

Life's structure in space and time: Information flow in the biosphere

Abstract

Earth's biosphere is diverse, but is this a product of evolutionary chance or a necessary outcome? And would re-running evolution lead to a biosphere that is similar to ours or one that is unrecognisable different? What, therefore, is the significance of the particular diversity seen today? What, then, is the particular position of humans in this diversity? Are we one species among many or in a category of our own? Basic concepts of information theory allow to shed some light onto these questions. On the one hand, the information content of organisms and ecosystems can be estimated by analysing their spatial structure, allowing to assess the extent of structural information contained in the biosphere and its diversity. On the other hand, life is a phenomenon characterised by inherited information that flows through channels on the genetic, epigenetic, behavioural and symbolic levels. The relatively recent emergence of human communication systems can be understood as the opening up of an additional information inheritance channel that now is part of the ongoing global transformation of the biosphere.

In his talk, Wolfgang Lucht provided a story of almost everything, but mainly of human's history, evolution and future. He did this in an objective manner and with a broad perspective, although it was an aperitif talk - a well and truly aperitif talk.

The first part of his talk he addressed to the Biosphere's evolution and what role humans played as part of it (more or less summarized in the abstract). In order to stress the information flow in the biosphere, he pointed out exemplarily how long it took to invent stone tools compared to satellites (see page 5). In the second part he highlighted the emergence of human communication (information flow on a symbolic level), which led to a new epoch, called the 'Anthropocene' in which humankind has emerged as globally significant – and potentially intelligent – force of reshaping the face of the planet (Crutzen 2002).

At the same time, the ability to do so and the consciousness about it impose responsibility for sustainability in order to maintain Earth's life-support systems. By using the metaphor of a ship with 6 billion people, sailing through the possible phase space (i.e. possible states of the Earth System, somewhere located between those of Mars and Venus), he developed the idea that humans could steer their ship (i.e. our Earth) safely through narrows and cliffs (i.e. inhabitable states of the Earth System). But what is required to find the safety course for the future? - Overall, a better understanding of the Earth system, including its vital organs (see also 'tipping points in the Earth System' page 19). In order to come back to the ship with 6 billion people, there is need for (I) good navigation charts (Earth system models), (II) checking on reality (Earth system observations, environmental experiments) and (III) being prepared (expect surprises).

In order to plot the future course of our 'ship'- the Earth, we do have a lot of choices, because humans have evolved to a consciousness force and a pioneer of non-genetic information flows within the biosphere.

Crutzen, P.J. (2002): The Anthropocene: Geology of mankind. Nature 415: 23

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