



ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ УЧРЕЖДЕНИЕ НАУКИ

ИНСТИТУТ МОНИТОРИНГА
КЛИМАТИЧЕСКИХ И ЭКОЛОГИЧЕСКИХ СИСТЕМ

СИБИРСКОГО ОТДЕЛЕНИЯ РОССИЙСКОЙ АКАДЕМИИ НАУК

THE RESULTS OF THE COMPREHENSIVE STUDY OF SIBERIAN SPRUCE SEEDLINGS RESPONSE TO UV-B RADIATION EXPOSURE

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UV-B radiation as a factor of mountain forests drying

- UV-B radiation is a reason of plant stress, photosynthesis degradation and growth inhibition;
- Forest drying is a complex process, including climatic, biotic and anthropogenic factors;

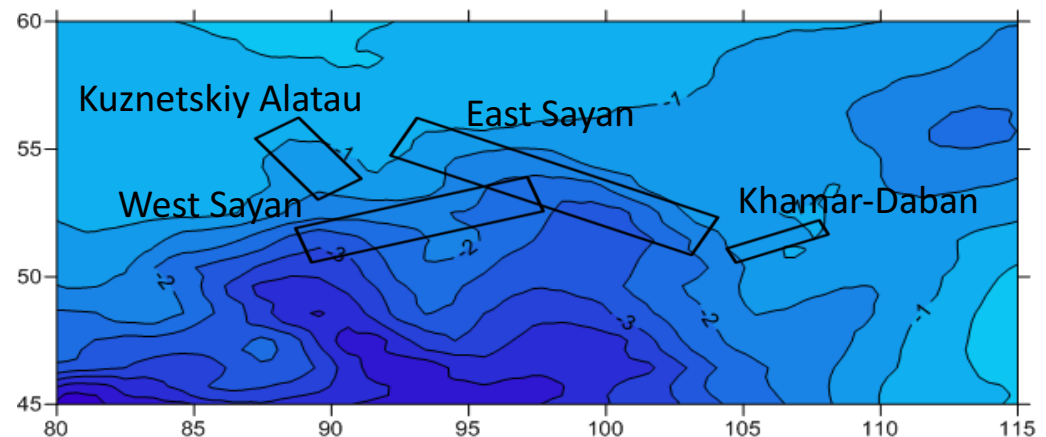
The main goal:

Estimation of the role of the UV-B radiation in forest drying of South Siberia mountains

Forest drying in the mountains of South Siberia is observed at:

- Kuznetskiy Alatau;
- West Sayan;
- East Sayan;
- Khमार-Daban.

Ozone depletion above the South Siberia mountains



Experiment as a decision

The aim of the present study:

To investigate the effect of additional UV-B radiation exposure on the state of conifers using not only biological, but ecological approach

We are interested in:

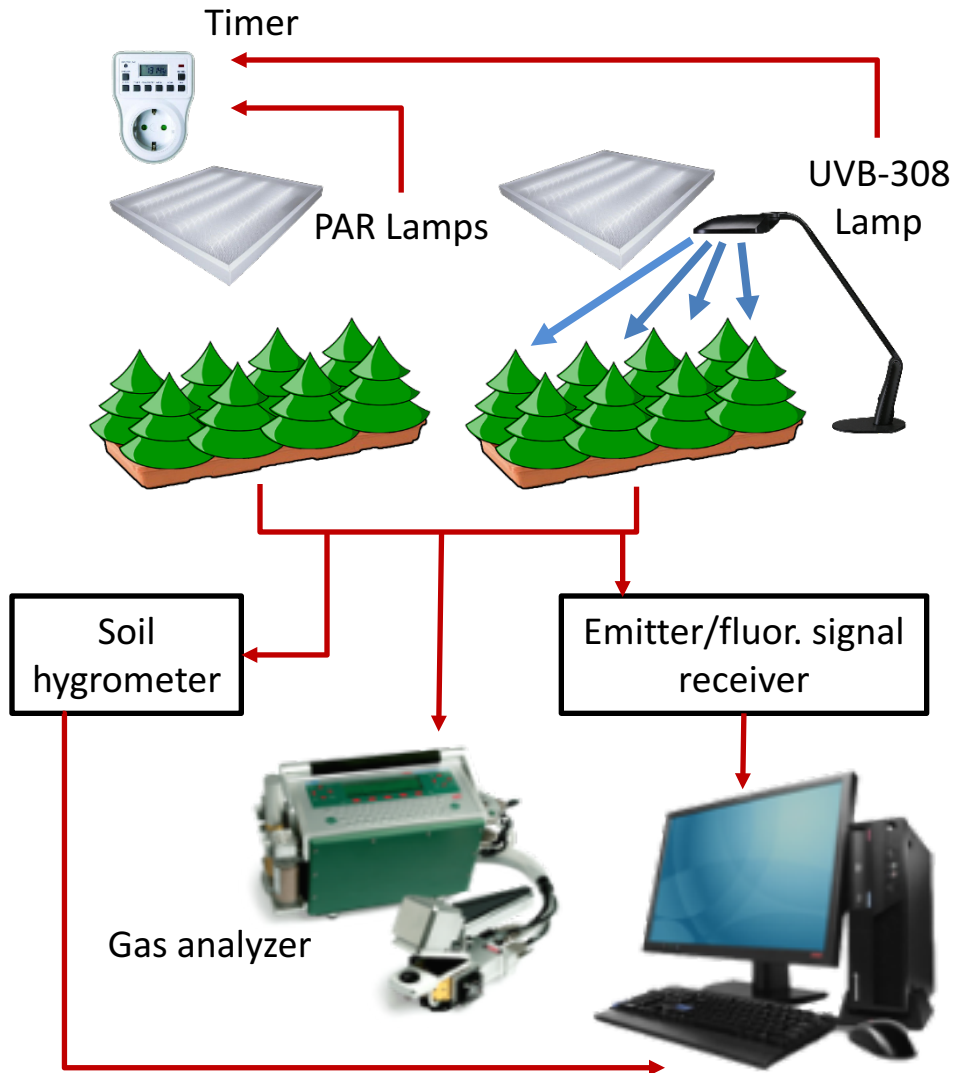
- Vital status of the plants
- Photosynthesis and transpiration changes
- Soil moisture changes (evaporation, consumption by plants)

About experiment

The experiment was carried out on spruce seedlings during the period from **June to August of 2015**. The test plants were divided into two groups: one **experimental** and one **control group**. The seedlings were planted in plastic containers and placed in the experimental room with access for the background solar radiation and natural ventilation. The experimental group of plants was exposed to **UV-B radiation** at a wavelength of **308 nm** for 4 hours daily. The plants received daily a dose of additional ultraviolet radiation comparable to a **30% deficit of ozone** in the atmosphere for Tomsk. Both groups of plants were further exposed to **photosynthetically active radiation** from fluorescent phytolamps.

Experiment

Experiment design



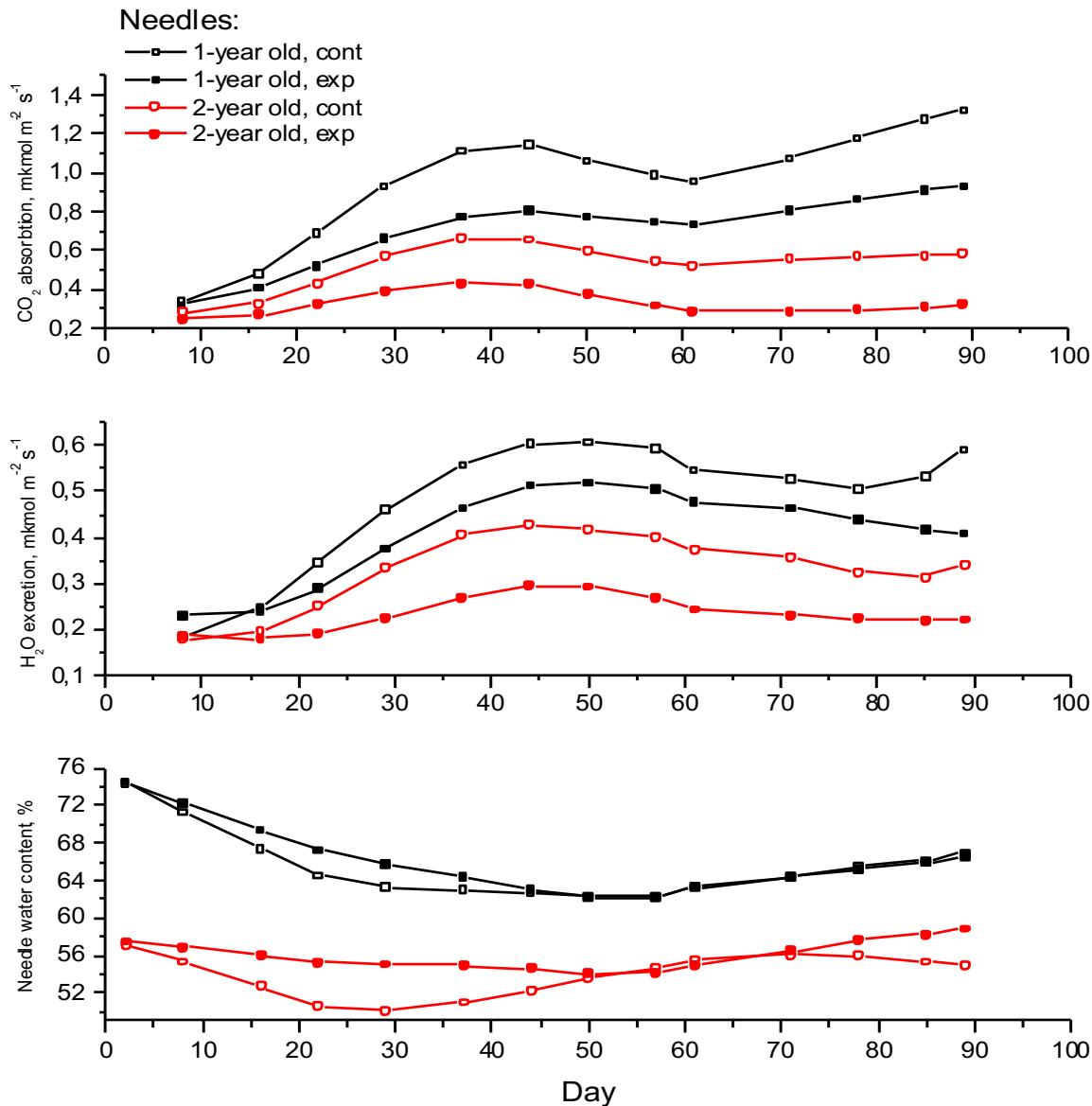
Measurements:

- Photosynthesis of the 1- and 2-year old needle;
- Transpiration of the 1- and 2-year old needle;
- Needle water content;
- Chlorophyll fluorescence response;
- Soil moisture.

Air temperature, humidity and other weather conditions were also fixed.



Photosynthesis, transpiration, needle water content



Photosynthesis rate :

1- and 2-year-old needles in the experimental group - 28% and 40% lower than that in the control group.

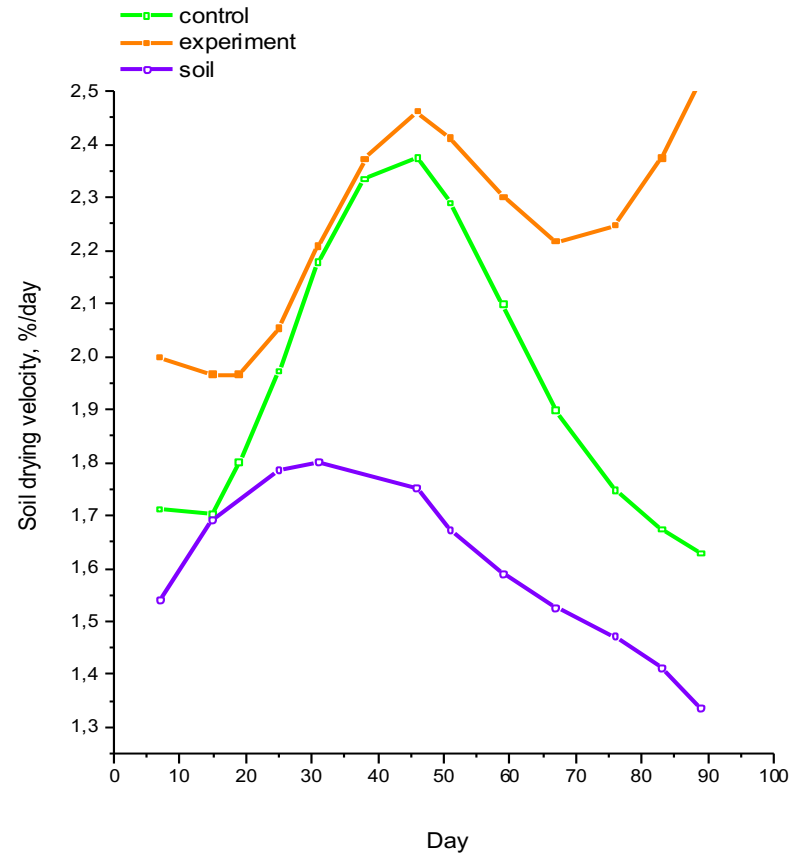
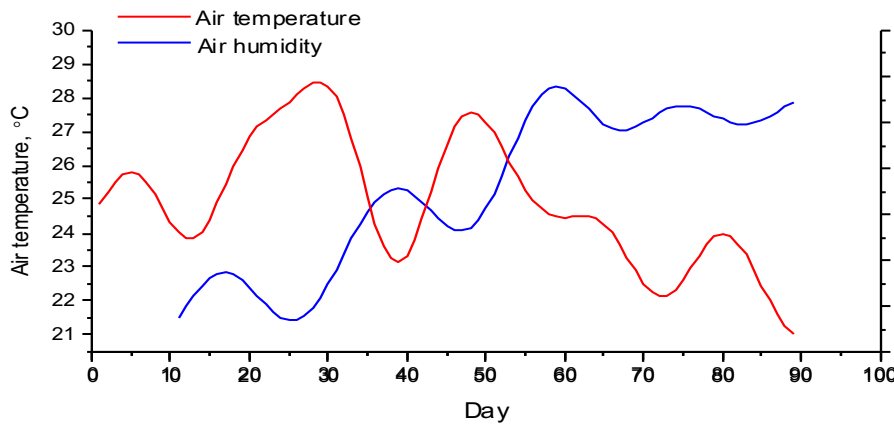
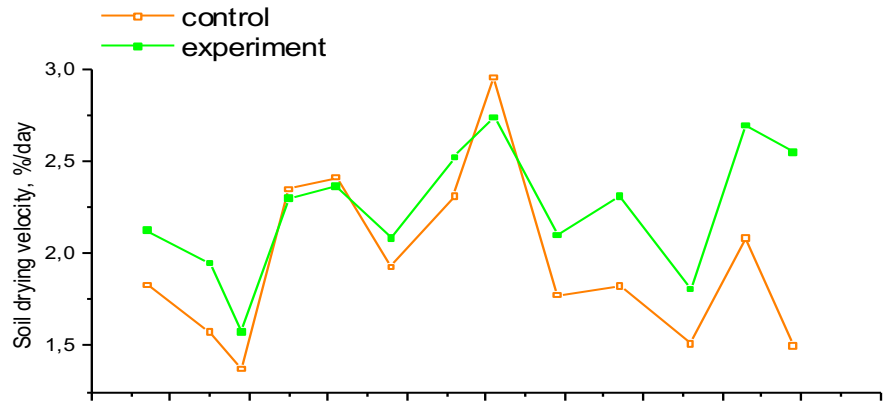
Transpiration rate:

1- and 2-year-old needles in the experimental group - 16% and 33% lower than that in the control group.

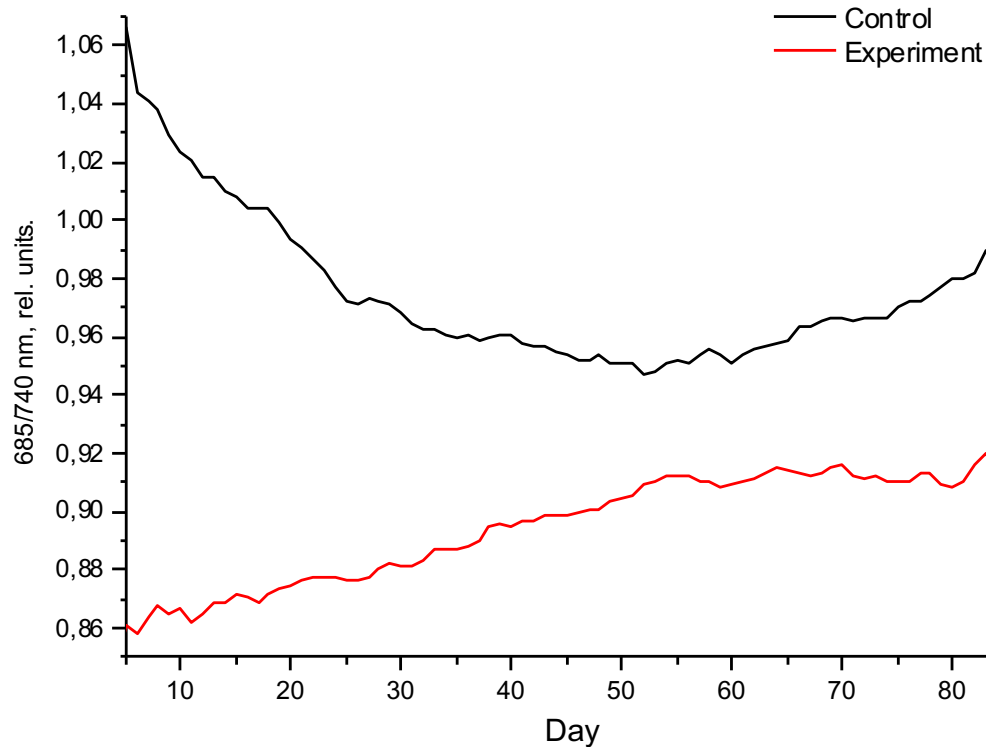
Needle water content:

No significant changes.

Soil moisture drying and air parameters dynamics

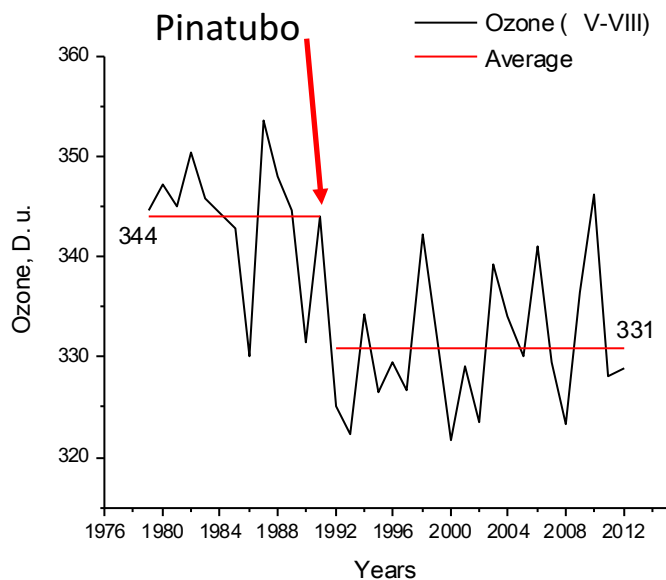


The results of the fluorescence response study

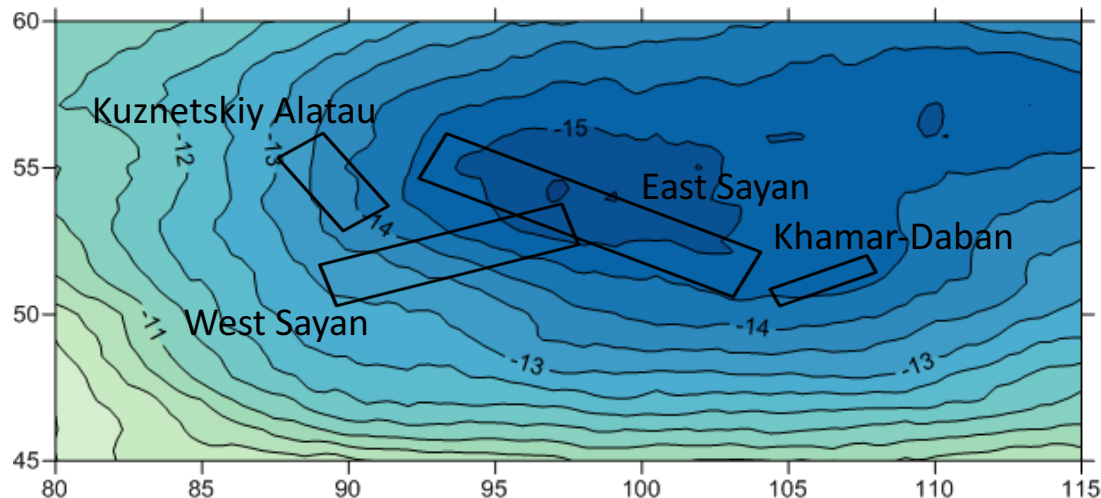


The chlorophyll fluorescence response in the **experimental** plant group showed the behavior **opposite to normal** response of the control plant group, revealing **photosynthesis degradation** and **plant stress**.

Ozonosphere behavior analysis



Ozone normals 1979-1991 and 1992-2012 differences (active vegetation period V-VIII)



The increase of intensity of conifer forests drying process in South Siberia mountains is registered since the second half of 1990-s.

Territory	Negative deviations of ozone from normal, %	
	1979-1991 гг.	1992-2012 гг.
Kuzneckiy Alatau	20	74
West Sayan	16	76
East Sayan	13	75
Khमार-Daban	13	76

Summary

- The experiment showed the **negative impact of UV-B radiation** on **photosynthesis** and its **decrease** in the needles of different ages. Chlorophyll fluorescence response also reveals the **changes in the photosynthetic apparatus** in the experimental plant group. The additional UV-B radiation exposure led to an **increase in water consumption** from the soil, **reducing** the level of **soil moisture** available to plants. Thus, the set of adverse effects due to an extra dose of UV - B radiation exposure, can be manifested not only directly, resulting in the weakening by **inhibiting photosynthesis and growth**, but also indirectly, i.e. creating a **moisture deficit** in the soil, due to increased water consumption.
- Actually, the **increase** of intensity of conifer **forests drying** process in South Siberia mountains since the **second half of 1990-s** is observed against a backdrop of **ozone depletion** from **1992**.



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THANK YOU FOR ATTENTION!

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