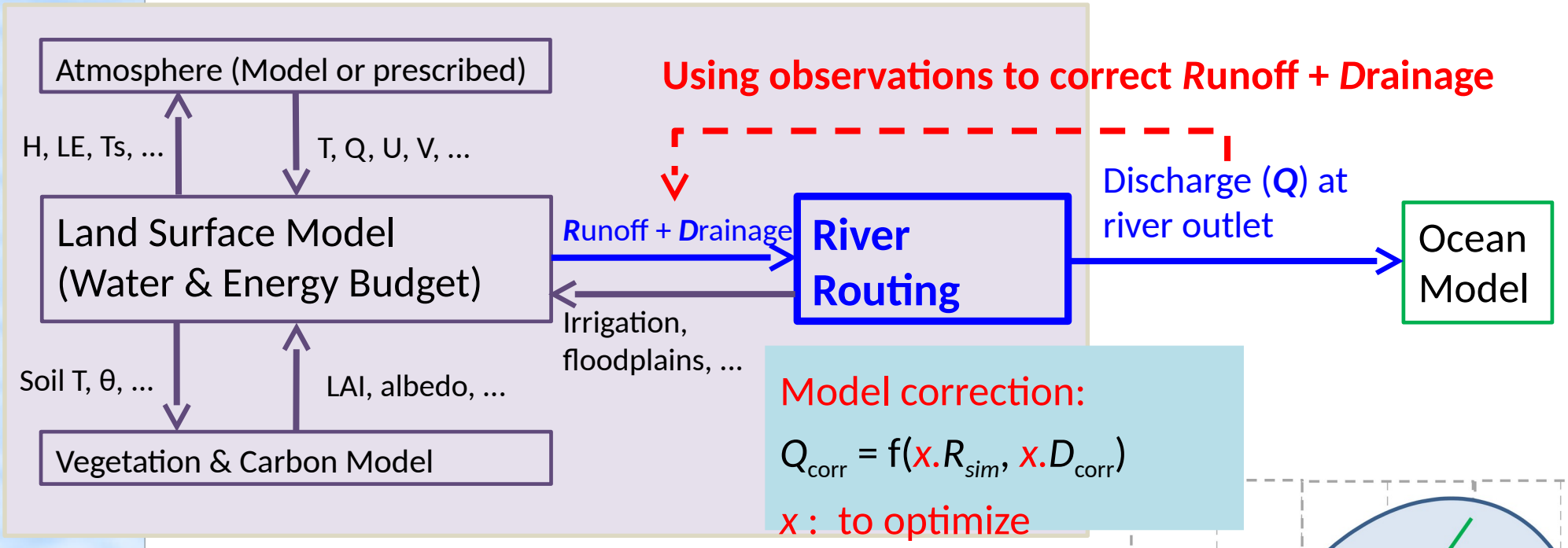
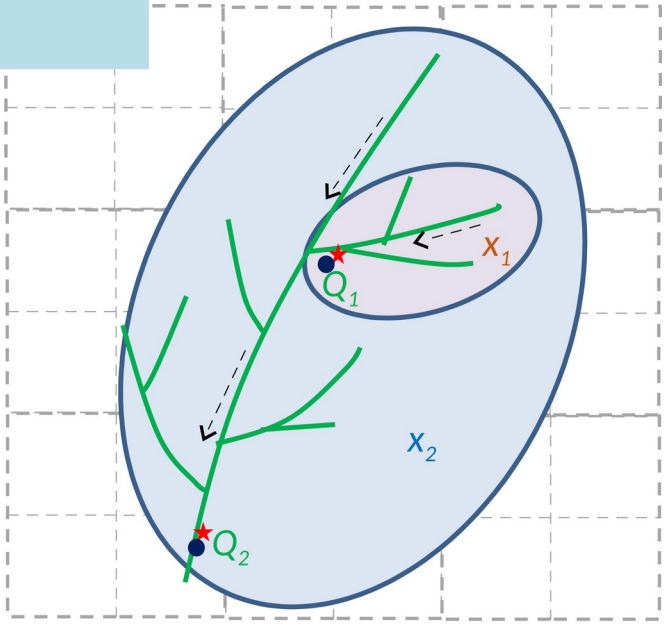
Assimilating river discharge observations



- This methodology allows to use all GRDC observations within the domain.
- We preserve the high temporal sampling of the model.
- The observations are placed within the inter-annual variability of climate.



★ River Discharge (**Q**) Simulations
● **Q** Observations

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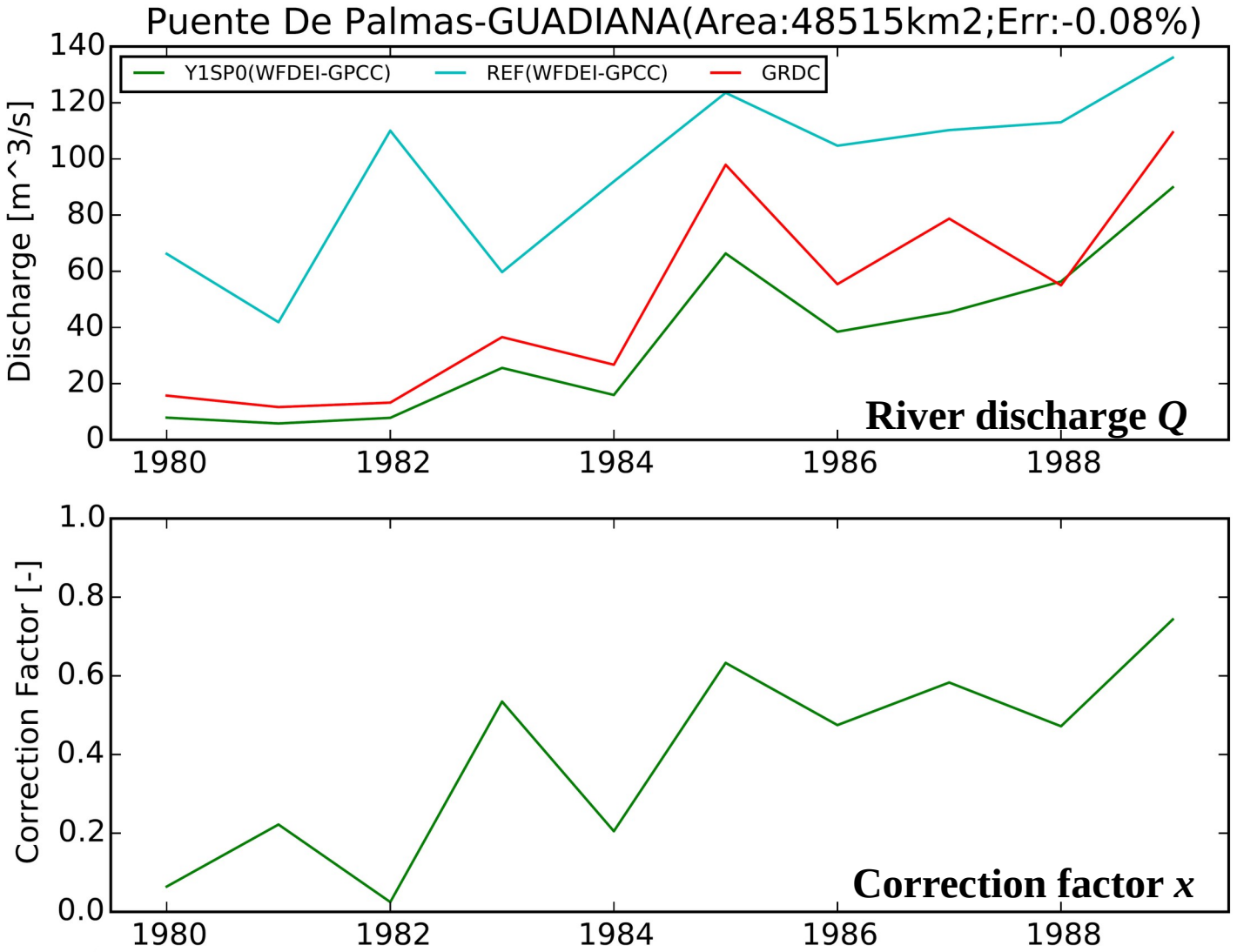
Impact of assimilation on river discharge

Inter-annual variation of river discharge *Q* and correction factor *x* :

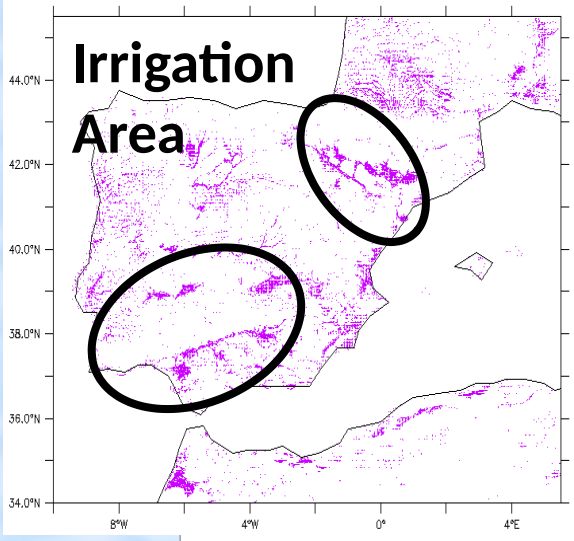


- The general trend of river discharge from climate is preserved
- Assimilation improves the river discharge inter-annual variability amplitude
- Fluctuation of correction factor *x* (variable error & human water usage)

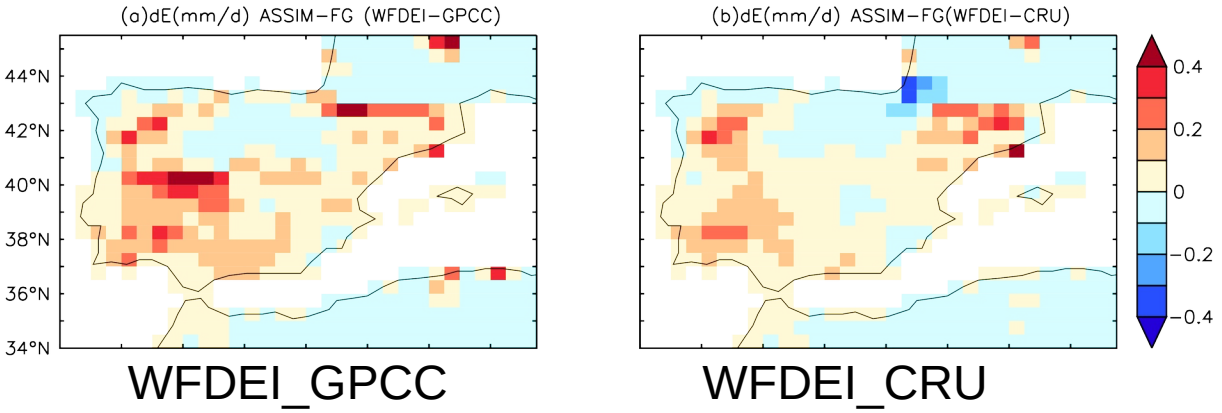
Interpreting the corrections as Evaporation changes

If we assume P is correct, we can deduce an evaporation correction :

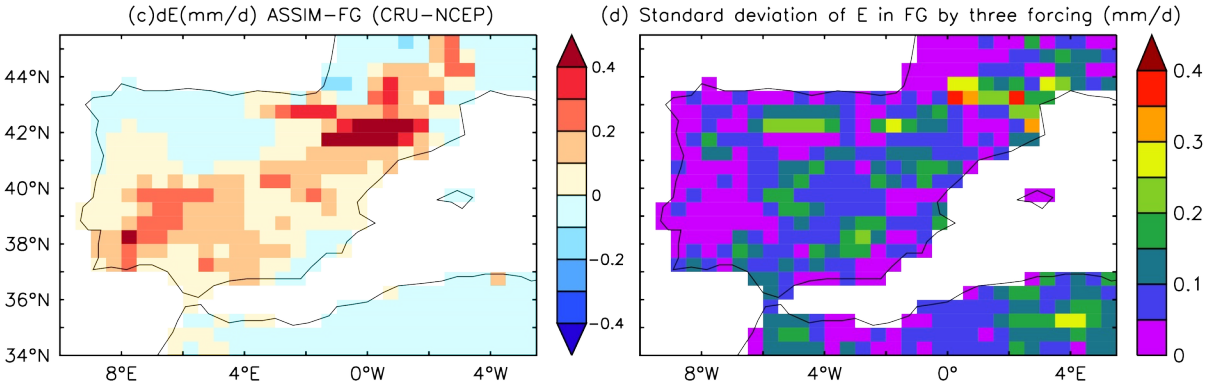
$$\frac{dW}{dt} = P - \frac{E}{x} - (R + D)$$



S. Siebert at al.



WFDEI_GPCC WFDEI_CRU



CRU_NCEP

***E* standard deviation (mm/d)**

The largest evaporation changes proposed are in the regions of high irrigation !

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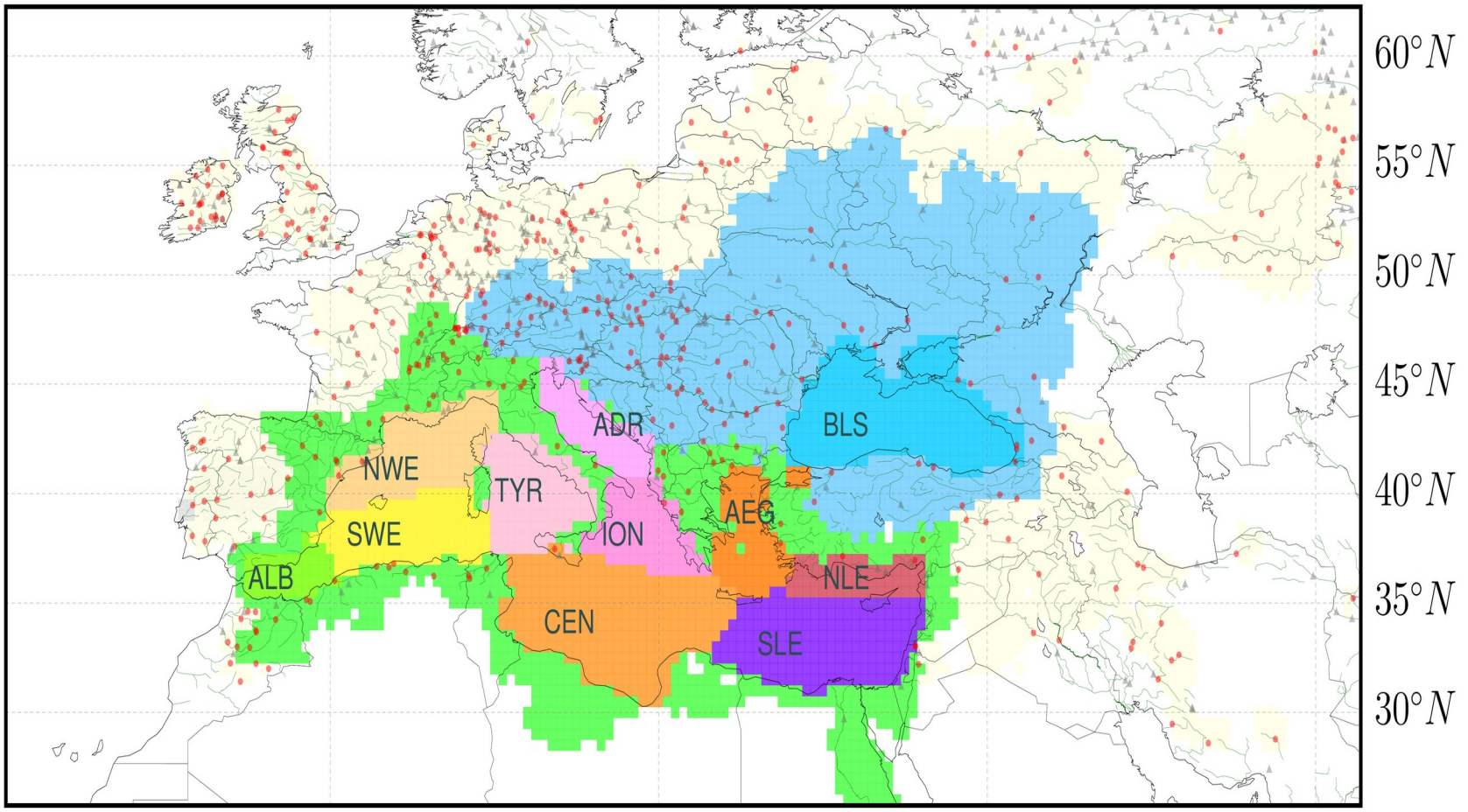
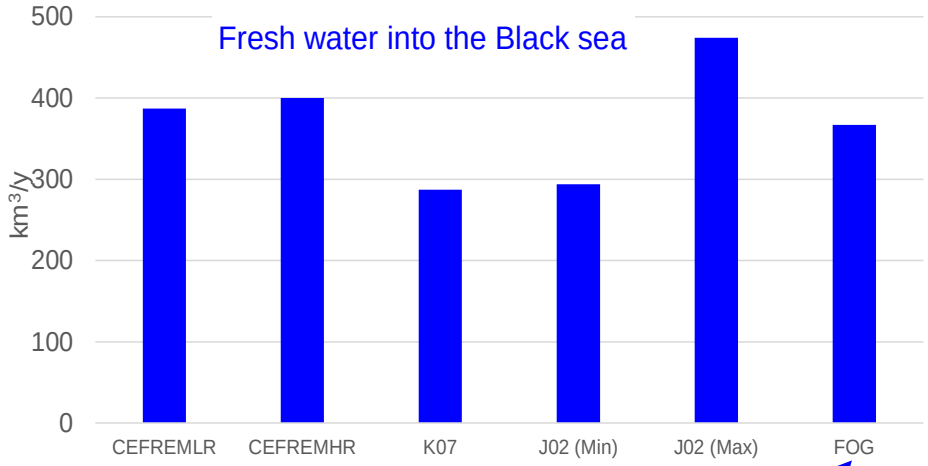
Datasets and study region

- **ORCHIDEE forced by WFDEI** (precipitation corrected by GPCC), 0.5°
- **River discharge observation: Global Runoff Data Centre (GRDC).**
  - ✓ GRDC selection criteria: the difference of upstream area and distance between GRDC and ORCHIDEE model subbasin < 10% and < 25 km.
  - ✓ **338**/792 GRDC stations (19.7ºW-62.7ºE, 25ºN-62ºN; without UK & Nile to accelerate computing)



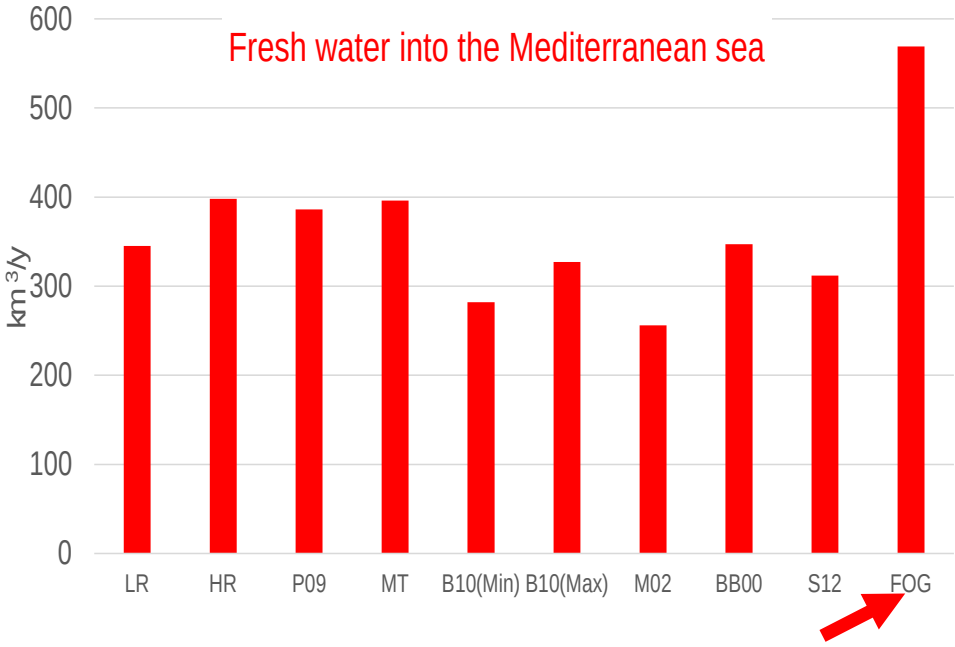
Estimated riverine input

Source	Water (km^3/y)	Method	Period
Ludwig et al., 2009 CEFREM	387 (LR) 403 (HR)	GRDC + water balance	1960-2000, 1980-2009
Kara et al., 2007	287	Model + obs.	1952-1984
Jaoshvili et al., 2002	294 to 474	Literature review	Various periods
Wang & Polcher, 2018 (FOG)	**389 (ORCHIDEE); 367±47 (FOG)**		



FOG (Fusion of ORCHIDEE and GRDC) ≈ previous studies.

Source	Water (km^3/y)	Method	Period
Ludwig et al., 2009 CEFREM	345 (LR) 398 (HR)	GRDC + water balance	1960-2000, 1980-2009
Peucker-Ehrenbrink, 2009	386	Land2Sea data	--
Margat & Treyer	396	--	--
Bouraoui et al. 2010	282-327	model	1980-2000
Mariotti et al., 2002; Struglia et al. 2004	256, <=328	GRDC,MED-HYCOS	>10 years
Boukthir & Barnier, 2000	347	UNESCO	various
Szczypta et al. 2012 (HESS)	312	GRDC	1991-2000
Wang & Polcher, 2018 (FOG)	**575 (ORCHIDEE); 569±66 (FOG)**		



- **FOG >> others** (e.g., 170-230 km^3/y higher than Ludwig et al., 2009). **Why ???**