

Table of contents

Preface	XIX
----------------	-----

CONFERENCE REPORT

On climate change	XXIII
<i>J.P. Pronk</i> , Netherlands minister of Housing, Spatial Planning and the Environment	

Summaries

Methane: progress on source strength	XXV
<i>E. Scheehle and I.S.A. Isaksen</i>	
Progress in source strength estimates of nitrous oxide (N ₂ O)	XXIX
<i>C. Kroeze and A. Mosier</i>	
Source strength estimates - fluorinated gases	XXXV
<i>J. Harnisch and S.D. Rand</i>	
Short-lived atmospheric species and their impact on climate	XXXVII
<i>A.P.M. Baede and R. Guicherit</i>	
Inventories, uncertainties and verification	XLI
<i>J.G.J. Olivier and K. Rypdal</i>	
Mitigation of emissions	XLV
<i>D. de Jager and J. Gale</i>	
Economic and policy aspects	XLVII
<i>J. Williams-Jacobse and D. Kruger</i>	
Round Table discussion on initiatives on climate change mitigation in developing countries	XLIX
<i>C.M. Farouque</i>	

OPENING SPEECHES

Welcome	LIII
<i>J.K. Mak</i> , president Netherlands Association of Environmental Professionals (VVM)	
Opening address	LV
<i>C.M. Zwartepoorte</i> , Netherlands Ministry of Housing, Spatial Planning and the Environment	
Keynote address	LIX
<i>H. Thorgeirsson</i> , chairman UNFCCC-SBSTA	
Address on behalf of IPCC	LXI
<i>B. Metz</i> , co-chairman IPCC Working Group on Mitigation	
Interest of the European Commission in non-CO ₂ greenhouse gases	LXV
<i>M. Vainio</i> , European Commission, Environment Directorate-General	
FAO involvement in climate change	LXIX
<i>M.D. Sanchez</i> , Inter-Departmental Working Group on Climate Change, FAO	
Non-CO ₂ greenhouse gases: progress and prospects	LXXI
<i>D. Kruger</i> , United States Environmental Protection Agency	

PAPERS

Review paper

- Greenhouse gases and atmospheric chemistry: towards integration of air pollution and climate change policies 1
F. Dentener and F. Raes

For other reviews refer to respective chapters.

THEME 1 SCIENTIFIC UNDERSTANDING: SOURCES AND SINKS

Agricultural sources for methane and nitrous oxide

- NCGG and carbon emissions and sinks from and into agricultural systems 17
Lin Erda, Li Yu'e and Guo Liping
- Simulated effects of tillage and timing of N fertilizer application on net greenhouse gas fluxes and N losses for agricultural soils in the Midwestern USA 23
S.J. Del Grosso, D.S. Ojima, W.J. Parton and A.R. Mosier
- Non-CO₂ greenhouse gas emissions from agricultural sector in Russia 29
A.A. Romanovskaya, M.L. Gytarsky, R.T. Karaban', I.M. Nazarov and D.E. Konyushkov
- The N₂O and CH₄ exchange of typical Black Forest soils with the atmosphere 35
H.P.F. Jungkunst, S. Fiedler and K. Stahr
- Reducing uncertainties to agricultural greenhouse gas inventories through improved inventory methodologies and activity data 41
J.M. Mangino and T. Wirth
- Effect of urea and nitrification inhibitors on methane consumption 43
D. Majumdar and S. Mitra
- Modelling the emissions of methane and nitrous oxide from dairy cattle 45
M. Plöchl, W. Berg and R. Brunsch
- Coping with scale issues in modelling nitrous oxide and methane emissions from soils 47
C.A. Langeveld and P.A. Leffelaar
- N₂O and CH₄ emission after surface application or injection of anaerobically digested cattle slurry 49
H.C. de Boer, G. Holshof, R.L.M. Schils and A. Van den Pol-Van Dasselaar
- Gaseous emissions from systems for pig slurry treatment 51
R.W. Melse, D.A.J. Starmans and N. Verdoes

Miscellaneous sources for methane and nitrous oxide

- Effect of forest fire on fluxes of CH₄ and N₂O in boreal forest soils, Interior Alaska 55
Y.W. Kim, N. Tanaka, M. Fukuda and K. Kushida
- SO₂, NO_x, organic and elemental carbon emission studies from biofuels used in India 61
R. Gadi, A.K. Sarkar, D.C. Parashar, A.P. Mitra and U.C. Kulshrestha
- N₂O and CH₄ emissions from different power plant processes 67
M. Fabritius, S. Korhonen, H. Hoffrén and J. Leskelä

Scenario study: development of non-CO ₂ greenhouse gas emissions in the land transport sector	73
<i>J. Linssen and M. Walbeck</i>	
Contribution to non-CO ₂ greenhouse gases inventory for Cotonou (Republic of Benin): waste sector	79
<i>G.H.S. Guendéhou and E.D. Ahlonsou</i>	

Sources and sinks of methane

Further correction of numerical estimations for anthropogenic methane emissions from Western Siberia gas deposits by applying 3D regional transport model in direct and inverse modes	85
<i>S.V. Jagovkina, I.L. Karol, V.E. Lagun, A.L. Reshetnikov, A.V. Zinchenko and N.N. Paramonova</i>	
Estimate of United States methane emissions from industrial wastewater; enhancing completeness of the annual national greenhouse gas inventory	91
<i>M.R.J. Doorn and E.A. Scheehle</i>	
Methane emission by grazing livestock: some findings on emission determinants.	95
<i>K.R. Lassey, C.S. Pinaro-Patiño and M.J. Ulyatt</i>	
Plant and soils factors associated with methane emission from irrigated rice ecosystems of Assam	101
<i>K.K. Baruah, N. Gogoi, B. Gogoi, S. Goswami, B. Barman and P.K. Gupta</i>	
Western Siberia natural methane emission assessment based on experimental data analysis and 3D regional modelling	107
<i>V.E. Lagun, S.V. Jagovkina and I. L. Karol</i>	
The role of domestic animals in production of GHGs in Iran	109
<i>A. Moharrery and A. Nikkhah</i>	
Methane emission from landfill sites and wastewater drains in big cities of India	111
<i>M.C. Jain, S. Kumar, G. Debnath, K.P. Sahu and S. Mitra</i>	
Characteristics of methane emission and its relations with soil carbon status and management practices under double rice systems	113
<i>L.P. Guo, Y.J. He, E.D. Lin and G.M. Zhang</i>	
Methane production and population dynamics of acetoclastic methanogens in rice rhizosphere	115
<i>S. Chawanakul, P. Chairasert, O. Kerchuechuen, S. Towprayoon and M. Tanticharoen</i>	

Sources and sinks of nitrous oxide

Calculation of regional budgets of N-trace gas emissions from soils using mechanistic models: results from a case study for Saxony, Germany	119
<i>K. Butterbach-Bahl, M. Kesik, P. Miehle, H. Papen and C. Li</i>	
N ₂ O-emission from tropical rain forest soils of the Wet Tropics, Queensland, Australia	125
<i>R. Kiese, H. Papen, K. Butterbach-Bahl and L. Breuer</i>	
Seasonal impact on N ₂ O source and sink potential in dry tropical climax forest and seral grassland in central India	131
<i>V.P. Singh, K. Kaur, P. Dass and S.K. Billore</i>	
Soil emissions of nitrous oxide from savannahs in Africa: estimating annual rates	139
<i>M. Andersson, A. Kjoller and S. Struwe</i>	

Simulation of nitrous oxide emissions from two grain maize cropped soils in the region of 'Middle Alsace'	145
<i>J. Hack and J.C. Munch</i>	
Denitrification and emission of N ₂ O from different soils and ¹⁵ N labelled fertilizers under anaerobic rice culture	147
<i>A.K. Patra, N.K. Banerjee and P.K. Chhonkar</i>	
Production of N ₂ O in grass-clover pastures	149
<i>M. Thyme and P. Ambus</i>	
The N ₂ O content of soil air at different depths as well as its related content in and transport by seepage in lysimeter soils.	151
<i>R. Russow, S. Knappe and H.-U. Neue</i>	
Nitrogen oxides emissions from European forest ecosystems	153
<i>N. Brüggemann and K. Butterbach-Bahl</i>	
Humans as a source of N ₂ O – Evidences from breath air analysis and ¹⁵ N tracer experiments	155
<i>R. Russow, H.-U. Neue, I. Wolf and Ch. Plath</i>	

N₂O production and emission in groundwater, riparian and vadose zones and freshwater aquatic systems

Review papers

Mechanisms, rates and assessment of N ₂ O in groundwater, riparian zones and rivers	159
<i>P. M. Groffman, A.J. Gold, D.Q. Kellogg and K. Addy</i>	
Methodical approaches for investigating the role of subsurface environments in the global N ₂ O budget	167
<i>R. Well</i>	
The concentration and distribution of groundwater N ₂ O in the Chalk aquifer of eastern England	179
<i>K.M. Hiscock, A.S. Bateman, T. Fukada and P.F. Dennis</i>	
N ₂ O discharge with drain water from agricultural soils of the upper Neckar region in Southern Germany	185
<i>J. Hack and M. Kaupenjohann</i>	
Fate of ¹⁵ NO ₃ ⁻ derived N ₂ O and denitrification products in the vadose zone during irrigation of soil columns	191
<i>T.J. Clough, D.E. Rolston, R.J. Stevens and R.J. Laughlin</i>	
Field and laboratory studies of N ₂ O turnover in the saturated zone of hydromorphic soils of Northwest Germany. I: N ₂ O surface emission and vertical distribution of concentrations and isotopomer signatures	197
<i>R. Well, O. Mehranfar, S. Toyoda and N. Yoshida</i>	
Field and laboratory studies of N ₂ O turnover in the saturated zone of hydromorphic soils of Northwest Germany. II: Laboratory incubations to determine total denitrification and N ₂ O production	199
<i>O. Mehranfar and R. Well</i>	
Determination of nitrogen isotope distribution in N ₂ O pool	201
<i>A.M. Zyakun</i>	
Release of water dissolved nitrous oxide by plants: Does the transpiration water flow contribute to the emission of N ₂ O?	203
<i>N.J. Ferch and V. Römheld</i>	

Sources of fluorine compounds

Estimating SF ₆ emissions from electrical equipment and magnesium production and processing in the U.S.	207
<i>D. O. Schaefer, S. Bartos and J. Blackman</i>	
Perfluorinated hydrocarbons in the primary aluminium processing – trends in the current decade	213
<i>W.R. Poganietz and P. Zapp</i>	
Determination of the fraction of blowing agent released from refrigerator/freezer foam after decommissioning the product	219
<i>P. Kjeldsen and C. Scheutz</i>	
International partnership for estimating greenhouse gas emissions	225
<i>T.E. Werkema, M. Cisneros and K.D. Smythe</i>	
A potential error associated with using chemical and equipment sales data to estimate greenhouse gas emissions from long-lived, pressurized equipment	229
<i>D. O. Schaefer</i>	

Inventories

N ₂ O emission from fertilizer use	233
<i>M. Lægveid and A.H. Aastveidt</i>	
Modelling nitrous oxide emission and inventory of German forest soils	239
<i>R. Brumme, H. Schulte-Bisping and E. Priesack</i>	
Another look at N ₂ O emission factors for agricultural soils, and implications for inventory calculations	245
<i>K.A. Smith and K.E. Dobbie</i>	
The effect of grassland conversion on CH ₄ and N ₂ O emissions and removals	251
<i>Li, Y., E. Lin, Z. Yang and Y. Wang</i>	
Global anthropogenic methane emissions	257
<i>E.A. Scheehle, W.N. Irving and D. Kruger</i>	
Development of consistent methodology for estimating greenhouse gas emissions from oil and gas industry facilities and operations	263
<i>M. Lev-on, K. Ritter, W. Retzsch and T. Shires</i>	
EU and Member States greenhouse gas emission trends and projections	269
<i>M. Ritter, B. Strobel, J. Bates, A. Gardiner, M. Cames, J. van Minnen and A. Jol</i>	
Nitrous oxide emissions from New Zealand agriculture: research to refine the national inventory	275
<i>C.A.M. De Klein, R.R. Sherlock, S.F. Ledgard, L. Barton, F.M. Kelliher, A.S. Walcroft and G. Rys</i>	
Indirect CO ₂ emissions from CH ₄ , CO and NMVOC oxidation: “the forgotten carbon in greenhouse gas emission inventories”	281
<i>M. Gillenwater, R. Lanza and R. Freed</i>	
Emissions of non-CO ₂ greenhouse gases in the Netherlands – an estimate for the period 2001-2010	283
<i>D. Beker and C.J. Peek</i>	
Identification of unknown sources of non-CO ₂ greenhouse gases, a theoretical approach	285
<i>M. de Groot, D. Jansen, K. van Dongen and V.A. Verburg</i>	
GHG emissions in Colombia 1998-2010	287
<i>F. González and H. Rodríguez</i>	

GHG emissions inventory and non-CO ₂ emissions: case of Russia <i>I.G. Gritsevich and A.Yu. Kolesov</i>	289
EDGAR 3.2: Reference database with trend data of global greenhouse gas emissions for 1970-1995 <i>J.G.J. Olivier, J.A.H.W. Peters, J. Bakker, J.J.M. Berdowski, A.J.H. Visschedijk and J.P.J. Bloos</i>	291

THEME 1 SCIENTIFIC UNDERSTANDING: ATMOSPHERIC MEASUREMENTS AND PROCESSES

Measurements and trends

Derived trends of CH ₄ in the stratosphere from HALOE measurements <i>P.K. Patra, S. Maksyutov and M.S. Santhanam</i>	295
Direct measurements of the long-term global increase in tropospheric nitrous oxide <i>R.F. Weiss</i>	301
Potential of the NDSC in support of the Kyoto Protocol: examples from the station Jungfrauoch, Switzerland <i>R. Zander, E. Mahieu, C. Servais, G. Roland, P. Duchatelet, P. Demoulin, L. Delbouille, C.P. Rinsland, M. De Mazière and R. Blomme</i>	305
Nitrous oxide emissions from three-way catalysts <i>H. Oonk, M. Feijen-Jeurissen, R. Gense and R. Vermeulen</i>	311

Ozone and atmospheric chemistry

Review paper

Atmospheric ozone and climate change <i>I.S.A. Isaksen and W.-C. Wang</i>	319
Model evaluation of the tropospheric CO and CH ₄ contents in the first half of the 21 st century <i>A.A. Kiselev and I.L. Karol</i>	331
Quantifying the contribution of ozone and stratospheric water vapour in a global chemistry/climate simulation <i>M. Ponater, C. Schnadt, M. Dameris, R. Hein and B. Steil</i>	337

Global Warming Potential

Review paper

Global Warming Potentials for non-CO ₂ greenhouse gases <i>R. G. Derwent, W.J. Collins, C.E. Johnson and D.S. Stevenson</i>	345
Indirect forcing from emissions of NO _x and CO: is the location of emissions important? <i>T.K. Berntsen, J.S. Fuglestvedt, M. Joshi, K.P. Shine, M. Ponater, R. Sausen and D. Hauglustaine</i>	363

Evaluating indicators for the relative responsibility for climate change – alternatives to the Brazilian proposal and global warming potentials <i>N. Höhne and J. Harnisch</i>	371
Climate response to inhomogeneously distributed forcing agents <i>R. Sausen, M. Ponater, N. Stuber, M. Joshi, K.P. Shine and L. Li</i>	377
Indirect global warming potentials of carbon monoxide and ozone <i>V.A. Frolkis, I.L. Karol and A.A. Kiselev</i>	383
The adequacy of current metrics of climate change and emission indices <i>J.S. Fuglestedt, O. Godal, T.K. Berntsen, T. Skodvin, K.P. Shine and R. Sausen</i>	389

THEME 2 CONTROL OPTIONS

Abatement of emissions of fluorine compounds

Abatement of emissions of the engineered chemicals <i>J. Harnisch and J.J. Gale</i>	397
Technology and economics of reducing PFC emissions from aluminium production <i>J. Marks, M. Atkinson, R. Chase and S.D. Rand</i>	403
Global semiconductor industry initiative to reduce PFC emissions <i>S.D. Rand, S.C. Bartos, C.L. Fraust, Y. Hayakawa and L. Klerks</i>	409
Existing and alternative vehicle air conditioning (A/C) systems <i>S.O. Andersen, W. Atkinson and J.A. Baker</i>	415
Abatement options and costs of reducing HFC, PFC and SF ₆ emissions in Finland <i>T.S. Oinonen and S.P.J. Soimakallio</i>	421
SF ₆ emission reduction in relation to switchgear <i>J.W. Wouda</i>	427

Abatement of methane emissions

Reduction of methane emissions from manure <i>M.A. Hilhorst, R.W. Melse, H.C. Willers, C.M. Groenestein and G.J. Monteny</i>	435
Mitigation of methane emission from paddy fields <i>D.C. Parashar, R. Gadi and A.P. Mitra</i>	441
Mitigation of methane emissions from disused coal mines <i>W. C. Davies</i>	447
Methane oxidation and degradation of halocarbons in landfill soil covers <i>C. Scheutz and P. Kjeldsen</i>	453
Reduction of CH ₄ emission from landfills via improved top soils <i>A. de Visscher, P. Boeckx, O. van Cleemput, H. Oonk and J.A. Woelders</i>	455
Rice cultivation by direct drilling and delayed flooding reduces methane emissions <i>A. Leip, G. Bidoglio, K.A. Smith, F. Conen and S. Russo,</i>	457
Anaerobic digestion of manure on dairy and pig farms <i>H.J.C. van Dooren, H.C. de Boer and A. van den Pol-van Dasselaar</i>	459

Abatement of nitrous oxide emissions

An assessment of the costs and global impact of nitrous oxide abatement measures <i>J.J. Gale and P. Freund</i>	463
Regional assessment of net greenhouse gas fluxes from agricultural soils in the USA Great Plains under current and improved management <i>S.J. Del Grosso, D.S. Ojima, W.J. Parton, A.R. Mosier and G.A. Peterson</i>	469
Reduction in methane and nitrous oxide emissions from animal slurry through anaerobic digestion <i>S.G. Sommer, H.B. Møller and S.O. Petersen</i>	475
<i>In vitro</i> screening of methane production from grass and maize silage based diets <i>H. van Laar, W.A.G. Veen, B. Vlaeminck, V. Fievez and D. Demeyer</i>	481
Mitigation options for CH ₄ , N ₂ O and NH ₃ emissions from slurry management <i>S. Wulf, R. Vandré and J. Clemens</i>	487
Suppression of nitrous oxide from agricultural soil-water system by on-site sulfur denitrification <i>K. Hasegawa, R. Kai and K. Hanaki</i>	493
Reduction of N ₂ O emission by introduction of precision fertilisation <i>G.J. Kasper, G. Holshof and A. van den Pol-van Dasselaar</i>	495
Co-fermentation of animal manure with organic wastes has potential to reduce emissions of greenhouse gases in the Netherlands <i>P.J. Kuikman and M. Buiter</i>	497
The impact of treated straw on CH ₄ emission from yellow cattle in China <i>H. Dong, E. Lin, Q. He, Y. Li and X. Tao</i>	499
Mitigation strategies of nitrous oxide emission from agricultural soils <i>C.M. Lai, W.C. Chiang, F.C. Liu and S.C. Yang</i>	501
Nitrous oxide emission from alluvial soils under rice-wheat cropping system in Indo-Gangetic plains of India: some mitigation options <i>M.C. Jain, H. Pathak, S. Kumar, A. Bhatia, S. Prasad and S. Mitra</i>	503
MITERRA-DSS: a decision support system to optimize the mitigation of greenhouse gas emissions from agriculture <i>G.L. Velthof, O. Oenema and P.J. Kuikman</i>	505
High temperature catalytic reduction of nitrous oxide emission from nitric acid production plants in the Netherlands <i>J. Kuiper and J.J.P.M. Goorden</i>	507

THEME 3 POLICY ASPECTS

Uncertainty of emission inventories and verification of emissions

Review papers

Verification of emissions by inverse modelling <i>R.G. Prinn</i>	511
Can we get rid of uncertainties in GHG inventories? <i>K. Rypdal</i>	517
Uncertainties in global, regional and national emission inventories <i>J.G.J. Olivier and J.A.H.W. Peters</i>	525
How to improve the monitoring of greenhouse gas emissions? <i>A. van Amstel, J.G.J. Olivier and P. Ruyssenaars</i>	541

Comparison of emission estimates derived from atmospheric measurements with national estimates of HFCs, PFCs and SF ₆ <i>N. Höhne and J. Harnisch</i>	547
Observations of halogenated greenhouse gases and estimation of European source strengths <i>B.R. Greally, P.G. Simmonds, S.J. O'Doherty, G. Nickless, A. McCulloch, S. Reimann, N. Schmidbauer, M. Maoiné, D.B. Ryall, R.G. Derwent and A.J. Manning</i>	553
The determination of agricultural methane emission fluxes based on air sampling and advanced modelling techniques <i>N.R. Gimson., K.R. Lassey, G.W. Brailsford, A.M. Bromley and M. Uliasz</i>	559
Emission measurements as a tool to improve methane emission estimates <i>H. Oonk, R. Vroon, H. Scharff, A. Henssen and D.M.M. Van Rijn</i>	565
Estimated emissions of halogenated greenhouse gases by analysis of on-line measurements at a high Alpine station (Jungfraujoeh) <i>S. Reimann, D. Schaub, A. Weiss, K. Stemmler and P. Hofer</i>	571
System for Observation of halogenated Greenhouse gases in Europe (SOGE): monitoring and modelling yielding verification and impacts of emissions <i>F. Stordal, N. Schmidbauer, P. Simmonds, B.R. Greally, A. McCulloch, S. Reimann, M. Maione, E. Mahieu, J. Notholt, I.S.A. Isaksen and R.G. Derwent</i>	573
On the impact of inventory uncertainties on non-CO ₂ greenhouse gas emission reduction options <i>M.A. Hilhorst, R.M. de Mol and C.J.H. Cozijnsen</i>	575
Verification of fluorinated greenhouse gas emissions from Ireland <i>A. McCulloch, S. O'Doherty, B.R. Greally, G. Nickles, P.G. Simmonds, R.G. Derwent, D.B. Ryall and T.G. Spain,</i>	577
The potential of SCIAMACHY to determine surface emissions of greenhouse gases and precursors <i>M. van Weele, H. Eskes, J.F. Meirink, I. Aben, H. Schrijver, A.G. Straume, M.C. Krol, P. Rayner, T. Butler and R. Law</i>	579

Policies for NCGGs

Stabilizing global methane emissions: a feasibility assessment <i>F.C. de la Chesnaye and D. Kruger</i>	583
Reaching reduction targets through co-operation: the Dutch reduction programme non-CO ₂ greenhouse gases (ROB) <i>J. Williams-Jacobse</i>	589
Australia's strategies for managing synthetic greenhouse gas emissions <i>J. Mummery and P. Curnow</i>	593
Australia's greenhouse gas abatement program and management of HFC emissions <i>P. Curnow</i>	599
The Greenhouse Gas Protocol: highlights of a corporate accounting and reporting standard <i>S. Haefeli and P. Bhatia</i>	601
Global climate change and the European refrigeration and air-conditioning industries <i>F.P. Busch and J.-P. Huguet</i>	607
HFC metered dose inhalers: a review of the medical, technological, economic and policy challenges <i>P. Wright</i>	615

The importance of local production of natural refrigerants in developing countries: case study Indonesia	621
<i>E.F.S. Dijkstra, J. Kodrajaya and C.H.M. Machielsen</i>	
TEWI: Total Equivalent Warming Impact: a practical approach	627
<i>M. Harmelink, D. de Jager, M. Kerssemeeckers, C. Hendriks and M. van Brummelen</i>	
Climate change mitigation strategy by multiple gas reduction	633
<i>A. Kurosawa</i>	
Combined greenhouse gas and SO ₂ -, NO _x -reduction strategies	635
<i>A. Fleury, W. Fichtner and O. Rentz</i>	

Economic aspects

Estimating methane mitigation in the USA and internationally beyond 2020	639
<i>K.C. Delhotal, F.C. de la Chesnaye and H.M. Pitcher</i>	
Development of an international marginal abatement curve for high Global Warming Potential gases	645
<i>D.R. Upson, J. Cohen, M. Van Pelt, J. King, C.S. Burton, D. Lieberman, P. Friedman, M. Barwis and R. Kantamaneni</i>	
Cost-effective abatement of nitrous oxide and methane from European agriculture considering interrelations with ammonia abatement	651
<i>C. Brink, E.C. van Ierland, L. Hordijk and C. Kroeze</i>	
Non-CO ₂ greenhouse gas emission reductions in the EU-15: reducing the costs of compliance to the Kyoto protocol	657
<i>D. de Jager, C. Hendriks, J. Harnisch, M. Harmelink, K. Blok, J. Bates, L. Mantzos and M. Vainio</i>	
Options for reducing GHG emissions in Colombia 1998-2010	663
<i>H. Rodríguez and F. González</i>	
Emissions of non-CO ₂ greenhouse gases from agricultural land and the implications for carbon trading	669
<i>K.A. Smith, F. Conen, B.C. Ball, A. Leip and S. Russo</i>	

Miscellaneous topics

Conflicting demands of Montreal Protocol & Kyoto agreement: an overview of eco-friendly refrigerants	673
<i>A. Agrawal, P.B. Sharma and R.K. Dave</i>	
Selection of safe refrigerant for mitigating ozone depletion and global warming: a case study of milk chiller	675
<i>A. Agrawal and R.K. Dave</i>	
Trend of stratospheric ozone at a location in Equatorial Africa	677
<i>S.E. Osaghaede and S.K. Muyiolu</i>	

Indexes

Participants list	681
Subject index	699
Authors index	711