IPCC AR5: Projections of Arctic Sea Ice Change

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Overview

- IPCC AR5/CMIP5 climate model simulations
  - what kind of models
  - large uncertainty range
- How to narrow the uncertainty range?
- Why are there still large differences?
- Summary
CMIP5 climate models

- Coupled Model Intercomparison Project (CMIP)
  standard experimental protocol for studying the output of coupled atmos.-ocean general circulation models
- by World Climate Research Programme (WCRP)
- standard experiments:
  - historical simulation (1850-2005)
  - future emission scenarios (2006-2100)
- IPCC AR5: CMIP5
How to narrow the uncertainty range?

Composite GCM Sfc. air temperature RMSE


Overland et al., 2011   DOI:10.1175/2010jcli3462.1
How to select the better models?
Sea ice area misfit: model - observations

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<th>norm. misfit WP4.1 regions</th>
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ACCESS report D1.51 by AWI (http://access-eu.org/en/deliverables2/wp1.html)
Future development of sea ice concentration

Future change in September sic mean(2025-2040) - mean(1991-2005); RCP 4.5
Why are there still large differences?

- global climate models
- different sea ice models
- other reasons?
  - yearly (Jul-Jun) sea ice area in the Barents Sea is strongly linked to warm Atlantic water inflow (Arthun et al., 2012; DOI: 10.1175/jcli-d-11-00466.1)
  - Arctic wide summer sea ice area is strongly linked to 2 m air temperature
  - are these links similar in the models?
Yearly Barents Sea sea ice area and warm Atlantic water inflow
Arctic wide September sea ice area and yearly T2m: 66° N-90° N
Summary

• CMIP5 models have different strengths in different regions
• a subset of models reduces the uncertainty range considerably
• still large differences are due to
  • applying different sea ice models
  • different distributions of ocean currents and air temperature
  in past and future simulations
• CMIP5 models help a lot, but analyse with caution