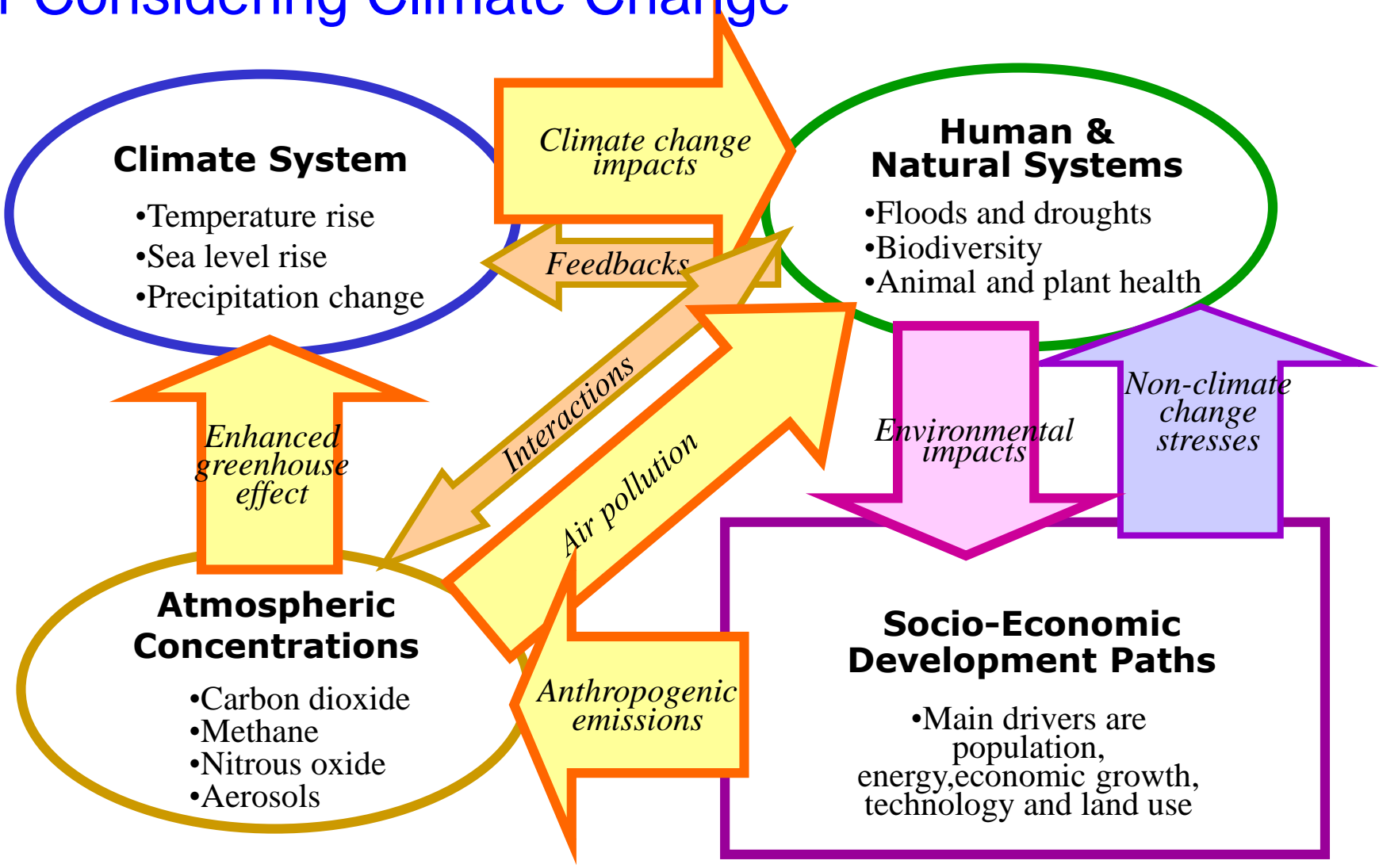


Climate Projection and Scenarios

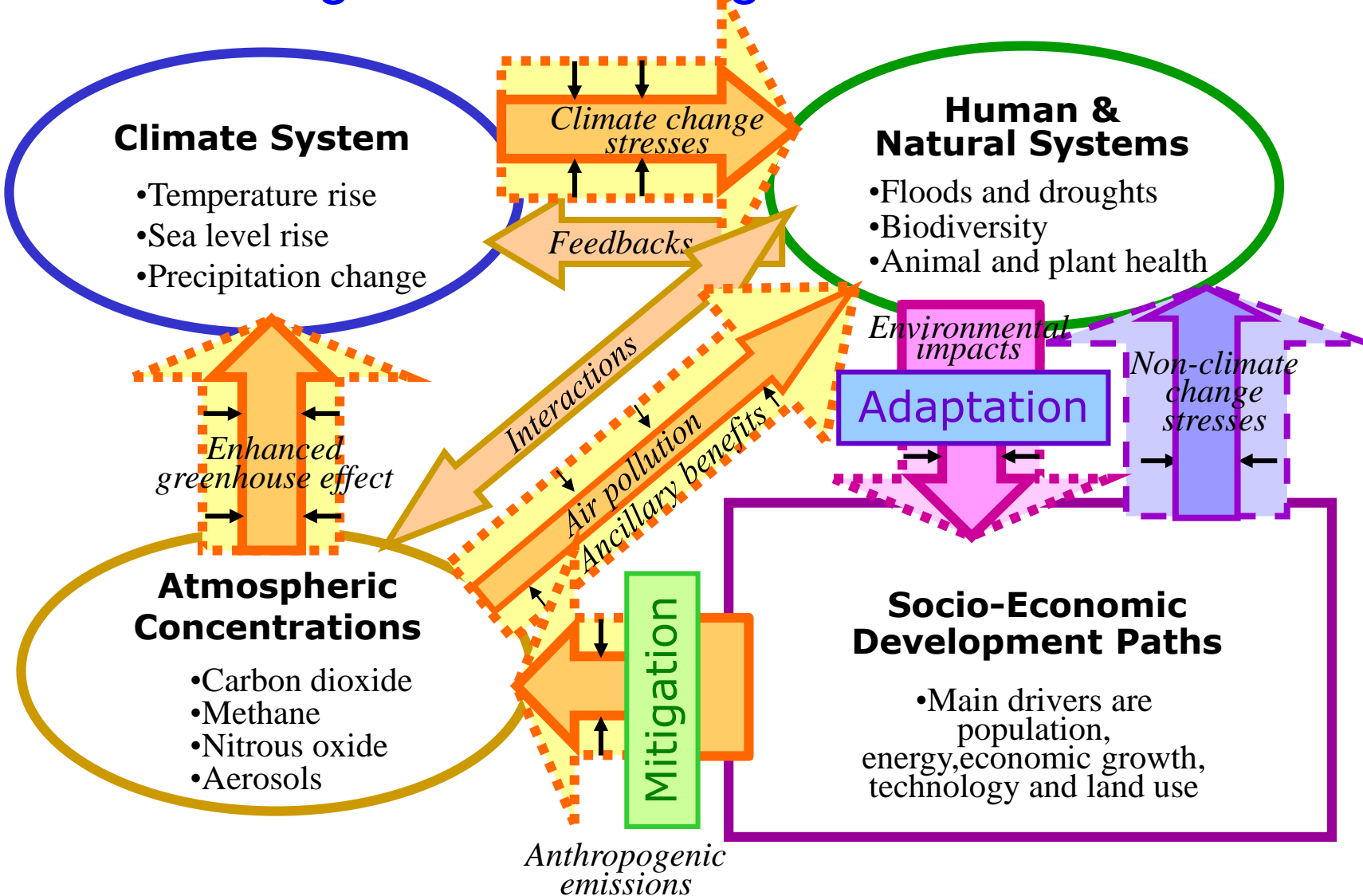
Kiyoshi Takahashi

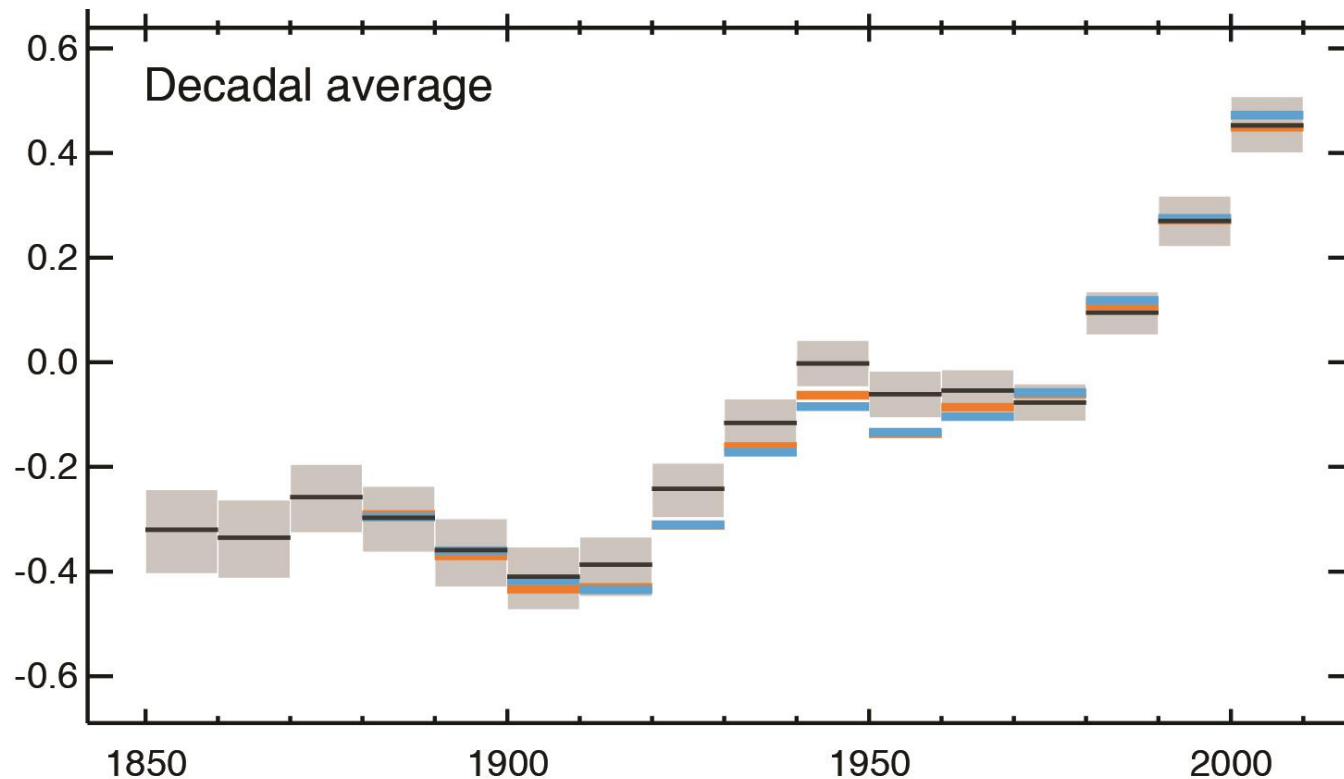
Center for Social and Environmental Systems Research
National Institute for Environmental Studies

An Integrated Assessment Framework for Considering Climate Change



An Integrated Assessment Framework for Considering Climate Change

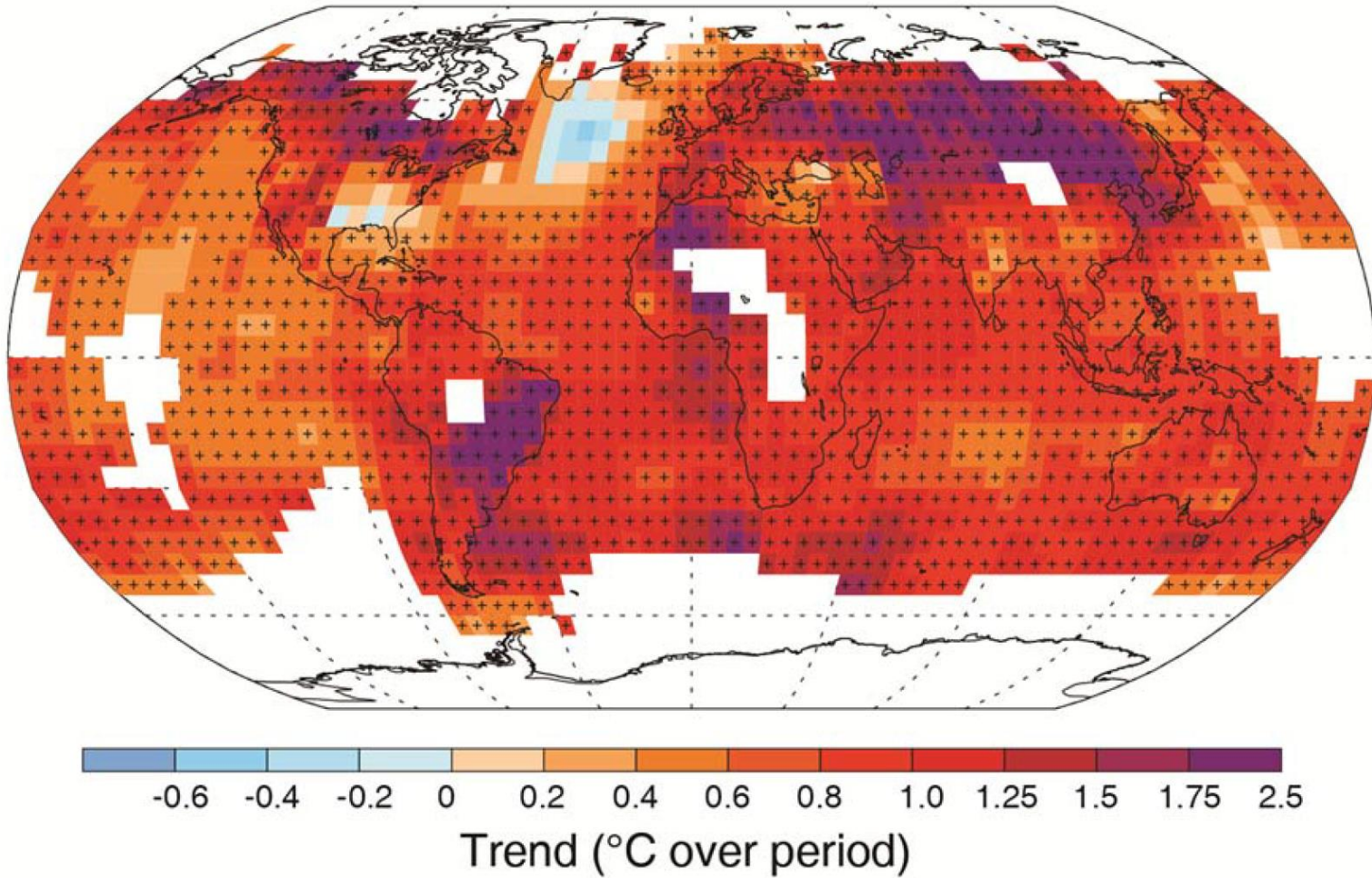




(IPCC 2013, Fig. SPM.1a)

Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850.

In the Northern Hemisphere, 1983–2012 was *likely* the warmest 30-year period of the last 1400 years (*medium confidence*).

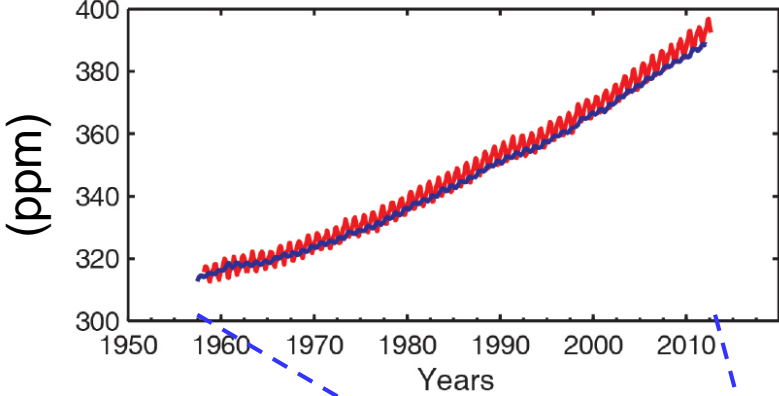


(IPCC 2013, Fig. SPM.1b)

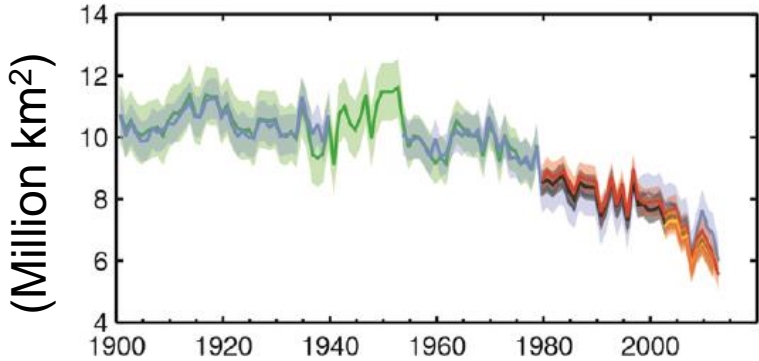
Warming in the climate system is unequivocal

GHGs, Temperatures and Sea level have rapidly risen since the 20th Century

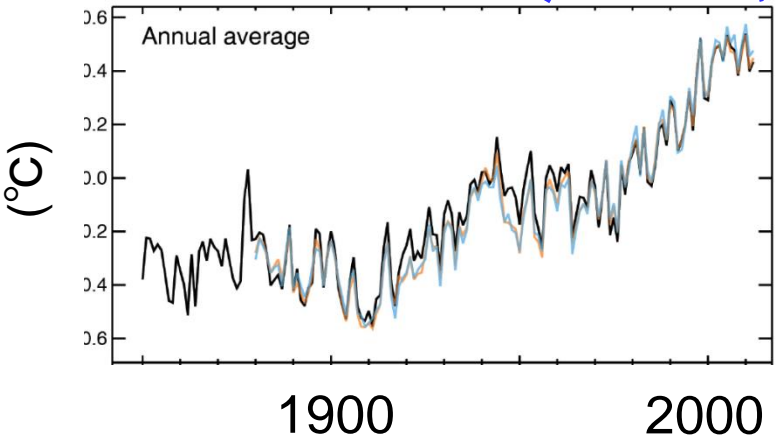
Carbon Dioxide
(ppm)



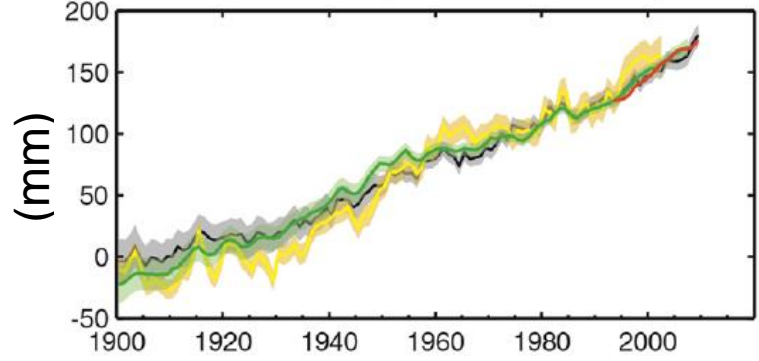
Summer Arctic
Sea Ice Extent



Global Mean
Temperature Change
(°C)

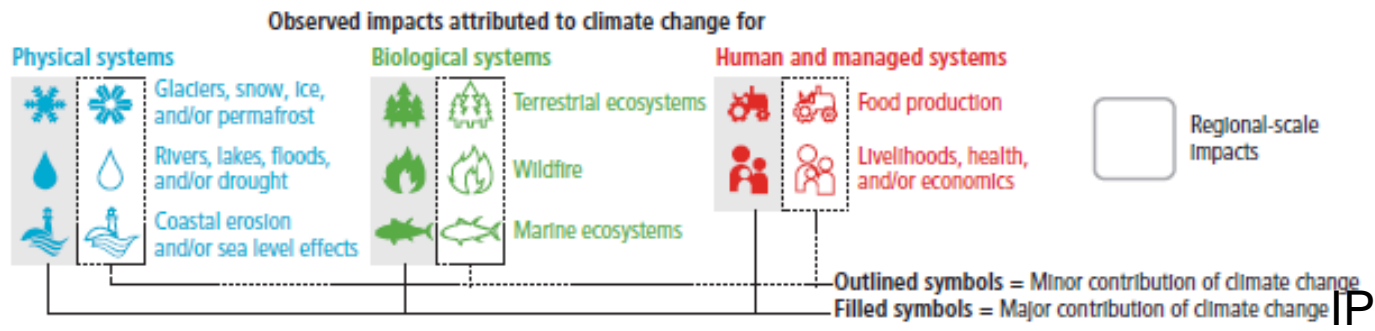
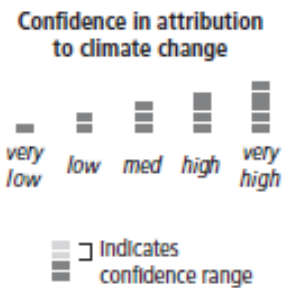
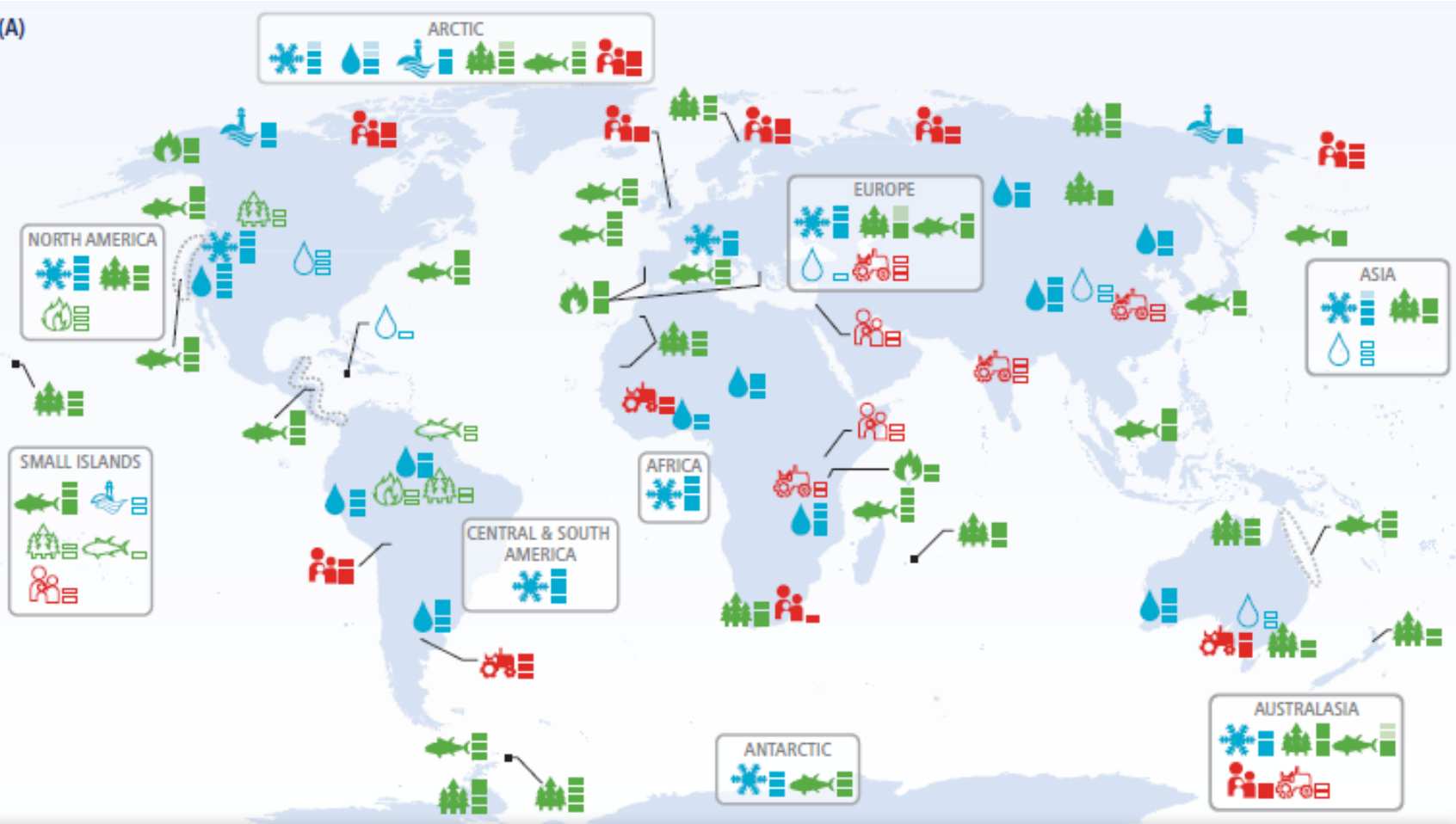


Global Mean Sea Level

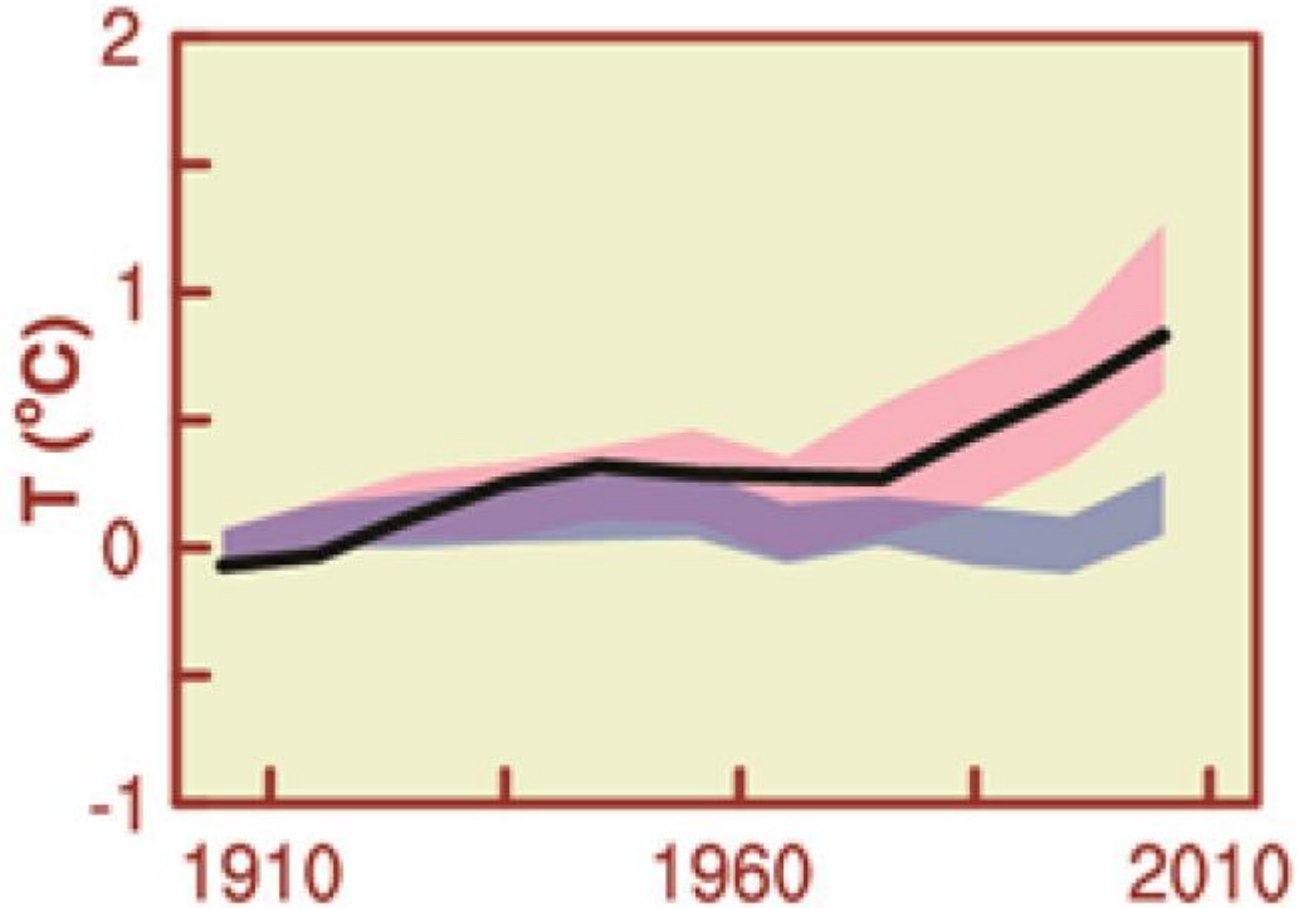


Observed Impacts

(A)



Attribution of the observed climate change



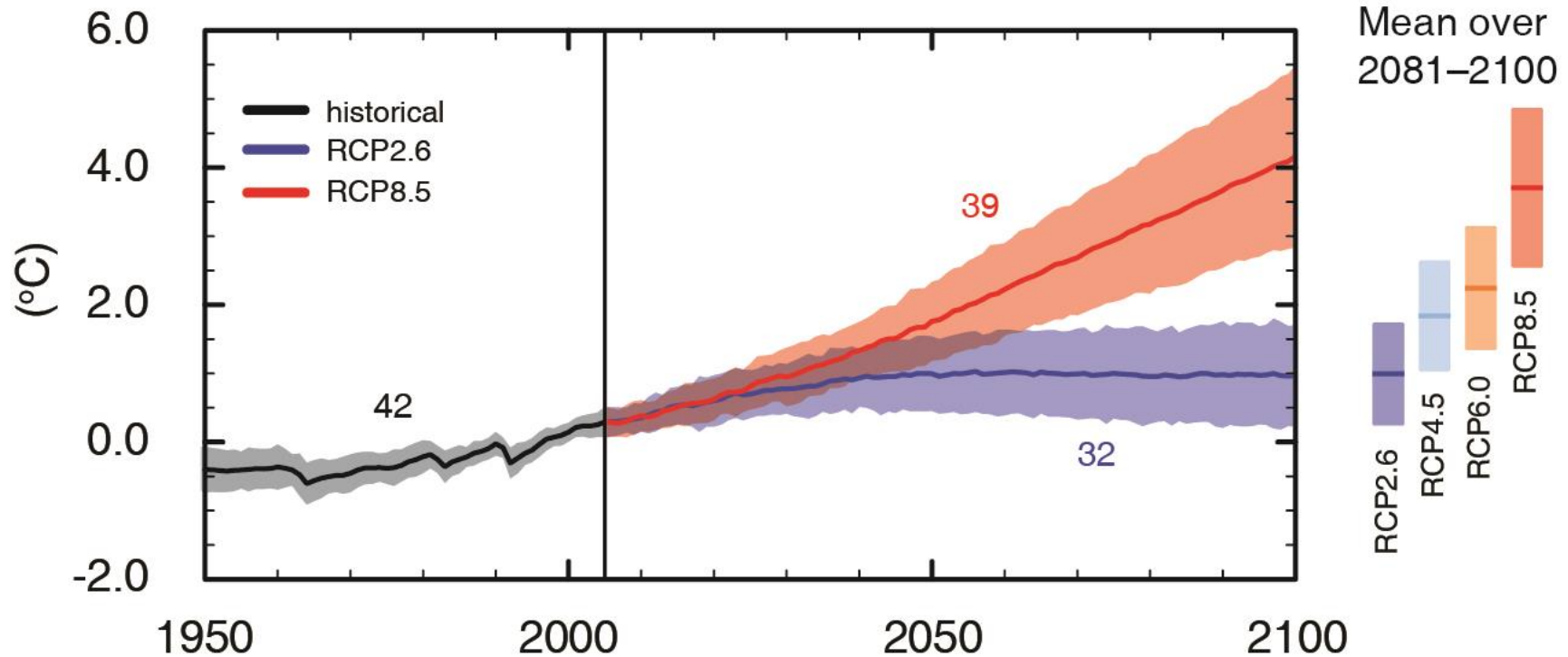
Black: observed

Red: Simulated with Natural (Solar+Volcanic) +Anthropogenic (GHGs etc.) forcings

Blue: Simulated only with Natural forcings

It is *extremely likely* (> 95%) that human influence has been the dominant cause of the observed warming since the mid-20th century.

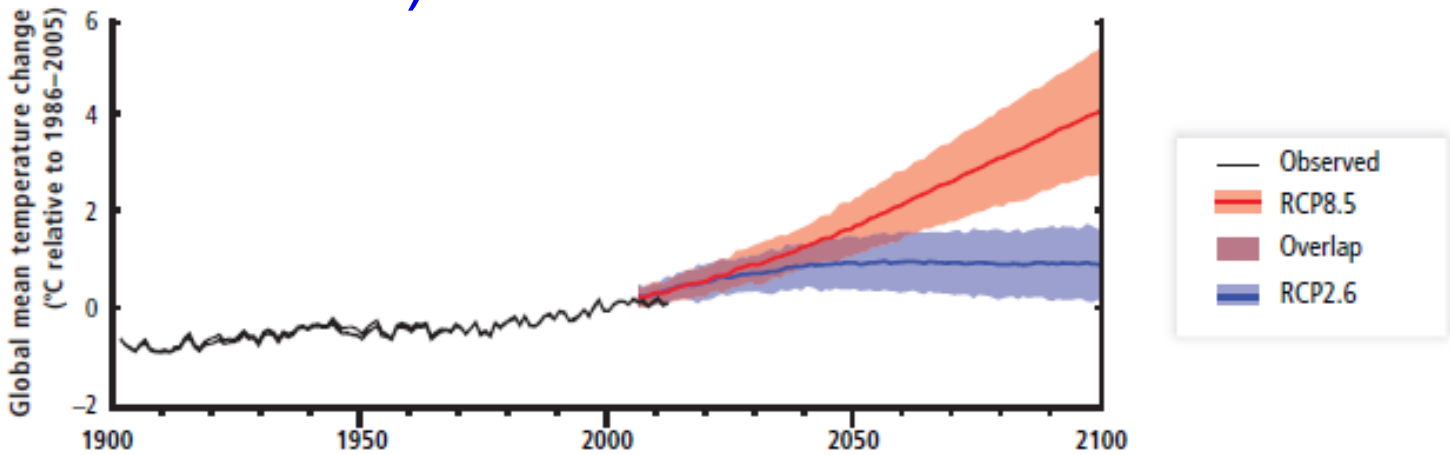
Global average surface temperature change



(IPCC 2013, Fig. SPM.7a)

Global surface temperature change for the end of the 21st century is *likely* to exceed 1.5° C relative to 1850 for all scenarios

Projected Temperature Change in the 21st century (RCP2.6 and RCP8.5)

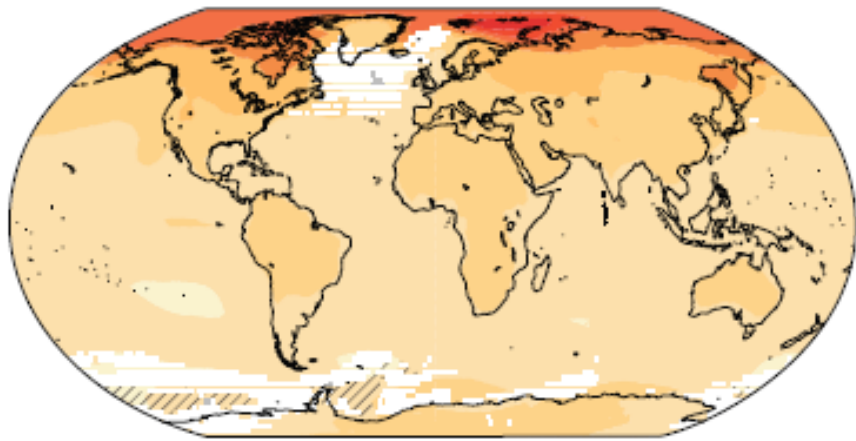


Projected Temperature Change

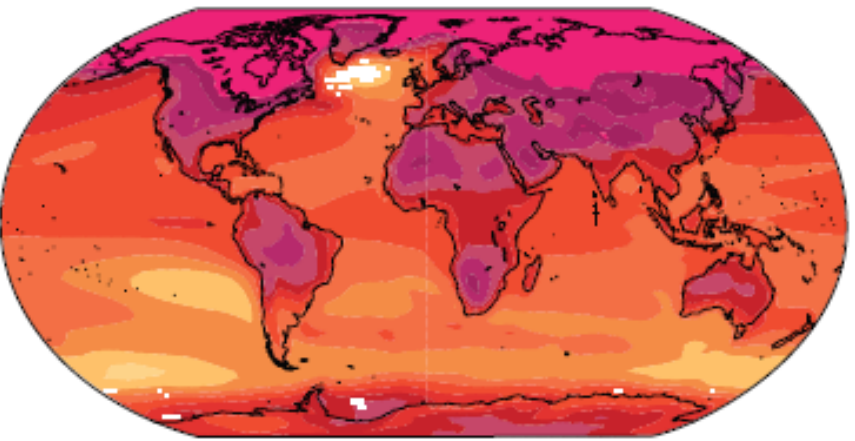


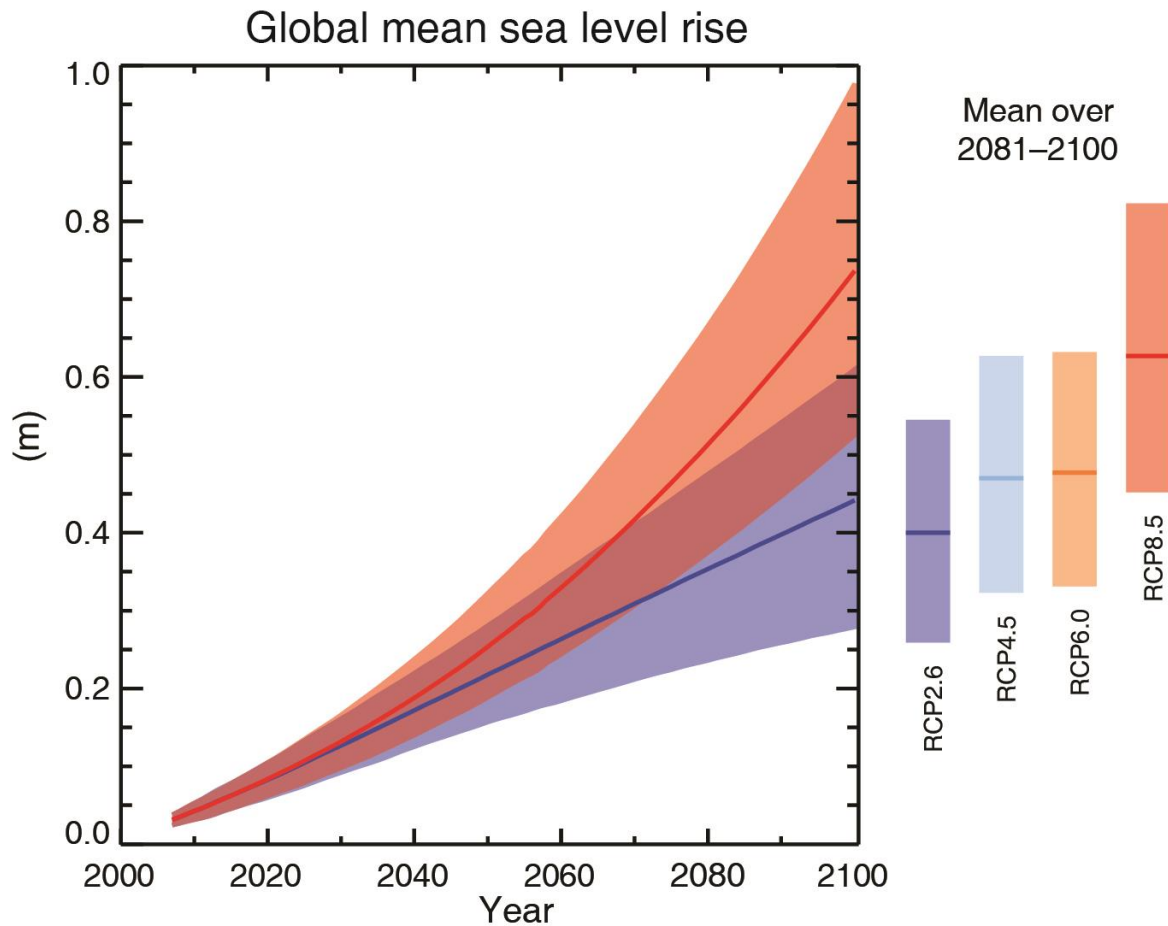
Solid Color	Very strong agreement	White Dots	Strong agreement
Gray	Divergent changes	Diagonal Lines	Little or no change

RCP2.6 2081-2100



RCP8.5 2081-2100





(IPCC 2013, Fig. SPM.9)

Global mean sea level will continue to rise during the 21st century

Past and Future Trends of Extreme Events

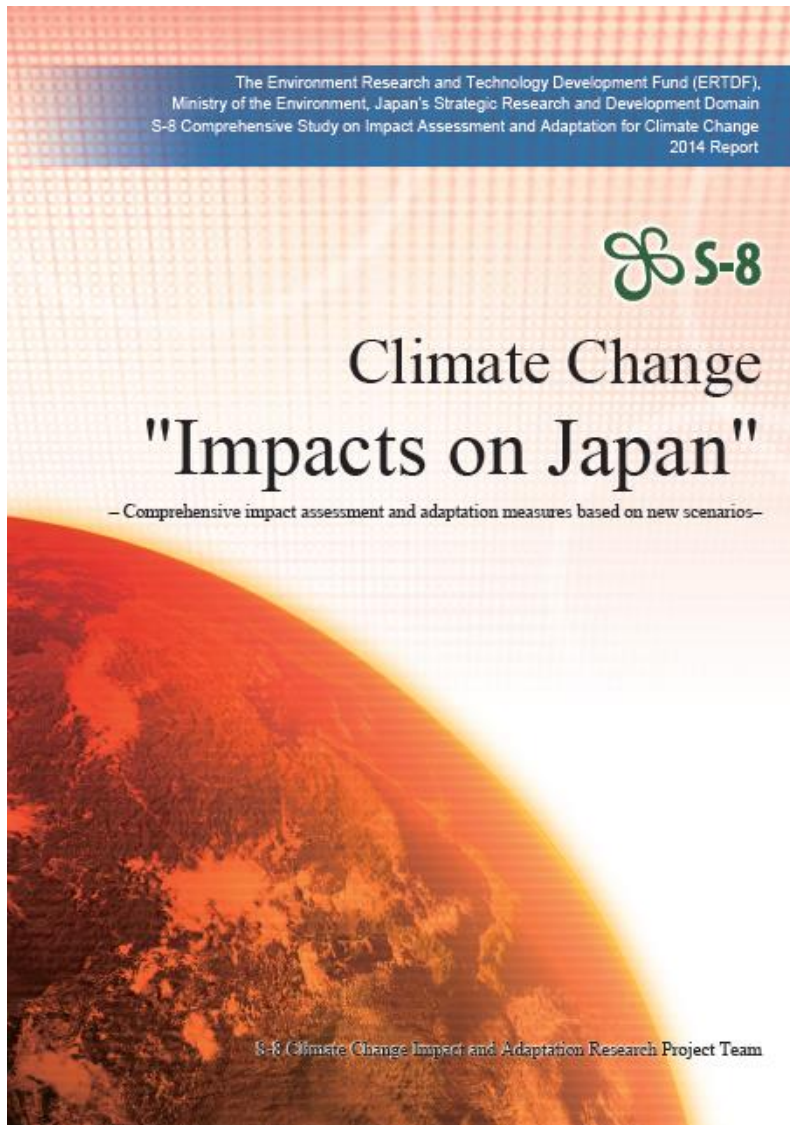
Phenomena and direction of trend	Changes occurred (typically 1950~)	Human contribution	Likelihood of future changes (Late 21C)
Warmer/fewer cold days/nights	Very likely	Very likely	Virtually certain
Warmer/more hot days/nights	Very likely	Very likely	Virtually certain
More/longer heat waves	Likely in some regions	Likely	Very likely
More/more intense heavy precipitation events	Likely more land with increases than decreases	<i>Medium confidence</i>	Very likely over most mid-latitude land and wet tropics
More/longer drought	Likely in some regions	<i>Low confidence</i>	Likely
Increases in intense tropical cyclones	<i>Low confidence</i>	<i>Low confidence</i>	More likely than not
More extreme high sea level	Likely	Likely	Very likely

Co-development of climate scenarios for impact assessment

- Examples of what we can provide -

- Utilization of CMIP5 climate projections
 - Experience in coordination of the scenarios used in S-8 project (MoEJ-funded project for comprehensive projection of climate change impacts in Japan).
 - Web database system for efficient handling of the CMIP5 data
- Provision of climate projections originally conducted in Japan after the CMIP5 process
 - MoEJ's climate projections for supporting adaptation planning
 - MEXT's large-ensemble experiments
 - d4PDF/d2PDF

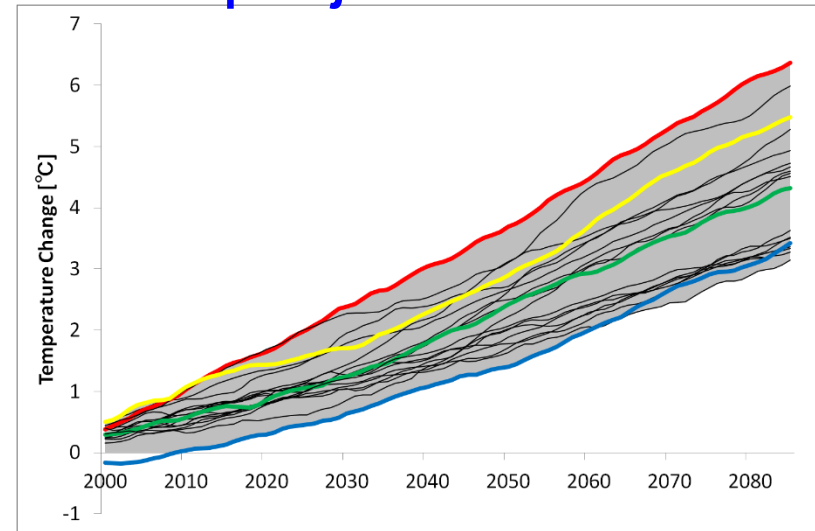
Experience in scenario development for the S-8 project



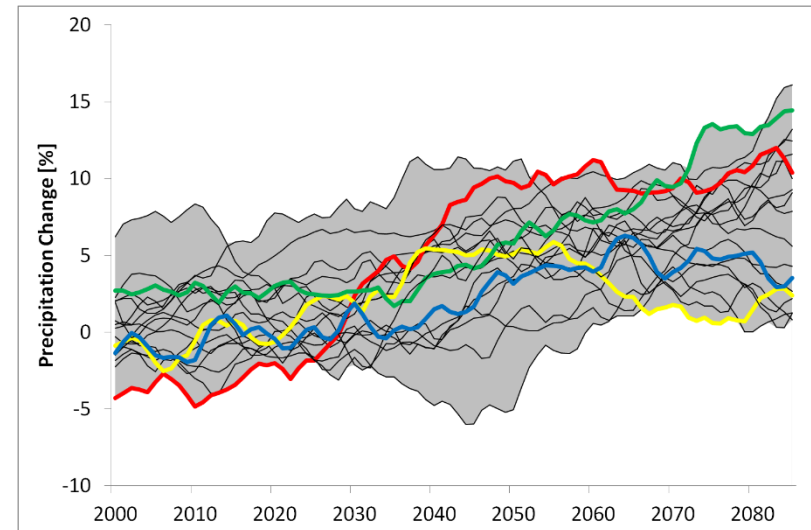
- S-8: Assessment of climate change impacts and adaptation strategy on whole Japan and local government (funded by MoEJ)
- The report which compiled research findings were published in March 2014.
 - http://www.nies.go.jp/s8_project/symposium/20141110_s8english.pdf

Choice of climate scenarios in the S-8 project

- Emission scenario
 - For considering uncertainty range, we chose RCP8.5 and RCP2.6.
 - Considering on the availability of dynamical downscaling data, we also chose RCP4.5.
- Climate model
 - Among the CMIP5 models, we chose two Japanese models (MIROC5 and MRI-CGCM3.0).
 - Additionally, two more GCMs (GFDL CM3 and HadGEM2-ES) were chosen.
 - Among the models with comparatively higher ability to reproduce 20c climate, we chose two models that could let us consider uncertainty range of temperature increase and precipitation change around Japan island.



Projected temperature change around Japan



Projected precipitation change rate around Japan

GFDL CM3; HadGEM2-ES; MIROC5; MRI-CGCM3 and other 15 GCMs (RCP8.5)

Web-based climate scenario database system

The screenshot shows the website for the Global Meteorological Data Server. At the top, there is a navigation bar with 'H08 Server', 'Terms and Conditions', 'Contents', and 'Link'. The main heading is 'Global Meteorological Data Server [beta release]'. Below this, there is introductory text about visualizing and downloading data, a disclaimer, and an important notice dated April 14, 2015, regarding equipment changes. A table of updates follows, with entries for Feb 20, 2014 and Nov 15, 2013. Three main tool buttons are visible: 'Data Downloader' (providing H08 / NetCDF files), 'Time Series Viewer' (providing time-series graphs), and 'Map Viewer' (providing colored map images). Below these are two sections for 'Recently downloaded monthly files' and 'Recently downloaded daily files', each containing a table of file names and dates. The footer includes funding information from NIES and a system tray at the bottom showing the date as 2015/08/21.

Global Meteorological Data Server [beta release]

You will be able to visualize and download various global meteorological data using sophisticated web interface. You will find complete datasets on climate change projection originally provided by CMIP3 and CMIP5. The data and interface are being updated. See README.pdf [en / ja] for more information. The present status of data collection is available here [en / ja].

Disclaimer: We do not provide any warranty that the contents will be error-free.

Important
Global Meteorological Data Server are going to be exchanged the equipment on April 14, 2015
It will be difficult to connect to Global Meteorological Data Server on this day. We apologize for the inconvenience, and thank you for your patience.

Date	Update [en]	Update [ja]
Feb, 20, 2014	Solved Find some technical problems on Data Downloader and revise the service. [Detail] (Japanese)]	Solved Data Downloaderにおいて技術的な問題が発見されたため、修正を行いました。[詳細]
Nov, 15, 2013	Solved Find some technical problems when processing CMIP5 daily datasets. The web service (file distribution via query) for the datasets is not available until we fix all problems.	Solved CMIP5の日単位データの処理において技術的な問題が見つかりました。全ての検証と調査が終わるまでこれらのモデルに関するwebサービス(クエリを介したファイルの配布)を停止します。この間、データダウンロードサービスは正常に動作します。

Data Downloader
provides H08 / NetCDF formatted files.
[GSWP2] [CMIP3] [CMIP5]

Time Series Viewer
provides time-series graphs using GrADS.
[GSWP2] [CMIP3] [CMIP5]

Map Viewer
provides colored map images using GrADS.
[GSWP2] [CMIP3] [CMIP5]

Recently downloaded monthly files
Latest 100 files archived. The complete list is available here [en / ja].

Date	Time	File Name
2015-02-10	11:21:31	tas_Amon_MIROC-ESM-CHEM_rcp45_g01p1_200601-210012.nc
2015-02-10	11:21:31	tas_Amon_MIROC-ESM-CHEM_rcp45_g01p1_200601-210012.nc
2015-02-02	09:43:35	zos_Omon_CESM1-FASTCHEM_historical_r11p1_185001-200512.nc
2014-11-11	14:53:43	hurs_Amon_GFDL-ESM2M_historical_r11p1_198001-199012.nc

Recently downloaded daily files
Latest 100 files archived. The complete list is available here [en / ja].

Date	Time	File Name
2015-02-10	11:21:31	tas_Amon_MIROC-ESM-CHEM_rcp45_g01p1_200601-210012.nc
2015-02-10	11:21:31	tas_Amon_MIROC-ESM-CHEM_rcp45_g01p1_200601-210012.nc
2015-02-02	09:43:35	zos_Omon_CESM1-FASTCHEM_historical_r11p1_185001-200512.nc
2014-11-11	14:53:43	hurs_Amon_GFDL-ESM2M_historical_r11p1_198001-199012.nc

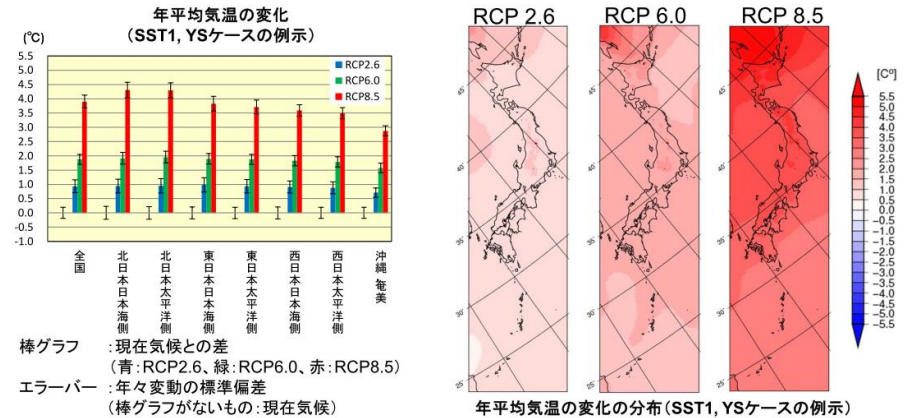
This project was funded by NIES Special Research Fund (Apr 2009 - Apr 2013)
Development of water demand and trade models for a global water-resources model and their application to long term scenario analysis

- Data archived
 - Present data (GSWP2) and future projections (CMIP3 and CMIP5; monthly and daily)
- Tools
 - Basic data processing (interpolation and regional trimming) and visualization

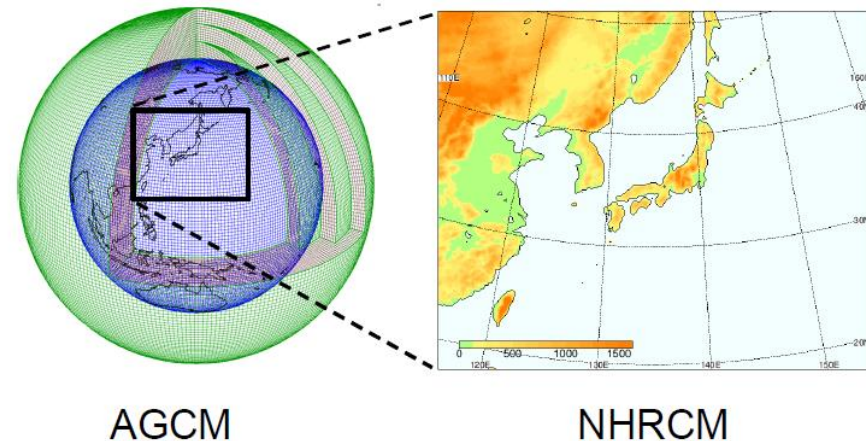
MoEJ's climate projections to support adaptation planning

- Background and objective
 - To support the development of the first national adaptation plan due in this summer
- Features of the projections
 - **GCM (MRI-AGCM60;60km)**
→ RCM (MRI-NHRCM20;20km)
 - Contribution of JMA/MRI
 - Present (1984-2004) and future period (2080-2100)
 - Four GHG emission scenarios (RCP2.6/4.5/6.0/8.5)
 - Three different Δ SST patterns based on CMIP5 data as a boundary condition
 - Three different physics schemes

Example: Temperature increase around Japan island in this century.

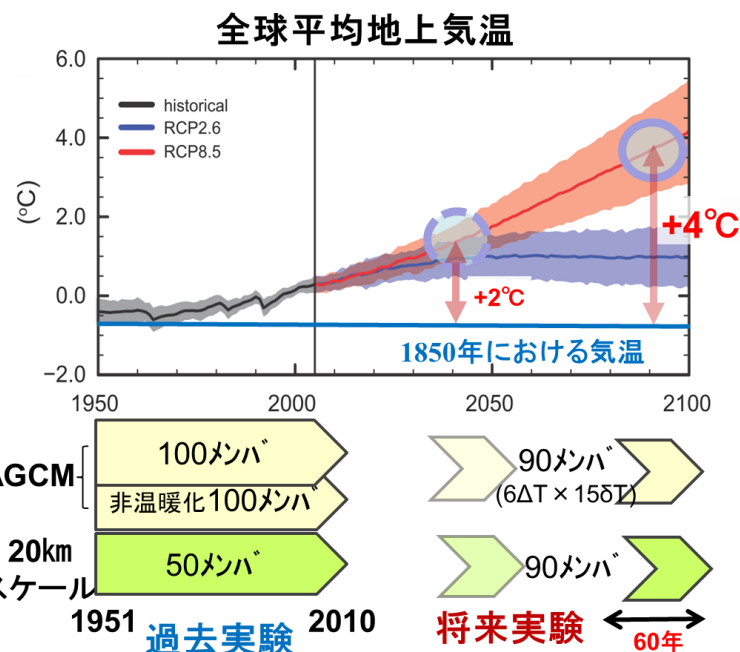
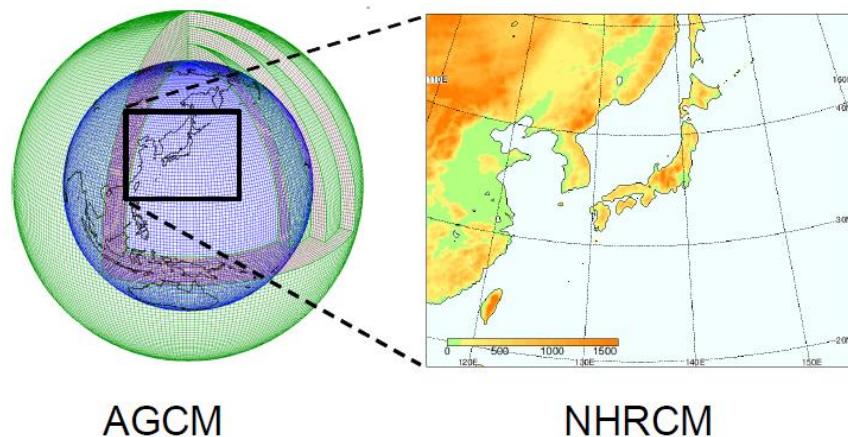


Both GCM outputs covering whole the world and RCM outputs exclusively for studies on Japan are publicized.



d4PDF by SOUSEI program funded by MEXT

- The d4PDF consists of outputs from **global warming simulations by a AGCM** and from regional downscaling simulations covering the Japan area by a RCM with **horizontal grid spacing of 60 km** and 20 km, respectively.
- The climate of the latter half of the 20th century is simulated for 6000 years (3000 years for the Japan area), and the climate **4 K warmer than the pre-industrial climate is simulated for 5400 years**, to see the effect of global warming.
- From large ensemble simulations, probabilistic future changes in **extreme events** are available directly without using any statistical models.
- The simulation outputs are open to the public, which is intended to be utilized for impact assessment studies and adaptation planning for global warming.



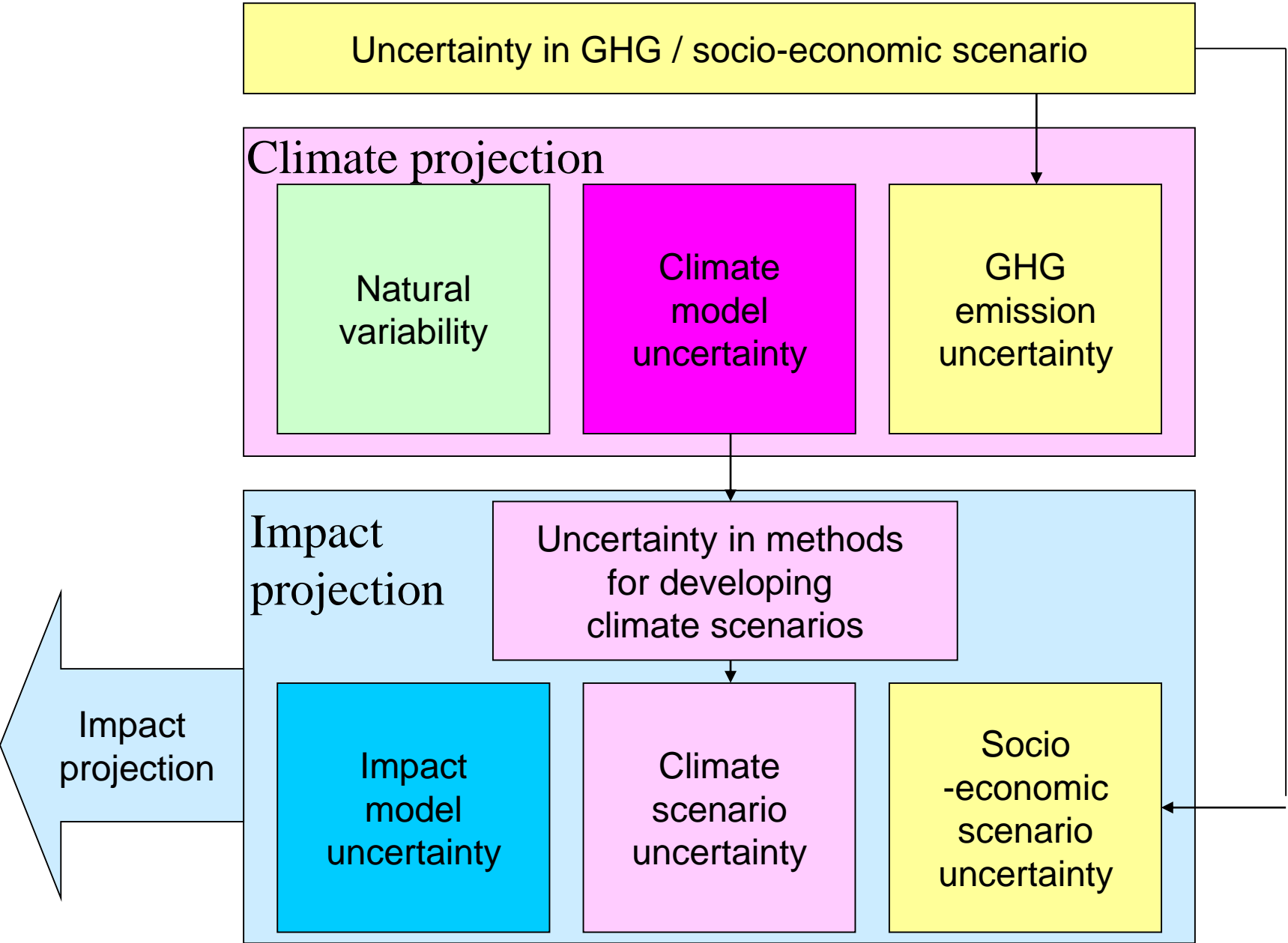
CORDEX South Asia, East Asia and Central Asia

- CORDEX

- Coordinated Regional Climate Downscaling Experiment
- 14 region domains including S.Asia, E.Asia, and C.Asia.
- Intercomparison of dynamical downscaling simulations conducted by regional climate models about 20km spatial resolution



Various uncertainties in impact projection



Thank you

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