Forcing of Kelvin Waves over South America

Brant Liebmann, George Kiladis, Leila Carvalho, Carolina Vera, Charles Jones, Ileana Bladé, Dave Allured

With support from:
CPPA GC07-042
CPPA GC07-134
Variance of Kelvin-filtered OLR

November - May

June - October

1979-2005
Correlation of Daily Kelvin variance with Niño 3.4

November - May (1979/80 - 2005/06)

June - October (1979 - 2005)
Lead and Lag Regressions

Base point: Kelvin-filtered OLR at 60W, Eq.

Fields: 30-day high-pass filtered OLR, 200 mb winds and stream function
Dates are found with a 1.5 standard deviations negative OLR anomalies at 60W, Eq.

The dates are then separated by additional criteria before compositing:

“Pacific” cases: 3 days before key date Kelvin-filtered OLR more than 16 Wm\(^{-2}\) below mean at 95W, 2.5N

“South America” cases: 3 days before key date, 30-day high-pass filtered OLR more than 50 Wm\(^{-2}\) below mean at 60W, 20S.

53 Pacific cases
48 South America cases
4 common cases
The dates are then separated by additional criteria before compositing:

- "Pacific" cases: 3 days before key date Kelvin-filtered OLR more than 16 Wm\(^{-2}\) below mean at 95W, 2.5N
- "South America" cases: 3 days before key date, 30-day high-pass filtered OLR more than 50 Wm\(^{-2}\) below mean at 60W, 20S.

Dates are found with a 1.5 standard deviations negative OLR anomalies at 60W, Eq. 3.

4 common cases
Pacific events
Base point: Kelvin-filtered OLR, 1.5 STD anomaly (plus constraint at 95W, 2.5N)
Fields: 30-day high-pass OLR 200 mb wind and streamfunction

Wm$^{-2}$
Pacific events
Base point: Kelvin-filtered OLR, 1.5 STD anomaly
(plus constraint at 95W, 2.5N)
Fields: 30-day high-pass OLR
200 mb wind and streamfunction
Contrast with “South America” example (note different latitude range)

30-day High-pass OLR, 200 mb wind and stream function
Fields lead base point by 5 days

Blue contours indicate positive height anomalies.
Fields lead base point by 5 days

200 mb Heights and OLR

850 mb Heights and Rain

1000 mb Heights and Unfiltered rain

Blue contours indicate positive height anomalies
Fields lead base point by 4 days
Fields lead base point by 3 days

200
85
0
1000
Fields lead base point by 2 days

-30 -25 -20 -15 -10 10 15 20 25 30

-6 -5 -4 -3 -2 2 3 4 5 6

8 10 12 14 16

200

85

0

1000
Fields lead base point by 1 day
Fields simultaneous with base point

200

85

1000
Fields lag base point by 1 day
Conclusions

• There are at least two mechanisms that force Kelvin waves over South America
  a) at upper levels from the Pacific
  b) at lower levels from southern South America
     (e.g., Garreaud and Wallace 1998; Garreaud 2000)

• Not all South American (cold) events force Kelvin waves
Fields lead base point by 3 days

Kelvin-filtered base point

30-day high pass base point

OLR, 200 mb winds and heights
Fields simultaneous with base point

Kelvin-filtered base point

30-day high pass base point

OLR, 200 mb winds and heights
Fields lag base point by 1 day

Kelvin-filtered base point

30-day high pass base point

OLR, 200 mb winds and heights
Fields lag base point by 2 days

Kelvin-filtered base point

30-day high pass base point

OLR, 200 mb winds and heights
Conclusions

• There are at least two mechanisms that force Kelvin waves over South America
  
  a) at upper levels from the Pacific  
b) at lower levels from southern South America  
  (e.g., Garreaud and Wallace 1998; Garreaud 2000)

• Not all South American (cold) events force Kelvin waves

• Some Kelvin waves may be initiated in-situ