

# RESEARCH AGENDA

## System understanding of the Arctic-boreal regions for scenarios and assessments of the Pan-Eurasian environments

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10 Dept. of Radiophysics, Nizhny Novgorod State University, Russia

**CRAICC- PEEX Workshop at DMI, Copenhagen:**

**Pan-Eurasian Experiment (PEEX)**

**A Research Initiative Responding Grand Challenges of Changing Environment in Northern Pan-Eurasian Arctic-Boreal Areas**



<http://www.atm.helsinki.fi/peex/>

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## **NORDFORSK CALL in March 2013 on “Nordic –Russian Cooperation within Top-level Research Initiative”**

### **BACKGROUND**

- originally planned “2-phase proposal round” was cancelled
- matching call in Russian was cancelled
- Russian partners in-kind contribution
- Research plan(s) accepted based on the “Expression of Interest”

### **AIMS OF THE CRAICC-PEEX COLLABORATION**

- To strengthen the collaboration between CRAICC institutes and key investigators and institutes of PEEX
- To make a detailed design enabling the long-term research activities in PEEX
- To contribute the PEEX Implementation planning
- To establish a student training and short term visits between the institutes



## ***List of Workshops / Pilot projects Topics, PIs, institutes***

1. *Short-lived climate forcers in the Arctic and Eurasia* Petäjä Univ.Helsinki
2. *Carbon exchange in the soil/cryosphere – vegetation - atmosphere continuum* Bäck, Laurila Univ.Helsinki & FMI Finland
3. ***Climate change for Arctic seas and shipping, Korsholm DMI Denmark***
4. *Estimating and monitoring anthropogenic emission in the Arctic by using remote sensing,* Nansen Norway
5. *Climatology of the high-latitude planetary boundary layer, Esau, Nansen Norway → PEEX Conference 2016*
6. *Turbulent exchange across strongly heterogeneous interface, Vesala, Zilitinlevich Univ.Helsinki & FMI, Finland → PEEX Conference May 2016 in Beijing China*

# GRAND CHALLENGES IN THE NORTHERN CONTEXT

## NORTHERN PAN-EURASIAN REGION = VERY IMPORTANT AREA

Crucial for global climate

Arctic, boreal

Albedo change

Carbon sink or source

Methane

Aerosol production  
via BVOCs

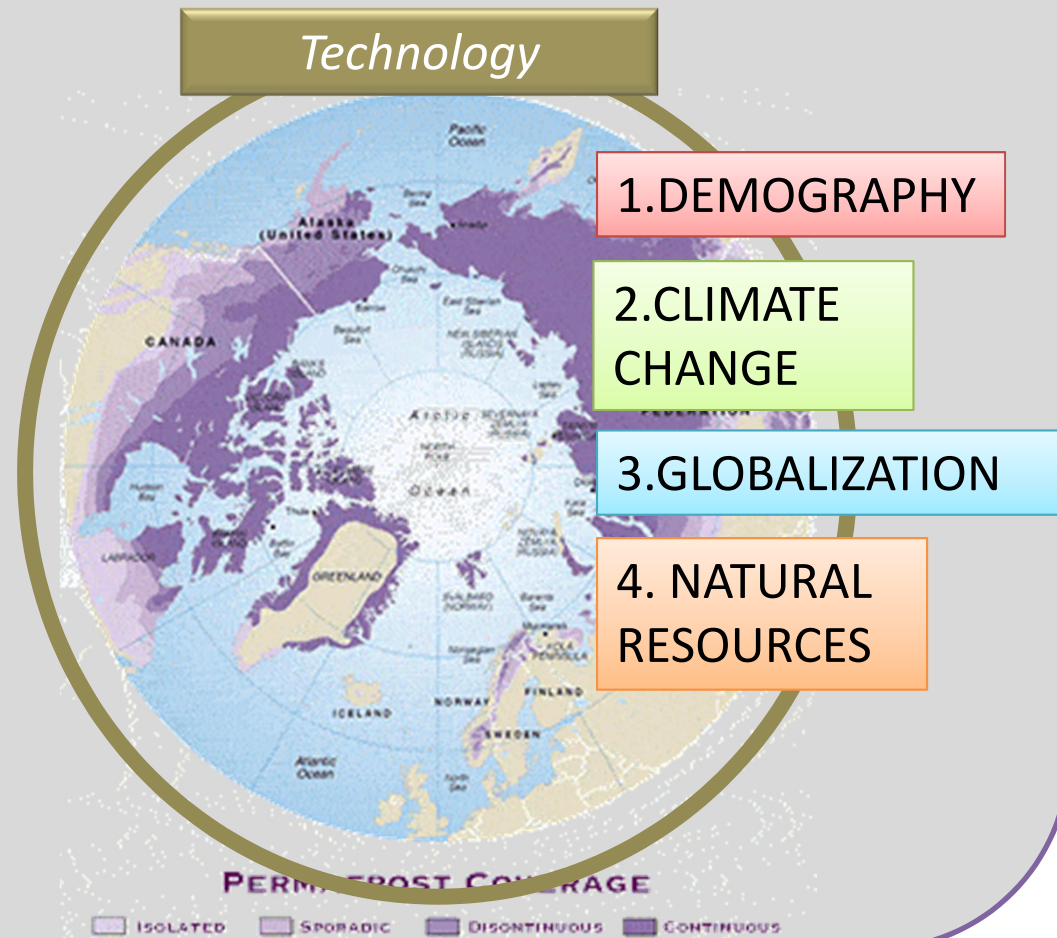
Air quality

Energy production

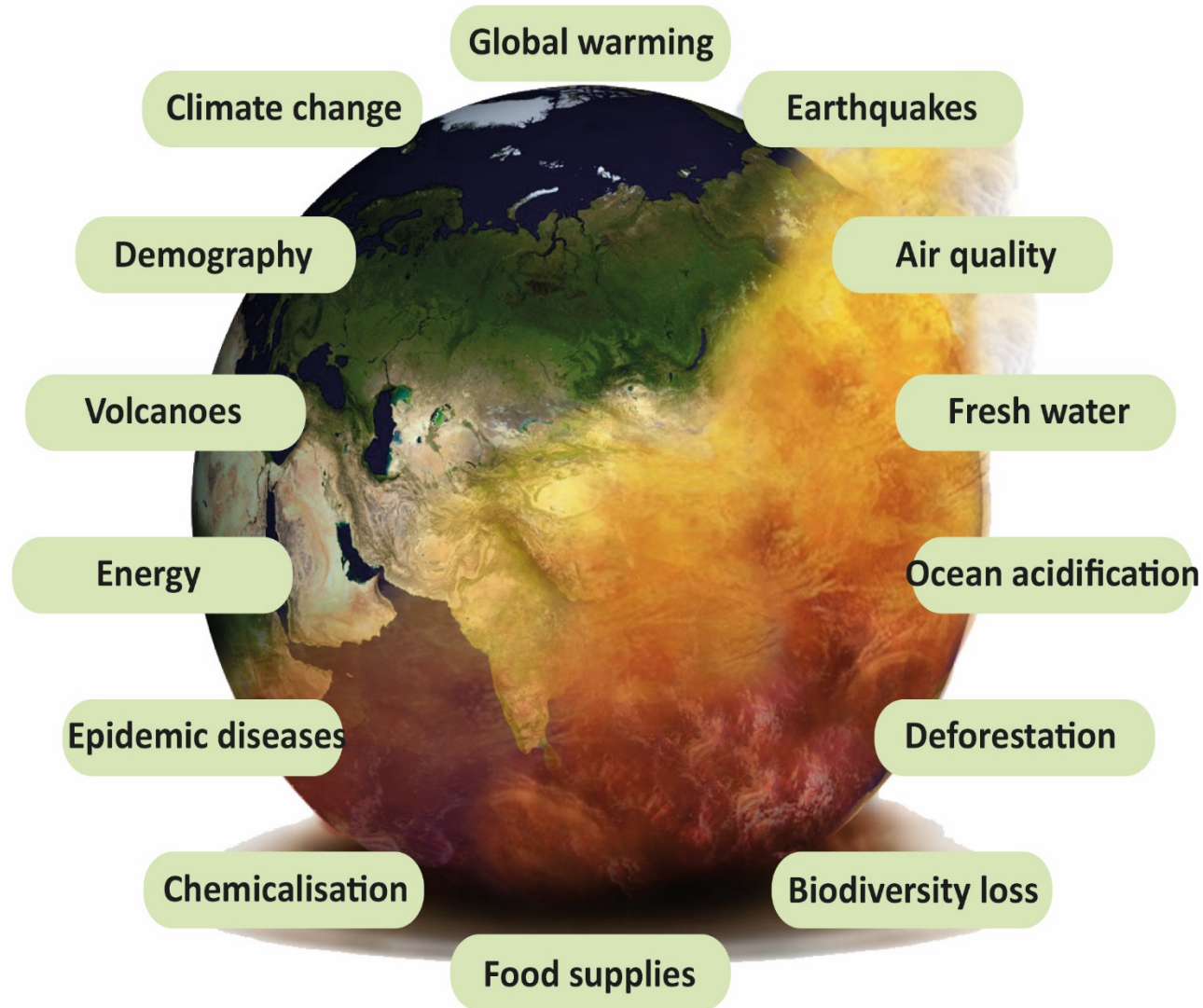
Permafrost

Arctic Ocean

Socioetal issues



# GRAND CHALLENGES



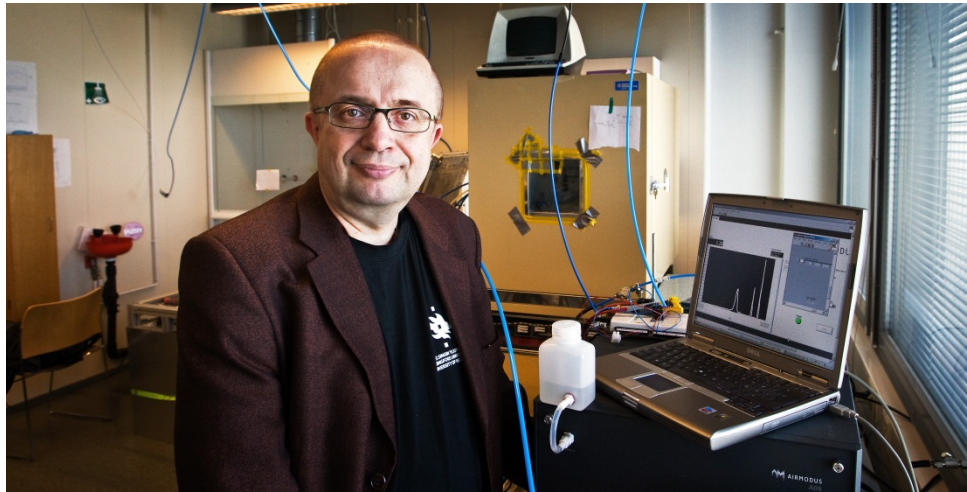
➤ Solving any of the grand challenges requires a multidisciplinary – multiscale approach

# Pan-Eurasian Experiment (PEEX)



- **International, multidisciplinary, bottom up initiative**
- **Kick off meeting in Oct 2012 in Helsinki**
- **Initiative has grown fast**
  - **Research communities from 20 different countries**
  - **80 institutes have contributed PEEX Science Plan**
- **Management:**
  - **Finland: HQ in Helsinki: Univ.Helsinki & FMI**
  - **Russia: 2 in Moscow: MSU, AEROCOSMOS**
  - **China: 2 offices: RADI Beijing , Univ. Nansing**

# PEEX PREFACE – Initiators



## **Academy Prof. Markku Kulmala, Univ. Helsinki**

- a world leader scientist in atmospheric aerosol science and one of the founders of “terrestrial ecosystem meteorology”
- EU Advanced Grant holder
- Coordinator of Nordic Center of Excellence “CRAICC”
- ISI Web of Knowledge, 1st in the Citation Rankings in Geosciences (since 1.5.2011). The total number of citations is over 25000 (from over 8000 different papers), H-factor is 76.



## **Prof. Sergej Zilitinkevich, FMI, Nizhny Novgorod State University**

- a world leader scientist in a field of atmospheric boundary layer physics
- Russian Mega Grant holder
- EU Advanced Grant holder
- ISI Web of Science 1637 citations of 110 articles of S.S. Zilitinkevich, H-index is 21.

# PEEX Research Community



<https://www.atm.helsinki.fi/peex/index.php/science-conference>

The 1<sup>st</sup> PEE X Science Conference and the 5<sup>th</sup> PEE X meeting were in **Helsinki, Finland on 10-13 February 2015** and gathered about 200 participants from Europe, Russia, China and overseas countries.

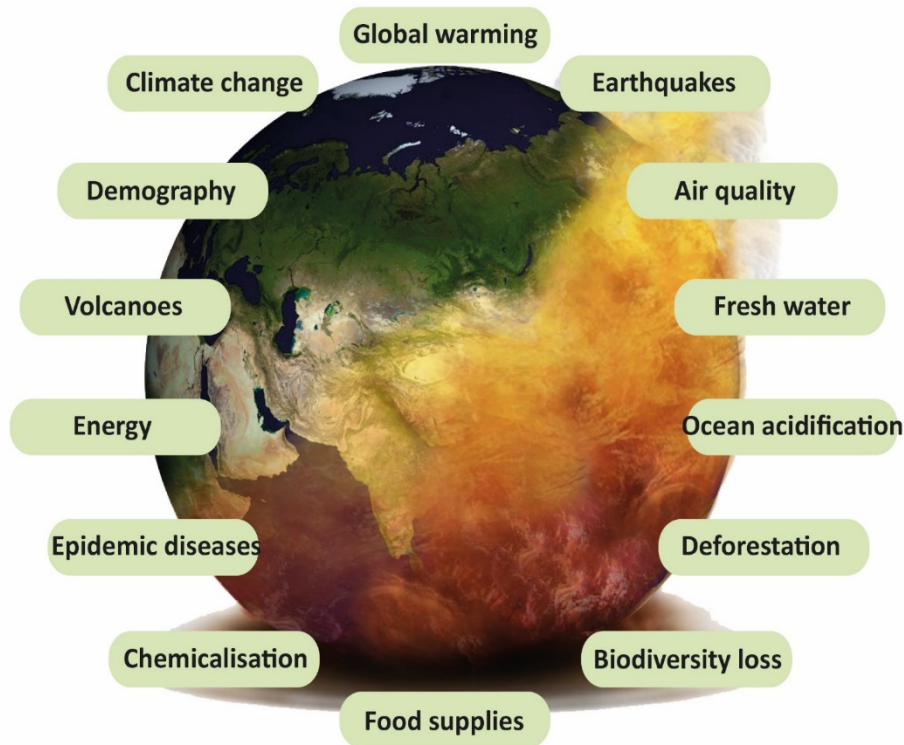
The 2<sup>nd</sup> PEE X Science Conference in Beijing, 18-20 May 2016 (week 20) , to be hosted by RADI





# Pan-Eurasian Experiment (PEEX)

is a new multidisciplinary research – research infrastructure - education initiative resolving the major uncertainties in the Earth system science and global sustainability questions **in the Arctic and boreal Pan-Eurasian region.**



**F1**

to solve interlinked global challenges influencing the human well-being and societies in the northern Eurasia

**F2**

to establish and maintain long-term coordinated research activities and research & educational infrastructures

**F3**

to contribute to the Earth system science agenda and climate policy in topics important to the Pan-Eurasian environment

**F4**

to provide adaptation and mitigation strategies for the societies to cope with climate change.

# PEEX SCIENCE PLAN

- as an outcome of the meetings
- identifies the PEEX program
- introduction to
  - Research agenda
  - Observation network
  - Implementation
- > Document -> peex website

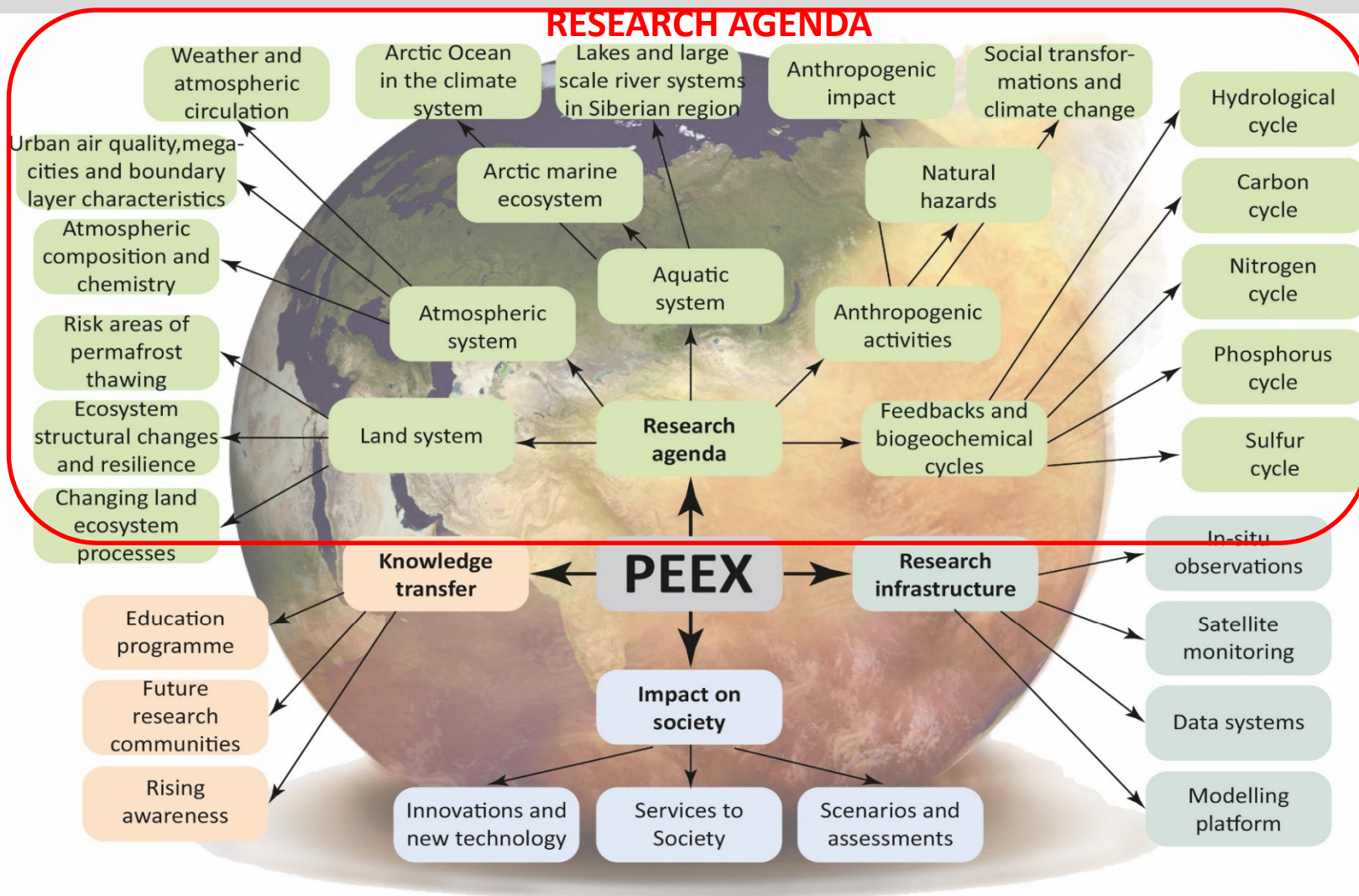


Editors  
H.K.Lappalainen.  
S. Zilitinkevich  
M. Kulmala



PAN-EURASIAN  
EXPERIMENT  
PEEX  
SCIENCE PLAN

# PEEX STRUCTURE

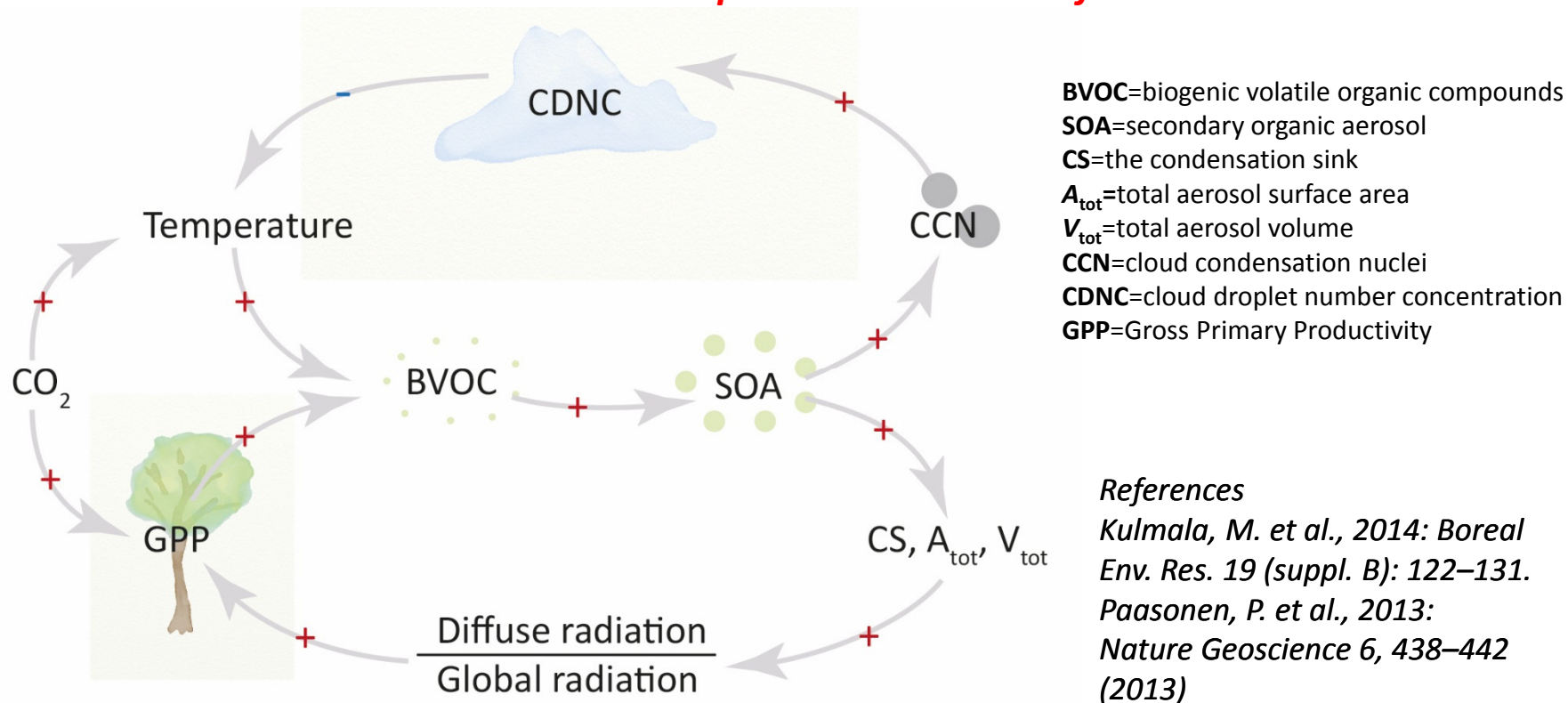


# EXAMPLE ON PEEEX RESEARCH: FEEDBACKS

Academy of Finland – Finnish Center of Excellence (FCoE)

## COBACC (COntinental Biosphere-Aerosol-Cloud-Climate)

❖ Feedback loop relevant to boreal forests

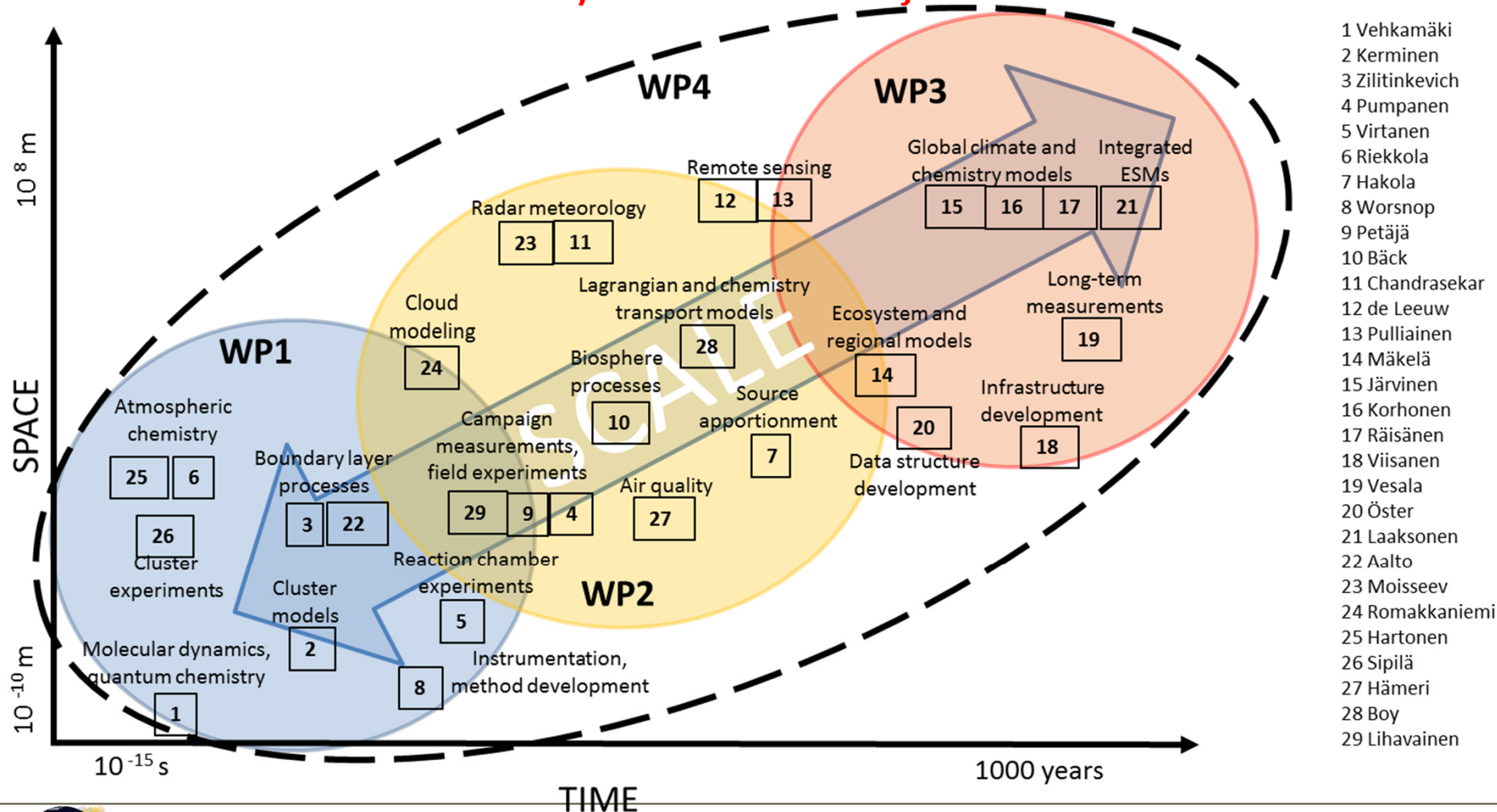


- higher temperatures and CO<sub>2</sub>-levels boost continental biomass production, leading to increased biogenic secondary organic aerosol (BSOA) and cloud condensation nuclei (CCN) concentrations, tending to cause cooling

# EXAMPLE ON PEEEX RESEARCH: FEEDBACKS MULTI-SCALE RESEARCH APPROACH (FCoE)

## COBACC (COntinental Biosphere-Aerosol-Cloud-Climate)

❖ Feedback loop relevant to boreal forests



# EXPANDING PEEEX MULTISCALE APPROACH

## EXAMPLES ONGOING ACTIVITIES

### (i) ATM-FCoE (Univ.Helsinki) - AEROCOSMOS collaboration

- AGREEMENT on scientific and technological cooperation
- PROJECT “Development of methods for monitoring of the dynamics of natural and anthropogenic emissions of trace gases and aerosols in the atmosphere based on satellite data and modeling”
- 2014-2016
- next meeting Sep.22-24. in Kuopio, Finland
- *Principal Investigator Academician Valery Bondur*



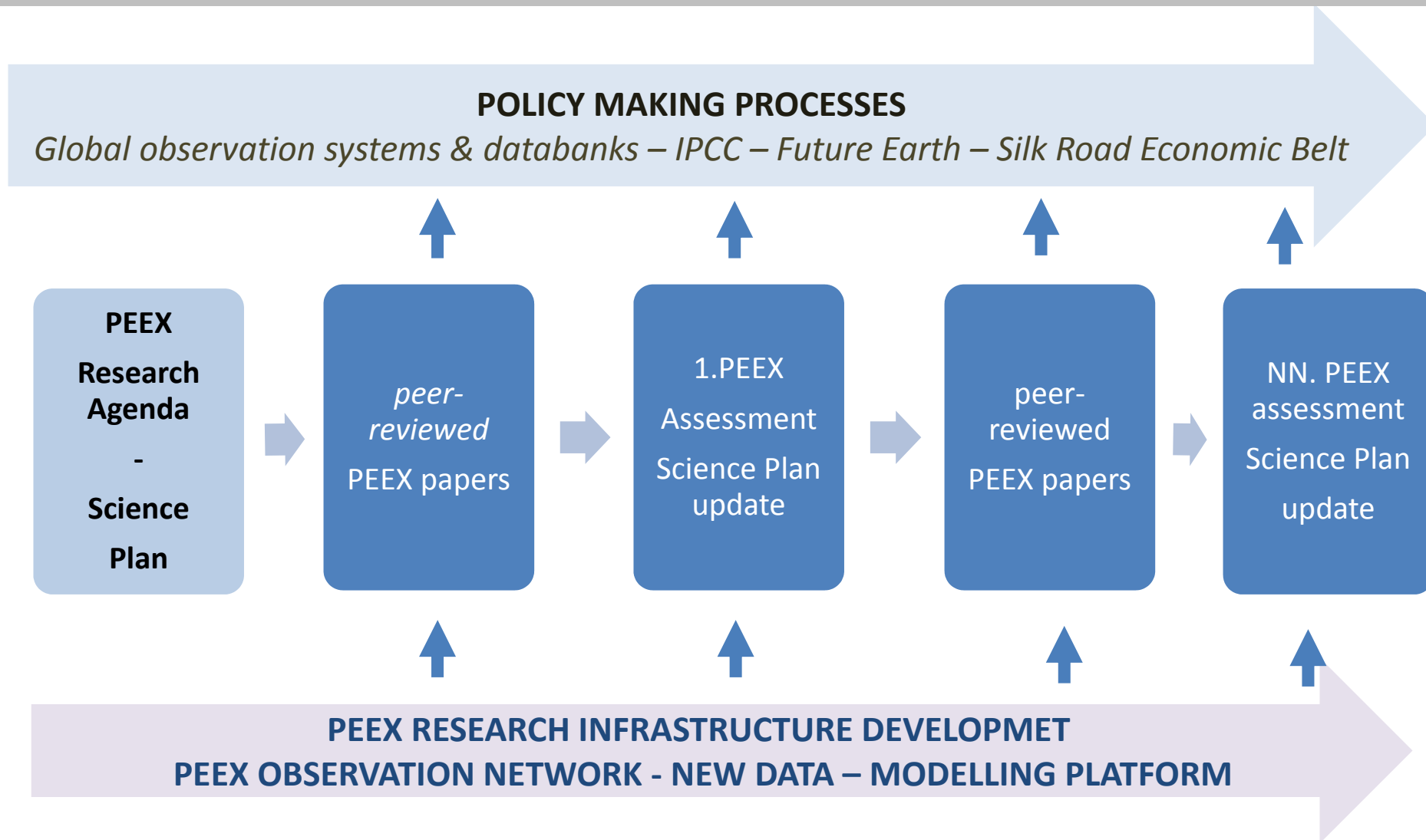
### (ii) Biogenic Aerosols – Effects on Clouds and Climate (BAECC)(Univ.Helsinki)

- Connecting in-situ with ground based active remote sensing
- 8-month intensive campaign in Hyytiälä, Finland Funded by US DOE (spring 2014)
- *Principal Investigator Prof. Tuukka Petäjä*



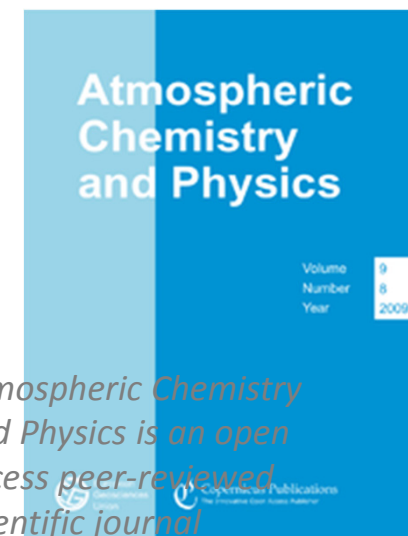
# UPDATING PROCESS FOR THE SCIENCE PLAN

□ to provide up-to-date information, the PEEEX-assessment, to policy makers, stakeholders



# Call for Papers - PEEEX Special Issue

- PEEEX Special has been opened in the Journal of Atmospheric Chemistry and Physics
- Themes: climate change, air quality, biodiversity loss, chemicalization, food supply, fresh water and the use of natural resources through mining, industry, energy production and transport
- Editors V.-M. Kerminen, M. Heimann, D. Spracklen, T. Laurila, A. Ding, and I. Salma.
- **PEEX Special Issue papers will be part of the PEEEX assessment process**



*Atmospheric Chemistry and Physics is an open access peer-reviewed scientific journal published by the European Geosciences Union.*



Pan-Eurasian Experiment

PEEX

<http://www.atm.helsinki.fi/peex/>

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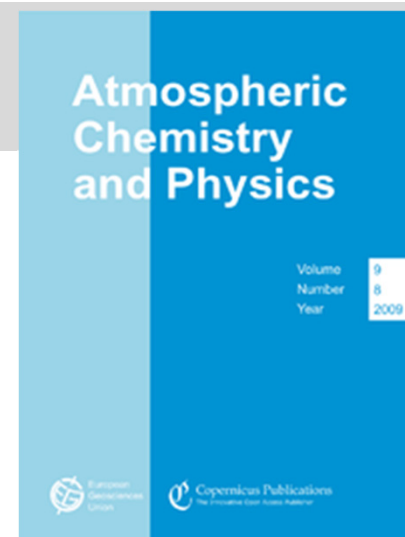
# PEEX Special Issue open

- 2 manuscripts already submitted:
  - Hari et al. Conceptual design of the PEEX in situ network
  - Kulmala et al. Motivation paper – Grand Challenges

**MANUSCRIPT TO BE SUBMITTED SOON...**

## Pan-Eurasian Experiment (PEEX):

**System understanding of the Arctic-boreal regions for constructing scenarios and assessments of the future development of the Northern Pan-Eurasian environments and societies**



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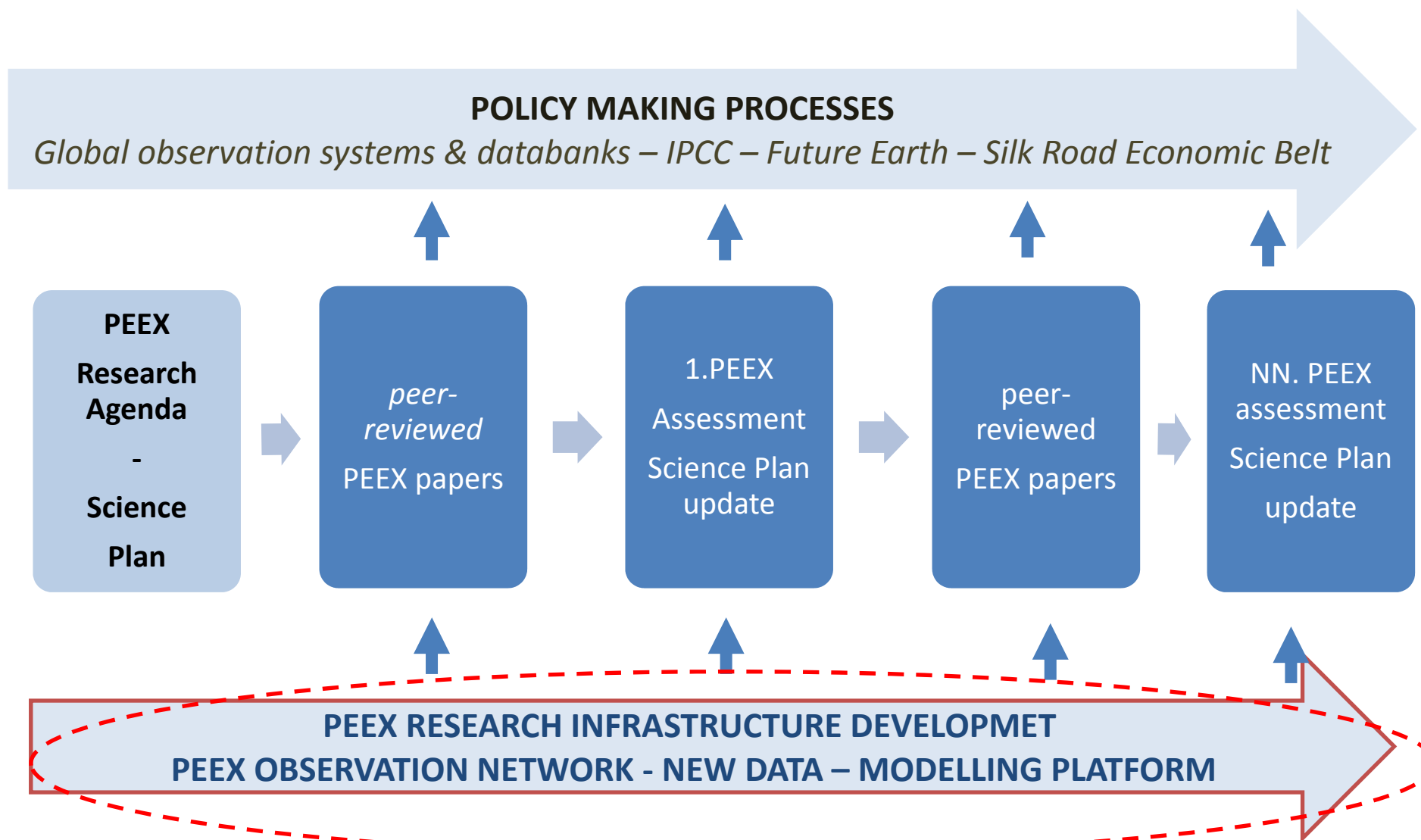
Pan-Eurasian Experiment

PEEX

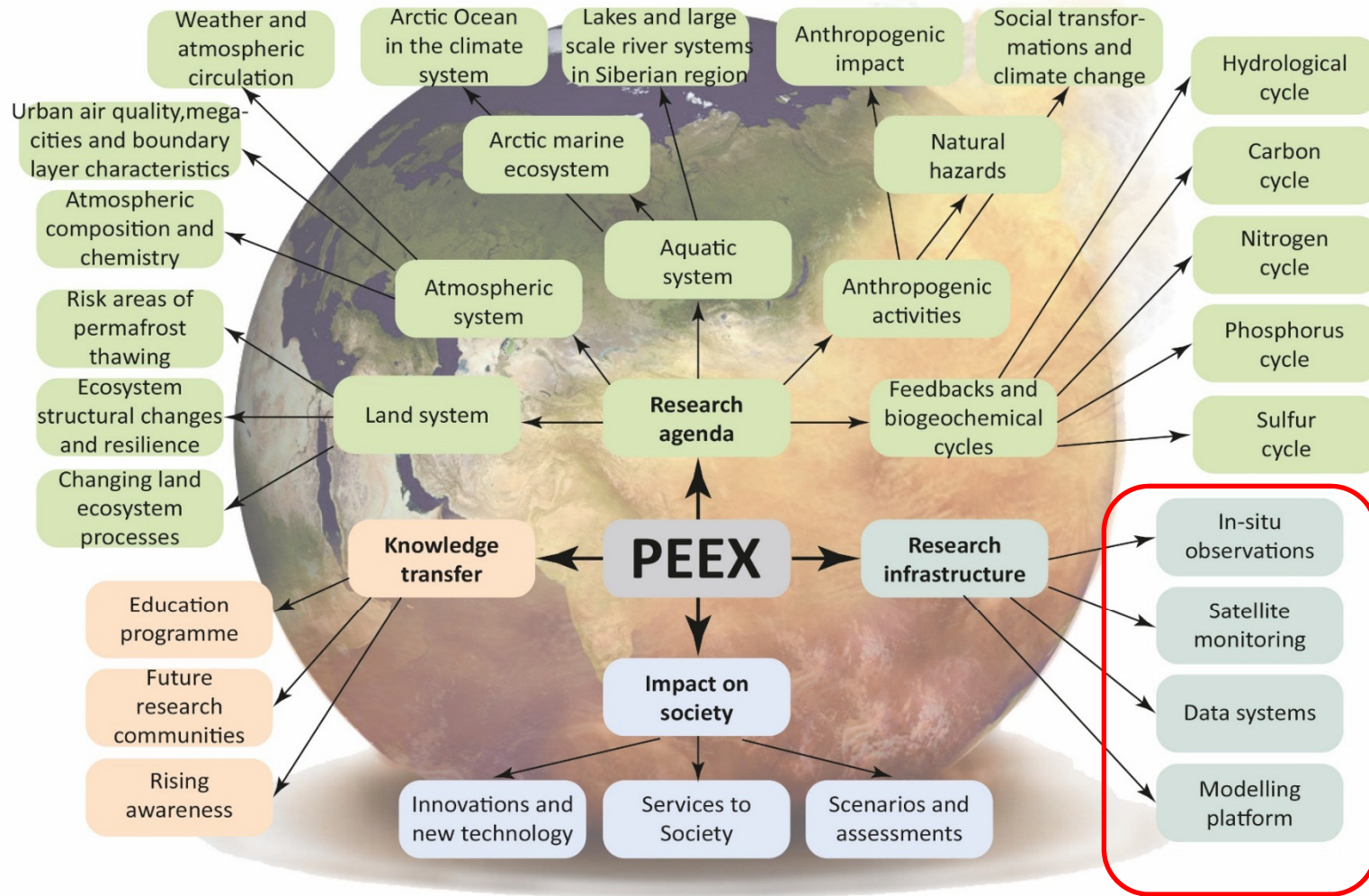
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# PEEX RI PROVIDING TOOLS & DATA FOR RESEARCH



# PEEX RI PROVIDING TOOLS FOR RESEARCH



# PEEX In-situ OBSERVATION NETWORK

## (i) CONCEPTUAL DESIGN OF THE NETWORK (*ref. Hari et al. 2015 ACPD PEEEX special issue*)

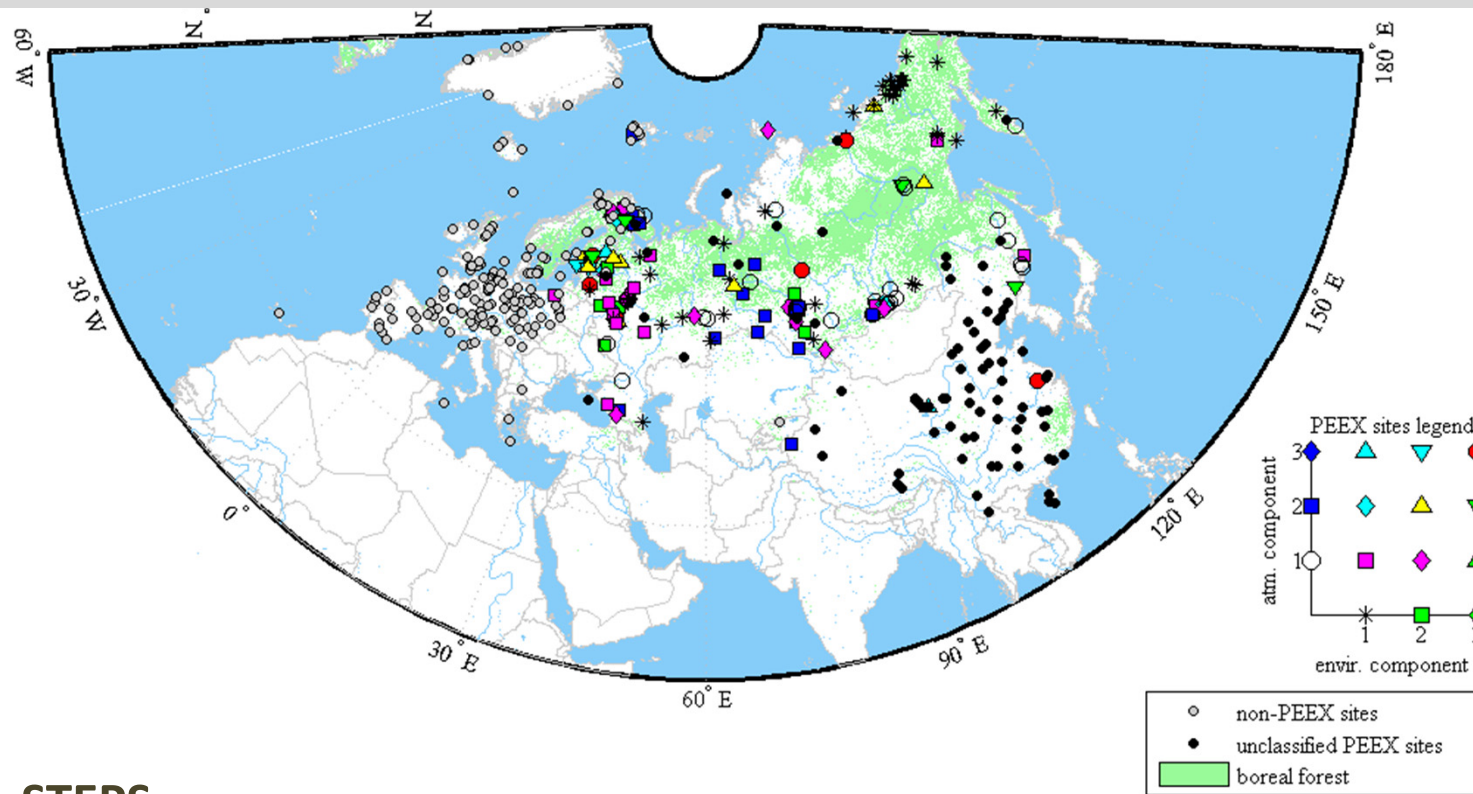
- to be performed at different ecosystems: boreal forest, tundra, peat land, urban + marine/inland waters environments
- land ecosystem stations network to be based on hierarcial structure:
  - standard stations - “the upgraded weather stations”
  - flux stations - “similar to Fluxnet stations”
  - Flag ship stations - “similar to SMEAR-II-type stations”
- Measurement setup in an environment specific manner

## (ii) IMPLEMENTATION PLAN

- updating of existing research stations
  - selection of stations for providing the pilot in 2015 (?)
- establishing new ones (national investments)
  - one flagship station (SMEAR-II) in all major ecosystem areas,
  - a station in every 2000 - 3000 km (10 MEURO+ 1MEURO)

# PEEX OBSERVATION NETWORK

In-situ, status in May 2015



## PRACTICAL STEPS

- collected preliminary information from Russia (RAS, MSU, Univ.Helsinki) and China (China FLUX, SORPES) made in 2013-2014
- PEEX station metadata - database 2015-2016 to identify the Pilot Stations for establishing the PEEX network

# PEEX STATION WEB-BASED METADATA ENQUERY

- station metadata inquiry opening in autumn 2015
- main focus of the metadata collection on the stations located in Russia and in China
- collecting information on
  - site description, facilities
  - atmospheric measurements
  - ecosystem measurements: forests, tundra, peatland
  - soil & lake measurements
  - collaboration & participation to networks
- specific scope index to be use for representative selection of the stations for the PEEX network
- **In situ data / societal data from the PEEX sites → scientific understanding, input to PEEX Modelling**
- **Linking station to PEEX Modelling platform (PEEX DEMO “PEEX View”)**
  - Short dataset from each station to the PEEX demo “PEEX view”
    - Provides a comprehensive view to PEEX future capacity
    - Initiates new scientific findings
    - PEEX community building

# PEEX RI PROVIDING TOOLS FOR RESEARCH



- **PEEX demo** visualizes the time series for the **modeled data** vs. **observed data** (aerosol number concentration).
- Modeled data based on Global Aerosol model (ECHAM-HAM)
- Observed data based on aerosol measurements made in Hyytiälä (SMEAR-II) / Pallas, Finland stations, June 2008.
  - In the future expand the analysis for other parameters: ecological data, economical data etc.
- At the moment trajectories (NILU pre-calculated product) and satellite products (AOD, MODIS data) shown in the same map
  - New components based on geo located data such as flight observations will be add to the next version of the PEEEX DEMO. **(CRAICC\_PEEEX WS: R.MAKKONEN PRESENTATION)**

# How to participate PEEEX ?

- Contact PEEEX HQ & PEEEX Offices in Moscow (AEROCOMOS, MSU) Beijing (RADI) , Univ.Nansing
- For Contacts see PEEEX Website
- e-mailing list
- PEEEX Working Groups
- PEEEX labeled proposals and projects
  - Partner database
- PEEEX special issue – scientific results for the impact making
- PEEEX in-situ observation network
  - *Field stations - Metadata inquiry connecting your data to PEEEX Modelling platform*
- PEEEX Conference May 2016, Beijing



# 2nd PEEEX Science Conference 2016

- **18 – 20 May 2016 in Beijing, CHINA**
- **organized by RADI**
- **1.announcement to be released soon**
- **focus on air quality & societal questions**



Institute of Remote Sensing and Digital Earth  
Chinese Academy of Sciences



Pan-Eurasian Experiment

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# PEEX - PAN-EURASIAN EXPERIMENT

**THANK YOU!**

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