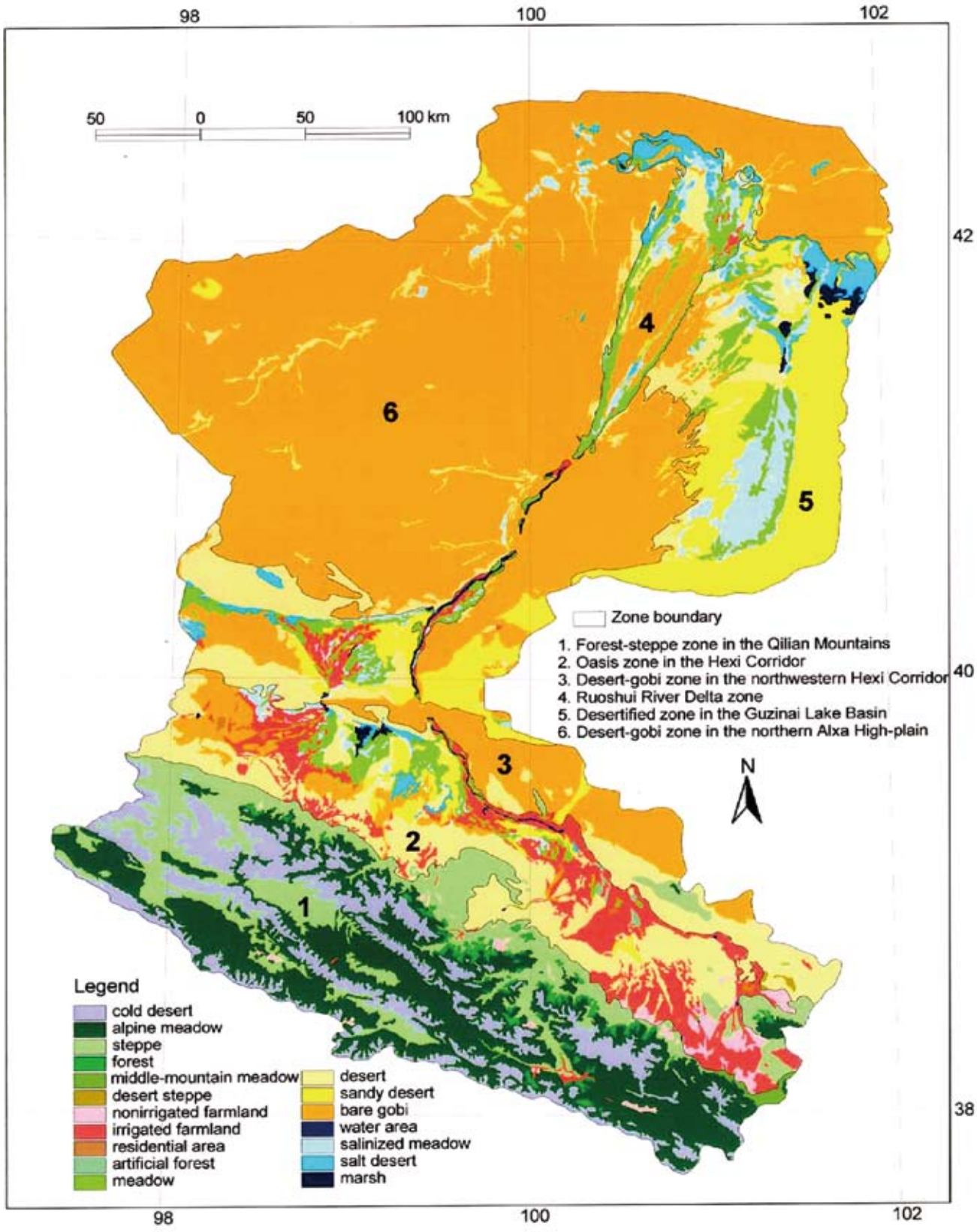
Landscape map of the Heihe River Basin



本图片由作者提供

内陆河流域综合集成研究所需的e-Science环境

张耀南[1,2] 肖洪浪[1] 李新[1] 程国栋[1]
1. 中国科学院寒区旱区环境与工程研究所，兰州 730000
2. 甘肃省高性能网格计算中心，兰州 730000

摘 要：

-

-

Web

—

e-Science

关键词：e-Science

E-Science Environment for Integrated Research of Inland River Basin

Zhang Yaonan[1,2], Xiao Honglang[1], Li Xin[1], Cheng Guodong[1]
1. Cold and Arid Regions Environment and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou 730000 , China
2. Gansu High Performance & Grid Computing Center, Lanzhou, Gansu 730000, China

Abstract: Analyzing demand of cyberinfrastructure for typical international catchment research programs and the research of Heihe river basin, a multi-scale eco-hydrological observational network is proposed for integrated research of eco-hydrological process from patch and watershed scale to river basin scale. The network includs a data platform, which can provide functions of data analysis, preparation model driven dataset and parameter etc. and an integrated modeling platform with graphic interface for model research and model development. Further more, based on high performance computing, a manipulating platform which provides visualized analyzing, data accessing , knowledge discovering and modeling analyzing operations through web is designed. All of above with a collaborative work environment will finally form an e-Science's environment for integrated research and resource management of inland river based on data, computing and modeling.

Keywords: Inland river basin; Integrated research; Monitoring platform; Data platform; e-Science

1. 流域研究与信息基础设施

CUAHSI ” [10]

CLEOs

[1]

1

[11]

[12,13,14,15]

National Ecological Observatory Network NEON

[2 3]

- -

[4,5] 2

ETR Electron Transfer Rate

USGS

[6] 3

Cyberinfrastructure

(spatially explicit)

IME(Integrated Modeling Environment,IME)

IHP-VII 2008-2013

[7]

NSF “

Cooperative Large-Scale Environmental Observatories CLEO ” [8]

“ Designing Hydrologic Observatories ” [9] “

Natural Reserve System James Reserve

[16]

MMS(Modular Modeling System)[17]

DIAS(Dynamic Information Architecture System) [18]

ICMS(Integrated Catchment

Modeling System)[19] Tarsier SME(Spatial Modeling Environment)[20] HarmonIT (OpenMI)[21]

SME Patuxent PLM(the Patuxent Landscape Model-PLM 1995)[22] ELM(the Everglades Landscape Model-ELM 1995)[23] MMS Module Modeling System GIS Yakima RIVERWARE[24]

1/3

[25]

-[26]

1 -

2. 黑河流域研究的观测、数据、模型环境

5 1 e-Science -

[27] 4

2

3

e-Science

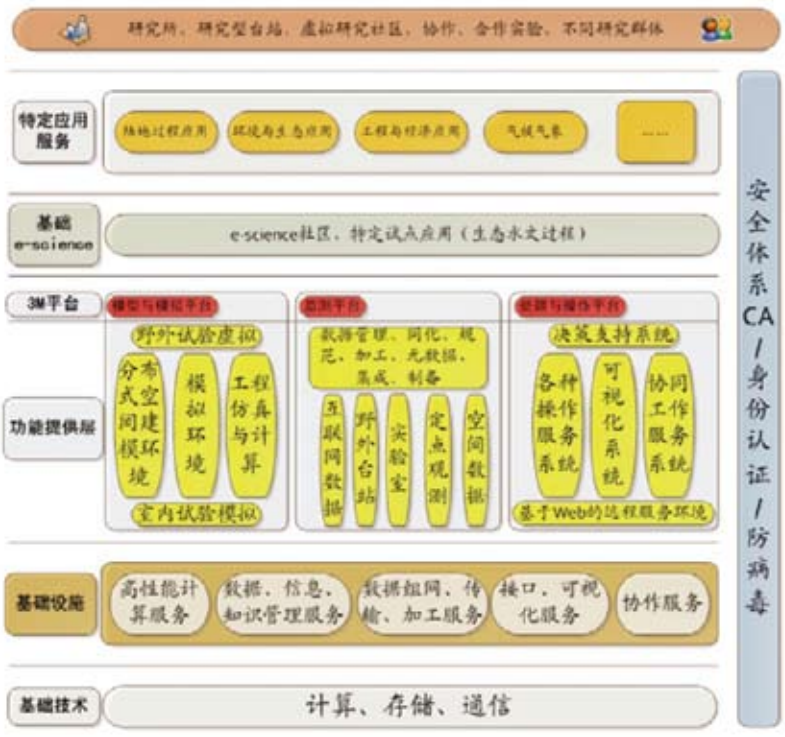


图1 理想的流域综合集成研究信息基础设施

1

/

GSM/CDMA/GPRS/ / -

2.1 以覆盖流域的数据观测网络为基础建立数据监测平台

2

-

-

-

-

[28]

2.2 以数据管理、分析、集成与制备为基础建立数据平台

/

-

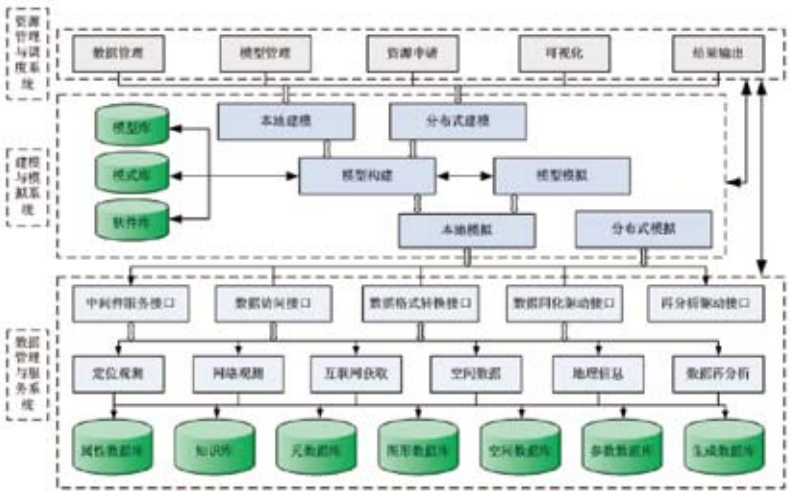


图2 黑河流域综合集成最基本的信息基础框架

2.3 以空间建模环境为基础建立模型研究与开发的模型平台

-

Web

/

6

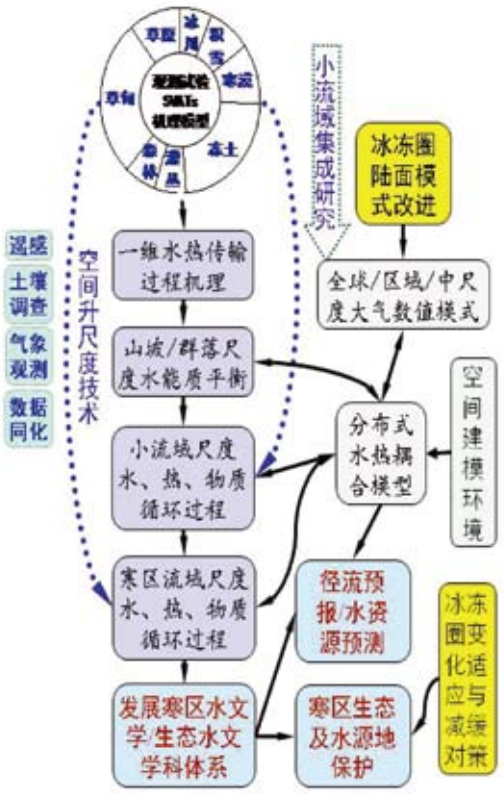


图3 小流域生态–水文模型综合集成过程架构

-

-

-

-

4

Web

-

Virtual Observatory

GSM/CDMA/GPRS/

Web /

-

3

- - -

-

- -

- -

-

- -

3. e–Science 基础环境的实现措施

3.1 引入新技术，建立流域生态水文观测网络

3.2 利用网格技术，建立流域数据管理、分析环境

2.4 以计算和可视化为基础建立支持虚拟协同工作的操作平台

4

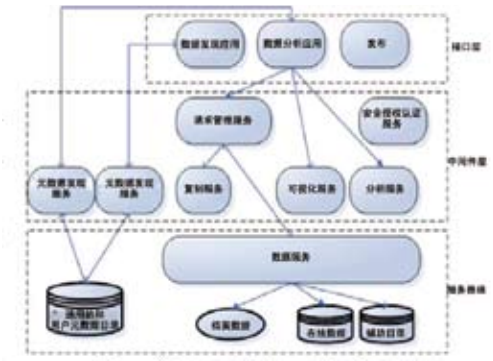


图4 数据平台的体系结构示意图

5 GIS

6 GIS

3.3 引进模型框架技术，建立图形化建模与模型集成环境

MMS SME

MMS SME SWAT TOPMODEL ICMS TARSIER

“ ” 5

3.4 基于WEB环境建立虚拟协同工作环境

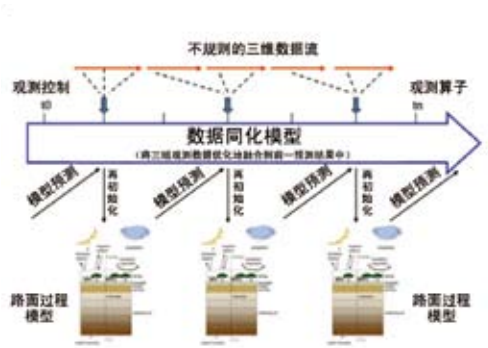


图6 基于路陆面模型的数据同化过程

VTK/OpenGL

scenario-driven

Web

- 3M Monitoring Modeling

Web Manipulating

Web

4. e–Science环境在内陆河研究中的预期作用

2 - -

1

4

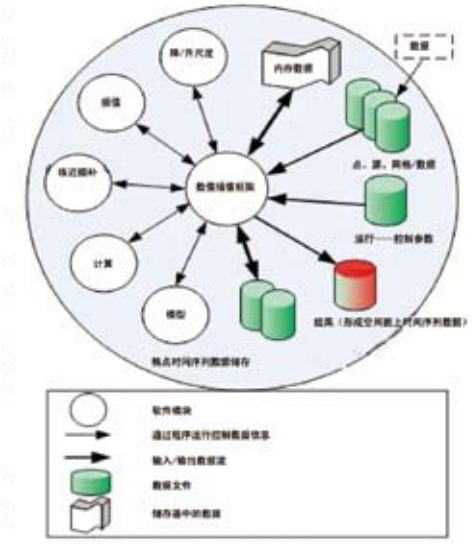


图5 数据插值分析框架

Web

3

5. 内陆河流域e–Science环境发展的思考

/

-

5)

3)

- -

e-Science

1) - - - 6)

4)

-

[27] (7)

- -

2)

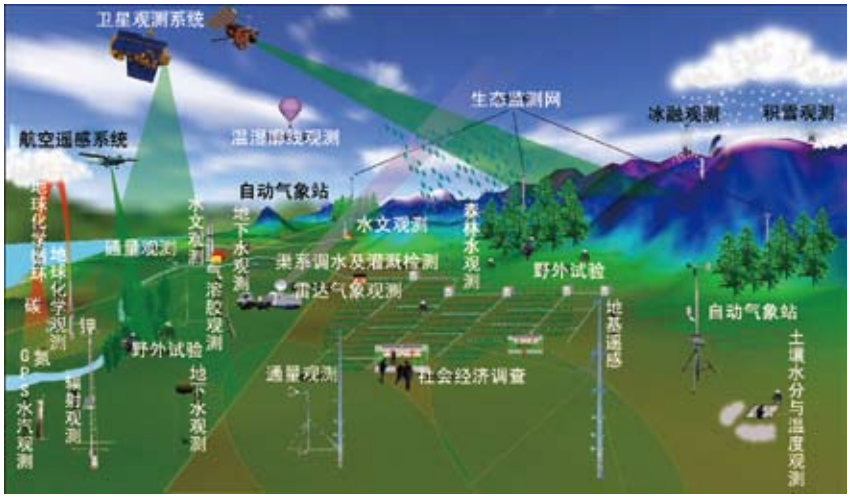


图7 黑河流域地–空一体综合观测网络示意图

参考文献:

[1] Vertessy R. Integrated catchment science. CSIRO land and water, technical report 21/01, 2001.

[2] Kijne J W, Barker R, Molden D. Water productivity in Agriculture–limits and opportunities for improvement. CABI Publishing, 2003.

[3] Falkenmark M, Rochstörm J. Balancing water for human and nature–the new approach in Ecohydrology. James & James/Earthsion,2004.

[4] Rockstriiml J, Gordon L. A ssessment of Green Water Flows to Sustain Major Biomes of the World: Implications for Future Ecohydrological Landscape Management. Phys. Chem. Earth,2001, 26(1 l–12): 843–851.

[5] UNESCO. Jean Burton: Integrated water resources management on a basin level, a training manua,2003.

[6] CRS (Committee on River Science), USGS, NRC (National Research Council). River Science at the U.S. Geological Survey. Washington D.C., National Academies Press, 2007.

[7] http://ihp.bafg.de/servlet.

[8] CLEANER (Committee on the Collaborative Large–Scale Engineering Analysis Network for Environmental Research, National Research Council). CLEANER and NSF's Environmental Observatories. Washington D.C., National Academies Press, 2006.

[9] Band, L., et al. Hydrologic Observatory Network. CUAHSI Technical Report #4. Washington, D.C. 26pg,2002.

[10] CUAHSI(The Consortium of Universities for the Advancement of Hydrologic Science). Hydrologic Information System, at: http://www.cuahsi.org/his/, 2004.

[11] CLEANER (Committee on the Collaborative Large–Scale Engineering Analysis Network for Environmental Research, National Research Council). CLEANER and NSF's Environmental Observatories. Washington D.C., National Academies Press, 2006.

[12] MREFC Guidelines. Guidelines for planning and managing the major research equipment and facilities construction account, at: http://www.joialliance.org/MREFC/mrefc.html, 2005.

[13] E–Science Institute. National e–Science Centre, OSI Report: Developing the UK’s e–Infrastructure for Science and Innovation, at: http://www.nesc.ac.uk/, 2005.

[14] UN. The Millnennium Development Goals Report,2007.

[15] NSF (USA). NSF investments and strategic goals, at: http://www.nsf.gov/index.jsp, 2005.

[16] http://www.jamesreserve.edu/.

[17] MMS .Modular Modeling System.URL：http://wwwbrr.cr.usgs.gov/projects/SW_precip_runoff/mms/,2003.

[18] Sydelko PJ, Majerus KA, Dolph JE, et al. A dynamic object–oriented architecture approach to ecosystem modeling and simulation[A]. Proceedings of 1999 American Society of Photogrammetry and Remote Sensing (ASPRS) Annual Conference[C],1999:410–421.

[19] Reed M, Cuddy S, Rizzoli AE. A framework for modelling multiple resource management issues—an open modelling approach[J]. Environmental Modelling & Software, 1999, 14: 503–509.

[20] Maxwell,T. and Costanza,R. Distributed Modular Spatial

Ecosystem Modeling. International Journal of Computer Simulation: Special Issue on Advanced Simulation Methodol ogies,1995.5(3):247–262.

[21] Blind M, Gregersen JB. Towards an Open Modelling Interface (OpenMI): The HarmonIT project[A]. Pahl–Wostl C, Schmidt S, Rizzoli AE, et al. Complexity and Integrated Resources Management, Transactions of the 2nd Biennial Meeting of the International Environmental Modelling and Software Society, Vol.1[C]. Manno, Switzerland: iEMSs, 2004,346–351.

[22] Voinov, A. ,Costanza, R., Wainger, L. [et al.]., The Patuxent landscape model: Integrated ecological economic modeling of a watershed. Environmental Modelling and Software, 1999,14, 473–491.

[23] http://www.sfwmd.gov/org/wrp/elm/[EB/OL], 2004–12–1–18.

[24] http://wa.water.usgs.gov/projects/yakimawarsmp/warsmp/riverware.htm.

[25] 程国栋,肖洪浪,等.黑河流域节水生态农业与流域水资源集成管理研究领域[J].地球科学进展,2008,23(7):661–665.

[26] 肖洪浪,程国栋,等.黑河流域生态–水文观测试验与水–生态集成各管理研究[J].地球科学进展,2008,23(7):667–670.

[27] 李新,程国栋,等.流域科学研究中的观测系统和模型系统建设[J].地球科学进展,2008,23(7):756–763.

[28] 张耀南,程国栋,等.适宜环境与生态研究的e–Science探讨[J].地球科学进展,2006,21(10):112–117.

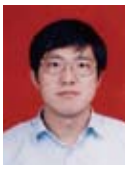
收稿时间:2009年3月30日

作者信息

张耀南

e-Science

肖洪浪



李新

程国栋