Atmos. Chem. Phys. Discuss., 3, S151–S154, 2003
www.atmos-chem-phys.org/acpd/3/S151/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Tropical tropospheric ozone derived using Clear-Cloudy Pairs (CCP) of TOMS measurements" *by* M. J. Newchurch et al.

M. J. Newchurch et al.

Received and published: 12 March 2003

Response to referee #2 comments.

Question: Section 2- please add a sentence quantifying the uncertainty in the THIR data and the corresponding uncertainty in CCP ozone.

Answer: The noise equivalent temperature of THIR instrument at 11.5um and 185K (the typical temperature of tropical upper-troposphere) is 1.5? [Hwang, 1982]. Because the THIR-measured equivalent blackbody temperature is compared with the local monthly temperature profile to derive the cloud top pressure, the accuracy of the derived cloud top pressure depends on the vertical variance of temperature profile. However, at the wet adiabatic lapse rate of 6.5 K/km, a THIR uncertainty of 1.5 K amounts to only ij km cloud top altitude uncertainty. That altitude uncertainty corresponds to less than 1 DU.

Corresponding modification to original paper: In section 2 insert after the 3rd sentence:Ť The noise equivalent temperature of THIR instrument at 11.5um and 185K (the typical temperature of tropical upper-troposphere) is 1.5? [Hwang, 1982]. Because the THIR-measured equivalent blackbody temperature is compared with the local monthly temperature profile to derive the cloud top pressure, the accuracy of the derived cloud top pressure depends on the vertical variance of temperature profile. However, at the wet adiabatic lapse rate of 6.5 K/km, a THIR uncertainty of 1.5 K amounts to only ij km cloud top altitude uncertainty. That altitude uncertainty corresponds to less than 1 DU.Ť

Question: Section 5.3 Please add a sentence or two quantifying how ozone absorption within clouds is likely to affect CCP ozone following Newchurch et al., 2001. Could ozone absorption within clouds explain the 4 DU wave-1 in stratospheric ozone since there is more ozone over the tropical Atlantic than over the tropical Pacific?

Answer: The anomaly correction will reduce the amplitude of the stratospheric ozone wave by a factor of two, on average.

Corresponding modification to original paper: Append to Section 5.3 2nd para:Ť The result of these corrections is to reduce the amplitude of the stratospheric ozone wave -1 by a factor of two, on average.Ť

Question: Please clarify the 2nd paragraph in section 5.3. If the SHADOZ data are regarded as independent of latitude, how can ozone in the Northern Hemisphere be six months out of phase with that in the Southern Hemisphere? It seems unreasonable to assume the SHADOZ data are independent of latitude or longitude given the large spatial variation in tropical ozone. The phrase, Şcorrections range from 5.5 to 5.5, and from 15 to 15Ť is especially confusing.

Answer: We meant independent of latitude within the Southern Hemisphere. The corrections range from 15DU to -15DU for cloudy total ozone.

ACPD

3, S151–S154, 2003

Corresponding modification to original paper: Section 5.3, 2nd para: following ŞĚ regarded as independent of latitude.Ť Add Świthin the southern hemisphereŠ. Change ŞThe corrections range from Ű5.5 DU to 5.5 DU and from Ű15 DU to 15 DU for clear and cloudy total ozone, respectively.Ť To ŞThe corrections range from -15 DU to 15 DU for cloudy total ozone scenes.Ť

Question: Please provide an estimate of the error in CCP ozone. Is the 4DU wave-1 in stratospheric ozone statistically significant?

Answer: The best estimate of the accuracy of CCP comes from comparisons to the only independent, in situ data available, the SHADOZ station measurements of tropospheric ozone. These results, described in Section 7 and Table 1, indicate a mean bias of 3 DU, s.d. of 5 DU and an SEM of 1 DU. The 4DU (2-3DU after cloud anomaly correction) wave amplitude of stratospheric ozone occurs in all months. An amplitude of 2 DU will result in a 4 DU difference between tropospheric ozone at Atlantic and Pacific, on average. This 4-DU difference is significantly larger than the sample SEMs of 1 DU and is comparable to the CCP accuracy standard deviation.

Corresponding modification to original paper: Change the title of section 7 to: ŞAccuracy assessment of CCP.Ť Append to the last para of section 7:Ť Overall the archived CCD tropospheric ozone column results are 9 ś 1 SEM DU higher than all SHADOZ stations, on average, while the CCP results are 3 ś 1 SEM DU higher. Change the abstract ŞĚare highly consistentŤ to Ş agree, on average, to within 3 ś 1 DU standard error of the mean .Ť

Question: Figure 6 and Table 1 Ű The last sentence of the introduction notes that Ziemke et al., (1998) recommend removing 5 DU from the CCD data, but this in not done in the current manuscript. It seems misleading to show the CCD data without the recommended correction. Suggest showing the CCD data with the recommended correction, or not show the uncorrected data (the black lines).

Answer: We also found and noted a consistent offset in cloudy/clear total ozone dif-

ACPD

3, S151–S154, 2003

ferences between Nimbus-7 and EP TOMS data that may result from the same fundamental cause as the difference of N7/EP TOMS total ozone mentioned by the reviewer. After significant thought about this question, because the CCD authors offer no physical reason for the correction (it simply removes an observed bias) we decided to present both the published (=website) CCD data and also mention the recommended correction and let the reader decide for himself whether to use the CCD correction for the suggested reason. The CCP results have no analogous bias removal between N7 and EP TOMS results.

Corresponding modification to original paper: none

Question: Technical comments: 2nd line of section 4.2, suggest changing first comma to a period. Suggest updating the references. Martin et al., 2001 was published in 2002 and Thompson et al., 2001 is in press. Section 5.3, change Ş(OZAC) due ozoneŤ to Ş(OZAC) due to ozoneŤ

Answer: We will correct these. Thanks.

Corresponding modification to original paper: As suggested.

References

Hwang, P. H. Ed., 1982: Nimbus-7 Temperature Humidity Infrared Radiometer (THIR) data userŠs guide. NASA/ Goddard Space Flight Center, Greenbelt, MD 20771, 52 pp.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 225, 2003.