Estimating land evaporation at field scales using GLEAM

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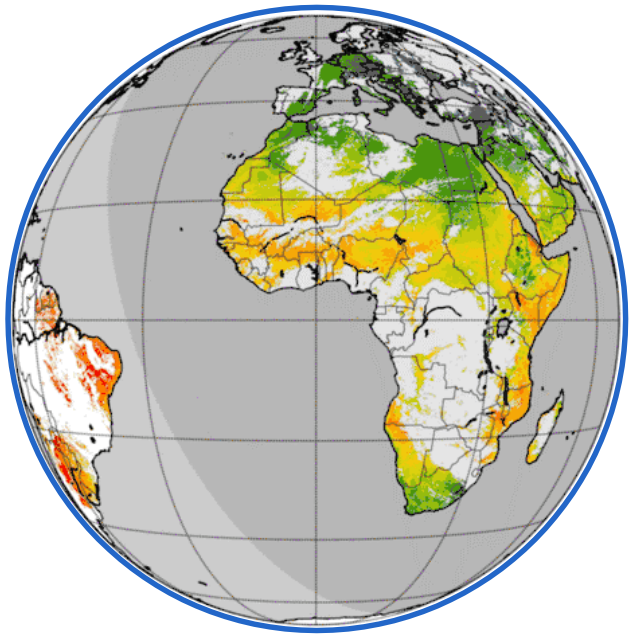
In situ measurements

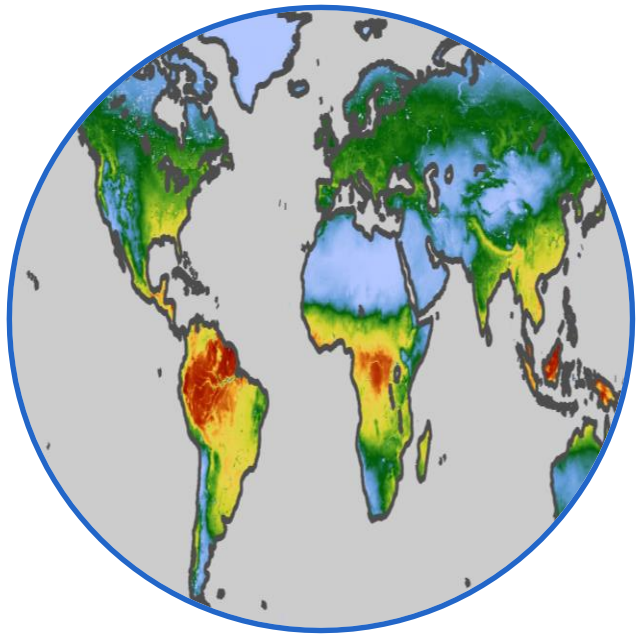
minutes
point–m

Energy-balance methods



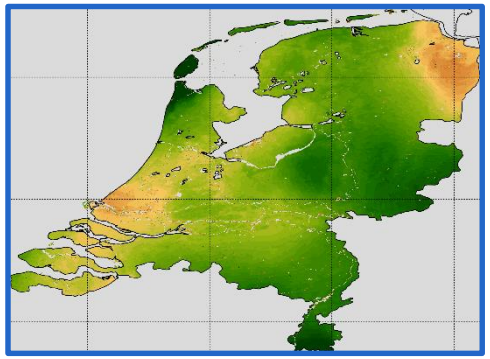
minutes
m–km (gaps)

Process-based methods

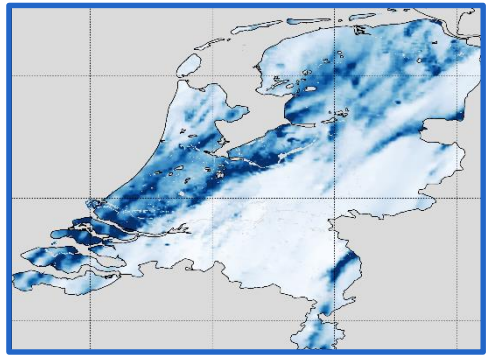


hours–days
km

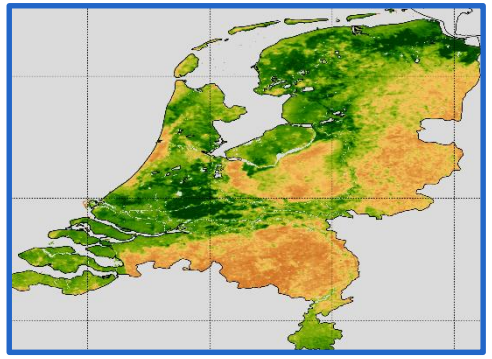
Vegetation



Meteorology

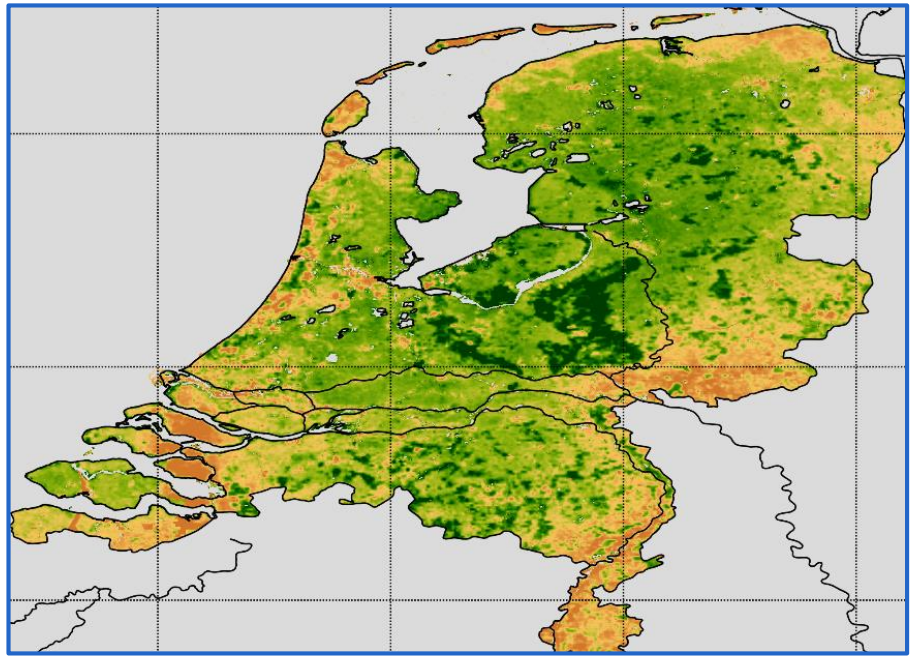


Soil moisture



SICAM

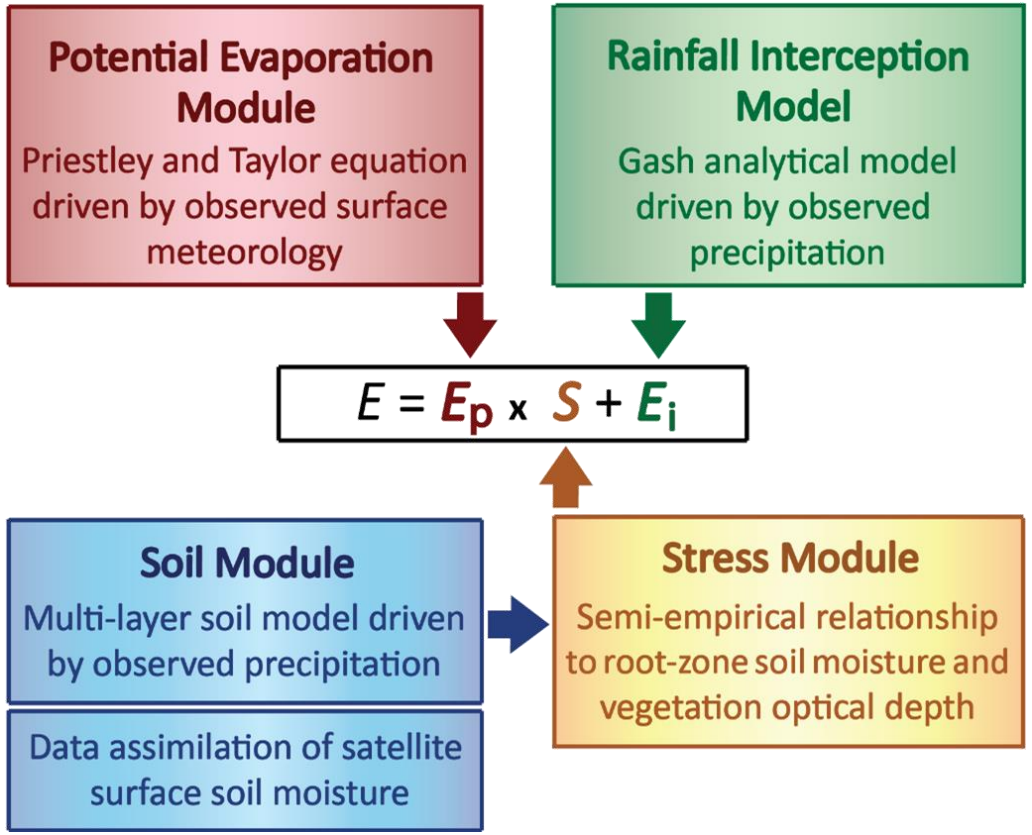
Land evaporation

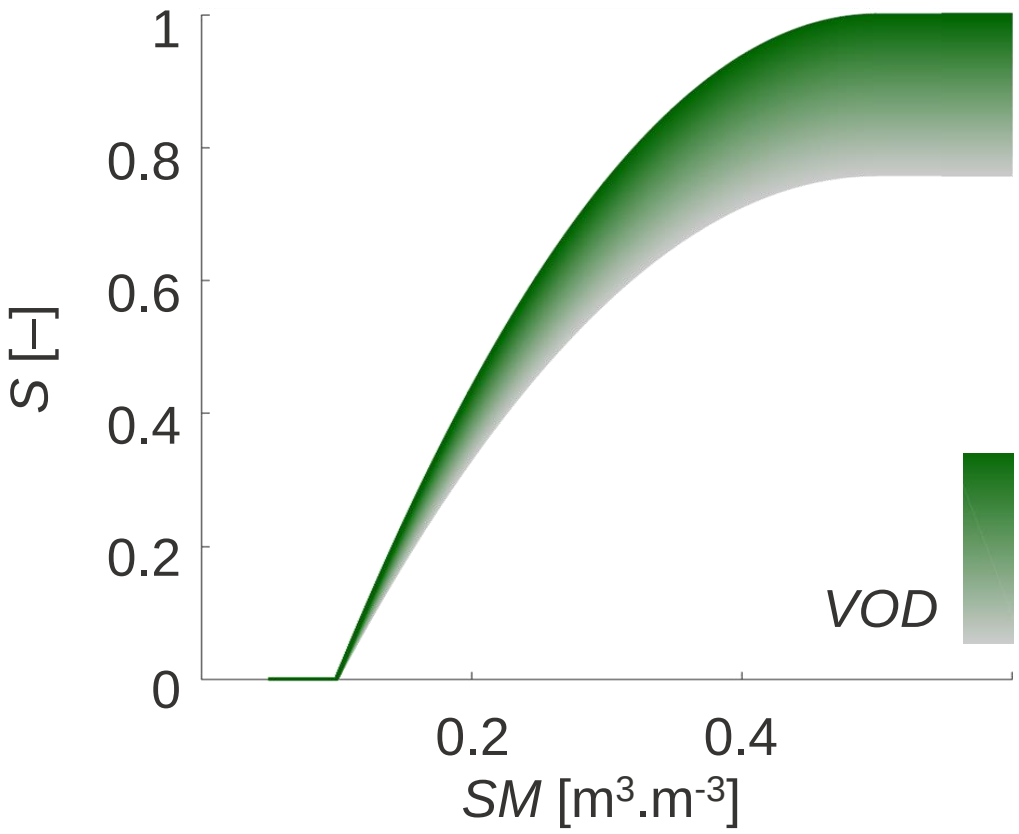


1 day

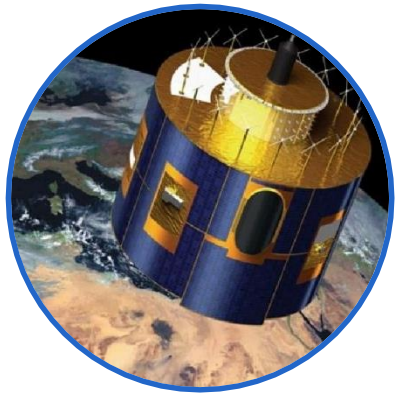
100 m

sicam


Potential Evaporation Module
Priestley and Taylor equation driven by observed surface meteorology
Rainfall Interception Model
Gash analytical model driven by observed precipitation
$E = E_p \times S + E_i$
Soil Module
Multi-layer soil model driven by observed precipitation
Data assimilation of satellite surface soil moisture
Stress Module
Semi-empirical relationship to root-zone soil moisture and vegetation optical depth


S [-]
1
0.8
0.6
0.4
0.2
0
0.2
0.4
SM [m³.m⁻³]
VOD

Raw satellite data

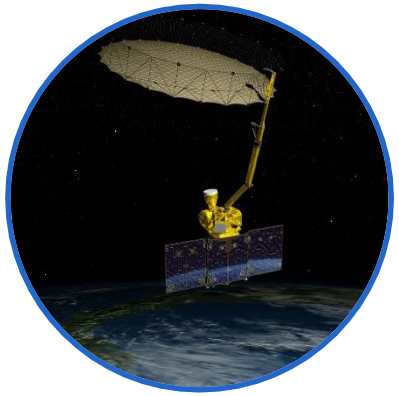


CERES	Radiation (net)	1°
SEVIRI	Radiation (in)	3 km
MODIS	Emissivity	3 km
	Albedo	500 m
	Land cover	250 m

Ground radar

C-Doppler	Precipitation	1 km

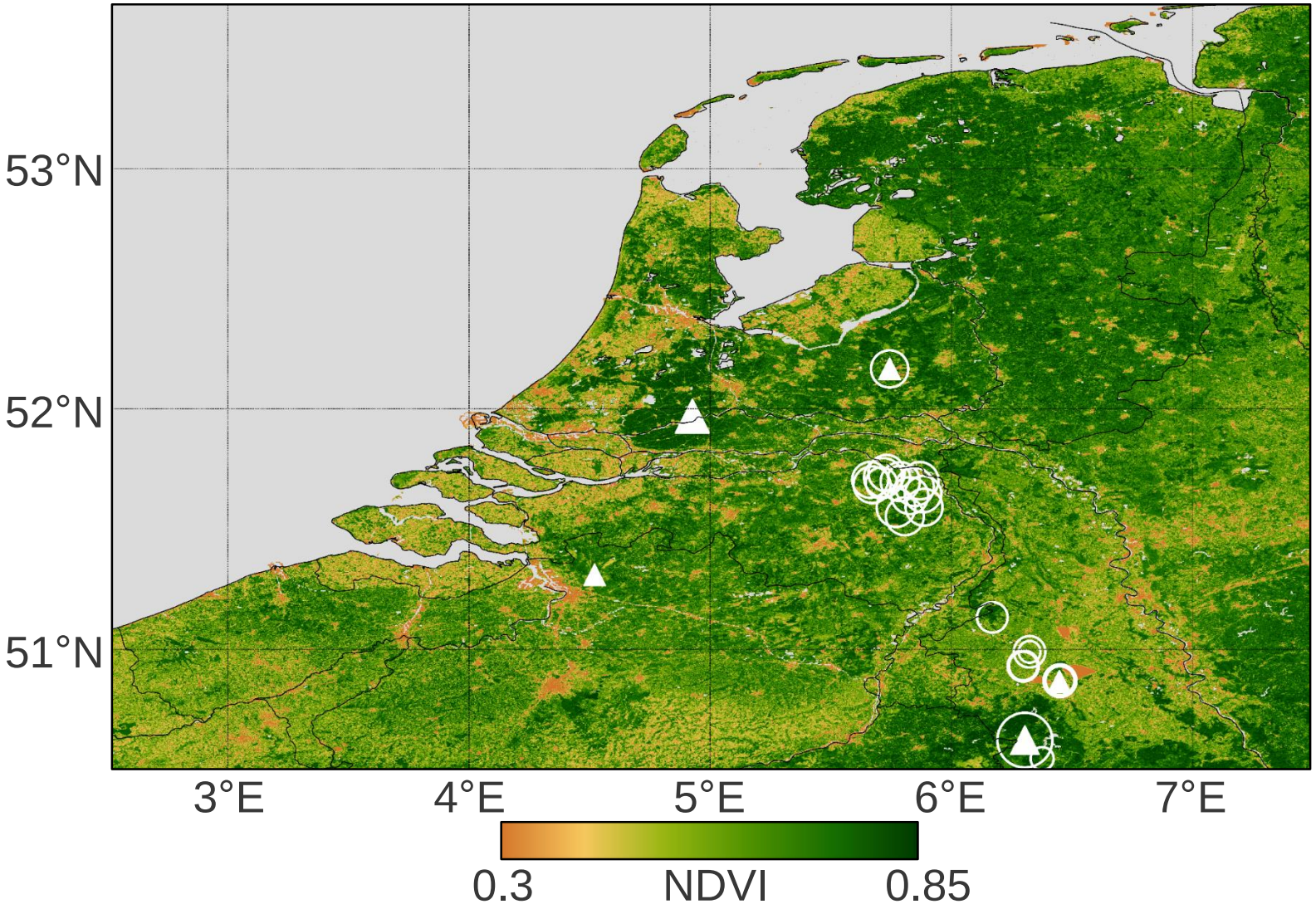
Downscaled MW data



MW	Soil moisture	100 m
	LST	100 m
	VOD	100 m

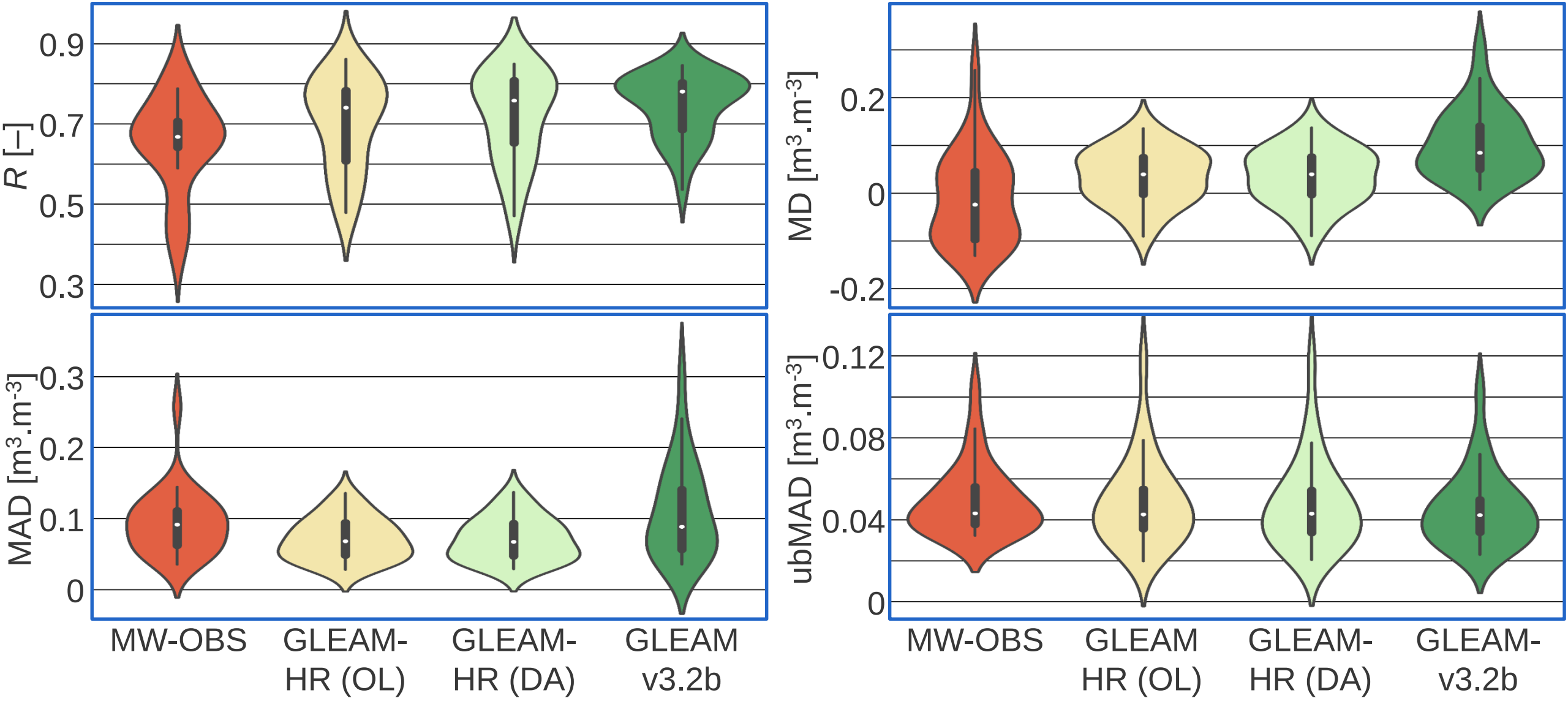
ISMN

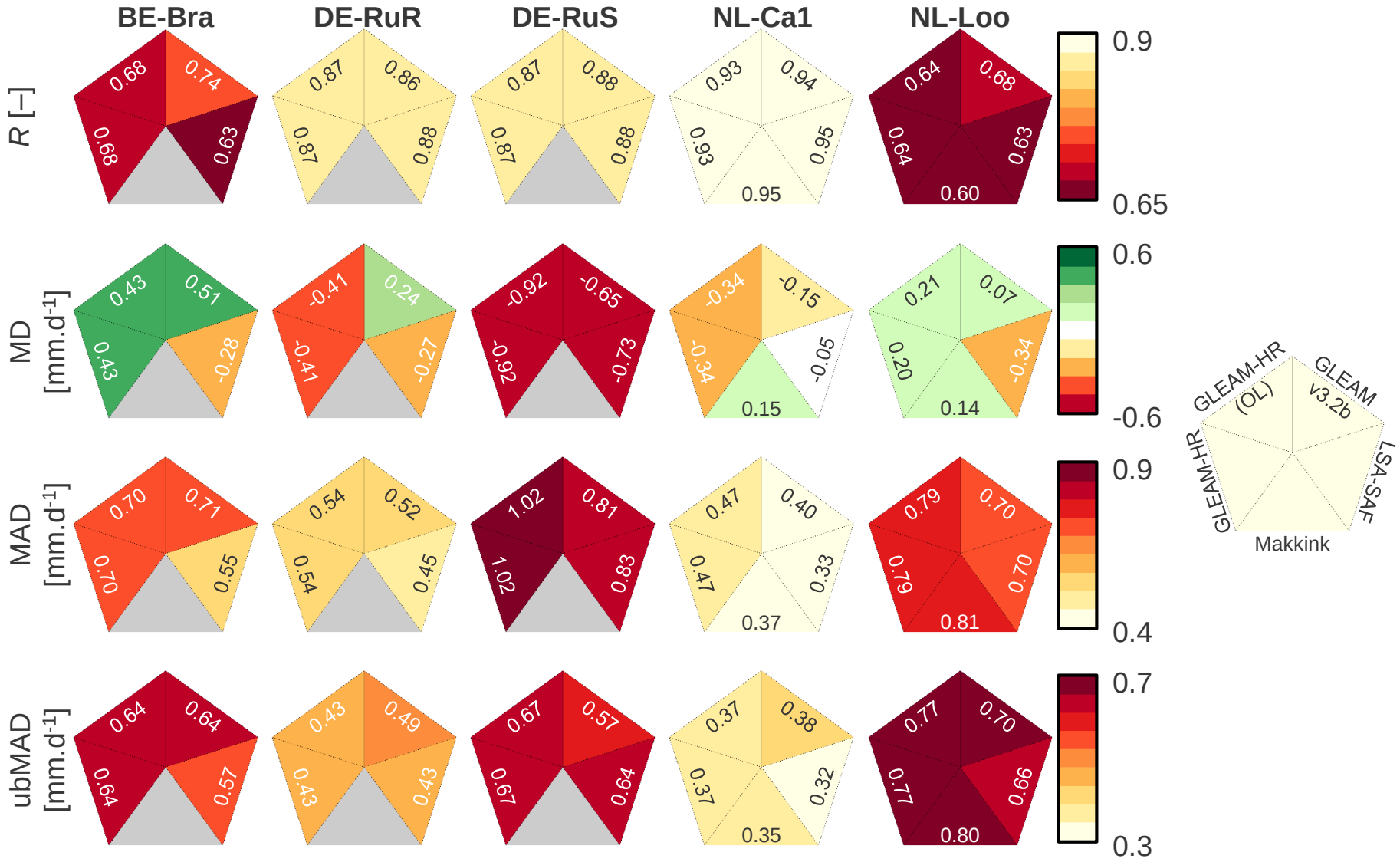
29 surface soil moisture sensors

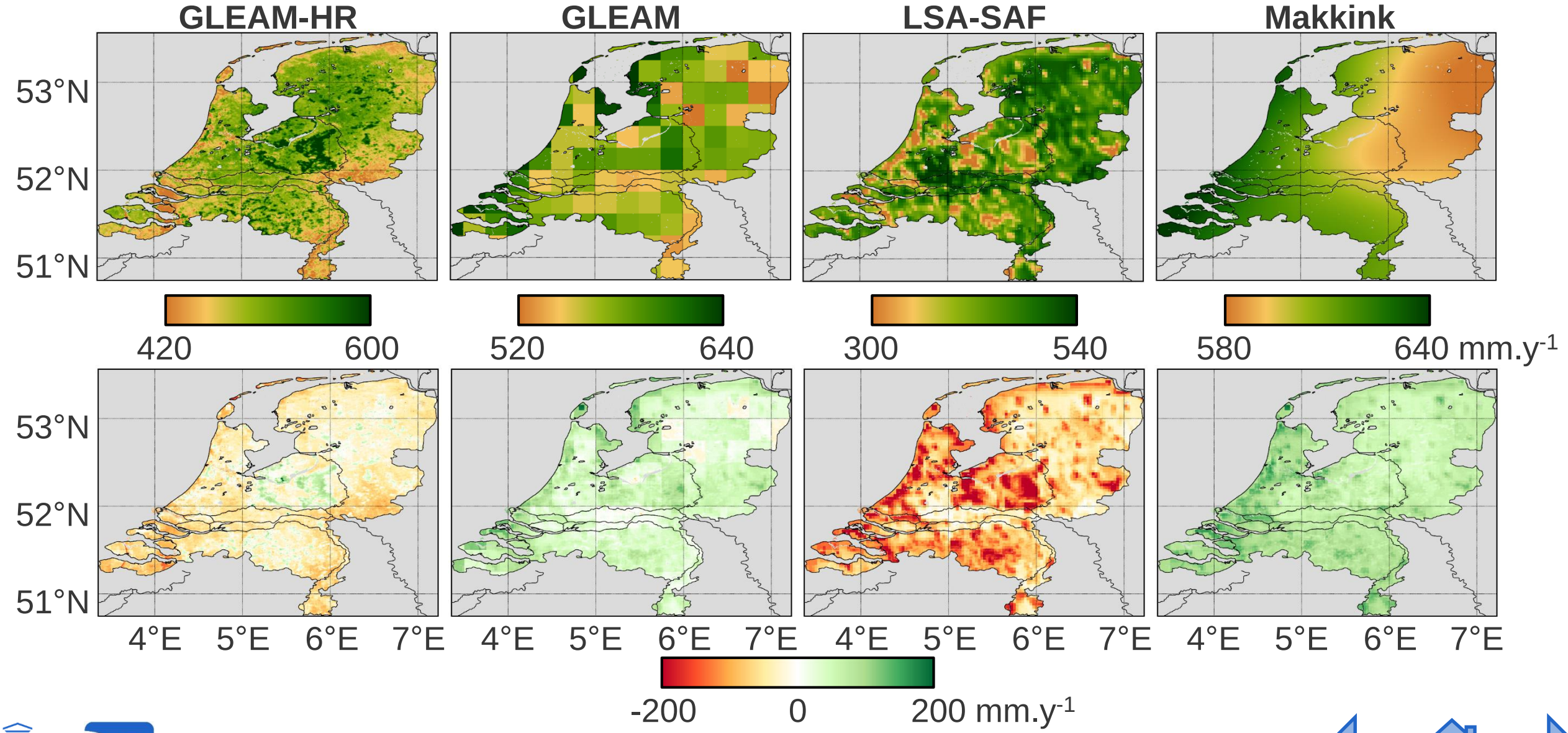


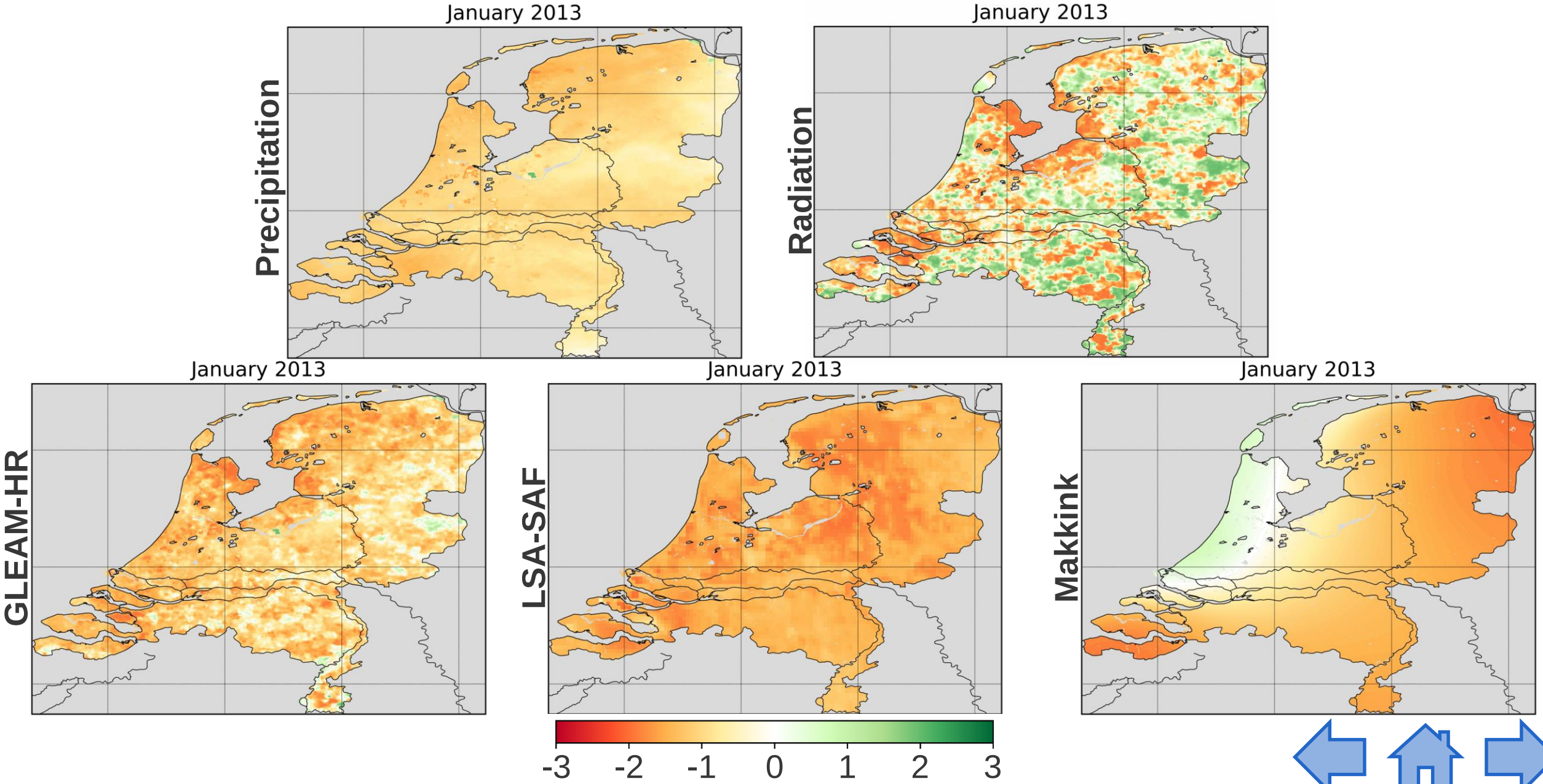
FLUXNET

5 eddy-covariance sites

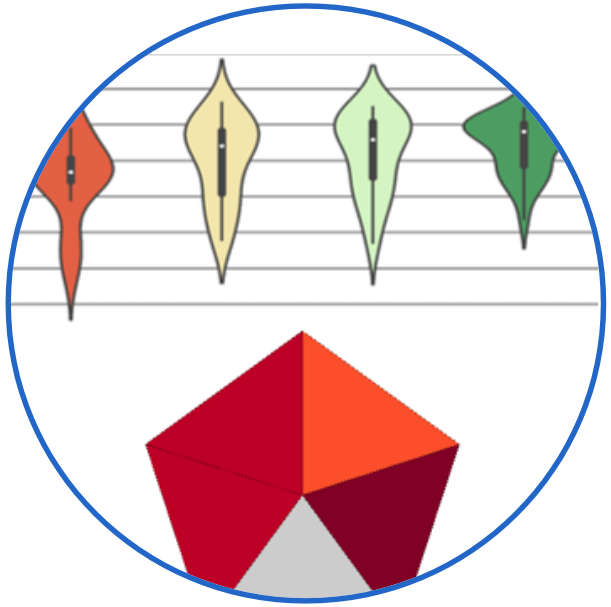

R [–]
0.9
0.7
0.5
0.3
MD [m3.m-3]
0.2
0
-0.2
MAD [m3.m-3]
0.3
0.2
0.1
0
ubMAD [m3.m-3]
0.12
0.08
0.04
0
MW-OBS
GLEAM-HR (OL)
GLEAM-HR (DA)
GLEAM v3.2b
MW-OBS
GLEAM HR (OL)
GLEAM-HR (DA)
GLEAM-v3.2b


BE-Bra
DE-RuR
DE-RuS
NL-Ca1
NL-Loo
R [–]
0.68 0.74 0.68 0.63
0.87 0.86 0.87 0.88
0.87 0.88 0.87 0.88
0.93 0.94 0.93 0.95 0.95
0.64 0.68 0.64 0.63 0.60
0.9
0.65
MD [mm.d-1]
0.43 0.51 0.43 -0.28
-0.41 0.24 -0.41 -0.27
-0.92 -0.65 -0.92 -0.73
-0.34 -0.15 -0.34 -0.05 0.15
0.21 0.07 0.20 -0.34 0.14
0.6
-0.6
MAD [mm.d-1]
0.70 0.71 0.70 0.55
0.54 0.52 0.54 0.45
1.02 0.81 1.02 0.83
0.47 0.40 0.47 0.33 0.37
0.79 0.70 0.79 0.70 0.81
0.9
0.4
ubMAD [mm.d-1]
0.64 0.64 0.64 0.57
0.43 0.49 0.43 0.43
0.67 0.57 0.67 0.64
0.37 0.38 0.37 0.32 0.35
0.77 0.70 0.77 0.66 0.80
0.7
0.3
GLEAM-HR (OL)
GLEAM v3.2b
LSA-SAF
Makkink
GLEAM-HR


GLEAM-HR
GLEAM
LSA-SAF
Makkink
53°N
52°N
51°N
420
600
520
640
300
540
580
640 mm.y-1
4°E
5°E
6°E
7°E
-200
0
200 mm.y-1


January 2013
Precipitation
January 2013
Radiation
January 2013
GLEAM-HR
January 2013
LSA-SAF
January 2013
Makkink
-3
-2
-1
0
1
2
3

Good temporal statistics

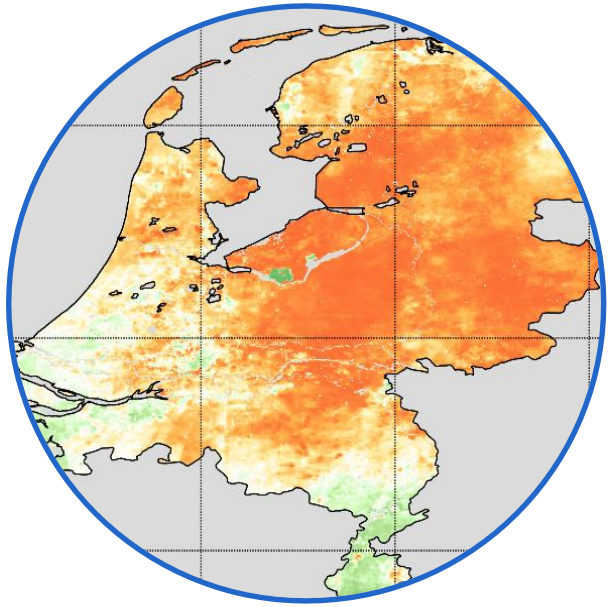


Need for larger sample of sites!

High and realistic spatial detail

Need for objective validation!

Realistic response to dry conditions



Need for validation in arid environments!