The network of the permanent forest plots in the Russian Far East and plot-based studies of climate change

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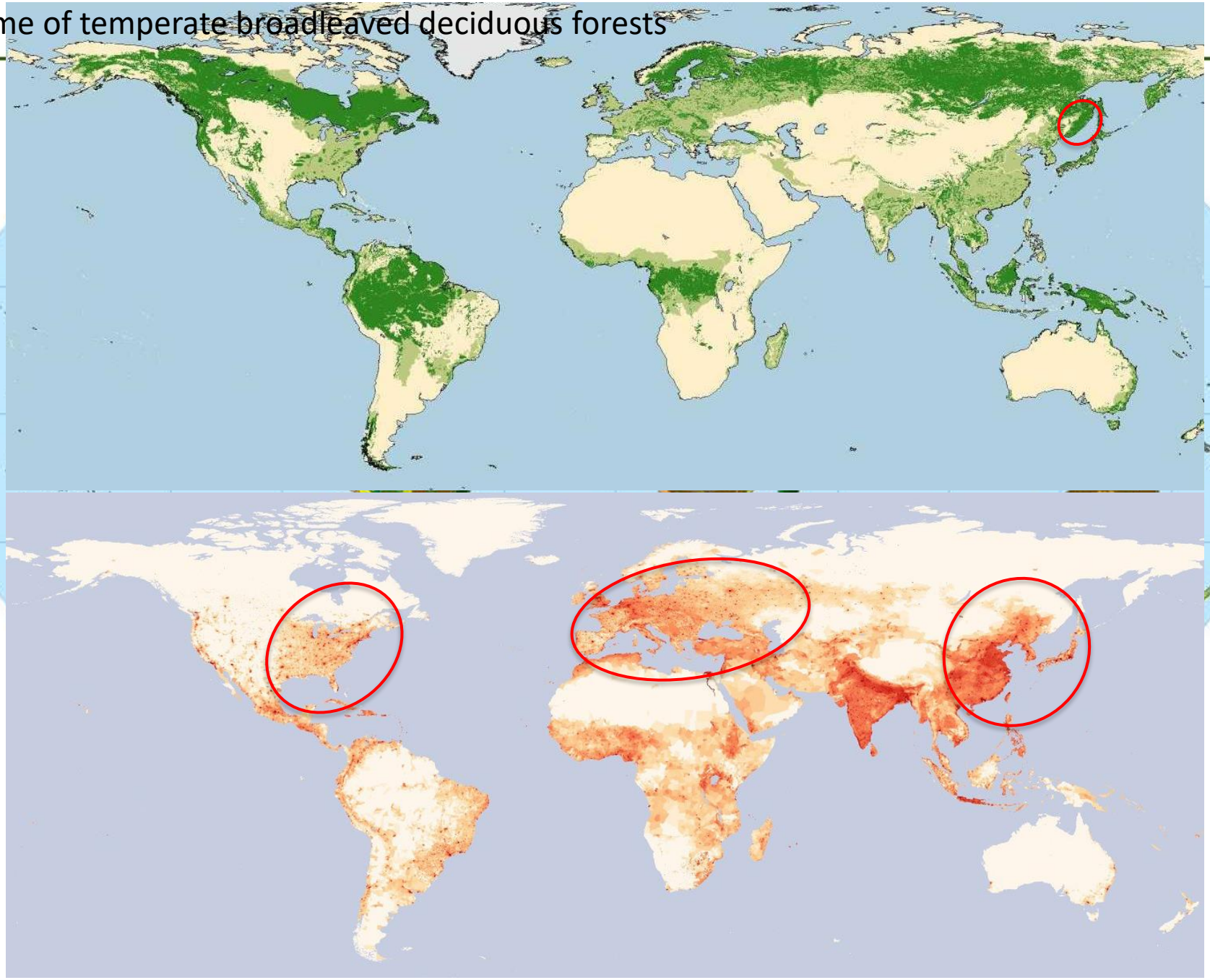
biome of temperate broadleaved deciduous forests



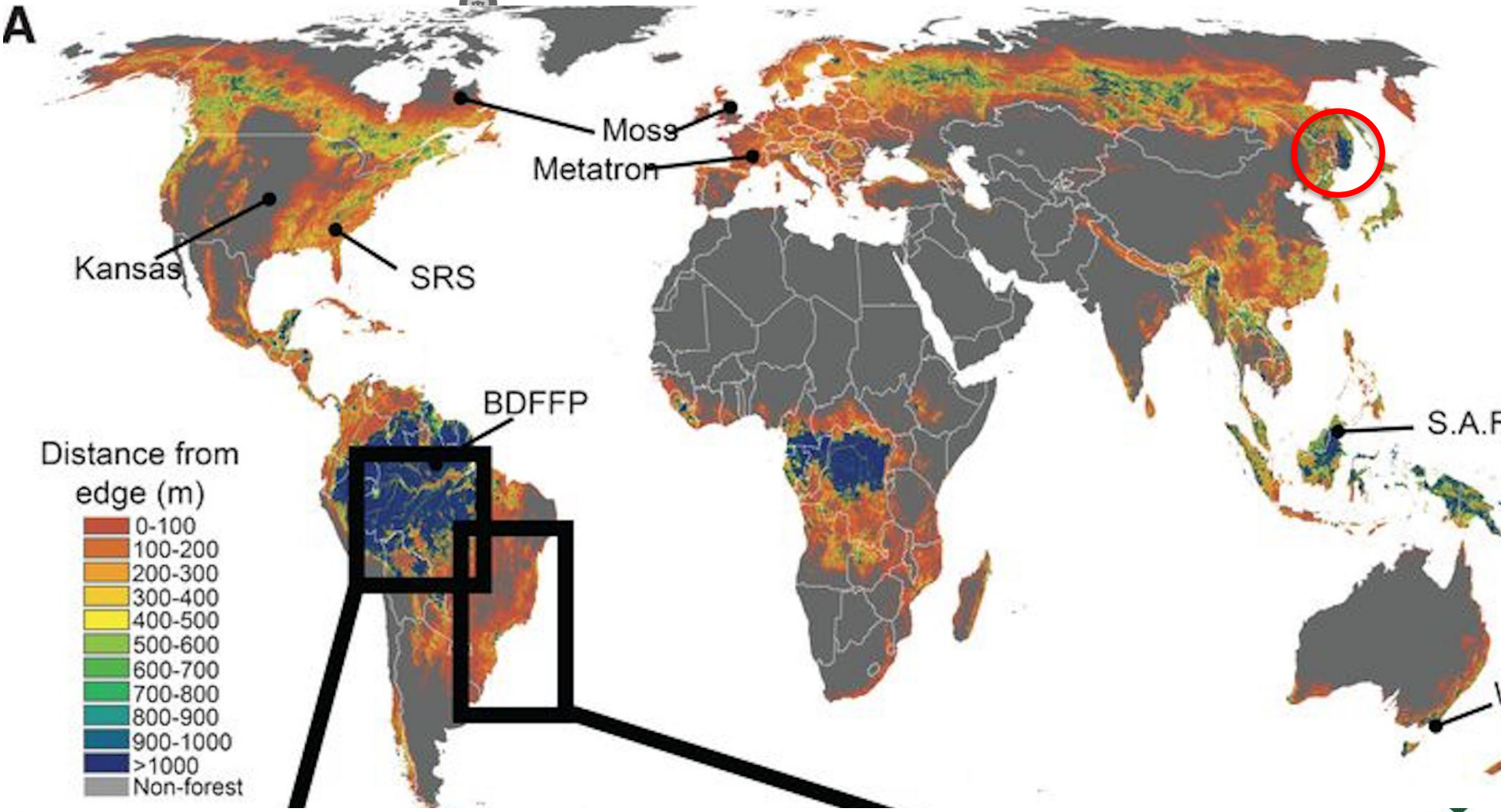
forest fragmentation

Science Advances

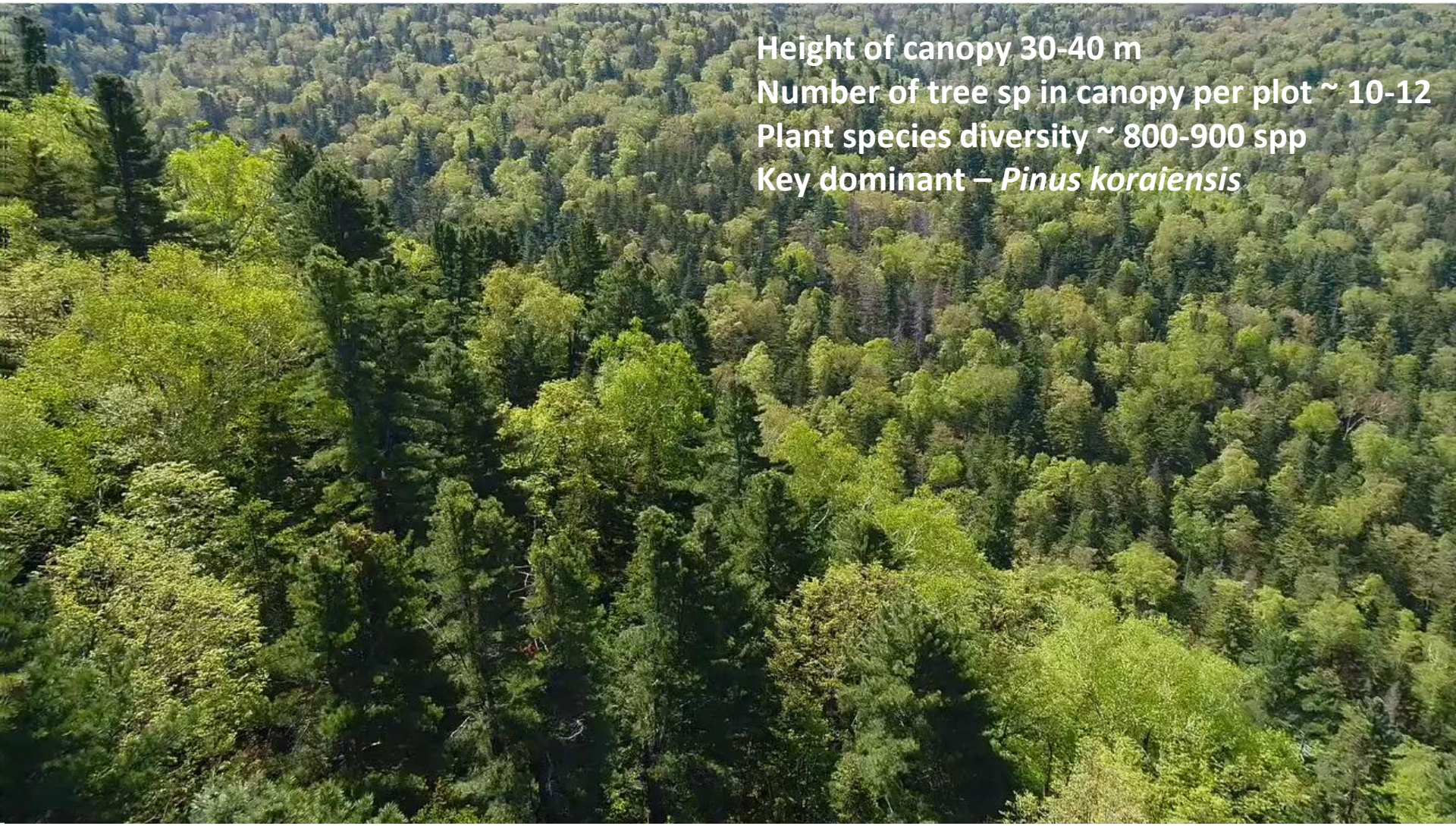
RESEARCH ARTICLE | APPLIED ECOLOGY

Habitat fragmentation and its lasting impact on Earth's ecosystems

Nick M. Haddad[1,*], Lars A. Brudvig[2], Jean Clobert[3], Kendi F. Davies[4], Andrew Gonzalez[5], Robert D. Holt[6], Thomas E. L…
+ See all authors and affiliations



mixed broadleaved-Korean pine forests



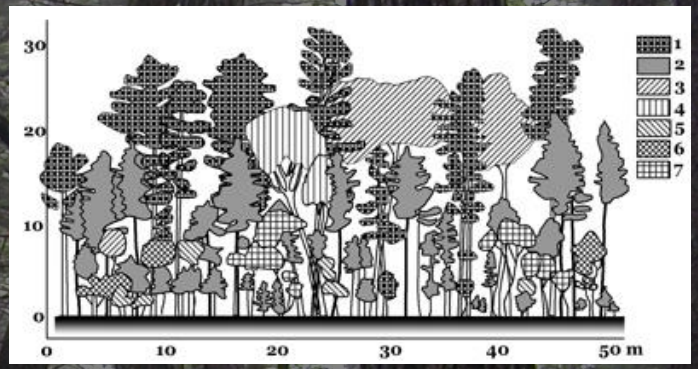
High productivity

Diversity

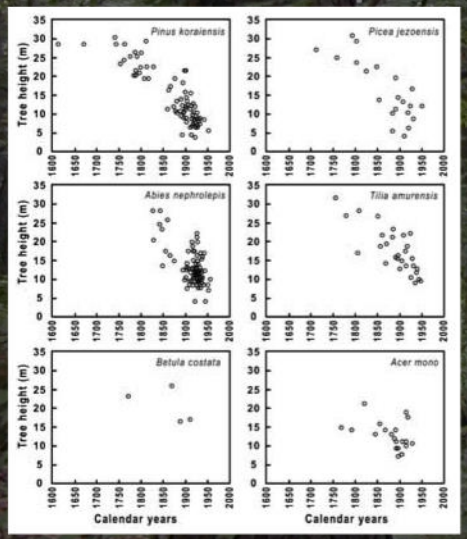
Potential dominants:

Pinus koraiensis
Abies holophylla
Quercus mongolica
Tilia amurensis
Tilia mandshurica
Fraxinus mandshurica
Fraxinus rhynchophylla
Kalopanax septemlobum
Phellodendron amurense
Abies holophylla
Betula costata

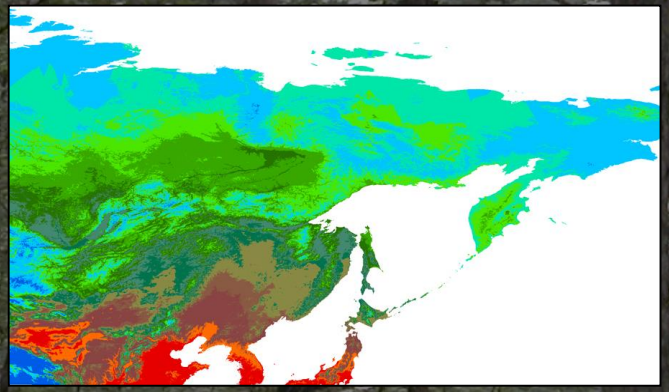
Ecosystem structure



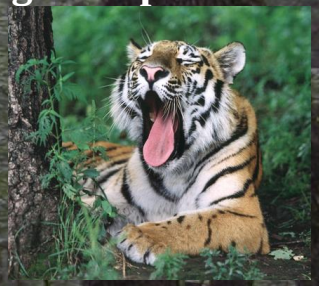
Stand dynamics



Global climatic contest



Remarkable endangered species



Aesthetic value

MANY MORE...

Pinus koraiensis Siebold et Zucc.

Nucifraga caryocatactes

Sitta europaea sibirica

Tamias sibiricus

Scirius vulgaris mantchuricus

Structure and morphology:
Five-needle pine.
Height: 25–30(45) m.
DBH: 60–80(150) cm.
Chromosome number: 2*n* = 24.
Life span: 400–500(600) years.

Reproduction: Monoecious.
Flowering: June
Ripening: October–November of the 2nd year.
Synzoochore by Nucifraga caryocatactes, small mammals and wild boar.
Seed is 25–30 mm long and 25–28 mm wide. Weight of 1000 seeds: 500–700 g.
Number per kilogram: about 2010.
Large crops are repeated at intervals of 3–4 years.

Habitat:
A wide spectrum of slope gradients, aspects and shapes from sea level to a elevation of 900 m in Sikhote-Alin.

Tolerances:
Low light: medium (saplings perform best under 70% shade).
Frost: medium.
Heat: high.
Water deficit: high. Water surplus: low

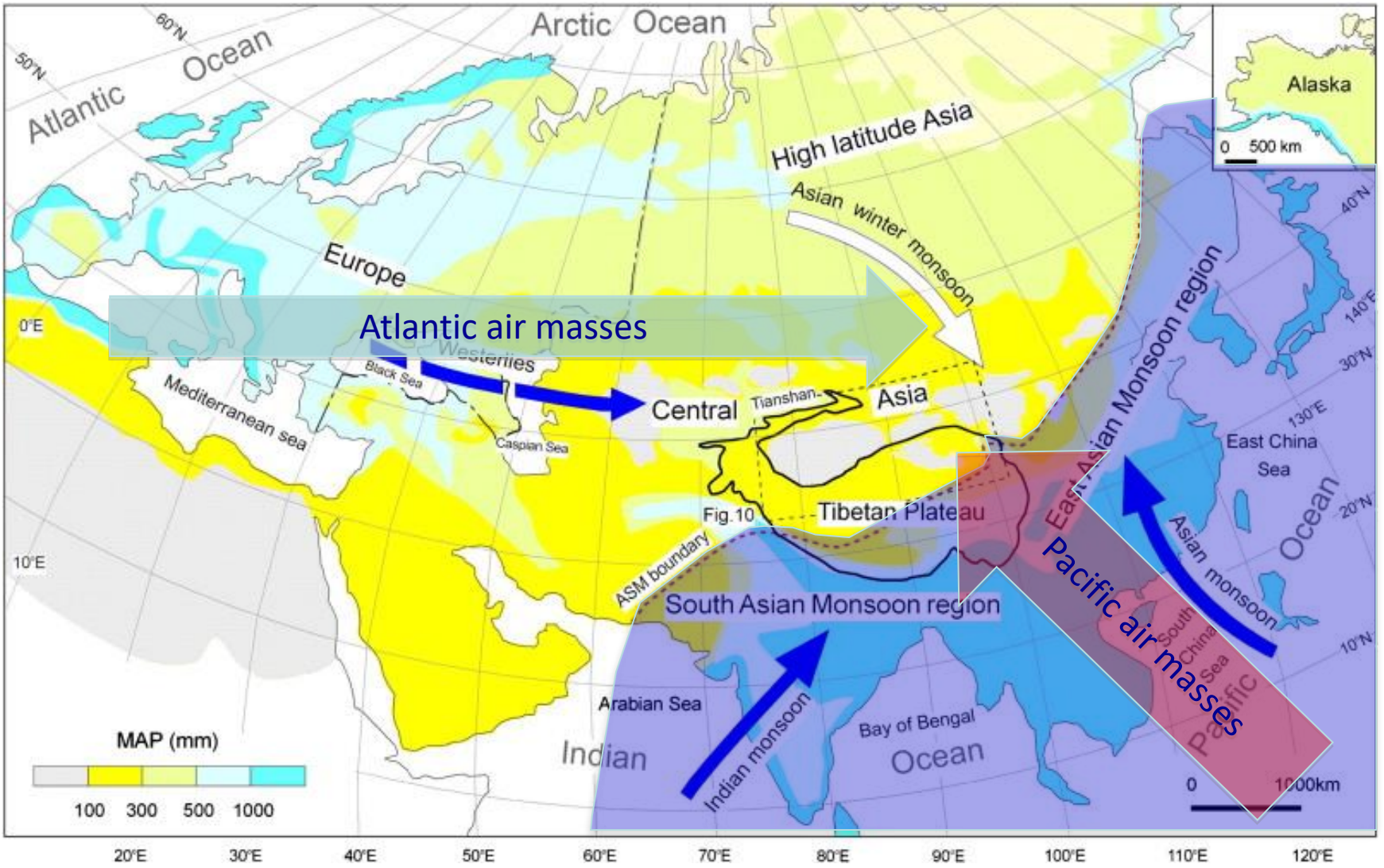
SEEDS

food chains

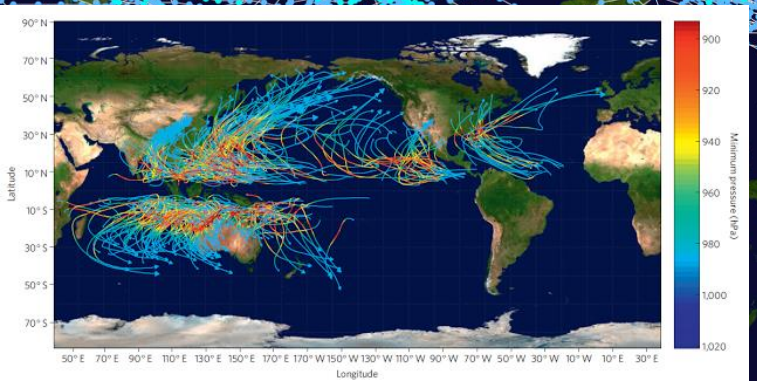
food chains

global climatic drivers

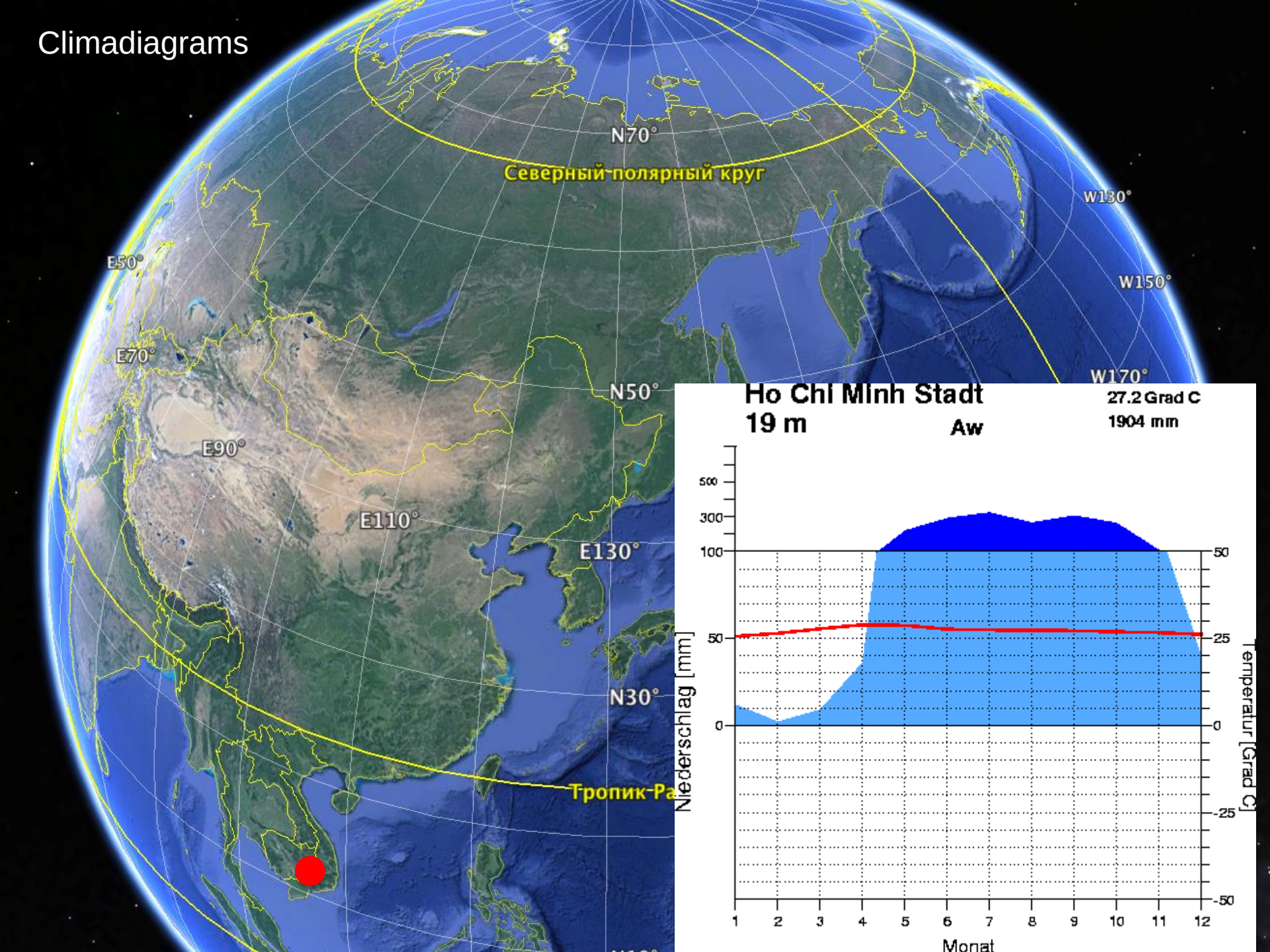
air flows and zone of monsoon activity



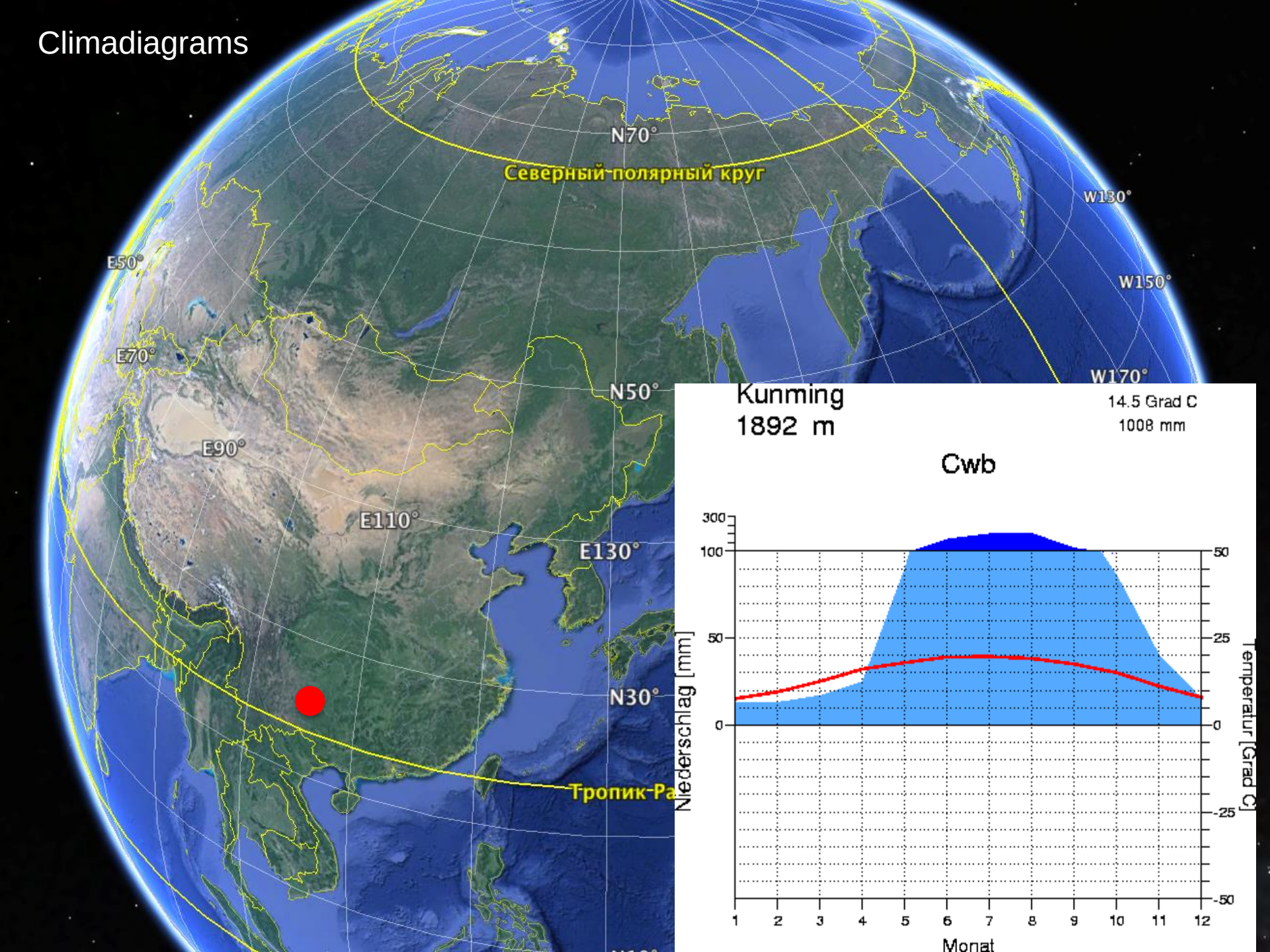
Typhoon traces in East Asia (Tokyo University of Information Sciences)



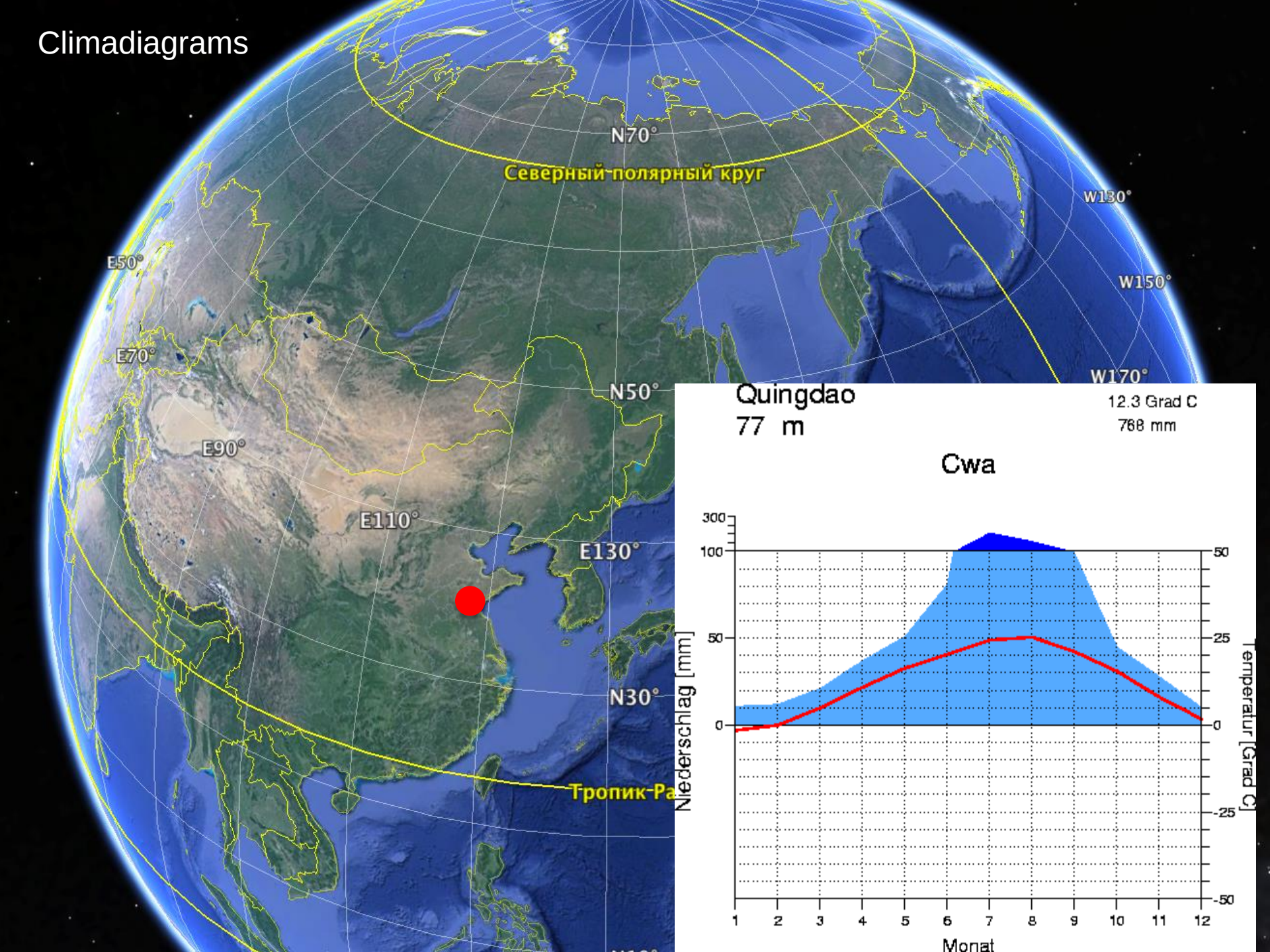
Climadiagrams



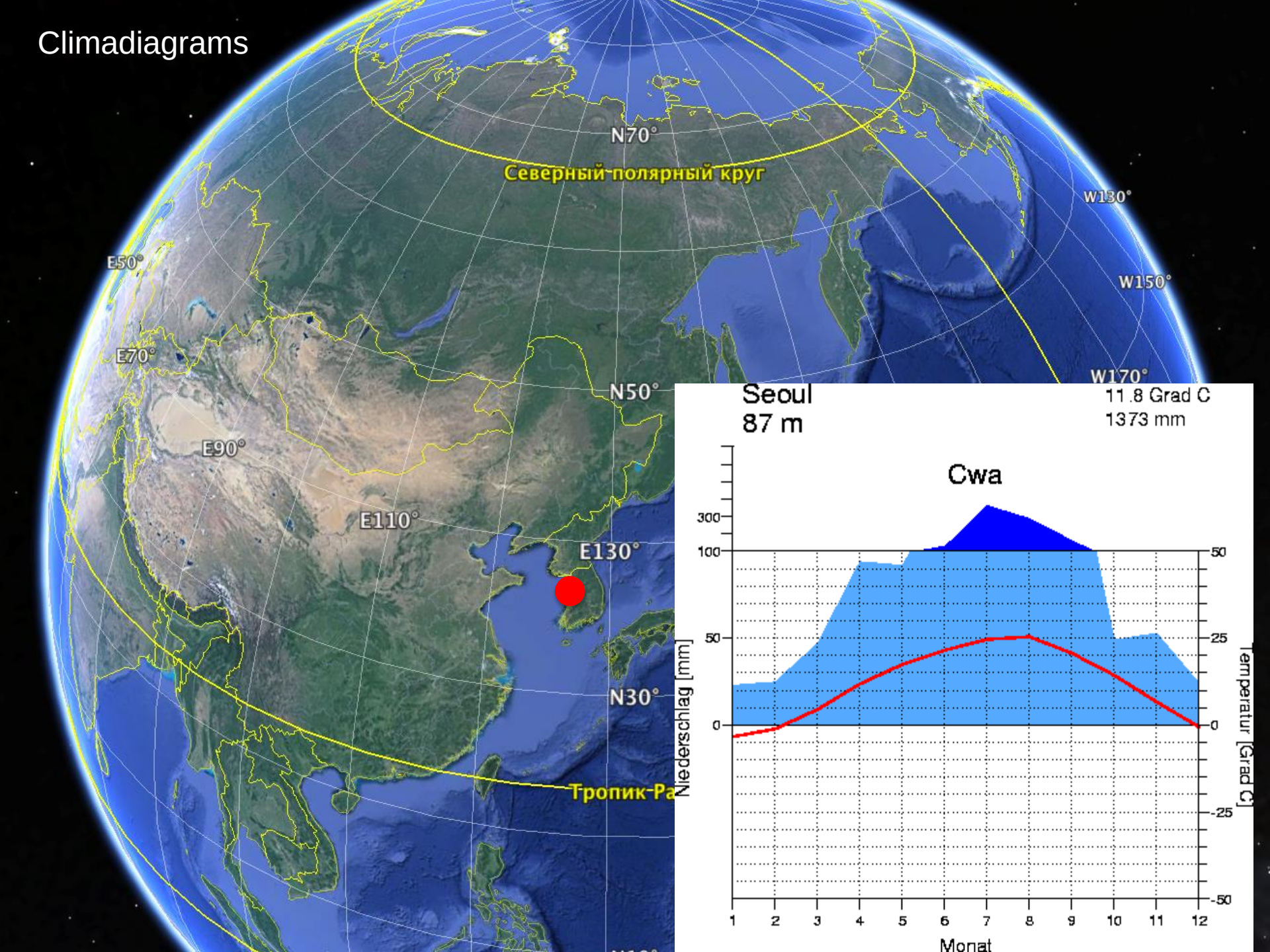
Climadiagrams



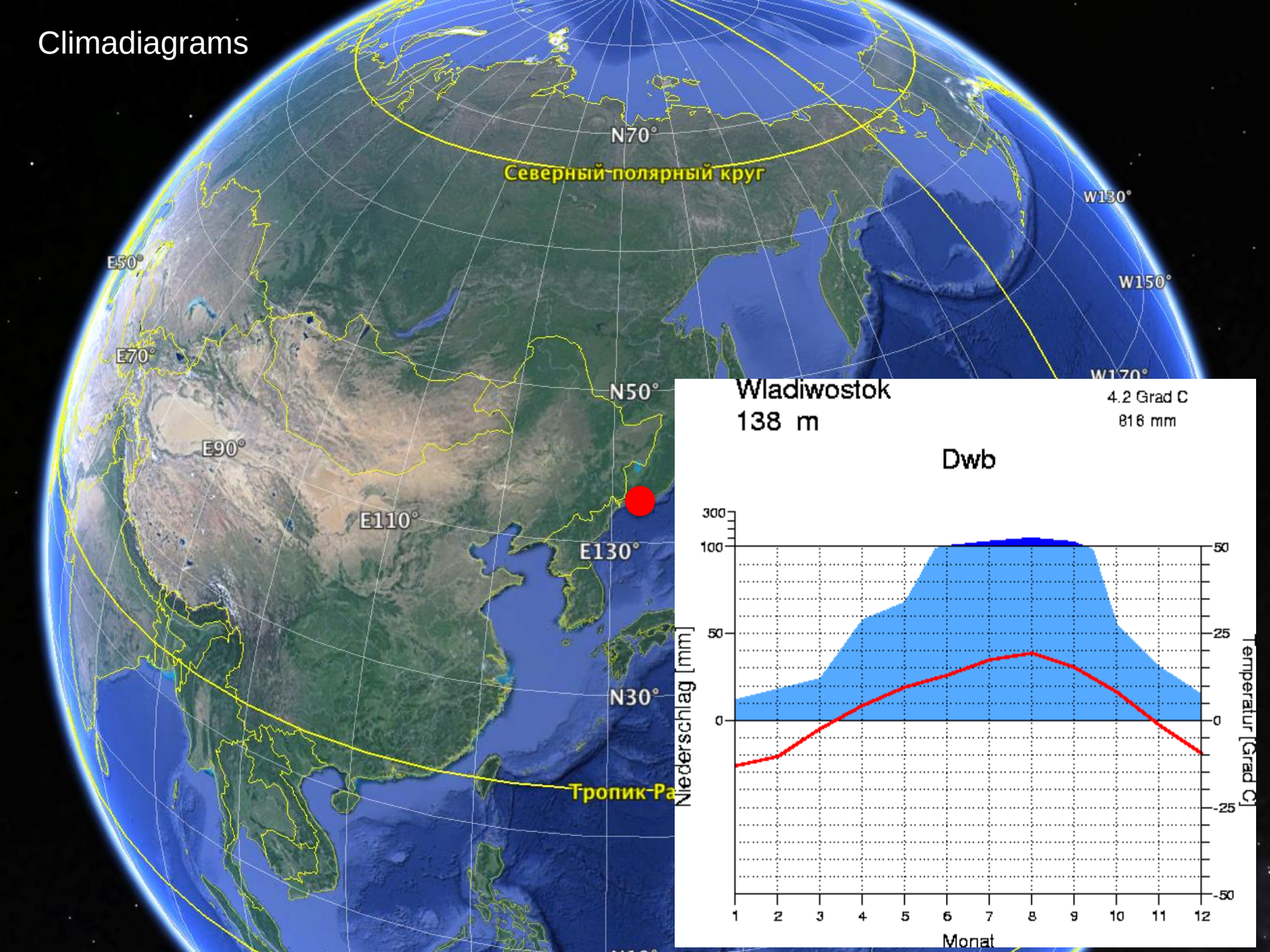
Climadiagrams



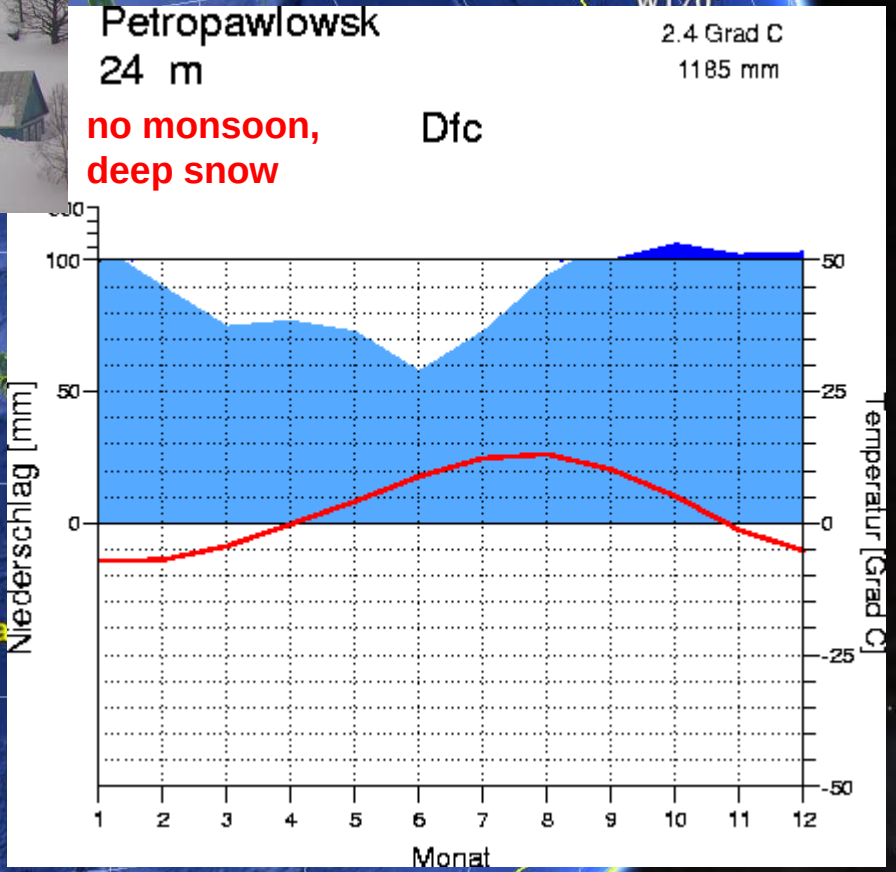
Climadiagrams



Climadiagrams



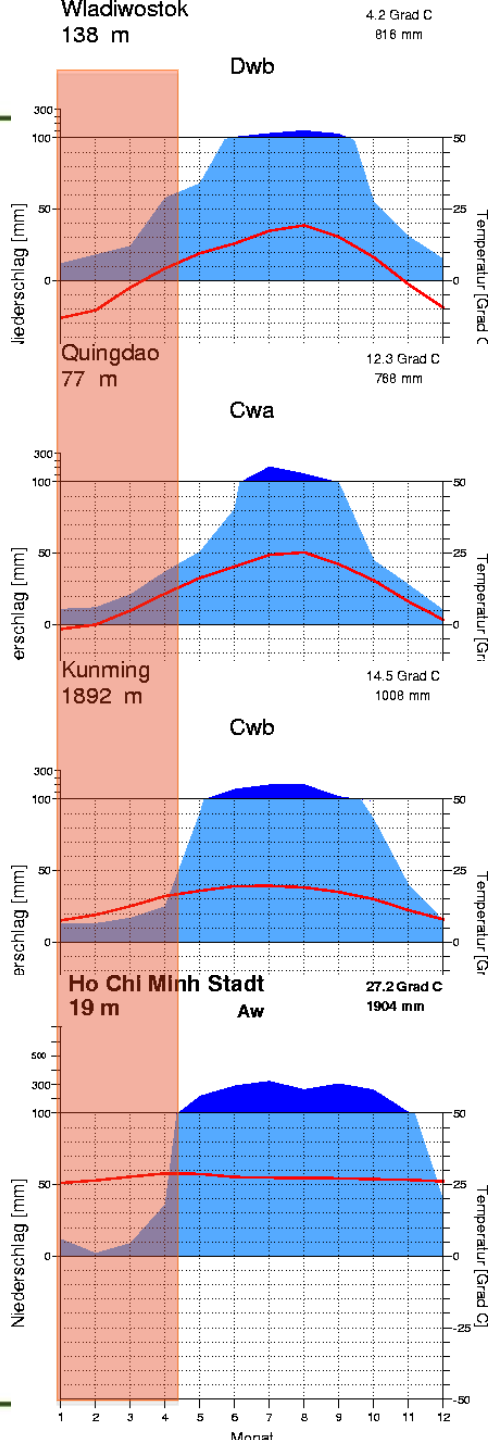
Climadiagrams



Distribution of precipitation during the year

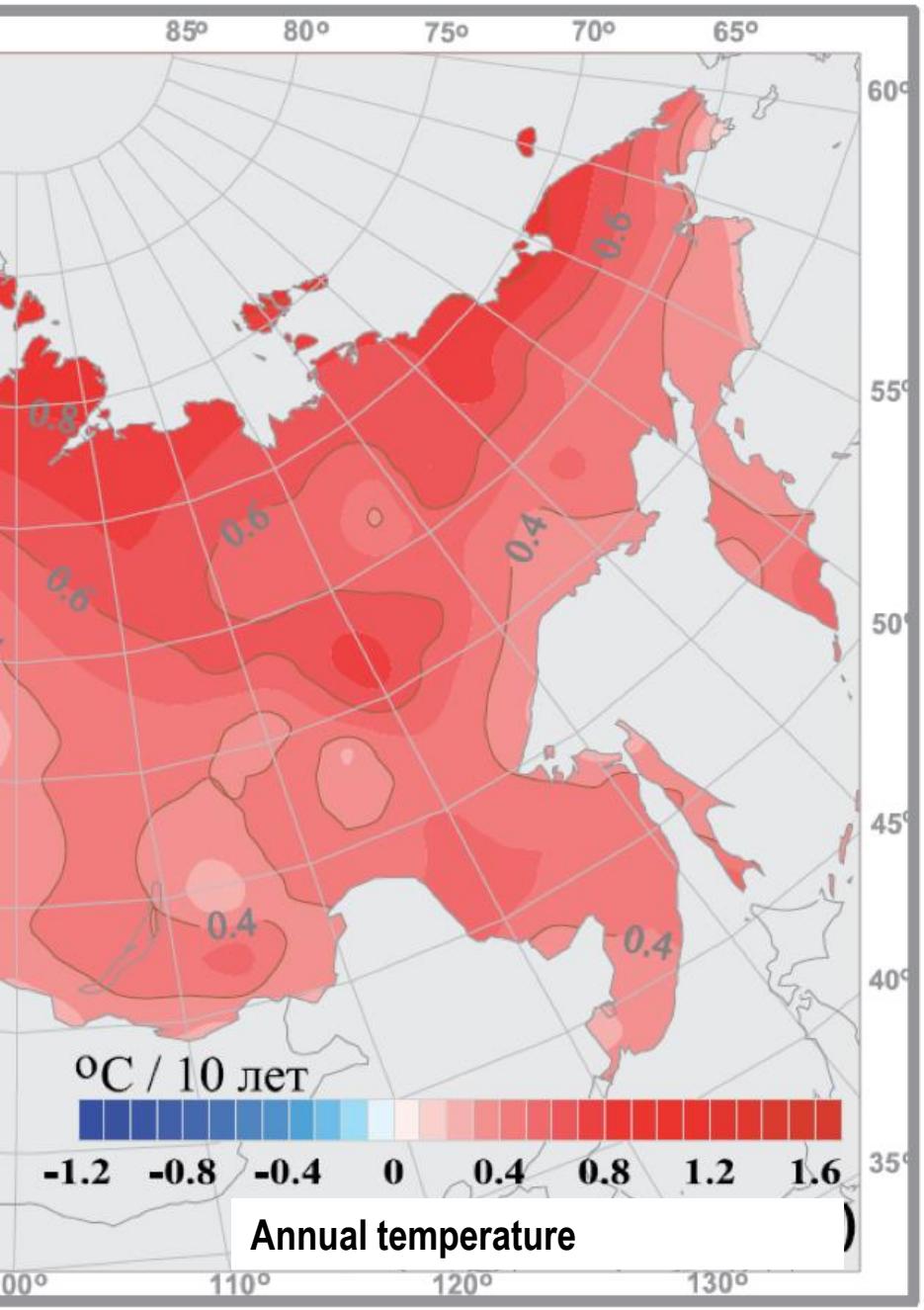
SMALL AMOUNT OF PRECIPITATION IN WINTER TIME

CAUSES PERIOD OF DROUGHTS IN SPRINGS

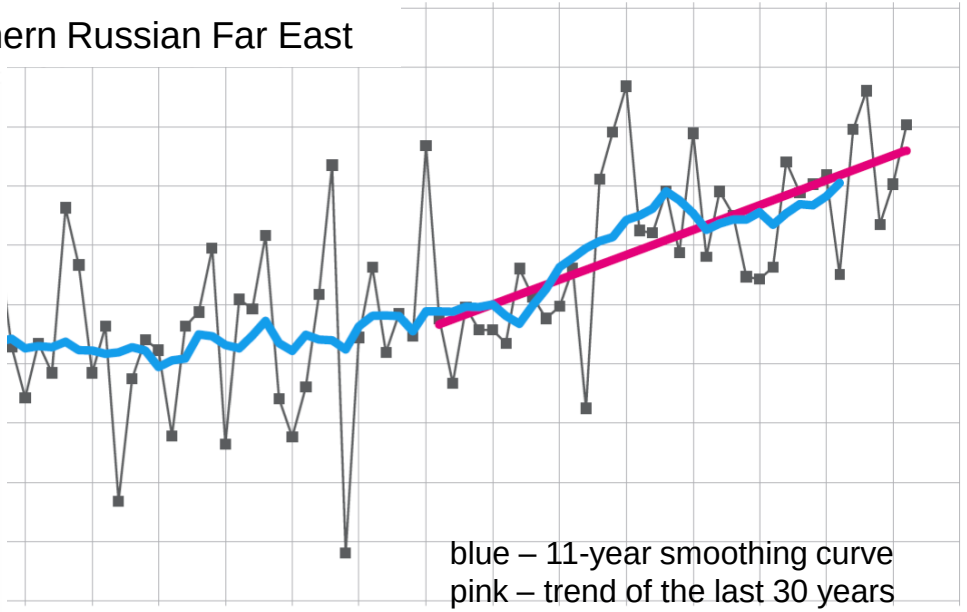


regional climatic trends

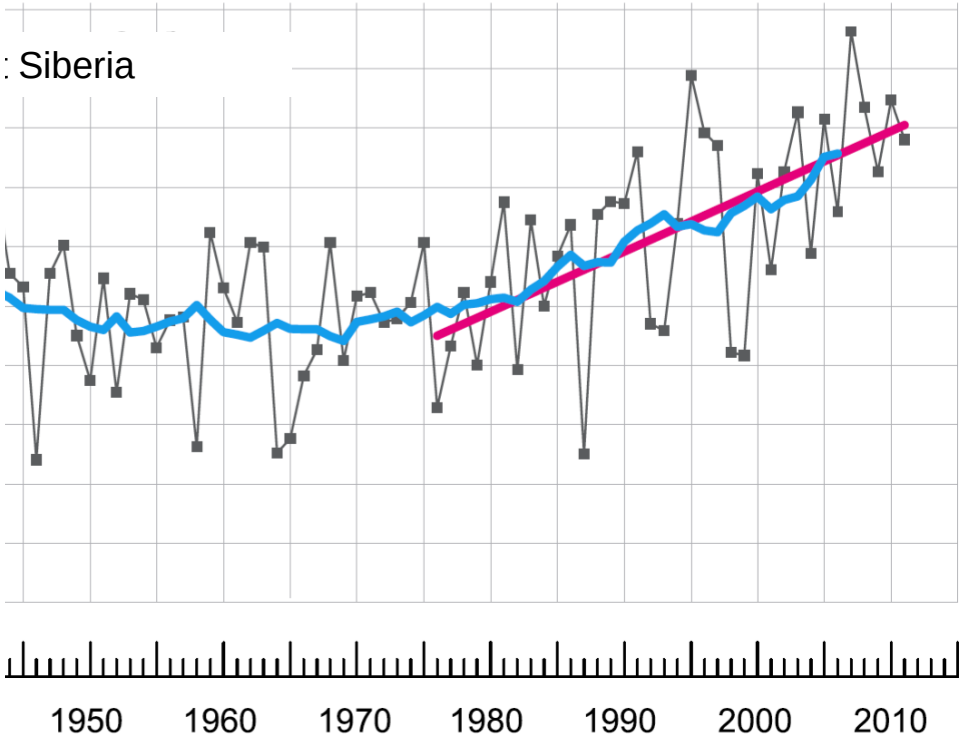
Climatic trends in the area



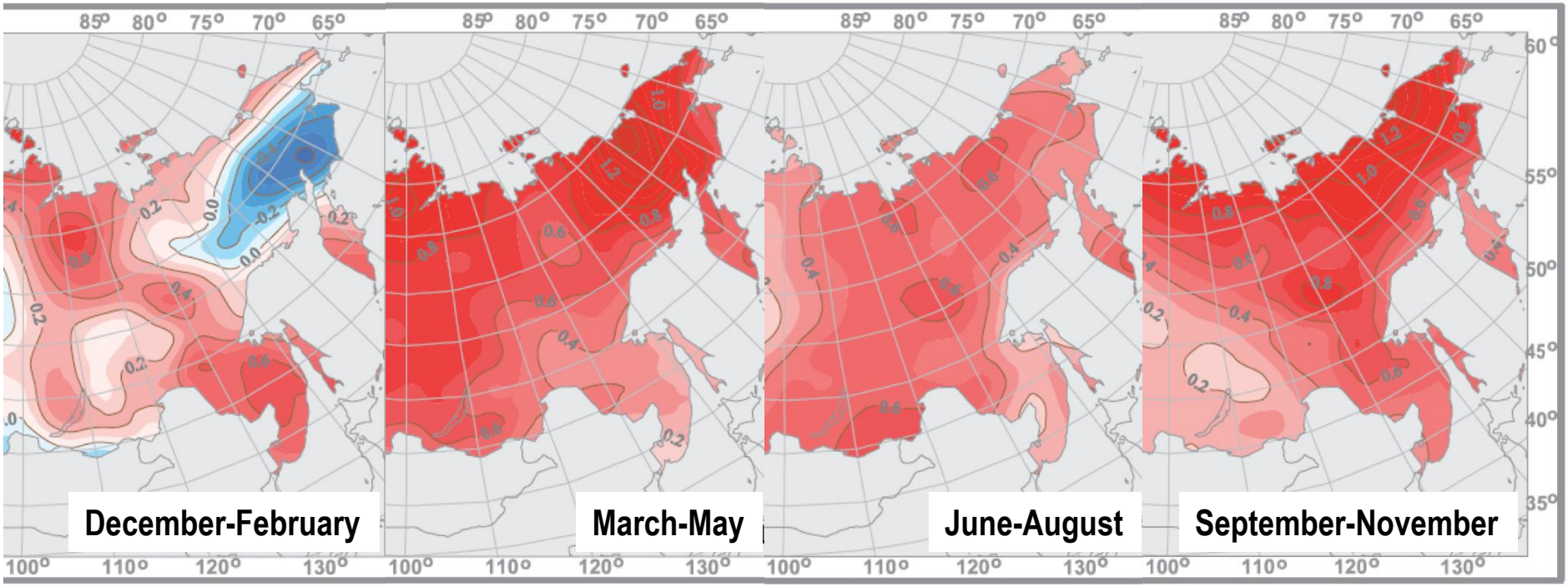
Southern Russian Far East



: Siberia

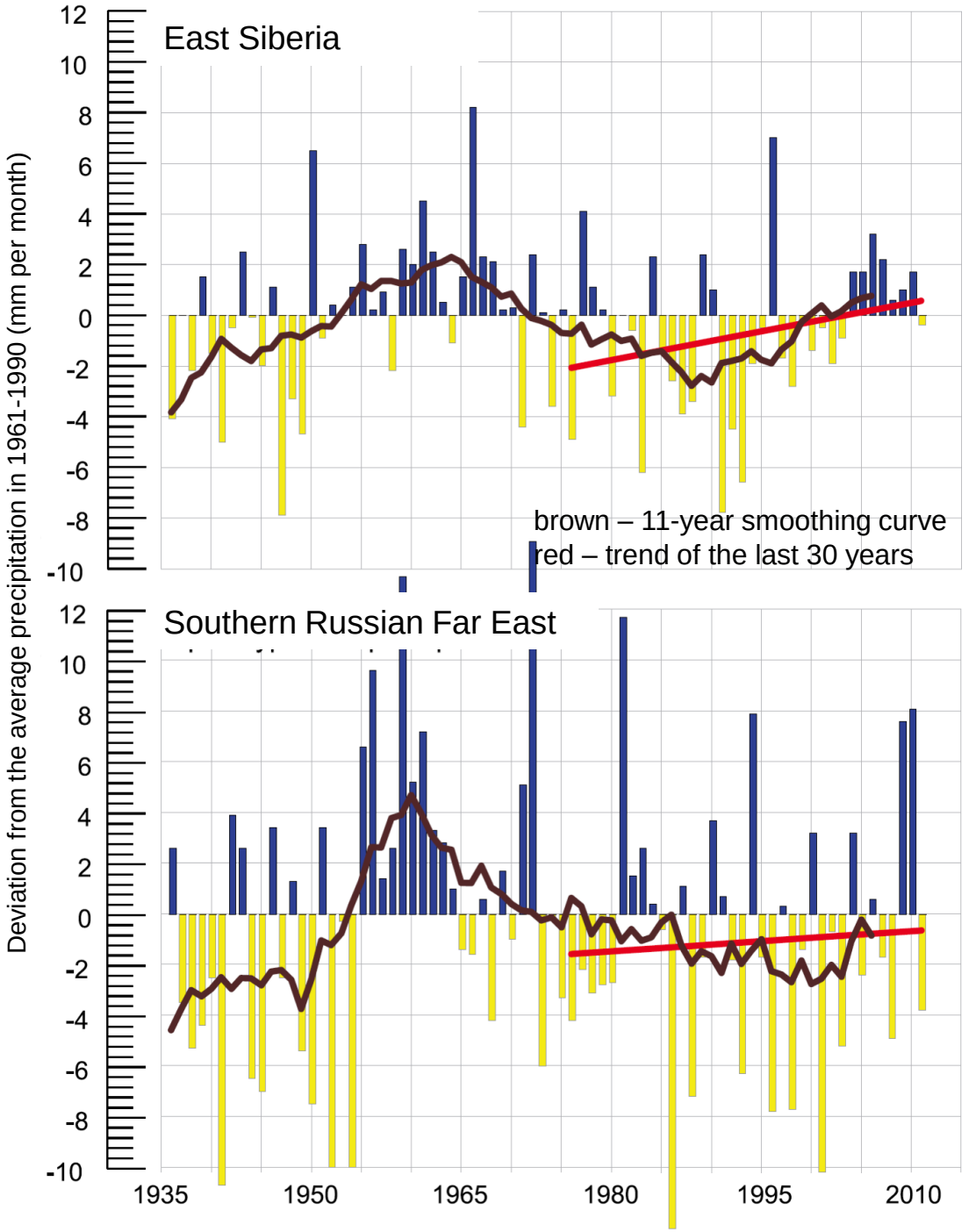


actual temperature against average temperature in 1961-1990



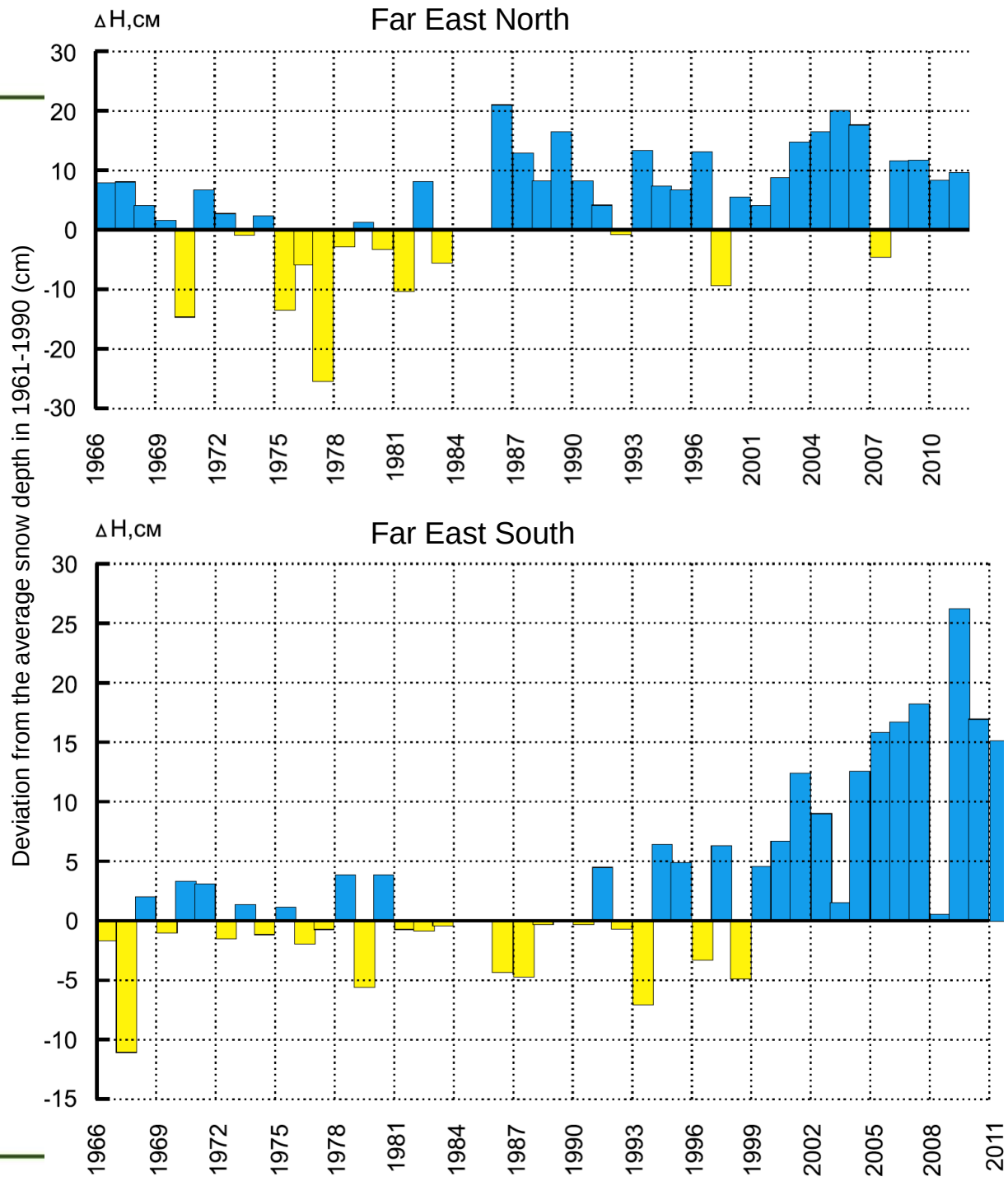
Annual precipitation trends

Drought is driving factor



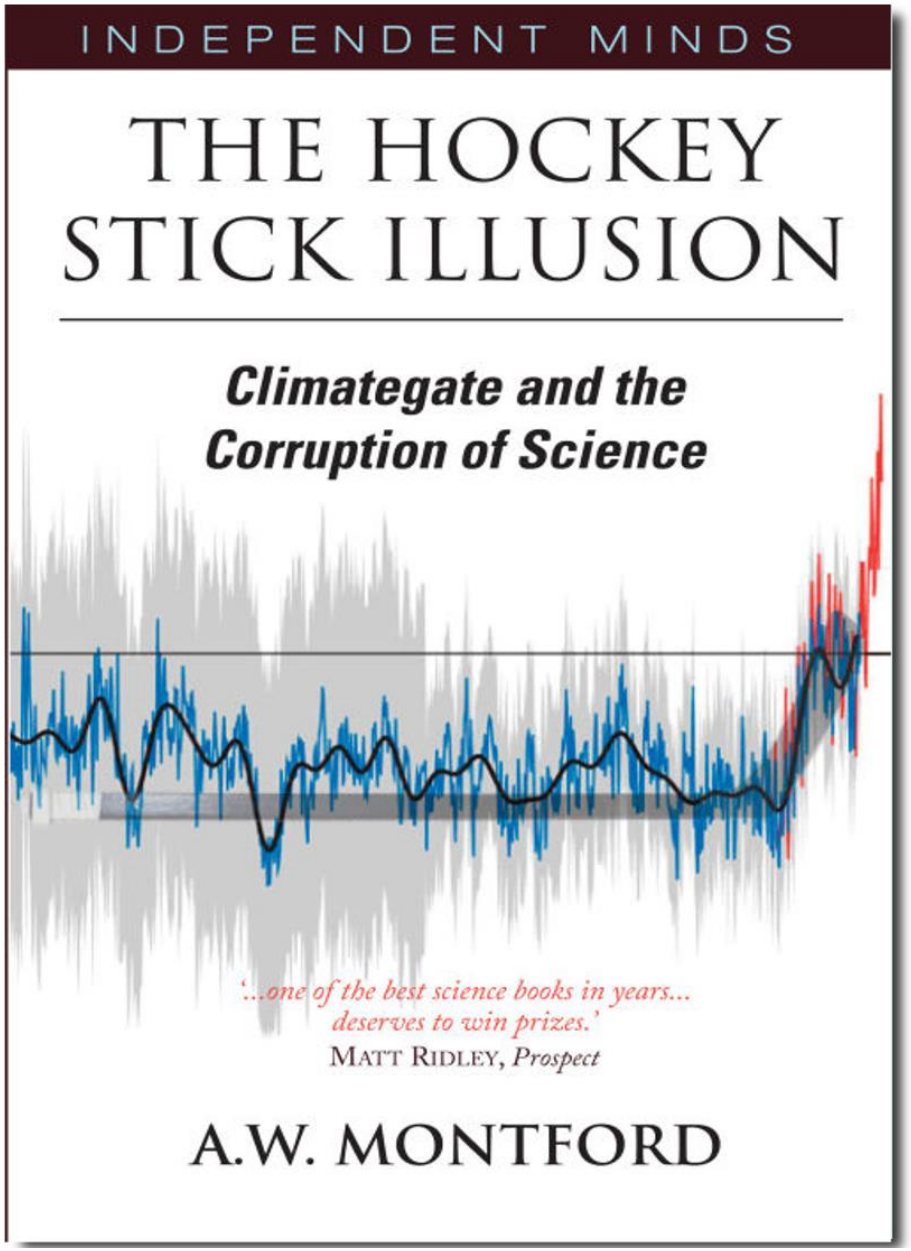
Snow depth trends

Spring droughts are less harmful



climate-plant relationships

problems in interpretations – “hockey stick”

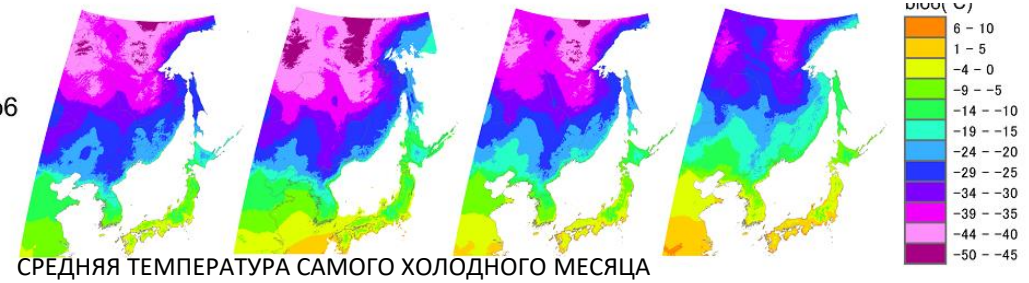


WORLDCLIM

Bioclimatic variable	Description
bio_1	Annual mean temperature
bio_2	Mean diurnal range (mean of monthly (max temp-min temp)
bio_3	Isothermality (100*mean diurnal range/annual temperature range) or (bio_2/bio_7*100)
bio_4	Temperature seasonality (standard deviation *100)
bio_5	Max temperature of warmest month
bio_6	Min temperature of coldest month
bio_7	Temperature annual range (bio_5 - bio_6)
bio_8	Mean temperature of wettest quarter
bio_9	Mean temperature of driest quarter
bio_10	Mean temperature of warmest quarter
bio_11	Mean temperature of coldest quarter
bio_12	Annual precipitation
bio_13	Precipitation of wettest month
bio_14	Precipitation of driest month
bio_15	Precipitation seasonality (coefficient of variation)
bio_16	Precipitation of wettest quarter
bio_17	Precipitation of driest quarter
bio_18	Precipitation of warmest quarter
bio_19	Precipitation of coldest quarter

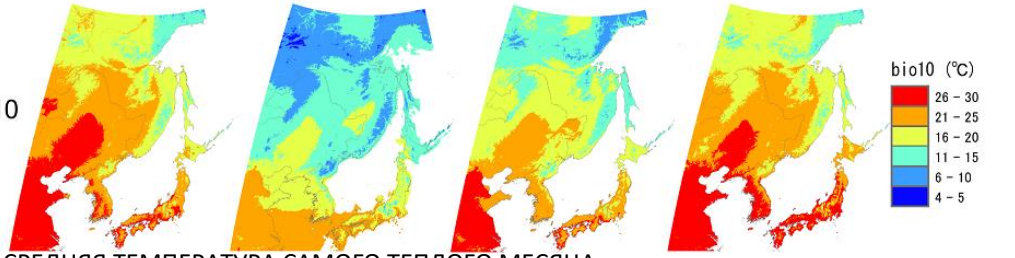
140,000BP **21,000 BP** **Current** **2081-2100**

bio6



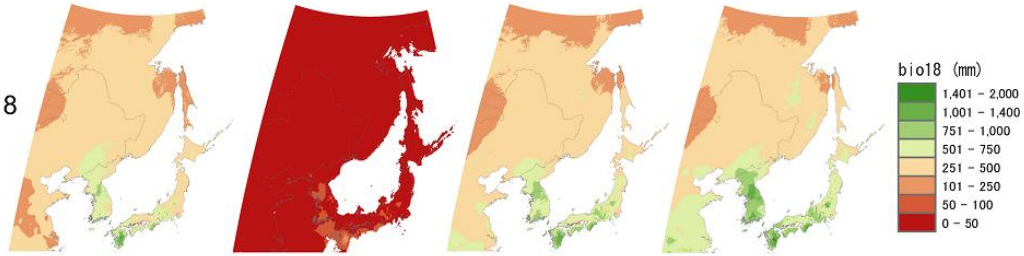
СРЕДНЯЯ ТЕМПЕРАТУРА САМОГО ХОЛОДНОГО МЕСЯЦА

bio10



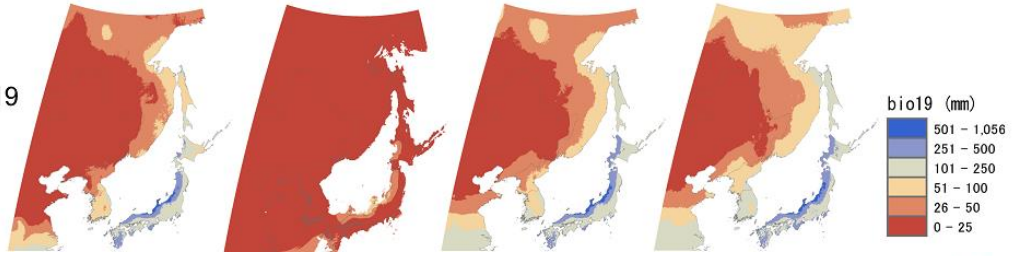
СРЕДНЯЯ ТЕМПЕРАТУРА САМОГО ТЕПЛОГО МЕСЯЦА

bio18



ОСАДКИ ТЕПЛОЙ ЧЕТВЕРТИ ГОДА

bio19



ОСАДКИ ХОЛОДНОЙ ЧЕТВЕРТИ ГОДА

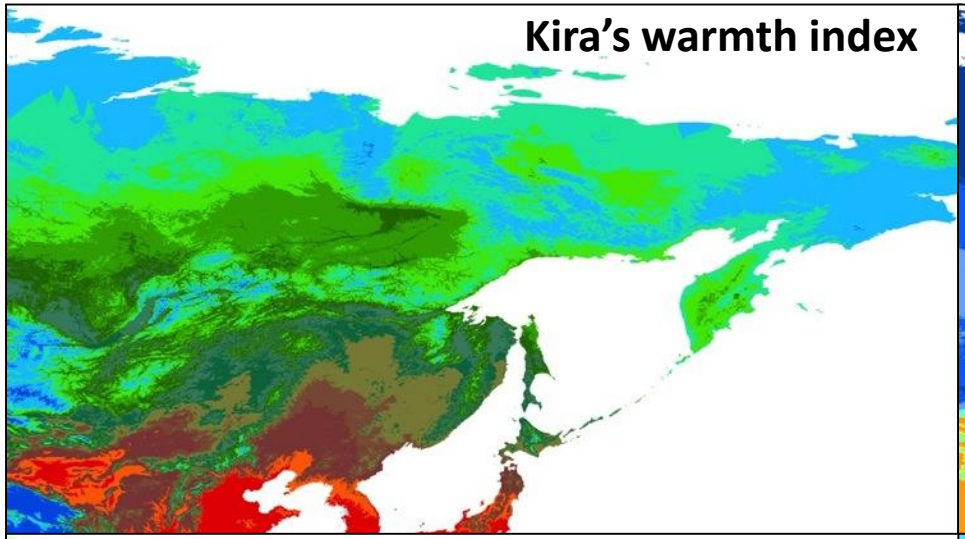
resolution ~ 1 km

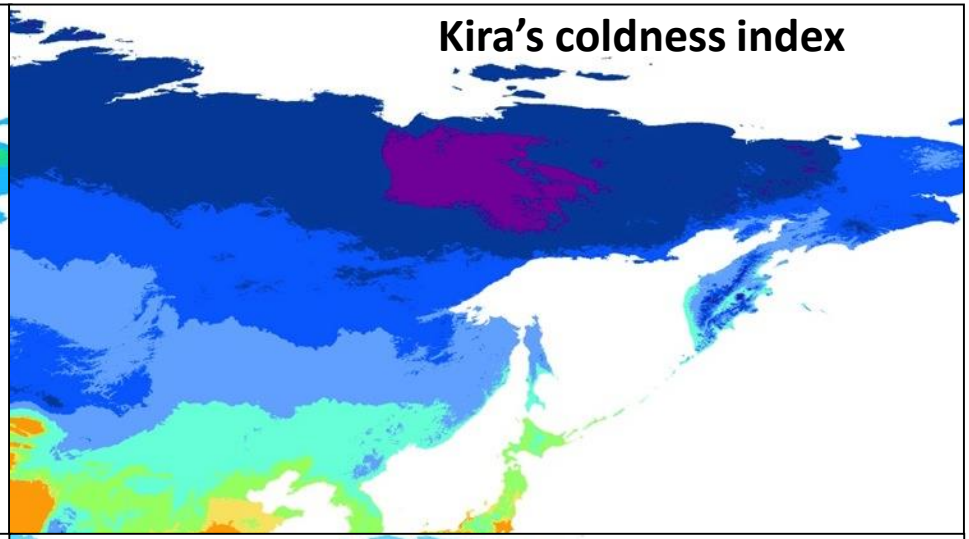
P: Mean annual precipitation
Ps: Summer Precipitation (3 summer months)
Tp: Sum of the monthly average temperature of months with positive mean temperatures
IC: Continentality Index (yearly thermic interval). Ic = Tmax – Tmin
Ioe: Ombro-Evapotranspiration Index. The quotient resulting value between the yearly positive precipitation in mm and the value of Thornthwaite yearly evapotranspiration

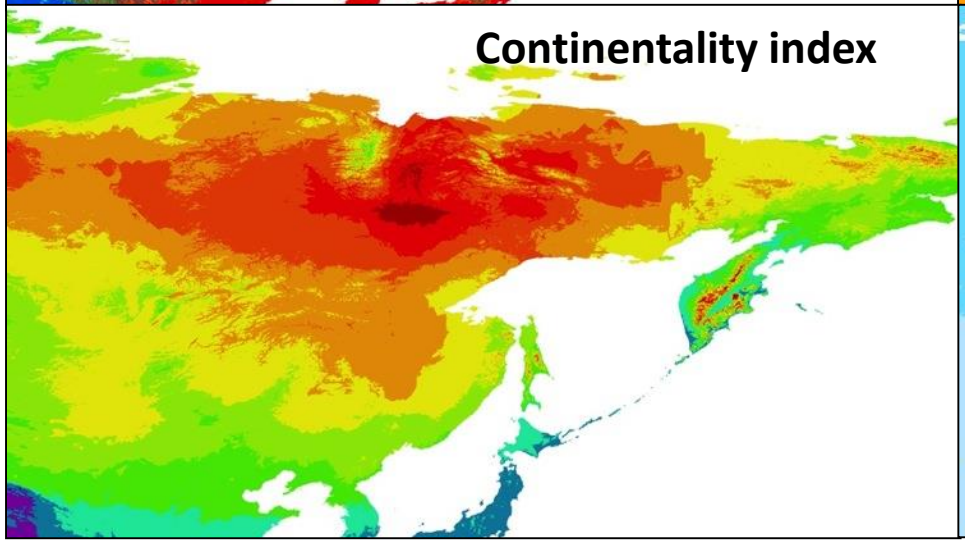
Wk: Kira's warmth index (sum of monthly average temperatures over 5ºC)
Ck: Kira's coldness index (sum of monthly average temperatures below 5ºC)
Pn: Sum of precipitation in months with negative monthly temperatures

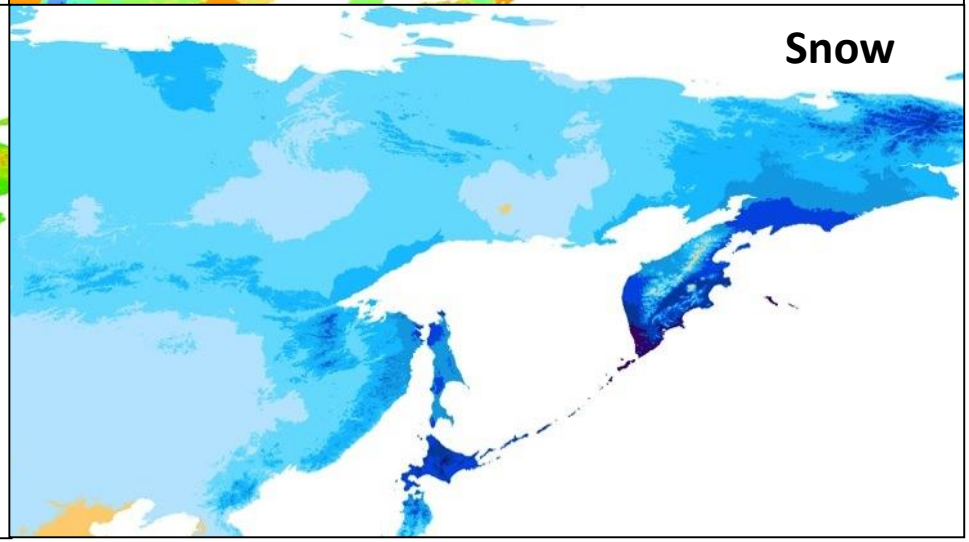
Krestov et al. 2011, 2015

bioclimatic models



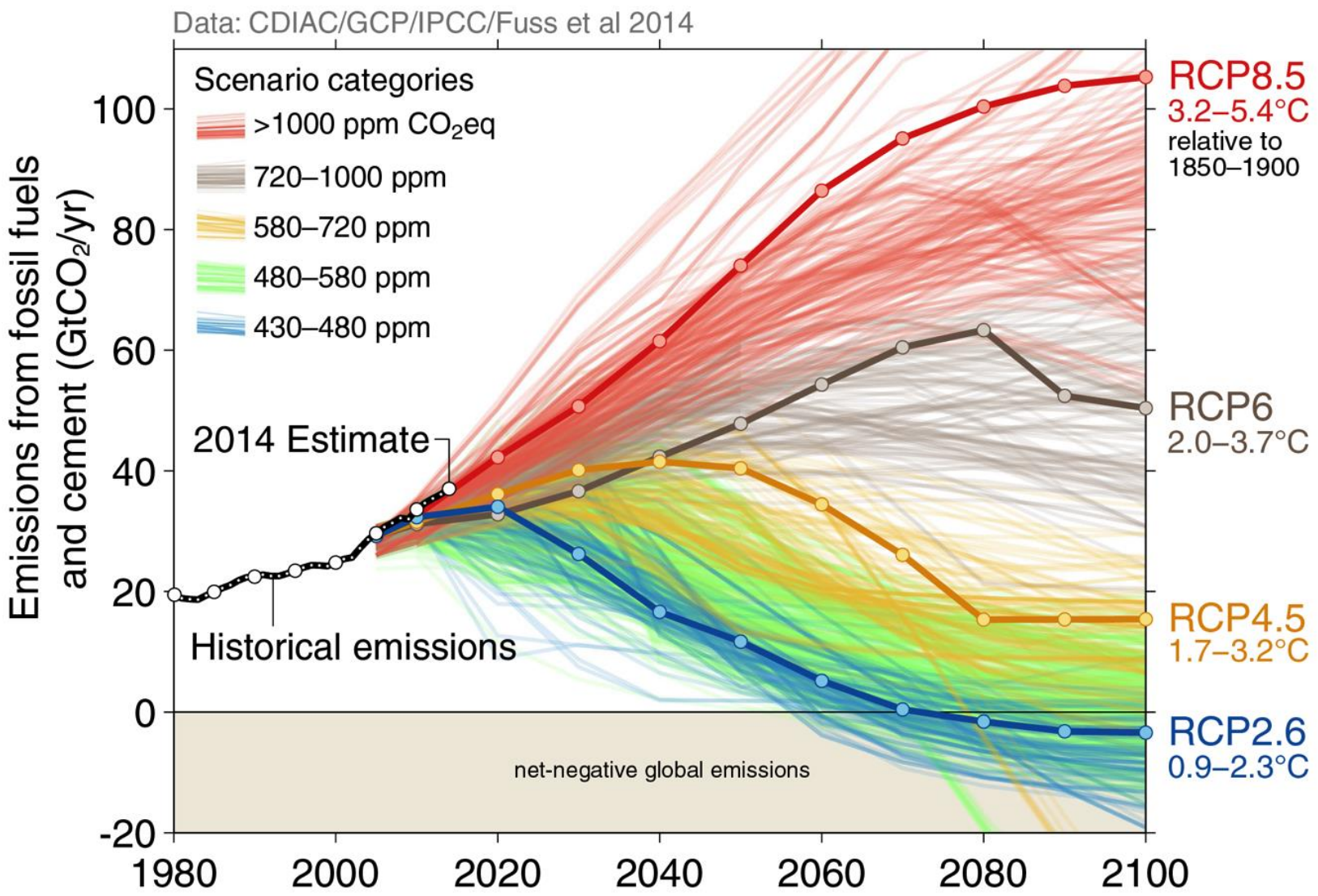






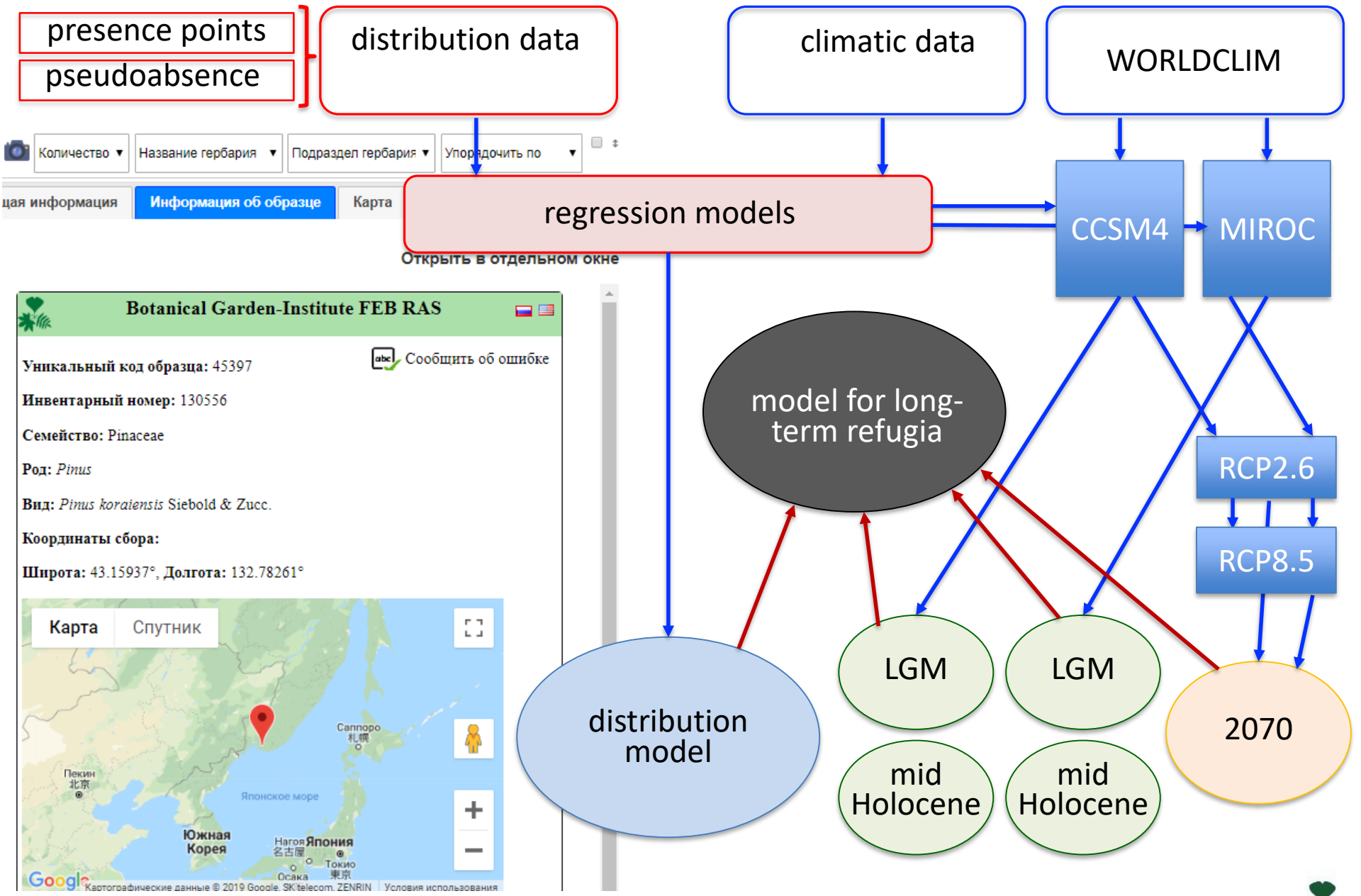
Krestov & Nakamura 2007, Nakamura et al. 2008, Krestov et al. 2011, 2015

resolution ~ 90 m



Source: global carbon project

analysis chart

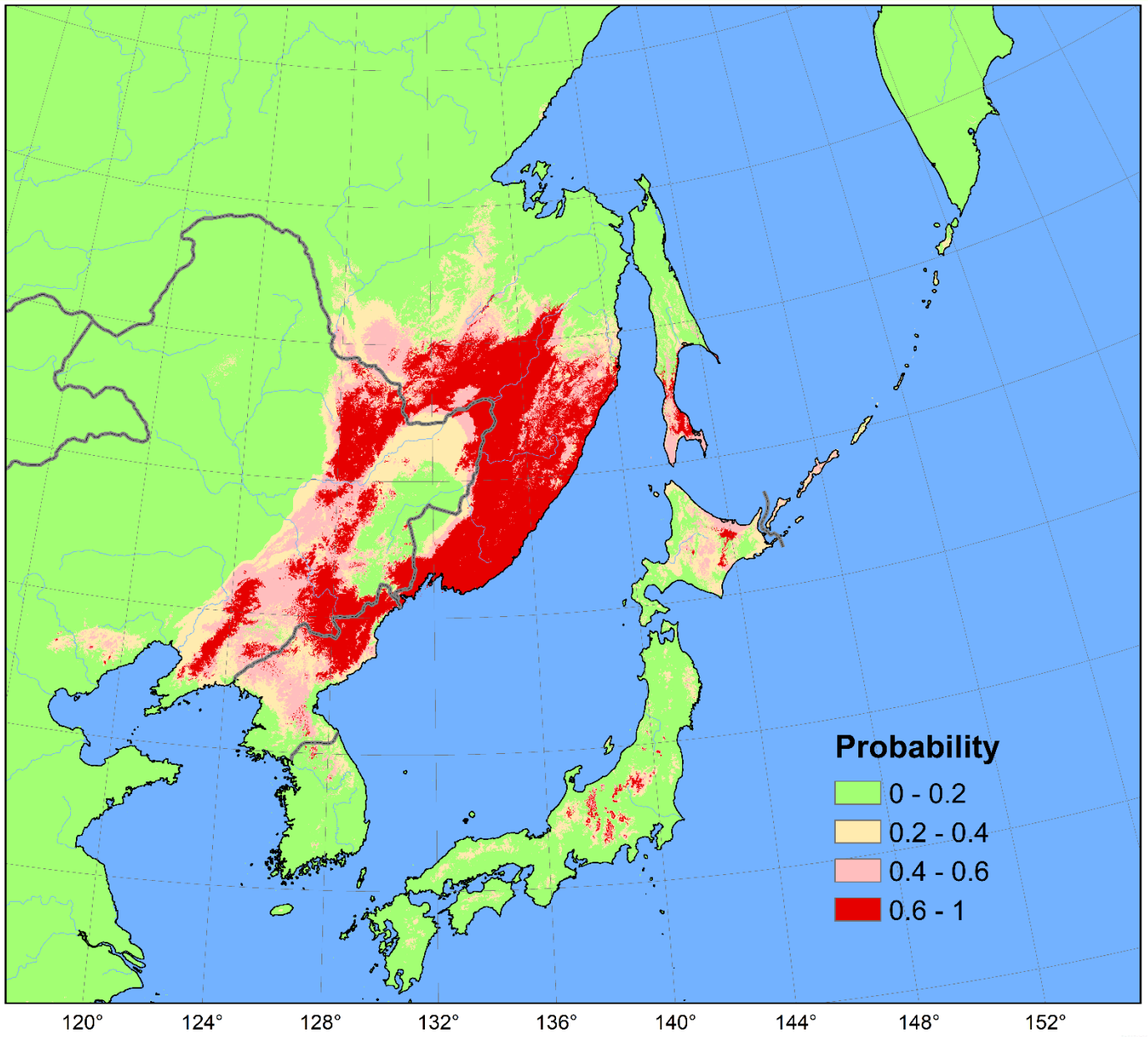


Pinus koraiensis …

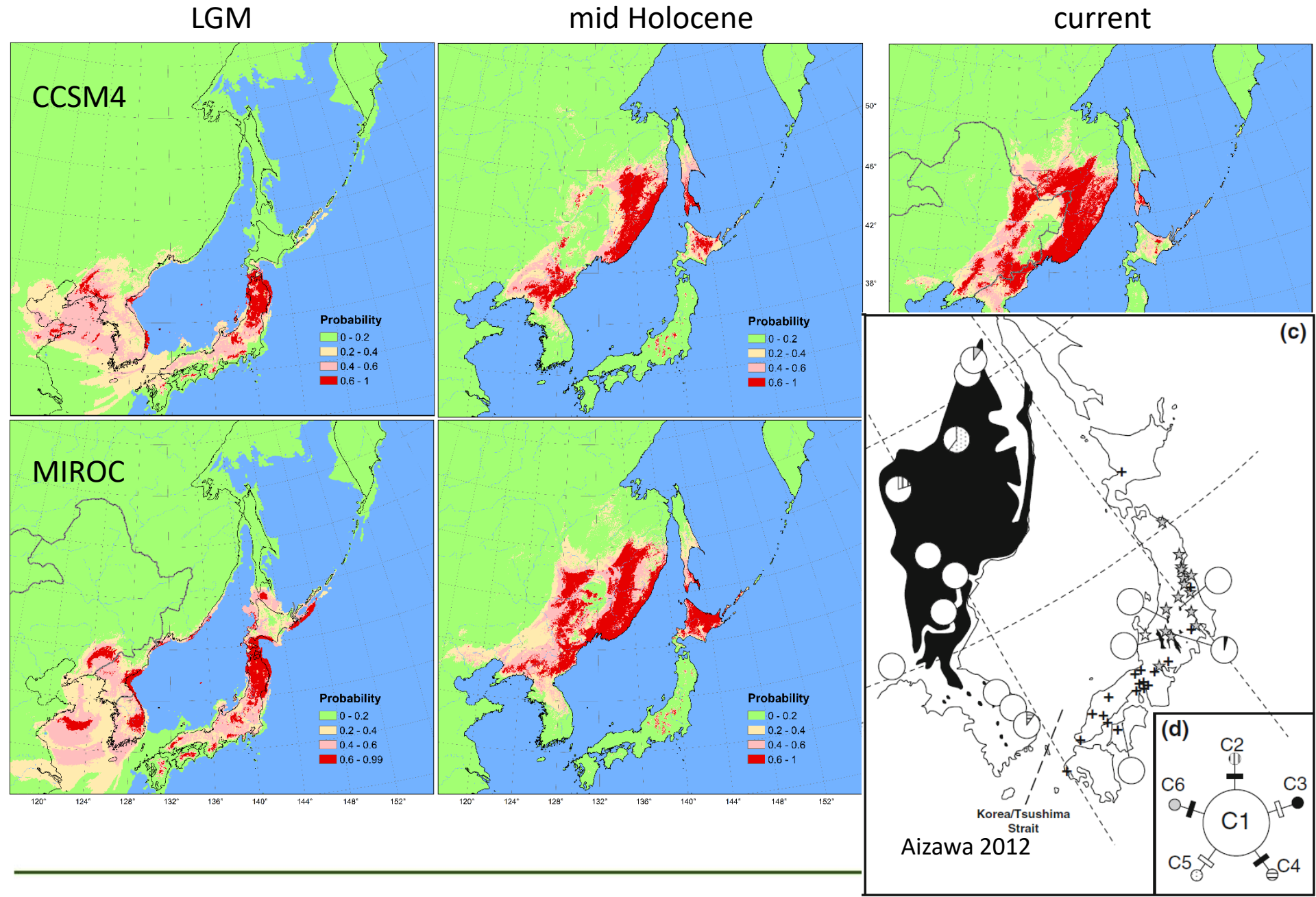
modeling value stock species

Korean pine

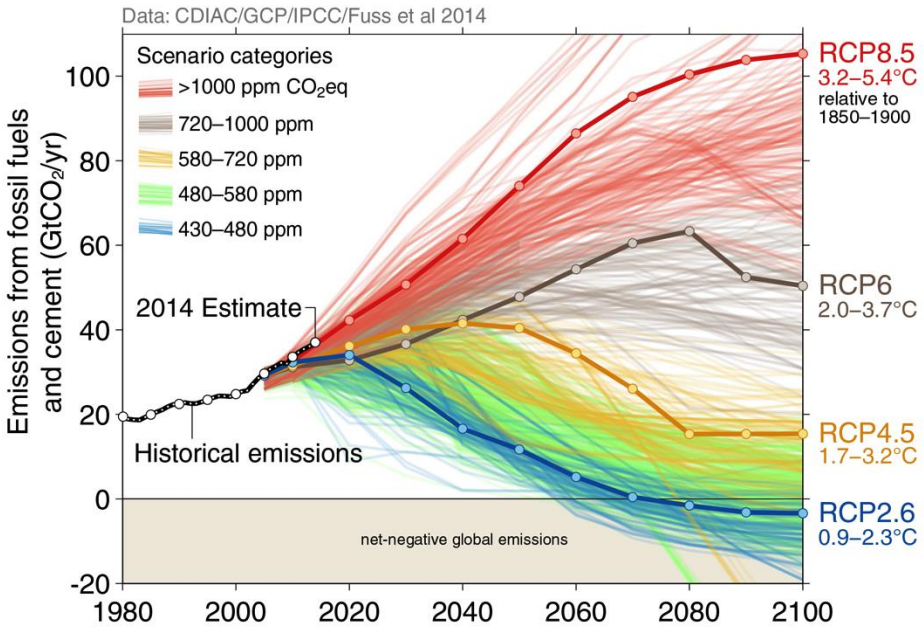
model for modern distribution of *Pinus koraiensis*

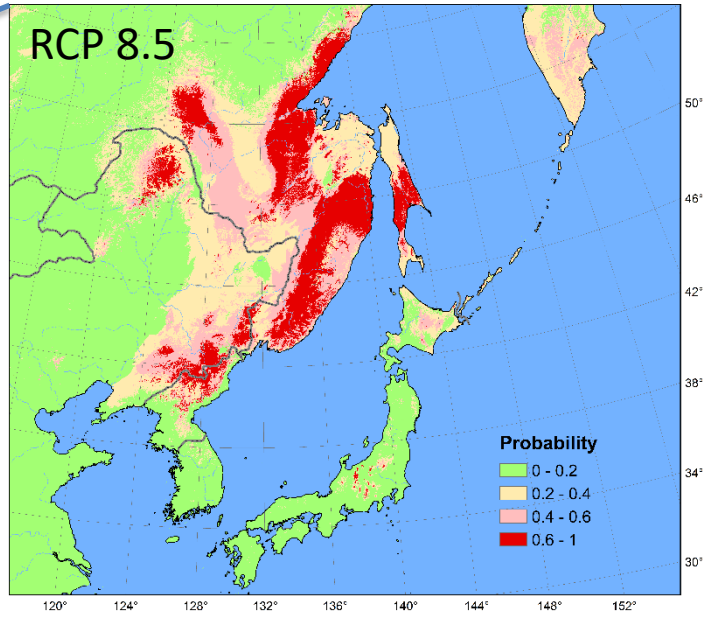


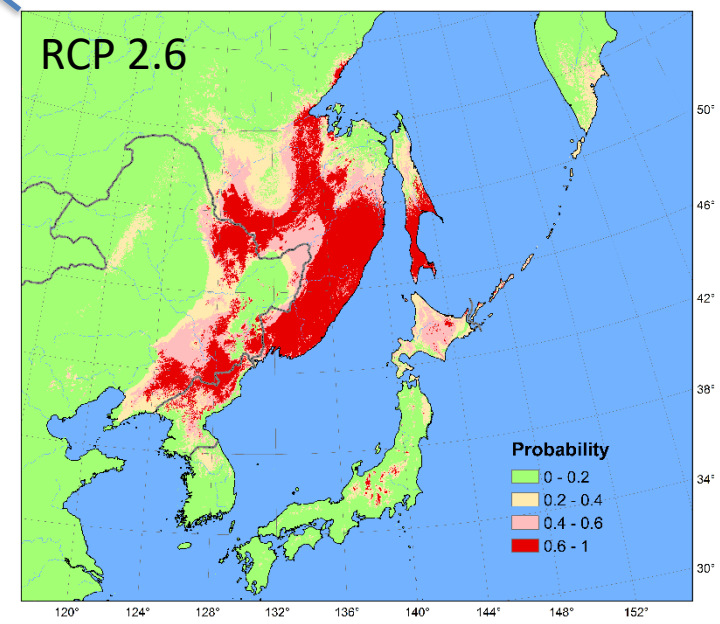
retrospective distribution of *Pinus koraiensis*

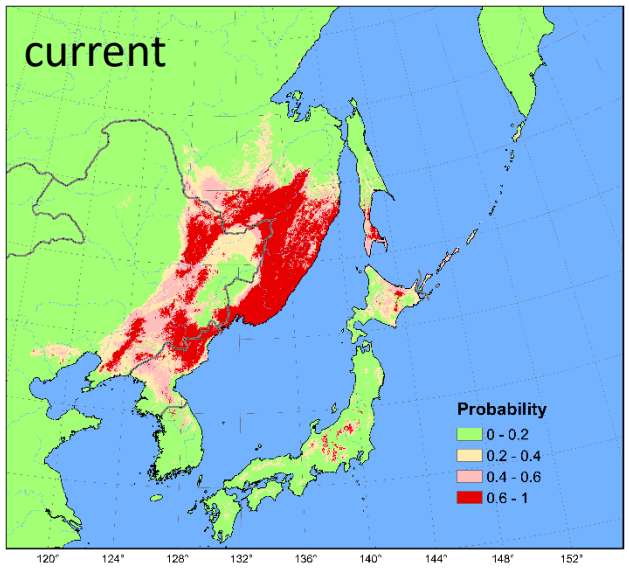


prognostic distribution model of *Pinus koraiensis*

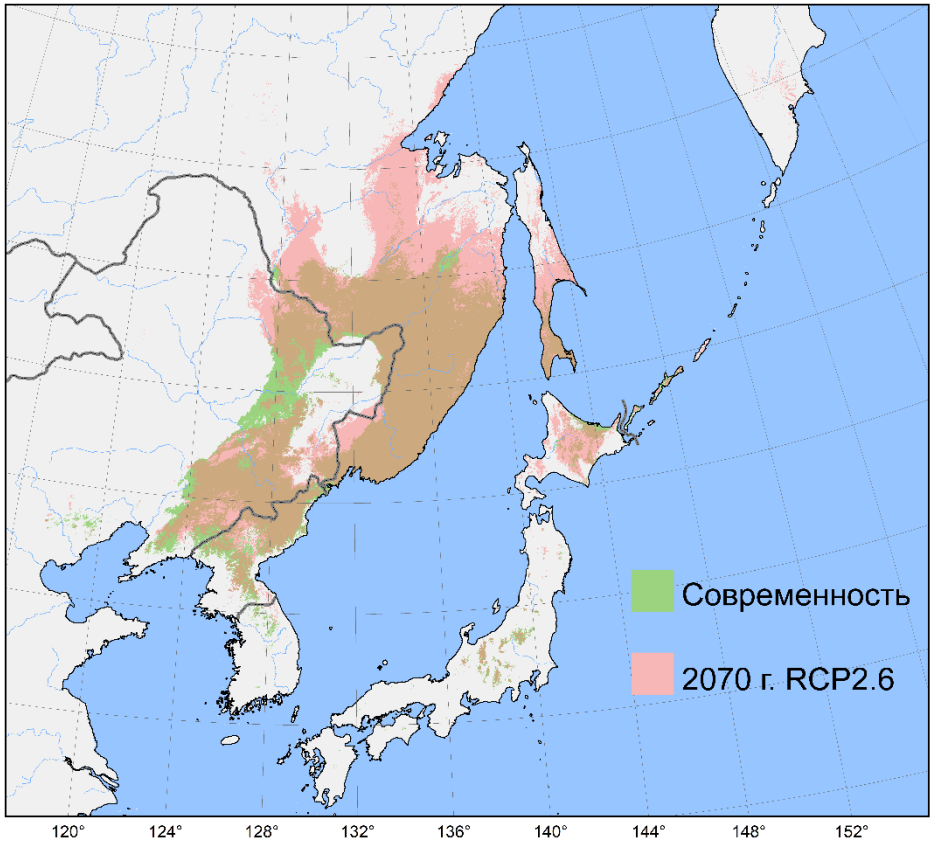


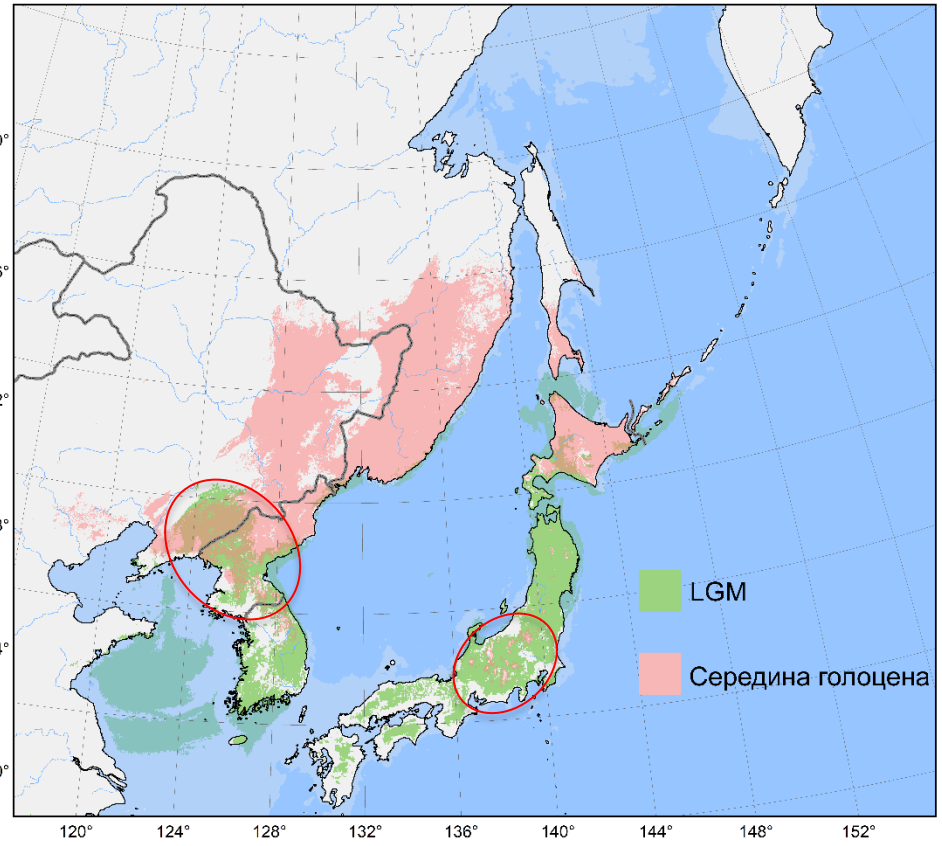






combination of retrospective and prognostic distribution models of *Pinus koraiensis*





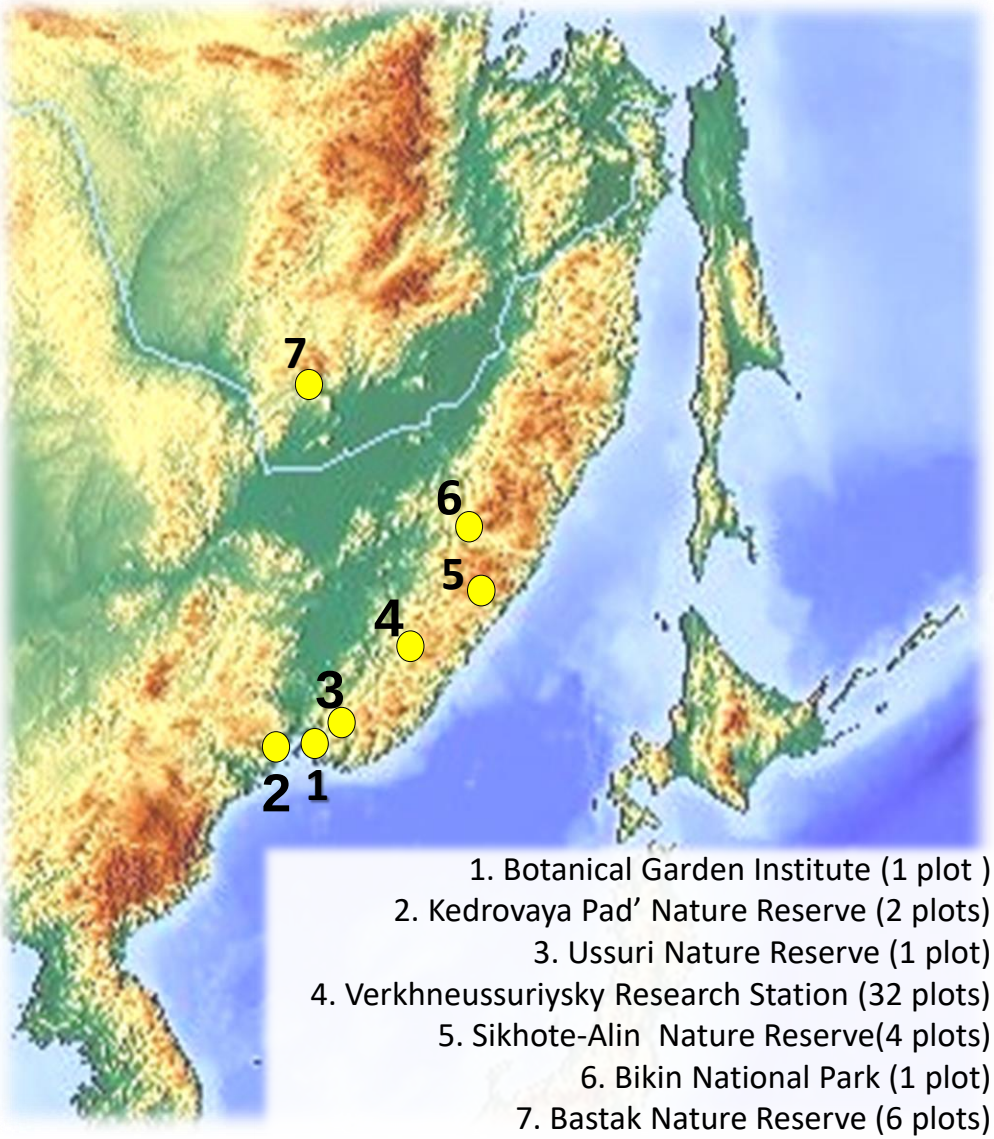
what happens

- Korean pine will lose a part of its habitats on the south of the Far East in coming 50 years
- oldest populations will disappear in the southern part of range

local indicators of climate change

natural ecosystem dynamics vs climate-induced change

network of permanent plots



1. Botanical Garden Institute (1 plot)
2. Kedrovaya Pad' Nature Reserve (2 plots)
3. Ussuri Nature Reserve (1 plot)
4. Verkhneussuriysky Research Station (32 plots)
5. Sikhote-Alin Nature Reserve(4 plots)
6. Bikin National Park (1 plot)
7. Bastak Nature Reserve (6 plots)

47 permanent plots:

Spatial structure
Age structure
Plants ontogeny
Gap dynamic
Disturbance regimes
Natural regeneration
Tree establishment
Biodiversity


Arboretum, Local forest ecosystems etc.
Protected forest
25-ha
sample plot

25-ha plot at Botanical Garden-Institute FEB RAS

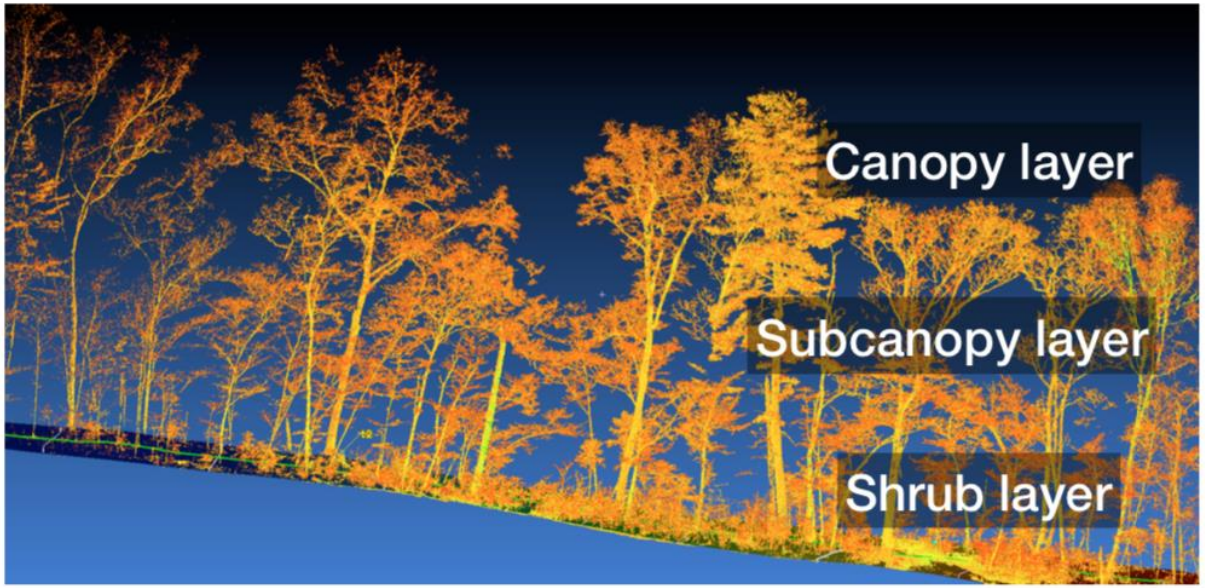
Tree species composition 25 tree species: 2 conifer 23 broadleaf

Canopy species
Abies holophylla
Betula costata
Pinus koraiensis
Tilia amurensis
Tilia mandshurica
Quercus mongolica
Juglans mandshurica
Kalopanax septemlobus
Ulmus laciniata
Ulmus japonica

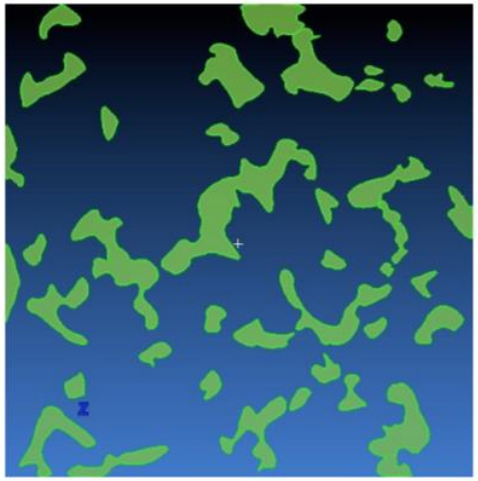
Subcanopy species
Acer barbinerve
Acer mono
Acer mandshuricum
Acer ukuruduense
Acer tegmentosum
Betula davurica
Betula platiphylla
Cerasus maximowichzii
Cerasus sakhalinensis
Fraxinus mandshurica
Fraxinus rhinchophylla
Micromeles alnifolia
Ligustrina amurensis
Ulmus laciniata
Padus maakii
Rhamnus davurica
Taxus cuspidata

MONITORING STUDIES

Stand canopy structure



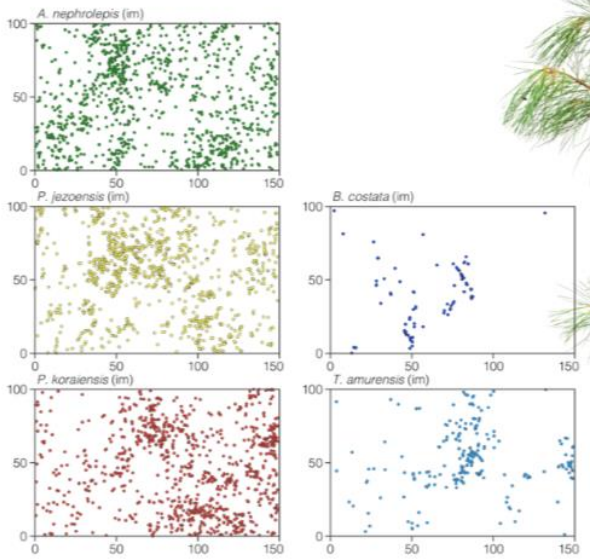
Stand canopy (TLS)



Gaps of different size

MONITORING STUDIES

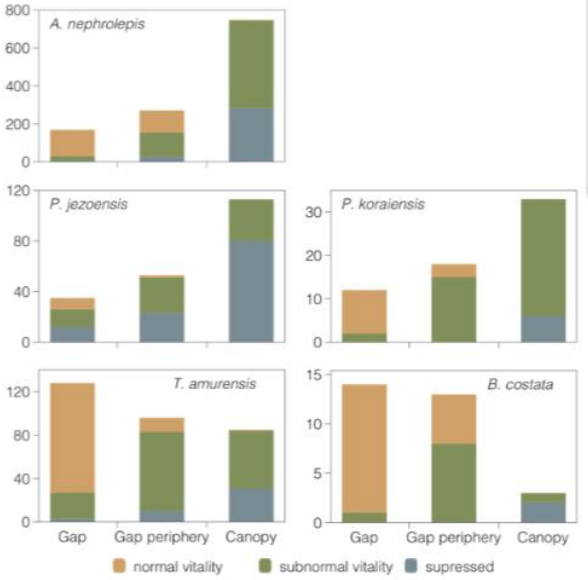
Natural regeneration of trees and shrubs



P. koraiensis (immature)

Distribution of immature plants of dominant tree species in the 1.5-ha sample plot

Accumulation of immature plants



Vitality of virginal plants

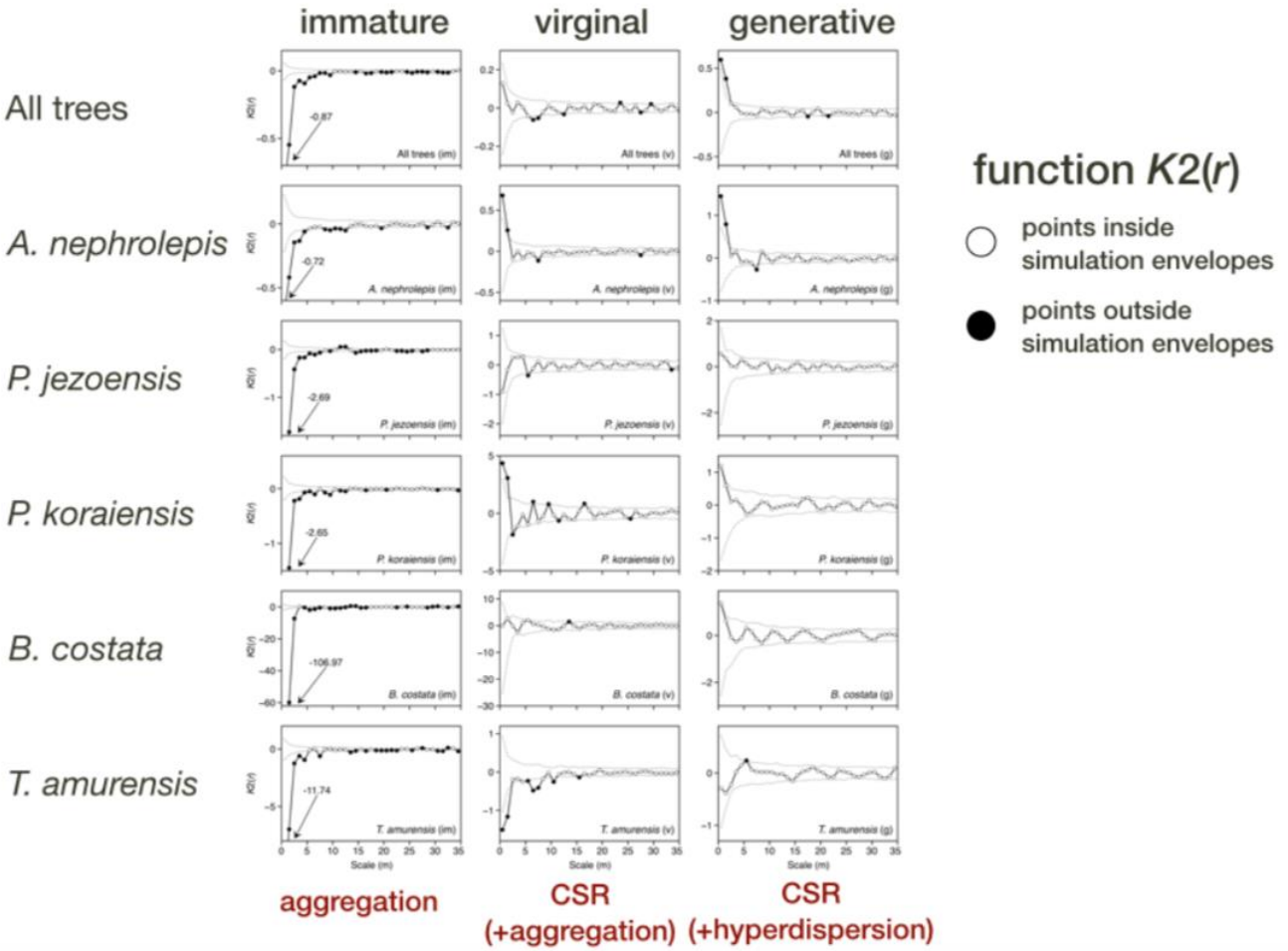
Virginal *P. jezoensis* trees with different vitality

Gap - tree crown in a gap
Gap periphery - largest part of a tree crown is in a gap
Canopy - tree crown is under stand canopy

MONITORING STUDIES

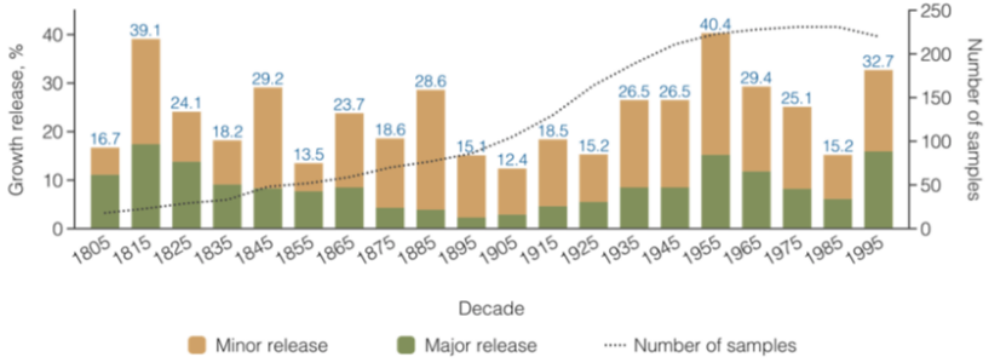
Structure of populations mosaics of different tree species, spatial associations, factors influencing structure of the mosaics

Spatial structure of population mosaics

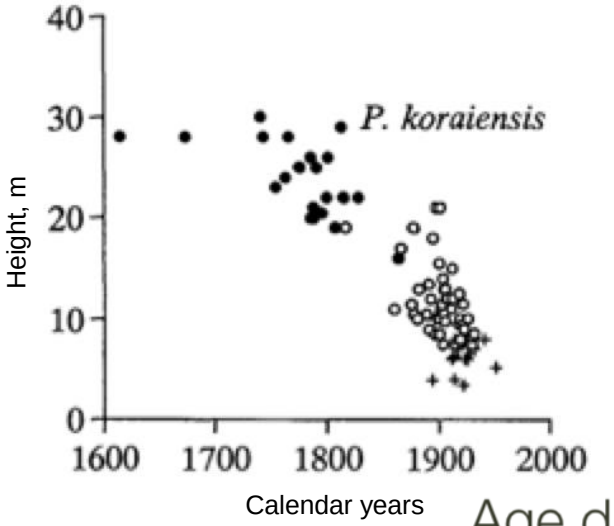


MONITORING STUDIES

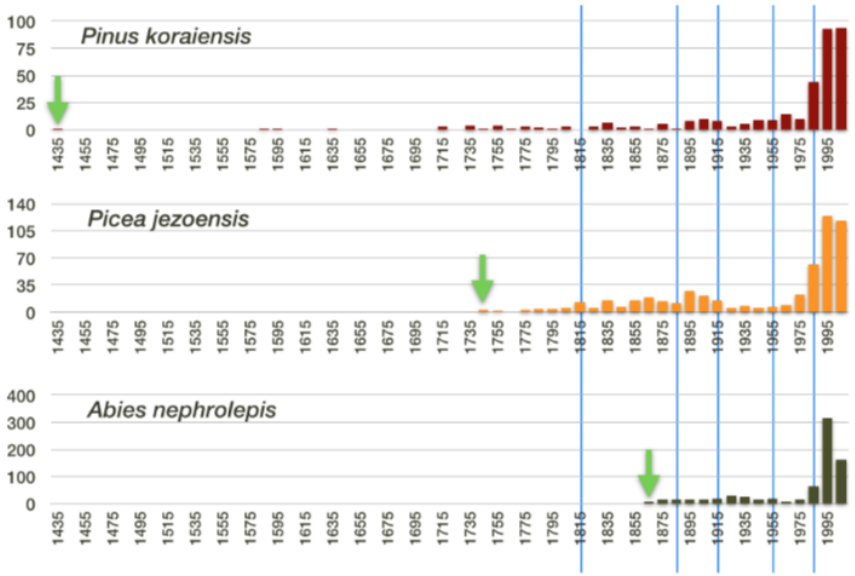
Stand disturbance history, disturbance regimes in old-growth forests



200-years disturbance history of an old-growth Korean pine dominated forest



Age distribution and regeneration waves

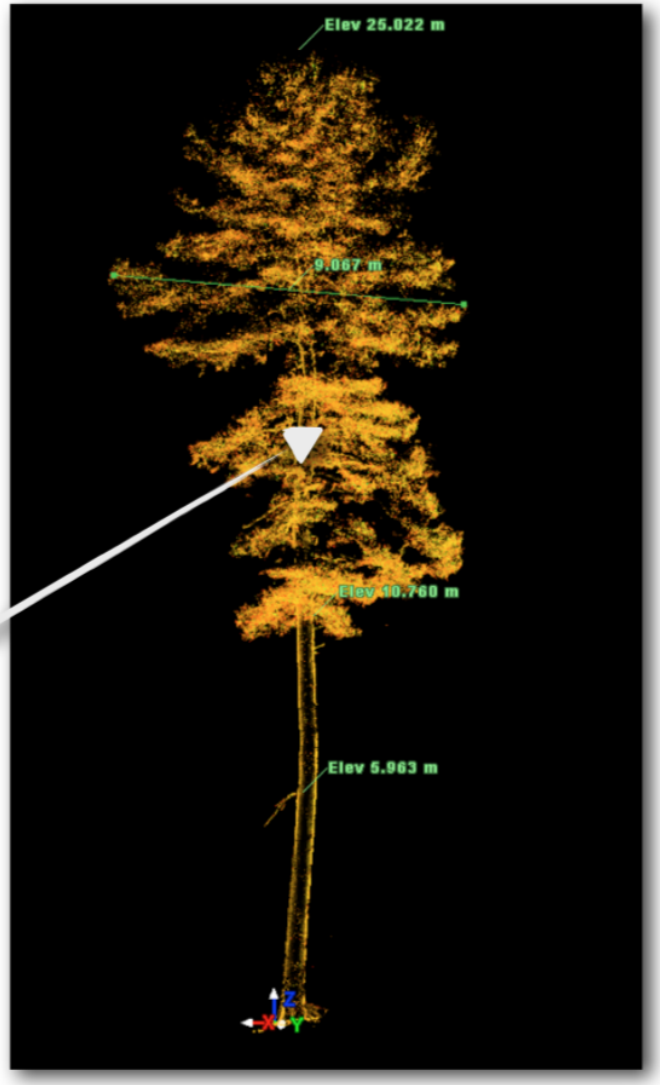


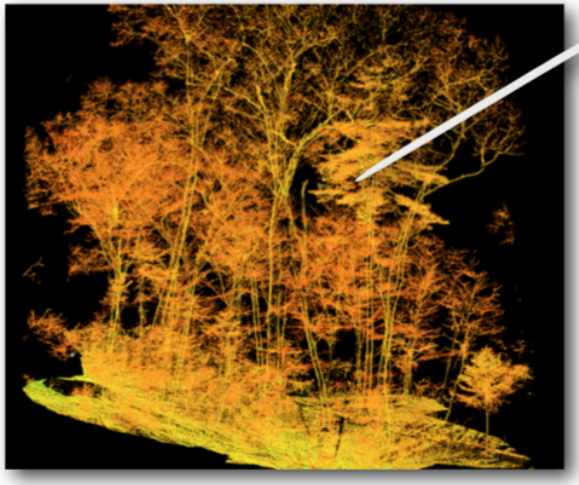
MONITORING STUDIES

Ontogeny of plants

Age limits of trees in the different ontogenetic stages

Ontogenetic stage	*P. koraiensis*	*P. jezoensis*	*A. nephrolepis*	*B. costata*	*T. amurensis*
immature	6-107	7-110	6-121	1-43	13-37
virginal	47-192	28-298	52-171	31-65	28-60
young reproductive	79-281	85-269	75-151	40-120	58-161
mature reproductive	158-303	69-317	67-166	85-224	105-235
old reproductive	242-527	183-269	116-214	258-340	120-250

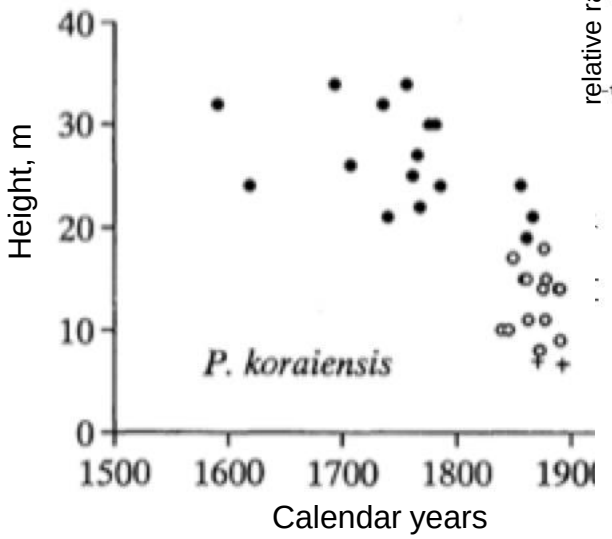


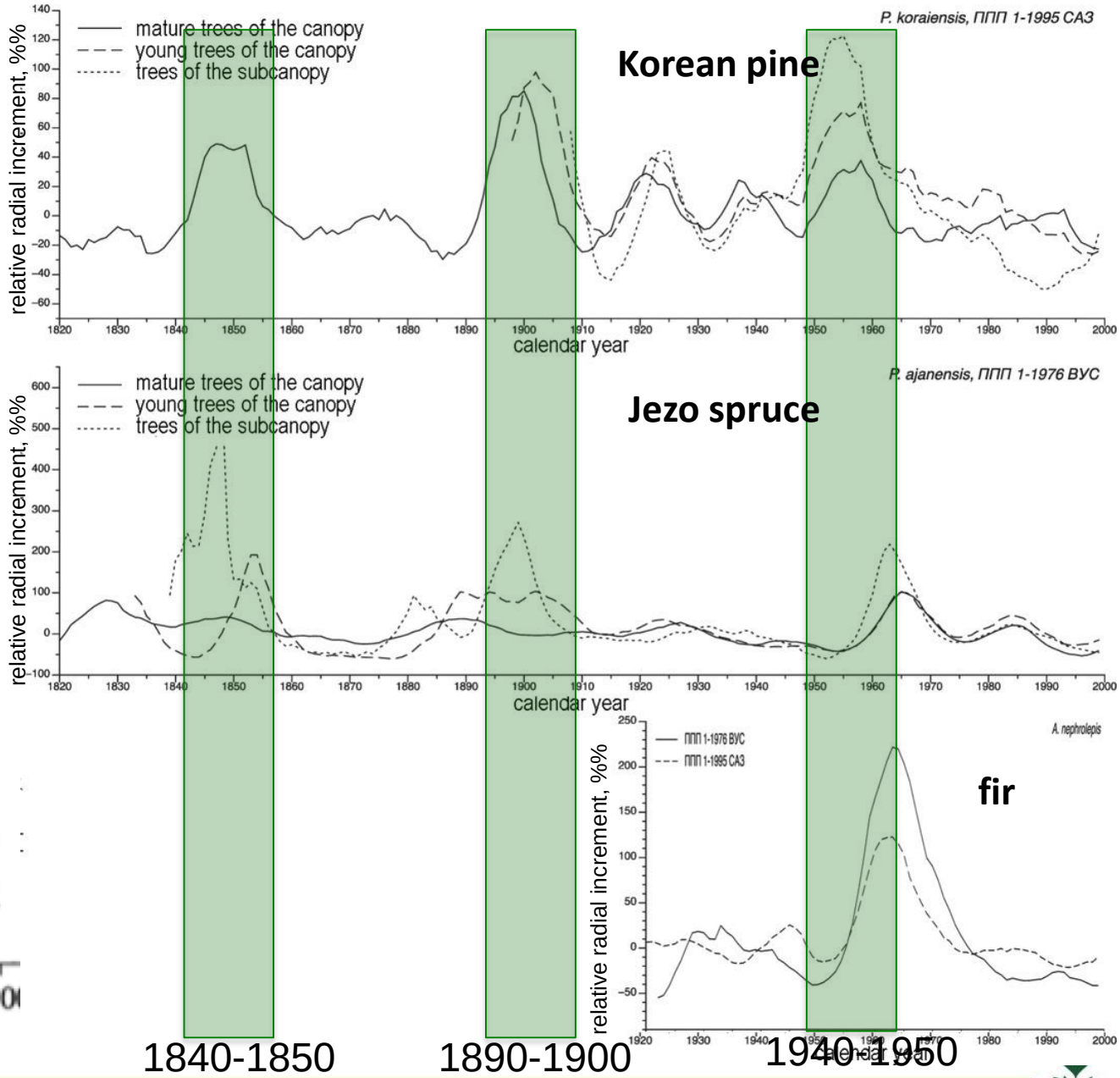


Pinus koraiensis

Ontogeny stage: **G_2**
Vitality: **normal**
Height: **25.00 m**
First branch: **5.96 m**
Crown begins at: **10.76 m**
Crown width: **9.07 m**

Dynamics of radial increment Korean pine, Jezo spruce and fir





Clim. Past, 14, 57–71, 2018
https://doi.org/10.5194/cp-14-57-2018

Climate of the Past
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EGU

Autumn–winter minimum temperature changes in the southern Sikhote-Alin mountain range of northeastern Asia since 1529 AD

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Revised: 22 November 2017 – Accepted: 5 December 2017 – Published: 16 January 2018

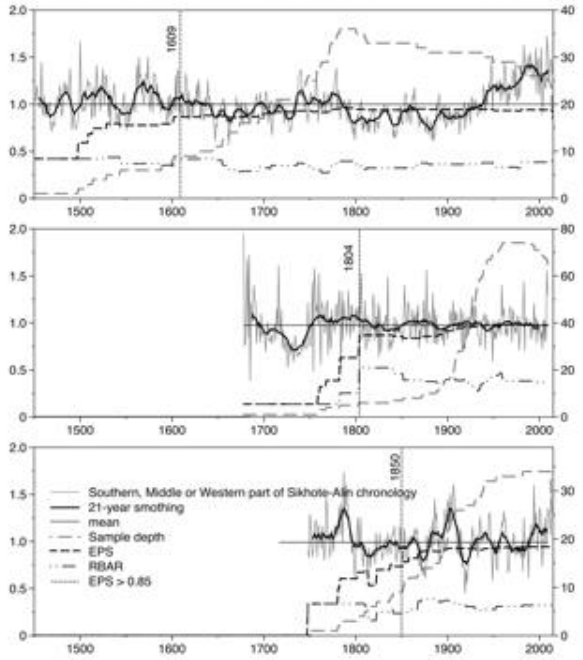
Western Sikhote-Alin	National park «Bikin», 46°41'47" N 135°45'54" E 500 m above see level 34 samples
Central Sikhote-Alin	Sikhote-Alin National Reserve 45°05'59" N 135°52'46" E 550 m above see level 54 samples
Southern Sikhote-Alin	Verkhneussuriisky Research Station 44°01'35" N 134°12'59" E 800 m above see level 45 samples

Variations in the chronology, sample depth, EPS and RBAR

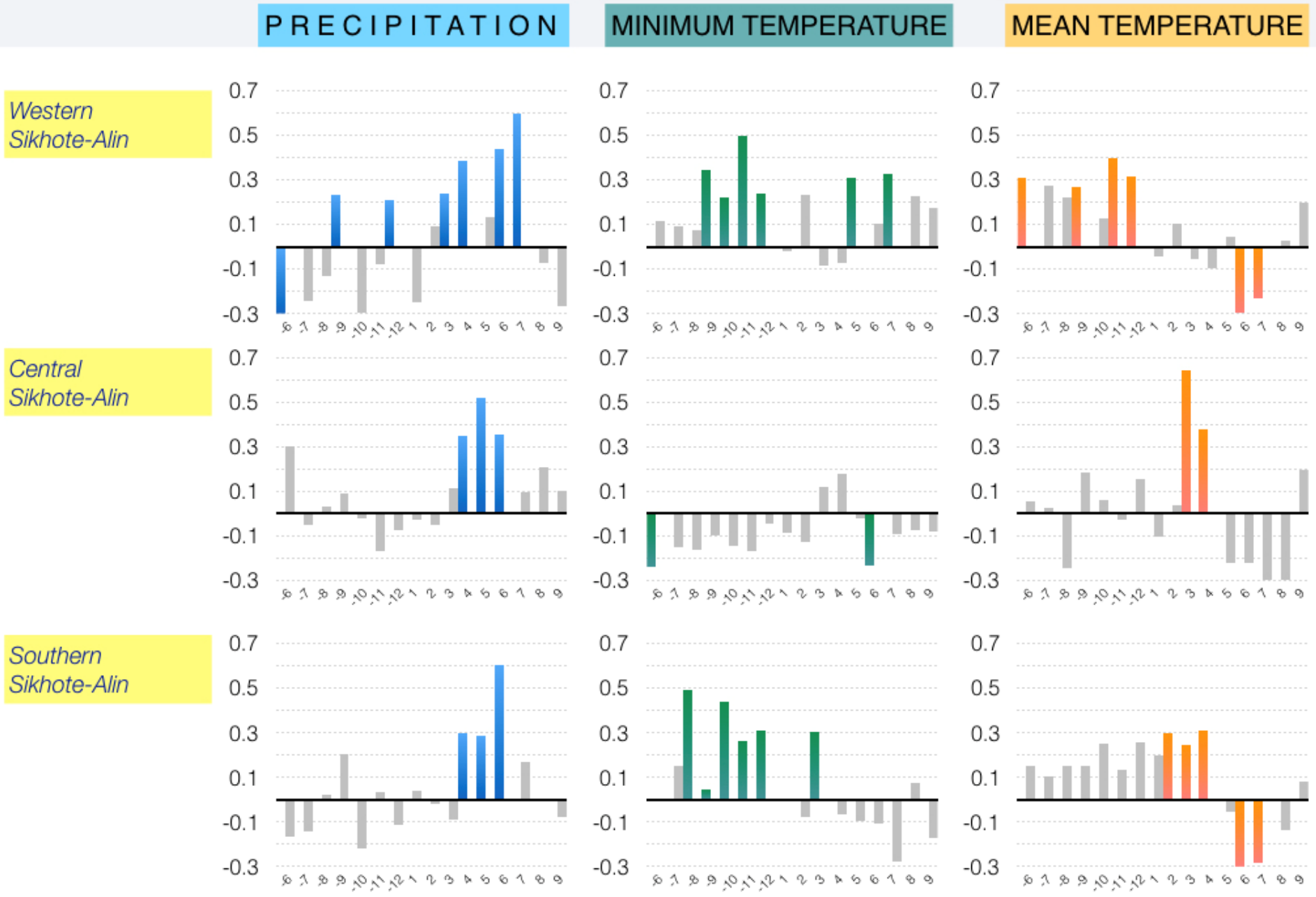
Southern Sikhote-Alin

Central Sikhote-Alin

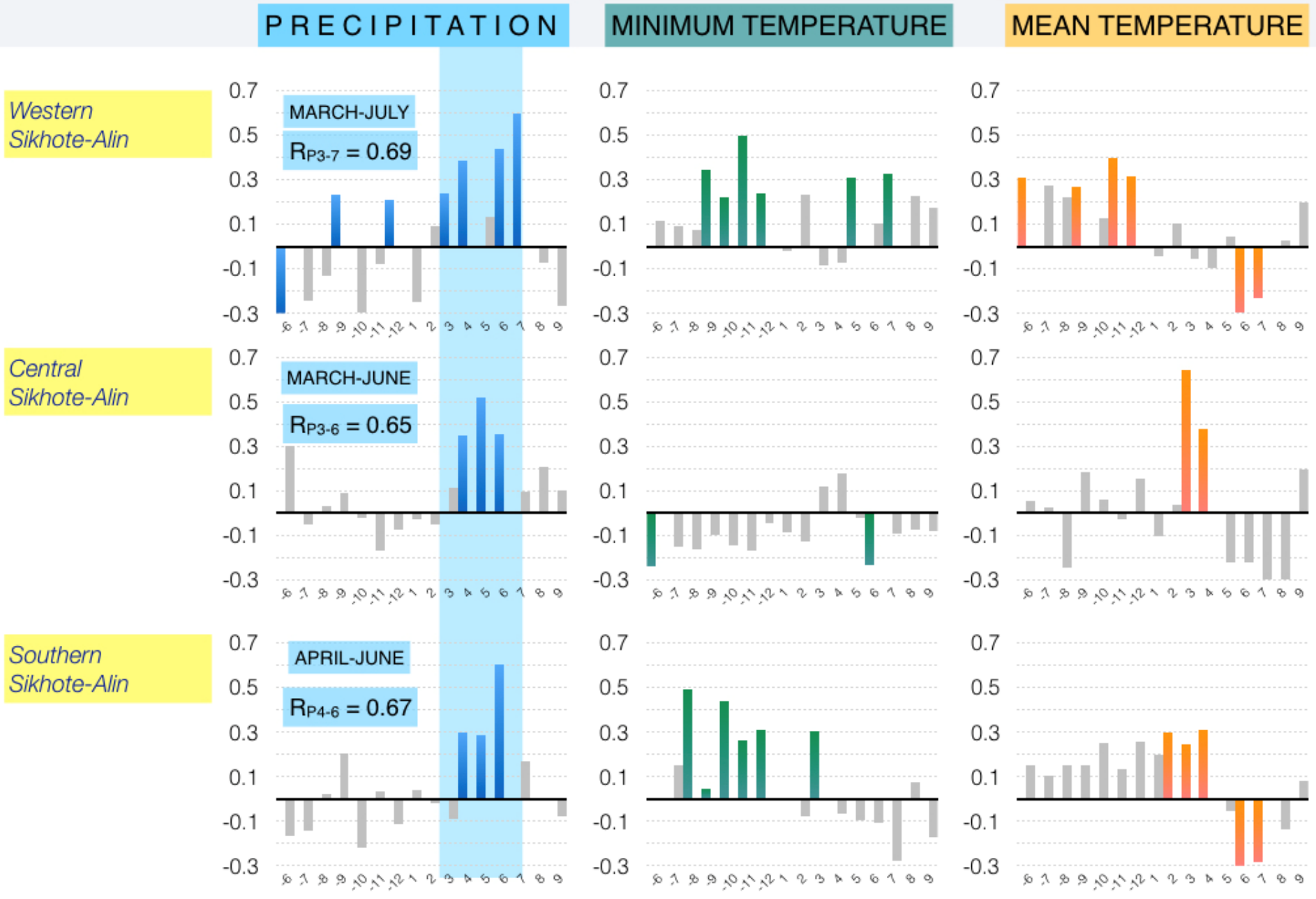
Western Sikhote-Alin



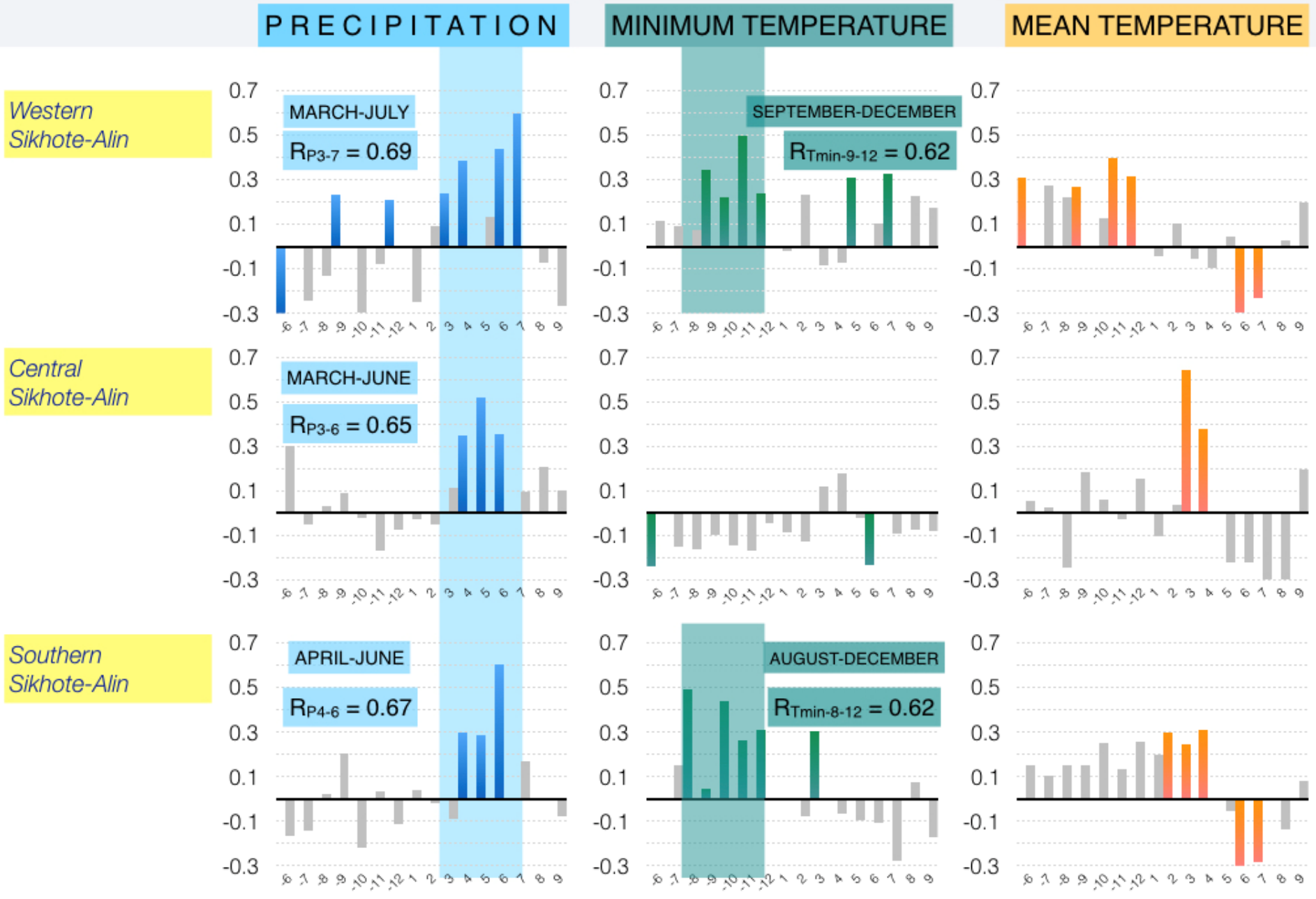
CLIMATE–RADIAL GROWTH RELATIONSHIP



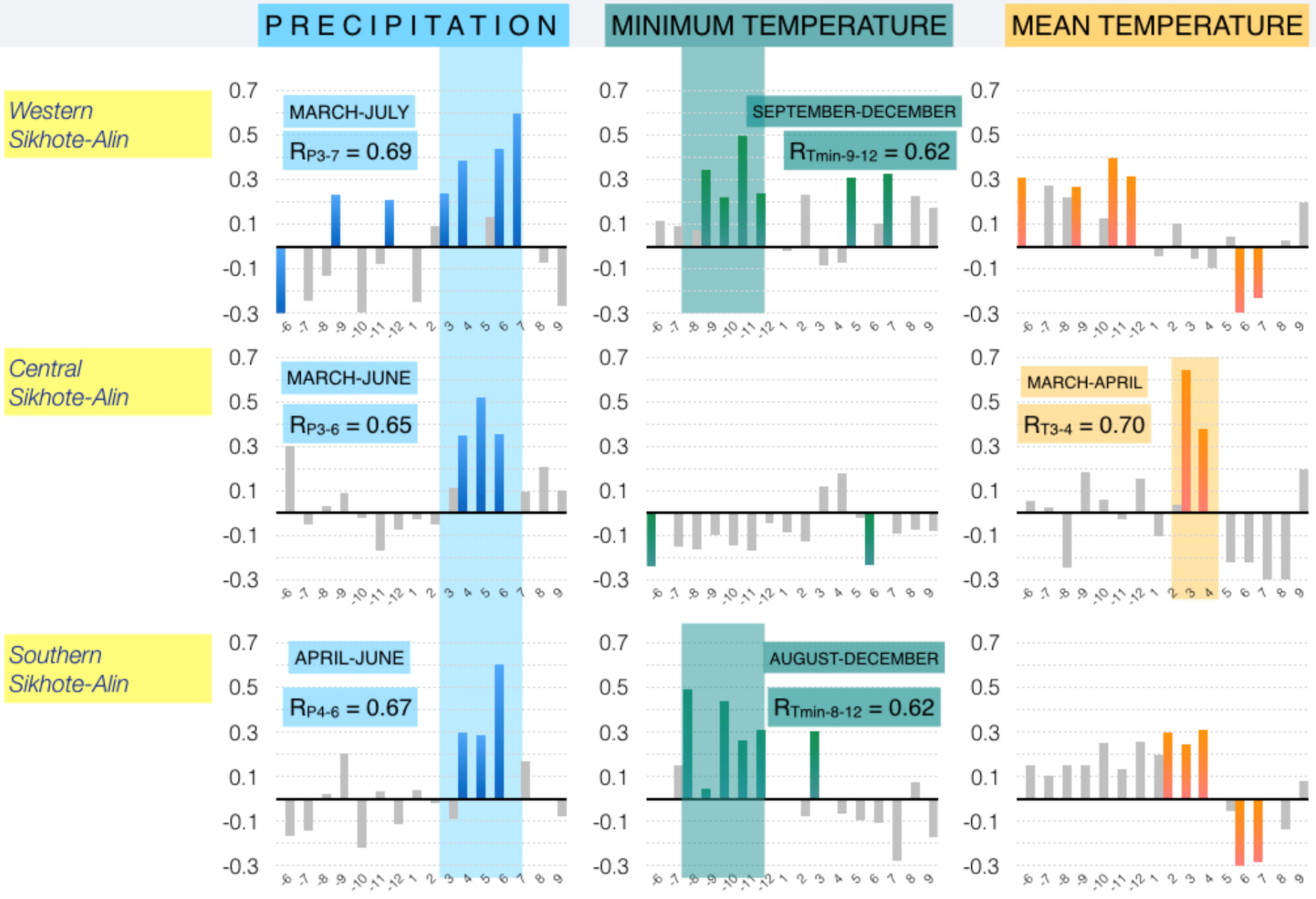
CLIMATE–RADIAL GROWTH RELATIONSHIP



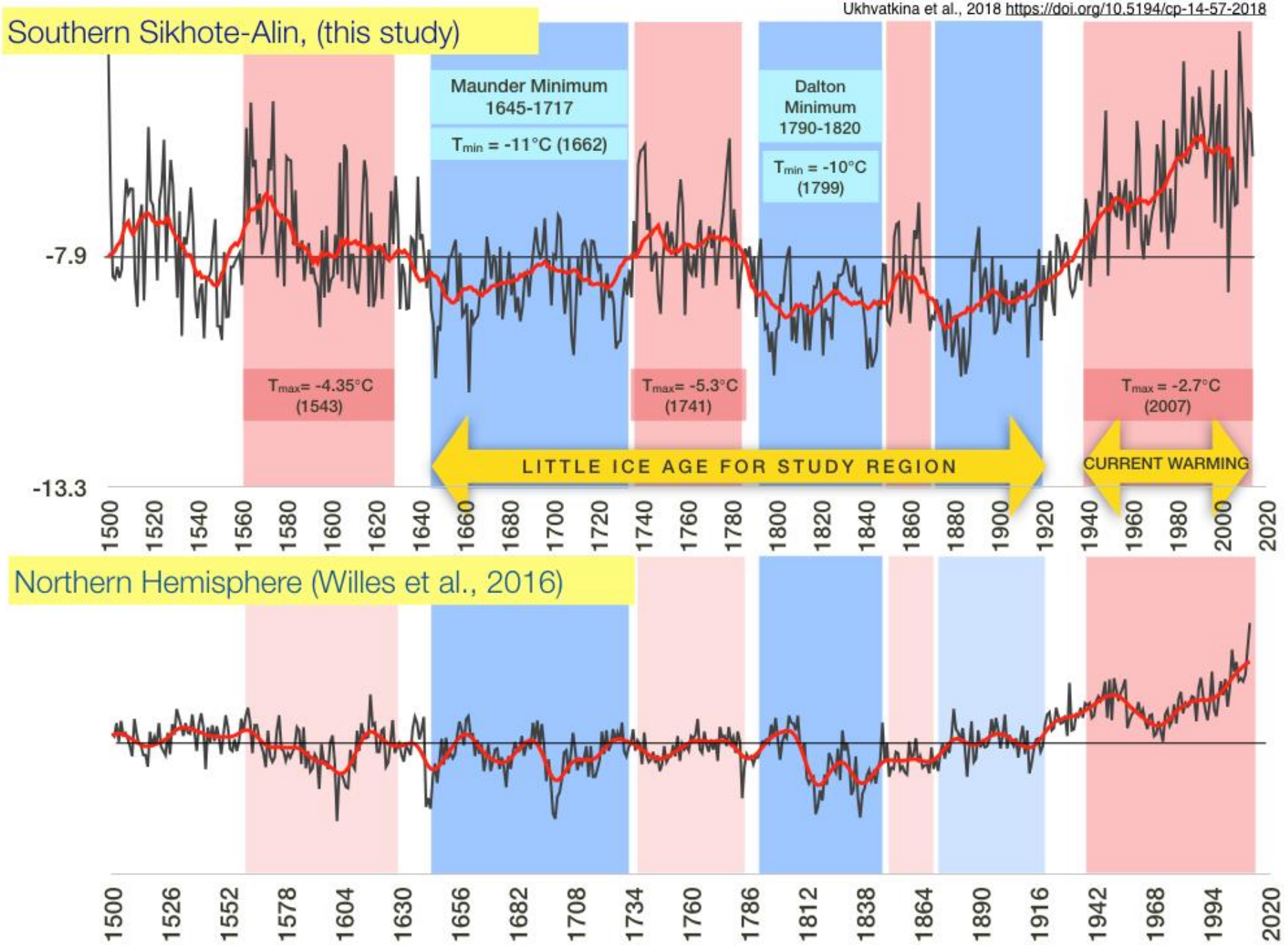
CLIMATE–RADIAL GROWTH RELATIONSHIP



CLIMATE–RADIAL GROWTH RELATIONSHIP



Ukhvatkina et al., 2018 https://doi.org/10.5194/cp-14-57-2018



PNAS

Poleward migration of the destructive effects of tropical cyclones during the 20th century

Jan Altman[a,b,1], Olga N. Ukhvatkina[c], Alexander M. Omelko[c], Martin Macek[a], Tomas Plener[a], Vit Pejcha[a], Tomas Cerny[d], Petr Petrik[a], Miroslav Srutek[e], Jong-Suk Song[f], Alexander A. Zhmerenetsky[c], Anna S. Vozmishcheva[g], Pavel V. Krestov[g], Tatyana Y. Petrenko[c], Kerstin Treydte[b], and Jiri Dolezal[a,e]

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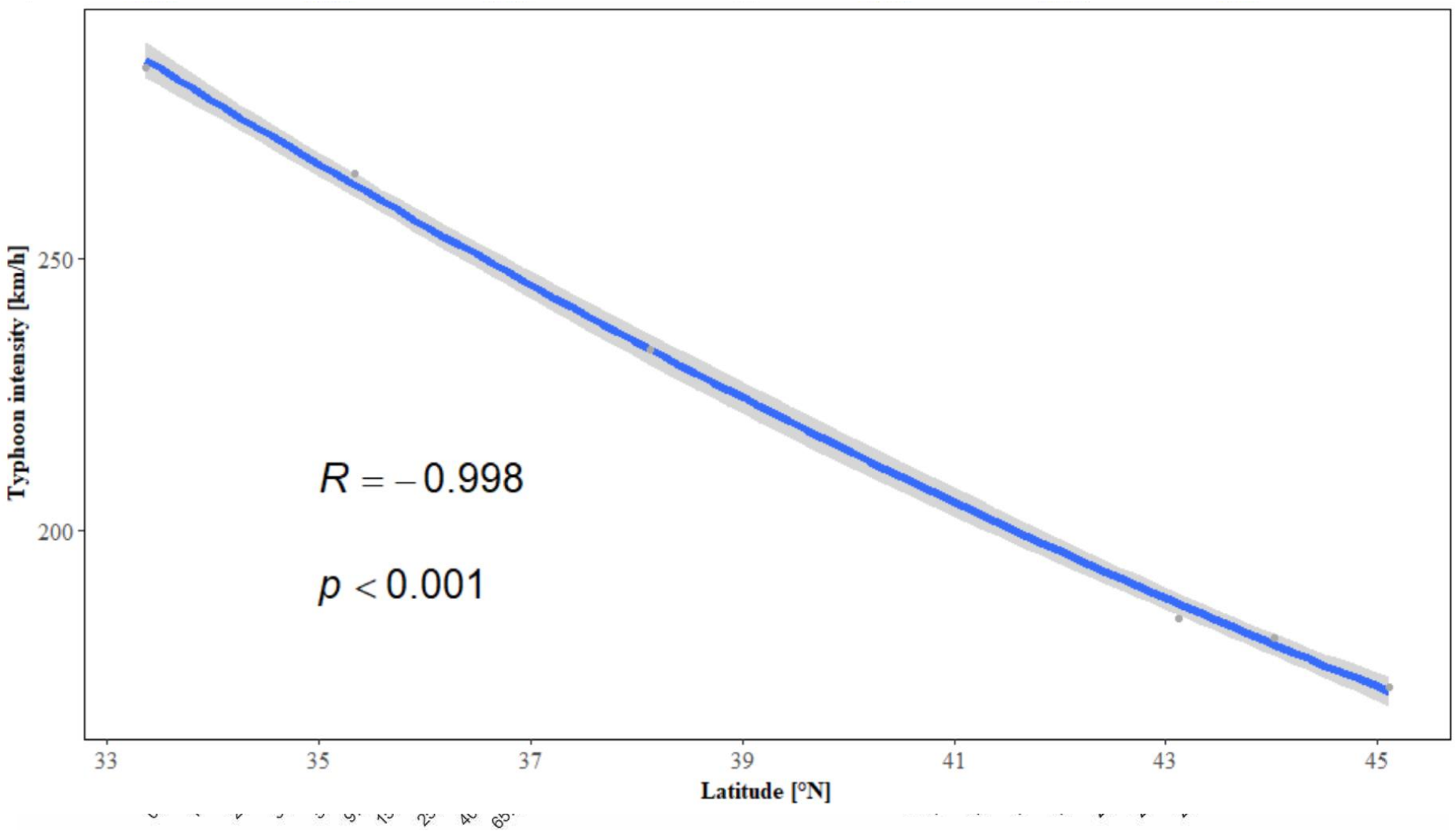
tropical cyclones and dendrochronological data



B. Consecutive steps of data analyses

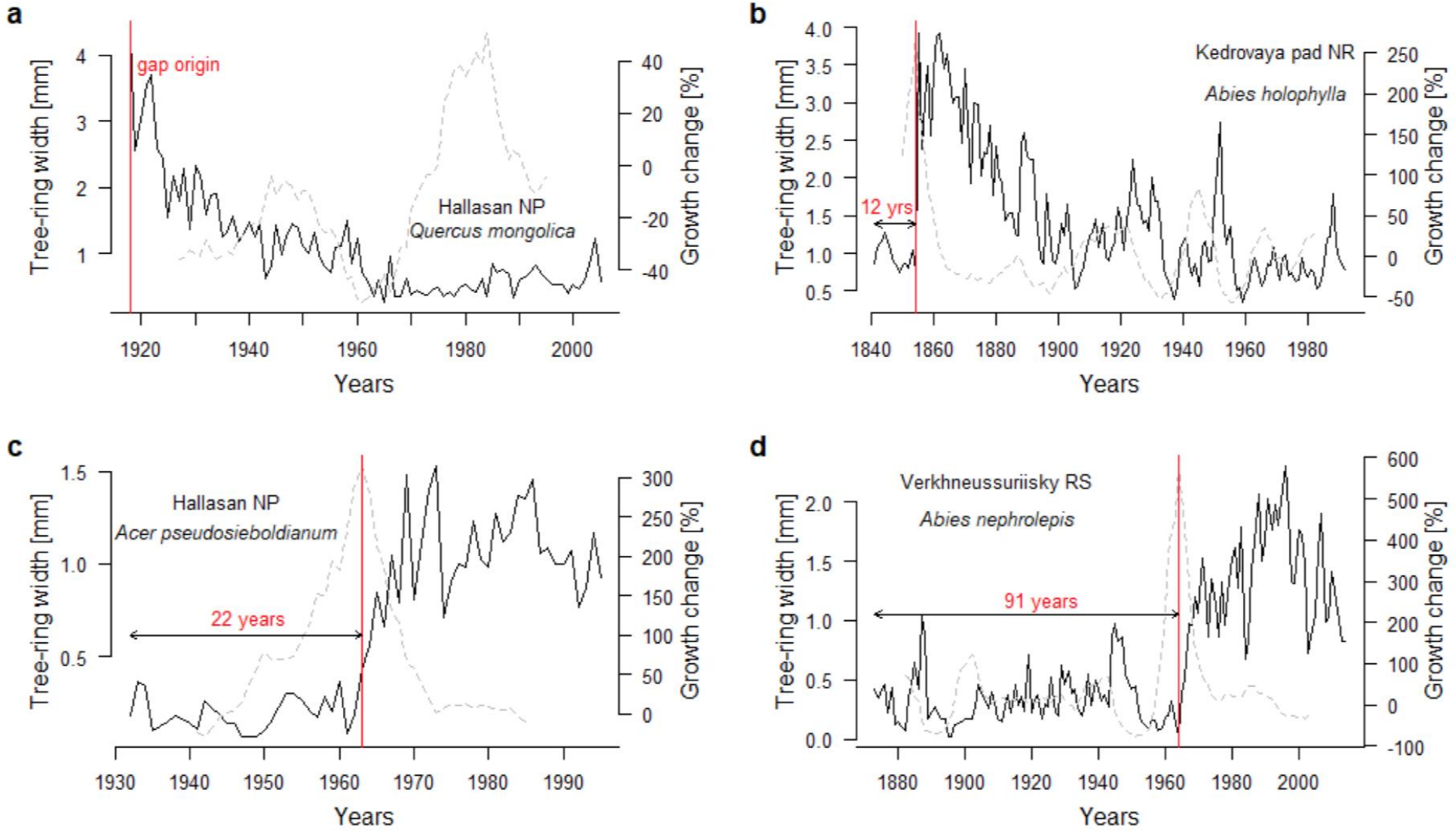
1) *Detection of* abrupt growth change indicating canopy disturbance induced by *tropical cyclone* (TC).

2) Canopy disturbance detected:
1) *during the early stage of tree life (≤15 years)*
2) *between 15th and 50th year of tree life*
3) *after 50th year of tree life*

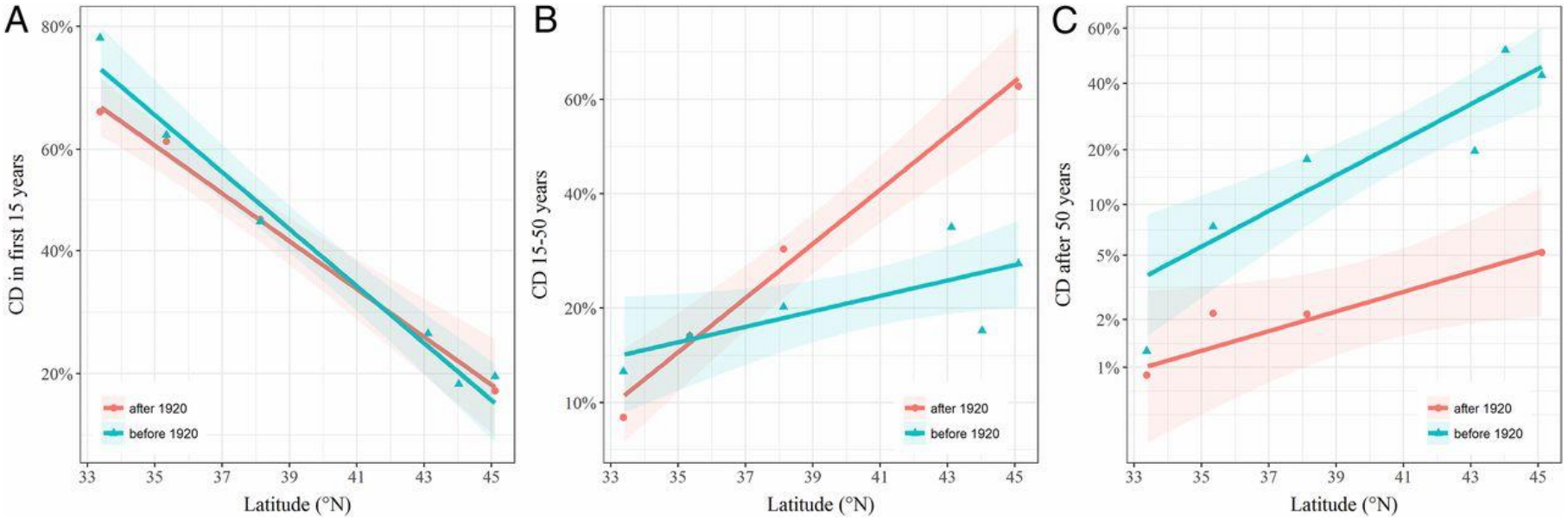
Longer period reflects decreasing TC activity

3) *Two periods investigated to determine long-term temporal stability/variability in TC activity* via proportion of trees according to the length of period preceding canopy disturbance:

defining canopy destructions

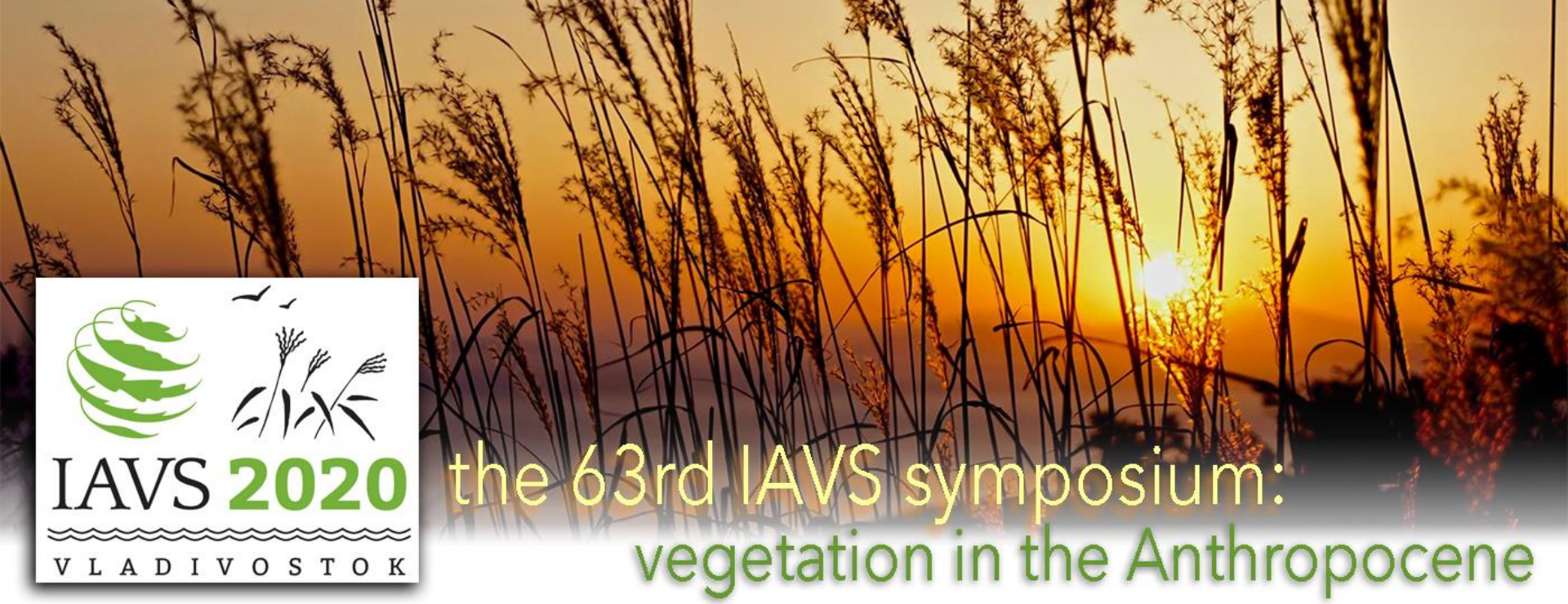


proportion of proportion of younger and older trees before (blue) and after 1920 (red)



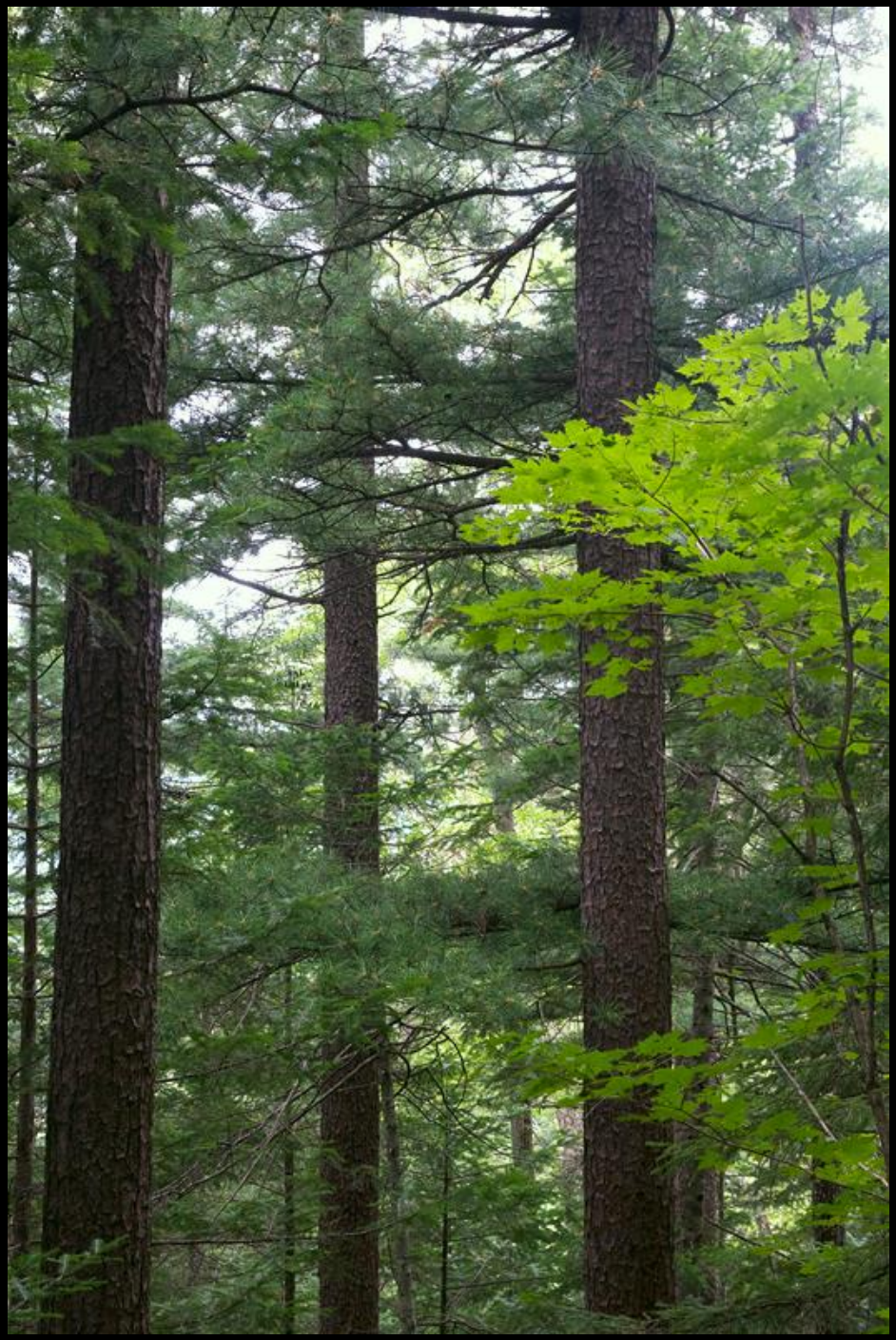
lower proportion of younger trees than older trees exposed to canopy disturbance after their 50th year reflects increased TC activity at northern latitudes, as most of the trees could already reach the canopy during the first 50 y of life

- observed changes in tropical cyclone activity, specifically northward tropical cyclone track migration, caused more frequent forest disturbances during the last century in the western North Pacific;
- the expansion of the tropics leads to increased sea surface temperatures at higher latitudes, where they trigger tropical cyclone genesis and hence poleward migration of tropical cyclone activity.



20 - 24 July 2020, Vladivostok, Russia

http://geobotanica.ru/symposium_2020/



谢谢您