**2014 European Summer School
in Resource and Environmental Economics**

# THE ECONOMICS OF ADAPTATION TO CLIMATE CHANGE

# SUMMER SCHOOL OVERVIEW

## ⬤   Index

## ⚪ **Welcoming letter**

*Dear Participants,*

*Welcome to the 2014 Summer School on "The Economics of Adaptation to Climate Change". We have an exciting program planned on climate change adaptation. Remember that this is a very new field. Although there was some abstract work begun on adaptation approximately 20 years ago, empirical analysis of adaptation is less than ten years old. Yet adaptation is a critical component of climate policy. One cannot measure the damage of climate change without understanding adaptation. Optimal mitigation policy consequently is dependent on understanding adaptation. Adaptation itself is an important part of climate policy because every person, firm, and government on earth is going to have to adapt to at least some climate change. Adaptation funds are eager to seek out how best to spend their resources. Finally, one cannot determine the equity effects of climate change without understanding how well different actors can adapt.*

*What is efficient adaptation? How much can it reduce damage? What specific adaptations are the most effective? When and where should they be deployed? Addressing these issues is a great challenge from an academic perspective, as adaptation tools and analyses are both new and yet complicated. We are just beginning and we have few answers to these pressing questions. The invited faculty will present and discuss the existing methodologies that have been developed to study adaptation in each sector and they will show some initial results. But new methods and new analyses are still needed.*

*One critical goal of this project is to excite the invited student body to take command of this promising field. A very elite group of students have elected to come to this event. The conference is an opportunity for each of you to get some hands on mentoring from faculty. But it is also an opportunity for you to meet each other and realize the potential that you all represent.*

*This Summer School will take place in an exceptional and stimulating location, and we do hope it will represent an important step of your career in environmental and resource economics. The topic chosen for this year's Summer School attracted many outstanding applicants, more than ever in the past.*

*The Summer School is one of the most important activities organized by the European Association of Environmental and Resource Economists to promote the work of doctoral students and early career researchers in the field of environmental economics and climate change. This Summer School has been made possible by the hospitality of the Venice International University and the ongoing support of the European Research Council, Fondazione Eni Enrico Mattei, and the European Association of Environmental and Resource Economists.*

*We look forward to spending time with you this week!*

*Emanuele Massetti and Robert Mendelsohn*
*2014 Summer School Coordinators*

# ⬤ Programme Overview

| Sunday July 6 | Monday July 7 | Tuesday July 8 | Wednesday July 9 | Thursday July 10 | Friday July 11 | Saturday July 12 |
|---|---|---|---|---|---|---|
| | 9:00 – 10:30 Lecture 1 Prof. Mendelsohn | 9:00 – 10:30 Lecture 3 Prof. Massetti | 9:00 – 10:30 Lecture 5 Prof. Hurd | 9:00 – 10:30 Lecture 7 Prof. Sohngen | 9:00 – 10:30 Lecture 9 Prof. Tol | 9:00 – 11:00 Reading Time and Consultations |
| | 10:30 – 11:00 Break | 10:30 – 11:00 Break | 10:30 – 11:00 Break | 10:30 – 11:00 Break | 10:30 – 11:00 Break | |
| | 11:00 – 12:30 Lecture 2 Prof. Mendelsohn | 11:00 – 12:30 Lecture 4 Prof. Massetti | 11:00 – 12:30 Lecture 6 Prof. Hurd | 11:00 – 12:30 Lecture 8 Prof. Sohngen | 11:00 – 12:30 Lecture 10 Prof. Tol | 11:00 – 12:30 Closing Remarks |
| | 12:30 – 13:30 Lunch | 12:30 – 13:30 Lunch | 12:30 – 13:30 Lunch | 12:30 – 13:30 Lunch | 12:30 – 13:30 Lunch | 12:30 – 13:30 Lunch |
| | 13:30 – 14:00 Reading Time and Consultations | 13:30 – 14:00 Reading Time and Consultations | 13:30 – 14:00 Reading Time and Consultations | 13:30 – 14:00 Reading Time and Consultations | 13:30 – 14:00 Reading Time and Consultations | |
| | 14:00 – 14:40 Frances Moore | 14:00 – 14:40 Sampo Pihlainen | Free afternoon | 14:00 – 14:40 Thomas Van der Pol | 14:00 – 14:40 Arnaud Goussebaile | |
| | 14:40 – 15:20 Esha Zaveri | 14:40 – 15:20 Corentin Girard | | 14:40 – 15:20 Chi Truong | 14:40 – 15:20 Anchal Arora | |
| | 15:20 – 16:00 Shun Chonabayashi | 15:20 – 16:00 Ingrid Dallmann | | 15:20 – 16:00 Ruth Dittrich | 15:20 – 16:00 Esther Delbourg | |
| | 16:00 – 16:20 Break | 16:00 – 16:20 Break | | 16:00 – 16:20 Break | 16:00 – 16:20 Break | |
| | 16:20 – 17:00 Martina Bozzola | 16:20 – 17:00 César Antonio Salazar Espinoza | | 16:20 – 17:00 Xiaohui Tian | 16:20 – 17:00 Allan Beltran | |
| | 17:00 – 17:40 Reading Time and Consultations | 17:00 – 17:40 Delavane Turner | | 17:00 – 17:40 Reading Time and Consultations | 17:00 – 17:40 Reading Time and Consultations | |
| 18:00 – 20:00 Welcome cocktail | | | | | | |
| | 19:45 Social Dinner | | | | | |

## ⬤ **Programme and Abstracts**

## Sunday 6th July

*18.00  Welcome Cocktail*

## Monday 7th July

9.00 - 10.30 Lecture 1

### Introduction to the Economics of Adaptation

ROBERT MENDELSOHN, *Yale University*, *United States*

The lecture introduces the basic concepts of the economics of adaptation. The concept of efficiency, public versus private adaptation, and anticipatory versus reactive adaptation are all covered. With short lived decisions in efficient systems, adaptation is often just a matter of fine tuning management to take into account current climate. With longer term decisions, adaptation must address the uncertain role of future climate. With decisions in inefficient systems, adaptation can also involve institutional reforms to improve the efficiency of the system. Precise changes are clear for each sector. This is why the summer school has focused on sectors.

*10.30 -11.00 Break*

11.00 - 12.30 Lecture 2

### Adapting to Extreme Events

ROBERT MENDELSOHN, *Yale University*, *United States*

The second lecture deals with the special case of extreme events. Extreme events occur rarely but have potentially devastating local effects. The lecture provides an overview of weather related extreme events and then develops an integrated assessment model to study tropical cyclones (hurricanes). The model forecasts how damage and fatalities would change as what is in harm's way increases and how climate change would affect these future impacts. The lecture concludes with an analysis to detect if adaptation is already being done in this area to limit damage and fatalities.

*12.30 - 13.30 Lunch*

13.30 - 14.00 Reading time and Consultations

14.00 - 14.40 Student talk 1

### Estimating the Potential for Adaptation in European Agriculture Using the Short- and Long-Run Response to Climate Change and the Detection of Impacts and Adaptation

FRANCE MOORE, *Stanford University, United States*

I will present results from two brief and very closely-related papers that have been written up in short-form for science journals. The first paper describes a new method for jointly

estimating both the short-run (limited adaptation) and long-run (substantial adaptation) response to climate change using panel data. We apply this method to Europe and find warming by 2040 will have negative impacts on wheat and barley yields with only limited potential for adaptation but smaller impacts on farm profits, particularly if farmers are able to adapt.

In the second paper, we use these short- and long-run response functions to describe two statistical tests: one for the detection of climate change impacts in a system that may be adapting at an unknown rate and one for the presence of adaptation to impacts. Simulations using realistic parameter values show the former should have high power in many contexts today whereas the latter is unlikely to have adequate power. Conducting tests for the impact of climate change on long-term yield trends in Europe we find evidence that since 1989 it has reduced wheat and barley yields by 2.7% and 3.9% respectively, explaining approximately 10% of the stagnation in European yield growth.

## 14.40 - 15.20 Student talk 2

### Adapting to Monsoon Variability in India: the Case for Irrigation

ESHA ZAVERI, *Pennsylvania State University, United States*

How will future changes in precipitation affect irrigation demand and supply in India? This paper provides econometric evidence for the demand side of the analysis by examining the relationship between monsoon changes and irrigation variability for one of the world's most water stressed countries, India. Using detailed crop-wise agriculture and weather data spanning 35 years, the econometric model isolates the historical impact of the distribution and total supply of monsoon precipitation on irrigation demand via the use of irrigated area for crops grown in the dry(Rabi) and wet(Kharif) seasons. We find differential impacts of the monsoon by crop, by season and by source of irrigation. In general, for crops grown in the wet season, irrigation is sensitive to both distribution and total monsoon rainfall but not to ground or surface water availability. For crops grown in the dry season, total monsoon rainfall matters most, and its effect is sensitive to groundwater availability. Over the historic period of analysis, the effect of the monsoon on irrigation has remained relatively stable. The econometric analysis, when combined with a process based hydrology model that accounts for the supply side response of water availability, can help quantify the (un)sustainable water use trajectory that different regions within India will face.

## 15.20 - 16.00 Student talk 3

### Accounting for Land Use Adaptation to Climate Change Impacts on US Agriculture

SHUN CHONABAYASHI, *Cornell University, United States*

There has been active debate on the impact of climate change on agriculture in the US. Many of previous literature assume that farmland area does not change. However, farmers should adapt their farmland area and even choose whether they stop or start farming due to climate change. In this paper, I analyze the impact of climate change on the US agriculture allowing farmers to adapt their land use such as farmland area and land type. Using Ricardian analysis, I regress farmland, cropland and pastureland areas on climate, soils, and socioeconomic variables, and the total land area in each country in the semi-log pooled model with year and state fixed effects. The Ricardian results are then used to forecast how farmland area would change with different future climate scenarios. The results trace out heterogeneous impacts of climate change on different regions of the US.

*16.00 - 16.20 Break*

16.20 - 17.00 Student talk 4

## A Ricardian Analysis of the Impact of Climate Change on Italian Agriculture

MARTINA BOZZOLA, *Centre for International Environmental Studies and IHEID, Switzerland*

This paper estimates the impact of climate change on Italian agriculture using the Ricardian method. Italy offers an excellent case study to investigate the impact of climate on European farms, due to the highly heterogeneous climatic, soil, socio-economic and topographical feature of the Italian peninsula. Climate, soil, geography and socio-economic variables at municipality level are matched with farm level data from more than 15,900 farms across Italy for 4 years. We estimate the relationship between farmland value and climate. The results suggest that Italian farms will be hurt by warming but generally helped by increased rainfall. But these marginal effects vary across the landscape. We also find evidence that different farm types have very different sensitivities to seasonal climate. The analysis suggests a powerful adaptation for Italy will be to change farm types across the landscape.

17.00 - 17.40 Reading Time and Consultations

### 19.45  Social Dinner at 'Bacarando ai Corazzieri' Restaurant

The Summer School Organisers are pleased to invite all the participants to the social dinner organised in Venice downtown *at 'Bacarando ai Corazzieri' Restaurant* (Salizada del Pignater, Castello 3839, Venice). The social dinner is arranged at 19.45.
The meeting point to reach together the restaurant from the San Servolo Island is in front of the island's waterbus landing stage at 19.15. The waterbus leaves at 19.20.

**Waterbus stop San Zaccaria M.V.E.**

**Bacarando ai Corazzieri**
Salizada del Pignater,
Castello 3839, Venice

# Tuesday 8th July

9.00 - 10.30 Lecture 3

**Adaptation in Agriculture I**

EMANUELE MASSETTI, *Fondazione Eni Enrico Mattei, Italy*

The aim of this module is to provide solid theoretical and empirical foundations to study adaptation to climate change in agriculture. The lecture introduces methods that rely on cross-sectional variation of climate and of agricultural practices to identify the optimal response of farmers to different temperature and precipitation normals. Studies that examine adaptation in South America, Africa, Asia and Europe are presented as examples.

*10.30 - 11. 00 Break*

11.00 - 12.30 Lecture 4

**Adaptation in Agriculture II**

EMANUELE MASSETTI, *Fondazione Eni Enrico Mattei, Italy*

The second lecture critically evaluates strengths and weaknesses of the cross-sectional methods in comparison with agronomic models and with methods that rely on short-term weather fluctuations. Short-term and long-term adaptation potential, the cost of adaptation and uncertainty in future climate change scenarios will be discussed in the second lecture.

*12.30 - 13.30 Lunch*

13.30 - 14.00 Reading time and Consultation

14.00 - 14.40 Student talk 5

**Economics of boreal Scots pine stands in changing climate**

SAMPO PIHLAINEN, *University of Helsinki, Finland*

We optimize the joint production of timber and carbon storage at Scots pine (Pinus sylvestris L.) stands in changing climate. In our economic-ecological model, a highly-sophisticated process-based forest growth model is connected to a detailed economic description of stand management. The optimized variables for each rotation in the changing and the changed climate are the timing, type, intensity and number of harvests, as well as the initial stand density. The results are presented for all relevant Nordic sites and using various levels of carbon subsidy. Our results suggest that in the changing climate optimal forest rotations first lengthen and then shorten, thinnings are heavier and the optimal number of thinnings is higher than in the current climate. Timber production and carbon yield both increase remarkably with climate change, especially at poor sites. Optimally adapted stand management yields significantly better land values compared to benchmark management.

14.40 - 15.20 Student talk 6

**Combining top-down and bottom-up approaches to define climate change adaptation measures at the river basin scale**

CORENTIN GIRARD, *Universidad Politécnica de Valencia, Spain*

This article presents a method to evaluate adaptation strategies to global change on water resources systems at the river basin scale. The method is based on a bottom-up meets top-down approach. The top-down modeling involves the use of a chain of models to assess the impacts of global change on water resources and its management. Potential acceptable adaptation measures are identified using a bottom-up approach through a consultation process with the relevant stakeholders. The optimal combination of adaptation measures is then defined using a least-cost optimization model. The programme of adaptation measures for future mid-term climate scenarios are climate checked to identify least-regret options based on trade-offs between costs and reliability of the supply to agricultural water demand and on preferences of stakeholders. The method is implemented on a case study in the Mediterranean basin, the Orb river basin (France).

15.20 - 16.00 Student talk 7

**Dengue, Weather and Urbanization in Brazil**

INGRID DALLMANN, *Université Paris Sud (RITM), France*

Since two decades, the population affected by dengue disease is exponentially increasing and dengue is now affecting more than 100 million people in the world. It ranks behind malaria as the second most important vector-borne disease in the world and the first one in Latin America. Despite the important economic and social cost of the uncontrollable growth of the disease, little economic analysis has been devoted to it. In addition to weather, socio-economic factors such as urbanization and sanitary systems play an important role in the proliferation of dengue. In this paper, we measure the impact of weather and urbanization factors on dengue incidence in Brazilian states during 2001-2012, since Brazil is the most affected country in Latin America. We find a positive and statistically significant effect of temperature, urbanization, access to waste management system and to piped water. While the results on weather and urbanization confirm our ex ante hypothesis, the results on access to sanitary system is less intuitive.

*16.00 - 16.20 Break*

16.20 - 17.00 Student talk 8

**Weather shocks and cropland decisions in rural Mozambique**

CÉSAR ANTONIO SALAZAR ESPINOZA, *University of Copenhagen, Denmark*

Economic development includes transformation processes that encourage farmers to devote more efforts to high-value agricultural activities. Such activities are often associated with higher risk, so understanding cropland decisions and how these interact with shocks is a key requisite to sound policy-making. This paper uses data from Mozambique to examine the effect of weather shocks on cropland decisions. We account for the bounded nature of land shares, and estimate the Pooled Fractional Probit (PFP) response model for panel data. The results suggest that crop choice is sensitive to past weather shocks and farmers. Furthermore, farmers in high drought risk areas are more responsive. While past floods move farmers out of cash crop production, farmers reallocate resources away from permanent crops and horticulture when hit by a past drought. Investments in irrigation and

intercropping emerge as two important policy implications that can help farmers keep self-sufficient in food while avoiding moving out of more profitable cropping activities.

17.00 - 17.40 Student talk 9

**The Roles of Adaptation and Mitigation for Coastal Impacts from Climate Change, Extreme Events, and Catastrophe**

DELAVANE TURNER, *Stanford University, United States*

Understanding the potential economic impacts of climate change on coastal resources involves analyzing a number of distinct courses of action. This paper presents a tool for such analysis, a spatially-disaggregated optimization model of sea level rise impacts, the Coastal Impact and Adaptation Model (CIAM), filling a gap between very detailed studies of specific locations and overly aggregate global analyses. CIAM determines the optimal quantity and strategy for adaptation at the local level, evaluating over 12,000 coastal segments, as described in the DIVA database, based on socioeconomic values and potential impacts. The model's decision to protect or retreat considers the costs of coastal defenses versus those of relocating people and capital in order to minimize damages from land inundation and uncertain storm surge events. CIAM provides new estimates of the global costs of SLR; moreover, these results can be compactly represented in a set of adaptation and damage functions that retain the rich detail of the underlying model. The subsequent part of this analysis introduces these CIAM damage functions into the DICE model to investigate how the optimal mitigation pathway responds to different levels of coastal adaptation. Finally, the deterministic model is reformulated as stochastic control such that the probability of collapse of the West Antarctic Ice Sheet is linked to warming, in order to test whether this threat leads to precautionary climate action. This modeling approach of applying bottom-up CIAM results in a top-down IAM explores the balance between adaptation and mitigation in the face of incremental climate change, extreme events, and catastrophe.

# Wednesday 9th July

9.00 - 10.30 Lecture 5

**Concepts and Methods for Assessing Water Sector Responses to Climate Change I**

BRIAN H. HURD, *New Mexico State University, United States*

1. Watershed Assessment in Concept and Theory
   • Economic valuation and opportunity costs
   • Private and Public Choices
     ➢ Market roles and limitations (pros and cons)
     ➢ Non-market values, externalities, and collective action
2. Modeling and Economic Assessment of Watersheds
   • Goals and objectives in watershed assessment
     ➢ Adaptation costs and benefits of water-use changes
     ➢ Balancing water supply and demand
   • Modeling approaches and platforms
     (1) System Dynamics Models (simulation)
     (2) Hydro-Economic Models (optimization)
   • Long-run watershed adaptation assessment and planning
     ➢ Conceptual framework and key economic principles
     ➢ Optimizing water allocations across uses, places and time.

*10.30 - 11.00 Break*

11.00 - 12.30 Lecture 6

**Concepts and Methods for Assessing Water Sector Responses to Climate Change II**

BRIAN H. HURD, *New Mexico State University, United States*

3.  Hydro-Economic Modeling Climate Change Adaptation Case Studies
    • Integrating climate, hydrology and Economics
    • Conceptual framework
    • Scenario design and data development
    • Economic valuation functions
    • Case #1: Colorado River
    • Case #2: Rio Grande
4.  Strategies for Developing Climate Change Scenarios and Modeling Data
    • Climate scenarios and data
    • Hydrological data and modeling
    • Economic data
        ➤ water supply (cost) estimation
        ➤ demand (benefit) estimation
    • Collaborate, work together and other final thoughts

*12.30 - 13.30 Lunch*

13.30 - 14.00 Reading time and Consultation

*Free afternoon*

# Thursday 10$^{th}$ July

9.00 -10.30 Lecture 7

**Forests and Ecosystems I**

BRENT SOHNGEN*, Ohio State University, United States*

1.  Ecosystem models and their implications for the impacts of climate change on forests
    ➤ Review of literature on ecological impacts
    ➤ Review of Dynamic Global Vegetation Models
2.  Alternative forestry economic modeling approaches
    ➤ Structural/dynamic models
    ➤ Reduced form/static models
3.  Methods for integrating ecosystem model results into economic models

*10.30 - 11.00 Break*

11.00 - 12.30 Lecture 8

**Forests and Ecosystems II**

BRENT SOHNGEN, *Ohio State University, United States*

4. Adaptation
   - ➢ Forest fires
   - ➢ Shifting species
   - ➢ Who owns the land? (Private/public)
   - ➢ Is the land managed? (managed/unmanaged/reserved/set-aside)
5. Role of government in adaptation
   - ➢ Private land
   - ➢ Public land
   - ➢ Collectively managed land
6. Special issues
   - ➢ Carbon sequestration/REDD policy and climate change
   - ➢ Biofuels
   - ➢ Managing biodiversity and reserved land

*12.30 - 13.30 Lunch*

13.30 - 14.00 Reading time and Consultation

14.00 - 14.40 Student talk 10

## Impacts of Rainfall Variability and Expected Rainfall Changes on Cost-Effective Adaptation of Water Systems to Climate Change

THOMAS VAN DER POL, *Wageningen University, The Netherlands*

Stormwater drainage and other water systems are vulnerable to changes in rainfall and runoff. In this paper, we study impacts of rainfall variability and changing return periods of rainfall extremes on cost-effective adaptation of water systems to climate change given that a system performance target, for example a flood risk standard, has been set. A model description is presented, and a solution method is developed for identification of cost-effective investments in stormwater drainage system adaptations. Runoff and water levels are simulated with rainfall from stationary rainfall distributions, and time series of annual rainfall maxima are simulated for a climate scenario. Cost-effective investment strategies are computed with dynamic programming. We find that increasing initial investments may not only increase system robustness to structural changes in rainfall, but could also offer insurance against costs from underestimation of the system's performance.

14.40 - 15.20 Student talk 11

## Optimal Timing of Investments into Climate Change Adaptation to Extreme Events

CHI TRUONG, *Macquarie University, Australia*

It is of significant concern that climate change will exacerbate the frequency and severity of extreme events. As the value of properties under risk increases, there is a need for government stakeholders to evaluate adaptation measures that reduce potential losses from these catastrophes. In this paper, we provide a framework to quantify the risk of catastrophic events under climate change and to evaluate optimal adaptation strategies by incorporating the value of flexible investment timing as well as risk preferences. The application of the model to a conducted case study on bushfire management in the northern Sydney area shows that ignoring the flexibility of the adaptation decision may result in significant losses. We also found that incorporating risk aversion is important when the flexibility of adaptation is ignored, but when the flexibility is considered, risk preference has little impact on the adaptation decision.

15.20 - 16.00 Student talk 12

## Appraising adaptation options to climate change: are robust methods the way forward?

RUTH DITTRICH, *Scottish Rural College/University of Edinburgh, United Kingdom*

Appraising adaptation investment aims to provide the best possible guidance for the allocation of resources, i.e. the optimum choice. Yet, applying standard optimality methods such as cost-benefit analysis in an area of high uncertainty such as climate change adaptation is challenging. The costs of adaptation might be observable and immediate, while the benefits are often uncertain. Still widely used in investment appraisal, the limitations of traditional optimisation methods are recognised and alternative decision making methods, so called robust approaches are therefore increasingly being explored in the literature. Robust approaches select projects that meet their purpose across a variety of futures by integrating a wide range of climate scenarios and are thus particularly suited for deep uncertainty. Here we provide an overview of widely discussed robust methods that may provide an alternative to traditional optimisation methods to appraise adaptation options, with a simple framework identifying which method is suited for which application, and discuss the limitations of the methods.

*16.00 - 16.20 Break*

16.20 - 17.00 Student talk 13

**The Greenhouse Gas Effects of Wood Bioenergy - A Dynamic General Equilibrium Model**

XIAOHUI TIAN, *The Ohio State University, United States*

This study examines the greenhouse gas (GHG) effects of wood biofuel policies and the implications of potential carbon policies with biomass production. Previous literature suggests that an increase in wood biomass demand will cause more carbon emissions, and they suggest emissions from wood based biomass should be taxed. These studies, however, are static, and they ignore forest growth and sequestration. This paper develops a forward looking dynamic general equilibrium with a dynamic forestry sector. By taking into account the dynamic land use adjustment in the forest sector, we show that the optimal strategy is to subsidize carbon growth in forests and to tax carbon emissions. Proposed strategies that would only tax carbon emissions from the forest sector including biomass energy production without compensating forest sequestration actually causes more net carbon emissions than if forest based bioenergy is simply treated as carbon neutral and ignored. This paper makes two major contributions to the economics literature.

17.00 - 17.40 Reading time and Consultation

# Friday 11th July

9.00 - 10.30 Lecture 9

**Sea level rise and Integrated assessment modelling I**

RICHARD TOL, *University of Sussex, United Kingdom*

*10.30 - 11.00 Break*

11.00 - 12.30 Lecture 10

**Sea level rise and Integrated assessment modeling II**

RICHARD TOL, *University of Sussex, United Kingdom*

*12.30 - 13.30 Lunch*

13.30 - 14.00 Reading time and Consultation

14.00 - 14.40 Student talk 14

**Natural disasters and urban development: insurance policy and zoning restrictions**

ARNAUD GOUSSEBAÏLE, *Ecole Polytechnique, France*

Cities located in regions prone to natural hazards, such as flooding, are not uniformly exposed to risks because of sub-city local characteristics (e.g. topography). Spatial

heterogeneity thus raises the issue of how these cities have spread and should continue to develop. The paper investigates these questions by using a mono-centric urban model in which each location is characterized by a transport cost to the city center and a risk exposure. It first shows that efficient insurance markets lead households to optimally settle in space. In this case, riskier areas are developed near the city center rather than further away. However, insurance market failures can lead policy makers to foster a culture of insurance subsidization or relief provision and thus lead households to settle in hazardous areas. Instead of addressing insurance market failures directly, policy makers can actually complement subsidization/relief policies with zoning restrictions. In the extreme case of a uniform insurance or full relief policy, I compute the optimal zoning restrictions for risk exposure as a function of the distance to the city center, lot size demand elasticity and disaster loss function. Results show that zoning restrictions should in general be less stringent near the city center rather than further away.

14.40 - 15.20 Student talk 15

**Farmers Preferences for Abiotic Stress Tolerant Rice Seeds in the presence of Climate Change: Evidence from Odisha, India**

ANCHAL ARORA, *Jawahar lal Nehru University (J.N.U), India*

A potential risk of climate change is increased variability in rainfall which may cause abiotic stresses such as droughts or floods that significantly constrain rice production in India and the frequency of such stresses is likely to increase with climate change. One of the possible adaptive measure could be to develop improved rice varieties that are better able to tolerate drought and floods and thus could ensure food security in India. Many public and private sector institutes in India are engaged in rice biotechnology research and are attempting to develop such rice seeds that has potential to increase rice production and reduce its variability.In this study, we examine farmers' preferences for various characteristics particularly drought tolerance and submergence tolerance traits. For this purpose, we employ a discrete choice experiment approach and collected primary data from various drought prone and submergence prone villages in Odisha, state of India. Using different versions of random parameter logit models we account for heterogeneity in the preferences of farmers and compute the willingness to pay estimates for various attributes. In addition, we used some post estimation conditioning approaches to account for attribute non-attendance and derive demand curves for hypothetical bundles of rice seeds. Our results depict considerable heterogeneity in farmers preferences and provide support to poverty trap hypothesis. It also informs the government regarding appropriate measures for equitable distribution of these new and improved technologies which could be seen as a measure to combat the adverse effect of climate change on crops such as rice.

15.20 - 16.00 Student talk 16

**The Globalization of Virtual Water Flows: how Trade reacts to variations in Water**

ESTHER DELBOURG, *Ecole Polytechnique, France*

The burgeoning literature on embedded or virtual water claims that food trade is increasingly threatened by water scarcity and increasing climatic uncertainties. But because water is only one of the many inputs required in the production of crops and livestock, focus has shifted to "water productivity" - or water footprint - which capital, knowledge and technology can greatly improve. In this paper, we empirically examine these three arguments, namely how water scarcity, water productivity and rainfall variation impact international food trade. Using panel data of bilateral virtual water trade of crops and livestock between 1994 and 2007, we demonstrate that relative water endowments, productivity, temporal and spatial rainfall variation have a significant role in shaping bilateral food trade. Our gravity model with high

dimensional fixed effects at the country-pair, year and product level shows that exporter-importer asymmetries in water endowments do have a positive effect on virtual water trade, suggesting that the driest countries use food trade as a means to alleviate water scarcity. On the other hand, asymmetries in water footprint have a strong non-linear impact on food trade, mostly because of demand effects. For moderate levels of water footprint asymmetries, and as to be expected, virtual water flows from relatively more to less water-productive countries. But passed a certain threshold, rather than importing goods for which their relative water productivity is low, countries import products that add up to their local production in order to satisfy national demand. In this case, virtual water flows from low to high water productive countries. We also show that countries with relatively high inter-annual rainfall resort to trade as a buffer against climatic uncertainty. Furthermore, our results support previous findings showing that nearly 80\% of food trade occurs between countries with low asymmetries in wealth and population growth. Gravity model control variables support results often cited in the international trade literature.

*16.00 - 16.20 Break*

16.20 - 17.00 Student talk 17

**Exploring Differences in the Implicit Price of Flood Risk: A Meta-analysis Approach from the Housing Market**

ALLAN BELTRAN, *University of Birmingham, United Kingdom*

Economic theory suggests that the implicit price of flood risk is reflected in the price differential of comparable properties located within and outside a floodplain. Empirical evidence suggests this differential ranges between -75% – +61%. I perform a meta-analysis on the relative price differential for floodplain location. The final meta-sample includes 38 studies and 364 point estimates. Results suggest houses in flood prone areas have a significant discount around 5.2%. Meta-regression results indicate a significant difference between river and coastal flood risk; results are sensitive to the elapsed time since previous flood events and support recent findings suggesting the discount decreases on time. Unlike recent studies concluding the price discount vanishes after 5 to 6 years after a flood; results from the meta-analysis suggest this process is much slower, especially in regions exposed to more frequent and more intense flooding.

17.00 - 17.40 Reading time and Consultation

# Saturday 12th July

9.00 - 11.00 Reading time and Consultation

11.00 - 12.30 Closing Remarks

*12.30 - 13.30 Lunch*

## ⬤ List of participants

## Lecturers

**Brian H. HURD**
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## ⬤  The Organisers

### European Association of Environmental and Resource Economists (EAERE)
http://www.eaere.org/

The European Association of Environmental and Resource Economists (EAERE) is a non-profit international scientific association which aims are: (a) to contribute to the development and application of environmental and resource economics as a science in Europe, (b) to encourage and improve communication between teachers, researchers and students in environmental and resource economics in the different European countries, (c) to develop and encourage cooperation between university level teaching institutions and research institutions in Europe.

Founded in 1990, EAERE has over 400 members from Europe and beyond, from academic institutions, the public sector, and the private industry. Interests span traditional economics, agricultural economics, forestry, and natural resource economics.

The aims of the Association are mainly accomplished by organising workshops, conferences, events, exhibitions, seminars, meetings, and discussions, by cooperating in editing professional journals, and by promoting postgraduate education for junior scholars. In particular, EAERE pursues its objectives through four main delivery mechanisms: EAERE annual Conferences, the annual European Summer School in Resource and Environmental Economics, the journal Environmental and Resource Economics (ERE) and the EAERE Newsletter.

### Fondazione Eni Enrico Mattei (FEEM)
http://www.feem.it/

Fondazione Eni Enrico Mattei (FEEM) is a nonprofit, nonpartisan research institution devoted to the study of sustainable development and global governance. Officially recognized by the President of the Italian Republic in 1989 and in full operation since 1990, FEEM has grown to become a leading research centre, providing timely and objective analysis on a wide range of environmental, energy and global economic issues.

FEEM's mission is to improve through research the quality of decision-making in public and private spheres. This goal is achieved by creating an international and multidisciplinary network of researchers working on several innovative programmes, by providing and promoting training in specialized areas of research, by disseminating research results through a wide range of outreach activities, and by delivering directly to policy makers via participation in various institutional fora.

### Venice International University (VIU)
http://www.univiu.org/

VIU is an association constituted by the following members: Ca' Foscari University of Venice (Venice, Italy), Istituto Universitario di Architettura di Venezia (Venice, Italy), Ludwig Maximilians Universität (Münich, Germany), Duke University (Durham, North Carolina, U.S.A.), Tel Aviv University (Tel Aviv, Israel), Tsinghua University (Beijing, China), Waseda University (Tokyo, Japan), Boston College (Boston, U.S.A.), the Consiglio Nazionale delle Ricerche (Rome, Italy), the Ministero dell'Ambiente e della Tutela del Territorio e del Mare (Rome, Italy), Tongji University (Shanghai, China), Koç Üniversity (Turkey), Università di Padova (Padove, Italy), European University at St. Petersburg (Russia) and the Province of Venice (Venice, Italy).

The aim of this International centre is to manage higher education and research centres on the San Servolo Island in Venice. VIU pursues its aim through the programming and promotion of undergraduate, graduate and continuing education and scientific research.

## ● VIU Campus

**The Campus**

The island of San Servolo is located in the Venetian lagoon, between Venice city center and the island of Lido. It takes 10 minutes by boat to reach Piazza San Marco, the heart of Venice.

The island was originally the home of the Venetian Calbana family and in 810 it became the seat of a Benedictine Monastery. Eventually, the monks were joined by a convent of nuns and both the monastery and the convent remained on the island until the mid eighteenth century. In the early 1700s San Servolo became the military hospital of the Venetian Republic and it remained a hospital until its closing in 1978. The island covers an area of over sixteen thousand square meters including the existing park that was once used for vineyards and gardens.

San Servolo is an oasis in a unique urban setting. Students can study, work, and relax in a peaceful park spread across 12 scenic acres with a panoramic view of Venice. In addition to this, students will have an extraordinary opportunity to study under conditions that are significantly different from their normal day-to-day studying environment. Professors, scholars and students from all over the world will be given the chance to interact and to share their experiences and knowledge.

The restoration work of the monumental complex on the Island of San Servolo started a few years ago and maintains the architectural qualities and natural landscape of the setting. Following completion of the first part of restoration in the spring of 1997, the Venice International University (VIU) has had access to use facilities on the island for conferences and seminar courses. The first semester of the academic year 1997/98 marked the beginning of VIU's undergraduate activities along with the complete restoration of the monumental complex and a 250 bed residential hall. All successive renovation was completed and the island was inaugurated and opened to the public in March 2004.

**Computer and internet facilities**

Wireless is available in the rooms, in the class room and in the snack bar common area.

Also, a PC room (room 7-A) is located on the ground floor of VIU main building. It is open 24 hours a day.

**Telephone facilities**

Telephone in room is usable buying a payment card at the accommodation reception open 24 hours a day.

**Photocopying facilities** are avaiable on the ground floor and it is open 24 hours a day.

**Washing and drying facilities** are located in Palazzina Maestrale. The load cost depends on the choosen program. There is no vending machine for washing powder etc.

**Housing**

The residential halls have approximately 300 places. The residential facilities are managed by a service company San Servolo Servizi Srl (http://www.sanservolo.provincia.venezia.it). If you are staying on the island you will receive a magnetic key to your room when you arrive. For any problems in your room (light bulbs, heating, A.C, etc.) please inform the reception.

The reception is open from 8.30 am to 20.00 pm. There is a night porter on duty from 20.00 pm to 8.30 am.

The reception is available for accommodation payments from 9.00 am to 6.30 pm; credit cards accepted are Visa and Mastercard.

Check-out is at 11 am of your departure day.

Please note that:
- Rooms are cleaned every day.
- No outside guests are allowed in the residential halls.
- No pets are allowed in the residential halls.
- Cooking is strictly prohibited in the residential halls.
- Smoking is strictly prohibited in the residential halls, including individual rooms.
- Noise levels should be kept to a minimum, especially after 10 pm.

### Cafeteria

The refectory is located on the ground floor of Building 15 (please see the enclosed map of the VIU campus on page 23). It is open every day with following timetable:

- Breakfast: 7.30 am - 9.30 am
- Lunch: 12.30 pm - 2.30 pm
- Dinner: 7.00 pm - 9.30 pm

### Snack Bar (café)

The snack bar is located on the ground floor of Area 6 in the VIU main buildings (please see the enclosed map of the VIU campus on page 23). It is open every day from 8.00 am to 6.00 pm.

## ⬤　**Practical Information**

### School Room and Secretariat Office

The School will be held in **room 9A** (please see the enclosed map of the VIU main bulding's first floor on page 30).

The Secretariat Office will be in **room 6G**. Telephone number is: +39 (0)41 2719541 (please see the enclosed map of the VIU main bulding's first floor on page 28).

### Subsistence

Breakfast, lunches and dinners will be provided in the VIU Cafeteria which is located on the ground floor of Building 15.

### Connection San Servolo Island – Venice centre

The public boat to San Servolo, line 20, runs according to the following schedule with a journey time of 10 minutes.

Tickets may be bought from a water bus stop landing stage. The limited one-way, one-stop, not-resident ticket costs € 4,00 (this ticket cannot be bought on board), whilst the regular not-resident ticket costs € 7,00.

Alternatively short term season tickets can be bought:

12-hour ticket: € 18,00

24-hour ticket: € 20,00

36-hour ticket: € 25,00

48-hour ticket: € 30,00

72-hour ticket: € 35,00

7-days ticket: € 50,00

Leaving S. Zaccaria M.V.E. for San Servolo Island

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6.55 | 7.15 | 8.10 | 8.40 | 9.00 | 9.20 | 9.50 | 10.30 | 11.10 | 11.50 |
| 12.30 | 13.10 | 13.50 | 14.30 | 15.10 | 15.50 | 16.30 | 17.10 | 17.50 | 18.30 |
| 19.10 | 19.50 | 20.30 | 21.30 | 22.30 | 23.30 | 00.25 | 01.30[1] | 02.10[1] | |

Leaving San Servolo Island for S. Zaccaria M.V.E.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 7.05 | 7.35 | 8.35 | 08.45 | 09.10 | 9.40 | 10.00 | 10.50 | 11.20 | 12.10 |
| 12.40 | 13.30 | 14.00 | 14.50 | 15.30 | 16.00 | 16.50 | 17.30 | 18.00 | 18.50 |
| 19.20 | 20.10 | 20.40 | 21.50 | 22.40 | 23.40 | 01.40[1] | 02.20[1] | | |

[1] waterbus run upon request by calling the free of charge number 800.845065 at least 20 minutes before the time scheduled for the trip.

### Alilaguna waterbus' timetable to the airport

Alilaguna offers a direct public transportation service from the Marco Polo Airport of Venice to all the main areas of Venice and viceversa.

From San Zaccaria waterbus station you can take the Alilaguna waterbus BLUE and RED lines (from San Marco waterbus station) which run respectively from 03.40 to 22.35 and from 09.05 to

17.05; the journey takes approx. 70 minutes and the price of one way ticket is €15,00 (luggage included). Tickets can be bought on board.

Further information about the Alilaguna waterbus is available at: http://www.alilaguna.it.

**BLUE line**

| S.MARCO | 03.40 | 04.50 | 05.50 | 06.50 | 07.20 | 07.50 | 08.20 | 08.50 | 09.20 | 09.50 | 10.20 | 10.50 | 11.20 | 11.50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.ZACCARIA | 03.44 | 04.54 | 05.54 | 06.54 | 07.25 | 07.55 | 08.25 | 08.55 | 09.25 | 09.55 | 10.25 | 10.55 | 11.25 | 11.55 |
| LIDO | 03.56 | 05.06 | 06.06 | 07.06 | 07.40 | 08.10 | 08.40 | 09.10 | 09.40 | 10.10 | 10.40 | 11.10 | 11.40 | 12.10 |
| *BACINI\** | - | - | - | - | - | - | - | *09.24* | *09.54* | *10.24* | *10.54* | *11.24* | *11.54* | *12.24* |
| *OSPEDALE\** | *04.16-* | *05.24* | *06.24* | *07.24* | *07.57* | *08.27* | *09.27* | *09.57* | *10.27* | *10.27* | *10.57* | *11.27* | *11.57* | *12.27* |
| FTE NOVE | 04.21 | 05.29 | 06.29 | 07.29 | 08.02 | 08.32 | 09.02 | 09.32 | 10.02 | 10.32 | 11.02 | 11.32 | 12.02 | 12.32 |
| MURANO | 04.29 | 05.37 | 06.37 | 07.38 | 08.09 | 08.39 | 09.09 | 09.39 | 10.09 | 10.39 | 11.09 | 11.39 | 12.09 | 12.39 |
| AEROPORTO | 04.59 | 06.07 | 07.07 | 08.08 | 08.39 | 09.09 | 09.39 | 10.09 | 10.39 | 11.09 | 11.39 | 12.09 | 12.39 | 13.09 |

| S.MARCO | 12.20 | 12.50 | 13.20 | 13.50 | 14.20 | 14.50 | 15.20 | 15.50 | 16.20 | 16.50 | 17.50 | 18.20 | 18.50 | 19.50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.ZACCARIA | 12.25 | 12.55 | 13.25 | 13.55 | 14.25 | 14.55 | 15.25 | 15.55 | 16.25 | 16.55 | 17.55 | 18.25 | 18.55 | 19.55 |
| LIDO | 12.40 | 13.10 | 13.40 | 14.10 | 14.40 | 15.10 | 15.40 | 16.10 | 16.40 | 17.10 | 18.10 | 18.40 | 19.10 | 20.10 |
| *BACINI\** | *12.54* | *13.24* | *13.54* | *14.24* | *14.54* | *15.24* | *15.54* | *16.24* | *16.54* | *17.24* | *18.24* | *18.52* | *19.24* | *20.24* |
| *OSPEDALE\** | *12.57* | *13.27* | *13.57* | *14.27* | *14.57* | *15.27* | *15.57* | *16.27* | *16.57* | *17.27* | *18.27* | *18.57* | *19.27* | *20.27* |
| FTE NOVE | 13.02 | 13.32 | 14.02 | 14.32 | 15.02 | 15.32 | 16.02 | 16.32 | 17.02 | 17.32 | 18.32 | 19.02 | 19.32 | 20.32 |
| MURANO | 13.09 | 13.39 | 14.09 | 14.39 | 15.09 | 15.39 | 16.09 | 16.39 | 17.09 | 17.39 | 18.39 | 19.09 | 19.39 | 20.39 |
| AEROPORTO | 13.39 | 14.09 | 14.39 | 15.09 | 15.39 | 16.09 | 16.39 | 17.09 | 17.39 | 18.09 | 19.09 | 19.39 | 19.09 | 21.09 |

| S.MARCO | 20.25 | 21.35 | 22.35 | 22.35 |
|---|---|---|---|---|
| S.ZACCARIA | 20.29 | 21.39 | 22.39 | 22.39 |
| LIDO | 20.41 | 21.51 | 22.51 | 22.51 |
| *BACINI\** | *20.56* | *22.06* | *23.06* | *23.06* |
| *OSPEDALE\** | *21.00* | *22.10* | *23.10* | *23.10* |
| FTE NOVE | 21.04 | 22.14 | 23.14 | 23.14 |
| MURANO | 21.13 | 22.23 | 23.23 | 23.23 |
| AEROPORTO | 21.43 | 22.53 | 23.53 | 23.53 |

**RED line**

| S.MARCO | 09.05 | 10.05 | 11.05 | 12.05 | 13.05 | 14.05 | 15.05 | 16.05 | 17.05 |
|---|---|---|---|---|---|---|---|---|---|
| LIDO S.M.E. | 09.25 | 10.25 | 11.25 | 12.25 | 13.25 | 14.25 | 15.25 | 16.25 | 17.25 |
| *CERTOSA\** | *09.35* | *10.35* | *11.35* | *12.35* | *13.35* | *14.35* | *15.35* | *16.35* | *17.35* |
| MURANO MUSEO | 09.48 | 10.48 | 11.48 | 12.48 | 13.48 | 14.48 | 15.48 | 16.48 | 17.48 |
| AEROPORTO | 10.18 | 11.18 | 12.18 | 13.18 | 14.18 | 15.18 | 16.18 | 17.18 | 18.18 |

*\* Stop upon request*

**Taxi and Bus to the airport**

The fastest and most direct way to get to the **Venice Marco Polo Airport** by water is by taking a **water taxi**. The price is based on the number of people and can vary after 20.00, on Sundays and public holidays. You may call the taxi company which guarantees fixed special prices for connections with San Servolo:

- San Servolo-Venice Airport (vice versa) €90,00 in day time and for up to 4 persons (€15,00 each one extra person)
- San Servolo-Tronchetto (vice versa) €70,00 in day time and for up to 4 persons (€10,00 each one extra person)
- San Servolo-Piazzale Roma/Railway station (vice versa) €60,00 in day time and for up to 4 persons (€10,00 each one extra person)
- San Servolo-San Zaccaria (vice versa) €50,00 in day time and for up to 4 persons (€5,00 each one extra person)

For reservation please call Franco Vitturi (Venezia Dream): +39 347.7915035.

In order to reach the Venice Marco Polo Airport from Piazzale Roma (car and bus terminal) you can take a road bus or a road taxi.

The **ACTV road bus no. 5**, (orange bus), travels between Piazzale Roma and the Venice Marco Polo Airport with a journey time of approx. 33 minutes and one way ticket costs € 5,00. On weekdays and Saturdays regular departures are between 4.35 and 00.40 every 15/30 minutes. On Sundays and public holidays regular departures are every 30 minutes. Information on the timetable and prices is available in the ACTV web-site at http://www.actv.it/en or contact +39 (0)41.2424.

The **ATVO road bus**, (blue bus), from Piazzale Roma to the Marco Polo Airport departs approximately every 30 minutes. The drive takes approx. 20 minutes and the one way ticket cost € 6,00 (luggage included). The service is guaranteed every day from 5.00 to 21.10. Information about the timetable and prices is available in the ATVO web-site at http://www.atvo.it/ or contact +39 (0)421 383672 – 38367.

A private **road taxi** from Piazzale Roma to the Venice airport costs approximately € 45,00. Road taxis are provided by the Cooperativa Radio Taxi and they are available 24 hours a day. For booking and tariffs please call the Cooperativa at +39 (0)41.5952080.

**Useful telephone numbers**

| | |
|---|---|
| Police emergency call | 113 |
| Police (European Mobile Phone Users) | 112 |
| Fire Department | 115 |
| First Aid | 118 |
| Car breakdown Service | 116 |
| Operator assisted international call | 170 |

**Lost and Found**

| | |
|---|---|
| Lost items on public water transport | +39 (0)41.2722179 |
| Lost items on public road transport | +39 (0)41.2722723 |

**Airport**

| | |
|---|---|
| Flight Information Office | +39 (0)41.2609260 |
| Lost and Found | +39 (0)41.2609222 |
| Customs Office | +39 (0)41.2699311 |
| Airport Parking | +39 (0)41.2603060 |

**Railway**

| | |
|---|---|
| Railway information | 892021 |
| Italo Contact Center | +39 (0)60708 |
| Train Station | +39 (0)41.785670 |

**Tourist Information Board**

| | |
|---|---|
| **Tourist Information Board** | +39 (0)41.5298711 |
| | +39 (0)41.5298730 |

**Bus and Water Bus**

| | |
|---|---|
| Boat and bus information | +39 (0)41.2424 |

**Water taxis**

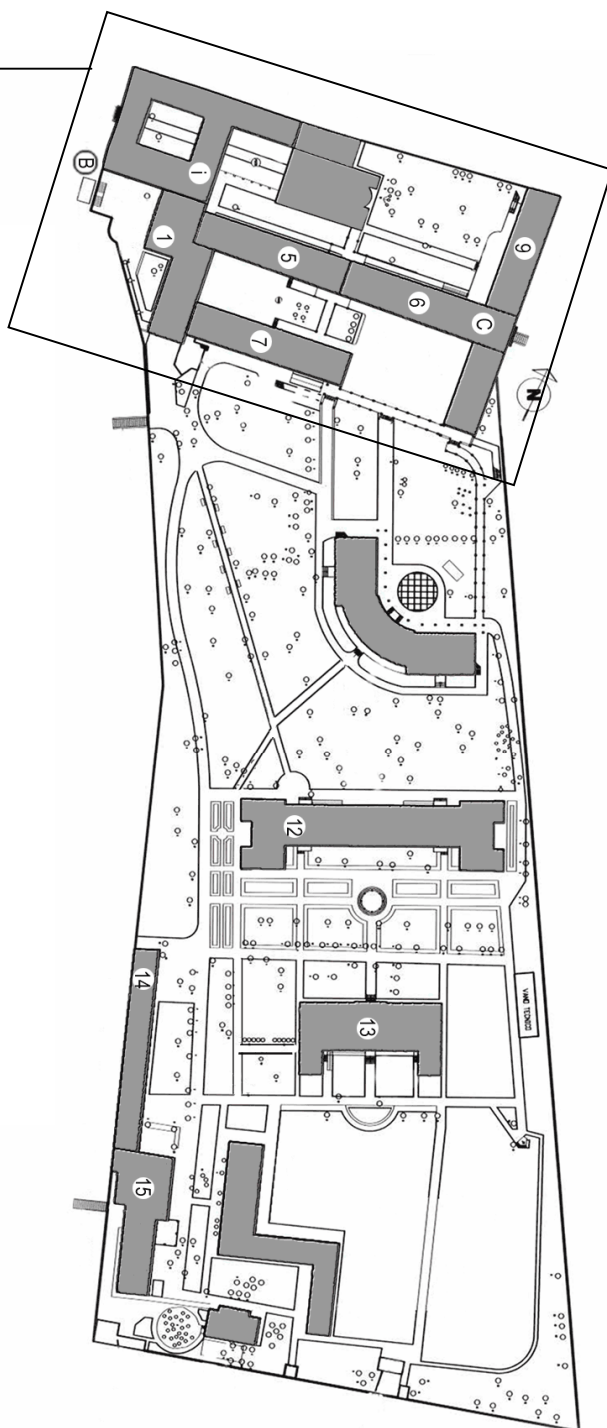| | |
|---|---|
| Water Taxis 24h (Consorzio Motoscafi Venezia) | +39 (0)41.5222303 |
| Franco Vitturi (Venezia Dream) affiliated taxi | 347.7915035 |
| Venice, Marco Polo Airport | +39 (0)41.5415084 |

**Taxis**

| | |
|---|---|
| Radiotaxi 24h/24h | +39 (0)41.5952080 |
| Venice, P. Roma (car terminal) | +39 (0)41.5237774 |
| Venice, Lido (S.M. Elisabetta) | +39 (0)41.5265974 |
| Venice, Marco Polo Airport | +39 (0)41.936222 |

# Map of the VIU campus

see the next maps for a
detailed enlargement

| | |
|---|---|
| B | Boat stop |
| 1 | Main Entrance/Accommodation Reception |
| i | VIU info point (front office) |
| 5, 6, 7, 9 | VIU Academic Activities |
| C | Café (snack bar) |
| 12, 13, 14, 15 | Residence Buildings |
| 15 | Cafeteria (refectory) |

# Map of the ground floor of the main building



GROUND FLOOR

Boat Stop

Reception

Front Office

7A

PC Room

Snack Bar
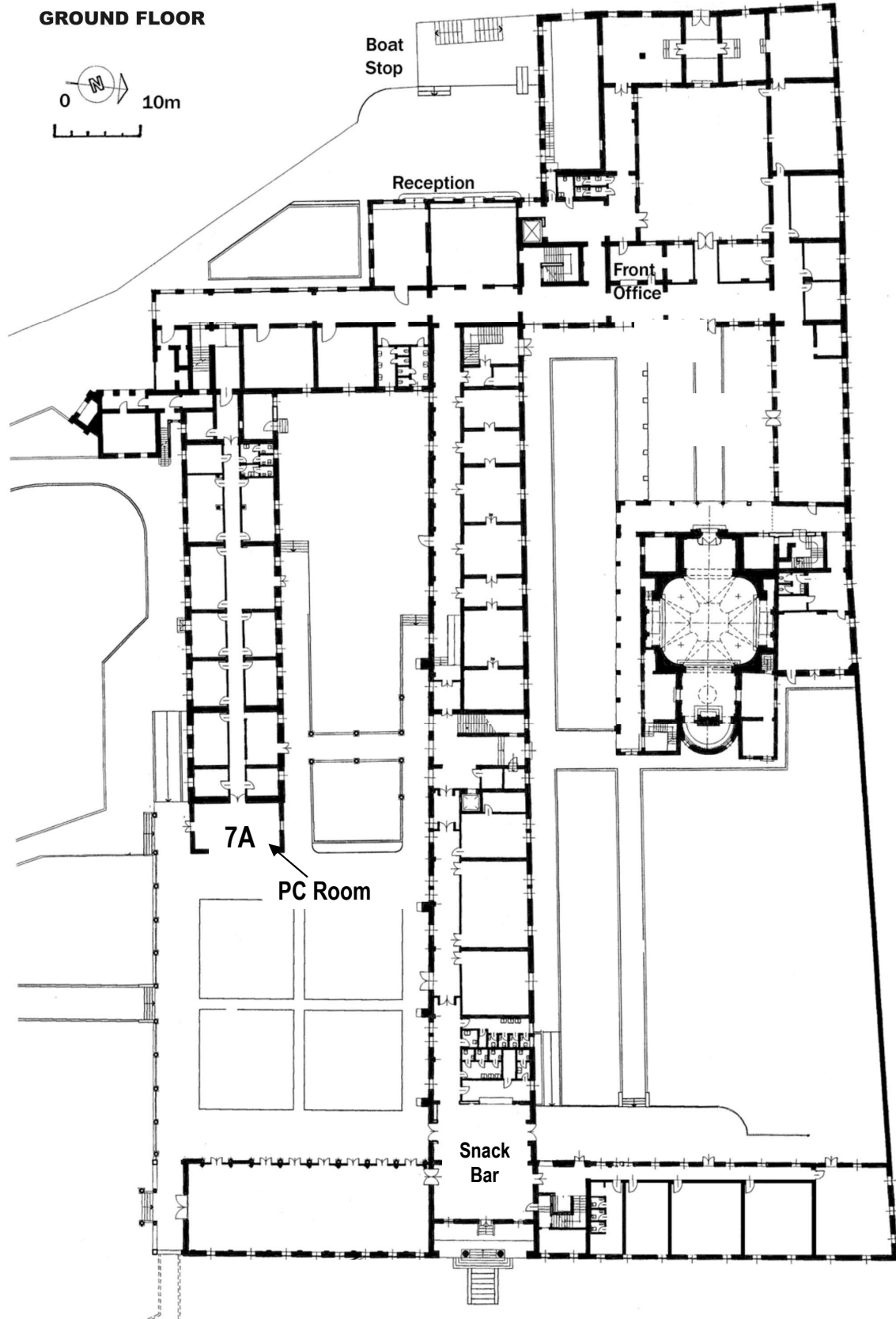
## Map of the first floor of the main building

**FIRST FLOOR**

0        10 m

**SUMMER SCHOOL**
**SECRETARIAT** ➝ Office 6G

Atrio
Colonne

**SUMMER SCHOOL**
**CLASSES**
↓

Room
9A

**WELCOME**
**COCKTAIL**

## Notes

EAERE
Fondazione Eni Enrico Mattei
Isola di San Giorgio Maggiore 8
I-30124 Venice
Italy
Tel: +39.041.2700437
Fax: +39.041.2700412
email: eaere@eaere.org
URL: http://www.eaere.org

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Tel: +39.041.2700443
Fax: +39.041.2700413
email: ess@feem.it
URL: http://www.feem.it

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