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**A comparison of global tropospheric teleconnections  
using observed satellite and general circulation model  
total ozone column data for 1979–91**

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By Thamirys

# Estrutura da Apresentação

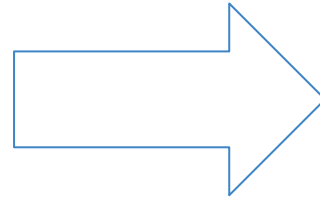
1. Propósito do Artigo
2. Introdução
  - a. ozônio e El Niño na troposfera
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4. Procedimentos de análises
5. Resultados
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# Propósito do estudo

É documentar e investigar detalhadamente os padrões de teleconexões pela técnica multivariada e análises de EOF, compreendendo melhor as causas de usar um simples modelo barotrópico

# Ozônio e El Niño na troposfera

1. A coluna total de ozônio apresenta uma boa correlação com os campos da troposfera,
  - a. pode fornecer informação sobre a variabilidade temporal da troposfera;
2. A alta densidade de ozônio na baixa estratosfera faz com que o padrão sinótico do ozônio total reflita as variações na alta tropopausa associadas aos distúrbios troposféricos;
3. A temperatura da superfície do oceano (do inglês, SST) tropical pode influenciar a concentração de ozônio, pois
  - a. pode mudar a altura da tropopausa, e
  - b. advecção vertical;
4. A variação tropical do ozônio reflete a variabilidade de baixa frequência da troposfera devido:
  - a. a variabilidade do El Niño/ Southern Oscillation (ENSO);



afetando o aquecimento  
adiabático da troposfera

# Ozônio e El Niño na troposfera

1. Teleconexão é utilizada para estudos de larga escala para analisar variações de baixa frequência do clima.
2. Ondas 1 são responsáveis pelas mudanças dinâmicas na troposfera durante Southern Oscillation:
  - a. afeta as queimadas na África e no Brasil;
3. Anomalia de vorticidade potencial extratropical forçadas remotamente junto anomalias de aquecimentos tropical gera:
  - a. variações na concentração de ozônio total e temperaturas mais baixas na estratosfera
4. Anomalias podem gerar:
  - a. ondas estacionárias no sul polar fracas / intensas durante eventos quentes / frios do ENSO

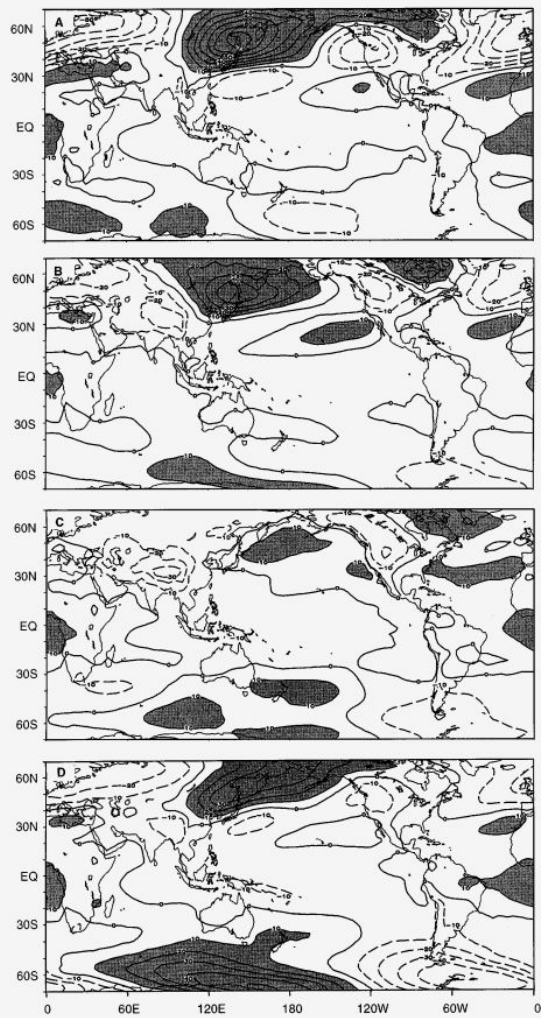
# Dados utilizados

1. Total Ozone Mapping Spectrometer (TOMS)
  - a. 1979 a 1991
  - b.  $2,5^\circ \times 2,0^\circ$
  - c.  $70^\circ\text{N}$  a  $70^\circ\text{S}$
2. Atmospheric General Circulation Model (GCM)
  - a. 1979 a 1991
  - b.  $2,8^\circ \times 2,8^\circ$
  - c.  $70^\circ\text{N}$  a  $70^\circ\text{S}$
  - d. Truncado horizontalmente com número de onda total 42 (T42)
  - e. simula El Niño
3. Dados observacionais
  - a. 200 hPa do campo geopotencial

# Procedimentos de análise

1. Procedimento de filtragem
  - a. média zonal da coluna de ozônio
2. Cálculo da Anomalia de vórtices
  - a. base climatológica, subtraindo média anual climatológica
3. 1A Vórtices
  - a. variabilidade anual (filtro passa baixa)
4. Análise da Teleconectividade
  - a. filtros das anomalias de ozônio sazonal
5. EOF
  - a. estrutura de covariância espacial

**Fig. 1A–D** Eddy time-mean of the seasonal climatology of the TOMS IA filtered total ozone data for **A** DJF, **B** MAM, **C** JJA, and **D** SON. The contour interval is 10 DU and positive values greater than 10 are shaded



**Fig. 2A–D** Eddy time-mean of the seasonal climatology of the GCM IA filtered total ozone data for **A** DJF, **B** MAM, **C** JJA, and **D** SON. The contour interval is 10 DU and positive values greater than 10 are shaded

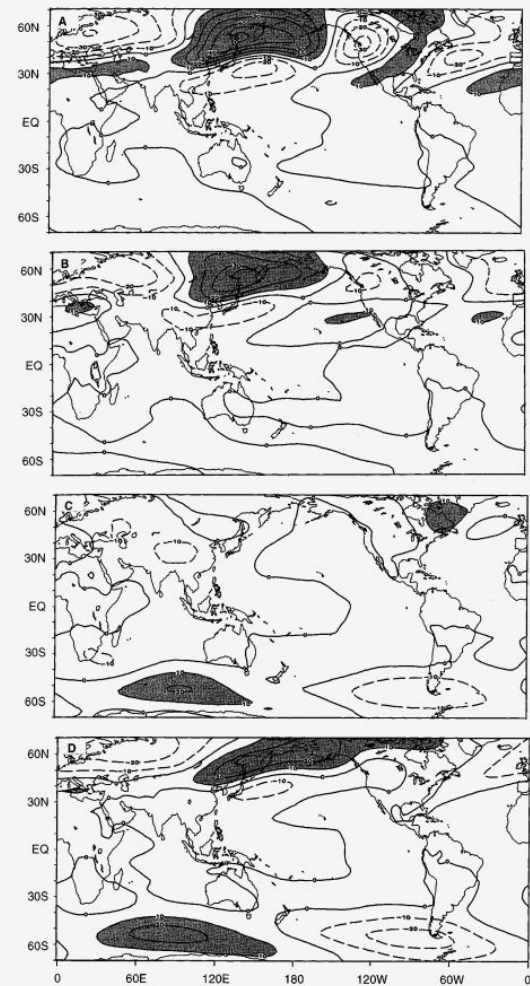
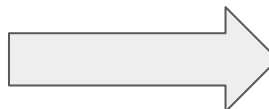
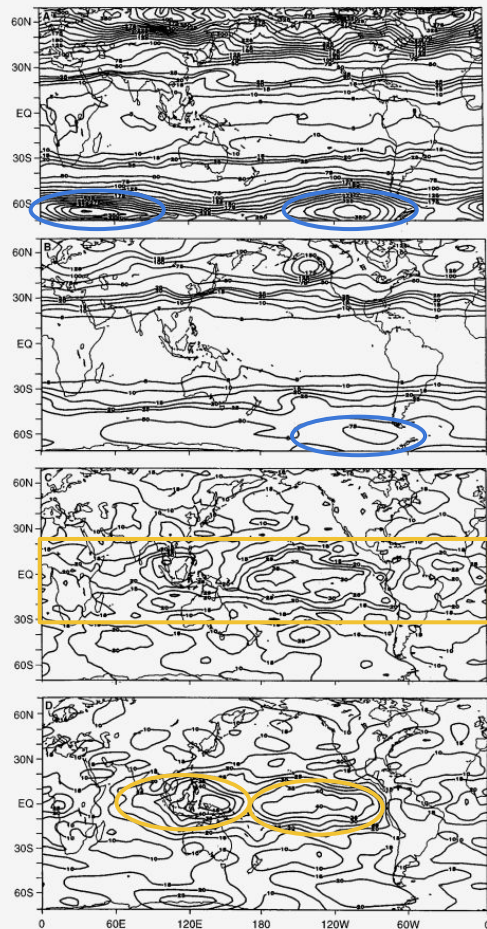




Fig. 3A–D TOMS and GCM ozone variances: A TOMS total variance, B GCM total variance, C TOMS variance ratio between total and 1A variance, and D same as C for the GCM variance. The contour intervals are 25 DU in A and B, and 5% in C and D. Additional contours have been drawn for values less than 25 DU in A and B (contours every 5 DU)

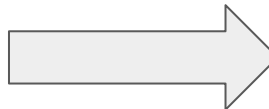


Variância Total TOMS



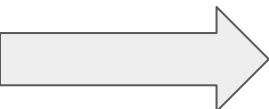
Variância Total GCM

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Razão da Variância Total TOMS e 1A

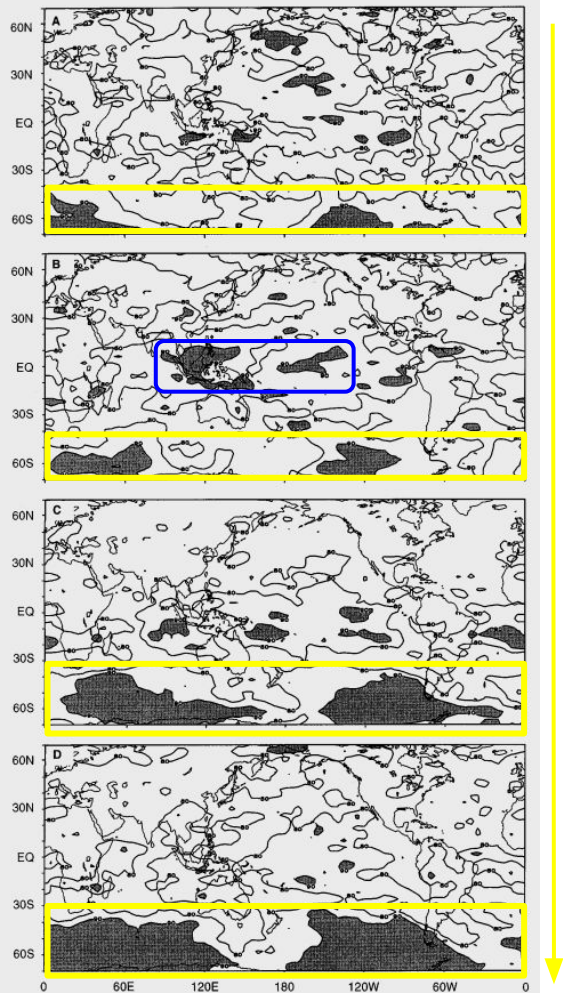
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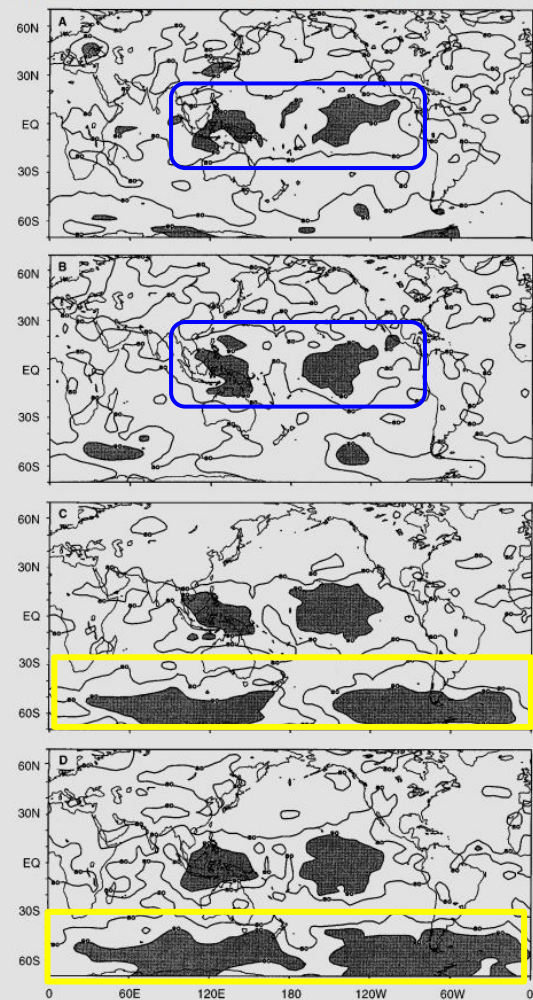
Razão da Variância Total GCM e 1A

Semelhante

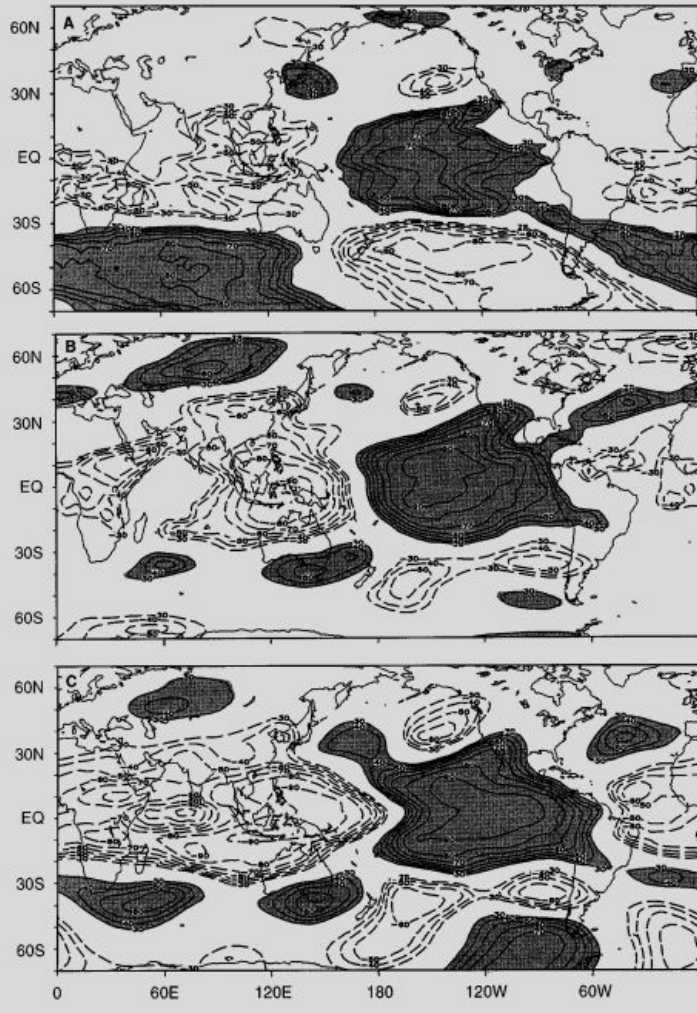
**Fig. 4A–D** Teleconnectivity maps of 1A TOMS total ozone eddy data for A DJF, B MAM, C JJA, and D SON. The values have been multiplied by 100 and the *darker shades* mean stronger teleconnectivity. Values smaller than 80 are not contoured, and the contour interval is 10



**Fig. 5A–D** Teleconnectivity maps of 1A GCM total ozone eddy data for A DJF, B MAM, C JJA, and D SON. The values have been multiplied by 100 and the *darker shades* mean stronger teleconnectivity. Values smaller than 80 are not contoured, and the contour interval is 10



**Fig. 6A–C** The first unrotated IA patterns for **A** TOMS and **B** GCM total ozone eddy anomalies and **C** GCM geopotential height, computed for the period 1979–1991. The loadings are contoured with *positive (negative) values* indicated by *solid (dashed)* lines and they were multiplied by 100. The contour interval is 10 and *positive values are shaded*



TOMS: 1A s/ rotação  
Presença de Dipolo

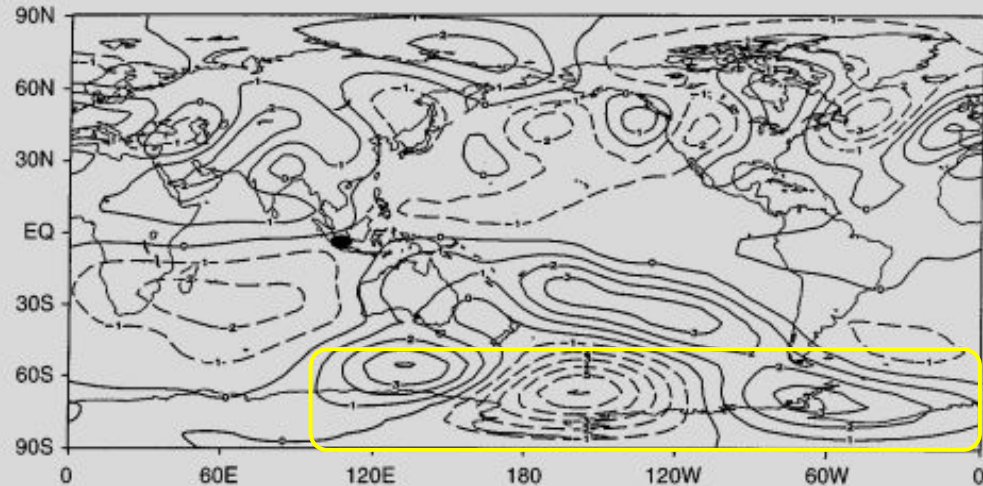


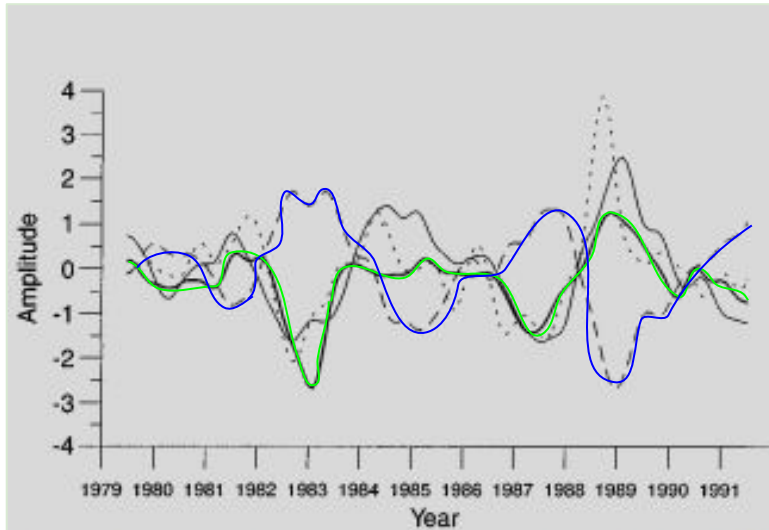
GCM: 1A s/ rotação  
Ondas de Rossby Estacionárias



GCM Geopotencial  
Ondas de Rossby Estacionárias

**Fig. 7** Stream function anomaly produced by a barotropic model with a June-August mean 300 hPa data as a basic state and for a stationary forcing centred at 120°E on the equator at day 12. The contours were multiplied by  $1 \times 10^{-6}$  and the contour interval is  $1 \text{ s}^{-1}$ ; negative values are dashed, and the zero contour is dotted. The black circle indicates the forcing position

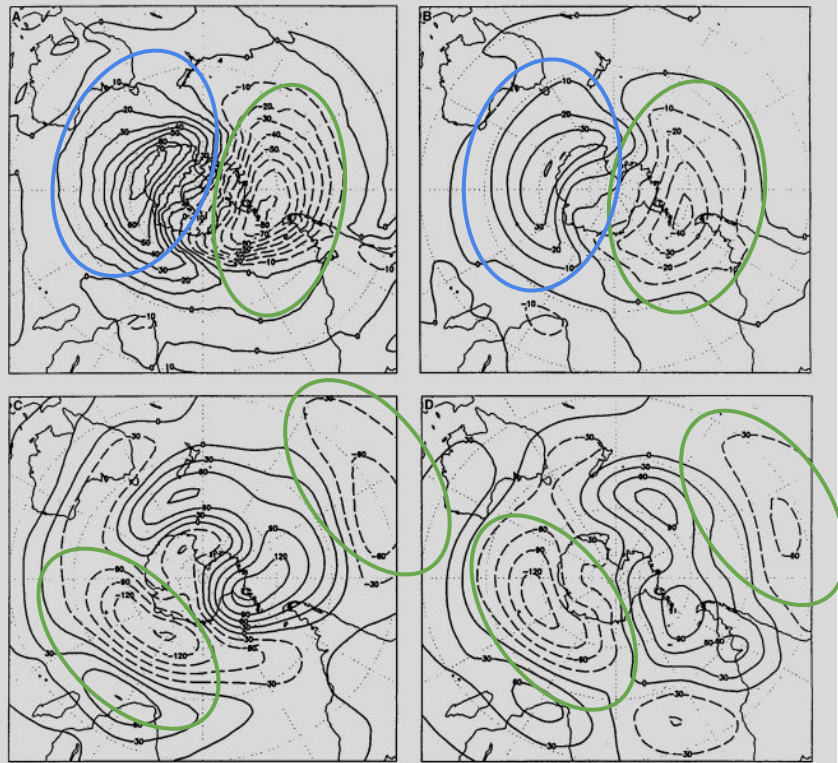




**Fig. 8** The corresponding amplitude time series (PC1) related to the first EOF mode of the TOMS/GCM ozone data and the GCM geopotential height shown in Fig. 6. The *short dashed line* is for the ozone real, *lighter continuous line* is for the model data, *long dashed line* is for the geopotential height and the *thick solid line* illustrates the IA filtered Southern Oscillation Index for the same period

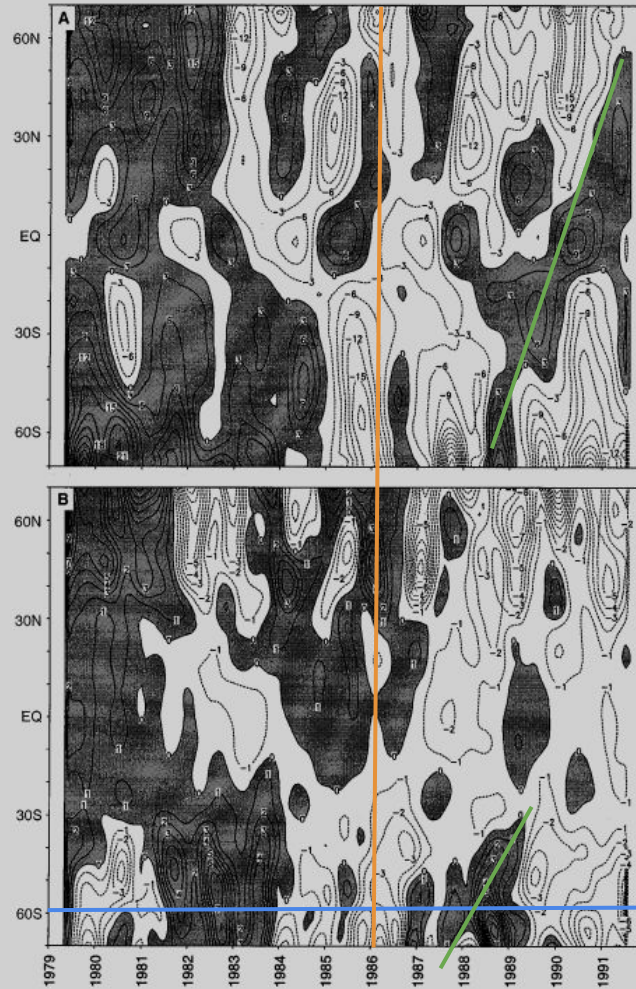
PC1: Principal Componente

Os dados do **modelo** estão fora de fase com **geopotencial**



**Fig. 9A–D** Zonal deviations average for the August–November 1988 period for the **A** TOMS total ozone, **B** GCM total ozone, **C** observed 200G hPa geopotential height, and **D** GCM 200G hPa geopotential height. The contour interval is 10 DU for **A** and **B** and 30 gpm for **C** and **D**; negative lines are dashed

**Fig. 10A, B** Latitude versus time plots for the period from 1979 to 1991 of the **A** TOMS and **B** GCM total ozone IA zonal mean anomalies. The contour interval is 3 DU in **A** and 1 DU in **B**; *negative values are dashed and positive values are shaded*



# Conclusões

1. A coluna total de ozônio mostra uma forte teleconexão com as ondas ENSO1 nos extratropicos do Hemisfério Sul;
2. Há uma relação inversa entre o ozônio total e os níveis mais altos do geopotencial sobre os trópicos;
3. A linearização dos modelos barotrópicos é importante para entender a resposta do hemisfério sul, mas não capta ondas do ENSO1.



Obrigada !