Observed Budgets for the Global Climate

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LANDOLT-BÖRNSTEIN Numerical Data and Functional Relationships in Science and Technology
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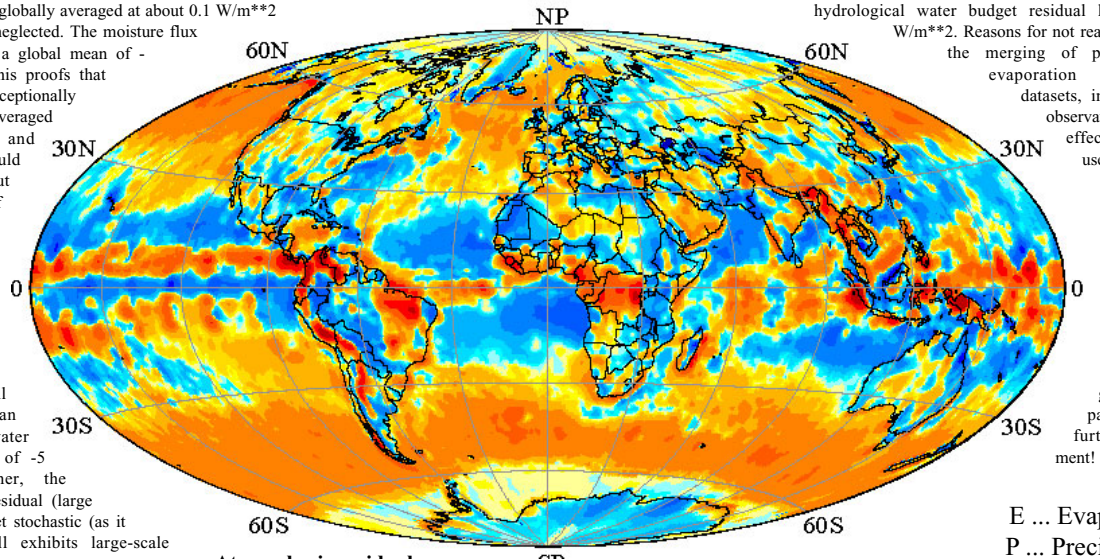
PROBLEMS AND TASKS

A global dataset for selected budget quantities specifying the present climate for the period 1991-1995 has been compiled. This dataset is an essential component of the new climate volume within the series Landolt-Börnstein - Numerical Data and Functional Relationships in Science and Technology, to be published soon. Budget quantities are those that appear in a budget equation. Emphasis in this collection is placed on observations of both in situ and remotely sensed data. Main focus is on climatologically relevant state and flux quantities throughout all components in the climate system. Selected secondary and complex climate elements are also presented (e.g. tornadoe frequency). The progress of this collection as compared to other climate datasets is, apart from the quality of the input data, that all fields are presented in standardized form. For some budget quantities, e.g. precipitation, it has been necessary to merge data from different sources; insufficiently observed parameters have been supplemented through the ECMWF ERA-40 re-analyses. If all quantities of a budget have been evaluated the gross residual represents an estimate of data quality.

ATMOSPHERIC WATER BUDGET

The global water budget is used here as an example to verify some climate quantities concerning their consistency and is calculated for the years 1991-1995. Precipitation from HOAPS, GPCC and ERA-40 and evaporation from HOAPS and ERA-40 is used. No observations are available for the moisture flux divergence, so it is derived from wind and moisture analyses from ERA-40. But the water budget residual is not zero! The storage term lies globally averaged at about 0.1 W/m**2 and was rightly neglected. The moisture flux divergence has a global mean of -0.01 W/m**2, this proofs that the balance is exceptionally good. Globally averaged precipitation and evaporation should also balance, but the merging of precipitation and evaporation data from different datasets produces inhomogeneous fields. This plays the main role for not reaching the null and provides an atmospheric water budget residual of -5 W/m**2. Further, the pattern of the residual (large picture) is not yet stochastic (as it should) but still exhibits large-scale systematic features.



Atmospheric residual

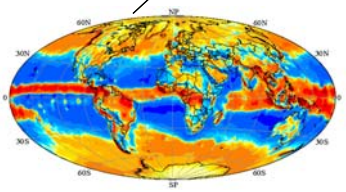
LAND HYDROLOGICAL WATER BUDGET

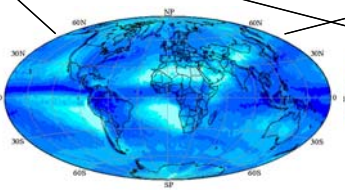
Compared to the atmospheric water budget the hydrological water budget is calculated only over land for the same period and with the same parameters from the same datasets. Instead of the moisture flux divergence the runoff data from UNH/GRDC are used - a combination of observations and analyses from the Water Balance Modell (WBM). These runoffs are available over all continents except Antarctica. The corresponding land hydrological water budget residual lies at about -6 W/m**2. Reasons for not reaching the null are the merging of precipitation and evaporation from different datasets, insufficient runoff observations and spin-up-effects in the models used.

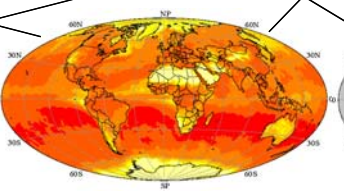
Not reaching a budget residual zero suggests, that the observation of global water parameters, respectively of general global climate parameters, needs further improvement!

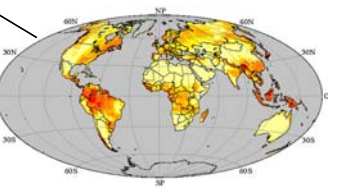
E ... Evaporation < 0
P ... Precipitation > 0
$\nabla \cdot \mathbf{Q}$ ... Moisture flux divergence
$\partial W^{a,l}/\partial t$ ... Moisture storage term ~ 0
R ... Runoff < 0

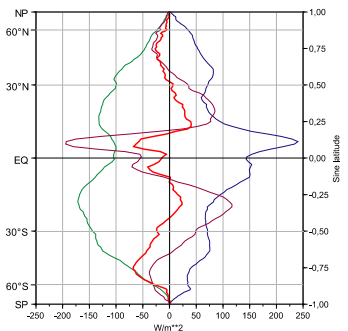
$$\frac{\partial W^a}{\partial t} + \nabla \cdot \mathbf{Q} + P + E = 0 \qquad \frac{\partial W^l}{\partial t} + R + P + E = 0$$


Moisture flux divergence


Precipitation


Evaporation


Runoff



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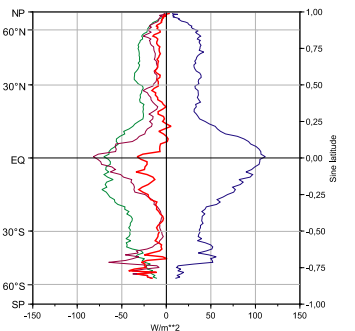
REFERENCES

Hantel, M., 1987: The present global surface climate. In *Landolt-Börnstein - Numerical Data and Functional Relationships in Science and Technology, New Series, V/4c2*, 117-474. Springer, Berlin.

Kottek, M. and F. Rubel, 2003: Global climate data in standardised description. *Wiener Meteorologische Schriften*, **1**, pp. 137.



Precipitation — Evaporation — Div Q / Runoff — Residual