DISCUSSION ABOUT COMPUTING PARALLACTIC REFRACTION IN MODEL ATMOSPHERES

Chairman: T.J. Kukkamäki

J. Saastamoinen: (introduction to the discussion)
The problem with parallactic refraction for points within the atmos-
phere is that - in my opinion - there is no model atmosphere that can
be used for calculating it. In astronomical refraction, the thing is
different. We measure the refractive index at the ground level and we
know that at the top of the atmosphere it is equal to 1. But in parall-
actic refraction, when the flash is inside the atmosphere, we should
have meteorological information at that point, too. Otherwise we can
compute the parallactic refraction only on the basis of our particular
model, which may be not good. It may well be good for astronomical re-
fraction but not for parallactic refraction. There is also the effect
of uncompensated isopycnic tilts. If we have a level surface and con-
stant temperature, everything is fine, as the isopycnic layers are
horizontal . But going from South to North, the temperature gradient
will cause a meridional tilt of the isopycnics at the ground level.
At a height of approximately 8 km this tilt has become zero, and above
that it takes the opposite direction. Now in astronomical refraction
the combined effect of these tilts is largely cancelled out. But when
we deal with parallactic refraction we miss the upper compensating
layers, and there will be quite a sensible correction for tilt, which
is difficult to take into account in atmospheric models.

B. Garfinkel: Regarding your statement, that the models are good for
astronomical refraction but not for parallactic refraction, I am in-
clined to question the statement. If the model is good for infinity,
it should be good for a distance which is less than that.

J. Saastamoinen: I stated that if the object is inside the atmosphere,
the model is not good, because we don't use the upper part of the
atmosphere, that compensates for the lower part.

B. Garfinkel: But you use the upper part if you have astronomical re-
fraction for zenith distances large enough where the profiles make a
difference.

J. Saastamoinen: But we know the refractive index only at the ground
level and that it is 1 at the top level.

B. Garfinkel: But you also need the intermediate values if you have
large zenith distances.

J. Saastamoinen: We don't usually know the values in between.

B. Garfinkel: But you assume, that you know what you need to be able
to calculate the astronomical refraction. And the same information
could be used to calculate the parallactic refraction just as well.

J. Saastamoinen: No, it can not. You see, in parallactic refraction the
main term depends on the difference in barometric pressure between the
two points, and this term may change quite a lot without any change in
astronomical refraction.

B. Garfinkel: Well, I don't quite agree.

G. Teleki: I support completely Dr Saastamoinen's conclusions. It is a
realistic conception. Your conception is idealistic. From Dr Kakkuri's
investigations it is visible, that at higher zenith distances there
are some differences from the theory. But it is a result of the tilt-
ing of the realistic atmosphere.

J. Saastamoinen: You see, the ground pressure at the sea level is quite
constant. It only changes about 5% at the most. If you take the vertical
differences of pressure, they change much more because the air is free
to go up and down.

B. Garfinkel: But when you calculate astronomical refraction for large
zenith distances and have no accurate data from the intermediate layers,
how can you get a reliable result? You have to make use of all inform-
ation about the structure of the atmosphere.

J. Saastamoinen: We don't have at all the information we need in the
case of parallactic refraction. But for astronomical refraction we
have reasonable information.

B. Garfinkel: For large zenith distances?

J. Saastamoinen: Not for large.

B. Garfinkel: This is just the point. If you work with small zenith
distances then you have a different situation.

J. Saastamoinen: Yes, but for parallactic refraction we don't have the
information even for small zenith distances.

J.A. Hughes: Regardless of the model atmosphere which is used, be it
good or bad, it can be applied to any kind of refraction. Parallactic

refraction however, involves geometric considerations which depend upon
where the object and observer are. One may have one model for parallact-
ic refraction and one for astronomical refraction, but the essential
difference is a geometric one, it seems to me.

J. Saastamoinen: Well, the thing is that for astronomical refraction,
if the model is bad, the result is not that bad because we measure
through the whole atmosphere whose refractive index at the upper bound-
ary is necessarily 1. And we also know from ground pressure the total
weight of the column. But if we stop somewhere inside at a point we
don't know anything about, we need some observations made at that point.

J.A. Hughes: I agree that in this case a correct model is more import-
ant.

D.G. Currie: I think that one relationship that Dr Garfinkel was
mentioning, if you have a model which has purely horizontal layers,
then the only information you obtain for the distribution of layers
are, at least in the astronomical language, very extreme zenith dis-
tances where there is not a lot of data. With the parallactic refrac-
tion you are within these layers. Neglecting the tilting of the layers,
you can have a good number for the astronomical, and a weak determina-
tion of that distribution of layers will cause problems if you are
asking what happens when you are half way down to the layer.

J.A. Hughes: We don't have to discuss parallactic refraction in terms
of the atmospheric structure only. The moon has a parallactic refrac-
tion which can amount to a couple of arc seconds from geometry alone.

J. Saastamoinen: In that case, the question is extremely simple.

J.A. Hughes: Yes, of course, as you say, with objects within the atmos-
phere you have an especially difficult case.

B. Garfinkel: The polytropic model that I assumed in my theory provides
information for the calculation of the astronomical refraction, as well
as parallactic refraction. The question of whether or not the model is
sufficiently accurate can be settled only by observational checks of
the theory. I recommend that such checks be carried out.

J. Saastamoinen: The main correction term in astronomical refraction
depends only on the ground pressure and the angle.