Global data for local applications

How useful are global data for river basin modelling?

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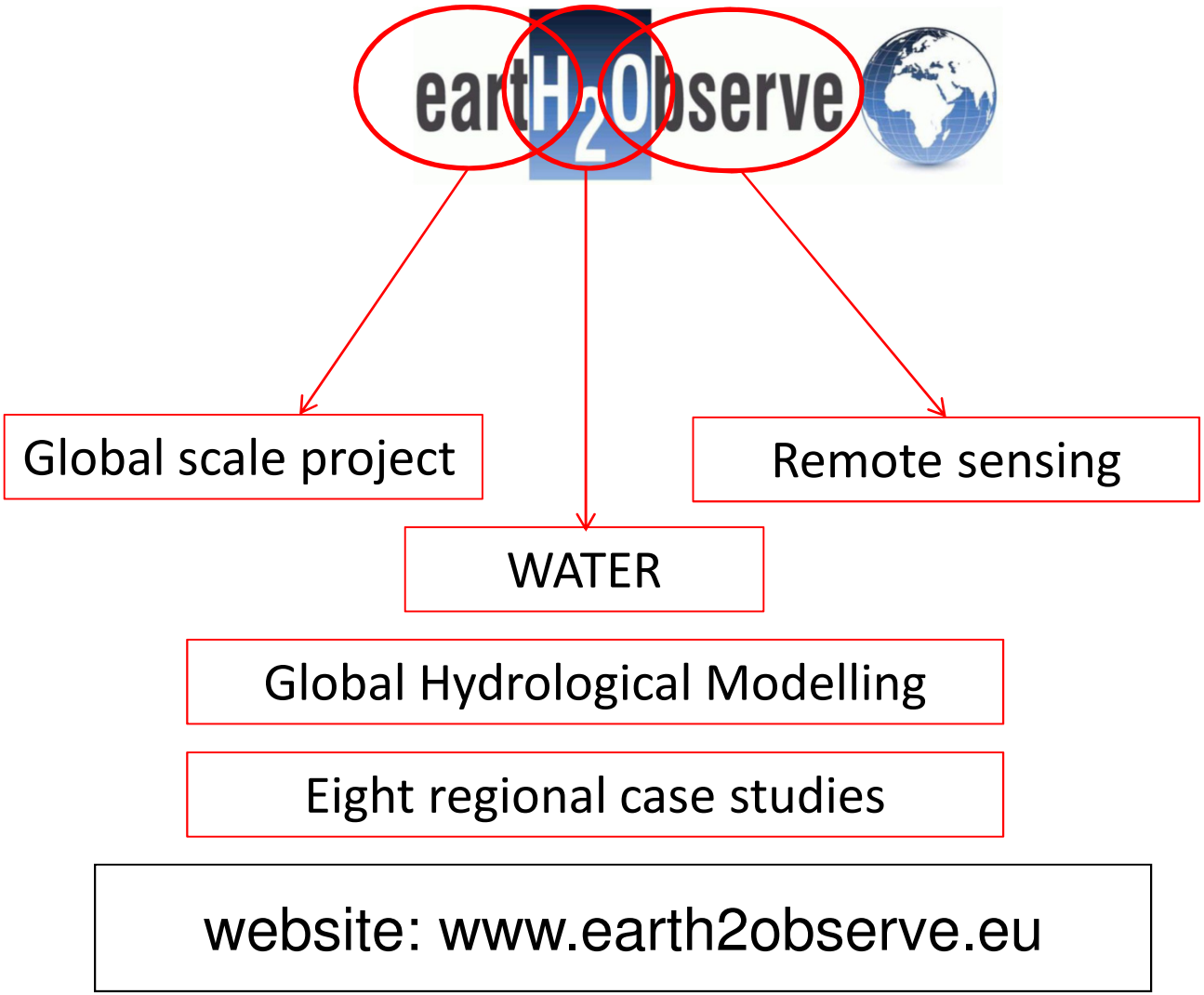
- eartH2Observe case studies
- Preliminary results
  - Forcing data, EO data, global hydrological data
- Morocco case study

eartH2Observe project

- EU-funded project (FP 7)
- 2014-2017
- 27 partners
  - 22 Scientific research organisations
    - 4 non-European partners
  - 5 SME's

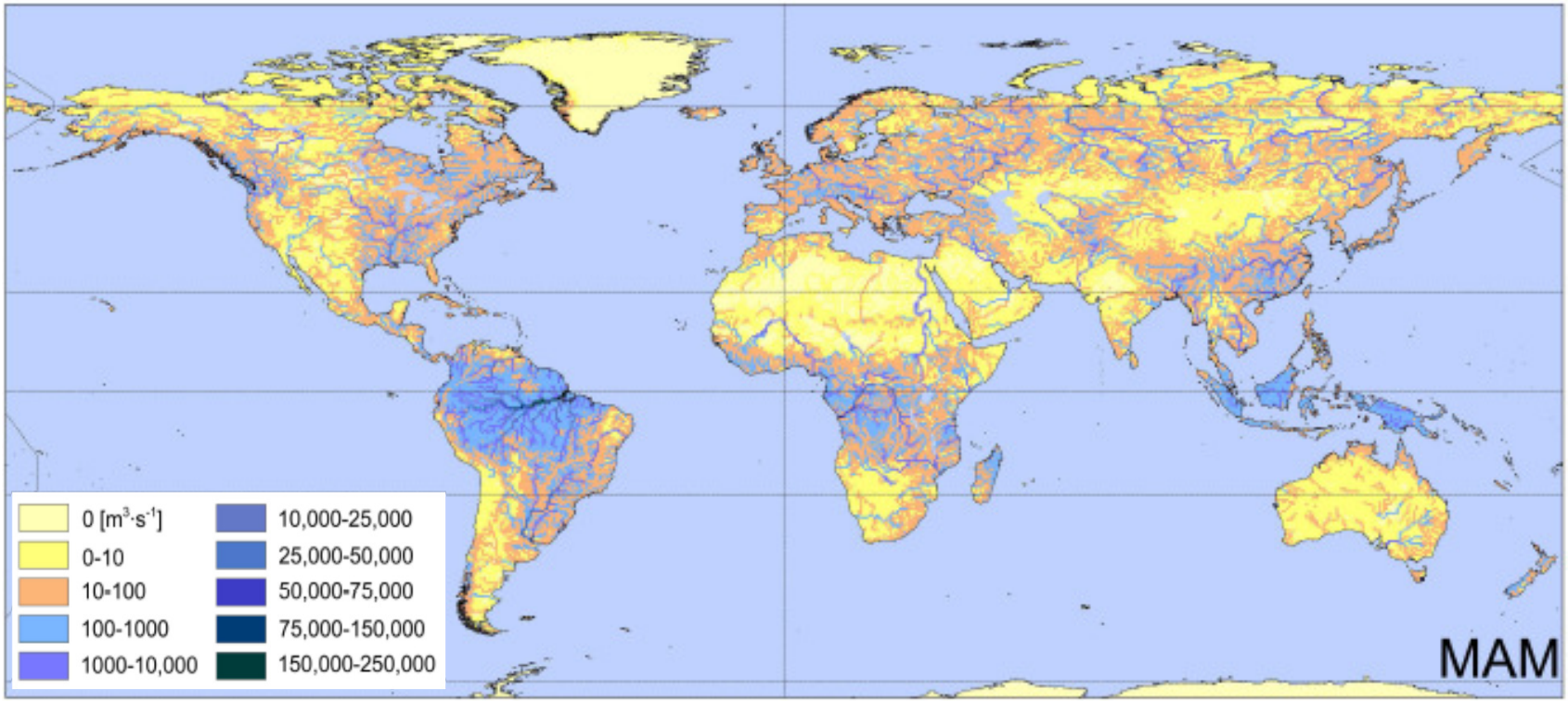

earth2observe
Global scale project
Remote sensing
WATER
Global Hydrological Modelling
Eight regional case studies
website: www.earth2observe.eu

eartH2Observe project and datasets

- Many countries lack information about water availability
  - Especially developing countries
- Aim: to provide better water resources information
  - Earth Observation
  - Global hydrological modelling
- How good are these datasets for local applications?
- Eight case studies to help answer this question

eartH2Observe project and datasets

- Earth Observation data
  - Remote sensing products
- Global forcing data
  - ECMWF – ERA interim 0.5^{o} global data (3 hourly)
- Global Water Resources Reanalysis (WRR) Tier 1
  - Based on ensemble of global hydrological models
  - 30 years; 50 x 50 km; 3-hourly/daily time steps
  - Data available through our data portal

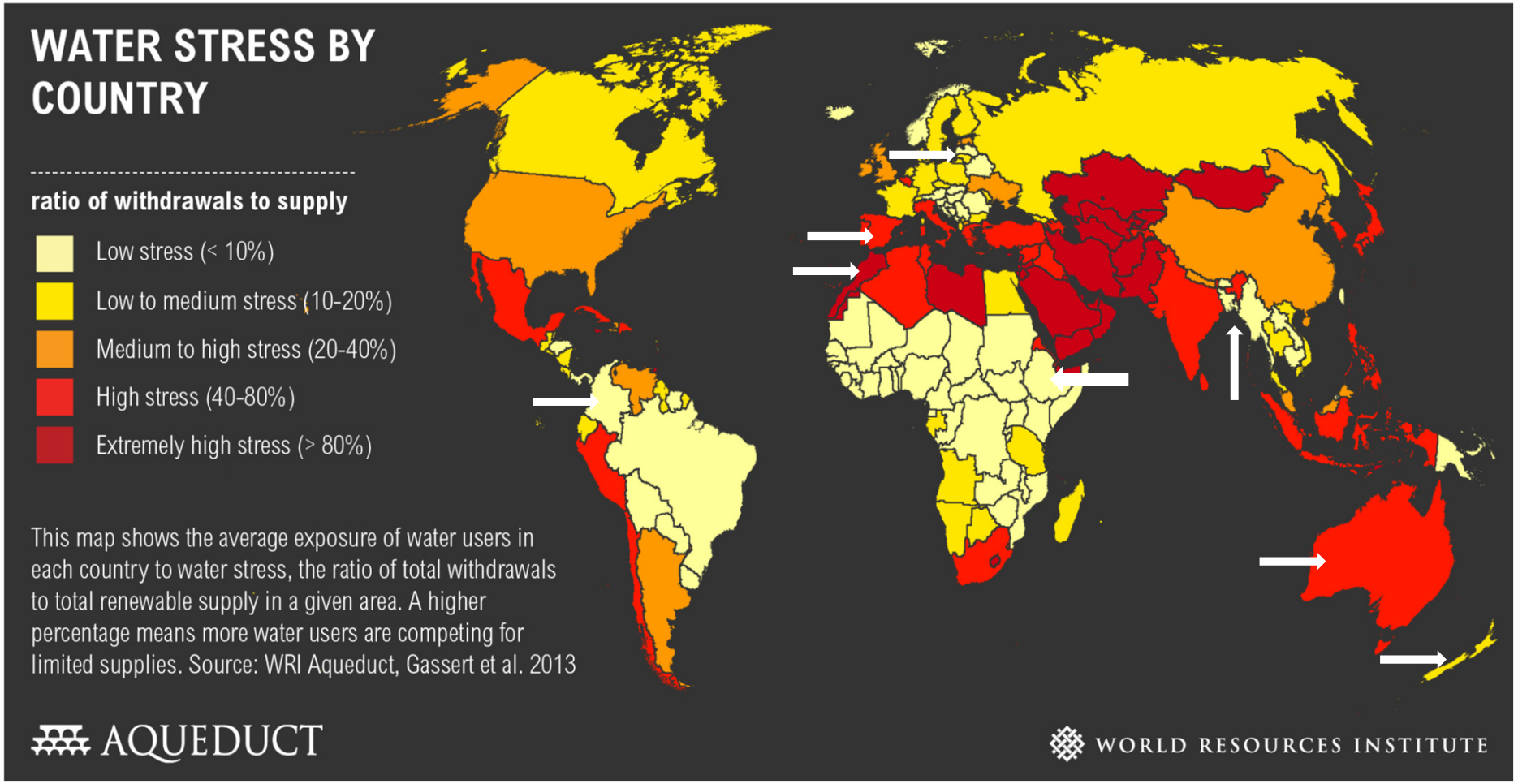


Global river discharge (year 2000; PCR-GLOBWB simulation)

eartH2Observe case studies

- Eight different countries
  - Variation in hydrological conditions
  - Data rich versus data poor

- Each case study has its own focus
  - Flooding, drought, groundwater, water quality, etc.
  - Collaboration with scientific partner and end-user(s)



eartH2Observe case study countries

eartH2Observe case studies

- Project is in its 3rd year
  - 2014 - 2017
- Preliminary results only
  - We have 20 months left

Preliminary results: forcing data

Preliminary results: forcing data

- ECMWF – ERA-Interim reanalysis
  - 0.5^{o} spatial resolution
  - 3 hourly
- Used in six countries
  - For modelling
  - For rainfall comparison
- Some mixed results

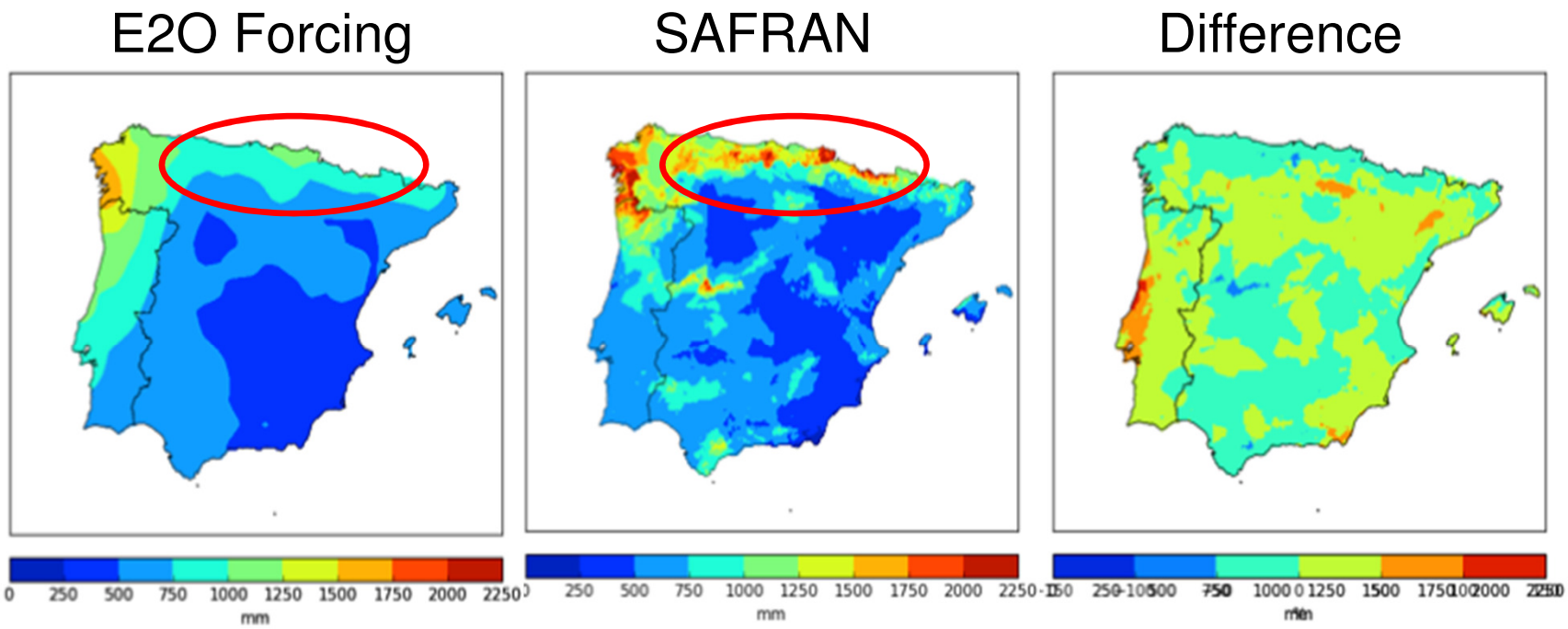
Preliminary results: forcing data

- Colombia (Magdalena basin)
  - Good seasonality; but overestimation of total rain
- Ethiopia (upper Blue Nile)
  - Rainfall from forcing not as good as EO products
- Bangladesh (Brahmaputra)
  - Good seasonality; but overestimation of total rain
  - Better model efficiency with forcing than with EO rain

Preliminary results: forcing data

- Spain
  - Comparison with local climate product (SAFRAN)
- SAFRAN
  - 5 x 5 km
  - ERA-interim combined with local meteo data
- Forcing quite OK, but bias in mountainous areas

Preliminary results: forcing data

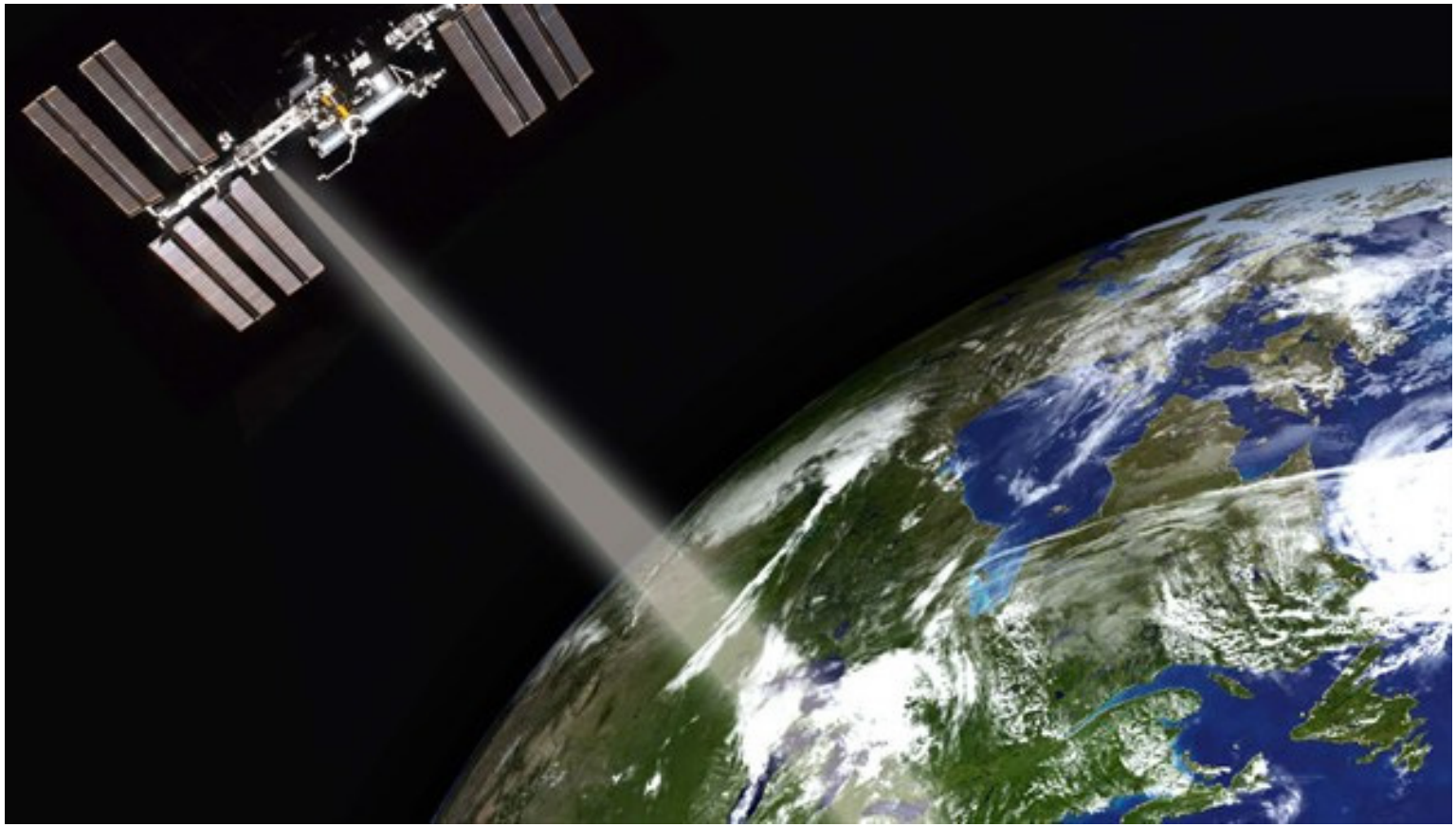


Mean annual rainfall for Iberian Peninsula

Preliminary results: forcing data

- In conclusion
  - Forcing data are pretty good
  - But coarse resolution is a problem
- Australia
  - Downscaling from 50 x 50 to 10 x 10 km
  - Improved results for Murrumbidgee river
- Downscaling will be tried in all case studies

Preliminary results: EO data



Preliminary results: EO data

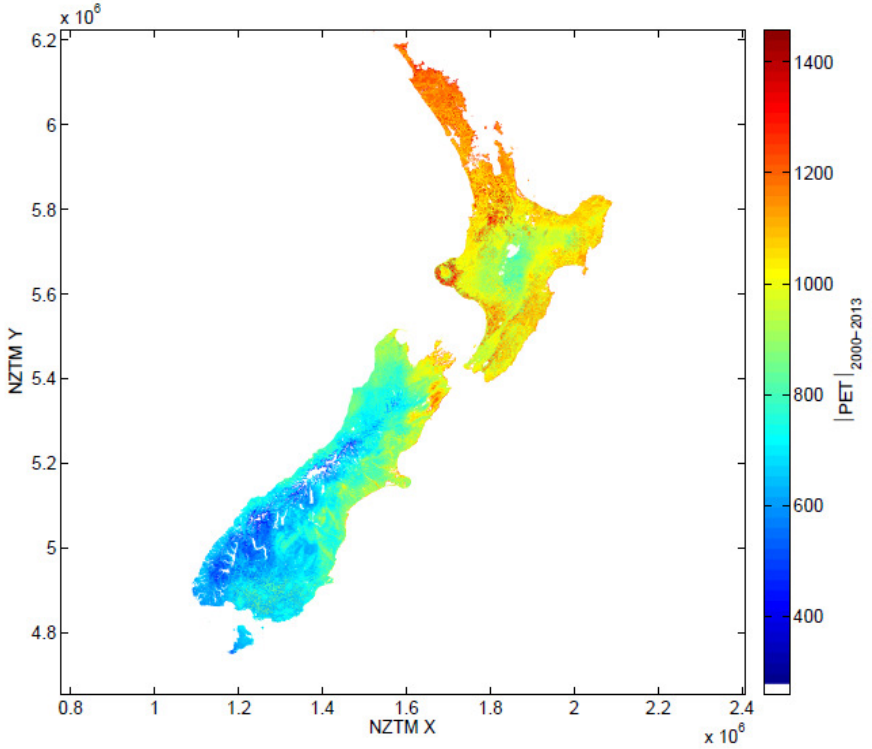
- Precipitation
  - Colombia, Ethiopia, Bangladesh
  - Comparison with in-situ data and used in modelling

- Colombia: CMORPH and TRMM are both good
- Ethiopia: CMORPH and TRMM are both good
- Bangladesh: TRMM data are best
  - CMORPH and GSMap are useless

Preliminary results: EO data

- New Zealand
  - Evapotranspiration based on MOD16 EO data
  - AET and PET at 1 x 1 km and monthly time step
  - Patterns are quite good
  - Strong bias in mountainous areas

Preliminary results: EO data

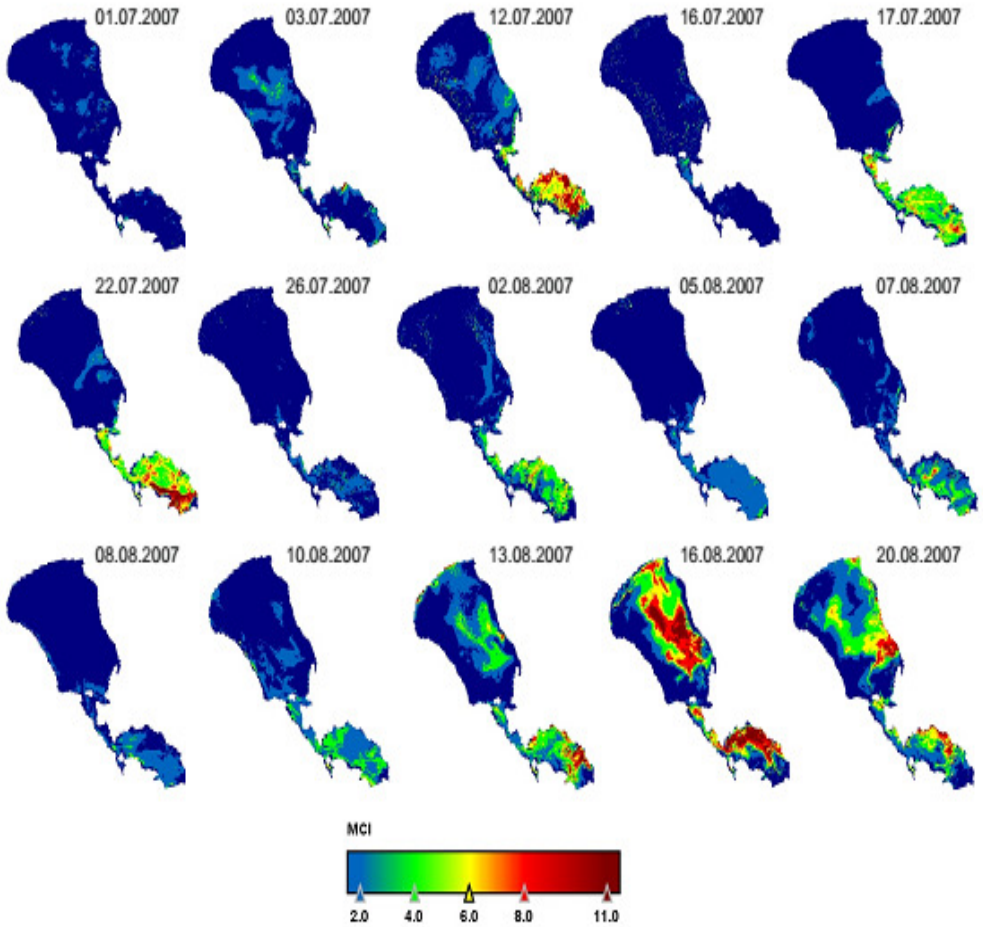


Mean annual Penman PET based on Mod16 data

Preliminary results: EO data

- Estonia
  - MERIS data (Envisat) + improved algorithm
  - Accurate quantification of chlorophyll in lake Peipsi
  - High temporal and spatial resolutions

Preliminary results: EO data



MERIS-based chlorophyll concentrations in Lake Peipsi, July-August 2007

Good match with in-situ measurements

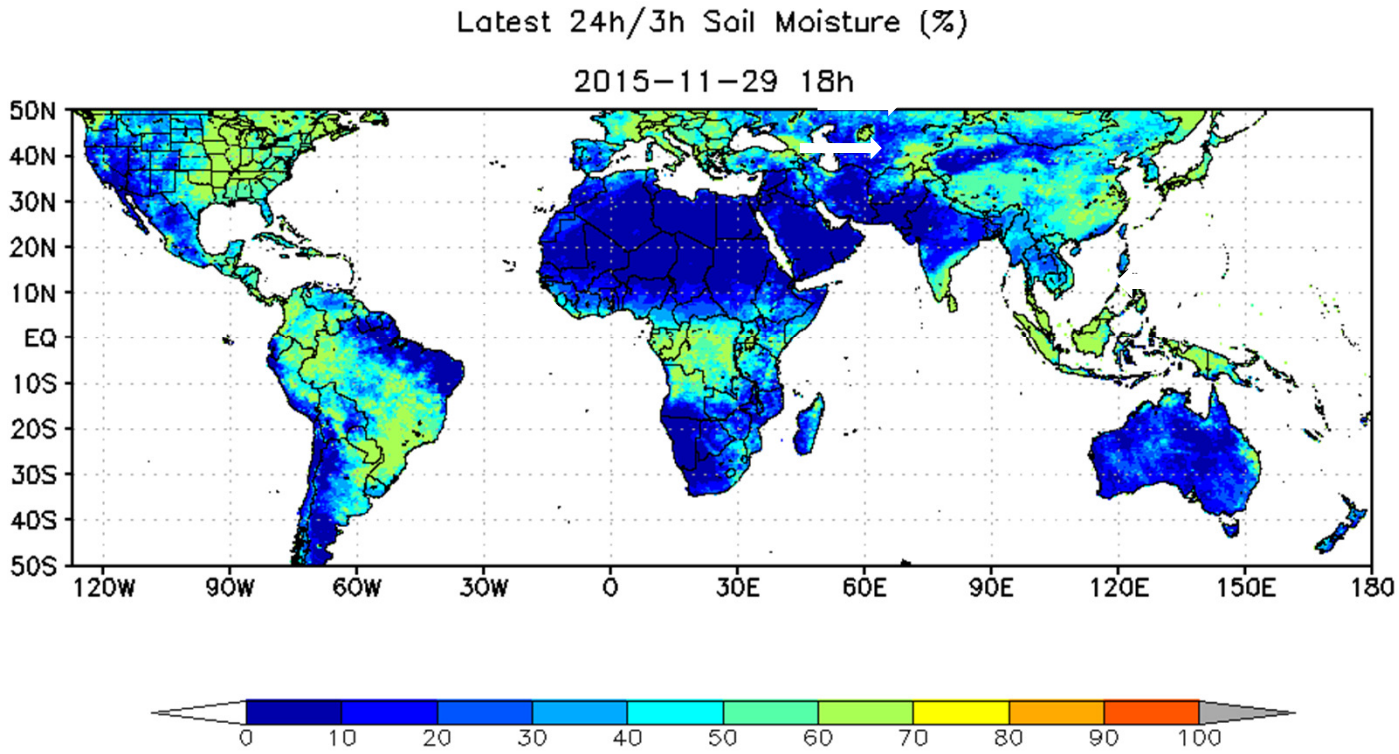
Preliminary results: EO data

- In conclusion:
  - EO rainfall products can provide good estimates
  - But quality seems location dependent

  - MOD16 product good for ET estimation
  - Requires validation using station data

  - MERIS data: accurate quantification of chlorophyll
  - High temporal and spatial resolutions

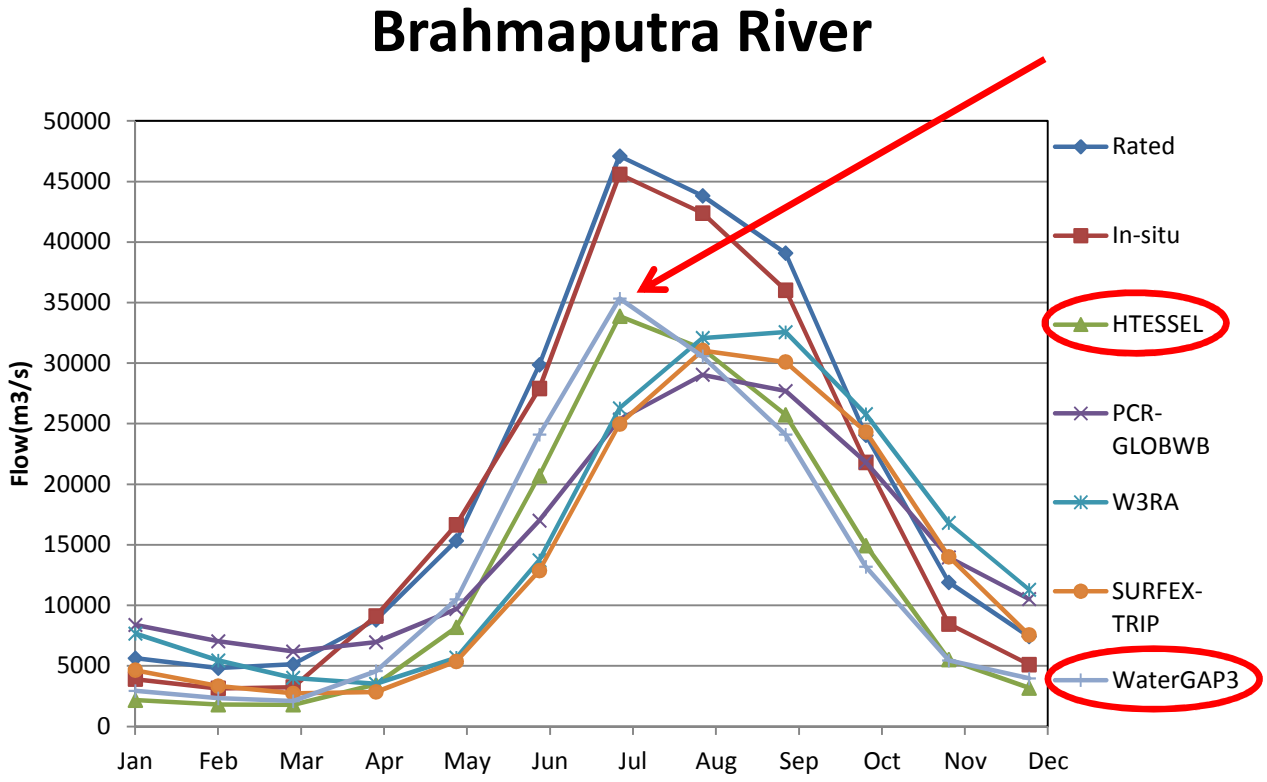
Preliminary results: WRR-Tier 1 data



Preliminary results: WRR-Tier 1 data

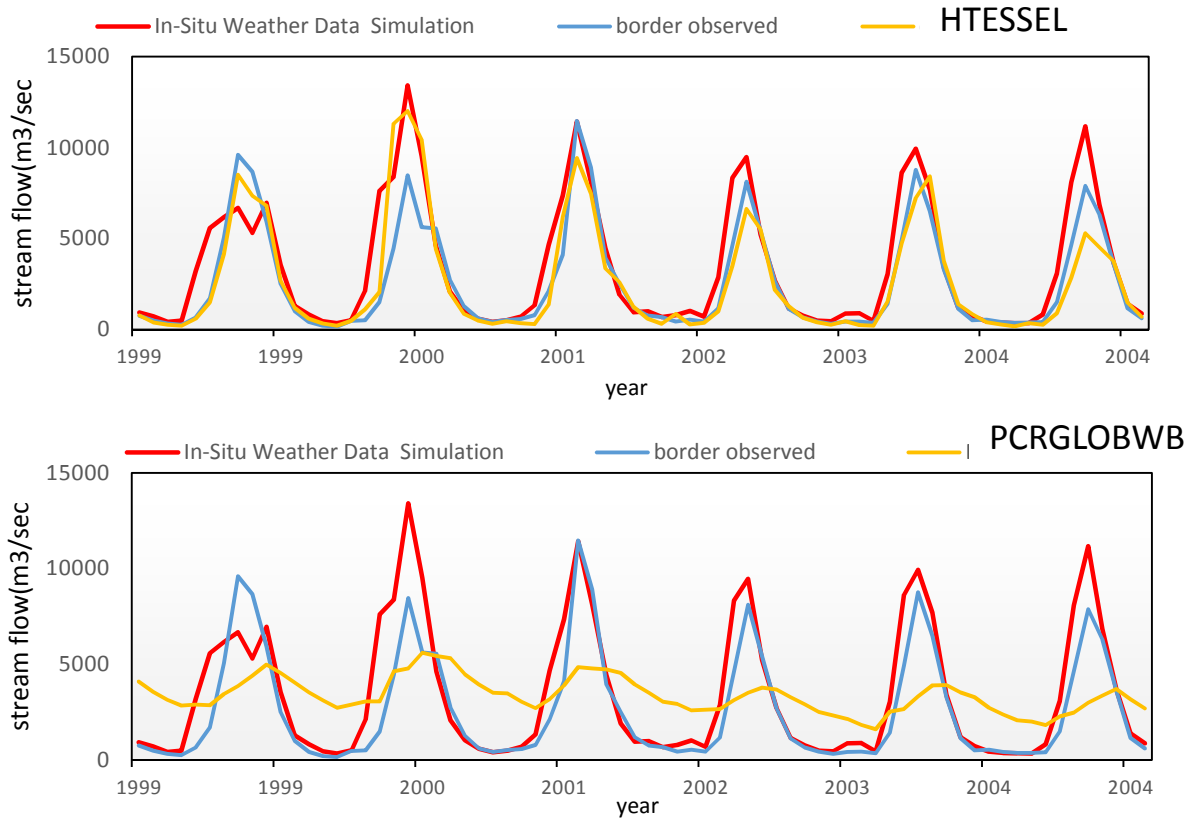
- Ethiopia, Colombia, Bangladesh
  - Comparison modelled with measured discharge
- Mixed results
  - The same model (PCR-GLOBWB) reasonable in one place (Brahmaputra) and the worst in another (Blue Nile)

Preliminary results: WRR-Tier 1 data



Comparison of mean monthly discharge with WRR Tier 1

Preliminary results: WRR-Tier 1 data



Modelled and measured mean monthly discharge, Blue Nile

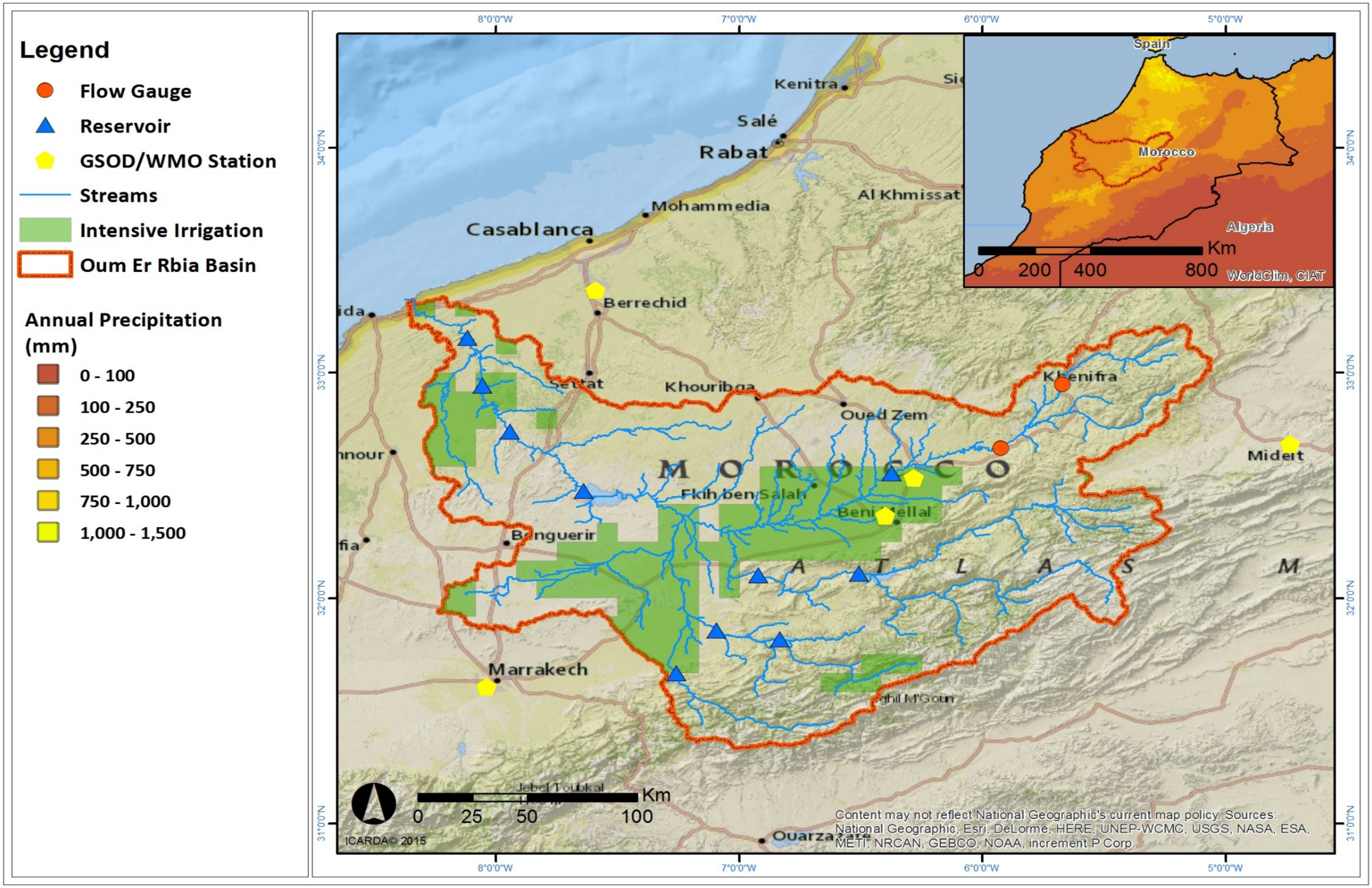
Preliminary results: WRR-Tier 1 data

- In conclusions
  - WRR Tier 1 not much used yet in case studies
  - Discharge results differ per model
  - Requires in-situ data to select best model

  - Need for more research
  - Model structure, specific conditions, etc.
  - How good is the ensemble median discharge?

Morocco case study

- Oum Er Rbia basin
- Aims:
  - 1. to model water resources in the basin
  - 2. to develop water management tools for end users
- Models: SWAT and PCR-GLOBWB
- Lack of in-situ data


Legend
Flow Gauge
Reservoir
GSOD/WMO Station
Streams
Intensive Irrigation
Oum Er Rbia Basin
Annual Precipitation (mm)
0 - 100
100 - 250
250 - 500
500 - 750
750 - 1,000
1,000 - 1,500
8°0'0"W
7°0'0"W
6°0'0"W
5°0'0"W
34°0'0"N
33°0'0"N
32°0'0"N
31°0'0"N
Kenitra
Salé
Rabat
Mohammedia
Casablanca
Al Khmissat
Berrechid
Settat
Khouribga
Oued Zem
Khenifra
Midelt
M O R O C C O
Fkih ben Salah
Beni Mellal
Benguerir
A T L A S
M
Marrakech
Jebel Toubkal
Km
0 25 50 100
ICARDA© 2015
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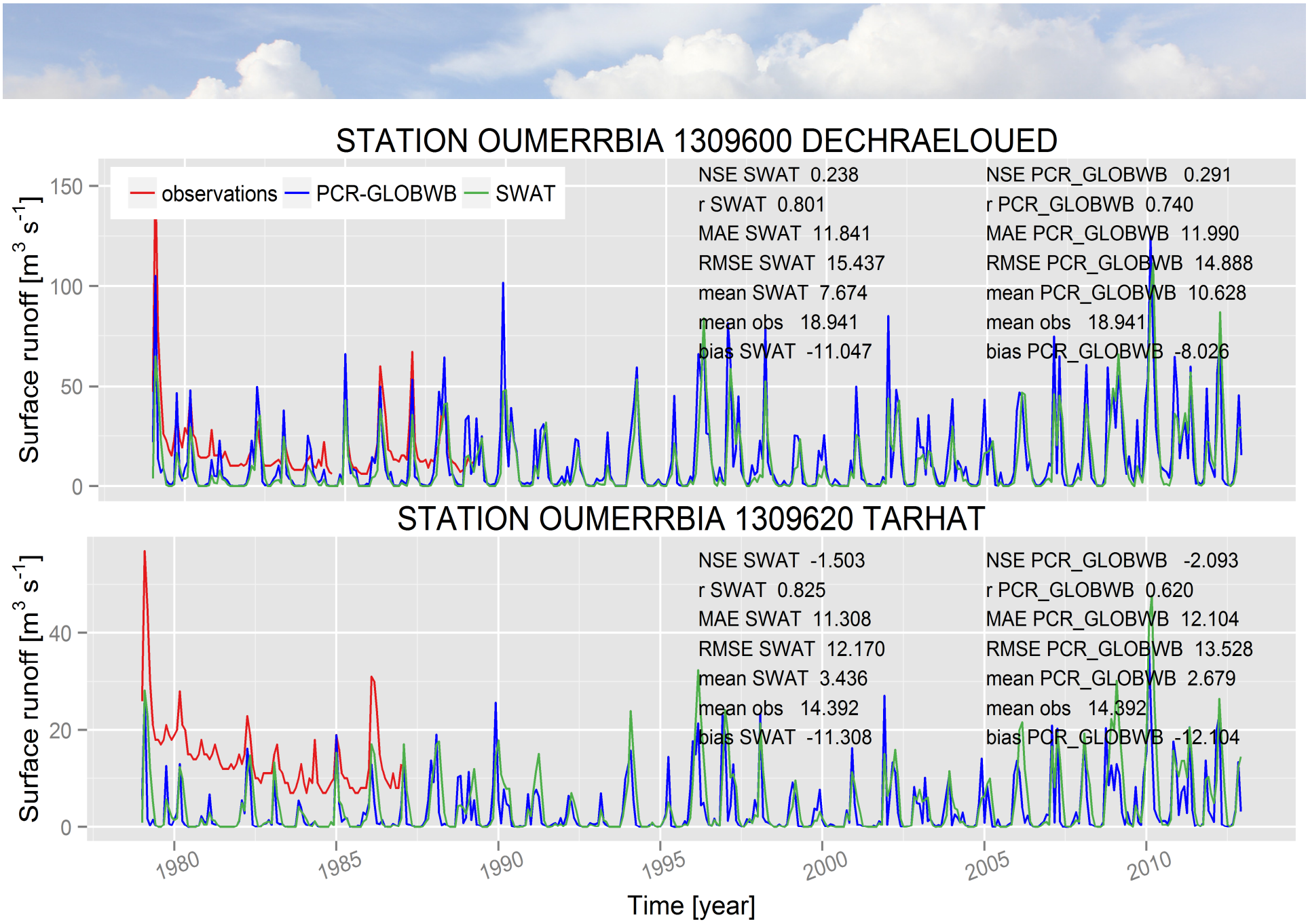
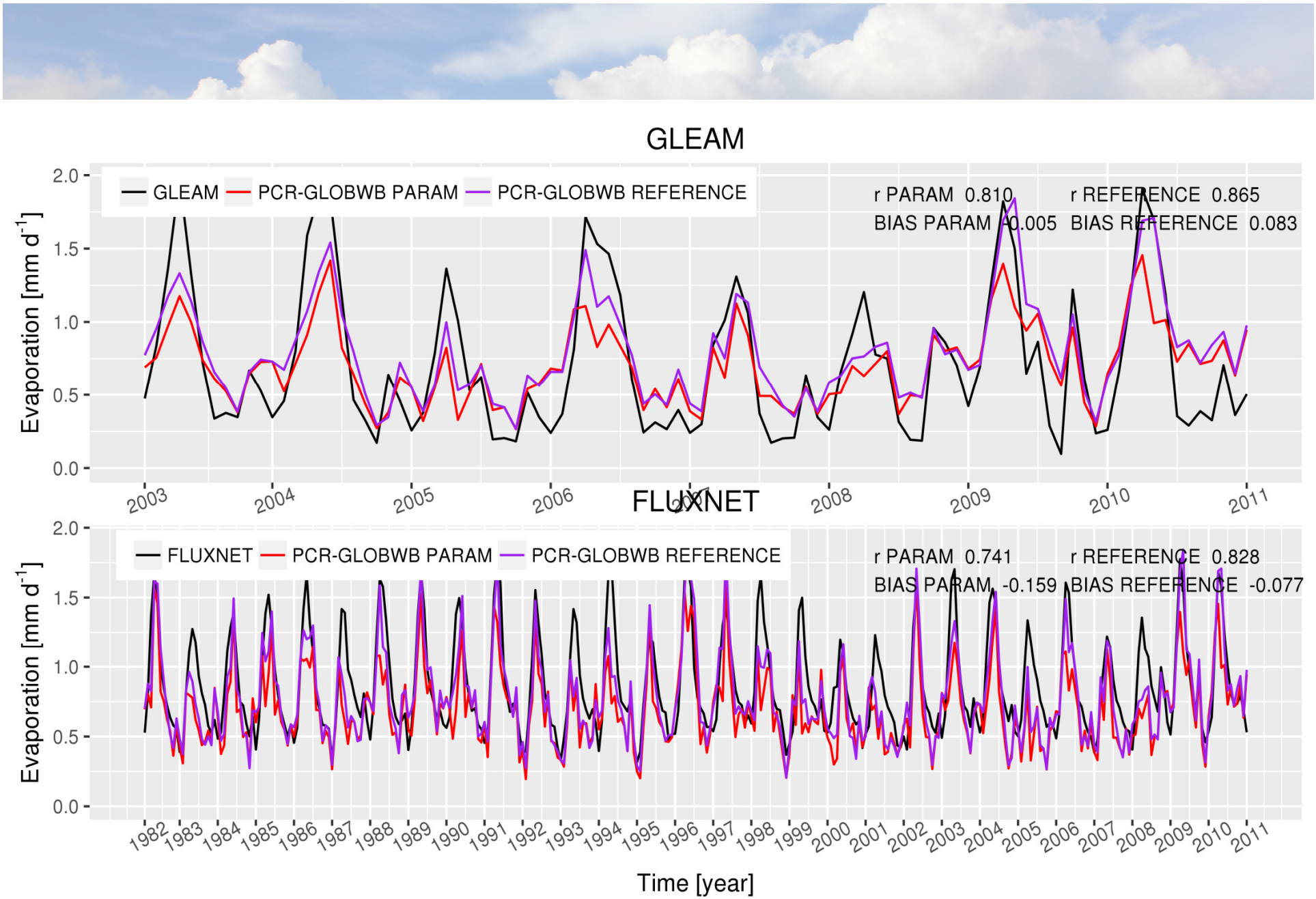
Spain
Morocco
Algeria
Km
0 200 400 800
WorldClim, CIAT

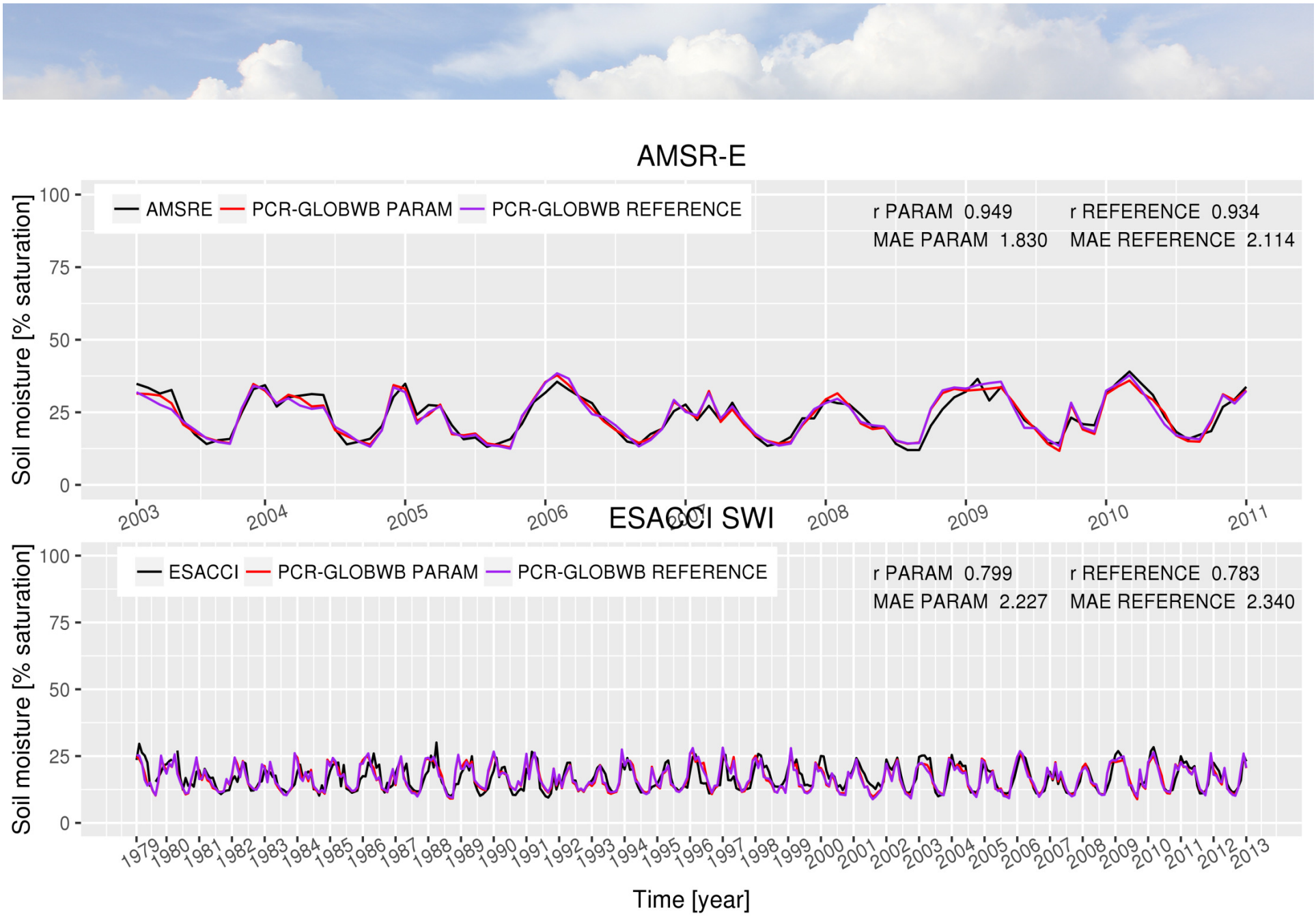
Morocco case study

- Modelling using SWAT and PCR-GLOBWB
  - E2O forcing (downscaled to ?? km)
  - No calibration
  - Validation at 2 discharge stations

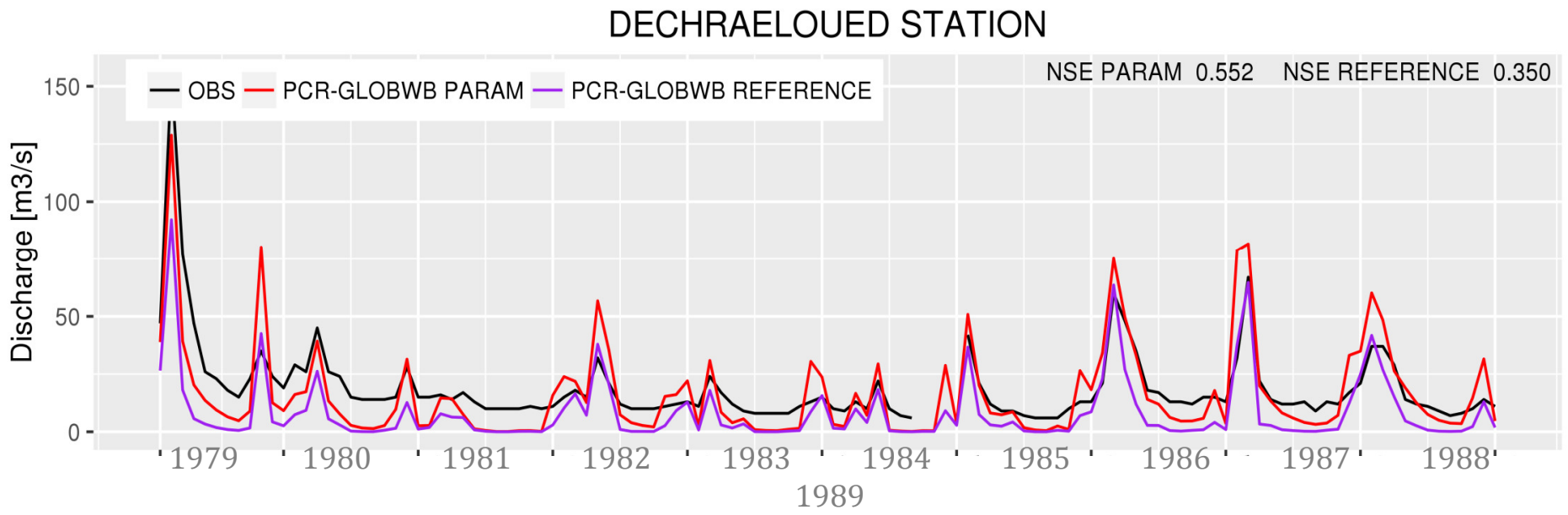
- Model calibration (PCR-GLOBWB)
  - Using soil moisture data (AMSR-E and ESACCI-SWI)
  - Using evapotranspiration data (GLEAM and FLUXNET)


STATION OUMERRBIA 1309600 DECHRAELOUED
observations
PCR-GLOBWB
SWAT
NSE SWAT 0.238
r SWAT 0.801
MAE SWAT 11.841
RMSE SWAT 15.437
mean SWAT 7.674
mean obs 18.941
bias SWAT -11.047
NSE PCR_GLOBWB 0.291
r PCR_GLOBWB 0.740
MAE PCR_GLOBWB 11.990
RMSE PCR_GLOBWB 14.888
mean PCR_GLOBWB 10.628
mean obs 18.941
bias PCR_GLOBWB -8.026
Surface runoff [m3 s-1]
150
100
50
0
STATION OUMERRBIA 1309620 TARHAT
NSE SWAT -1.503
r SWAT 0.825
MAE SWAT 11.308
RMSE SWAT 12.170
mean SWAT 3.436
mean obs 14.392
bias SWAT -11.308
NSE PCR_GLOBWB -2.093
r PCR_GLOBWB 0.620
MAE PCR_GLOBWB 12.104
RMSE PCR_GLOBWB 13.528
mean PCR_GLOBWB 2.679
mean obs 14.392
bias PCR_GLOBWB -12.104
Surface runoff [m3 s-1]
40
20
0
1980
1985
1990
1995
2000
2005
2010
Time [year]


GLEAM
GLEAM
PCR-GLOBWB PARAM
PCR-GLOBWB REFERENCE
r PARAM 0.810
r REFERENCE 0.865
BIAS PARAM -0.005
BIAS REFERENCE 0.083
Evaporation [mm d-1]
2.0
1.5
1.0
0.5
0.0
2003
2004
2005
2006
2007
2008
2009
2010
2011
FLUXNET
FLUXNET
PCR-GLOBWB PARAM
PCR-GLOBWB REFERENCE
r PARAM 0.741
r REFERENCE 0.828
BIAS PARAM -0.159
BIAS REFERENCE -0.077
Evaporation [mm d-1]
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Time [year]


AMSR-E
AMSRE
PCR-GLOBWB PARAM
PCR-GLOBWB REFERENCE
r PARAM 0.949
r REFERENCE 0.934
MAE PARAM 1.830
MAE REFERENCE 2.114
Soil moisture [% saturation]
ESACCI SWI
ESACCI
PCR-GLOBWB PARAM
PCR-GLOBWB REFERENCE
r PARAM 0.799
r REFERENCE 0.783
MAE PARAM 2.227
MAE REFERENCE 2.340
Soil moisture [% saturation]
Time [year]

Improved discharge simulation, but base flow still too low.



Other challenges: inclusion of reservoirs; developing water management tools for end-users

Thank you!

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