Multistability in a Coupled Ocean-Atmosphere Low Order Model

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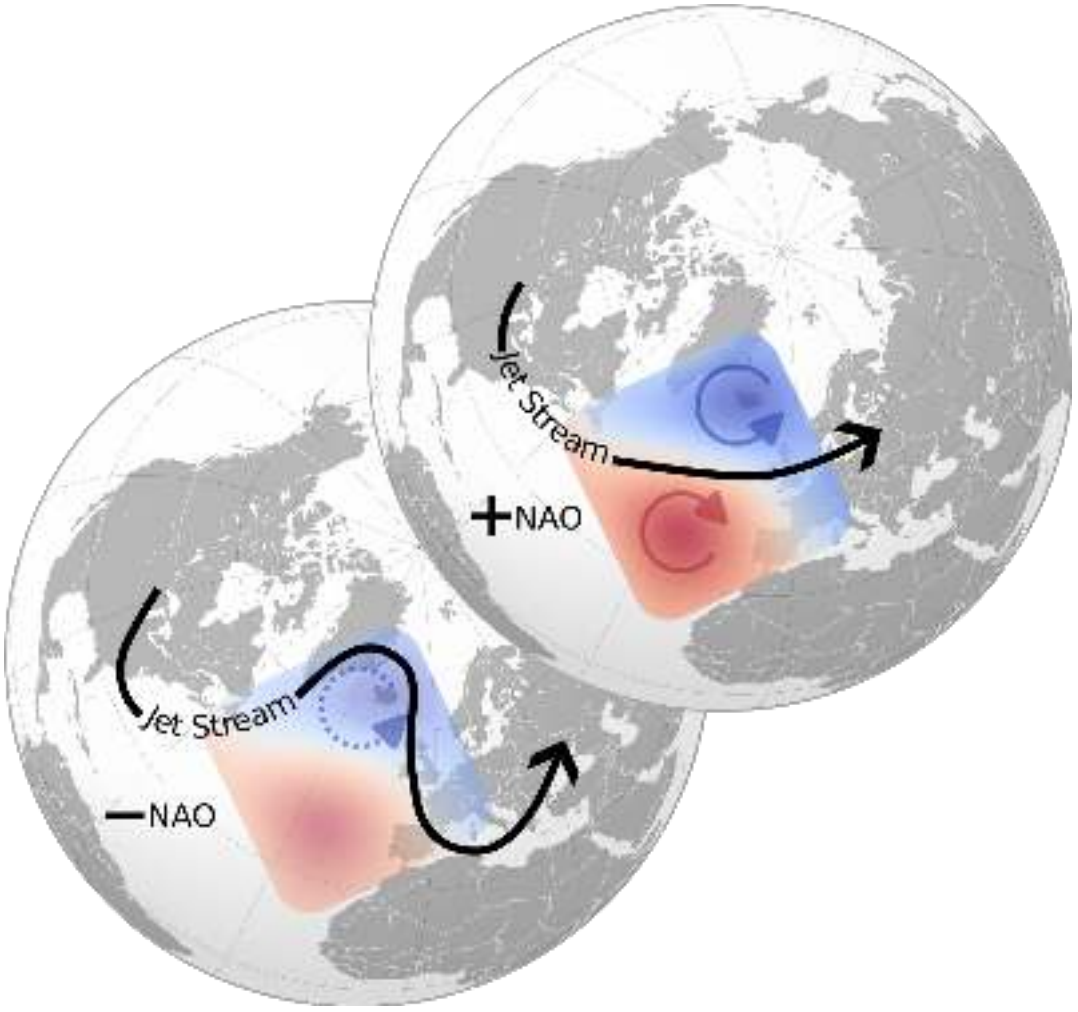
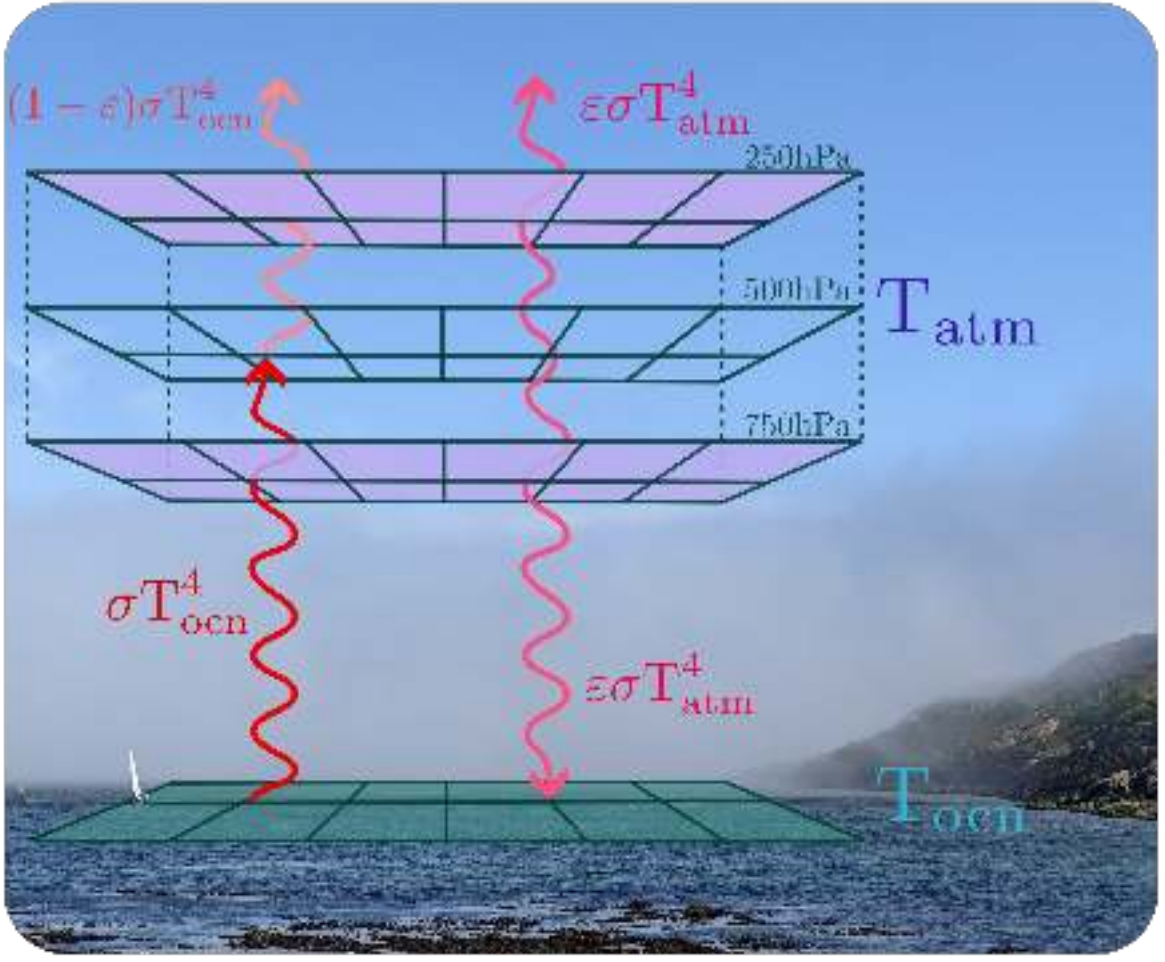
Motivation

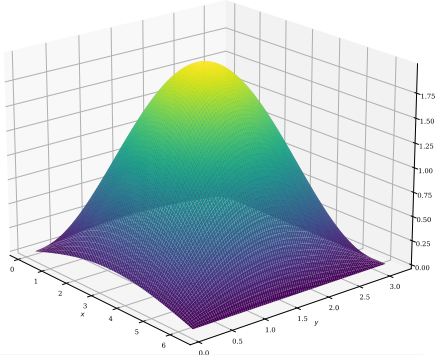


QGS Model

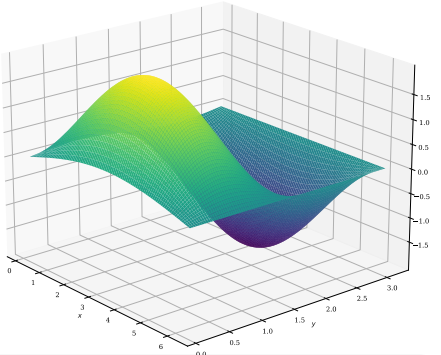

$(1-\varepsilon)\sigma T_{ocn}^4$
$\varepsilon\sigma T_{atm}^4$
250hPa
500hPa
750hPa
T_{atm}
σT_{ocn}^4
$\varepsilon\sigma T_{atm}^4$
T_{ocn}

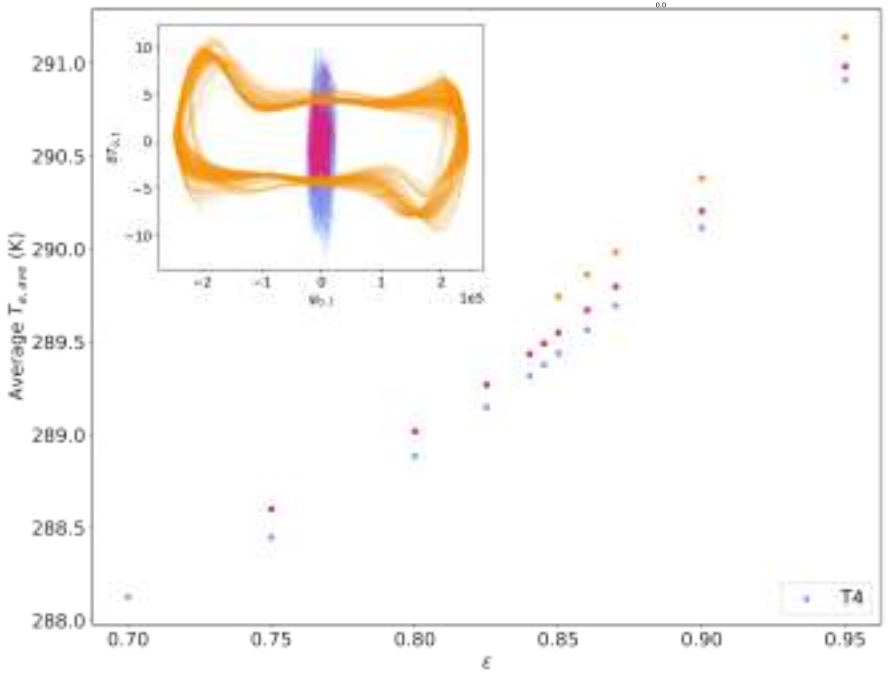
Model Results

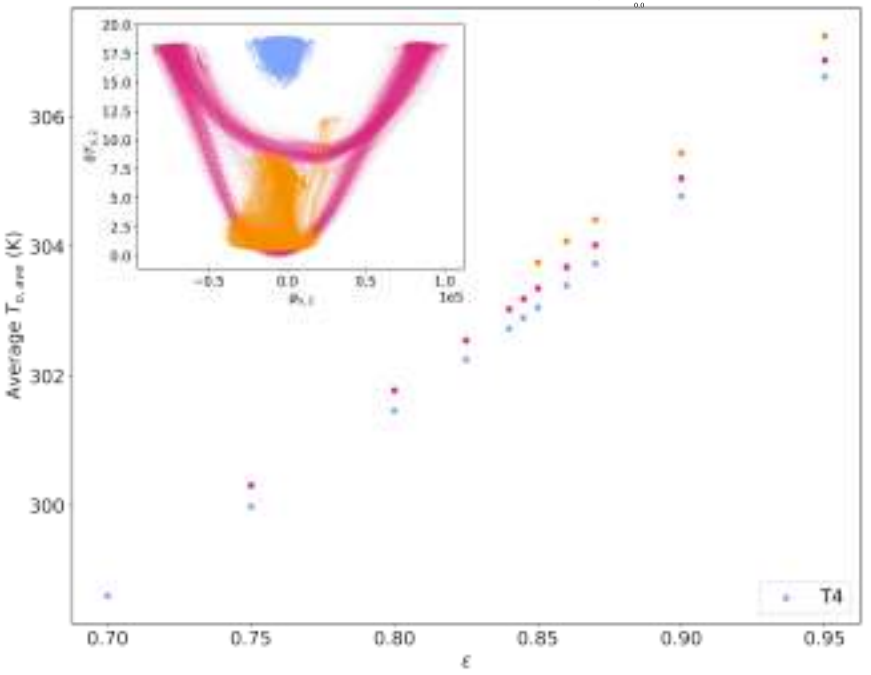
ϕ_1



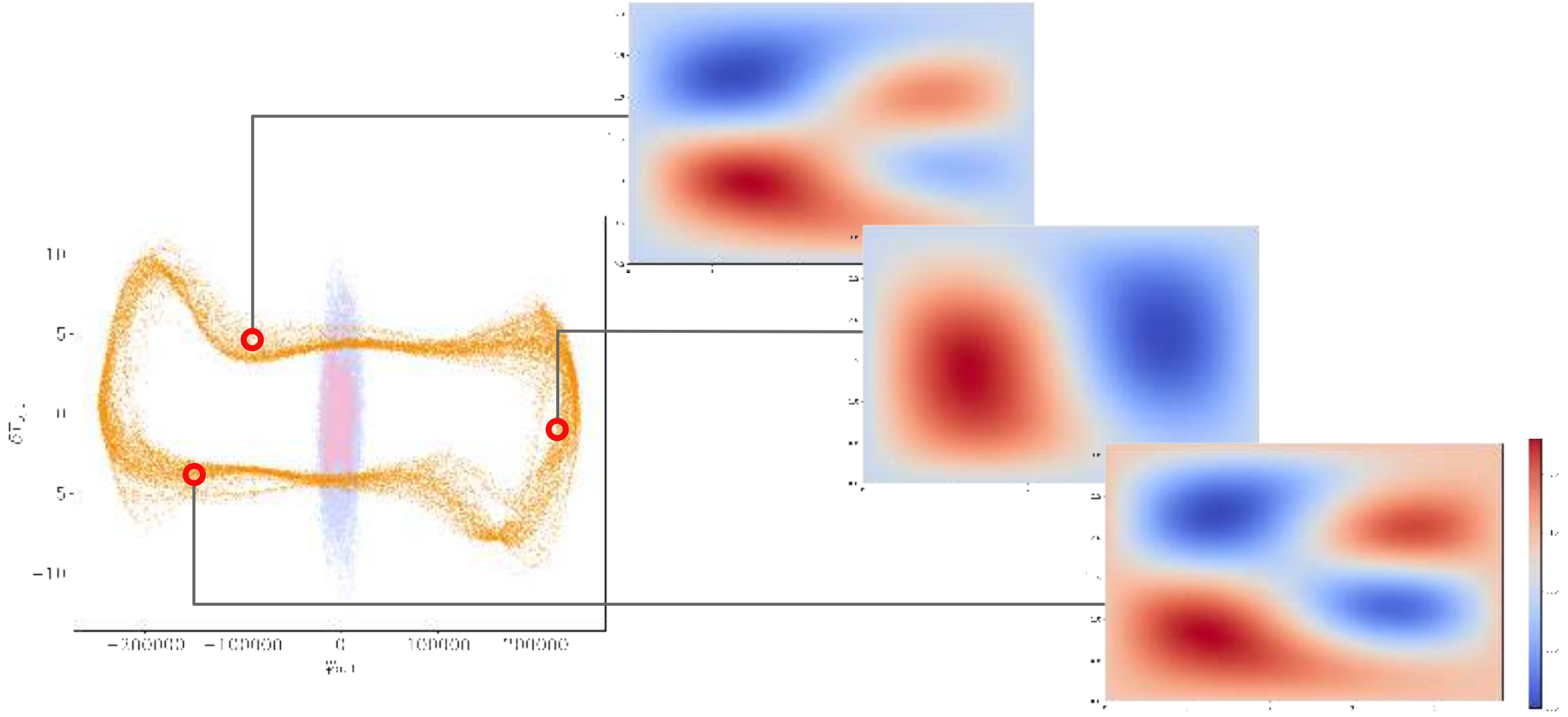
ϕ_2



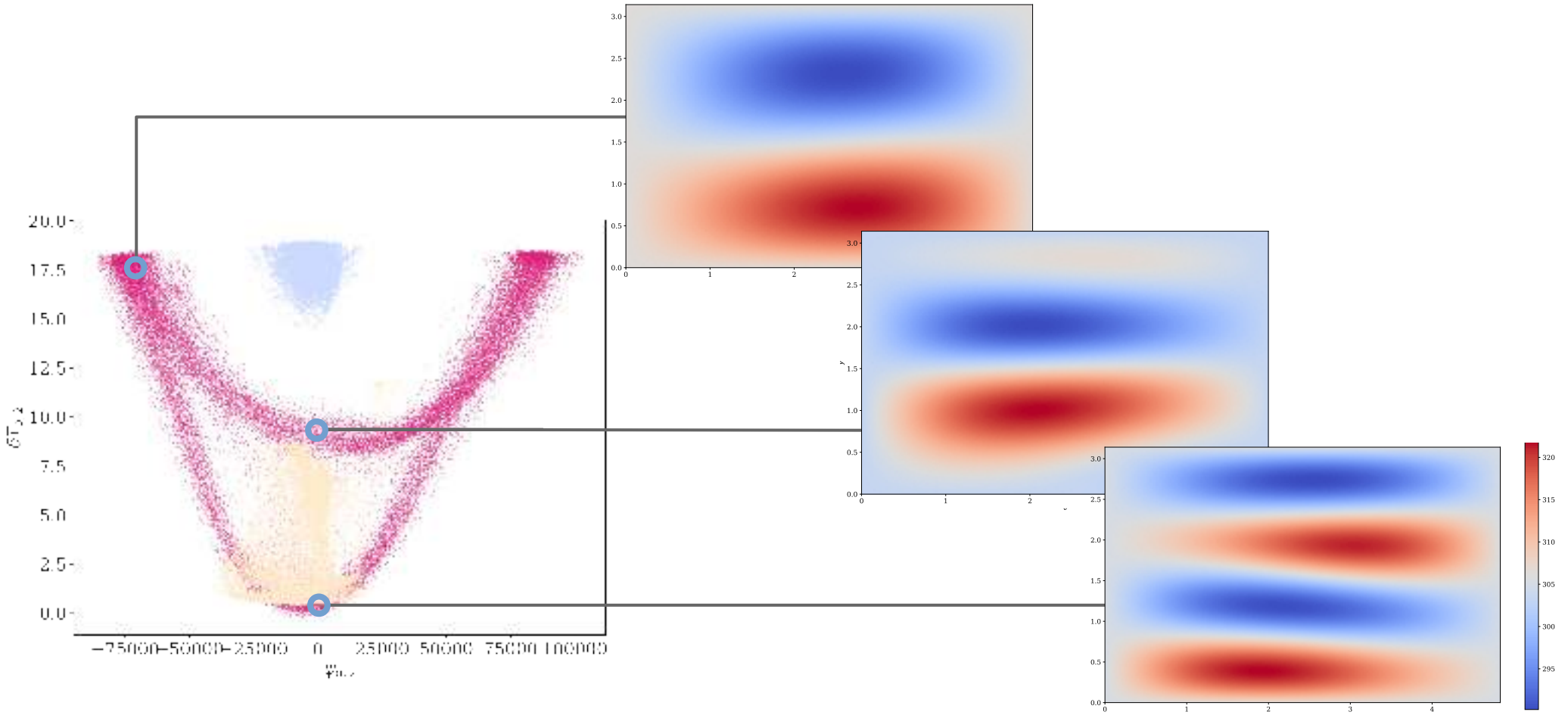




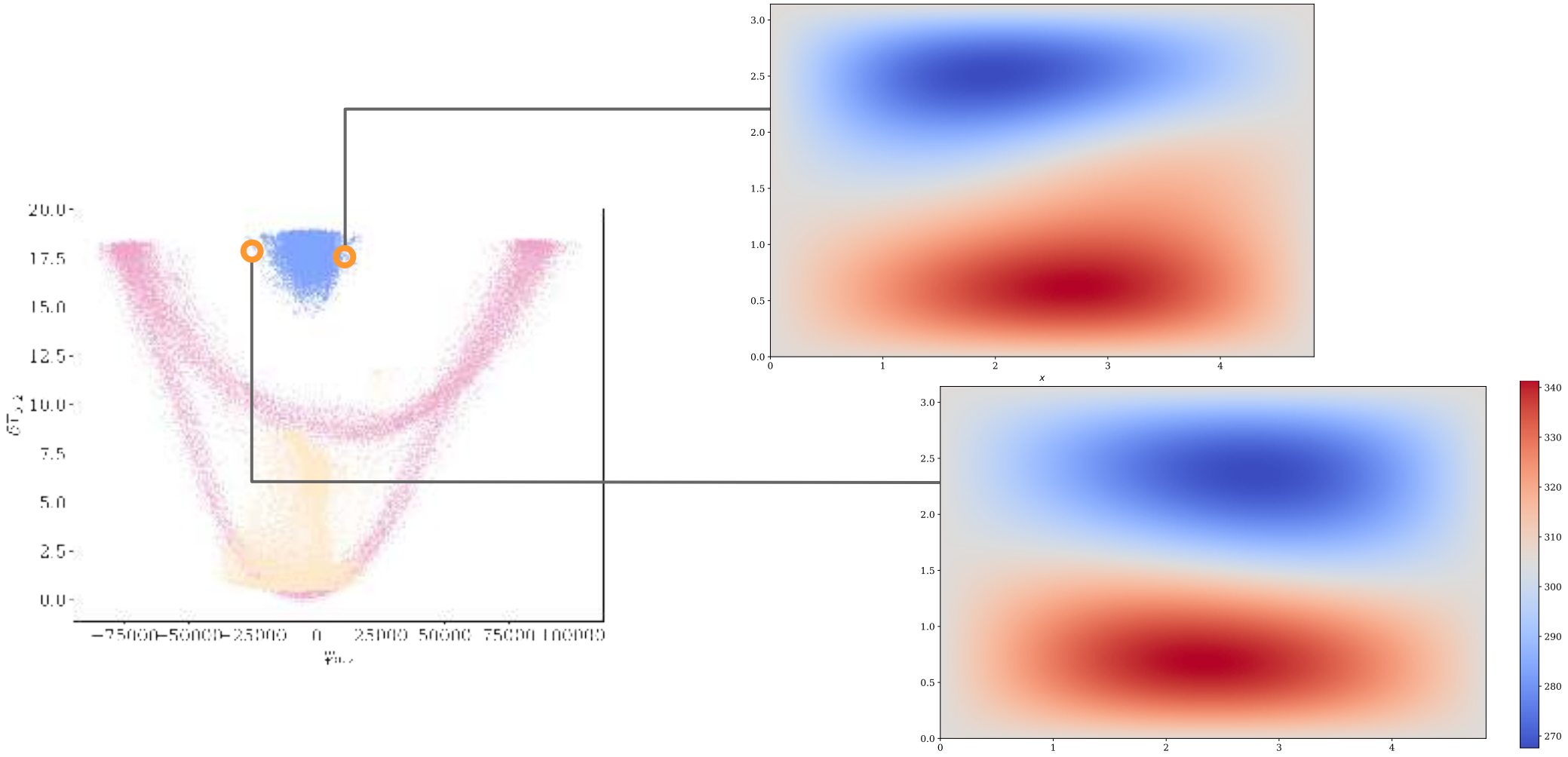
Model Results



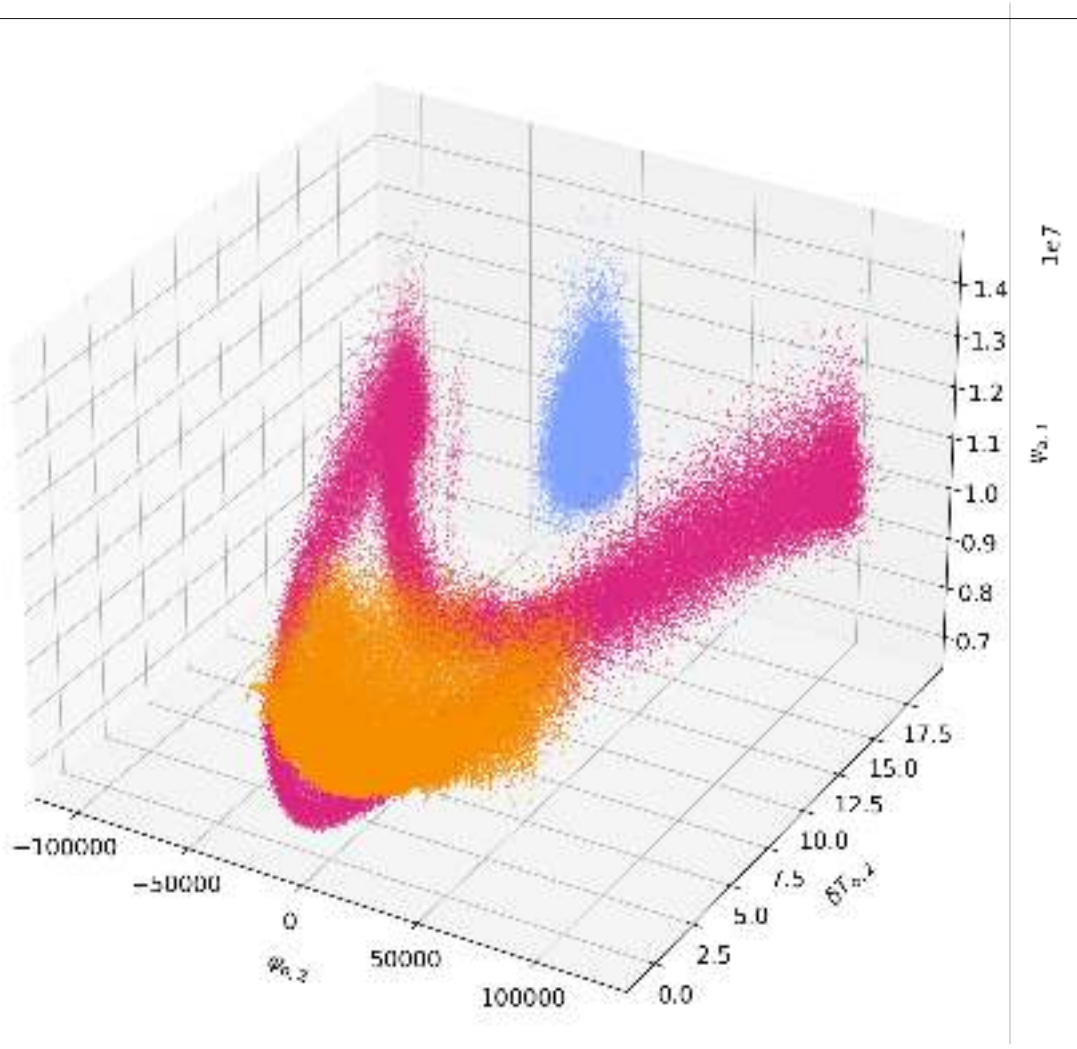
Model Results



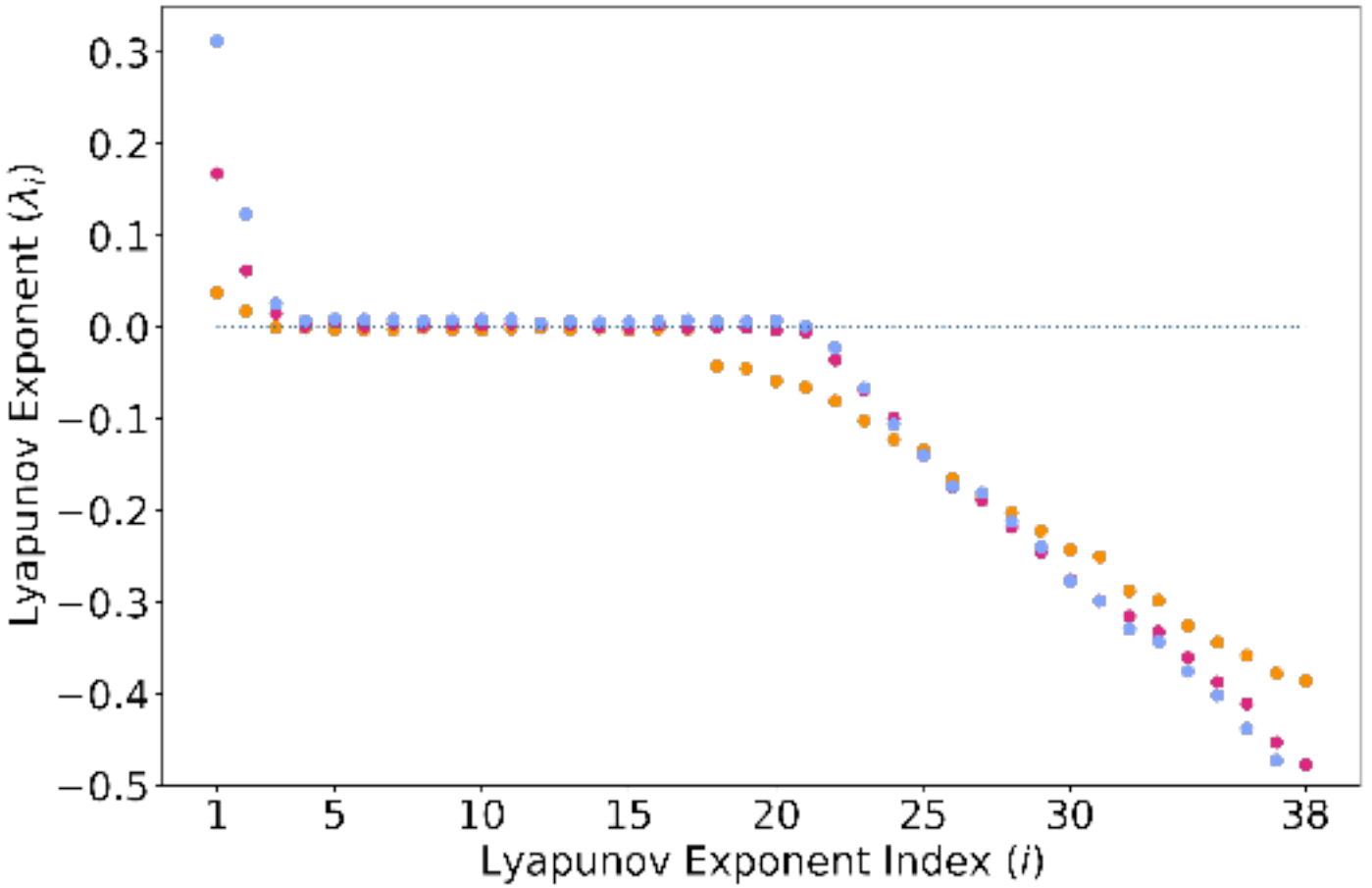
Model Results



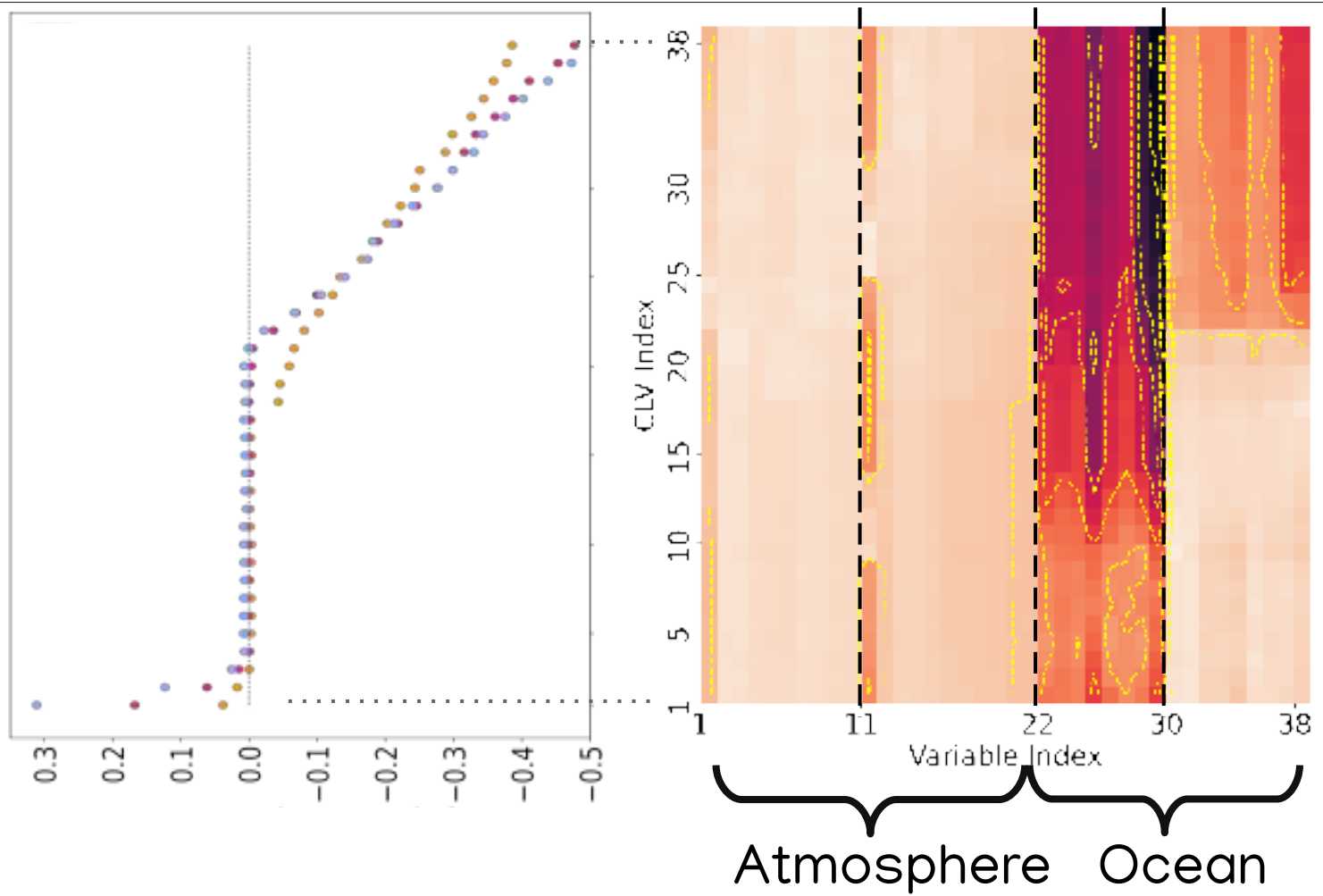
Coupling


1e7
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
17.5
15.0
12.5
10.0
5.0
2.5
0.0
−100000
−50000
0
50000
100000

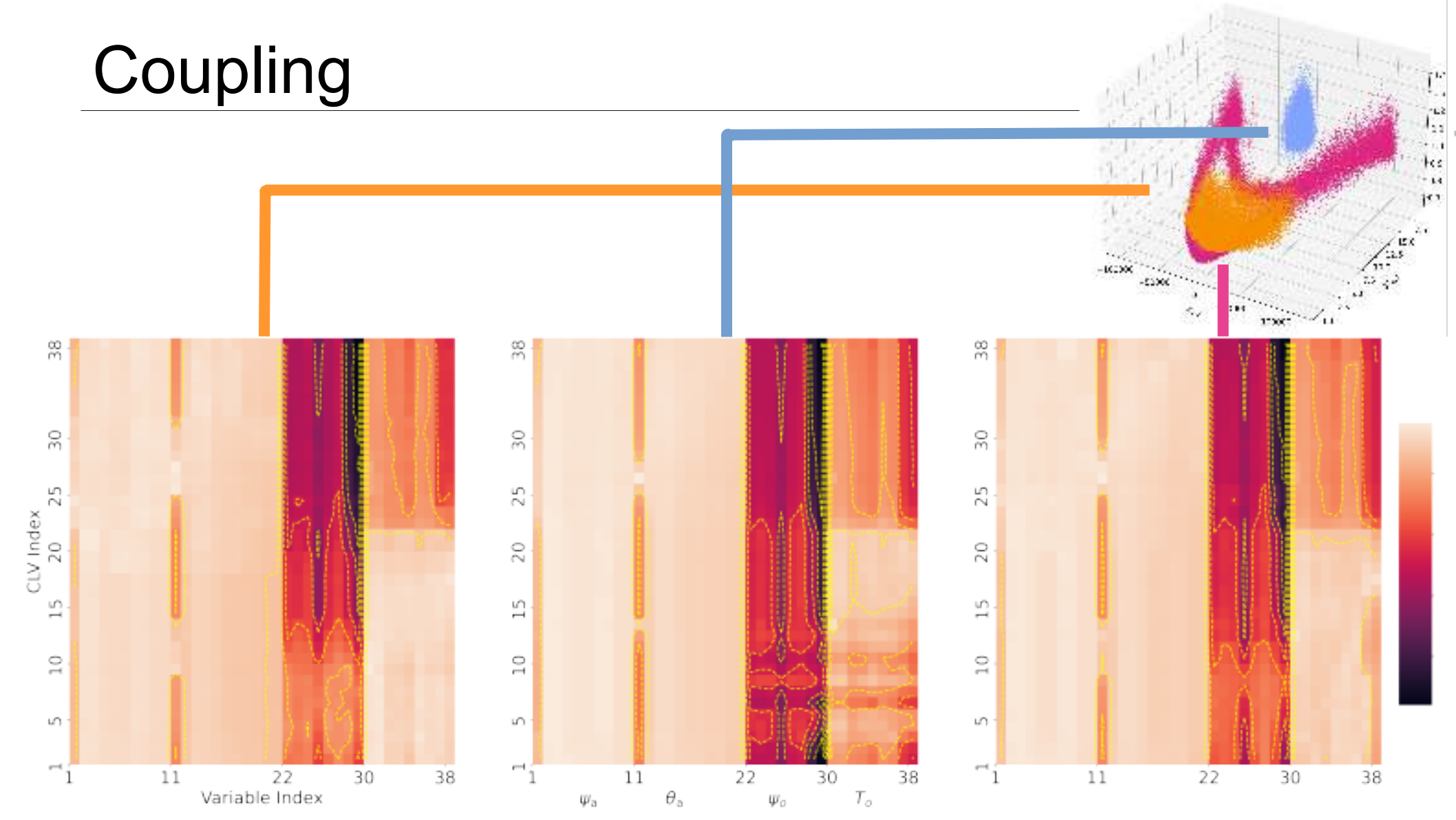
Coupling


0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
−0.5
Lyapunov Exponent (λ_i)
1
5
10
15
20
25
30
38
Lyapunov Exponent Index (i)

Coupling


0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
−0.5
CLV Index
1
5
10
15
20
25
30
38
1
11
22
30
38
Variable Index
Atmosphere
Ocean

Coupling

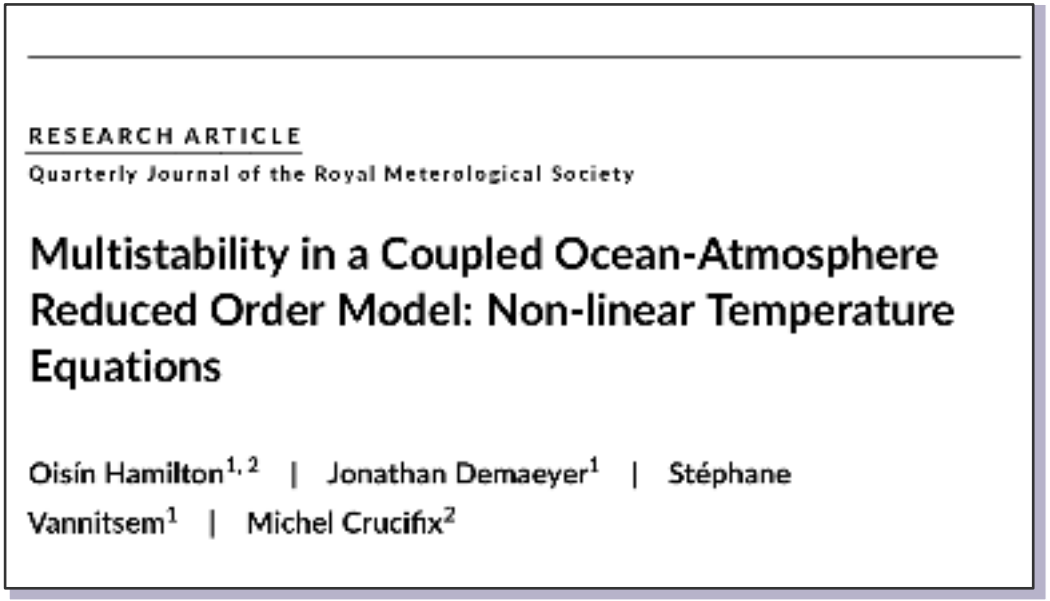

CLV Index
Variable Index
1
5
10
15
20
25
30
38
1
11
22
30
38
ψ_a
θ_a
ψ_o
T_o

Conclusions

Not linearising the σT^4 terms produces multiple equilibria

These equilibria present distinct coupled flows

The coupled flows have different predictability



Thank you

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CriticalEarth

UCL

RMI