

# Manual for Package: ecohydrology

## Revision 2:3M

Karl Kästner

November 3, 2022

## Contents

<b>1</b>	<b>@Klausmeier</b>	<b>1</b>
1.1	Klausmeier . . . . .	1
1.2	dy_dt . . . . .	1
1.3	dy_dx . . . . .	1
1.4	dy_dx_lin . . . . .	1
1.5	extract . . . . .	1
1.6	homogeneous_state . . . . .	1
1.7	init . . . . .	2
<b>2</b>	<b>@Rietkerk</b>	<b>2</b>
2.1	Rietkerk . . . . .	2
2.2	celerity . . . . .	2
2.3	critical_rainfall_depth . . . . .	2
2.4	diffusion_rate . . . . .	2
2.5	dlogz_dx . . . . .	2
2.6	dz_dt . . . . .	2
2.7	dz_dt_coefficient . . . . .	2
2.8	dz_dx . . . . .	3
2.9	extract1 . . . . .	3
2.10	extract2 . . . . .	3
2.11	growth_rate . . . . .	3
2.12	homogeneous_state . . . . .	3
2.13	infiltration_enhancement . . . . .	3
2.14	init . . . . .	3
2.15	initial_condition_from_central_frequency . . . . .	3
2.16	jacobian . . . . .	4
2.17	make_symbolic . . . . .	4
2.18	random_state . . . . .	4
2.19	reaction_matrix . . . . .	4

2.20	solve . . . . .	4
2.21	solve_split . . . . .	4
2.22	solve_stationary . . . . .	4
2.23	solve_trapezoidal . . . . .	4
2.24	stationary_step . . . . .	5
<b>3</b>	<b>@Rietkerk_Map</b>	<b>5</b>
3.1	Rietkerk_Map . . . . .	5
3.2	hash . . . . .	5
3.3	run . . . . .	5
3.4	write_table . . . . .	5
<b>4</b>	<b>ecohydrology</b>	<b>5</b>
4.1	migration_celerity_1d . . . . .	5
<b>5</b>	<b>test</b>	<b>5</b>
5.1	test_rietkerk_asymptote . . . . .	5
5.2	test_rietkerk_celerity . . . . .	6
5.3	test_rietkerk_convergence . . . . .	6
5.4	test_rietkerk_homogeneous . . . . .	6
5.5	test_rietkerk_implicit_1d . . . . .	6
5.6	test_rietkerk_implicit_2d . . . . .	6
5.7	test_rietkerk_zero_inertia . . . . .	6
<b>1</b>	<b>@Klausmeier</b>	
<b>1.1</b>	<b>Klausmeier</b>	
<b>1.2</b>	<b>dy_dt</b>	
<b>1.3</b>	<b>dy_dx</b>	
<b>1.4</b>	<b>dy_dx_lin</b>	

## 1.5 extract

## 1.6 homogeneous\_state

## 1.7 init

# 2 @Rietkerk

## 2.1 Rietkerk

c.f. Rietkerk et al. 2002, Self-Organization of Vegetation in Arid Ecosystems

## 2.2 celerity

migration celerity of the pattern

## 2.3 critical\_rainfall\_depth

## 2.4 diffusion\_rate

## 2.5 dlogz\_dx

Rietkerk pde transformed to set of odes through assuming wave-equations

## 2.6 dz\_dt

time-derivative of the Rietkerk-pde

## 2.7 dz\_dt\_coefficient

time-derivative of the Rietkerk-pde

## 2.8 dz\_dx

## 2.9 extract1

extract biomass, soil water and surface water from the combined  
vector

## 2.10 extract2

## 2.11 growth\_rate

migration celerity of the pattern

## 2.12 homogeneous\_state

homogeneous (not necessarily stable) states of the Rietkerk system

## 2.13 infiltration\_enhancement

infiltration enhancement of the Rietkerk model

## 2.14 init

initialize all variables

## 2.15 initial\_condition\_from\_central\_frequency

extract dominant frequency from a previous model run and generate a  
new  
initial condition with only this frequency  
for faster generation of asymptotic patterns

## 2.16 jacobian

jacobian of the Rietkerk model

## 2.17 make\_symbolic

make model parameters symbolic

## 2.18 random\_state

generate random initial state

## 2.19 reaction\_matrix

## 2.20 solve

solve the Rietkerk model

## 2.21 solve\_split

## **2.22 solve\_stationary**

solve until stationary state is reached

## **2.23 solve\_trapezoidal**

trapezoidal time stepping with fixed time step

## **2.24 stationary\_step**

quasi-stationary time-step

# **3 @Rietkerk\_Map**

## **3.1 Rietkerk\_Map**

database for Rietkerk model runs

## **3.2 hash**

has the model parameters for filename generation

## **3.3 run**

run the Rietkerk model with parameters specified by varargin,  
or retrieve the saved results, when the model was already run

## **3.4 write\_table**

write hashtable as human readable csv

## 4 ecohydrology

### 4.1 migration\_celerity\_1d

estimate migration celerity of a travelling wave

## 5 test

### 5.1 test\_rietkerk\_asymptote

### 5.2 test\_rietkerk\_celerity

### 5.3 test\_rietkerk\_convergence

### 5.4 test\_rietkerk\_homogeneous

### 5.5 test\_rietkerk\_implicit\_1d

### 5.6 test\_rietkerk\_implicit\_2d

### 5.7 test\_rietkerk\_zero\_inertia