A WMT service component for HydroTrend: simulating sediment transport in large river deltas

Stephanie Higgins & Irina Overeem, CU Boulder Belmont Forum DELTAS Webinar · 4/29/2015
WMT: Web Modeling Tool

The CSDMS Web Modeling Tool

Model (*HydroTrend 0)

Parameters (HydroTrend)

- Simulation run time (d): 365
- Basin hypsometry file: welapa.hyps
- Mean annual temperature at the start of the simulation (deg C): 14.26
- Rate of change of mean annual temperature (deg C / yr): 0.0
- Standard deviation of mean annual temperature (deg C): 0.0
- Mean temperature for January (deg C): 19.14
- Mean temperature for February (deg C): 18.86
- Mean temperature for March (deg C): 17.48
- Mean temperature for April (deg C): 14.76
- Mean temperature for May (deg C): 12.00
- Mean temperature for June (deg C): 9.99
About HydroTrend v.3.0

- Water balance and sediment transport model
- Inputs: climate data (meteorological station data or global circulation model output), and basin characteristics (altitudinal temperature gradients, topography, glacier equilibrium line altitudes, sediment transport and erosion coefficients)
- Outputs: Synthetic river discharge and sediment load (multiple grain size): 10–100,000 years [Kettner & Syvitski, *Computers and Geosciences* 2008]
Xing et al., *STOTEN* 2014
Ebro River Watershed, Spain

Ebro watershed hypsometry (Xing et al., 2014)

Xing et al., STOTEN 2014
Xing et al., *STOTEN* 2014

Ebro River Watershed, Spain

HydroTrend Output

Ebro watershed hypsometry (Xing et al., 2014)
Objective: open source and automatic hypsometry files

- Previously, RiverTools® was used to generate hypsometry input files.
- Now, we are wrapping Terrain Analysis Using Digital Elevation Models (TAUDEM) – Developed by David Tarboton at Utah State University (http://hydrology.usu.edu/taudem/taudem5/index.html)
- Free and open-source
- WMT users will be able to generate HydroTrend hypsometry input for any specified point
- Match discharge stations of interest
- Allow multiple sub-basins: important for large deltas
Manual TauDEM to HydroTrend Workflow

- Source a hydrologically correct digital elevation model
- Set-up working environment
- Create a shapefile with a point of interest (GIS)
- Run a number of TauDEM tools:
  - Fill pits in DEM
  - Calculate flow directions
  - Calculate contributing area
  - Determine stream network
  - Determine contributing cells to point of interest
- Extract watershed DEM
- Reproject to equal-area projection (GIS)
- Create a HydroTrend input (.hyps) file from data
New Python wrappers allow user to specify any number of points: TauDEM and GEOS do the rest.
Running HydroTrend in WMT

Goal: allow user to specify latitudes and longitudes in WMT, have hypsometry curve automatically generated
Sub-basins can improve results

Higgins et al., *CSDMS Annual Meeting 2015*

Sub-basins: Pervez & Henebry, *J. Hydrology* 2014
Example application: Indian River Inter-links

PROPOSED INTER BASIN WATER TRANSFER LINKS

HIMALAYAN COMPONENT
1. Manas-Sankosh-Tista-Ganga
2. Kosi - Ghagra
3. Gandik - Gandar
4. Ghagra - Yamuna**
5. Sarda - Yamuna**
6. Yamuna - Rajasthan
7. Rajasthan - Subarnati
8. Chunar - Son Barrage
9. Sone Dam-Southem Tributaries of Ganga
10. Ganga - Damodar - Subarnarekha
11. Subarnarekha - Mahanadi
12. Kosi - Mechi
13. Farakka - Sunderbans
14. Jogighopa-Tista-Farakka (Alternative to 1)

PENINSULAR COMPONENT
15. Mahanadi (Manishahar) - Godavari (Dowlaleswaram)*
16. Godavari (Inchampalli) - Krishna (Pulichintala)*
17. Godavari (Inchampalli) - Krishna (Nagarjunasagar)*
18. Godavari (Polavaram) - Krishna (Vijayawada)*
19. Krishna (Almatti) - Pennar*
20. Krishna (Srisailam) - Pennar*
21. Krishna (Nagarjunasagar) - Pennar (Gomasila)*
22. Pennar (Somasila) - Causer (Grand Anicut)*
23. Cauvery (Kattalai) - Vaigai - Gundar*
24. Ken - Betwa*
25. Parbati - Kalisindh - Chambal*
26. Par - Tapj - Narmada*
27. Damanganga - Pinjol*
28. Bodh - Varda
29. Netravati - Hernavati
30. Panbaj - Achankovil - Vaippar*

* FR Completed  **FR Completed for Indian portion
Example application: Indian River Inter-links