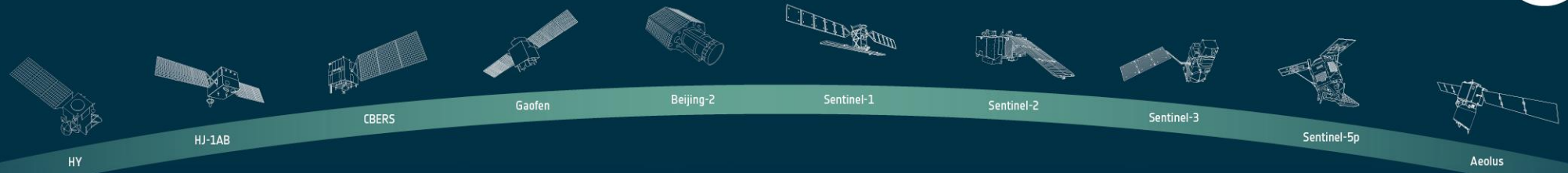


2022 DRAGON 5 SYMPOSIUM

MID-TERM RESULTS REPORTING

17-21 OCTOBER 2022

PROJECT ID. 59316

PROTOTYPE REAL-TIME REMOTE SENSING LAND DATA ASSIMILATION ALONG THE SILK ROAD ENDORHEIC RIVER BASINS AND EUROCORDEX-DOMAIN

THURSDAY, 20/OCTOBER/2022

ID. 59316

PROJECT TITLE: PROTOTYPE REAL-TIME REMOTE SENSING LAND DATA ASSIMILATION ALONG THE SILK ROAD ENDORHEIC RIVER BASINS AND EUROCORDEX-DOMAIN

PRINCIPAL INVESTIGATORS: XIN LI, HARRY VEREECKEN

CO-AUTHORS: DONGHAI ZHENG, HARRIE-JAN HENDRICKS FRANSSEN, MIN FENG, CARSTEN MONTZKA, YINGYING CHEN, FENG LIU, CHUNFENG MA, LING ZHANG, KUN ZHANG, YUSHAN ZHOU

PRESENTED BY: DONGHAI ZHENG

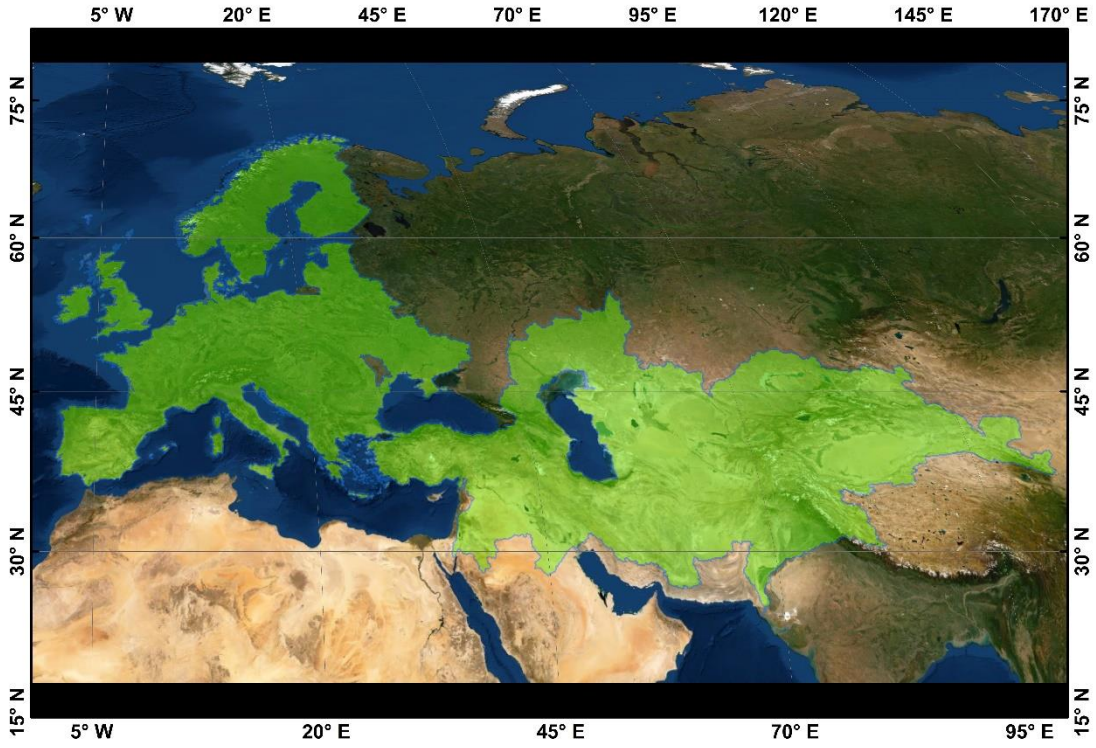
Dragon 5 Mid-term Results Reporting

- Project's objectives
- Satellite data utilised after 2 years of activity
- In-situ data measurements and field data collection campaigns
- Project's results after 2 years of activity
- Project's schedule and planning
- Contributions of young scientists

Project's Objectives

To develop prototypes of real-time RS LDAS for monitoring the water cycle in the silk road endorheic river basins and EUROCORDEX-domain

- WP1: Retrieval of key water cycle variables from RS data
- WP2: Development of real time RS LDAS
- WP3: Cal/val of terrestrial system models using RS retrievals
- WP4: Closing water cycle at the watershed/regional scale using LDASs



EO Data Delivery

Data access (list all missions and issues if any). NB. in the tables please insert cumulative figures (since July 2020) for no. of scenes of high bit rate data (e.g. S1 100 scenes). If data delivery is low bit rate by ftp, insert “ftp”

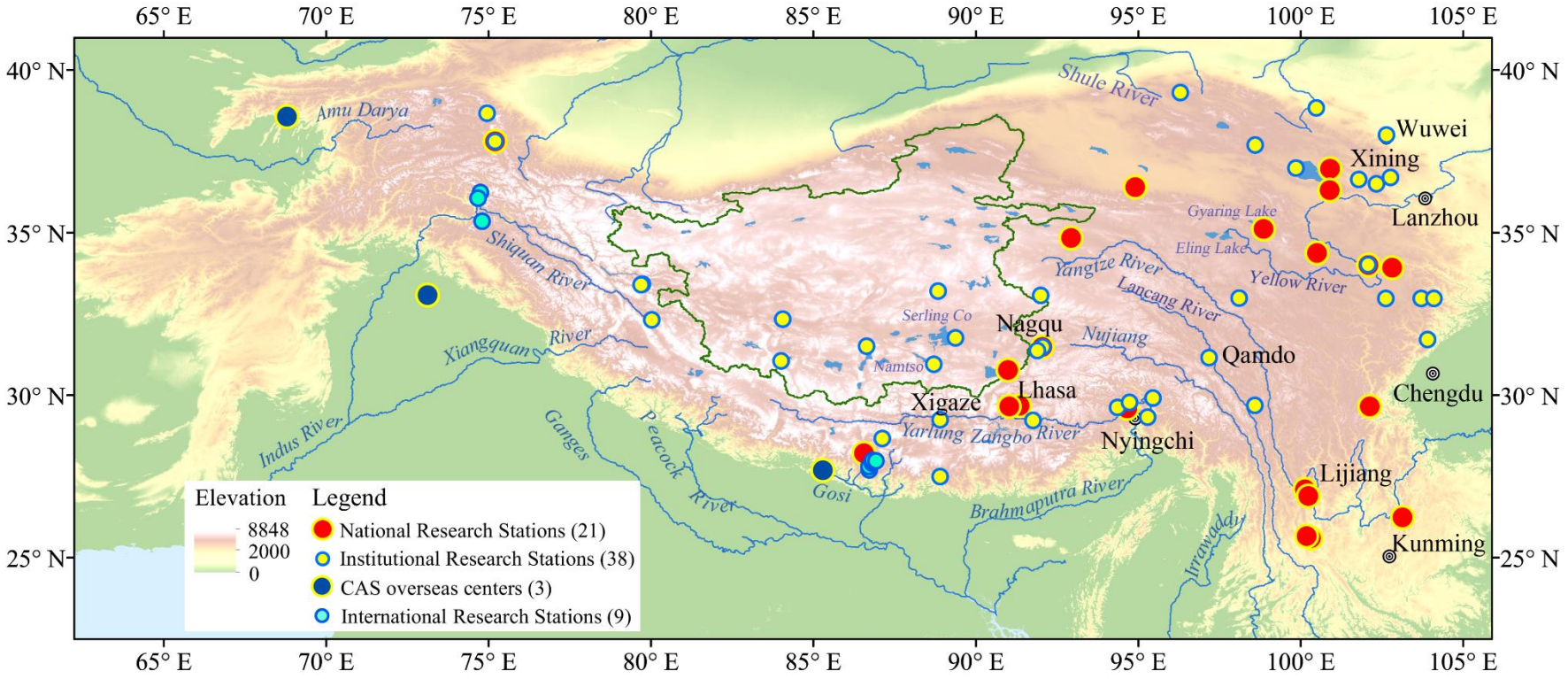
ESA EO data	No. Scenes
1. Sentinel-1	1500
2. Sentinel-2	2400
3.	
4.	
5.	
6.	
Total:	
Issues:	

ESA Third Party Missions data	No. Scenes
1. SMAP	2000
2. AMSR2	2000
3. Landsat	2000
4.	
5.	
6.	
Total:	
Issues:	

Chinese EO data	No. Scenes
1. GaoFen-6	1000
2.	
3.	
4.	
5.	
6.	
Total:	
Issues:	

In-situ data measurements and field campaigns

Comprehensive field stations on TP




NAMORS(Nam co)


QOMS(Qomolangma)


NaPlaCE(Nagqu)


SETORS(Southeast TP)


NASDE(Ngari)


SHORS(Shuanghu)


MAWORS(Muztagh)

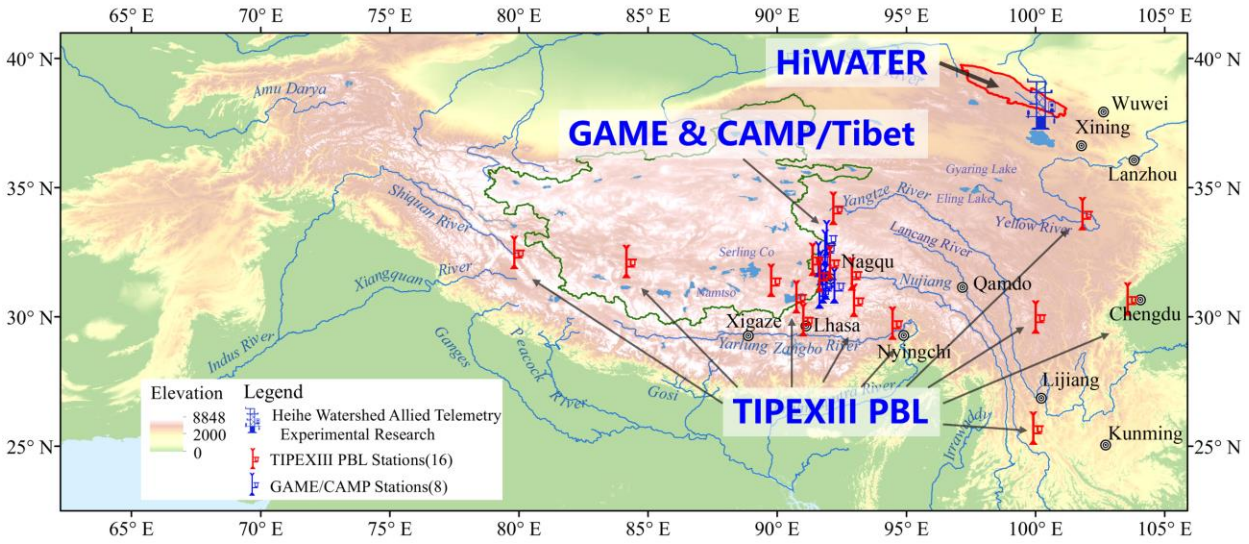

Medog Observation & Research Center for Earth Landscape and Earth System

- 59 domestic comprehensive stations on TP
  - 21 national stations, 38 institutional stations
- 12 international field stations
  - 3 CAS oversea centers, 3 ITPCAS oversea stations, 6 stations of Pyramid International Laboratory

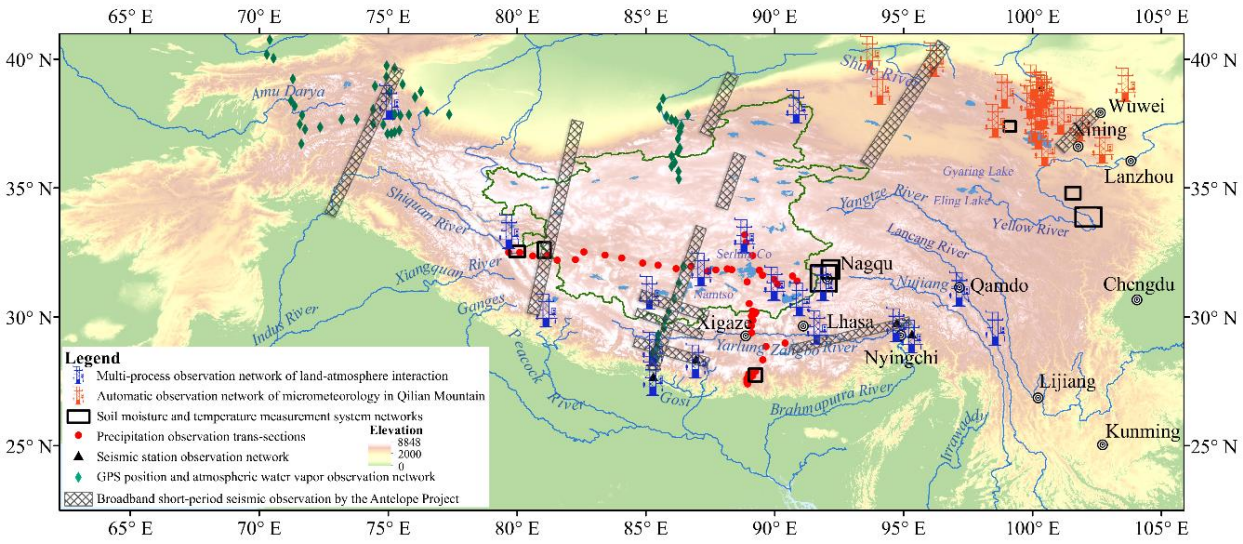
- 8 stations operated by ITPCAS, including 3 national stations.

In-situ data measurements and field campaigns

Scientific observation experiments



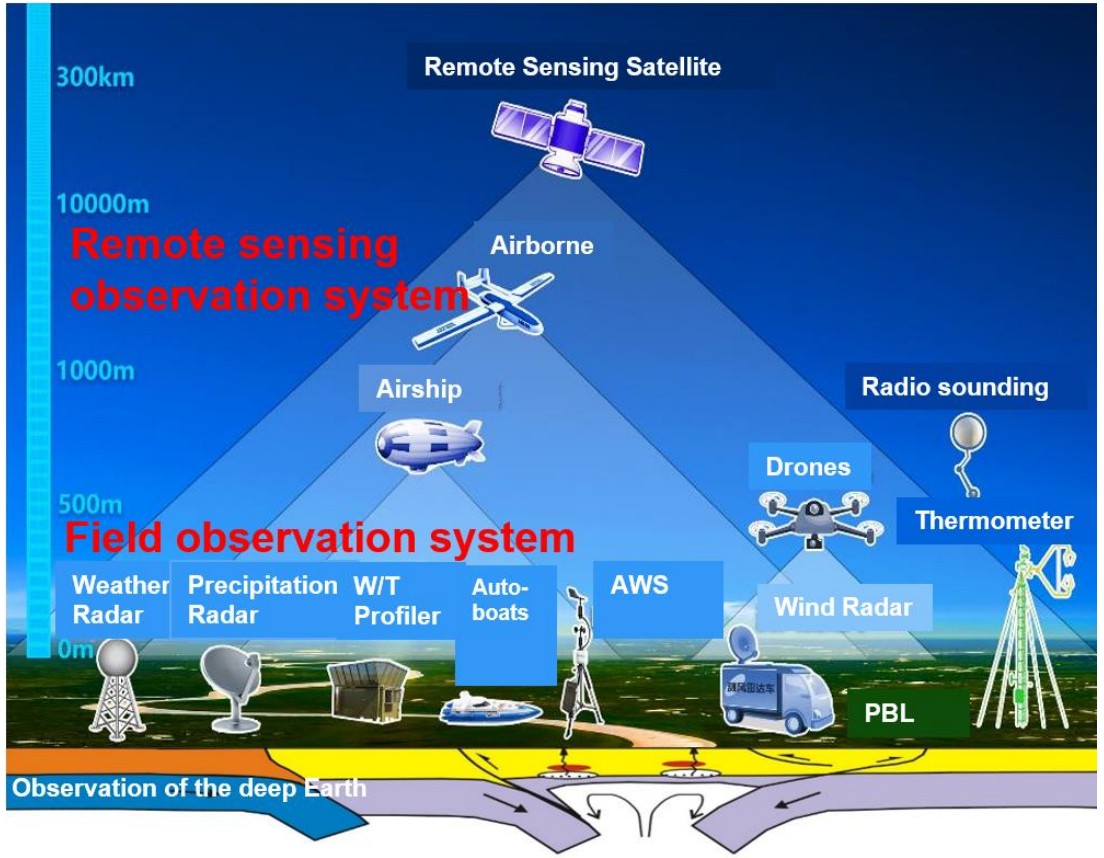
Thematic observations

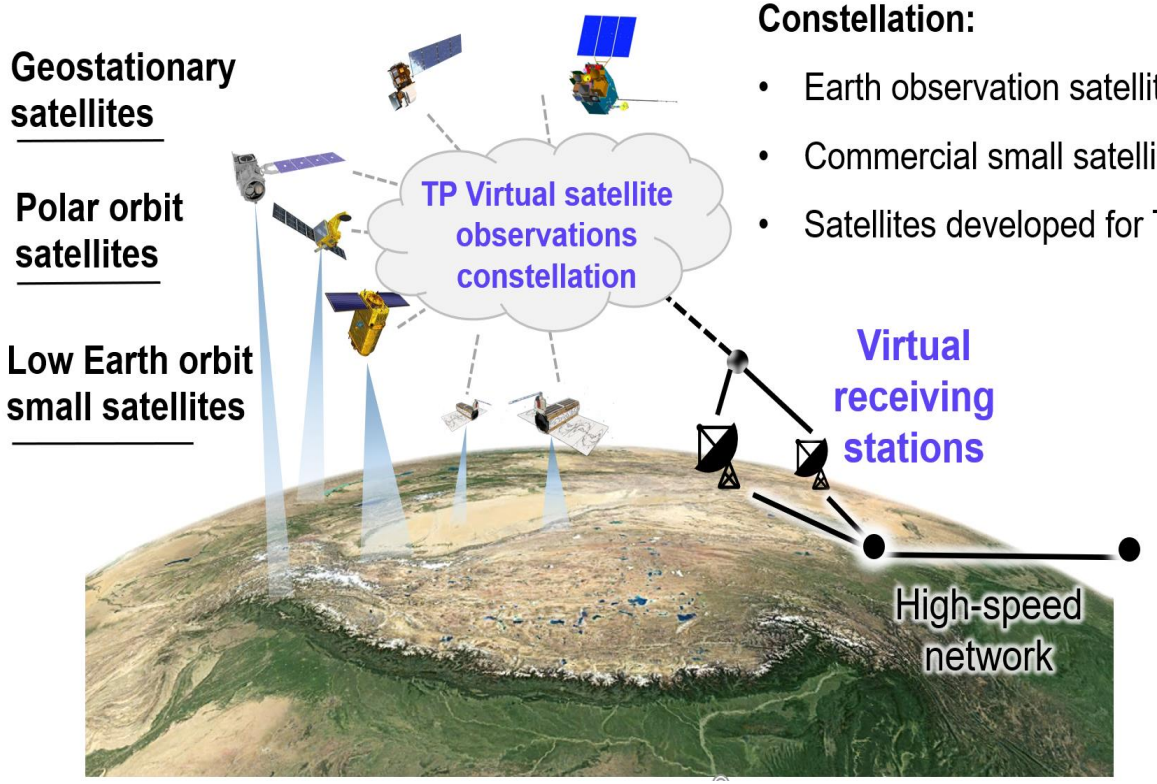


In-situ data measurements and field campaigns

TP Observation Platform: International Observation Alliance of the Third Pole

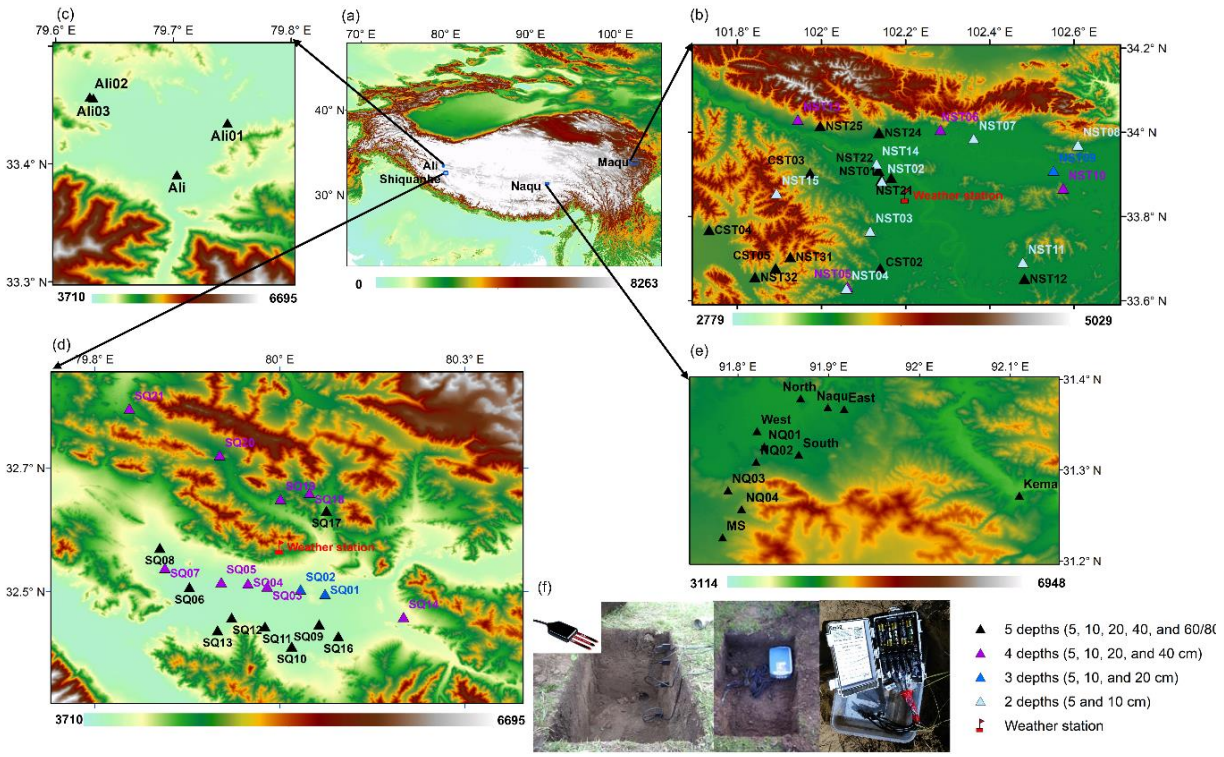
Build a space-airborne-ground integrated IoT observation system, consisting of a field observation system and a remote sensing observation system.



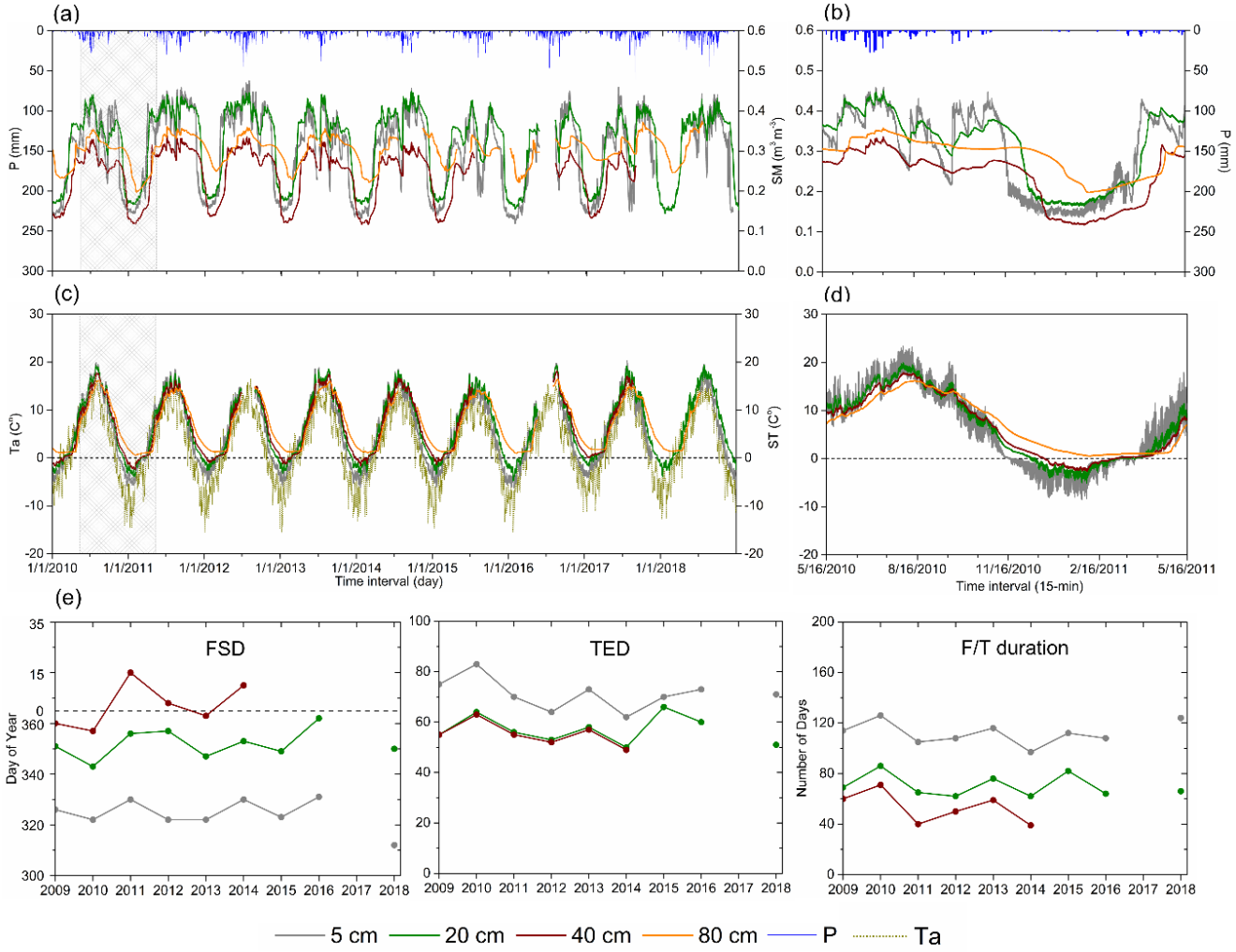


In-situ data measurements and field campaigns

10-year regional-scale soil moisture and soil temperature measurements



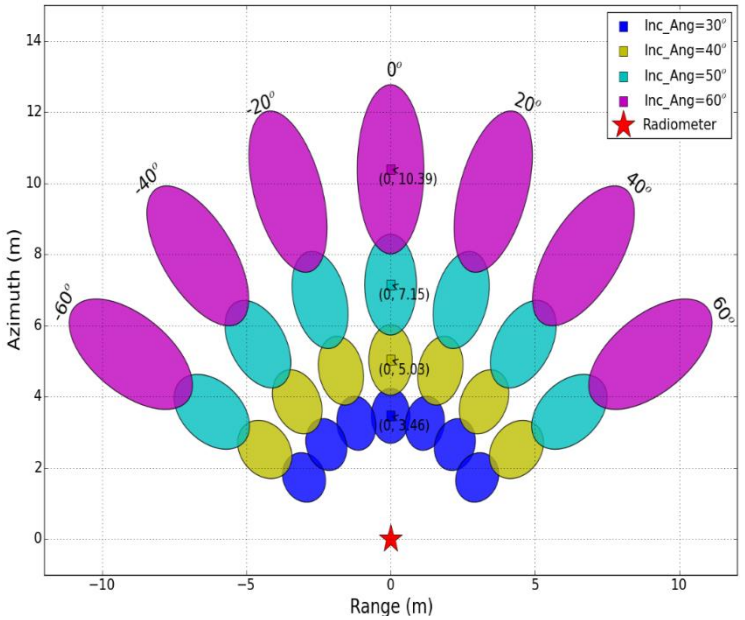
(Zhang, Zheng et al., 2021, 2022 *ESSD*)



In-situ data measurements and field campaigns

Field campaign in Heihe river, western China

Ground-based radiometry experiment

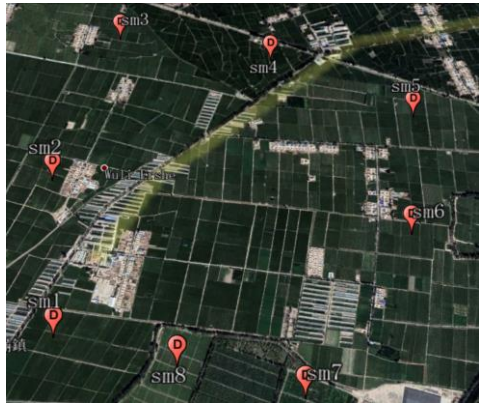


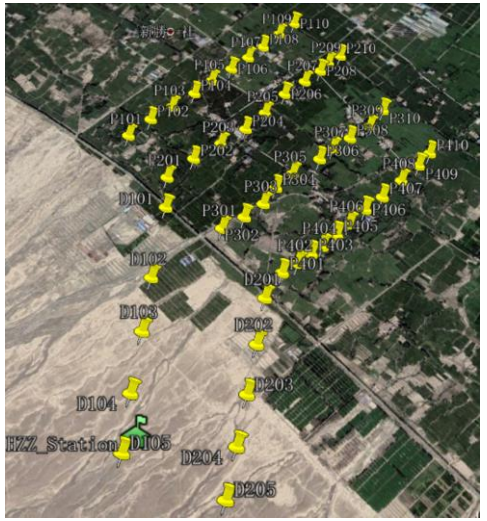
Design of Experiment

Implementation of Experiment

(Wang et al., 2020 *Sensors*)

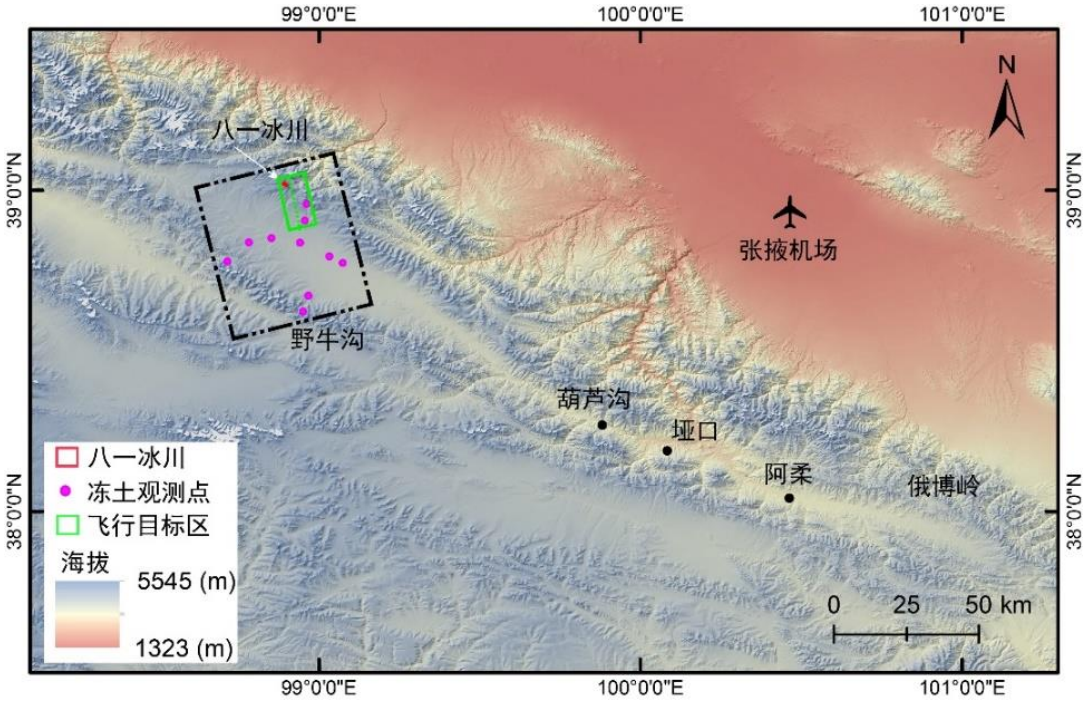
Gaofen Cal/Val flight campaign



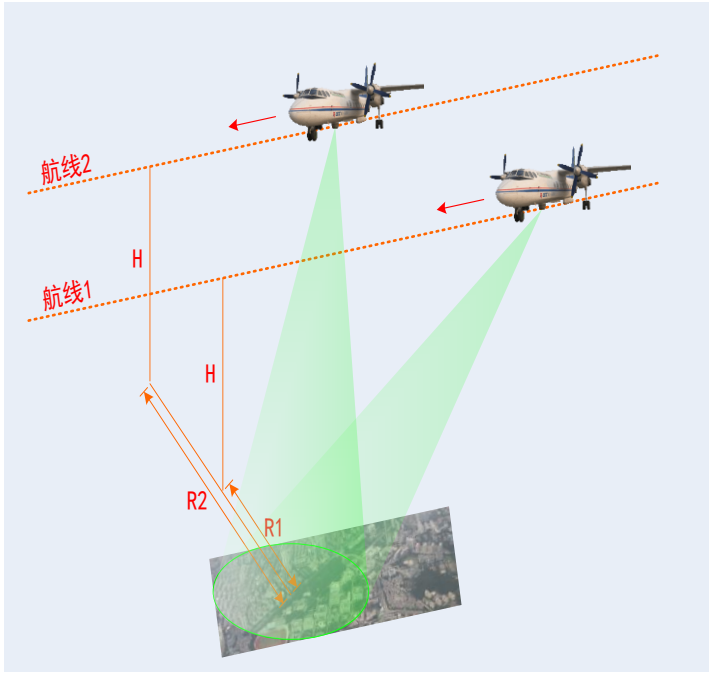


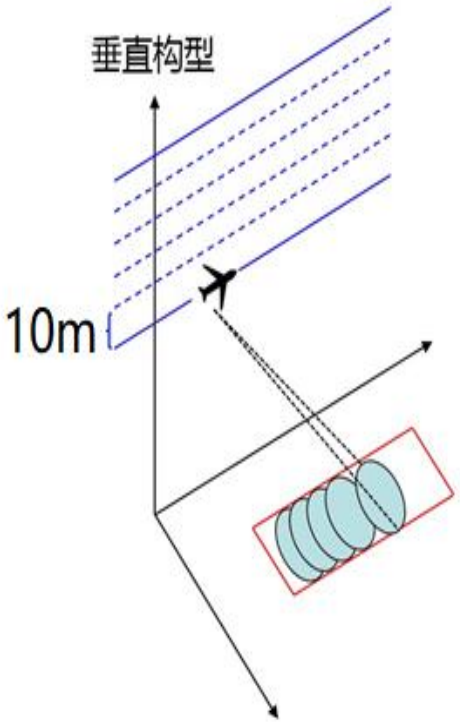
In-situ data measurements and field campaigns

P-band SAR Flight Campaign in Heihe river, western China



Source Region of Heihe River





Schematic diagram of TomoSAR Observation Mode

In-situ data measurements and field campaigns in Europe

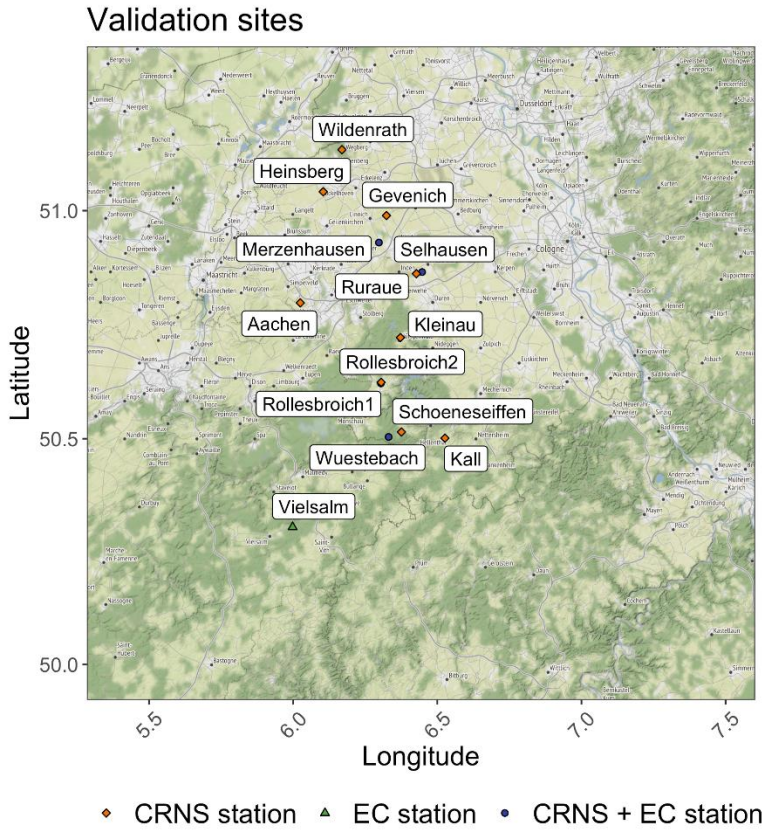
- **Cosmic Ray Neutron Sensors (CRNS)**

Soil moisture at intermediate scale.

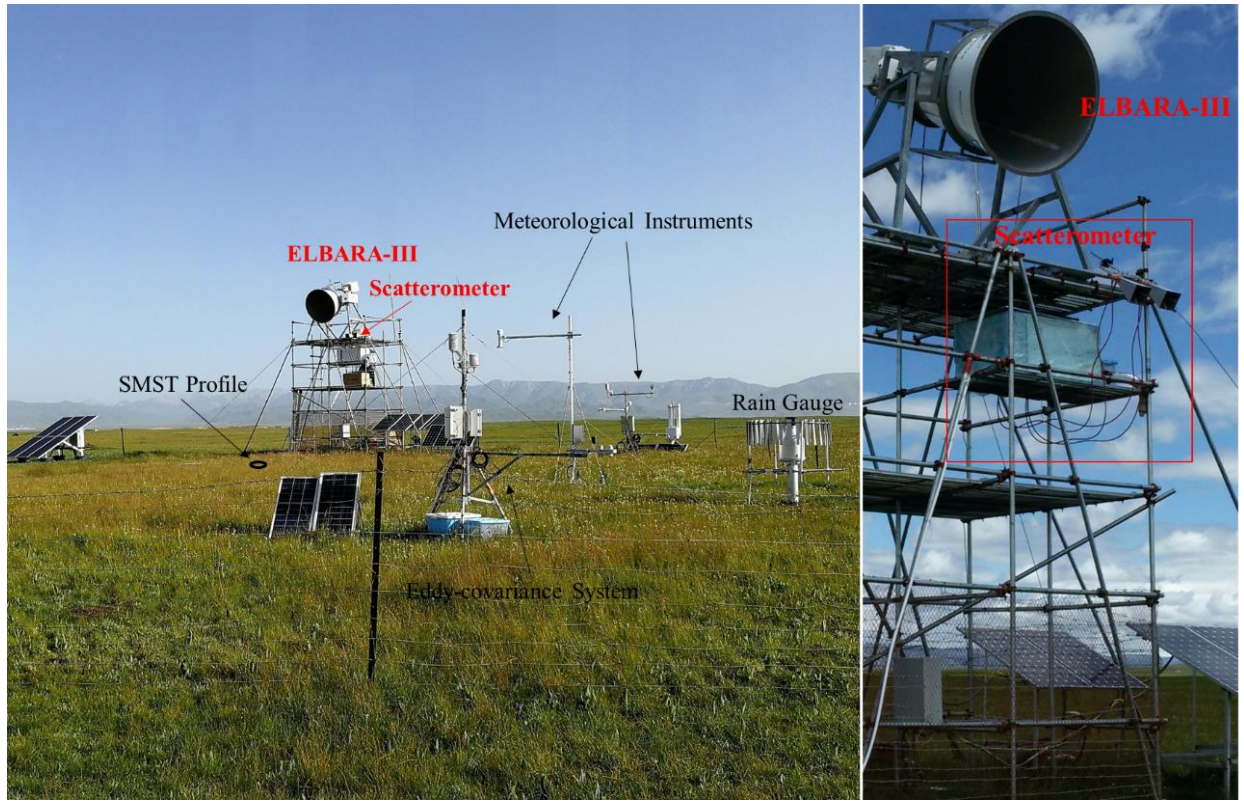
- **Eddy Covariance (EC) method**

Field-scale ET.

source: H.R.Bogena et al., 2013,
Photo:Marius Schmidt



Active and Passive Microwave Observations and Simulations of Frozen Soil

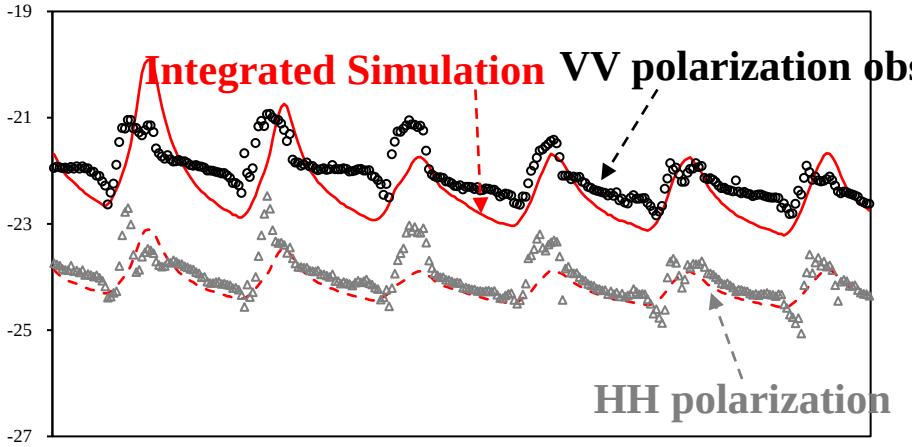


Modelling Platform

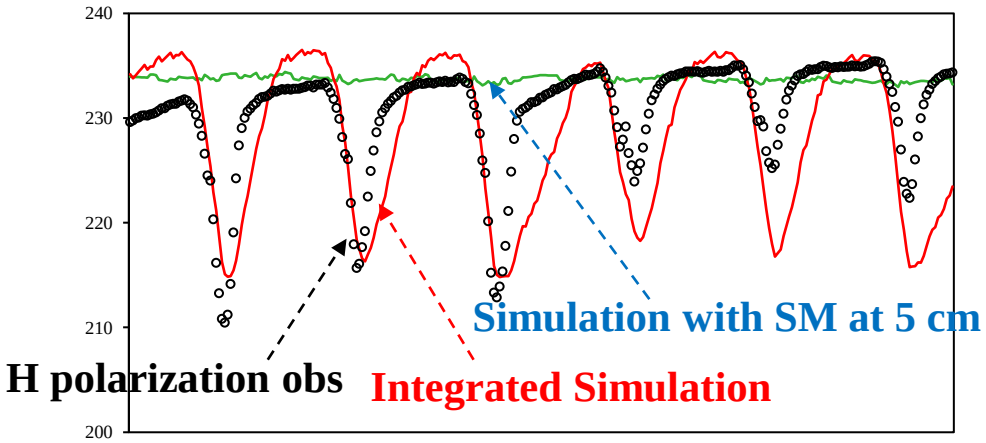
Tor Vergata+AIEM+Wilheit+Noah

(Zheng et al., 2022 *IEEE TGRS*)

C-band backscattering coefficients

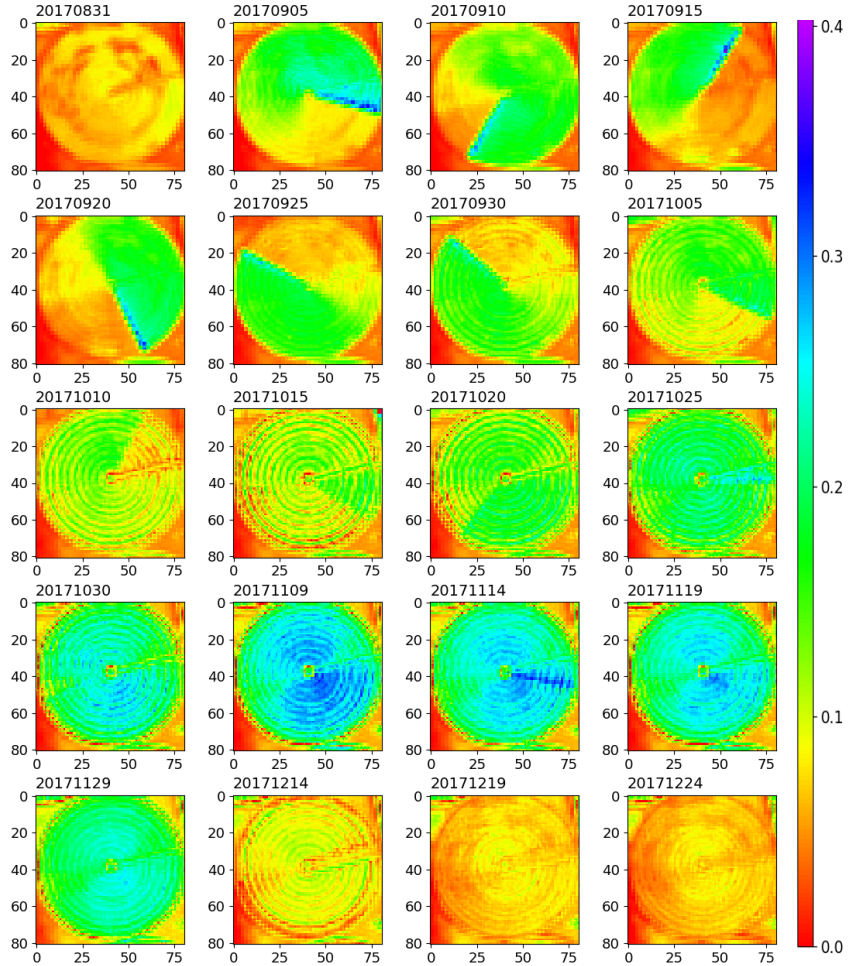


L-band brightness temperature



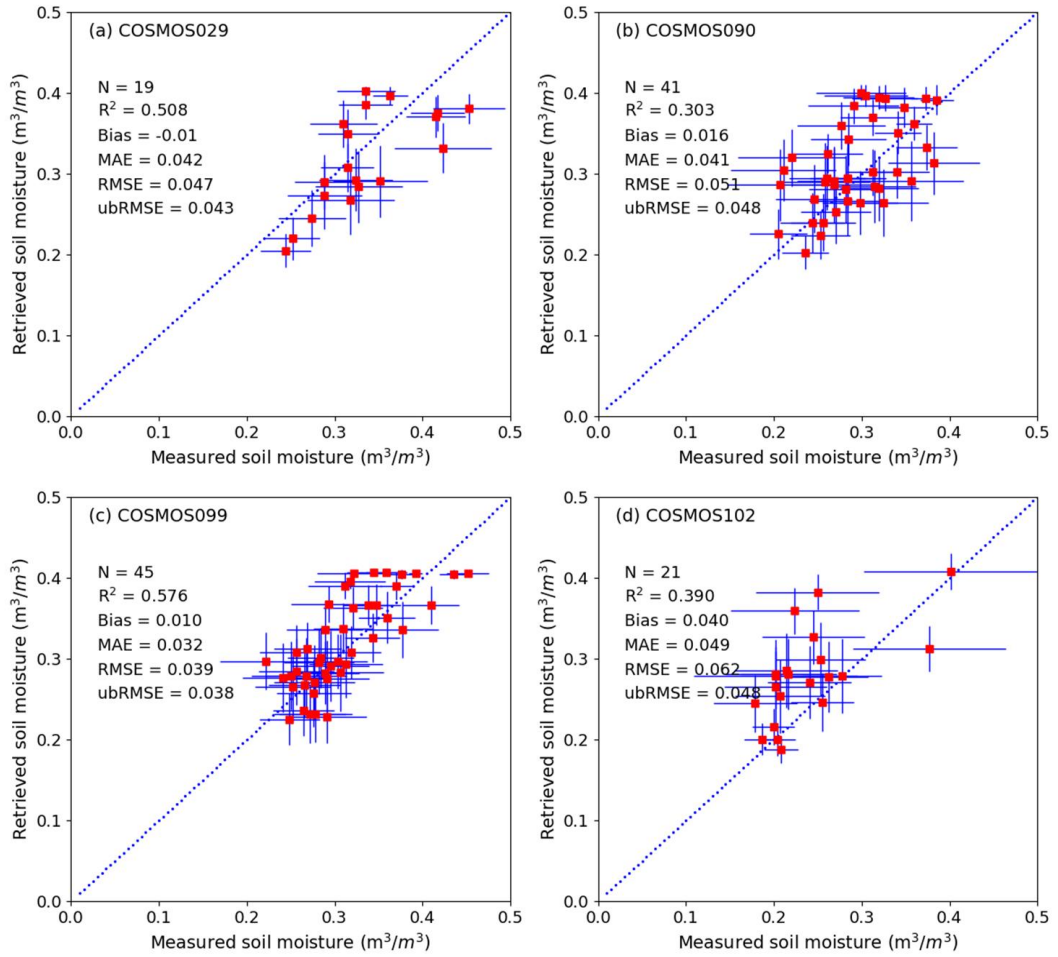
Soil Moisture Retrieval

Soil moisture retrieval in Central Asia based on Sentinel2



(Ma et al., 2022 *AWM*)

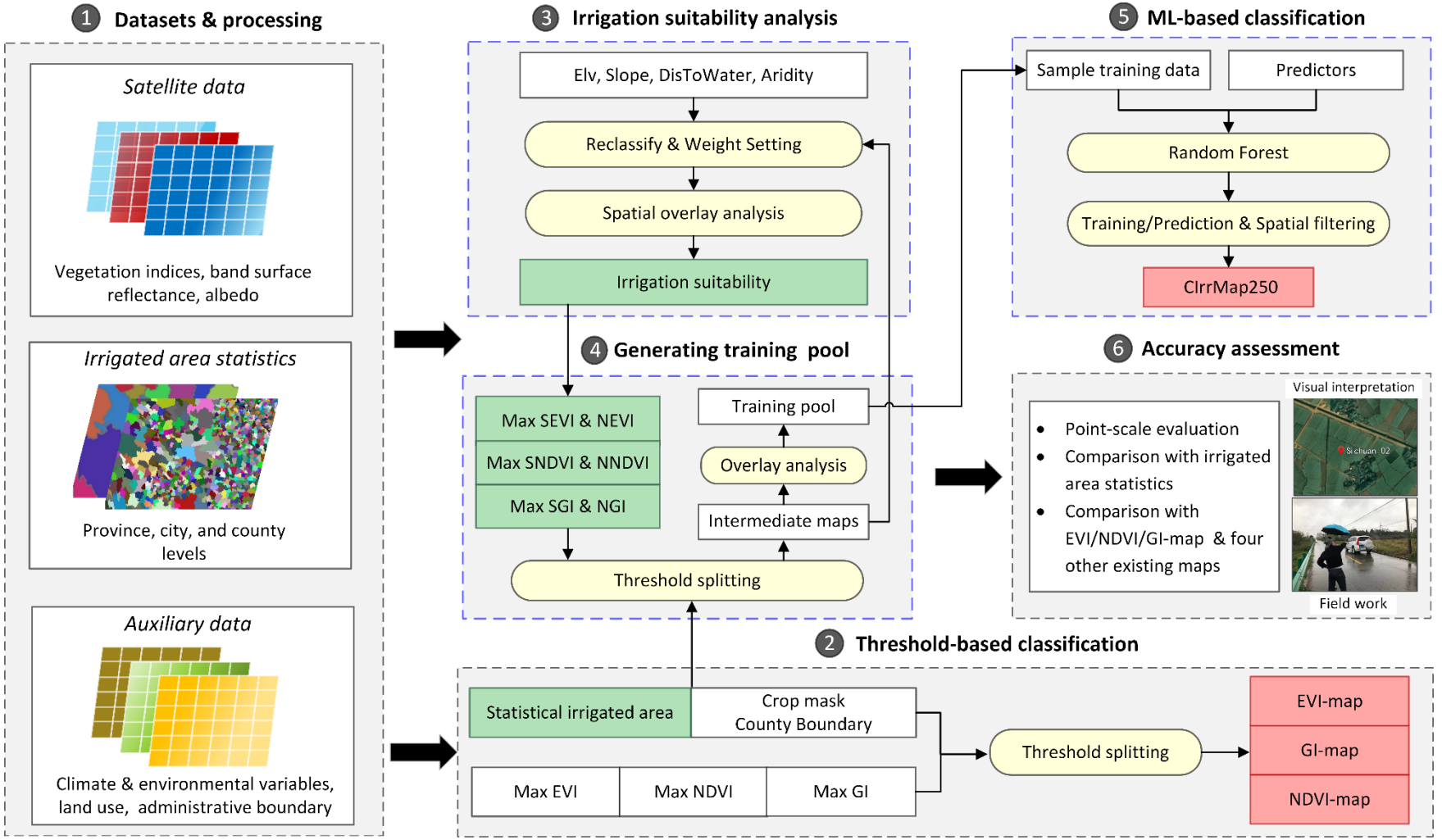
Soil moisture retrieval in Western China based on combined Sentinel-1/2



(Ma et al., 2020 *RS*)

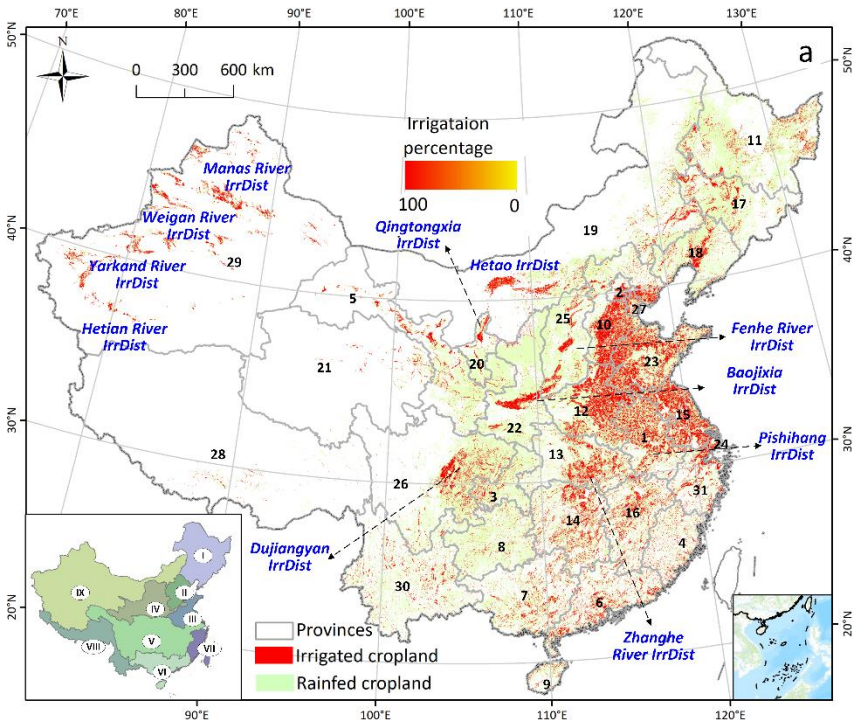
Map of Irrigation Area

- Remote sensing, irrigation suitability and statistical data were integrated for irrigated cropland mapping in China
- The first 250-m irrigation map in China (CIrrMap250). was developed

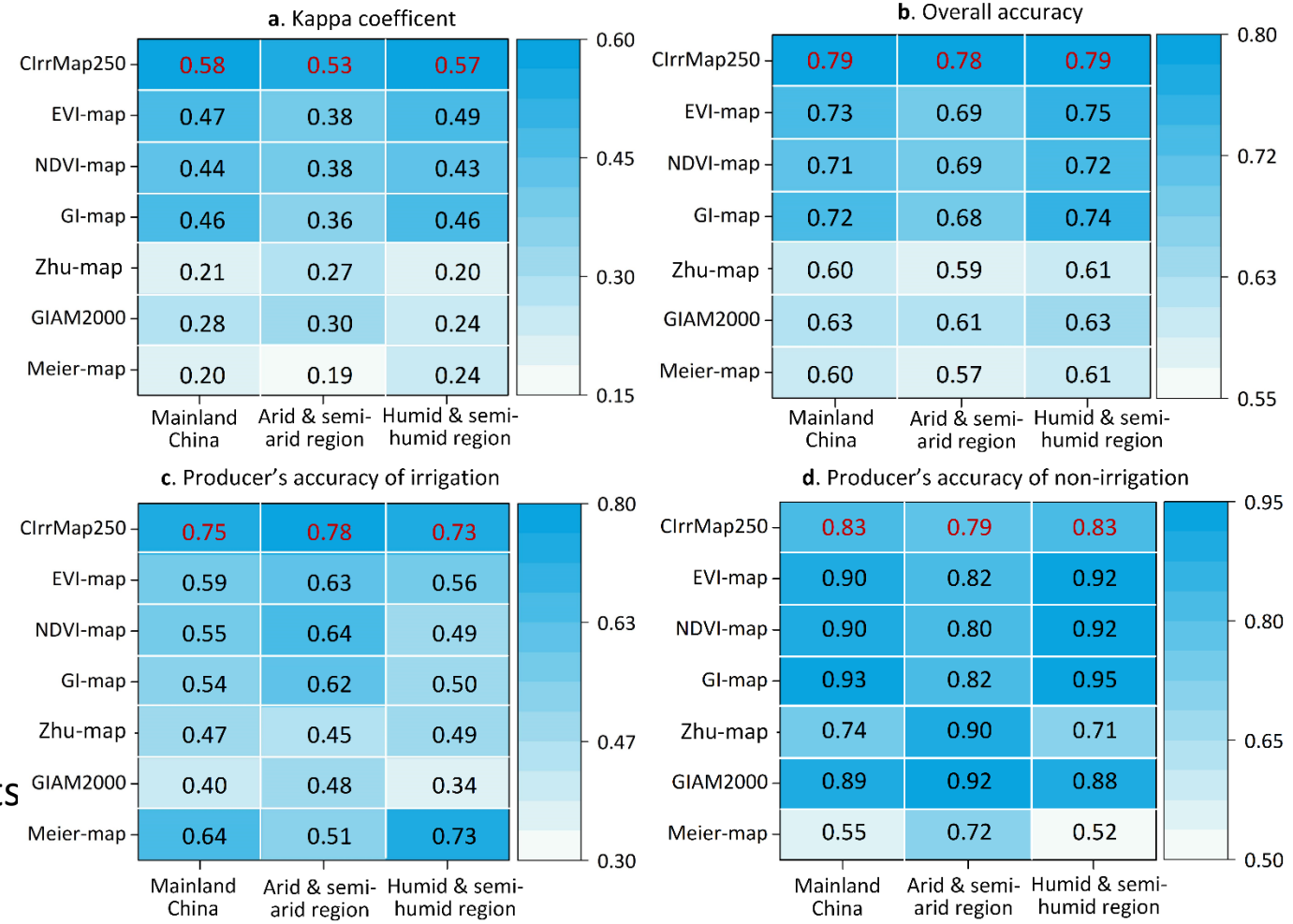


(Zhang et al., 2022 *Journal of Hydrology*)

Map of Irrigation Area



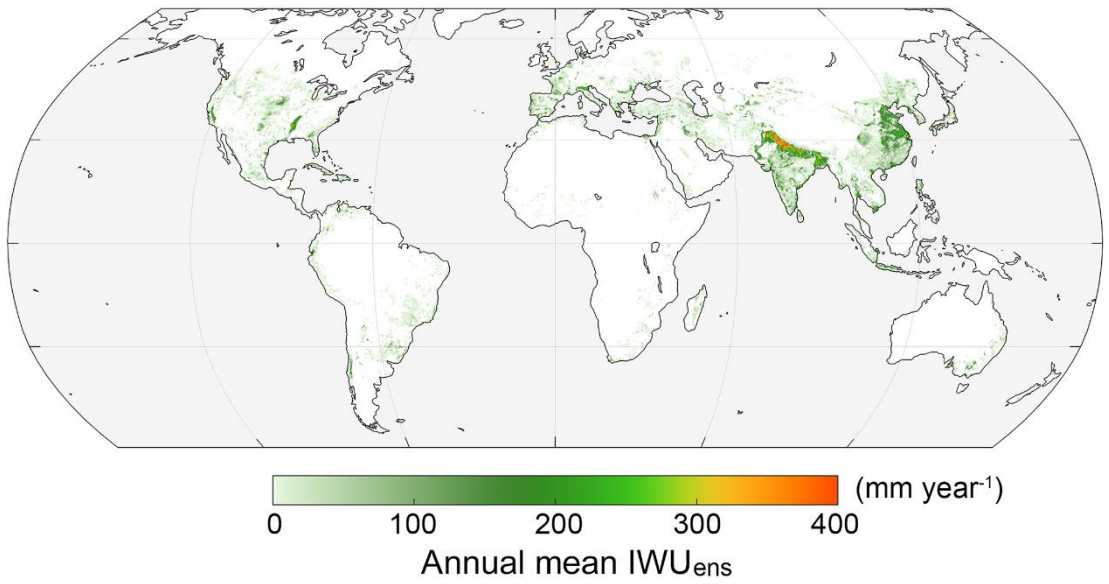
- CIrrMap250 captures well the intensively irrigated areas and large-scale irrigation districts
- CIrrMap250 exhibits a better agreement with reference points than other irrigation maps.



(Zhang et al., 2022 *Journal of Hydrology*)

Estimation of Irrigation Water Use

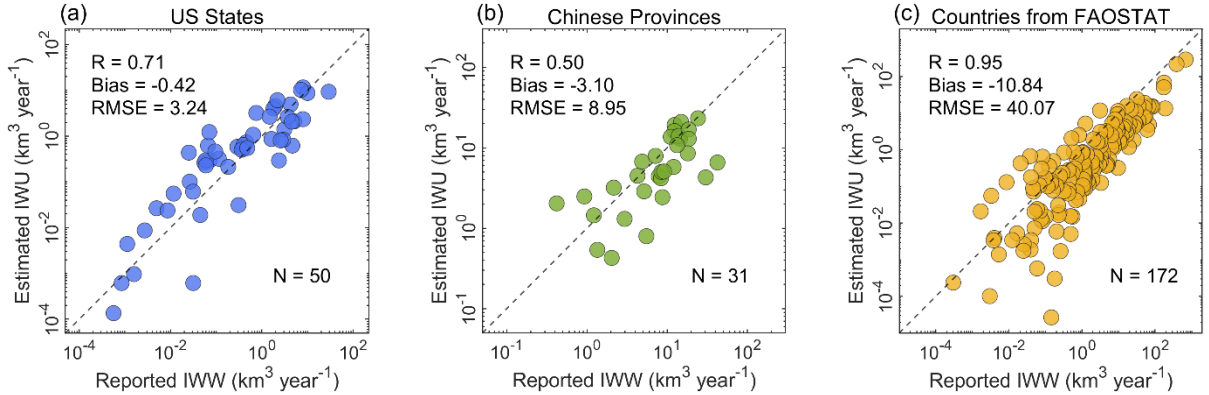
Integration of multiple satellite-based observations



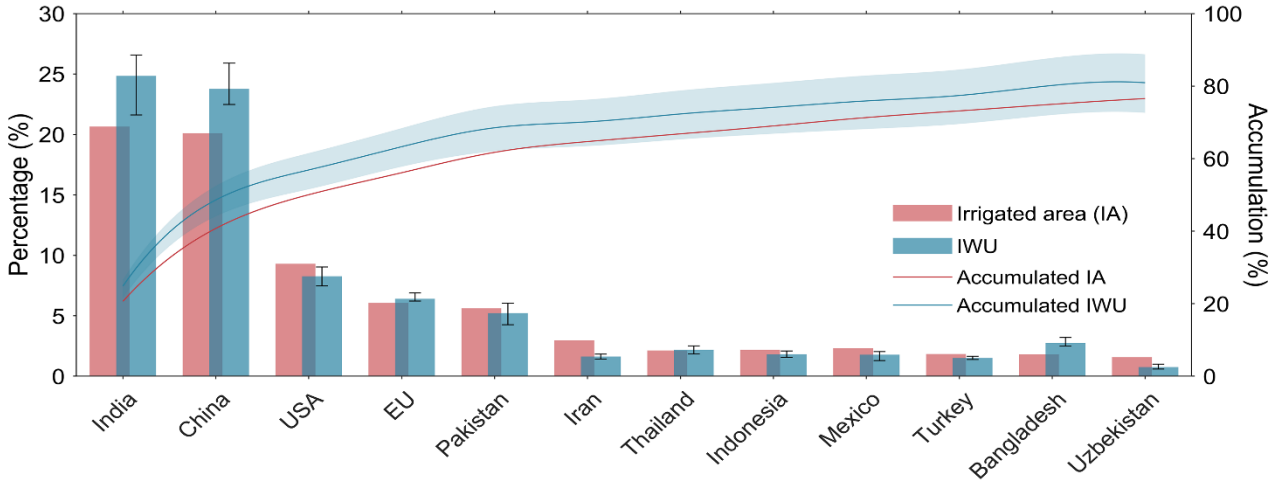
Annual mean IWU from 2011 to 2018

The microwave-based satellite observations can capture the irrigation signal, and the IWU can be further estimated based on the dynamical balance of soil moisture.

(Zhang et al., 2022 *Water resources research*)



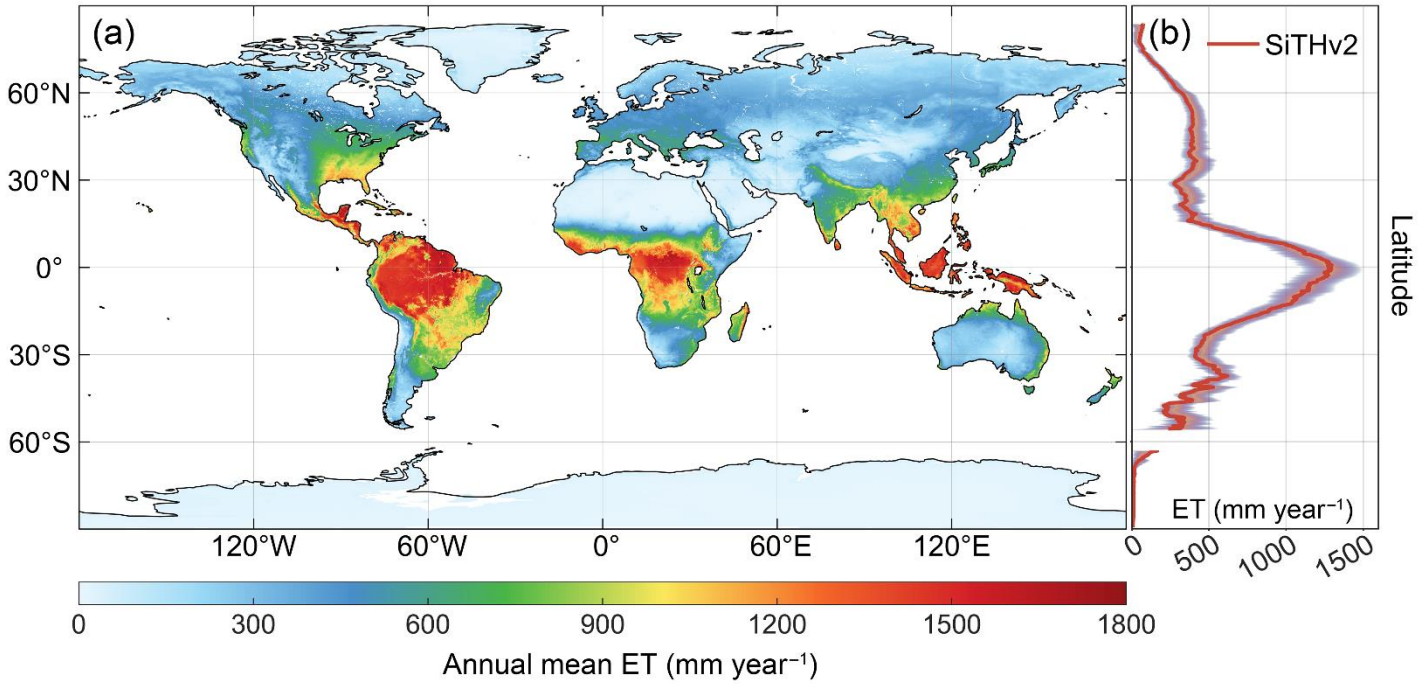
Comparison with reported data



Top 12 irrigated countries/regions from 2011 to 2018

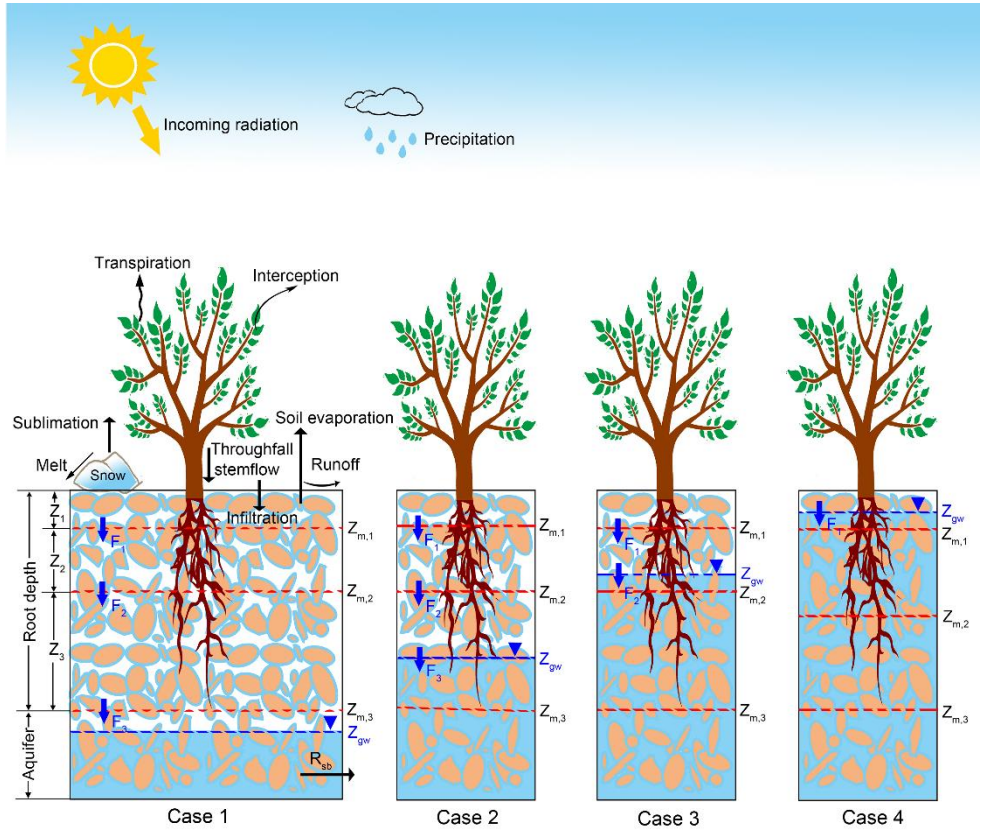
Evapotranspiration

Groundwater-soil-plant-atmosphere Continuum



Annual mean terrestrial ET from 2001 to 2018

The performance of the SiTHv2 ranks well when compared to the main-stream global ET models/products.

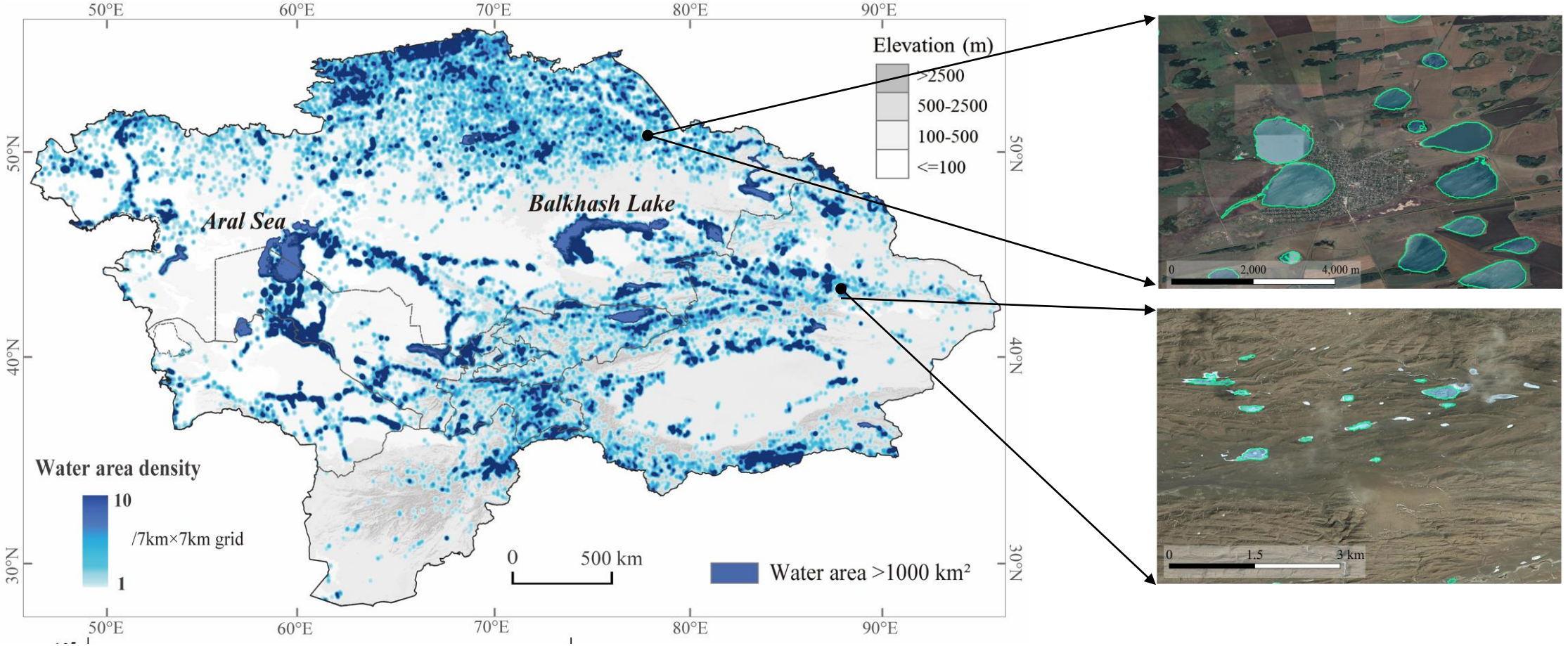


Hydrologic process in the SiTHv2 model

(Zhang et al., 2022 *Journal of Hydrology*)

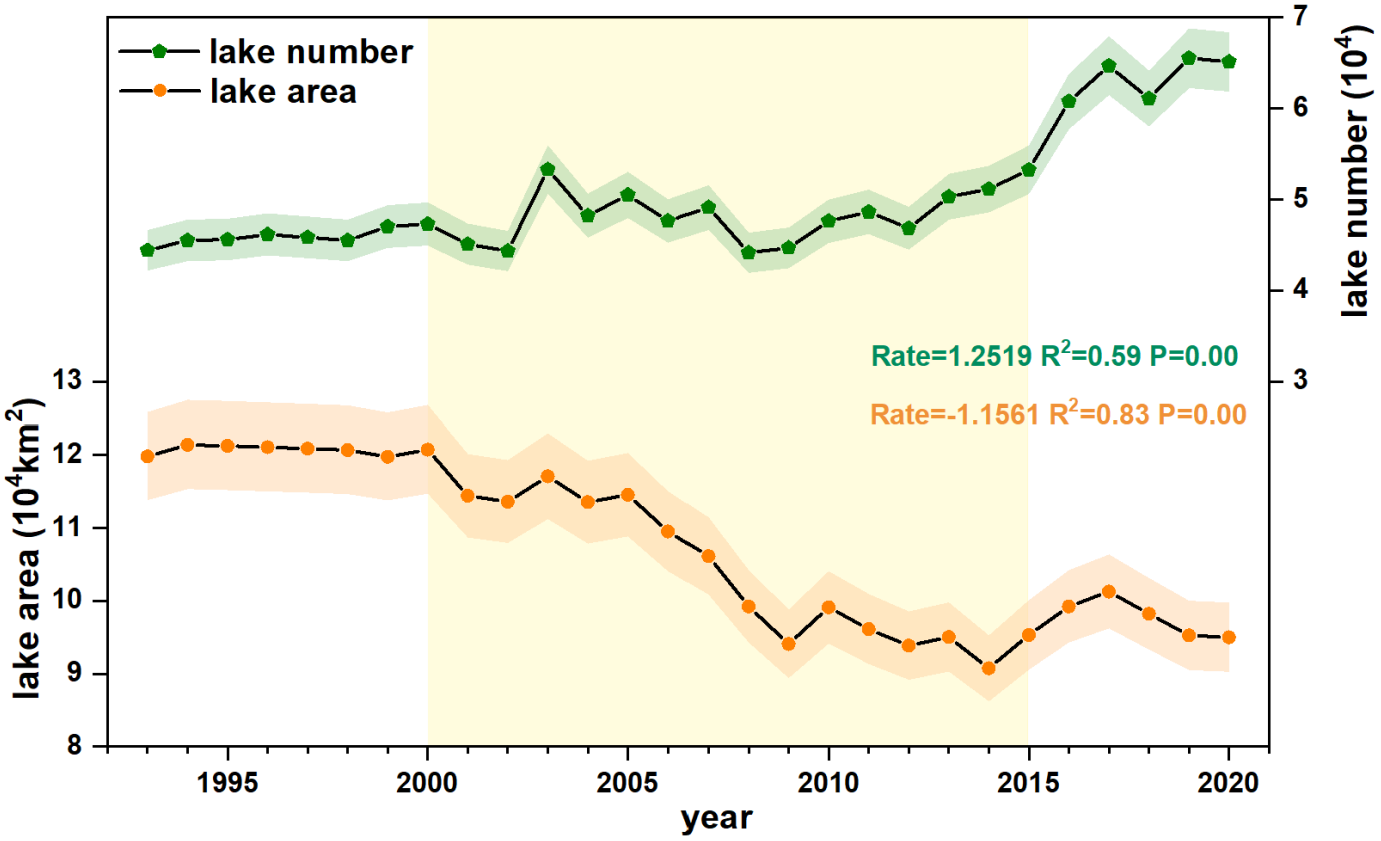
Surface water bodies in center Asia

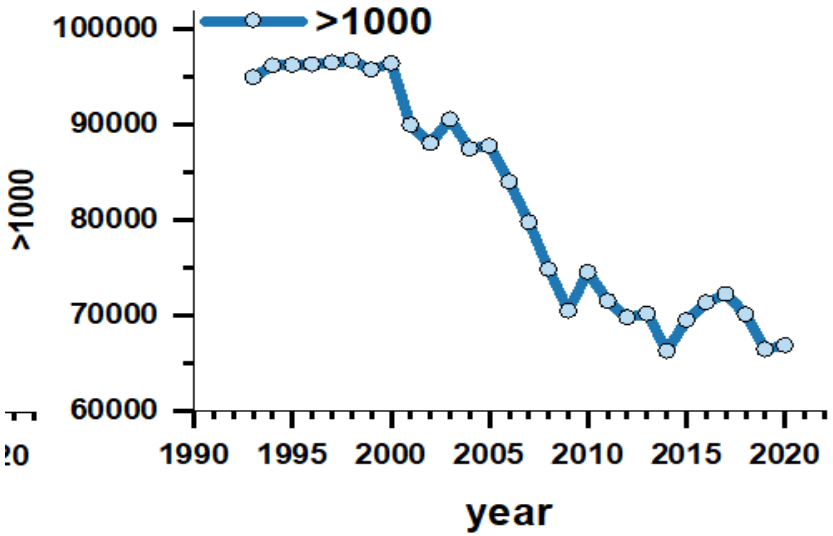
- Identified 93,230 water bodies in central Asia by combining the Landsat and Sentinel-2 data, providing the most detailed delineation of water in this arid region.

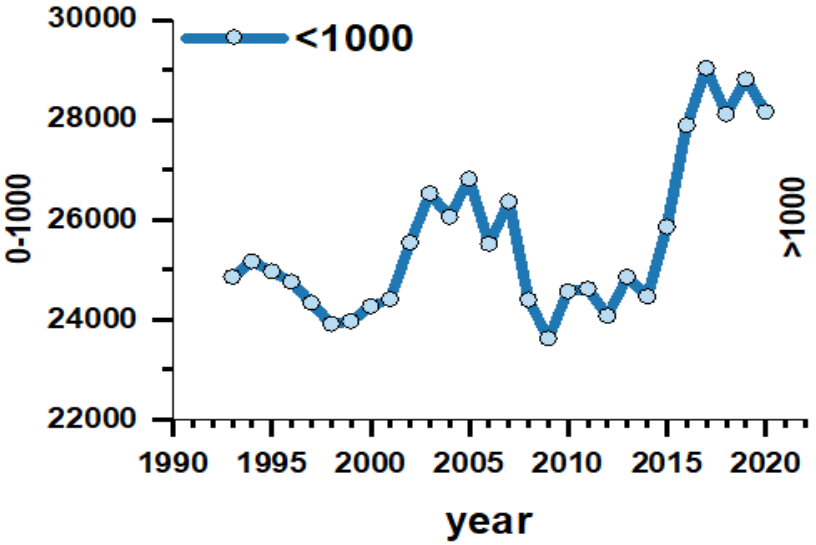


Surface water bodies in center Asia

- Large lakes (>1000 km²) shrunk while small water bodies expanded in central Asia since the beginning of 1990s

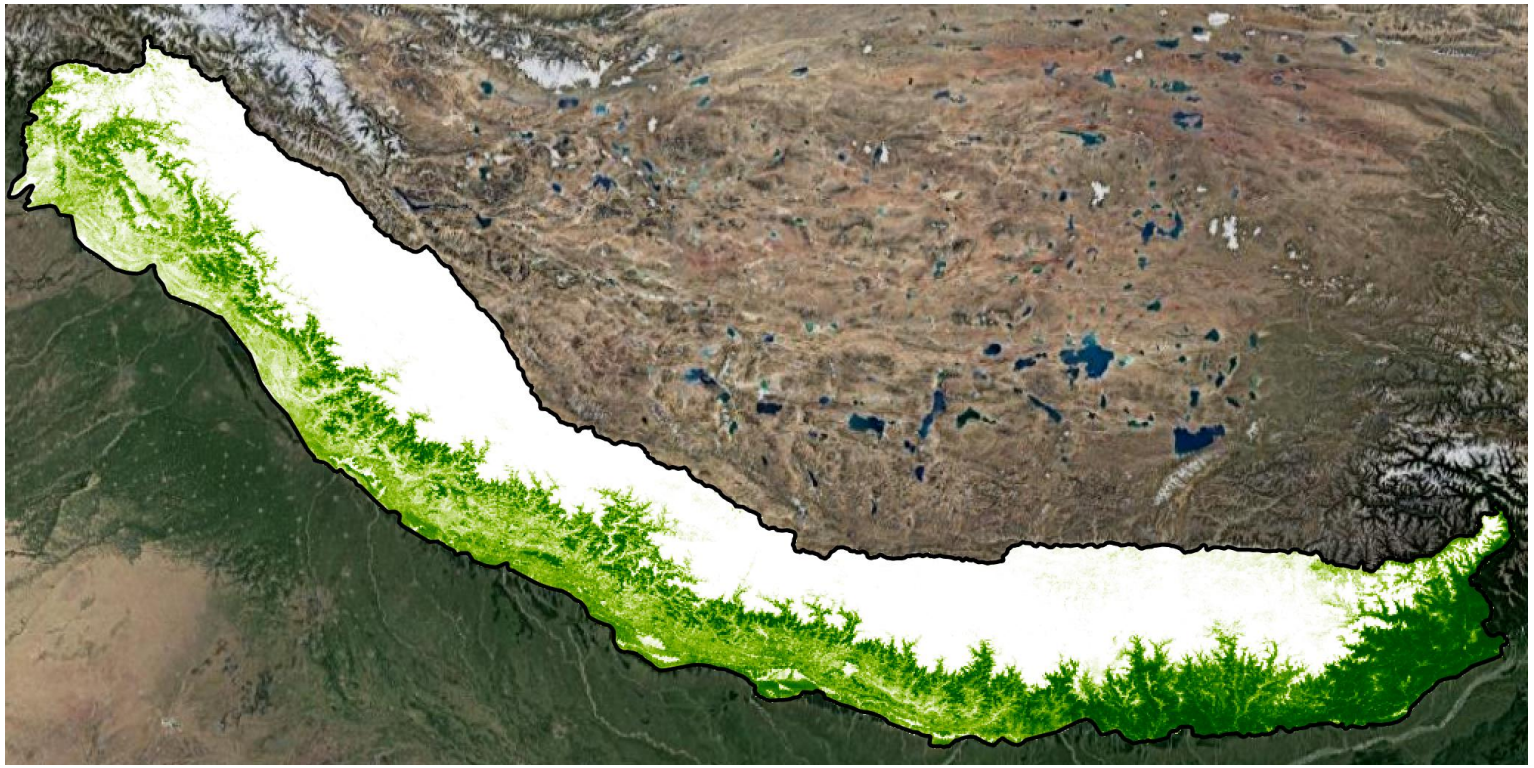


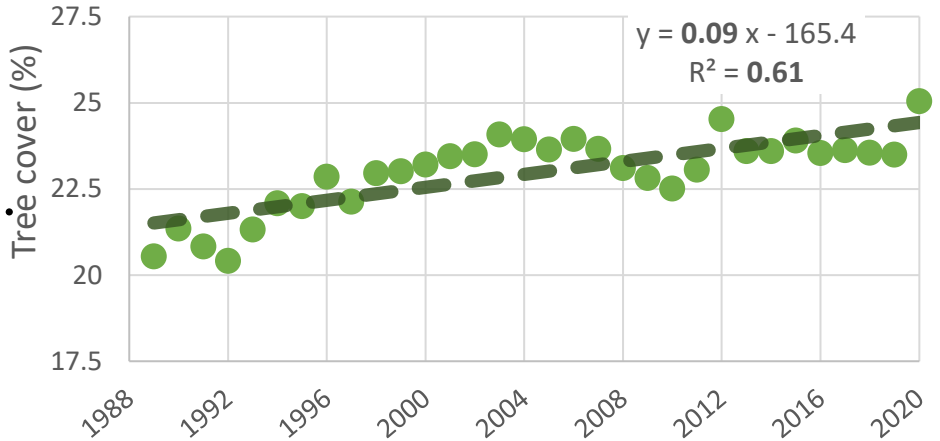


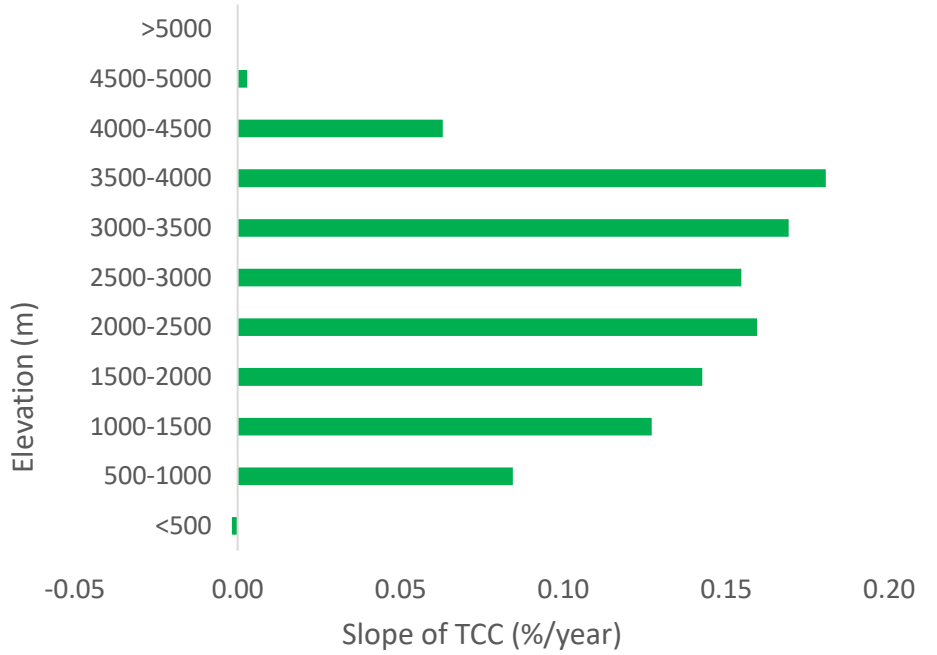


Forest changes in the Himalayans

- Derived tree cover from 1990s to 2020, and identified a increasing trend in the Himalayans, especially in high altitudes.

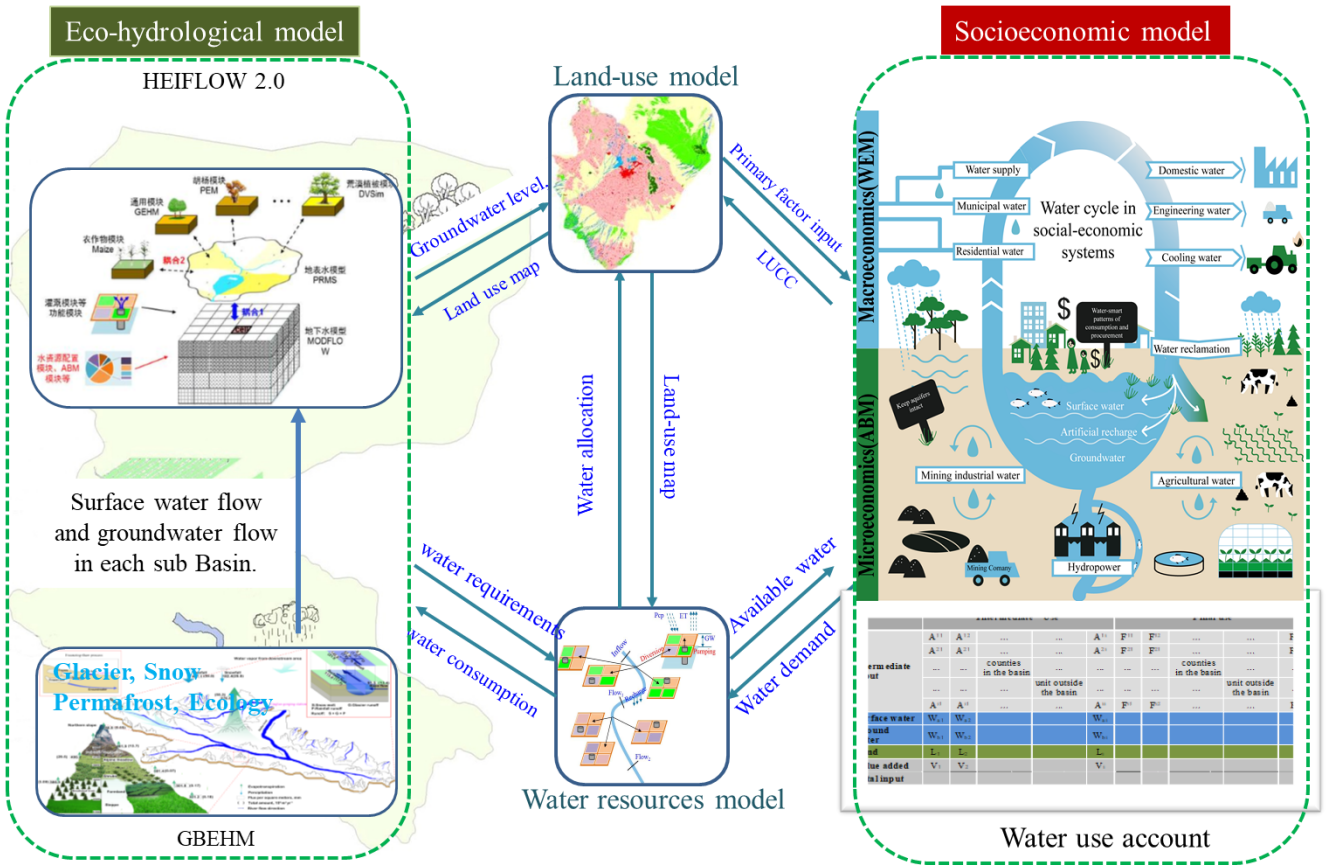




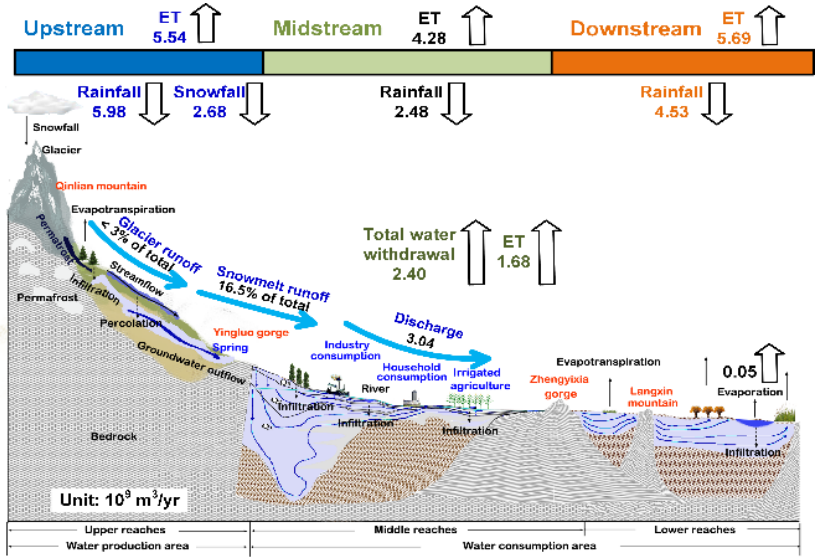


Project's results after 2 years of activity

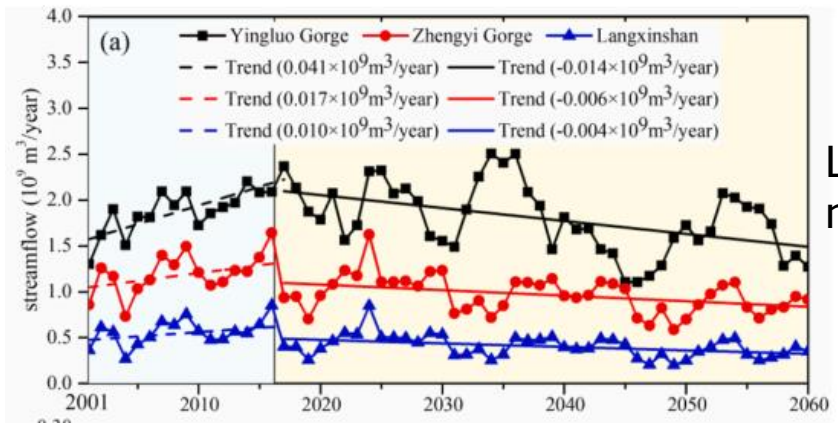
Watershed System Model



Coupling of ecohydrology and socioeconomy



Water balance closure

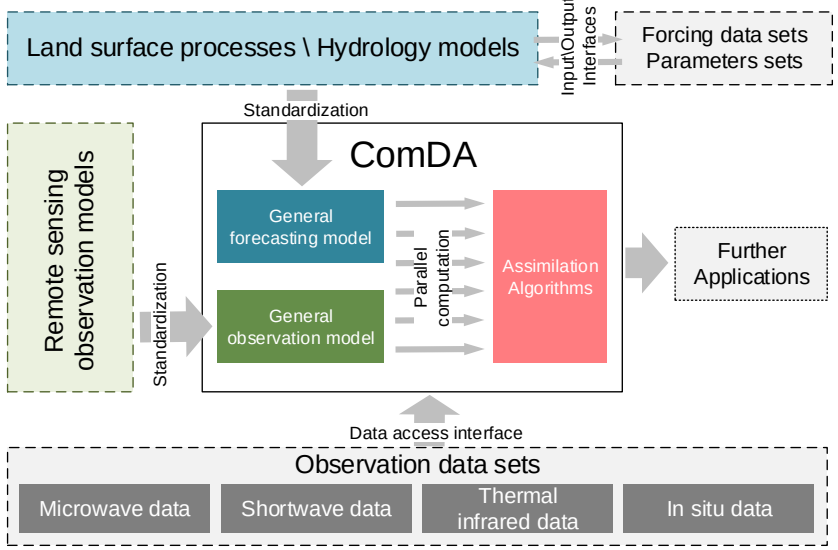


Long-term modeling

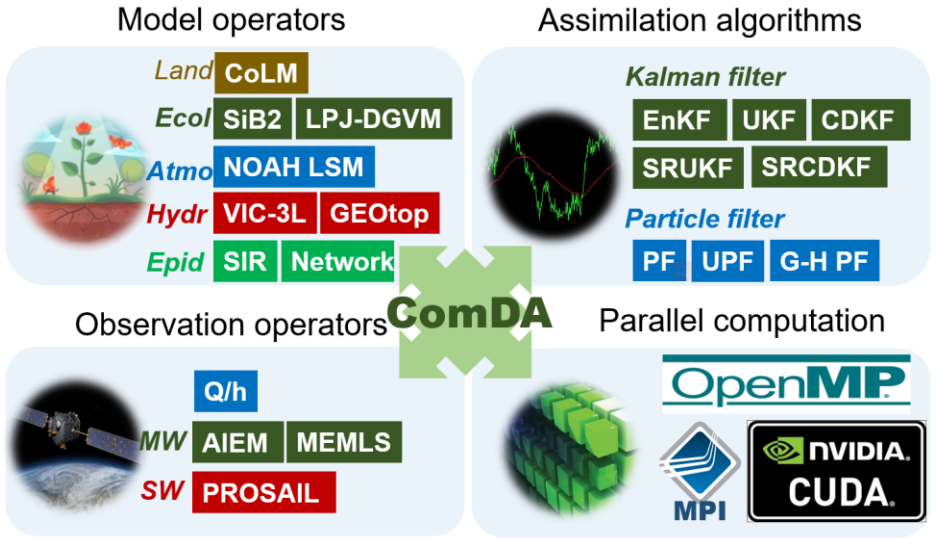
(Li et al., 2021 *EMS*)

ComDA

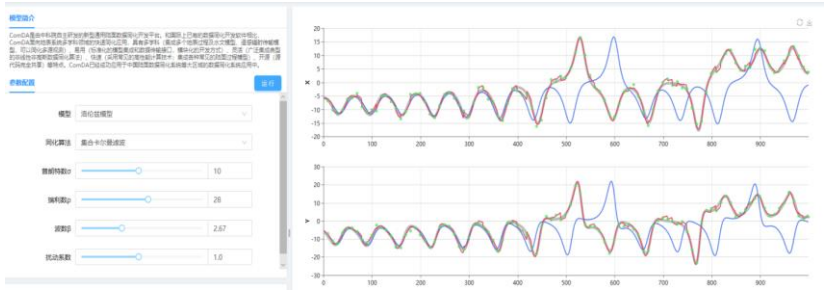
A Common Software for Nonlinear and Non-Gaussian Land Data Assimilation



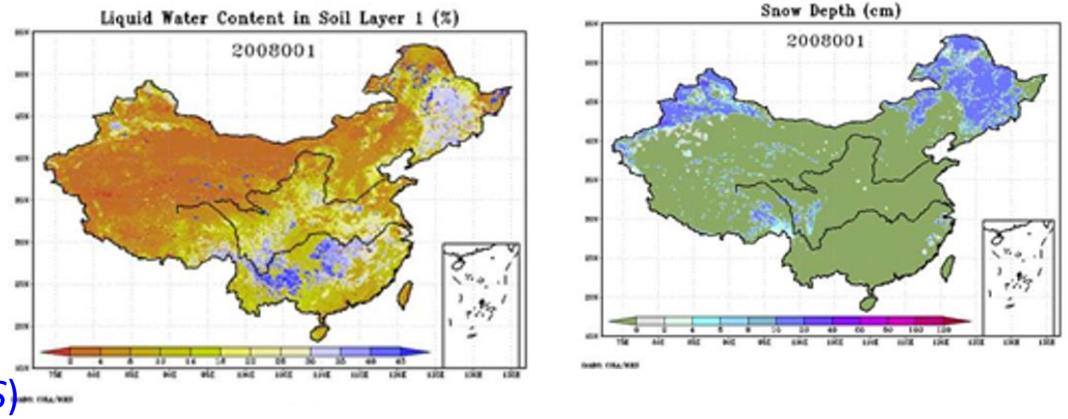
Materials



Online demo



Practices



(Liu et al., 2021 *EMS*)

Project's results after 2 years of activity

Development and Application of real time RS LDAS for Pan-TP

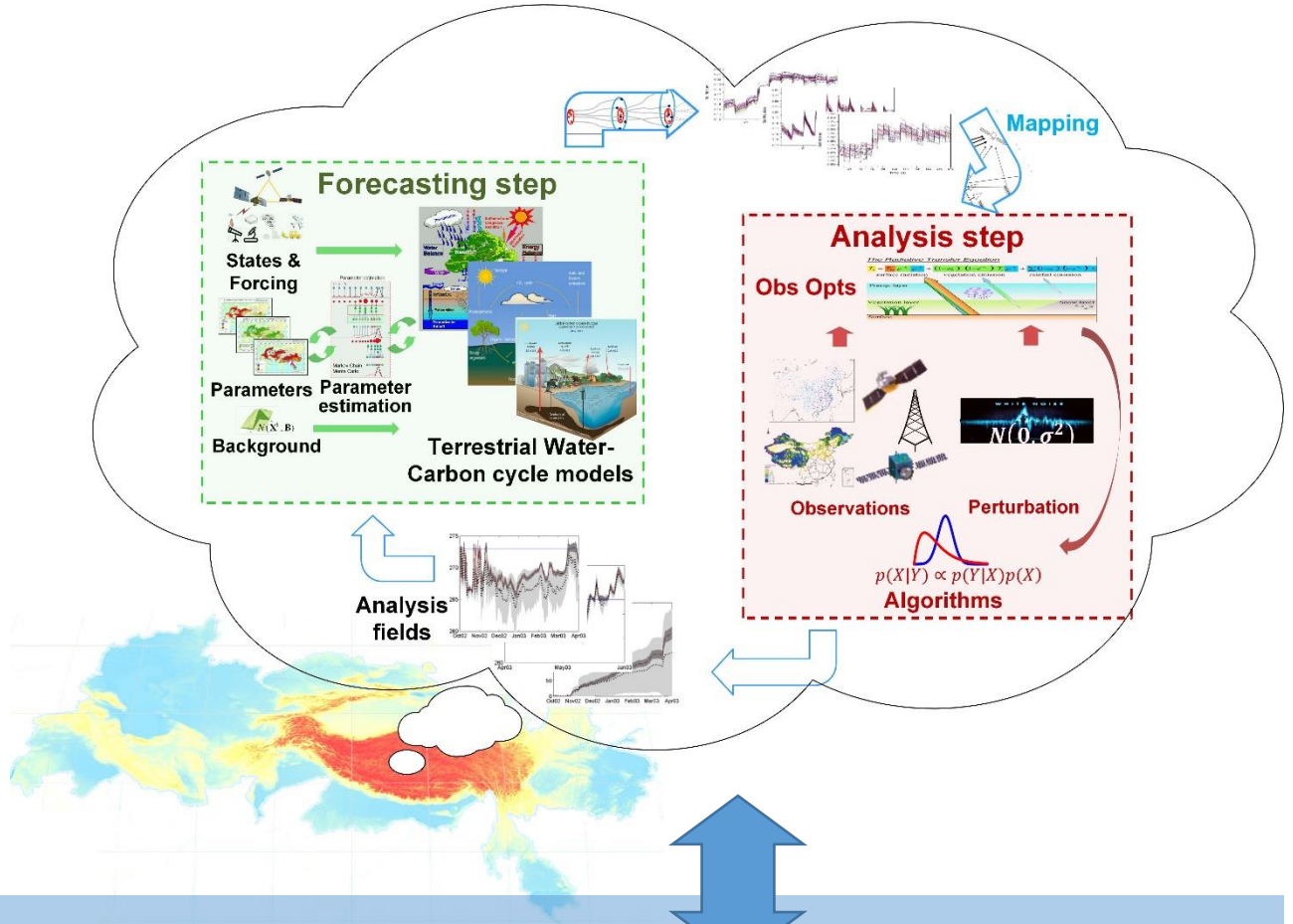
Schematic

Soil Moisture
SMAP
NNsm (Yao and Lu)
…

Soil Temperature
Aqua MODIS LST and
GLDAS
AMSR-E/AMSR2
…

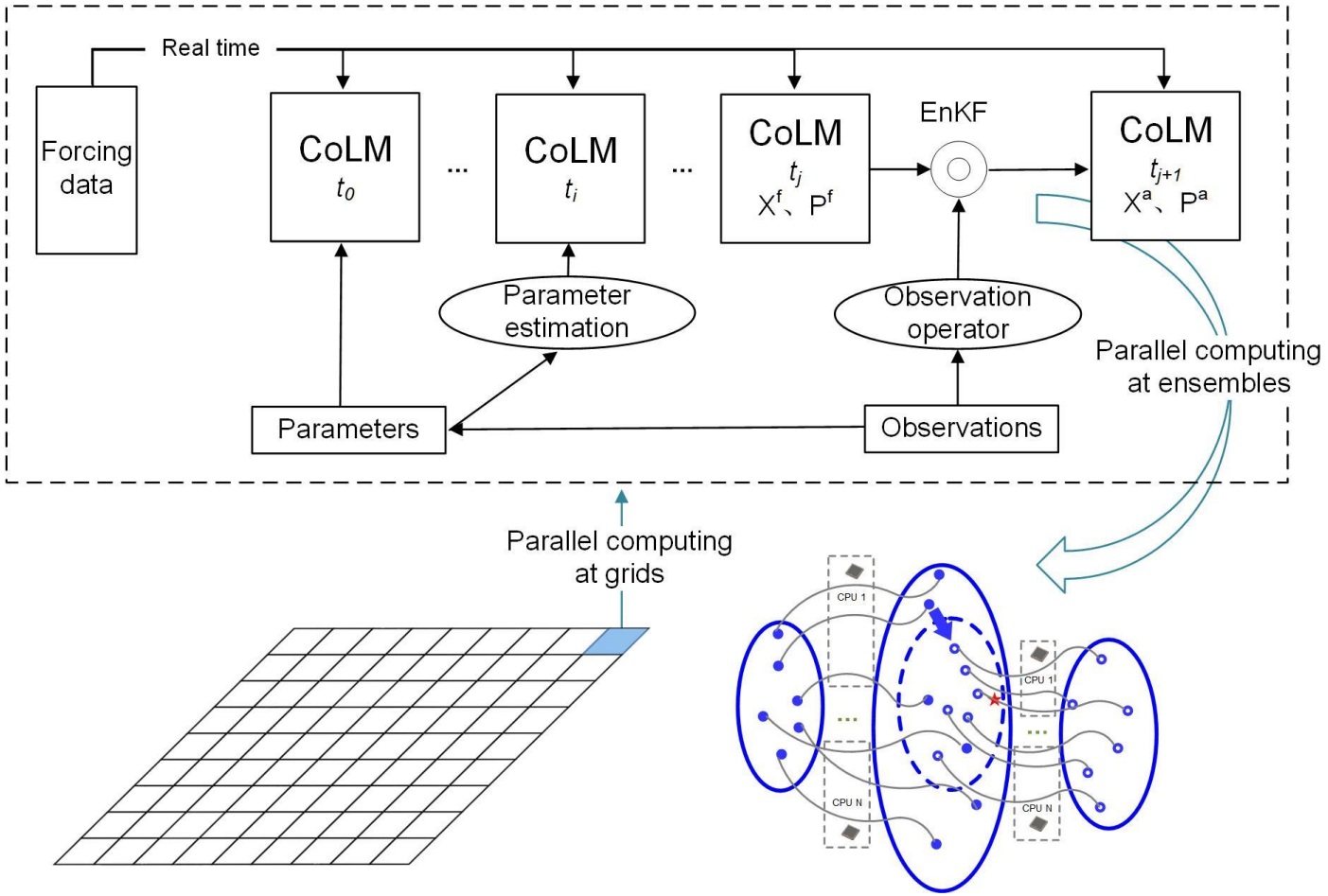
Snow
MODIS
VIRRS/NPP
…

LAI & Chlorophyll fluorescence
GLASS LAI
GOSIF
…



Cloud computing and storage

Development and Application of real time RS LDAS for Pan-TP — data assimilation strategy

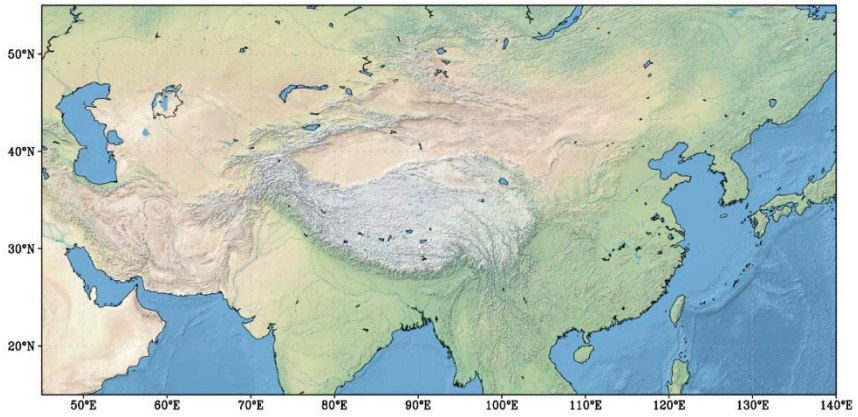


- Forcing:
  CMFD 1.7
- Parameter estimation:
  Metropolis–Hastings sampling
- Data assimilation algorithm：
  Ensemble Kalman filter
- Model operator：
  CoLM 2022
- Parallel computing:
  MPI CUDA

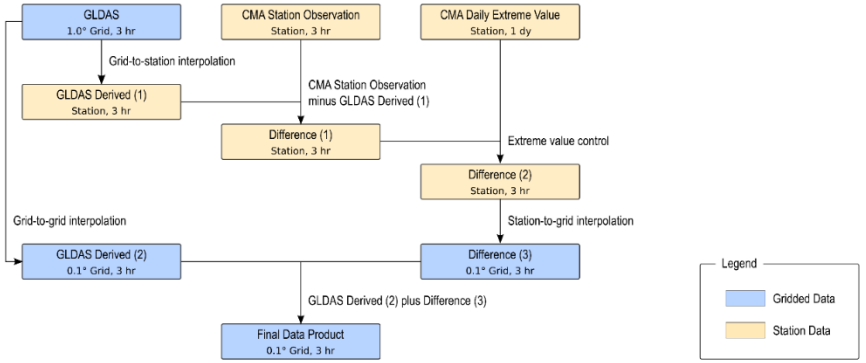
Development and Application of real time RS LDAS for Pan-TP

Forcing data:
China Meteorological Forcing Data (CMFD 1.7)

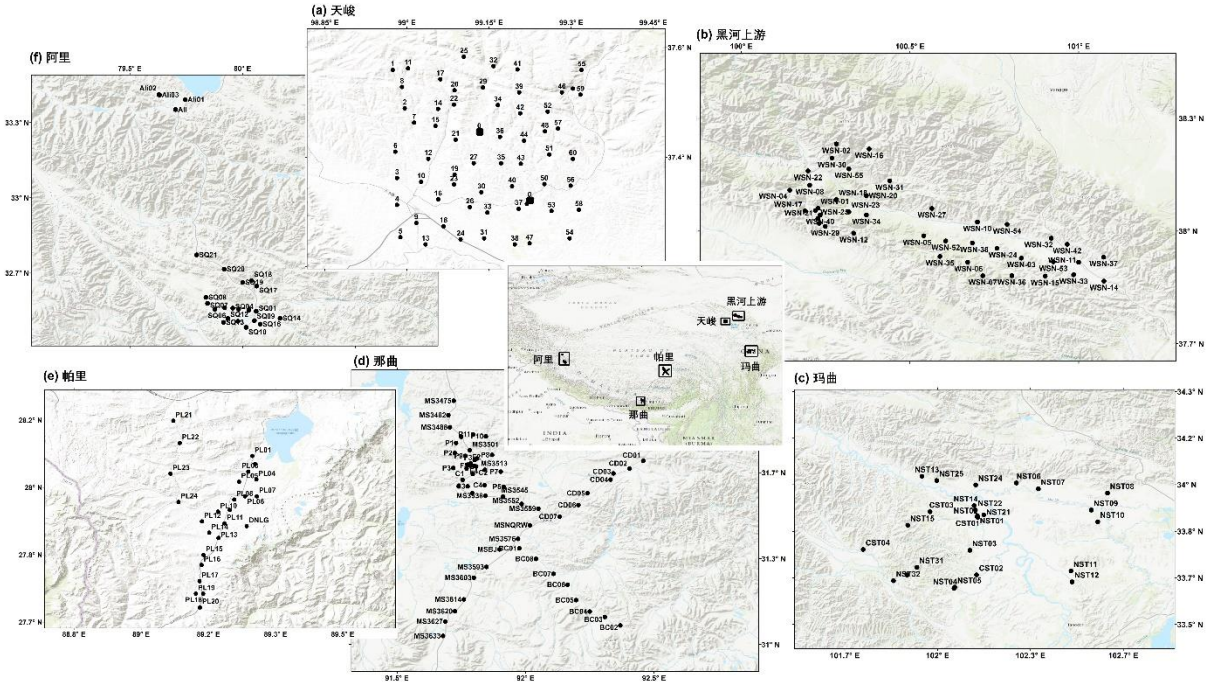
Study region



Core algorithm

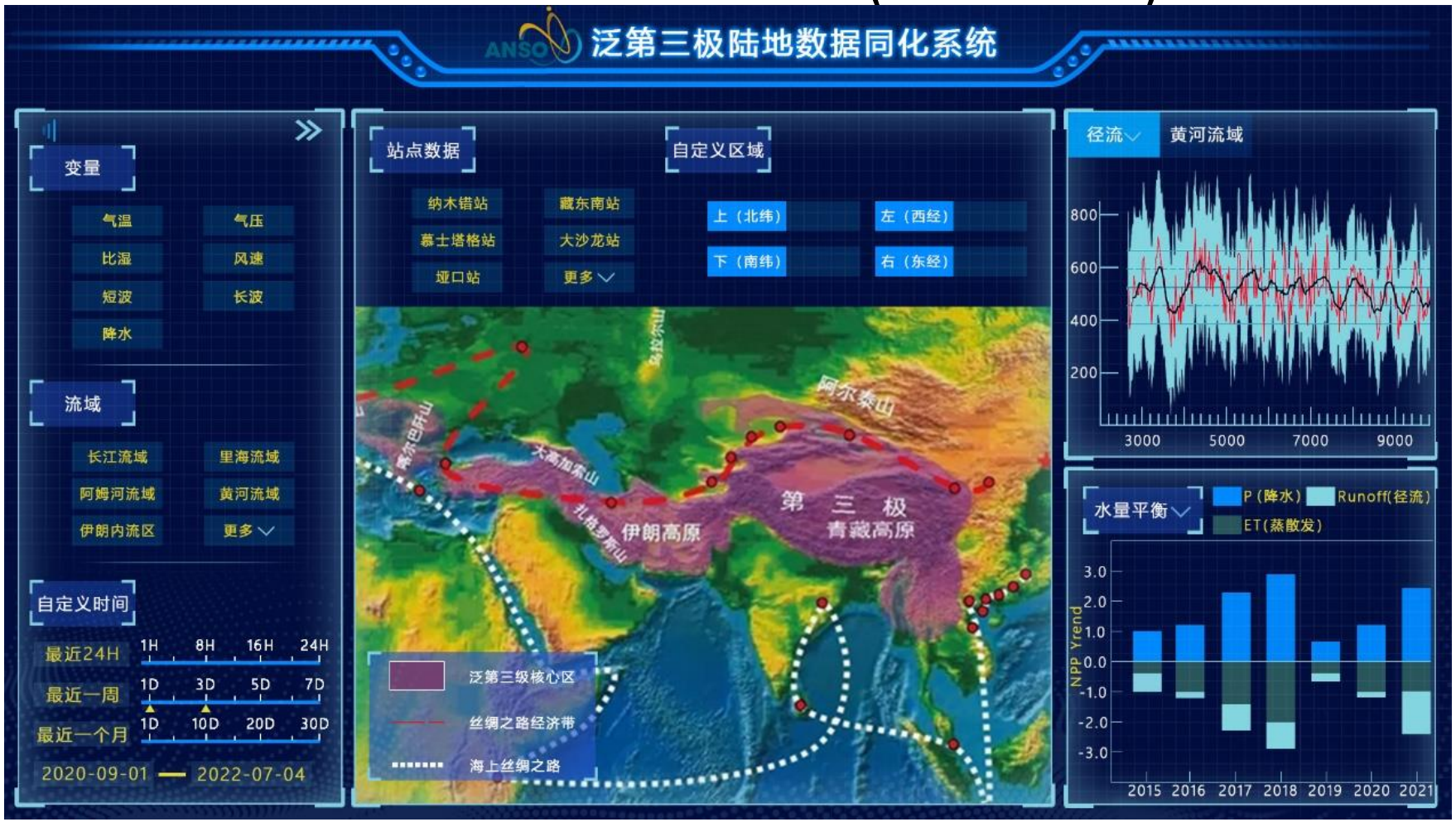


In situ observations for assimilation and validation



Development and Application of real time RS LDAS for Pan-TP Users Interface (in Chinese)

Products



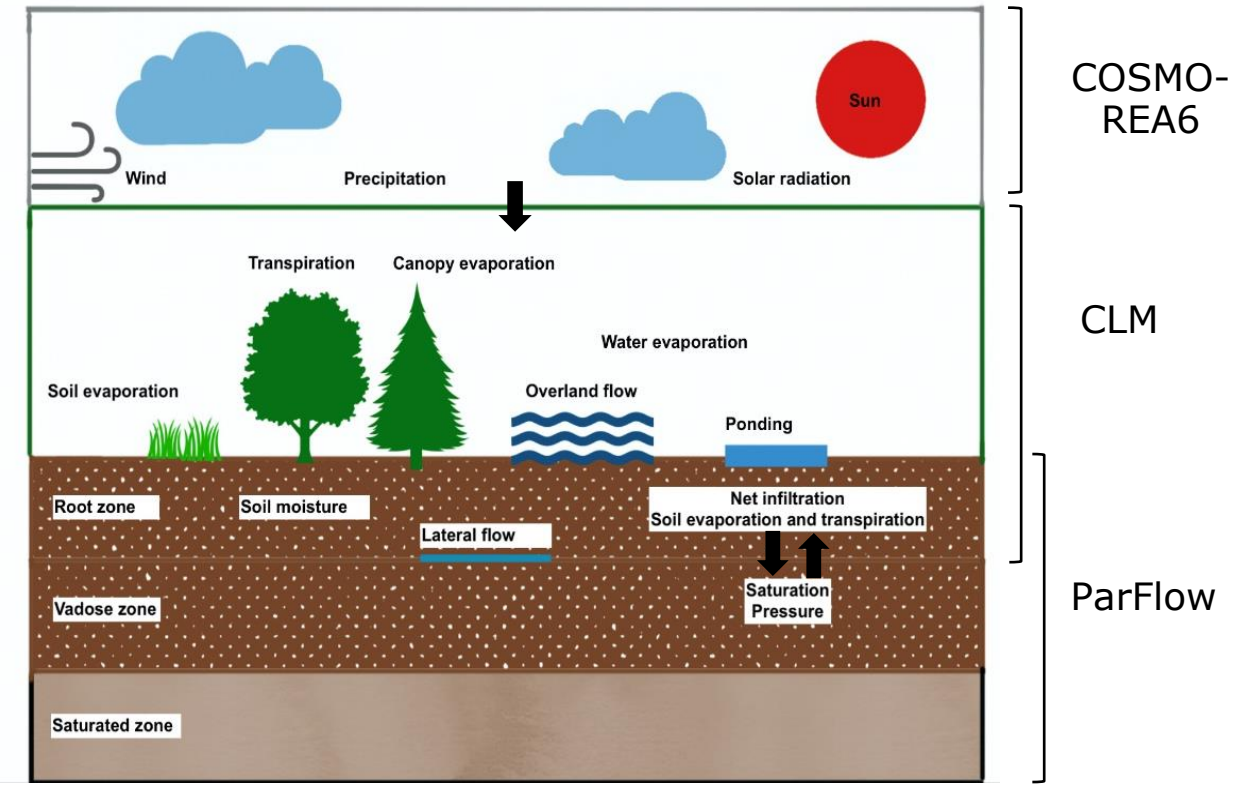
State variables ensembles

Precipitation / ET / Runoff balance

Data visualization with WebGIS

Retrieval of key water cycle variables from RS data in Europe

Terrestrial System Modeling Platform

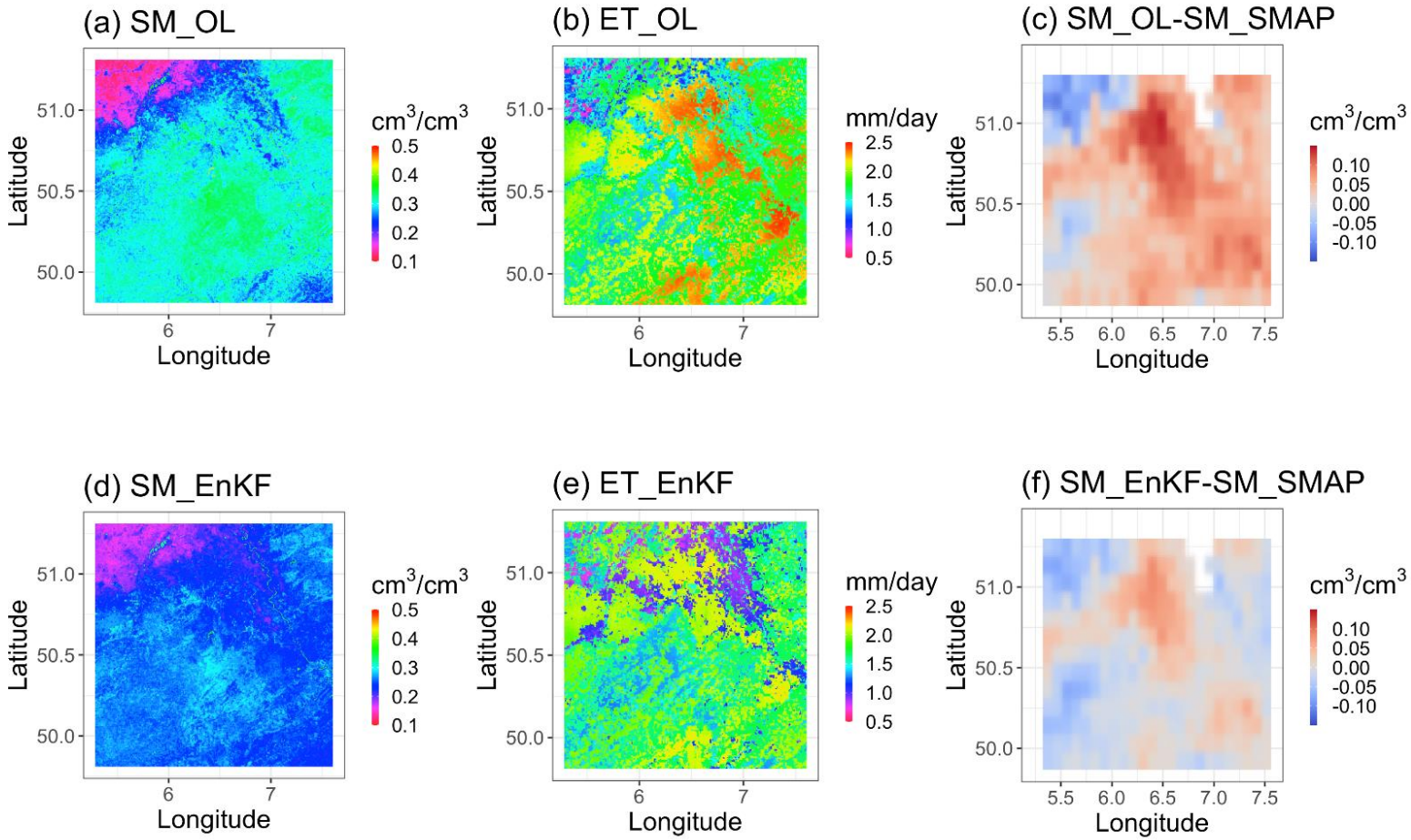


Model inputs

- Topography
- Vegetation
- Soil texture: SoilGrids
- Meteorological forcing: COSMO-REA6
- Subsurface hydraulic parameters
- Rosetta pedo-transfer function

Retrieval of key water cycle variables from RS data in Europe

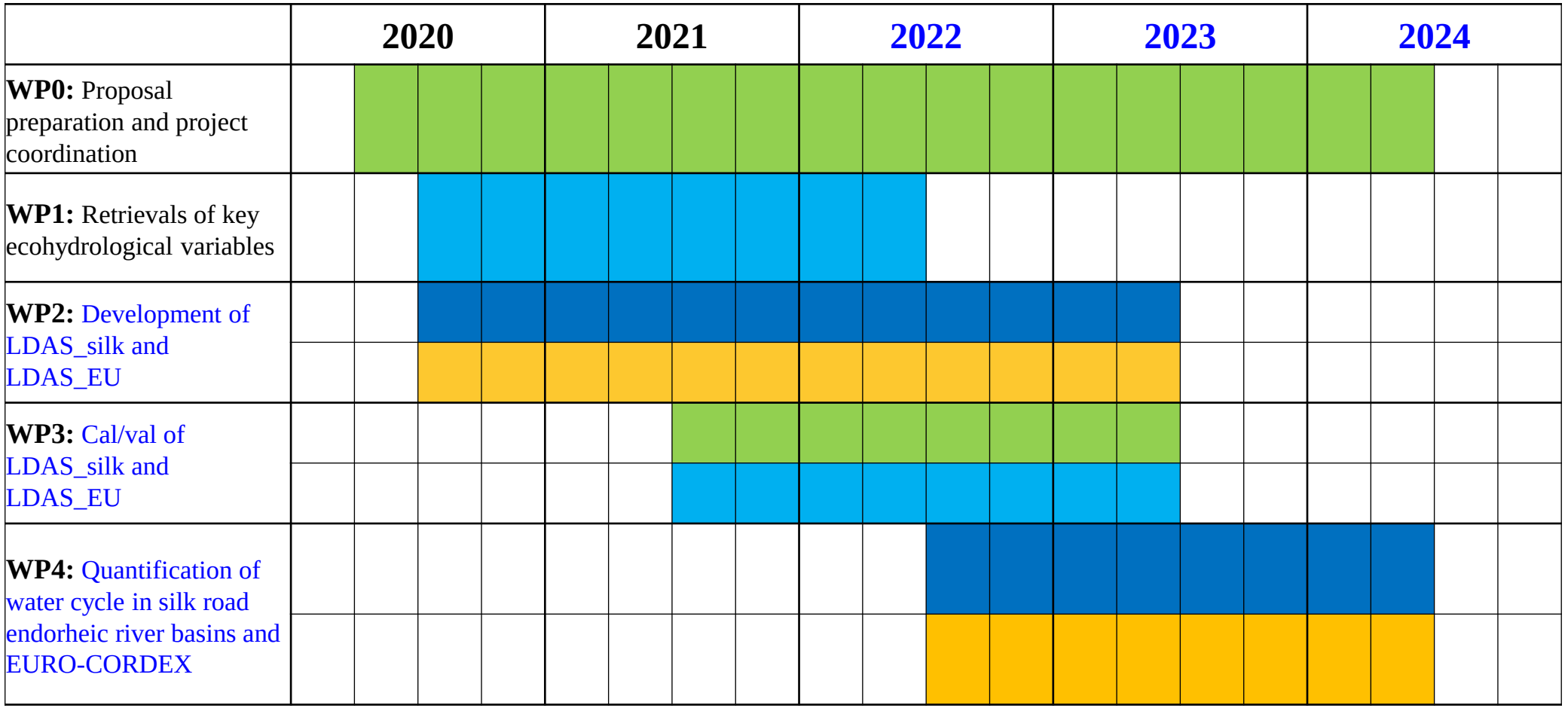
Data Assimilation Experiment



- Temporally averaged soil moisture (SM) and ET for 2018.03 – 2018.11 for OL and EnKF (DA)
- DA with EnKF reduces soil moisture differences with SMAP-product

Project's schedule and planning

The Chinese team focus on developing LDAS for silk road endorheic river basins (LDAS_silk), and the European team focus on the EUROCORDEX-domain (LDAS_EU)



European Young scientists contributions in Dragon 5

Name	Institution	Poster title	Contribution
Zhenlei Yang	Institute of Bio- and Geosciences: Agrosphere (IBG-3)	-	WP1: Retrieval of key water cycle variables from RS data
Ching-Pui Hung		-	WP1: Retrieval of key water cycle variables from RS data
Bibi Naz		-	WP2: Development of real time RS LDAS
Haojin Zhao		-	WP2: Development of real time RS LDAS
Fang Li		-	WP2: Development of real time RS LDAS

Chinese Young scientists contributions in Dragon 5

Name	Institution	Poster title	Contribution
Ling Zhang	Northwest Institute of Eco-Environment and Resources, CAS	-	WP1: Retrieval of key water cycle variables from RS data
Feng Liu		-	WP2: Development of real time RS LDAS
Kun Zhang	Institute of Tibetan Plateau Research, CAS	-	WP1: Retrieval of key water cycle variables from RS data
Yushan Zhou		-	WP1: Retrieval of key water cycle variables from RS data

Thank you !

Xin Li
xinli@itpcas.ac.cn