Large Scale Temperature Trends

In light of Myles' and other comments w.r.t. instrumental data, I thought this might be a good time to quickly try and address some of Andrew~~s~~'s observations that he made in his talk at St Andrews a few weeks ago.

I had hoped to write a guest post along with Richard Betts and others at the Met Office, but I already see the summer running away and what spare time I have, I would rather concentrate on a series of later guest posts focussing on dendroclimatology.

There were two issues that Andrew raised:

1. That updates of large scale temperature data-sets appear to depress 19th century and raise 21st century temperature values.
2. That over the last decade or so, there had been a flattening off in temperature trends.

At the time, I could not comment on either as I had not looked at the new data-sets in detail.

So – for all your information, the following link will take you to a series of figures that compares CRUTEM3 and 4 (land temperatures) and HADSST2 and 3 (SST) for northern and southern extra-tropics (ET) and tropical (TROP) latitudinal bands. References at end.

http://www.st-andrews.ac.uk/~rjsw/ftp/TempTrends.htm

For those of you who want to check and replicate my plots, the data can be easily accessed from the Met office website:
http://www.metoffice.gov.uk/hadobs/hadcrut3/
http://www.metoffice.gov.uk/hadobs/hadcrut4/
http://www.metoffice.gov.uk/hadobs/hadsst2/
http://www.metoffice.gov.uk/hadobs/hadsst3/

or perhaps an even more user friendly site is:
http://climexp.knmi.nl

I have purposely not added trend lines, or smoothing functions and have just plotted the temperature anomalies (w.r.t. 1961-1990).

I am not going to describe trends in exhaustive detail, but really want to address Andrew's two main concerns.

Older vs. Newer temperature data-sets

There has been little change in the NH ET input data-sets. The major changes I am aware of are some early instrumental corrections of temperature data-sets in the Greater Alpine Region. However, this is only a small number of records in the extensive NH data-set so does not impact the large scale mean series.

Böhm R, Jones PD, Hiebl J, Frank D, Brunetti M, Maugeri M (2010) The early instrumental warm-bias: a solution for long central European temperature series 1760 – 2007. Climatic Change 101, 41-67.
http://www.slf.ch/fe/landschaftsdynamik/dendroclimatology/Publikationen/index_DE/Bohm_2010_ClimCha.pdf

For TROP and southern ET land temperatures, the major changes are in the 19th century which reflects the addition of newly digitized station records – probably mainly from Australia. Early instrumental temperatures are always going to be less certain and there is less data.
Changes in the late 20th century appear to be minimal.

w.r.t. SST, again little difference between HADSST2 and 3 in the ET NH.
The period of greatest difference in the TROP SST data is around the post 1940's period which are related to biases in HADSST2 w.r.t. "uncorrected change from engine room intake measurements (US ships) to uninsulated bucket measurements (UK ships) at the end of the Second World War." These have been adjusted in HADSST3.
Thompson et al. (2008) A large discontinuity in the mid-twentieth century in observed global-mean surface temperature. Nature 453, 646-649
http://www.roberts.cmc.edu/159/2009%20Combined%20pdfs/Feb%2010%202009.pdf

Correction for homogeneity biases in temperature record is very important and if you want more information on the basic theory, a really good review paper is:
Peterson,T.C. et al, (1998). "Homogeneity adjustments of in situ atmospheric climate data: a review." International Journal of Climatology, 18 1493-1517
http://www.st-andrews.ac.uk/~rjsw/PalaeoPDFs/Peterson-etal-1998.pdf

Could mention that extra tropical SH in SSTs is actually colder in HadSST3 and HadSST2 for the more recent years, and that tropical SSTs have been moved warmer in 19th century, showing that corrections do go both ways. Tropical is also spelt incorrectly on a couple of the plots.

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The recent flattening of temperature trends
As for the recent flattening. Well this appears to vary markedly. Statistically, due to multi-decadal variability which we can see in all of these records and the fact that we are "at the end of the time-series", I think it is really very difficult to "quantify" a flattening or even a continued increase – this will become more clear over the next 10-20 years. For NH ET winter temperatures, there is clearly an "eye-ball" flattening in winter temperatures, but likewise, a continued increase~~d~~ in summer temperatures. Tropical land temperatures appear to show continued warming for all seasons, but tropical SST records could be argued to have flattened.

SH ET land temperatures is a little mixed – perhaps a flattening in summer, but still increasing in spring and autumn.

Final thought
So – my take home message. Let's not generalise too much. The newer data-sets are incrementally improved data-sets which have been corrected related to robust theory and methods. Many on this blog will disagree with this statement, but all I can urge is please read the papers below. Much effort is focussed on the uncertainties and biases in these records. I do not see a systematic change (between old and new) to cooling (warming) of early (late) large scale instrumental series.

As for temperature trends, in the same way that it does not matter if the medieval period was warmer or cooler than today, it does not matter if a particular seasonal time series shows an increase or flattening in temperatures. What is important is that we need to understand the drivers of these changes. Natural or anthropogenic (or a mix of both). CO2 cannot explain all trends since the 1850s, but likewise internal dynamics (PDO, ENSO, NAO etc) or changes in the sun or large-scale volcanic events cannot along explain the variability in climate.

References:

Jones, P. D., D. H. Lister, T. J. Osborn, C. Harpham, M. Salmon, and C. P. Morice (2012), Hemispheric and large-scale land surface air temperature variations: An extensive revision and an update to 2010, J. Geophys. Res., 117, D05127, doi:10.1029/2011JD017139.
http://www.metoffice.gov.uk/hadobs/crutem4/CRUTEM4_accepted.pdf

Kennedy J.J., Rayner, N.A., Smith, R.O., Saunby, M. and Parker, D.E. (2011b). Reassessing biases and other uncertainties in sea-surface temperature observations since 1850 part 1: measurement and sampling errors. J. Geophys. Res., 116, D14103, doi:10.1029/2010JD015218
http://www.metoffice.gov.uk/hadobs/hadsst3/part_1_figinline.pdf

Kennedy J.J., Rayner, N.A., Smith, R.O., Saunby, M. and Parker, D.E. (2011c). Reassessing biases and other uncertainties in sea-surface temperature observations since 1850 part 2: biases and homogenisation. J. Geophys. Res., 116, D14104, doi:10.1029/2010JD015220
http://www.metoffice.gov.uk/hadobs/hadsst3/part_2_figinline.pdf

Morice, C. P., J. J. Kennedy, N. A. Rayner, and P. D. Jones (2012), Quantifying uncertainties in global and regional temperature change using an ensemble of observational estimates: The HadCRUT4 dataset, J. Geophys. Res., doi:10.1029/2011JD017187, in press.
http://www.metoffice.gov.uk/hadobs/hadcrut4/HadCRUT4_accepted.pdf