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A COMMON HORIZON FOR HUMANITY AND THE PLANET

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Summary

NASA's latest technological marvel, the James Webb Space Telescope, is sending us detailed and absolutely breathtaking images from the deep history of the universe. These will allow us to answer more questions about how the universe is put together. They will also present some key facts that will aid us in thinking in another dimension as we work to destroy our planet: The observations made by the James Webb telescope provide inspiring information on the existence and physical/chemical structures of solar systems and planets other than our own. With the Earth-like conditions on these planets, there is a high probability that the physicochemical systems that make our planet special, that is, life, are similar.

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Global Change, Science and Society: Where do we stand?

by Prof. H. Nüzhet DALFES

Global change, science and society: where do we stand?

We live in interesting times: The environmental disasters that we encounter almost every day are associated with climate change in the media. Turkey (and many other countries) has ministries with "climate change" in their names. In addition, albeit on a smaller scale, NGOs are trying to bring extinct or endangered species, in other words the loss of biodiversity, to the agenda. The portrait created in the seas by plastics that are indispensable for daily life, chemicals that perhaps extend human life through hygiene, and artificial fertilizers that are used to grow food for the increasing population is revealed even more dramatically. To sum up, we are becoming more and more aware of how 'special' our planet is, and how we are changing our planet at an incredible speed, as revealed by space technologies before our very eyes...

Since the 1980s the need to look at the natural and human-induced changes inflicted on our planet as a whole, rather than individually, has begun to be better understood. It has thus become certain that there is a need to create an airtight scientific framework to aggregate the global change statement by considering individual processes (human-induced climate change, ozone depletion, biodiversity loss, etc.) with an integrated Earth System understanding rather than individually.

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Planetary system: multiscale, complex and nonlinear

Energy from the Sun powers the Earth System 'machine': temperature differences set the atmosphere-ocean liquids in motion. The starting point of the biosphere, on the other hand, is the photosynthesis that 'works' with energy from the Sun, and the energetic plants produced by photosynthesis form the starting point of a multi-stage nutrient cycle.

The elements that make up the system and their interactions are not always at the same scale. For example, the Hadley Circulation, which carries energy from the equator to the mid-latitudes, is 'organized' at the scale of thousands of kilometers. On the other hand, the flow of sap in a tree that carries the water in the soil from the roots to the leaves and the atmosphere is on a scale of 10 meters. This situation,

that is, understanding the 'sum' of processes operating at different scales, requires a serious abstract framework.

Of course, mathematically speaking, there's also a nonlinearity of processes and their interactions, as the total effect of two variables does not have to be the sum of their effects. Similarly, when you double an effect, the result is not always doubled. Understanding that nonlinearity can cause chaotic behavior in a system is perhaps *one of the two most important paradigm shifts witnessed in the second half of the 20th century.

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Requirements of the science of global change

The evaluation of the global (and regional) changes in the Earth System from a historical perspective, and thus understanding the human contributions to these changes, and the fact that the system requires the association of the scientific accumulation of two or three centuries on living and non-living components by 'drilling' the interdisciplinary walls were accepted toward the end of the 20th century.** Of course, this 'requires the scientific sub-worlds that had, up to that point, created different word/concept strings, to engage in serious communication and mutual education efforts, however there is still significant distance to be covered at the beginning of the 21st century.. Another obstacle to these integration efforts is the theoretical frameworks reached by different disciplines and the accepted 'quantitative laws': While we have the Navier-Stokes Equations for modeling the atmosphere, there are no similarly proven, generally accepted quantitative relations can be used to formulate the dynamics of a plant-animal community.

Both the mathematical model you will develop for such a complex system (in fact, hundreds of thousands of lines of computer code) and the relationships you will develop for the processes contain many degrees of freedom. The ability to test the 'mathematical analogy' that you build is limited by the observations you can gather. Therefore, the 'global' organization required for the collection and continuity of this data and t**he liberal attitude to be adopted regarding the sharing of data** necessitate ridding ourselves of the old reflexes and developing new ethics. In the 21st century, the science of global change is developing as the science of 'big data'. Quality-checked and reliable data is also essential for the rapidly evolving and self-imposed 'deep learning' approach.

Studies of global change (especially efforts to model the atmosphere-ocean system) have made maximum use of information technologies. Running simulations of increasingly meaningful time intervals through the use of gigantic computer programs consisting of hundreds of thousands of developed lines is only possible with 'supercomputers'. Since the development of the first electronic computers in the 1950s, modelers have become impatient customers of these technologies. Nowadays, a significant proportion of the computational resources devoted to civil applications are being used by climate modelers.

In the mid-1980s, Internet protocols developed in the 1960s were unearthed to make the above-mentioned computational facilities available to scientists, and became rapidly widespread. The Internet plays a very important role in the production of the science of global change and in the sharing of results. For example, anyone can access the climate model results on which the IPCC reports are based from the archives. As we will also underline in the future, it is possible to build **transparency and freedom into the accessing of data** through Internet technologies.

* Lorenz, E. N., 1963: Deterministic Nonperiodic Flow. https://doi.org/ 2 10.1175/1520-0469(1963)0202.0.CO;2

** It is necessary to mention here the great naturalist and explorer Alexander von Humboldt, who at the beginning of the 19th century advocated this holistic approach.

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Organization and promotion of the science of global change

Studies in the field of human-induced climate change, as one of the most important components of global change, were carried out in the 1970s, primarily in the United States, the United Kingdom, France and Germany. The most important input when modeling the global climate was fast computers, however such technologies were available only to a handful of countries in those years. In the 1980s, Earth System Models (ESMs) were able to make projections for the future, at least at a regional level, and scientists began to share their results with governments and the media, especially in Western countries. It was in this atmosphere in 1988 that the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in order to 'distill' what the scientific world has produced on climate change and to create an airtight scientific basis for international discussions. The IPCC published its first assessment report (FIR) in 1990, and the report would serve as the scientific basis for the UN Conference on Environment and Development, known also as the Rio Summit, which was to be held two years later in 1992.

The importance of the IPCC lies in the international credibility it lends to the projections produced by science on climate change. The meticulously prepared reports of the scientists from all over the world who collaborate within its structure (albeit with the approval of their countries) still constitute the most fundamental response to 'climate change rejectionists'. It is known fact that there discussions are held right up until the last moment in the production of IPCC reports, especially in the writing of the executive summaries.

Three conventions and an agenda* (Agenda 21) were on the table at the Rio Summit. In the 30 years following the Rio Summit, numerous meetings (often called the Conference of the Parties) were to discuss global change policy, and protocols aimed at implementation/sanctions (and often unsuccessful) were defined and submitted to the approval of nations. Subsequently, the three conventions were sent to the relevant organizations for the monitoring of the science in their subject areas and for submission to the decision makers. The IPCC has undertaken this role in the field of climate. The IPBES, on the other hand, has emerged as a similar structure for the Convention on **Biological Diversity.

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* Their full names: Convention on Biological Diversity (CBD), United Nations Framework Convention on Climate Change (UNFCCC), and United Nations Convention to Combat Desertification (UNCCD).

** Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)

Explaining science: decision makers and 'others'

Throughout the ages, 'explaining' to decision makers and, of course, the public in democracies, what the developing science and science-based technological developments mean for human life and well-being have involved complex processes. What is decisive here is the 'intellectual distance' between the 'explainer' and the 'listener'. This 'distance' depends on the conceptual framework of the listener, and there are significant differences in different cultures. It is of course desirable for decisions to be made by managers on the basis of knowledge, and that the decisions taken create at least an awareness through healthy discussion in the public sphere. One should not be under the misapprehension that in society, decisions are always made by rational processes, and that there is only one 'right decision', however I believe that an environment in which choices are made from among 'possibles' that do not conflict with nature is a desirable feature in successful governance.

In the context of global change, we can talk about the unique qualities of the above-mentioned matters. First of all, there are significant obstacles in front of the perception of the action-result relationship in both time and in space. Considering that the interdependencies of the processes of global change are distributed in space, it is certain that the 'global' or 'regional' change cannot be perceived based solely on 'local' observations. We may 'see' a polluted shoreline or a forest fire threatening our vacation, but the increasing acidification of the oceans is beyond our power of observation. Similarly, we may experience floods or storms in our daily lives, but we cannot observe their increased frequency/magnitude over the last 50 years. In such cases, the importance of establishing reliable and effective tools/channels for communication between the scientific world and the public is gradually increasing.

Acknowledging what we know and what we do not know

Even if they do not deal with science themselves, a significant proportion (almost all!) of people who accept that science is the right approach are unaware of the scientific method. They accept that science must have an answer to every question, and the idea that this answer is an 'updated' answer is counterintuitive to them – according to them, science should not revise its narratives or explanations. Building structures on 'falsifiable' hypotheses with a Popperian approach can easily be perceived as a reliability issue.

It may not be easy to cope with the communication/perception problem that is endeavored to be described above. Perhaps one way, although it might not suit everyone, is to verbally assign 'reliabilities' to the developed propositions. This is the approach followed in IPCC reports, with statements such as 'almost certain', 'very likely' or 'very unlikely' added in parentheses next to the propositions.

Participatory Science or Citizen Science

It is certain that understanding and monitoring global (or local)-scale environmental problems and creating public support for the measures that need to be put into action is the greatest challenge ahead of us. In addition to communication with decision makers/persuasion efforts, participation-based projects have been attempted in recent years.

Another approach in this direction may require an expansion of the scientific knowledge production process. The 'participatory science', or 'citizen science', approach is the most effective means of involving people who do not 'professionally' engaged in science, who have no formal science education, but who find the idea of contributing to science attractive. Here, it is used to collect data that would not otherwise be possible to obtain from people both young and old, and people with different levels of education. Observations, which require care and patience, but no specialized training or equipment, are carried out in many settings and by many people, and the results are collated in databases. Numerous examples of this can be given in the context of global change. Birdwatching is a good example, as in some countries, continuous or seasonal observations (and even counts) are providing us with invaluable data on the populations of bird species. Similarly, observing the seasons (bud emergence, bud opening, flowering, fruit formation, leaf fall, etc.) of a plant we have chosen nearby provides data on the timing of plant-climate relationships. The organization of 'citizen scientists' via the Internet (by creating 'networks') and collecting the data they produce in a database, for example, via a smartphone, will provide a deep awareness of the rhythm of nature in those who collect this data, while also supporting an accumulation of data that 'science professionals' cannot easily create. In this respect, 'citizen science' is a complete 'win-win' relationship.

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Results and some recommendations

Considering the issues we have described briefly above about the science of global change in the 21st century and the awareness that will turn this science into action, some trends and suggestions emerge:

- Understanding the Earth System is not just about understanding the dynamics of its components. The history of the different branches of science that focus on living and non-living components goes back at least two centuries, and these branches have developed their own conceptual and methodological frameworks over time. Unfortunately, although we do not break down the interdisciplinary walls when it comes to the interaction of system elements, making them permeable is vital, for which scientists from different disciplines must learn each other's languages and 'glossaries'. What is needed is perhaps to start with '**multidisciplinary**' work and then reach an '**interdisciplinary**' **level**.
- **Sharing is essential:** the collected data and the results produced by the models should be easily explorable and accessible by everyone, without question. At the same time, certain standards should be followed to make the data analyses and models reproducible. In this sense, ethical constructs should be created for an authorship that respects effort. These rules should be followed by institutions and individuals alike.
- **Outreach:** The world of science should allocate the necessary resources and time to allow non-scientists, too, to experience the scientific process and 'adventure'. If the public is to be encouraged to participate in decision-making processes related to the environment, they must be informed (if they desire) how science achieves its results. With the possibilities we have today, such outreaches can also be realized remotely (online) to a certain extent.
- **Environmental humanities:** On the bridge between the world of natural sciences and public opinion is an insufficiently 'explored' space in which art in all its forms (literature, visual/plastic arts, drama, film, etc.) can take a part. It should be possible to articulate environmental sciences through environmental humanities. Furthermore, what an anthropological perspective can bring to the problems of communication and scientific organization discussed in this article is a compelling thought.

About the Author

Professor Nüzhet Dalfes, who has been working in the fields of climatology, paleoclimatology, ecology, and applied informatics for many years, completed his undergraduate education in Physics at Boğaziçi University in 1975, his master's education in Geophysics Engineering at İstanbul Technical University in 1977, and his doctorate in Space Physics and Astronomy at Rice University (USA) in 1984. In the following years, he continued his research at the Dynamic Meteorology Laboratory in France and at the TÜBİTAK Marmara Research Center in Turkey. Between 1990 and 1992, he worked as associate professor at the Institute of Environmental Sciences at Boğaziçi University where he taught courses on ecology as well as on climatology. In 1992, he started working at İstanbul Technical University where he designed and taught courses on ecology at the then newly-founded Department of Molecular Biology and Genetics. For many years he served as administrator of the various academic units specializing on informatics and earth sciences. Currently, he is engaged in research on regional climate change, ecosystem modelling, and ecological informatics. Since 2012, he has been endeavoring to establish in Turkey a phenology network (TR Pheno) based on 'citizen science' and a monitoring system of 'pheno cameras'.

ABOUT THE PROJECT

Imagining A Common Horizon for Humanity and the Planet

The world is passing through an extremely troubled period in its history, with a seemingly new challenge encountered at every turn. Serious economic, social, cultural, environmental and political crises at a global level are exacerbated by those being felt in individual countries. The challenges we are facing take a variety of forms, from financial collapses to climate change, from international terrorism to regional conflicts, and from the refugee problem to xenophobia.

All of these crises are being aggravated by the impact of the pandemic, revealing the inability of humanity to tackle them collectively, and invalidating the romantic discourse of globalization. As history continues its march, we are reminded that the answer to the common problems of humanity cannot be found by becoming more introverted, polarized or prejudiced. No matter how severe our problems, our destiny should not be seen as unchangeable. The problems we experience are primarily a result of human activity, and can be overcome only through human effort, but we should remain aware that there are many different hurdles to be passed if we are to rid ourselves of the crises being experienced in many parts of the world.

Only through conscious, patient and collective effort can we overcome the problems of humanity. Now is the time for dignified people from the different cultures and geographies of the world to come together in solidarity. It is time to speak with full respect of human dignity, setting aside the importance we place in our individual identities. An alliance of people who see truth and justice as the major pillars of our kind, will be able to open the door to a new era of solidarity for humanity. A dignified future is possible. We believe that Turkey holds a special, if not privileged, position, based on its geographical, historical and cultural characteristics, and can serve as a host to this joint effort of humanity.

Our goal within the scope of this project is to bring together the leading thinkers of the world, to create an international intellectual platform that draws its strength from human dignity, and that aims to build for the future of humanity and the planet with a holistic synergy with a view to offering humanity a common horizon. As Cappadocia University, our vision in this regard is to provide an academic platform from where esteemed intellectuals from around the world can share their visions for a common future of humanity and our planet, and to comment on the challenges and opportunities they envisage.

You can find detailed information about the Project at https://commonhorizon.kapadokya.edu.tr/en/

ABOUT THE CAPPADOCIA UNIVERSITY

Cappadocia University (https://kapadokya.edu.tr/en/) is a young foundation (private) university in central Turkey, Cappadocia. The main goal of the university is to raise generations of opinion leaders who can read the 21st century realistically, and whose views therefore carry weight and significance – go-to men and women who are highly knowledgeable in their fields, who are happy to share their knowledge, and who will thus be respected and trusted by others. Cappadocia University is home to a highly successful dual-pronged system of academic and vocational programs that act in support of each other.