Problems and their solutions for using SI in Earth Sciences

Hiroshi Shigeno[1]

[1] G.S.J., A.I.S.T.

http://staff.aist.go.jp/hiroshi-shigeno/index.html

1. Introduction

The present Japanese Metric (Measurement) Law was established in 1992, and the present SI (Le Systeme international d'unites) has been recommended to use in education and science in Japan. However, its use is not always beneficial, as already pointed out. Here, a recent report discussing the problems and their solutions for using the present SI in Earth Sciences by Shigeno (2004) is outlined.

2. Problems

The preset SI, based mainly on science of physics, is characterized by its generality, integrity, accuracy, and absoluteness among others. And, the slogan, 'principle (ideal?) of one unit for one quantity', has been publicized for recommending the use of the present SI in Japan. However, the present SI is not always suitable to reasonably and intuitively presenting data in Earth Sciences whose objectives are understanding the present conditions and history of the earth, and applying the results to its development and protection.

Some examples of the intuitive units, not encouraged to use (or out of the scope of the discouragement?) by the present SI, are: (1) atm and bar to Pa for pressure; (2) cal to J for heat energy; (3) yr (year) to s (second) for time; and (4) index (logarithmic) presentation of pH and M to mol/L and J for hydrogen ion activity in solution and earthquake magnitude. (Use of atm, bar and pH are temporally accepted by the present Japanese Metric Law.)

Various problems are expected to have been occurring as the results of accepting the above recommendation as follows: (1) By losing the intuitiveness, scientific analysis, discussion and understanding would become more difficult. (2) Students with less basic knowledge may easily lose their interests in science due to the difficulty accelerated by the above (1). (3) Experimental measurements and operations may fail when prompt judgments are necessary, even producing dangerous situations.

3. Solutions

Extreme integration tends to cause various problems in the actual world, even though it seems ideal to idealist. The solutions of the problems are probably in making the ideal more flexible according to the real world conditions. Concerning the present SI, the units that are recommended not (not encouraged by SI documents) to use should be admitted if they are reasonable, and make understanding much easier. Well-known simple solutions are, (1) writing two value-units (SI and non-SI) by putting one in parenthesis (more likely the data in SI), and (2) putting one and its relations to the others in footnote or appendix (also the data in SI). Science journals have generally recommended the use of SI as a basic rule, but it is expected to be reconsidered for the above points.

Future systematic solutions would improve the present SI, through widely discussing the present problems and enhancing the mutual understanding. If the problems caused by the strict use of the present SI in education and security were severe, it would be necessary to have the occasions to discuss them in science societies. Internet may contribute to wide mutual understanding of the problems and promptly improving the present SI by diminishing the time-consuming voluminous efforts to them.

4. Summary

The summary of this paper is that we need more reasonable, intuitive and flexible applications of unit system for our better understanding and acting in the global environment where we live. The ideal represented by the slogan of 'principle of one unit for one quantity' for overwhelming integration of science, and convenience of international trade may be fairly dangerous, because it could cause less understanding and losing interests in science to many ordinary people. Reconsidering the use of the present SI in education and science (especially in Earth Sciences) would be necessary on the basis of the objectives, principles, and origins of units.