

## **GEOPHYSICAL SYSTEMS**

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### **Contents**

1. Introduction
  2. Tectonics and Motion of Continents
  3. Role of Terrestrial Heat
  4. Volcanic Activity
  5. Surface Processes in Interaction with Tectonic Processes
  6. Coastal Processes
  7. Interaction of Human Activity with Natural Processes
- Glossary  
Bibliography  
Biographical Sketch

### **Summary**

Geophysical systems are complex systems consisting of interactive structures, phenomena and processes. They include the solid Earth as well as the hydrosphere and atmosphere. Here we consider the geophysical systems which are related to Earth's surface—the environment humans are living in. These systems are substantially influenced by tectonic processes, volcanic activity, terrestrial heat flow, and ocean/sea interaction in coastal areas. These processes have important and sometimes devastating impacts on the lives of people. On the other hand, particularly in recent centuries, humans increasingly affect the environment they are living in, including geophysical processes, both in positive and negative ways. To find a reasonable balance between humans and environmental nature, and to reduce negative impacts of human activities, is the necessary condition for sustainable development of the human race on Earth.

### **1. Introduction**

What does the term 'system' mean? It is not easy to answer this question. In geophysics it means a complex set of interrelated and interactive structures, phenomena and processes. However, such a definition is very general and does not say much about geophysical systems. Therefore it is better to use some examples and then to specify which kind of geophysical system will be treated hereafter.

One type of generally known geophysical system (in the sense of Earth's systems) is climate. The climatic system is formed by four basic components: atmosphere (the troposphere and a bit of the stratosphere), hydrosphere (mainly the oceans), ice sheets and land cover (mainly biosphere). Each of these components itself represents a

complex system of various structures, processes and phenomena. Moreover, the Earth's interior can affect climate via volcanic activity, and on very long time-scales via tectonic processes, i.e. motion of continents. Very important climatic forcing is so called orbital or astronomic forcing, which consists of more or less periodic changes of tilt of the Earth's rotational axis and of the Earth's orbit. The orbital forcing is considered to be the primary factor responsible for the glacial-interglacial climatic cycle. The climatic system is very complex and interrelated.

Another example is the system Earth's core - lower mantle (see *Mantle and Core of the Earth*) – geodynamo (see *Magnetohydrodynamics of the Earth's Core*) – the main magnetic field of the Earth (see *Earth's Magnetic Field*). Various processes of mechanical, thermal and electric origin connect these structures and phenomena, creating again a very complex system. Each part of this system may be itself considered to be a complex system of various structures, phenomena and processes.

Hereafter we shall deal with another complex geophysical system related to the Earth's surface, including the role of the crust and lithosphere. Its various components are described in more detail in the following articles:

Continents on the Move  
Tectonic Processes  
Tectonic and Surface Processes Interaction  
Geophysical Processes and Human Activities  
Terrestrial Heat Flow  
Structure and Function of Marine Shoreline Ecosystems

Tectonic processes, which induce seismic and volcanic activity, and on the long-term time scale re-shape continents, are related to convection in the mantle, which is associated with the terrestrial heat flow. The seismic and volcanic activity modifies the environment we are living in, and sometimes earthquakes and volcanic eruptions kill thousands of people. Seashore processes are important for life of about half of the world population, people living in the coastal zone. On the other hand, not only the nature influences our life, but humans influence the nature, as well. Some of these activities result in phenomena dangerous to people, like quakes (tremors) in mines.

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### **Biographical Sketch**

**Dr. Jan Lastovicka**, is currently director of the Institute of Atmospheric Physics of the Academy of Sciences of the Czech Republic and vice-president of the International Association of Geomagnetism and Aeronomy. He graduated in geophysics at Charles University in Prague in 1966. He obtained a CSc (= PhD) in 1974 and DrSc (~ Prof.) in 1987, both from the Czechoslovak Academy of Sciences. From 1967 to 1994 he was with the Geophysical Institute of the Czechoslovak Academy of Sciences, from doctoral student to head of the Ionospheric Department. Since 1994 he has been working in the Institute of Atmospheric Physics of the Academy of Sciences of the Czech Republic. His main research interests are: ionosphere, solar-terrestrial relations, middle atmosphere (including ozone and effects of atmospheric waves on the ionosphere), and long-term trends (potentially of greenhouse origin). He is author/co-author of more than 220 published papers in scientific journals and various proceedings, and more than 210 presentations at scientific meetings. He has organized a number of international scientific meetings.

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