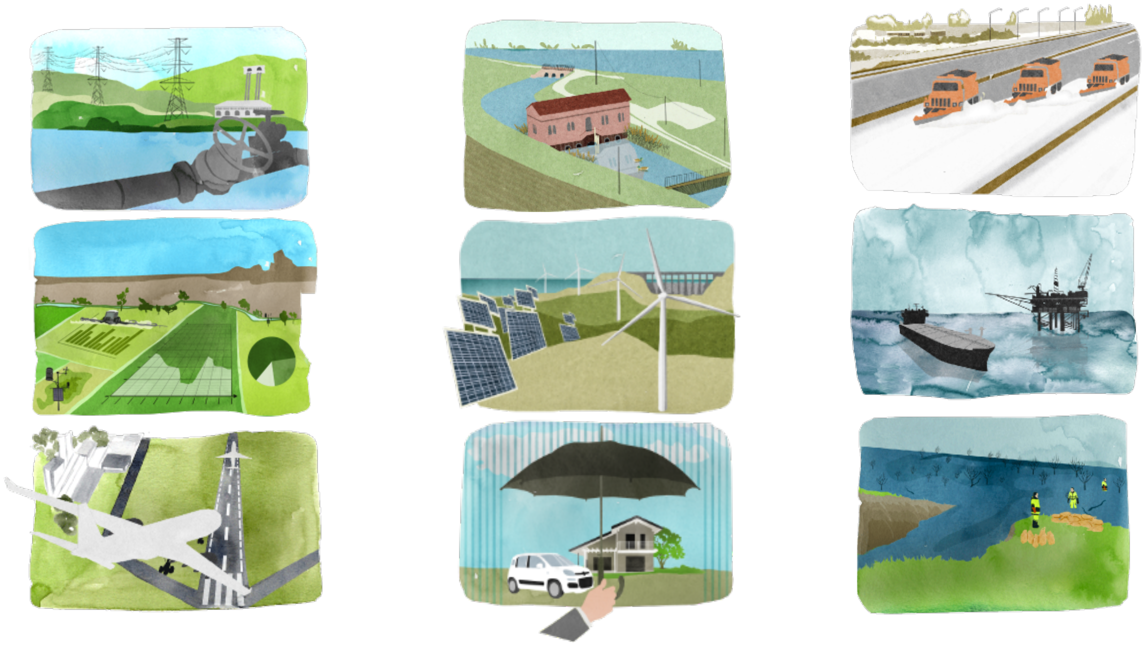

Fig. 3 Meteorology, economics, territories.

Equal and growing attention to those issues is now also evident on the part of public opinion, the press and the general population, although, to tell the truth, in the West we are still affected only episodically by the climate phenomenon and its consequences. And yet, sensitivity is growing and, thanks to a cultural process permeating all the various modes of information, the substance of this sensitivity is expanding. The characteristics of this issue are changing from a merely environmental problem — that is not really personal and direct, but limited to the common territorial areas, the idea that *it is not in my backyard* 23 — to a question that enters our homes and affects our health, that is both personal and direct. It is, however, an awareness still saddled with major limitations, fuelled in part by the multifarious, generally denialistic voices which are so often of an exclusively "antagonistic" nature, voices that find their audience thanks to the fact that, in most of the more highly developed countries, the climate emergency has yet to become systemic.

22 Set of various evaluations required to define an innovative insurance policy.
23 "Not in my backyard": an expression used to indicate agreement with an idea or project as long as it does not directly affect our personal interests or lives. E.g.: I agree to building a garbage dump but I don't want it near my home.

2.3. THE DIGITAL TRANSITION

Often, blinded by technology, the epistemological references are lost; therefore, it is advisable to maintain an open, holistic view that is, at the same time, both critical and detached. From Luciano Floridi: "digital technologies are not just tools that merely change the way we interact with the world, like the wheel or the motor. They are primarily systems that increasingly shape (format) and influence the way we understand and relate to the world, as well as the way we conceive of ourselves and interact with each other. In other words, they are re-ontologizing, that is, they change the intrinsic nature (the ontology) of what they touch [...]"24 (Fig. 4).

Fig. 4 Understanding the world through digital science

Therefore, given how digital processes represent the substrate and matrix by which thought differently organizes the world around us — or rather our relationship with it — we must explore its knowledge and characteristics.
It gives us a detailed, discretized and vectorial reality, rich in informational content and metadata. We find this form of "point-based" structure in the pre-expressionist *pointillism* of George Seurat25 (Fig. 5) and his contemporaries or in the divisionism of Giuseppe Pellizza da Volpedo26, art forms which construct space and time as a set of detailed information contents that can be aggregated and disaggregated as needed.

24 Floridi, 2020.
25 French painter (1859-1891).
26 Italian painter (1868-1907).

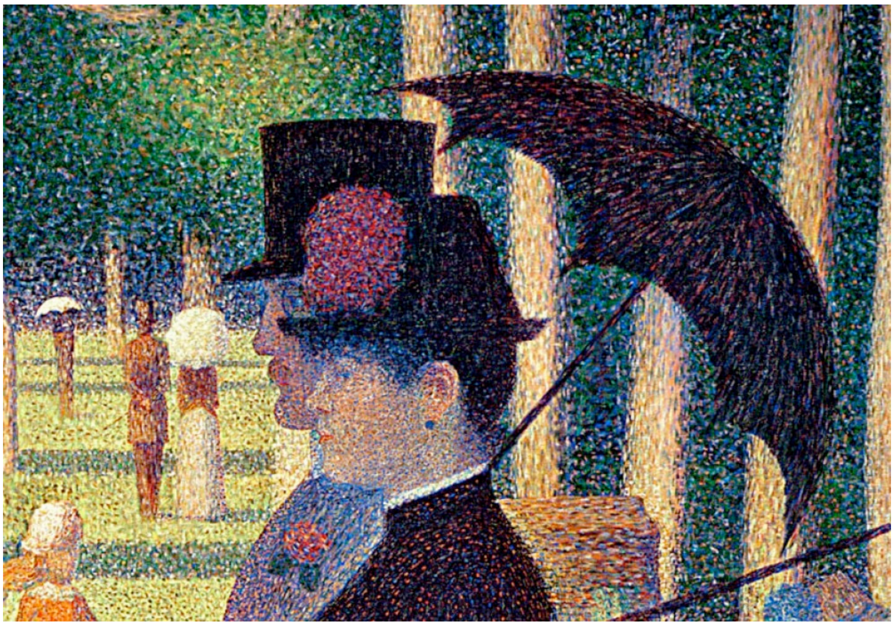

Fig. 5 Georges Seurat: “A Sunday Afternoon on the Island of La Grande Jatte”. Detail. 1884-86

The elaborative mode that enables us to achieve this spatial, temporal detail is called retrospective analysis, or meteorological reanalysis. Using appropriate scale, method and language, it brings weather and climate information closer together, superimposing them on other knowledge, other experiences, other insights, thus providing each with its own segment of knowledge.

2.3.1. Reanalysis or retrospective analysis

Meteorology collects large masses of data that, when processed digitally, can be transformed into detailed, representative — and thus reliable — information.

Fig. 6 Data grids obtained by reanalysis

These data may be used immediately, as for forecasting purposes, or their use may be deferred. In the latter case, they are aggregated into datasets and undergo various forms of data processing, the main one being reanalysis or retrospective analysis, to build data grids (Fig. 6) used for specific needs. This process is well-established in a myriad of applications, not merely scientific or experimental in nature, but also for technical and management applications, for example, those related to risk management, in general, and any other form of digital-based management requiring meteorological input.

The new aspect of meteorology is tested here. Thanks to current digital maturity, it picks up the gauntlet posed by different technological contexts. It moves agilely through time and space, proposing not so much isolated datasets, but producing a sort of hologram, a digital reconstruction of the environment in which the physical phenomenon moves, a reconstruction that may consist of a specific microcosm such as a city, a basin, an airport, or the atmosphere as a whole (Fig. 7), tracing its past, present and future evolution.

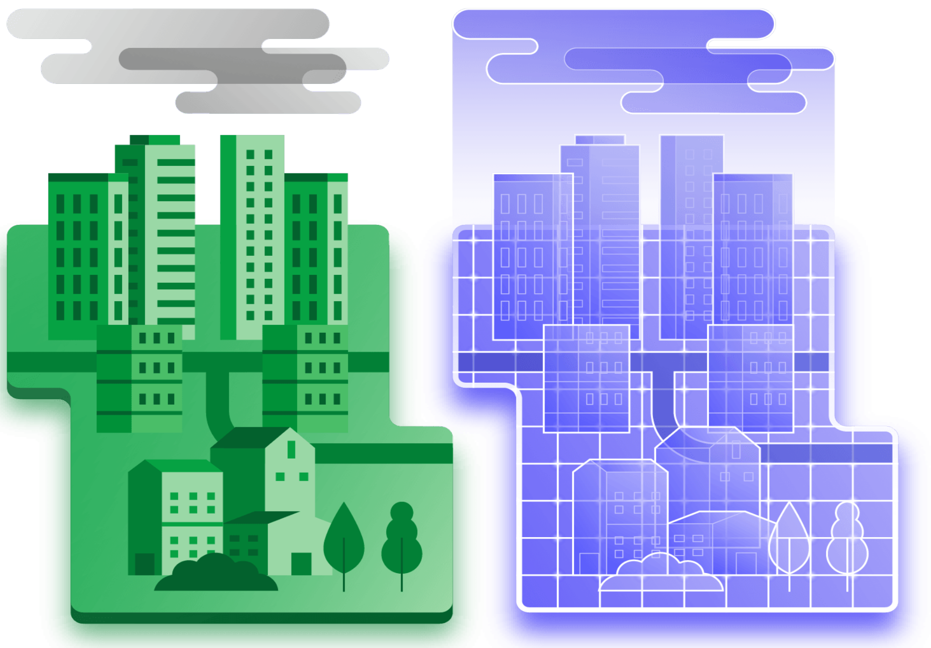

Fig. 7 A digital copy of the atmosphere

DATA CENTRALITY

With the substantial growth of elaborative and statistical processes, data acquires an increasingly central and strategic role, conditioning and determining final product quality (Fig. 8)

As the WMO[27] and the scientific literature often reminds us, the conformity and representativeness of meteorological data is a direct function of the purposes for which they are intended; therefore, it is up to the user to ensure that the characteristics of the data meet the degree of quality, even conventional, required to meet the specific need.
In a didactic breakdown, the qualitative features of weather data can be categorized as intrinsic and extrinsic.

3.1. INTRINSIC PROPERTIES

This family of characteristics is closely related to the data itself, its collection, its history, and the purpose for which it is collected and used.

Fig. 8 Data centrality

3.1.1. Data conformity

One of the salient aspects determining the conformity of meteorological data regards the characteristics of the measurement sites, which the WMO divides into five categories: the first three envisage situations of conformity, the last two situations of nonconformity[28].
Applying the standard to the Italian context, a panel of stations and sensors falling within the standards outlined by the WMO were selected, their data (Fig. 9) then entered into the

27 *World Meteorological Organization,* the United Nations Technical Agency tasked with global coordination of operational meteorology, climatology and hydrology.
28 WMO "*Guide to Instruments and Methods of Observation - Volume I - Measurement of Meteorological Variables*" (WMO-No. 8, 2018, Chap. 1.1.2).

national database29. These networks and sensors can also be traced to the following classification30:

official: belonging to the governmental bodies and organisations legally responsible for meteorological-environmental monitoring;
certified: subject to formal certification procedures with regard to the type of instrumentation installed, the positioning of the survey sites, maintenance procedures and data validation,
WMO compliant: belonging to associations, research institutes, NGOs, land management companies that comply with the installation, management, maintenance and validation procedures compliant with WMO Guidelines,

Fig. 9 Compliant, official and certified data

3.1.2. Data representativeness

"*In the simplest terms, if the data can answer the question, it is representative*" (Ramsey and Hewitt, 2005).
The representativeness of the piece of data depends directly on the purpose for which it is intended. This is a key concept in meteorology, where the most diverse technologies and needs intersect. In fact, different scales of phenomena (lightning, thunderstorms, storm fronts, tornadoes, cyclones, etc.), different instrumentation (on-site, remote, conventional, unconventional, direct, indirect), and different requirements (civil defence, agriculture, urban areas, energy, insurance, etc.) all coexist.

---

29 This is a national, non-public, independent, third-party database separate from the network of operators or owners, managed by Radarmeteo to gather and process data used in evidential contexts.
30 Massimo Crespi: "*Characteristics and Representativeness of Precision Meteorology in the Italian National Context*" - "Open meteorology journal" no. 1-2020 www.radarmeteo.com.

Each application requires its own specific product, commensurate with its use; it may be operational or statistical or experimental, and must enable the phenomenon to be measured in a manner appropriate with its possible quantification, scale of representation, established limits of conventionality or defined thresholds.
There are activities that require real time and *nowcasting* 31 forecasting, activities that use data which have not yet been validated; instead, others aim at reconstructing events that have already occurred while still others are climatology-oriented, requiring validation processes, metadata as well as substantial historical background.
Thus it is that representativeness takes on a concrete form in a given moment in time, expressing a value that summarizes, in and of itself, the technological-instrumental component, the formal-conventional component, and the heuristic-experiential component, thus integrating itself into the context for which it is intended, albeit with its own limitations.

3.2. EXTRINSIC PROPERTIES

In general terms, this family of characteristics corresponds to those that describe *open data*32, determined by factors substantially external to the data itself, such as:

accessibility: in standard formats,
free of charge: also free in usable formats;
continuity: included in a consistent historical series;
availability: made available according to *open data* criteria;
accessibility: can be acquired promptly;
lack of bias: not attributable to any party;
transparency: accompanied by metadata;
unambiguousness: they lend themselves to a single interpretation.

In meteorology, open, rapid access to data plays a key role because, in addition to the processing and analysis of historical data, data are needed in real-time for many economic activities (agriculture, energy, transportation, etc.); such real-time data not only add value to the activities themselves, but can also support their environmental sustainability.

OPEN DATA AND OPEN SOCIETY

The previous chapters sought to depict the path by which meteorology has adapted to the technical and scientific knowledge needed to participate in economic and social life by developing tools and languages that interact and interconnect with other interfaces.
For this to make a useful contribution to the actions being implemented in the pursuit of climate neutrality and decarbonization, we must determine whether and how the digital complex can meet the deeper, analogical requirements and integrate into the heritage and culture of the individuals, meeting and embodying their expectations (Fig. 10) and whether everyone involved in the process is fully aware of their role.

31 Very short-term (1-3 hours), high-precision weather forecasts.
32 *Open data*: public data, accessible to all in a usable format and free of charge.

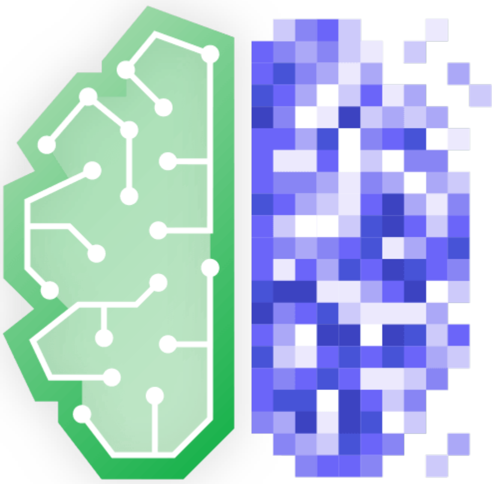

Fig. 10 Analogical intelligence and digital intelligence

4.1. THE "PUBLIC/PRIVATE" SYNERGY

Climate, and the way a community copes with climate changes, has become part of the basket measuring a country's degree of maturity and democracy.
In Italy, policy has not yet grasped this importance, merely adhering to the charters and deliberations of international bodies. The weakness of its institutions has made itself evident in the attempts — both past and more recent — to coordinate, at the national level, meteorological and climatological activities. Indeed, Italy is one of the very few countries in the world that does not have a national weather service, and thus such activities continue to be shared among about thirty entities with different affiliations and hierarchies, including the regions, ministries, agencies and offices. Moreover, these are spread out over a peninsula characterized by widely differing climatic systems: from continental alpine to temperate, from semi-desert to oceanic.
Recently, the government has followed up by establishing yet another agency33 which is supposed to undertake this coordination; however, it will be operating with a very weak programme. First of all, it does not rest on any organic law. It is the offspring of a few articles of an old financial law and is dispersed over a patchwork of norms and provisions. Given their chaotic commingling, these have often been censured by the Presidency of the Republic and thus deprived of even the slightest debate — parliamentary, public, in the

33 Italiameteo.

media — that should have involved society as a whole and the vast range of stakeholders — not strictly governmental — who have not even been heard.
It is also a voluntary body, so the various regional weather services may or may not join it as they see fit. The entire structure, its regulations and by-laws, do not at any stage contemplate the national framework, the country's needs, its role; rather it remains locked in a highly self-referential, top-down ministerial form of decision-making, devoid of economic and social representation and thus also isolated.
This is in contrast to a very advanced national legislative and regulatory framework governing the use of public data and *open data* due in part to the "National Guidelines for the Enhancement of Public Information Assets" issued by the Agency for Digital Italy of the Presidency of the Council of Ministers34, or the established practices under which ISTAT35 operates.
Thus, appropriate constitutional and legislative action is desirable and can no longer be deferred. In the near future, this should lead to the establishment of a national public weather service able to fully support and monitor climate and ecological transition policies, including parametric monitoring.
By addressing the issue in concrete terms — that is, in the institutional context in which we are currently operating — we can still adopt policies that respond to the times and problems. The underlying consideration is that weather services consist of two elements: data collection and data usage. In Italy, the first of these has traditionally been entrusted to public agencies, which builds, implements and manages most monitoring networks, both the weather stations and weather radars, and liaises with the major satellite operators and international bodies. The constitution entrusts this role to the competition between the state and the regions, generating an initial intermingling of competencies that does not always result in the best use of the funds — always public — or in improved services for the general public. It should be noted that, in recent years, the opening of the meteorological market, on the one hand, and the structural deficiency of the public service, on the other, have encouraged other entities — land reclamation authorities, utility companies, some associations and non-profit organizations — to implement meteorological monitoring networks. These are WMO-compliant networks that are often also certified, networks capable of providing high-quality data.
The second step, namely the processing and use of the data, is much more diversified because their assets, which are available to the entire country, are intended to serve multiple functions. Some of these are public or governmental in nature as they meet the responsibilities managed directly by the executive branch (civil defence, armed forces, agricultural market analysis, etc.). Until a few years ago this was the component that made the most use of weather data.
Today the picture has changed greatly, the need for precision weather data has pervaded the market, economy and society, driven also by the digital sciences, able to power diversified and advanced services. However, this is not all. The weather-climate component

34 Agency for Digital Italy of the Presidency of the Council of Ministers, *Dati pubblici-Linee guida patrimonio informativo pubblico* (2018).
35 National Institute of Statistics, *Carta dei Servizi*, 2021.

transcends the immediate economic value and participates in the *assessment* and political evaluation of decarbonization scenarios.
In this new situation — reflected by more careful use of public resources, greater participation of the citizens in social life, increased industrial demand for innovation, requiring greater service agility and, above all, with climate-derived external effects that heavily impact industrial and social reconversion choices — the role of the public sector must also be defined, or redefined. Indeed, the public sector can bring a major contribution to the national economy if, first and foremost, it performs its fundamental role with commitment. This means basing the full aggregate value of meteorology and its cultural value on high quality data. This can be achieved through maintenance, expansion, management and updating of the infrastructural component of the monitoring networks comprising the observation set, using the financial resources available in that precise area, without squander them in anything other than institutional or governmental tasks.
To break out of this pattern — that is, to advocate for every possible non-institutional weather need emerging from the microeconomic fabric or from society — seems inappropriate in many ways. From an economic point of view: given that the public resources to be used stem from different sources, are separate from private revenues, their economic estimates vague, with undefinable real service costs, this would trigger non-transparent forms of competition with the market. From an ethical point of view: since obtaining additional revenues for public services already financed by taxation does not appear reasonable as it would weaken, among other things, the allocation of resources for institutional tasks, and this at a time when these are considered priority and strategic. From a technical point of view: given that the typically self-referential, rigid approach of public administrations makes it difficult to adapt the structure to meet the agility required in innovative processes and their ongoing evolution.
A public service that provides, and guarantees, quality data already brings a huge contribution to the country, especially when it enables the economic system to transform it into further value and employment. In fact, Italian meteorology is not represented by the public service alone. Fortunately, there are forces and resources — in both the research and business spheres — that, in recent years, have made up for the lack of a unified national vision by providing structured, reanalysed weather and climate information for the markets, for agricultural and property risk management, for sustainability, decarbonization, and credit, and this despite the lack of a reference framework. The hope is that this great resource — which has given rise to a good national meteorological community, capable of interacting with the real needs of society because it was created by those very needs — can continue to grow, thus providing prospects for young meteorologists who have no other option but to place themselves on the market. In addition, it is hoped that the public meteorological agency — which has thus far failed to consider its role in the context of the real national economy — will realize that it is in that very country that it can find support and credibility.
Indeed, it is up to those working directly with the markets to take on the role, and the risk, of coupling data with the complex range of requirements and products and their rapid evolution, gaining experience and knowledge, quickly and effectively investing adequate resources in a transparent, competitive environment.

In weather services, the broad intersection and interaction between the public and private sectors should therefore be read from a functionalistic perspective and resolved in a synergistic manner, both because the regulatory tool for this exists — the guidelines issued by the Digital Italy Agency — defining the key requirements characterizing *open data*:

legal requirement: available;
technology requirement: accessible;
economic requirement: free of charge;

and because the experience of other weather services and the analyses of international bodies clearly point in this direction, as underscored by recent resolutions36 issued by the WMO and the extensive analysis37 issued by the *World Bank* 38 on the subject.

4.2. SOCIAL LIQUIDITY AND MICRO-MACROECONOMIC SCENARIOS

As in the case of the pandemic, the debate and representation of the climate emergency take place in a context where communication tends to transcend not only ontological concreteness, epistemological reality and concepts, but also technological reality — the things to be done. The resulting breakdown of the social fabric undermines the mechanisms of consensus formation and the very credibility and legitimacy of the institutions understood as instruments of democracy39.
Zygmunt Bauman40 had long understood that the current model of development does not allow one to lie down in the here and now, in the moment. There are no pauses for reflection. Continuously under tension, life — each and every life — flows toward a post-modernism that constantly anticipates, and thus voids and debases life itself. In essence, one lives in a tendentially dystopian world in which one is modern to the extent that one is post-modern; the example of Hamlet41 is as apt as ever.
But other estrangements loom large. In part, they stem from digital science, which has overstepped its instrumental role to assume a progressive inertia that may in part marginalize the holistic and political approach, the faculty and freedom of doubt, the richness of opinions and divergences, criticisms, readings, visions — in short, the world of differences versus the world of indifference, all the more in the face of the debasement and ethical, aesthetic decadence induced by the massified validation of "post-truth"42.

---

36 *Policy framework for public-private engagement* Approved at the 70th session of the Executive Council, June 2018.
37 World Bank, *The power of Partnership: public and private engagement in hydromet services*, 2020.
38 International institution that seeks to reduce poverty and promote prosperity in developing countries.
39 Ferraris, 2017.
40 Bauman, 2000.
41 William Shakespeare, *The Tragedy of Hamlet*, 1600-02.
42 Ferraris, ibidem.

This scenario must be acknowledged in order to seek concrete, viable solutions and answers. In this set of aspects, which touch on social, cultural and communication aspects, meteorology and climatology act as a trigger43, defining the thresholds at which specific policies, behaviours and actions are adopted or implemented — by both households and businesses — in relation to credit, insurance and health issues.

Even in the more strictly microeconomic sphere, the need for weather and climate services and data is steadily growing, both thanks to the degree of quantitative accuracy now being achieved through integration of the observation dataset, and because of the digital fragmentation that makes it possible to meet every different need, feeding statistical models, decision-making systems and platforms. Each use, each process, each logic has its own structured observational *dataset*, organized according to its function, in which all discontinuities in the raw data are smoothed out.

From a macroeconomic perspective, the E.C.B.44 is applying some sets of assumptions regarding the burden the climate emergency will have on the overall economic system, and the effort that will be required to achieve neutrality and decarbonization. The eight R.C.P.45 scenarios chosen assume increasing context severity. Their analysis has shown that the greatest risk is not the physical damage that the climate emergency may cause (flooding, increased mortality, water shortages, reduced productivity, etc.); rather it is the transitions that — assuming government does not take incisive action — will need to be compressed into a rather short time frame and thus will prove chaotic and be characterized by uncertainty and conflict.

From a weather and climatic point of view, two other weaknesses are represented by a total misalignment between the time horizons for economic and climate cycles and a general lack of data suitable for that type of analysis.

Whatever policy is adopted, the weather and climate characterization will still be a constitutive part of each company which will, in turn, address its direct or indirect action to ensure adoption of E.S.G. criteria46 to prevent *greenwashing* 47, but even more so to improve all processes, products and services with environmental relevance.

The productive world is usually quite agile in adapting to innovation; indeed, in this respect it is proactive and concrete when innovation affects the markets, as it does in this case where the microeconomic action of climate resilience can constitute a factor in competition, business qualification, sustainability, reputation and better access to credit.

4.3. THE DEGREE OF ANALOGIC ABSTRACTION48

43 See note no. 21.

44 European Central Bank: the bank of the 19 EU countries that use the Euro.

45 *Representative Concentration Pathways*: scenarios used by the IPCC (*Intergovernmental Panel on Climate Change*) in their own evaluation reports.

46Acronym for *Environmental Social Governance*: key factors for measuring the sustainability and ethical impact of an investment.

47 Environmentalism at face value.

48 Floridi, 2019.

In these times of overall homologation and direct pseudo-democracy, it is difficult to leave any traces or deeper marks on the reasonings, which are daily wiped away, like writings in the sand at the shore.
This does not detract from the fact that the world of weather-climatology needs to look very carefully at these social dynamics, to try to place the narrative of events in the right perspective and align physical understanding of the atmosphere with other primary sensitivities, operating on the correct level of intermediation.
Of the waning of the role of the *elites* we must take note. Moreover, we must identify those mechanisms able to foster a more general participation of consciences in climate sensitivity. Indeed, this has happened, for example, with the environmental question which, at least in some of its main instances, has to a large extent overcome the partisan view and has now become part of the common heritage.
As a good practice, suitable for acclimating everyone's life to this new horizon, one can point out the impartiality of the bodies of analysis and dissemination of knowledge and climate scenarios, called upon to express themselves in a transparent, solid, credible, open and mutually shared manner. Another example is the appropriate, duly resilient policies that take into account the voice of society as a whole as well as its individual components. Conceptions, trajectories, visions, even lateral visions, can all provide substantial critical support for the choices made, transcending mere technicist visions, leading them to achieve greater cultural concreteness.
In identifying this match, climatology — which had the undoubted merit of identifying the process of global warming years ago, even the warming induced by human activity — now plays a role different from the new protagonists of the emergency: the big decision makers, those able to define policies and govern the system. It is called upon to propose scenarios — for which time horizons differ from the timing and modalities required for resilience —, to monitor the achievement of certain physical goals, and to bring its own expertise to bear on all the multifarious resilience processes.

Fig. 11 An abstraction plane for the data/economy/society coupling

In this context of great operational responsibility, even of a parametric nature, it is appropriate to compact the entire weather and climate function into a clearly legible, integrated public/private system, the plane of abstraction intersecting all areas of osmosis, contact and synergy with other systems and needs (Fig. 11).

Representing all possible contexts, all the different dataset options and all their uses into a single matrix produces a mesh of points drawing an extremely fluid, mobile surface, the edge of which is constantly shifting toward new solutions and experiences — also in response to external factors. This makes planning much more difficult, so much so that the popularity of the "digital" is followed by a new adjective: "agile".

In such an evolving context, however, it is advisable to set some deontological rules, a code of ethics so as to prevent technicist drift. Thus, several aspects are to be considered: i) technological aspects such as the use of open, industrial data structures, thus preventing the hand-crafted aspects sometimes incurred by those lacking a broad vision; ii) communications aspects such as the third party nature of climate communications, even with respect to governments; and iii) structural aspects such as the advisability of a national civil weather service guaranteeing the quality of data observed and ensuring integrated operation with the entire national economy.

But these actions do not pertain to the digital world, which is actually a mere instrumental sub-set of the analogical world, because the latter is where the conscious, pre-emptive choices are made — the only choices capable of ensuring paths of economic and cultural growth and social cohesion — thus helping reduce inequalities, territorial disparities and poverty.

GENERAL BIBLIOGRAPHY

Bibliographic sources

Bauman, 2000: Bauman Z., *Modernità liquida*, Rome-Bari, 2000, [or. ed. *Liquid Modernity*, Cambridge, 2000].

Ferraris, 1998: Ferraris M., *L'ermeneutica*, Rome-Bari, 1998.

Ferraris, 2017: *Postverità e altri enigmi*, Bologna, 2017.

Floridi, 2014: Floridi L., *La quarta rivoluzione*, Milan, 2014.

Floridi, 2019: *Pensare l'infosfera*, Milan, 2019.

Floridi, 2020: Floridi L. *Il verde e il blu*, Milan, 2020.

Habermas, 1986: Habermas J., *Teoria dell'agire comunicativo*, *Razionalità nell'azione e razionalizzazione sociale*, edited by G.E. Rusconi, Bologna, 1986, [or. ed. *Theorie des kommunikativen Handelns. Band 1: Handlungsrationalität und gesellschaftliche Rationalisierung*, Frankfurt, 1981].

Lévi-Strauss, 1962: Lévi-Strauss C., *Il pensiero selvaggio*, Milan, 1962, [or. ed. *La Pensée sauvage*, Paris, 1962].

Piketty, 2014: Piketty T., *Il capitale nel XX° secolo*, 2013 [or. ed. *Le Capital au XXIe siècle,* Paris, 2013].

Popper, 1973-74: Popper K., *La Società aperta ed i suoi nemici*; vol. I: Platone totalitario; vol. II: Hegel e Marx falsi profeti, Collana «Filosofia e problemi d'oggi» Rome, 1973-74, [or. ed. *The Open Society and Its Enemies*, London, 1945].

Essential reference bibliography

Baatz C., *Climate Change and Individual Duties to Reduce GHG Emissions*, in «Ethics, Policy & Environment», vol. 10, pp. 1 – 19, Milton Park, 2014.

Banca d'Italia, *Banche centrali, rischi climatici e finanza sostenibile*, Rome, 2021.

Banca d'Italia, *Relazione annuale*, Rome, 2021.

Banca d'Italia, *Aspettative di vigilanza sui rischi climatici e ambientali*, Rome, 2022.

Banca d'Italia, *Rapporto sugli investimenti sostenibili e sui rischi climatici*, Rome, 2022.

Boonin D., *The non-identity problem and the ethics of future people*, Oxford, 2014.

Caney S., *Justice and the distribution of greenhouse gas emissions*, in «Journal of Global Ethics» vol. 5, pp. 125 – 146, Milton Park, 2009.

Daniel K., Riishojgaard L. P., Eyre J., Varley R. A., *The Value of Surface-based Meteorological Observation Data*, The World Bank, World Meteorological Organization, British Crown, Met Office, 2021.

Elderson F., Mauderer S., *A sustainable and responsible investment guide*, Network for Greening the Financial System (NGFS), NGFS Technical document, October 2019.

Elderson F., Choo Goh G., *Progress report on the guide for supervisors*, Network for Greening the Financial System (NGFS), NGFS Technical document, October 2021.

Elderson F., Mauderer S., *Progress report on the implementation of sustainable and responsible investment practices in central bank's portfolio management*, Network for Greening the Financial System (NGFS), NGFS Report, December 2020.

Heyward C., Roser D., *Climate Justice in a Non-Ideal World*, Oxford, 2016.

Menon R., Choo Goh G., *Capturing risk differentials from climate-related risks*, Network for Greening the Financial System (NGFS), NGFS Report, May 2022.

Menon R., Amis P., Natalucci F., *Final report on bridging data gaps*, Network for Greening the Financial System (NGFS), NGFS Technical document, July 2022.

Network for Greening the Financial System (NGFS), *Annual report*, NGFS Report, March 2022.

Network for Greening the Financial System (NGFS), *Credit ratings and climate change-Challenges for central bank operations*, NGFS Report, May 2022.

Network for Greening the Financial System (NGFS), *Glasgow declaration*, NGFS Document, Glasgow, November 2021.

Network for Greening the Financial System (NGFS), *Statement on nature-related financial risks*, NGFS Document, Paris, March 2022.

Page E., *Climate Change, Justice and Future Generations*, Cheltenham, 2007.

The World Bank, *The power of partnership – Public and private engagement in hydromet services*, Washington, 2019.

World Meteorological Organization (WMO), *Policy framework for public-private engagement*, June 2018.

THE AUTHOR

Massimo Crespi

Former Inspector of the State Forestry Corps-Ministry of Agriculture and Forestry, Director of the Experimental Centre for Avalanches and Hydrogeological Defence of Arabba (Veneto Region), Director of the Meteorological Centre of Teolo (ARPA Veneto), Director of Research and Communication of ARPA Veneto, Director General of Planning and Programming of the Veneto Region, National Delegate at the UN WMO, Director of the Environmental and Hydrological Monitoring Centre of the European Union in Asunción (Paraguay). CEO of Radarmeteo Srl and Chairman of Hypermeteo Srl.