



Cycles and Budgets Task Team

Jan Polcher (GEWEX), Andrea Steiner (SPARC), Fangli Qiao (CLIVAR), Pierre Friedlingstein (JSC), Helen Cleugh (JSC), Han Dolman (GCOS)

Monitoring cycles and budgets

- This objective revolves around the continuity equation :

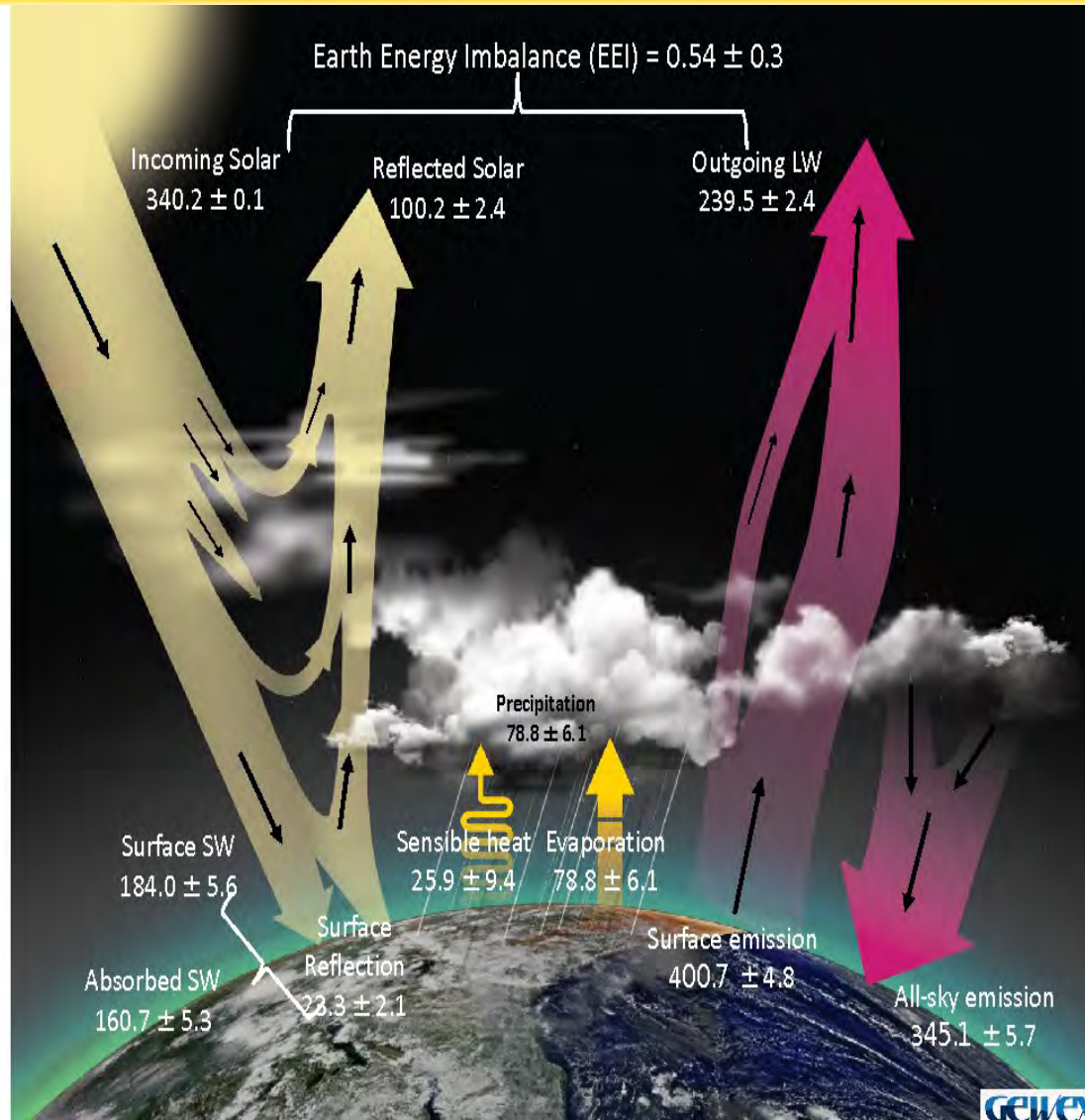
$$\frac{\partial \rho}{\partial t} + \nabla \cdot f = \sigma$$

- The first issue is to defined a closed system over which the equation can be established
- Then identify all fluxes and reservoir changes which are part of the cycle. This often depends on our process understanding
- Except for some particular cases, the equality cannot be established. Thus everything hinges on the error estimation for the fluxes and reservoirs.

GEWEX's experience

- GEWEX has performed many such studies for water from catchments to global and for energy mostly global.
- All previous closure studies done by the community have shown limitations in either :
 - Data availability or quality leading to large error bars.
 - Processes not properly taken into account and thus missing interactions or unmonitored boundary conditions.
- They have all lead to new process studies which have advanced our understanding.
- Cycle closure is an axiom for the community and serves to verify that our process knowledge or data are correct.

Latest estimates for the water and energy cycles



- This budget (in Wm^{-2}) was achieved using a 'global' optimization described in L'Ecuyer et al (2015).
- Uses more recent data that produce a more consistent set of fluxes.
- The global approach simplifies the problem.

Proposal from the Task Team

- Poll all core programs of WCRP to see where their knowledge of cycle & budget closure stands.
- Expected results :
 - Build an Earth system wide view on the energy and water cycle.
 - Assess observations and models available for all components.
 - Evaluate the possibility (relative to the errors) to detect and quantify imbalances of Earth's energy and water cycles.
- This could lead to an Earth system wide vision of our ability to monitor the energy, water and biogeochemical cycles.
- Identify regions which are either easier to analyse or critical because of large trends.
- Identify the time and space scale which could be covered with current observations and models.

A questionnaire for all core projects

For each study, within WCRP's core projects which has attempted to close a budget equation, the questionnaire should be filled out. It will ask the following questions :

- Cycle analysed : energy, water, carbon or other biogeochemical species.
- Spatial & temporal scale of analysis
- Earth system component analysed
- Method used : 3 options and any combination of the 3 :
 - Fully based on observed data
 - Data/model fusion
 - Statistically or AI based to derived unobserved quantities.
- Error characterisation for the fluxes and reservoir changes.
- Free text for : description of method and main conclusions of the study

Next steps

- Send the questionnaire to other core programs to see if it corresponds to their view on such studies.
- Send it to LHAs to see if it fulfils their needs.
- Evaluate the responses and organise a workshop to process the gathered information.
- The process should allow to draw some conclusions on what would be possible or where the road blocks are.