Green Water - **Bodenfeuchtigkeitsmessungen im Großraum Urumqi**

und deren Bedeutung als Parameter für die Bewertung des Klimawandels

绿水 - **乌鲁木齐及其周边土壤湿度的测量**

以及作为气候变化评估参数的重要性

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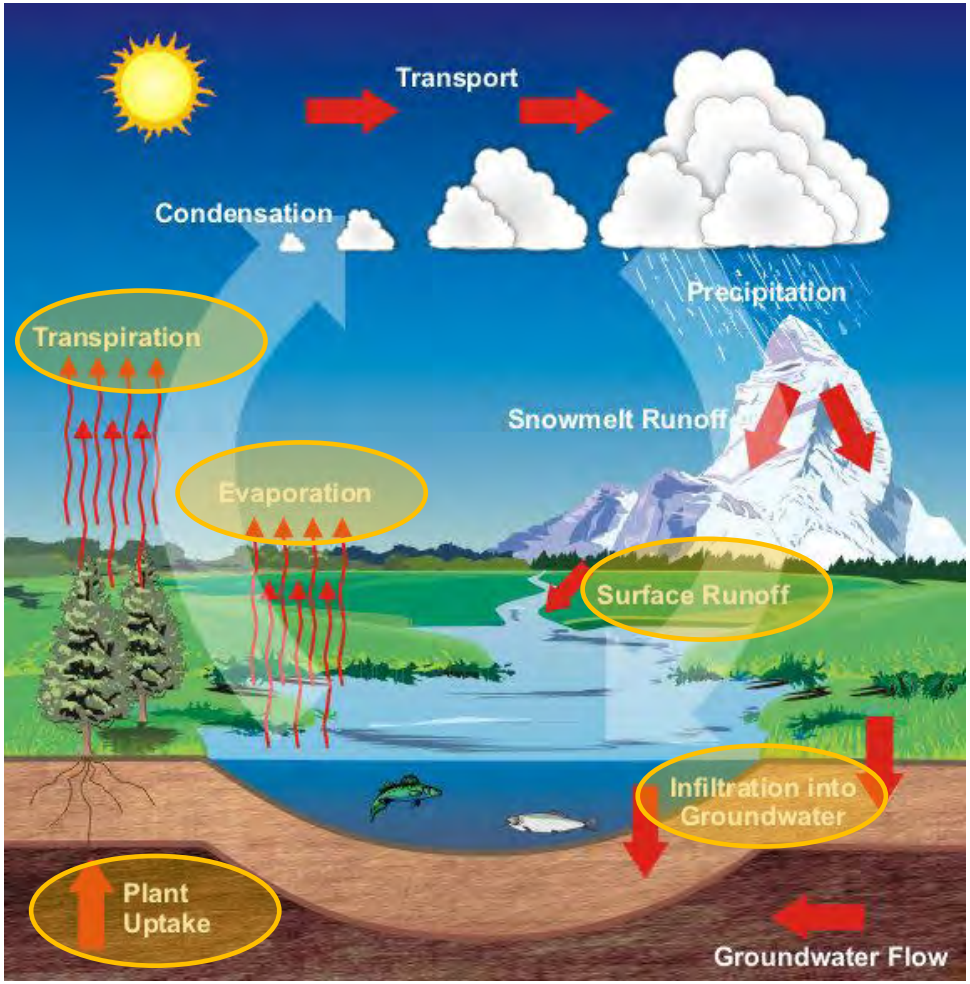
Green Water – Why it is important
绿水 – 为什么重要



http://www.srh.noaa.gov/images/crp/education/water_cycle/hydrologic_cycle2.jpg

Soil moisture: less than 1 %
土壤湿度：小于1%

but: 但是

Controls land surface processes:
控制各种各样的地表过程：

- Runoff / infiltration径流/渗入
- energy exchange能量交换
- water/vapour dynamics in the root zone
  水/水蒸气在根部地区的动态变化

Drives驱动力:

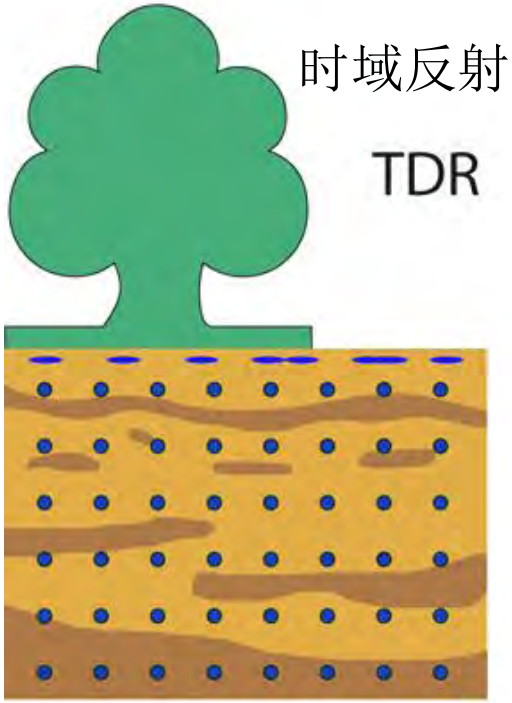
- regional weather models区域性天气模拟

regional to global scale climate models
区域到全球性的气候模型

- fastest adapting climate variable
  最快适应变化的气候参数

→Indicator for climate change
→气候变化的指标

The challenge – measurement scales
面临的挑战 - 测量尺度

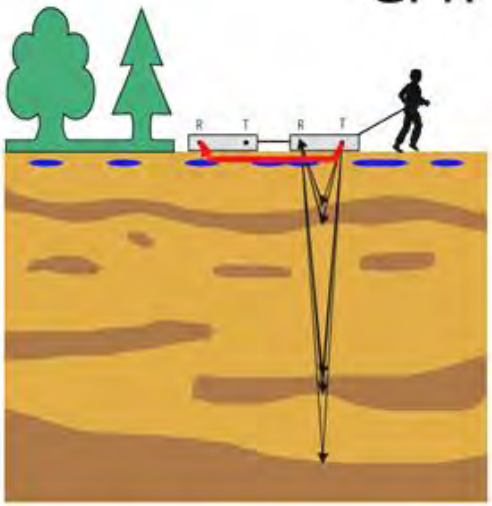


时域反射仪

TDR

pointscale: 0.1 - 0.5 m

单点尺度：0.1 – 0.5m



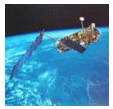
探地雷达

GPR

fieldscale 10 - 1000 m

中大尺度：10 – 1000m

卫星/航空遥感

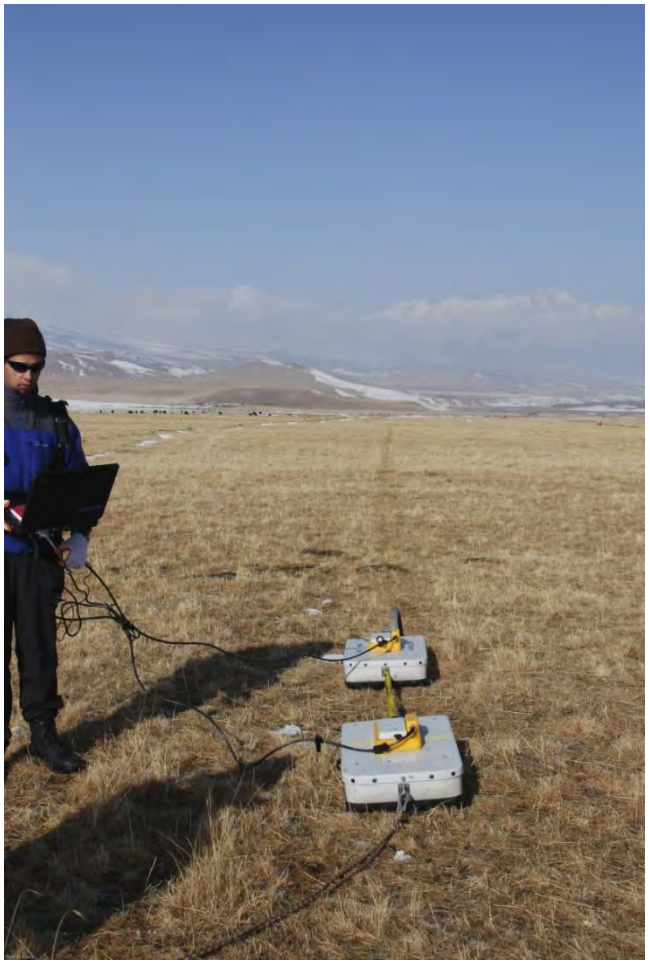


RS scale 30m to > km

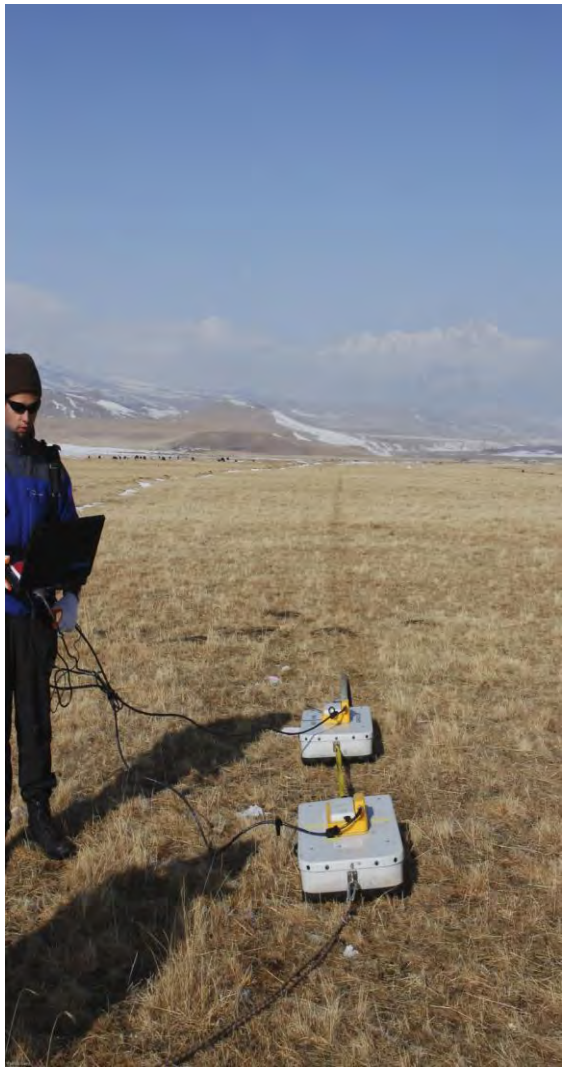
特大尺度：30m 到 >km

Our approach – from field to regional scales
我们的方法 – 从野外到区域尺度

Point scale measurements
单点尺度测量

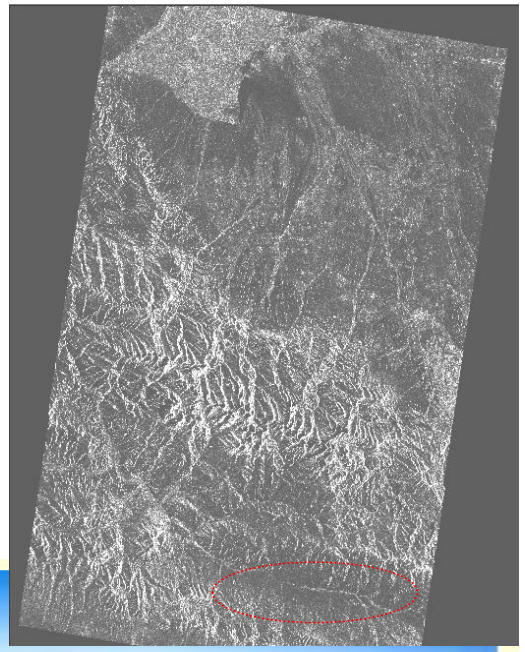


Field scale
中大尺度



field scale
中大尺度

regional scale
区域尺度



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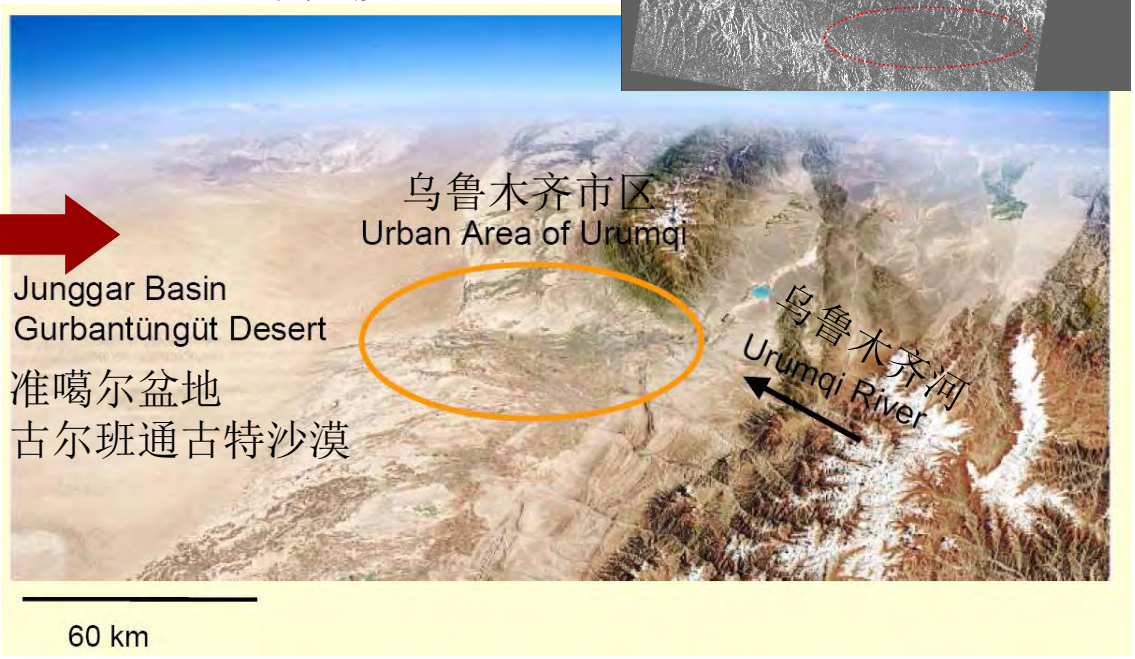
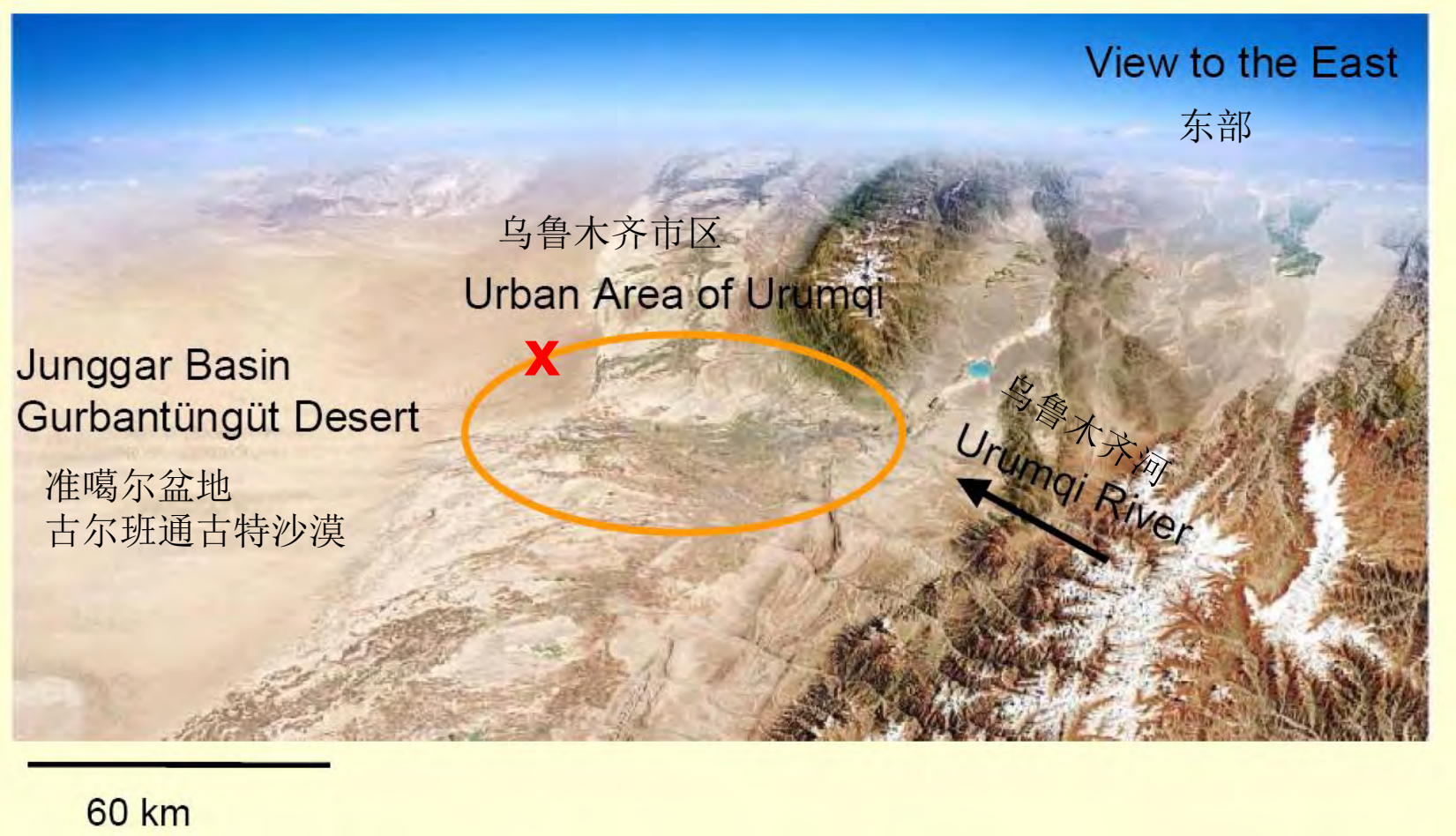
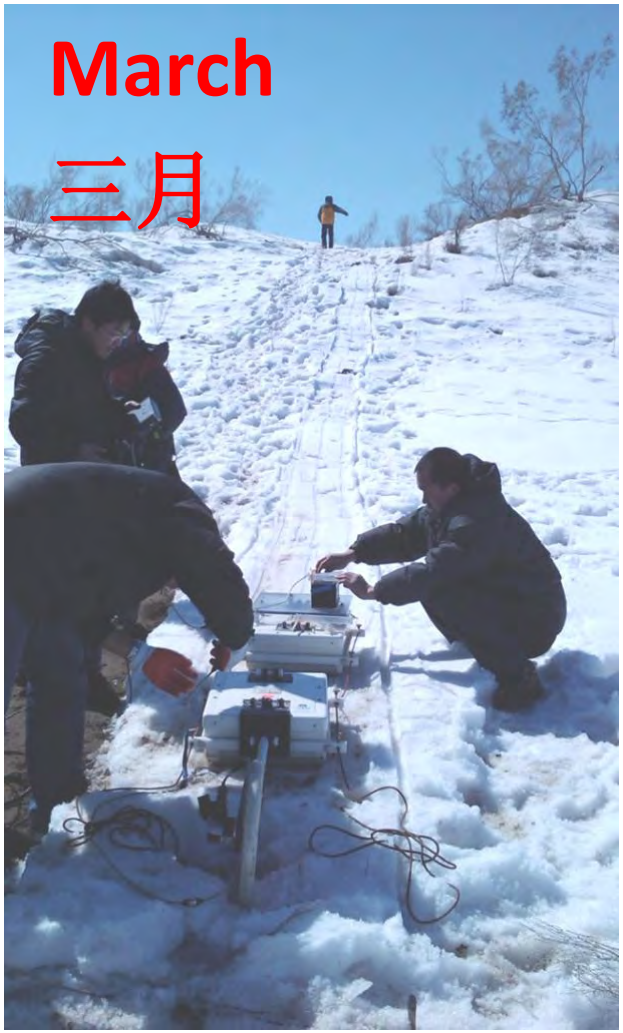
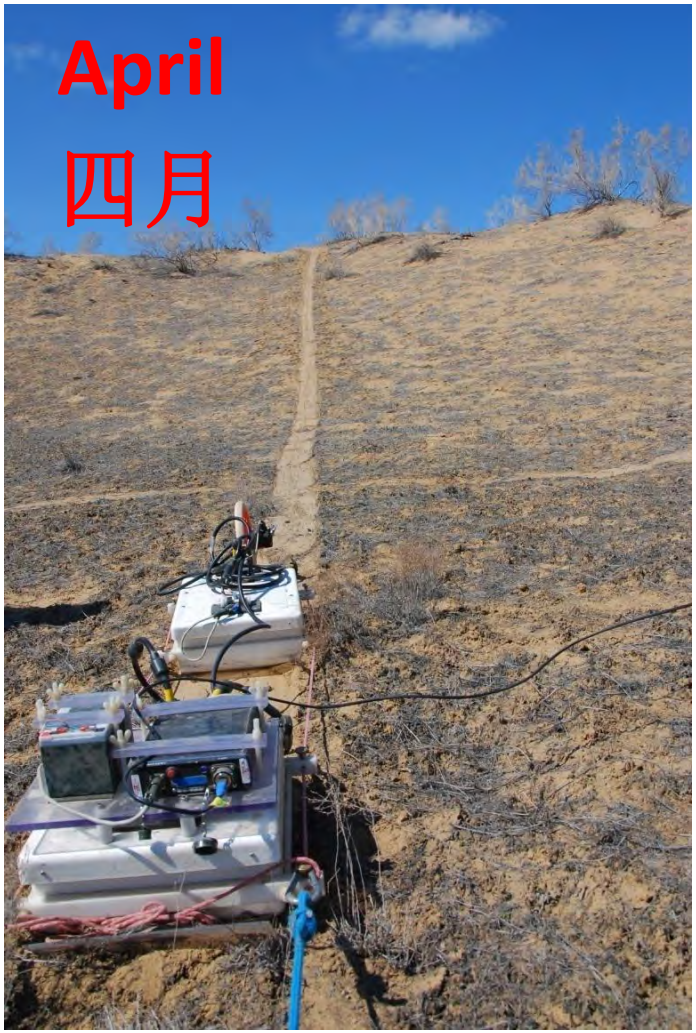


Measurement Campaign March / April 2010
测量活动2010年3月/4月



Large seasonal changes
大幅度季节变化

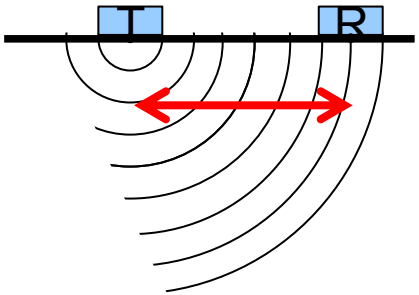




The measurement principle - 测量原理

Near-surface soil moisture content from the ***direct ground wave signal***

通过评估**直接地面波**信号，得到近地表土壤水分含量



$$t_{GW} = \frac{a\sqrt{\varepsilon_r}}{c_0}$$

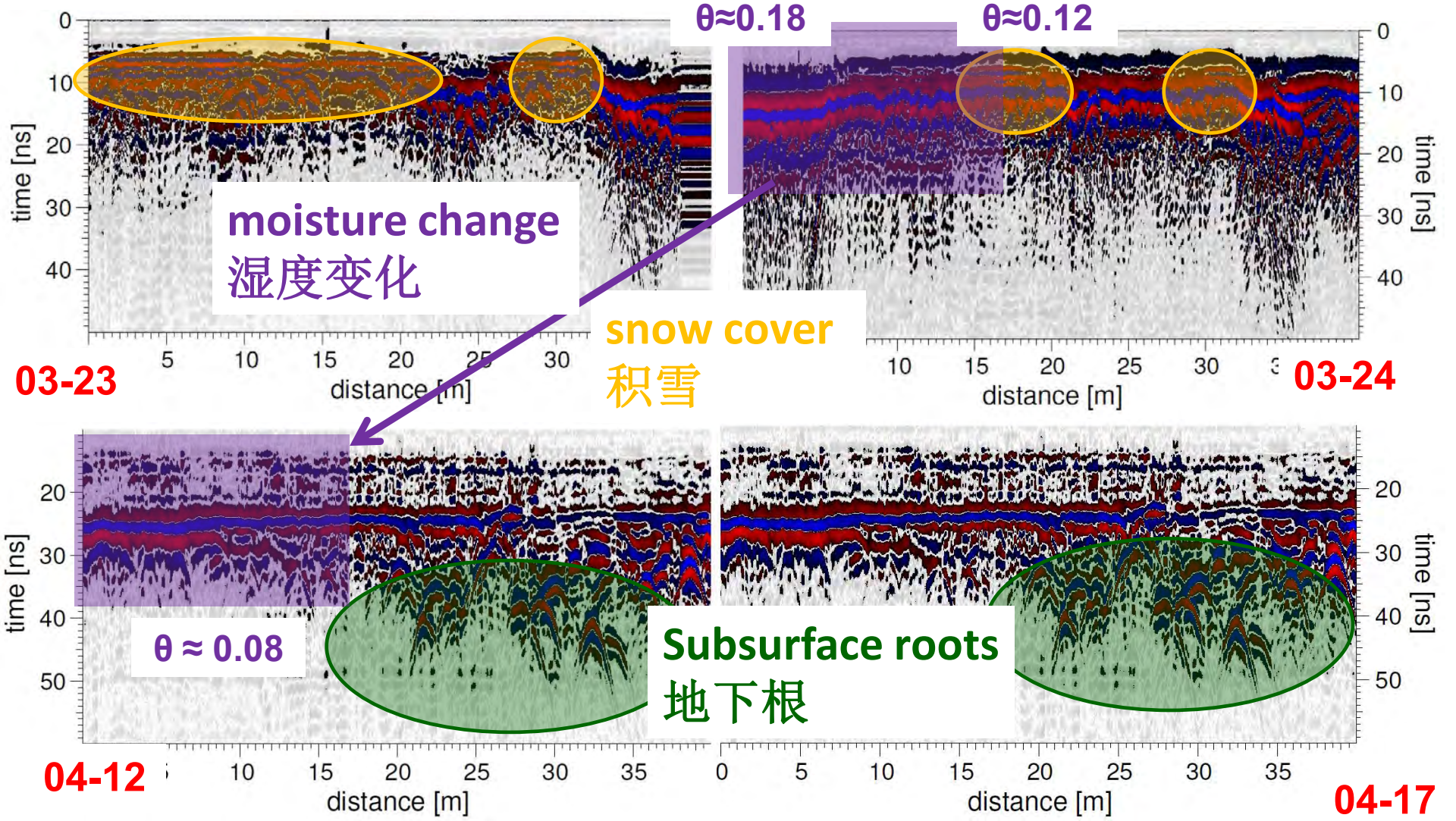
ε_r

$$\theta = \frac{\sqrt{\varepsilon_r} - \sqrt{\varepsilon_s} - \phi\,(1 - \sqrt{\varepsilon_s})}{\sqrt{\varepsilon_w} - 1}$$

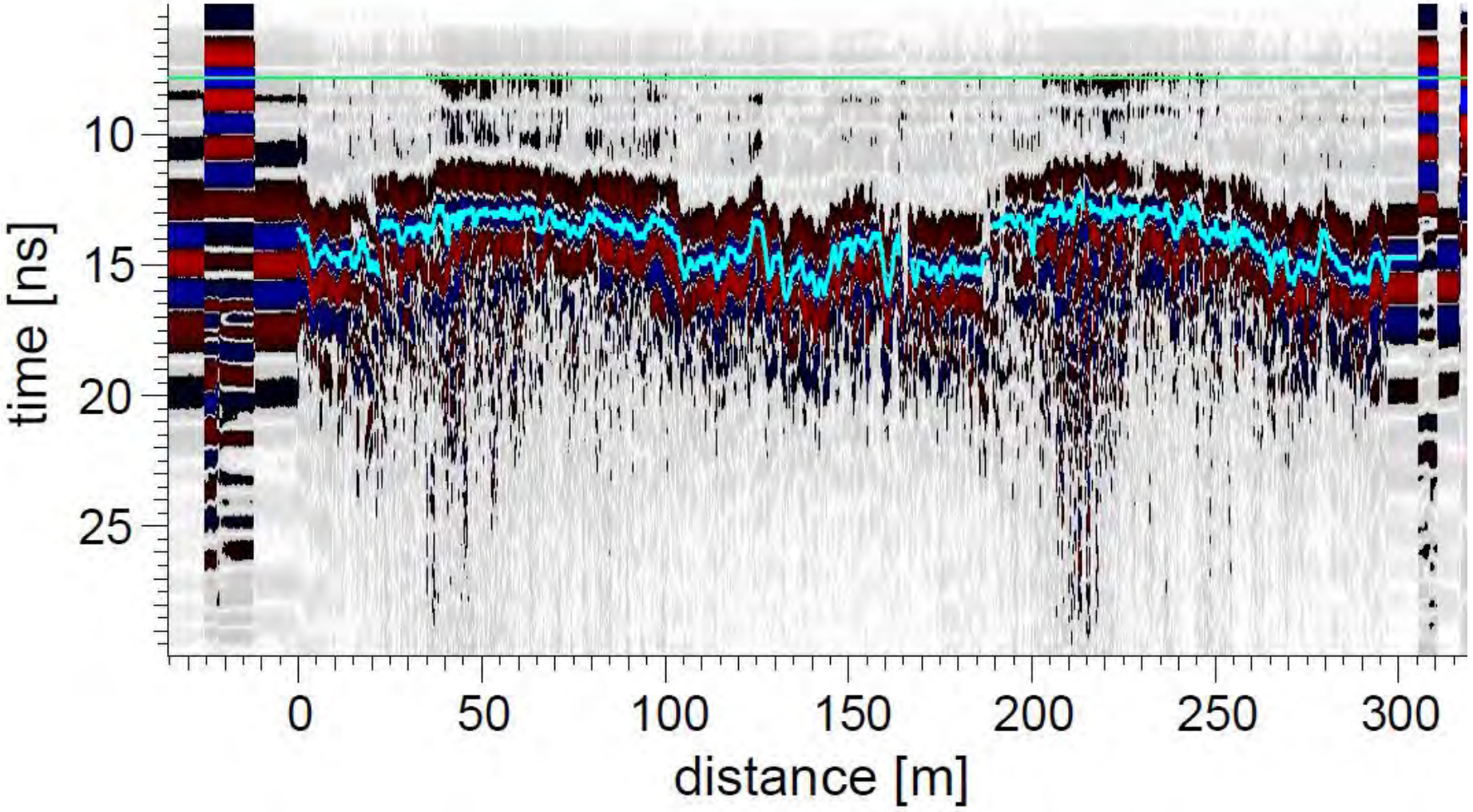
$\theta_{groundwave}$

Dielectric mixing model (CRIM)
介电混合模型

Mapping Seasonal Changes
季节变化映射



Spatial Variations across several dunes
几个沙丘的空间变化



Spatial Variations across several dunes
几个沙丘的空间变化

- Evaluation of profile measurements across several hundred meters show two regimes:

纵横几百米的探地雷达坡面分析结果显示两个不同体系:

- High water contents between dunes (mean 0.11)

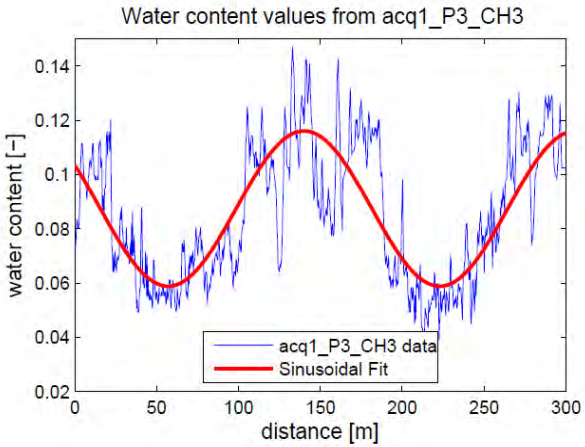
沙丘间高含水量（平均0.11）

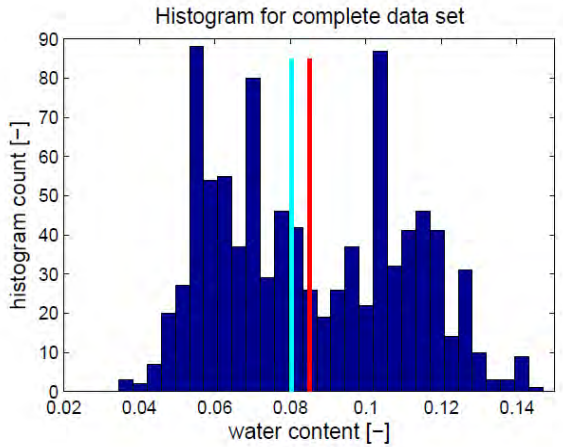
- Lower water contents at dune tops (mean 0.07)

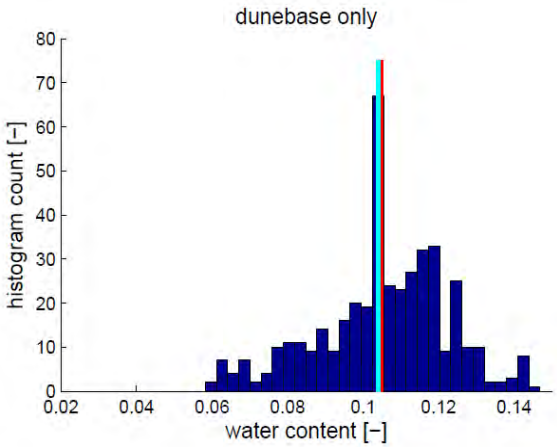
沙丘顶部低含水量（平均0.07）

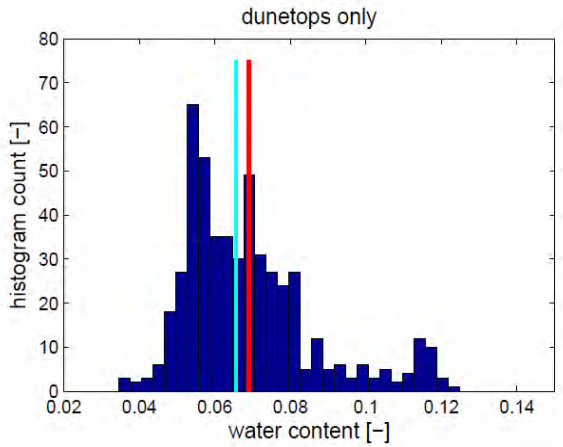
- robust estimate of small-scale spatial variability

精确判断小性空间变化









Conclusions & Outlook
结论及展望

- Green water as an indispensable parameter

绿水作为不可缺少的参数

- GPR for mapping field scale soil water content changes at scales pertinent to remote sensing

探地雷达测绘为了中大和遥感尺度土壤水分含量的时空变化

Urgent need for迫切需要

  - **time series measurements** at

    多次测量（比如季节性测量）

  - **representative sites** throughout the study region

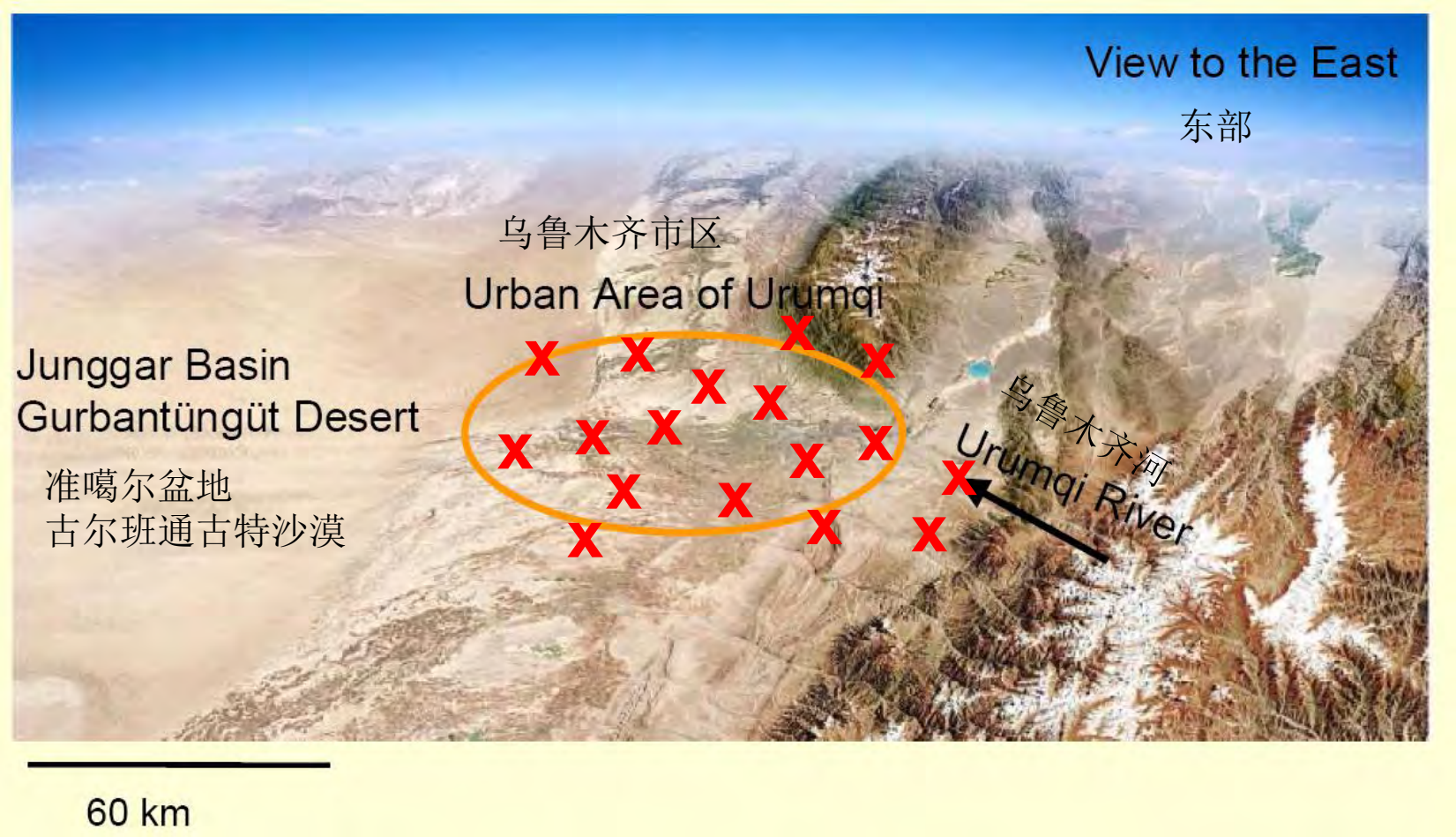
    整个研究区域代表地点

    → Input for Hydrologic Modeling水文模型的输入

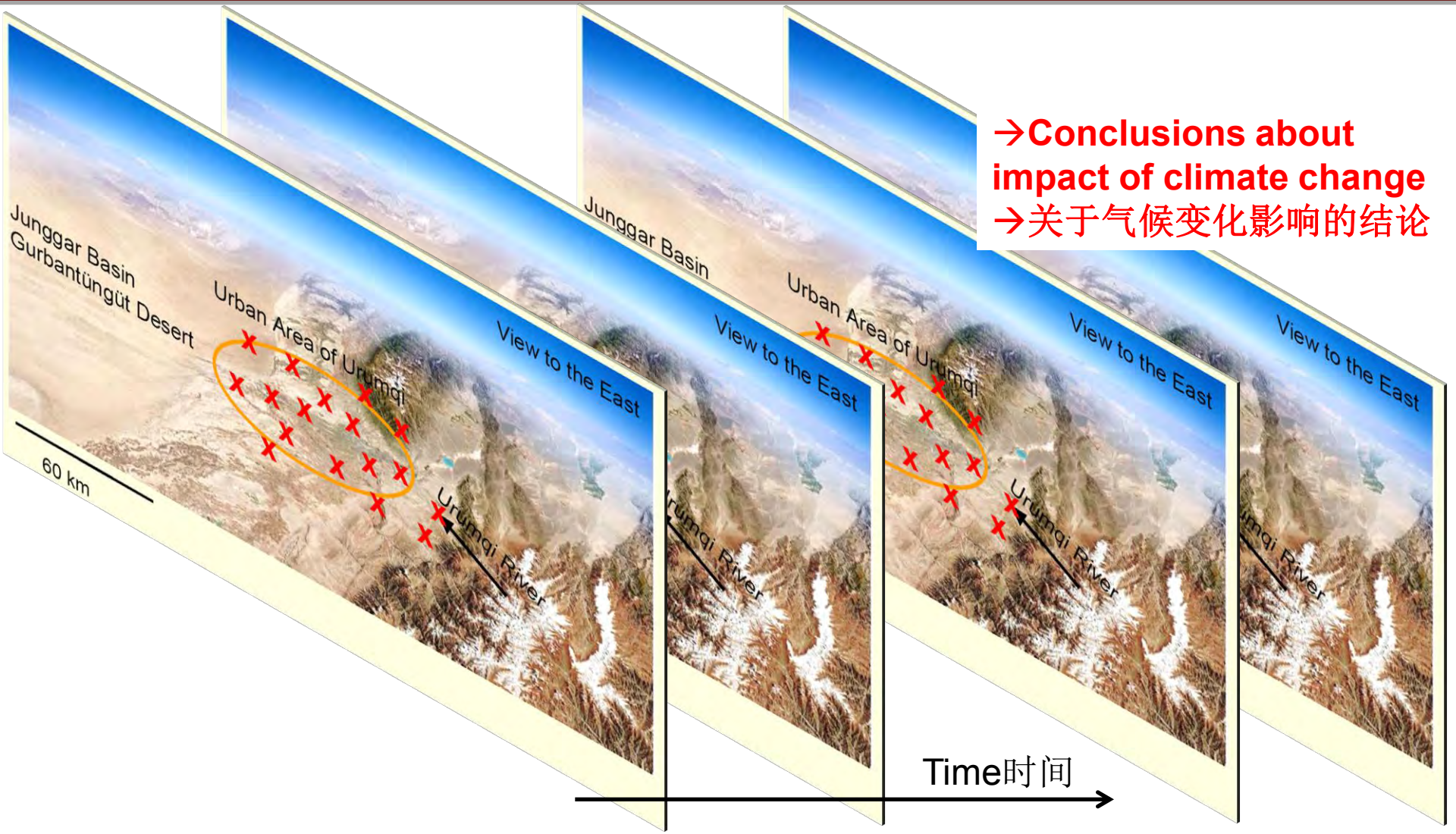
    → Conclusions about hydrologic changes under climate change impacts

    关于气候变化影响下水文变化的结论

Outlook: need for representative sites
展望：需要有代表性的地点



Outlook: need for time series
展望：以时间为序列



→Conclusions about impact of climate change
→关于气候变化影响的结论

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Thank You!
谢谢大家！

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