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United Nations
Educational, Scientific and
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IAEA
International Atomic Energy Agency

NeQuick model
Overview

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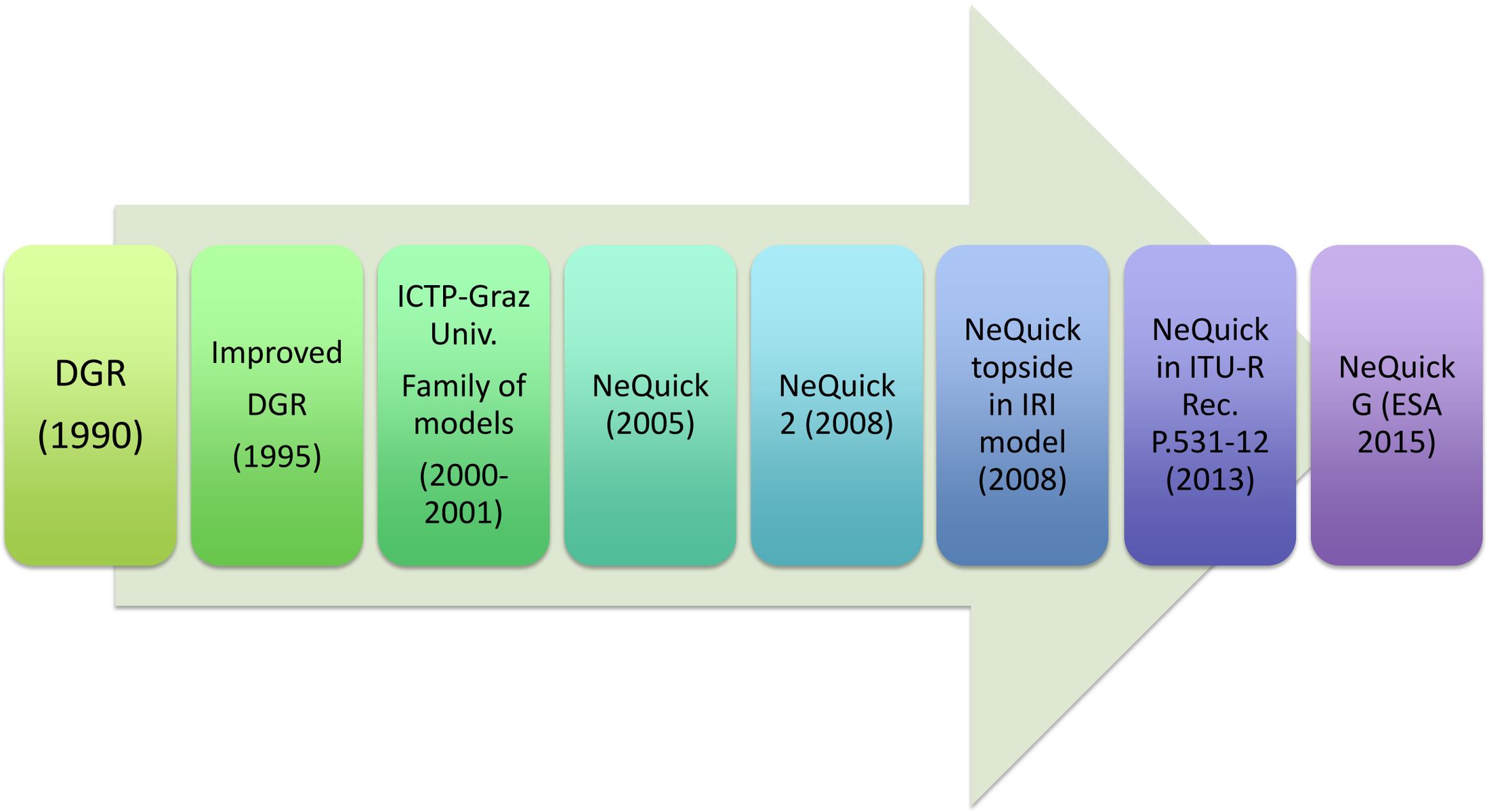
Ionospheric Modelling

The understanding of the behaviour of the ionosphere and its effects of the human activity is determined by the ability to model at least the height, geographical and time distributions of the electron density.

1. A historical view



Trieste-Graz Family of models

HOCHEGGER, G., B. NAVA, S.M. RADICELLA, R. LEITINGER (2000) Family of Ionospheric Models for Different Uses, Physics And Chemistry Of The Earth, Part C: Solar, Terrestrial & Planetary Science (25) 4, 307-310

RADICELLA, S.M., R. LEITINGER, The Evolution of the DGR Approach to Model Electron Density Profiles, Adv. Space Res., Vol. 27, No. 1, 35-40, 2001

A family of Ne models, differing in complexity and with different but related application areas based on the DGR «profiler» concept has been developed in collaboration with the University of Graz, Austria.

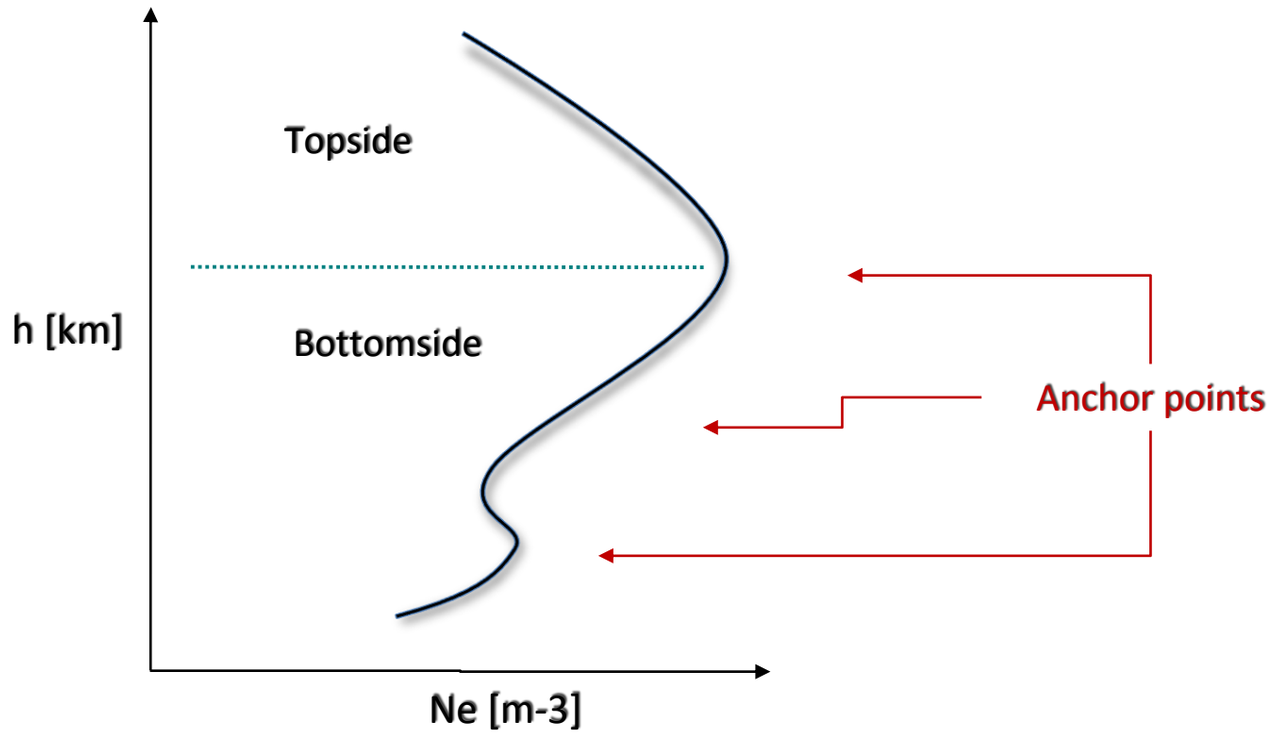
COSTprof: For ionospheric and plasmaspheric satellite to ground propagation with particular attention to the changes of gradients in the topside profile of electron density. This model was adopted by the COST 251 action of the European Commission as “profiler” for its final product.

NeUoG-plas: For assessment studies involving satellite to satellite propagation paths to take into account an accurate plasmaspheric electron density.

NeQuick: A quick-run model for transionospheric applications that allows to calculate both vertical or slant profile of electron density and TEC for any specified path.

NeQuick model Overview. General model description

NeQuick's profile formulation includes 6 semi-Epstein layers with modelled thickness parameters and it is based on anchor points defined by foE, foF1, foF2 and M(3000)F2 values.

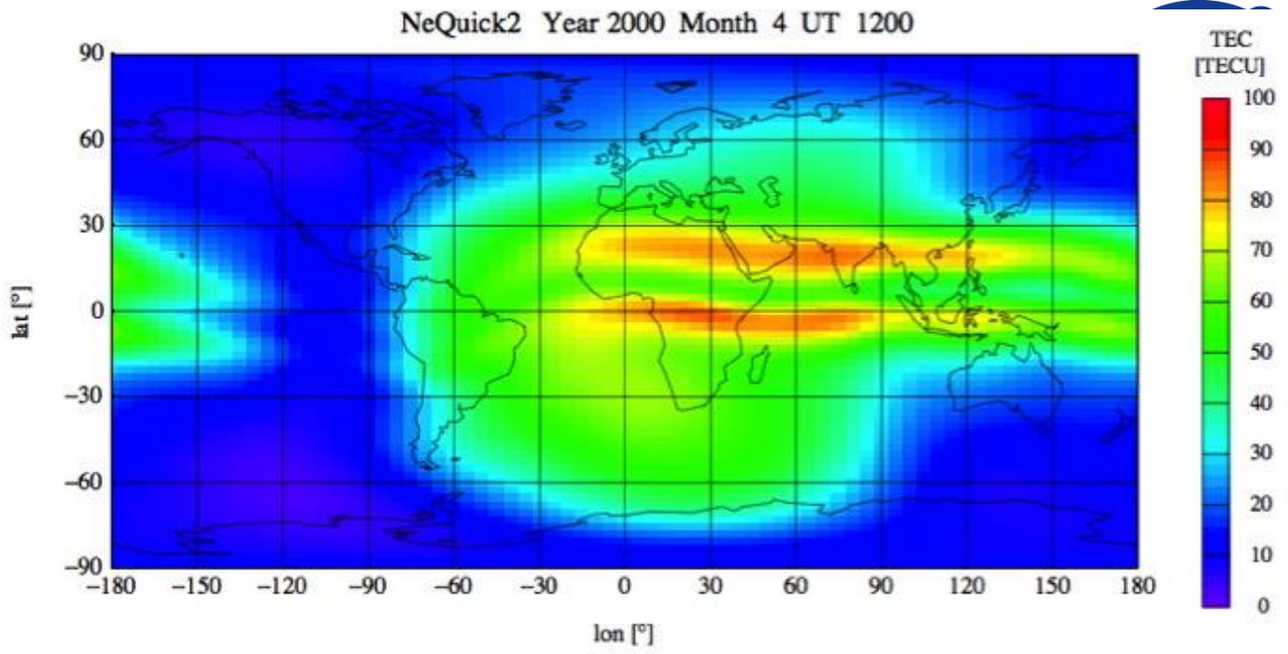


These values can be modelled (e.g. ITU-R coefficients for foF2, M(3000)F2) or experimentally derived.

Position (degN,degE,km)
Time (mth, UT)
Solar Activity (R12,F10.7)

→ Ne (φ,λ,t)
TEC

NeQuick 2



•An elaborated revision of the original DGR approach for the F1 and E regions formulation was done.

• Important improvement of the NeQuick topside.

•The computer code of the model was also improved.

COÏSSON, P. AND S.M. RADICELLA, R. LEITINGER AND B. NAVA (2006) Topside electron density in IRI and NeQuick: features and limitations parameters, Adv. Space Res., 37, 937-942

LEITINGER, R., M.L. ZHANG and S. M. RADICELLA (2005), An improved bottomside for the ionospheric electron density model NeQuick, Annals of Geophysics 48(3) 525-534

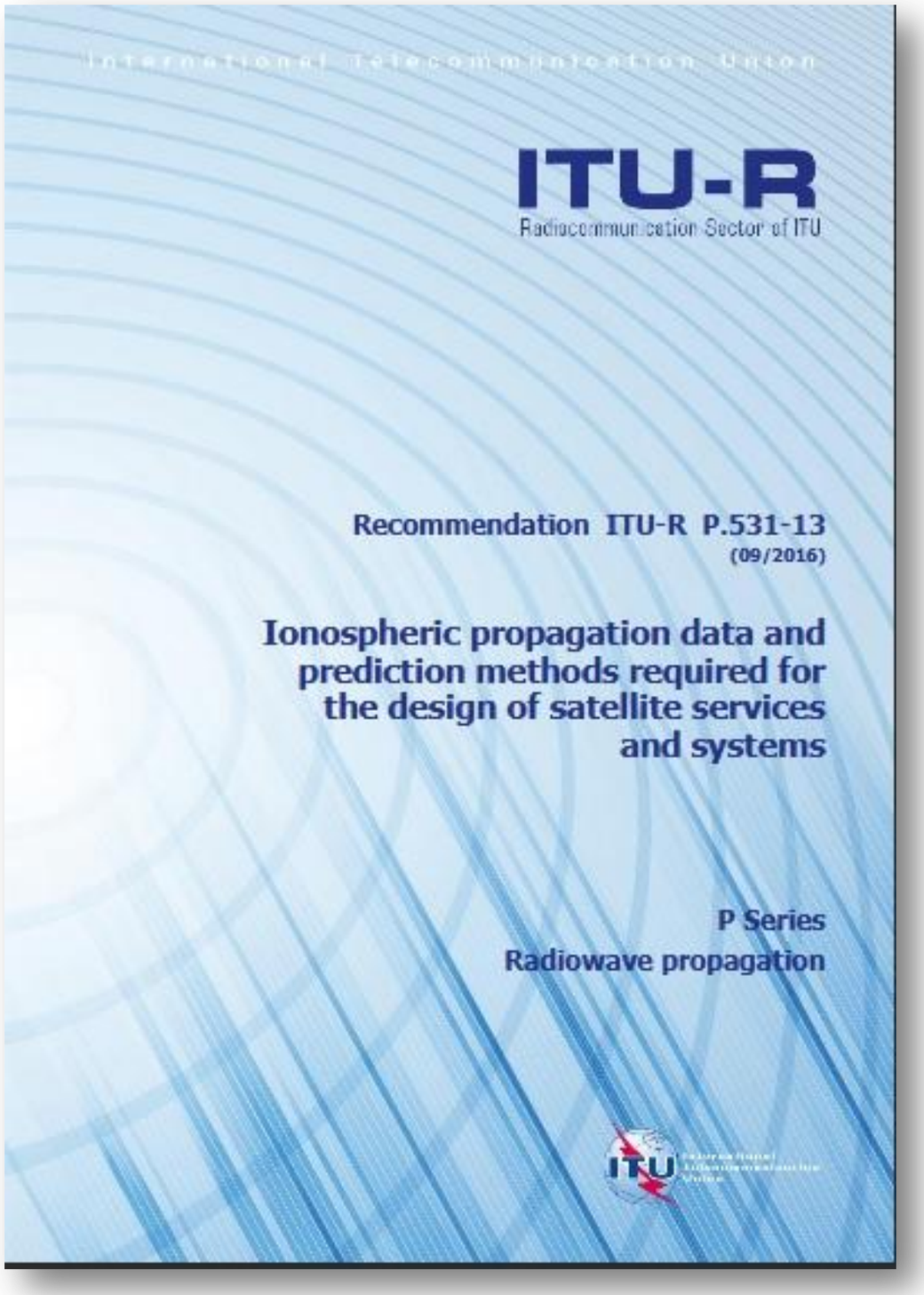
NAVA. B., P. COÏSSON AND S.M. RADICELLA (2008), A new version of the NeQuick ionosphere electron density model; J.of Atmos.and Solar-Terr. Physics.

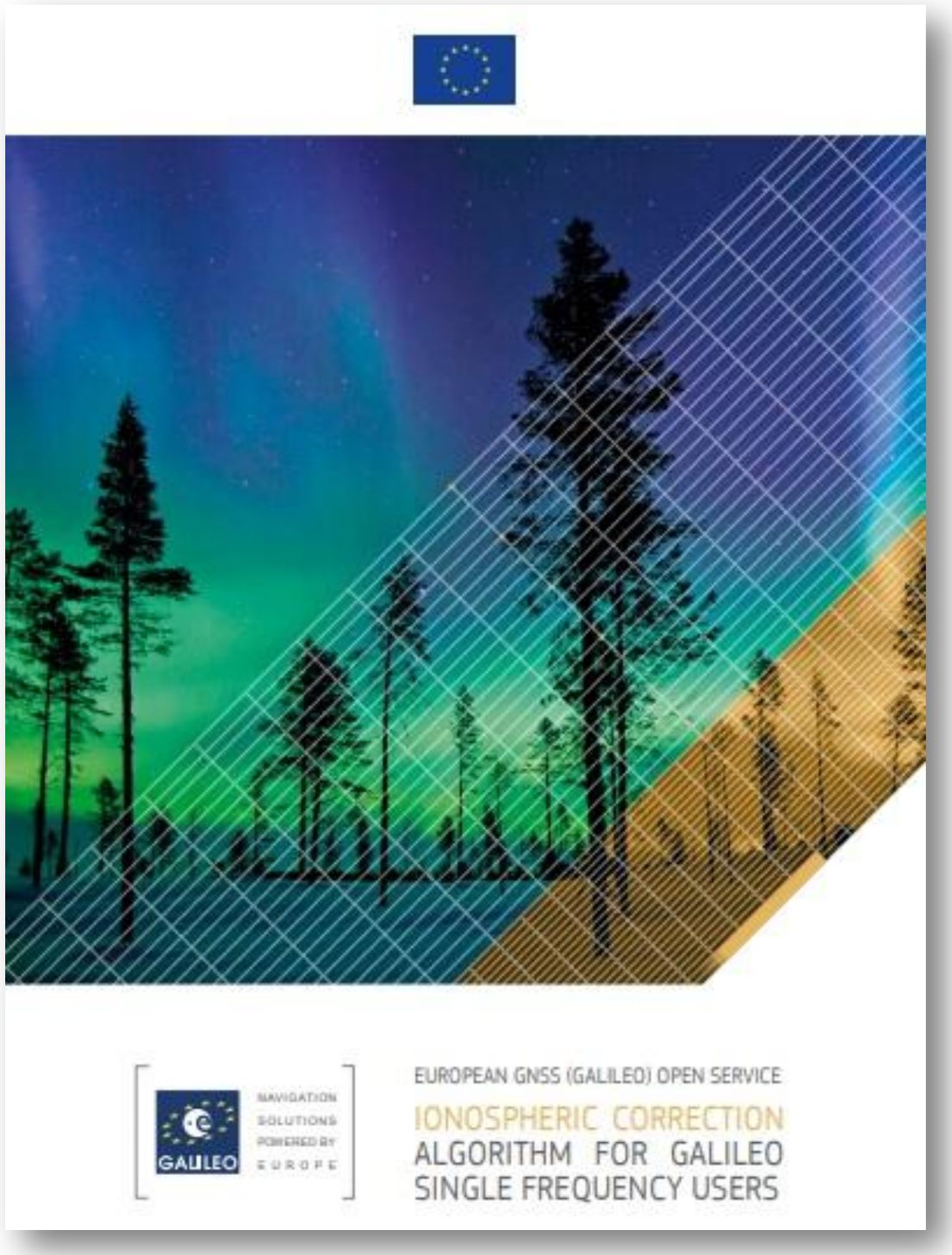
3. Uses of NeQuick

Radicella, 2009 Annals of Geophysics

- NeQuick 2 topside has been adopted in IRI (since version 2007) as default topside option for the electron density profile calculation.
- NeQuick has been used to produce 'ionospheric scenarios' for EGNOS.
- NeQuick 2 has been included in the ESA (SPENVIS) Space Environment Information System.
- NeQuick has been used in the Support and Development of SW prototype on ionosphere models for Telespazio.
- NeQuick adopted as the model for ionospheric corrections in the single frequency operation of GALILEO.

NeQuick 2 in ITU-R and NeQuick G



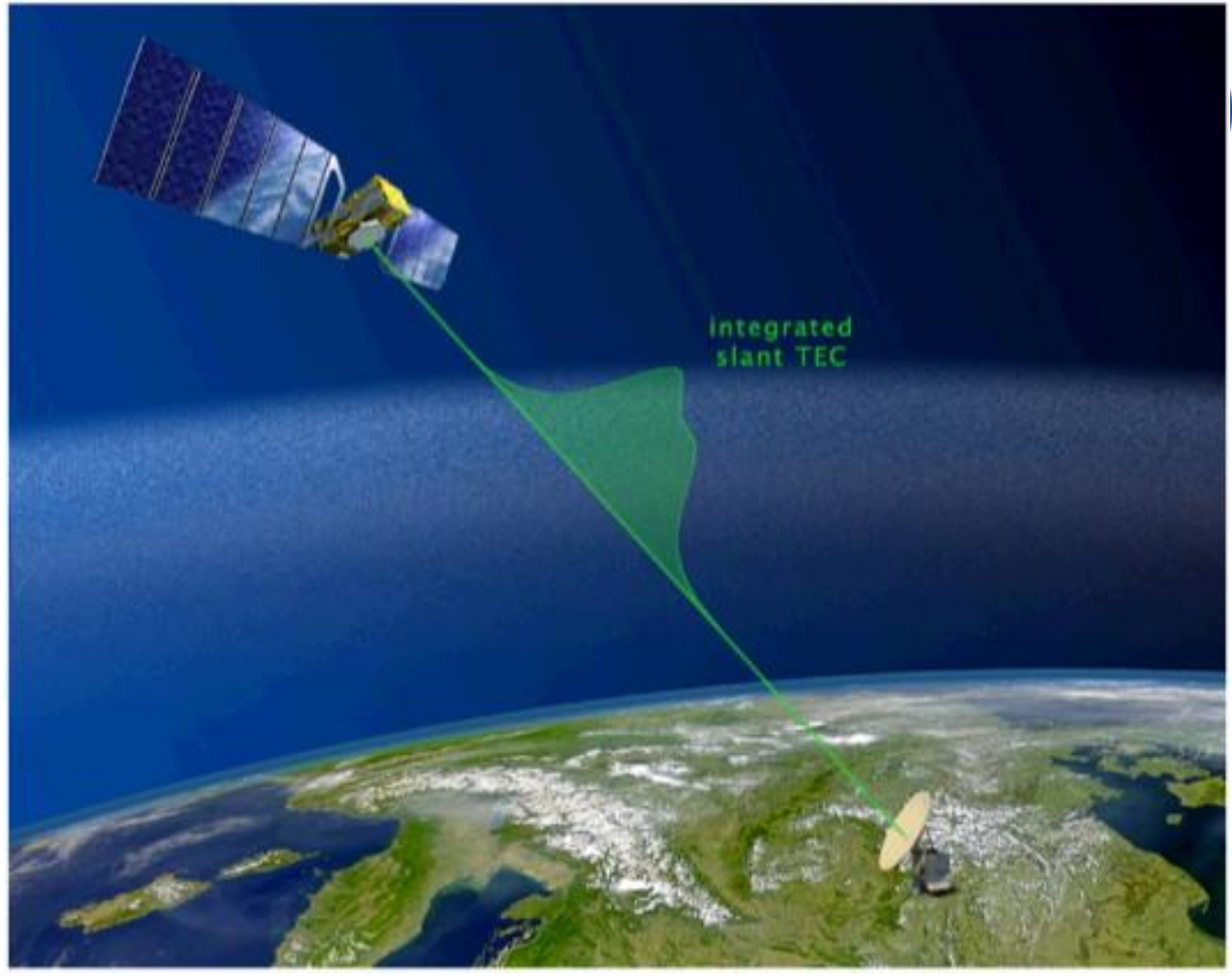


ICG Working Groups Recommendations

- NeQuick Ionospheric Model

To assess the performance and usability of a NeQuick ionospheric correction algorithm for the single frequency users similar to the one adopted by Galileo in view of its expected good performance compared with other models, i.e. at low latitudes: http://www.gsc-europa.eu/system/files/galileo_documents/Galileo_Ionospheric_Model.pdf

4. NeQuick : versions



- NeQuick 1: available in ITU-R

- NeQuick 2: ITU-R source code,

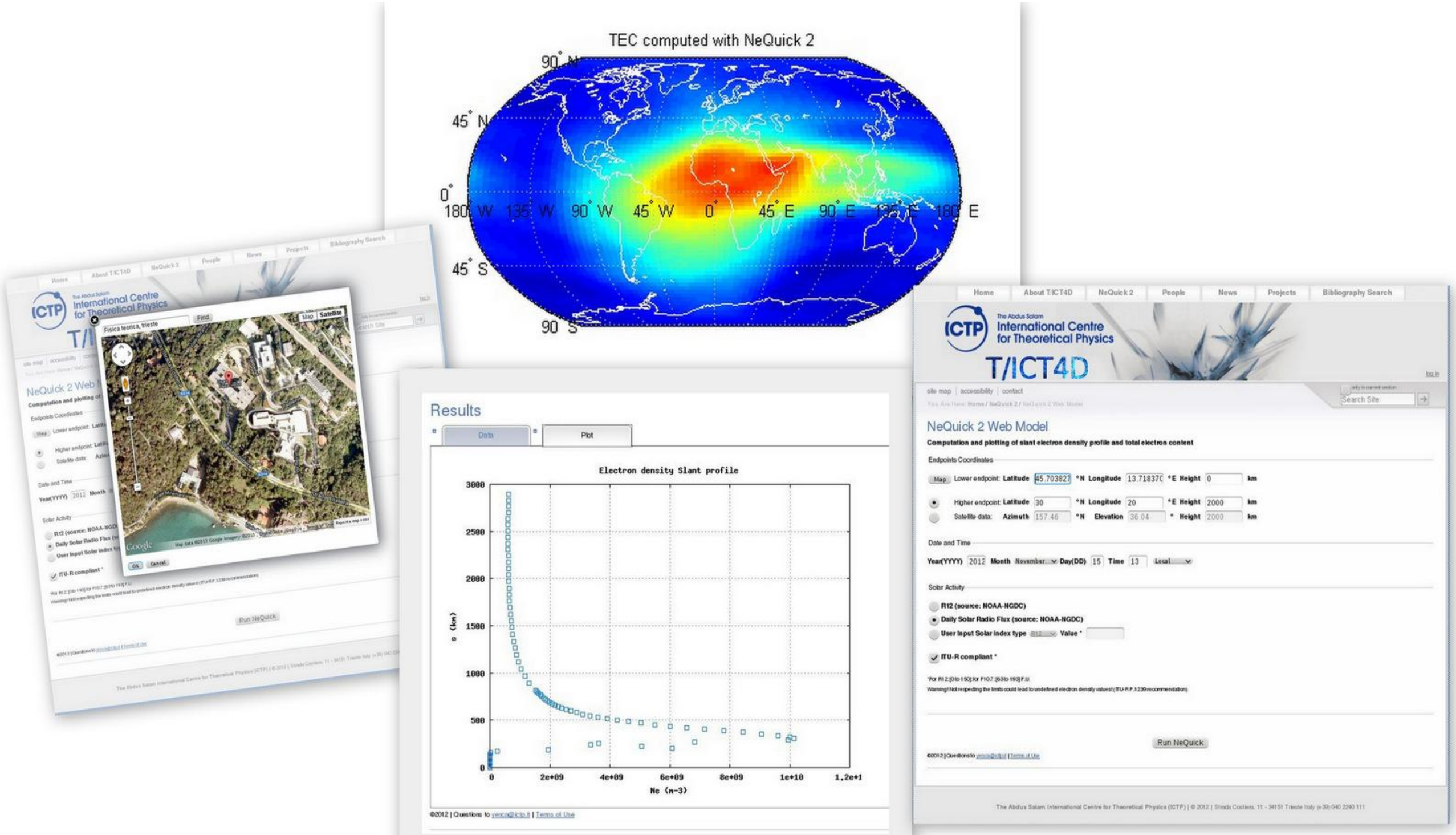
http://www.itu.int/rec/R-REC-P.531-12-201309-I/en

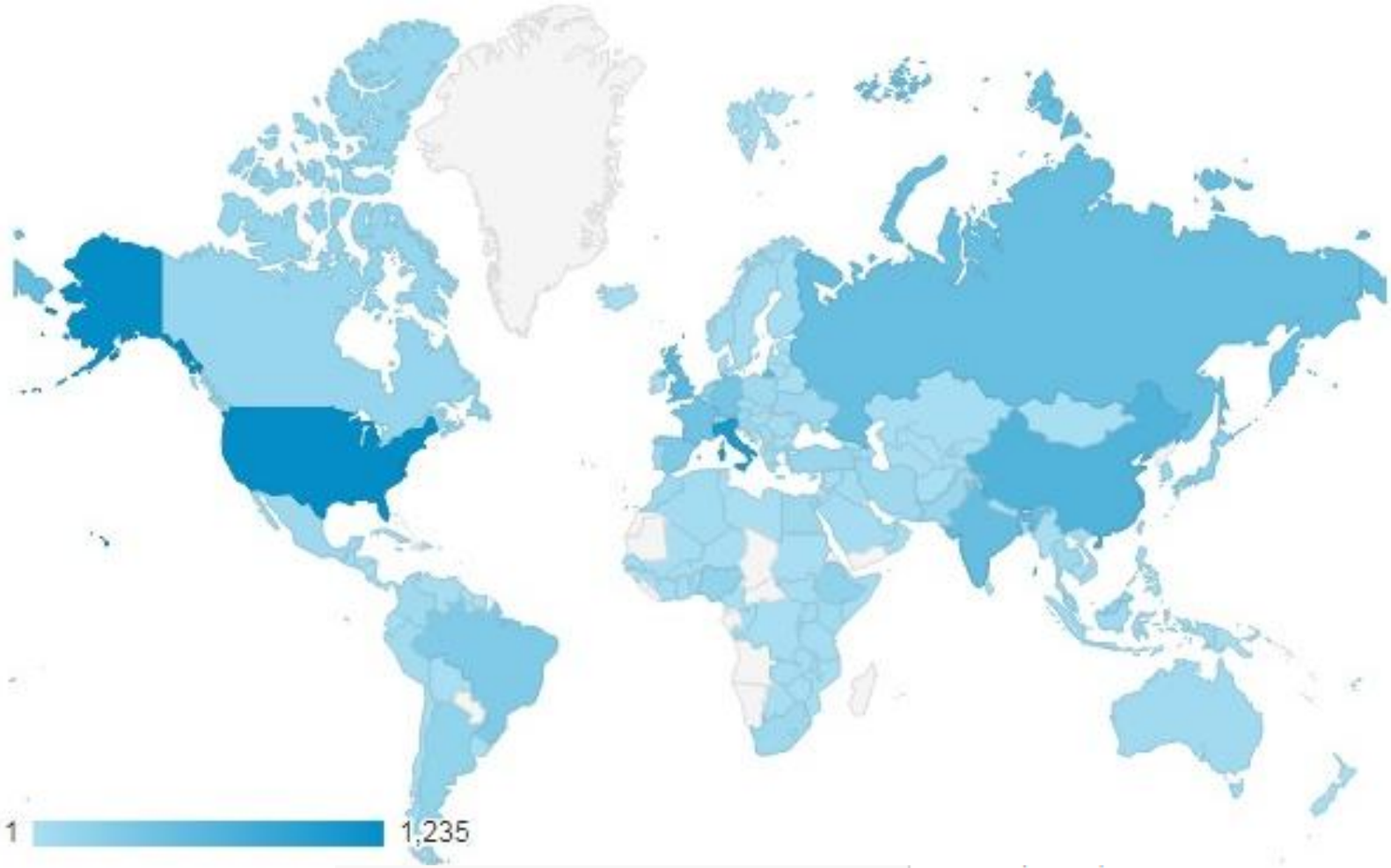
Online

- NeQuick G (ESA)

$$Az = a_0 + a_1\mu + a_2\mu^2$$

NeQuick 2 online: http://t-ict4d.ictp.it/nequick2





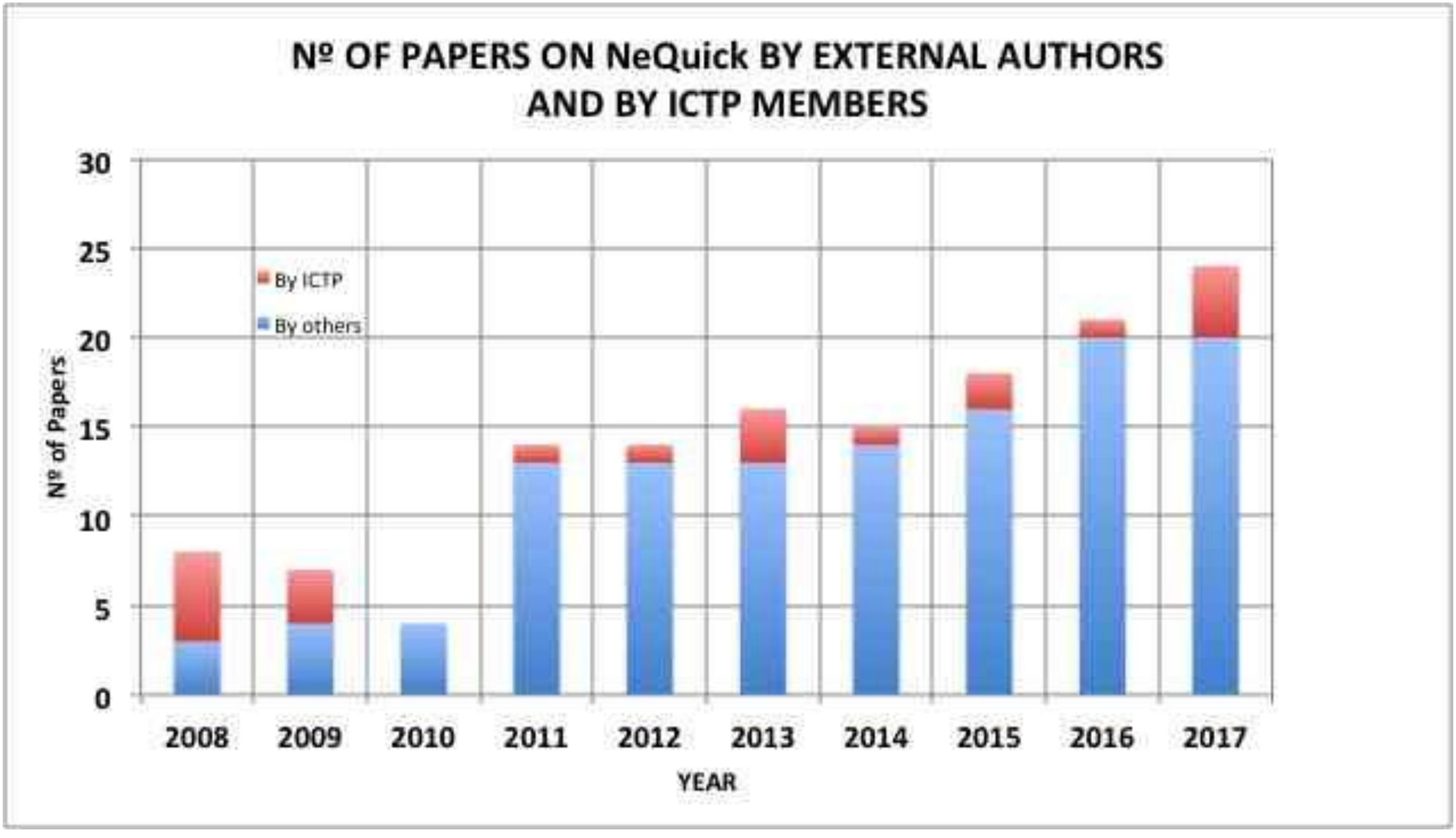
Statistics

On T/ICT4D

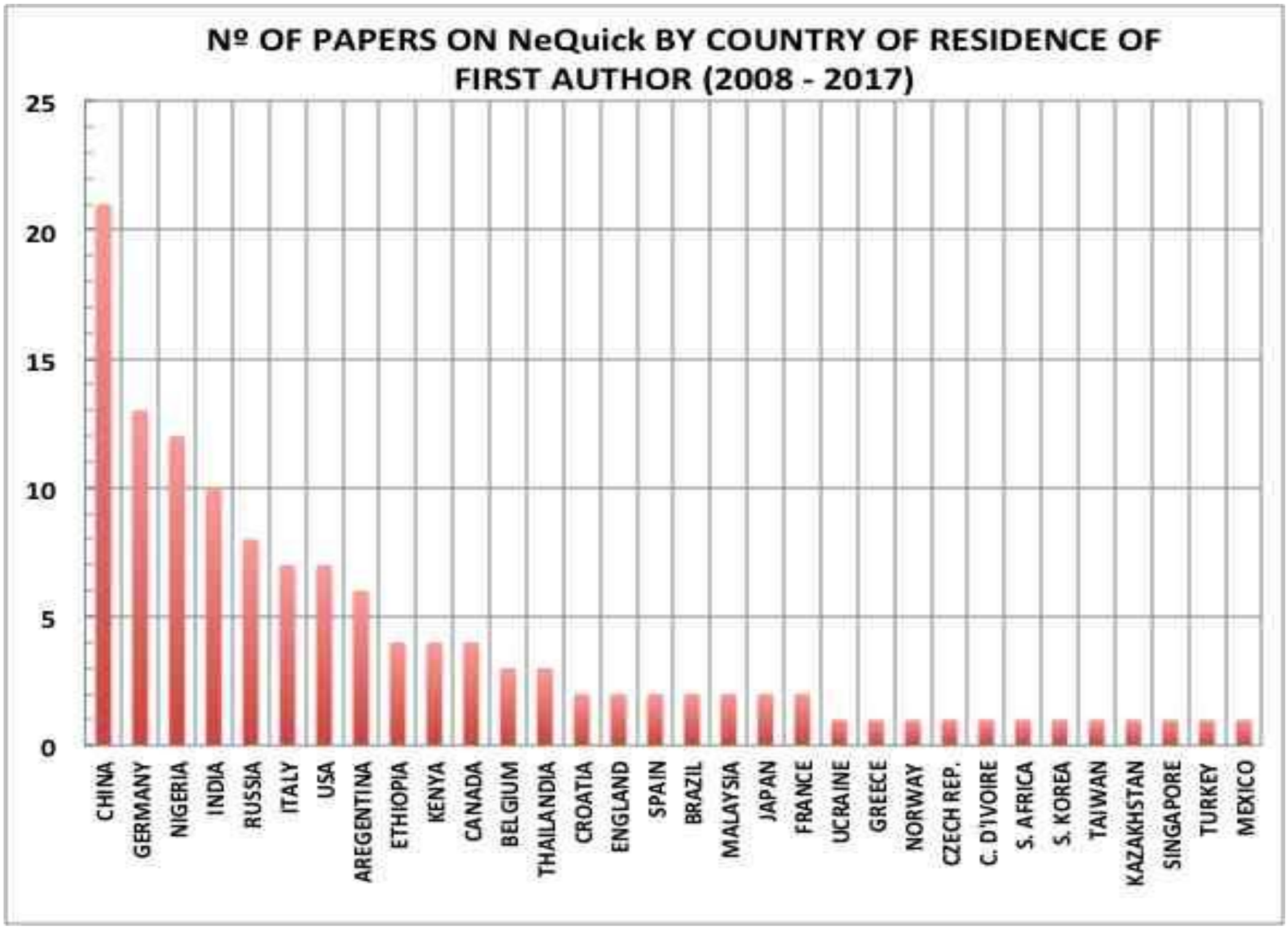
Web services usage

1.	United States	**1,235** (11.99%)
2.	Italy	**1,052** (10.21%)
3.	China	**661** (6.42%)
4.	United Kingdom	**557** (5.41%)
5.	India	**505** (4.90%)
6.	Russia	**488** (4.74%)
7.	France	**422** (4.10%)
8.	Germany	**372** (3.61%)
9.	(not set)	**318** (3.09%)
10.	Spain	**308** (2.99%)

NeQuick **60k/year**

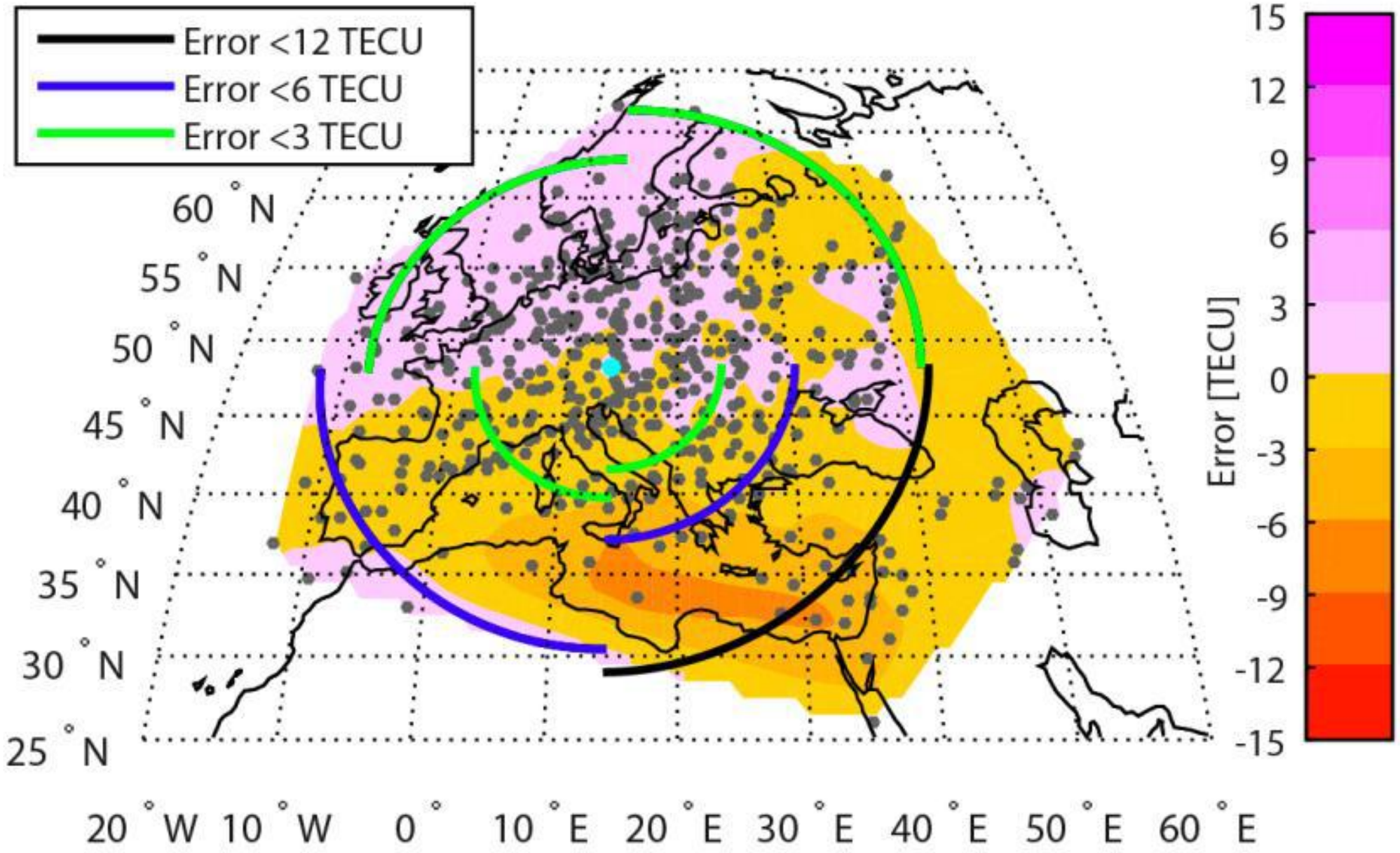

Nº OF PAPERS ON NeQuick BY EXTERNAL AUTHORS
AND BY ICTP MEMBERS
By ICTP
By others
Nº of Papers
30
25
20
15
10
5
0
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
YEAR

NeQuick Overview



5. Some recent studies done with NeQuick

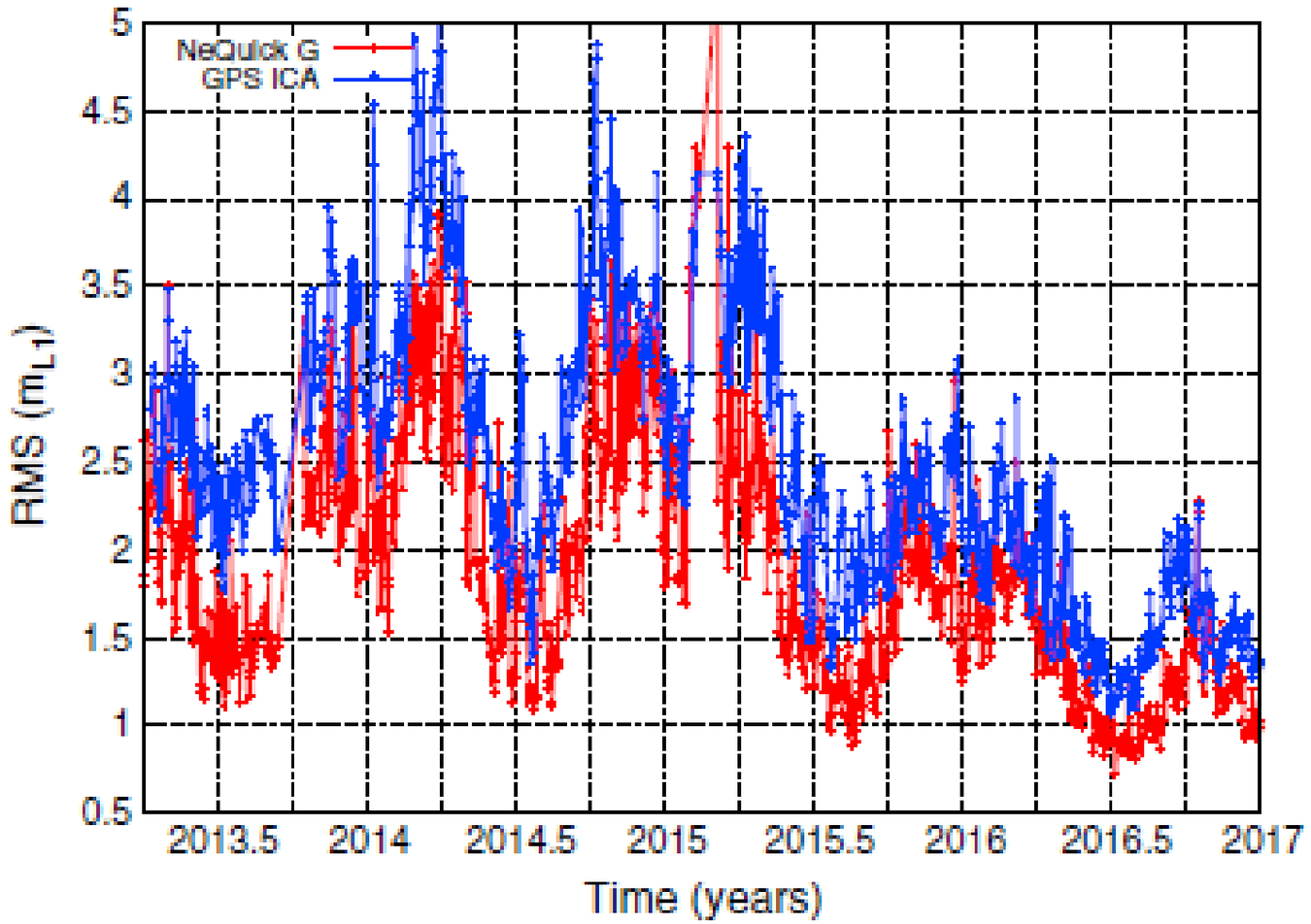
NeQuick performance evaluation after ingestion over Europe



Example of a map showing locally adapted NeQuick2 model accuracy on DOY 297 of 2013, 18:00 UTC.

Vukovic´, J., Kos, T. 2017. Locally adapted NeQuick 2 model performance in European middle latitude ionosphere under different solar, geomagnetic and seasonal conditions. *Adv. Space Res.*

Performance of Galileo single-frequency model



Global RMS error from Mar 2013 to Dec 2016 for NeQuick G and GPS ICA.

Orus Perez et al.,(2018). Status of NeQuick G after the solar maximum of cycle 24. Radio Science, 53.

Summary

- NeQuick is a three-dimensional and time dependent ionospheric electron density model based on an empirical climatological representation of the ionosphere.

- The predecessors and versions of the Model have been presented.

- The model is currently widely used and its performance is continuously assessed. Some recently published results have been exposed.

Miramare's castle

Thank you for your attention

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http://t-ict4d.ictp.it