LARGE-SCALE RESEARCH QUESTIONS

LAND SYSTEM

Q-1 How could the land regions and processes that are especially sensitive to climate change be identified, and what are the best methods to analyze their responses?
Key topic: shifting of vegetation zones, Arctic greening

Q-2 How fast will permafrost thaw proceed, and how will it affect ecosystem processes and ecosystem–atmosphere feedbacks, including hydrology and greenhouse gas fluxes?
Key topic: risk areas of permafrost thawing

Q-3 What are the structural ecosystem changes and tipping points in the future evolution of the Pan-Eurasian ecosystem?
Key topic: Ecosystem structural changes

ATMOSPHERIC SYSTEM

Q-4 What are the critical atmospheric physical and chemical processes with large-scale climate implications in a northern context?
Key topic: atmospheric composition and chemistry

Q-5 What are the key feedbacks between air quality and climate at northern high latitudes and in China?
Key topic: urban air quality, megacities and changing PBL

Q-6 How will atmospheric dynamics (synoptic scale weather, boundary layer) change in the Arctic-boreal regions?
Key topic: weather and atmospheric circulation

AQUATIC SYSTEMS – THE ARCTIC OCEAN

Q-7 How will the extent and thickness of the Arctic sea ice and terrestrial snow cover change?
Key topic: The Arctic Ocean in the climate system

Q-8 What is the joint effect of Arctic warming, ocean freshening, pollution load and acidification on the Arctic marine ecosystem, primary production and carbon cycle?
Key topic: The Arctic maritime environment

Q-9 What is the future role of Arctic-boreal lakes, wetlands and large river systems, including thermokarst lakes and running waters of all size, in biogeochemical cycles, and how will these changes affect societies (livelihoods, agriculture, forestry, industry)?
Key topic: lakes, wetlands and large river systems in the Siberian region

ANTHROPOGENIC ACTIVITIES

Q-10 How will human actions such as land-use changes, energy production, the use of natural resources, changes in energy efficiency and the use of renewable energy sources influence further environmental changes in the region?
Key topic: Anthropogenic impact

Q-11 How do the changes in the physical, chemical and biological state of the different ecosystems, and the inland, water and coastal areas affect the economies and societies in the region, and vice versa?
Key topic: Environmental impact

Q-12 In which ways are populated areas vulnerable to climate change? How can their vulnerability be reduced and their adaptive capacities improved? What responses can be identified to mitigate and adapt to climate change?
Key topic: Natural hazards

FEEDBACKS – INTERACTIONS

Q-13 How will the changing cryospheric conditions and the consequent changes in ecosystems feed back to the Arctic climate system and weather, including the risk of natural hazards?

Q-14 What are the net effects of various feedback mechanisms on (i) land cover changes, (ii) photosynthetic activity, (iii) GHG exchange and BVOC emissions (iv) aerosol and cloud formation and radiative forcing? How do these vary with climate change on regional and global scales?

Q-15 How are intensive urbanization processes changing the local and regional climate and environment?
Key topics Q 13-15: Atmospheric composition, biogeochemical cycles: water, carbon (C), nitrogen (N), phosphor (P), sulfur (S)

AN EXAMPLE, HOW TO ANSWER THE QUESTONARY

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Activity Type and title	**Outcome type**	**Outcome details**	**Who was involved**	**Question(s) treated**	**Geographical area(s) treated**	**Main finding(s)**
Specify which of these: • PEEX related project • PEEX working group • Other activity Provide as applies: title, acronym, or description in brief	Specify which of these: • Paper • Model • Infra • Dataset • Thesis • Other (what?)	Provide as applies: reference/citation, web-link to reference (or provide pdf-file). location of infra, hosting of model or data set.	List of Institutions and Researchers (Provide list if it does not appear in the outcome details)	According to PEEX SP. See list in attachment	Whole Eurasia, rivers, mountains, marine…etc	One sentence that summarises the main finding resulting from this activity.
PEEX related project: ERC Advanced grant ATM-GTP/ERC	Paper	Ezhova, E., Ylivinkka, I., Kuusk, J., Komsaare, K., Vana, M., Krasnova, A., Noe, S., Arshinov, M., Belan, B., Park, S.-B., Lavrič, J. V., Heimann, M., Petäjä, T., Vesala, T., Mammarella, I., Kolari, P., Bäck, J., Rannik, Ü., Kerminen, V.-M., and Kulmala, M.: Direct effect of aerosols on solar radiation and gross primary production in boreal and hemiboreal forests, Atmos. Chem. Phys., 18, 17863-17881, https://doi.org/10.5194/acp-18-17863-2018, 2018.	INAR, University of Helsinki University of Tartu, Estonia Estonian University of Life Sciences, Estonia V.E. Zuev Institute of Atmospheric Optics of Siberian Branch of the Russian Academy of Sciences, Russia Max Planck Institute for Biogeochemistry, Germany	Q-14	Boreal and hemiboreal forests in Eurasia	We quantified aerosol effect on solar radiation in boreal forests and forest ecosystems response to this change in the radiation conditions.