Characteristics of Lake Ice Phenology in Tibetan Plateau and Analysis of Influencing Factors

Yifan Yu[1,2] Yuqing Luo[1,2] Shujin Wang[1,2]

[1] Institute of Tibetan Plateau Research, Chinese Acadamy of Science(ITP,CAS)
[2] University of Chinese Academy of Science(UCAS)

Research Background

Lake Ice

- Long-term records exist
- Shorter ice duration
- **Seasonal Ice-cover Lake**: Typical characteristics of lakes in temperate regions of the Northern Hemisphere
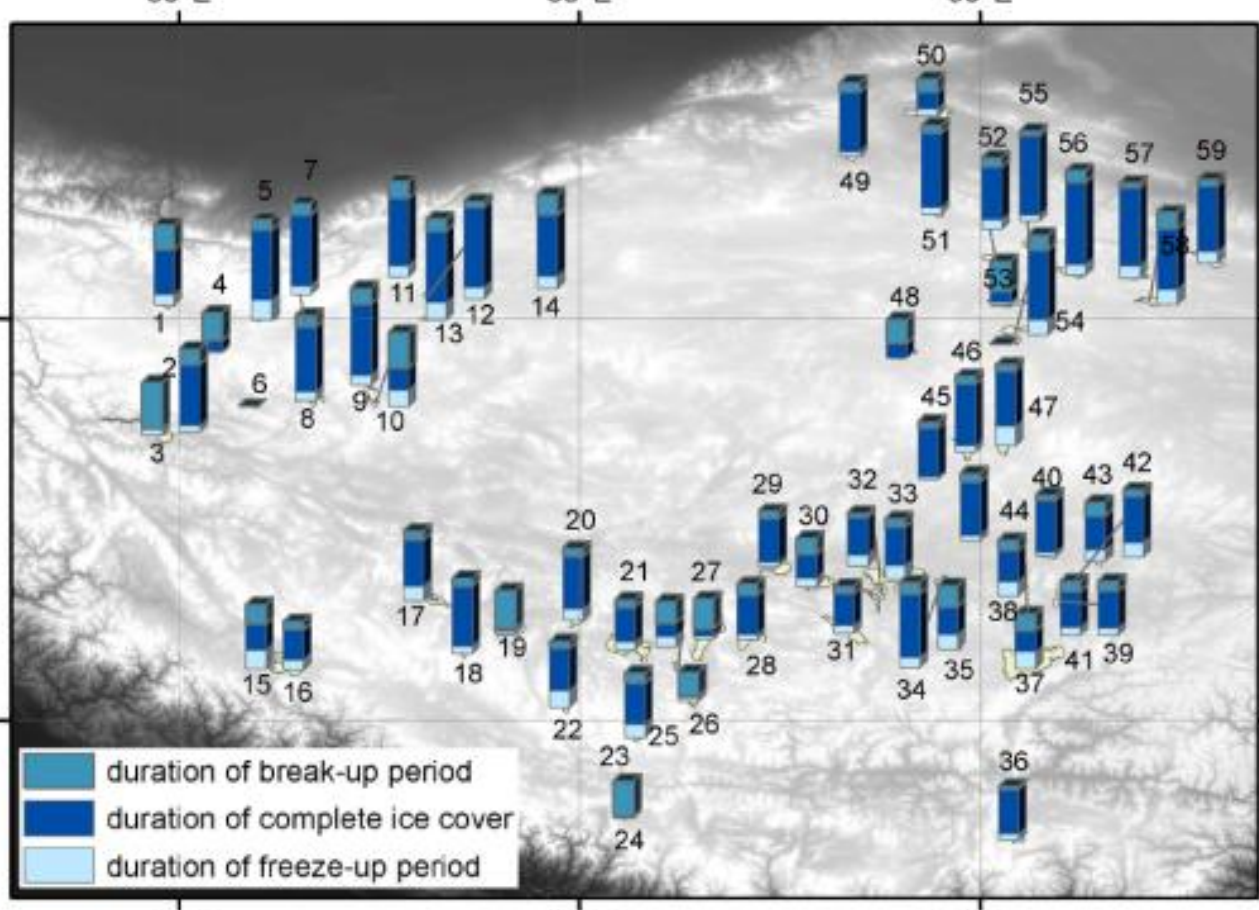
Lake Ice on Tibetan Plateau(TP)

- Low latitude and high altitude
- Significant climate change
- Some lakes on TP don't have complete ice cover in winter already(Paikuco, Tangrayumco)
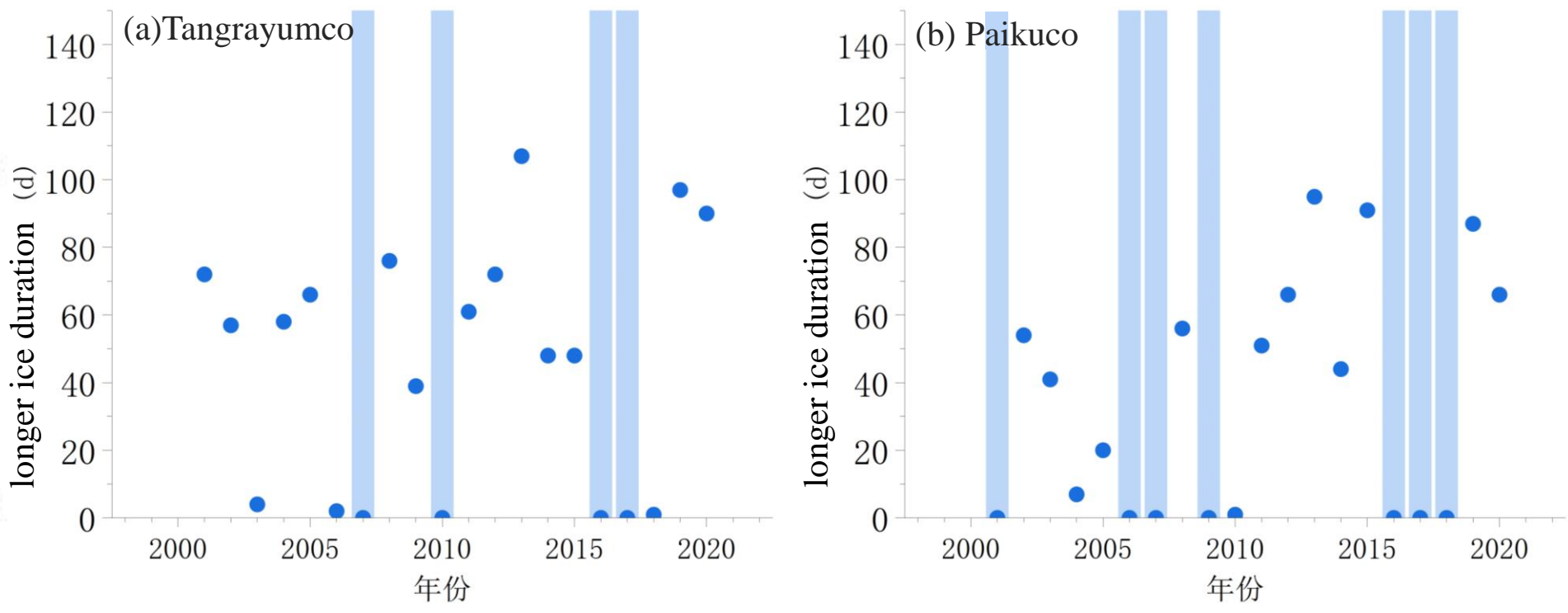- More lakes to be ice-free in winter in the future

Figure 1 Ice Duration of TP Lakes(Kropáček, et al , 2013)

Figure 2 Change of ice within 2001-2020 (Blue shading indicates ice-free years) ; (a)Tangrayumco, (b) Paikuco

Can we investigate the meteorological conditions leading to winter ice-free status in lakes and the time required to attain this condition?

Research Methods

Field Observations

- Monitoring sites: Lake water temperature profiles; Lake level ; Automatic Weather Stations.
- Time-lapse camera: Recording live images of lake ice phenology.

Dataset

- Global annual lake ice phenological dataset 2001-2020 (Wang, et al , 2022)
- A high-resolution near-surface meteorological forcing dataset for the Third Pole region 1979-2020 (He, et al , 2020)
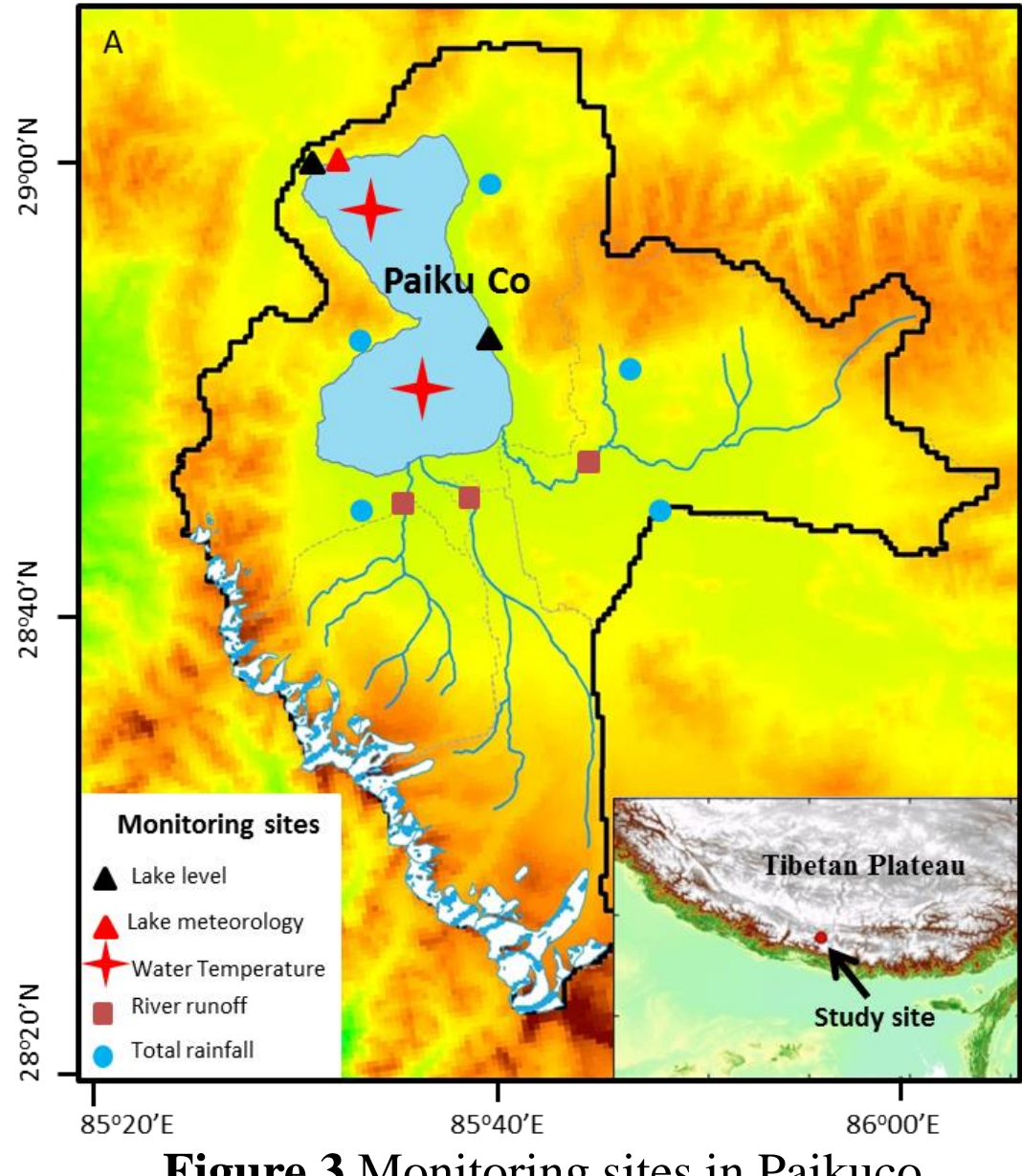

Figure 3 Monitoring sites in Paikuco

Figure 4 Ice Formation in Lake Paikuco in 2020

Results & Future Work

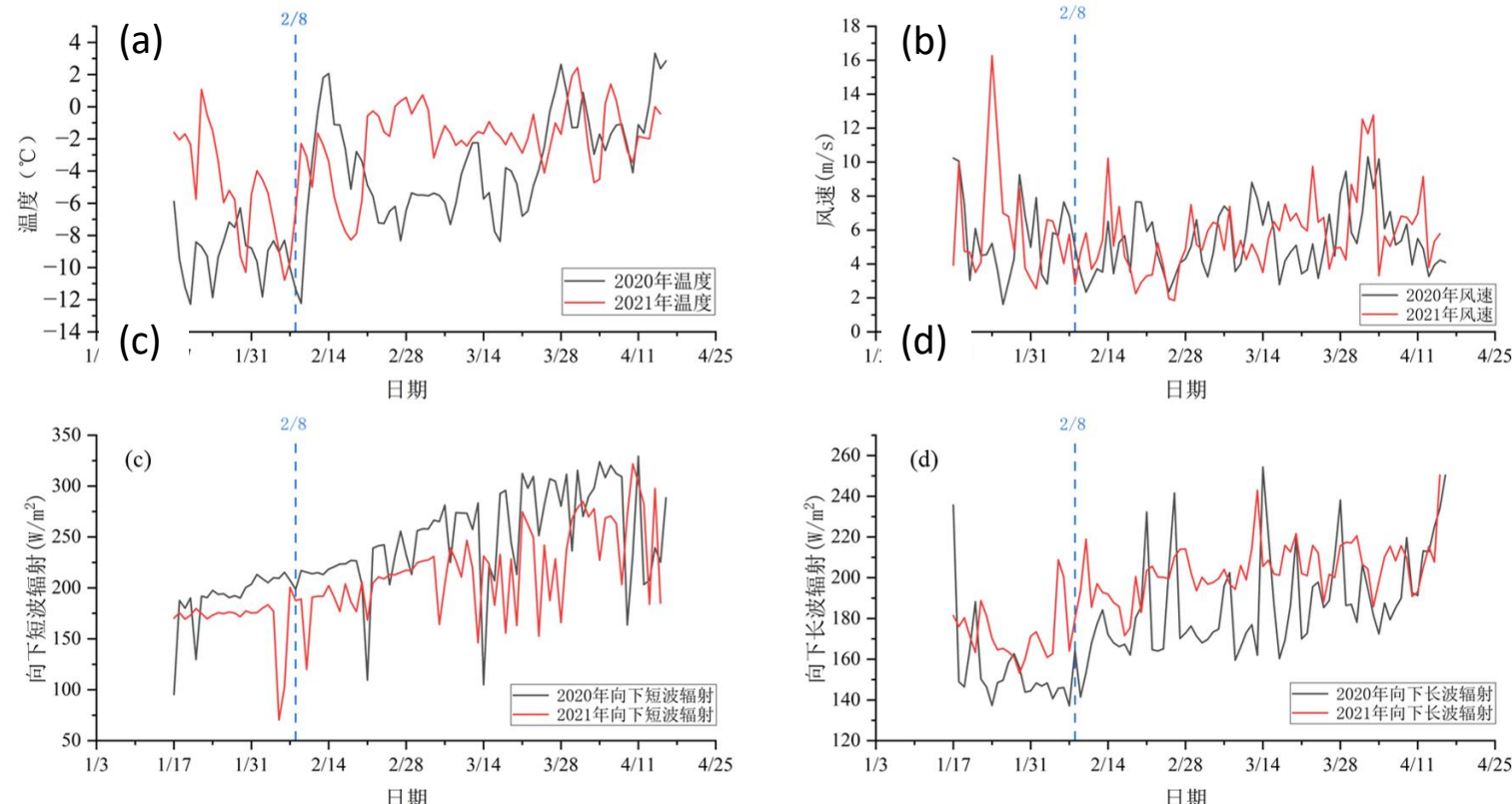### Meteorological Data Analysis

Figure 5 Meteorological Data; temperature(a) wind(b) srad(c) lrad(d)

Further Work

- Base on previous **results**:
  Meteorological: Temp: 2021 > 2020
    Wind: 2021 > 2020
    Srad: 2021 < 2020
    Lrad: 2021 > 2020
  Correlation: Full Break-up Day——
    Lrad > shum > temp and wind
    Full Freeze-up Day——
    Srad.

Figure 8 RSA Experimental Actual V.s. Predicted

- We will **then:** Selected Paikuco ice duration with downward longwave radiation, air temperature and wind speed for response surface analysis.
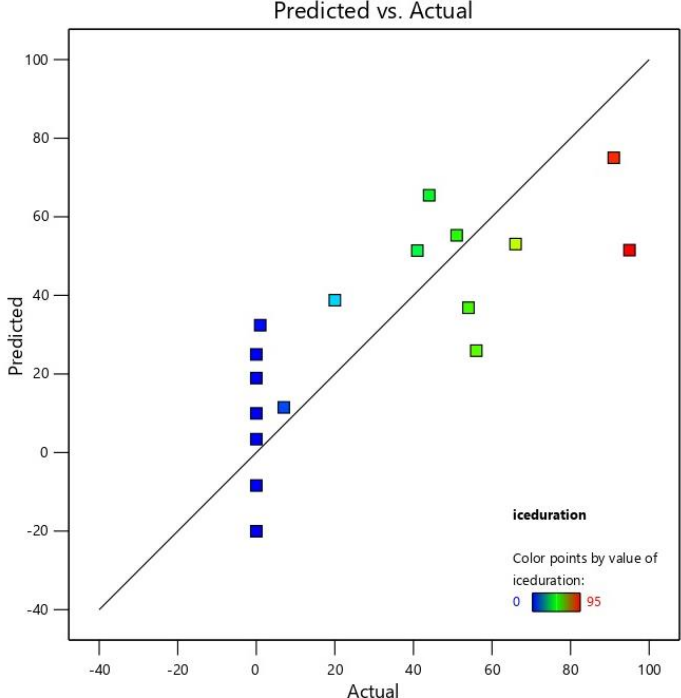
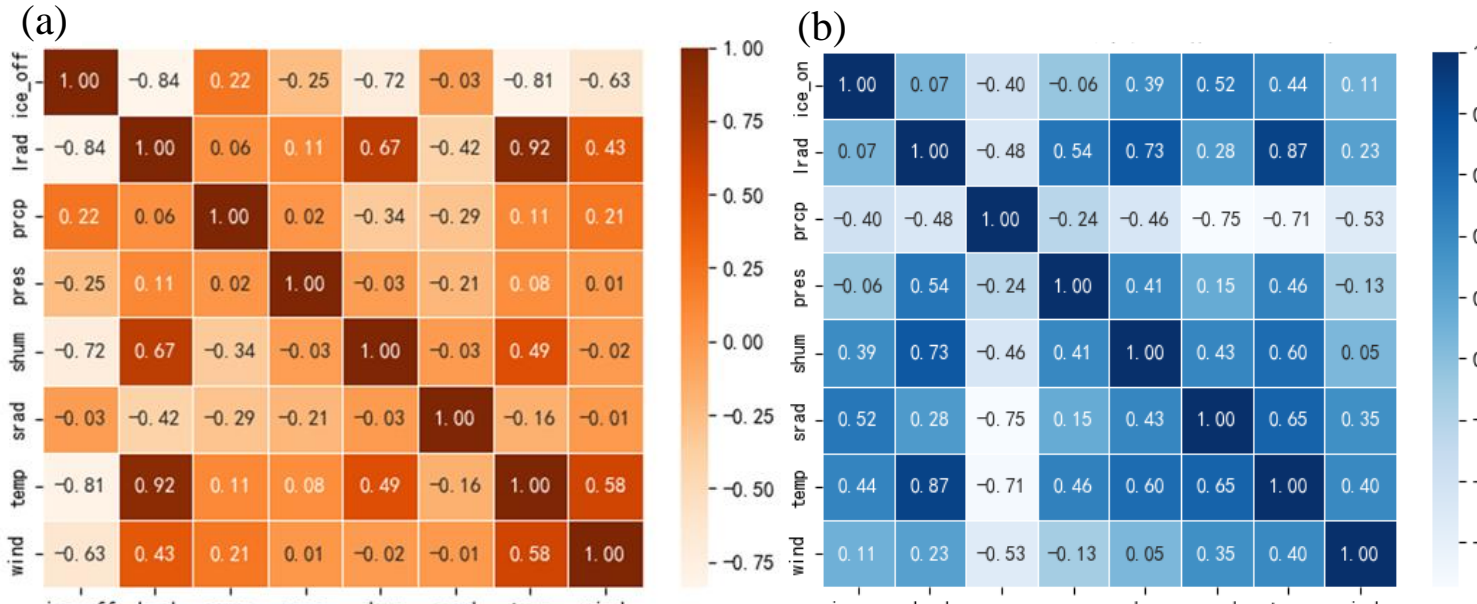### Correlation Analysis

Figure 6 Correlation between days of full break-up(a)/freeze-up(b) and meteorological elements

Table 1 RSA Result of Ice Duration and Three Meteorological Elements

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	11085.35	3	3695.12	6.84	0.0052	significant
A-lrad	830.78	1	830.78	1.54	0.2368	
B-temp	139.72	1	139.72	0.2587	0.6195	
C-wind	101.32	1	101.32	0.1876	0.6720	
Residual	7021.59	13	540.12			
Cor Total	18106.94	16				