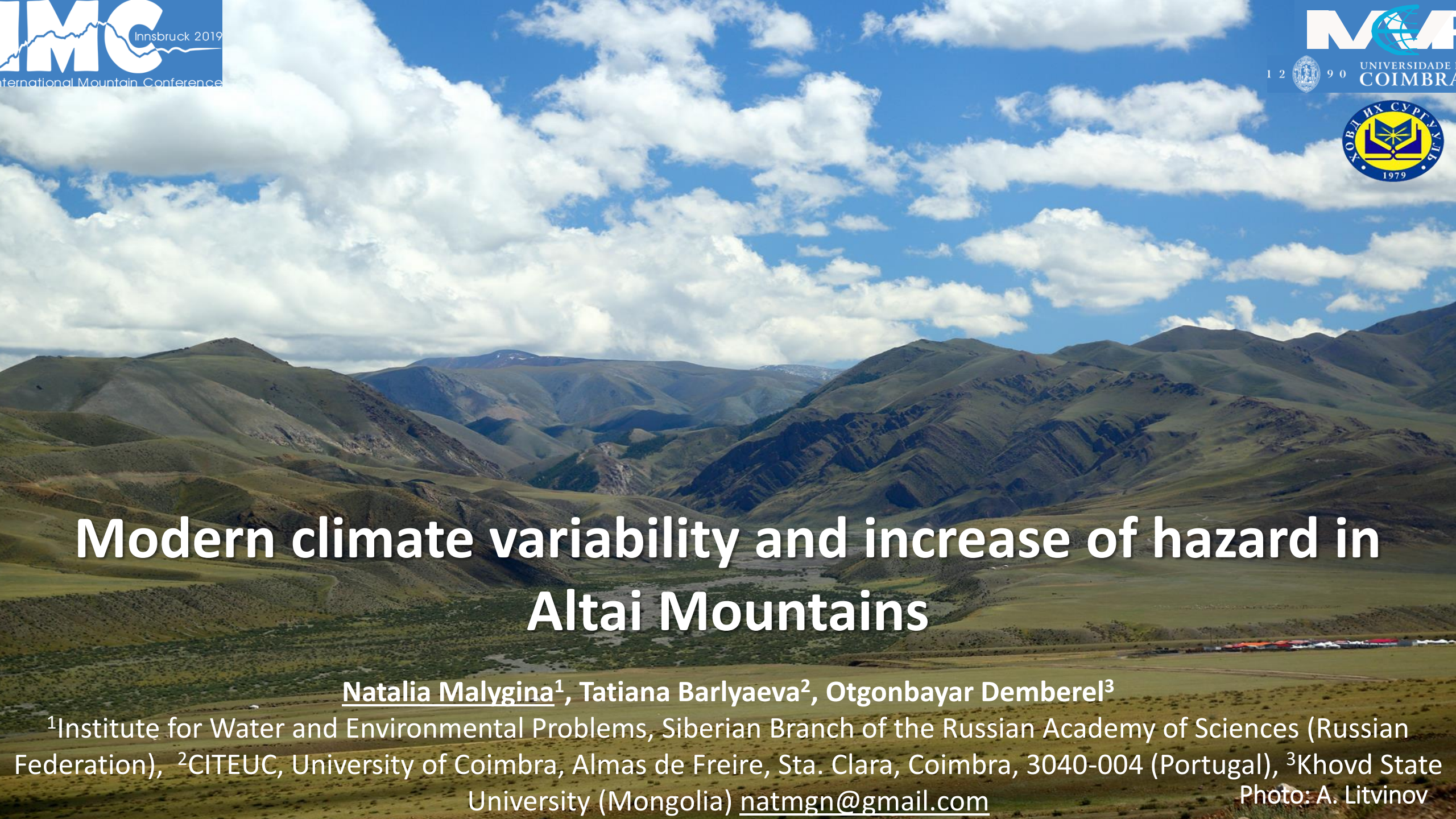


Modern climate variability and increase of hazard in Altai Mountains

Natalia Malygina[1], Tatiana Barlyaeva[2], Otgonbayar Demberel[3]

[1]Institute for Water and Environmental Problems, Siberian Branch of the Russian Academy of Sciences (Russian Federation), [2]CITEUC, University of Coimbra, Almas de Freire, Sta. Clara, Coimbra, 3040-004 (Portugal), [3]Khovd State University (Mongolia) natmgn@gmail.com

Photo: A. Litvinov

INTRO

Climate change affects the world's mountain regions and may jeopardize the services provided by mountains.

This is especially important for mountain regions located within the boundaries of several countries, for example, Altai Mountains that stretch over Mongolia, Russia, China and Kazakhstan.

The Altai Mountains (85-92^{0}E and 48-52^{0}N) is a big region located in the Northern Asia, that is extended for more than 1200 km from the north to the south and can be divided into two areas: Russian Altai at north and Mongolian Altai at south. In this work we report the results of comparison of climate (both temperature and precipitation) trends in Russian and Mongolian Altai in 1979-2017.

Climate changes in Altai Mountains

Period	Station	NCEP/NCAR	ERA-Interim
Annual temperature (^{0}C)			
1979-2017 (all period)	+0.05	-4.02	-2.07
1979-1997 (first period)	-0.27	-4.04	-2.27
1998-2017 (second period)	+0.32	-3.63	-1.87
Trend(^{0}C per decade)			
1979-2017 (all period)	+0.21	+0.16	+0.17

The temperature in Altai Mountains, in the period of 1979-2017, increased by both meteorological stations (trend +0.21^{0}C per decade) and NCEP/NCAR (trend +0.16^{0}C per decade) and ERA-Interim reanalysis (trend + 0.17^{0}C per decade). The results of the trends are consistent with trends calculated for 1896-2018 (trend + 0.18^{0}C per decade). Based on «step change point», it is shown that the most intense warming has been observed in the last 20 years (since 1997), both in Russian and Mongolian Altai with similar warmest years during this period.

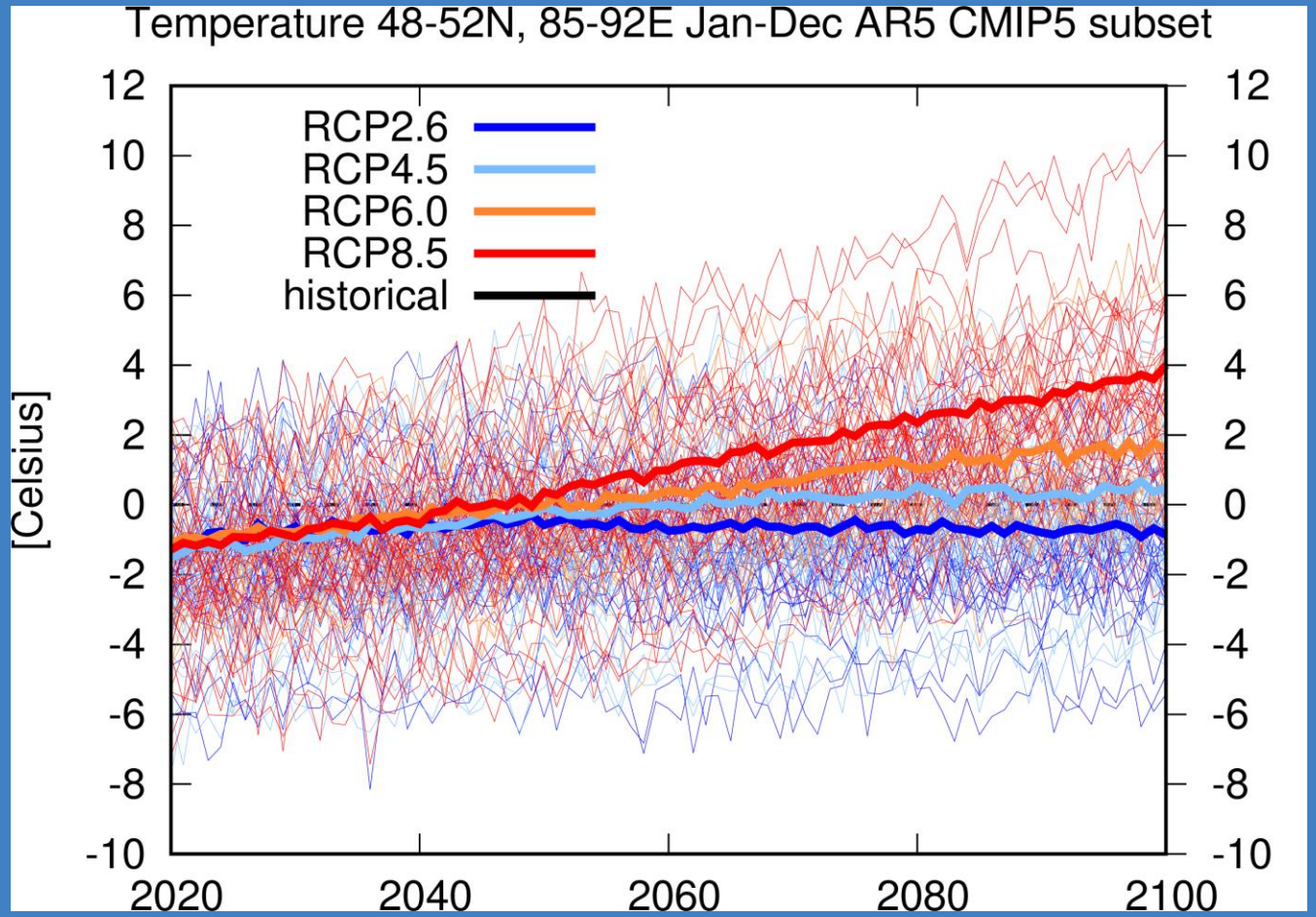
Climate changes in Altai Mountains

Period	Station	NCEP/NCAR	ERA-Interim
	Annual precipitation (mm)		
1979-2017 (all period)	400	541	558
1979-2002 (first period)	420	537	585
2003-2017 (second period)	367	549	502
	Trend(mm yr^{-1} per decade)		
1979-2017 (all period)	-2.3	+4.3	-2.8

The precipitation in Altai Mountains is decreasing two times faster (trend -2.3 mm y^{r-1} per decade) compared to Mongolian Altai, unlike Russian Altai. This trend is confirmed by the results of calculations for the ERA-Interim reanalysis (trend -2.3 mm yr^{-1} per decade). According to NCEP/NCAR reanalysis, the obtained trends give a positive position (trend +4.3 mm yr^{-1} per decade), in contrast to the trends obtained from two other sources (meteorological stations and ERA-Interim). Based on the “step change point”, it was shown that the most dramatic decrease in precipitation, both in Russian and in Mongolian Altai, occurred in 2002.

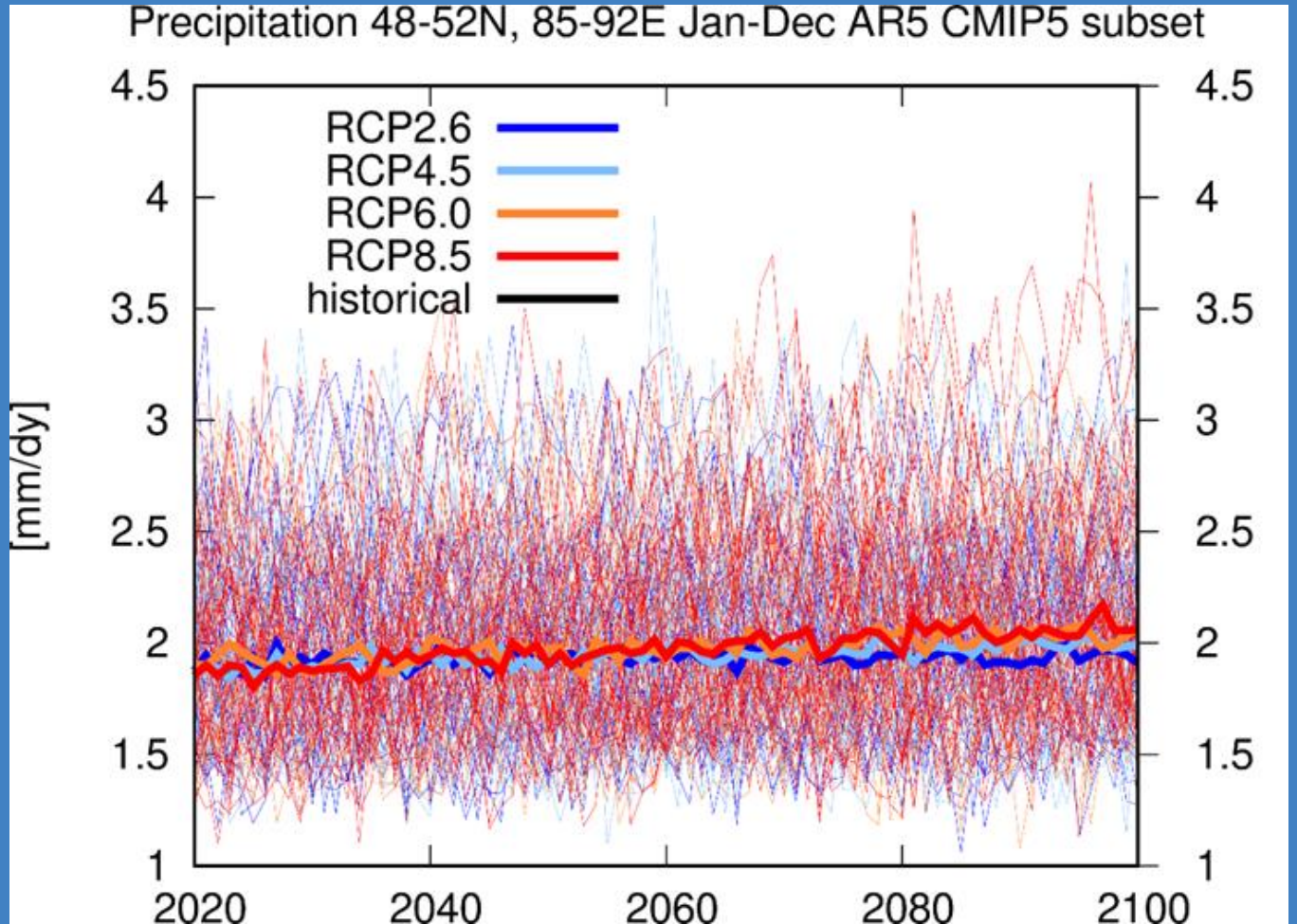
For the Fifth Assessment Report (AR5) of IPCC, the scientific community has defined a set of four new scenarios.

The CMIP5 simulations were performed with prescribed CO_2 concentrations reaching: 421 ppm (RCP2.6),538 ppm (RCP4.5), 670 ppm (RCP6.0) and 936 ppm (RCP 8.5) by the year 2100. [https://www.ipcc.ch/; https://climexp.knmi.nl].



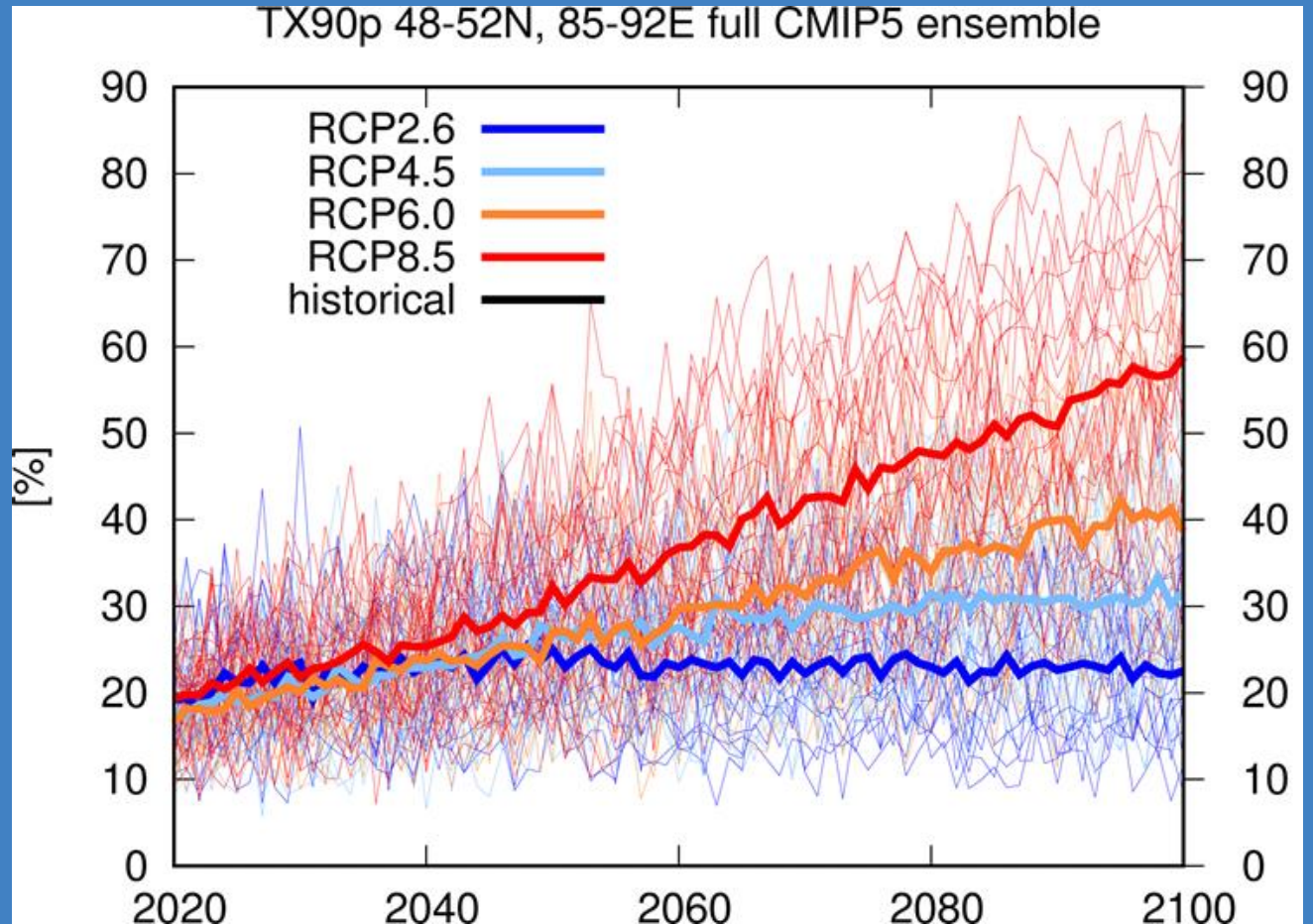
For the Fifth Assessment Report (AR5) of IPCC, the scientific community has defined a set of four new scenarios.

The CMIP5 simulations were performed with prescribed CO_2 concentrations reaching: 421 ppm (RCP2.6),538 ppm (RCP4.5), 670 ppm (RCP6.0) and 936 ppm (RCP 8.5) by the year 2100. [https://www.ipcc.ch/; https://climexp.knmi.nl].



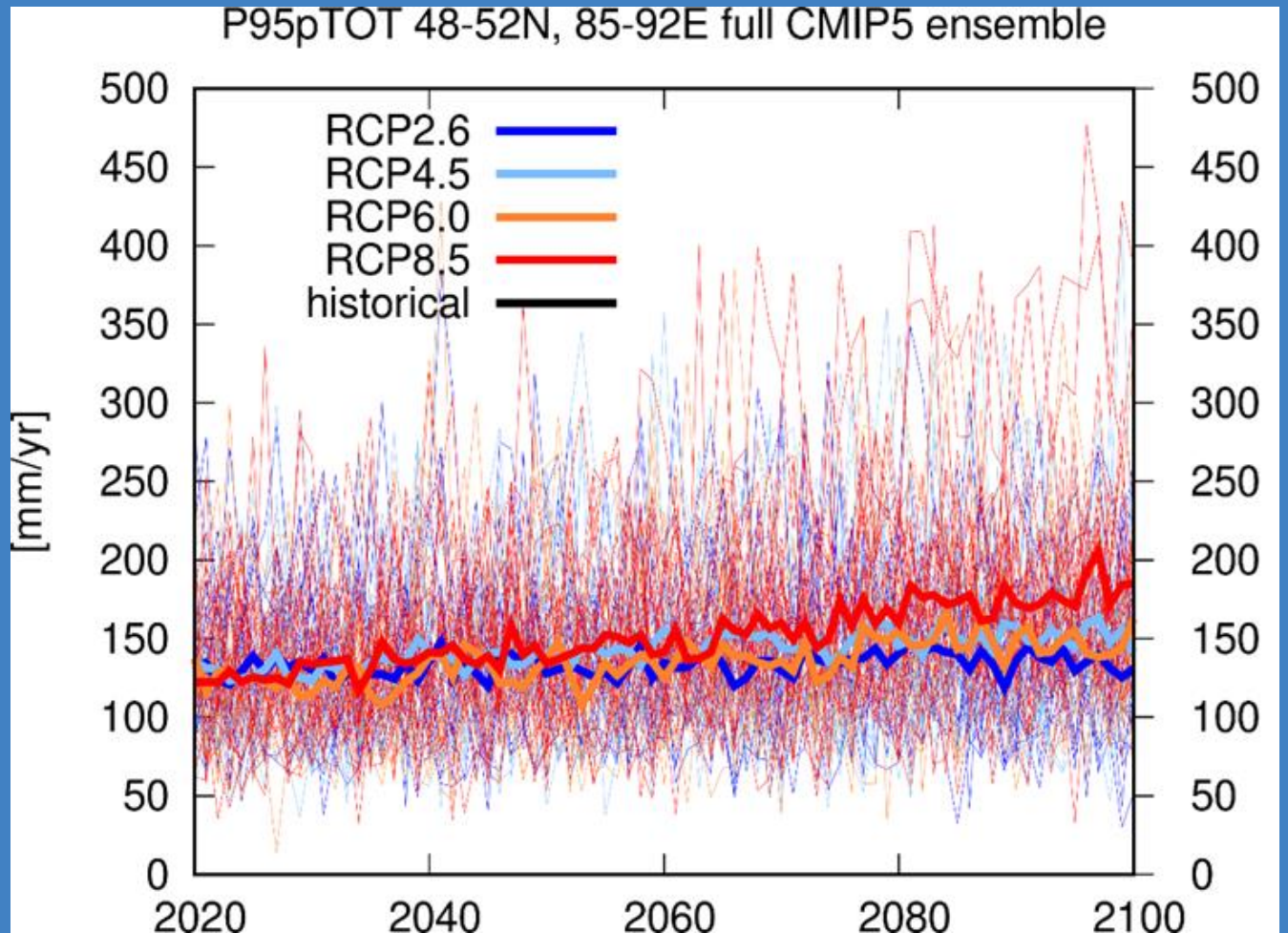
For the Fifth Assessment Report (AR5) of IPCC, the scientific community has defined a set of four new scenarios.

The CMIP5 simulations were performed with prescribed CO_2 concentrations reaching: 421 ppm (RCP2.6),538 ppm (RCP4.5), 670 ppm (RCP6.0) and 936 ppm (RCP 8.5) by the year 2100. [https://www.ipcc.ch/; https://climexp.knmi.nl].



For the Fifth Assessment Report (AR5) of IPCC, the scientific community has defined a set of four new scenarios.

The CMIP5 simulations were performed with prescribed CO_2 concentrations reaching: 421 ppm (RCP2.6),538 ppm (RCP4.5), 670 ppm (RCP6.0) and 936 ppm (RCP 8.5) by the year 2100. [https://www.ipcc.ch/; https://climexp.knmi.nl].



Conclusions

In Altai Mountains, by the end of the century, the temperature is projected to increase from 0.5^{0}C (RCP 2.6) to 5^{0}C (RCP 8.5), with no significant increase in precipitation (up to 0.2 mm for RCP 8.5), and the precipitation-evaporation rate will be the same. The temperature increase at RCP 8.5 to 5^{0}C will be by 2100 in Altai Mountains in the warmest daily and on warmest nights. But, the number of cold days and nights will decrease and the number of warm days and warm nights to 2100 for RCP 8.5 will increase by 40-45%. At the same time, the wettest day can increase by 5 mm/day at RCP 8.5 and daily intensity index will be an increase of almost 50 mm/year by 2100.

Thank you for attention!