

Key advances since AR5

Observations

- Longer and improved records (longer time perspectives possible, better handle on decadal variability)
- Formal quantification of uncertainties, availability of ensembles of observations for many variables
- Growing appreciation for systematic differences between observations and simulations which can come from range of influences (forcing, internal variability, observational uncertainty, model errors), aka warming slowdown, problem in AR5 turning into opportunity for scientific community
- obs4MIPs activity, allowing for more straight forward use in model evaluation
- Taken together, all of these advances will enable researchers to have more time for actual science and should have positive effect on quality of the science

Evaluation tools

- Availability of tools with the capability of relatively automated, quick look evaluation
- More comprehensive evaluation beyond the mean state, including variability, a wide range of different processes; evaluation involving many communities
- Availability of multiple independent evaluation tools allows for sanity check
- Availability of these tools will make for more rapid feedback to modelling groups, expose issues early on and lead to more time for assessment
- The broader range of experiments and more expansive list of output variables available within CMIP6, together with evaluation tools, will help to probe many aspects that were not investigated in past
- Availability of large ensembles has allowed investigation into variability to a degree not possible before, providing better handle on longer term variability and better separation of forced and unforced changes (relevant for model evaluation, D&A etc.)
- Additional complexities in models representing whole range of new processes, require evaluation tools to keep up with increased complexity

Systematic biases

- Some aspects of long standing biases have been resolved (e.g. ...), but focused effort will be required to address others
- Increased resolution may help with some of them, but many will remain in the near future

Emergent constraints

- An area of scientific research that has advanced substantially since AR5, with a wider range of processes being investigated
- Recognition that not all Emergent Constraints are equally valuable, need for mechanistic understanding to accompany them
- Classification system for maturity level

Weighting

- Beginning to recognise the limits of performance based weighting (random selection might be better than performance weighting, Herger et al 2017, ESDD)
- The emergence of interdependence based weighting schemes and the recognition of their importance
- Perfect model experiments to investigate if weighting improves future projections; recognition that model errors are a function of space, time, and variable; there is no one performance metric to rule them all
- Which metrics are relevant for problem at hand?

Impacts

- More communication between impacts community and model projection community
- VIACS activity with clear ideas of which impacts metrics are needed
- Advancement in impacts models
- Model intercomparison projects for impacts models