

Manual for Package: sediment-transport

Revision 10M

Karl Kästner

September 2, 2021

Contents

1	@GrainSizeDistribution	1
1.1	GrainSizeDistribution	1
1.2	assign_channel	1
1.3	bimodality	1
1.4	export_csv	1
1.5	export_shp	1
1.6	group_channels	1
1.7	group_curvature	2
1.8	group_histograms	2
1.9	load_coordinates	2
2	bedform	2
2.1	bedform_dimension_rijn	2
2.2	dune_celerity	2
2.3	dune_dimension_allen_1978	2
2.4	dune_dimension_bradley_venditti	2
2.5	dune_dimension_gill	2
2.6	dune_dimension_julien_klaassen_1978	2
2.7	dune_dimension_yalin	3
2.8	dune_height_karim	3
3	bedload	3
3.1	angle_of_repose	3
3.2	bedload_direction	3
3.3	bedload_einstein	3
3.4	bedload_engelund_fredsoe	3
3.5	bedload_layer_thickness	3
3.6	bedload_layer_thickness_mclean	3
3.7	bedload_transport_ashida_michue_1972	3

3.8	bedload_transport_bagnold_1941	4
3.9	bedload_transport_bagnold_1973	4
3.10	bedload_transport_egashira	4
3.11	bedload_transport_mpm	4
3.12	bedload_transport_rijn	4
3.13	bedload_transport_wu	4
4	sediment-transport	4
4.1	bifurcation_critical_aspect_ratio	4
4.2	critical_grain_size	5
4.3	critical_shear_stress	5
4.4	critical_shear_stress_ratio	5
4.5	critical_shear_stress_wiberg	5
4.6	critical_shear_stress_wu	5
4.7	critical_shear_velocity	5
5	derive	5
5.1	derive_critical_grain_size	5
5.2	derive_mpm_foramitive_discharge	6
5.3	derive_suspended_sediment_concentration_profile	6
5.4	derive_suspended_sediment_concentration_profiles	6
5.5	mpm_solve_for_dm	6
6	sediment-transport	6
6.1	dimensionless_grain_size	6
6.2	dynamic_shear_stress	6
7	empirical-laod	6
7.1	sediment_load_ART_syvitski_2003	6
7.2	sediment_load_ART_syvitski_2003b	6
8	sediment-transport	7
8.1	formative_discharge	7
8.2	grain_size_from_shear_stress	7
8.3	hiding_exposure_wu	7
8.4	integration_factor_wright_parker	7
8.5	mobility_parameter_rijn	7
9	morphodynamics/@Nodal_Point	7
9.1	Adot	7
9.2	Nodal_Point	7
9.3	Qs_in	7
9.4	Qs_out	8
9.5	derive_jacobian	8
9.6	discharge	8

9.7	geometry	8
9.8	jacobian	8
9.9	phase_diagram	8
9.10	phase_diagram_wang	8
9.11	solve	9
9.12	stability_analysis	9
10	morphodynamics	9
10.1	bar_mode_crosato	9
11	sediment-transport	9
11.1	mpm2diameter	9
11.2	reference_to_flux_averaged_concentration_rijn	9
12	roughness-and-shear-stress	9
12.1	bedform_roughness_rijn	9
12.2	bedform_roughness_rijn_2007	9
12.3	chezy_roughness_engelund_fredsoe	10
12.4	grain_roughness_mpm	10
12.5	grain_roughness_nikuradse	10
12.6	grain_roughness_rijn	10
12.7	grain_roughness_wu	10
12.8	nikuradse_roughness_length	10
12.9	roughness_einstein	10
12.10	roughness_height_mclean	10
12.11	roughness_height_mclean_1972	10
12.12	skin2total_stress_ratio	11
12.13	skin_2_total_friction_eh	11
12.14	total2skin_stress_ratio	11
12.15	total_2_skin_friction	11
12.16	total_roughness_engelund_fredsoe	11
12.17	total_roughness_engelund_fredsoe2	11
12.18	total_roughness_karim	11
12.19	total_roughness_karim2	11
12.20	total_roughness_length_mclean	11
12.21	total_roughness_parker	12
12.22	total_roughness_rijn	12
12.23	total_roughness_yalin	12
12.24	total_to_skin_stress_kishi	12
13	sediment-transport	12
13.1	saltation_layer_thickness	12
13.2	sediment_transport_scale	12
13.3	sediment_transport_waves	12

13.4	shear2shields	12
13.5	shear_velocity_mclean	13
13.6	shields_number	13
14	suspension	13
14.1	adaptation_length_armanini	13
14.2	adaptation_length_bed	13
14.3	adaptation_length_flow	13
15	suspension/concentration-profiles/@Hermite_profile	13
15.1	Hermite_profile	13
15.2	fit	13
15.3	predict	13
15.4	regmtx	14
15.5	transform	14
16	suspension/concentration-profiles/@Parabolic_Constant_Profile	14
16.1	Parabolic_Constant_Profile	14
16.2	fit	14
16.3	predict	14
16.4	regmtx	14
16.5	transform	14
17	suspension/concentration-profiles/@Rouse_Profile	15
17.1	Rouse_Profile	15
17.2	fit	15
17.3	mean_concentration	15
17.4	predict	15
17.5	regmtx	15
17.6	rouse_number	15
17.7	rouse_number_to_grain_diameter	15
17.8	set_parameters	15
17.9	transform	16
18	suspension/concentration-profiles	16
18.1	Exponential_SSC_Profile	16
18.2	vertical_ssc_profile_exponential	16
18.3	vertical_ssc_profile_mclean	16
19	suspension	16
19.1	eddy_viscosity_mclean	16
19.2	matching_level_mclean	16
20	suspension/reference-concentration	16
20.1	reference_concentration_einstein	16

20.2	reference_concentration_mclean	16
20.3	reference_concentration_mclean_2	17
20.4	reference_concentration_rijn	17
20.5	reference_concentration_wright_parker	17
20.6	reference_concentration_zyserman_fredsoe	17
21	suspension	17
21.1	reference_height_mclean	17
21.2	reference_height_rijn	17
21.3	settling_time_constant_eddy_viscosity	17
21.4	settling_velocity	17
21.5	settling_velocity_to_diameter	18
21.6	stratification_parameter_rijn	18
21.7	stratification_parameter_wright_parker	18
21.8	stratification_profile_mclean	18
21.9	suspended_grain_size	18
21.10	suspended_grain_size_non_linear	19
21.11	suspended_grain_size_rijn	19
21.12	suspended_sediment_adaptation_length_claudin	19
21.13	suspended_transport_mclean	19
21.14	suspended_transport_rijn	19
21.15	suspended_transport_van_rijn_simplified_1984	19
21.16	suspended_transport_wright_parker	20
21.17	suspended_transport_wu	20
21.18	suspension_parameter	20
21.19	viscosity_correction_sediment	20
22	test	20
22.1	test_Rouse_profile_fit	20
22.2	test_adaptation_length_bed	20
22.3	test_bed_load_transport_rijn	20
22.4	test_bedform_roughness_rijn_2007	20
22.5	test_bedload_transport_mpm	20
22.6	test_critical_shear_stress	21
22.7	test_sediment_transport	21
22.8	test_sediment_transport_engelund_hansen_1	21
22.9	test_sediment_transport_engelund_hansen_2	21
22.10	test_sediment_transport_karim	21
22.11	test_sediment_transport_relation	21
22.12	test_sediment_transport_rijn	21
22.13	test_settling_velocity_to_diameter	21
22.14	test_suspended_transport_mclean	21
22.15	test_suspended_transport_wright_parker	21
22.16	test_total_transport_engelund_hansen	22

22.17	test_total_transport_yang	22
23	total-transport	22
23.1	fractional_transport_engelund_hansen	22
23.2	sediment_transport_directed	22
23.3	sediment_transport_relation_fit	22
23.4	sediment_transport_relation_predict	22
23.5	total_transport_ackers_white	22
23.6	total_transport_bagnold	22
23.7	total_transport_eh_distribution	23
23.8	total_transport_engelund_hansen	23
23.9	total_transport_engelund_hansen_2	23
23.10	total_transport_karim	23
23.11	total_transport_rijn	23
23.12	total_transport_wu	23
23.13	total_transport_yang	23
24	sediment-transport	23
24.1	transport_sensitivity_engelund_hansen	23
24.2	transport_stage_mclean	24
24.3	transport_stage_rijn	24

1 @GrainSizeDistribution

1.1 GrainSizeDistribution

1.2 assign_channel

1.3 bimodality

1.4 export_csv

1.5 export_shp

1.6 group_channels

1.7 group_curvature

1.8 group_histograms

1.9 load_coordinates

2 bedform

2.1 bedform_dimension_rijn

bed form dimensions
cf. rijn 1984 iii

2.2 dune_celerity

2.3 dune_dimension_allen_1978

2.4 dune_dimension_bradley_venditti

2.5 `dune_dimension_gill`

2.6 `dune_dimension_julien_klaassen_1978`

2.7 `dune_dimension_yalin`

2.8 `dune_height_karim`

3 `bedload`

3.1 `angle_of_repose`

3.2 `bedload_direction`

`bedload transport direction`

3.3 `bedload_einstein`

`bed load transport according to einstein jr.`

3.4 `bedload_engelund_fredsoe`

`bed load transport according to engelund and fredsoe`

3.5 `bedload_layer_thickness`

3.6 bedload_layer_thickness_mclean

3.7 bedload_transport_ashida_michue_1972

3.8 bedload_transport_bagnold_1941

3.9 bedload_transport_bagnold_1973

3.10 bedload_transport_egashira

3.11 bedload_transport_mpm

bed load transport rate according to meyer-peter-mueller

3.12 bedload_transport_rijn

bed load transport
method of van Rijn (1984)

d50 [mm] (converted to m)
d90 [mm] (converted to m)

d : depth
b : width

3.13 bedload_transport_wu

bed load transport according to Wu

4 sediment-transport

analysis and prediction of fluvial sediment transport and
morphodynamics

4.1 bifurcation_critical_aspect_ratio

critical aspect ratio of a bifurcation
c.f. redolfi and pittaluga

4.2 critical_grain_size

critical grain size for a given shear velocity

4.3 critical_shear_stress

critical shear Stress

4.4 critical_shear_stress_ratio

critical shields parameter
aka critical shear stress ratio
aka shields curve

4.5 critical_shear_stress_wiberg

4.6 critical_shear_stress_wu

critical shear stress, according to wu

4.7 critical_shear_velocity

critical shear velocity

5 derive

5.1 derive_critical_grain_size

5.2 derive_mpm_foramtive_discharge

5.3 derive_suspended_sediment_concentration_profile

5.4 derive_suspended_sediment_concentration_profiles

5.5 mpm_solve_for_dm

6 sediment-transport

analysis and prediction of fluvial sediment transport and
morphodynamics

6.1 dimensionless_grain_size

dimensionless grain size

6.2 dynamic_shear_stress

dynamic shear stress

7 empirical-laod

7.1 sediment_load_ART_syvitski_2003

7.2 sediment_load_ART_syvitski_2003b

8 sediment-transport

analysis and prediction of fluvial sediment transport and
morphodynamics

8.1 formative_discharge

8.2 grain_size_from_shear_stress

8.3 hiding_exposure_wu

8.4 integration_factor_wright_parker

8.5 mobility_parameter_rijn

9 morphodynamics/@Nodal_Point

9.1 Adot

ODE of the nodal point relation (time-derivative of branch cs-area)

9.2 Nodal_Point

Nodal point relation for bifurcations, according to Wang

9.3 `Qs_in`

sediment entering branches

9.4 `Qs_out`

sediment leaving branches

9.5 `derive_jacobian`

derive Jacobian of the nodal point relation

9.6 `discharge`

discharge through branches
there is a problem with this relation, as soon as the bed of one
channel is perturbed,
the water level at the bifurcation changes, so the depth of the
second channel is not
entirely independent

9.7 `geometry`

cross section geometry of branches

9.8 `jacobian`

jacobian of the nodal point relation
semi-autogenerated

9.9 `phase_diagram`

phase diagram

9.10 phase_diagram_wang

phase diagram of Nodal point relation

9.11 solve

solve the nodal point relation for critical points

9.12 stability_analysis

stability analysis for a given configuration

10 morphodynamics

10.1 bar_mode_crosato

bar mode of a river according to crosato

11 sediment-transport

analysis and prediction of fluvial sediment transport and
morphodynamics

11.1 mpm2diameter

11.2 reference_to_flux_averaged_concentration_rijn

12 roughness-and-shear-stress

12.1 bedform_roughness_rijn

form drag according to van Rijn

12.2 bedform_roughness_rijn_2007

12.3 chezy_roughness_engelund_fredsoe

chezy roughness according to engelund and fredsoe

12.4 grain_roughness_mpm

12.5 grain_roughness_nikuradse

12.6 grain_roughness_rijn

grain roughness (skin friction) according to van Rijn

12.7 grain_roughness_wu

12.8 nikuradse_roughness_length

12.9 roughness_einstein

chezey coefficient according to Einstein

12.10 roughness_height_mclean

12.11 roughness_height_mclean_1972

12.12 skin2total_stress_ratio

12.13 skin_2_total_friction_eh

skin friction to total friction conversion according to engelund
and hansen
function [theta,C] = skin_2_total_friction_eh(theta_t,Ct)

12.14 total2skin_stress_ratio

12.15 total_2_skin_friction

12.16 total_roughness_engelund_fredsoe

roughness lenght according to engelund and fredsoe

12.17 total_roughness_engelund_fredsoe2

12.18 total_roughness_karim

12.19 total_roughness_karim2

12.20 `total_roughness_length_mclean`

12.21 `total_roughness_parker`

12.22 `total_roughness_rijn`

`total roughness according to van rijn`

12.23 `total_roughness_yalin`

12.24 `total_to_skin_stress_kishi`

13 sediment-transport

`analysis and prediction of fluvial sediment transport and
morphodynamics`

13.1 `saltation_layer_thickness`

13.2 `sediment_transport_scale`

13.3 `sediment_transport_waves`

`sediment transport by waves`

13.4 shear2shields

13.5 shear_velocity_mclean

13.6 shields_number

normalized shear stress, shear stress ratio

14 suspension

14.1 adaptation_length_armanini

14.2 adaptation_length_bed

adaptatoion lenght of bed morphology

14.3 adaptation_length_flow

adaption length of the flow

15 suspension/concentration-profiles/@Hermite_profile

15.1 Hermite_profile

suspended sedimen profile in form of a hermite polynomial

15.2 fit

fit suspended sediment profile

15.3 predict

predict suspended sediment concentration

15.4 regmtx

regression matrix

15.5 transform

hermite profile

16 suspension/concentration-profiles/@Parabolic_Constant_Profile

16.1 Parabolic_Constant_Profile

parabolic-constant profile

16.2 fit

fit the suspended sediment concentration profile

16.3 predict

predict suspended sediment concentration

16.4 regmtx

regression matrix

16.5 transform

transformation of vertical coordinate

17 suspension/concentration-profiles/@Rouse_Profile

17.1 Rouse_Profile

suspended sediment concentration profile

17.2 fit

fit the suspended sediment concentration profile

17.3 mean_concentration

17.4 predict

predict the suspended sediment concentration

17.5 regmtx

regression matrix

17.6 rouse_number

rouse number (suspension number) for given grain size and shear velocity

17.7 rouse_number_to_grain_diameter

convert known rous number (suspension parameter) to grain size diameter

17.8 set_parameters

17.9 transform

transform the vertical coordinate

18 suspension/concentration-profiles

18.1 Exponential_SSC_Profile

18.2 vertical_ssc_profile_exponential

18.3 vertical_ssc_profile_mclean

vertical profile of the suspended sediment according to McLean

19 suspension

19.1 eddy_viscosity_mclean

19.2 matching_level_mclean

20 suspension/reference-concentration

20.1 reference_concentration_einstein

20.2 reference_concentration_mclean

20.3 reference_concentration_mclean_2

reference concentration according to smith and mclean

20.4 reference_concentration_rijn

20.5 reference_concentration_wright_parker

20.6 reference_concentration_zyserman_fredsoe

21 suspension

21.1 reference_height_mclean

21.2 reference_height_rijn

21.3 settling_time_constant_eddy_viscosity

21.4 settling_velocity

Settling velocity
5.23d in julien-2010
settling velocity according to cheng
settling velocity in water
stokes settling velocity
d : [mm] diameter of sediment particle
ws : [m/s] settling velocity

signed ws < 0 : falling
(Note: was R, radius in m)

valid for small particles

21.5 settling_velocity_to_diameter

invert settling velocity to diameter

21.6 stratification_parameter_rijn

21.7 stratification_parameter_wright_parker

21.8 stratification_profile_mclean

21.9 suspended_grain_size

suspended grain size distribution based on bed material grain size distribution

assumes that probability of suspension is inverse proportional to grain diameter

as in Engelund-Hansen transport relation

- no hiding effects considered
- no threshold for large grains applied
- no flocking considered

note: actual distribution varies with the depth

d : [1xnd] grain size in arbitrary units (on linear, not on log scale)

h_bed : [nsxnd] fractions of sediment of size d

21.10 `suspended_grain_size_non_linear`

suspended grain size distribution based on bed material grain size distribution

assumes that probability of suspension is inverse proportional to grain diameter

as in Engelund-Hansen transport relation

- no hiding effects considered

- no threshold for large grains applied

- no flocking considered

note: actual distribution varies with the depth

`d` : [1xnd] grain size in arbitrary units (on linear, not on log scale)

`h_bed` : [nsxnd] fractions of sediment of size `d`

21.11 `suspended_grain_size_rijn`

grain size of the suspended sediment according to van rijn, empirical

21.12 `suspended_sediment_adaptation_length_claudin`

21.13 `suspended_transport_mclean`

vertical profile of the suspended sediment according to McLean

$u := u_s / (\kappa \log(z/z_0))$;

$I = 1 / (\int_a^h c \, dz \int_a^h u \, dz) \int_a^h c \, u \, dz$

21.14 `suspended_transport_rijn`

suspended load transport according to van Rijn

21.15 `suspended_transport_van_rijn_simplified_1984`

21.16 suspended_transport_wright_parker

21.17 suspended_transport_wu

suspended sediment transport according to widthu

21.18 suspension_parameter

21.19 viscosity_correction_sediment

22 test

22.1 test_Rouse_profile_fit

22.2 test_adaptation_length_bed

22.3 test_bed_load_transport_rijn

22.4 test_bedform_roughness_rijn_2007

22.5 test_bedload_transport_mpm

22.6 test_critical_shear_stress

22.7 test_sediment_transport

22.8 test_sediment_transport_engelund_hansen_1

22.9 test_sediment_transport_engelund_hansen_2

22.10 test_sediment_transport_karim

22.11 test_sediment_transport_relation

22.12 test_sediment_transport_rijn

22.13 test_settling_velocity_to_diameter

22.14 test_suspended_transport_mclean

22.15 test_suspended_transport_wright_parker

22.16 `test_total_transport_engelund_hansen`

22.17 `test_total_transport_yang`

23 `total-transport`

23.1 `fractional_transport_engelund_hansen`

`fractional sediment transport according to engelund and hansen`

23.2 `sediment_transport_directed`

`directed sediment transport`

23.3 `sediment_transport_relation_fit`

23.4 `sediment_transport_relation_predict`

23.5 `total_transport_ackers_white`

23.6 `total_transport_bagnold`

`total sediment transport according to bagnold`

23.7 total_transport_eh_distribution

total sediment transport according to engelund hansen
for a given grain size distribution

23.8 total_transport_engelund_hansen

total sediment transport according to Engelund and Hansen

23.9 total_transport_engelund_hansen_2

sediment transport according to engelund and hansen

23.10 total_transport_karim

23.11 total_transport_rijn

total sediment transport according to van rijn

23.12 total_transport_wu

total sediment transport according to wu 2000b

23.13 total_transport_yang

24 sediment-transport

analysis and prediction of fluvial sediment transport and
morphodynamics

24.1 transport_sensitivity_engelund_hansen

24.2 transport_stage_mclean

transport stage according to McLean

24.3 transport_stage_rijn

transport stage as defined by van Rijn