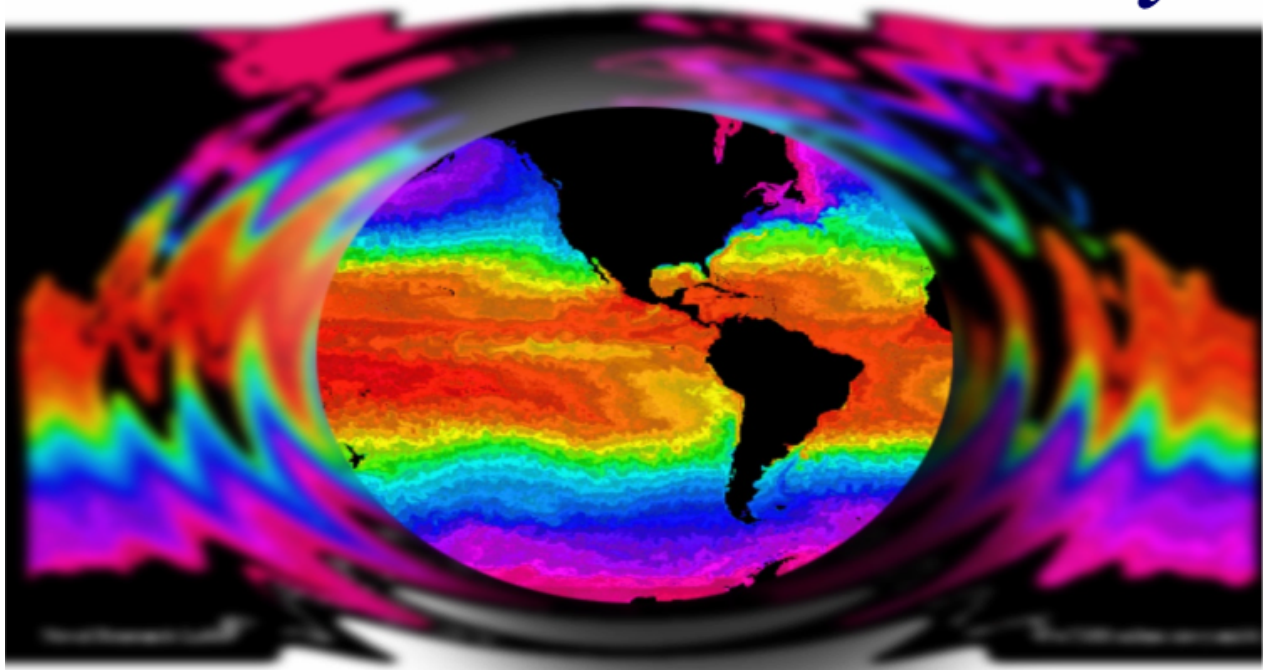
Naval Research Laboratory



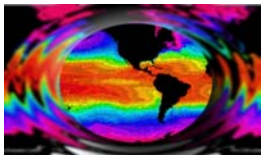
Keeping an eye on the worlds oceans...

http://www.ocean.nrlssc.navy.mil

Global River Inflow within the Navy Coastal Ocean Model

Charlie Barron Lucy Smedstad

NRL 7323 Oceans MTS/IEEE 2002



Global River Inflow within the Navy Coastal Ocean Model (NCOM)

- Objectives
- Data Sources
- Construction
- Evaluation
- Application
- Future Work

Acknowledgements

This work was supported by the Oceanographer of the Navy through 6.4 SPAWAR PMW155 and 6.2 ONR projects.

Thanks to NRL collaborators Paul Martin, for his model development work, and Jan Dastugue, for her web page and graphics work.

Global River Database for NCOM: Objectives

One of the primary purposes for the transition of global NCOM to NAVOCEANO is to provide improved global short-notice capability for initializing and nesting fixed and relocatable coastal ocean models.

the NCOM global database of river discharge rates

- Centralized data source
- Rivers in global model
  - Better nearshore salinity
  - Better initial and boundary conditions

Global River Database for NCOM: Data Sources

- Perry Database (Perry et al., JGR, 1996)
  - Annual means discharge compiled from many sources
  - River mouth location
- USGS Database (Wahl et al., USGS Survey, 1995)
  - Monthly and daily means at various U.S. river stations, many upstream
  - http://waterdata.usgs.gov/nwis
- RIVDIS (Vorosmarty et al., Oak Ridge National Lab., 1998)
  - Monthly means at various global river stations, many upstream
  - http://www.daac.ornl.gov
- Arcticnet Database (Lammers et al., U. New Hampshire, 2000)
  - Monthly means at various Arctic river stations, many upstream
  - http://www.r-arcticnet.sr.unh.edu

Global River Database for NCOM: Construction

- Database Fields (986+ rivers)
  - River Name
  - Annual mean transport rate
  - Monthly mean transport rate
  - Mouth location (some changes from Perry locations)
  - County of mouth location
  - Monthly salinity values
- Annual mean transport rate
  - U.S. rivers calculate annual transport from USGS data nearest river mouth
  - World rivers use transport from larger of Perry or multiannual observations at station nearest river mouth
- Monthly mean transport rate
  - Monthly variations from river stations scaled to average to annual mean
  - For rivers missing monthly data, nearby monthly cycles are scaled to local mean.
- River temperature interpolated at run time from T assimilation field

Global River Database for NCOM: Combined and Distributed FLOW

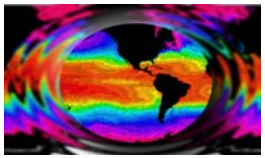
Single outflow from combined sources

River Name (Country)	Source Rivers
Pearl/ZhuJiang/Xi (China)	Bei Jiang, Dong Jiang, and Xi Jiang
Shatt-Al-Arab (Iraq)	Tigris and Euphrates
Kola/Tuloma (Russia)	Kola and Tuloma
Harricana (Canada)	Harricana and Kesagami

Distributed outflow from single source

Rivers with large deltas (relative to model grid size) may be represented by a distributed outflow with multiple entries for different mouth locations:

Orinoco
Ganges/ Brahmaputra



Global River Database for NCOM: Imputed monthly signal

For nations completely missing monthly data, monthly cycles of rivers from nearby nations are scaled to local annual mean.

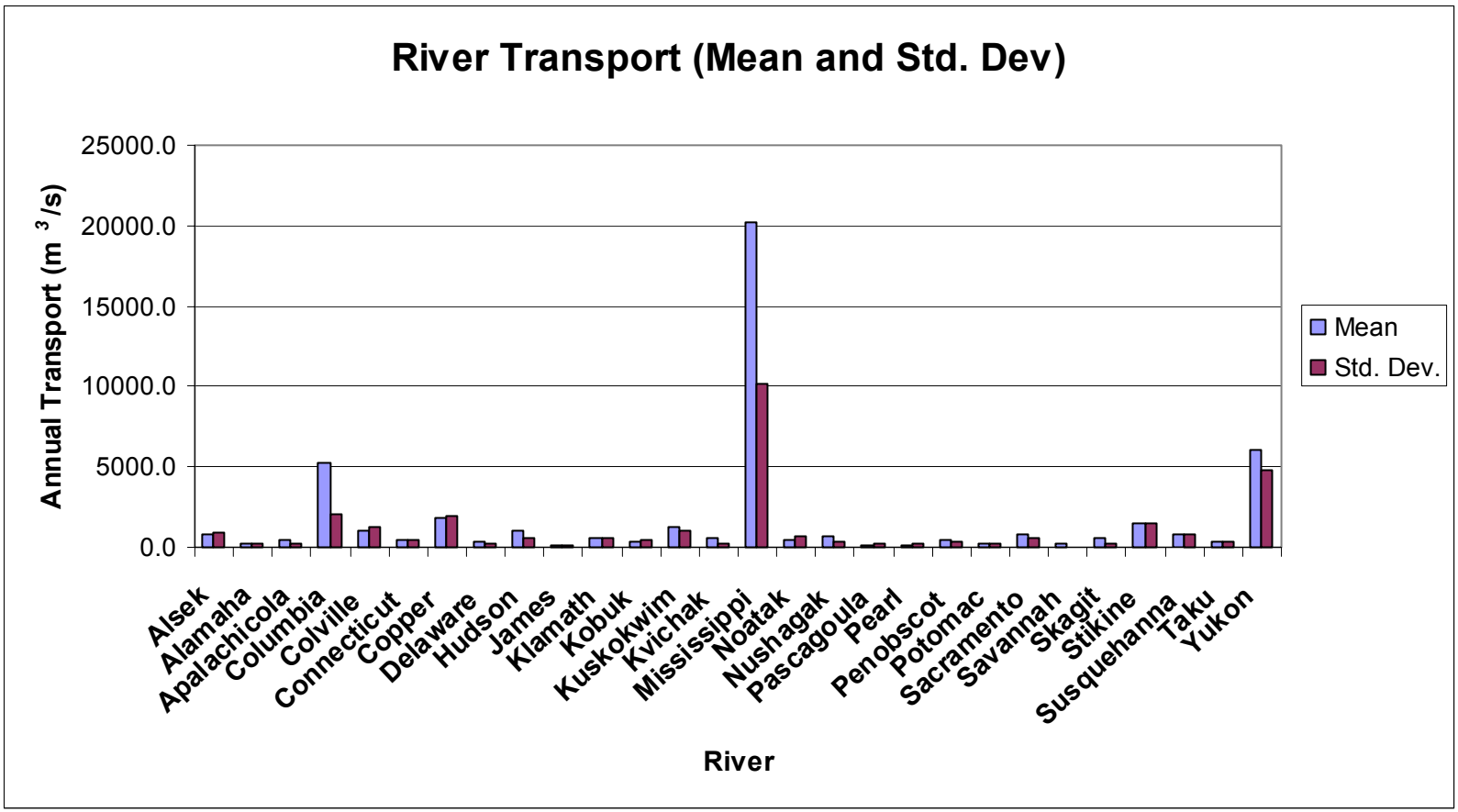
Missing monthly data	Imputed signal source
Myanmar	Thailand and India
Indonesia	New Guinea and Malaysia
Vietnam (some)	Thailand and available Vietnam
Norway	Sweden
Angola	Congo/Zaire
Guadeloupe	Dominican Rep.
Guam	New Guinea
Kenya	Tanzania
Latvia	Lithuania

Missing monthly data	Imputed signal source
Martinique	Dominican Rep.
Mauritius	Madagascar
Reunion	Madagascar
Sao Tome	Gabon
Sardinia	Italy
Singapore	Malaysia
Somalia	Tanzania
Tahiti	New Zealand
Taiwan	China
Togo	Ghana
Trinidad&Tobago	Dominican Rep.

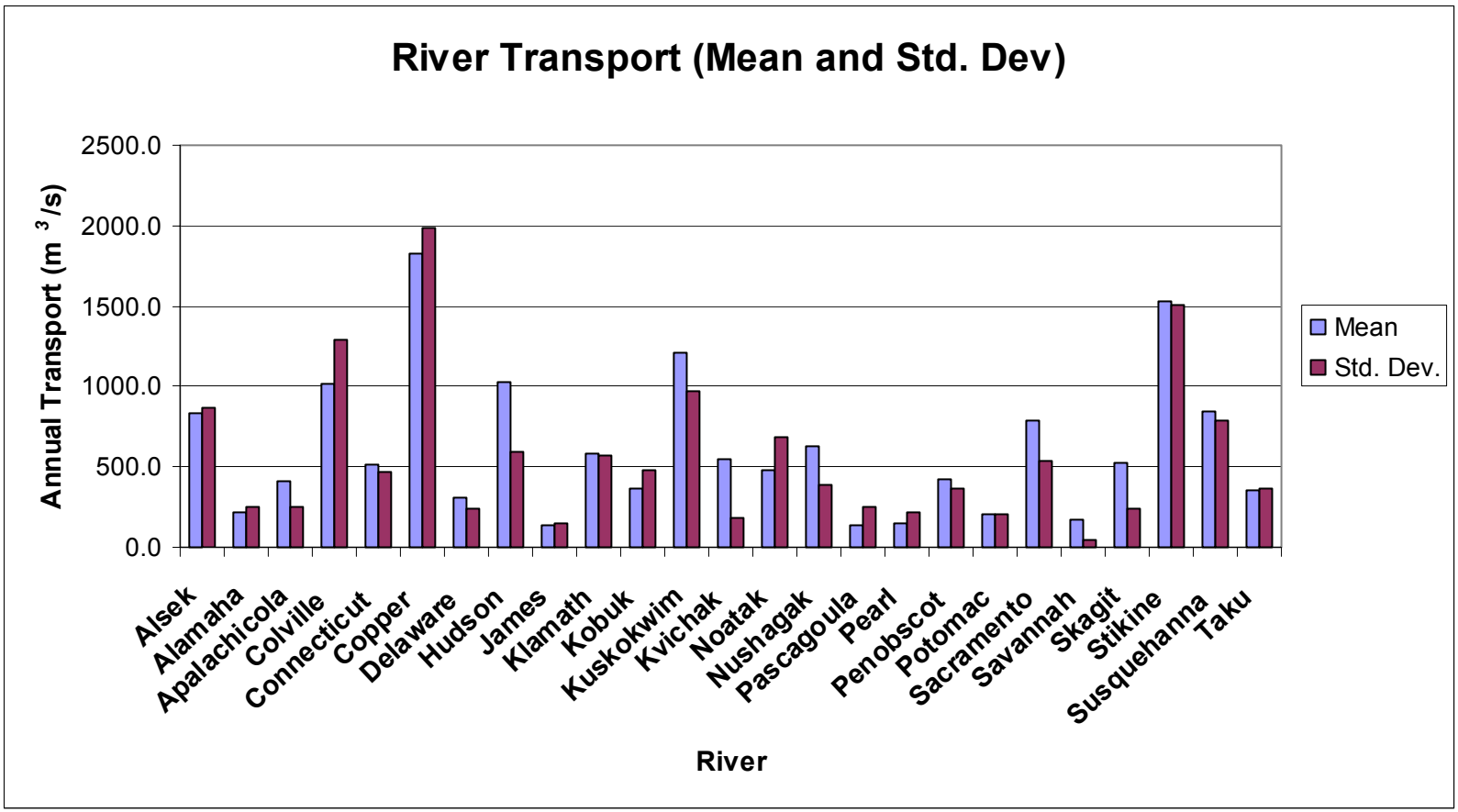
Global River Database for NCOM: Evaluation

- Daily Mean Transport Rate
  - Available for U.S. rivers from USGS database
  - Selected 28 largest U.S. rivers with continuous daily values for two years
  - Generally unavailable operationally for non-U.S. rivers
- Evaluation of Predictions
  - Annual means or linear interpolation of monthly means
  - Calculate errors and root mean squared (RMS) error

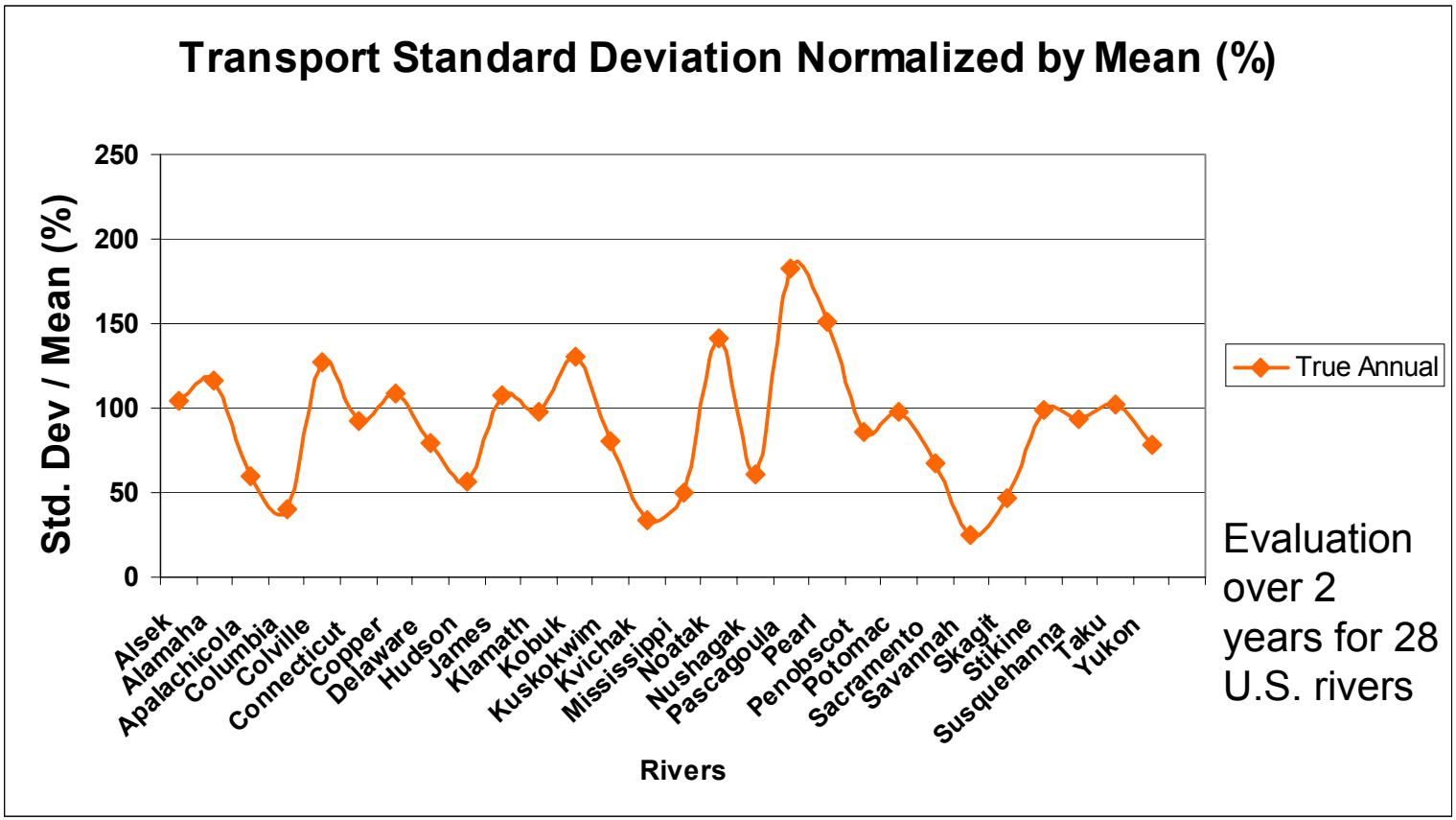
Global River Database for NCOM: U.S. River Means and Std. Dev.



Global River Database for NCOM: U.S. River Means and Std. Dev.

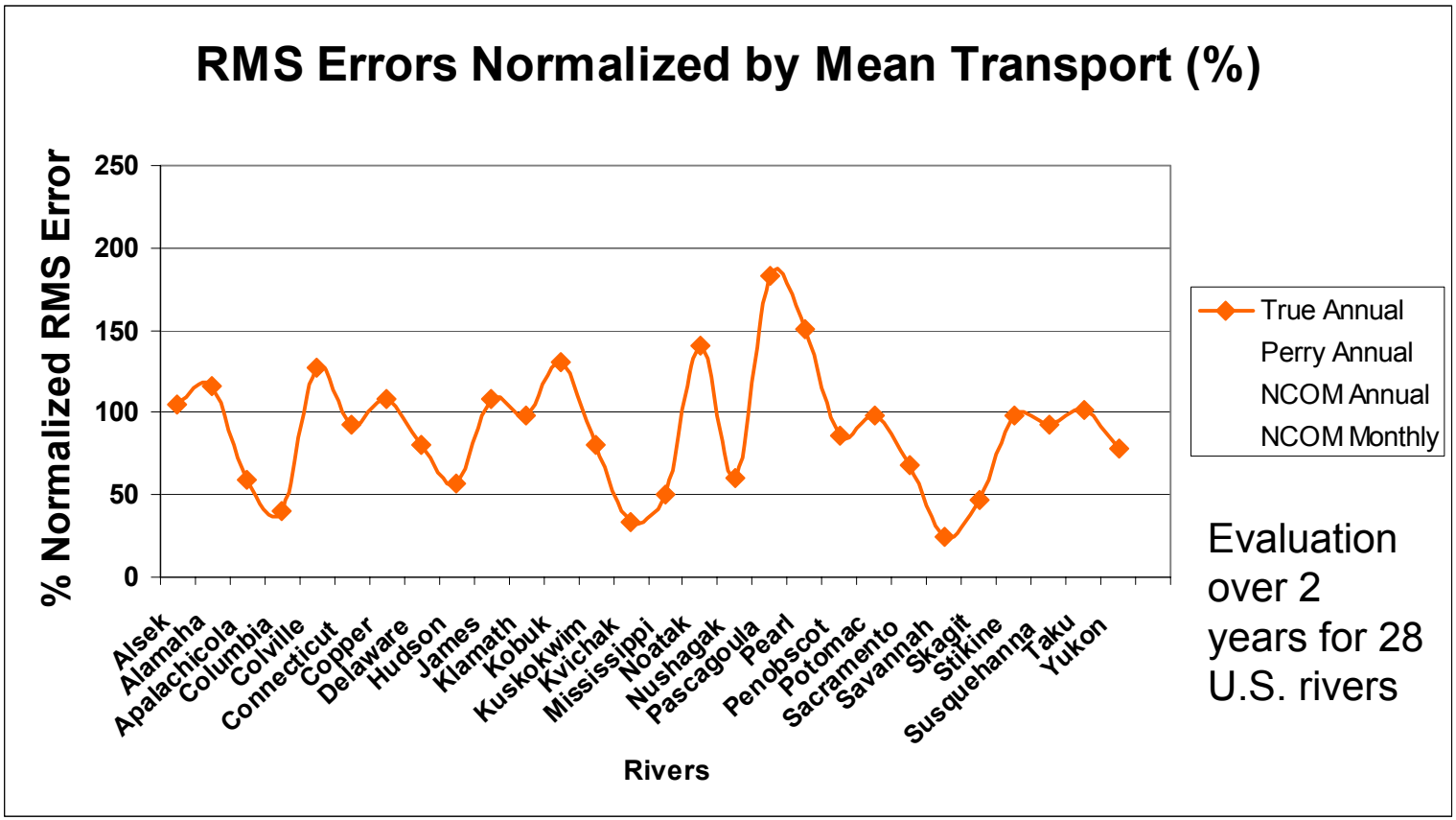


Measured River Transport: Std. Dev. of Daily Transport, Normalized by 2-year Mean



Evaluation over 2 years for 28 U.S. rivers

Using Annual or Monthly Means to Estimate Daily River Discharge Rate



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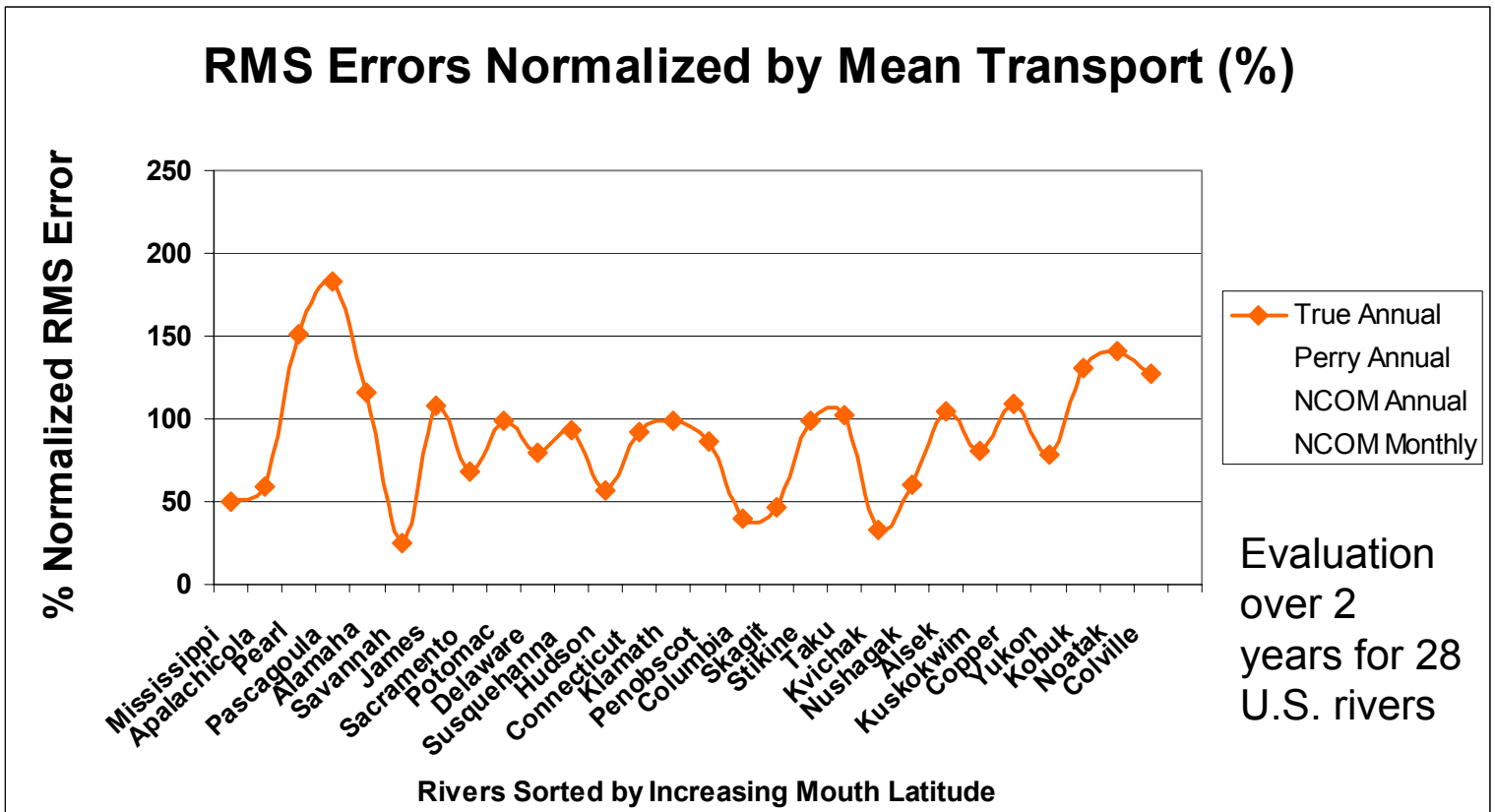

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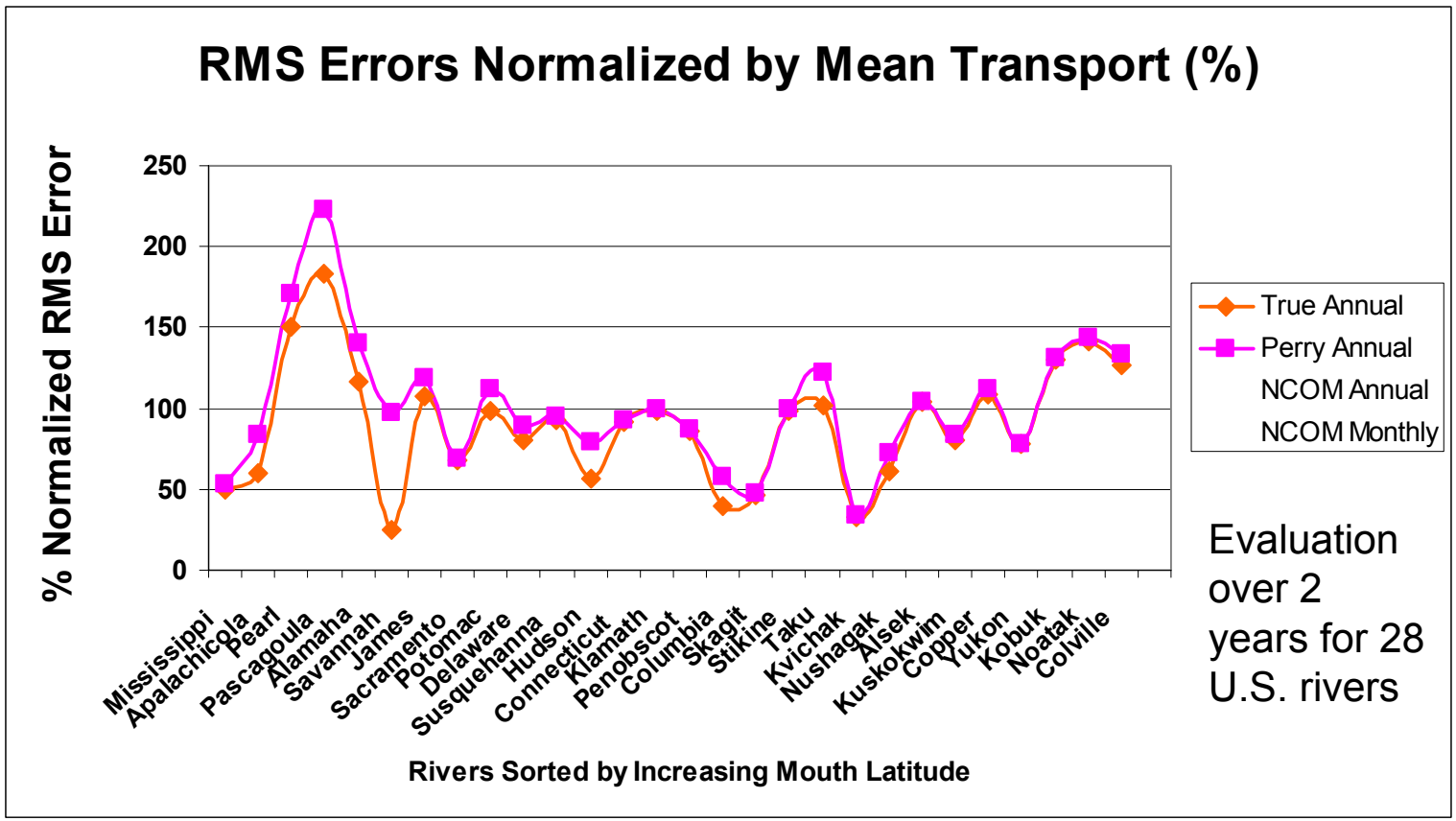

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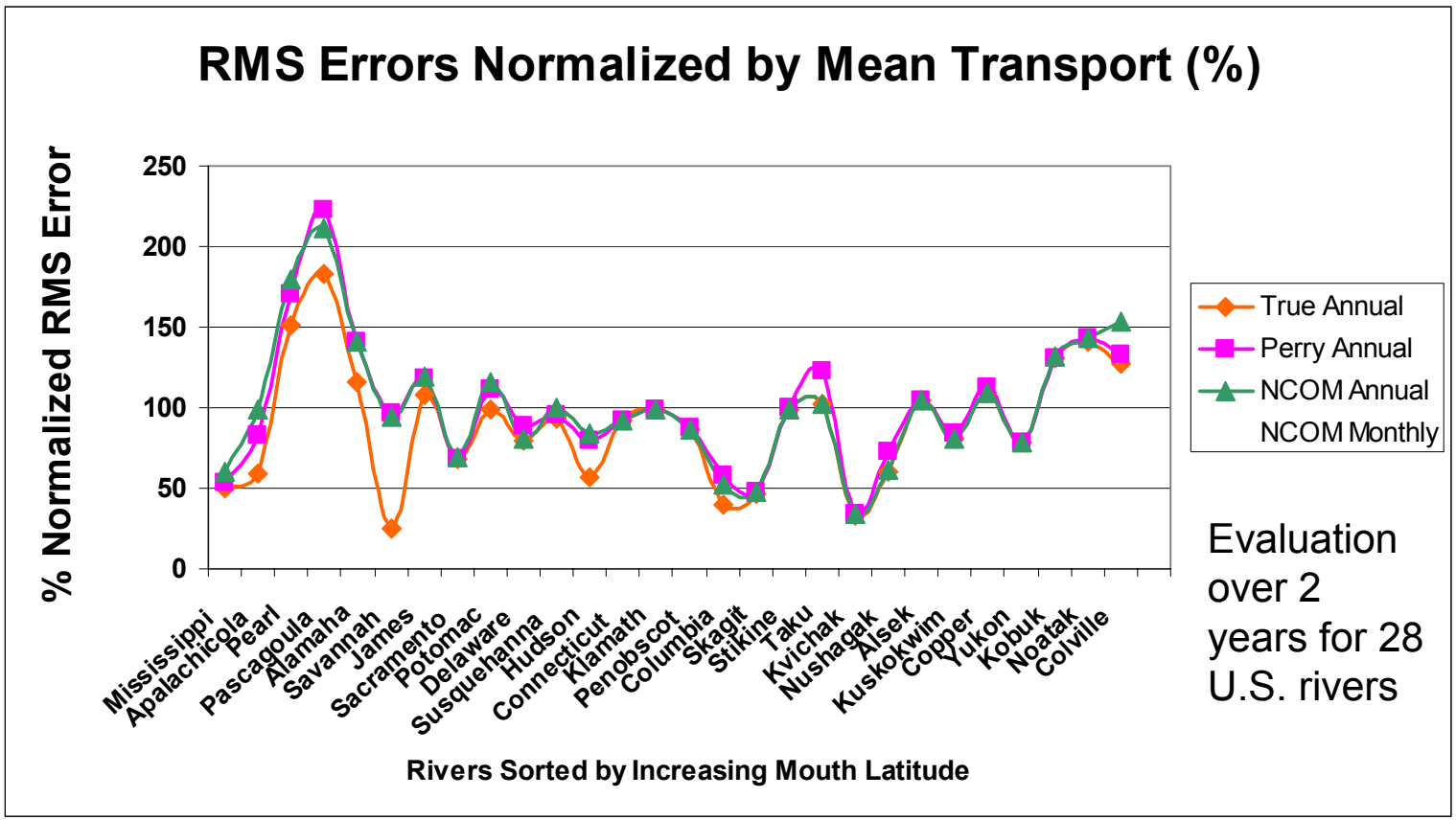

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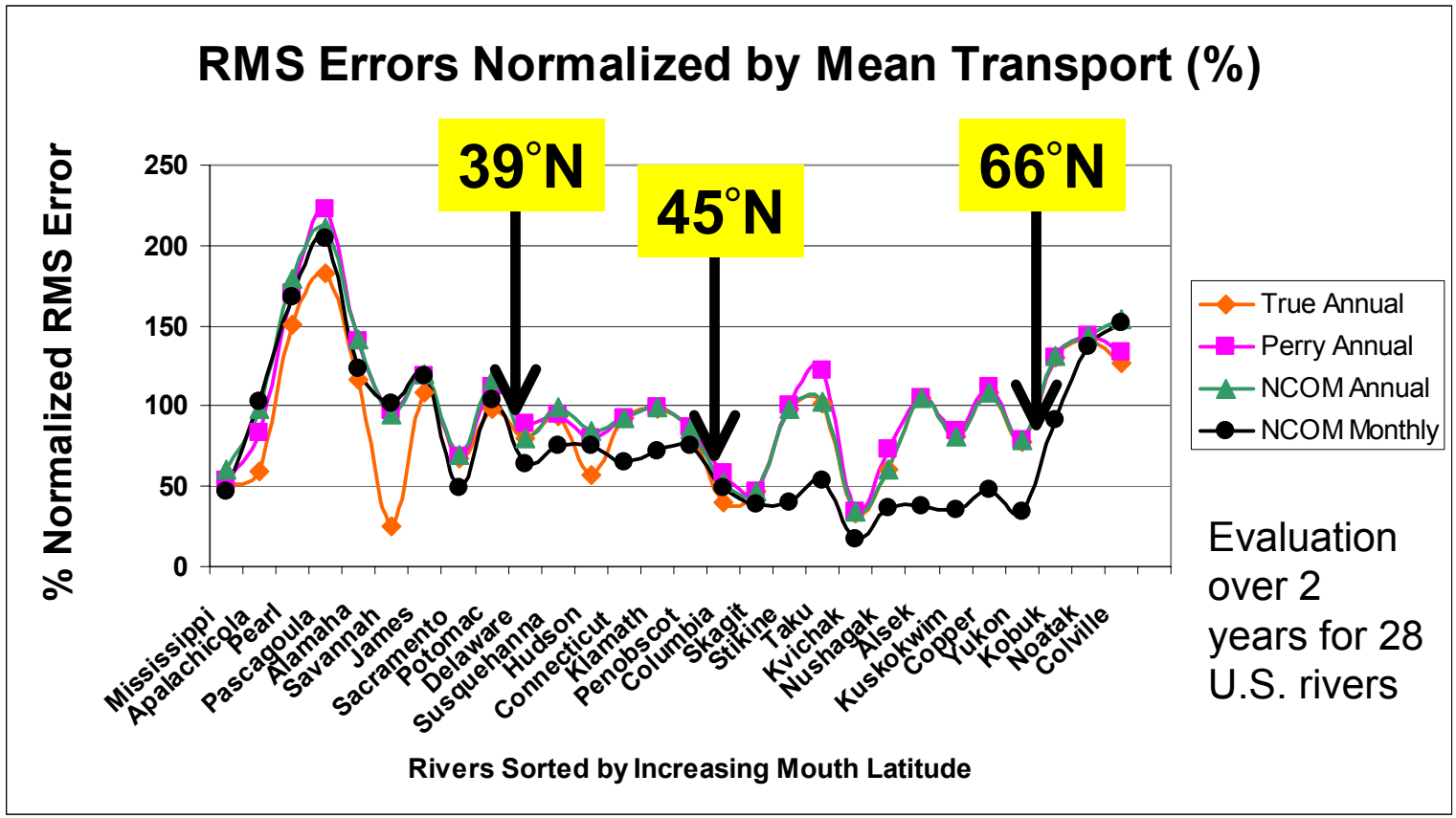

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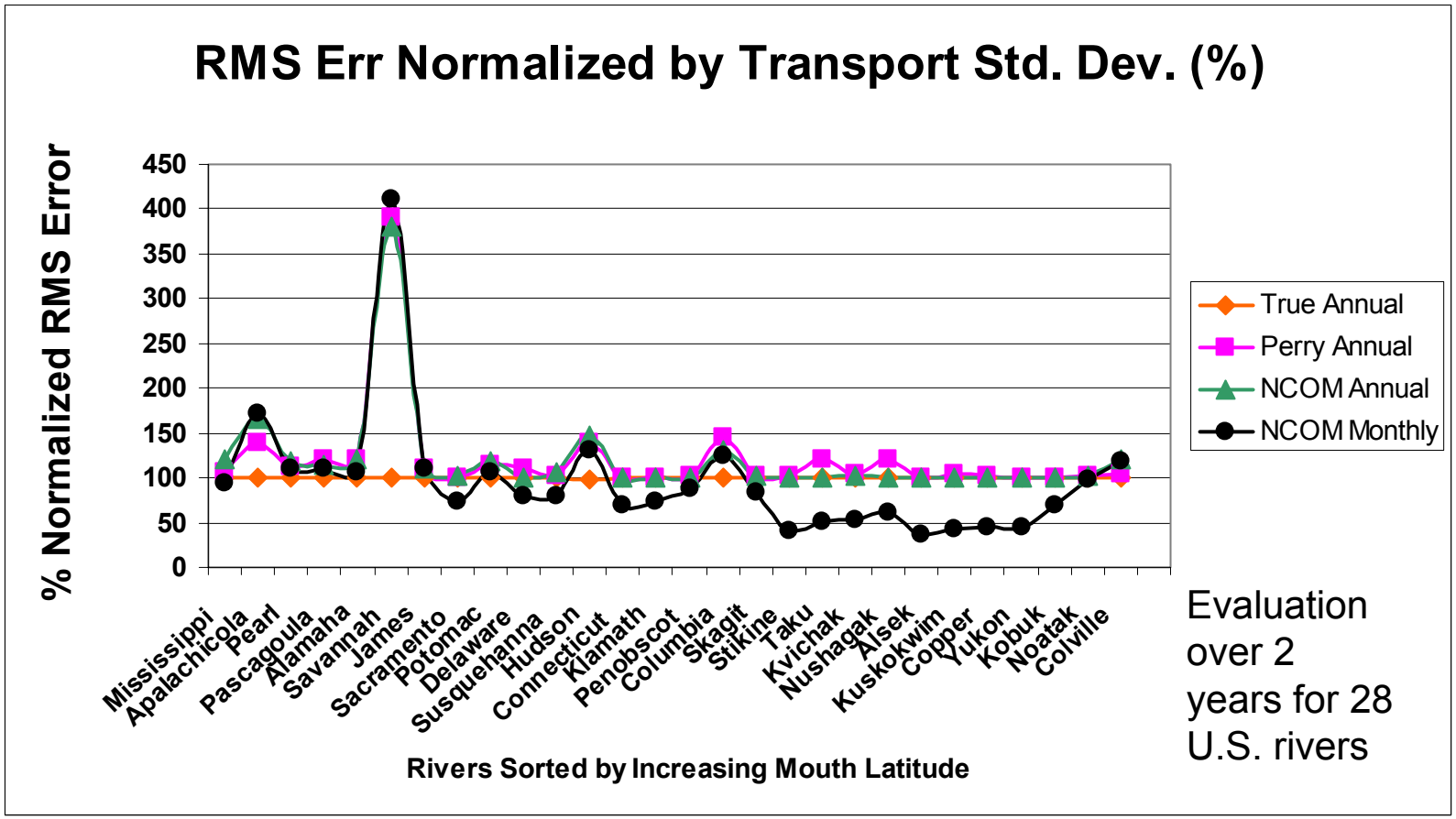
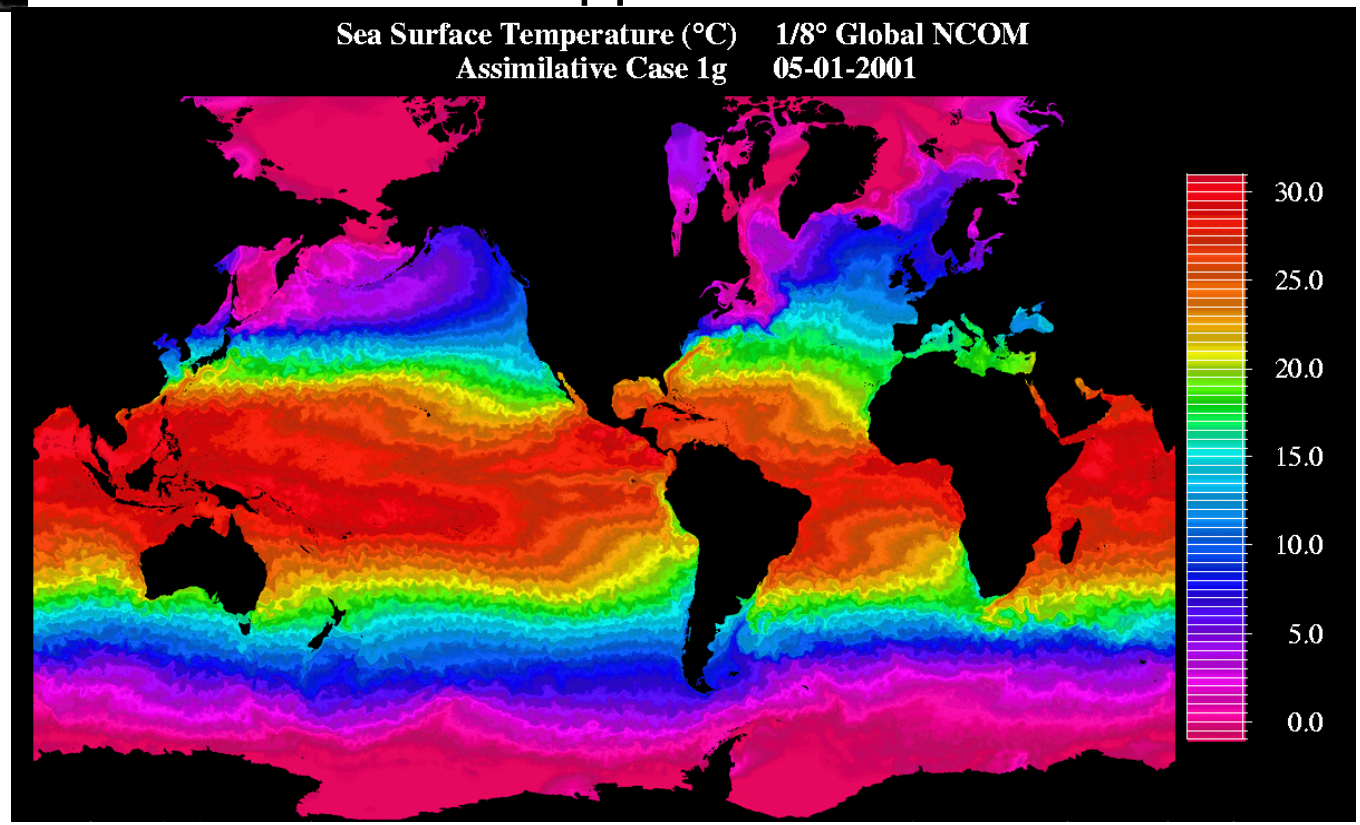


Evaluation over 2 years for 28 U.S. rivers

Global River Database for NCOM: Application

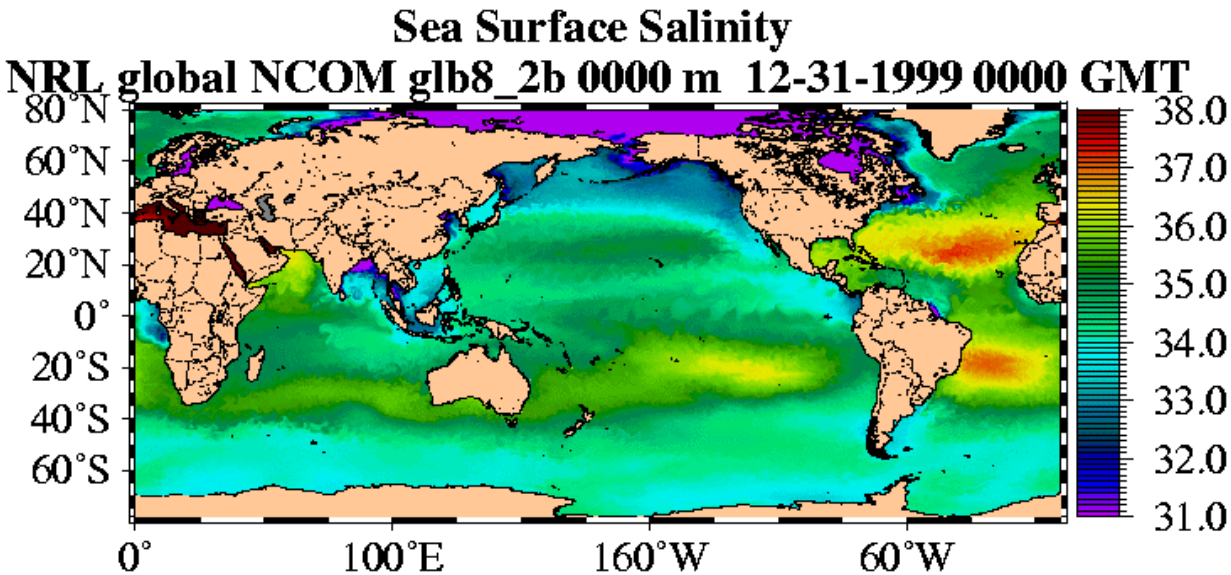


- 40 (19/21) σ/z levels in the vertical (41 interfaces)
- 1m maximum top level thickness; log stretching
- assimilation of SST, SSS, 3-d T&S from MODAS syn using 1/16° NLOM SSH and MODAS2D SST
- NOGAPS wind stress, radiation, heat flux
- generic grid extraction capability

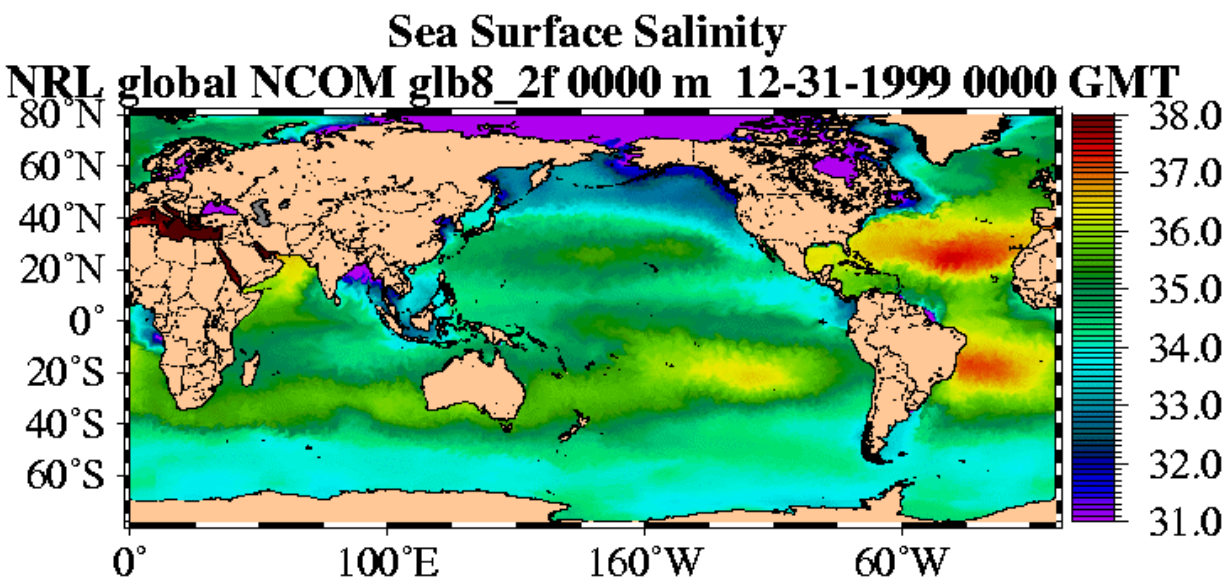
Recent additions:

- Internal calculation of latent and sensible heat flux using model SST
- Adding global rivers: fresh water flux distributed over upper 50 meters of ocean cell nearest to river mouth

1/8° Global NCOM river database impact:



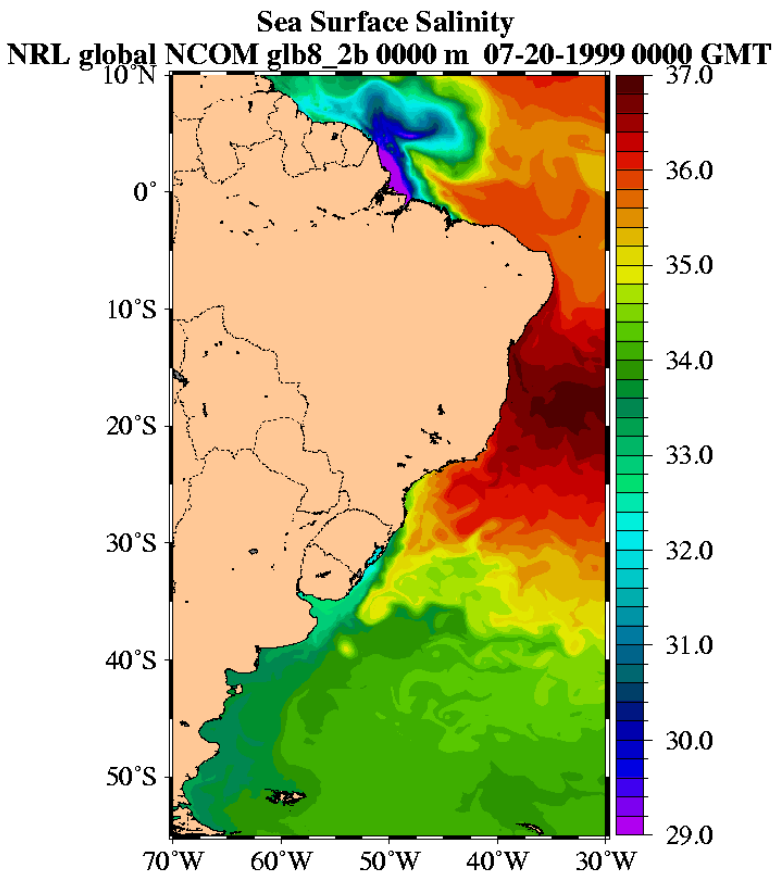
Without Rivers: Salinity from surface salinity flux based on MODAS SSS.

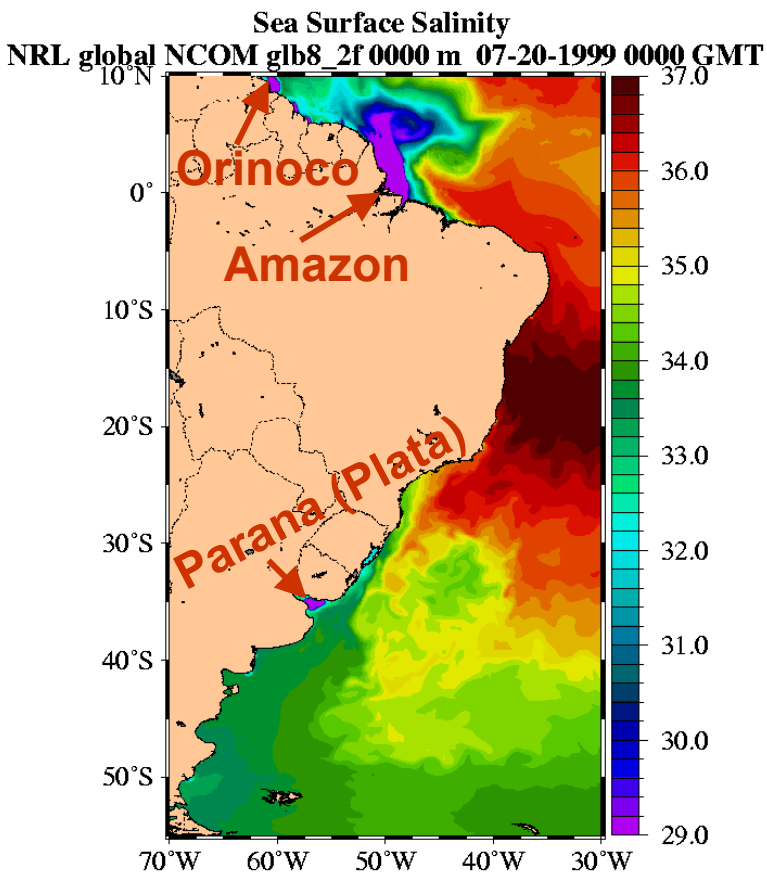


With Rivers: Fresh water from rivers modifies coastal and interior regions

1/8° Global NCOM river database impact:

Amazon and other South American Rivers

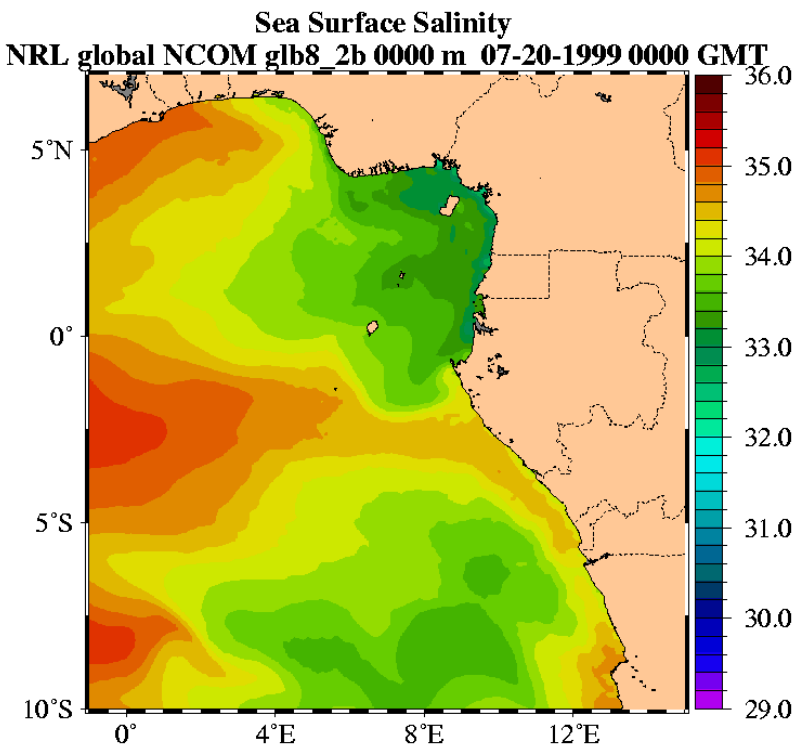


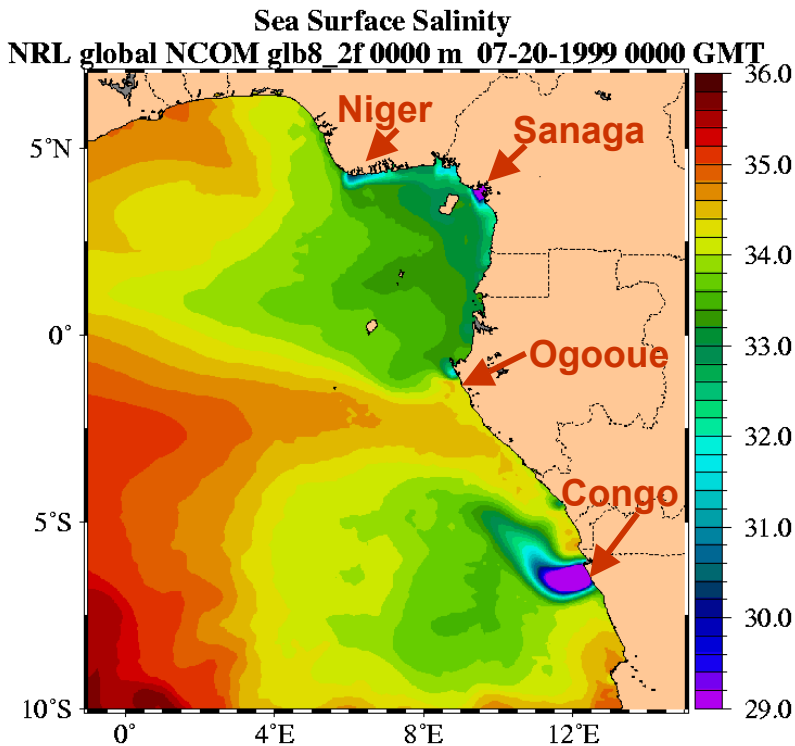


There are 986 rivers in the global river database, 34 in this region

1/8° Global NCOM river database impact:

Congo (Zaire) and other West African rivers

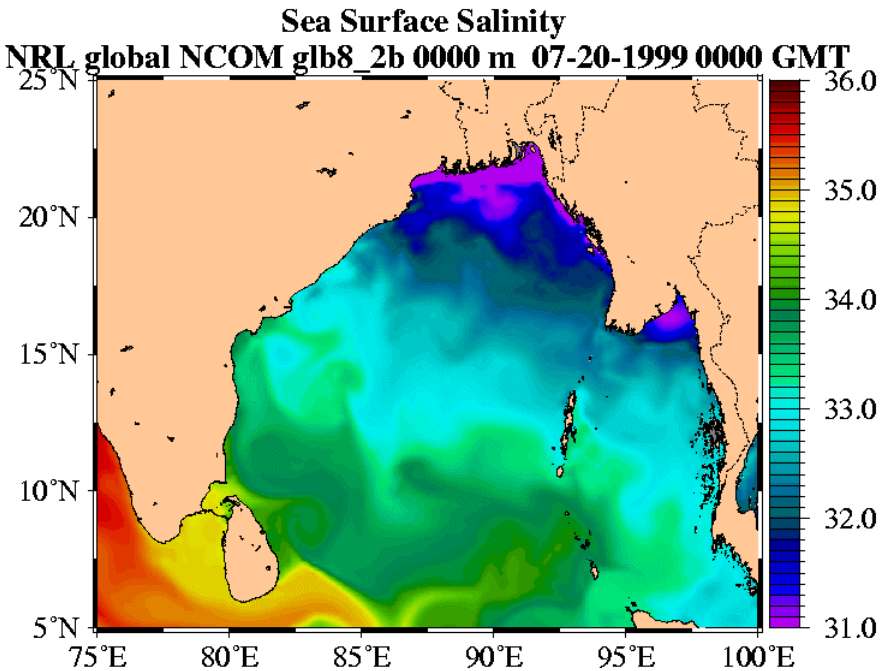


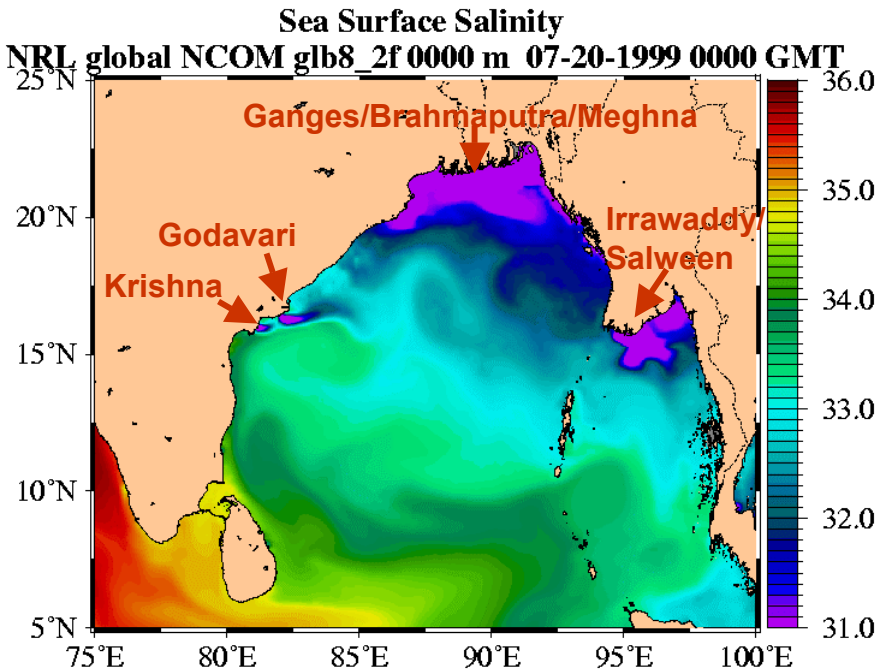


There are 986 rivers in the global river database, 26 in this region

1/8° Global NCOM river database impact:

Ganges and other South/Southeast Asian Rivers





There are 986 rivers in the global river database, 40 in this region

Global River Database for NCOM: Summary and Future Work

- Evaluation indicates the database provides the largest improvement over annual means in the midlatitude range from 39° to 66° latitude.
- The rivers have been incorporated within the global NCOM hindcast run. Evaluation of these results are ongoing.
- Future Work
  - Additional rivers
  - Spatial distribution of river discharge
  - Correlation between river stage and transport
  - Rainfall/runoff models (especially for tropics and subtropics)
  - Add evaporation-precipitation water flux to NCOM