### PACIFIC DECADAL VARIABILITY by Emanuele Di Lorenzo



#### Georgia Ocean Science Tech & Engineering

### PACIFIC DECADAL VARIABILITY by Emanuele Di Lorenzo

PACIFIC MERIDIONAL MODES (PMMS)

2015-2016

PACIFIC DECADAL OSCILLATION (PDO)

NORTH PACIFIC GYRE OSCILLATION (NPGO)

INTERDECADAL PACIFIC OSCILLATION (IPO) EL NIÑO SOUTHERN OSCILLATION (ENSO)

SOUTH PACIFIC DECADAL OSCILLATION (SPDO)

2014-2015

2013-2015

### Georgia Ocean Science Tech & Engineering

### How to make sense of this?

PACIFIC MERIDIONAL MODES (PMMS) PACIFIC DECADAL OSCILLATION (PDO)

NORTH PACIFIC GYRE OSCILLATION (NPGO)

INTERDECADAL PACIFIC OSCILLATION (IPO) EL NIÑO SOUTHERN OSCILLATION (ENSO)

### How to make sense of this?

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PACIFIC MERIDIONAL MODES (PMMS)

PACIFIC DECADAL OSCILLATION (PDO)

INTERDECADAL PACIFIC OSCILLATION (IPO)

EL NIÑO SOUTHERN OSCILLATION (ENSO) North Pacific Gyre Oscillation (NPGO)

#### converge in space & time

PACIFIC MERIDIONAL MODES (PMMS)

**INTERDECADAL** 

PACIFIC

**OSCILLATION** 

(**IPO**)

**EL NIÑO** 

SOUTHERN

**O**SCILLATION

(ENSO)

PACIFIC DECADAL OSCILLATION (PDO)

NORTH PACIFIC GYRE OSCILLATION (NPGO)

#### converge in space & time

#### *interaction between* Meridional and ENSO Modes

PACIFIC MERIDIONAL MODES (PMMS)

PACIFIC DECADAL OSCILLATION (PDO)

North

**PACIFIC GYRE** 

**OSCILLATION** 

(NPGO)

INTERDECADAL PACIFIC OSCILLATION (IPO)

EL NIÑO SOUTHERN OSCILLATION (ENSO)

SOUTH PACIFIC DECADAL OSCILLATION

(SPDO)



-200

60

40

20

-20

-40

-250

-0.5

### ENSO-LIKE DECADAL

VARIABILITY

SSTa Correlation with PC1 of 6year lowpass SSTa

0 **R** 

-150

-100

0.5

Zhang et al. 1997; and many others

PACIFIC MERIDIONAL MODES (PMMS)

**INTERDECADAL** 

PACIFIC

**OSCILLATION** 

(**IPO**)

**EL NIÑO** 

SOUTHERN

**OSCILLATION** 

PACIFIC DECADAL OSCILLATION (PDO)

NORTH PACIFIC GYRE OSCILLATION (NPGO)



SSTa Correlation with PC1 of 6year lowpass SSTa





SSTa Correlation with PC1 of 6year lowpass SSTa



#### **OBSERVATIONS**





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#### Meridional Modes:

in the extra-tropics initiates the evolution of Pacific decadal variability



Di Lorenzo et al. GRL, 2015

#### **OBSERVATIONS**





#### **SLPa** Correlation with ENSO Mode

Work by Zhang, Chiang, Vimont, Anderson, and others



Zhao and Di Lorenzo, 2017, in revision



Zhao and Di Lorenzo, 2017, in revision









**NSLP** pre

**SSLP** pre

#### **QUESTION**:

So how does a Meridional work and how does it interact with ENSO?





#### **QUESTION**:

So how does a Meridional work and how does it interact with ENSO?













































#### SUGGESTION:

Increase in multi-year persistence of the **Atmospheric Drivers** of the marine heatwaves

Summer & Fall

2015

THERMODYNAMIC FEEDBACKS AMPLIFY SUB-TROPICAL SSTA ACTIVATING ENSO FEEDBACKS

Di Lorenzo et al. GRL, 2015



#### SUGGESTION:

Increase in multi-year persistence of the **Atmospheric Drivers** of the marine heatwaves

SUMMER & Fall

Spring (AMJ)

### **CLIMATE HYPOTH**



**Observations ENS** 

**VARIABILITY** orenzo et al. GRL, 2015



Di Lorenzo et al. GRL, 2015





### Cl

#### Evidence for a Significant **INCREASE IN THE PDV VARIANCE**



### CL

#### Evidence for a Significant **INCREASE IN THE PDV VARIANCE**





#### Evidence for a Significant **INCREASE IN THE PDV VARIANCE**

### **QUESTIONS**

**NPGO-like** 

Why is Pacific Decadal Variance increasing? Is this related to greenhouse forcing?



**PDO-like** 

Di Lorenzo et al. GRL, 2015

























# END

Pacific Decadal Variability (PPAI Talk)

Pacific climate modes tend to ENSO-like pattern in low-frequency limit 0 Map of low frequency modes, and their tendency to approximate ENSO-like The dynamics of ENSO-like decadal variability can be understood as the interactions between MM/ENSO Yingying progression Diagram introduction with processes and relation to climate modes Schematic intro PDV variance increasing Ο PDV index in observations and model showing increasing variance Mechanisms for PDV increasing WES and increase thermodynamic feedback Stronger coupling may impact statistics of extremes How stronger coupling MM/ENSO can lead to stronger coupling of North Pacific mode and the multi-year persistence of warm/cold events Predictability of PDV may want to explore subsurface dynamics О Source of surface PDV predictability are related to the growth and decay of the PDV, but limited to a 1-3 years Exploiting and understanding subsurface dynamics may lead to longer "decadal" predictability