Rationale

Recent studies (1-4) highlight the degree of uncertainty in upper-air temperature records and the effect that this can have upon e.g. detection studies (4). It is imperative that we create multiple independent long-term homogeneous timeseries to fully investigate and understand this uncertainty. The Hadley Centre’s current radiosonde-based global gridded upper-air product, HadRT2.1s (5), has major limitations regarding the selection of potential break-points and their treatment with MSU satellite-based co-located series, limiting our corrections solely to post-1979. These corrections reduce the dataset’s spatio-temporal consistency (6) and independence from MSU. We aim to address these deficiencies in creating our new dataset: HadAT1.

Method

We augment our CLIMAT TEMP station records with data held by NCDC as part of the CARDS project (7). We also consider two additional datasets – LKS (8, 87 stations) and GUAN (9, 151 stations). This combined database contains over 2,000 stations, some with multiple dataset versions, a subset of which by NCDC as part of the CARDS project (7). We also consider 151 stations). This combined database contains over 2,000

We homogenise the individual station series by near-neighbour checks to maintain spatio-temporal consistency. Neighbours are drawn from the contiguous region with correlation r>1/e for each target station, as defined by NCEP neighbours fields (10). Weightings used to develop neighbour averages for each station are the NCEP correlation. We apply a moving Kolomogrov-Smirnov test through the difference series (target station – neighbour average) on a level-by-level and seasonal basis to identify potential jump-points, using metadata, where available, to confirm these jump-points. Timeseries are corrected based upon the change in the mean difference series across the break-point. We only process if this is >0.1K to avoid artificially reddening the series (target station – neighbour average) on a level-by-level and seasonal basis to identify potential jump-points, using

Results

Our QC procedure has been through a total of six iterations, with only 23 of the 477 stations requiring correction on the last iteration. Figure 2 shows a randomly chosen station series for the first three iterations. Although we have not necessarily removed all discontinuities from all station records we have removed the major discontinuities, at least away from the sparsely-sampled high southern latitudes. The resulting zonal trends are spatio-temporally smoother than either the uncorrected analysis or HadRT2.1s (Figure 3). Importantly, the observed tropical tropospheric cooling over the satellite period remains. Grid-box trends on specific levels for 1958-2001 are spatially consistent (Figure 4).

Future work

We plan to calculate error estimates, initially based solely upon our station corrections, to quantify uncertainty in grid-box and larger-scale trends. We have also rejected a further 277 stations in our initial selection which were not in sufficient agreement with GUAN / LKS – many in poorly sampled regions – for which we could calculate a climatology. We will incorporate these in our next generation of this product. In addition to these long-term stations there are over 1,000 extra shorter-record stations from which we could potentially incorporate information.

Acknowledgements and references

The Met Office is supported by the Department of the Environment, Food and Rural Affairs under contract DE/H/N01073 and the Government Met Research program under contract DE/H/2013. We acknowledge the University of East Anglia and Hadley Centre for Climate Prediction and Research. The authors acknowledge the financial contributions of the UK Department for Environment, Food and Rural Affairs (Defra), the Met Office, the UK government Met Research Program, and the National Centre for Atmospheric Science (NCAS). The Met Office is part of the DECC/NSF Ozone Task Force and the Ozone Layer Protection Initiative. We also acknowledge the EU’s Earth Observation Programme and the European Commission’s Great Barrier Reef Project. The Met Office is supported by the Department of the Environment, Food and Rural Affairs under contract DE/H/N01073 and the Government Met Research program under contract DE/H/2013. The authors acknowledge the University of East Anglia and Hadley Centre for Climate Prediction and Research. The authors acknowledge the financial contributions of the UK Department for Environment, Food and Rural Affairs (Defra), the Met Office, the UK government Met Research Program, and the National Centre for Atmospheric Science (NCAS). The Met Office is part of the DECC/NSF Ozone Task Force and the Ozone Layer Protection Initiative. We also acknowledge the EU’s Earth Observation Programme and the European Commission’s Great Barrier Reef Project.

Peter W. Thorne, David E. Parker, Simon F. B. Tett, Phil D. Jones, and Mark McCarthy

Hadley Centre for Climate Prediction and Research, Met Office, UK. Climatic Research Unit, University of East Anglia, UK.