A View on Future Baltic Science

Markku Kulmala University of Helsinki

Background: Scope of Global Grand Challenges



Demography / Population

Grand Challenges: How to answer

- \checkmark clear and ambitious vision / from deep understanding to practical solutions
- ✓ empirical and experimental / modelling and new theories
- multidisciplinary (physics, chemistry, biology, meteorology, economy, social sciences etc)
- ✓ from research to innovations; new SMEs



CONTINUOUS, COMPREHENSIVE OBSERVATIONS



Over 1200 different variables

SMEAR II: Flagship site for integration combines IPCC with all climate relevant processes

SMEAR II-station (boreal forest, countryside)



SMEAR SCIENCE RESULTS: Observation of Nucleation Burst in Finland



Kulmala et al., 2007, Science



Carbon sink

Kulmala et al., 2014, BER

<u>Observation for Climate and Air Quality, A Three-way Street:</u> Satellites provide context, Ground-based provides details, & Models complete the picture



Secondary Products from Satellite data

- From conceptual Understanding obtained from theoretical work and ground based observations we can derive proxies and utilise satellite remote sensing more effectively to obtain global picture
- Examples:
 - N (3-25 nm), Kulmala et al., 2011, ACP
 - New ideas (in preparation)
 - N(25-100 nm)
 - Growth rate for aerosol particles
 - Precursor vapour concentrations
 - COBACC feedback loop verification
 -

Global SMEAR – the integrated approach

Currently Observations (see IPCC 2013) are fragmented into:

- 1) Greenhouse gases
- 2) Aerosols
- 3) Air quality
- 4) Ecosystems
- 5) ...

We need an integrated approach!



PEEX (Pan Eurasian Experiment) 2013 - 2033 (-2100) www.atm.helsinki/peex



Station network, marine, airborne, remote sensing, multiscale modelling; Supradisciplinary concept

Pan-Eurasian Experiment (PEEX)



- a bottom up initiative by several European, Russian and Chinese research organizations and institutes
- involving research communities from 20 different countries
 - 80 institutes
- started in 2012, set for years 2013-2033 (-2100) as a long-term continuing activity

BASELINE

"THE NORTHERN REGIONS (> 45°N) WILL UNDERGO SUBSTANTIAL CHANGES DURING THE NEXT 40 YEARS " ref. L. Smith 2010

NORTHERN PAN-EURASIAN REGION

VERY IMPORTANT AREA Crucial for global climate Arctic, boreal Albedo change Carbon sink or source Methane **Aerosol production** via **BVOCs** Air quality **Energy production, minerals** Permafrost **Arctic Ocean** Socioetal issues



PEEX STRUCTURE



Silk Road Economic Belt and Maritime Silk Road

- North
- Central
- South belts proposed

Focus on:

- Economy
- Infrastructure
- Cultural exchanges
- Trade

Related activities:

- Asian Infrastructure Investment Bank
 - China-led, lending for infrastructure projects
- Silk Road Fund
 - Invest in businesses



Silk Road

- Silk Road Economic Belt and PEEX
 - Several similar objectives
 - PEEX and DBAR
- International Silk Road Academy of Sciences
- Earth Observations for One Belt and One Road
 - SMEAR Concept / Global SMEAR
 - Comprehensive, continuous in situ observations
 - Provides a crucial contribution
 - Remote sensing
 - Open data, data flows
 - Joint multidisciplinary efforts



Crucial

- Vision
- Multiscale, multinational, multidisciplinary
- EU-Russia connections
- PEEX, Silk Road, Global SMEAR