Joint assimilation of streamflow and downscaled satellite soil moisture observations to improve large-scale hydrological modelling.

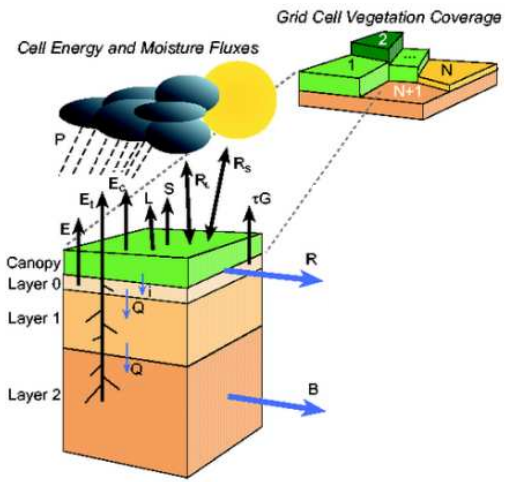
Patricia Lopez, Niko Wanders, Jaap Schellekens, Luigi Renzullo, Edwin Sutanudjaja, Geert Sterk and Marc Bierkens

OzEWEX – 2nd National Workshop
2nd December 2015

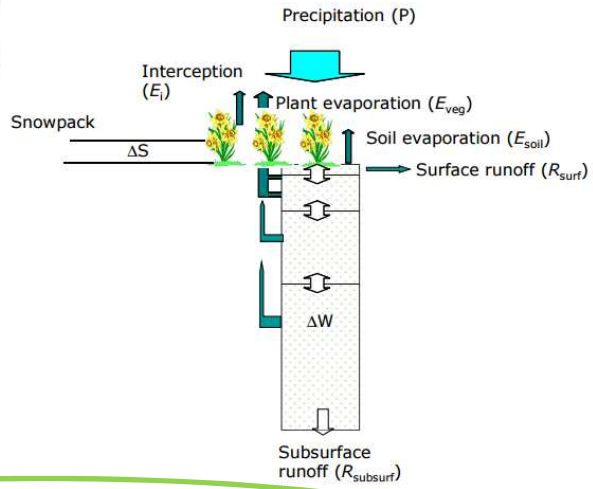
Introduction

Large - scale hydrological models

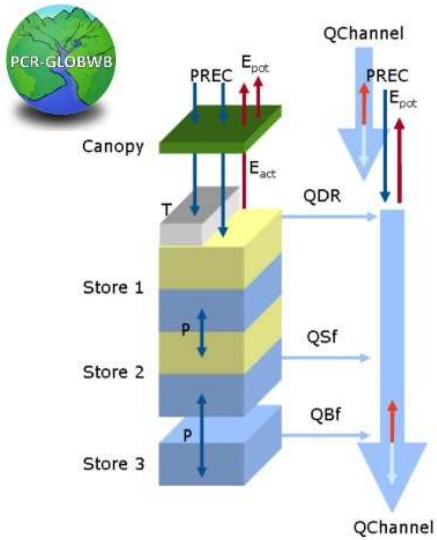
VIC



HTESSEL



PCR-GLOBWB



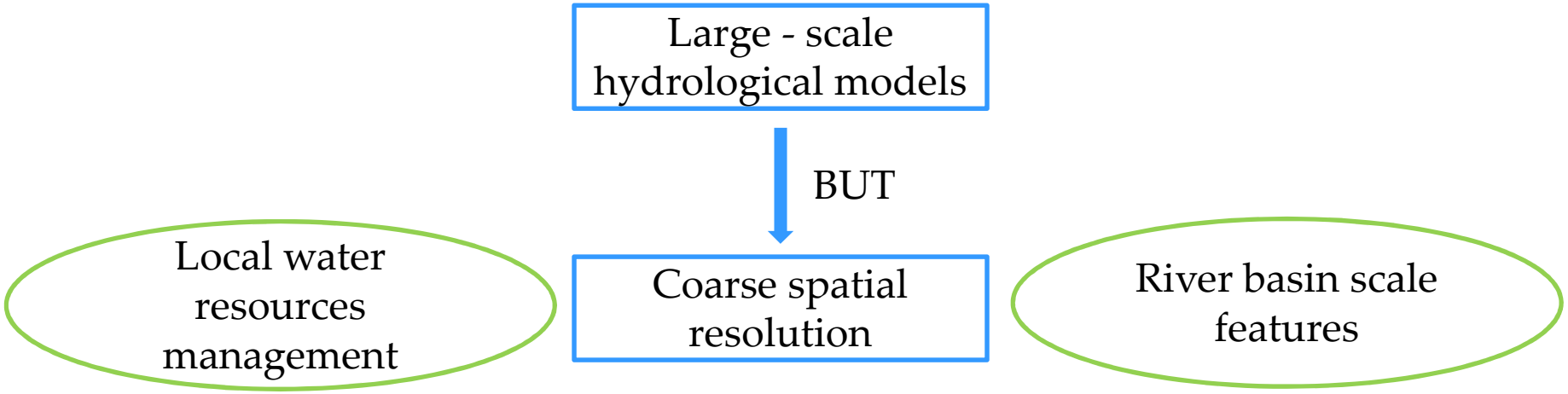
ETC, …

Global water balance: historical variations, human uses of water, impact on availability, etc.

Climate change impact on water resources

Assessment of global hydrological extremes: floods and droughts

Introduction



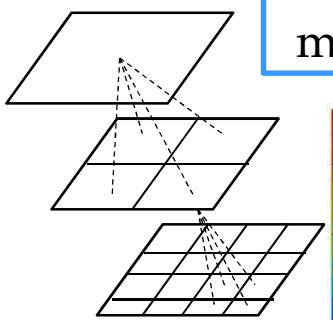
Introduction

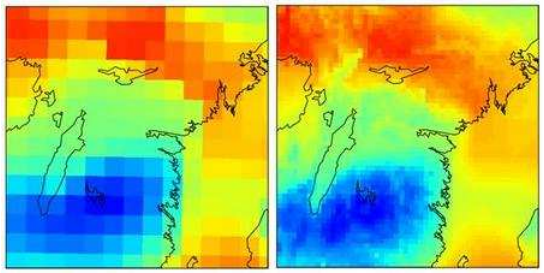
Large - scale hydrological models

BUT

Coarse spatial resolution

High resolution meteorological forcing data





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Large - scale hydrological models

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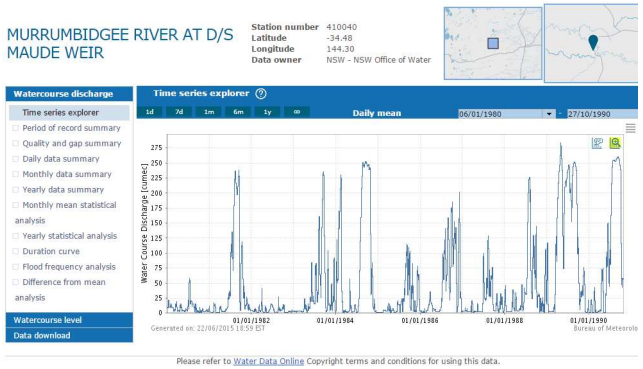
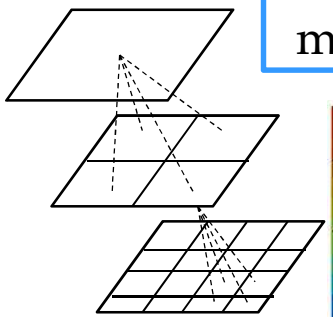
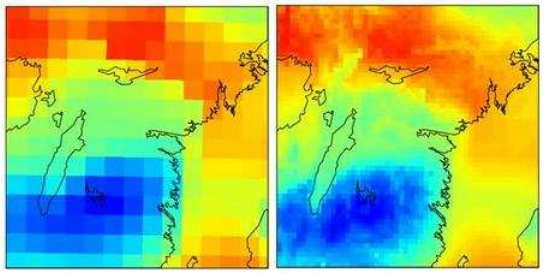
Coarse spatial resolution

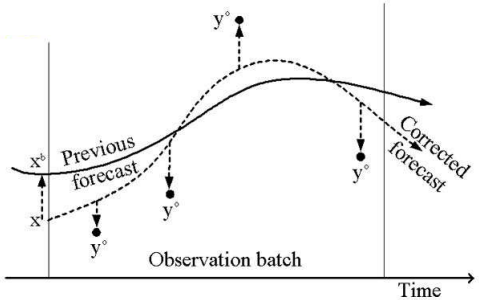


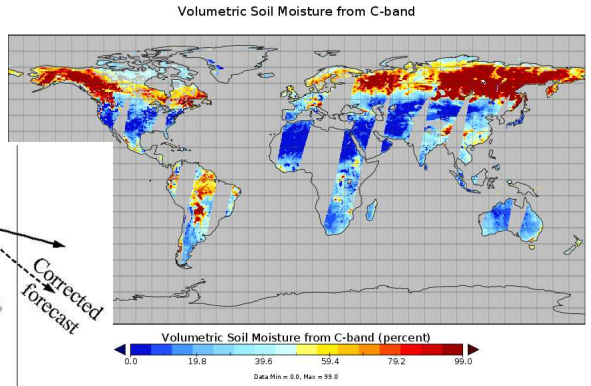
High resolution meteorological forcing data



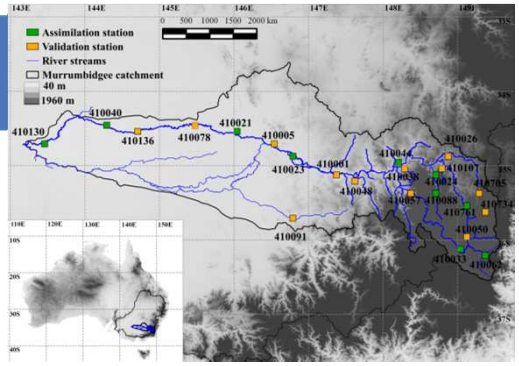


Assimilation of observations





Approach


Assimilation station
Validation station
River streams
Murrumbidgee catchment
40 m
1960 m
410130
410040
410136
410078
410021
410005
410023
410001
410048
410091
410026
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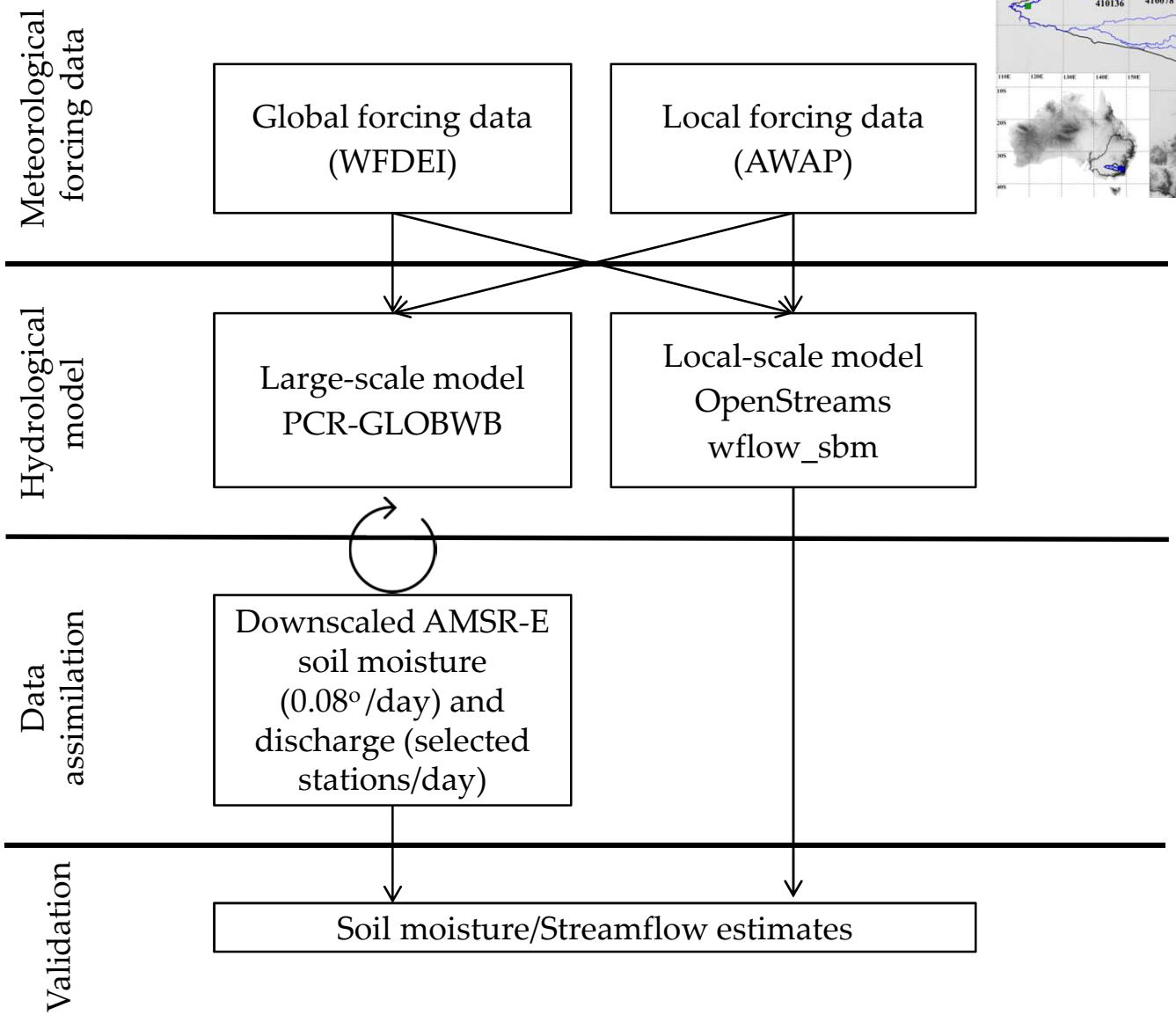
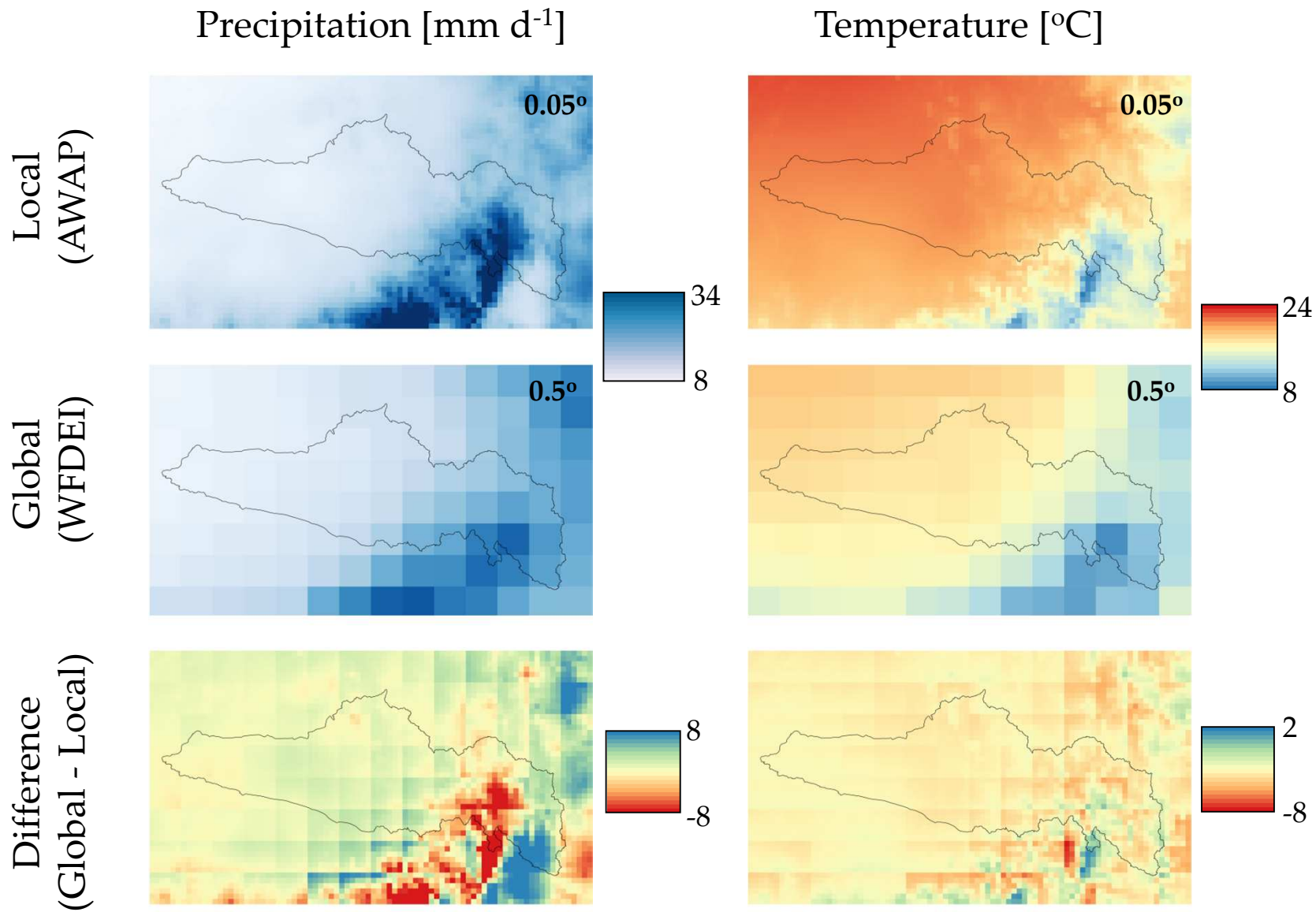
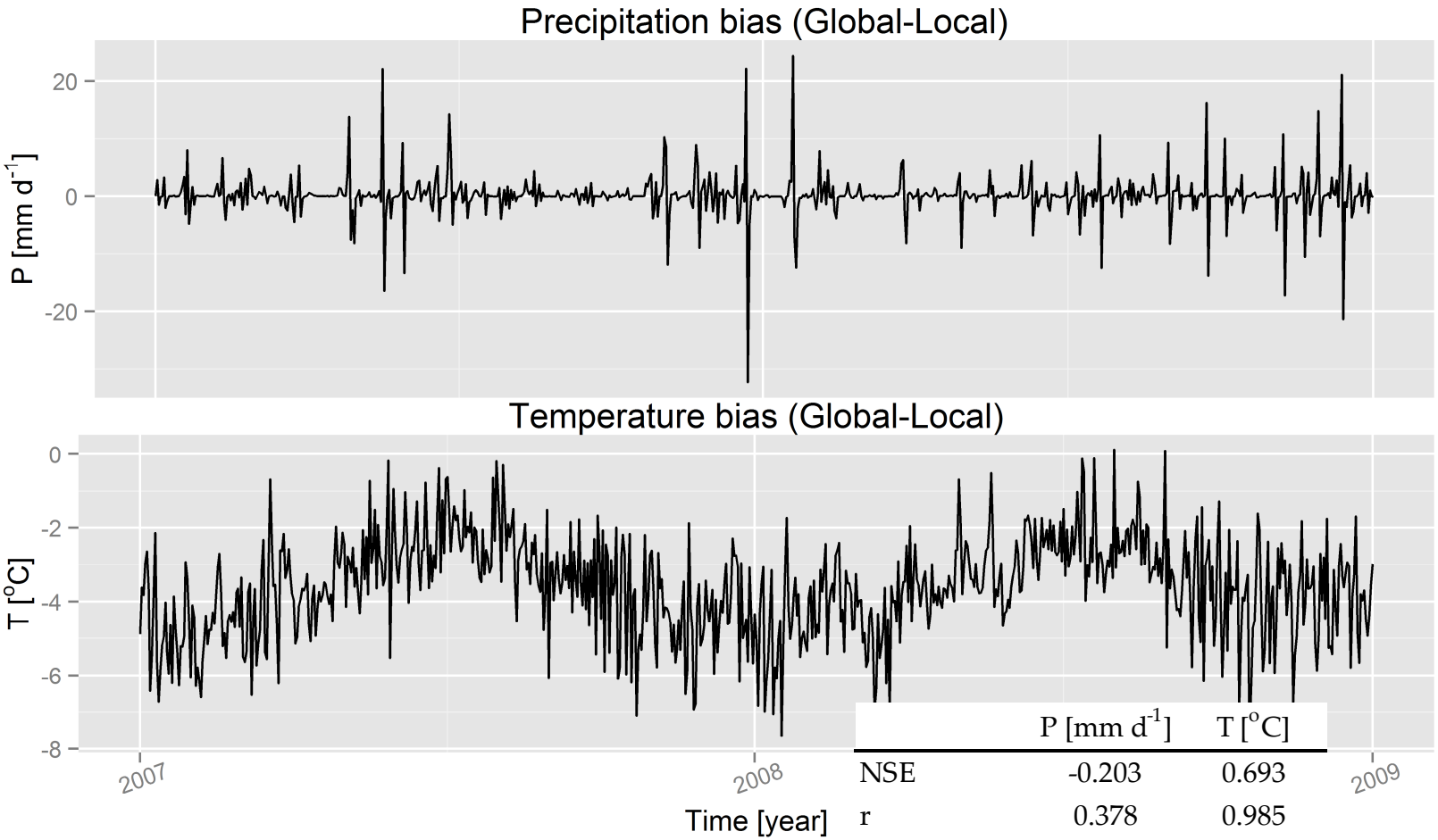

Meteorological forcing data
Global forcing data (WFDEI)
Local forcing data (AWAP)
Hydrological model
Large-scale model PCR-GLOBWB
Local-scale model OpenStreams wflow_sbm
Data assimilation
Downscaled AMSR-E soil moisture (0.08° /day) and discharge (selected stations/day)
Validation
Soil moisture/Streamflow estimates

Meteorological forcing data



Meteorological forcing data

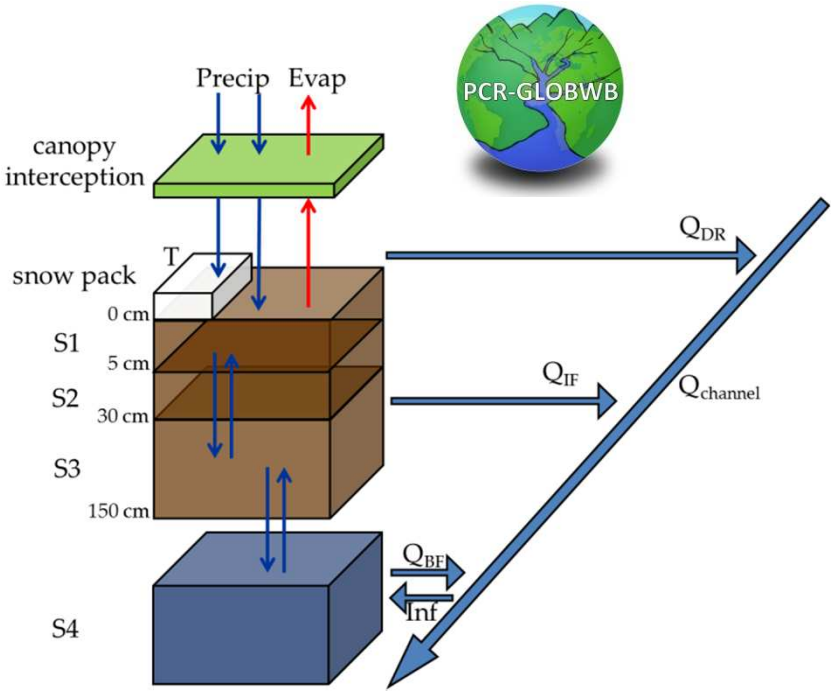


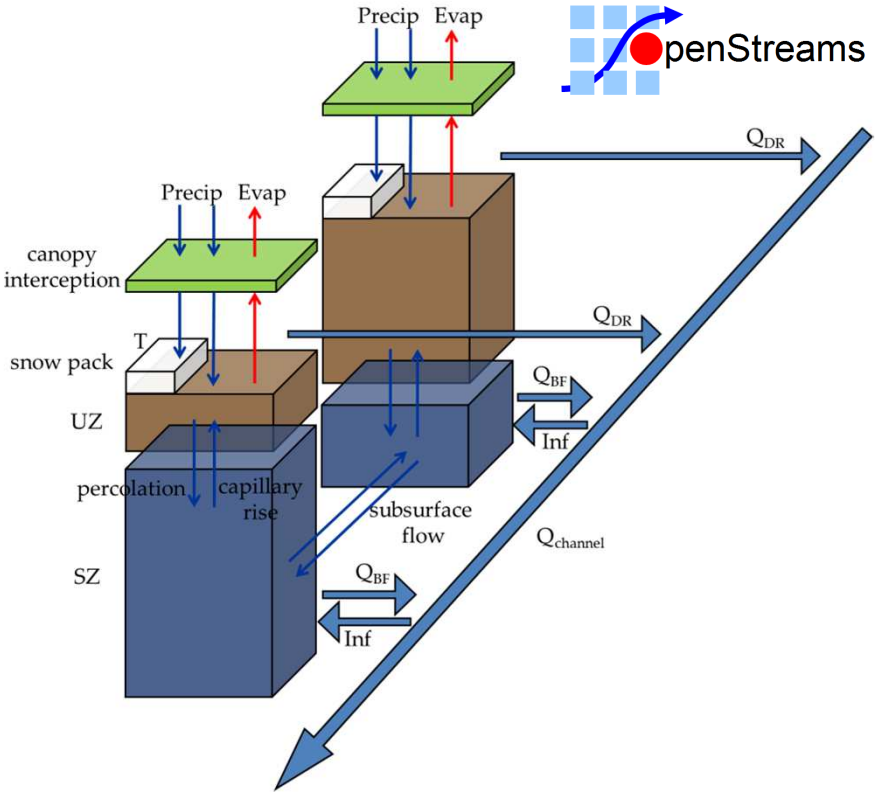
	P [mm d^{-1}]	T [°C]
NSE	-0.203	0.693
r	0.378	0.985
MAE	1.739	3.527
RMSE	3.817	3.794
mean E2O	1.708	15.598
mean AWAP	1.573	19.122
bias	0.135	-3.525

PCR-GLOBWB and OpenStreams wflow_sbm models

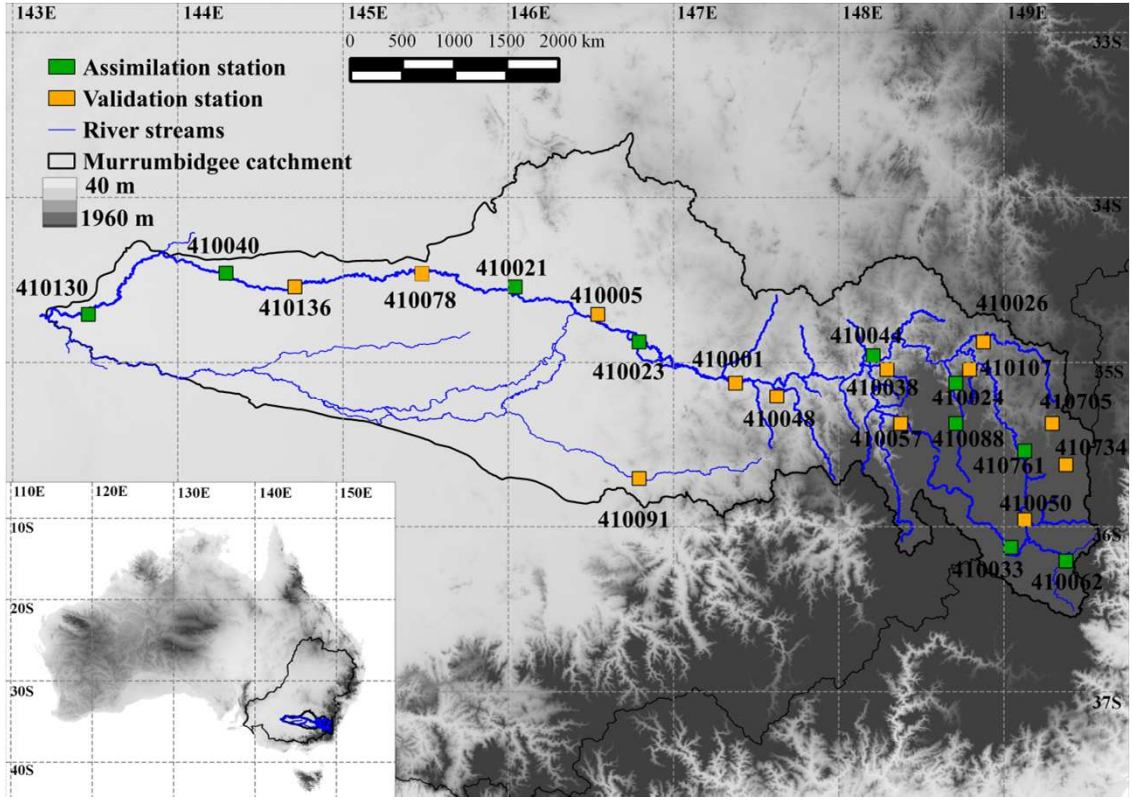
- Large-scale hydrological model
- Temporal resolution: daily
- Spatial resolution: ~10 km (0.08° x 0.08°)
- Soil schematization → 3 layers: 0 – 5 cm
  5 – 30 cm
  30 – 150 cm

- Local-scale hydrological model
- Temporal resolution: daily
- Spatial resolution: ~1 km (0.01° x 0.01°)
- Soil schematization (topog_sbm) →2 layers: UZ
  SZ



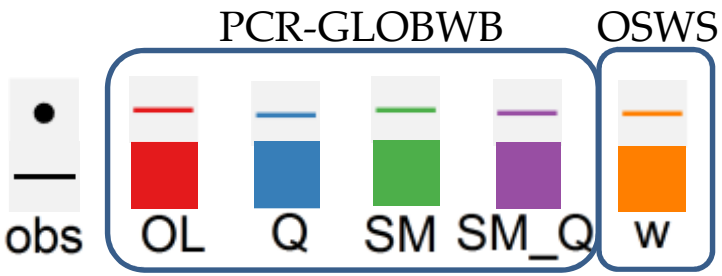


Data assimilation

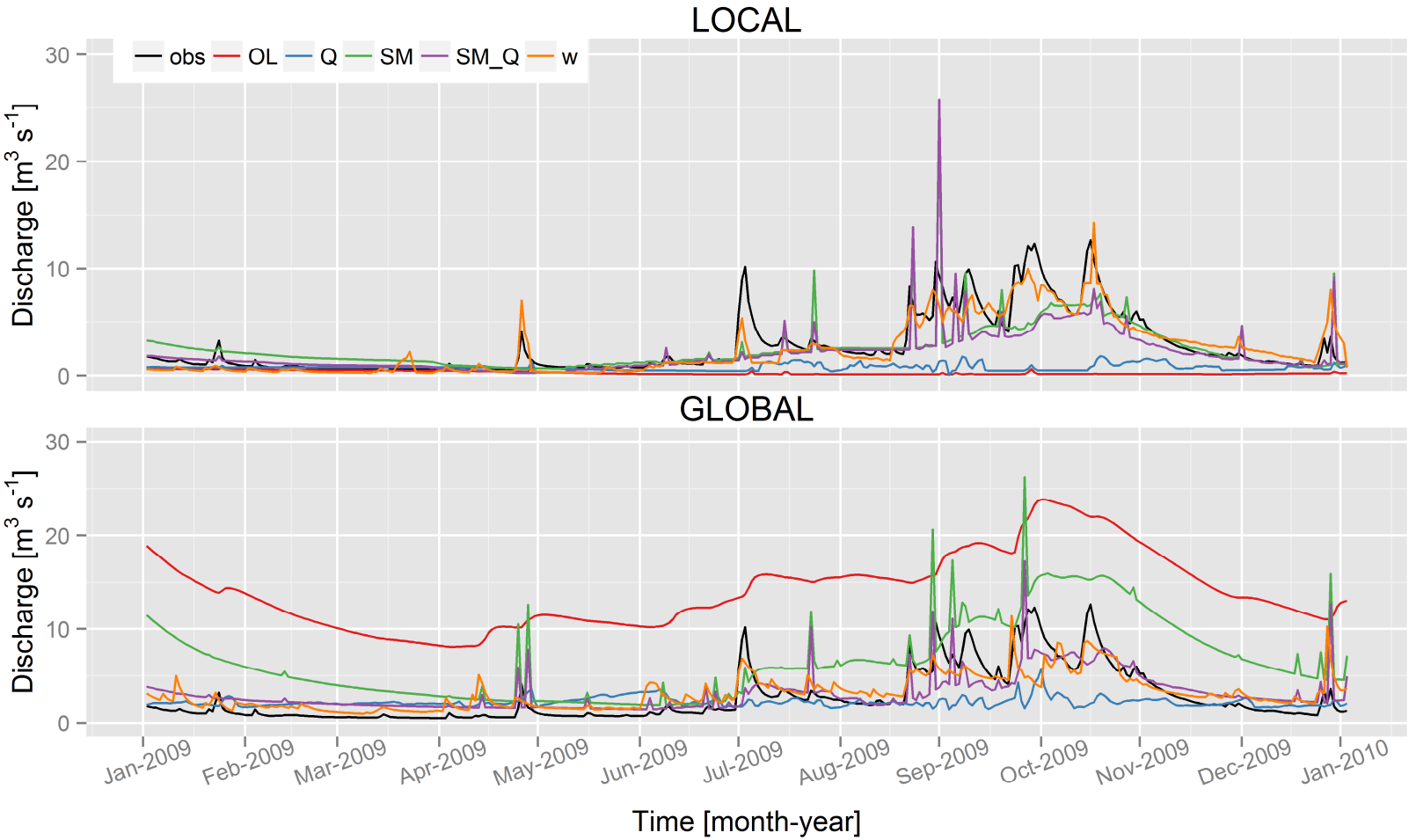


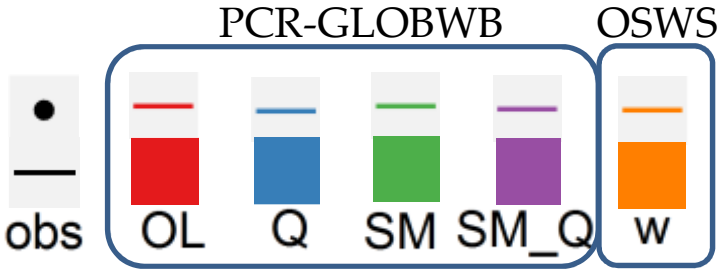
- Observations:
  - SM (AMSR-E)
  - Q (BoM and CSIRO)
- Assimilation period: 2007 – 2010
- Ensemble Kalman Filter
  - (100 ensemble members)
- Model and observations uncertainty

DA scenarios

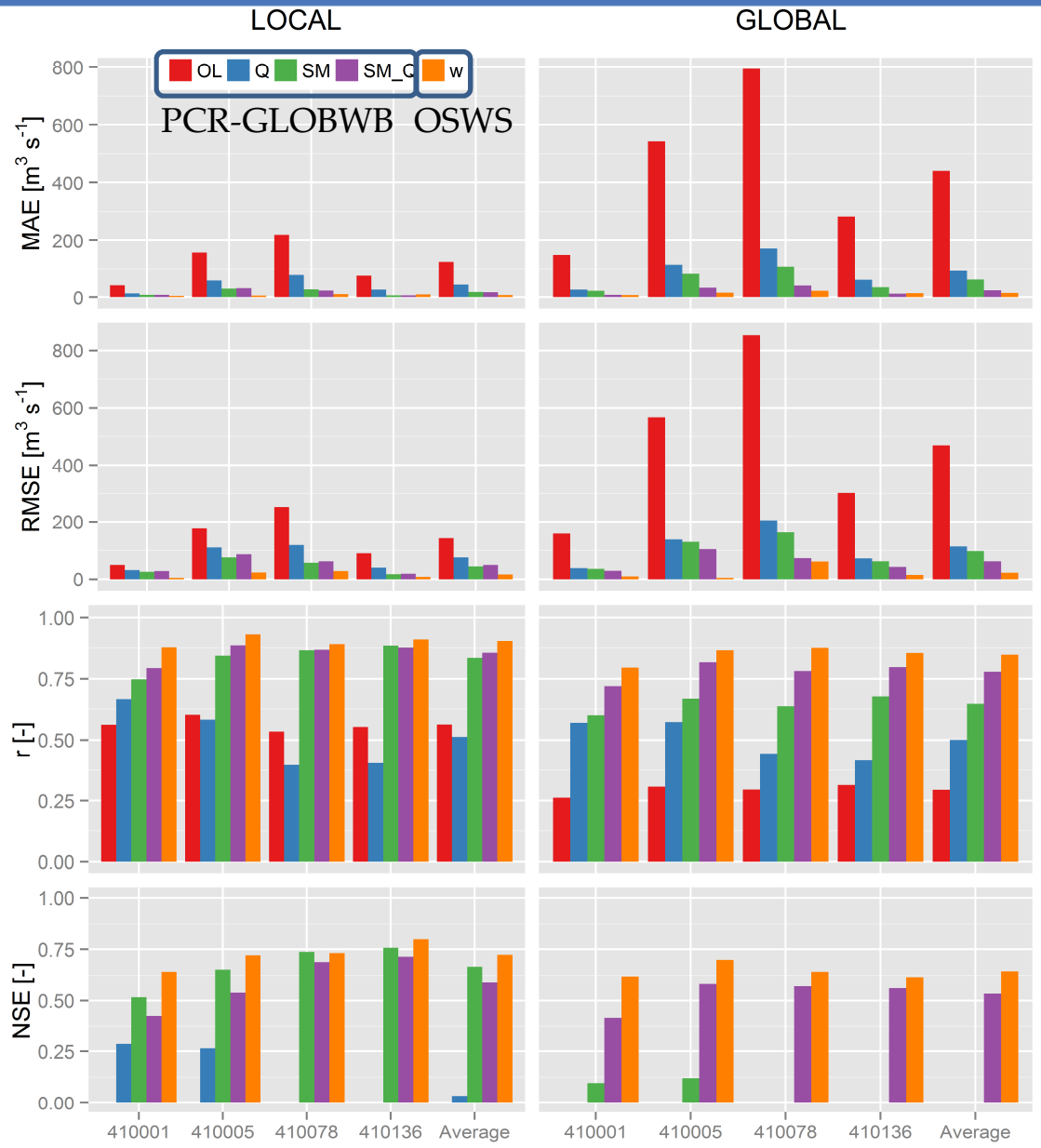


Impact on runoff estimates





Impact on streamflow estimates



Conclusions

1. **Assimilating** downscaled **soil moisture observations** produces **the largest improvement** on the streamflow model estimates, compared with the independent discharge assimilation.

2. The joint **assimilation** of both **discharge and downscaled soil moisture observations** leads to **further improvement** on streamflow estimates, mainly for upstream catchments (20 % reduction in RMSE).

3. The higher spatial resolution of the **local forcing data** results in **higher models performances** on both soil moisture and streamflow estimates.

4. **The additional contribution of data assimilation**, for any considered scenario, is **more pronounced** when **global meteorological data** are used to force the models.

5. **Data assimilation** of **high resolution soil moisture** can partly **overcome the difference** in model performance between a **large-scale** hydrological model driven by coarse resolution forcing data and a **local-scale** model forced with higher resolution meteorological data

Thank you

Questions

p.lopezlopez@uu.nl / patricia.lopez@deltares.nl