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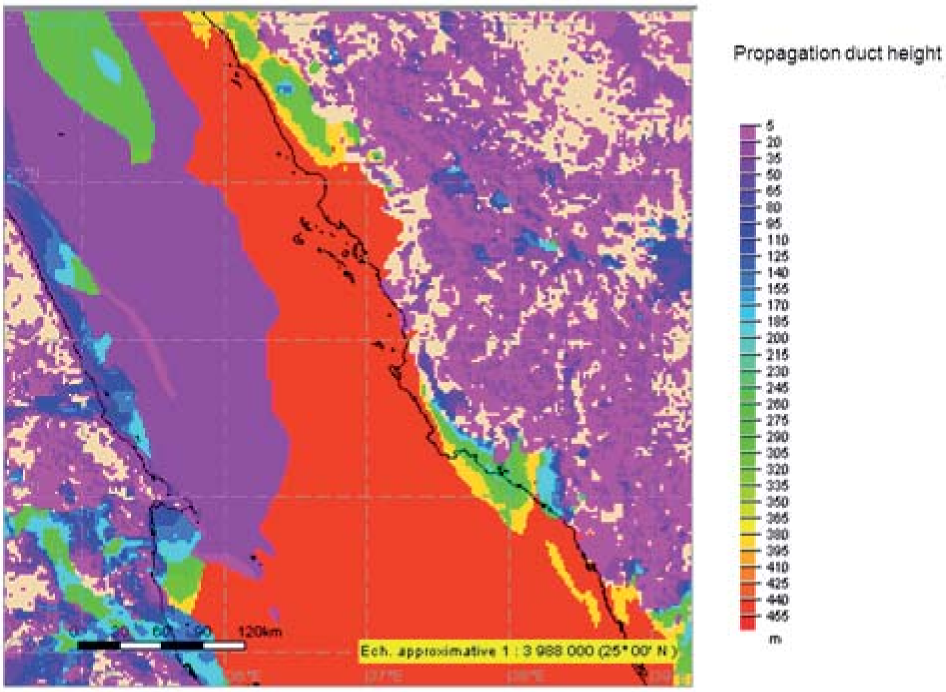

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Contents

Front cover: See the paper by Y. Hurtaud and Claverie on pp. 10-16.

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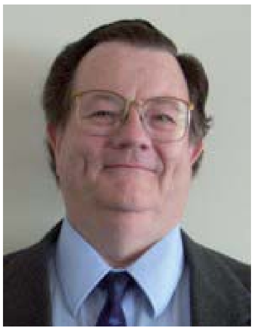

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With this June issue of the *Radio Science Bulletin*, we are going to start an evolutionary change in the *Bulletin* to enhance its magazine-like qualities. The goal is to still provide technical papers that are of broad interest to the URSI audience, while adding columns and other features that will appeal to specific interests of those within the radio-science community. The material that was appearing in the URSI *Newsletter* is also going to be incorporated into the *Bulletin*. There will be some modest changes in the appearance, designed to better visually distinguish various items in each issue. Please let me know what you think of the changes, and offer your suggestions.

Our Contributions

Electromagnetic propagation near the shore of a body of water (i.e., in a littoral environment) is complicated. Such propagation typically involves the effects of atmospheric ducts over the surfaces of both the land and the sea, propagation over both types of surfaces, and scattering from the sea's surface. The paper by Yvonick Hurtaud and Jacques Claverie describes a method for taking the complex geophysical environment into account in a decision-aid tool for understanding the effects of such propagation. The paper begins with a review of how refractivity profiles are specified, and the conditions under which ducting occurs. The *PREDEM* decision-aid software tool is introduced, and its capabilities for predicting the performance of electromagnetic systems in the presence of ducting environments are summarized. The methods whereby data from forecasts of atmospheric structure are used by the software are explained. The way in which the sea surface is modeled, including effects of wind speed, wave height, sea state, and sea direction, is detailed. The method of modeling sea clutter is covered. A description is given of a series of radar and meterological measurements that were carried out near the French Mediterranean coast for the purpose of verifying the accuracy of *PREDEM* simulation results. The paper concludes with examples of several cases were *PREDEM* could be used to predict radar coverage and the effects of sea clutter on detection range for different sets of geophysical conditions. This paper gives a very interesting introduction to the challenges of predicting electromagnetic propagation in land- and sea-based ducting environments, how geophysical data can be incorporated into such predictions, and the success in developing a specific software tool for doing this.

URSI is one of the three sponsoring organizations of the Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science: IUCAF. IUCAF plays a very important role, because it studies and coordinates the frequency allocations and requirements for passive radio-science activities, and makes them known to the national administrations and international bodies that allocate frequencies. These activities include radio astronomy, remote sensing, and space research. The annual report of IUCAF in pursuing these functions appears in this issue. Since the availability and protection of such frequency allocations are critical to the existence of these radio-science activities, the information on what IUCAF has been doing that is in this report should be of interest to all of those involved in radio science.

In his Radio-Frequency Radiation Safety and Health column, Jim Lin looks at the interesting issue of the effects of exposure to radio-frequency fields on human sleep. The column provides a nice introduction to human sleep patterns and their measurement using electroencephalography (EEG). Results of a number of recent studies of the effects of RF exposure on sleep are reported and analyzed.

In this issue, Özgür Ergül introduces a new column, called Solution Box. The purpose of the column is to provide a forum for those searching for solutions to problems in computational electromagnetics, with applications across all areas of radio science. Readers are invited to submit problems to which they need solutions, and other readers are invited to provide candidate solutions. To introduce the column and explain the process, Özgür presents an example problem and solution, using these to also illustrate the formats for submitting problems and solutions. The intention is to both provide cross-collaboration within URSI for solving problems, as well as to allow our readers to learn from the process.

Tayfun Akgül is an electrical engineer and radio scientist working the area of signal and image processing. He also is a professional cartoonist, and his cartoons have received worldwide recognition. His cartoons usually showcase the humorous side of science and the way scientists think. His column, Et Cetera, begins in this issue, to share that humor with our readers. I hope you enjoy it as much as I do.

You will find the reports of some of the Commission business meetings, held at the URSI Beijing General Assembly and Scientific Symposium (GASS), in this issue.

AT-RASC, AP-RASC, and GASS

The first URSI Atlantic Radio Science Conference (AT-RASC) was held May 18-22, 2015, in Gran Canaria. It was a huge success, with about 565 accepted papers and about 460 attendees. George Uslenghi and Peter Van Daele did an outstanding job of organizing this conference. AT-RASC will be held every three years, as are the URSI Asia-Pacific Radio Science Conference (AP-RASC) and the General Assembly and Scientific Symposium (GASS). This gives URSI a flagship conference, covering all 10 scientific Commissions, in each year. The next AP-RASC will be held August 21-25, 2016, in the 63 Convention Center in Seoul, Korea. The next GASS will be held August 19-26, 2017, in Montréal, Canada. Please mark these meetings on your calendar, and start planning to submit papers and attend, now.

I began this column with a request for feedback and suggestions. I will end it with the same. Please let me know what you would like to see in your *Bulletin*. Better yet, volunteer to contribute!

Ross

Geophysical Information Inputs for Computing the Performance of EM Systems in Littoral Environments

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Abstract

This paper presents *PREDEM V2*, a decision-aid tool dedicated to the French Navy. It can be used for radar applications, but also for various electromagnetic systems that are sensitive to various propagation effects (refraction including ducting, sea reflection, and scattering, diffraction by the coastline). Many efforts have been made to obtain a complete and accurate four-dimensional (three dimensions plus time) refractivity mapping. Other current works concern sea-surface effects, especially in terms of clutter modeling.

Some of the capabilities of *PREDEM V2* are illustrated, and some promising experimental results are also discussed.

1. Introduction

The performance of electromagnetic systems working in a littoral environment or in the open sea is generally sensitive to meteorological and oceanographic conditions. The radiation propagation depends on the atmospheric structure, which is characterized by the presence of evaporation ducts, surface-based ducts, or elevated ducts.

In open-sea conditions, horizontal homogeneity of the geophysical parameters may reasonably be assumed for radar applications. Knowledge of one vertical refractivity profile is sufficient to characterize electromagnetic propagation for tens of kilometers. In littoral environments, strong horizontal variations can be observed. For instance, the sea temperature (especially, the skin temperature used in surface-layer models) decreases as you move seaward. The wind speed is also subject to rapid changes, and the circulation of the sea breeze is generally associated with the presence of surface ducts. Moreover, the phenomena of diffraction and diffusion due to the presence of the coastline also affect the signal strength. Finally, in the case of radars, sea and terrain clutters can contribute significantly to the received noise.

In order to compute the *in situ* performance of EM systems (the detection range, the interception and telecommunication ranges, etc.), it is necessary to take into account the whole of these effects, with suitable spatial and temporal resolutions.

The purpose of this paper is to present a way of taking the geophysical environment into account in decision-aid tools (DAT) for French Navy applications. The environmental data come from various origins, according the types of missions: long-term planning at a strategic level (few months), short-term operational planning (hours or days), and operational management (real-time). These environmental data are exploited following two main axes: presentation of the meteorological context and helping to interpret it, and their use for performance computation and visualization of results. This general view is illustrated here by referring to *PREDEM V2*, software dedicated to the prediction of naval electromagnetic performance.

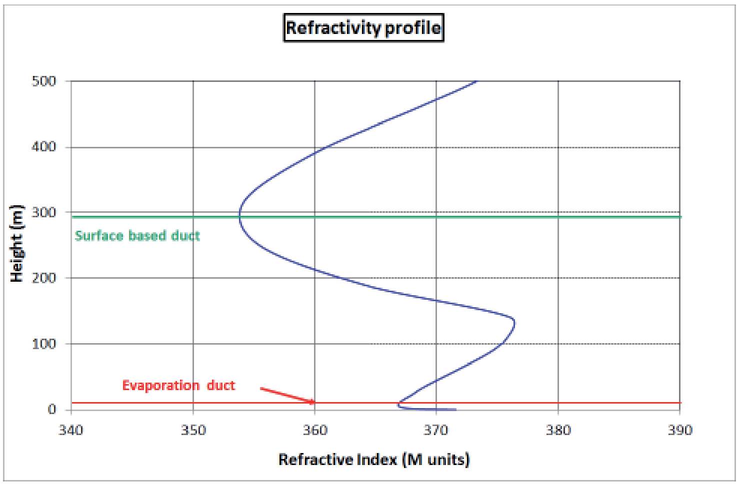


Figure 1. An example of a vertical refractivity profile, characterized by the presence of an evaporation duct and of a surface-based duct.

2. Refractivity Profiles and Ducting Situations

Because the tropospheric refractive index, denoted *n*, is very close to unity, the use of the refractivity, *N*, is generally preferred. The refractivity is defined by

$$N = 10^{6}\left(n-1\right). \qquad (1)$$

The refractivity is a function of the following meteorological parameters: the total atmospheric pressure, *p* (in hPa); the air temperature, *T* (in K); and the water vapor pressure, *e* (in hPa). They are related by

$$N = \frac{77.6}{T}\left(p + 4810\frac{e}{T}\right). \qquad (2)$$

Refractivity therefore depends on the height, *z*. The function $N(z)$ is referred to as the vertical refractivity profile. Considering long-distance propagation, especially in littoral environments, the horizontal variations of the refractivity also have to be taken into account. The mean statistical behavior of the meteorological vertical profiles results in the definition of a *standard* atmosphere characterized by

$$\frac{dN}{dz} \approx -39 \text{ N/km}. \qquad (3)$$

The lowest values of the vertical refractivity gradient lead to a super-refraction situation. In particular, if

$$\frac{dN}{dz} < -157 \text{ N/km}, \qquad (4)$$

ducting situations occur. A part of the transmitted electromagnetic energy may propagate within trapping layers, and reach receivers or targets located beyond the standard electromagnetic horizon. More generally, refraction effects may strongly modify the radar-coverage diagrams compared to what they should be, assuming standard conditions. To visualize the presence of an eventual duct for a given refractivity profile, it is more convenient to use the *modified* refractivity, *M*, practically defined as

$$M = N + 0.157z. \qquad (5)$$

The ducting condition expressed in Equation (4) thus simply becomes

$$\frac{dM}{dz} < 0. \qquad (6)$$

Above the sea surface, the rapid decrease of moisture with height explains the existence of a particular type of duct, called an evaporation duct. Evaporation ducts exist most of the time above the seas and the oceans. Their heights may vary from a few meters to a few tens of meters. Due to specific advection phenomena, a dry and hot air mass may cap a wet and cold air mass. This results in the existence of an elevated trapping layer, leading to the existence of a surface-based duct or of an elevated duct. These ducts may have a height of a few hundreds of meters. The occurrence of such ducts greatly depends on the geographical location. For instance, they are quite infrequent above the North Atlantic, but very common in the Persian Gulf.

Figure 1 is an example of a vertical refractivity profile (in *M* units). It corresponds to a summer Mediterranean case. In this case, the evaporation duct was overlaid by a strong trapping layer, giving rise to a surface-based duct.

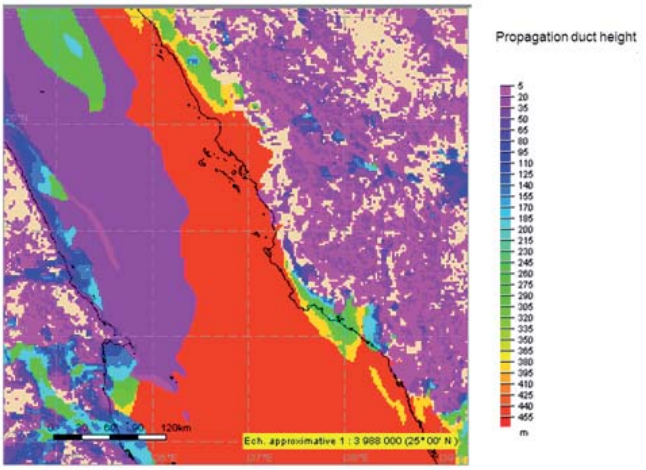


Figure 2. An example of a forecast duct mapping in the Red Sea, deduced from the *AROME NWP* code. The horizontal resolution was 2.5 km. Strong surface-based ducts were present above the sea near the eastern coasts and in the southern part of the area (red color). Meanwhile, an evaporation duct was the main refraction mechanism near the western coasts (purple color).

3. A Short Overview of *PREDEM V2*

The *PREDEM* software (*PREDEM* is a French acronym for "*PREDiction de performances des systèmes ElectroMagnétiques,*" which can be translated as "*Performance prediction of EM systems*") was developed by the CS company under DGA specifications [1, 2].

Version 2 of *PREDEM* is now close to being an operational code. Covering the spectral range from 100 MHz to 20 GHz, its main objective is to provide to the Navy credible prediction of the performance of EM systems, especially for radar detection. The main outputs of *PREDEM* are presently the following:

- Context visual aids, such as the cartography of duct heights, vertical profiles of refractivity, emagrams or terrain profiles (ground composition and features);
- Performance predictions (radar coverage, telecommunication ranges, etc.);
- Decision-aid tools: dual mode (implying, for example, a ship and an aircraft), and determination of the best altitude of the patrol aircraft to detect any target at the sea's surface.

The propagation code of *PREDEM* is the Advanced Propagation Model (APM), developed by SPAWAR (USA), and based on the Parabolic Equation Method (PEM), including a split-step Fourier resolution scheme. More precisely, this is a hybrid code, only using the Parabolic Equation Method in regions of strong refractivity gradients or/and at low altitudes. At short ranges or above the Parabolic Equation Method domain, other methods, such as flat-sea-model geometrical optics or extended geometrical optics, are used.

Compared to the previous version, many improvements have been done to make the code more robust and more operational. We will focus here on the functionalities related to the atmospheric structure and the sea surface. The new capabilities to access two-dimensional sea surfaces or three-dimensional atmospheric descriptions show the temporal and spatial heterogeneities of the marine boundary layer, and their impacts on the predicted performance of EM systems.

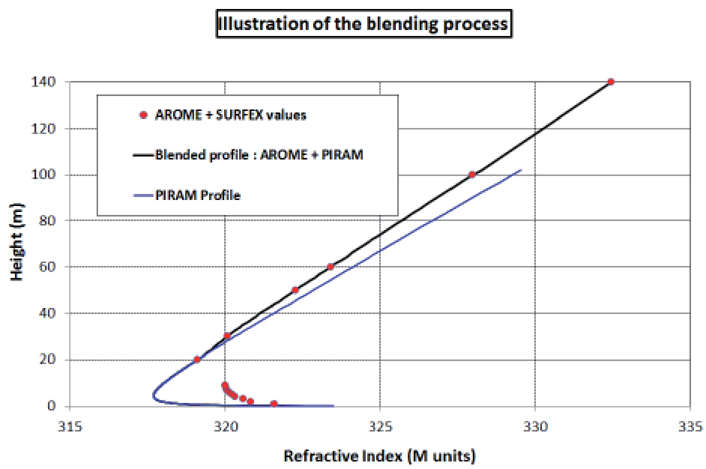


Figure 3. A comparison between the *AROME+SURFEX/CANOPY M* profile (red circles) and the *PIRAM M* profile (in blue) for an event of the *PREDEM* winter campaign (February 14, 2006, 8 am). *PIRAM* was initialized by the *AROME* values at 20 m. The black curve was the resulting blended profile used within *PREDEM* for propagation computations.

4. Forecast of the Atmospheric Structure

In *PREDEM V2*, the description of the short-term meteorological environment (i.e., the next 24 hours) is compatible with the outputs of the *Numerical Weather Prediction* (*NWP*) codes, by way of a GRIB file. The considered parameters are either the atmospheric pressure, the air humidity, and the air temperature, or the modified refractive index, *M*, the vertical gradient of which conditions the atmospheric propagation (see Section 2). The horizontal resolution of the Méteo-France *NWP* code *AROME* is 2.5 km, which allows visualizing the temporal evolution of the atmospheric structure, and rapidly identifying the geographical regions where the propagation is favorable (see Figure 2).

One of the crucial points is the way of merging the evaporation-duct structure with the upper layers. At the present time, the operational *NWP* codes do not consider this structure with enough vertical resolution to be useful for propagation computation. For example, in *AROME*, only two levels (2 m and 20 m) are given. This is the reason why – with the help of Météo-France – we studied a procedure to add a sufficient number of levels to access of the vertical profile in a manner fully compatible with the propagation core of *PREDEM V2*. Two methods to merge the evaporation-duct structure with the profile given by the *NWP AROME* have been developed, and are illustrated in Figure 3.

- The first method consists of adding five levels below 10 m, by running the multi-layer surface scheme *SURFEX/CANOPY*. However, for several cases it introduces *M*-index slope discontinuities between 10 m and 20 m, creating artificial propagation effects.
- The second method aims to compute the *M*-refractivity profiles using the *Marine Surface Boundary Layer* (*MSBL*) code *PIRAM* [3, 4], by taking as the reference point the level at 20 m given by *AROME*. A polynomial blending above 20 m is introduced to fit the *AROME* profile. This method leads to a continuous vertical *M*-profile that respects the vertical shape of the evaporation duct. Further work is in progress to validate this approach with various sets of data, including those of the *PREDEM* campaigns (summer 2005 and winter 2006, near the French Mediterranean coast).

5. Sea-Surface Effects

5.1 Sea-Surface Description in *PREDEM V2*

The description of the geophysical environment of *PREDEM V2* is completed by a representation of the sea surface that interacts with the electromagnetic propagation. The influence of the sea characteristics, in terms of roughness, on the propagation is slight (VHF-UHF bands) or significant (X, Ku bands) according to the ratio between the rms sea height and the wavelength. The forward propagation is linked to the sea-reflection coefficient's dependence on the significant wave-height ($H_{1/3}$), whereas the sea clutter depends on $H_{1/3}$ but also on the wave direction.

The main inputs of *PREDEM* for the characterization of the sea surface are then the following:

- Considering the sea to be homogeneous: Douglas sea state, significant wave height, wind speed, average sea direction;

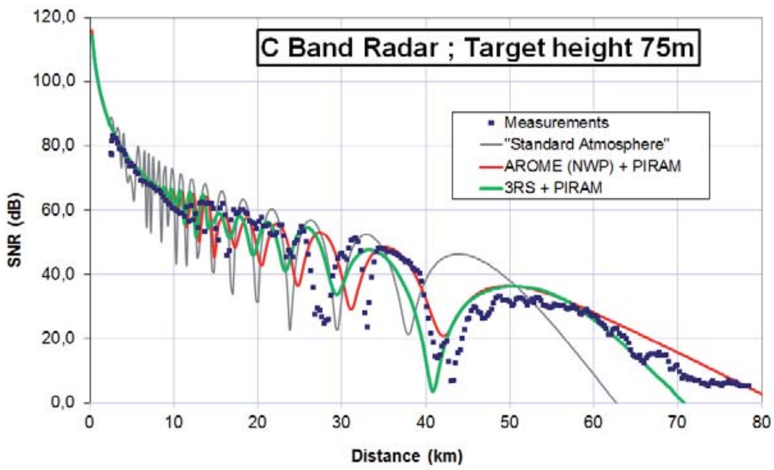


Figure 4. The measured and model results in terms of signal-to-noise ratio (SNR) for a data set collected on February 14 at 2 pm.

- Considering two-dimensional variations: GRID files issued from sea-wave forecast modeling and/or *NWP* codes, including significant wave height and average direction, sea state, or wind speed.

When the wind speed is taken as the input, the sea surface is considered fully developed by the wind (infinite fetch).

5.2 Modeling of the Sea Clutter

In order to take into account the sea clutter in the computation of the radar performance, the Georgia Technical Institute (GIT) model is widely accepted by the radar community. This empirical model [5] computes the apparent reflectivity, σ_0, as a function of radar parameters (frequencies from 1 GHz to 100 GHz, H and V polarizations) and of environmental parameters (wind speed, average wave height, look direction relative to wind direction, grazing angle). Due its large applicability and despite some limitations (discontinuity at 10 GHz, underestimation of sea clutter at low sea states and low grazing angles), the GIT model was introduced into *PREDEM V2*. In order to compute sea reflectivity in the presence of non-standard propagation conditions, the coupling between the Parabolic Equation Method and the GIT model cannot be modeled by a simple product $\sigma_0 F_{PE}^4$. $\sigma_0 . F_{PE}^4$ Effectively, the interference factor is taken into account by both the *APM* code and the GIT model. To overcome this problem, one of the functions of the GIT model, concerning the interference factor, A_i, was modified, as follows:

$$A_i^{GIT\,\mathrm{mod}} = A_i^{GIT} \frac{F_{PE}^4(\delta z)}{A_i^{DP}}, \tag{7}$$

where A_i^{GIT} A_i^{GIT} is the interference factor of the original GIT model, F_{PE}^4 is the radar propagation factor given by *APM*, A_i^{DP} A_i^{DP} is the radar propagation factor of a double path (direct and reflected paths on a spherical Earth for a standard atmosphere), and δz is the first height considered in the Parabolic Wave Equation Method resolution.

Recent work on the sea reflectivity has been conducted to propose new empirical models by revisiting the Nathanson set of measurements [6], and by extending physical modeling to low grazing angles. In the framework of an upstream study (MOFREM) driven by DGA MI, ONERA (the French Aerospace Lab) and the Mediterranean Oceanographic Institute (MIO) are developing an extension of the unified model *GOSSA* by combining the small-slope approximation with the Kirchhoff approximation [7]. This new model should include the very-low-grazing-angle case, and the effects of wave shadowing and of breaking waves. Furthermore, actual research concerning new formulations of the boundary conditions within the Parabolic Equation Method should lead to avoiding instabilities in the propagation field resolution [8].

6 Experimental and Simulation Results

6.1 The *PREDEM* Campaigns

In June 2005 and February 2006, complete radar and meteorological measurements were performed near the French Mediterranean coast [1]. S-band and C land-based radars, with vertical polarizations, tracked canonical surface or airborne targets along a constant path with distances up to 100 km. Several times per day, three simultaneous radio soundings were performed along this path. *AROME* and *PIRAM* refractivity profiles were computed for the entire studied periods.

Figure 4 shows a representative result of the winter campaign. For this particular case, the atmospheric structure was similar to the structure plotted in Figure 3. The evaporation-duct height was around 9 m, and quite constant along the propagation path. As the radar height above sea level was 35 m and the target height was 75 m, assuming a standard atmosphere, the radio-electrical horizon should have been around 60 km. The presence of an evaporation duct permitted a target detection beyond this standard horizon. Using the radiosonde (RS) profiles blended with *PIRAM* gave results in good agreement with the radar measurements. However, the modeled refractivity profiles issued from the blending of *AROME* with *PIRAM* also fit the observed data very well.

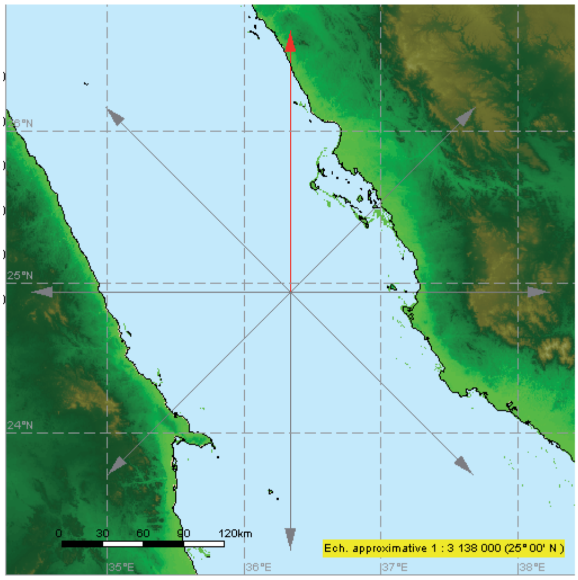


Figure 5. The localization of the onboard C-band radar in the Red Sea, and an indication of the considered radar directions.

6.2 Illustration of the Geophysical Environment Impact on Radar Coverage

The impact of the environment on radar coverage at centimeter wavelengths is illustrated in this paragraph by using concrete situations encountered in a littoral environment. In such environments, the combined effects of the atmospheric structure and the terrain (including the presence of features) significantly modify the radar coverage compared to the standard conditions.

To illustrate the influence of the three-dimensional atmospheric structure, we considered a ship located in the middle of the Red Sea, and equipped with a C-band radar (H polarization). In order to estimate the coverage of this radar, a computation was realized with *PREDEM V2* in the eight directions plotted in Figure 5 (N, NE, E, SE, S, SW, W, and NW).

The atmospheric structure was that corresponding to Figure 2. Strong surface-based ducts with a thickness of more than 400 m were present on the eastern and southern parts of the area of interest. The plots on the left (respectively, right) side of Figure 6 present the radar coverage for a bearing W (NE) up to an altitude of 2000 m and a range of 180 km. The lower curves can be compared with the upper curves showing the radar coverage diagrams for the same directions, but simply assuming a standard atmosphere. The increase of radar range due to the surface-based duct and evaporation duct can clearly be seen. Obviously, due to the different duct heights, the changes in the radar-coverage diagrams do not concern the same target heights.

6.3 Clutter Effects

Figure 7 shows the effect of sea clutter on the detection range. This simulated result concerned an X-band radar, with horizontal polarization[1], located 15 m above the sea surface, and we assumed an evaporation-duct height of 10 m. As for the previous plot, the detection probability was computed for a target having an RCS of 20 m^2 . The left plot was obtained by considering a flat sea surface (no clutter), while the right plot considered a very rough sea surface (a wind speed of 15 m/s was used as an input to the original GIT model). A significant decrease in the maximum detection range due to clutter could easily be observed. The impact of the modified GIT model (Section 5.2) will be studied in the very near future, and experimental results are needed to validate these simulations.

7. Conclusion

With the introduction of precise geophysical information completed with realistic radar modeling, the credibility of decision-aid tools is significantly increased. However, efforts must be pursued on the following points:

- *Interoperability of the use of weather forecasting files*

  The transcription between the meteorological files coming from different sources and the format accepted by the decision-aid tools has to be done by dedicated codes like *NCOMET*

- *Clutter modeling.*

  Modeling the clutter properties and the interaction with atmospheric propagation in the presence of a rough sea and a propagation duct are still open topics.

- *Global validation of radar performance codes in the littoral environment.*

  This needs the installation of important means of measurements, including powerful radars, moving targets, atmospheric soundings, and sea-surface characterization. The analysis of the *PREDEM* campaigns has shown the necessity of having a four-

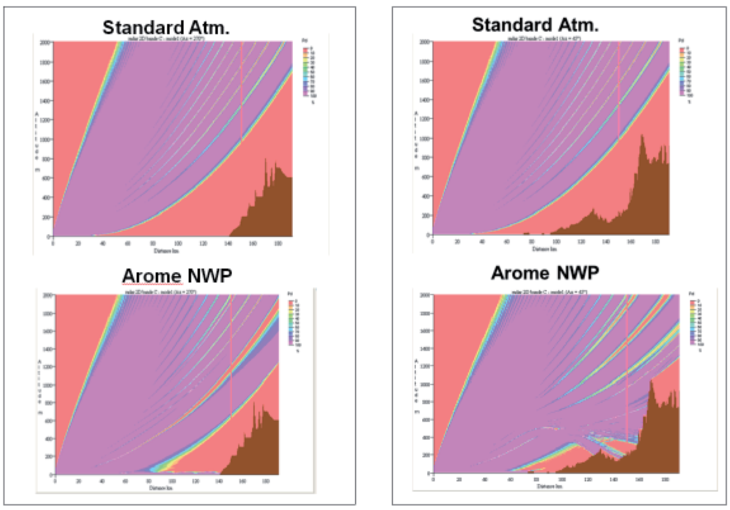
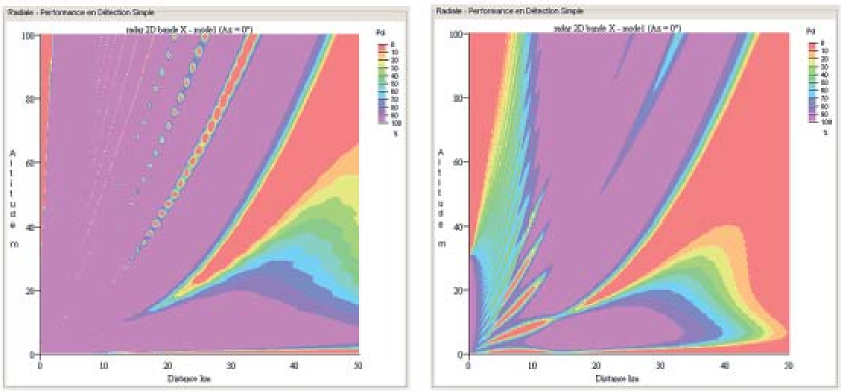


Figure 6. Radar-coverage diagrams for a C-band radar located near the sea in the presence of a forecasted atmospheric structure (lower plots) and for a standard atmosphere (upper plots). The coverage diagrams were drawn with a color scale spread from purple to red (detection probability between 100% and 0%, computed for a target with an RCS of 20 m^2). The red vertical line at 150 km was due to the blind distance of the radar.



Without sea clutter With sea clutter ws=15m/s

Figure 7. The combined effects of ducting conditions with sea clutter for an X-band radar. As in Figure 6, the color scale was linked to the detection probability of a given target (RCS of 20 m^2).

dimensional (three dimensions plus time) refractivity mapping provided by *NWP* codes.

A new experiment, called TAPS, in a tropical environment on the northeast coast of Australia was conducted at the end of 2013, in the framework of an international cooperation (United Kingdom, United States of America, New Zeeland, Australia, and France). The complete analysis of this new set of experimental data will give us the opportunity to continue to test and improve the atmospheric modeling, especially the blending between the *MSBL* and the upper atmospheric structure.

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IUCAF 2014 Annual Report

1. Introduction

The Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science, IUCAF, was formed in 1960 by its sponsoring scientific unions, the IAU, URSI, and COSPAR. Its brief is to study and coordinate the requirements of radio-frequency allocations for passive (i.e., non-emitting or receive-only) radio science, such as radio astronomy, space research, and remote sensing, in order to make these requirements known to the national administrations and international bodies that allocate frequencies. IUCAF operates as a standing interdisciplinary committee under the auspices of ICSU, the International Council for Science. IUCAF is a Sector Member of the International Telecommunication Union (ITU).

2. Membership

At the end of 2014, the membership for IUCAF elected by the three parent organizations was as follows:

URSI

S. Ananthakrishnan (Comm J)	India
S. Reising (Comm F)	USA
I. Häggström (Comm G)	Sweden
A. Tzioumis (Comm J)	Australia
W. van Driel (Comm J)	France

IAU

H. Chung	Korea (Republic of)
H. S. Liszt (Vice Chair)	USA
M. Ohishi (Chair)	Japan
T. Gergely	USA
A. Tiplady	South Africa

COSPAR

Y. Murata	Japan

IUCAF also has a group of Correspondents, in order to improve its global geographic representation, and for issues on spectrum regulation concerning astronomical observations in the optical and infrared domains.

3. International Meetings

During the period of January to December 2014, its Members and Correspondents represented IUCAF in the following international meetings:

February, 2014	ITU-R Joint Task Group 4-5-6-7 Geneva, Switzerland
April, 2014	IUCAF School on Spectrum Management Santiago, Chile
May, 2014	Working Party 7D (Radio Astronomy) Geneva, Switzerland
May, 2014	Working Parties 5A (Land mobile, amateur service) and 5B (Aeronautical mobile, radar, etc.) Geneva, Switzerland
May, 2014	56th CRAF (Committee on Radio Astronomy Frequency) Dwingeloo, the Netherlands
July, 2014	ITU-R Joint Task Group 4-5-6-7 Geneva, Switzerland
August, 2014	URSI General Assembly and Scientific Symposia Beijing, China
September, 2014	Study Group 7, ITU-R Geneva, Switzerland
October, 2014	Working Party 7D (Radio Astronomy) Geneva, Switzerland
October, 2014	Study Group 7, ITU-R Geneva, Switzerland

Additionally, many IUCAF members and their associates participated in numerous national or regional meetings (including CORF, CRAF, RAFCAP, the FCC, etc.), dealing with spectrum-management issues, such as the preparation of input documents to various ITU meetings.

4. IUCAF Business Meetings

IUCAF had face-to-face committee meetings during the WP7D meetings in May and October. IUCAF ad-hoc meetings were held to further discuss its meeting strategy. IUCAF also had a business meeting at the URSI General Assembly and Scientific Symposia, Beijing, China (CIE).

Although such face-to-face meetings have been convenient and effective, throughout the year, much IUCAF business is undertaken via e-mail communications among the members and correspondents.

5. The 4th IUCAF School on Spectrum Management

The 4th IUCAF School on Spectrum Management for radio astronomy was successfully held between April 7 and 11, 2014, at the Joint ALMA Observatory, Santiago, Chile. This was the first IUCAF school on spectrum management held in the southern hemisphere. There were more than 50 people registered, from 13 countries: Chile, Brazil, Argentina, Japan, Germany, UK, the Netherlands, USA, China, South Korea, Australia, and Malaysia (Figure 1). The primary targets of the school were newcomers in spectrum management. Since there are a few regulators from Chile, the school was an ideal opportunity to create a good relationship with the Chilean government.

The summer school program (see http://www.iucaf.org/sms2014/) covered introductions to radio astronomy and Earth observations, radio science and related technologies, and procedures on how to use (allocate) frequency resources. This included the structure and role of the International Telecommunications Union (ITU) and regional telecommunities (CEPT, CITEL, APT); the roles of science bodies in protecting radio astronomy and Earth observations (IUCAF, CRAF, CORF, RAFCAP); interference-mitigation techniques; and radio-interference topics, such as software-defined radio (SDR), cognitive radio systems (CRS), and others. There was also a lecture on the SKA project, and radio-quiet zones for future radio astronomy.

It should be noted that the school was supported financially by IUCAF, CRAF, CORF, and RAFCAP.

The school was run in a very friendly atmosphere and excellent weather. The participants, especially young students, actively asked questions. After the school, there was a special tour to visit the ALMA site.

It can be concluded that the 4th IUCAF School on Spectrum Management was quite successful. The participants were able to learn many topics to be utilized to ensure the protection of radio astronomy and Earth observations towards a better understanding of the Earth and the universe.

6. Protecting the Passive Radio-Science Services

The most important event in protecting the passive radio-science services occurred during the World Radiocommunication Conferences (WRCs). These are held every three to four years for updating international rules (the Radio Regulations) in using frequency resources, which are then referred to by each government in order to update its national radio act. The next WRC is scheduled to be held in 2015 (WRC-15).

An agenda item regarding the protection of radio-astronomical observations from possible (highly probable) interference caused by collision-avoidance radars at around the 79 GHz region (77 GHz to 81 GHz) is of importance to the radio-astronomy community. IUCAF submitted a few contributed documents on how to protect radio-astronomy observations at around 79 GHz. Since radio-astronomy observations are quite susceptible to manmade radio interference, the studies concluded that a separation distance of about 40 km would be required to protect radio-astronomy observations from collision-avoidance radars operating at around 79 GHz. However, the car radar industries strongly hope to operate the collision-avoidance radars, even if the devices cause serious impairment to radio-astronomy observations. This will violate the fundamental rule in using the radio resource: any new service must protect already existing radio services.

There is another agenda item to consider possible allocations for radar operations to monitor the Earth environment. A radar is planned to operate in the ranges of 8700 MHz to 9300 MHz and 9900 MHz to 10500 MHz from a satellite orbiting the Earth. Since the radar operations require a wide frequency range (600 MHz), the sidelobes away from the center frequency of the transmission may interfere with passive remote-sensing observations and radio-astronomy observations in the 10.6 GHz to 10.7 GHz band. IUCAF and CRAF have submitted study results to the ITU-R regarding the probable impact on passive observations by the proposed radar, which are incorporated in a new ITU-R report.

IUCAF published its position paper regarding relevant agenda items for WRC-2015. The position paper was presented at the Conference Preparatory Meeting (CPM) prior to WRC-2015, and was referred to by CRAF in developing its position paper towards WRC-2015.

IUCAF member A. Tzioumis is the Chair of ITU-R Working Party 7D (Radio Astronomy). IUCAF member H. Chung is the Vice Chair of ITU-R Study Group 7 (Science Services).

7. Contact with the Sponsoring Unions and ICSU

IUCAF maintains regular contact with its supporting scientific unions and with ICSU. The unions play a strong supporting role for IUCAF, and the membership is greatly encouraged by their support.

Pursuing its brief, IUCAF continued its activities towards strengthening its links with other passive radio-science communities, in particular in space science, and with defining a concerted strategy in common spectrum-management issues.

Figure 1. Attendees at the 4th IUCAF School on Spectrum Management, held April 7-11, 2014, at the Joint ALMA Observatory, Santiago, Chile.

Many IUCAF members presented their research results at the URSI General Assembly and Scientific Symposium (GASS), held in August 2014 in Beijing. IUCAF members also actively participated in national URSI meetings.

Two IUCAF members, A. Tzioumis and M. Ohishi, are appointed the organizing committee (OC) members of IAU Commission 50. M. Ohishi is also an organizing committee member of IAU Commission 51 (Bioastronomy). M. Ohishi chairs the Working Group on Astrophysically Important Spectral Lines under Division B, IAU. He was also appointed the official liaison between the IAU and the ITU, and a member of WG Redefinition of UTC, Division A, IAU. IUCAF member S. Ananthakrishnan is the Chair of URSI Commission J (Radio Astronomy).

IUCAF was informed by ICSU that it plans to review the activities of IUCAF towards the end of 2015 and the beginning of 2016. The review will be conducted by the Committee on Scientific Planning and Review (CSPR) of ICSU, which decided on a working plan to review all of the ICSU Interdisciplinary bodies at regular intervals (normally, every five years). This will be a good opportunity for IUCAF to revisit its 40-year-old Terms of Reference.

8. Publications and Reports

IUCAF has a permanent Web address, http://www.iucaf.org/, where the latest updates on the organization's activities are made available. All contributions to IUCAF-sponsored meetings are made available on this Web site.

9. Conclusion

IUCAF's interests and activities range from preserving what has been achieved through regulatory measures or mitigation techniques, to looking far into the future of high-frequency use, giant radio telescope use, and large-scale distributed radio telescopes. Current priorities for the coming years are the protection of radio-astronomy observations from collision-avoidance radars at around the 79 GHz region, and studies on the operational conditions that will allow the successful operation of future giant radio telescopes.

IUCAF successfully held the 4th Summer School on Spectrum Management in April, 2014, in Santiago, Chile. This success was owed to the financial support from URSI, IAU, COSPAR, and other organizations.

IUCAF is grateful for the moral and financial support that has been given for these continuing efforts by ICSU, URSI, IAU, and COSPAR during recent years. IUCAF also recognizes the support given by radio-astronomy observatories, universities, and national funding agencies to individual members in order to participate in the work of IUCAF.

Masatoshi Ohishi, IUCAF Chair
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IUCAF website: http://www.iucaf.org

In Memoriam: Thomas Damboldt

Thomas Damboldt passed away on March 30, 2015, in Darmstadt, after a serious illness, at the age of 73.

Thomas Damboldt was born on May 19, 1941, in Stettin, Germany. His childhood and school days were spent in Frankfurt am Main. After graduation, he studied geophysics at the Fachhochschule Darmstadt (now Technical University of Darmstadt). He was affiliated with the Astronomical Institute of the University of Frankfurt, and spent some time at a research center on the Shetland Islands. After graduation, he was a research assistant at the FH Darmstadt, where he also obtained his PhD degree.

Very early in his life, Thomas became a dedicated radio amateur. His call sign was DJ5DT (silent key), which he held until the end. He was particularly interested in Earth-moon-Earth connections and meteor-scatter connections, and he wrote numerous publications about these topics.

In 1974, he joined FTZ, the Research Institute of the Deutsche Bundespost (DBP) in Darmstadt, and until 2000, was research group leader. His was responsible for issuing short- and long-term forecasts for shortwave services, and for improving the prediction methods. To this end, global field-strength measurements were made that led to the world's leading collection of RF propagation measurements. These data have recently been passed to the ITU in a standardized format.

For many years, Thomas was also responsible for the operation of the Regional Warning Center (RWC) Darmstadt, generating space weather warnings under the auspices of the Internal URSIgram World Day Service (IUWDS).

Early in his career, Thomas began his involvement in the work of the ITU as part of the German delegation to CCIR Study Group 6. He initially contributed to the work of IWP 6/1 under the leadership of Peter Bradley. The peak period was the 1980s, when IWP 6/12, chaired by Don Lucas, was tasked to find a suitable RF forecasting method that would replace the existing program Rep 252. It was decided at that time to create a worldwide database of RF measurements. A large number of measurements have been conducted in Germany, taking a large part of the German field-strength measurements. This originated as CCIR RF database D1. Thomas was appointed Chair of IWP 6/13, which was responsible for improving the prediction models on the basis of the newly established databank. The result was a largely improved version of ITU Report 894.

For many years, Thomas was the secretary of the German URSI Committee, responsible for organizing the annual Kleinheubach meeting. In addition, he worked for AGARD, and was involved in a COST project.

By the end of 1993, DBP terminated all activities in the field of ionospheric research. Until his retirement in 2000, Thomas conducted research in electromagnetic waves and biological effects.

Thomas continued his interest and involvement in ionospheric propagation well after his retirement. He was actively involved in a research project for creating a large worldwide database of ionosonde data, and in a project for the conversion of ionospheric coefficients (foF2 and M(3000) F2) in height forecasts as global maps).

His last project was the reprogramming of ITU-R Rec P. 533, in collaboration with Chris Behm from NTIA-ITS in Boulder. The extensive verification, with the aid of the RF database D1, led to some improvements that were completed at the ITU meeting in autumn 2014.

Thomas was survived by his wife, Brunhilde, his daughter, Marion, and his two grandsons, Lina and Paul.

Peter Süßman
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In Memoriam: Andrzej Władysław Wernik

It is with great regret that we announce that Prof. Andrzej W. Wernik died April 24, 2015, at the age of 76, after a long and serious illness.

Prof. Wernik was the founder and leader of ionospheric research in Poland. He was one of the pioneers of Polish space research, and a world-renowned specialist in ionospheric physics. He was born in Warsaw on November 26, 1938.

He was the author and/or coauthor of approximately 160 papers, published in peer-reviewed journals and conference proceedings. These publications dealt with wave propagation in the ionosphere, wave propagation in stochastically inhomogeneous media, ionospheric physics, ionospheric plasma turbulence, acoustic-gravity waves in the upper atmosphere, and methods of data analysis.

His MSc in Astronomy was earned from Warsaw University in 1960, with a thesis entitled "Extinction of the Night Sky Light in an Anisotropically Scattering Atmosphere." In 1960, he started his scientific career in the Institute of Geophysics of the Polish Academy of Sciences (PAS). In 1977, he moved, together with his group, to the newly established Space Research Center PAS, where he worked until the end of 2014.

In 1963, during his work on geomagnetic data interpretation, he became fascinated with the ionosphere. In 1966, he organized the first regular observations of Explorer 22 (Polar Beacon-B) 20 MHz radio signals, to study the ionosphere using measurements of Faraday rotation and signal-amplitude fluctuations. The same year, he initiated the project to construct an advanced receiver for satellite radio beacons at frequencies of 20 MHz, 30 MHz, 40 MHz, 90 MHz, and 360 MHz, with an aim to measure the dispersive Doppler frequency at any pair of these frequencies, as well as the Faraday rotation. The great accuracy of these measurements made it possible to investigate small frequency scintillations. The apparatus has been used since January 1969 to receive beacon signals from Explorer-22, from a number of Intercosmos satellites, and, after some modifications, from the geostationary ATS-6 satellite. In such a way, for a long time he became engaged in the problem of scintillations in satellite telecommunications. Some of his work on scintillations was made at that time in cooperation with Dr. Ludwik Liszka of Kiruna Geophysical Observatory in Sweden, during several research stays in Kiruna.

Prof. Wernik's PhD in Geophysics was obtained from the Institute of Geophysics, PAS, in 1968. It was based on the thesis, "Effects of Non-Uniform Ionospheric Structure on the Propagation of Radio Signals from the Earth's Artificial Satellites." His promoter was Prof. Stefan Manczarski, the legendary radio specialist working during World War II for the Polish underground Home Army.

Later, during his post-doc stay (1972/1973) in the Department of Electrical Engineering of the University of Illinois, Prof. Wernik worked in cooperation with Profs. K. C. Yeh and C. H. Liu on the development of the scattering theory of radio scintillations, including multiple scattering and GHz signals. This work was recognized with the prestigious award of the Scientific Secretary of the Polish Academy of Sciences.

In 1978, Prof. Wernik obtained the DSc habilitation degree from the Institute of Fundamental Technological Research PAS for his scientific work assembled under the title, "Theory of Scintillations of Trans-Ionospheric Radio Waves." The same year, he was awarded the Silver Crest of Merit by the Polish Council of State, the Medal of the Space Research Committee PAS, and the Brown Medal for the Services for State Defense.

In 1968 in Poland, the cooperation with the INTERCOSMOS organization started. Prof. Wernik used this opportunity to access the Intercosmos satellite ionospheric data (for his research on photoelectrons), and to launch own instruments in space. This materialized only in December of 1981, aboard the Vertical-10 rocket, with the Polish digital analyzer of plasma-density fluctuations probing the mid-latitude ionosphere at altitudes of 200 km to 1500 km. Observations of intense and sharp irregularities of ionospheric plasma density during this experiment allowed modifying scintillation theory, giving better agreement with observations.

As an acknowledgement of his achievements in science, education, and activities to the benefit of Polish space research, the prestigious scientific title of Professor in Physics was awarded Prof. Wernik by the President of Poland in 1989.

Prof. Wernik was involved in wide international cooperation during his career. Between 1972 and 1988, he visited the Department of Electrical and Computer Engineering of the University of Illinois at Urbana-Champaign, USA, many times. In 1984-1987, in cooperation with this university and the University of Oulu, Prof. Wernik initiated systematic studies of radio scintillations at the Polish Hornsund station at Svalbard, where HILAT (USAF HIgh LATitude Research Satellite) and Polar Bear (USAF Polar Beacon and Research satellite) radio beacon signals were received.

In 1993, Prof. Wernik spent six months as a visiting scholar at the National Central University in Chung-Li, Taiwan. With the specialists from the University of Oslo, he worked on ionospheric plasma turbulence. He worked on the statistical model of scintillation and space-plasma turbulence with the Italian scientists from the Istituto dei Sistemi Complessi and Istituto Nazionale di Geofisica e Vulcanologia.

He participated as an expert in many international scientific and educational projects of the European Commission and ESA. Recently, this included the TRANSMIT project: Training Research and Applications Network to Support the Mitigation of Ionospheric Threats.

Prof. Wernik was a splendid lecturer, and promoter of more than 10 PhD students. His last student was Dr. Shishir Priyadarshi of India, the grantee of the TRANSMIT project. Working under the supervision of Prof. Wernik, he defended his PhD thesis. “B-Splines Model of Ionospheric Scintillation,” earning his PhD in October 2014. This work was based on the last project of Prof. Wernik: the analysis of scintillation data from GPS receivers placed at the Polish Hornsund station at Svalbard and in Warsaw.

Prof. Wernik served the scientific community in many ways during his professional life. In 1990-1992, he chaired Commission G on Ionospheric Radio and Propagation of URSI. In 1996-1999, he was a member of the Bureau of the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP). In 1996-2000, he was an Associate Editor of *Radio Science*, published by the American Geophysical Union. From 1999 to 2002, he was a Vice President of URSI, and from 2002 to 2005, he was a Vice President and Treasurer of URSI. He was the Honorary Chair of Commission G of the Polish National URSI Committee.

Prof. Wernik was a member of the Research Council of the Institute of Geophysics PAS, Research Council of the Space Research Center PAS, Committee of Geophysics, Polish National URSI Committee, American Geophysical Union (silver pin), Polish Astronomical Society, Polish Geophysical Society, and the Advisory Committee of *Acta Geophysica* (published by Springer).

Prof. Wernik was survived by his beloved wife Maria, his daughter Dorota, and his two grandchildren Zofia and Jan (*Sophie* and *John*). He will be remembered by his friends and coworkers as a nice person of positive attitude toward everybody. Hew was generous and warm, of noble manners, with a passion for science: a splendid example of a fruitful great scientist and a good man. Throughout all the difficult moments in the history of Poland before 1989, and the transformation later on that disturbed research work in our Institute, he was always quiet and determined to steadily continue his work, creating a much-needed peaceful atmosphere around himself.

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Important Information

Preliminary paper due on
16 October 2015

Notification of acceptance
12 December 2015

Updated paper due on
23 January 2016

Convened sessions proposal due on
01 June 2016

Paper Format

Authors are invited to submit contributions in the form of a paper with a minimum length of two A4 pages (the maximum accepted length is five A4 pages including figures and references).

The paper must contain enough information for the Technical Programme Committe (TPC) and reviewers to judge on the originality and quality of the work.

For further details visit the conference website

http://www.eucap2016.org

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THE CONFERENCE

The European Conference on Antennas and Propagation is owned by the European Association on Antennas and Propagation (EurAAP) and is organised each year since 2006. The conference is supported by top level Associations on Antennas and Propagation and provides a forum on the major challenges faced by these communities.

Contributions from European and non-European industries, universities, research centres and other institutions are solicited. The conference provides an overview of the current state-of-the-art in Antennas, Propagation and Measurements topics, highlighting the latest developments and innovations required for future applications.

APPLICATION TRACKS

Aiming at increasing the interaction between academia and industry, the conference will feature session tracks focused on applications. See below for a list of application tracks.

Conference Topics

ANTENNAS AND RELATED TOPICS

A01 Antenna and Electromagnetic theory
A02 High frequency and asymptotic methods
A03 Computational and numerical techniques
A04 Optimization methods in EM
A05 Antenna interactions and coupling
A06 Antenna systems and architectures
A07 Metamaterials, metasurfaces and EBG for antennas
A08 Active and integrated antennas
A09 Nanoantennas
A10 Millimetre-wave, submillimetre-wave and Terahertz antennas
A11 Conformal antennas
A12 Multiband and wideband antennas
A13 Reflector, feed systems and components
A14 Lens, radomes and dielectric resonator antennas
A15 Waveguide and leaky- wave antennas
A16 Small antennas and RF sensors
A17 Wearable antennas
A18 Printed and wire antennas
A19 Array antennas
A20 Reflectarrays and transmitarrays
A21 Frequency and polarization selective surfaces
A22 Adaptive and reconfigurable antennas
A23 UWB antennas and time-domain techniques
A24 Beamforming and signal processing
A25 MIMO, diversity, and smart antennas
A26 3D printed antennas and structures
A27 Imaging, sensing and radar antennas
A28 Antennas for wireless power transmission and harvesting

PROPAGATION AND RELATED TOPICS

P01 Propagation modelling and simulation
P02 Imaging and inverse scattering
P03 Scattering, diffraction and RCS
P04 Measurement techniques
P05 Millimetre- and submillimetre-wave propagation
P06 UWB propagation
P07 Aeronautical and maritime propagation
P08 Body area propagation
P09 Indoor and outdoor propagation topics
P10 Radioastronomy and deep space communication propagation
P11 Satellite propagation
P12 Trans-ionospheric and tropospheric propagation
P13 Vehicle-to-vehicle and vehicle to-infrastructure propagation
P14 Propagation aspects in remote sensing
P15 Propagation in and interaction with biological tissues
P16 Propagation in natural and complex media
P17 Propagation in random media and diffuse scattering
P18 Radio climatology propagation aspects
P19 Polarisation issues in propagation
P20 Radar, localisation and sensing
P21 Multi-link MIMO and cooperative channels
P22 Space-time channel characterisation
P23 Channel-sounding and channel-estimation techniques
P24 Joint antenna-channel issues in propagation

ANTENNA AND RCS MEASUREMENT TECHNIQUES

M01 General antenna measurements
M02 RF materials characterisation, test techniques and facilities
M03 Measurement standards and range comparisons
M04 Radar scattering measurement and calibration techniques
M05 Near-field, far-field, compact and RCS test ranges
M06 Data acquisition, imaging algorithms and processing methods
M07 Fast scanners
M08 EMI/EMC/PIM chamber design, instrumentation and meas.
M09 End-to-end system testing
M10 Over-The-Air (OTA) multipath testing
M11 Time-domain metrology, EM-field and EMC metrology
M12 Dosimetry, exposure and SAR assessment

APPLICATION TRACKS

T01 Biomedical applications and biological effects
T02 Cellular mobile communications
T03 Defence and security
T04 Electromagnetic education
T05 EM modeling and simulation
T06 Fundamental research
T07 Localisation and signal processing
T08 Radar
T09 RFID and sensor networks
T10 Short-range and gigabit communications
T11 Space
T12 Wireless networks

Contact Information

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Radio Frequency Exposure on Sleep EEG Patterns in Humans

Under both normal and abnormal conditions, weak electrical current and voltage signals from nerve cells or neurons in the brain may be recorded non-invasively using electrodes attached to different areas of a person's scalp [1]. Electroencephalography (EEG) is the most commonly used method and protocol for acquiring the spatial-temporal information contained in recordings from multiple scalp electrodes. The EEG recordings are used to display wave patterns of electrical activity that occur in the brain. They are used to assess a variety of brain functions and for neurological examinations, including sleep patterns (the different stages of sleep), and assorted psychological disorders.

Since body movement and nervousness can change brain-wave patterns, patients usually are instructed to recline in a chair or on a bed during the test, which can take up to an hour. The EEG reflects synchronous activity in relatively large populations of neurons in the cerebral cortex of the human brain. It is a particularly useful measure of such behavioral states as wakefulness and variations during different stages of sleep.

Clinically useful information is extracted by visual inspection of EEG recordings, or in combination with computer-assisted topographical mapping and display of data as color images. Complexity, uncertainty, and difficulty may arise from human factors, cognitive psychology, and visual psychophysics and perception, as well as data acquisition, analysis, and display technology.

The EEG can provide a complementary measure to physical examination of neural function, with weaker spatial resolution, but greater temporal resolution, which is sufficient to capture temporally discrete processes.

Given the EEG's usefulness in assessing brain functions and for neurological examination, the topic of sleep EEG is of strong interest or considerable importance. It therefore has been deemed worthy of research investigation to help determine whether RF-EMF influences brain activity.

The normal human EEG patterns are divided into discrete frequency bands, which are generally designated as delta (< 4 Hz), theta (4 Hz to 8 Hz), alpha (8 Hz to 12 Hz), and beta (12 Hz to 30 Hz).

In a recently reported study, 20 young male subjects were exposed twice to the same amplitude-modulated radio-frequency electromagnetic fields (RF-EMF, 2 Hz, 900 MHz, peak-to-average ratio of four and spatial peak, specific absorption rate, SAR, of 2 W/kg averaged over 10 g), two weeks apart for 30 min prior to sleep [2]. Topographical analysis of the EEG power spectrum during all-night, non-rapid-eye-movement (REM) sleep revealed exposure-related increases in the delta-theta frequency band (1.25 Hz to 9 Hz) from electrodes placed in the frontal-central areas of a subject's scalp, but showed no differences in sleep spindles within the 13.75 Hz to 15.25 Hz frequency band. However, the study did not find any reproducible within-subject RF-EMF effects on delta-theta and sleep spindle EEG.

Sleep can be divided into two major phases: REM and non-REM sleep. A typical night's sleep consists of 25% REM sleep and 75% non-REM sleep. EEG patterns are routinely used as indices of the different sleep stages. According to the levels of the EEG, non-REM sleep can be subdivided into three stages. Each successive stage of non-REM sleep is associated with a deeper sleep, with stage

1 as the lightest and stage 3 as the deepest. Dreams occur during the REM and the sleeper's eyes move to follow the dream gaze. A high-level mental activity takes place during dreaming. The brain is creating the scenes; however, under normal circumstances, it does not perform the same perception or reaction function as in waking. Indeed, most muscles in the body do not move, except for those involved in vital functions.

Unlike REM sleep, non-REM sleep is typically accompanied by infrequent, low-level muscular movements involving most of the body, some parts more so than others.

Stage 1 non-REM sleep is a transitional period, from wakefulness to the other two stages of non-REM sleep. It is of short duration, usually lasting only a few minutes. It can be easily interrupted, and is characterized by EEGs of low amplitude and mixed frequencies.

Nearly one-half of a person's sleep each night consists of Stage 2 non-REM sleep. Stage 2 sleep is characterized by the presence of sleep spindles in the EEG waves. A *sleep spindle* **is** recognizable as a brief (one-to-two second) packet of higher-frequency signals in the EEG wave pattern.

Stage 3 is also referred to as *slow wave* **or** *delta wave* **sleep**. This is qualified by the population of high-amplitude, low-frequency (< 4 Hz) waves in the EEG. It should be noted that REM and non-REM sleep patterns alternate throughout the night. In normal human sleep, a healthy individual will move between the different sleep stages during the night.

Many studies have been conducted to investigate RF-EMF, or whether RF from mobile-phone use may affect neurological response as measured by brain electrical activity in sleep EEG. Some of the most-consistent effects reported in these studies are increases of spectral power in the sleep spindle and in the delta-theta frequency ranges during sleep from low-level RF exposure (< 2 W/kg).

In particular, while many studies showed an increase of spectral power in the sleep-spindle frequency (10 Hz to 15 Hz) band, the specific frequency ranges within the band and the observed times of occurrence of the effect tend to be variable [3-6]. Some studies also found increased spectral power in the delta (1 Hz to 4 Hz) and theta (5 Hz to 8 Hz) frequency ranges during sleep [7, 8].

The most recent study mentioned above [2] aimed at investigating whether individual subjects reacted in a similar way when repeatedly exposed to RF-EMF. An explicit motivation for conducting the research was that previous reports [3, 4] had indicated that RF exposure-related effects on sleep EEG were reproducible in a defined group of participants.

The more specific questions were as follows:

- Are there reproducible within-subject RF field effects in the sleep EEG?

- What may be the inter-individual variation and intra-individual stability of RF field effects?

- If so, what are the biological attributes that would indicate how a subject's brain may respond to RF-EMF?

The study was thus designed to address whether individual subjects, in addition to a group of subjects, responded in a like manner by performing correlational analysis.

A total of 20 healthy male subjects (normal sleepers at a mean age of 23 years) participated in the experiment, and completed the four-week study. Only male subjects were included, because female spindle activity is known to vary by menstrual cycle, complicating detection of any RF-exposure-related effect. Participants underwent a telephone and questionnaire screening to exclude personal or family history of psychopathology, chronic diseases, sleep disorders, and current use of psychoactive agents or other drugs or medications.

All were right-handed, non-smokers, and were moderate mobile-phone users (< 2 h per week). Subjects had to abstain from caffeine, naps, and alcohol use three days before study nights. Physical exercises and use of mobile phones were not allowed on the day of the study night. Compliance with instructions was controlled by breath alcohol test, wrist-worn activity meters, and sleep logs.

A 900 MHz patch antenna in a plastic-box casing, positioned laterally at a distance of 1.1 cm from the left side of the head, was used to provide a 2 W/kg peak spatial SAR averaged over 10 g in the whole head. An identical box casing was used on the right side to help blind the subject from knowing the source of RF exposure. The RF exposure system was fully computer controlled under a double-blind protocol. Computer simulation using anatomical human models gave SAR values of 2.12 W/kg and 0.62 W/kg in the left cortex and thalamus, respectively.

In contrast to other studies, EEG electrodes were mounted after each RF exposure to avoid electrode coupling with incident fields. A high-density, 128-electrode-cap EEG net was used for long-term monitoring during the 8 h nighttime sleep period, and to provide EEG recordings of superior temporal resolution with high spatial resolution. The cap EEG net also allowed topographical analysis of sleep EEG and assessment of regional differences.

Mean spectral power densities were computed for all-night non-REM sleep, and averaged for both RF and sham exposure nights, respectively.

The authors [2] reported that "there was no overall *RF* field effect in our study in the spindle frequency range."

Furthermore, "subjects did not react in a similar way in the first and second exposure condition since no correlation between the effects in the spindle frequency range of these two exposures."

This conclusion was in sharp contrast to one of the most-consistent effects reported in RF sleep EEG studies: an increase of spectral power in the sleep spindle-frequency (10 Hz to 15 Hz) band, although the specific frequencies affected and the observed time course of the effects were variable. In addition to some of the papers already mentioned, other relevant published scientific papers giving evidence of a sleep spindle effect included [9-11].

In addition, the report [2] also did not found any correlation or group difference between the two exposure conditions in the delta-theta frequency range sleep. Again, this was in contrast to previous reports of increased EEG spectral power in the delta (1 Hz to 4.5 Hz) and theta (5 Hz to 8 Hz) frequency bands during sleep [7, 8]. However, the study revealed some exposure-related increases in the delta-theta frequency band (1.25 Hz to 9 Hz) from electrodes placed in the frontal-central areas of a subject's scalp

Obviously, speculations and questions arise regarding why the most recent paper on this topic differs from so many other previously reported studies.

Some educated guesses could involve a protocol where EEG electrodes were mounted after instead of during RF exposure; influences of the time window between the end of exposure and EEG recording; the exclusion of female subjects in the study, compounding any potential gender-specific response; and the effects of differences in amplitude-modulation and frequency-filtration schemes. Other explanations perhaps could be the biases of learning tasks performed by subjects as a part of the experiment and, in this case, participants had no adaptation night prior to experimental nights.

In summary, there have now been a fairly large number of sleep EEG studies performed to investigate whether RF – or, more specifically, the RF fields from mobile phones – affect brain electrical activity. There is significant consistency in results, with one recent exception: most studies reported increases of spectral power in the sleep spindle and delta-theta frequency ranges recorded during sleep from low-level RF exposure at or below current exposure guidelines (< 2 W/kg).

It should be noted that these effects seen in healthy adults are small changes.

Observed changes in sleep-spindle and delta-theta EEG should be investigated in future studies to help resolve the issue of whether such small changes in cerebral neural responses are biologically relevant or consequential. It is currently unclear whether these effects represent anything harmful or not to people, or whether it is premature to suggest that these RF exposure-related effects are in some way related to human health or wellbeing.

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2^{nd} URSI- Regional Conference on Radio Science

(URSI-RCRS-2015)

16-19 November, 2015

The Indian Committee for International Radio Science Union (INC-URSI), under the auspices of the Indian National Science Academy (INSA) and Jawaharlal Nehru University, New Delhi, jointly propose to hold a Regional Conference on Radio Science (URSI-RCRS2015) during November 16-19, 2015 at Jawaharlal Nehru University, New Delhi, in which we welcome participation from both Indian and foreign participants, in particular, all those interested from neighbouring countries in the Asian and African region with whom INSA has already signed MOUs with the respective academies on scientific cooperation and exchange. It is noteworthy that the previous RCRS2014, held in Symbiosis Inst. of Technology, Pune in January 2014 was very successful. International Radio Science Union (URSI) is a global entity whose mission is to disseminate knowledge of radio science in all its facets.

Jawaharlal Nehru University, New Delhi (JNU) is set up in the terrain of the Aravali hill range and spread over an area of about 1000 acres. The campus maintains large patches of scrub and forestland. JNU ridge is home to over 100 species of birds and other wildlife.

Delhi is easily reached via air and land. The weather in mid November will be very pleasant with bright sunny days and cool nights. There are plenty of accommodations of different kinds available near the campus. Details will be updated shortly on the website www. JNU.ac.in\conference\ursi-rcrs2015

Abstract submission:

Submit an electronic copy of MS WORD in single space with 25 mm margins on all sides. The title (14 points/Times New Roman) should be followed by the name (s) of authors(s) with the name of the person presenting underlined and their affiliation (12 points/ Times New Roman). Full text (12 points/ Times New Roman) of the abstract should follow the affiliation. Abstract length is limited to a minimum of one page or maximum of 6 pages, following URSI guidelines. All abstract must be written in English and submitted through email (rcrsdelhi@gmail.com). All the abstracts would be reviewed by experts.

We are happy to state that MAPAN-The Journal of Metrology Society of India (IF 0.5) would be willing to publish papers which deal with radio measurements under any of the Commissions, after suitable refereeing. Other relevant papers may be sent to Radio Science and Radio Science Bulletin (RSB) which will be published as per their editorial practice. While submitting the abstract, authors may indicate whether they wish to be considered for the MAPAN submission.

Registration Fee

Indian Participants
- General : Rs. 5000/-
- Accompanying Person : Rs. 2000/-
- Students : Rs. 3000/-
- Participants from Industry/Research Lab : Rs. 6000/-

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- General : 150 USD
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- Student : 100 USD

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Registration includes Registration Kit, lunches, Teas and banquet dinner.

Important Dates

Submission of extended abstracts (limited to 2 pages): Deadline July31, 2015

Acceptance of abstracts-information to participants from LOC: September 7, 2015

*All Visa related matters: any help required by participants from abroad – September 15, 2015.***

Deadline for Payment of registration fees online for all participants (incl. speakers, guests): October 15, 2015

*(** participants from outside India are requested to contact the LOC secretariat at (email: <rcrsdelhi@gmail.com>) for any clarifications, help with Visa matters, etc.*

Student Paper Competition & Young Scientist Awards: (Details to be put on the website shortly)

Venue:

Convention centre
Jawaharlal Nehru University, New Delhi

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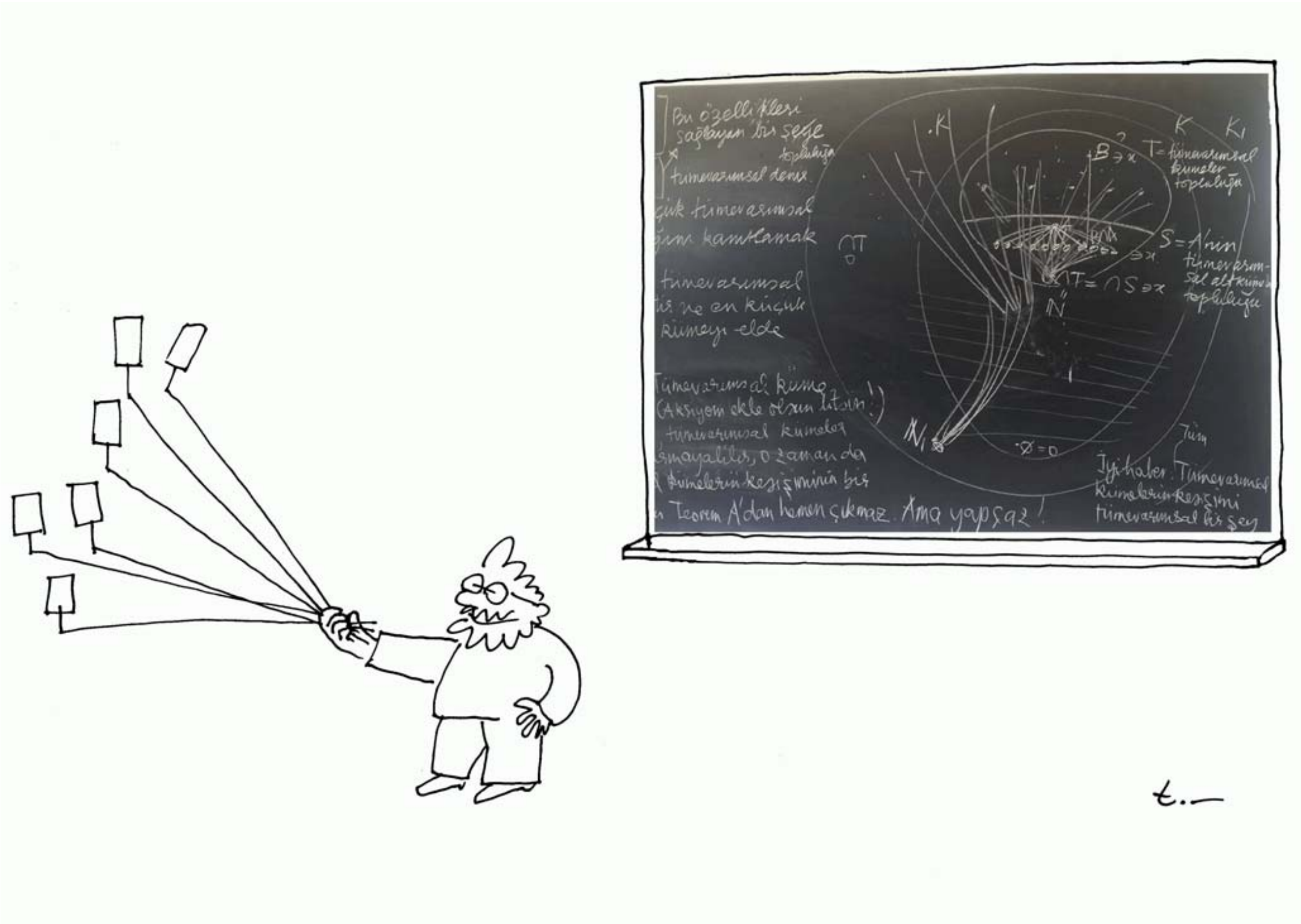
[Editor's note: This starts a new column for the *Radio Science Bulletin*, called Et Cetera. It features a humorous look at radio science through the eyes of an engineer and radio scientist who is also a professional cartoonist. WRS]

Introducing Tayfun Akgül, Associate Editor for Et Cetera

Tayfun Akgül has been a Professor in the Faculty of Electrical-Electronics Engineering, Department of Electronics and Telecommunications, at Istanbul Technical University (ITU) since 2002, where he teaches graduate- and undergraduate-level signal-processing courses. His ongoing research is in the area of signal/image processing, array processing, acoustics, speech and geophysical signal processing. Between 1999 and 2002, he was Chief Senior Researcher in the Information Technologies Research Institute at TUBITAK, Turkey. He was an Assistant and later Associate Professor in the Department of Electrical Engineering at Cukurova University in Turkey. Between April 1997 and November 1998, he was also a Visiting Scholar in the Electrical and Computer Engineering Department at Drexel University, USA. Between 1996 and 1997, he was a NATO postdoctoral fellow at the University of Pittsburgh. He received his PhD in Electrical Engineering from the University of Pittsburgh in April 1994.

Tayfun Akgül is also a professional cartoonist. He has been regularly published in the "Science and Technology" section of the prestigious daily newspaper *Cumhuriyet*, in Turkey. He has been an active member of the Cartoonists' Association of Turkey since 1986, and he was a member of its Administrative Board in 2005. His drawings have appeared in various Turkish and international math and science books and magazines. He has published a dedicated book of science- and engineering-related cartoons, and has had several public showings of his cartoon and facial montage art. His cartoon corner, "Et Cetera," has appeared in the *IEEE Engineering in Medicine and Biology Magazine* and in the *IEEE Antennas and Propagation Magazine*. He is a Senior Member of the IEEE, and has served or is serving on various IEEE boards.



"data MINING"

June 19, 2015 IEEE meeting New Brunswick

URSI-JRSM 2015

Announcement and Call for Papers

2015 URSI-Japan Radio Science Meeting

Tokyo Institute of Technology, Tokyo, Japan
September 3-4, 2015
http://ursi.jp/jrsm2015/

The "URSI-Japan Radio Science Meeting" (URSI-JRSM) is the URSI conference organized by the Japan National Committee of URSI (JNC-URSI). The URSI-JRSM provides a regional scientific forum for radio scientists and engineers in Japan and the Asian region. The objective of the Meeting is to review current research trends, present new discoveries, and make plans for future research and special projects in all areas of radio science, and a particular emphasis is placed on enhancing the visibility of URSI in the Asian countries and encouraging young scientists to contribute to various URSI activities.

The URSI-JRSM 2015 will have a scientific program including a poster session, keynote and special lectures, and invited talks from all the 10 URSI Commissions.

Call for Papers:

The poster session covers scientific activities by the URSI Commissions A-K:

- Commission A: Electromagnetic metrology
- Commission B: Fields and waves
- Commission C: Radiocommunication systems and signal processing
- Commission D: Electronics and photonics
- Commission E: Electromagnetic environment and interference
- Commission F: Wave propagation and remote sensing
- Commission G: Ionospheric radio and propagation
- Commission H: Waves in plasmas
- Commission J: Radio astronomy
- Commission K: Electromagnetics in biology and medicine

Prospective authors are invited to submit a one-page abstract via the URSI-JRSM 2015 website by **July 29, 2015**. Please visit the Conference website for instructions of paper submissions.

Student Paper Competition:

Any full-time university student who is the principal (first-named) author and the presenter of a paper at the URSI-JRSM 2015 can apply for the Student Paper Competition (SPC). Applications should be completed by **July 29, 2015**. Every SPC applicant must submit a one-page abstract, a full-length paper (4 pages), and a certification letter by his/her advisor. Please visit the URSI-JRSM 2015 website for details of the SPC applications.

The SPC Special Issue is planned to be published in the March 2016 issue of the URSI *Radio Science Bulletin*. The winners of the SPC program will be invited to submit their papers for publication in this Special Issue.

Sponsorships:

The URSI-JRSM 2015 is sponsored by:

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Technically supported by:

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Contact:

For any inquiries, please contact the Conference Secretariat at:

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Ionospheric Prediction and Forecasting

by Bruno Zolesi and Ljiljiana Cander, Springer Geophysics, 240 pp., DOI:10.1007/978-3-642-38430-1_1, 2014

Since its "discovery" in the early 19th century (not the 18th century, as the authors inadvertently state on page 2), the Earth's ionosphere has fascinated scientists and engineers. The book by Zolesi and Cander, *Ionospheric Prediction and Forecasting*, offers an excellent introduction for the understanding of the ionosphere and its interaction with radio waves, with the objective of providing a "coherent presentation...of contemporary research directly related to ionospheric prediction and forecasting." The prediction of the status of the ionosphere as a function of time, location, and solar and magnetic activity has become of paramount importance nowadays for a multitude of human activities, ranging from long-term HF radio planning to "nowcasting" and space-weather applications. While extensive literature exists on the physics of the ionosphere and on physics-based and empirical ionospheric models, there was no comprehensive, critical review of the different ionospheric measuring techniques that form the basis for the development of ionospheric models. I am happy to confirm that the authors – Dr. Bruno Zolesi of the Istituto Nazionale di Geofisica e Vulcanologia, Italy, and Dr. Ljiljiana Cander of the Rutherford Appleton Laboratory, United Kingdom – have done a marvelous job in collecting the relevant material, and presenting it in a coherent and easily readable form.

The text is clearly structured, in ten chapters. After the introduction in Chapter 1 (where the authors inadvertently placed the discovery of the ionosphere in the 18th century, when they meant the 19th), a preliminary description of the basic physics for the formation and structure of the ionosphere and the coupled ionosphere-plasmasphere system is given in Chapter 2. Chapter 3 reviews the existing ionospheric measurement techniques that are most relevant for prediction and forecasting. These include ground-based, in situ, and transionospheric measurements, with special emphasis on HF sounding by contemporary regional and global ionosonde networks. The physical principles of the magnetoionic theory are developed, introducing the concepts of *plasma frequency*, *gyrofrequency*, *collision frequency*, and *index of refraction* that are relevant to the propagation of electromagnetic waves in a magnetoplasma. In Section 3.2.2, the microphysics approach is used to derive the dispersion relation, which is generally cited in the literature and also in this book as the *Appleton-Hartree formula*. To my knowledge, Appleton and Hartree had independently developed dispersion relations for the ionosphere. However, Hartree's formula was incorrect, since it included a "Lorentz correction term" for the interactive forces between the charged particles. The dispersion relation we use today and that is derived in the book should instead be called the "Appleton-Lassen" formula, since Hans Lassen had published (in German) the correct formula in the same year Edward Appleton published his in 1927. In Section 3.3.1, on vertical-incidence sounding, the authors state – without qualification – that "according to the magneto-ionic theory," the index of refraction is given by $n^2 = 1 - \left(f_N / f \right)^2$. This phrasing may confuse a student reader, and should be clarified in a second edition.

The effects of variations in the solar and magnetic activity on the characteristics of the ionosphere are described in Chapter 4 for high, mid, and low latitudes, and for the D, E, F1, and F2 layer characteristics. A very illuminating discussion on the close relationship between the peak density in the F2 layer, NmF2, and the solar proxy index, F10.7p, is given at the end of the chapter.

Chapter 5 reviews the existing electron-density models for the ionosphere that are widely used for ionospheric prediction and forecasting purposes. The authors correctly distinguish between global or regional three-dimensional electron-density distributions (Chapter 5), and global or regional two-dimensional models/maps of ionospheric characteristics (Chapter 6). To classify the assimilative models for the three-dimensional electron-density distribution as a third type of model (as the authors do as #2 on page 101) seems counterintuitive, since assimilation techniques are applied to both three-dimensional and two-dimensional models. The inversion of ionogram traces $h'(f)$ to real height profiles of the electron density, which is discussed in Section 5.2, would have better fit into Chapter 3. Alternatively, the inversion could have been included in Section 5.4.1, which discusses the calculation of the real height, hmF2, of the F2 layer peak from the ionogram traces. Currently, Section 5.4.1 only describes the historical technique that uses the relationship between the propagation factor M(3000)F2 and hmF2 to derive the latter. The section does not mention that modern digital ionosondes perform the profile inversion in real time, directly giving the hmF2 values using, in most cases, the *ARTIST* auto-scaling and the *NHPC* profile-inversion algorithms. Another widely used inversion algorithm is Titheridge's *POLAN* program, which is cited in Section 5.2. In this context, I am reminded of a request that my former professor, Karl Rawer, made at the final discussion sessions of virtually every IRI workshop, looking at me: "...and you will provide the measured hmF2 values for the calculation of the hmF2 maps in IRI." The most widely used three-dimensional electron-density models – at least for radio communication and navigation applications – are discussed, specifically the *IRI model* (International Reference Ionosphere) and the *NeQuick model*. An instructive description of these empirical models is given in Sections 5.4.3 and 5.4.4, respectively. Section 5.5 briefly reviews several of the assimilative global three-dimensional models that are currently being developed. The discussion focuses on the *GAIM* model (Global Assimilation of Ionospheric Measurements) in the USA, and the *EDAM* model (Electron Density Assimilative Model) in the UK. I admit that I was pleased, noticing that a passing mention is also made of the IRI-based Real Time Assimilative Model, *IRTAM*, currently under development in the USA.

Having provided the underlying physics and the measuring techniques in the preceding chapters, Chapter 6 focuses on the diverse techniques of generating maps of ionospheric characteristics and parameters useful for radio-propagation purposes, especially the foF2 and MUF(3000) F2 maps. The global CCCIR (now ITU-R) maps, which are widely used today, are based on the pioneering work at the Institute of Telecommunication in Boulder, Colorado, in the 1960s and 1970s. Modified foF2 maps were developed in the 1980s as part of an URSI initiative. The Australian mapping technique uses the so-called T index, which is derived from measured foF2 values, to assess the solar activity, rather than directly using the smoothed sunspot numbers. A brief review is given of a number of the existing *regional* mapping techniques, such as SIRM developed in Italy, and MQMF2R, in Russia. In this chapter and the next two, the authors attempt to clarify the distinctions among *prediction*, *nowcasting*, and *forecasting*. They assign – I believe correctly – the term *prediction* to long-term climatological prediction; *nowcasting* to the adjustment of the model prediction using space-weather indicators and/or measured ionospheric characteristics that are available in real time; and *forecasting* to the prediction of the ionospheric conditions for the next 24+ hours, based on the best available now conditions. Later, in Section 8.3, the authors remind the reader that for foF2 forecasting, the label "*short-term ionospheric modeling*" is also used in the literature.

Chapter 7 surveys the currently existing modeling and mapping techniques for the total electron content, TEC. This is derived from ground-based measurements of GNSS signals using the dual-frequency code pseudo-range and carrier phase, or the single-frequency ionospheric-correction algorithm developed at the ICTP in Trieste, Italy, and at the University of Graz, Austria.

Chapter 8 is dedicated to *ionospheric forecasting*, discussing the day-to-day variations in the ionospheric conditions caused by solar and magnetic disturbances that affect the climatological diurnal, seasonal, and solar-cycle variations. The basic principles of point-to-point ionospheric HF communication links are given in Chapter 9, which also summarizes the HF prediction and nowcasting techniques. Chapter 10 emphasizes the role that ionospheric prediction and forecasting plays in space weather diagnostics, and the current importance of real-time data streams coming from global and/or regional networks such as DIAS (European Digital Upper Atmosphere Server) and GIRO (Global Ionosphere Radio Observatory).

There is no doubt that this new book fills a real need, and will be of great benefit to students, researchers, and engineers who enter the fields of radio exploration of the ionosphere, space weather, radio-frequency planning, spectrum management, and radio-system design. For those already working in these areas, it will provide valuable context. The material in this book has been judiciously selected, and together with the extensive list of relevant references, it provides a comprehensive picture of the demands and challenges of ionospheric prediction and forecasting. This is not by accident, of course, since both authors have for many decades been leaders in this field, within the European ionospheric and space-weather research community.

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Introduction to a New Column on Computational Electromagnetics

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[Editor's note: This contribution introduces a new column, Solution Box, dedicated to computational electromagnetics across all areas of radio science represented in URSI. The intent is to provide a forum for those seeking solutions to computational problems to find help and to share interesting results with the radio science community. Submissions can deal with specific problems or applications and/or their solutions, or with issues related to algorithms. Readers are encouraged to submit their material directly to the Associate Editor in charge of the column, Özgür Ergül. WRS]

1. Introduction

Can we solve a challenging problem with unprecedented levels of accuracy and/or efficiency? Are we confident that our solver is most suitable for that special problem we have investigated for many years. Alternatively, are we looking for other algorithms and techniques, but hesitate to spend time developing new codes?

As researchers in computational electromagnetics (CEM), we often find ourselves forcing our algorithms and in-house codes to solve a given problem, while wondering if there is a better way to do. Indeed, most of the time, there is. However, we are continuously spending our precious time twisting and reshaping our codes, knowing that they may never be the optimal tools, rather than efficiently using them where they are really good. On the other hand, our codes could provide urgently needed solutions to some complex problems on the desks of other researchers, while we are unaware of such potential applications waiting for us.

The purpose of this column, Solution Box, will be to provide a direct platform for matching CEM problems with optimal solution techniques. In each issue, we will present both new problems and possible solutions to earlier problems. Each issue will hence be a collaborative work of researchers who submit their problems and/or solutions to problems submitted by other researchers. As a starter, this first issue contains a problem and its (most probably not optimal) solution, as well as some descriptions of how submissions should be made. We are looking forward to receiving submissions of alternative solutions, and new problems to be solved.

Solution Box will not be a competition among researchers. Rather, it will be a friendly environment to allow us share our knowledge and know-how. Our aim is to find and acknowledge the most optimal (e.g., accurate, efficient, stable, easy-to-obtain) solutions to scientific problems, to the extent possible, and to focus our abilities and capabilities in the most efficient way, in a collective manner.

2. Problems

This section will present the electromagnetic problems the optimal solutions for which are sought. Each problem (which will be tagged as SOLBOX-xx, for reference) should be described very clearly. This should include the geometry of the structure, material properties, excitations, and frequencies, as well as the required results, e.g., scattered fields, far-field radiation patterns, transmission characteristics, etc. Discretizations and formulations are not included in problem definitions; however, for some problems, discretized models can be described and even provided (e.g., to be downloaded from a Web site), if the discretization is a part of the "scientific problem." While it is not mandatory, a reference solution (perhaps not optimal) can be simultaneously submitted with the problem, to provide a guide for volunteers who will attempt alternative solutions.

2.1 Problem SOLBOX-01 (by B. Karaosmanoğlu, A. Yılmaz, and Ö. Ergül)

As depicted in Figure 1, problem SOLBOX-01 involves a 5 × 5 array of identical wires, with dimensions of 0.1 μm × 0.1 μm × 5 μm. The structure is excited with a pair of Hertzian dipoles, which are located symmetrically, 0.2 μm above the array. The frequency is fixed at 250 THz. The dipoles have opposite directions, and are separated by a distance of 0.2 μm. The wires are made of Ag. It is required to obtain the electric-field intensity, magnetic-field intensity, and power-density distributions in the vicinity of the structure. The relative values are important, rather than the absolute values; the dipole moments are thus irrelevant.

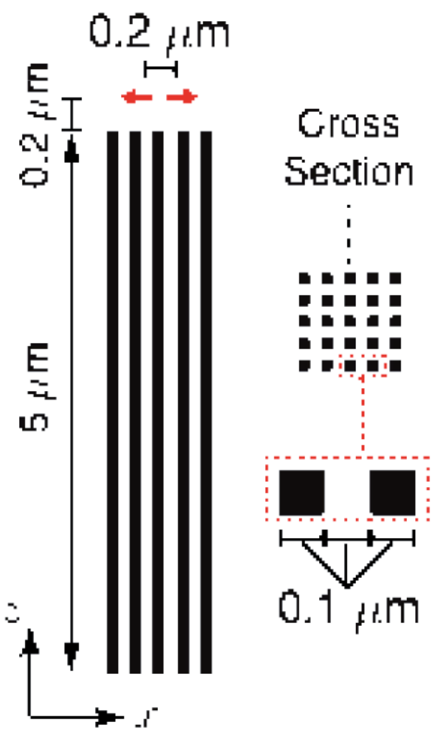

Figure 1. The description of the structure and excitation for problem SOLBOX-01.

3. Solution to Problem SOLBOX-01

Each solution of a given problem will be presented as a section of the column. In addition to a solution summary with short answers to predefined questions (see below), we expect a short paragraph to describe the numerical solution performed. The summary should include the solver type (e.g., commercial, noncommercial, hybrid, research-based); the core algorithm (including a reference, if possible); the programming language or environment (including compilers, special routines, and libraries used); the properties of the computer used (especially, the most critical properties, e.g., the number of cores used and the models of processors); and the total time required to produce results shown. The total time should include preprocessing and post-processing, if available. Only the category for the total time (see below) should be indicated. More-precise time measurements, as well as other critical resources (e.g., memory), may be provided in the short description.

The short description should be concise and easy to follow, such that the proposed solutions could be reproduced by other researchers, while the purpose of this column is minimizing duplicate efforts. The text should be direct and objective, rather than the advertisement of a solver. While the purpose is to reach optimal solutions, all readers will appreciate many alternative solutions. We hence encourage the submission of any solution, provided that it addresses the required results given under the problem definition.

In the final subsection, the numerical results will be shown. If a reference solution was submitted with the problem, the result is preferred to be in the same format, for fair comparisons. The solution submitter may prefer sending the data to be plotted (by us), and to even be directly compared with previous solutions.

3.1 Solution Summary

Solver Type (e.g., noncommercial, commercial):
Noncommercial research-based code developed at CEMMETU, Ankara, Turkey

Core solution algorithm or method:
Frequency-domain multilevel fast multipole algorithm (MLFMA) [1]

Programming language or environment (if applicable):
MATLAB + MEX

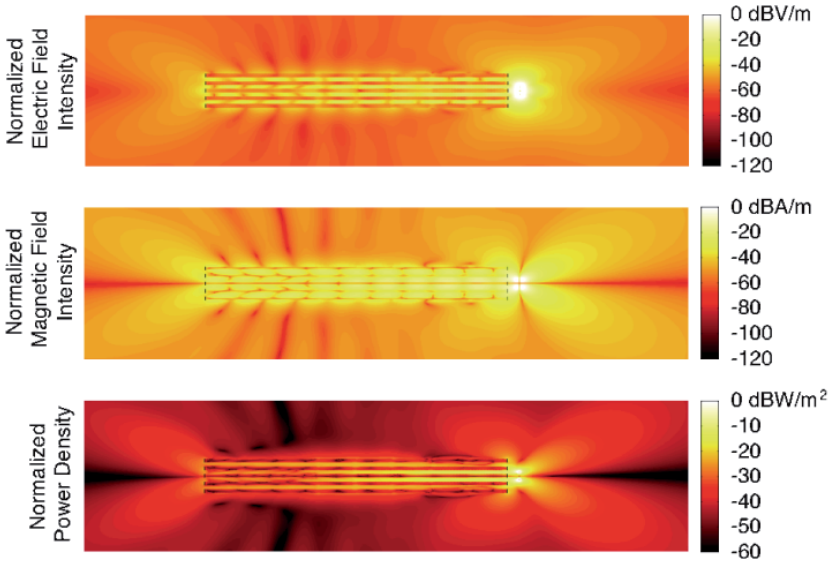

Figure 2. A solution to problem SOLBOX-01.

Computer properties and used resources:
Single core of 3 GHz Intel Xeon E5-2690v2

Total time required to produce the results shown (categories: <1 sec, <10 sec, <1 min, <10 min, <1 hour, <10 hours, <1 day, <10 days, >10 days): <10 days

3.2 Short Description of Numerical Solution

Problem SOLBOX-01 was solved using the *MLFMA* in the frequency domain [1, 2]. The problem was formulated with the combined-field integral equation (CTF) [3, 4], which is suitable for penetrable objects. The combined-field integral equation was discretized with the Rao-Wilton-Glisson (RWG) functions [5] on $\lambda/24$ triangles. The Siemens *NX* program was used to generate a mesh, with special care taken on the symmetry. The total number of unknowns was 122,400. The permittivity of Ag was found by using the Lorenz-Drude model, leading to $-60.6699 + i4.3028$ at 250 THz. The number of iterations to reach a residual error of 0.001 was 1418, using *GMRES* without preconditioning and restart. Both near-field and far-field interactions were computed with maximum 1% error. The field intensities and the power density were calculated in the vicinity of the structure at 801 × 201 points with 20 nm and 12.5 nm intervals.

3.3 Results

Figure 2 depicts the electric-field intensity (dBV/m), magnetic-field intensity (dBA/m), and power density ($\mathrm{dBW/m^2}$) distributions in the vicinity of the structure for SOLBOX-01. The color maps were adjusted with 120 dB ranges in the field plots, and with a 60 dB range in the density plot. In each figure, 801 × 201 data samples were plotted using the `imagesc` command of *MATLAB*. The good transmission property of the structure was clearly visible, i.e., electromagnetic power was transmitted along the wire system.

4. Concluding Remarks

We have presented a new column, Solution Box, which will serve as a platform to present electromagnetic problems and their solutions in a collaborative way. The purpose is to match interesting problems with correct methods and techniques. We have also presented a kickoff problem and its solution. As a conclusion, let us answer some possible questions regarding this nontraditional column.

Can a problem be submitted that has been presented in an earlier publication?

Yes. By adequately referencing the related publications, problems can be submitted to seek more-optimal solutions.

Can a problem be submitted that does not have a solution?

Yes. One purpose of this column is to find optimal solutions to problems, even when they have not been properly solved before. In this case, we will particularly welcome alternative solutions from multiple readers. It would not be helpful if a solution was available but knowingly not submitted.

What if a solution is not optimal?

We welcome all solutions, provided that they are motivated for solving a given problem. It does not matter if another faster, more efficient, or more accurate solution is submitted later.

How will the submitters be acknowledged?

In each issue, problem and solution submitters will be directly acknowledged as contributing authors. In addition, with the permission of submitters, we are planning to make collections of problems and all their solutions appear as standalone papers in the URSI *Radio Science Bulletin*. These papers will be interesting contributions of multiple authors who may never have worked together.

Can a response to a solution be submitted?

Only problem submitters will be able to provide comments on solutions to their problems, for the purpose of better describing the associated problems, or to add more parameters that are perhaps missing in the original definitions. Solution Box is not a column for unfruitful discussions.

Can a solution that is obtained fully by a commercial solver be submitted?

Yes, if the submitters believe it is an optimal solution. In this case, we will require the core algorithm and all parameters related to the solution, e.g., accuracy thresholds.

We look forward to receiving your contributions!

5. References

1. Ö. Ergül and L. Gürel, *The Multilevel Fast Multipole Algorithm (MLFMA) for Solving Large-Scale Computational Electromagnetics Problems*, New York, Wiley-IEEE, 2014.

2. W. C. Chew, J.-M. Jin, E. Michielssen, and J. Song, *Fast and Efficient Algorithms in Computational Electromagnetics*, Norwood, Artech House, 2001.

3. P. Ylä-Oijala, M. Taskinen, and S. Järvenpää, "Surface Integral Equation Formulations for Solving Electromagnetic Scattering Problems with Iterative Methods," *Radio Science*, **40**, RS6002, November 2005.

4. Ö. Ergül and L. Gürel, "Comparison of Integral-Equation Formulations for the Fast and Accurate Solution of Scattering Problems Involving Dielectric Objects with the Multilevel Fast Multipole Algorithm," *IEEE Transactions on Antennas and Propagation*, **AP-57**, 1, January 2009, pp. 176-187.

5. S. M. Rao, D. R. Wilton, and A. W. Glisson, "Electromagnetic Scattering by Surfaces of Arbitrary Shape," *IEEE Transactions on Antennas and Propagation*, **AP-30**, 3, May 1982, pp. 409-418.

Introducing Özgür Ergül, Associate Editor for Solution Box

Özgür Ergül received the BSc, MS, and PhD from Bilkent University, Ankara, Turkey, in 2001, 2003, and 2009, respectively, all in Electrical and Electronics Engineering. He is currently an Assistant Professor in the Department of Electrical and Electronics Engineering at Middle East Technical University (METU), Ankara, Turkey, and the Principal Investigator of the CEMMETU research group. Dr. Ergül's research interests include fast and accurate algorithms for the solution of electromagnetics problems involving large and complicated structures, integral equations, iterative methods, parallel programming, and high-performance computing.

He was a recipient of the 2007 IEEE Antennas and Propagation Society Graduate Fellowship, a 2011 URSI Young Scientist Award, a 2013 ACES Early Career Award, and the 2014 TUBITAK Incentive Award. He is the author of the undergraduate textbook, *Guide to Programming and Algorithms Using R* (Springer), coauthor of the graduate textbook, *The Multilevel Fast Multipole Algorithm (MLFMA) for Solving Large-Scale Computational Electromagnetics Problems* (Wiley-IEEE), and coauthor of more than 170 journal and conference papers. He also serves as an Associate Editor of the *IEEE Antennas and Propagation Magazine* (the Open Problems in CEM column) and an Editorial Board Member of *Scientific Reports* (Nature Publishing Group).

The Asia-Pacific Radio Science Conference (AP-RASC) is a triennial conference for the exchange of information on the research and development in the field of radio science. It is one of URSI flagship conferences with URSI GASS and URSI AT-RASC. The objective of the AP-RASC is to review current research trends, present new discoveries, and make plans for future research and special projects in all areas of radio science, especially where international cooperation is desirable.

This AP-RASC, 2016 URSI Asia-Pacific Radio Science Conference (URSI AP-RASC 2016) will be held at 63 Convention Center, Seoul, Korea on August 21-25, 2016. We will have an open scientific program composed of submitted papers within the domains covered by all 10 commissions of URSI.

Topical Areas

- Commission A: Electromagnetic Metrology, Electromagnetic Measurements and Standard
- Commission B: Fields and Waves
- Commission C: Radio-communication Systems and Signal Processing
- Commission D: Electronics and Photonics
- Commission E: Electromagnetic Noise and Interference
- Commission F: Wave Propagation and Remote Sensing
- Commission G: Ionospheric Radio and Propagation
- Commission H: Waves in Plasmas
- Commission J: Radio Astronomy
- Commission F: Electromagnetics in Biology and Medicine

Young Scientist Programs

The following two programs are planned for young scientists.

- Student Paper Competition (SPC)
- Young Scientist Award (YSA)

Abstract Submission Deadline : *March 15, 2016*

All authors are requested to submit their abstract via on-line. Please prepare the abstract both PDF and MS Word format for the submission. The detailed information on abstract submission will be posted at the URSI AP-RASC 2016 website (www.aprasc2016.org).

Important Dates

- **Abstract Submission**
  March 15, 2016
- **YSA/SPC Paper Submission**
  March 31, 2016
- **Acceptance Notification**
  April 30, 2016
- **Author Registration**
  June 15, 2016
- **Early Registration**
  July 15, 2016

Organized by

KIEES U.R.S.I.

Co-organized by

RRA NATIONAL RADIO RESEARCH AGENCY

ETRI Electronics and Telecommunications Research Institute

KASI Korea Astronomy and Space Science Institute

www.aprasc2016.org

URSI Accounts 2014

AT-RASC 2015, the first edition of this newly established URSI conference was a success, both with regard to the quality of the presented papers as to the number of participants. The event however also marks the start of the new policy of URSI to organise yearly flagship meetings. The URSI Flagship meetings will, as multi-commission meetings, be characterised by their interdisciplinary nature which is a distinguishing feature of URSI conferences.

Besides the initiative of organising AT-RASC, the URSI Board has also decided to redesign the URSI website based on the input from the Early Career Representatives. This website will also give access to the rich URSI archives.

Special attention will be paid to the successful URSI Young Scientist programme, which will be continued and even enlarged in view of the establishment of the URSI Flagship meetings.

All this is possible thanks to the financial management by the URSI Board and continued careful control of the administrative expenses by the secretariat. Prudent and conservative management has resulted in safeguarding of the URSI reserves in the current difficult financial circumstances, so that it is possible to invest in new initiatives that will enhance the visibility and usefulness of URSI for the radio science community

Thanks to the continued effort and commitment of our URSI Member Committees, of the URSI Commissions and of all of you as individual scientists, we are confident that URSI, as it enters its second century of existence, still faces a long and bright future.

Prof. Paul Lagasse
Secretary General of URSI

BALANCE SHEET: 31 DECEMBER 2014

	EURO	EURO
ASSETS		
Dollars		
PNB Paribas Fortis	16,594.80	
Smith Barney Shearson	0.00	
		16,594.80
Euros		
Banque Degroof	0.00	
BNP Paribas Fortis zichtrekening	79,055.01	
BNP Paribas Fortis spaarrekening	156,415.02	
BNP Paribas Fortis portefeuillerekening	196,047.39	
		431,517.42
Investments		
Degroof Bonds EMU (formerly Demeter Sicav Shares)	22,681.79	
Rorento Units	111,614.53	
Degroof Monetary Eur Cap (formerly Aqua Sicav)	63,785.56	
Bonds	279,000.00	
Massachusetts Investor Fund	0.00	
Provision for (not realised) less value	0.00	
Provision for (not realised) currency differences	0.00	
	477,081.88	
673 Rorento units on behalf of van der Pol Fund	12,214.69	
		489,296.57
Petty Cash		317.63

Total Assets		937,726.42
Less Creditors		
IUCAF	24,976.24	
ISES	5,053.53	
		(30,029.77)
Balthasar van der Pol Medal Fund		(12,214.69)
Payed Remuneration		6,018.12
NET TOTAL OF URSI ASSETS		**901,500.08**

The net URSI Assets are represented by:	EURO	EURO
Closure of Secretariat		
Provision for Closure of Secretariat		100,000.00
Scientific Activities Fund		
Scientific Activities in 2015	55,000.00	
Routine Meetings in 2015	15,000.00	
Publications/Website in 2015	15,000.00	
Young Scientists in 2015	0.00	
Administration Fund in 2015	105,000.00	
I.C.S.U. Dues in 2015	10,000.00	
		200,000.00
XXXI GASS 2014 Fund:		
During 2012-2013-2014 (GASS 2014)		70,000.00
RASC Fund		
AT - Gran Canaria		150,000.00
AP - Seoul		50,000.00
Total allocated URSI Assets		570,000.00
Unallocated Reserve Fund		331,500.08
		901,500.08

Statement of Income and expenditure for the year ended 31 December 2014

I. INCOME

Grant from ICSU Fund and US National Academy of Sciences	0.00	
Allocation from UNESCO to ISCU Grants Programme	0.00	
UNESCO Contracts	0.00	
Contributions from National Members (year -1)	37,898.71	
Contributions from National Members (year)	165,004.01	
Contributions from National Members (year +1)	5,125.00	
Special Contributions	0.00	
General Assembly 2014	61,638.40	
Sales of Publications, Royalties	0.00	
Sales of scientfic materials	0.00	
Bank Interest	1,432.68	
Other Income	6,216.16	
Total Income		**277,314.96**

II. EXPENDITURE

A1) Scientific Activities		84,417.17
General Assembly 2008/2011/2014	75,326.21	
Mid Term Meetings 2015	0.00	
Scientific meetings: symposia/colloqiua	9,363.38	
Working groups/Training courses	0.00	
Representation at scientific meetings	(272.42)	
Data Gather/Processing	0.00	
Research Projects	0.00	
Grants to Individuals/Organisations	0.00	
Other	0.00	
Loss covered by UNESCO Contracts	0.00	
A2) Routine Meetings		15,331.11
Bureau/Executive committee	15,331.11	
Other	0.00	
A3) Publications		0.00
B) Other Activities		12,291.00
Contribution to ICSU	10,291.00	
Contribution to other ICSU bodies	2,000.00	
Activities covered by UNESCO Contracts	0.00	
C) Administrative Expenses		115,920.46
Salaries, Related Charges	85,872.79	
General Office Expenses	8,661.33	
Travel and representation	5,887.46	
Insurances/Communications/gifts	2,466.36	
Office Equipment	0.00	
Accountancy/Audit Fees	6,497.70	
Bank Charges/Taxes	6,534.82	
Loss on Investments (realised/unrealised)	0.00	
Total Expenditure:		**227,959.74**

Excess of Expenditure over Income	49,355.22
Currency translation diff. (USD => EURO) - Bank Accounts	1,172.24
Currency translation diff. (USD => EURO) - Investments	0.00
Currency translation diff. (USD => EURO) - Others	0.00
Accumulated Balance at 1 January 2013	850,972.62
	901,500.08

Rates of exchange

January 1, 2014	1 $ = 0.7250 EUR
December 31, 2014	1 $ = 0.8226 EUR

Balthasar van der Pol Fund	
673 Rorento Shares : market value on December 31 (Aquisition Value: USD 12.476,17/EUR 12.214,69)	38,562.90
Book Value on December 31, 2014/2013/2012/2011/2010	12,214.69

Market Value of investments on December 31, 2014-2010		
Degroof Bonds (formerly Demeter Sicav Shares)		90,631.20
Rorento Units (1)		744,900.00
Degroof Monetary Eur Cap (formerly Aqua Sicav)		90,106.27
Massachusetts Investor Fund		0.00
Bonds		279,000.00
		1,204,637.47
Book Value on December 31, 2014/2013/2012/2011/2010		489,296.57

(1) Including the 673 Rorento Shares of v d Pol Fund

APPENDIX : Detail of Income and Expenditure

I. INCOME

Other Income		
Income General Assembly 2011	0.00	
Income General Assembly 2014	0.00	
Young scientist support (Japan)	3,815.00	
Support Koga Medal	0.00	
Closure Radio Science Press	0.00	
Commission B+C	0.00	
Income bonds	2,876.39	
Other	0.00	
		6,691.39

II . EXPENDITURE

General Assembly 2011		
Organisation	0.00	
Vanderpol Medal	0.00	
Young scientists	0.00	
Expenses officials	0.00	
Support Commissions	0.00	
General Assembly 2014		
Organisation	119.40	
		119.40
Symposia/Colloquia/Working Groups		
Commission A	1,000.00	
Commission B	9,000.00	
Commission C	2,000.00	
Commission D	1,000.00	
Commission E	3,250.00	
Commission F	7,400.00	
Commission G	3,100.00	
Commission H	3,581.61	
Commission J	2,600.00	
Commission K	9,000.00	
Central Fund	4,750.00	
Central Fund (Student Award MC)	1,500.00	
		48,181.61
Contribution to other ICSU bodies		
FAGS	0.00	
IUCAF	2,000.00	
		2,000.00
Publications		
Printing 'The Radio Science Bulletin'	0.00	
Mailing 'The Radio Science Bulletin'	0.00	
		0.00

Reports on GASS Commission Business Meetings

Commission H (Waves in Plasmas)

Commission H business meetings were held three times during the 2014 URSI GASS in Beijing. The first business meeting, chaired by Ondřej Santolík, was held on Monday, August 18, 2014. The second business meeting was organized as a joint meeting of Commissions G and H on Wednesday, August 20, 2014. It was jointly chaired by John Mathews and Ondřej Santolík. The last Commission H business meeting was held on Friday, August 22, 2014. It was again chaired by Ondřej Santolík.

1. Results of Election of Vice Chair

János Lichtenberger (Hungary) was appointed as the new Vice Chair of Commission H after voting from the member committees by mail-in ballots and during the first Commission H business meeting on August 18, 2014. The results were approved by the URSI Council on August 19.

The former Vice Chair, Meers Oppenheim (USA), who was elected in 2011, was unfortunately unable to serve as Chair in 2014-2017 for serious personal reasons. In this exceptional situation, the URSI Board and the Commission H business meeting held on August 18, 2014, approved the continuation of the term of Ondřej Santolík (Czech Republic) as Chair of Commission H until the end of the next General Assembly. He will share these responsibilities with the newly elected Vice Chair and Early Career Representative. He will also seek advice from the Commission H past Chair, Yoshi Omura (Japan), whose continuing help is gratefully acknowledged.

2. Results of Election of Early Career Representative

Wen Li (USA) was appointed as the new Early Career Representative (ECR) of Commission H, after voting from the member committees by mail-in ballots and during the first Commission H business meeting held on August 18, 2014. The results were approved by the URSI Council on August 19.

3. Appointment of Associate Editors for *Radio Science Bulletin*

The Commission H Vice Chair, János Lichtenberger, and the Commission H ECR, Wen Li, agreed to become Associate Editors of the *Radio Science Bulletin*.

4. Updates/Status of Working Groups

Activities of the working groups related to Commission H were reviewed, and their organization was renewed.

Inter-Commission Working Group EGH on Seismo-Electromagnetics was renewed, with Y. Hobara serving as co-Chair for Commission E, S. Pulinets serving as co-Chair for Commission G, and H. Rothkaehl serving as co-Chair for Commission H.

Inter-Commission Working Group GH on Active Experiments in Space Plasmas was renewed, with T. R. Pedersen serving as co-Chair for Commission G, and M. Kosch serving as co-Chair for Commission H.

The Inter-Union Working Group VERSIM (VLF/ELF Remote Sensing of Ionosphere and Magnetosphere) was renewed as an URSI/IAGA Joint Working Group, with the involvement of URSI Commissions E, G, and H, and with URSI co-Chair M. Clilverd and IAGA co-Chair J. Bortnik

The Inter-Commission Working Group on Solar Power Satellites was renewed, with K. Hashimoto serving as co-Chair for Commission H.

The Inter-Commission Working Group HJ on Computer Simulations in Space Plasmas was renewed, with Y. Omura and B. Lembege serving as co-Chairs for Commission H, and K. Shibata serving as co-Chair for Commission J.

A new Inter-Commission Working Group EFGHJ on Characterization and Mitigation of Radio Interference was established, with H. Rothkaehl serving as co-Chair for Commission H.

5. Updates to the Terms of Reference of the Commission

The terms of reference of Commission H were reviewed, and no changes were proposed.

6. Meetings Proposed to be Supported in the Coming Triennium

Geospace Revisited, September 15-20, 2014, Rhodes, Greece

7th VERSIM Workshop, Hermanus, South Africa, September 2016.

Further suggestions will be handled by Commission H Chair O. Santolík during the three-year period. However, new URSI rules for the Commission budgets do not leave space for supporting all meetings linked to URSI Commission H activities.

7. Report and Comments on the Scientific Program of the Commission for the Current GASS

Ample discussion on the organization of the current GASS was held during the last Commission H business meeting on Friday, August 22, 2014. The scientific program of the Commission was found to be successfully prepared, with nine sessions led by Commission H (6 × H, HGE, 2 × HG), where 128 papers were presented (91 oral presentations and 37 posters). There were five sessions with Commission H participation (EGH, 3 × GH, GHE), where 34 oral talks were presented. The total number of 162 Commission H related papers was nearly the same as the comparable number of 164 Commission H related papers presented during the last 2011 GASS in Istanbul.

The discussion further showed that the online program that was technically managed by the URSI Secretariat was very useful, and should stay online as a record for future reference. The need for a functional Wi-Fi connection at the meeting place was emphasized in this context. The topology of the posters in a "chevron" geometry (/\/\/\) was found to be an unfortunate solution, to be avoided for future meetings. A shorter delay between the abstract submission and the meeting is required. Preferences for a shorter and more-attractive opening ceremony, as well as for a readable program, and for a reasonable size of the general lecture room, were expressed. However, the GASS was generally considered an overall success.

8. Proposed Sessions for the Next GASS

The following sessions were proposed:

An H session on "Macro/Micro-Scale Kinetic Processes at Natural Boundary Layers in Terrestrial and Planetary Environments," proposed by B. Lembège, I. Shinohara, and G. Lakhina

An H session on "Remote Sensing and Modeling of the Earth's Plasmasphere and Plasmapause," proposed by B. Heilig, A. Jorgensen, and V. Pierrard

An H session on "Wave-Particle Interactions and Their Effects on Planetary Radiation Belts," proposed by R. B. Horne, C. A. Kletzing, and D. Shklyar

An H session on "Drivers, Detection, and Ionospheric Impacts of Precipitation from the Radiation Belts," proposed by C. Rodger and M. Clilverd

An H session on "Laboratory Simulations," proposed by A. Fredriksen

An HG or GH session on "Active Experiments and Radio Sounding," proposed by V. Sonwalkar, R. Moore (H), and N. Jackson-Booth (G)

An HGE session on "Atmospheric, Ionospheric, Magnetospheric and High-Energy Effects of Lightning Discharges," proposed by S. Celestin (H), N. Liu (G), and M. Fullekrug (E)

An EGH session on "Seismo Electromagnetics (Lithosphere-Atmosphere-Ionosphere Coupling)," proposed by Y. Hobara (E), S. Pulinets (G), and H. Rothkaehl (H)

A GH session on "Transient Phenomena," proposed by J. Mathews

GH session on Plasma instabilities and irregularities, proposed by F. Lind, and R. Pfaff (H)

A JFGH session on "Characterization and Mitigation of Radio Interference," proposed by H. Rothkaehl, W. Baan, and J. Matthews.

9. Proposed Sessions for the AT-RASC

General topics:

H.1 "Chaos and Turbulence in Plasma"

H.2 "Plasma Instabilities and Wave Propagation"

H.3 "Spacecraft-Plasma Interactions"

H.4 "Solar/Planetary Plasma Interactions"

H.5 "Wave-Wave and Wave-Particle Interactions"

H.6 "Waves in Laboratory Plasmas"

H.7 "Other"

H "Special Session on Space Radio Weather: The Radio Subdomain of Space Weather," proposed by M. Messerotti and V. Pierrard

HG "Special Session on Highly-Transient Space Plasma Events," proposed by G. Ganguli, C. Hartzell, and J. Mathews

GH "Special Session on Modeling Geospace Boundaries and the need for Radio Science Observations," proposed by T. Fuller-Rowell

10. Other Business

A discussion on the implementation of Commission awards for excellent poster papers at the next GASS was initiated.

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Commission J (Radio Astronomy)

1. Results of Election of Vice Chair

Dr. Richard Bradley (NRAO, USA) was elected as Vice Chair for the coming cycle.

2. Results of Election of Early Career Representative

The votes for the two ERC candidates showed a minimal difference. Considering that in the future there should be two ERC members on a two times three-year rotation, Commission J decided to retain both candidates. Dr. Stefan Wijnholds (ASTRON, NL) was appointed for a six-year term, and Dr. Andrew Siemion (UC Berkeley, USA) was appointed for a three-year term (with travel support as available).

3. Appointment of Associate Editor for *Radio Science Bulletin*

Dr. Jaap Baars (Germany) will remain Associate Editor of the *RSB* for Commission J. He will be supported in this activity by the ECRs.

4. Updates/Status of Working Groups

A proposal was made by Kenneth Kellermann and Richard Schilizzi to establish a Commission J Working Group on the "History of Radio Astronomy." While this is a clear Commission J subject, this working group will be jointly organized with the IAU Working Group on Historical Astronomy. An organizational meeting will be planned during the IAU GA in 2015.

An inter-Commission Working Group with Commissions E, F, G, H, and J on "Characterization and Mitigation of Radio Interference" was proposed by Willem Baan, and this has been agreed upon by the other Commissions. An inter-Commission working group would bundle the individual activities of the various Commissions by means of regular workshops at the URSI meetings. This allows for learning from the experience of others, and for solving interference problems together. Plans are being made to have the first of such workshops during the AT-RASC.

5. Updates to Terms of Reference of Commission

No changes were made in the TOR of Commission J.

6. Meetings Proposed to be Supported in the Coming Triennium

No proposals were discussed for the support of meetings.

7. Report/Comments on the Scientific Program of the Commission for the Current GASS

Part of the attractiveness of URSI lies with the (potential of) cross-fertilization between Commissions. It is therefore regrettable that there were so few inter-Commission sessions at this URSI GASS. Commission J should strive to have more coordination between Commissions (inter-Commission sessions).

There should be more flexibility in assigning timeslots during some sessions, in particular for the Commission J standard sessions on “Observatory Reports” and “Latest Results.”

8. Proposed Sessions for the Next GASS

- A session on mm/sub-mm VLBI
- A session on radar reflections from solar system bodies
- A session on real-time processing systems, with Commission C
- A session on characterization of the ionosphere, with Commission G
- An URSI-wide session on data (archiving/accessibility) (together with the CODATA initiative or big ICT companies?)

9. Proposed Sessions for the AT-RASC

Some of the above proposals will be implemented during AT-RASC.

10. Other Business

None.

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Alexander Nosich Receives Docteur Honoris Causa

Prof. Alexander I. Nosich was awarded the title of Docteur Honoris Causa of the Université de Rennes 1, France, on April 3, 2015 (Figures 1 to 4). The President of the university handed him a diploma (Figure 5) and a memorial medal (Figures 6 and 7) at a special ceremony where involved participants wore academic dress and made short speeches.

The ceremony was attended by approximately 200 guests. These included faculty members and students of IETR and Université de Rennes 1, representatives of the city administration, business and industry, and friends of the awardee. This included Prof. Ronan Sauleau of IETR, the nominator (Figure 8).

Prof. Nosich is Principal Scientist and Head, Laboratory of Micro and Nano Optics of the Institute of Radio-Physics and Electronics of the National Academy of Sciences of Ukraine. His research interests are in computational electromagnetics, and span a wide spectrum of applications and frequencies, from microwaves to optics. He has published over 140 journal papers and eight book chapters. His personal H-index is 30 by Google and 24 by Scopus. He is a Fellow of the IEEE. His collaboration with the Institute of Electronics and Telecommunications of Rennes (IETR) of the Université de Rennes 1 started in 1995. It has resulted in 25 journal and 75 conference papers published jointly with IETR scientists, eight successful PhD theses, and 20 joint projects, including the International Research Chair of the Université Europeenne de Bretagne in 2009-2010, funded by the Regional Council of Brittany.

Figure 1. The opening of the Docteur Honoris Causa award ceremony at the Campus Beaulieu of Université de Rennes 1.

Figure 2. The President of the Université de Rennes 1 fixes epitoga (a piece of cloth with white fur stripes) to the left shoulder of the fresh Docteur Honoris Causa.

Figure 3. The President of the Université de Rennes 1 (c) hands the academic regalia to the Docteur Honoris Causa (l). In France, the toga (gown) color represents the academic field. For exact and experimental science, it is amaranth.

Figure 4. The new Docteur Honoris Causa makes a short speech about his 20-year collaboration with Université de Rennes 1.

DOCTEUR HONORIS CAUSA de l'université de Rennes 1

à

Monsieur Alexander Nosich

Professeur et chercheur principal à l'Institut de Radiophysique et d'électronique, Académie des sciences d'Ukraine

L'insigne de son titre lui a été remis le 3 avril 2015

Professeur Guy Cathelineau
Président de l'université de Rennes 1

RENNES 1

Figure 5. The diploma of Docteur Honoris Causa of the Université de Rennes 1.

Other funding agencies in this collaboration were CNRS, the Ministry of Foreign and European Affairs, the Ministry of National Education and Research, the NATO Science Division, and the European Science Foundation.

Prof. Nosich is an active contributor to URSI at the national and international level. In 1993, he represented Ukraine at the URSI General Assembly in Kyoto, where Ukraine joined URSI. He later was active in Commission B of the Ukraine national URSI committee. He took part in many conferences organized or cosponsored by URSI, such as the Commission B Symposia on Electromagnetic Theory; Asia-Pacific Radio Science Conferences; and Kharkiv Symposia on Microwaves, Millimeter and Sub-Millimeter Waves.

In 1995, he was organizer and Chair of the IEEE AP-S East Ukraine Chapter, the first AP-S mono-chapter in the

Figure 6. The front of the medal in commemoration of the Docteur Honoris Causa.

Figure 7. The back of the medal in commemoration of the Docteur Honoris Causa.

former USSR. In 2003, he was elected an IEEE Fellow with the citation, "For contributions to the applications of computational electromagnetics to antennas and open waveguides."

Figure 8. Prof. Alexander Nosich (r) and his nominator, Prof. Ronan Sauleau of IETR.

In 2001-2003, he served as a delegate of Ukraine and Poland at the European Microwave Association. Since 2008, he has served as an observer from Ukraine and Georgia at the European Association for Antennas and Propagation. From 1989-2014, he was one of the initiators and later the Technical Program Committee Chair of the series of international conferences on Mathematical Methods in Electromagnetic Theory (MMET), held in Ukraine.

We extend our hearty congratulations to Prof. A. I. Nosich.

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Conferences

URSI Conference Calendar

July 2015

CEM'15 – Computational ElectroMagnetics International Workshop
Izmir, Turkey, 2-4 July 2015
Contact: cemworkshop@gmail.com or Prof. Levent Gürel ABAKUS Computing Technologies, Fax +90 312 265 0671 E-mail: cemworkshop@gmail.com or Prof. Levent Gürel, ABAKUS Computing Technologies, Fax +90 312 265 0671, E-mail: lgurel@gmail.com, http://cem15.computing.technology/index.html

August 2015

IconSpace 2015 - 2015 International Conference on Space Science and Communication
Langkawi, Malaysia, 10 - 12 August 2015
Contact: ANGKASA, Institute of Climate Change, Level 2, Research Complex Bldg, 43600 UKM Bangi, Selangor MALAYSIA, Fax: +603-8911 8490, Email: iconspace@ukm.edu.my, http://www.ieeemy.org/iconspace2015/

September 2015

URSI-JRSM 2015
Tokyo, Japan, 3-4 September 2015
Contact: Prof. Kazuya Kobayashi, Department of Electrical, Electronic and Communication Engineering, Chuo University, 1-13-27 Kasuga, Bunkyo-ku, Tokyo 112-8551, Japan, Fax: +81-3-3817-1847, E-mail:kazuya@tamacc.chuo-u.ac.jp, http://www.ursi.jp/jrsm2015/

Metamaterials 2015
Oxford, United Kingdom, 7-10 September 2015
Contact: Prof. Richard W. Ziolkowski, Litton Industries John M. Leonis Distinguished Professor, Electrical and Computer Engineering Professor, College of Optical Sciences, University of Arizona, Tucson, AZ 85721, E-mail: ziolkowski@ece.arizona.edu, http://congress2015.metamorphose-vi.org

IEEE Radio and Antenna Days of the Indian Ocean 2015
Mauritius, 21 - 24 September 2015
Contact: RADIO 2015 Conference Secretariat, Radio Society (reg. no. 13488), Gobinsing Road, Union Park, Mauritius, Email: radio2015@radiosociety.org http://www.radiosociety.org/radio2015

November 2015

COSPAR 2015 - 2nd Symposium of the Committee on Space Research (COSPAR): Water and Life in the Universe
Foz do Iguacu, Brazil, 9-13 November 2015
Contact: COSPAR Secretariat, 2 place Maurice Quentin, 75039 Paris Cedex 01, France
Tel: +33 1 44 76 75 10, Fax: +33 1 44 76 74 37, E-mail: cospar@cosparhq.cnes.fr, http://cosparbrazil2015.org/

URSI-RCRS 2015 - 2nd URSI Regional Conference on Radio Science
New Delhi, India, 16-19 November 2015
Contact: Dr. Paulraj R., Convener, URSIRCRS2015, School of Environmental Sciences, Jawaharlal Nehru University, New Mehrauli Road, New Delhi, 110 067, India, Tel: + 91 11 2670 4162, Email: rcrsdelhi@gmail.com, http://www.ursi.org/img/website24x24.jpg

April 2016

EuCAP 2016 - European Conference on Antennas and Propagation 2016
Davos, Switzerland, 10 - 15 April 2016
Contact: Prof. Juan R. Mosig, LEMA – EPFL, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, E-mail juan.mosig@epfl.ch

July 2016

COSPAR 2016 - 41st Scientific Assembly of the Committee on Space Research (COSPAR) and Associated Events
Istanbul, Turkey, 30 July – 7 August 2016
Contact: COSPAR Secretariat, 2 place Maurice Quentin, 75039 Paris Cedex 01, France, Tel: +33 1 44 76 75 10, Fax: +33 1 44 76 74 37, E-mail: cospar@cosparhq.cnes.fr https://www.cospar-assembly.org/

August 2016

EMTS 2016 - 2016 URSI Commission B International Symposium on Electromagnetic Theory
Espoo, Finland, 14-18 August 2016
Contact: Prof. Ari Sihvola, Aalto University, School of

Electrical Engineering, Department of Radio Science and Engineering, Box 13000, FI-00076 AALTO, Finland, E-mail: ari.sihvola@aalto.fi

HF13 - Nordic HF Conference with Longwave Symposium LW 13
Faro, Sweden (north of Gotland in the Baltic Sea), 15-17 August 2016
Contact: Carl-Henrik Walde, Tornvägen 7, SE-183 52 Taby, Sweden, tel +46 8 7566160 (manual fax switch, E-mail info@walde.se, http://www.ursi.org/img/website24x24.jpg

AP-RASC 2016 - 2016 URSI Asia-Pacific Radio Science Conference
Seoul, Korea, 21 - 25 August 2016
Contact: URSI AP-RASC 2016 Secretariat, Genicom Co Ltd, 2F 927 Tamnip-dong, Yuseong-gu, Daejeon, Korea 305-510, Fax.: +82-42-472-7459, E-mail: secretariat@aprasc2016.org, http://www.ursi.org/img/website24x24.jpg

October 2016

ISAP 2016 - 2016 International Symposium on Antennas and Propagation
Okinawa, Japan, 24-28 October 2016
Contact: Prof. Toru Uno, Tokyo Univ. of Agriculture & Technology, Dept of Electrical and Electronic Engineering, 2-24-16 Nakamachi, Koganei 184-8588, Japan, Fax +81 42-388 7146, E-mail: uno@cc.tuat.ac.jp, http://isap2016.org/

August 2017

URSI GASS 2017 - XXXIInd URSI General Assembly and Scientific Symposium
Montreal, Canada, 19-26 August 2017
Contact: URSI Secretariat, c/o INTEC, Sint-Pietersnieuwstraat 41, 9000 Gent, Belgium, E-mail info@ursi.org

May 2019

EMTS 2019 - 2019 URSI Commission B International Symposium on Electromagnetic Theory
San Diego, CA, USA, 27-31 May 2019
Contact: Prof. Sembiam R. Rengarajan, California State University, Northridge, CA, USA, Fax +1 818 677 7062, E-mail: srengarajan@csun.edu

URSI cannot be held responsible for any errors contained in this list of meetings

Correction

The President of the Australia Member Committee of URSI should have appeared on page 101 of the December 2014 issue of the *Radio Science Bulletin* (No. 351) as Prof. P. Smith. The contact information given for Prof. Smith in that issue was correct.

Information for Authors

Content

The *Radio Science Bulletin* is published four times per year by the Radio Science Press on behalf of URSI, the International Union of Radio Science. The content of the *Bulletin* falls into three categories: peer-reviewed scientific papers, correspondence items (short technical notes, letters to the editor, reports on meetings, and reviews), and general and administrative information issued by the URSI Secretariat. Scientific papers may be invited (such as papers in the *Reviews of Radio Science* series, from the Commissions of URSI) or contributed. Papers may include original contributions, but should preferably also be of a sufficiently tutorial or review nature to be of interest to a wide range of radio scientists. The *Radio Science Bulletin* is indexed and abstracted by INSPEC.

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Submissions

Material submitted for publication in the scientific section of the *Bulletin* should be addressed to the Editor, whereas administrative material is handled directly with the Secretariat. Submission in electronic format according to the instructions below is preferred. There are typically no page charges for contributions following the guidelines. No free reprints are provided.

Style and Format

There are no set limits on the length of papers, but they typically range from three to 15 published pages including figures. The official languages of URSI are French and English: contributions in either language are acceptable. No specific style for the manuscript is required as the final layout of the material is done by the URSI Secretariat. Manuscripts should generally be prepared in one column for printing on one side of the paper, with as little use of automatic formatting features of word processors as possible. A complete style guide for the *Reviews of Radio Science* can be downloaded from http://www.ips.gov.au/IPSHosted/NCRS/reviews/. The style instructions in this can be followed for all other *Bulletin* contributions, as well. The name, affiliation, address, telephone and fax numbers, and e-mail address for all authors must be included with All papers accepted for publication are subject to editing to provide uniformity of style and clarity of language. The publication schedule does not usually permit providing galleys to the author.

Figure captions should be on a separate page in proper style; see the above guide or any issue for examples. All lettering on figures must be of sufficient size to be at least 9 pt in size after reduction to column width. Each illustration should be identified on the back or at the bottom of the sheet with the figure number and name of author(s). If possible, the figures should also be provided in electronic format. TIF is preferred, although other formats are possible as well: please contact the Editor. Electronic versions of figures *must* be of sufficient resolution to permit good quality in print. As a rough guideline, when sized to column width, line art should have a minimum resolution of 300 dpi; color photographs should have a minimum resolution of 150 dpi with a color depth of 24 bits. 72 dpi images intended for the Web are generally *not* acceptable. Contact the Editor for further information.

Electronic Submission

A version of Microsoft *Word* is the preferred format for submissions. Submissions in versions of $\mathrm{T_EX}$ can be accepted in some circumstances: please contact the Editor before submitting. *A paper copy of all electronic submissions must be mailed to the Editor, including originals of all figures.* Please do *not* include figures in the same file as the text of a contribution. Electronic files can be send to the Editor in three ways: (1) By sending a floppy diskette or CD-R; (2) By attachment to an e-mail message to the Editor (the maximum size for attachments *after* MIME encoding is about 7 MB); (3) By e-mailing the Editor instructions for downloading the material from an ftp site.

Review Process

The review process usually requires about three months. Authors may be asked to modify the manuscript if it is not accepted in its original form. The elapsed time between receipt of a manuscript and publication is usually less than twelve months.

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Application for an URSI Radioscientist

APPLICATION FOR URSI RADIOSCIENTIST

I have not attended the last URSI General Assembly & Scientific Symposium, and wish to remain/become an URSI Radioscientist in the 2014-2017 triennium. This application includes a subscription to *The Radio Science Bulletin* and inclusion in the URSI mailing lists.

(Please type or print in BLOCK LETTERS)

Name : Prof./Dr./Mr./Mrs./Ms. ____

Family Name First Name Middle Initials

Present job title: ____

Years of professional experience: ____________________

Professional affiliation: ____

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E-mail: ____

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- ☐ A Electromagnetic Metrology
- ☐ B Fields and Waves
- ☐ C Radio-Communication Systems & Signal Processing
- ☐ D Electronics and Photonics
- ☐ E Electromagnetic Environment & Interference
- ☐ F Wave Propagation & Remote Sensing
- ☐ G Ionospheric Radio and Propagation
- ☐ H Waves in Plasmas
- ☐ J Radio Astronomy
- ☐ K Electromagnetics in Biology & Medicine

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