Evaluation of Snow Water Equivalent and Runoff from land surface models using river discharge data and satellite observations for the pan-arctic region

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EU FP7 project: **MONitoring and Assessing Regional Climate change at High latitudes and in the Arctic.**

Goals: Better understanding of the processes affecting terrestrial carbon and water fluxes at high latitudes by:

i) Synthesizing available data sets

ii) Generating time series

iii) Interfacing ECVs with models

Objectives of this talk:

1. To examine the water balance of high-latitude basins and compare model estimates with data.
2. To investigate sources of uncertainty in model estimates.

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<th>Essential Climate Variables Considered</th>
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Modeled & Observational Data Sets

**Precipitation**
- CRU station-based data (LPJ-WM, SDGVM)
- ERA-Interim data from ECMWF (ORCHIDEE)
- WATCH (JULES)
- GPCC

**Runoff**
- Global Runoff Data Centre

**Snow Water Equivalent**
- LEGOS
- GlobSnow

Annually: Precipitation – EVT – Runoff – Δstorage ≈ 0
Water Balance of the Ob

Precipitation

Evapotranspiration

Runoff

Snow Water Equivalent
February Average SWE (mm) 1997-2006

- SWE underestimated by LEGOS
- Good agreement between GlobSnow & Models
Good agreement on timings of snow fall & snow melt.

Model values lie between GlobSnow and LEGOS except for LPJ, which has higher SWE due to lack of sublimation processes.
February values of SWE per year (mm): Models vs LEGOS
February values of SWE per year (mm): Models vs GlobSnow
1) ORCHIDEE: higher Precipitation (ECMWF ERA Interim) leads to Runoff that is overestimated compared to data.

2) JULES: higher EVT leads to lower Runoff that agrees well with data; LPJ also does very well
Annual Runoff (mm): Models vs GRDC
Ob runoff

Runoff Monthly (mm)

- JULES
- LPJ
- ORCHI
- SDGVM
- GRDBC

Years: 1997 to 2002
SDGVM* utilises a simple water transport model where runoff is transported directly to the river mouth at 0.2 m s\(^{-1}\) (17 km day\(^{-1}\)).
Conclusions

Snow water equivalent:
1) Very good match between model and data estimates of start and end of snow season.
2) LEGOS SWE is significantly lower than estimates by GlobSnow and models.
3) Correlation between time series of SWE from models and Globsnow is quite good, but poor between models and LEGOS data.

Runoff:
1) JULES and LPJ-WM give good agreement between observed and predicted runoff, implying that they get the right balance between precipitation and estimated EVT.
2) A major uncertainty in runoff calculations is precipitation; this appears to be why ORCHIDEE gives values of runoff that are too large.
3) Delay time to the river mouth must be included to match the observed timing of peak flow; a simple flow model gives good results.