# Potential predictability of seasonal mean river discharge in prescribed SST ensemble predictions at different horizontal resolutions

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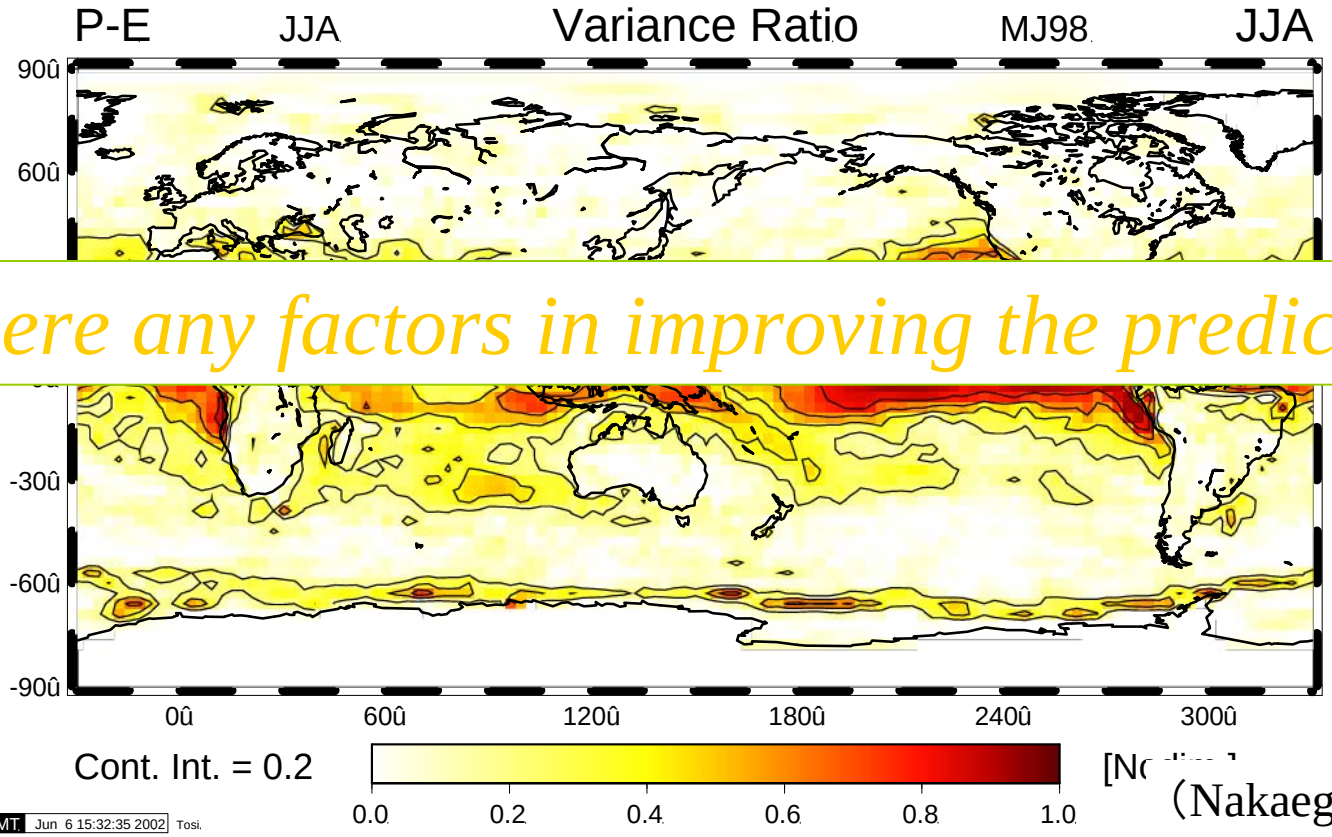
# Background

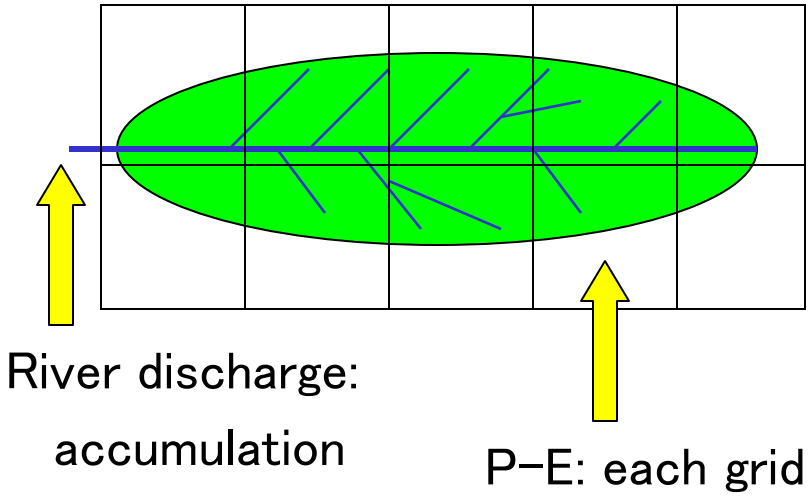
- Potential predictability of potentially available water resources (*P*-*E*) is low in most of land areas.




*Are there any factors in improving the predictability?*

（Nakaegawa et al.2003）

# Physical characteristics of river discharge




- River discharge is a collection of total runoffs in an upper river basin, which is similar to the area average process.

*The collection is likely to reduce the unpredictable variability and, as a result, to enhance the predictability.*

# Objectives

- Estimation of the potential predictability of sesonal mean river discharge based on an ensemble experiment
- Examination of the effects of land surface hydrological processes on the predictability, in comparison with that of *P*-*E*, *The collection effect*
- Comparisons of the variance ratios between different horizontal resolutions.

# Experiment setup

- AGCM: MJ98, T42 with 30 vertical layers
- River Routing Model: GRiveT, 0.5$^{o}$ river channel network of TRIP, velocity: 0.4m/s
- Member: 6
- SST & Sea Ice : HadISST (Rayner et al. 2003)
- $CO_2$ : annualy varying
- Analysis period : 1951-2000

# Potential Predictability

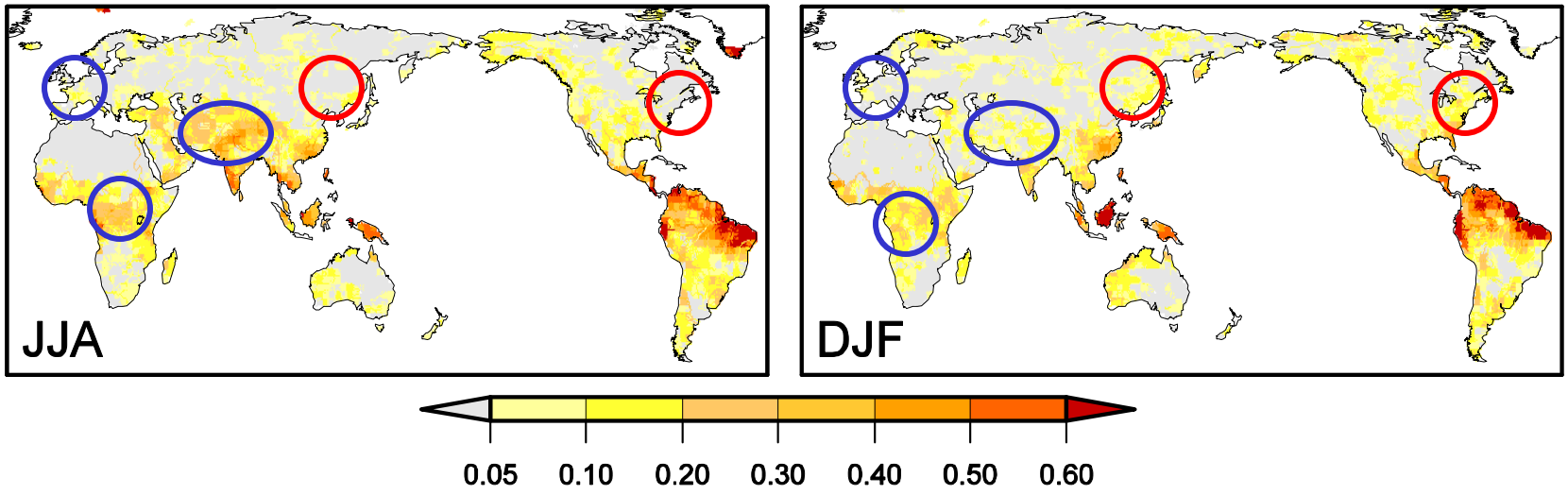
- Definition: The maximum value that an ensemble approach can reach, assuming that perfectly predicted SSTs are available and that the model perfectly reproduces atmospheric and hydrological processes.
- Variance ratio: measure of PP based on the ANOVA (Rowell 1998).

$$R = \sigma^2_{SST} / \sigma^2_{TOT}$$

$$\sigma^2_{SST} = \sigma^2_{EM} - \sigma^2_{INT} / n$$

$$\sigma^2_{TOT} = \sigma^2_{SST} + \sigma^2_{INT}$$

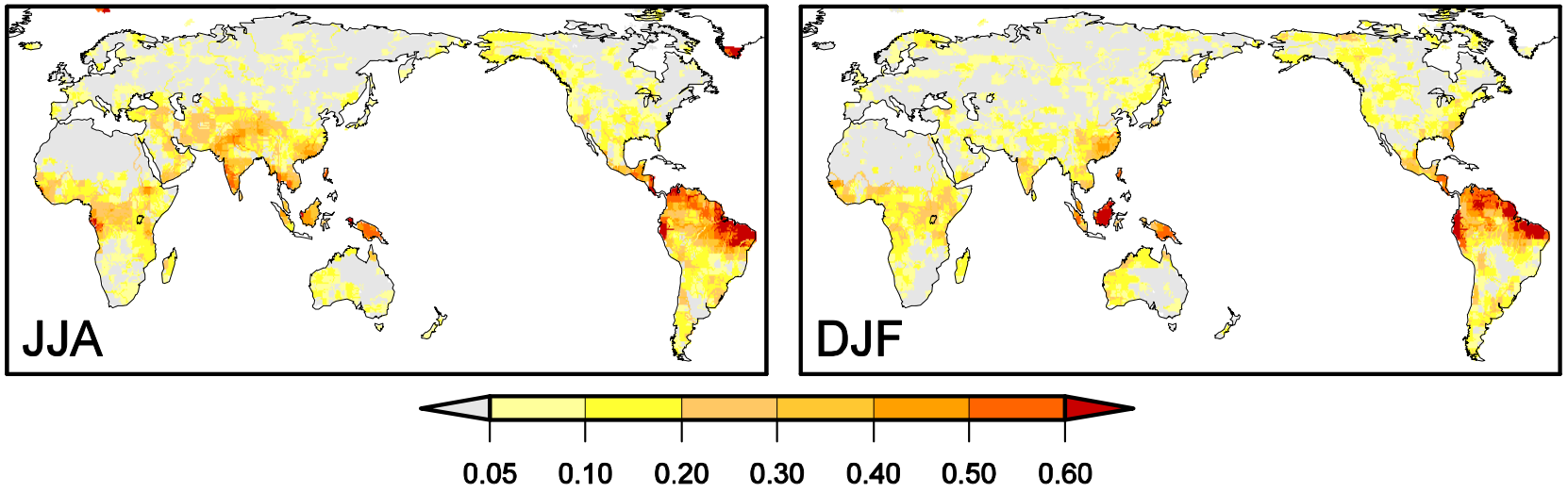
# Seasonal Mean River Discharge




- High in Tropics and Low in Extratropics and inland areas
- Seasonal cycles in both Tropics and Extratropics

  High in JJA; high in DJF

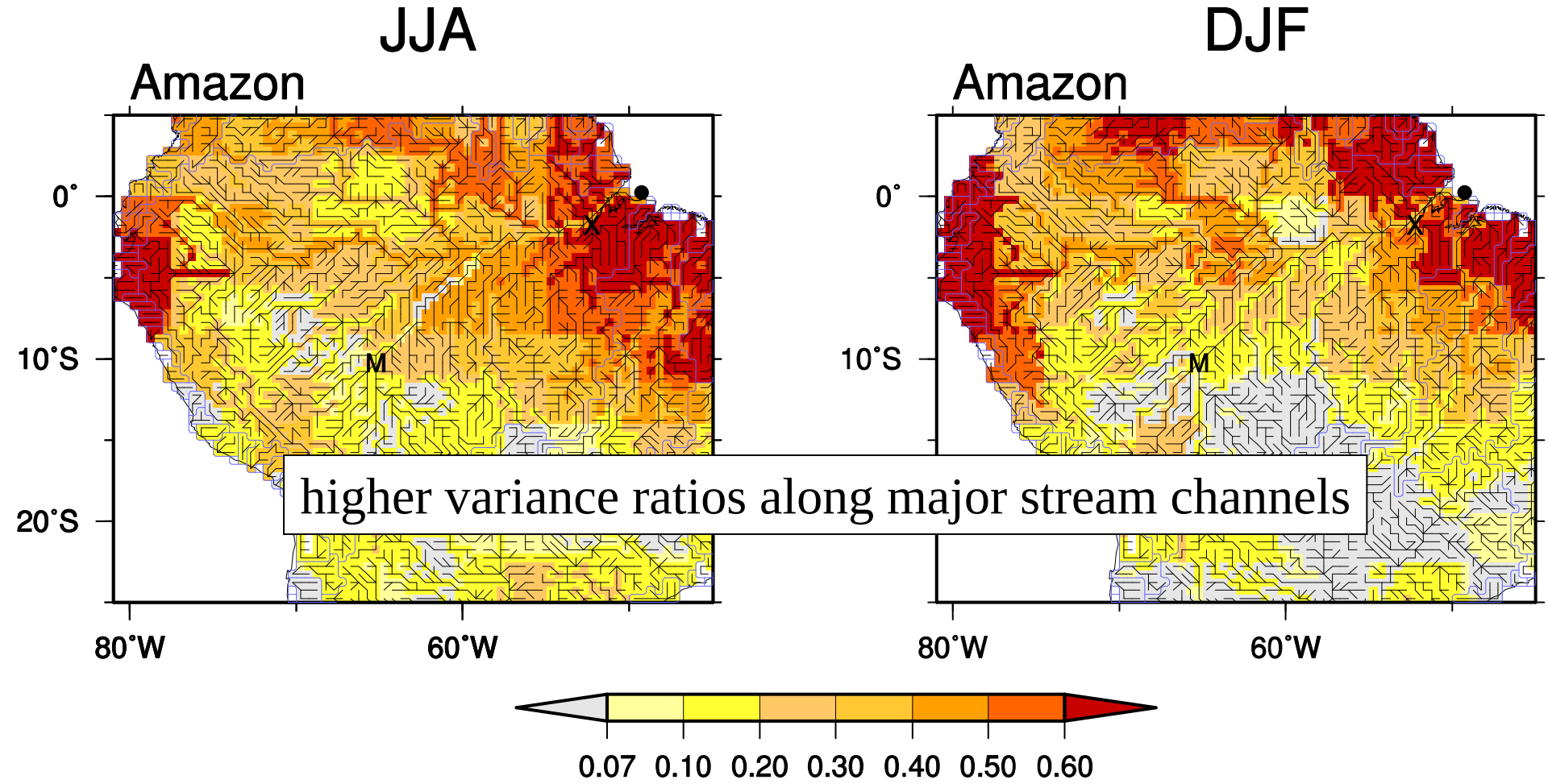
# Seasonal Mean River Discharge




・Resemblance of geographical distributions of the variance ratios of precipitation and P−E

A major factor in the predictability of river discharge

# Variance Ratio in the Amazon River Basin

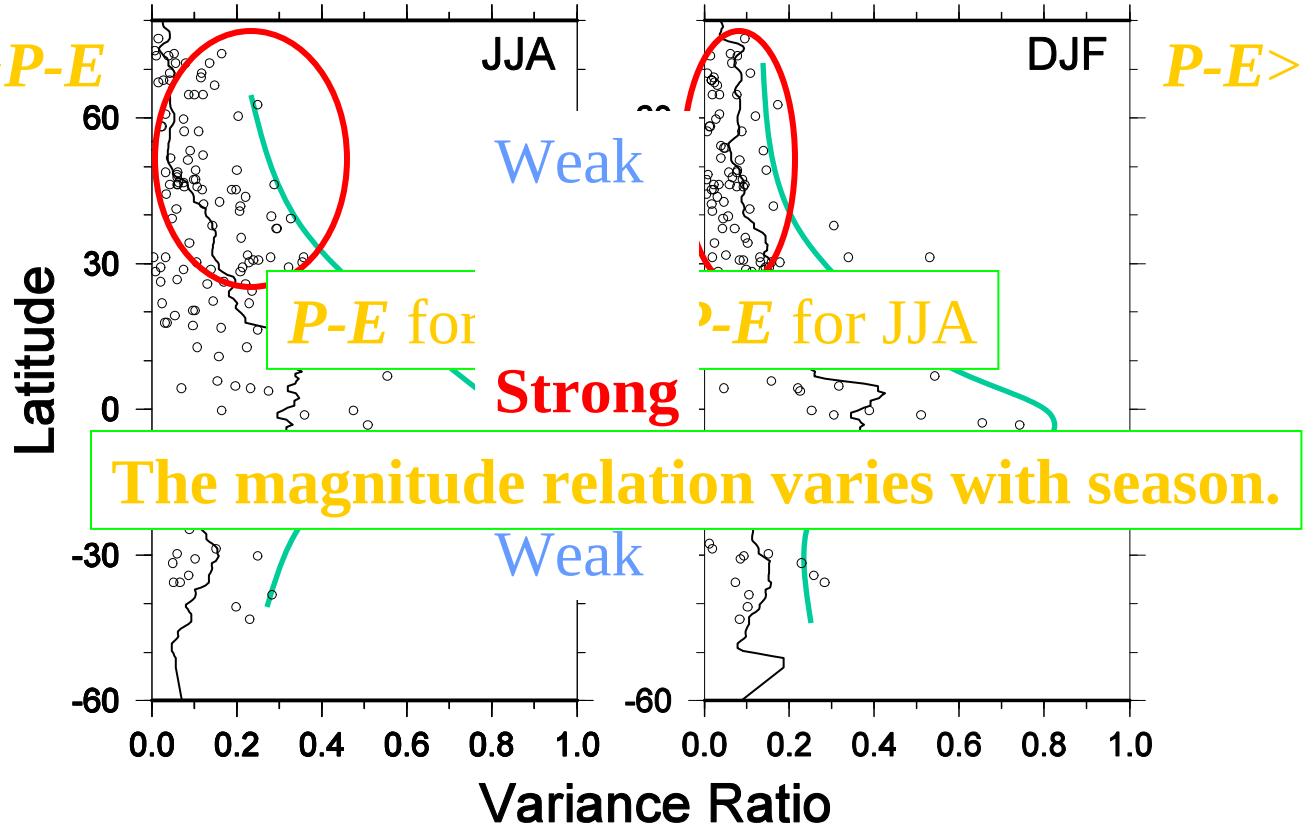



Runoff collection through a river channel network may enhance the variance ratio.

# Latitudinal distribution of variance ratios

**Discharge>*P-E***

***P-E*> Discharge**

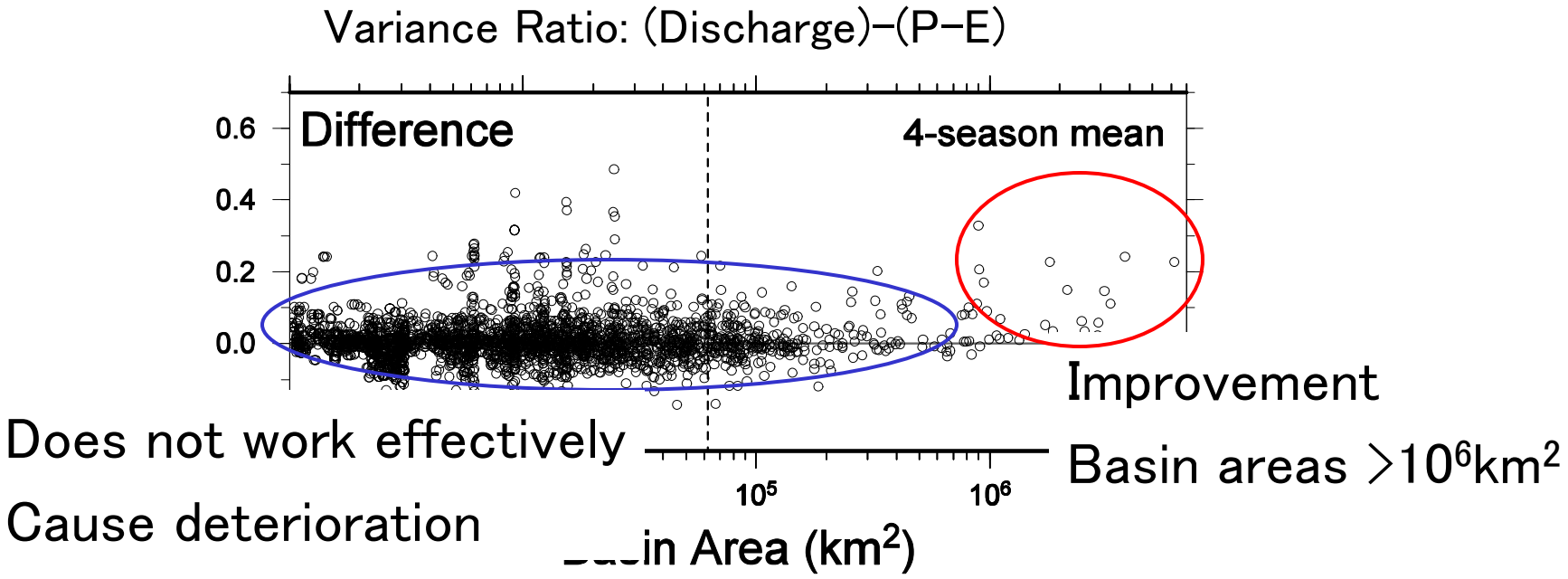



○: Variance ratio at river mouths of basins larger than $10^5 km^2$

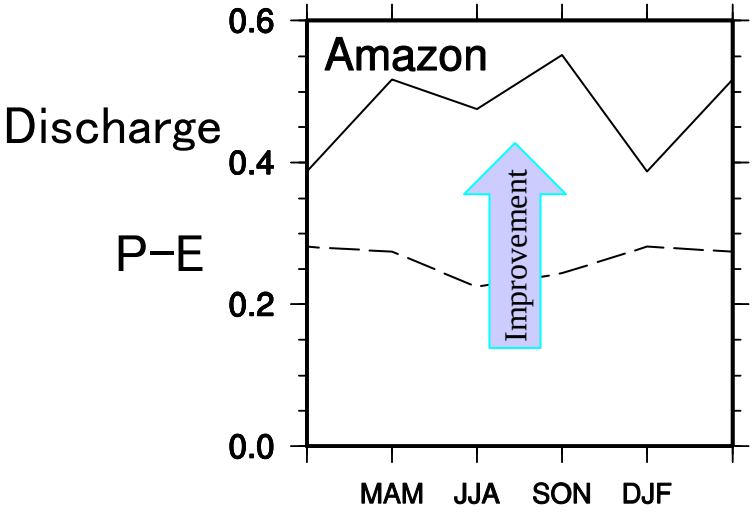
Solid line: Zonal mean of the variance ratio of *P–E* over land areas

# Collection Effect

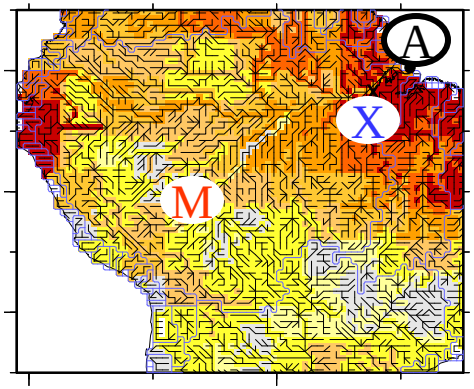
- How much influence does the collection effect over a river basin have on the potential predictability of river discharge?



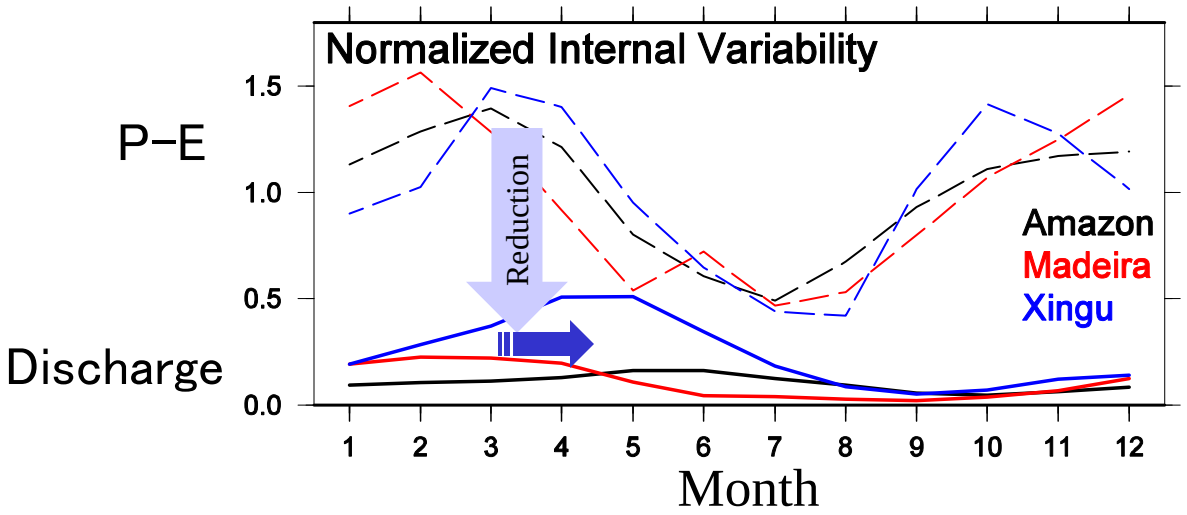
# The Amazon River




Semi−annual cycle




Amazon River

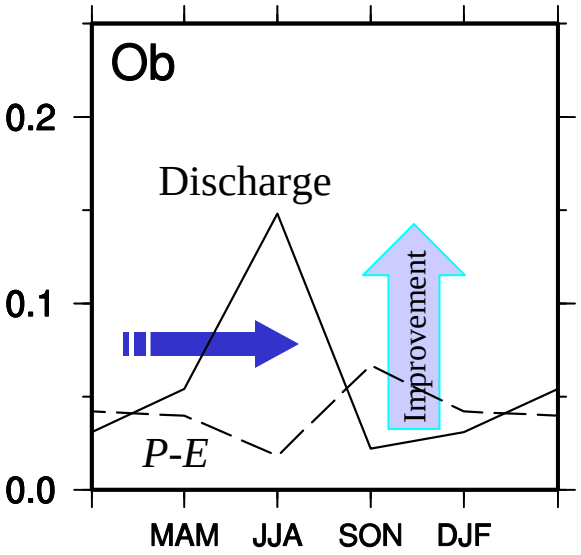



Mean travel time

Madeira: 86 days

Xingu: 45 days

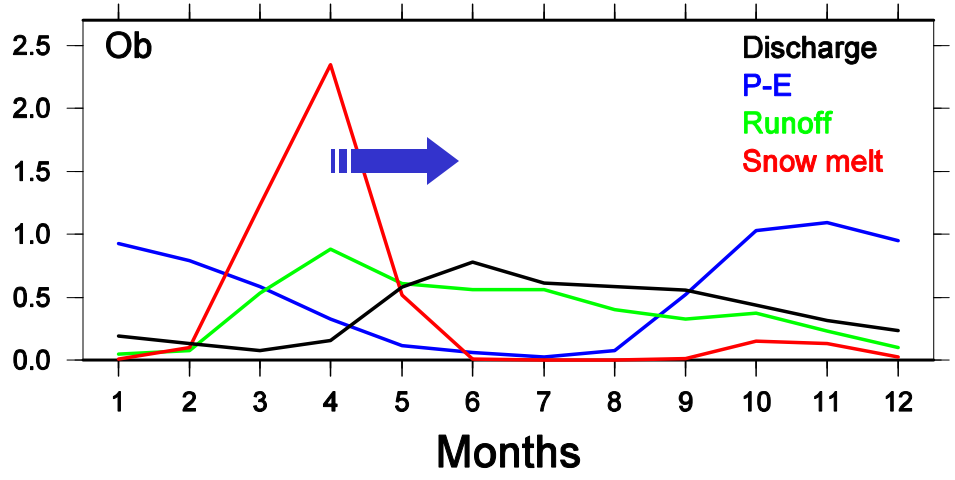
# The Ob River




The peak of the variance ratio

River discharge: JJA; P-E: SON&DJF

The mean travel time: 68 days



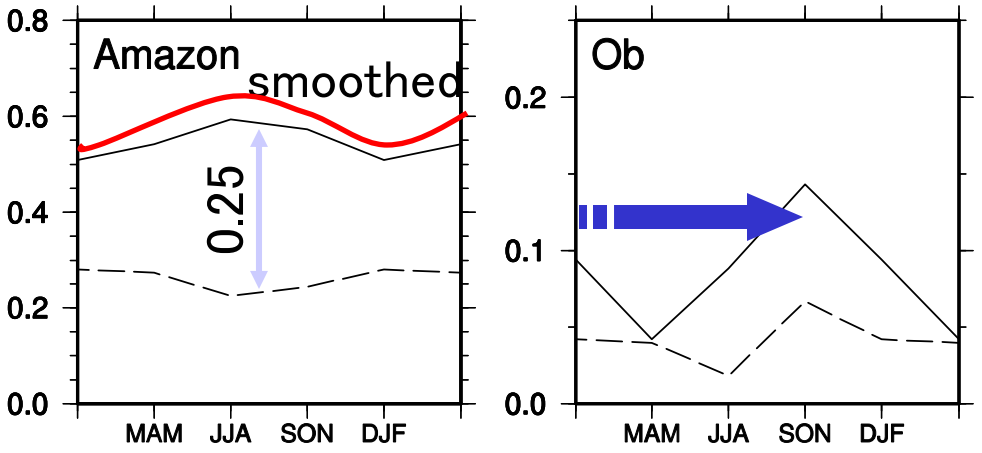

River discharge in JJA mostly originates from snow melt water, not from *P-E*.

# Further Experiment

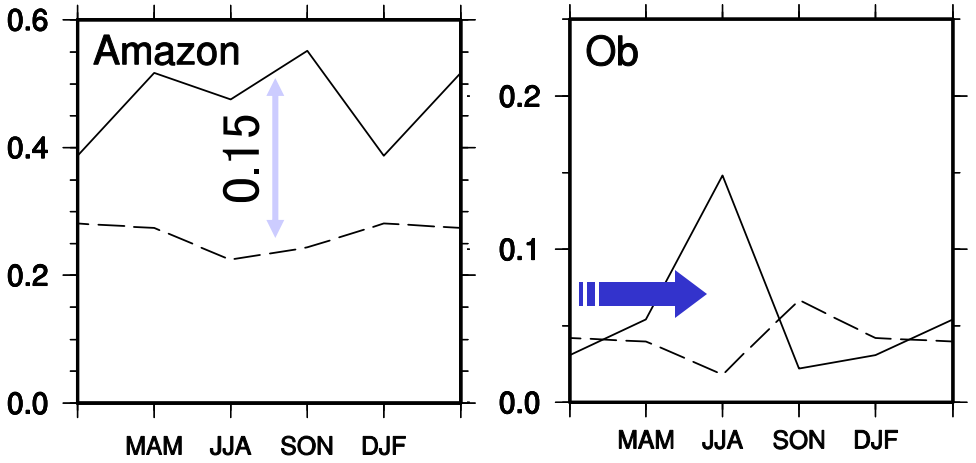
Further experiment:
slower velocity v=0.14m/s

(Hagemann and Dumenil 1998)

v=0.14m/s




v=0.40m/s



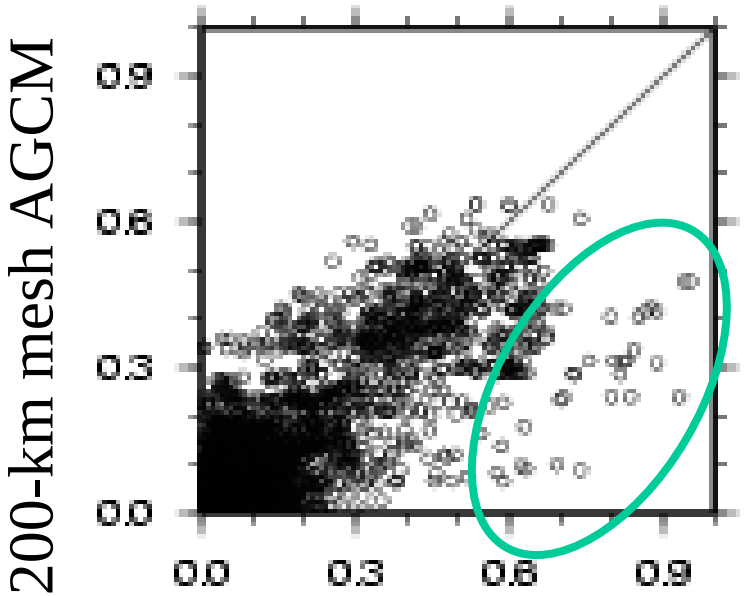

The collection effects:

- Improvement
- Phase shift, and
- Smoothing

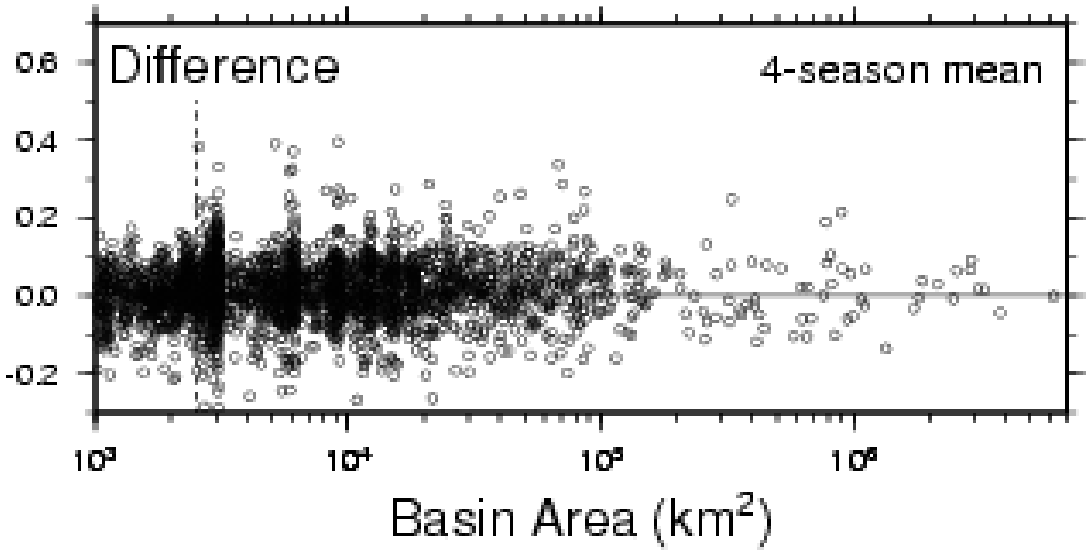
# High resolution model simulations

- GSM  TL319 (60km) and TL95 (200km)
- Member: 3; Period: 1979-2004

**River discharge**



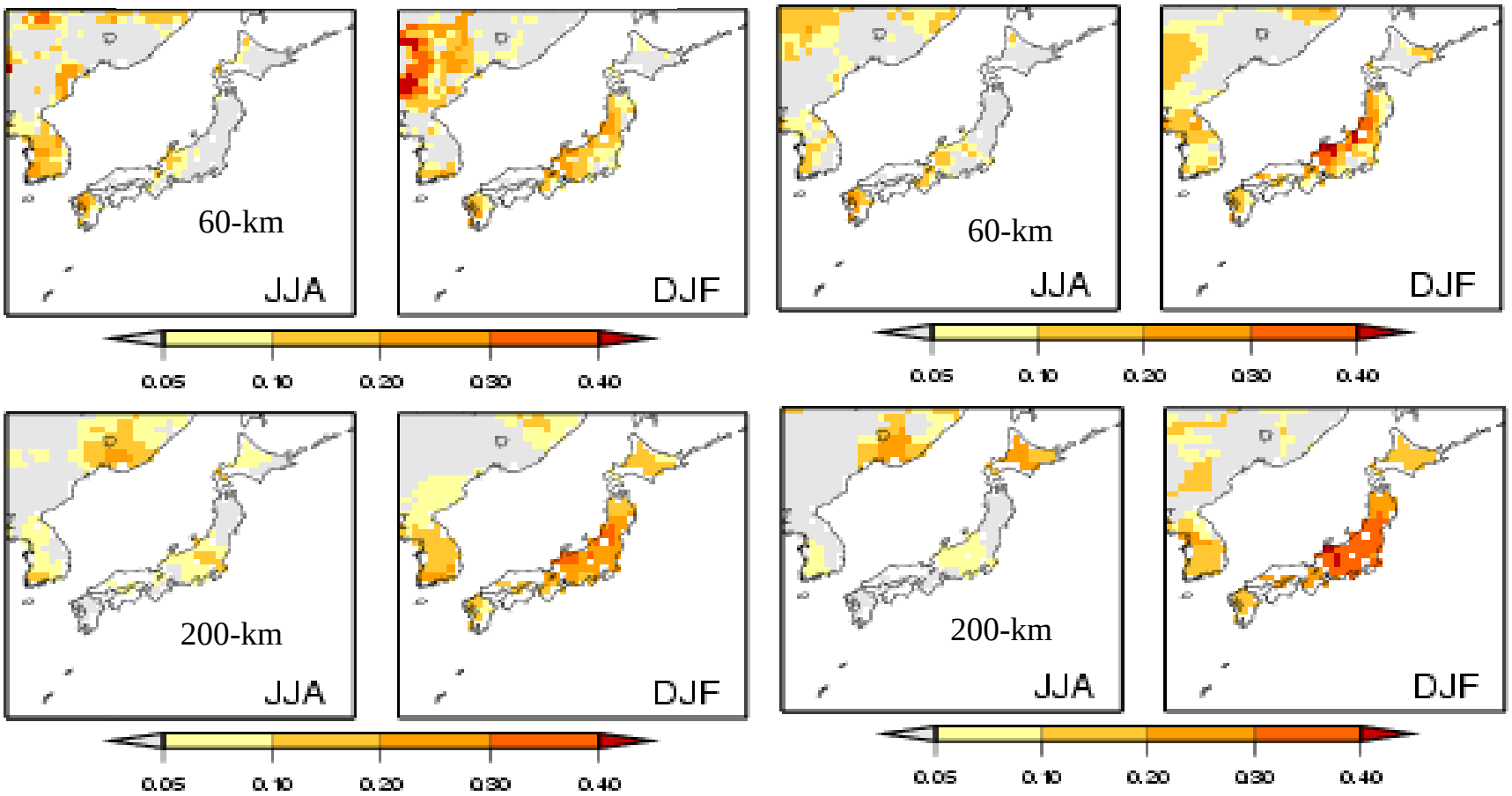

**Difference in variance ratio difference between the 60-km and 200-km**



# High-resolution model simulations

**River discharge**

**Precipitation**



# Concluding Summary (1)

- Estimation of the potential predictability of river discharge based on an ensemble experiment.

**Similar geographical distribution to P-E**
**•High in Tropics and low in extratropics and in inland areas**

# Concluding Summary (2)

- Examination of the effects of land surface hydrological processes on the predictability, in comparison with that of *P*-*E*.

**Distinctive collection effects are identified in large basins with greater than $10^6 km^2$.**

Improvement in the variance ratio, phase shift, and smoothing

**Snow processes significantly influences on the predictability for the mid- and high latitude river basins.**

Snow accumulation and snow-melting

# Concluding Summary (3)

- Comparisons of the variance ratios between different horizontal resolutions.

**The collection effect is not dependent by the AGCM's horizontal resolutions.**