

Previsões por Ensemble de Curto Prazo

SREP

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CPTEC/INPE

II Workshop em Modelagem Regional de
Tempo e Clima Utilizando o Modelo Eta:

Aspectos Físicos e Numéricos

Cachoeira Paulista

Maio/2007

Desenvolvimentos Numéricos no Modelo Regional Eta - Módulo I

Previsibilidade da Atmosfera



Sistemas dinâmicos Instáveis



Sistemas dinâmicos Estáveis

Perturbações de pequena amplitude afetam a atmosfera:

- pequenos erros nas observações tendem a dobrar em 3 dias (grande escala).
- pequenos erros na mesoescala dobram em horas.
- erros da pequena escala geram erros na macroestrutura.

Previsões por Conjunto (Ensemble)

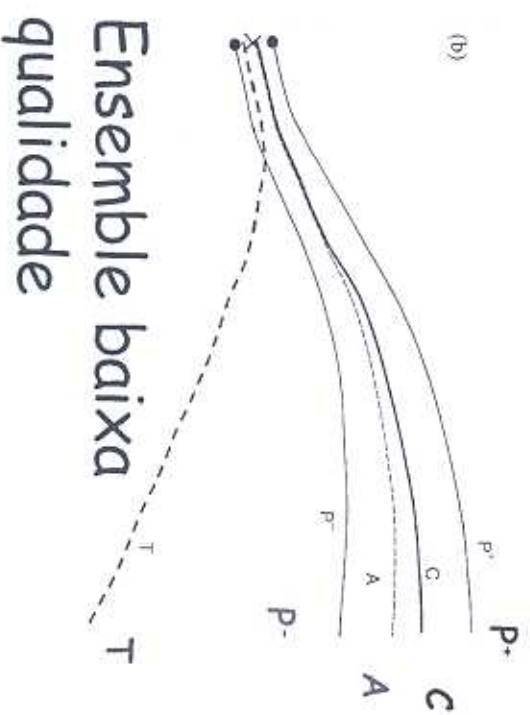
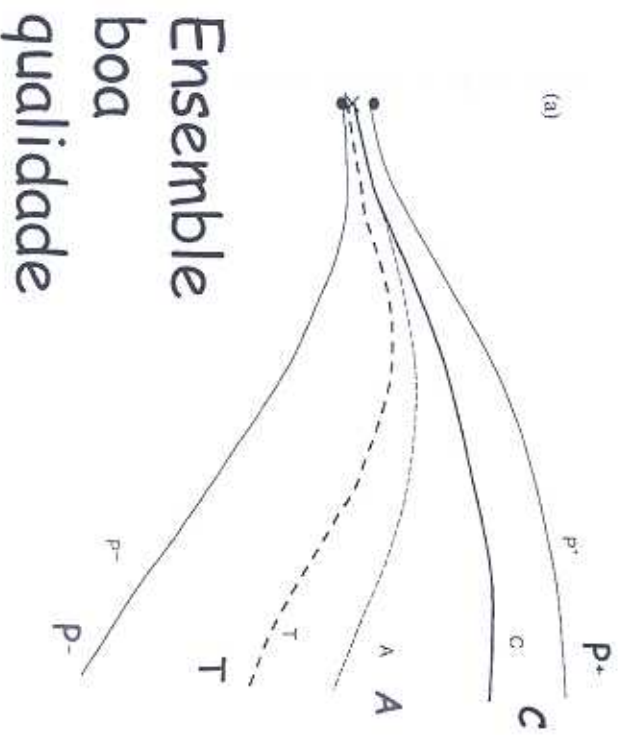
Explorar de maneira sistemática a natureza caótica da atmosfera..

Eficiência da previsão depende:

- acurácia das condições iniciais.
- precisão dos modelos.
- instabilidades.

Principais objetivos de uma previsão por ensemble:

- Ensemble médio (ensemble médio tende a filtrar os componentes da previsão que são incertos e manter os componentes que mostram concordância).
- Medir a confiabilidade da previsão.
- Base quantitativa para previsões probabilísticas.



C - previsão
controle

P⁺ - pert. positiva

P⁻ - pert. negativa

A - ensemble médio

T - estado real da
atmosfera

Previsões por Ensemble de Curto Prazo

SREP - Metodologia

Duas fontes de incertezas:

• *CONDIÇÕES INICIAIS*

- Os dados observacionais não podem ser medidos com infinito grau de precisão.

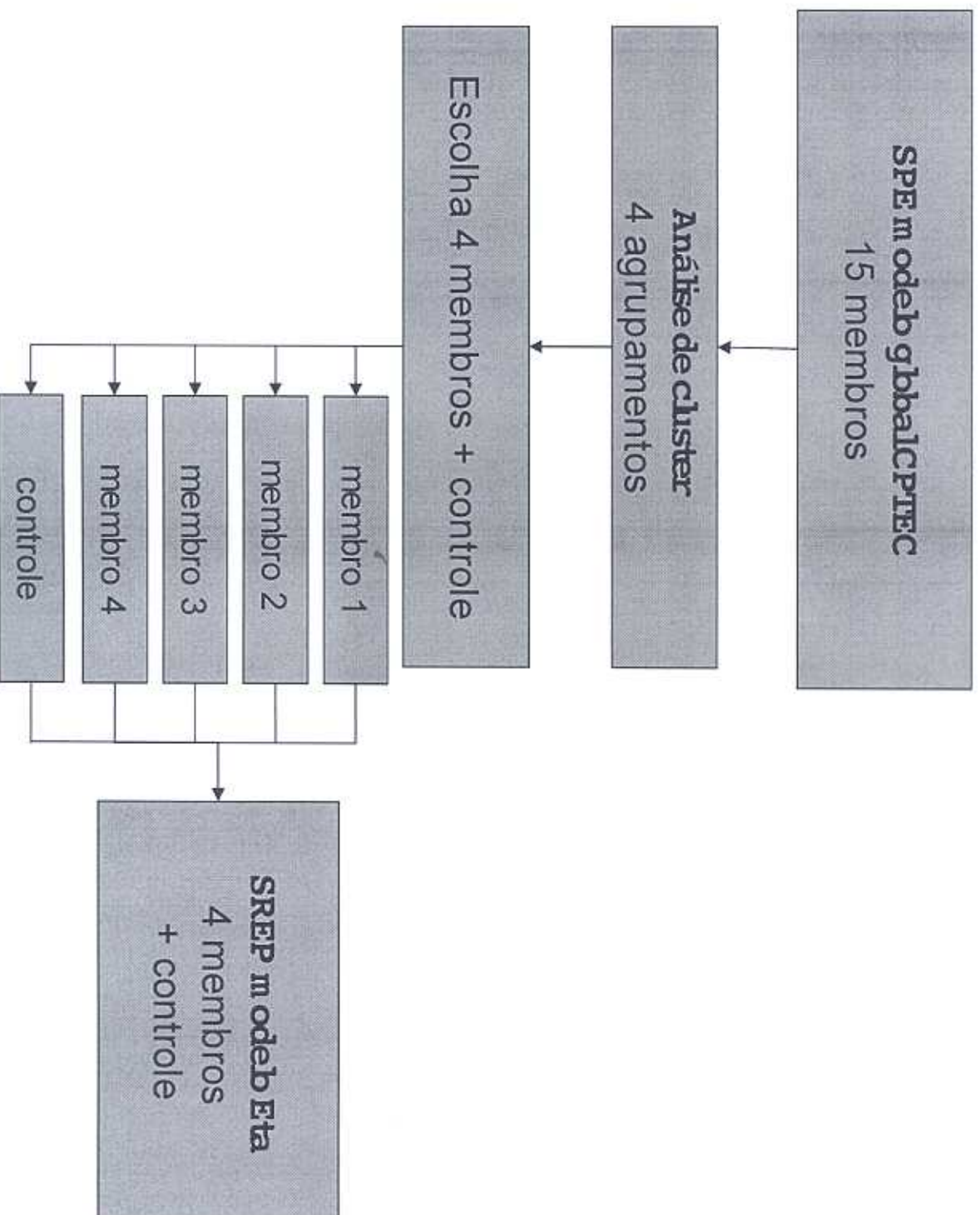
Ensemble Condição Inicial - ENSCI

• *DEFICIÊNCIAS DOS MODELOS.*

- Equações utilizadas pelos modelos não capturam todos os processos na atmosfera.
- Resolução dos modelos não é suficiente para capturar todas as características da atmosfera.

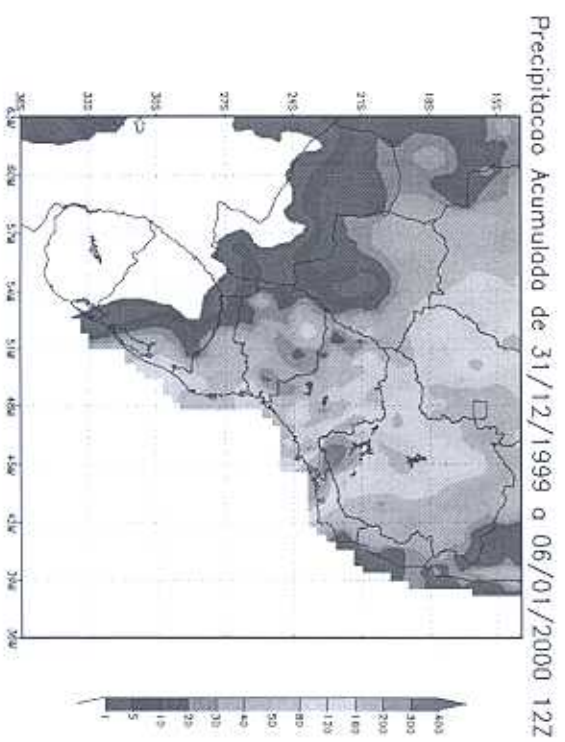
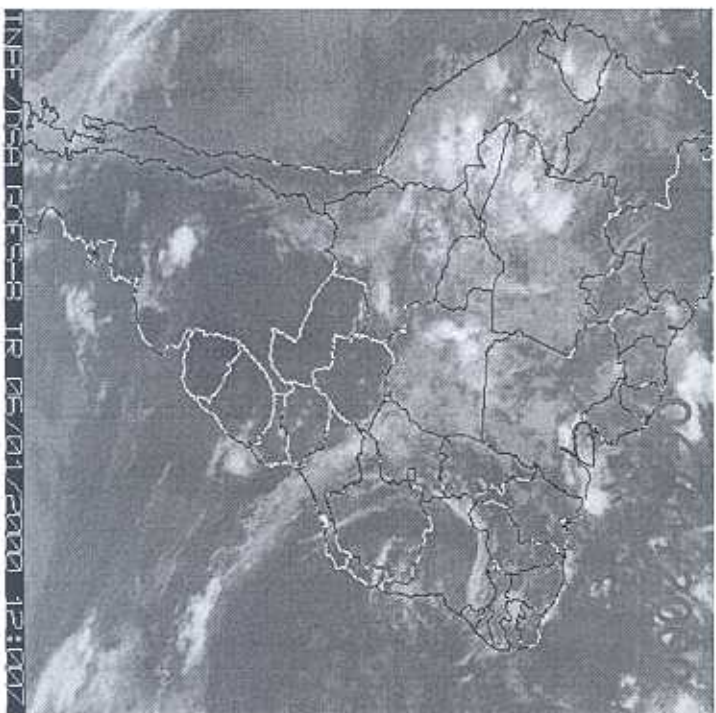
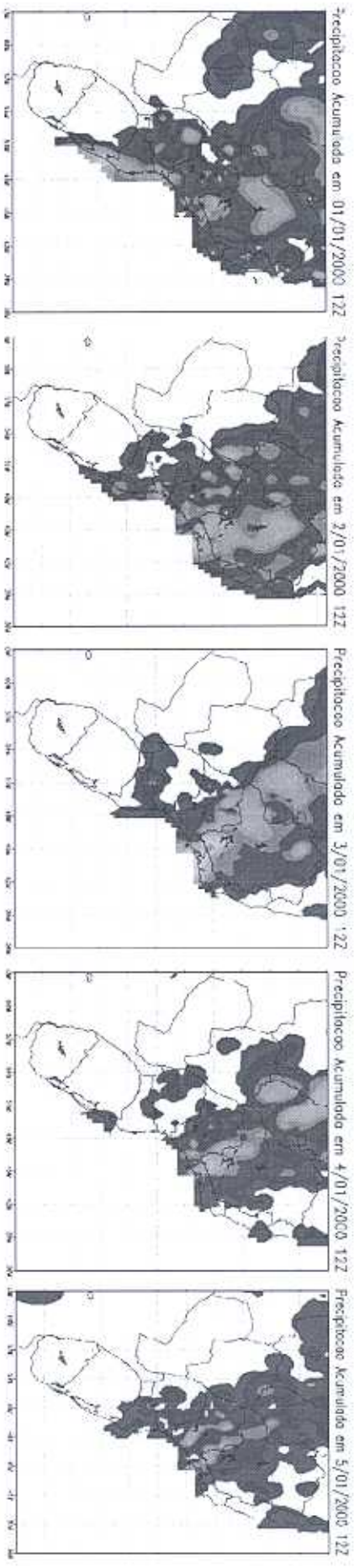
Ensemble Física - ENSFIS

Metodologia: Ensemble Condição Inicial



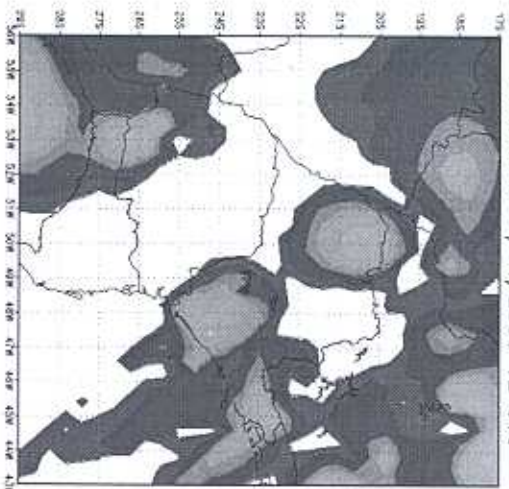
Metodologia: Casos Analisados

ZCAS janeiro 2000

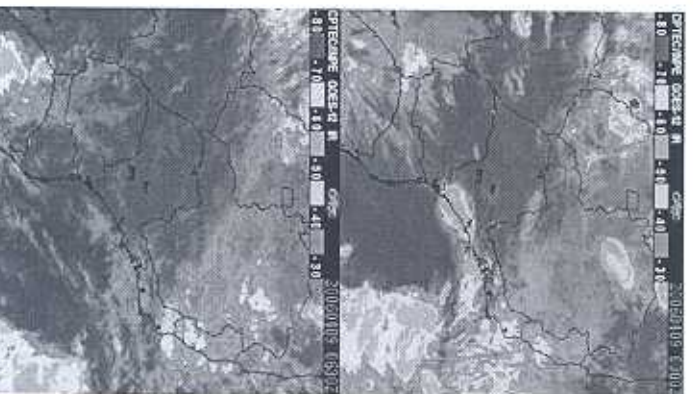
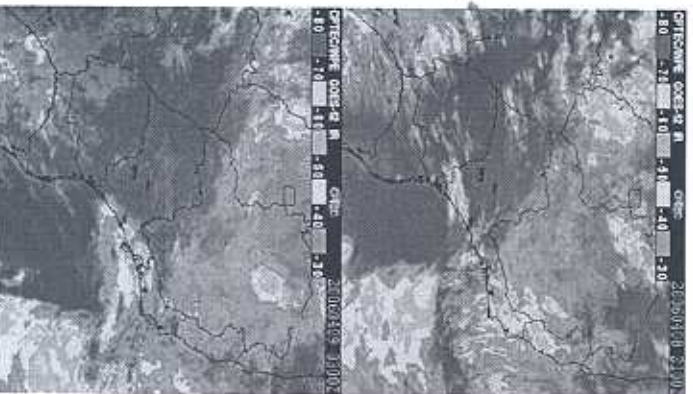
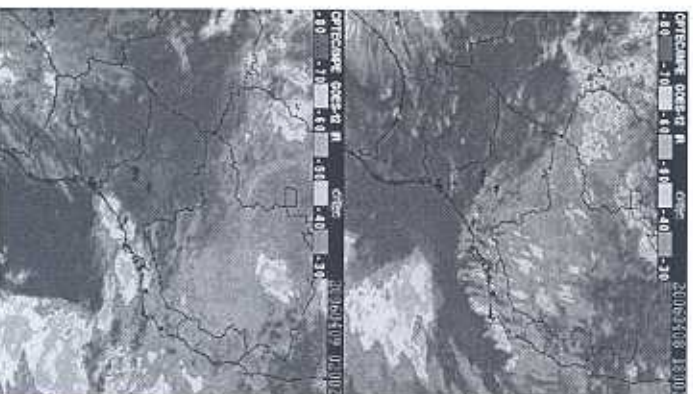
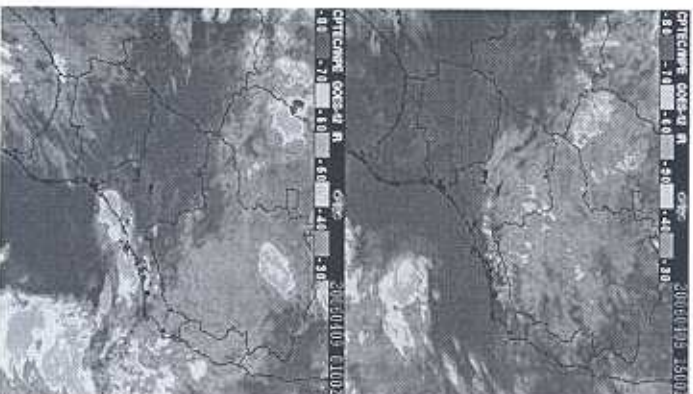
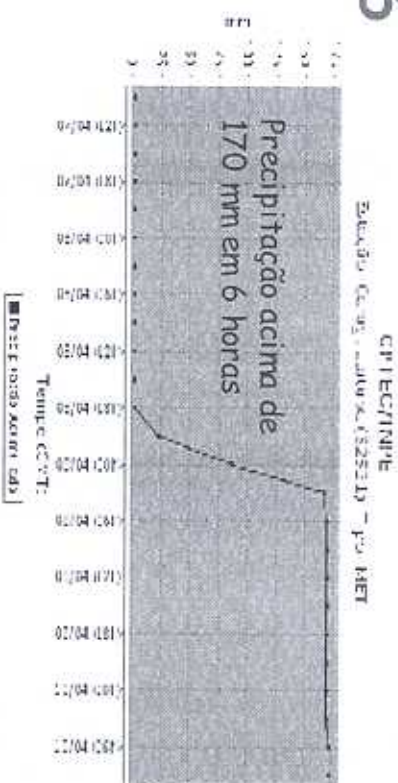


Metodologia: Casos Analisados

Prec. Obs. 09/04/2006 12 UTC



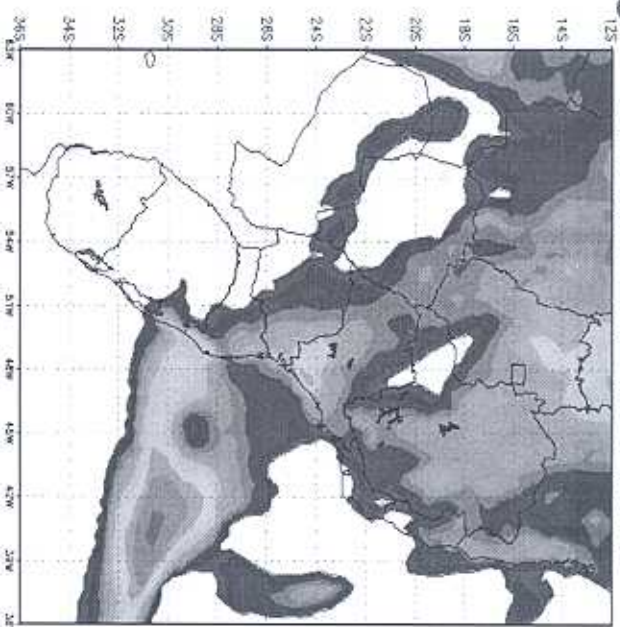
Caraguatatuba 09 de abril de 2006



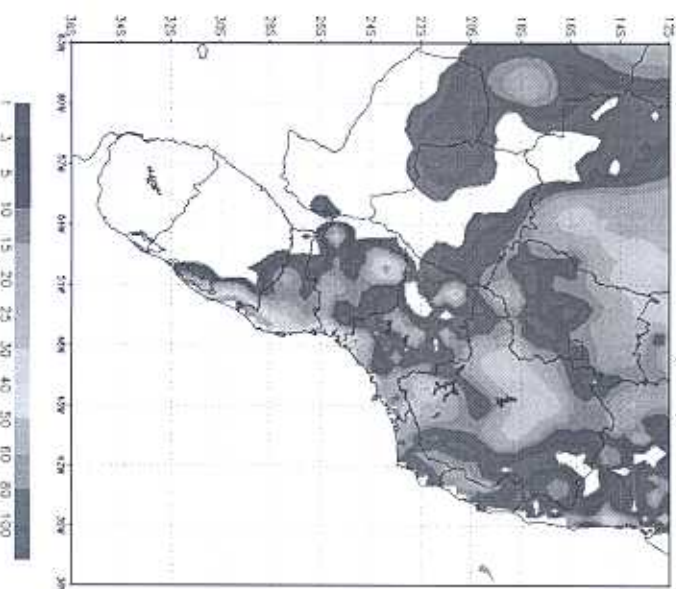
ZCAS janeiro 2000

Previsão do modelo operacional Eta 40km

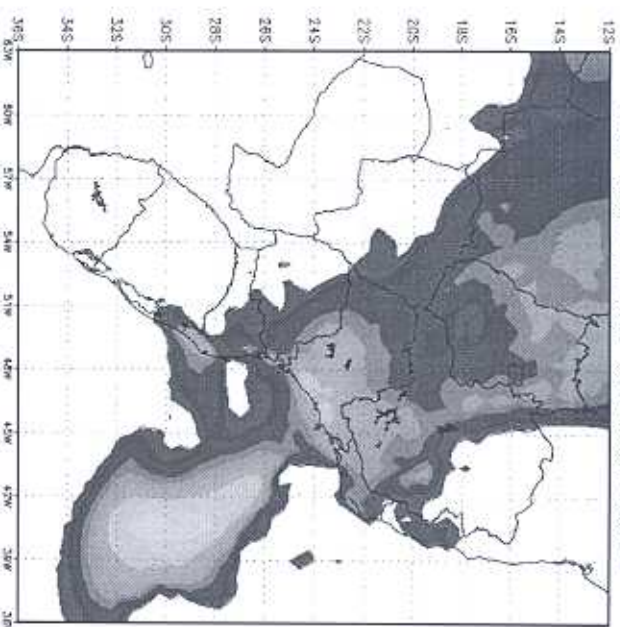
Eta 40km T+48h CI:1999123012



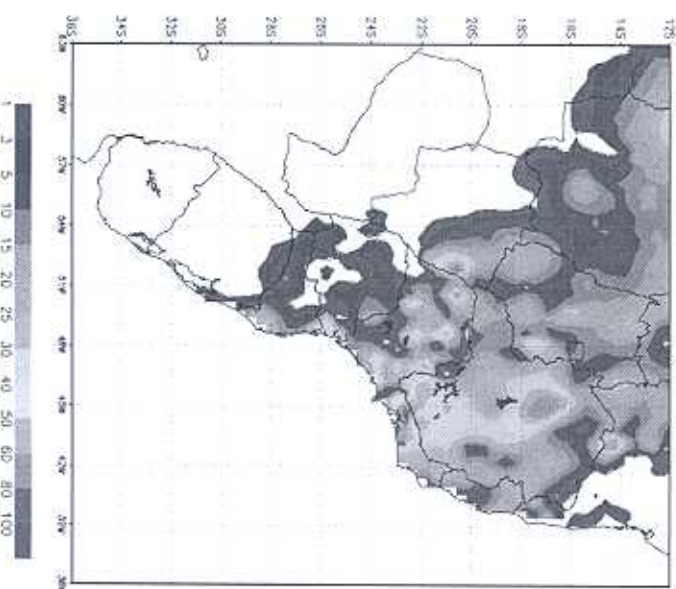
Precipitacao Observada 01/JAN/2000 12 UTC



Eta 40km T+72h CI:1999123012



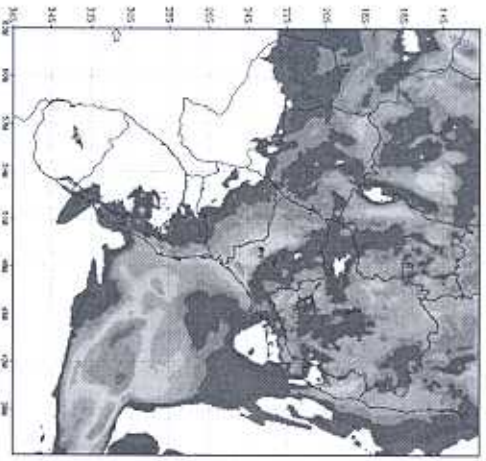
Precipitacao Observada 02/JAN/2000 12 UTC



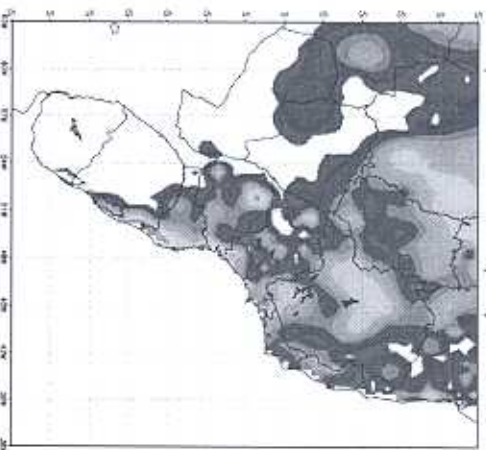
Resultados - ZCAS200

Obs

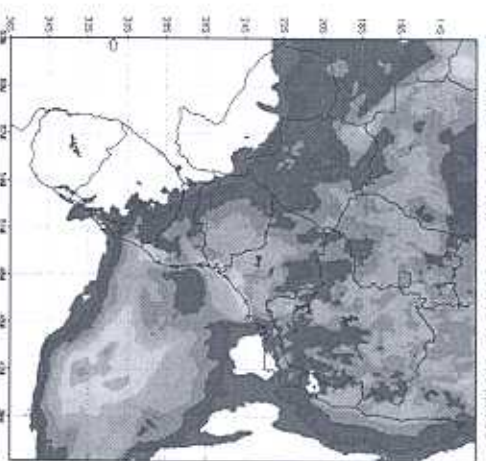
T+48h 01/Jan/2000 12 UTC



Control T+48h 1999123012 zcas2000



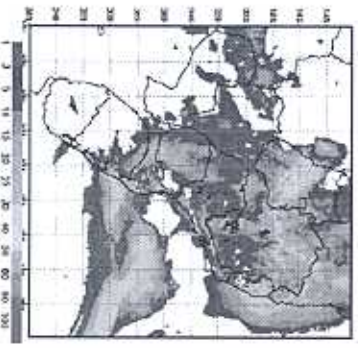
Precipitacion Observada 01/JAN/2000 12 UTC



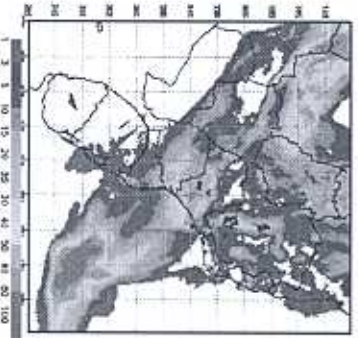
EnMed CI T+48h 1999123012 zcas2000

Control

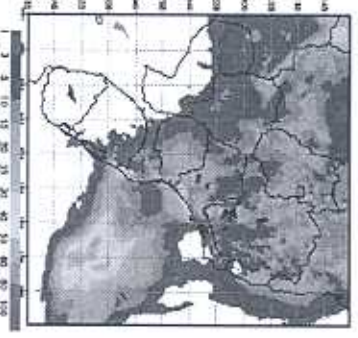
ENSCI



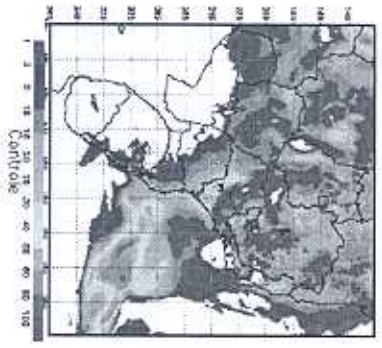
Membro1



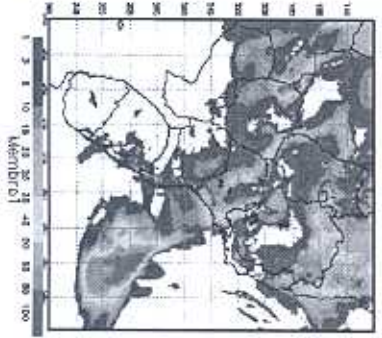
Membro4



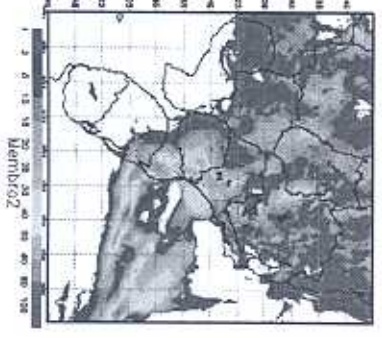
Ensemble Medio



Control



Membro1



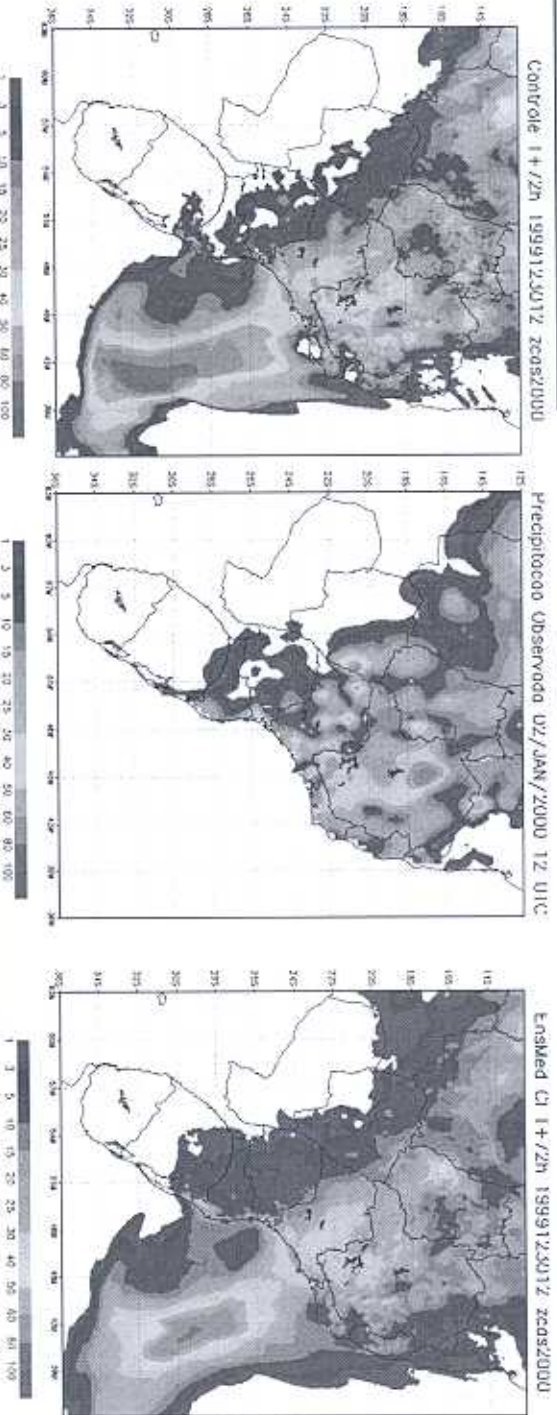
Membro2

ENSCI

Resultados - ZCAS200

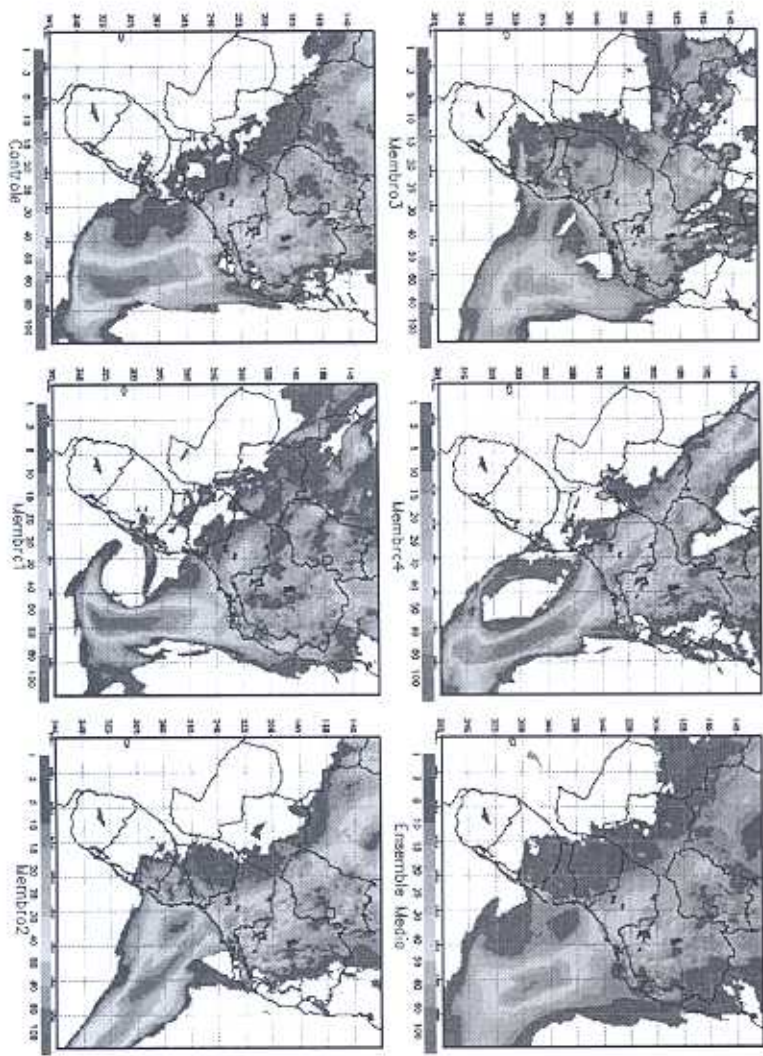
Obs

T+72h 01/Jan/2000 12 UTC



Controle

EnSCI

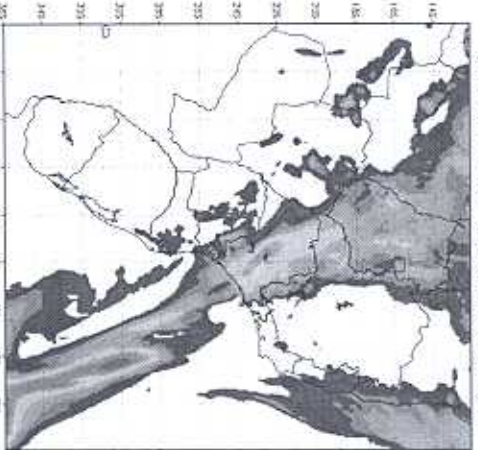


Resultados - ZCAS200

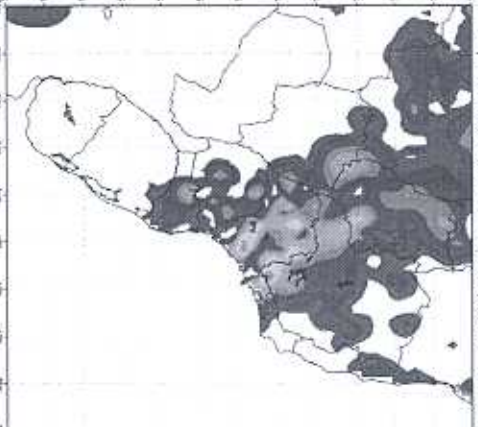
Obs

T+144h 01/Jan/2000 12 UTC

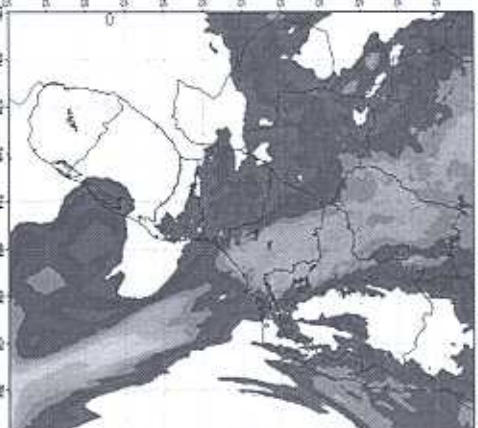
Control T+144h 1999123012 zcas2000



Precipitacao Observada 05/JAN/2000 12 UTC

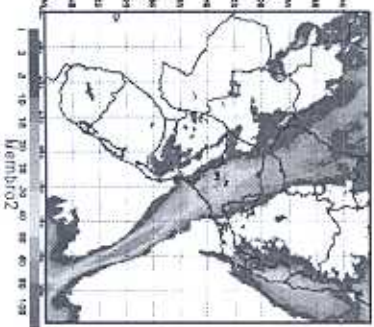
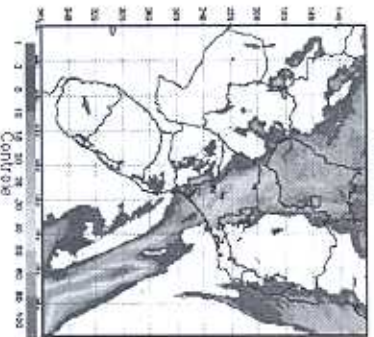
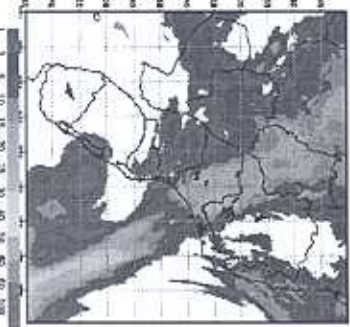
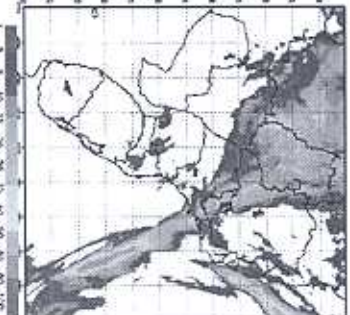
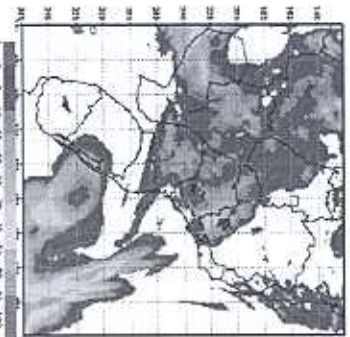


Ensmad CI T+144h 1999123012 zcas2000



Control

EnSCI



EnSCI

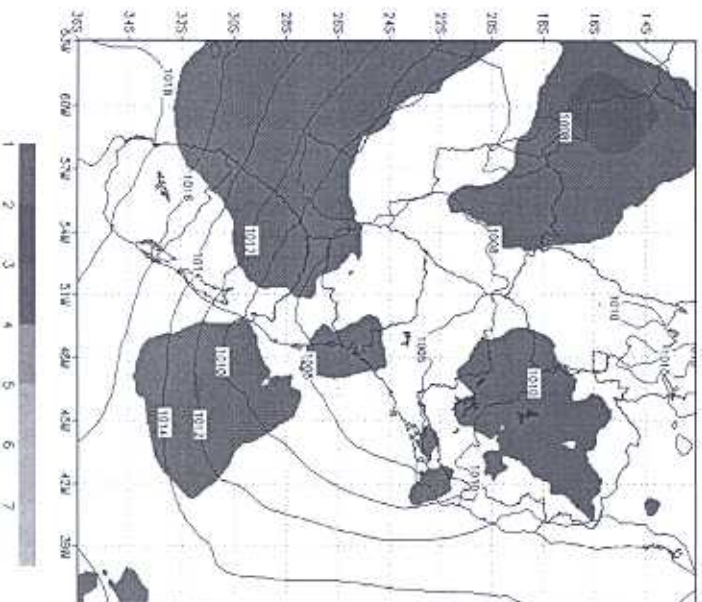
Ensemble Médio x Espalhamento

PSLM

EnSCI

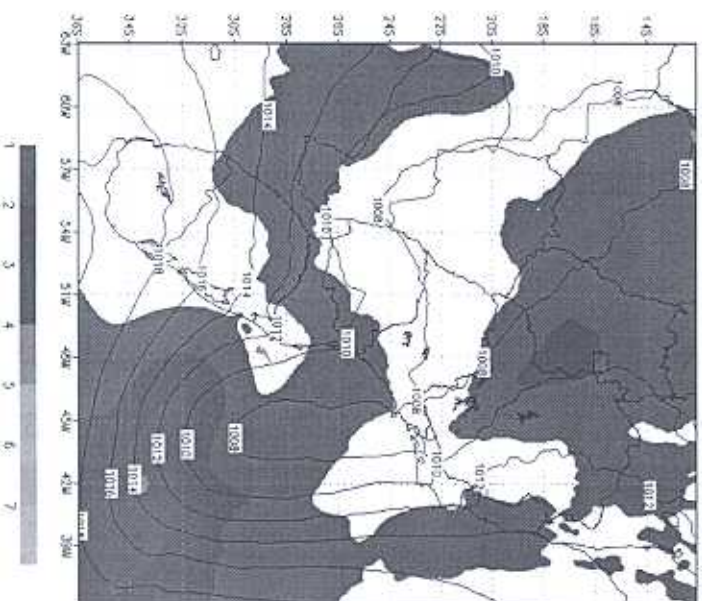
ZCASS2000

PROJEÇÃO POR ESCALA DE CURTO PRAZO (ENEP) - MODELO EM 10m
 Período: 31/12/1999, 120h - Pressão ao nível médio do mar
 Escantele médio (contorno) - Escalhamento (área)



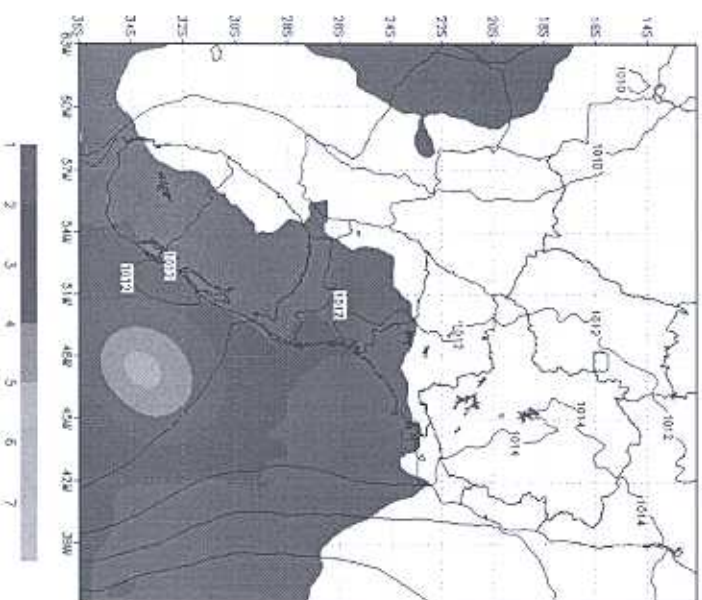
T+24h

PROJEÇÃO POR ESCALA DE CURTO PRAZO (ENEP) - MODELO EM 10m
 Período: 01/01/2000, 120h - Pressão ao nível médio do mar
 Escantele médio (contorno) - Escalhamento (área)



T+72h

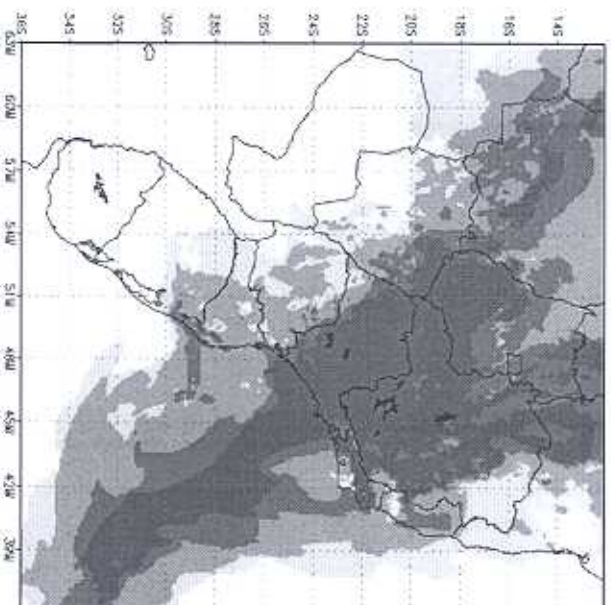
PROJEÇÃO POR ESCALA DE CURTO PRAZO (ENEP) - MODELO EM 10m
 Período: 05/01/2000, 120h - Pressão ao nível médio do mar
 Escantele médio (contorno) - Escalhamento (área)



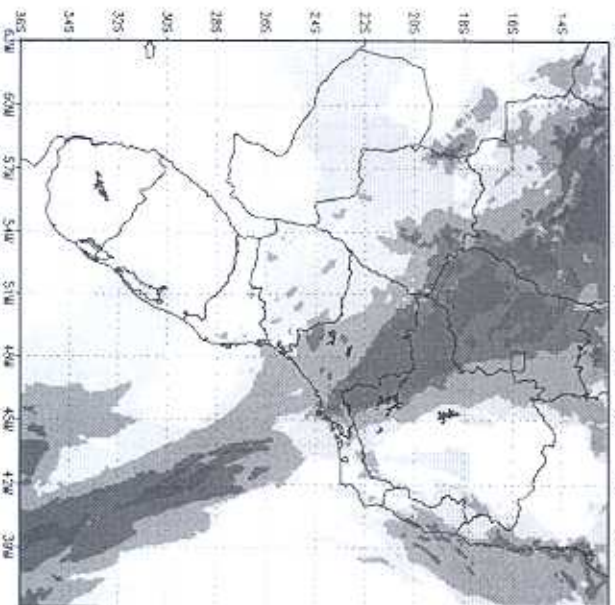
T+144h

Precipitação **Probabilidade > 5.0 mm** **ZCAS2000** ENSCI **Obs**

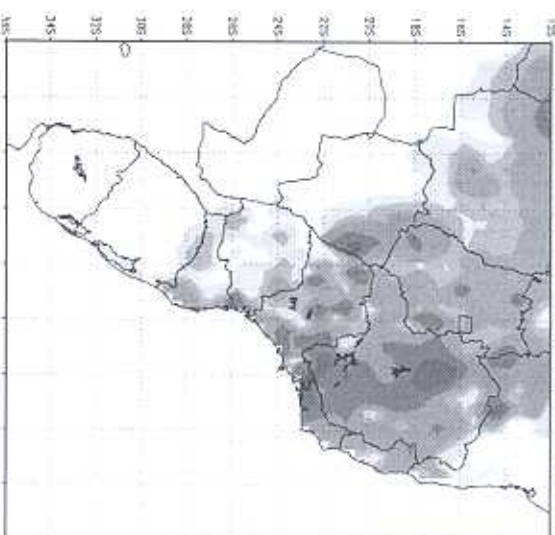
T+72h



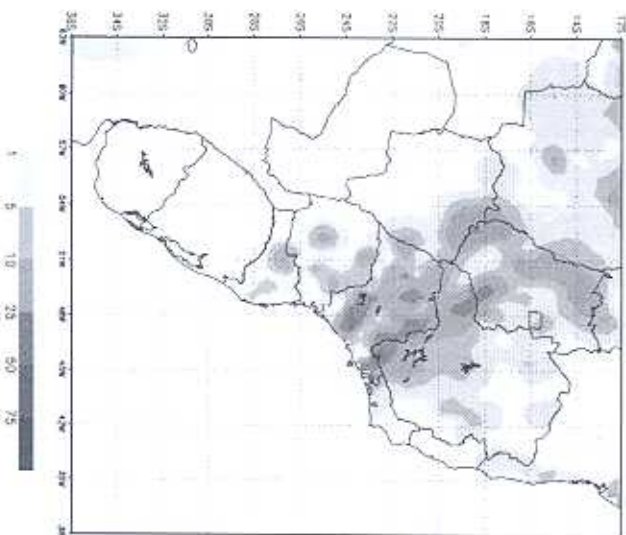
T+144h



Precipitacao Observada 02/JAN/2000 12 UTC



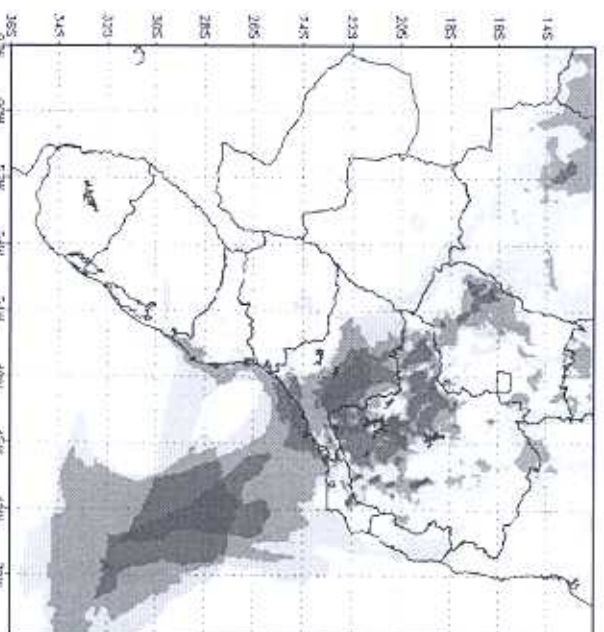
Precipitacao Observada 05/JAN/2000 12 UTC



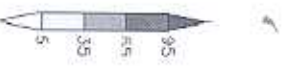
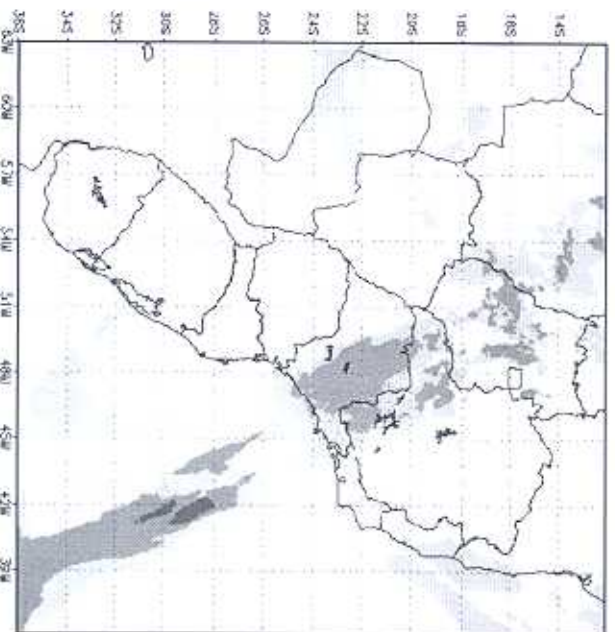
Precipitação Probabilidade > 25.0 mm

EnSCI ZCAS2000

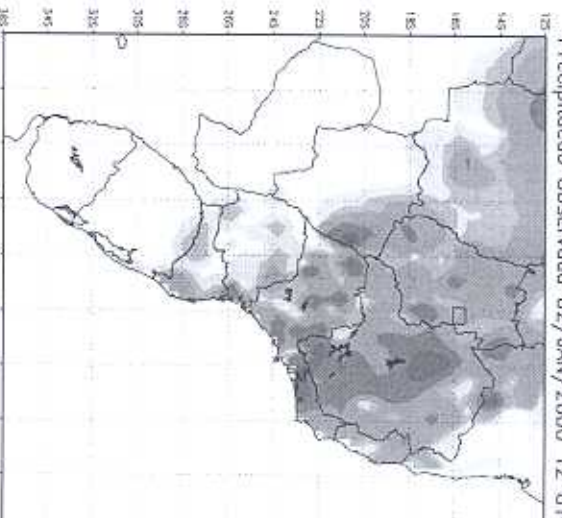
T+72h



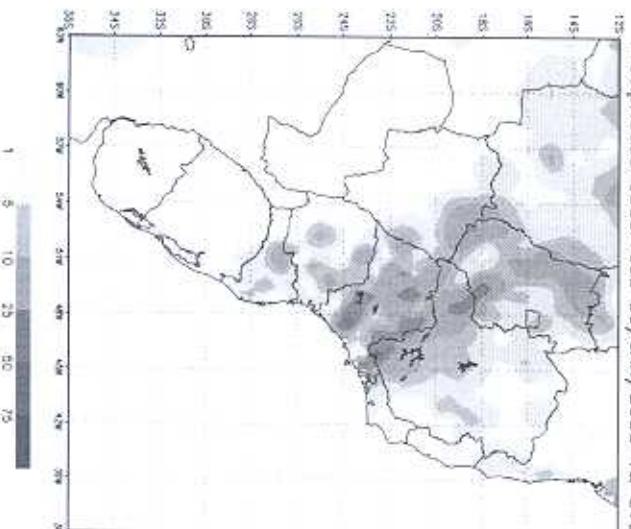
T+144h



Precipitação Observada 02/JAN/2000 12 UTC

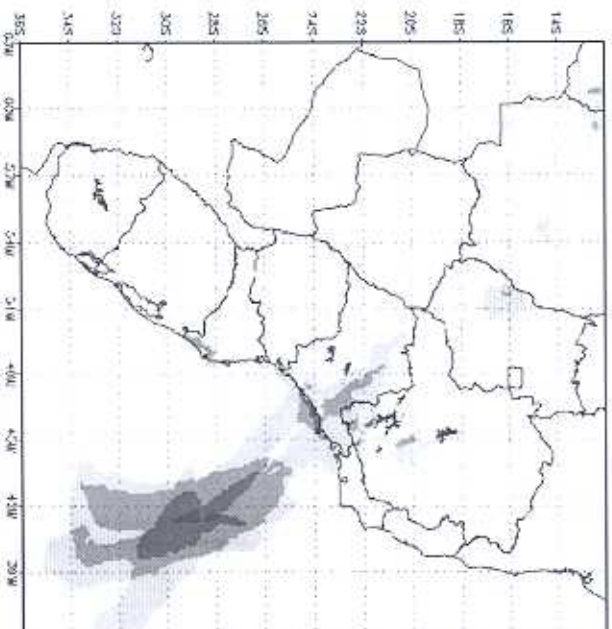


Precipitação Observada 05/JAN/2000 12 UTC

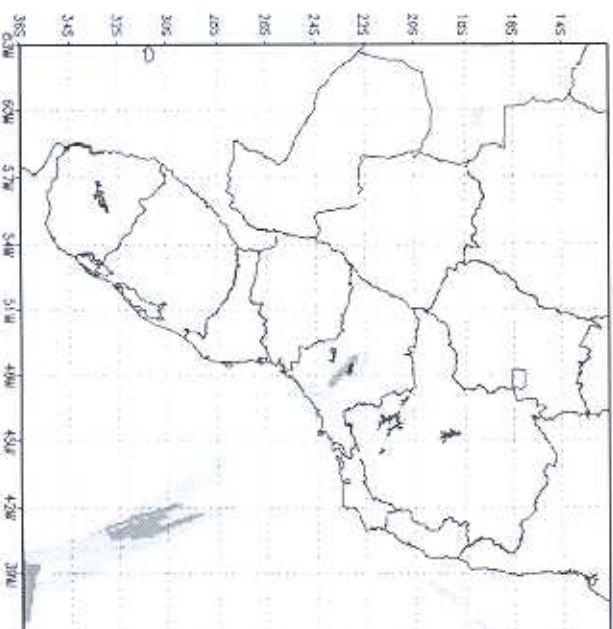


Precipitação **Probabilidade > 50.0 mm** **ZCAS2000** **EnCI** **Obs**

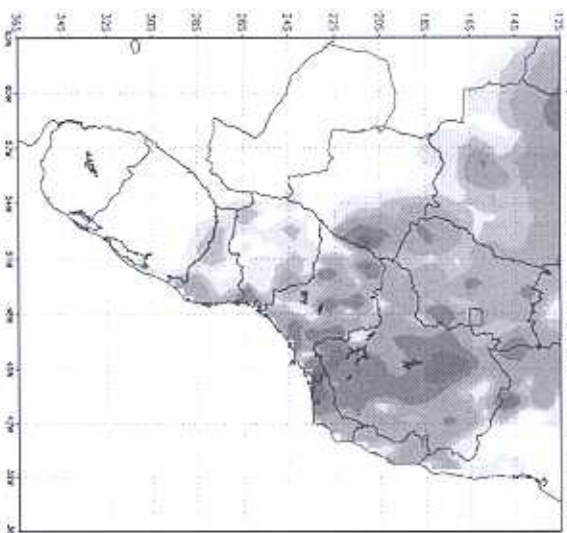
T+72h



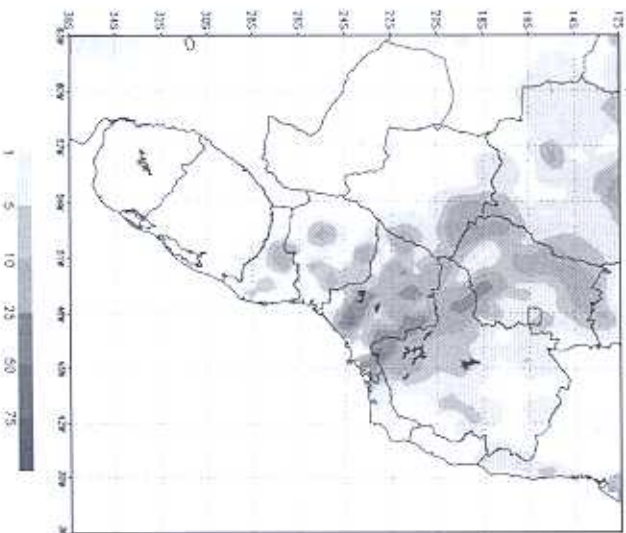
T+144h



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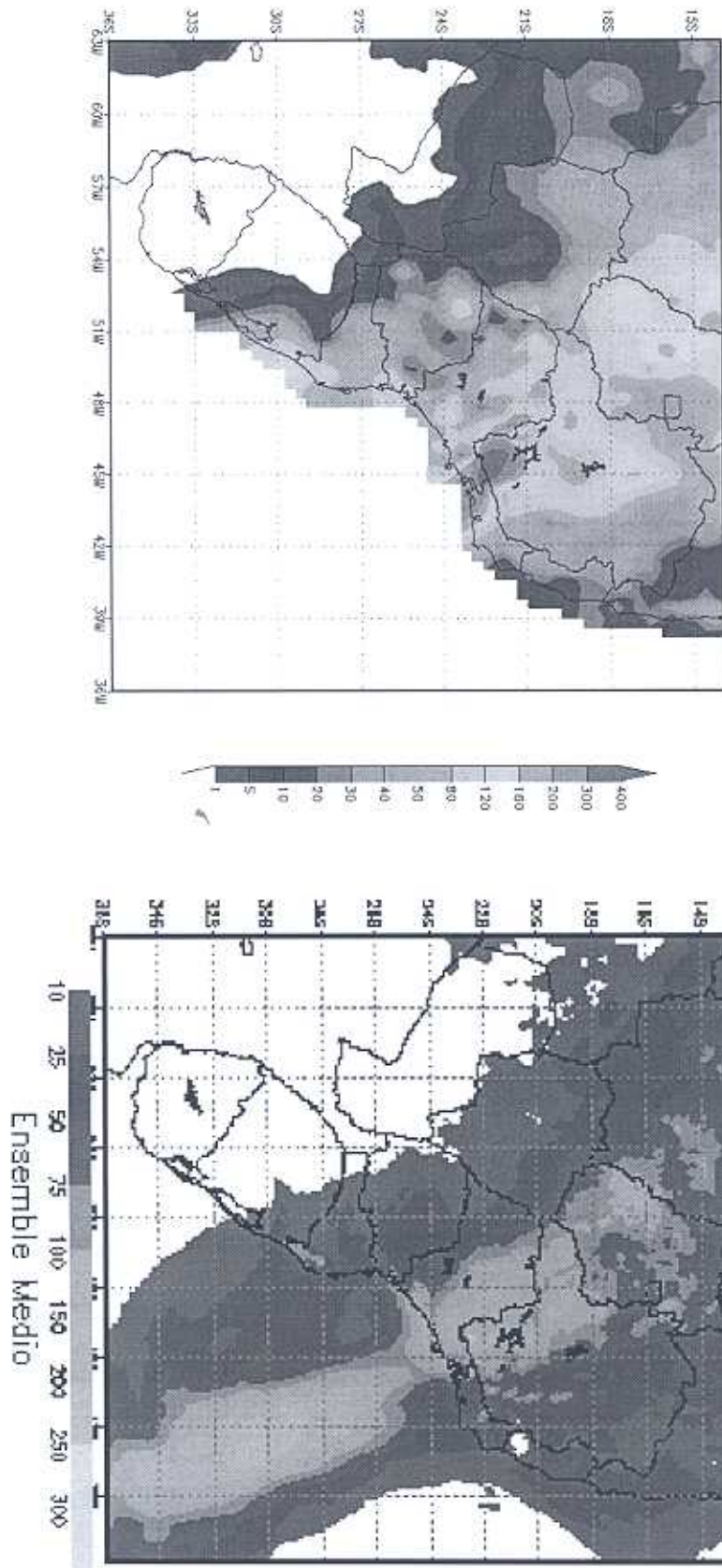


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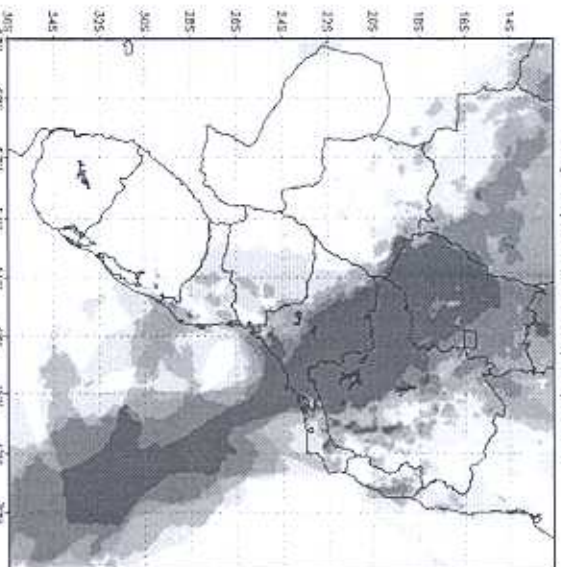


Precipitação Acumulada de 31/Dez/1999 a 05/Jan/2000 12 UTC

Precipitacao Acumulada de 31/12/1999 a 06/01/2000 12Z

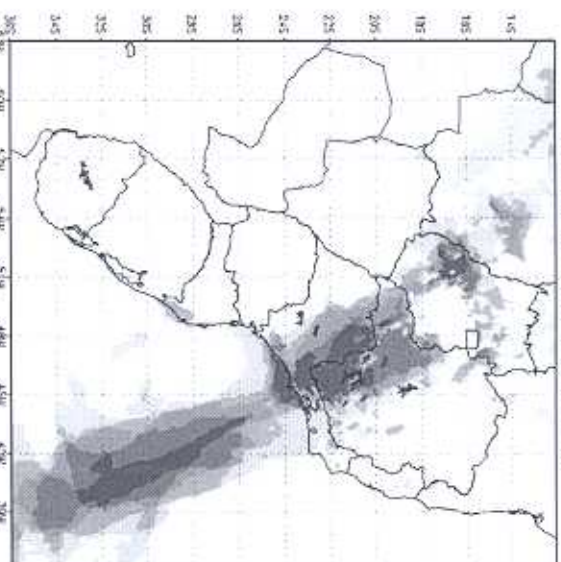


Probabilidade de precipitação > 50.0 mm
31/12/1999 a 05/01/2000



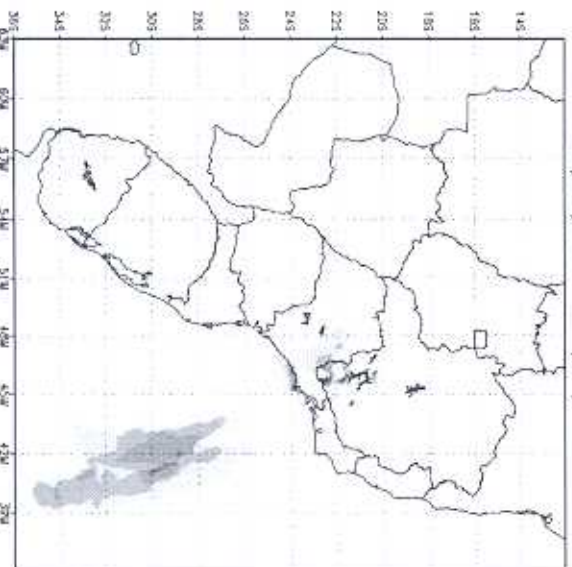
> 50.0
mm

Probabilidade de precipitação > 100.0 mm
31/12/1999 a 05/01/2000



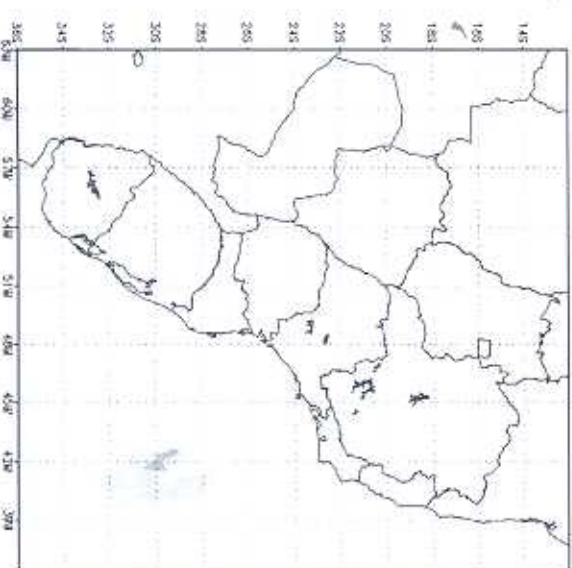
> 100.0 mm

Probabilidade de precipitação > 200.0 mm
31/12/1999 a 05/01/2000



> 200.0 mm

Probabilidade de precipitação > 300.0 mm
31/12/1999 a 05/01/2000

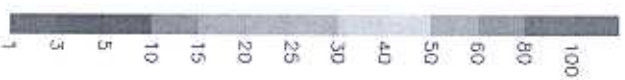
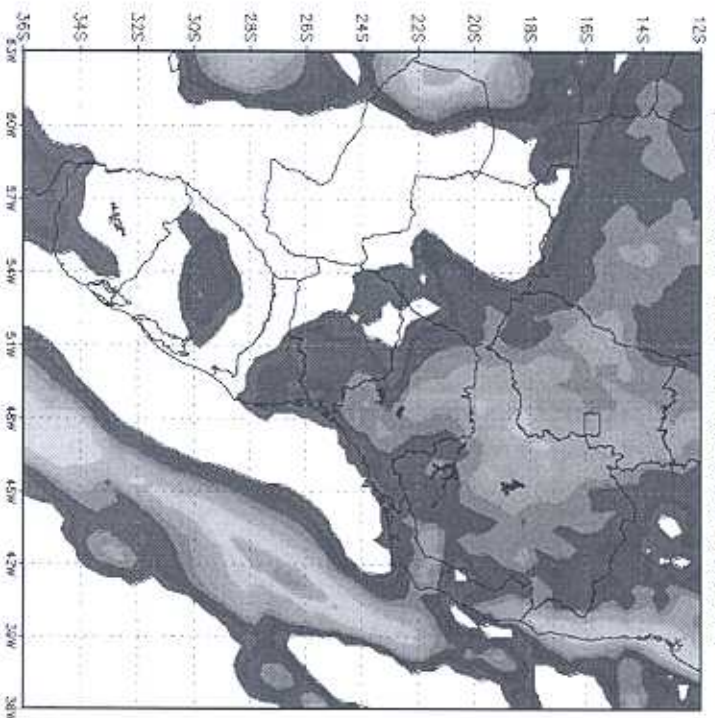


> 300.0 mm

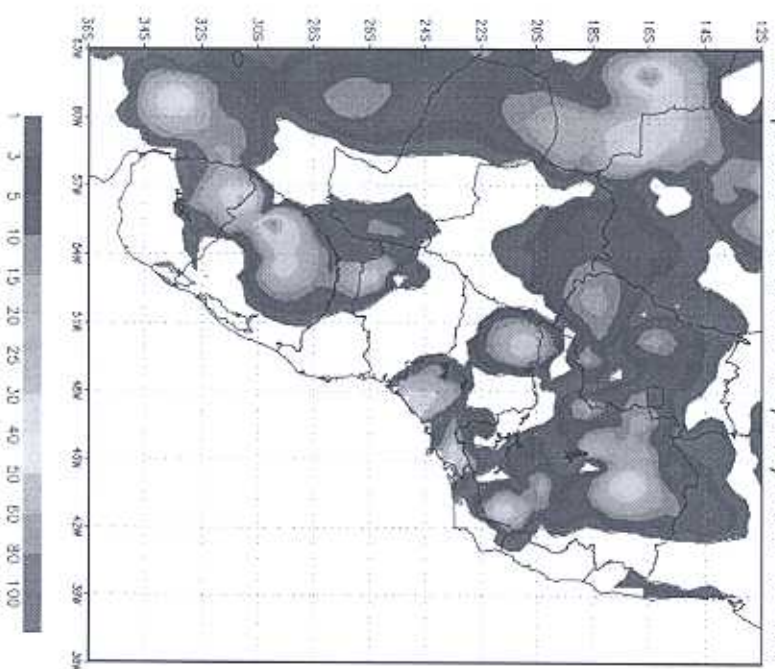
Caragua2006

Previsão do modelo operacional Eta 40km

Eta 40km T+72h CI:2006040612



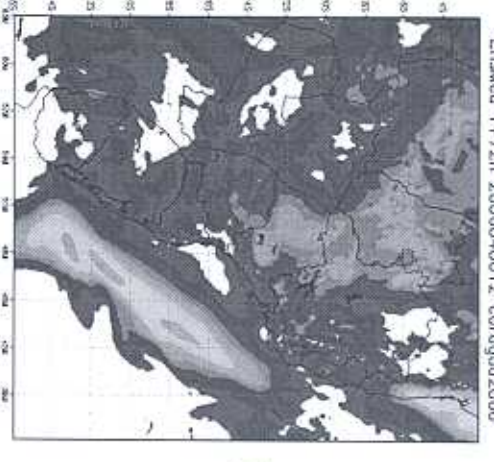
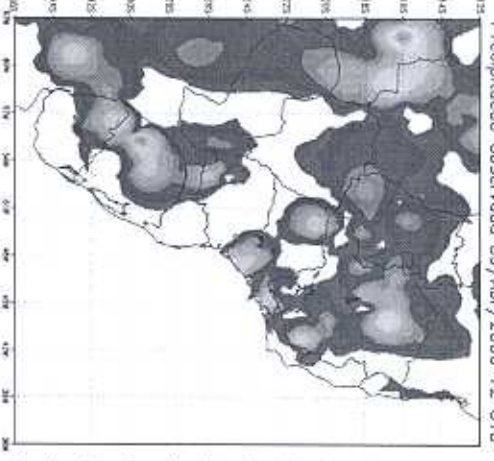
Precipitacao Observada 09/Abr/2006 12 UTC



Resultados -Caraguaya2006

Obs

T+72h 09/Abr/2006 12 UTC



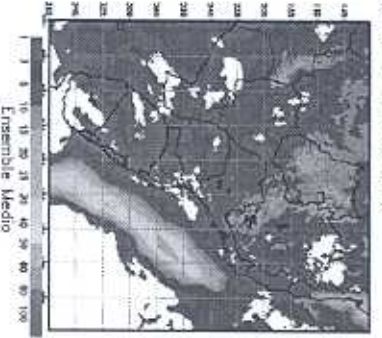
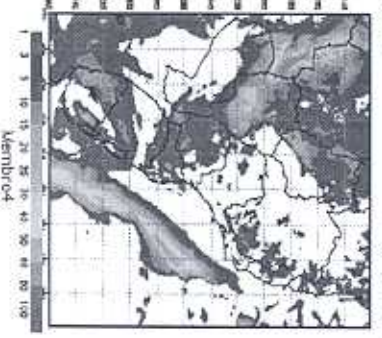
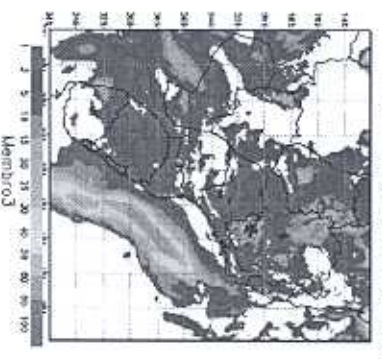
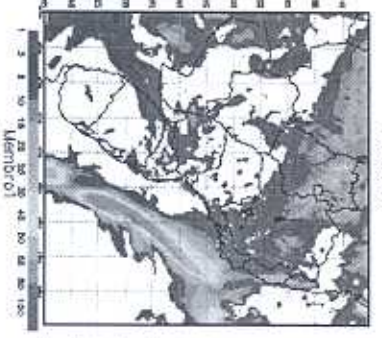
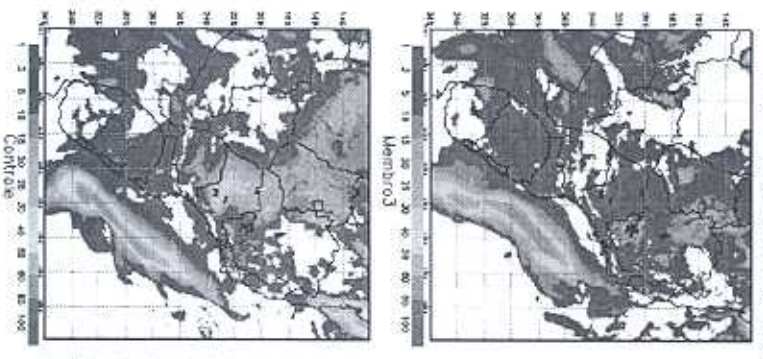
Control T+72h 2006040612 coragua2006

Precipitacco Observada 09/Abr/2006 12 UTC

Ensked T+72h 2006040612 coragua2006

Control

EnSCI



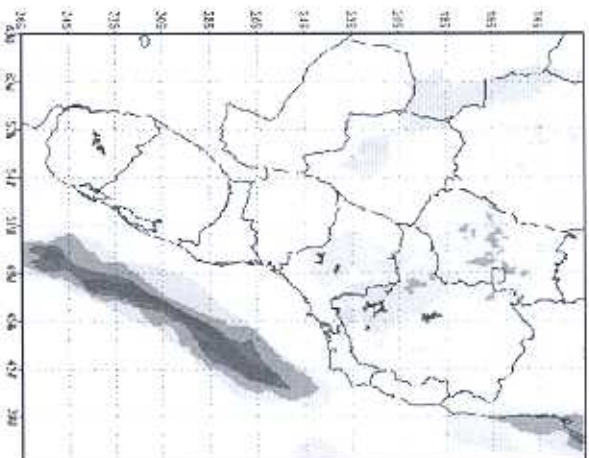
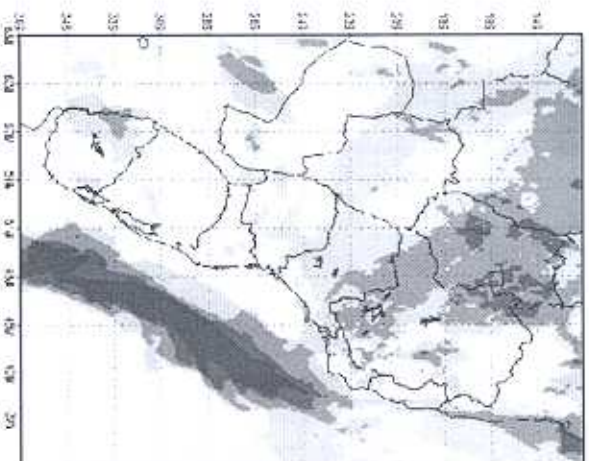
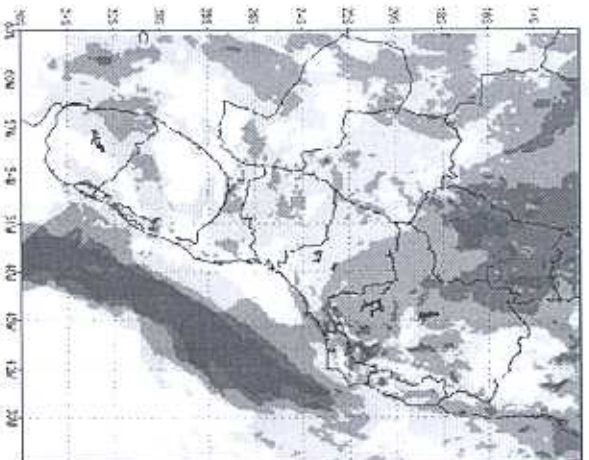
EnSCI

Precipitação

Probabilidade

Caragua2006

EnsCI
T+72h



> 5.0 mm

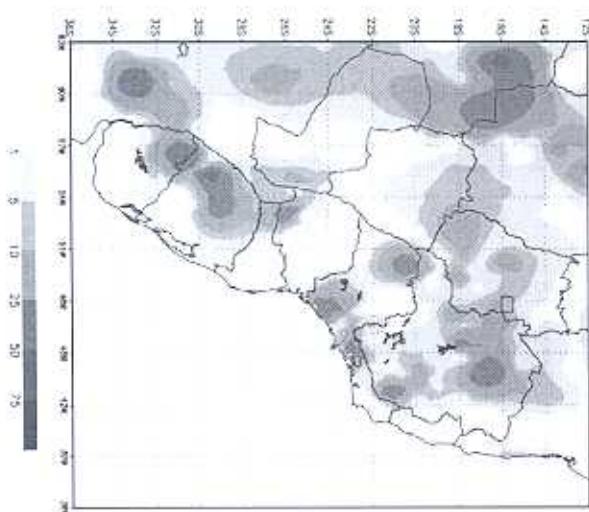
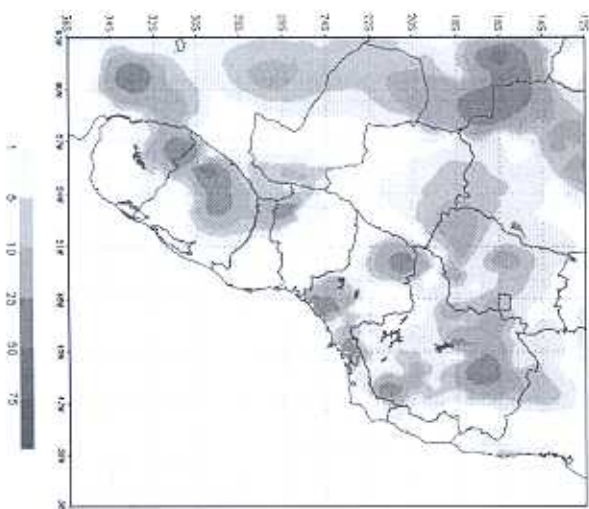
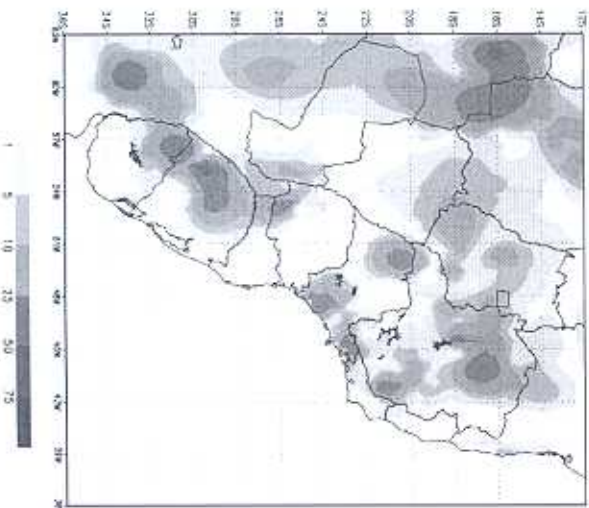
> 10.0 mm

> 25.0 mm

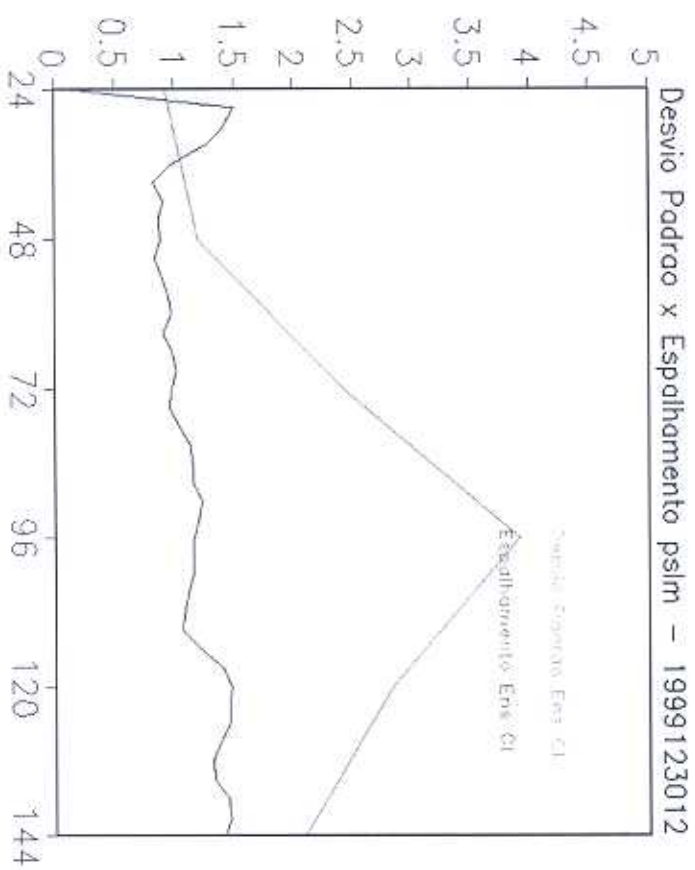
Precipitacao Observada 09/Abr/2006 12 UTC

Precipitacao Observada 09/Abr/2006 12 UTC

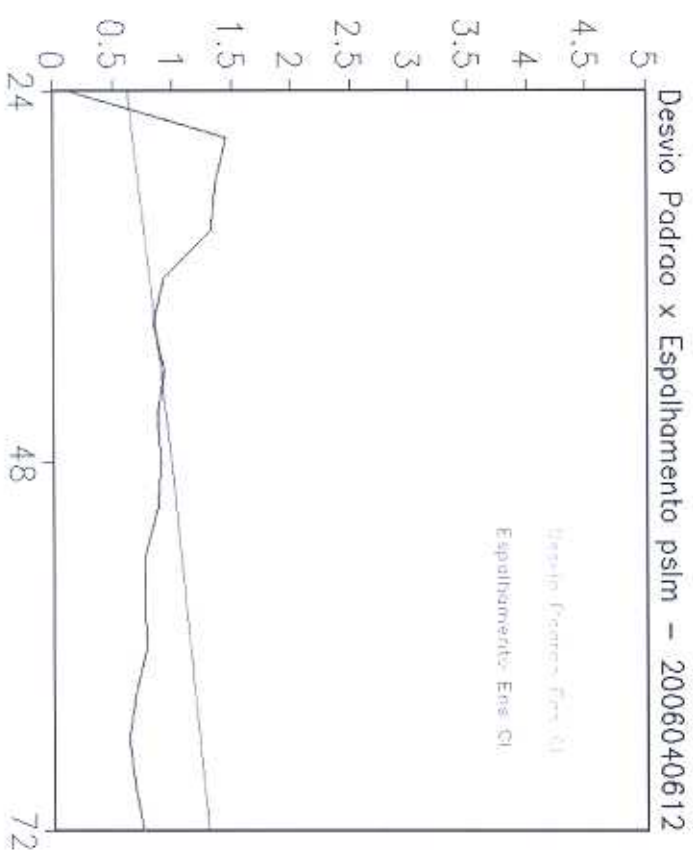
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Desvio Padrão x Espalhamento



ZCAS2000



Caragua2006

SREP usando Modelo Eta

Conclusões preliminares

CASO ZCAS2000

- 1- Padrão da precipitação melhor previsto pelo SREP.
- 2- Probabilidade de valores de precipitação intensa é pequena.
- 3- Ensemble médio padrões mais próximo ao observado que o controle.

CASO CARAGUA2006

- 1- Dificuldade de previsão da precipitação ocorrida.
- 2- Baixa qualidade da análise utilizada como condição inicial.
- 3- SREP agregou pequeno valor a previsão, porém Ensemble Médio indica mais chuva que o Eta40.

GERAL

- 1- Ensemble médio representam os padrões de precipitação.
- 2- Espalhamento com comportamento similar ao erro da previsão.
- 3- Subestimativa dos valores intensos de precipitação.
- 4- ENSFIS.