FEDERAL UNIVERSITY OF TECHNOLOGY

AKURE, ONDO STATE,
NIGERIA

WASCAL
THE WEST AFRICAN SCIENCE SERVICE CENTER FOR CLIMATE CHANGE AND ADAPTED LAND USE (WASCAL)

BROCHURE

OF THE

GRADUATE RESEARCH PROGRAM (GRP)

ON THE

WEST AFRICAN CLIMATE SYSTEM

1. ABOUT WASCAL AND THE GRP

The West African Science Service Center on Climate Change and Adapted Land Use (WASCAL) is a German initiative and will be funded by the German Ministry of Science and Education (BMBF).

The WASCAL Program is novel in concept and international in scope. One of the major aims of WASCAL is the establishment of Graduate Research Programs (GRPs) in seven(7) foremost Universities across West Africa. The Federal University of Technology, Akure, was selected as the Lead University for the Graduate Research Program (GRP) on the West African Climate System. The program is for the training of Doctor of Philosophy (Ph. D) students only in all aspects of the West African Climate System. The others GRPs are in specific fields, e.g. GRP in Climate Change and Water, Climate Change and Land Use, etc.

The FUTA Ph. D GRP in the West Africa Climate System will admit, in the first year (September 2011), only 10 students. There will be a maximum of 30 students at full growth in the third year. Admission is limited to only one (1) student per country of the West African WASCAL family: Nigeria, Ghana, Benin Republic, Cote d'Ivoire, Niger, Senegal, Togo, Mali, Burkina Faso and Germany.

2. The International Advisory Board

There is an International Advisory Board, comprising eminent scientists from seven (7) WASCAL countries and the FUTA GRP Director as Secretary as listed below, which will ensure international standards for the GRP:

Vice Chancellor	Federal University of Technology, Akure (FUTA), Nigeria.
Prof. Dr. Harald Kunstmann	Augsburg University, Institute for Meteorology and Climate Research, Germany
Dr. Seydou Traore	AGRHYMET, Niamey, Niger
Prof. Amadou Thiemo Gaye	Univesite Cheikh Anta Diop, Dakar (UCAD), Senegal
Prof. Abel A. Afouda	Universite d'Abomey-Calavi, Benin Republic
Prof. Sylvester K. Danour	Kwame Nkrumah University of Science & Tech. (KNUST), Kumasi, Ghana
Dr. Abdourahamane Konare	University Cocody-Abidjan, Cote d'Ivoire
Dr. Made Fode	University Abdou Moumouni, Niamey, Niger
Director WASCAL FUTA	WASCAL GRP, Federal University of Technology, Akure (FUTA), Nigeria

3. **Program Offered:** Doctor of Philosophy (Ph. D) in Climate Science.

4. **Program Philosophy**

The philosophy of the WASCAL GRP is to train climate scientists empowered with adequate scientific and professional capacities needed to provide appropriate and effective solutions to the multi-dimensional problems of the negative impacts of climate change and variability.

5. **Program Objectives:**

The objectives of the GRP are to

(a) provide theoretical and practical training in the West African climate system;

(b) produce, through multi-disciplinary approach, the required critical mass of climate scientists needed for the daunting task of developing effective and sustainable adaptation and mitigation strategies needed to assist the governments of West Africa;

(c) develop the intellectual capital and potential of the region to address the threats and negative impacts of climate change and variability as they would impact vital economic sectors such as agriculture, weather forecasting services, water resources, transport industry, energy, the environment and natural disaster management efforts;

(d) network the Lead University with the academic research communities in the region on climate change issues through collaboration with other GRPs in the partner Universities also supported by WASCAL. This will maximize their capabilities to improve the training of meteorologists and climate scientists for better overall results and increased benefit to West Africa and;

(e) carry out its mandate in partnership with German institutions.

6. **THE NEED FOR THE GRADUATE RESEARCH PROGRAM (GRP)**

West Africa has been identified by the Intergovernmental Panel on Climate Change (IPCC, 2007) as one of the areas of the world that is most vulnerable to the impacts of climate change but with the least existing adaptation and mitigation capacities. Also, present global and regional climate models are incapable of representing or capturing the many local peculiarities that determine and shape the climate of West Africa. Furthermore, comprehensive solutions to climate change impacts are multi-dimensional and thus, require a multi-disciplinary approach.

Although meteorology and climate science education programs exist in a few West African countries, even fewer number offer these courses at the Masters and Ph. D levels and, in such cases, far below the critical mass needed for the task of developing effective and sustainable adaptation and mitigation strategies that could assist the governments of the region. Therefore, there is a strong need to encourage and support the few universities and research institutions to synergize their efforts on a regional basis and thus maximize their capabilities to improve the training of meteorologists and climate scientists for better overall results and increased benefit to West Africa.

7. PROGRAM DURATION

The Ph. D in the West African Climate System is a full-time program, with a sponsored duration of 36 months. It has the following components:

i) Lecture component – first six (6) months

ii) Research Plan preparation – concurrent with (i) above

iii) Field/Research Work – twenty (20) months

iv) Visit to Germany – five (5) months – also for Research work

v) Final Thesis write-up and defense – five (5) months

The Language Program

An intensive English language course will be offered for the French-speaking students during the first four (4) months of study at the Centre for Continuing Education of the Federal University of Technology, Akure,. However, during the last 2 months of this course, the English-speaking students from the Gambia, Ghana and Nigeria will join their colleagues for a French language course.

The French language course will be offered at two levels: the Basic and the Functional certificate levels

The Language courses aim at giving participants a comprehensive and practical understanding of English and French languages, culture and traditions as well as to contribute to fostering international friendships particularly between the Francophone and Anglophone countries. Since the language of instruction is English language, use of the language to understand scientific/technical language with bias for meteorology/climate science will be emphasized.

8. ACADEMIC LECTURERS

GRP students will have the rare opportunity of having a truly international program with a full compliment of international faculty/staff. Faculty members will be drawn from the Federal University of Technology, Akure, the partner Universities: Augsburg University/KIT, Germany, Univesite Cheikh Anta Diop, Dakar (UCAD), Senegal, University Abdou Moumouni, Niamey, Niger, AGRHYMET, Niamey, Niger, Universite d'Abomey-Calavi, Benin Republic, Kwame Nkrumah University of Science & Tech., Kumasi, Ghana and University Cocody-Abidjan, Cote d'Ivoire.

9. ADMISSION REQUIREMENTS

Candidates for the Graduate Research Program must:

a) be holders of a good Masters degree from a recognized University with an average of at least 60% or CGPA of 3.50 in any of the fields of Meteorology, Climate Science, Physics (specialization in Atmospheric Physics), Mathematics, Computer Science and other relevant disciplines;

b) possess at least a Bachelor's degree at the Second Class (Upper Division);

c) possess credit passes at GCE “O” level, West African Senior School Certificate or equivalent in five (5) subjects, which must include Mathematics, Physics and English or at Baccalaureate;

d) in the case of non-English speaking candidates must Pass a proficiency test in English Language e.g. TOEFL (75% or above);

e) be from the WASCAL countries: Nigeria, Togo, Republic of Benin, Ghana, Burkina Faso, Niger, Cote d’Ivoire, Mali, Senegal and Germany;

f) provide three (3) referees, one of whom must be the applicant’s Masters thesis Supervisor and;

g) submit soft and hard copies of their project pre-proposal.

10. GRADUATION REQUIREMENTS

To be eligible for the award of Ph. D degree in Climate Science, a student must have:

a) scored a minimum of 60% or a graduate-level Cumulative Grade Point Average (CGPA) equivalent to 'B' in all the prescribed courses;
b) presented at least two (2) Ph. D progress seminars, one Course and one Workshop seminars;
c) published at least one (1) article from his/her Ph. D research findings in reputable journals;
d) presented and successfully defended his/her Ph. D thesis in an oral examination;
e) submitted the manuscript for the publication of a monograph of the student’s Ph. D thesis;
f) fulfilled all other conditions as prescribed by the Board of the School of Postgraduate Studies and;
g) fulfilled all other conditions as prescribed by the WASCAL International Advisory Board.

11. COURSE OUTLINE

First 3 months

Course Code	Course Title	Contact Hours			Credit Units
		Lecture	Tutorial	Practical	
WSC 901	Basic Meteorology and Climatology	2	0	0	2
WSC 903	Climate Modelling and Downscaling Methods	1	0	3	2
WSC 905	Climate Change Impacts, Adaptation and Mitigation	2	0	0	2
WSC 907	Economics, Policies and Politics of Climate Change	1	1	0	2
WSC 909	Climate Change and Energy	1	1	0	2
WSC 911	Climate Change and Agriculture	2	0	0	2
WSC 913	Climate Change and Biodiversity	1	1	0	2
	Total				**14**

Second 3 months

Course Code	Course Title	Contact Hours			Credit Units
		Lecture	Tutorial	Practical	
WSC 902	Advanced Meteorology and Climatology	2	0	0	2
WSC 904	Case Studies and Seminar	-	2	-	2
WSC 906	Workshops	-	1	3	2
WSC 908	Research Methodology	2	0	0	2
WSC 910	Climate Change and Water Resources	2	0	0	2
WSC 912	Climate Change and Land Use	1	0	3	2
Total					**12**

12. COURSE SYNOPSES

The Language course will be in modules:

Module I

Introduction to French/English sounds and pronunciation, intensive work on spoken language with the aid of pre-recorded voices on tape. Intensive work on phonetic distinctions and mechanism, interpretation of accents, liaisons, intonations, melody and rhythm.

Module II

Oral expression and comprehension with emphasis on vocabulary for expressing feelings. Common day- to-day conversation, finding one's way on, street, road, town, buying and selling, transport and social activities, post office, religion, family, education, weather, etc. Complex sentences structure with verbs in the present, future and past tenses and various parts of speech including pronouns, adjectives, adverbs, conjuction, preposition, etc.

Module III

Introduction to grammer and structure with emphasis on recognizing the verb in various forms in the present tenses, making short sentences and taking short dictations. Distinction of verb group/forms, conjugation, syntax, sentence analysis and longer dictation exercise, simple composition of sentences and paragraphs. Practice in oral and written composition, analysis of simple texts on science, economic, political and social issues (sports, religion, family, etc). Guided essay writing, short narrative and descriptive essays, informal letter writing.

Module IV

Comprehension of basic science subjects – Physics, Mathematics, Chemistry, Biology, Agriculture, Meteorology and Climate Science. Reading and comprehension of science/technical journals and proceedings. Vocabulary of science/technical words. English/French translation of science/technical vocabulary.

WSC 901: Basic Meteorology and Climatology (2 units)

The earth's atmosphere: composition and structure and other features of the atmosphere. Barotropic and baroclinic flows; fronts, clouds, storms, jet streams, environmental pollution. Basic equations of state; compressibility. Boussinesq approximation. Geostrophic balance, Divergence and vorticity, The Primitive equations, Rossby number, Ekman layer, Ekman pumping; Planetary boundary layer. Tropical meteorology with emphasis on the West African monsoon system: African Easterly Jet (AEJ), Tropical Easterly Jet (TEJ), Inter-tropical Discontinuity (ITD), mesocale weather sytems (MCS, MCC, Thunderstorms, squall-line), easterly waves. Dynamics and energetics of West African weather systems.

WSC 902: Advanced Meteorology and Climatology (2 units)

Turbulence and turbulent fluxes; averaging. Convection and shear instability; Monin-Obukhov similarity theory, surface roughness. Wind profiles; Organized large eddies. Energy fluxes at ocean and land surfaces, diurnal cycle; Convective and stably stratified boundary layers; Modelling equations, atmospheric models and predictability; Simple modeling exercises; Physical processes that determine the climate of Earth and its past and future changes, Climate of the last centuries, Greenhouse effect; Radiative and dynamical feedback processes, Method of climate change detection; Critical analysis of climate change predictions; monsoon and climate change in West Africa.

WSC 903: Climate Modelling and Downscaling Methods (2 units)

Module 1: Statistical methods, cluster analysis, Principal Component Analysis, Canonical component analysis, Self organizing maps, Statistical modeling, Statistical downscaling methods.

Module 2: Introduction to dynamic climate modeling, Climate models, (global, regional and mesoscale), Dynamic downscaling, Practical work in climate modeling and downscaling.

Module 3: Coupled climate systems, Effects of land-use, Climate modeling for hydrology, agriculture and policy development.

WSC 904: Case Studies and Seminar (by students) (2 units)

The goal is to develop students' communication skills and competence in climate science through careful construction of figures, and written and oral presentations. Students are expected to choose current topical issues in climate change and variability, West African monsoon and weather systems.

WSC 905: Climate Change: Impacts, Adaptation and Mitigation (2 units)

Module 1: Impacts and vulnerability: IPCC assessment reports, Regional Impact studies, Knowledge of past/future patterns of climate on resource management in West Africa, Predictability of natural/human-caused climate changes; Past societal reactions to climate impacts on water, fish, forest, and coastal resources; How climate and public policies interact to affect ecosystems and society

Module 2: Adaptation: coping strategies, indigenous knowledge and culture, etc

Module 3: Mitigation: carbon trading and auditing, carbon sequestration, methods in agro-forestation and reforestation**.**

WSC 906: Workshops (2 units)

Seminars on current research in topics related to climate change sciences, conducted by faculty and visiting professors/scientists; The refresher workshops would focus on various courses like computer programming (FORTRAN, VB, C and C++, R, GrADS); Shell scripting (Ferret) and other scripting languages; Statistical packages, Proposal writing; Doctoral research dissertation

preparations, Communication in climate change sciences, etc. The workshop would be conducted by internal or external resource persons.

WSC 907: Economics, Policies and Politics of Climate Change (2 units)

Climate change impact analysis, IPCC assessment reports; Economic and policy implications of climate change; Climate change and MDGs, Climate change and implications on sustainable farming; Climate change and environmental sustainability; Climate change and global poverty; Climate change and energy politics; Emissions trading; Clean development and energy efficiency.

WSC 908: Research Methodology (2 units)

Research topic conceptualization; Research plan, design and implementation; Data requirements and constraints; Methods of data analysis and manipulation, design of field experiments, Final research write-up.

WSC 909: Climate Change and Energy (2 units)

Renewable and non-renewable energy, World energy demand; Weather variables and their energy potentials (wind energy, water energy, bio fuel, solar power, tidal power, wave power, biomass etc). Climate change effects on power generation; Problems of energy production and adaptability; Review of Solar Energy fundamentals (radiation laws, solar geometry etc); Interactions of radiation and atmosphere; Radiation climatology and assessment of solar energy potential; Solar radiation modeling; Review of Wind Energy fundamentals; Wind climatology; Assessment of wind energy potential; The Betz criterion, Beaufort scale, Aerodynamics; Wind speed fluctuations; Power spectrum of horizontal wind; Rated wind power and rated wind speed; wind turbine power curve.

WSC 910: Climate Change and Water Resources (2 units)

World water resources; Changes in the hydrological cycle and ocean salinity; The carbon cycle and acidity effects on climate, Sea level: contributions from glaciers and ice caps, the ice sheets of Greenland and Antarctica, ice shelves and also changes in the terrestrial storage of water, Ocean warming; Changes in air-sea heat flux and basal melting. Effects of climate change on the components of the hydrological cycle; implications on the design of water resources infrastructure; mitigation efforts. Water balance: periods of surplus and deficit; effect of vegetation on water balance; climate change and drought and effect on ground water movement and balance.

WSC 911: Climate Change and Agriculture (2 units)

Weather observations for agriculture: winds, precipitation, evaporation, evapo-transpiration (potential and actual) temperature; winds and humidity extremes. Agro-climatic zoning. Climate change and rainfall factors: onset, cessation, amount (annual and monthly) and dry spell (frequency and intensity). Climate change and variability effects on crop yield, food security, animal production and fisheries. Farming systems. Climate change and cultural practices, including land preparation timing and technique. Effect of climate on soil properties. Soil erosion. Crop-climate modeling for growths and yields.

WSC 912: Climate Change and Land Use (2 units)

Determinants of urban rural land uses – social, economic, government and physical controls and interrelationships among these factors; The process of land use change; Deforestation and climate change; Methods of land use classification; Climate change and implications for the architects, urban designers, planners and policy makers; Urban Heat Island; Thermal comfort and implications for urbanization; The concept and principles of sustainable development

WSC 913: Climate Change and Biodiversity (2 unit)

Ecology and ecosystems; influence of man on the ecosystem; population and community dynamics and effect of climate change; conservation of natural resources including current environmental issues like biodiversity loss and conservation.

WSC 999: Doctoral Research Project

This project is by research whereby the student will prepare a research proposal in any area of meteorology and climate science. The proposal has to be approved by the WASCAL Advisory Board after consideration by the WASCAL Technical Committee. The project will be supervised by at least two (2) lecturers, at least one of whom shall be a staff of FUTA.