Extreme events: Past and future changes in the attributes of extreme rainfall and the dynamics of their driving processes (K5/1960)

Christopher Lennard

Mark Tadross

Lisa Coop

David Morrison

Climate Systems Analysis Group
University of Cape Town

Task 1. Producing a quality controlled rainfall data set for extreme rainfall analysis

i) Quality control procedures applied to station data

ii) Concatenation of multiply sourced data

iii) Largely completed but there are still some surprises

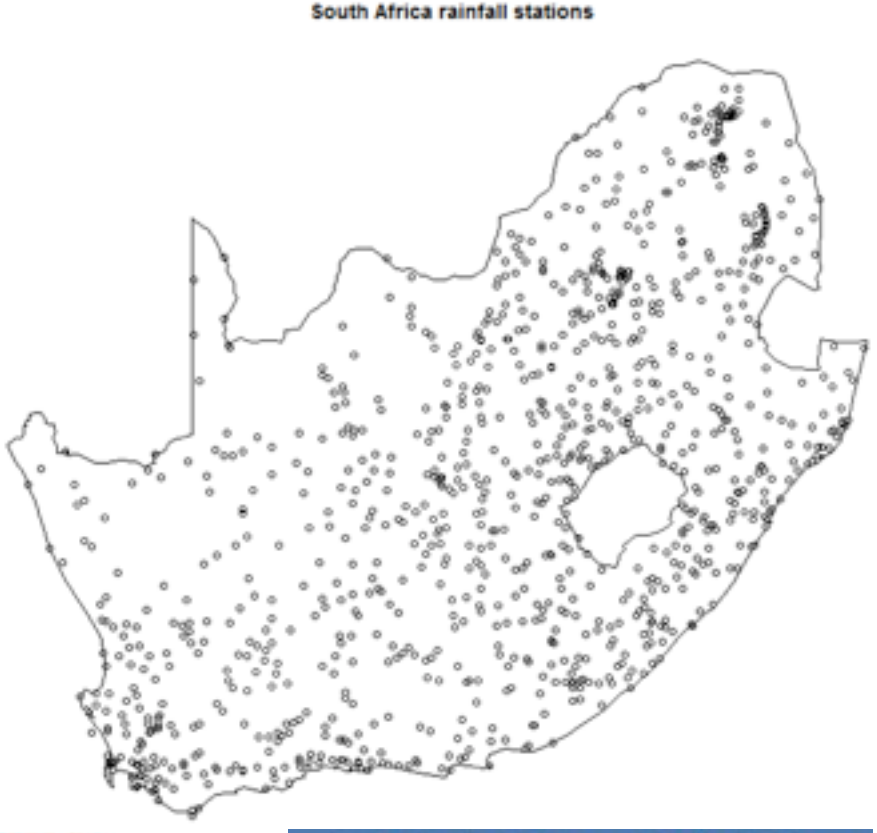
Task 2. Assessment of station data

Selection of stations for assessment

All stations that passed QC checks were included

Stations that covered the study period from 1979 to 2009 -> 1034

At least a 95% complete record during this period -> 696 stations



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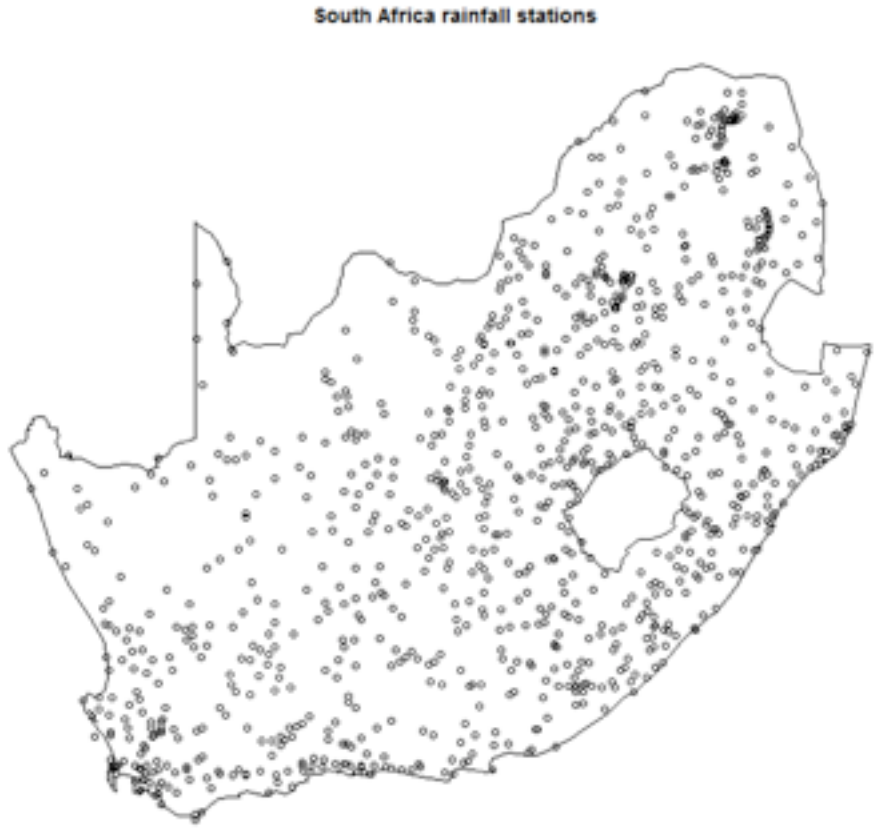
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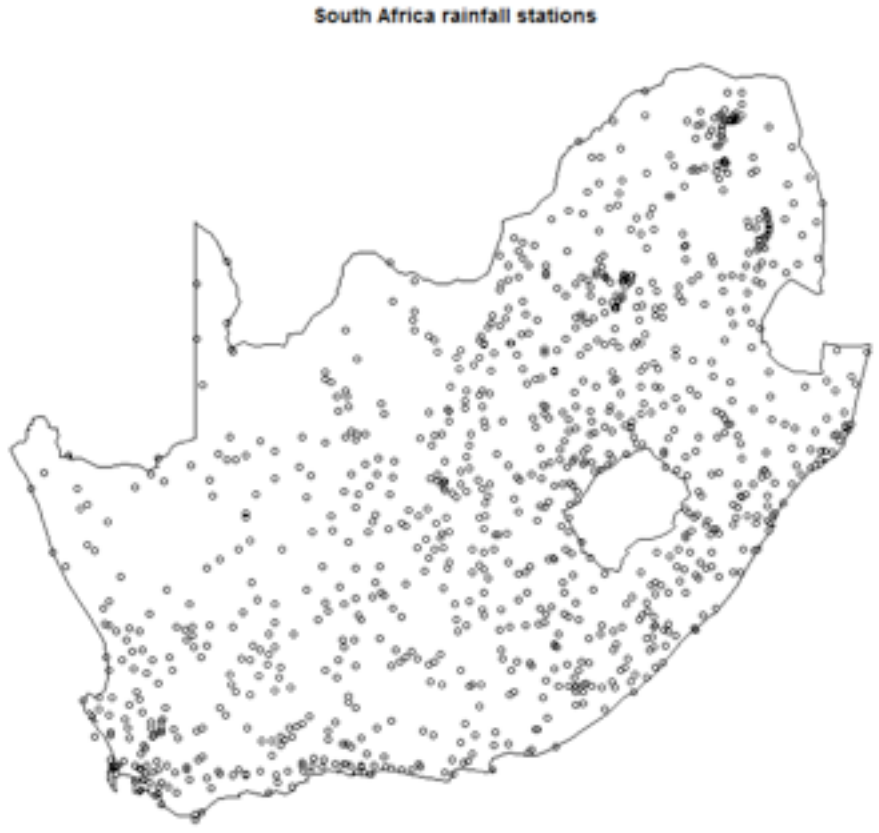
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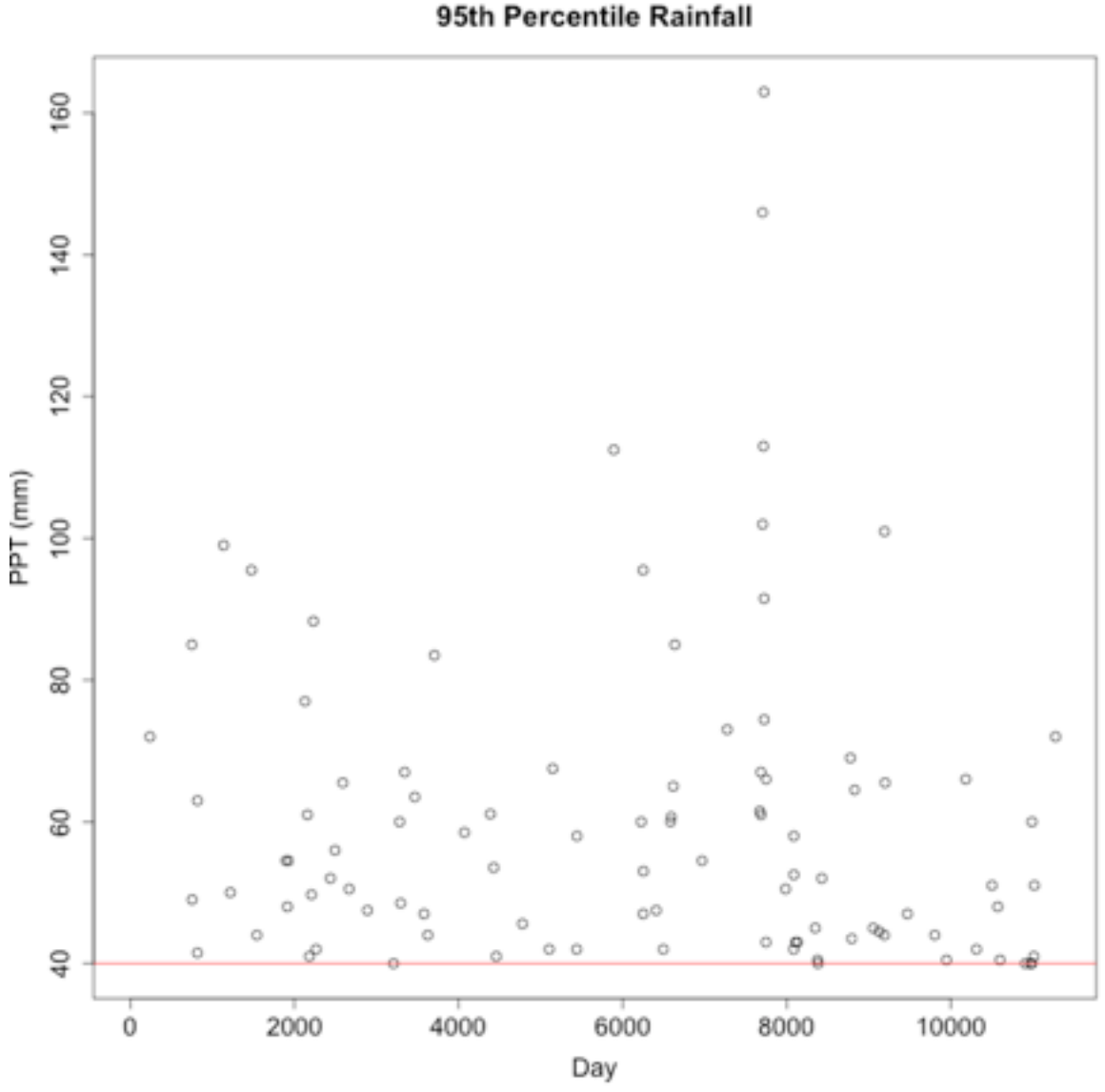
Divergence into Task 3.....

Task 3. Relating attributes of extreme rainfall to synoptic drivers

1. For each station, 95th percentile rainfall days were extracted

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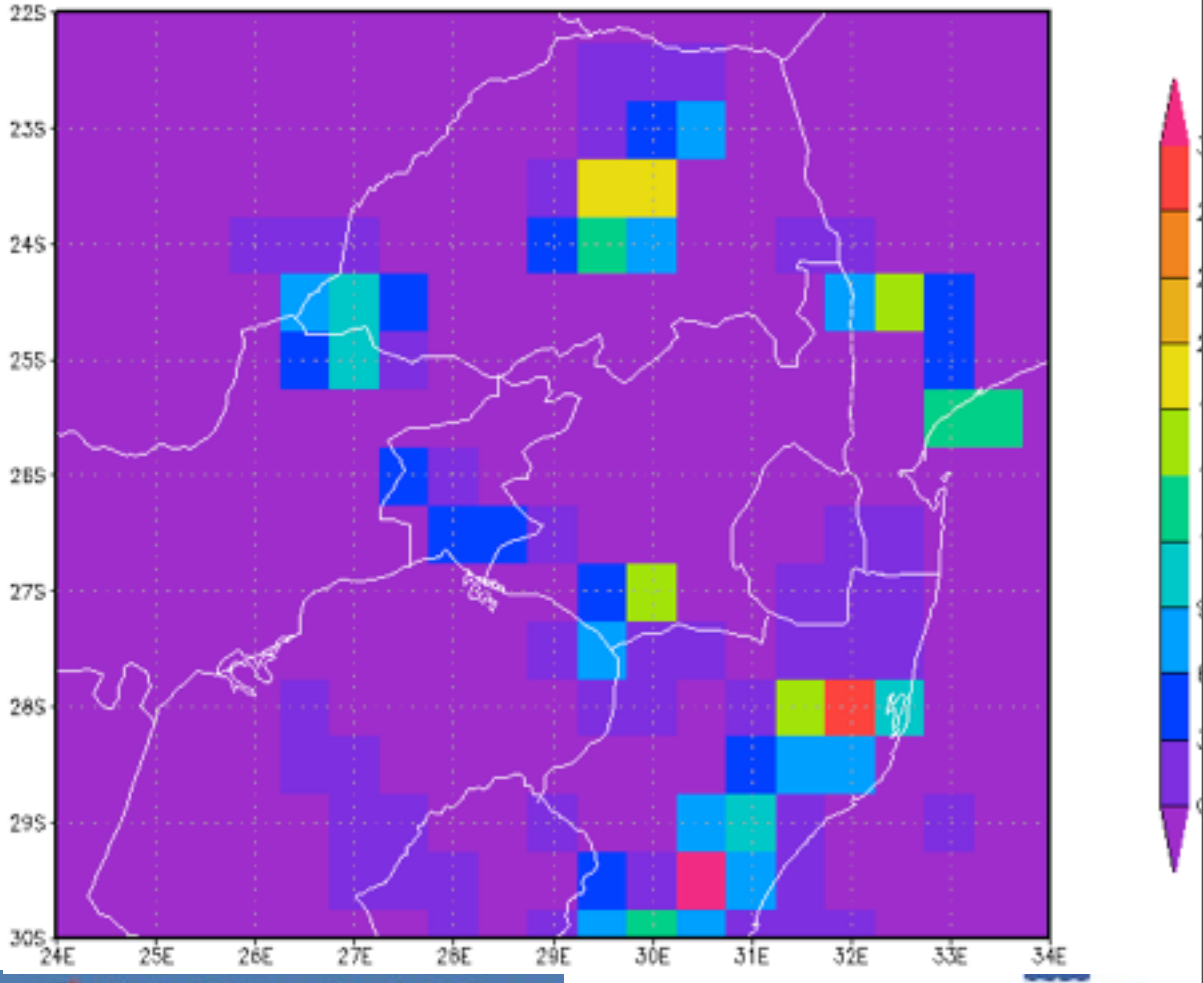
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   Daily **CFSR** data for each day extreme rainfall is recorded

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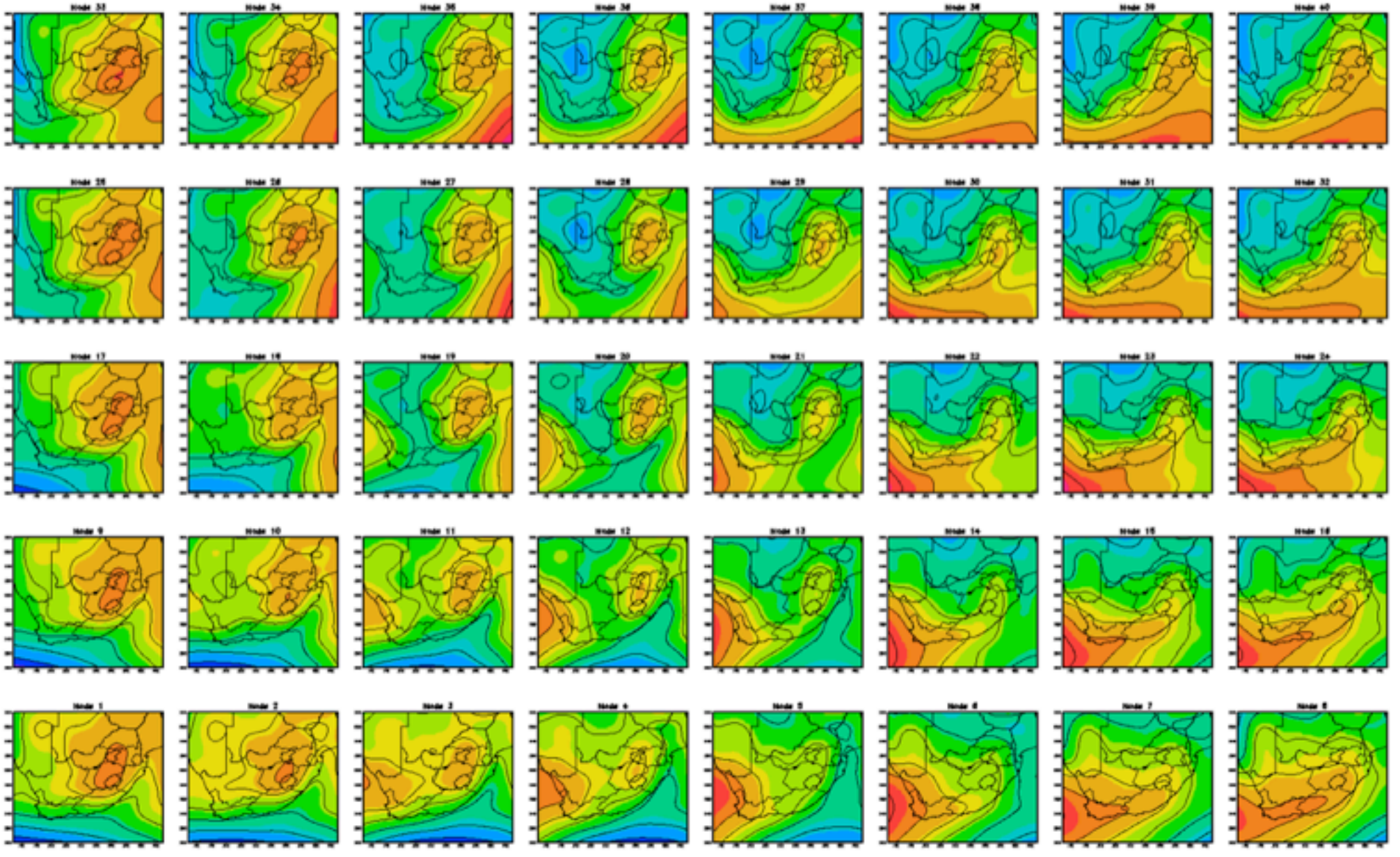
Step 1 - Use all the data (1998 - 2009)

SLP

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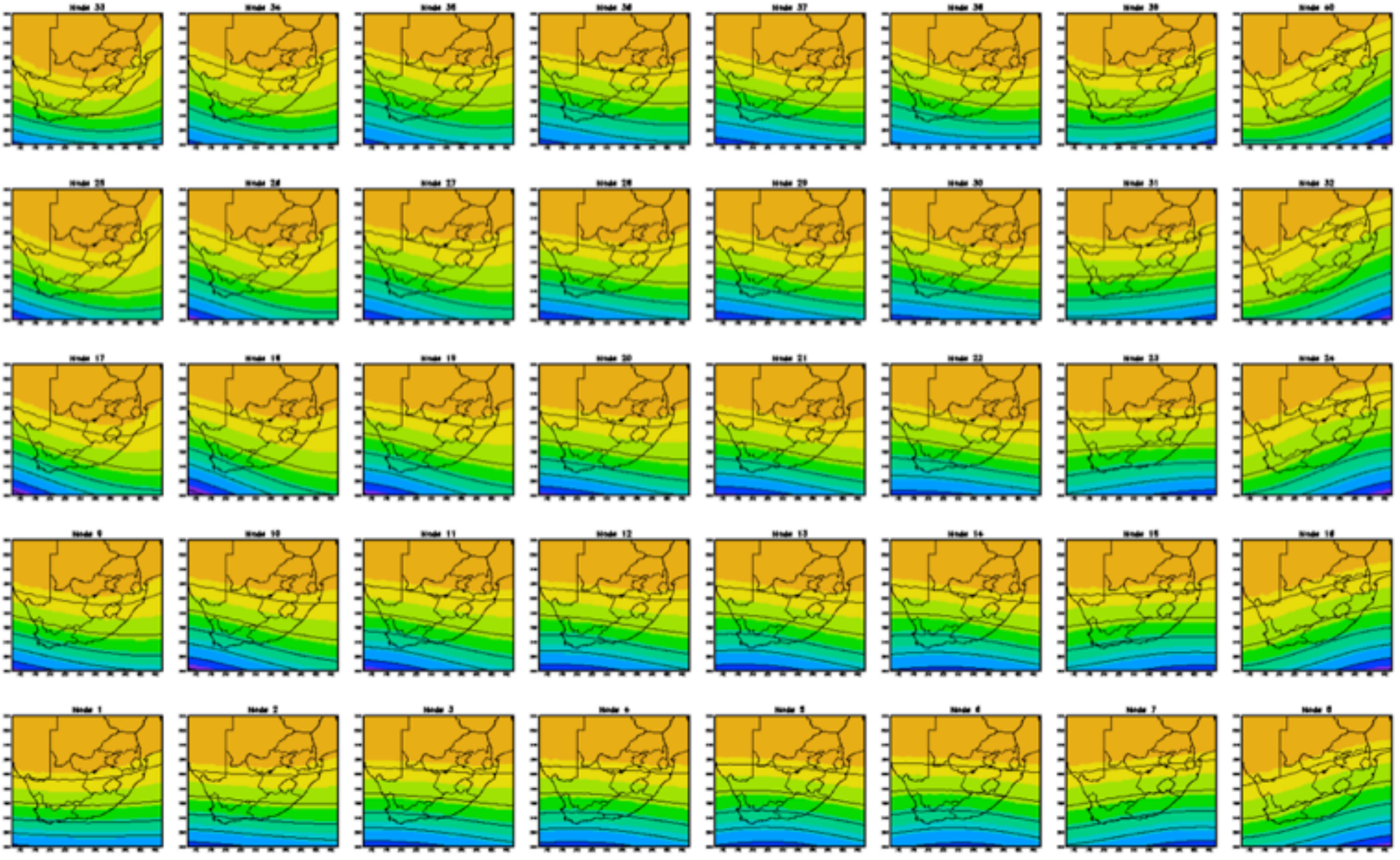
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Z500

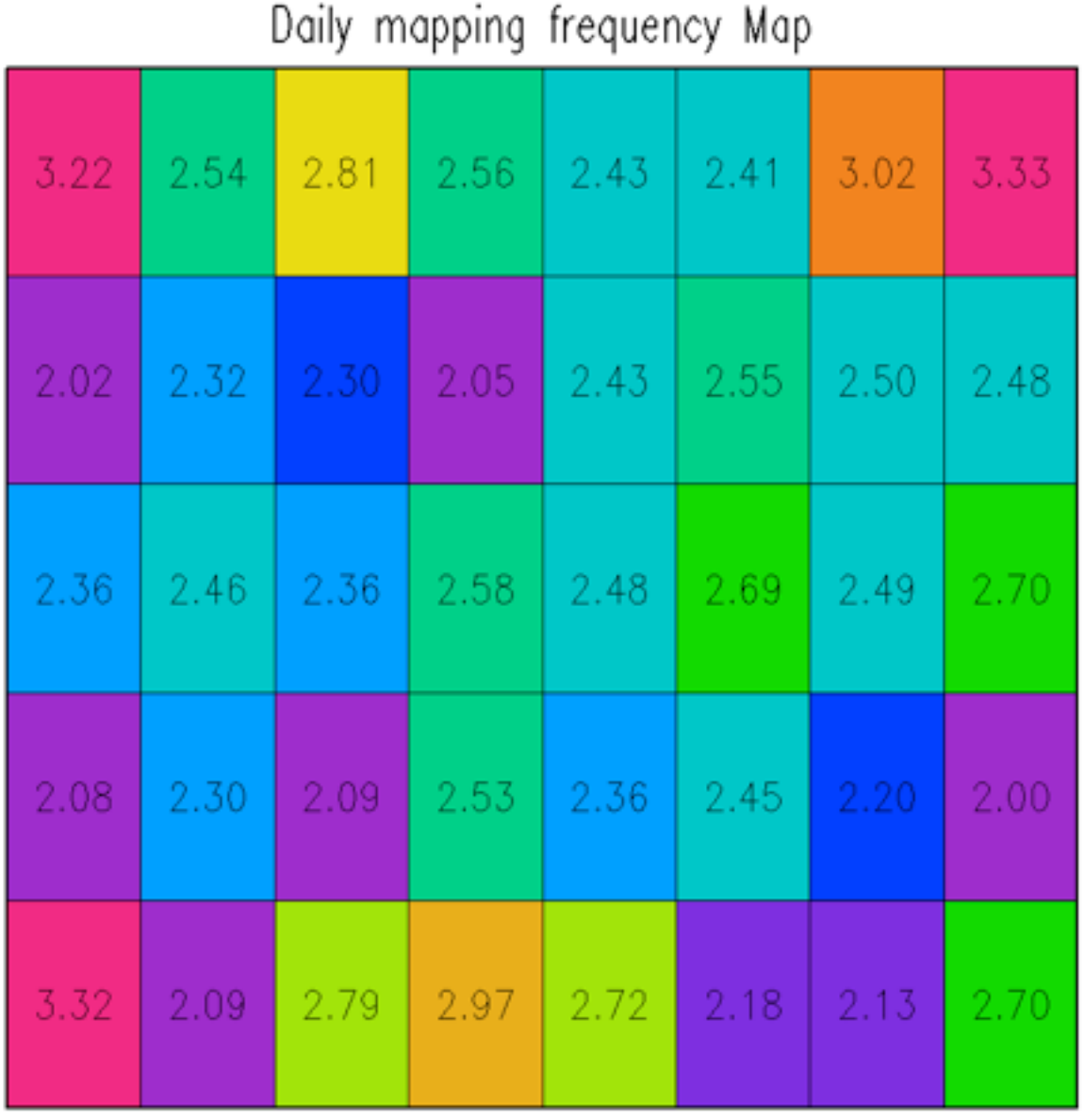


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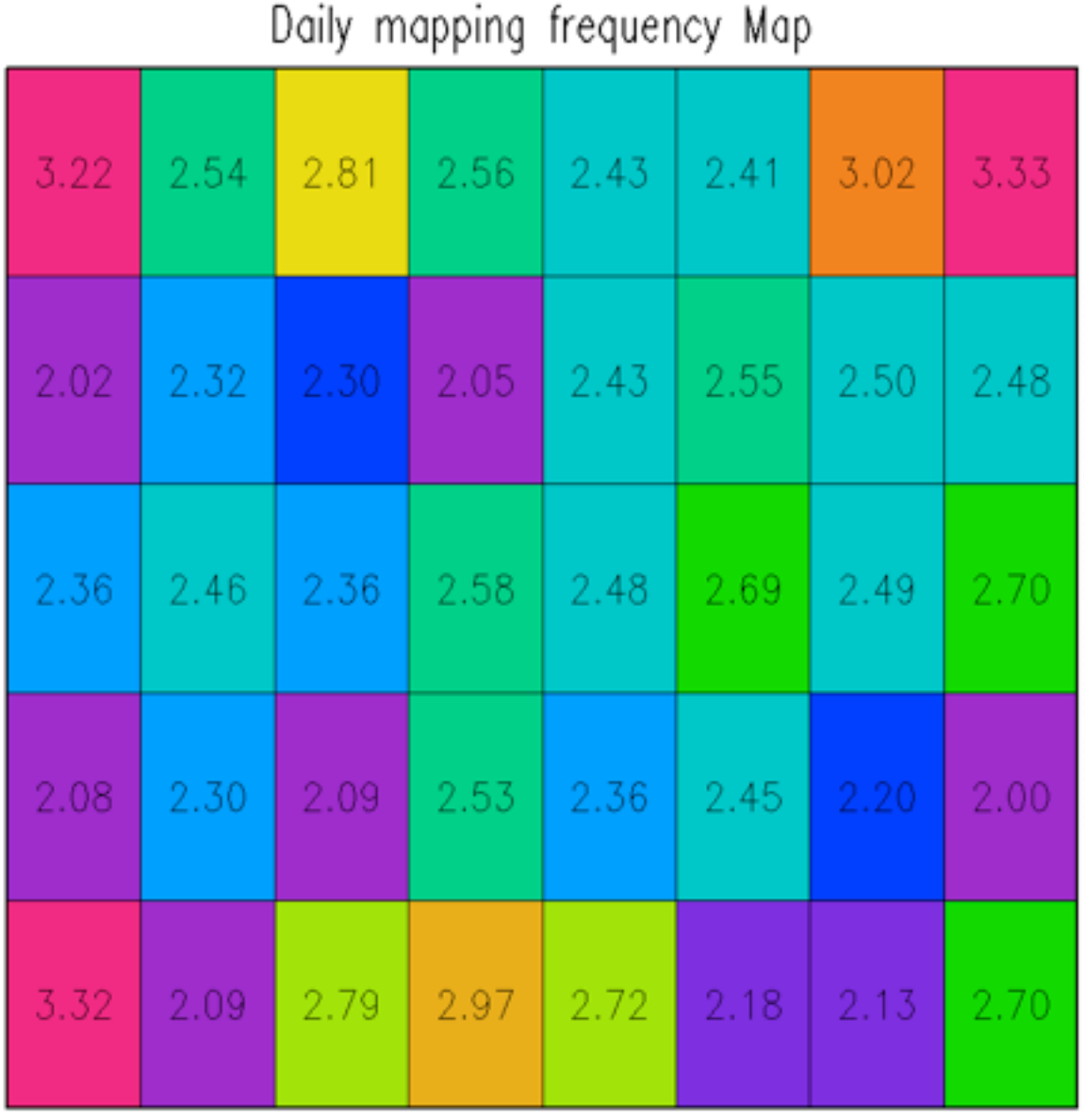
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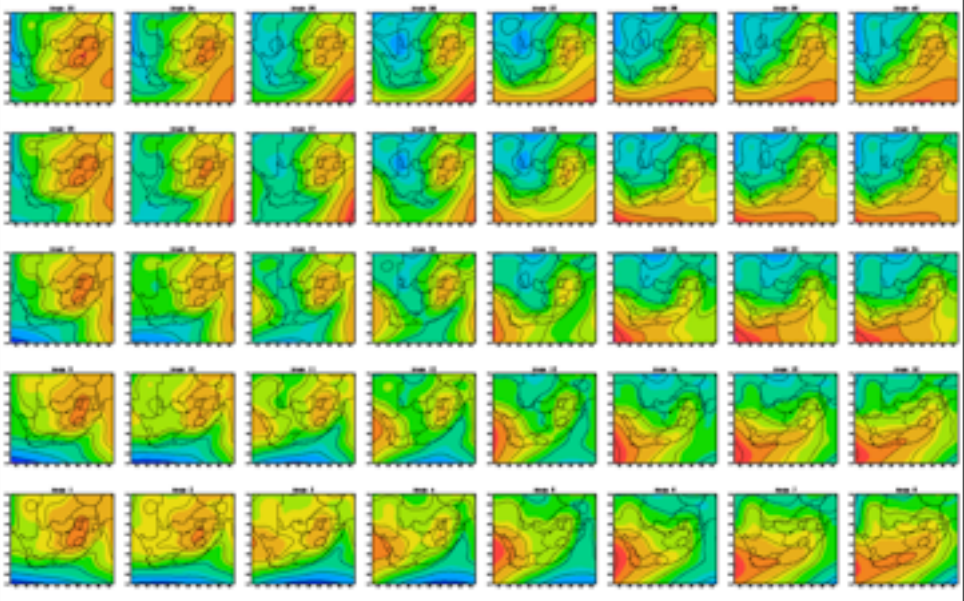
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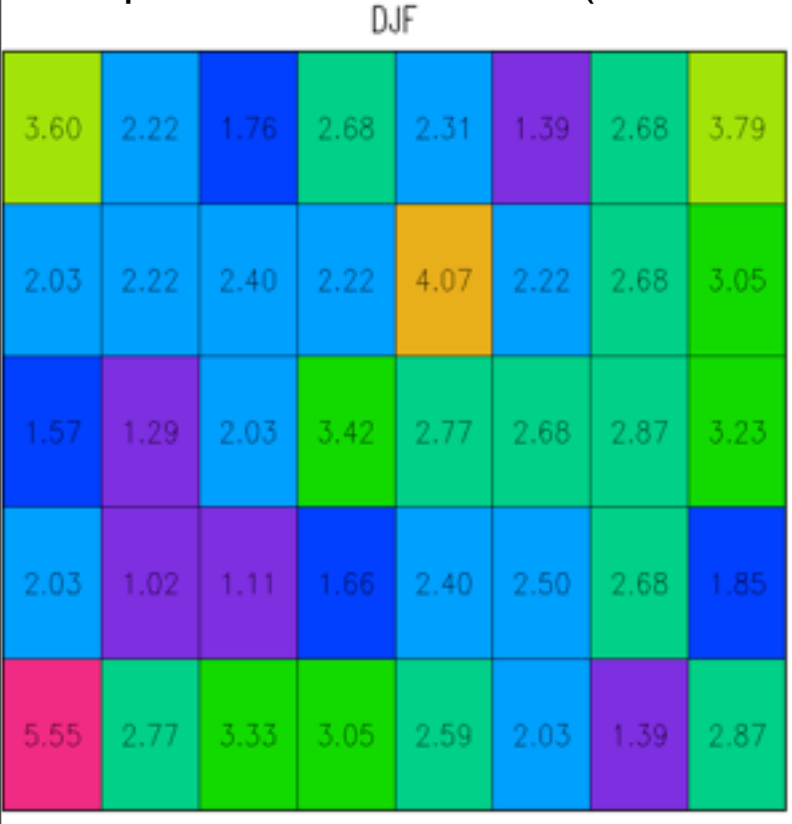
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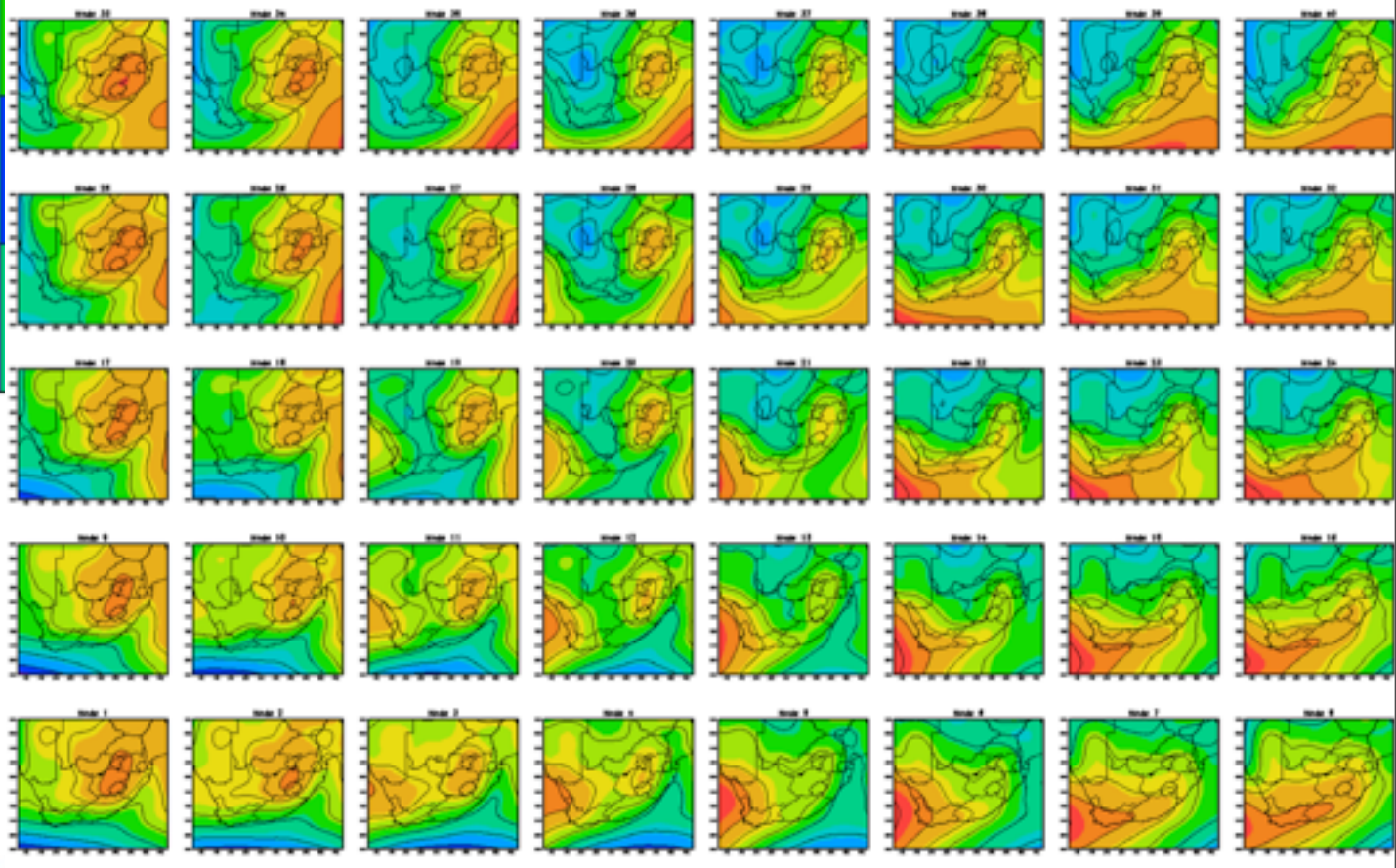


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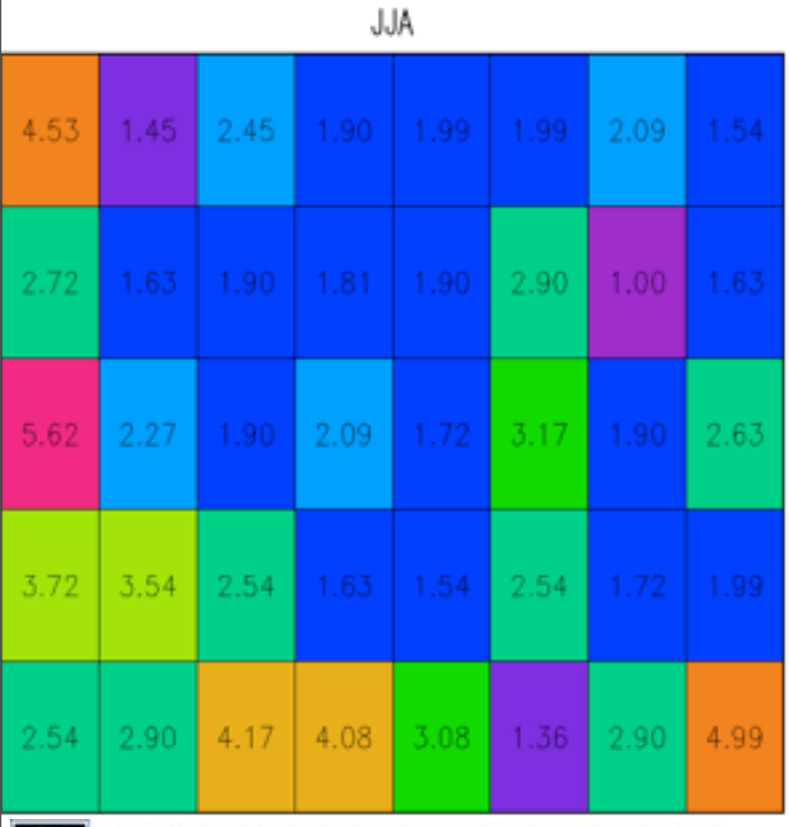
DJF

3.60	2.22	1.76	2.68	2.31	1.39	2.68	3.79
2.03	2.22	2.40	2.22	4.07	2.22	2.68	3.05
1.57	1.29	2.03	3.42	2.77	2.68	2.87	
2.03	1.02	1.11	1.66	2.40	2.50	2.68	
5.55	2.77	3.33	3.05	2.59	2.03	1.39	



Task 3. Relating attributes of extreme rainfall to synoptic drivers

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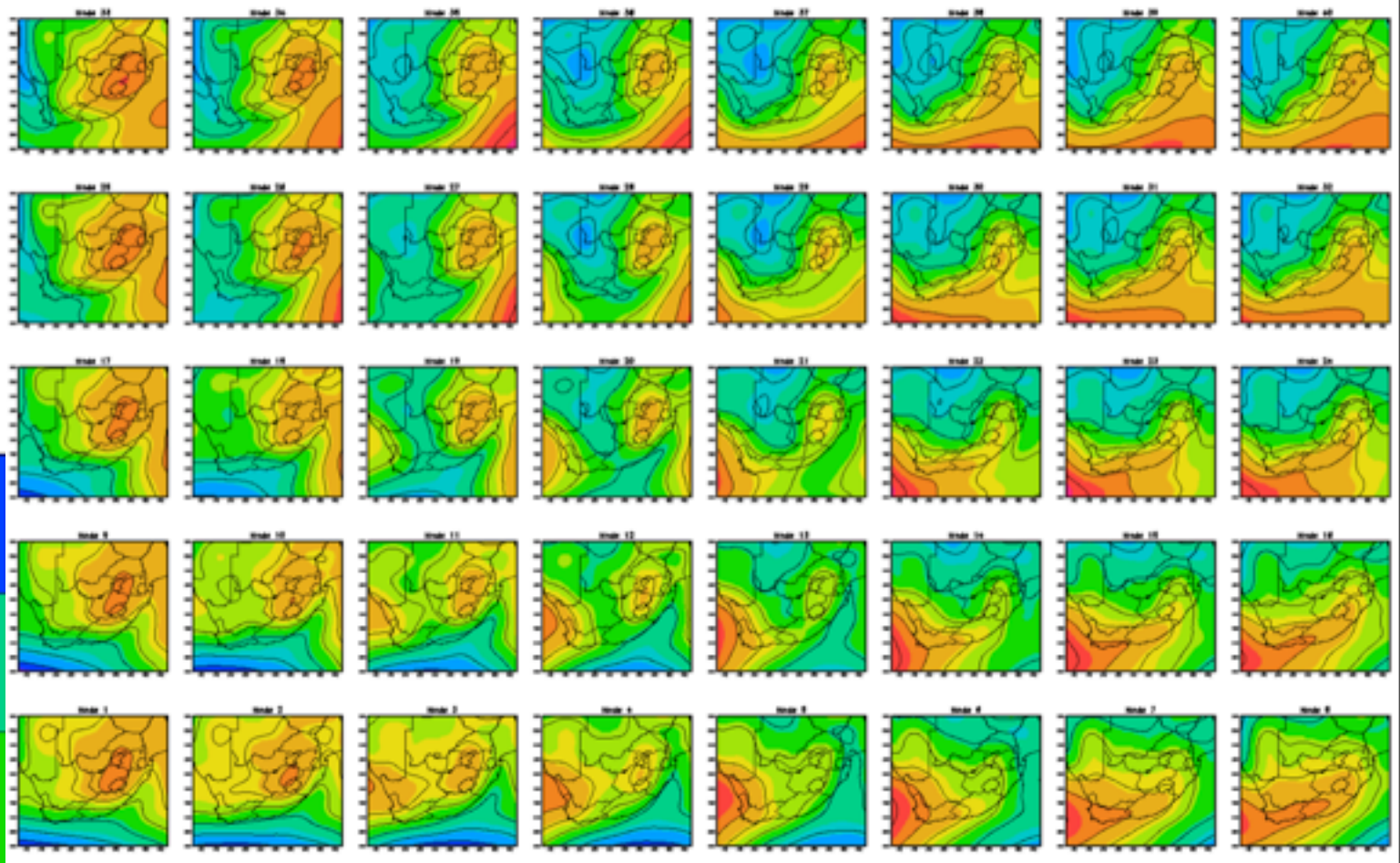
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Task 3. Relating attributes of extreme rainfall to synoptic drivers

Step 1 - Use all the data (1998 - 2009)



JJA

4.53	1.45	2.45	1.90	1.99	1.99		
2.72	1.63	1.90	1.81	1.90	2.90		
5.62	2.27	1.90	2.09	1.72	3.17		
3.72	3.54	2.54	1.63	1.54	2.54	1.72	1.99
2.54	2.90	4.17	4.08	3.08	1.36	2.90	4.99

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Task 3. Relating attributes of extreme rainfall to synoptic drivers

Step 2 - Use only extreme rainfall days recorded in station data (1998 - 2009)

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1. The 696 stations were assessed for 95th rainfall days

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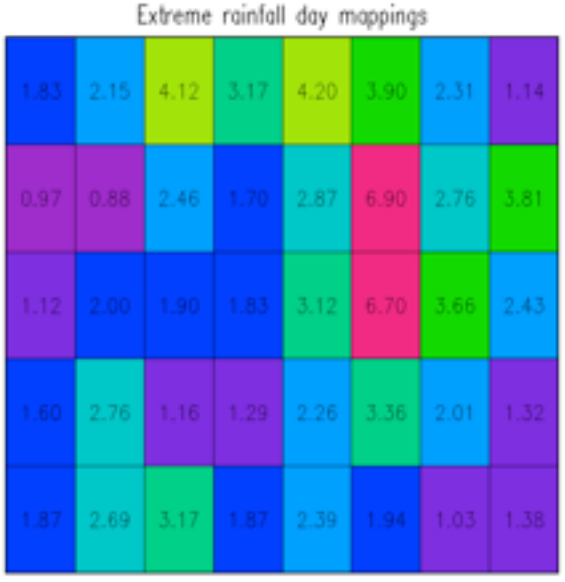
2. These days were extracted from the CFSR data and used in 2 ways

   i. These data were passed through the trained SOM to see which synoptic states they mapped to

   ii. A new SOM was generated using only these data and a similar general and seasonal assessment was performed

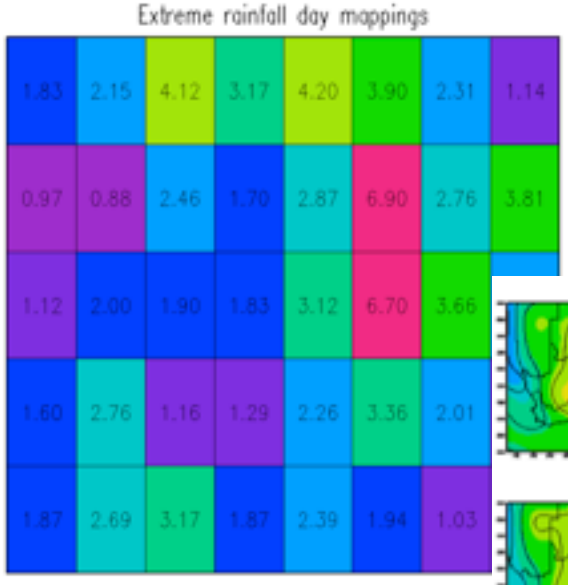
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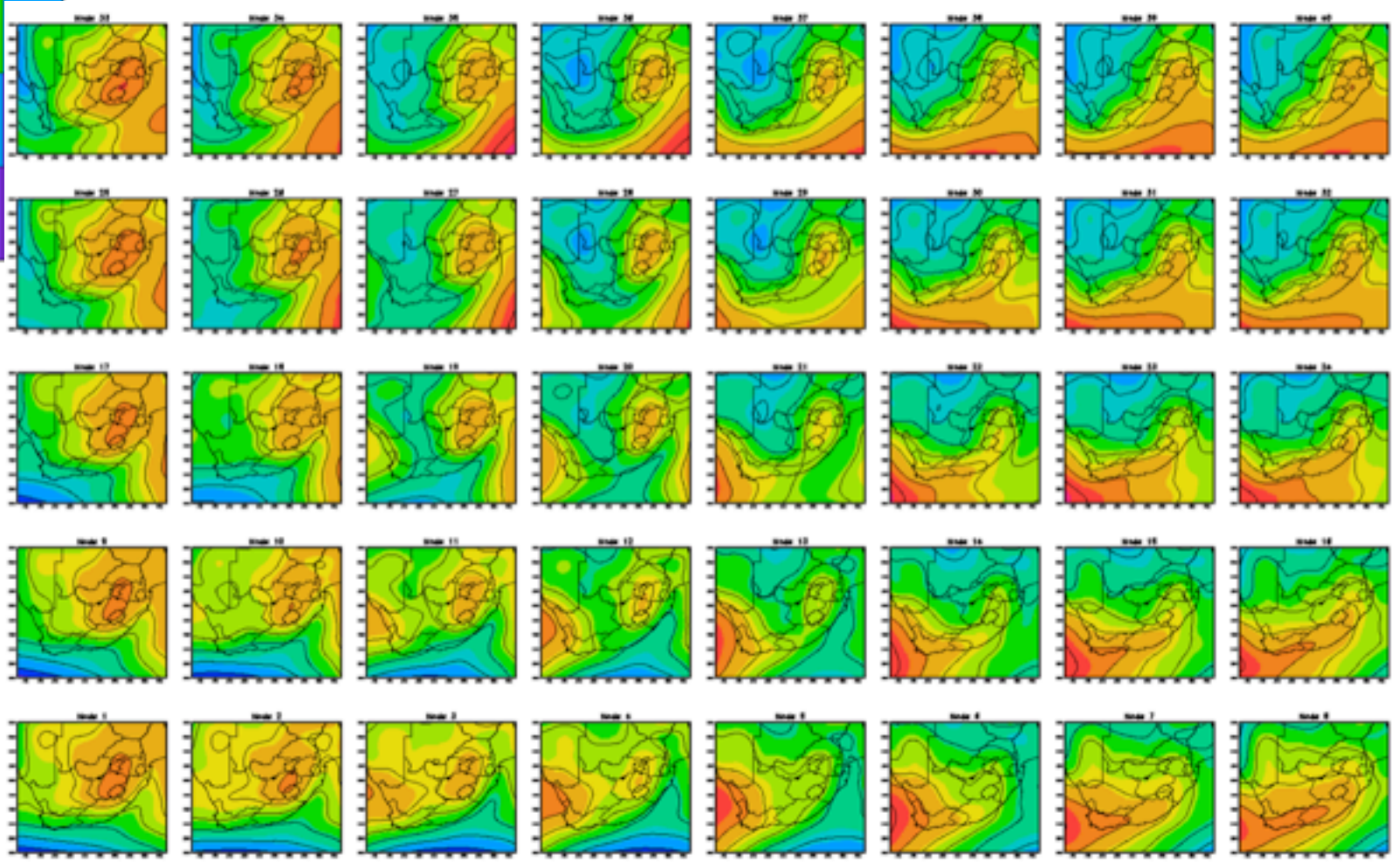
i. All data mappings (1998 - 2009)



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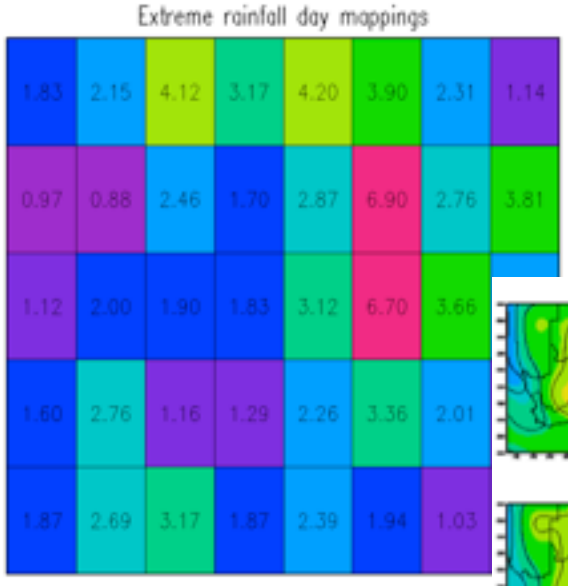
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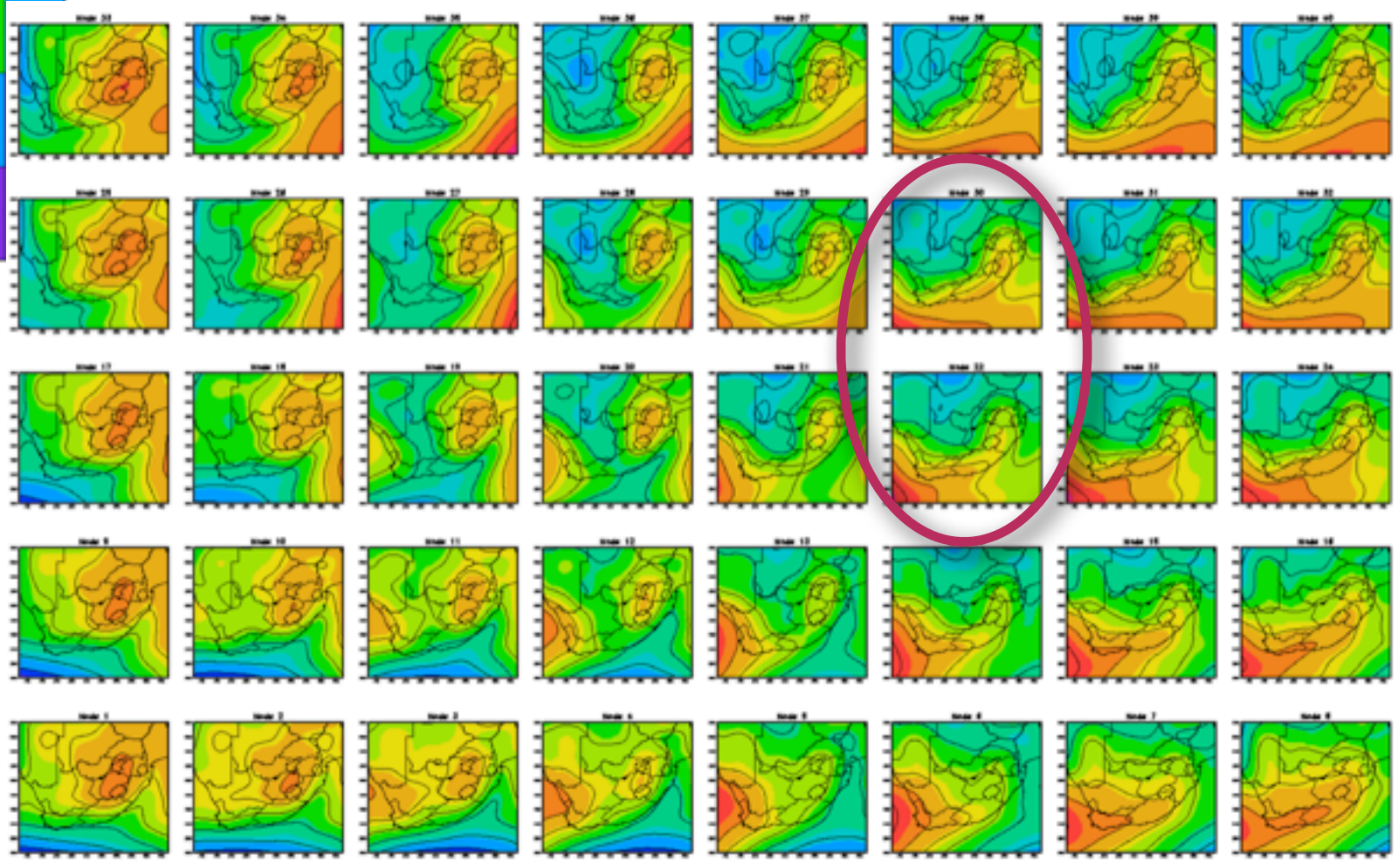




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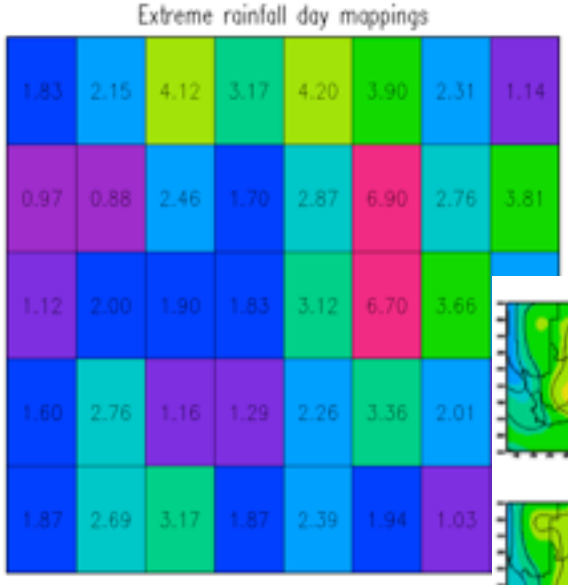
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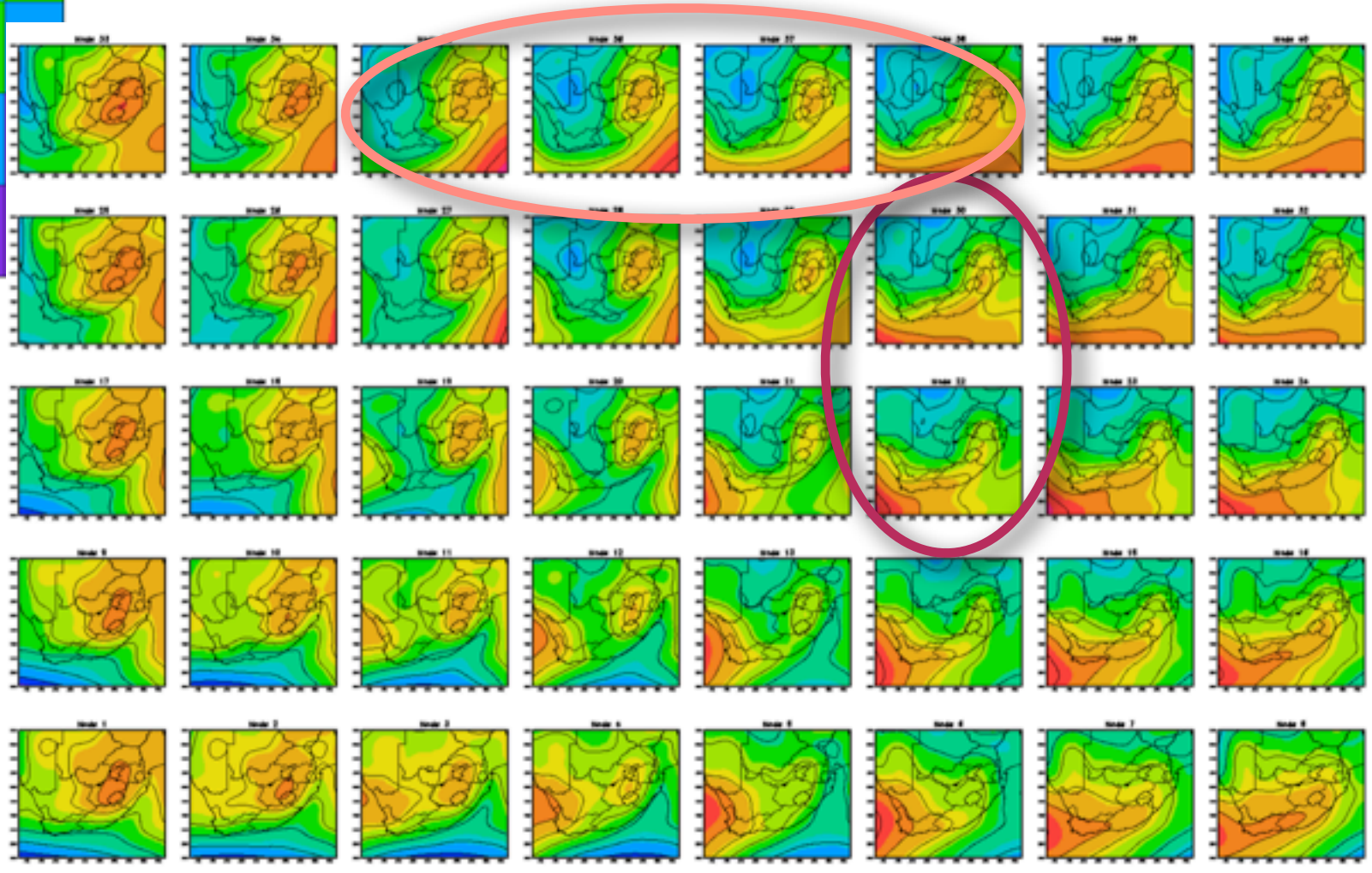




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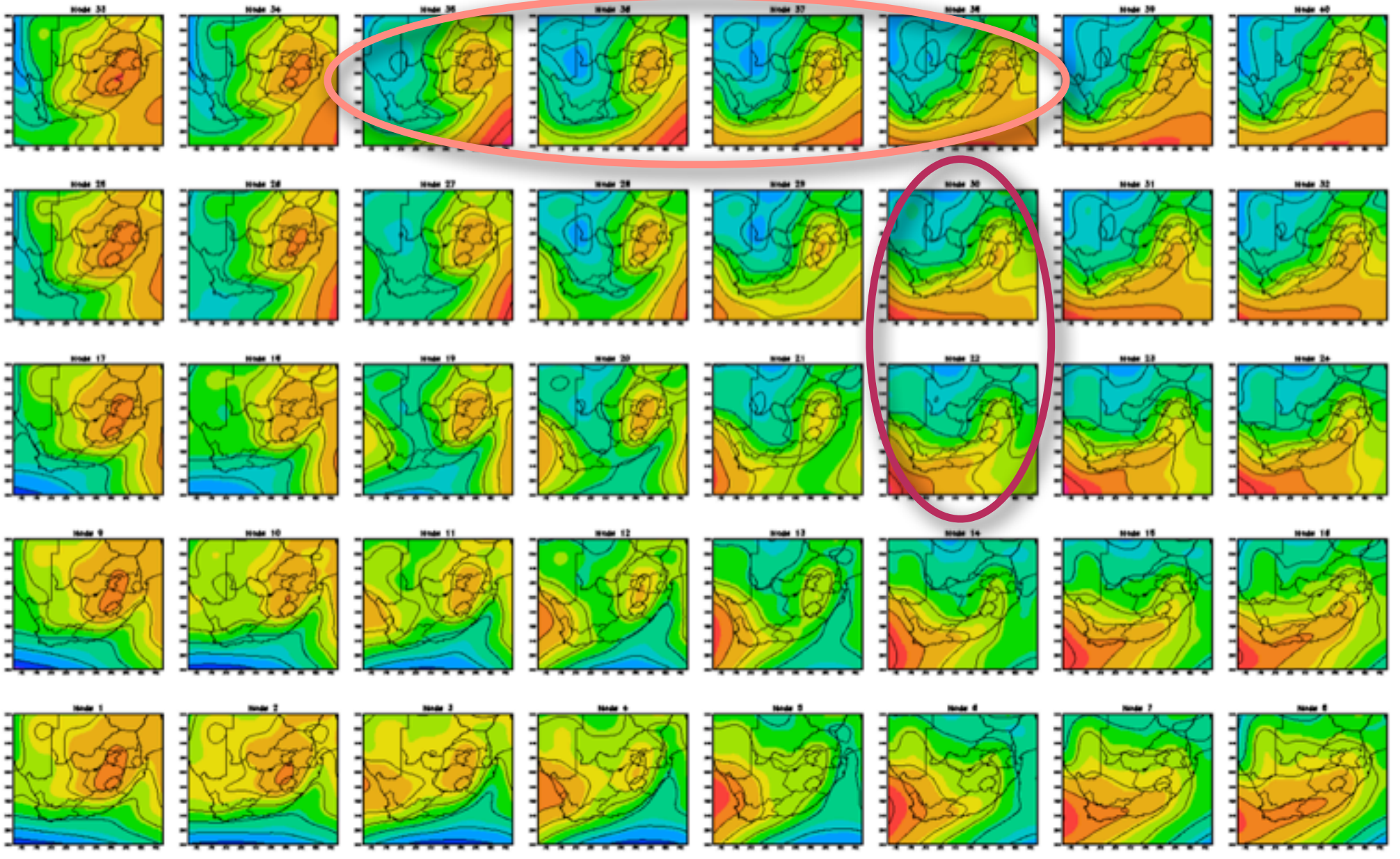




Task 3. Relating attributes of extreme rainfall to synoptic drivers

i. All data mappings (1998 - 2009)

SLP



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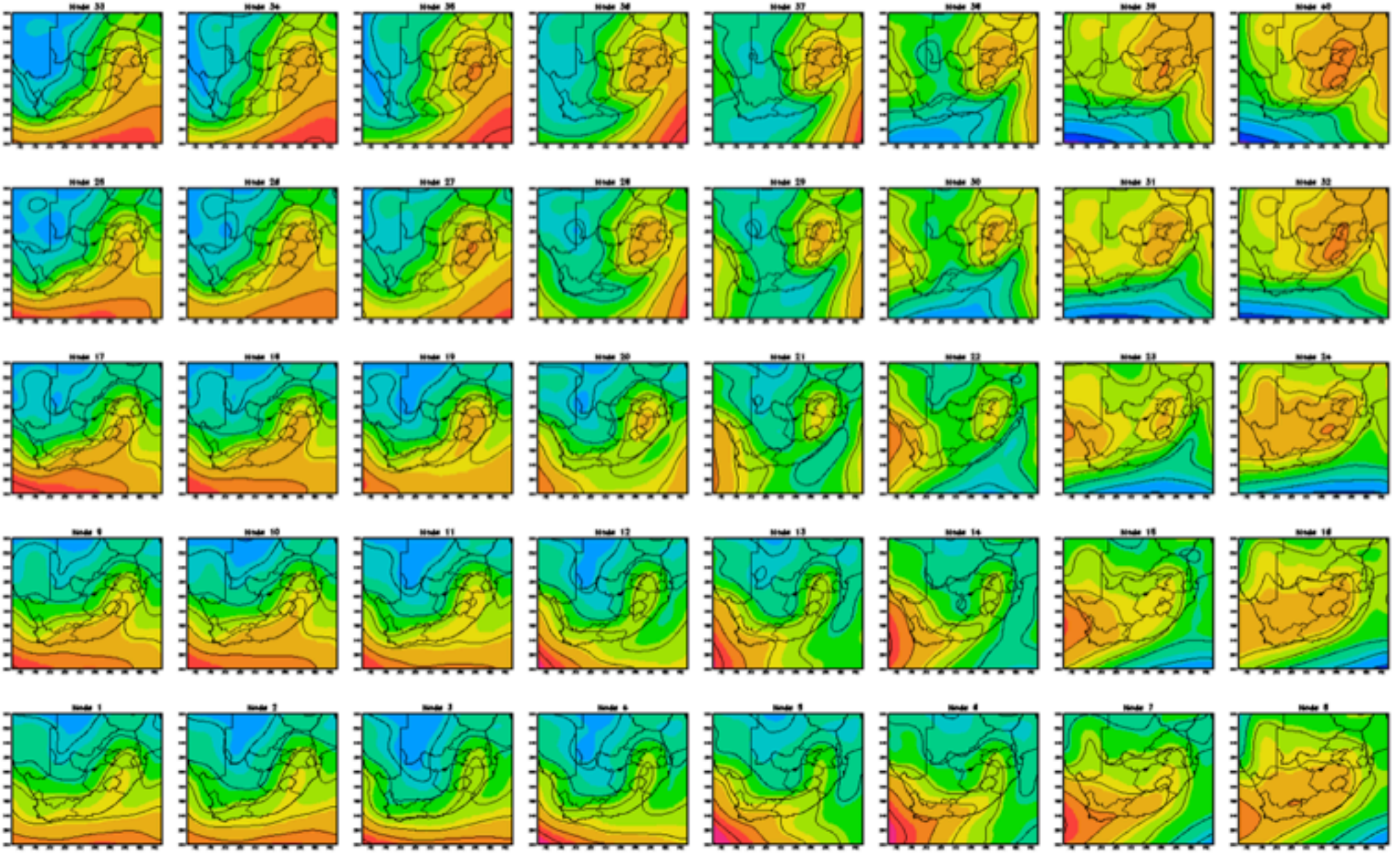
i. Only extreme days (1998 - 2009)

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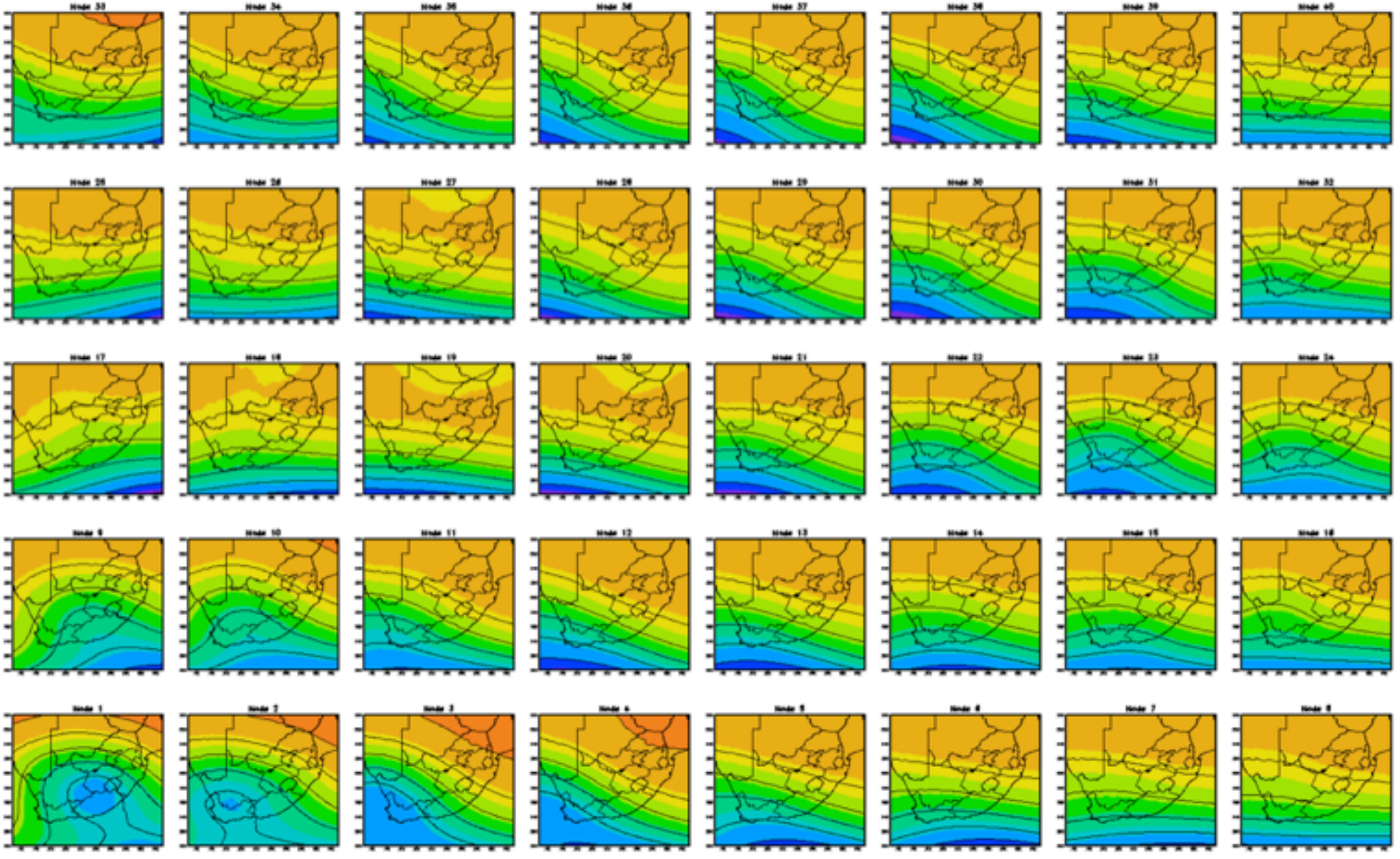
i. Only extreme days (1998 - 2009)

Z500

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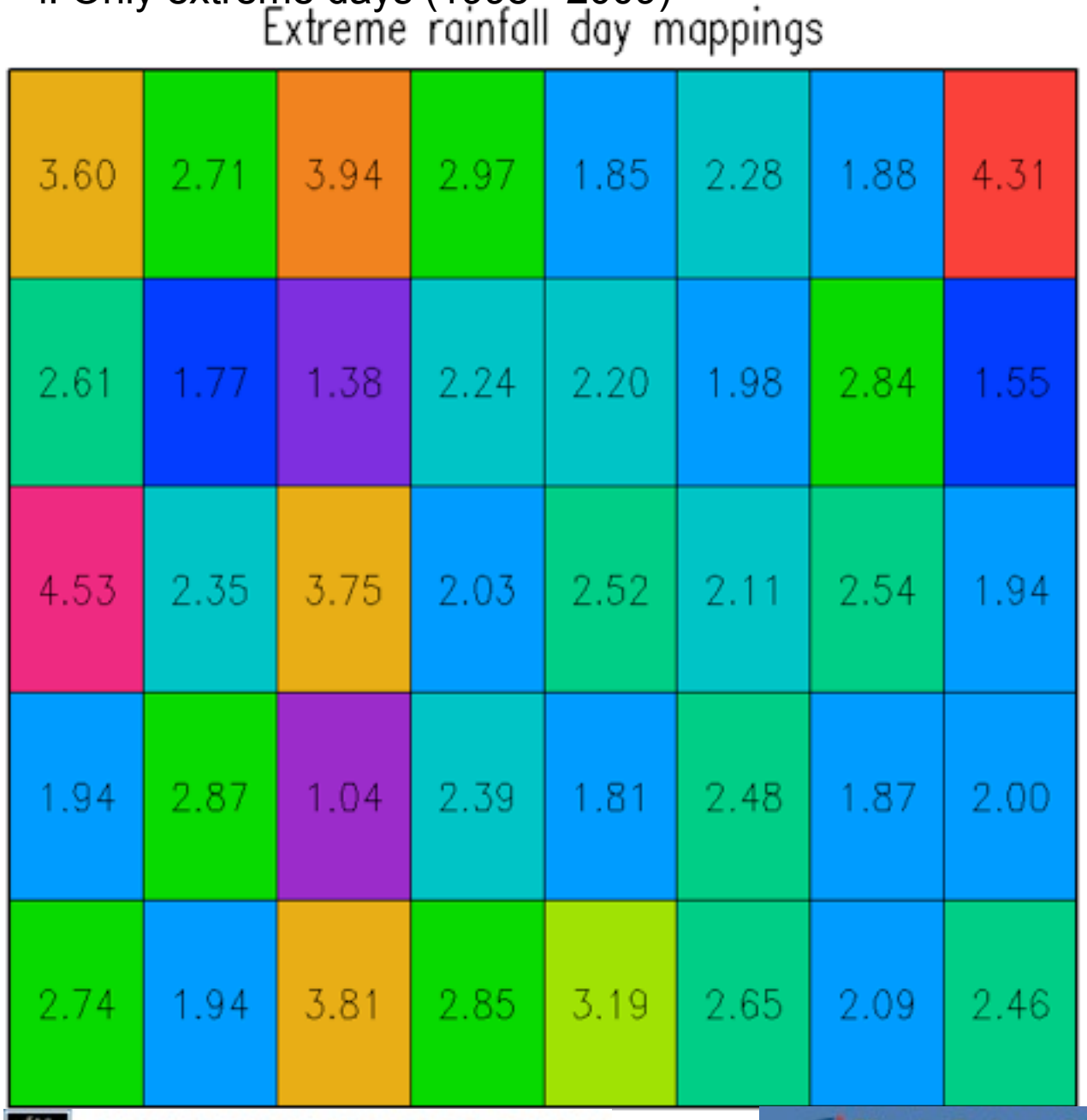
Z500



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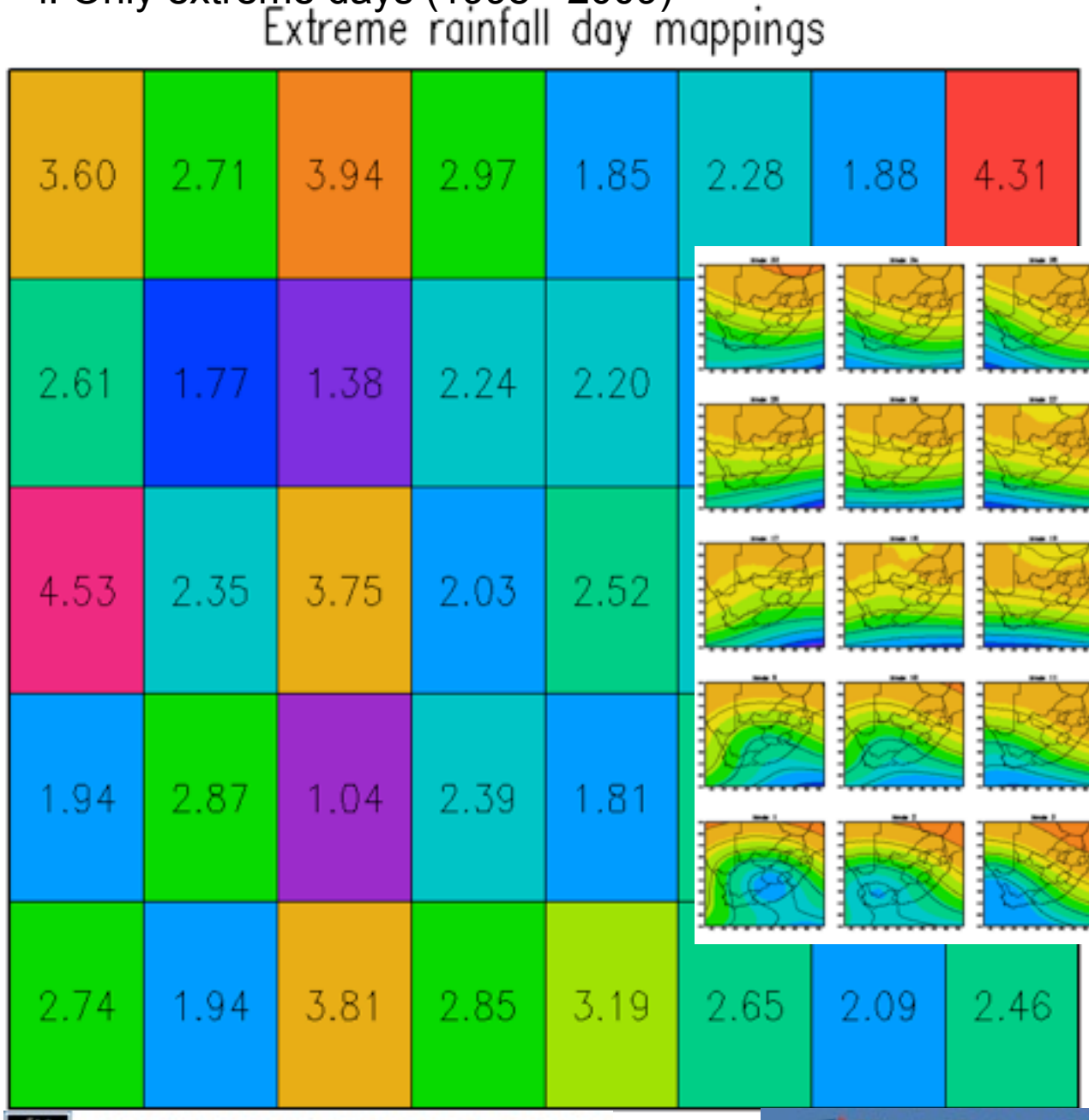
Z500

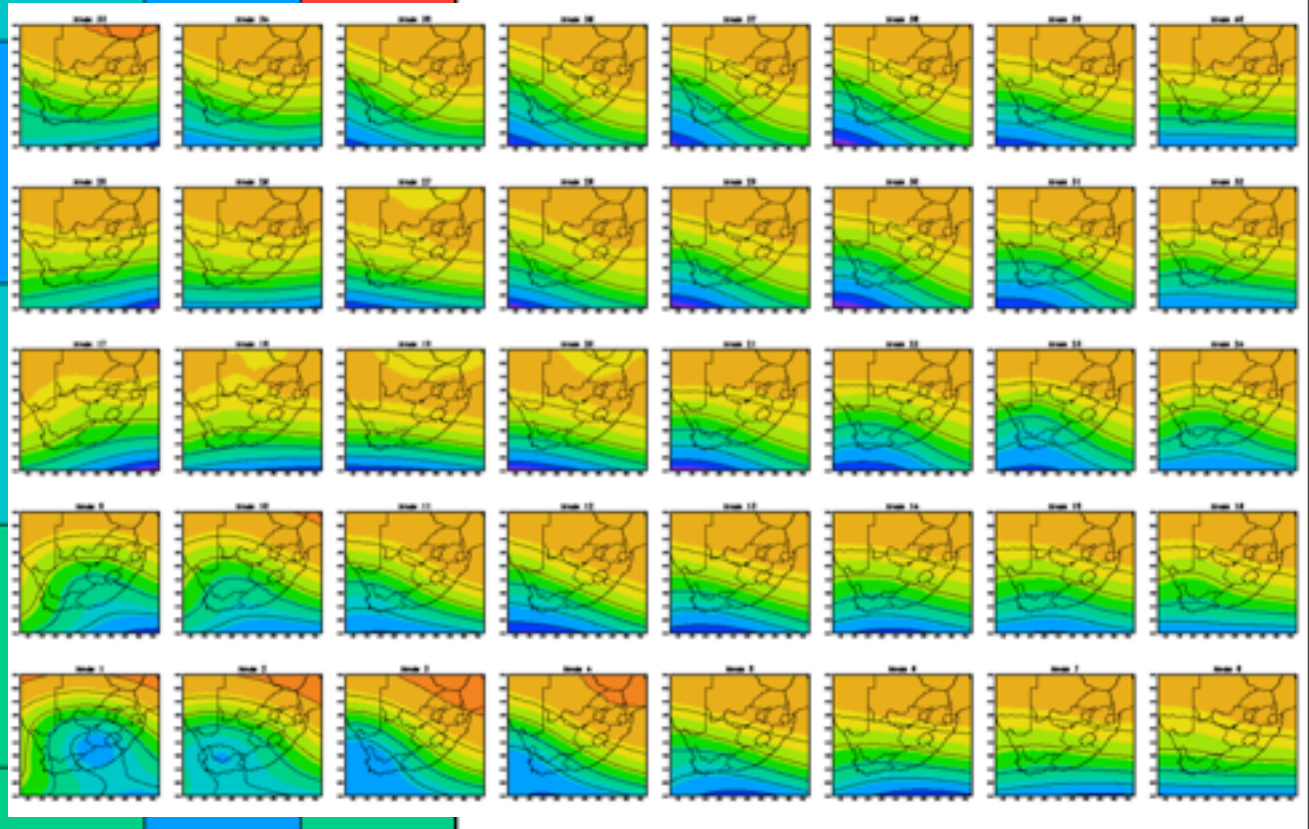


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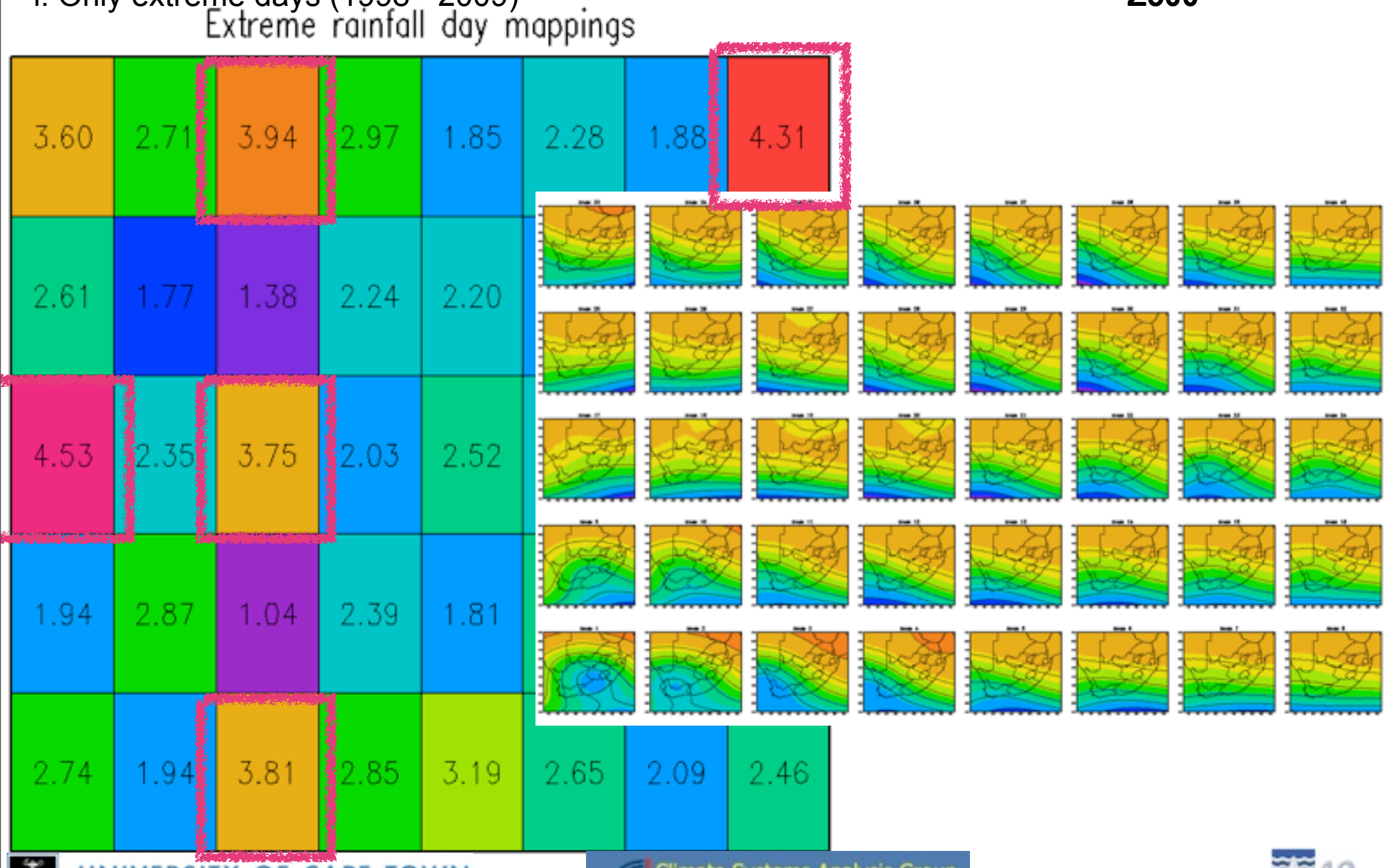
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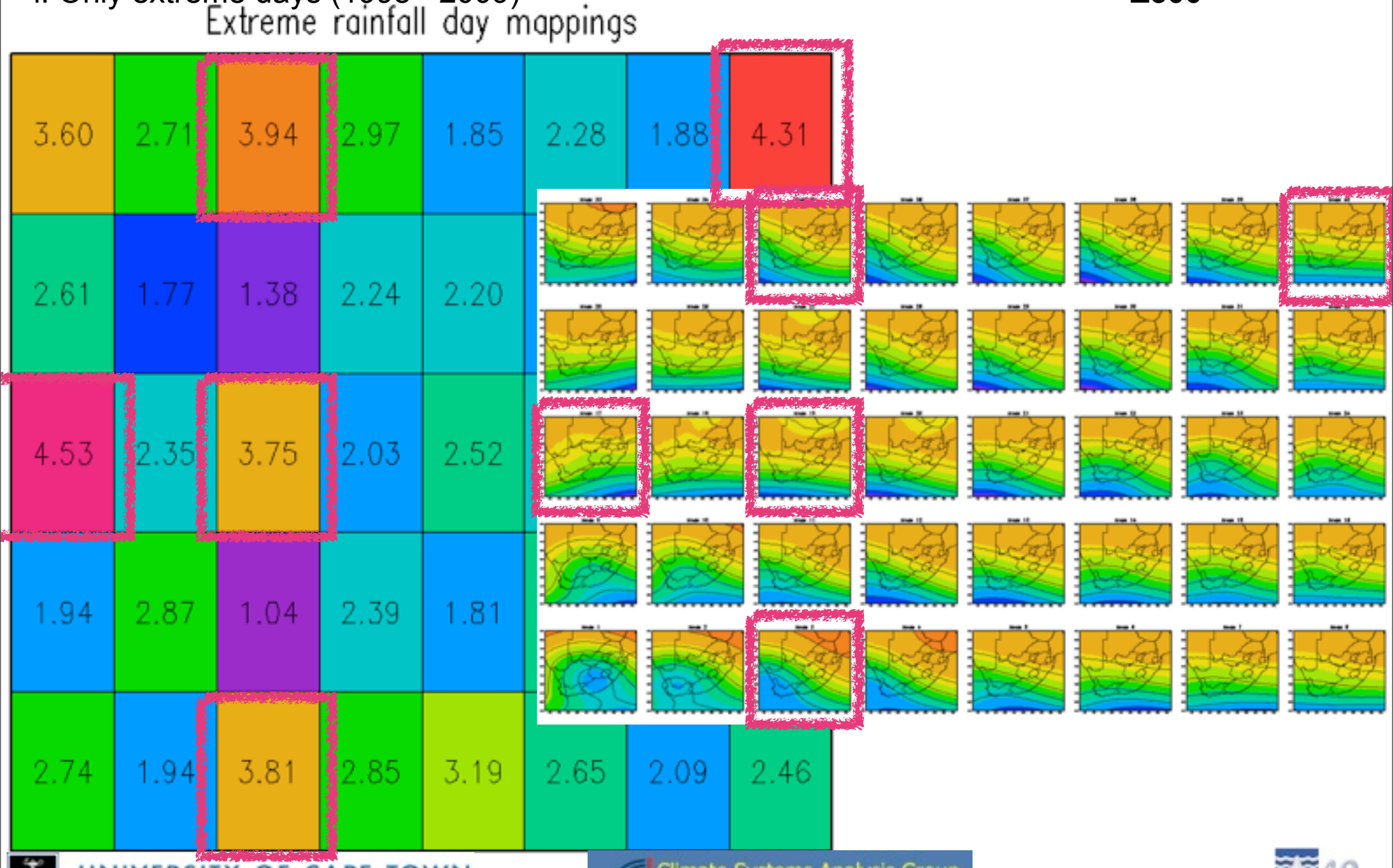
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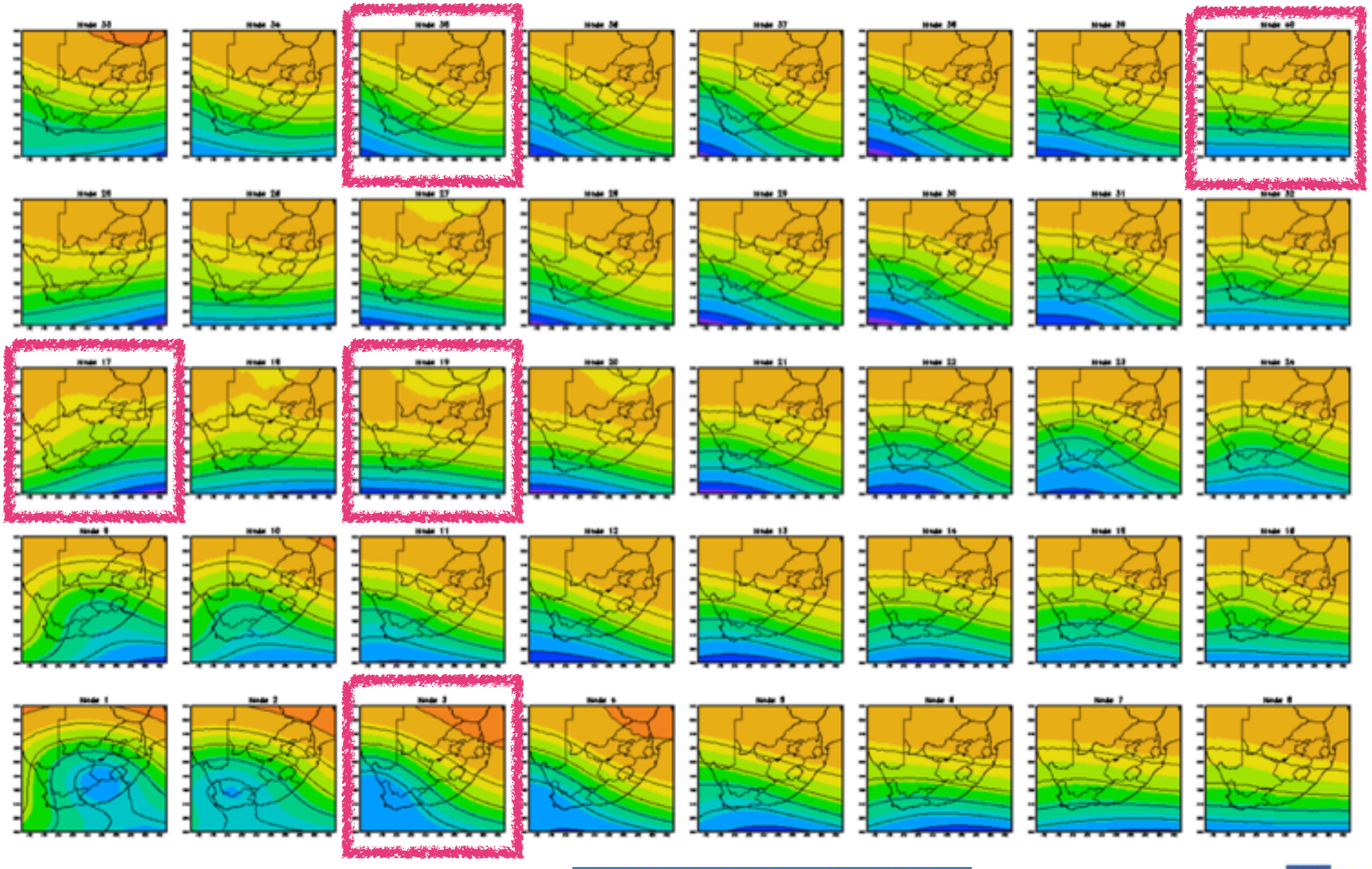
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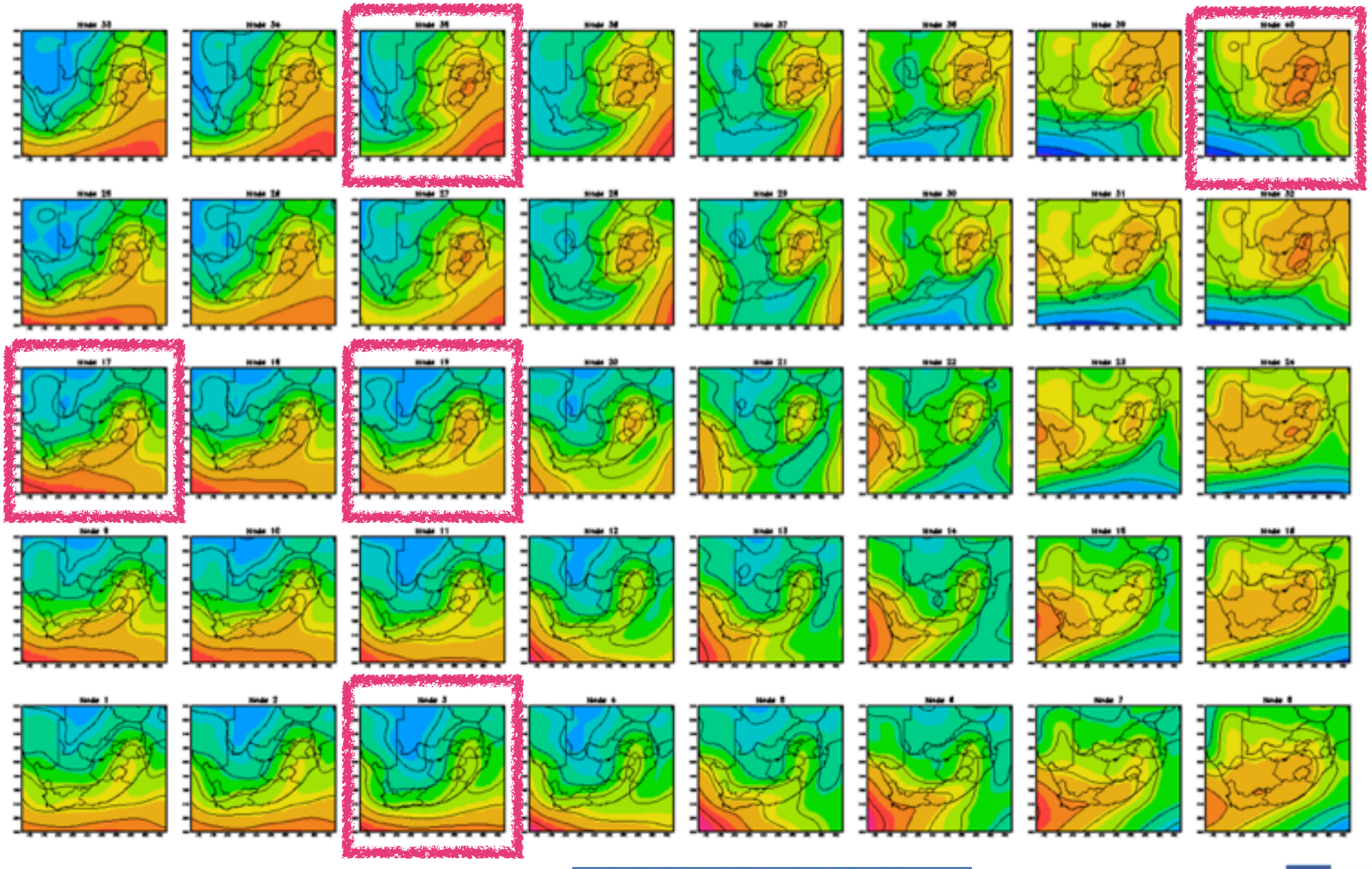
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Task 3. Relating attributes of extreme rainfall to synoptic drivers

i. Only extreme days (1998 - 2009)

SLP



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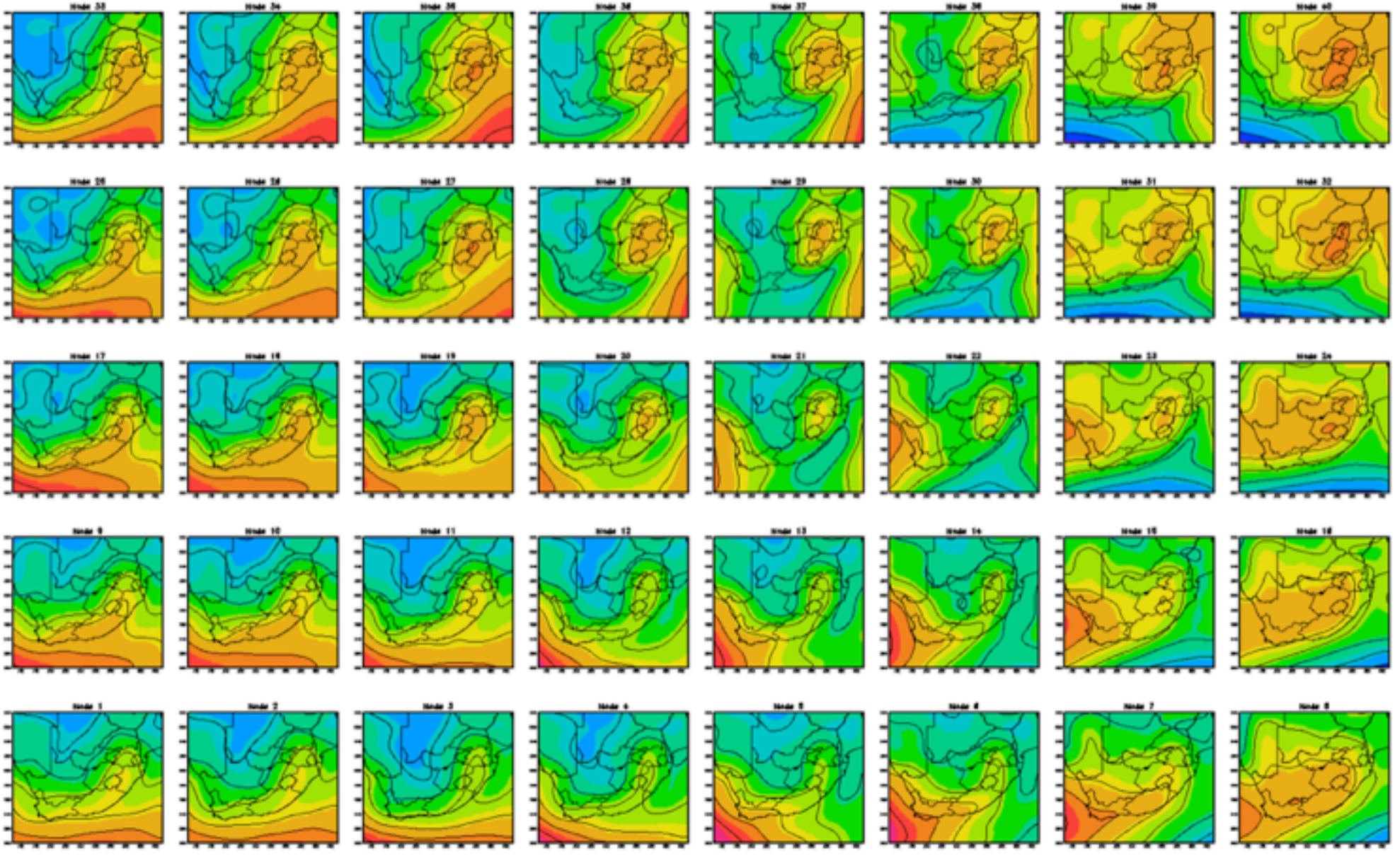
i. Only extreme days (Seasonal)

DJF- SLP

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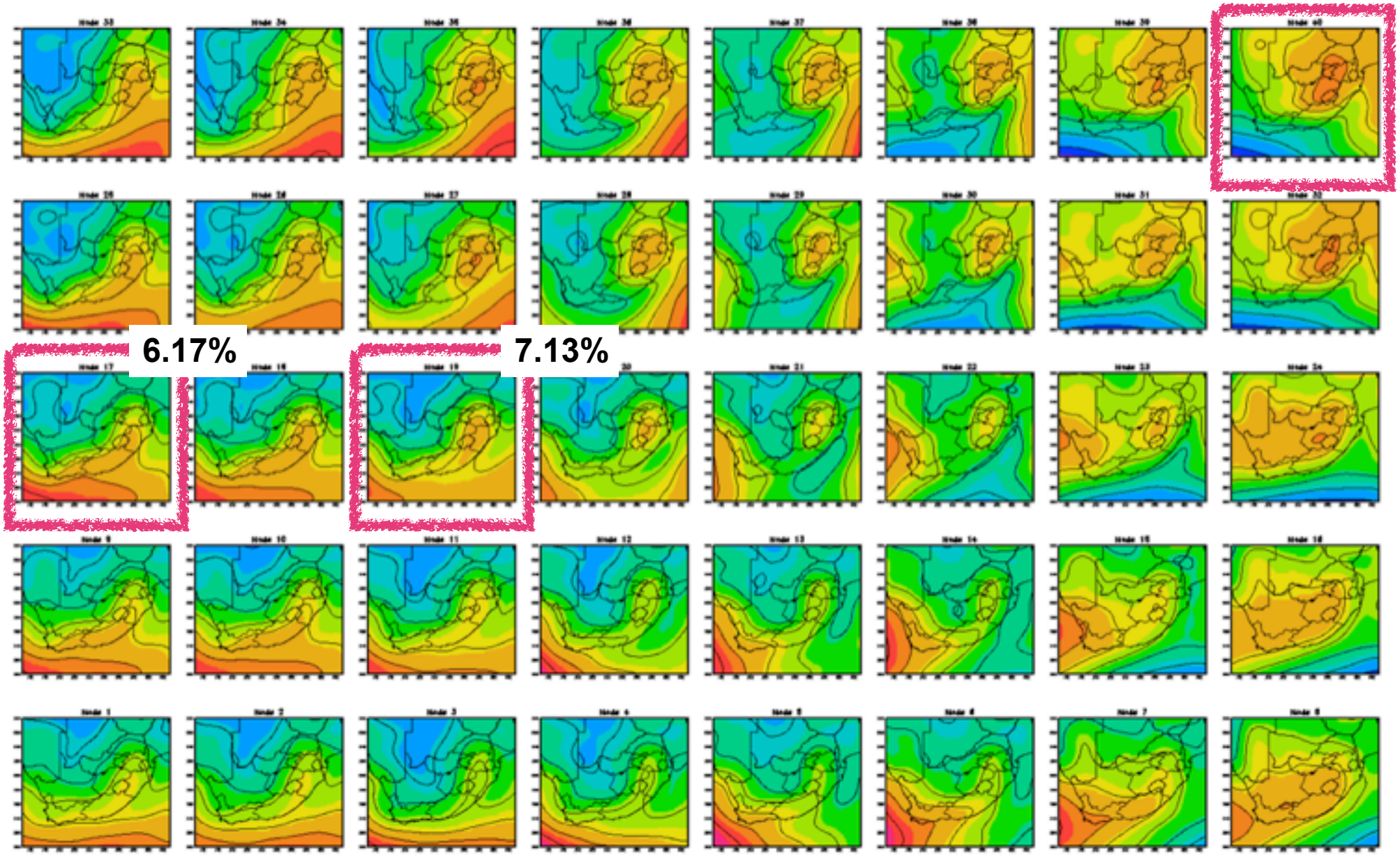


Task 3. Relating attributes of extreme rainfall to synoptic drivers

i. Only extreme days (Seasonal)

DJF- SLP

8.05%

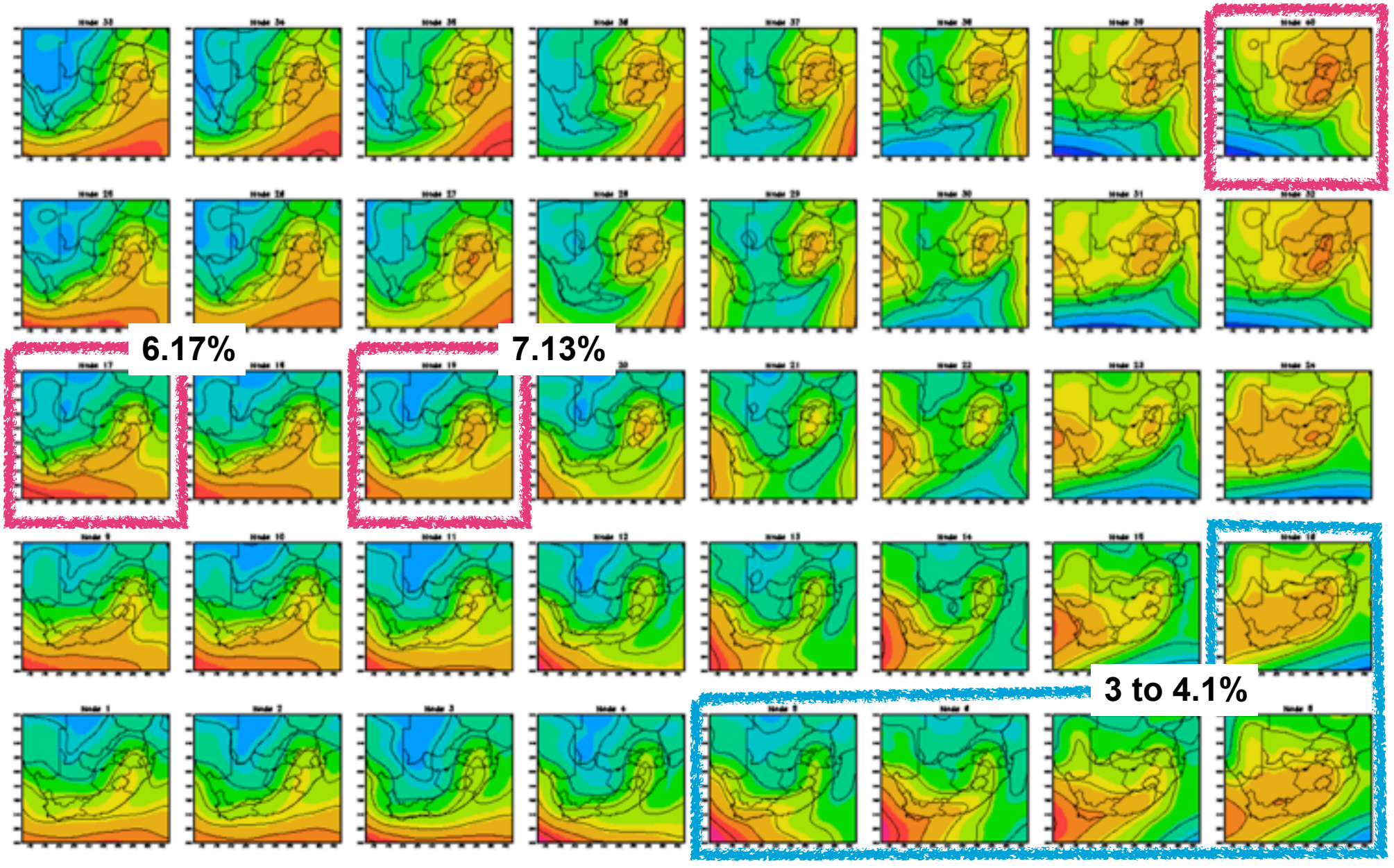


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DJF- SLP

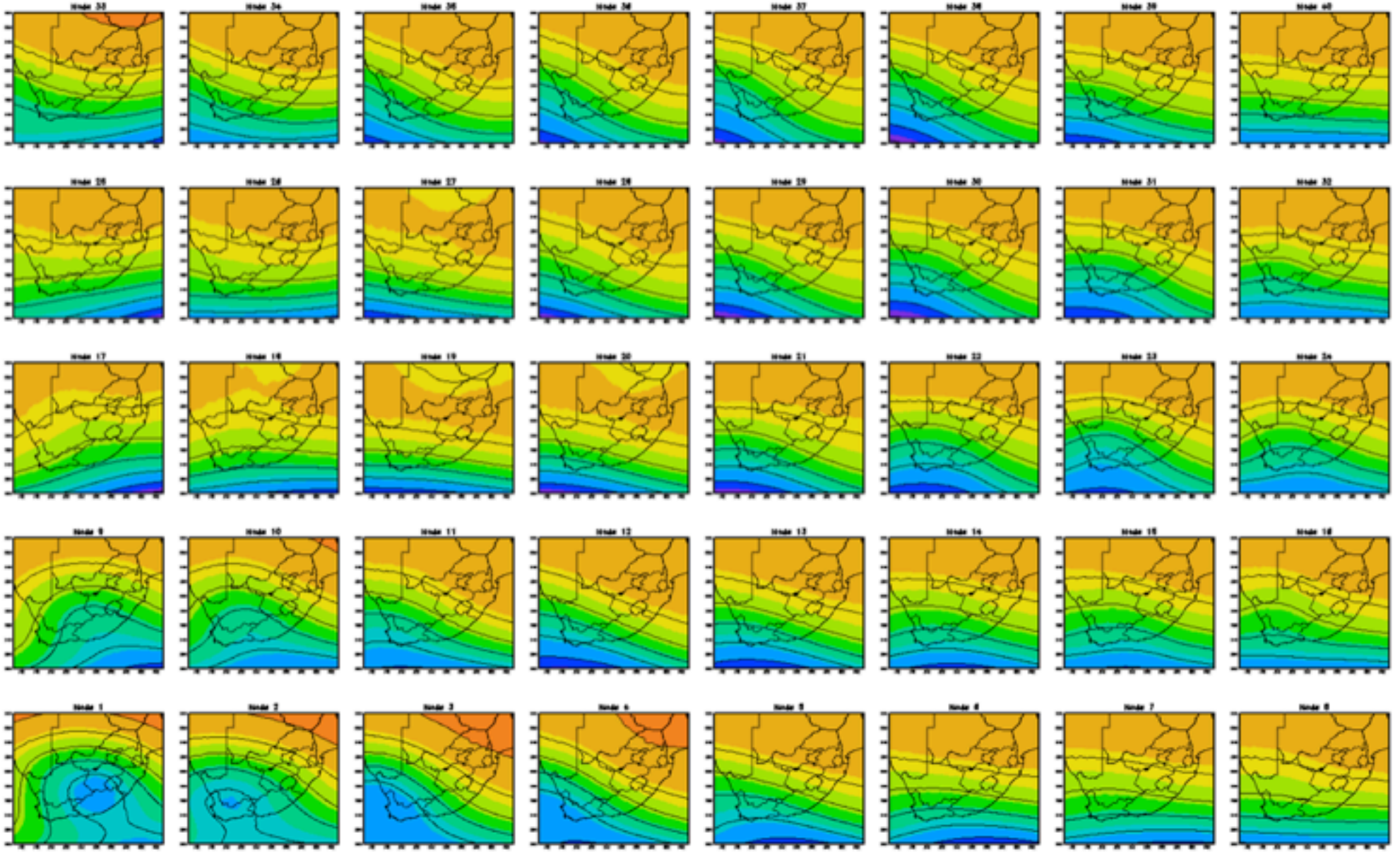
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Task 3. Relating attributes of extreme rainfall to synoptic drivers

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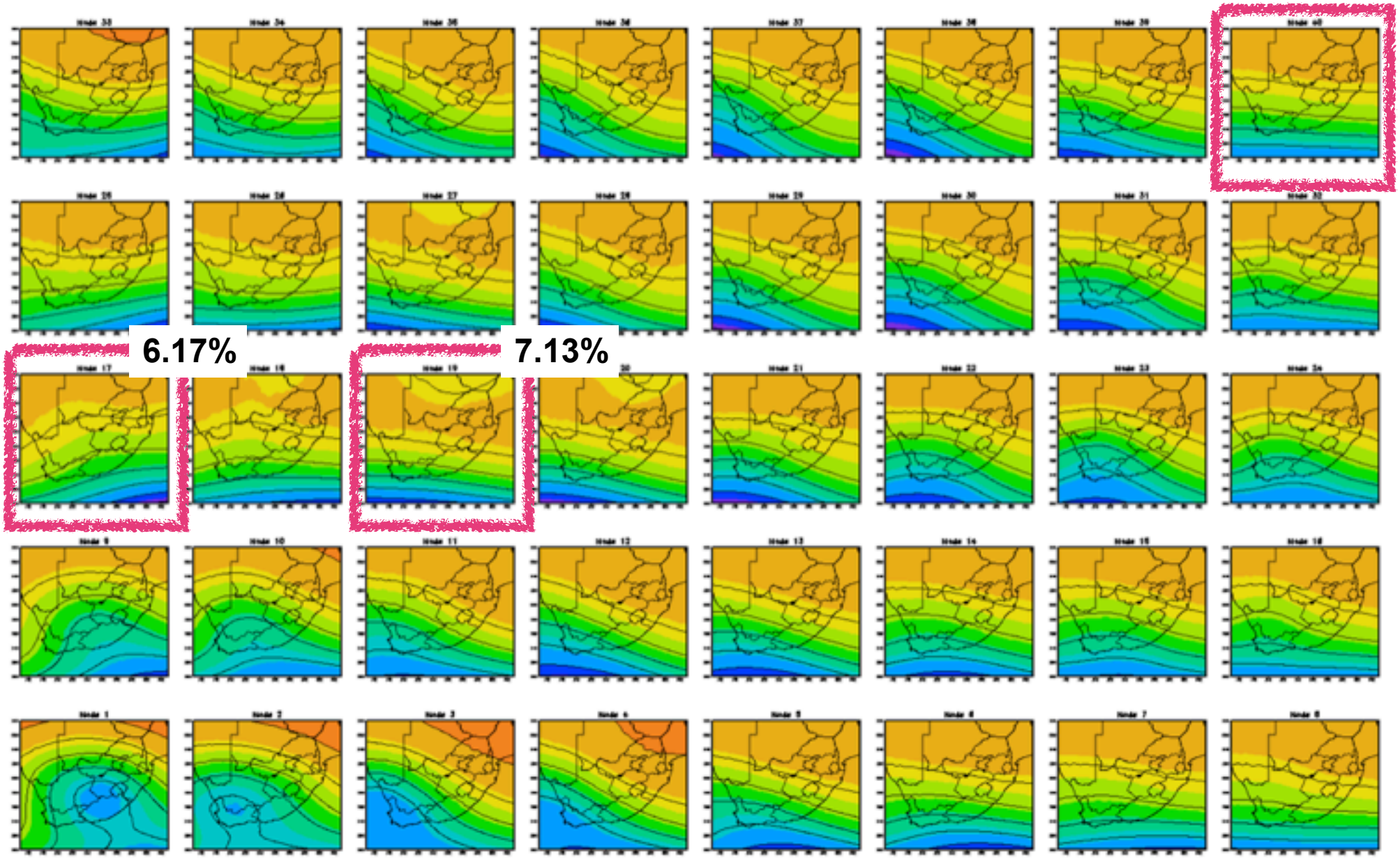
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DJF- Z500

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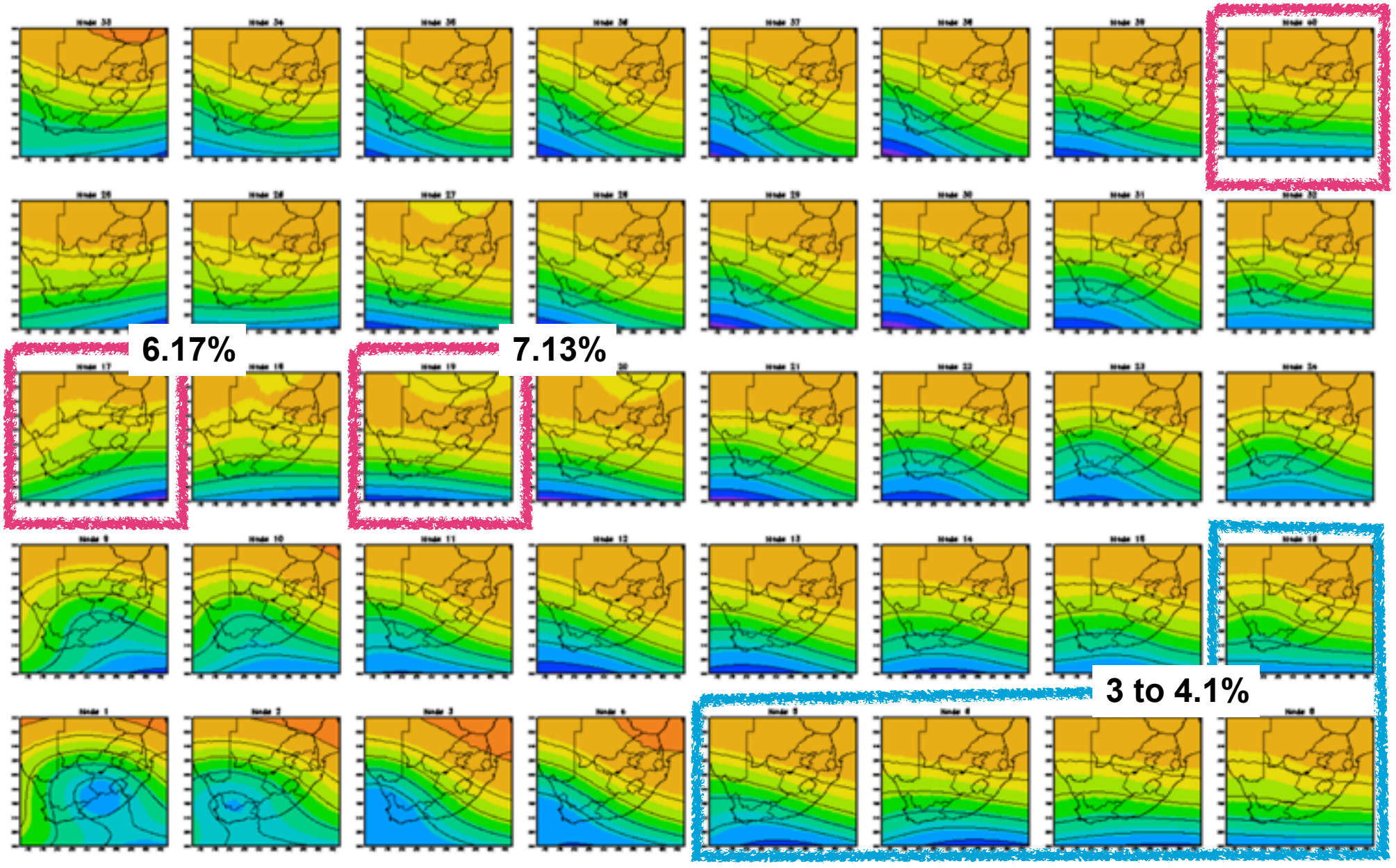


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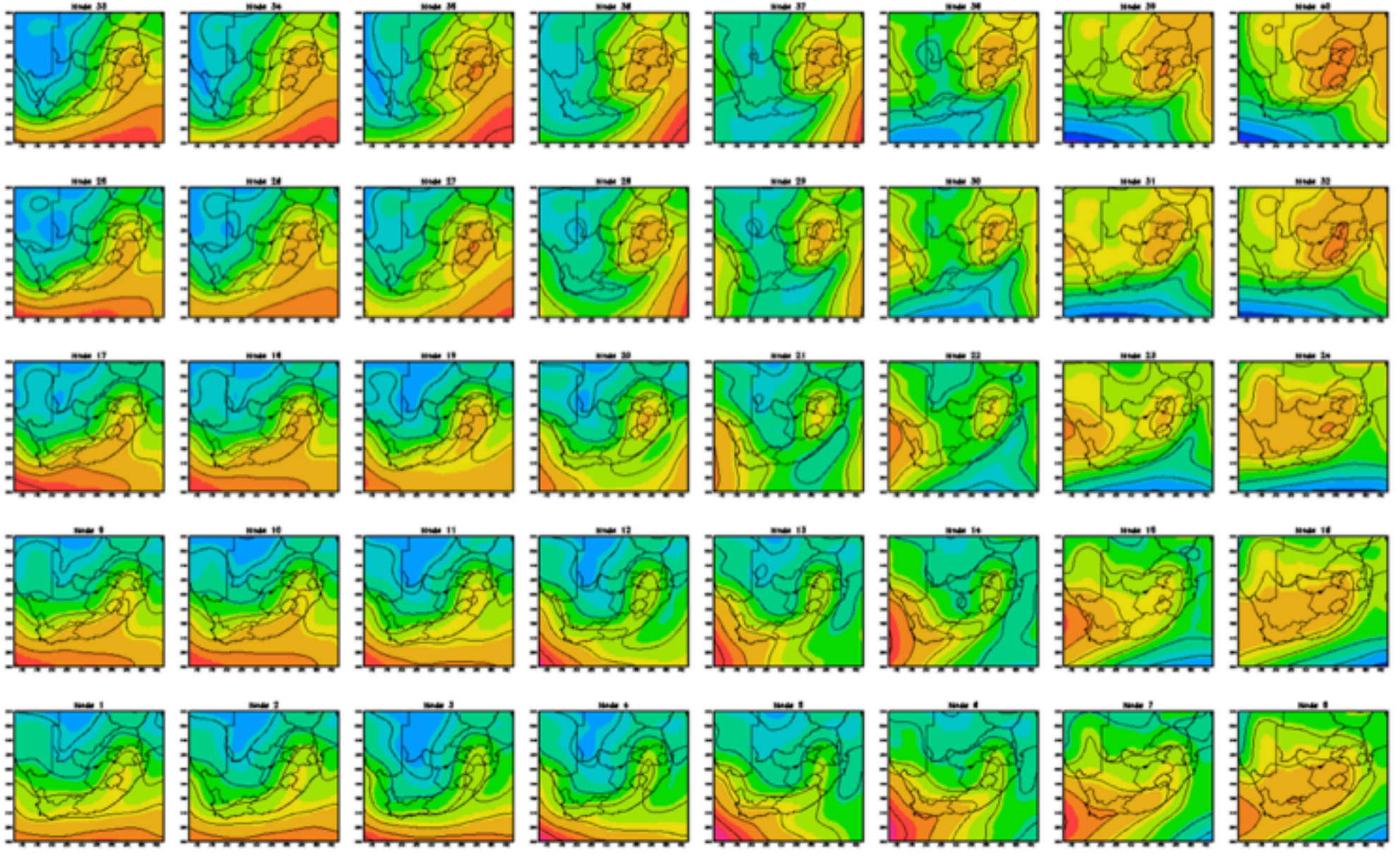
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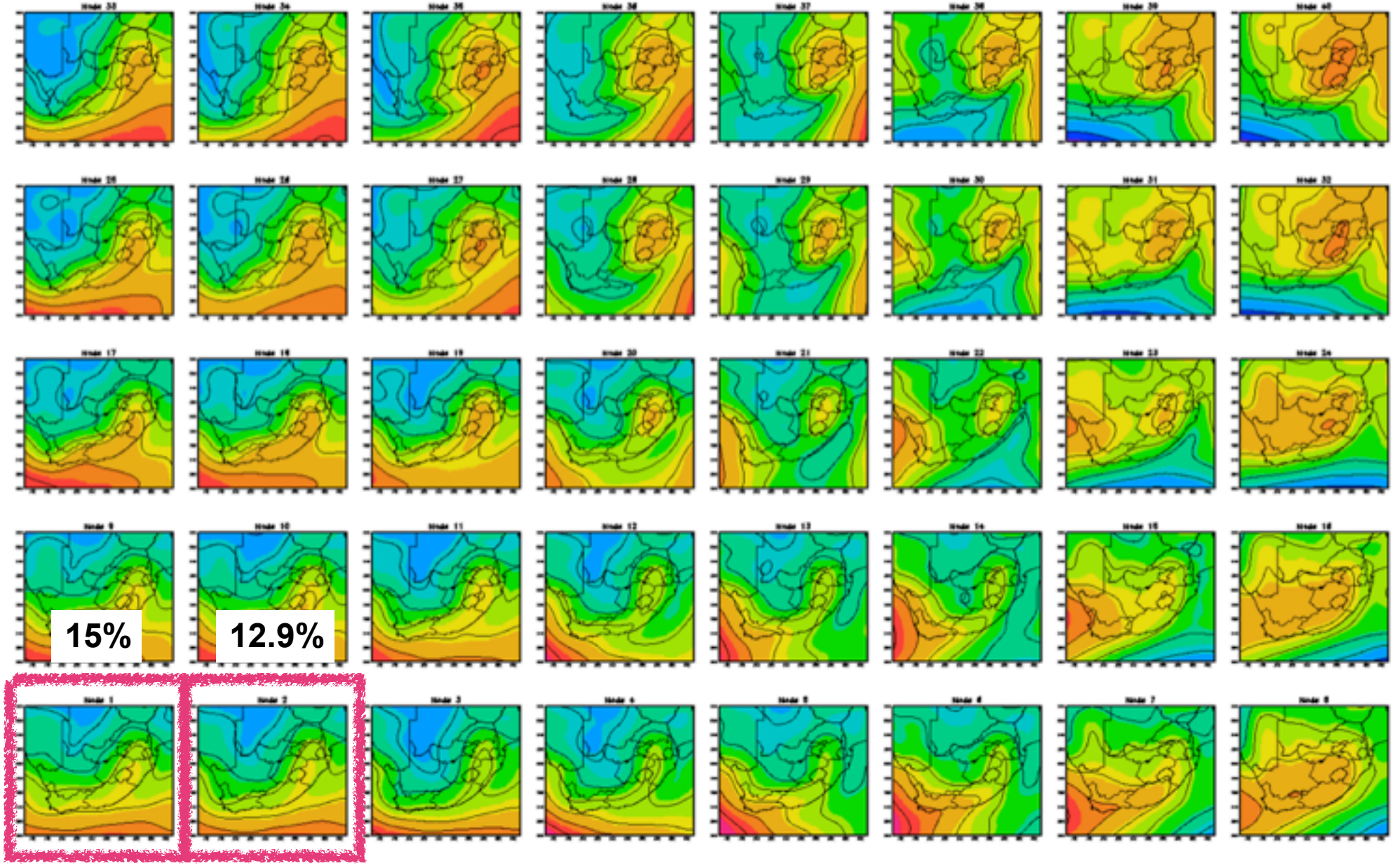
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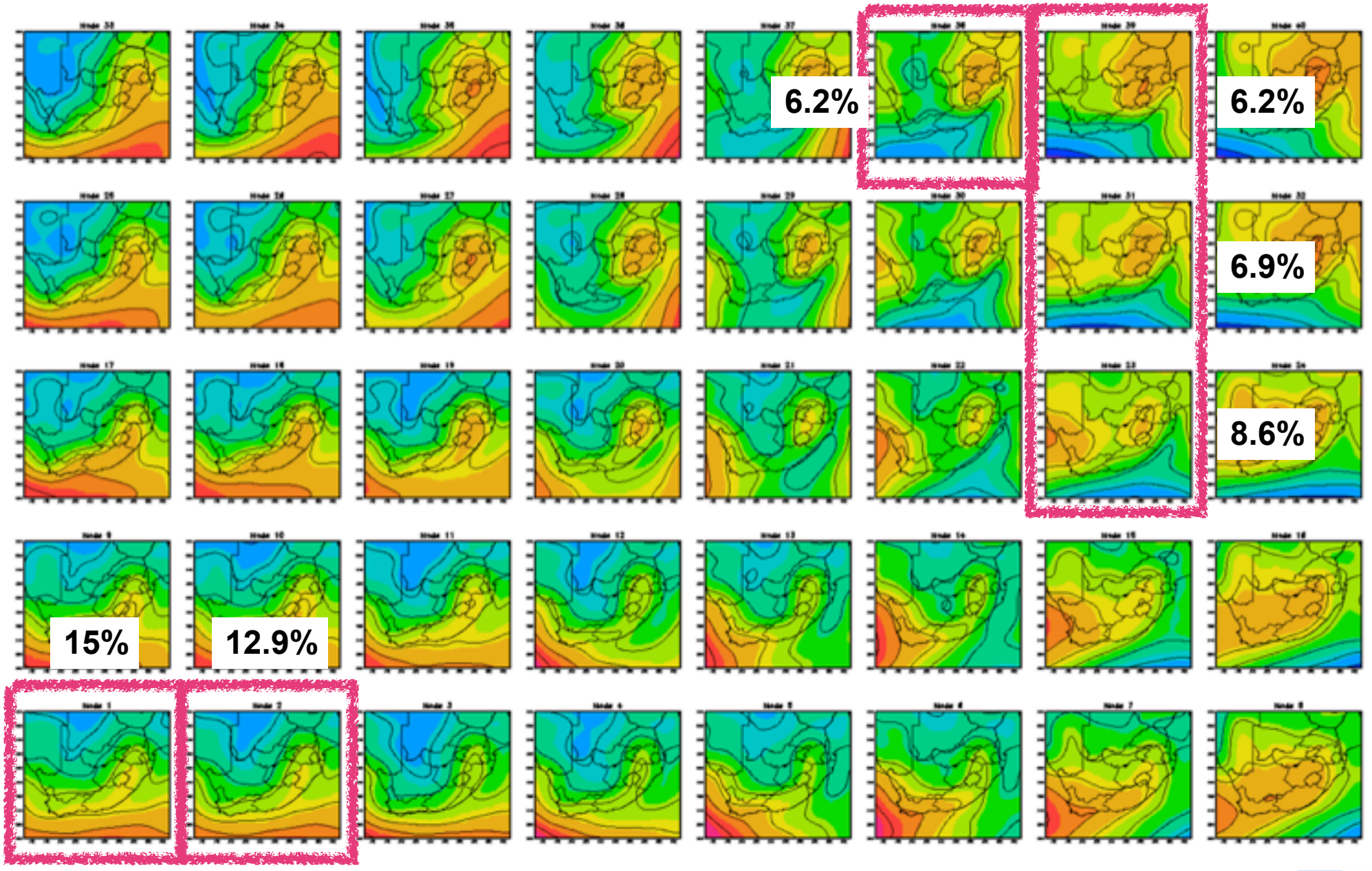
JJA- SLP



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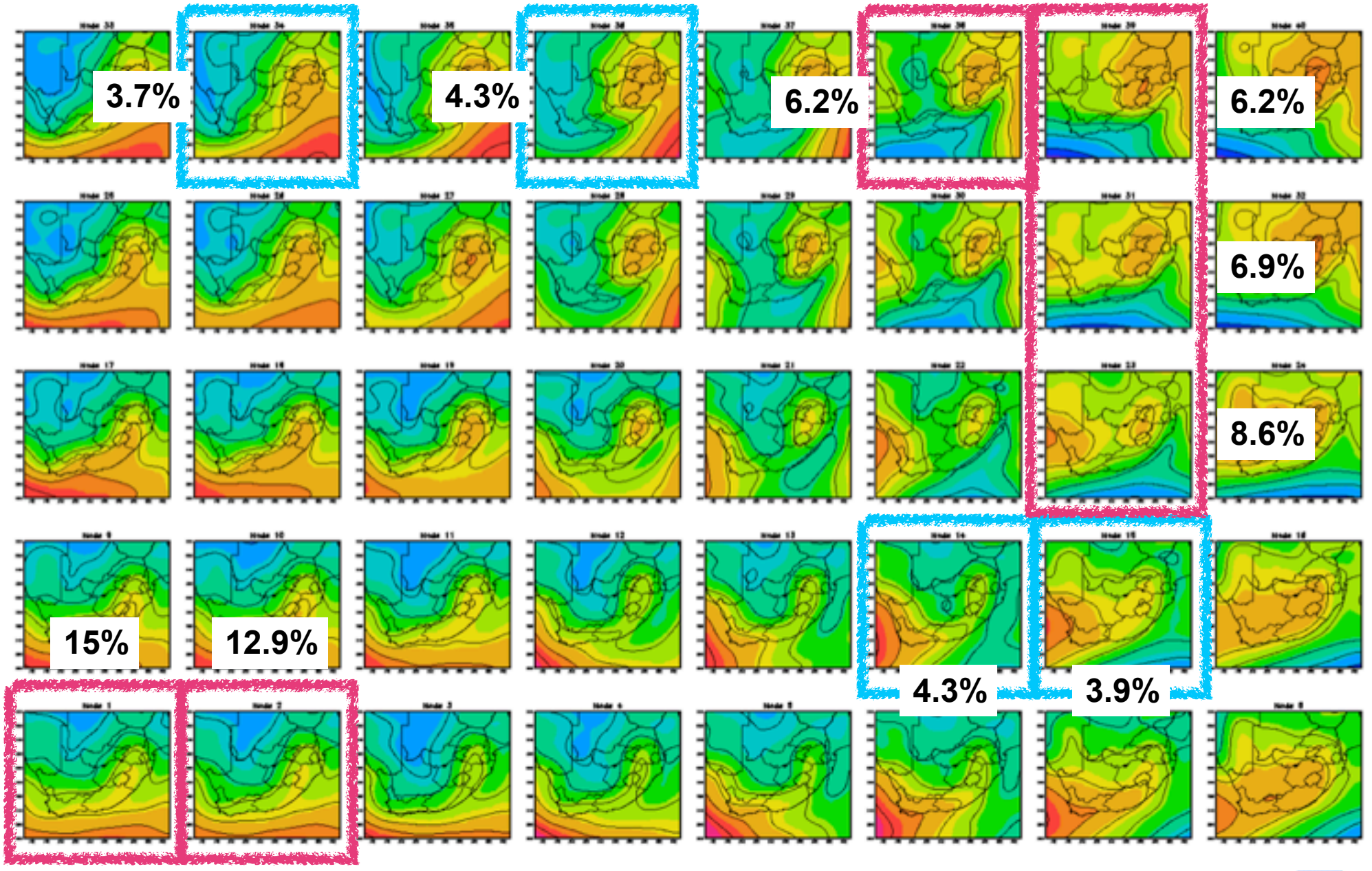
Climate Systems Analysis Group
START/PACOM Centre of Excellence
Regional node for climate modeling

40 Years of Excellence
WATER RESEARCH

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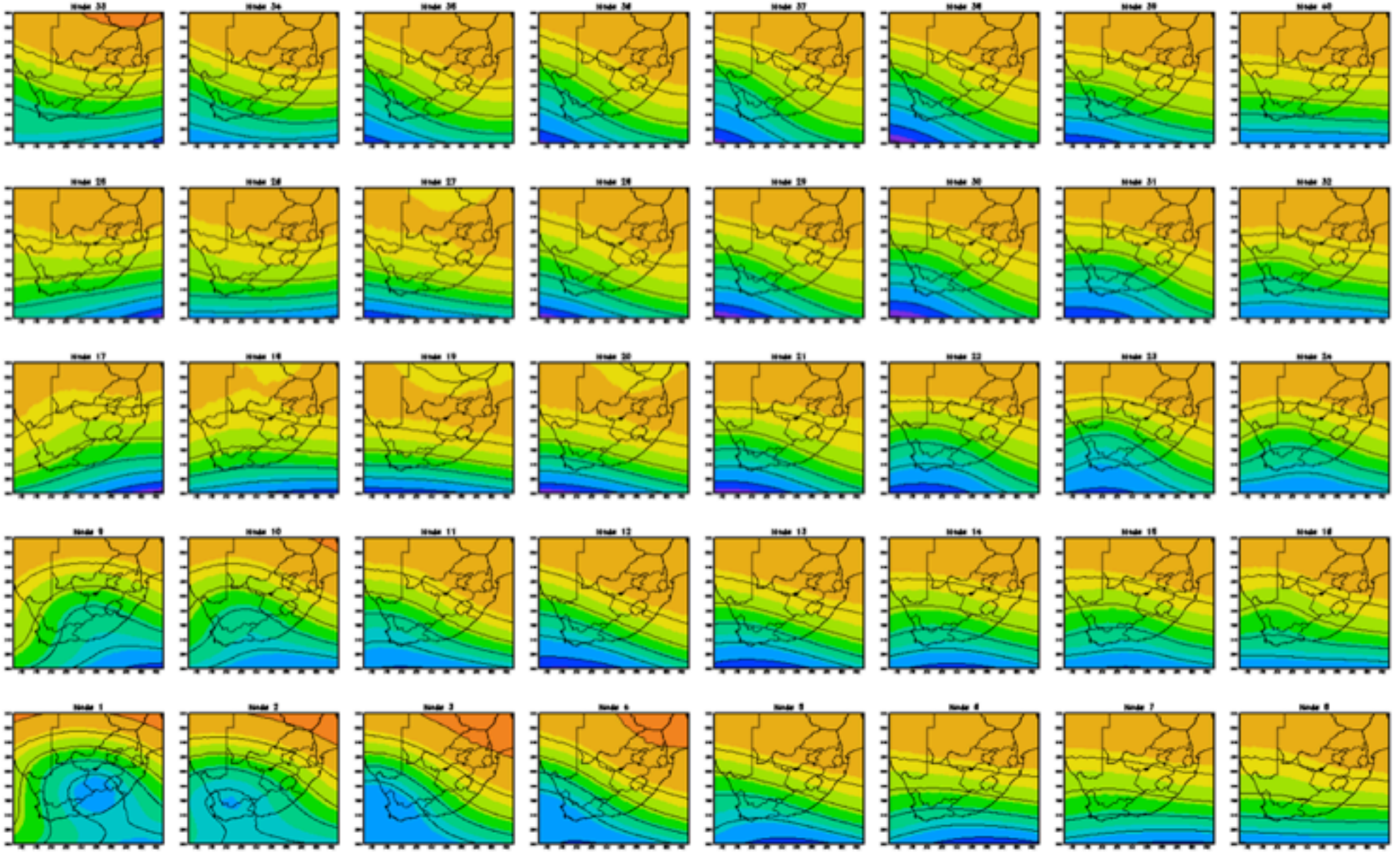
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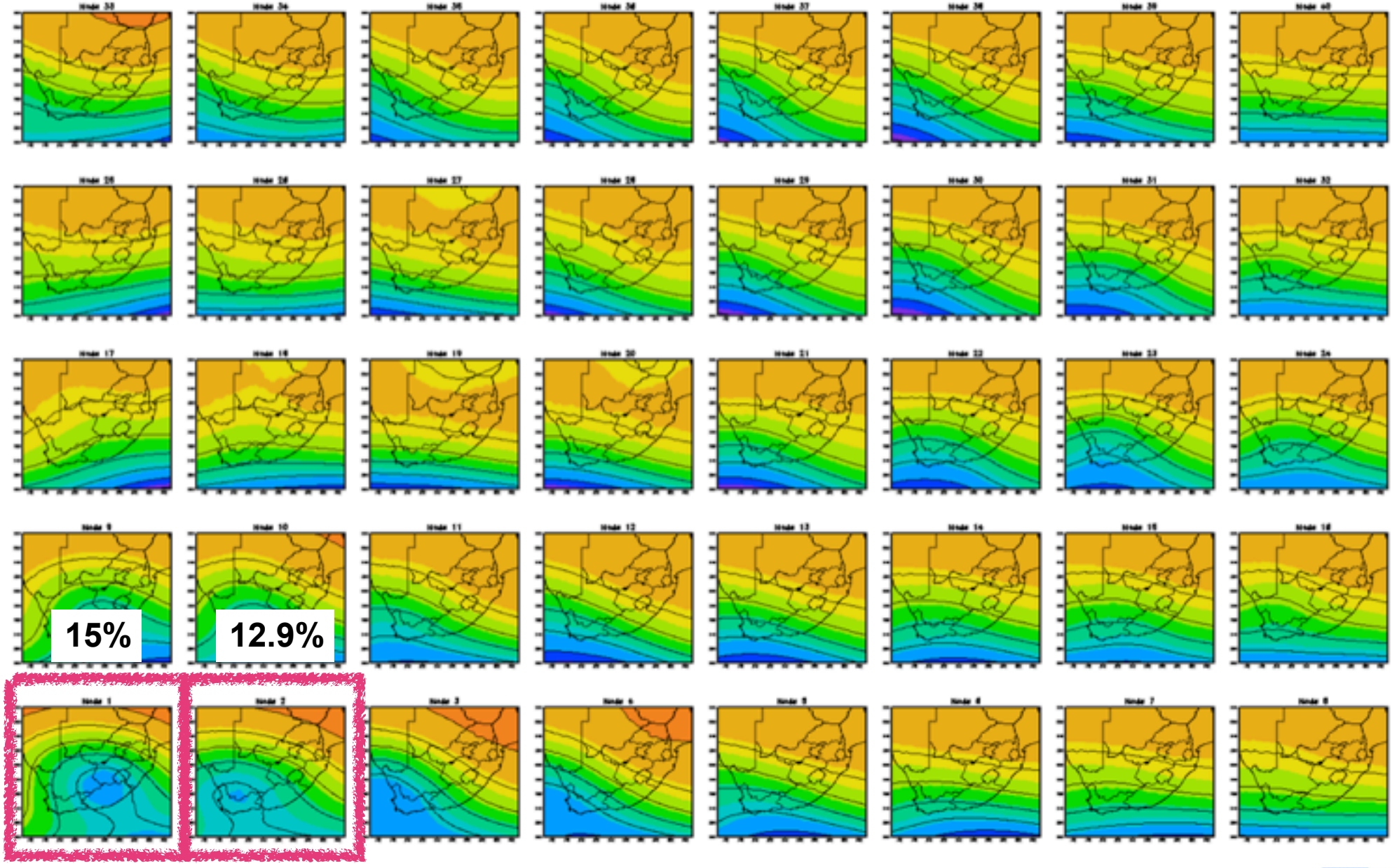
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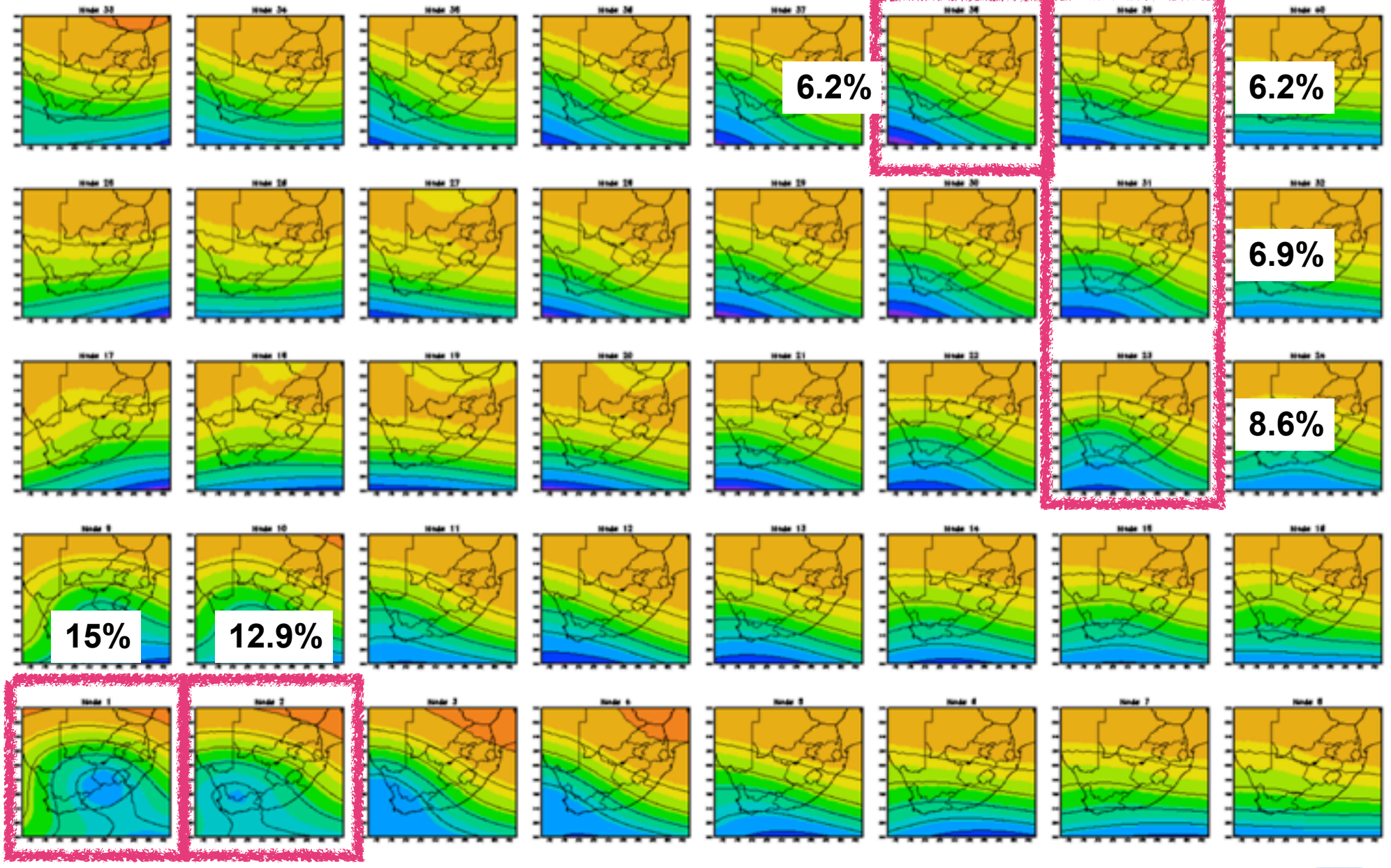
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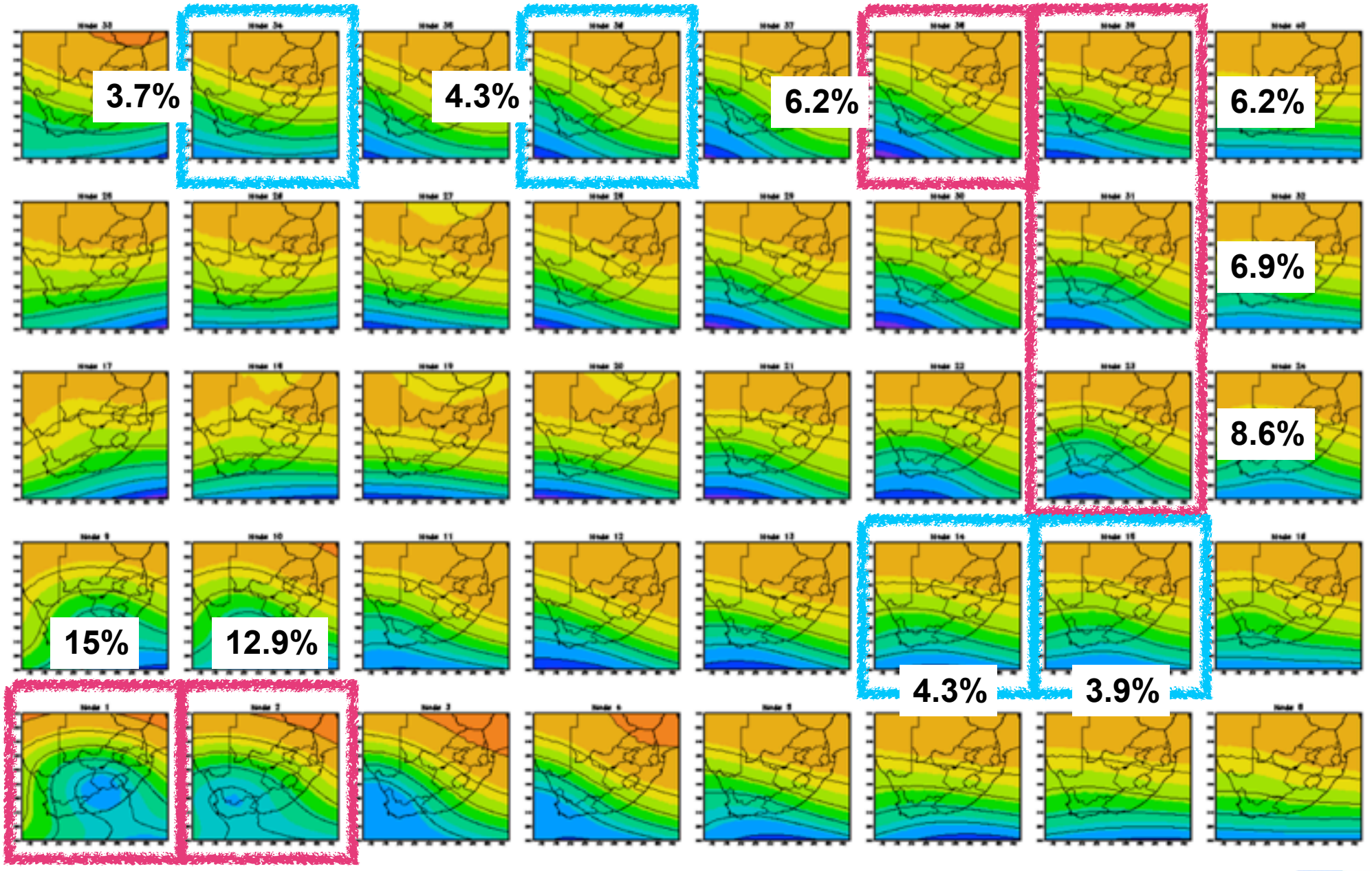
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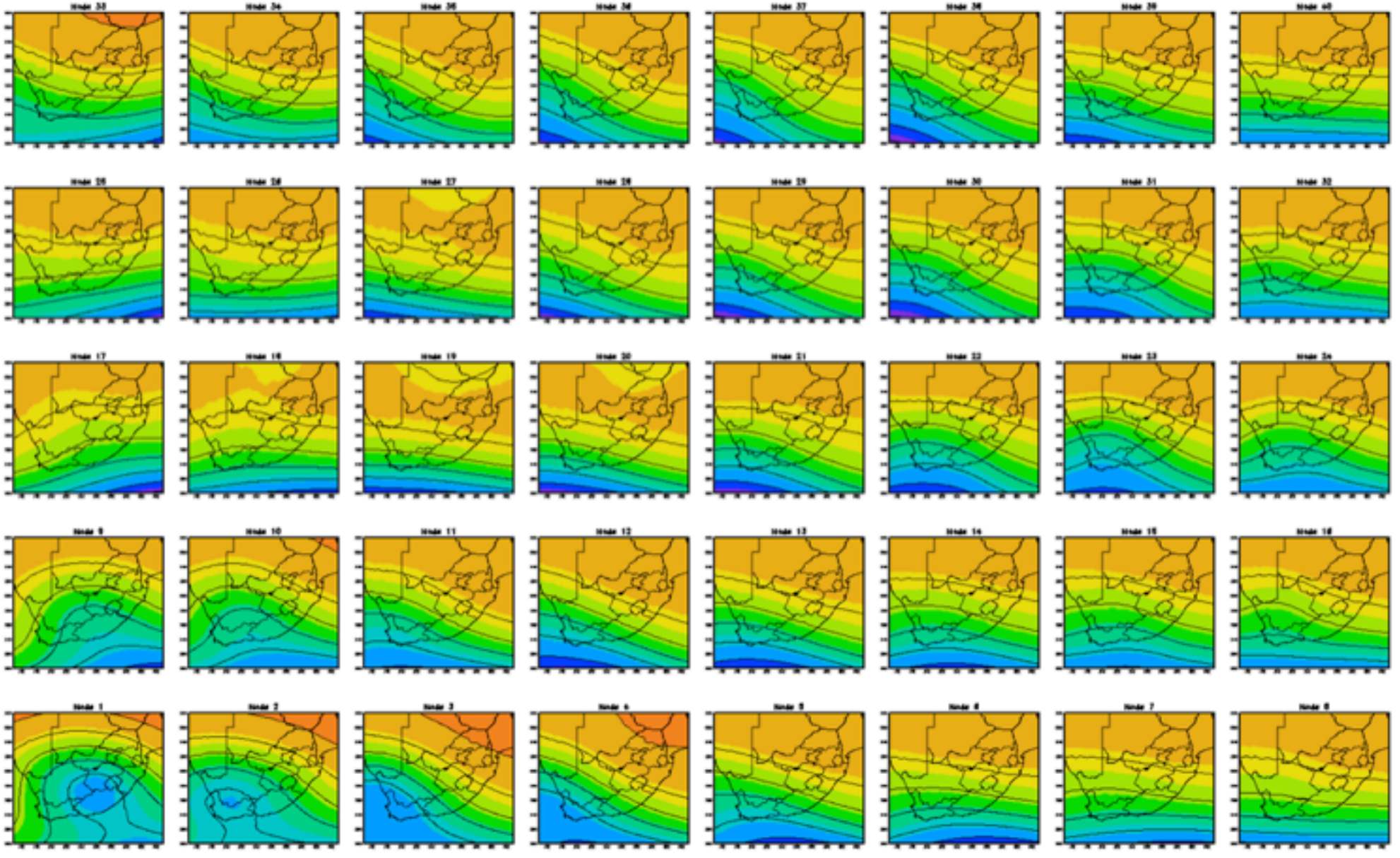
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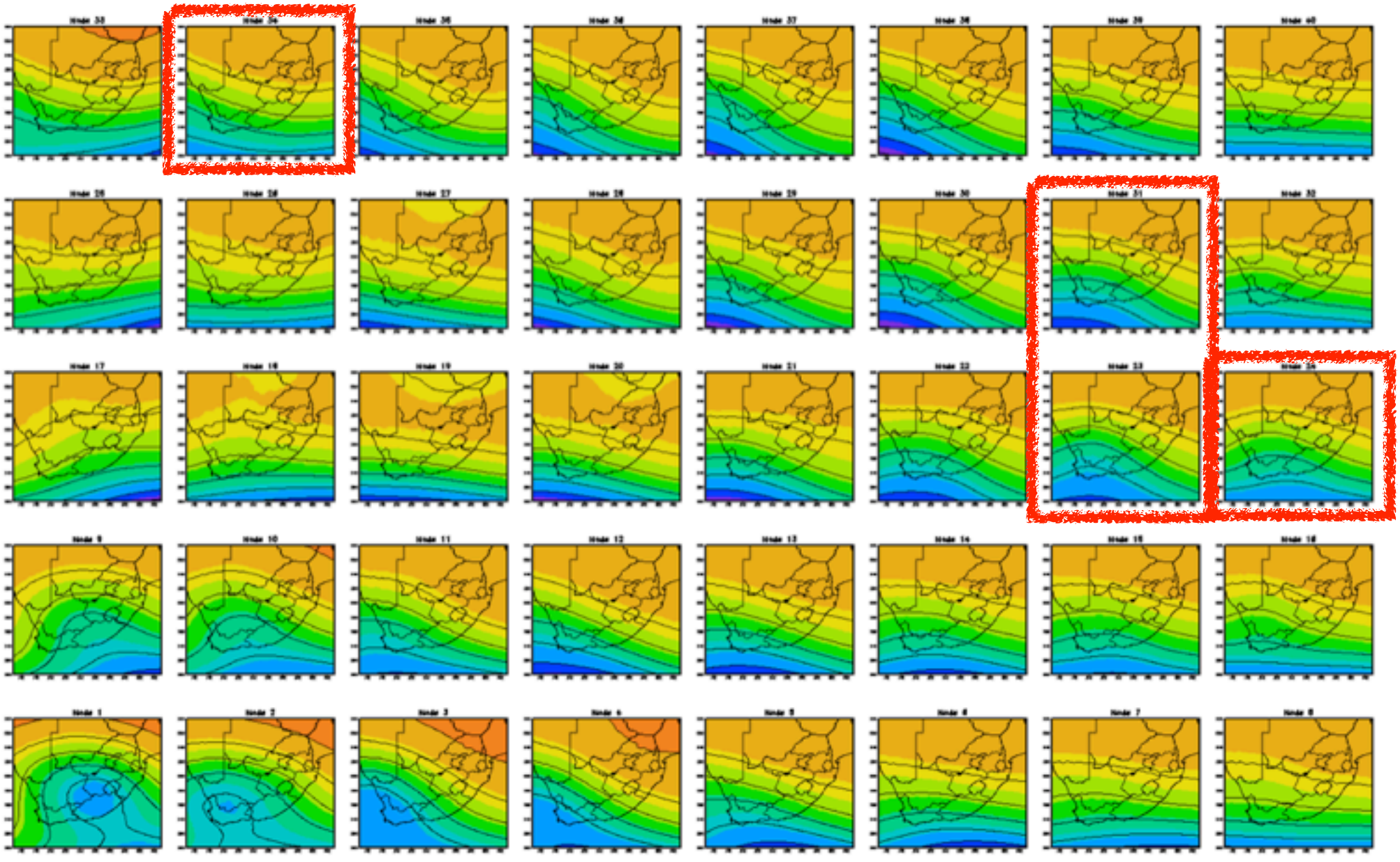
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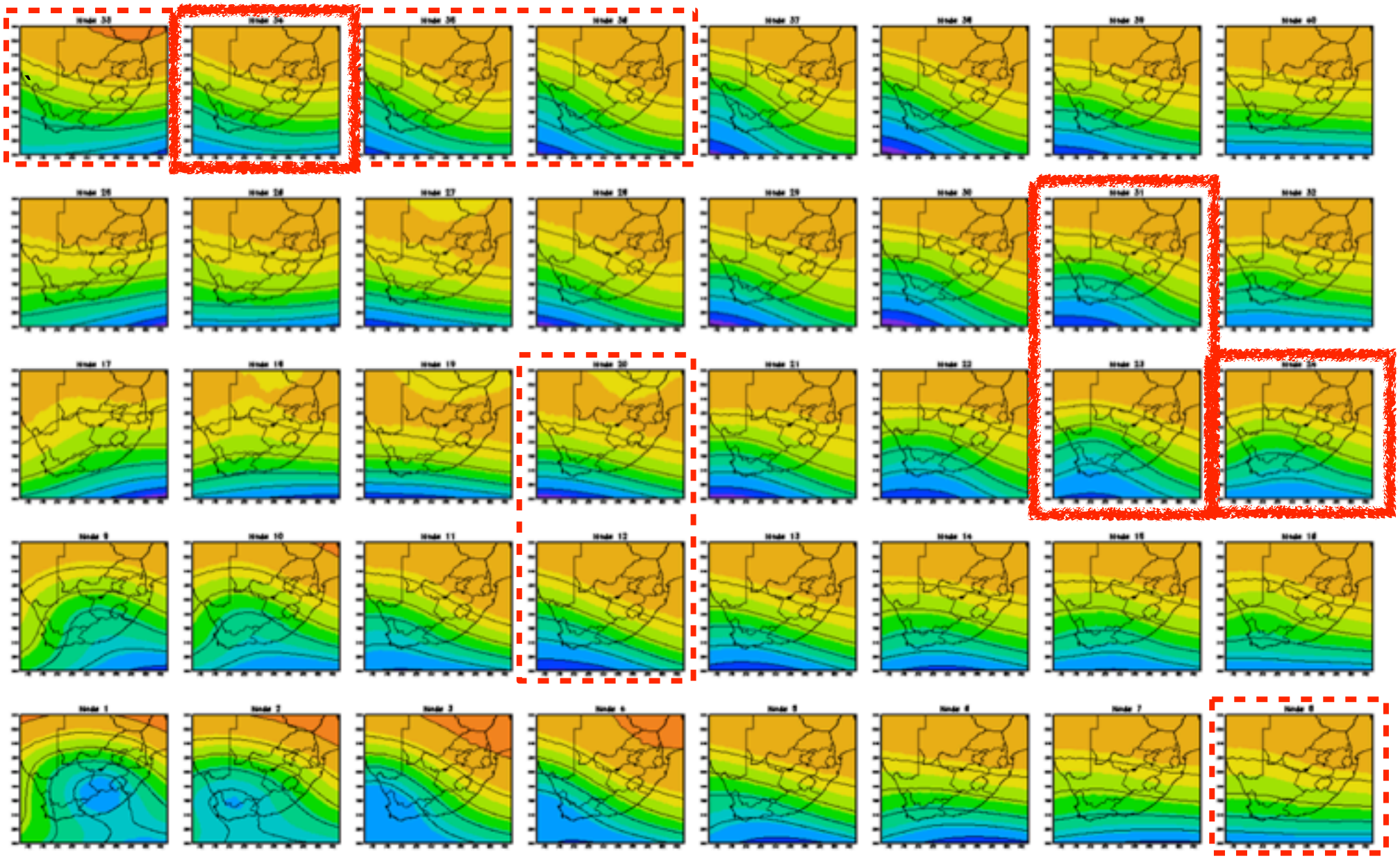
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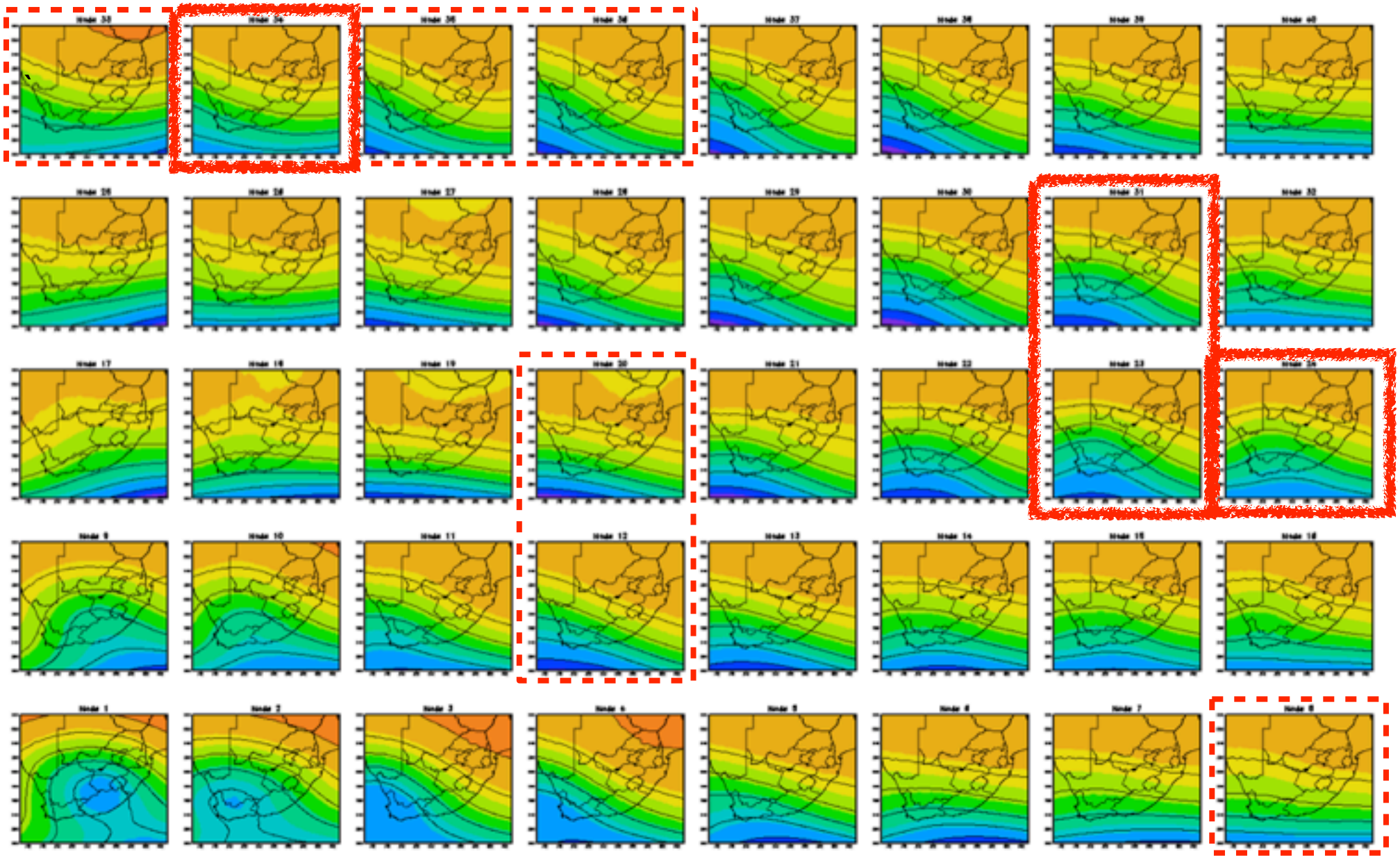


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30% + 20%

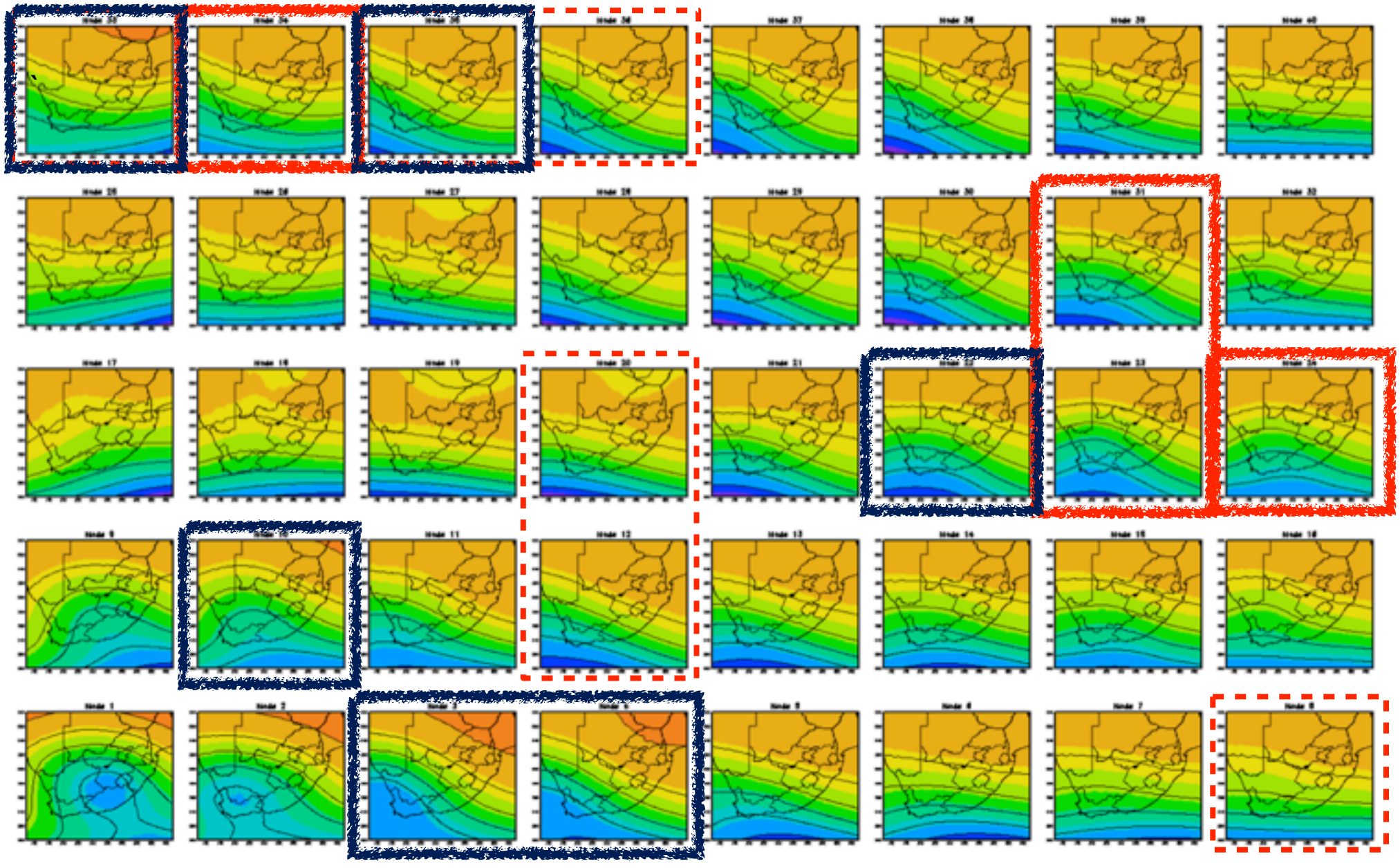


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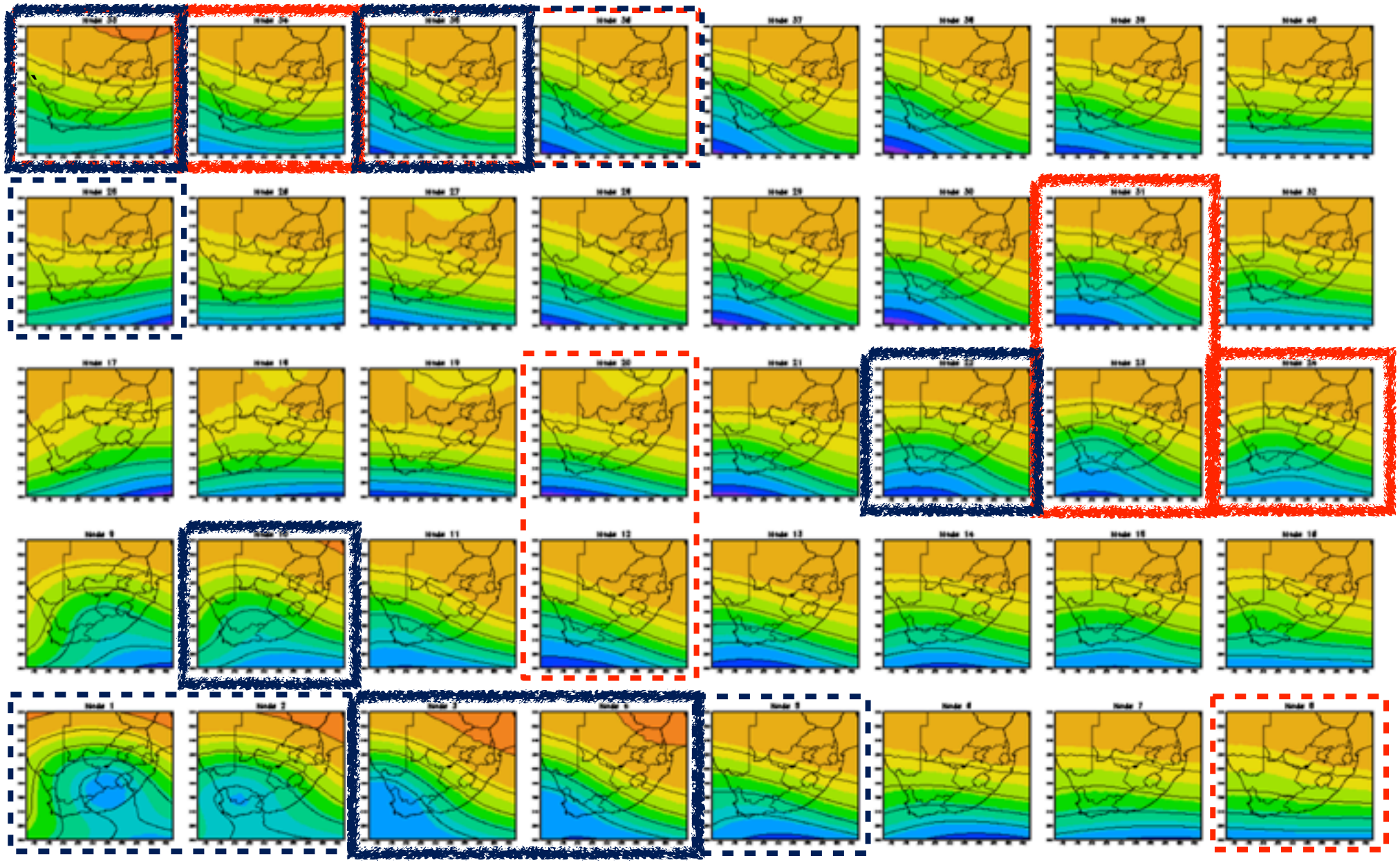


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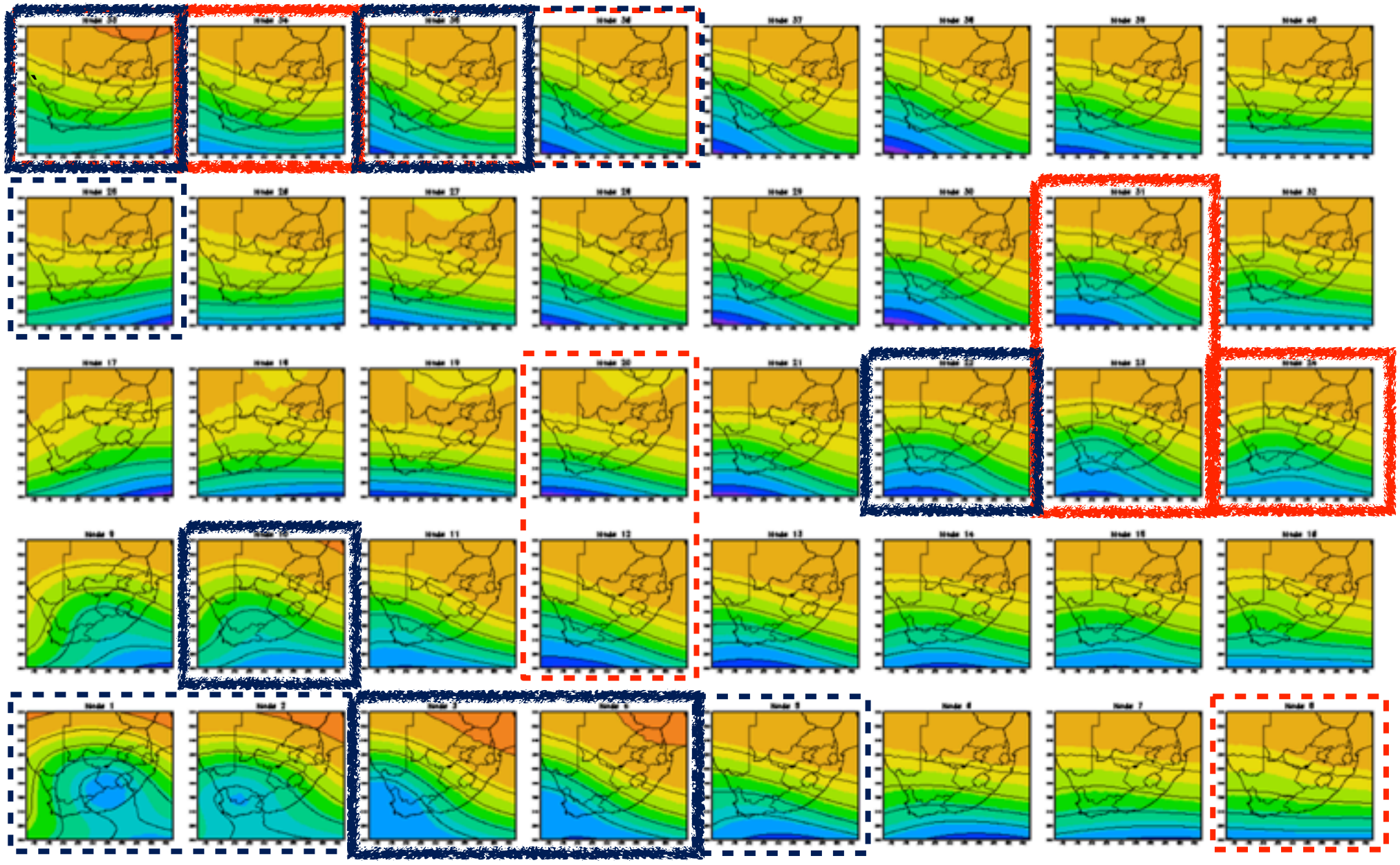
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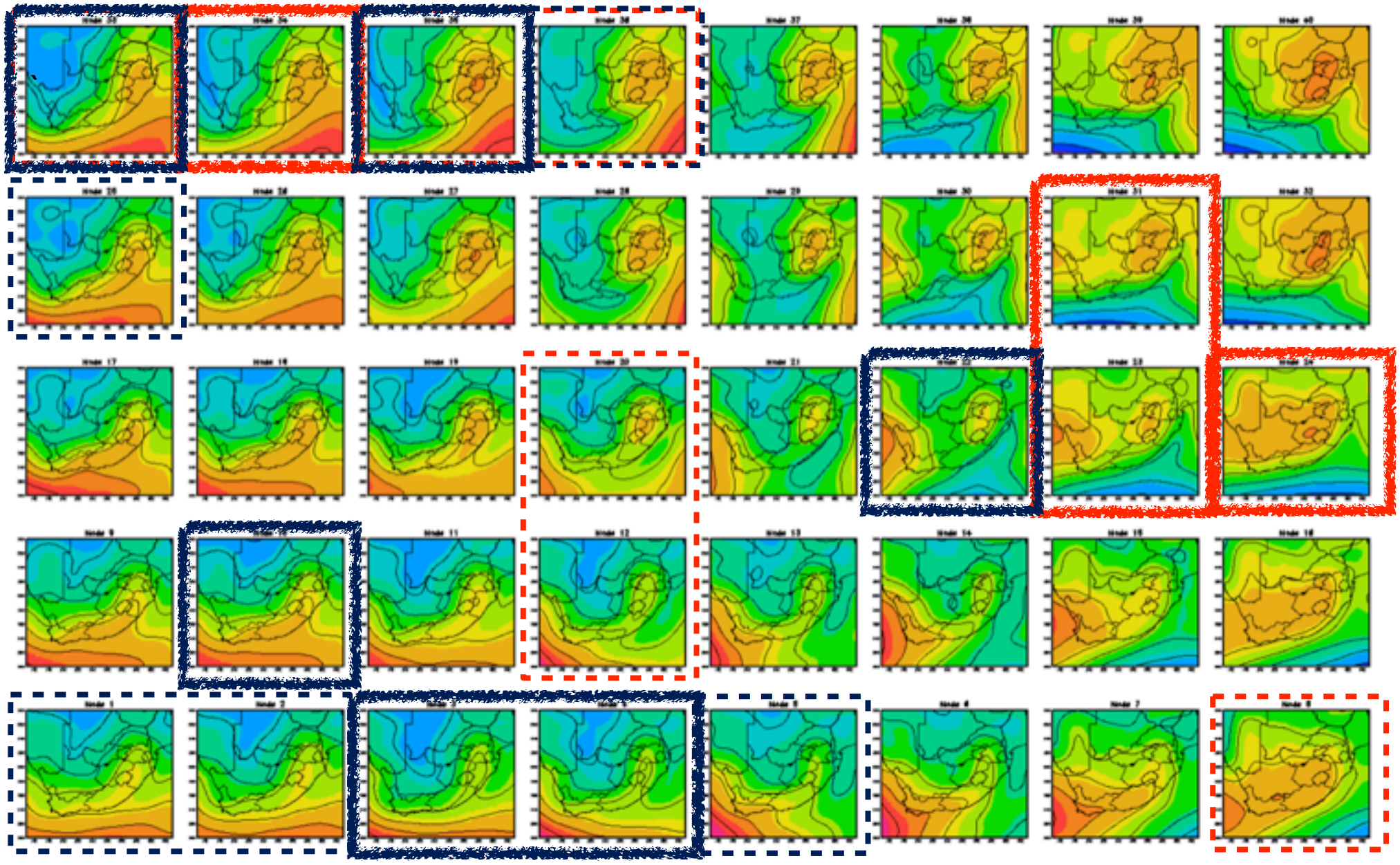
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Task 3. Relating attributes of extreme rainfall to synoptic drivers

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   Spring: More winter-like circulations
   Autumn: More summer-like circulations

Task 2. Assessment of station data

Back to the station data...

Task 2. Assessment of station data

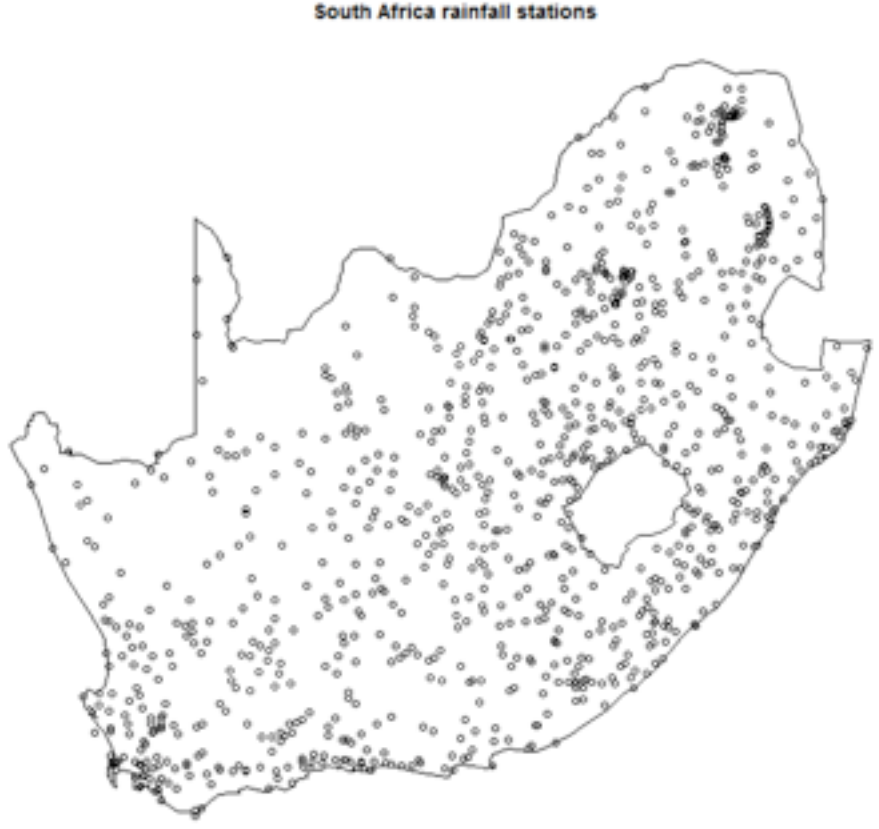
Back to the station data...

Selection of stations for assessment

All stations that passed QC checks were included

Stations that covered the study period from 1979 to 2009 -> 1034

At least a 95% complete record during this period -> 696 stations



Task 2. Assessment of station data

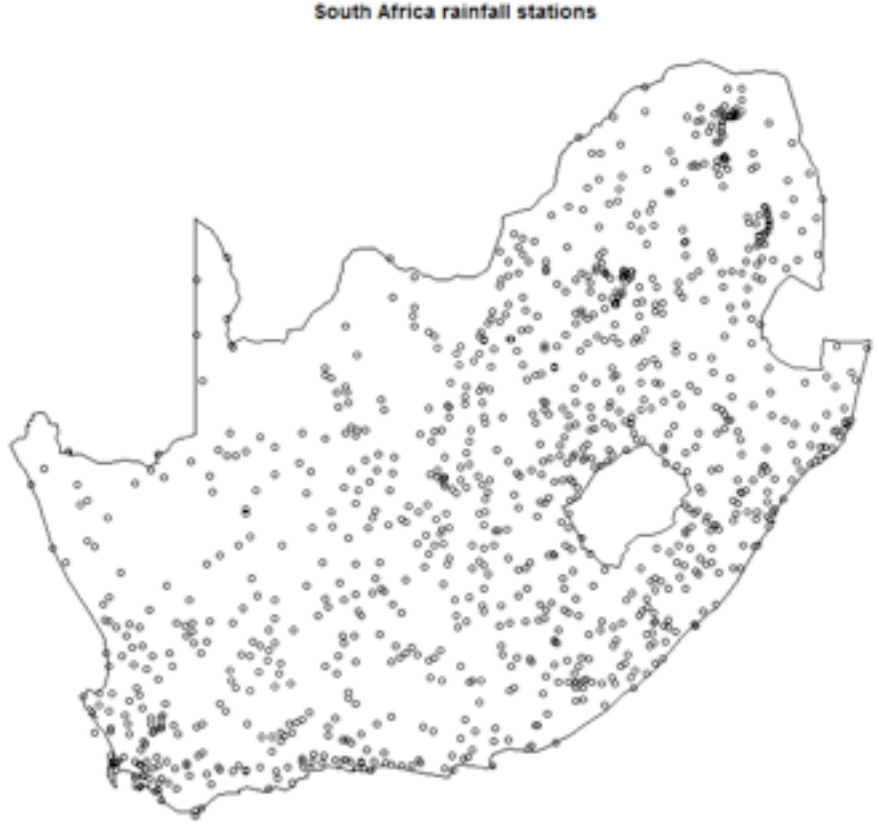
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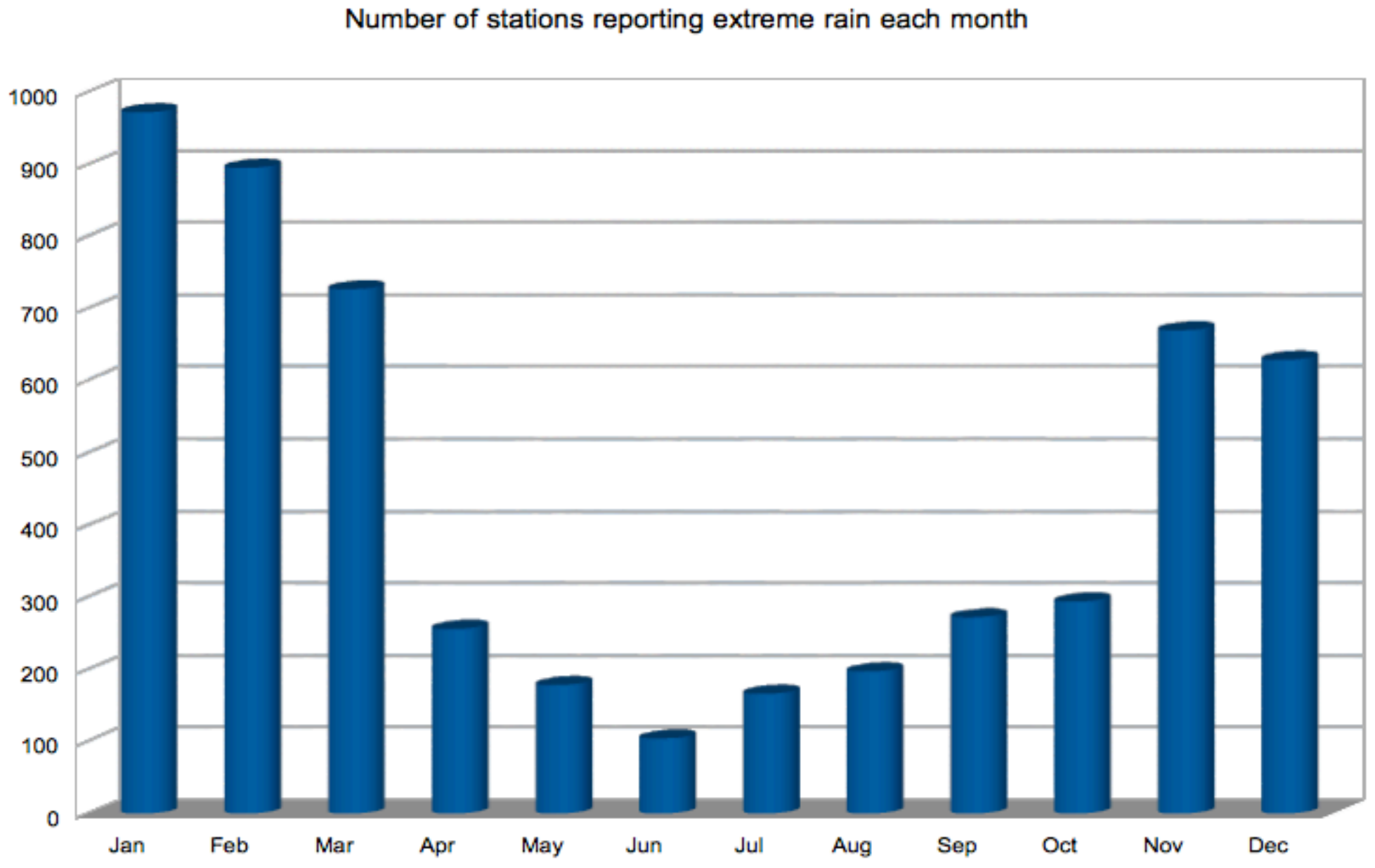
Distribution of extreme rainfall reports in time

Task 2. Assessment of station data

Frequency of occurrence of extreme rainfall for 1979 - 2009

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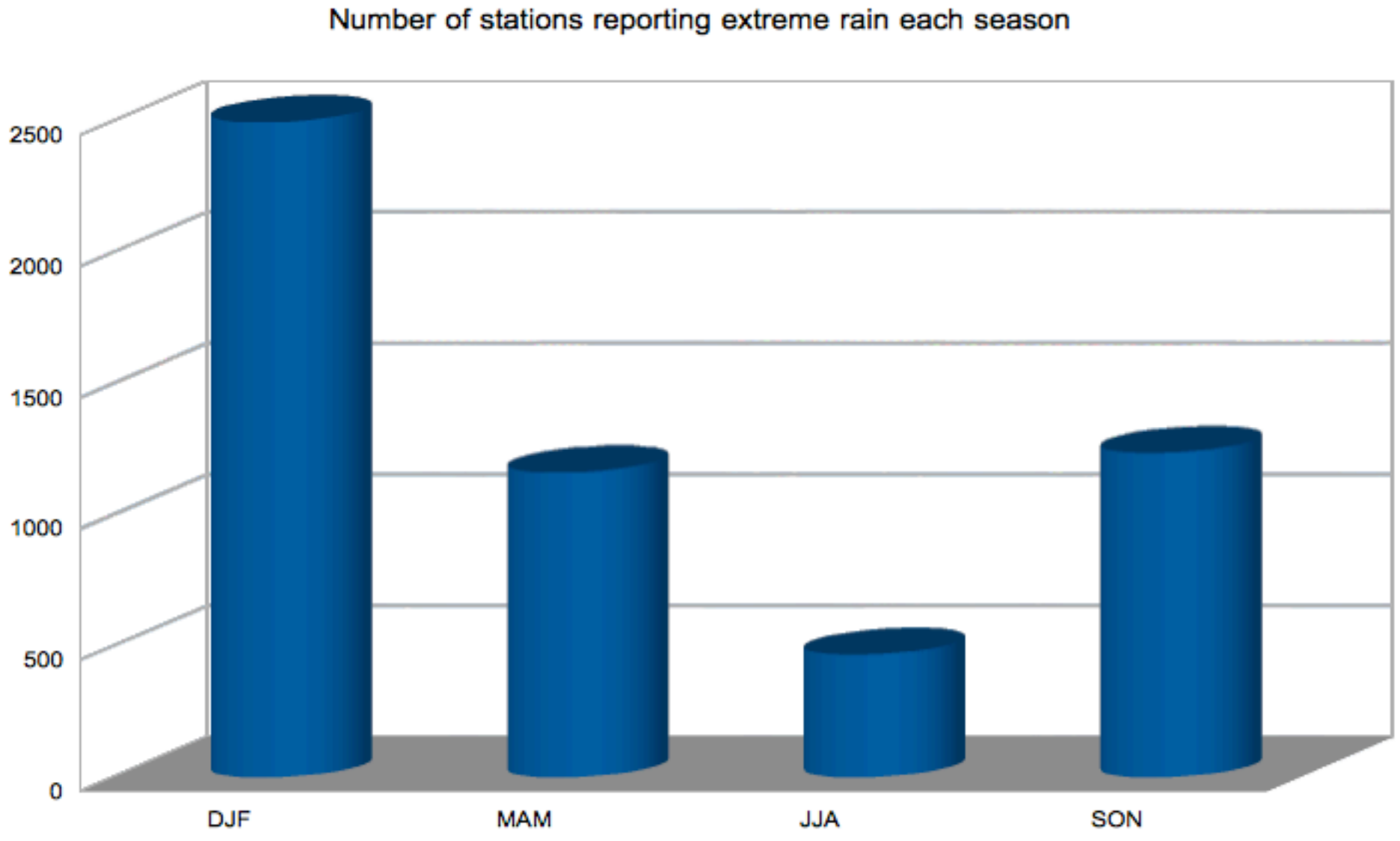


Task 2. Assessment of station data

Frequency of occurrence of extreme rainfall for 1979 - 2009

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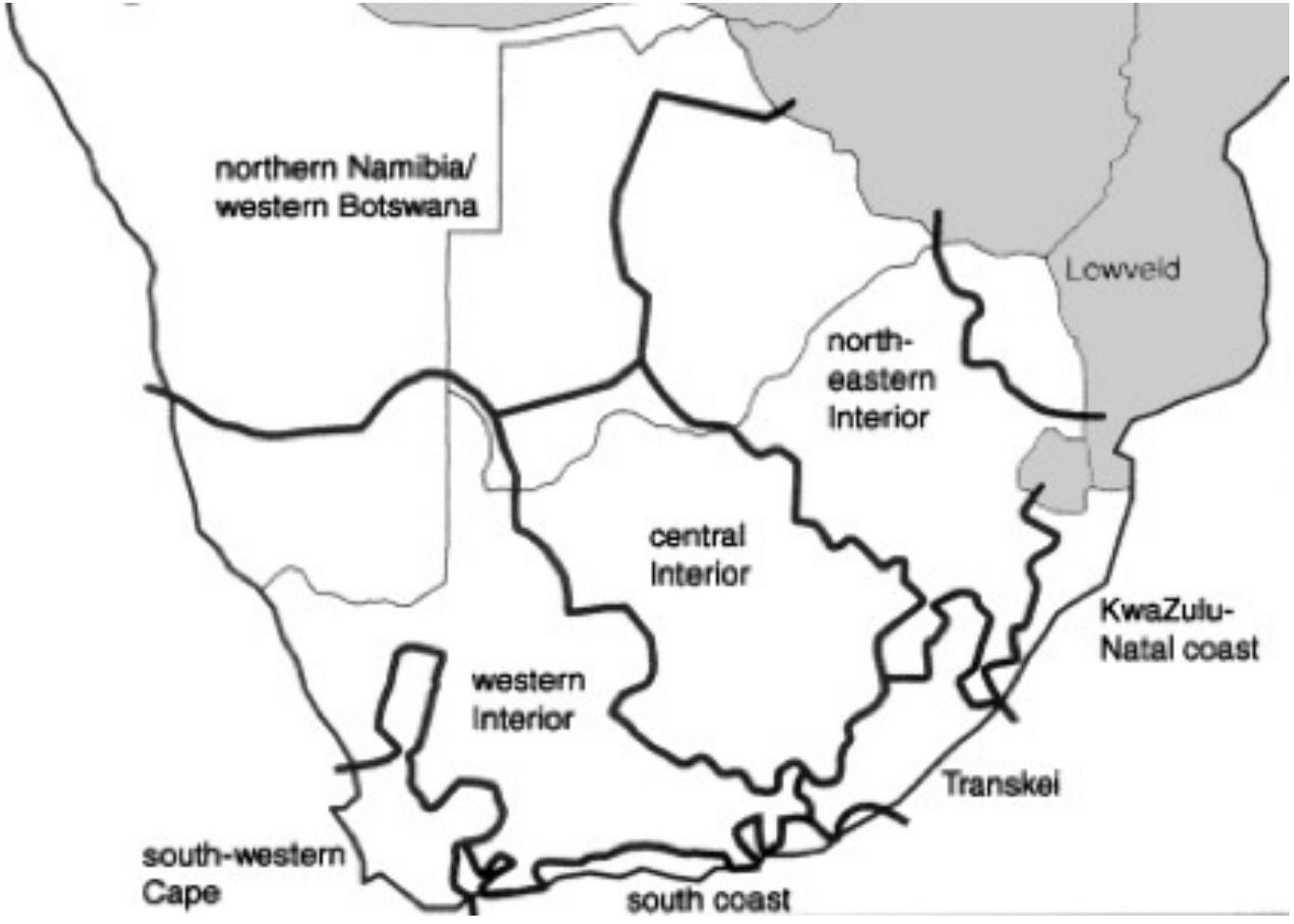
Task 2. Assessment of station data

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Reducing the number of stations - regional assessment

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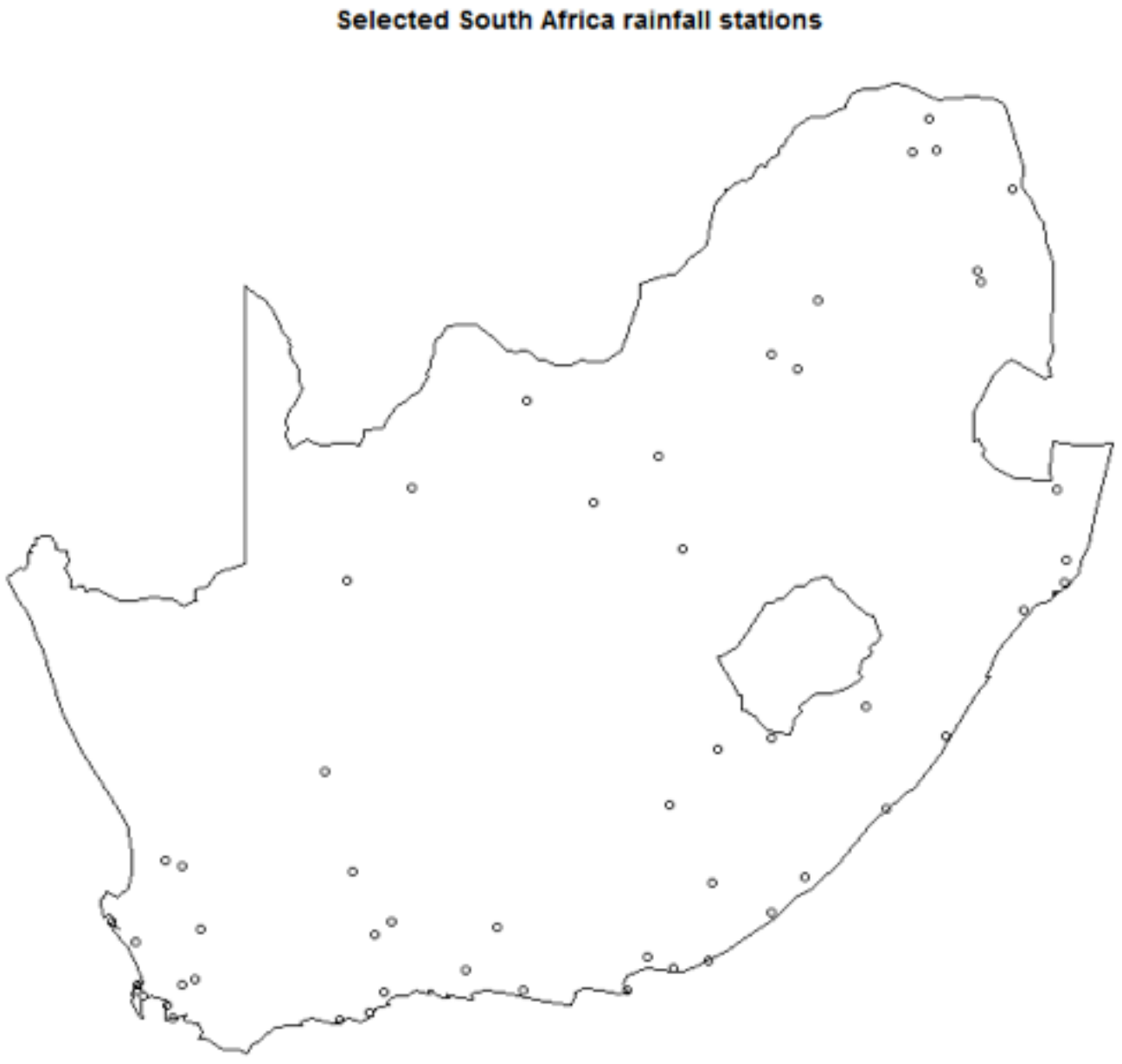
Reducing the number of stations - regional assessment



Landman and Mason (1999) and Landman *et al*. (2001)

Task 2. Assessment of station data

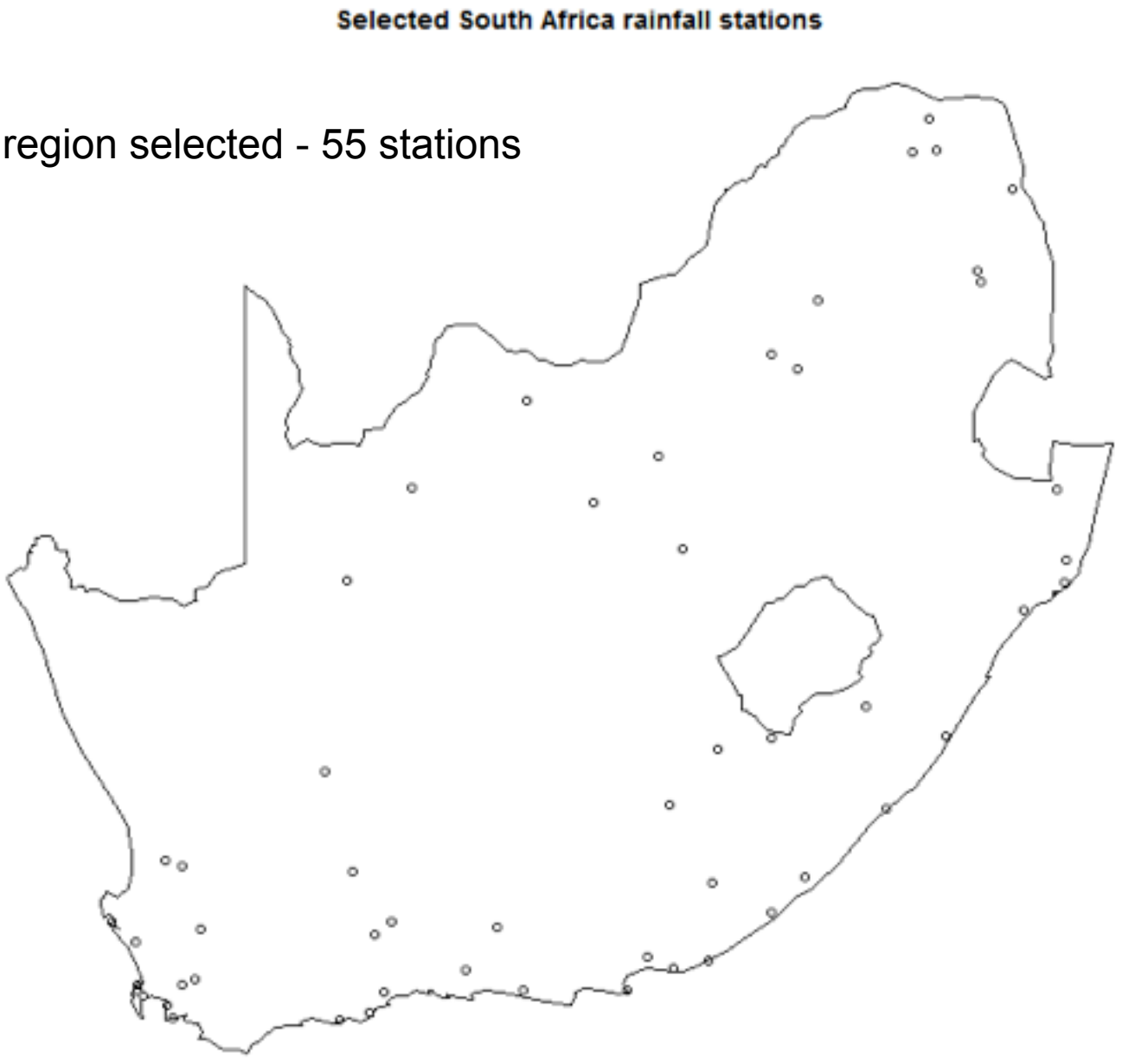
Reducing the number of stations - regional assessment



Task 2. Assessment of station data

Reducing the number of stations - regional assessment

Five stations per region selected - 55 stations



Task 2. Assessment of station data

RClimdex Analysis on these

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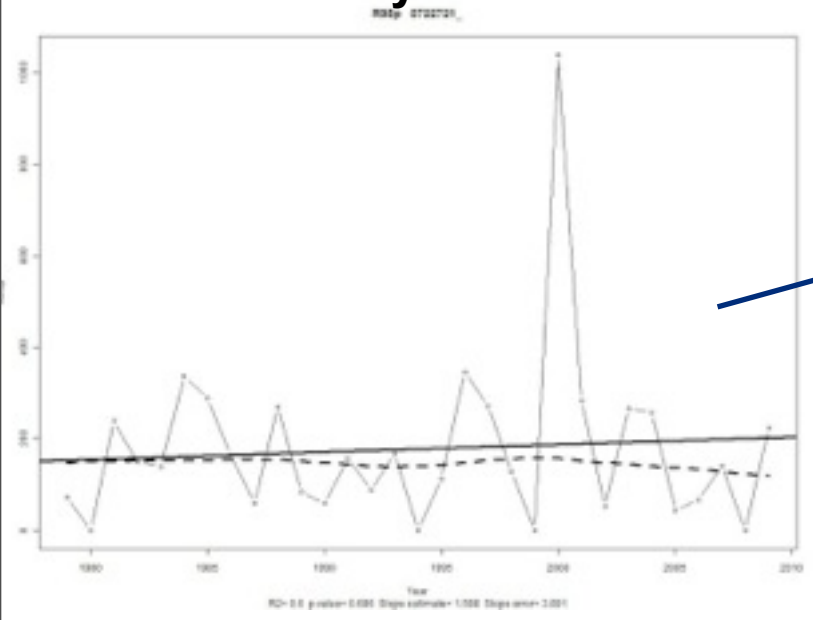
RClimdex Analysis on these



Annual total precipitation from RR > 95th percentile

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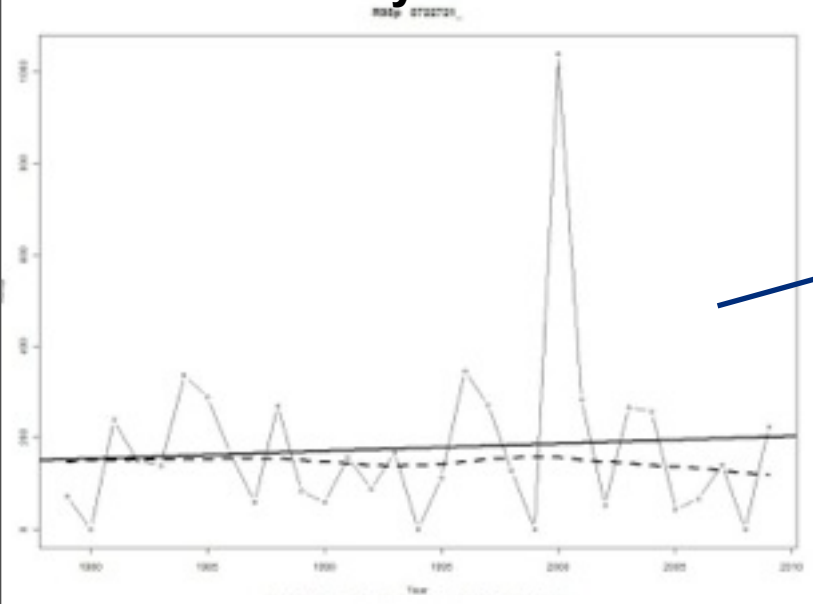


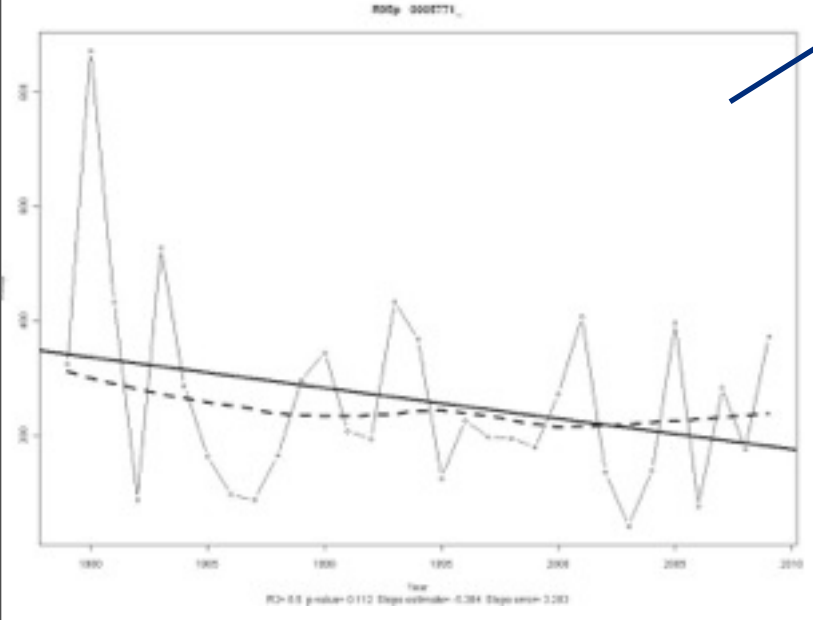


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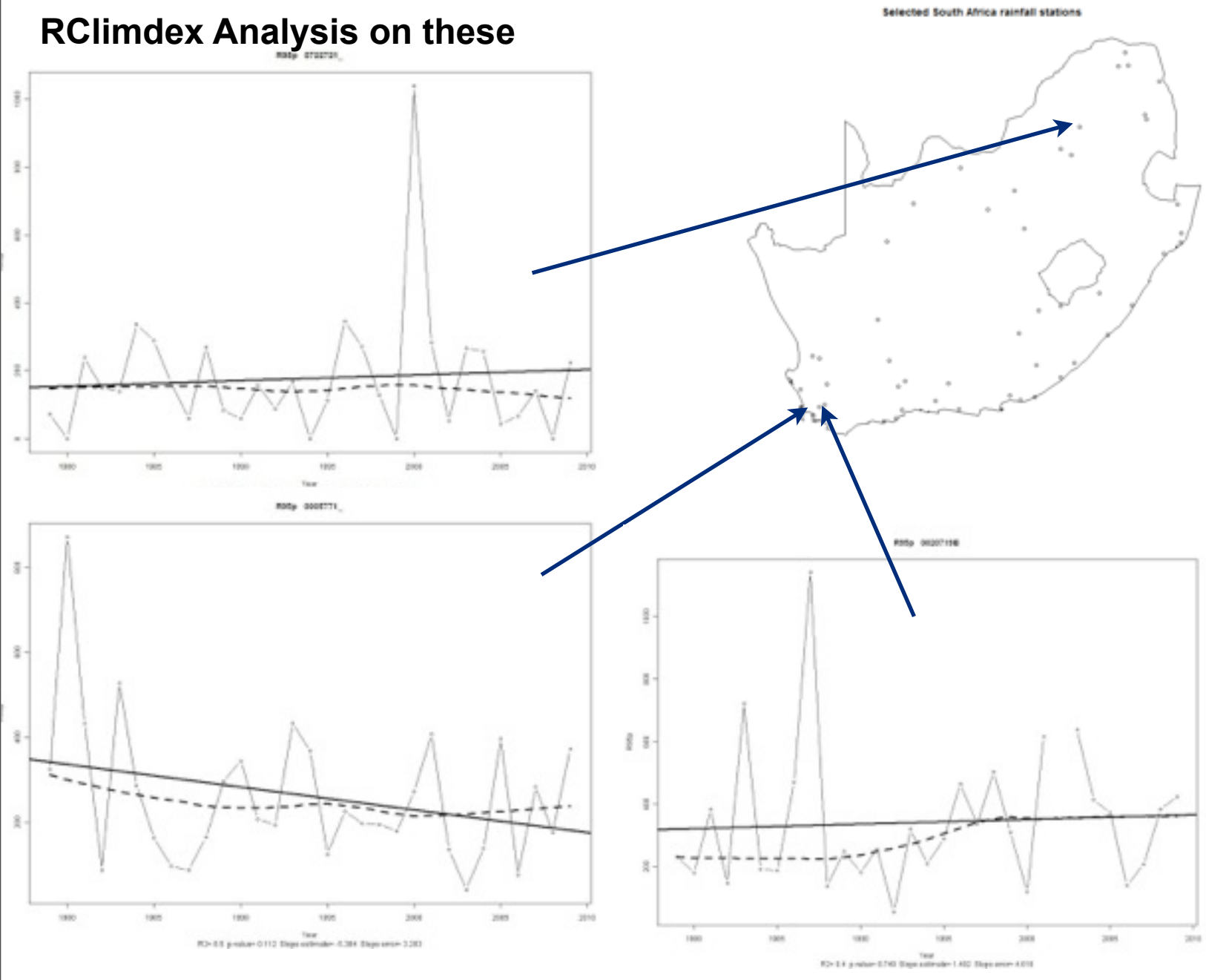




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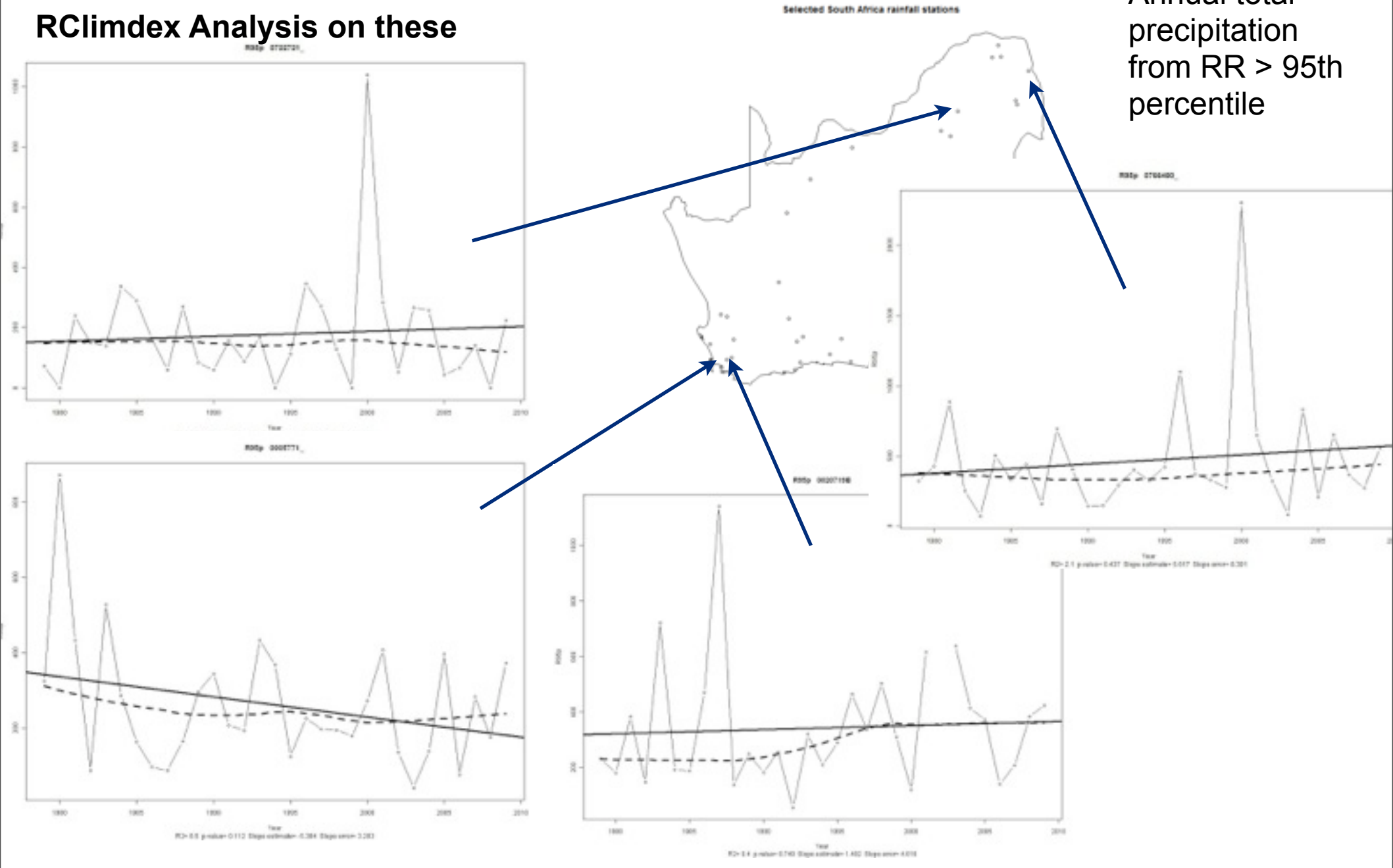


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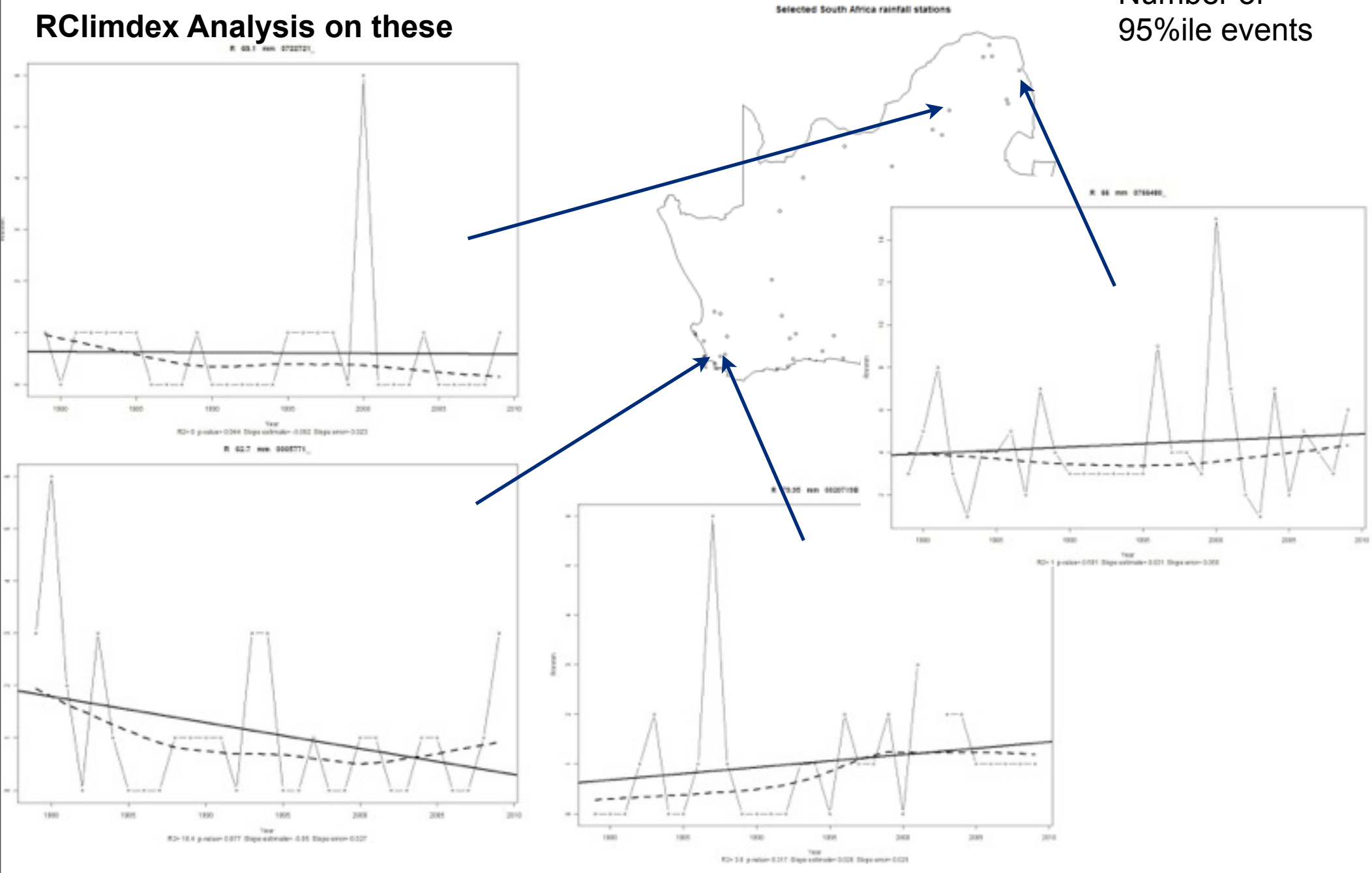


Number of 95%ile events

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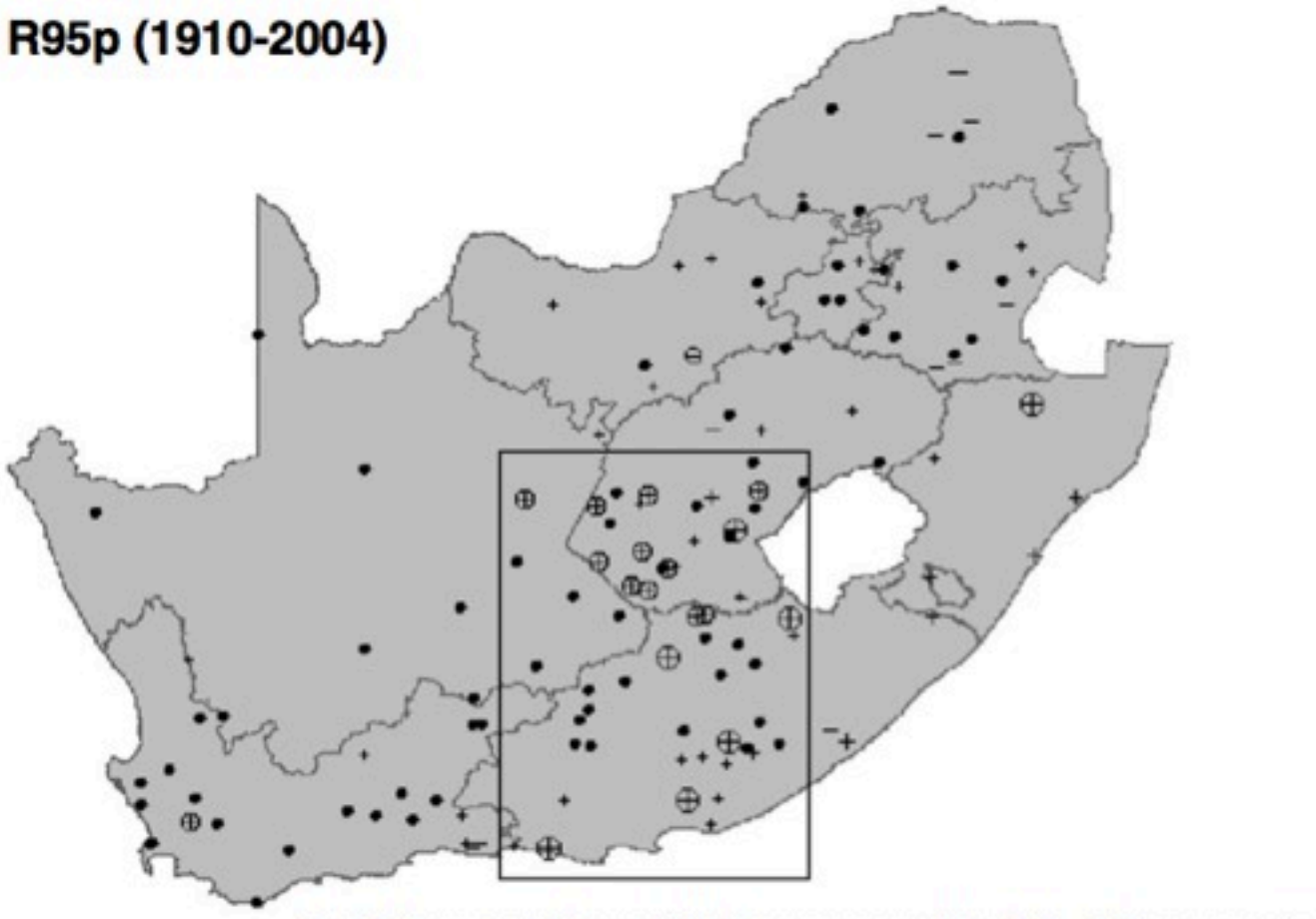


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RClimdex Analysis on these, end up something like this....

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From Kruger, 2006

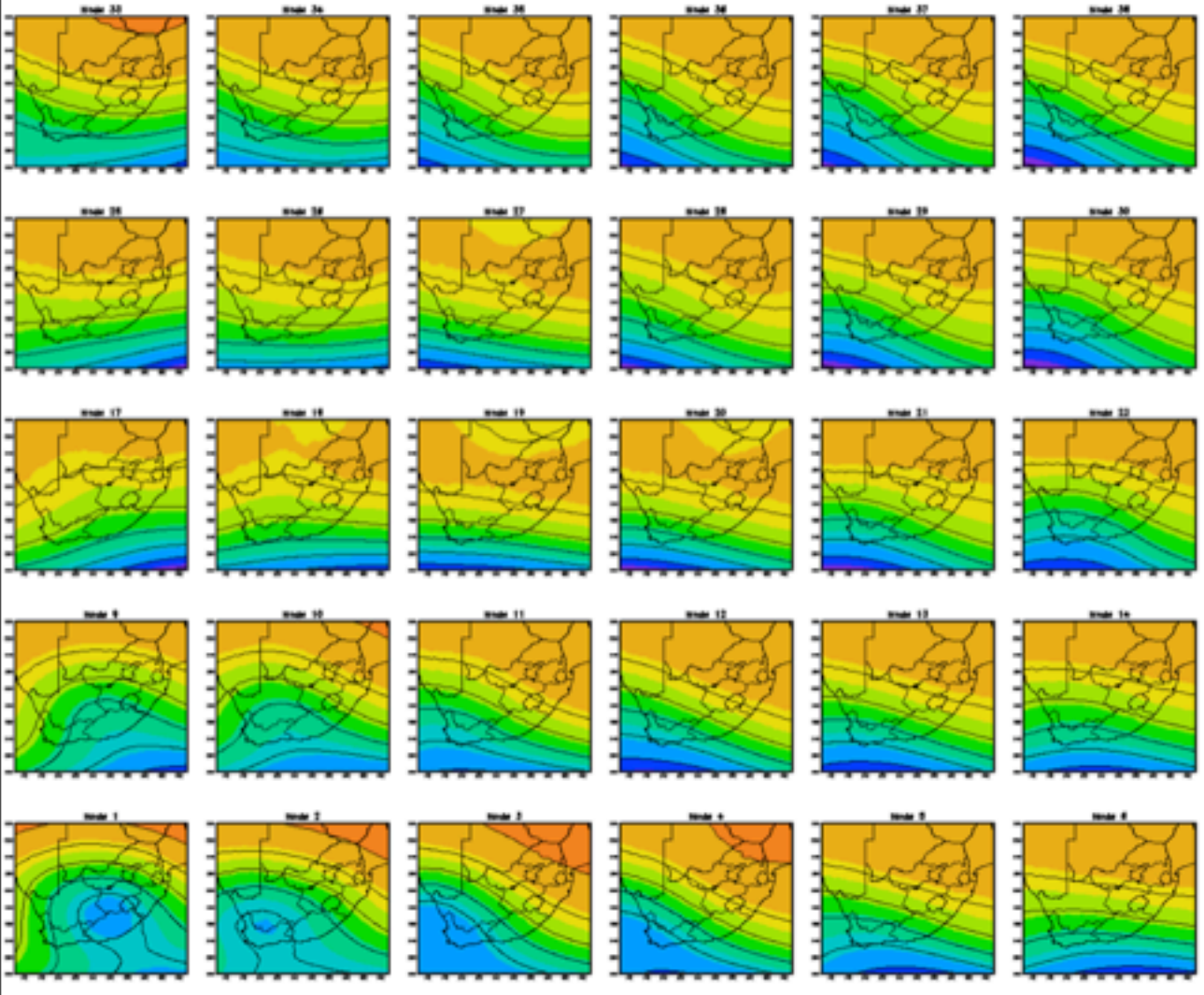
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Then relate back to synoptic trends

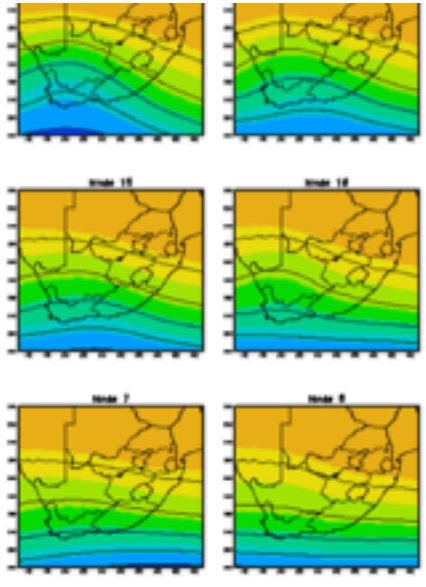
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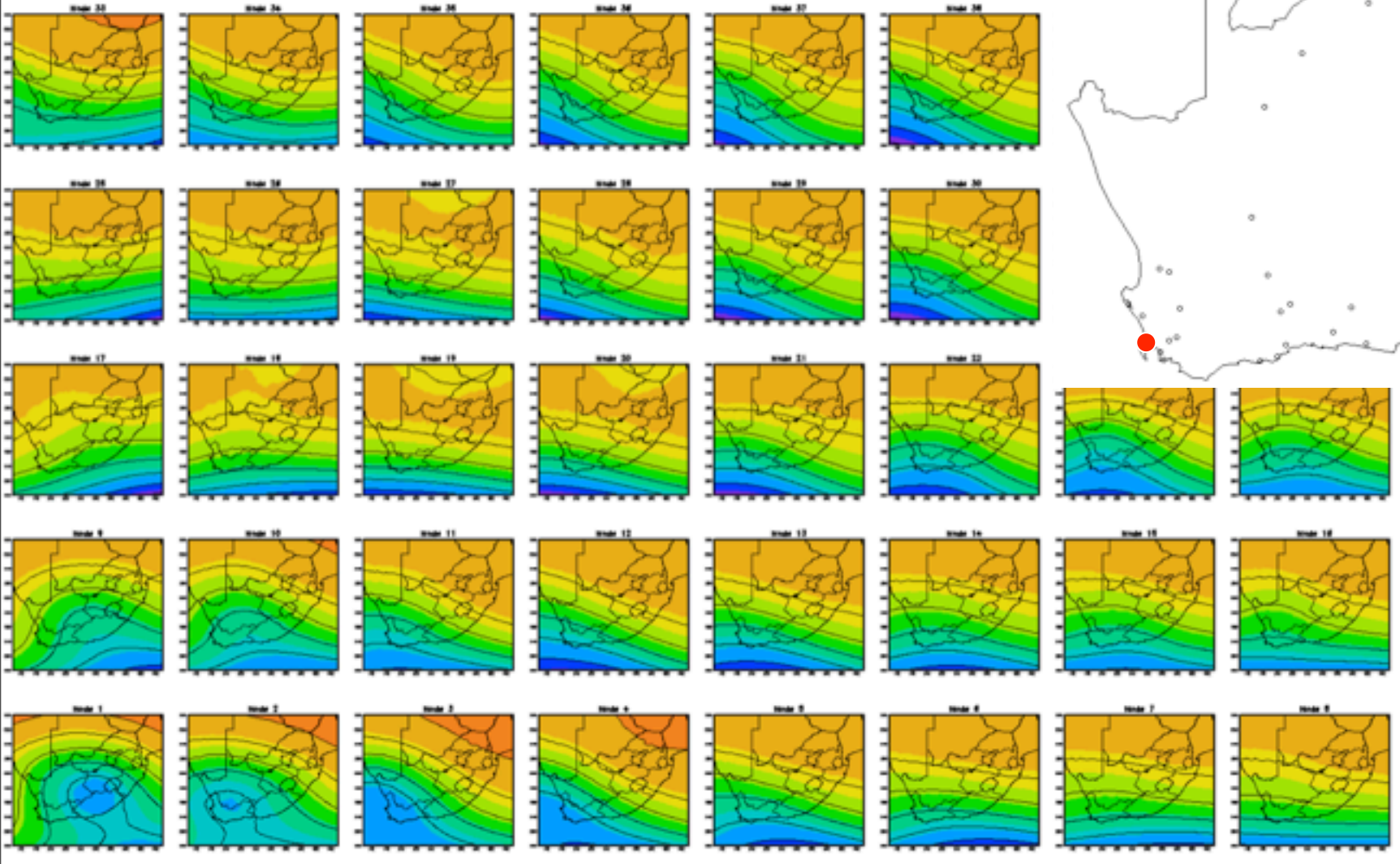
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Each station extreme rain day mapping



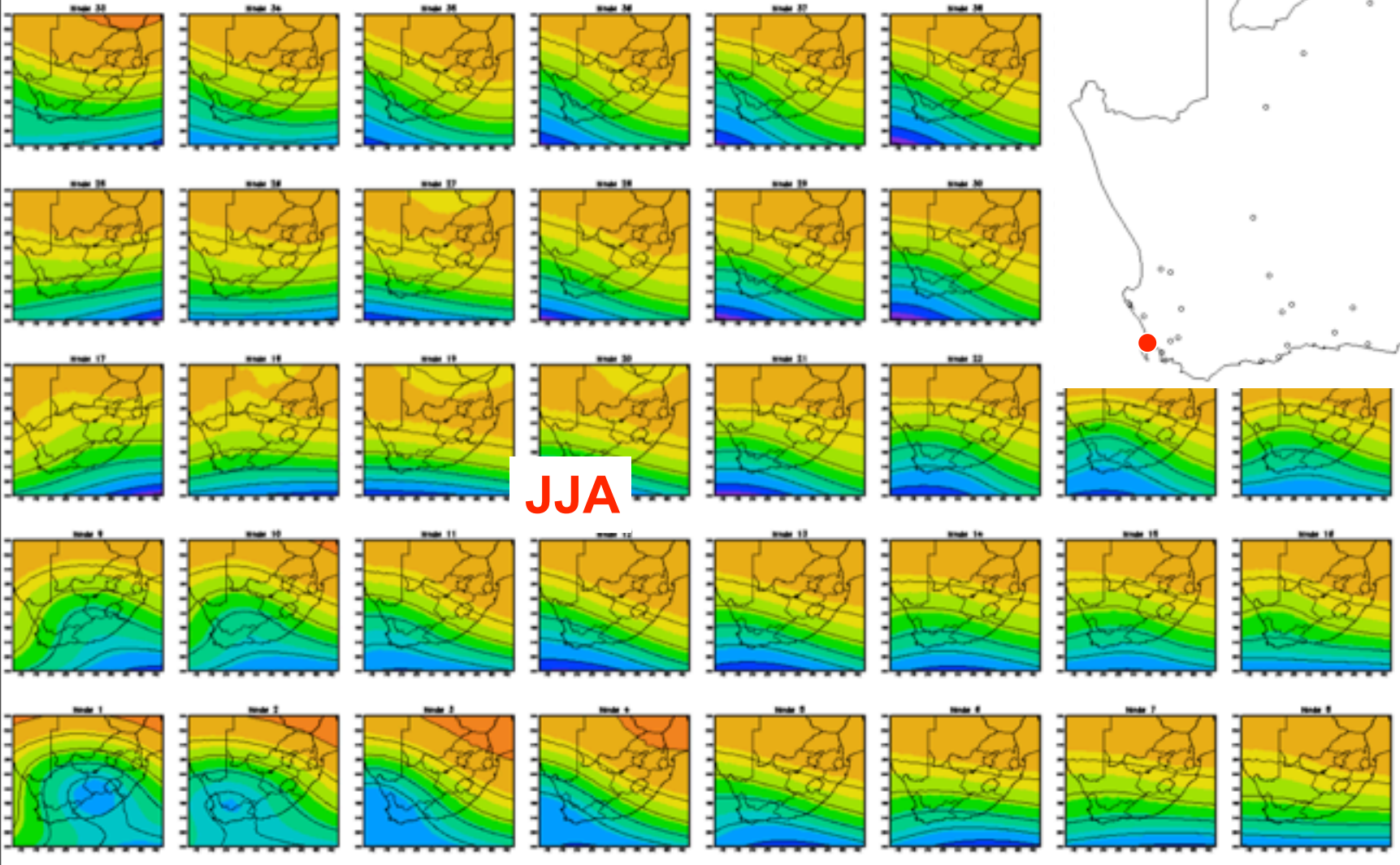


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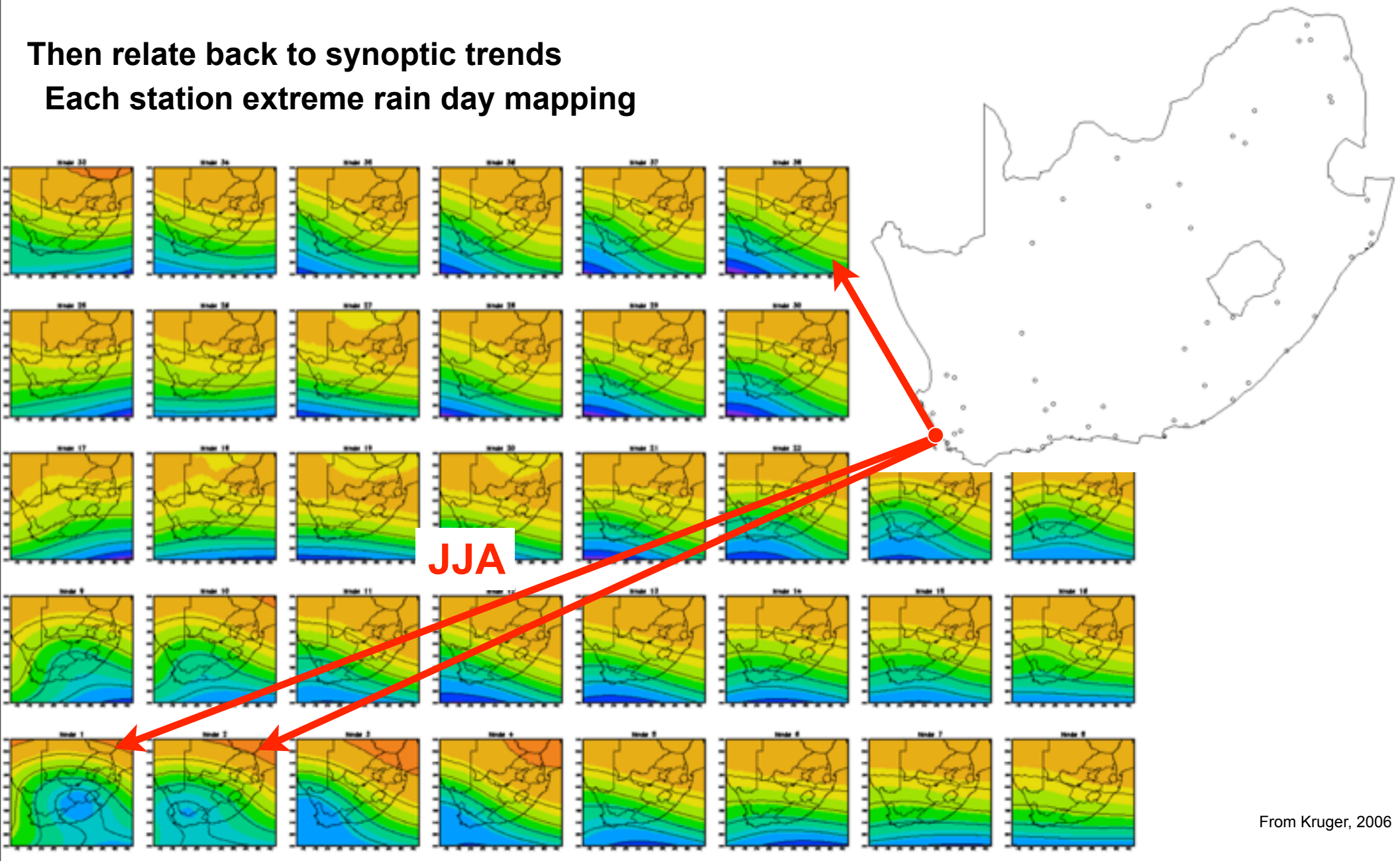


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From Kruger, 2006

Work plan until end of Project

Task	Completion date
Regional assessment of extreme rainfall circulations	End November 2011
Regional trend analysis	End January 2012
Final report	End March 2012

Work plan until end of Project

Final Report Table of Contents