SISTEMA TIERRA

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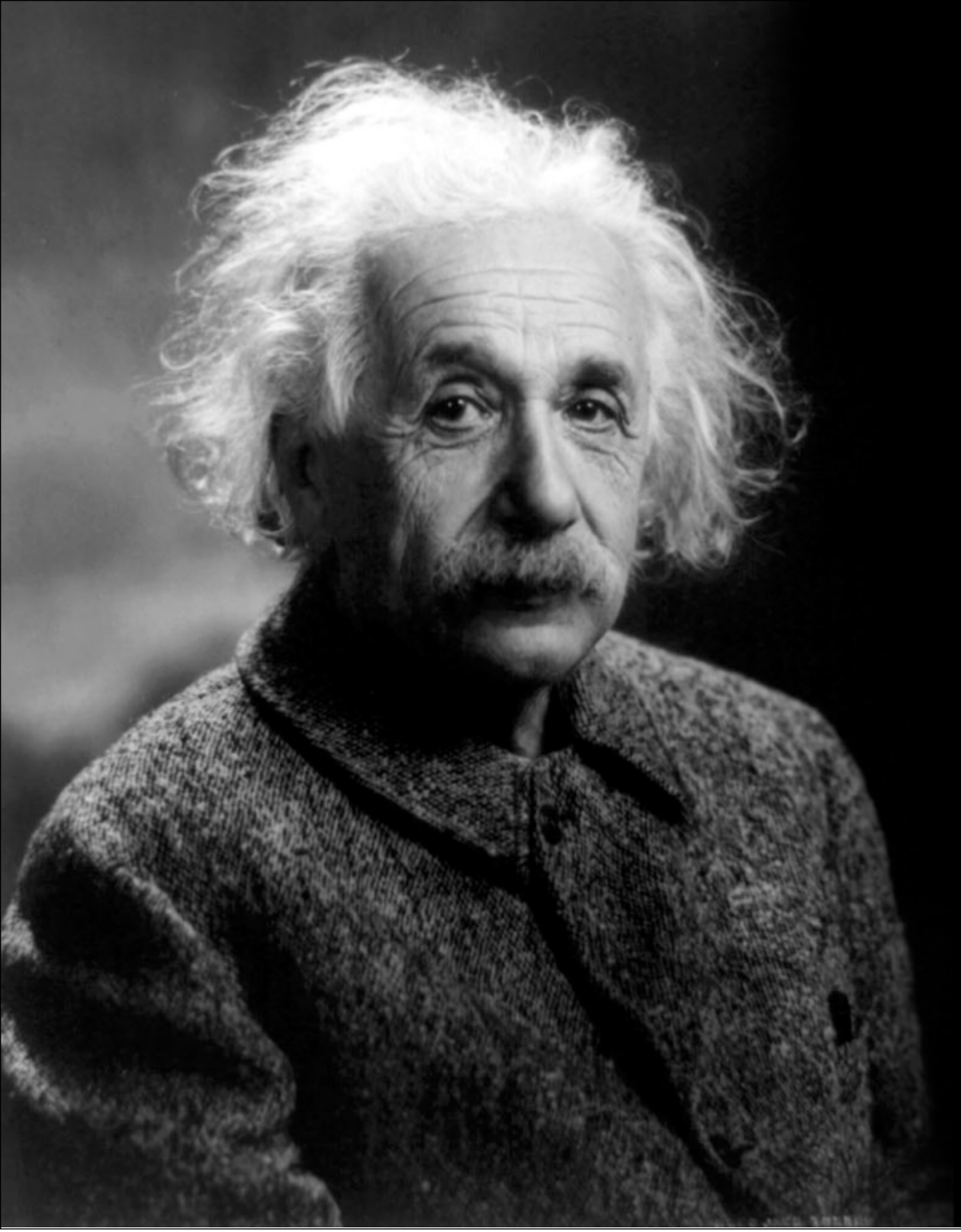


"Es mas fácil

desintegrar un átomo

que un prejuicio"

Albert Einstein

¿Vamos a armar un puzzle?

Esferas

Globalization's Impact on Air Environment in Santiago, Water Environment in Osaka, and Soil Environment in Shanghai, Leiva, M.A., Sei, K., Soda, S., Yanai, J., Chen, A., 2004. APRU Special Paper. Association of Pacific Rim Universities, Singapore, pp. 6–24. Available on line http://www.apru.org/activities/afp/collab_paper.htm>.


Química - Física - Orografía - Meteorología - Fuentes y Sumideros

HIDRO

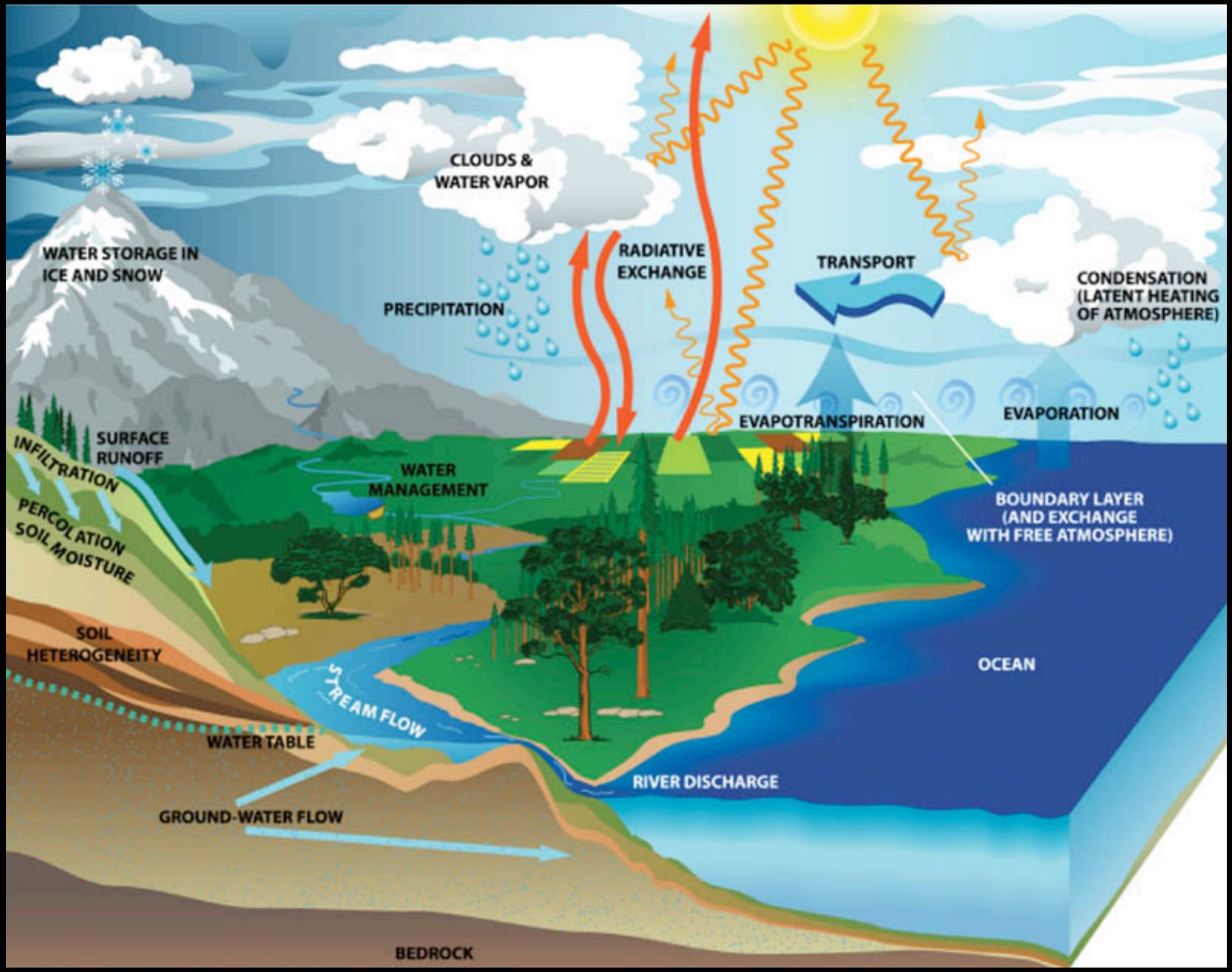
Conflictos

Cambio Climático

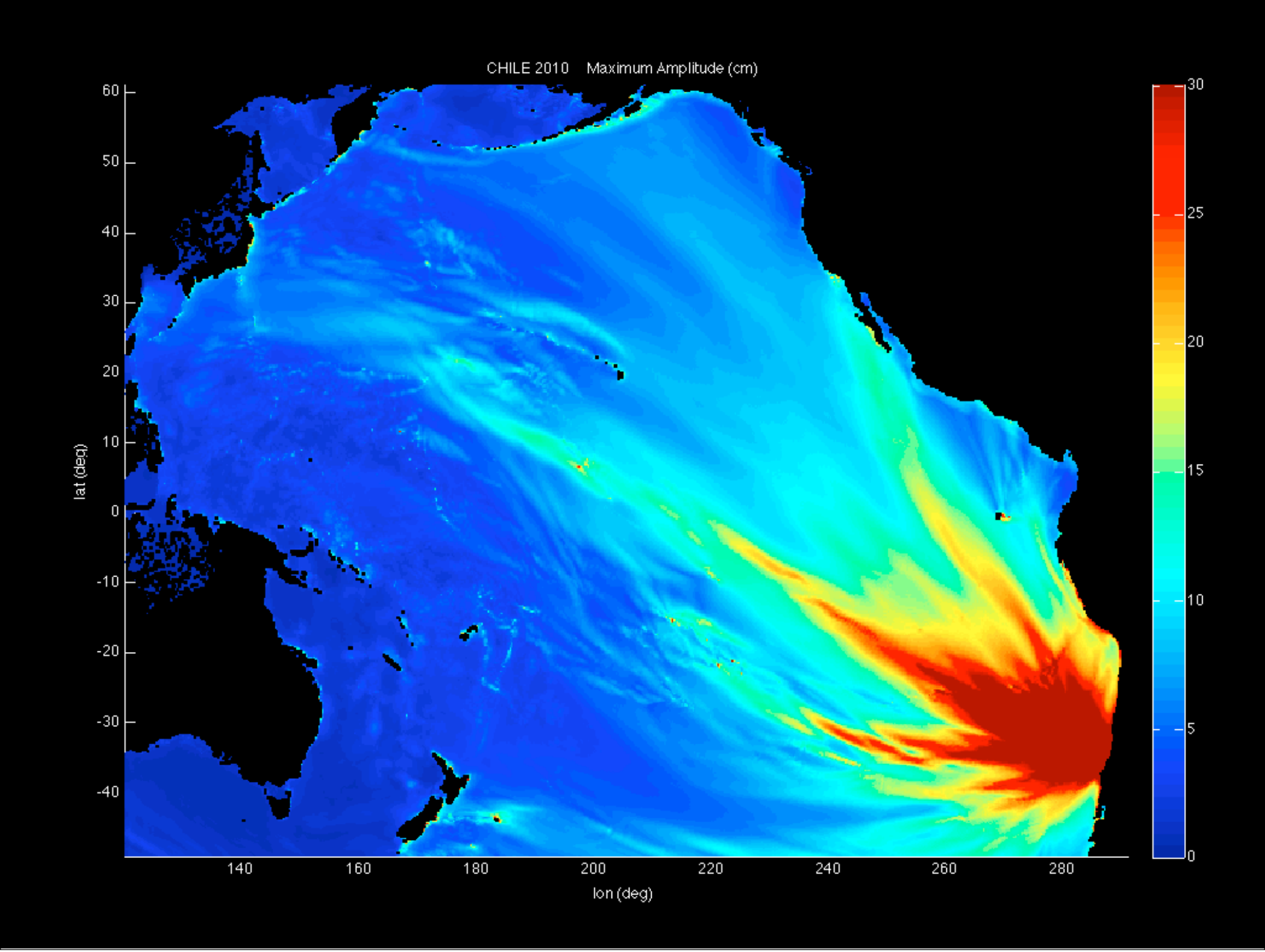
Lluvia Acida

Uso del Agua

Calidad de Agua


CLOUDS &
WATER VAPOR
WATER STORAGE IN
ICE AND SNOW
RADIATIVE
EXCHANGE
TRANSPORT
CONDENSATION
(LATENT HEATING
OF ATMOSPHERE)
PRECIPITATION
EVAPOTRANSPIRATION
EVAPORATION
SURFACE
RUNOFF
INFILTRATION
WATER
MANAGEMENT
PERCOLATION
SOIL MOISTURE
BOUNDARY LAYER
(AND EXCHANGE
WITH FREE ATMOSPHERE)
SOIL
HETEROGENEITY
OCEAN
STREAM FLOW
WATER TABLE
RIVER DISCHARGE
GROUND-WATER FLOW
BEDROCK

Mar de Aral

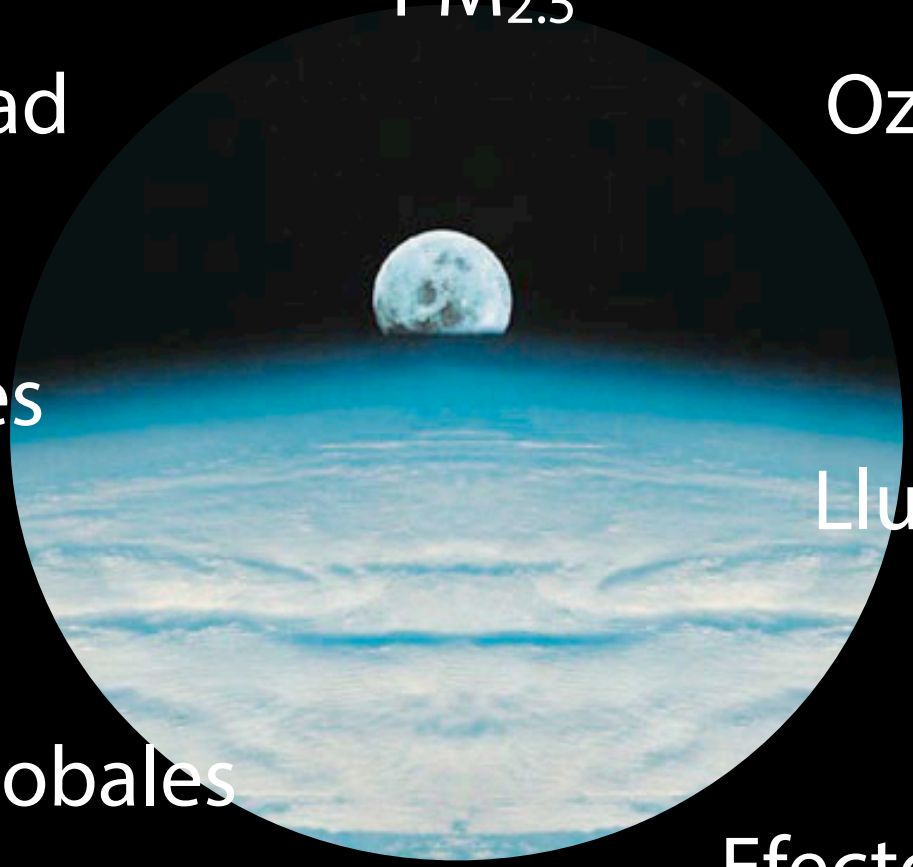

CHILE 2010 Maximum Amplitude (cm)
60
50
40
30
20
10
0
-10
-20
-30
-40
lat (deg)
140
160
180
200
220
240
260
280
lon (deg)
30
25
20
15
10
5
0

ATMO

$PM_{2.5}$

Visibilidad

Ozono



Eventos Naturales Extremos

Lluvia acida

Cambios globales

Efectos

$$VOCs + OH \rightarrow PM$$

$$\left.\begin{matrix} SOx \\ NOx \end{matrix}\right\} + NH_3 + OH \rightarrow \left\{\begin{matrix} (NH_4)_2SO_4 \\ NH_4NO_3 \end{matrix}\right.$$

$PM_{2.5}$

Visibilidad

$$Nitratos + Sulfatos + PM_{org}$$

Ozono

$$VOCs + NOx + OH + h\nu \rightarrow O_3$$

Lluvia acida

$$\left.\begin{matrix} SO_2 \\ NO_2 \end{matrix}\right\} + OH \rightarrow \left\{\begin{matrix} H_2SO_4 \\ HNO_3 \end{matrix}\right.$$

Cambios globales

Cambio Climatico y Ozono troposferico

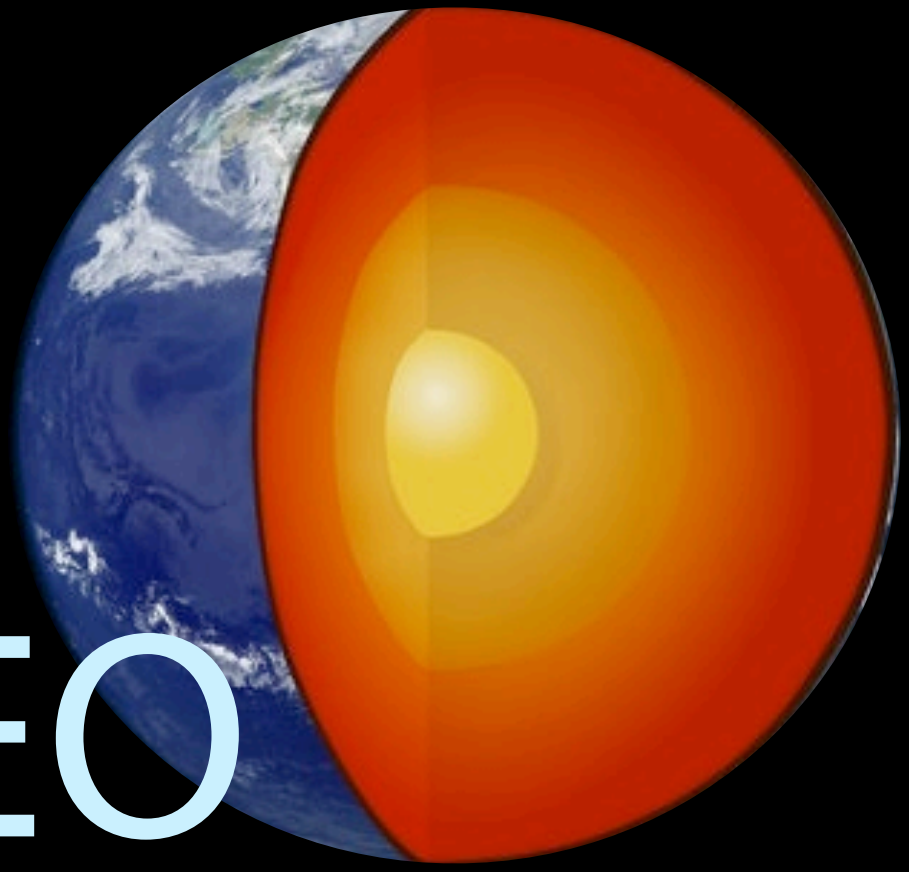
Efectos

Personas, animales, plantas y materiales

Santiago de Chile


Química - Física - Orografía - Meteorología - Fuentes y Sumideros
GEO

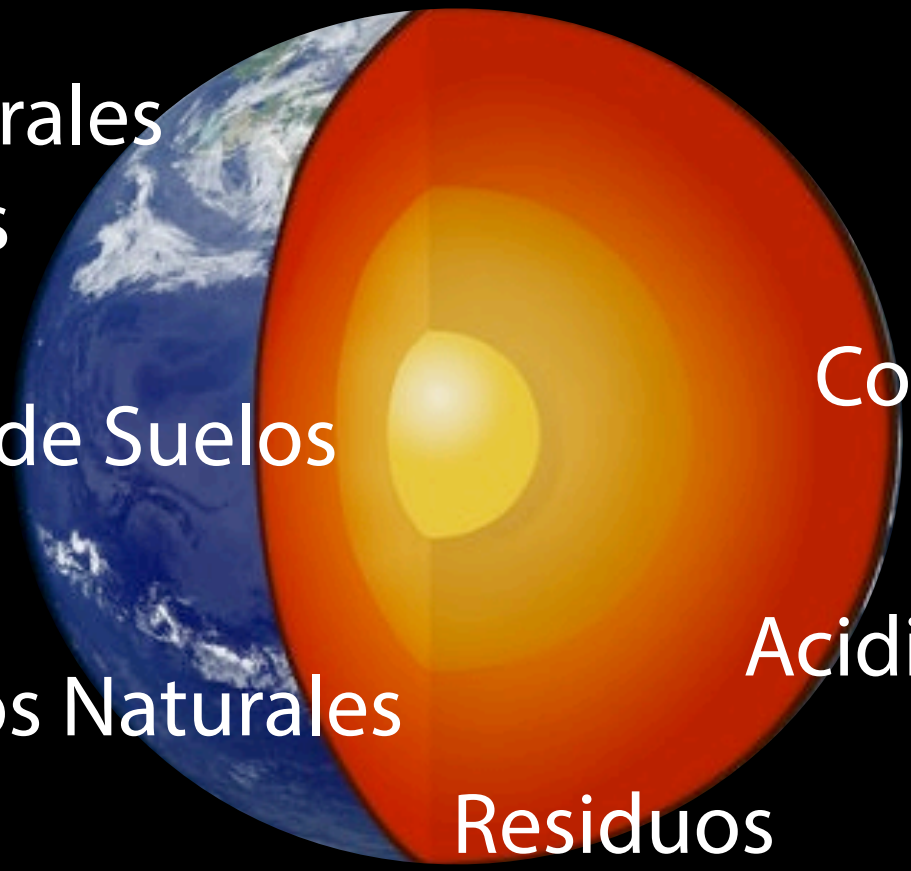
GEO



Eventos Naturales Extremos

Degradación de Suelos

Recursos Naturales



Residuos

Acidificacion

Conflictos

Chaitén de Chile


Química - Física - Orografía - Meteorología - Fuentes y Sumideros
BIO

BIO

Uso de suelos

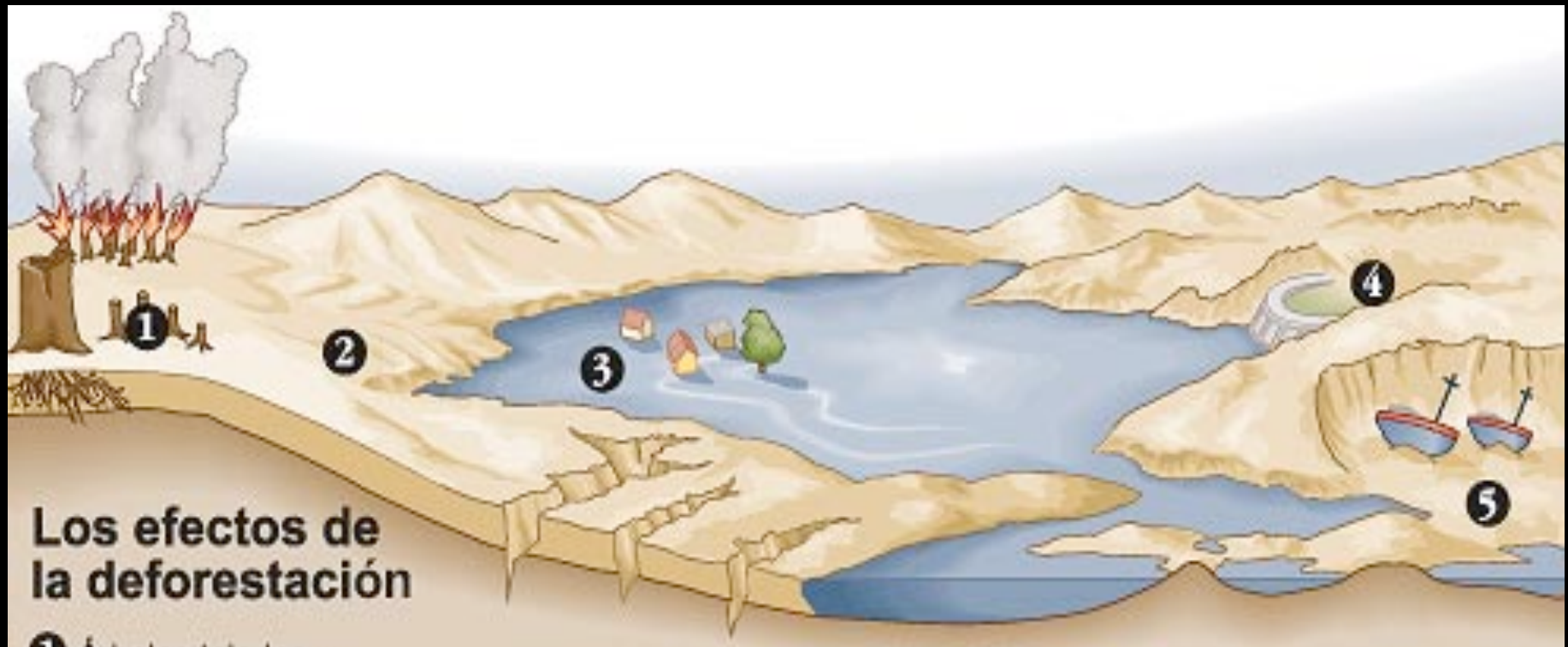
Biomasa

Biodiversidad

Cambios globales

Recursos Naturales

Pudu,Chile



Los efectos de la deforestación

1. Árboles talados.
2. Al carecer de la protección de los árboles, el suelo es arrastrado por las pendientes, lo que causa deslizamiento de tierras y pérdidas en las cosechas.
3. El suelo eleva los lechos de los ríos, ocasionando inundaciones.
4. La tierra rellena los pantanos, acortando la vida de las represas.
5. Los sedimentos arrastrados forman nuevas islas en los estuarios y reducen las pesquerías de las zonas costeras.


Química - Física - Orografía - Meteorología - Fuentes y Sumideros

ANTROPO

ANTROPO

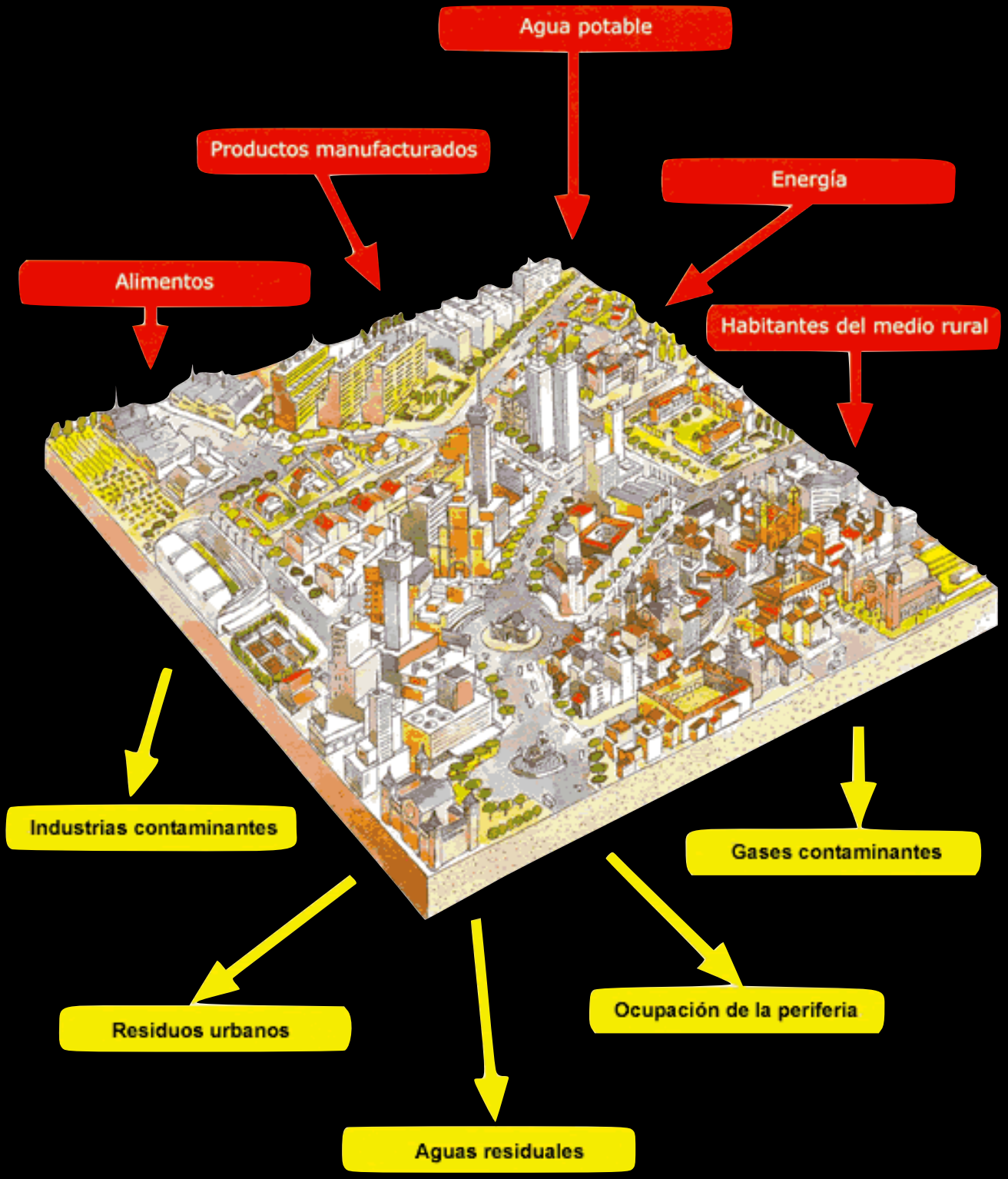
Sustentabilidad

Futuro Urbano

Recursos Naturales

Calidad de Vida


World Population (est.) 10,000 BC - 2,000 AD
billions of people
7
6
5
4
3
2
1
0
-10000
-8000
-6000
-4000
-2000
0
2000
year


Agua potable
Productos manufacturados
Energía
Alimentos
Habitantes del medio rural
Industrias contaminantes
Gases contaminantes
Residuos urbanos
Ocupación de la periferia
Aguas residuales

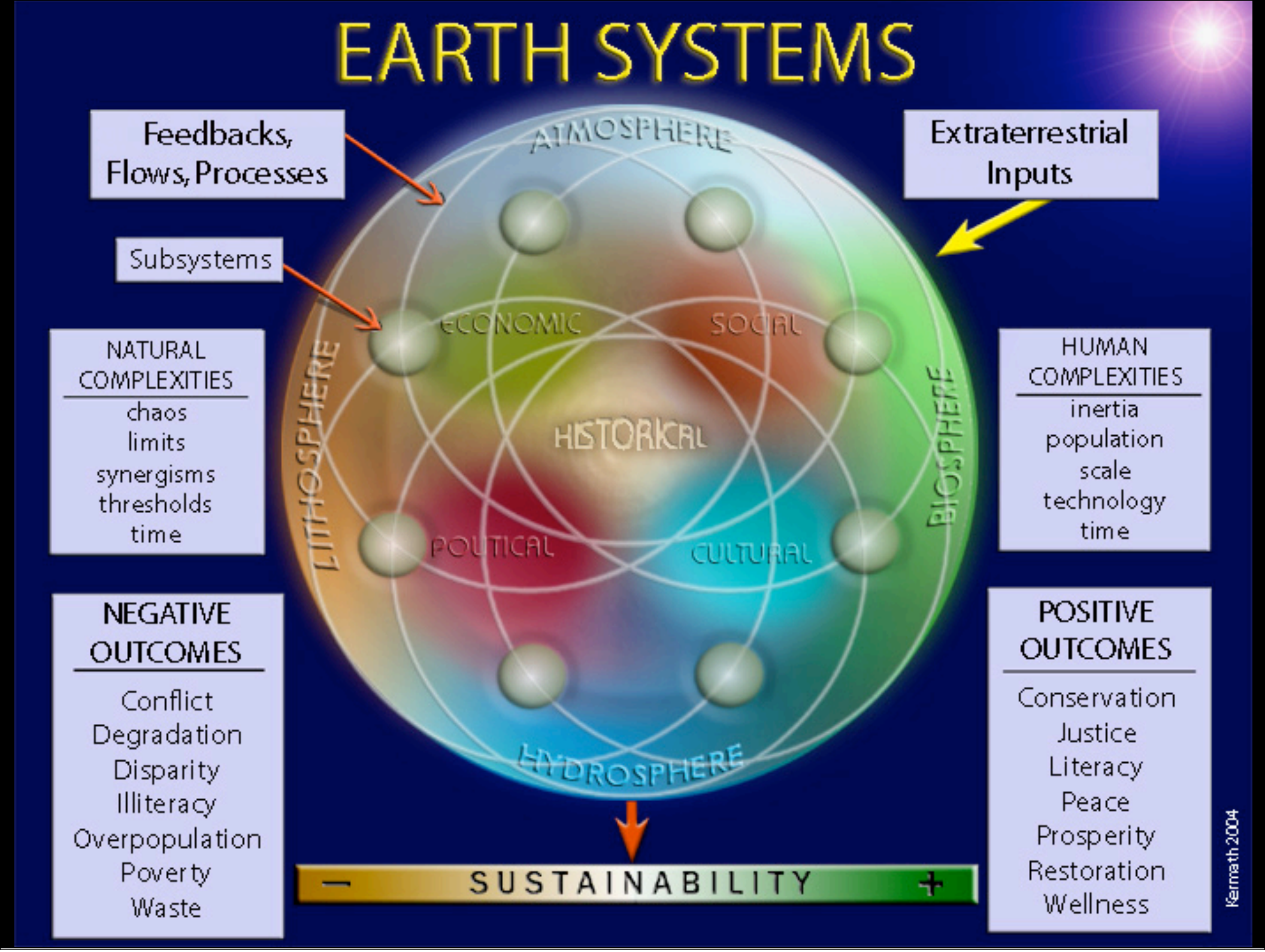

2015
2000
1950
NORTH AMERICA
SOUTH AMERICA
ASIA
AFRICA
AUSTRALIA
BURGEONING BIG CITIES
Country with at least one city of five million or more residents
Country without a city of five million or more residents
Population in millions
Cities with populations of five million or more

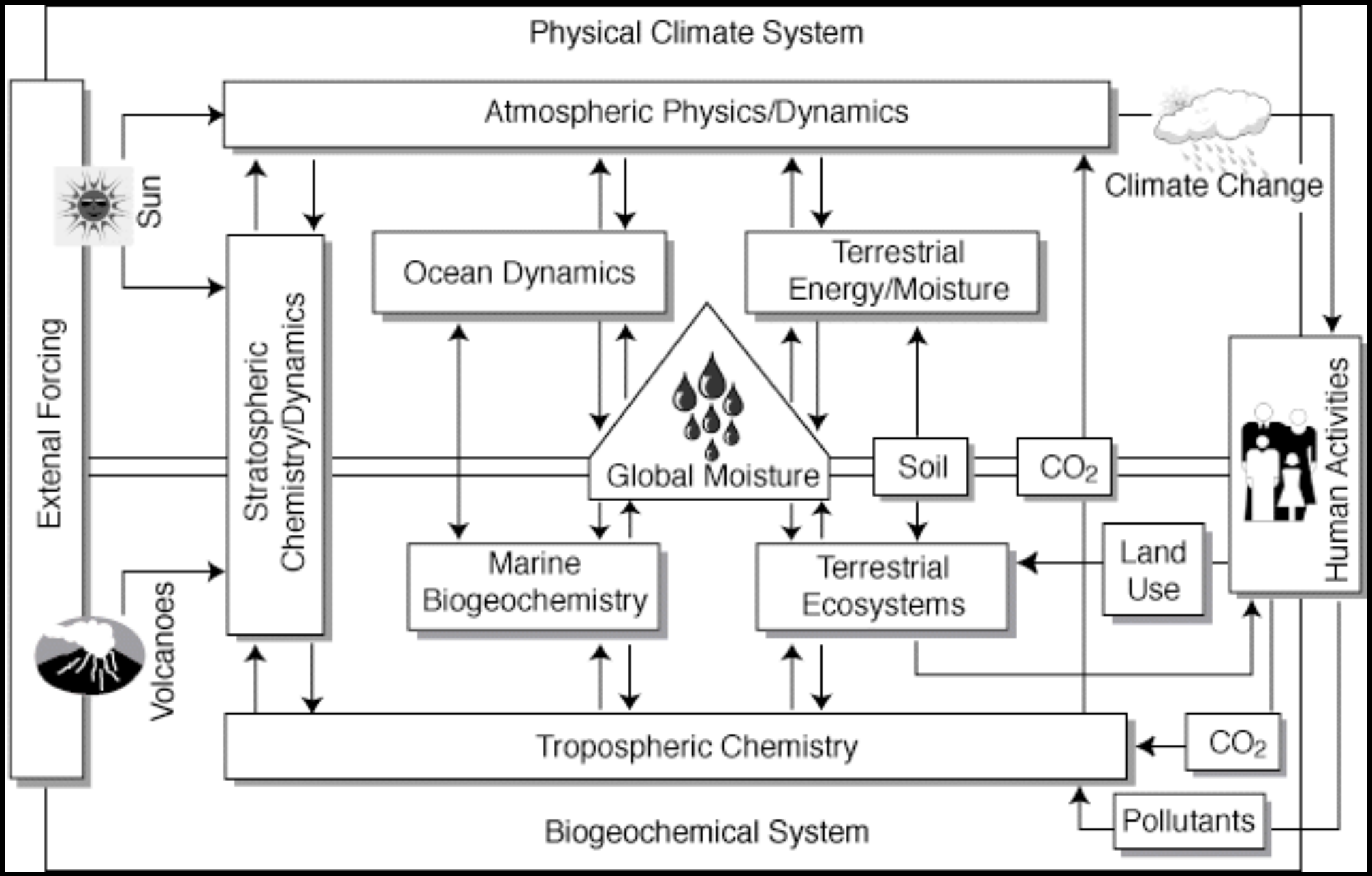
Un planeta

Un planeta

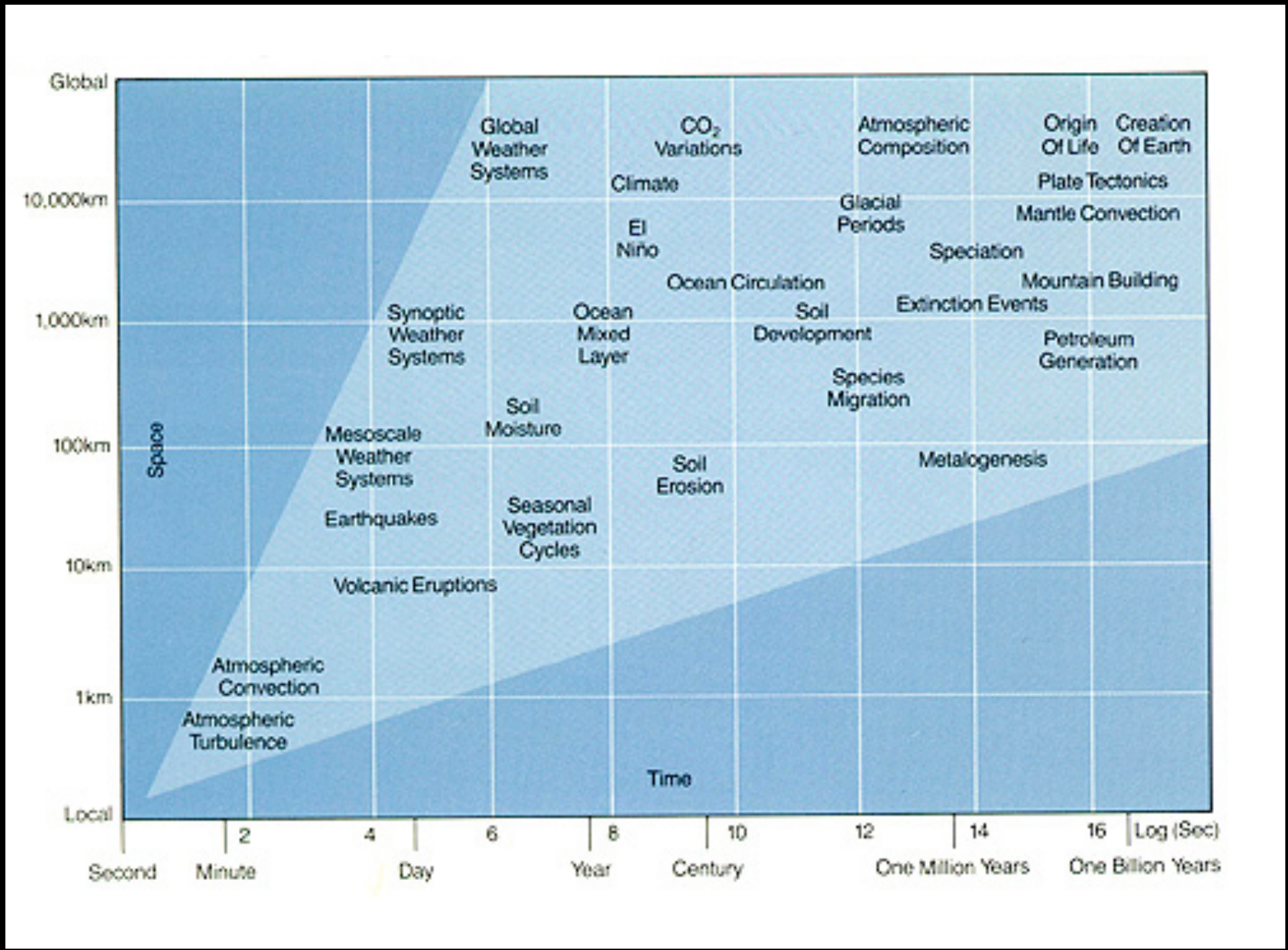
Interacción

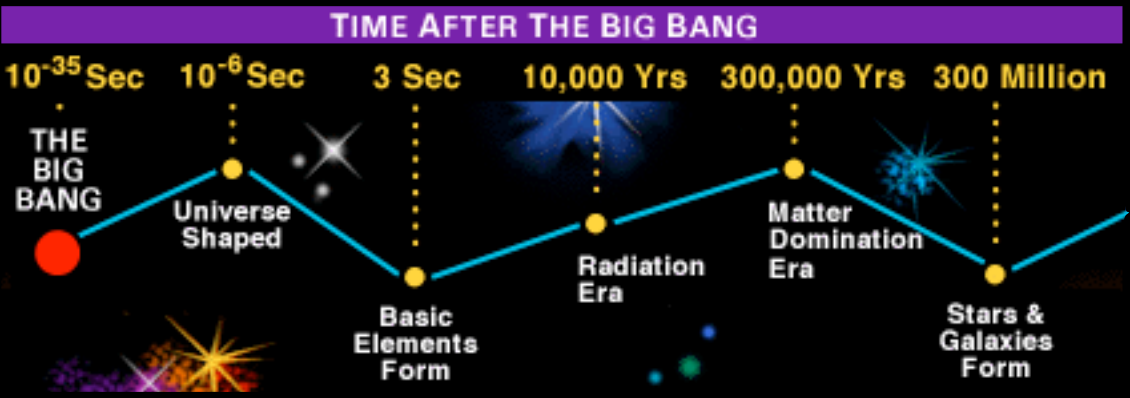
Una Tierra... varias esferas

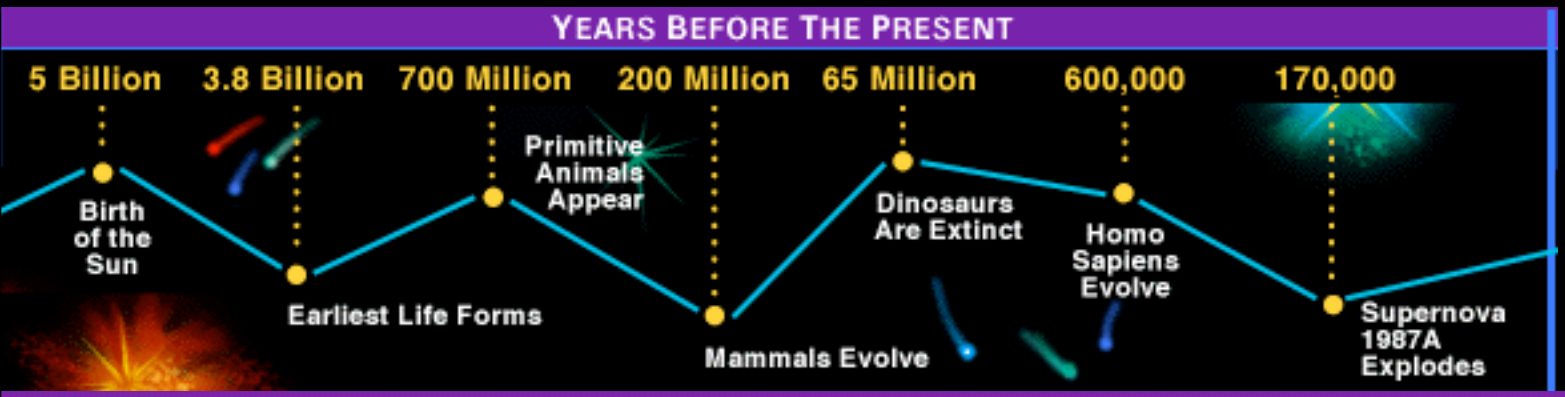

EARTH SYSTEMS
Feedbacks, Flows, Processes
Extraterrestrial Inputs
Subsystems
ATMOSPHERE
ECONOMIC
SOCIAL
HISTORICAL
POLITICAL
CULTURAL
LITHOSPHERE
BIOSPHERE
HYDROSPHERE
NATURAL COMPLEXITIES
chaos
limits
synergisms
thresholds
time
HUMAN COMPLEXITIES
inertia
population
scale
technology
time
NEGATIVE OUTCOMES
Conflict
Degradation
Disparity
Illiteracy
Overpopulation
Poverty
Waste
POSITIVE OUTCOMES
Conservation
Justice
Literacy
Peace
Prosperity
Restoration
Wellness
— SUSTAINABILITY +
Kermath 2004

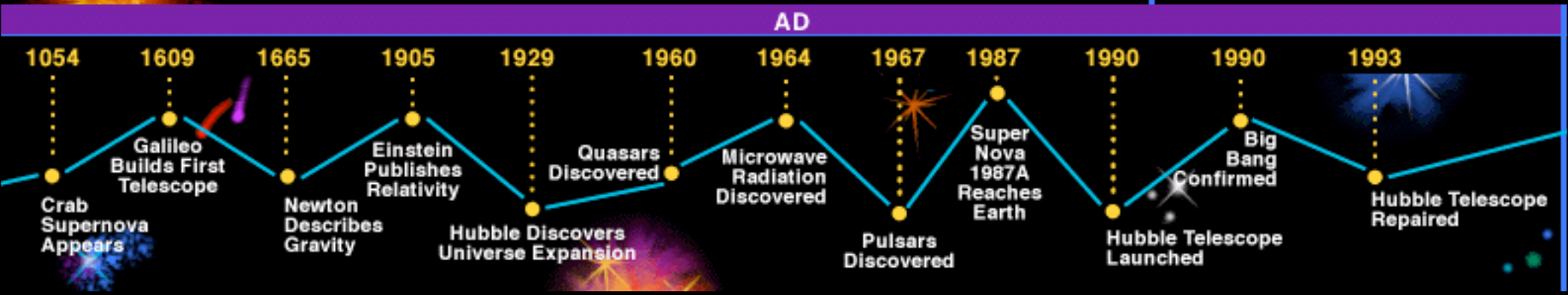

Physical Climate System
Atmospheric Physics/Dynamics
Climate Change
Sun
Extenal Forcing
Stratospheric Chemistry/Dynamics
Ocean Dynamics
Terrestrial Energy/Moisture
Global Moisture
Soil
CO_2
Human Activities
Land Use
Marine Biogeochemistry
Terrestrial Ecosystems
Volcanoes
Tropospheric Chemistry
CO_2
Pollutants
Biogeochemical System

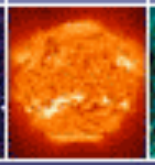
Espacio y Tiempo


Global
10,000km
1,000km
100km
10km
1km
Local
Space
Global Weather Systems
CO_2 Variations
Atmospheric Composition
Origin Of Life
Creation Of Earth
Climate
Plate Tectonics
Glacial Periods
Mantle Convection
El Niño
Speciation
Ocean Circulation
Mountain Building
Synoptic Weather Systems
Ocean Mixed Layer
Soil Development
Extinction Events
Petroleum Generation
Species Migration
Soil Moisture
Mesoscale Weather Systems
Soil Erosion
Metalogenesis
Earthquakes
Seasonal Vegetation Cycles
Volcanic Eruptions
Atmospheric Convection
Atmospheric Turbulence
Time
2
4
6
8
10
12
14
16
Log (Sec)
Second
Minute
Day
Year
Century
One Million Years
One Billion Years


TIME AFTER THE BIG BANG
10-35 Sec
10-6 Sec
3 Sec
10,000 Yrs
300,000 Yrs
300 Million
THE BIG BANG
Universe Shaped
Basic Elements Form
Radiation Era
Matter Domination Era
Stars & Galaxies Form


YEARS BEFORE THE PRESENT
5 Billion
3.8 Billion
700 Million
200 Million
65 Million
600,000
170,000
Birth of the Sun
Earliest Life Forms
Primitive Animals Appear
Mammals Evolve
Dinosaurs Are Extinct
Homo Sapiens Evolve
Supernova 1987A Explodes

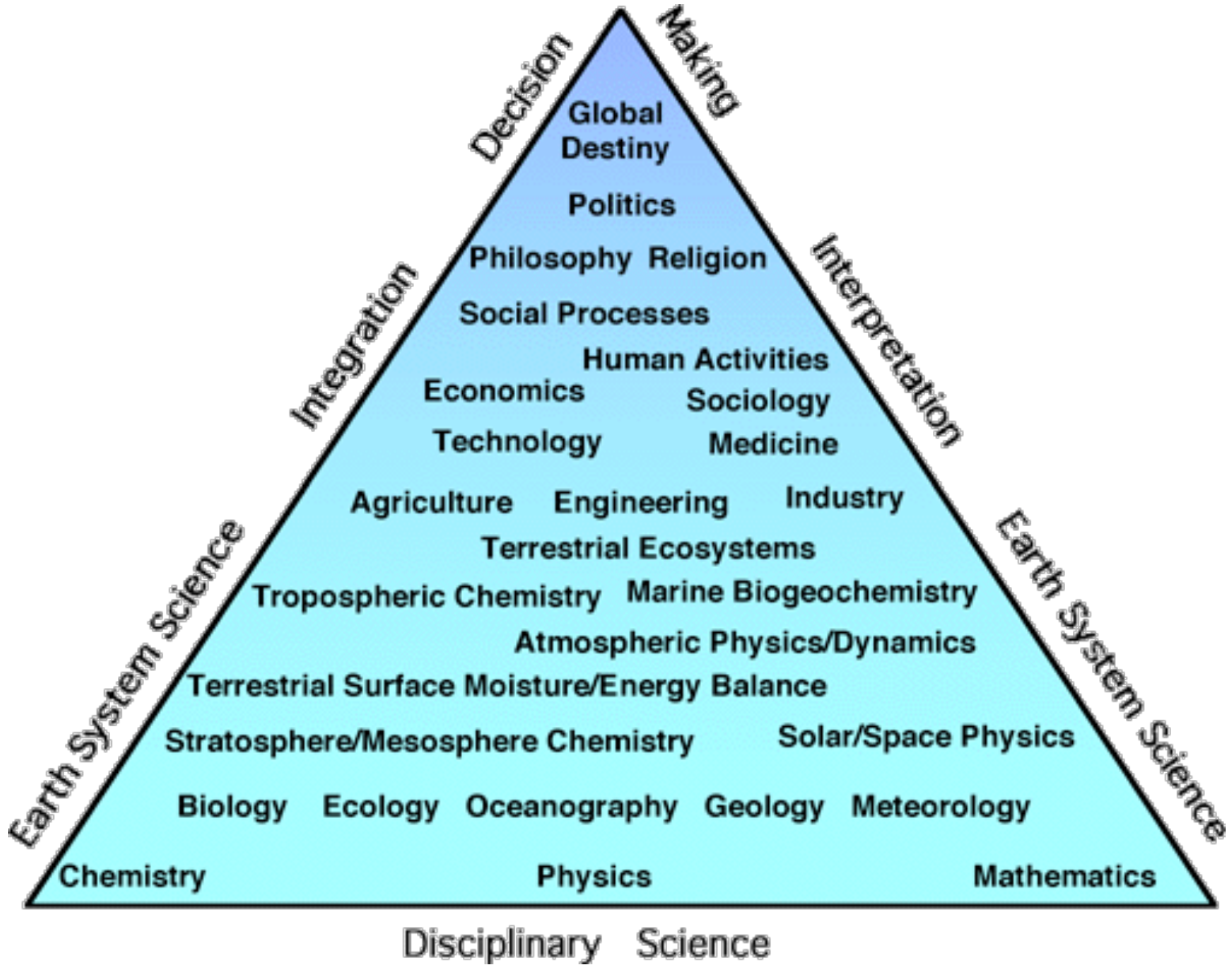

AD
1054
1609
1665
1905
1929
1960
1964
1967
1987
1990
1990
1993
Crab Supernova Appears
Galileo Builds First Telescope
Newton Describes Gravity
Einstein Publishes Relativity
Hubble Discovers Universe Expansion
Quasars Discovered
Microwave Radiation Discovered
Pulsars Discovered
Super Nova 1987A Reaches Earth
Hubble Telescope Launched
Big Bang Confirmed
Hubble Telescope Repaired

January	February	March	April	May	June	July	August	September	October	November
										
New Year's Day: The Big Bang		Mily Way forms					Sun and planets form	Oldest known life.(single celled).		First multi-celluar organisms

December

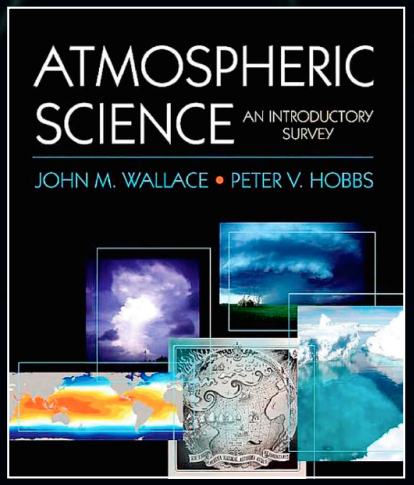
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15 Cambrian Explosion (burst of new life forms)	16	17 Emergence of first vertebrates	18 Early land plants	19	20 First four-limbed animals	21 Variety of insects begin to flourish
22	23	24 First dinosaurs appear	25 First mammalian ancestors appear	26	27 First known birds	28
29 Dinosaurs wiped out by asteroid or comet	30	31 10:15am Apes appear 9:24pm First human ancestors to walk upright 10:48pm Homo erectus appears 11:54pm Anatomically modern humans appear 11:59:45pm Invention of writing 11:59:50pm Pyramids built in Egypt 1 second before midnight: Voyage of Christopher Columbus				

Disciplinas


Decision Making
Integration
Interpretation
Earth System Science
Earth System Science
Global Destiny
Politics
Philosophy Religion
Social Processes
Human Activities
Economics
Sociology
Technology
Medicine
Agriculture
Engineering
Industry
Terrestrial Ecosystems
Tropospheric Chemistry
Marine Biogeochemistry
Atmospheric Physics/Dynamics
Terrestrial Surface Moisture/Energy Balance
Stratosphere/Mesosphere Chemistry
Solar/Space Physics
Biology
Ecology
Oceanography
Geology
Meteorology
Chemistry
Physics
Mathematics
Disciplinary Science

SISTEMA TIERRA

Lectura recomendada



Capitulo 2.

The Earth System