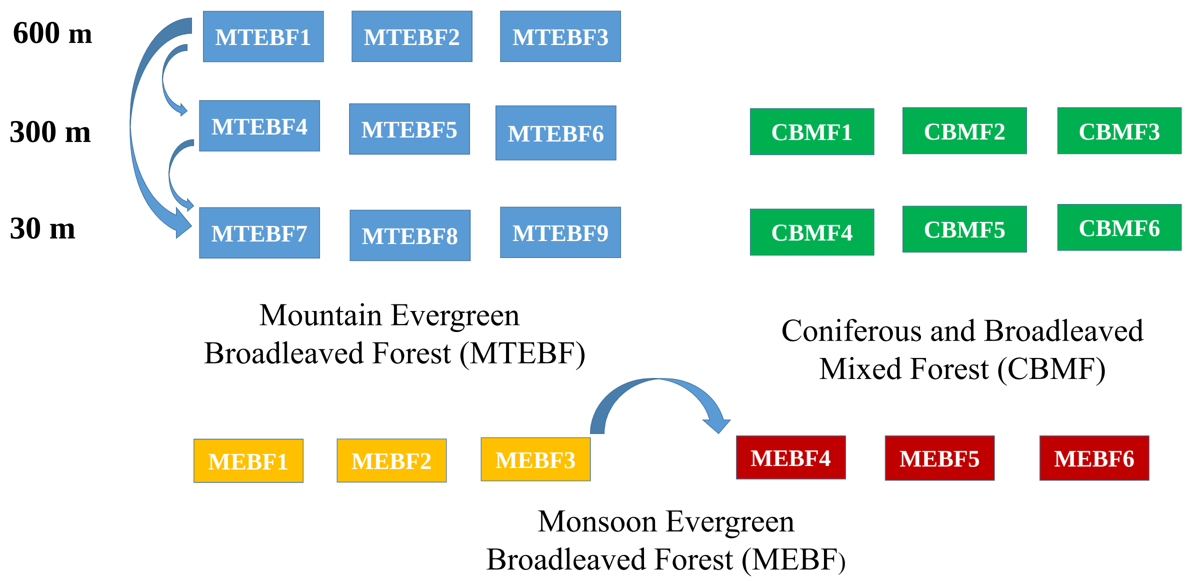
Experimental platform of forest ecosystems translocated down an elevation gradient

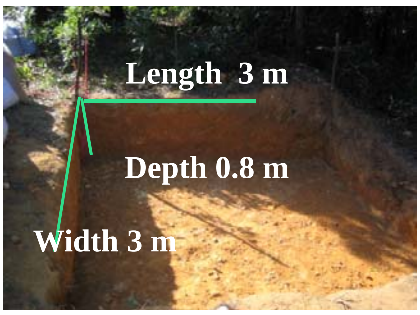
We initiate warming treatments by translocating forest ecosystems to lower elevation so that temperature is the main altered environmental factor. Meanwhile, we control over the inputs and outputs of forest ecosystems, so that material balance and energy flow can be quantified.



Open-Top chamber: 21-semi-closed chambers (depth 0.8 m × length 3 m × width 3 m) in three sites

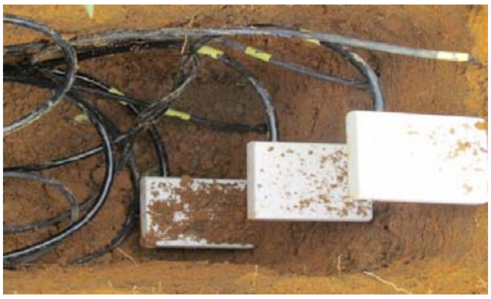
Soil collection: MTEBF at the altitude of 600 m, CBMF at the altitude of 300 m, MEBF at the altitude of 30 m, containing three different layers of soils (0-20 cm, 20-40 cm and 40-70 cm)

Soil transfer: Three different layers of soils were transferred into the growth chambers correspondingly at the three sites



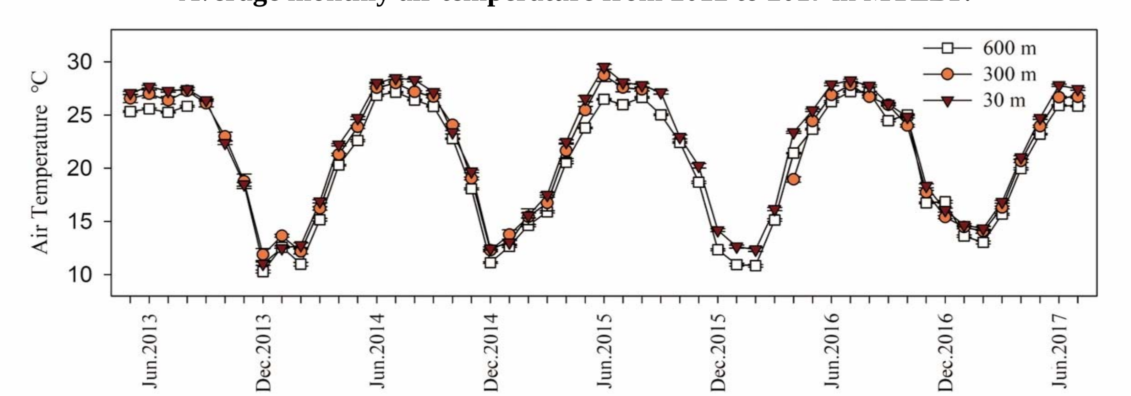



Experimental platform of forest ecosystems translocated down an elevation gradient

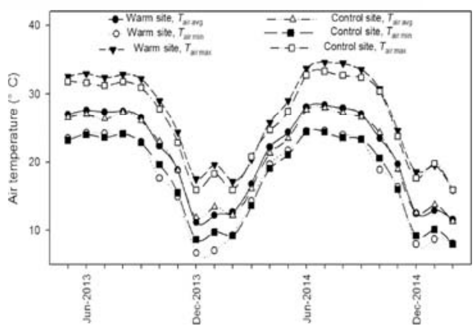


Altitude (m)	Vegetation Type	Soil Type	Planted Tree Species
600	Mountain Evergreen Broadleaved Forest	Yellow Soil	*Schima superba, Syzygium rehderianum, Machilus breviflora*, *Itea chinensis, Myrsine seguinii, Ardisia lindleyana*
300	Mountain Evergreen Broadleaved Forest	Yellow Soil	*Schima superba, Syzygium rehderianum, Machilus breviflora*, *Itea chinensis, Myrsine seguinii, Ardisia lindleyana*
300	Coniferous and broad-leaved mixed Forest	Lateritic Soil	*Schima superba, Syzygium rehderianum, Machilus breviflora*, *Pinus massoniana, Castanopsis hystrix, Ardisia lindleyana*
30	Mountain Evergreen Broadleaved Forest	Yellow Soil	*Schima superba, Syzygium rehderianum, Machilus breviflora*, *Itea chinensis, Myrsine seguinii, Ardisia lindleyana*
30	Coniferous and broad-leaved mixed Forest	Lateritic Soil	*Schima superba, Syzygium rehderianum, Machilus breviflora*, *Pinus massoniana, Castanopsis hystrix, Ardisia lindleyana*
30	Monsoon Evergreen Broadleaved Forest	Lateritic Soil	*Schima superba, Syzygium rehderianum, Machilus breviflora*, *Castanopsis hystrix, Ormosia pinnata, Psychotria asiatica*
30	Monsoon Evergreen Broadleaved Forest	Lateritic Soil	*Schima superba, Syzygium rehderianum, Machilus breviflora*, *Castanopsis hystrix, Ormosia pinnata, Psychotria asiatica*

Average monthly air temperature from 2012 to 2017 in MTEBF.



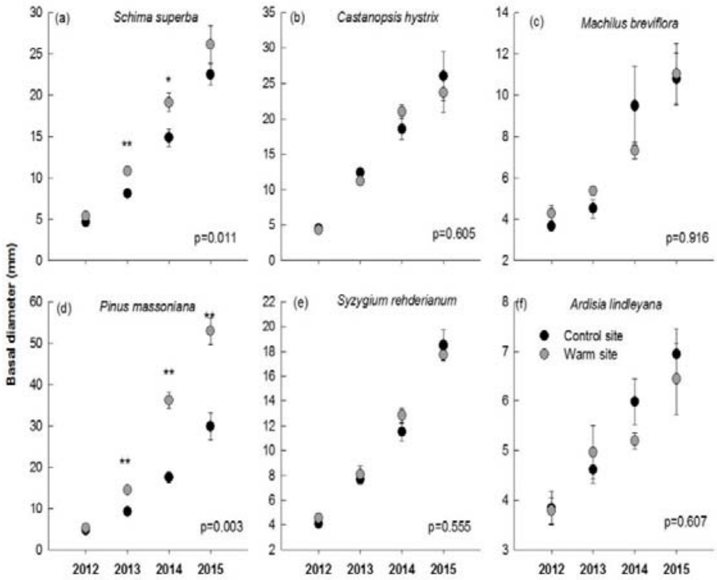
Average monthly maximum, minimum and mean air temperature from 2013 to 2015 in CBMF.



Preliminary Findings in Coniferous and Broadleaved Mixed Forest

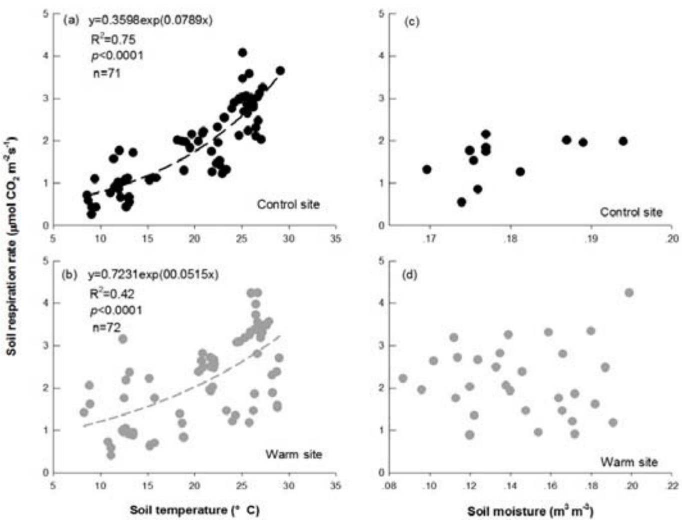
Plant growth

Warming significantly increased the basal diameter and height of *Schima superba* and *Pinus massoniana*, however, it did not affect other tree species.
(Li et al, 2017 Frontiers in Plant Science)



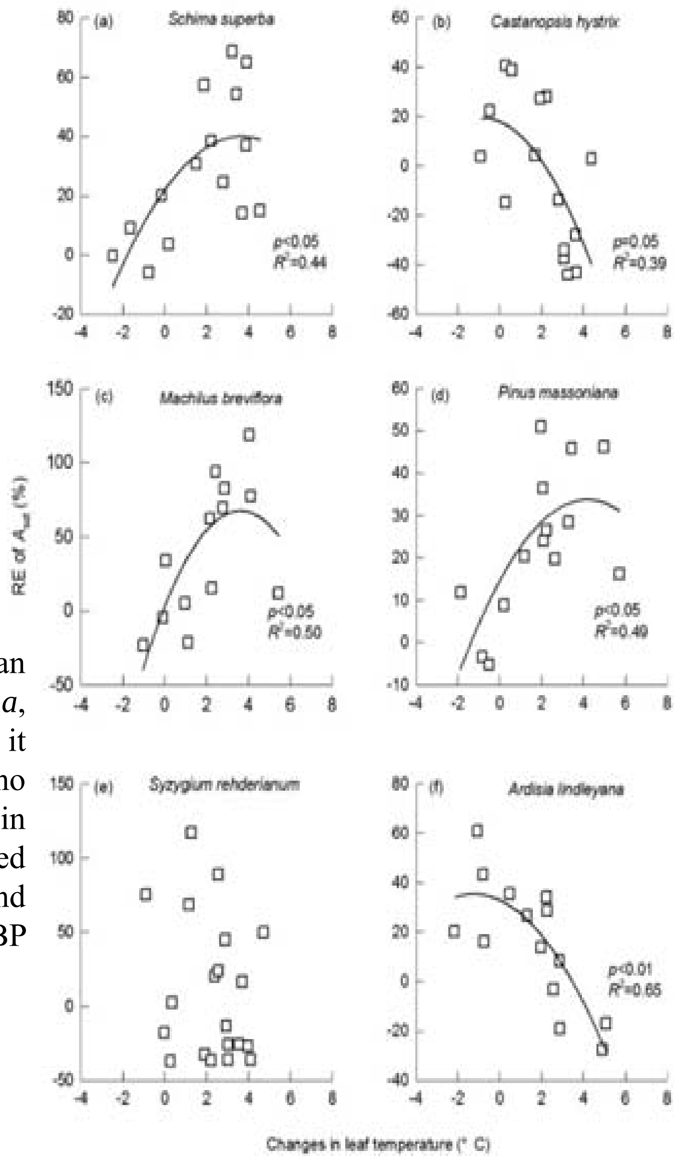
Soil respiration

Soil respiration (R_s) responded strongly to downward translocation, suggesting that climate warming exacerbated R_s and tended to reduce soil C sequestration. The ability of subtropical forests to act as CO_2 sink may be reduced under climate warming.
(Li et al, 2016 Plant and Soil)

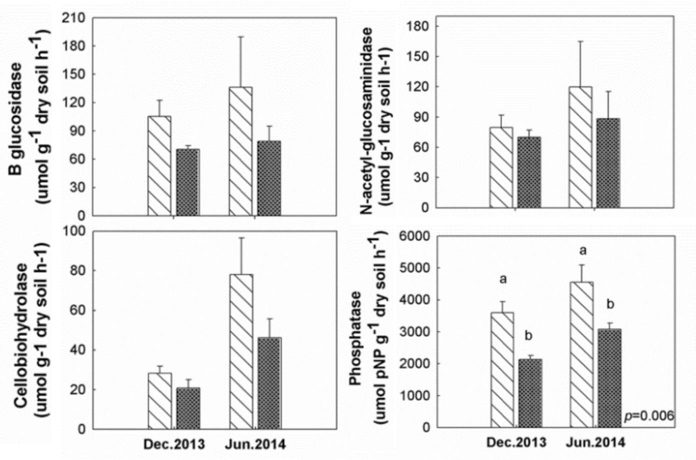


Photosynthesis

Downward translocation significantly increased mean average A_{sat} of *Schima superba*, *Pinus massoniana*, *Machilus breviflora*, *Ardisia lindleyana*; however, it decreased that of *Castanopsis hystrix* and had no significant effect on *Syzygium rehderianum*. Changes in A_{sat} in response to translocation were mainly associated with those in leaf stomatal conductance (g_s) and photosynthetic capacity (RuBP carboxylation, RuBP regeneration capacity).
(Li et al, 2016 Scientific Reports)



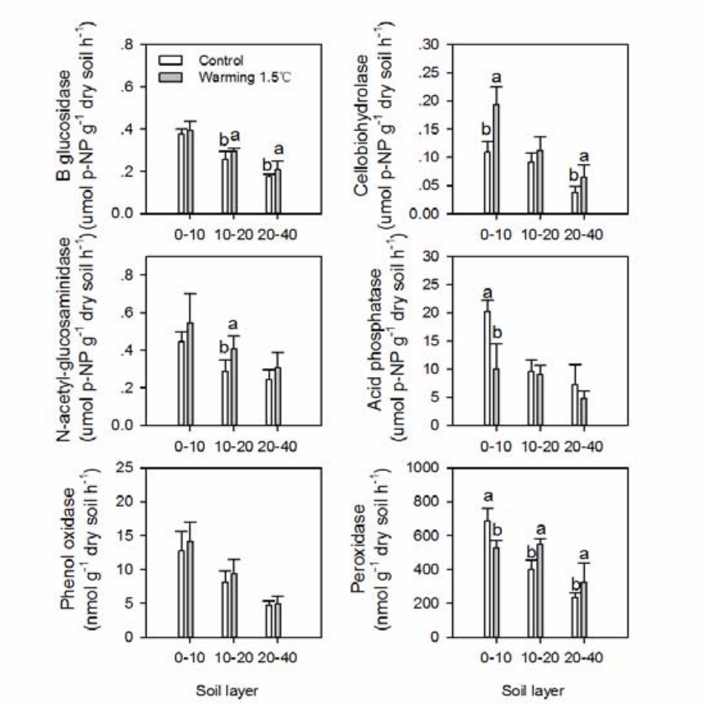
Microbial communities and enzyme activities in soil

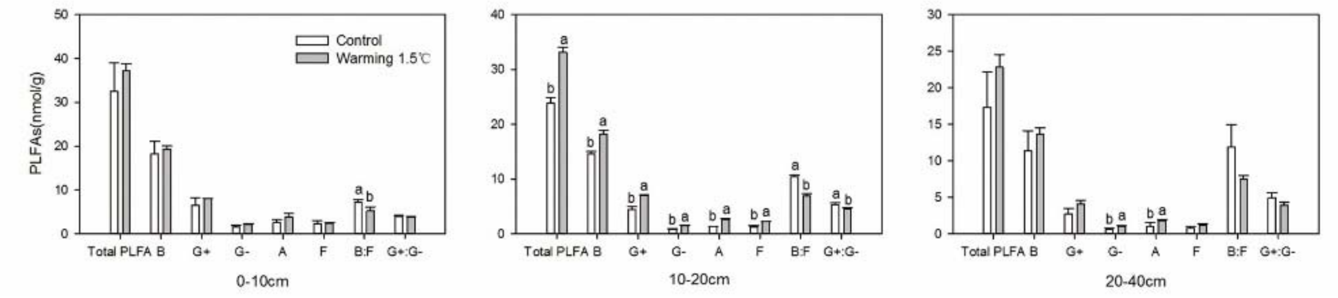


Parameters	Warming (W)	Aggregate (A)	W × A
Total PLFAs	0.415	<0.001	0.001
Bacteria	0.361	<0.001	0.001
G^+ bacteria	0.42	<0.001	<0.001
G^- bacteria	0.245	<0.001	<0.001
Fungi	0.662	<0.001	0.003
Actinomycetes	0.345	<0.001	0.002
B:F ratio	0.133	0.525	0.557
G^+:G^- ratio	0.087	0.03	0.001
Stress ratio	0.025	0.042	0.001
Acid phosphatase activity	0.004	0.073	<0.001
β glucosidase activity	0.153	0.594	0.715
Cellobiohydrolase activity	0.266	0.19	0.463
N-acetyl-glucosaminidase activity	0.286	0.522	0.808
Phenol oxidase activity	<0.001	0.45	0.004
Peroxidase activity	0.008	0.102	0.011

G^+ bacteria Gram-positive bacteria, *G^- bacteria* Gram-negative bacteria, *B:F ratio* the ratio of bacterial biomass to fungal biomass, *G^+:G^- ratio* the ratio of Gram-positive bacterial biomass to Gram-negative bacterial biomass

Soil warming significantly altered the soil microbial community composition in the large macroaggregates, and significantly decreased acid phosphomonoesterase activity and increased oxidase activities. It suggested that soil microbial community composition in the large macroaggregates might be more sensitive to warming.
(Fang et al, 2016 Biol Fertil Soils)

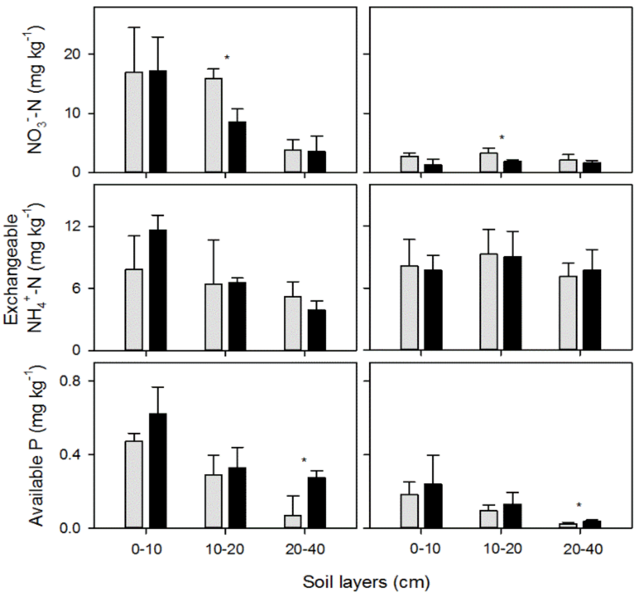




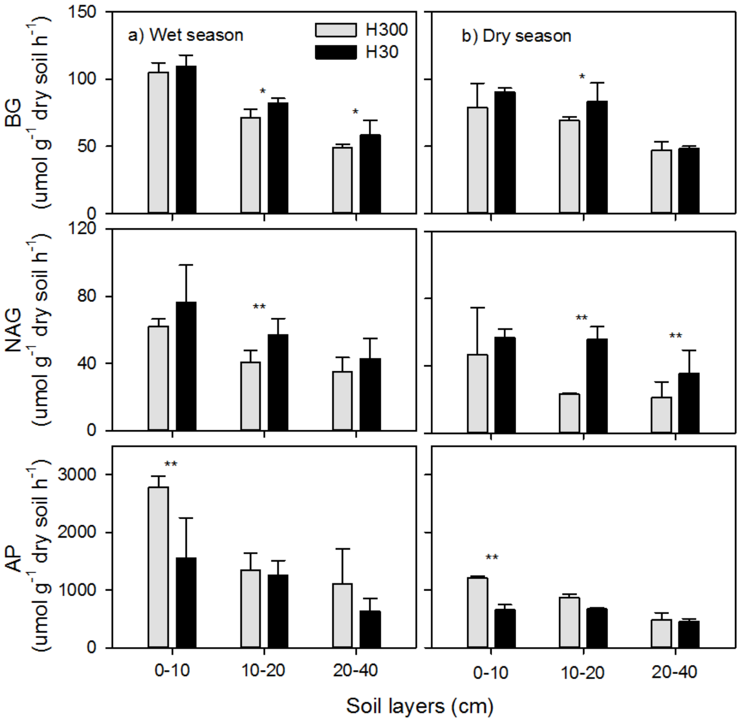
Simulated 5-years warming increased β-glucosidase, cellobiohydrolase, and N-acetylglucosaminidase, while decreased acid phosphatase. Phenol oxidase had an increased trend and peroxidase was significantly decreased in 10-20 and 20-40 cm of soil. With the warming effect, soil microbial biomass significantly increased and soil microbial community composition altered with lower F:B and G+:G−ratio.

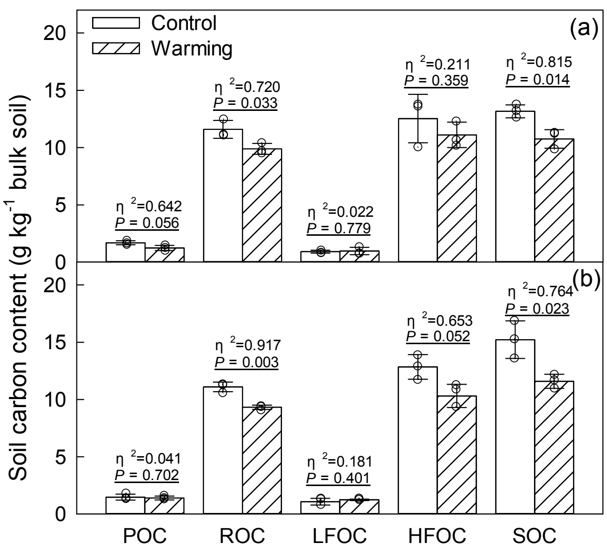
Preliminary Findings in Coniferous and Broadleaved Mixed Forest

The P availability increased but the NO_3^-–N concentration decreased under warming in both wet and dry seasons. However, warming had no effect on exchangeable NH_4^+–N concentration.
(Lie et al, 2019 Biol Fertil Soils)

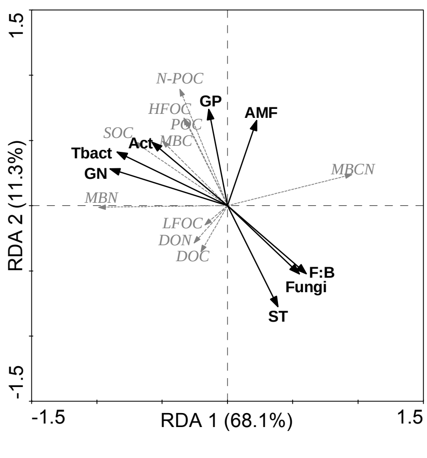


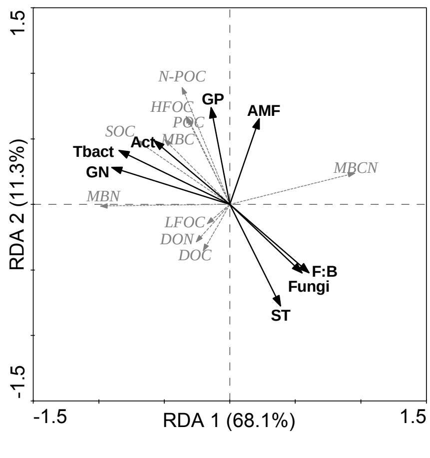
Warming led to higher BG and NAG activities and lower AP activity in the two seasons. Enhanced BG and NAG activity by warming suggested that more nutrient substrates were decomposed. Besides, warming might reduce microbial demands for available P and investment in AP enzyme synthesis.





Warming significantly decreased the total SOC content by 21.1% and decreased the mineral-associated organic C by an average of 14.8%. The decline in the N-POC was highly correlated to the increases in the relative abundance of fungi, oxidase and mass-specific oxidase activities. Our results suggest that climate warming may increase the potential for fungal decomposition of mineral-associated organic C by increasing oxidase activities, leading to greater C losses than previously estimated in the subtropical forest.
(Fang et al, SBB under review)

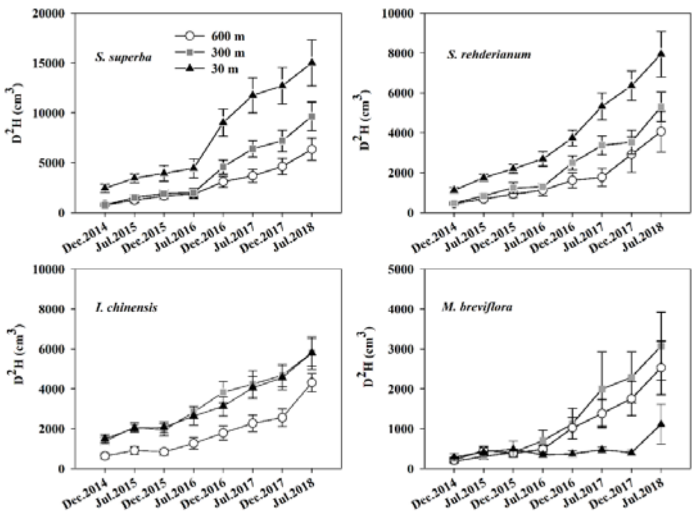




Preliminary Findings in Mountain Evergreen Broadleaved Forest

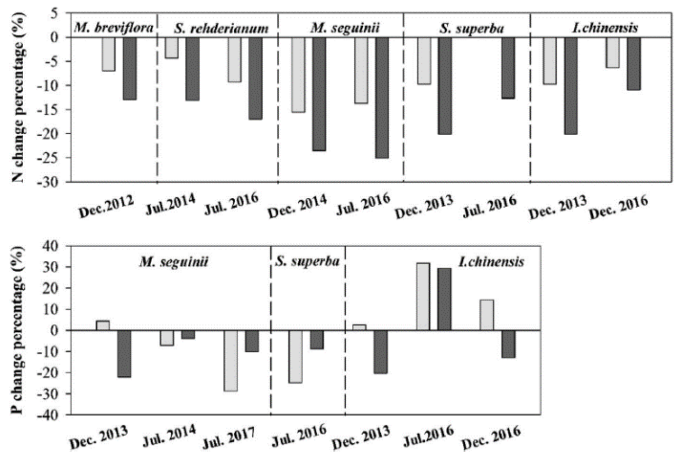
Plant growth

Warming significantly increased the growth of *Schima superba*, *Syzygium rehderianum and Itea chinensis*, but decreased the growth of *Machilus breviflora*.



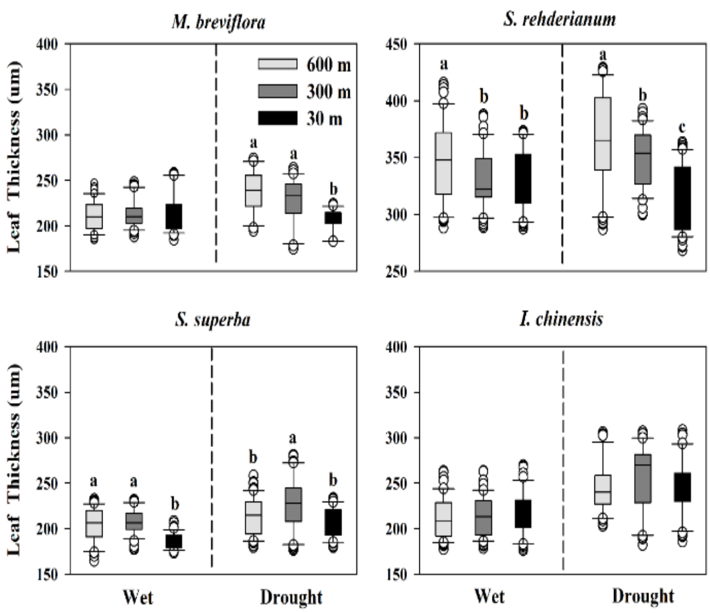
Leaf nutrients

Warming decreased leaf N concentrations in all plant species. However, there was no consistent pattern for the effects of warming on P concentrations in the leaves of all species.
(Wu et al, 2019 Plant Ecology)



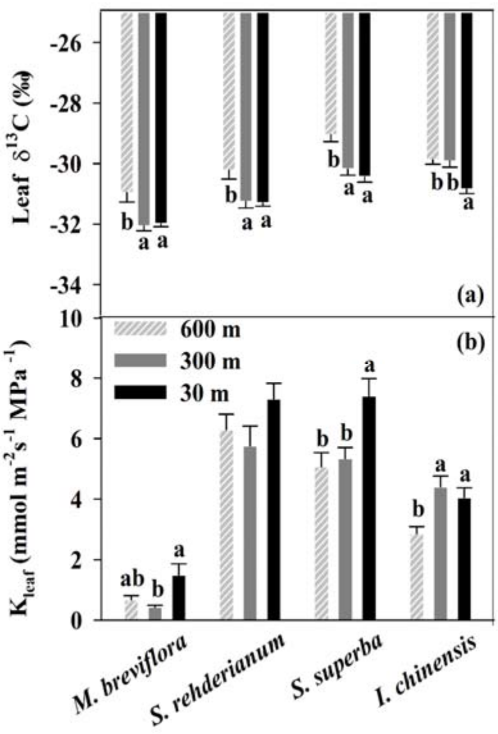
Leaf thickness

Warming significantly decreased leaf thickness of *Machilus breviflora*, *Syzygium rehderianum*, *Itea chinensis* and *Schima superba*.



Leaf hydraulic traits

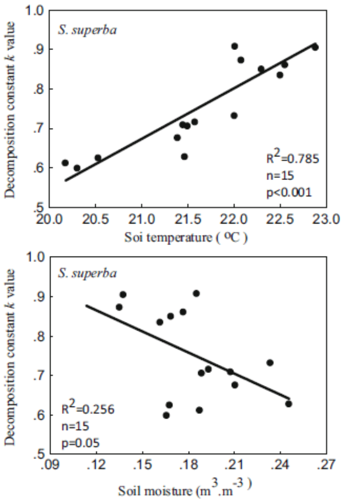
Leaf $\delta^{13}C$ decreased but leaf hydraulic conductance increased under warming for these four tree species.

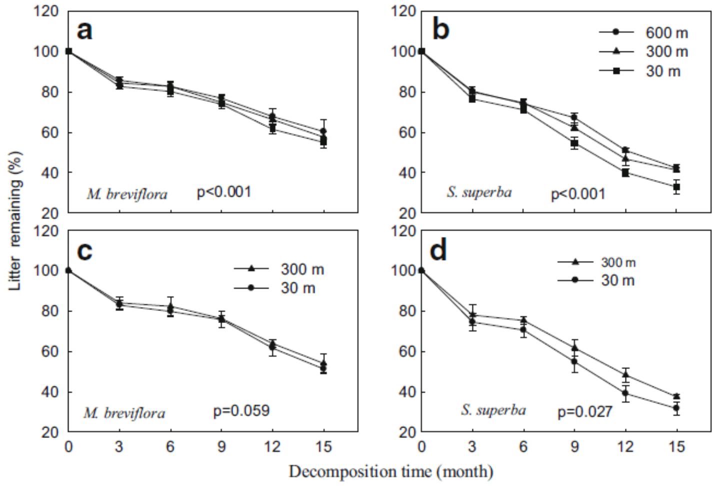


Litter decomposition

Leaf litter decomposition was facilitated by experimental warming in model forests. The litter with high quality (*Schima superba*) had stronger response to warming than low quality litter (*Machilus breviflora*). Litter decomposition was controlled by the order: soil temperature > litter quality > soil moisture > litter incubation forest type under experimental warming in the subtropical China.

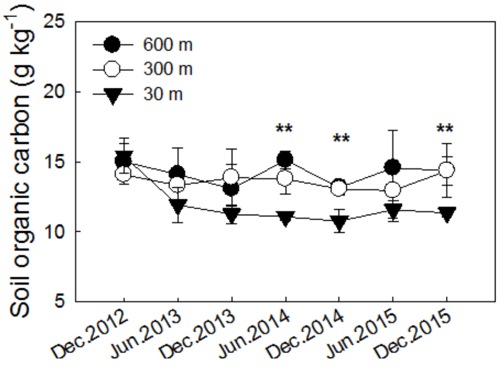
(Liu et al, 2017 Plant and Soil)

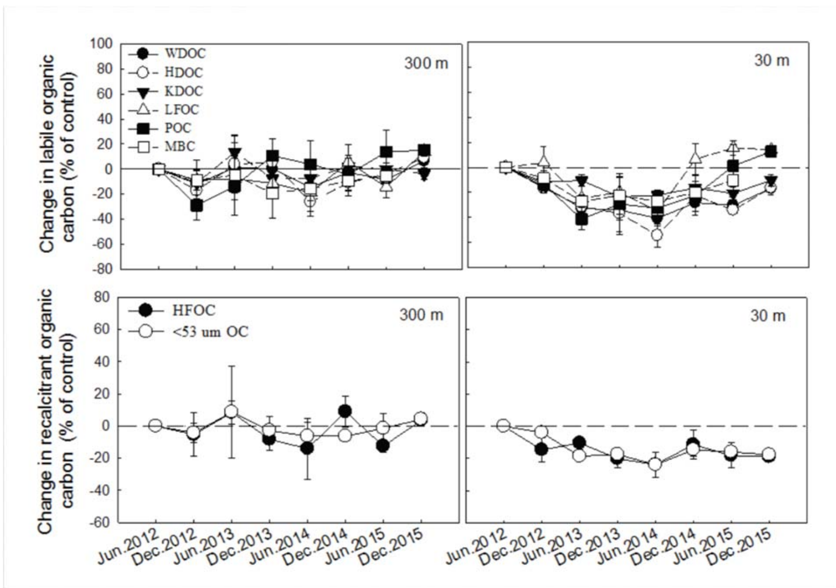


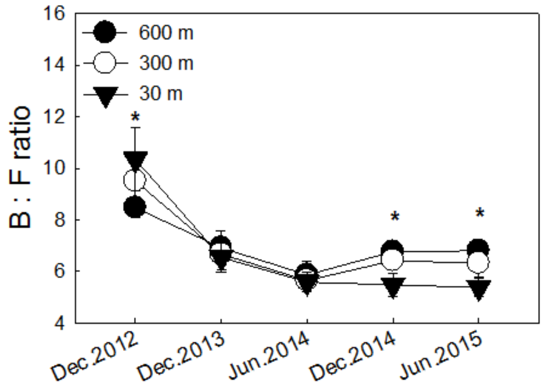


Soil carbon dynamics

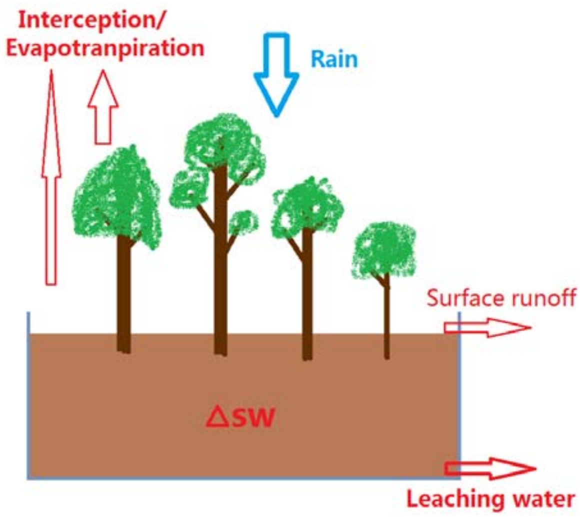
Soil warming changed the composition of microbial communities and enhanced the recalcitrant C acquisition for phenol oxidase and peroxidase, which may lead to greater microbial mediated C losses than previously estimated in subtropical forest.



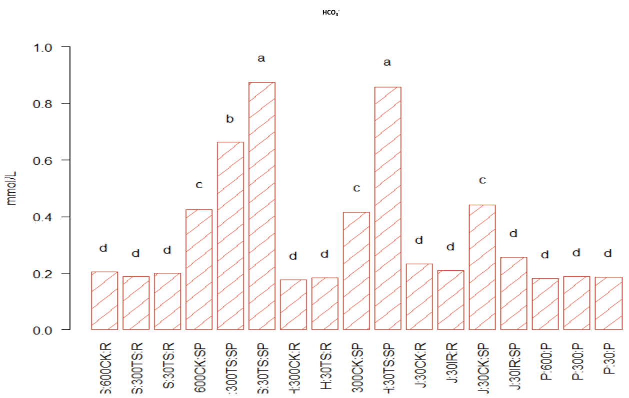


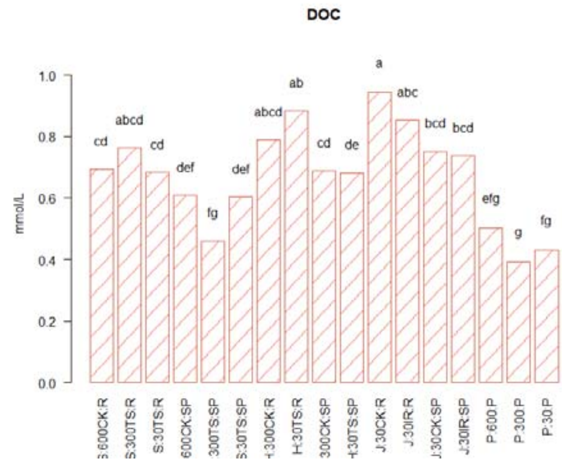


Preliminary Findings in Mountain Evergreen Broadleaved Forest

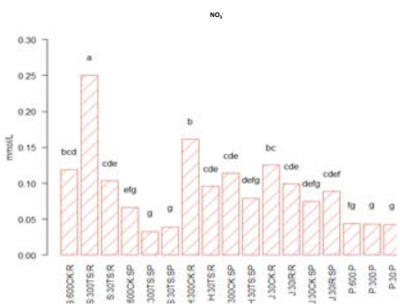


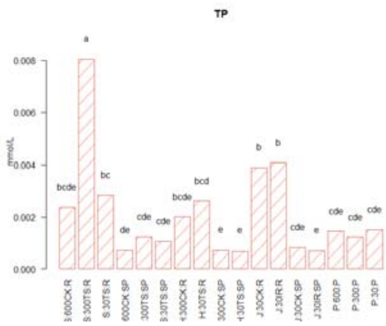
How do hydrological processes of ecosystem change after warming?

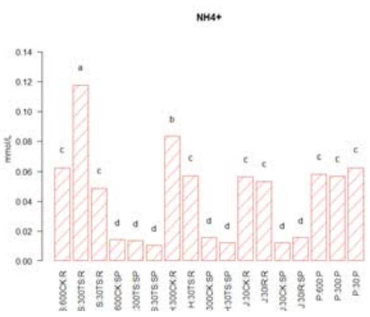


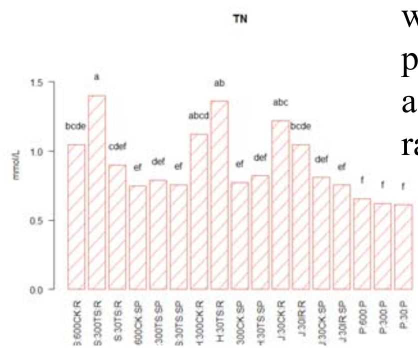


While the concentration of HCO_3^- in surface water of 3 forests and precipitation had no difference, the warming aggravated the loss of HCO_3^- in leaching water in MTEBF and CBMF, and had no significant impact on DOC. It suggested that warming enhanced soil C mineralization. But in MEBF, the concentration of HCO_3^- in leaching water decreased with warming, causing the soil temperature didn't increase so much as air under warming of infrared radiators.









The concentration of N and P in surface water at 300 m site was highest, both in MTEBF and CBMF, while it had no difference in MEBF. And the soil water content at 300 m site was higher than the other 2 sites and infrared radiators warming MEBF, which implied that the leaching processes of N and P was more affected by the soil water content rather than temperature.