The 20th century warming and projections for the 21st century climate in the region of the Ukrainian Antarctic station Akademik Vernadsky

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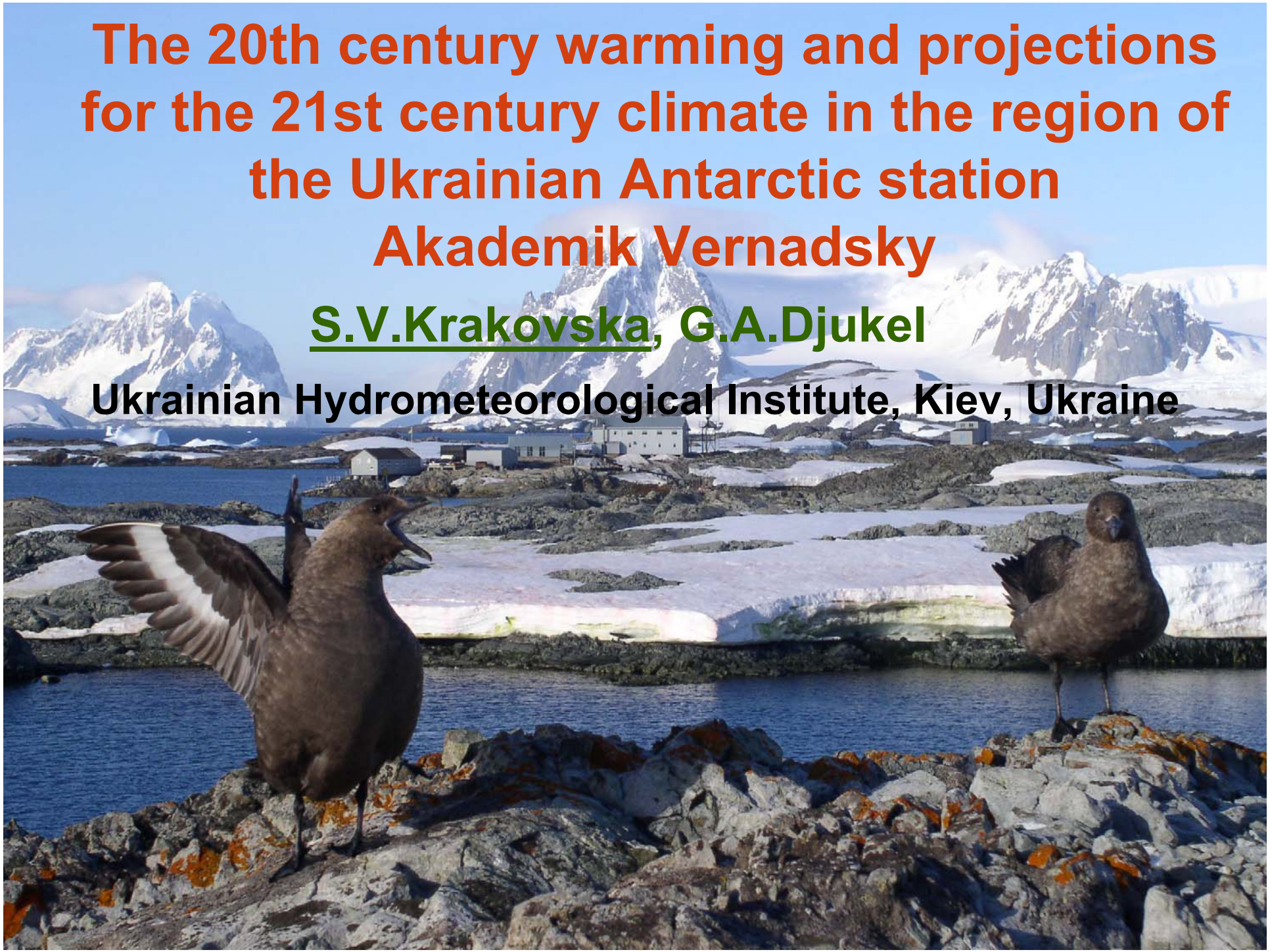


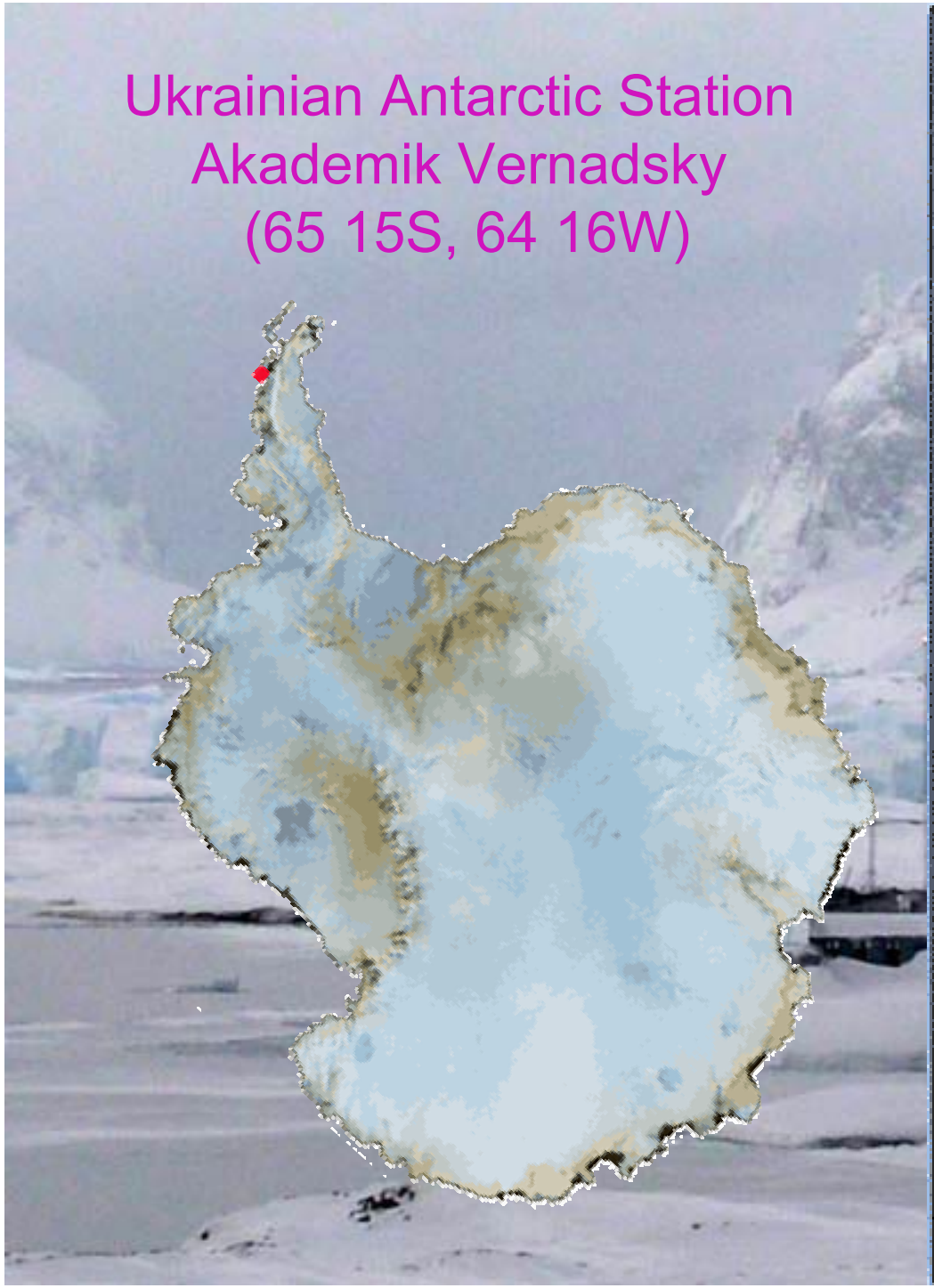
Objective:

- To demonstrate the ability of modern AOGCMs to represent the recent warming in the Antarctic Peninsula region where simulations of numerical models are not too much accurate.
- To analyze climate projection for the region at the different scenarios for the XXI century.

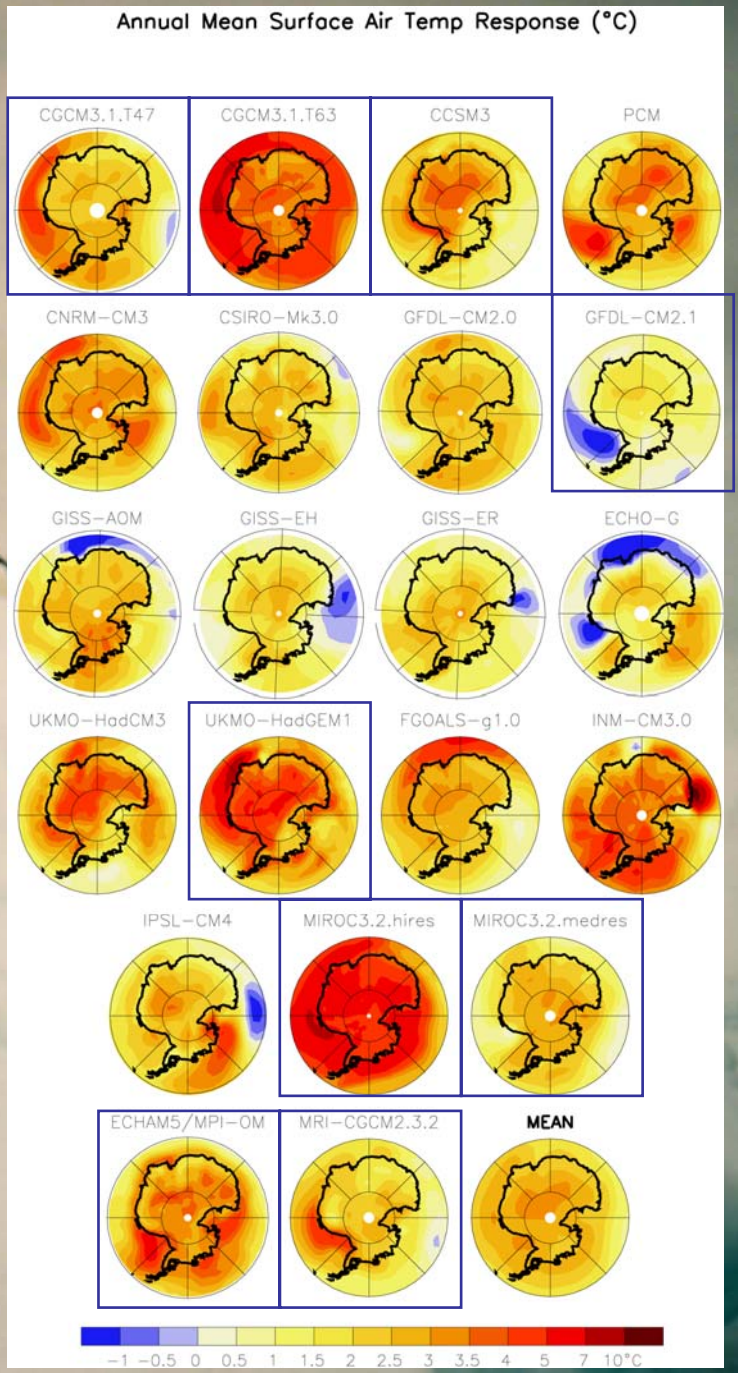
Methodology:

- A set of 10 AOGCMs with the highest complexity and resolution presented in the IPCC AR-4 (2007) were chosen.
- Model runs for the control 20th century (20c3m) experiments and three SRES scenarios (B1, A1B, F2) were used in the study. If a model had more than one run, an ensemble mean was obtained for such models.
- Yearly mean surface temperatures in four grid points 2x2 centered over the “Akad. Vernadsky” station were selected and averaged for every model. Then ensemble mean of all models was obtained and compared with observation data.

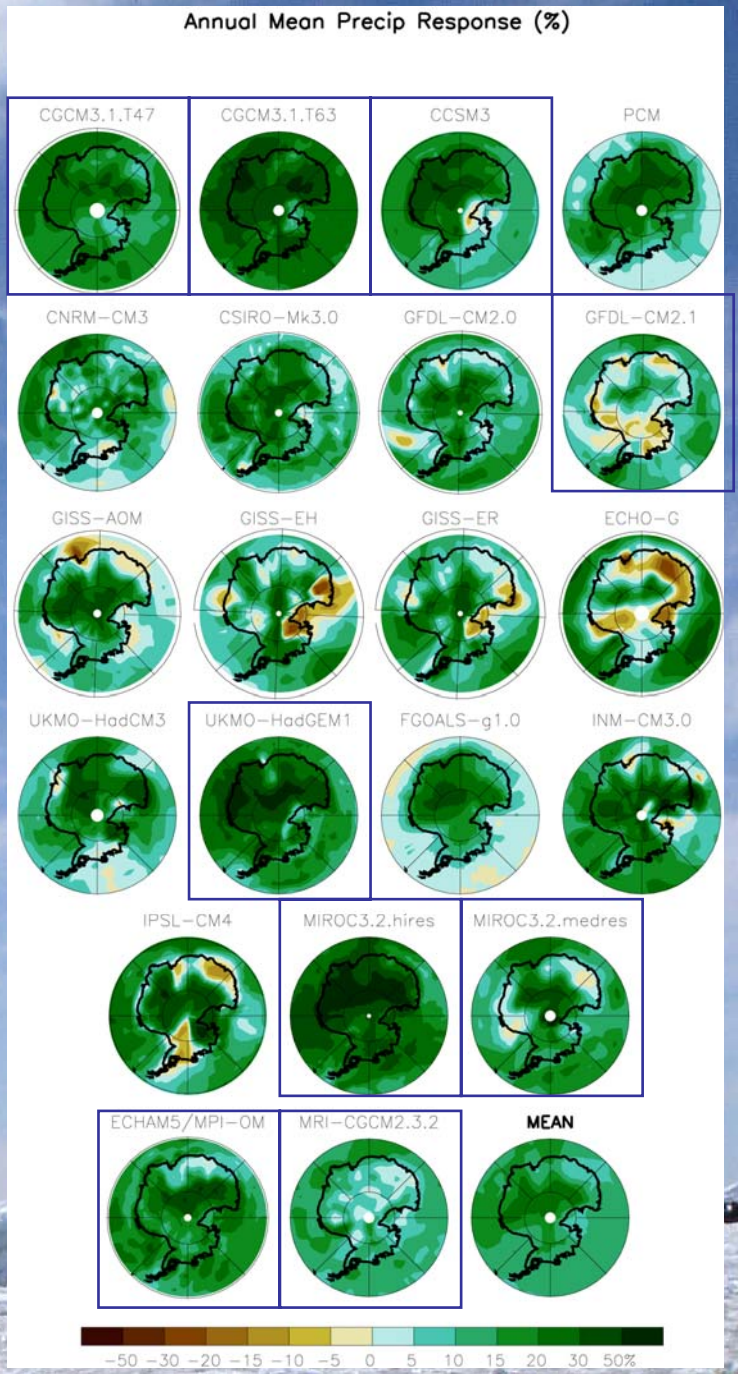
Ukrainian Antarctic Station
Akademik Vernadsky
(65 15S, 64 16W)



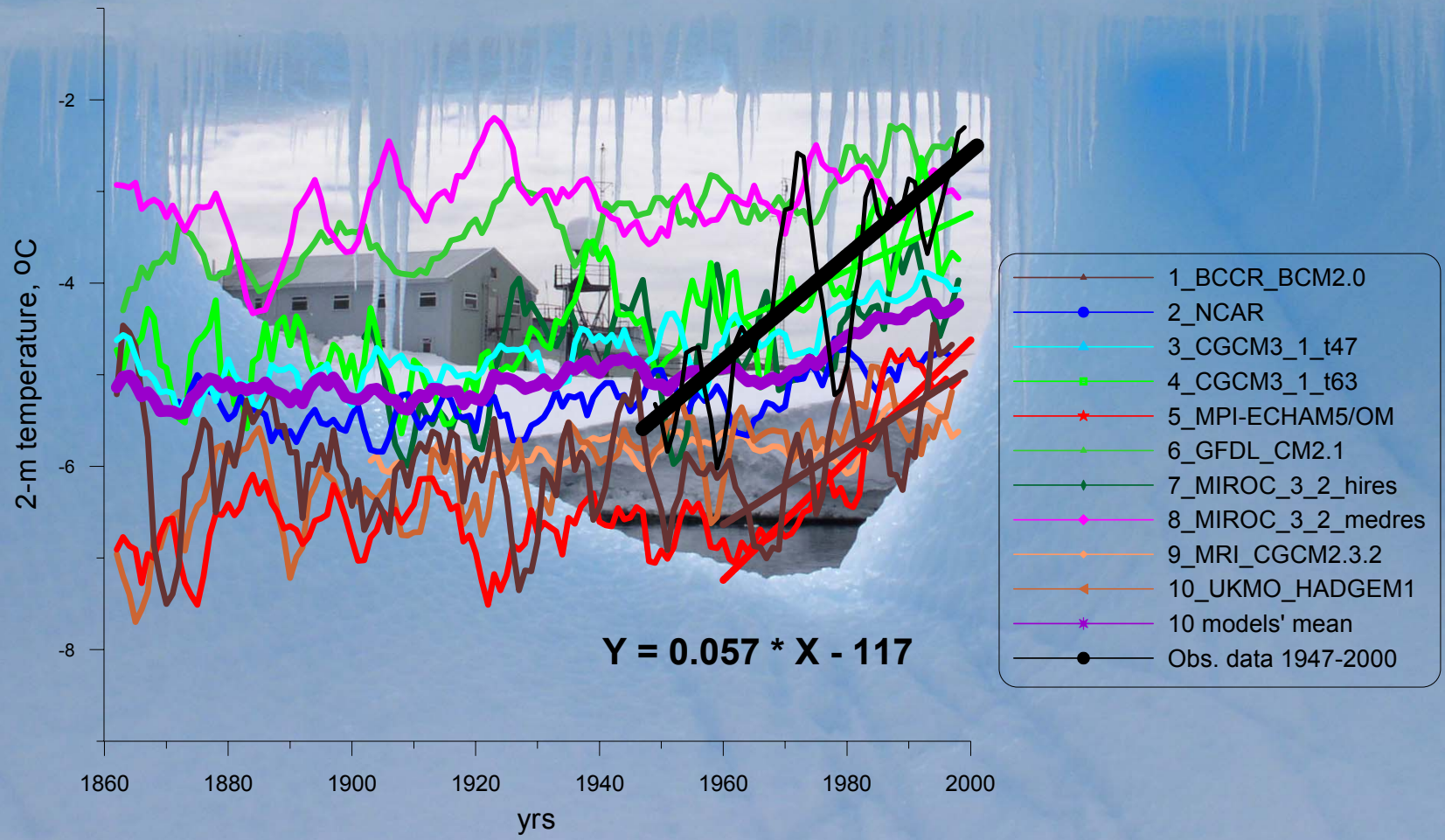
Model ID, Vintage	Sponsor, country	Atmosph. Top,resol.	Number of expe-rim. B1-A1B-A2
1: BCCR-BCM2.0, 2005	Bjerknes Centre for Climate Research, Norway	top = 25 hPa T63 (1.9°x1.9°) L16	1-1-1
2: NCAR-CCSM3, 2005	National Center for Atmospheric Research, USA	top = 2.2 hPa T85 (1.4°x1.4°) L26	9-7-4
3:CGCM3.1 (T47), 2005	Canadian Centre for Climate Modelling and Analysis, Canada	top = 1 hPa T47 (2.8°x2.8°) L31	5-5-5
4:CGCM3.1 (T63), 2005	Canadian Centre for Climate Modelling and Analysis, Canada	top = 1 hPa T63 (1.9°x1.9°) L31	1-1-0
5: ECHAM5 / MPI-OM, 2005	Max Planck Institute for Meteorology, Germany	top = 10 hPa T63 (1.9°x1.9°) L31	5-4-3



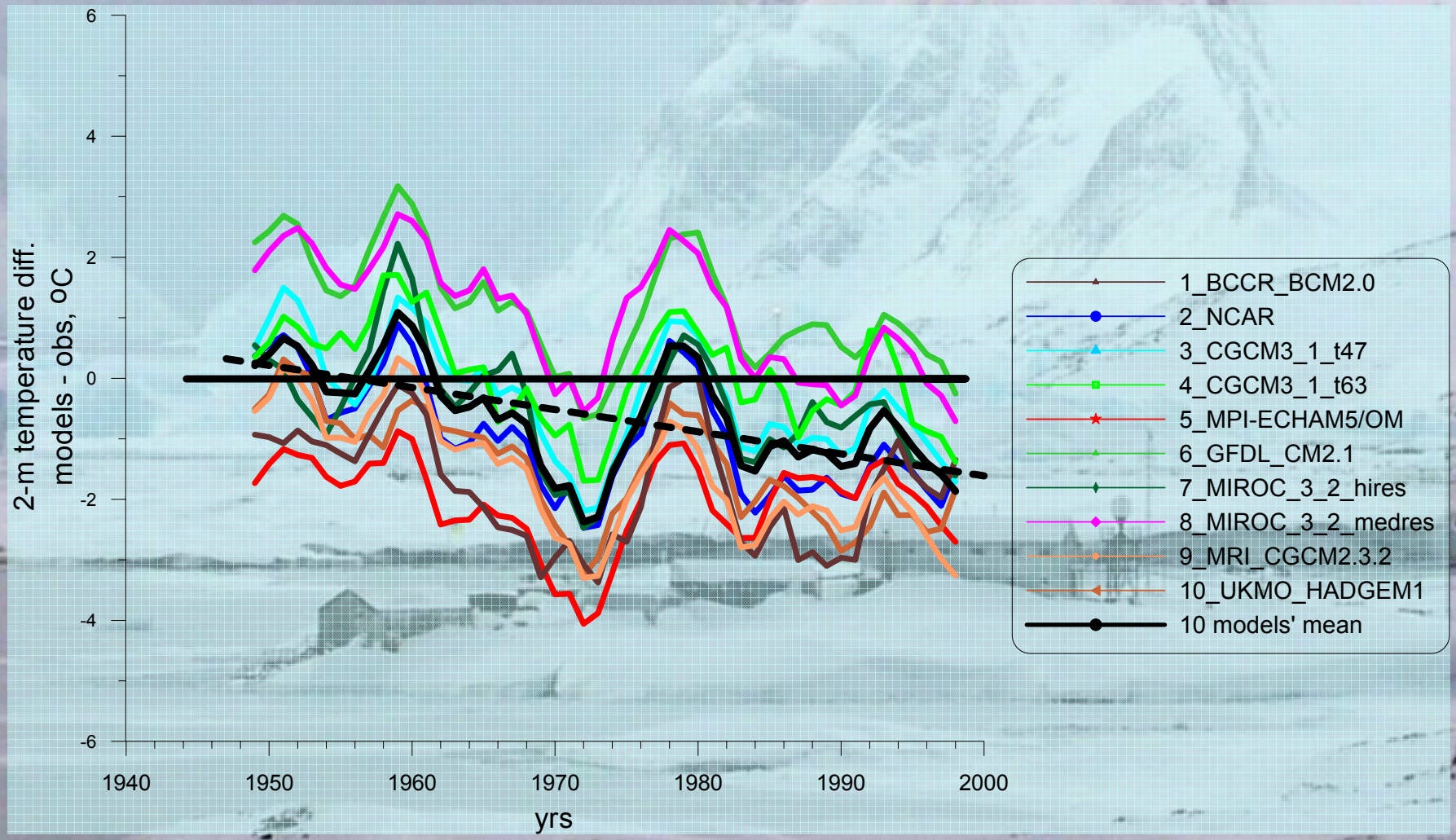
Model ID, Vintage	Sponsor, country	Atmosph. Top,resol.	Number of expe-rim. B1-A1B-A2
6: GFDL-CM2.1, 2005	U.S. Department of Commerce / NOAA / GFDL, USA	top = 3 hPa 2.0° x 2.5° L24	1-1-1
7: MIROC 3.2 (hires), 2004	Center for Climate System Research, National Institute for Environmental Studies, JAMSTEC, Japan	top = 40 km T106 (1.1°x1.1°) L56	1-1-0
8: MIROC 3.2(medres), 2004	JAMSTEC, Japan	top = 30 km T42 (2.8°x2.8°) L20	3-3-3
9: MRI-CGCM2.3.2, 2003	Meteorological Research Institute, Japan	top = 0.4 hPa T42 (2.8°x2.8°) L30	5-5-5
10: UKMO-HadGEM1, 2004	Hadley Centre for Climate Prediction and Research / Met Office, UK	top = 39.2 km (1.3°x1.9°) L38	1-1-1



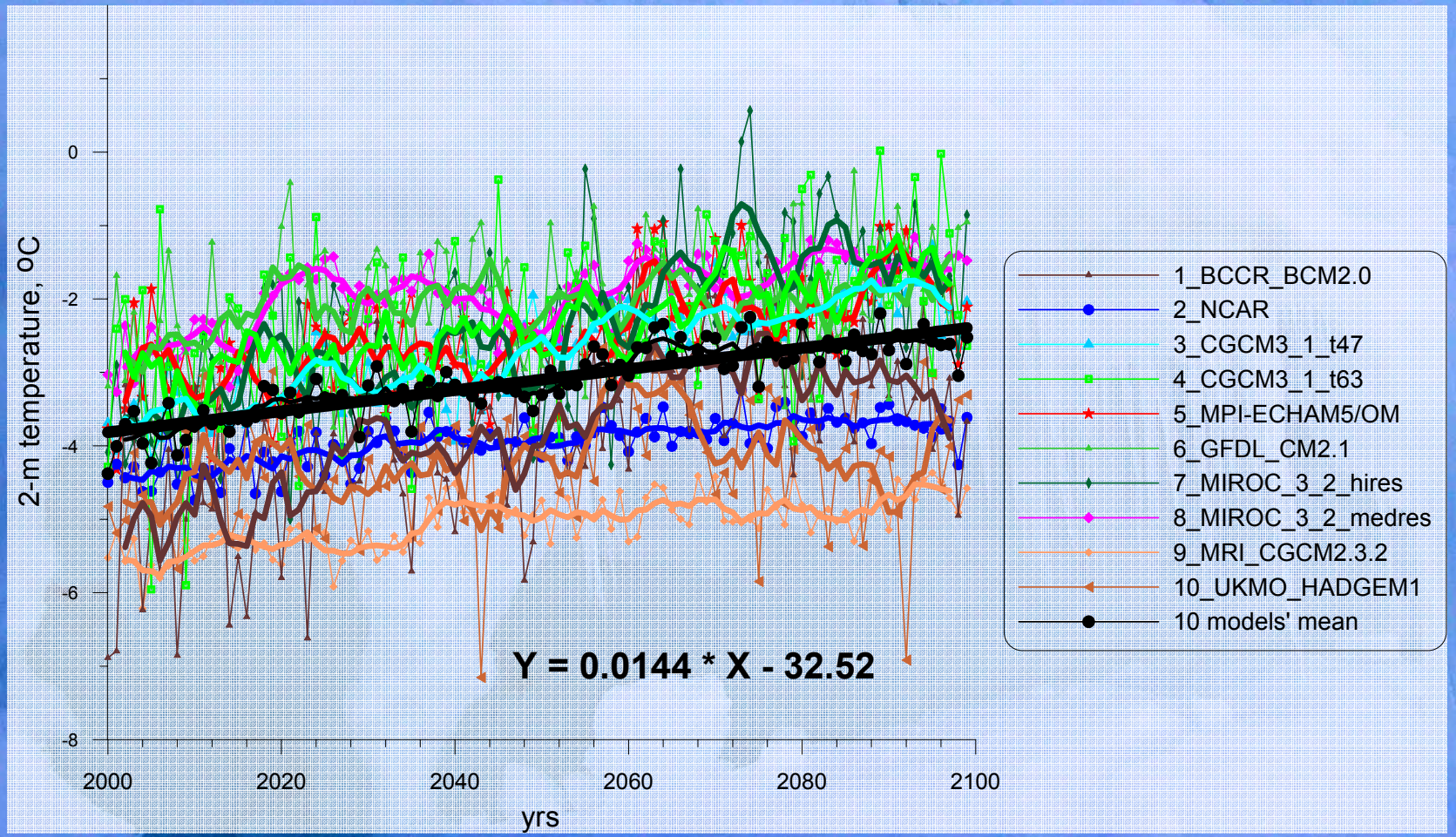
5-year running averages of temperature for 10 AOGCMs and data of observation at the Akademik Vernadsky station



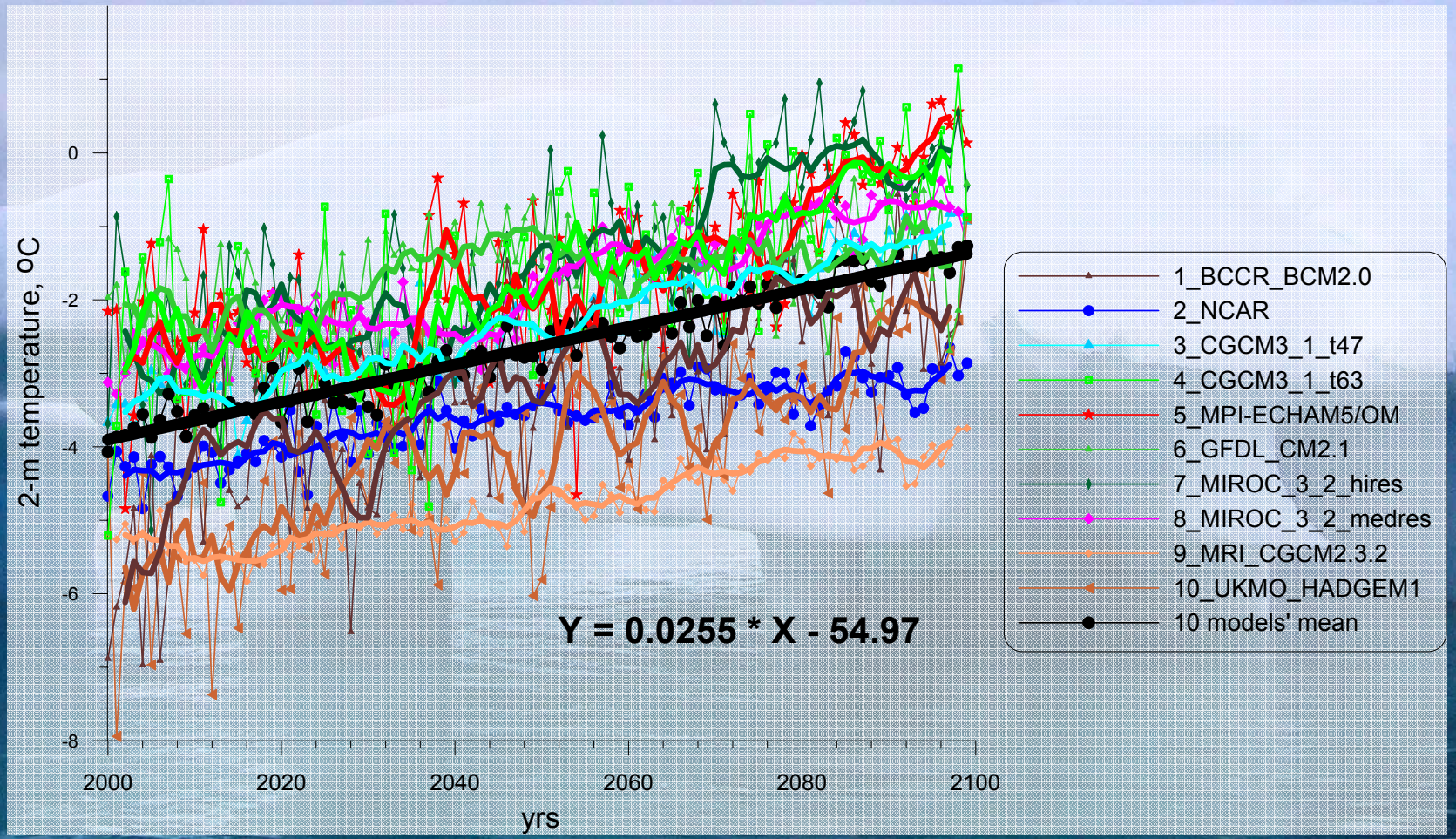
Temperature differences between year-mean model and observation data



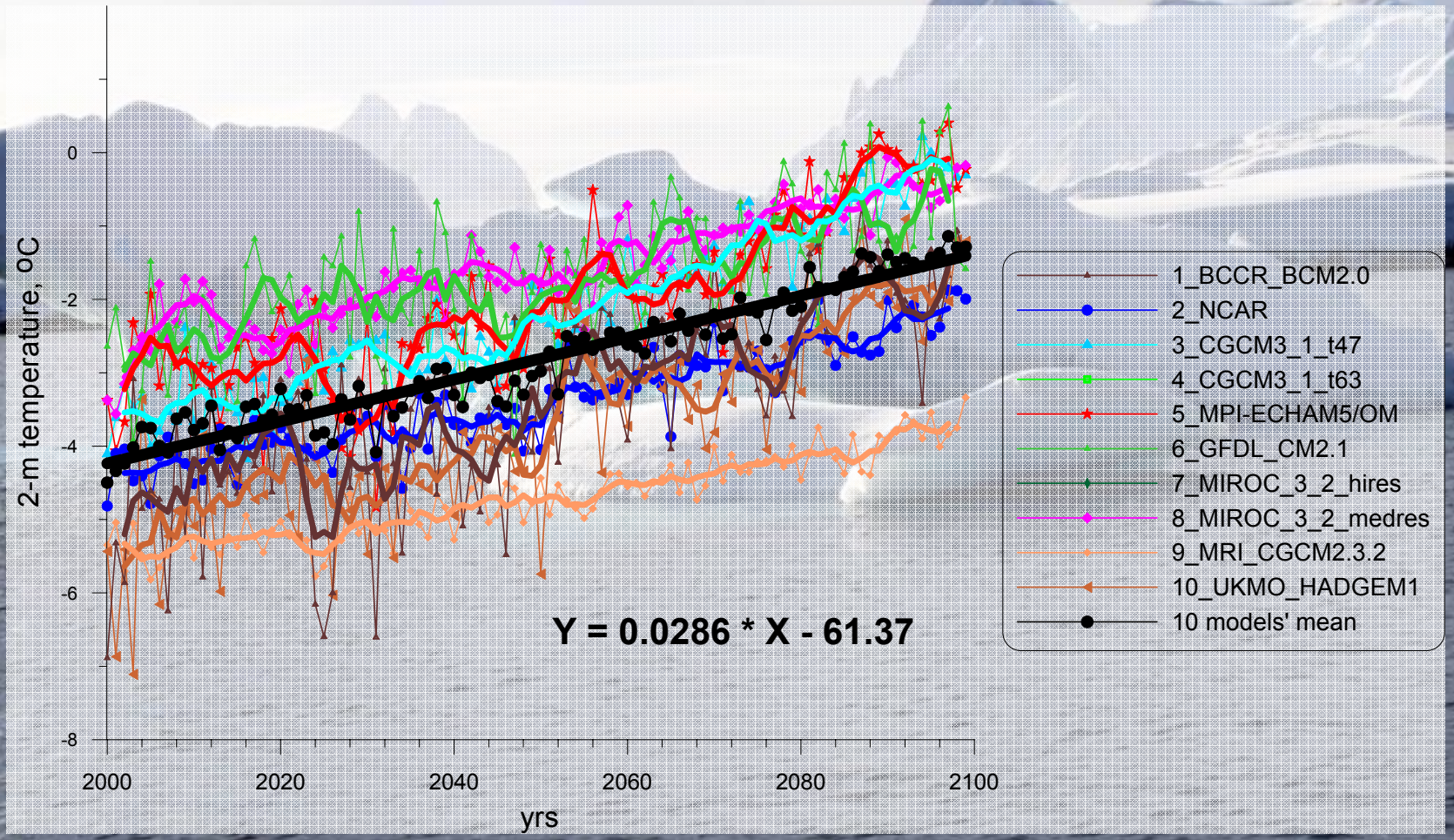
The 21st century projection (scenario B1) for the Akademik Vernadsky station region



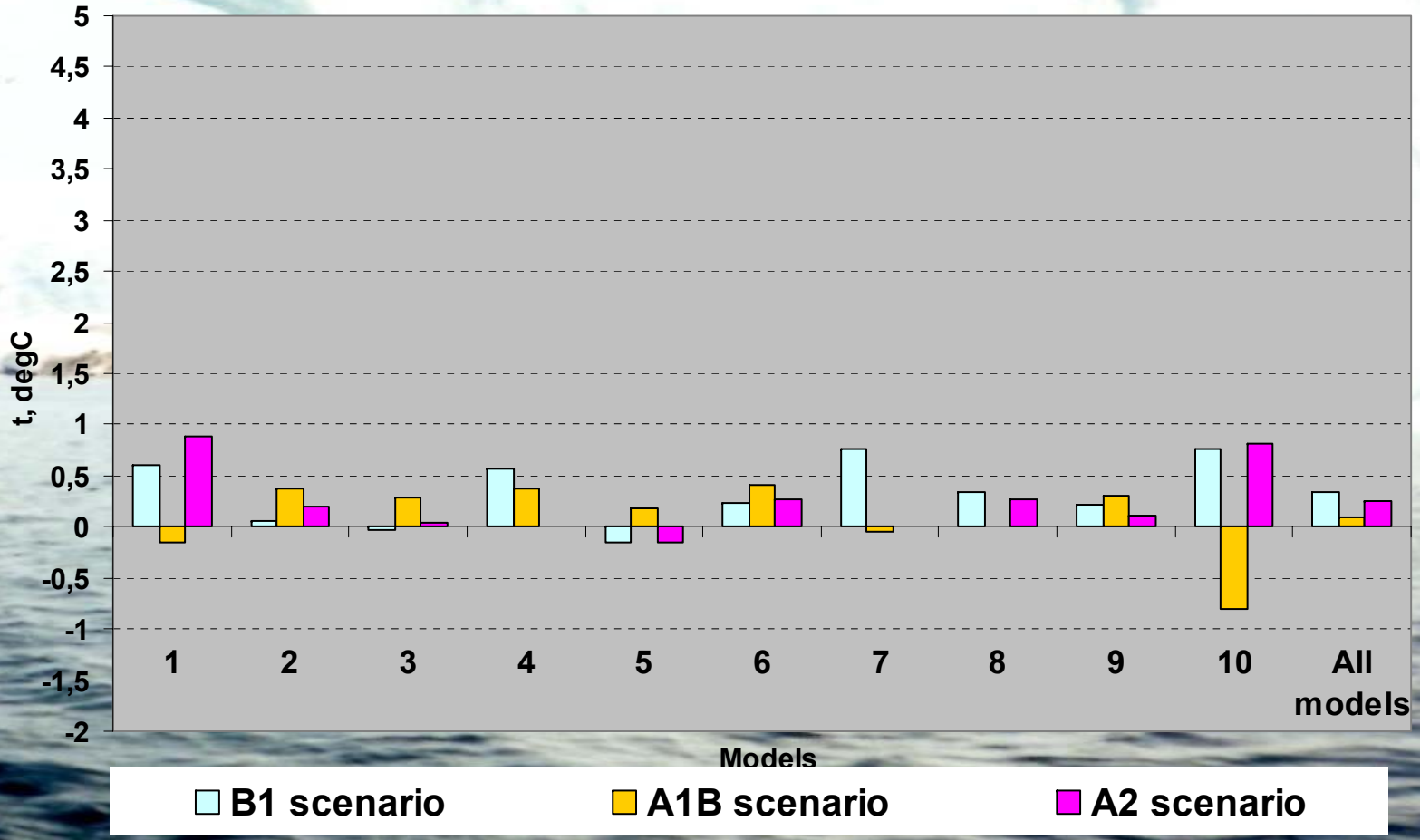
The 21st century projection (scenario A1B) for the Akademik Vernadsky station region



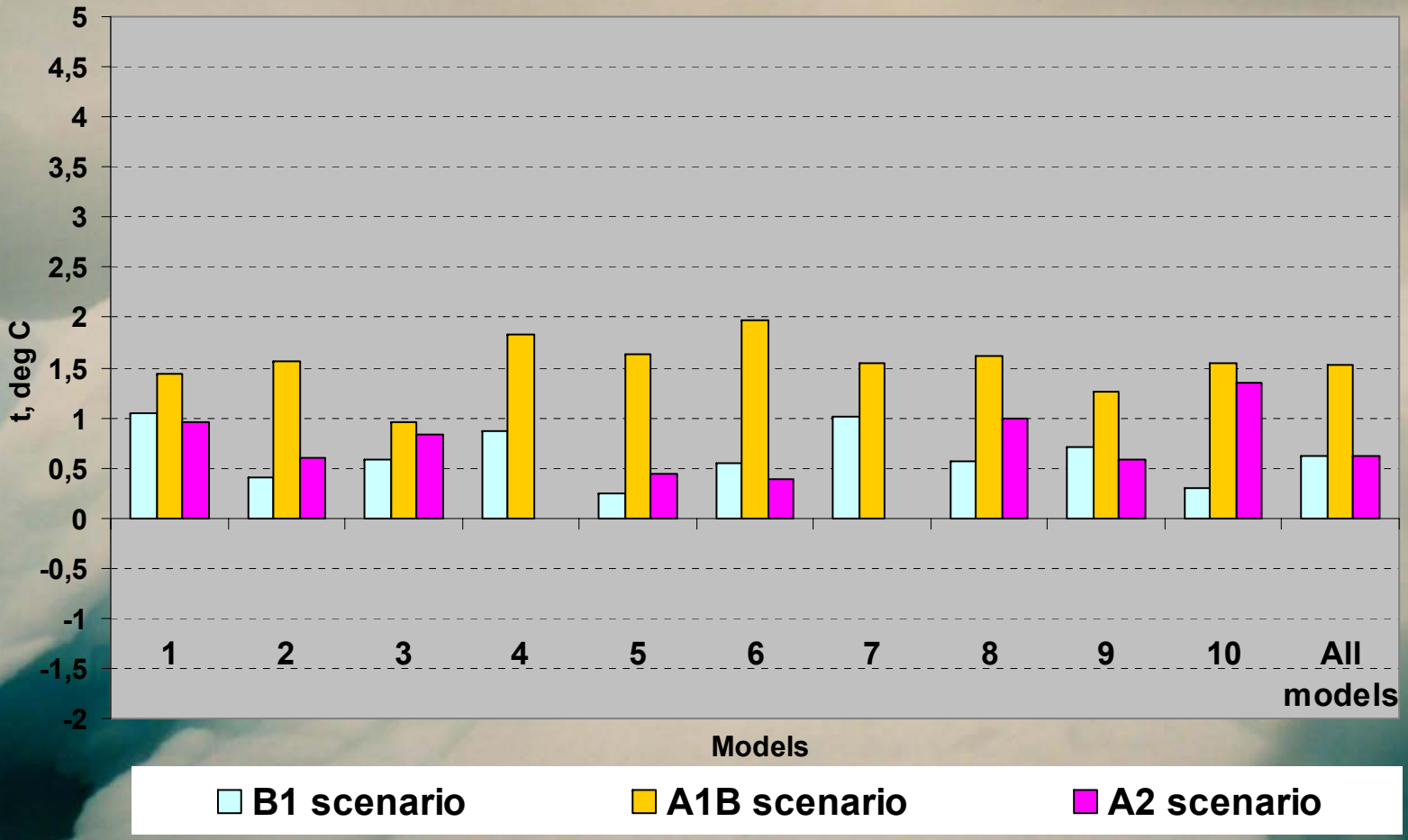
The 21st century projection (scenario A2) for the Akademik Vernadsky station region



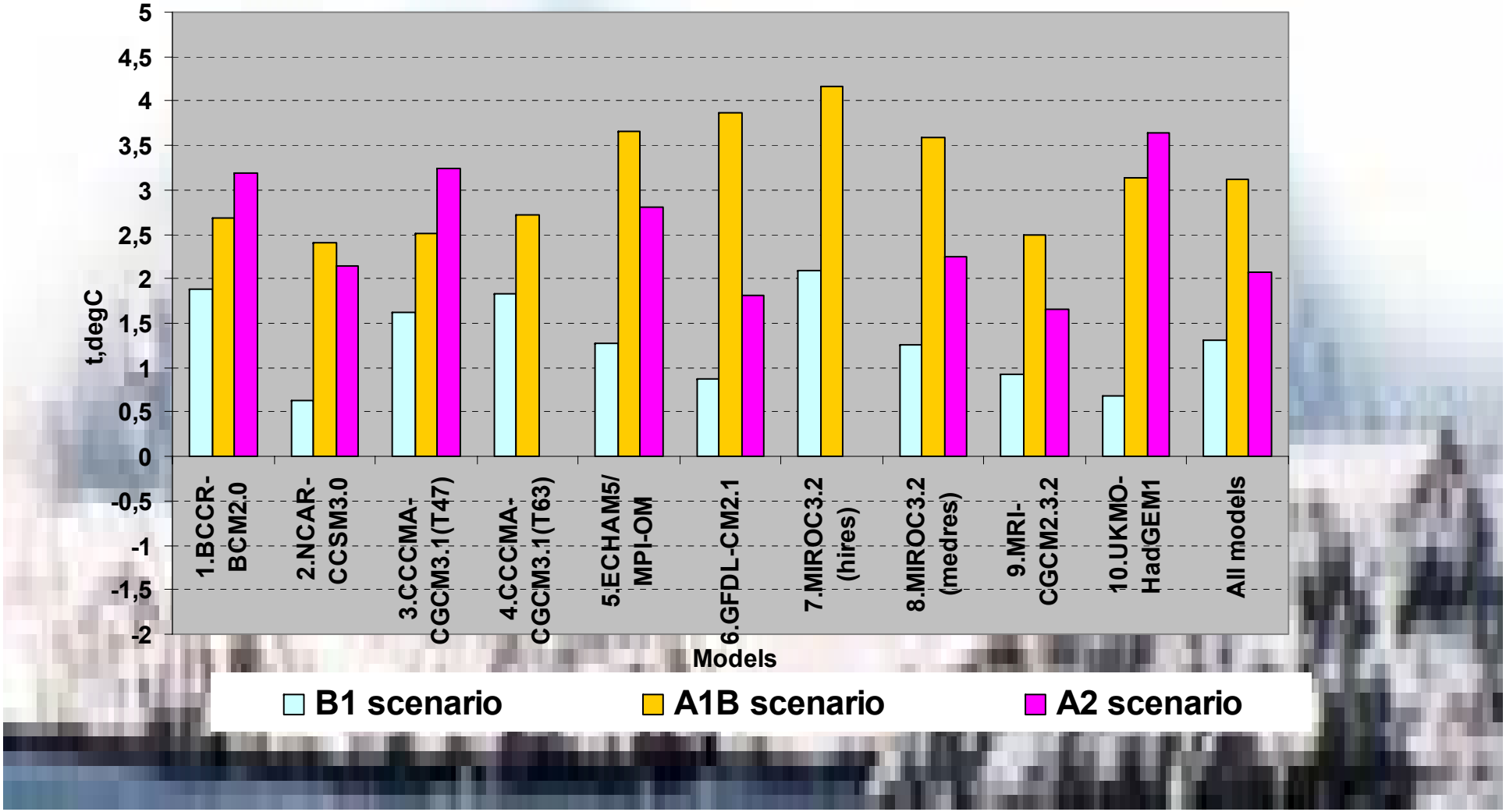
Projected 10-year mean air temperature differences (degC) of 2020-2029 and 2000-2009 at the Ukrainian Antarctic station Akademik Vernadsky



Projected 10-year mean air temperature differences (degC) of 2040-2049 and 2000-2009 at the Ukrainian Antarctic station Akademik Vernadsky



Projected 10-year mean air temperature differences (degC) of 2090-2099 and 2000-2009 at the Ukrainian Antarctic station Akademik Vernadsky



10-year mean temperature differences comparable to the 2000-2009 period

	10-years periods in the XXI century								
	2	3	4	5	6	7	8	9	10
B1 scenario									
Mean	0,3	0,5	0,7	0,6	0,9	1,3	1,2	1,3	1,3
σ	0,3	0,3	0,3	0,3	0,5	0,6	0,7	0,7	0,5
Min	-0,2	0,1	0,4	0,2	0,3	0,5	0,5	0,7	0,6
Max	0,8	1,1	1,5	1,0	1,9	2,5	2,5	2,4	2,1
A1B scenario									
Mean	0,1	0,5	1,0	1,5	1,9	2,3	2,6	2,8	3,1
σ	0,4	0,4	0,3	0,3	0,3	0,3	0,5	0,6	0,7
Min	-0,8	-0,2	0,4	1,0	1,5	1,8	1,6	2,2	2,4
Max	0,4	1,2	1,5	2,0	2,6	2,8	3,3	3,9	4,2
A2 scenario									
Mean	0,2	0,4	0,5	0,6	1,0	1,2	1,4	1,8	2,1
σ	0,4	0,3	0,3	0,3	0,5	0,5	0,5	0,8	0,7
Min	-0,1	-0,1	0,1	0,4	0,7	0,9	1,2	1,2	1,6
Max	0,9	0,9	0,9	1,4	2,2	2,2	2,4	3,3	3,6

CONCLUSIONS

- Ensemble of 10 AOGCMs has demonstrated a good ability to represent the recent warming at the Akademik Vernadsky region.
- At the same time, linear trends of just a few models (MPI-ECHAM5/OM, BCCR_BCM2.0 and CGCM3.1-t63) were close to the observed one since 1960, but an ensemble mean trend is twice less.
- The same fault is evident from the obtained temperature differences *models-obs*, when the models show less warmer climate than observed in the last decades of XXth century.
- Projections for the XXIth century show the same rate of warming for A1B and A2 scenarios as during 1960-2000 and almost twice less for B1 scenario, but the most warming is projected for A1B scenario.