THE REGIONAL SCIENCE ASSOCIATION INTERNATIONAL

RSAI

June 2011

Regional Science and Climate Change

The newsletter of the RSAI *New Series 5: June 2011*

Contents

1. Introduction

1.1 Welcome from the President: Yoshiro Higano

Greetings from Japan. I am delighted to be the president of RSAI for the next two years and look forward to taking the association onwards, especially in the Asian-Pacific region. I would like to thank outgoing President Roberta Capello for her energy and commitment to RSAI during the last two years. I shall report more on advances in Asia in the next newsletter.

In relation to climate change the UNFCCC (United Nations Framework Convention on Climate Change) have highlighted some key concepts or phrases: carbon neutral, renewable energy, low carbon society, recycling-oriented society, etc. Global warming, as the causative agent of climate change, is not a subject to be scientifically analysed or politically discussed for the sake of it – it is an urgent issue to be fixed for real by 2050 if we accept the IPCC (Intergovernmental Panel on Climate Change) scenarios for change. In order to combat climate change we need to conduct research from our own regional science perspectives. We must design a practically implementable scenario based set of actions using the latest scientific knowledge and technologies. In particular, scenario analysis must discuss the impacts on particular regions.

Typical examples of energy sources having carbon neutral properties are those of biomass and solar energy. Their availability and effectiveness will differ region by region. The spatial density of energy demand and supply is a key parameter for evaluation of any scheme. Proper adjustments, and a balance in the interregional (and international) inflow and outflow of materials, is a prerequisite for attaining a recycling-oriented society. A sudden economic or physical block of infrastructure and/or the supply chain caused by climate change, can cause the isolation of a region. Overall, proper precautions against such impacts must be made. It is widely thought that a multi-disciplinary approach must be taken to solve climate change issues. Environmental and risk communication among stakeholders in an international setting are essential to develop solutions. All these areas fit well in the field of regional science and provide fertile and vast research frontiers for our community. I believe that we as regional scientists are capable of treating the issues properly, backed not only by our accumulated scientific knowledge and experiences from more than a half century, but also by the flexible and diversified international structure of the RSAI. We must now contribute to fixing and stabilizing climate change issues.

1.2 Welcome from the Editors

Graham Clarke and
Eveline van Leeuwen

Welcome to this latest RSAI newsletter on the subject of climate change. This time we present you with three short

articles addressing the theme from very different parts of the world. We also have our usual features on 'meeting the Fellows' and a focus on a noted regional science research centre. In addition, we update the membership on the transfer of RSAI headquarters from Leeds to the Azores. This has presented a number of challenges and the new ED Tomaz Dentinho discusses these (and solutions!) later on. We would also like to welcome Yoshiro Higano to the Presidency and thank Roberta Capello for her help and support over the last two years.

Enjoy the newsletter!

2. Regional Science and Climate Change (1): Systemic Economic Effects of Climate Change in Brazil: A Regional Science Perspective

Eduardo A. Haddad (left) and Carlos R. Azzoni, University of São Paulo, Brazil

This article emphasizes the economic aspects of the multidisciplinary study on "The Economics of Climate Change in Brazil", which was supported by the British Embassy to Brazil, Fapesp – Fundação de Amparo à Pesquisa do Estado de São Paulo, and CNPq – Conselho Nacional de Pesquisas. It brings together excerpts from the final report. The study was coordinated by Jacques Marcovitch (FEA/USP), Sergio Margulis (World Bank) and Carolina Burle Schmidt Dubeux (COPPE/UFRJ). The principal authors of the related parts of the original study are Alexandre Szklo (COPPE/UFRJ), Carlos Azzoni (USP), Eduardo Assad (EMBRAPA), Eduardo Haddad (USP), Eneas Salati (FBDS), Hilton Pinto (UNICAMP), José Feres (IPEA), José Marengo (CCST/INPE), and Roberto Schaeffer (COPPE/UFRJ). For more information, visit www.economiadoclima.org.br. Inspired by the Stern Review, the purpose of the study was to conduct an integrated economic assessment of the impacts of climate change in Brazil. Considering the various scenarios for this phenomenon, Brazil's main economic and social vulnerabilities were identified. A fundamental issue discussed is the extent to which global warming has an influence on the country's development agenda, given that Brazil has large areas covered by forests and the agriculture sector contributes a significant share to the GDP and exports.

Integrated Economic Assessment

The regional climate models point to a risk of "savannization" of a sizeable portion of the Amazon, more intense and frequent droughts in the Northeast region, heavy rainfalls and floods in coastal and urban areas in the Southeast and South regions, and significant reductions in the hydropower generation potential in the North, Mid-West and Northeast regions. This is, however, just a part of the problem. Countless uncertainties are involved in the modelling of the impacts of climate change, especially when the 20–50 year planning timeframe is extrapolated.

Economic assessment of climate changes and the policies to address them depend on information that is not yet available. The uncertainty associated with the science of climate and climate

projections has a substantial influence on economic analyses and the policy-making process. This uncertainly, however, should not be a reason for inaction; rather, it should be the opposite: it simply increases the cost of inaction.

The great methodological challenge in this study was to establish a link between future climate projections and business sectors and several environmental and socio-economic features at local and regional levels. Additionally, a level of aggregation or disaggregation of analyses that makes this study relevant and a faithful reflection of the 'local' reality at a minimum must be established, and it must also be feasible from the perspective of information and data handling. This is a critical issue in a study that involves a myriad of industries with very diverging natures. Hence, the study attempted to reconcile the macroeconomic perspective (which supposedly integrates sector-specific analyses in an aggregate fashion) with an industry – or microeconomic – perspective. Sector-specific studies seek to include climate variables and analyse their economic effects on the individual sectors, while at the national level a macroeconomic model brings together cross-sector analyses and climate variables.

Climate Scenarios in Brazil

The task of building future climate scenarios in Brazil was performed by the National Institute for Space Research (INPE) in 2007. The analyses of economic impacts discussed below are based on these climate projections, which reflect high and low global greenhouse gas emission scenarios – A2-BR and B2-BR, respectively – which in turn are based on global projections by the IPCC (2007).

The Amazon and the Northeast region are considered to be the most vulnerable areas. Average temperatures could increase by 5°C in 2100 under the A2-BR

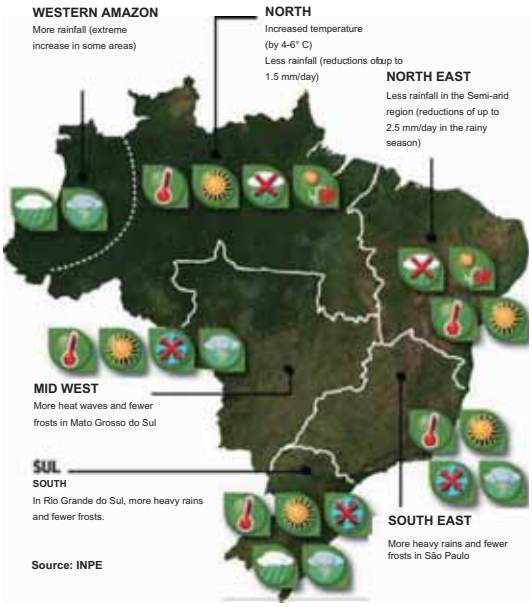


Fig. 1. CHANGES IN BRAZIL: Climate projections by region in 2100

scenario, and 3°C according to the B2-BR scenario, although in the Amazon progressive warming could reach 7–8°C or 4–6°C in 2100, respectively. Rainfall is likely to decrease during the 21st century, with the most substantial reductions taking place in the North East region (2–2,5 mm/day) and the Amazon (1–1,5 mm/day). For Brazil as a whole, the projections show increased temperatures and bouts of hot weather, as well as less frequent frosts due to an increase in the minimum temperature, especially in the states situated in the Southeast, South and Mid-West regions (Figure 1).

Sectoral Impacts

The key question that runs through the article is: "Given the climate change projections, what should we expect in terms of economic, social and environmental impacts?" From this question we derive the sector-specific analyses and models that link temperature and rainfall variations to specific changes in the various economic sectors (sometimes called 'dose-response' relations). Topics

covered include: water resources; agricultural production; land use patterns; and the energy sector.

Systemic Economic Effects

Climate shocks, i.e., unusual changes that generate impacts, that were projected by INPE for Brazil and captured by the models through impacts on water resources, the agricultural/ livestock and energy sectors, were applied in an integrated modelling system for the generation of temporal socio-economic trends of the scenarios with and without global climate change.

Macroeconomic results: Regarding the impacts of climate change on the economy, the simulations revealed a permanent loss for Brazil's GDP by 2050 of approximately 0.5% when the trends for A2-BR with and without climate change are compared, and about 2.3% between trends for B2-BR with and without climate change.

In order to calculate annual GDP losses that are accrued until 2050 at their present value, three different discount rates were used: 0.5%, 1% and 3% per year. Losses range between 13.6% and 147% of the GDP for 2008. Hence, if the costs from climate change in Brazil by 2050 were brought forward to today, at an intertemporal discount rate of 1.0% per year, for example, the cost in terms of GDP would be between R$719 billion under A2-BR and R$3.655 trillion under B2-BR, which would account for 25–125% of the GDP for 2008.

Sectoral and regional results: The economic impacts of climate change are experienced in different ways across the business sectors, regions, states, and large cities. For example, agriculture is the business sector most directly sensitive to climate, with a permanent decline in production of 3.6% under A2-BR and 5.0% under B2-BR by 2050.

From the regional perspective, the greatest threat looms over the poorest regions in the country. It is fair to conclude that climate change will exacerbate regional inequalities in Brazil. The most significant discrepancy can be found in the trend for A2-BR by comparing the effects of climate change in the South region (gains of 2% by 2050) to the effects in the Mid-West region (losses of 3%) in relation to the same scenario A2-BR without climate change. When the states are considered, the exceptions are the southern states, which will have milder temperatures and, therefore, will become more suitable for agriculture. All other states will incur dramatic losses. At the city level, the results show that the most substantial losses should be sustained away from the big cities. It should be pointed out that only GDP losses from the perspective of goods and services production were calculated; impacts of climate change on the urban infrastructure have yet to be incorporated.

Socio-economic results: With regard to welfare aspects, the average Brazilian would suffer losses of R$534 (US$291) under A2-BR in comparison to this scenario without climate change, or R$1,603 (US$874) under B2-BR against this scenario without climate change. The present value in 2008 of reductions in consumption accrued by 2050 would be between R$6,000 and R$18,000, thus accounting for 60% to 180% of the current annual per capita consumption.

Finally, as far as poverty is concerned, the results for the per capita GDP are consistent with the results for the GDP. A permanent loss of approximately 0.5% (A2-BR) and 2.3% (B2-BR) of the national per capita GDP by 2050 is calculated for the comparison with a climate change-free world. Interestingly, these tend to marginally increase poverty in Brazil.

Conclusions

This study of economic impacts from climate change in Brazil, despite the limitations, showed that the problem is

Table 1. DETAILS OF THE IMPACT ON SOCIETY: effects by sector, region, state, networks of cities, and poverty level. Regional inequalities are exacerbated

COSTS OF CLIMATE CHANGEIN BRAZIL. AS A % OF GDP				
REGIONS AND STATES[1]	**Scenario A2-BR**		**Scenario B2-BR**	
	2035	**2050**	**2035**	**2050**
North	**–0.7%**	**–1.2%**	**–2.1%**	**–3.1%**
Rondônia	–0.9%	–1.7%	–2.7%	–4.1%
Acre	–0.2%	–0.5%	–1.5%	–2.1%
Amazonas	–0.6%	–1.0%	–2.3%	–3.2%
Roraima	–1.1%	–1.8%	–2.6%	–3.6%
Pará	–0.6%	–1.1%	–1.7%	–2.5%
Amapá	–0.1%	–0.4%	–2.0%	–3.1%
Tocantins	–1.6%	–2.7%	–2.8%	–4.3%
North East	**–1.0%**	**–1.6%**	**–2.1%**	**–2.9%**
Maranhão	–3.8%	–5.5%	–5.0%	–7.0%
Píauí	–0.8%	–1.3%	–3.6%	–5.5%
Ceará	–1.6%	–2.7%	–3.5%	–4.4%
Rio Grande do Norte	–0.8%	–1.4%	–2.5%	–3.6%
Paraíba	–1.6%	–2.6%	–2.7%	–1.1%
Pernambuco	–0.8%	–1.4%	–2.6%	–4.1%
Alagoas	–6.2%	–8.2%	–6.5%	–7.6%
Sergipe	–0.5%	–1.0%	1.2%	1.7%
Bahia	0.2%	–0.1%	–0.3%	–0.7%
South East	**–0.3%**	**–0.6%**	**–1.5%**	**–2.4%**
Minas Gerais	–0.5%	–1.0%	–1.7%	–2.7%
Espírito Santo	–2.4%	–3.6%	–3.0%	–4.5%
Rio de Janeiro	0.2%	0.1%	–0.9%	–1.4%
São Paulo	–0.3%	–0.5%	–1.6%	–2.5%
South	**1.3%**	**2.0%**	**0.0%**	**0.0%**
Paraná	1.8%	2.9%	0.5%	0.8%
Santa Catarina	0.1%	0.2%	–1.6%	–2.5%
Rio Grande do Sul	1.5%	2.3%	0.4%	0.6%
Mid-West	**–1.8%**	**–3.0%**	**–3.0%**	**–4.5%**
Mato Grosso do Sul	–2.1%	–3.5%	–3.3%	–5.2%
Mato Grosso	–6.7%	–9.9%	–7.7%	–11.1%
Goiás	–0.3%	–0.7%	–1.8%	–3.1%
Federal District	–0.1%	–0.2%	–1.2%	–1.8%
SECTORS				
Livestock	–1.7%	–2.5%	–2.9%	–4.5%
Industry	–0.2%	–0.3%	–1.3%	–2.0%
Services	–0.1%	–0.4%	–1.4%	–2.1%
NETWORKS OF OITIES[2]				
Metropolitan areas	–0.1%	–0.3%	–1.3%	–2.0%
Capital cities	–0.2%	–0.4%	–1.4%	–2.1%
Small towns	–0.5%	–0.8%	–1.8%	–2.6%
SOCIAL				
GDP/per capita[3]	–0.3%	–0.5%	–1.5%	–2.3%
Poverty[4]	0.02%	0.02%	0.06%	0.06%

[1] In comparison with the respective GDPs that were projected without climate change.
[2] In percentage terms of the respective regional GDPs that were projected without climate change. Metropolitan areas: Manaus, Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba, Porto Alegre; capital cities, microrregions of state capitals. **[3]** In comparison with the respective figures that were projected without climate change. **[4]** Annual average percentage variation for the period.

of great importance for the country's development agenda. Potential costs and risks are high and a burden to the poorer and more vulnerable brackets of the population particularly in the North and Northeast region. In addition to this high social relevance, fighting climate change is both an opportunity and a requirement for public policies to be integrated.

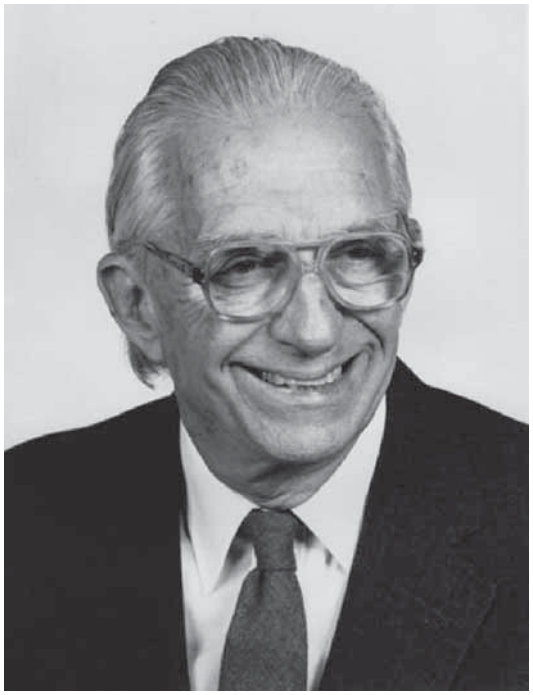
In regional terms, the main impact of climate change is the bigger threat to poorer regions in the country, intensifying regional inequalities. They increase the concentration of activity in these spaces and also reinforce social inequalities, increasing poverty. The reduction of well-being in rural areas may generate pressure on urban clusters, although there may be sectors and regions that benefit from the process. The biggest losses will probably take place in the interior areas of the country. The impacts of climate change on urban infrastructure require further studies. The areas most vulnerable to climate change in Brazil are the Amazon and the Northeast, which are the poorest regions. In the Amazon, gradual warming may reach 7–8°C by 2100 in scenario A2-BR, meaning a radical change in the Amazon Forest – so called 'savannization'. One of the key questions to be answered by scientists is: What are possible tipping points after which the savannization process of the Amazon would be irreversible? Without a doubt this is one of the most relevant and complex issues related to climate change in Brazil and research is still in its initial stages.

In the case of the Northeast, rainfall levels are predicted to decrease during the 21st Century, at a rate of 2–2.5 mm/day. This will lead to agricultural losses in all states of the region and its concomitant change to livestock. With the advance of livestock, the future situation of the northeastern rural zone tends to deteriorate even more, as the dominant livestock practices show low yield levels. In this sense, it is necessary to better investigate the caatinga biome – one of the most populated and biologically diverse semi-arid regions in the world located in the Northeast region of Brazil – in terms of expected impacts and its future support capacity.

3. News and Recent Events

3.1 In memoriam: Walter Isard

The following brief biography is based on Boyce (2011) and Boyce and Miller (2011). Our thanks to David Boyce for allowing publication here.



Walter Isard in 1989
Photo courtesy of Peter Isard

In December 1950, at the age of 31, Walter Isard organized a meeting of leading economists, geographers, sociologists and demographers on

interdisciplinary regional research, which he later considered to be the birth of the field of regional science (Isard 2003, p. 11). Ongoing efforts to organize such discussions found a welcome audience among participants of annual disciplinary conferences, and continued intensively throughout the next four years.

For the 1954 meetings of the Allied Social Science Associations, held in December at Detroit, Isard organized a conference programme of 25 papers. At the business meeting, 60 scholars in attendance endorsed unanimously Isard's proposal to form the Regional Science Association (RSA). Unfortunately, the founder of Regional Science passed away at age 91 on November 6, 2010 at home in Drexel Hill, Pennsylvania.

With his determined leadership, the interdisciplinary field of regional and urban research flourished in North America, Europe and Asia. Isard encouraged economists, geographers, sociologists and urban and regional planners, and occasionally even civil engineers, to ignore disciplinary boundaries, construct theories of urban and regional phenomena and apply methods of analysis to the emerging urban, regional, transportation and environmental policy issues of the mid and late twentieth Century.

In 2003, on the occasion of the 50th North American Meetings of the RSAI, Walter Isard published his History of regional science and the Regional Science Association International, the beginnings and early history, which begins with a memoir of his early scientific activities and the explorations that led to the formation of the RSA.

Throughout his career, Isard also pursued policy interests related to conflict management and resolution, disarmament and peace science. He founded the Peace Research Society, later renamed the Peace Science Society, and founded the Graduate Group in Conflict Analysis and Peace Research at the University of Pennsylvania. Today, as we mourn his passing, we remember Walter for his tremendous energy and relentless pursuit of his scientific objectives and their fulfillment. His optimism about science, and what it can accomplish, was pervasive in all of his reflections on the future of our field.

Sources:

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Boyce, D.E. and Miller, R.E. (2011), IN MEMORIAM: WALTER ISARD (1919–2010). *Journal of Regional Science, 51: 1–4. doi: 10.1111/j.1467-9787.2010.00710.x*

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3.2 NARSC 2010

Neil Reid, University of Toledo, USA

The 57th annual meeting of the North American Regional Science Council was held in Denver, Colorado, November 10–13, 2011. This was NARSC's second visit to the Mile High City, the 1984 meetings having been held there. The meetings were extremely successful with 605 registrants, the third highest ever for a NARSC meeting. The meetings also saw NARSC experiment with poster sessions for the first time, an innovation that seemed to work well.

Delegates mingling at a coffee break in Denver

Kauai, Hawaii. More information on the WRSA meeting can be found on the WRSA website (www.wrsa.info).

3.3 Western Regional Science Association Celebrates 50th Anniversary

Rachel Franklin, Brown University, USA.

Terrific weather, stimulating sessions, and traditional regional science collegiality all came together in late February to help the Western Regional Science Association celebrate its golden anniversary. This year's attendance of over 200 meeting participants included large numbers of international regional scientists, in particular from Sweden, Japan, Korea, and the Netherlands. The longer session times and opportunity for in-depth discussion, which are hallmarks of the WRSA's annual meetings, were enhanced this year by the welcoming weather and the special 50th birthday program – which included birthday cake, a champagne toast, and even a musical program. If you missed out on this year's meeting, don't worry: next year's WRSA meeting is already on the calendar for February 8–11, 2012 in sure-to-be-sunny

3.4 RSAI Membership update

Tomaz Ponce Dentinho and Elisabete Martins, University of the Azores, Portugal.

According to Article III of the RSAI constitution "the principal criterion of eligibility for membership shall be a mature and deep interest in the field of regional science. Membership of RSAI is normally obtained through membership of a local Section. Nevertheless, in exceptional circumstances direct individual membership may be considered by the Executive Director. Membership is renewed annually by payment of dues. This is usually done through a capitation levied on a section but can also be collected through one of the superregional organizations established by the Association".

The records collected and shown here correspond to the members that have access to RSAI journals, published by Wiley Blackwell – Papers in Regional Science and Regional Science Policy and Practice. It is possible to make various interpretations of these data. The one that we would like to highlight

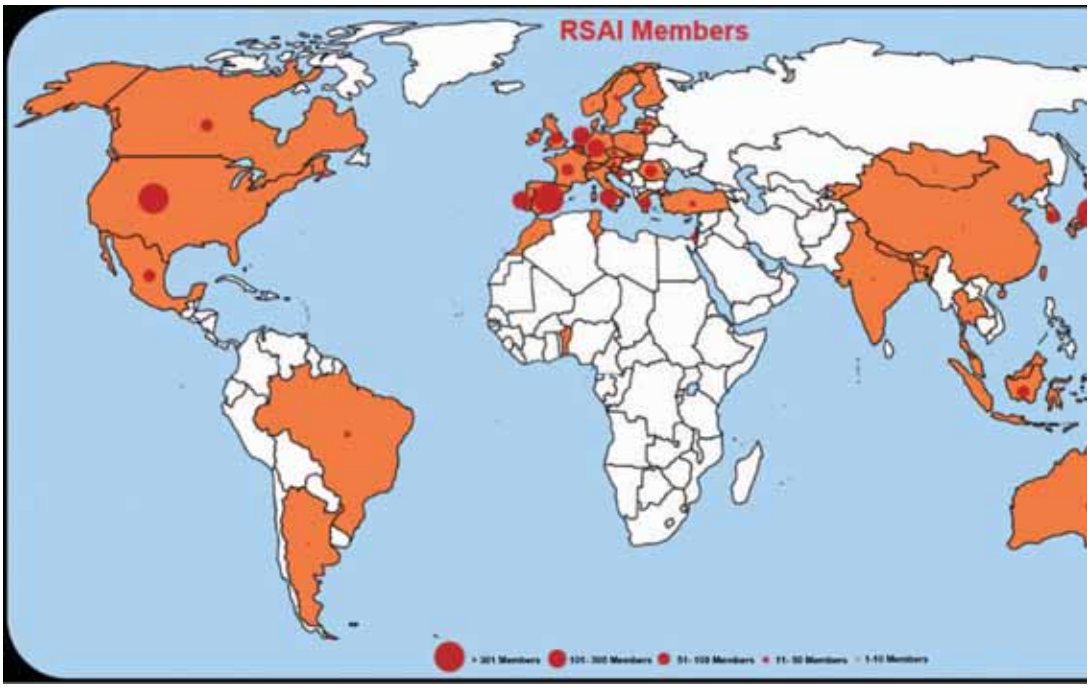

Fig. 1. RSAI Map

are the ones that present challenges for RSAI:

First, it is clear from Figure 1 that there are many 'empty' areas for Regional Science, mainly in Africa, Middle East and Central Asia. Furthermore, although it is reported from our colleagues that there is a very good dynamism in South America, in China and in India, the registration of RSAI members is naturally only at the beginning and hopefully more expansion will be seen in these regions.

Second, the density of RSAI membership is quite different from country to country (Figure 2). The average for all the countries that have members is 2.3 members per one million of residents. If that number could be reached for all the countries where RSAI has already a member the total number would be 10000. And if all the countries have a RSAI section then the total number could be around 15000.

To achieve 10000 members some easy actions can be implemented: i) First, we must continue to adapt the services provided by RSAI to the demand of the members expressed by their own section and supranational representatives; ii) Second, we must support the actions that are being implemented in China, India, Latin America and Africa; iii) Finally, we must work hard with the sections that have relatively low densities of RSAI members to increase participation in RSAI activities.

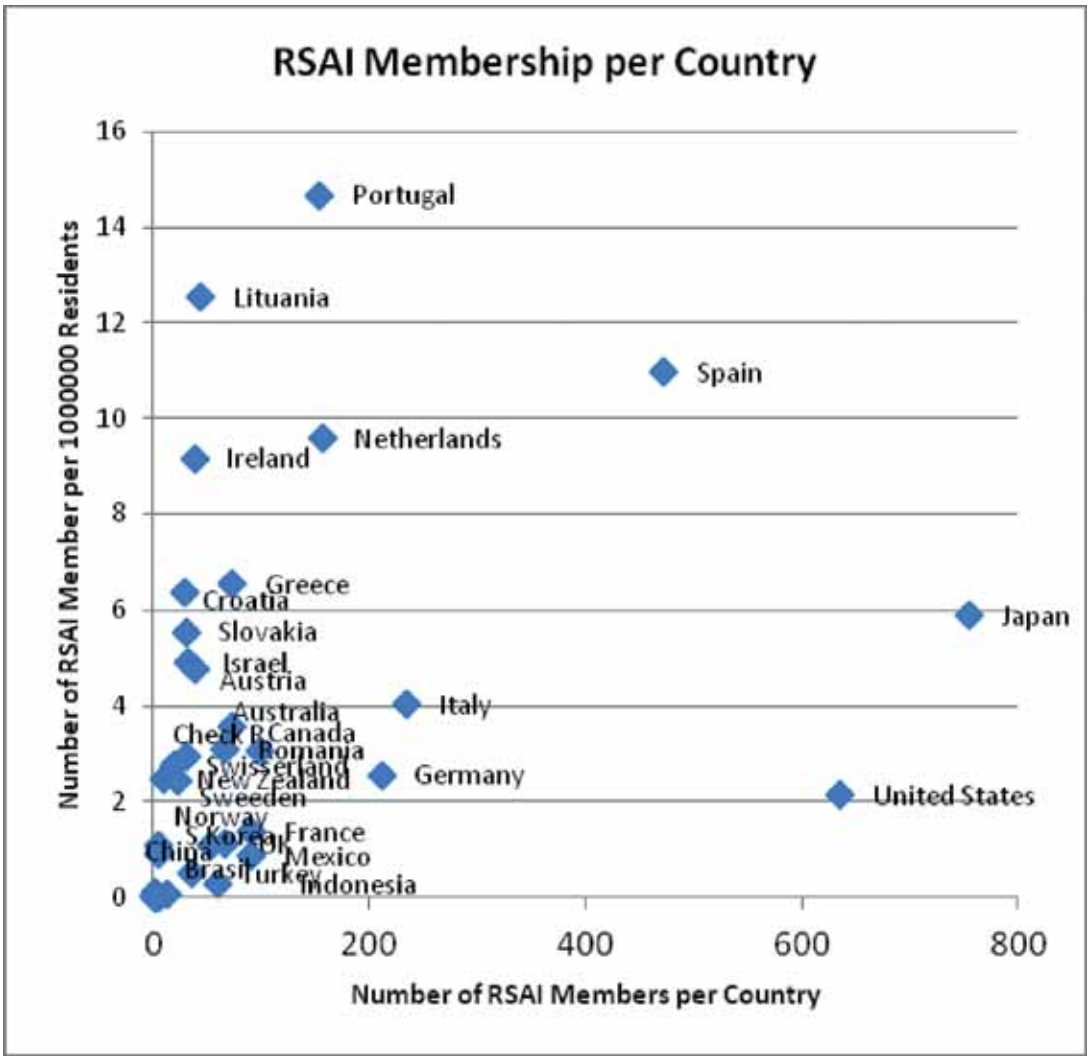

Fig. 2. Density of RSAI membership

4. Meet the fellows: Manfred Fisher

Manfred Fisher, University of Vienna, Austria

Manfred M. Fischer is Professor Ordinarius of Economic Geography at the Wirtschaftsuniversität Wien (Vienna University of Economics and Business), and Adjunct Professor at the University of Vienna. He holds a Dr.rer. nat. degree (1975, summa cum laude) in geography and mathematics from the Friedrich-Alexander University Erlangen-Nuremberg and a Dr.habil. degree(1982) in human geography from the University of Vienna. He is one of the founding editors of the Springer book series on Advances in Spatial Science, and co-founder and editor-in-chief of the Journal of Geographical Systems, a journal that bridges the work between regional science, quantitative geography and GIScience.

For about 35 years Manfred has been involved in the development and application of (mathematical and statistical) models, methods and techniques in regional science and related fields, a time period during which he has published 32 books, 110+ papers in refereed journals and 115 book chapters and encyclopedia articles. In recognition of his academic achievements, he has been named a fellow of the World Academy of Arts and Sciences, the International Eurasian Academy of Sciences, the Austrian Academy of Sciences and the Koninklijke Nederlandse Akademie van Wetenschappen.

In relation to the theme of this newsletter, Manfred sees a great challenge for regional scientists to analyse, for example, some of the regional consequences of climate change. In doing so, one has to be aware that the coupled atmosphere-ocean general circulation models – the most powerful tools today for global climate simulation – still run at relatively coarse horizontal spatial resolutions (ca. 300 km). To get regional information from such models one has to rely on some regionalization technique. Such a technique essentially rests on two assumptions, namely, the ability of general atmosphere-ocean circulation models, first, to provide accurate climate features over the region of interest, and, second, to produce reliable "predictions" of the response of broad scale climatic features to changes in external events.

Given these assumptions, the analysis of regional consequences of climate change is characterized by high degrees of uncertainty. Standard approaches to modelling the economics of regional climate change – even those that purport to treat risk by Monte Carlo simulations – very likely fail to account adequately for the implications of large impacts with small probability. Indeed, climate change appears to be a problem characterized by Knight-uncertainty. That is to say, modelling regional impacts of climate change is a monumental exercise in which various subjective probabilities have to be assigned in the course of the analysis. A Bayesian framework appears to be most appropriate to move forward quickly and surely, and creatively enough to realize the potential now before us.

5. Regional Science and Climate Change (2): Climate Change and Changes in Agriculture

Sanderine Nonhebel and Dirk Strijker, University of Groningen, the Netherlands

Photographer: P. van der Sande

Introduction

Agricultural yields are affected by the prevailing weather conditions. The changes expected in the climate due to the rising CO2 concentrations in the atmosphere are therefore likely to affect agricultural productivity. However, weather is not the only factor, as the varying abilities of farmers to obtain the highest yields under given circumstances also play a role. In this short research note we determine the order of magnitude of the impact of the two processes (changes in climate and changes in technological development). We discuss the expected changes in climate in the next 80 years and their possible effects on agricultural production. We compare these results

with the historical developments in agricultural production from 1950 to 2004, a period where climate change did not play an important role, although some increase in temperature (0.5oC, IPCC 2007) was recorded.

Boundary conditions for primary production

The photosynthetic process that forms the basis of our food production is temperature dependent. In this process CO2 and water are converted into glucose with the sun acting as an energy source. To properly function, this process requires temperatures between 10 and 30oC and sufficient water. These boundary conditions mean that not all places on Earth are suitable for agriculture. The poles are too cold and the deserts too dry. Only the humid tropics have climatic conditions that allow crop production all year round. In other regions crop production is only possible for a part of the year: the growing season. The various growing seasons vary greatly: in Scotland temperatures hardly ever reach values above 18oC, while in southern Europe 30oC in not uncommon. The varieties of crops grown in the different regions are adapted to these conditions, and as a consequence a Scottish wheat variety will not produce a yield in Spain and vice versa.

Impact of climate change on growing seasons and precipitation

Global warming will affect the growing seasons across the globe. Its impact however will differ per region. Regions where the growing season is limited by low temperatures in the rest of the year (northern Europe) are likely to benefit from global warming. In regions where the growing season is limited by high temperatures the growing season will become shorter and yields are likely to decline.

In regions where crop production is determined by the availability of water (the Mediterranean) a change in precipitation patterns will have significant consequences. Where the amount of precipitation decreases, yields will decline.

Rising CO2 concentrations in the atmosphere are affecting the global radiation balance. As a consequence, average air temperatures will rise, leading to changing pressure systems and changing precipitation patterns. Climate models that simulate these changes are under development. Examples of the outcomes of such models (in this case Hadcm3) are shown in Figures 1 and 2. The graphs were obtained from the Peseta project: impacts of climate change in Europe (Iglesias et al., 2009; Peseta 2009).

The climate changes shown are the result of a business-as-usual scenario (this implies that no changes in energy systems are assumed, thus no major shift to CO2 neutral energy sources, resulting in a 1250 ppm CO2 concentration in 2100 (IPCC 2007)). They show conditions for 2070–2100

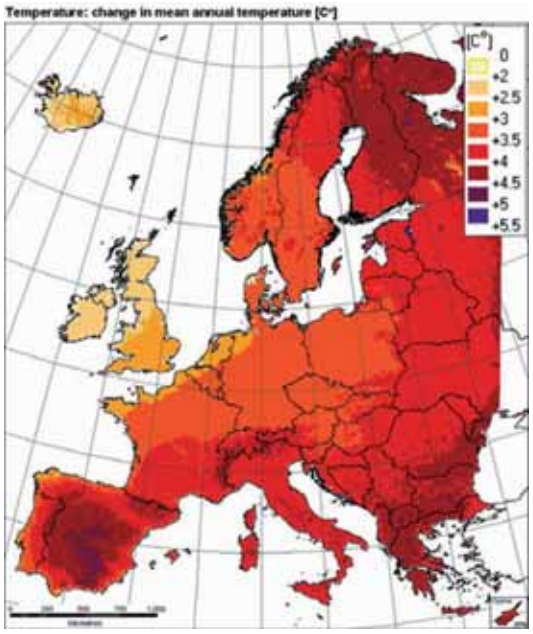

Fig. 1. Mean annual temperature change (Peseta 2009)

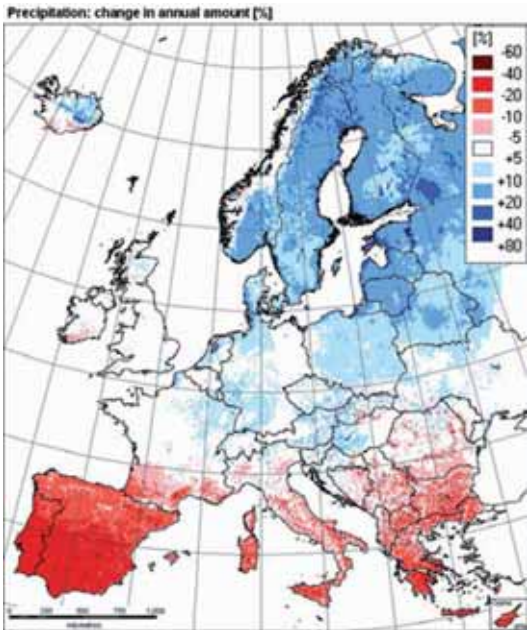

Fig. 2. Change in annual precipitation (Peseta, 2009)

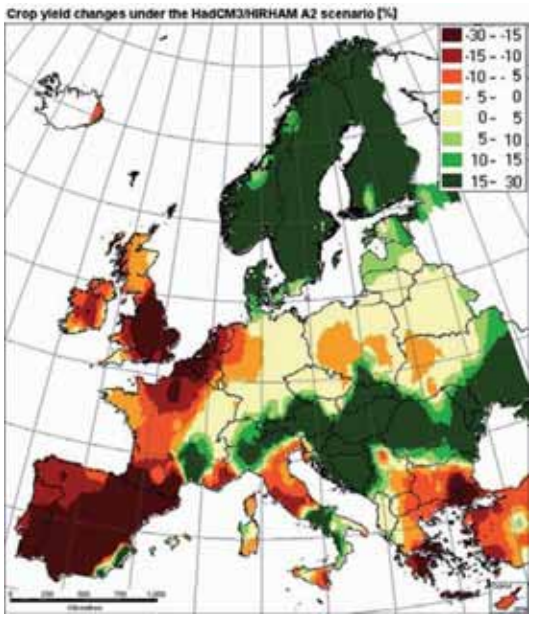

Fig. 3. Crop yield changes, source: Peseta, 2009

compared to conditions in 1960–1990. Temperatures will rise across Europe. Average temperatures are expected to rise by 2oC in Scotland, and by 5oC in central Spain and northern Finland. The precipitation pattern is also expected to change: southern Europe will become dryer, northern Europe wetter.

Consequences for yields

Such changes are expected to have substantial impacts on the present growing seasons and therefore on yields. With the aid of crop growth models the impact of changing climatic conditions on yields can be evaluated. These models simulate the growth of crops under given weather conditions. Iglesias et al. (2009) conducted a detailed study on climate change and the impact on European crop yields. Different climate models and different crop growth models for different crops were used. Figure 3 presents the integrated outcome of this study (using the climate conditions shown in Figures 1 and 2): yields decline (30%) in south-western Europe, remain the same in central Europe and increase in northern Europe.

It should be stressed that the Figure does not provide a forecast for yields in 2080, it only shows how climate change will affect growing conditions. The actual yield is determined by the ability of agriculture to make optimal use of the prevailing conditions. In principle, growing conditions could get worse while the increase of knowledge and the improvement of technology could compensate for this, leading to higher yields.

Past increases in yields

To provide insights into the impact of changing agricultural practices on crop yields, we analysed the changes in crop yields over the last 50 years. The analysis is based on regional data for the period 1950–53 to 2001–2004 for the EU-9 in 86 regions, partly NUTS-1, partly NUTS-2 (see De Boer & Jacobs (1979) for details about the data). Data

on physical production (*1000 tons) and the planted area (*1000 ha) for wheat were used in the analysis.

From earlier research (Strijker, 2008) we know that between 1950–53 and 2001–2004 the average location of wheat production in the EU-9 (the centre of gravity) moved several hundred kilometres to the northwest (see Figure 4). We also know that wheat is not an exception: most agricultural production moved gradually to the north-northwest in that period. The map also shows that on average the production per hectare is higher to the northwest: production is ahead of land use for wheat.

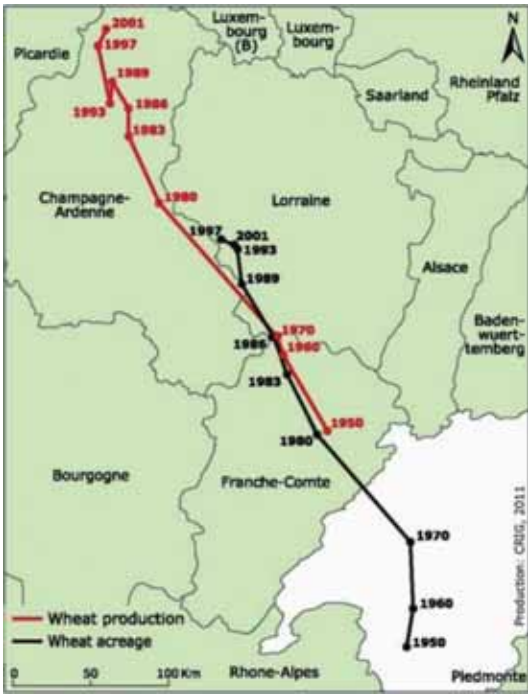

Fig. 4. Spatial development of the centre of gravity for wheat (1950–2001)

The inter-temporal changes in the average location for production and the land use for wheat – and for many other crops – were caused by a spatially unequal increase in the yields of these productions. These increases in yields have many different causes: new technology, new varieties, water management and education, with changing prices and agricultural policies acting as triggers.

To provide a greater insight into the spatial pattern of the increases in yields, Figures 5 to 7 show the production per

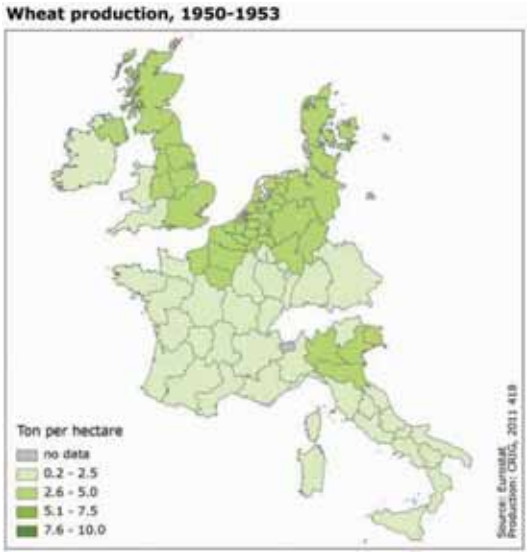

Fig. 5. Yield (tonne/ha) for wheat in 1950–53

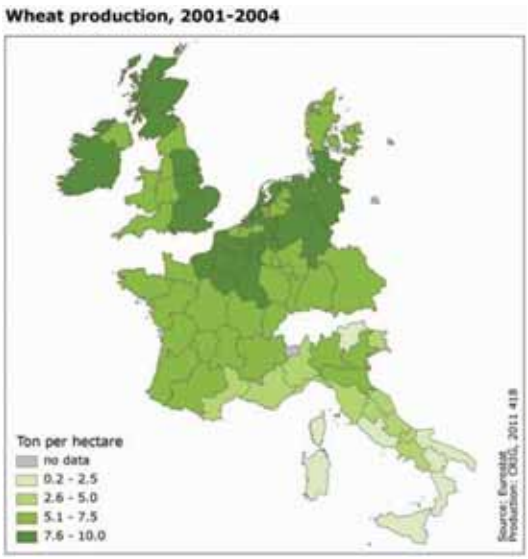

Fig. 6. Yield (tonne/ha) for wheat in 2001–04

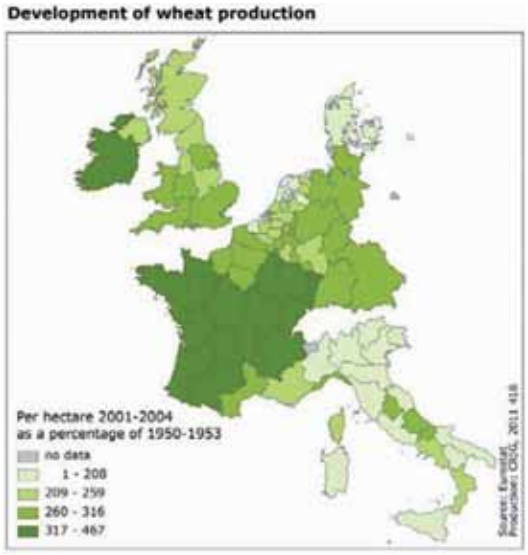

Fig. 7. Increase of wheat yields (1950–53 = 100)

hectare of wheat for 1950–53, for 2001–04, and the percentage difference between the two periods. It is clear that the highest yielding regions were and remain in the northern EU, but the regions in the central west (parts of France, England and Ireland) have made remarkable progress. By percentages, and even in tonnage, they increased faster than the southern regions and sometimes even than the northern regions.

Reasons and implications

Of course, there are many different forces at work behind the pattern we observed above. Two are especially important here: agricultural policy and physical-technical circumstances. Traditional agricultural policy has stimulated the increase in agricultural productivity by ensuring reasonable and stable prices (see Tracy, 1989; and Oskam, Meester & Silvis, 2010 for overviews of policy development). The fact that from 1980 onwards the centre of gravity shifted to the northwest is caused by Denmark, UK and Ireland joining the EU. For the latter two this implied an important increase in the farm price for wheat. The higher prices for wheat after accession resulted in an increase and intensification of wheat production.

For arable crops the period after 1990 is also important because the influence of the MacSharry and subsequent reforms (from price support to income support) was felt at that time (Oskam, Meester & Silvis, 2010). The development to the northwest has been tempered since then.

Changes in the physical-technical level also played a role. For instance, the production of corn (not shown here) moved rapidly northwards: due to technical improvements the crop could be grown in increasingly cooler climatic zones. However, the production of wheat also increased rapidly in parts of Europe. In western France and Ireland the yield per hectare increased by more than 200%: the yields in 2001–04 are three times as high in those regions as they were in 1950–53. Yields doubled in many other regions in the northern EU-9. Moreover, because yields were already quite high in the 1950s, they are still among the highest in Europe. Only regions in Italy and Denmark remain behind. The increases in yields in the Po area and Denmark (starting from high levels in the 1950s) were quite moderate.

These developments show that technological progress and change in agricultural practices, partially enhanced by agricultural policy, has resulted in enormous increases in agricultural productivity, and in the spatial redistribution of the agricultural production. This all happened in a period where climate change did not play an important role.

The changes in yields due to climate change as determined by crop growth models are small (30% decline) compared to changes due to

technological improvements achieved over the last 50 years. The price of agricultural products has played an important role in driving intensification. Price developments are determined by socioeconomic parameters, which cannot be assessed on the timescales discussed in this paper (50 years). An assessment of future yields is therefore difficult to make. However, it is obvious that climate change will affect agriculture, but given the enormous variation within this system – different crops, different varieties, different growing seasons, different production techniques etc. – there is great potential for adaptation. Developments in the previous century have shown that such changes in the system (adaptation) can occur quickly. Therefore, it is unlikely that the currently expected changes in climate due to rising CO2 concentrations will have major effects on food supply.

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6. RSAI prize winners

During the NARSC 2010 in Denver, RSAI President Roberta Capello presented awards to 5 new fellows. Congratulations again to all.

a) Gerald Carlino, Federal Reserve Bank of Philadelphia, USA

b) Aura Reggiani, University of Bologna, ITALY

c) Diego Puga, Madrid Institute for Advanced Studies, SPAIN

d) David Plane, University of Arizona, USA

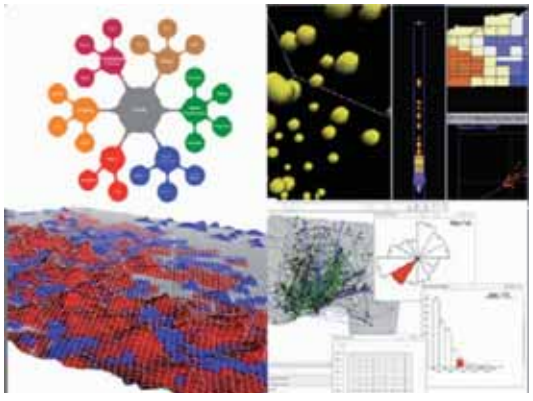
e) Richard Morrill, University of Washington, USA

7. Centres of Regional Science: The GeoDa Center for Geospatial Analysis and Computation

The GeoDa Center for Geospatial Analysis and Computation develops state-of-the-art methods for geospatial analysis, implements them through free and/or open source software tools, applies them to policy-relevant research in the social and environmental sciences, and disseminates them through research publication, training and support to a growing worldwide community.

Faculty and Staff

The GeoDa Center is directed by Luc Anselin, Walter Isard Chair and Director of the School of Geographical Sciences and Urban Planning at Arizona State University. Research and development is coordinated through a senior executive committee that includes Professors Anselin, Subhro Guhathakurta, Alan Murray, Sergio Rey and Elizabeth Wentz. Research director Julia Koschinsky heads up a team of approximately 20 postdocs, analysts and graduate researchers.



Graph of PySAL's spatial analytic functionality (top left), OpenGeoDa's interactive ESDA (top right), Digital Phoenix urban modeling (bottom left),

and exploratory space-time analysis of sex offender movements (bottom right).

Research

Since its inception at ASU in 2008, the GeoDa Center has received over $5 million in external grant support from agencies like the National Science Foundation (NSF), the National Institutes of Health (NIH), the National Institute of Justice (NIJ), the U.S. Economic Development Administration and the U.S. Army Corps of Engineers. The research team has published over 100 refereed journal articles, chapters and books over this time. These research findings were further disseminated in over 70 conference and other presentations.

Research in the GeoDa Center has focused on spatial statistical model specification, clustering, exploratory analysis, geovisual analytics, spatial optimization and GIS development to address a range of important problems. Examples of problem areas range from crime, water management in desert cities, HIV/AIDS in Mozambique, cancer, economic development, property valuation and home foreclosures to human-elephant conflicts.

Spatial software development efforts are integrated with several major research projects. Examples include CyberGIS software integration, flexible geospatial visual analytics and simulation technologies to enhance criminal justice decision support systems, a spatial analytical framework for examining sex offender residency issues over space and time, new spatial regression tools to study health-seeking behavior, the Digital Phoenix Project to develop tools for a better understanding and visualizing impacts of policy choices in Metro Phoenix and a spatial decision support system for minimizing nitrogen impacts on watersheds.

Spatial Software Development

Software under active development at the GeoDa Center includes spatial analysis programs for cross-sectional area and point data (OpenGeoDa, PySAL and GeoDaSpace), space-time data (PySAL), points on networks (GeoDaNet), binary dependent variables, and origin-destination data. In addition, Roger Bivand maintains information about R spatial projects on the Center's website.

OpenGeoDa is a free software program that serves as an introduction to spatial data analysis, with a focus on exploratory spatial data analysis (ESDA) and basic spatial regression modeling. Over 57,600 analysts now use GeoDa worldwide. OpenGeoda runs on Windows, Mac and Linux (its source code will be released soon). The GeoDa Center also recently released PySAL 1.1, an open source cross-platform library of spatial analysis functions written in Python, which is increasingly used in geographic information systems. PySAL provides a collection of spatial analytical methods that developers can incorporate into their own application development, and that spatial analysts may customize to further their research.

GeoDaSpace is a suite of recently developed advanced spatial econometric methods, including spatial two stage least squares with a HAC estimator and generalized spatial two stage least squares for heteroskedastic errors. It has a user-friendly interface that will soon be released for alpha testing. The source code will also soon be released as part of PySAL.

Training and Support

The GeoDa Center offers extensive software documentation and hosts an Openspace listserv to help address technical questions about open source spatial analysis software. Its website contains links to several hundred publications applying GeoDa around the world. Further, the website's two dozen e-talks, four dozen e-slides and half dozen e-courses on spatial analysis

provide free spatial analysis training opportunities. Additional trainings with in-person components are in planning.

GeoDa Center Executive Committee, from left to right: Luc Anselin, Elizabeth Wentz Julia Koschinsky, Serge Rey, Subhro Guhathakurta and Alan Murray

More Information

For more information, please contact geodacenter@asu.edu or visit the GeoDa Center's website at http://geodacenter.asu.edu. You can also follow the Center on Twitter (http://twitter.com/GeoDaCenter) and Facebook (http://www.facebook.com/geodacenter).

8. Regional Science and Climate Change (3): An Agenda for Regional Science Research on Climate Change

Kieran P. Donaghy, Cornell University, USA

Understanding, mitigating, and adapting to anthropogenically induced climate change poses what is perhaps the greatest challenge to global society in the 21st Century. Climate change and its manifestations – global warming, melting glaciers and loss of sea ice, sea rise, desertification, extinction of species, reduced air quality, increased incidence of extreme weather events, etc. – are affecting different areas of the world differently. But there is overwhelming evidence that, in relative terms, climate change is proceeding at an alarmingly rapid pace and that its net effects will be deleterious.

A very human response to a threatening development is to deny that it exists or that it is as serious as may be claimed, especially if responding to the development entails significant and costly changes in behavior and there is uncertainty associated with potential effects of such changes. Another human response, when a development induces a cognitive dissonance, is to redefine matters of fact as matters of faith. There are many who are as skeptical of climate change as they are of Darwinian theories of evolution because climate change and evolution are inconsistent with their core beliefs. Still a third human response is to explore alternative paths of transition to sustainable life styles and to engage in planning to bring about appropriate changes in behavior. The adaptive response, remarked upon by philosophers of ancient Greece, has served the human species well over many millennia.

Most people acquainted with the facts of climate change appreciate the need for conserving energy and resources and reducing greenhouse gas emissions. It is difficult to bring about sufficiently large shifts in political will to promote changes in life styles, however, if people cannot see how to get from 'here' to 'there.' Through their research regional scientists can help to chart and explore the implications of alternative transition paths – over space and time – to sustainable life styles on regional scales and thereby help societies to muster the political will necessary to slow, adapt to, and mitigate the effects of climate change.

There are many ways in which regional scientists can assist in this valuable work. Persisting within conventional disciplinary research protocols, they can, for example, examine the spatial and temporal implications of changes in the production and distribution of energy and in the design and operation of transportation systems. Fundamental changes in such interdependent infrastructure-based networked systems will have impacts on patterns of land use, the location of economic activities, the evolution of supply chains, and the physical environment more broadly. They will also beget adjustments in labor and housing markets and government finances. In a globalizing world, we would anticipate that such changes and associated impacts will spillover into areas that are adjacent or remotely connected via networks. Clearly, the analysis of such phenomena is needed from scholars working in physical, economic, and human geography, civil engineering and operations research, urban and regional economics, urban and regional planning, spatial statistics and geo-informatics, and the decision sciences.

The complexity of both climate change and the question of how to respond to it societally, however, is such that these matters cannot be fully fathomed or meaningfully engaged from a single disciplinary perspective, even as disciplinary expertise is essential. This reality has led the community of scholars addressing themselves to the study of climate change and its mitigation to pursue 'integrated assessments.' While one may question the extent to which there is true systemic interdependency in the modeling frameworks employed to conduct these assessments, hence adequate integration in the assessments, the pursuit of such assessments is a step in the right direction. A step further in this direction would be the development of integrated modeling frameworks that can support thought experiments that would allow researchers and stakeholders from various communities of interest to envision what the likely spatial and temporal effects of a set of transitions will be and develop plans to achieve desired or politically acceptable outcomes. Before making or supporting decisions that will affect generations now living and to come, stakeholders will be interested to learn what changes to their (and their children's) physical environment, their industries, their jobs, their communities and institutions, their freedom of movement, their quality of life a particular transition plan implies. Scholars working in regional science and allied fields possess the skills and knowledge bases needed to collaborate in the development and improvement of such frameworks to advance and raise the level of the essential and in-eliminable discourse of interest-group politics concerning these issues.[1]

The fact that we are trying to understand the potential effects of intervening in systems that are not only complex and adaptive but are also integrated into higher-order systems of such systems (SOS), implies that new methods of examining potential responses – new research protocols – may need to be constructed. Robert Lempert, among others, has called for the development of 'computer-assisted reasoning' to help us understand interventions in complex adaptive systems. (See his paper on new decision sciences for complex systems, www.pnas.org_cgi_doi_10.1073_pnas.082081699.) Clearly, as regional scientists attempt to come to

[1] It is interesting to note that in his early descriptions of the field, Walter Isard viewed regional science as a 'positive [i.e., not normative] science,' whose findings were without political implications. Towards the end of his long and productive life he came to view regional science more as an institutionally embedded and applied discipline serving to advance the resolution of substantive political conflicts in which culturally variant viewpoints need to be explicitly taken into account.

terms with climate change and appropriate responses, and collaborate with other natural and social scientists in joint research, they will need to develop further the computational-science aspects of their craft.[2]

Ancient Greeks understood that it is easier to do the right thing by our contemporaries and descendents if we know how to do it. Regional scientists – working within traditional disciplines, across disciplinary lines, and at the interface of new computational approaches – can help people of good will identify and bring about changes toward sustainable communities and regions through their research. The U.S. National Science Foundation has recently established a cross-directorate program in Science, Engineering and Education for Sustainability (SEES) to support such valuable and timely work. One would anticipate that other national research bodies will be initiating similar programs. Take notice regional scientists!

9. Report on the Transfer of the RSAI Office to the Azores

Tomaz Ponce Dentinho, University of the Azores, Portugal

The RSAI Constitution says that "The Executive Director shall serve a three-year term of office. He/she shall be the chief executive officer in charge of setting and managing programs. The Executive Director shall be the chief operating officer in charge of implementing the policies of the Council, overseeing the day-to-day operations of the Association and establishing contacts with new regional science organizations throughout the world. The duties of the Executive Director shall encompass those normally associated with the positions of Secretary but would have joint authority with the Treasurer for the finances of the RSAI and issuing bank account movements to cover the Association's operating expenses and the preparation of a financial statement to be submitted, by March 31 of each year, to the Council's standing Finance Committee, in charge of financial planning and budgeting. The Executive Director shall oversee the production and distribution of a newsletter to the membership, shall maintain the roll of members and the association's web site, shall oversee the collection of annual dues and the conduct of elections, and shall serve as international conference coordinator, keeping a calendar of regional science meetings and events throughout the world, providing advice on their scheduling, and monitoring the dates of other meetings so as to minimize scheduling conflicts. The Executive Director shall also have responsibility, as designated by the Council, for the organization and operation of the World Congresses of the Association".

Graham Clarke, the outgoing ED, visited the Azores in early December 2010. The visit was supported by the University of the Azores and RSAI. We agreed that the change of RSAI headquarters to the Azores will take place during 2011, with the hope that most of the Executive Director duties will pass to me and to my small team (Elisabete Martins and Rui Luís – hopefully the new treasurer if agreed by Council in Seoul in July) during the first semester of the year. This implies: a) the registration of RSAI in Portugal; b) the change of the

[2] In the last few years a new computational science – computational sustainability – has emerged and several international conferences have been organized around the challenges of studying how sustainability in complex adaptive systems can be brought about.

accounting system of RSAI to Portugal; c) the editing of the newsletter; d) the maintenance of the roll of members and communications with Wiley Blackwell; e) the change of RSAI website management; f) the international coordination of the calendar of events; g) the organization and operation of the World Congresses of the Association; i) maintaining relations with the board supporting and complementing the respective programmes of growth; j) maintaining the relations with the council, supra regional associations, sections and members. I shall discuss each of these in turn below.

a) *Registration of RSAI in Portugal*. The first attempt initiated in October 2010 failed due to the Portuguese bureaucracy that, for the transference of RSAI headquarters to Portugal, required the registration documents of RSAI in the US (not easily available) or some hard copy document of the registration of RSAI charity in the UK (only available in digital form). We initiated a new process that, as was done when RSAI was transferred from the US to the UK, involved the creation of a Non-profit organization in Portugal. The name is now registered, we translated the Laws and By-Laws into Portuguese and I think everything will go well with the registration of the finances and with the opening of a bank account. RSAI was registered in the Azores on the 6th of April 2011. The Council Meeting in Seoul will include a few items on the agenda to finish the transference (Nomination of the New Treasurer, small changes in the final parts of the RSAI Constitution).
b) *Change of the accounting system of RSAI to Portugal.* With the support of Rui Luis we agreed fees with an accounting company (500 Euros per year) and with the auditor of University of the Azores (1000 Euros per year) to independently check and audit RSAI accounts. This can only start after the registration of RSAI in Portugal (see a). In close cooperation with Graham Clarke, with Rui Luis and with the RSAI Council, we will propose a financial planning agenda and a budget for the Seoul Council Meeting. Graham and Dimitris Ballas (outgoing treasurer) will present the last Financial Statement for 2010 based on the UK operations.
c) *Editing of RSAI Newsletter*. Eveline van Leeuwen and Graham Clarke have agreed to continue to be the editors of RSAI Newsletter during 2011. I would like Eveline to continue as principal editor but if she does not wish to do that we must find someone to replace her stupendous job. It must be someone closer to the "centers" and with good English. I have asked Wiley Blackwell the cost of editing the RSAI newsletters with an improved lay-out, so that a few, improved hard copies can be distributed in the Supra regional and World Conferences.
d) *Maintenance of the roll of members*. In the present system RSAI sections send to Wiley Blackwell the list of their members and respective payments. This creates some difficulties: i) First, not all the sections send their list and payments on time; ii) Second, there are members that pay directly and others pay through the supra regional associations; iii) Third, there are persons that are proposed for RSAI Fellow awards that are not members; iv) Four, although not referred to in the Constitution, there are life time members who, necessarily, do not pay Wiley Blackwell but are entitled to have the right to RSAI services . . . I believe the best solution could be that the registrations and payments are done directly between the RSAI Executive Director and the Supra Regional Associations, the sections or the members, who then makes the agreed transferences to Wiley Blackwell for the publishing services they provide. I will talk on this issue

with Wiley Blackwell and the others at a meeting in Oxford, UK, in May. Following this I will present a proposal to the Seoul Council meeting.

e) *The change of RSAI webmaster*. Melanie Tomintz, the former RSAI webmaster, has visited the Azores and passed to Elisabete Martins her knowledge on the management of the RSAI website. Elisabete is already able to change the webpage which is updated whenever there is news from the members and sections after being checked by me and, during this transference period, also by Graham when there are doubts. Only when we have full access to the web codes we can make a better use of the web-pages (for instance to check where the visitors come from, to introduce some maps and pictures etc). I hope that we can talk with the designers of the web when we visit the UK in May.

f) *International Coordination of the Calendar of Events.* We have not explored this area yet but when contact is made with the sections to check the list of members we will also discuss the flexibility of the dates of their conferences.

g) *Organization of the World Conference*. I have just collaborated in an exchange of emails concerning the Congress in Romania 2012. Nevertheless I think this is something that the Executive Director and related staff could do better, namely through the organization of the scientific program of the World Congresses based on existing platforms for the organization of conferences or on new ones. This will allow the launching of World Congresses more often in places and dates that do not conflict with existing initiatives (Central Asia, Africa, Middle East, . . .).

Finally, I would like to note that, in cooperation with RSAI Council, we have launched a new RSAI Summer Course in the Azores and we are trying to do the same in East Asia (Macau). We will continue to try and develop regional science in Africa with the creation of the Cape Verde section, with the organization of a Congress in Guine Bissau (now postponed to December 2011) and a visit to Angola to think about their hosting a workshop sometime in the future.

With the help of Graham we will continue to try to respond promptly to the mails sent by the members and build a better future for RSAI.

10. Future Events

The 58th meeting of NARSC will be held in held in Miami, Florida, November 9–12, 2011. This will be held in conjunction with the 2nd meeting of the Regional Science Association of the Americas (RSAmericas). More information about these meetings will be available at the NARSC website http://www.narsc.org/newsite/?page_id=10.

11. Next issue

The theme of the next issue will be Regional production specialization' (especially the importance to regional economies of the production of famous global products). Please send any contributions directly to Eveline van Leeuwen E.S.van.Leeuwen@vu.nl or Graham Clarke G.P.Clarke@Leeds.ac.uk.