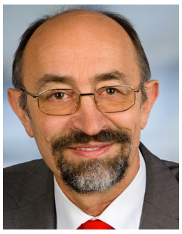
GEOQ EGU VOICE

Letter from the EGU President

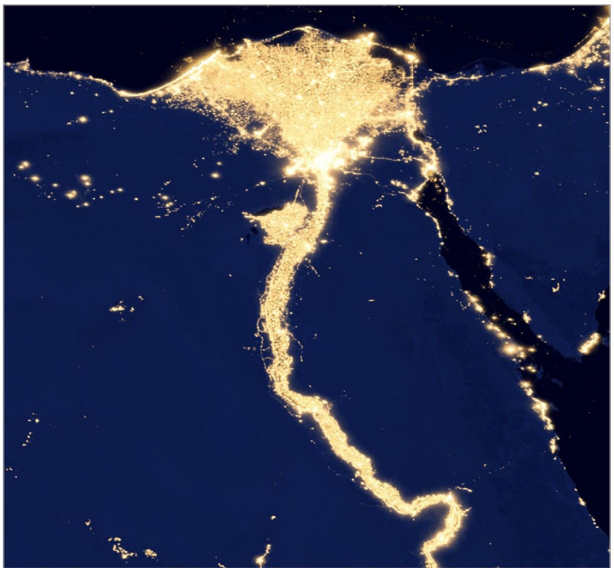
New thinking, data and models for doing geosciences in the Anthropocene



In my letter in the September issue of GeoQ I noted: "It may no longer suffice to treat humans as boundary conditions in an isolated way but as an integral part of the coupled human-nature system when advancing Earth system sciences in the Anthropocene." Now, in December, we have a full issue dedicated to the Anthropocene. In this letter I would like to propose three theses on doing geosciences in the Anthropocene and illustrate them with examples:

- Thesis 1: We need a new thinking to treat humans as an integral part of the geosystem.
- Thesis 2: There are (new) data that allow such integration.
- Thesis 3: We need new models that capture the co-evolution of people and the geosystem.

New thinking. Most textbooks start from the assumption that the geosystem can best be studied without human effects. There are of course very good reasons for leaving out humans, as they add enormously to the complexity. Yet, there is an increasing number and variety of patterns that can no longer be explained without integrating anthropocenic processes. A new thinking that revolves around the dynamic coupling of geo-processes and human action/reaction is therefore needed: a genuine two-way coupling rather than boundary conditions that have been the norm in the past. An example of this new thinking has been furnished by Kandasamy et al. (2014) who analysed the drivers of a 'pendulum swing' between agricultural development and environmental health in the Murrumbidgee River basin, Australia, in the 20th century. They explained how societal norms, policy frameworks, water fluxes and quality in the landscape depended on each other, resulting in an emergent behaviour that could not possibly be understood by looking at individual factors in isolation. Often such systems are 'slow-fast systems' that produce interesting dynamics by the coupling across space and timescales.



Nightlights across the Nile River and Delta region. (Source: Ceola et al. 2014)

New data. For better understanding how humans are integrated in the geosystem, data are needed that reflect this coupling. The past approach has often been to consider the human fingerprint a nuisance and filter it out to get 'clean' data. Yet, perhaps now is the time to leave the human effect in the data and seek to represent the entire system. Even more importantly, there is a need for new data, or use of existing data in a new way, that exactly addresses the human component. An example of this new data and data use has been furnished by Ceola et al. (2014) who analysed satellite nightlight data to show that nocturnal lights close to rivers are consistently related to flood damages. They found increasing nightlights to be associated with flood damage intensification around the world. The nightlight data are an excellent example of creative research where data collected for completely different reasons are used in a geoscience context to unravel new patterns of human-geosystem interactions.

New models. As the complexity of coupled systems increases, modelling becomes increasingly difficult. Once political processes come in, for example, there is little hope of deterministic descriptions. I believe there are opportunities for new model types that conceptualise processes in an integrated way, taking advantage of co-evolutionary principles of the geosystem, including humans. While such models are not inconsistent with micro-scale physics and chemistry, they exploit laws at more integrated scales. An example of a simple model deciphering co-evolutionary characteristics has been furnished by Gao et al. (2014) who inferred the water storage capacity of the root zone at the catchment scale from effective rainfall and plant transpiration. They demonstrated that the ecosystems dynamically design their root systems to bridge droughts that re-occur every two decades but no more than that, as it is increasingly expensive in terms of carbon allocation to roots. These kinds of models may play an increasingly important role in understanding the patterns we see in the Anthropocene.

Obviously, many other recent examples of creative thinking, data usage, and modelling exist across the geosciences. If interested, you may want to explore this emerging research direction starting from papers such as those mentioned here. Creativity is the key, and we can learn from each other across different disciplines in the geosciences. The theme of the next EGU General Assembly, A Voyage Through Scales, is intended to work as a coherent thread, fostering creativity across the geosciences.

Günter Blöschl
EGU President