



The 17th US-China Carbon Consortium Annual Meeting

Brief introduction of the Chongqing Jinfo Mountain Karst Ecosystem

National Observation and Research Station

重庆金佛山喀斯特生态系统国家野外科学观测研究站

Mingguo Ma

Chongqing Beibei, August 1st, 2021



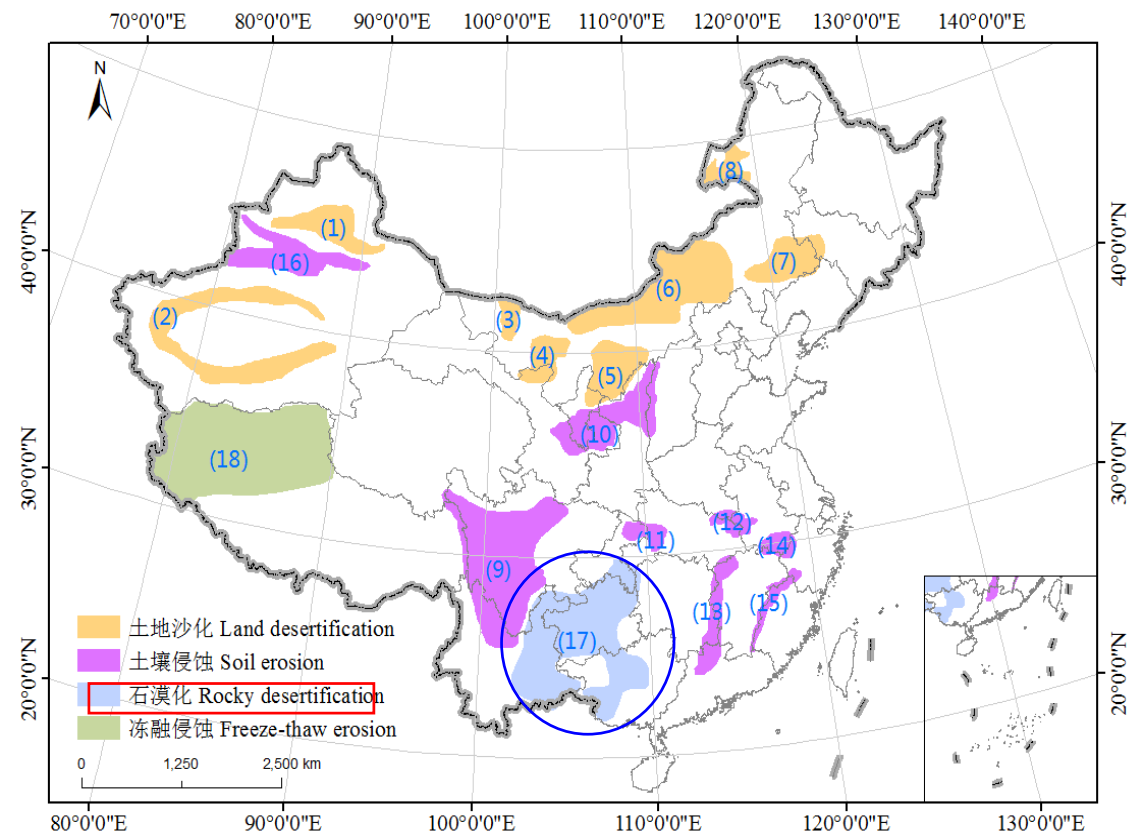
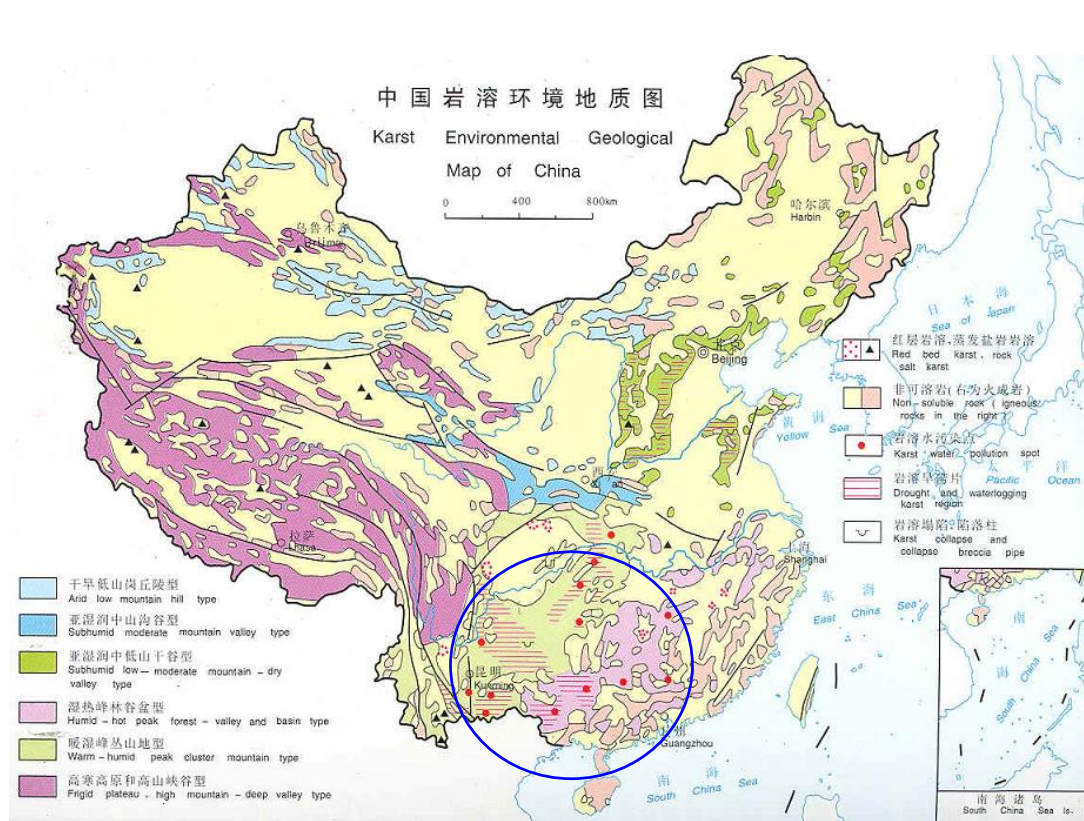


1. Background (背景)
2. Present basis (现有基础)
3. Development plans (发展规划)
4. Capability construction (能力建设)



1.1 Representativeness and significance 代表性和科学意义

Southwest China is **the largest continuous karst outcrop in the world** and **one of the four ecologically fragile areas in China**. Therefore the region is one of the main battlefields for the construction of ecological civilization in China. 中国西南地区是**全球最大范围的喀斯特连续出露地区**，也是我国的**四大生态环境脆弱区**之一，因此该地区是我国生态文明建设的主战场之一。

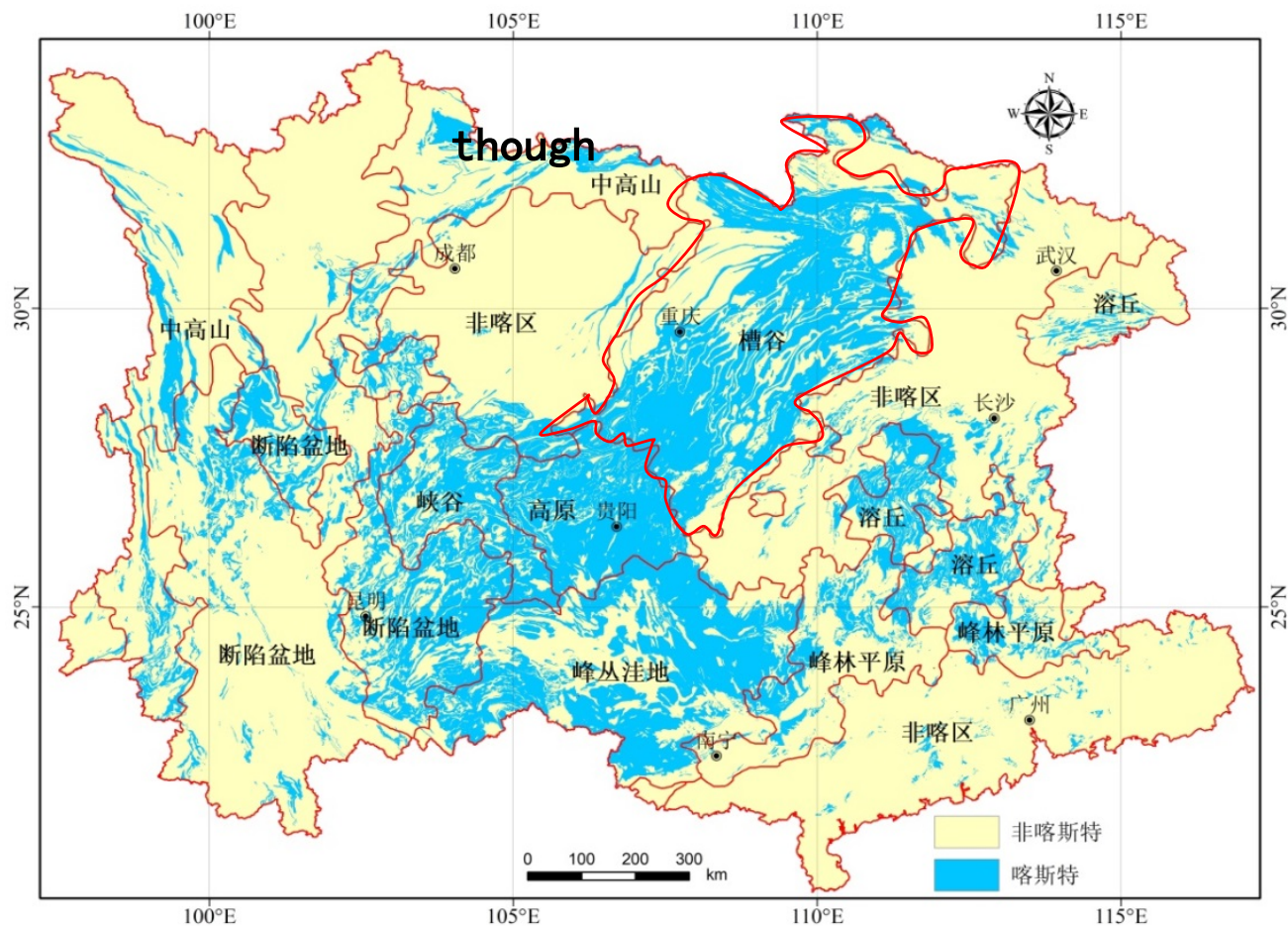




1.1 Representativeness and significance 代表性和科学意义

The southwest region mainly includes six typical karst landforms. Karst troughs are mainly located in Chongqing and surrounding areas, and are the largest in area among all karst types.

西南地区主要包括6种典型喀斯特地貌类型：峰林平原、峰丛洼地、**喀斯特槽谷**、喀斯特高原、喀斯特峡谷和断陷盆地。**喀斯特槽谷**主要分布在重庆及周边地区，面积最大的类型。



1.1 Representativeness and significance 代表性和科学意义

Landform features:

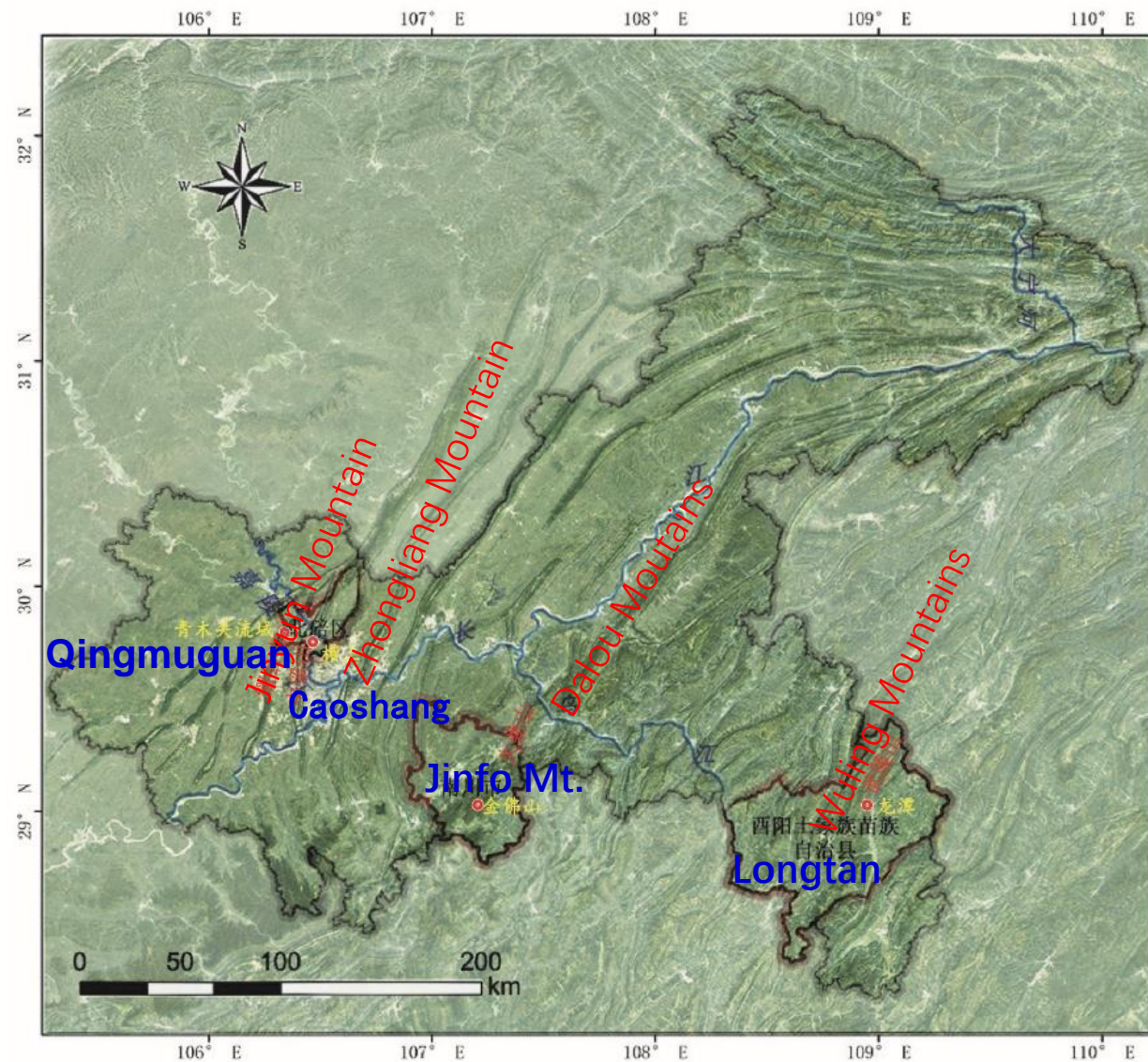
The paralleled ridge-valley of east Sichuan is the most typical folded mountain and paralleled ridge-valley landform in the world.

川东平行岭谷是世界上最为典型的褶皱山地和平行岭谷地貌。

Regional representation:

The karst trough, most typical of the paralleled ridge-valley in east Sichuan, has strong human activities and is one of the regions with serious rocky desertification in southwest China.

喀斯特槽谷，以川东平行岭谷最为典型，人类活动强烈，为西南石漠化严重的区域之一。





1.2 Construction mode of the station 建站模式



The building mode of Jinfo Mountain Station is “one station, multiple”.

金佛山站采用一站多点的模式建站

The “one station” is located at Jinfo Mountain. 一站位于金佛山。

(1) The Jinfo Mt. has the complete distribution of stratigraphy and lithology, including the main karst lithology types in southwest China. 地层、岩性分布齐全，包含了西南主要喀斯特岩性类型

Limestone of Permian
Qixia Formation 二叠系
栖霞组石灰岩

Silurian shale and
siltstone 志留系的
页岩、粉砂岩

Cambrian and Ordovician
limestone and dolomite 寒武
系、奥陶系的石灰岩、白云岩





1.2 Construction mode of the station 建站模式

(2) Significant vertical climate variation

There is a gradual transition from a **subtropical humid monsoon climate** at the foot of the mountain to a **temperate climate** at the top of the mountain.

由山麓的**亚热带湿润季风气候**逐渐过渡为山顶的**温带气候**。



(3) Abundance of species

The rare biological gene pool in the southwest of China is one of **the richest in biodiversity** at the same latitude.

我国西南地区罕见的生物基因库，是同纬度**生物多样性最为丰富**的地区之一。



"Plant Panda"
Cathaya argyrophylla
“植物熊猫”银杉



Dove tree
珙桐



1.2 Construction mode of the station 建站模式



The building mode of Jinfo Mountain Station is “one station, multiple”.

金佛山站采用一站多点的模式建站

The “multiple points” include:

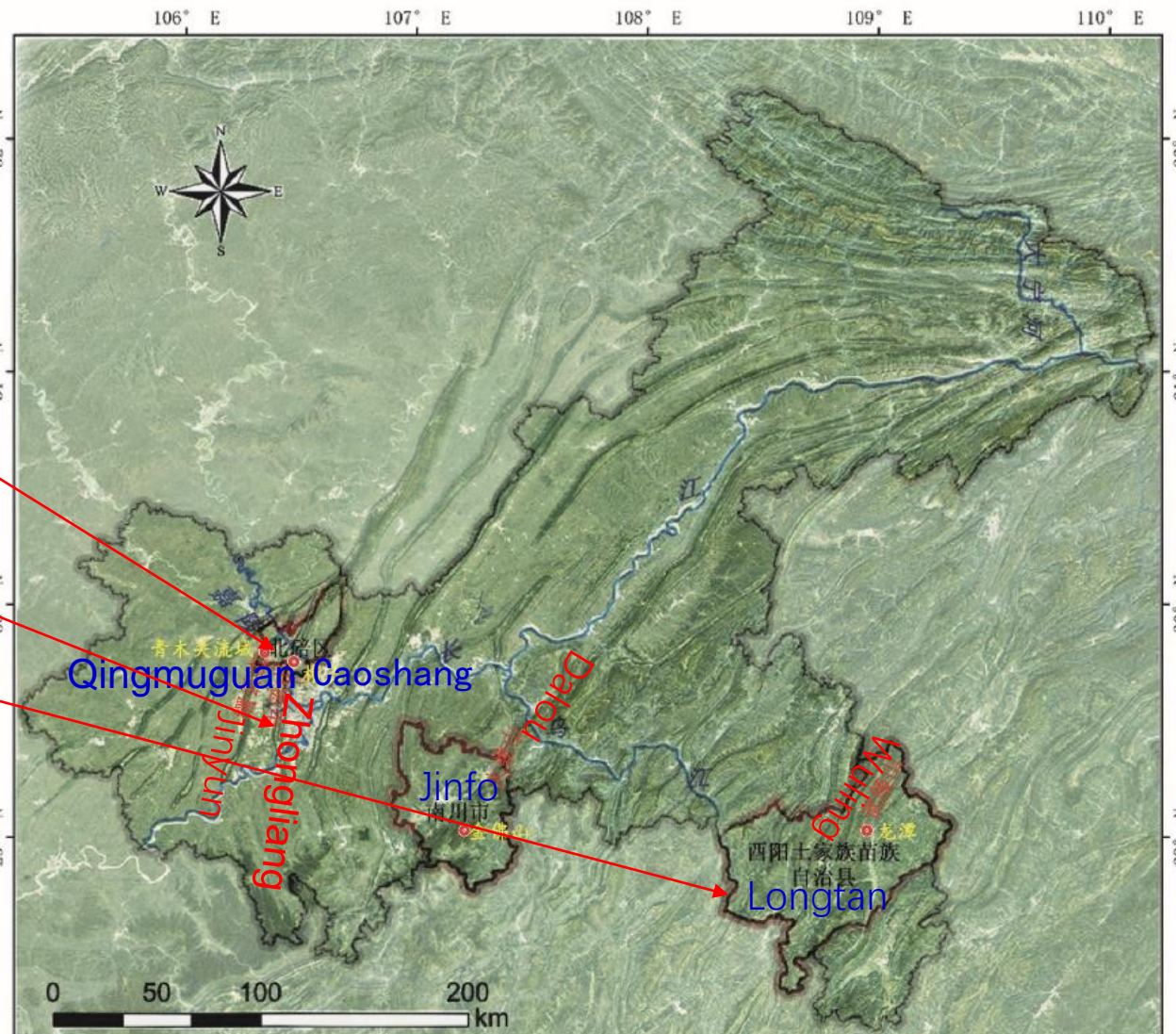
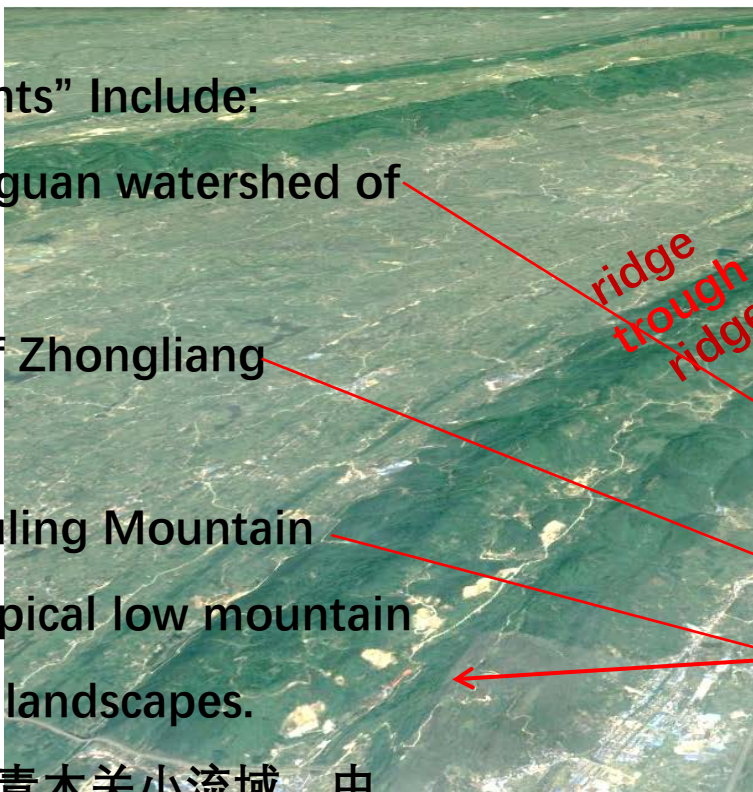
(1) the Qingmuguan watershed of Jinyun Mountain

(2) Caoshang of Zhongliang Mountain

(3) Longtan of Wuling Mountain

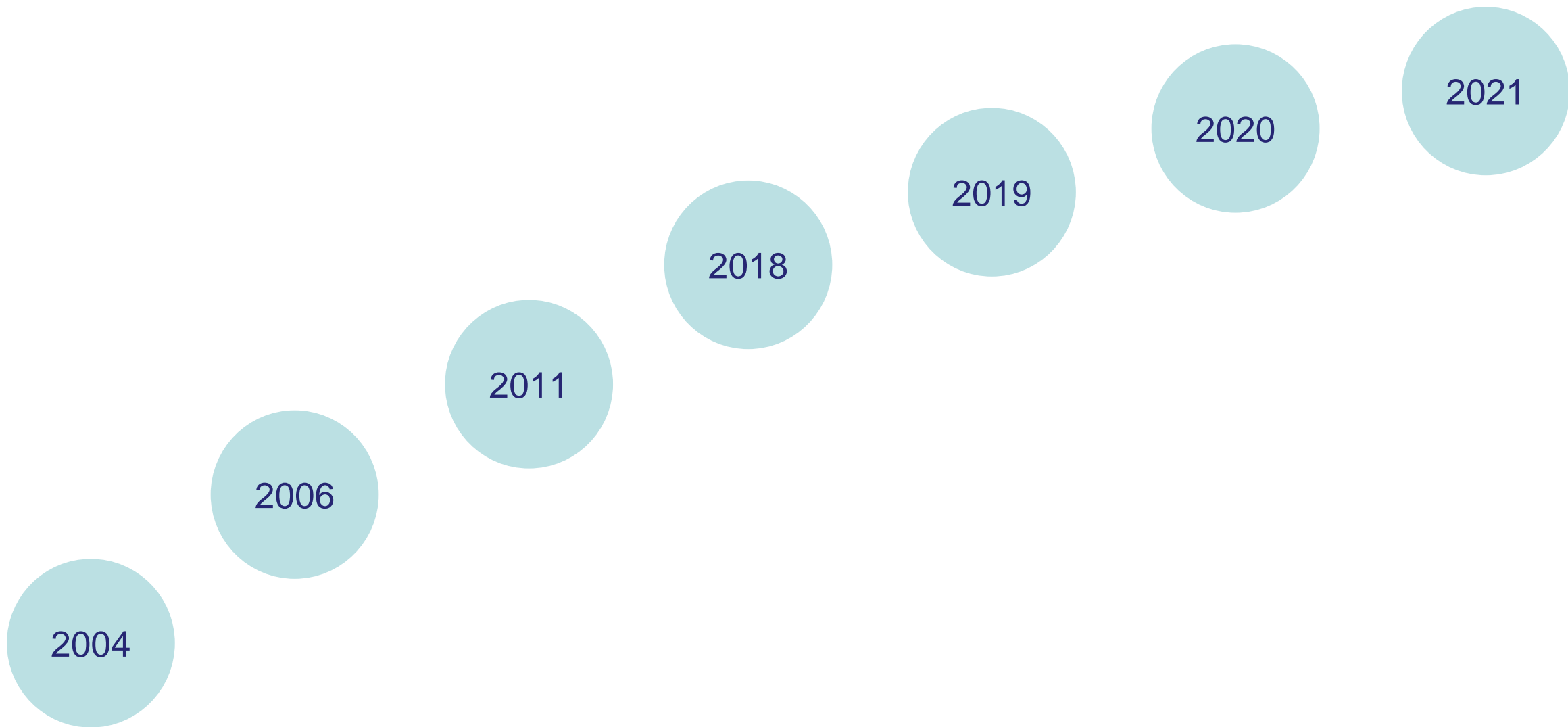
all of which are typical low mountain trough and valley landscapes.

多点包括：缙云山青木关小流域、中梁山槽上和武陵山龙潭、是典型的低山槽谷地貌类型。





1.3 Construction mode of the station 历史沿革



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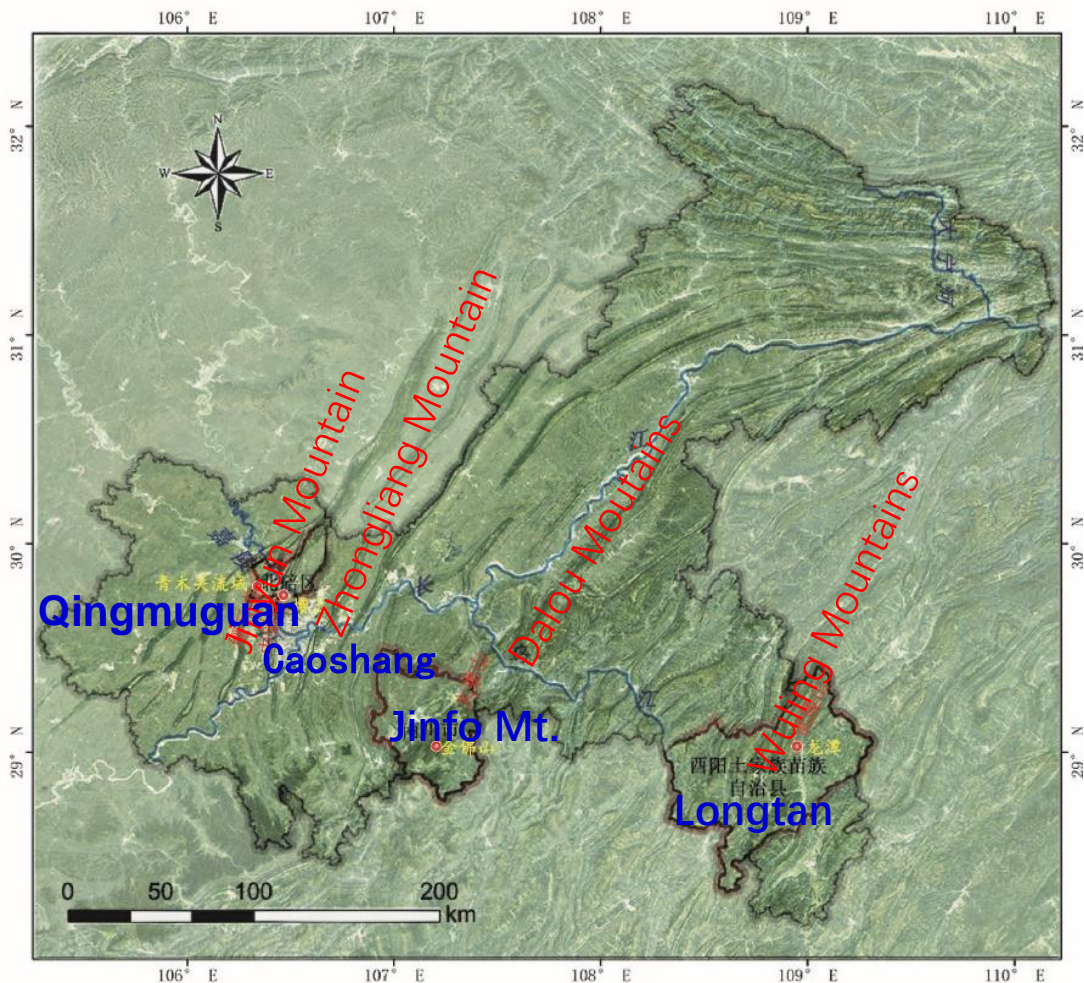
社



1. Background (背景)
2. Present basis (现有基础)
3. Development plans (发展规划)
4. Capability construction (能力建设)



In the paralleled ridge-valley of east Sichuan, four ridge and valley of Dalou Mountain, Jinyun Mountain, Zhongliang Mountain and Wuling Mountain were selected to deploy observation sites for field stations.
在川东平行岭谷选择了大娄山、缙云山、中梁山和武陵山4条岭谷布设野外站的观测场。



Jinfo Mountain: Mainly in the natural state

Observation objectives:

- Forest community dynamics and renewal mechanisms
- biodiversity conservation, impact of human activities on karst aquifers
- cave response to climate change.

金佛山: 自然状态为主

观测目标: 森林群落动态与更新机制、生物多样性保护、人类活动对岩溶含水层影响、洞穴对气候变化响应

The Qingmuguan watershed of Jinyun Mountain:

Strong early human activity, better recovery

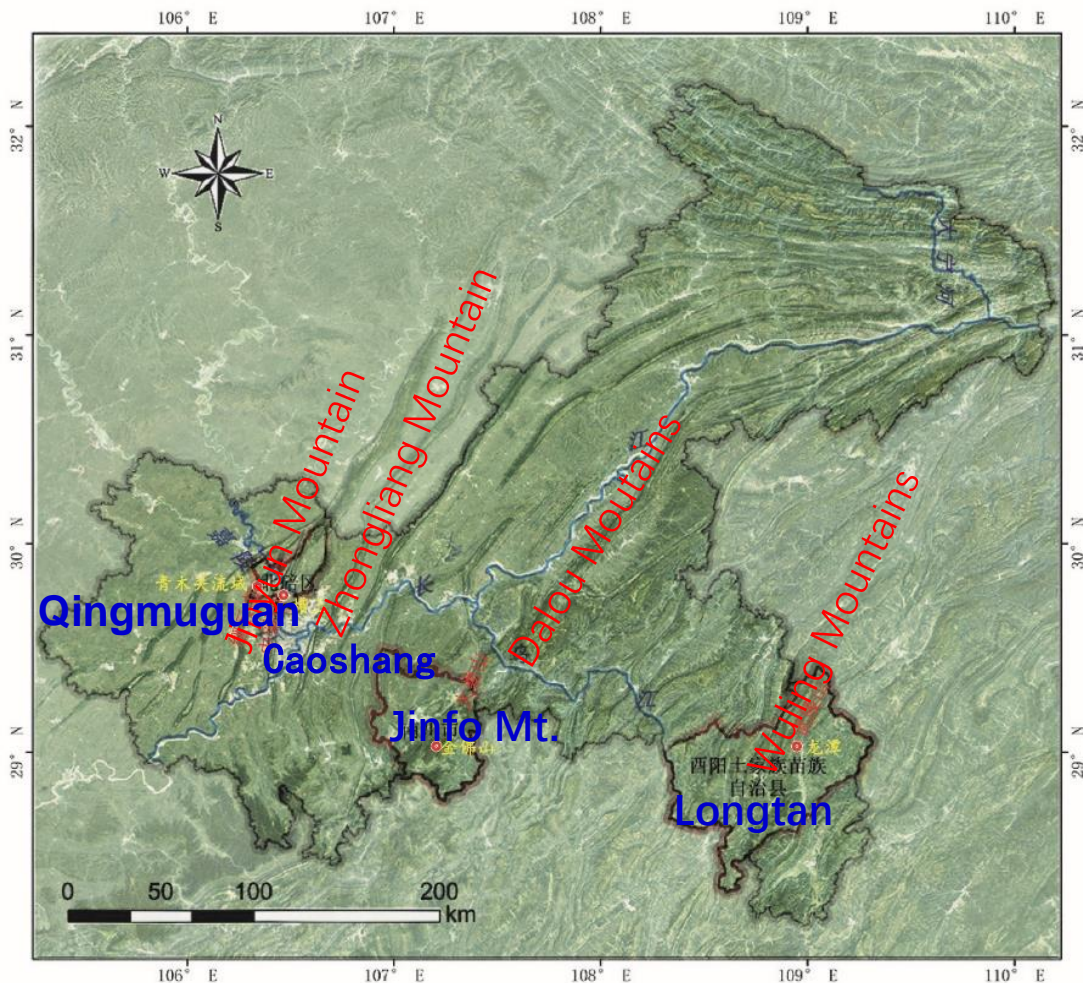
Observation objectives:

- Ecohydrological process cycles in critical zones,
- development of complex surface land surface process
- models, and remote sensing in mountainous areas.

缙云山青木关流域: 早期人类活动强烈, 恢复较好

观测目标: 关键带生态水文过程循环、复杂地表陆表过程模型发展、山地遥感

In the paralleled ridge-valley of east Sichuan, four ridge and valley of Dalou Mountain, Jinyun Mountain, Zhongliang Mountain and Wuling Mountain were selected to deploy observation sites for field stations.
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Caoshang of Zhongliang Mountain:

Strong human activities, rocky desertification management area

Observation objectives: Controlled tests of ecological restoration, effects of tunneling on ecohydrological processes.

中梁山槽上:

人类活动强烈，石漠化治理区

观测目标：生态恢复控制性试验、隧道工程对生态水文过程影响

Longtan of Wuling Mountain:

Strong human activities, rocky desertification management area

Observation objectives: Model of rocky desertification management, demonstration of efficient use of water resources.

武陵山龙潭:

人类活动强烈，石漠化治理区

观测目标：石漠化治理模式、水资源高效利用示范



2.1 Experimental observation site and infrastructure 观测场和仪器配置



金佛山

监测内容:

次生林

烂坝菁 (60-70年)
山王坪 (10-20年)

地下河出口

水房泉 (固定断面)
碧潭泉 (固定断面)

喀斯特洞穴

羊口洞
金岚洞

繁育基地

三泉道地药材
华耳寺道地药材
滥坝菁银杉

Jinfo Mountain

Monitoring items:

Secondary forest

Lanbajing
(60-70 years)
Shanwangping
(10-20 years)

Underground river exit

Shuifangquan
(fixed section)
Bitanquan
(fixed section)

Karst cave

Yangkou Cave
Jinlan Cave

Breeding base

Sanquan authentic herbs
Huaersi authentic herbs
Lanbajing Cathaya argyrophylla





2.1 Experimental observation site and infrastructure 观测场和仪器配置



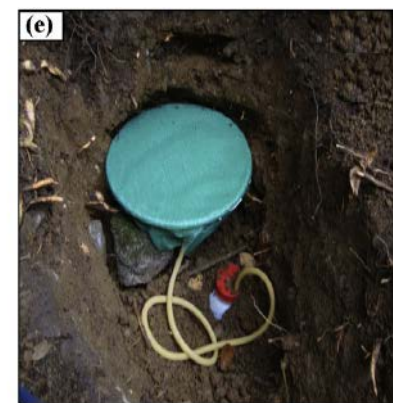
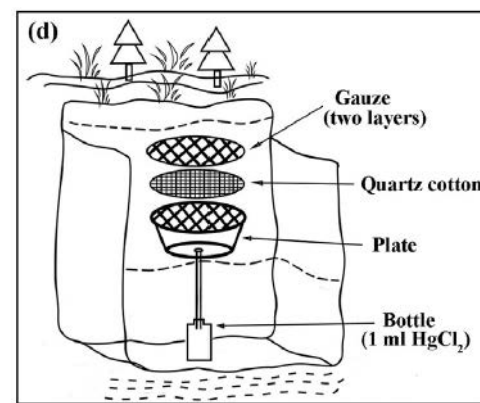
Shanwangping automatic weather station & vortex system
山王坪自动气象站&涡动系统



Shuifangquan underground river outlet hydrographic section
水房泉地下河出口水文断面



Trunk sap flow and evapotranspiration meter
树干液流和蒸渗仪



Drip observation in Yangkou Cave
羊口洞洞穴滴水观测



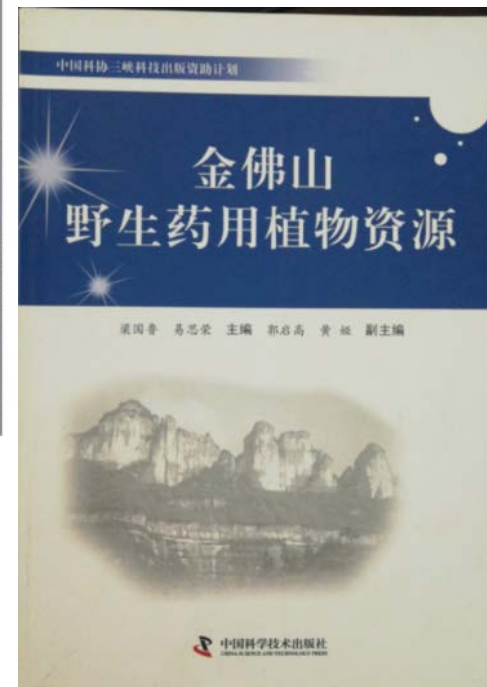
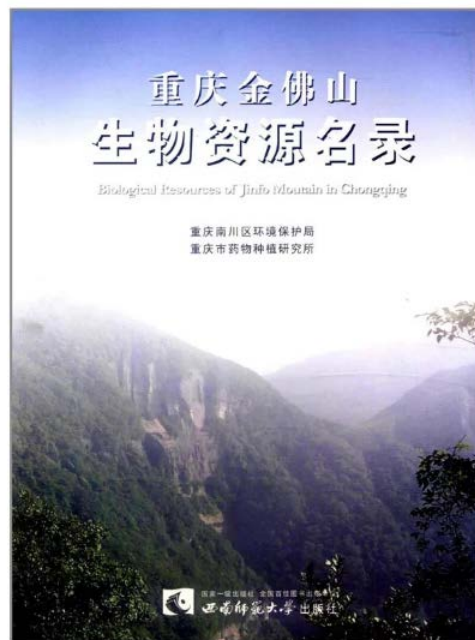
2.1 Experimental observation site and infrastructure 观测场和仪器配置



The selection and breeding base of authentic herbs
道地药材良种选育基地

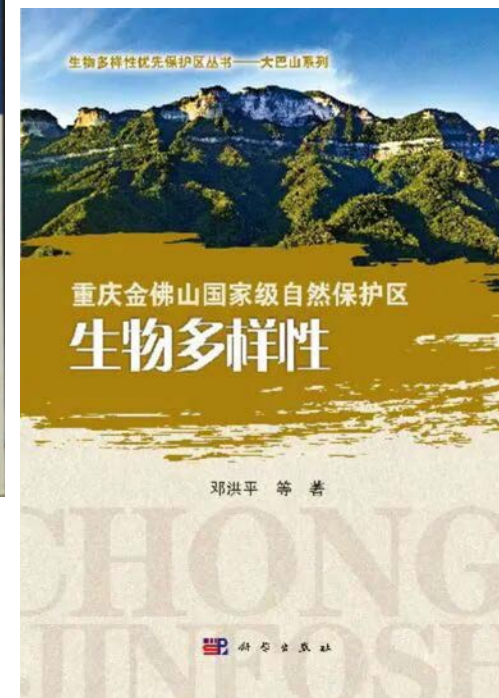


Breeding base for *Cathaya argyrophylla*
银杉繁育基地



Biodiversity survey results of Jinfo Mountain
from 2012-2014

2012-2014年金佛山生物多样性调查成果

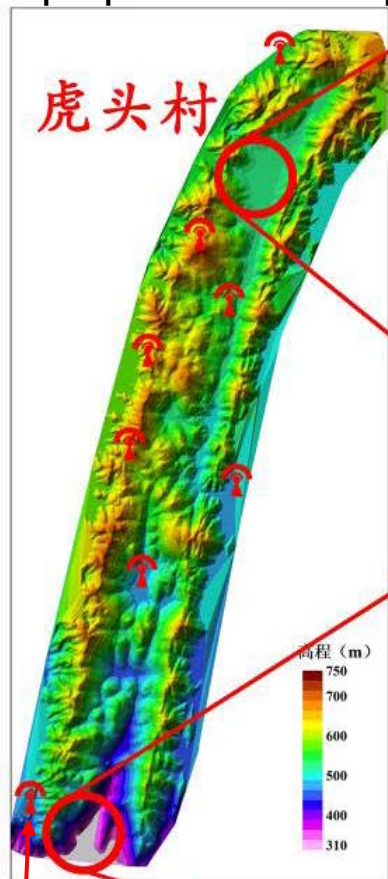




2.1 Experimental observation site and infrastructure 观测场和仪器配置



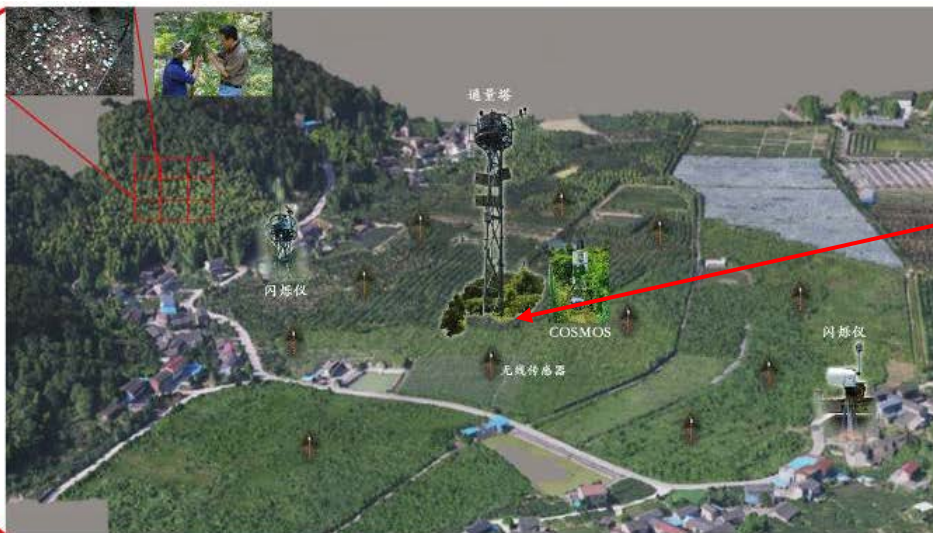
马尾松森林样地
Forest sample plot of horsetail pine



姜家泉

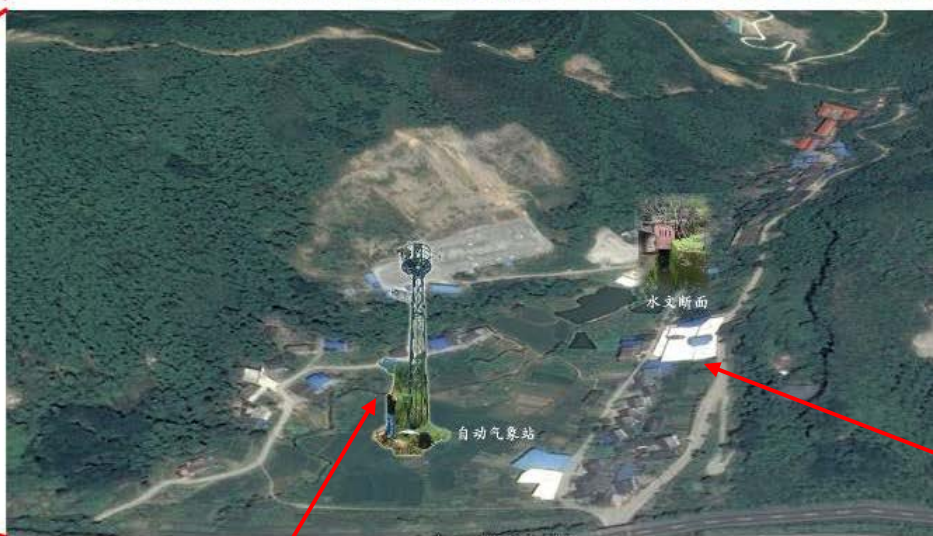
Gradient precipitation
SM、Small sample plot

梯度降水、土壤水分、小样地



Multi-scale
remote sensing
observation field
in the upper
watershed

流域上游
多尺度遥
感观测场



Hydrographic cross section of the
underground river at the outlet
of the watershed

流域出口地下河水文断面

Automatic weather station at
the outlet of the watershed

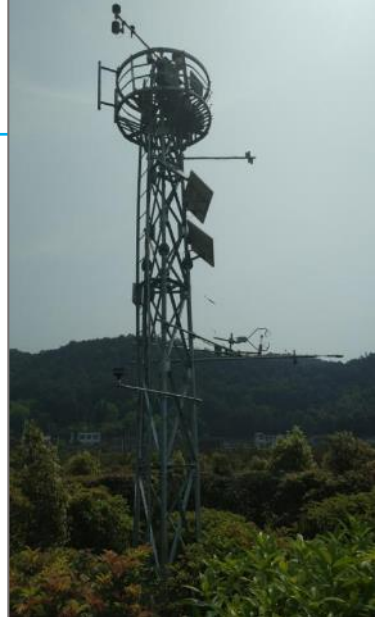
流域出口自动气象站



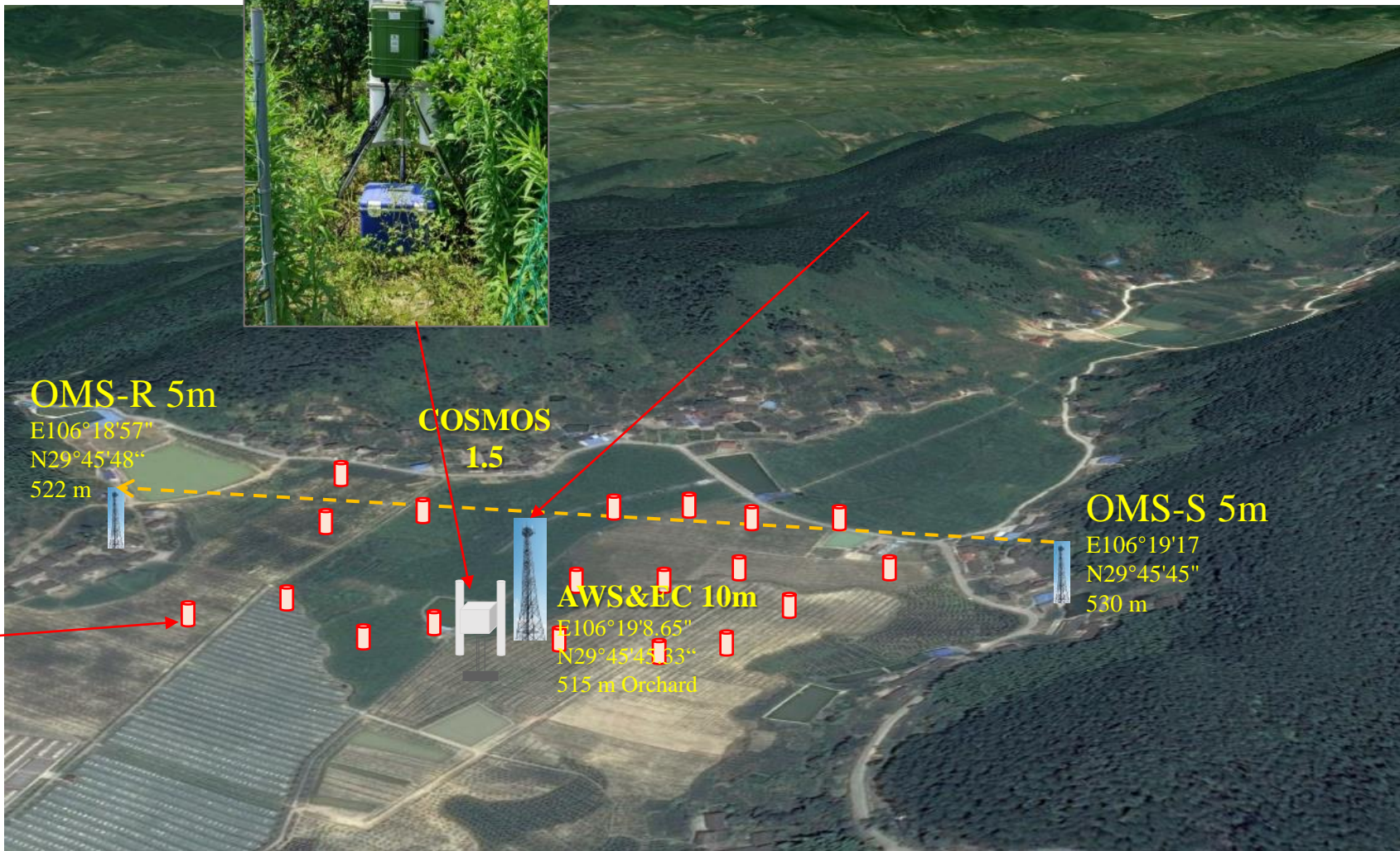
Large aperture scintillator
Microwave scintillation
大孔径闪烁仪
微波闪烁仪



Regional soil moisture
区域土壤水分



Automatic weather
stations
Eddy system
Vegetation
fluorescence
自动气象站
涡动系统
植被荧光



OMS-R 5m
E106°18'57"
N29°45'48"
522 m

COSMOS
1.5

AWS&EC 10m
E106°19'8.65"
N29°45'43.83"
515 m Orchard

OMS-S 5m
E106°19'17"
N29°45'45"
530 m

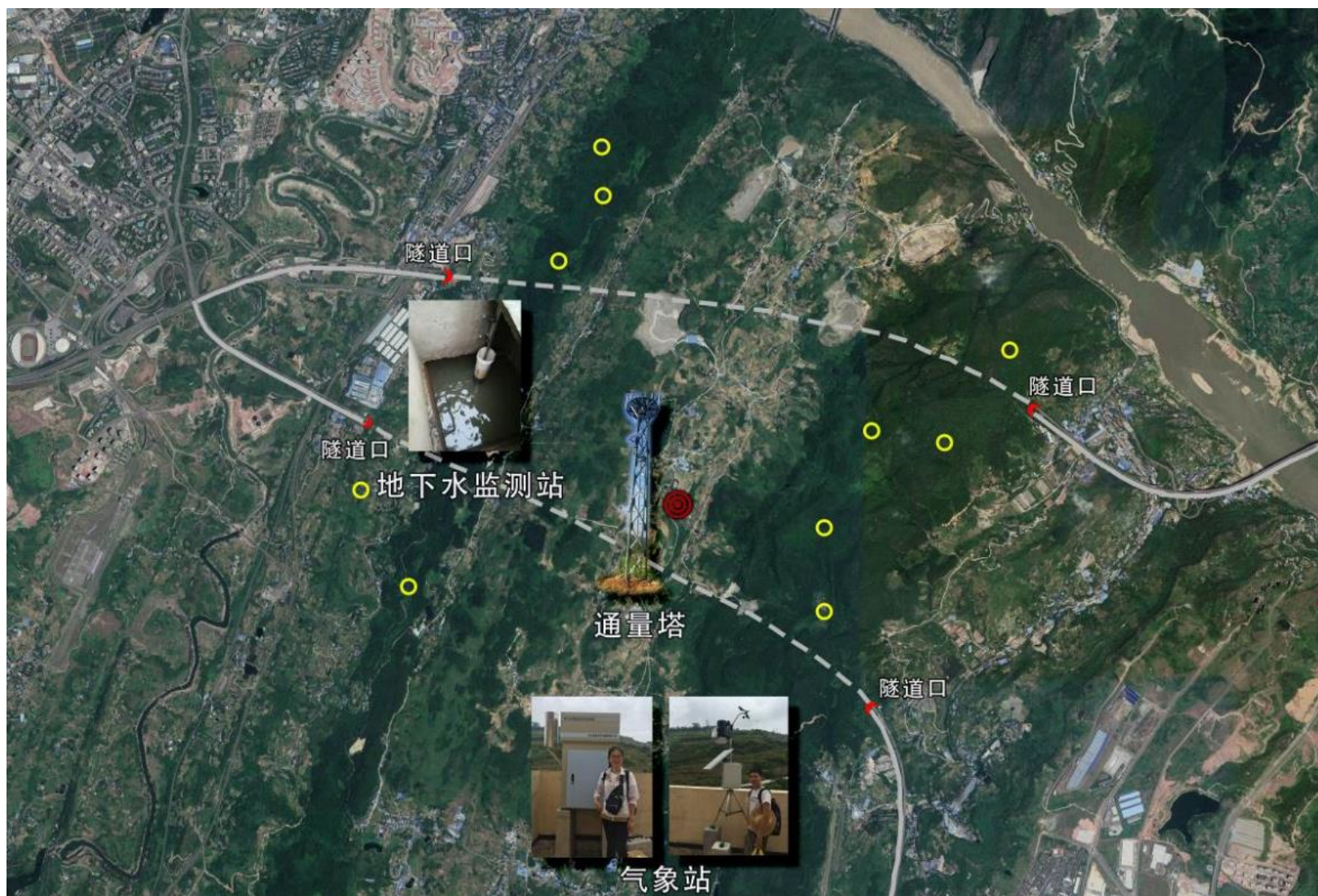


Wireless Sensor Networks
(WSN) 无线传感器网络 (WSN)

Multi-scale remote sensing observation site in Hutoucun
虎头村多尺度遥感观测场



2.1 Experimental observation site and infrastructure 观测场和仪器配置



Ecological restoration observation site of rocky desertification at Caoshang on Zhongliang Mountain

中梁山槽上石漠化生态恢复观测场



2.1 Experimental observation site and infrastructure 观测场和仪器配置



Observation system for rocky desertification management at Caoshang on Zhongliang Mountain
中梁山槽上石漠化治理观测系统

Observation site for ecological restoration of stone desertification

石漠化生态恢复观测场



Slope runoff field
坡面径流场



Automatic weather stations, eddy systems 自动气象站、涡动系统



冠层下节点



无线传输模块



Phenology Camera



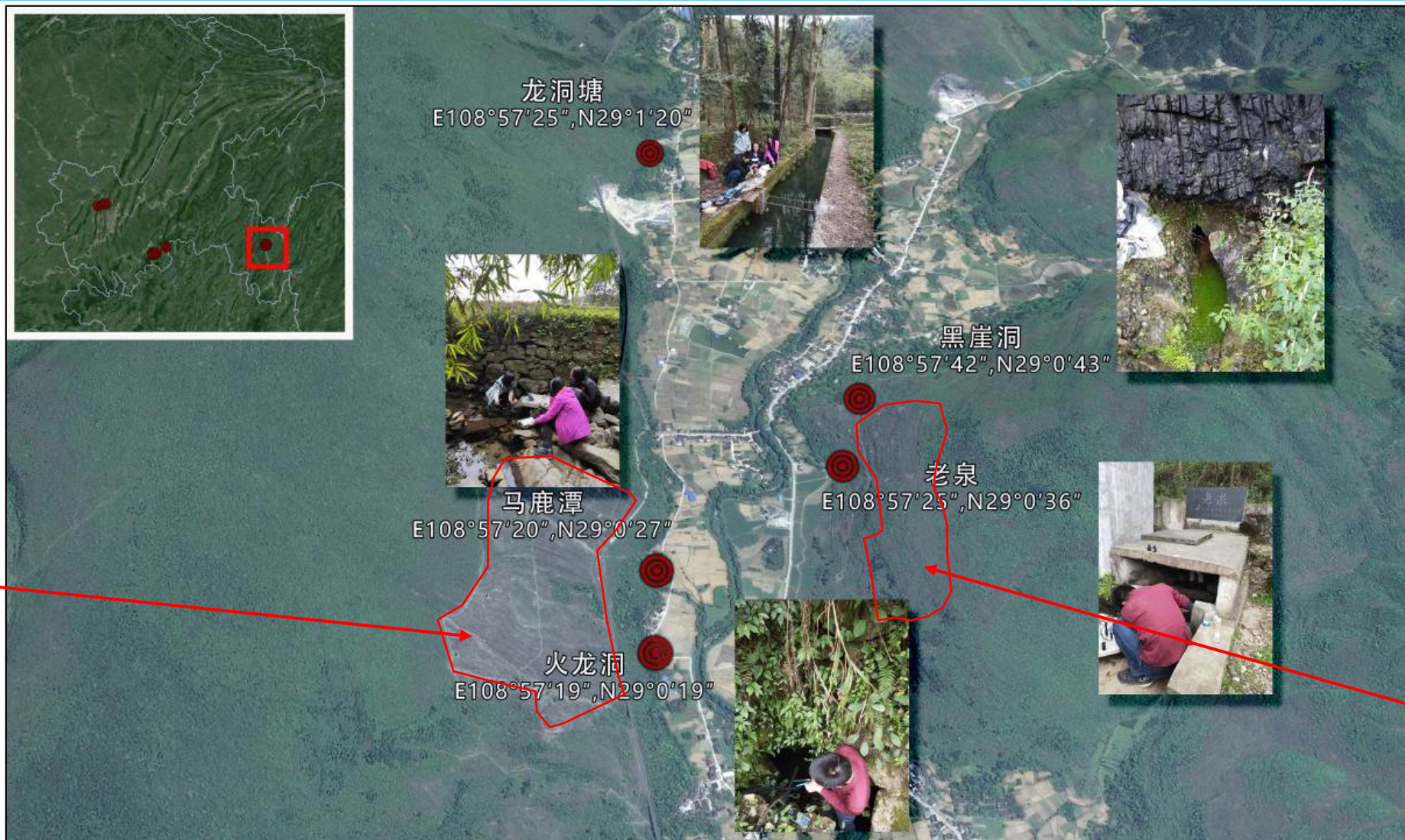
Wireless Sensor Network
无线传感器网络



Control test site
控制试验场



2.1 Experimental observation site and infrastructure 观测场和仪器配置



600 acres
along the
bedding
slope
Pepper
planting base

600亩顺层坡
花椒种植基地

300 acres of reverse
layer slope
Pepper planting base

300亩逆层坡
花椒种植基地

Ecological restoration observation site of rocky desertification at Longtan on Wuling Mountain

武陵山龙潭石漠化生态恢复观测场



2.1 Experimental observation site and infrastructure 观测场和仪器配置



Groundwater outlet observation
地下水出口观测



Rainfall and Dust Observation
降雨降尘观测



Automatic weather station
自动气象站

Hydrological section observation
水文断面观测



Rainwater harvesting irrigation system
集雨灌溉系统

Ecological restoration observation site of rocky desertification at Longtan on Wuling Mountain

武陵山龙潭石漠化生态恢复观测系统



2.2 Equipment for observation and analysis tests 观测和测试系统



The Jinfo Mountain Station has been equipped with more than 200 sets of field ground observation and mobile observation equipment, with a total value of more than 14 million yuan, and is equipped with **full-time field observation engineers**. 目前金佛山站已经配备野外地面观测设备和移动观测设备200余台套，总价值在1400万元以上，配置了**专职野外观测工程师**。



EC(3 open-circuit + 4 closed-circuit)
涡动相关仪 (3开路+4闭路)



Large aperture scintillation(1)
and microwave scintillation(1)
大孔径闪烁仪(1)和微波闪烁仪(1)



Automatic weather stations (11)
自动气象站 (11)



Trunk sap flow(9) &
evapotranspiration meter(3)
树干液流(9)&蒸渗仪(3)



Fluorescence
observation system (1)
荧光观测系统 (1)



Regional soil moisture(1)
区域土壤水分(1)



SM、LAI and phenology WSN(100)
SM、LAI和物候 WSN(50)



Multi-parameter water quality meter (20)
多参数水质仪 (20)



Total Station
Mobile observation equipment
移动观测设备



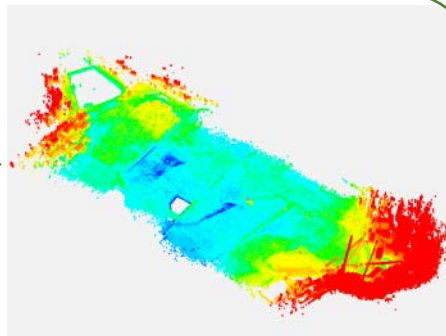
Differential GPS

We have the **unmanned aircraft observation team**, equipped with a **full-band unmanned aircraft observation system**.

我们组建了**无人机观测团队**，配备了**全波段无人机观测系统**，可以定期对观测样地开展航空飞行，获取高分辨率遥感监测数据。



Dajiang M600
Load:Tovos Dronescan



3d point cloud at
Hutoucun

Laser Scanner激光扫描仪



Dajiang M210
Load:X5S high-resolution
visible light camera

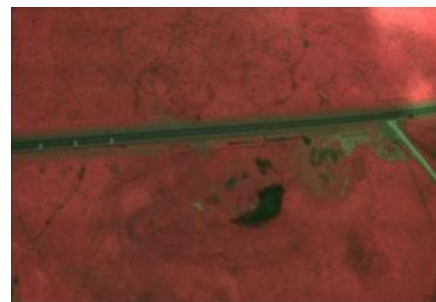


Hutoucun DSM

High resolution optical camera高分光学相机



Agricultural
multispectral
cameras:ADC Lite

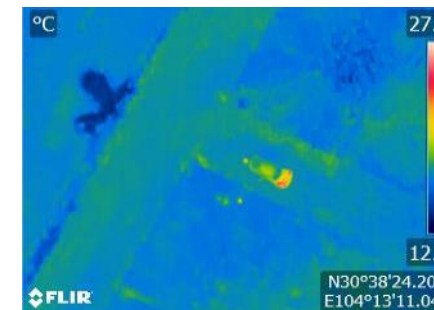


Multispectral false color images

Multispectral cameras多光谱相机



Chansi
ZENMUSE XT2



Thermal infrared images

Thermal infrared imager热红外成像仪



2.2 Equipment for observation and analysis tests 观测和测试系统



More than 100 sets of indoor testing and analysis equipment worth more than 20 million yuan were equipped. 购置室内测试分析设备100余套，价值2000余万元。



Inductively coupled plasma mass spectrometer
电感耦合等离子体质谱仪



Stable Isotope Mass Spectrometer
稳定同位素质谱仪



Total Organic Carbon Analyzer
总有机碳分析仪



High Performance Liquid Chromatograph
高效液相色谱仪



Gas-mass spectrometry system
气-质联用系统

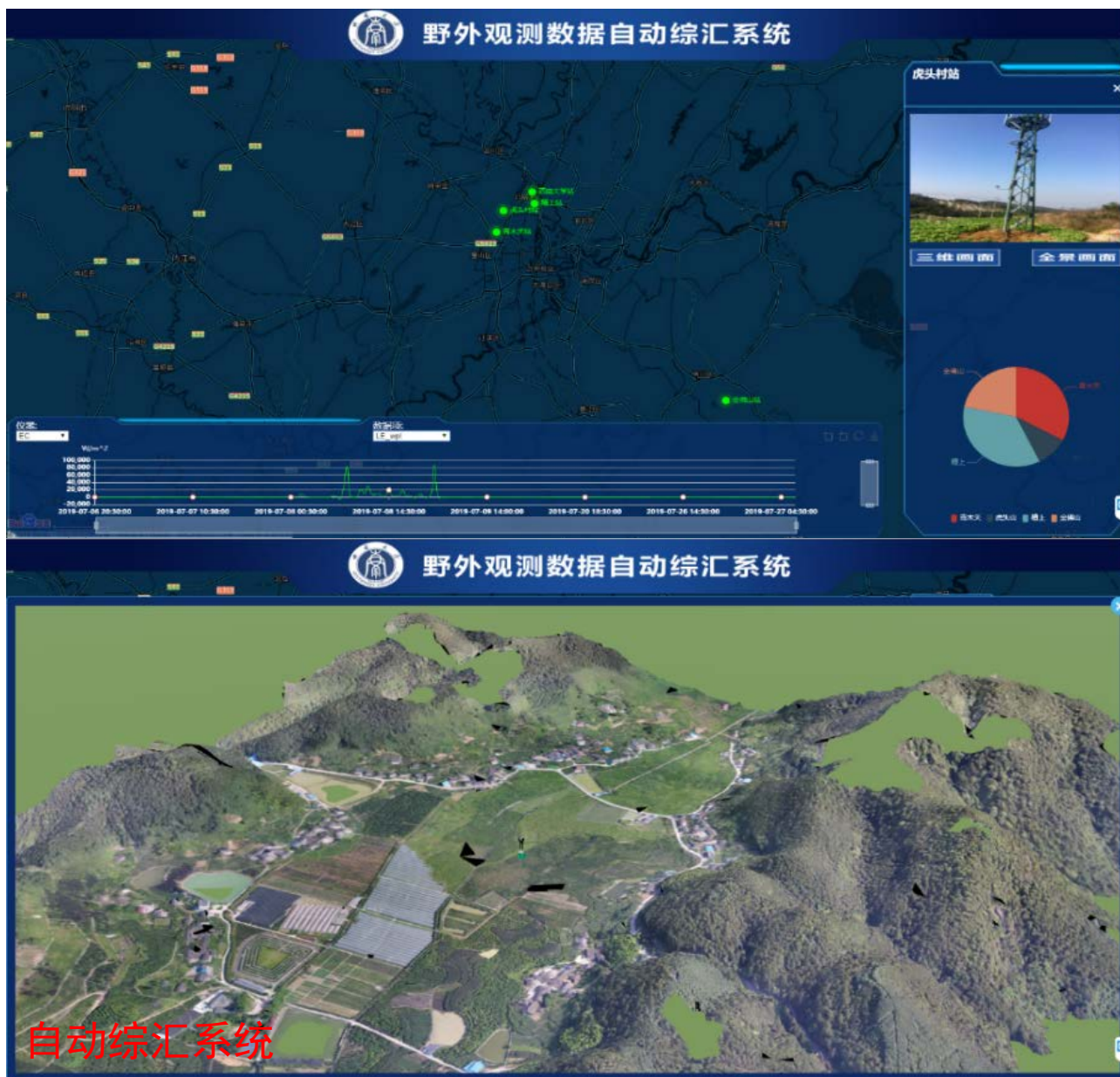


Inductively coupled plasma emission spectrometer
电感耦合等离子发射光谱仪



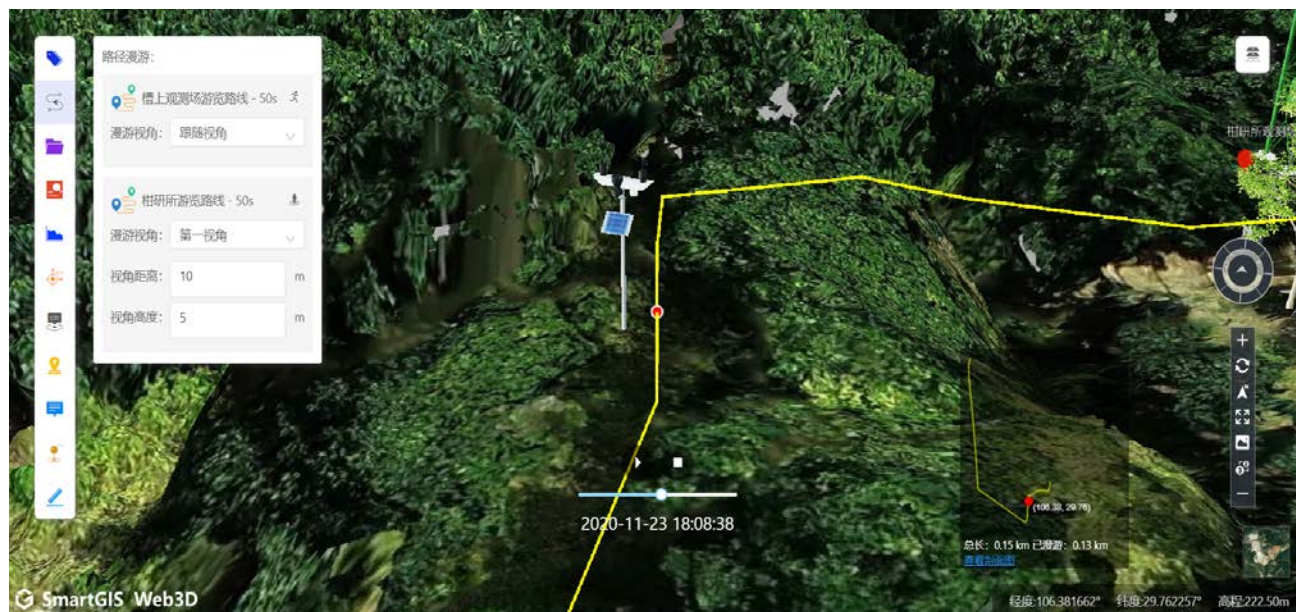
Vacuum condensation and extraction system

真空冷凝抽提系统

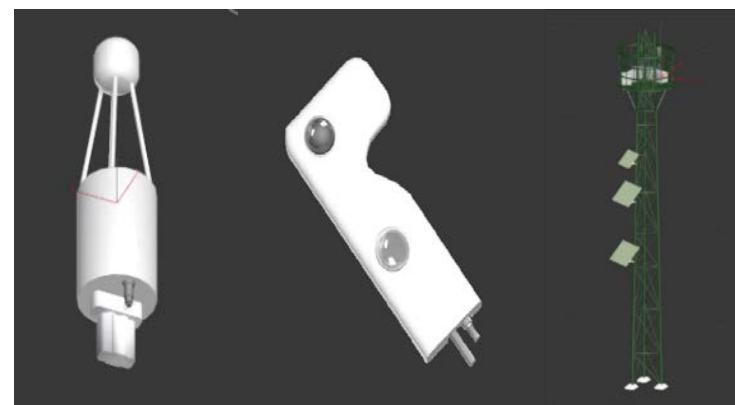


Self-developed **automatic synthesis system for field observation data**, with supercomputing and disk array, can obtain data in real time and realize rapid storage, processing and analysis.

自主研发**野外观测数据自动综汇系统**，拥有超算和磁盘阵列，可以实时获取数据，快速进行存储、处理与分析。



Develop a **virtual simulation platform** for in-situ observation fields and observation equipments.
研发野外观测场和观测设备的虚拟**仿真平台**。





1. Background (背景)
2. Present basis (现有基础)
3. **Development plans (发展规划)**
4. Capability construction (能力建设)





Observation object: Complex ecosystem of karst trough area.

观测对象：喀斯特槽谷区复合生态系统

Research content: 研究内容

(1) Ecosystem evolution mechanism and ecological security in karst trough area.

喀斯特槽谷区生态系统演化机理及生态安全

(2) Hydrological processes and efficient use of soil and water resources in the key

zone of karst trough area. 喀斯特槽谷区关键带水文过程及水土资源高效利用

(3) Evolution of landscape patterns and optimization of ecosystem services in karst

trough areas. 喀斯特槽谷区景观格局演化和生态系统服务优化

(4) Ecosystem restoration and characteristic resource conservation and utilization

in karst trough area. 喀斯特槽谷区生态系统恢复及特色资源保护利用

3.2.1 Observation Sample Plots 构建以喀斯特槽谷生态系统为主的观测样地

(1) Improve the monitoring system of composite ecosystem in karst trough area.

完善喀斯特槽谷区复合生态系统监测体系



Cropland 农田



Retreat 2 years
退耕2年



Retreat 20 years
退耕20年



Retreat 60-70 years
退耕60-70年



Artificial forest (Masson Pine)
人工林 (马尾松)



Native Forest 原生林





3.2 Long-term stable observations 长期科学观测

3.2.1 Observation Sample Plots 构建以喀斯特槽谷生态系统为主的观测样地

(2) Improve the conservation of rare and endangered species sample sites. 完善珍稀濒危物种保育样地



IUCN Red List of Threatened Species, national-level protected species of forest musk.
世界自然保护联盟濒危物种红色名录、国家一级保护动物林麝, 林麝繁育基地



“Plant Panda” Silver Fir “植物界的熊猫” 银杉繁育基地



3.2 Long-term stable observations 长期科学观测

3.2.1 Observation Sample Plots 构建以喀斯特槽谷生态系统为主的观测样地

(3) Construction of sample plots for breeding and promotion of authentic herbs and rhododendrons.

建设道地药材和杜鹃花繁育推广样地



Tomentulose
corydalis dried
herb on Jinfo
Mountain
金佛山干岩砭
名贵中药材



More than 600,000
wild alpine
rhododendrons on
Jinfo Mountain
金佛山上60多万株野
生高山杜鹃



Authentic herbs
道地药材繁育基地



Rhododendron
杜鹃花材繁育基地



3.2 Long-term stable observations 长期科学观测



3.2.2 Improve the air-sky-ground three-dimensional observation system 完善空天地立体观测体系.

Multi-source satellite observation 多源卫星观测

地表多尺度嵌套
观测系统
Surface Multiscale Nested
Observing System

Karst surface
observation
system 岩溶地表观
测系统

Slope runoff field 坡面径流场








Ecological 生态样地
sample plots

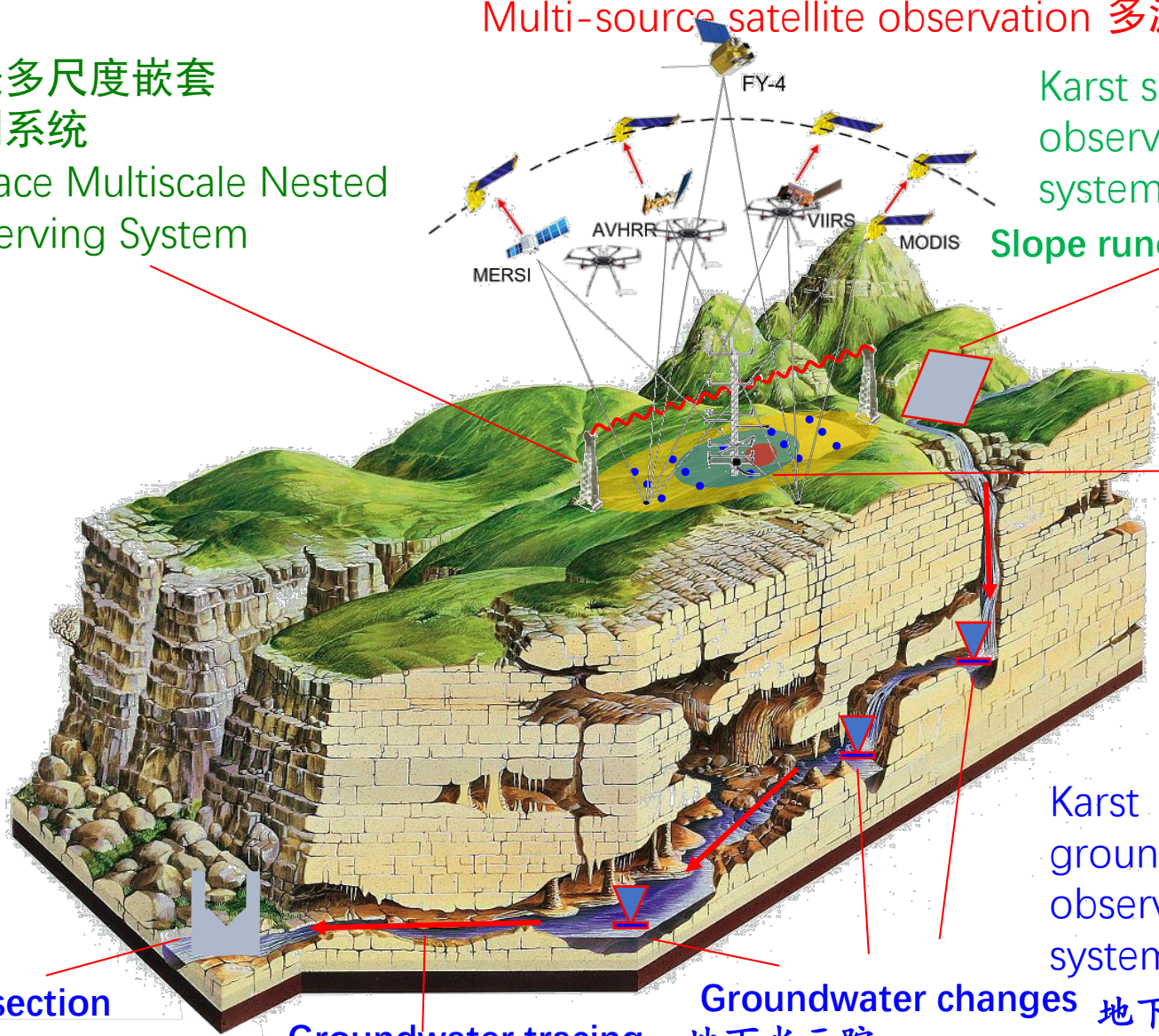
Karst
groundwater
observation
system 岩溶地下水
观测系统

水文断面 Hydrographic section

Groundwater tracing 地下水示踪

Groundwater changes 地下水变化

-  LAS
-  EC、AWS
-  LAS footprint
-  EC footprint
-  COSMOS
-  Isotope, soil carbon
-  WSN





3.2 Long-term stable observations 长期科学观测



3.2.2 Improve the air-sky-ground three-dimensional observation system 完善空天地立体观测体系.

Water
水



Water quantity, water quality, water isotopes, soil moisture, evapotranspiration, precipitation, water surface evaporation, etc. Add 1 hydrological section and 2-3 slope runoff fields. Additional 3.5 million observations can be added in the next 5 years. 水量、水质、水同位素、土壤水分、蒸散发、降水、水面蒸发等。

Soil
土



Physical, chemical and biological parameters of soils. 10,000 additional observations can be made in the next 5 years. 土壤物理、化学和生物学参数。

Air
气



Observations of wind temperature, humidity, pressure, quadratic solar radiation, photosynthetically active radiation, sunshine hours, carbon dioxide fluxes, etc. About 14 weather stations. 1.2 million observations can be added in the next 5 years. 风温湿压、四分量太阳辐射、光合有效辐射、日照时数、二氧化碳通量等要素的观测数据。

Bio
生



Sample site survey, plant functional traits and phenology, leaf area index, vegetation fluorescence, trunk sap flow and other key ecological parameters. About 120,000 observations can be added in the next 5 years. 样地调查、植物功能性状及物候、叶面积指数、植被荧光、树干液流等关键生态参数。

RS
遥感

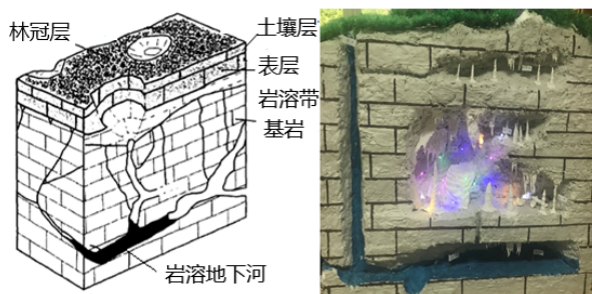


UAV observation including Visible/NIR, thermal IR, hyperspectral, LIDAR; satellite remote sensing data such as MODIS, GF, HJ, FY ; 1TB of aerial data and 10TB of satellite data can be added in the next 5 years. 可见光/近红外、热红外、高光谱、激光雷达等无人机观测卫星遥感数据



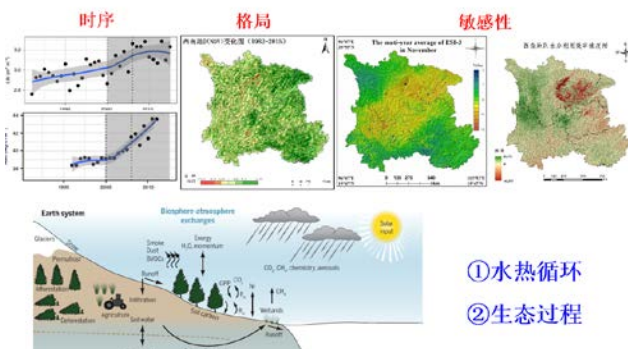
Long-term study on natural recovery of vegetation and nutrient cycling mechanisms in karst areas.
喀斯特地区植被自然恢复及养分循环机制长期研究

Long-term control experiments on the effects of extreme climate events on the functioning of degraded karst farmland ecosystems. 极端气候事件对喀斯特退化农田生态系统功能影响的长期控制实验

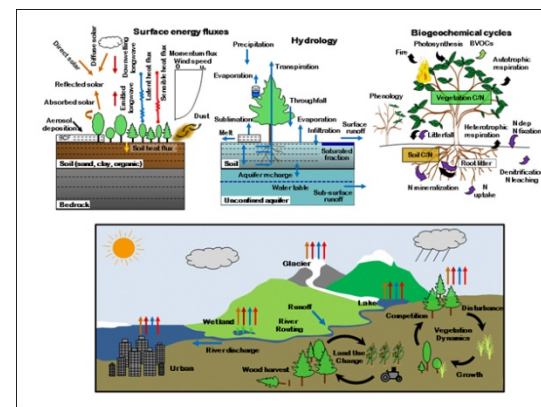


a. 岩溶水文网格单元结构 (改自任启伟, 2006) b. 岩溶水文网格单元模型图

Groundwater observation and small basin hydrological simulation 地下水观测与小流域水文模拟的野外科学试验研究



Integrated air-sky-ground ecological monitoring and global change response. 空天地一体化生态监测与全球变化响应野外科学试验研究



Assimilation and simulation of land surface process data. 陆表过程数据同化与模拟的野外科学试验研究



3.3 Collection of the data, germplasm, and service 科技资源的采集、汇交、服务



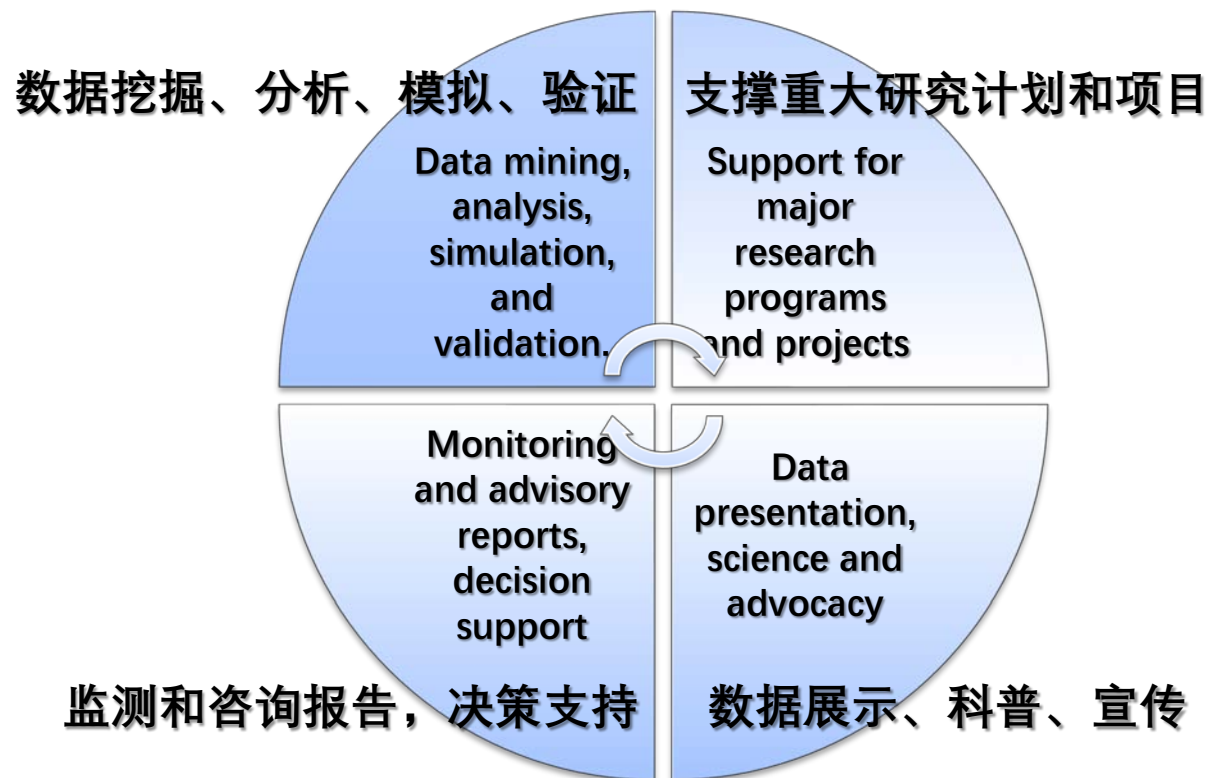
(1) Collection and convergence of biological germplasm resources. 生物种质资源采集与汇交



It is expected that more than 300 new seeds will be added and more than 100 live plants will be preserved in 5 years.



(2) Comprehensive utilization of scientific and technological resources. 科技资源综合利用





3.4 Scientific Popularization 科普活动



Jinfo Mountain National
Science Education Base

金佛山全国科普教育基地



Astronomy and Geology Museum of
Southwest University, Chongqing
Science Base

重庆市科普基地西南大学天文地质馆



The Institute of Medicinal Plant

药物所药用植物

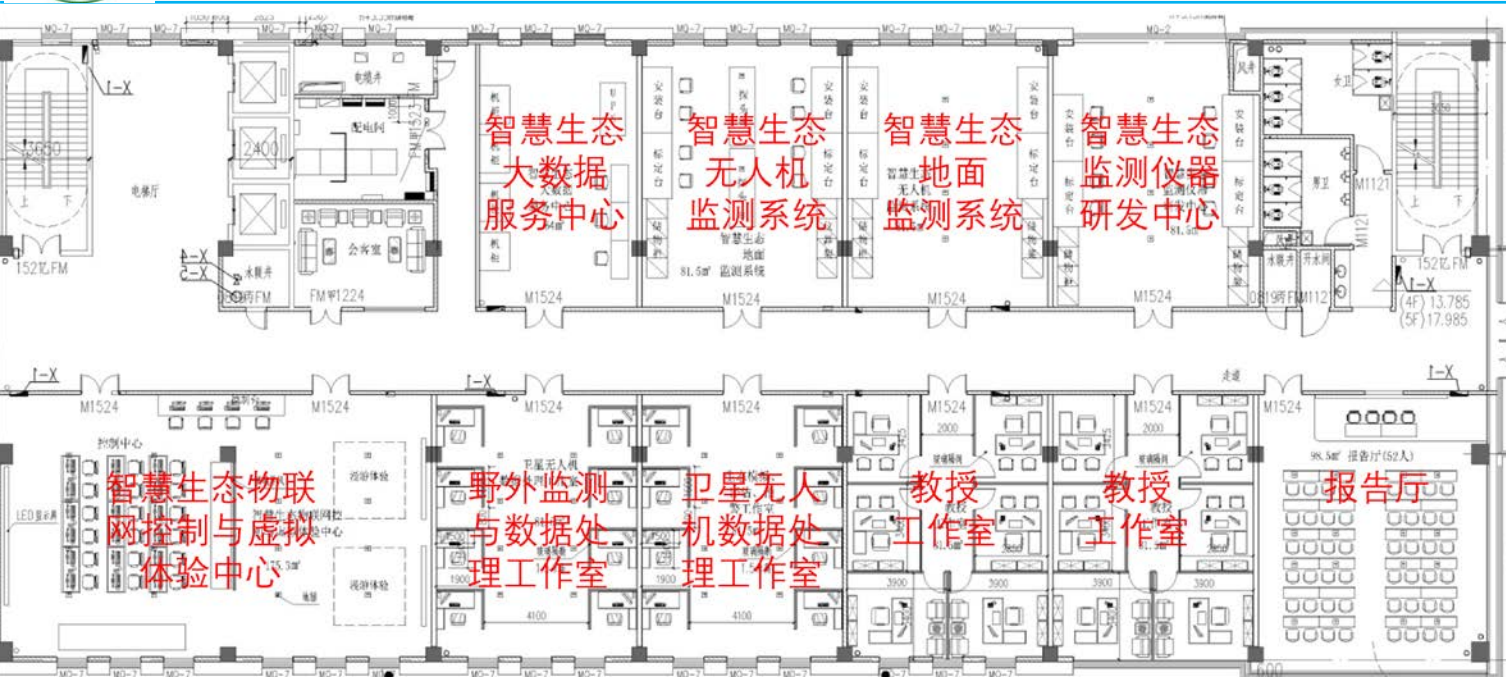


1. Background (背景)
2. Present basis (现有基础)
3. Development plans (发展规划)
4. Capability construction (能力建设)



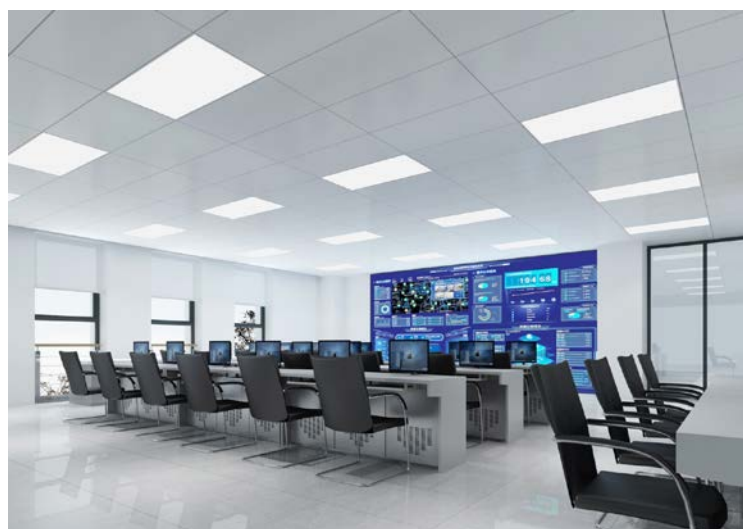


4.1 Base construction基地建设



Build a field station intelligent ecological IOT R&D center in Science City (Xiema) with an area of 1,500 square meters. The renovation will be completed in August 2021 and the center will be occupied in the next semester.

科学城（歇马）建设野外站智慧生态物联网研发中心，面积1500平米，2021年7月完成装修，下学期入驻。





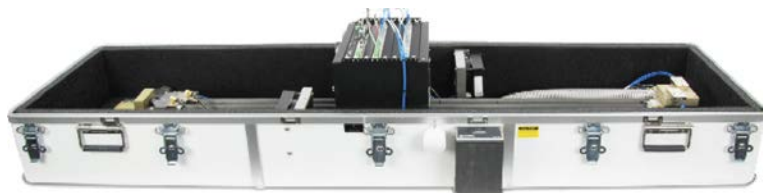
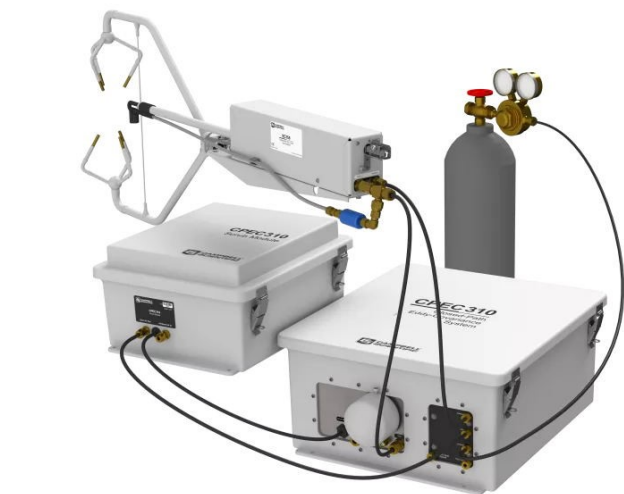
4.1 Base construction 基地建设



The Sanquan base covers an area of 16 acres, and land allocation has been completed. Ensure that construction will start in 2022, with a construction area of 2,200 square meters in the first phase.
三泉基地16亩，已经完成土地划拨，确保2022年开工建设，一期建设面积2200平方米。



4.2 Building instrument resources 观测系统



In the next five years, increase 50 sets instruments and equipment for field observation and indoor testing and analysis worth 20-30 million yuan.

未来五年新增野外观测和室内测试分析仪器设备50台套，价值2000-3000万元。



4.3 Website 网站建设



西南大学

重庆金佛山喀斯特生态系统国家野外科学观测研究站
重庆金佛山喀斯特生态系统教育部野外科学观测研究站
自然资源部岩溶生态环境—重庆南川野外基地
重庆市金佛山喀斯特生态系统野外科学观测研究站

首页 | 概况 | 新闻动态 | 科研队伍 | 科学研究 | 科研平台 | 运行管理 | 人才培养 | 开放交流 | 资料下载 | English

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Thanks for your attention!



Welcome to Mt. Jinfo Karst Station.