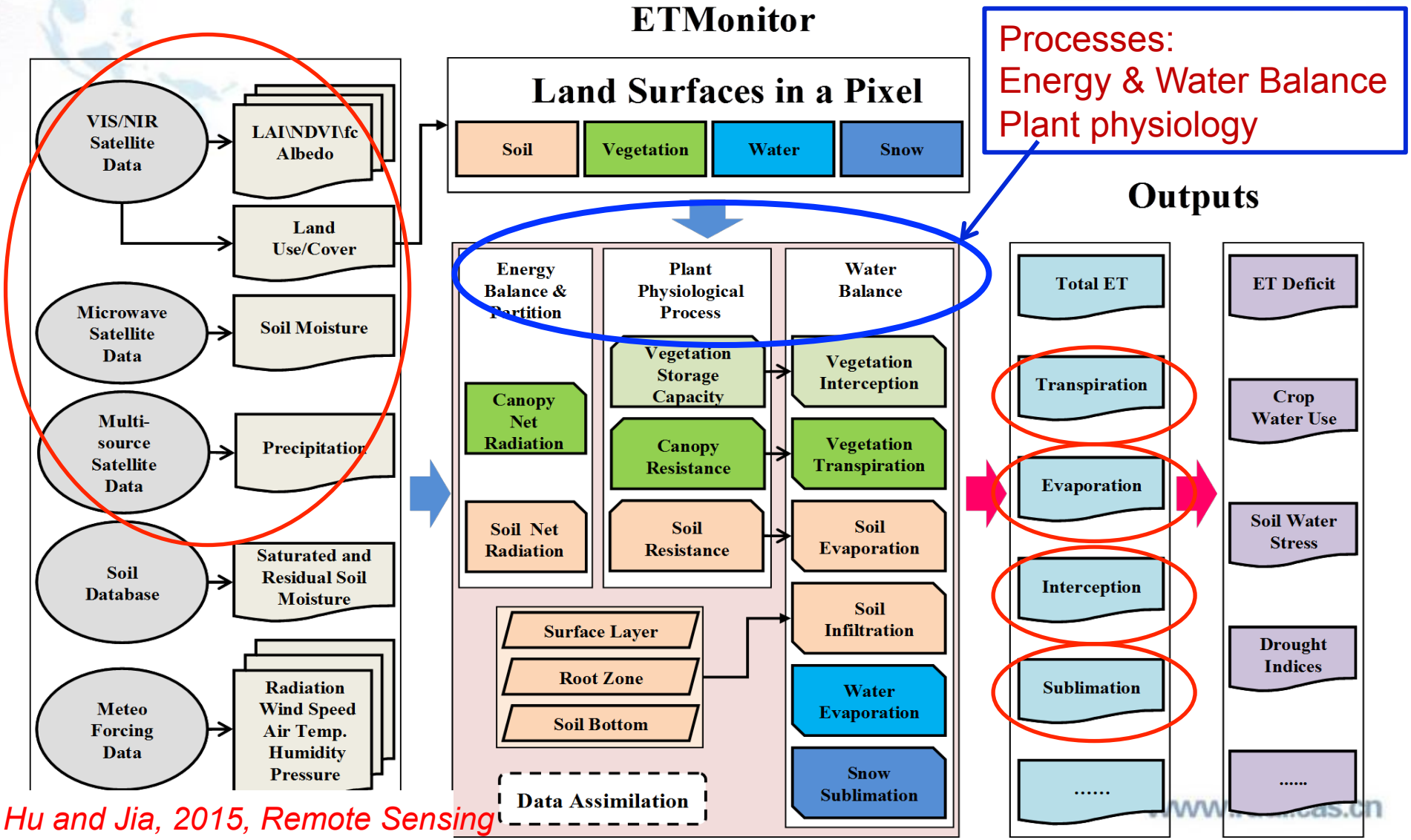
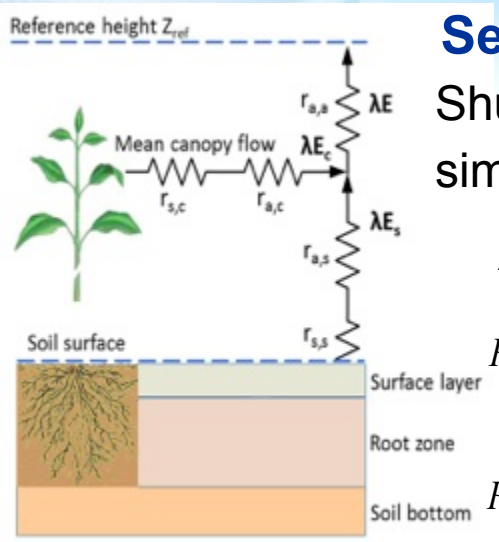
Evapotranspiration

ETMonitor: a remote sensing based model combining optical and microwave remote sensing observations



Hu and Jia, 2015, Remote Sensing

ETMonitor



Separation of soil evaporation and plant transpiration

Shuttleworth-Wallace dual-source concept + soil water balance simulation for root zone soil moisture

$$\lambda E = C_c PM_c + C_s PM_s$$

$$PM_c = \frac{\Delta(R_n - G) + [\rho C_p D - \Delta r_{a,c}(R_{n,s} - G)]/(r_{a,a} + r_{a,c})}{\Delta + \gamma[1 + r_{s,c}/(r_{a,a} + r_{a,c})]}$$

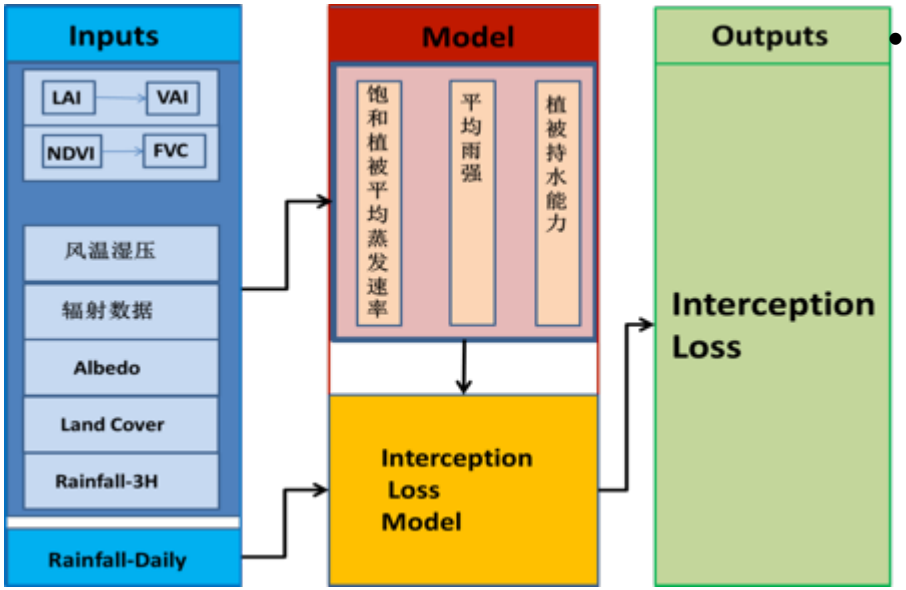
$$PM_s = \frac{\Delta(R_n - G) + (\rho C_p D - \Delta r_{a,s} R_{n,c})/(r_{a,a} + r_{a,s})}{\Delta + \gamma[1 + r_{s,s}/(r_{a,a} + r_{a,s})]}$$

Canopy resistance

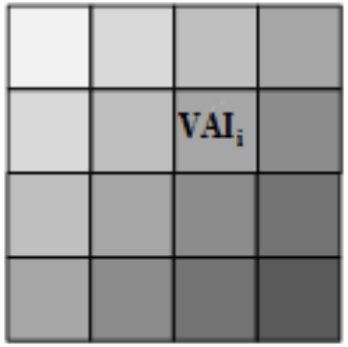
$$r_{s,c} = \frac{0.3LAI + 1.2}{LAI} \frac{r_{st,min}}{f_1(R_s) f_2(T_a) f_3(VPD) f_4(\theta_r)}$$

Hu and Jia, 2015
Zheng & Jia et al., IGARSS 2016

Interception evaporation: Remote Sensing based Gash model (RS-Gash)



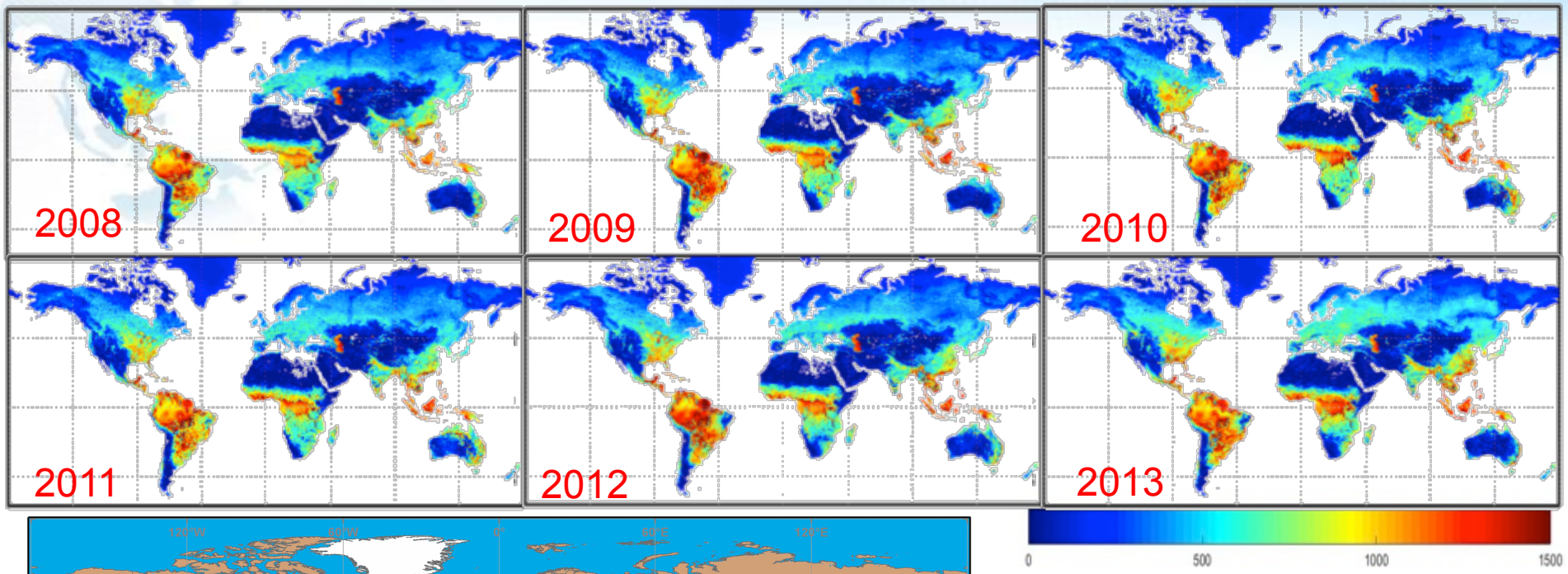
- Poisson distribution function is used to deal with sub-pixel heterogeneity

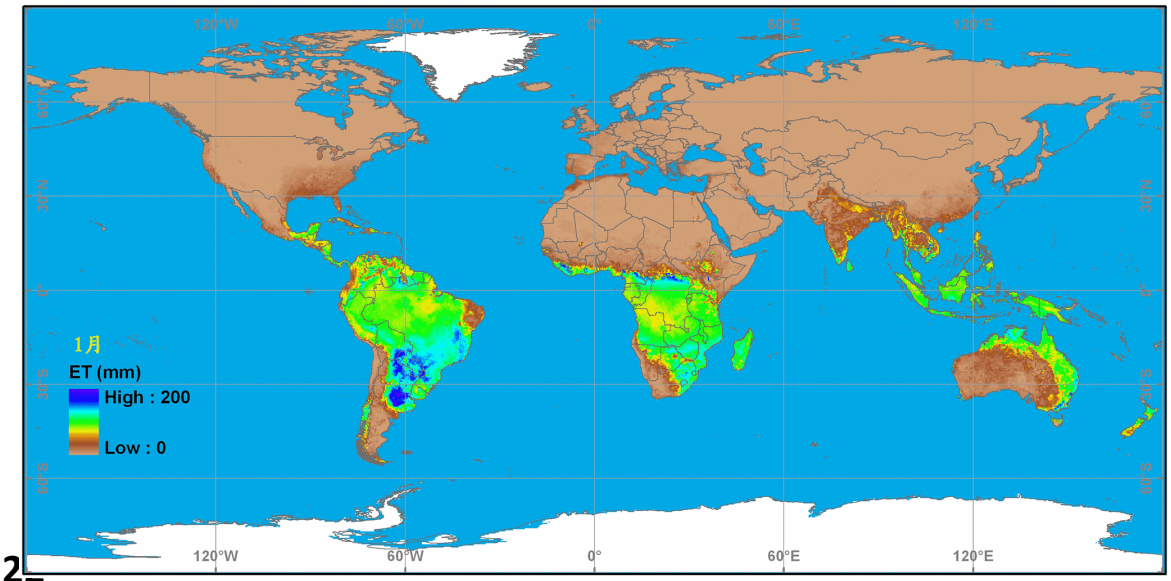


Cui and Jia, 2014, Water
Cui, Jia, et al., 2015, IEEE GRSL

Global ET by ETMonitor

- Global annual mean ET, 2008-2013（mm/yr）

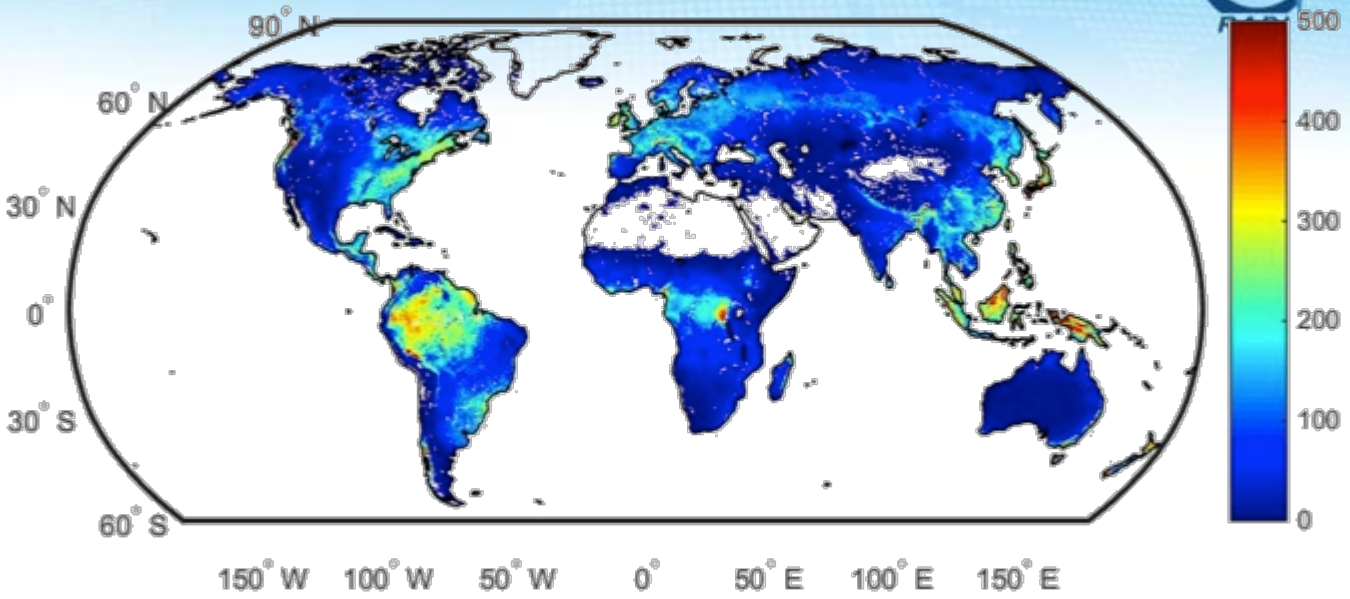




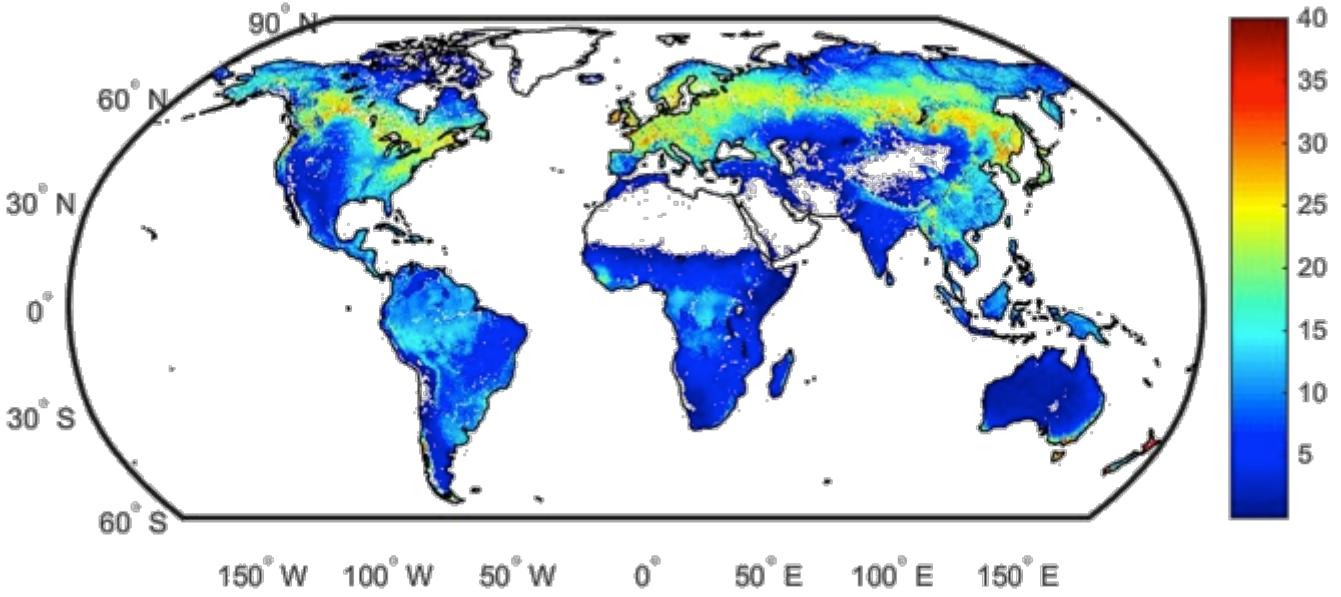
- Global monthly ET, mean of 2008-2013

Global interception loss by ETMonitor

Global annual averaged interception loss 2001~2013 (mm/yr)

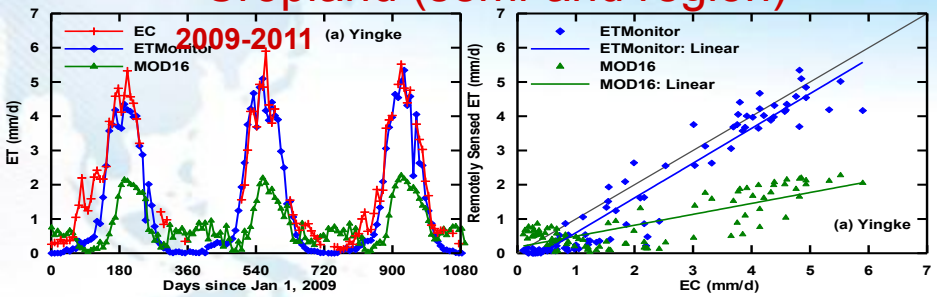


Interception ratio: annual averaged interception loss / annual averaged precipitation, 2001~2013 (%)

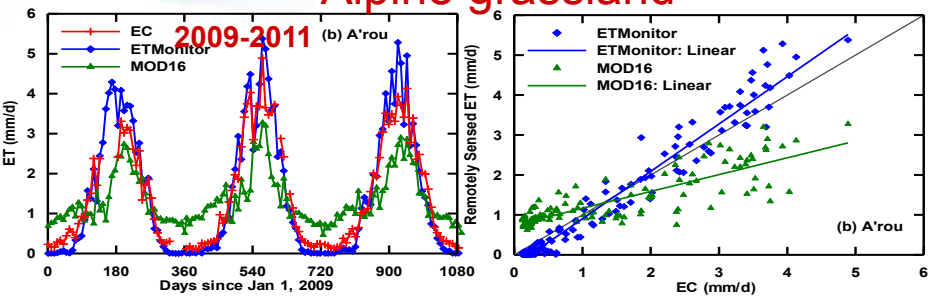


Evapotranspiration from ETMonitor

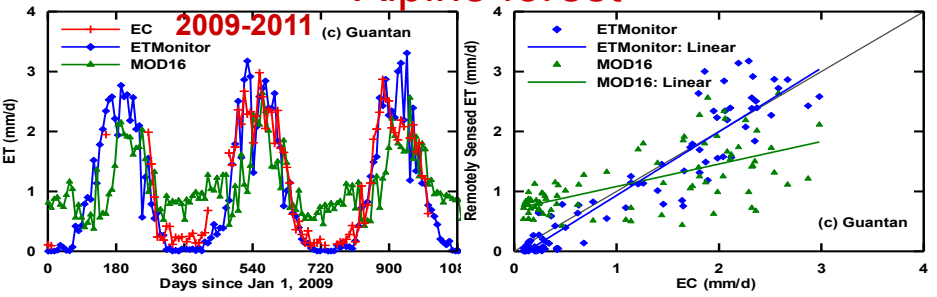
Cropland (semi-arid region)



Alpine grassland

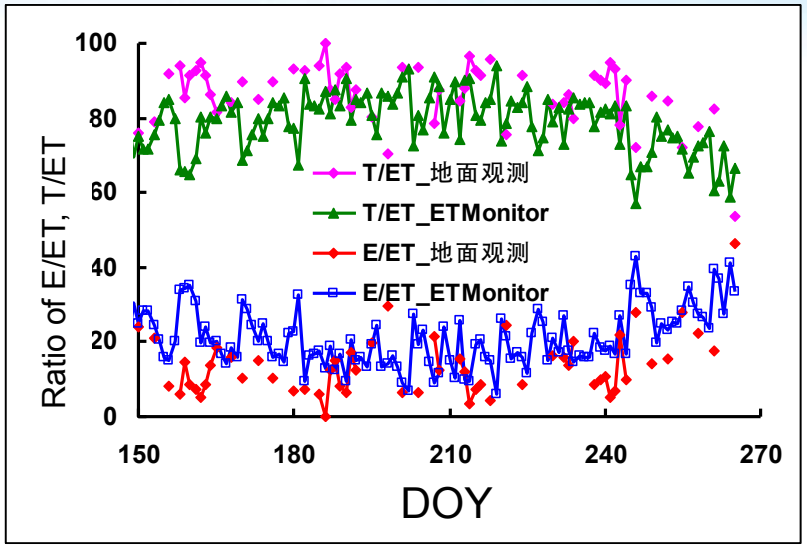


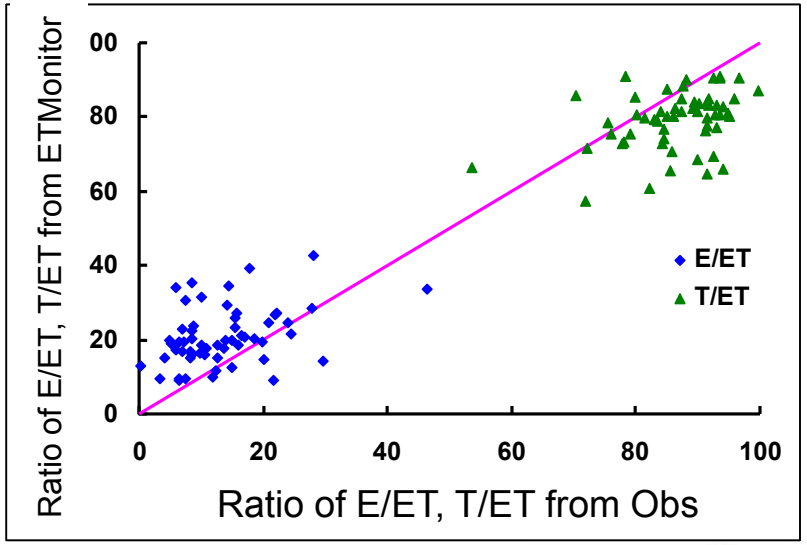
Alpine forest



	R2	RMSE (mm/d)
Alpine grassland	0.96	0.39
Alpine forest	0.87	0.38
Cropland	0.92	0.59

Separation between E and T

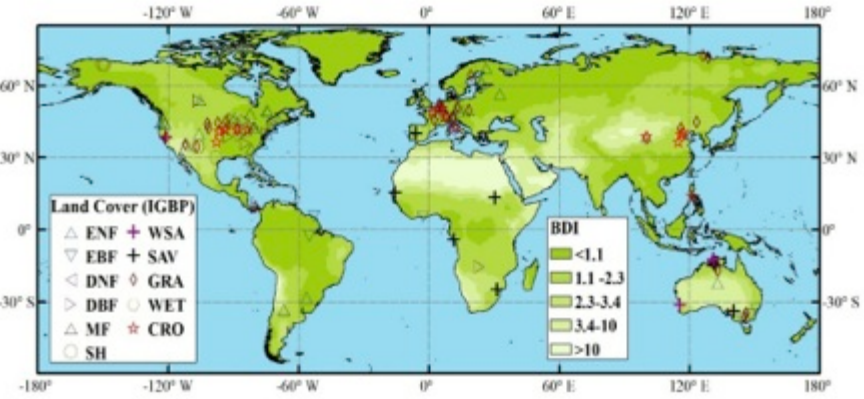


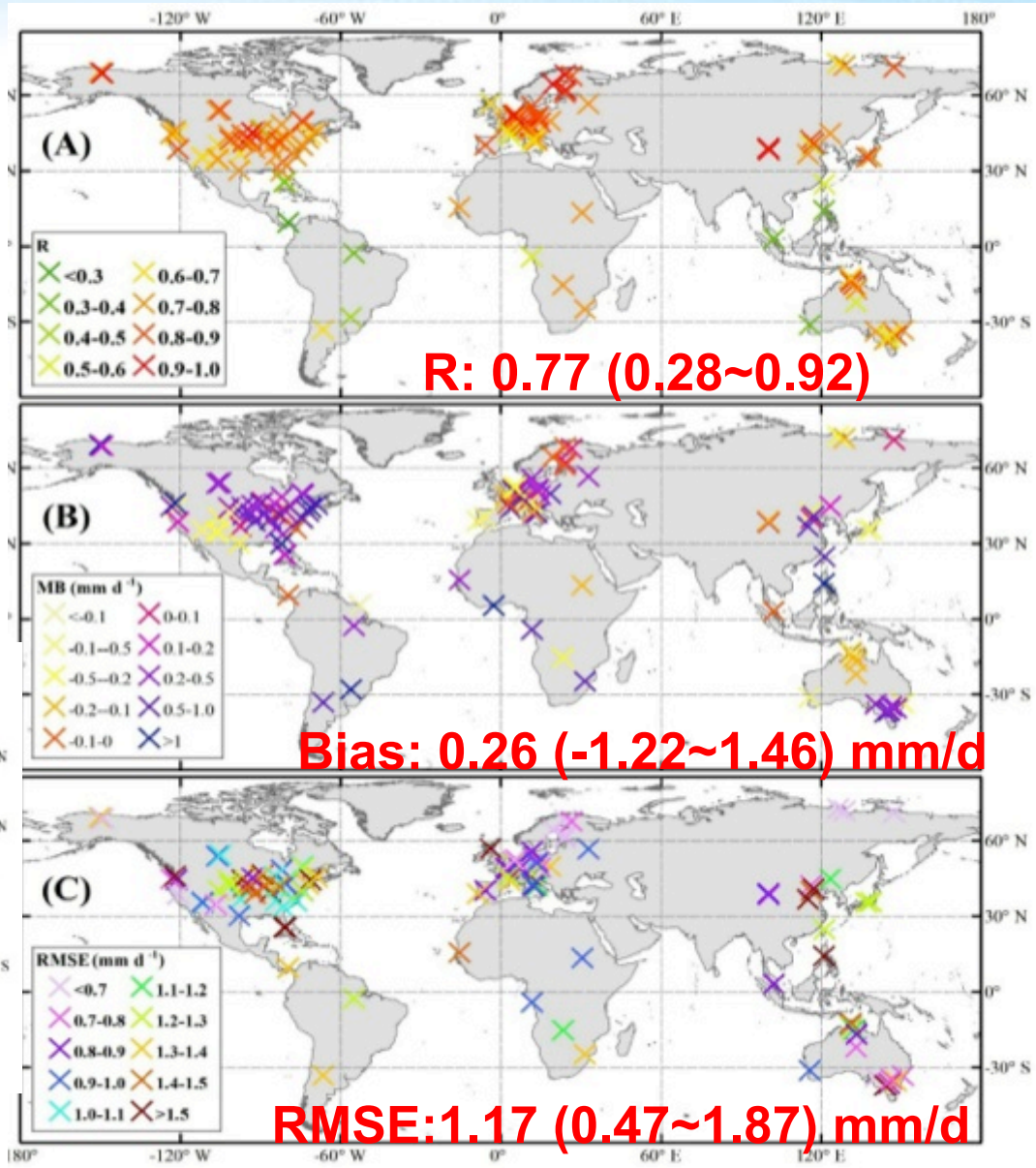


Evapotranspiration from ETMonitor

Global Validation

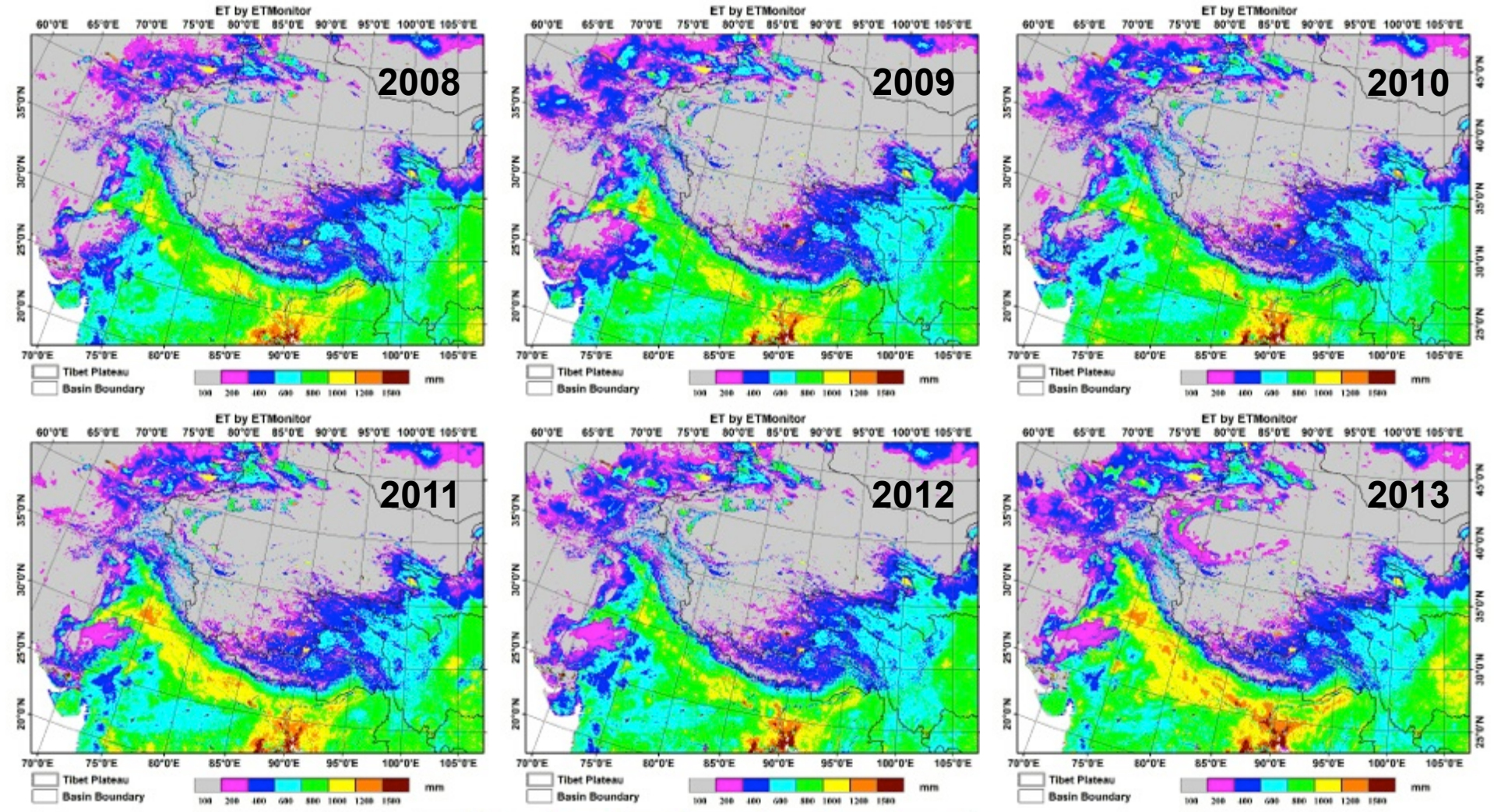
- 153 flux sites **(FLXUXNET2015数据)**
  - 98 from Fluxnet2015
  - 6 from HiWATER
  - 37 from AmeriFlux
  - 8 from EuroFlux
  - 4 from AsiaFlux



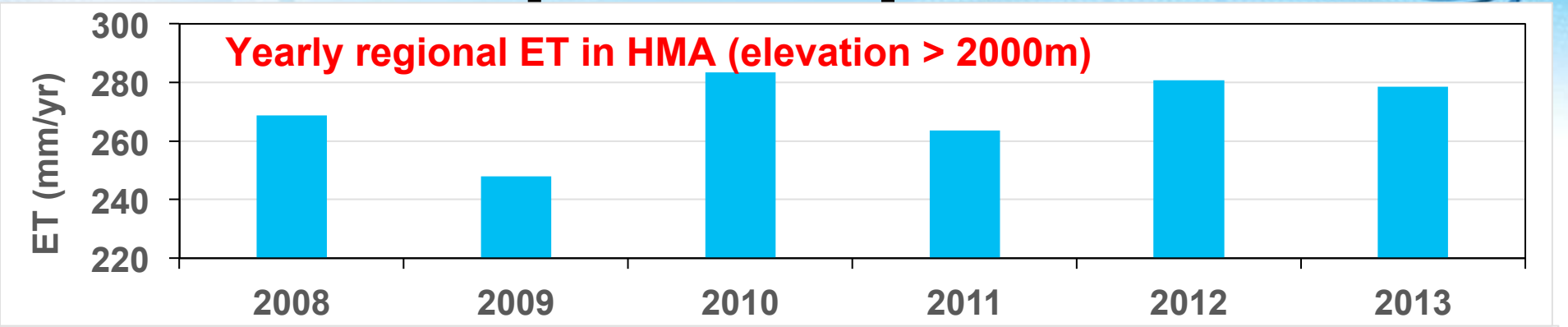


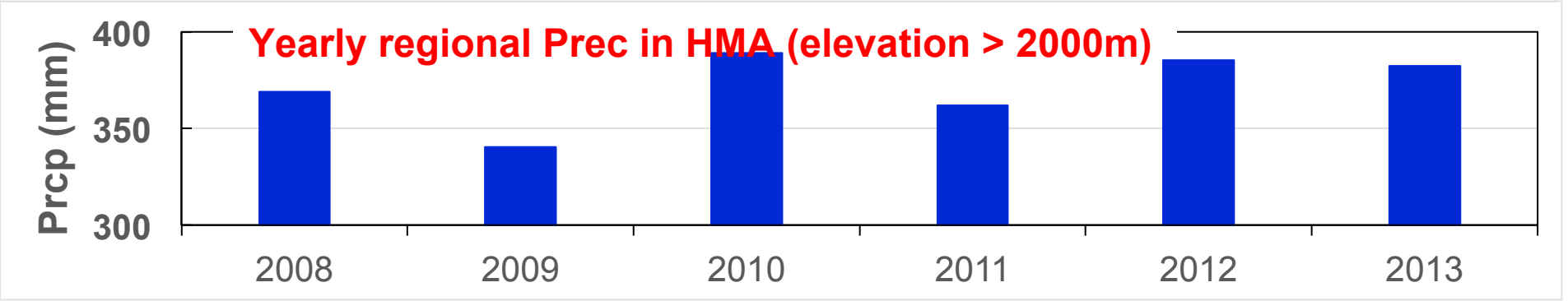
Evapotranspiration

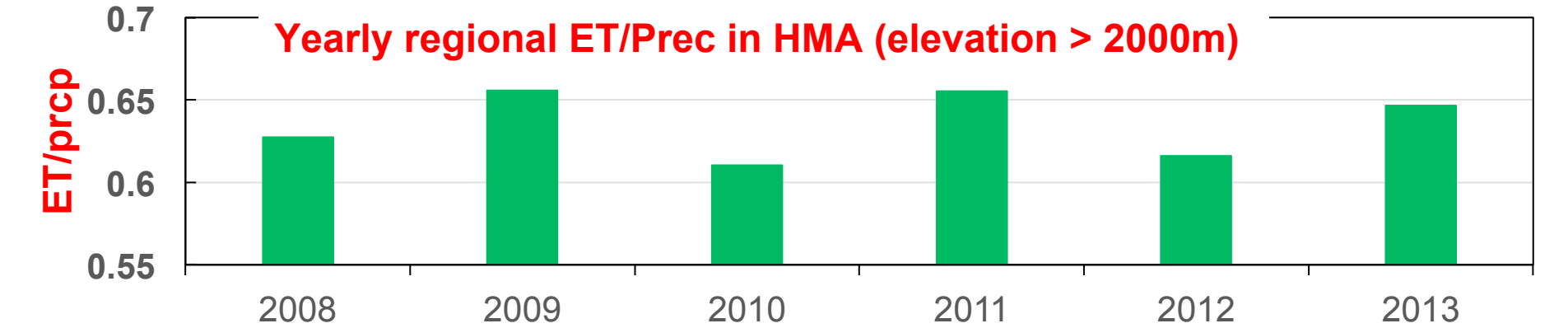
Yearly Evapotranspiration in HMA (ETMonitor Product)



Evapotranspiration



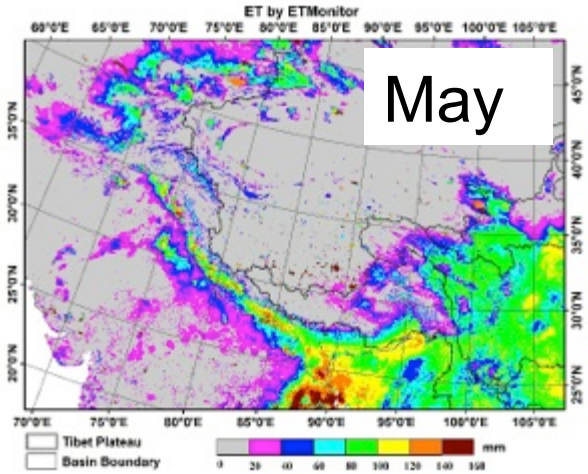


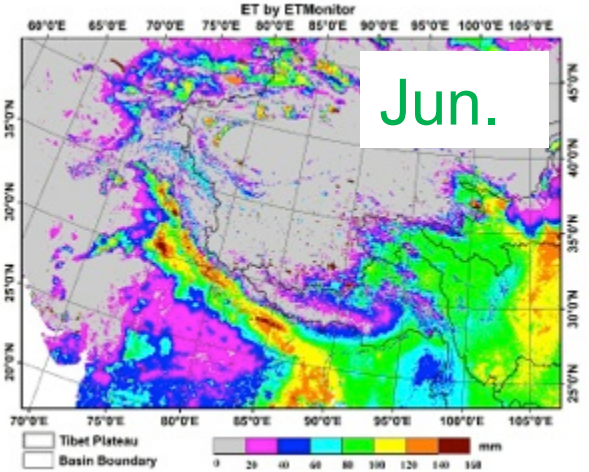


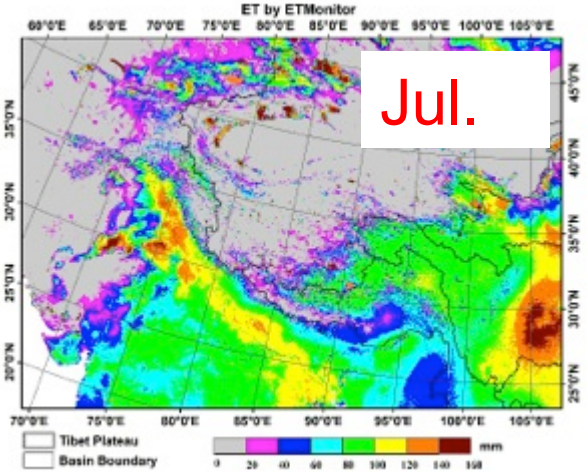
Need to understand the controlling process: energy or water limits spatially and seasonally

Evapotranspiration

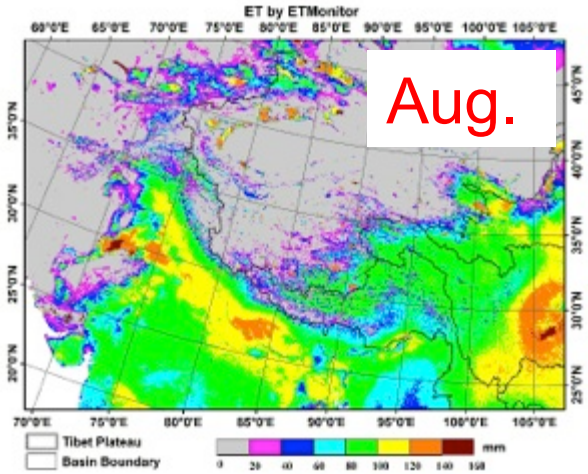
Seasonality of ET in high Asia

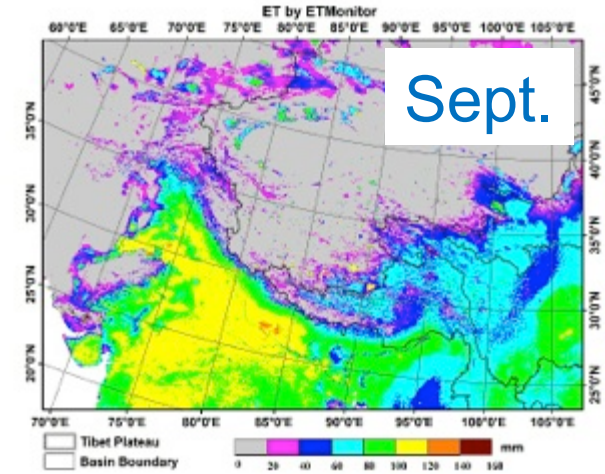


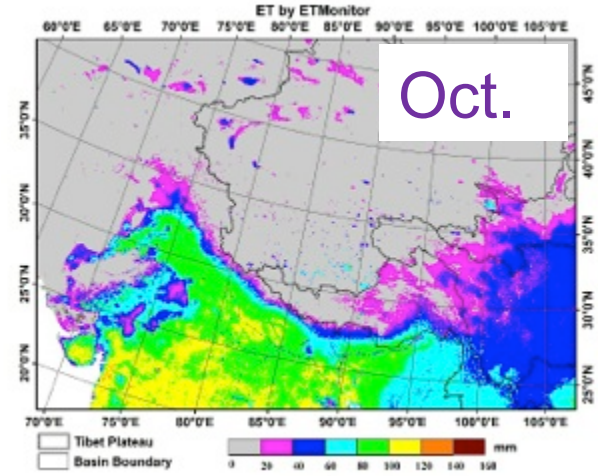




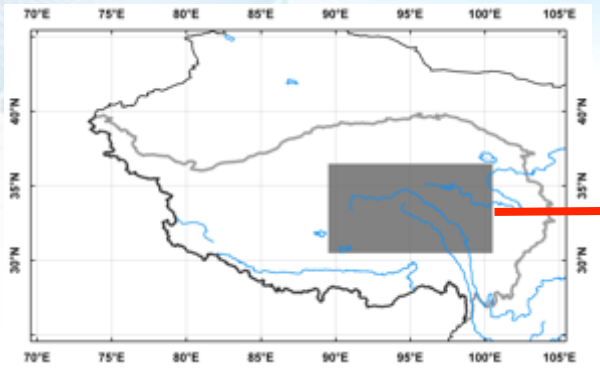
Pre monsoon	Transition	Monsoon season
Monsoon season	Transition	Post monsoon





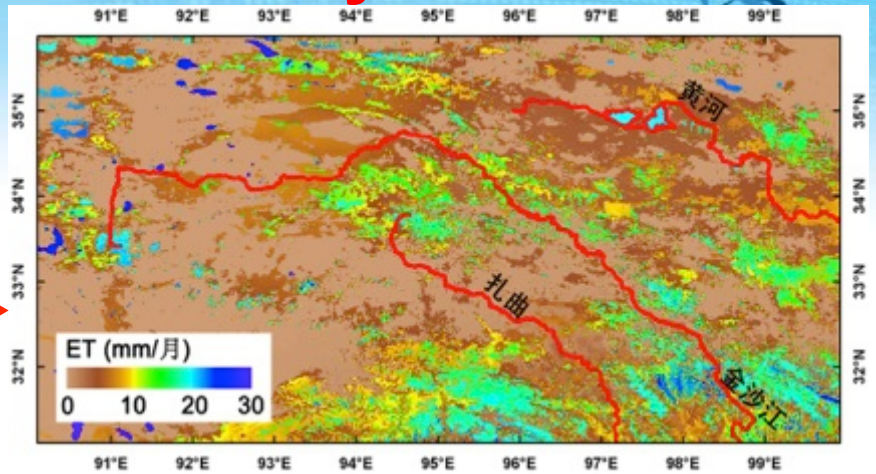


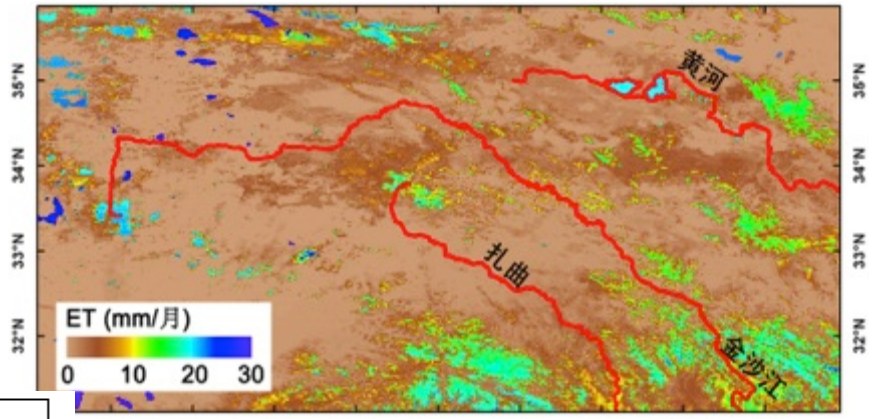
ET vs Snow Cover

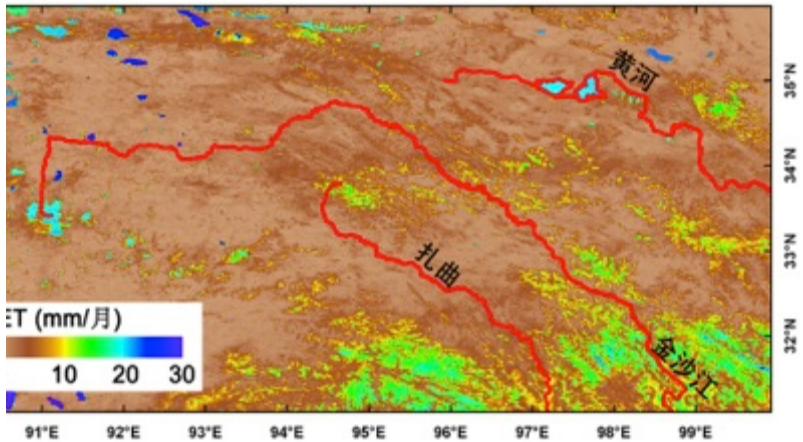


Headwater Area of Three Rivers on TP

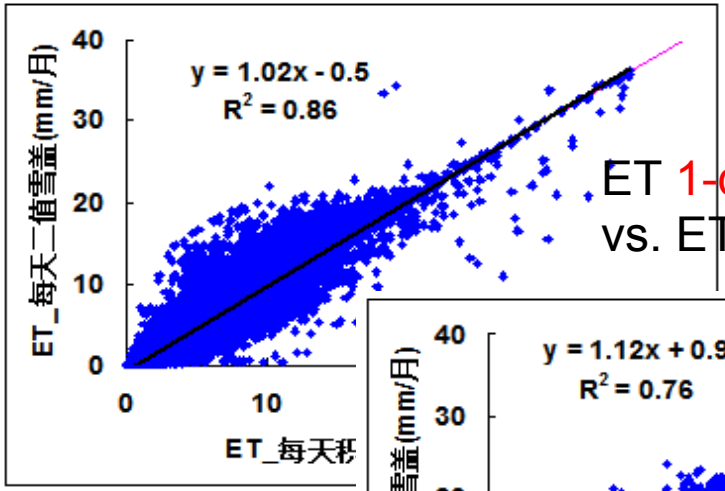
Januarary 2010



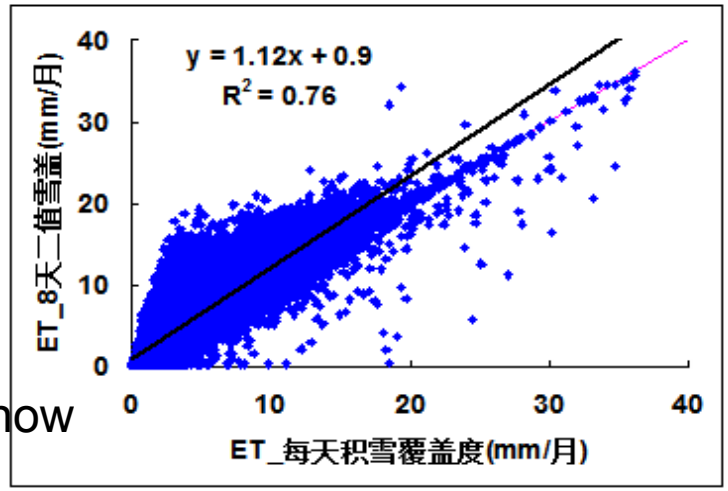




Impact of snow cover on ET estimate

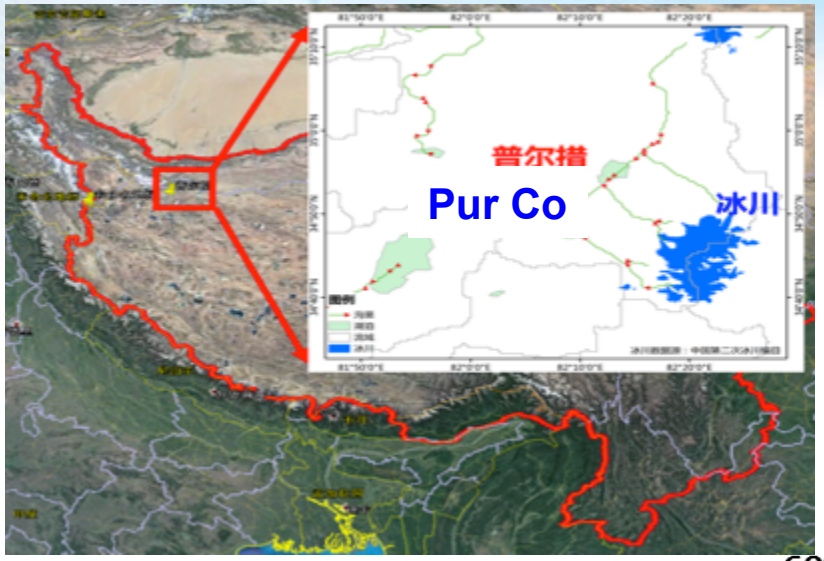


ET 1-day SC vs. ET 1-day Fsnow

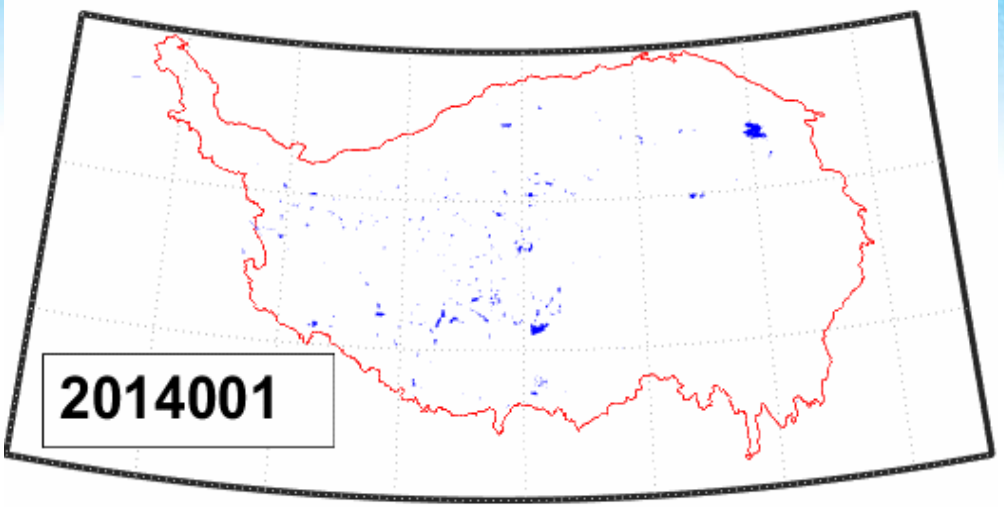


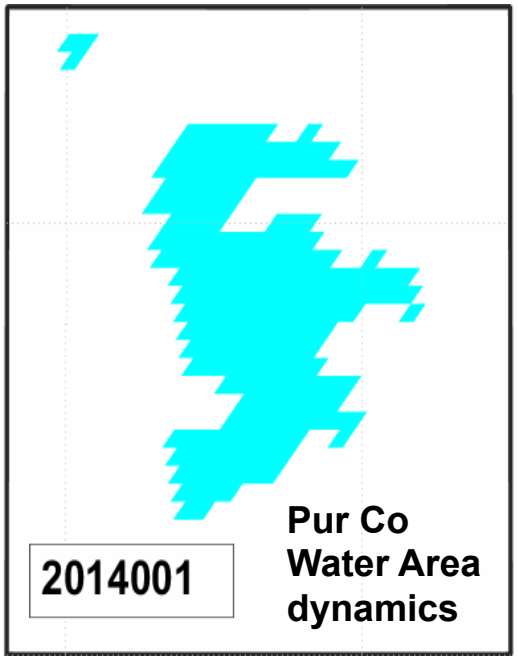
ET 8-day SC vs. ET 1-day Fsnow

ET vs Lake Area

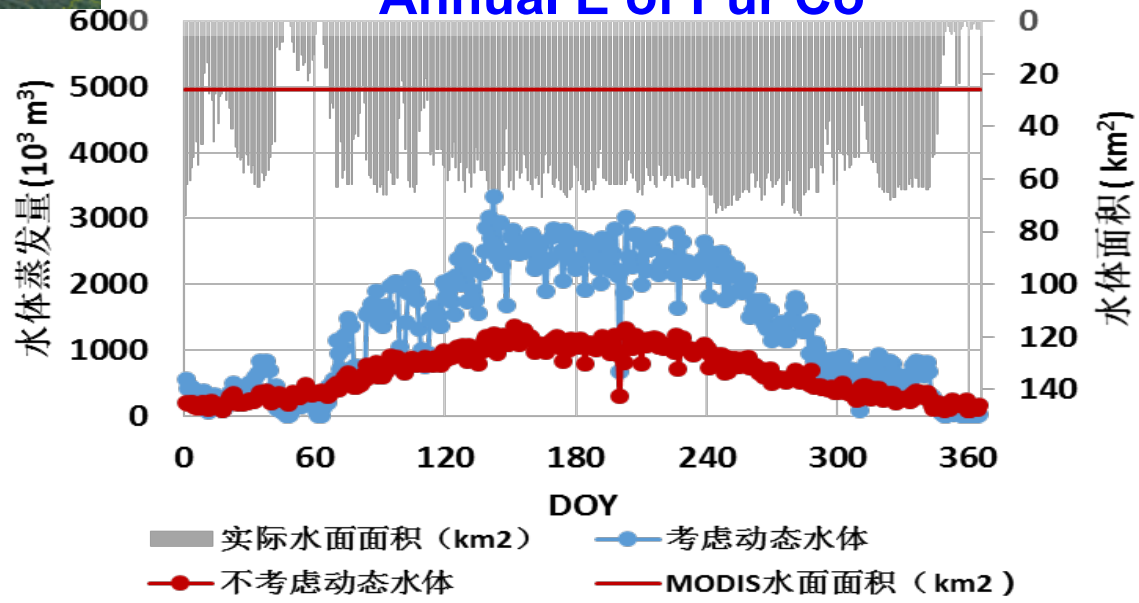


TP Dynamic Lake Area, 2014





Annual E of Pur Co



$5x10^8$ m^3 (dynamic); $2.4x10^8$ m^3 (static).
Relative error 53%.

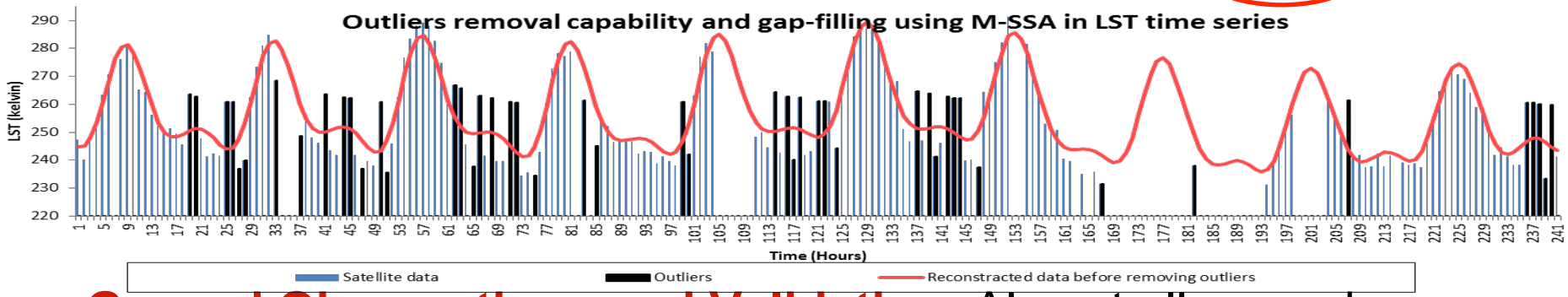
Summary (1)

Radiation balance

Lack of thorough validation in the HMA environment for algorithms and products of **radiation balance** estimates:

- **Algorithms**: Clouds process and topography correction are two essential issues in algorithm development in HMA;
  - not limited to downward radiation fluxes, but also for upward longwave flux, i.e. LST dependent.

$$R\downarrow n = R\downarrow n\uparrow s + R\downarrow n\uparrow l = (1-\alpha)R\downarrow d\uparrow s + \varepsilon R\downarrow d\uparrow l - \sigma\varepsilon T\uparrow 4$$



- **Ground Observations and Validation**: Almost all ground instruments are installed on flat terrain; Very few sites on glaciers; Scaling difference between spatial representativeness of ground site and satellite pixel size;

Summary (2)

Evapotranspiration:

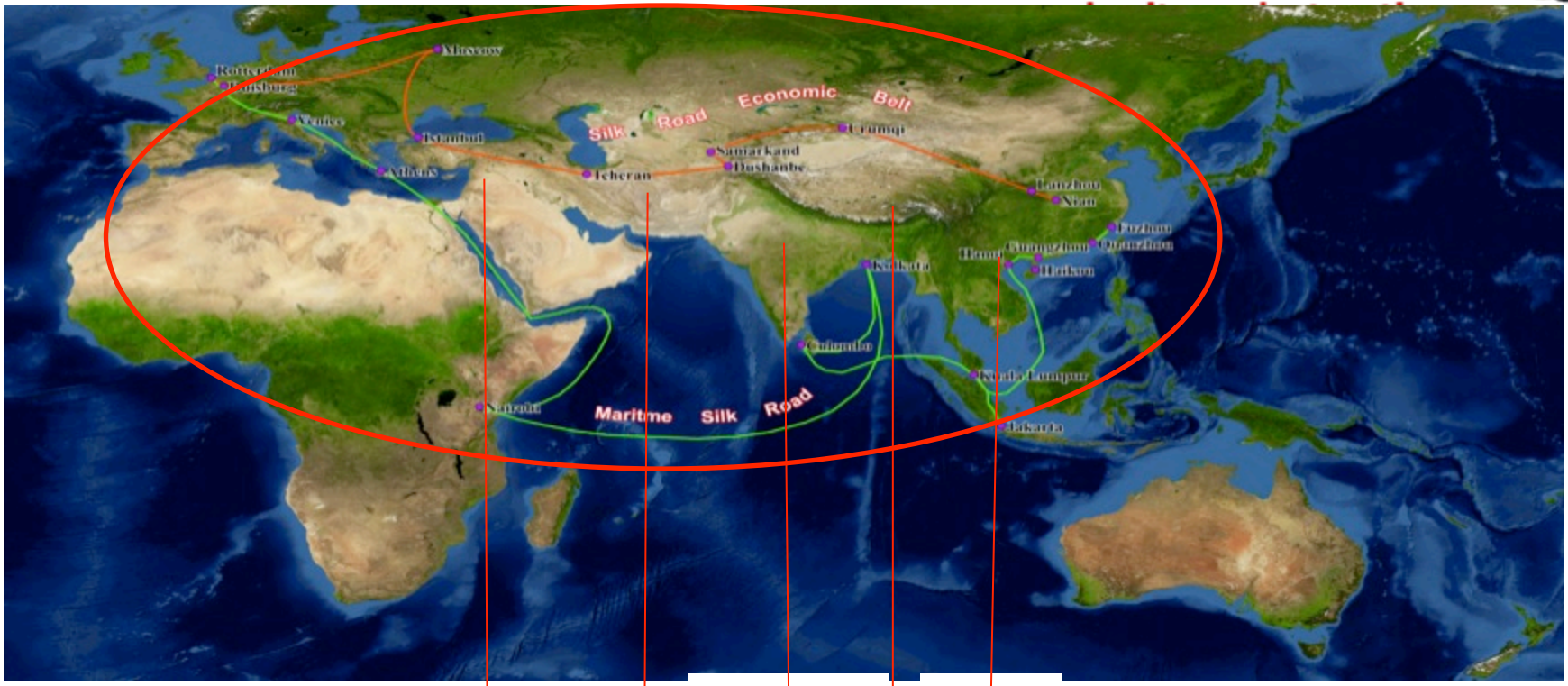
- Parameterization for plant transpiration needs to be evaluated for high elevation vegetation;
- Impact of topography not yet understood;
- Impact of freeze/thaw processes on ET;
- Better sublimation algorithm;
- Validation: need good quality data, scaling difference between model and ground measurements.

Uncertainties in input variables/parameters:

- Radiation budget (incl albedo), precipitation, soil moisture, snow cover, LAI, ……among others.
- Meteorological data: wind speed, Tair, RH, …

DBAR - Digital Belt and Road

EO-based Technologies for the Belt and Road



land degradation

drought

flood

food security

heritage destruction

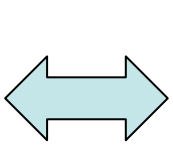
water scarcity

glacial melt

DBAR Digital Belt and Road

DBAR - Digital Belt and Road

- **International Science Program: EO-based Technologies for the Belt and Road**
- **Promotes cooperation among the Belt and Road countries**
- **Smart use of Big Earth Data**



Objective:

- **Scientific contributions**

To address **knowledge gaps** in Earth system processes, which are limiting the **achievement of the SDG targets in the Belt and Road countries**.

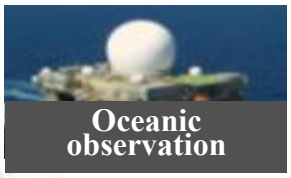
- **Facilitating platform**

To promote **advanced science and decision support services** to extract effective information from massive and diverse data in light of Big Earth Data.

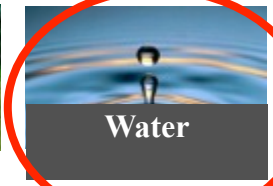
- **Stakeholders**

To enhance capacity building and technology transfer towards a system of **partnerships and research networks**.

DBAR - Digital Belt and Road



6 Themes:



2 Task Forces:

- DBAR Urban
- DBAR Cold Region

International Programs

International Organizations

Science and Policy

DBAR-Water Research Activities

Good data → Understanding of processes → Specific issues

Task 1
General Water Resource Mapping

Task 2
Hydrosphere processes vs climate and human activity

Task 3
Adaptation of water management systems

Task 4
Water productivity of agriculture

Task 5
Drought and flood

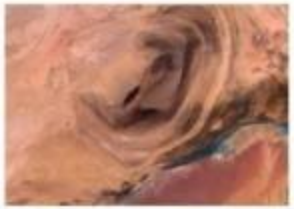
Task 6
High elevation hydrology

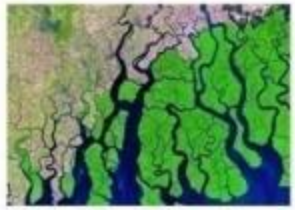
Task 8 ??
Urban Hydrology

Working Group:
Co-chairs: Li Jia (RADI-CAS, China)
Bob Su (TU, Netherlands)
Marco Mancini (Politecnico di Milano, Italy)
Participants: Pakistan, Iran, Thailand, Mongolia, India, Vietnam, Kenya, Morocco, Uganda, Tunisia, …
Nepal?
To cooperate with/contribute to:
TPE, GEO, AOGEOSS, GEWEX, WCRP, FAO, UN,…

谢 谢 ！





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