Development of Global Basins Database (GBDB)

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Motivation and Objectives

- Development of Global Basins Database

- Global basins database can be used in a broad range of global studies

- Global basins database gives:
  - Information of hydrological flow
    - For modeling
      - In hydrology, biogeochemistry, ecosystem,...
  - Appropriate spatial unit
    - For hydrological assessment and management
Motivation and Objectives II
- Early studies-

- HYDRO1k: Global hydrological datasets
  - feature
    - comprehensive hydrological datasets
      - basin boundary, stream line, flow direction,…
    - first dataset which are derived from a global 1km-DEM
  - defect
    - low reliability because of no validation with existing data
    - includes only topographical information

The goal is development of **Global Basins Database**
which is

1. validated and reliable
2. not only topographical information but also hydrological, climatic, social,…
Methodology I - Outline -

1. DEM
2. Basin Delineation
3. Basin Boundary Data
4. Adding attributes

Basin Boundary Data

GBDB

DEM

Basin Boundary
Methodology II - Basin Delineation –

- Raw DEM has many errors to derive incorrect basin boundaries.
- We used DEM enhanced by Stream Burning method
  - Stream Burning: decreasing the value of DEM along river data

The generated basin is consistent with river data which is used in stream burning method!!

- River data which are the most reliable for each region are used in Stream Burning method

<table>
<thead>
<tr>
<th>River Data</th>
<th>Region</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>KS-272</td>
<td>Japan</td>
<td>Ministry of Land Infrastructure and Transport(1978)</td>
</tr>
<tr>
<td>River-Korea</td>
<td>Korea Peninsula</td>
<td>Korea Environment Institute</td>
</tr>
<tr>
<td>Canadskel_I</td>
<td>Canada</td>
<td>National Resources Canada(2003)</td>
</tr>
<tr>
<td>VMAP0</td>
<td>the other regions</td>
<td>Defence Mapping Agency(1993)</td>
</tr>
</tbody>
</table>
Methodology Ⅲ- Basin Delineation -

- In stream burning procedure, some errors are often created.
  - River data error
  - DEM resolution
  - …
- In order to find those errors, we had two comparison with
  - collected basin maps
  - upstream area of river discharge gauging stations
- The generated basin map is compared with collected basin maps
- Calculated upstream area were compared with reported ones at the discharge gauging station provided by Global Runoff Data Center (GRDC)
- If an error was found, DEM would be modified and Basin data would be regenerated from the modified DEM.
- The procedure of comparing and regenerating basin data is iterated until there is no error.
Each polygon has geographic, topographic, and social information. The attributes of each polygon can be browsed by clicking a polygon on GIS.

- Ids and Nextdown Basin ID
- Geographic
- Topographic
- Country
- Population/Population Density
- Land Use/Cover
GBDB - general information and status of development -

- **general information**
  - **Format**: ArcGIS Geodatabase Format
    - = ArcGIS + Microsoft Access
      - We can use query, VBA, and so on…
  - **Regions**: 6 regions
    - Africa, Asia-Pacific, Europe+ Central East, North and Central America, Oceania, South America

- **Status of development**
  - For Asia and Pacific region, basins database has been completed
  - For the other regions, basin delineation has been finished once and now we are checking the generated basin data
Validation I - upstream area of discharge gauging station of GRDC -

- Comparison the calculated upstream area in the basin data of GBDB with the reported ones by GRDC

- selected 1231 gauging stations from 1383 ones in Asia
  - The omitted stations have clearly wrong value of upstream area or location.

```
y = 1.0082x + 666.65
R^2 = 0.9944
```

![Graph showing comparison]

```
y = 1.0176x + 1535.5
R^2 = 0.9606
```

![Graph showing comparison]
Validation II - 1
- collected basin maps -

- Geographical comparison basins data of GBDB with collected digital and paper basin maps

- 176 basins in Asia

- Average Match Area Rate (AMAR) is introduced in order to evaluate geographical agreement

\[
AMAR = \frac{MA}{CA} + \frac{MA}{RA} \times 0.5
\]

The nearer to 1 AMAR is, the better geographical agreement

- \(MA/CA\) is the ratio of geographical agreement area to area of a basin of GBDB
- \(MA/RA\) is the ratio of geographical agreement area to area of a basin of a collected map
Almost all of the basins of GBDB are in good geographical agreement with those of collected maps.

The values of AMAR of GBDB are higher than those of collected maps for almost all of the basins.
We have developed Global Basins Database (GBDB) in Asia-Pacific region.
The results of validation reveal that the database is reliable.
The database has many attributes which are useful in modeling, assessment, and management.
Now we are still developing for the other region.
The output will be distributed in the web of the Center of Global Environmental Research (CGER) soon.
I am preparing for using the GBDB in hydrological modeling.
If you have basin map of your country, Please give me it!
Thank you!
Methodology

1. Stream Burning Ridge Fencing
2. Terrain Preprocessing in Arc Hydro Tools
3. Comparison of Burned/Fenced-DEM
4. Modification of Burned/Fenced-DEM

Modified-DEM

Finished!!
**Step1: Stream Burning/ Ridge Fencing**

**Stream Burning:**

**Ridge Fencing:** DEM (Digital Elevation Model)

<table>
<thead>
<tr>
<th>Region</th>
<th>DEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>250m-DEM</td>
</tr>
<tr>
<td>Korean Peninsula</td>
<td>3sec-DEM</td>
</tr>
<tr>
<td>Other regions</td>
<td>1km-DEM</td>
</tr>
</tbody>
</table>
Each polygon has geographic, topographic, social information
- The attributes of each polygon can be browsed by clicking a polygon on GIS
What is GBDB?-basic-

- GBDB consists of polygons which are elementary drainage areas
- Each polygon has geographic, topographic, and social information