Temperature and precipitation extreme changes in Siberia

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Ongoing climate dynamics in Siberia

Changes

- High temperature trends in the second half of 20th century
  more than 0.2 °C per 10 years,
  in some regions – up to 0.5 °C/10 years
- Precipitation intensity increase in the northern part of Siberia [1-3]
- Climatic extremes have
  considerable geographical variations
  more frequent occurrence and stronger impacts

Impacts

- natural disasters
  fires, floods, droughts
- socio-economical disasters
  losses of life and increasing death rates, infrastructure failures and crop damages

The summer 2012 heat waves in Russia led to large-scale forest fires and about 58,000 related deaths [4]

1. *Kabanov M.V. and Lykosov V.N.,* 2006: Monitoring and modeling of climatic changes in Siberia // Atmospheric and Oceanic Optics. Vol. 19. No. 09. p. 675–85.
2. *Groisman P.Ya, Gutman G.,* 2012: Environmental Changes in Siberia: Regional Changes and their Global Consequences / Springer. 357 pp.
3. *Shulgina T.M., Genina E.Yu. and Gordov E.P.,* 2011: Dynamics of climatic characteristics influencing vegetation in Siberia // Environmental Research Letters, 7 pp.
4. http://ifaran.ru/docs/resolution.pdf

Objectives

To investigate the spatial and temporal behavior of temperature and precipitation extremes in Siberia

based on statistical analysis of meteorological data with regular spatial resolution that adequately reproduce observed climatic extremes in the region for the past century.

Data for temperature: ECMWF ERA Interim (ERA-40 for basic period)[3]
for precipitation: APHRODITE JMA[3] (0.25°×0.25°)

Area Siberia (50°–75°N, 55°– 130°E)

Time 1979 – 2012 (basic period is 1961-1990)

Climatic extremes extremely hot and cold nights and days,
very heavy rainfalls

In the context of this investigation the term 'extreme' is defined as a value that crosses a prescribed statistical threshold and is at the tail of the probability distribution.

Methodology

The set of temperature and precipitation extreme indices defined by the Expert Team on Climate Change Detection and Indices (ETCCDI):

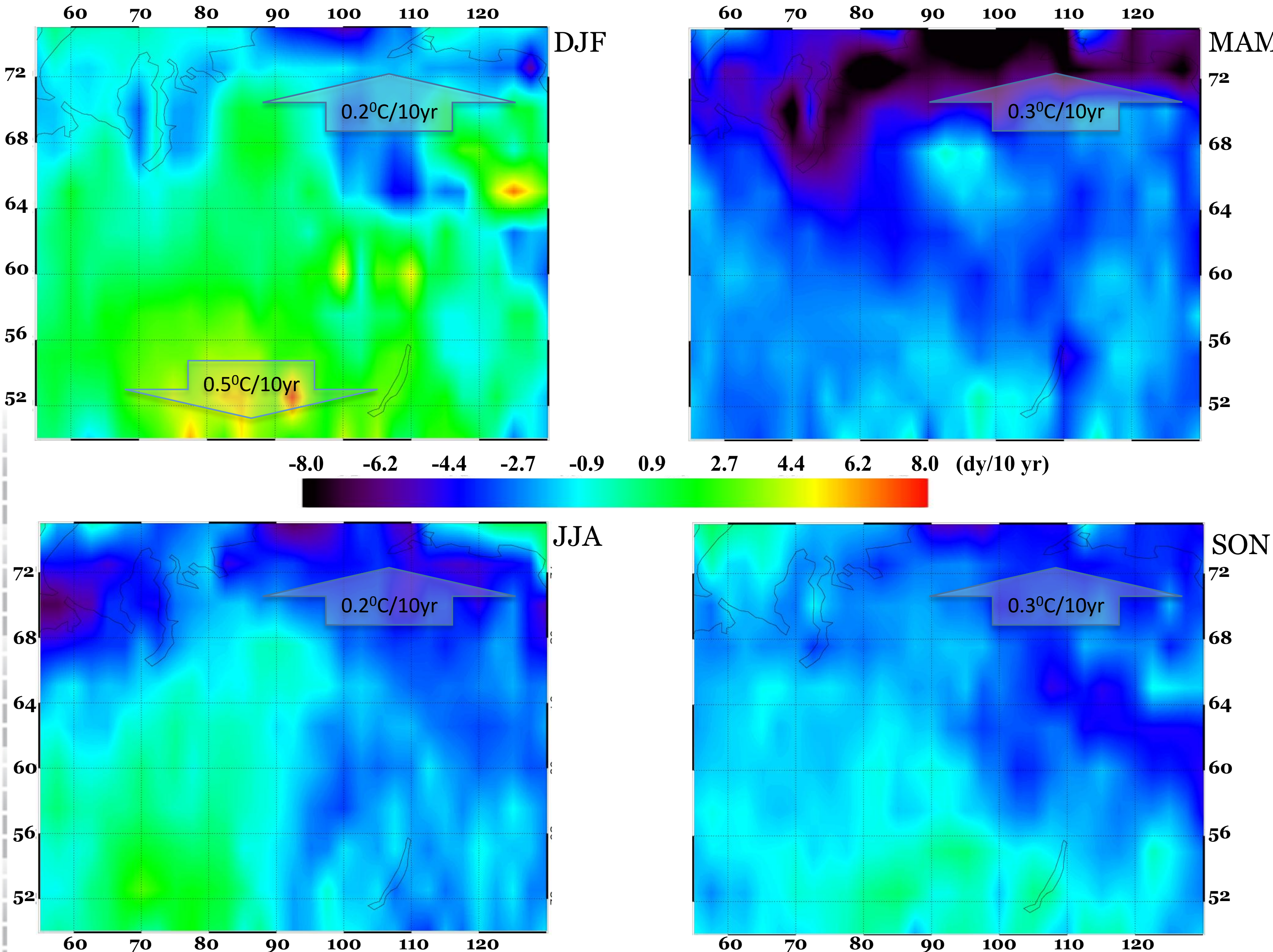
Abbr.	**Index**	**Definition**
Frequency related indices		
TN10n	Frequency of cold nights	Number of days with TN < 10th percentile
TN90n	Frequency of warm nights	Number of days with TN > 90th percentile
TX10n	Frequency of cold day-times	Number of days with TX < 10th percentile
TX90n	Frequency of warm day-times	Number of days with TX > 90th percentile
R95n	Frequency of very wet days	Number of days with PRC > 95th percentile
Intensity related indices		
TN10p	Threshold of extremely cold TN	10th percentile of TN
TN90p	Threshold of extremely warm TN	90th percentile of TN
TX10p	Threshold of extremely cold TX	10th percentile of TX
TX90p	Threshold of extremely warm TN	90th percentile of TX
R95TOT	Threshold of very wet days	PRC > 95th percentile

The percentile thresholds have been determined from data for the selected basic period 1961 – 1990 and are calculated using the following formula:

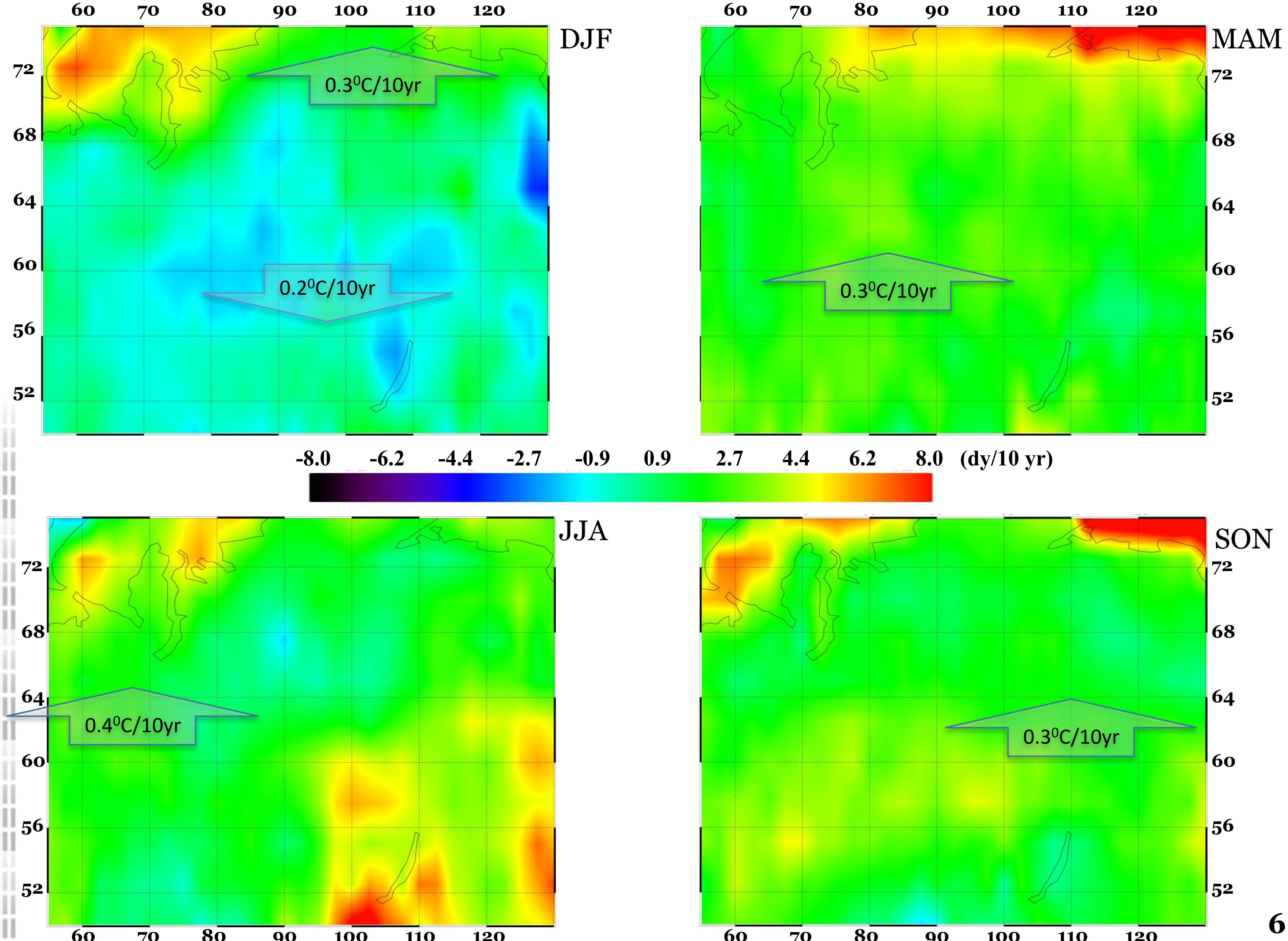
$$PREC = \frac{(100-p)\cdot y_k + p\cdot y_{k+1}}{100} \qquad k = \mathrm{int}\left(\frac{n\cdot p}{100}\right)$$

Here p is percentile, y_k and y_{k+1} are two neighboring positions within the series collected from values of basic period (1961-1990) sorted by ascending, n is the size of the sorted time series.

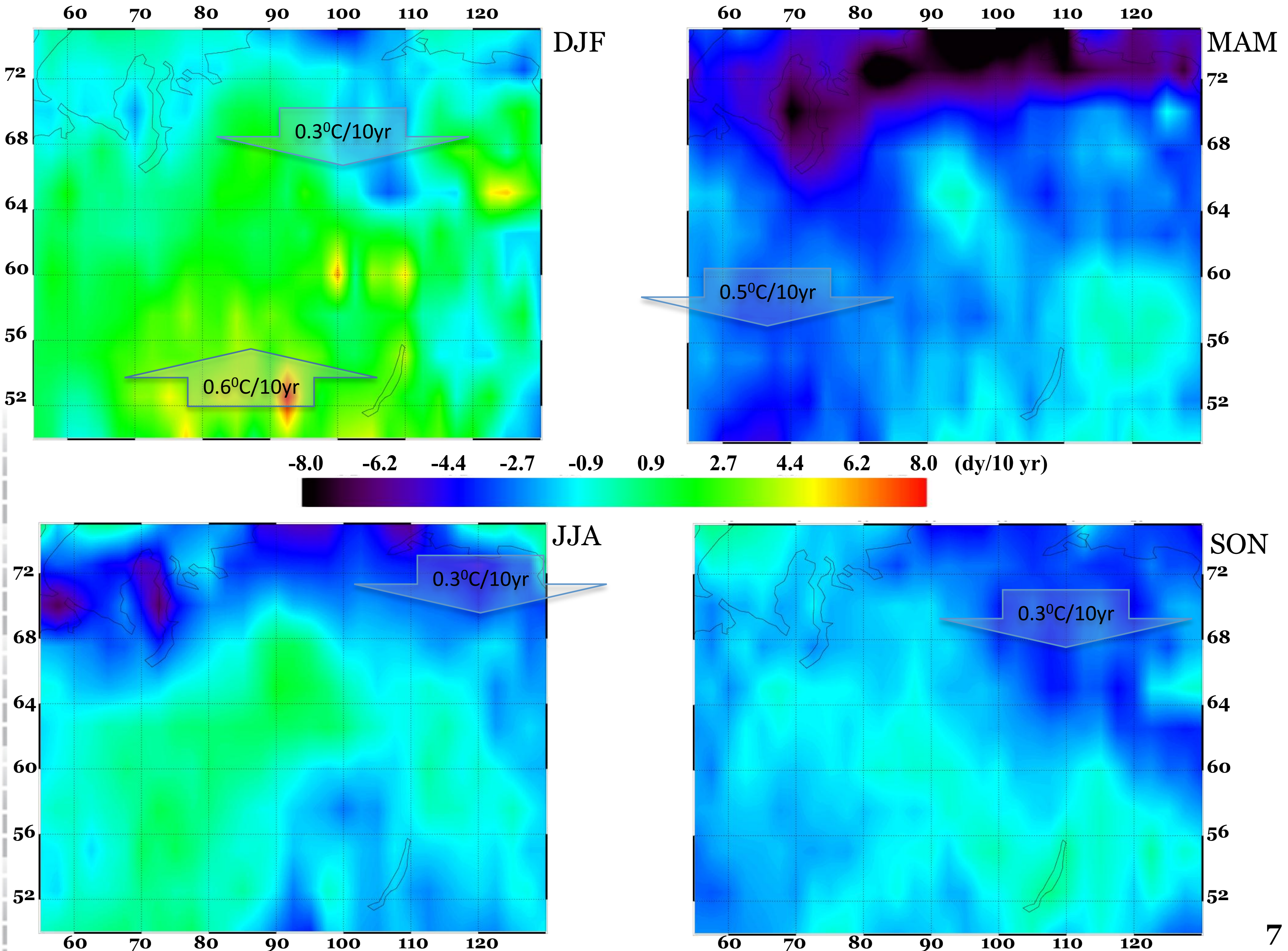
Results: *Trends of frequency of cold nights (TN10)*



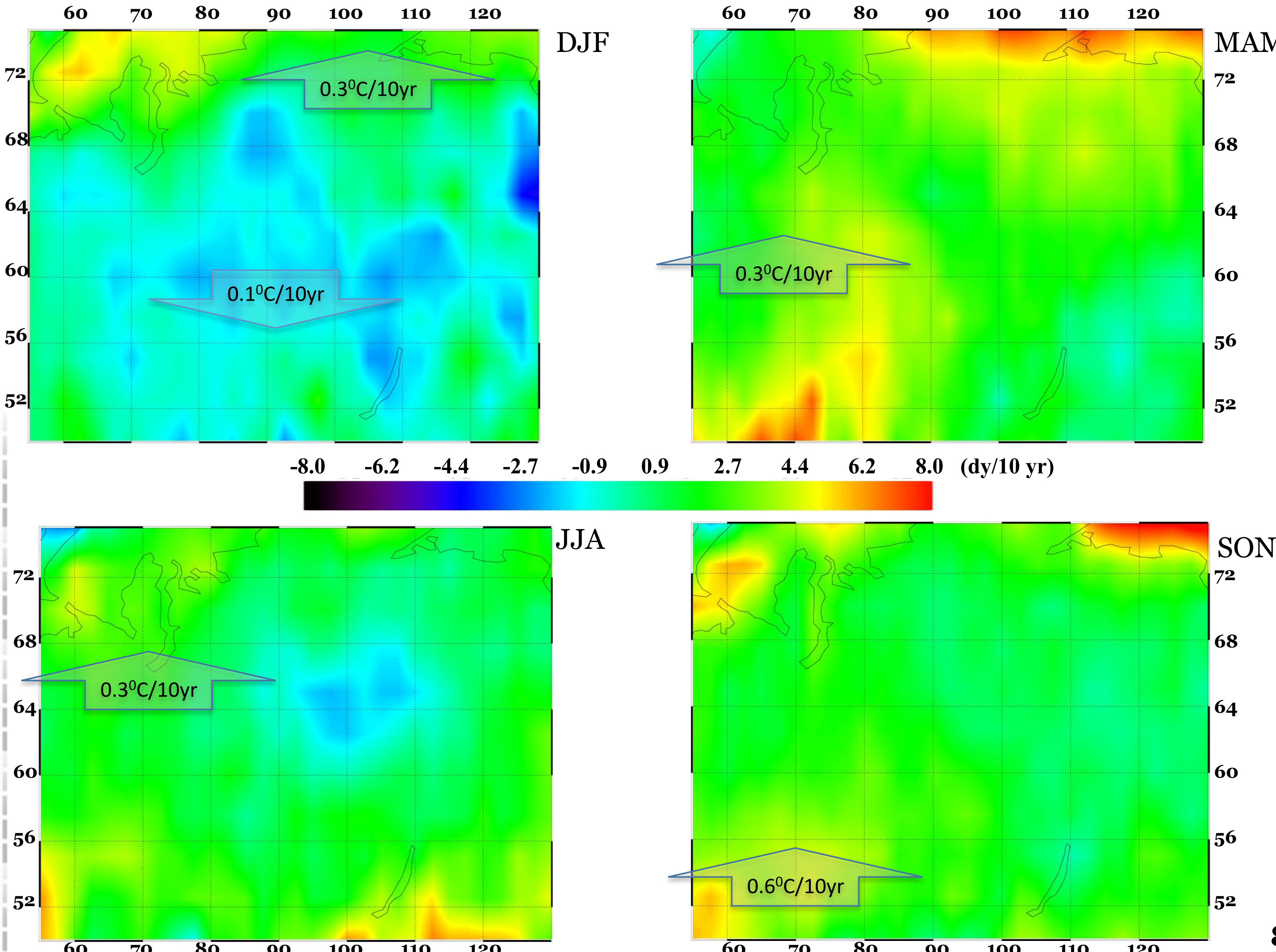
Results: *Trends of frequency of warm nights (TN90)*



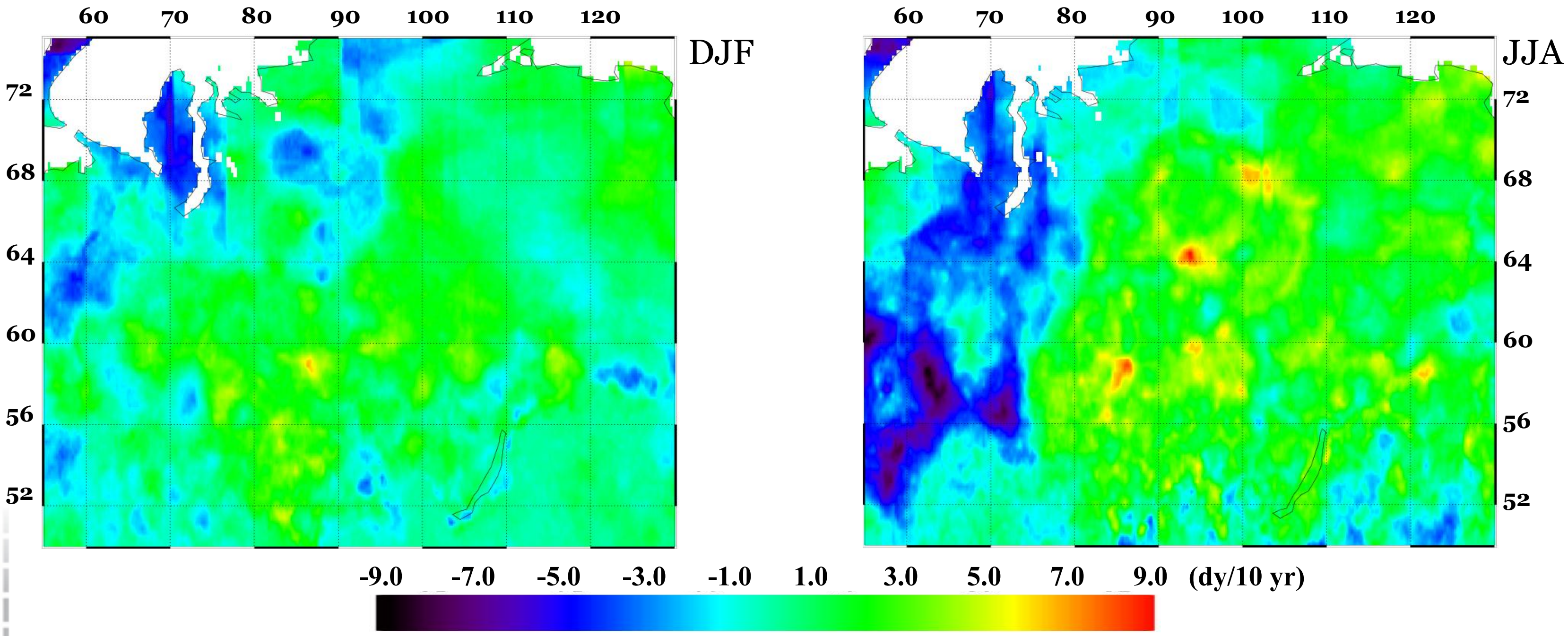
Results: *Trends of frequency of cold days* (TX10)



Results: *Trends of frequency of warm days (TX90)*



Results: *Trends of heavy precipitation (RR95)*



Summary remarks:

- Dynamics of temperature extremes shows asymmetric warming according to determined tails of cold and warm temperature extremes distributions.
- At the high latitudes of Siberia the indices of warm temperature extremes show more significant trends (TN90 and TX90 in frequency dynamics) than trends calculated for cold temperature extremes (TN10 and TX10) during whole year.
- South area of Siberia has slight cooling during winter (mostly out of cold temperature extremes) and during summer (associated with warm temperature extreme decrease).
- Increase in very wet days is observed particularly in middle and high latitudes of East Siberia.

Thank you for your attention!