SPARC Workshop SHARP2016

Reassessment of MIPAS age of air trends and variability

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The mean age of air (AoA), which is the average transit time of an air parcel from the entry point of the stratosphere, the tropical tropopause, has become a measure for the strength of the Brewer-Dobson-Circulation (BDC). However, observations on a possible change of the BDC, due to climate change, are sparse. Here we present a new global data set of AoA derived from SF6-measurements from the MIPAS instrument on ENVISAT over the time period 2002-2012. An improved retrieval setup for SF6 together with a newly calibrated version of level 1b spectra (version 5) was used. Monthly and zonally averaged SF6-profiles were converted into mean AoA using a tropospheric SF6-reference curve. The new SF6 - and AoA-data set was compared to ACE-FTS and to air- and balloon-borne measurements. To investigate a possible change in AoA over the MIPAS period a regression model consisting of a constant and a linear trend term, 2 proxies for the QBO variation, sinusoidal terms for the seasonal and semi-annual variation and overtones was fitted to the MIPAS AoA time series in 10° latitude and 1-2 km altitude bins. The AoA trend was assessed and compared to previous findings of Stiller et al. (ACP, 12, 3311-3331, 2012). While results in trends were partially confirmed, differences were found in the tropics and Northern polar region. Overall, the new distribution of trends in a latitude-altitude-plane appears to be less patchy and more contiguous. A clear asymmetry of significant negative AoA-trends in the Southern hemisphere and positive AoA trends in the Northern hemisphere is found, which is also reproduced by atmospheric models driven with ECMWF-data. The magnitude of trends in the Northern mid-latitude middle stratosphere match now almost perfectly with trends observed by Engel et al. (2009) from 30 year record of balloon data. The new data provide evidence of an accelerating shallow branch of the BDC, at least in the Southern Hemisphere.