Notes on the method of estimating the distance to the object

Let's consider the simplest case

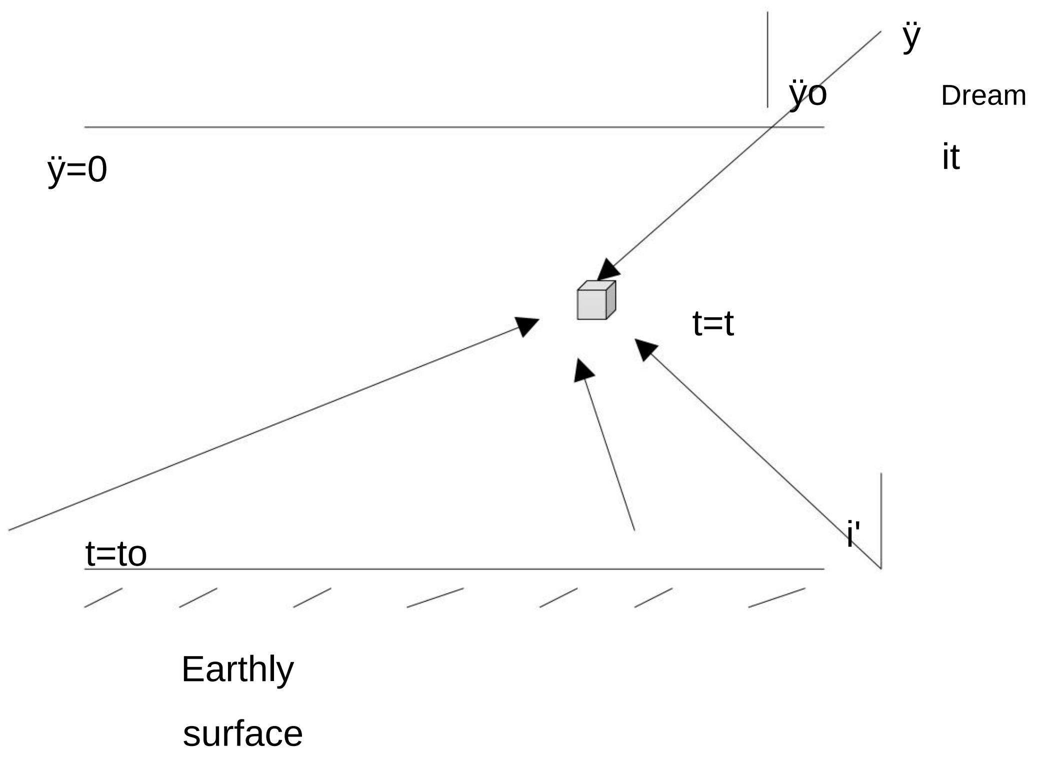
1) flat homogeneous atmosphere
2) the optical thickness is small, so we limit ourselves to the approximation of single scattering in the atmosphere.

Solar radiation falls on the atmosphere at a certain angle ÿ0 . It is scattered and absorbed both in the atmosphere and on the Earth's surface.

Consider a volume element in the atmosphere at the optical depth ÿ, which is counted from the outer boundary of the atmosphere

ÿ = zÿÿ ÿ dz (1),

where ÿ is the extinction coefficient (the sum of scattering and absorption coefficients), z is the height above the earth's surface. The total optical thickness of the atmosphere ÿ0.



The flux of solar radiation that falls on the atmosphere at an angle ÿ0 is equal to ÿF.

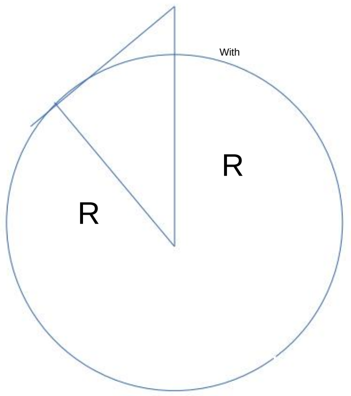
Energy is absorbed in the volume element at the optical thickness ÿ (meaning and absorption and scattering)

apF exp[- ÿ Sec(ÿo)], (2)

In addition, it is necessary to take into account solar radiation scattered by the earth's surface and also absorbed and scattered in the atmosphere. The flow of radiation scattered by the earth's surface and absorbed in the atmosphere
in the volume element at the optical thickness ÿ

ÿ ÿ ÿ F exp[-ÿ Sec(ÿo) – (ÿo-ÿ) Sec(ÿ')]Cos(ÿo)dÿ, (3)

where A is the albedo of the earth's surface (we use a rough approximation of isotropic scattering) and the integration is carried out over the earth's surface visible from a given point in the atmosphere (in the case of objects in the atmosphere z<<R)



that is, along ÿ from 0 to 2ÿ, and along ÿ' from 0 to ÿ ÿ/2 . where R is the radius of the Earth.

That is, we have

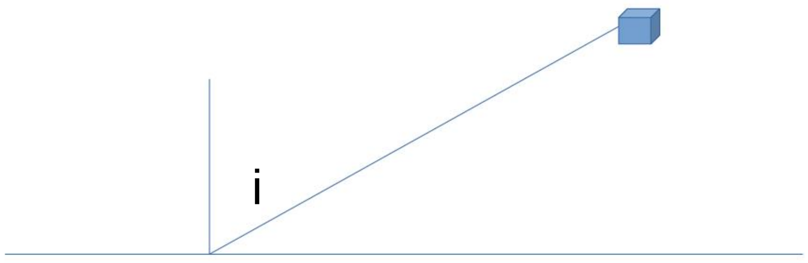
2ÿÿ a F exp[-ÿ0 Sec(ÿo) ÿ2(ÿo-ÿ) Cos(ÿo), (4)

where **E2(ÿo-ÿ) = 1ÿ ÿ exp[(ÿo-ÿ)x] dx/x2 is** the integral exponential function 2
of order

Consider the radiation transfer equation (we omit the frequency sign)

Cosÿ dI/dz = -ÿ I + ÿ (5)

where ÿ is the emission coefficient, ÿ is the absorption coefficient, ÿ is the radiation intensity, ÿ is the angle at which the scattered radiation spreads in the direction of the observer.



Let's move on to a new variable - optical thickness (1)

Cos ÿ dI/dÿ = I – ÿ/ÿ = I - S **(6)**

If ÿ is the probability of survival of a quantum during scattering, then, taking into account (2) and (4) for the emission coefficient, we have:
for diffuse solar radiation

ÿ1 = ÿ/(4) ÿF exp[- ÿ Sec(ÿo)], **(7)**

and for the volume of radiation scattered by the element and reflected from the Earth's surface

ÿ2 = ÿ/(2)ÿ ÿ F exp[-ÿ0 Sec(ÿo) ÿ2(ÿo-ÿ) Cos(ÿo), **(8)**

Thus the source function

S = ÿ1 + ÿ2 **(9)**

Thus we have

Cosÿ dI/dÿ = I-ÿ/(4) F{exp[- ÿSec(ÿo)] - ÿ/(2)ÿFexp[-ÿ0 Sec(ÿo) ÿ2(ÿo-ÿ) Cos(ÿo),
(10)

If we integrate over the entire atmosphere, we get the intensity I(ÿo,ÿ). Integrating from ÿ0 to ÿ we obtain the intensity of scattered radiation in the direction of the object

I (ÿ0,ÿo,ÿ) = Iÿÿ exp[(ÿ0 -ÿ) Sec(ÿ)] + ÿF/(4) {exp[ÿ(Sec(ÿ) - Sec(ÿo)] – exp[ÿ0 (Sec(i) – Sec(ÿo)]}/ [Sec(ÿ) – Sec(ÿo)] – ÿ/(2)ÿF exp[-ÿ0 Sec(ÿo) ÿoÿ ÿ ÿ2(ÿo-ÿ) Cos(ÿo) exp[ÿ0 Sec(i)] dt **(11),**

Iob is the radiation intensity of the object itself, which is located at the point
t.

Thus, the difference in brightness in the stellar magnitudes of the area where the object is observed and the area of the clear clear sky is determined by the ratio

ÿm = lg [I (ÿ0,ÿo,ÿ))/Io] /lg2.512 **(12)**

That is, the dependence is completely different from what the authors use. It can be seen that, in principle, it is possible to estimate the distance based on the data of observations at different frequencies to the object and this idea has the right to life, but the method of determining the distance implemented in the work is erroneous.

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