



Integrated Water Management

Week 6:

IWRM Revisited

Nick van de Giesen

Water Management
Civil Engineering and Geosciences
Technical University Delft

Week 6: IWRM Revisited

Course Outline

Day		Subject	Teacher
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2: Scenarios & Tools



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4: Water, food, energy



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6: IWRM re-visited

7: Presentations



Week 6: IWRM Revisited

Outline

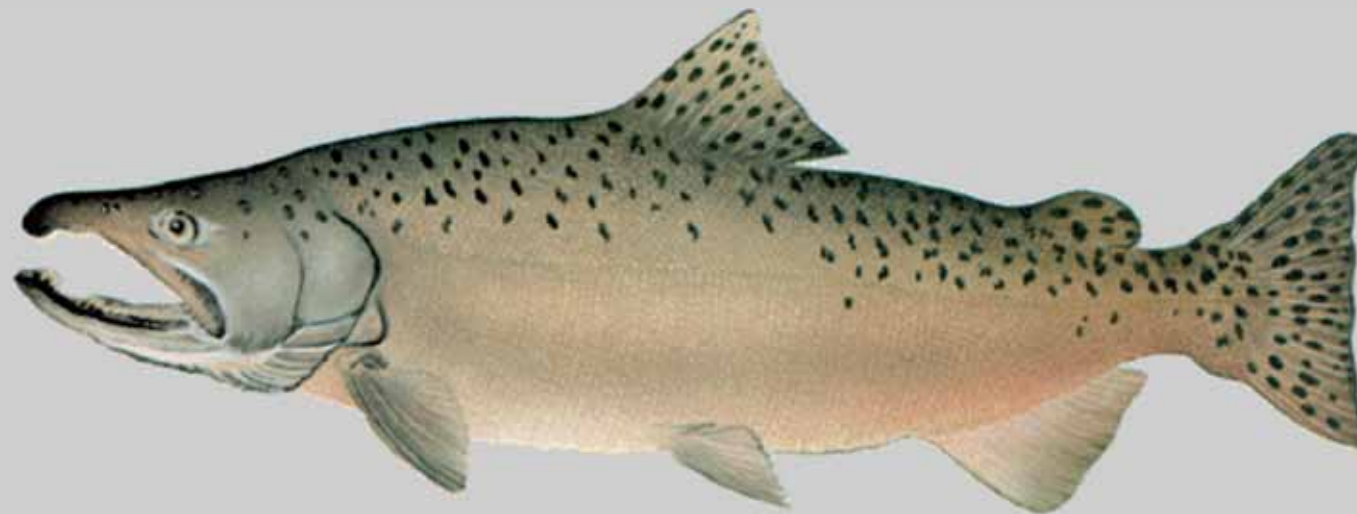
- Back to lecture 1
- Principles of IWRM
- Integration strategies
- Feed-back from groups

- IWRM & Role of Engineers: Read / discuss
- Group work



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Lecture 1



Source: www.psmfc.org

Sacramento river, Salmon

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Lecture 1



NYC watershed



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Lecture 1



Source: tpeblog.wordpress.com

Malaria & irrigation

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Case 1



Source: www.opposingviews.com

Rhine



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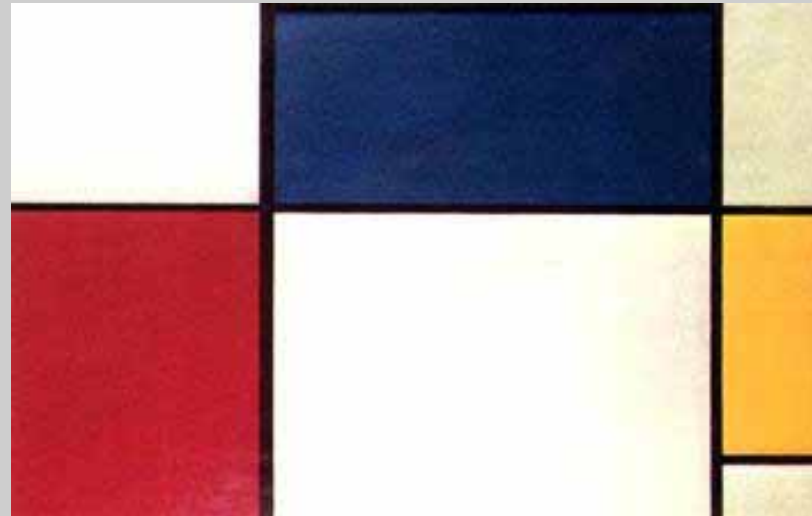
Case 2



Volta

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Lecture 1



Source: Jackson Pollock, Lavender Mist: Number One; 1950

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There is no theory of IWRM, just practice...



Source: Monet, "Water Lilies" (The Clouds)



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General concepts in IWRM

- Concepts and definitions
- Historical developments
- Policy principles
- Strategic issues

Follows Savenije



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What is Water Resources Management?

- To people in arid countries:
 - drought relief, irrigation
 - jobs, food
 - groundwater, flash floods
- To people in wet countries:
 - surface water, water infrastructure
 - navigation, flood protection
 - hydropower generation
- To the water engineer:
 - dams, reservoirs, well field development
 - flood protection, water treatment



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What is Water Resources Management?

- To the environmentalist:
 - wetlands, ecosystem rehabilitation
 - deforestation, land degradation, erosion, pollution
- To the lawyer:
 - ownership of water
 - water law and regulations
 - water rights and licences
- To the economist:
 - water markets, privatisation of water supply
 - water pricing, cost recovery, water use efficiency
- To the politician:
 - water conflicts (between sectors, nations)
 - allocation of water, water self-sufficiency, food security



Week 6: IWRM Revisited

Definitions

Water Resources Development (WRD)

Actions, mostly physical, that lead to the beneficial use of water resources for single or multiple purposes.

Water Resources Planning (WRP)

Planning of the development, conservation and allocation of a scarce resource (sectoral and intersectoral), matching water availability and demand, taking into account the national objectives and constraints and the interests of stakeholders

Water Resources Management (WRM)

The whole set of technical, institutional, managerial, legal and operational activities required to plan, develop, operate and manage water resources



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Integrated Water Resources Management

- **All natural aspects** of the water system: surface water, groundwater, water quality (physical, biological and chemical).
- **All sectors** depending on water: agriculture, households, industry, hydropower, navigation, fisheries, recreation, ecosystems.
- The relevant **national objectives** and constraints: social, legal, institutional, financial, environmental.
- The **institutional** hierarchy: national, provincial, local.
- The **spatial variation** of resources and demands: upstream-downstream interaction, basin-wide analysis, inter-basin transfer.
- The **temporal variation**: floods, droughts, peak demands, growth patterns.



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Dimensions of IWRM

- 4 Dimensions
 - Water Resources
 - Water Users
 - Spatial Scales
 - Temporal Scales and Patterns

- Cross-cutting Policy Issues and Objectives
 - Sustainability
 - Public Interest



Dimensions of IWRM

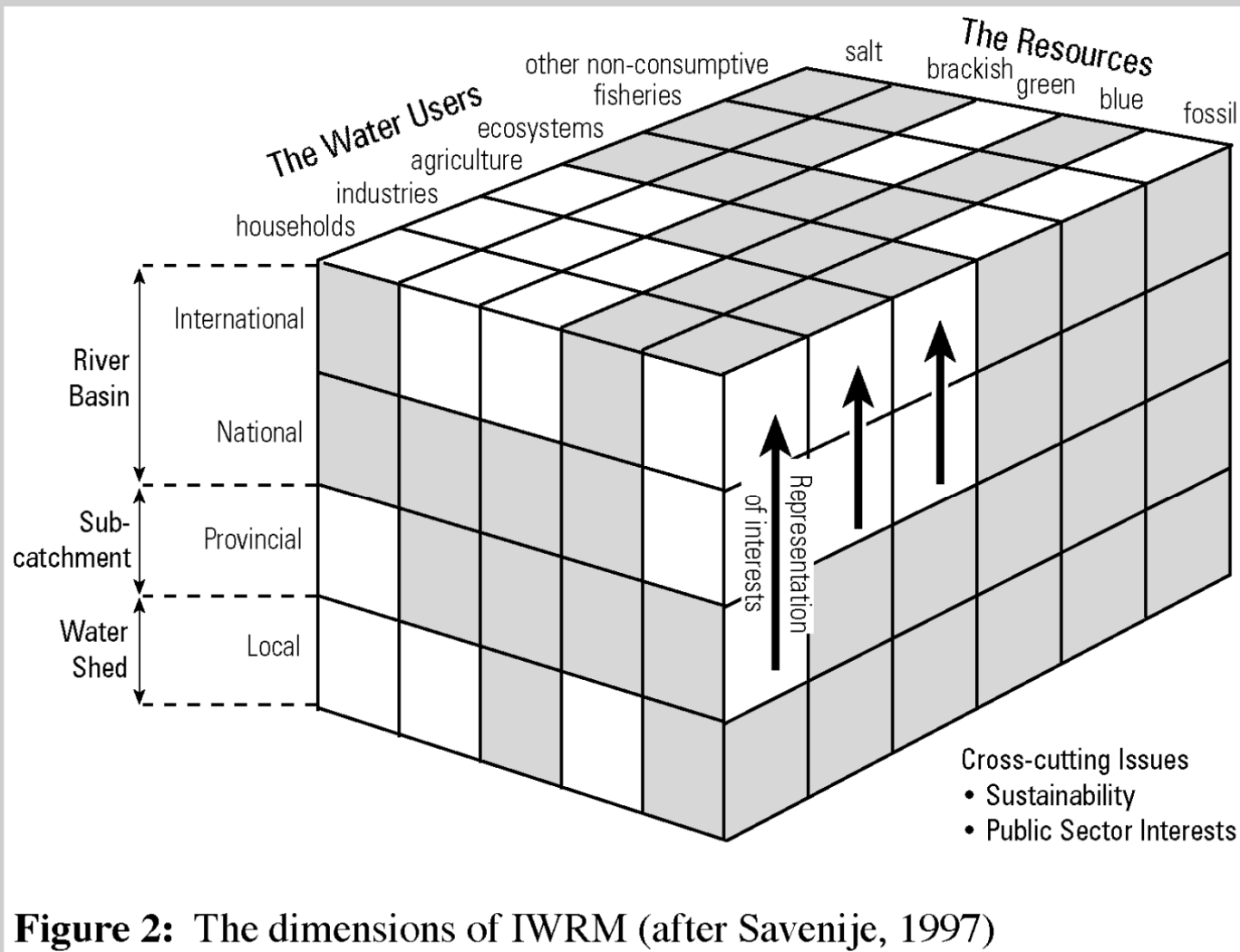


Figure 2: The dimensions of IWRM (after Savenije, 1997)



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Policy principles

- 3 E's of Postel:
 - Equity
 - Ecological integrity (sustainability)
 - Efficiency

- Agreed (Dublin) Principles:
 - IWRM
 - Participatory approaches
 - Water as an economic good
 - Essential role of women

- Further:
 - Management at the lowest appropriate level (subsidiarity)



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Policy principles

- How to marry Equity and Efficiency:
 - Cost recovery (the full financial cost, not the economic cost)
 - Financial autonomy and accountability
 - Water pricing with adequate cross-subsidies



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Policy principles

➤ Sustainable development:

“Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs”

(WCED, 1987)



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Policy principles

- How to attain sustainability:
 - Closing cycles (physical condition)
 - rural scale
 - urban scale
 - river basin scale
 - global scale
 - Short cutting cycles (economic condition)



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Policy principles

- Sustainable WRM
 - Combination of:
 - Demand Oriented Measures
 - Supply Oriented Measures

 - Or:
 - Demand Management
 - Supply Management



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Policy principles

- Water supply management
 - Infrastructure policy: dams, canals, etc.
 - Water quality policy: quality standards
 - Land use policy: watershed management
 - Desalination, Re-use
- Water demand management
 - Enabling environment: policy, legal framework
 - Water supply technology: reduction of losses
 - Legal incentives: quota, licenses, rights, penalties
 - Economic incentives: subsidies, taxing, pricing
 - Water education: increasing awareness



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Policy principles

- What is demand management:
 - Not the same as water pricing!
 - Water pricing is for financial cost recovery
 - Demand management is an approach to stimulate the user to assume more desirable patterns of demand



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General concepts in IWRM

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Historical developments, evolution

- Water resources development
 - Dominant paradigm: water is a resource to be exploited
 - The engineering approach
 - Emphasis on infrastructure
 - Individual projects

- Water resources management
 - Recognition that water can be 'overexploited'
 - Accounting for ecological and social constraints
 - Regional & national planning instead of a project approach

- Integrated water resources management
 - Water management embedded in an overall policy for socio-economic development, physical planning and environmental protection



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Historical developments, events

1965-1974	International Hydrological Decade
1970	Helsinki Rules on the use of international rivers
1977	UN Water Conference, Mar del Plata
1981-1990	Drinking Water Supply and Sanitation Decade
1992	International Conference on Water and the Environment, Dublin
1992	UN Conference on Environment and Development, Rio de Janeiro
2000	European Water Directive (Mostert)
2000	2 nd World Water Forum, The Hague
2002	World Summit on Sustainable Development, Water Dome , Johannesburg
2003/6/9/12	World Water Forum, Kyoto, Mexico, Istanbul, Marseille



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Dublin principles

1. Water is vital and finite. An integrated approach (holistic approach) to water management is needed.
2. Water management should be based on a participatory approach.
3. Women take a central role in the provision and management of water.
4. Water should be considered an economic good, but people should have access to clean water and sanitation at an affordable price.



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Strategic issues

- Global water scarcity
- Blue versus green water
- Food security: self-sufficiency or self-reliance?
- Virtual water
- Dublin Principles on IWRM
- Value of water
- Participation, stakeholder involvement
- River basin approach
- Priorities for allocation
- Decentralisation, privatisation
- Role of government
- Awareness, water literacy



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Strategic issues

- Global water scarcity:
 - Water scarcity is NOT the reason for “Thirst”
(quantities required for basic needs are very small)
 - Water use for sanitation is an outdated approach
(non-water borne sanitation is the future)
 - The problem is food
(1 kg of cereals require 1-2 m³ of water)



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Strategic issues

- Global water scarcity:
 - 1700 m³/cap.yr (no shortage)
 - drinking
 - cooking etc.
 - washing etc.
 - toilet flush
 - industry
 - vegetarian diet
 - meat diet add:



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Strategic issues

- Global water scarcity:
 - 1700 m³/cap.yr (no shortage)
 - drinking 1 m³/cap.yr
 - cooking etc. 5 m³/cap.yr
 - washing etc. 10 m³/cap.yr
 - toilet flush 20 m³/cap.yr
 - industry 200 m³/cap.yr
 - vegetarian diet 500 m³/cap.yr
 - meat diet add: 500-1000 m³/cap.yr



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Strategic issues

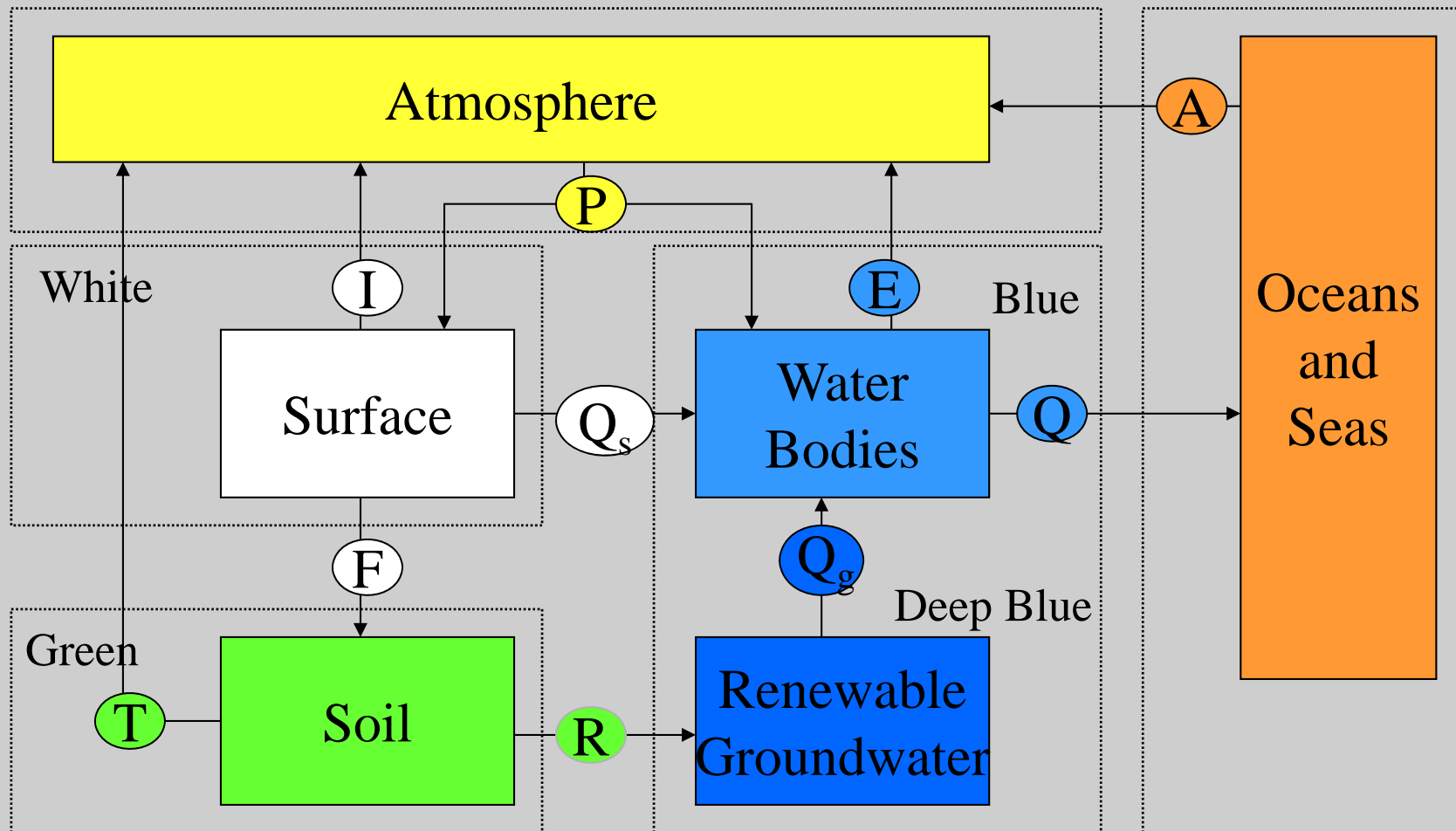
- Green water
 - Water rainbow
 - Blue water: runoff (surface water, groundwater)
 - Green water: transpiration by plants
 - White water: evaporation through interception or directly from the soil
 - Black water: fossil groundwater
 - Brown water: wastewater
 - Grey water: treated wastewater, for reuse
 - Virtual water: water 'hidden' in an agricultural or industrial product



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Strategic issues

➤ Green water, global cycle





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Strategic issues

- Green water
 - 67% of the world staple food is from green water
 - Meat production is almost 100% green water (grazing)
 - Forest and ecosystem products are 100% green water
 - Cereal production in sub-Saharan Africa near 100% green water



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Strategic issues: Consensus

- Basic human needs have priority
- Further prioritising on the basis of socio-economic criteria
- The river basin as the logic unit for WRM
- Participatory approaches and the crucial role of women



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Strategic issues: Remaining issues

➤ Emerging issue:

Water – Energy nexus:

- Hydropower
- Cooling water
- CO₂/climate
- Heat storage

Food – Water – Energy nexus:

- Biofuels



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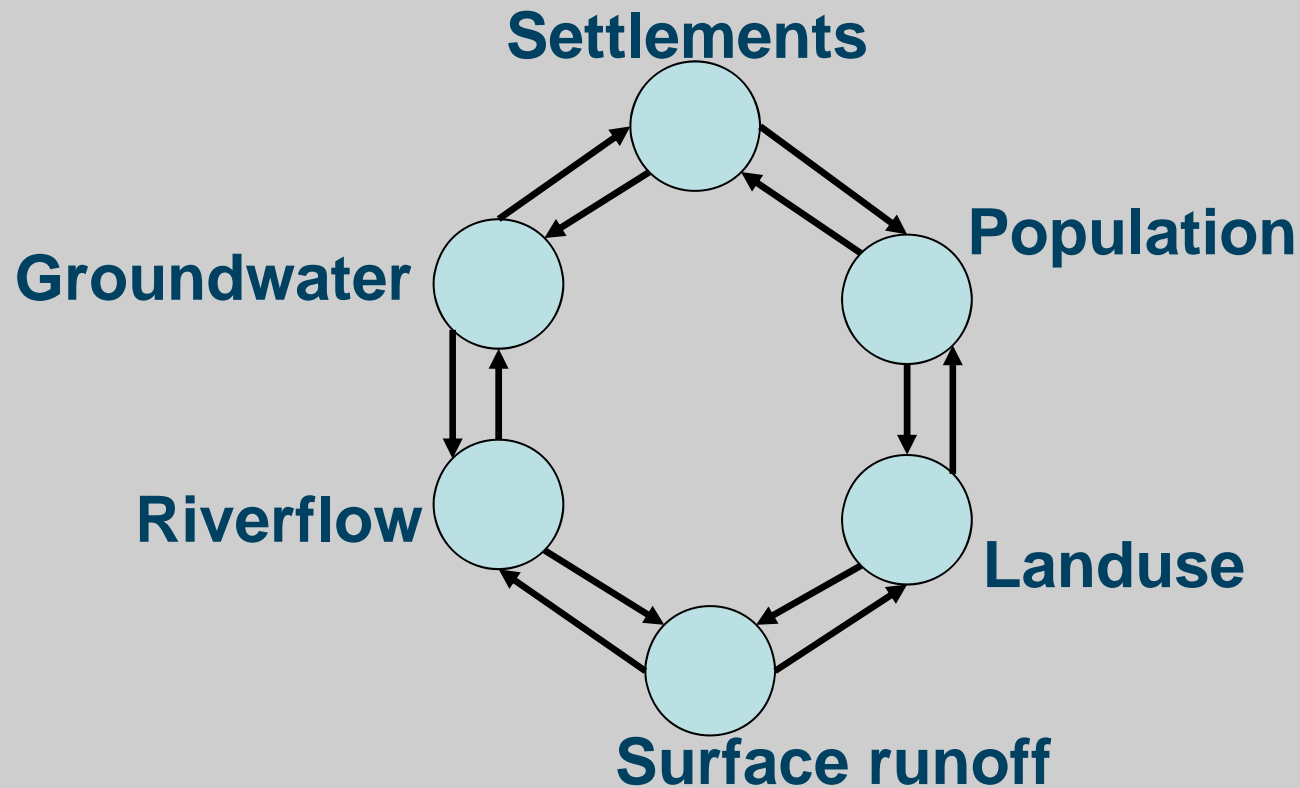
Integration strategies

- **How to connect models?**
 - Everything has to do with everything
 - Dead buffalo
 - Symmetry
 - The real thing

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Integration strategies: model structures

➤ Everything has to do with everything

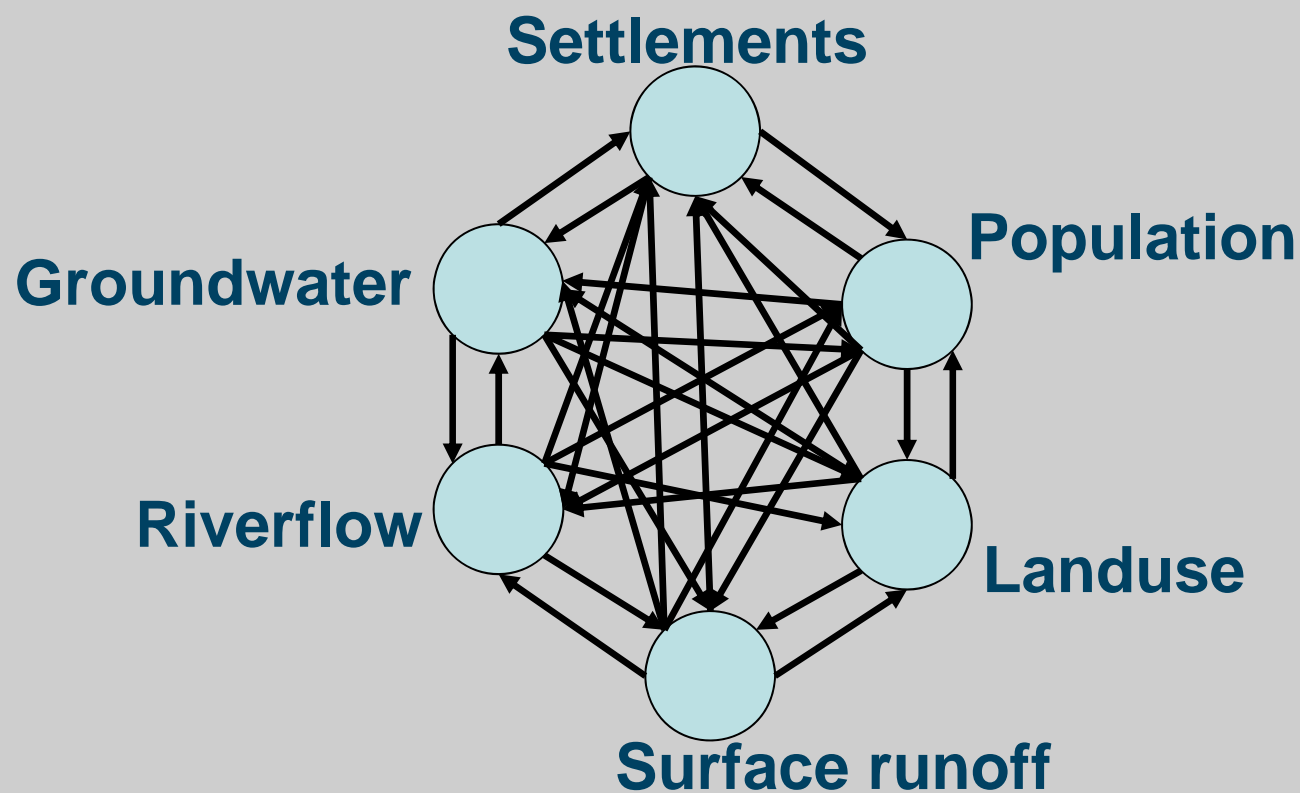




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Integration strategies: model structures

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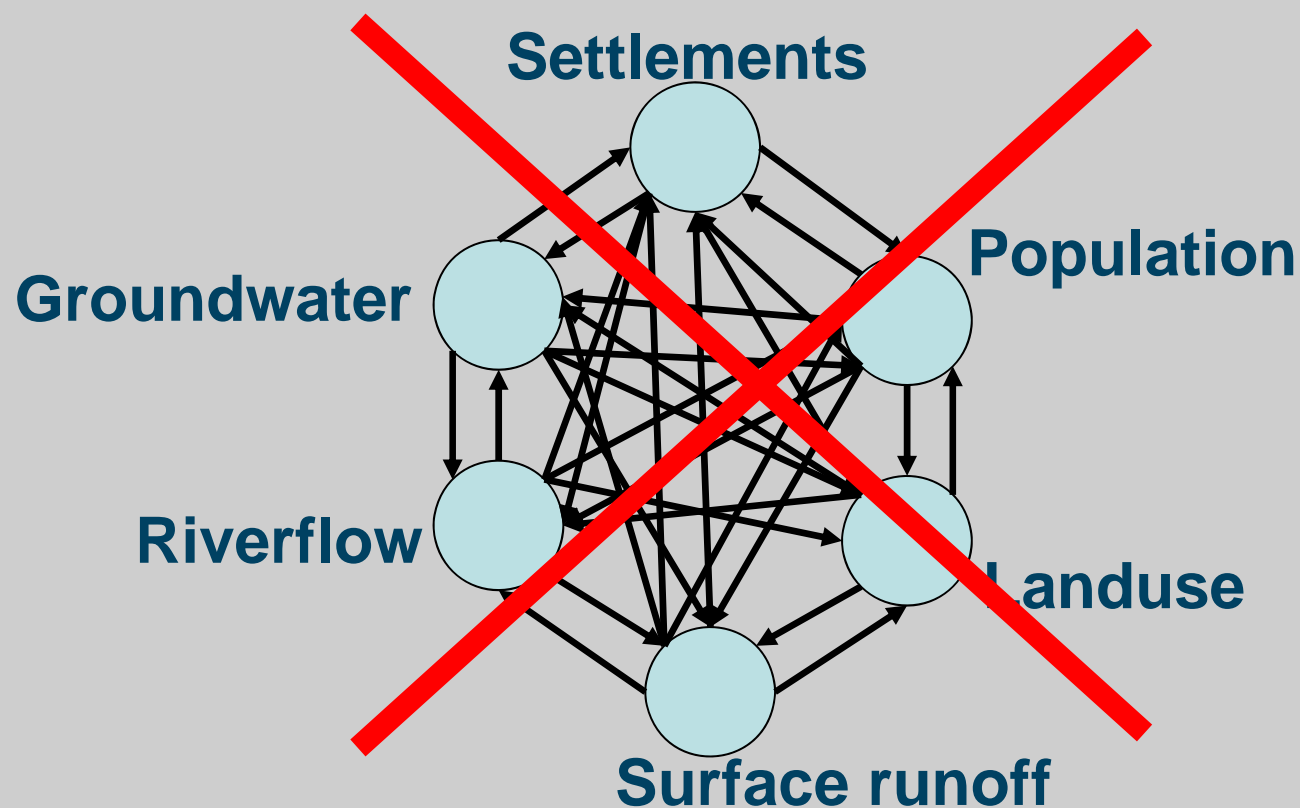




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Integration strategies: model structures

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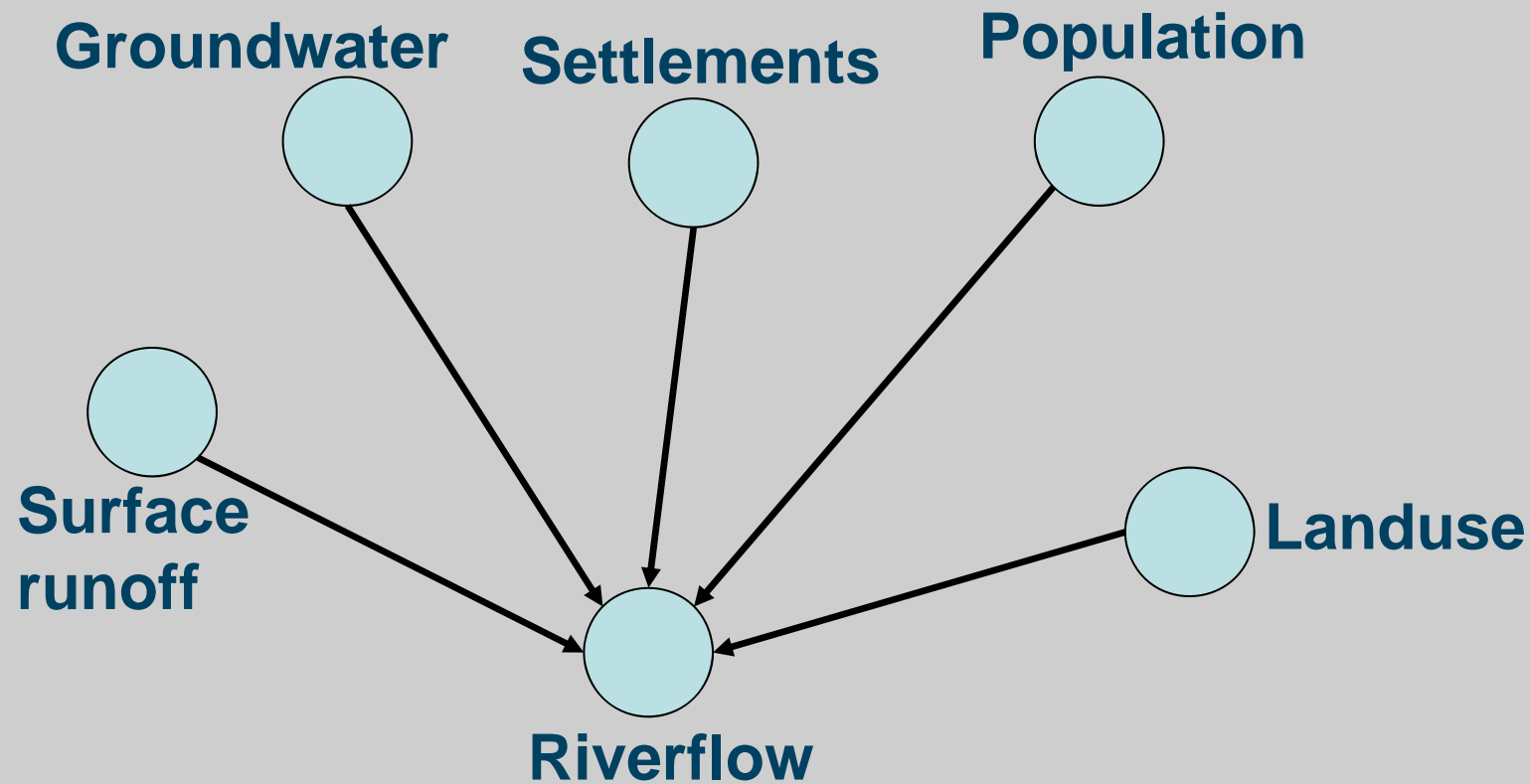




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Integration strategies: model structures

➤ “Dead buffalo”

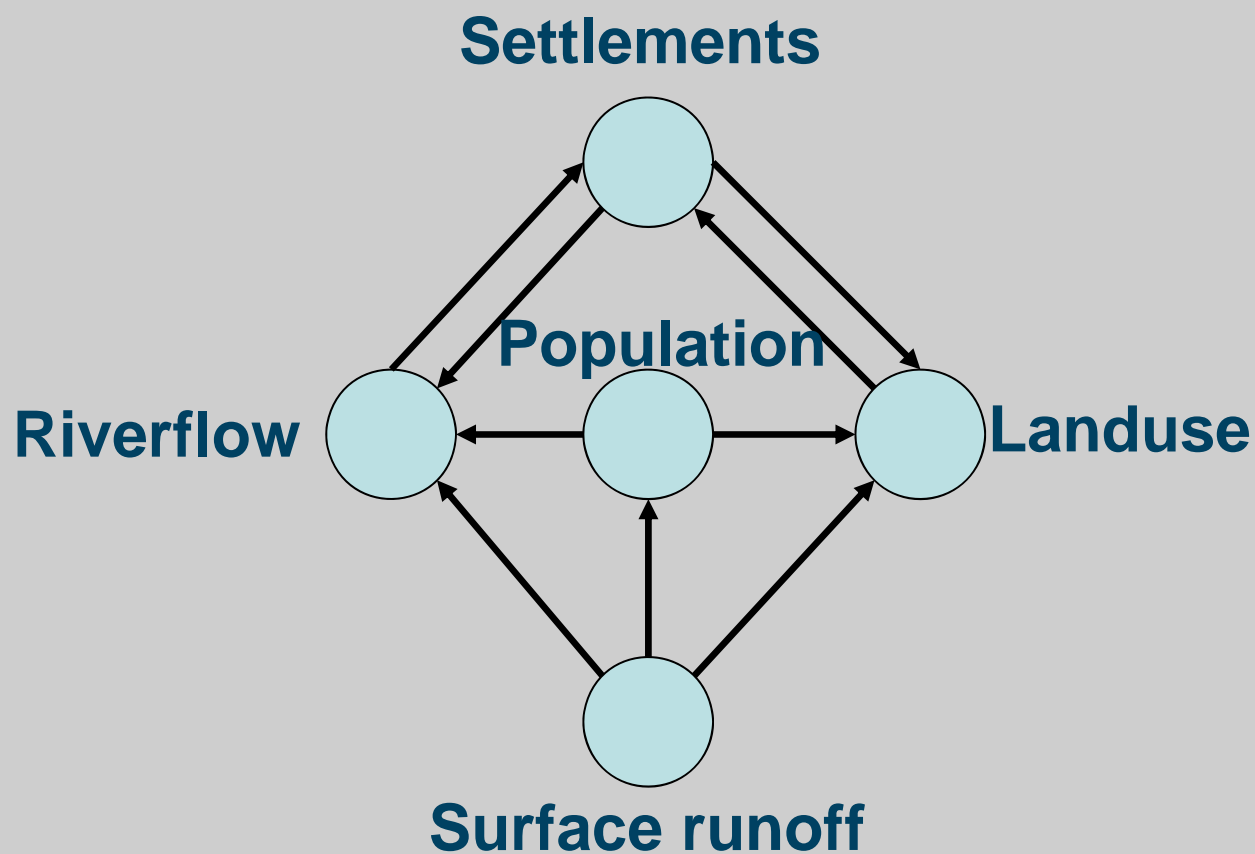




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Integration strategies: model structures

➤ Symmetry





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Integration strategies: model structures

- The real thing (Letcher et al, 2004):
 - A problem-focused activity, needs driven; and likely project based
 - An interactive, transparent framework; enhancing communication
 - Linking of policy to research
 - Connection of complexities between natural and human environment;
 - Recognition of spatial dependencies, feedbacks and impediments



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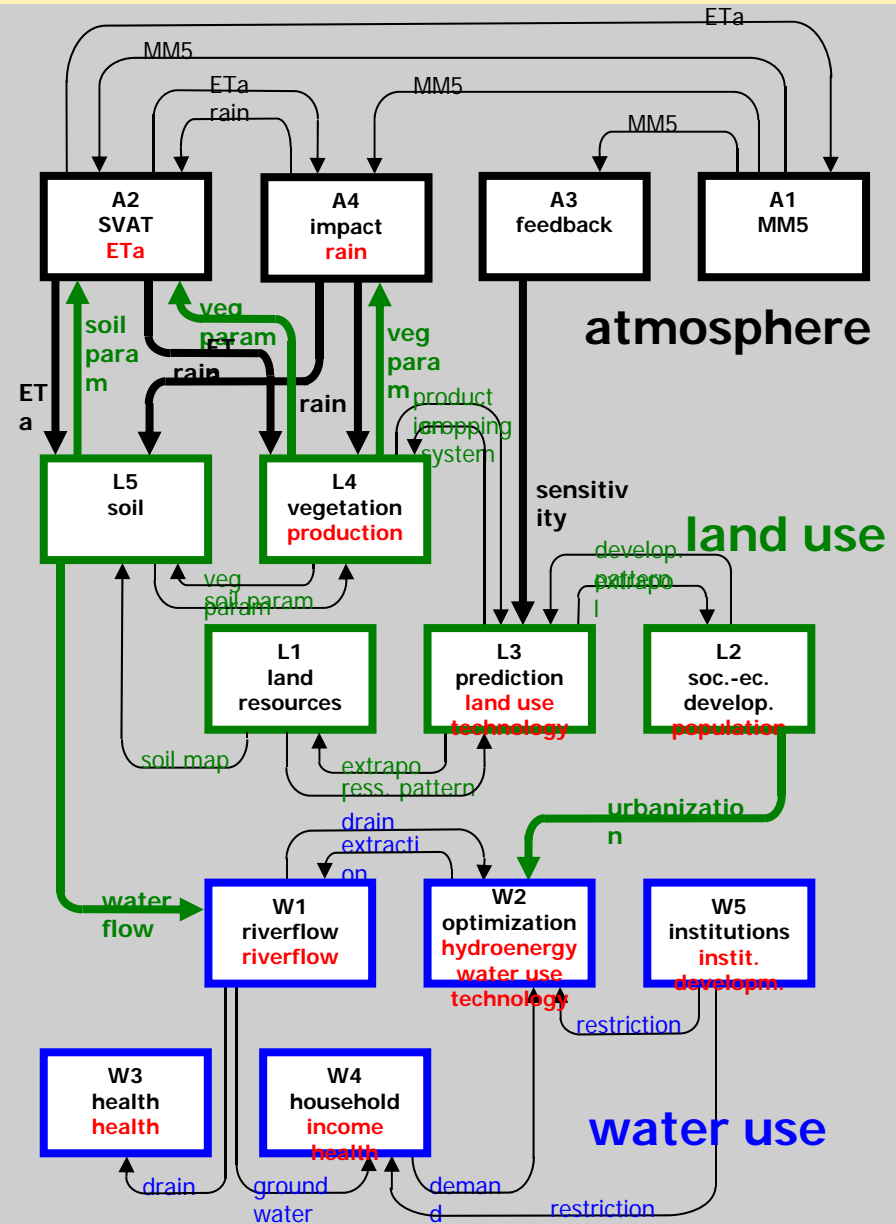
Integration strategies: model structures

- The real thing (continued):
 - An iterative, adaptive approach
 - A focus on key elements
 - Recognition of essential missing knowledge for inclusion
 - Team shared objectives, norms and values; disciplinary equilibration
 - Science not always new but always intellectually challenging
 - Characterisation and reduction of uncertainty in prediction

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Integration strategies:
model structures

GLOWA Volta

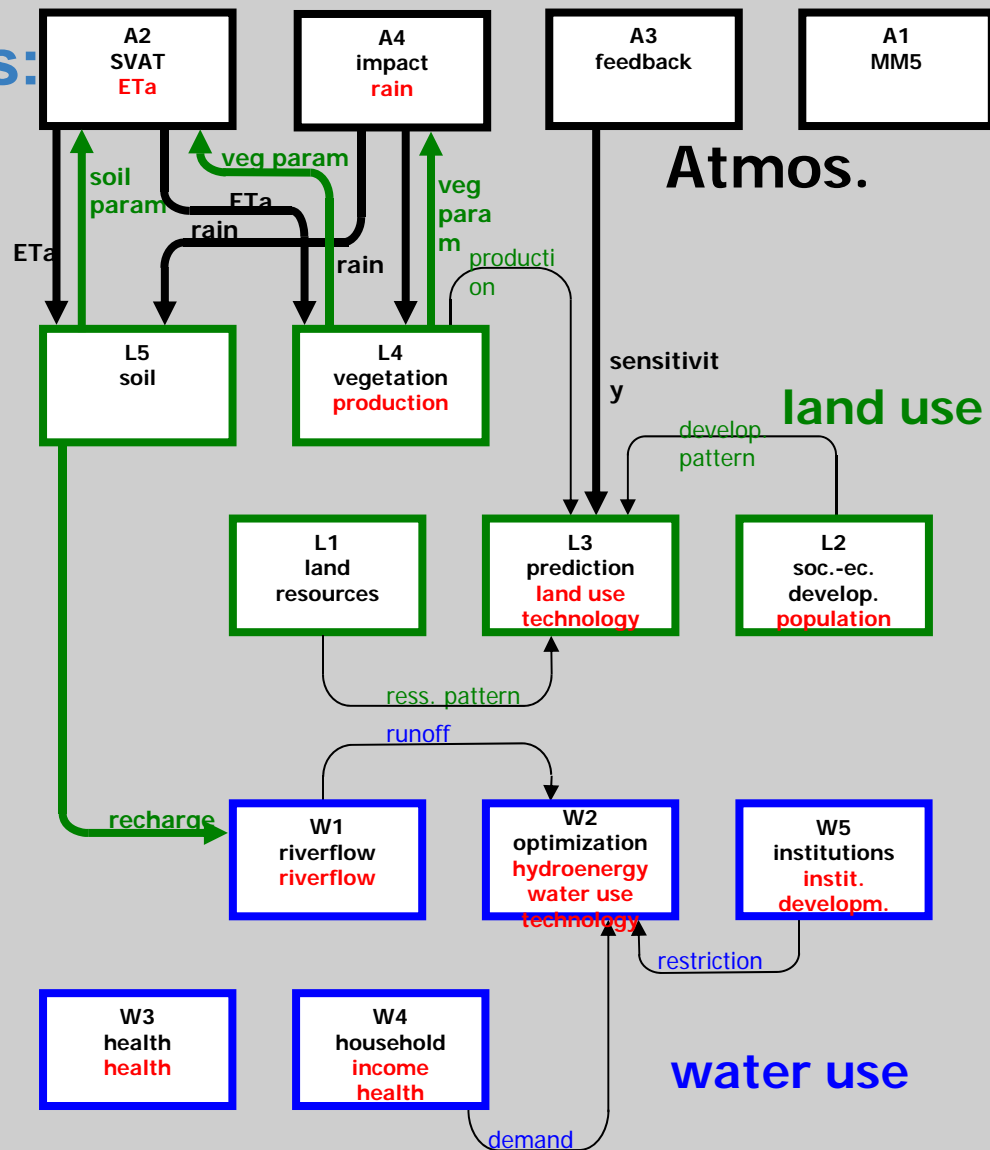




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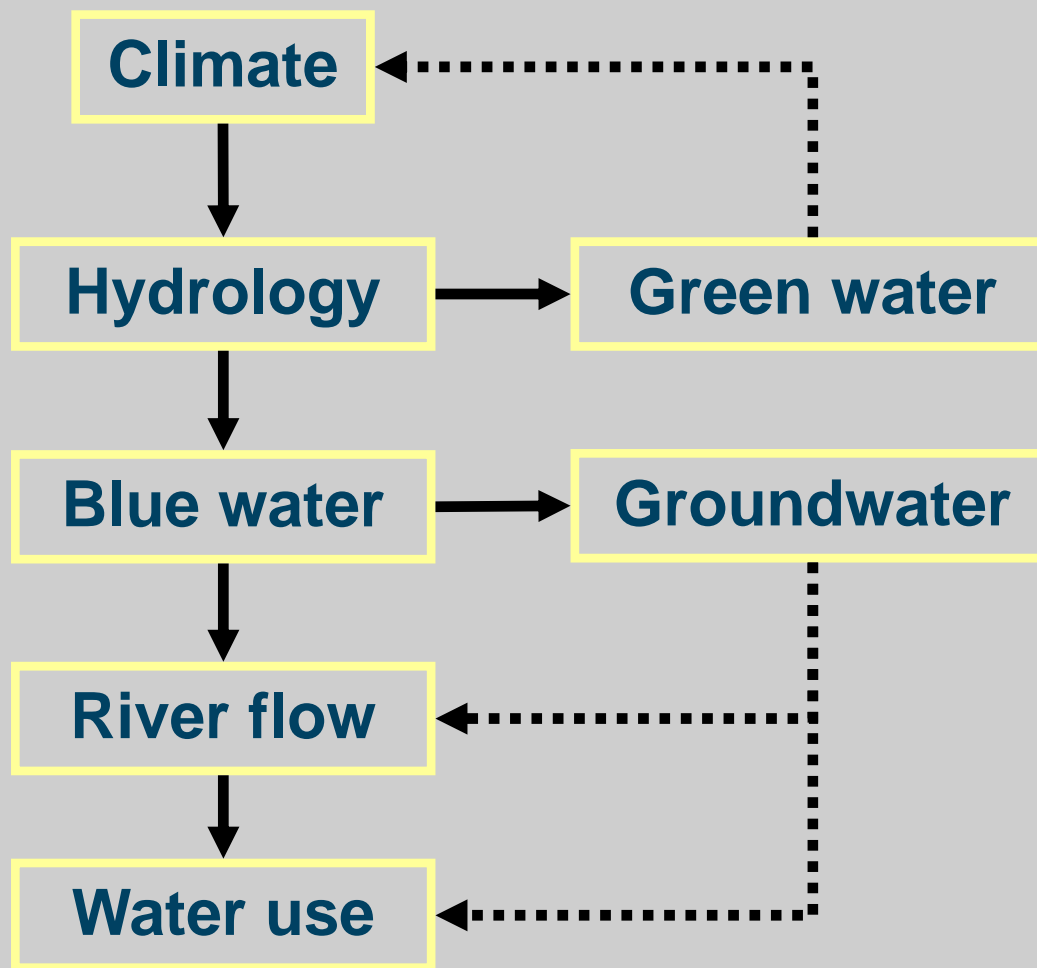
Integration strategies: model structures

GLOWA Volta





Integration strategies: model structures



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Integration strategies



▶ Never forget why you are modeling!



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General concepts in IWRM

Literature:

- Global Water Partnership, Background Paper 4 (Blackboard / Reader)
- World Bank Briefing Notes
- Loucks & van Beek
(http://www.deltares.nl/xmlpages/TXP/files?p_file_id=11853)

Water Resources Systems Planning and Management

An Introduction to Methods, Models
and Applications

Daniel P. Loucks and Eelco van Beek
with contributions from

Jery R. Stedinger
Jos P.M. Dijkman
Monique T. Villars



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World Bank