

Interaction and collaborative management of water and ecosystems in the Great Lakes region of Central Asia

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Lakes are sensitive indicators of climate and environmental changes in arid/semi-arid areas, and an important part of the water cycle. Under the influence of climate factors and human activities, the spatial distribution of water resources in this region and the temporal and spatial processes of surface water cycles have undergone significant changes in recent decades, causing a series of ecological crises. Fully understanding the temporal and spatial change mechanisms of these lakes is conducive to correctly assessing the impact of climate change and human activities on water resources and ecological environment in the arid regions of Central Asia. In addition, the uneven spatial and temporal distribution of transboundary rivers and water resources has long been a major constraint on the economic development and geopolitical situation in Central Asia. Water resources and ecological issues in the Great Lakes region have become important international issues.

This study explores ecological management measures and future changes in the Aral Sea, Lake Balkhash and Lake Issyk-Kul, and projects future systemic risks in the Great Lakes region. The main outcomes are:

- The ecological restoration roadmap for the dry lake area of the Aral Sea, including the vegetation restoration area (37%), halophyte and engineering measures restoration area (31%), water saving restoration and engineering measures restoration area (32%) and open water area.
- From 1971 to 1987, the water level of Lake Balkhash dropped by 2m. The analysis shows that the main reasons are: the water storage and evaporation of the Kapchagai Reservoir and the reduction of water production in the source area, not the water diversion and water use in the upper reaches of China.
- Under different scenarios, the water level, the area of water bodies and the area of wetlands will decrease, which will bring great ecological impact; in the next 20-50 years, in RCP4.5, the available water in the Yili River Basin will be greatly decreased as well.
- Lake Issyk-Kul experienced a drop in water level (1951-1985) and a continuous rise (1999-2020). In the next 30 years (2021-2050), natural factors will be dominating and the water level will slightly drop and it will not have a major impact on the ecosystem.
- The comprehensive benefits of the basin ecosystem services are as follows: Syr Darya River Basin > Balkhash Lake > Tarim River Basin > Amu Darya River Basin. In the next 30 years, under the RCP2.6 and RCP4.5 scenarios, the Central Asian Great Lakes' overall ecosystem service function will show a downward trend (-7.7% - -12.8%).

Fundamental Research

Solution

Aral Sea

Sandstorm-Propagation-Impact on Ecology

Dry Lake Region Ecological Restoration

Balkhash Lake

Influence of Basin development on Water Level

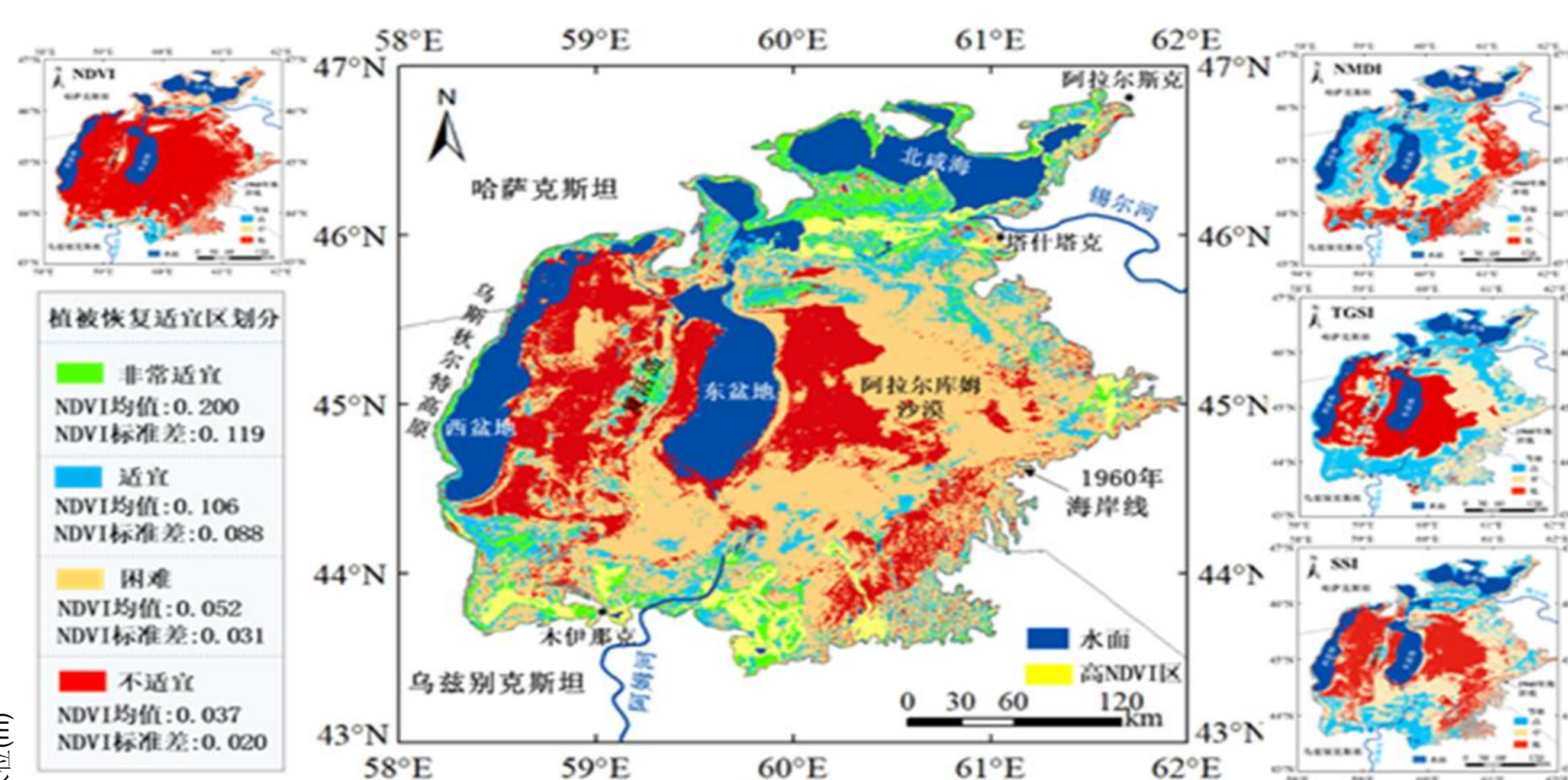
Basin Water Resource Utilization Scheme

Issyk-Kul Lake

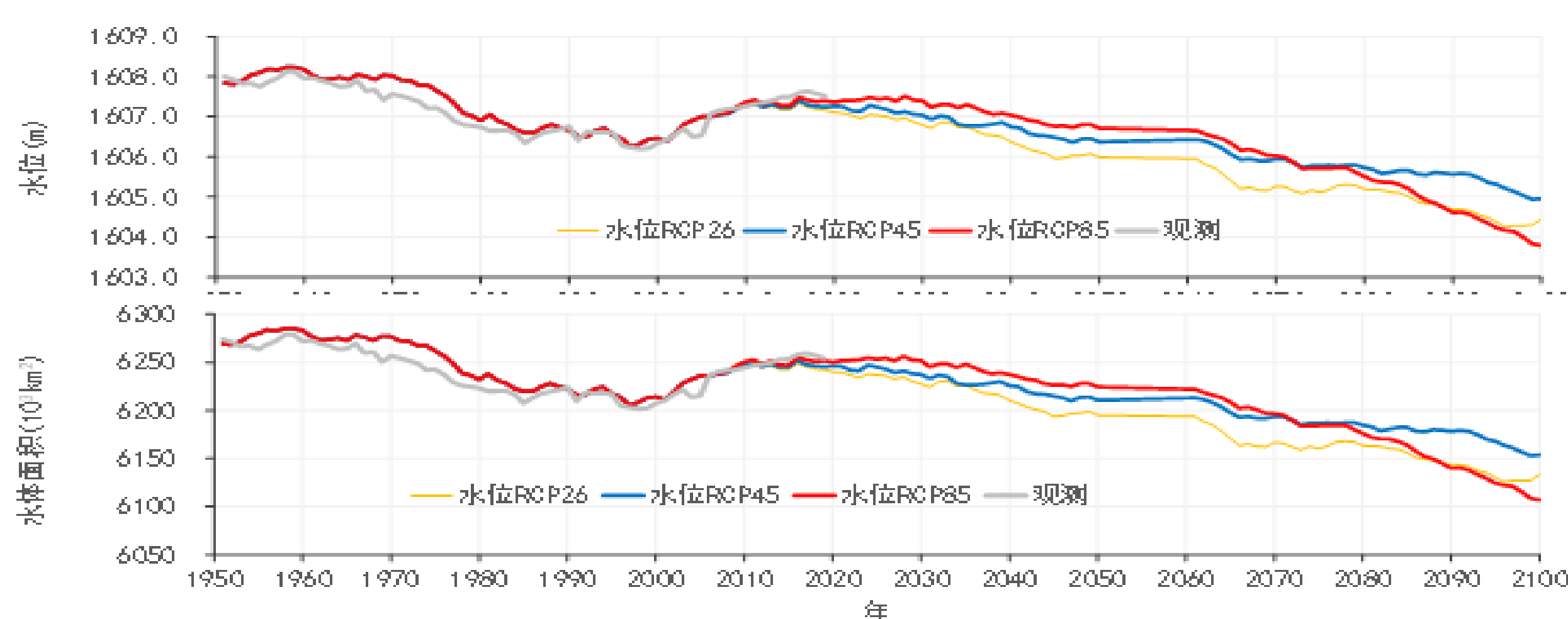
Water Level Changes Attribution and Future Trends

Tourism Planning Adjustment Scheme

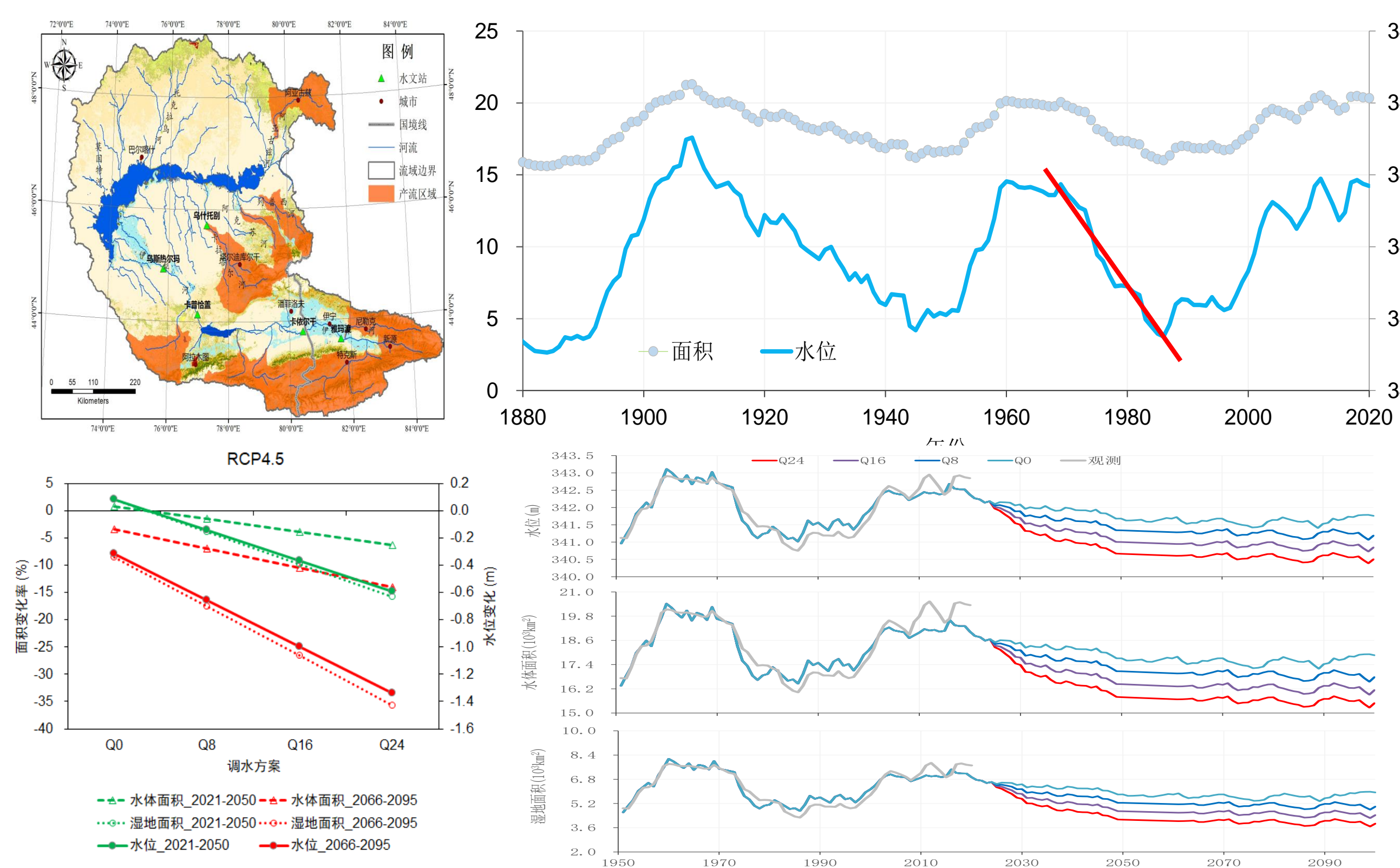
Roadmap for Ecological Governance of the Three Great Lakes in Central Asia — The Chinese Scheme



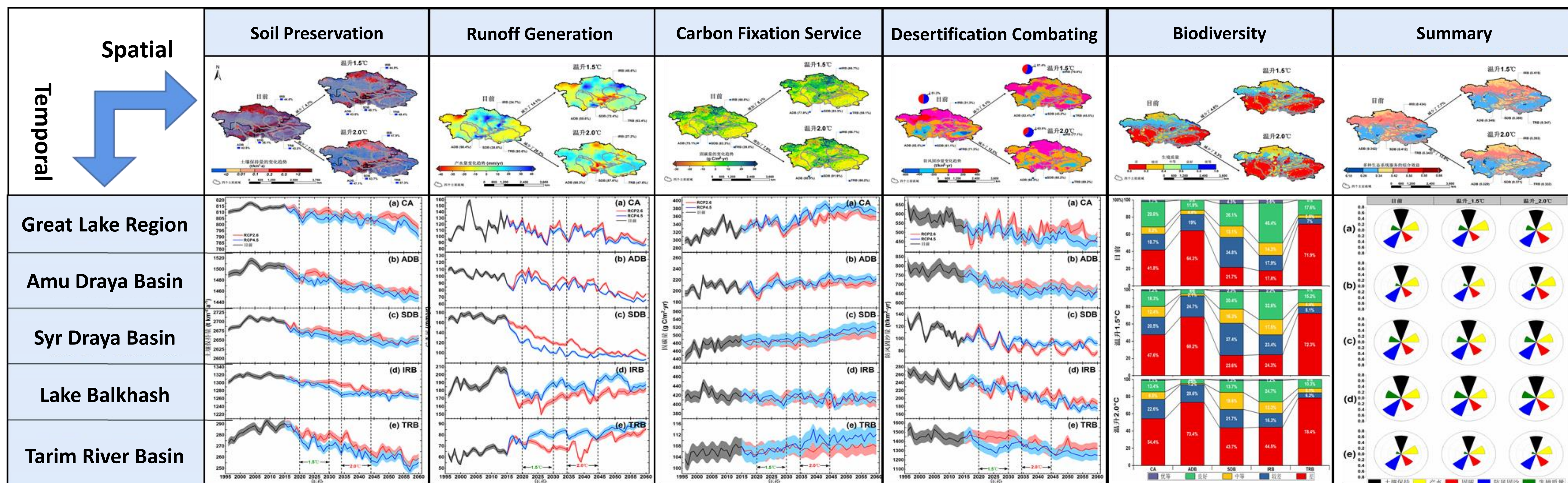
Ecological Restoration Roadmap for the Dry Lakes of the Aral Sea



Driving factors and future trends of water level change in Lake Issyk-Kul



The future of Lake Balkhash water ecosystem is still facing huge challenges



Projected future ecosystem risks in the Great Lakes region

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