Report about IPCC AR4 WG1 (The Physical Science Basis) and NIES Contribution to Asian Climate Change Research Coordination

夏の 2007 大公開

LA of AR4 WG1 Chapter 5:
Observations: Oceanic Climate Change
and Sea Level
National Institute for Environmental Studies
Center for Global Environmental Research
Yukihiro NOJIRI

ここまで
明らかになった
地球温暖化

執筆者が解説する
2007 年 IPCC
第４次評価報告書

（独）国立環境研究所 地球環境研究センター

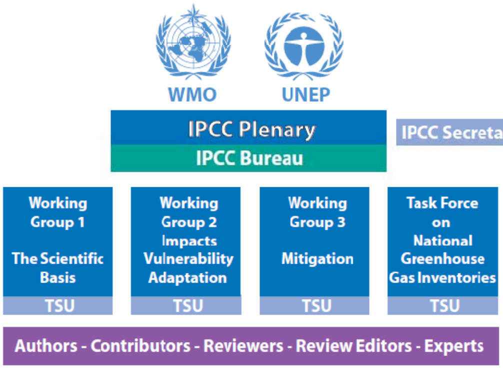
Status of IPCC AR4 publication

- WG1 “The Physical Science Basis”, Full report available online.

  SPM: 18 pages, TS 73 pages, Chapter 1 to 11: 849 pages, Appendix: 47 pages, totally 987 pages.
- WG2 “Impacts, Adaptation, and Vulnerability”, SPM available online.
- WG3 “Mitigation of Climate Change”, Full report available online (pre-copy version).
- Ministry of Environment, Japan, prepared IPCC web link for Japanese people, including graphic summary of the report series in Japanese.

http://www.env.go.jp/earth/ipcc/4th_rep.html

Full reports of WG1 and 3



Working Group I assesses the scientific aspects of the climate system and climate change; **Working Group II** assesses the scientific, technical, environmental, economic and social aspects of the vulnerability (sensitivity and adaptability) to climate change of, and the negative and positive consequences (impacts) for, ecological systems, socio-economic sectors and human health, with an emphasis on regional, sectoral and cross-sectoral issues; **Working Group III** assesses the scientific, technical, environmental, economic and social aspects of the mitigation of climate change.

The Task Force on National Greenhouse Gas Inventories

The Task Force is mandated to carry out work on inventory-related methodologies and practices. The Bureau of the Task Force is elected by the Panel, but only the Co-chairs of the Task Force Bureau are members of the IPCC Bureau. Reports prepared by the Task Force are accepted by the Panel.

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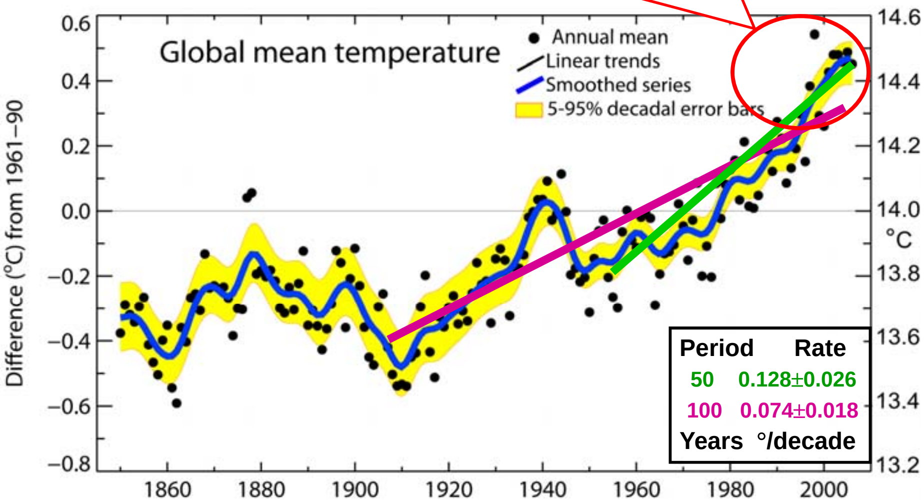
AR4 is based on the direct obs. of recent climate change

Since the TAR, progress in understanding how climate is changing in space and in time has been gained through:

- improvements and extensions of numerous datasets and data analyses
- broader geographical coverage
- better understanding of uncertainties, and
- a wider variety of measurements

Global mean temperatures are rising faster



Direct Observations of Recent Climate Change

Global average air temperature

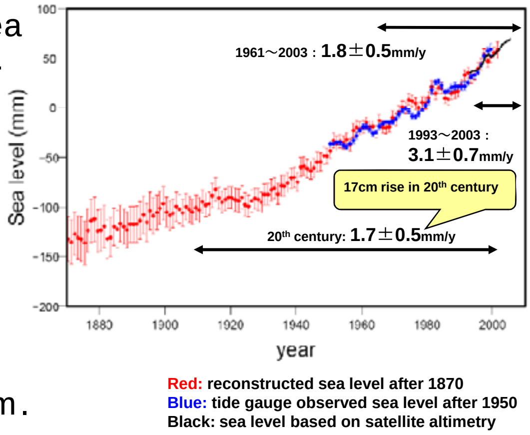
- Updated 100-year linear trend of 0.74 [0.56 to 0.92] °C for 1906-2005
- Larger than corresponding trend of 0.6 [0.4 to 0.8] °C for 1901-2000 given in TAR

- Average ocean temperature increased to depths of at least 3000 m – ocean has absorbed 90% of heat added

  > seawater expansion and SLR

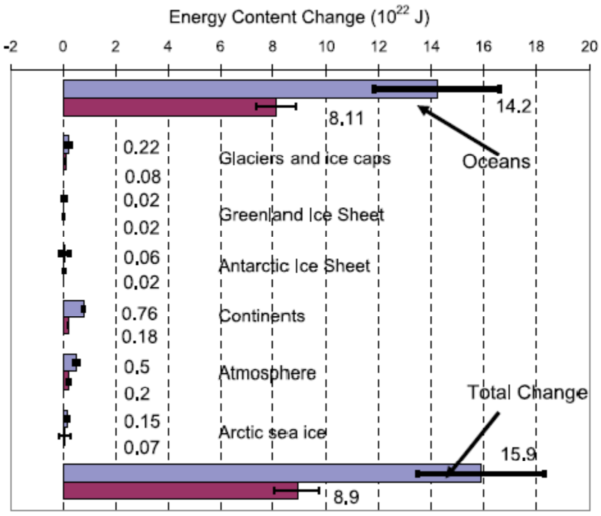
Annual averages of the global mean sea level

- Averaged global sea level rise for 1961-2003 is 1.8mm/y.
- Rising rate increased to 3.1 mm/y for 1993-2003.
- Sea level rise in 20th century is estimated as 0.17m.



Energy content in the climate system

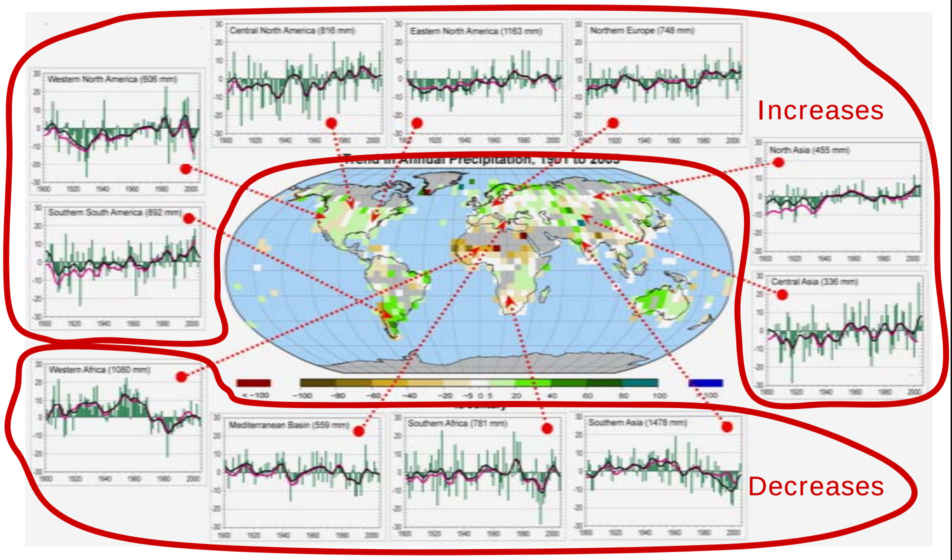
- Recent ocean observation using ships and buoys detected the heat content rise of upper 3000m of the global ocean.
- It accounts about 90% of the heat content rise. Especially the recent 10 year heat content rise is close to half of change in 42 years for 1961-2003.
- Ocean surface 700m showed approximately 0.1 degree C temperature rise.



Changes in Precipitation, Increased Drought

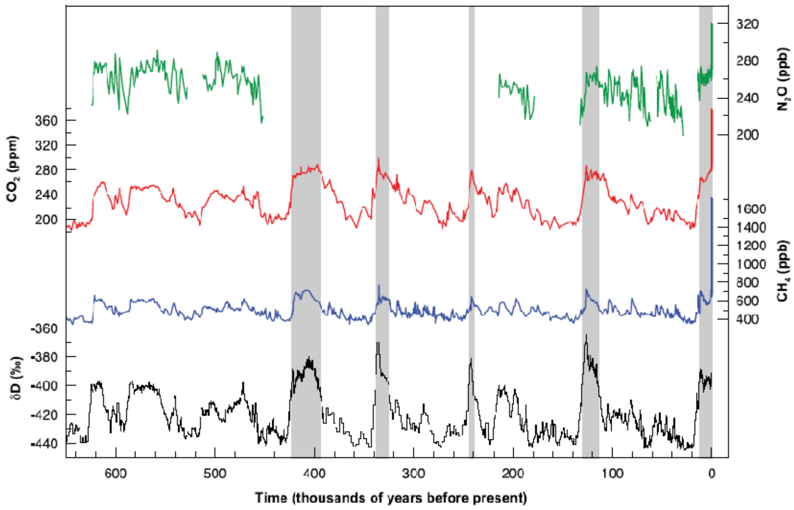
- Significantly increased precipitation in eastern parts of North and South America, northern Europe and northern and central Asia.
- The frequency of heavy precipitation events has increased over most land areas - consistent with warming and increases of atmospheric water vapor.
- Drying in the Sahel, the Mediterranean, southern Africa and parts of southern Asia.
- More intense and longer droughts observed since the 1970s, particularly in the tropics and subtropics.

Land precipitation is changing over broad areas



Smoothed annual anomalies for precipitation (%) over land from 1900 to 2005; other regions are dominated by variability.

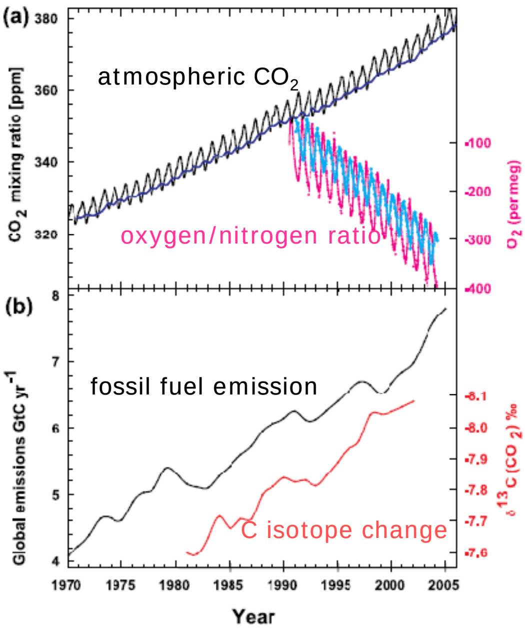
Glacial and Interglacial ice core data of GHGs



The atmospheric concentration of CO_2 and CH_4 in 2005 exceeds by far the natural range of the last 650,000 years

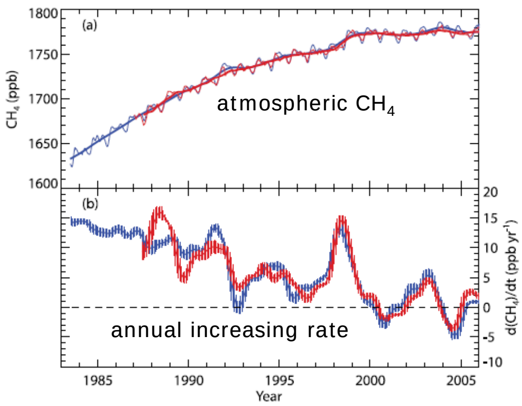
Recent atmospheric CO_2 change

- Atmospheric CO_2 is increasing relating to the fossil fuel emission rate.
- Atmospheric oxygen gives constraint for estimating terrestrial and oceanic CO_2 sinks.
- Atmospheric C isotope change is one of strong evidence of anthropogenic emission.

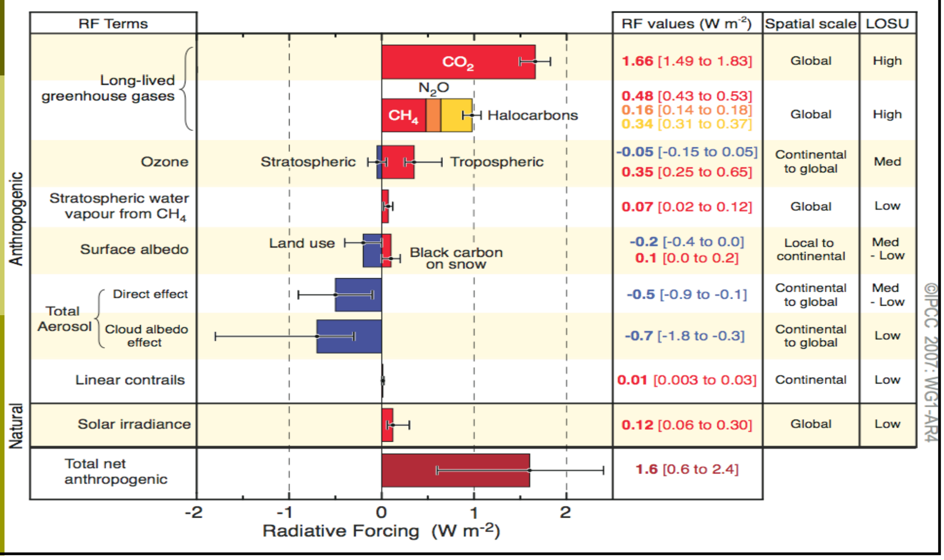


Decreased atmospheric CH_4 increasing rate

- Atmospheric CH_4 concentration increase decreased for late 1990s, however, the reasons are not understood.
- Atmospheric radical reaction change and/or the source intensity change should be attributed for the change.

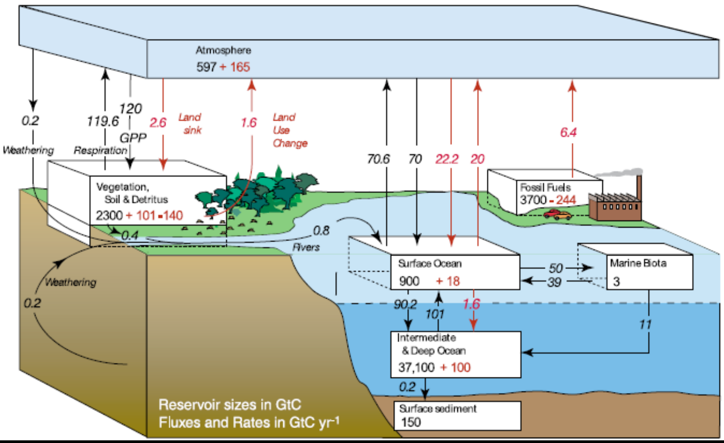


Global-average radiative forcing estimates and ranges



Global carbon cycle estimate for 1990s

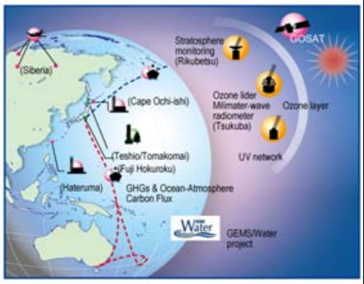
- Annual fossil CO_2 emissions increased from an average of 6.4 GtCper year in the 1990s, to 7.2 GtC per year in 2000-2005
- CO_2 radiative forcing increased by 20%from 1995 to 2005, the largest in any decade in at least the last 200 years



Monitoring the Global Environment

Monitoring Greenhouse Gases

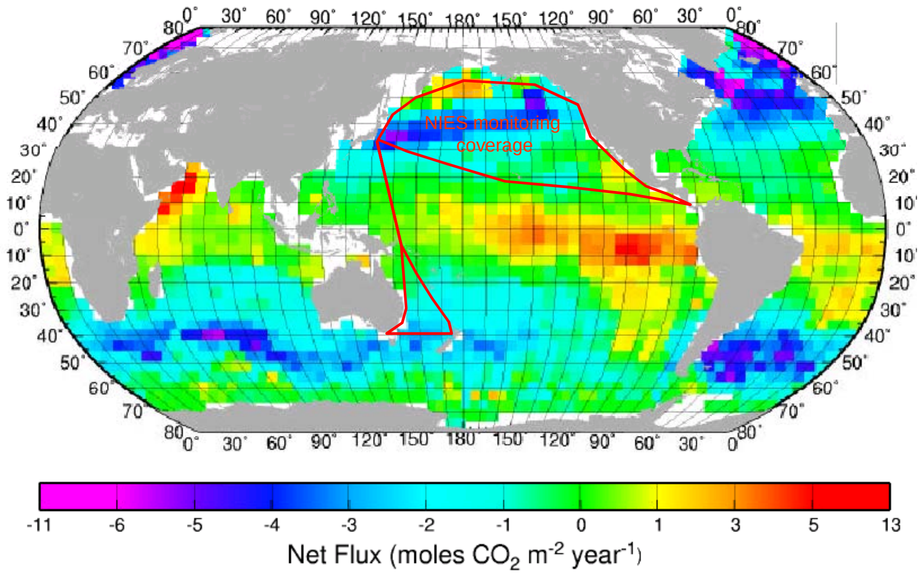
- Monitoring at in-situ observation stations
  (Hateruma and Cape Ochi-ishi)
- Monitoring by aircraft and ship
  (Siberia and JAL project)
  (VOS program, 4 VOS for atmospheric monitoring)
- Establishing/maintaining standard scales for greenhouse gases
  (CO_2 gas scale covering atmosphere and ocean)



CGER Monitoring Platforms

Monitoring Carbon Budget

- Using commercial freight ships to monitor the carbon balance in the North Pacific
  (VOS program, 2 VOS for ocean monitoring)
- Monitoring the carbon balance in boreal forests
  (Flux stations)

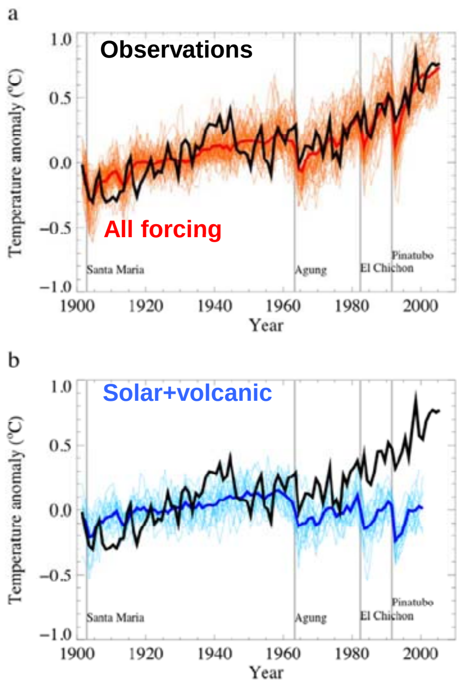


Pacific pCO_2 observation coverage by CGER/NIES monitoring by commercial ship line

Base map by CO_2 annual flux estimated from global pCO_2 data integration (T.Takahashi et al., 2002), including NIES observation for north Pacific by Skaugran and Alligator Hope

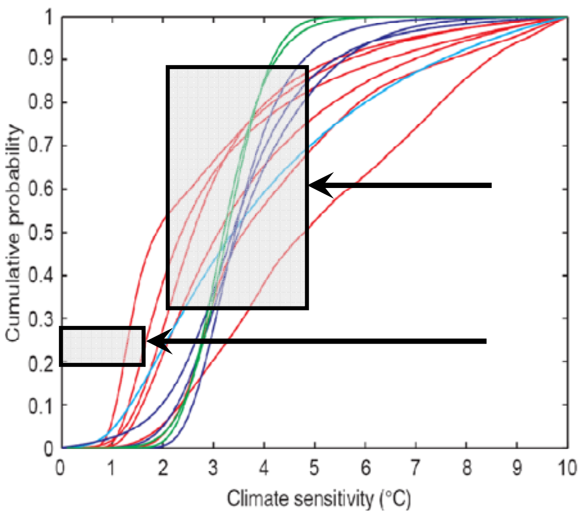
Attribution

- are observed changes consistent with
- ☑ expected responses to forcings
- ☒ inconsistent with alternative explanations



Equilibrium Climate Sensitivity

Surface warming following a sustained doubling of CO_2 concentrations



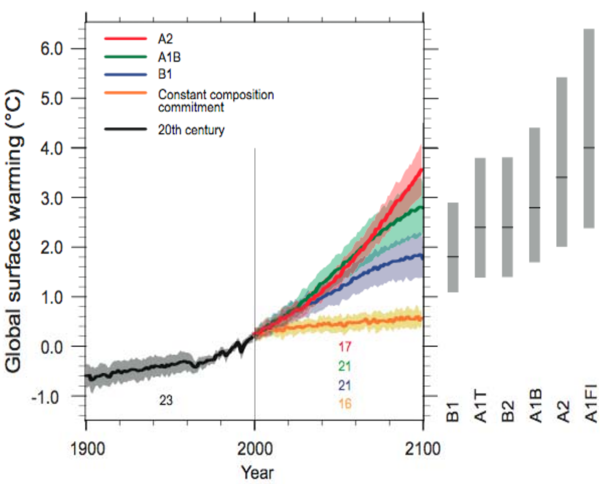
Best estimate 3 C; *likely* 2-4.5 C;

very unlikely less than 1.5 C;

higher values not ruled out

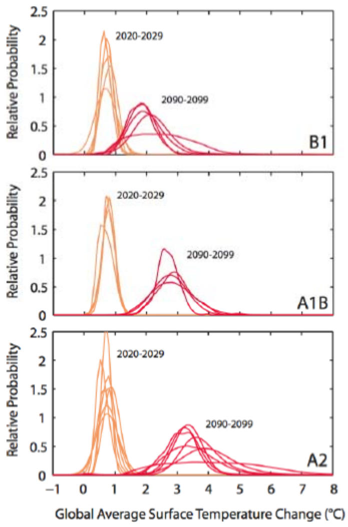
Projections of Future Changes in Climate

- Best estimate for low scenario (B1) is 1.8C (*likely* range is 1.1C to 2.9C), and for high scenario (A1FI) is 4.0C (*likely* range is 2.4C to 6.4C).
- Temperature increase for the coming 20 years is estimated to be 0.2 C/decade, which is independent to scenarios.



Projections of Future Changes in Climate

- Near term projections insensitive to choice of scenario
- Longer term projections depend on scenario and climate model sensitivities

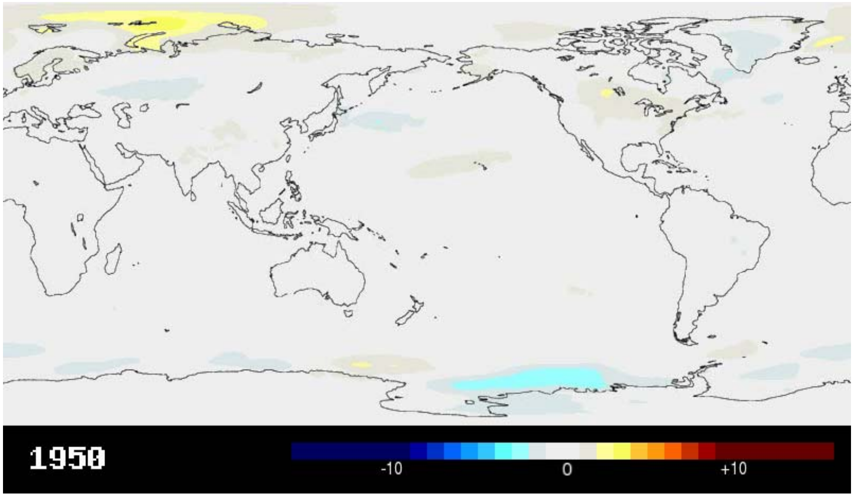


Projections of Future Changes in Climate

- There is now higher confidence in projected patterns of warming and other regional-scale features, including changes in wind patterns, precipitation, and some aspects of extremes and of ice.

21th century climate simulated by NIES/JAMSTEC/U-Tokyo using E.S.

A1B scenario having climate sensitivity of 4 C. Temperature is compared with 1971-2000 average.



Projections of future changes in climate

- Snow cover is projected to contract
- Widespread increases in thaw depth most permafrost regions
- Sea ice is projected to shrink in both the Arctic and Antarctic
- In some projections, Arctic late-summer sea ice disappears almost entirely by the latter part of the 21st century

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Projections of future changes in climate

- *Very likely* that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent
- *Likely* that future tropical cyclones will become more intense, with larger peak wind speeds and more heavy precipitation
  - **less confidence in decrease of total number**
- Extra-tropical storm tracks projected to move poleward with consequent changes in wind, precipitation, and temperature patterns

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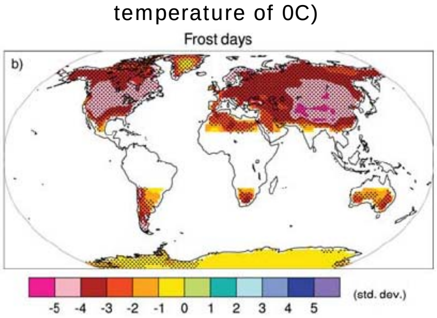
Frost days and heat waves

- Extreme events like heat wave, draughts or floods are likely to increase in the future climate.

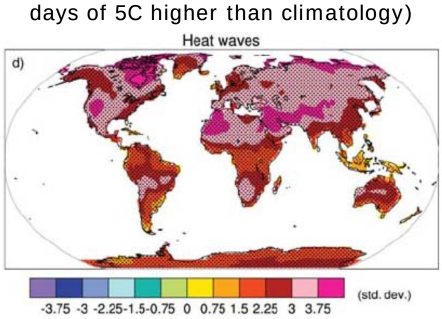
Frost days (days of minimum temperature of 0C)



decreasing

- Winter warming may be more significant than summer warming.

Heat waves (length of the period of days of 5C higher than climatology)



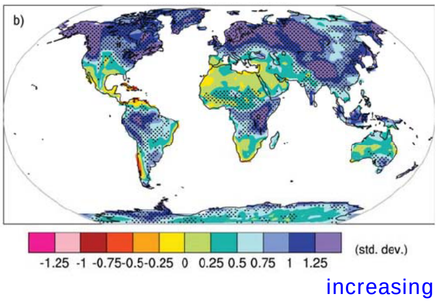
increasing

- Heat waves may increase globally, especially Mediterranean and Western North America.

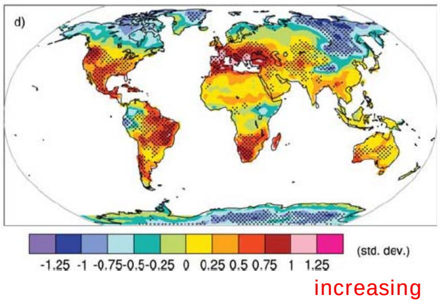
Change of precipitation

- Extreme events like heat wave, draughts or floods are likely to increase in the future climate.

Precipitation intensity (annual total precipitation/number of wet days)



Dry days (annual maximum of consecutive dry day)



- Most of the area may have increasing chance of heavy rain fall.
- Subtropical to mid latitude area may have increasing chance of draught.

Projections of future changes in climate

- Based on current model simulations, it is *very likely* that the meridional overturning circulation (MOC) of the Atlantic Ocean will slow down during the 21st century.
  - longer term changes not assessed with confidence
- Anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized.

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NIES Contribution to IPCC AR4

- 5 Lead Authors and 1 Reviewing Editor for the 3 WGs
  - WG1: Y. Nojiri (LA) and contributors
  - WG2: H. Harasawa (CLA), K. Takahashi, S. Nishioka (RE) and contributors
  - WG3: M. Kainuma (LA), S. Hashimoto (LA) and contriutors
  - NIES research field covers the whole aspect of climate change sciences
- AIM project promotes capacity building of Asian countries

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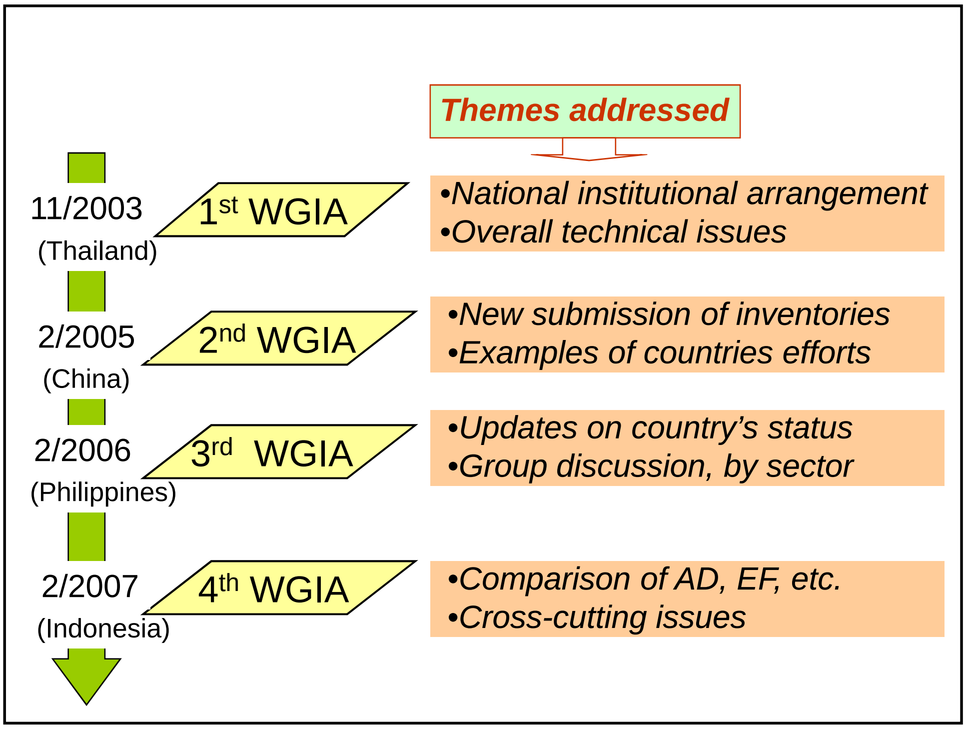
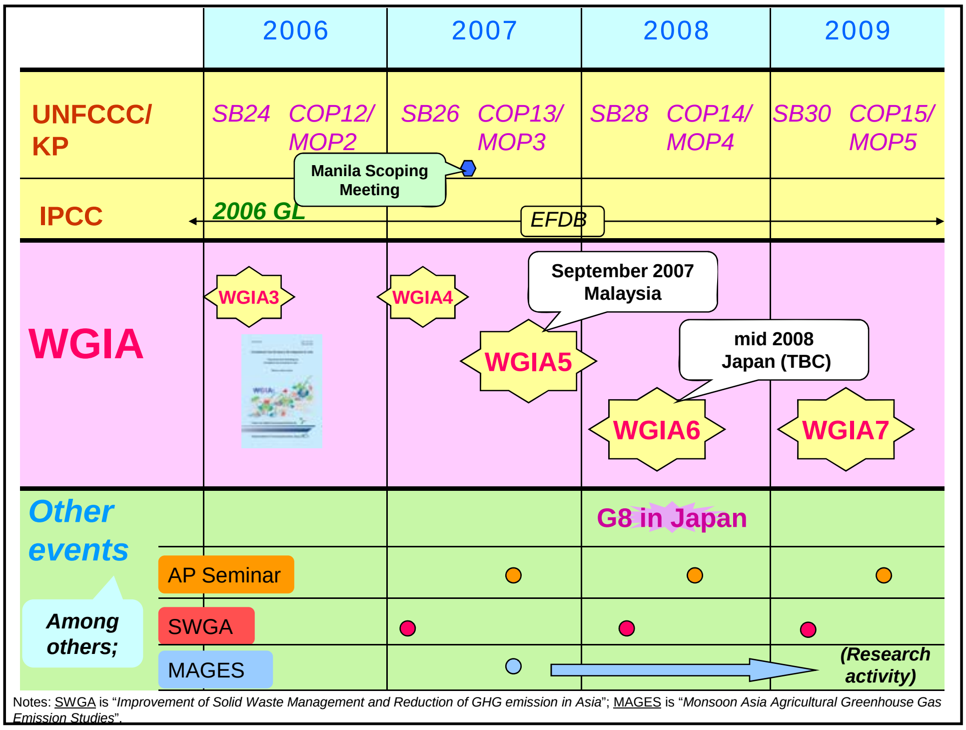
Greenhouse gas Inventory Office of Japan (GIO) in NIES

- Established in 2002
- Committed to prevention of global warming through international collaboration
- Engaged in:
  - Preparation of Japan's national GHG inventories
  - Development of methodologies for compiling GHG inventories
  - Analysis of GHG emissions/removals in Japan
  - **Cooperation on GHG inventory preparations among Asian countries: Workshop on GHG Inventories in Asia (WGIA)**


Themes addressed
11/2003
(Thailand)
1st WGIA
•National institutional arrangement
•Overall technical issues
2/2005
(China)
2nd WGIA
•New submission of inventories
•Examples of countries efforts
2/2006
(Philippines)
3rd WGIA
•Updates on country's status
•Group discussion, by sector
2/2007
(Indonesia)
4th WGIA
•Comparison of AD, EF, etc.
•Cross-cutting issues


2006
2007
2008
2009
UNFCCC/ KP
SB24 COP12/ MOP2
SB26 COP13/ MOP3
SB28 COP14/ MOP4
SB30 COP15/ MOP5
Manila Scoping Meeting
IPCC
2006 GL
EFDB
WGIA
WGIA3
WGIA4
September 2007 Malaysia
WGIA5
mid 2008 Japan (TBC)
WGIA6
WGIA7
Other events
G8 in Japan
AP Seminar
Among others;
SWGA
MAGES
(Research activity)
Notes: SWGA is "Improvement of Solid Waste Management and Reduction of GHG emission in Asia"; MAGES is "Monsoon Asia Agricultural Greenhouse Gas Emission Studies".