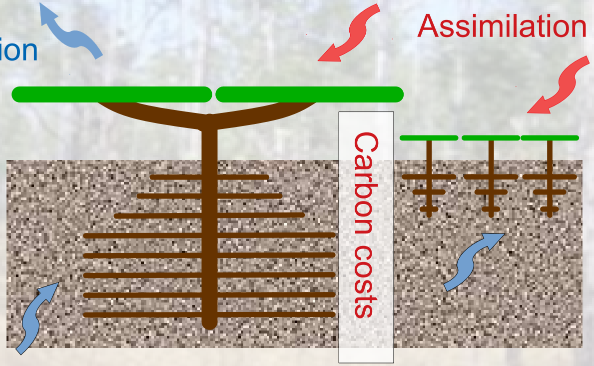
Evaluation of the **Vegetation Optimality Model** along the **North-Australian Tropical Transect** using a fully **Open Science approach**

R.C. Nijzink[1], J. Beringer[2], L.Hutley[3], C. Ramakrishnan[4], R. Roskar[4], S. Schymanski[1]

[1] Luxembourg Institute of Science and Technology, Belvaux, Luxembourg,
[2]University of Western Australia, Crawley,Australia
[3]Charles Darwin University, Darwin, NT, Australia
[4]Swiss Data Science Center, Zurich, Switzerland



Supported by the Luxembourg National Research Fund (FNR)
ATTRACT programme (A16/SR/11254288)

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

STATE-OF-THE-ART

Motivation

Hypotheses

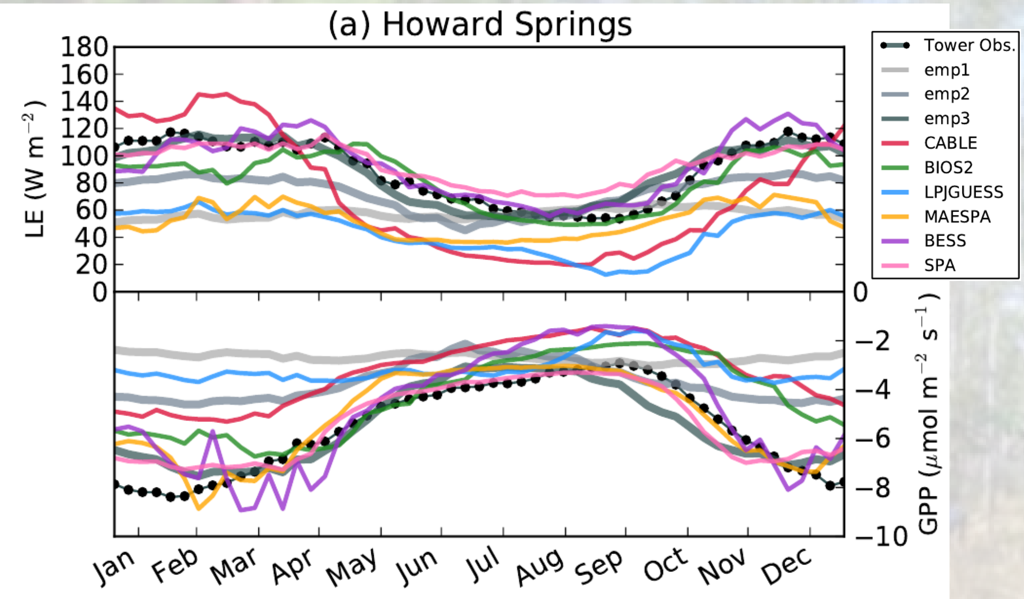
Methods

Results

Conclusions

Knowledge graph

Renku workflow



Whitley et al. (2015): Biogeosciences 13

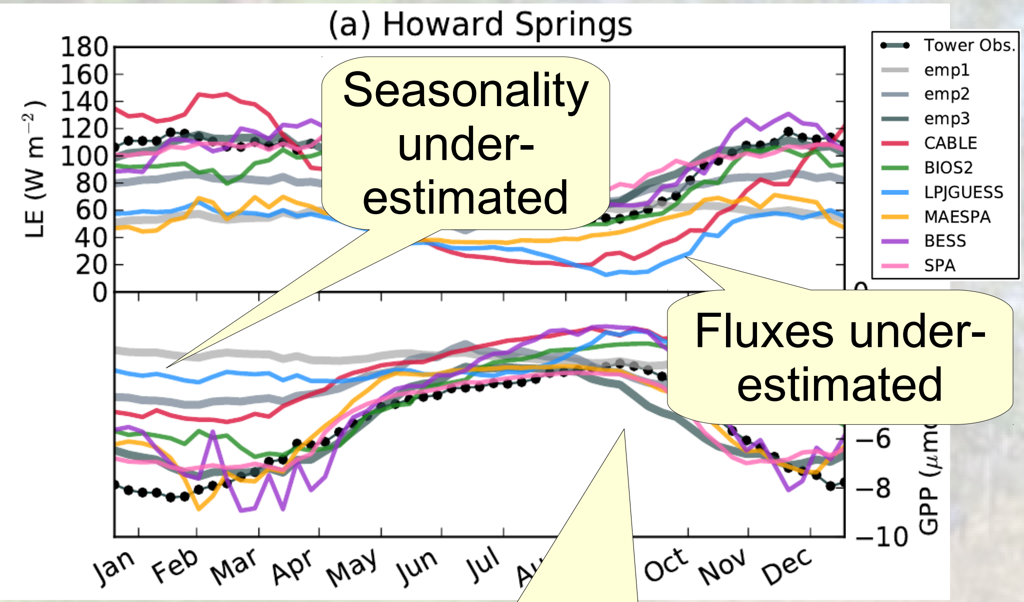
Land Surface Models today:

...produce very different results for unclear reasons

Previous Home Next

STATE-OF-THE-ART

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST
Luxembourg National Research Fund



Seasonality under-estimated

Fluxes under-estimated

Differences due to different structure, parametrization…?

…15): Biogeosciences 13

Land Surface Models today:

...produce very different results for unclear reasons

STATE-OF-THE-ART

Motivation

Hypotheses

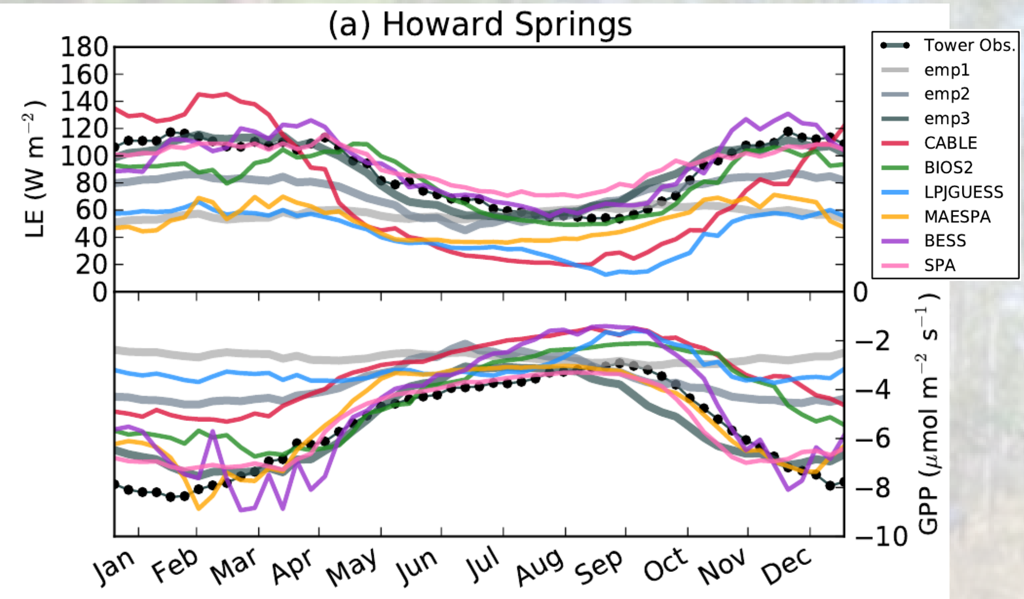
Methods

Results

Conclusions

Knowledge graph

Renku workflow



Whitley et al. (2015): Biogeosciences 13

Land Surface Models today:

...produce very different results for unclear reasons

...commonly rely on past observations

Previous Home Next

STATE-OF-THE-ART

Motivation

Hypotheses

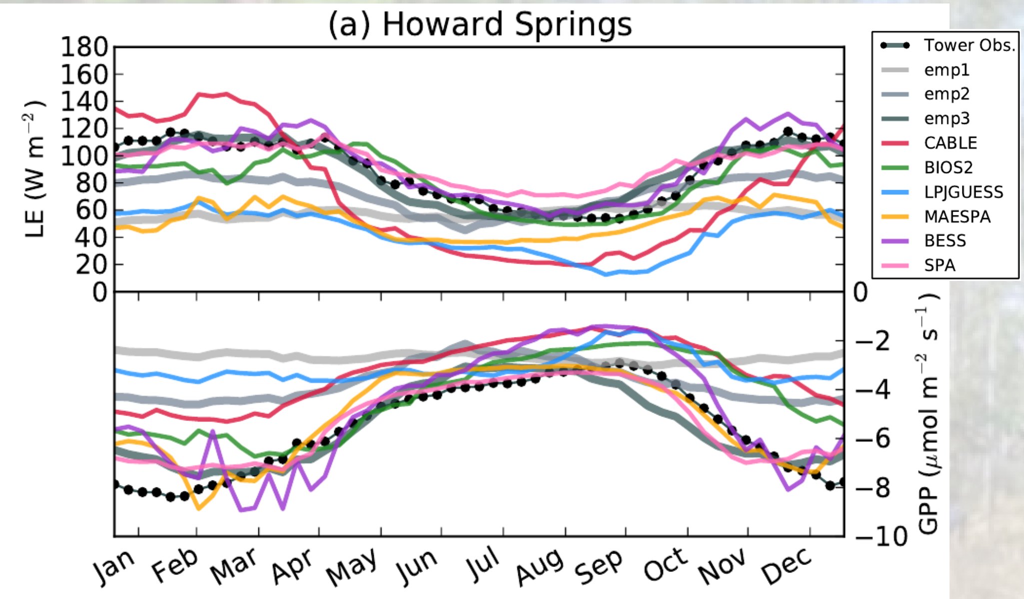
Methods

Results

Conclusions

Knowledge graph

Renku workflow



Whitley et al. (2015): Biogeosciences 13

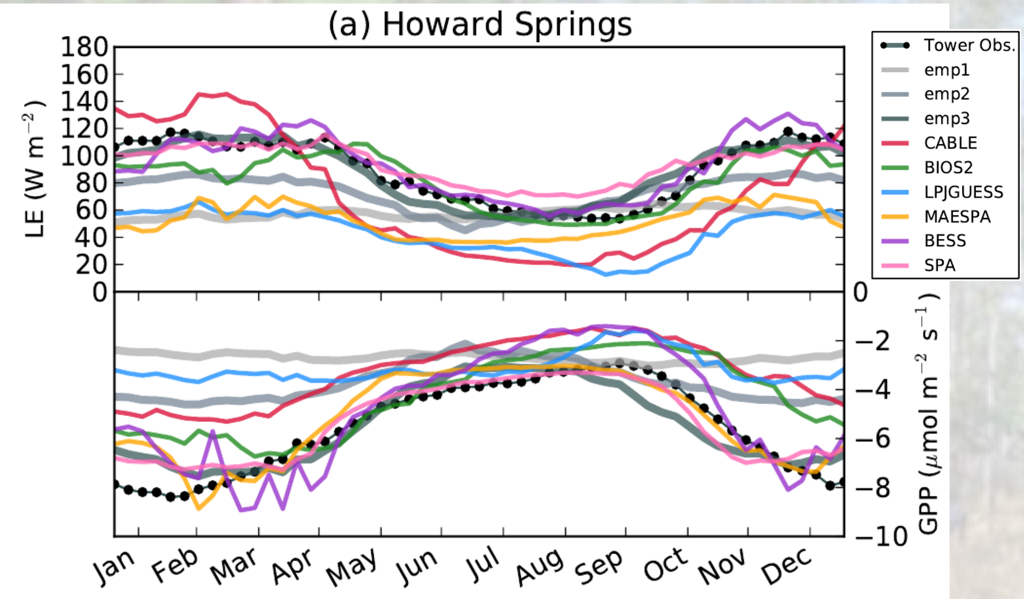
Land Surface Models today:

...produce very different results for unclear reasons

...commonly rely on past observations

...cannot simulate full response to change due to prescribed properties

STATE-OF-THE-ART



Whitley et al. (2015): Biogeosciences 13

Land Surface Models today:

...produce very different results for unclear reasons

...commonly rely on past observations

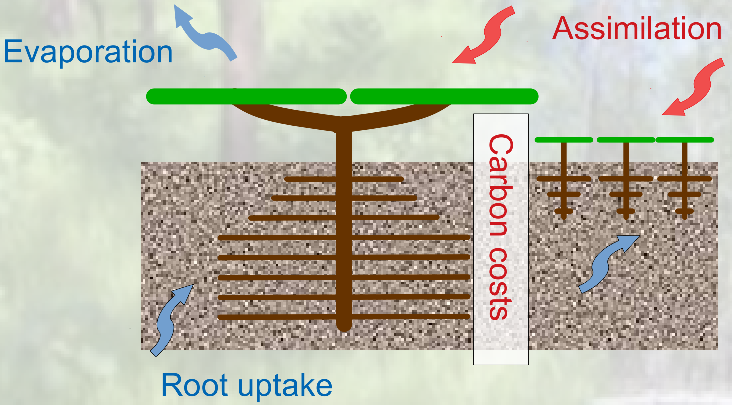
...cannot simulate full response to change due to prescribed properties

And how about reproducibility and repeatability?

VEGETATION OPTIMALITY

Net Carbon Profit :

Difference carbon uptake and carbon costs



Motivation

Hypotheses

Methods

Results

Conclusions

Knowledge graph

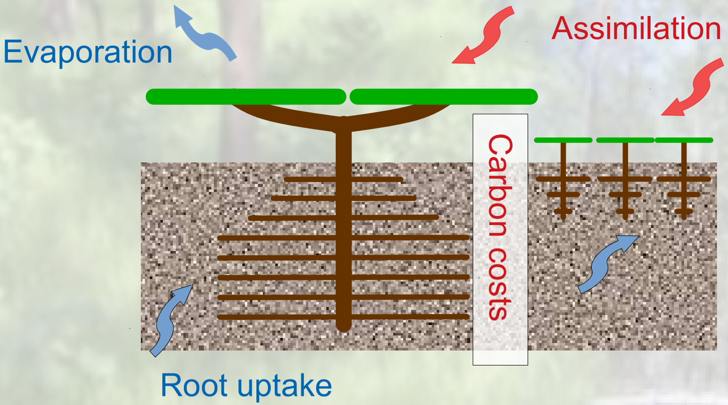
Renku workflow

VEGETATION OPTIMALITY

Renku workflow

Net Carbon Profit :

Difference carbon uptake and carbon costs



Vegetation Optimality Model

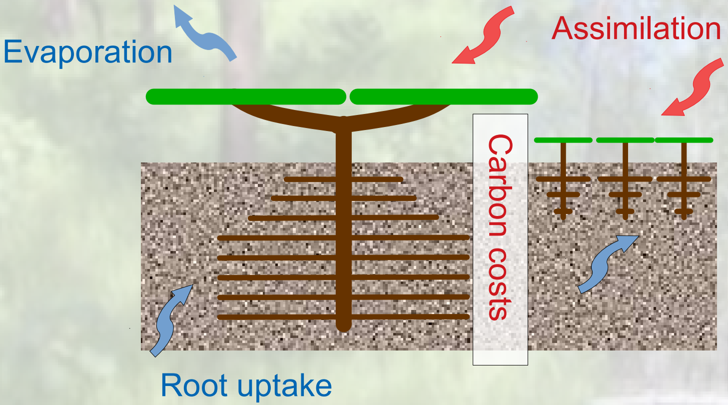
Optimizes vegetation properties to maximize **NCP**

VEGETATION OPTIMALITY

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow

Net Carbon Profit :

Difference carbon uptake and carbon costs



Vegetation Optimality Model

Optimizes vegetation properties to maximize NCP

No vegetation data needed

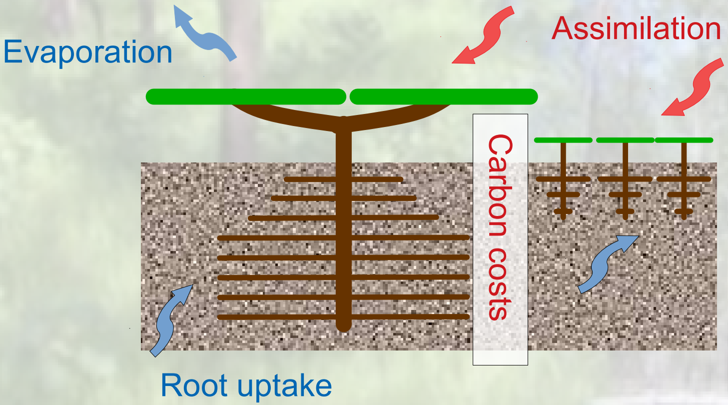
Previous Home Next

VEGETATION OPTIMALITY

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST
Luxembourg National Research Fund

Renku workflow

Net Carbon Profit :
Difference carbon uptake and carbon costs



Vegetation Optimality Model
Optimizes vegetation properties to maximize NCP

No vegetation data needed

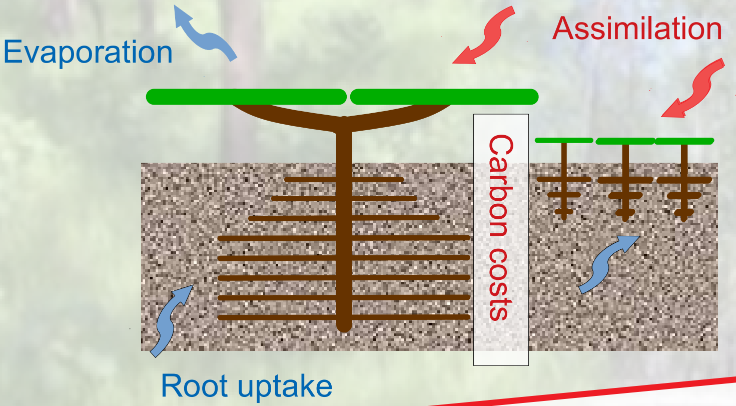
Dynamically adapts to change

Previous Home Next

VEGETATION OPTIMALITY

Renku workflow

Net Carbon Profit :
Difference carbon uptake and carbon costs



Vegetation Optimality Model
Optimizes vegetation properties to maximize NCP

No vegetation data needed

Dynamically adapts to change

And how about reproducibility and repeatability?

VEGETATION OPTIMALITY

Motivation

Hypotheses

Methods

Results

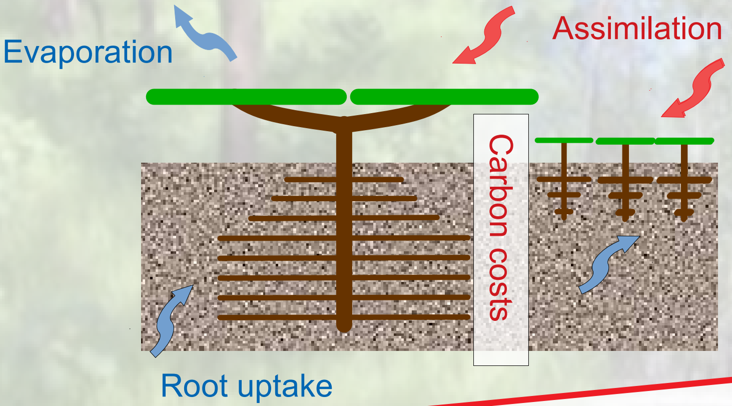
Conclusions

Knowledge graph

Renku workflow

Net Carbon Profit :

Difference carbon uptake and carbon costs



Vegetation Optimality Model

Optimizes vegetation properties to maximize NCP

No vegetation data needed

Dynamically adapts to change

And how about reproducibility and repeatability?

Renku 連句

Software platform for reproducible and collaborative science

Previous Home Next

PREVIEW...

Motivation

Hypotheses

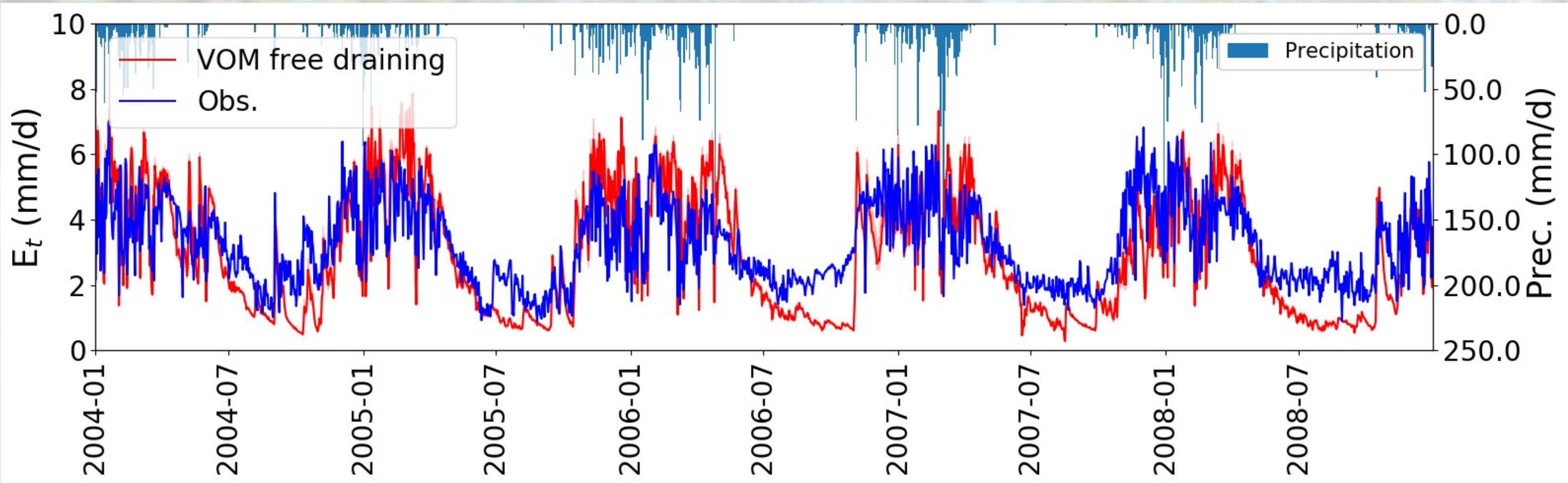
Methods

Results

Conclusions

Knowledge graph

Renku workflow



Evaporation is quite right!

Previous Home Next

PREVIEW...

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

Motivation

Hypotheses

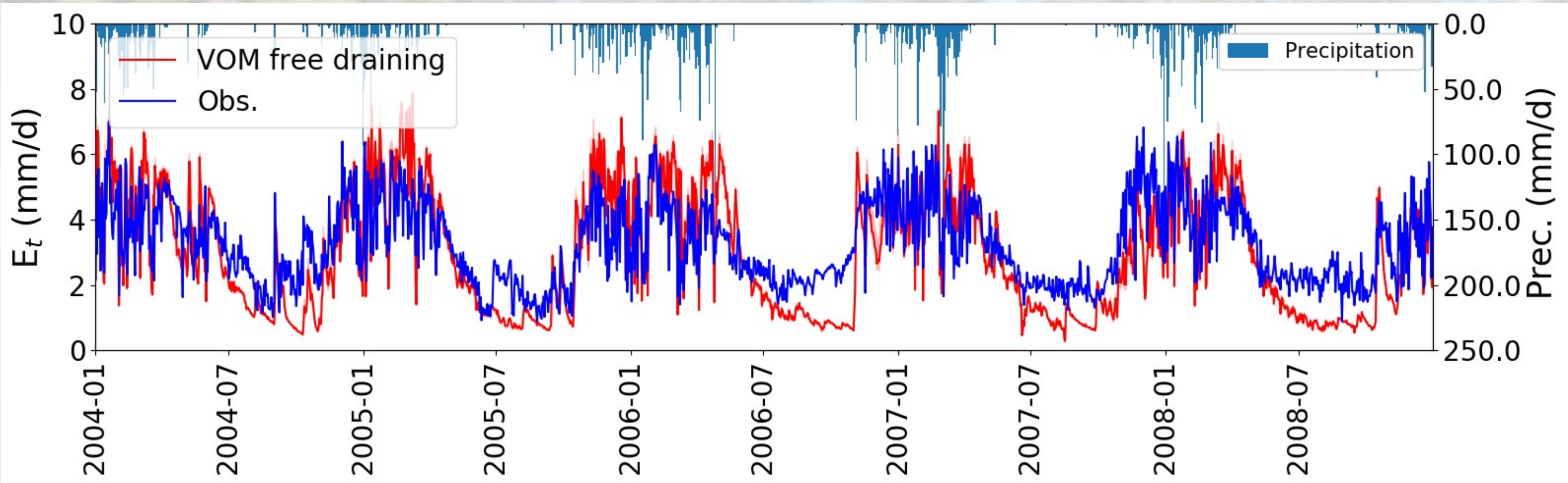
Methods

Results

Conclusions

Knowledge graph

Renku workflow



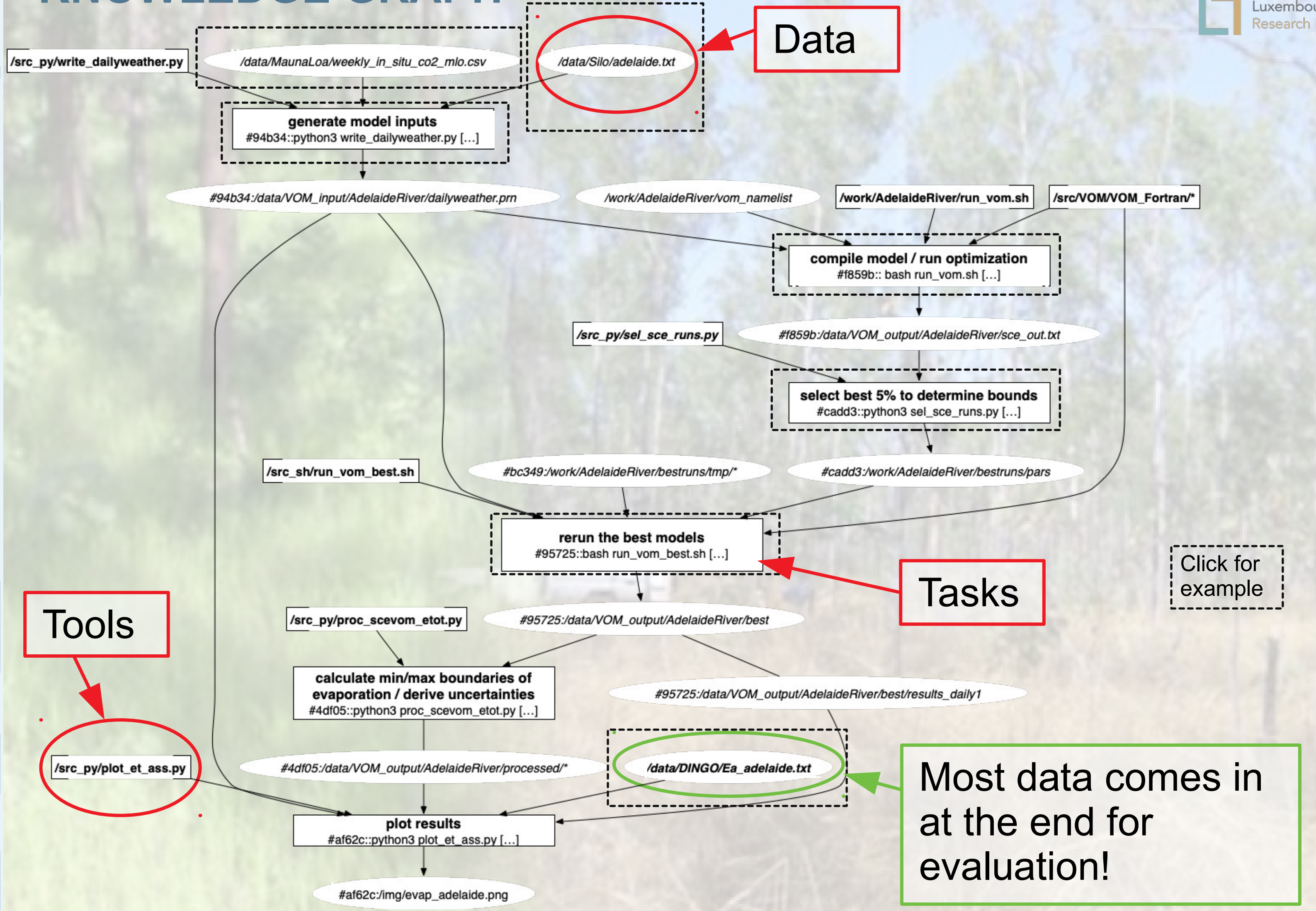
With less data!

Evaporation is quite right!

Previous Home Next

KNOWLEDGE GRAPH

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow



Click for example

Previous
Home
Next

Evaluation of the Vegetation Optimality Model along the North-Australian Tropical Transect using a fully Open Science approach

R.C. Nijzink[1], J. Beringer[2], L.Hutley[3], R. Roskar[4], S. Schymanski[1]

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

Highlights

Motivation
State-of-the art
Vegetation Optimality

Hypotheses

Methods
VOM
NATT

Results
Initial Results
Model Comparison
Hydrology and carbon costs
Vegetation dynamics

Conclusions

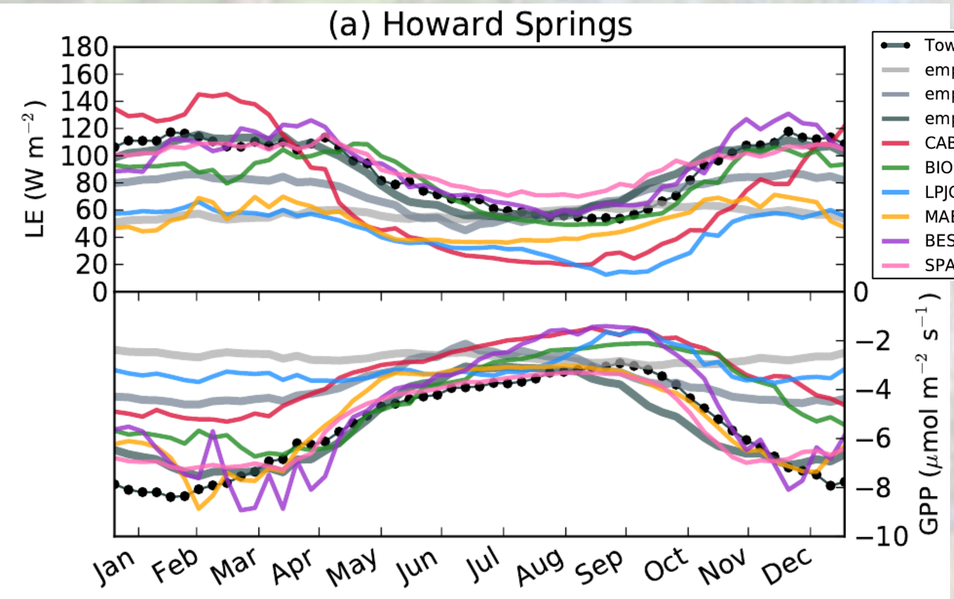
Knowledge graph

Renku workflow

[1] *Luxembourg Institute of Science and Technology, Belvaux, Luxembourg,*
[2] *University of Western Australia, Crawley,Australia*
[3] *Charles Darwin University, Darwin, NT, Australia*
[4] *Swiss Data Science Center, Zurich, Switzerland*

STATE-OF-THE-ART

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow
Previous
Home
Next



Whitley et al. (2015): Biogeosciences 13

Land Surface Models today:

...produce very different results for unclear reasons

...commonly rely on past observations

...cannot simulate full response to change due to prescribed properties

And how about reproducibility and repeatability?

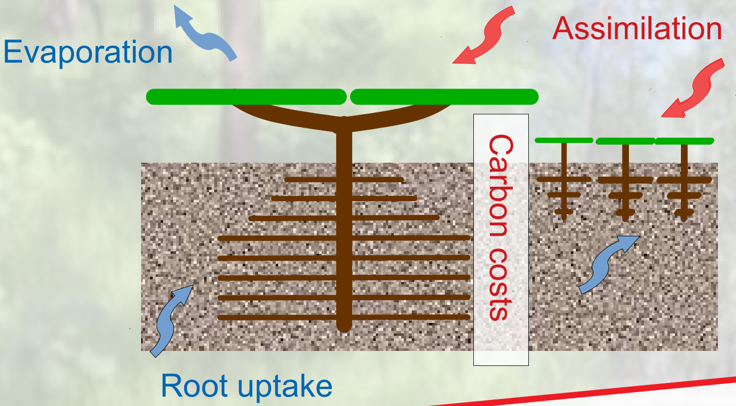
Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph

Renku workflow

VEGETATION OPTIMALITY

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST
Luxembourg National Research Fund

Net Carbon Profit :
Difference carbon uptake and carbon costs



Vegetation Optimality Model
Optimizes vegetation properties to maximize NCP

No vegetation data needed

Dynamically adapts to change

And how about reproducibility and repeatability?

Renku 連句
Software platform for reproducible and collaborative science

Previous Home Next

HYPOTHESES

- Observed vegetation dynamics in tropical savanna sites can be explained by the maximization of **Net Carbon Profit**.
- Optimization of vegetation properties for the **Net Carbon Profit** leads to reduced data requirements for Land Surface Models
- **Hydrological formulation** of Land Surface Models matters for flux exchanges

Highlights

Motivation

Hypotheses

Methods

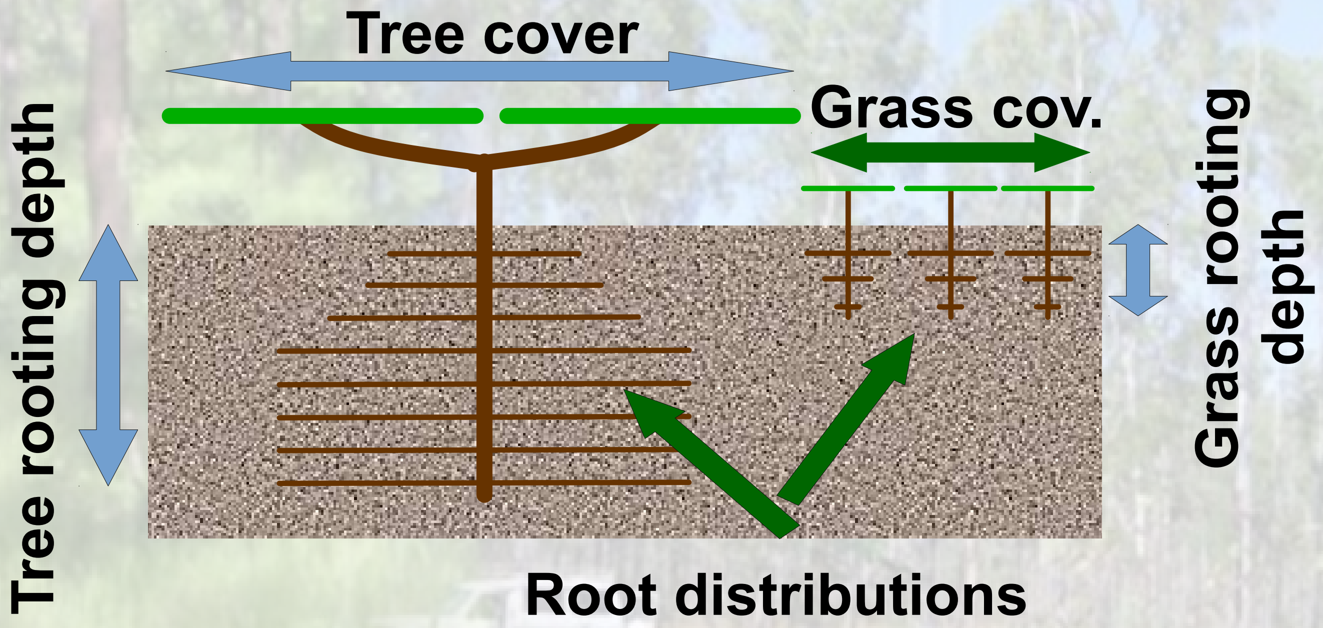
Results

Conclusions

Knowledge graph

Renku workflow

VEGETATION OPTIMALITY MODEL



Optimized constants

- Tree cover fraction
- Tree rooting depth
- Grass rooting depth
- Water use strategies

Dynamically optimized variables:

- Grass cover fraction
- Photosynthetic capacity
- Stomatal conductances
- Fine root surface area

Previous Home Next

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow
Previous
Home
Next

VEGETATION OPTIMALITY MODEL

Getting the hydrology right:

- Groundwater influences root water uptake
- Water balance should be correct
- Modelling for the *right reason*

Free draining conditions

- Conventional approach
- Large unsaturated zone (Zr = 30m)
- No influence of groundwater table

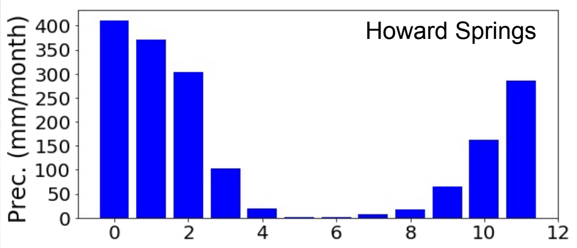
Dynamic water tables

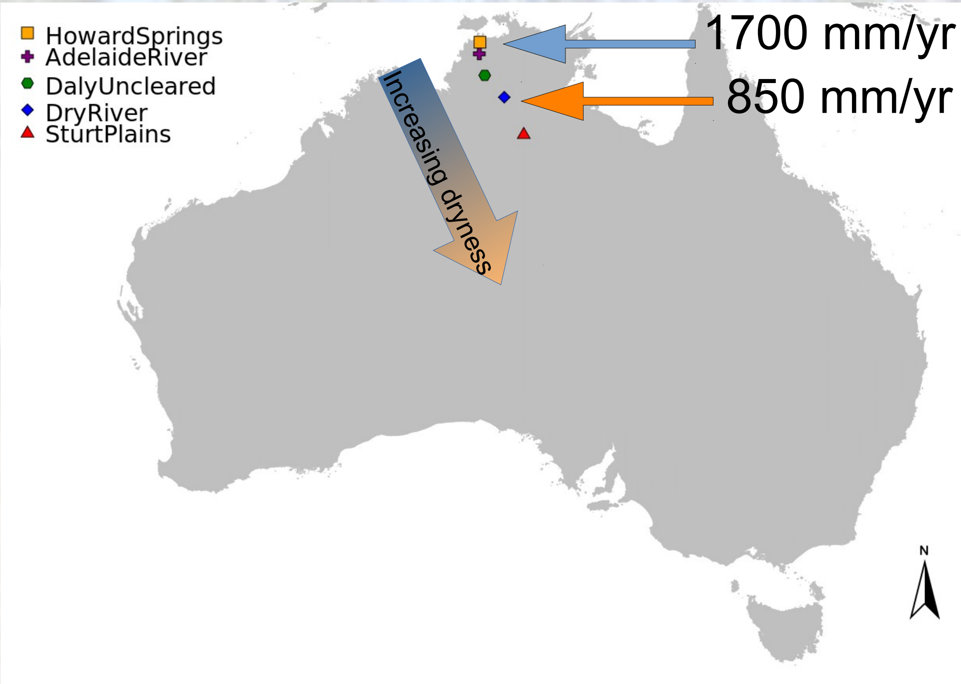
- Unsaturated zone from 5 – 30m
- Based on max. elevation and stream elevation
- Drainage depends on slopes
- Influence of groundwater tables

NORTH AUSTRALIAN TROPICAL TRANSECT

- Mean annual rainfall: 500-1800 mm
- Pronounced wet season: Nov-Feb
- Evergreen trees + seasonal grass
- Evaporation and CO_2 fluxes >10 years

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow
Previous
Home
Next





LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST
Luxembourg National Research Fund

RENKU 連句

Renku is an environment for collaborative, reproducible data science

Concepts

- Tracking of scientific steps to create data lineage, i.e. a knowledge graph
- Updating of out-dated results
- Tool to re-use or re-run analyses
- Sharing of analyses

Features

Renku is based on :

- Gitlab
- JupyterHub
- Kubernetes
- Keycloak
- Common Workflow Language

Motivation
Hypotheses
Methods
Results
Conclusions
Renku workflow
Knowledge graph
Previous
Home
Next
Go to RENKU website →

RENKU 連句

Renku run makes sure the workflow is tracked

Renku run

Renku status shows if all outputs are generated from the most recent input data

Renku status

Renku update re-runs everything to have all outputs based on the most recent inputs

Renku update

Renku log shows how a file is generated. In other words, is shows the knowledge graph.

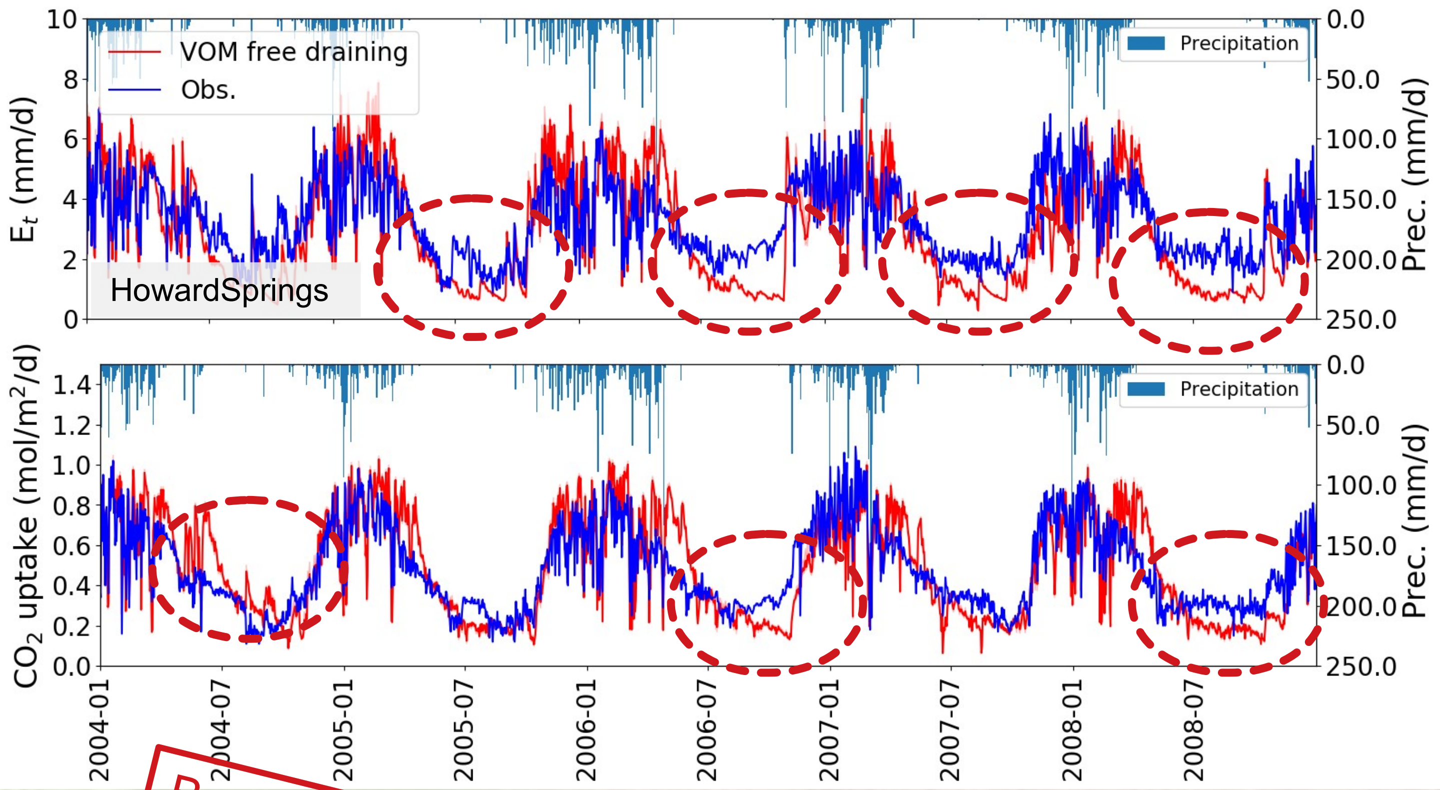
Renku log

Show knowledge graph

Go to workflow of this experiment→

INITIAL RESULTS

Reasonable match observed and modelled fluxes



But there is room for improvement...

Motivation

Hypotheses

Methods

Results

Conclusions

Knowledge graph

Renku workflow

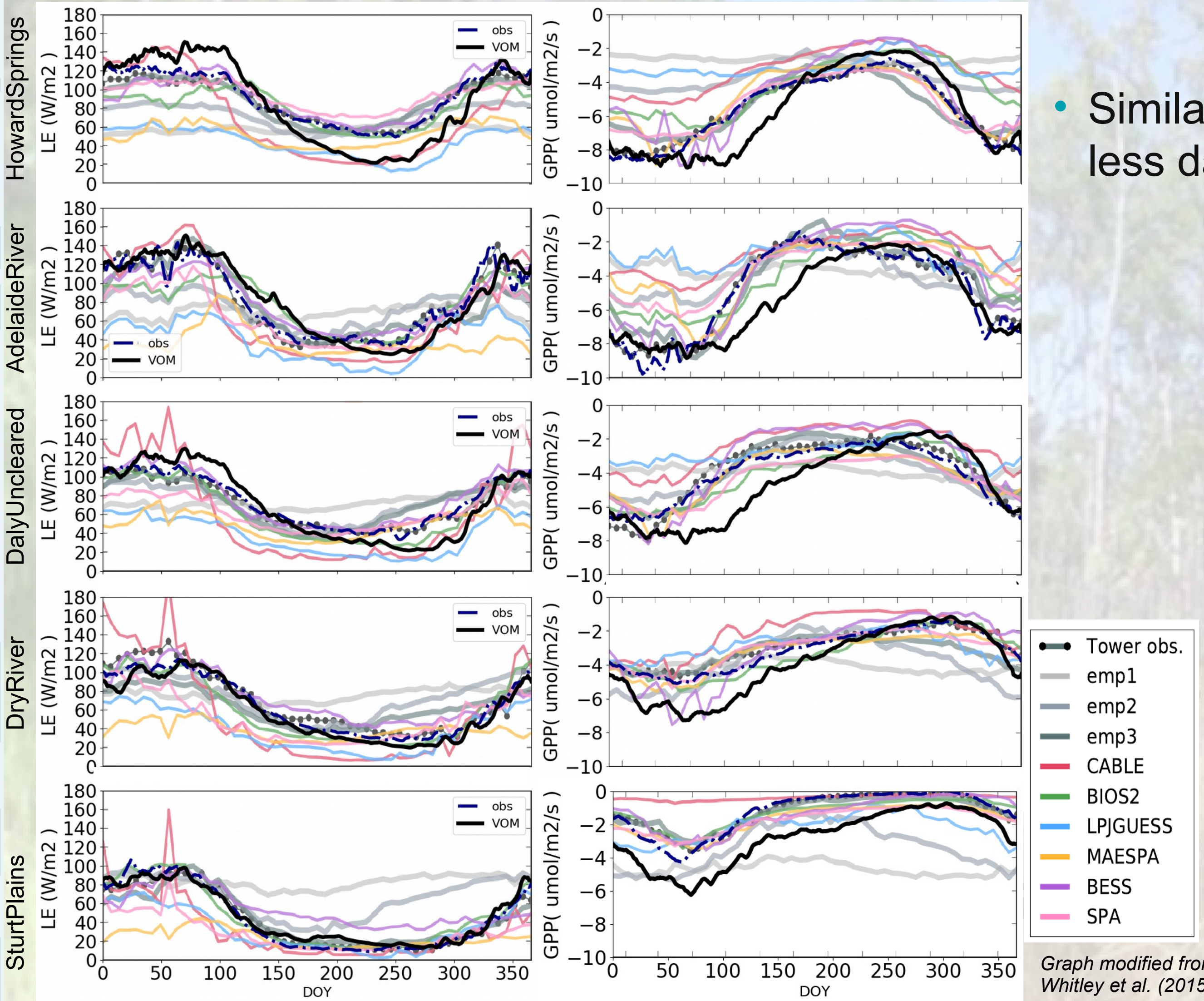
Previous Home Next

MODEL COMPARISON

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY
LIST
Luxembourg National Research Fund

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph

Renku workflow



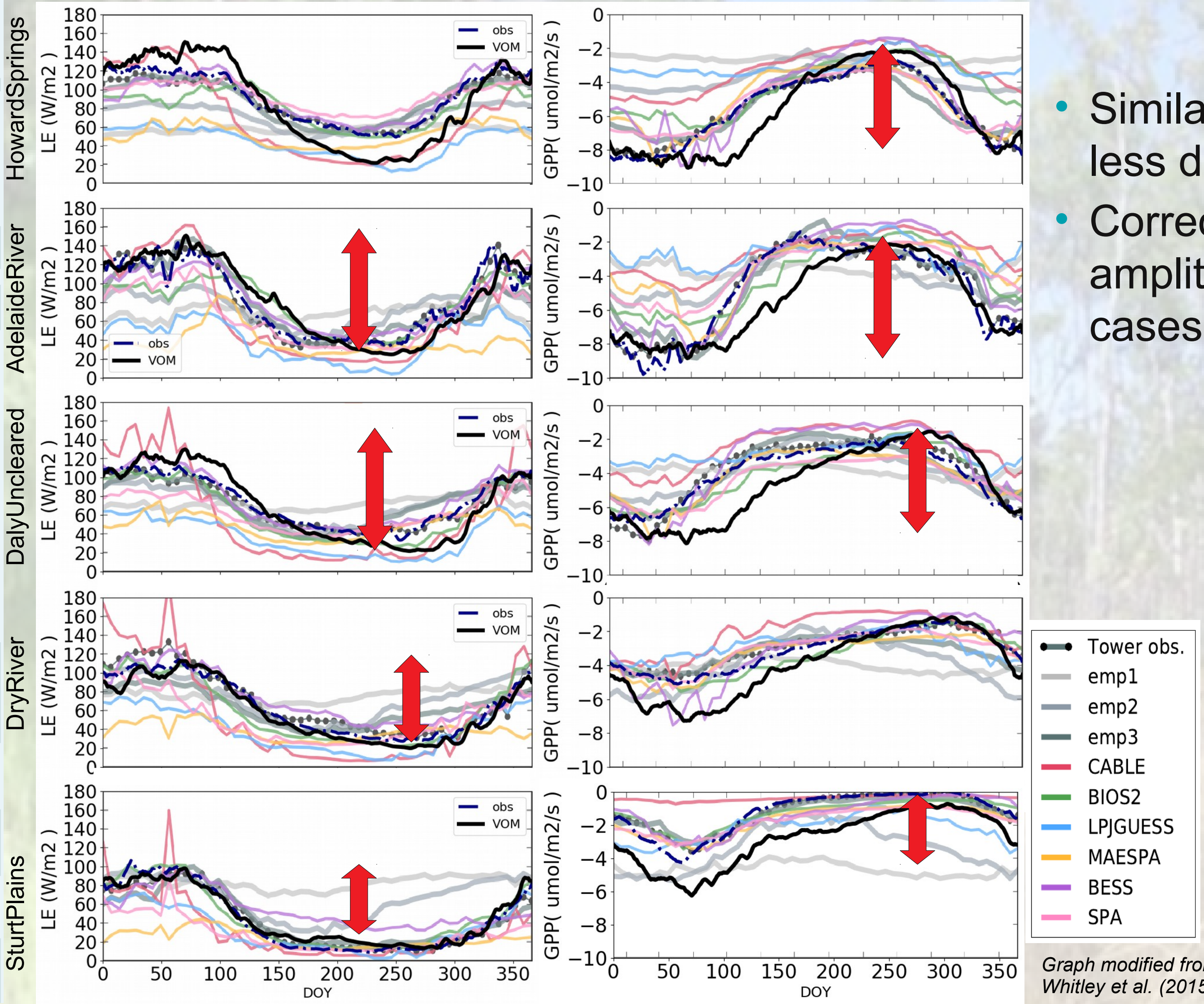
Graph modified from:
Whitley et al. (2015): Biogeosciences 13

- Similar results with less data

Previous
Home
Next

MODEL COMPARISON

Renku workflow

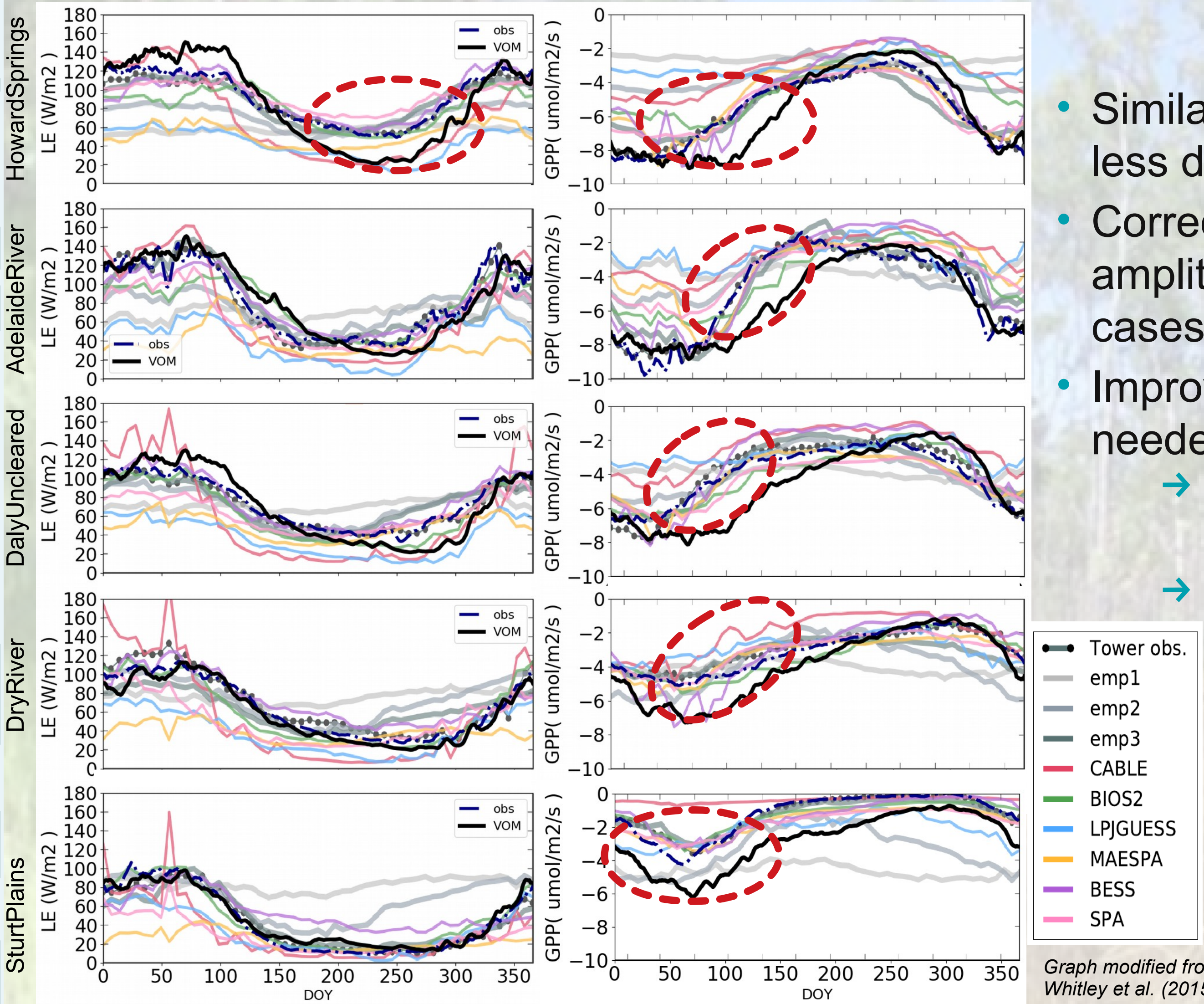


- Similar results with less data
- Correct seasonal amplitude in most cases

Graph modified from:
Whitley et al. (2015): Biogeosciences 13

Previous Home Next

MODEL COMPARISON



Graph modified from:
Whitley et al. (2015): Biogeosciences 13

- Similar results with less data
- Correct seasonal amplitude in most cases
- Improvements still needed:
  - → Assimilation too high
  - → Especially for drier sites

MODEL COMPARISON

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST
Luxembourg National Research Fund

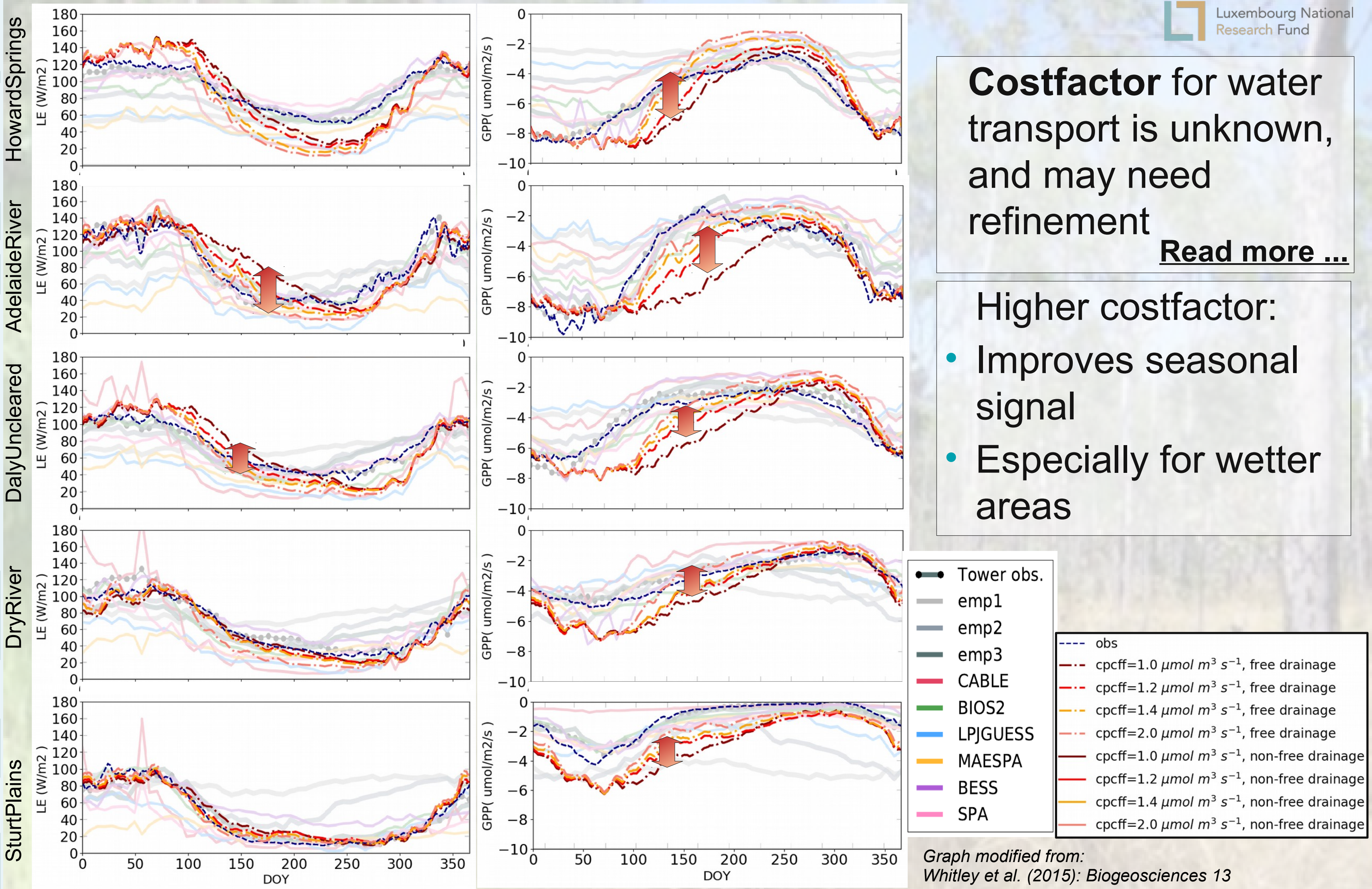
Costfactor for water transport is unknown, and may need refinement

Read more ...

Higher costfactor:

- Improves seasonal signal
- Especially for wetter areas

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow



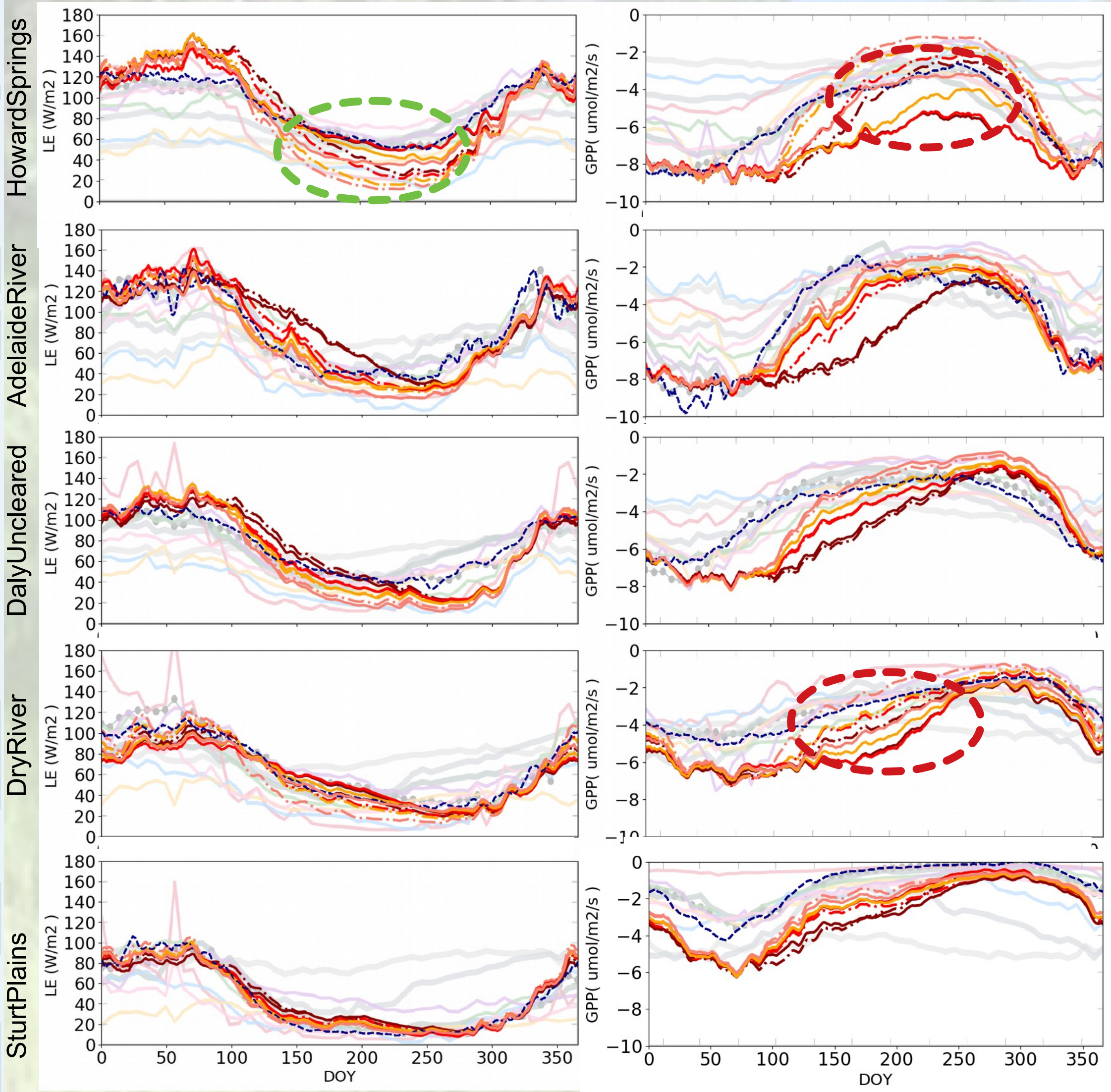
Graph modified from:
Whitley et al. (2015): Biogeosciences 13

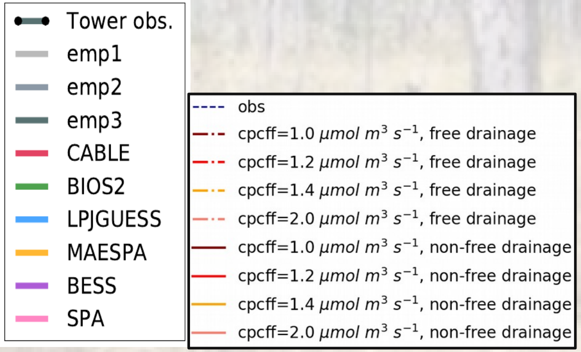
Previous Home Next

Highlights

MODEL COMPARISON

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow





Graph modified from:
Whitley et al. (2015): Biogeosciences 13

Hydrology is parameterized for free draining and non-free draining conditions

- Some improvements
- Some deteriorations
- Mostly similar results

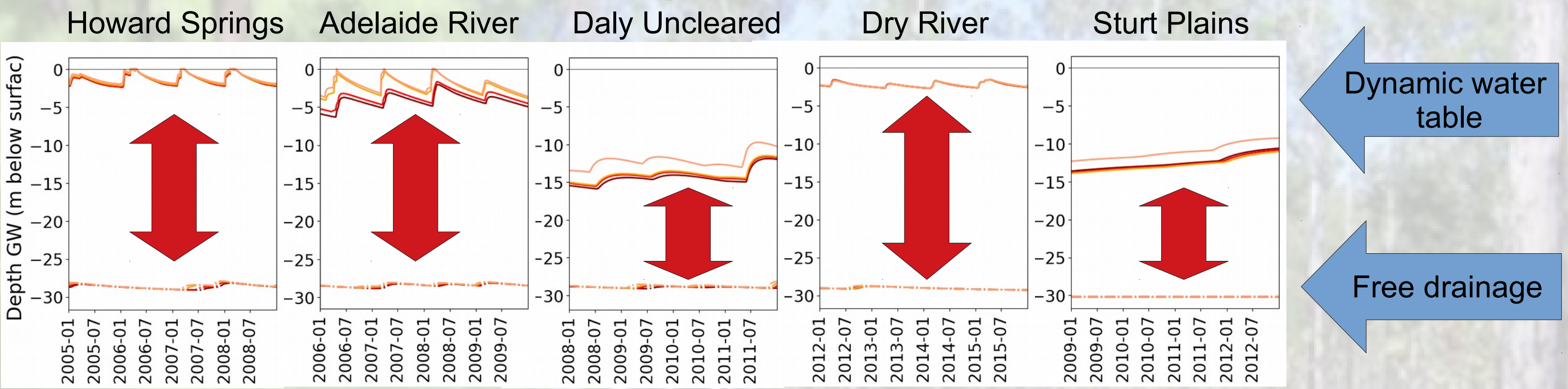
Uniqueness of place?
Robust model?

Previous
Home
Next

IMPROVING HYDROLOGY AND CARBON COSTS

Hydrology differs strongly, but has hardly any influence on fluxes

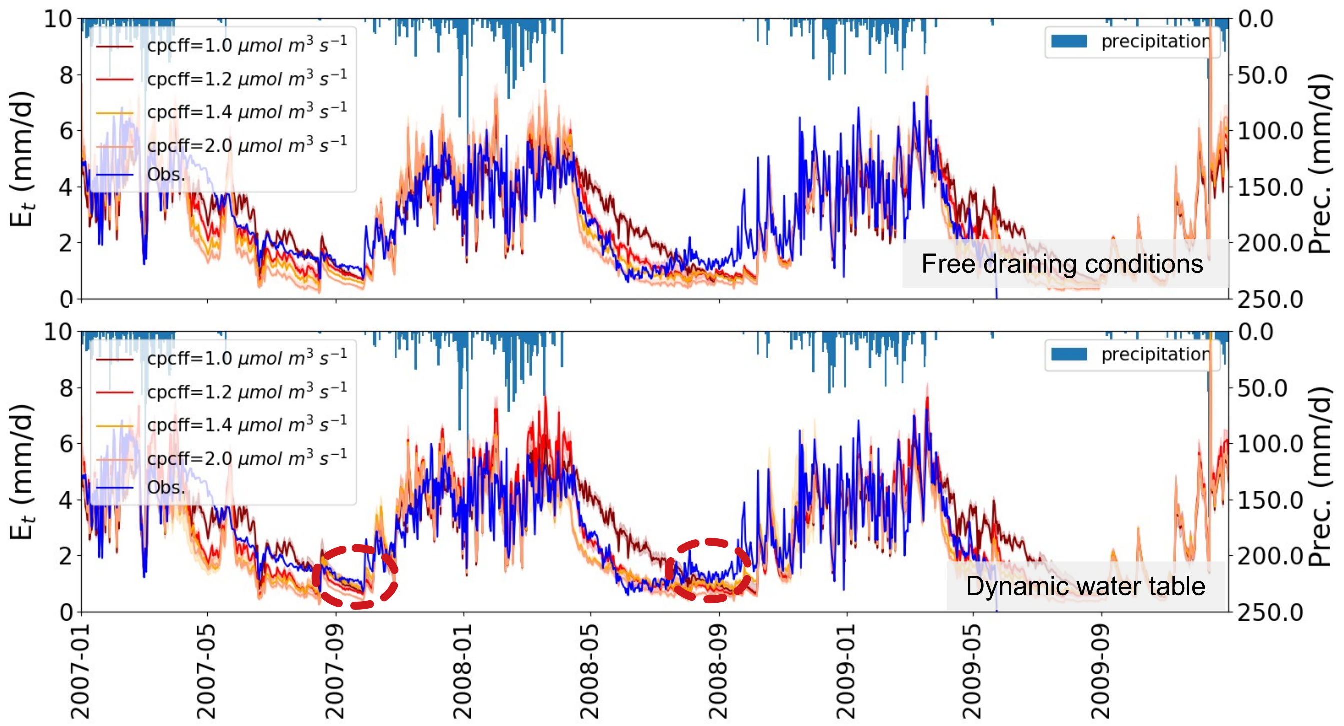
Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow



- cpcff=1.0 $\mu mol\ m^3\ s^{-1}$, free drainage
- cpcff=1.2 $\mu mol\ m^3\ s^{-1}$, free drainage
- cpcff=1.4 $\mu mol\ m^3\ s^{-1}$, free drainage
- cpcff=2.0 $\mu mol\ m^3\ s^{-1}$, free drainage
- cpcff=1.0 $\mu mol\ m^3\ s^{-1}$, dynamic water table
- cpcff=1.2 $\mu mol\ m^3\ s^{-1}$, dynamic water table
- cpcff=1.4 $\mu mol\ m^3\ s^{-1}$, dynamic water table
- cpcff=2.0 $\mu mol\ m^3\ s^{-1}$, dynamic water table

Previous Home Next
See more...

IMPROVING HYDROLOGY AND CARBON COSTS



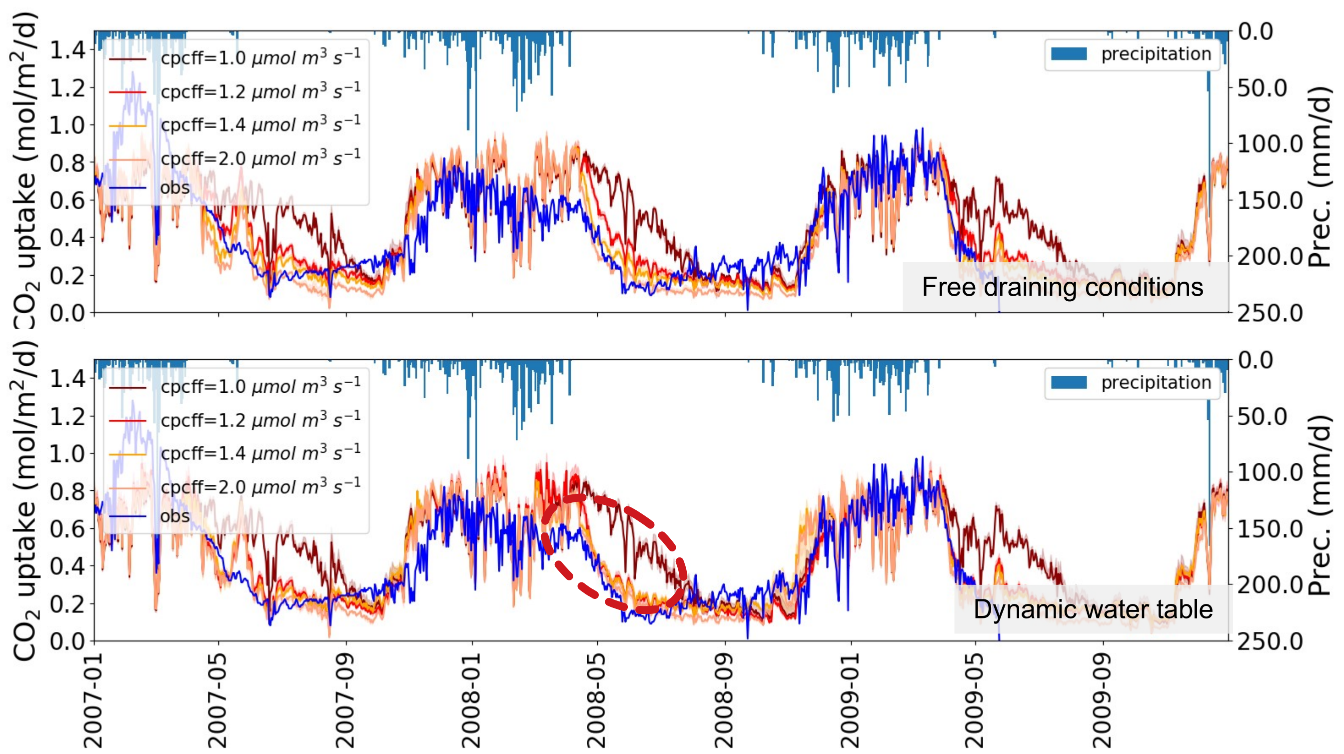
Improvements by the hydrology:

- Only small improvements at end of dry season

See more ...
Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains
Previous
Home
Next

IMPROVING HYDROLOGY AND CARBON COSTS

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow



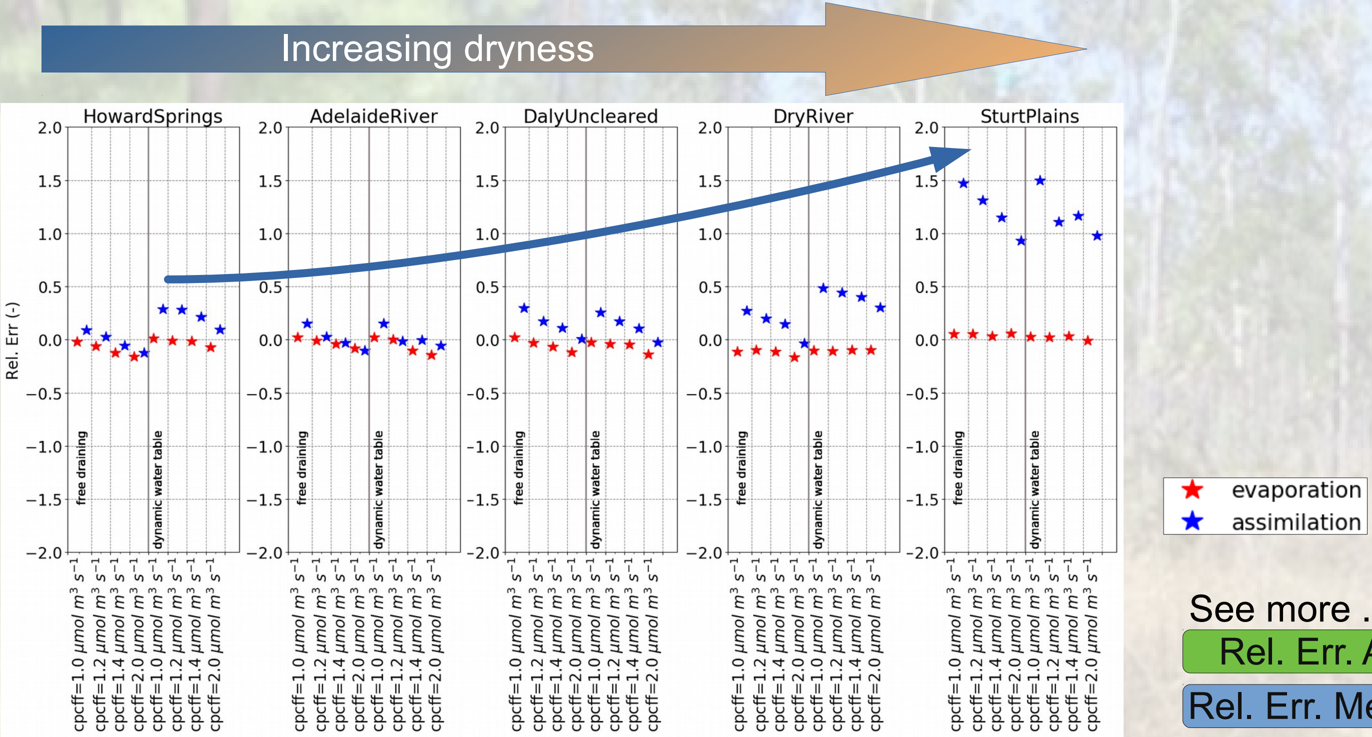
- Higher values of the water transport cost parameter improve assimilation
- Only small differences for dynamic water tables

See more ...

Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains
Previous
Home
Next

PERFORMANCES

- Assimilation increasingly over-estimated for drier areas
- Evaporation still okay

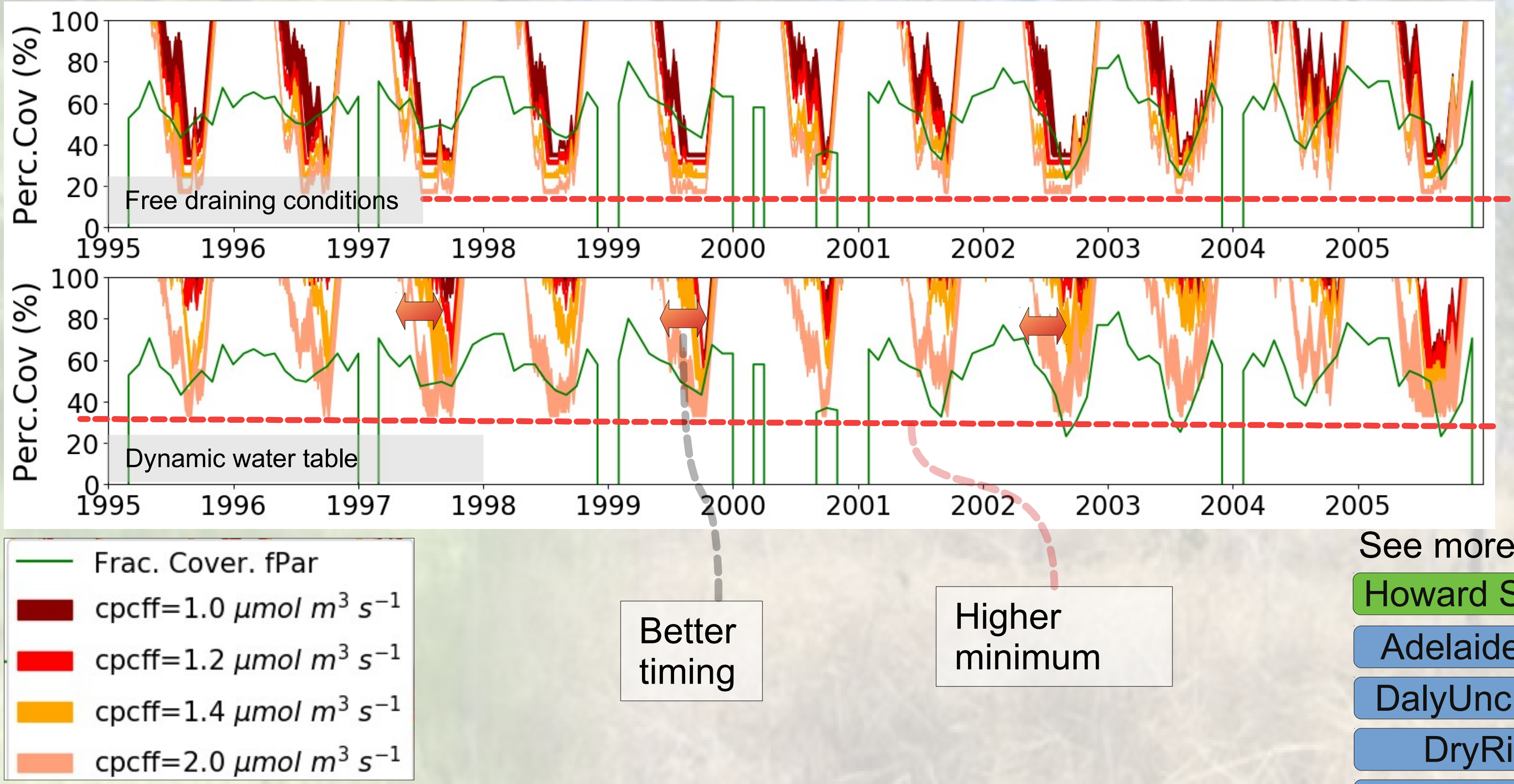


Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow
Previous
Home
Next

See more ...
Rel. Err. Annual Means
Rel. Err. Mean Dry Season
Rel. Err. Mean Wet Season
Kling-Gupta Efficiency

VEGETATION DYNAMICS

- Temporal signal largely reproduced
- Timing improves for higher cost factor
- Higher minimum cover for non-freely draining conditions



Motivation

Hypotheses

Methods

Results

Conclusions

Knowledge graph

Renku workflow

See more ...

Howard Springs

AdelaideRiver

DalyUncleared

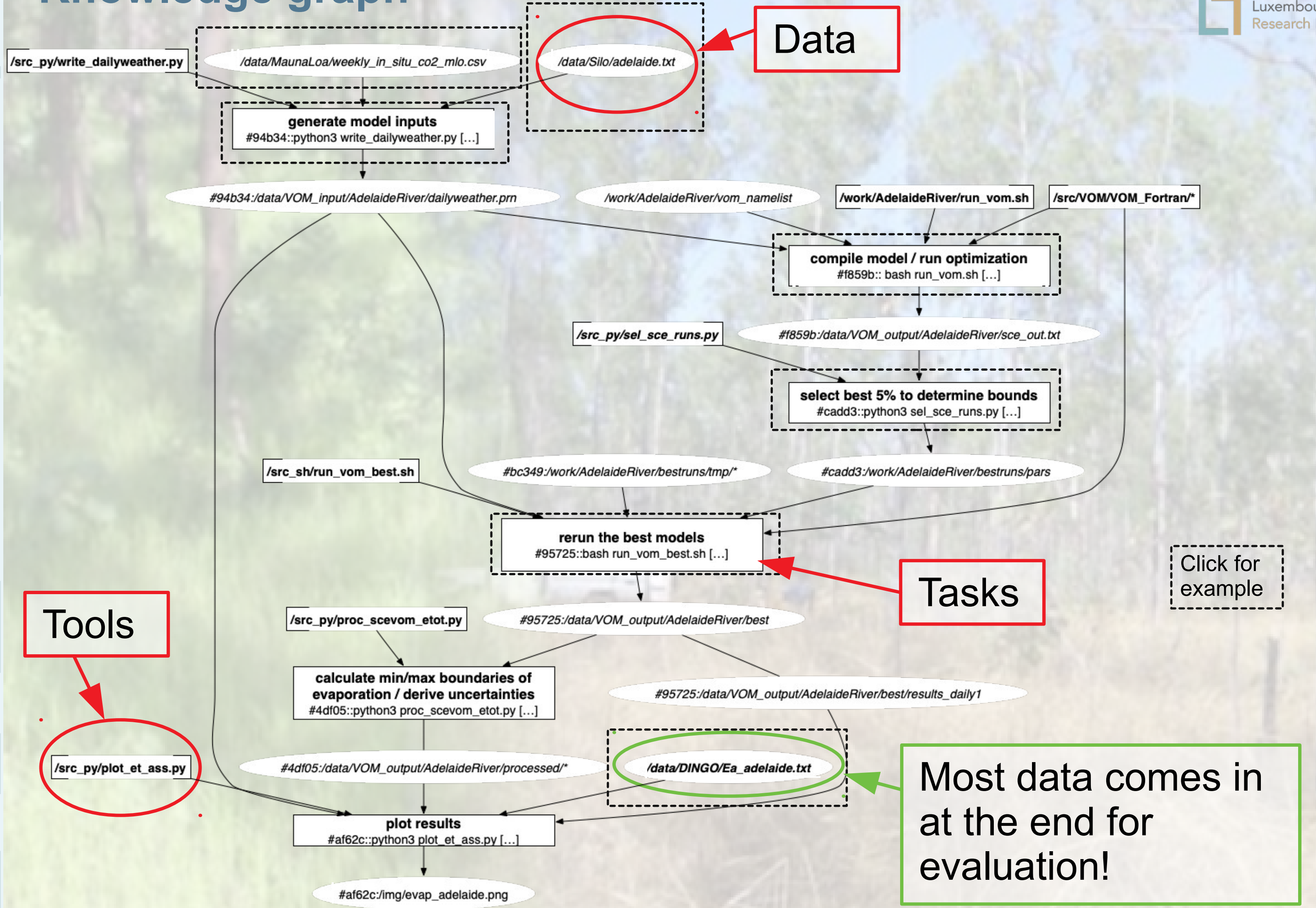
DryRiver

SturtPlains

CONCLUSIONS

- Optimizing for the **Net Carbon Profit** leads to similar vegetation dynamics as observed
- Similar performances as conventional models, with **less data**
- Not a clear influence of the **hydrological formulation**
- **Cost factor** for water transport needs to be refined
- Reproducible science with **Renku!**

Knowledge graph



Click for example

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow
Previous Home Next

CARBON COSTS

- **Root respiration** is a function of respiration rate (c_{Rr}, *mol s⁻¹ m⁻³*), fine root radius (r_r, *m*), root surface area per unit ground area (S_{Ar}, m^2 m^{-2}) :

$$R_r = c_{Rr}\left(\frac{r_r}{2} S_{Ar}\right)$$

- **Leaf area costs** are a function of vegetated fraction (M_A, -) , clumped leaf area index (*2.5, -*), average carbon investment (*0.22 μmol* s^{-1} m^{-2}):

$$R_f = 2.5 \times 0.22\,\mu mol s^{-1} m^{-2} M_A$$

- **Water transport costs** are a function of rooting depth (y_r), vegetated fraction (M_A, -) and a cost factor (*cpcff, mol* s^{-1} m^{-3}):

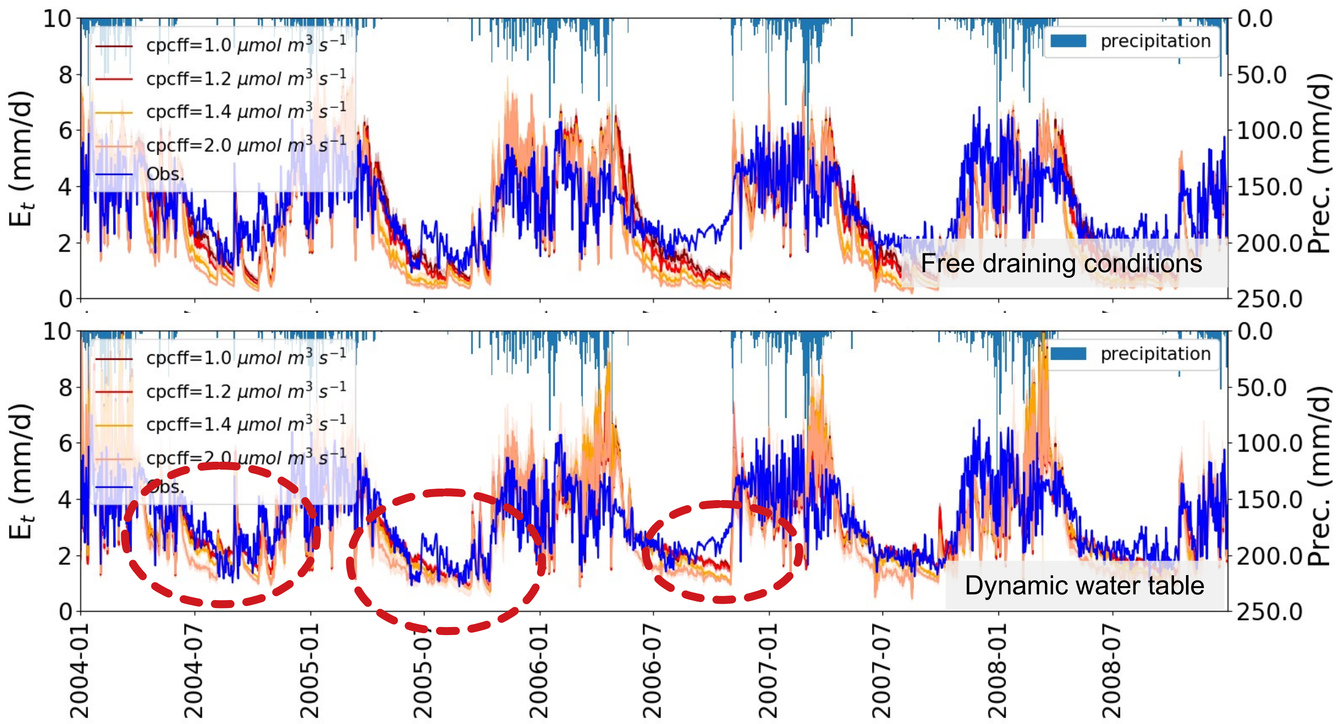
$$R_v = cpcff * M_A\, y_r$$

The cost factor *cpcff* is rather unknown, and may need refinement.

HYDROLOGY AND CARBON COSTS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST
Luxembourg National Research Fund

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow



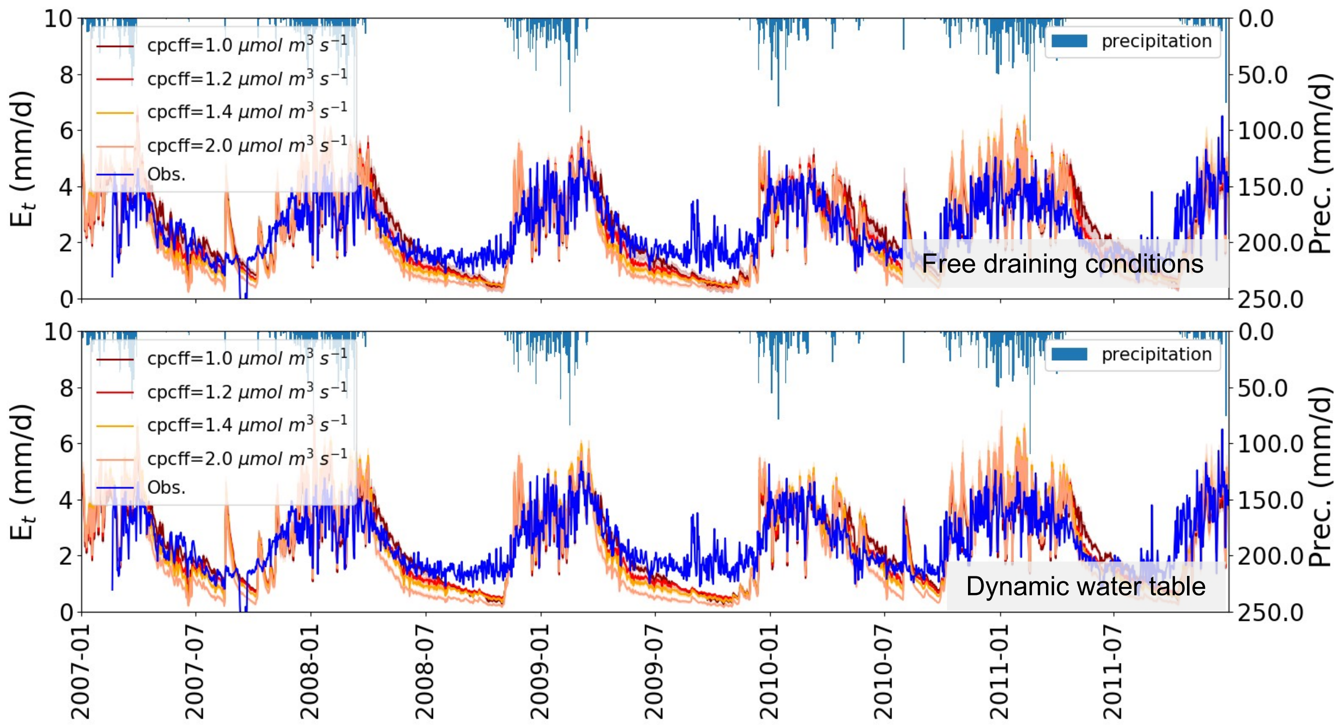
Improvements by the hydrology:

- Dynamic groundwater tables improve evaporation at end of dry season
- Still just small improvements

See more ...
Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

Previous
Home
Next

IMPROVING HYDROLOGY AND CARBON COSTS



Improvements by the hydrology:

- Dynamic groundwater tables do not show a strong improvement

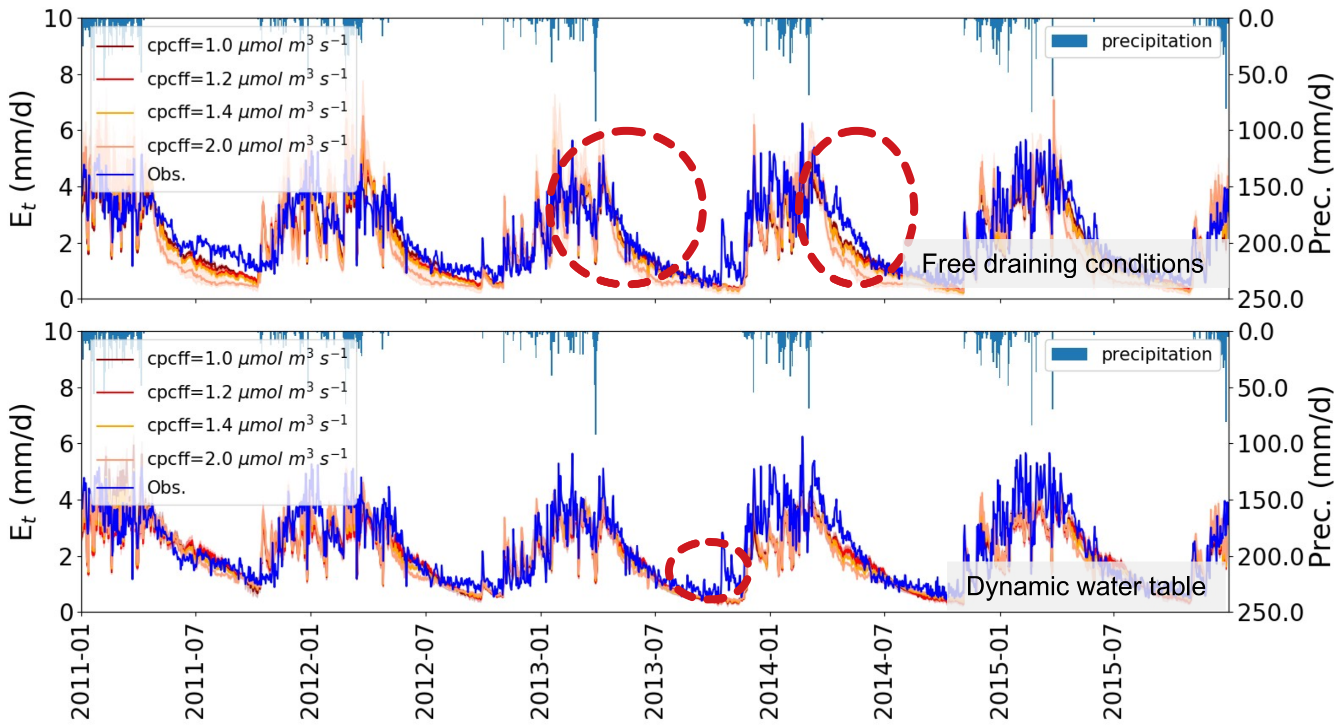
See more ...
Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

Previous
Home
Next

IMPROVING HYDROLOGY AND CARBON COSTS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund



- Higher values of the water transport cost parameter improve assimilation
- Dynamic groundwater tables do not help for assimilation

See more ...

Howard Springs

AdelaideRiver

DalyUncleared

DryRiver

SturtPlains

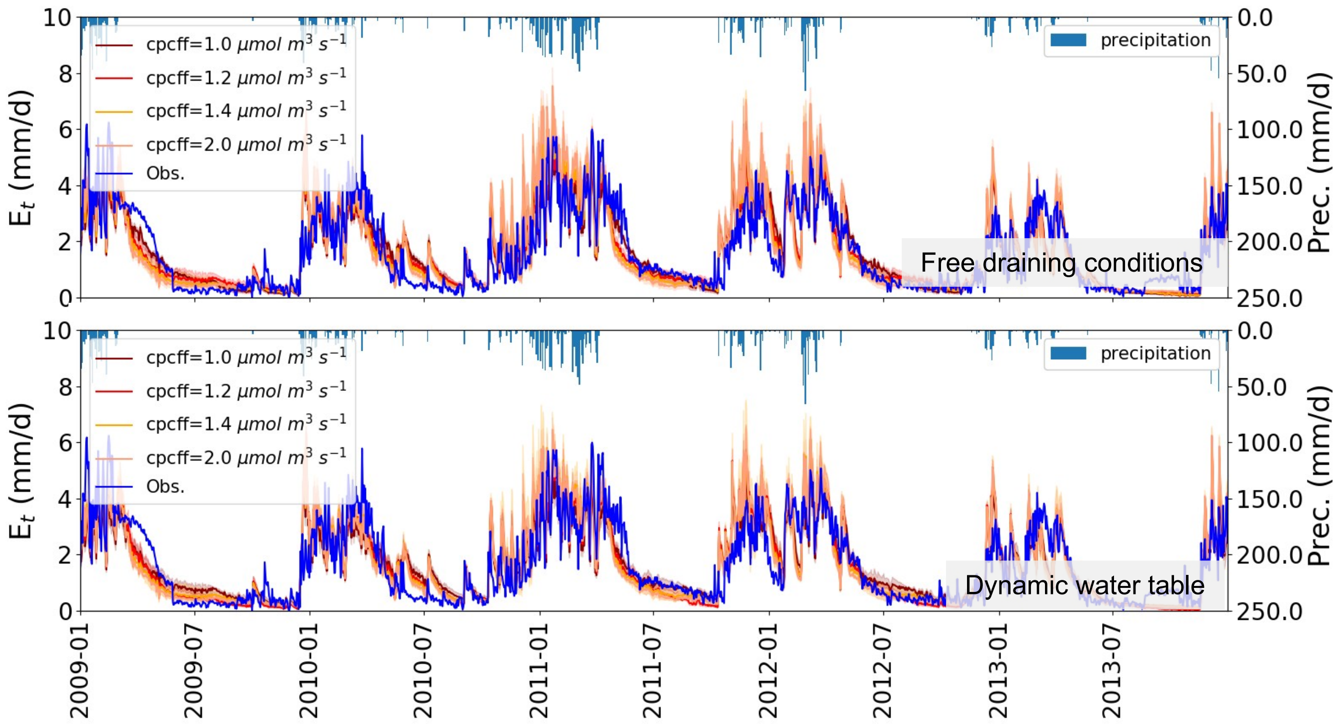
Previous Home Next

IMPROVING HYDROLOGY AND CARBON COSTS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow



Improvements by the hydrology:

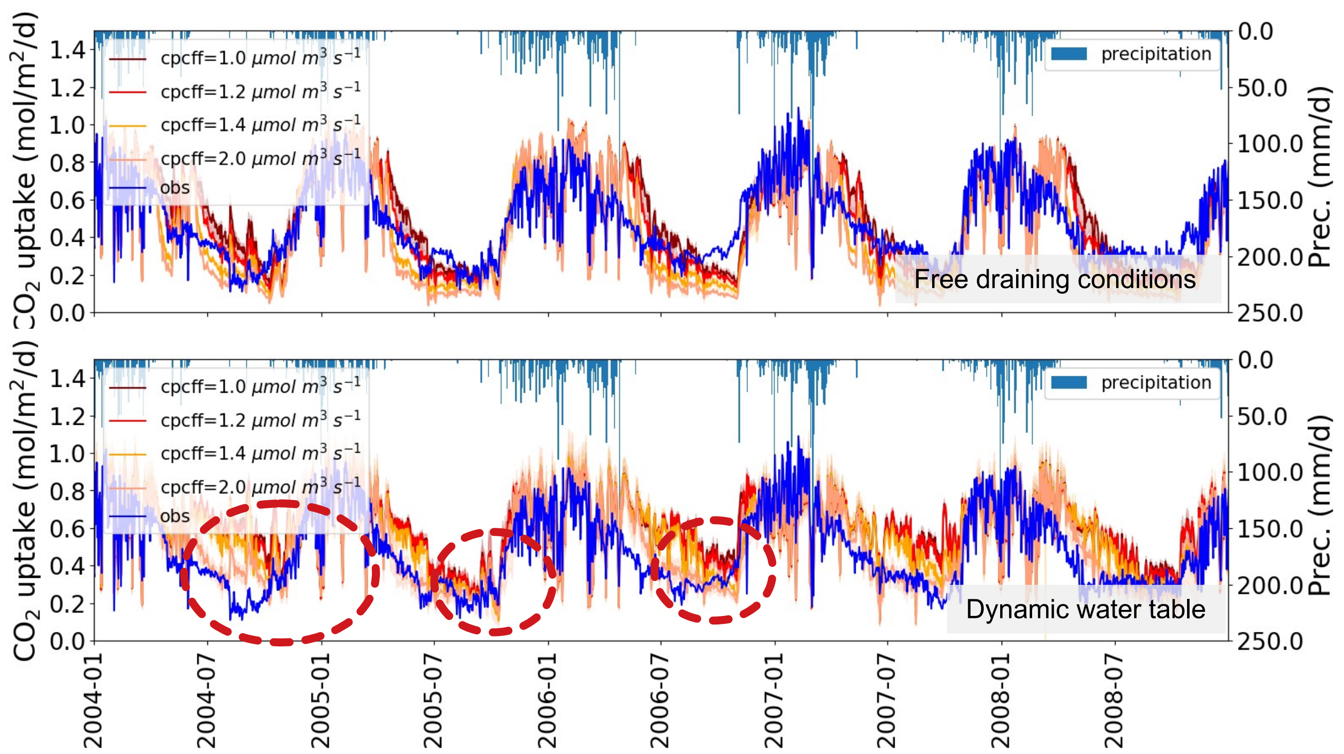
- Dynamic groundwater tables do not show strong improvements

See more ...

Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

Previous
Home
Next

HYDROLOGY AND CARBON COSTS



- Higher values of the water transport cost parameter improve assimilation
- Dynamic groundwater tables do not help for assimilation

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow
Previous
Home
Next
See more ...
Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

IMPROVING HYDROLOGY AND CARBON COSTS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

Motivation

Hypotheses

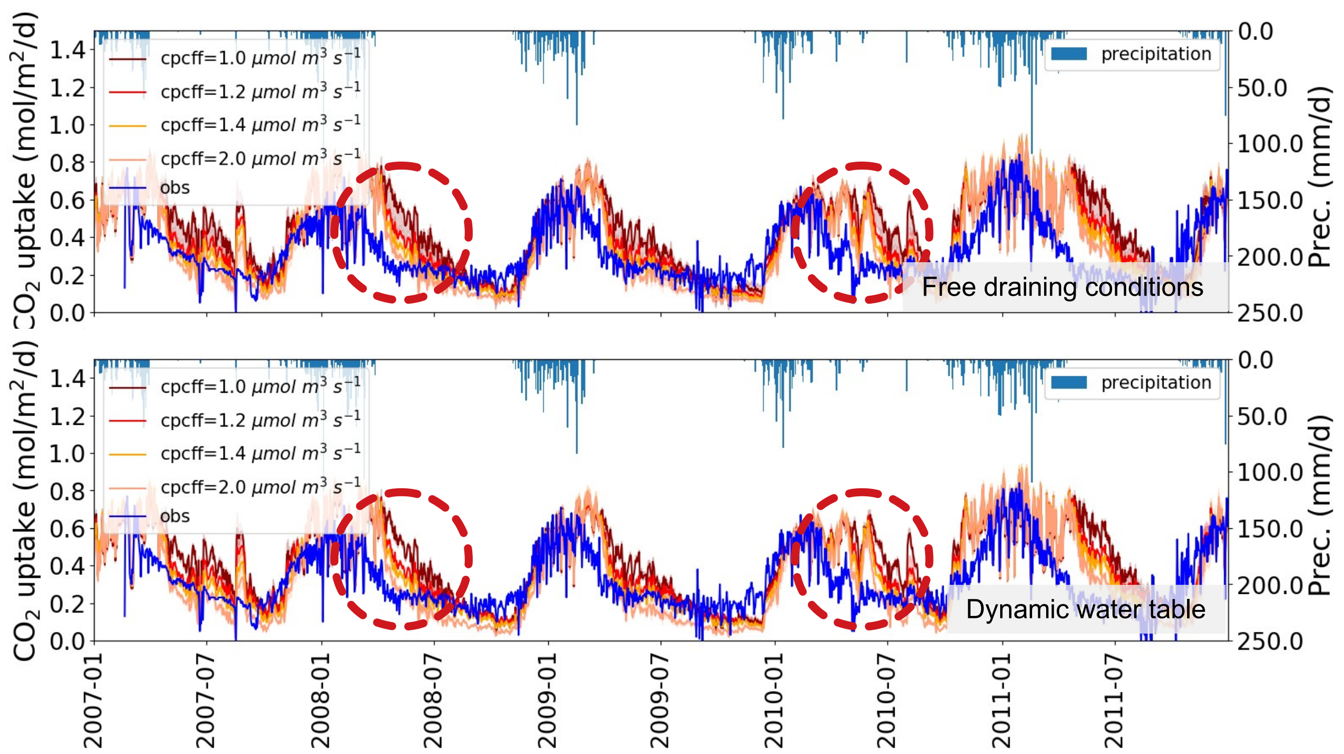
Methods

Results

Conclusions

Knowledge graph

Renku workflow



- Higher values of the water transport cost parameter improve assimilation
- Dynamic groundwater tables do not help for assimilation

See more ...

Howard Springs

AdelaideRiver

DalyUncleared

DryRiver

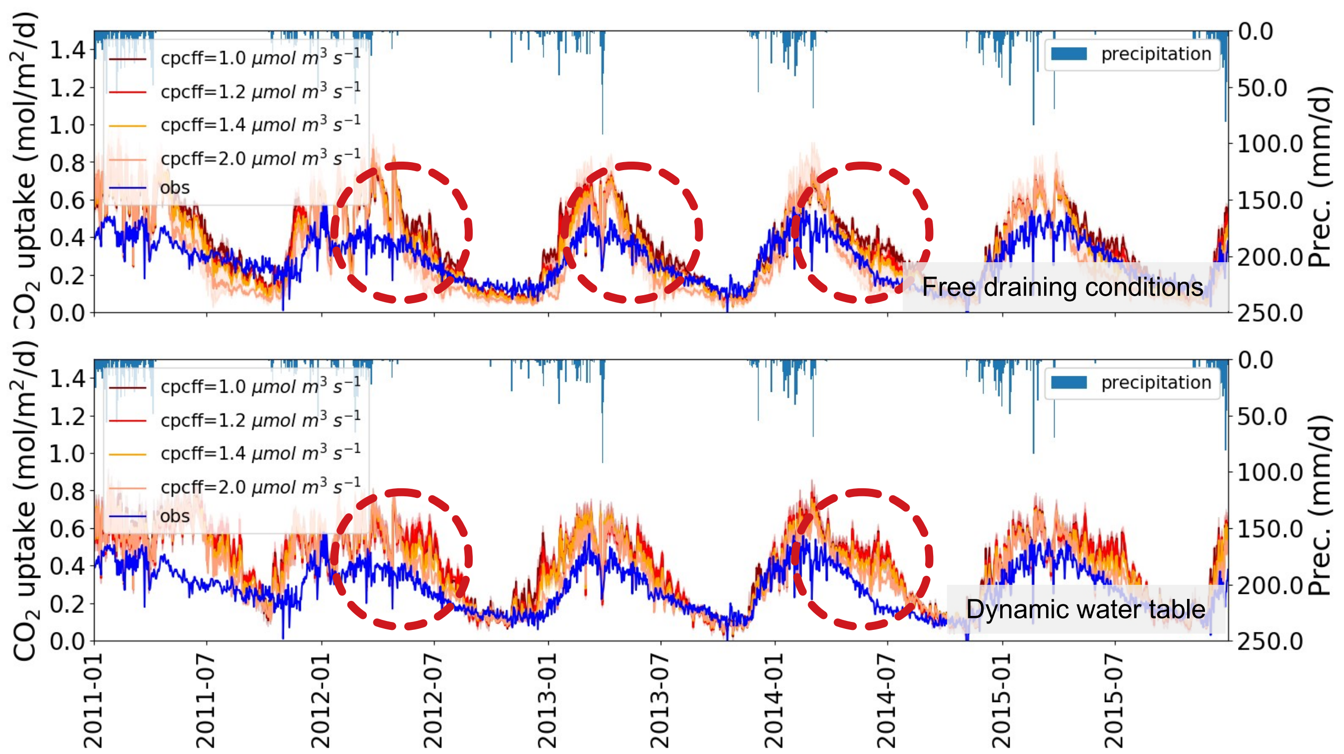
SturtPlains

Previous Home Next

IMPROVING HYDROLOGY AND CARBON COSTS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund



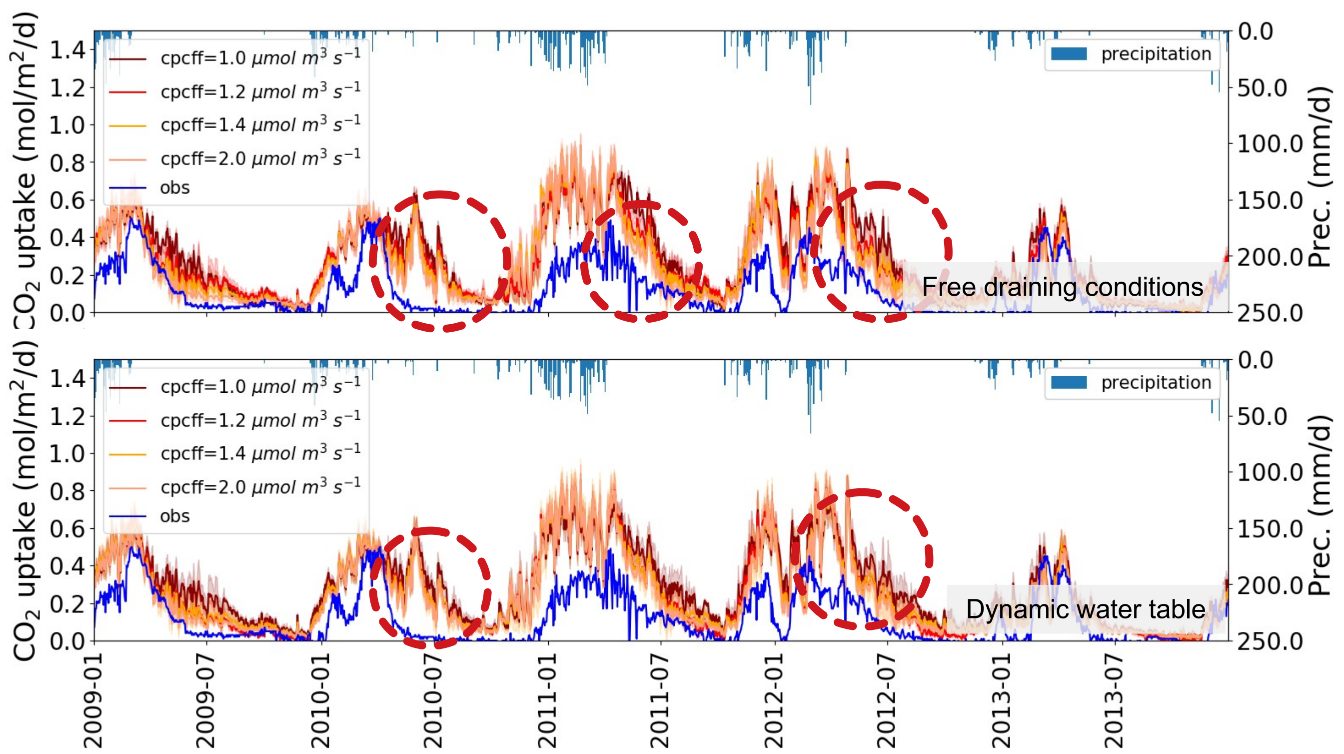
- Higher values of the water transport cost parameter improve assimilation
- Dynamic groundwater tables do not help for assimilation

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow
Previous
Home
Next
See more ...
Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

IMPROVING HYDROLOGY AND CARBON COSTS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund



- Higher values of the water transport cost parameter improve assimilation
- Dynamic groundwater tables do not help for assimilation

Motivation

Hypotheses

Methods

Results

Conclusions

Knowledge graph

Renku workflow

Previous Home Next

See more ...

Howard Springs

AdelaideRiver

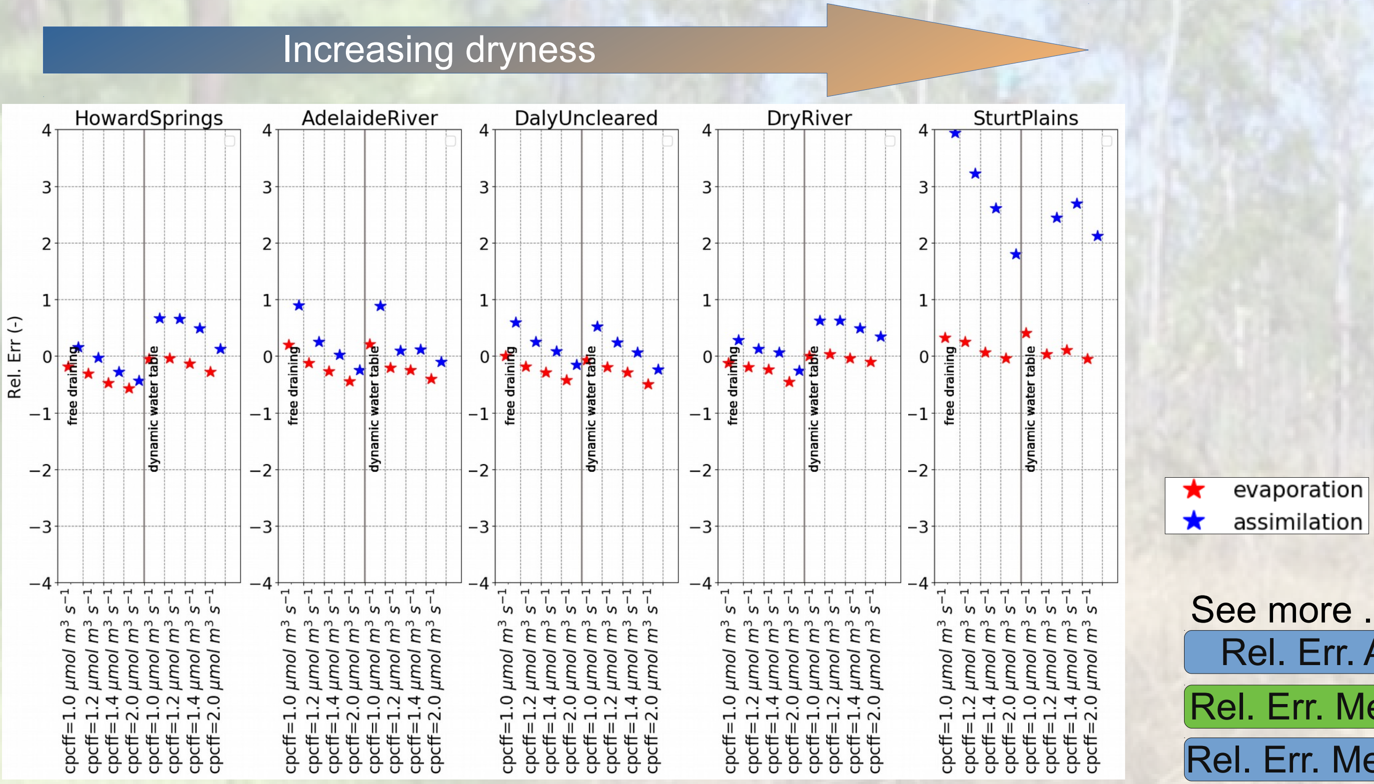
DalyUncleared

DryRiver

SturtPlains

PERFORMANCES

- Assimilation increasingly over-estimated for drier areas
- Evaporation still okay



Motivation

Hypotheses

Methods

Results

Conclusions

Knowledge graph

Renku workflow

See more ...

Rel. Err. Annual Means

Rel. Err. Mean Dry Season

Rel. Err. Mean Wet Season

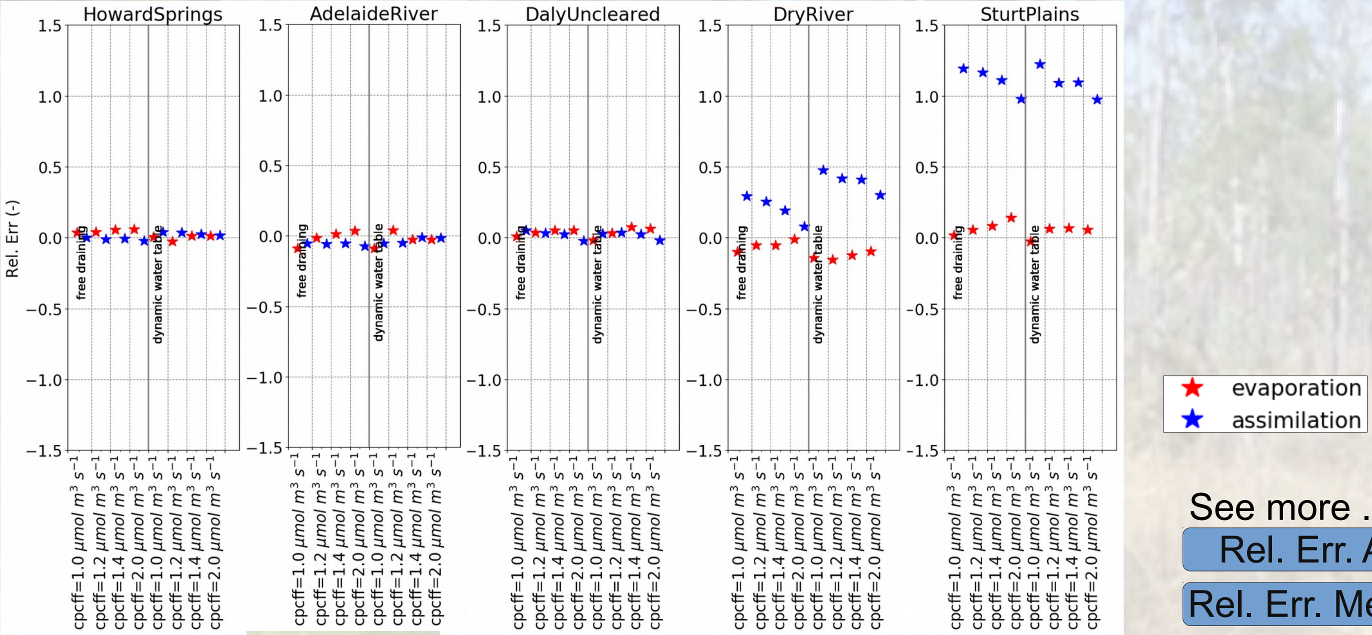
Kling-Gupta Efficiency

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST
Luxembourg National Research Fund

PERFORMANCES

- Assimilation increasingly over-estimated for drier areas
- Evaporation still okay

Increasing dryness



See more ...

Rel. Err. Annual Means
Rel. Err. Mean Dry Season
Rel. Err. Mean Wet Season
Kling-Gupta Efficiency

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST
Luxembourg National Research Fund

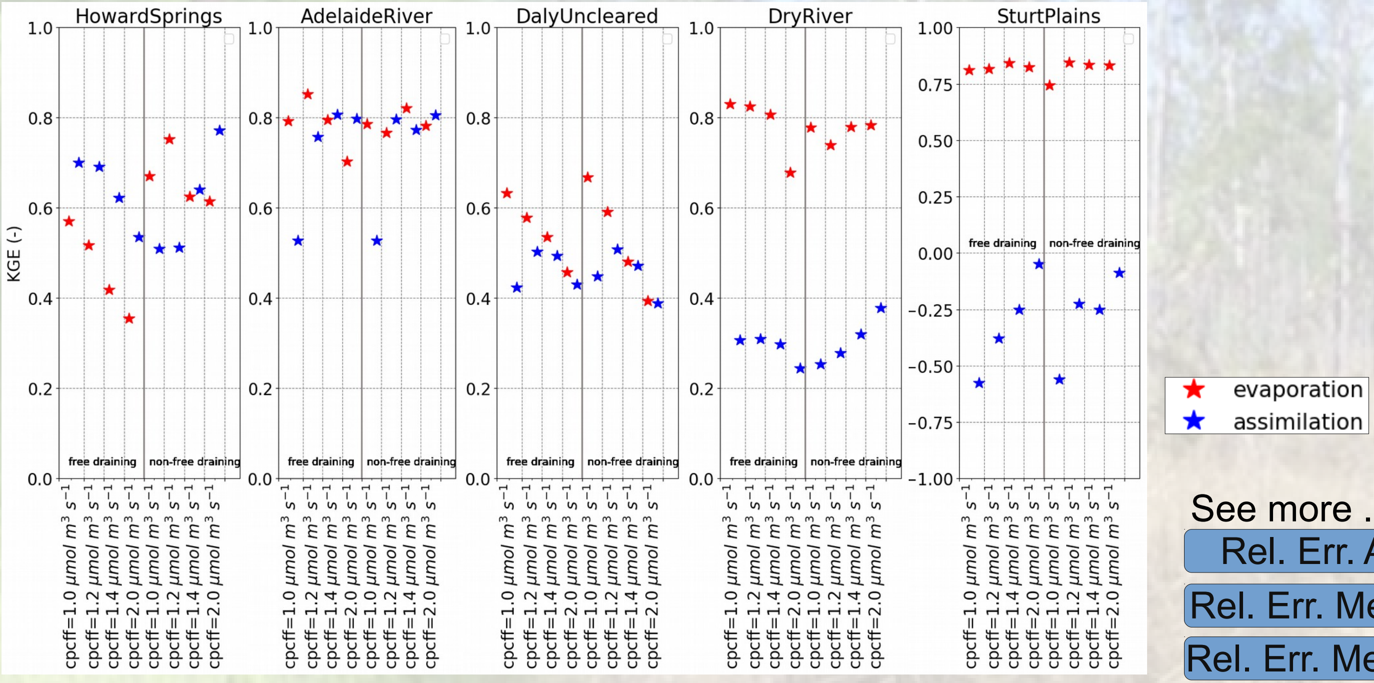
PERFORMANCES

- Assimilation increasingly over-estimated for drier areas
- Evaporation still okay

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph

Renku workflow

Increasing dryness

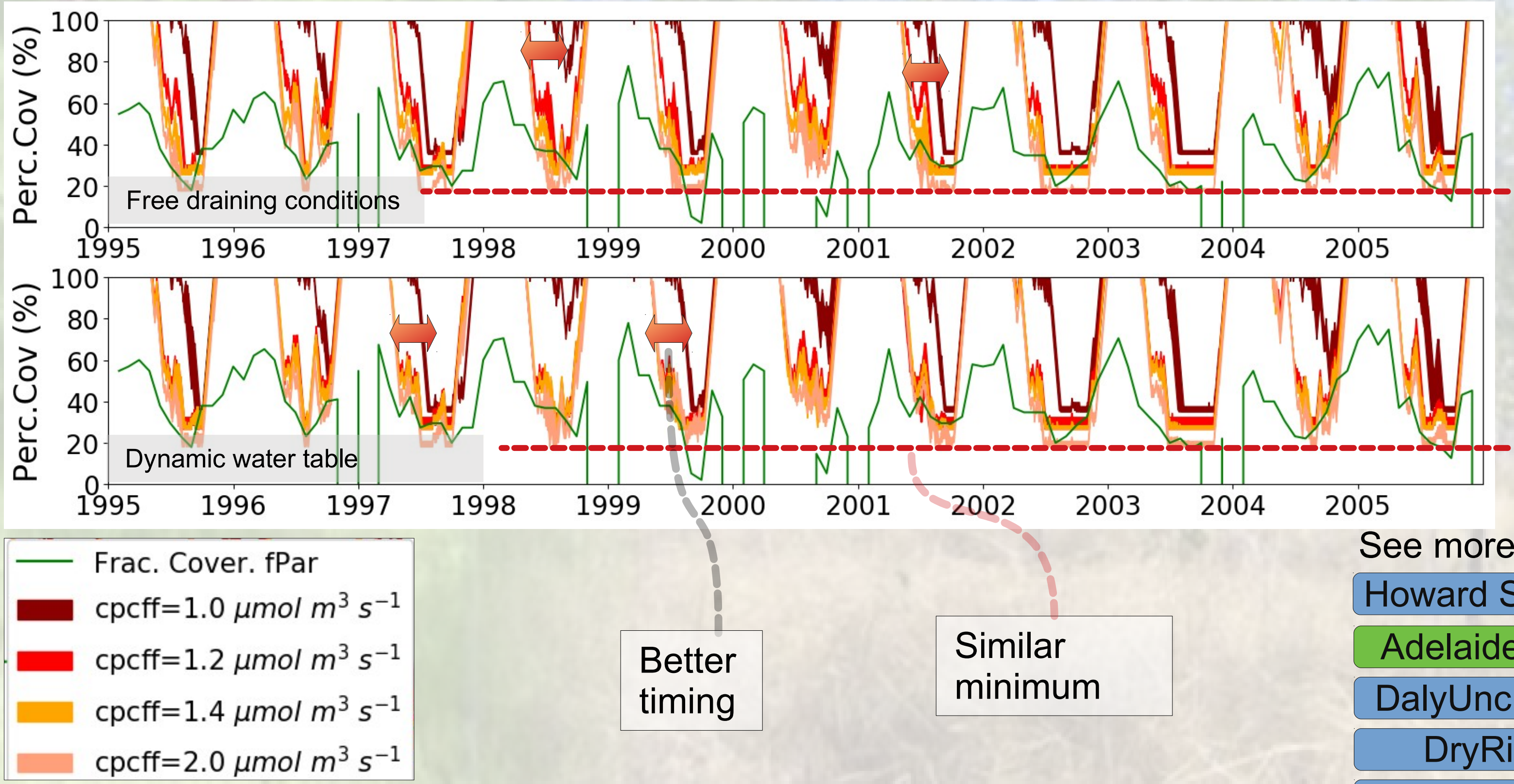


See more ...

Rel. Err. Annual Means
Rel. Err. Mean Dry Season
Rel. Err. Mean Wet Season
Kling-Gupta Efficiency
Previous
Home
Next

VEGETATION DYNAMICS

- Temporal signal largely reproduced
- Timing improves for higher cost factor
- Similar minimum cover for dynamic water tables



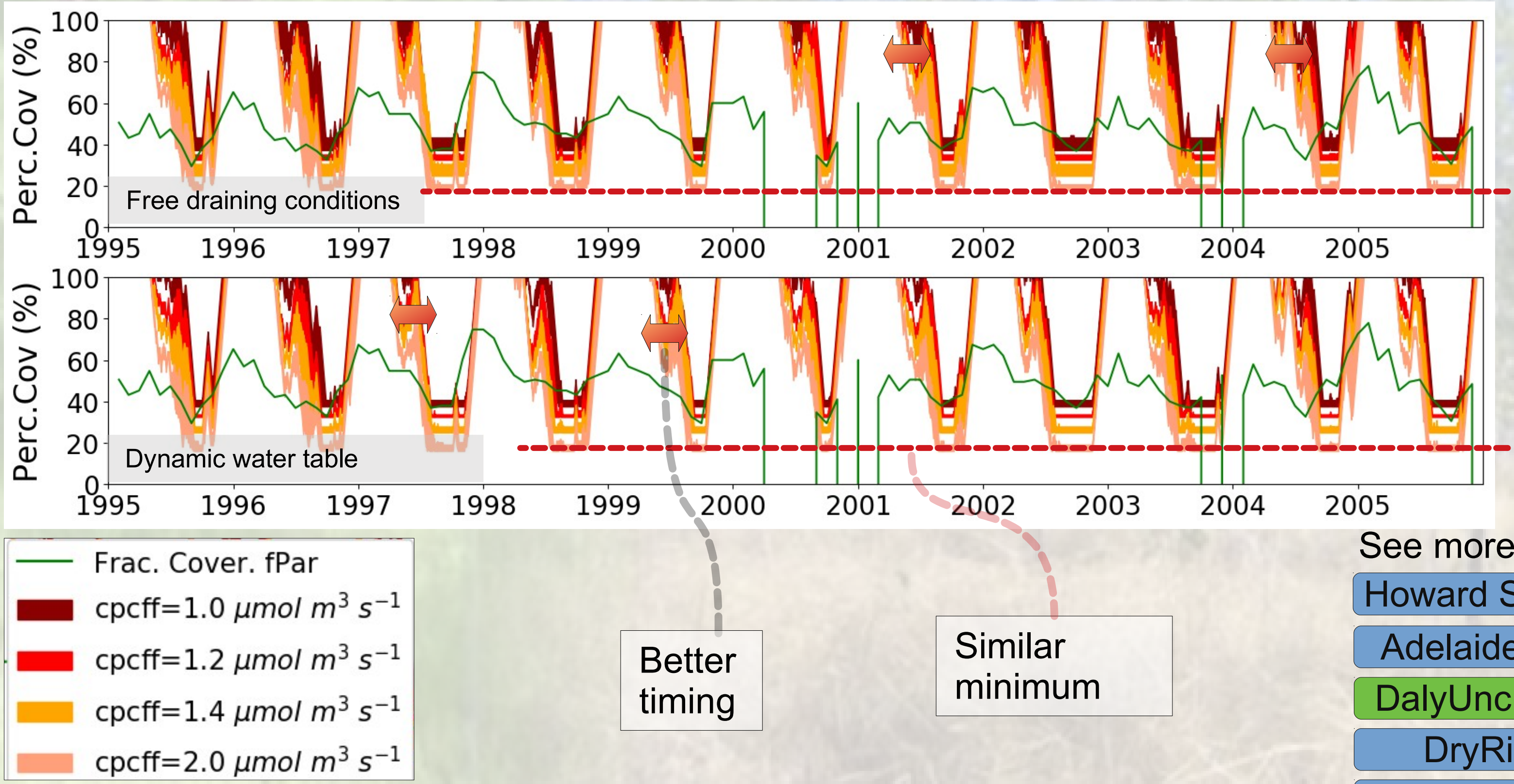
Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph

Renku workflow

See more ...
Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

VEGETATION DYNAMICS

- Temporal signal largely reproduced
- Timing improves for higher cost factor
- Similar minimum cover for dynamic water tables



Motivation

Hypotheses

Methods

Results

Conclusions

Knowledge graph

Renku workflow

Previous Home Next

See more ...

Howard Springs

AdelaideRiver

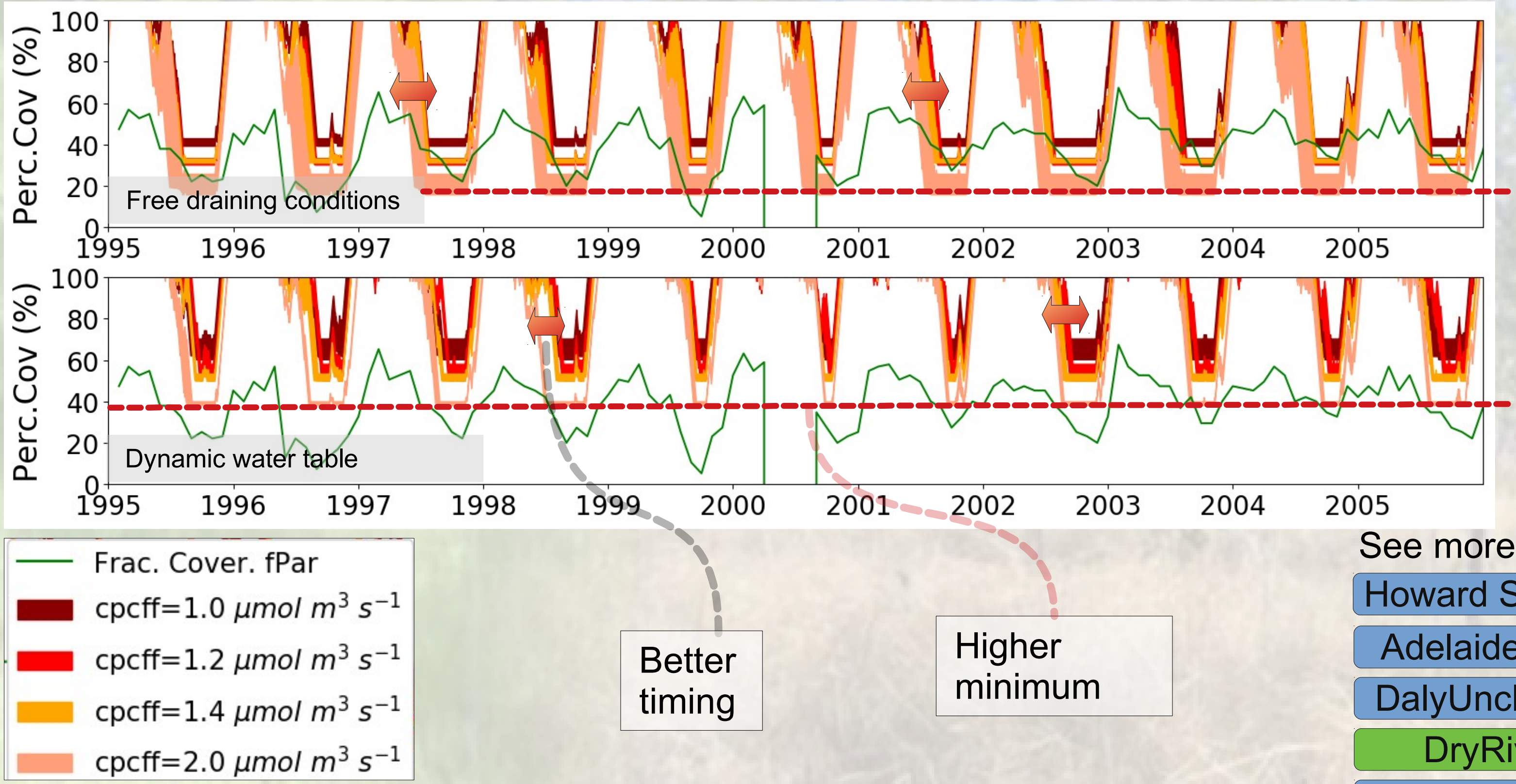
DalyUncleared

DryRiver

SturtPlains

VEGETATION DYNAMICS

- Temporal signal largely reproduced
- Timing improves for higher cost factor
- Higher minimum cover for non-freely draining conditions



See more ...

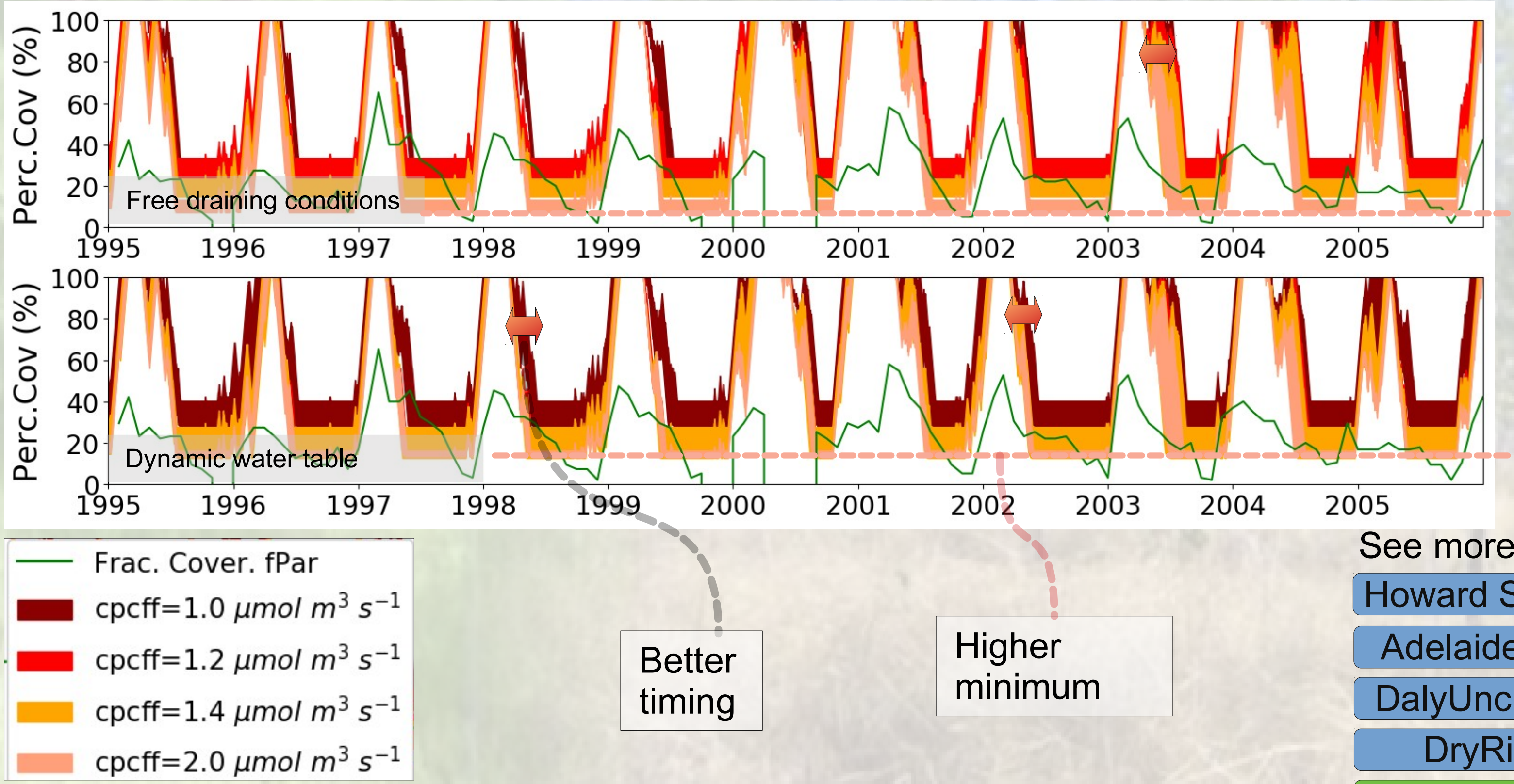
Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

VEGETATION DYNAMICS

- Temporal signal largely reproduced
- Timing improves for higher cost factor
- Higher minimum cover for non-freely draining conditions



Motivation

Hypotheses

Methods

Results

Conclusions

Knowledge graph

Renku workflow

Previous Home Next

See more ...

Howard Springs

AdelaideRiver

DalyUncleared

DryRiver

SturtPlains

RENKU 連句

remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~/renku_egu$ renku run bash run_vom.sh ../../data/VOM_input/HowardSprin
gs/dailyweather.prn vom_namelist ../../src/VOM/VOM_Fortran/VOM-code/*
```

X

- Motivation
- Hypotheses
- Methods
- Results
- Conclusions
- Knowledge gra

Renku log shows how a file is generated. In other words, is shows the knowledge graph.

Renku log

Show knowledge graph

Previous Home Next

Go to workflow of this experiment→

RENKU 連句

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY
LIST
Luxembourg National Research Fund

remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~/renku_egu$ renku status
On branch master
All files were generated from the latest inputs.
remko@ERIN-RNI-30243:~/renku_egu$ 
```

X

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph

Renku workflow

Previous
Home
Next

n
us
ate
g
e graph
eriment→

RENKU 連句

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow

remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~/renku_egu$ renku update
Resolved '.renku/workflow/21b601c544df4dc8872173d045c3d8d6.cwl' to 'file:///home
/remko/renku_egu/.renku/workflow/21b601c544df4dc8872173d045c3d8d6.cwl'
[workflow ] start
[workflow ] starting step step_1
[step step_1] start
[job step_1] /tmp/tmp4qpm8jfl$ cp \
    /tmp/tmptjlyrl2o/stg2e3a4e46-0fc8-4bc9-af40-55831c9b59ae/evi_adelaide.txt \
    pc_mod.txt
[job step_1] completed success
[step step_1] completed success
[workflow ] completed success
remko@ERIN-RNI-30243:~/renku_egu$
```

X

Show knowledge graph

Previous Home Next

Go to workflow of this experiment→

RENKU 連句

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph

Renku workflow

Renku run makes sure the workflow is tracked

Renku run

remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~$ cd renku_egu/
remko@ERIN-RNI-30243:~/renku_egu$ renku log --format dot evap_adelaide.png | dot
 -Tpng > ../../../knowledge_graphs/evap_adelaide.png
```

x

s

te

other words, is shows the knowledge graph.

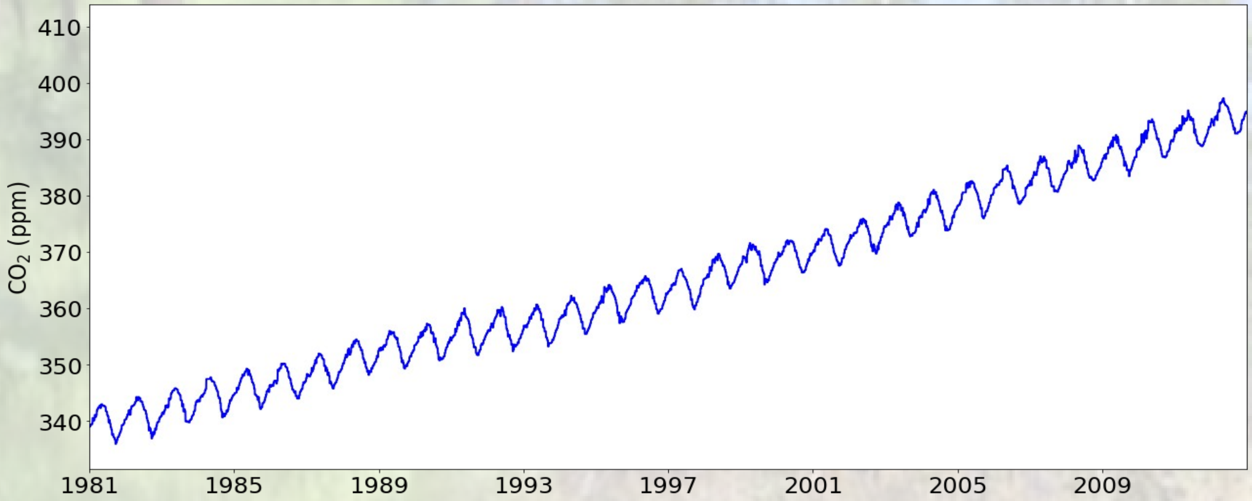
Show knowledge graph

Previous Home Next

Go to workflow of this experiment→

CO_2 RECORDS

Atmospheric CO_2 levels are needed as input for the VOM model. Therefore, weekly data is taken from the Mauna Loa observatory.



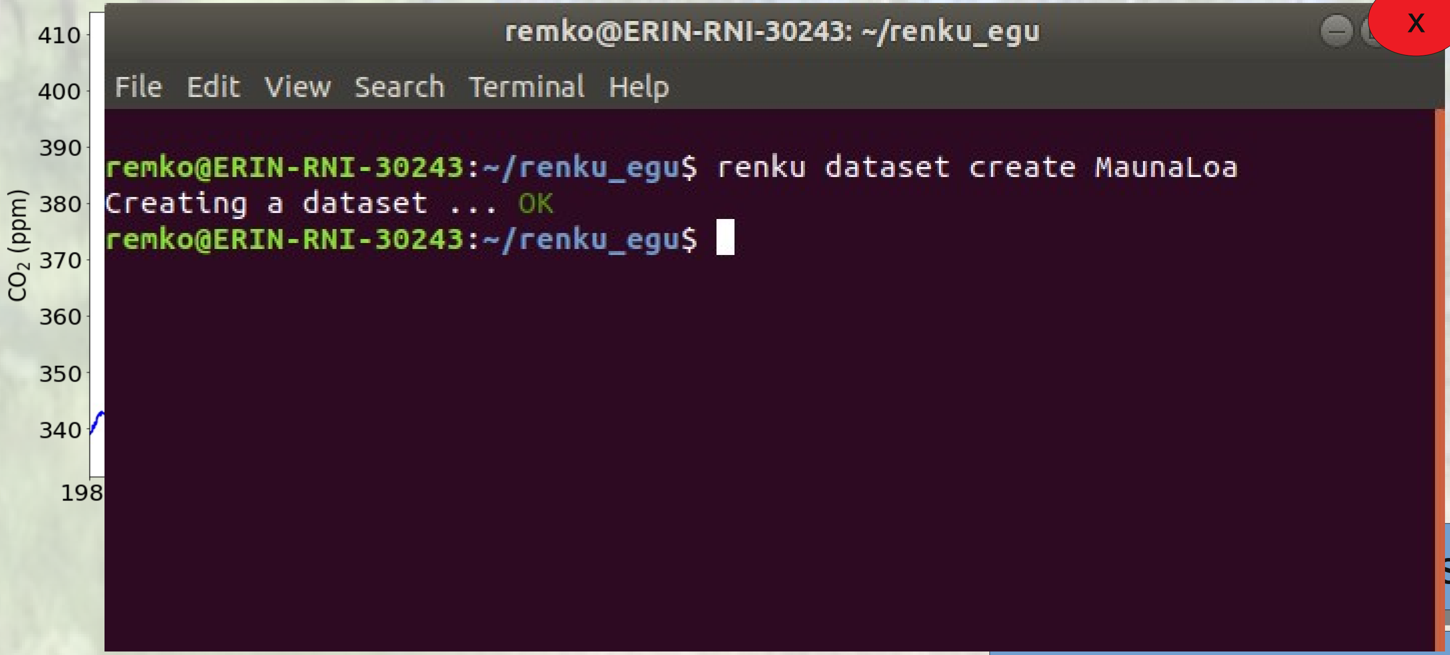
Create renku dataset

Add data

Back to knowledge graph

CO_2 RECORDS

Atmospheric CO_2 levels are needed as input for the VOM model. Therefore, weekly data is taken from the Mauna Loa observatory.



x

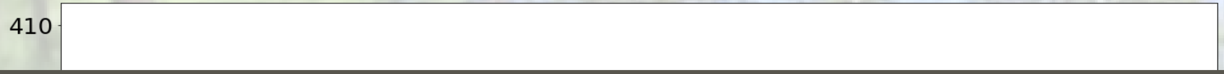
set

Add data

Back to knowledge graph

CO_2 RECORDS

Atmospheric CO_2 levels are needed as input for the VOM model. Therefore, weekly data is taken from the Mauna Loa observatory.



remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~/renku_egu$ renku dataset add MaunaLoa http://scrip
psco2.ucsd.edu/assets/data/atmospheric/stations/in_situ_co2/weekly/weekly
_in_situ_co2_mlo.csv
Adding data to dataset  [                                    ]  1/1  http
://scrippsco2.ucsd.edu/assets/data/atmospheric/stations/in_situ_co2/weekl
Adding data to dataset  [                                    ]  1/1


remko@ERIN-RNI-30243:~/renku_egu$
```

X

Motivation

Hypotheses

Methods

Results

Conclusions

Knowledge graph

Renku workflow

dataset

ta

Back to knowledge graph

Previous

Home

Next

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

SILO WEATHERDATA

Meteorological data are needed as input for the VOM model. Data is taken from the Australian Silo weatheroffice.

Motivation

Hypotheses

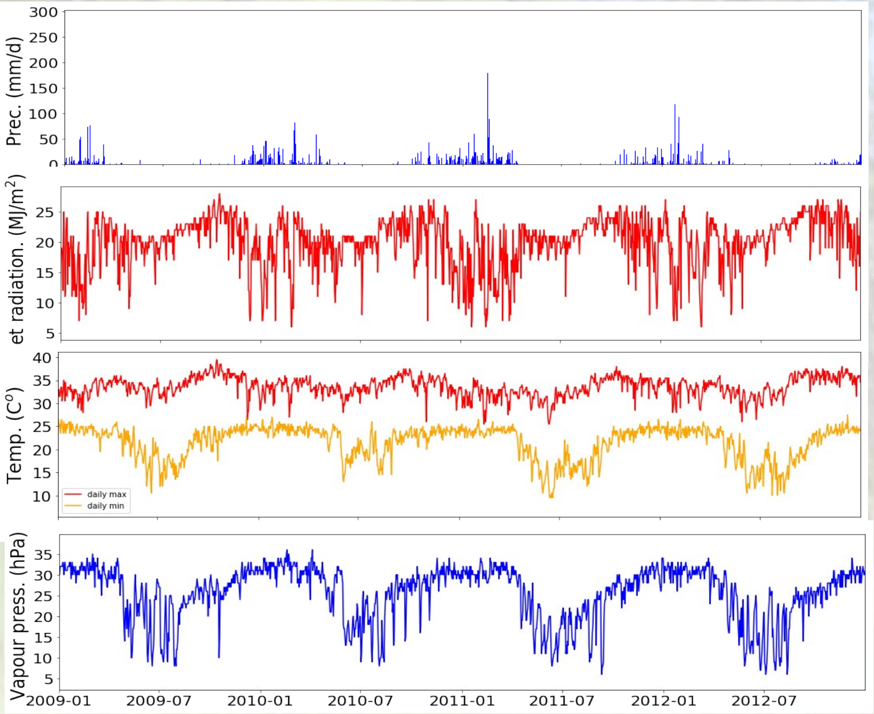
Methods

Results

Conclusions

Knowledge graph

Renku workflow



Create renku dataset

Add data

Back to knowledge graph

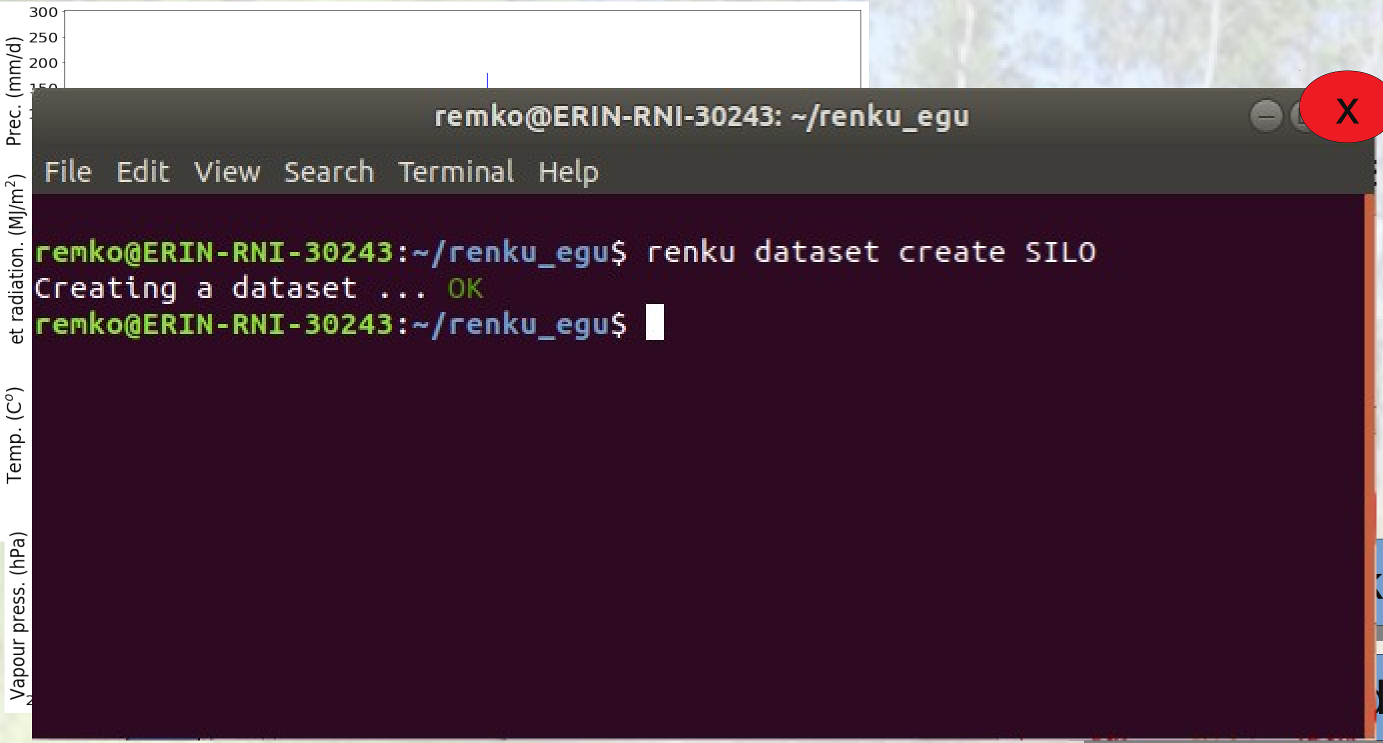
Previous

Home

Next

SILO WEATHERDATA

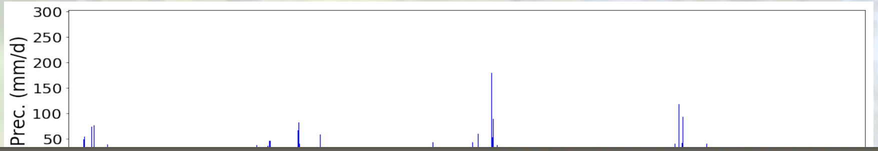
Meteorological data are needed as input for the VOM model. Data is taken from the Australian Silo weatheroffice.



ku dataset
data
Back to knowledge graph
Previous Home Next

SILO WEATHERDATA

Meteorological data are needed as input for the VOM model. Data is taken from the Australian Silo weatheroffice.



remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~/renku_egu$ renku dataset add SILO ../data/Silo/howard.txt
```

X

CREATE MODEL INPUT

The meteorological data and the atmospheric CO_2 data need to be processed and formatted in order to serve as input for the model.

dailyweather.prn
~/Documents/renku-projects/VOM_cases_renku/vomcases/data/VOM_input/HowardSprings

Dcum	Day	Month	Year	T.Max	T.Min	Rain	Radn	VP	Pres	Ca
1	1	1	1980	31.50	23.50	10.70	10.00	30.00	1005.00	337.67
2	2	1	1980	28.50	23.50	40.90	6.00	29.00	1004.00	337.67
3	3	1	1980	28.50	23.50	14.10	7.00	30.00	1004.50	337.67
4	4	1	1980	30.00	23.00	14.30	10.00	31.00	1004.50	337.67
5	5	1	1980	31.00	24.00	17.60	12.00	31.00	1005.00	337.67
6	6	1	1980	31.50	24.50	12.90	14.00	33.00	1004.00	337.48
7	7	1	1980	32.00	24.00	85.20	16.00	31.00	1005.50	337.48
8	8	1	1980	33.50	24.00	30.50	24.00	34.00	1006.50	337.48
9	9	1	1980	32.50	22.50	17.30	17.00	31.00	1006.50	337.48
10	10	1	1980	32.50	24.50	8.10	20.00	31.00	1007.00	337.48
11	11	1	1980	34.00	25.00	16.20	22.00	33.00	1008.50	337.48
12	12	1	1980	32.50	26.50	11.20	14.00	34.00	1009.00	337.48
13	13	1	1980	34.00	25.50	17.90	19.00	33.00	1007.50	338.38
14	14	1	1980	34.50	24.00	26.80	15.00	32.00	1008.50	338.38
15	15	1	1980	33.50	24.00	26.10	20.00	34.00	1009.00	338.38
16	16	1	1980	34.00	26.00	2.50	21.00	34.00	1008.50	338.38
17	17	1	1980	32.50	21.50	20.10	14.00	29.00	1009.00	338.38
18	18	1	1980	29.00	23.50	25.70	6.00	30.00	1009.00	338.38
19	19	1	1980	31.50	24.50	8.10	16.00	31.00	1008.00	338.38
20	20	1	1980	33.00	23.50	9.50	20.00	32.00	1009.50	338.49
21	21	1	1980	32.50	24.00	41.60	17.00	30.00	1010.00	338.49
22	22	1	1980	31.50	22.00	10.70	17.00	26.00	1009.00	338.49
23	23	1	1980	32.00	23.50	9.10	18.00	29.00	1009.00	338.49
24	24	1	1980	31.50	24.50	9.00	16.00	32.00	1008.50	338.49
25	25	1	1980	32.00	24.50	1.80	19.00	32.00	1008.50	338.49
26	26	1	1980	31.00	24.50	6.50	16.00	31.00	1007.50	338.49
27	27	1	1980	31.00	23.50	20.00	10.00	31.00	1005.50	338.05
28	28	1	1980	29.50	23.50	23.40	11.00	30.00	1005.00	338.05
29	29	1	1980	31.00	24.50	6.20	14.00	32.00	1005.50	338.05
30	30	1	1980	30.00	25.50	9.70	10.00	30.00	1006.50	338.05
31	31	1	1980	32.50	24.50	3.80	10.00	33.00	1008.50	338.05
32	1	2	1980	31.00	24.50	20.10	12.00	33.00	1010.00	338.05
33	2	2	1980	30.50	22.50	38.40	9.00	30.00	1009.50	338.05
34	3	2	1980	30.50	23.50	14.00	12.00	30.00	1006.50	338.14

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph

Renku workflow

Run command
Back to knowledge graph
Previous
Home
Next

CREATE MODEL INPUT

The meteorological data and the atmospheric CO_2

remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~/renku_egu$ renku run python3 src_py/write_dailyweather.py
 -im data/Silo/howard.txt -ic data/MaunaLoa/weekly_in_situ_co2_mlo.csv -p linear
 -o data/VOM_input/HowardSprings/dailyweather.prn
```

X

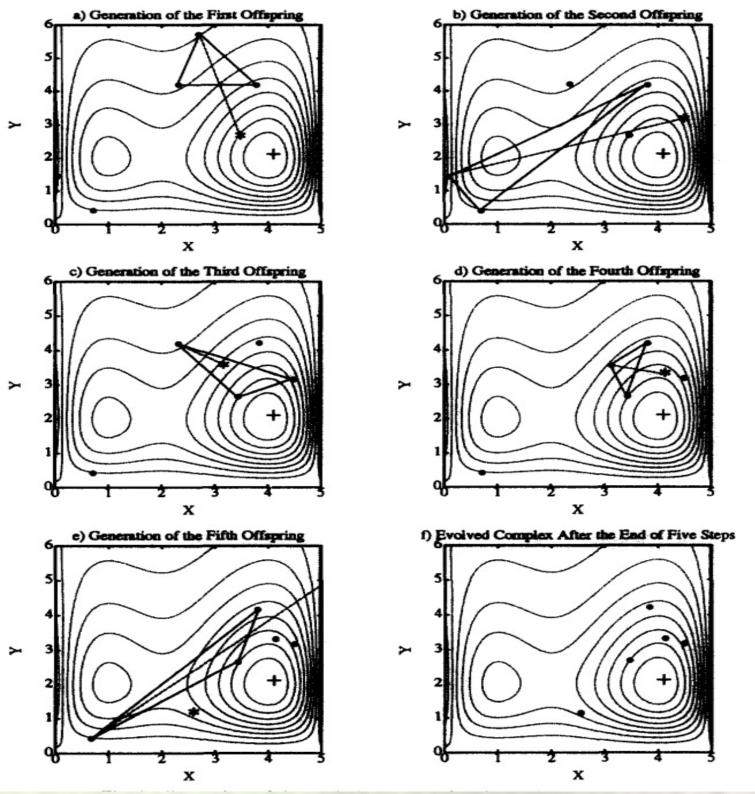
hand

dge graph

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST
Luxembourg National Research Fund

RUN VOM OPTIMIZATION

The Shuffled Complex Evolution algorithm is used in order to derive the vegetation properties that maximize NCP.



- Sample *s* points
- Rank points
- Partition into complexes
- Evolve complex
- Shuffle complexes
- Check convergence

Run command

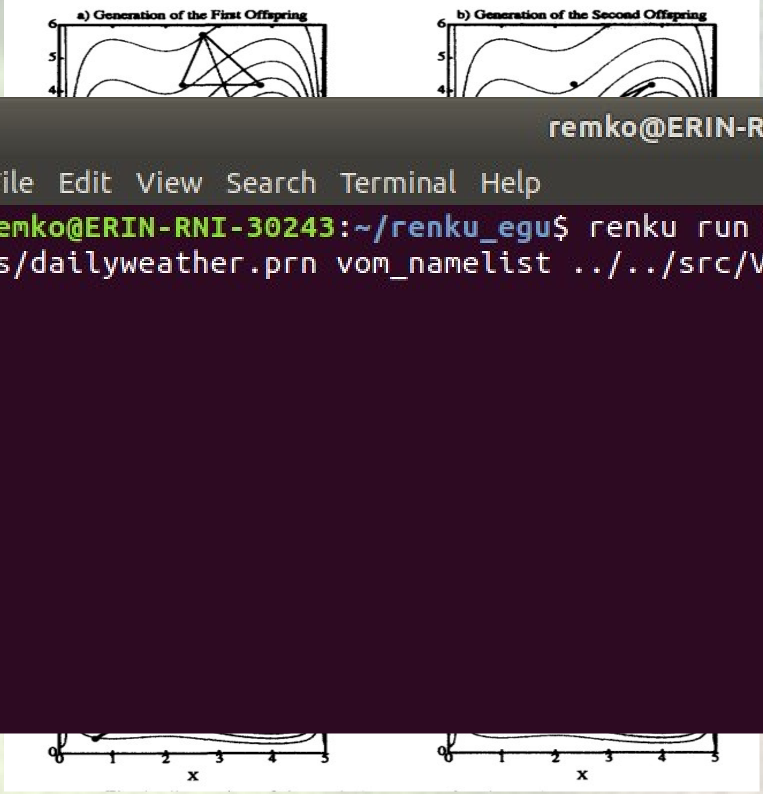
Back to knowledge graph

Figure from : Duan, Q., Sorooshian, S., Gupta, V.K., 1994. Optimal use of the SCE-UA global optimization method for calibrating watershed models. Journal of Hydrology 158, 265–284. https://doi.org/10.1016/0022-1694(94)90057-4

RUN VOM OPTIMIZATION

The Shuffled Complex Evolution algorithm is used in order to derive the vegetation properties that maximize NCP.

- Sample *s* points



remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~/renku_egu$ renku run bash run_vom.sh ../../data/VOM_input/HowardSprin
gs/dailyweather.prn vom_namelist ../../src/VOM/VOM_Fortran/VOM-code/*
```

X

Figure from : Duan, Q., Sorooshian, S., Gupta, V.K., 1994. Optimal use of the SCE-UA global optimization method for calibrating watershed models. Journal of Hydrology 158, 265–284. https://doi.org/10.1016/0022-1694(94)90057-4

Back to knowledge graph

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

UNCERTAINTY ESTIMATES & STATISTICS

The model runs with the 5% highest NCP are selected in order to construct uncertainty bounds.

To assess the model performance, several independent datasets are used:

- DINGO fluxdata
- Fraction vegetation cover from fPar

The performances are assessed by:

- Timeseries with uncertainties
- Relative errors annuan and seasonal means
- Kling-Gupta efficiencies
- Residuals

UNCERTAINTY ESTIMATES & STATISTICS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

The model runs with the 5% highest NCP are selected in order to construct uncertainty bounds.

- Motivation
- Hypotheses
- Methods
- Results
- Conclusions
- Knowledge graph

Renku workflow

remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~/renku_egu$ renku run python3 src_py/sce_uncertainty.py -i
 data/VOM_output/HowardSprings/sce_out.txt -o data/VOM_output/HowardSprings/free
drainage_cpcff1.0/bestruns/ -p -w work/HowardSprings/freedrainage_cpcff1.0/best/
 5 -op 1 1 1 1 1 1 0 1 -d data/VOM_input/HowardSprings/dailyweather.prn -eo data
/DINGO/Ea_howard.txt -ea data/DINGO/GPPdaily_howard.txt
```

X

T

- Ti
- R
  means
- Kling-Gupta efficiencies
- Residuals

Run command

Back to knowledge graph

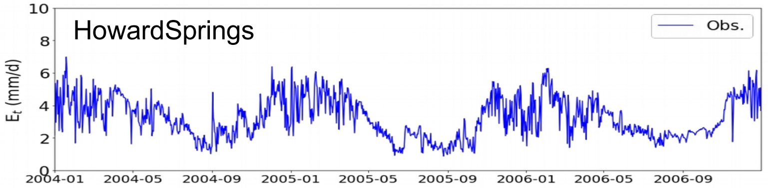
Previous Home Next

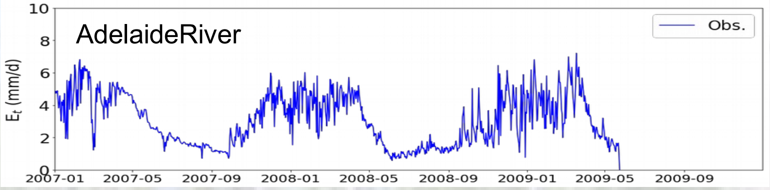
LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

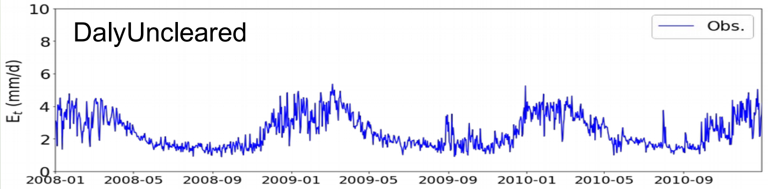
Luxembourg National Research Fund

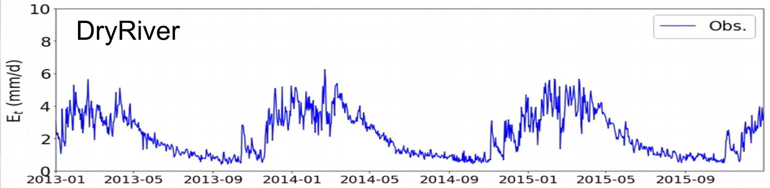
DINGO

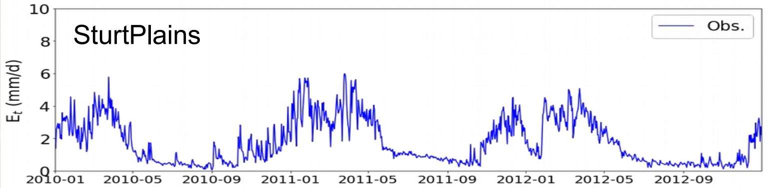
Fluxes are derived with the DINGO algorithm from the flux towers at the study sites.











Create renku dataset

Add data

Back to knowledge graph

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow
Previous
Home
Next

DINGO

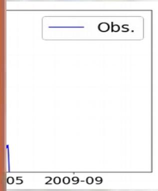
Fluxes are derived with the DINGO algorithm from the flux towers at the study sites

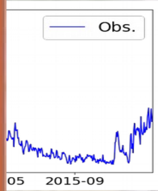
remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~/renku_egu$ renku dataset create DINGO
Creating a dataset ... OK
remko@ERIN-RNI-30243:~/renku_egu$
```

X





aset

graph

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow
Previous Home Next

DINGO

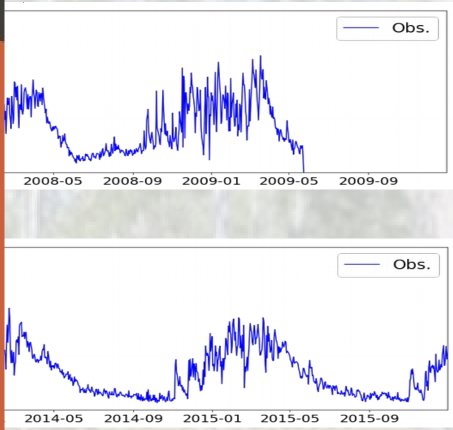
Fluxes are derived with the DINGO algorithm from the flux towers at the study sites.

remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~/renku_egu$ renku dataset add DINGO ../data/DINGO/Ea_howar
d.txt
remko@ERIN-RNI-30243:~/renku_egu$ renku dataset add DINGO ../data/DINGO/GPPdaily
_howard.txt
remko@ERIN-RNI-30243:~/renku_egu$ 
```

X



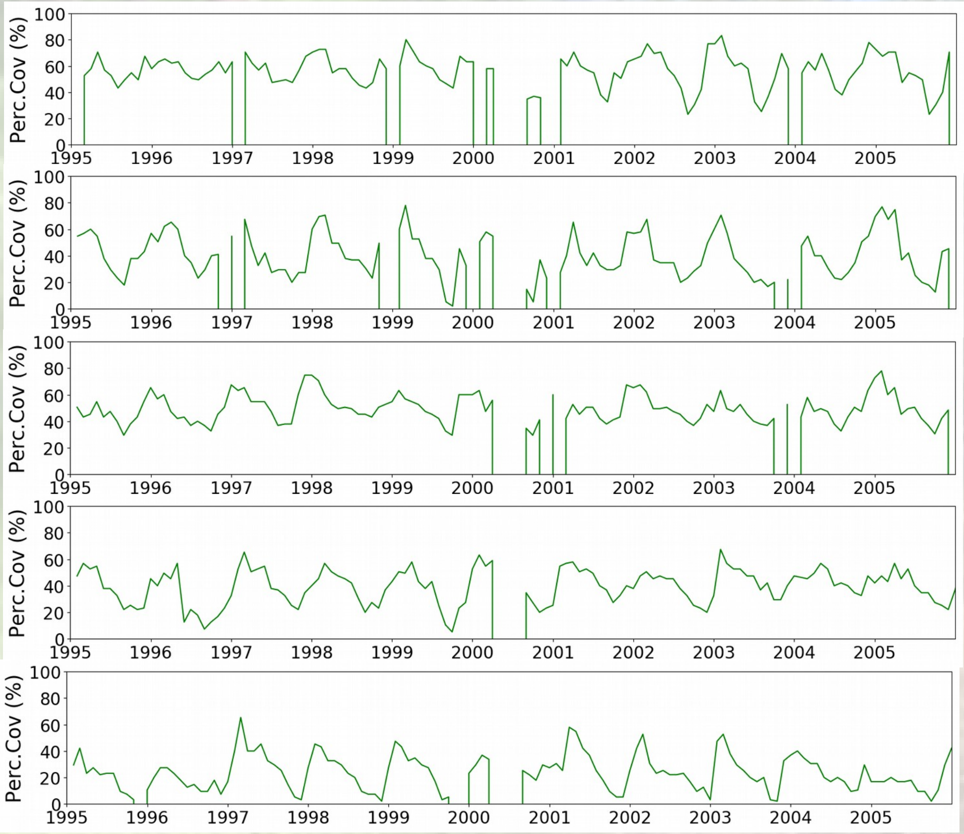
Motiv
Hypo
Meth
Resu
Conc
Know
ate renku dataset
Add data
Back to knowledge graph
Previous
Home
Next

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

FRACTIONAL COVER

The Enhanced Vegetation Index from MODIS is used to compare the modelled and observed vegetation dynamics.



Fractional cover derived from satellite observed fPAR are used to compare with modelled vegetation cover

Motivation

Hypotheses

Methods

Results

Conclusions

Renku workflow

Knowledge graph

Create renku dataset

Add data

Back to knowledge graph

FRACTIONAL COVER

The Enhanced Vegetation Index from MODIS is used to compare the modelled and observed vegetation dynamics.

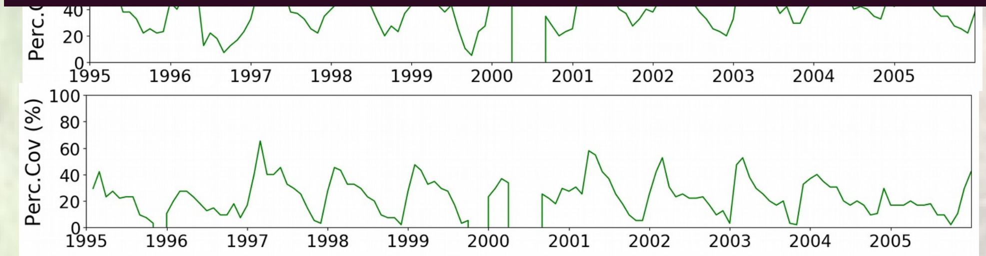
remko@ERIN-RNI-30243: ~/renku_egu

File Edit View Search Terminal Help

```
remko@ERIN-RNI-30243:~/renku_egu$ renku dataset create fPAR
Creating a dataset ... OK
remko@ERIN-RNI-30243:~/renku_egu$
```

X

rived
ved fPAR
e with
n cover



Create renku dataset

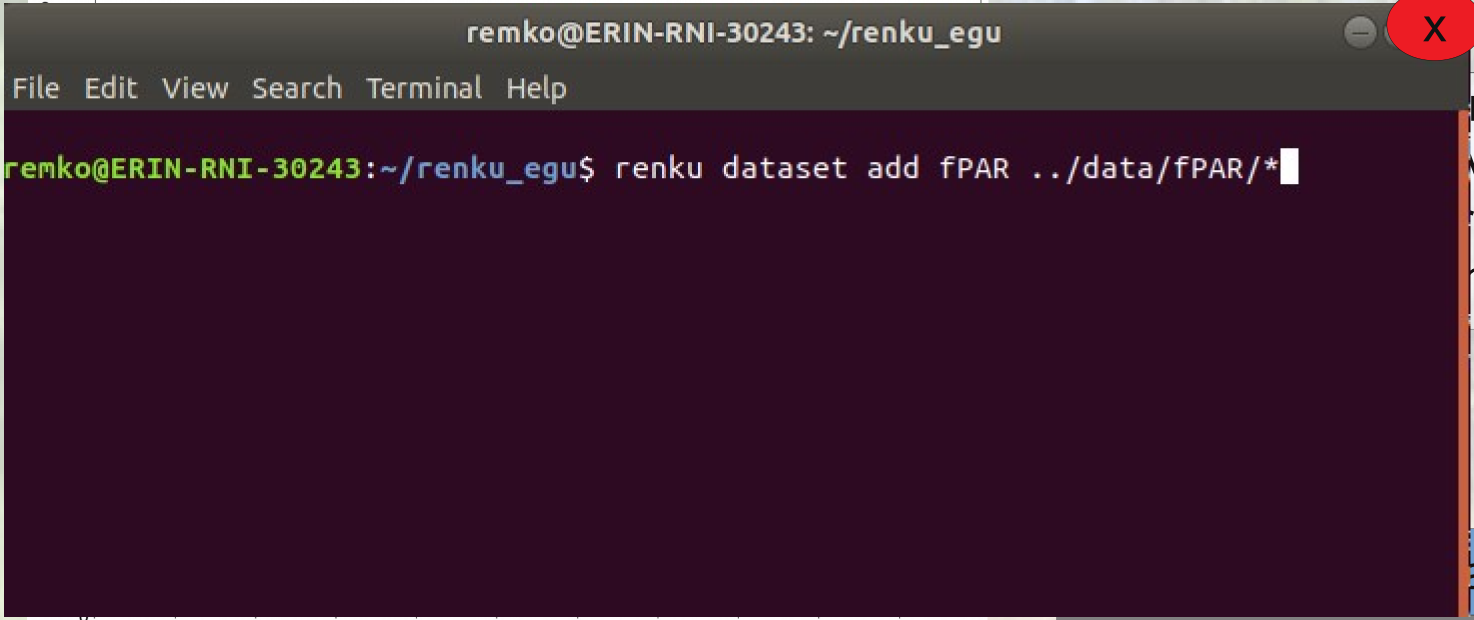
Add data

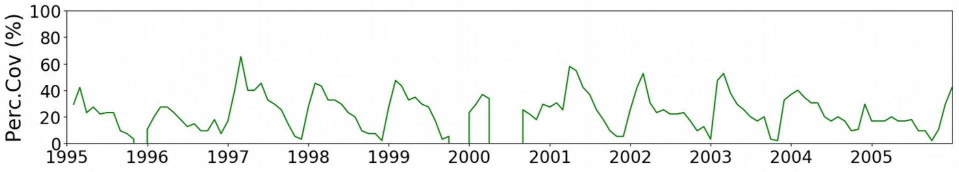
Back to knowledge graph

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow
Previous
Home
Next

FRACTIONAL COVER

The Enhanced Vegetation Index from MODIS is used to compare the modelled and observed vegetation dynamics.





rived
ved fPAR
e with
n cover

aset

Add data

Back to knowledge graph

Motivation
Hypotheses
Methods
Results
Conclusions
Renku workflow
Knowledge graph
Previous Home Next

HYDROLOGY AND CARBON COSTS

Motivation

Hypotheses

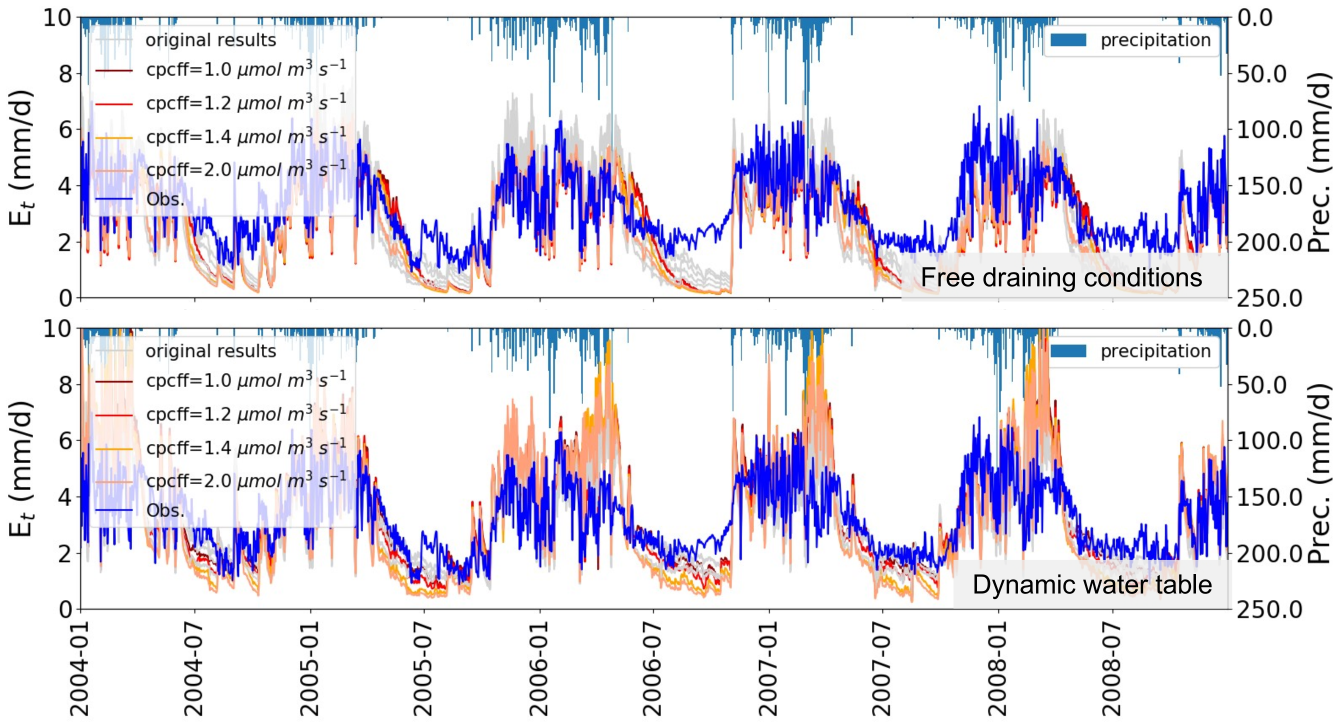
Methods

Results

Conclusions

Knowledge graph

Renku workflow



Vegetation parameters from dynamic water table

Vegetation parameters from free draining conditions

Switching the vegetation properties for the two hydrological situations leads to similar results:

- Hydrological formulation not of influence

See more ...

Howard Springs

AdelaideRiver

DalyUncleared

DryRiver

SturtPlains

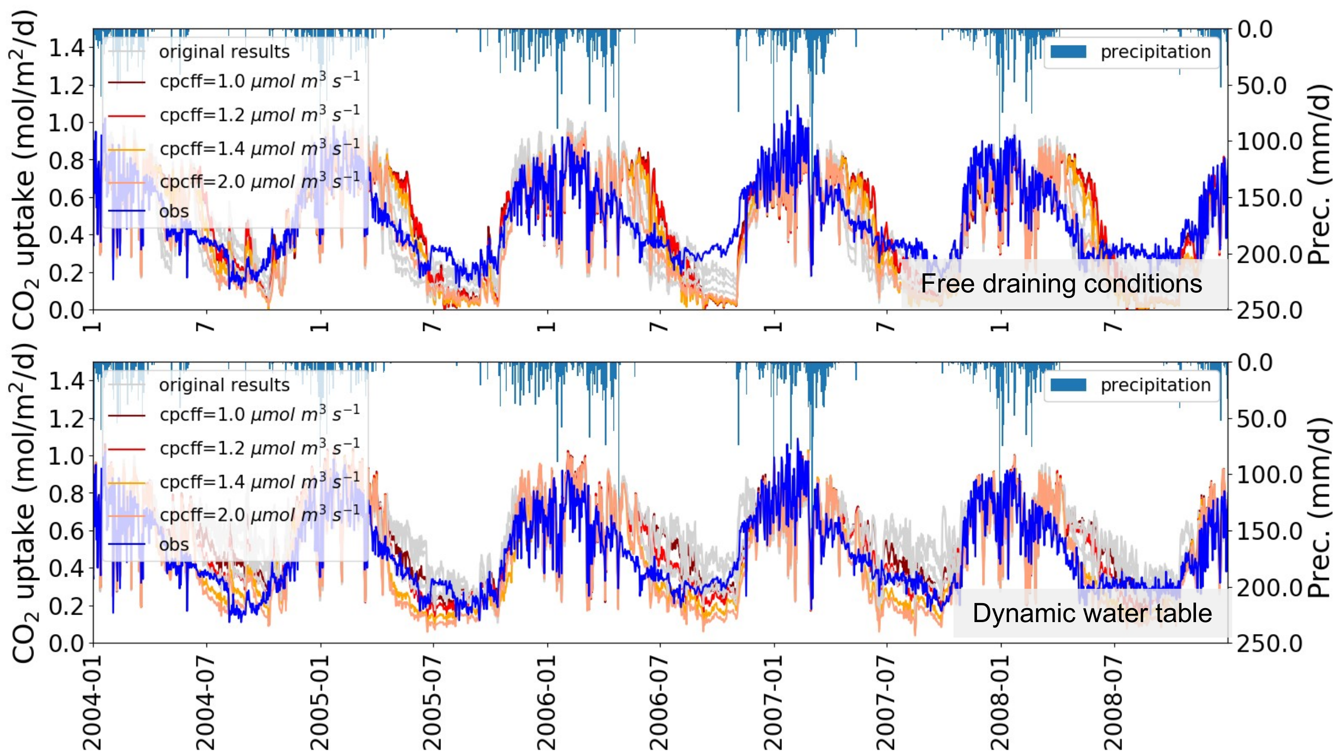
Previous Home Next

HYDROLOGY AND CARBON COSTS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY
LIST
Luxembourg National Research Fund

- Motivation
- Hypotheses
- Methods
- Results
- Conclusions
- Knowledge graph

Renku workflow



Vegetation parameters from dynamic water table

Vegetation parameters from free draining conditions

Switching the vegetation properties for the two hydrological situations leads to similar results:

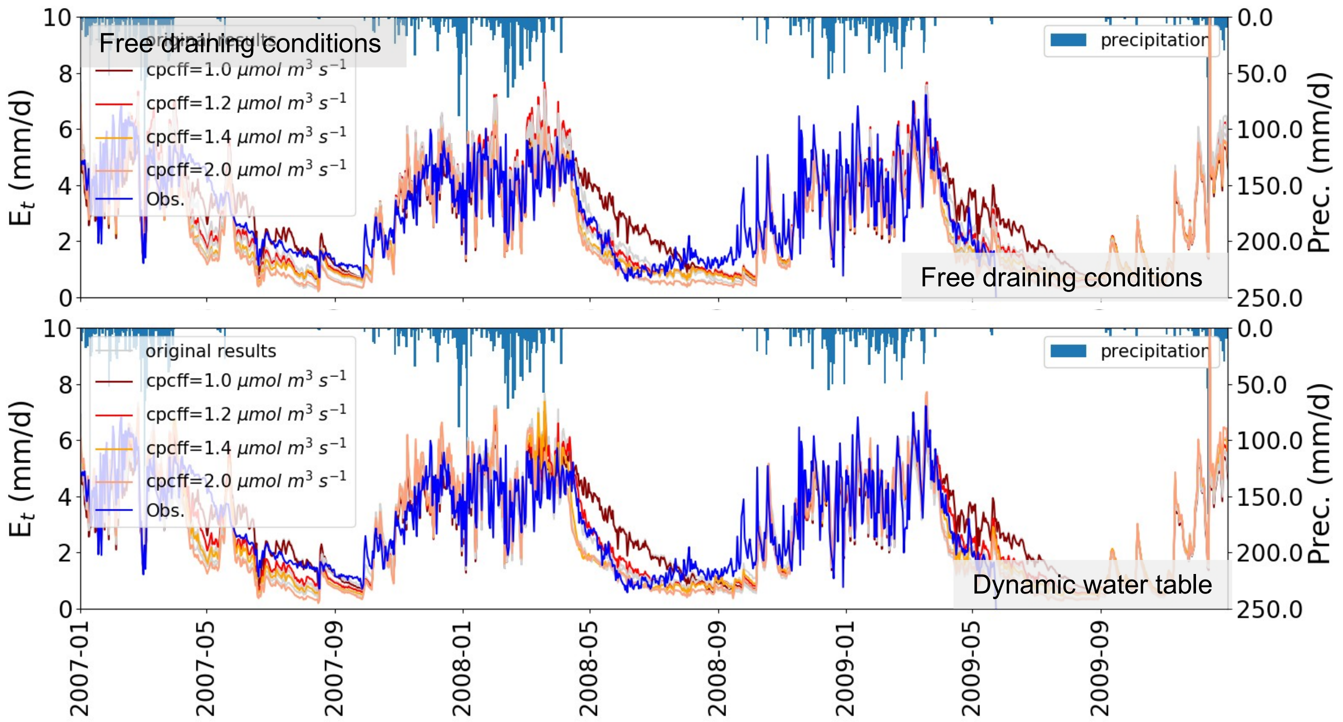
- Hydrological formulation not of influence

See more ...

- Howard Springs
- AdelaideRiver
- DalyUncleared
- DryRiver
- SturtPlains

Previous Home Next

HYDROLOGY AND CARBON COSTS



Vegetation parameters from dynamic water table

Vegetation parameters from free draining conditions

Switching the vegetation properties for the two hydrological situations leads to similar results:

- Hydrological formulation not of influence

Motivation

Hypotheses

Methods

Results

Conclusions

Knowledge graph

Renku workflow

See more ...

Howard Springs

AdelaideRiver

DalyUncleared

DryRiver

SturtPlains

Previous Home Next

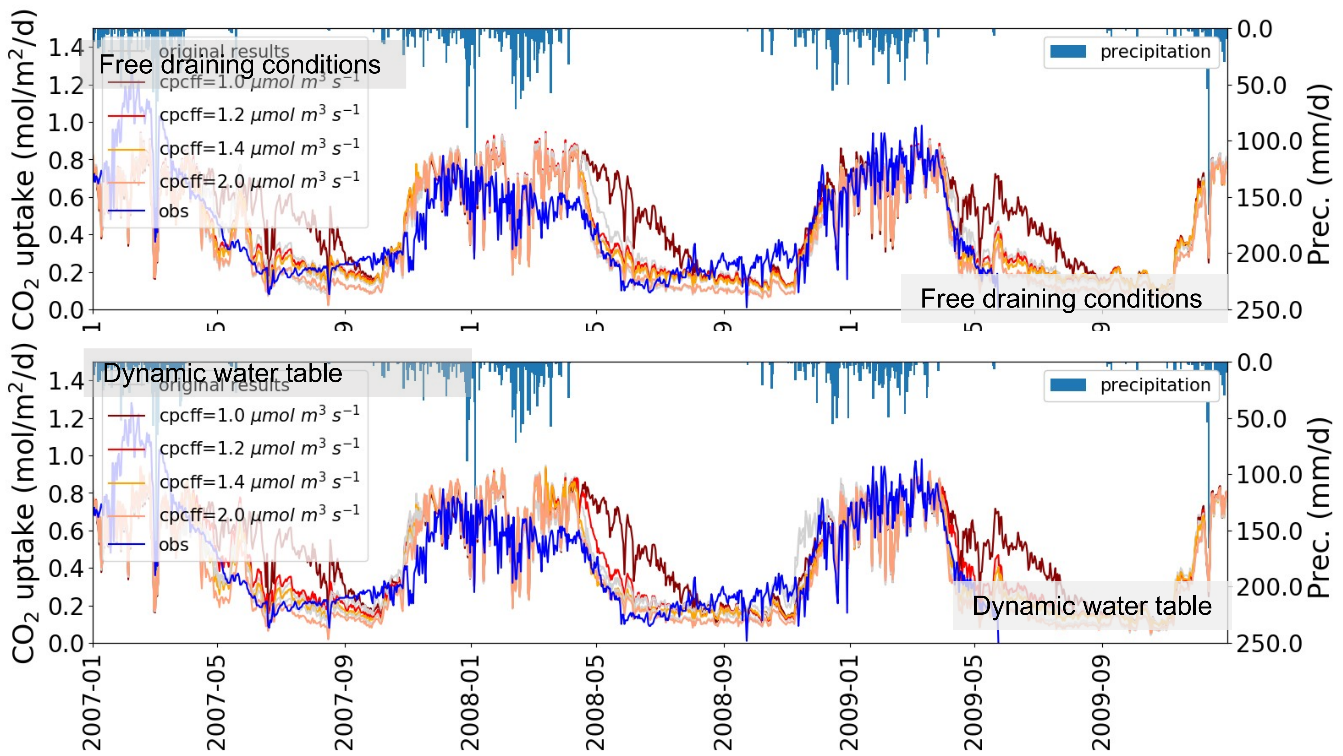
HYDROLOGY AND CARBON COSTS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund

- Motivation
- Hypotheses
- Methods
- Results
- Conclusions
- Knowledge graph

Renku workflow



Vegetation parameters from dynamic water table

Vegetation parameters from free draining conditions

Switching the vegetation properties for the two hydrological situations leads to similar results:

- Hydrological formulation not of influence

See more ...

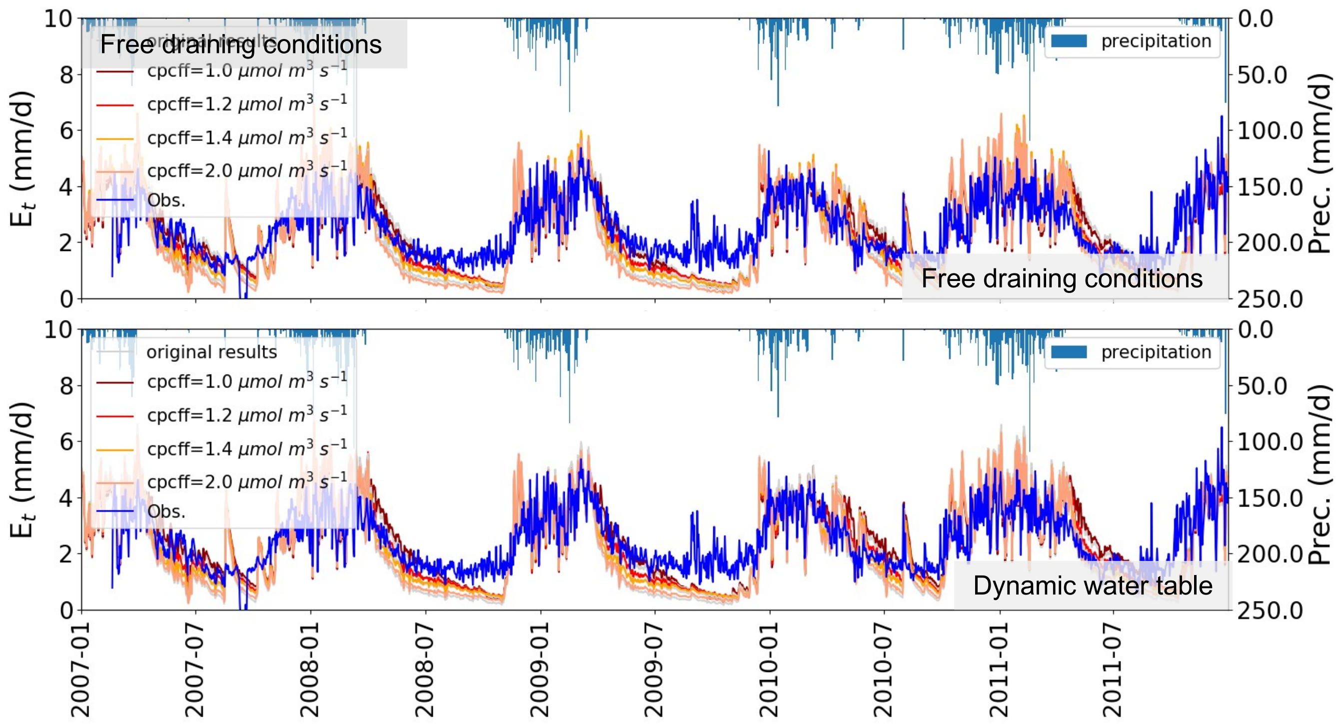
- Howard Springs
- AdelaideRiver
- DalyUncleared
- DryRiver
- SturtPlains

Previous Home Next

HYDROLOGY AND CARBON COSTS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund



Vegetation parameters from dynamic water table

Vegetation parameters from free draining conditions

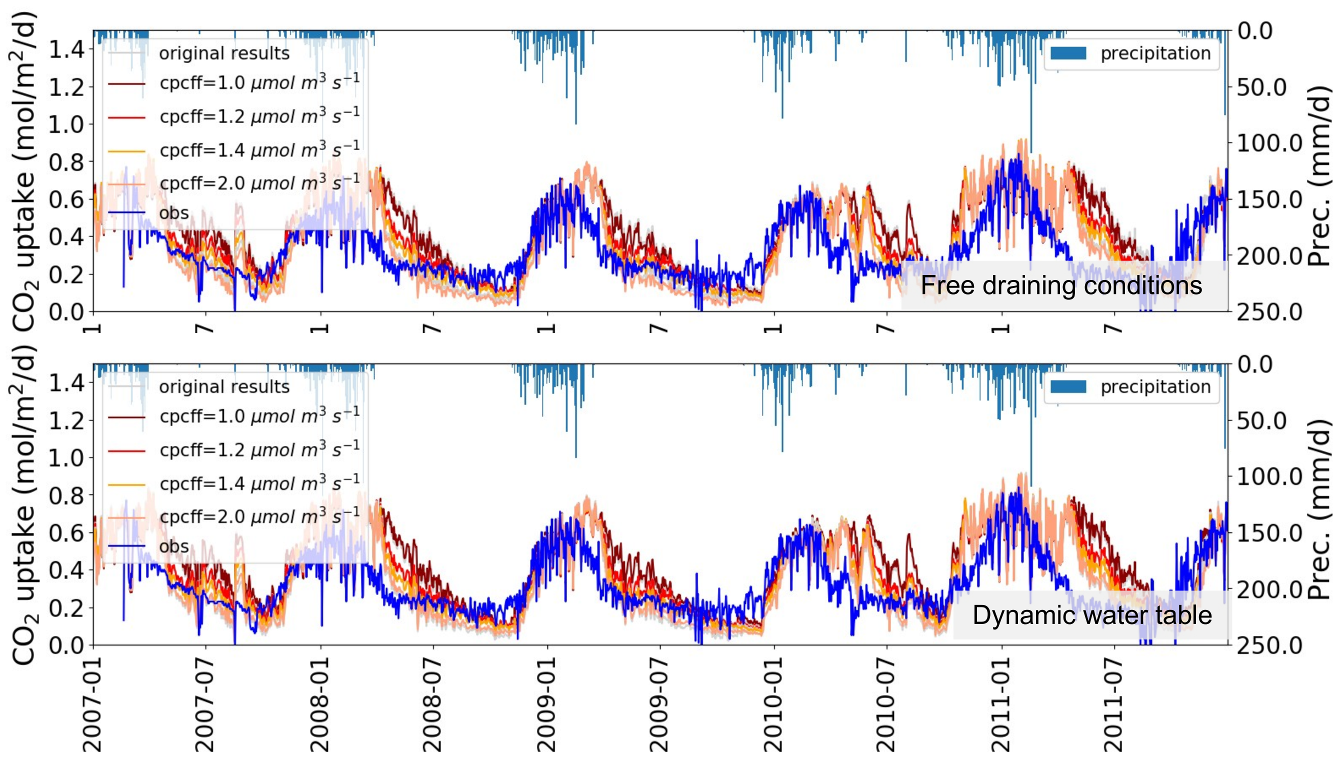
Switching the vegetation properties for the two hydrological situations leads to similar results:

- Hydrological formulation not of influence

See more ...
Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

HYDROLOGY AND CARBON COSTS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY
LIST
Luxembourg National Research Fund



Vegetation parameters from dynamic water table

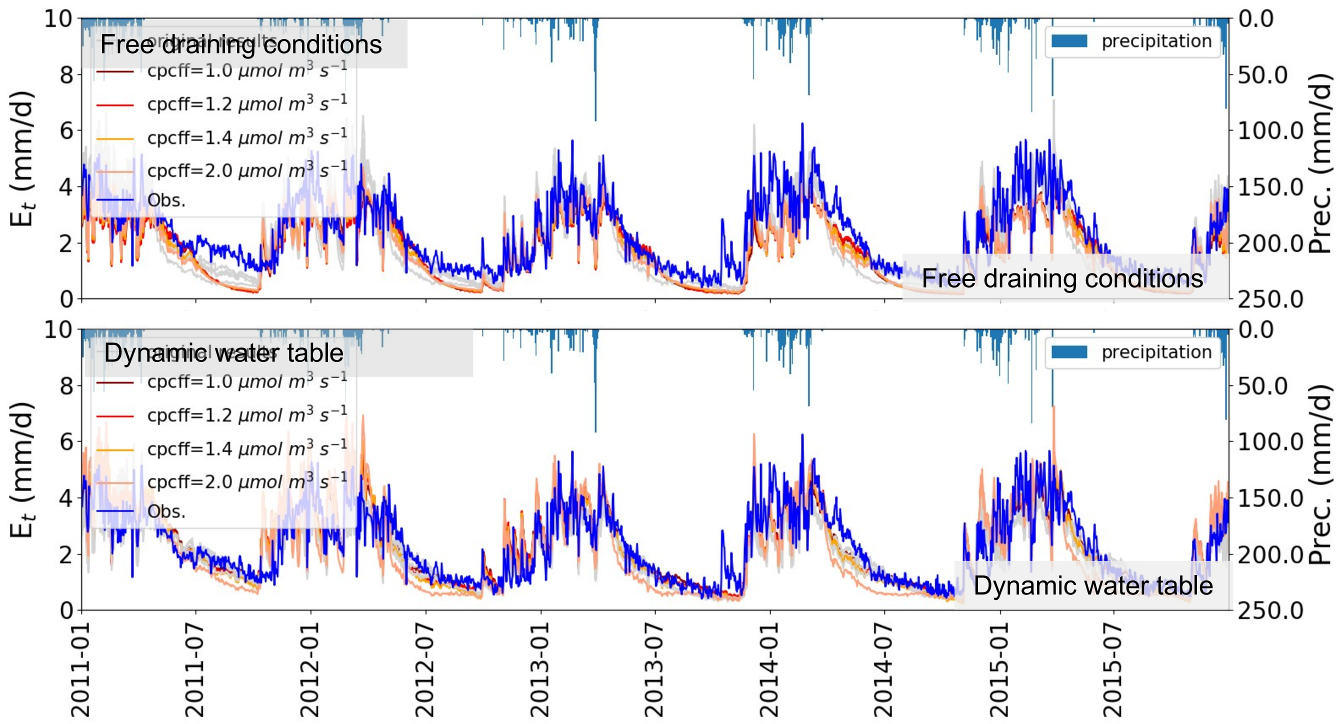
Vegetation parameters from free draining conditions

Switching the vegetation properties for the two hydrological situations leads to similar results:

- Hydrological formulation not of influence

Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow
Previous
Home
Next
See more ...
Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

HYDROLOGY AND CARBON COSTS



Vegetation parameters from dynamic water table

Vegetation parameters from free draining conditions

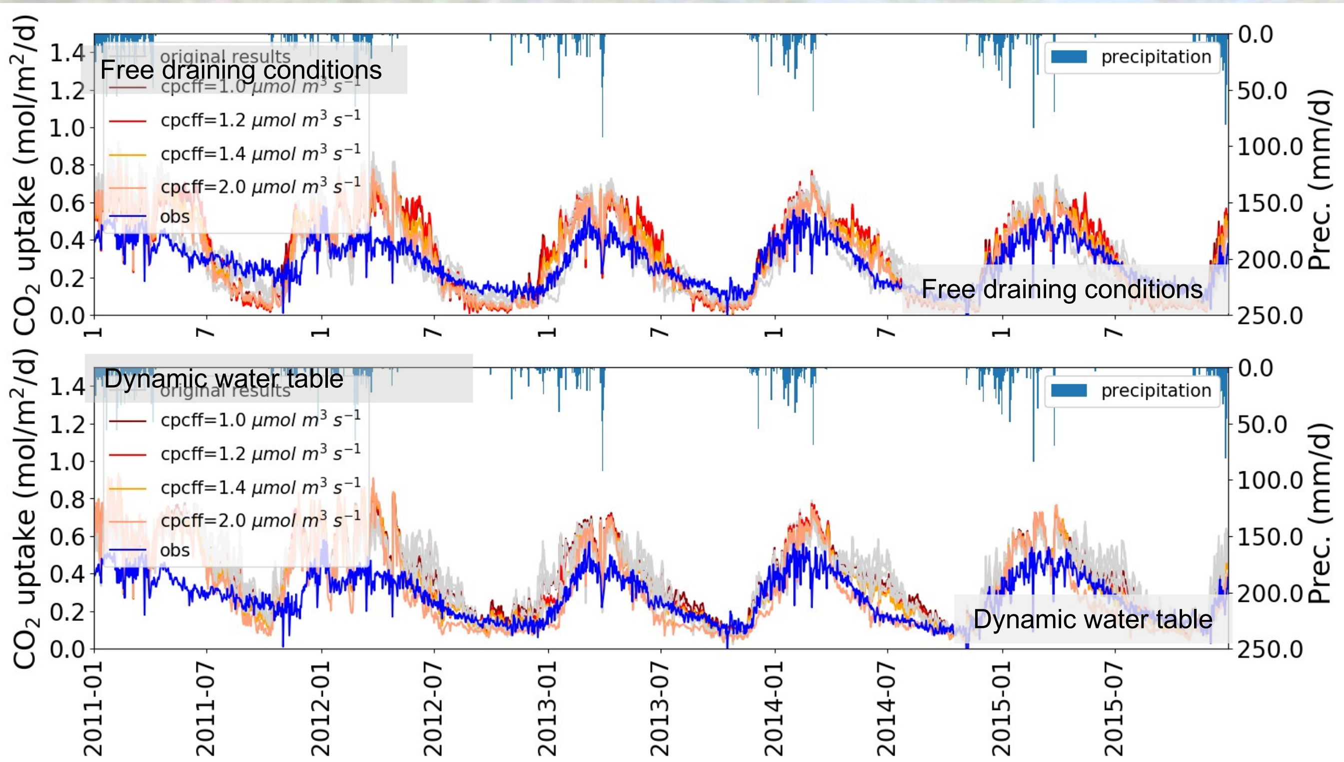
Switching the vegetation properties for the two hydrological situations leads to similar results:

- Hydrological formulation not of influence

See more ...

Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

HYDROLOGY AND CARBON COSTS



Vegetation parameters from dynamic water table

Vegetation parameters from free draining conditions

Switching the vegetation properties for the two hydrological situations leads to similar results:

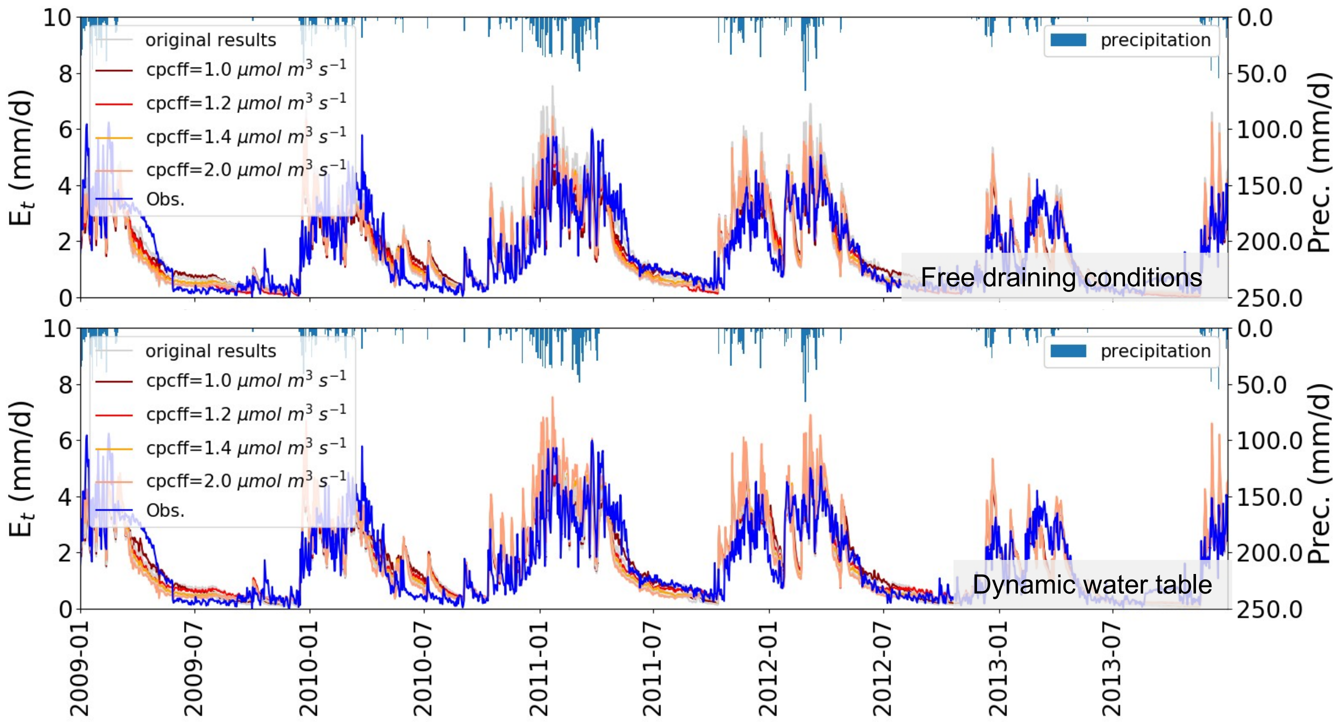
- Hydrological formulation not of influence

See more ...
Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

HYDROLOGY AND CARBON COSTS

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST

Luxembourg National Research Fund



Vegetation parameters from dynamic water table

Vegetation parameters from free draining conditions

Switching the vegetation properties for the two hydrological situations leads to similar results:

- Hydrological formulation not of influence

Motivation

Hypotheses

Methods

Results

Conclusions

Knowledge graph

Renku workflow

Previous Home Next

See more ...

Howard Springs

AdelaideRiver

DalyUncleared

DryRiver

SturtPlains

HYDROLOGY AND CARBON COSTS

Motivation

Hypotheses

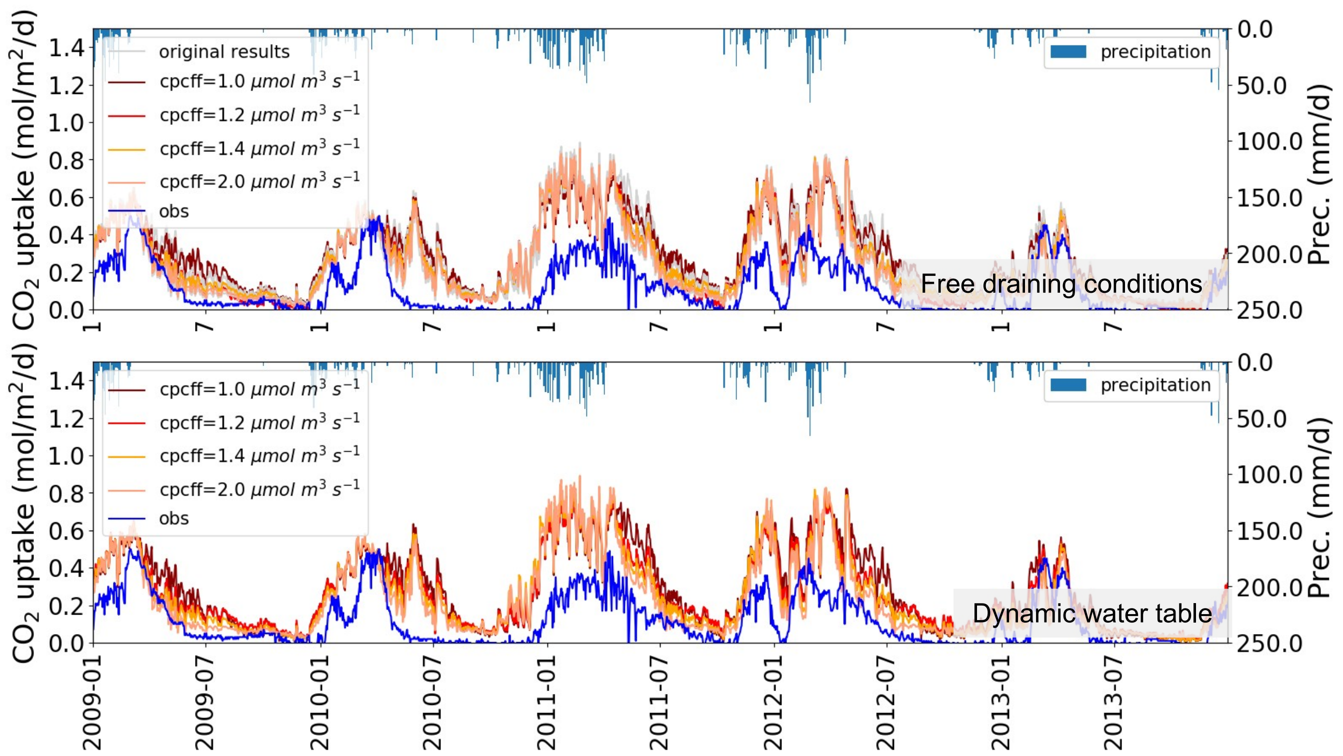
Methods

Results

Conclusions

Knowledge graph

Renku workflow



Vegetation parameters from dynamic water table

Vegetation parameters from free draining conditions

Switching the vegetation properties for the two hydrological situations leads to similar results:

- Hydrological formulation not of influence

See more ...

Howard Springs

AdelaideRiver

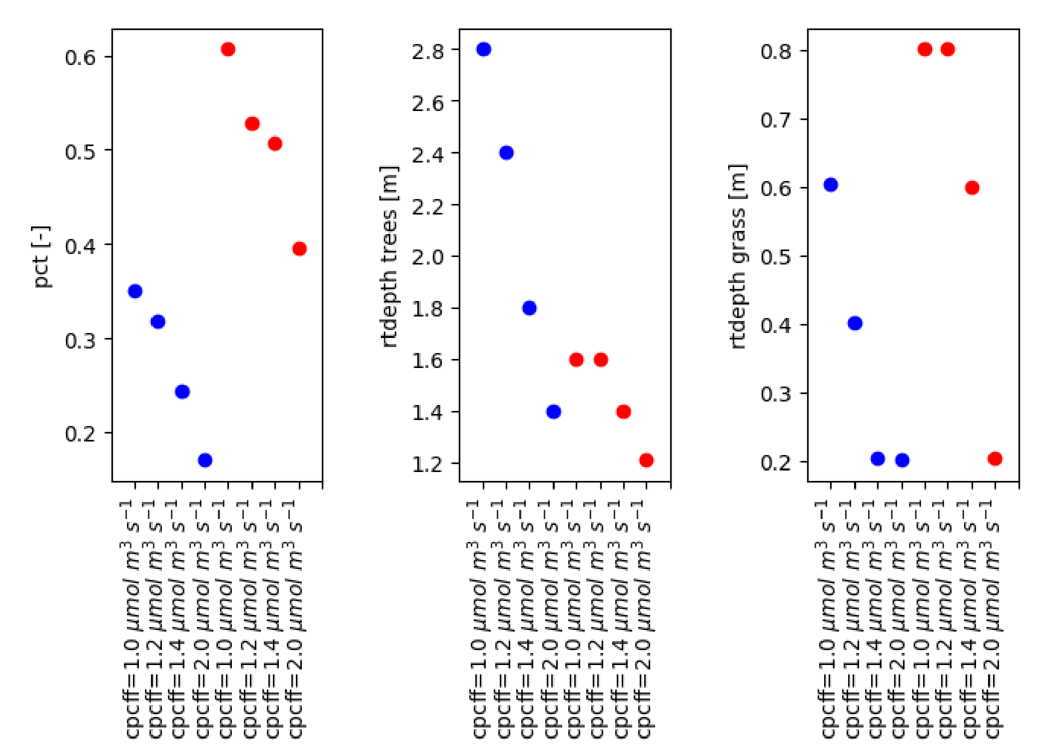
DalyUncleared

DryRiver

SturtPlains

Previous Home Next

HYDROLOGY AND CARBON COSTS



Motivation

Hypotheses

Methods

Results

Conclusions

Knowledge graph

Renku workflow

Howard Springs

AdelaideRiver

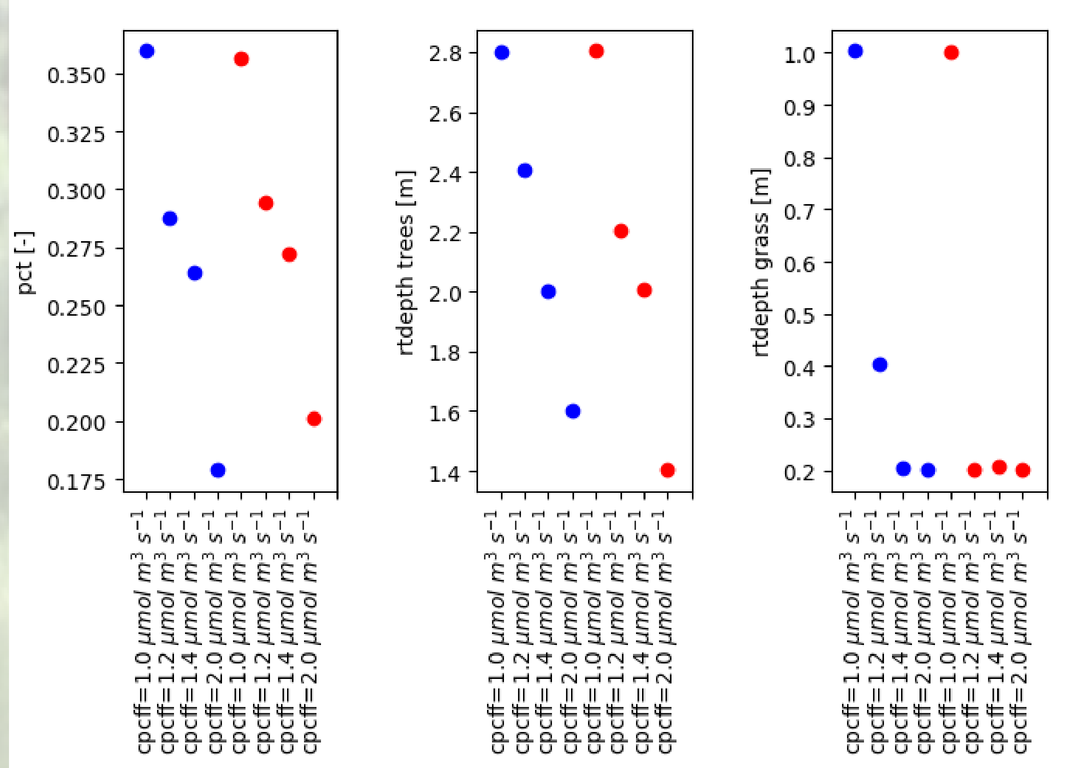
DalyUncleared

DryRiver

SturtPlains

HYDROLOGY AND CARBON COSTS

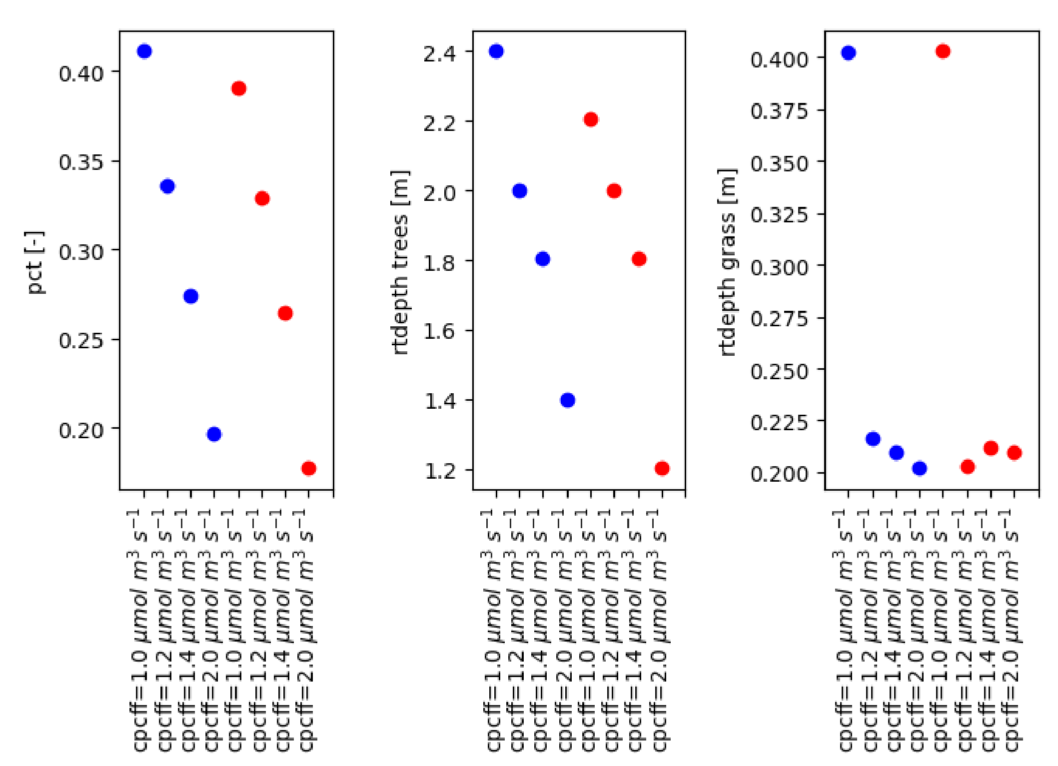
Motivation
Hypotheses
Methods
Results
Conclusions
Knowledge graph
Renku workflow



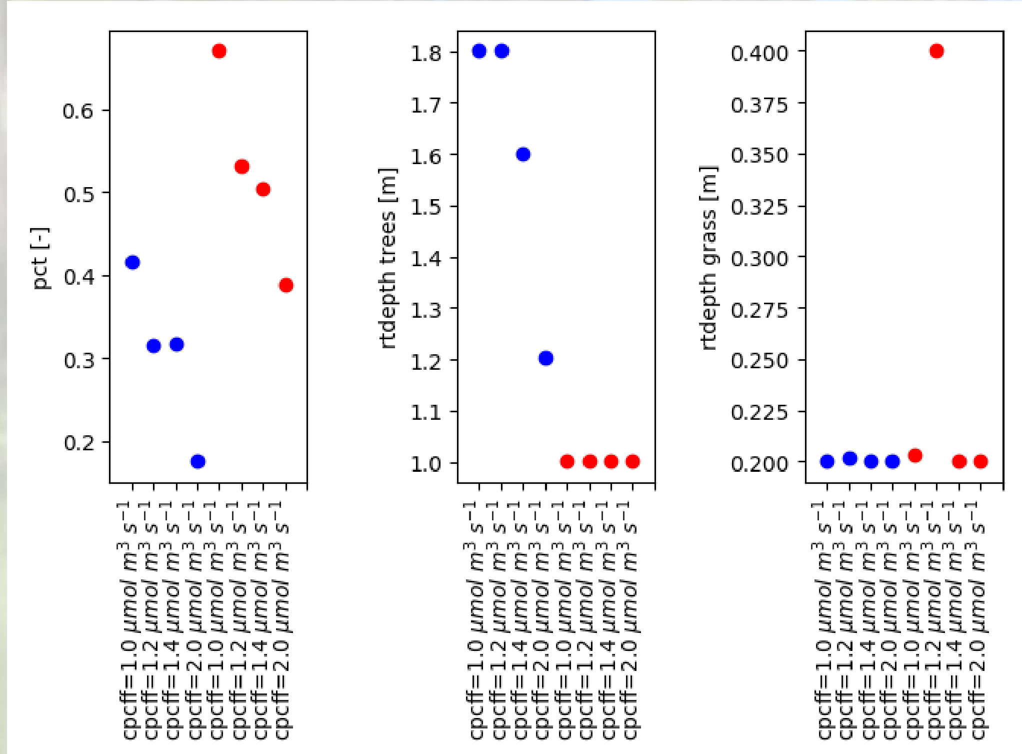
Howard Springs
AdelaideRiver
DalyUncleared
DryRiver
SturtPlains

Previous
Home
Next

HYDROLOGY AND CARBON COSTS



HYDROLOGY AND CARBON COSTS



HYDROLOGY AND CARBON COSTS