Ecosistemas II

Ecología General 2018
Relación entre ciclos de materiales y el flujo de energía
Entradas y salidas de nutrientes en los ecosistemas

**Figure 18.2** Components of the nutrient budgets of a terrestrial and an aquatic system. Note how the two communities are linked by stream flow, which is a major output from the terrestrial system and a major input to the aquatic one. Inputs are shown in color and outputs in black.
Balances
Balances

Table 18.1 Annual nutrient budgets for forested catchments at Hubbard Brook (kg ha$^{-1}$ year$^{-1}$). Inputs are for dissolved materials in precipitation or as dryfall. Outputs are losses in streamwater as dissolved material plus particulate organic matter. (After Likens et al., 1971.)

<table>
<thead>
<tr>
<th></th>
<th>$NH_4^+$</th>
<th>$NO_3^-$</th>
<th>$K^+$</th>
<th>$Ca^{2+}$</th>
<th>$Mg^{2+}$</th>
<th>$Na^+$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>2.7</td>
<td>16.3</td>
<td>1.1</td>
<td>2.6</td>
<td>0.7</td>
<td>1.5</td>
</tr>
<tr>
<td>Output</td>
<td>0.4</td>
<td>8.7</td>
<td>1.7</td>
<td>11.8</td>
<td>2.9</td>
<td>6.9</td>
</tr>
<tr>
<td>Net change*</td>
<td>+2.3</td>
<td>+7.6</td>
<td>−0.6</td>
<td>−9.2</td>
<td>−2.2</td>
<td>−5.4</td>
</tr>
</tbody>
</table>

* Net change is positive when the catchment gains matter and negative when it loses it.
Balances
Ciclos biogeoquímicos: Agua
Ciclo del Carbono
Bomba biológica de carbono
CO₂ Time Series in the North Pacific

- Red: Mauna Loa Atmospheric CO₂ (ppm)
- Blue: Aloha seawater pCO₂ insitu (μatm)
- Green: Aloha seawater pH (insitu)

NOAA’s PMEL Carbon Program (www.pmel.noaa.gov/co2/)
Flujos de carbono superficie-atmósfera a escala global.
Ciclo del Nitrógeno
Ciclo del nitrógeno en el océano
Reservorios (cajas) Tg y flujos (flechas) Tg yr⁻¹

Nitrato NO₃
AMONIO NH₄
Oxido Nitroso N₂O
Amoníaco NH₃
How a century of ammonia synthesis changed the world

On 13 October 1908, Fritz Haber filed his patent on the “synthesis of ammonia from its elements” for which he was later awarded the 1918 Nobel Prize in Chemistry. A hundred years on we live in a world transformed by and highly dependent upon Haber–Bosch nitrogen.

Although over 78% of the atmosphere is composed of nitrogen, it exists in its chemically and biologically unusable gaseous form. Haber discovered how ammonia, a chemically reactive, highly usable form of nitrogen, could be synthesized by reacting atmospheric dinitrogen with hydrogen in the presence of iron at high pressures and temperatures. Today, this reaction is known as the Haber–Bosch process: Fritz Haber was the inventor who created the breakthrough and laid the foundations for high-pressure chemical engineering, but it was Carl Bosch who subsequently developed it on an industrial scale, for which he was awarded a Nobel Prize in 1931. The importance of Haber’s discovery cannot be overestimated — as a result, millions of people have died in armed conflicts over the past 100 years, but, at the same time, billions of people have been fed.

In his Nobel lecture, Haber explained that his invention was for mankind.

Agricultural production for food and fuel has increased in the past few years; for example, oilseed rape as shown here.
Global Nr Creation by Human Activity 1850 to 2005

In 2005 187 Tg Nr was created by humans.

Total Nr Production
- Fossil fuel combustion, 25 Tg Nr yr\(^{-1}\)
- Cultivation-induced BNF, 40 Tg Nr yr\(^{-1}\)
- Haber-Bosch process
  - Fertilizer, 100 Tg Nr yr\(^{-1}\)
  - Industrial feedstock, 23 Tg Nr yr\(^{-1}\)

Galloway et al., 2003; 2008
Patrones globales de deposición de N
Fig. 14.10

Chapin et al., 2011

Global Phosphorus Cycle

Atmosphere 0.028

Sea-spray 0.3

Deposition 3

Dust 4

Surface water 3,000

Mixing 40

Biota 60

Redeposition 20

Vegetation 500

Erosion 27

Crops

Fertilizer P 13

Mineable P 15,000

Soils 150,000

Deep water 87,000

Sediments 2.5 x 10^9

Dust 1

Sea-spray 0.3

Deposition 3

Dust 4