



Departamento de Ciencias de la Atmósfera y los Océanos

Facultad de Ciencias Exactas y Naturales

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***Report of activities to be presented to WMO
representatives – May 2009***

General remarks

This report has been structured in a similar way as the Self Assessment Questionnaire requested by the WMO last year.

We consider that there are several aspects of our activities that can not be fully documented through the Questionnaire, so we did not attached to its format too strictly. Still, we kept the main points for ease of the assessment.

Part A

WMO-RTC Regional Activities

The *Department of Atmospheric and Oceanic Sciences* (Departamento de Ciencias de la Atmósfera y los Océanos, from now on DCAO) is within the Faculty of Exact and Natural Sciences of the University of Buenos Aires and is an academic unit responsible for five educational programmes:

- Licencee in Atmospheric Sciences
- Licencee in Oceanography
- Bachelor in Atmospheric Sciences (with 4 specializations)
- PhD in Atmospheric Sciences
- PhD in Oceanography

The DCAO is also involved in interdisciplinary graduate and postgraduate programmes:

- Licencee in Paleontology (coordinated by the Dept. of Geology)
- Licencee in Biology (coordinated by the Dept. of Biology)
- Master in Environmental Sciences (co-sponsored by our dept. and several Faculty departments)

Its staff is comprised of 27 professors, being 17 of them full-time. The DCAO also hosts many researchers and PhD students (currently we have 35 PhD students, being 5 of them foreign), many of whom also act as teaching assistants. These full-time researchers and PhD students are supported by different programmes within the University, the National Council of Scientific and Technical Research (CONICET) and other national and international Agencies. Some of these programmes supported short and long stays of students coming from other countries (i.e Uruguay, Brazil, France, and Germany, among others).

This shows that our Department has a strong commitment to capacity building within the region, through education and research activities.

In what follows, the evolution of graduate and undergraduate students in Atmospheric Sciences is provided (all refer to students that have finished their career). For a better interpretation of these numbers it should be clarified the following (for more details see Appendix I):

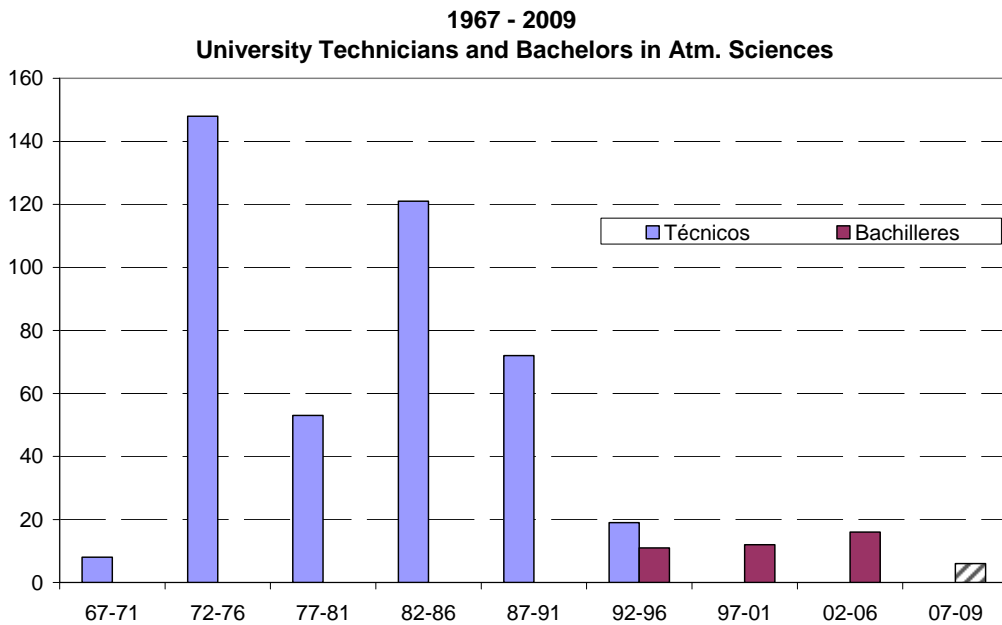
from 1953 to 1989 the offered degrees in meteorology were:

- Licencee in Meteorology

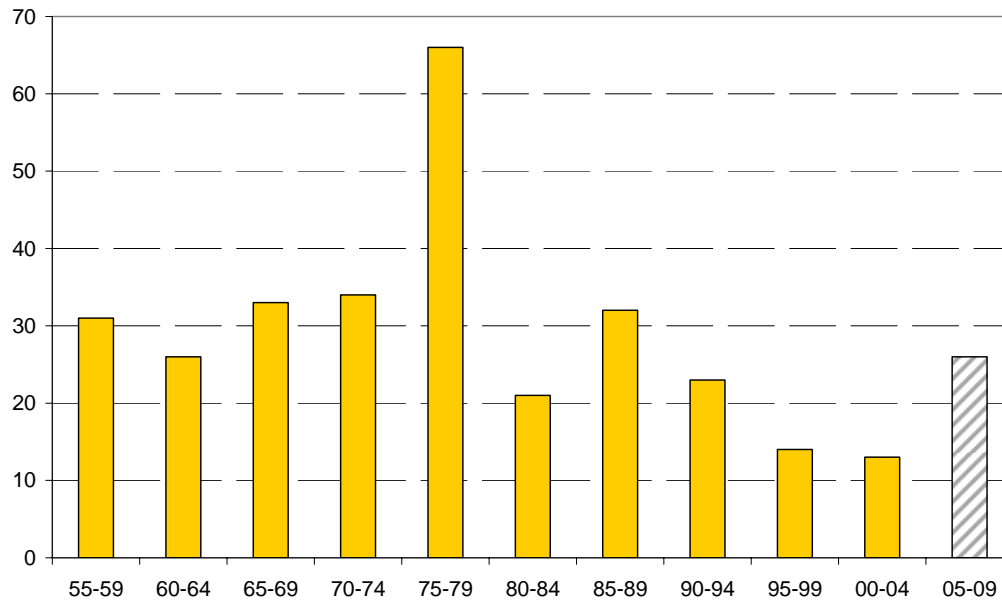
- Meteorology Technician (with four specialties)
- PhD in Meteorology (started by 1973)

since 1989, the degrees in meteorology are:

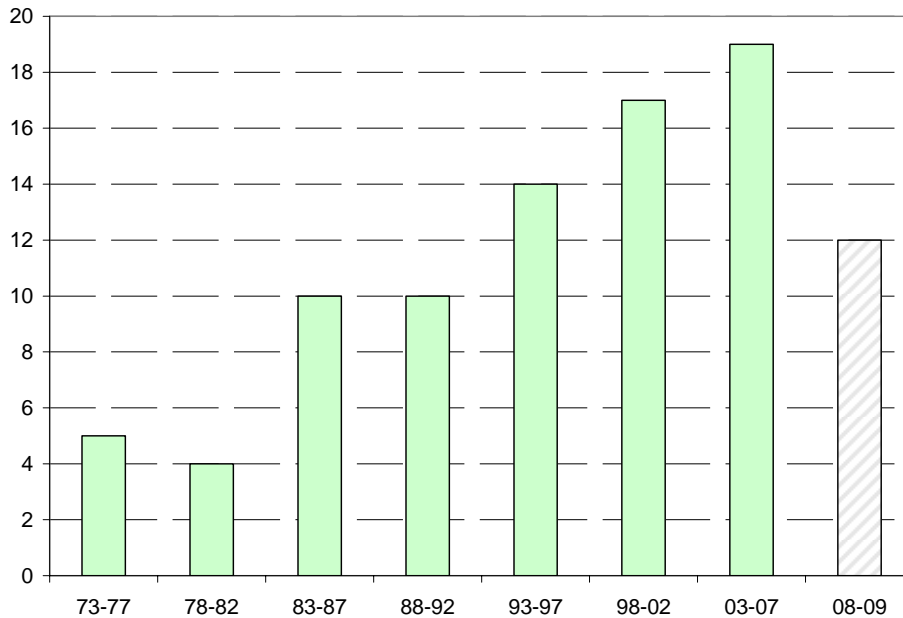
- Licencee in Atmospheric Sciences
- Bachelor in Atmospheric Sciences (with four specialties)
- PhD in Atmospheric Sciences



Licencees in Meteorology and Licencees in Atmospheric Sciences



PhDs in Atmospheric Sciences



These figures show a dramatic decrease in the amount of graduate students and an increase in PhDs. Clearly, one of our main concerns is to increase the number of graduate students. The other one is to work in a redefinition of the original Meteorological Technician into a BIP-MT kind of training, according to the framework provided by WMO 258 Guidelines (see Part F of this report, “challenges”). However, the decrease of graduate students is very well correlated with the policy of our National Weather Service: since 1991 our NWS did not open positions neither at the technical nor at the licencee levels. This policy has been gradually changing since 2007 and we expect an impact of this change to become evident in our activities rather soon.

International and regional scope:

An almost unique characteristic of the University of Buenos Aires, compared with other Universities of the region is that all its graduate programmes have no tuition fees. This applies to both, Argentine and foreign students. Moreover, there are also several postgraduate training activities that are completely free of charge as well. We consider that this policy is crucial to aid in the training and education of students from every country of the region.

Particularly focusing in recent international training and workshop activities hosted or co-hosted by our Department and Faculty, we would like to highlight:

- Workshop on the Interdisciplinary Science of Climate Changes: Basic Elements. Buenos Aires 12 March - 4 April, 2007. <http://www.fcen.uba.ar/ictp1877/>
- Meteorología Tropical. Buenos Aires 14 July – 15 August, 2007
- Curso Regional de Entrenamiento en Técnicas Satelitales Aplicadas a la Meteorología y Temáticas Afines, para las Regiones III y IV – 22 September – 3 October, 2008. Córdoba, Argentina (Course information available in <http://www.met-elearning.org/moodle/course/info.php?id=39>)
- Intensive Course on Data Assimilation, Buenos Aires, Argentina 27 October - 7 November 2008. <http://4dvarenkf.cima.fcen.uba.ar/course/> (see Appendix II for a short report on this activity)
- Workshop on 4D-Var and Ensemble Kalman Filter Intercomparisons, 10-13 November 2008, Buenos Aires, Argentina. <http://4dvarenkf.cima.fcen.uba.ar/> (see Appendix II for a short report on this activity)
- CO₂: Océano y Clima. 1 – 12 December, 2008.

Part-B

Education level of the various courses of instruction carried out at the RTC consistent with the guidance material issued by WMO

As has been mentioned in Part A we are very active in training activities, providing two degrees in Meteorology: the Licencee in Atmospheric Sciences and the Bachelor in Atmospheric Sciences. The first one can be considered as a BIP-M level, although its training *exceeds* in depth and duration the basic OMM requirements for this level, since it takes around 6 years to complete this graduate level (including the Licencee Thesis). The second one (Bs in Atmospheric Sciences) is in-between the BIP-M level and the BIP-MT level, and it takes 3 years and a half to be completed. The design of the current curricula allows that those graduated as Bs in Atmospheric Sciences can have a number of subjects recognized and continue their studies to obtain a Licencee degree.

Both careers are open every year to Argentine and foreign students. The curriculum and the specific courses syllabus are available in our web page <http://www.at.fcen.uba.ar/planes.php>. This Department is also the only one having a degree and a PhD in Oceanography. We consider that this is a very interesting characteristic of our Department, which fosters the interaction between atmospheric and oceanic scientists and students.

There are many Continuous Education and Training (CET) activities at our department, being the PhD Programmes and the Master in Environmental Sciences the most popular ones, even for foreign participants (this year, the Ms has 11 foreign students among 17). It should also be mentioned that there are at least 4 postgraduate courses given at each semester that can be attended by any graduate student (being an official PhD student is not

mandatory). In addition, our graduate courses are open to students from our Faculty and also to students from other institutions. The list of optional/postgraduate courses (with their contents) is also available in our web page, as an example we list here a few of them:

Hydrology, Mesometeorology, Statistical Methods in Atmospheric Sciences (II), Agro-meteorology (I and II), Advanced topics in Synoptic Meteorology, Advanced topics in Dynamics, Advanced topics in Statistical Methods, Numerical Modeling of the Atmosphere, Principles of Remote Sensing and their application to Meteorology, Waves in the Ocean, among others.

It should be remarked that the content of our graduate, optional and post-graduate courses closely follow the recommendations of the WMO N°258 Guidelines.

The main source of information about our activities is our web page (<http://www.at.fcen.uba.ar/>), but the students can also find valuable information about different programmes, scholarships, facilities, opportunities, etc, through the web page of our Faculty: www.exactas.uba.ar.

The DCAO is involved in activities related to school and public education as part of the role that has as an academic and public institution. There are specific activities organized in the Faculty of Exact and Natural Sciences that include a week on the year dedicated to the different departments. In our case it is the Earth Sciences week. During this week, the staff of the Department (Professors, Teaching Assistants and Students) organizes workshops on themes of interest, visits to our meteorological station in the campus and talks to audiences of students and teachers at the primary and secondary level. Besides that, several talks are offered at different schools, which are visited by some of our professors or teaching assistants. We provide brochures and posters to publicize our careers. There are also visits of students to our department. In our faculty there is a short internship program in which the students at the secondary level can initiate in some activity related with research.

PART-C

Processes of the RTC to identify training needs and to evaluate the training provided

Training needs are identified through specific requirements that we receive from our National Weather Service, through our graduate students and through our staff, who is involved in a wide variety of professional and research activities at national and international levels. The participation of our staff in many Panels (VAMOS, WCRP, LPB, and IPCC among others) provides a critical feedback to keep our programmes updated.

The DCAO is a centre of excellence very well positioned among the Meteorological and Oceanographical international communities, and this facilitates its interactions with other Universities and Research Centres around the world, keeping our training adjusted to the state-of-the-art in both disciplines. Still, we are currently undergoing a self assessment of the curricula in terms of re-definition of its design.

An additional aspect that contributes to the identification of training needs is related to the increasing concern of the society on environmental issues. The current or future staff should be properly trained to provide better and effective answers to the requirements of the governmental agencies, private companies, non-governmental associations and the general public among others.

Up to this moment, we did not establish a formal process to evaluate neither the effectiveness of training nor the DCAO as a whole; however, there are informal ways to recognize our effectiveness, like the large number of students that are accepted in Master, PhD and Post-doc programs around the world. On the other hand, the publication of the results of research activities of our staff in a wide range of peer-reviewed International Journals and the number of funded projects both from national or international agencies is an indication of the effectiveness of the training provided.

PART-D

WMO-RTC buildings, training materials, equipment and facilities

The DCAO is physically located inside the university campus which is comprised of 3 main pavilions and many other buildings, mostly corresponding to different research centers. Of particular interest for Atmospheric and Oceanic Sciences is the vicinity with the Centro de Investigaciones del Mar y la Atmósfera, (CIMA <http://www.cima.fcen.uba.ar/>), devoted to research in both disciplines, with a strong emphasis in modelling issues.

The Faculty has the Dr. Luis Federico Leloir library (<http://www.bl.fcen.uba.ar/>), which includes free access to on-line journals (AMS journals are available by a donation of the National Science Foundation –USA- while the Roy. Met. Soc. Journals are available since 2008 until 2016), e-books, and all kind of material to support teaching and research activities. Most of the classrooms include projectors. There are 4 computer labs, equipped with Windows and/or Linux machines (each one has at least 20 PCs) which are exclusively for training activities. The campus also has several restaurants, cafes, a doctor's office and a sports centre. We also have a meteorological surface station and two automatic meteorological stations.

Our Department is in the 2nd floor of the Pavilion II, where we have 3 classrooms, a computing lab (8 PC's, OS: Windows/Linux), a laboratory, a library, meeting rooms, and several rooms for our staff members. We also

host the IAI-FCEN office (http://www.iai.int/index.php?option=com_content&view=article&id=35&Itemid=84), and the Centro Argentino de Meteorólogos office (Argentine Meteorological Society). Through the University of Buenos Aires, we have access to high velocity internet connection (there is an optic fibre connection between our Faculty and the internet provider).

With more funding, what additional programmes or courses could you provide to support the mission of the RTC?

The aforementioned facilities, equipments and infrastructure are adequate to carry out our activities; however, we would need to improve our computer lab through the upgrade of our servers. Also, additional human resources are needed to develop and maintain modern databases and also to optimize the use of UNIDATA services. Finally, it would be of great help to have funding to support visits of experts on several fields, who could be invited to give short-intensive courses open for the regional community. In this sense, it would be particularly interesting to bring experts in Aeronautic Meteorology.

Is the instructional technology both current and adequate to support the RTC's mission, and if not, what needs to be improved or provided?

As mentioned before, the instructional technology is current and adequate but could be improved in order to support better computational labs (i.e. development of on-line training material or remote (distance-learning) education material). This will improve the capability of our RTC to broaden and strengthen the activities in the regional context. The enhancement of our geophysical fluid mechanics laboratory (TALLEX, http://www.at.fcen.uba.ar/actividades_ext.php), which is very helpful in providing experimental evidences to the theoretical explanations of dynamics and mechanics, would also be important.

What, if any, additional library resources would be useful to support your course?

We would like to develop a digital library password protected for our students and researchers. There are many teaching and research tools that are only available in CD and their access is now quite restricted.

Part-E

Technical ability and training skills of trainers/instructors

Our staff exhibits very high skill. All our professors are PhDs, many have post-docs outside Argentina and most of our teaching assistants also have PhD-education level. The DCAO has around 39 full-time staff (meaning

40 hours a week dedication) involved in training activities at the different levels. The Curriculum Vitae of our staff can be found in our web page.

The majority of our staff is supported by the University. Having a rented position in our University is very competitive, and, depending on category, personnel performance is evaluated each 3 or 7 years in a public and open contest. It should be stressed that all the Professors are judged once each 7 years through the participation of a board of experts coming from outside the University (most of them, in fact, come from other countries). After this evaluation, the contract can be renewed or not.

We have very few administrative and technical staff (2 administrative and 2 technical) being this a strong limitation for some of our activities.

Main research areas at our Department can be summarized in the following items:

1. Weather Analysis and forecasting
2. Study and modeling of the oceans and seas
3. Climate variability of the oceans and the atmosphere
4. Environmental Meteorology and Oceanography
5. Interactions among the components of the climatic system
6. Remote sensing applied to the oceans and the atmosphere

Linkages with other national and international organizations are strong and can be identified through the analysis of our “Memory 2007” as well as through the vitae of our staff (see our web page). It is important to highlight the membership to different WMO-Panels (VAMOS, WCRP SSG, IPCC, WGSIP), and the participation of our scientists in several Research Projects funded by NOAA-European Community- IAI, among others. Also, Vicente Barros, Emeritus Professor of our Department, is currently Co-Chair of IPCC Working Group II.

In order to improve the ability of our trainers, a course on Didactic on Natural Sciences is currently taking place at DCAO. The professor belongs to the Centre for the training and research in sciences teaching (CEFIEC, Centro de Formación e Investigación en Enseñanza de las Ciencias).

Part-F

WMO-RTC arrangements for administration, governance, planning and self assessment

Has your WMO-RTC implemented the recommendations made during previous external review?

Unfortunately, our RTC was not informed about the recommendations made during the previous WMO external review. We hope that in the future, WMO can supervise whether the RTCs effectively receive this important material.

Who is involved in the planning and decision-making processes in your RTC?

Our RTC is part of the University of Buenos Aires (UBA), consequently its decision-making processes are in accordance with UBA rules. The highest authority at the Faculty level is the Dean so, the Department Director is under his supervision. A very important characteristic of the UBA organization is that the DCAO has a team of authorities (Chair and Vice-chair, and Academic Secretary and Vice-Secretary) who are engaged in the administration and planning, but every decision is subject to a discussion within a committee (CODEP) integrated by representatives of Professors, Graduates and Students. This structure gives a particular character to the governance of the DCAO, which is common to the governance of the whole University system.

Indicate one or two significant achievements associated with developing training and enhancing facilities during the last five years

Besides the training courses and workshops highlighted in Part A, we can list the following activities, all of them have great impact among our students and staff members.

Between 2002-2003 there was an international Field Experiment (SALLJEX <http://www.eol.ucar.edu/projects/salljex/>) co-sponsored by scientists from our institution and many other institutions in South America and North America. Many students and staff members participated of this campaign, which had a strong impact in the region, since it had an important capacity building component, training activities, and observation enhancement over the region. It also helped to strengthen inter-institutional relationships at national and international levels, including NWS involvement.

Once a week, the DCAO organizes a forum to discuss the forecast for the upcoming weekend, which also includes the presentation of any significant weather event that could have occurred at regional or global level.

Once a month, the DCAO organizes a forum to discuss the climate tendency and to analyze climate anomalies for the last period at global and regional levels.

Participation on the monthly Visit (Virtual Institute for Satellite Integration Training) sessions.

Since 2007 there is a Geophysical Fluids Laboratory (TALLEX) that involves professors and students (http://www.at.fcen.uba.ar/actividades_ext.php)

What are the three main challenges facing your RTC?

The design of a new degree in atmospheric sciences, closely following WMO N°258 BIP-MT level.

The implementation of a Condensed BIP-M programme, which could help us to receive students from other universities of the region, after they get their first-university level (maths, physics, engineers) at their local institutions.

The increase of human resources so as to strengthen our research and teaching capacity in: remote sensing, urban pollution, atmospheric chemistry, hydrometeorology and agro-meteorology.

The achievements in these aspects will significantly improve the role of our RTC as the University component of the WMO Regional III.

Indicate one or two development plans for the training programmes, technical and residential facilities during the next five years

Since two of our main challenges are related with training programmes, it is clear that the inclusion of these careers is going to be accompanied by developments required to be successful.

Besides this, we are already working in the organization of a training course in Aeronautic Meteorology, specially designed following our NWS requirements. This course will be open to the region and is planned for the first semester of 2010. Also, and given the great success of the IPCC training course, and the Intensive Course on Data Assimilation, we are also working in the organization of a Training Course on the use of seasonal predictions for applications in Latin America (co sponsored with WGSIP and other agencies).

Finally, we would like to mention the proposal presented by our Department at the WMO meeting held in Panamá. This proposal consisted of a Training course on Aeronautical Meteorology, which includes 4 modules and is organized so as to fit the necessities of the region (see Appendix III for further details).

Indicate one or two actions that could be taken to enhance relationships between your RTC and other components of the WMO community.

We consider that WMO has a critical role in facilitating the integration of our RTC with the region. The mechanisms already established seem not to be effective enough.

Appendix I

A brief history and evolution of the DCAO with reference to the careers in atmospheric sciences

The Department of Atmospheric and Oceanic Sciences was created in 1953. Since then, it has done a pioneering work in Atmospheric Sciences in South America.

Until 1989, the Department was formerly called Department of Meteorology and was responsible of the following careers:

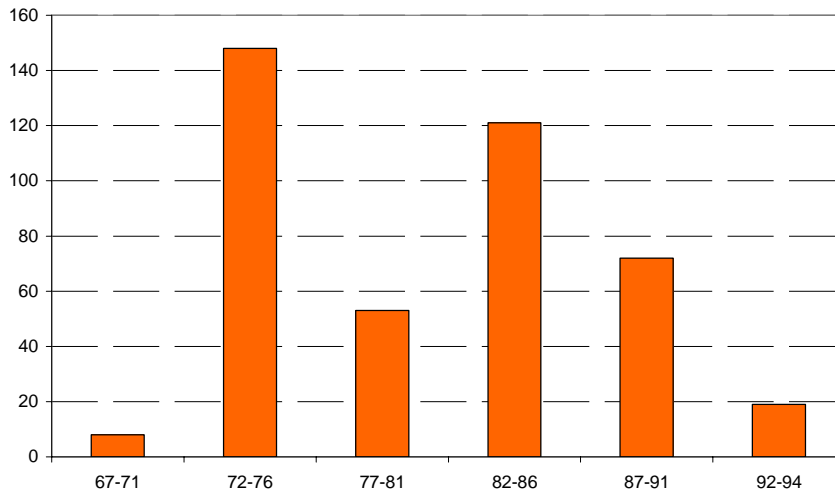
- Licencee in Meteorological Sciences
- University Technician (Specializations: Synoptic Meteorology, Climatology, Agricultural Meteorology and Hydrometeorology)
- Doctor in Atmospheric Sciences.

In 1989, the Curricula of the Licencee on Atmospheric Sciences were modified, the University Technician career was discontinued and the University Bachelor in Atmospheric Sciences was created. In 1994 the Licencee in Oceanography was created. From 1994 the Department received its current name and it is responsible of the following careers:

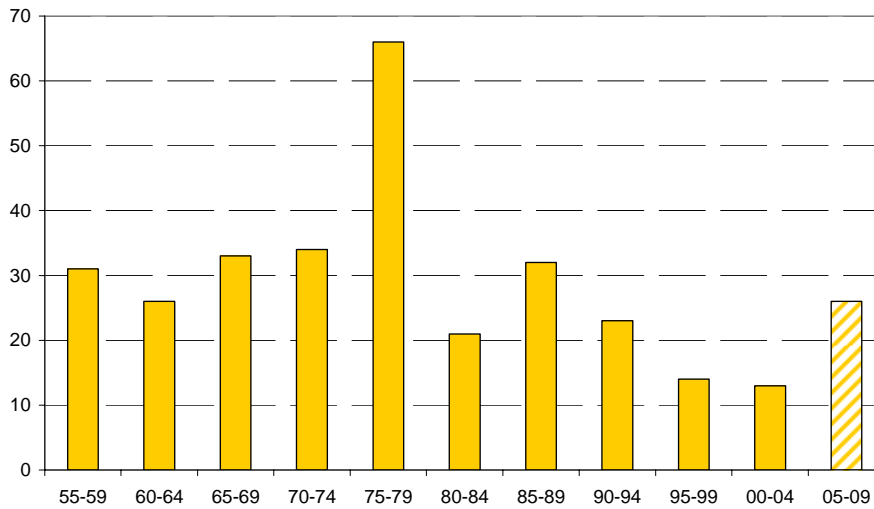
- Licencee in Atmospheric Sciences
- Licencee in Oceanography
- Bachelor in Atmospheric Sciences (with 4 specializations)
- PhD in Atmospheric Sciences
- PhD in Oceanography

The following graph depicts the number of University Technicians and Licencees in Meteorology that obtained their diploma from 1967 to 1994.

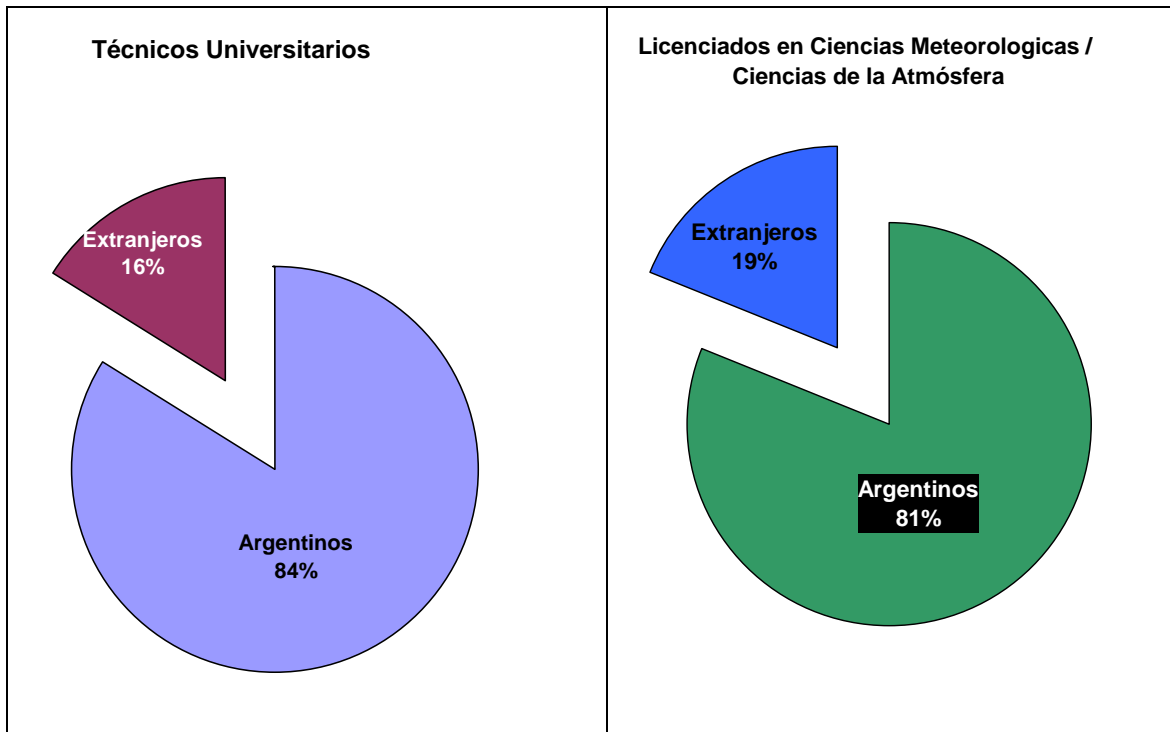
EGRESADOS - TECNICOS UNIVERSITARIOS



Egresados - Licenciatura Ciencias Meteorológicas / Ciencias de la Atmósfera



Before 1989 in the case of University Technicians and 1991 for Licencees, foreign students from different countries in South and Central America have obtained their diplomas at RTC University Argentina.

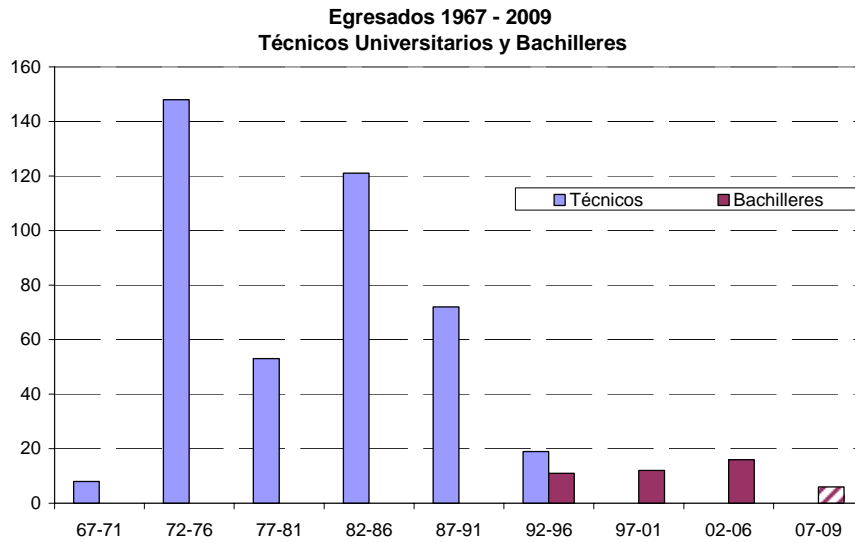


The Table provides the detailed information about the countries from which they belong:

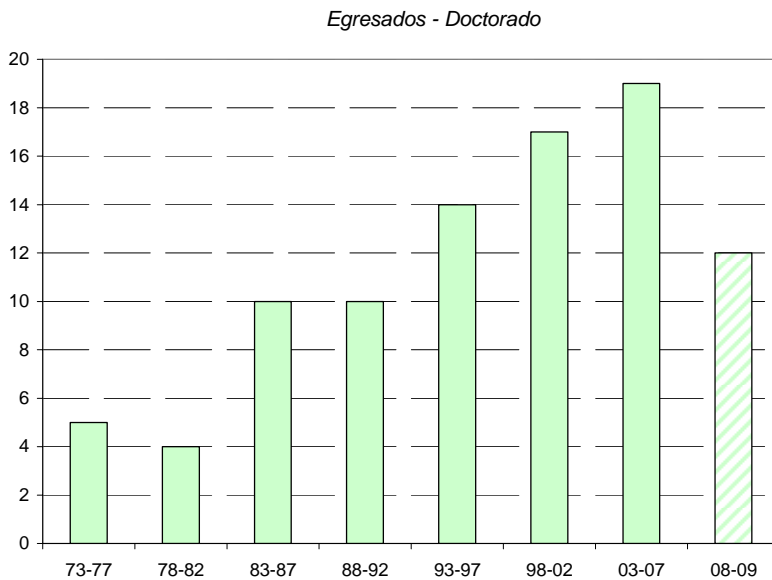
	<i>Technicians</i>	<i>Licencees</i>
Bolivia	11	
Perú	4	2
Paraguay	5	4
Chile	1	2
Uruguay	7	4
Brasil		10
Ecuador	14	2
Rep. Dominicana	7	
Panamá	1	
Honduras	4	1
Costa Rica	4	
El Salvador	7	6
Guatemala	1	
Venezuela		15
Colombia		6

The curricular changes introduced in 1989, with the discontinuation of the University Technicians career and the start of the Bachelor in Atmospheric Sciences, are thought as one of the main causes of the decrease in the

number of students at the Department, as could be appreciated in the following graph:



Contrarily to the observed decrease in the number of students that graduated from 1980, the postgraduates have significantly increased, as illustrated in the graph:



Appendix II

Brief report of the Workshop on 4D-Var and Ensemble Kalman Filter Intercomparisons and the Intensive Course on Data Assimilation

By Prof. Eugenia Kalnay

The Workshop on 4D-Var and Ensemble Kalman Filter Intercomparisons that took place in Buenos Aires, 10-13 November 2008, was very successful. It had more than 130 participants, about 40 from Latin America, and the rest from North America, Europe and Asia. It had the participation of most leading experts in 4D-Var and EnKF, for both operational and research applications, as well as many young researchers from all over the world. It was generously supported by the WMO, NSF, Argentine Ministry of Science and Technology, the Centro de Investigacion para el Mar y la Atmosfera, the Argentine National Weather Service, the Departement of Atmospheric and Oceanic Sciences and the Centro Argentino de Meteorologos.

The sessions were structured around broad themes: Introductory Review, Balance, Issues of Non-linearity and non-Gaussianity, Model Errors, Background Error Estimation, Computational Issues, Validation and Intercomparisons, and Synergistic Approaches. Each one started with a poster session, followed by 2-3 invited talks on the subject including both 4D-Var and EnKF approaches, and ended with extensive open discussions. Many theoretical and applicational studies were presented and openly discussed. The schedule, presentations and posters are all available at <http://4dvarenkf.cima.fcen.uba.ar/>

The most comprehensive inter-comparison study was presented by Martin Buehner of Environment Canada, where versions of the 4D-Var and EnKF similar to those used in operations but modified to have similar resolution were compared for February 2007. The conclusions were that the high-resolution medium-range global deterministic forecasts initialized with either 4D-Var (Bnmc) or EnKF (ensemble mean) analyses have comparable quality, with virtually identical scores. In this case 4D-Var used the NMC method for the background error covariance, as in operations. 4D-Var using instead the flow-dependent EnKF covariances (4D-Var Benkf) yields a gain of ~10 hours at day 5 in southern extra- tropics.

Many promising approaches such as methods to deal with model errors and non-Gaussianity, more efficient localization, hybrid approaches combining both methods, were presented and discussed, and it became clear that both methods can benefit from what is learned in the other (synergy).

Intensive Course on Data Assimilation

The Workshop was preceded by an Intensive Course for Data Assimilation, also generously supported by the WMO, NSF, Argentine Ministry of Science and Technology, the Centro de Investigaciones del Mar y la Atmósfera, the Argentine National Weather Service, the Department of Atmospheric and

Oceanic Sciences and the Centro Argentino de Meteorólogos. The University of Buenos Aires (Facultad de Ciencias Exactas y Naturales) provided their facilities including the Aula Magna for the lectures, and two computer laboratories for the computer exercises. The need for such a course was reflected in the fact that more than 140 applications were received, generally of well qualified students or young researchers. Of these about 95 were accepted, many of them with modest but essential support from the WMO and Ministry of Science and Technology.

The first week (27 October to was an introduction to data assimilation, including 4D-Var and EnKF, radiative transfer and forward observational models. During the second week (3-7 November 2008), many participants of the Workshop generously came earlier and gave lectures on topics such as a review of data assimilation at ECMWF and JMA, information content, hybrid and coupled ocean-atmosphere data assimilation, adjoint models, nonlinearity and Gaussianity, and Bayesian Quality Control. The students were organized in groups and gave presentations on results they obtained comparing background error covariances from 3D-Var and EnKF with the SPEEDY model, Observing System Simulation Experiments, and many other topics that indicated they were able to acquire a remarkably solid understanding of data assimilation theory and practice during the two week course.

The schedule of the course, lectures, and most importantly, the computational exercises with both a Lorenz toy model and with the SPEEDY global primitive equations model are available on

<http://4dvarenkf.cima.fcen.uba.ar/course/en/index.php?m=2>

Appendix III **Proposal of a Specific Course on Aeronautical Meteorology**

In order to *meet national, regional and international requirements in special areas; strengthen cooperation; contribute to the update in priority topics; develop, apply and shear tools, materials and methodologies among training centers,*

As the responsibility of the DCAO as the **University Component -Regional III** of the **World Meteorological Organization** and as a follow-up of the following activities:

- Working Group on Distance Education Meteorology, Lima, Perú, 1 to 3 July, 2008
- Regional Training on Satellite Techniques on Meteorology, Regions III and IV, Córdoba, Argentina, 23 September to 3 October, 2008
- Training Seminar on the Management of Meteorological Training Institutions, which took place in Langen, Germany, 20 to 24 October, 2008: a joint proposal of Argentina and Costa Rica representatives was to offer courses for the Spanish speaking countries on Regions III and IV.

A **Course on Aeronautical Meteorology** is proposed based on four correlative modules:

Modules:

1. Fog, low stratus and visibility reduction
2. Icing
3. Storms
4. Turbulence

The course is motivated by:

- Joint Interest of DCAO and National Weather Service as components of the Regional III - WMO
- Attend OACI and WMO requirements

DCAO will coordinate and administrate the courses.

As a **First Stage** the proposal involves **face to face** courses and a **Second Stage** considers “**distance learning**” modality. An **Itinerant Option** is offered for the face-to-face course

During the first year two courses could be offered

Minimum Pre-requisites: WMO High Level Technicians and “Bachelors in Atmospheric Sciences”.

Duration: 2 weeks (60 hr total) each module

Features: Theoretical and practical with laboratory work, with 2 teachers selected by DCAO (not only DCAO professors).

Evaluation: final exam

Estimated costs for each module on **face-to-face** courses for 15 students maximum: U\$S 5000.

Infrastructure: room with 15 computers, digital media and Internet access.

Language: Spanish

The **Itinerant Option** must add the travel and living costs for two professors during two weeks and the requirement of the necessary infrastructure at the host institution

The estimated **cost** of the **first course** with **distance learning** is U\$S 16000 each module, which includes two weeks of intensive course and one week for evaluation, servers y specialized assistance in the informatics and distance education areas.

Topics outline

Module 1:

Fog, low stratus and visibility reduction

- Fog: definition and types
- Effects of precipitation in visibility reduction
- Forecasting tools on fog and low stratus (in different geographical environments)
- Low clouds and fog diagnosis using satellite images
- Visibility reduction due to dust, sand and volcanic ash
- Case studies

Module 2:

Icing

- General features and impact on aviation
- Physical processes in the development of condensate and solid fases and transformations
- Favorable environments
- Forecasting Tools
- Case studies

Module 3:

Storms

- General features and impact on aviation
- life cycle of storms
- Supercels conceptual model
- Clouds related to convection
- Squall lines
- Mesoscale Convective Systems

- Observations: Satellite and Radar Images
- Forecasting Tools
- Case studies

Module 4:
Turbulence

- General features of types and turbulence origin
- Impact on aviation
- Clear air Turbulence
- Mechanical Turbulence
- Convective Turbulence
- Orographic Turbulence
- Case studies