



CMIP6 ECS update

WGCM23

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December 2020



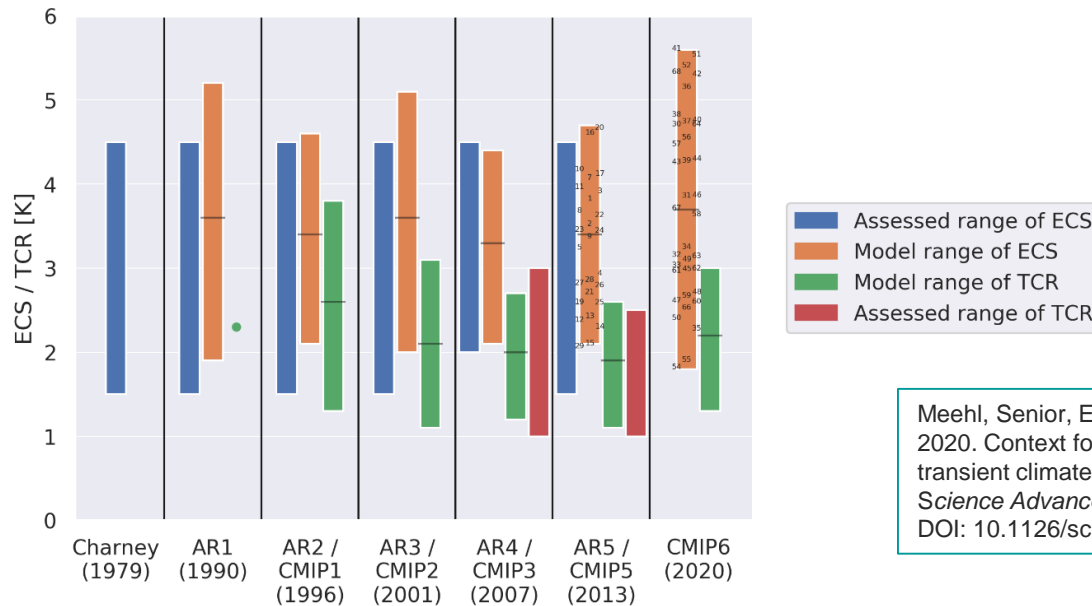
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Climate Sensitivity in CMIP6

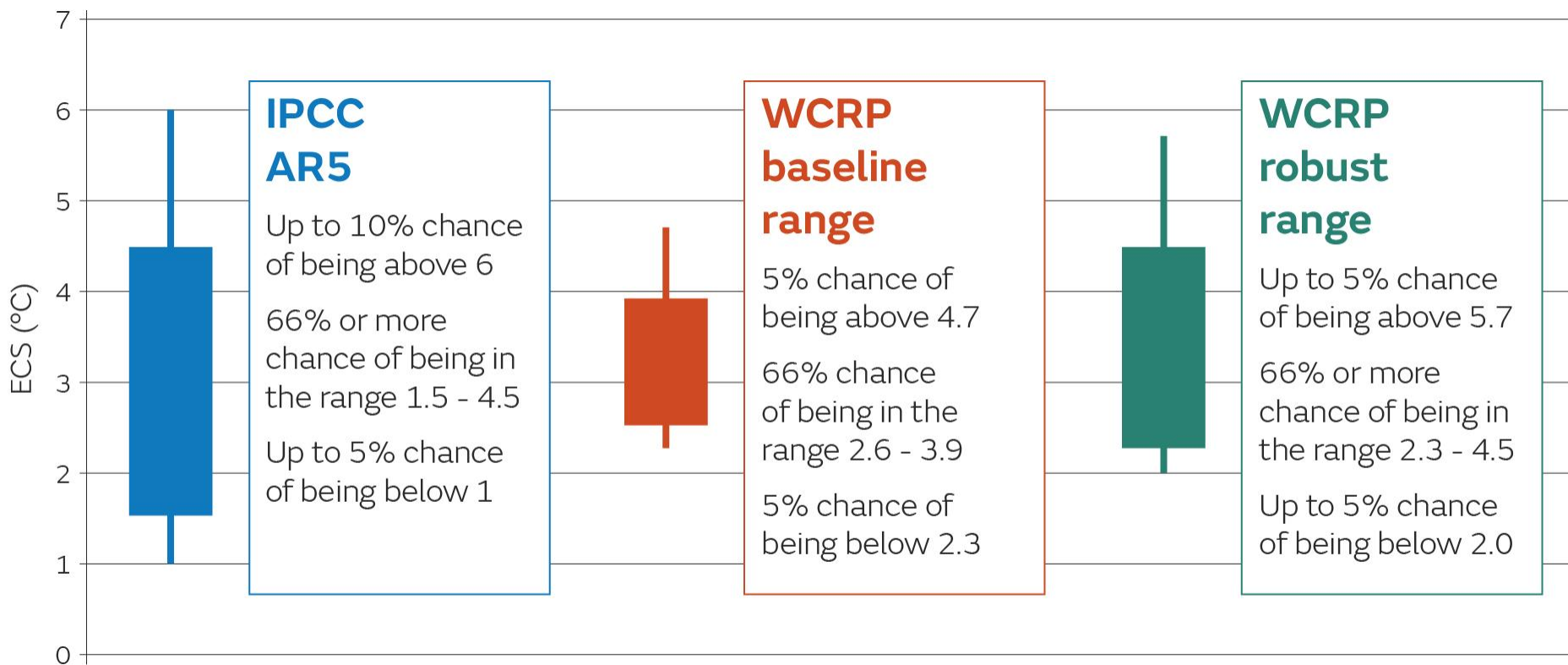
- CMIP panel paper (Meehl et al) on ECS/TCR published in Science Advances in June 2020
- 39 CMIP6 models compared to CMIP5
- Identified substantial number of high ECS models and pointed to cloud feedbacks and specifically cloud-aerosol interactions as most likely contributor
- Change in TCR range is more modest than ECS

Equilibrium Climate Sensitivity (Gregory method) and Transient Climate Response



Meehl, Senior, Eyring, Flato, Lamarque, Stouffer, Taylor, and Schlund, 2020. Context for interpreting equilibrium climate sensitivity and transient climate response from the CMIP6 earth system models; *Science Advances* 24 Jun 2020: Vol. 6, no. 26, eaba1981 DOI: 10.1126/sciadv.aba1981

ECS estimates from the WCRP assessment compared with IPCC AR5

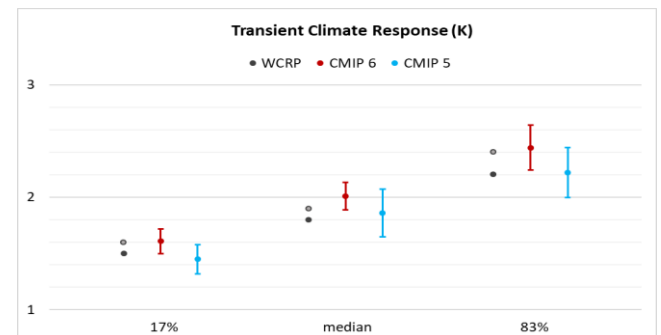
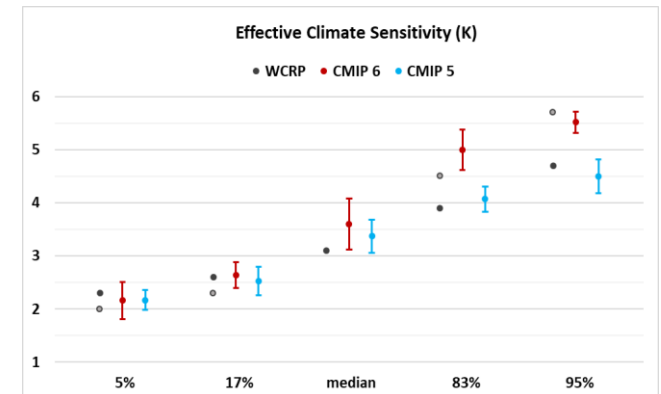
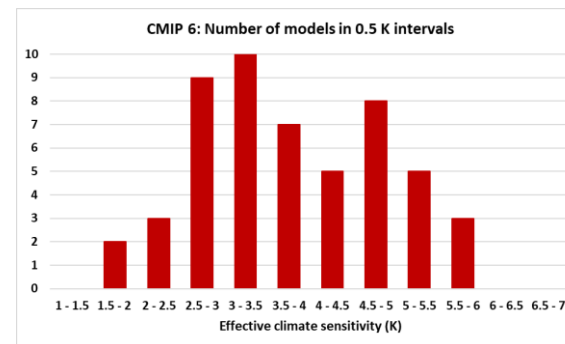
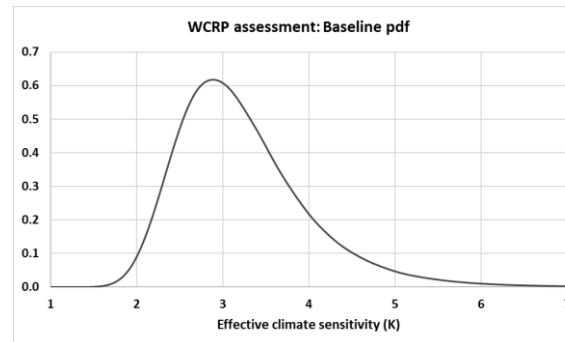


WCRP Assessment: Sherwood et al. (2020) *Reviews of Geophysics*

Sherwood, S. et al. (2020) An assessment of Earth's climate sensitivity using multiple lines of evidence, *Reviews of Geophysics* doi.org/10.1029/2019RG000678

Comparing WCRP Assessment with CMIP6

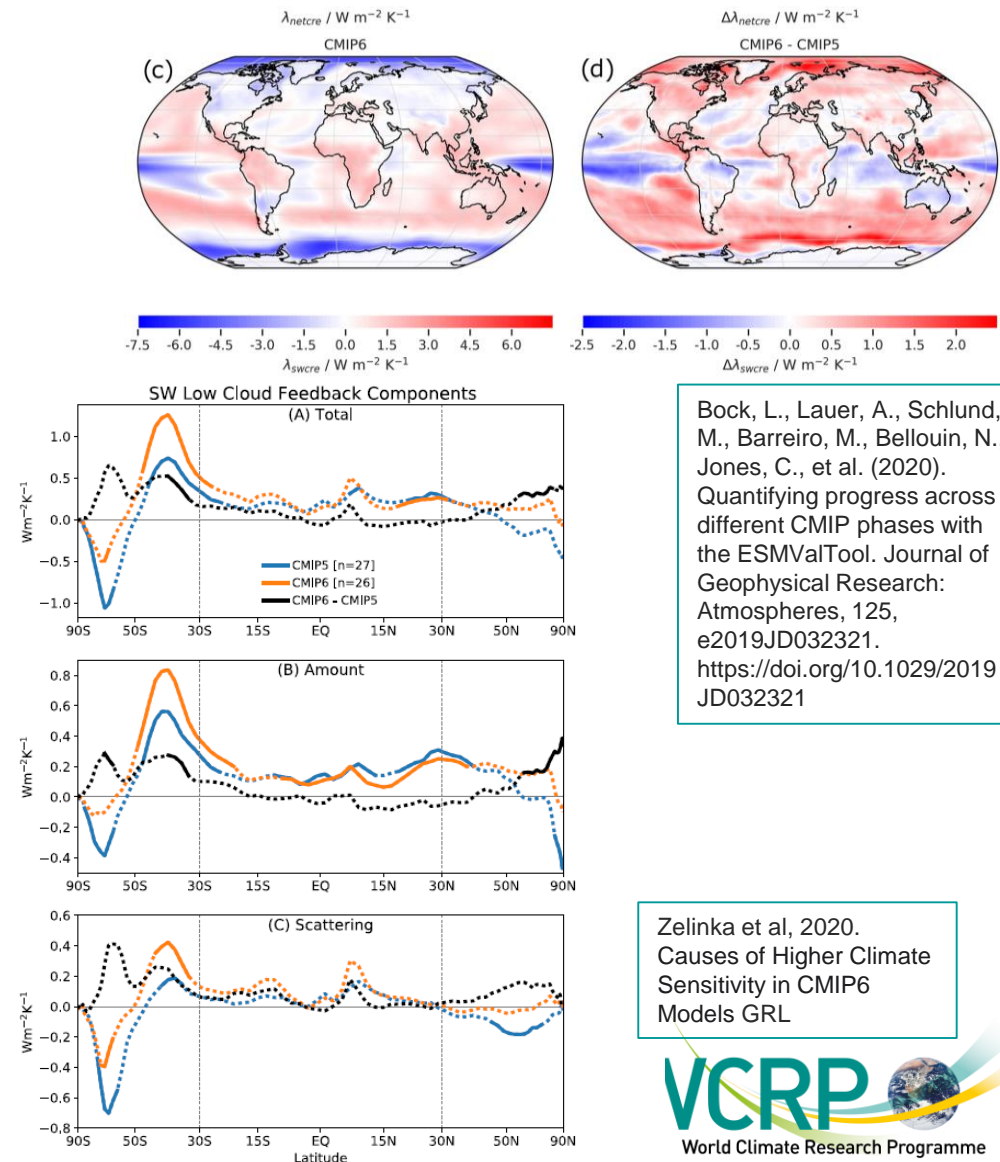
- 52 CMIP6 models
- 30% (16/52) have an ECS higher than 4.5°C . The assessment gives this a chance of 6-18%
- Suggestion of “convergence” at the lower end; Assessment and state-of-the-art models now agree on low likelihood of $\text{ECS} < 2\text{K}$.
- Comparison is slightly better for TCR (14/52 exceed baseline 83rd percentile) - but consistency with the robust estimate.



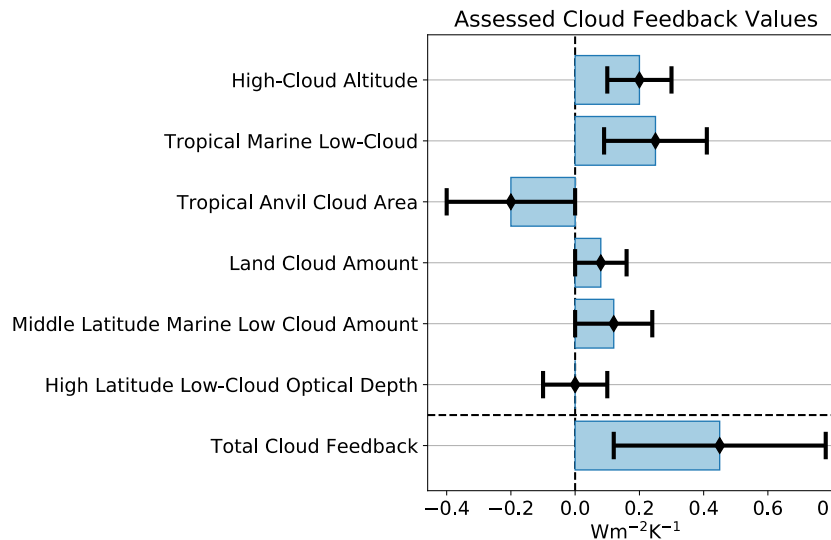
Mark Ringer

Causes of high climate sensitivity in CMIP6

- Increase in the shortwave cloud feedback over the Southern Ocean in CMIP6 compared with CMIP5
- stronger positive low-level cloud feedback
- Smaller increases in extratropical low-level cloud cover and associated liquid water content
- Zelinka et al document increased liquid condensate fraction (LFC) simulated in clouds for the preindustrial and present-day periods
- Limits the 'change-of-phase feedback'



Understanding the role of Cloud Feedbacks

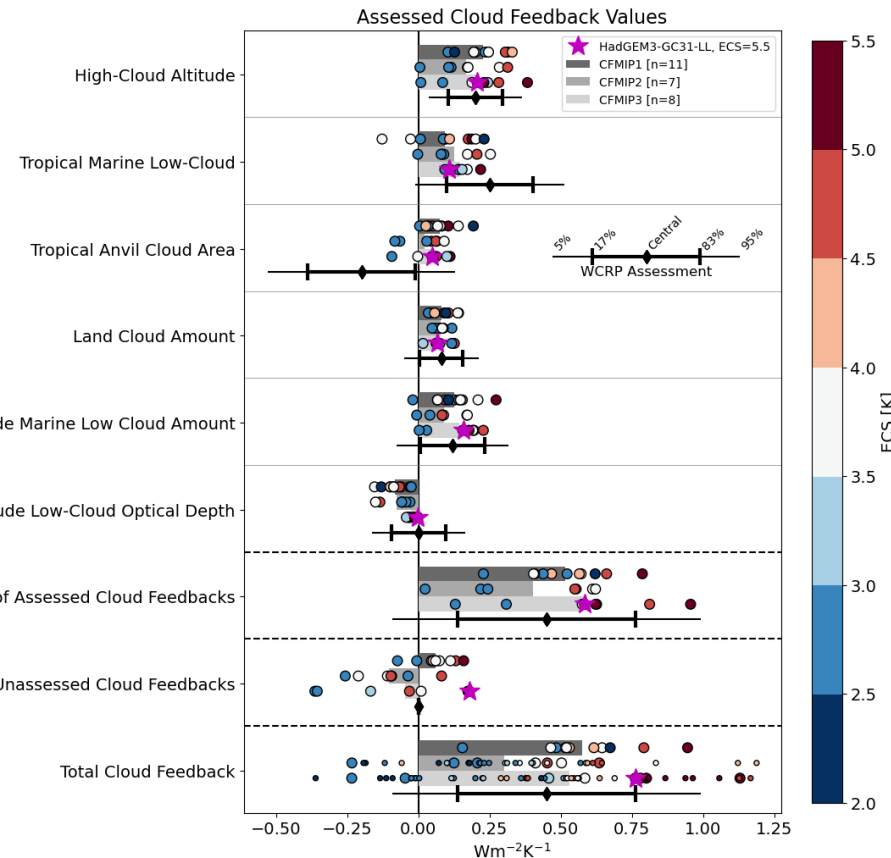


Sherwood, S. et al. (2020) An assessment of Earth's climate sensitivity using multiple lines of evidence, Reviews of Geophysics doi.org/10.1029/2019RG000678

- Cloud feedbacks contribute most to feedback uncertainty
- Sherwood et al (2020) includes assessment of feedbacks from various cloud types individually for the first time
- We can start to assess cloud feedbacks in models across ECS range



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Mark Zelinka (unpublished)