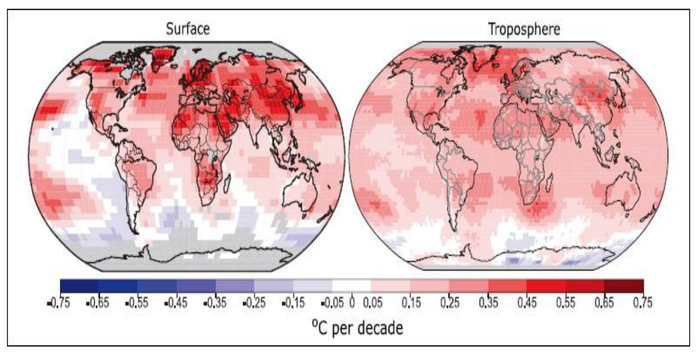
Dinghushan Forest Ecosystem Research Station, Chinese Academy of Sciences

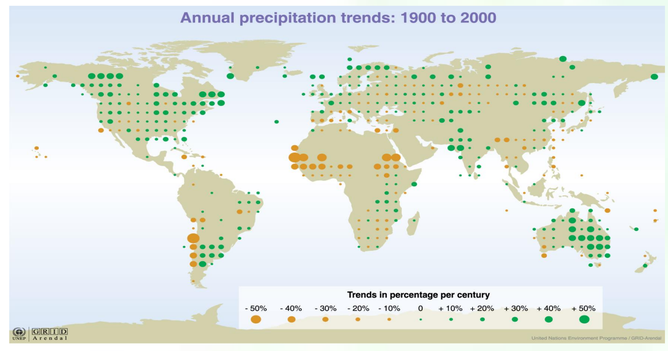
Rainfall Manipulation Experiment Platform

1、Research Background

Since the industrial revolution, human activities especially the extensive using of fossil fuel and large-scale deforestation emit a large number of CO_2 and other greenhouse gas to the atmosphere, causing global warming and changes in rainfall pattern.

1) Global Scale



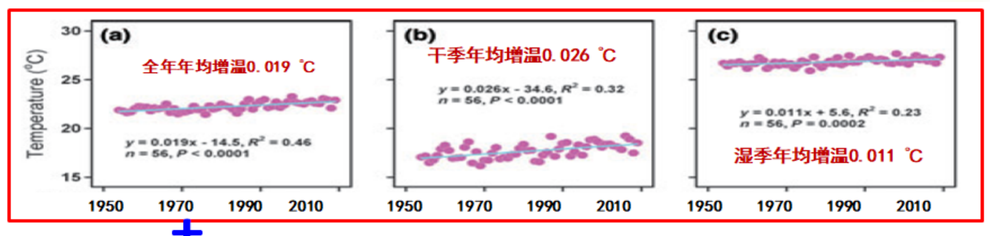


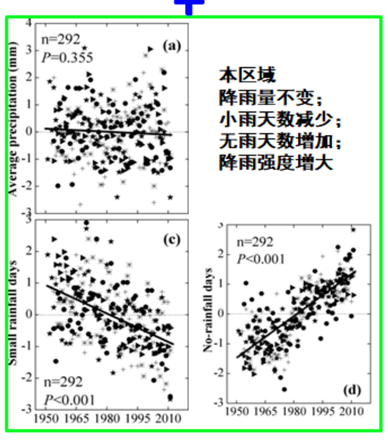
Global warming→Earth energy balance→Water cycle process→Rainfall pattern

2、Research Objectives

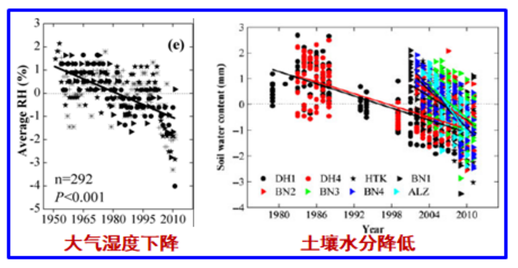
1. evaluate the effects of rainfall changes on soil carbon dynamics;
2. explore the underlying mechanism;
3. reveal the potential interaction effects between rainfall change and nitrogen deposition.

2) Dinghushan Forest Ecosystem





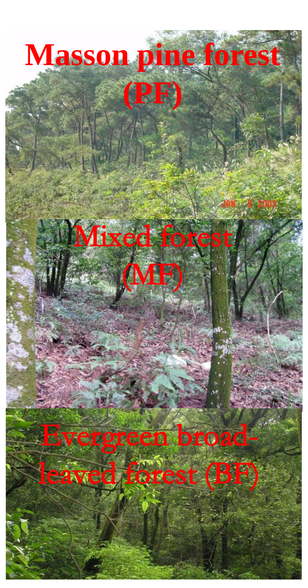
气温上升 + 降水格局改变 ⇨ 环境变干

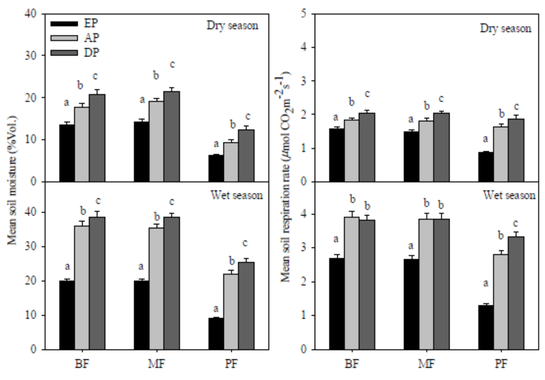


Total annual precipitation changed little from 1950 to 2009, with decrease in the annual number of no-rain days and increased in the annual proportional amount of rainfall with intensity 50–100 mm day^{-1} Accordingly, soil moisture decreased significantly (Zhou et al., GCB, 2011).

3、Experimental design and results

1) Altered precipitation（2007-2010）



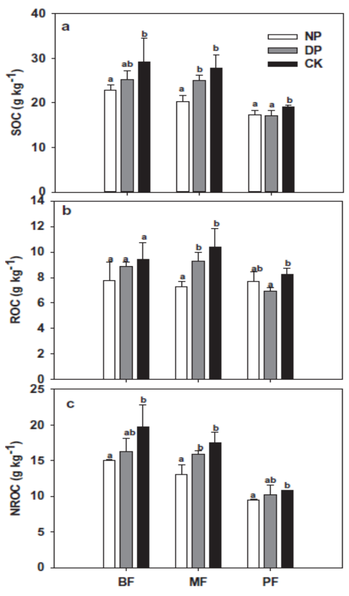


Deng et al., Plos One, 2012

$$R = (a + c \cdot M) \cdot e^{b \cdot T}$$

Forest types	Treatment	a	c	b	R^2
PF	EP	0.080 ± 0.010^a	0.010 ± 0.002^a	0.082 ± 0.005^a	0.82^{**}
	AP	0.269 ± 0.033^b	0.011 ± 0.004^a	0.066 ± 0.006^a	0.75^{**}
	DP	0.254 ± 0.015^b	0.007 ± 0.001^a	0.079 ± 0.003^a	0.93^{**}
MF	EP	0.256 ± 0.022^a	0.011 ± 0.002^a ↑	0.070 ± 0.002^a	0.87^{**}
	AP	0.570 ± 0.040^b	0.006 ± 0.001^b	0.066 ± 0.003^a	0.80^{**}
	DP	0.808 ± 0.0468^c	0.0078 ± 0.002^b	0.056 ± 0.003^b ↓	0.79^{**}
BF	EP	0.194 ± 0.040^a	0.018 ± 0.004^a ↑	0.066 ± 0.005^a	0.59^{**}
	AP	0.549 ± 0.0368^b	0.008 ± 0.001^b	0.065 ± 0.003^a	0.83^{**}
	DP	0.716 ± 0.027^c	0.009 ± 0.001^b	0.054 ± 0.002^b ↓	0.91^{**}

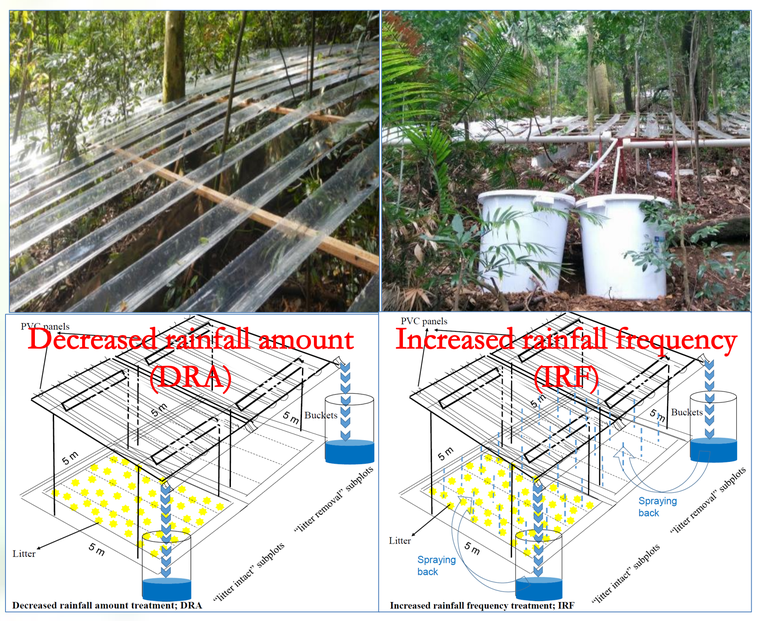
Jiang et al., Biogeosciences, 2013

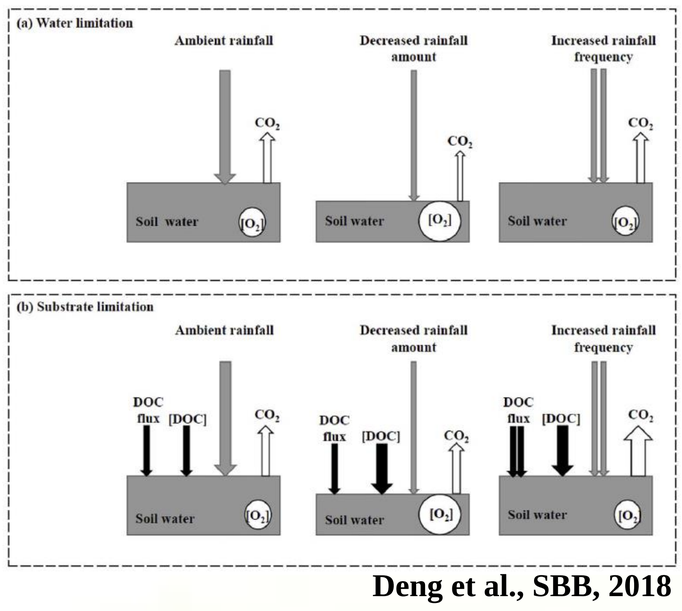


Chen et al., JPE, 2015

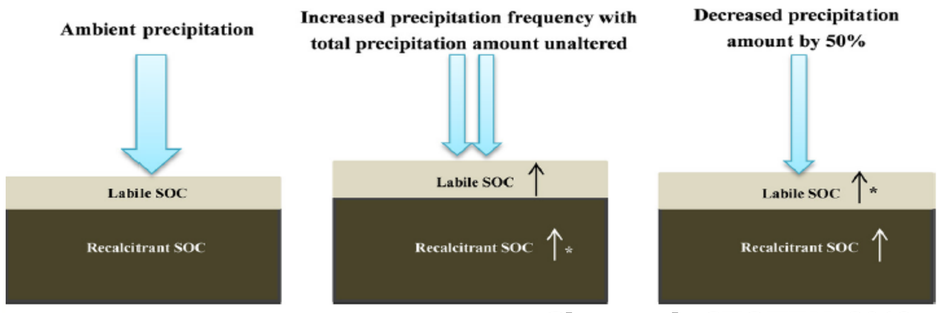
Changes of precipitation significantly altered soil respiration and its temperature / moisture sensitivities, as well as soil organic carbon fractions.

2) Altered rainfall frequency（2013-2017）





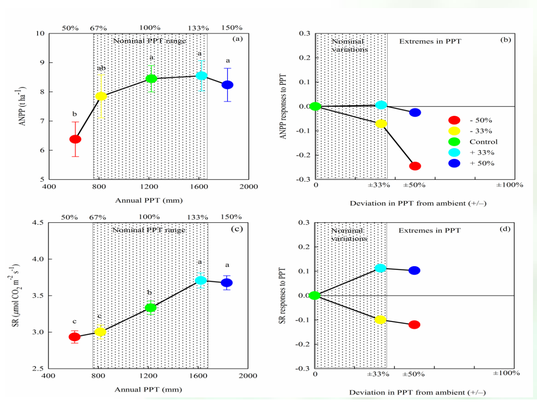
Deng et al., SBB, 2018



Chen et al., STOTEN, 2018

Increased rainfall frequency accelerated the rate of litter decomposition, causing 27% increase of DOC through leaching from litter layer into the soil, hence stimulated microbial activity and soil respiration by 17%, and also altered soil organic carbon fractions.

3) Multi-gradient precipitation change（2015- ）



Deng et al., AGEE, 2017

The responses of ANPP and soil respiration to precipitation change showed two nonlinear but asynchrony patterns, suggesting that extreme wet or dry conditions may shift ecosystem from carbon accumulation toward debt.

4) Nitrogen-water interaction（Conducting…）