New approaches to accounting for observational shortcomings

Key scientific advances since AR5

- Ensembles of observations now available (e.g, surface temperature, SSMI column water vapor)
- Wider use of measurement proxies (mapping of models to observations)
- Availability of Obs4MIPs helped model development
- Longer records of novel satellite data – need to continue those into the future
- Better coordination between land use data developers and modelers
- Historical reanalysis & state estimates & ocean and coupled reanalysis
- ARGO data
- Better understanding of Model forcings uncertainty:
  - Better understanding of volcanic data sets used for model forcing
  - Better understanding of uncertainties in Ozone data sets used to force models
- Making room for multiple explanations for model-obs differences (lessons learned from hiatus analysis)

Shortcomings, gaps, opportunities

- How to use ensembles of observations in model evaluations → Statisticians
- Encourage obs groups to do better in characterizing obs uncertainty
- One error number is not enough (decompose the error budget, into instrument, sampling, processing errors)
- How do we use the better error estimates for model evaluation?
- Update and check forcing data sets more regularly
- Continue crucial satellite observations used for climate model evaluation (SSMIS sea ice satellite series to be discontinued when DMSP-F18 fails)
- How to represent biodiversity?

Long term perspective

- Need DIPS – data intercomparison projects
- Need MIPs4Obs: perfect model experiments using measurement proxies/Observing System Simulation Experiment (OSSE)
    - test different obs data products within models to better understand consistency, to establish expected mis-match between models and obs
    - Self-consistency check of benchmark datasets used for model evaluation
- Need new obs for unconstrained processes and features that models show sensitivity to
  – (e.g., biomass/carbon cycle, snow on sea ice, topography under ice sheets, potentially currently unobservable)