Department of Meteorology

University of Reading

MOAP WATER VAPOUR MEETING, READING 19/02/20

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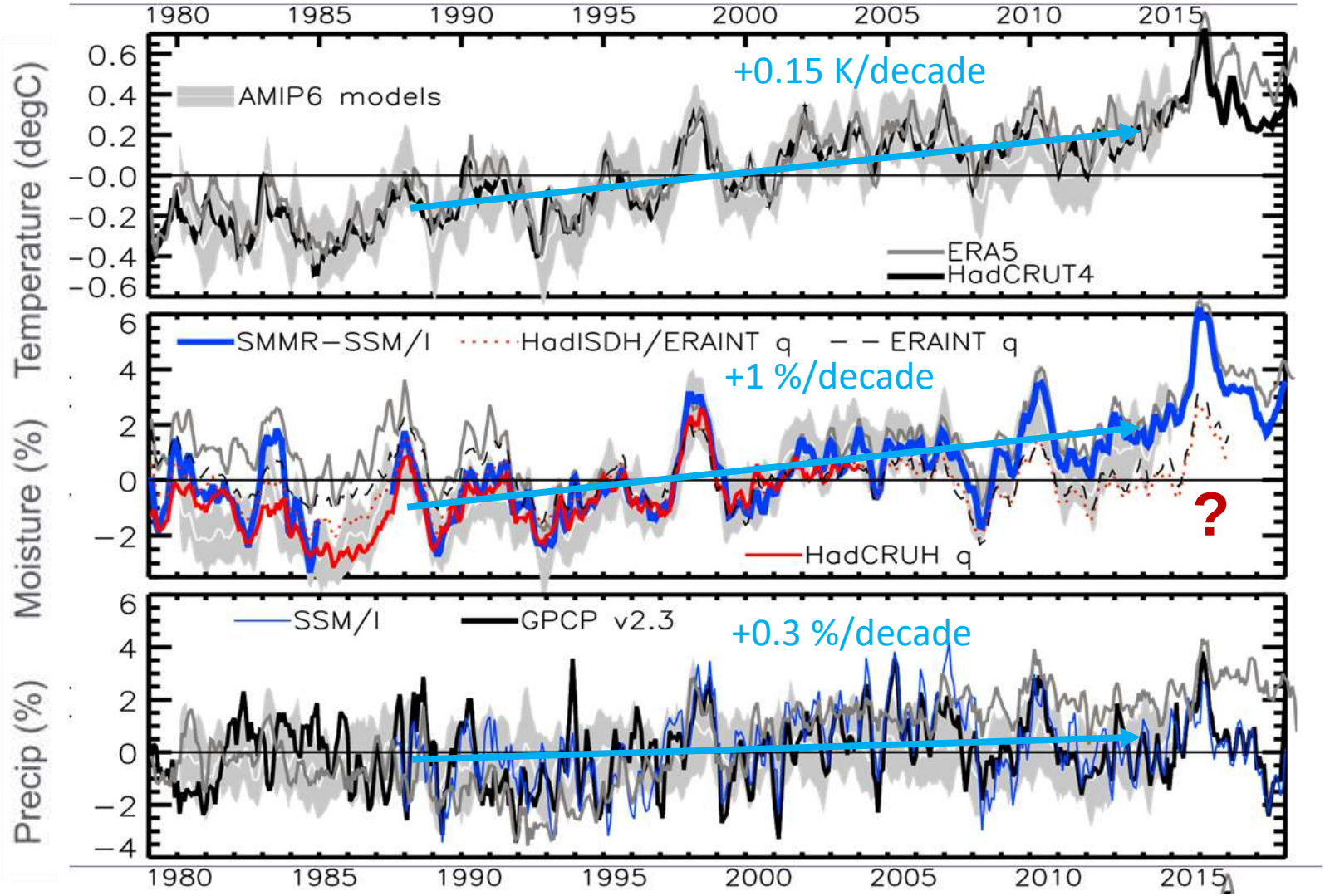
National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

AGENDA

Attending: Richard Allan, Kate Willett, Rob Chadwick, Tim Trent, Michaela Hegglin, + remotely: *Viju John Alan Vance?*, *Christoforos Tsamalis?* 10:30am Coffee

- 11am Introduction – Richard Allan
- Talks from Kate Willett, Viju John Skype, others…
- 12:30pm Lunch
- 1pm – Outcomes: prioritise 1 paper, 1 grant proposal
- 2pm Close

- Meeting number (access code): 144 236 781
- Meeting password: 8fZYDBWGy33
- Join meeting: https://eumetsat.webex.com/eumetsat/j.php?MTID=mb02ece6a6ac2f0b4a1ca0768add213a5



Update from Allan et al. (2014) Surv. Geophys.

- Small precipitation response so far expected on energetic grounds (cooling from sulphate aerosol and fast adjustments to GHGs and absorbing aerosol) Allan et al. 2020
- ERA5 captures water vapour changes since mid-1990s but not precipitation since water budget not closed (e.g. Allan et al. 2014 SG)

NEAR SURFACE HUMIDITY TRENDS

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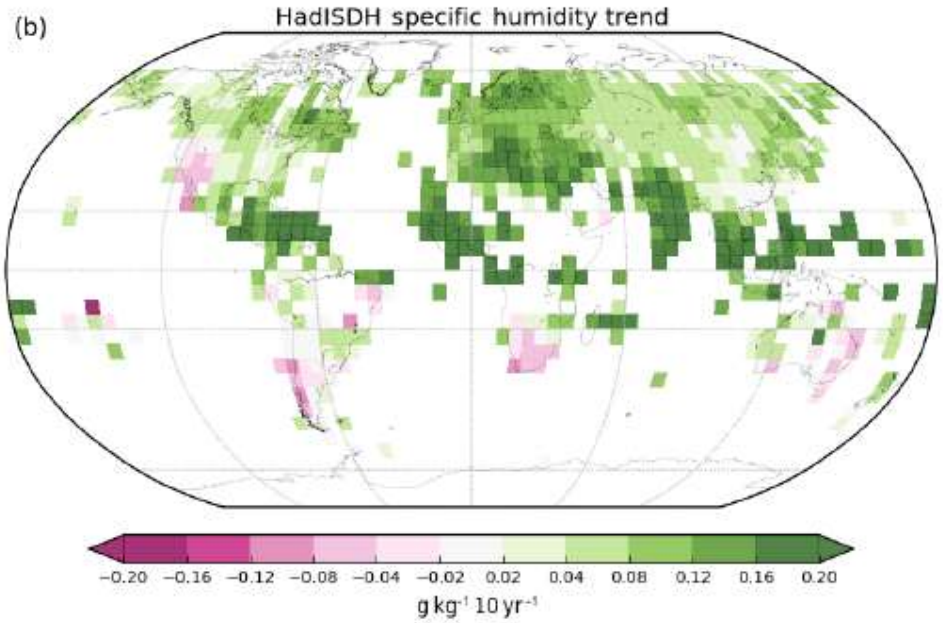
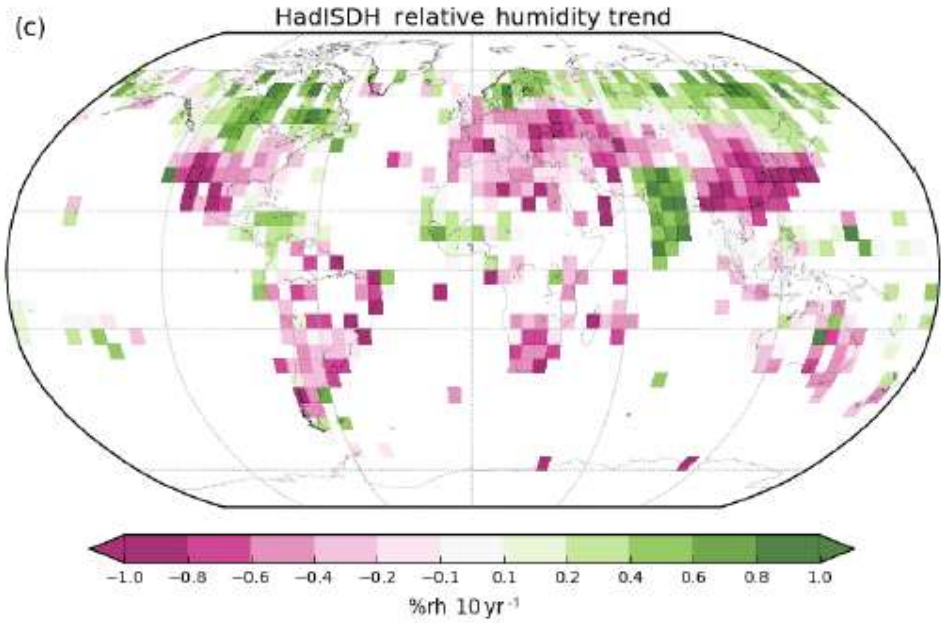
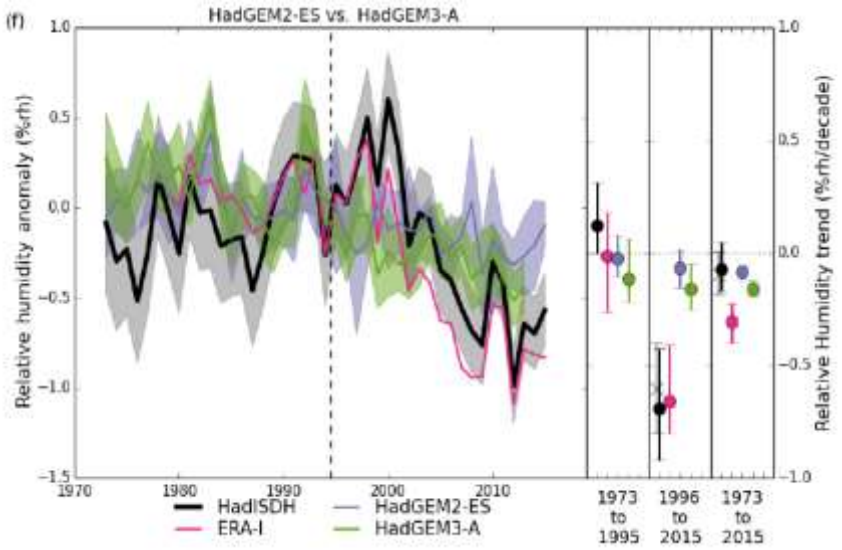


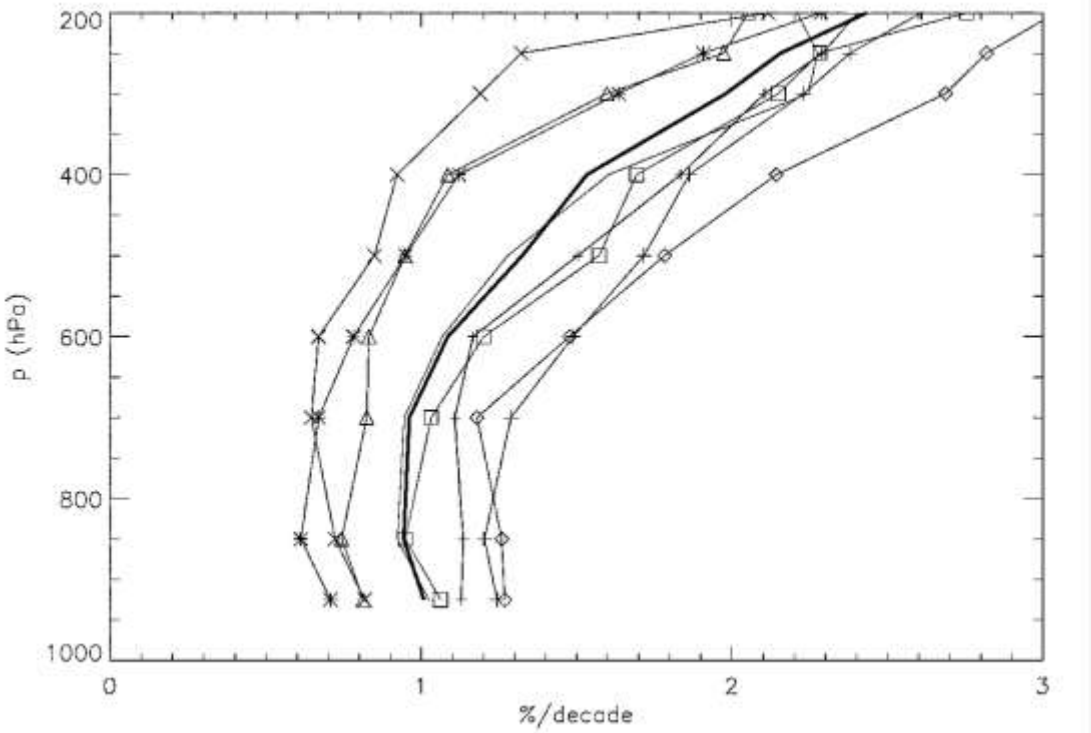


- HadISD specific and relative humidity trends (Dunn et al. 2017 ESD)
- Declining RH over land since ~2000.
- Not captured by CMIP5 simulations but is when models forced with SST
- Explained by land/sea warming contrast: O'Gorman & Byrne (2018) PNAS



SIMULATED WATER VAPOUR CHANGES

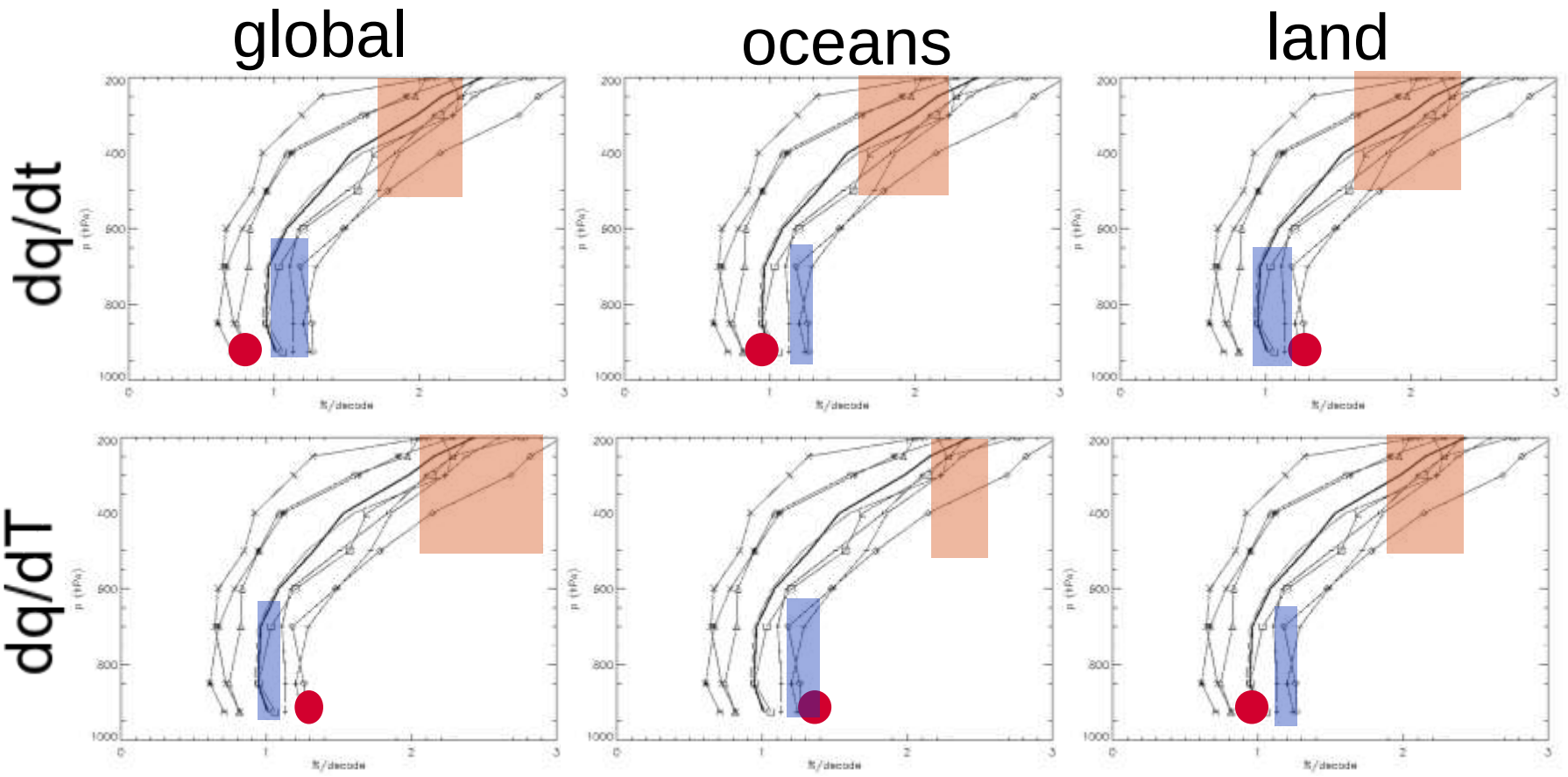
Right: water vapour trends (1980-2014) in 8 CMIP6 amip simulations →



- Low-level water vapour increases around 1%/decade based on SSM/I-ERA5 record (see also Schroeder et al. 2016)
- Mid-upper tropospheric water vapour increases drive powerful amplifying feedback (e.g. John et al. 2019 in BAMS State of Climate)

POSSIBLE FUTURE ANALYSIS?

- Synthesis plots (different datasets/metrics e.g. HADISDH q_0, ERA5, AIRS q(p), SSMIS CWV, AMSU-B q(dUTH)?, …)
- Global, Tropical vs high lat? Land vs ocean; Trends, sensitivity to Ts. CMIP6 (hist, amip) vs Obs, time series, zonal, maps; 1988-present?



STALLED INITIAL WORK PLAN

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1) **CMIP6 data (1979-2014) – have some monthly amip/historical**
2) **AIRS (2003-2018) - Viju to get monthly q, (T?)**
3) **ERA5 (1979-2018) – have some monthly data, need to calc surface q?**
   a. **Get monthly T, q, RH (p-level) and tas**
4) **SSM/I TCWV (1988-2019)**
   a. **Merge with ERA5 & regrid**
   b. **CMSAF data?**
5) **HadISDH (+HadCRUH)**
   a. **Merge with ERA5?**
6) **UTH (1994-2018 microwave; 1979-? HIRS)**
   a. **Investigate how to convert to q' proxy using ERA5**
   b. **Calculate on overpasses, make conversion, calc 2.5x2.5 mean**
7) **Analysis (**?ECV inventory: https://climatemonitoring.info/ecvinventory/)
   a. **Begin with AIRS/CMIP6, add in other data, monthly, deseasonalise at grid point level?**
   b. **Merge at high resolution, then regrid to 2.5x2.5 or 1x1 degree**
   c. **Convert UTH' into UTSH' proxy (investigate uncertainty) ?? Merge hi-lat with ERA5?**
   d. Timeseries (global, ocean, land) TCWV, huss, upper trop q?
   e. Maps of trends
   f. Table of trends and detrended regression with Ts, also calc dX/dT=dX/dt*dT/dt
   g. Height dependent changes (AIRS/reanalyses) possibly adding indicative symbols for in situ and TCWV changes plus upper tropospheric q proxy

SEEKING FUNDING?

- Need big issue question, preferably with initial work highlighting this
- E.g. Continental RH changes, model processes & regional precipitation

- Do models underestimate continental RH decline and if so why?
- How is water vapour changing across datasets and throughout the atmosphere (synthesis of surface and satellite data including
  - HadISDH, microwave CWV, ?radiosonde, AIRS, microwave UTH, ...)
- What are the regional changes in RH and can this help in understanding regional precip changes?
- Can we improve on regional precipitation projections by more intelligent consideration of model biases (too dry region can't get much drier)?
- Are there hooks we can initiate a NERC proposal/collaboration such as RH decline discrepancy and/or regional changes in RH/P