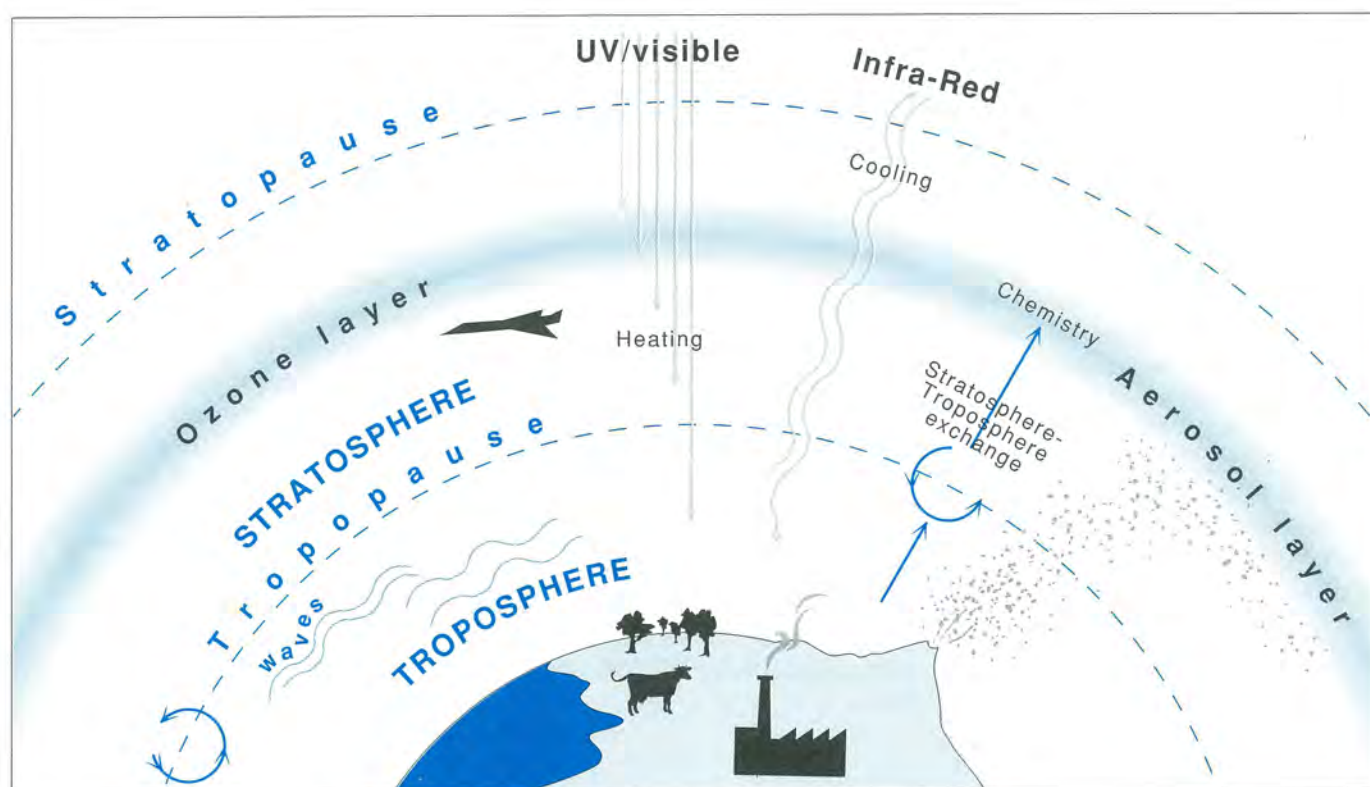


SPARC¹⁹⁹³ newsletter n° 1

July

STRATOSPHERIC PROCESSES AND THEIR ROLE IN CLIMATE
A Project of the World Climate Research Programme



Processes affecting the troposphere-stratosphere system

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Greetings from SPARC

It is a pleasure to bring you the first newsletter of SPARC (Stratospheric Processes And their Role in Climate) which is a project of the World Climatic Research Programme (WCRP). Until now, the WCRP has emphasised the ocean-troposphere system in its studies of climate, but in implementing the SPARC project in March 1992, the Joint Scientific Committee (JSC) of the WCRP has recognised that the stratosphere can play an important role in many aspects of climate change. For instance, one should consider what effects anthropogenic changes in stratospheric ozone might have on climate. Also, the recent eruption of Mt. Pinatubo in the Philippines has once again illustrated how volcanically induced changes in the stratospheric aerosol veil can influence climate. It is finally becoming clearer that the stratospheric changes resulting from the increasing concentration of greenhouse gases must be considered both in identifying and evaluating greenhouse influences on the troposphere.

In recognition of these facts, the JSC decided in March 1992 to implement a programme called Stratospheric Processes And their Role in Climate with four

major research themes : (1) The influence of the stratosphere on climate, (2) Process studies associated with stratospheric ozone change, (3) Stratospheric variability and Monitoring and (4) Monitoring and Modelling of UV irradiance changes.

An international SPARC Scientific Steering Group (SSG), appointed by the JSC, is chaired by Marie-Lise Chanin and Marvin Geller. In addition, ex-officio members were named to represent the relevant IGBP Core Projects : Global Change and Terrestrial Ecosystems (GCTE), Joint Global Ocean Flux Study (JGOFS), Land-Ocean Interactions in the Coastal Zone (LOICZ), as well as the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP), the Global Atmospheric Watch (GAW), the Scientific Committee on Problems of the Environment (SCOPE), the International Centre for Theoretical Physics (ICTP) and the Committee on SPACe Research (COSPAR). The SSG will be in charge of defining the future SPARC activities.

The first informal meeting of the SPARC SSG was held on September 19-20, 1992 in conjunction with a NATO Advanced Study Institute on «The Role of the Stratosphere in Global Change» (14-25 Sept. 1992, Carqueiranne, France). During this meeting, the SPARC Scientific Objectives were discussed. A document on this subject will be soon published as a WCRP document. A SPARC Project Office has been set up in France that has taken the responsibility in the organisation of SPARC activities.

We greatly appreciate the comments on the formats and contents of this newsletter. We also encourage the submission of news of interest including plans for campaigns and recent publications which may be of interest to the SPARC community. The news and comments may be directly submitted to the SPARC Office in Verrières-le-Buisson.

● Marie-Lise Chanin,
● Marvin Geller,
SPARC Chairpersons

Composition of the SPARC OFFICE

Chairperson :
M.L. Chanin

Project scientist :
S. Chandra

Assistant :
M.C. Torre

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SPARC Scientific Steering Group

Co-chairpersons

M.L. Chanin (France)
M. Geller (USA)

Members

D. Ehhalt (Germany)
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IGBP/JGOFS : J. Priddle (UK)
IGBP/GCTE : H. Mooney (USA)
SCOSTEP WG 1 : P. Simon (Belgium)
SCOSTEP WG 5 : K. Labitzke (Germany)
WMO/GAW : R. Bojkov (Canada)
SCOPE : E. De Fabo (USA)
COSPAR : J. Gille (USA)
ICTP : S. Radicella (Argentina)

Initial discussions on the organisation of SPARC

Most members of the SPARC SSG participated in the Advanced Study Institute on the Role of the Stratosphere in Global Change in Carqueiranne, France, 14-25 September 1992, and the opportunity was taken to arrange initial discussions (19-20 September) on the organisation of the WCRP/SPARC programme and plans for further activities. The SSG laid out its preliminary ideas of what its role should be and what it saw as the objective of internationally co-ordinated SPARC activity on top of the existing programmes. The following points were made :

I - The SSG should establish an overall scientific research strategy and identify the key scientific issues that need to be addressed to understand the impact of stratospheric, chemical, dynamical and radiative processes on global climate. The Steering Group should promote studies of specific questions which are not being addressed.

II - The Steering Group should ensure that existing and planned stratospheric monitoring programmes provide adequate information to study the wide range of data needed to study the important coupled dynamical-radiative-chemical processes in the stratosphere. An essential role in this regard is also to foster the appropriate co-ordination between the many different monitoring activities in order to gain maximum benefit from otherwise independent efforts (one example quoted in this context was the benefit that could be derived through increased interaction between the EASOE and AASE-II programmes).

III - SPARC should provide the means of bringing together the many different disciplines currently involved in studying often individual aspects of stratospheric physics and chemistry. The Advanced Study Institute which provided the opportunity for the present initial discussions on the SPARC

programme had been an effective forum in this respect. Other such meetings should be arranged under SPARC auspices, as well as the organisation of SPARC-oriented sessions at multi-disciplinary meetings such as EGS or IAMAP assemblies.

IV - SPARC should be an international umbrella programme providing compelling scientific arguments for justifying specific stratospheric research activities at a national or regional level and for securing resources from science funding agencies for such research.

V - The SPARC Scientific Steering Group (SSG) should become a focal point for formulating consistent and generally agreed scientific views on questions relating to stratospheric change (e.g. for input to IPCC).

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SPARC Major Themes

Focus 1 : The influence of the stratosphere on climate

Objectives: (I) Study the Influence of the Stratosphere on Tropospheric Climate, and (II) Assess the Potential Role of Stratosphere/Troposphere Interactions in Climate Change

Focus 2 : Process studies associated with stratospheric ozone decrease

Objectives: (I) Study Chemical and Aerosol Processes, (II) Dynamical Transport of Chemical Constituents, and (III) Radiative-Dynamical-Chemical Interactions

Focus 3 : Stratospheric variability and monitoring

Objective: Understand the Variability of Long-Term Trends in the Stratosphere

Focus 4 : Monitoring and modelling of UV irradiation changes

Objectives: (I) Modelling and Experimental Validation of UV Penetration, and (II) Establishment of UV Climatology and prediction

The NATO Advanced Study Institute on «The Role of the Stratosphere in Global Change»

Carqueiranne, France, 14-25 September, 1992

SPARC organised its first lecture series on «The Role of the Stratosphere in Global Change» under the auspices of the NATO Advanced Summer Institute (ASI) at Carqueiranne, France from September 14 to September 25, 1992. The thematics of the NATO ASI covered a wider range than the traditional Stratospheric Summer School as it included lecturers not only from the stratospheric community but also climate specialists and biologists.

4 This NATO ASI focused first on the basic radiative, dynamical and chemical processes taking place in the Stratosphere and the representation of the Stratosphere and more generally of the Troposphere-Stratosphere system by increasingly sophisticated models. The major issue of concern was how stratospheric changes may impact the troposphere. Models of the present state of the coupled stratosphere-troposphere system and predictions of its future state were presented and discussed in the light of the recently updated trend determination of both stratospheric ozone and temperature.

Stratospheric changes, which may occur either from natural variability (e.g. solar, volcanic) or from anthropogenic forcing were presented and discussed in order to delineate the different components of the observed variability and assess the stratospheric global trends. It was clearly stressed that continuous monitoring of the basic parameters of the stratosphere and of the consti-

tuents responsible for their change is urgently needed and should be performed in a complementary manner from space and from the ground, in order to obtain both global coverage and absolute calibration of the satellite data. The plans for such monitoring were presented.

Although it is now well established that polar stratospheric clouds (PSC) interacting with anthropogenic chlorine and bromine species are causing ozone depletion in the Antarctic, key questions related to the global consequences of similar processes occurring at Northern latitudes and in connection with stratospheric aerosols are still under discussion. This was even of higher concern than ever in recent years after the eruption of Mt. Pinatubo. Preliminary results from the latest Arctic and Antarctic Ozone campaigns (AASE I and II, EASOE) and from the recently launched UARS satellite and ATMOS missions were presented relating to this issue.

One of the expected consequences of changes in the stratospheric composition, mainly the ozone depletion, is the change in the penetration of UV-B in the troposphere, at the surface, and in the top layers of the ocean. Modelling of those changes shows that the implications may be of utmost importance for the whole biosphere. A coordinated monitoring network for UV-B is still in infancy however, even though a large number of organisations are concerned

and convinced that the issue requires urgent action. The four major aspects of the consequences of UV-B changes on aquatic ecosystems, terrestrial vegetation and human health were presented by biologists experts in these different fields. These sessions on UV-B and the biospheric aspects of stratospheric change raised strong general interest, and the future interaction among physicists, chemists and biologists was the subject of intense discussion and planning.

This NATO ASI was very timely, especially considering the recent implementation of the new SPARC programme which is pleased to bring out a book entitled, «The Role of the Stratosphere in Global Change» based on the lectures presented at Carqueiranne. This book is being published by the Springer-Verlag Co. It contains most of the lectures given during the two weeks (see the contents of The Role of the Stratosphere in Global Change) and should be a useful reference for those wishing to contribute to the understanding of the role of the stratosphere in climate and Global Change. It is also hoped that it will be useful for the biologists who desire to work closely with SPARC within their own organisations, so that a close cooperation can be maintained between these communities.

The Role of the Stratosphere in Global Change

Edited by M. L. Chanin

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Processes associated with Stratospheric Ozone Decrease : Homogeneous Chemistry : E.E. Ferguson

Heterogeneous Chemistry of Polar Stratospheric Clouds and Volcanic Aerosols : R.P. Turco, K. Drdla, A. Tabazadeh, P. Hamill

Mixing Processes in the Extra Tropical Stratosphere : M. Schoeberl, J.T. Bacmeister

The Methane Atmospheric Cycle : I.L. Karol

Part II. Modelling of the Troposphere - Stratosphere System

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Implications of increased Solar UVB for Terrestrial Vegetation : M. M. Caldwell, S. D. Flint

Implications of increased Solar UVB for Cancer Incidence : B. K. Armstrong

Ultraviolet-Induced immune suppression and its relationship to stratospheric ozone depletion : E. C. De Fabo, F. P. Noonan

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Heidelberg 1, Germany

Meetings relevant to SPARC

In the past

Sept 1992 : NATO ASI «The Role of the Stratosphere in Global Change», Director : M-L Chanin, Carqueiranne, France.

May 1993 : Sparc Session, Convenors : M-L Chanin, K. Labitzke, Wiesbaden, Germany.

July 1993 : SPARC Symposium at the IAMAP meeting, Convenors : H. Tanaka, M-L Chanin, Yokohama, Japan.

In the future

Sept. 1993 : NATO ARW on Stratosphere-Troposphere exchange, Convenors : J. Holton, P. Haynes, Cambridge, UK.

April 1994 : SPARC Session at the EGS Assembly «Dynamical processes in the stratosphere relevant to natural variability and climatic changes» Convenors : A. O'Neill, M-L Chanin, Grenoble, France.

1994 : NATO ARW « The Effect of Pinatubo» Convenor : G. Fiocco, Italy.

1994-1995 : NATO ASI on «Stratospheric Dynamics and its Coupling with the Troposphere» Convenor : G. Brasseur.

EGS-SPARC session in Wiesbaden May 6 1993

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SPARC organised a one-day session on May 6, 1993, at Wiesbaden, Germany, under the auspices of the European Geophysical Society. A total of 13 papers were presented at this session including 10 invited papers. These papers covered a wide range of topics related to troposphere-stratosphere interactions and its possible implications for climate change. Dr. J. Mahlman set the theme of this session by giving an excellent review on the changes in climate forcing caused by recent increase in greenhouse gases. He showed how the recent decrease in stratospheric ozone may have partly compensated for the warming caused by greenhouse gases such as CH₄, CFC's, and N₂O. He also presented some new results on coupled radiative-chemical-dynamical modelling of the Antarctic ozone hole which showed some very interesting impacts on the global stratosphere (see figure on page 7). Dr. K. Shine discussed changes in radiative forcing of the troposphere caused by recent decrease in total column ozone. He stressed the need for a better knowledge of height dependence of on-going changes in ozone because of its impact on radiative forcing affecting climate. Dr. S. Madronich, Dr. C. Granier and Dr. I. Isaksen, discussed the chemical implications of the ozone decrease in the stratosphere on the tropospheric gases. One of the major new results concerned the feedback of the observed ozone depletion on the increase of

OH and therefore the decrease of methane and tropospheric ozone. Dr. F. Arnold discussed the potential impact of increasing air traffic on the atmosphere. He suggested that the future increase in stratospheric subsonic and supersonic air traffic may have significant climatic impact as a result of perturbations in ozone, water vapour content, aerosol and possibly CNN and cirrus clouds.

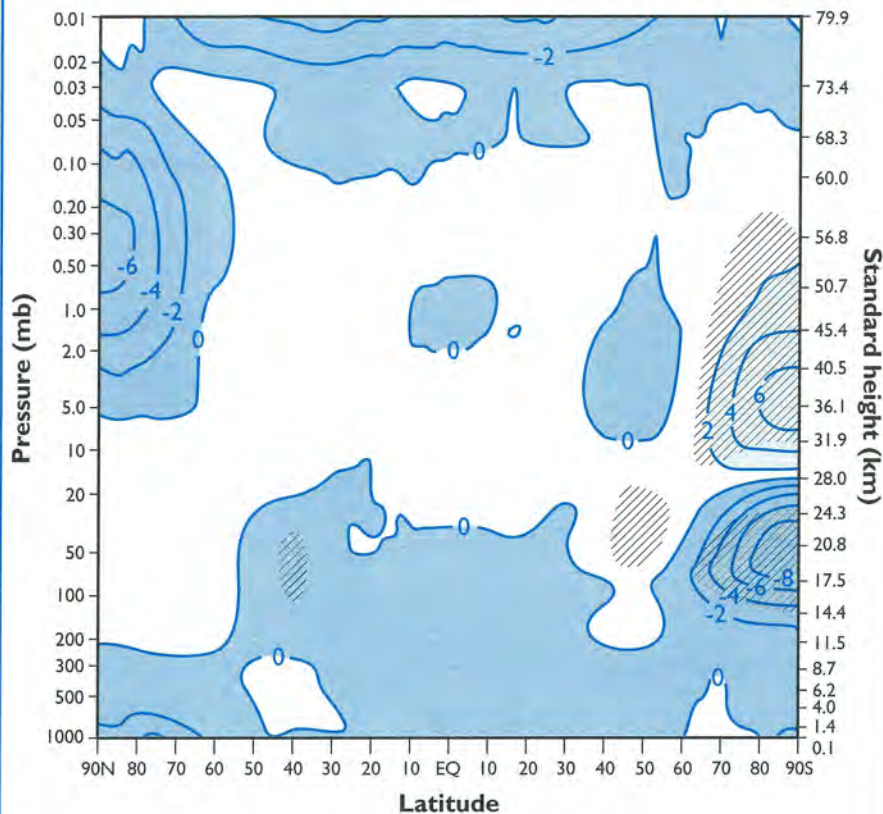
Prof. M. Geller and Dr. G. Reid discussed the dynamical aspects of the coupling between the troposphere and the stratosphere with a special emphasis on the sea surface temperature, El Niño, and QBO. Prof. Geller emphasised the importance of non-linear processes in relating the troposphere-stratosphere interactions. Dr. Reid discussed the implications of troposphere-stratosphere coupling that is implied by observations of the tropical tropopause. He emphasised the roles of localised convection as well as those of the large-scale Hadley and Walker circulation in the tropical atmosphere. The rising of the tropopause height observed in the equatorial region could be a sign of greenhouse warming. Dr. Stordal discussed a new 2-D model of the troposphere, stratosphere and the mesosphere which solves the potential vorticity equation for a single planetary-scale Rossby wave in conjunction with conventional equations for zonal mean scale. Dr. Kodera, discussed the problems related to modelling the influence of solar cycle in

GCM and stressed the need for improving the numerical models in simulating the solar UV effects on atmospheric dynamics.

Dr. L. Hood, using recently reprocessed ozone data from the Nimbus-7 SBUV spectrometer and the NMC temperature, estimated both the linear trend and the solar cycle component of ozone and temperature in the stratosphere from 20 to 50 km. He indicated that the cooling associated with the O₃ depletion at 15-18 km was mostly localised in the SH tropics where it reaches about 0.1 K/year. He attributed a positive change of about 3-4% in ozone and 4 K in temperature at 45 km related to increase in solar activity from solar minimum to solar maximum. Dr. Jager presented a time history of aerosol measured at Garmish-Partenkirchen, Germany since 1976. His analysis indicates an increase of 5% per year in stratospheric background aerosol mass. He suggested that anthropogenic sources may be contributing to the steady increase in aerosol background since 1987.

There was general agreement at this meeting that recent changes in stratospheric ozone and aerosol background has affected both the radiative and chemical properties of the stratosphere and the troposphere even though such changes are difficult to quantify. It was also clear that much model development as well as better observations are needed to better understand stratosphere-troposphere interactions.

Temperature Change Ozone Hole - Control December



The GFDL "SKYHI" 3-D model simulation of changes in atmospheric temperature related to Antarctic ozone hole. The figure shows December zonal-mean temperature change ($^{\circ}\text{C}$) between results from 5 years of the ozone hole model experiment and those from 6 years of the model with the unperturbed ozone. Regions where the statistical confidence for the change exceeds 99 % are shaded. The Antarctic region shows cooling exceeding 8°C in the lower stratosphere. Quite remarkably, the middle and the upper stratosphere in the same region shows warming ranging from 0° - 6° . This pattern of heating is consistent with a change in the meridional overturning rate characterised by the increased high Southern Hemisphere latitude sinking motion (causing warming) and compensatory increased rising motion at other latitudes. Note a pattern of weak cooling from about 40°S to 40°N . The statistically significant patch near 40°N may or may not be a physically real response. The nearly 6°C cooling at 50 km at Northern Hemisphere high latitudes is not statistically significant because this region in December is characterised by very high natural climate variability (Courtesy : Dr. J. Mahlman).

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Acronyms

AASE : Airborne Arctic Stratospheric Expedition
ARW : Advanced Research Workshop
ASI : Advanced Study Institute
ATMOS : Atmospheric Trace Molecule Spectroscopy
COSPAR : COmmittee on Space Research
EASOE : European Arctic Stratospheric Ozone Experiment
EGS : European Geophysical Society
ENSO : El Niño Southern Oscillation
GAW : Global Atmospheric Watch
GCTE : Global Change and Terrestrial Ecosystems

IAMAP : International Association of Meteorology and Atmospheric Physics
ICTP : International Centre for Theoretical Physics
IGBP : International Geosphere Biosphere Programme
IPCC : Intergovernmental Panel on Climate Change
IUGG : International Union of Geodesy and Geophysics
JGOFS : Joint Global Ocean Flux Study
JSC : Joint Scientific Committee
LOICZ : Land-Ocean Interactions in the Coastal Zone
PSC : Polar Stratospheric Clouds
QBO : Quasi-Biennial Oscillation

SCOPE : Scientific COmmittee on Problems of the Environments
SCOSTEP : Scientific COmmittee on Solar-TERrestrial Physics
SPARC : Stratospheric Processes And their Role in Climate
SSG : Scientific Steering Group
UARS : Upper Atmosphere Research Satellite
UV-A : 320-400 nm UV Wavelength Interval
UV-B : 280-320 nm UV Wavelength Interval
WCRP : World Climatic Research Programme

Position Open

SPARC project scientist for 1 year period beginning from January 1994. The candidate will work at the Project Office which is located at Service d'Aéronomie in Verrières-le-Buisson. His/Her duty will include the following :

- Publish SPARC reports and insure their updating
- Report to WCRP of all scientific activities of SPARC
- Organise with WCRP the SPARC-SSG yearly meeting

- Support SPARC Working Groups

- Help organising SPARC related Workshops & Schools

- Maintain contact with STEP, IGBP, SCOPE...

- Edit SPARC publications including a SPARC booklet, a SPARC poster...

The work is expected to take about 25 hours per week and the remaining time can be used for research at Service d'Aéronomie. The

position is suited for scientists willing to spend their sabbatical leave in France. The SPARC Office can only cover the expenses related to staying in France.

For more details, please write to :

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France.

To our readers

We are striving to reach every one who is interested in the SPARC programme. We would appreciate your sharing this newsletter with your colleagues who may be interested in our programme. We would also appreciate your returning the following form to our SPARC Office (CNRS, Service d'Aéronomie, BP 3, 91371 Verrières-le-Buisson, FRANCE) with your current address and comments.

Name : MR./MRS./DR.

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Address correction ? yes - no (circle one)

Do you wish to receive the newsletter ? yes - no (circle one)

Comments

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