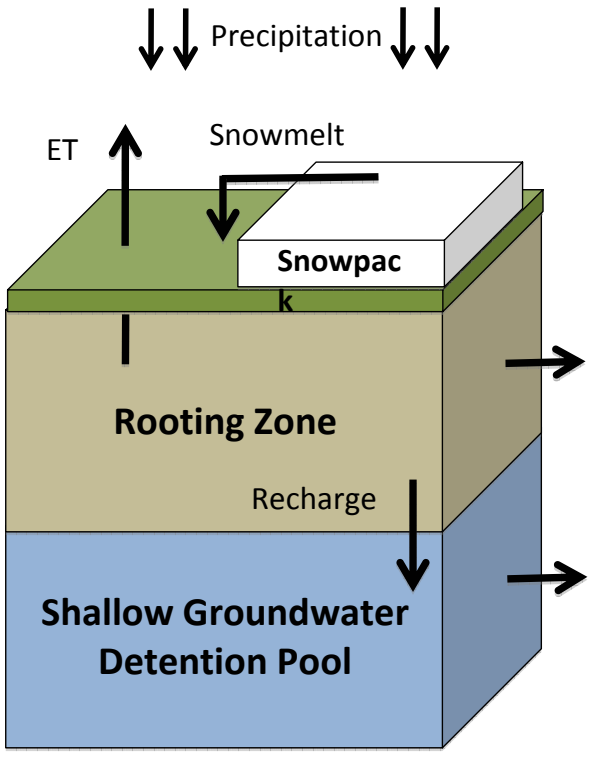
Overview of Water Balance Model (WBM)

1. Driven by global input data for precipitation (CRU), temperature (NCEP), soil and vegetation characteristics (FAO)
2. Spatially distributed, grid-based (30 min x 30 min), daily time-step
3. Drainage network based on STN-30 (Vörösmarty et al. 2000)
4. Runoff is simulated using a bucket model (6 global parameters)
1. River widths and depths are simulated using simulated discharges

1.) Linking WBM and Thermal Loading

WBM Grid Cell



Thermal Loading

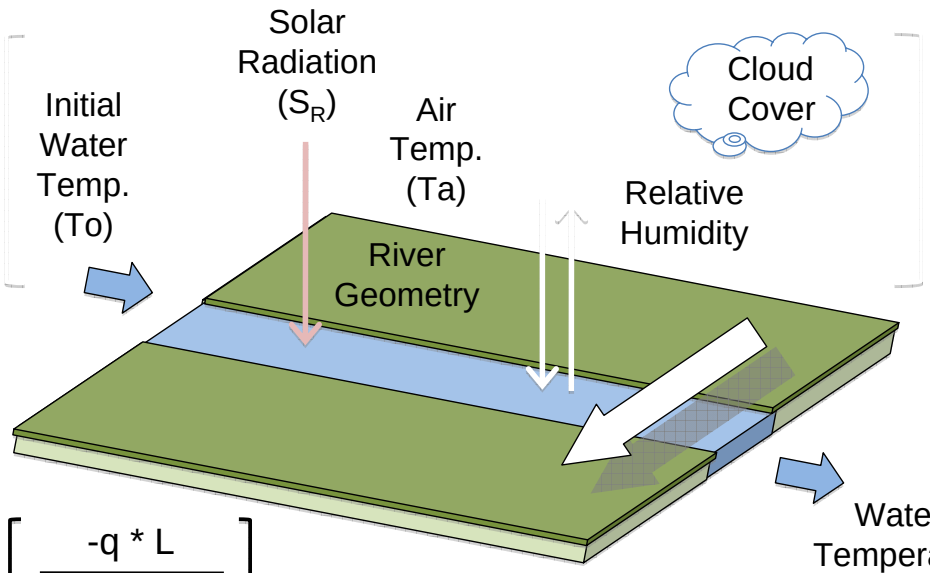
Precipitation = Mean Daily Air Temperature

Snowmelt = 0 °C

Ro_{surf} = Volume weighted mixture of **precipitation** and **snowmelt** temperatures

Ro_{gw} = Volume weighted mixture of **recharge** temperatures over time

2.) In-Stream Temperature Equilibrium Model
(Dingman, 1972)

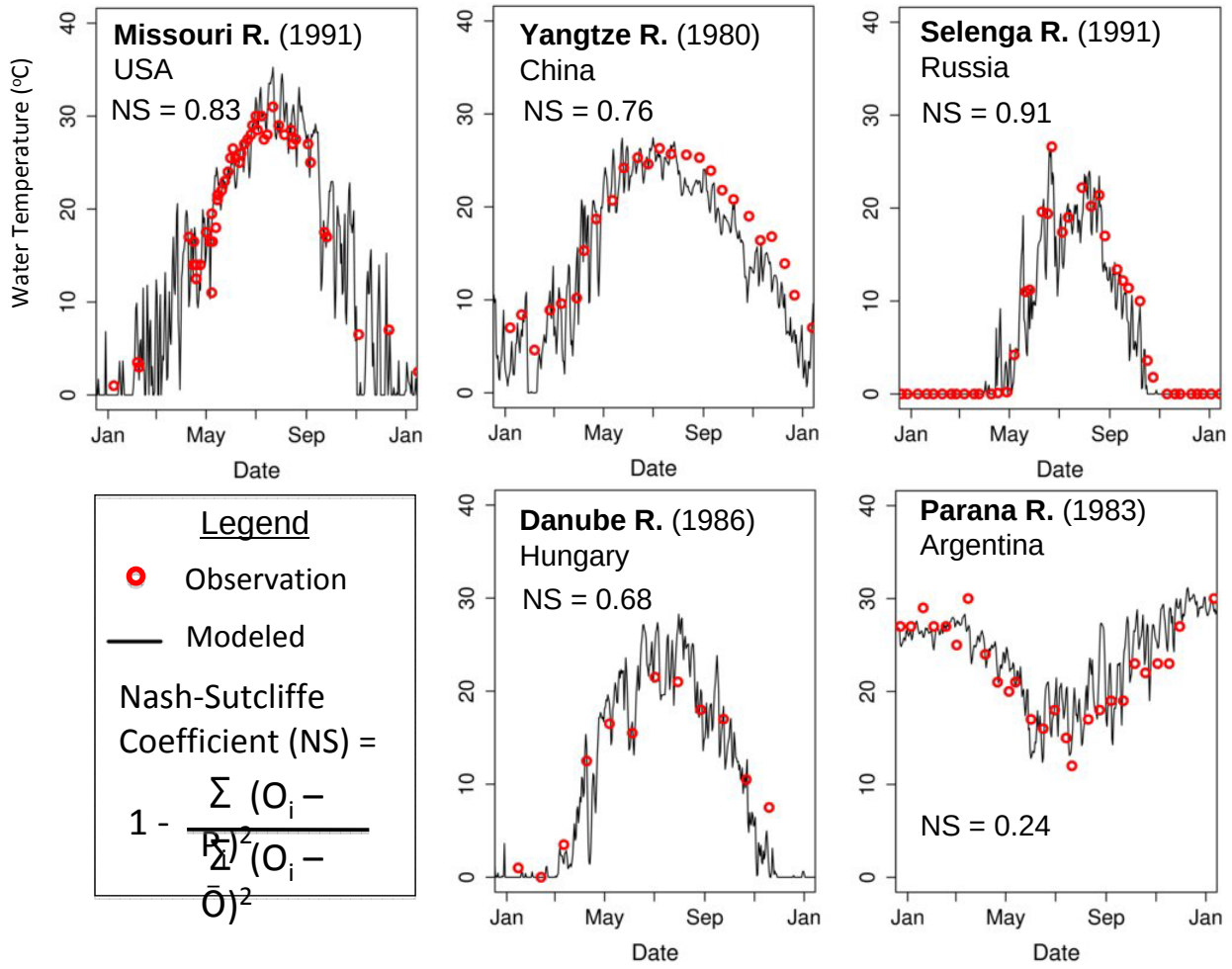


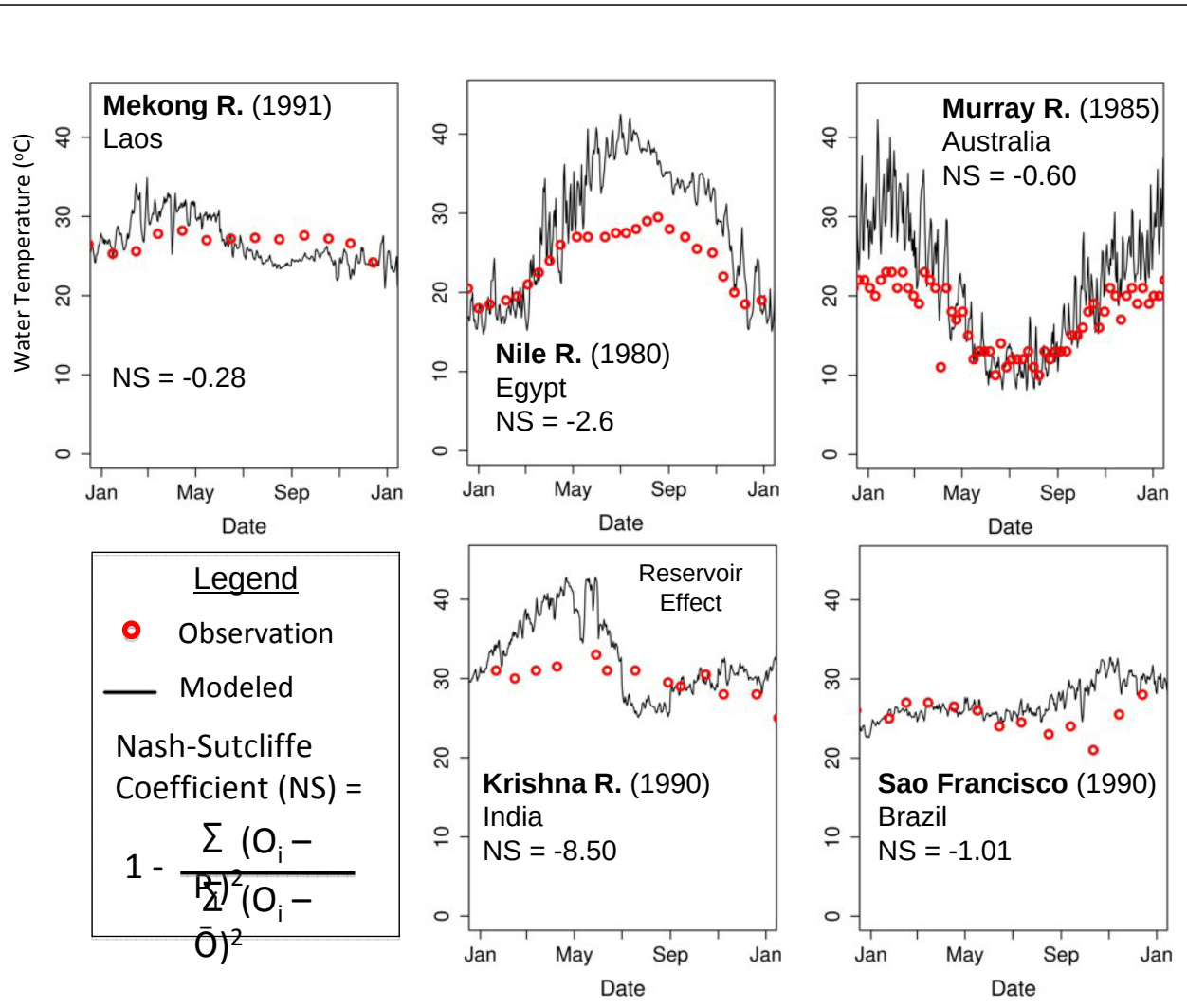
$$Tw = (To - Te) \exp\left[\frac{-q * L}{\rho * Cp * d * v}\right]$$

$$Te = Ta + [\,(S_R - Q_O) / q\,]$$

Global Scale Model Results

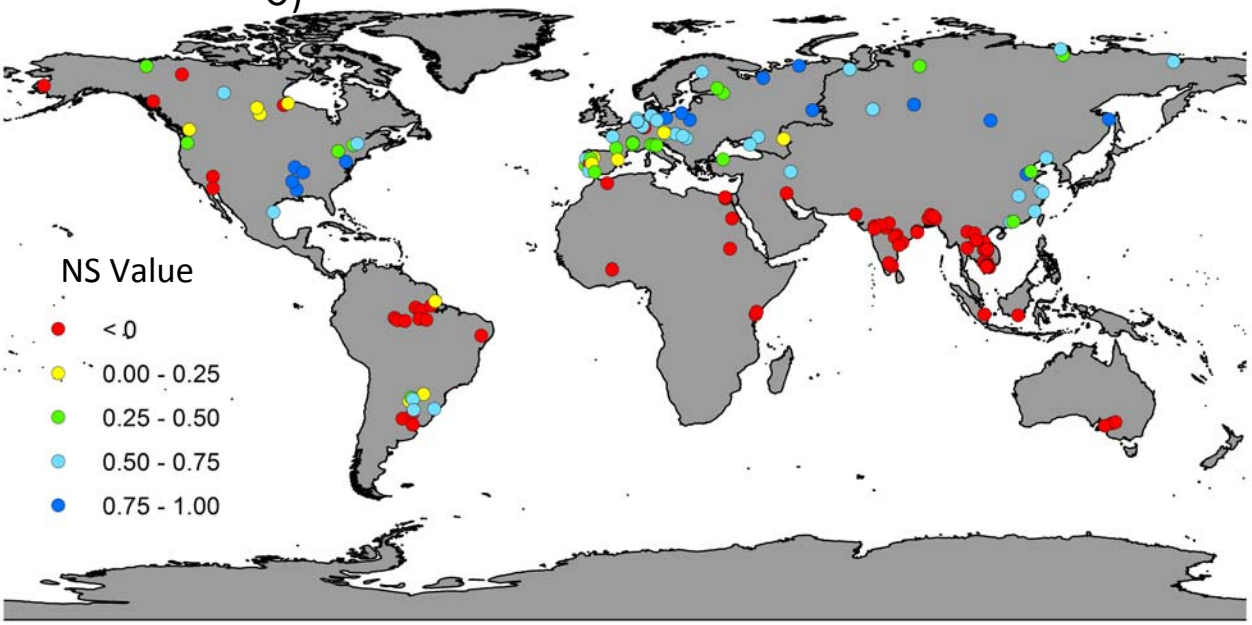
Daily comparisons at Global Environment Monitoring System (GEMS) gauging stations (n = 172)
[1970 – 2001]


Water Temperature (°C)
Missouri R. (1991)
USA
NS = 0.83
Yangtze R. (1980)
China
NS = 0.76
Selenga R. (1991)
Russia
NS = 0.91
Danube R. (1986)
Hungary
NS = 0.68
Parana R. (1983)
Argentina
NS = 0.24
Jan
May
Sep
Jan
Date
0
10
20
30
40
Legend
Observation
Modeled
Nash-Sutcliffe Coefficient (NS) =
1 - Σ (Oi – P)2 / Σ (Oi – Ō)2

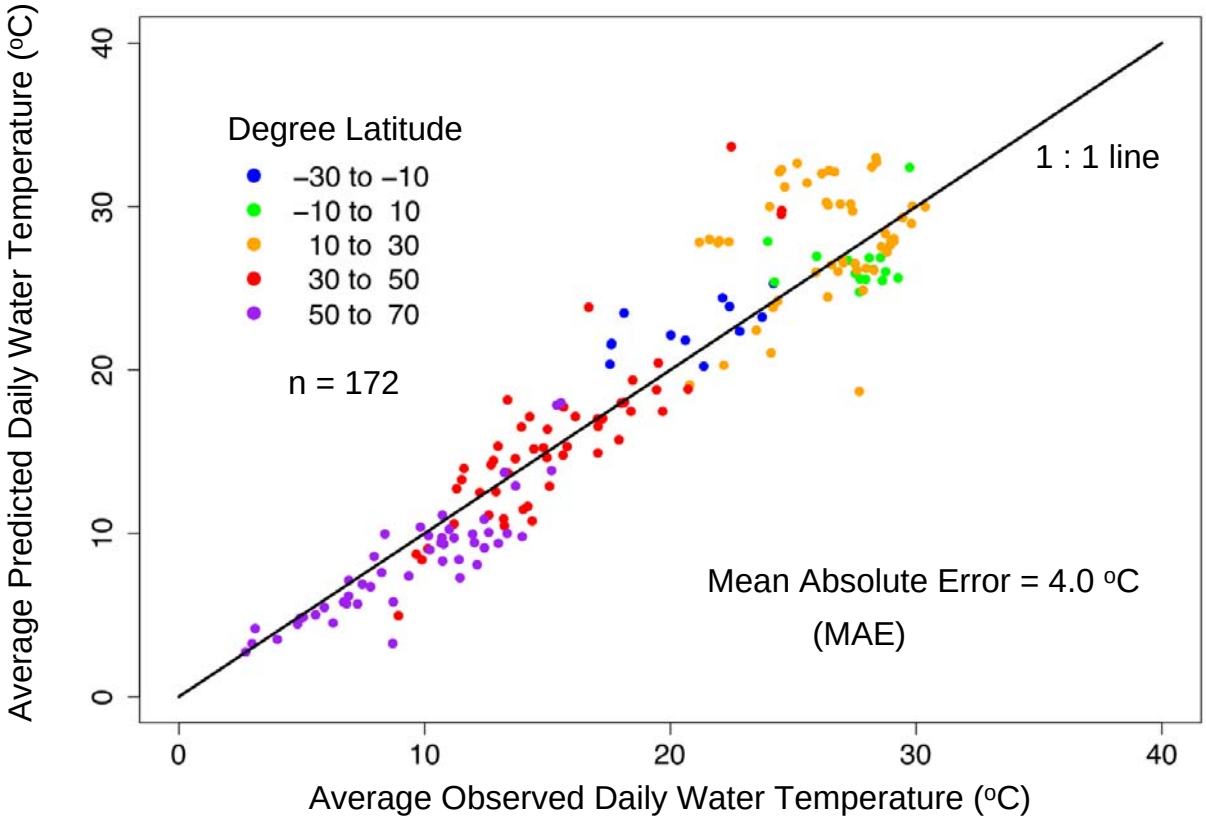

Water Temperature (°C)
Mekong R. (1991)
Laos
NS = -0.28
Nile R. (1980)
Egypt
NS = -2.6
Murray R. (1985)
Australia
NS = -0.60
Krishna R. (1990)
India
NS = -8.50
Reservoir Effect
Sao Francisco (1990)
Brazil
NS = -1.01
Jan
May
Sep
Jan
Date
0
10
20
30
40
Legend
Observation
Modeled
Nash-Sutcliffe Coefficient (NS) =
1 - Σ (Oi – P)2 / Σ (Oi – Ō)2

Nash-Sutcliffe Coefficient (NS)

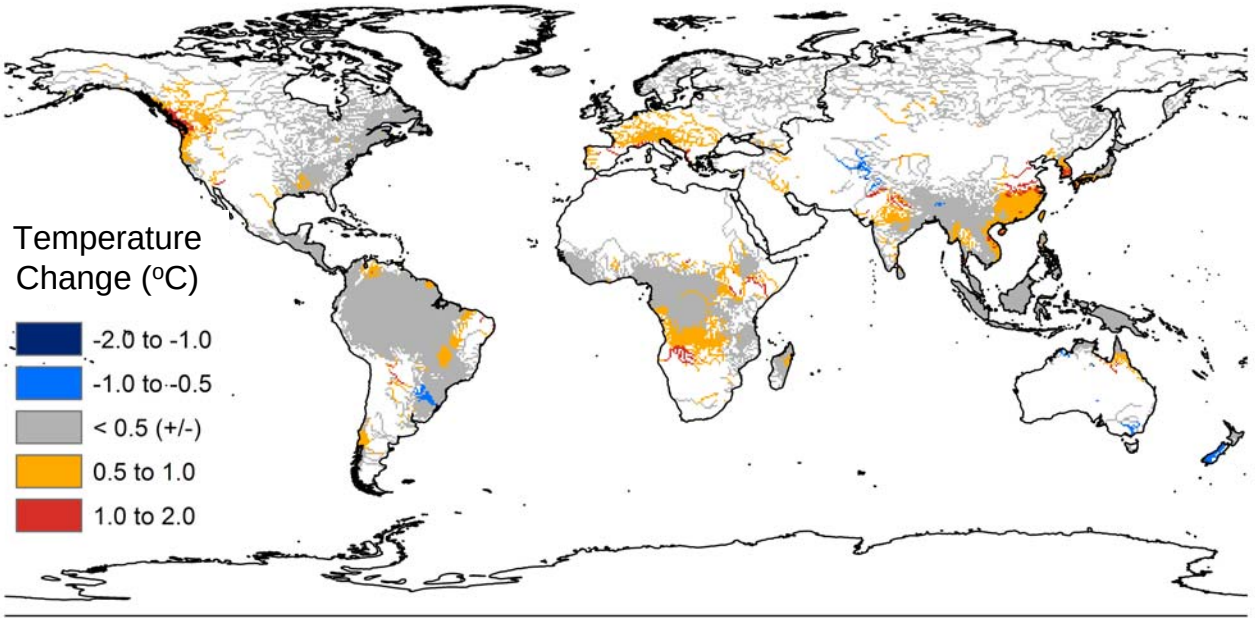
$$NS = 1 - \frac{\sum (O_i - P_i)^2}{\sum (O_i - \bar{O})^2}$$



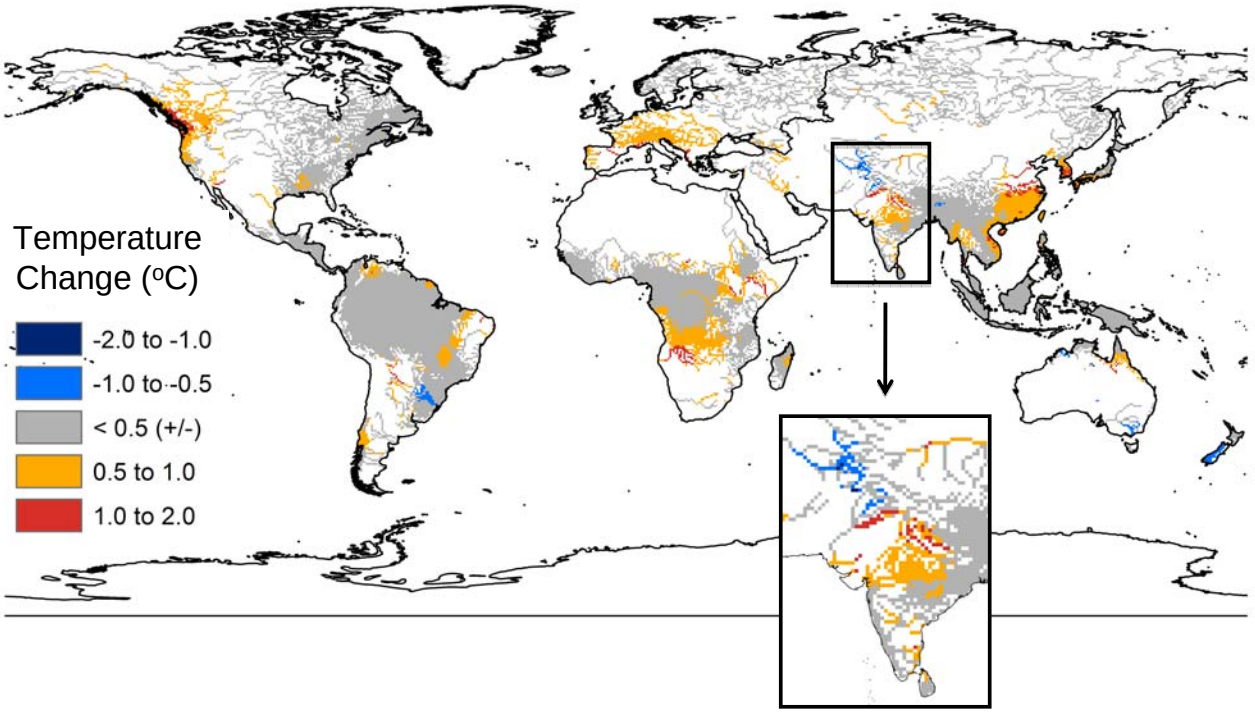
Comparison of Average Daily Observed and Predicted Temperatures



Change in Mean Decadal Water Temperatures in Large Rivers
[1970-1979] to [1990-1999]
($Q > 30\ m^3\ s^{-1}$)

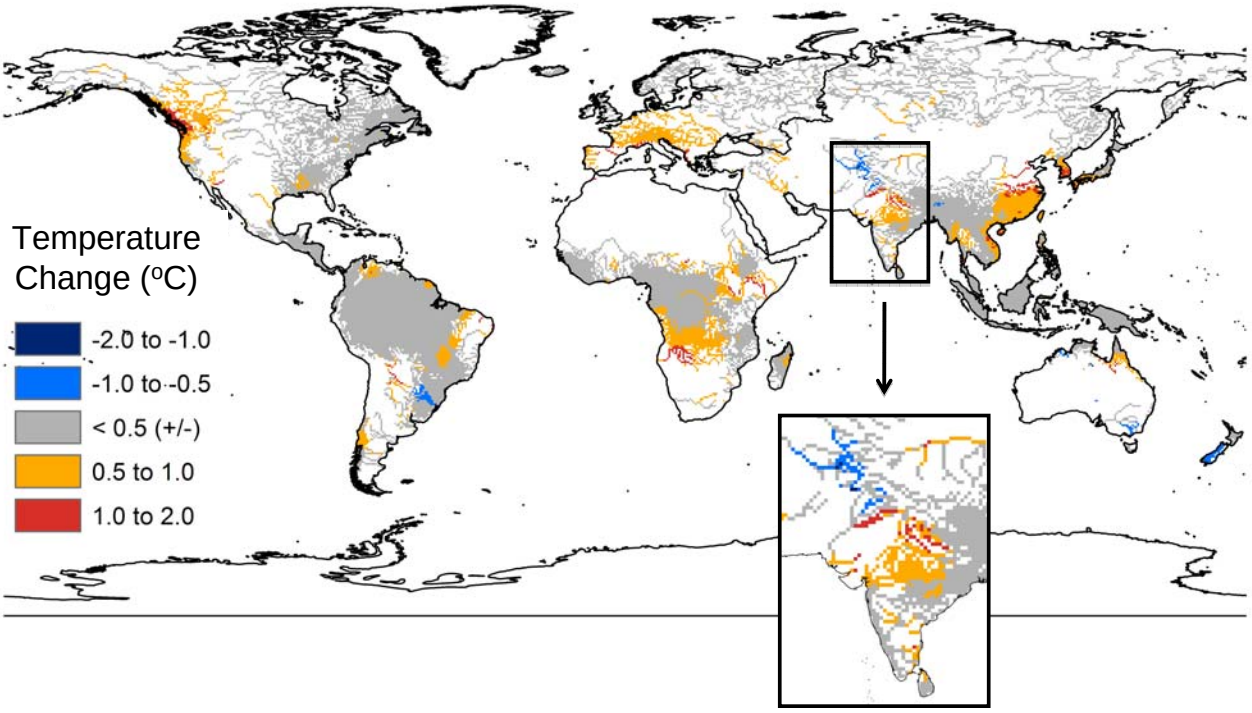


Change in Mean Decadal Water Temperatures in Large Rivers
[1970-1979] to [1990-1999]
($Q > 30\ m^3\ s^{-1}$)

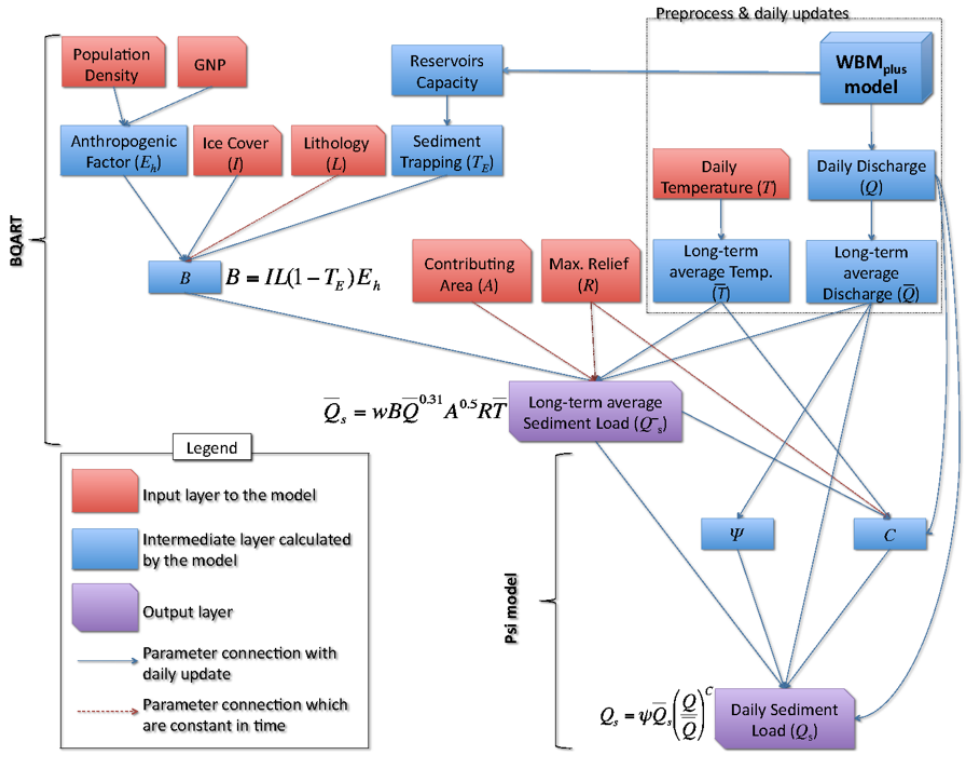


Change in Mean Decadal Water Temperatures in Large Rivers [1970-1979] to [1990-1999]

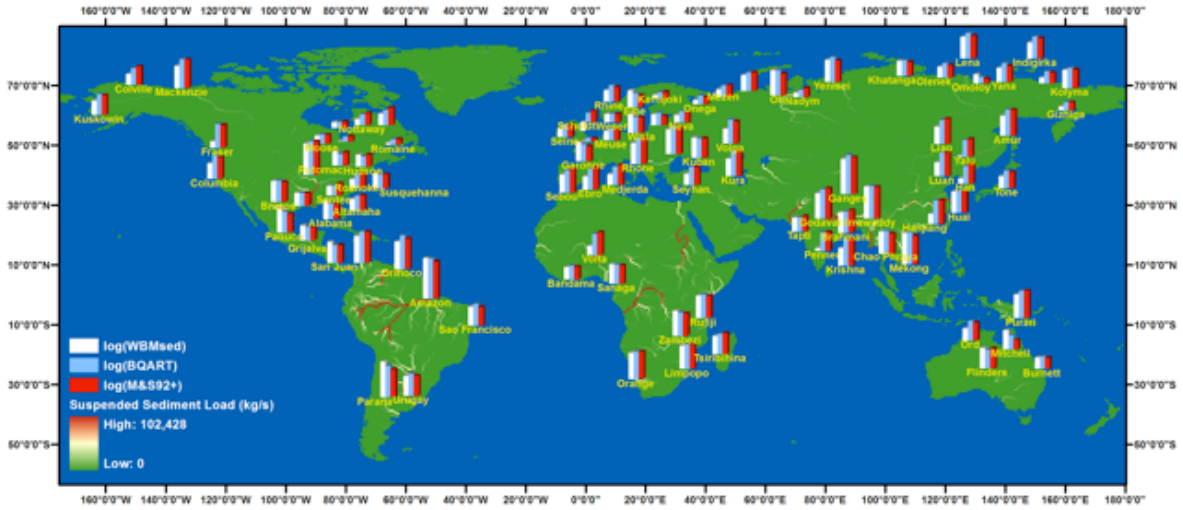
(Q > 30 m^3 s^{-1})



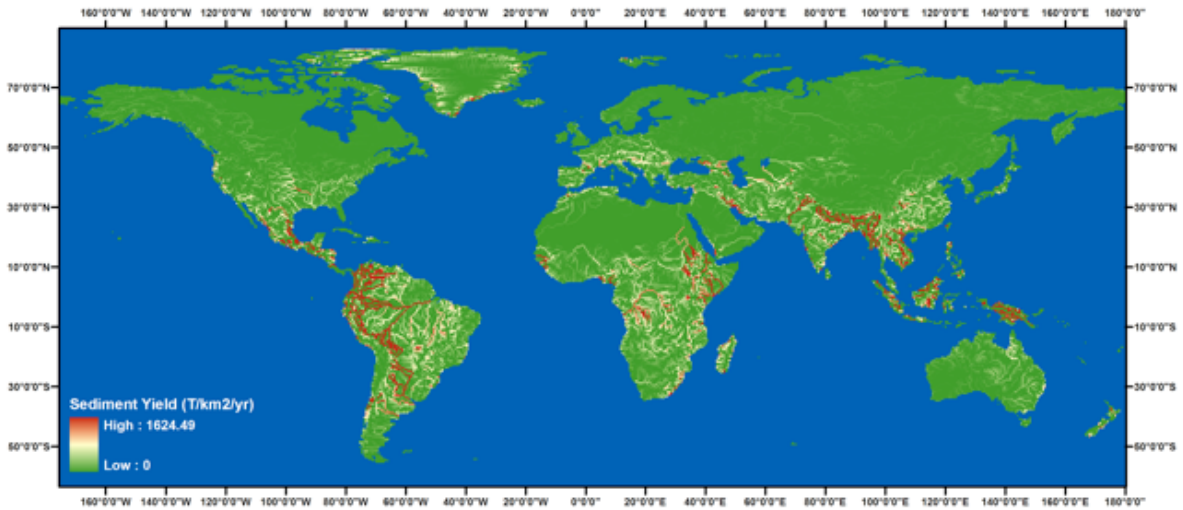
BQART Sediment Transport



Long-term (1948-2007) average suspended sediment load (kg s-1)



Long-term (1948-2007) average suspended sediment yield (T km2 yr-1)



WBMsed-predicted average suspended sediment load in 2007 (0.1° spatial resolution)

Sediment flux time series