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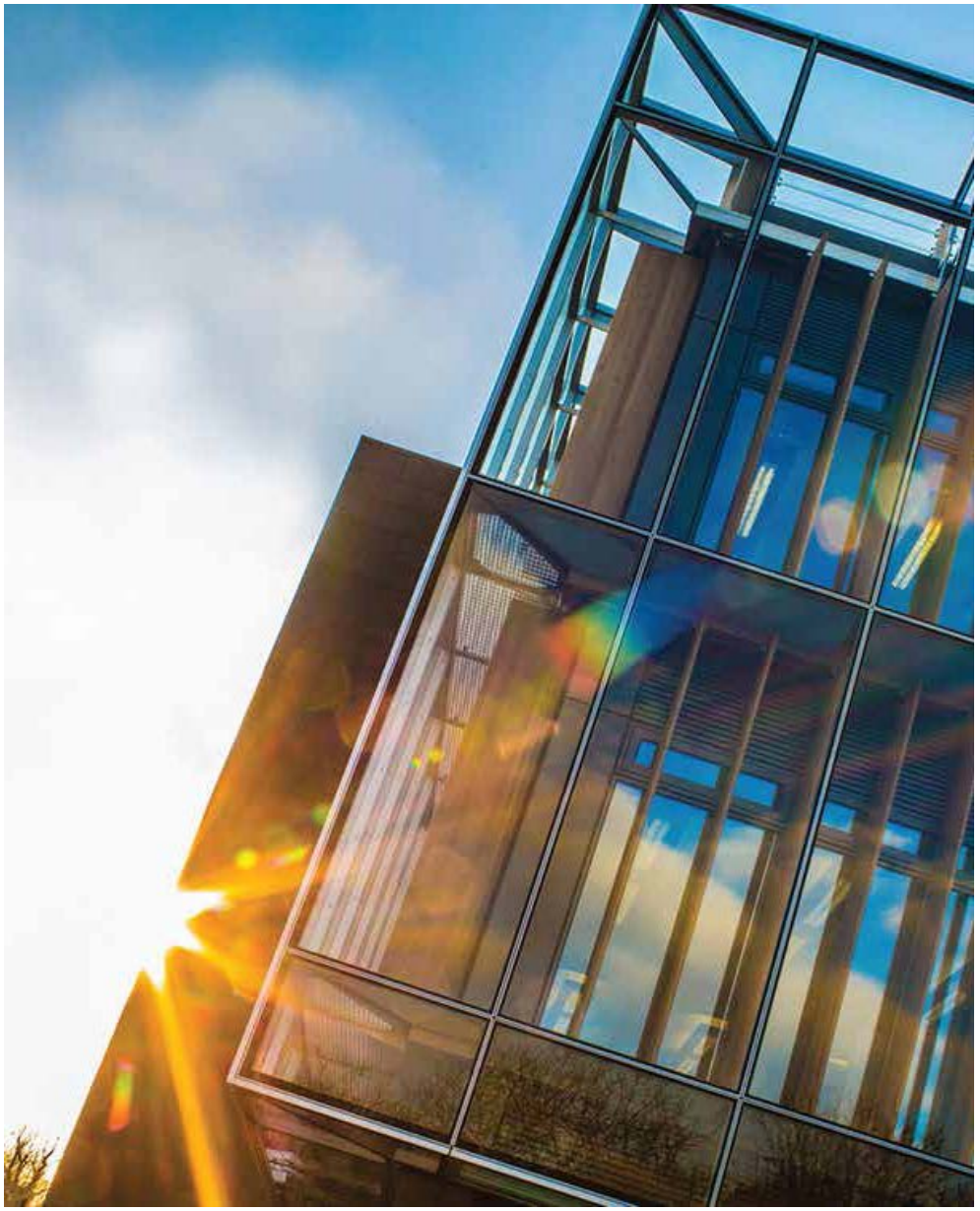
The potential role of GNSS-RO data in the IPCC AR6 report

Peter Thorne



Talk outline

- Start by highlighting a number of areas where RO measurements might help advance climate knowledge above and beyond long-term monitoring
  - Tropical tropospheric warming behavior
  - UTLS humidity
  - Diurnal cycle aspects
- Go on to consider how these and RO climate work provide potential inputs explicitly to IPCC AR6

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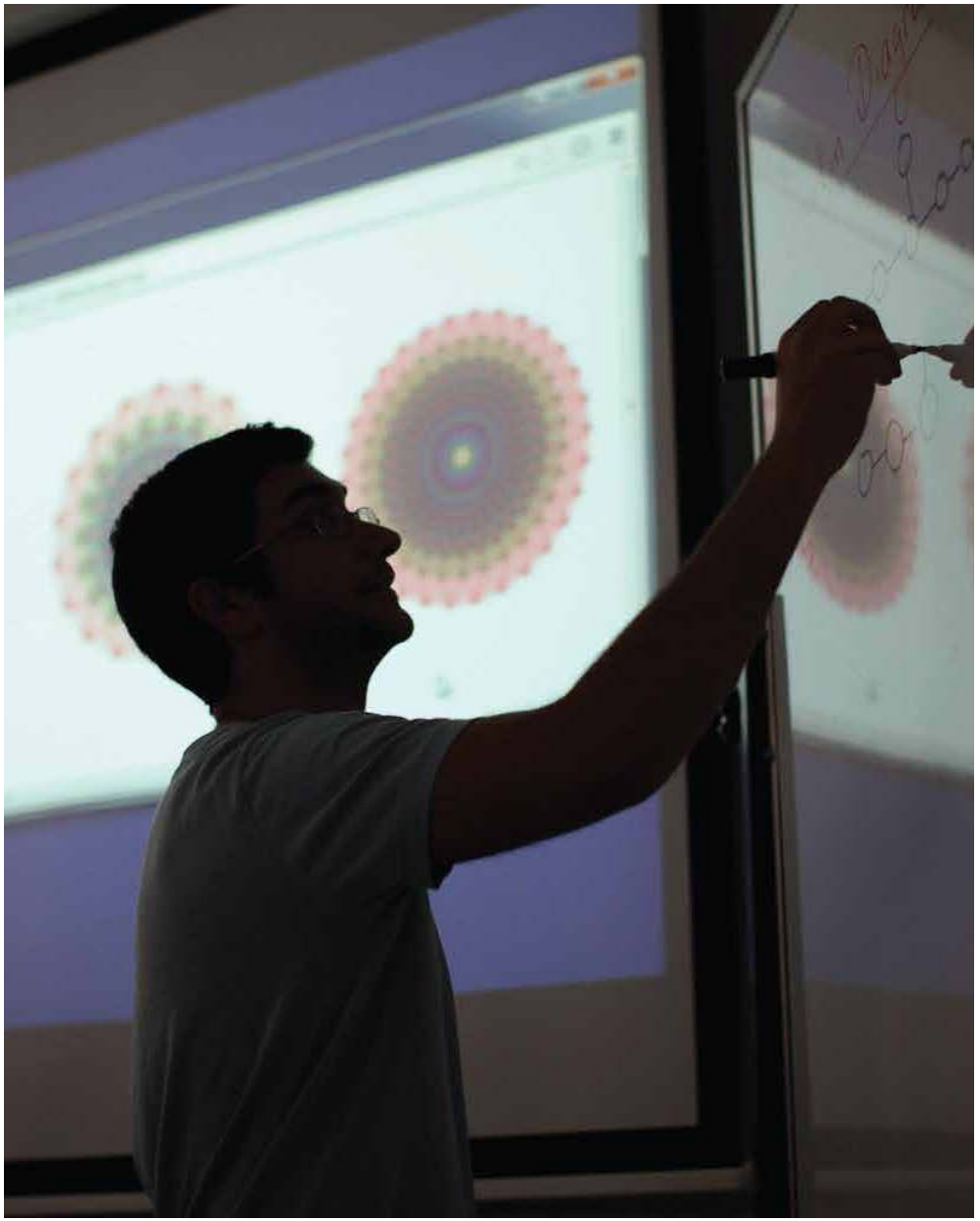
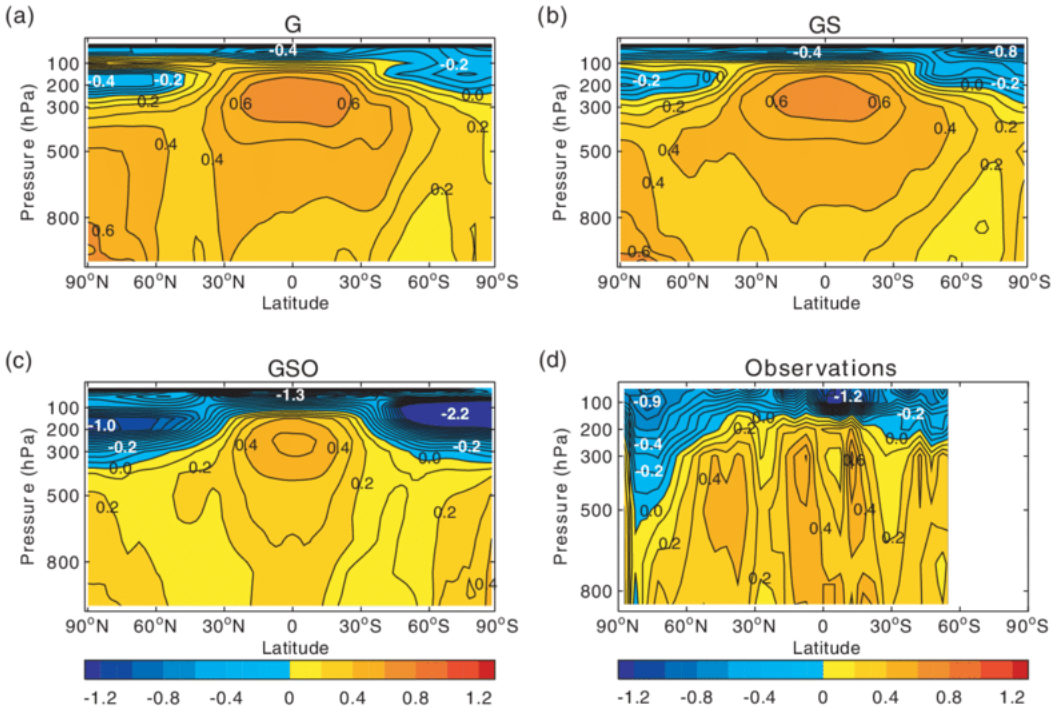
Tropical upper tropospheric temperatures



Tropical troposphere dominated by convective adjustment



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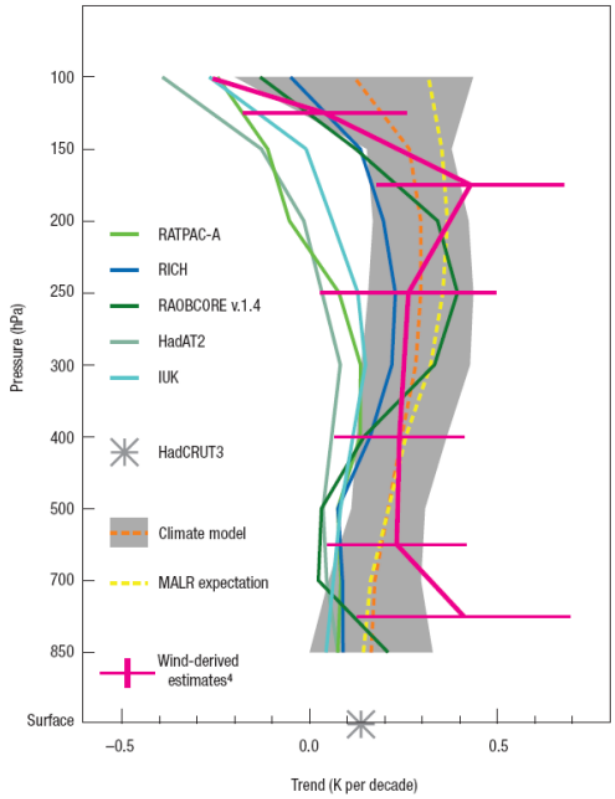
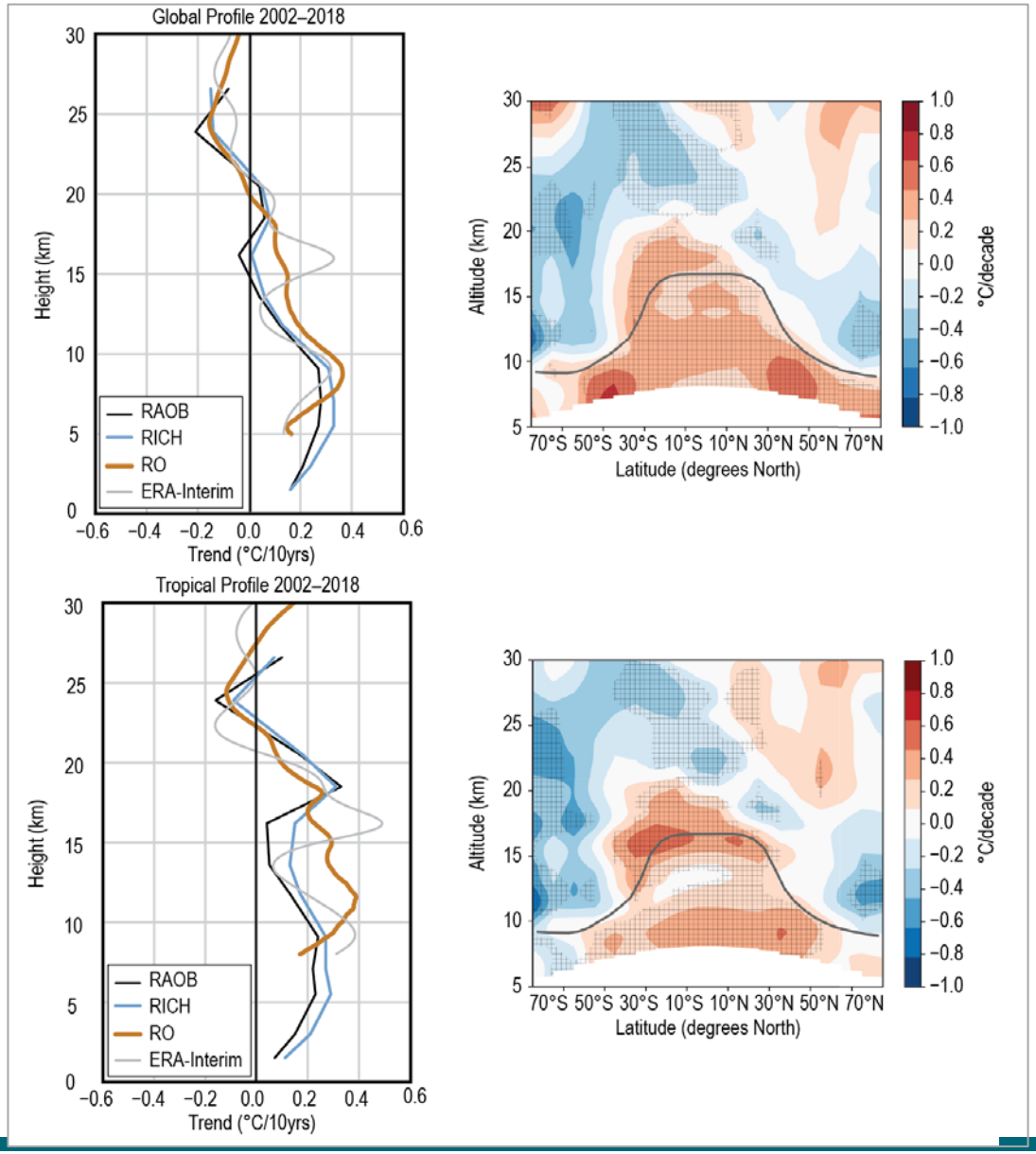
uncertainty in whether models and observations agree



Important considerations

- Check the constrained behavior – amplification – rather than comparing absolute trends
- Need for vertically resolved measurements (hard from passive remote sensing)
- Need for sufficient observations (hard from sparse radiosonde network)
- Need for high-quality observations (hard for radiosondes – solar effects)
- Role for GNSS-RO – dense sampling, vertically resolved



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UTLS humidity

Water vapour most important high up

- In the Boundary Layer and lower troposphere the water vapour bands are pretty much saturated everywhere
- In the UTLS absolute WV concentrations are small and the bands are not saturated
- If we care about the TCR and ECS metrics what matters is the UTLS water vapour as this determines the strength of the positive feedback
- We only have sparse and discontinuous frostpoint hygrometer measures
- Passive sensors have very broad averaging kernels

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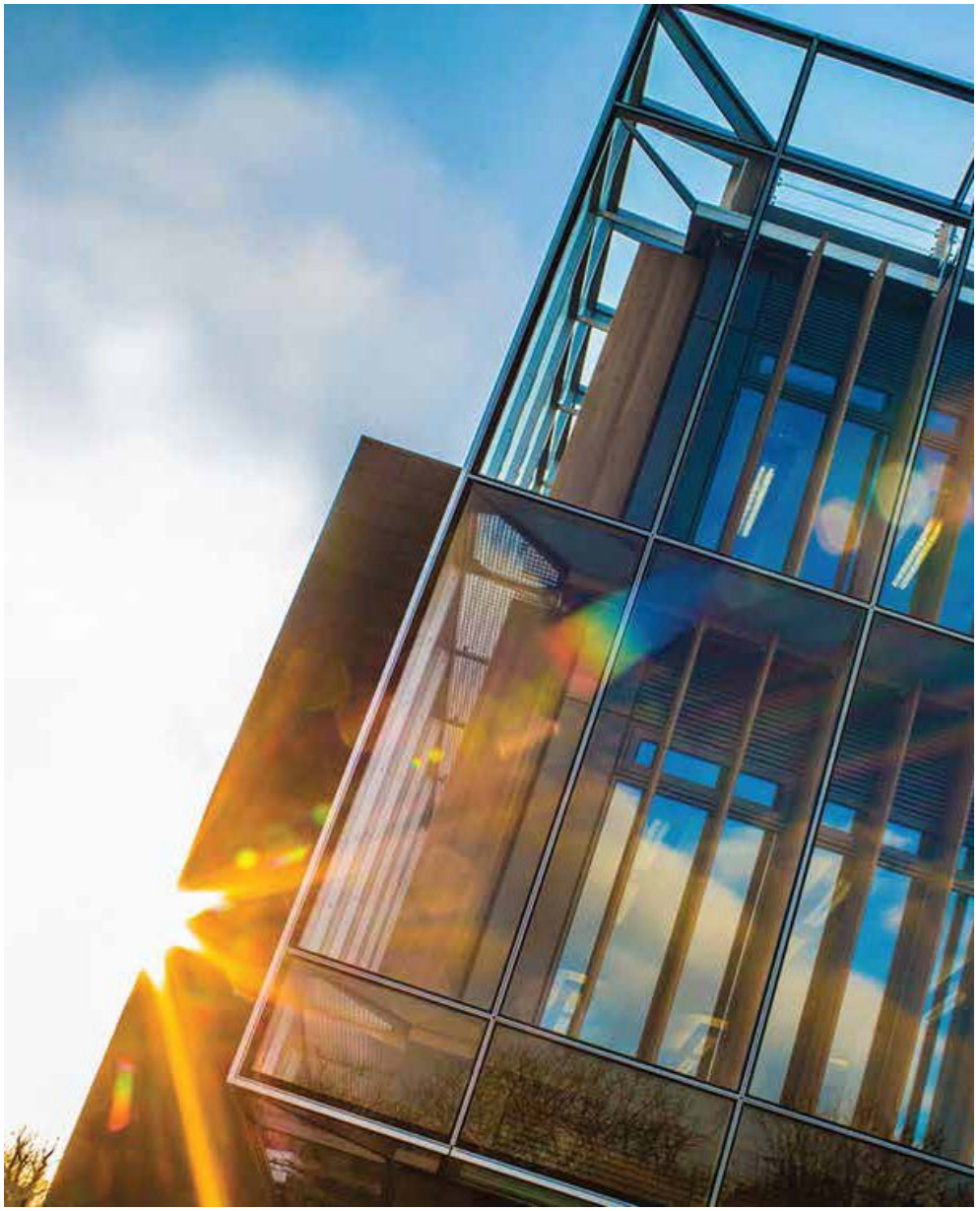
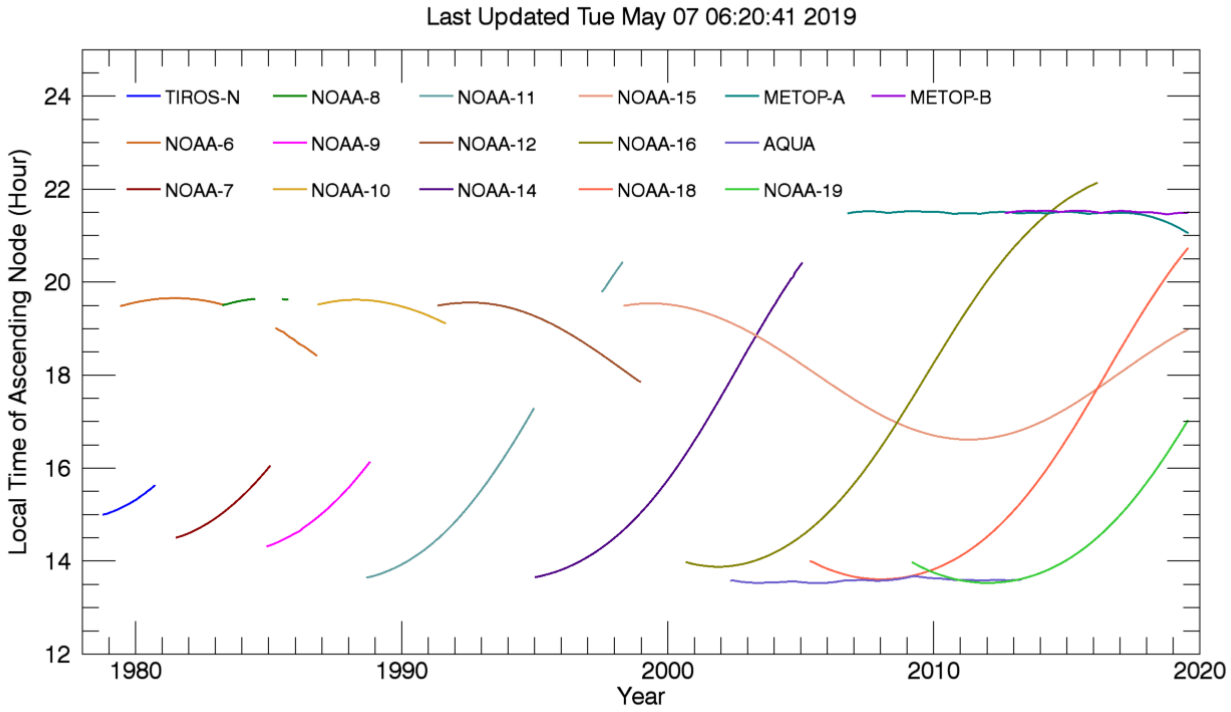
Diurnal cycle of temperature and humidity



Historical polar orbiter station keeping issues



Ambiguity in MSU/AMSU/ATMS records

- Largest when satellites were drifting rapidly as alias in diurnal effects
- No robust estimate of the diurnal cycle
  - For lowermost channels need estimate of skin surface cycle
  - Most radiosondes at 00 and / or 12Z
  - Reanalyses will suffer from this
  - Climate models are imperfect

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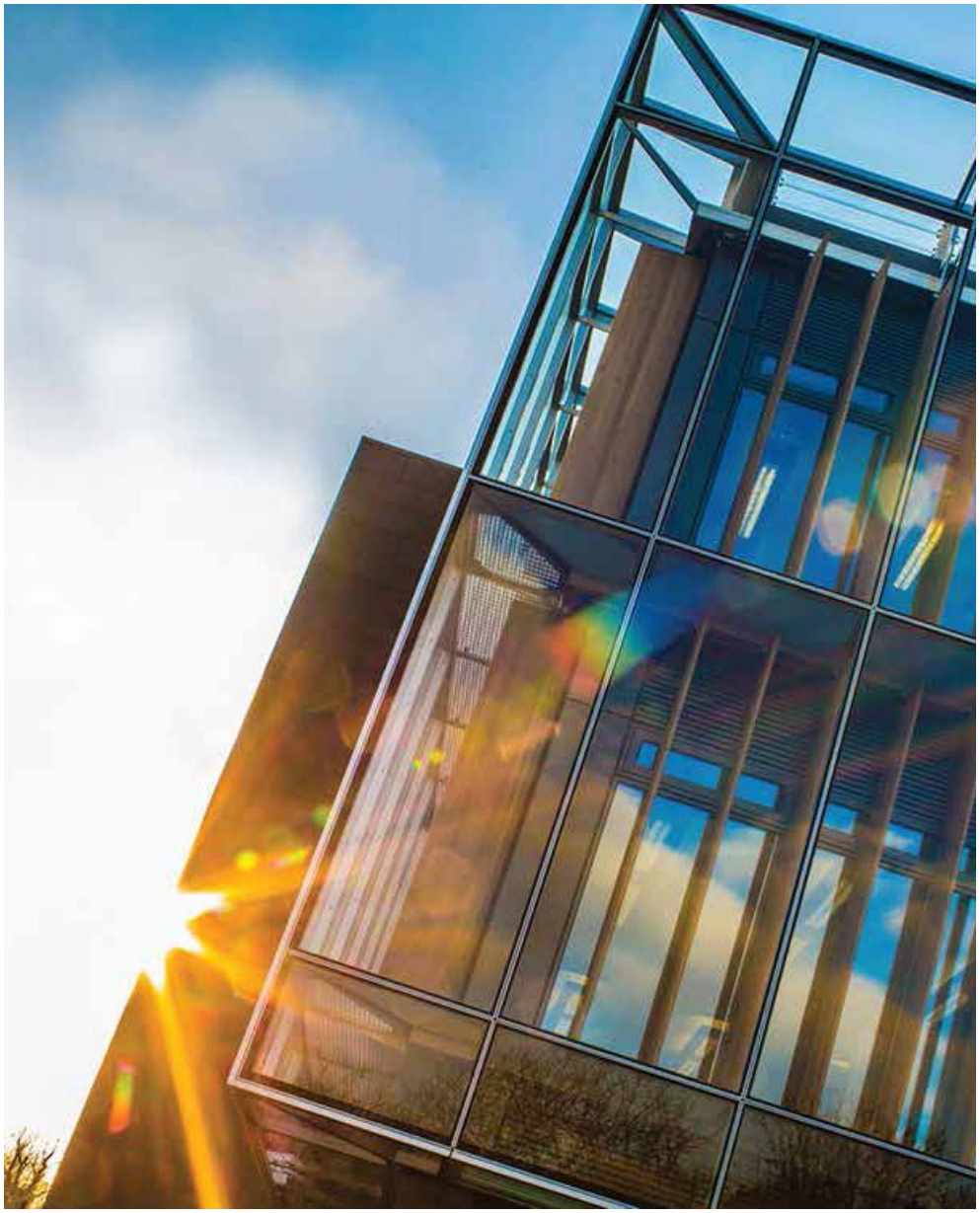
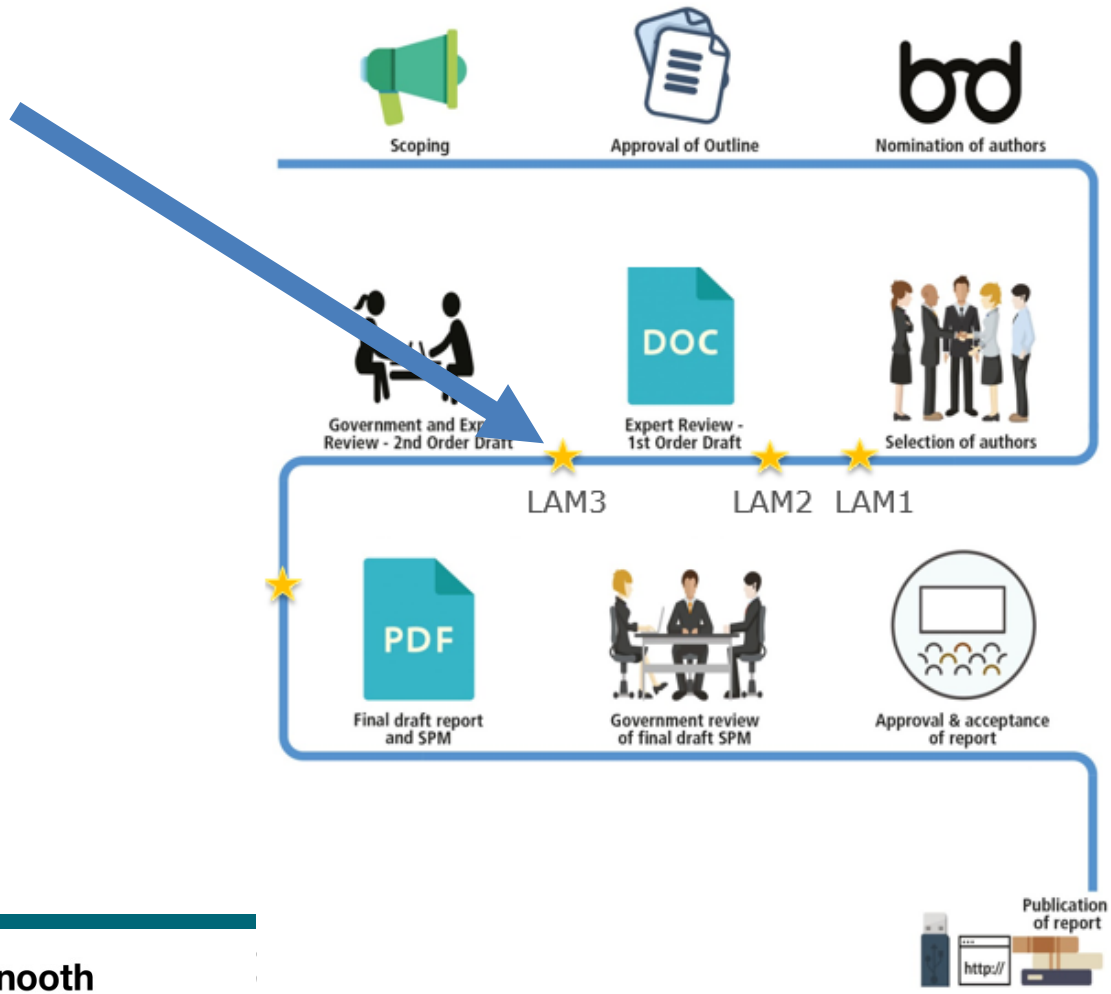
IPCC AR6



Process timeline

We are here



WG1 contribution can benefit from RO community input

- To be included in the SOD papers must be submitted by 31st December (and chapter authors alerted)
- To be included / retained in the final draft papers must be accepted by 30th Sept 2020
- Data from RO community have been involved in the FOD and will be retained in subsequent drafts

Specific potential inputs

- Chapter 2 – global scale changes in key variables (T,q)
- Chapter 3 – model evaluation
- Chapter 7 – water vapour feedback implications for climate sensitivity
- Chapter 8 – Hydrological cycle
- Chapter 11 – extreme events analysis?

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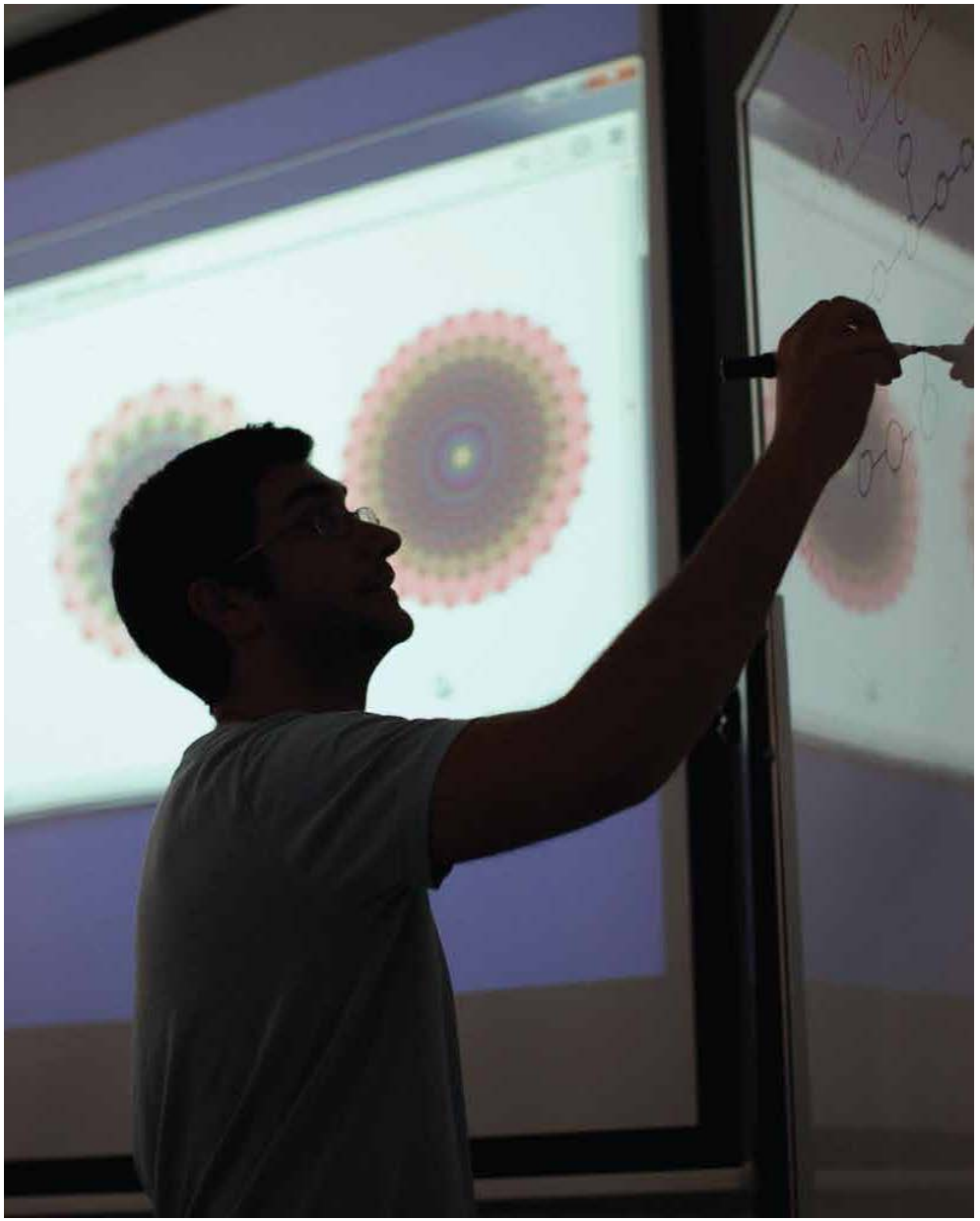
Summary



Summary

- There remain important questions which require measurements of:
  - High fidelity
  - Vertically resolved
  - Long-term sustained
  - Measuring the diurnal cycle and any changes therein
  - Of temperature and humidity through the troposphere and stratosphere
- And their analysis…!
- To be included in IPCC AR6 publications submission / acceptance deadlines should be adhered to …