WULCA midpoint suggestion

For discussion – stress meeting of Feb.18\textsuperscript{th} 2014
Approach (a): From endpoint to midpoint:

Single indicator for water use
(see Ridoutt and Pfister 2013 IJLCA 18:204-207 for example, also discussion in Ridoutt and Pfister 2013 JIE 17:337-339)

Water inventory

Endpoint impact assessment model(s) relevant to AoP Human Health

Indicator results for HH (DALYs)

Weighting

Translation of combined weighted results into familiar unit, such as m3 equiv

Endpoint impact assessment model(s) relevant to AoP Ecosystems

Indicator results for Ecosystems (eg species.yr)

Note: consensus needed on which model(s) are preferred (where more than one model exists for a particular impact pathway) and whether models for new impact pathways are mature enough to include. This fits in with other WULCA activity to reach consensus on models for HH impact of water use, etc.
Approach (b): generic midpoint

• Include Vulnerability Factors for HH ($V_{HH}$) and EQ ($V_{EQ}$) based on endpoint modelling

  – The general structure could be:

  $WIF_{midpoint} = f\left[\frac{\text{Consumption}}{\text{Availability}} \times V_{HH} \times V_{EQ}\right]$ 

  – The factors need to account for regional specific circumstances
Approach (b1): generic midpoint

- Existing ideas for VF can be
  - For $VF_{EQ}$
    - Based on environmental water requirements (EWR):
      $$VF_{EQ} = 1/(1-EWR)$$
    - Based on ecosystem vulnerability (EV):
      $$VF_{EQ} = EV$$
    - The result would be combination:
      $$VF_{EQ} = EV/(1-EWR)$$
  - For $VF_{HH}$
    - Based on GDP or human development index (HDI):
      $$VF_{EQ} = (1-HDI) \text{ or } 1/HDI \text{ or more complex}$$

- Simplified first approach:

$$WIF_{midpoint} = f \left[ \frac{consumption \times (1 - HDI^x)}{availability \times (1 - EWR^y) \times EV^z \times c} \right]$$

$x,y,z$, $c$= factor for adjusting impact function

- WSI functions could be applied as done by Boulav et al. 2011 and ofister et al.
Approach (b2): stress based on the ratio of all water user’s needs to available water

\[
\text{STRESS} = F \left( \frac{\text{Water needs (humans + ecosystems)}}{\text{Renewable water availability}} \right)
\]

**Water needs - humans:** water consumption

**Water needs - ecosystems:** needs to be modeled (see next slide)

**Renewable water availability:** considering only renewable water allows to reflect aquifer overuse (to be discussed following Jane’s suggestion)
Water needs- ecosystems (suggestion)

- A very detailed and updated (2001) map exists of the world’s vegetation coverage and mass of live carbon/m² $(0.5^\circ \times 0.5^\circ)$

Question:

• Can we relate the water requirement of terrestrial ecosystems with the mass of live carbon present?

• If we can, then...
Water needs- ecosystems (suggestion)

• Terrestrial ecosystems water needs:

\[(A \text{ kg carbon/m}^2) \times (B \text{ m}^3 \text{ water/kg carbon – year}) \times \text{(Area (m}^2))\]

• Aquatic ecosystems water needs (using area of water bodies from Ohlson map)

Water needed per year = water evaporation from surface (to maintain volume)