


Can daily GRACE data be used to evaluate short-term hydro-meteorological fluxes over the continents?

from global
atmospheric reanalyses



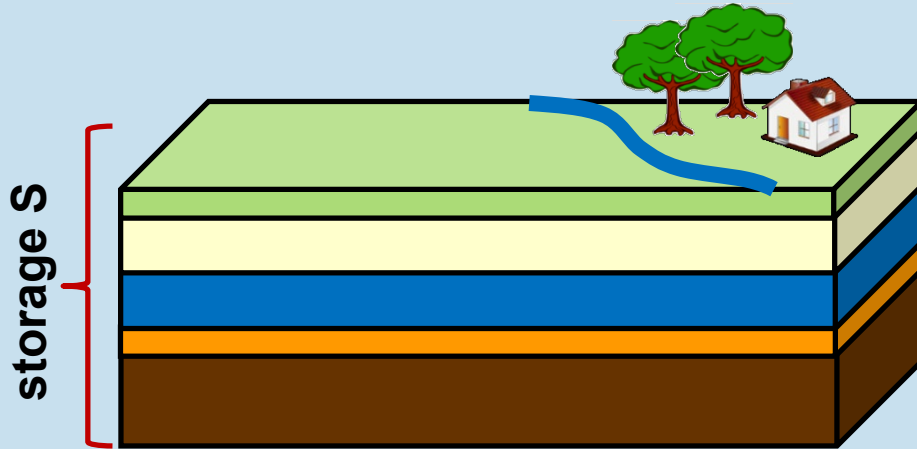
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- 1) HafenCity University Hamburg
- 2) Graz University of Technology
- 3) GFZ Potsdam

EGU General Assembly 2020



ITSG-Grace2018 daily

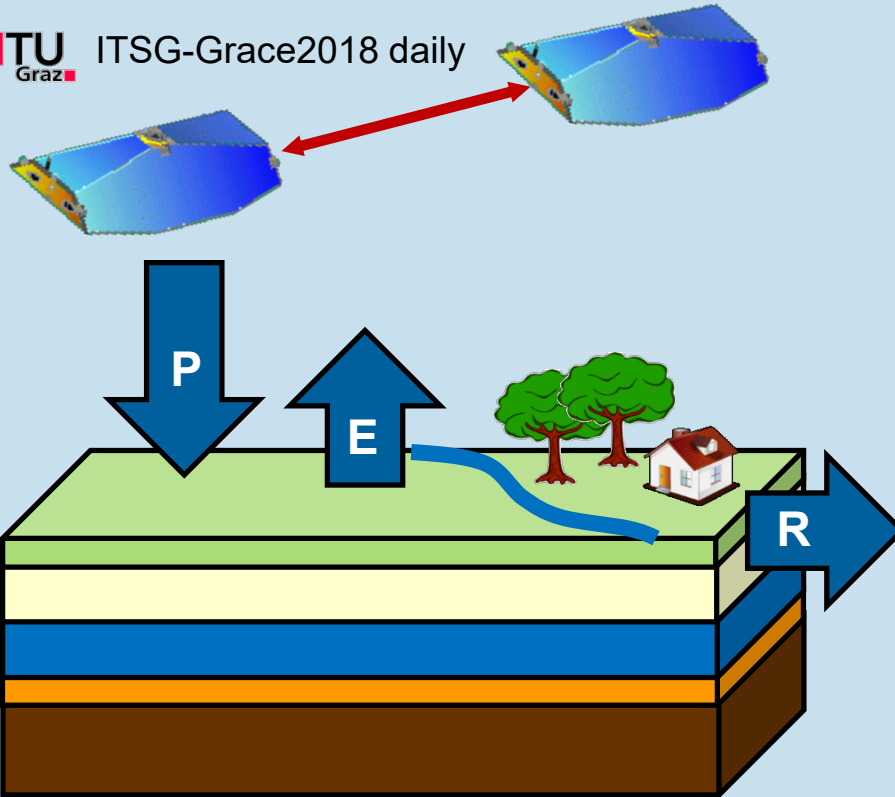


All results can also be found here:

Eicker, A., Jensen, L., Wöhnke, V., Dobsław, H., Kvas, A., Mayer-Gürr, T., Dill, R. (2020): Evaluating short-term hydro-meteorological fluxes with daily satellite data from the GRACE mission, *Scientific reports*, 10, 4505, <https://doi.org/10.1038/s41598-020-61166-0>



ITSG-Grace2018 daily



Terrestrial water balance

precipitation

runoff

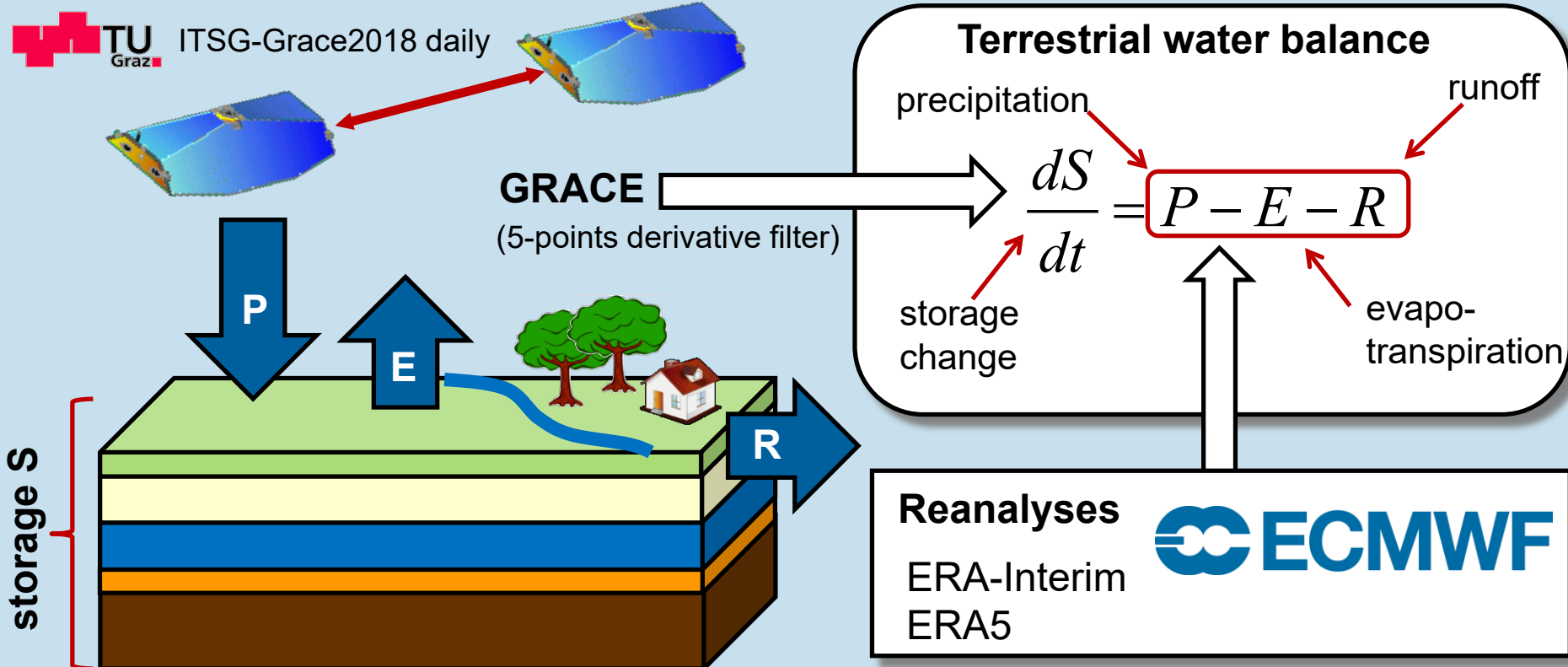
$$\frac{dS}{dt} = P - E - R$$

storage
change

evapo-
transpiration

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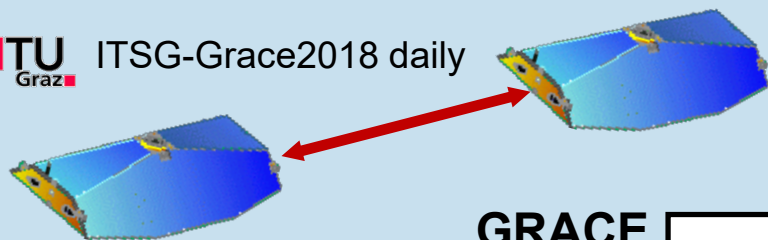


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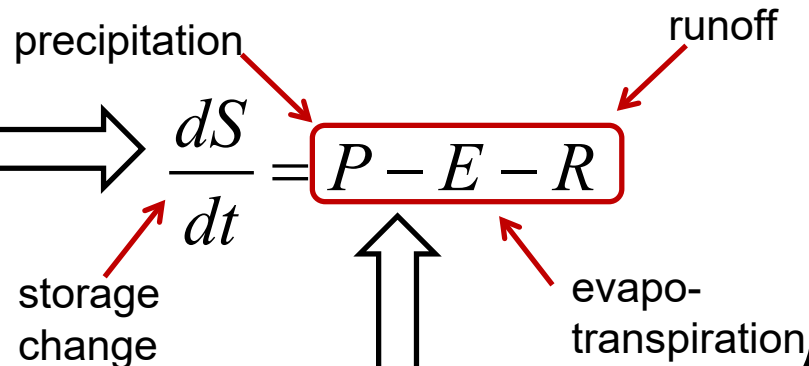


ITSG-Grace2018 daily



GRACE
(5-points derivative filter)

Terrestrial water balance



Approach:

- compare both sides of water balance equation
- focus on **sub-monthly** time scales => apply **high-pass filtering** with 30-days cut-off to daily time series

Results shown here:

- comparison of **time series** GRACE/ERA5 for one exemplary grid cell in Brazil
- global **maps of evaluation metrics** (correlation and root mean squared deviation)
- identification of **improvements of new reanalysis** (ERA5) over its predecessor (ERA-Interim)

Reanalyses

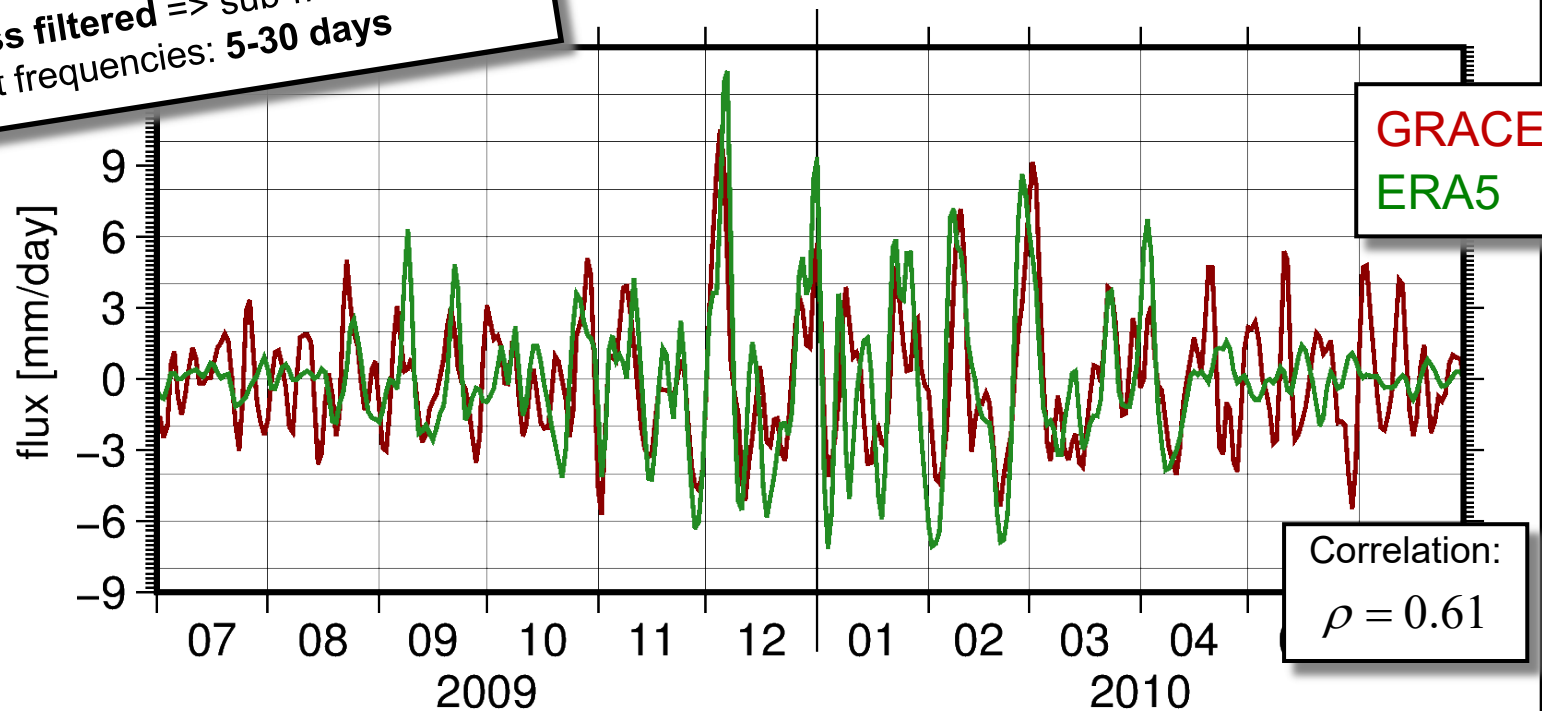
ERA-Interim
ERA5



Comparison GRACE vs. ERA5

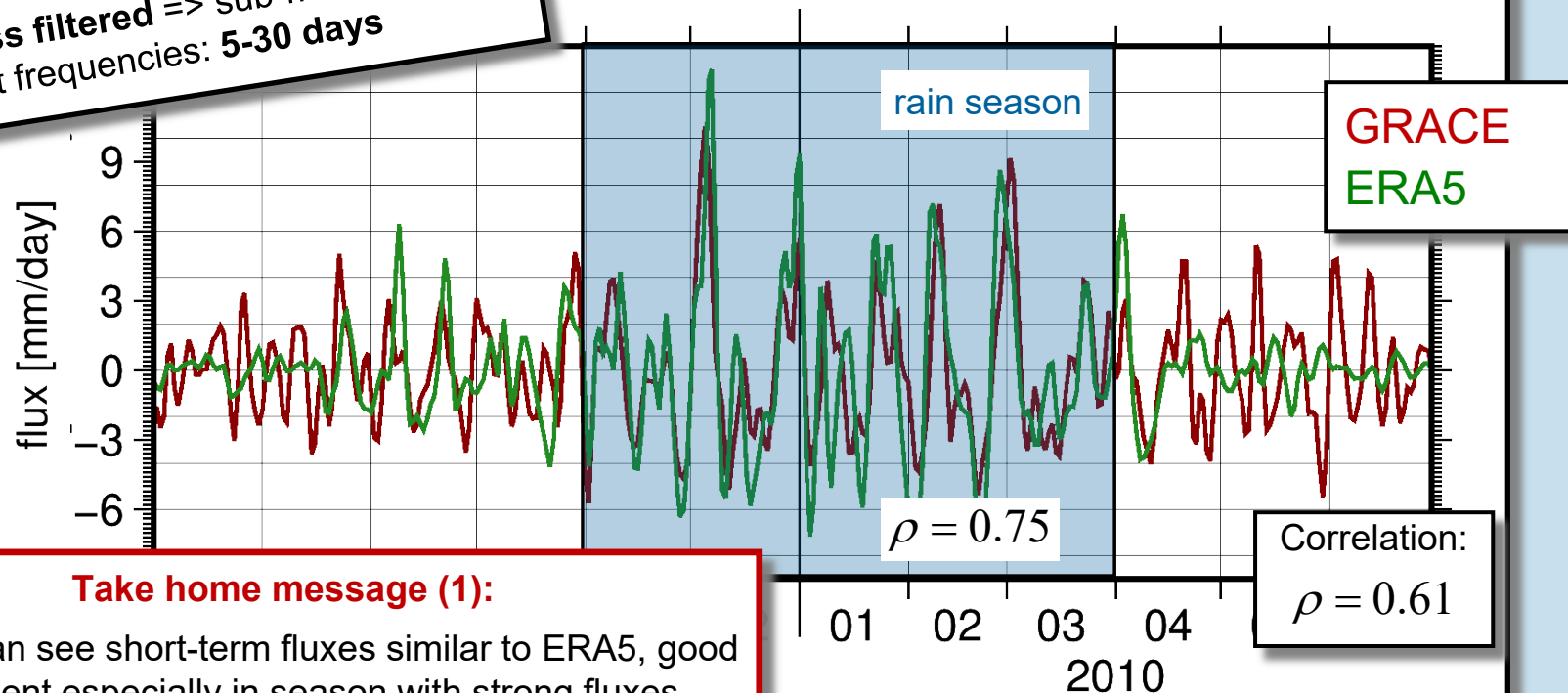
High-pass filtered => sub-monthly signal
dominant frequencies: 5-30 days

Fluxes in Aruanã, Brazil



High-pass filtered => sub-monthly signal
dominant frequencies: 5-30 days

Fluxes in Aruanã, Brazil



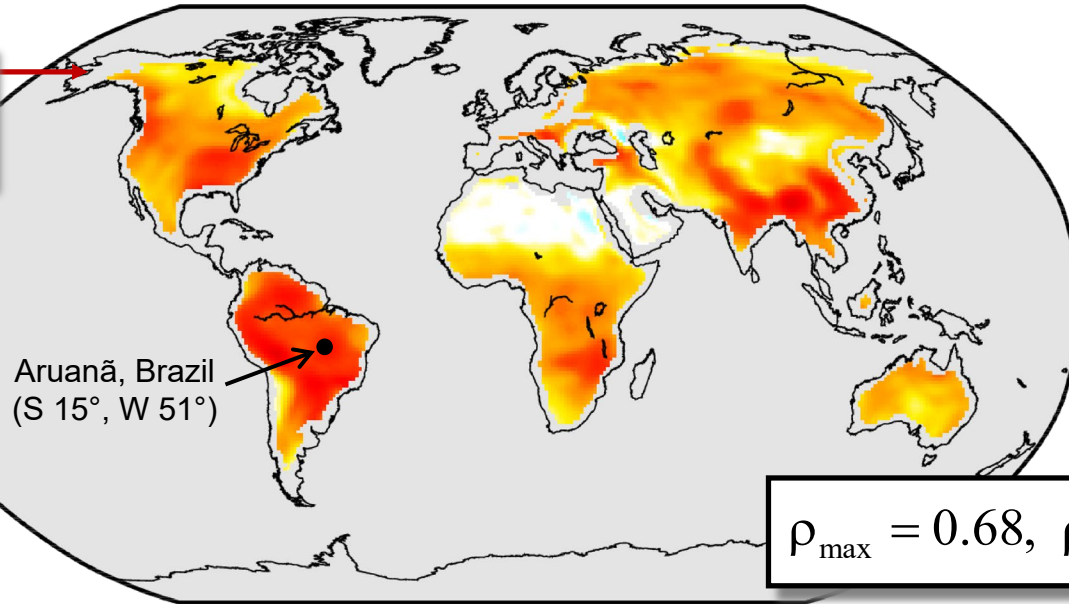
Take home message (1):

GRACE can see short-term fluxes similar to ERA5, good agreement especially in season with strong fluxes.

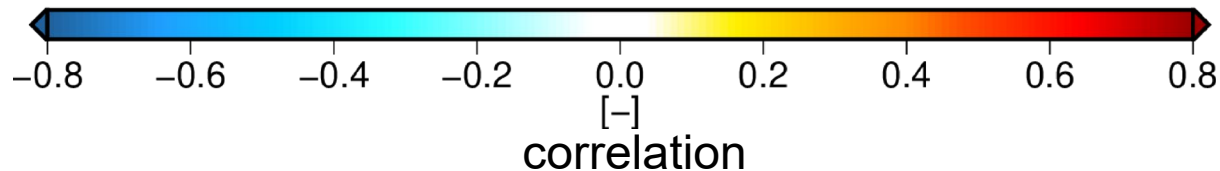
Next: Can this data be used to evaluate quality differences between ERA5 and ERA-Interim?

GRACE vs. ERA5

Coastal regions strongly
affected by ocean leakage
are masked out.

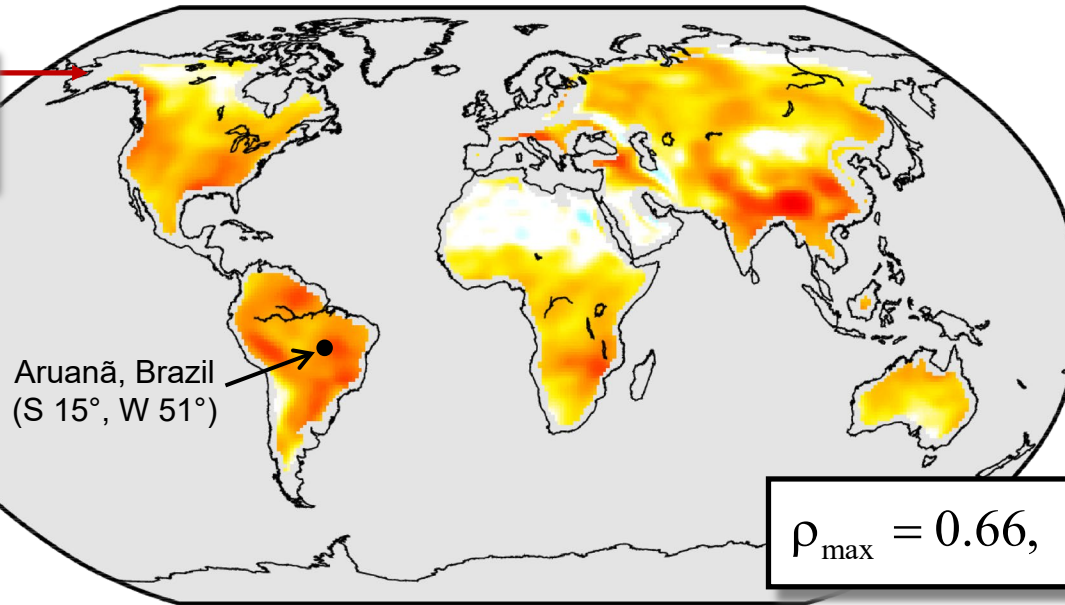


$$\rho_{\max} = 0.68, \rho_{\text{median}} = 0.32$$

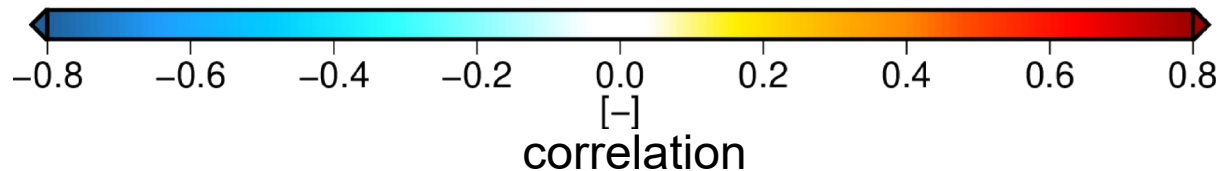


GRACE vs. ERA-Interim

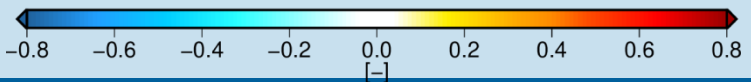
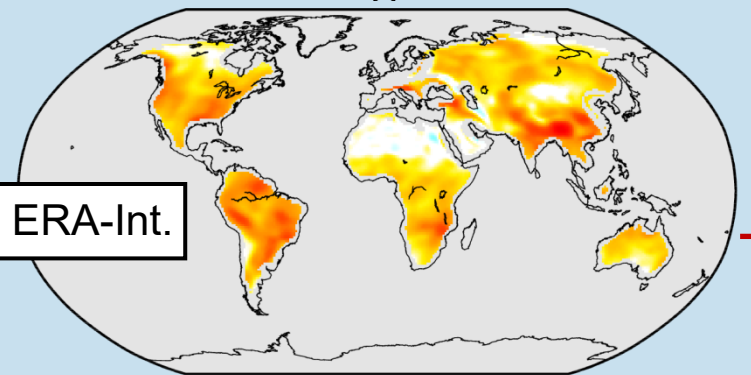
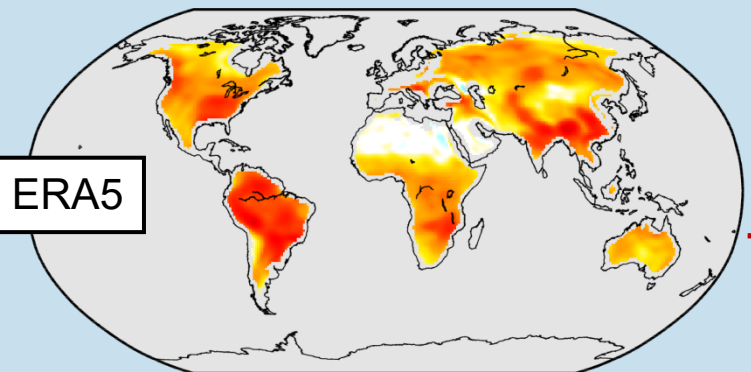
Coastal regions strongly affected by ocean leakage are masked out.



$$\rho_{\max} = 0.66, \rho_{\text{median}} = 0.23$$



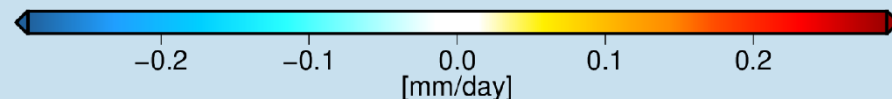
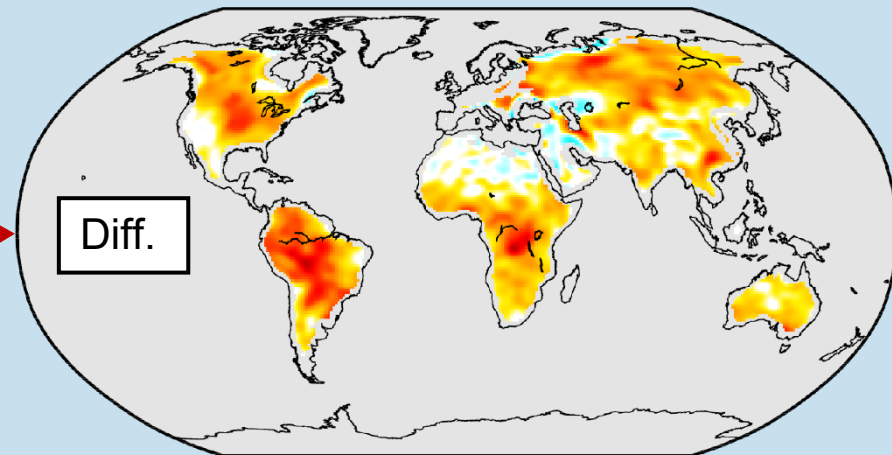
Correlation (difference ERA5 vs. ERA-Interim)



Clear improvement of
ERA5 vs. ERA-Interim

large is better

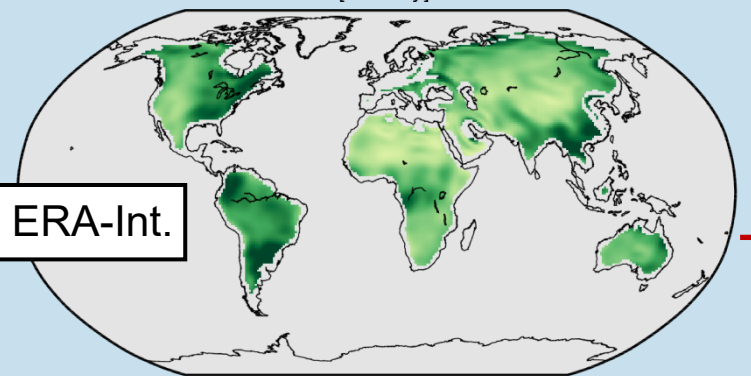
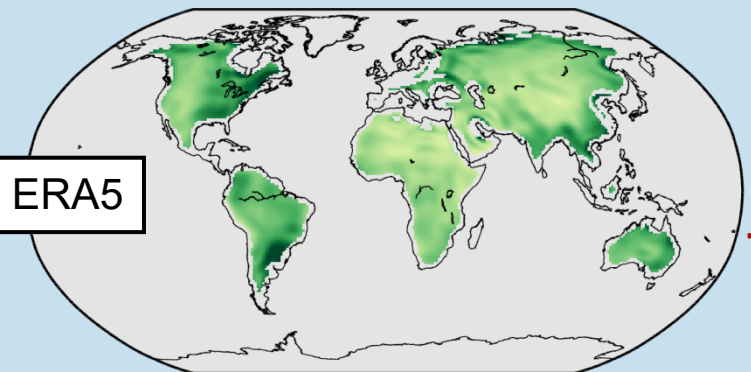
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ERA-Int. better

ERA5 better

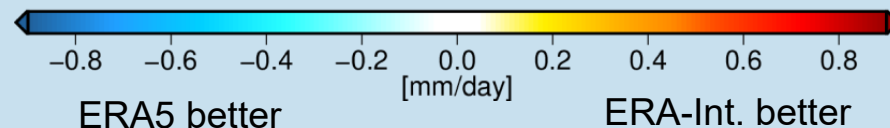
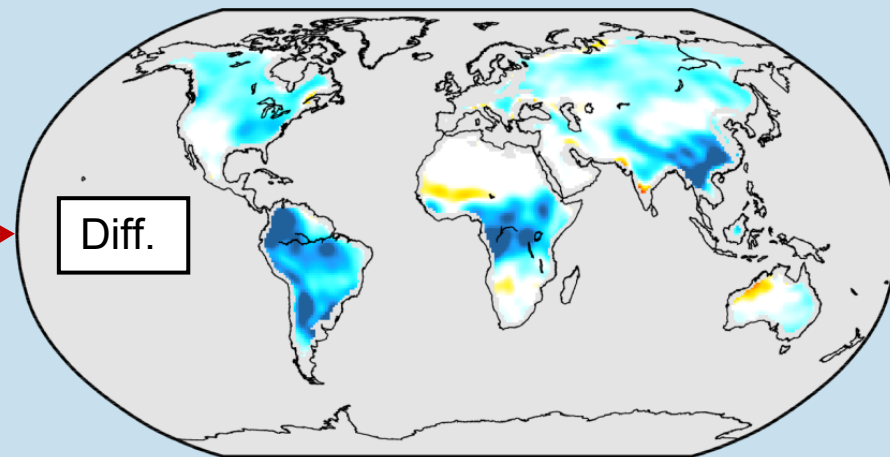
Root mean squared deviation (RMSD)



Clear improvement of
ERA5 vs. ERA-Interim

small is better

—



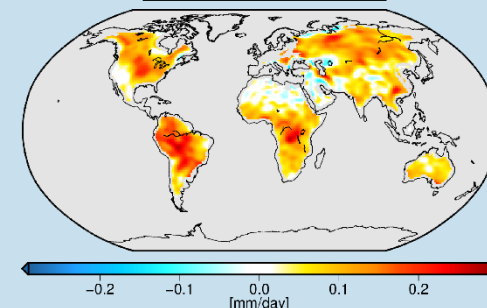
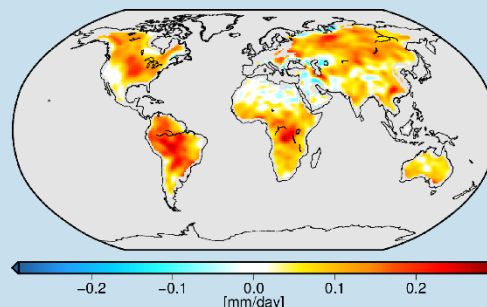
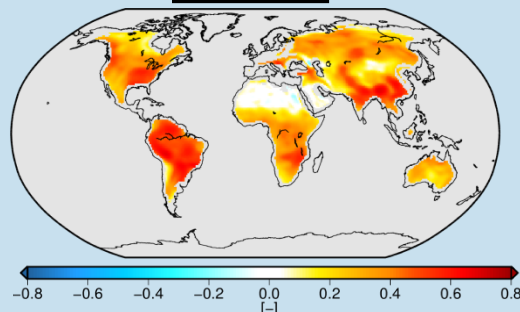
Evaluation metrics: Summary

ERA5

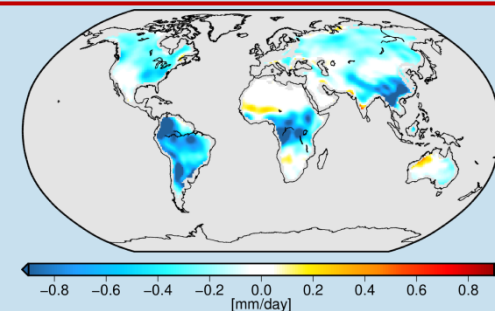
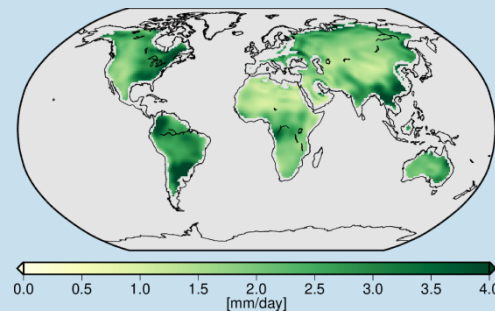
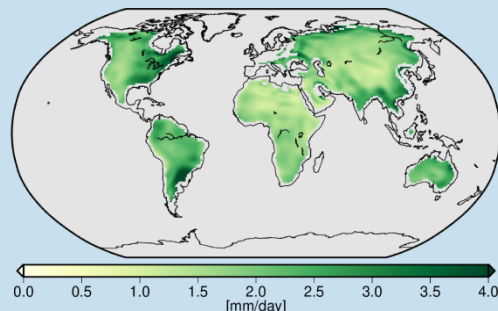
ERA-Int.

Difference

Correlation



RMSD

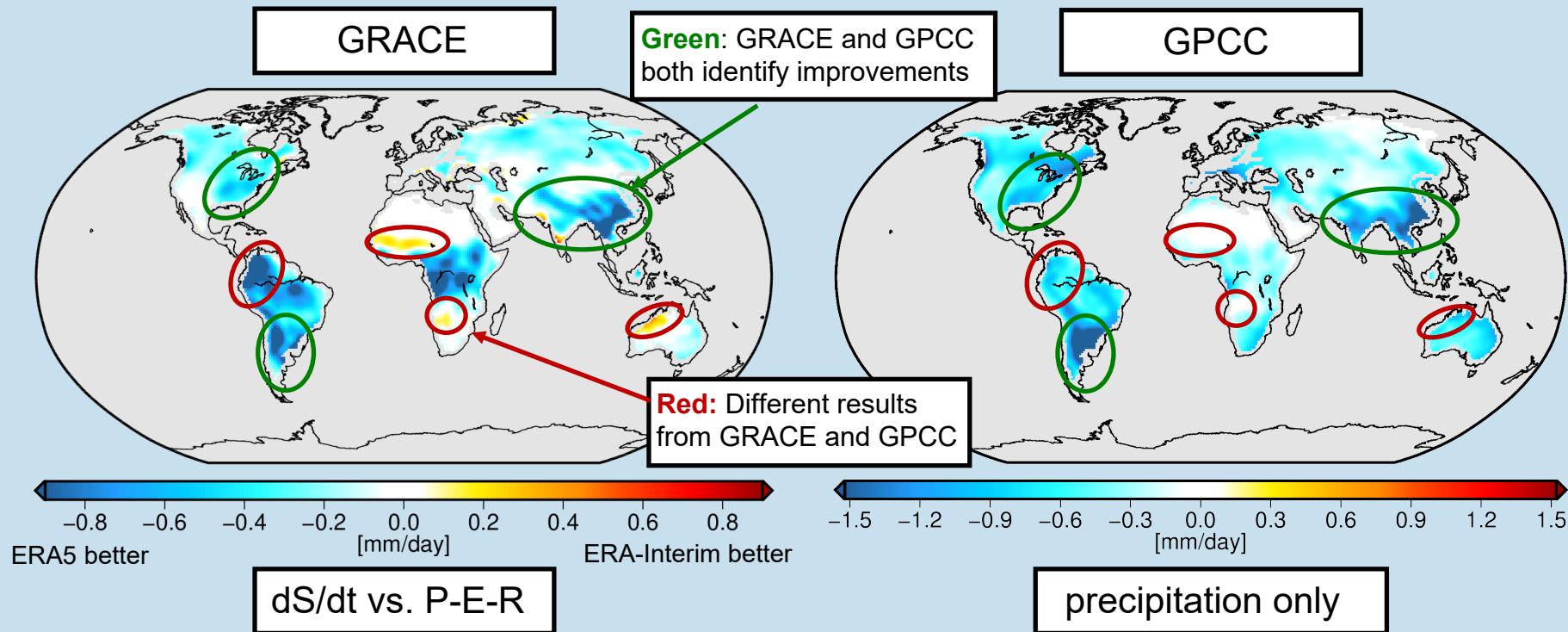


Take home message (2):

Quality improvement of ERA5 vs. ERA-Interim can clearly be detected by GRACE

Next: Are the results reliable?

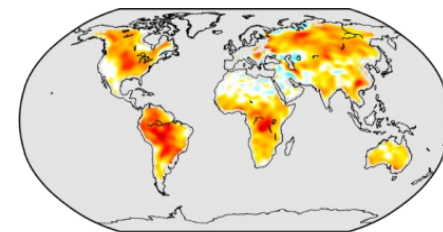
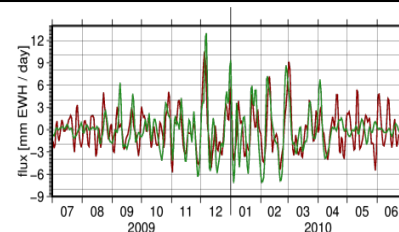
=> Comparison of GRACE results to rain gauge evaluation using GPCC precipitation data.



Take home message (3)

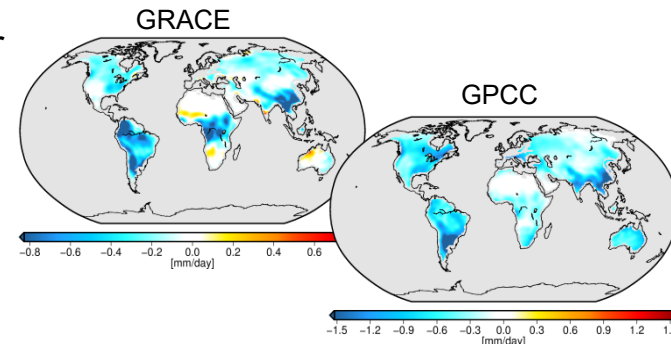
GRACE largely confirms regions of improvement identified by GPCC...
... but also identifies a few differences => info about other fluxes (E, P)?

GRACE can clearly identify quality differences between net fluxes in reanalyses down to time scales of 5-30 days...



GRACE fully confirms the quality improvement in ERA5 over ERA-Interim in agreement with rain gauge observations.

GRACE identifies degradation of ERA5 fluxes relative to ERA-Interim in just three dedicated regions not detectable from rain gauges comparison.



Questions?



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@IAG_climate

Eicker, A., Jensen, L., Wöhnke, V., Dobsław, H., Kvas, A., Mayer-Gürr, T., Dill, R. (2020): Evaluating short-term hydro-meteorological fluxes with daily satellite data from the GRACE mission, *Scientific reports*, 10, 4505, <https://doi.org/10.1038/s41598-020-61166-0>