Analysis of the ongoing extreme events on the territory of Siberia

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Introduction

The second part of **1970s** is characterized by **the beginning of modern global climate change.**

Heavy precipitation and **strong storms**, **droughts** and **heat wave** show **positive trends** in several regions of the world.

We need **to better understand their impact** on the environment and also **be able to predict them** and **minimize their consequences**.

Web-GIS system “Climate”

In our analysis, we use the web-GIS system “Climate”.

This system:

- is based on a combined use of web and GIS technologies;
- is a part of a hardware and software complex for “cloud” data analysis using:
- significantly facilitates and accelerates analysis of big volumes of geospatial data.

System “Climate” allows researchers to perform **complex climate data analysis** using desktop PCs with internet connection.

Analysis based on extreme indices:

- **Indices:** frequency of cold days/nights, frequency of warm days/nights.
- **Base period:** 1961-1990 yy.
- **Investigated period:** trend since 1979 to 2010 years.
- **The input data in the first case:**
  - Base period: interpolated Era40 Reanalysis to the grid 0.75×0.75.
  - Investigated period: ERA Interim Reanalysis, 0.75×0.75°.
- **The input data in the second case:**
  - Base period: Era40 Reanalysis, 2.5×2.5.
  - Investigated period: interpolated ERA Interim Reanalysis to the grid 2.5×2. 5°.
- **Territory:** South Siberia (50°-65° N, 60°-120° E).

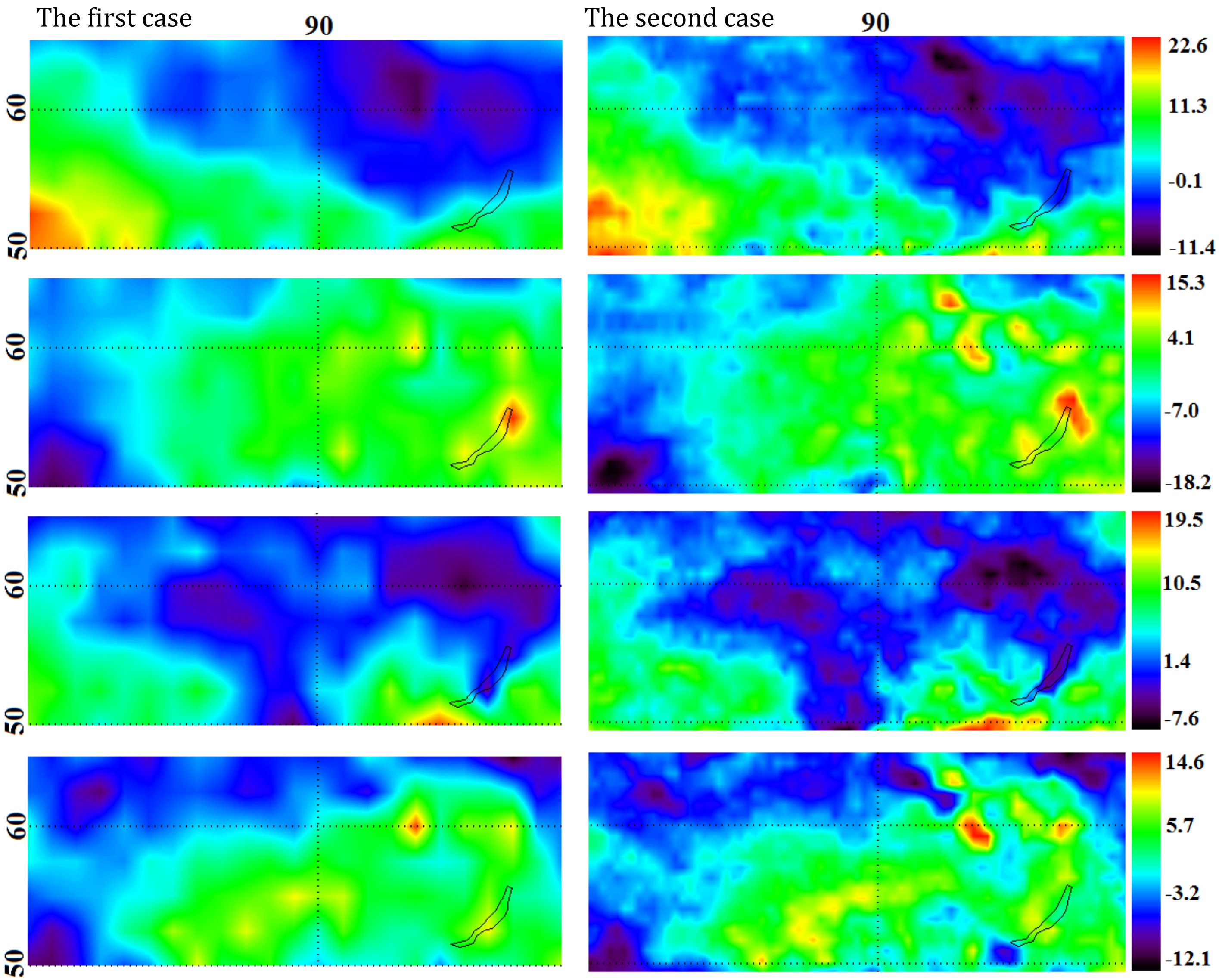
Trend of frequency:

Warm days
(TX90p)

Cold days
(TX10p)

Warm nights
(TN90p)

Cold nights
(TN10p)



Analysis based on extreme value theory

- $M_n = \max\{X_1, \ldots, X_n\}$ – block maxima;

here, $X_1, \ldots, X_n$ – daily precipitation, n – quantity of days in month

- PDF of M_n: $n \to \infty$ (the Fisher-Tippett theorem)

$$G(z;\mu,\sigma,\xi) = \exp\left\{-\left[1+\xi\left(\frac{z-\mu}{\sigma}\right)\right]^{-\frac{1}{\xi}}\right\},$$

where **$G(z; \mu, \sigma, \xi)$** is called **the generalised extreme value distribution** (**GEV**) and is defined on $\{z : 1 + \xi(z - \mu)/\sigma > 0\}$.

- **Non-stationary GEV:**

$\mu_i = \mu_0 + a_\mu \sin(\omega c_i) + b_\mu \cos(\omega c_i)$, $i = 1, \ldots, 12$ *(month),*

  - **$\omega = (2\pi)/365.25$**;
  - **c_i** denotes the **centre of the i-th month** counted in days starting from the beginning of the year.

For **σ_i** is analogous.

- **Return levels**

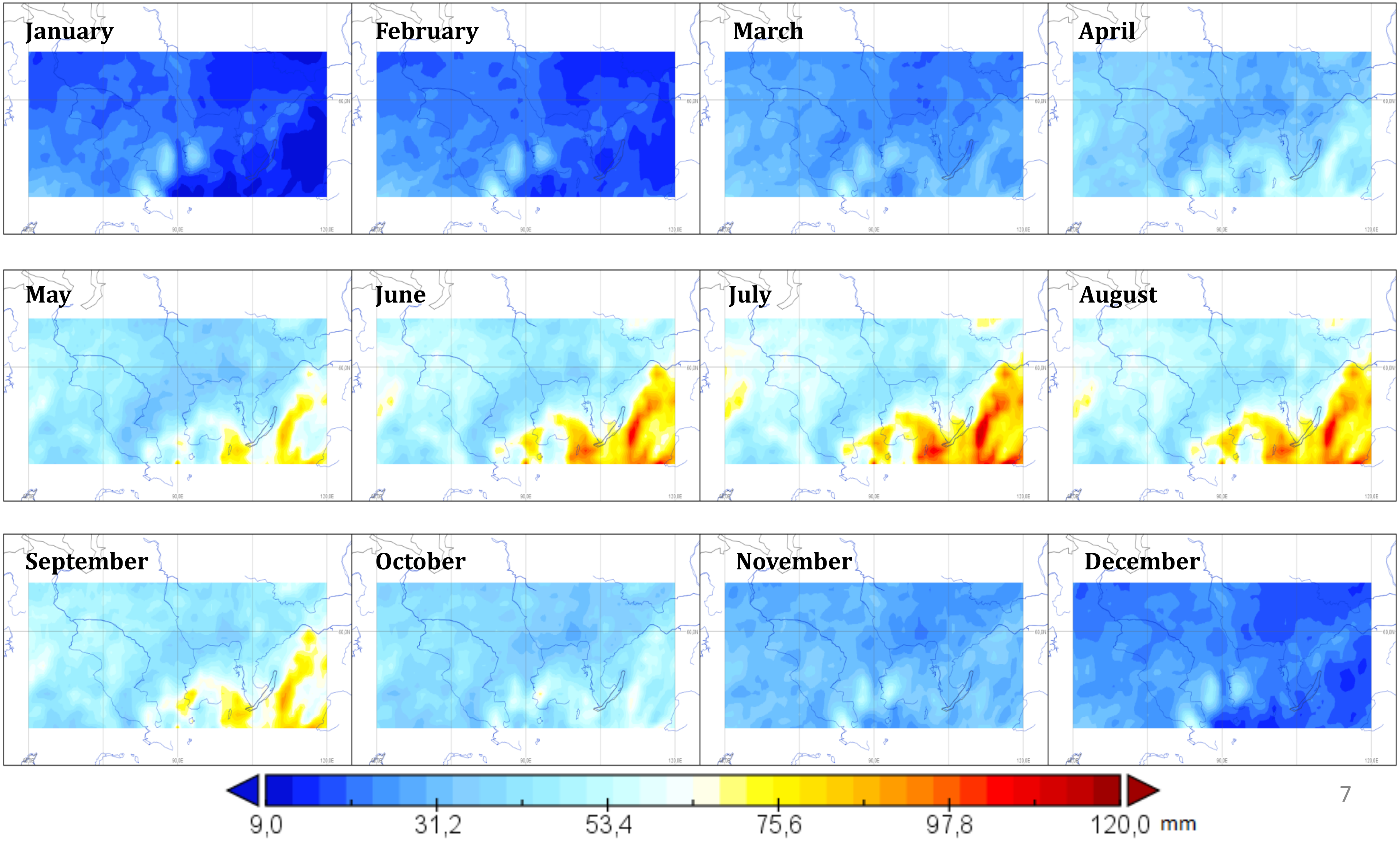
A physically more meaningful and also more relevant quantity for risk assessment is the probability of the observed variable (here, daily precipitation) exceeding a certain level. These levels can be calculated from the parameterised GEV and are frequently expressed as return levels rT for a certain return period T.

r_T is defined as the level which is exceeded on average every T blocks, i.e., with probability 1/T.

$$P(z < r_T) = G(r_T; \mu, \sigma, \xi) = 1 - \frac{1}{T}.$$

100-year return levels of precipitation conditioned on the month of their occurrence

Input data: Era Interim reanalysis, 0.75×0.75°, 1979-2012 yy.



Thank you for attention!