

Current results of the

# Earth Orientation Parameters Prediction Comparison Campaign

Maciej Kalarus<sup>1</sup>, Wiesław Kosek<sup>1</sup> and Harald Schuh<sup>2</sup>

<sup>1</sup> Space Research Centre, Polish Academy of Sciences, Warsaw

<sup>2</sup> Institute of Geodesy and Geophysics, Vienna University of Technology

presented at

Journées “Systèmes de référence spatio-temporels”

Paris, France, 17-19 September 2007



# Overview

- 1 Objectives
- 2 History
- 3 Analyses
- 4 Results
- 5 Prospects



# Objective and Motivation

- importance of EOP prediction within the IERS
- comparing the various methods, models, techniques and strategies which can be applied for EOP prediction with equal rules
- applying the **same statistical method** for all results by a "referee"
- collecting the predictions **before** any EOP observations are available
- computing the combined predictions



# Milestones

- Call for participation (IERS Message No. 74) (*July 14<sup>th</sup>, 2005*)
- Beginning of the EOPPCC (*October 1<sup>st</sup>, 2005*)
- Second Call for participation (IERS Message No. 95)  
(*September 25<sup>th</sup>, 2006*)
- New rules (*October 1<sup>st</sup>, 2006*)
- Termination of the EOPPCC (*March, 2008*)



# Presentations

- "First results of the Earth Orientation Parameters Prediction Comparison Campaign"  
poster at EGU 2006, Vienna (*April, 2006*)
- "Earth Orientation Parameters Prediction Comparison Campaign - Report"  
oral presentation at IAU 2006, Prague (*August, 2006*)
- "Current results of the Earth Orientation Parameters Prediction Comparison Campaign"  
poster at EGU 2007, Vienna (*April, 2007*)
- "Current results of the Earth Orientation Parameters Prediction Comparison Campaign"  
oral presentation at Journées 2007, Paris (*September, 2007*)



# List of participants

ID	Participant	Institute/Organization
011 012	Sergey Kumakshev	IPM RAS, Russia
021	Orhan Akyilmaz Hansjoerg Kutterer	ITU, Turkey University of Hannover, Germany
031	Richard Gross	NASA JPL, USA
051 052 053	Wiesaw Kosek	Space Research Centre PAS, Poland
061	Maciej Kalarus	Space Research Centre PAS, Poland
071	EOP Product Center	Paris Observatory, France
072 073 074 075	Daniel Gambis	Paris Observatory, France
091 092 093	Leonid Zotov	SAI, Moscow State University, Russia
101	Sergey Pasyok	SAI, Moscow State University, Russia
111	Paulo Jorge Mendes Cerveira	IGG, Vienna University of Technology, Austria
121	Bora Jovanovic	Astronomical Observatory, Belgrade, Serbia



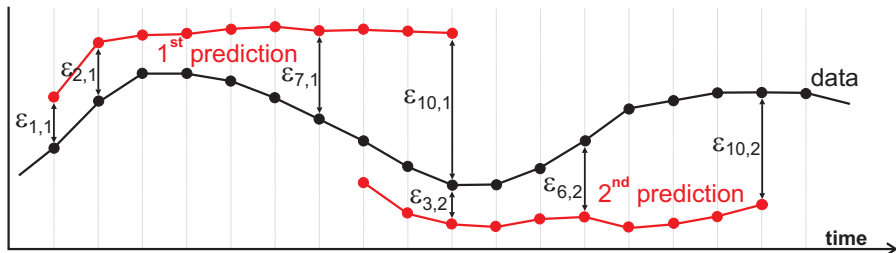
# Data sets

- IERS /eoppc/eop/eopc04/eopc04\_IAU2000.62-now
- predictions (total number: 5349)
  - ultra short-term (for 10 days) (received before 24 August 2007)
  - short-term (for 30 days) (received before 03 August 2007)
  - medium-term (for 500 days) (received before 16 September 2006)



# Main Equation

Mean Absolute Error -  $MAE_i$  for  $i^{th}$  day in the future



$$MAE_i = \frac{1}{N} \sum_{n=1}^N |\epsilon_{i,n}|, \quad i = 1, 2, \dots, l$$

$N$  - number of predictions sent by given participant for given parameter

$l$  - prediction length (10,30 or 500 days)





# Excluding bad predictions

**Median Absolute Error -  $MDAE_i$**  for  $i^{th}$  day in the future

$$MDAE_i = median(|\varepsilon_{i,1}|, |\varepsilon_{i,2}|, \dots, |\varepsilon_{i,P}|),$$

$I$  - prediction length (10,30 or 500 days)

$P$  - number of all available predictions for given parameter

$\beta_n$  coefficient

$$\beta_n = \sum_{i=1}^I (\alpha \cdot MDAE_i - |\varepsilon_{i,n}|),$$

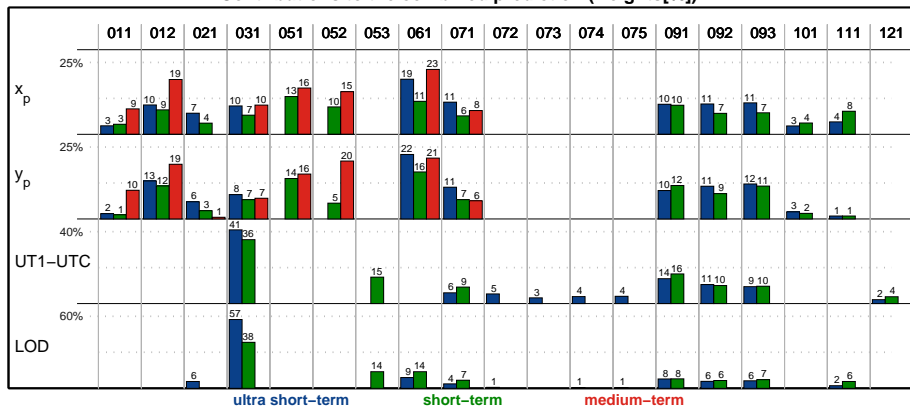
$\alpha = 10$  (deduced empirically)

Only predictions with  $\beta_n \geq 0$  are accepted! (practically - 98.62%)



# Combined prediction

Contributions to the combined prediction (weights[%])



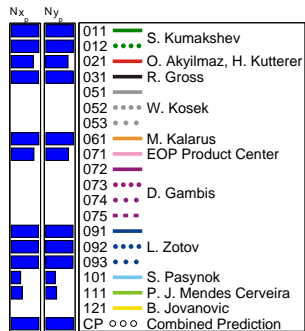
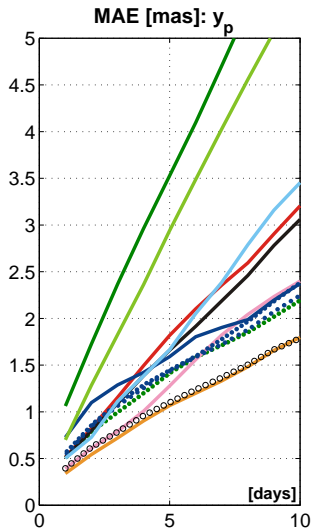
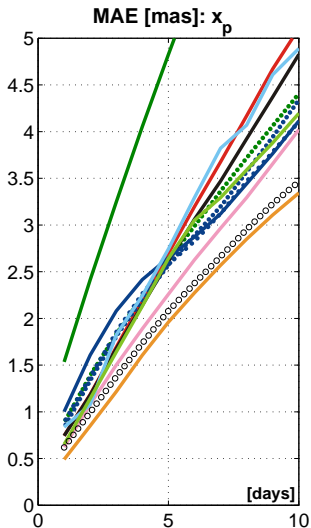
Weight -  $W$ , Quality -  $Q$ ,

$$W \sim [Q^2 \cdot N_{Accepted}],$$

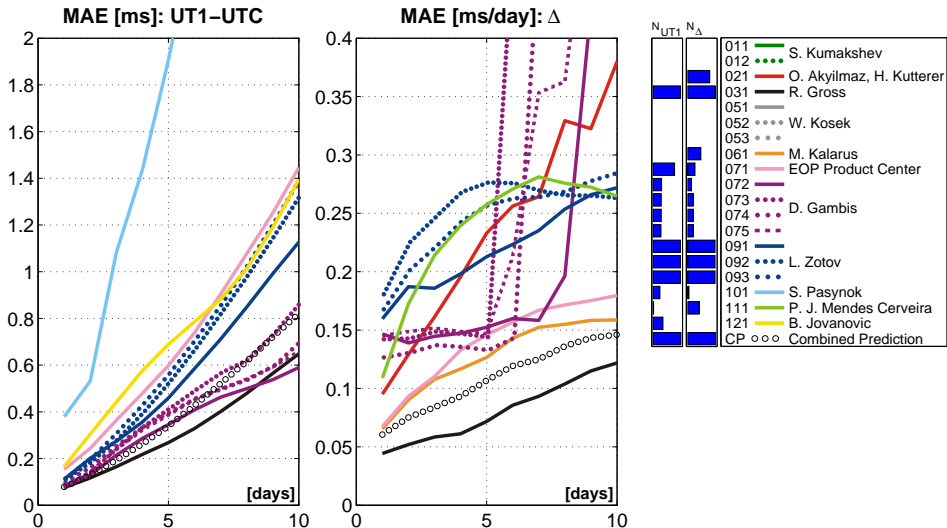
$$Q = \left( \sum_{i=1}^I MAE_i \right)^{-1}$$



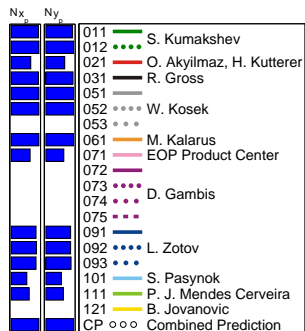
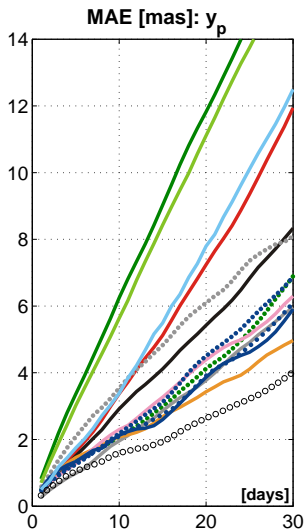
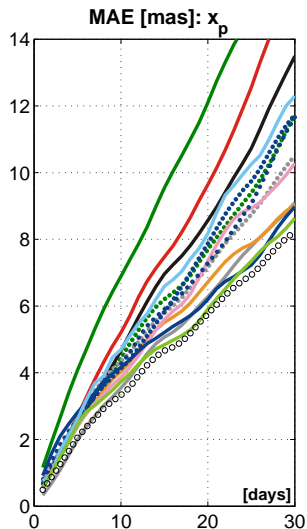
# Ultra short-term predictions of polar motion



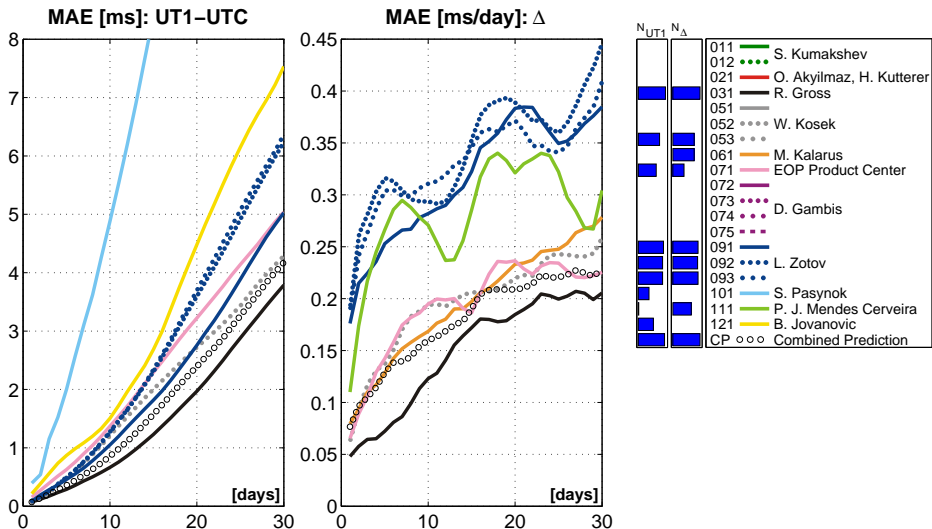
# Ultra short-term predictions of UT1-UTC and LOD



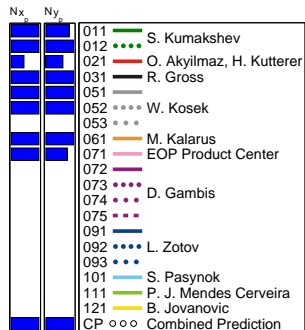
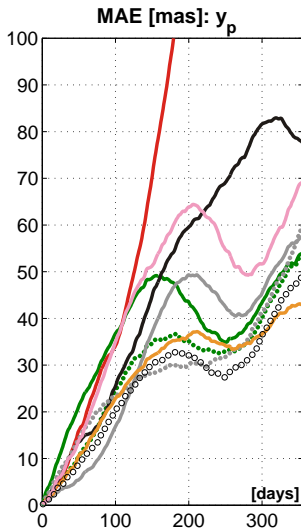
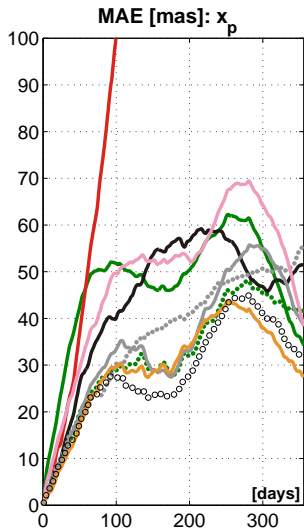
# Short-term predictions of polar motion



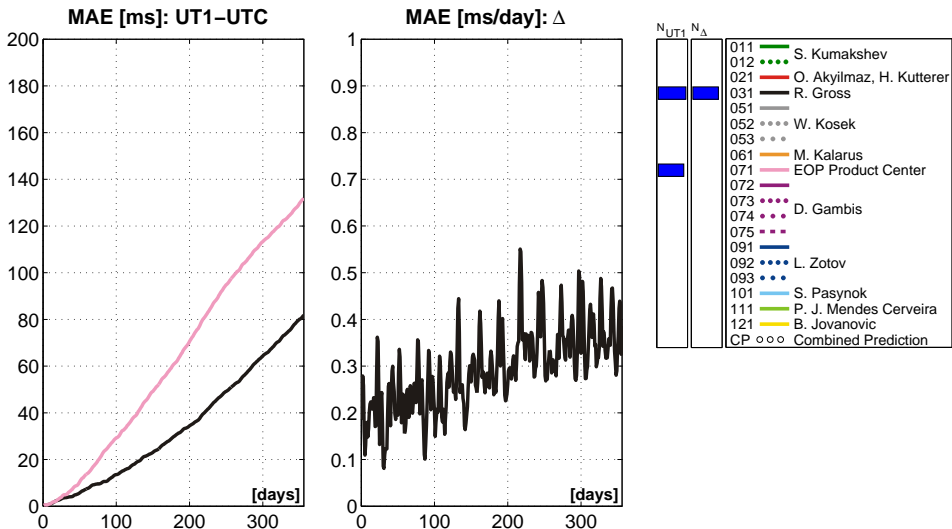
# Short-term predictions of UT1-UTC and LOD



# Medium-term predictions of polar motion



# Medium-term predictions of UT1-UTC and LOD

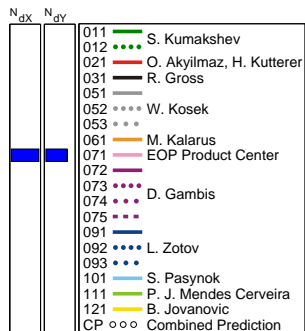
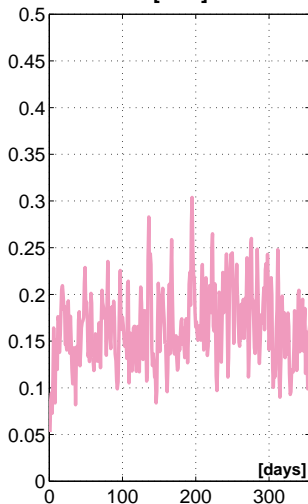
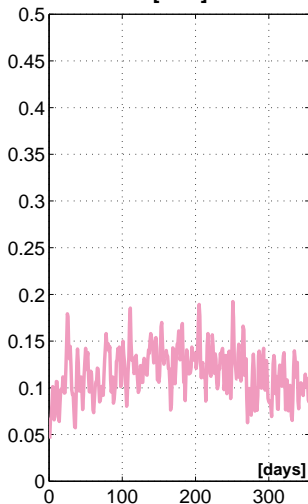




# Medium-term predictions of dX and dY

MAE [mas]: dX

MAE [mas]: dY



# Conclusions

- **combined predictions are better than most individual predictions**
- there is no direct way to compare all predictions
- in case of medium-term predictions we have to wait for observed data to compute more reliable statistics



# Prospects

- comparison of the results with respect to different input data used by participants
- comparison of different types of algorithms (e.g. LS vs AR)
- "Current results of the Earth Orientation Parameters Prediction Comparison Campaign"  
presentation at AGU 26<sup>th</sup> General Assembly 2007, San Francisco (*December, 2007*)
- "Termination of EOPPCC - General Conclusions"  
presentation at EGU 2008, Vienna (*April, 2008*)
- cooperation with IERS Working Group on Prediction
- final paper



website: [www.cbk.waw.pl/EOP\\_PCC](http://www.cbk.waw.pl/EOP_PCC)

e-mail: [EOP\\_PCC@cbk.waw.pl](mailto:EOP_PCC@cbk.waw.pl)

Thank you for your attention

I am grateful to the Advisory Board  
of the "Descartes-nutation project" for the financial support.

