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HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

SMEAR

STATION FOR MEASURING
EARTH SURFACE – ATMOSPHERE
RELATIONS

INAR

INSTITUTE FOR ATMOSPHERIC
AND EARTH SYSTEM RESEARH

SMEAR CONCEPT

SMEAR MEASUREMENT CONCEPT

- SIMULTANEOUS
- CONTINUOUS
- COMPREHENSIVE

- METEOROLOGY
+
ATMOSPHERIC COMPOSITION
+
FLUXES
+
ECOSYSTEM

- ON VARIETY OF SURFACES
FOREST
PEATLANDS
LAKES
COASTAL
URBAN AREAS

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SMEAR
STATIONS FOR MEASURING EARTH SURFACE-ATMOSPHERE RELATIONS

- **SMEAR Concept** offers an observation platform that provides continuous, comprehensive environmental information from local level up-to the global Grand Challenges.
- The SMEAR concept is based on the experience of University of Helsinki in operating SMEAR station network in Finland for more than 20 years.
- The SMEAR stations have produced over 2500 scientific, peer reviewed publications, 45 in Nature or Science, and obtained 15 European Research Council grants based on the comprehensive analysis of the atmosphere-biosphere interactions.

Why SMEAR ?

- Science-based, independent data on quality of the environment
- Capacity for monitoring regional and long-range, transboundary pollution transport
- A quantitative budget of GHG (CO_2, N_2O and CH_4) sinks and sources and their development over time
- Data on ecosystem processes incl. water use efficiency, photosynthesis and C allocation

- Enables identification of particular pollutant sources, such as one ship, or a manufacturing plant
- An early warning system and mechanism for safe operation / evacuation in the case of industrial accidents
- Improved use of existing infrastructures and institutional resources by modernizing monitoring methodologies

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University of Helsinki and INAR, together with SMEAR Ltd. are providing
expert and consultant services
to create or update
your station with
SMEAR standards.
Including design of
tailored measurement setups,
technical installation,
and data flows.

SMEAR STATIONS

SMEAR I Värriö
Lapland 1990-

SMEAR III urban
Helsinki 2004-

SMEAR IV
Puijo 2008-

SMEAR-Estonia
Järviselja 2010-

SORPES station
Nanjing China

SMEAR-
BUCT
Beijing,
China 2018-

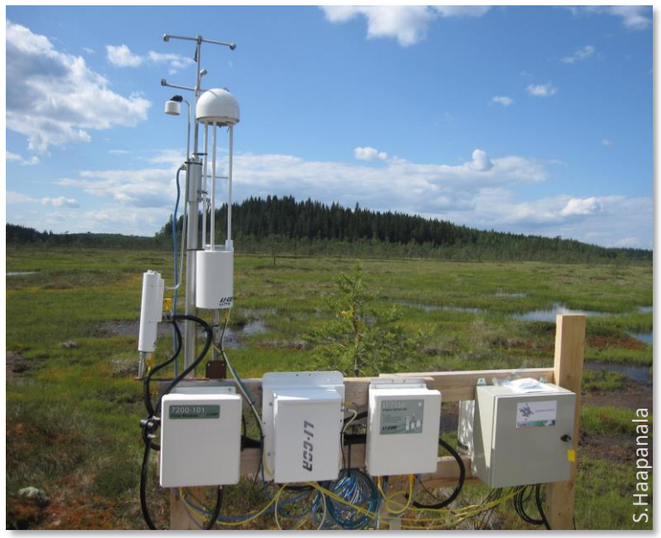
Flagship station SMEAR II
Hyytiälä, Finland 1995-

Flagship station SMEAR II

N 61° 50.845', E 24° 17.686', altitude 180 m a.s.l.

Instrument cottage

Instruments on mast (130m) and towers to measure at different heights

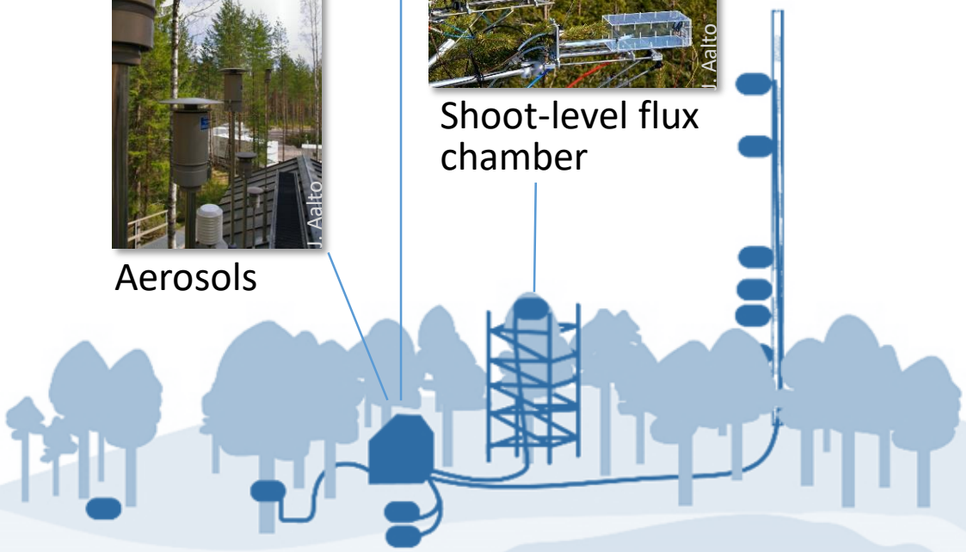


Eddy Covariance systems

Shoot-level flux chamber

Aerosols

Lake raft housing instruments



FOREST

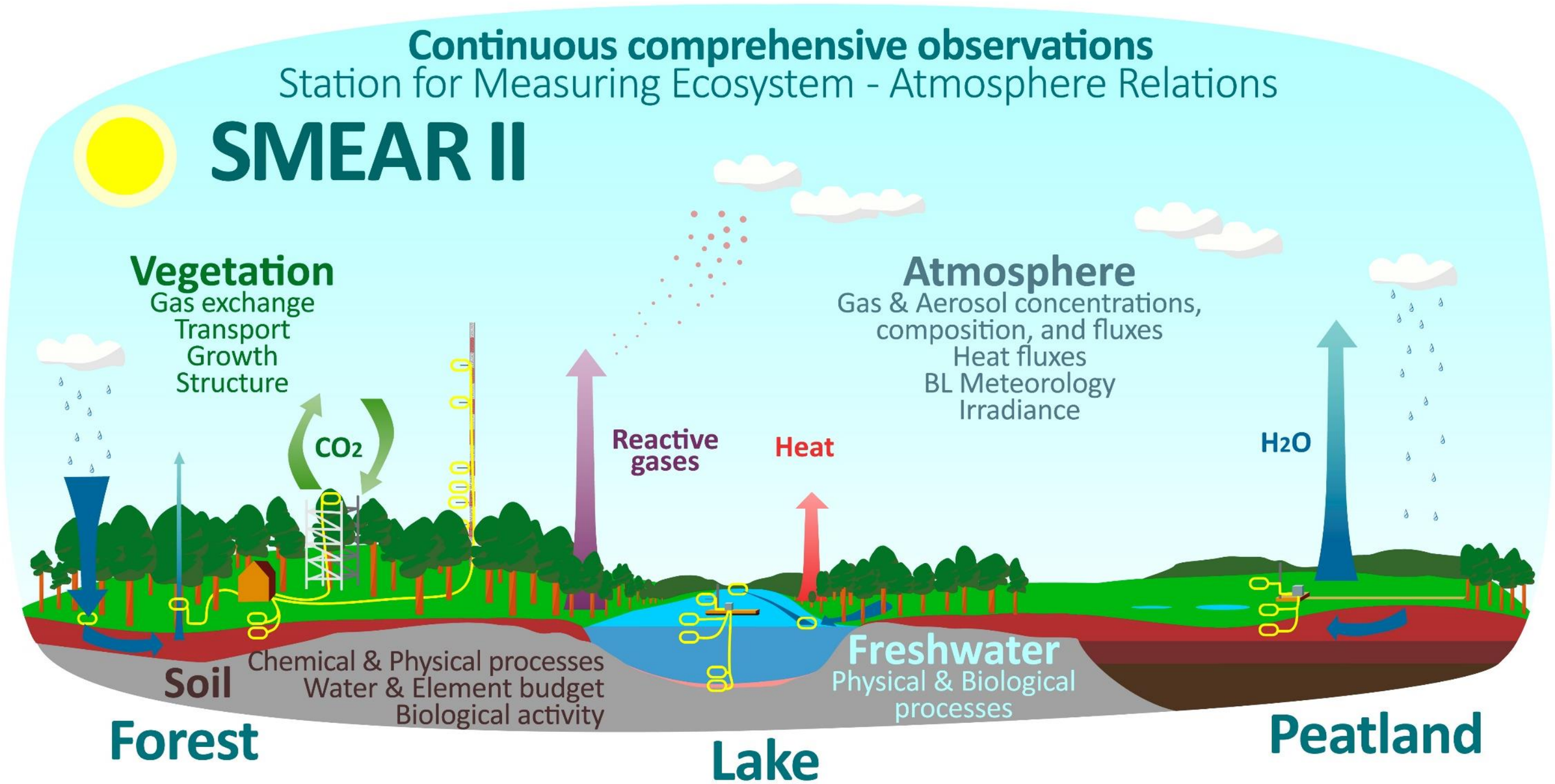
LAKE

PEATLAND

Biosphere Pedosphere Hydrosphere Atmosphere

N.Altimir

Flagship station SMEAR II



Over **1200** different variables

Flagship site for integration: combines all IPCC components. **Contributes to :**

ACTRiS ICOS INTEGRATED CARBON OBSERVATION SYSTEM AnaEE Analysis and Experimentation on Ecosystems LTER europe Pan-Eurasian Experiment PEEX World Meteorological Organisation

N.Altimir

SMEAR measurements and new initiatives in different environments

Show cases

N.Altimir

Upgrading your station to SMEAR

COMPONENTS

SUPPORTING INFRASTRUCTURE

INSTRUMENTS

STAFF TRAINING

OPEN DATA AND DATA FLOWS

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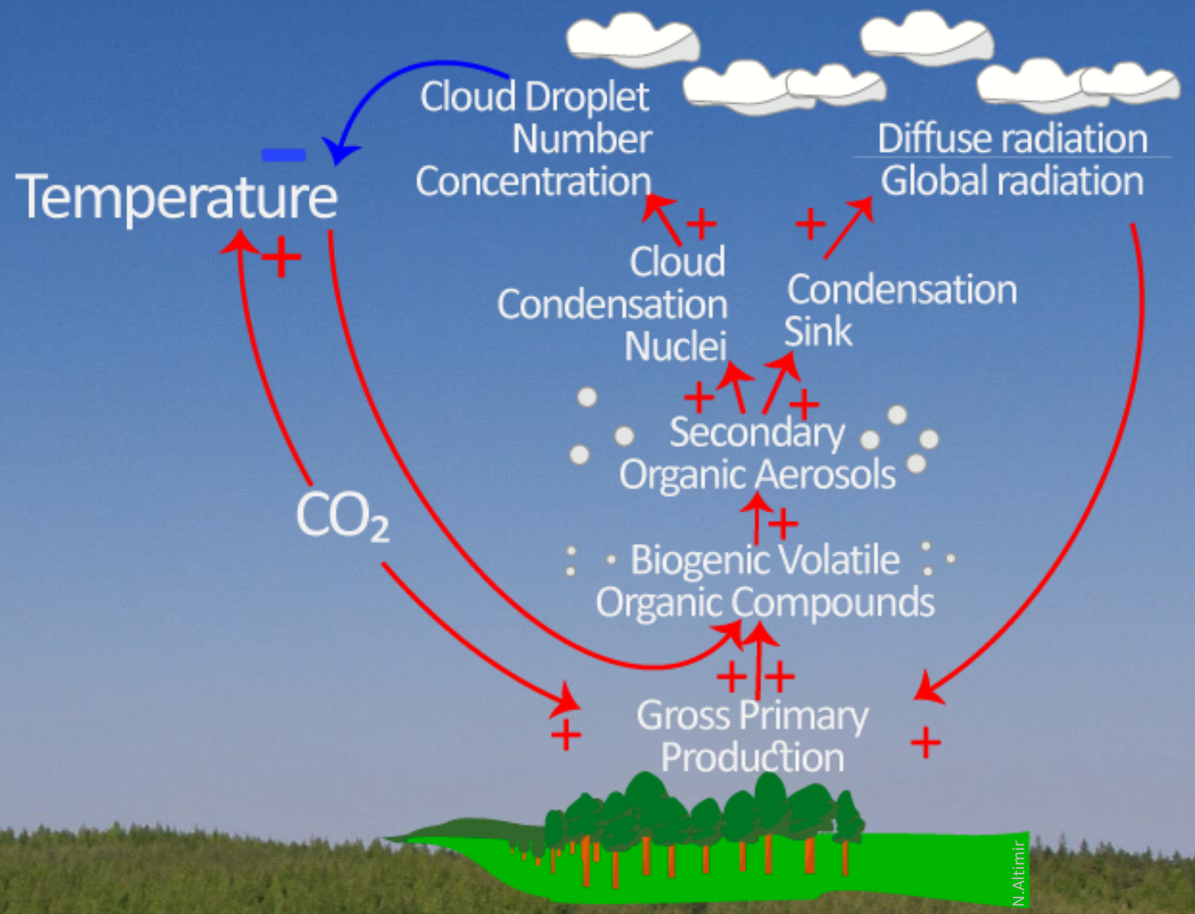
Case - Feedback loop analysis



Instruments needed for feedback loop analysis	
Variables	**Instruments**
Fluxes of CO_2, H_2O, CO, CH_4	Picarro + 3D anemometer
Concentration of VOCs	PTRMS and/or GC-MS
Aerosol number size distribution	DMPS
	NAIS
Meteorological station including radiation (total and diffuse)+ceilometer	
Mast and cottage	
Data	

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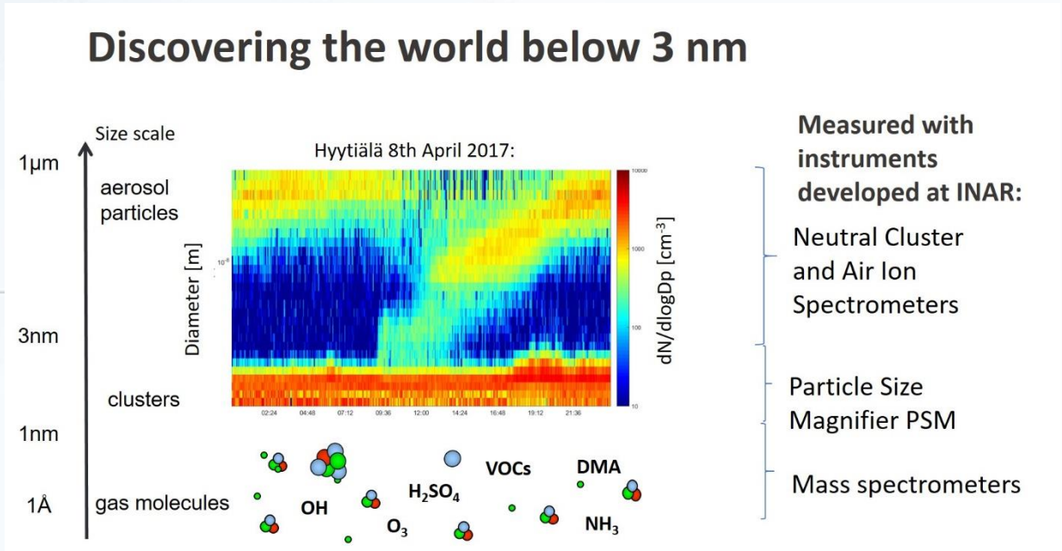
Case - New particle formation



Instruments needed for nano-GTP

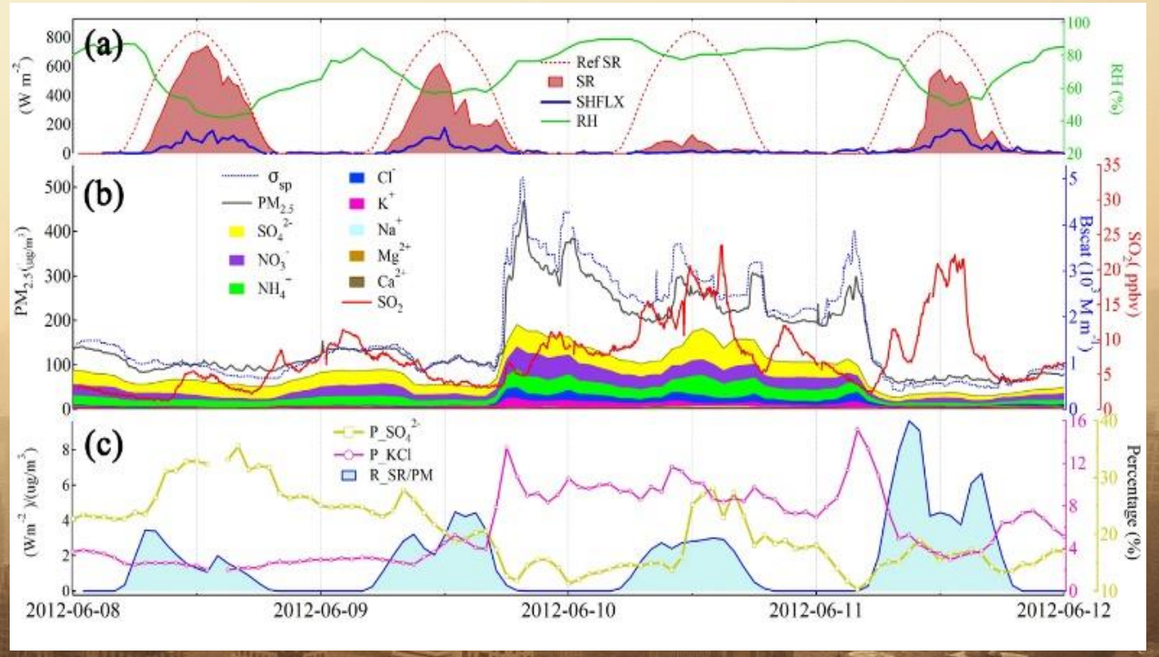
Variables	Instruments
Clusters	PSM
	NAIS
Bigger particles	CI-APi-ToF
	DMPS
	APS

Case - Air Quality


COMMENT

China's choking cocktail

Cleaning up city and indoor air will require a deeper understanding of the unprecedented chemical reactions between pollutants, says Markku Kulmala.

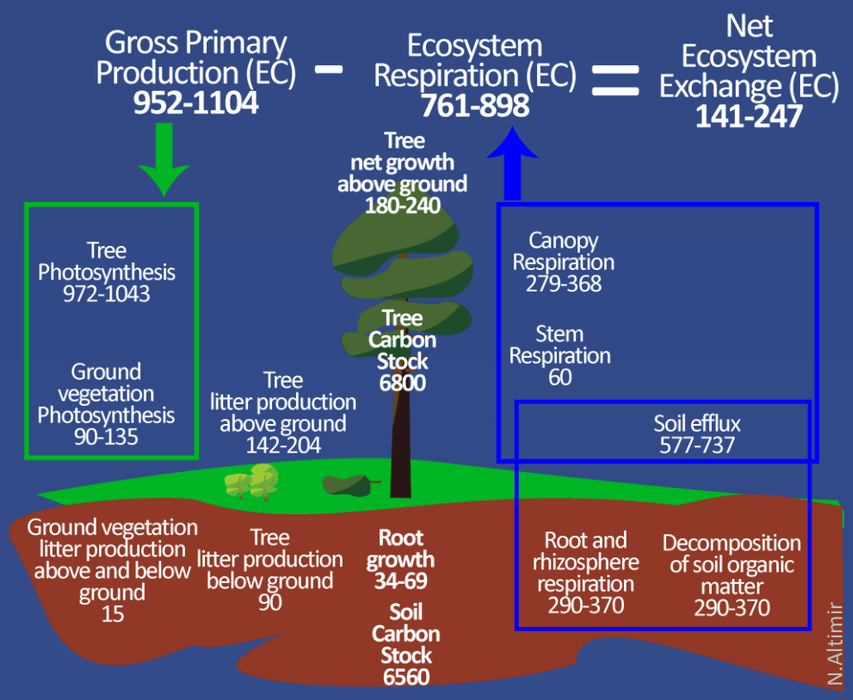


(a) Solar radiation, sensible heat flux and relative humidity recorded at a urban flux site of SORPES. (b) PM2.5 mass, water-soluble ions, aerosol scattering coefficient (at 650nm) and SO_2 measured at the SORPES Xianlin site. (c) Proportions of sulfate and KCl in the total PM2.5 mass and the ratio of "blocked" solar radiation over the PM2.5 mass concentrations at the Xianlin Site (Ding et al. 2013).

Instruments needed for Air Quality

Option 1	**Option 2**
Variables and instruments	**Variables and instruments**
PM2.5 and 10	Number size distribution
Trace gases (Thermo package) NO_x, CO, O_3, SO_2 +Calibrations	Aerosol optics, Nefelometer
	ACSM
BC	MARGA

Case - Ecosystem carbon balance



Apportioning the carbon fluxes in the SMEAR II forest stand to canopy, understorey and soil contributions. (Ilvesniemi et al 2009). Values in gC/m^2

Variables	Instruments
Branch-level fluxes of CO_2, H_2O, CO, CH_4	Custom made automated chamber systems
	CO_2/H_2O analysers
	$CO_2/H_2O/N_2O/CH_4$ analysers
	Custom-made automated sampling control and data logging
Soil moisture and temperature at 5 depths	
Ancillary measurements	Tower incl. meteorological station
Ecosystem-level fluxes of CO_2, H_2O, CO, CH_4	Eddy/Micrometeorology Module Instruments

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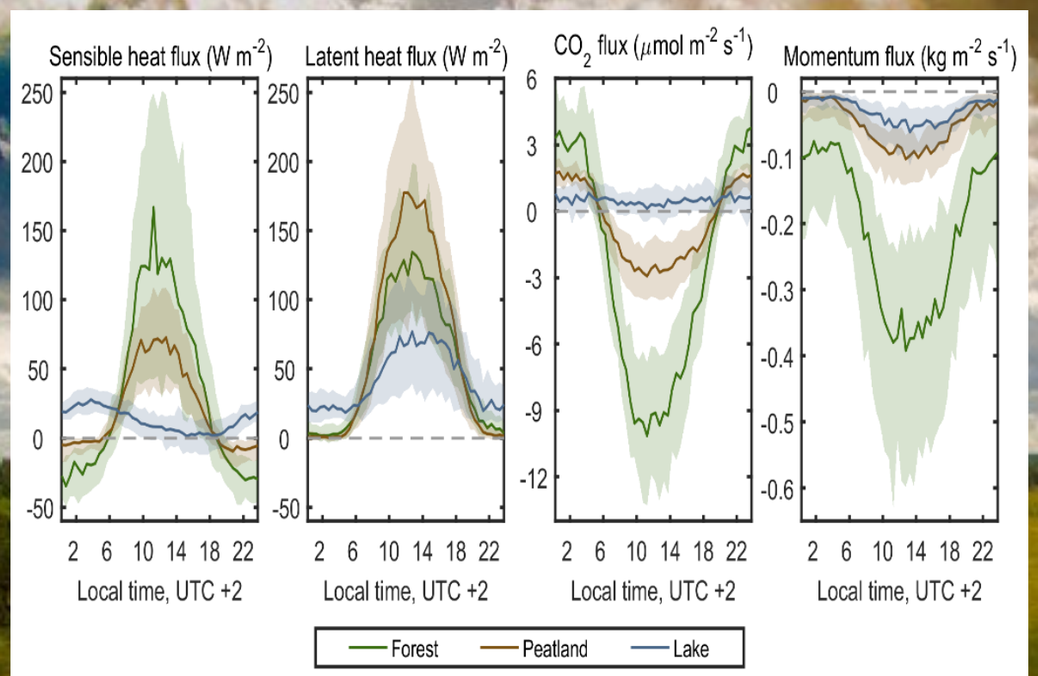
Case – Surface-atmosphere exchange of energy and GHG



Diel patterns of eddy covariance fluxes observed during summer 2016 above SMEAR II pine forest, Siikaneva peatland and lake Kuivajärvi. Positive values indicate emissions to the atmosphere, while negative values indicate ecosystem uptake.

Variables	Instruments
Eddy covariance fluxes of momentum, sensible and latent heat, CO_2, H_2O, CH_4, N_2O, O_3, COS	3D Ultrasonic anemometer + fast response gas analysers
Automated data logging and calibration	Custom-made
Meteorological station (radiation fluxes, air temperature, relative humidity, wind speed and direction, precipitation, etc)	
EddyUH software for data post-processing and flux calculation, footprint and QC/QA.	

Customer journey timeline

M 1 M 3 M 8 M 12 M 18

Engage

- Contacting with the INAR Institute SMEAR Team or SMEAR Ltd.
- Identification of the primary your interests; main research topics / early warning / etc.
- Overview of your existing capacity and expertise
- Discussion on optimum instrument / SMEAR block
- Budget planning
- Data exploitation plan

Plan

- Tailored upgrade and capacity building plan
- Optimized instrumentation selection
- Purchase of equipment
- Data user rights
- Timing and schedules

Install

- Instrument installation
- Data integration to the coordinated SMEAR frameworks
- SMEAR observation network certificate
- Contracts on payments and other relevant issues

Use

- Station in operation
- Standard SMEAR data outputs
- Specialized data products
- Specialized use cases: research / early warning systems / environmental monitoring /

Share

- Data sharing
- International collaboration
- SMEAR network activities
- Result dissemination
- Interactions with the stakeholders
- Further capacity building
- Further upgrading to the next SMEAR level









J.Aalto

Contact us

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Towards coordinated continuous comprehensive Global Earth Observatory