Federal Service for Hydrometeorology and Environmental Monitoring

VOEIKOV MAIN GEOPHYSICAL OBSERVATORY

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ГЕОФИЗИЧЕСКАЯ
ОБСЕРВАТОРИЯ
им. А.И.ВОЕЙКОВА

APCC extending its scope over decadal through centennial time scales?

Vladimir Kattsov

APEC Climate Symposium 2010
23 June 2010, Busan, Korea

Roshydromet's First Assessment Report (2008)

ГЛАВНАЯ
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Projecting climate change in APEC economies

ГЛАВНАЯ ГЕОФИЗИЧЕСКАЯ ОБСЕРВАТОРИЯ им. А.И.ВОЕЙКОВА

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ГЛАВНАЯ ГЕОФИЗИЧЕСКАЯ ОБСЕРВАТОРИЯ им.А.И.ВОЕЙКОВА

CLIMATE CHANGE PROJECTIONS
IN APEC REGIONS AND ECONOMIES

Technical Report

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Saint Petersburg,
January 2010

Projecting climate change in APEC economies

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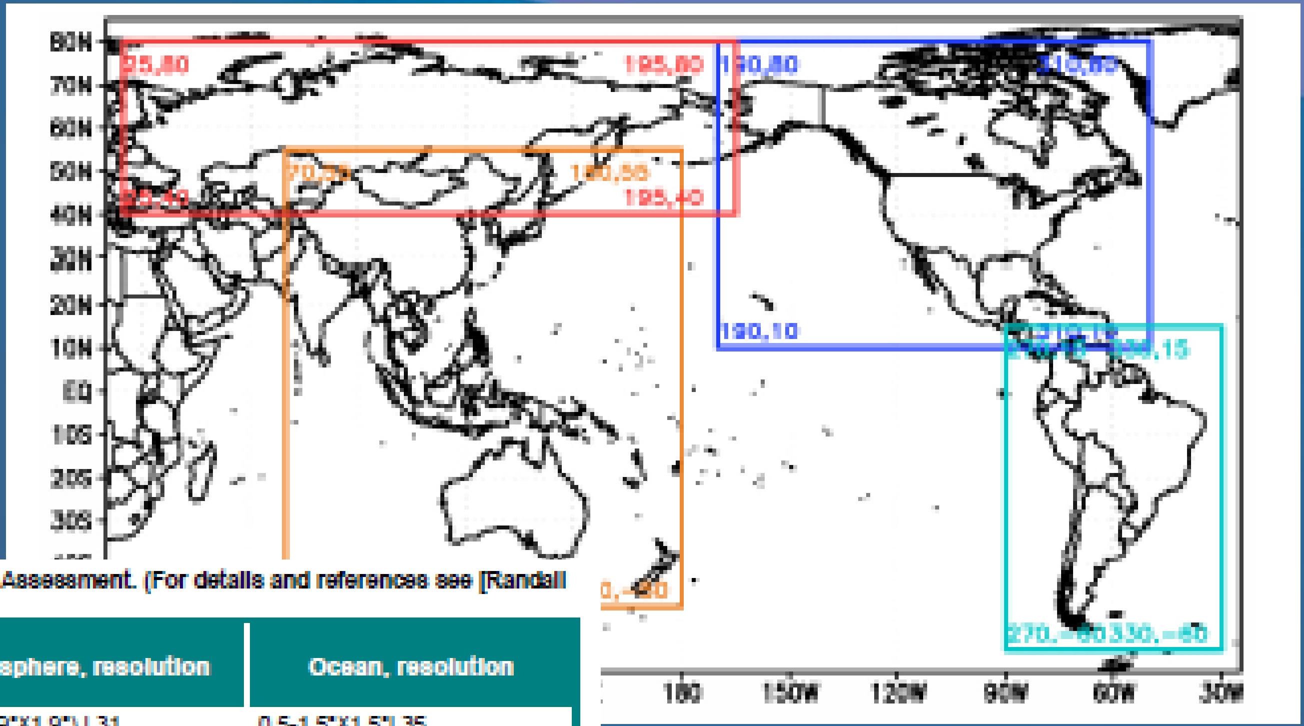

Table 1. A subset of CMIP3 models used in this Assessment. (For details and references see [Randall et al., 2007].)

Model ID, country, vintage	Atmosphere, resolution	Ocean, resolution
BCCR-BCM2.0, Norway, 2005	T63 (~1.9°×1.9°) L31	0.5-1.5°×1.5°L35
CCSM3, USA, 2005	T85 (~1.4°×1.4°) L26	0.3-1°×1°L40
CGCM3.1(T47), Canada, 2005	T47 (~2.8°×2.8°) L31	1.9°×1.9°L29
CNRM-CM3, France, 2004	T63 (~1.9°×1.9°) L45	0.5-2°×2°L31
CSIRO-Mk3.0, Australia, 2001	T63 (~1.9°×1.9°) L18	0.8°×1.9°L31
ECHAM5/MPI-OM, Germany, 2005	T63 (~1.9°×1.9°) L31	1.5°×1.5°L40
ECHO-G, Geramany/Korea, 1999	T30 (~3.9°×3.9°) L19	0.5-2.8°×2.8°L20
GFDL-CM2.0, USA, 2005	2.0°×2.5°L24	0.3-1.0°×1.0°L20
GFDL-CM2.1, USA, 2005	2.0°×2.5°L24	0.3-1.0°×1.0°L20
INM-CM3.0, Russia, 2004	4°×5°L21	2°×2.5°L33
IPSL-CM4, France, 2004	2.5°×3.75°L19	1-2°×2°L31
MIROC3.2 (medres), Japan, 2004	T42 (~2.8°×2.8°) L20	0.5-1.4°×1.4°L44
MRI-CGCM2.3.2, Japan, 2003	T42 (~2.8°×2.8°) L30	0.5-2.0°×2.5°L23
PCM, USA, 1998	T42 (~2.8°×2.8°) L26	0.5-0.7°×1.1°L40
UKMO-HadCM3, UK, 1997	2.5°×3.8°L19	1.5°×1.5°L20
UKMO-HadGEM1, UK, 2004	1.3°×1.9°L38	0.3-1.0°×1.0°L40

SAT changes (different time slices/scenarios) in APEC economies

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Table 2. Annual mean surface air temperature changes (°C) by early, mid- and late 21st century for B1 (15 models), A1B (16 models), and A2 (16 models) scenarios. Standard deviations given as lower indices provide a measure of inter-model scatter.

Time slice	2011-2030			2041-2060			2080-2099		
Region/ economy	B1	A1B	A2	B1	A1B	A2	B1	A1B	A2
Australia	$0.7_{\pm0.3}$	$0.7_{\pm0.3}$	$0.7_{\pm0.2}$	$1.3_{\pm0.2}$	$1.7_{\pm0.4}$	$1.7_{\pm0.4}$	$2.0_{\pm0.4}$	$3.0_{\pm0.4}$	$3.7_{\pm0.5}$
West Australia	$0.8_{\pm0.3}$	$0.7_{\pm0.3}$	$0.7_{\pm0.2}$	$1.3_{\pm0.2}$	$1.8_{\pm0.4}$	$1.7_{\pm0.4}$	$2.0_{\pm0.4}$	$3.1_{\pm0.5}$	$3.9_{\pm0.6}$
East Australia	$0.7_{\pm0.3}$	0.7	0.7	1.3	1.7	1.6	1.9	2.8	3.5
Brunei Darussalam, Malaysia, Singapore	$0.6_{\pm0.2}$	0.6							
Canada	$1.1_{\pm0.6}$	1.1							
North Canada	$1.2_{\pm0.7}$	1.2							
West Canada	$0.9_{\pm0.7}$	0.9							
East Canada	$1.1_{\pm0.6}$	1.2							
Chile	$0.6_{\pm0.2}$	0.6							
North Chile	$0.7_{\pm0.2}$	0.8							
South Chile	$0.5_{\pm0.2}$	0.5							
China	$0.9_{\pm0.3}$	0.9							
NW China	$1.0_{\pm0.4}$	1.0							
NE China	$1.0_{\pm0.4}$	0.9							
SW China	$0.9_{\pm0.3}$	0.9							
SE China (incl. Hong Kong)	$0.8_{\pm0.3}$	0.7							
Indonesia	$0.6_{\pm0.1}$	0.6							
Japan	$0.9_{\pm0.3}$	0.8							
Korea	$0.9_{\pm0.3}$	0.7							

Continuation

Table 2. Annual mean surface air temperature changes (°C) by early, mid- and late 21st century for B1 (15 models), A1B (16 models), and A2 (16 models) scenarios. Standard deviations given as lower indices provide a measure of inter-model scatter.

Time slice	2011-2030			2041-2060			2080-2099		
Region/ economy	B1	A1B	A2	B1	A1B	A2	B1	A1B	A2
Mexico	$0.8_{\pm0.2}$	$0.8_{\pm0.3}$	$0.8_{\pm0.2}$	$1.4_{\pm0.3}$	$2.0_{\pm0.4}$	$1.8_{\pm0.3}$	$2.1_{\pm0.5}$	$3.2_{\pm0.7}$	$4.0_{\pm0.8}$
New Zealand	$0.5_{\pm0.3}$	$0.6_{\pm0.2}$	$0.6_{\pm0.2}$	$0.9_{\pm0.2}$	$1.3_{\pm0.3}$	$1.3_{\pm0.2}$	$1.5_{\pm0.3}$	$2.1_{\pm0.4}$	$2.7_{\pm0.4}$
Papua New Guinea	$0.6_{\pm0.2}$	$0.6_{\pm0.1}$	$0.6_{\pm0.1}$	$1.0_{\pm0.2}$	$1.4_{\pm0.2}$	$1.4_{\pm0.2}$	$1.5_{\pm0.3}$	$2.4_{\pm0.5}$	$3.0_{\pm0.5}$
Peru	$0.8_{\pm0.2}$	$0.8_{\pm0.2}$	$0.8_{\pm0.2}$	$1.4_{\pm0.3}$	$1.9_{\pm0.4}$	$1.8_{\pm0.3}$	$2.1_{\pm0.5}$	$3.3_{\pm0.8}$	$4.0_{\pm0.8}$
Philippines	$0.5_{\pm0.2}$	$0.6_{\pm0.1}$	$0.5_{\pm0.1}$	$1.0_{\pm0.2}$	$1.3_{\pm0.2}$	$1.3_{\pm0.2}$	$1.5_{\pm0.3}$	$2.3_{\pm0.4}$	$2.8_{\pm0.4}$
RF	$1.2_{\pm0.4}$	$1.1_{\pm0.5}$	$1.1_{\pm0.5}$	$2.1_{\pm0.6}$	$2.9_{\pm0.7}$	$2.6_{\pm0.7}$	$3.0_{\pm0.9}$	$4.7_{\pm1.1}$	$5.6_{\pm1.2}$
Eurpean RF	$1.2_{\pm0.4}$	$1.1_{\pm0.7}$	$1.0_{\pm0.5}$	$2.1_{\pm0.7}$	$2.7_{\pm0.7}$	$2.5_{\pm0.7}$	$2.9_{\pm1.1}$	$4.3_{\pm1.1}$	$5.1_{\pm1.2}$
West Siberia	$1.2_{\pm0.4}$	$1.1_{\pm0.5}$	$1.2_{\pm0.5}$	$2.1_{\pm0.7}$	$3.0_{\pm0.8}$	$2.6_{\pm0.7}$	$3.0_{\pm0.9}$	$4.8_{\pm1.2}$	$5.7_{\pm1.3}$
East Siberia	$1.2_{\pm0.5}$	$1.1_{\pm0.5}$	$1.2_{\pm0.5}$	$2.1_{\pm0.6}$	$2.9_{\pm0.7}$	$2.6_{\pm0.7}$	$3.0_{\pm0.8}$	$4.7_{\pm1.2}$	$5.7_{\pm1.2}$
Chinese Taipei	$0.6_{\pm0.2}$	$0.6_{\pm0.2}$	$0.5_{\pm0.2}$	$1.0_{\pm0.2}$	$1.4_{\pm0.3}$	$1.3_{\pm0.2}$	$1.5_{\pm0.3}$	$2.4_{\pm0.4}$	$2.7_{\pm0.4}$
Thailand	$0.6_{\pm0.2}$	$0.6_{\pm0.2}$	$0.6_{\pm0.2}$	$1.2_{\pm0.2}$	$1.6_{\pm0.3}$	$1.5_{\pm0.3}$	$1.8_{\pm0.4}$	$2.8_{\pm0.5}$	$3.3_{\pm0.5}$
USA (excl. Alaska)	$1.0_{\pm0.3}$	$1.0_{\pm0.3}$	$0.9_{\pm0.3}$	$1.7_{\pm0.4}$	$2.3_{\pm0.5}$	$2.2_{\pm0.5}$	$2.5_{\pm0.6}$	$3.7_{\pm0.9}$	$4.5_{\pm1.0}$
West USA	$1.0_{\pm0.4}$	$1.0_{\pm0.3}$	$0.9_{\pm0.3}$	$1.6_{\pm0.4}$	$2.3_{\pm0.5}$	$2.1_{\pm0.6}$	$2.5_{\pm0.7}$	$3.7_{\pm0.9}$	$4.4_{\pm1.0}$
Centre USA	$1.1_{\pm0.3}$	$1.0_{\pm0.3}$	$1.0_{\pm0.3}$	$1.7_{\pm0.4}$	$2.5_{\pm0.6}$	$2.2_{\pm0.5}$	$2.5_{\pm0.6}$	$3.9_{\pm0.9}$	$4.7_{\pm1.1}$
East USA	$1.0_{\pm0.3}$	$1.0_{\pm0.3}$	$0.9_{\pm0.3}$	$1.6_{\pm0.3}$	$2.3_{\pm0.5}$	$2.1_{\pm0.5}$	$2.4_{\pm0.5}$	$3.6_{\pm0.8}$	$4.4_{\pm1.0}$
Alaska	$1.0_{\pm0.7}$	$1.0_{\pm0.5}$	$0.9_{\pm0.7}$	$1.9_{\pm0.6}$	$2.6_{\pm0.7}$	$2.2_{\pm0.6}$	$2.8_{\pm0.8}$	$4.4_{\pm1.3}$	$5.1_{\pm1.3}$
Vietnam	$0.6_{\pm0.3}$	$0.6_{\pm0.2}$	$0.5_{\pm0.3}$	$1.2_{\pm0.3}$	$1.5_{\pm0.3}$	$1.4_{\pm0.3}$	$1.7_{\pm0.4}$	$2.7_{\pm0.6}$	$3.2_{\pm0.6}$

SAT changes (A2, different seasons) in APEC economies

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Table 3c. Seasonal surface air temperature changes (°C) by early, mid- and late 21st century for A2 scenario (16 models). Standard deviations given as lower indices provide a measure of inter-model scatter.

Time slice	2011-2030				2041-2060				2080-2099			
Region/ Economy	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Australia	$0.7_{\pm0.3}$	$0.7_{\pm0.3}$	$0.7_{\pm0.2}$	$0.8_{\pm0.3}$	$1.6_{\pm0.4}$	$1.6_{\pm0.4}$	$1.6_{\pm0.4}$	$1.7_{\pm0.4}$	$3.7_{\pm0.7}$	$3.6_{\pm0.6}$	$3.5_{\pm0.7}$	$3.9_{\pm0.5}$
West Australia	$0.7_{\pm0.3}$	$0.7_{\pm0.3}$	$0.7_{\pm0.3}$	$0.8_{\pm0.3}$	$1.7_{\pm0.4}$	$1.7_{\pm0.4}$	$1.7_{\pm0.4}$	$1.8_{\pm0.4}$	$3.8_{\pm0.7}$	$3.8_{\pm0.6}$	$3.7_{\pm0.7}$	$4.1_{\pm0.5}$
East Australia	$0.7_{\pm0.3}$	$0.7_{\pm0.2}$	$0.7_{\pm0.2}$	$0.7_{\pm0.3}$	$1.6_{\pm0.4}$	$1.6_{\pm0.4}$	$1.6_{\pm0.4}$	$1.7_{\pm0.4}$	$3.6_{\pm0.7}$	$3.5_{\pm0.5}$	$3.4_{\pm0.7}$	$3.7_{\pm0.5}$
Brunei Darussalam, Malaysia, Singapore	$0.5_{\pm0.2}$	$0.6_{\pm0.2}$	$0.6_{\pm0.2}$	$0.6_{\pm0.1}$	$1.3_{\pm0.2}$	$1.4_{\pm0.3}$	$1.4_{\pm0.3}$	$1.3_{\pm0.3}$	$2.9_{\pm0.5}$	$3.1_{\pm0.5}$	$3.0_{\pm0.5}$	$2.9_{\pm0.4}$
Canada	$1.3_{\pm0.7}$	$0.8_{\pm0.3}$	$0.7_{\pm0.4}$	$1.0_{\pm0.4}$								
North Canada	$1.4_{\pm0.8}$	$0.9_{\pm0.6}$	$0.7_{\pm0.5}$	$1.3_{\pm0.7}$								
West Canada	$0.9_{\pm1.0}$	$0.5_{\pm0.4}$	$0.7_{\pm0.3}$	$0.7_{\pm0.4}$								
East Canada	$1.5_{\pm0.6}$	$0.9_{\pm0.4}$	$0.8_{\pm0.4}$	$1.0_{\pm0.4}$								
Chile	$0.6_{\pm0.2}$	$0.6_{\pm0.2}$	$0.6_{\pm0.2}$	$0.6_{\pm0.1}$								
North Chile	$0.7_{\pm0.3}$	$0.7_{\pm0.3}$	$0.7_{\pm0.3}$	$0.7_{\pm0.1}$								
South Chile	$0.5_{\pm0.2}$	$0.5_{\pm0.2}$	$0.4_{\pm0.2}$	$0.5_{\pm0.1}$								
China	$1.1_{\pm0.4}$	$1.0_{\pm0.2}$	$0.8_{\pm0.3}$	$0.9_{\pm0.4}$								
NW China	$1.2_{\pm0.7}$	$1.1_{\pm0.4}$	$1.1_{\pm0.4}$	$1.0_{\pm0.5}$								
NE China	$1.3_{\pm0.5}$	$1.0_{\pm0.4}$	$0.8_{\pm0.4}$	$1.0_{\pm0.5}$								
SW China	$1.0_{\pm0.4}$	$0.9_{\pm0.3}$	$0.8_{\pm0.3}$	$0.8_{\pm0.4}$								
SE China (incl. Hong Kong)	$0.9_{\pm0.6}$	$0.9_{\pm0.3}$	$0.7_{\pm0.3}$	$0.7_{\pm0.4}$								
Indonesia	$0.5_{\pm0.1}$	$0.6_{\pm0.2}$	$0.6_{\pm0.1}$	$0.6_{\pm0.2}$								
Japan	$1.0_{\pm0.3}$	$0.9_{\pm0.3}$	$0.7_{\pm0.3}$	$0.8_{\pm0.4}$								

Continuation

Table 3c. Seasonal surface air temperature changes (°C) by early, mid- and late 21st century for A2 scenario (16 models). Standard deviations given as lower indices provide a measure of inter-model scatter.

Time slice	2011-2030				2041-2060				2080-2099			
Region/ Economy	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Korea	$1.1_{\pm0.5}$	$0.9_{\pm0.3}$	$0.7_{\pm0.3}$	$0.8_{\pm0.5}$	$2.1_{\pm0.5}$	$1.8_{\pm0.4}$	$1.6_{\pm0.4}$	$1.7_{\pm0.5}$	$4.2_{\pm0.9}$	$3.6_{\pm0.6}$	$3.6_{\pm0.7}$	$3.7_{\pm0.7}$
Mexico	$0.7_{\pm0.3}$	$0.9_{\pm0.2}$	$0.8_{\pm0.2}$	$0.8_{\pm0.3}$	$1.7_{\pm0.5}$	$2.0_{\pm0.3}$	$1.9_{\pm0.4}$	$1.9_{\pm0.4}$	$3.6_{\pm0.9}$	$4.3_{\pm0.7}$	$4.1_{\pm0.8}$	$4.0_{\pm0.8}$
New Zealand	$0.7_{\pm0.3}$	$0.7_{\pm0.2}$	$0.5_{\pm0.2}$	$0.5_{\pm0.2}$	$1.4_{\pm0.4}$	$1.4_{\pm0.3}$	$1.2_{\pm0.2}$	$1.1_{\pm0.3}$	$2.8_{\pm0.6}$	$2.8_{\pm0.5}$	$2.6_{\pm0.4}$	$2.3_{\pm0.4}$
Papua New Guinea	$0.5_{\pm0.1}$	$0.6_{\pm0.1}$	$0.6_{\pm0.2}$	$0.6_{\pm0.2}$	$1.3_{\pm0.3}$	$1.4_{\pm0.3}$	$1.4_{\pm0.2}$	$1.4_{\pm0.3}$	$2.9_{\pm0.4}$	$3.0_{\pm0.5}$	$3.1_{\pm0.5}$	$3.0_{\pm0.5}$
Peru	$0.7_{\pm0.3}$	$0.7_{\pm0.2}$	$0.9_{\pm0.3}$	$0.8_{\pm0.2}$	$1.7_{\pm0.4}$	$1.7_{\pm0.3}$	$2.1_{\pm0.4}$	$1.9_{\pm0.4}$	$3.6_{\pm0.8}$	$3.7_{\pm0.7}$	$4.5_{\pm1.0}$	$4.1_{\pm1.0}$
Philippines	$0.5_{\pm0.2}$	$0.5_{\pm0.2}$	$0.5_{\pm0.1}$	$0.5_{\pm0.1}$	$1.2_{\pm0.2}$	$1.3_{\pm0.3}$	$1.3_{\pm0.2}$	$1.3_{\pm0.2}$	$2.7_{\pm0.4}$	$2.8_{\pm0.5}$	$2.8_{\pm0.4}$	$2.8_{\pm0.4}$
RF	$1.4_{\pm0.7}$	$1.0_{\pm0.6}$	$0.8_{\pm0.4}$	$1.3_{\pm0.6}$	$3.4_{\pm0.8}$	$2.2_{\pm0.8}$	$1.9_{\pm0.7}$	$2.9_{\pm0.8}$	$7.3_{\pm1.5}$	$4.8_{\pm1.1}$	$4.2_{\pm1.3}$	$6.0_{\pm1.3}$
Eurpean RF	$1.2_{\pm0.9}$	$0.8_{\pm0.8}$	$0.9_{\pm0.5}$	$1.0_{\pm0.6}$	$3.4_{\pm0.9}$	$2.2_{\pm0.8}$	$2.1_{\pm0.7}$	$2.3_{\pm0.8}$	$6.8_{\pm1.4}$	$4.7_{\pm1.3}$	$4.2_{\pm1.4}$	$4.8_{\pm1.2}$
West Siberia	$1.4_{\pm0.7}$	$1.0_{\pm0.7}$	$0.8_{\pm0.5}$	$1.4_{\pm0.6}$	$3.4_{\pm1.0}$	$2.2_{\pm0.8}$	$2.0_{\pm0.8}$	$3.0_{\pm0.9}$	$7.2_{\pm1.8}$	$5.1_{\pm1.3}$	$4.4_{\pm1.4}$	$6.2_{\pm1.4}$
East Siberia	$1.5_{\pm0.8}$	$1.0_{\pm0.6}$	$0.7_{\pm0.4}$	$1.4_{\pm0.7}$	$3.6_{\pm0.9}$	$2.0_{\pm0.7}$	$1.7_{\pm0.7}$	$3.2_{\pm0.9}$	$7.7_{\pm1.7}$	$4.5_{\pm1.0}$	$3.9_{\pm1.4}$	$6.6_{\pm1.4}$
Chinese Taipei	$0.6_{\pm0.3}$	$0.5_{\pm0.2}$	$0.5_{\pm0.1}$	$0.5_{\pm0.2}$	$1.3_{\pm0.3}$	$1.2_{\pm0.3}$	$1.3_{\pm0.2}$	$1.3_{\pm0.3}$	$2.7_{\pm0.5}$	$2.7_{\pm0.5}$	$2.8_{\pm0.5}$	$2.7_{\pm0.4}$
Thailand	$0.5_{\pm0.4}$	$0.7_{\pm0.3}$	$0.6_{\pm0.2}$	$0.5_{\pm0.3}$	$1.4_{\pm0.4}$	$1.7_{\pm0.4}$	$1.4_{\pm0.2}$	$1.3_{\pm0.4}$	$3.4_{\pm0.7}$	$3.7_{\pm0.7}$	$3.1_{\pm0.5}$	$3.0_{\pm0.6}$
USA (excl. Alaska)	$0.8_{\pm0.4}$	$0.8_{\pm0.3}$	$1.1_{\pm0.4}$	$1.0_{\pm0.3}$	$2.0_{\pm0.6}$	$2.0_{\pm0.6}$	$2.5_{\pm0.7}$	$2.2_{\pm0.5}$	$4.0_{\pm1.1}$	$4.1_{\pm1.0}$	$5.2_{\pm1.4}$	$4.7_{\pm1.0}$
West USA	$0.8_{\pm0.4}$	$0.7_{\pm0.4}$	$1.1_{\pm0.4}$	$0.9_{\pm0.3}$	$1.8_{\pm0.8}$	$1.9_{\pm0.7}$	$2.6_{\pm0.7}$	$2.1_{\pm0.5}$	$3.9_{\pm1.2}$	$3.9_{\pm1.1}$	$5.3_{\pm1.3}$	$4.6_{\pm0.9}$
Centre USA	$0.8_{\pm0.5}$	$0.9_{\pm0.4}$	$1.1_{\pm0.4}$	$1.0_{\pm0.4}$	$2.1_{\pm0.7}$	$2.2_{\pm0.8}$	$2.5_{\pm0.8}$	$2.2_{\pm0.6}$	$4.2_{\pm1.3}$	$4.4_{\pm1.0}$	$5.2_{\pm1.6}$	$4.9_{\pm1.1}$
East USA	$0.8_{\pm0.5}$	$0.8_{\pm0.4}$	$1.0_{\pm0.3}$	$1.0_{\pm0.4}$	$2.1_{\pm0.6}$	$2.0_{\pm0.6}$	$2.3_{\pm0.6}$	$2.1_{\pm0.6}$	$4.0_{\pm1.1}$	$4.2_{\pm0.9}$	$4.9_{\pm1.5}$	$4.5_{\pm1.0}$
Alaska	$1.2_{\pm1.1}$	$0.7_{\pm1.0}$	$0.7_{\pm0.5}$	$1.2_{\pm0.8}$	$3.2_{\pm1.0}$	$1.9_{\pm0.8}$	$1.3_{\pm0.7}$	$2.6_{\pm0.8}$	$7.5_{\pm2.2}$	$4.5_{\pm1.4}$	$3.1_{\pm1.3}$	$5.2_{\pm1.2}$
Vietnam	$0.4_{\pm0.4}$	$0.6_{\pm0.4}$	$0.6_{\pm0.2}$	$0.5_{\pm0.3}$	$1.3_{\pm0.4}$	$1.6_{\pm0.5}$	$1.5_{\pm0.3}$	$1.3_{\pm0.3}$	$3.1_{\pm0.7}$	$3.4_{\pm0.7}$	$3.2_{\pm0.6}$	$3.0_{\pm0.6}$

SAT changes

ГЛАВНАЯ
ГЕОФИЗИЧЕСКАЯ
ОБСЕРВАТОРИЯ
им. А.И.ВОЕЙКОВА

A2 winter and summer

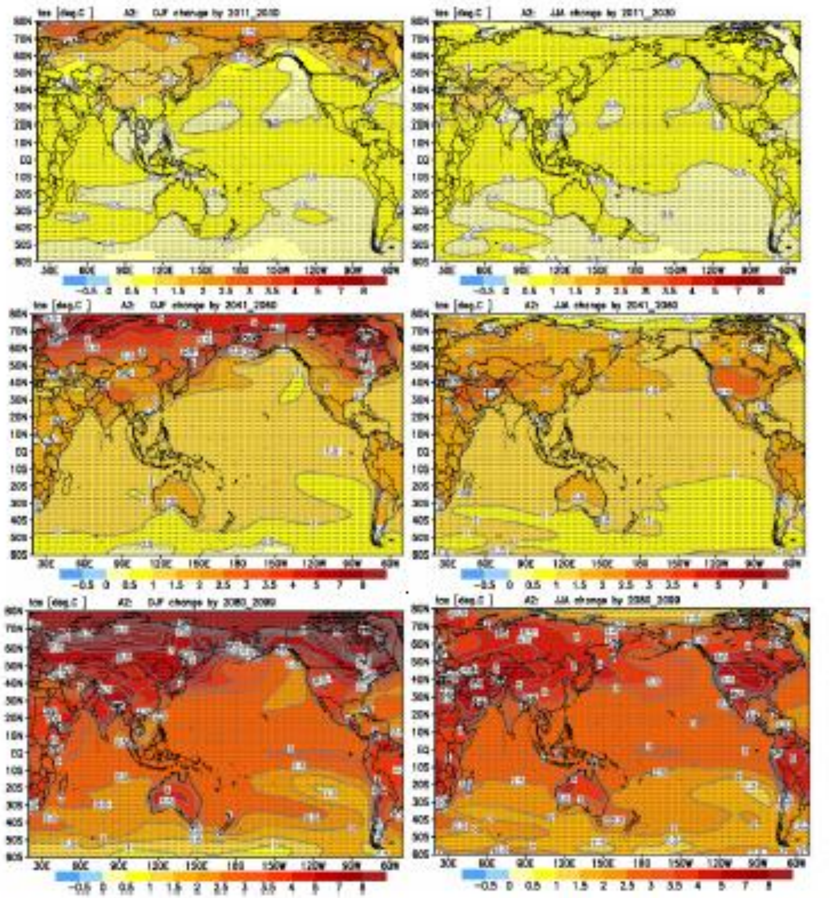

Figure 2. Surface air temperature changes (°C) by early-(top), mid-(middle) and late (bottom) 21st century in boreal winter (left) and summer (right) for A2 scenario. Dotting denotes areas where signal-to-noise (intermodel root mean square) is >1.

A2-B1 winter and summer

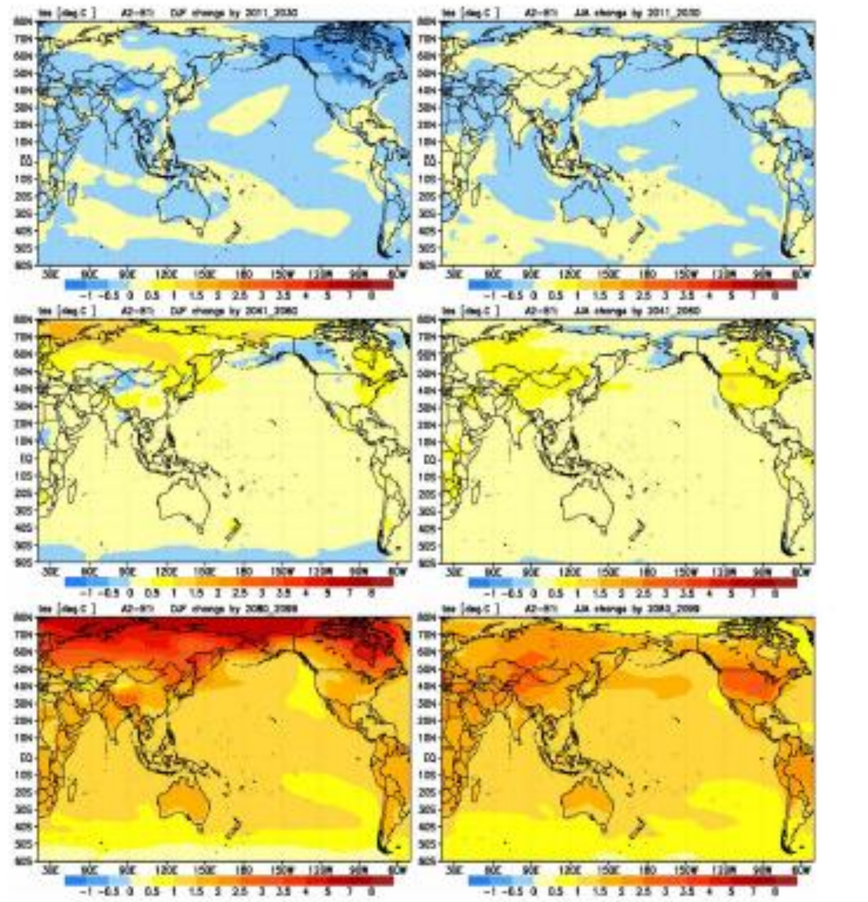

Figure 3. Surface air temperature change difference (°C) between the “strong” A2 and “weak” B1 scenarios by early-(top), mid-(middle) and late (bottom) 21st century in winter (left) and summer (right).

SAT changes: annual range, highest and lowest

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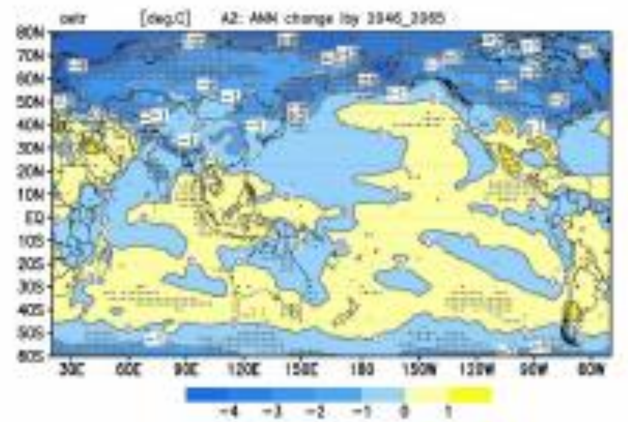

Figure 4. Changes (°C) of the annual extreme temperature range (difference between highest and lowest temperatures in a year) as simulated by mid 21st century relative to the late 20th century. The stippling indicates areas where the signal-to-noise ratio is >1.

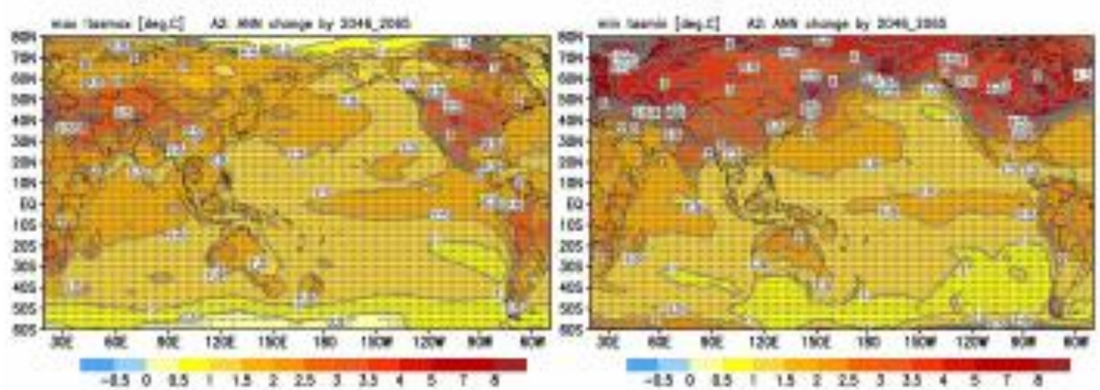

Figure 5. Changes (°C) of the annual highest (left) and lowest (right) surface air temperature as simulated by mid 21st century relative to the late 20th century. The stippling indicates areas where the signal-to-noise ratio is >1.

Precipitation changes

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Table 5b. Seasonal precipitation chang
(16 models). Estimates are highlighted

Time slice Region/ Economy	2011-20 DJF	MAM
Australia	$3.1_{\pm7.2}$	$3.8_{\pm6.6}$
West Australia	$0.6_{\pm8.6}$	$5.7_{\pm8.7}$
East Australia	$6.4_{\pm9.5}$	$2.0_{\pm11.7}$
Brunei Darussalam, Malaysia, Singapore	$-0.9_{\pm4.9}$	$-0.1_{\pm5.0}$
Canada	**$6.3_{\pm3.5}$**	**$5.6_{\pm4.0}$**
North Canada	$5.6_{\pm5.4}$	**$6.8_{\pm4.6}$**
West Canada	$4.0_{\pm4.2}$	$5.0_{\pm4.7}$
East Canada	**$6.6_{\pm5.0}$**	**$6.0_{\pm4.7}$**
Chile	**$-3.4_{\pm3.3}$**	$-2.4_{\pm3.2}$
North Chile	$-3.0_{\pm6.1}$	**$-7.7_{\pm7.4}$**
South Chile	**$-3.8_{\pm3.1}$**	$-1.4_{\pm3.5}$
China	$2.7_{\pm7.6}$	$1.1_{\pm3.7}$
NW China	**$8.8_{\pm8.8}$**	$3.6_{\pm7.4}$
NE China	$8.2_{\pm8.9}$	$3.3_{\pm6.9}$
SW China	$1.4_{\pm6.4}$	$0.9_{\pm3.9}$
SE China (incl. Hong Kong)	$1.4_{\pm14.8}$	$0.1_{\pm5.3}$
Indonesia	$1.1_{\pm2.5}$	$1.5_{\pm2.7}$
Japan	$2.4_{\pm5.7}$	$4.5_{\pm6.3}$
Korea	$5.0_{\pm13.5}$	$5.3_{\pm8.2}$

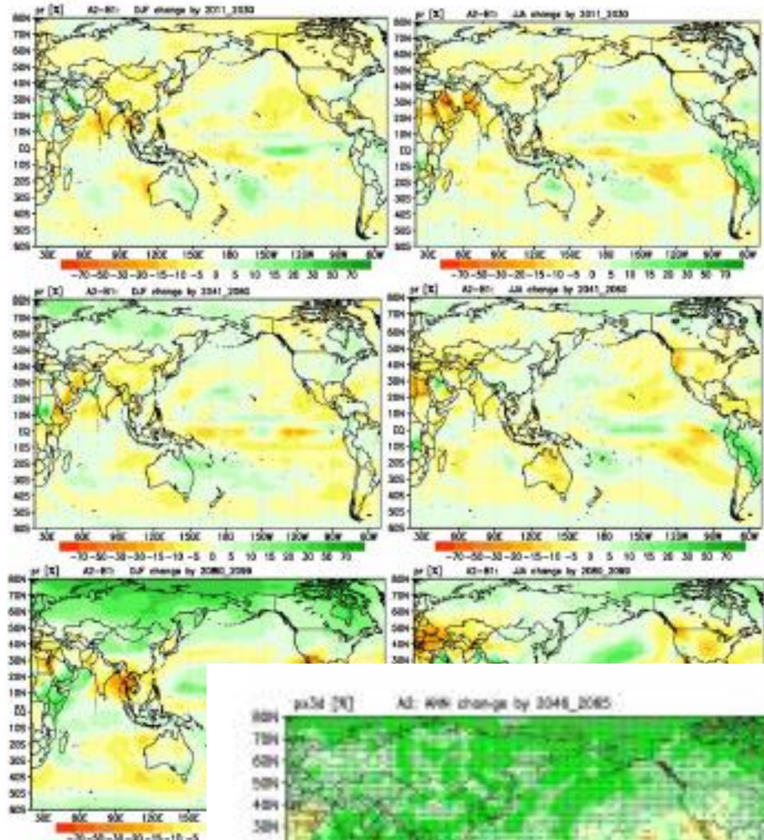


Figure 7. Precipitation chang
early-(top), mid-(middle) and

East Siberia	$7.2_{\pm4.8}$	4.
Chinese Taipei	$-1.7_{\pm10.4}$	-3.
Thailand	$-6.4_{\pm17.0}$	-2.
USA (excl. Alaska)	$2.6_{\pm5.3}$	0.
West USA	$3.1_{\pm8.5}$	0.
Centre USA	$0.2_{\pm9.0}$	0.
East USA	$3.8_{\pm5.9}$	1.
Alaska	$3.3_{\pm6.6}$	4.
Vietnam	$-5.6_{\pm10.6}$	-5.

Continuation

s (%) relative to values at baseline period by early, mid- and late 21st century for B1 (15 models), scenarios. Standard deviations given as lower indices provide a measure of inter-model scatter. bold) for which the change exceeds the standard deviation.

2011-2030 A1B	A2	2041-2060 B1	A1B	A2	2080-2099 B1	A1B	A2
$-3.7_{\pm5.6}$	$-3.4_{\pm5.9}$	$-5.6_{\pm6.4}$	$-5.8_{\pm6.9}$	$-6.9_{\pm6.5}$	$-6.0_{\pm10.0}$	$-9.1_{\pm13.2}$	$-13.3_{\pm14.0}$
$0.0_{\pm1.8}$	$-0.3_{\pm3.0}$	$1.3_{\pm2.6}$	$1.2_{\pm2.3}$	$1.1_{\pm2.5}$	$1.3_{\pm3.0}$	$2.0_{\pm3.6}$	$1.6_{\pm4.4}$
$1.0_{\pm4.4}$	$1.7_{\pm4.6}$	$3.9_{\pm6.6}$	$4.1_{\pm7.1}$	$3.7_{\pm6.6}$	$7.1_{\pm7.5}$	**$10.1_{\pm9.4}$**	$11.7_{\pm13.6}$
$1.1_{\pm2.2}$	$0.9_{\pm3.1}$	$2.2_{\pm2.5}$	$2.8_{\pm4.2}$	$2.1_{\pm3.6}$	**$4.1_{\pm3.7}$**	$5.5_{\pm5.6}$	**$6.9_{\pm6.2}$**
$-0.2_{\pm2.8}$	$-1.0_{\pm2.2}$	$1.3_{\pm3.0}$	$3.4_{\pm4.7}$	$0.4_{\pm2.7}$	$3.4_{\pm3.6}$	$4.3_{\pm6.6}$	$4.4_{\pm6.1}$
$3.5_{\pm1.8}$	**$3.9_{\pm1.4}$**	**$7.0_{\pm2.6}$**	**$9.7_{\pm2.9}$**	**$8.2_{\pm2.6}$**	**$10.8_{\pm2.6}$**	**$15.3_{\pm3.8}$**	**$17.8_{\pm3.7}$**
$2.9_{\pm2.0}$	**$3.5_{\pm2.3}$**	**$5.4_{\pm2.7}$**	**$7.4_{\pm3.9}$**	**$6.4_{\pm2.9}$**	**$8.5_{\pm2.0}$**	**$11.4_{\pm4.8}$**	**$12.4_{\pm4.6}$**
$3.5_{\pm2.1}$	**$4.0_{\pm1.4}$**	**$7.2_{\pm2.6}$**	**$9.9_{\pm2.7}$**	**$8.4_{\pm2.6}$**	**$10.8_{\pm2.7}$**	**$15.4_{\pm3.9}$**	**$18.4_{\pm3.9}$**
$4.2_{\pm3.3}$	**$4.4_{\pm2.1}$**	**$8.4_{\pm3.6}$**	**$11.9_{\pm4.1}$**	**$9.8_{\pm3.6}$**	**$13.0_{\pm4.3}$**	**$19.2_{\pm5.4}$**	**$22.2_{\pm6.3}$**
$-0.8_{\pm4.2}$	$0.1_{\pm5.0}$	$0.9_{\pm4.0}$	$2.4_{\pm6.1}$	$-1.1_{\pm4.8}$	$2.3_{\pm5.8}$	$3.6_{\pm8.7}$	$-2.1_{\pm8.4}$
$-1.3_{\pm3.9}$	$-3.1_{\pm4.1}$	$1.3_{\pm3.7}$	$2.3_{\pm4.3}$	$-0.5_{\pm4.5}$	$3.8_{\pm5.0}$	$4.3_{\pm3.7}$	$3.1_{\pm4.9}$
	$.9_{\pm3.0}$	$1.3_{\pm3.5}$	$0.5_{\pm4.0}$	$1.1_{\pm4.0}$	$1.4_{\pm3.5}$	$2.0_{\pm5.4}$	$0.7_{\pm7.7}$
	$.5_{\pm3.9}$	$2.0_{\pm4.3}$	$0.8_{\pm4.1}$	$1.0_{\pm5.3}$	$1.5_{\pm4.5}$	$2.1_{\pm8.9}$	$1.6_{\pm7.7}$
	$.4_{\pm3.3}$	$-0.7_{\pm5.1}$	$-1.2_{\pm8.2}$	$-0.8_{\pm5.8}$	$-0.7_{\pm6.4}$	$-1.3_{\pm6.7}$	$-3.4_{\pm11.6}$

Continuation
A1B scenario

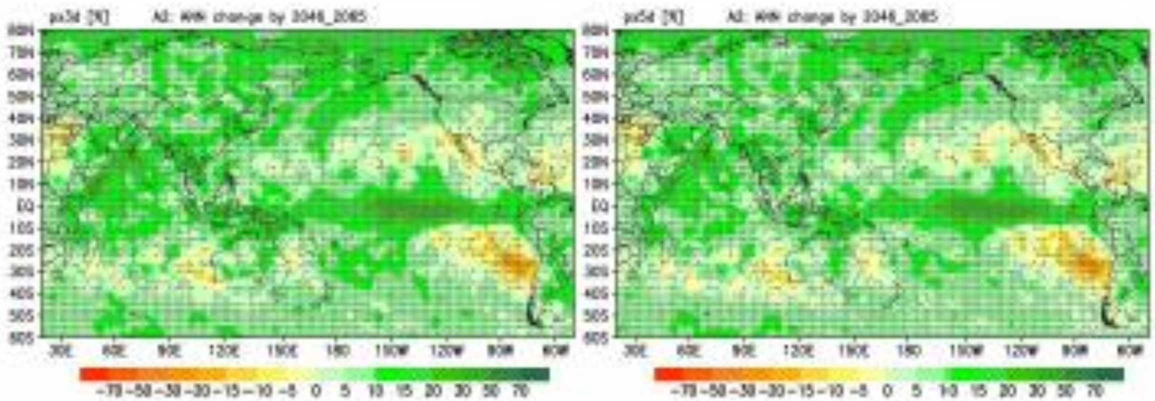


Figure 9. Changes (%) of the annual largest 3-day (left) and 5-day (right) precipitation totals (px3d and px5d) as simulated by mid 21st century relative to the late 20th century. The stippling indicates areas where at least 2/3 of models agree on the sign of the changes.

World Climate Conference-3

WCC-3 addressed the state of the knowledge and the capacity to mobilize climate science globally to advance **seasonal to inter-annual to decadal climate predictions**, including current gaps.

WCC · 3

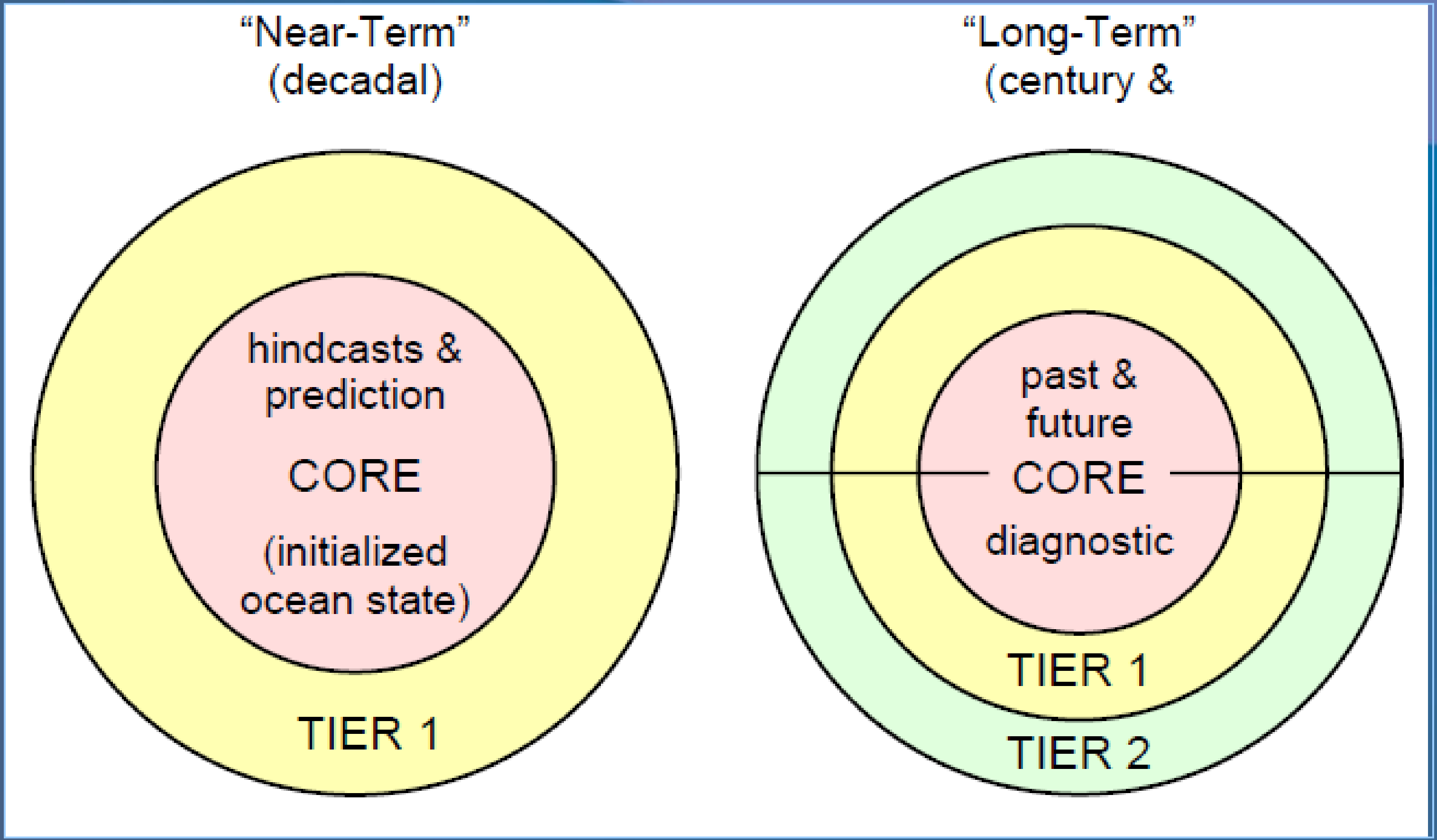
Geneva, Switzerland

31 August–4 September 2009

World Meteorological Organization
Weather • Climate • Water

Climate prediction and information for decision making

CMIP5: two focus areas

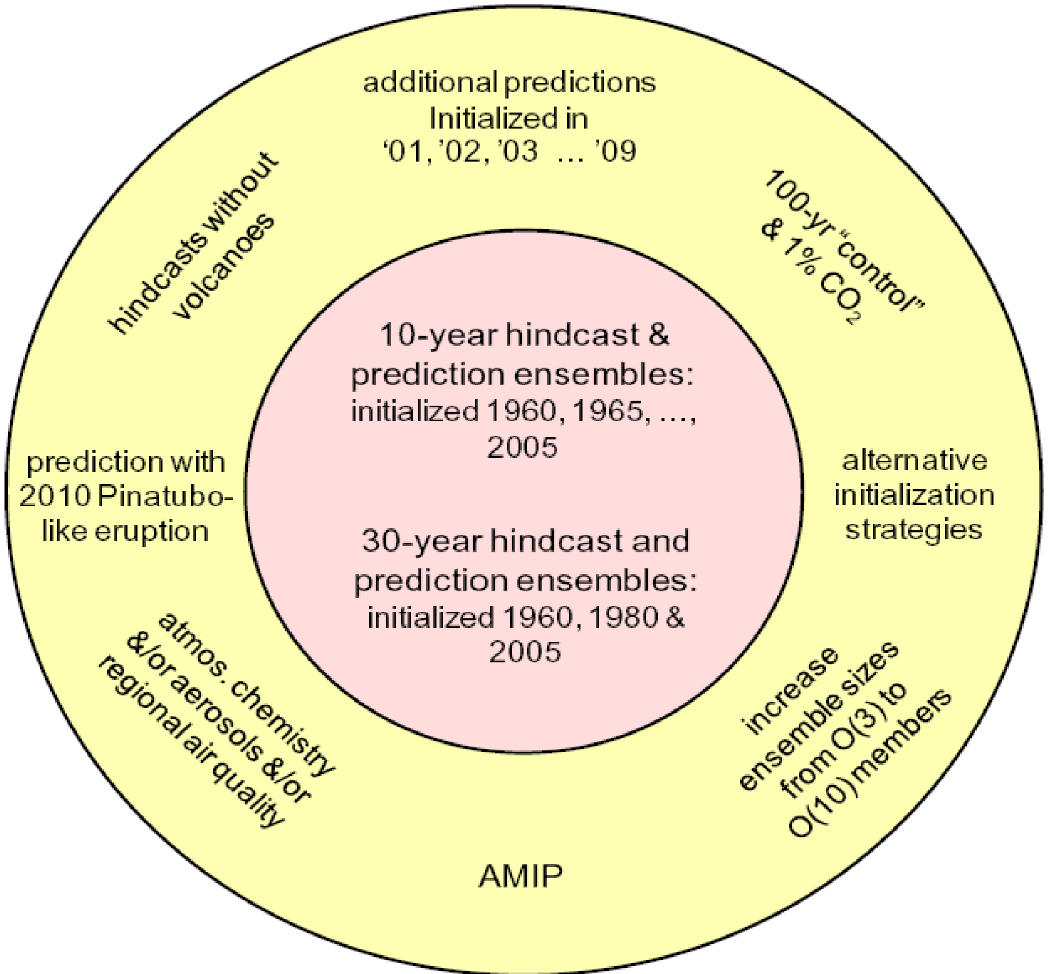


The CMIP5 experiment design:

- ✓"near-term" (decadal) hindcast/prediction simulations (out to about 2035)
- ✓"long-term" simulations (out to 2100 and beyond)
- ✓"atmosphere-only" (prescribed SST) simulations.

Taylor et al., 2007

CMIP5 (near term)



Taylor et al., 2007

CMIP5 (long term)

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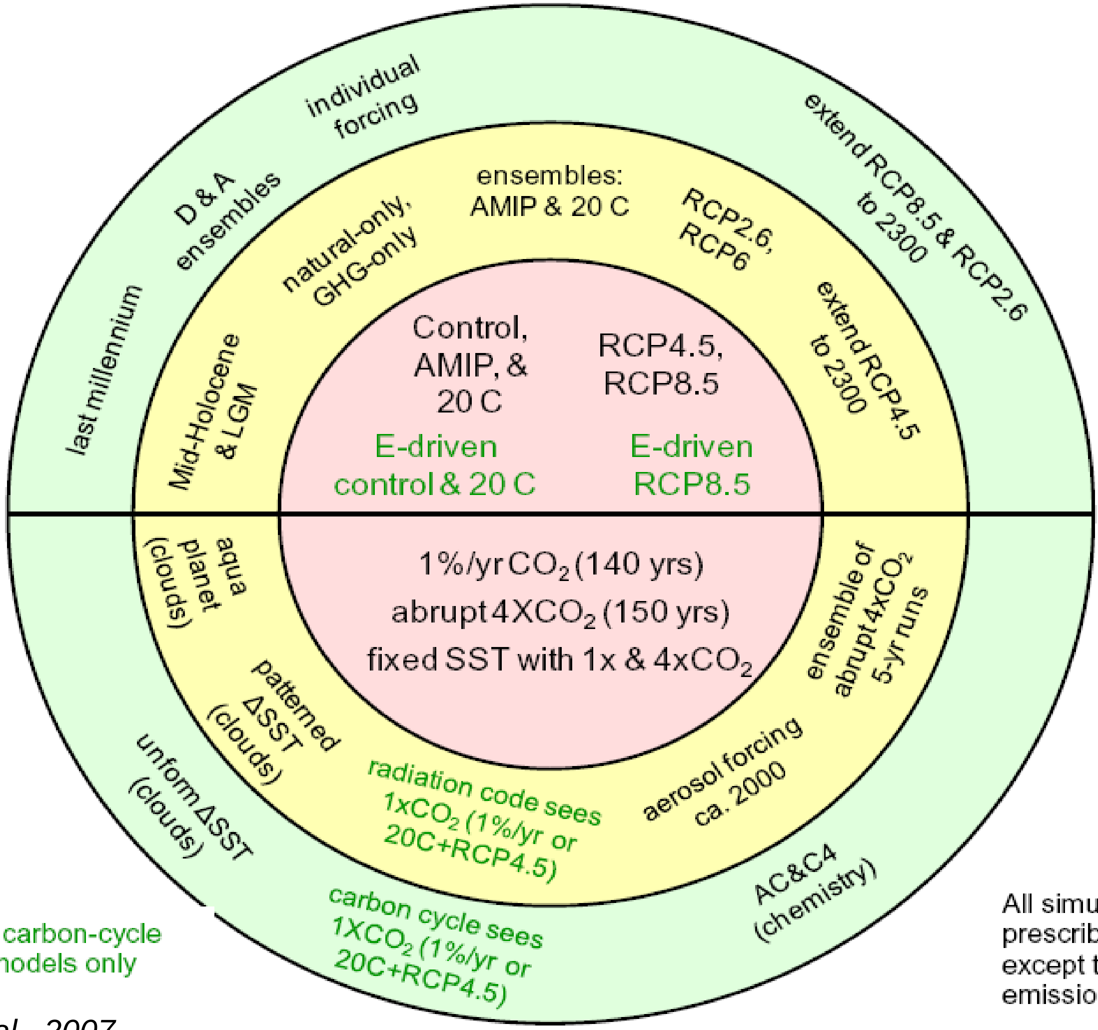

Coupled carbon-cycle climate models only

All simulations are forced by prescribed concentrations except those “E-driven” (i.e., emission-driven)

Taylor et al., 2007

CORDEX

World Climate Research Program (WCRP) recently formed a task Force on Regional Climate Downscaling (TFRCD) whose mandate is to:

1. Develop a framework to evaluate and possibly improve RCD techniques for use in downscaling global climate projections.

2. Foster an international coordinated effort to produce improved multi-model RCD-based high resolution climate change information over regions worldwide for input to impact/adaptation work and to the IPCC AR5.

3. Promote greater interaction and communication between global climate modelers, the downscaling community and end-users to better support impact/adaptation activities.

As a result of the first activities of the TFRCD, and in consultation with the broader scientific community, a framework was initiated called the COordinated Regional climate Downscaling Experiment (CORDEX) aimed at improving coordination of international efforts in RCD research.

CORDEX

- Provide a quality-controlled data set of RCD-based information for the recent historical past and 21st century projections, covering the majority of populated land regions on the globe. The RCD information will sample uncertainties in Regional Climate Change associated with (i) varying GCM simulations; (ii) varying GHG concentration scenarios; (iii) natural climate variability; and (iv) different downscaling methods. The CORDEX downscaling activities will be based on the latest set of GCM climate scenarios and predictions produced within CMIP5.
- Define a common set of RCM domains for dynamical downscaling and define a standard set of variables, frequency and format for output and archival at a number of CORDEX data centres.
- Coordinate a range of RCM simulations for the defined domains, forced by analyses of observations (currently ERA-Interim) to provide a benchmark framework for model evaluation and assessment. This exercise should include also statistical downscaling (SD) methods.
- Encourage and coordinate the development of Regional Analysis and Evaluation Teams to; (i) Evaluate the ensemble of RCD simulations, (ii) Develop a suitable set of regionally-specific metrics for RCD evaluation, (iii) Collect suitable observational data to evaluate high-resolution RCD simulations and (iv) Design experiments to investigate the added-value of RCDs and target future priorities in RCD research.
- Engage the broad RCD community in its activities and discussions.
- Provide support and information to climate impact assessment and adaptation groups interested in utilizing CORDEX RCD material in their research.

CORDEX

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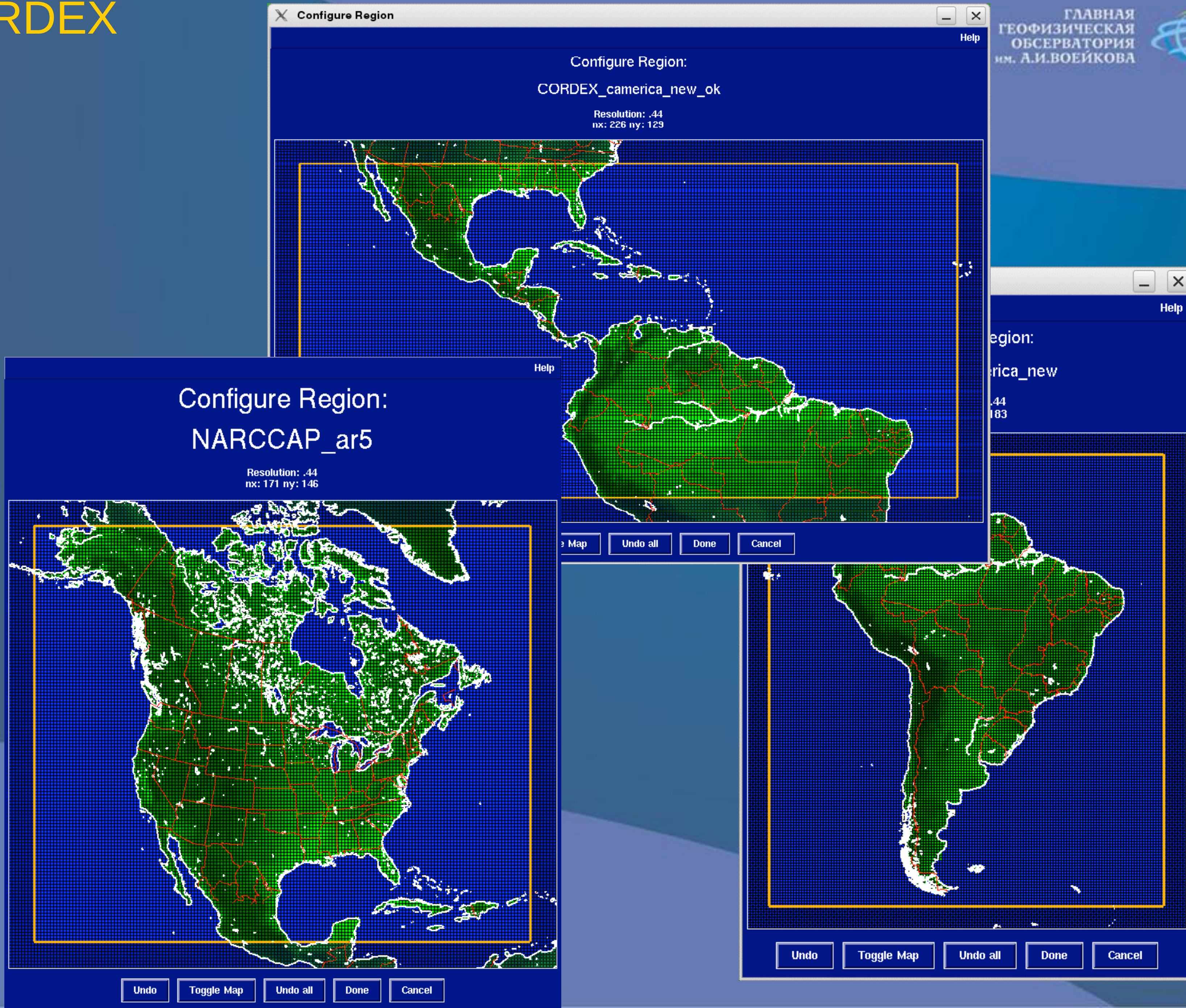

CORDEX

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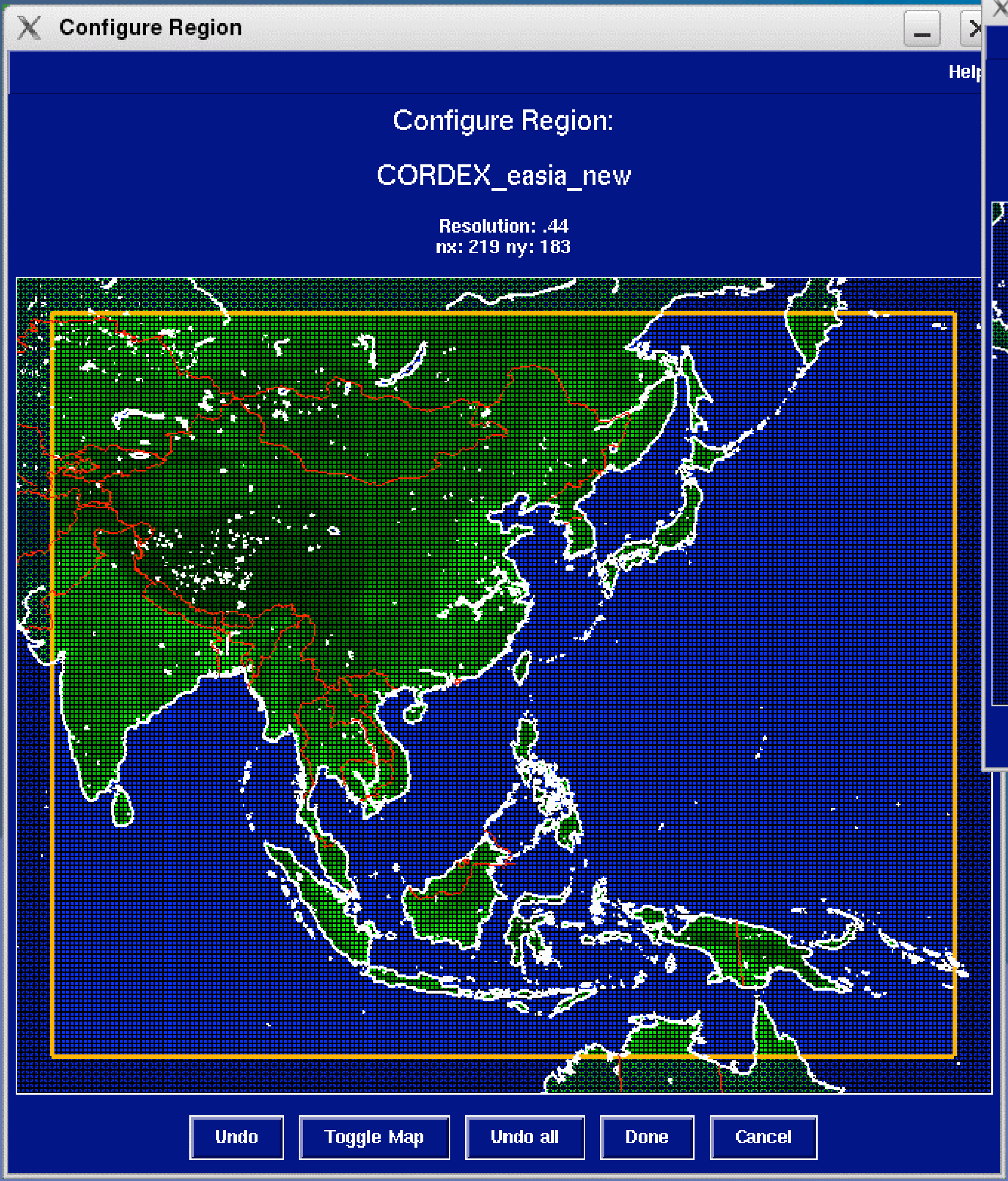
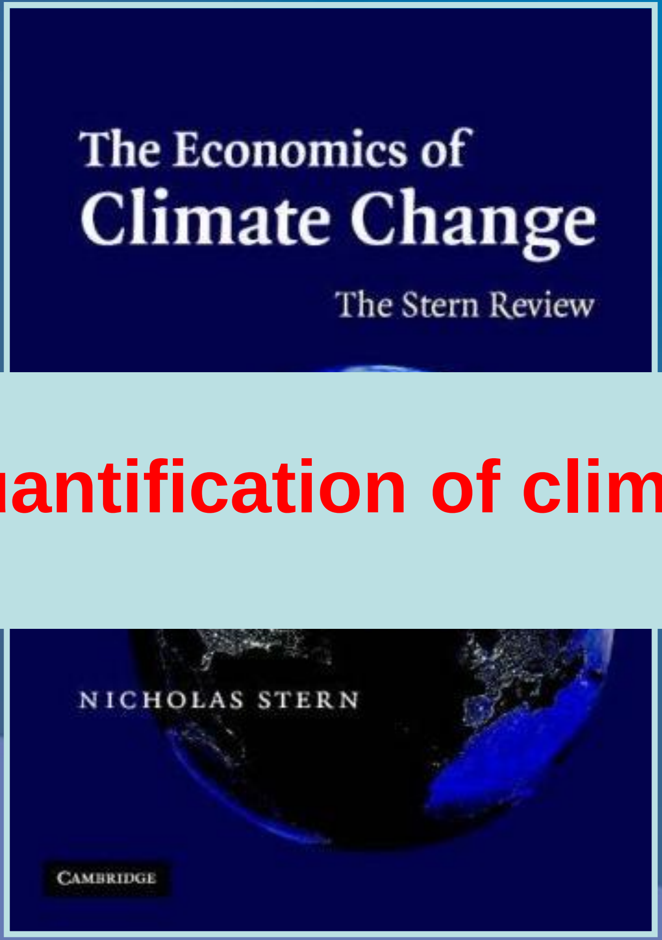


What else?



We need quantification of climate impacts!

Instead of conclusion…

APCC is doing a good job in real time seasonal predictions (and should go on).

At the same time, a climate centre is expected to be a source of information on climate change, particularly its predictions/projections.

CMIP5 provides an opportunity for an international diagnostic project focused on climate change predictions/projections and quantification of associated impacts on the APEC economies.

CORDEX should provide high resolution suitable for smaller territories.

APCC could serve an umbrella for the APEC-focused diagnostic projects, with possible responsibilities ranging from a coordinator to a principal investigator.

In addition to developing the interface between the science and society, this effort might serve an efficient training course for young scientists and specialists from developing economies.

Next step could be towards assessment of the economics of climate change in APEC economies.

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Thank you!