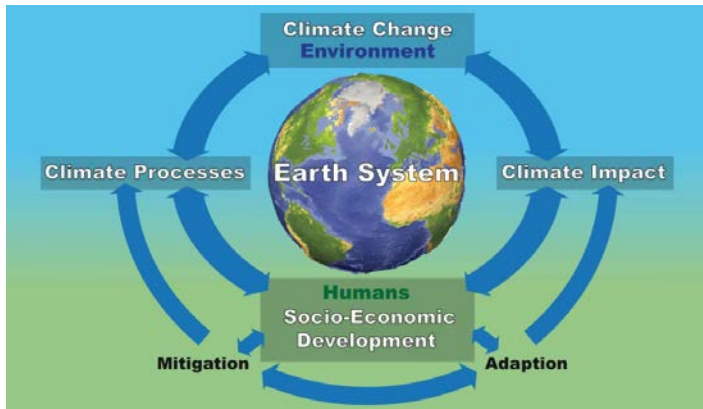


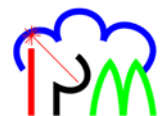
Master Program

Earth System Science (ESS)

at University of Hohenheim



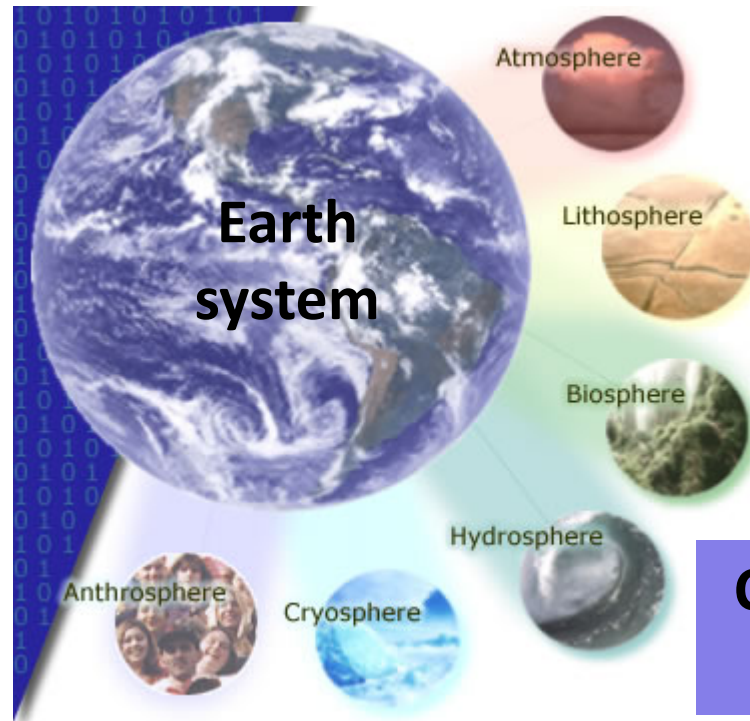
Institute of Physics and Meteorology (IPM)
Prof. Dr. Volker Wulfmeyer, Dr. Andreas Behrendt
and the lecturers of the Master Class ESS



Planet under pressure: The Anthropocene

Food security
and health

Land use
(desertification,
deforestation)



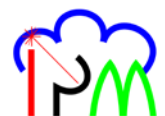
Population
growth

Energy
production
and demand

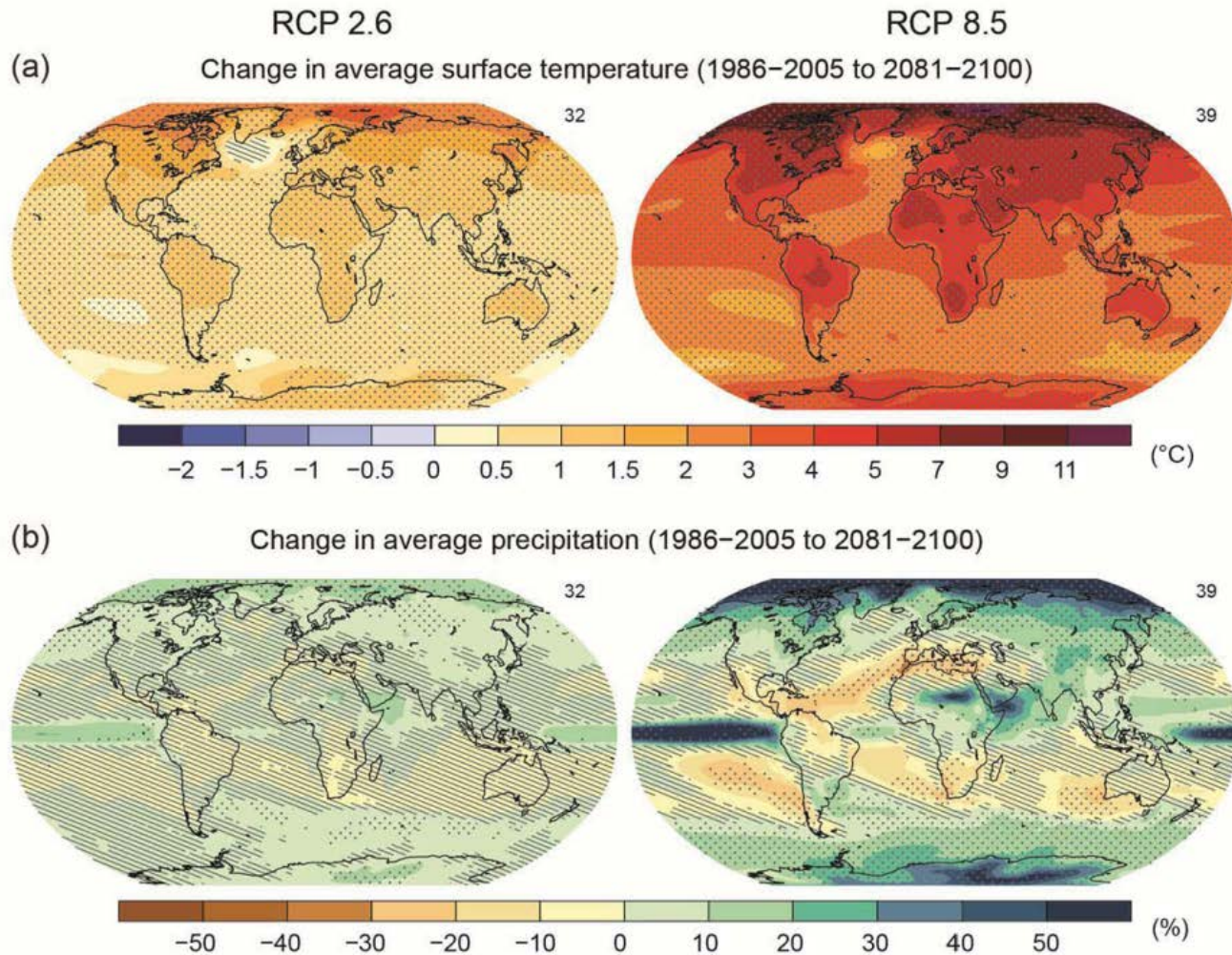
Climate variability
and change

Socio-economic and political development

Vision: equitable, sustainable development

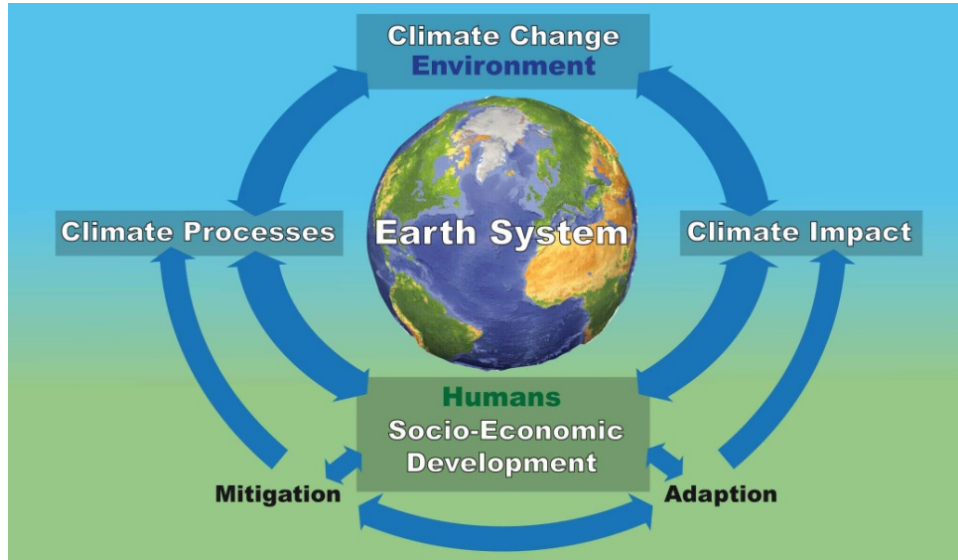


Climate Projections



IPCC 5th Assessment Report 2013: www.climatechange2013.org

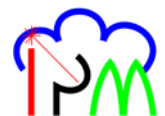
Goals



- Analyze and evaluate the state of the Earth system
- Understand the interaction and feedbacks between system components
- Model subcomponents of this system

www.earth-system-science.de

www.uni-hohenheim.de/ess



Concept

Basic lectures, compulsory: Physics, Chemistry, Biology, Economy,
Climate History and Evolution, Energy and Water at the Land Surface

Lecture series in ESS and debate seminar

...for motivation and base knowledge about Earth system processes

Six elective modules in order to explore and deepen topics of own interest

1 Semester for the master thesis

**Competence in the solution
of problems
related to Earth system science**



- Transfer of knowledge in natural sciences
- Autonomous learning and problem solving
- Practical experience
- Team work and communication
- Interdisciplinary context

Continuous learning during the semester, independent training,
application of basic knowledge, formation of working teams



Curriculum

Semester: October 01, 2014 – March 31, 2015

Lectures: October 13, 2014 – February 07, 2015

Strong thematic interaction between the modules.

	6 credits		12 credits		18 credits		24 credits		30 credits		
1 st sem.	Lecture Series Earth System Science (1201-550)	Economics for Earth System Science (1201-510)	Measurement, Modeling and Data Assimilation		Physics of the Earth System (1201-580)	Chemistry of the Earth System (1301-460)		Biology of the Earth System and Biodiversity (2101-500)		1 st sem.	
2 nd sem.	Climate History and Evolution of the Earth System (1201-560)		Energy and Water Regime at the Land Surface (3103-500)		Debate Seminar (1201-570)	Mathematical Methods in Earth System Science (1201-610)		Elective Module		2 nd sem.	
3 rd sem.	Land Use Economics (4904-430)		Elective Module		Elective Module		Elective Module		3 rd sem.		
4 th sem.	Master's Thesis Earth System Science (1200-500)										4 th sem.

Elective modules:

Summer Semester

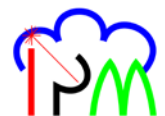
1201-620 Special Topics of Earth System Science
 1102-500 Statistics for Natural Scientists
 3102-420 Project in Soil Sciences
 1301-430 Practical Course Chemical Evolution
 1201-500 Remote Sensing

Winter Semester

1201-540 Data Assimilation
 1201-590 Agricultural and Forest Meteorology
 1301-430 Practical Course Chemical Evolution
 3202-420 Global Change Issues
 3202-430 Air Pollution and Air Pollution Control
 3302-460 Plant Quality
 4901-420 Poverty and Development Strategies
 4901-470 Quantitative Methods in Economics
 4303-490 Ethics of Food and Nutrition Security
 4303-470 Gender, Nutrition and Right to Food
 4303-440 Social Conditions of Organic and Sustainable Agriculture
 3802-410 Ecology and Agroecosystems
 4201-440 Economics and Environmental Policy
 3000-410 Portfolio Module (Master)
 TBD Natural Resource Use and Conservation in the Tropics and Subtropics

Requirements for ESS

- Interest in natural sciences
- Interest in agriculture and economics
- Interdisciplinary thinking
- Transdisciplinary communication and collaboration



System Science

System science can be coined by the following maxim:

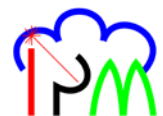
The whole is more than the sum of its pieces

(Aristotle, 384-322 BCE)

The goal of system science:

Analysis of the structure and behavior of a system in order to understand, to predict, and to steer a future, **sustainable** development.

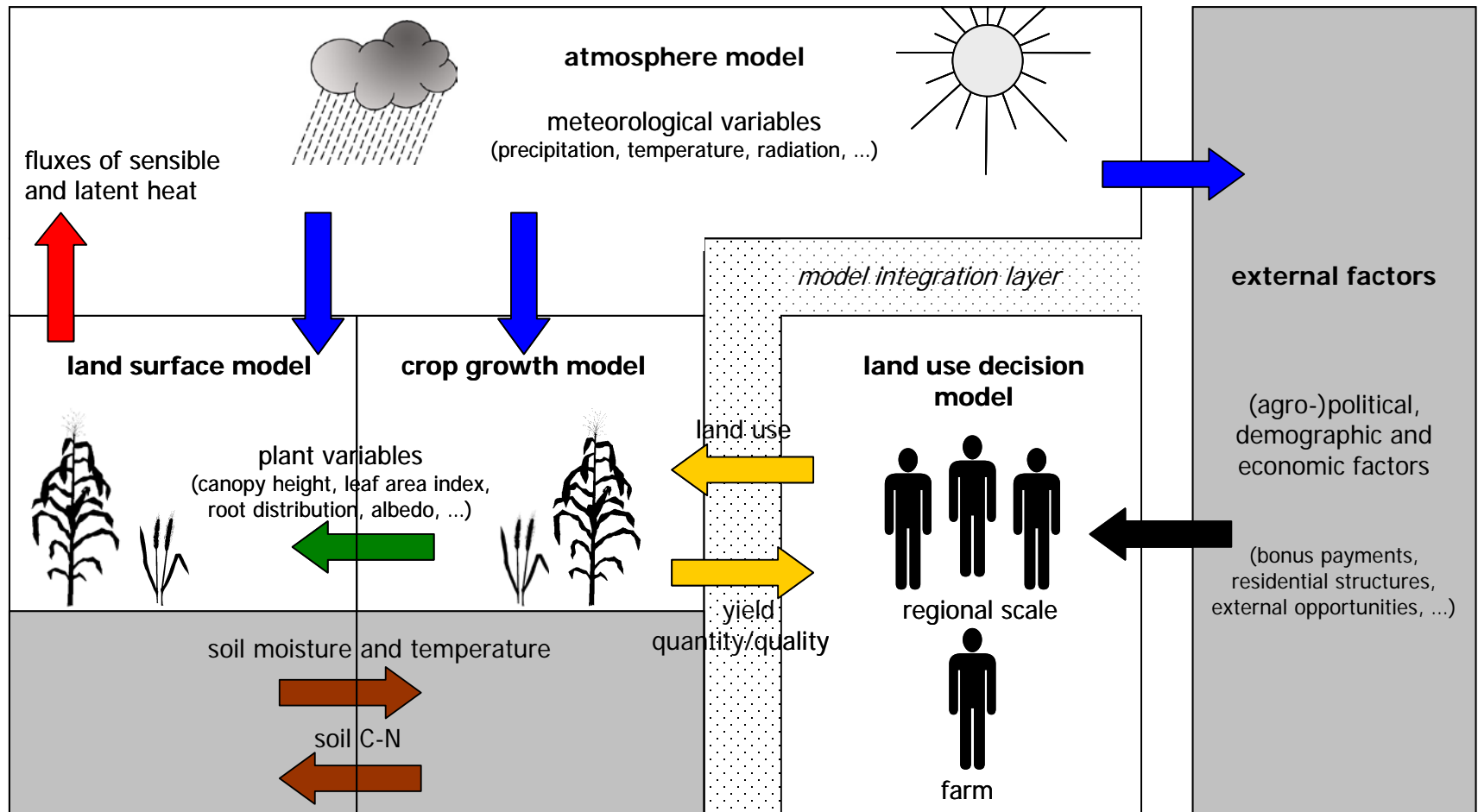
We expect that similar structural behavior exists in different systems. This makes system science an interdisciplinary and even transdisciplinary science.



Research at the University of Hohenheim

Integrated Land System Model: DFG FOR 1695

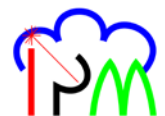
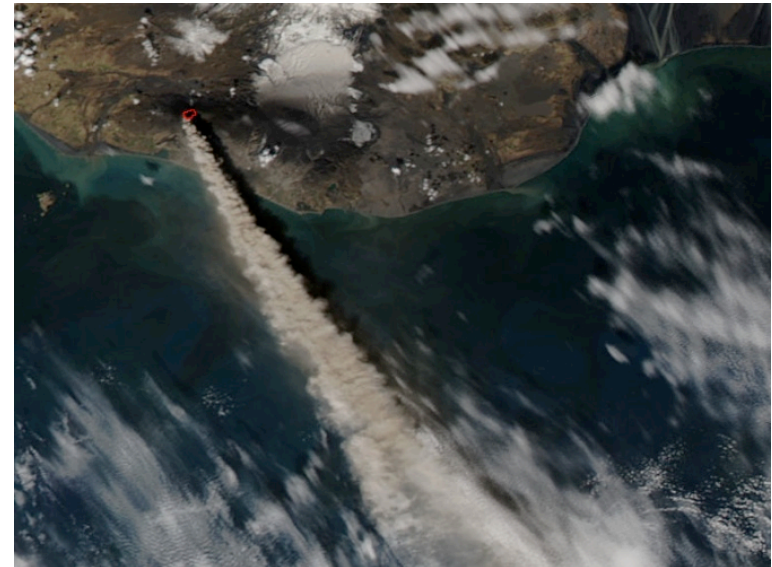
(see <https://klimawandel.uni-hohenheim.de/home>)



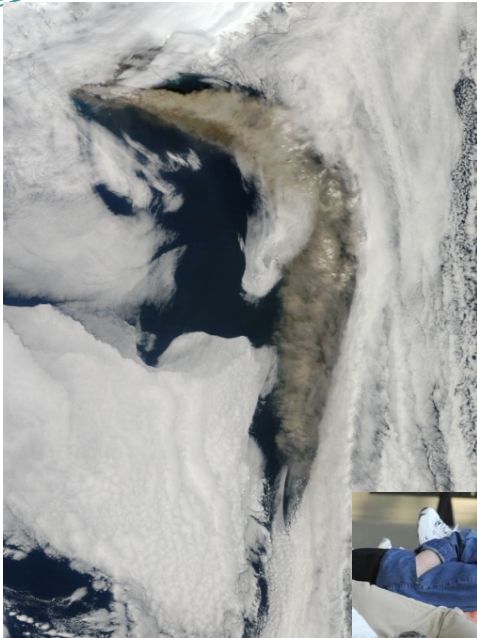
Eruption of the volcano Eyjafjallajökull on Iceland



- Duration: 14.04. -24.05.2010
- Moderate Intensity: Volcano Eruption Index (VEI) 3
- Emission and long-range transport of ash and silicate particles
- Not predicted



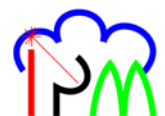
Impact of the Eruption



8:40 Mauritius	QF3455	Cancelled
9:40 Edinburgh	BA755	Cancelled
10:55 Basel	BA375	Cancelled
11:05 Toulouse	BA559	Cancelled
12:00 Rome	BA819	Cancelled
13:00 Copenhagen	BA355	Cancelled
14:00 Nice	QF3522	Cancelled
15:00 Hamburg	BA735	Cancelled
16:00 Geneva	BA441	Cancelled
17:00 Amsterdam		



- Shutdown of European air traffic area from 16.04.-20.04.2010, various local measures
- Economic loss: 1-3 Billion Euro
- Fortunately: **No fatalities!**



Jatropha and Jojoba

Jatropha curcas

- Indigenous to Americas
- Widely planted / infrastructure
- Good drought resistance
- Needs 200 to 1800 mm annually
- Quick return



Jatropha curcas

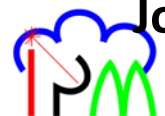
Jojoba

- Indigenous to Sonoran desert
- Better known for cosmetic oils
- Similar yield to Jatropha
- Slight lag until profit
- 50 to 250 mm rainfall
- Excellent drought resistance <25mm
- Higher temperatures (up to 54 °C)



Jojoba

Jojoba better suited to hot deserts?

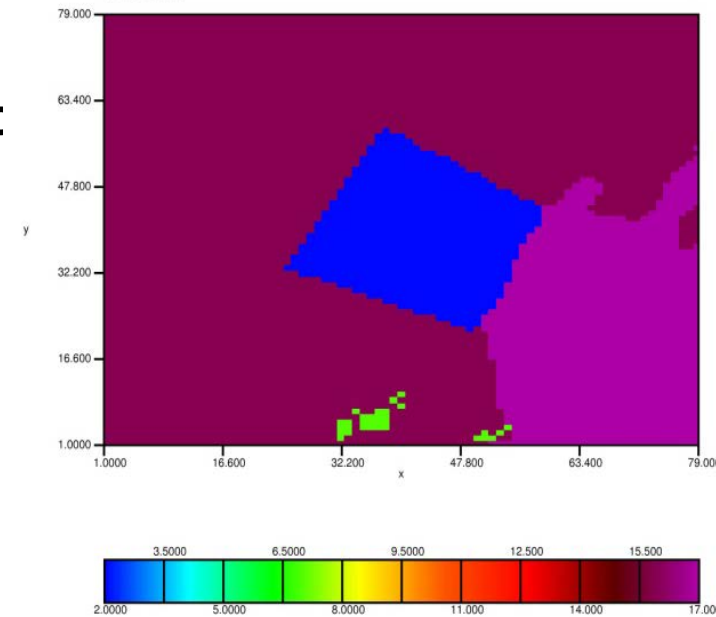
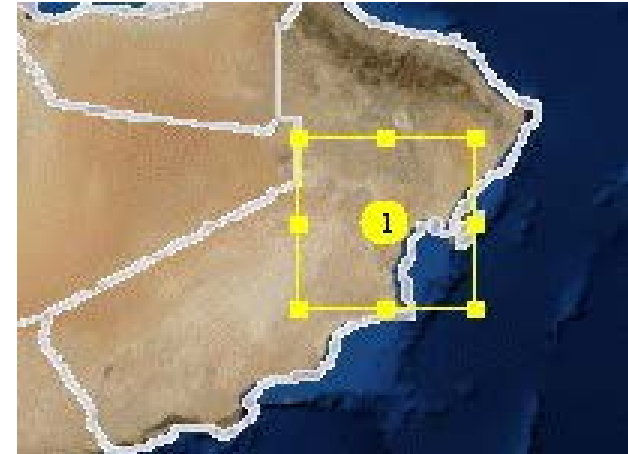


Can large desert plantations affect the mesoscale climate ?

Case study in Oman – WRF/NOAH model simulation:

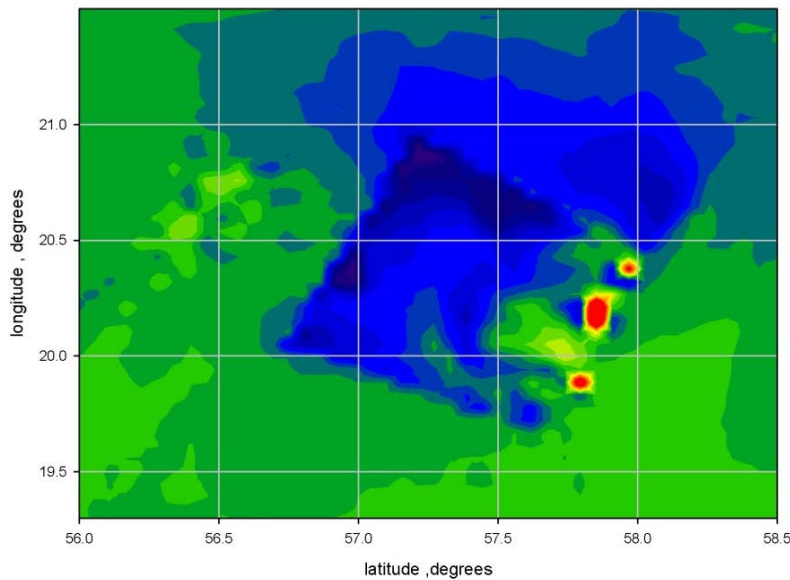
- Coupled atmosphere / land surface model
- High resolution (4 km)
- Simulated 100 × 100 km *Jatropha plantatic* compared to desert surface

- Changes in land surface/atmosphere exchanges of energy, moisture and radiation

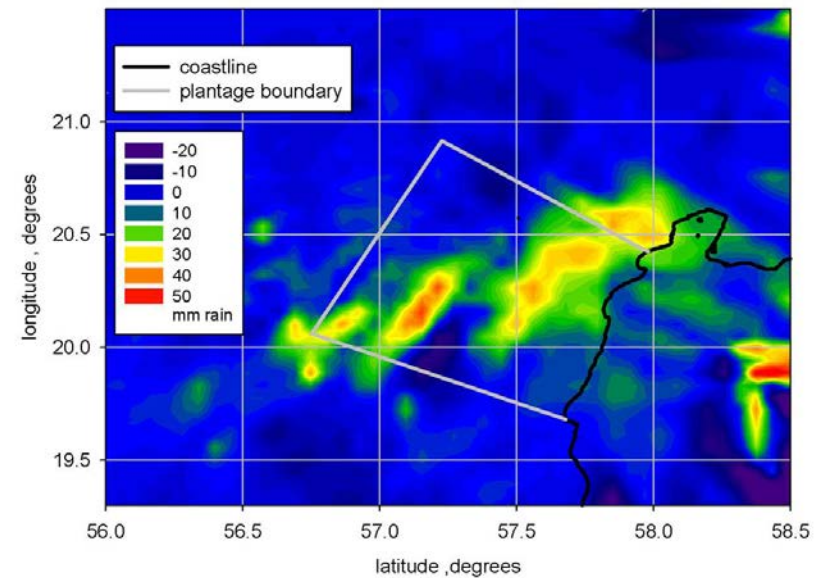


Summary of Results – Oman

Mean difference in summer temperature and precipitation



Lower mean temperature



Onset and modification of precipitation

