SIXTH ASSESSMENT REPORT
Working Group I – The Physical Science Basis

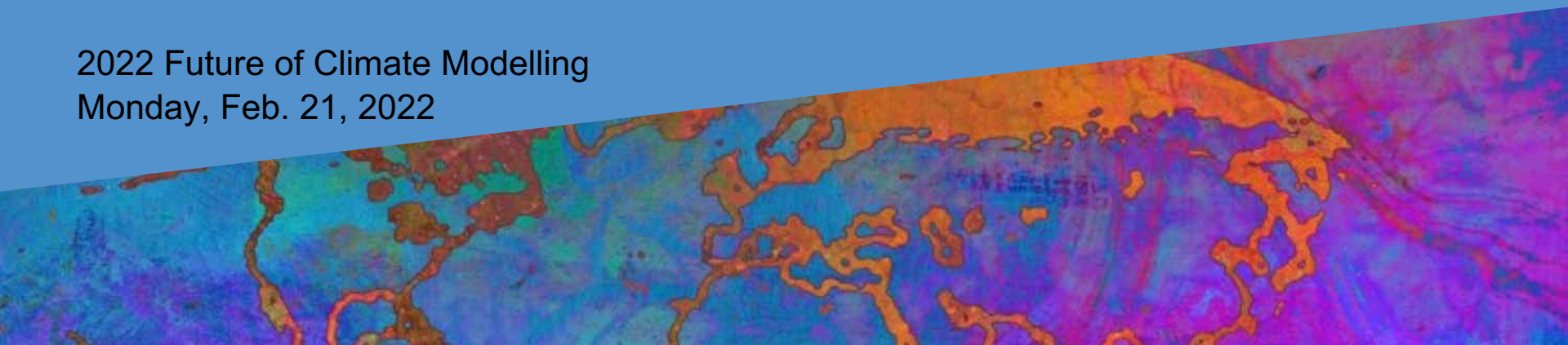
ipcc
INTERGOVERNMENTAL PANEL ON climate change

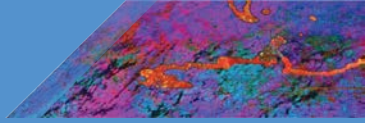
WMO UNEP

Challenges of Climate Modelling: AR6

June-Yi Lee, IBS Center for Climate Physics
Baylor Fox-Kemper, Brown University

2022 Future of Climate Modelling
Monday, Feb. 21, 2022





In AR6, important roles played by (especially in process/regional chps):

CMIP6

1) Deck--notable for ECS/TCR vs. CMIP5
2) Scenarios
3) HighResMIP
4) PMIP
5) other MIPs

Other Models

1) Emulators
2) Reanalysis
3) CORDEX, RCMs
4) Other Regional/Process Models, e.g.,

   GlacierMIP

   ISMIP6

Sea Surface Temperature (SST) and its changes with time.

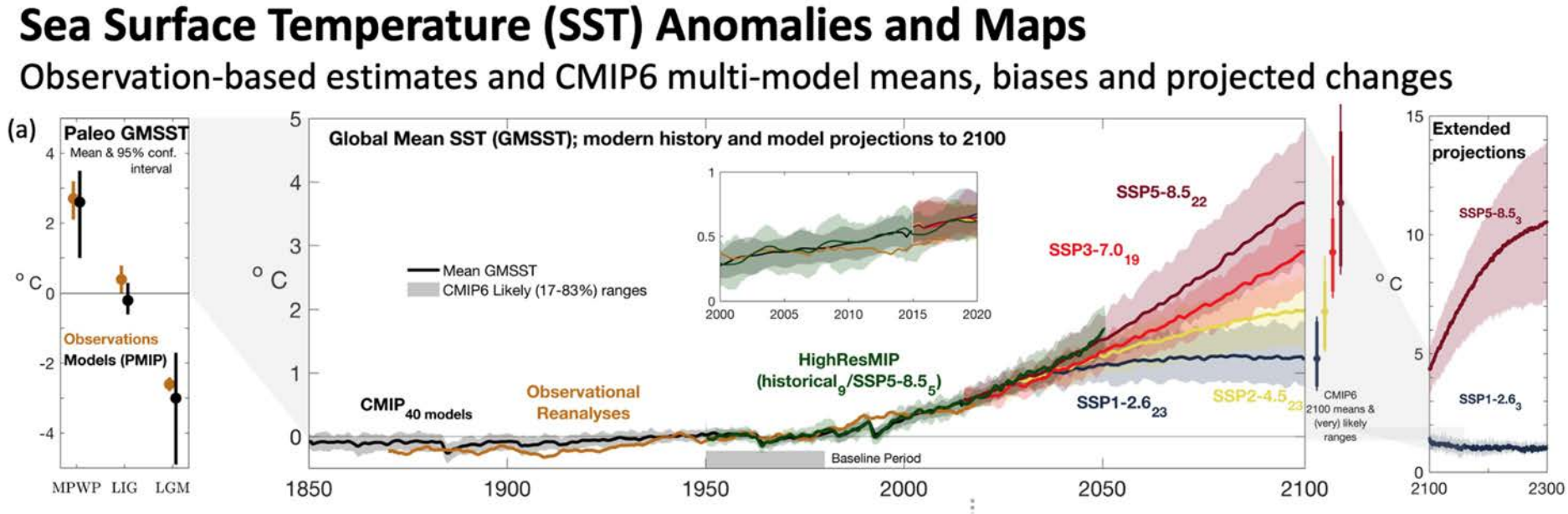
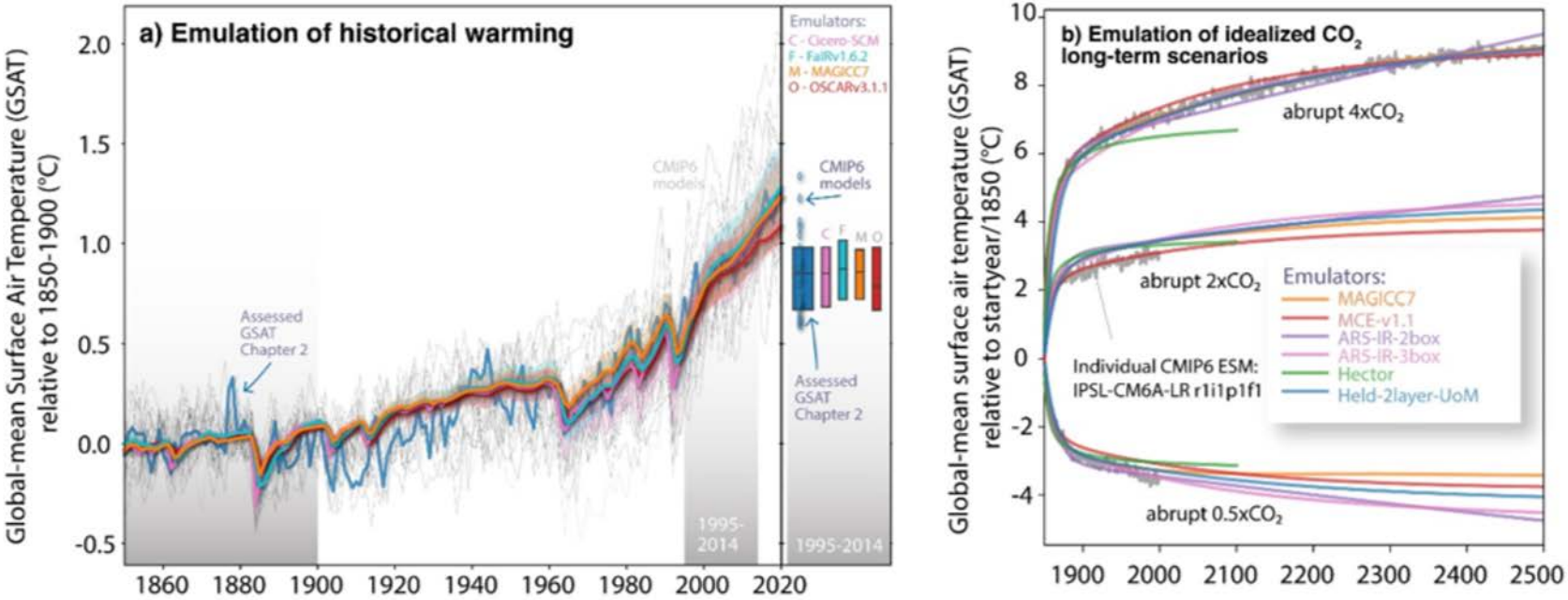
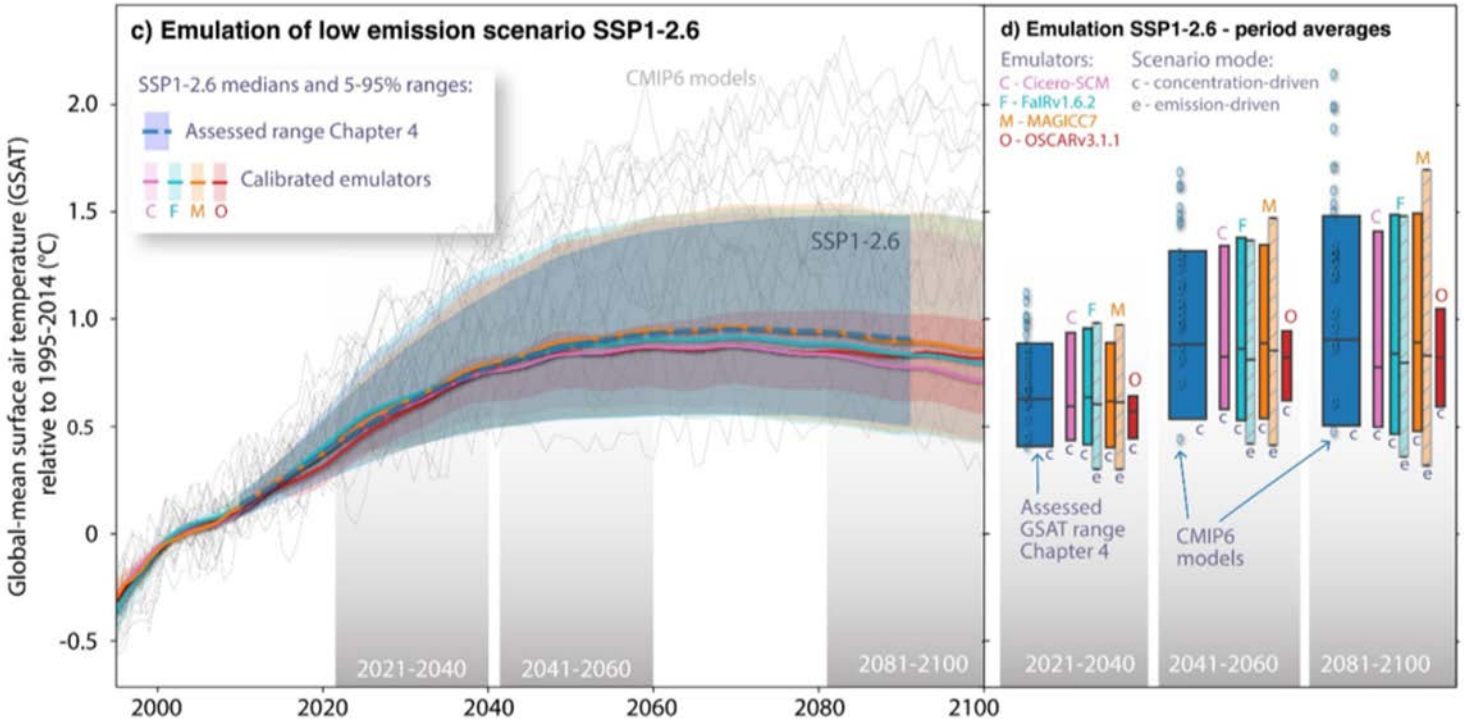


Fig 9.6: Reanalysis, CMIP6, HighResMIP, PMIP, Extended



Cross-Chapter Box 7.1, Fig 1: CMIP6, Historical, Deck, Emulators



Cross-Chapter Box 7.1, Fig 1: CMIP6, Scenarios, Emulators

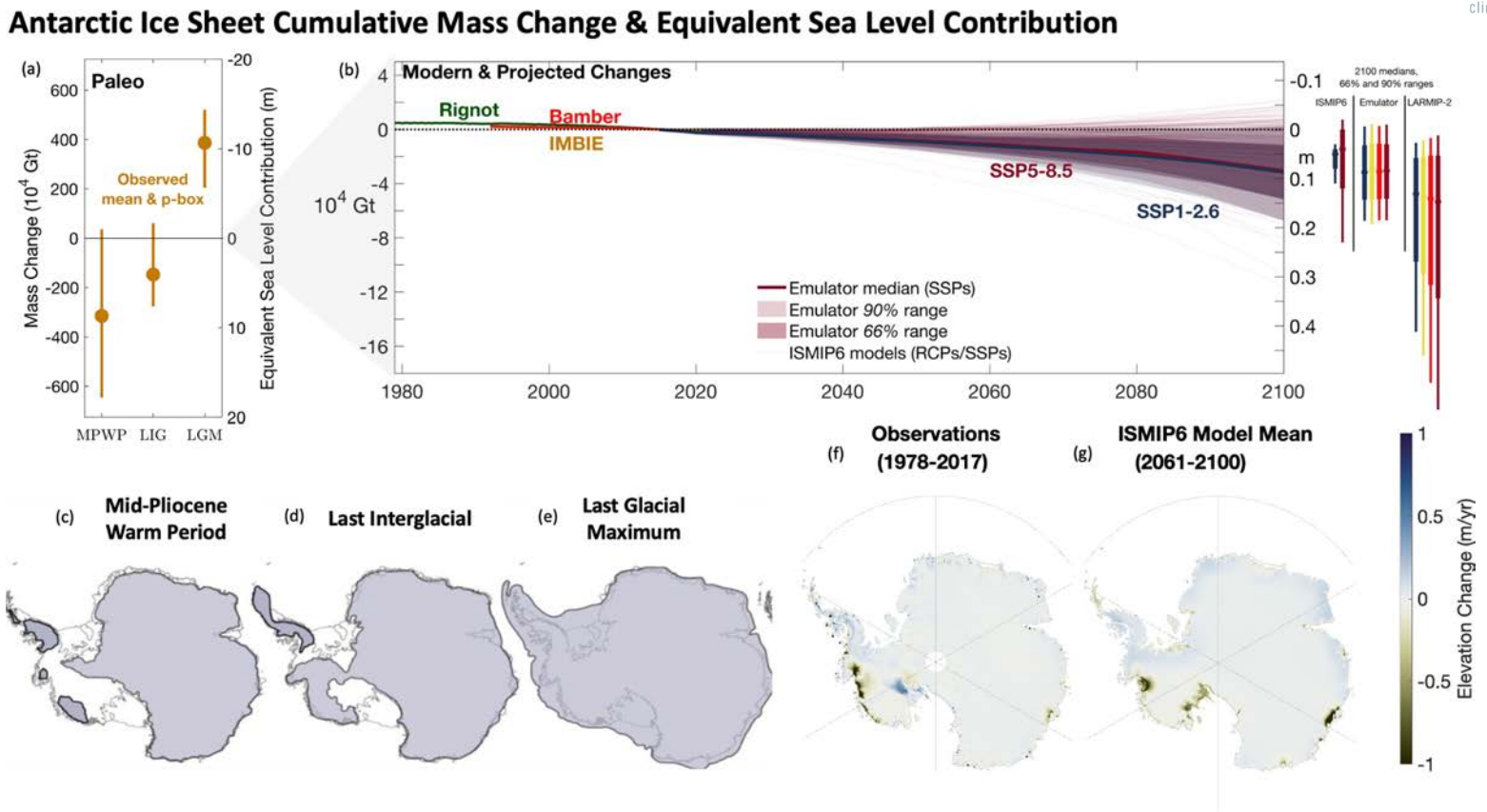


Fig 9.19: CMIP6, ISMIP6, Scenarios, Emulators, PMIP

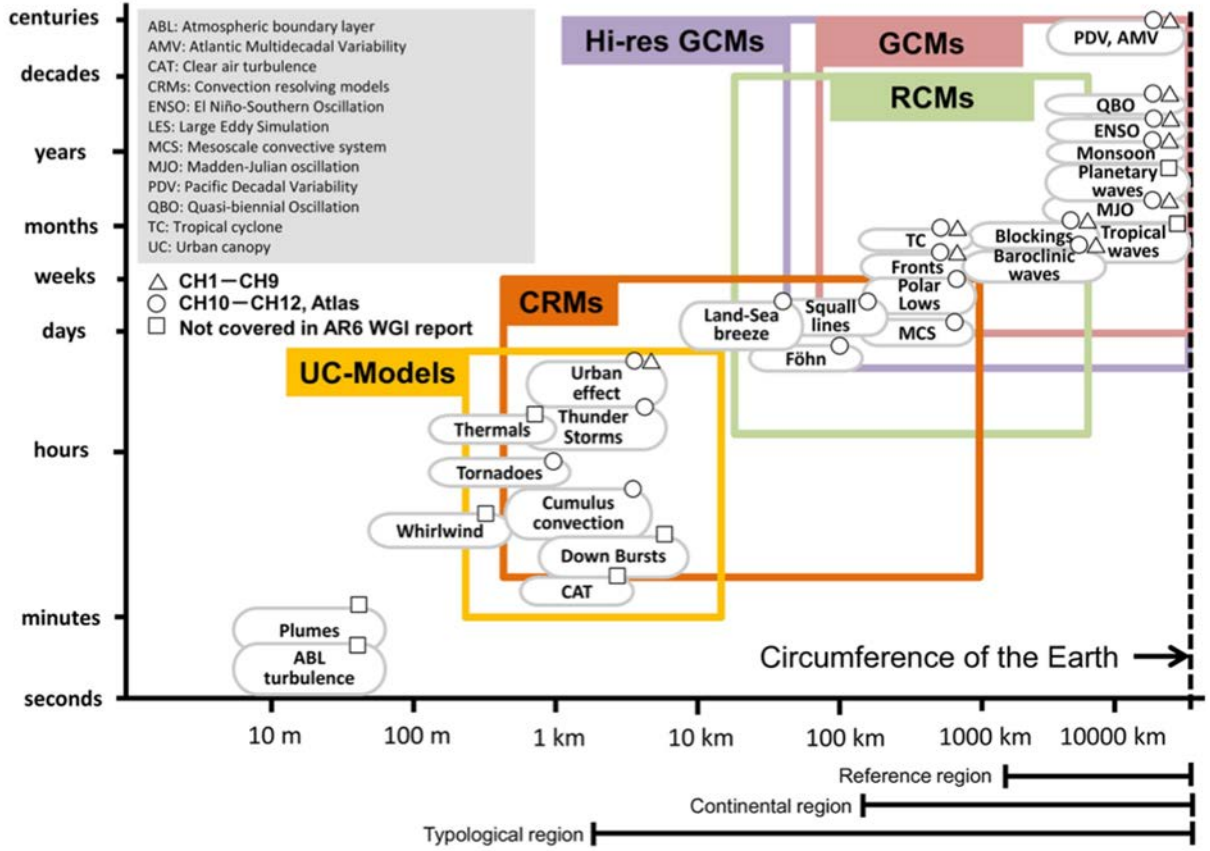
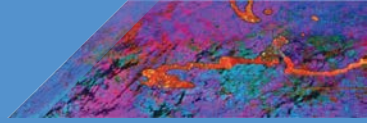


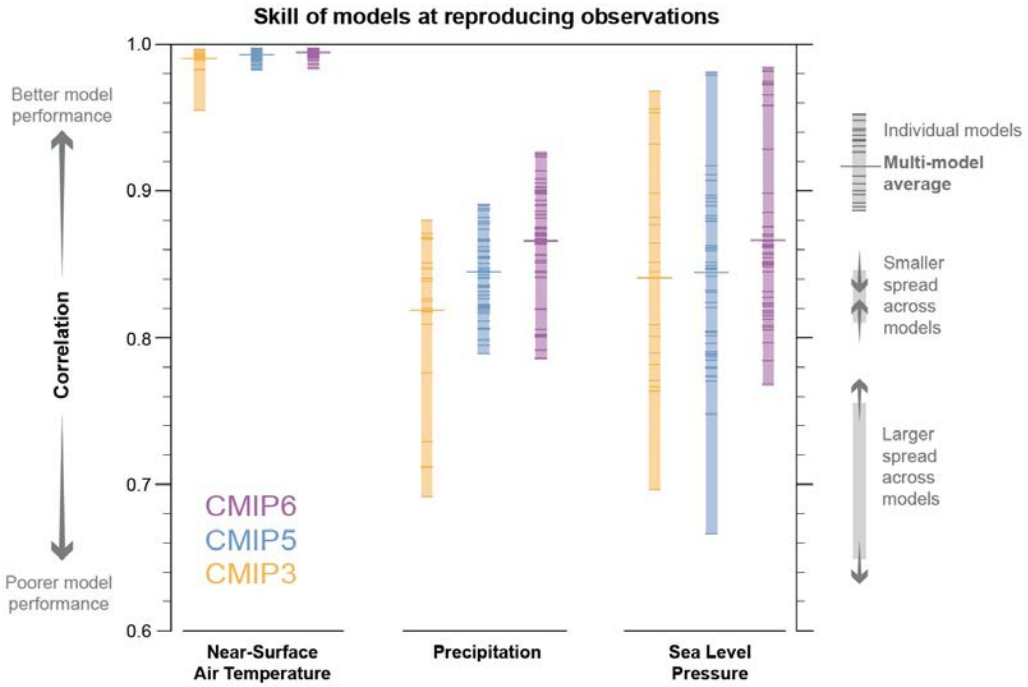
Fig 10.3: CMIP, RCMs, CORDEX, etc.



Challenges of Climate Modeling:
The IPCC Assessment Perspective

- Improving the “fitness-for-purpose” of climate models
- Better quantifying various sources of uncertainty
- Improving near-term climate information for risk assessment and adaptation
- Better constraining future changes beyond GSAT, OHC, and GMSL
- Improving regional climate information
- Issues on scenario selection and scenario feasibility

Improving the "fitness-for-purpose" of the climate models



FAQ 3.3, Fig.1

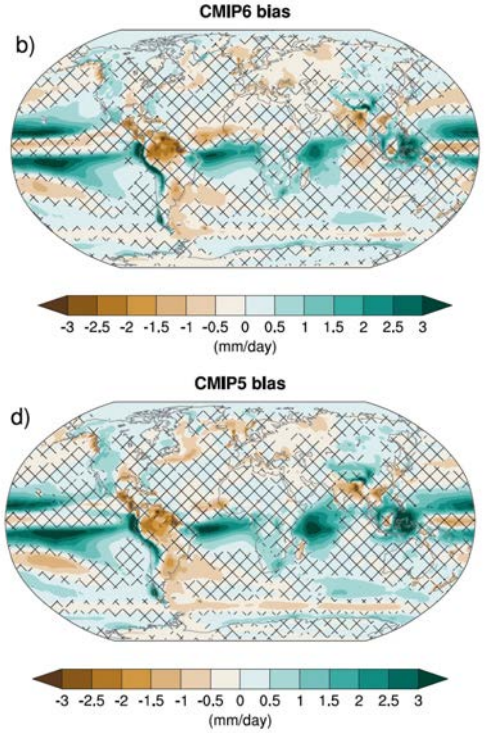
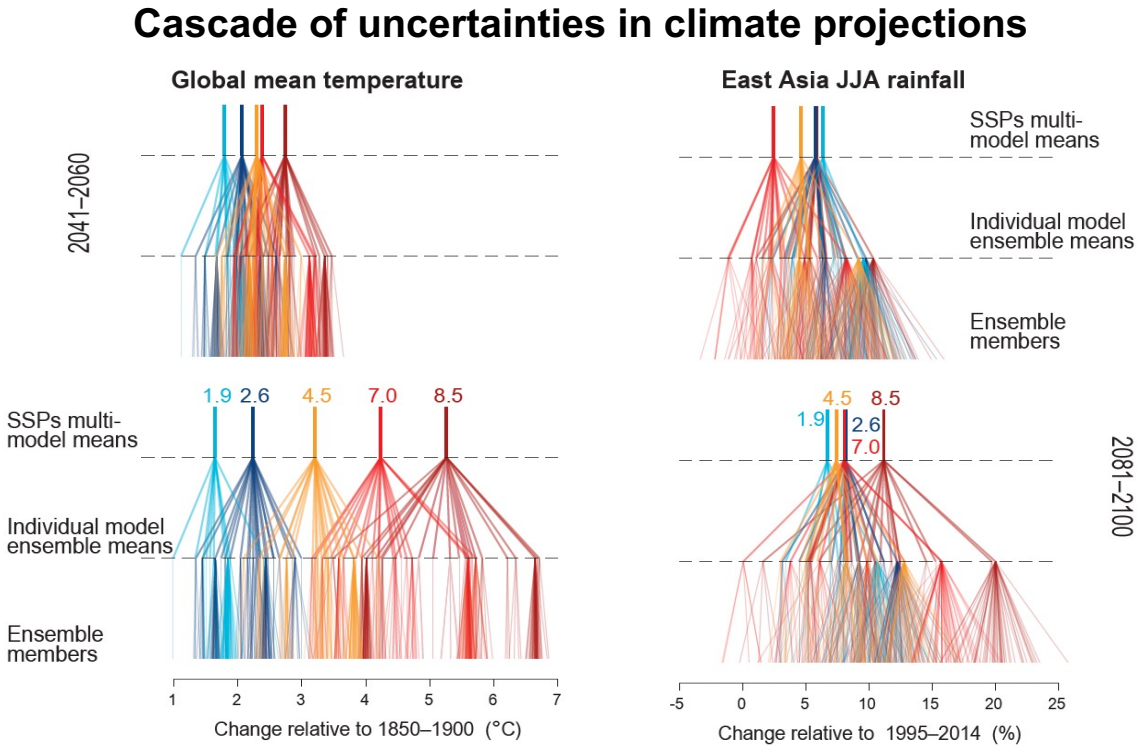


Fig 3.13

Better quantifying various sources of uncertainty

Dominated by scenario and model response uncertainties



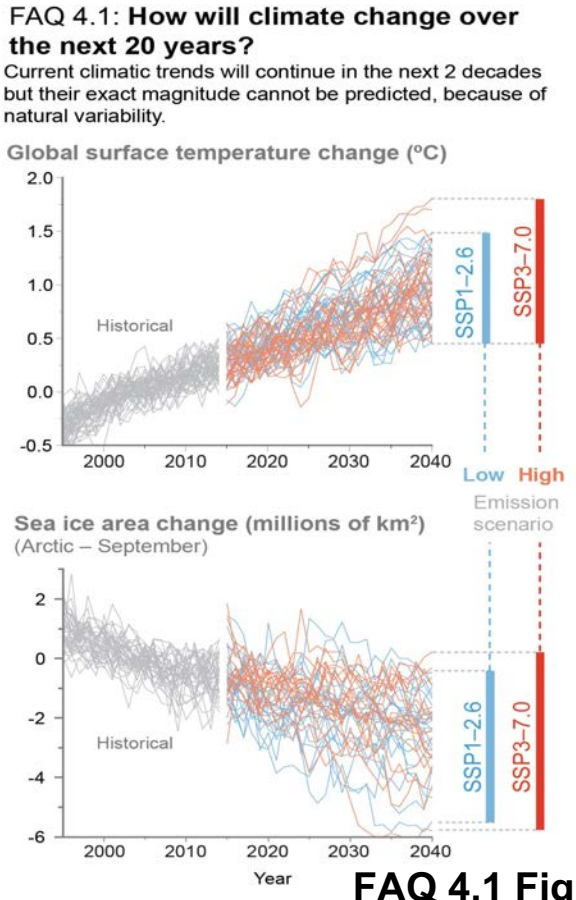
Dominated by internal variability and model uncertainties

Fig 1.15

Improving near-term information for risk management and adaptation

Large uncertainties in near-term information due to

- **Internal variability** (single-model initial-condition large ensembles and storylines approach providing a more comprehensive spectrum of possible changes associated with internal variability)
- **Model uncertainty**
- **Uncertainties in forcings from natural and anthropogenic aerosols**



FAQ 4.1 Figure 1

Better constraining future changes beyond GSAT, OHC, and GMSL

Procedure for the assessed GSAT change

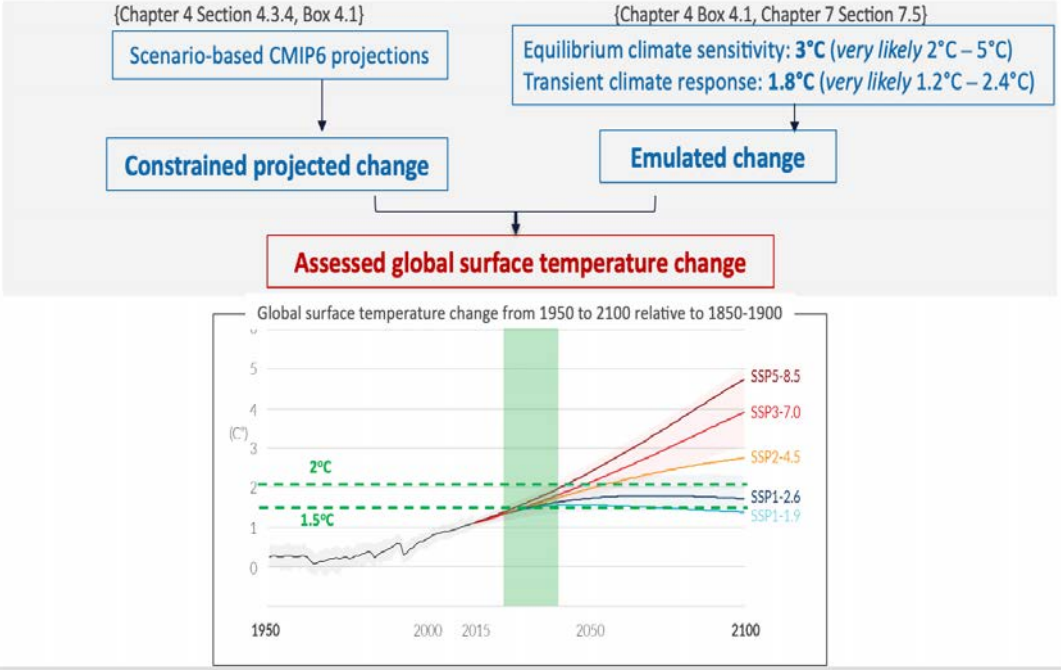
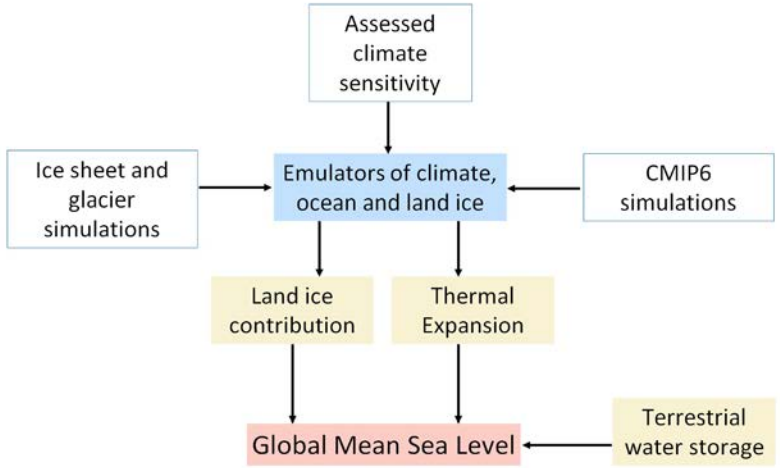


Fig SPM.8, Figure 4.11

Procedure for the assessed GMSL change



Schematic based on 9.6.3.2; Table 9.7; 9.SM.4

Improving regional climate information

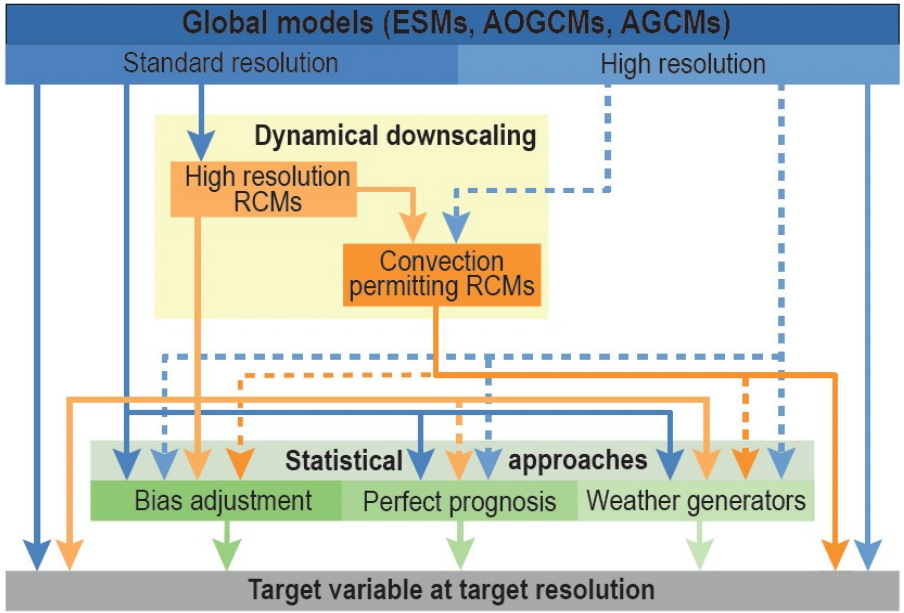
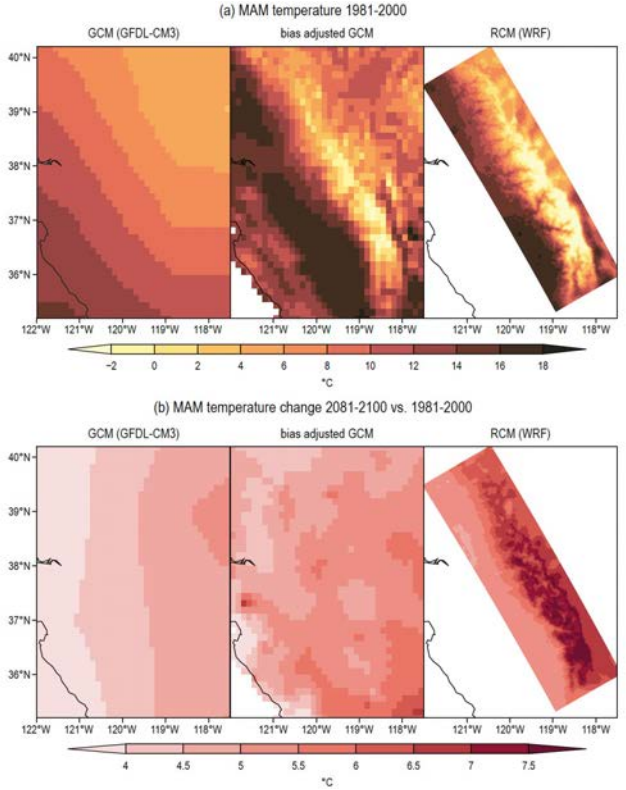


Figure 10.5



Cross-Chapter Box 10.2, Fig. 1

Issues on scenario selection and scenario feasibility

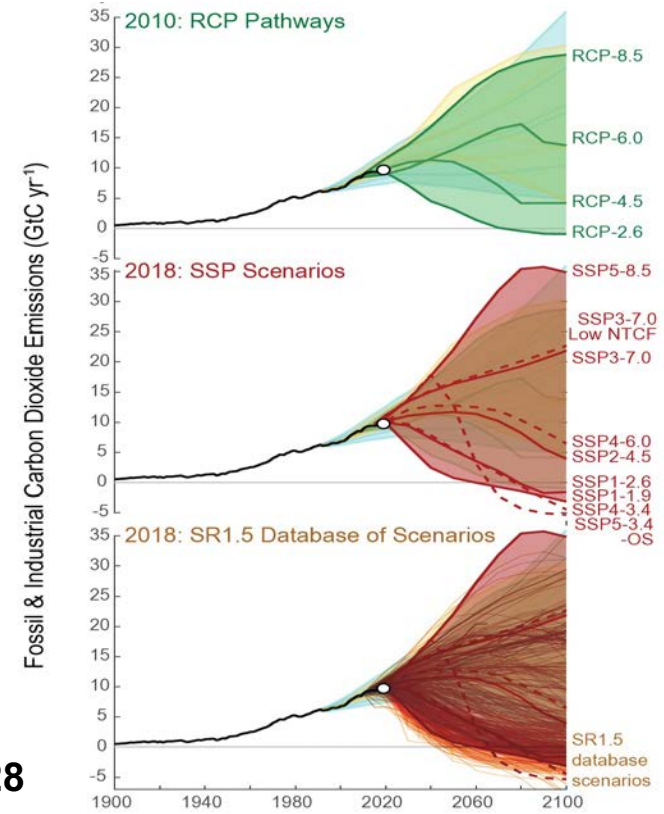
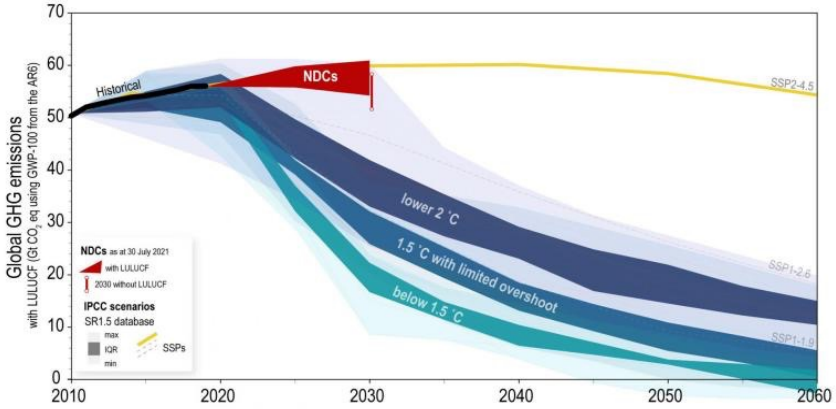


Figure 1.28



Source: UN Climate Change Full DNC Synthesis Report (2021)

Summary and Discussion

- A wide range of numerical models from physical emulators to Earth System models of varying resolution are used to investigate climate futures under a range of scenarios in AR6
- Challenges still remain on adequacy and causation of recent climate change and future climate in some metrics (fitness-for-purpose)
- Deeper analysis of these multiple lines of modeling evidence benefits from better temporal alignment of the CMIP cycle with the IPCC assessment process (e.g., SROCC=deeper analysis, AR6=newer models)