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Thermodynamic analysis of ecosystem based on remote sensing data

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Transformation of matter and energy in plant associations and their relationship with other parts of the ecosystem are being determined by the physiological processes in plants. Accordingly, to identify general patterns of ecosystem energy transformation, assessment of an energy balance components reflecting the nature of physiological processes: photosynthesis, transpiration (of which carbon balance is evaluated), water and minerals exchange, is required.

Assessment of the main energy variables for ecosystems is possible on the basis of information-thermodynamic approach in which the ecosystem – is an open system, producing yield for self-maintenance on its structure through the conversion of solar energy. In doing so, the distribution of energy absorbed by balance components depends on the structure of the system that determines the nonequilibrium energy conversion. In the information-thermodynamic approach essential component in the transformation of solar energy is exergy - the maximum work that a thermodynamic system may commit during its transition from the current state to the state of equilibrium with the environment. Exergy sometimes called system yield, it is the function of the distance between the current state of the system and thermodynamic equilibrium. Relating to ecosystems, exergy – part of absorbed solar energy, spend on biological productivity and evapotranspiration (exergy of solar radiation). The rest goes into the bound energy – energy transition in the heat flow and entropy, and in increment of internal energy – system energy accumulation wich in its turn spend on maintenance of intercomponent and interspecific interactions, local cycles. Get estimation of energy balance for the entire set of ecosystems based on ground-based measurements is virtually impossible. Such assessments are possible on the basis of remote sensing data, which show the energetic state of the Earth's surface at the time of shooting in different spectral bands. Satellite measurements of reflected solar energy in relation to the solar constant allow the calculation of solar radiation absorbed per unit surface. Heat channel allows to calculate the heat flow from the surface and its temperature. The development of remote sensing and instrument base allows to measure a wide range of ecosystems characteristics: measurements are preformed directly in the field on transects with the regular testing step, and through remote sensing and digital models of different relief. Ultimately, the combination of complex ground and remote measurements in the study of energy balance should promote understanding of the interaction mechanism between relief, soil, vegetation and atmosphere at various hierarchical levels of the landscape cover and create a basis for the development of models describing mesoclimate, as a result of landscape functioning and self-evolution.