The El Nino teleconnection to the isopycnal fluctuations in the southwestern East/Japan Sea

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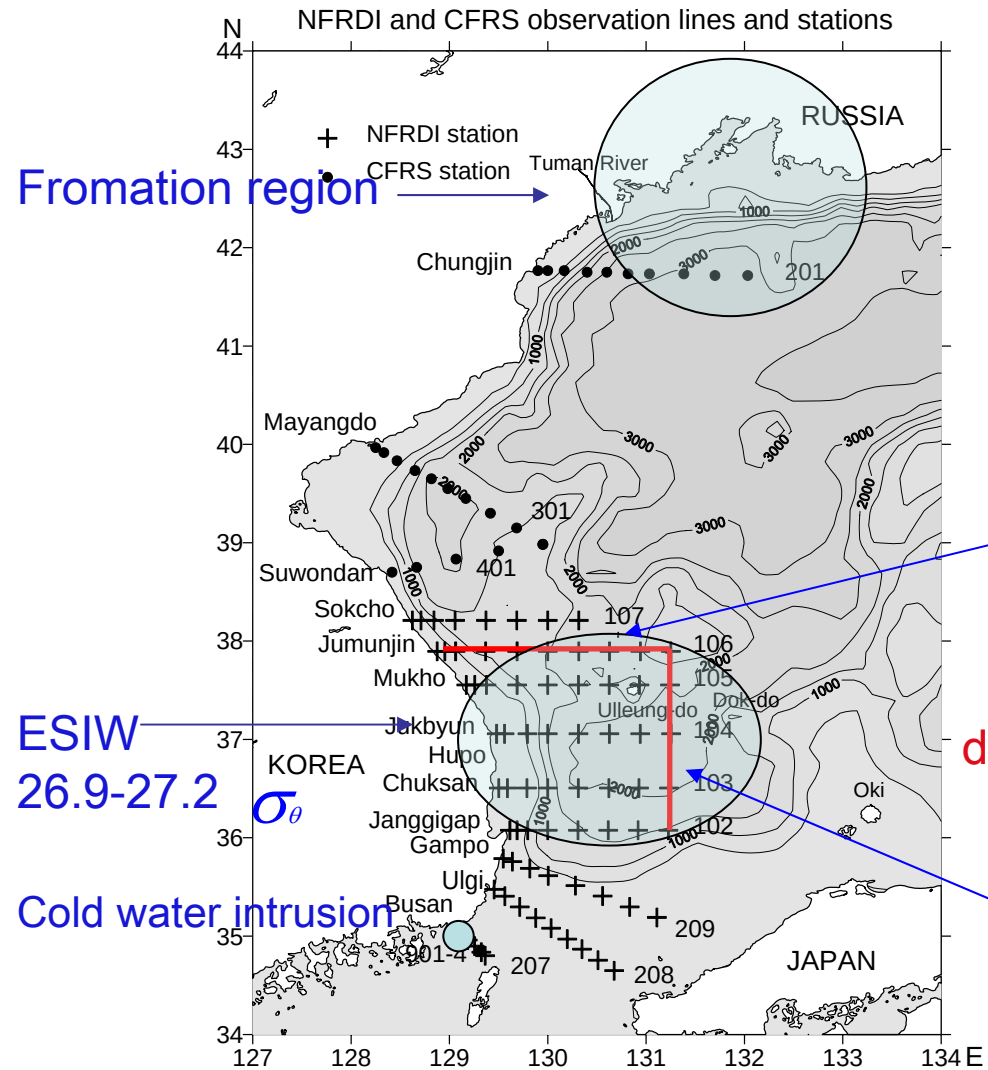
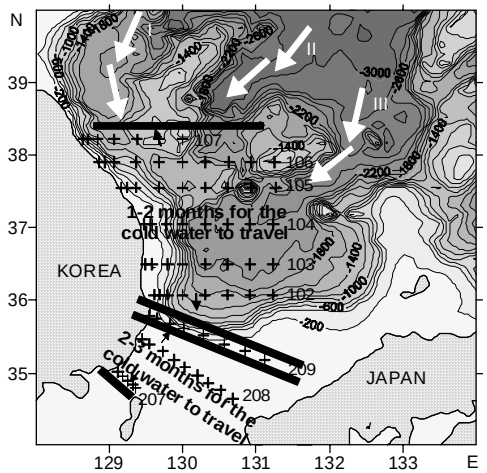
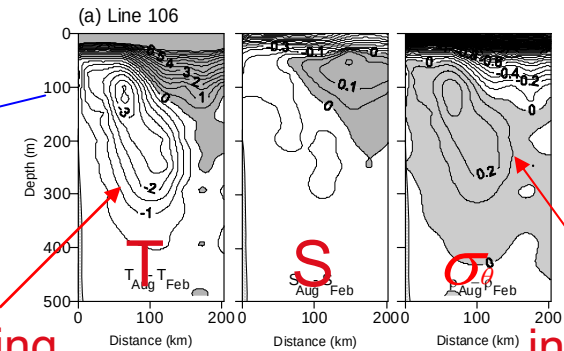
Background of Study

Yun et al.(2004)





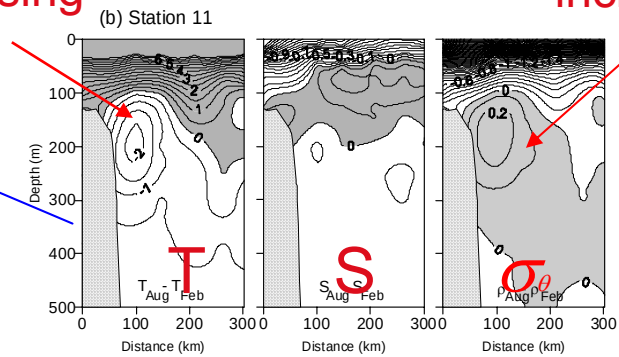


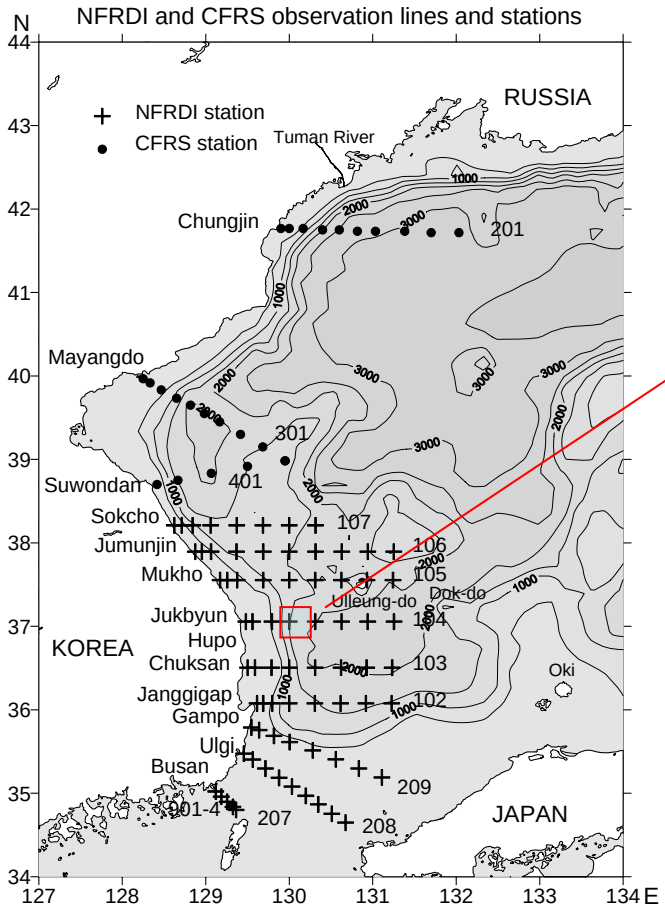
Summer
(Aug. mean)

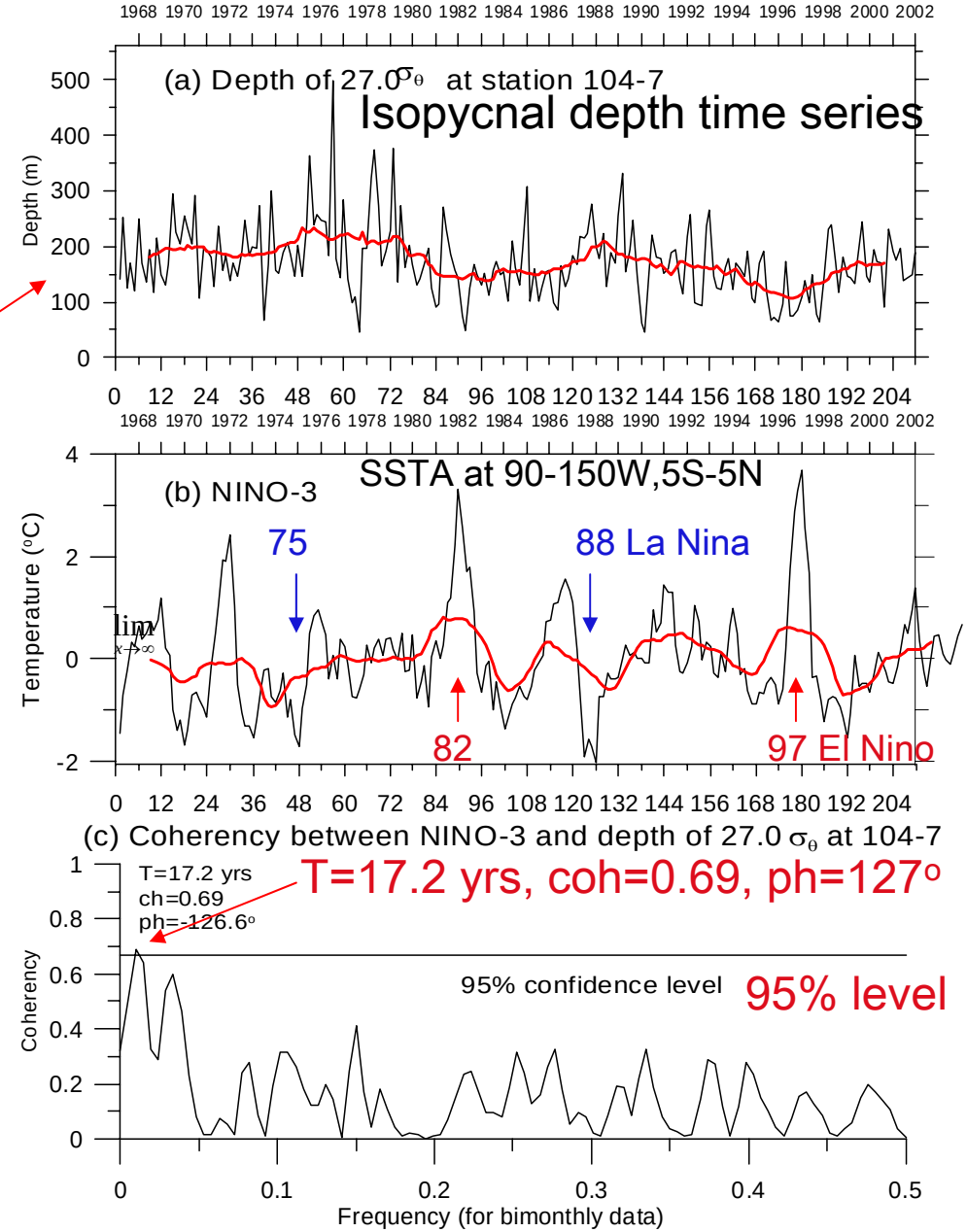
Winter
(Feb. mean)

decreasing

increasing







15 year interval ← 1997-1982
(strong El Ninos)

A band of 17.2 year period
→ 13.7~22.9 years

Purpose

- To show some evidence of teleconnection between strong El Ninos and the isopycnal fluctuations in the southwestern East/Japan Sea at the 17.2 year period

- To determine the causal mechanism of the teleconnection

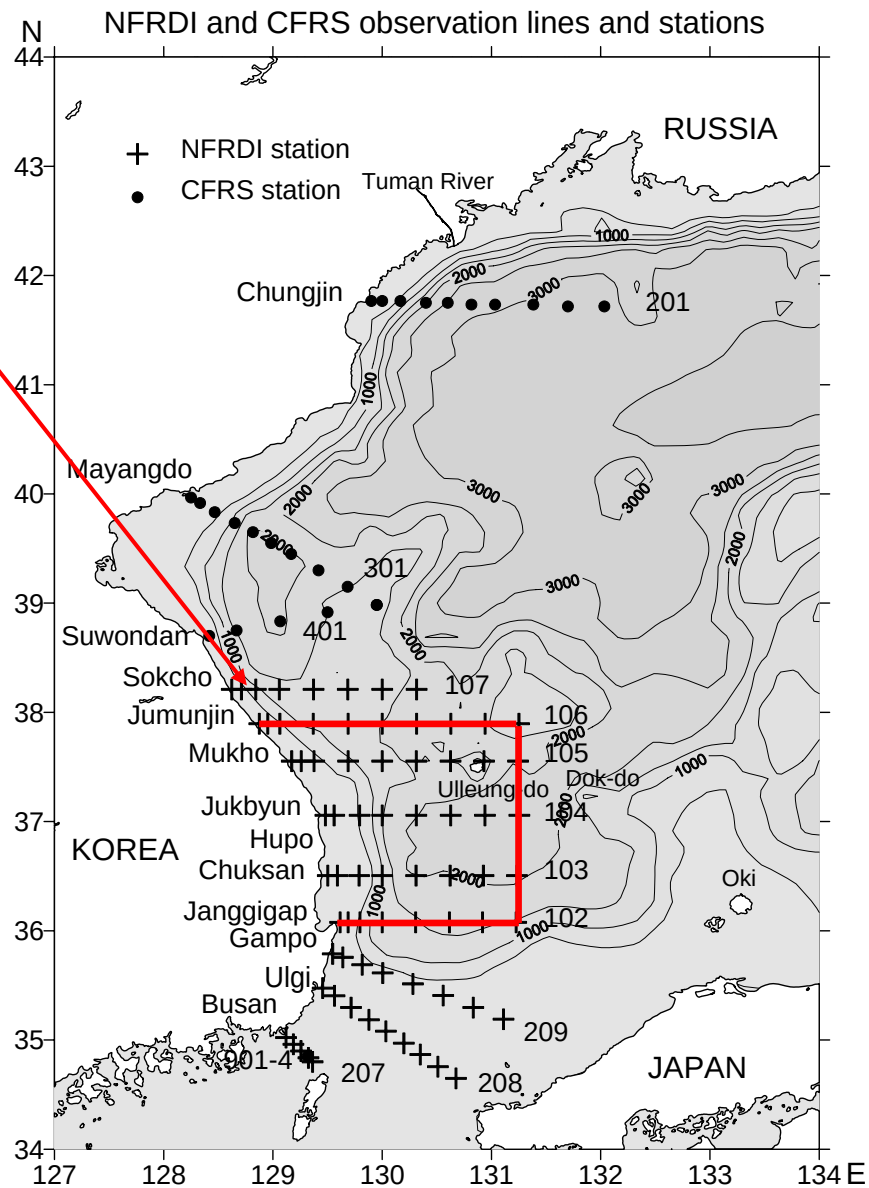
Data

- Isopycnal depth data from the bimonthly T, S data of the NFRDI of Korea from 1968 to 2002

- ECMWF reanalysis data

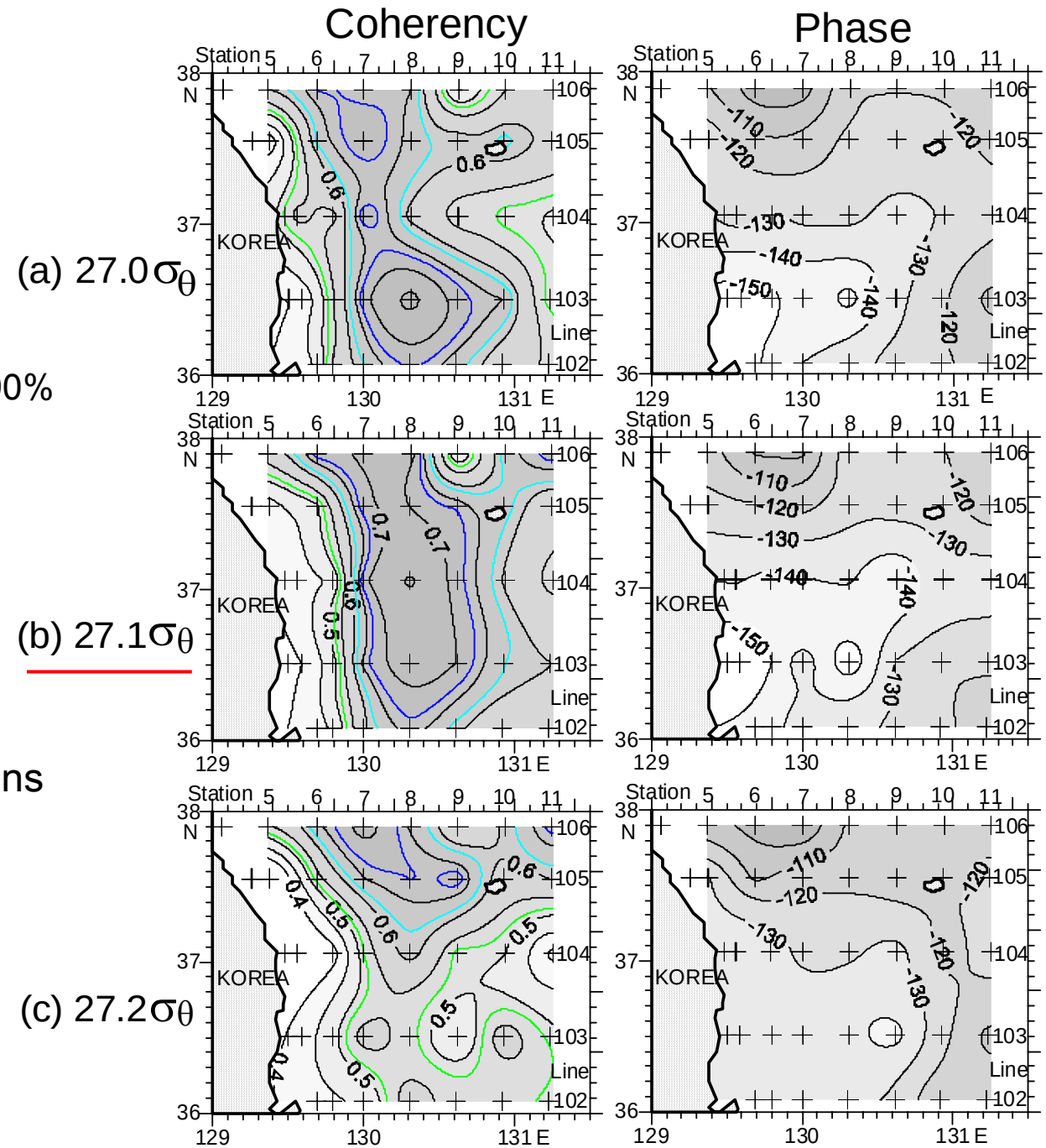
-Data 1
Area: East Asian region
Period: Jan. 1968 – Aug. 2002
Spatial resolution: 1.125°

-Data 2: ERA40
Area: entire globe
Period: same as above
Spatial resolution: 2.5°



- Significant level:
  Green: coh=0.52 at 80%
  Light blue: coh=0.62 at 90%
  Blue: coh=0.67 at 95%

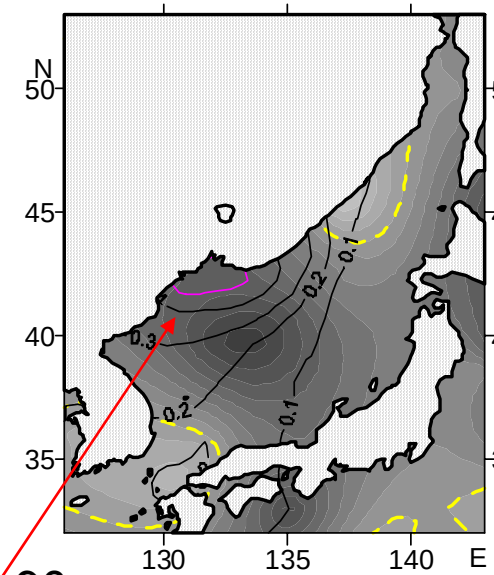
- High coherency
  → Teleconnection b/w Nino-3 and isopycnal fluctuations



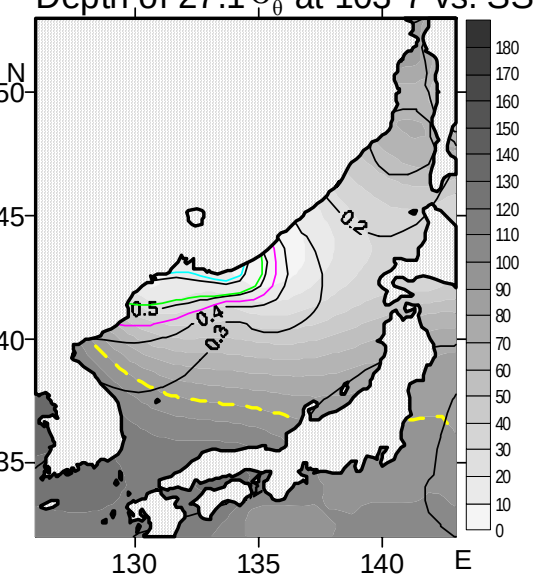
Coherency:
- : 0.4
- : 0.52 → 80%
- : 0.62 → 90%
- : 0.67 → 95%
- : 0.80

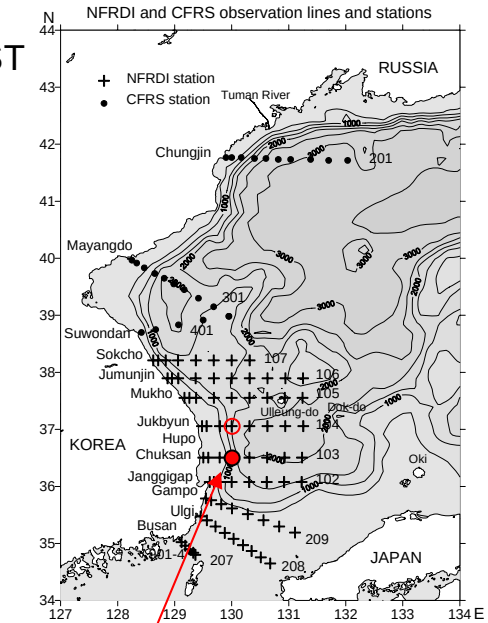
Phase:
no shading: 0°
darkest: 180°
yellow broken line:90°

(a) Coherency and phase
NINO-3 vs. ECMWF SST



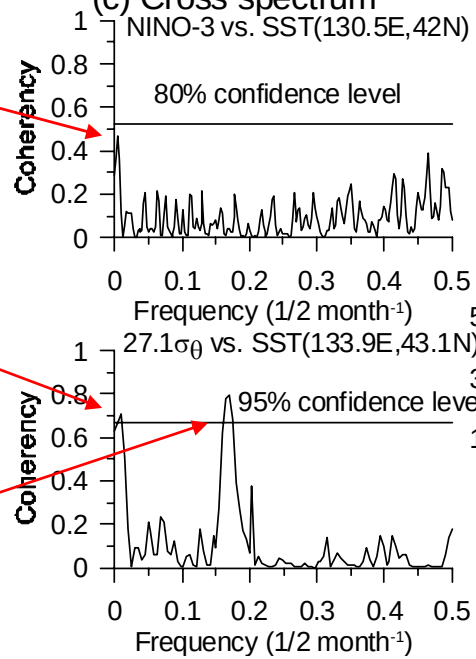
(b) Coherency and phase
Depth of 27.1 σ_θ at 103-7 vs. SST



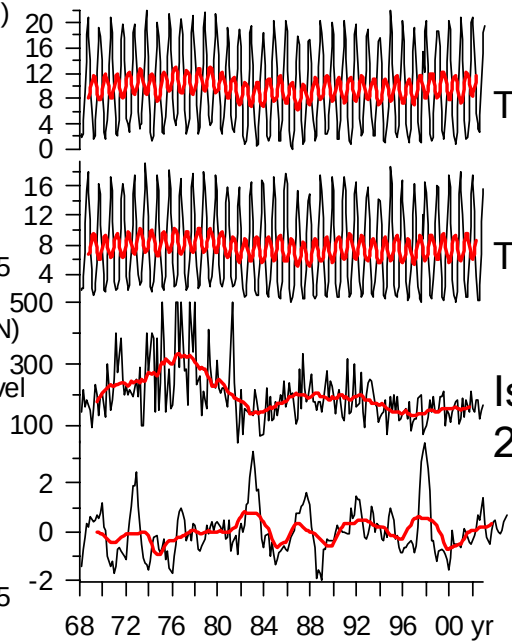


Depth of 27.1 σ_θ
at a different station

(c) Cross spectrum



(d) Time series



T at 130.5°E, 42.0°N

T at 133.9°E, 43.1°N

Isopycnal depth of
27.1 σ_θ at 103-7

Nino-3

Coh=0.47
Ph=-139.9°
(130.5°E, 42.0°N)

T=17.2 yrs
Coh=0.71
Ph=-8°
(133.9°E, 43.1°N)

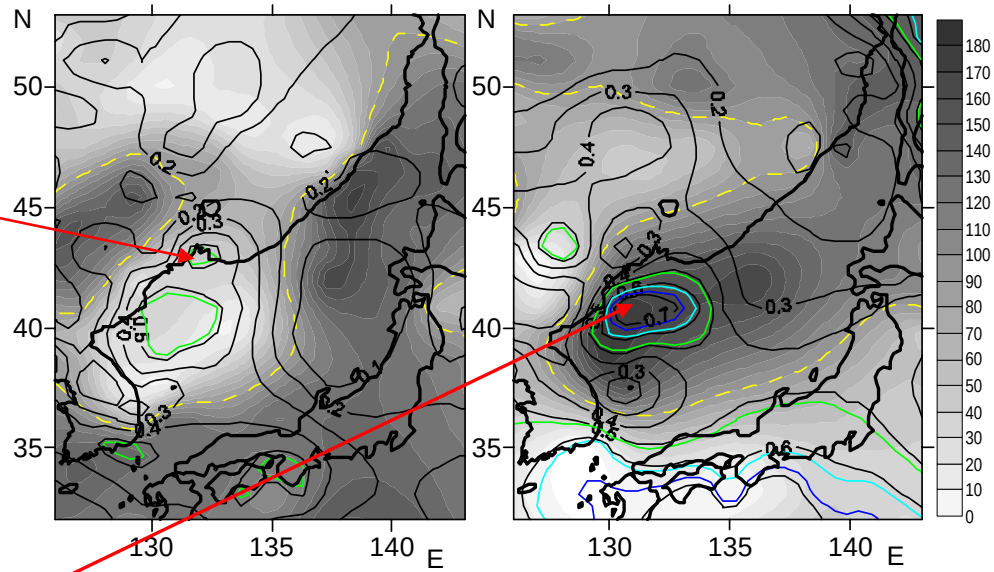
T=11.8 mos
Coh=0.80
Ph=154.8°
(133.9°E, 43.1°N)

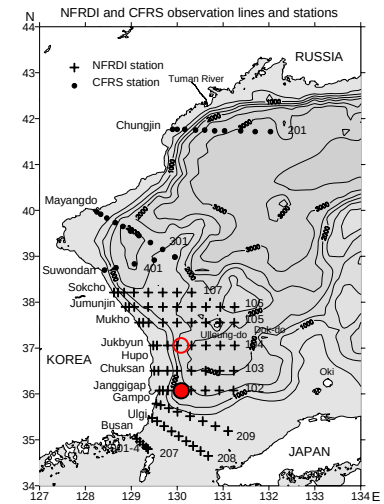
To verify the teleconnection

(a) Coherency and phase NINO-3 vs. SLHF

(b) Coherency and phase Depth of 27.1σ_θ vs. SLHF (surface latent heat flux)

coh=0.58
ph=43.5
(131.6°E, 43.1°N)

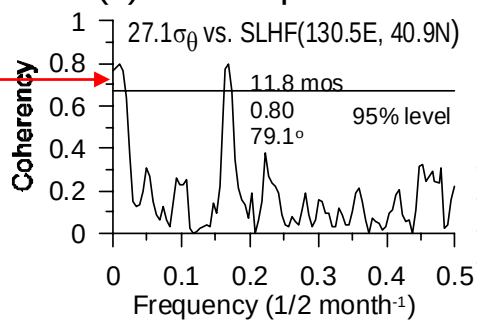




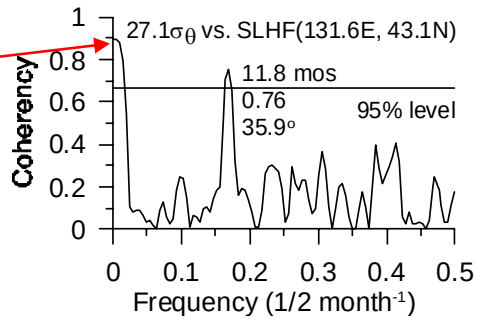
(c) Cross spectrum

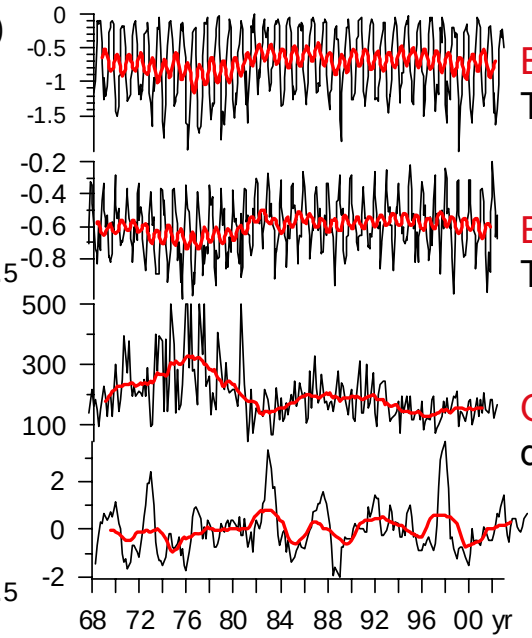
(d) Time series

T=17.2 yrs
coh=0.80
ph=178.5°
(130.5°E, 40.9°N)



T=17.2 yrs
coh=0.88
ph=176.1°
(131.6°E, 43.1°N)





ECMWF
T at 130.0°E, 40.9°N

ECMWF
T at 131.6°E, 43.1°N

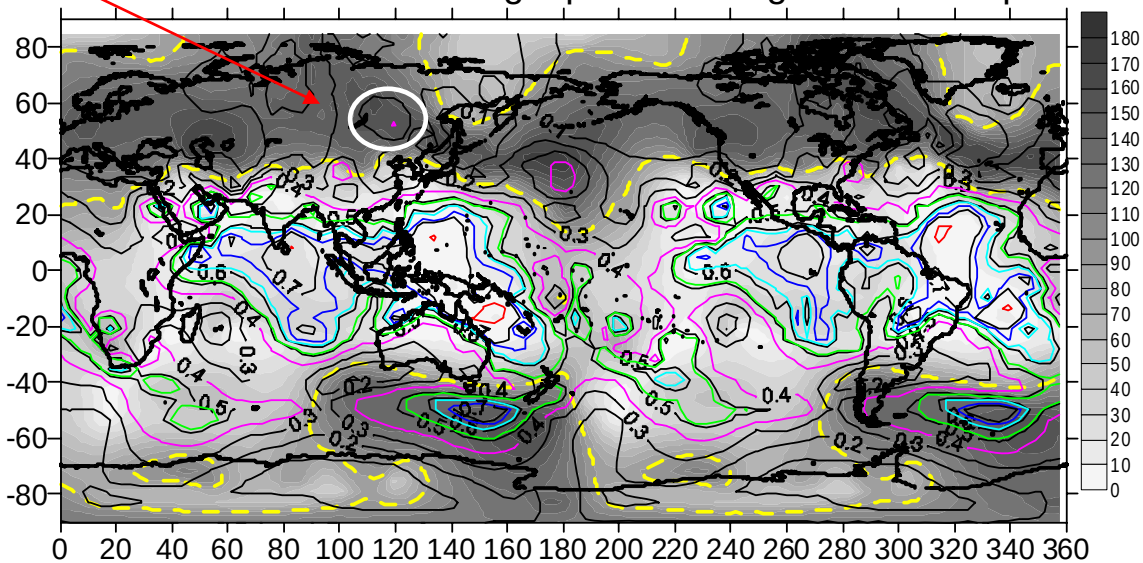
Observed
depth of 27.1 σ_θ at 103-7

Nino-3

To examine the teleconnection mechanism

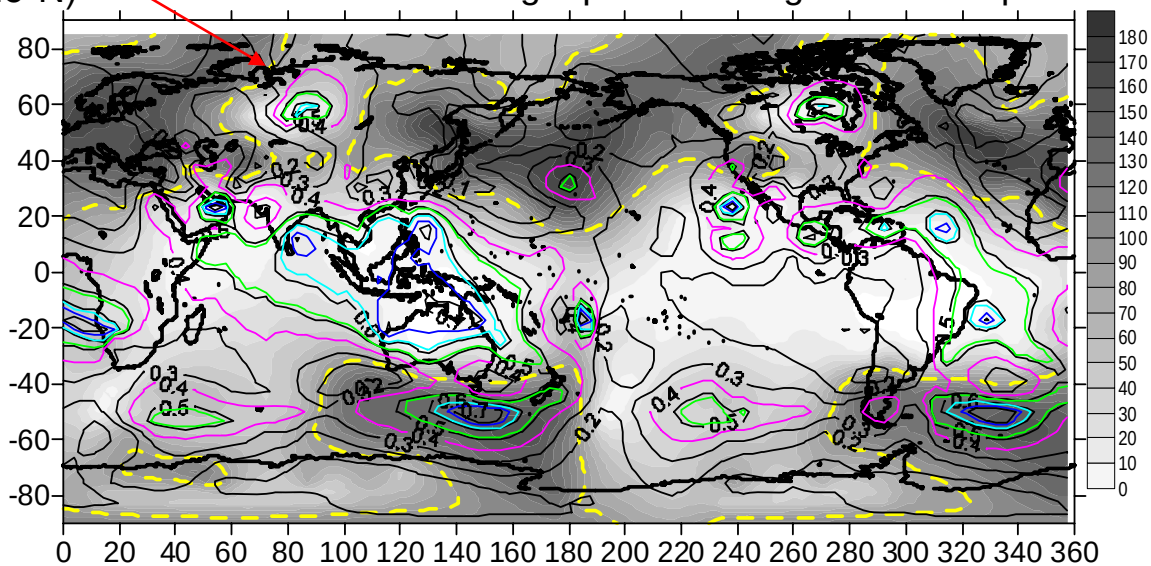
(122.5°E, 50°N)
coh=0.42
ph=162°

(a) Coherencies and phases
between NINO-3 and geopotential heights at 1000 hpa

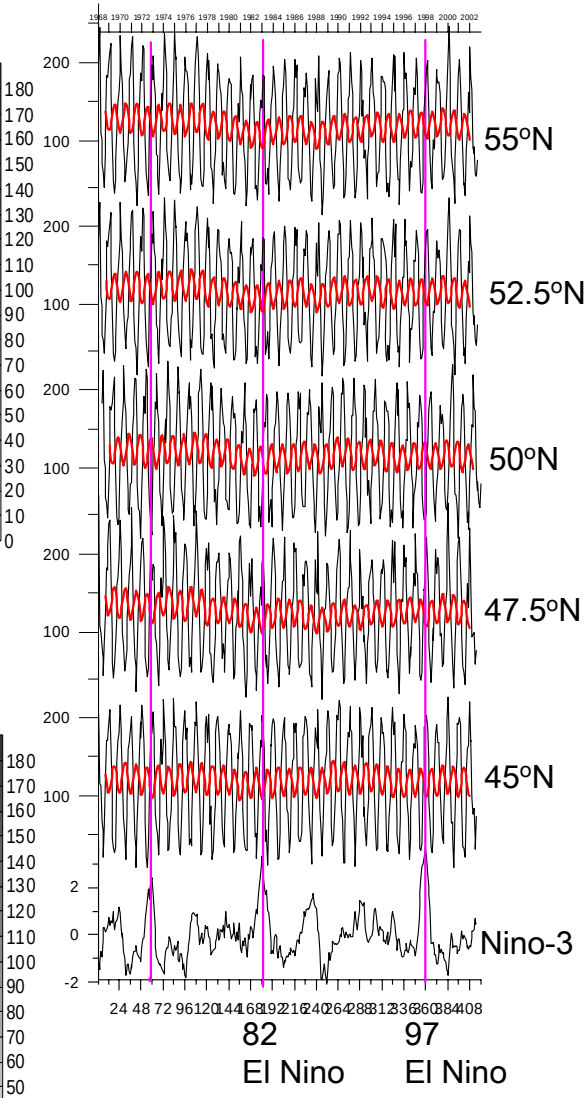


coh=0.70
ph=-12.2°
(87.5°E, 57.5°N)

(b) Coherencies and phases
between NINO-3 and geopotential heights at 850 hpa



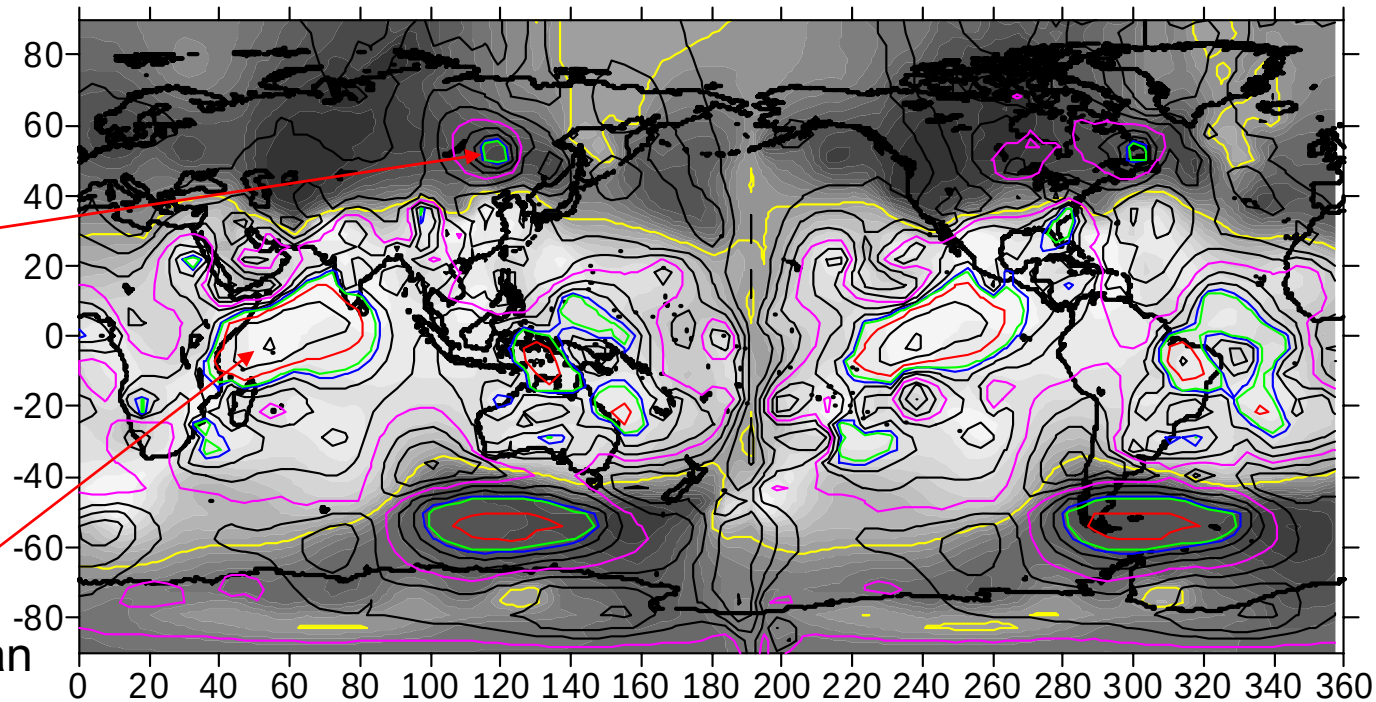
Goepotential height at 122.5°E



To see the atmospheric bridge effect

Coherency and phase of 1000 hpa geopotential heights between the western Indian Ocean (55E, 2.5S) and the Siberian high (117.5E, 52.5N)

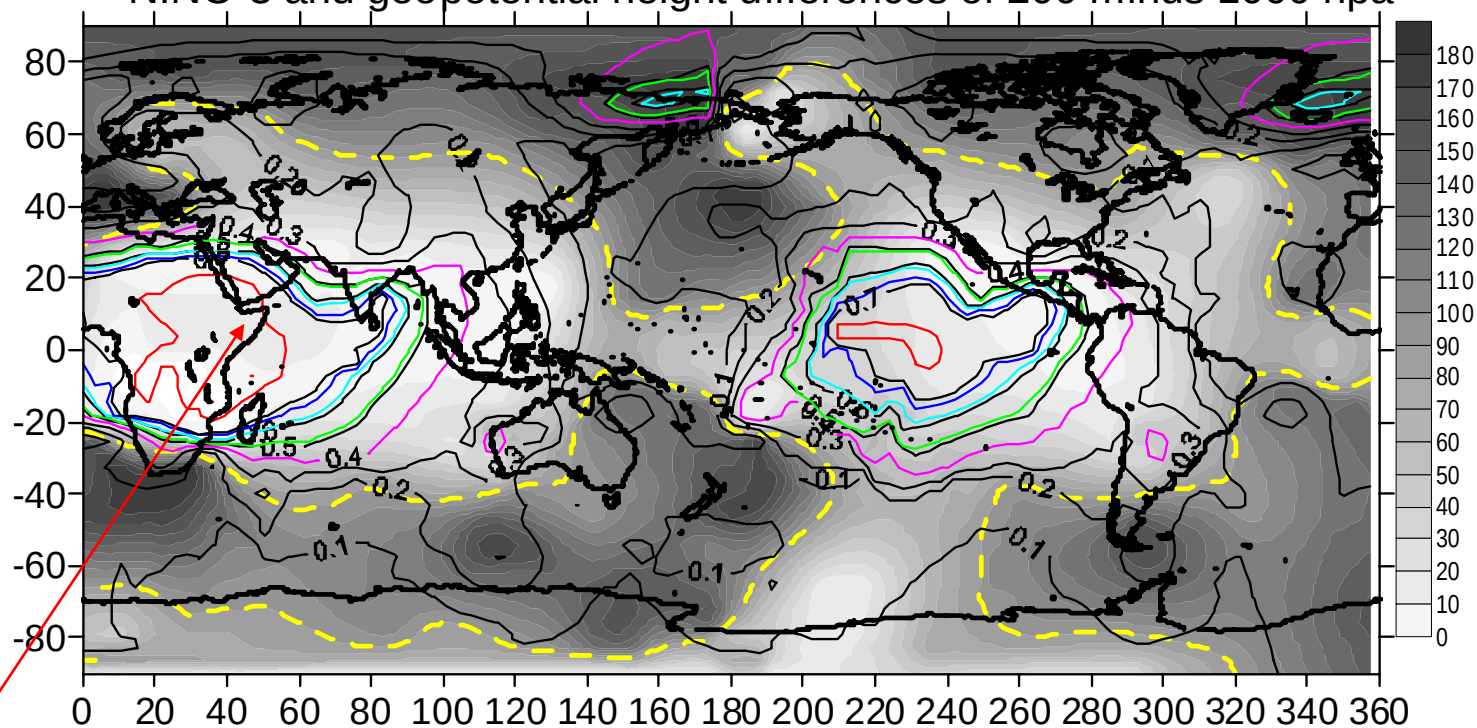
Siberian high region
coh=0.84
ph=165°
at 117.5°E, 52.5°N



Western Indian Ocean
coh=1.0
ph=0.0°
at 55°E, 2.5°S

To examine further the atmospheric bridge effect

(a) Coherencies and phases between
NINO-3 and geopotential height differences of 200 minus 1000 hpa

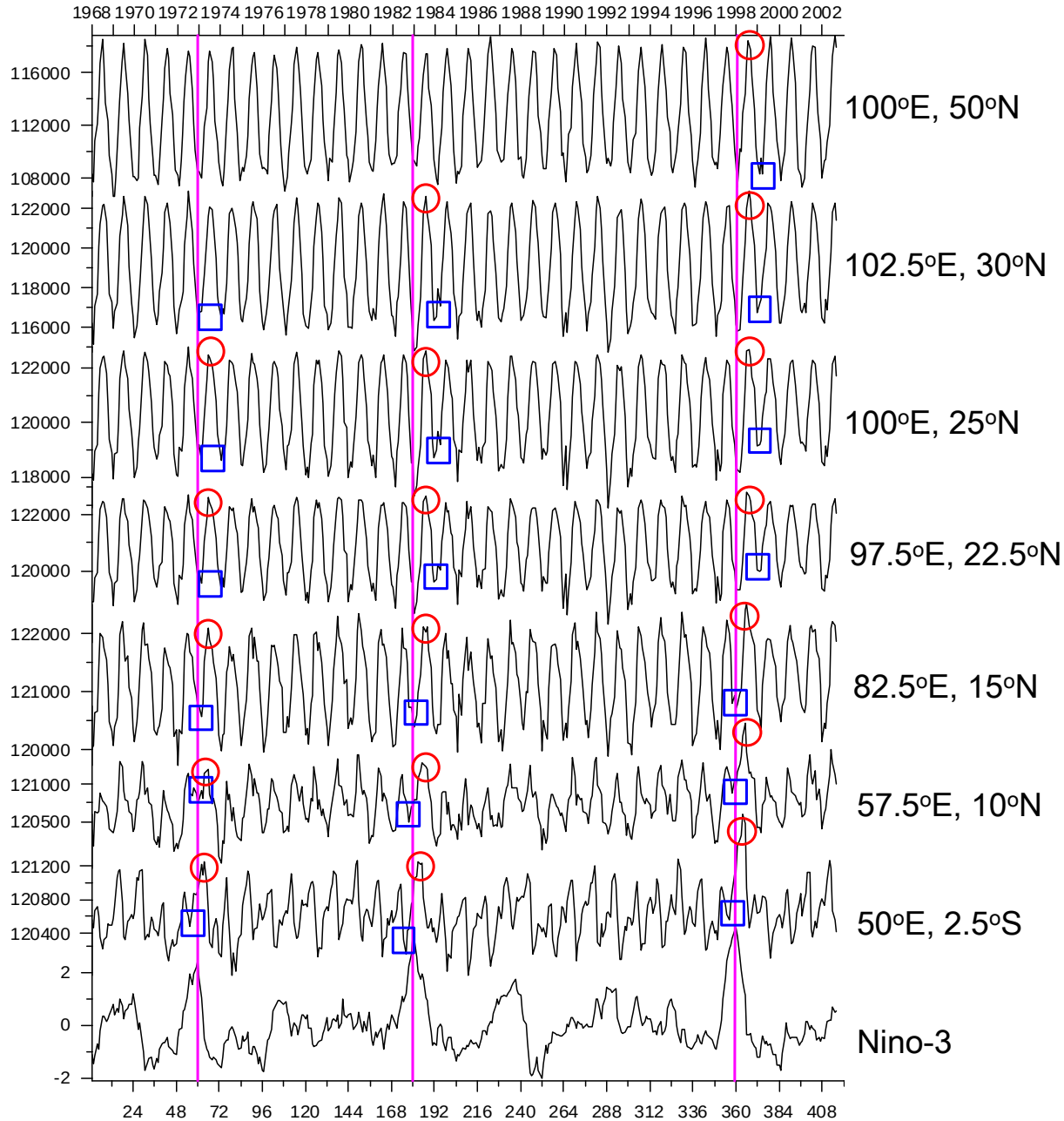


coh=0.86
ph=-11.3 (6 month time difference b/w Nino-3 and large thickness)
(45°E, 15°N)

Thickness time series of 200-1000 hpa along the high coherency path

○ : Thickness in summer after a strong El Nino

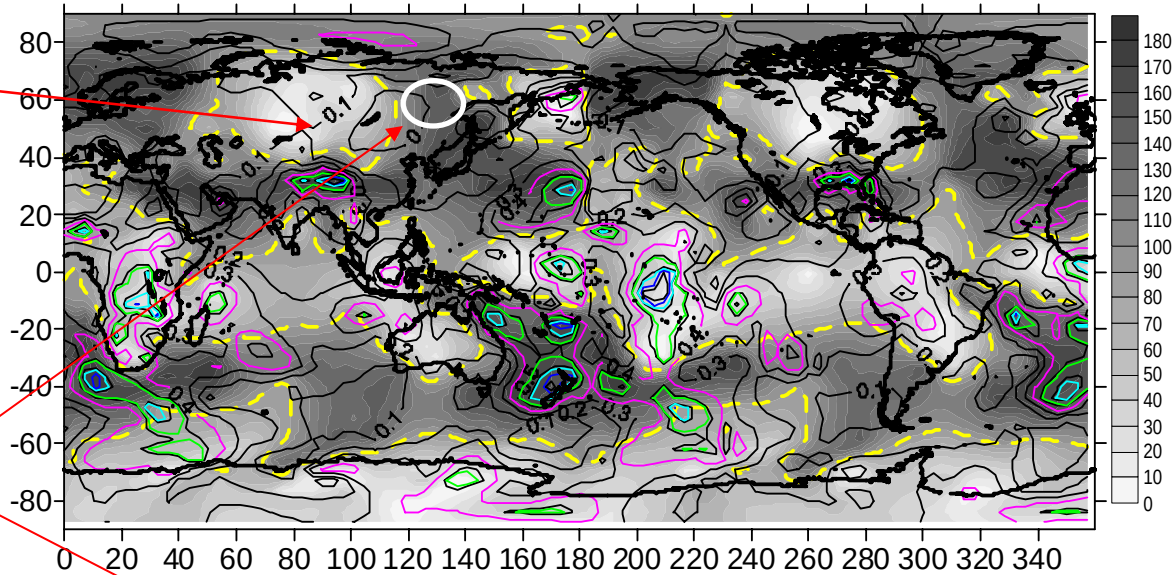
□ : Thickness in winter after a strong El Nino



To see if the temperatures and specific humidities support the idea of the atmospheric bridging

(a) Cohrencies and phases between NINO-3 and air temperatures at 1000 hpa

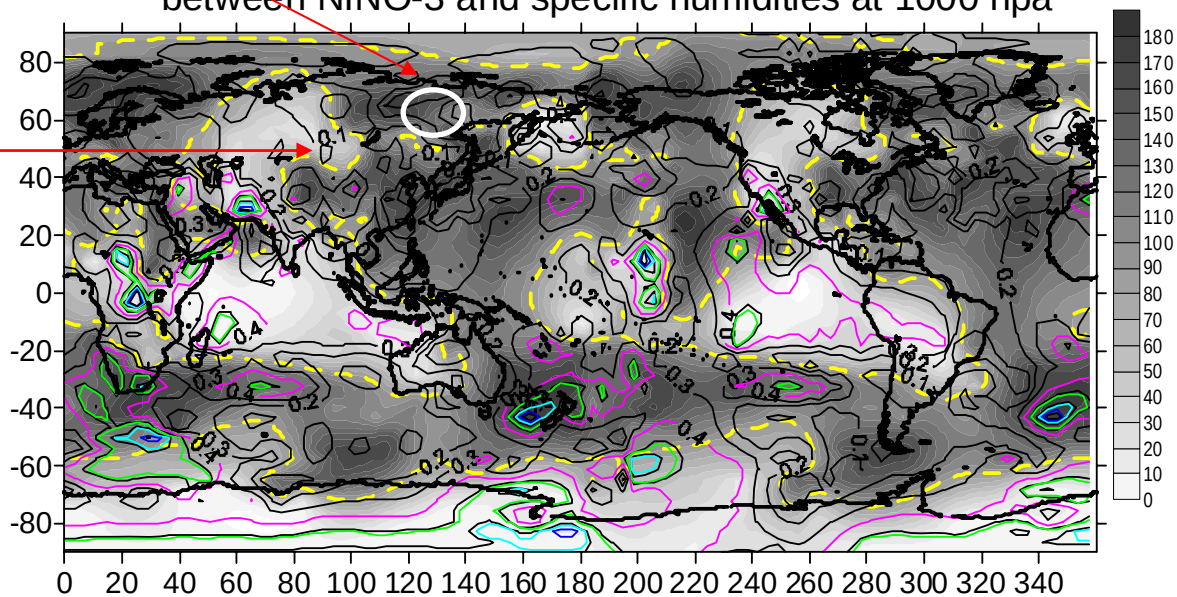
coh=0.23
ph=-30.8°N
(87.5°E, 60°N)



Dark shading: opposite phasing to Nino-3

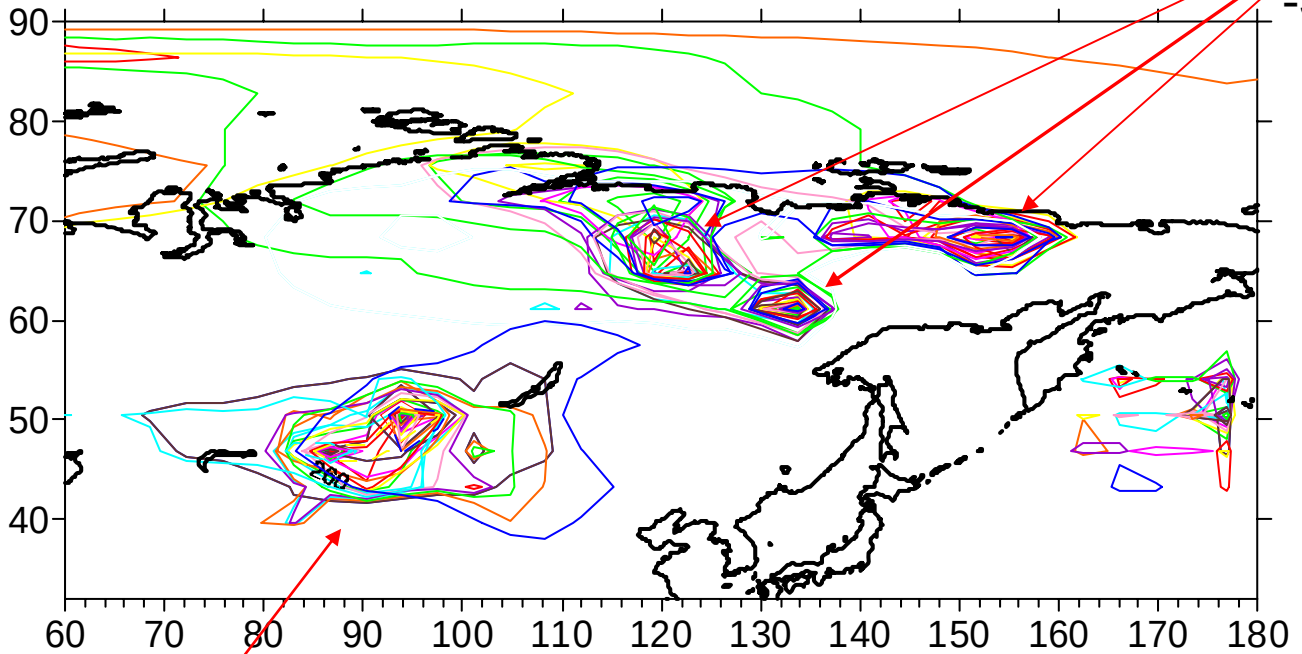
(b) Coherencies and phases between NINO-3 and specific humidities at 1000 hpa

coh=0.25
ph=37.7°
(90.0°E, 50°N)



Specific humidity= mass of water vapor/ a unit mass of air

1000 hpa geopotential heights above 260 m and winter (DJF) average temperatures of below -30C



Cold core regions with winter (DJF) avg. temp. below -30°C in each year

Location of the Siberian high center with 1000 hpa gpht above 260m in each year

higher humidity

more precipitation → wetter ground → more evaporation

cloudy → less solar radiation

plus the deep basin effect In the region

convergence of colder air into the basin

Conclusions

- There seems to be some teleconnection between a strong El Nino and the isopycnal fluctuations in the southwestern East Sea/Japan Sea.

- The teleconnection mechanism may be the atmospheric bridging between the Indian Ocean and the Siberian high region and the related cold surges toward the East Sea/Japan Sea

- This leads to lower SSTs in the northwestern East Sea/Japan Sea and to shallower isopycnal depths in the ESIW, when a strong El Nino occurs.