

# **The Effect of Computer Network On Cold and Arid Regions Environmental and Engineering *Scientific Research Work***

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# content

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- Computer Network have an important effect on peoples's ideas, study methods, and study tools of geography research.
- The computer network speeds up the research's process of geography study.
- Alone with the computer network being used in geography study, many new research fields have been developed.
- The integrated study capability of geography has been boosted by the use of the computer and network.
- The needs for next generation network or e-science of our main geography scientific research.

# Our Research background

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- Cold and Arid Regions Research focuses on the exploration of the land surface process, structure and interaction in cold and arid regions, the study of the regional environmental changes and global climate changes, the important engineering projects and sustainable development problems
  - Our research activities main focus on glaciology, geocryology, desert research, plateau atmospheric science, hydrology and water resource as well as restoration ecology and ecological agriculture.

# **1. Effect on people's ideas, study methods, and study tools**

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- **The research ideas of environmental and engineering have been changed by using the Internet.**
  - **The ideas would be evaluated firstly whether it is the newest in research field by analyzing the related information which was collected on the Internet.**
  - **Then they decided if they do the research according to their ideas or others.**

## **Study methods have been improved by applying computer and network**

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- **Computer simulation, modular modeling model, data downscaling, land surface assimilation, and so on were applied to the research of cold and arid environmental and engineering scientific research.**

## **New Study tools have been widely used**

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- **Network provide a powerful communication method to transfer massive data and computing analysis results**
  - **Remote sensing approach was widely applied to the research of the investigation of water resources, soil multipurpose use, snowfall, snow disaster, desert distributing and dust happened in cold and arid regions.**
  - **The high performance computer has been used to simulate cold regions engineering project and arid inland river basin research.**

## **Information Search and Knowledge Discover**

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- People can find relational knowledge about their research project from internet instead of the conventional methods.
  - Digital library based on internet
  - Electronic magazine
  - Research institute, organization, university, etc
- Environmental observation data , spatial data and GIS data can frequently transfer or share between researchers through the internet .

# **education, management, intercommunication**

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- **The Long-distance Education becomes a kind of very useful teaching approaches for student to learn some new knowledge and accept technique training from the Internet.**
- **Project and knowledge management system has been used in Qinghai-Tibet Railway research project over the Internet.**
- **Email as an easy way enhanced the international communication and has an important effect on the cold and arid geographical research.**



## **2. Speeding up the process of geography study of cold and arid regions**

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- **The exchange of information and data through the Internet provides the good help for the arrangement of research schedule.**
- **Advanced research methods application by researchers on cold environment and engineer research has shortened the study periods.**

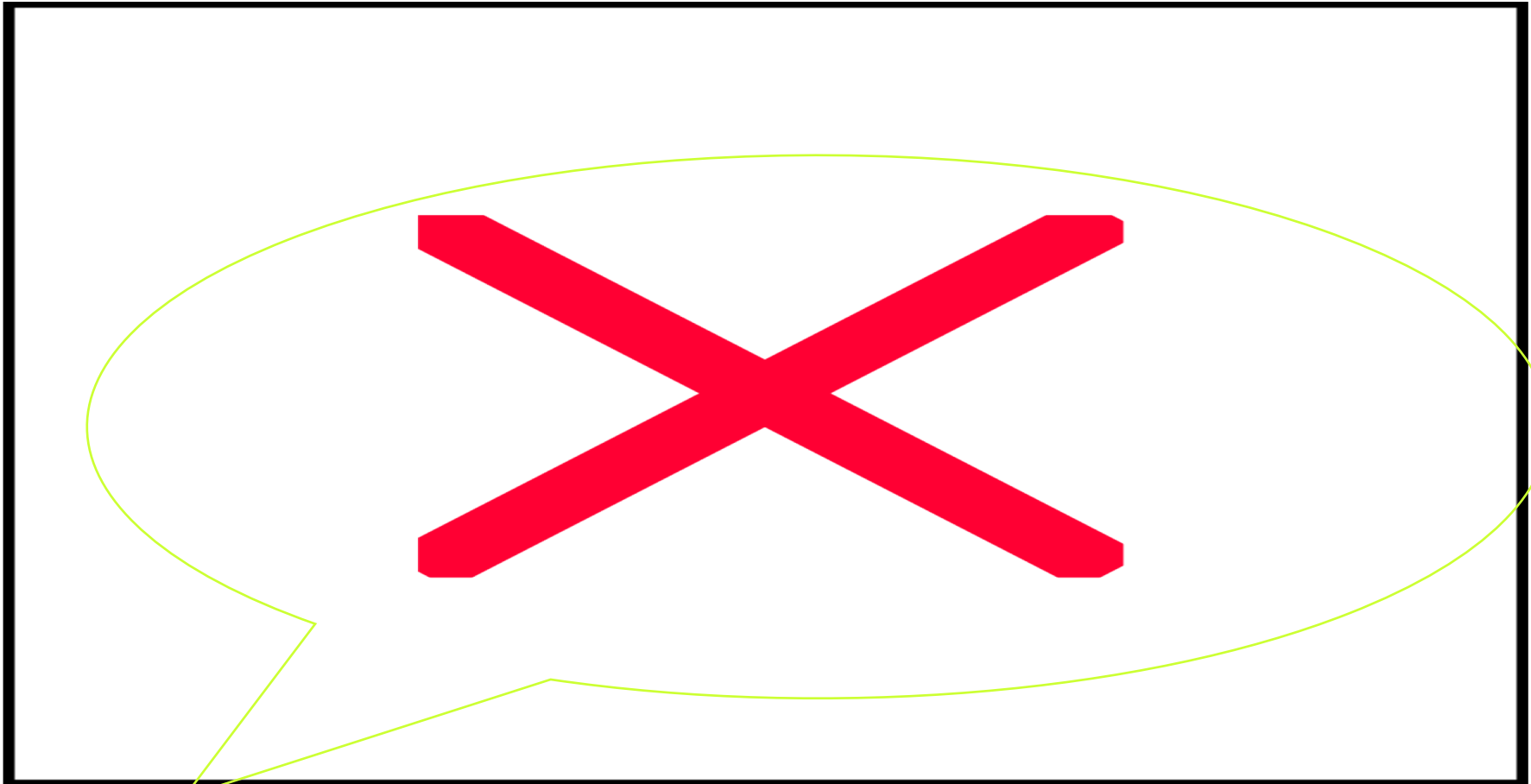
## **Speeding up the data analysis process of geography study of cold and arid regions**

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- Statistical and dynamical downscaling for data analysis speeded up the hydrological model analysis progress
  - Daily data was collected through internet from NCEP( National Centers For Environmental Prediction ) and ECMWF ( European Centre for Medium-Range Weather Forecasts ) re-analysis.
  - Running Statistical Downscaling and Dynamical Downscaling programs on high performance computer which connected with the Internet.
  - Downscaling results pass to user from networks to drive hydrological model.

# **The computer network speeding up the process of geography study.**

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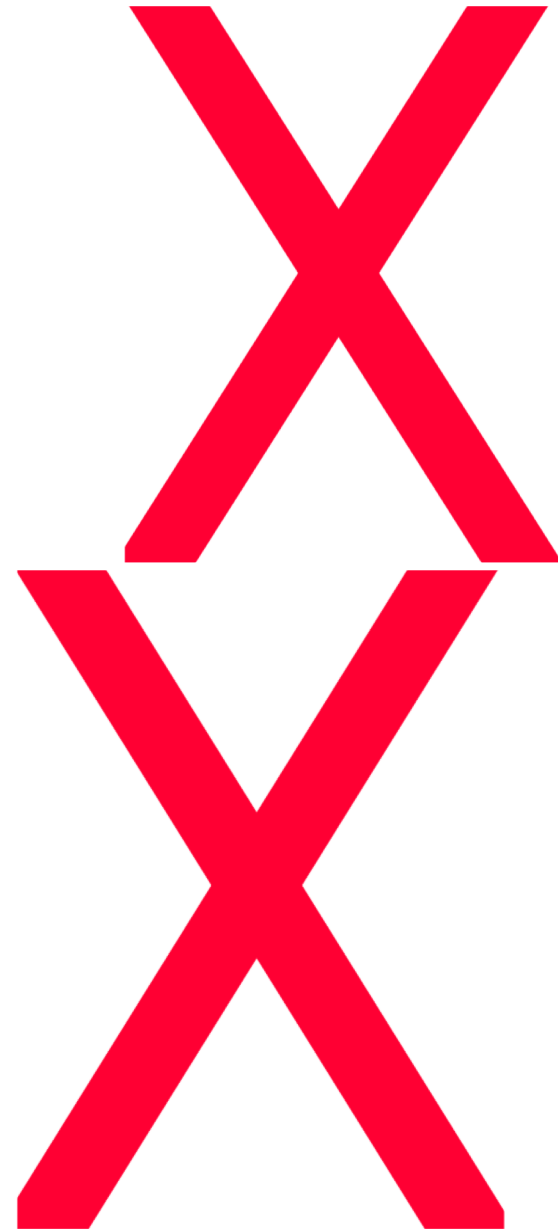


Based on the network

# Application of Data Downscaling

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- Application of downscaled atmospheric model output to water resources management (a work in progress )
  - Atmospheric Model Outputs
  - Direct Use of Model Output
  - Statistical Downscaling
  - Dynamical Downscaling
- The use of computer network saves the much time for the study work



hehei inland river basins  
**Spatial dataset input  
into SWAT**

### **3. Promoting the new research fields development**

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- when the computer network were used in geography study
- The new study fields of land surface assimilation modeling, distributed hydrological modeling, Basin-scale climate modeling, ecosystem modeling, economical modeling, society modeling which is to give a decision support system for heihe inland river basin have made some progresses.

### **3. Promoting the new research fields development.**

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- In order to maintain the frozen condition of soil below permafrost, the roadbed of a lot of sheet-stone, the ventilation embankment, heat pipe and macadam have been used. What the principles and the effect of these methods worked in the protect roadbed of Qinghai-Tibet Railway have began to study based on data, computer and network by using ANSYS, ADINA, Fluent, ect. finite analysis system.

# **Integrated Model and Modeling Research**

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- Spatial Modeling Environment (SME) and Modular Modeling System (MMS) which were built on high performance computer and network environments have become a useful platform for researchers to develop, build, and analyse models of hydrological and ecosystem of heihe inland river basin.

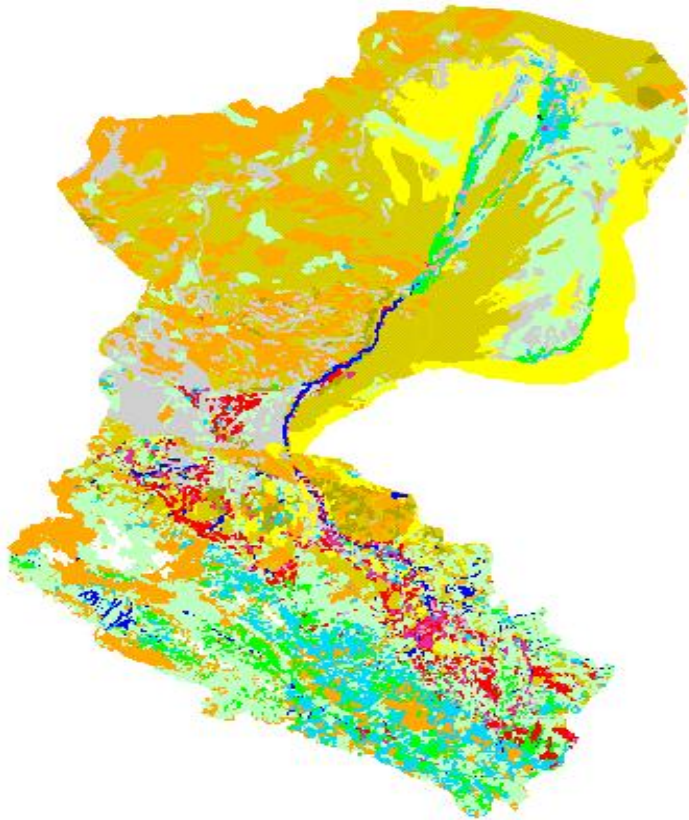


# **SME (Spatial Modeling Environment)**

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**On the computer network**

- **applied the SME modeling platform to simulate ecosystem and economy system of inland river basin**



## **MMS (Modular Modeling System)**

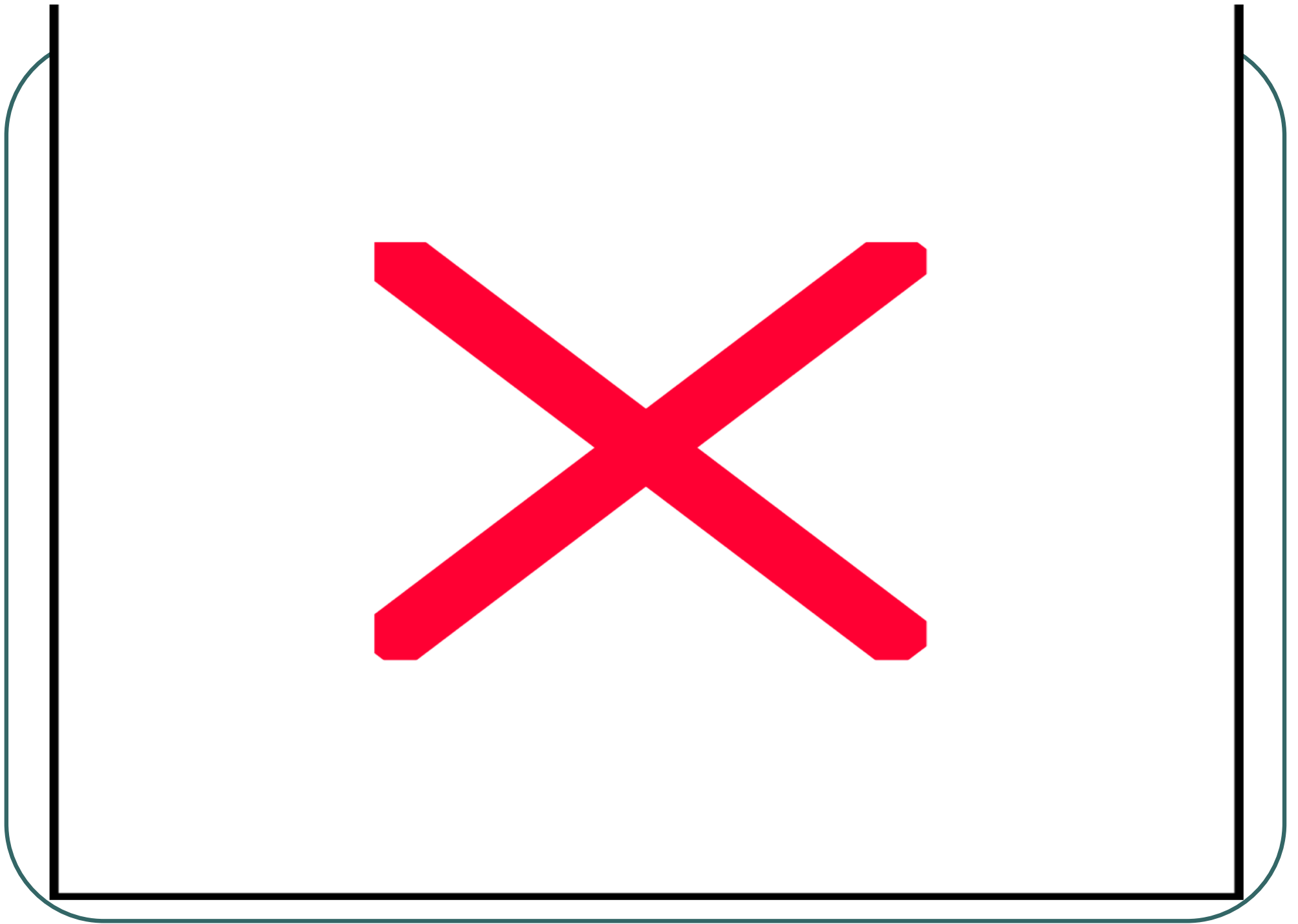
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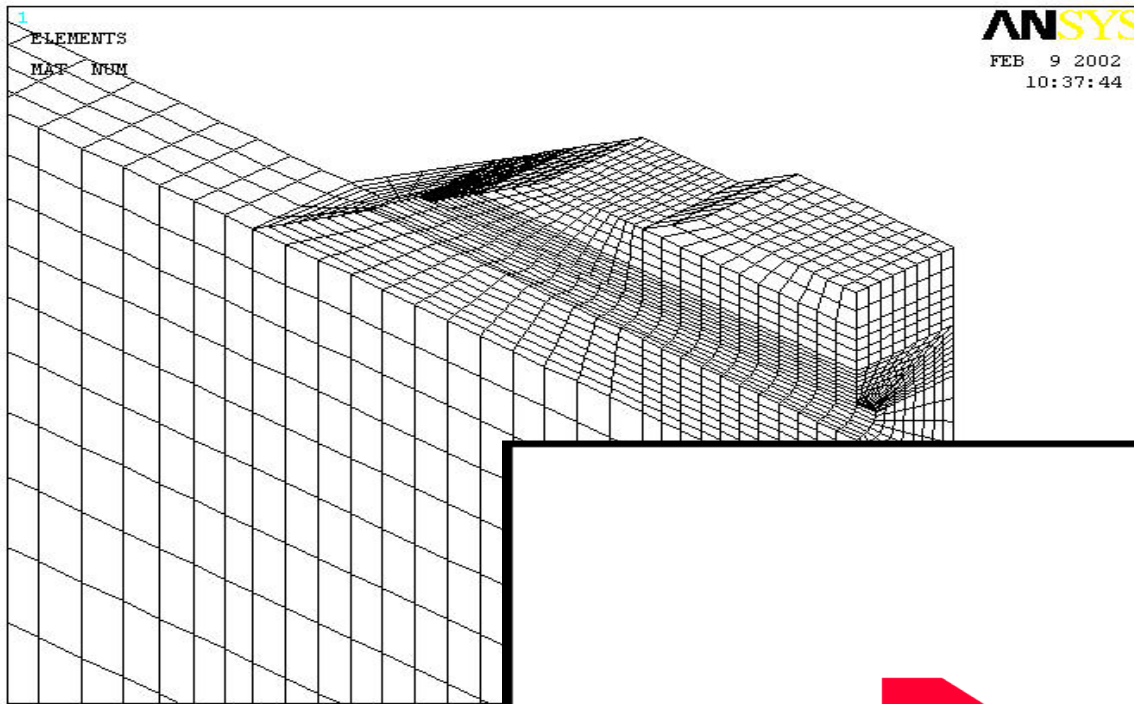
- **Providing an easy platform for the development and application of the water, energy, biogeochemical budget model and for deepening the multidisciplinary cooperation, such as atmosphere, geography, hydrography, mathematics, computer etc.**

# Engineering Simulation in Qinghai-Tibet Railway Study



- By using the Internet, Researchers
  - Using finite analysis system based on high performance computer to do cold regions engineering research and problem analysis.
  - ANSYS was used in Qinghai-Tibet railway roadbed design and stability research
  - ADINA (Automatic Dynamic Incremental Nonlinear Analysis) was used to analyse heat exchange of frozen roadbed.





**two years later  
temperature  
distributing figure of  
ventilation  
embankment roadbed  
obtained by ANSYS**





The temperature graphs of simulation in roadbed

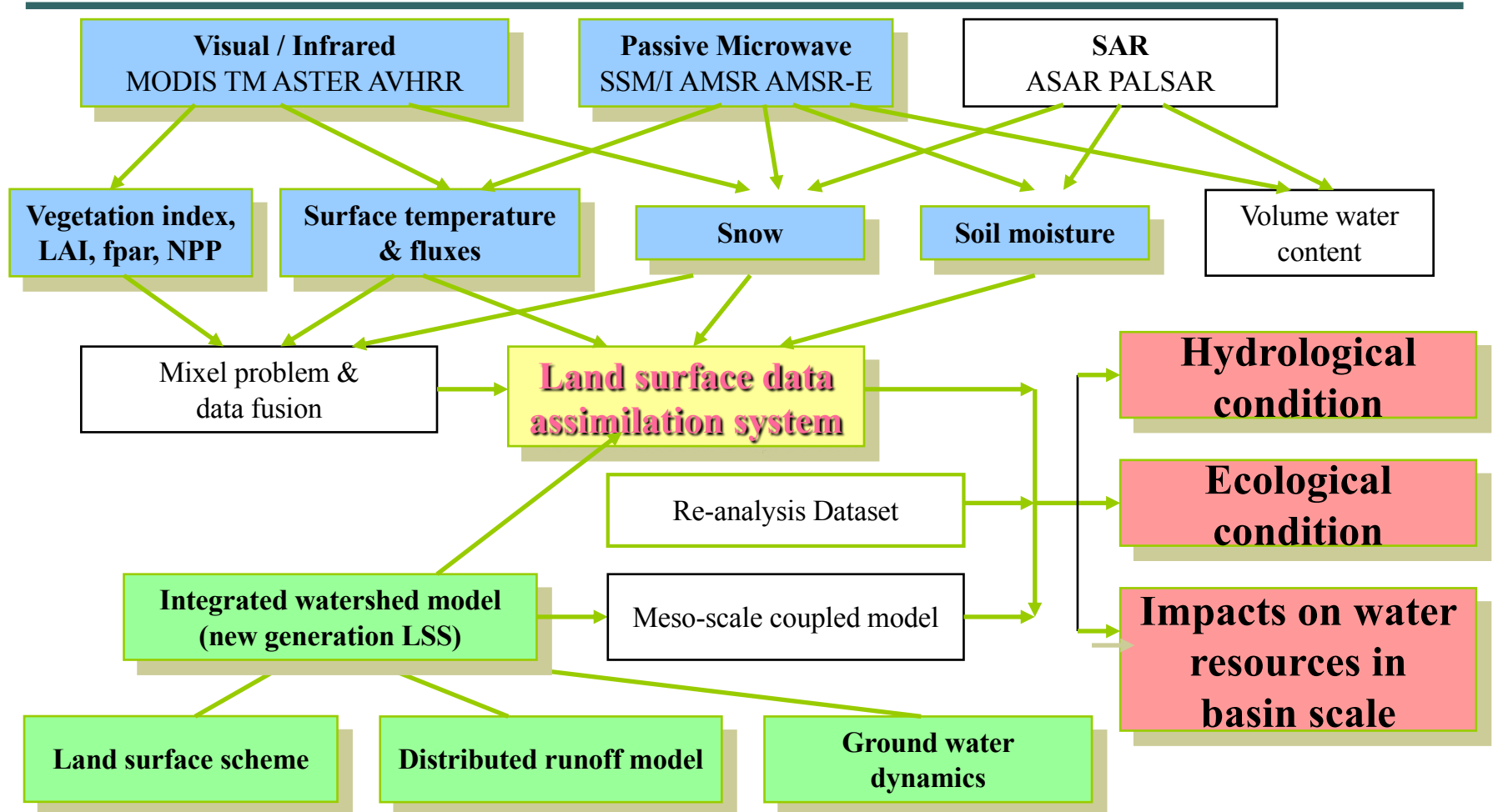
## **4. Deepening the Cooperation of the Multidisciplinary Approaches**

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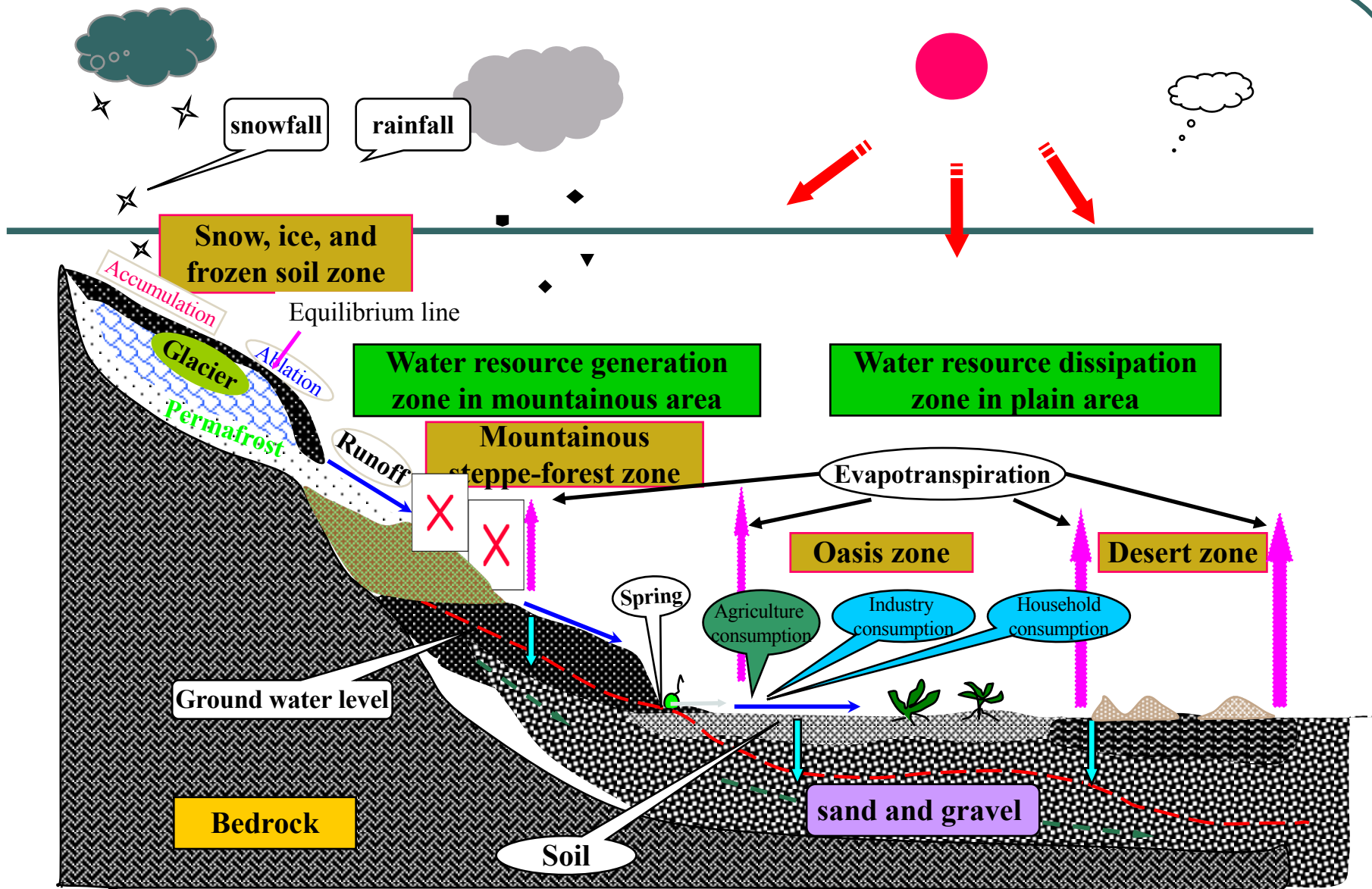
- The use of the integrated model application in Heihe basin research has increased the complexity of the study problems , multidisciplinary approaches, large new data resources, and high performance computing are needed to complete these complex tasks.
- Qinghai-Tibet Railway research needs multidisciplinary researchers to cooperate over the Internet and the multidisciplinary knowledge needs to be syncretized deeply in the research projects.

# Model integration, the strategy

## Remote sensing







**Water cycle in typical inland river basin of northwest China**

## **5. The needs for next generation network**

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- The Requirements of the next network in the Projects of Global Climate Change Research and HEIHE River Basin Management, Simulation and Models Integration Research.
- permafrost physics and cold regions engineering, freezing-thawing process and its control, Qinghai-Tibet railway roadbed stability analysis.

# **The needs for next generation network**

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- In this research project, it need e-science to provide research community with a collaboration work platform. It can also prompt the scientific research results to be shared and converted into productivities .This long term research project need a large number of scientists come from many countries to cooperate with work together on the next generation network or e-science.

# The needs for next generation network

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- The research of heihe river basin model cross integrate we just started involved water-ecological-economic-managing modeling model about up、middle、 down of heihe river region research.
- The high performance computer will be needed to computing and massive data which come from our field observation station and come from NASA、Europe、 Japan etc. will be input in this modeling model. It will need large network bandwidth to transfer a mass of remote sensing spatial data and GIS data.

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***Thank You for your attention***

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