

The new Geodetic Prediction Center at ETH Zurich

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Institute of Geodesy and Photogrammetry, ETH Zürich

25th May 2022, EGU22





- GGOS initiative to define Essential Geodetic Variables (EGV)
- EGV key to characterize and understand geodetic properties of the Earth
 - EOP, positions, gravity, atmospheric parameters, etc.
- EGV with specific requirements, in particular for real-time applications
 - Accuracy, spatial and temporal resolutions, latency
- Spatio-temporal predictions to overcome insufficient latencies and resolutions

→ establish a service to provide high-quality predictions of EGV



Geodetic Prediction Center

- EOP
- Positions
- Troposphere
- Ionosphere
- Orbits

Space Geodesy > GPC

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EOP

EAM

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Geodetic Prediction Center

Developed and maintained by the [Chair of Space Geodesy](#), ETH Zurich

With the increasing volume of geodetic data, new mathematical models have the potential to exploit the data for scientific purposes. These mathematical models are based on big data processing algorithms that are typical in the fields of data science and machine learning. At the Geodetic Prediction Center (GPC), we mainly focus on applying advanced machine learning and deep learning algorithms to predict essential geodetic parameters, such as the Earth Orientation Parameters (EOP), GNSS station coordinates, and tropospheric parameters.



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Imprint

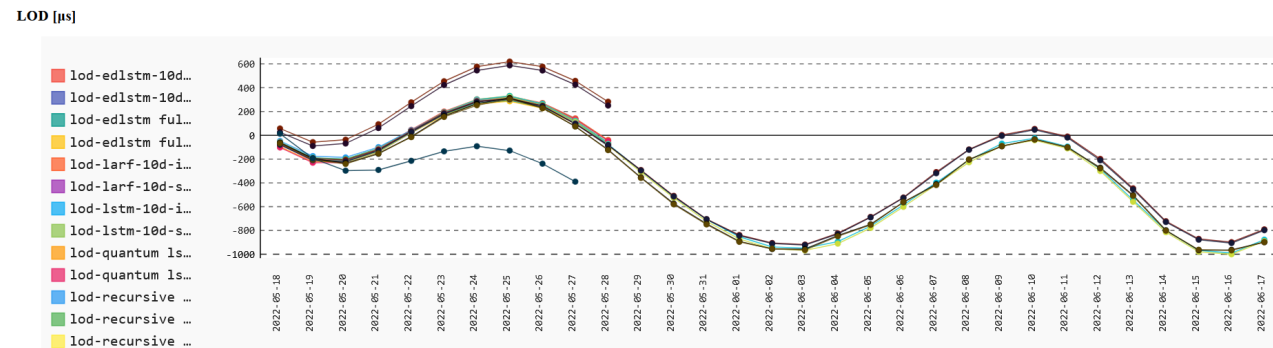
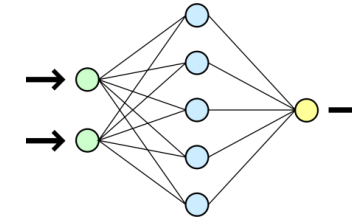
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GPC approach to parameter prediction

- Data-driven machine learning methods
 - Neural networks, tree-based algorithms
- Considering environmental and physical information
 - Meteorological models, space weather, ...
- Operational quality control



<https://gpc.ethz.ch/EOP/report/>

prediction day	0	1	2	3	4	5	6	7	8	9
lod-edlstm-10d-iers-gfz	50.5	55.2	58.6	62.2	67.7	76.3	87.3	97.8	106.7	112.8
lod-edlstm-10d-syrte-gfz	43.7	48.4	51.0	53.2	58.9	68.2	78.2	88.1	96.9	104.5
lod-edlstm full eam-10d-iers-gfz	43.6	46.6	50.7	53.9	58.0	66.9	75.3	83.2	93.7	100.4
lod-edlstm full eam-10d-syrte-gfz	35.0	39.9	43.8	46.3	49.3	58.1	67.8	78.9	87.9	95.1
lod-larfm-10d-iers-gfz	50.1	54.8	58.5	62.7	68.7	77.3	88.0	97.9	106.2	112.7
lod-larfm-10d-syrte-gfz	41.7	47.2	50.4	53.2	59.5	68.9	78.7	88.0	96.5	104.2
lod-lstm-10d-iers-gfz	55.3	59.8	63.6	67.0	73.6	82.5	93.5	104.0	112.3	119.7
lod-lstm-10d-syrte-gfz	48.9	54.0	56.9	60.0	66.4	76.8	87.7	97.5	105.5	114.2
lod-quantum lstm-10d-iers-gfz	59.0	62.6	65.3	67.5	71.7	80.0	90.4	100.2	107.9	113.4
lod-quantum lstm-10d-syrte-gfz	50.8	55.1	57.0	58.8	63.5	71.7	82.1	91.6	98.8	105.2
lod-recursive ode-10d-iers-gfz	55.4	58.8	61.3	63.2	66.5	74.2	84.7	95.0	104.2	111.0
lod-recursive ode-10d-syrte-gfz	38.8	44.4	46.6	50.2	55.1	64.0	73.6	83.9	94.7	103.8
lod-recursive ode full eam-10d-iers-gfz	43.9	48.9	51.2	53.7	59.5	68.5	77.0	86.4	96.1	103.2
lod-recursive ode full eam-10d-syrte-gfz	32.0	37.1	41.6	45.6	50.1	60.0	69.6	81.7	92.2	99.4
lod-recursive ode full eam-30d-iers-gfz	43.6	48.8	51.3	54.0	60.1	69.2	77.6	87.0	96.5	103.4
lod-recursive ode full eam-30d-syrte-gfz	32.0	37.1	41.6	45.6	50.2	59.9	69.6	81.7	92.2	99.4
lod-rem-10d-iers-gfz	52.7	55.0	59.3	64.0	69.6	78.0	88.9	101.3	108.5	114.1
lod-rem-10d-syrte-gfz	39.4	44.6	47.7	52.2	58.1	68.4	78.7	90.0	98.5	106.0
lod-rem-30d-iers-gfz	53.5	57.6	60.5	65.6	71.8	79.8	91.5	102.1	108.5	116.6
lod-rem-30d-syrte-gfz	39.4	45.3	48.7	53.5	60.0	69.4	80.1	90.6	98.9	107.6
lod-rem full eam-30d-iers-gfz	98.1	107.6	110.6	112.4	125.7	137.5	157.5	172.6	188.4	201.4
lod-rem full eam-30d-syrte-gfz	49.6	59.4	59.5	68.5	71.1	73.8	94.5	107.9	128.6	137.3
lod-trend only-10d-iers-gfz	108.7	117.4	124.5	132.4	141.4	147.9	150.8	153.7	156.8	158.6
lod-trend only-10d-syrte-gfz	67.6	76.3	85.3	95.3	104.6	112.8	121.0	127.2	134.3	138.9
reference-syrte-none	26.4	59.5	101.2	143.3	185.0	224.7	257.9	286.3	310.6	334.3

GPC operational status – May 2022



Earth orientation parameters: **operational**



Earth angular momentum: **operational internally, validation in progress**



Station positions

Tropospheric parameters

Ionospheric parameters

Satellite orbits

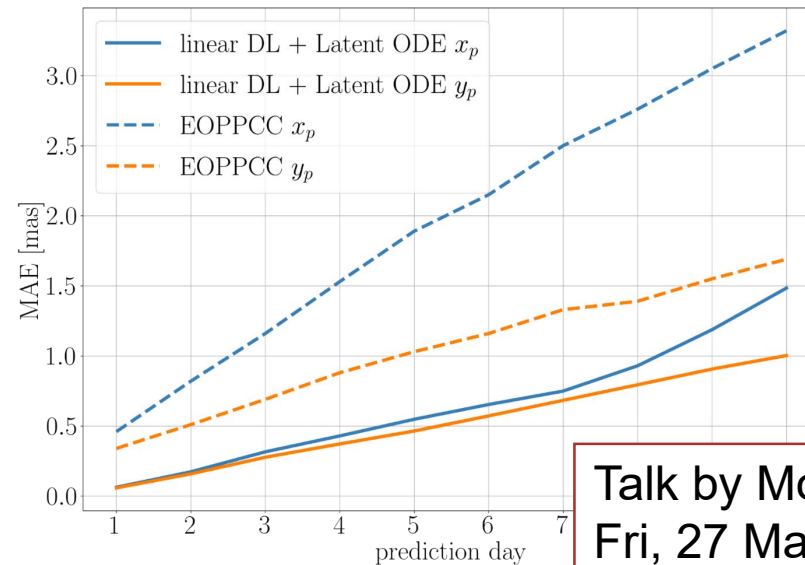


scientific studies conducted

Earth orientation parameters

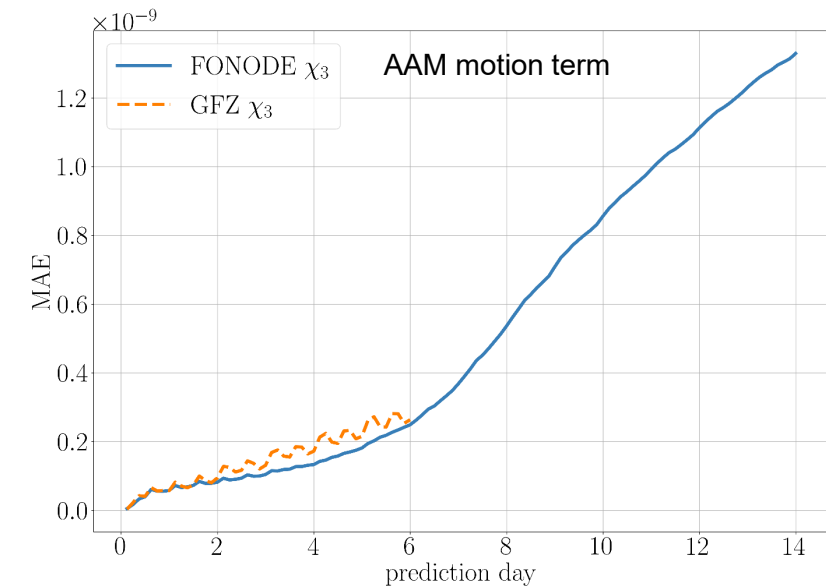
- Daily forecasts of x_p , y_p , dUT1, LOD, dX, dY
- 10-day and 30-day predictions operational, 365-day predictions tested internally

Polar motion



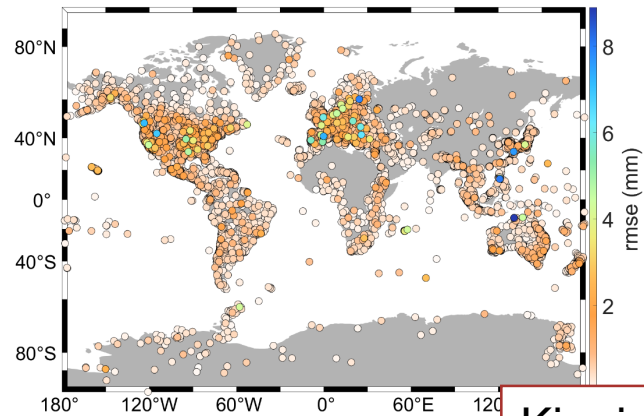
Talk by Mostafa Kiani
Fri, 27 May, 08:45

Earth angular momentum (preliminary)



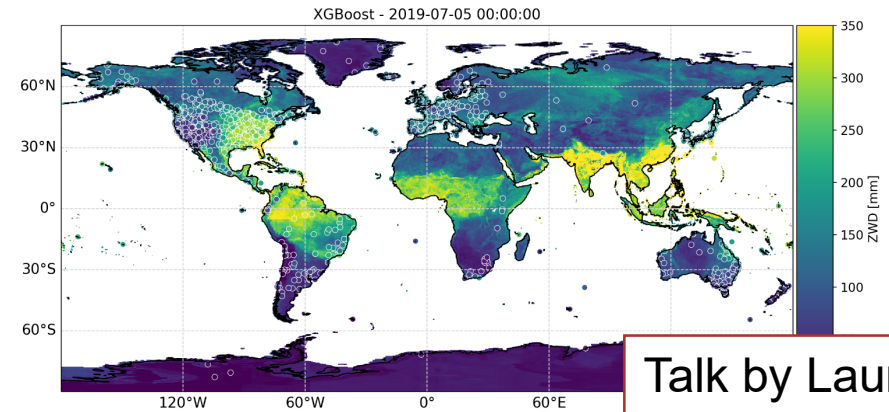
Prediction of other essential geodetic variables

Station positions



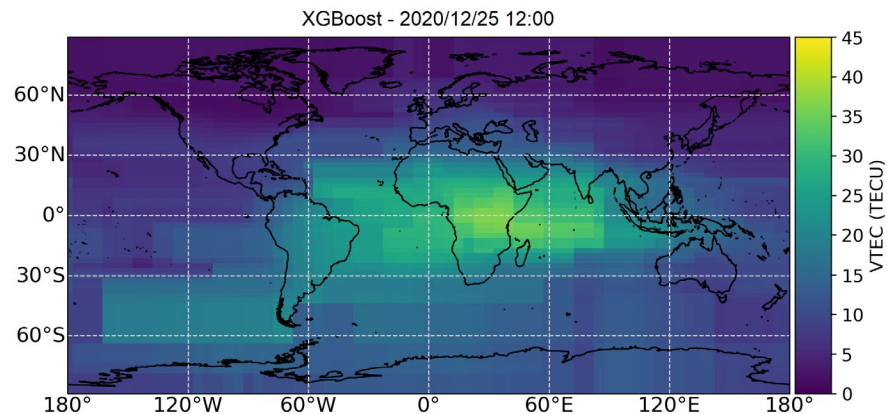
Kiani & Soja, 2021

Tropospheric zenith wet delay



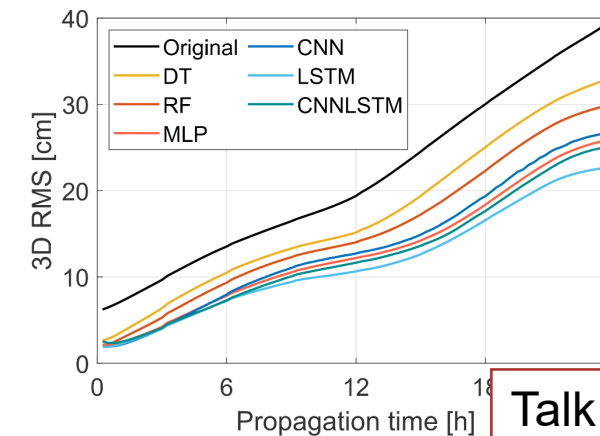
Talk by Laura Crocetti
Fri, 27 May, 09:45

Ionospheric total electron content



Mudathir Awadaljeed

Satellite orbits



Talk by Junyang Gou
Fri, 27 May, 09:03

Summary

- Established the **Geodetic Prediction Center** at ETH Zurich
- **Spatio-temporal predictions** of essential geodetic variables
- **Operational** predictions of Earth orientation parameters
- Outlook:
 - Implementation of other geodetic parameters
 - Uncertainty quantification
 - Ensemble predictions
- Feedback appreciated!

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