

# The Atmospheric Sounding Station “ El Arenosillo”

By Dr. Benito A. De la Morena Carretero and Nicolás Mélida Garrido

The Atmospheric Sounding Station “El Arenosillo” (hereinafter called ESAt) dependent on the Earth’s Observation, Remote Sensing and Atmosphere Department of the Search and Atmospheric Instrumentation of Instituto Técnica Aeroespacial (INTA), is situated at CEDEA (El Arenosillo Experimental Centre) in Mazagón - Moguer, Huelva, Spain.

Located in Southwest Europe (37.1 N-6.7 W) ESAt is an Observatory dedicated to the atmospheric research since 1969. It is integrated in the Ionosphere International Network with the **INAG** code **EA-036**, and in the World Ozone Ultraviolet Data Centre with the number 213.



Due to the almost 300 clear sky days a year and uniform albedo El Arenosillo is considered to be a good platform for optical observations. Numerous Institutions and groups, national and international, take advantage of its optimal conditions for campaigns or permanent observation of the most varied atmospheric parameters: aerosols, UV.B., UV.A, PAR, NO<sub>2</sub>, stratospheric ozone, tropospheric ozone, radon, erithemal dose in the human beings by biofilm techniques, among others.

Huelva, a city of Tartessus origin, surrounded by beautiful and white villages, is internationally known by its gastronomy (wines, ham, seafood, fish...) and the quality of its beaches and tourist towns perfectly communicated by its local and national road network. It is situated 45' from San Pablo's Airport at Seville by the Madrid-Huelva motorway A-49, and 1h 20' from Faro's Airport in Portugal. In this beautiful region with 40% natural parks, intensive agriculture (orange, strawberry...) and a high quality tourism INTA has available for you the scientific means for the observation of the atmosphere at the Atmospheric Sounding Station El Arenosillo.

## 1 RADIO PROPAGATION RESEARCH GROUP ACTIVITIES

The INTA, through the Atmospheric Sounding Station “El Arenosillo” (37.1 N; 6.7W), comes developing from 1966 a work of observation of the Atmosphere (dynamic stratospheric and total electron content in the Ionosphere) by means of systematic soundings carried out by rockets, globes, ionosondes, radiometers..., thanks to co-operative agreements with the most significant Organisms of the time, NASA, Max Planck Institute of Lindau, CNES...

Since 1969, ionospheric systems of vertical incidence soundings and absorption by Method A3 are available to study the evolution and the behaviour of the ionospheric regions F2, F1, E, and D respectively. And from 1993, a new sounder, the Digisonde 256, is acquired integrating the Station

in the World-wide Ionospheric Network with the code EA036, and in the European Network of Ionosphere.

The ionospheric digital data base of the Arenosillo covers from 1974 up to date.

## **2 COLLABORATIONS**

The ESA frequently work together national and international research centers:

- Ebro Observatory (Tarragona, Spain)
- Institute of Solar-Terrestrial Physics (Irkutsk, Russia)
- Institute of Atmospheric Physics (Prague, Czech Republic)
- Hungarian Academy of Sciences (Sopron, Hungary)
- Centro de Investigaciones Regionales (San Juan, Argentina)
- Istituto Nazionale di Geofisica, (Roma, Italy)
- Istituto di Ricerca, (Firenze, Italy)
- Abdus Salam International Center for Theoretical Physics ICTP-(Trieste, Italy)
- Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation (Moscow, Russia)
- Lowell University (Massachusetts, USA)
- National Observatory of (Athens, Greece)
- Rutherford Appleton Laboratory (RAL) (Chilton, UK),
- Royal Meteorological Institute (Dourbes, Belgium)
- Complutense University (Madrid, Spain)
- Algarve University (Faro, Portugal).
- Huelva University (Huelva, Spain)

## **3 PROJECTS & RESEARCH LINES**

- Project COST238 PRIME of UE: “Prediction and Retrospective Ionospheric Modelling over Europe”. From 1991 to 1994.
- Project COST251 IITS of UE: “Improved Quality of Ionospheric Telecommunication System Planning and Operation”. From 1995-1999
- Spanish Project CICYT (TIC 97/0787-CO2): “Ionospheric Communications Link with Spread Spectrum INTA (El Arenosillo)-La Salle(Universidad Ramón Llull)” in collaboration with La Salle School of Engineering, Polytechnical School of La Rabida (Huelva University) and INTA, from 1997 to 1999.
- Spanish Project Special Action CICYT (TIC99-1284-E): “Ionospheric Link with Spread Spectrum INTA (El Arenosillo)-La Salle(Universidad Ramón Llull)”. From 1999 to 2000.
- Project COST271 of UE “Effects of the upper atmosphere on terrestrial and Earth-space communications”. From 2000-2004.
- Spanish Project CICYT (BTE 2000-0825): “Ionospheric variability; interaction between neutral and ionised atmosphere. Ionospheric model over Iberian Peninsula INTA (el Arenosillo)- Observatorio del Ebro. From 2001-2004.

In addition to this research task, this Station sends its ionospheric data to the following Data Centers every year:

- World Data Center A (Boulder, USA)
- World Data Center C1 (Slough, UK)

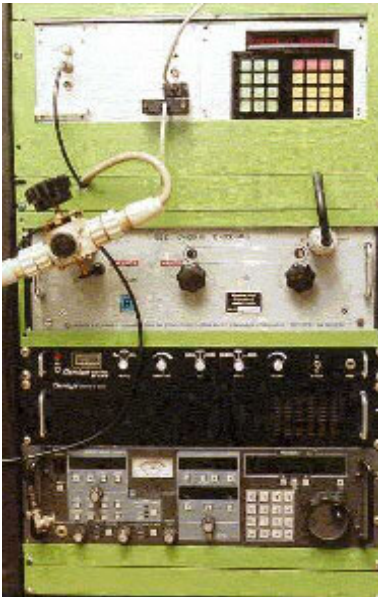
- World Data Center C2 (Tokio, Japan)
- European Data Center (Trieste, Italy)

Besides, foF2 and M(3000)F2 data are daily sent to the RAL (Chilton, UK) and to the Space Research Centre (Warsaw, Poland).

## 4 INSTRUMENTATION

### 4.1 Radio Wave Absorption In The Lower Ionosphere– Method A3

This ground-based sounding system records electromagnetic wave variations after the pass through ionospheric layer D.



Ionospheric absorption (60-90 Km)  
 Oblique sounding.  
 Tx: Torrejon 40 N 20W  
 Rx: El Arenosillo 37 N 6 W  
 Reflection point: 38.8N, 5.2W.  
 Distance: 440 Km.  
 Frequency: 2,830 Mhz.  
 Power transmission: 1 Kw

### 4.2 Digisonde 256

This is a digital ionospheric high frequency pulse sounding system (0.4-30 MHz) designed by the Center for Atmospheric Research of the University of Massachusetts – Lowell (USA). The system measures and analyses the behaviour of the overhead ionosphere, especially the E and F layers. It automatically records, displays and transmits vertical ionospheric information in the form of digital ionograms, ionospheric parameters (foF2, h'F2...foF, h'F...foE, h'E...MUF, M(3000)...) and electron density profiles. It can carry out both vertical and oblique soundings.



**Digisonde DGS 256**  
 Ionospheric variability (100-400 Km)  
 Vertical sounding.  
 El Arenosillo 37 N 6 W  
 Range of frecuencies: 0,4-30 Mhz.  
 Pulse Wide Band Transmitter:10Kw



Figure: One of the seven receiving antenna of the array with North-South and East-West oriented loops which do an equilateral triangle with 62 meters of side.

**WWW page:** <http://www.inta.es/iono>. Where is possible to see the last ionogram realized by DGS256 which has been sent automatically via ftp. This ionogram is sent simultaneously at RAL too.

## 5 RESEARCH PUBLICATIONS

### 5.1 Doctoral Thesis

From the ESA have been realized the following Physical Doctoral Thesis:

- Morena, B.A., **Stratosphere lower Ionosphere Coupling**, Granada University, 1995
- Miró, G., **Characterization Ionospheric Channel for a point to point HF link by raytracing techniques**, Complutense University, Madrid, 2000.
- Marín, D., **Long-term changes in the Ionosphere and their relation with the Geomagnetic Activity**, Complutense University, Madrid, 2003.

### 5.2 Publications (From 1999)

De la Morena B.A., and E.S. Kazimirovsky, **Investigation stratosphere-lower thermosphere coupling in SW Spain**, STEP GBRSC News, Vol. 4, No. 2, 1999

Pancheva D., L. F. Alberca and B. A. de la Morena, **Simultaneous observations of the quasi-two-day variations in the lower and upper ionosphere over Europe**, Journal of Atmospheric and Terrestrial Physics, Vol. 56, No 1, 43-50, 1999

De la Morena B.A., J.M. Vilaplana and E.S. Kazimirovsk, **The Climatology of radiowave absorption in south-west Spain**, Proceedings VIII Asamblea Nacional de Geodesia y Geofísica, Univ. Complutense, Madrid, 1999

Alberca L. F., E. M. Apostolov, M. Gil, E. Kazimirovsky, J. Lastovicka, B. A. de la Morena, D. Pancheva, **The possible coupling of the stratosphere/lower ionosphere at middle latitudes**, Advances in Space Research, Vol. 18, No 3, 141-144, 1999

Alberca L. F., E. M. Apostolov, M. Gil, D. Danilov, E. Kazimirovsky, J. Lastovicka, B. A. de la Morena, and D. Pancheva, **A coupling of the stratosphere and lower ionosphere at middle latitudes**, Geomagnetism and Aeronomy, Vol. 36, No 3, 145-153, 1999

De la Morena B, L. F. Alberca, J. G. Solé, J. M. Vilaplana, and E. Kazimirovsky, **Correlation in foF2 and M(3000)F2 variations in south-west Europe**, Annali di Geofisica. Vol XXXIX, N.4, 735-750, 1999

De la Morena B.A. and E.S. Kazimirovsky, **The experimental investigation of the lower ionosphere response to forcing from above and below**, Scientific Report INTA 1995, J. Torres and B.A. de la Morena Ed's, El Arenosillo, 1999

- Alberca, L. F., E. Kazimirovsky, B. A. de la Morena, J. G., Solé, and J. M., Vilaplana, **The applicability of fmin-parameter for the study of radiowave absorption in the lower ionosphere**, *Anales de Física*. Vol 93, No. 2, 83-92, 1999
- De la Morena B., R. Rodrigo, E. Kazimirovsky and J.M. Vilaplana, **The experimental investigation of the coupling processes in the middle atmosphere/lower thermosphere/ionosphere system**, *Advances Space Research*, Vol 20, No. 6, pp. 1157-1160, 1999
- Villanueva, L., M. Herraiz, B.A. de la Morena, G. Miró, and J.M. Vilaplana, **Long-Term model comparison for foF2 at El Arenosillo ionospheric station**. En COST251TD(97)006 (Part I) "Joint COST 251/IRI Workshop and Working Group Sessions Proceedings, Institute of Atmospheric Physics, Kühlungsborn, Germany, pp 14, 1999
- Vergasova G.V., E.S. Kazimirovsky, and B.A. de la Morena, **Ionospheric radiowave absorption, thermospheric dynamics and geomagnetic activity**, *Research of Geomagnetism, Aeronomy and Solar Physics*, Vol. 106, pp. 186-196, 1999
- Marín D., A. Herraiz, B.A. de la Morena and M. Herráiz., **Intercorrelation between Parameters of Middle Atmosphere in El Arenosillo Latitude**, *Proceedings I Asamblea Hispano-Portuguesa de Geodesia y Geofísica*, Aguadulce – Almería, 1999
- Marín D., and J. Lastovicka, **Do Solar Flares Affect Total Ozone?**, *Studia Geophysica et Geodaetica*, Vol. 42, No. 4, pp. 533-539, 1999
- Miró G., D. Marín, B.A. de la Morena, and A.M. Casimiro, **Ionospheric Profiles in Middle Latitudes**, *Proceedings I Asamblea Hispano-Portuguesa de Geodesia y Geofísica*, Aguadulce – Almería, 1999
- Miró G., I.Bellido, B.A. de la Morena, and M. Herraiz, **Evolution of upper Inosphere during high and low solar activity periodes in the SW of Europe**, *Proceedings I Asamblea Hispano-Portuguesa de Geodesia y Geofísica*, Aguadulce – Almería, 1999
- Alberca L. F., G. Juchnikowski, S., Kouris, A. V. Mikhailov, V.V. Mikhailov, G. Miró, B. A. De la Morena P. Mukhtarov, D. Pancheva, J. G. Solé, I. Stanislawska, L. Villanueva, and T. Xenos, **Comparison of variuos foF2 single station models for European area**, *Acta Geophysica Polonica*, Vol XLVII, No. 1, 77-91, 1999
- Boska J., D. Marín, G. Miró, M. Herráiz, B. A. de la Morena, and E. S. Kazimirovsky, **AGW Spectra in the Electron Density**, COST251TD(99)003 "COST 251/Workshop On "Procedures and Testing of the Models for Ionospheric Telecommunications Application", R. Hanbaba and B. A. de la Morena Ed's, Huelva, pp 215-232, 1999
- Gherm, V., N. Zernov, G. Miró, and S. Radicella, **The HF link characterization for the one-hop path between Barcelona and El Arenosillo**, COST251TD(99)008 "COST 251/Workshop On "Procedures and Testing of the Models for Ionospheric Telecommunications Application", Madeira, Portugal, pp. 48-51, 1999
- Lastovicka, J., D. Pancheva, D. Altadill, E. A. Benediktov, J. Boska, J. Bremer, M. Dick, K. Igarashi, P. Mlch, B. A. de la Morena, Z. T. Rapoport, V.A. Vyakhivev, B. O. Vugmeister, X. Zhang, and B. Zolesi, **Ionospheric measurements during the CRISTA/MAHRSI campaign: their implications and comparison with previous campaigns**, *Annales Geophysicae*, Vol. 17, No. 8, 1040-1052, 2000
- Leschinskaya, T. Yu., G. Miró, and A. V. Mikhailov, **Statistical results of Ne(h) models testing using incoherent scatter and digisonde observations**, COST251TD(99)003 "COST251/Workshop On "Procedures and Testing of the Models for Ionospheric Telecommunications Application", R. Hanbaba and B. A. de la Morena Ed's, Huelva, pp 337-347, 2000
- Mikhailov A.V., and D. Marín, **Geomagnetic Control of the foF2 Long-Term Trends**, COST251TD(99)008 "COST 251/Workshop On "Procedures and Testing of the Models for Ionospheric Telecommunications Application", Madeira, Portugal, pp.155-164, 2000

- Mikhailov A. V., B.A. de la Morena, G. Miró, and D. Marín, **A Method for foF2 Monitoring over Spain using the El Arenosillo Digisonde Current Observations**, *Annali di Geofisica*, Vol.42, No. 4, 683-689, 2000
- Mikhailov A. V., B.A. de la Morena, G. Miró, and D. Marín, **A Comparison of foE and hmE Model Calculations with El Arenosillo Digisonde Observations. Seasonal Variations**, *Annali di Geofisica*, Vol.42, No. 4, 691-698, 2000
- Mikhailov A.V., B.A. de la Morena, G. Miró, and D. Marín, **On Theoretical Modelling of the Midlatitude Daytime Ionospheric E-Layer Parameters**, COST251TD(99)003 "COST 251/Workshop On "Procedures and Testing of the Models for Ionospheric Telecommunications Application", R. Hanbaba and B. A. de la Morena Ed's, Huelva, pp 279-288, 2000
- Miró G., M. Herráiz, B.A. de la Morena, T.L. Gulyaeva, D. Marín, **Round-The-World Propagation of the Ionospheric Disturbances at Low Middle Latitudes**, COST251TD(99)003 "COST 251/Workshop On "Procedures and Testing of the Models for Ionospheric Telecommunications Application", R. Hanbaba and B. A. de la Morena Ed's, Huelva, pp 169-174, 2000
- Miró G., N. Jakowsky and B.A. de la Morena, **Equivalent slab thickness of the ionosphere in middle latitudes based on TEC/foF2 observations over El Arenosillo**, COST251TD(99)003 "COST 251/Workshop On "Procedures and Testing of the Models for Ionospheric Telecommunications Application", R. Hanbaba and B. A. de la Morena Ed's, Huelva, pp 87-92, 2000
- Miró G., and S. Radicella, **Characterization of "worst case" conditions of HF radiopropagation using a 2D raytracing program**, COST251TD(99)008 "COST 251/Workshop On "Procedures and Testing of the Models for Ionospheric Telecommunications Application", Madeira, Portugal, pp. 40-47, 2000
- Marín D., G. Miró, and A.V. Mikhailov, **A Method for foF2 Short-Term Prediction**, *Physics and Chemistry of the Earth*, Vol. 25, No. 4 ,pp. 327-332, 2000
- Miró, G., S.M. Radicella, M. Herraiz, and B.A. de la Morena, **Analysis of Characterization of "worst case" conditions of Ionospheric Channel in HF Communications**. *Tendencias Actuales en la Investigación de la Ionosfera*, M. Herraiz and B.A. de La Morena Editores. Colección Física de la Tierra n. 12, Universidad Complutense de Madrid, 337-351, 2000
- Marín, D., A.V. Mikhailov, B.A. de la Morena, y M. Herraiz, **Long term trends in F2 region of The Ionosphere and his relation with the Geomagnetic Activity**. *Tendencias Actuales en la Investigación de la Ionosfera*, M. Herraiz and B.A. de La Morena Editores. Colección Física de la Tierra n. 12, Universidad Complutense de Madrid, 263-280, 2000
- Mikhailov, A. V. y D. Marín, **Geomagnetic Control of the foF2 Long-Term Trends**. *Ann. Geophysicae* 18, 653-665, 2000
- Marín, D., A.V. Mikhailov, B.A. de la Morena, M. Herraiz **Long-term hmF2 trends in the EuroAsian longitudinal sector on the ground-base ionosonde observations**. *Proceedings ST11 Section XXV General Assembly de la European Geophysical Society*, Niza, Francia., 2000
- D. Marín, A.V. Mikhailov, B.A. de la Morena, M. Herriz, **Long- term hmF2 trends en the EuroAsian longitudinal sector on the ground-base inosonde observations**. *Ann. Geophysicae*, Volume 19, Number 7, 2001.
- A.V. Mikhailov y D. Marín. **An interpretatio of the f0F2 and hmF2 long-term trends in the framework of the geomagnetic control concept**. *Ann. Geophysicae*, v.19, 733-748, 2001.
- A.V. Mikhailov, D. Marín, T.Yu. Leschinskaya, y M. Herraiz. **A revised approach to the f0F2 lon-term trends analisis** *Ann. Geophysicae* 2001.
- G. Miró, b.A. de la Morena, S.M.Radicella, M. Herraiz, **Worst cases for a one-hopHigh Frequency Link**. *Annals of Geophysics*, Vol. 45, N.1, pp. 201-205, 2002.

G. Miró, S. M. Radicella, B.A. de la Morena, M. Herraiz, L. Ciarolo. **Effects of geomagnetic storms on the ionospheric regions over the Southwest of Europe. An approach of the influence of the G condition on ionospheric values.** Acta Geodaetica et Geophysica Hungarica, 37 (2-3),pp. 343-349, 2002.

D.Buresova, J. Lastovicka, D. Altadill, G. Miró. **Daytime electron density at the F1 region in Europe during geomagnetic storms".** Annales Geophysicae, 20 (7), pp. 1007-1021, 2002.

### **For future contacts:**

Dr. Benito A. De la Morena ([morenacb@inta.es](mailto:morenacb@inta.es))

Nicolás Mérida ([melidagn@inta.es](mailto:melidagn@inta.es))

Pilar Sanz, ([sanzcp@inta.es](mailto:sanzcp@inta.es)).

Fax: +34 959 208 859/57