PERÚ Ministerio del Ambiente | Instituto Geofísico del Perú

Ciencia para protegernos
Ciencia para avanzar

Prediction of El Niño/La Niña, their diversity and climate impacts in Peru

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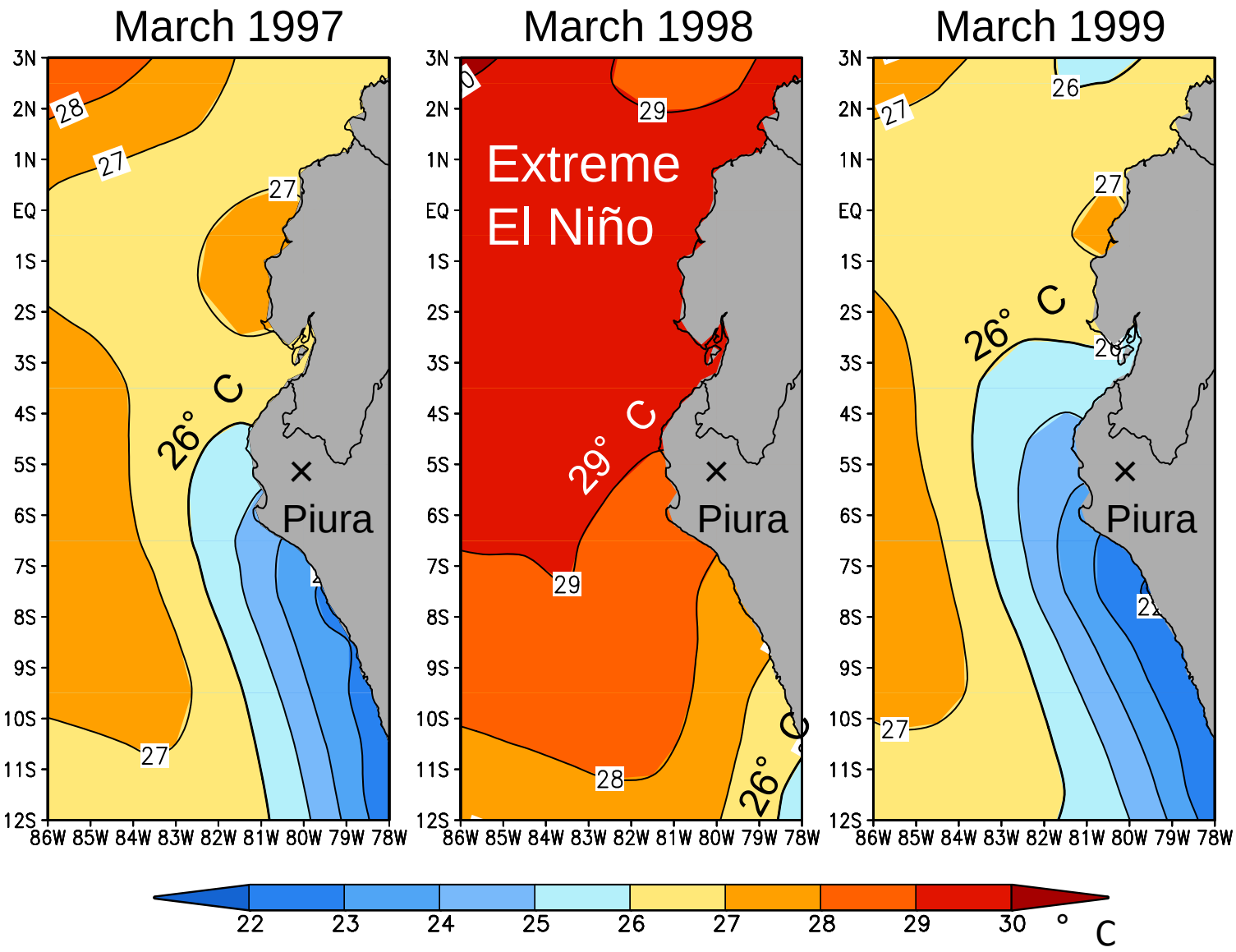
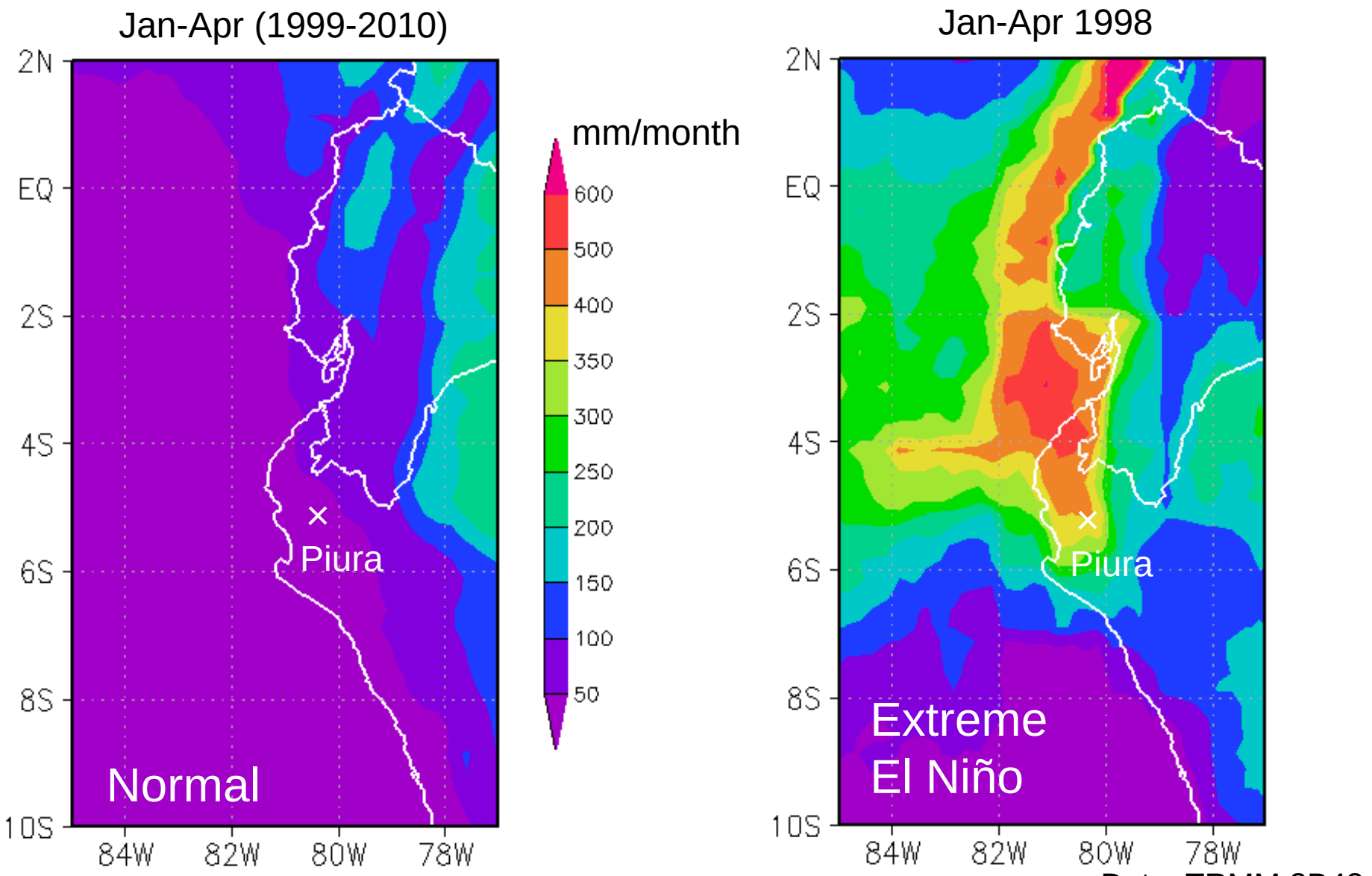
Strong interannual variability of the sea surface temperature

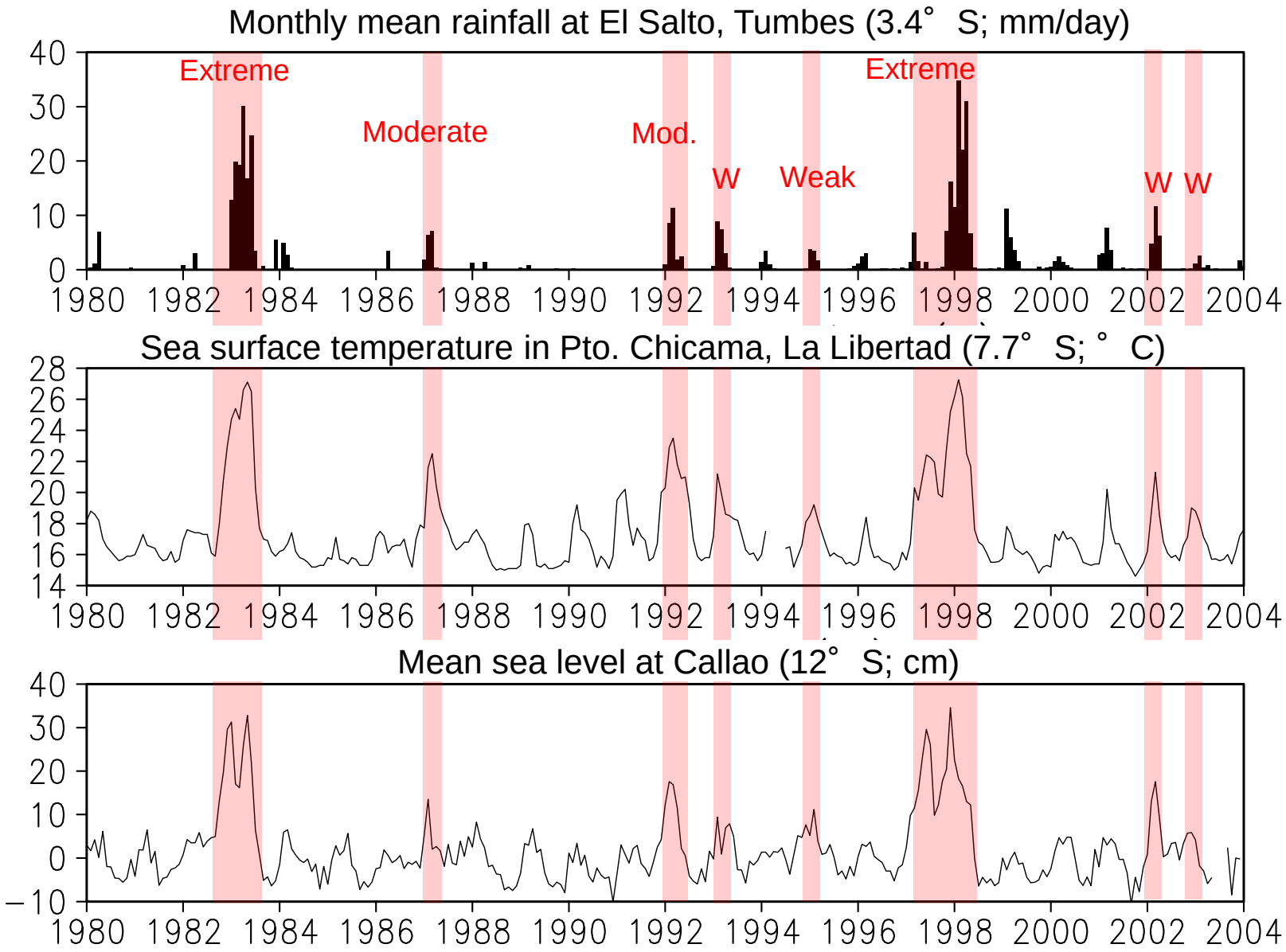


Variability in precipitation



Data: TRMM 3B43

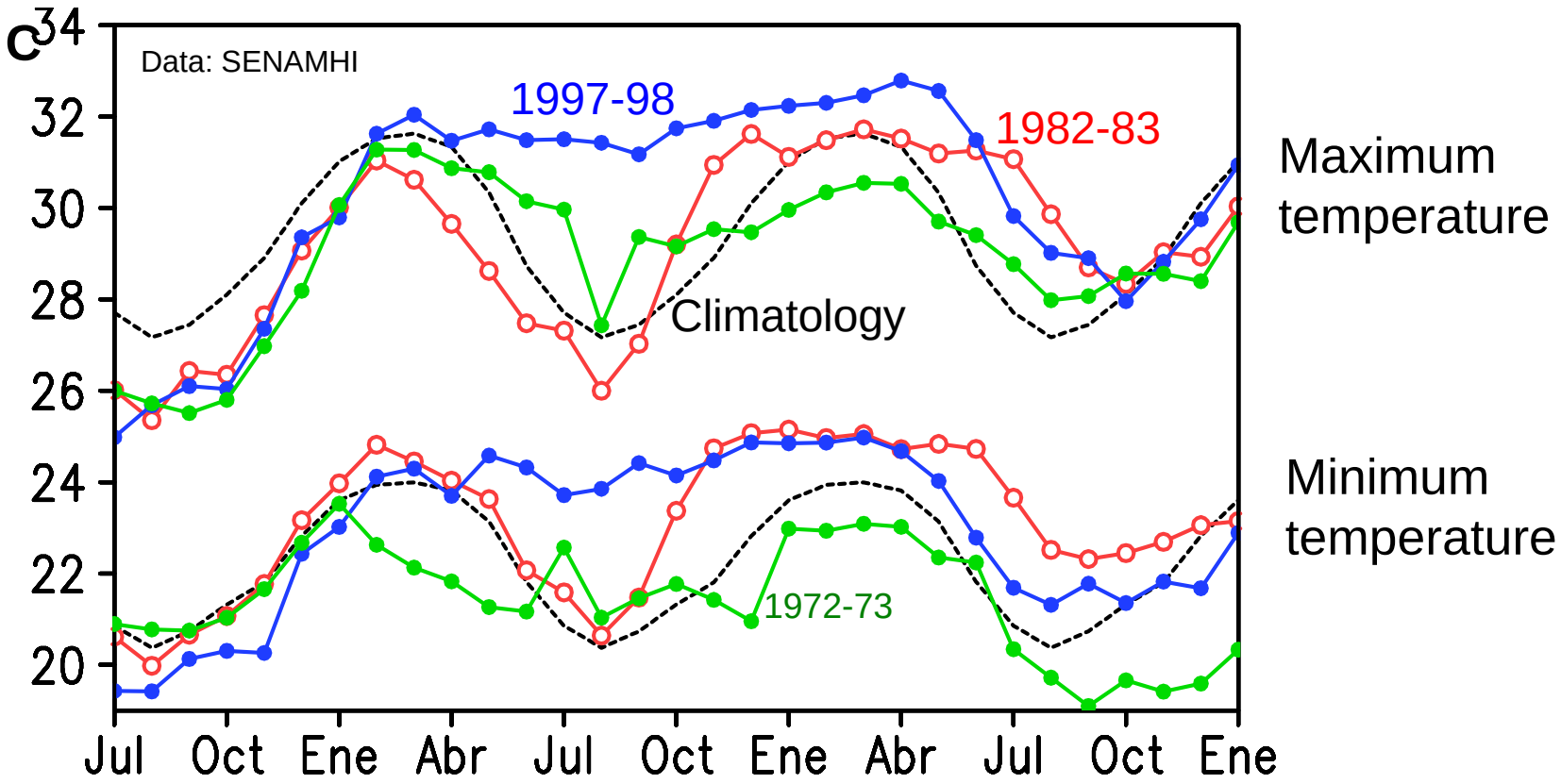
El Niño on the coast of Peru



Monthly coastal air temperature

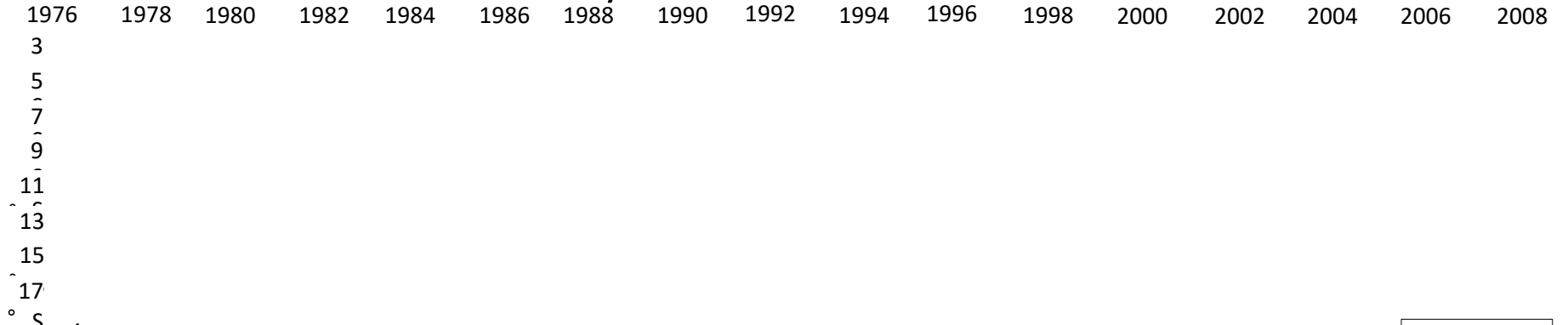
Puerto Pizarro, Tumbes (3.5° S)

Winter was not experienced during the extreme 1997-1998 El Niño



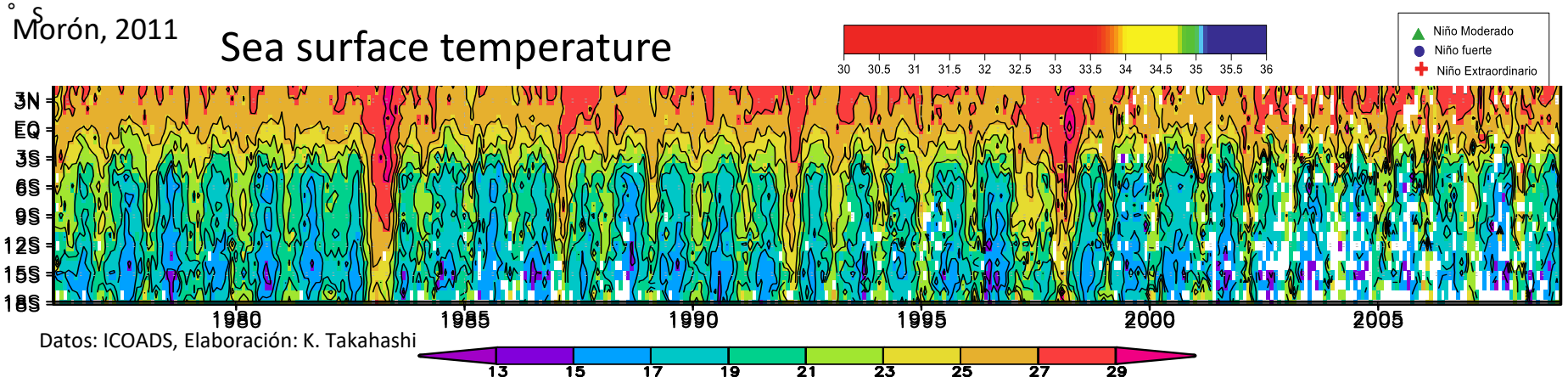
Interannual variability along the coast

Surface ocean salinity



Morón, 2011

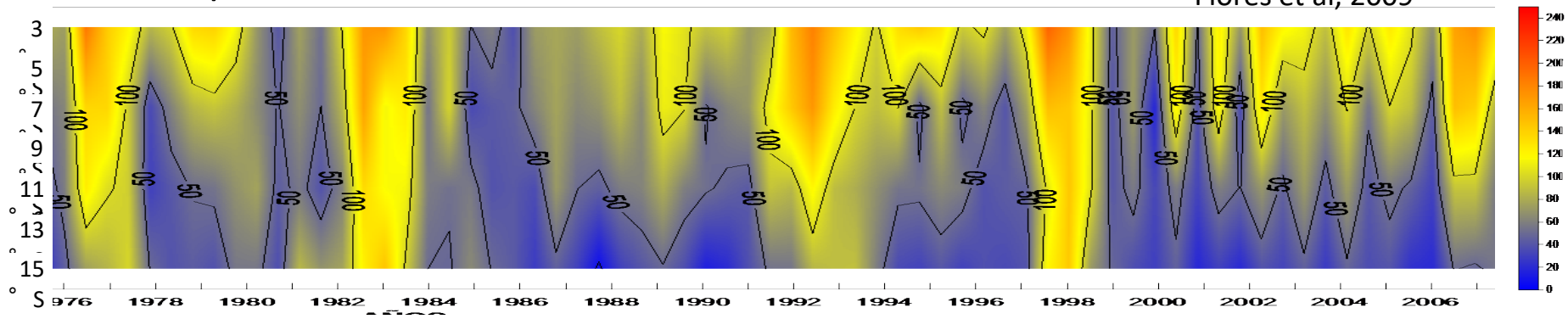
Sea surface temperature



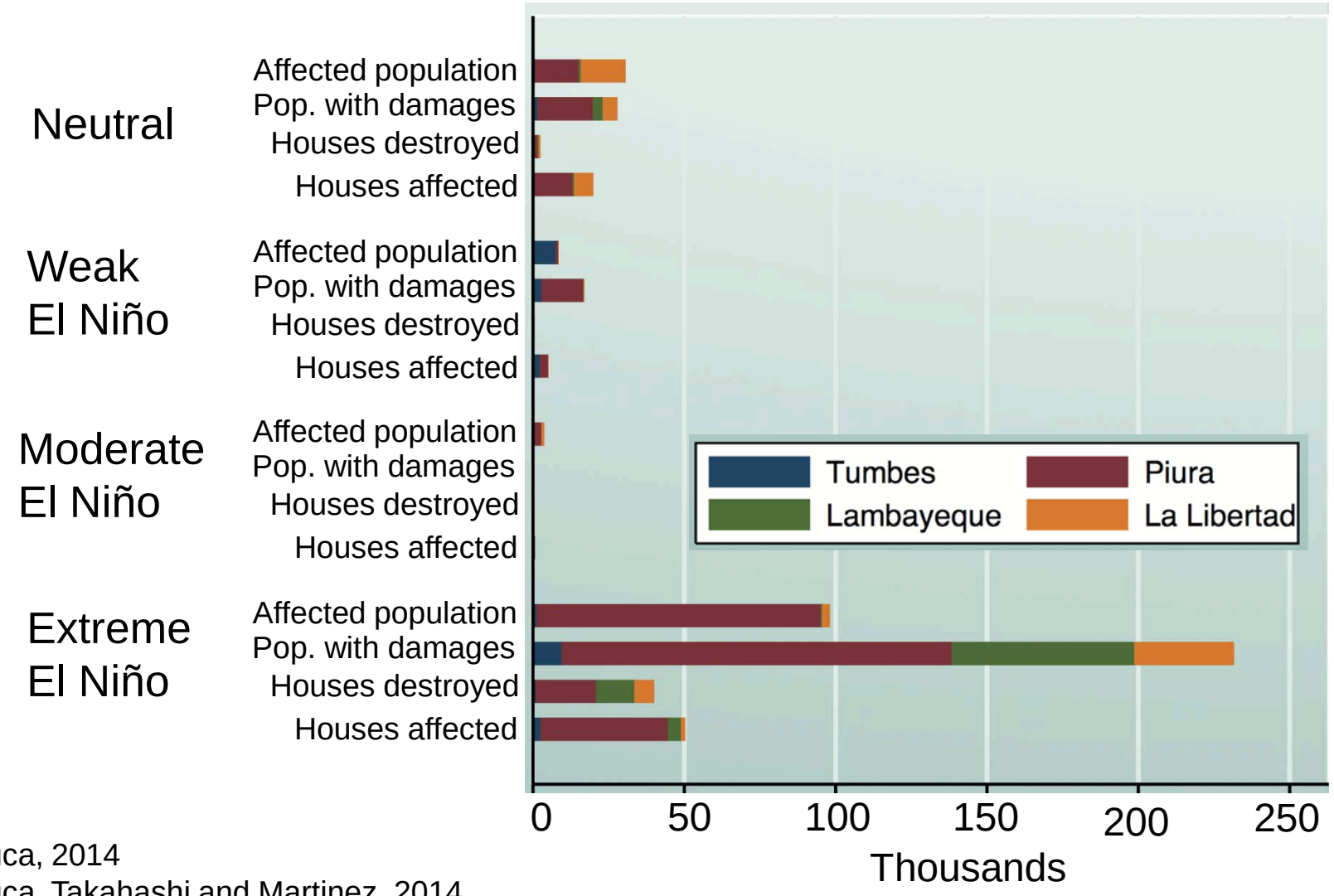
Datos: ICOADS, Elaboración: K. Takahashi

Depth of the 15° C water

Flores et al, 2009

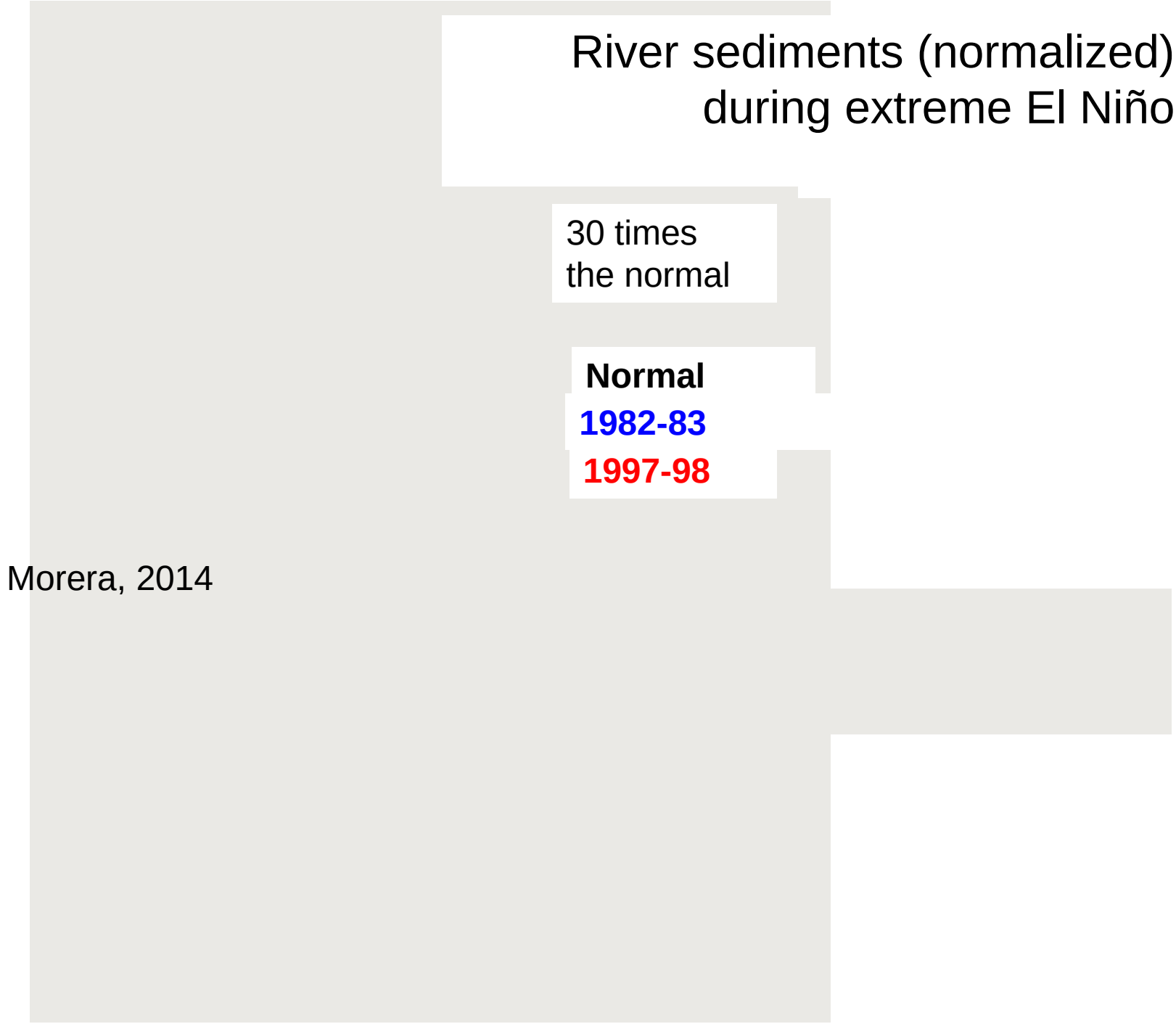


Impacts by flooding in the northern coast according to the the coastal El Niño strength



Machuca, 2014
Machuca, Takahashi and Martinez, 2014

River sediments (normalized) during extreme El Niño

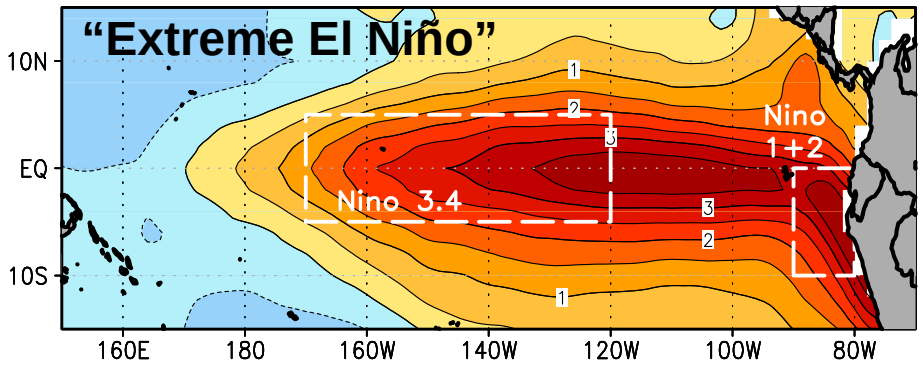


Morera, 2014

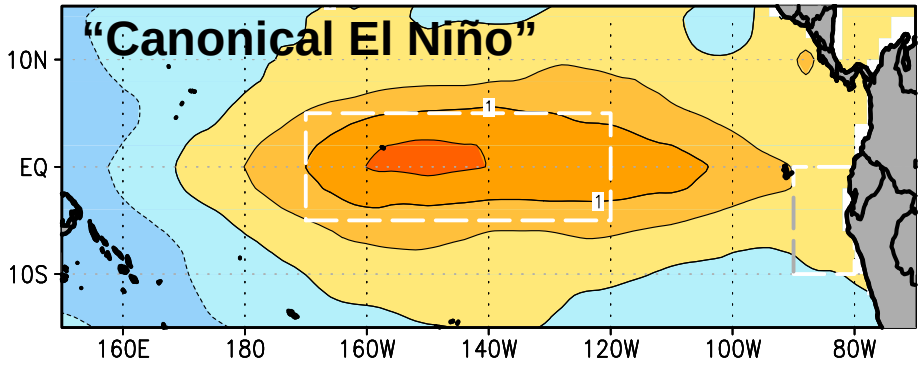
Diversity of El Niño

December-February mean sea surface temperature anomalies

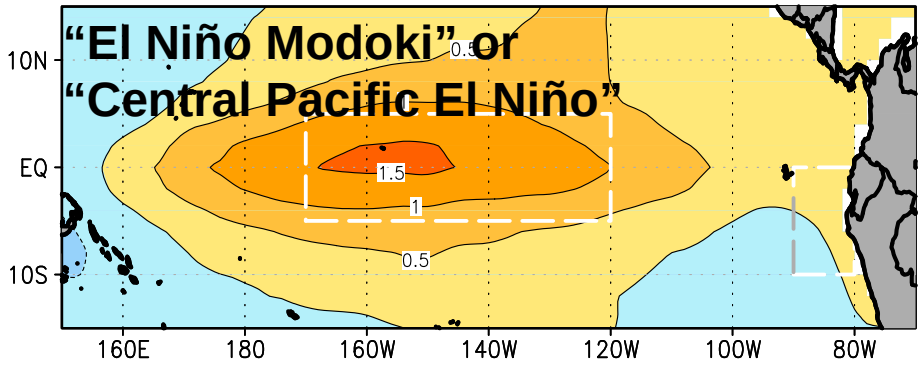
El Nino Extraordinario (1982, 1997)



El Nino "Canonico" (1951, 1953, 1957, 1965, 1969, 1972)

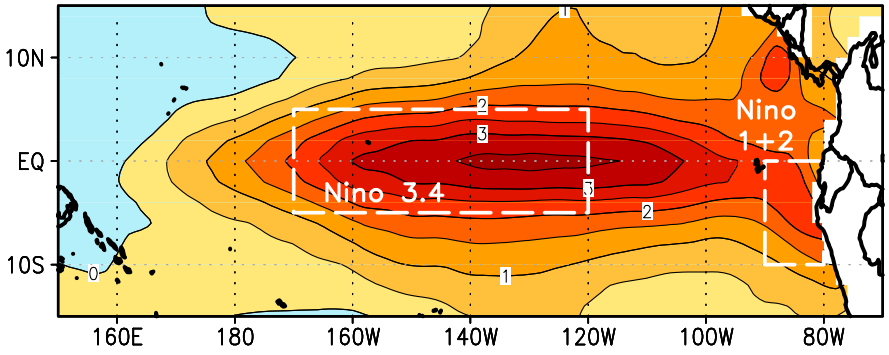


El Nino "Modoki" (1977, 1990, 1994, 2002, 2004, 2009)

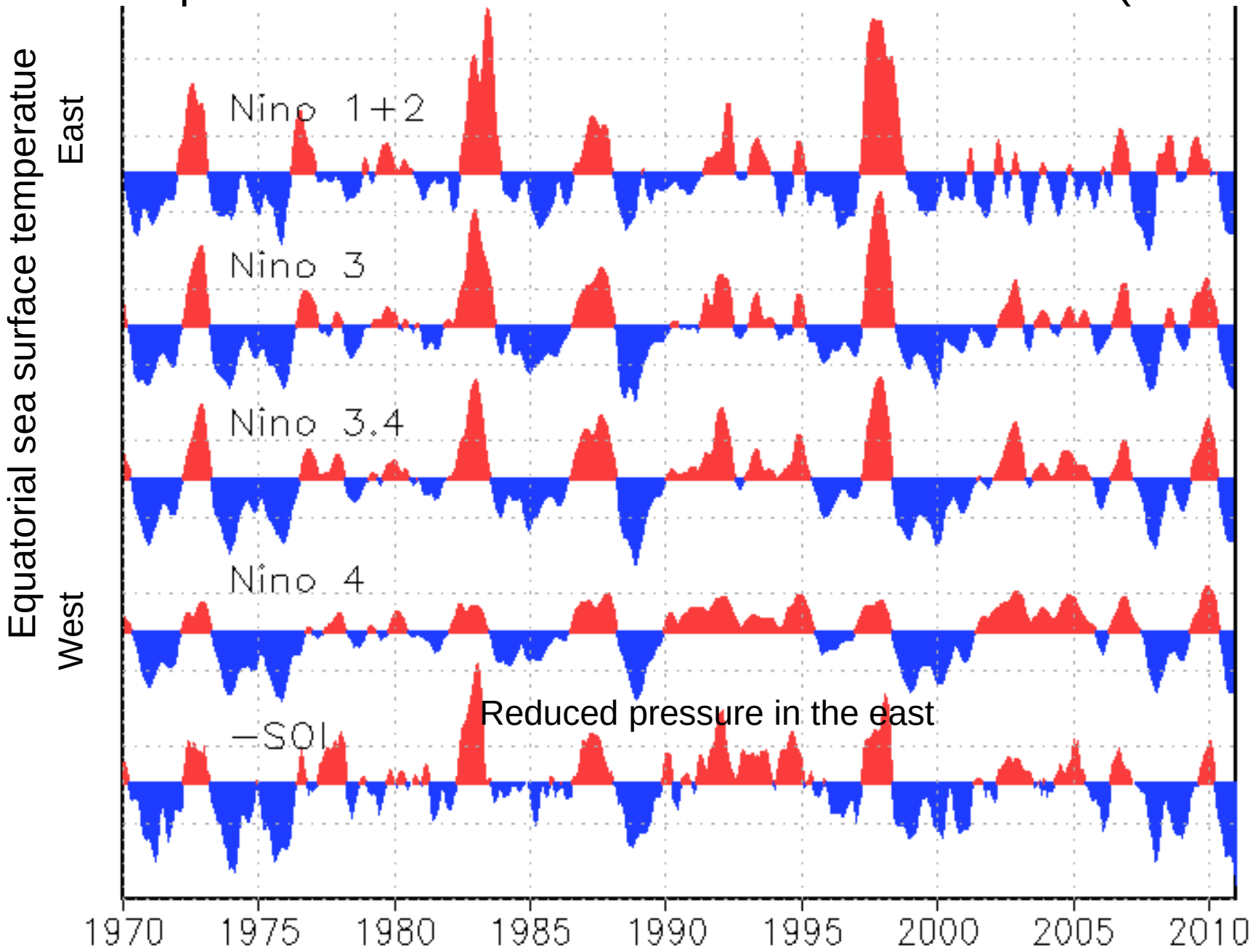


Takahashi, 2014

El Niño 2015-2016

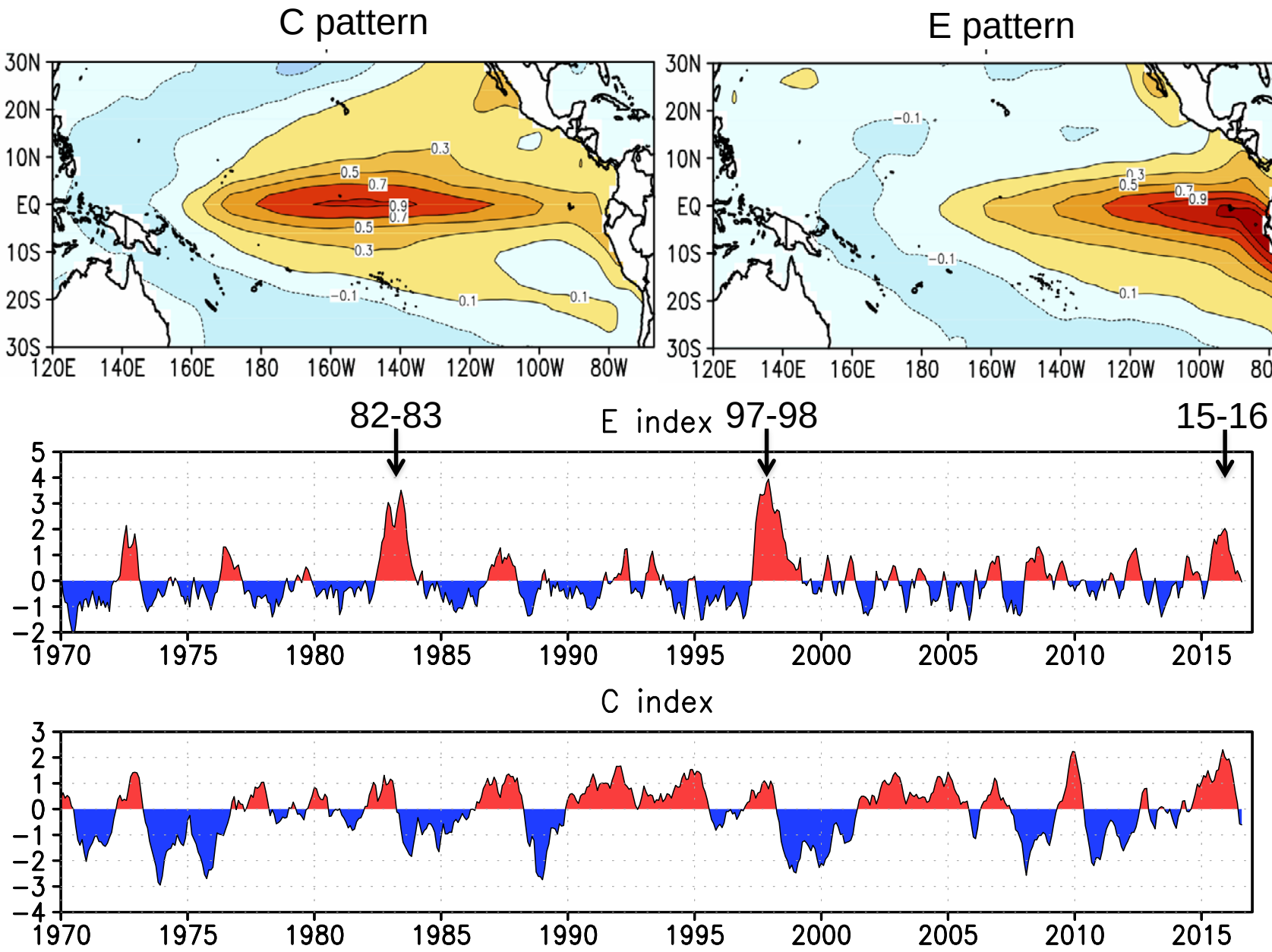


Popular indices for El Niño-Southern Oscillation (ENSO)



El Niño temperature patterns/indices

Takahashi et al, 2011



Sea surface temperature patterns

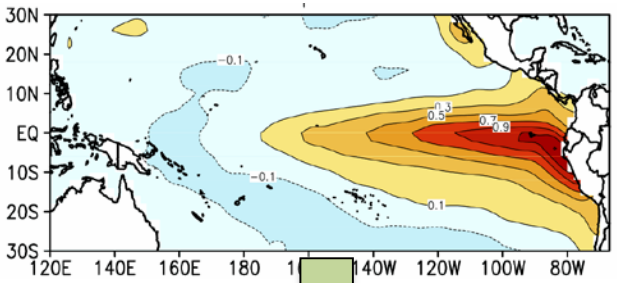
Takahashi, Montecinos, Goubanova and Dewitte, 2011

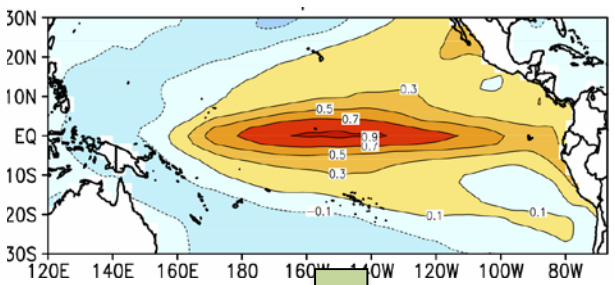
Effect on annual rainfall

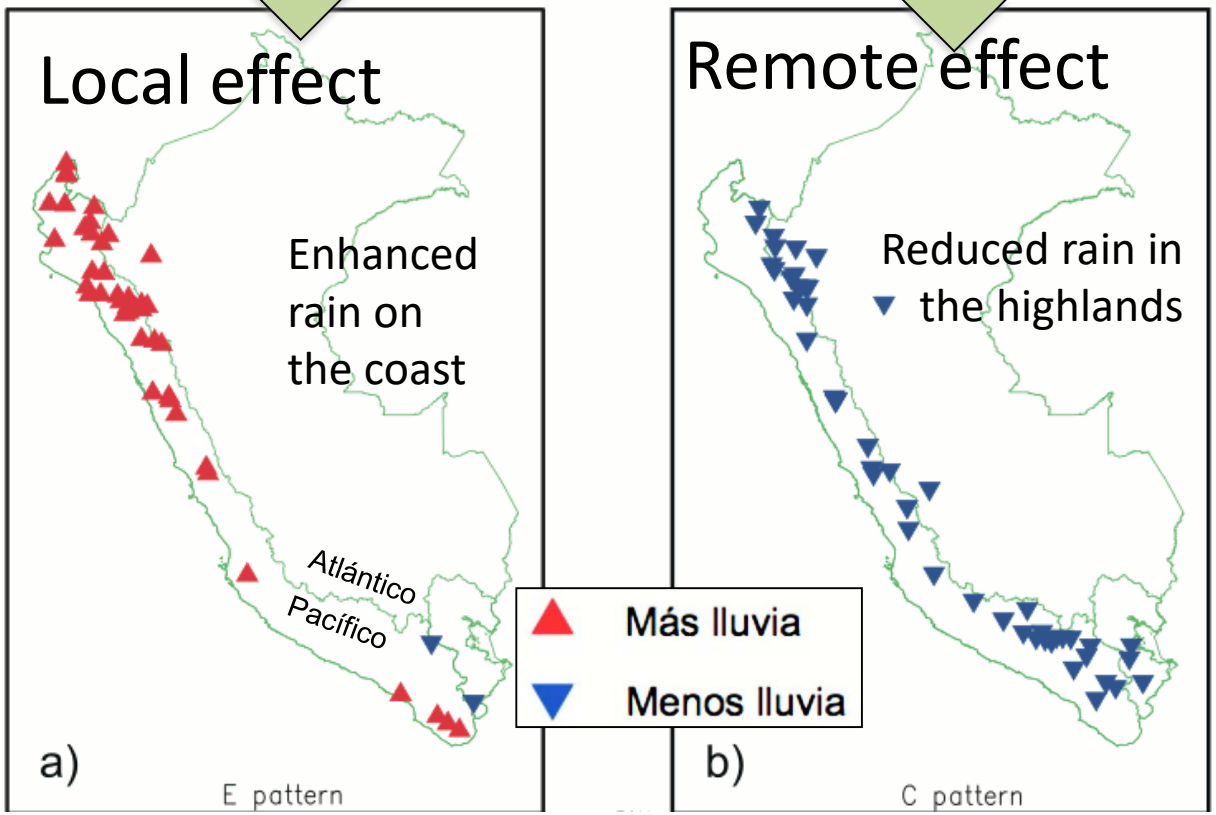
Lavado and Espinoza, 2014

Eastern Pacific (coastal) warming

Central Pacific warming

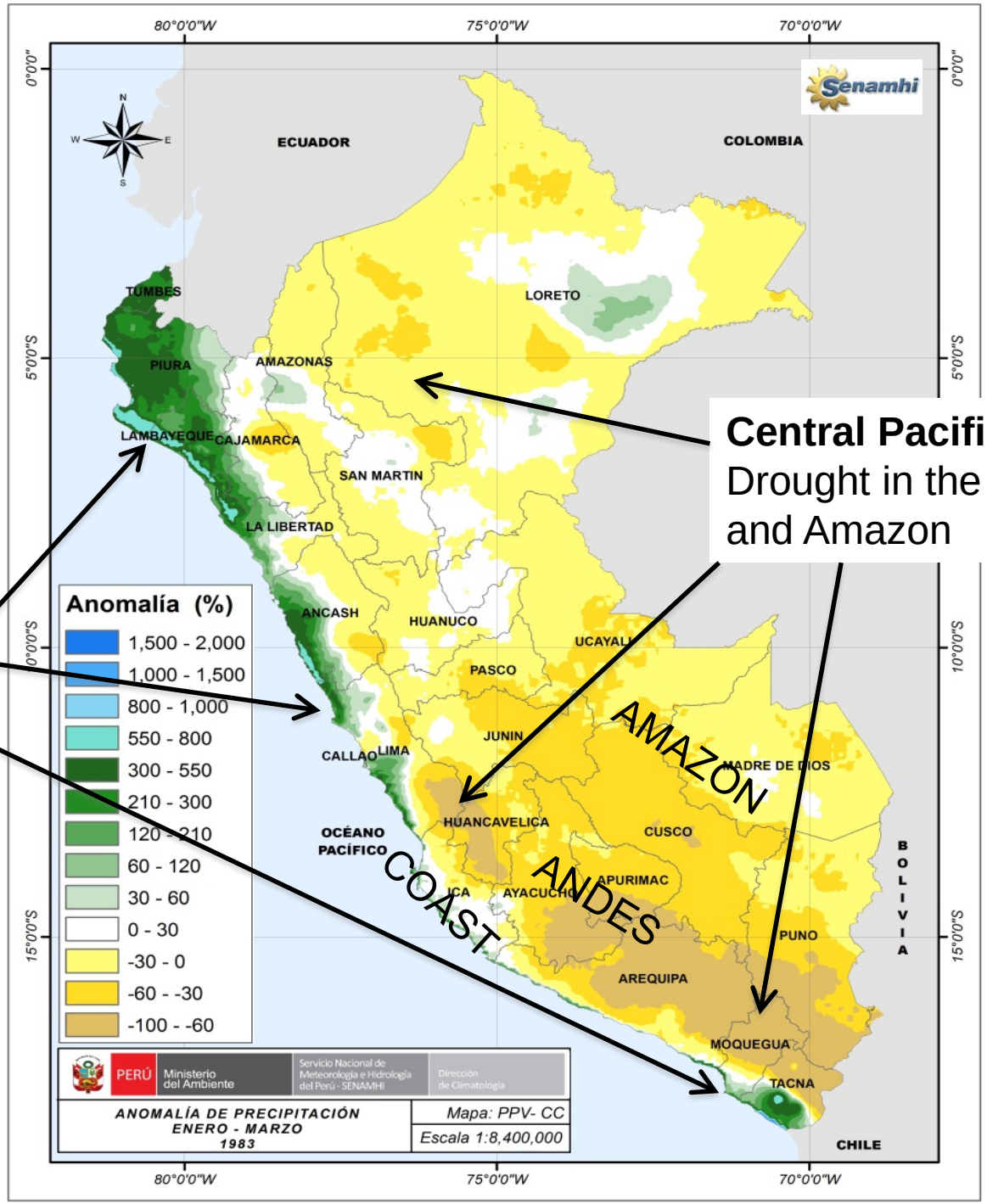






Rainfall anomalies (%) during an extreme El Niño

(Jan-Mar 1983)

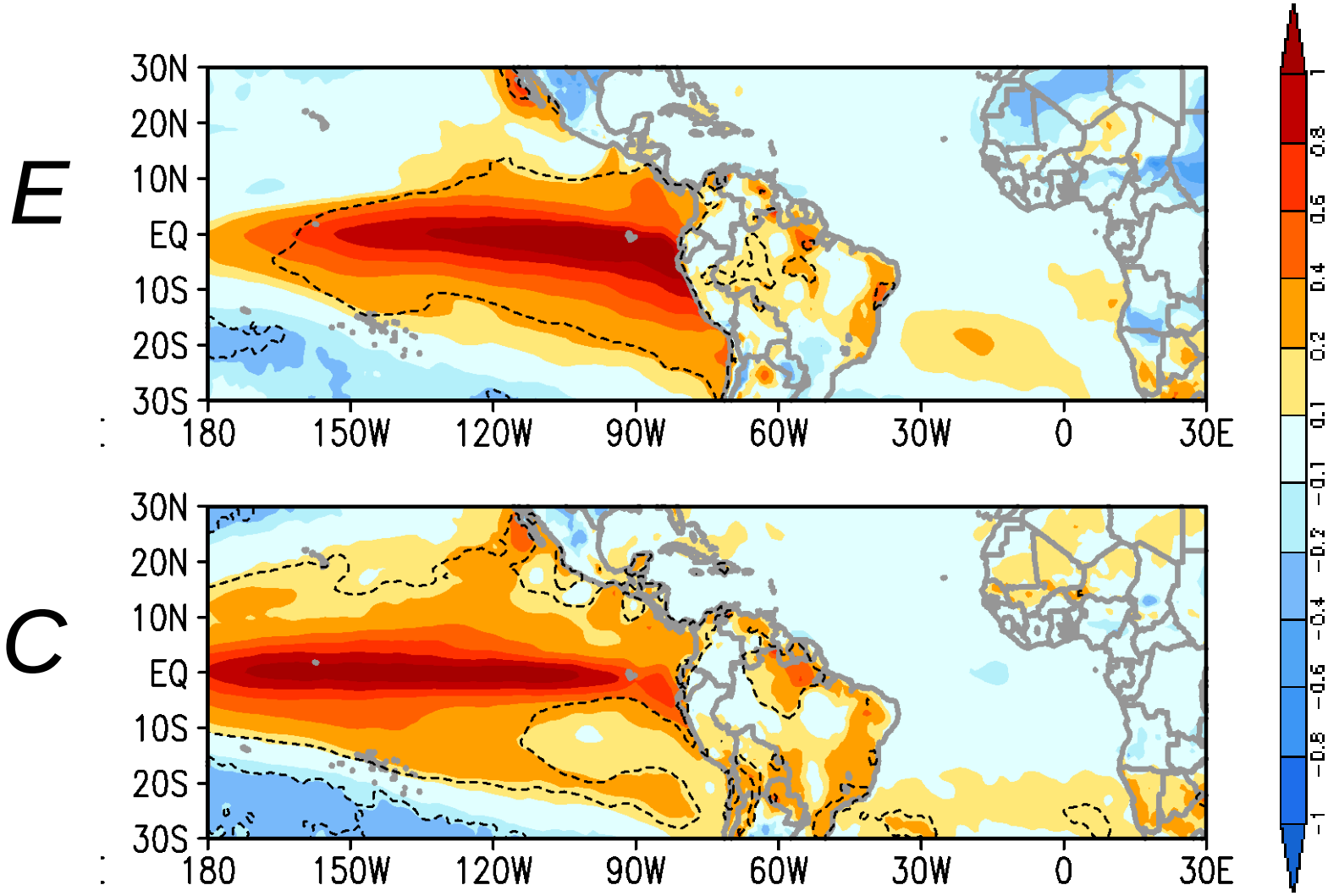


Central Pacific El Niño: Drought in the Andes and Amazon

Coastal El Niño: Heavy rainfall in the arid coast

Source: SENAMHI

Effect on surface temperature of a unit *E* and *C* indices (°C; October-December)



Jiménez-Muñoz, …, Takahashi, et al., 2016

Multisectoral Committee of the National Study of El Niño (ENFEN), Peru

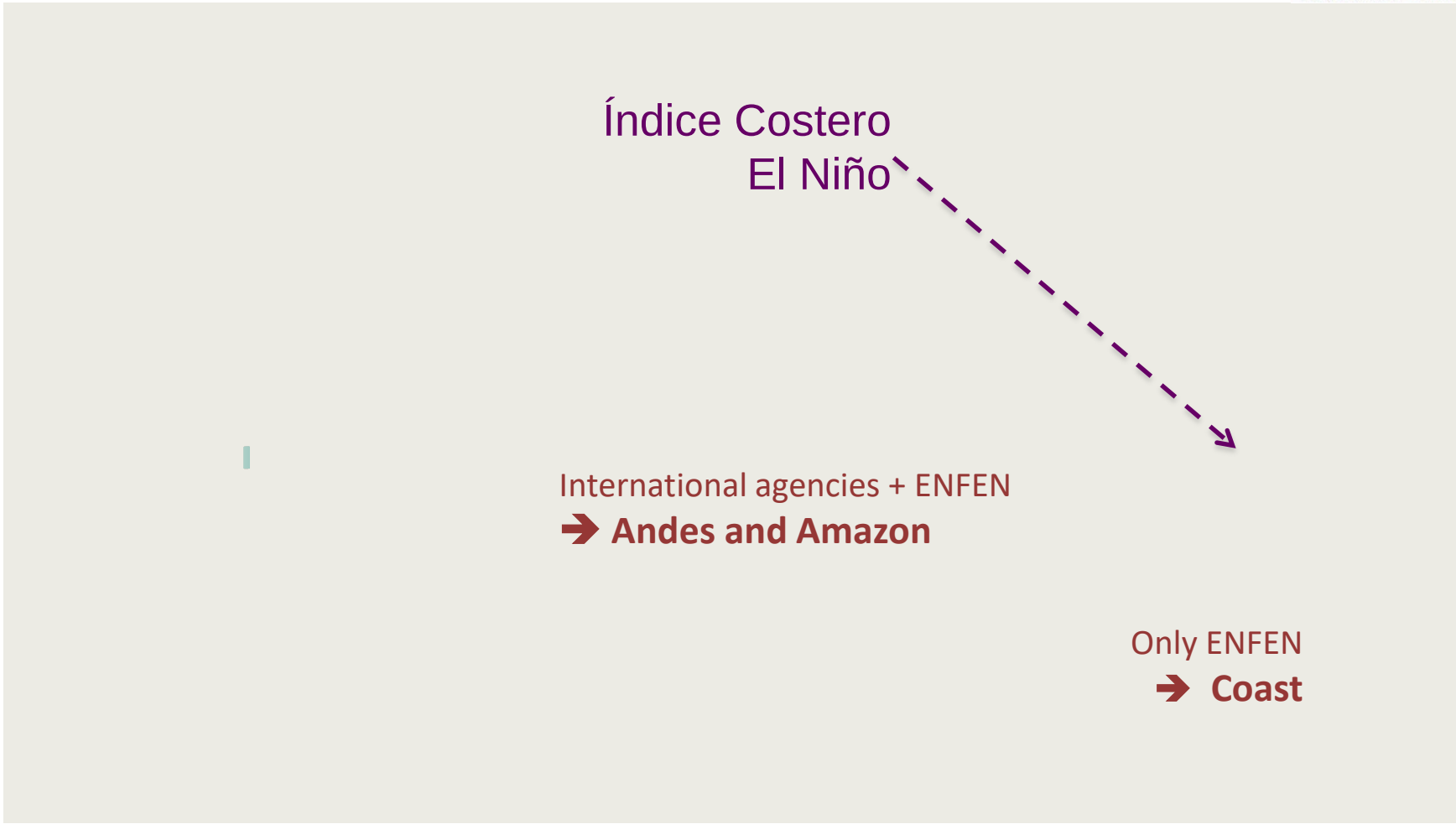
Permanent scientific/technical committee that issues the periodic official assessments and predictions of El Niño and La Niña in Peru

Formed by:

- Instituto del Mar del Perú (IMARPE) *
- Autoridad Nacional del Agua (ANA)
- Dirección de Hidrografía y Navegación de la Marina (DHN)
- Instituto Geofísico del Perú (IGP)
- Instituto Nacional de Defensa Civil (INDECI)
- Servicio Nacional de Meteorología e Hidrología (SENAMHI)

* Presidencia permanente

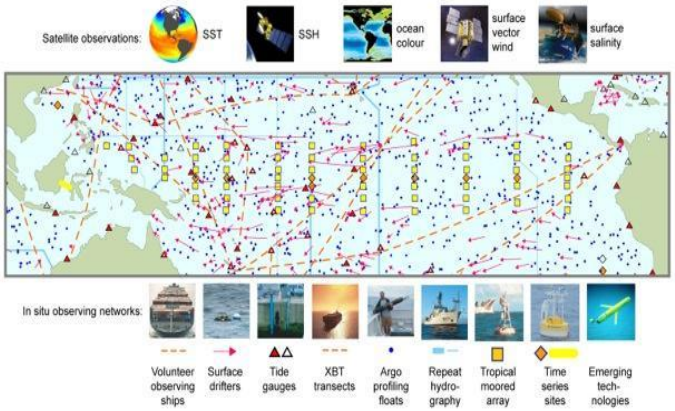
The main regions for the monitoring of SST by ENFEN



Prediction timescales at ENFEN

Range	Lead time	Phenomenon
Short	Hours to weeks	Weather, intraseasonal oscillations
Medium	2-3 months	Equatorial oceanic Kelvin waves and their coastal effects
Long	> 3 months	El Niño-Southern Oscillation (coupled ocean-atmosphere system)

El Niño/La Niña prediction in Peru



Observations
(local and international)

IMARPE SENAMHI DHN IGP INDECI ANA

ENFEN

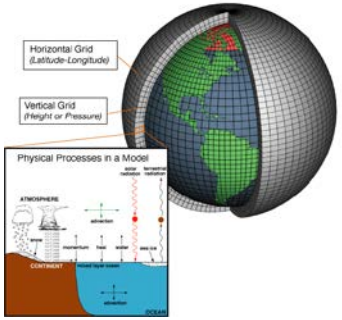
ESTUDIO NACIONAL DEL FENÓMENO "EL NIÑO"

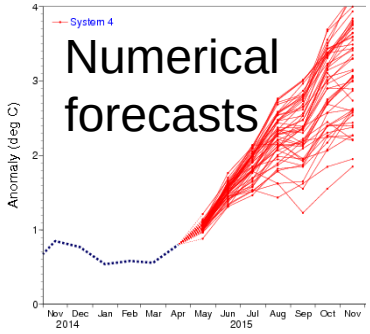
Expert assessment

Prediction

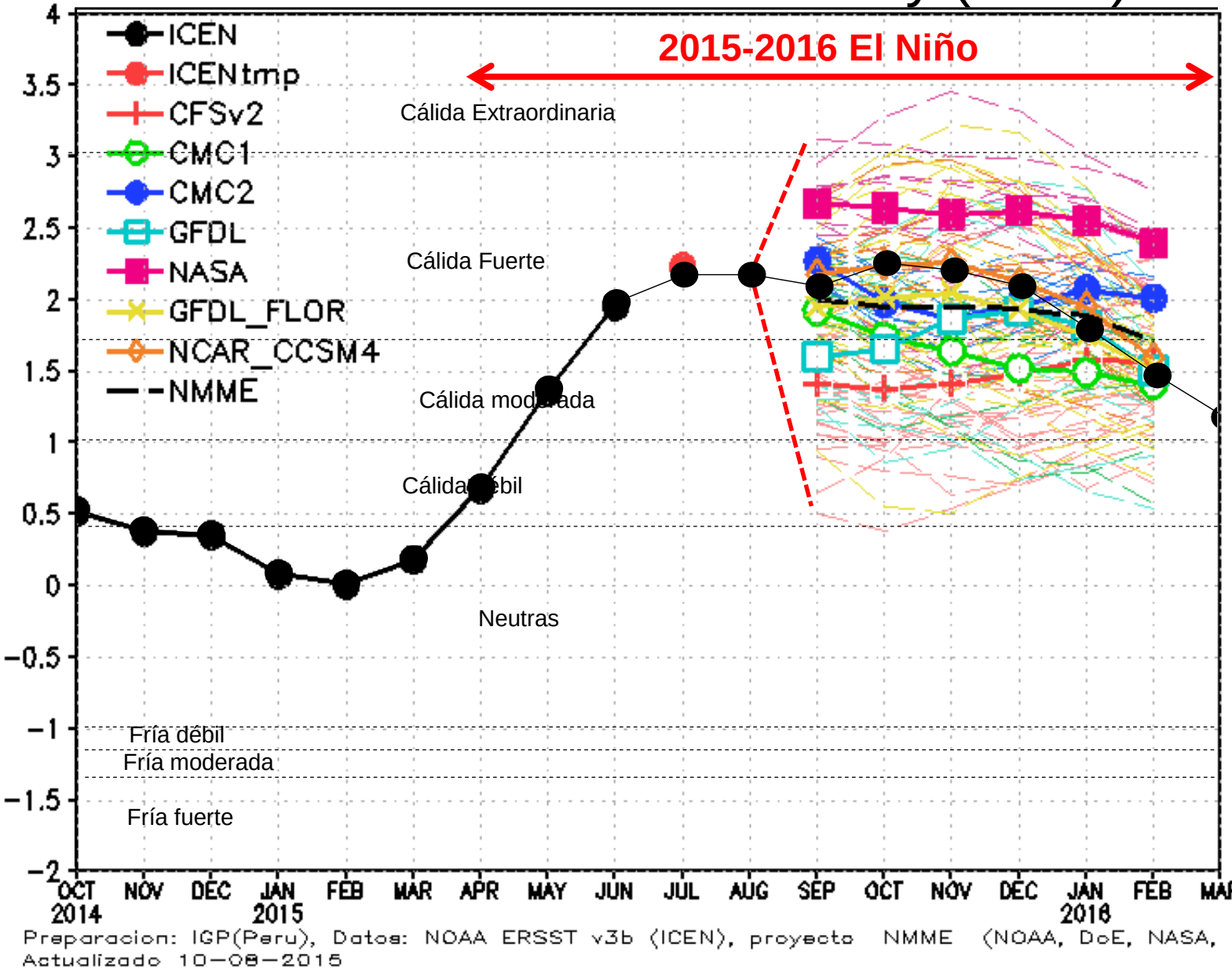
Magnitud del evento durante diciembre 2015-marzo2016	Probabilidad de ocurrencia
Normal o La Niña costera	5%
El Niño costero débil	5%
El Niño costero moderado	35%
El Niño costero fuerte	40%
El Niño costero extraordinario	15%

Climate models (local and international)



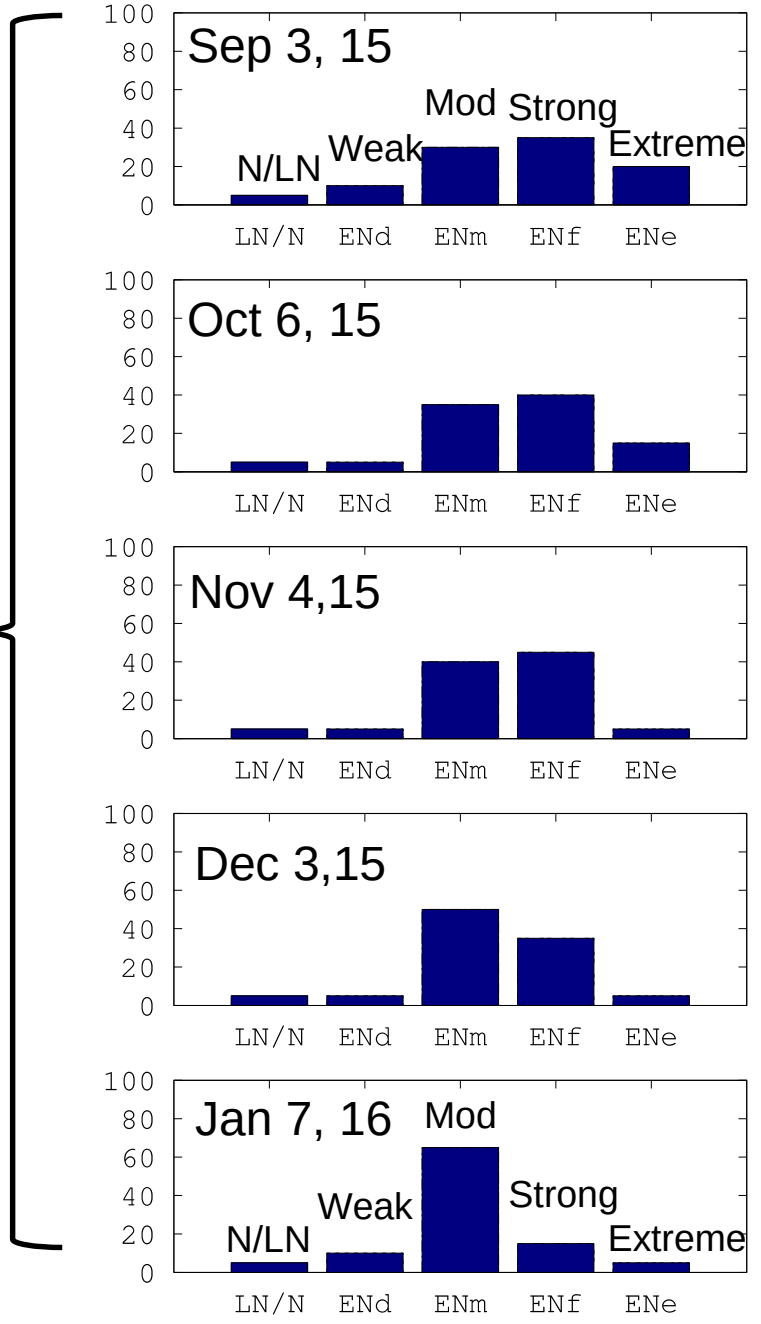


Multi-model (NMME) ensemble prediction of the Niño 1+2 SST anomaly (ICEN)



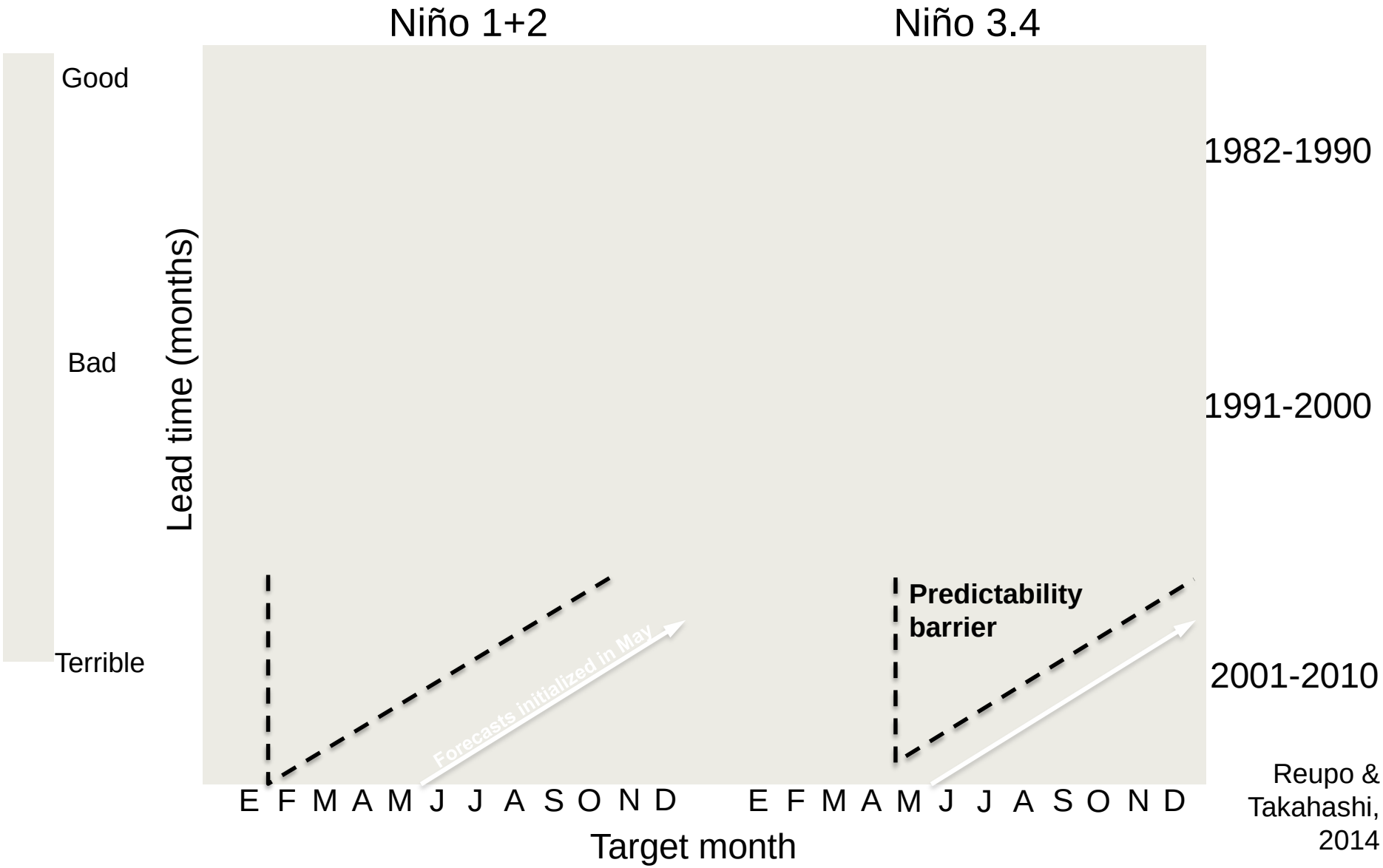
ENFEN probabilistic forecasts (%) of the coastal El Niño strength for the 2015-16 rainy season (Dec-Mar)

Based on expert assessment of observations and models.



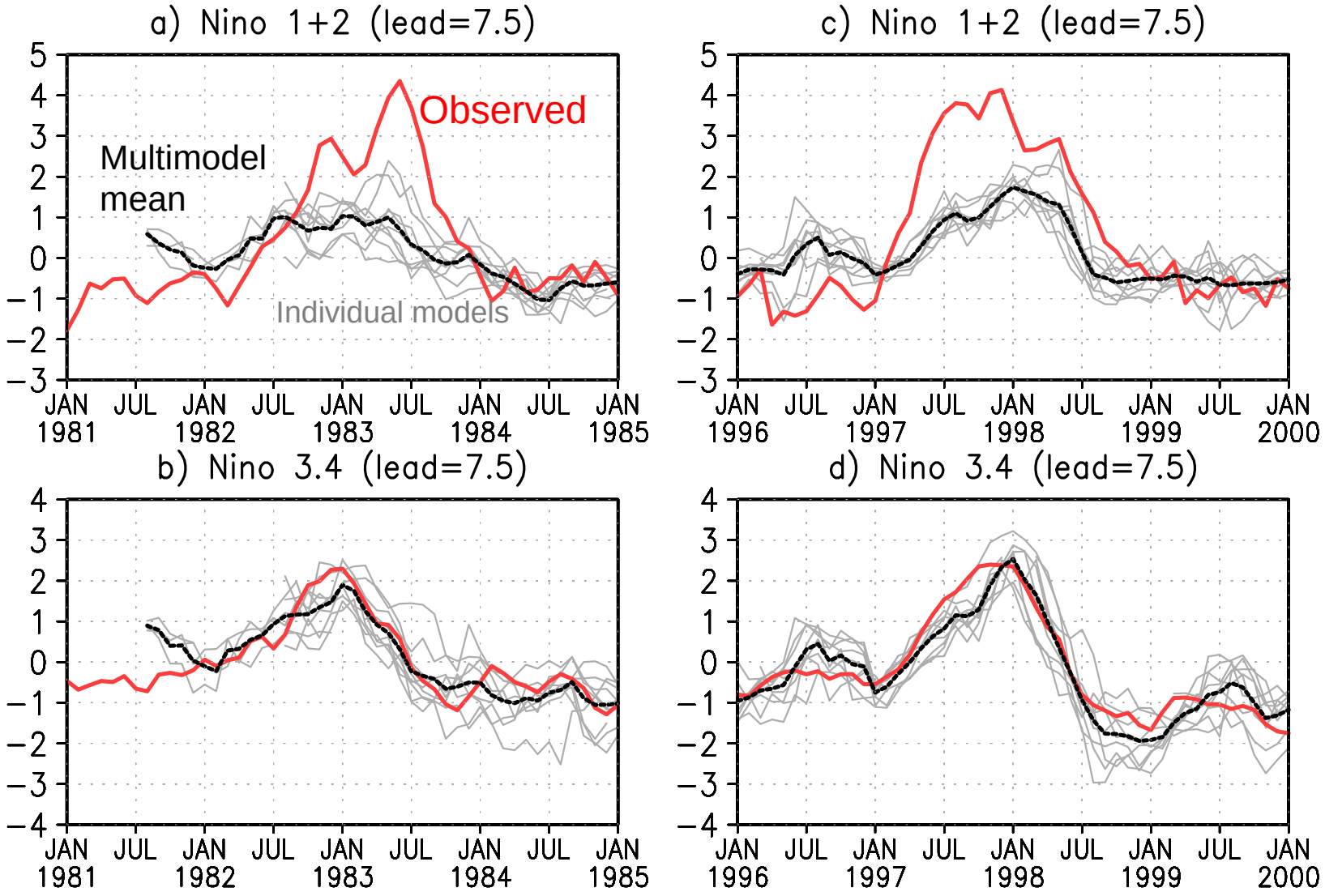
Observed: ▲ (May 5, 16)

Correlation between observed SST anomalies and the predicted by the NOAA CFSv2 model



Reupo & Takahashi, 2014

7.5-month lead NMME forecasts of the extreme El Niño (1982-83, 1997-98)

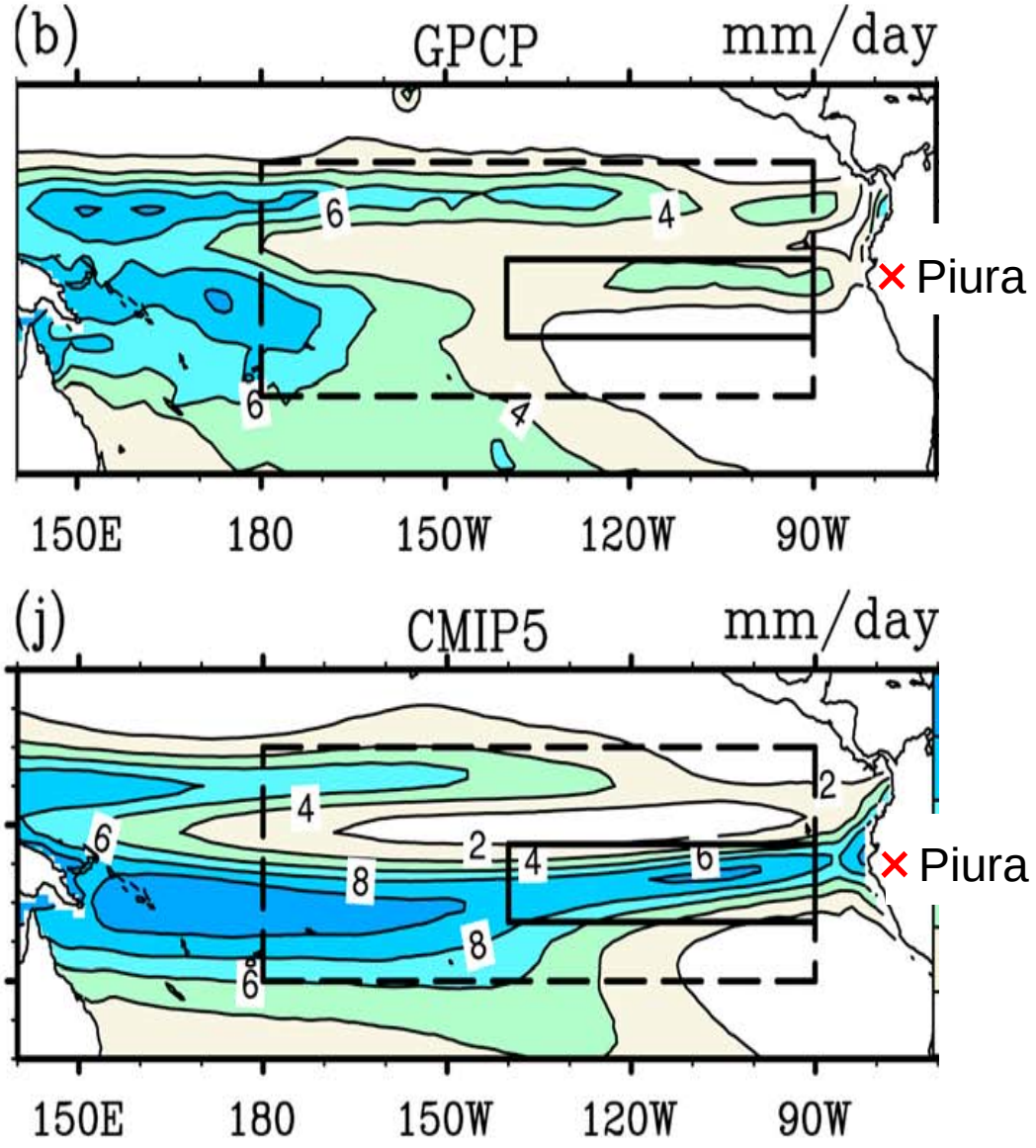


Takahashi et al, en desarrollo

March precipitation: The double ITCZ bias

Observed

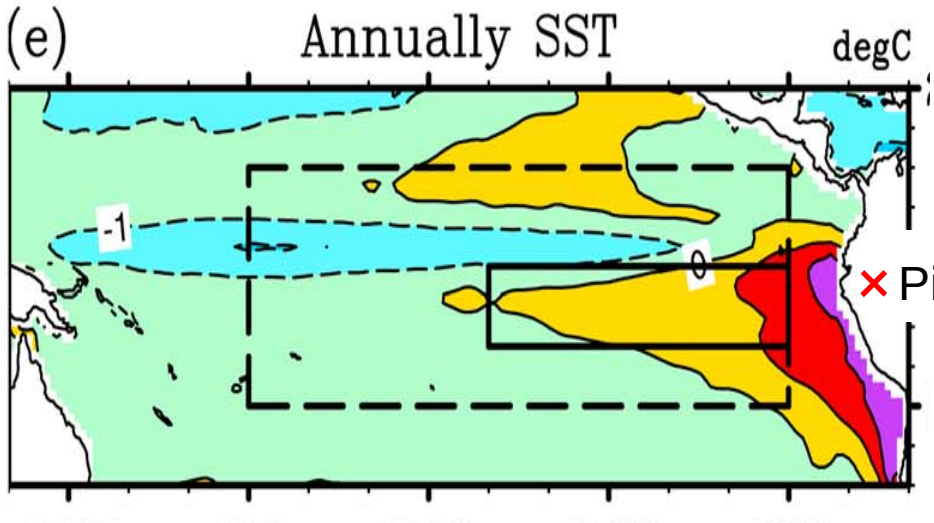
Climate models



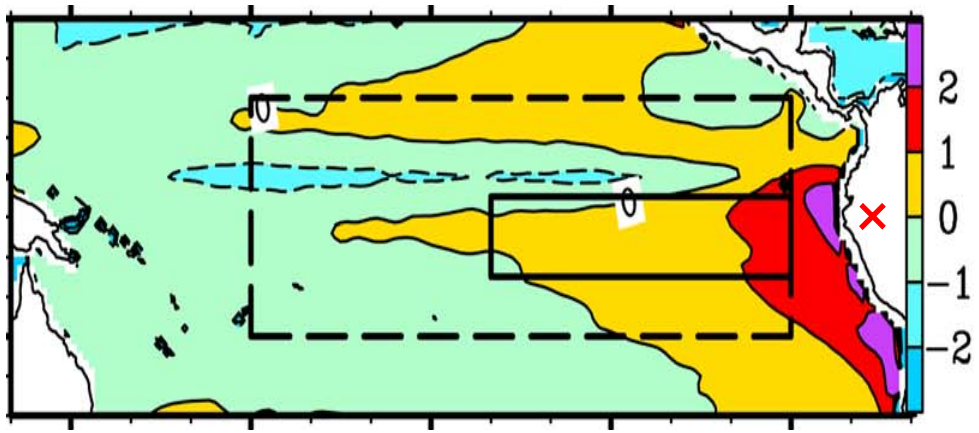
Zhang et al 2015

Annual mean bias in sea surface temperature in the two latest generations of climate models

CMIP3



CMIP5



Zhang et al 2015

Final comments

- The climate effects of El Niño/La Niña in Peru depend on the strength and the details of the sea surface temperature pattern. However, unrelated phenomena also have a substantial effect on climate variability in Peru. This needs to be addressed.

- To the extent that vulnerability to extreme El Niño remains, seasonal forecasts of sea surface temperature in the tropical Pacific (and Atlantic) have substantial value. The terms “El Niño” and “La Niña” need to be carefully qualified.

- Global climate models are currently the main tools for long-range seasonal forecasts, but they share common biases in both the mean state and in the interannual variability, particularly in the eastern Pacific. This precludes depending solely on them and it is necessary to rely on expert assessment for the predictions.

- Decadal variability and climate change will have effects on the predictability (could dominate over forecast system improvement) and should be explicitly taken into consideration.

- The improvement of the models and the predictions will depend on increasing the scientific understanding of the physical mechanisms, both in nature and in the models (free-running and initialized).

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