Processing of observational data – theory

The methodology of measurements and calculation of total ozone is defined in the fundamental papers *[Dobson. 1957a]* and *[Komhyr, 1980]*.
Measurement of total column ozone in the atmosphere with the Dobson ozone spectrophotometer comes out from the equation of attenuation of the solar ultraviolet radiation by key atmospheric constituents.

$$\log I = \log I_0 - \alpha \mu O_3 - \beta m p/p_o - \delta \sec ZA \quad (1)$$

where:
I_0 ... spectral intensity outside the atmosphere (extraterrestrial)
I ... spectral intensity of solar radiation at the ground
O_3 ... total amount of ozone in the atmosphere in Dobson Units (mili-atm-cm)
ZA ... zenith angle of the Sun
m ... relative path of the solar radiation through the atmosphere
p ... observed air pressure at the ground
p_o ... mean sea level pressure
α ... spectral absorption coefficient of ozone
β ... spectral Rayleigh molecular scattering coefficients of the air
δ ... spectral scattering coefficients of aerosol particles
μ ... relative path of the solar radiation through the ozone layer

For two wavelengths with a high (α_1) and low (α_2) ozone absorption selected in the ultraviolet part of the solar spectrum the total ozone can be calculated from the relation:

$$O_3 = (N - (\beta_1-\beta_2) m p/p_o - (\delta_1 - \delta_2) \sec ZA) / (\alpha_1 - \alpha_2) \mu \quad (2)$$

where:
$$N = \log(I_{01}/I_{02}) - \log(I_1/ I_2) = N_0 - \log(I_1/ I_2) \quad (3)$$

If wavelength pairs A,C,D are taken then the influence of aerosol particles can be eliminated by subtraction of their equations (2) and the relation for total ozone adjusted for the pairs AD, CD as:

$$O_{3AD} = (N_A / \mu_A - N_D / \mu_D) / (\alpha_A - \alpha_D) - (\beta_A - \beta_D) m p / (\alpha_A - \alpha_D) \mu_{AD} p_o \quad (4)$$
$$O_{3CD} = (N_C / \mu_C - N_D/ \mu_D) / (\alpha_C - \alpha_D) - (\beta_C - \beta_D) m p / (\alpha_C - \alpha_D) \mu_{CD} p_o \quad (5)$$

where μ_A, μ_C, μ_D are values of μ calculated for times of each observed wavelength pair separately *[Komhyr, 1988]*.
The parameter N expresses the difference between logarithms of ratios of extraterrestrial and ground intensities of radiation at both wavelengths as it can be measured by a Dobson instrument. Values of N therefore depend on actual properties of the atmosphere (mainly on total amount of ozone) represented by $\log(I_1/ I_2)$ and on technical condition of the instrument given by the ratio $N_0 = \log(I_{01}/I_{02})$ that is called the "extraterrestrial constant - ETC". ETC is defined for a particular spectrophotometer and used for development of N-Tables that convert R-values (position of the dialing ring) onto N-values (3).