Controls on aboveground net primary productivity & the partitioning of canopy and wood production in tropical rainforests

Florian Hofhansl, & Wolfgang Wanek
Potential net primary production (NPP)

Tropical Forests:

- 12% of Earth's land surface
- 25% of the world's biomass C
- 40% of terrestrial NPP

Climatic Controls

Temperature

Precipitation

Climatic drivers:

Mean annual temperature (MAT)

Mean annual precipitation (MAP)

Expected changes:

- Drought frequency
- Precipitation intensity
- Temperature

Net primary production (NPP):

**Aboveground NPP**
- Canopy production (47%)
- Wood production (53%)

**Belowground NPP**

Methodology

Net primary production (NPP):

- Aboveground NPP
- Stem increment (ABI)
- Litter fall (LF)

Relationship explained

ABI ~ 60%
LF ~ 40%
→ about 50% undetermined
Methodology

Number of studies (ISI):

- Net primary production
- Stem increment
- Litter fall
- Stem increment & Litter fall

< 1% measured both !!!

Source: ISI webofknowledge.com
Local Study

Tropical Field Station
La Gamba: (since 2005)

Topographic positions:
- Ridge
- Slope
- Ravine

Stem increment
(DBH>10 cm)

Litter fall
(n=15 per site)

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Local Controls

Climatic controls:

- **ANPP**: No sign. effect
- **Stem increment** (ABI)
- **Precipitation**
- **Litter fall** (LF)
- **Drought and Temperature**

Different Controls

**ABI / LF**

Global Study

>100 sites, S-America (62), Asia (26), Hawaii (12), Africa (3), Australia (2)

**Global Controls**

**Classification Tree (CART):**

**MAT**
All forest sites 
(n=105)

**MAP**
Lowland Sites 
(>21.65°C)

**Soil N:P ratio**
Montane Sites 
(<21.65°C)

Global Controls

Structural equation model (SEM):

Overall Model

Lowland Model

Montane Model

Temperature

MAT

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<thead>
<tr>
<th>Effect</th>
<th>Overall</th>
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<th>Montane</th>
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<tbody>
<tr>
<td>ANPP</td>
<td>+</td>
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Precipitation

MAP

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Introduction – Global carbon cycle

Soil N:P ratio

Effect | Overall | Lowland | Montane
--- | --- | --- | ---
ANPP | – | – | –
% WP | – | – | –
Conclusion

• Local Controls on ANPP differ for **canopy** & **wood** production

• **Global Controls** on tropical ANPP:
  - **MAT** → (+) overall and montane ANPP, overall %WP
  - **MAP** → (+) lowland ANPP, lowland & overall %WP
  - **Soil N:P** → (−) overall and montane ANPP and %WP

• **Global change effects:**
  - **MAT** → enhance productivity of **montane** forests
  - **MAP** → alter C-sequestration potential of **lowland** forests
  - **Soil N:P** → N-deposition might decrease tropical productivity
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