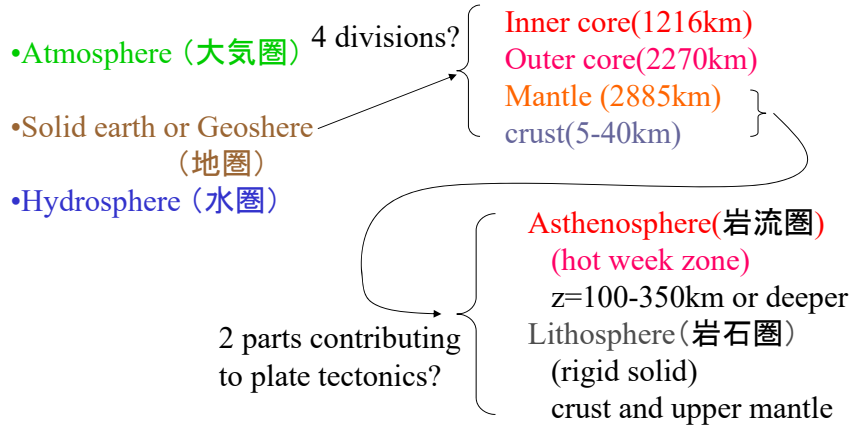


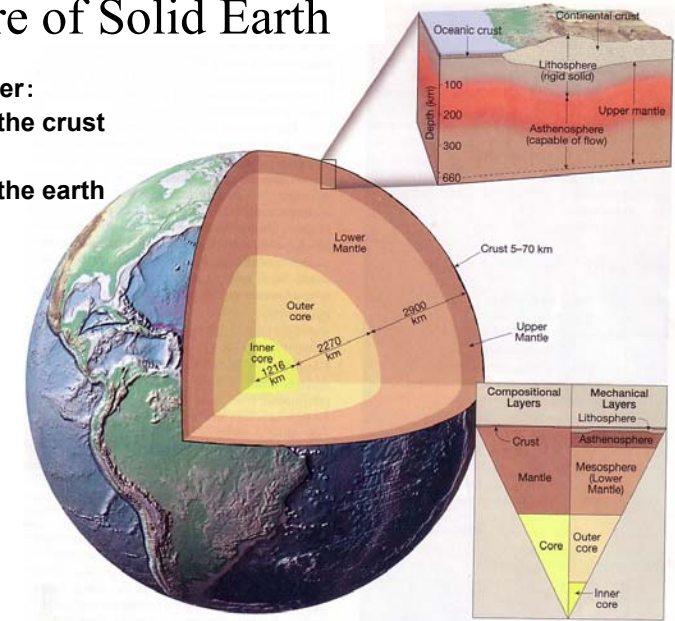
# Fundamental Knowledge on Earth Science

Earth mainly consists of three major parts (spheres)??



# Structure of Solid Earth

Geotechnical layer:  
thin surface of the crust  
Crust:  
thin surface of the earth

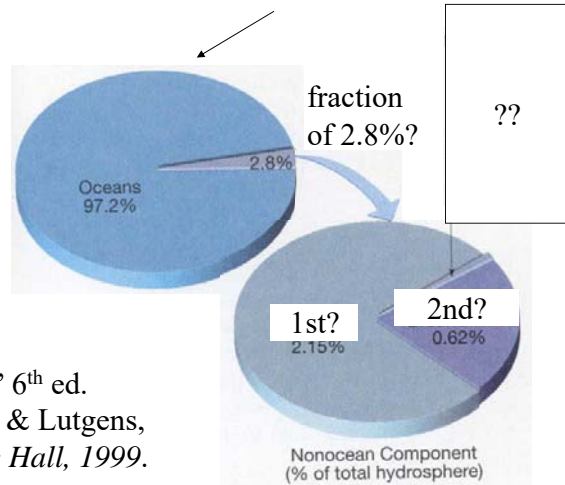


“Earth” 6<sup>th</sup> ed. Tarbuck & Lutgens, Prentice Hall, 1999.

# Hydrosphere??

How much is total volume? **1.36 Bkm<sup>3</sup> (13.6億km<sup>3</sup>)**

Fraction of ocean and non-ocean water?



Average sea water depth=3729m  
Sea area 361.06Mkm<sup>2</sup> (71%),  
Land area: 148.89km<sup>2</sup>

Radius of the Earth: 6370km

“Earth” 6<sup>th</sup> ed. Tarbuck & Lutgens, Prentice Hall, 1999.

# Fresh water of Hydrosphere

Parts of hydrosphere	Volume of fresh water (km <sup>3</sup> )	Share of total volume of freshwater (%)	Average rate of water exchange
Ice sheets and glaciers	24,000,000	84.945	8000 years
Ground water	4,000,000	14.158	280 years
Lakes and reservoirs	155,000	0.549	7 years
Soil moisture	83,000	0.294	1 year
Water vapor in the atmosphere	14,000	0.049	9.9 days
River water	1,200	0.004	11.3 days
<b>total</b>	<b>28,253,200</b>	<b>100.000</b>	

(source: “Earth” 6<sup>th</sup> ed., J. Tarbuck & F. K. Lutgens, Prentice Hall)

GW flow rate is very small.

Not easy to find the GW contamination  
Not easy to remove the contaminant

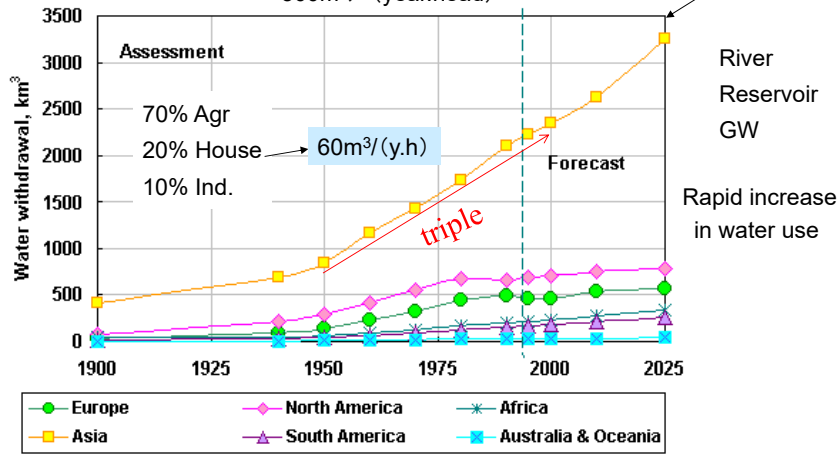
# Use of water in the world

Annual water withdrawal => actual use about the half

1995: 3800km<sup>3</sup> withdrawal, 2000km<sup>3</sup> in use

300m<sup>3</sup> / (year.head)

5200km<sup>3</sup>



[http://webworld.unesco.org/water/ihp/db/shiklomanov/summary/html/figure\\_8.html](http://webworld.unesco.org/water/ihp/db/shiklomanov/summary/html/figure_8.html)

## Access to safe drinking water

- <95%
- 60-95%
- 60%<
- Insufficient data

1.1B / 6.0B  
not access to SDW

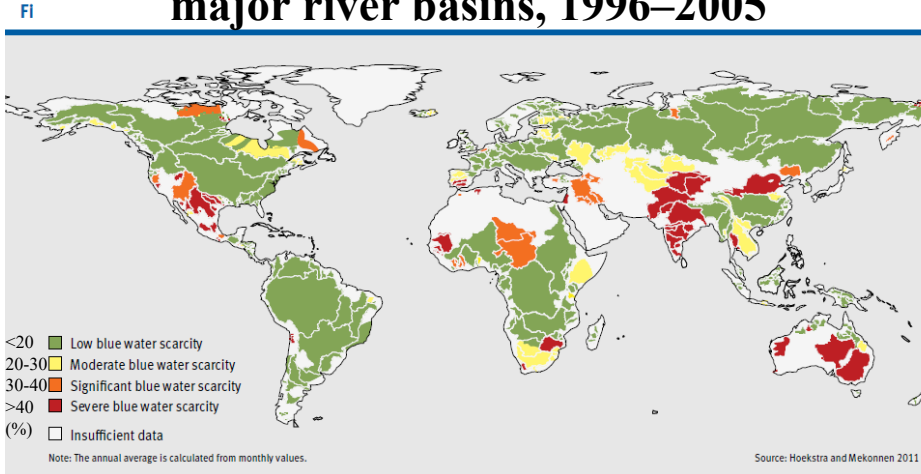
## Access to appropriate sanitation

2.4B / 6.0B  
not access to AS

GEO-4: Global Environmental Outlook 4, UNEP

Source: WHO and UNICEF 2006

# Annual average blue water scarcity in major river basins, 1996–2005

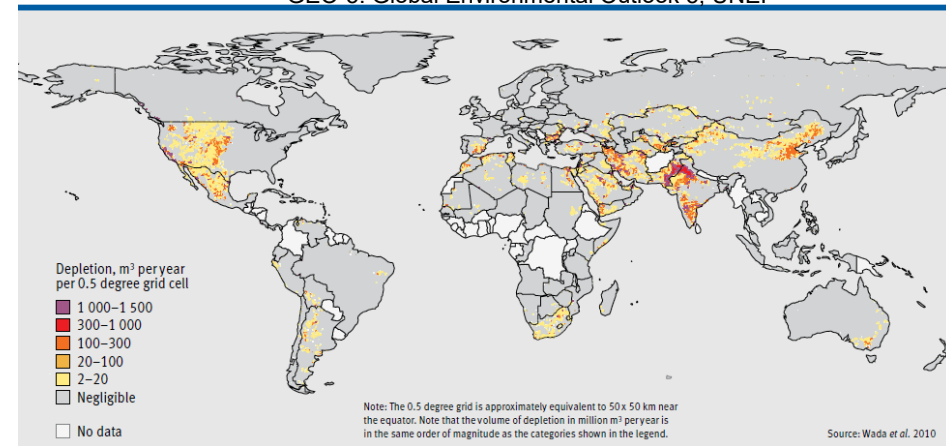


GEO-5: Global Environmental Outlook 5, UNEP

$$\text{blue water scarcity} = \frac{\text{blue water footprint}}{\text{blue water availability}}$$

# Global annual groundwater depletion, 2000

GEO-5: Global Environmental Outlook 5, UNEP



	1960	=>	2000
Global GW withdrawal:	312km <sup>3</sup>	=>	734km <sup>3</sup>
global GW depletion:	126km <sup>3</sup>	=>	283km <sup>3</sup>

