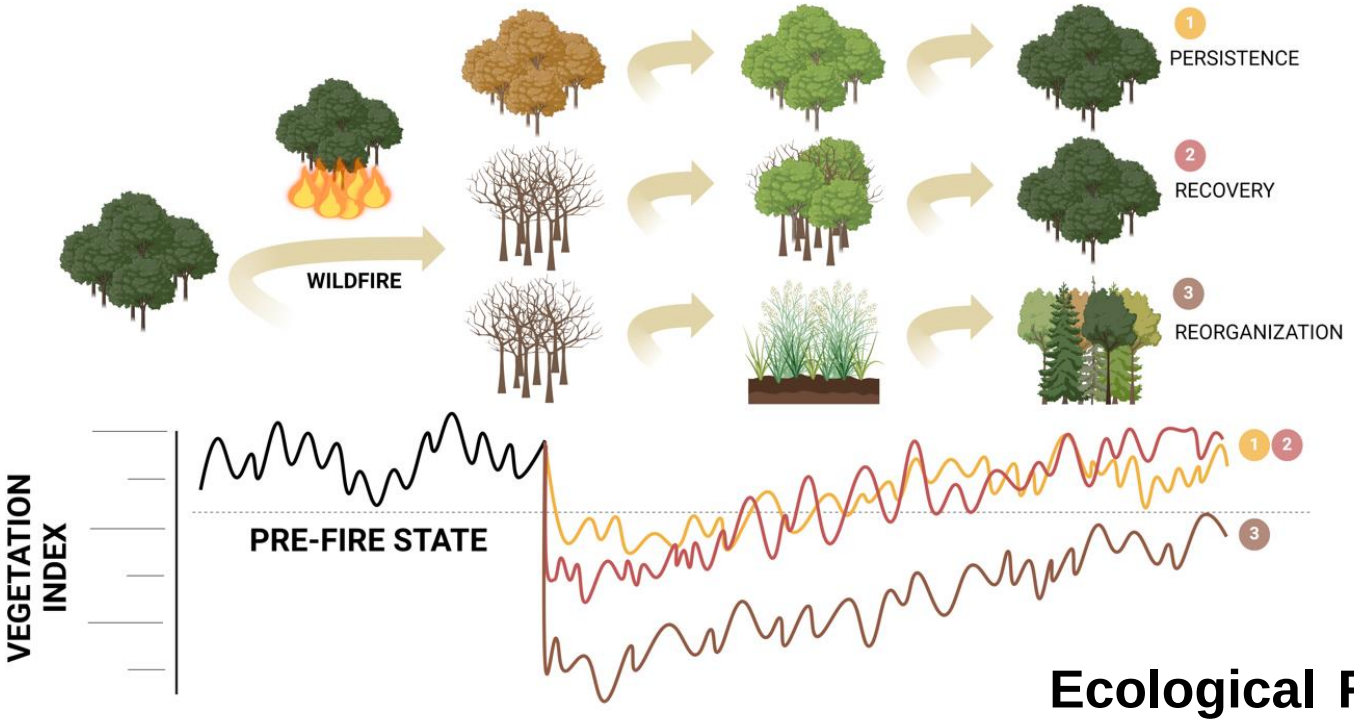
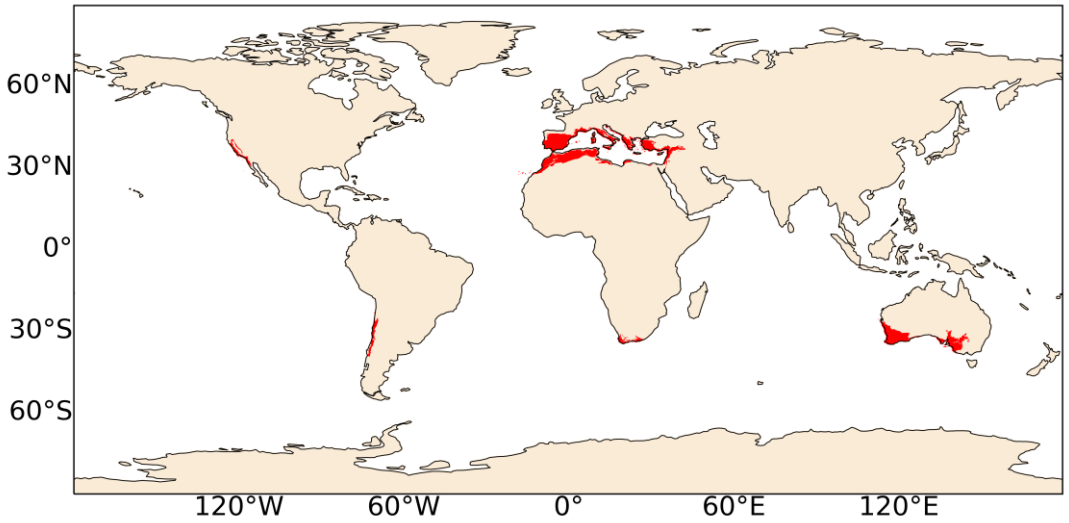
GLOBAL PATTERNS OF MEDITERRANEAN ECOSYSTEMS RECOVERY FROM RECURRENT FIRES

Tiago Ermitão[1,2], Célia Gouveia[1,2], Ana Bastos[3], Ana Russo[1]

1 Instituto Português do Mar e da Atmosfera (IPMA), Earth Observation Unit, Lisbon, Portugal
2 Instituto Dom Luiz (IDL), Faculty of Sciences of University of Lisbon, Lisbon, Portugal
3 Max-Planck Institute for Biogeochemistry, Dept. of Biogeochemical Integration, Jena, Germany

MOTIVATION & CONCEPTS





Dinerstein et al., (2017)

Ecological Resilience: ability of a vegetation community to recover or adapt following a disturbance (Gessler et al., 2020; Falk et al., 2022).

MAIN GOALS

- **Modulate the burned vegetation recovery of Mediterranean Biome**
- How the burned vegetation has been recovering after recurrent fires in the Mediterranean biome
- Observe the recovery rates among the different land covers
- Fire severity, pre-fire state of vegetation and post-fire climate conditions modulate the recovery rate

BURNED AREAS
(MODIS 2001-2022)

Selection of areas burned TWICE between 2001 and 2022

16-day Enhanced Vegetation Index (EVI)
(MODIS 2001-2022)

PRE-PROCESSING
- Cloud | Snow | Ice correction
- Interpolation of missing data
- Fast Fourier Transform application
- Detrend using LOESS

Land Cover
(ESACCI 2001-2020)

AGGREGATION INTO 6 MAIN CLASSES

BROADLEAVES
(1st and 2nd Events)

SHRUBLAND
(1st and 2nd Events)

NEEDLELEAVES
(1st and 2nd Events)

TRANSITIONAL WOODLAND
(1st and 2nd Events)

MIXED FOREST
(1st and 2nd Events)

FOREST CHANGE
(1st Event: Forest | 2nd Event: Other Type)

Precipitation T2m
(ERA-LAND 2001-2022)

PRE-PROCESSING
- Hourly to Daily
- Daily to 16-day composites

LOSS OF GREENNESS ~ Fire Damage

$$y(t) = EVI(t) - EVI_{MAX}(t)$$

Ideal healthy state of vegetation

$$\frac{dy}{dt} = -by$$

RECOVERY MODEL EQUATION

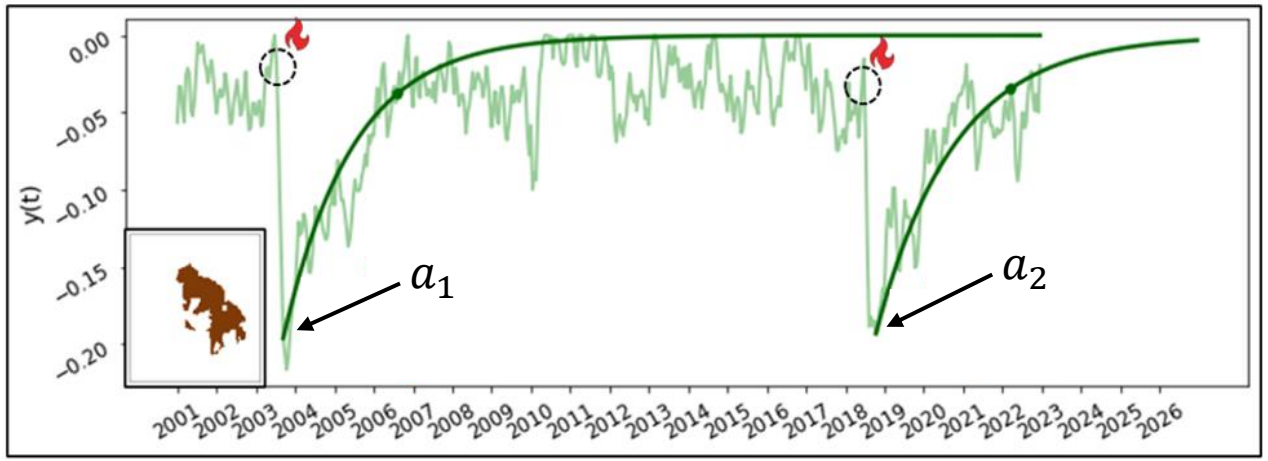
$$y = ae^{-bt}$$

Minimum value

$$a = EVI(t = Event_N) - EVI_{MAX}(t = Event_N)$$

Recovery rate

$$bt = \ln\left[\frac{y(t)}{a}\right]$$

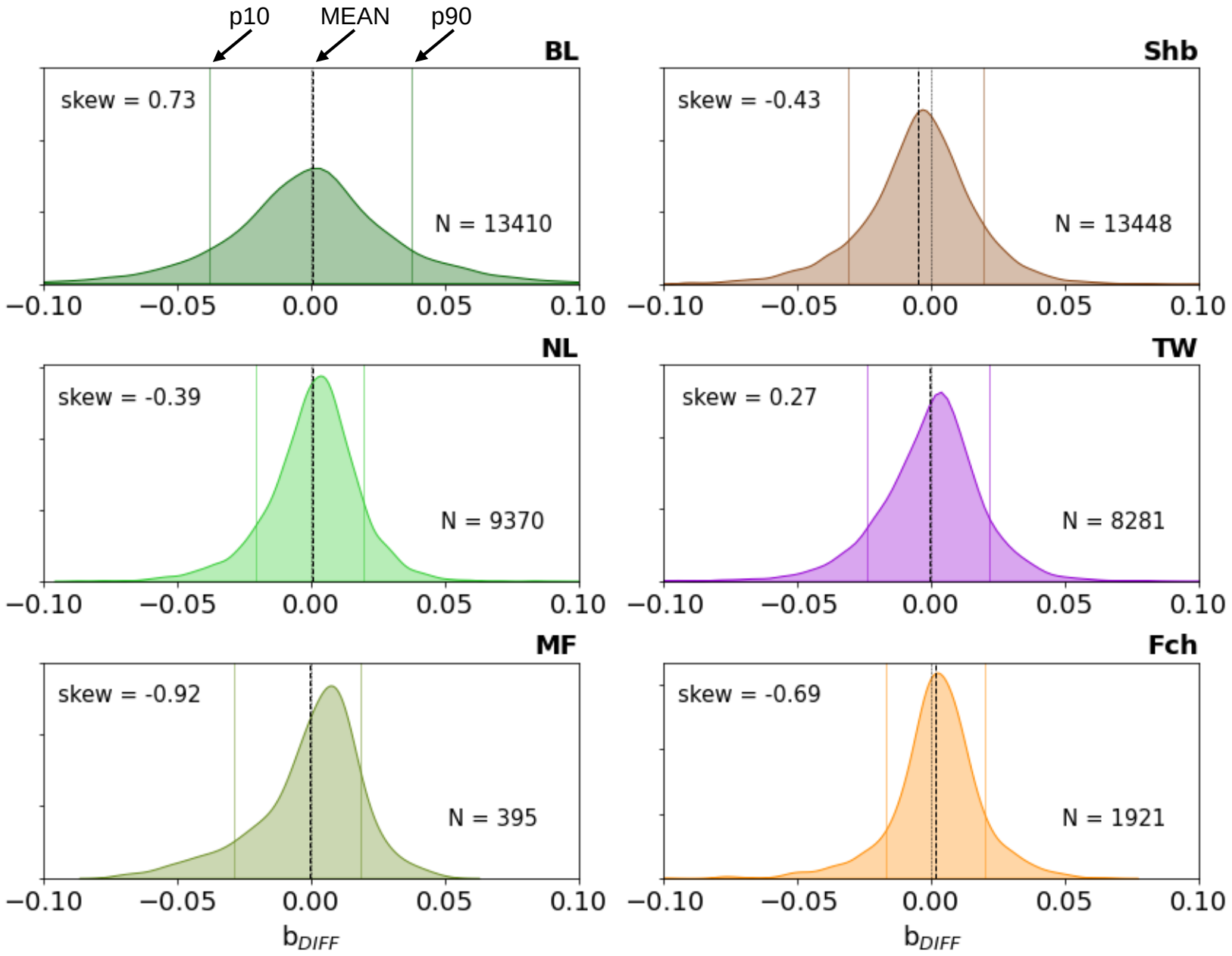


MODEL FITTING

MINIMUM: Value of **a**
Set following the fire event

RECOVERY RATE: Value of **b**
By means of a linear regression, tested for different time-steps between 2 and 5 years.
Slope *of linear regression with the highest* r^2

Gouveia et al., (2010); Bastos et al., (2011); Gouveia et al., (2018)



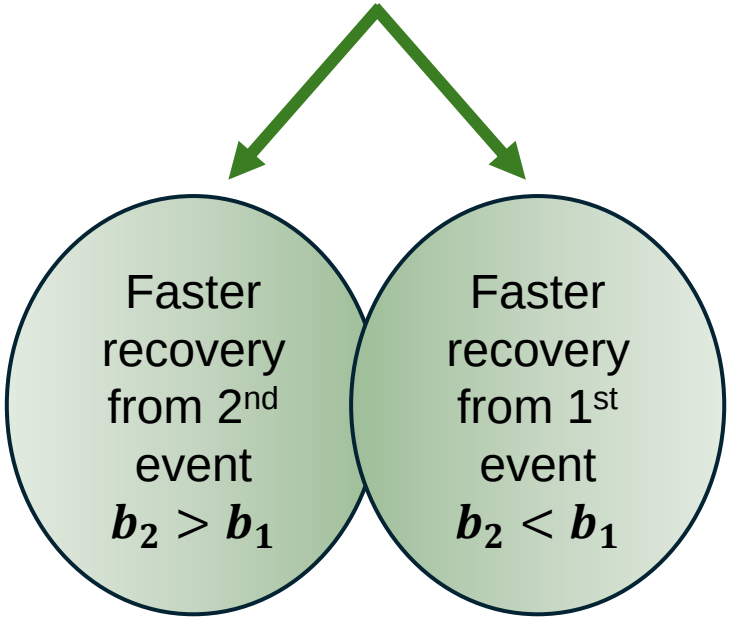
$$b_{DIFF} = b_2 - b_1$$

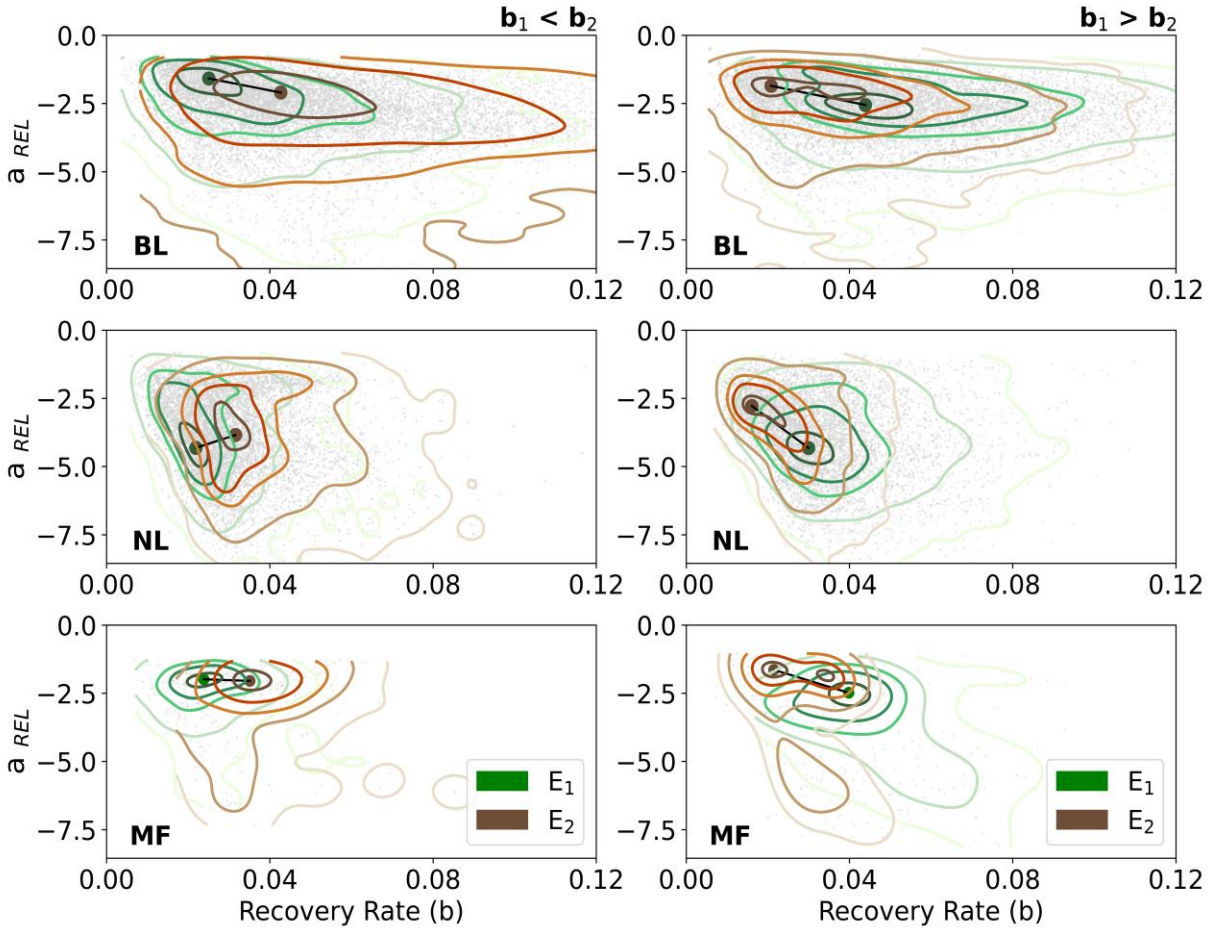
b_1 recovery rate from event 1

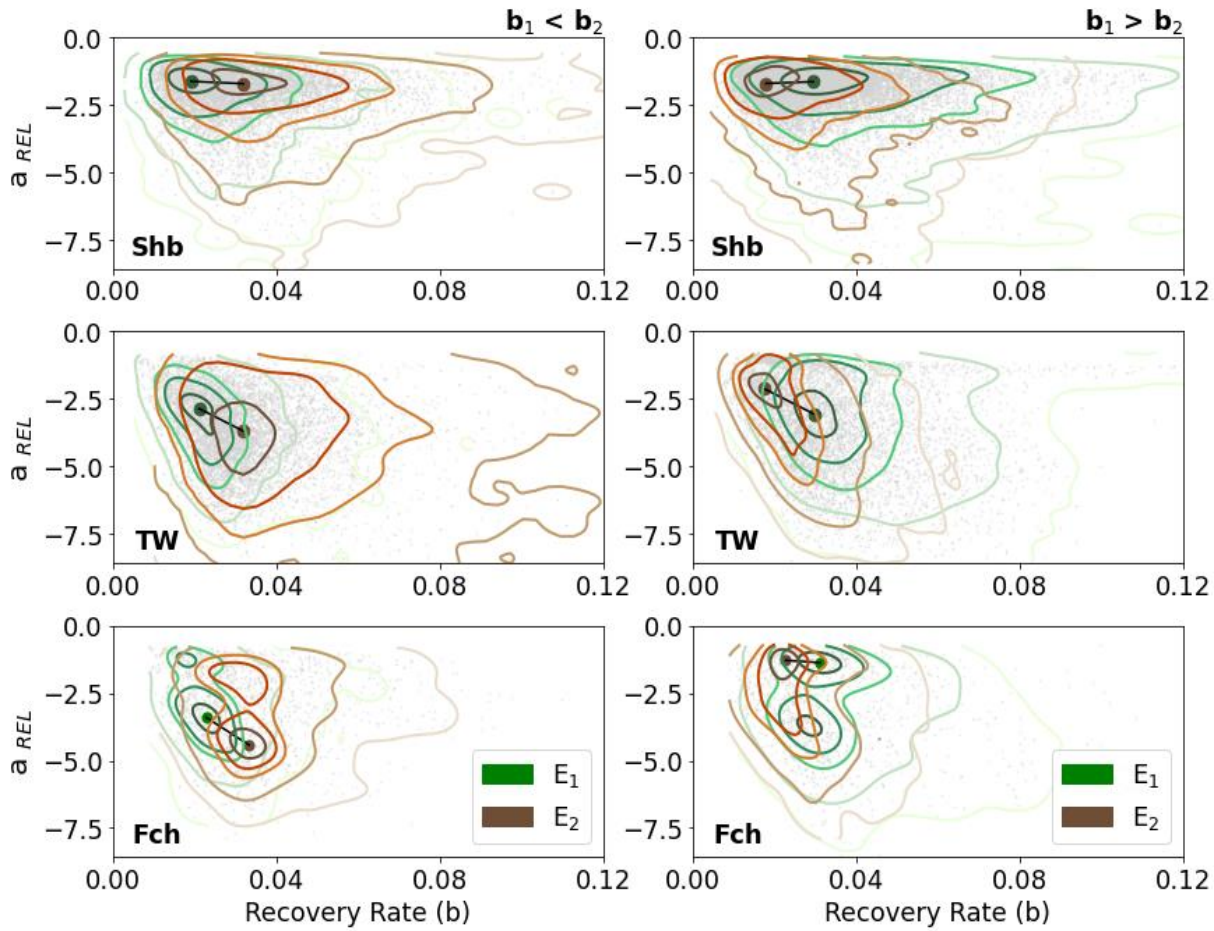
b_2 recovery rate from event 2

$b_{DIFF} > 0$ indicates $b_2 > b_1$

$b_{DIFF} < 0$ indicates $b_2 < b_1$



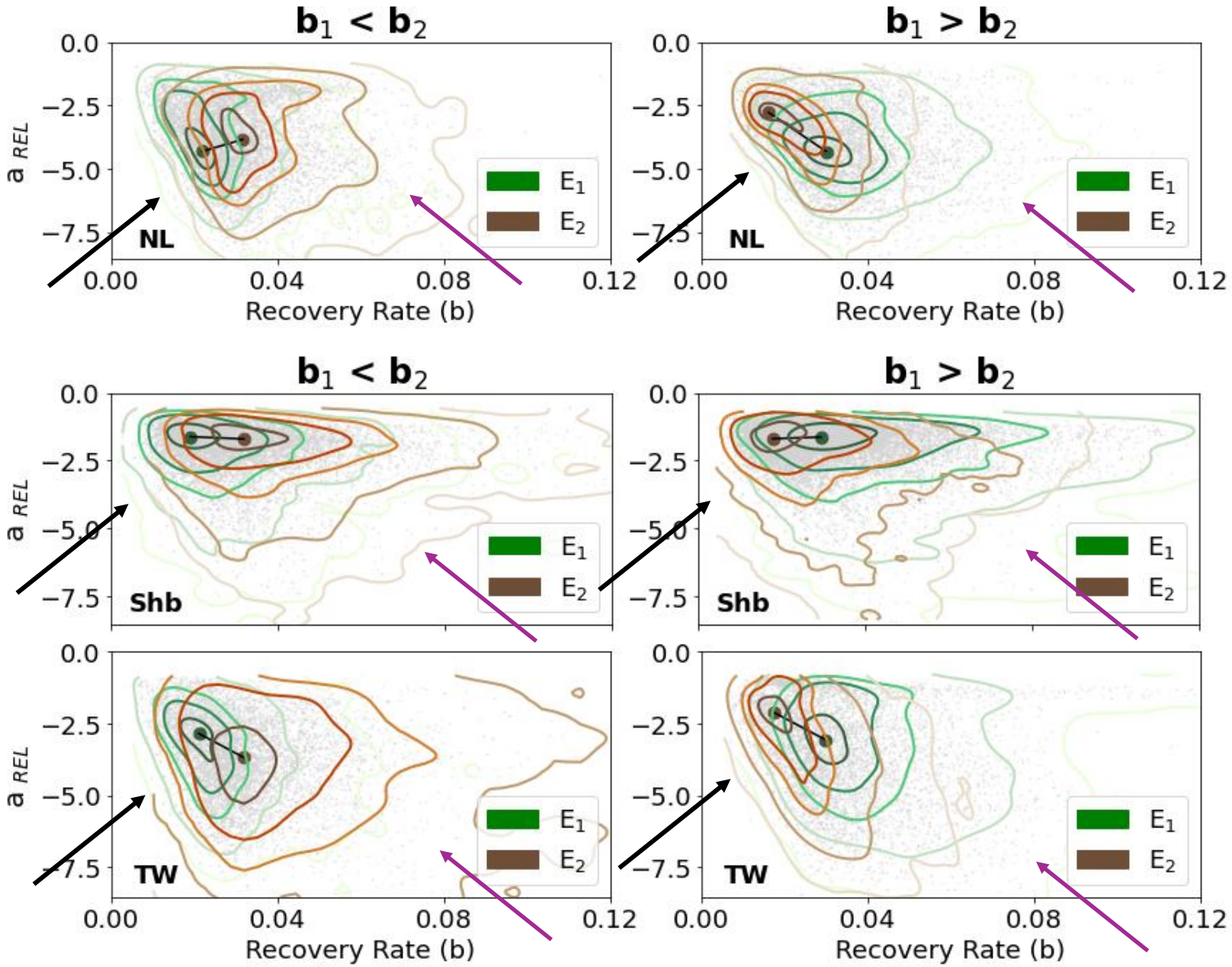




$$a_{REL} = \frac{a}{GY_{MEAN}}$$

b_1 Recovery Rate from Event 1 (E_1)

b_2 Recovery Rate from Event 2 (E_2)



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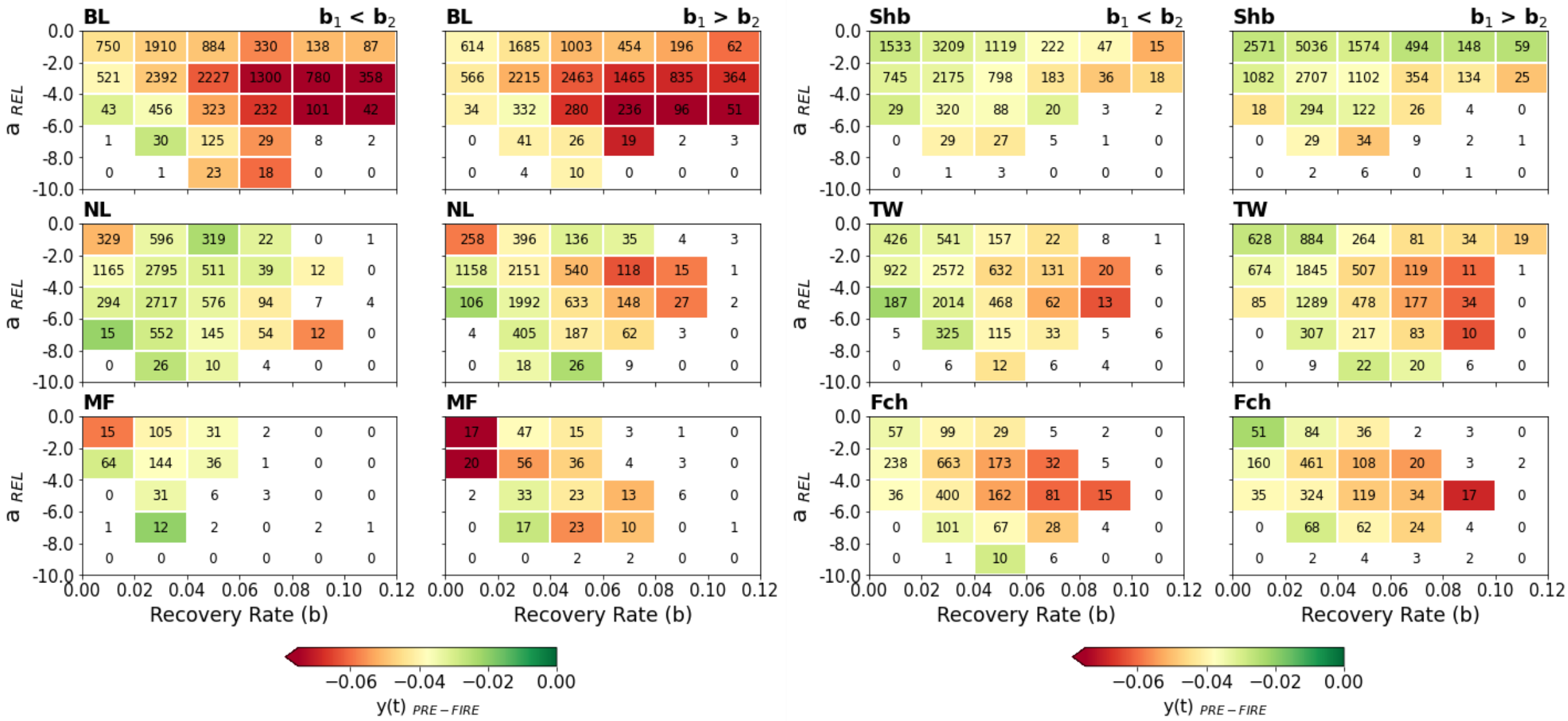
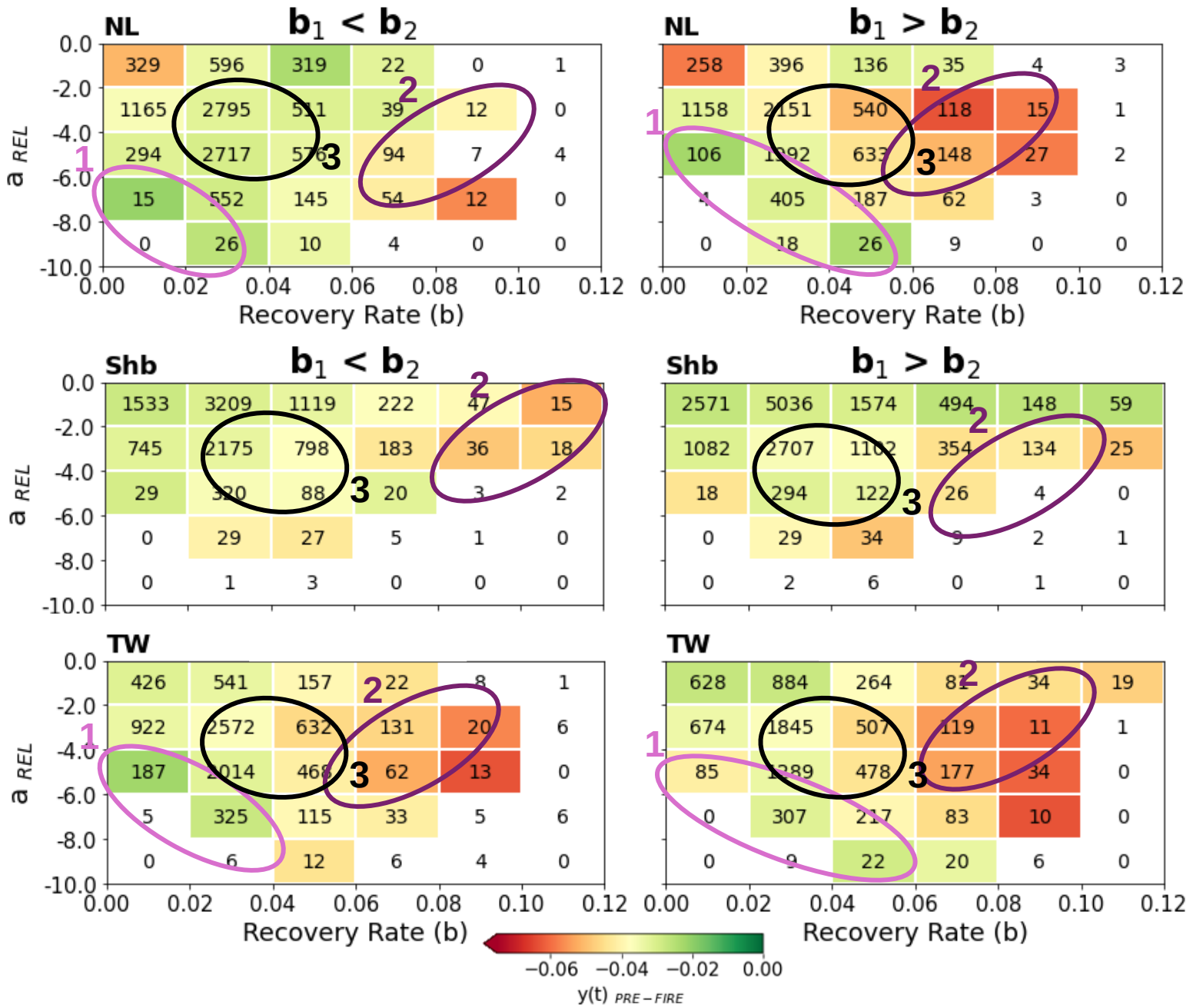

BL
$b_1 < b_2$
750 1910 884 330 138 87
521 2392 2227 1300 780 358
43 456 323 232 101 42
1 30 125 29 8 2
0 1 23 18 0 0
BL
$b_1 > b_2$
614 1685 1003 454 196 62
566 2215 2463 1465 835 364
34 332 280 236 96 51
0 41 26 19 2 3
0 4 10 0 0 0
NL
329 596 319 22 0 1
1165 2795 511 39 12 0
294 2717 576 94 7 4
15 552 145 54 12 0
0 26 10 4 0 0
NL
258 396 136 35 4 3
1158 2151 540 118 15 1
106 1992 633 148 27 2
4 405 187 62 3 0
0 18 26 9 0 0
MF
15 105 31 2 0 0
64 144 36 1 0 0
0 31 6 3 0 0
1 12 2 0 2 1
0 0 0 0 0 0
MF
17 47 15 3 1 0
20 56 36 4 3 0
2 33 23 13 6 0
0 17 23 10 0 1
0 0 2 2 0 0
a REL
0.0 -2.0 -4.0 -6.0 -8.0 -10.0
0.00 0.02 0.04 0.06 0.08 0.10 0.12
Recovery Rate (b)
−0.06 −0.04 −0.02 0.00
y(t) PRE − FIRE
Shb
$b_1 < b_2$
1533 3209 1119 222 47 15
745 2175 798 183 36 18
29 320 88 20 3 2
0 29 27 5 1 0
0 1 3 0 0 0
Shb
$b_1 > b_2$
2571 5036 1574 494 148 59
1082 2707 1102 354 134 25
18 294 122 26 4 0
0 29 34 9 2 1
0 2 6 0 1 0
TW
426 541 157 22 8 1
922 2572 632 131 20 6
187 2014 468 62 13 0
5 325 115 33 5 6
0 6 12 6 4 0
TW
628 884 264 81 34 19
674 1845 507 119 11 1
85 1289 478 177 34 0
0 307 217 83 10 0
0 9 22 20 6 0
Fch
57 99 29 5 2 0
238 663 173 32 5 0
36 400 162 81 15 0
0 101 67 28 4 0
0 1 10 6 0 0
Fch
51 84 36 2 3 0
160 461 108 20 3 2
35 324 119 34 17 0
0 68 62 24 4 0
0 2 4 3 2 0
a REL
0.0 -2.0 -4.0 -6.0 -8.0 -10.0
0.00 0.02 0.04 0.06 0.08 0.10 0.12
Recovery Rate (b)
−0.06 −0.04 −0.02 0.00
y(t) PRE − FIRE

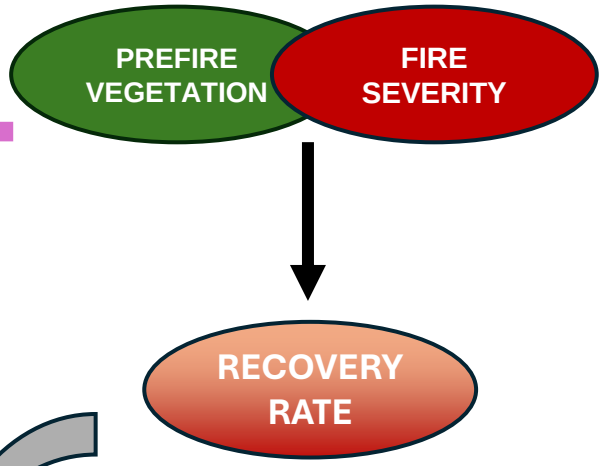


b_1 Recovery Rate from Event 1 (E_1)

b_2 Recovery Rate from Event 2 (E_2)

Strong performance of statistical model of EVI on capturing both fire events, determining recovery rate, fire severity and pre-fire conditions.

1



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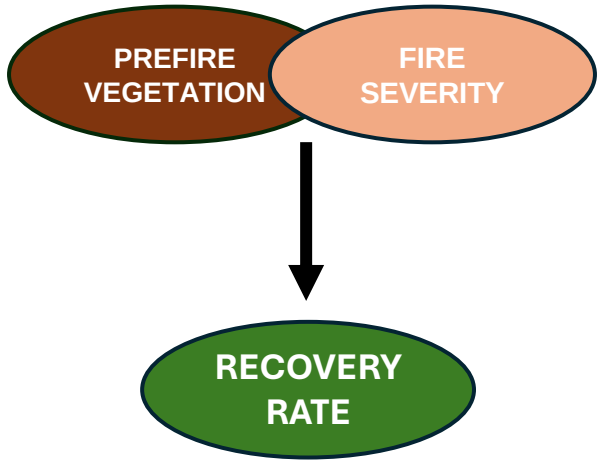

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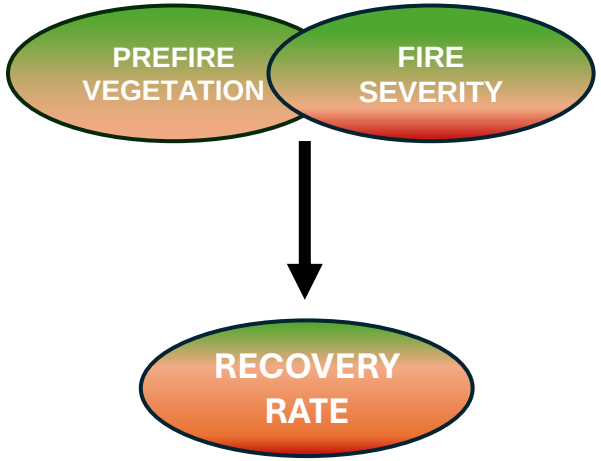
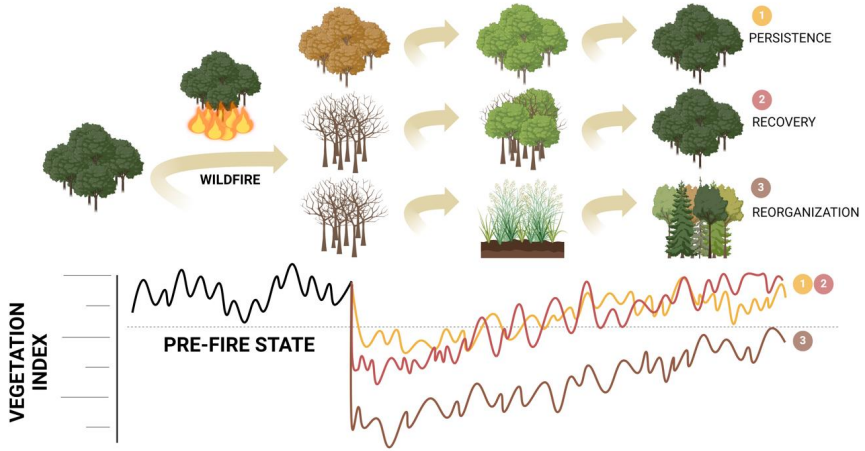
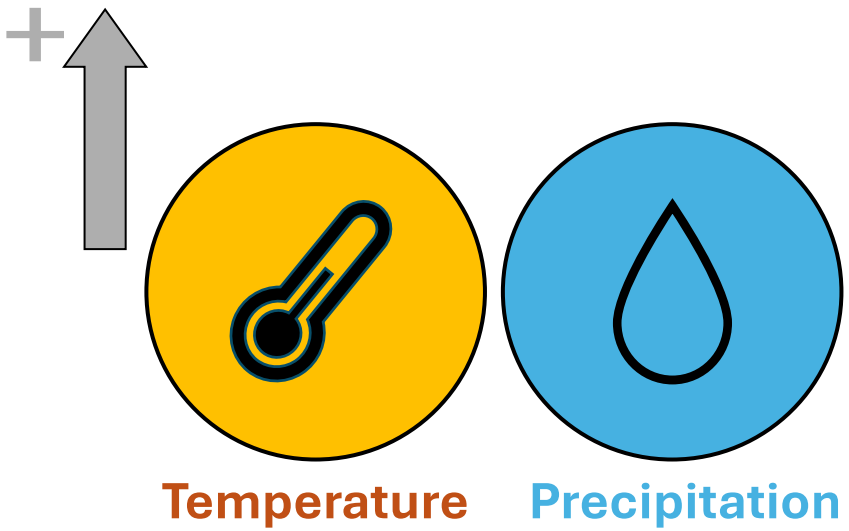
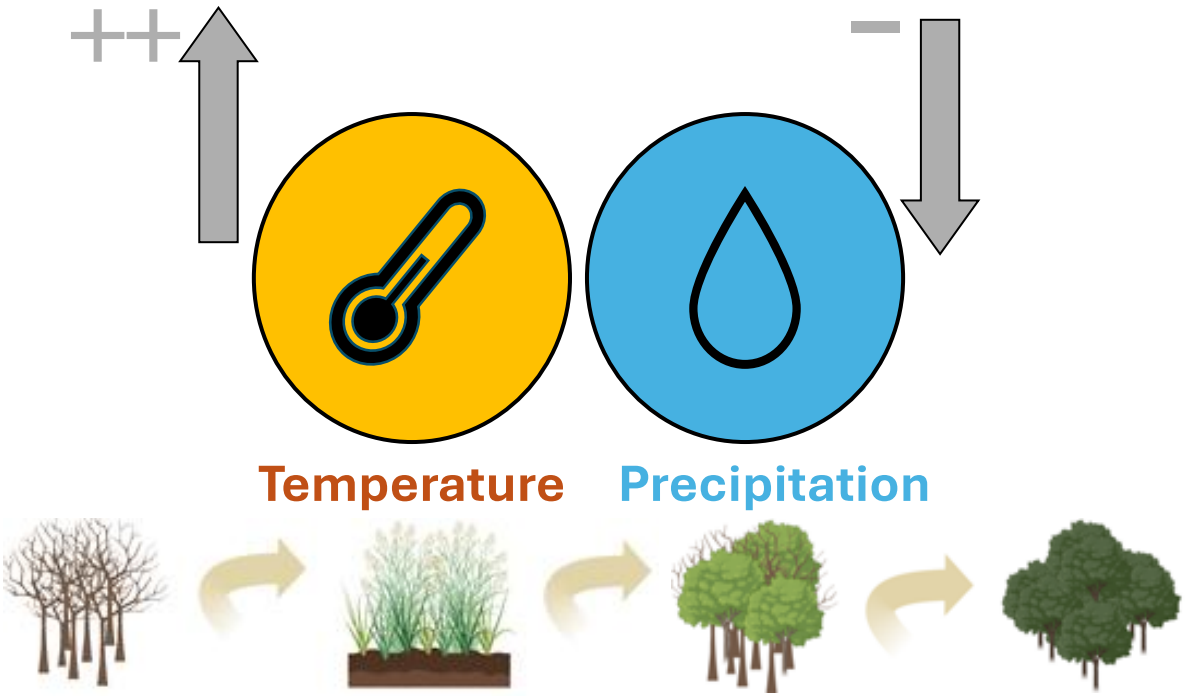


NO RECOVERY REORGANISATION





HIGH RECOVERY RATES



LOW RECOVERY RATES

THANK YOU !

tmrsilva@fc.ul.pt

@tiago_ermitao

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