GEODEZJA I KARTOGRAFIA
GEODESY AND CARTOGRAPHY
Vol. 53, No 2, 2004, pp. 79-83

Professor Aleksander Brzeziński – a winner of the prestigious 2003 EU Descartes Prize

Barbara Kołaczek

Space Research Centre
Polish Academy of Sciences
18a Bartycka St., 00-716 Warsaw, Poland
e-mail: kolaczek@cbk.waw.pl

Received: 23 March 2004/Accepted: 18 June 2004

Abstract: Prof. Aleksander Brzeziński, Ph.D. of the Planetary Geodesy Department of the Space Research Centre of the Polish Academy of Sciences, was awarded the Descartes Prize as a member of the team of 25 researchers from 9 countries, headed by Professor Veronique Dehant from the Royal Observatory of Belgium for completing the research on "Non-rigid Earth nutation model".

In the note some information about two 2003 EU Descartes Prizes is given. The 1980 IAU model of nutation worked out by J. Wahr is mentioned and the most important achievements of the Working Group on "Non-Rigid Earth nutation model", with the emphasis on A. Brzeziński contribution, are presented.

Keywords: Nutation model, Descartes Prize, Aleksander Brzeziński

Prof. Aleksander Brzeziński, Ph.D. of the Planetary Geodesy Department of the Space Research Centre of the Polish Academy of Sciences, the member of the Committee of Geodesy of the Polish Academy of Sciences and the vice-president of its Section of Earth Dynamics, was awarded the Descartes Prize as a member of the team of 25 researchers from 9 countries, headed by Professor Veronique Dehant from the Royal Observatory of Belgium for completing the research on "Non-rigid Earth nutation model", (see Appendix).

The European Descartes Prize has been awarded since 2000 for outstanding scientific and technological achievements, resulting from European collaborative research performed by the European groups of researchers, which may be also attended by researchers and groups of researchers from non-EU member states.

The Descartes Prize 2003 was awarded on November 20, 2003 in Rome, at the "Academia Nazionale dei Lincei", basing on the resolution of the Descartes Prize Grand Jury. Out of eight teams of researchers, selected from 230 applications submitted for the nomination (900 scientists), 2 projects were finally awarded, including the team headed by Professor Veronique Dehant, the member of which was Professor Aleksander Brzeziński. The other awarded project, "Polymer light-emitting diodes for displays (PLEDD)" was lead by Prof. Richard Friend of the University of Cambridge (UK).

The team of Professor Dehant was the Working Group, established by the International Astronomic Union (IAU) in 1994 in order to develop the theory of non-rigid Earth nutation. This Group was operating under the auspices of the IAU and the International Union of Geodesy and Geophysics (IUGG).

The new theory for nutation of non-rigid Earth, developed by Mathews and his collaborators MHB2000 (Mathews et al., 2002), adopted by the XXIV IAU General Assembly in Manchester in 2000 and approved by the IUGG in 2003, is the most outstanding achievement of the discussed team. The MHB2000 theory describes the non-rigid Earth nutation and considers all effects exceeding 0.1 microsecond of arc. Its abbreviated version, MHB2000B defines nutation at the accuracy level of 1 millisecond of arc (IERS 2003).

Those investigations have been initiated as a consequence of use of new satellite observation techniques, and especially VLBI (Very Long Baseline Interferometry) for the determination of the Earth orientation parameters. The VLBI observations proved the existence of large corrections to the IAU 1980 theory of nutation, developed by Wahr (Wahr, 1981) (Fig. 1a, b). That theory was developed for the ellipsoidal, elastic Earth (without oceans) and ensured the accuracy of the orientation of the Earth rotation axis equal to 2–3 metres on the Earth surface; the new satellite observation techniques: SLR and GPS, as well as VLBI reached the cm level of accuracy of determination of position on the Earth surface and the pole motion, that specifies the direction of the Earth rotation axis.

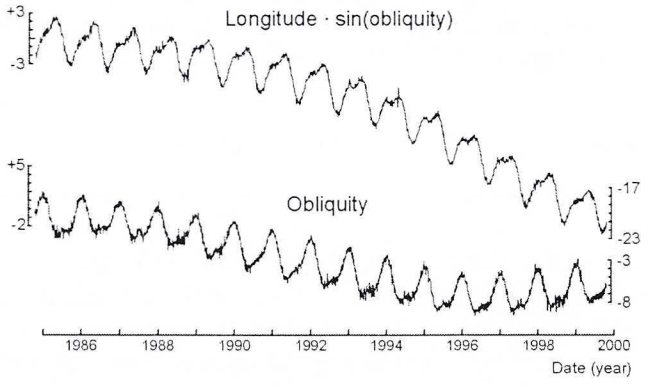

Fig. 1a. Nutation corrections $\Delta\psi\sin\varepsilon$ – in longitude, and $\Delta\varepsilon$ – in obliquity, determined by the VLBI observations with respect to the IAU 1980 nutation theory and IAU 1976 precession model (IERS, 2000)
(units: 0.001 as)

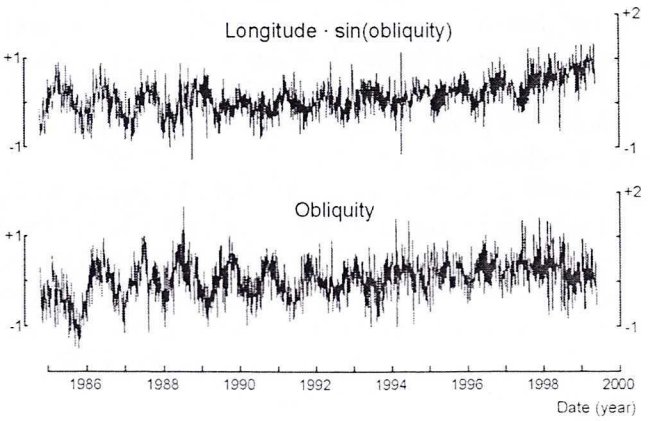

Fig. 1b. Nutation corrections $\Delta\psi\sin\varepsilon$ – in longitude, and $\Delta\varepsilon$ – in obliquity, determined by the VLBI observations with respect to the IERS Convention 1996 precession/nutation model (IERS, 2000)
(units: 0.001 as)

Such precision of nutation theory is recently of high importance for space navigation, where precise knowledge of the Earth orientation is required. It is also crucial in satellite geodesy that deals with precise positioning, with determination of station movements, as well as determination of parameters of Earth rotation.

The Earth nutation theory also contributed to the knowledge of the Earth structure and it became the tool for investigations of its interior, its solid and liquid cores. Professor A. Brzeziński has contributed to modelling of free nutation of the non-rigid Earth (Brzeziński 2001, 2003 a, b) and to estimation of impact of the atmosphere and non-tidal oceanic disturbances on the polar motion and nutation (Brzeziński et. al., 2002; Brzeziński and Nastula, 2002).

Works of Professor V. Dehant's team, which lasted for several years, were completed with many significant achievements. Three Earth nutation theories were developed for the rigid Earth: RDAN97 (Roosbeek and Dehant, 1998), SMART97 (Bretagnon et al., 1998), REN2000 (Souchay et al., 1999). Accuracy of considered effects achieved the level of the tenths of a microsecond of arc. Differences between complete expansions of those three theories are of the order of the tenths of a millisecond of arc.

Theories of nutation for the non-rigid Earth were also developed, which did not utilise the theory of nutation of the rigid Earth by means of calculation of the transfer function. One of those theories utilised Hamilton equations, applied for the layer structure of the Earth (Gettino and Ferrandiz, 2000). Herring with his collaborators (Herring et al., 2002) presented a numerical model of nutation, based on analysis of 20 years of VLBI observations. Differences between that model of nutation and the MHB2000 theory achieve several dozens of microseconds of arc.

Professor V. Dehant's team participated also in preparation of nine resolutions for the XXIV IAU General Assembly held in 2000, that besides accepting the new precession/nutation theory, specified in details, the definitions of the celestial and terrestrial co-ordinate systems, the Celestial Intermediate Pole – CIP, the Celestial and Terrestrial Ephemeris Origins and defined required relativistic corrections (IAU, 2001; Krynski and Sekowski, 2003). In co-operation with Dr. N. Capitaine of the Paris Observatory, Professor A. Brzeziński, have significantly contributed to the development of the CIP definition (Capitaine and Brzeziński, 1998).

The resolutions of the XXIV IAU General Assembly were discussed during the IAU Colloquium 180 "Towards Model and Constants for Sub-Microarcsecond Astrometry" in 2000, with participation of Professor Brzeziński. Those resolutions, approved at the XXIV IAU General Assembly held in Manchester in 2000, allow for performing astrometric research and investigations of the Earth dynamics at the level of one microarcsecond.

References:

Bretagnon P., Francou G., Rocher P., Simon J.-L., (1998) *"SMART97": A new solution for the rotation of the rigid Earth*, Astronomy and Astrophysics, 329, pp. 329-338.

Bretagnon P., Rocher P., Simon J.-L., (2000): *Nonrigid-Earth rotation solution*, Proc. of IAU Colloquium 180, K.J. Johnston, D.D. McCarthy, B. Luzum, G. Kaplan (eds.), U.S. Naval Obs., Washington, D.C., pp. 230-235.

Brzeziński A., (2001): *Diurnal and subdiurnal terms of nutation: a simple theoretical model for a nonrigid Earth*, Proc. of the Journees Systemes de Reference Spatio-temporels 2000, N. Capitaine (ed.), Observatoire de Paris, pp. 51-58.

Brzeziński A., (2003a): *Oceanic excitation of polar motion and nutation. An Overview*, Proc. of IERS Workshop on Combination Research and Global Geophysical Fluids, IERS Technical Note No 30, pp. 144-149.

Brzezinski A., (2003b): *Chandler Wobble and free core nutation: observation, modelling and geophysical interpretation*, Proc. of the Seminar "Earth Rotation and Satellite Geodesy from Astrometry to GNSS", publ. on CD, Warsaw, Poland.

Brzeziński A., Nastula J., (2002): *A study of the oceanic excitation of the Chandler Wobble using a 50-year time series of Ocean Angular Momentum*, Proc. of the IAG Symposium No 125, Vistas for Geodesy in the New Millenium, Budapest, Hungary, Springer Verlag, pp. 434-440.

Brzezinski A., Bizouard C., Petrov S. D., (2002): *Influence of the atmosphere on Earth rotation: What new can be learned from the recent Atmospheric Angular Momentum estimates? Surveys in Geophysics*, An International Review Journal of Geophysics and Planetary Sciences, Vol. 23, No 1, pp. 33-69.

Capitaine N., Brzeziński A., (1998): Definition and observation of the pole at a microarcsecond accuracy, Journee 1998, Observatoire de Paris, France, pp. 155-163.

Gettino J., Ferrandiz J. M., (2000): *Advances in the unified theory of the rotation of the nonrigid Earth*, Proc. of IAU Coll. 180, (eds.) K.J. Johnston, D.D. McCarthy, B. Luzum, G.H. Kaplan, Washington DC., USA, pp. 236-241.

Herring T.A., Mathews P.M., Buffet B.A., (2002): *Modeling of nutation-precession: Very long baseline interferometry results*, Journ. of Geophys. Res., Vol. 107, No B4, 10.1029/2001JB000165, pp 4-1 - 4-13.

IAU (2001): *Transactions of the International Astronomical Union*, XXIVB, H. Rickman (ed.), Dodrecht, Kluwer, The Netherlads.

IERS (2000): *1999 IERS Annual Report*, Observatoire de Paris, France.

IERS (2003): *IERS Conventions 2003*, IERS Central Bureau, Frankfurt am Main, Germany.

Krynski J., Sekowski M., (2003): *Rocznik Astronomiczny na rok 2004*, Institute of Geodesy and Cartography, Warsaw, Poland, J. Krynski (ed.), (221 pp).

Mathews P.M., Herring T.A., Buffet B.A., (2002): *Modeling of nutation-precession: New nutation series for non-rigid Earth, and insights into Earth's interior*, J. Geophys. Res., Vol. 107, No B4, 10.1029/2001JB000390.

Roosbeek F., Dehant V., (1998): *RDAN97: An analytical development of rigid Earth nutation series using torque approach*, Celestrial Mechanics, 70, pp. 215-253.

Souchay J., Loysel B., Kinoshita H., Folgueira M., (1999): *Corrections and new developments in rigid Earth nutation theory, III, Final tables REN-2000 including crossed-nutation and spin-orbit coupling effects*, Astronomy and Astrophysics, Suppl. Ser., 135, pp. 111-131.

Wahr J.M., (1981): *The forced nutation of an elliptical, rotating elastic and oceanless Earth*, Geophys. J. Roy. Astron. Soc., Vol. 64, pp. 705-727.

Prof. Aleksander Brzeziński – laureatem prestiżowej Europejskiej Nagrody Kartezjusza w 2003 roku

Barbara Kołaczek

Centrum Badań Kosmicznych
Polskiej Akademii Nauk
ul. Bartycka 18a, 00-716 Warszawa
e-mail: kolaczek@cbk.waw.pl

Streszczenie

Prof. dr hab. Aleksander Brzeziński został nagrodzony w 2003 r. Europejską Nagrodą Kartezjusza w zespole 25 naukowców z 9 krajów, kierowanym przez prof. Veronique Dehant z Królewskiego Obserwatorium Belgijskiego, za pracę pt. "Model nutacji dla niesztywnej Ziemi".

W notatce podane są informacje o dwóch Europejskich Nagrodach Kartezjusza przyznanych w 2003 r. W notatce wspomniano o teorii nutacji opracowanej przez Wahr'a w 1980 r. i ważniejszych wynikach wyznaczeń nutacji Ziemi niesztywnej i sztywnej uzyskanych w zespole prof. Veronique Dehant z podkreśleniem prac wykonanych przez prof. Brzezińskiego.

Appendix

The diploma of the EU Descartes Prize 2003