General statistical model for analysis of space-time variations in climatology

V. A. Lobanov

State Hydrological Institute, St. Petersburg , Russia (lobanov@EL6309.spb.edu / Phone: +7-812-5726

All space-time fluctuations of the most meteorological characteristics can be represented as 3-dimentio
with the following main axes:
- seasonal fluctuation inside each year and at each station,
- inter-annual long-term fluctuations of different time scales on each station,
- space fluctuations of each year during long-term period and for all stations over the area.
Development of general space-time model includes three main consecutive phases of aggregation an
gregating of information:
- stage 1: aggregation inside of intra-annual time interval in different forms: averaging, summarizing,
ters of seasonal function, etc;
- stage 2: modelling over the long-term period for each point (station) including the decomposition an
tion of homogeneous components of different time scale (interannual, decadal, centural) and determi
time model in stochastic (distribution function) or deterministic-stochastic (for example, autoregressio
forms;
- stage 3: regionalization and spatial modelling inside of homogeneous regions.
Regionalization is based on the indexes of classification or similarity. In modern changing conditions
dexes of spatial classification can be the dynamic properties of the extracted climate tendencies: their s
significance, direction, form of tendency, its contribution, etc. Time series with the same main prop
climate tendencies can be combined into homogeneous region. Modelling inside of such homogeneou
can be realized in one of the following forms: averaging, isolines, and parameters of space model.
The particular methods have been developed for the realization of each stage of the simulation. M
seasonal function has been developed for the first stage of intra-annual aggregation. This model h
structure, connects the conditions of each year with the average historical conditions and represent
year fluctuations as two coefficients connected with amplitude and level of the function and one para
represented as standard deviation of remainders of each-year seasonal function, which characterises an
of synoptic and macro-synoptic processes. Statistical methods of decomposition and extraction of homo
components of different time scales have been developed for realization of the second stage of the m
Suggested methods are the most robust in comparison with the well known methods such as spectral
and averaging of different kind (weights, smoothing, etc). Principle of a regionalization on the bas
same tendencies of climate change has been developed and structure of a spatial model with three pa
has been suggested, which characterize amplitude and a level of field and intra-field fluctuations.
Application of developed approach and methods has been given for modeling of air temperature in Eu
this purposes about 120 the longest time series of monthly air temperature have been selected. Time
parameters of seasonal function as well as annual temperature have been obtained and climate change
nents were extracted. On the basis structure of these components homogeneous regions have obtaine
each region the spatial model has been developed. The results of the tendencies in time series of the pa
of spatial models are discussed. Others examples connect with modeling and regionalization of prec
and temperature in the European North of Russia, temperature in Central England.