




## Linking Measurements with Modeling Tools - A challenge for air pollution research


Peter Suppan  
[peter.suppan@kit.edu](mailto:peter.suppan@kit.edu)

Institute for Meteorology and Climate Research (IMK-IFU), Karlsruhe Institute of Technology (KIT),  
Campus Alpine, Germany




KIT – University of the State of Baden-Wuerttemberg and  
National Laboratory of the Helmholtz Association

[www.kit.edu](http://www.kit.edu)




## Overview

- Introduction
- Background
- Examples
- Conclusions



2 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of  
Environmental Biotechnology  
19.-21. October 2011 – Dalian



## Impact on Health

Region	Percentage change	Reference
Asia	4.9% (2.3-7.6)	HEI, 2004
Europe	6.0% (4.0-8.0)	Katsouyanni, 2001
Latin America	6.1% (1.6-10.7)	PAHO, 2005*
United States	2.1% (0.9-3.3)	Dominici, 2003
Worldwide	6.5% (5.1-7.6)	Stieb, 2002


**PM<sub>10</sub> and Mortality Risk**

PAN American Health Organization, 2005

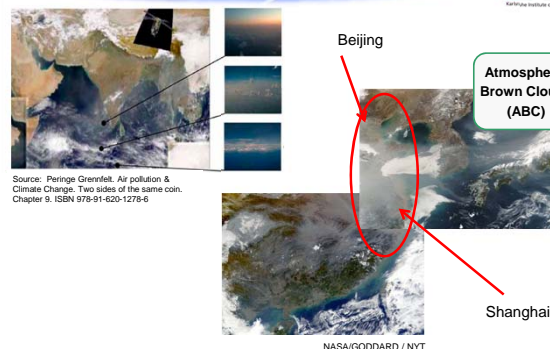
\* Based on studies in Mexico City, São Paulo, Santiago de Chile

3 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of  
Environmental Biotechnology  
19.-21. October 2011 – Dalian



## Impact on Climate Change



Beijing

Shanghai


Atmospheric Brown Clouds (ABC)

Source: Peking Greenfall, Air pollution & Climate Change. Two sides of the same coin. Chapter 9. ISBN 978-91-620-1278-6

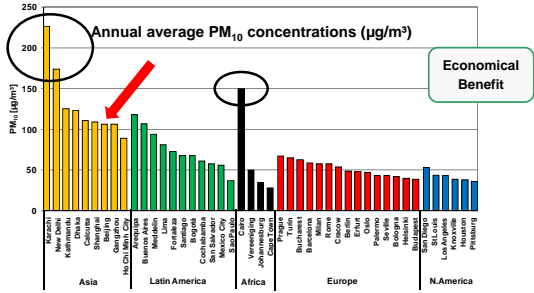
NASA/GODDARD / NYT

4 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of  
Environmental Biotechnology  
19.-21. October 2011 – Dalian



## Impact on Economy



Annual average PM<sub>10</sub> concentrations (µg/m<sup>3</sup>)

**Economical Benefit**


Reduction benefit is 10 times higher as for ozone, e.g. Mexico City about \$2 Bill.

M. Krzyzanowski & H-G. Mucke, WHO update by Jordan et al, CEPAL

Molina and Molina, 2002

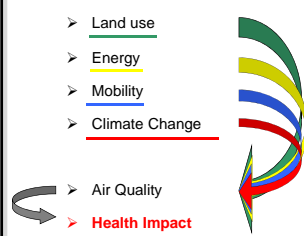
5 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of  
Environmental Biotechnology  
19.-21. October 2011 – Dalian




## What Affects Air Quality ?

- Land use
- Energy
- Mobility
- Climate Change
- Air Quality
- Health Impact



Global surface warming (°C)



Santiago de Chile

Bogotá

Year

**Integrated Approach**

6 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of  
Environmental Biotechnology  
19.-21. October 2011 – Dalian

### What Affects Air Quality ?

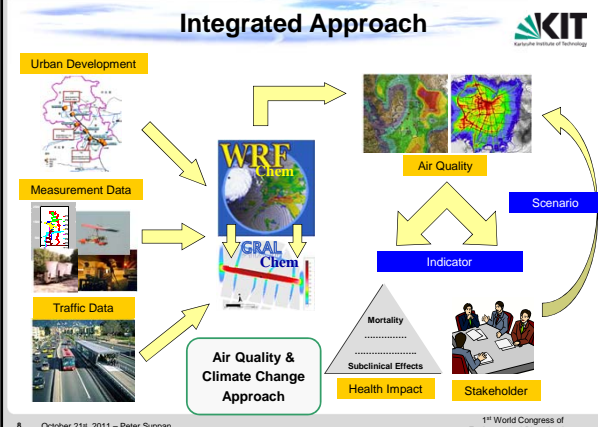
The complex interactions of causes of emissions – transmission - air pollution - deposition / exposure and climate change need detailed investigations on the causal chain

*Only multidisciplinary approaches allow a holistic analysis*

7 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of Environmental Biotechnology 19-21, October 2011 – Dailan

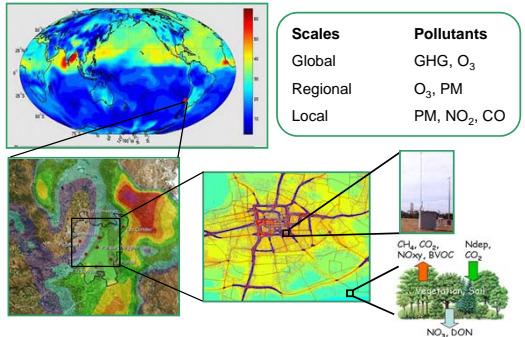
### Integrated Approach



8 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of Environmental Biotechnology 19-21, October 2011 – Dailan

### Problem: Scales



Scales	Pollutants
Global	GHG, O <sub>3</sub>
Regional	O <sub>3</sub> , PM
Local	PM, NO <sub>2</sub> , CO

9 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of Environmental Biotechnology 19-21, October 2011 – Dailan


### Measurement & Modeling Tools

- In-situ measurements
  - Active & passive measurements
- Remote sensing measurements
  - Horizontal & vertical
- Aircraft measurements
- Air pollution dispersion models on all scales
  - Box, Gaussian, Eulerian & Lagrangian models
- Models for different compartments
  - Hydrology, biosphere, soil, ...

10 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of Environmental Biotechnology 19-21, October 2011 – Dailan

### Eruption of Eyjafjallajökull (E15)

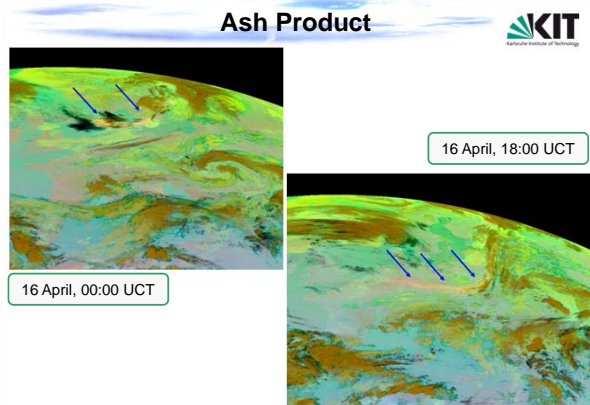


14 April: eruption plume rose to up to 9.5 km height deflected to the east by westerly winds  
16 April: pulsating eruptive plume reaches above 8 km, with overall height of 5 km  
17 April: eruption plume loaded with tephra (ash) rises to more than 8 km

11 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of Environmental Biotechnology 19-21, October 2011 – Dailan

### Ash Product

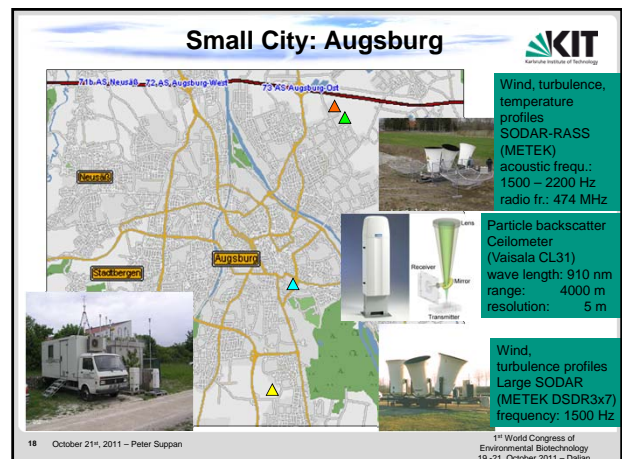
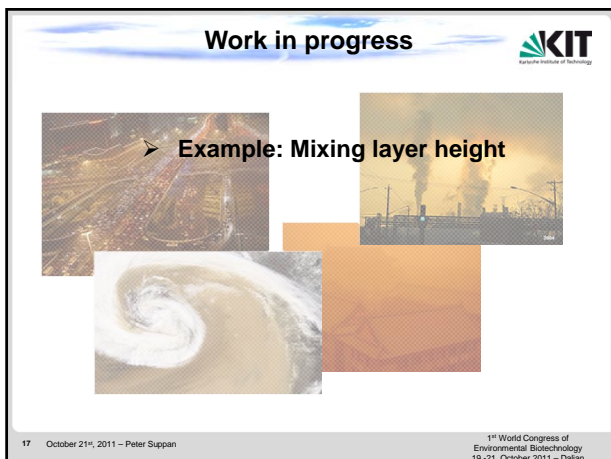
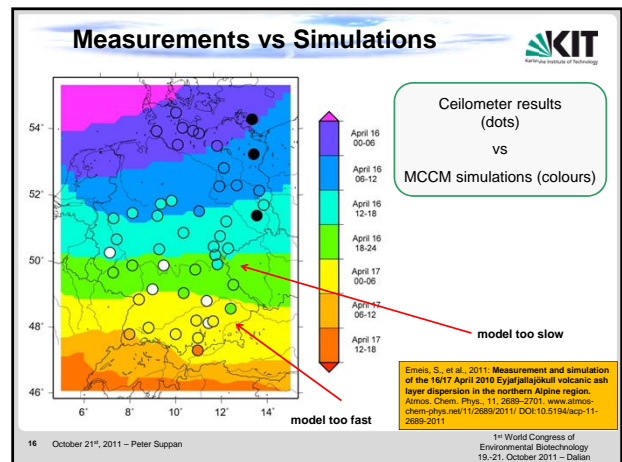
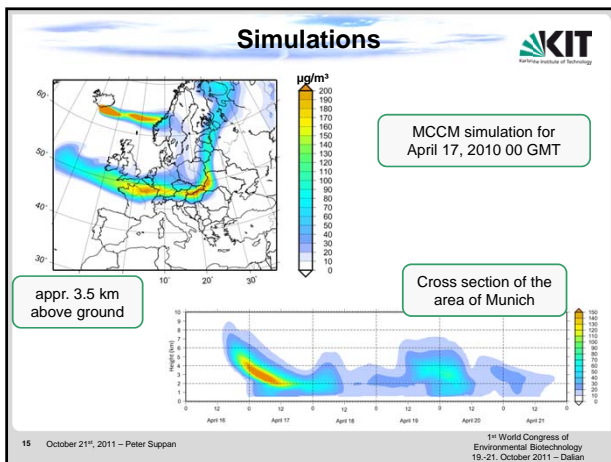
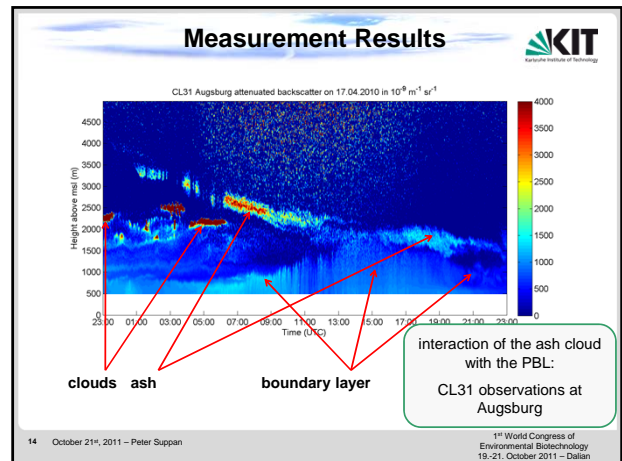
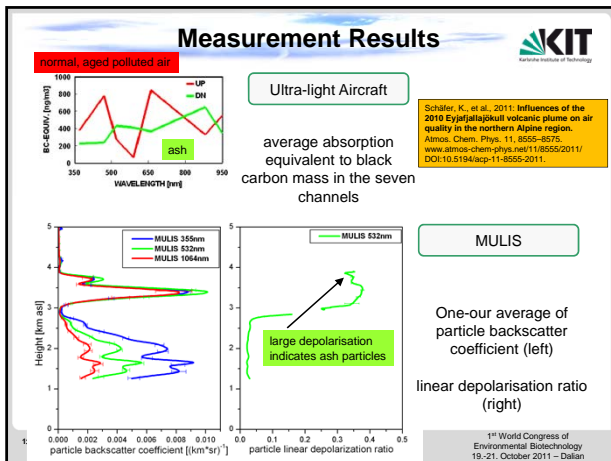


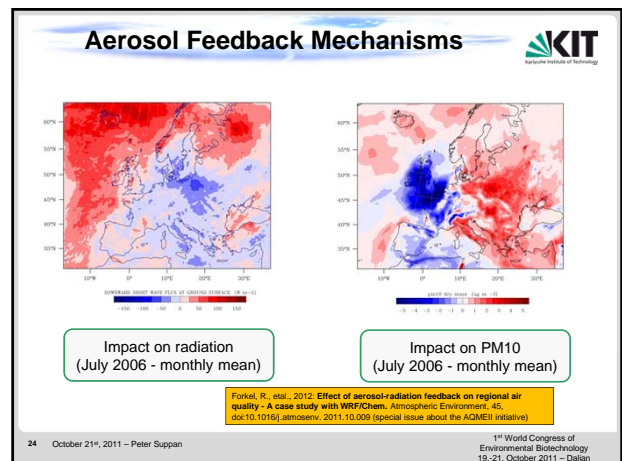
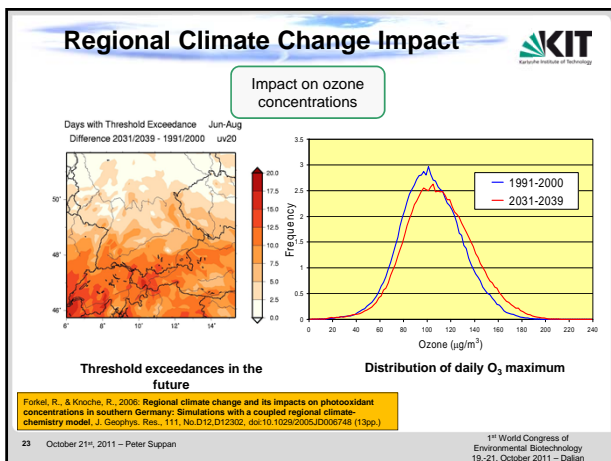
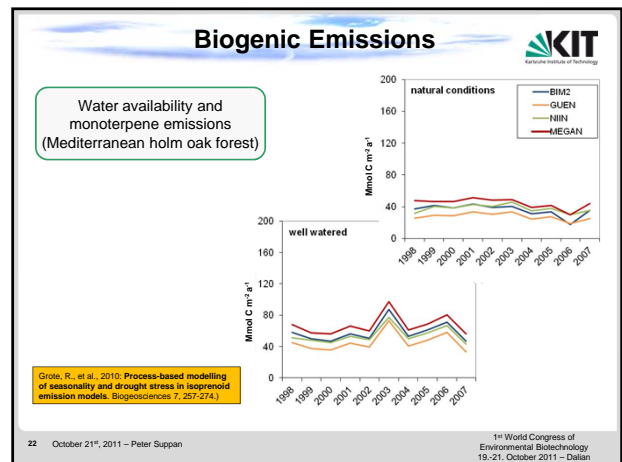
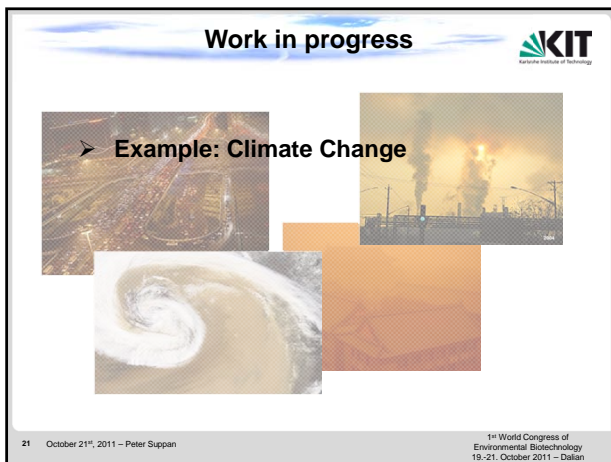
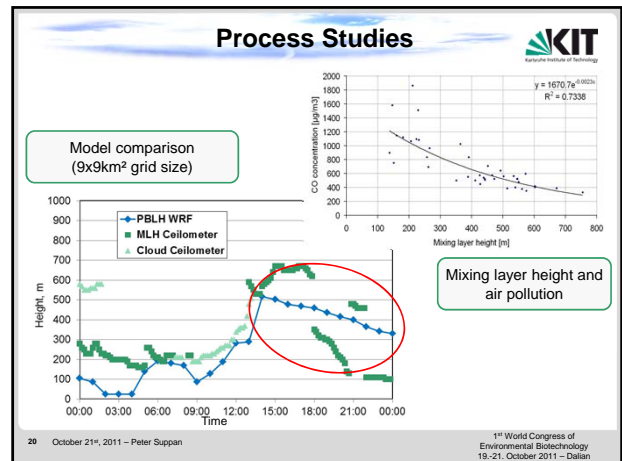
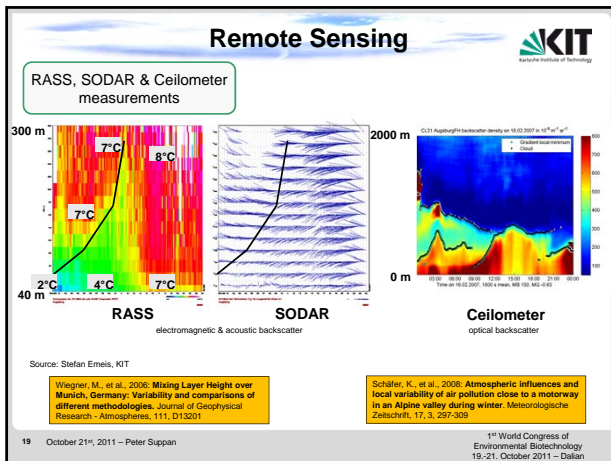
16 April, 00:00 UCT

16 April, 18:00 UCT


12 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of Environmental Biotechnology 19-21, October 2011 – Dailan





## Conclusions




- Measurements are mainly representative for a certain location
- Models can integrate locations and can overcome the scale problem
- Measurement & modeling platforms have to go hand in hand
- Only holistic and multidisciplinary approaches can help to get a deeper knowledge about air quality & climate change issues
- Only this understanding allows investigations in future developments and recommendations for decision makers and stakeholders to improve air quality and to limit climate change

25 October 21<sup>st</sup>, 2011 – Peter Suppan

1<sup>st</sup> World Congress of Environmental Biotechnology  
18-21, October 2011 – Delft

## Thank you very much for your attention



Cooperation Partners

Bhola R. Gurjar	Indian Institute of Technology (IIT), Department of Civil Engineering, Roorkee, India
Stefan Nara	Institute of Mineralogy and Geochemistry (IMG), Karlsruhe Institute of Technology (KIT)
Yuesi Wang, Guojian Tang, Xin Jinyuan	Chinese Academy of Sciences (CAS), Institute of Atmospheric Physics (IAP), Beijing
Longyi Shao	Chinese University of Mining and Technology (CUMTB), Beijing
Kuang Cen	Chinese University of Geosciences (CUG), Beijing
Jose Agustin Garcia, Gerardo Ruiz	Universidad Nacional Autonoma de Mexico (UNAM), Mexico City
Rainer Schmitz, Ricardo Muñoz	Universidad de Chile (UdC), Santiago de Chile
Barbara Lenz, Andreas Justen	Görlman Aerospace Center (DLR), Berlin, Germany
Ulrich Franck	Helmholtz Zentrum für Umweltforschung (HZU), Leipzig, Germany
Annette Peters, Alexandra Schneider	Helmholtz Zentrum München (HMU), Institute for Epidemiology, Munich, Germany
Johannes Rehnlein, Ricardo Jordán	Economic Commission for Latin America and the Caribbean (ECLAC/CEPAL) in the UN