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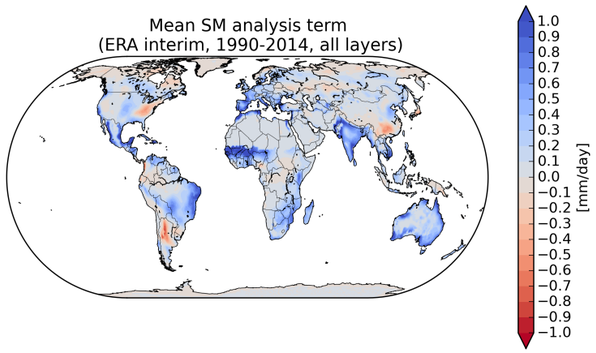
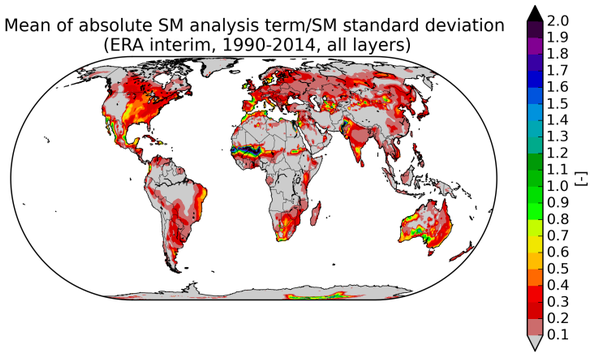
Irrigation Effects on Soil Moisture Analysis in ERA-Interim

Background

In the ERA interim atmospheric re-analysis system, the model state is constrained by measurements. This leads to addition or removal of water from the system (the analysis term). Here, the spatial and temporal patterns of these additions are related to the precipitation bias and irrigation activity.

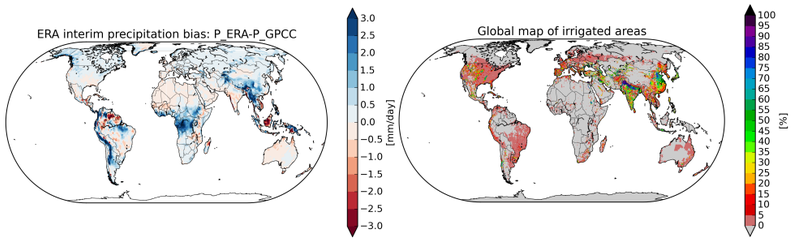




Soil moisture analysis term

These soil moisture corrections show a clear global pattern of mean soil moisture additions in many areas, which cover a significant part of the total soil moisture variability. These patterns are compared to irrigation water demand and precipitation bias, which could both be causing the soil moisture additions.

Possible Causes: Precipitation bias and Irrigation

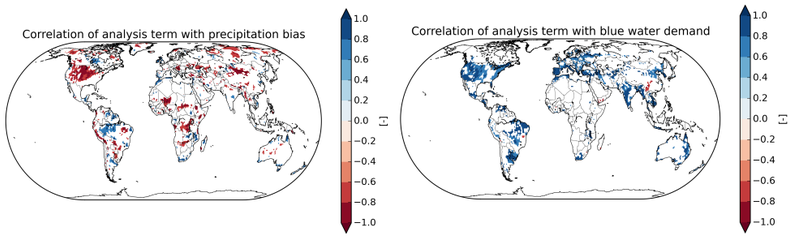


Expectation:

- Precipitation bias → **negative correlation** with soil moisture analysis term, because the reanalysis system will counteract the bias.
- Irrigation → **positive correlation** with soil moisture analysis term, because the reanalysis system is drier than reality.

Correlation of annual cycles

In irrigated areas, the annual means and cycles of these soil moisture additions correlate well with blue water demand (irrigation demand) and less with the precipitation bias. Therefore, we conclude that in irrigated areas, it is more likely that the soil moisture additions are caused by irrigation than by the precipitation bias. In non-irrigated areas, a weak statistical relation between soil moisture additions and precipitation bias is present.

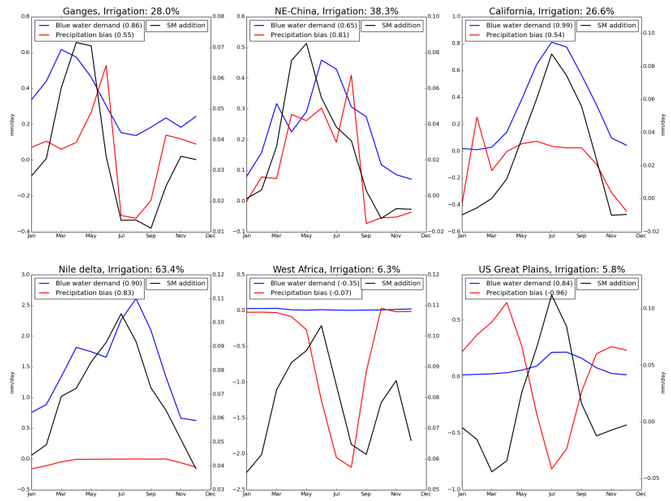


Local differences

In heavily irrigated areas (Ganges, Nile delta, California, North-East China):

- There is a strong correlation between blue water demand and soil moisture additions.
- And potentially a negative correlation between precipitation bias and soil moisture additions (US Great plains).

In West-Africa, the soil moisture additions are more likely to be caused by a monsoon bias.



Conclusions

- As irrigation influences the water balance in atmospheric reanalysis systems, it is recommended to include this process in the reanalysis models.
- Moreover, as irrigation has an influence on the local and regional atmosphere, this influence should be taken into account when interpreting atmospheric data over strongly irrigated areas.

Data sources:

ERA-interim: *Dee et al.*(2011), QJRMS
Blue water demand: *Siebert and Döll*(2010), JHM
Map of irrigated areas: *Siebert et al.*(2005), HESS