Report of informal meeting held on July 29, 2012 in Uvalde, Texas, USA

Subject: Earth models used for scoring purposes at FAI International Championships

Participants: Erazem Polutnik, Andrej Kolar (SeeYou developers), Rick Sheppe (Annex A Subcommittee), Dick Bradley (IGC Bureau, Chief Steward at Uvalde), Peter Ryder (Jury President at Uvalde)

The meeting was prompted by the recent controversial discussion of the Annex A Subcommittee's proposal (adopted by the IGC and included in the latest version of Annex A) to use the "FAI Sphere" for all geographical calculations involved in scoring of championships. Since the meeting had a purely informal character, no attempt was made to formulate any conclusions or specific recommendations for the FAI/IGC rules. The purpose was to exchange information with the aim of clearly understanding the reasons for the Annex A proposal and the arguments which have been brought forward for and against it in the discussion.

Rick explained the problem as seen by the Annex A Subcommittee: At present the earth model used for all geographical calculations, including badges, diplomas, records and championships, is the WGS-84 ellipsoid. This is in principle no problem for the programmers, because, although there are no simple formulae for calculating distances and bearings on the surface of an ellipsoid, there is a standard, well-tried numerical algorithm available (the Vincenty method). However, there is no standard method for calculating distances from a point to a line, and different scoring programs apparently use different approximations, because they arrive at slightly different results. The Annex A Subcommittee is of the opinion that this situation is unacceptable, and that the IGC must therefore define the method of calculation in such a way that all programs come to the same result, hence the FAI Sphere proposal as the solution.

Such approximations are required when calculating the distance of a fix from a line or the bearing of a fix from a point, e.g. when

- determining start and finish times,
- checking airspace infringements
- determining distances from a fix to a start line or to an assigned area boundary.

Erazem expressed the opinion that the use of the FAI Sphere for competitions presented absolutely no problems in itself, and there was general agreement on this. After all, not long ago the task setters and scorers used to measure the distances with a ruler on a wall map (flat earth model). Some fears that there could be some conflicts with the IGC flight recorders, which use WGS-84, were dispelled by Erazem, who explained that the flight recorders only use the WGS-84 ellipsoid for calculating the geographical coordinates from the satellite data, not for calculating distances. However there was some sympathy for the GFAC view that, once having adopted the WGS-84 ellipsoid as our standard, we should stick to it for all calculations. Further, both Dick and Peter expressed the opinion that, contrary to the view of the Annex A Subcommittee, the change was unnecessary, for two reasons:

1. In our experience as stewards and jury members at several events since the introduction of WGS-84, no serious problems with this model have been encountered in practice.

2. In the case of small infringements, e.g. airspace, the competition director and any persons involved in dealing with protests must use their judgment in deciding whether or not the pilot should be given the benefit of the doubt.

Rick agreed that the use of judgment could be a solution, but this mus be explicitly foreseen in the Sporting Code. Another solution which was discussed was to keep the WGS-84 ellipsoid, but allow specified approximations for certain cases, e.g. the list above.

Andrej mentioned that airspace boundaries are usually defined as “polygons”, i.e. points joined by “lines”, where the exact definition of the lines is not known. Thus the result of the calculation of the distance from an airspace boundary may depend on the assumption made about the form of the lines. This is of no concern to anybody (except glider pilots?), because slight infringements of airspace boundaries are generally ignored.

As a physicist, Peter suggested that the inaccuracies of the GPS fixes should be taken into account, but this idea was strictly rejected by the programmers, who claimed that the IGC had decided that the GPS fixes must be considered to be “exact”.

Rick provided the following short summary of the various possible solutions which had come up in the course of the discussion.

1. *The Annex A solution:* Use the sphere for all calculations.
2. *The programmer’s solution:* Use the ellipsoid for point-to-point calculations and use the flat map for point-to-line calculations.
3. *The solution that gives the pilot the benefit of the doubt:* “Any disputes due to small discrepancies in evaluation shall be resolved in favor of the pilot.”
4. *The scientific solution:* Introduce the concept of uncertainty to the Sporting Code.
5. *The traditional solution:* Do not address the problem with a rule. Rather, trust the judgment of the officials to resolve any dispute in a fair manner.