

# **The Recycling Rate of Moisture in the Atmosphere Based on AIRS Observations**

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# Overview

- **Motivation**
- **Previous Studies**
- **New Results**
- **Discussions**

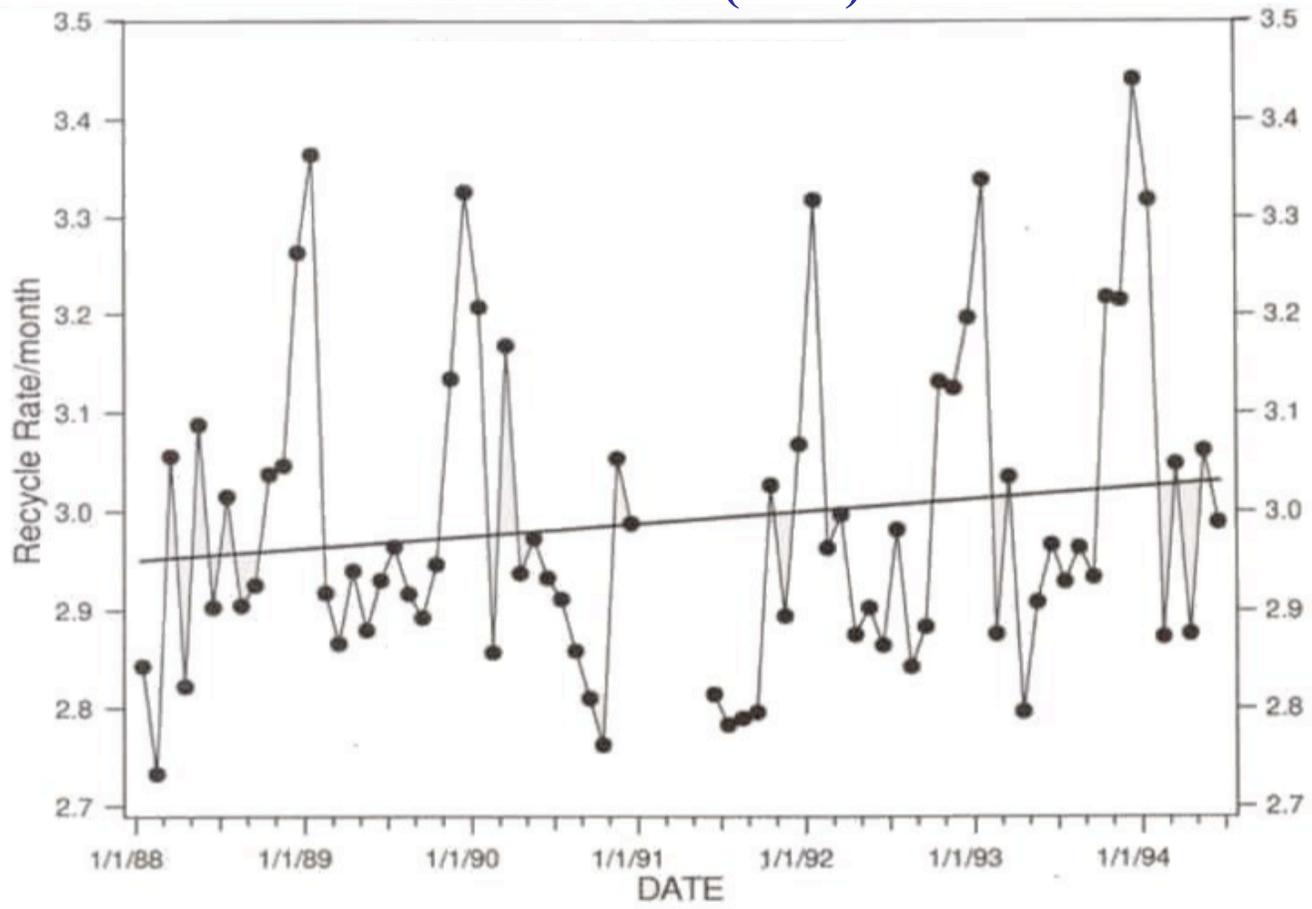
# Motivation

$$\text{Recycling Rate} = \frac{\text{Total Monthly Precipitation}}{\text{Monthly Mean Precipitable Water Vapor}}$$

The temporal variations and spatial distribution of recycling rate (or residence time) of atmospheric moisture is an important index of climate changes.

# Previous Study (1988-1994)

Chahine et al. (1997)



**Linear trend ~1.0%/yr for 1988-1994.**

# Data

## I) Monthly Mean Precipitable Water Vapor

AIRS  $1^{\circ} \times 1^{\circ}$  monthly column water vapor (2002-2008)

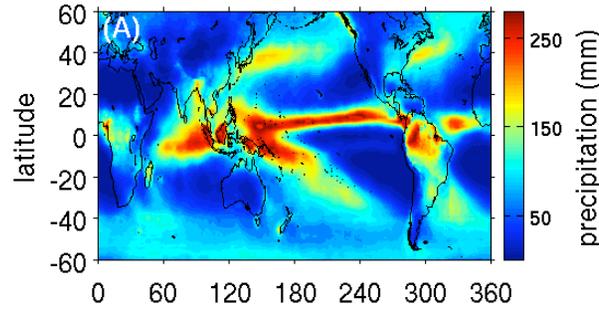
## II) Total monthly Precipitation

GPCP  $1^{\circ} \times 1^{\circ}$  daily precipitation (1996-2008)

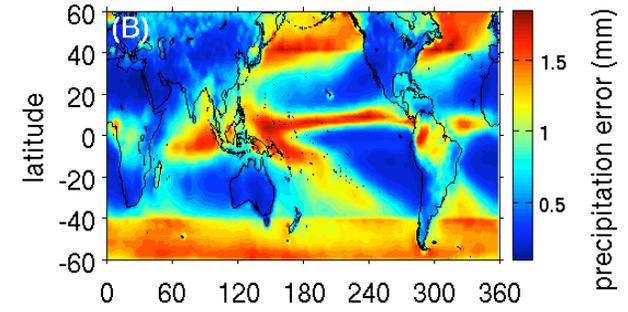
# Error Estimates

Precipitation →

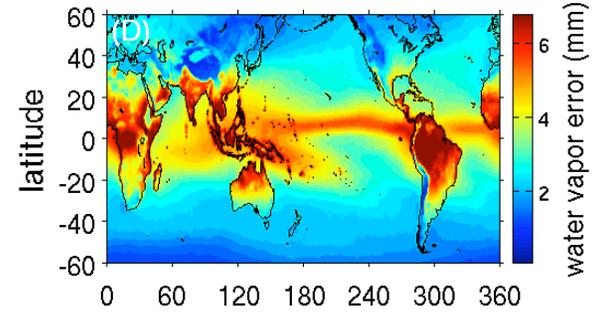
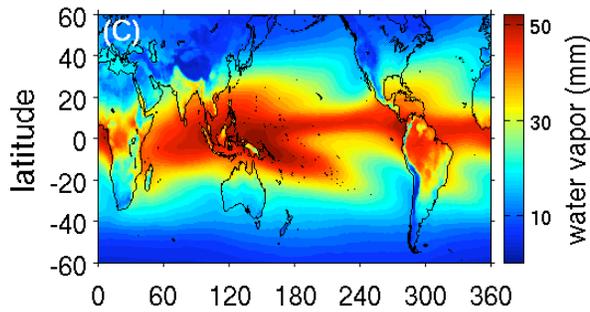
**Climatology**



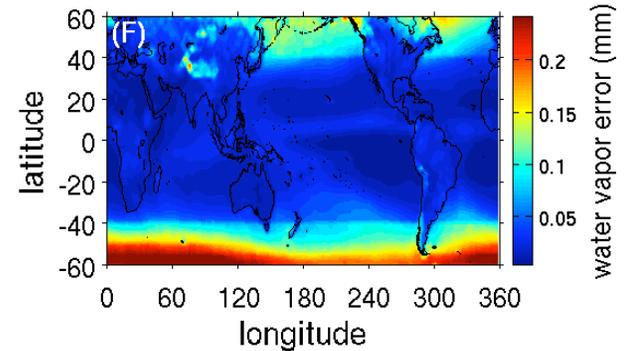
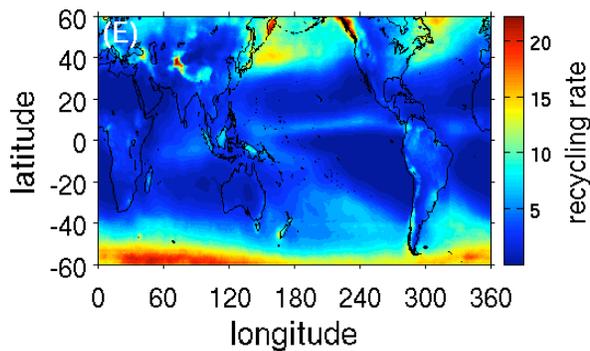
**Uncertainty**



Precipitable water vapor →



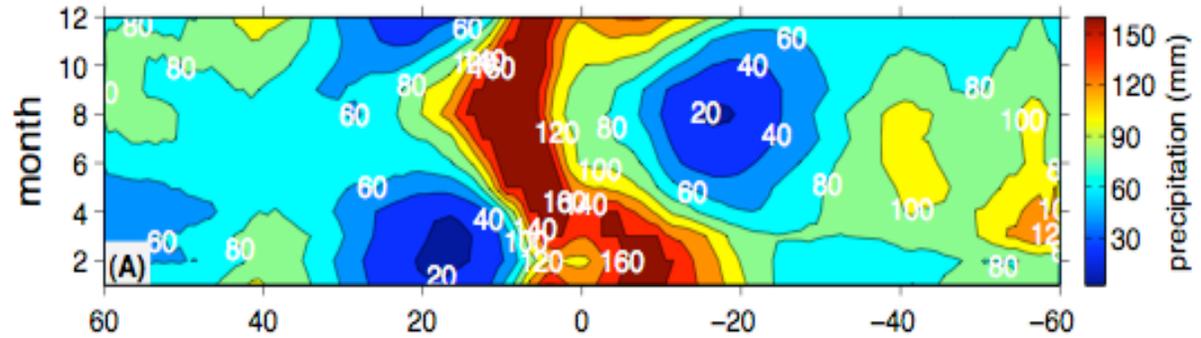
Recycling rate →



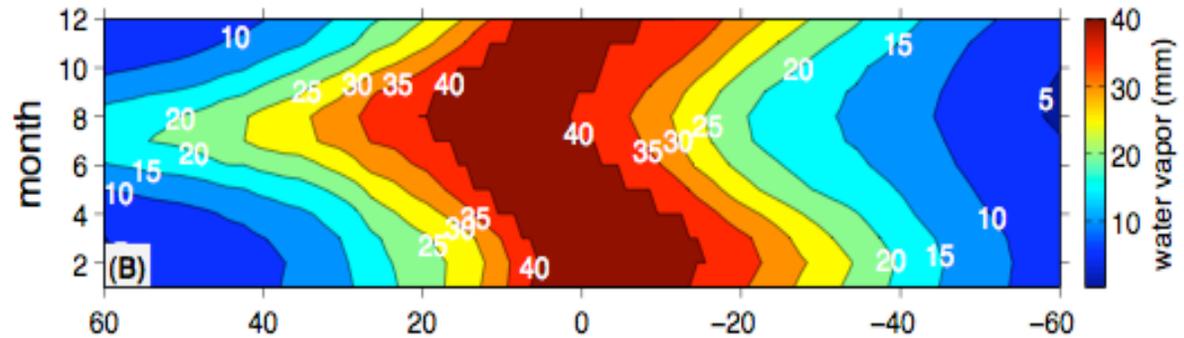
$$\text{Uncertainty of recycling rate} = \frac{\text{Error of precipitation}}{\text{Mean precipitable water vapor}}$$

# Seasonal Cycle I (Zonal Mean)

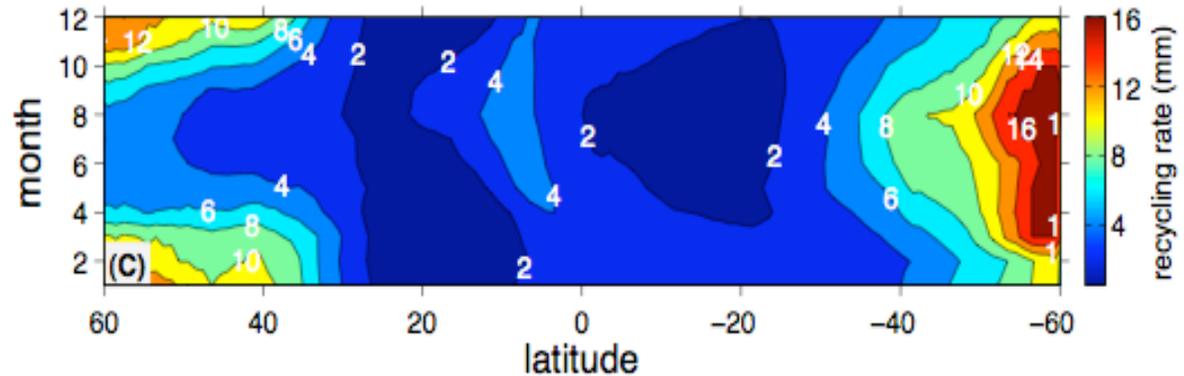
Precipitation →



Precipitable water vapor →

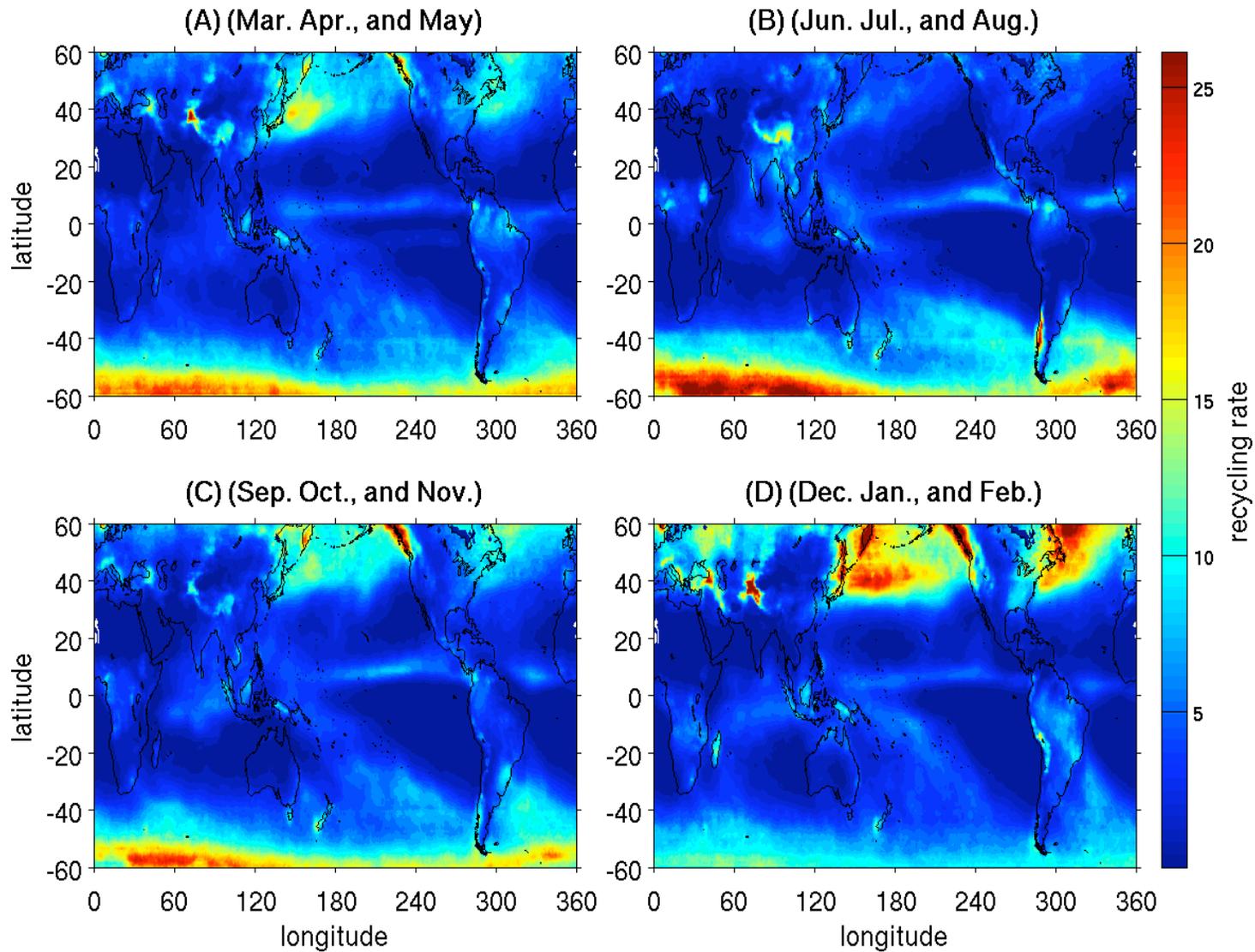


Recycling rate →



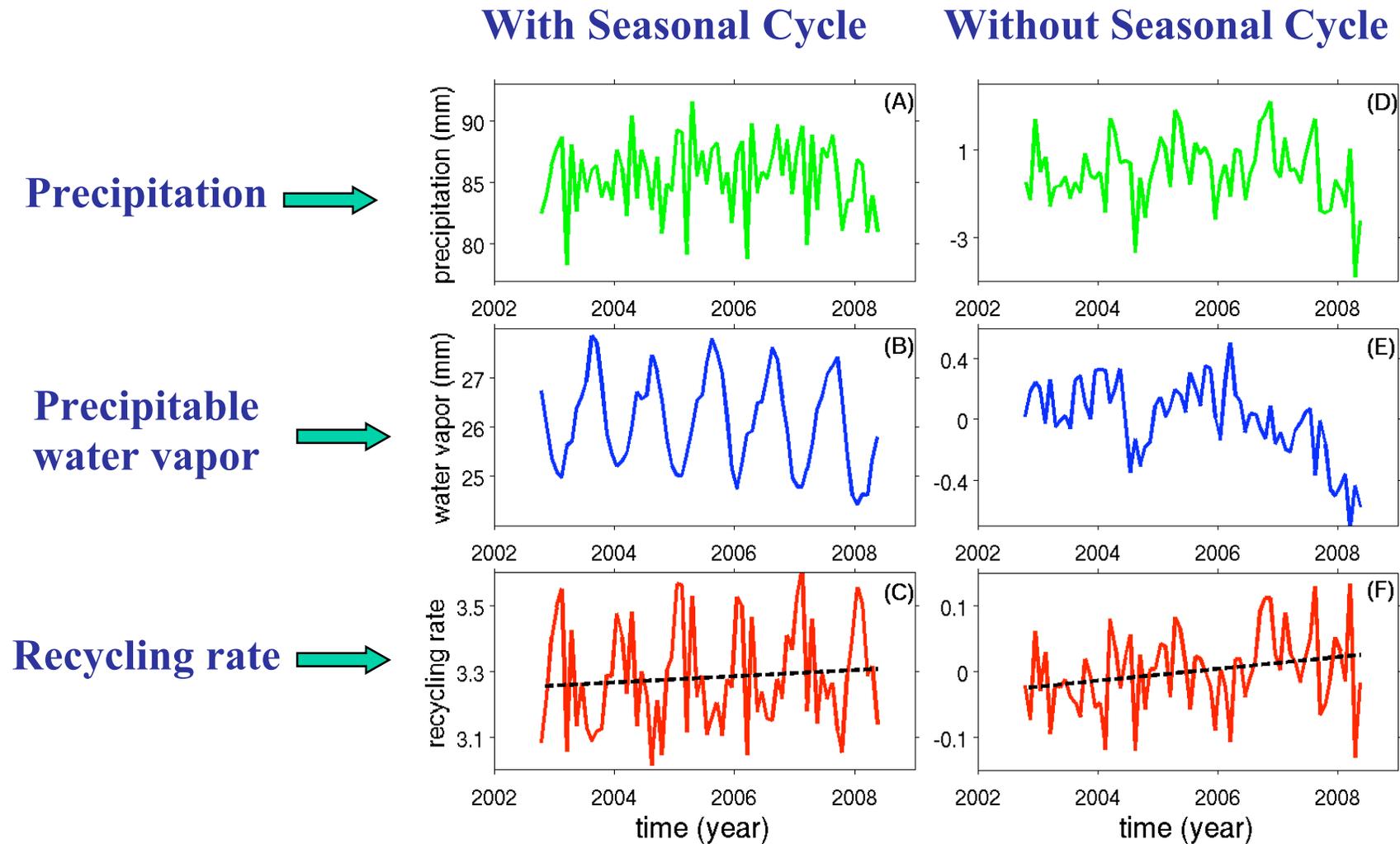
Maximal recycling rates exist in mid-latitude winter hemisphere. 7

# Seasonal Cycle II (Global Maps)



**Recycling rate is concentrated over oceans and coasts.**

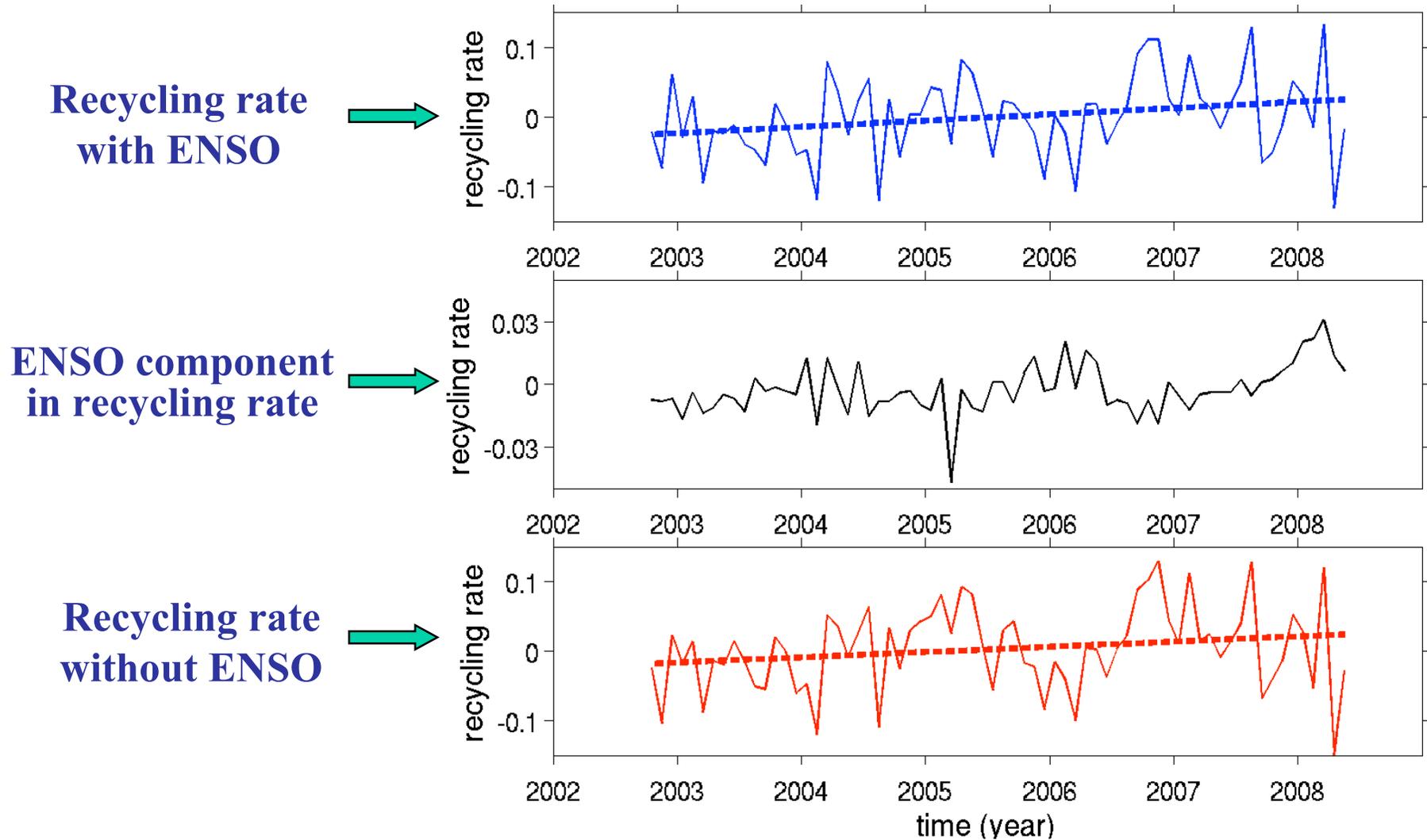
# Time Series (60N-60S Mean for 2002-08)



**Trend with and without seasonal cycle (C and F) : ~ 1.0%/yr (2002-08)**

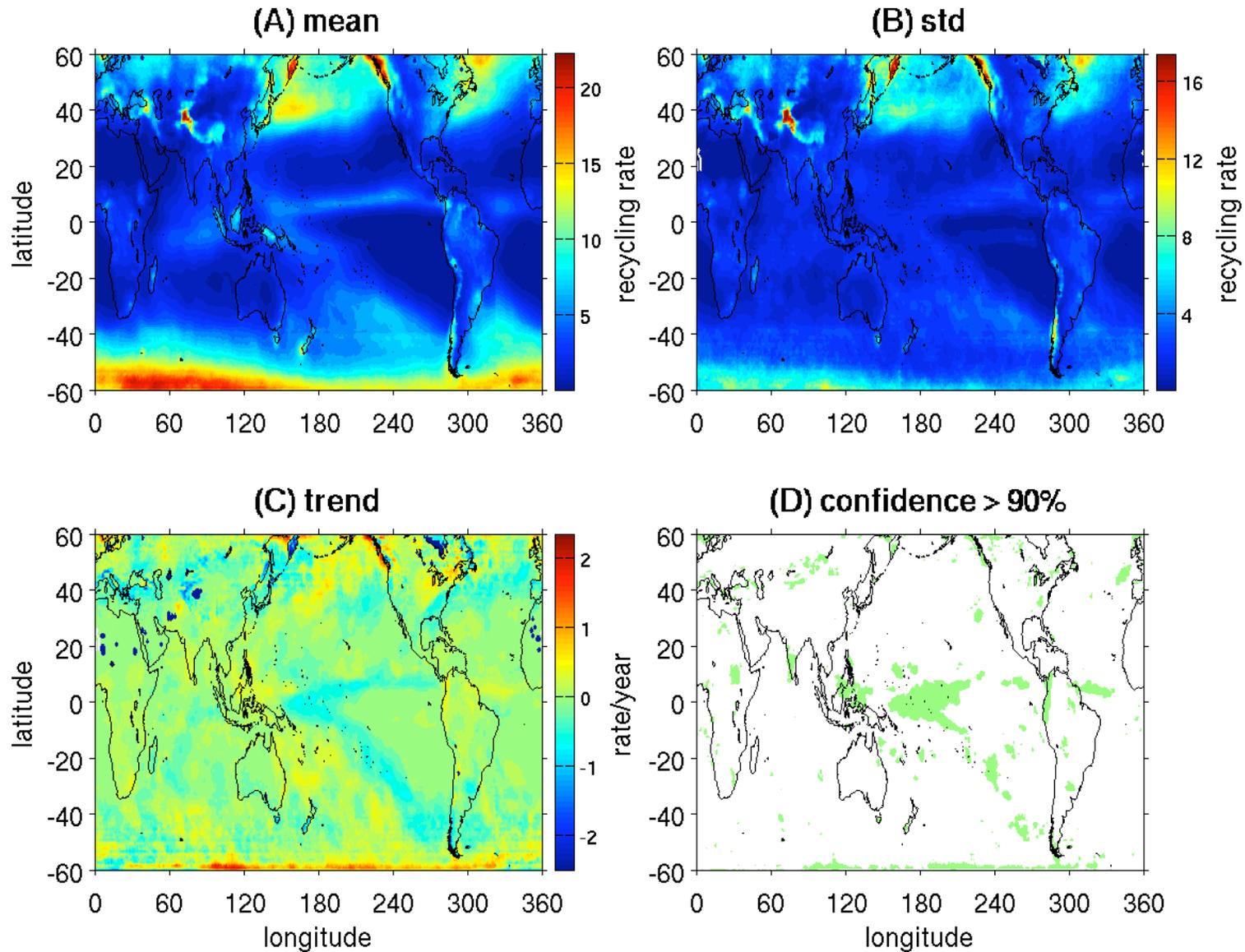
**Confidence level of trend: C < 85%    F ~ 95%**

# Time Series (Remove ENSO signal)



**Slope with ENSO (1.0%/yr)**  
**Slope without ENSO (0.9%/yr)**

# Spatial Distribution of Linear Trend



**Extended period of observations is needed.**

## Discussions

- i) Positive trend ( $\sim 1\%/yr$ ) is found in the recycling rate of atmospheric moisture for the period 2002-2008.**
- ii) Similar linear trends ( $\sim 1\%/yr$ ) in this work (2002-08) and in the previous work (1988-94) suggest a long-term consistent trend in the recycling rate.**
- iii) Extended period of observations are in process.**