U.S. Environmental Protection Agency – Region 9’s California Sustainability Indicators Suite
Linking Earth Observations to Societal Benefits: Global Earth Observation System of Systems
California Water Plan 2013 Update

Deliverables

- Dec. 2013: Final Update 2013

- Sept. 2013: Plenary and Tribal Summit
**Ecological Footprint** compares the use of natural resources to biological capacity to supply them.

**Plant Growth Index (PGI)** measures changes in photosynthesis in plant communities.

**Water Footprint** accounts comprehensively for sources and uses of water in a specified area.

**Gravity Recovery and Climate Experiment** measures changes in total water in a specified area.
Decision Support Tool

Ecological Footprint
- Data gathering
- Input into model

Plant Growth Index
- Processed Data
  - from NASA/NOAA

Water Footprint
- Data gathering
  - Input into model

GRACE
- Processed Data
  - from NASA

Use Footprint to inform policy

Using models to connect with Eco & H₂O footprints

Indicators
California’s Central Valley: Terrestrial Water Storage changes measured from GRACE 2003 - 2011

Map from Famiglietti et al., 2011

All Water Storage Components (incl. soil moisture, snow, reservoirs, and groundwater)

Drought period

2010 & 2011: Two wet winters -> Rebound?

Soil moisture
Snow
Reservoirs

-> need to be subtracted from GRACE

Units: Meters H₂O

Felix W. Landerer, JPL
Nov-29, 2011
GRACE spatial view
Total water storage, California

Figure 8: Total water storage anomalies for the month of February for the years shown. Units: m-H$_2$O.
Total change over the time period October 2004 to September 2009

C2VSim total change = \(-20.6 \pm 3.01\) km\(^3\)
GRACE downscaled change = \(-20.7 \pm 7.57\) km\(^3\)
Plant Growth Index

Statistically significant trends in Plant Growth Index from 1982 to 2010, calculated from 8 km data
Plant Growth Index: changes in NDVI over time

Ecosystem Area with Increasing or Decreasing Plant Growth Index Relative to Average for 1982-2010

- 0 to 0.02
- 0.02 to 0.05
- >0.5
Ecological Footprint

**Biocapacity:**
How much bioproductive area is **available to us?**

**Ecological Footprint:**
How much bioproductive area **do we demand?**
The Ecological Footprint
Ecological Footprint analysis

National Footprint Accounts 2011 Edition - Data Year 2008

California

Ecological Footprint Totals

<table>
<thead>
<tr>
<th>Demand Type</th>
<th>EF\text{Production} [gha]</th>
<th>EF\text{Imports} [gha]</th>
<th>EF\text{Exports} [gha]</th>
<th>EF\text{Consumption} [gha]</th>
<th>Brocacity [gpa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Footprint</td>
<td>89,548,955</td>
<td>103,474,631</td>
<td>35,765,348</td>
<td>157,269,236</td>
<td>-</td>
</tr>
<tr>
<td>Cropland</td>
<td>12,359,580</td>
<td>21,794,376</td>
<td>5,481,598</td>
<td>26,688,961</td>
<td>12,359,580</td>
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<tr>
<td>Grazing Land</td>
<td>2,836,741</td>
<td>566,941</td>
<td>815,902</td>
<td>2,588,780</td>
<td>2,836,741</td>
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<tr>
<td>Fishing Grounds</td>
<td>744,853</td>
<td>3,040,176</td>
<td>754,485</td>
<td>2,990,545</td>
<td>8,246,214</td>
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<tr>
<td>Forest Land</td>
<td>2,242,887</td>
<td>20,288,391</td>
<td>695,295</td>
<td>21,816,583</td>
<td>9,933,040</td>
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<tr>
<td>Built-up Land</td>
<td>1,920,316</td>
<td>-</td>
<td>-</td>
<td>1,920,316</td>
<td>1,920,316</td>
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<tr>
<td>TOTAL</td>
<td>109,554,352</td>
<td>149,144,119</td>
<td>43,566,028</td>
<td>215,142,423</td>
<td>35,495,890</td>
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</table>

ECological Footprint and Brocacity Per Capita

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<thead>
<tr>
<th>Demand Type</th>
<th>EF\text{Production} [gpa person](^{-1})</th>
<th>EF\text{Imports} [gpa person](^{-1})</th>
<th>EF\text{Exports} [gpa person](^{-1})</th>
<th>EF\text{Consumption} [gpa person](^{-1})</th>
<th>Brocacity [gpa person](^{-1})</th>
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</thead>
<tbody>
<tr>
<td>Carbon Footprint</td>
<td>2.44</td>
<td>2.82</td>
<td>0.97</td>
<td>4.26</td>
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<tr>
<td>Cropland</td>
<td>0.34</td>
<td>0.56</td>
<td>0.15</td>
<td>0.78</td>
<td>0.34</td>
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<tr>
<td>Grazing Land</td>
<td>0.08</td>
<td>0.02</td>
<td>0.02</td>
<td>0.07</td>
<td>0.08</td>
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<tr>
<td>Fishing Grounds</td>
<td>0.02</td>
<td>0.08</td>
<td>0.02</td>
<td>0.06</td>
<td>0.22</td>
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<tr>
<td>Forest Land</td>
<td>0.06</td>
<td>0.56</td>
<td>0.02</td>
<td>0.55</td>
<td>0.27</td>
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<tr>
<td>Built-up Land</td>
<td>0.05</td>
<td>-</td>
<td>-</td>
<td>0.05</td>
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<tr>
<td>TOTAL</td>
<td>2.58</td>
<td>11.10</td>
<td>8.00</td>
<td>6.81</td>
<td>0.96</td>
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Forwground of Consumption by Land Use Type

<table>
<thead>
<tr>
<th>Land Use Type</th>
<th>Consumption [gpa]</th>
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</thead>
<tbody>
<tr>
<td>Carbon Footprint</td>
<td>73%</td>
</tr>
<tr>
<td>Cropland</td>
<td>13%</td>
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<tr>
<td>Forest Land</td>
<td>1%</td>
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<tr>
<td>Grazing Land</td>
<td>2%</td>
</tr>
<tr>
<td>Fishing Grounds</td>
<td>10%</td>
</tr>
<tr>
<td>Built-up Land</td>
<td>1%</td>
</tr>
</tbody>
</table>

Number of planets demanded if world's population lived like residents of California

3.73
California Ecological Footprint Analysis: Preliminary Results

Ecological Footprint and biocapacity of the United States compared to California, 2008.
Contacts

Vance Fong: fong.vance@epa.gov, (415) 972-3798
Don Hodge: hodge.don@epa.gov, (415) 972-3240