Climate Monitoring and Prediction

… are prerequisites for the planning of climate change adaptation measures

Definition and Objective

Climate monitoring and prediction (CMP) is turning into one of the main pillars for developing countries to cope with climate change. CMP delivers data for the adaptation of livelihoods to future conditions and can thus be seen as a planning tool for the macro, meso and micro level. CMP can be applied in various contexts like infrastructure planning and building, housing, disaster risk management, agriculture, or coastal zone management. Yet, CMP methods and techniques vary considerably in price, complexity and focus, which makes it a challenge to choose the appropriate technology.

Types and Description

CMP methods can be divided into three groups: 1) practices measuring surface and subsurface elements, 2) practices measuring upper atmosphere elements, and 3) practices based on remote sensing. Each of the three groups should be applied by following the standards of the "Guide to Climatological Practices" by the World Meteorological Organization (WMO, 2011, third edition).

The first group's spectrum ranges from simple measurements with regard to, e.g., temperature or precipitation to a broader variety of phenomena (like humidity, atmospheric pressure and radiation) or to marine observations concerning biochemical (dissolved oxygen, etc.) or physical and chemical elements (e.g. salinity, sea level, etc.). The constant gathering and provision of data on one particular factor which reflects the essential characteristics of the respective area can be decisive in ensuring an effective forecasting, planning and sometimes even warning: e.g. the hydrological conditions for areas prone to flooding or droughts. The second group of practices concerns the measurement of upper-air elements, e.g. temperature, air pressure, radiation and the chemical composition in different layers of the atmosphere. This practice is of major importance in climate change monitoring, climate and air-quality prediction. The third group - the remote-sensing measurement of e.g. the albedo, sea surface and atmospheric temperatures - is advantageous in data-sparse areas and with regard to spatial and temporal coverage. Nonetheless, its homogeneity and lower accuracy only makes it complimentary to surface measurements.

The gathered data is then usually processed by applying computer models, which range from highly complex to quite simple versions based on empirical or statistical relationships. These models are used to produce climate outlooks, i.e. climate predictions or climate projections. Climate predictions are based on the known current conditions and derived by applying assumptions regarding future physical processes. Climate projections explicitly allow for changes in the setting of boundary conditions. The best-known ones are the Assessment Reports published by the Intergovernmental Panel on Climate Change (www.ipcc.ch).

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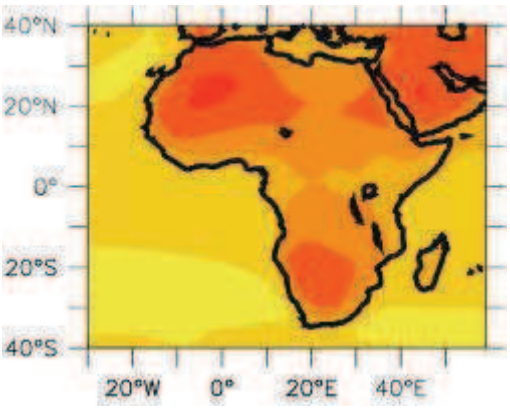
Issues to Consider

Within the context of International Cooperation, climate predictions are the most important tool for planners, as they provide information on the changes which are to be expected. It is important to choose easy-to-use climate models in order to get comprehensible, clear outlooks and thus allow planners and decision makers to draw conclusions and take respective actions. In addition to the simplicity of the design, further criteria to select the appropriate practice and instrument are a) the reasons for making observations; b) the required accuracy; c) the suitability for the operational environment; d) the reliability and e) the acquisition and maintenance costs. The prevention of costs is another major objective in this context and can be achieved by carefully planning the climate monitoring network (e.g. the placement of climate stations) as well as the concept for data management from the very start.

The benefits of this highly time and cost-consuming process can be maximized by feeding in the gathered data into the WMO network for world-wide use (www.wmo.int). The other way round, large scale data is downscaled to regions - mostly by using regression methods - in order to generate locally relevant data. The thus generated data are estimates only, but often provide the most useful outlook available.



Modeling Future Climate on a Regional Scale by the National Earth Science Teachers Association Windows to the Universe (www.windosw2universe.org)

Advantages

- Provides data for climate change prediction and thus for an effective long-term forecasting and planning
- Data is a key factor to infrastructure building and agriculture (short and long-term)
- Powerful tool in disaster risk management, mainly regarding disaster prevention and risk reduction
- Climate information for international negotiations and agreements

Challenges

- Preparation and dissemination of information to users and decision makers
- Close the gap between climate prediction and political action
- High price differences, as some methods are based on highly sophisticated technology
- Quality control of the data has to be done regularly
- Information with high resolution is required for the application at the micro level, which the global and regional climate models generally do not provide

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