Goals for today:
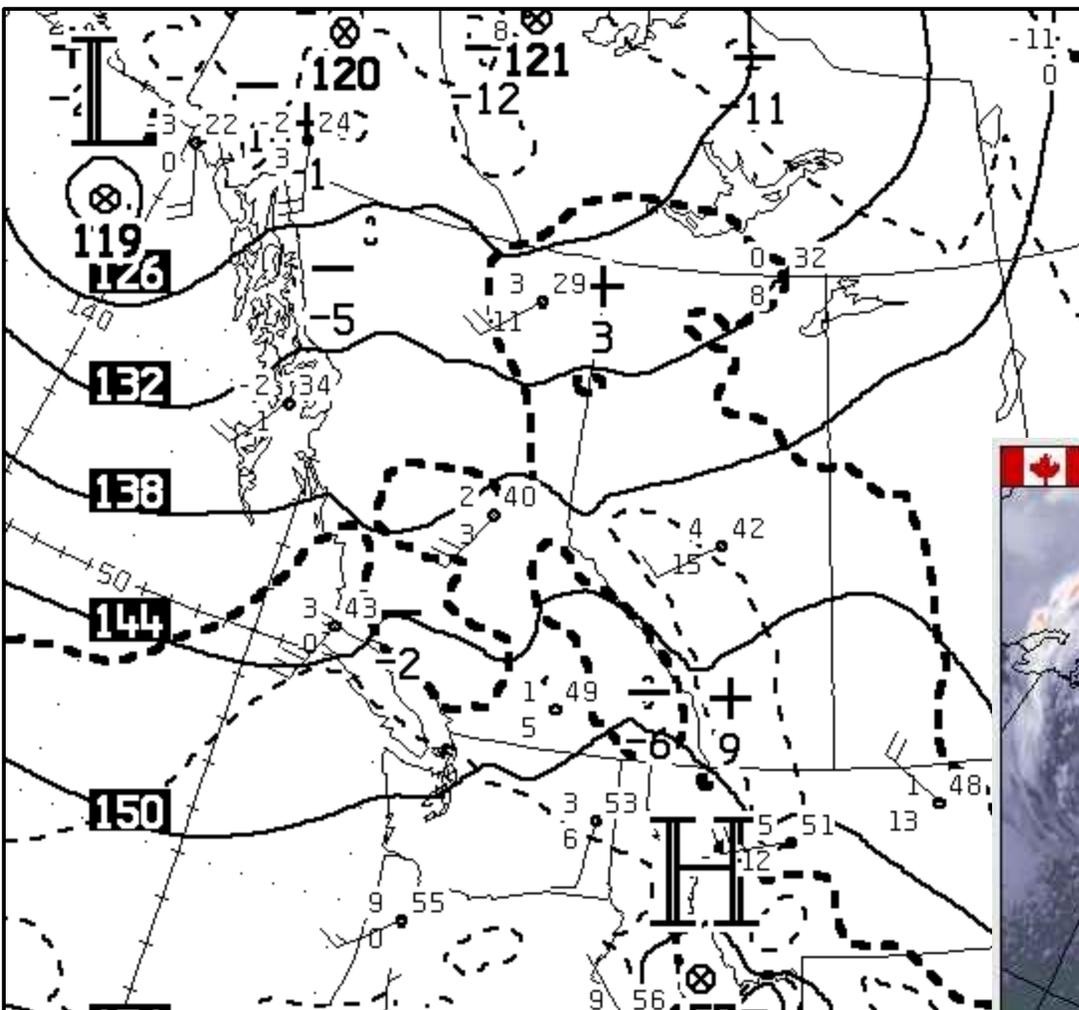
• GOES IR images

• continue with oceanic circulation (last few slides of lec19.pdf, Wed 26 Oct.)

• El Nino-Southern Oscillation (ENSO)

High, stratiform cloud tops (red) over Ab.

Low, spotty (cumuliform) cloud tops associated with the coastal storm

CMC 850 hPa analysis, 12Z Sun 30 Oct. 2011. Lee trough. Warm air aloft in lee of Rockies (GOES image suggests subsidence)

NSC/SMC-CMC   GOES-11 2011-10-30 11:30 UTC   IR
CELSIUS

GOES ir (10.7 µm, resolution 2 x 4 km (on equator)
• Green = intense = warm source = gnd/ocean
• White = less intense = intermediate temperature
• Red = weak radiation = cold src= high cloud tops
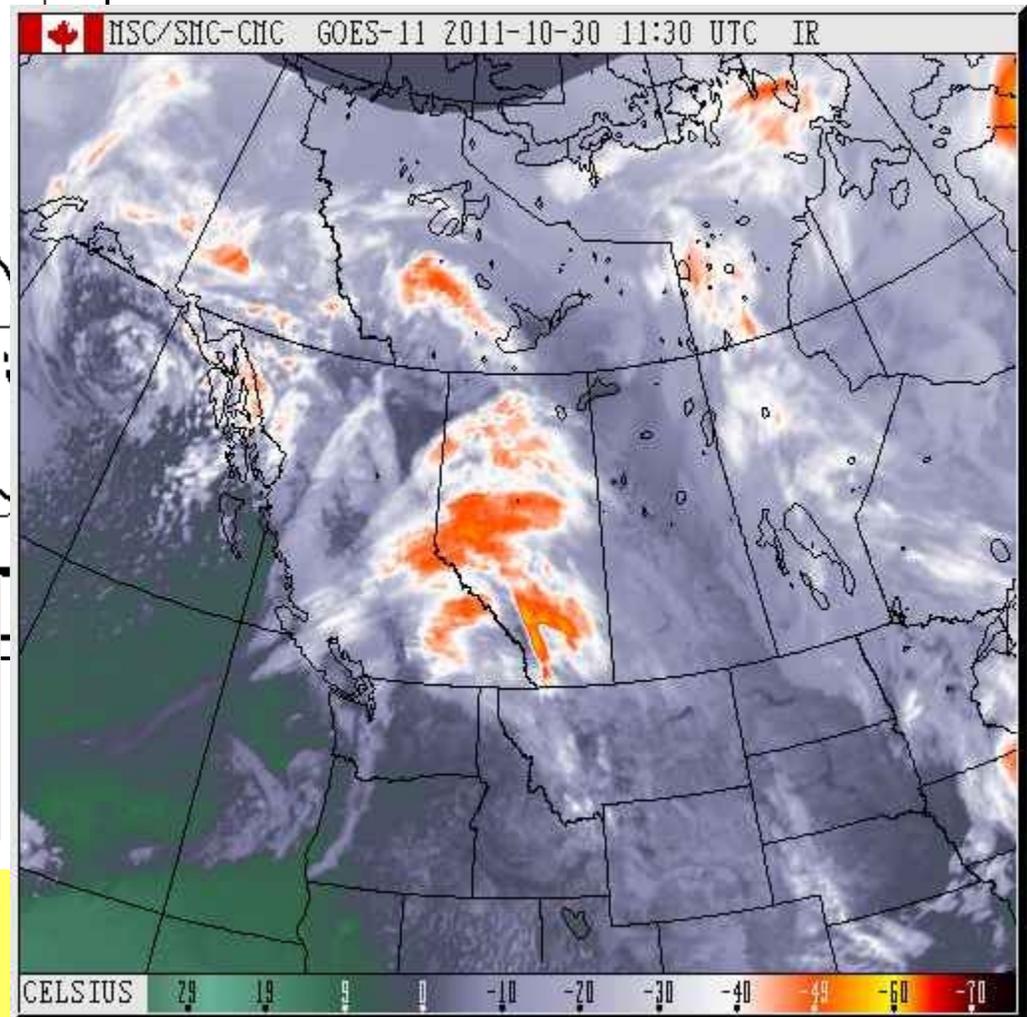
Normal conditions

• easterly Pacific tradewinds pile up warm surface water in the west Pacific - so that sea surface is about 1/2 meter higher at Indonesia than at Ecuador. A weak surface ocean counter-current then develops

• sea surface temperature is about 8°C higher in the west, with cool temperatures off South America, due to an upwelling of cold (nutrient-rich) water from deeper levels

• strong convection/rain over the warmest water, and the east Pacific is relatively dry

• strong equatorward-flowing coastal current ("Humboldt" or "Peruvian") sustains the upwelling cold deep-water

Surface wind

an flow

N

Upwelling

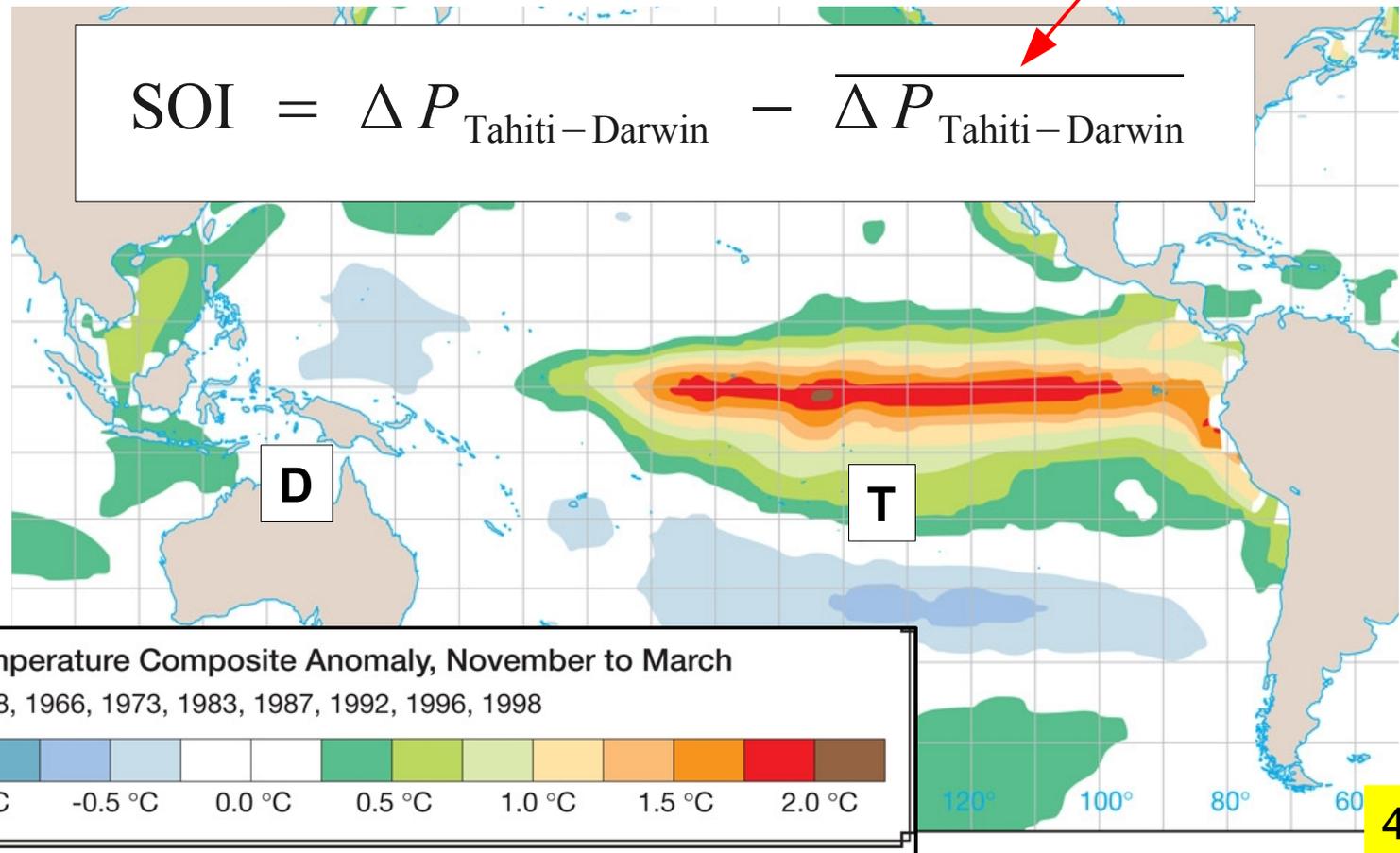Equivalent to Fig. 8-18, for S. hemisphere

3
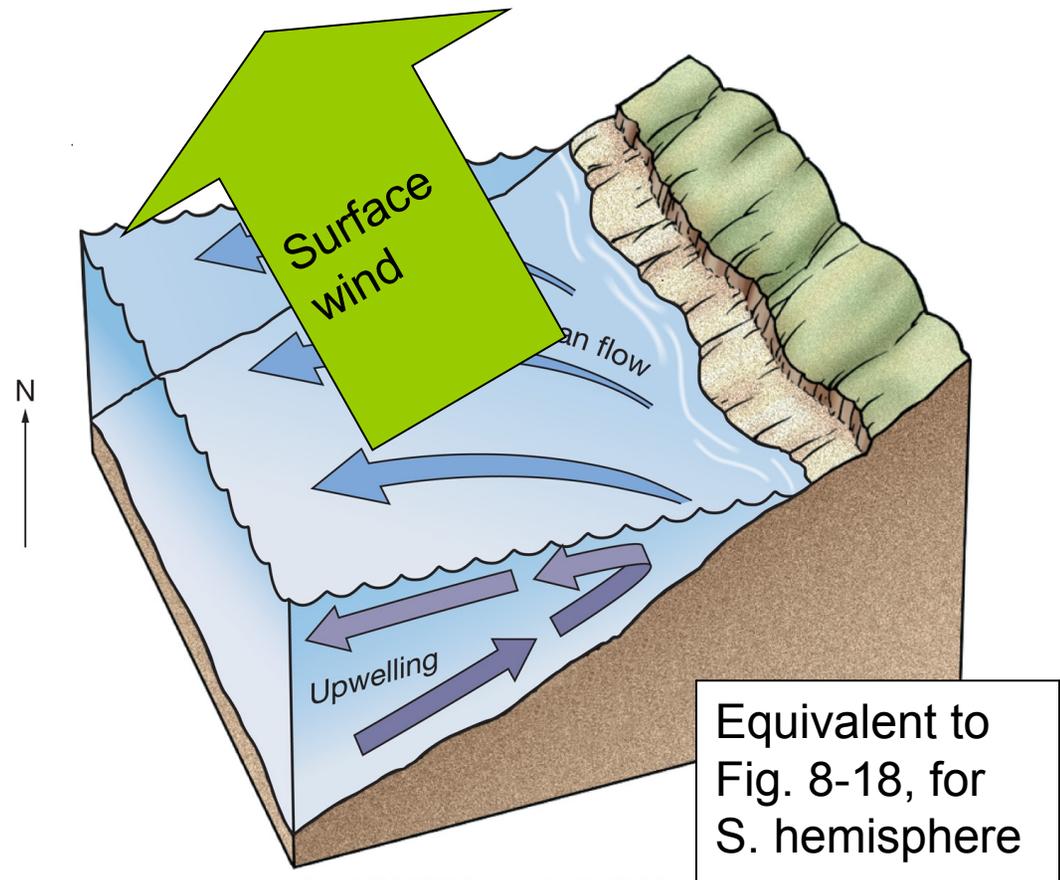
El Nino phase

Reversal in sea-level east-west pressure gradient across equatorial Pacific. Abnormal winds (weakened easterly trades, or even westerlies)

The warm surface water normally found in the western equatorial Pacific "sloshes eastward", and the warm sea surface temperature anomaly in the eastern Pacific suppresses upwelling of cold deep-water
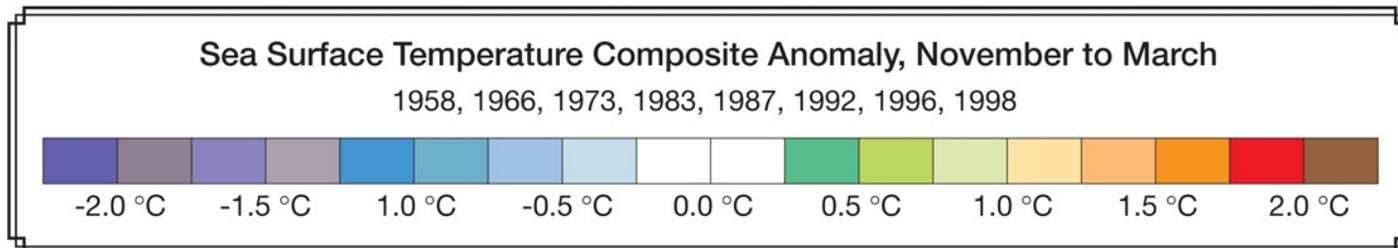
overbar denotes climatological value

Fig. 8-31… sea sfc temperature anomaly averaged over eight El-Nino's (red = + 2ºC)

$$ \text{SOI} = \Delta P_{\text{Tahiti} - \text{Darwin}} - \overline{\Delta P_{\text{Tahiti} - \text{Darwin}}} $$

D

T

Sea Surface Temperature Composite Anomaly, November to March
1958, 1966, 1973, 1983, 1987, 1992, 1996, 1998

-2.0 °C   -1.5 °C   1.0 °C   -0.5 °C   0.0 °C   0.5 °C   1.0 °C   1.5 °C   2.0 °C

120°   100°   80°   60

El Nino phase

Warm sea-surface temperature anomaly along west coast of USA & Canada – increases air temperature and humidity.

Sea Surface Temperature Composite Anomaly, November to March
1958, 1966, 1973, 1983, 1987, 1992, 1996, 1998

-2.0 °C   -1.5 °C   1.0 °C   -0.5 °C   0.0 °C   0.5 °C   1.0 °C   1.5 °C   2.0 °C

© 2010 Pearson Education, Inc.
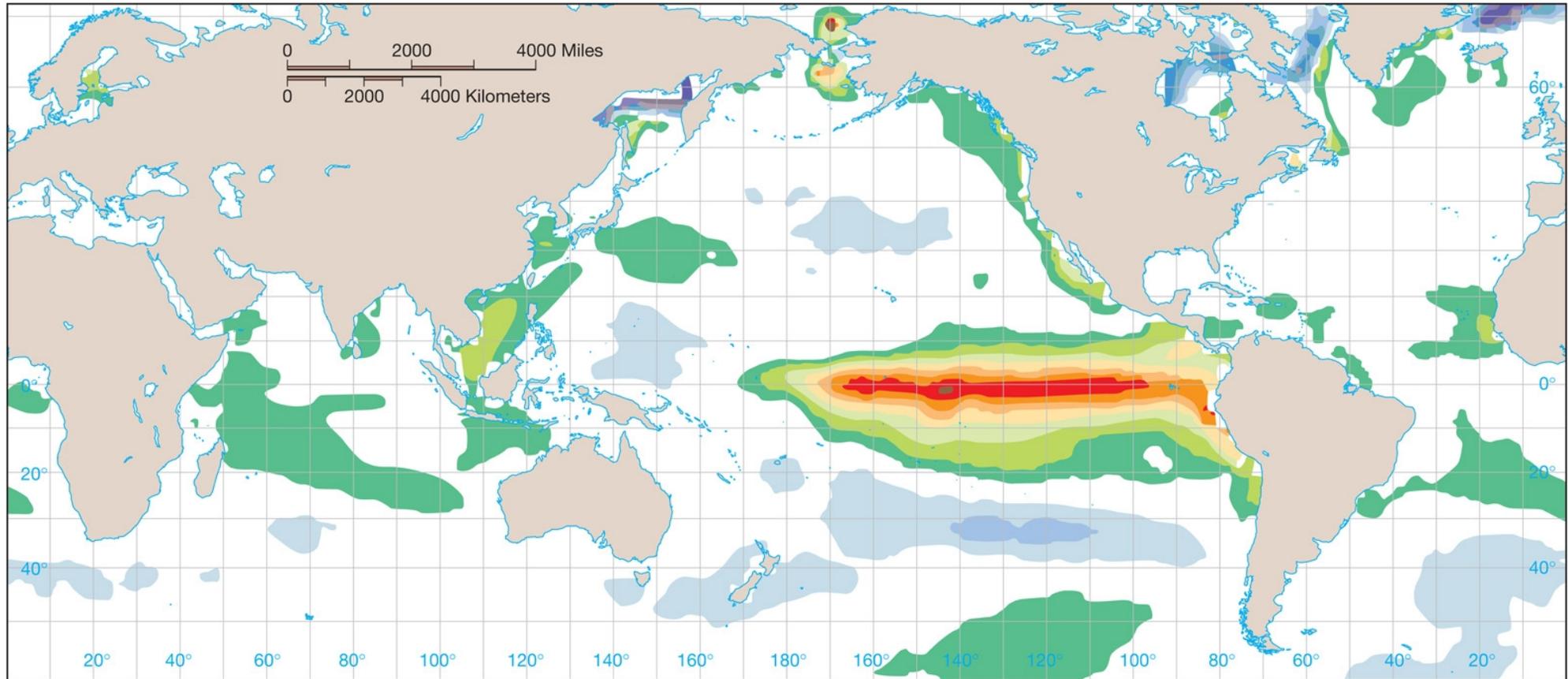
- La Niña phase is characterized by unusually *cold* ocean temperatures in the eastern equatorial Pacific
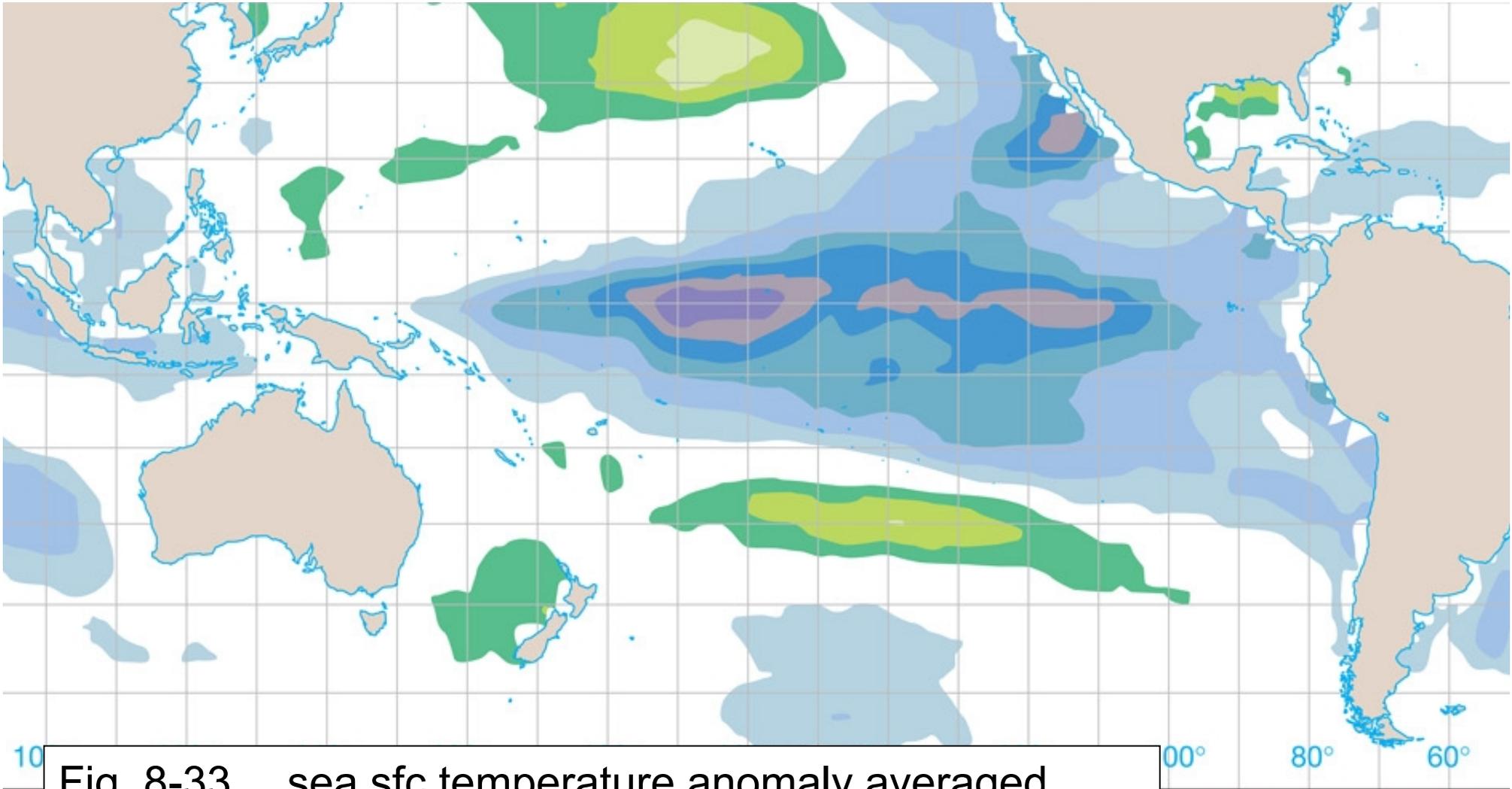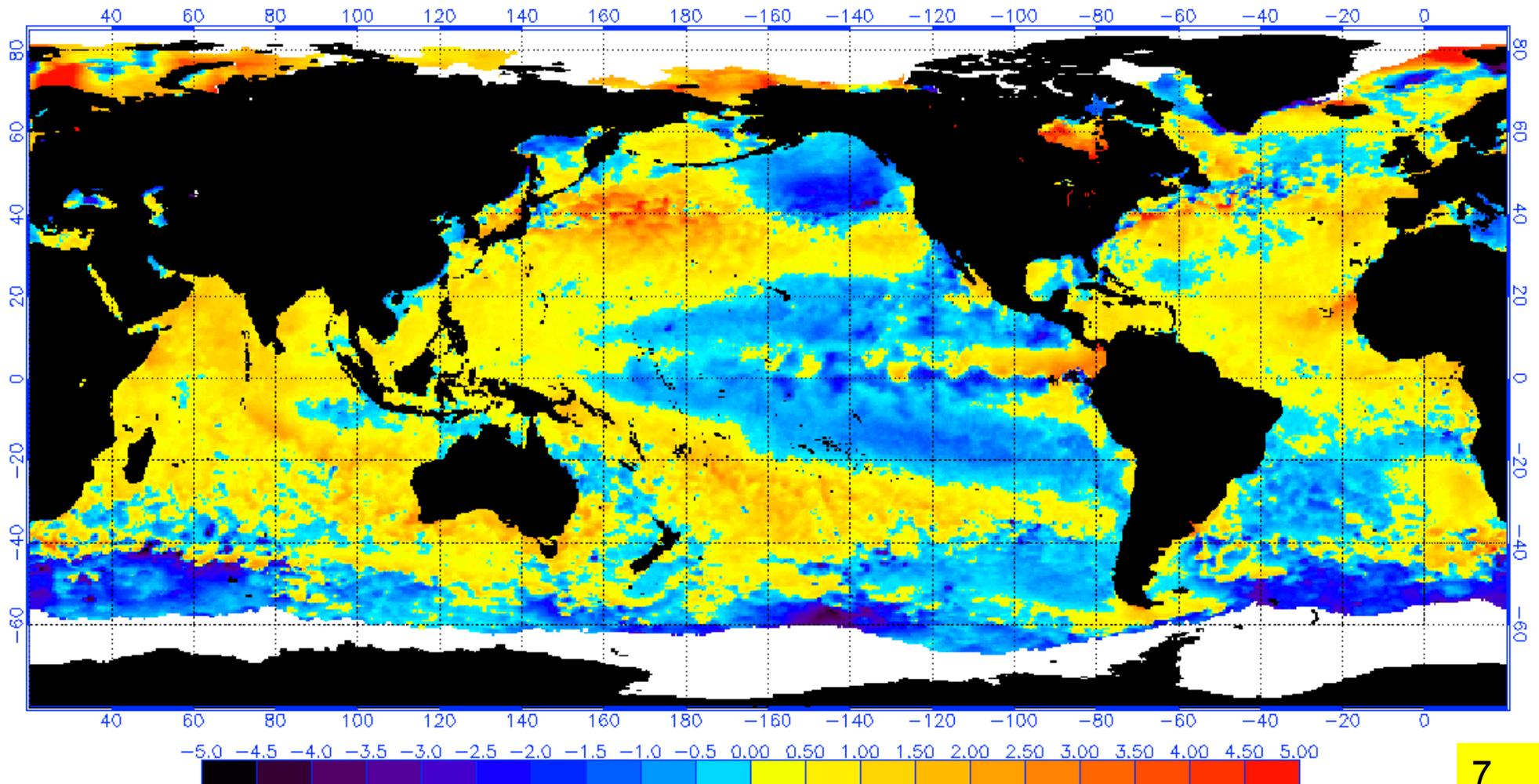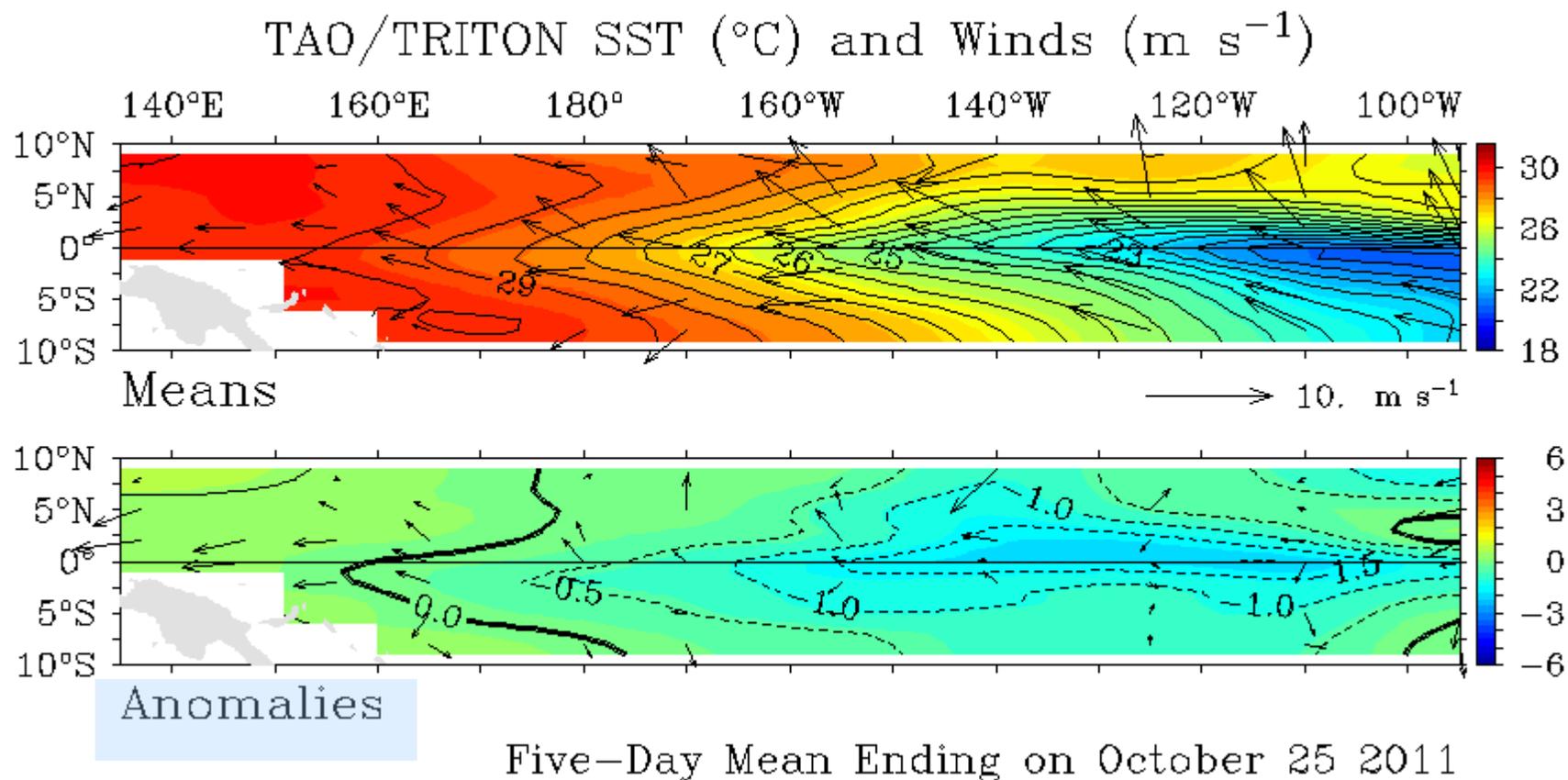

Fig. 8-33… sea sfc temperature anomaly averaged over eight La-Nina's   (blues, about = minus 1°C)

- **La Niña conditions are present across the equatorial Pacific.***

- **Sea surface temperatures (SST) were at least -0.5°C below average across the central and eastern equatorial Pacific Ocean.**

- **Atmospheric circulation anomalies are consistent with La Niña.**

- **La Niña is expected to strengthen and continue through the Northern Hemisphere winter 2011-12.***

(Climate Prediction Center / NCEP 24 October 2011)

NOAA/NESDIS 50 KM GLOBAL ANALYSIS: SST Anomaly (degrees C), 10/24/2011
(white regions indicate sea-ice)

-5.0 -4.5 -4.0 -3.5 -3.0 -2.5 -2.0 -1.5 -1.0 -0.5 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00

Present state of the equatorial Pacific

TAO/TRITON SST (°C) and Winds (m s^{-1})

Means

Anomalies

Five-Day Mean Ending on October 25 2011

Source: http://www.pmel.noaa.gov/tao/

Anomalies correlated with La Nina...

- An *internally-generated* disruption or instability of the ocean-atmos. system in the tropical Pacific having important consequences for weather around the globe and giving some basis for long range weather forecasting (though presently with low skill) – not externally forced

La Nina **ON** , Fig. 8-35c
Cold wet BC winter
(no signal in summer for W. Cda)

Cold Episode Relationships, December to February

October 20, 2011. "ABNORMALLY COLD OCEAN SURFACE TEMPERATURES ACROSS THE CENTRAL AND EASTERN EQUATORIAL PACIFIC... INDICATE THAT LA NINA CONDITIONS EXIST. IMPACTS ASSOCIATED WITH LA NINA ARE LIKELY DURING THE AUTUMN, WINTER AND SPRING MONTHS.

THE SEASONAL OUTLOOK FOR NDJ 2011-12 SHOWS... BELOW-NORMAL TEMPERATURES ARE FAVORED FOR … NORTHERN SECTIONS OF THE NORTHERN GREAT PLAINS AND NORTHERN ROCKIES AND MUCH OF SOUTHERN ALASKA..." (NCEP)
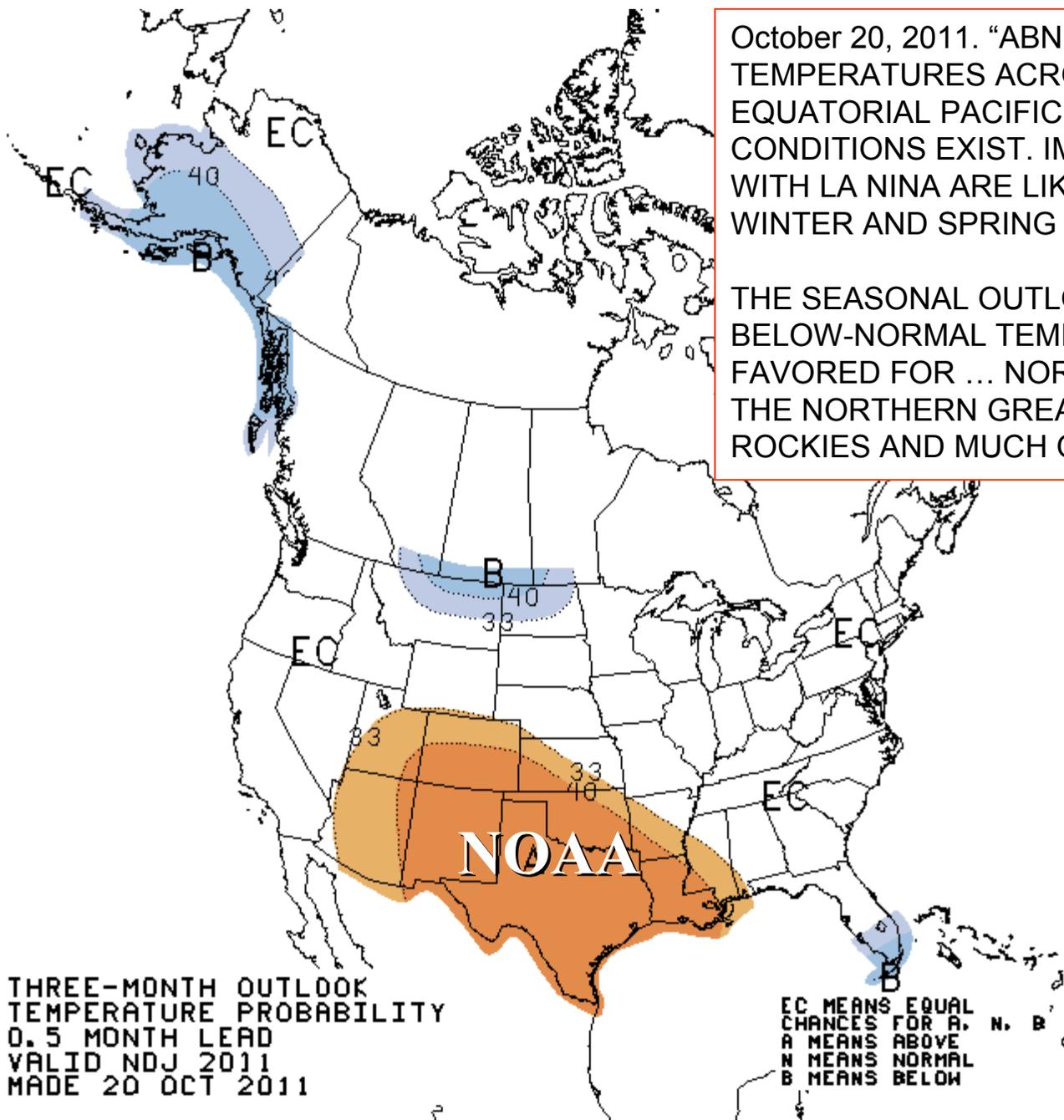
THREE-MONTH OUTLOOK
TEMPERATURE PROBABILITY
0.5 MONTH LEAD
VALID NDJ 2011
MADE 20 OCT 2011

EC MEANS EQUAL
CHANCES FOR A, N, B
A MEANS ABOVE
N MEANS NORMAL
B MEANS BELOW

NOAA

10

Below Normal=blue-dash   Sous la normale=bleu-tirets
Above Normal=red   Au-dessus de la normale=rouge
Normal=white   Près de la normale=blanc
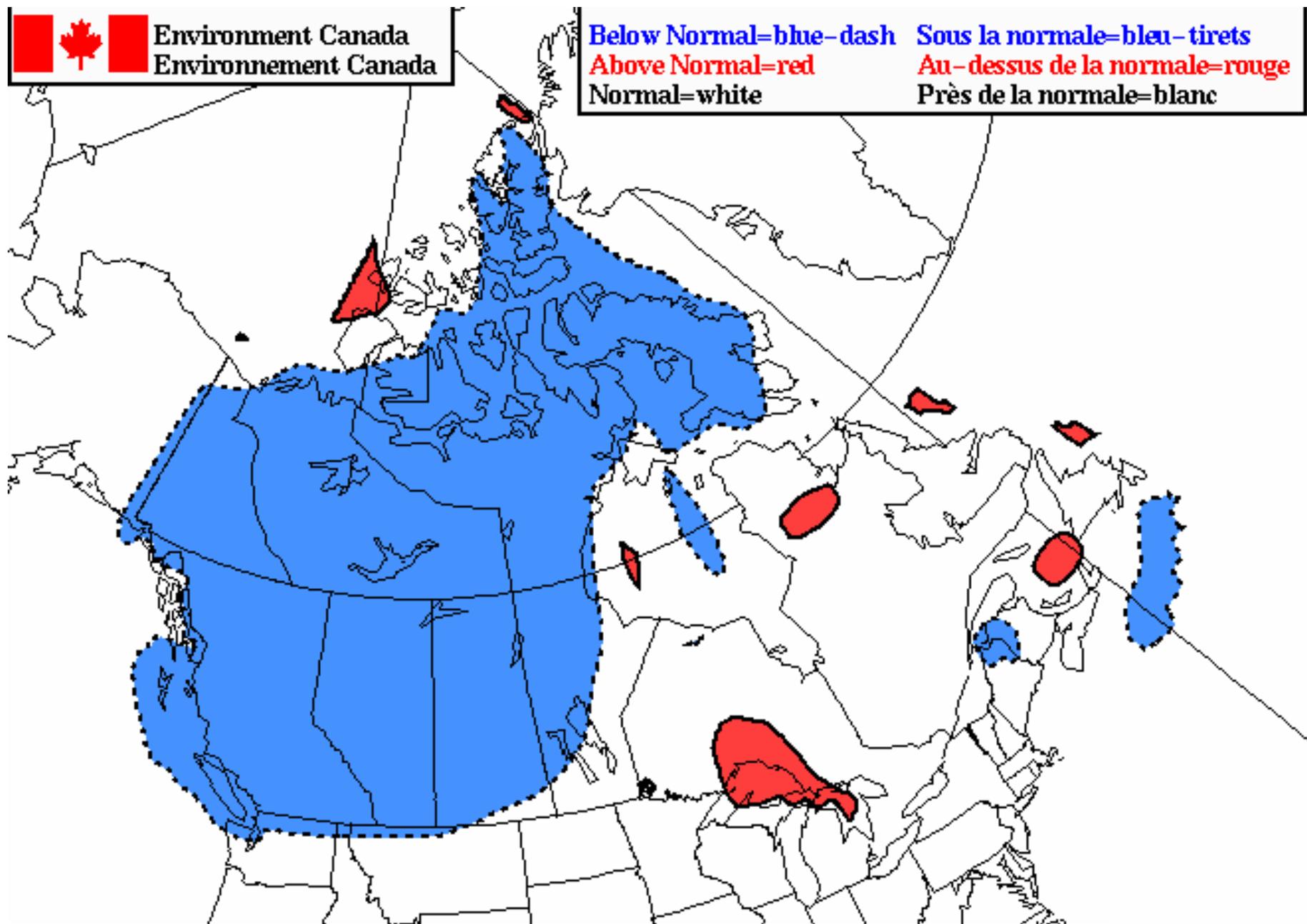
Temperature Anomaly Outlook   Aperçu de l'anomalie de la température
Period: October–November–December 2011   Periode: octobre–novembre–décembre 2011
Issued on October 1 2011   Émis le 1 octobre 2011
Based on 3 equiprobable categories   Basé sur 3 catégories équiprobables
from 1971–2000 climatology   de la climatologie 1971–2000

11

0 à 40% : Pas de différence significative avec le hasard
0 to 40% : Not significantly better than chance

PC (%)
100
95
90
85
80
75
70
65
60
55
50
45
40
0
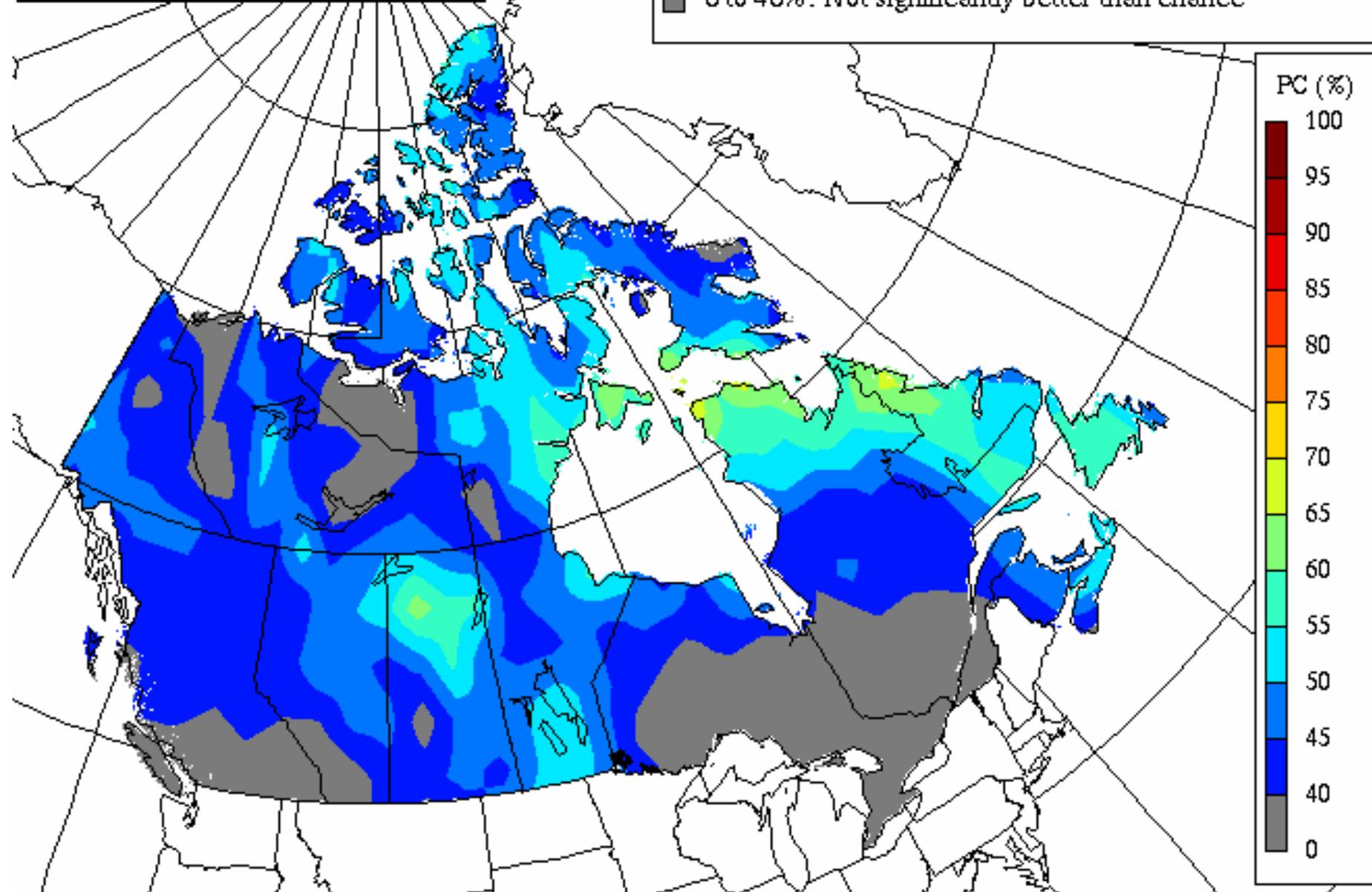
Historical Percent Correct
1 to 3 month Temperature Anomaly Forecast
Period: Oct–Nov–Dec 1971–2000
Canadian average: 45.2%

Pourcentage correct historique
Prévision des anomalies de température de 1 à 3 mois
Période: oct–nov–déc 1971–2000
Moyenne canadienne: 45.2%

12