

## Summary and Recommendations

Dennis D. McCarthy

*U. S. Naval Observatory*  
*3450 Massachusetts Ave., NW*  
*Washington DC 20392-5420, USA*  
*e-mail: dmc@maia.usno.navy.mil*

### 1. Summary

IAU Colloquium 178 was held to mark the occasion of the 100-year anniversary of the founding of the International Latitude Service (ILS). This occasion provided an opportunity not only to review the history of past international collaboration in the areas of fundamental astronomy, geodesy, and geophysics, but also to establish the current level of knowledge of the phenomenon of polar motion. It also provides us the opportunity to identify the current issues and to establish the areas where further efforts are needed.

In sessions devoted to the historical development of the field of polar motion study, authors stressed the need to find and collect observations that may have been made before the establishment of the ILS. All of these observations need to be analyzed in one system consistent with current definitions and conventions. It was also suggested that histories of the ILS, the International Polar Motion Service, and the Bureau International de l'Heure be written now in order to document historical development of cooperative efforts in the field. A promise to complete Part I of the final report of Project MERIT was made.

Since the study of polar motion has required a wide geographic distribution of astronomical observing sites, this has been an area of research that has depended heavily on international cooperation. In this respect, considering the hundreds of observers and the numerous participating agencies, the past has served as an example for the future. One important lesson to be drawn is the example of the unified procedure used by all who participated in the ILS. Modern analyses also need to make efforts to unify standards and procedures.

In scientific sessions it was clear that there is improving agreement between geophysical data and models on the one hand and the astro-geodetic observations on the other. Future meetings and discussions will have to deal with future steps to be taken to refine the nature of the agreement. One specific suggestion is the need to develop an atmospheric model intermediate between the "inverted barometer" and the "non-inverted barometer" models.

Issues that deserve attention in the future were recognized at the colloquium. Among these are the future definition of Coordinated Universal Time, and standards, models and procedures for the future. Developments will be needed to deal with currently unmodelled site motion, combination of data from different techniques, and the documentation of the importance of *a priori* data in the current analyses.

Issues related to diurnal and sub-diurnal polar motion received a great deal of discussion. Developments needed here include a definition of the CEP consistent with modern observations, tidal models, and further analyses of the role of atmospheric and oceanic angular momentum in polar motion.

It is clear that the efforts of this community have provided both service to users of the data and insight into the physical processes of the planet Earth. The development of the current standard celestial and terrestrial reference frames have, in fact, been driven by those scientists working at the limits of technology to study the Earth's polar motion.

## 2. Recommendations

As a consequence of the meeting and the associated discussions, participants in IAU Colloquium 178 discussed and endorsed the following recommendations that have been passed on to the appropriate international agencies.

### Recommendation 1.

IAU Colloquium 178 "Polar Motion: Historical and Scientific Problems"

Considering the importance of the contribution of the International Latitude Service to the study of polar motion,

Recommends that concerted efforts be made to preserve the buildings and instruments associated with the observatories of the International Latitude Service and predecessor observatories especially the associated geodetic monuments or pillars.

### Recommendation 2.

IAU Colloquium 178 "Polar Motion: Historical and Scientific Problems"

Recognizing the need for high-frequency polar motion for accurate artificial Earth satellite orbit determination and the study of the physics of the Earth at daily and subdaily frequencies,

Recommends that the International Earth Rotation Service (IERS) coordinate the establishment of a series of high-frequency polar motion estimates consistent with the current IERS reference systems in cooperation with the International GPS Service, International Laser Ranging Service, and the International VLBI Service.

### Recommendation 3.

IAU Colloquium 178 "Polar Motion: Historical and Scientific Problems"

Recognizing that

1. Coordinated Universal Time (UTC) is the basis for modern world-wide time keeping and navigation systems, and
2. the astronomical contribution to UTC in the form of leap seconds,

Recommends that

1. the International Astronomical Union form a working group to consider the possible redefinition of UTC, particularly the requirement for leap seconds, and
2. that this study be undertaken in cooperation with the appropriate groups of the International Union of Radio Science (URSI), the International Telecommunications Union (ITU), and the International Committee for Weights and Measures (CIPM).

Recommendation 4.

IAU Colloquium 178 "Polar Motion: Historical and Scientific Problems"

Recognizing the requirement for accurate polar motion to

1. provide accurate transformation between celestial and terrestrial reference frames, and
2. investigate the physics of the Earth,

Encourages both

1. high-frequency astronomical and geophysical observations of high precision, and
2. further studies to establish the nature of polar motion on time scales from hours to centuries.

Recommendation 5.

IAU Colloquium 178 "Polar Motion: Historical and Scientific Problems"

Considering the need for clear, concise definition of the transformation between the terrestrial and celestial reference frames,

Recommends

1. that the appropriate working group of the International Astronomical Union (IAU) study the definition of the most appropriate parameters to accomplish this transformation, the definition of the Celestial Ephemeris Pole, and the definition of the rotational time scale UTI, and
2. that this working group prepare its recommendations regarding these definitions for the IAU General Assembly in 2000, and
3. that this work be carried out in consultation with the IAG.

Recommendation 6.

IAU Colloquium 178 "Polar Motion: Historical and Scientific Problems"

Considering the value of the recent re-reduction of past observations of the Earth's orientation in the Hipparcos reference frame to studies of the Earth's orientation,

Recommends that the International Astronomical Union undertake additional efforts to

1. collect further historical data, and
2. reduce these data in the International Celestial and Terrestrial Reference Systems.

Recommendation 7.

IAU Colloquium 178 “Polar Motion: Historical and Scientific Problems”

Recognizing

1. the excellent arrangements made by the Local Organizing Committee (LOC),
2. the kind hospitality of the members of the LOC, and
3. the important contributions of local agencies to the success of the Colloquium,

Thanks the members of the LOC, the Stazione Astronomica di Cagliari-Carloforte, Università degli Studi di Cagliari, the Ministero dell'Università e Ricerca, Regione Autonoma della Sardegna, and the Comune di Monserrato for their efforts to make IAU Colloquium 178 a success.