

# **El Nino/La Nina (ENSO) Impacts on Ohio River StreamFlows**

## **NWA Annual Meeting**

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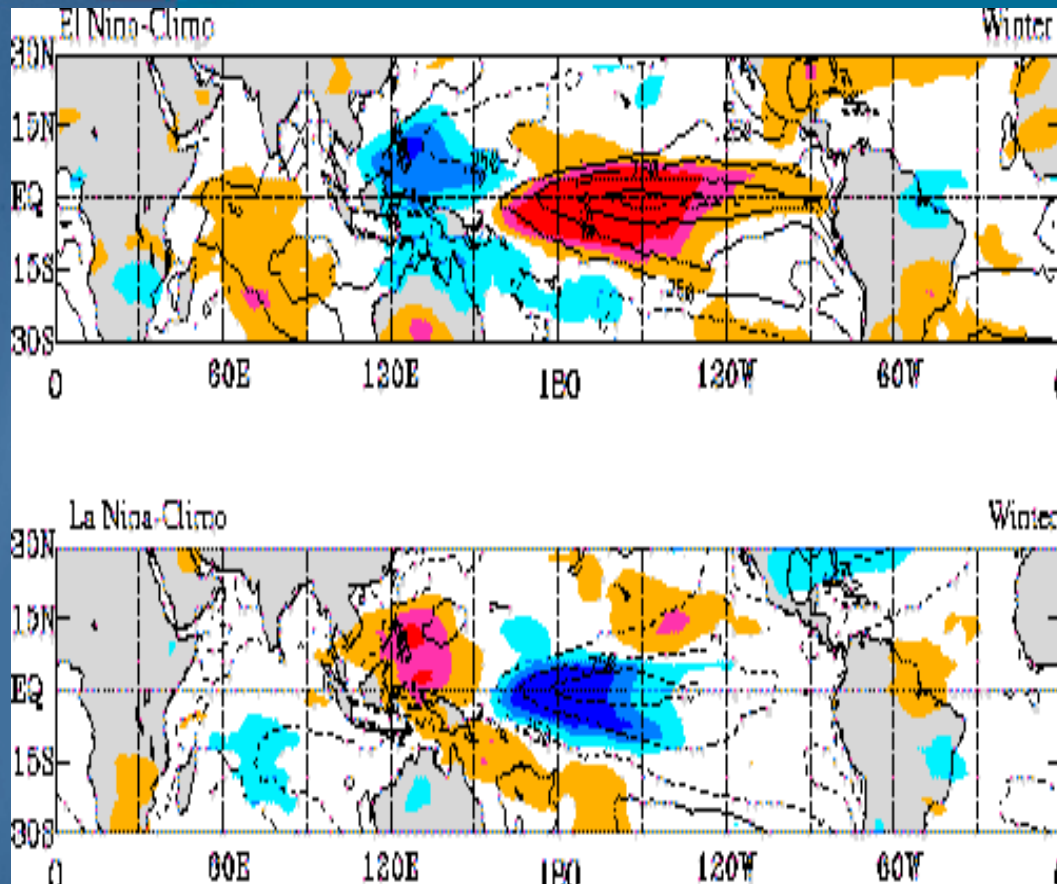
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# Outline

- **What is El Nino/Southern Oscillation ENSO?**
- **ENSO Impacts on Ohio River Streamflows**
  - *Cool Season (Dec-Feb)*
  - *Warm Season (Jun-Aug)*
- **ENSO Impacts on Ohio River Streamflows**
  - *Statistics By Season*
- **Summary**

# What is El Niño/Southern Oscillation ENSO?

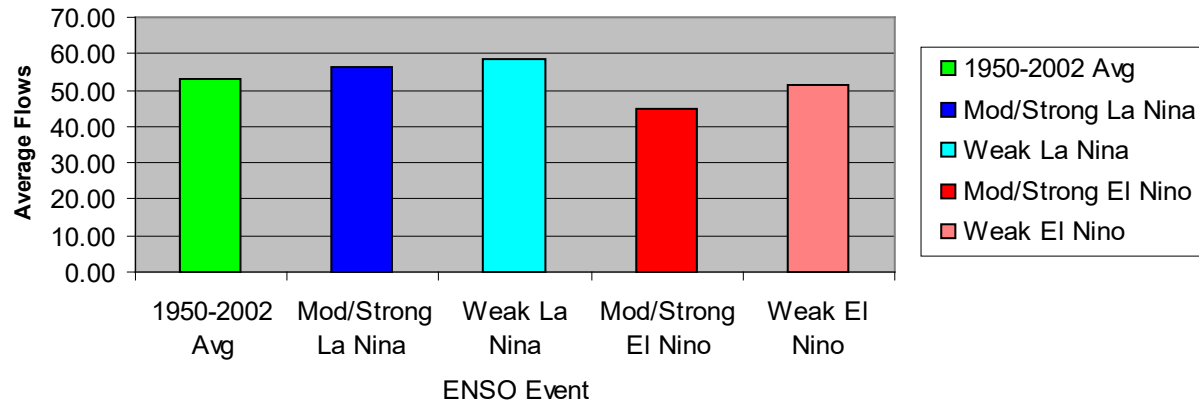


El Niño and La Niña and the Southern Oscillation events play an important role especially in cool season stream flows in the Ohio River basin.

El Niño is referred to as the warming of the equatorial Pacific Ocean along and east of the dateline while La Niña is referred to as the cooling of the equatorial Pacific Ocean along and east of the dateline.

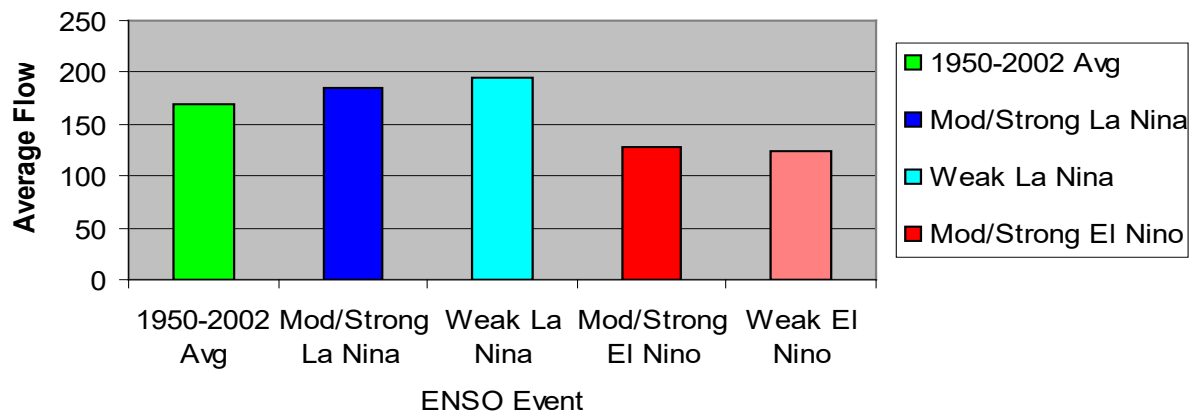
# ENSO Impacts on Ohio River Streamflows – Cool Season

## Sewickly Cool Season



- La Nina events usually produce above normal stream flows on the upper half of the Ohio River in the cool season

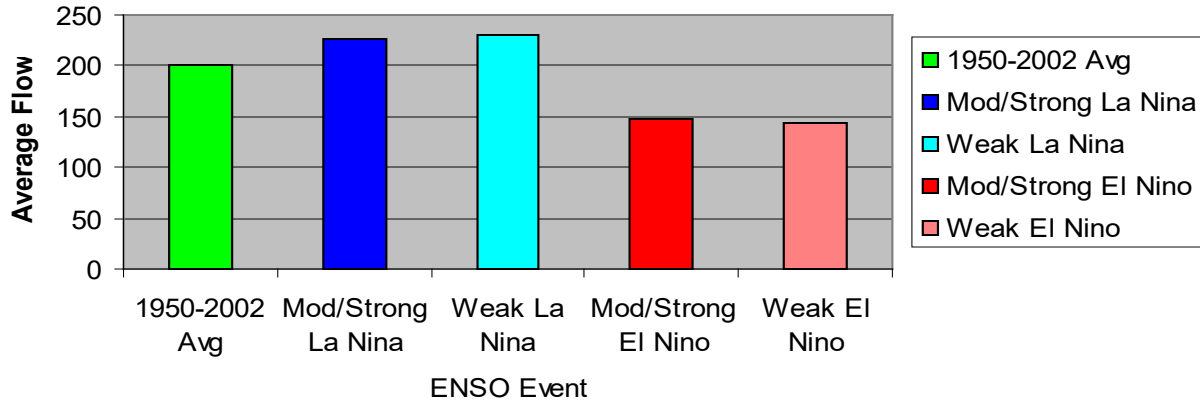
## Cincinnati Cool Season



- El Nino events usually produce below normal stream flows on the upper half of the Ohio River in the cool season

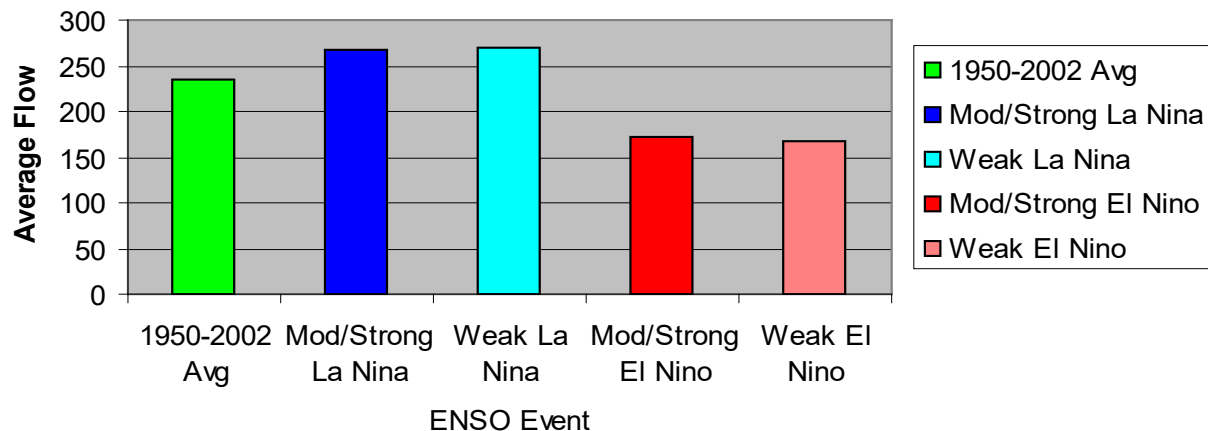
# ENSO Impacts on Ohio River Streamflows – Cool Season

## Louisville Cool Season



- La Nina events usually produce above normal stream flows on the lower half of the Ohio River in the cool season

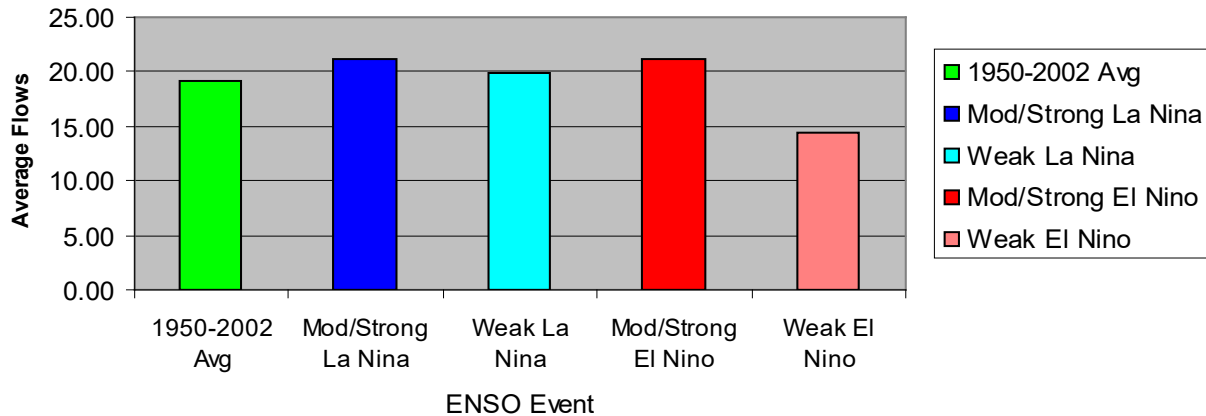
## Evansville Cool Season



- El Nino events usually produce below normal stream flows on the lower half of the Ohio River in the cool season

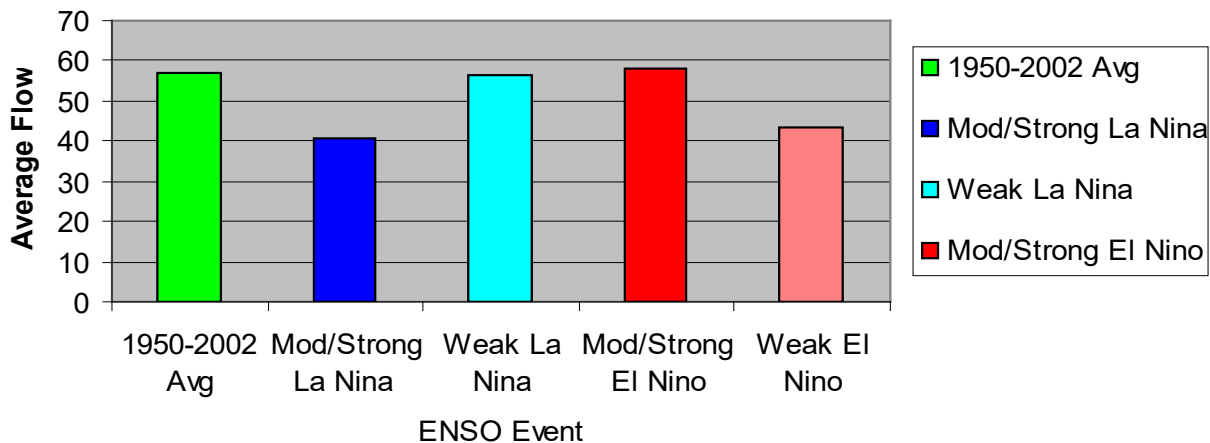
# ENSO Impacts on Ohio River Streamflows – Warm Season

## Sewickly Warm Season



- Normal to below normal stream flow trends occur for both El Nino and La Nina events in the upper Ohio River.

## Cincinnati Warm Season

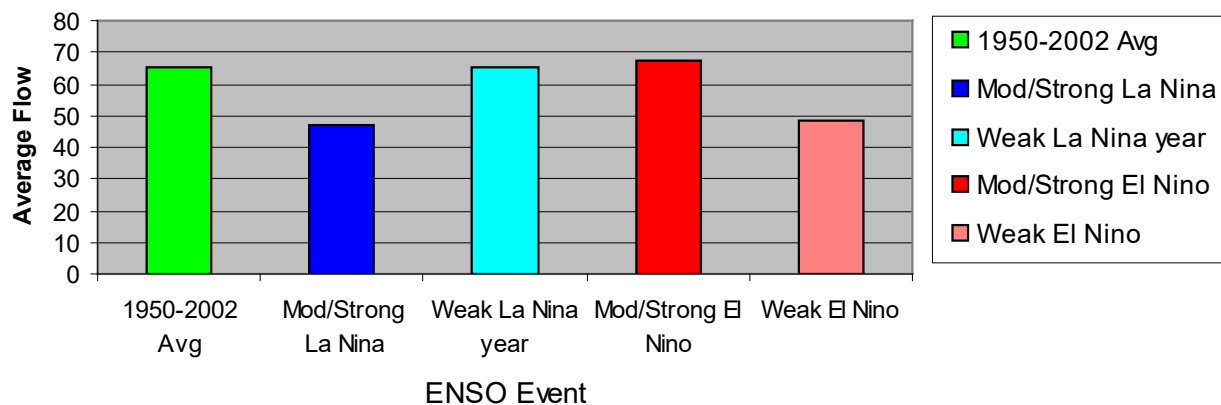


- The exception was moderate to strong El Nino events which showed a trend in the upper Ohio River of above normal stream flows.



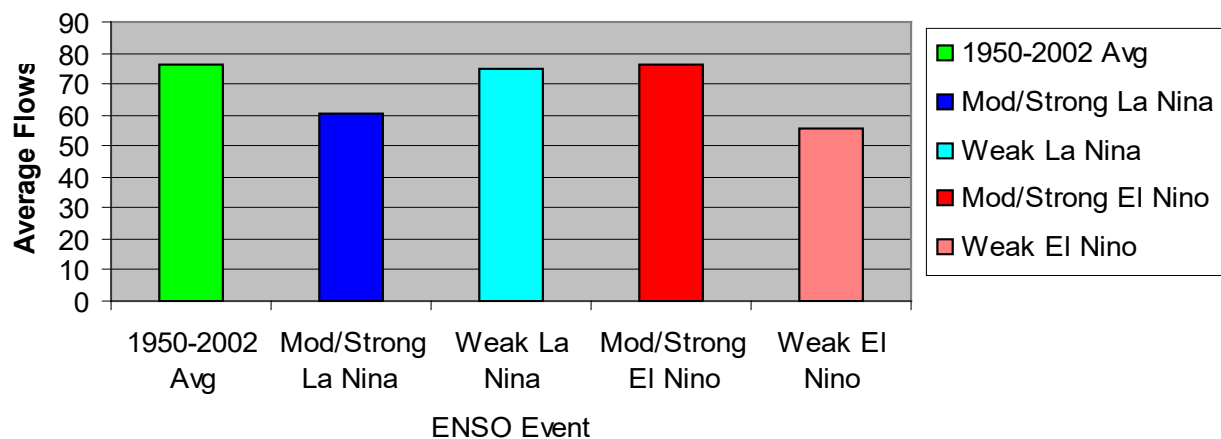
# ENSO Impacts on Ohio River Streamflows – Warm Season

## Louisville Warm Season



- Normal to below normal stream flow trends occur for both El Nino and La Nina events in the lower Ohio River.

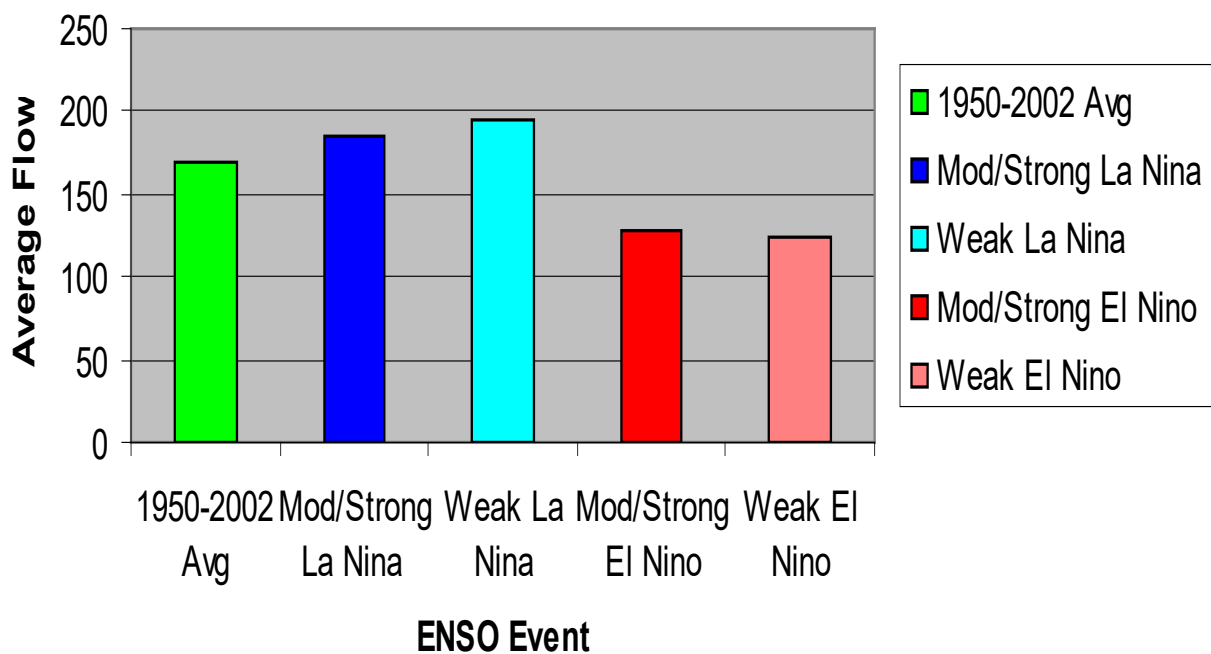
## Evansville Summer



- The exception was moderate to strong El Nino events which showed a trend in the lower Ohio River of above normal stream flows.

# ENSO Impacts on Ohio River Streamflows – Winter Statistics

Cincinnati Cool Season



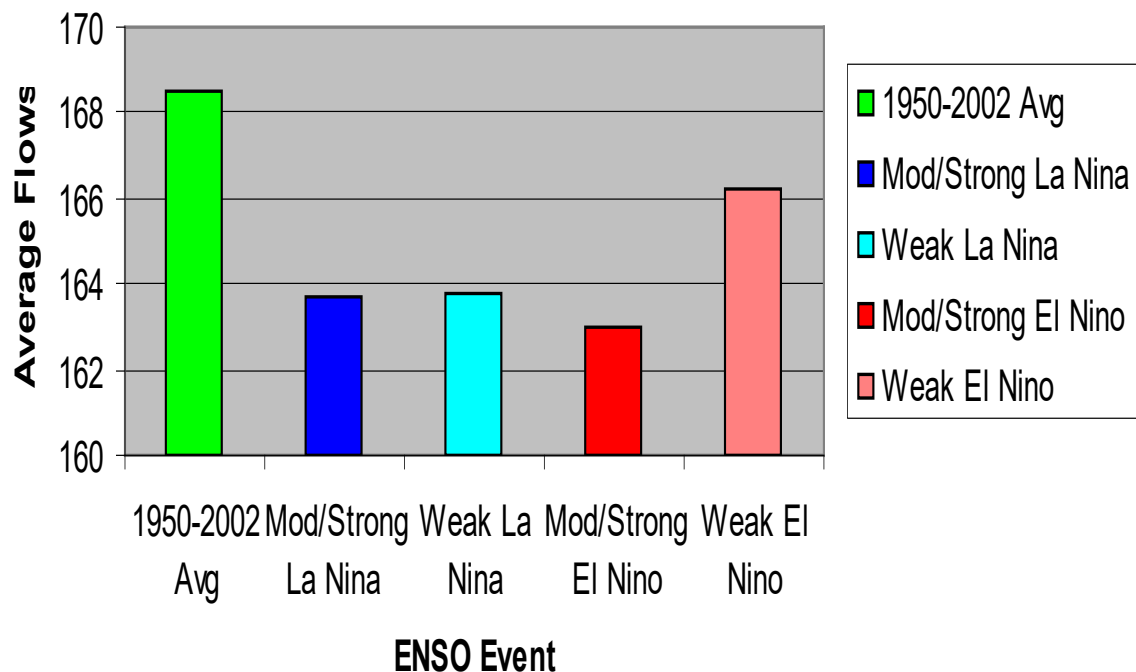
## Statistical Significance

- All La Nina – 0.02
- Mod/Strong – 0.38
- Weak – 0.06
  
- All El Nino – 0.01
- Mod/Strong – 0.01
- Weak – 0.10



# ENSO Impacts on Ohio River Streamflows – Spring Statistics

Cincinnati Spring Season

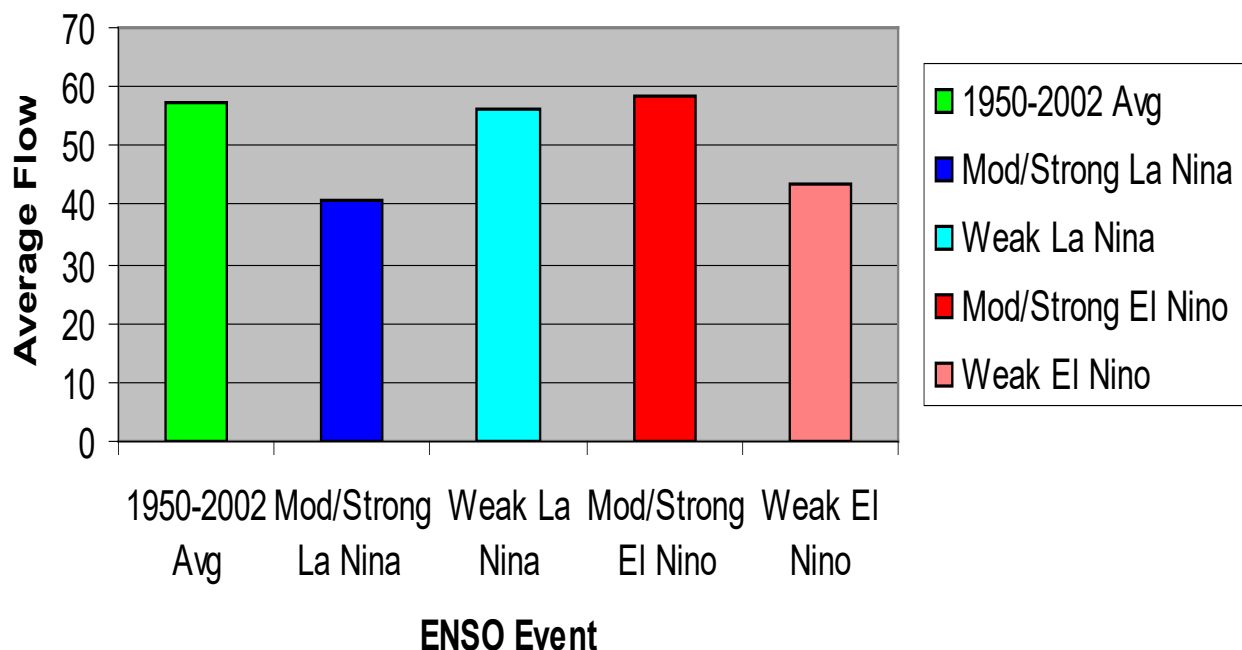


## Statistical Significance

- All La Nina – 0.62
- Mod/Strong – 0.82
- Weak – 0.69
  
- All El Nino – 0.75
- Mod/Strong – 0.77
- Weak – 0.88

# ENSO Impacts on Ohio River Streamflows – Summer Statistics

Cincinnati Warm Season

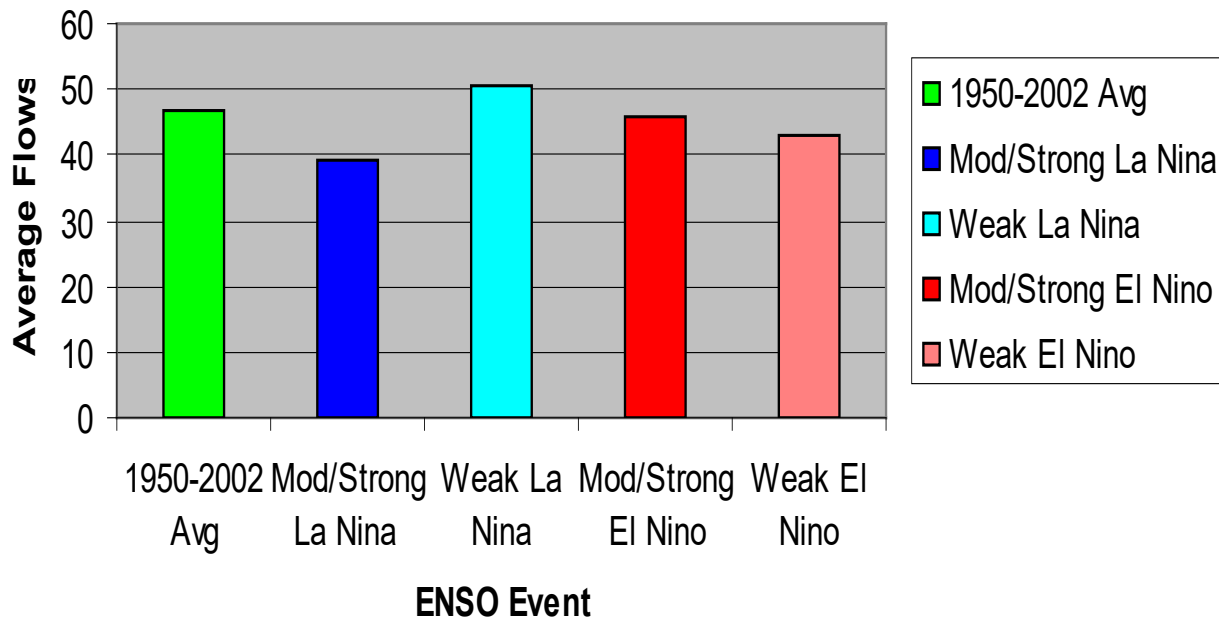


## Statistical Significance

- All La Nina – 0.37
- Mod/Strong – 0.18
- Weak – 0.92
- All El Nino – 0.23
- Mod/Strong – 0.93
- Weak – 0.10

# ENSO Impacts on Ohio River Streamflows – Autumn Statistics

Cincinnati Fall Season



## Statistical Significance

- All La Nina – 0.68
- Mod/Strong – 0.33
- Weak – 0.63
  
- All El Nino – 0.59
- Mod/Strong – 0.69
- Weak – 0.57

# Summary

- **El Nino events usually produce below normal cool season flows along the Ohio River while La Nina events usually produce above normal flows. Both events are statistically significant above the 95% level using the student t-test.**
- **Flows tend to be below normal in the warm season. The exception is moderate to strong El Nino events trend toward slightly above normal. Only weak El Nino events were statistically significant at the 90% level.**
- **In seasons other than the winter cool season, weak El Nino and moderate to strong La Nina events and moderate to strong El Nino and weak La Nina events tend to show the same trends in streamflow.**
- **ENSO plays a role in Ohio River flows especially in the cool season where flows are statistically significant**