
# *Geoinformatics*

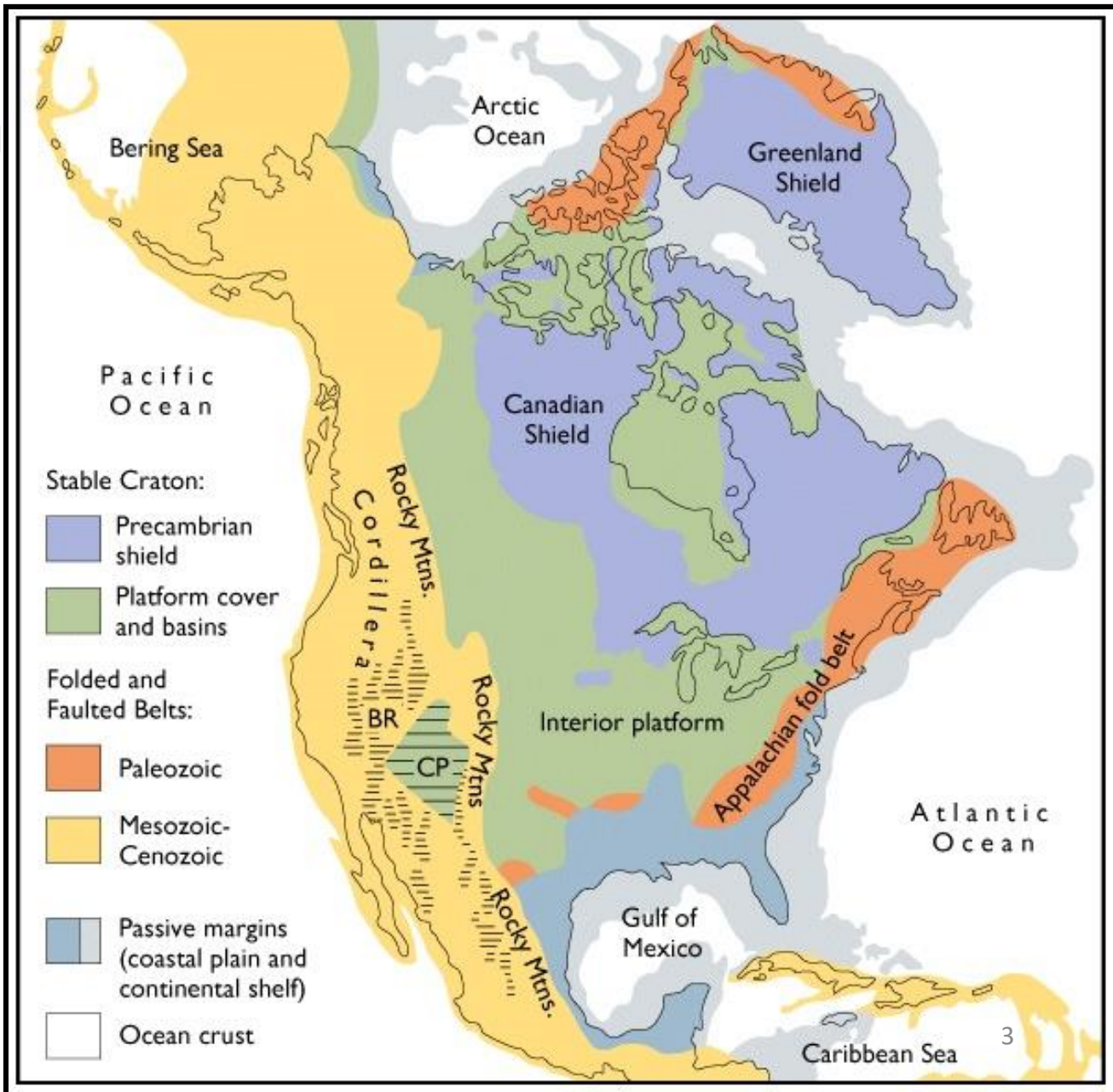
Frans Richard Kodong

# Road Map

- Introduction
- Earth Resources Exploration and Exploitation/2
- Seismic Methods/2
- Geographic Information System/2
- GPS Globall Posisitioning System/2
- Remote Sensing/2
- Mining Application/2
- Petroleum Applications/2

# The EARTHSCOPE Scientific Vision

**To understand the structure (evolution) and deformation of the North American continent in four dimensions (x,y,z,t)**



EarthScope

Geoinformatics
A LEARNING OPPORTUNITY FOR EARTH SCIENCE RESEARCH

# *Cyberinfrastructure for the Geosciences*
# *Why do we need it?*

Future research opportunities in the geosciences will be significantly affected both by the availability and utilization of Information Technology. Understanding the rock record that preserves ~4.5 billion years of history, Earth structure, and the processes at work is the key to answering scientific questions associated with studies of biodiversity, climate change, planetary processes, natural resources and hazards, and the 4-D architecture and evolution of continents. It has become evident that we can only answer these complex questions through the **integration** of all the data we have at hand and that this will require the **application of modern IT tools**.

# What is Geoinformatics?

**Geoinformatics** is a science which develops and uses information science infrastructure to address the problems of geosciences and related branches of engineering.

The three main tasks of geoinformatics are:

- development and management of databases of geodata
- analysis and modeling of geodata
- development and integration of computer tools and software for the first two tasks.

Geoinformatics is related to geocomputation and to the development and use of geographic information systems or Spatial Decision Support Systems

**Applications**·An object-relational database (ORD) or object-relational database management system (ORDBMS) Object-relational mapping (or O/RM) Geostatistics

# *Geoinformatics - Some key elements*

- A strong partnership between domain experts (geoscientists) and computer scientists
- A shared goal of doing better (and more) science
- A desire to create products that the scientific community actually needs and will use (not what you think they need or should want)
- Always give credit to original sources of data, software, etc.
- A desire to preserve data, make it easily used and discovered, and create living databases
- A desire to create user friendly and platform independent software
- A desire to facilitate data integration
- A desire to create cyberinfrastructure breakthroughs (e.g., visualization, 3-D model building editing, etc.)
- A desire to democratize the use of cutting edge technology in geoscience research and education

# Geoinformatics.info

"an information portal for the geoinformatics community..."

Resources | Community | Jobs | About

**Welcome to our geoinformatics portal!** **Date:** 15.8.2007

**Our goal** is to serve as a communication resource for members of the geoinformatics community. We solicit news, announcements of events, links, and other information to share with the geoinformatics community. *Check back for weekly updates!*

**New! Join our network, share, and discover at** Delicious.com

## Announcements

**The Geological Society of America is soliciting abstracts** for a topical s
(#121) on "Growing the Cyberinfrastructure for the Geosciences: Contribu
from State and Federal Agencies," for the Annual Meeting in Denver,Oct 2
2007. Abstracts can be submitted starting April 1 through July 10 at
. (Call for Papers: Announcement 1 | Announcement 2 )

## Upcoming Events

**The ACM Conference on Information and Knowledge Managen
2007 (CIKM)** | Lisboa, Portugal. Nov. 6-9, 2007 Read More | Call
Papers

| | |
|---|---|
| Aug. 13-17, 2007 | **Cyberinfrastructure Summer Institute for Geoscienti** San Deigo, CA. |
| Nov. 6-9, 2007 | **The ACM Conference on Information and Knowledge Management 2007 (CIKM)** \| Lisboa, Portugal. Read Mo Call for Papers |
| Nov. 7-9, 2007 | **15th ACM International Symposium on Advances in Geographic Information Systems (ACM GIS) 2007** \| Seattle, WA. Read More \| Call for Papers |
| Feb. 24-28, 2008 | **ESRI Petroleum User Group 2008 Meeting** \| Houston T |

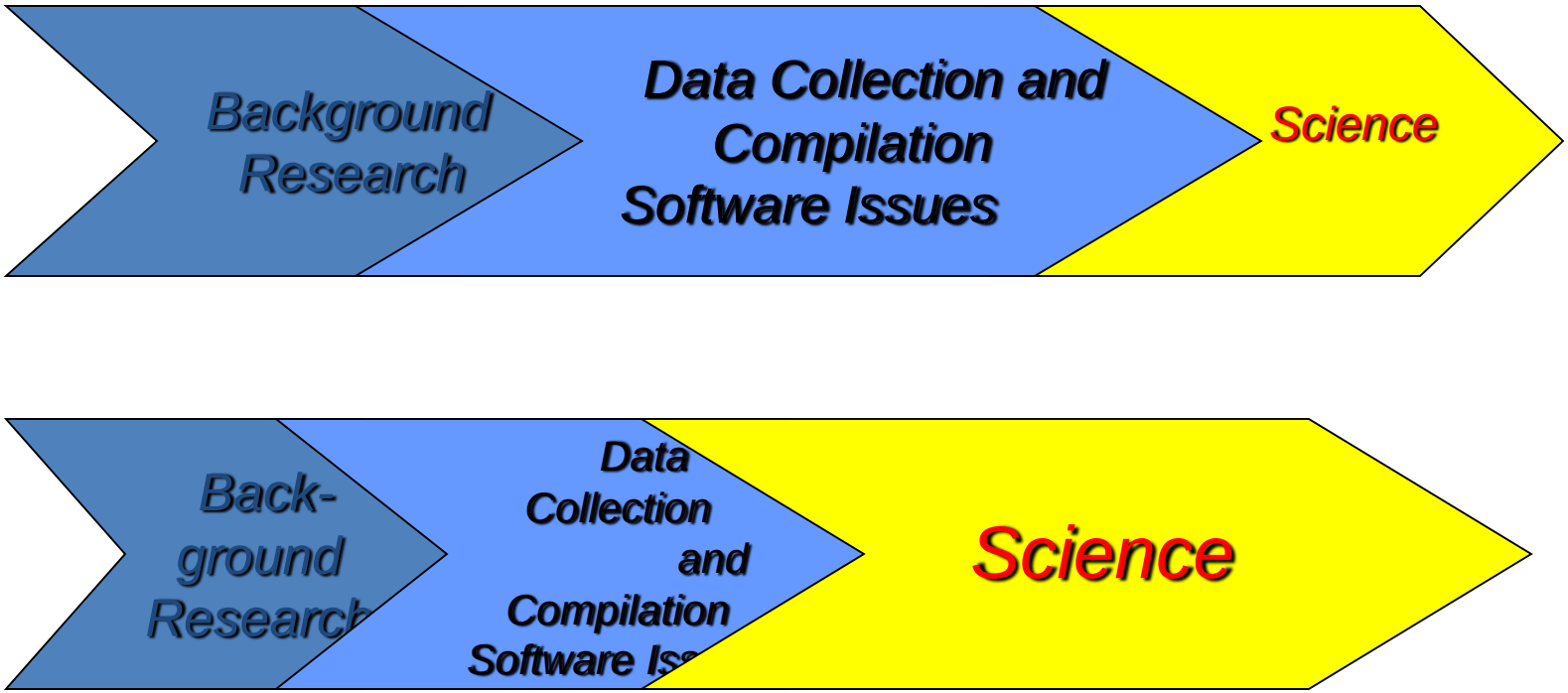
## News

- **U.S. Earth Information Strategy?** These Authors of the 'Decadal Survey' Seek to Form National Earth-Information Intitiative. Read More
- **Earth Portal Launched** by National Council for Science and the Environment The National Council for Science and the Environment (NCSE) has launched a new web-based resource! Check out the portal at EarthPortal.org
- **The EarthChem Deep Lithosphere Dataset** is now available! See it Now >
- **NASA and Google** bring space exploration to the internet. Read More
- **Digital Science Library** Developers Gather at AAAS to Ponder the Future. Read More
- **Digital Mapping Techniques '05 Proceedings** printed version is now available. Contact Dave Soller at the USGS (drsoller@usgs.gov). The web version of the Proceedings, as well as those for the previous eight meetings, is available Read More

## Project Showcase

**The Geotechnical, Rock & Water (GROW) Digital Library**

# A Scientific Effort Vector




Science - Analysis, Modeling, Interpretation, Discovery

Geoinformatics
A DEFINING OPPORTUNITY FOR EARTH SCIENCE RESEARCH

# Some Definitions about Data

**Data Set**: A relatively raw compilation of data (standards, formats, completeness may be questionable)

**Data Base**: A mature data compilation that has been "cleaned", standardized with input from the scientific community, formatted for use by others (independent of proprietary software, e.g., ORACLE)

**Data System**: A linked and organized set of data bases including public domain software (not platform dependent), tutorials, workflows, and procedures to analyze the data

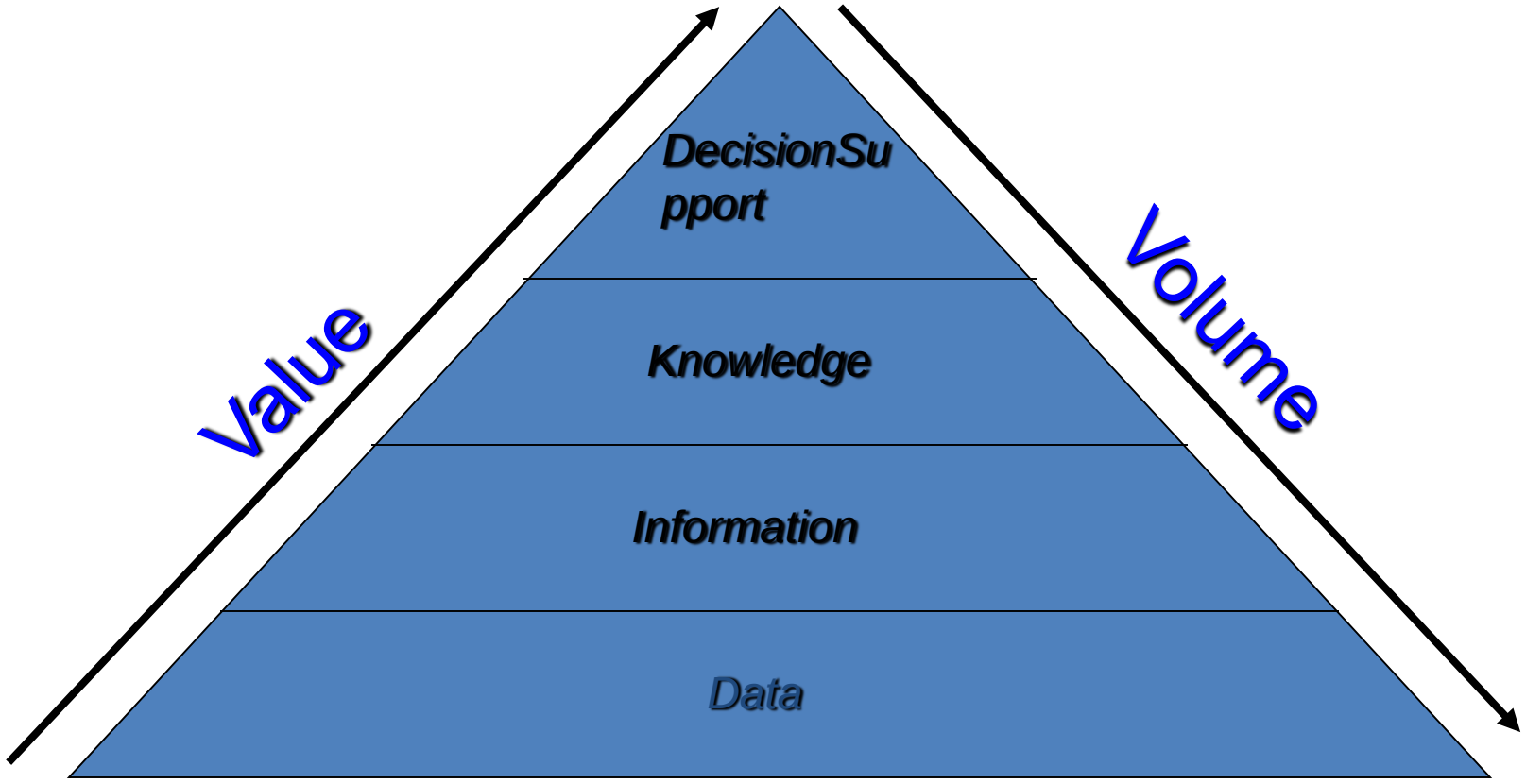
# *Data systems needed*

| | Property | X | Y | Z (elevation) | Z (depth) | T |
|---|---|---|---|---|---|---|
| **Seismicity** | Earthquake location | ✔ | ✔ | | ✔ | ✔ |
| **Gravity** | Density | ✔ | ✔ | ✔ | inferred | ✔ |
| **Aeromagnetic** | Magnetic Susceptibility | ✔ | ✔ | ✔ | inferred | |
| **Seismic Reflection** | Arrival times | ✔ | ✔ | ✔ | inferred | ✔ |
| **Seismic Refraction** | Arrival times | ✔ | ✔ | ✔ | inferred | |
| **Electromagnetic** | Electrical conductivity | ✔ | ✔ | ✔ | inferred | ✔ |
| **Heat Flow** | Thermal conductivity | ✔ | ✔ | ✔ | | |
| **Drill Hole Data** | Depth, Lithology, Physical properties | ✔ | ✔ | ✔ | ✔ | |

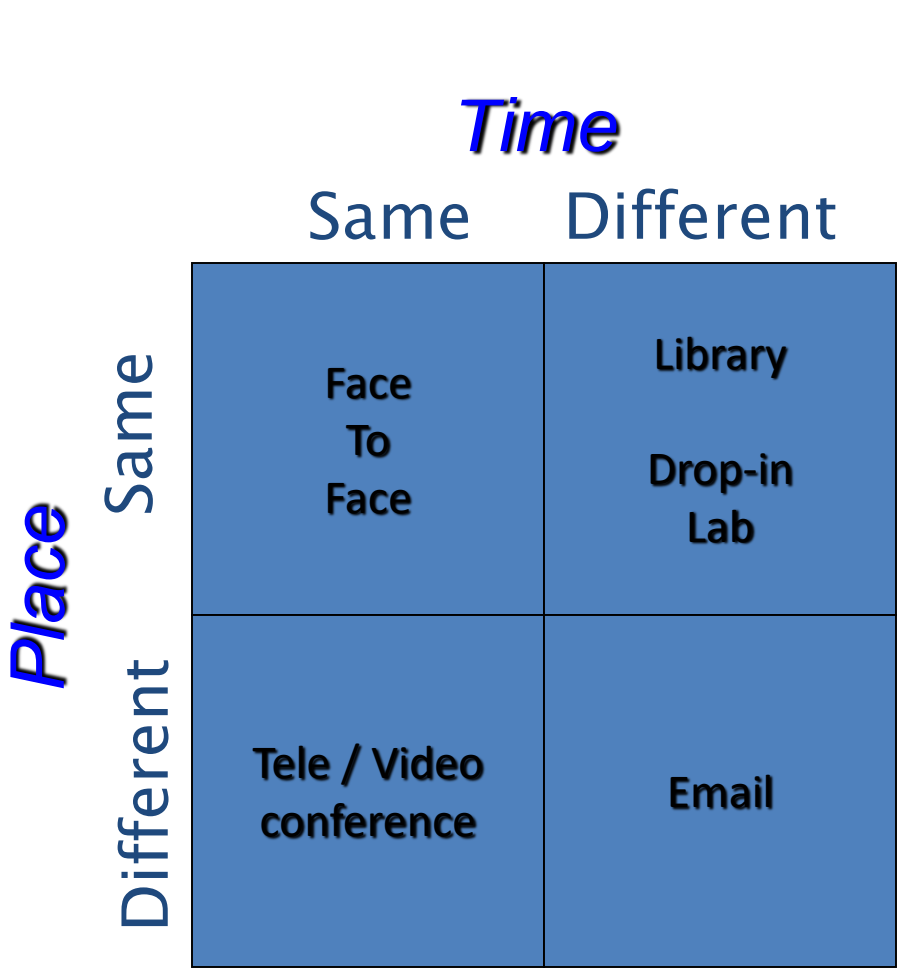
# *Data systems needed (continued)*

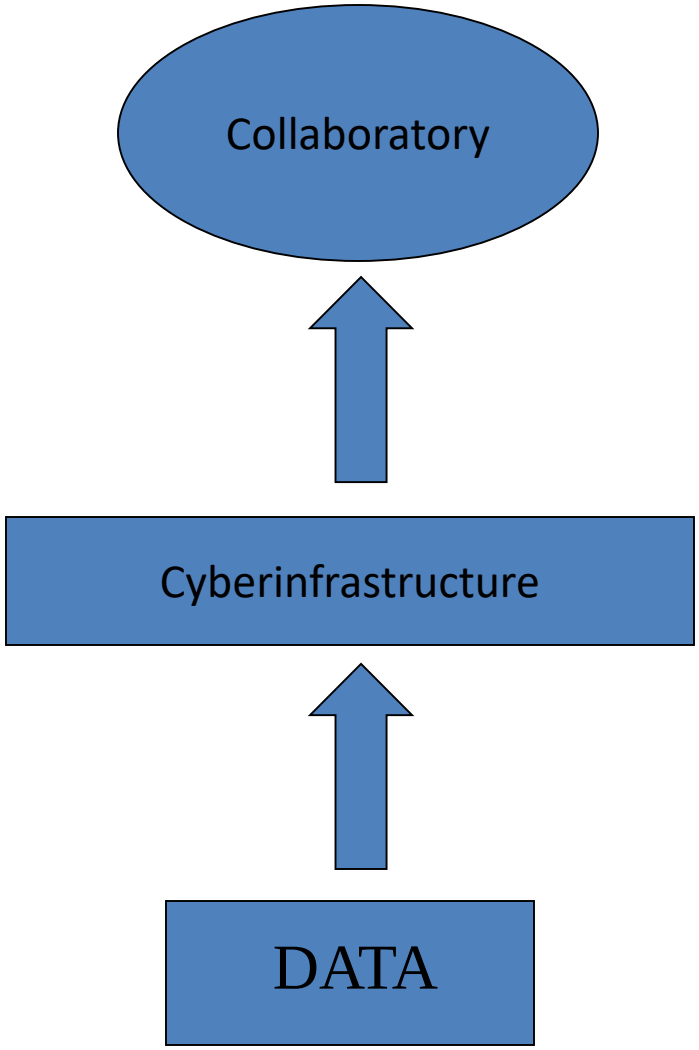
| | Property | X | Y | Z (elevation) | Z (depth) | T |
|---|---|---|---|---|---|---|
| **Geologic Maps** | Distribution of units | ✔ | ✔ | ✔ | | |
| **Faults (mapping and imaging)** | Geometry | ✔ | ✔ | ✔ | inferred | |
| **Geochemistry/Petrology** | Composition | ✔ | ✔ | | inferred | |
| **Geochronology** | Age | ✔ | ✔ | | | ✔ |
| **Global Positioning System** | Position | ✔ | ✔ | ✔ | | ✔ |
| **Digital Elevation Model** | Elevation grid | ✔ | ✔ | ✔ | | |
| **Remote Sensing (SAR)** | Image of reflectivity | ✔ | ✔ | ✔ | | ✔ |
| **Remote Sensing (multispectral)** | Image of reflectivity | ✔ | ✔ | | | ✔ |
| **Paleontology** | Ancient life | ✔ | ✔ | | | ✔ |
| **Sedimentology** | Ancient environments | ✔ | ✔ | inferred | inferred | ✔ |

# Data is only the beginning



# *Learning Environments*




**The independent scientist is not a thing of the past, but more and more big advances are made through collaboration.**

# INFORMATIKA ??


## EKSPLORASI ??

## EKSPLOITASI ??

# *E N E R G I !!!!!*

HEMAT, SILATURAHMI ???

TANTANGAN !!!

EKSPLORASI → PENCARIAN

EKSPLOITASI → PENGAMBILAN

} RESIKO

## MANAGEMEN RESIKO

# ISU EKSPLORASI

# KESIAPAN TEKNOLOGI

# KESIAPAN TEKNOLOGI UPGRADING

**TEKNOLOGI UPGRADING DI INDONESIA**

| NO | TEKNOLOGI | PENYEDIA TEKNOLOGI | PERUSAHAAN KERJASAMA DI INDONESIA | TAHAP TEKNOLOGI | | | | | LOKASI | KETERANGAN | SUMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | LAB | BENCH | PILOT | DEMO | COMM | | | |
| 1 | BCB (Binderless Coal Briquetting) | White Energy Company | Perusahaan Tambang | | | | DEMO | | Kaltim | • Bermasalah pada filter sehingga apa produksi hanya mencapai 60% kapasitas.<br>• Plant ditutup 4, Juli 2011:, 1 Juli 2011 (White Energy Coal , 2011) | • TEKMIRA<br>• Kaltim Supe Coal Press Release<br>• White Energy Coal Website |
| 2 | GeoCoal | PT. Total Synergy International | PLTU | | | | DEMO | | Banten | Sejauh ini implementasinya hanya untuk Mine Mouth Power Plant | • PT. Total Synergy International (TSI)<br>• Divisi Pengendalian Batubara PT. PLN |
| 3 | UBC (Upgraded Brown Coal) | PT. Upgrading Brown Coal Indonesia | Perusahaan Tambang | | | | DEMO | | Kalsel | Demo plant sudah dibongkar karena menghasilkan produk tidak sesuai harapan (masalah briket dan AFT) | • TEKMIRA<br>• PT. Arutmin<br>• PT. UBCI |
| 4 | CUT | PT. Advance Technology International | N/A | | | PILOT | | | Kalsel | Pilot plant di Rantau, Tapin | PT. Pamapersada Nusantara |
| 5 | CUB (Coal Upgrading Briquette) | PT .Teknologi Energi Nusantara | N/A | | BENCH | | | | Indonesia | Alat masih terpisah secara individual | PT. Advance Technology International (ATI) |

# STATUS SUMBER DAYA ENERGI INDONESIA

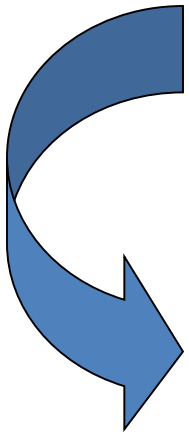
| Jenis Energi | Sumberdaya | Cadangan | Produksi | Life Time |
|---|---|---|---|---|
| Minyak Bumi | 86,9 Milyar Barel | 9 Milyar Barel | 500 Juta Barel | 18 Tahun |
| Gas Bumi | 384,7 TSCF | 188 TSCF | 3,0 TSCF | 62 Tahun |
| CBM | 453 TSCF | NA | NA | NA |
| Batubara | 105,2 Milyar ton | 21,1 Miltar ton | 300 Juta Ton | 93 Tahun |
| Shale Gas | 574,07 TSCF | NA | NA | NA |
| Serpih Bitumen | 11.427 Mton | NA | NA | NA |
| Panasbumi | 13.171 MWe | 15.867 MWe | 1189 MW | Sustainable |

***Badan Geologi, 2011***

# KONSEP EKSPLORASI

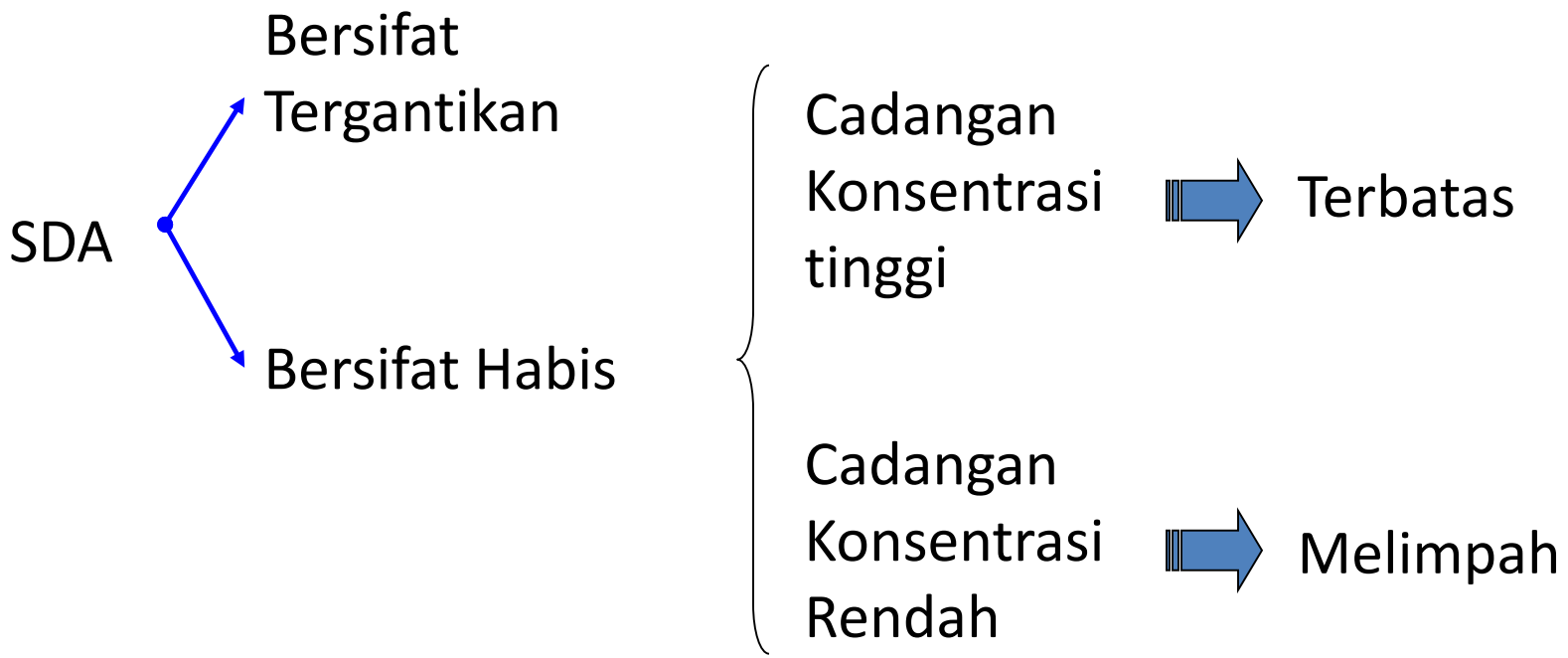
# PENDAHULUAN

Eksplorasi secara umum merupakan kegiatan untuk mencari keberadaan sumberdaya alam yang ditinjau dari segi genesa, bentuk geometri, parameter-parameter eksplorasi / eksploitasi, maupun berbagai parameter fisis lainnya yang berkaitan dengan penanggulangan masasalah lingkungan.



KE EKONOMIAN SDA :

- Tatanan geologi
- Cadangan
- Faktor kesulitan eksplorasi, eksploitasi, ekstraksi
- Keadaan sosial politik




**JADI :**

Keberhasilan suatu eksplorasi sangat tergantung pada konsep, strategi, serta metoda yang digunakan.

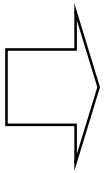
# EKSPLORATION MANAGEMENT

**DATA**

GEOLOGICAL, GEOPHYSICAL, ENGINEERING, FINANCIAL

**TECHNOLOGY**

SEISMIC, GEOLOGIC, GEOSTATISTICS, ENGINEERING, DRILLING & COMPLETIONS, ENC'D OIL REC., ENVIRONMENT, COMPUTER



**INTEGRATION**

**TOOLS**

SEISMIC INTERPT'N, TOMOGRAPHY, DATA AQUISITION, LOGGING-CORING, COMPLITIONS, GEOLOGICAL MODELING, PRESURE TRANSIENT, FRACTURING, RES'R. SIMULATION, ENHC'D. OIL REC., COMPUTER SOFTWARE, COMPOUTER HARDWARE

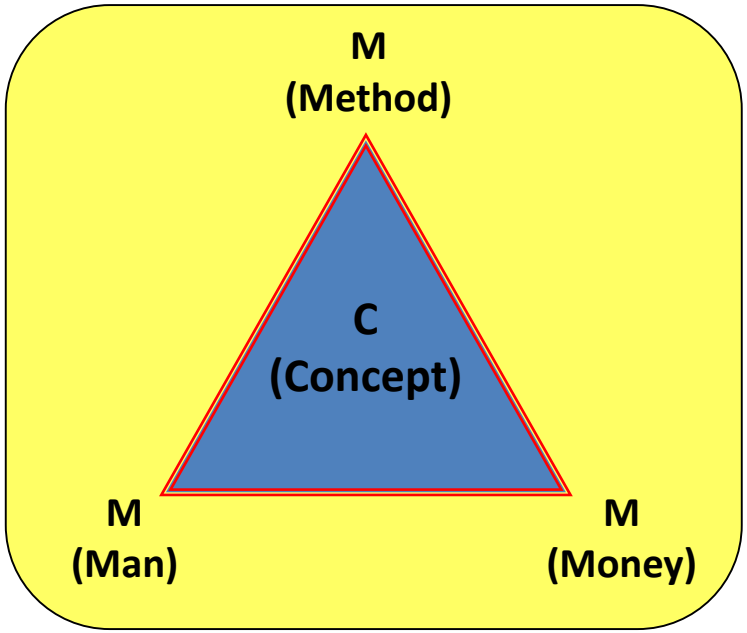
**PEOPLE**

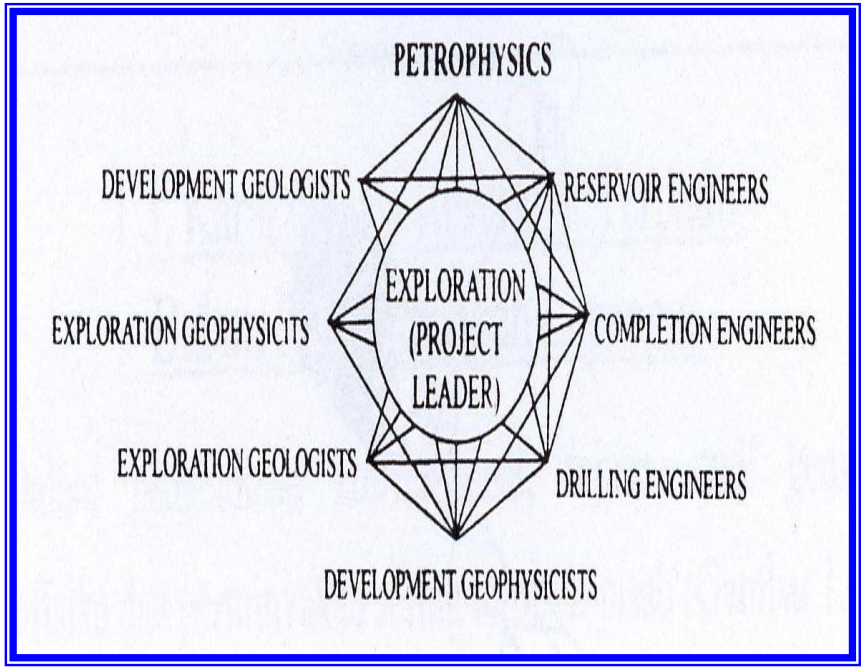
MANAGEMENT, GEOSCIENTISTS, ENGINEERING, LAND / LEGAL, FIELD, FINANCIAL

# Konsep dan Strategi Eksplorasi

*Hubungan kerja yang saling terkait.*

## Eksplorasi sinergis



## A. KONSEP / PEMIKIRAN

Pemikiran mengenai kemungkinan keberadaan hidrokarbon pada suatu daerah dengan kondisi geologi tertentu.

Secara rinci akan menjelaskan :

1. Menentukan tatanan, gejala, dan indikasi geologi yang memungkinkan terdapatnya cebakan Hidrokarbon.
2. Merencanakan metoda eksplorasi yang akan digunakan sesuai dengan kondisi geologi yang ada.
3. Memprediksi resiko yang mungkin terjadi.

B. SUMBER DAYA MANUSIA

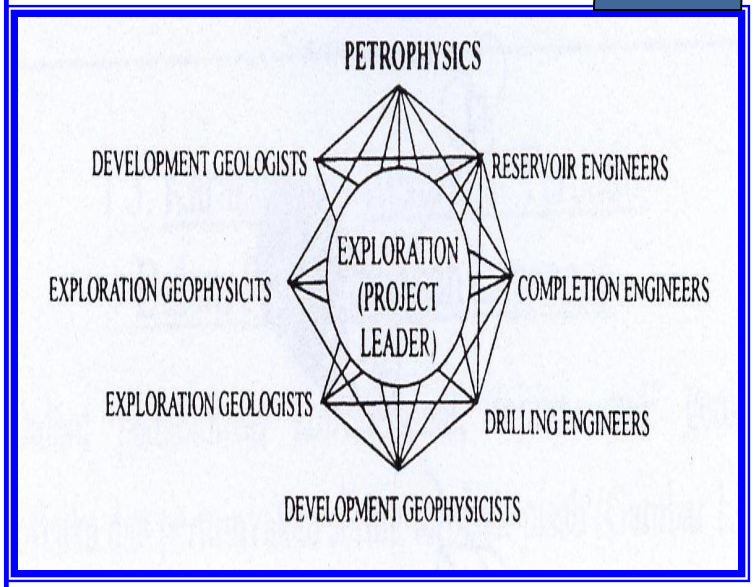
Merupakan tulang punggung dalam eksplorasi, sehingga harus mempunyai wawasan yang rinci tentang metoda eksporasi maupun konsep eksplorasi yang akan dilakukan.

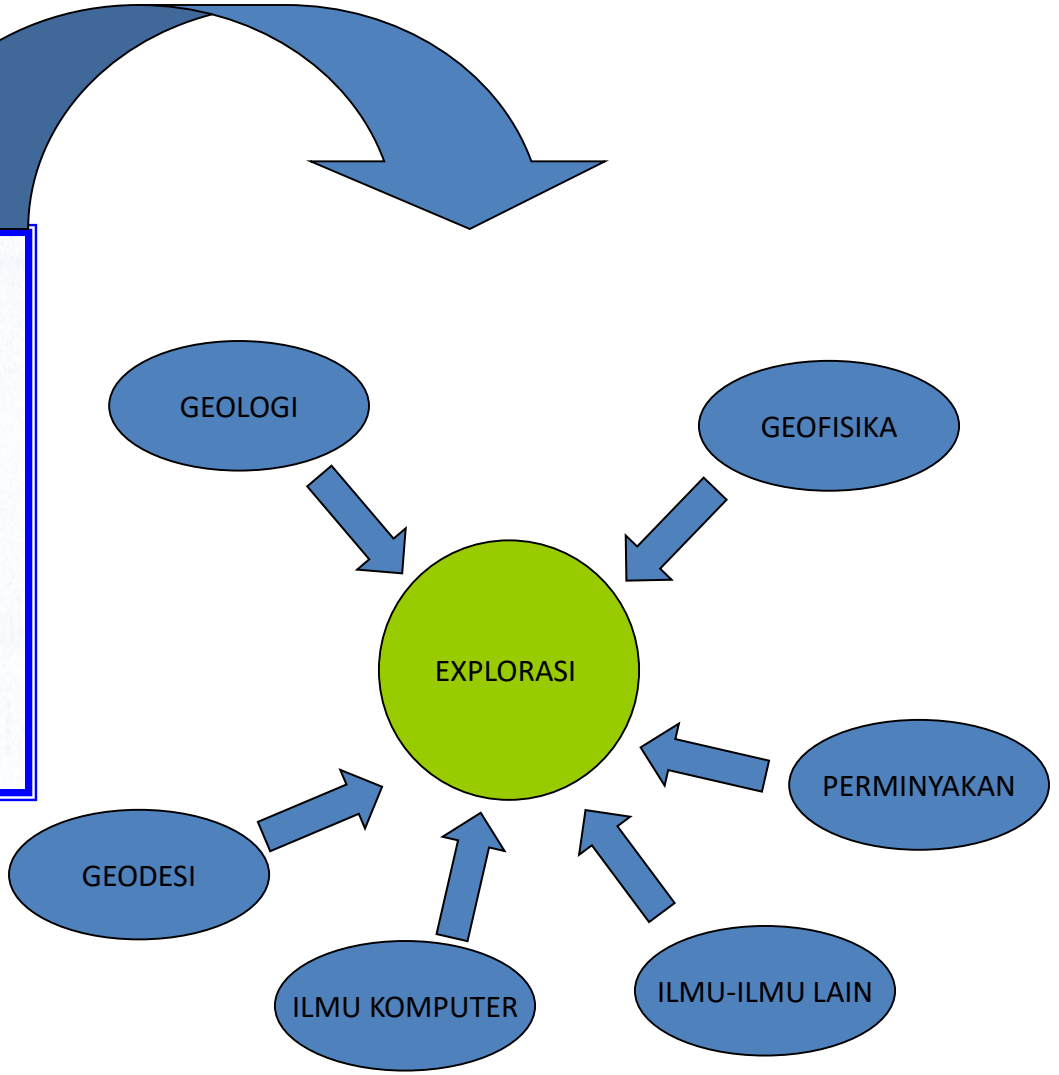
**Yang paling utama adalah etika, moral serta integritas yang tinggi.**

B. Dana / Modal

Penggunaan dana harus terencana serta dibelanjakan secara efisien. Dari dana yang digunakan akan menghasilkan kesimpulan bahwa pekerjaan tersebut mempunyai nilai ekonomis untuk dilanjutkan atau tidak.

# Eksplorasi Sinergis



**GEOLOGI : PENDEKATAN SIFAT FISIK BATUAN DAN GEJALA TEKTONIK**

**GEOFISIKA : PENDEKATAN ILMU FISIKA / MATEMATIS**

**GEODESI : POSITIONING DAN SURVEYING**

**PERMINYAKAN : BAGAIMANA MENGAMBIL MINYAK YANG TELAH DITEMUKAN (EXPLOITASI)**

**ILMU PENDUKUNG LAINNYA**

# TAHAPAN EKSPLORASI

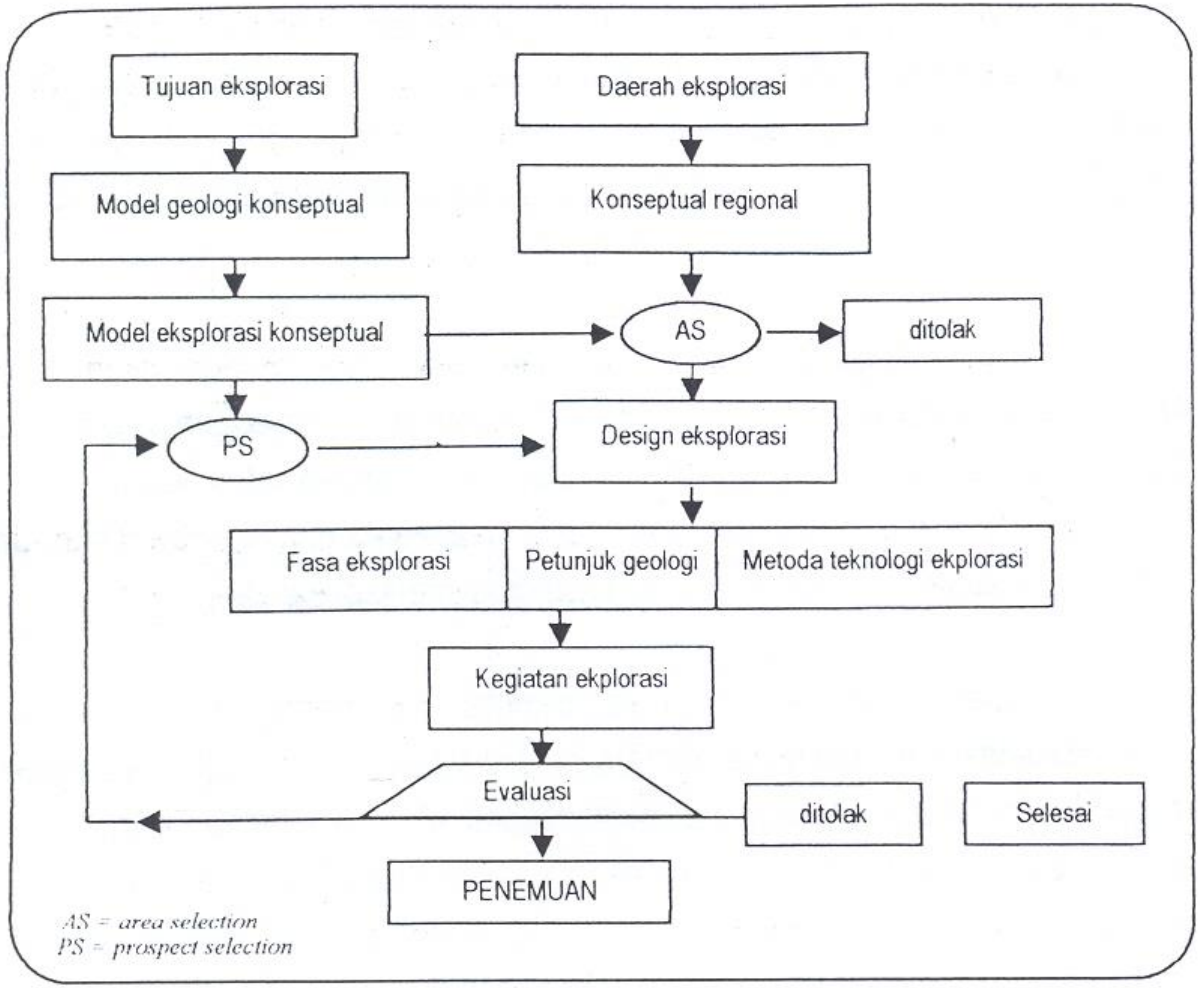
Tahapan Eksplorasi ini dilakukan dengan tujuan untuk :

1. Menghindari / mengurangi resiko eksplorasi
2. Menentukan metoda eksploitasi yang akan dilakukan.
3. Meningkatkan probabilitas ekspektasi SDA
4. Menekan kerugian yang lebih besar jika terjadi kegagalan eksploitasi

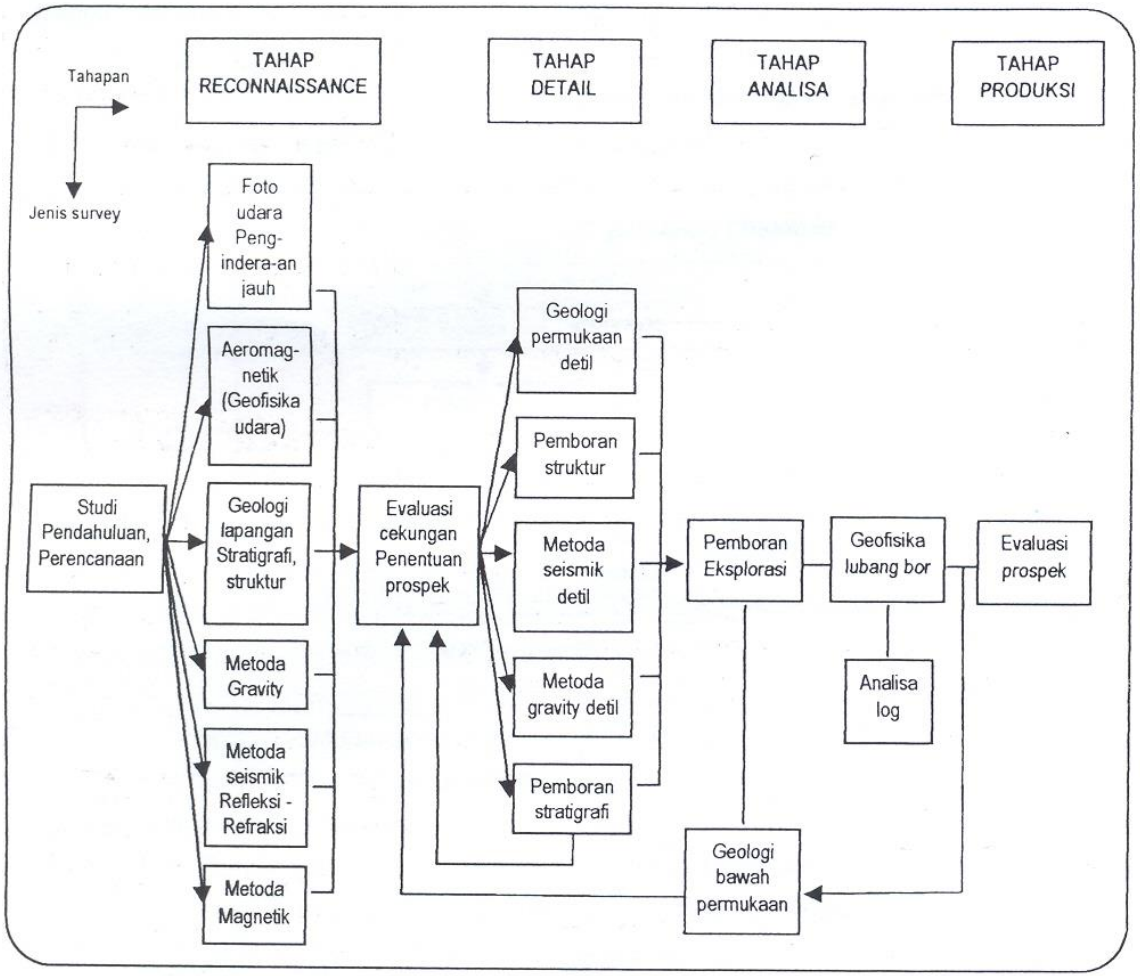
Beberapa konsep yang harus dipahami dalam tahapan eksplorasi :

1. Setiap tahap akan memperkecil daerah yang prospek, dan meningkatkan kemungkinan ditemukannya cebakan pada tahap berikutnya.
2. Pada setiap tahapan biaya metoda eksplorasi persatuan luas akan lebih mahal dari tahapan sebelumnya.
3. Suatu keiatan eksplorasi dapat berhenti pada suatu tahapan, jika tidak memberikan prospek yang baik.
4. Beberapa tahapan dapat dilewati jika pada tahap sebelumnya telah ditemukan suatu daerah yang jauh lebih prospektive dari tahap berikutnya.

# Alur pentahapan Koesoemadinata, 1978



# Tahapan-tahapan eksplorasi secara umum :

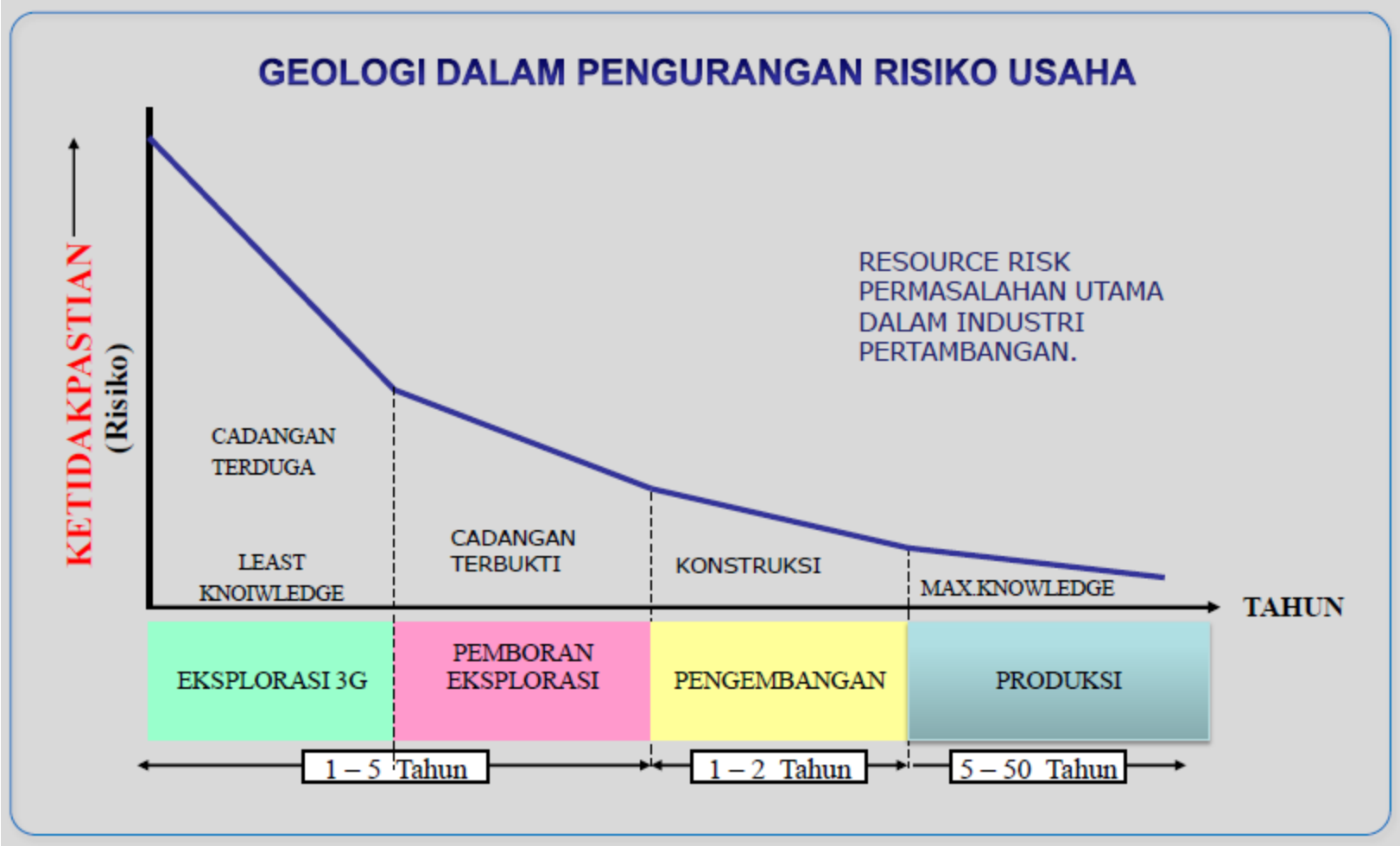


1. Studi pendahuluan : Review Literatur, geologi regional, studi citra landsat, sintesa-sintesa geologi, dan pengajuan hipotesa kerja.
2. Survey tinjau (Reconnaissance) : Observasi daerah secara global dapat dilakukan dengan Pemetaan dari udara, foto udara, pemetaan secara sepintas berdasar hasil studi pendahuluan.
3. Prospeksi umum. Penentuan daerah yang kemungkinan prospek untuk mengandung hidrokarbon.
4. Prospeksi detail/eksplorasi pendahuluan ; pemboran eksplorasi untuk penentuan lapisan prospek dan pengambilan sample.
5. Eksplorasi detail : pemboran yang lebih terperinci dan sistematik untuk penentuan cadangan.
6. Pengembangan wilayah

# GAMBARAN SINGKAT KEGIATAN OPERASIONAL

## Kebutuhan Eksplorasi & Penelitian Kebumian

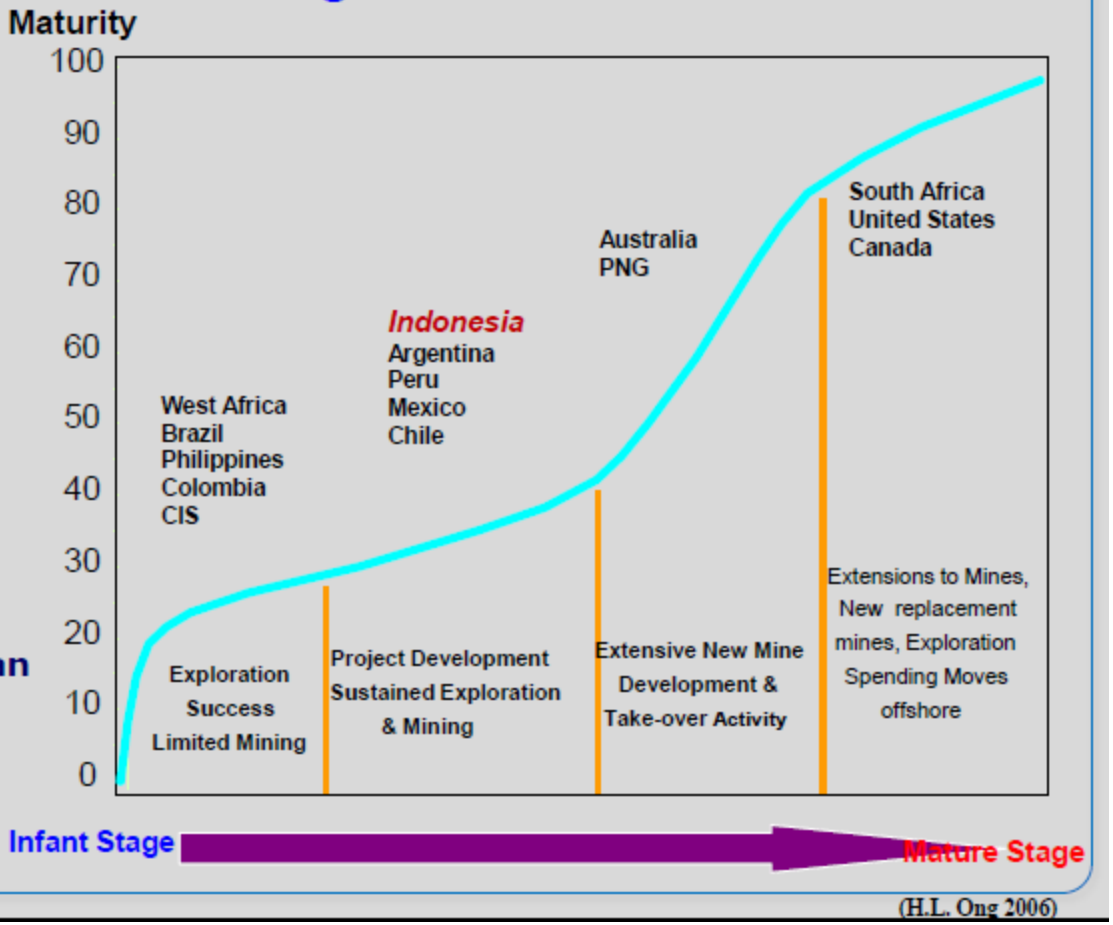
- Mitigasi bencana alam
- Geologi teknik dan lingkungan
- Eksplorasi
- Penelitian dan pengembangan


GEOLOGI DALAM PENGURANGAN RISIKO USAHA
KETIDAKPASTIAN
(Risiko)
RESOURCE RISK
PERMASALAHAN UTAMA
DALAM INDUSTRI
PERTAMBANGAN.
CADANGAN
TERDUGA
LEAST
KNOIWLEDGE
CADANGAN
TERBUKTI
KONSTRUKSI
MAX.KNOWLEDGE
TAHUN
EKSPLORASI 3G
PEMBORAN
EKSPLORASI
PENGEMBANGAN
PRODUKSI
1 – 5 Tahun
1 – 2 Tahun
5 – 50 Tahun

# Posisi Industri Pertambangan Indonesia Di Dunia

- Cadangan kelas dunia:
  - Cu/Au (Grasberg dan Batu Hijau)
  - Au (PT. Antam)
  - Nickel (PT. Inco & PT. Antam)
  - Tin (PT. Timah)
  - Coal (PT Bukit Asam, PT. KPC, PT. Arutmin)
- Indonesia produsen mineral penting di dunia :
  - Timah No. 2
  - Batubara No. 3
  - Tembaga No. 3
  - Nikel No. 5

**Masih banyak kesempatan untuk mengembangkan sumber daya energi dan mineral Indonesia**

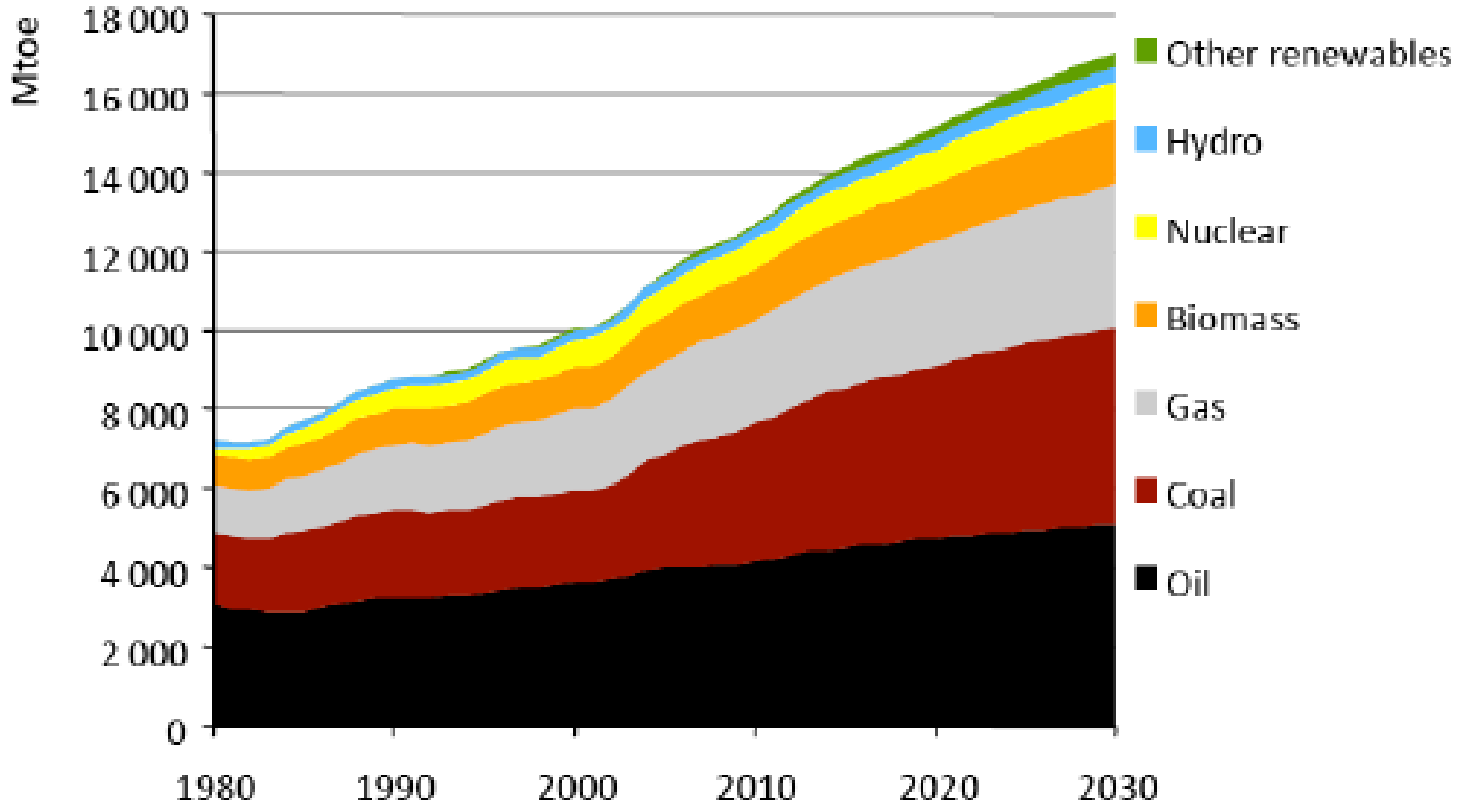



(H.L. Ong 2006)

# SUMBERDAYA DAN CADANGAN MINERAL INDONESIA
## *(PUSDATIN ESDM, 2005)*

| Komoditi | Resources (ton) | | | | Reserves (ton) | | | |
|---|---|---|---|---|---|---|---|---|
| | Indicated | | Measured | | Probable | | Proven | |
| | Ore | Metal | Ore | Metal | Ore | Metal | | Metal |
| Bauksit | 51.540.000,00 | 24.151.644,00 | 846.006.587,00 | 283.246.461,95 | 58.760.000,00 | 27.147.120,00 | 2.465.000,00 | 1.316.310,00 |
| Besi Laterit | 642.022.746,58 | 288.835.465,13 | 15.105.000,00 | 4.862.784,50 | 46.740.000,00 | 6.481.927,50 | 10.090.000,00 | 1.407.278,70 |
| Besi Primer | 1.257.528,00 | 707.633,90 | 68.903.283,00 | 31.822.192,51 | 0,00 | 0,00 | 0,00 | 0,00 |
| Emas Aluvial | 130.595.007,00 | 11,34 | 292.473.051,43 | 62,90 | 0,00 | 0,00 | 0,00 | 0,00 |
| Emas Primer | 154.081.500,00 | 236,22 | 812.643.148,34 | 1.501,31 | 408.326.075,00 | 222,11 | 2.988.705.945,00 | 2.903,73 |
| Kobal | 422.300.000,00 | 509.480,00 | 625.920.000,00 | 946.788,00 | 19.510.000,00 | 30.856,00 | 318.620.000,00 | 153.791,50 |
| Kromit Plaser | 1.382.471,00 | 576.894,59 | 891.813,00 | 371.716,49 | 0,00 | 0,00 | 0,00 | 0,00 |
| Kromit Primer | 234.000,00 | 111.150,00 | 10.000,00 | 3.150,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Mangan | 2.384.963,00 | 1.014.654,05 | 437.040,45 | 149.938,75 | 0,00 | 0,00 | 300.000,00 | 105.000,00 |
| Molibdenum | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Monasit | 4.492,80 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Nikel | 417.566.200,00 | 6.511.971,98 | 385.350.000,00 | 6.690.838,00 | 486.690.000,00 | 7.591.611,00 | 112.170.000,00 | 2.071.782,50 |
| Pasir Besi | 84.531.576,00 | 42.721.881,86 | 459.772,00 | 118.161,00 | 11.965.200,00 | 45.956.894,00 | 16.452.400,00 | 8.461.748,00 |
| Perak | 27.393.700,00 | 1.171,73 | 153.885.217,00 | 5.956,17 | 492.137.075,00 | 3.170,04 | 2.916.668.260,00 | 11.776,46 |
| Platin | 32.250.000,00 | 12.000,00 | 52.500.000,00 | 231,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Seng | 19.595.000,00 | 1.808.901,00 | 3.560.000,00 | 490.146,47 | 6.320.000,00 | 1.011.200,00 | 0,00 | 0,00 |
| Tembaga | 848.000,00 | 5.856,00 | 193.270.000,00 | 780.080,00 | 1.060.000.000,00 | 5.724.000,00 | 3.712.162.000,00 | 35.521.267,90 |
| Timah | 224.193,00 | 120.579,83 | 509.097,00 | 473.812,30 | 307.512,00 | 276.760,80 | 148.753,00 | 149.104,70 |
| Timbal | 12.220.000,00 | 566.148,96 | 4.531.108,00 | 276.939,99 | 6.320.000,00 | 625.680,00 | 0,00 | 0,00 |
| Titan Laterit | 828.673.796,51 | 2.813.146,70 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Titan Plaser | 12.036.998,70 | 975.319,08 | 136.420,00 | 10.231,50 | 0,00 | 0,00 | 0,00 | 0,00 |
| **TOTAL** | **2.841.142.172,59** | **371.444.146,37** | **3.456.591.537,22** | **330.250.992,84** | **2.597.075.862,00** | **94.849.441,45** | **10.077.782.358,00** | **49.200.963,49** |

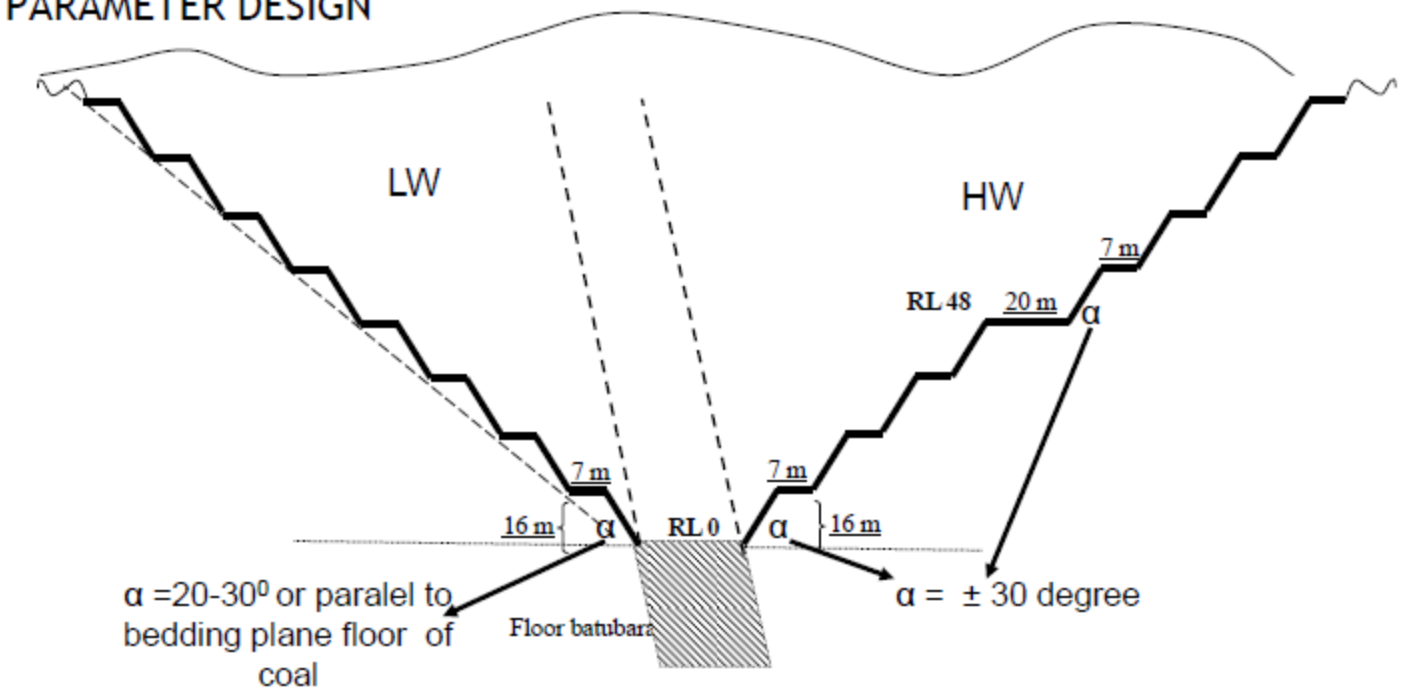
# Prediksi kebutuhan energi dunia

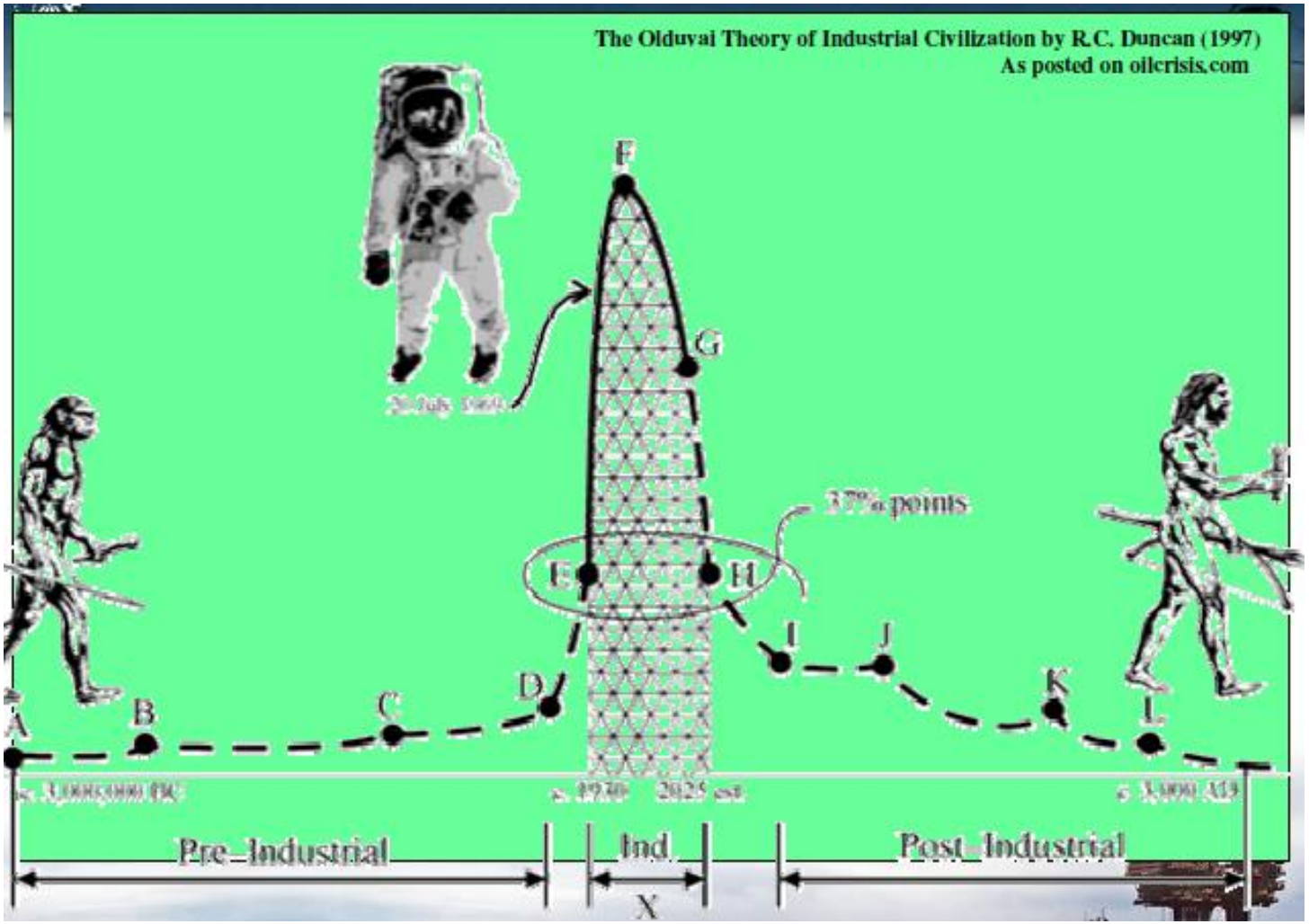



Sumber: IEA World Energy Outlook 2008

# PERENCANAAN IDEAL

## PARAMETER DESIGN




The Olduvai Theory of Industrial Civilization by R.C. Duncan (1997)
As posted on oilcrisis.com
F
G
17% points
E
H
I
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K
L
A
B
C
D
Pre_Industrial
Ind
X
Post_Industrial

# METODA SEISMIK

# (Aplikasi Seismik Attribute)

# Definisi :

Banyak definisi yang diberikan mengenai seismik atribut :

Barnes (1999) mendefinisikan atribut seismik sebagai sifat kuantitatif dan deskriptif dari data seismik yang dapat didisplay pada skala yang sama dengan data orisinil.

Brown (2000) mendefinisikan atribut sebagai derivatif (turunan) dari pengukuran seismik dasar.

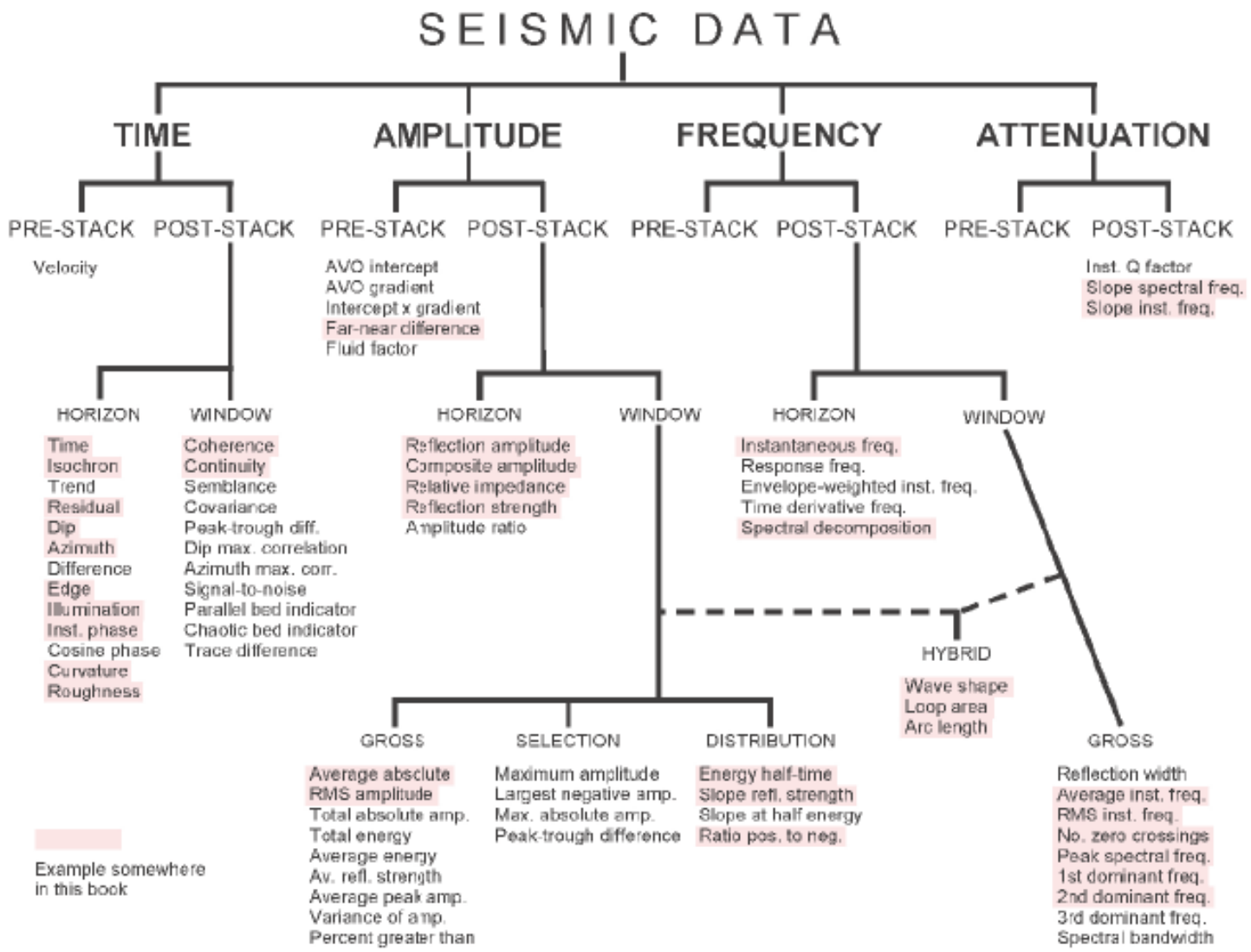
Turner (2000) adalah semua informasi yang didapatkan dari data seismik, yang antara lain dari pengukuran atau dari logika yang didasarkan pada alasan tertentu.

Arti atribut seismik :

Data seismik mengandung informasi mengenai parameter dasar gelombang yaitu :

- ✓ Amplitudo
- ✓ Frekuensi
- ✓ Fasa

***Jadi Atribut seismik merupakan*** : parameter seismik yang diturunkan dari parameter dasar (amplitudo, frekuensi, dan fasa), sehingga dapat memunculkan informasi mengenai sifat batuan yang di bawa oleh gelombang seismik.




**Klasifikasi Seismik Attribute (Brown, 2000)**

Secara umum :

- Atribut turunan waktu akan cenderung memberikan informasi perihal struktur.
- Atribut turunan amplitudo cenderung memberikan informasi perihal stratigrafi dan reservoar.
- Atribut turunan frekuensi sampai saat ini belum betul-betul dipahami, tapi banyak optimisme bahwa akan menyediakan informasi tambahan yang berguna perihal reservoar dan stratigrafi.
- Atribut atenuasi juga praktis belum dimanfaatkan saat ini, namun dipercaya bahwa atribut ini dimasa datang akan berguna untuk lebih memahami informasi mengenai permiabilitas.

Jenis atribut seismik :

- ***Amplitude attribute*** : ekstraksi langsung dari data *preserve amplitude* (amplitude rms, average, max, min etc)
- ***Intantaneous attribute (complex attribute):***
  - *Reflection strength*
  - *Instantaneous frequency*
  - *Instantaneous phase*
  - *Polarity*
  - *Energy*
- ***Time Attribute***

# ATTRIBUTE AMPLITUDE

- Attribut Amplitudo

  - Amplitudo merupakan atribut dasar dari seismik.
  - Attribut Amplitudo dan turunannya, diturunkan berdasarkan perhitungan statistik.
  - Amplitudo seismik paling banyak dimanfaatkan untuk mengenali anomali amplitudo akibat hidrokarbon (DHI), misalnya ***Bright spot, Dim spot,*** dll.

## Kegunaan Atribut Amplitudo

Secara umum, kegunaan utama atribut amplitudo adalah untuk mengidentifikasi parameter-parameter sbb. :

1. Akumulasi gas dan fluida
2. Memperkirakan jenis litologi
3. Memperkirakan porositas
4. Analisa sekuen stratigrafi misal channel, delta dll
5. Mengenali ketidak selarasan

## ➢ Attribut Amplitudo

Berbagai jenis atribut amplitudo primer yang sering digunakan adalah sebagai berikut :

1. Amplitudo RMS
2. Amplitudo Absolut Rata-rata
3. Amplitudo Puncak Maksimum
4. Amplitudo Puncak Rata-rata
5. Amplitudo Palung Maksimum
6. Amplitudo Palung Rata-rata
7. Amplitudo Absolut Maksimum
8. Amplitudo Absolut Total
9. Amplitudo Total
10. Energi Rata-rata
11. Energi Total
12. Amplitudo Rata-rata
13. Variansi Dalam Amplitudo
14. Skew Dalam Amplitudo
15. Kurtosis Dalam Amplitudo

# 1. Amplitudo RMS dan Absolut Rata-Rata

- RMS Amplitudo dan Amplitudo Absolut Rata-rata dihitung dengan menggunakan persamaan :

$$\text{Amplitudo RMS} = \sqrt{\frac{1}{N}\sum_{i=1}^{N} a_1{}^2} \qquad (3.1)$$

$$\text{Amplitudo Absolut Rata} - \text{rata} = \frac{1}{N}\sum_{i=1}^{N} |a_i| \qquad (3.2)$$

- Dimana N = jumlah sampel amplitudo pada jendela analisis
  a = besar amplitudo

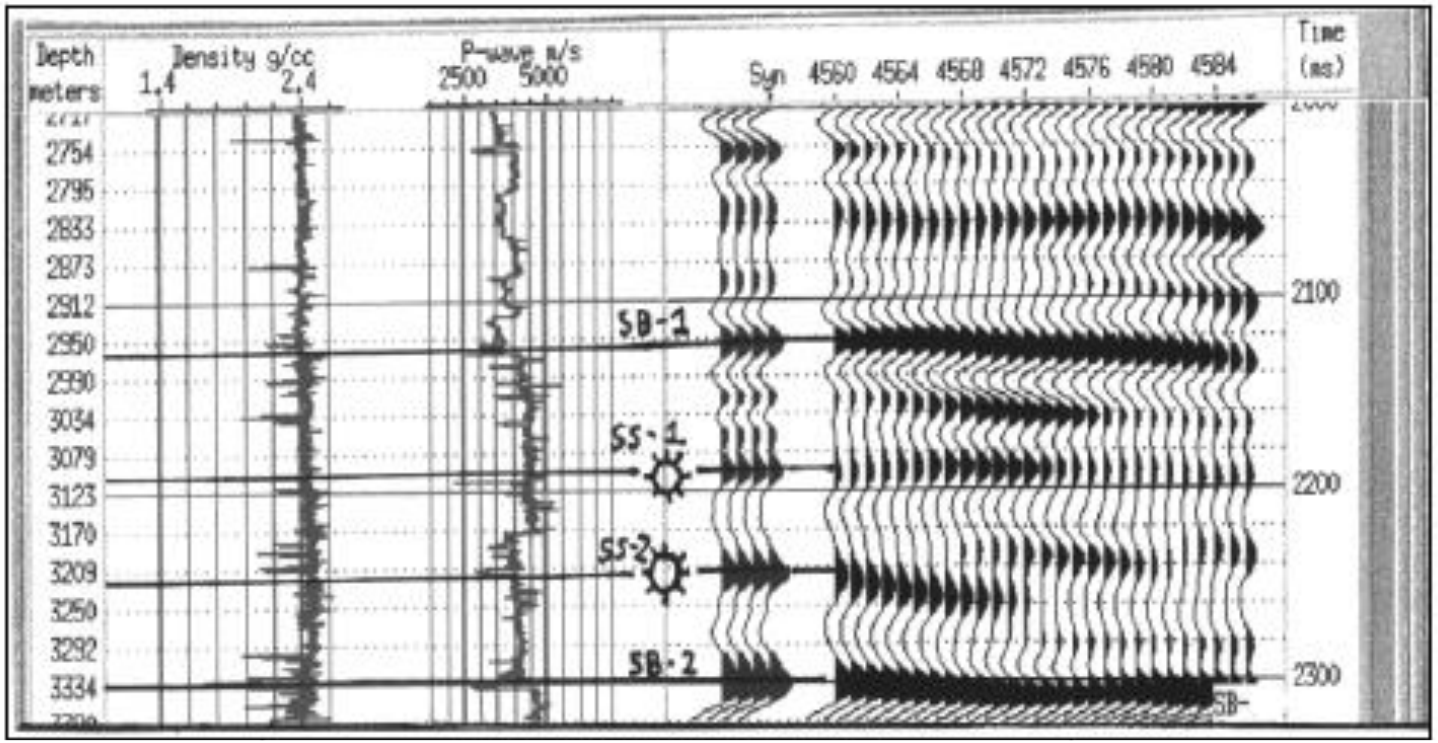
- Nilai amplitudo RMS diakarkan sebelum dirata-ratakan sehingga Amplitudo RMS sangat sensitif terhadap nilai amplitudo yang ekstrem; namun sebaliknya Amplitudo Absolut Rata-rata tidak terlalu sensitif terhadap perubahan amplitudo yang ekstrim.

Berdasarkan well seismic-tie di bawah ditunjukkan adanya reservoar pada SB1 dan SB 2, berdasarkan analisa geologi, reservoar yang produktif adalah batupasir dengan lingkngan pengendapan pada meandering-stream (time 2180-2260 ms).

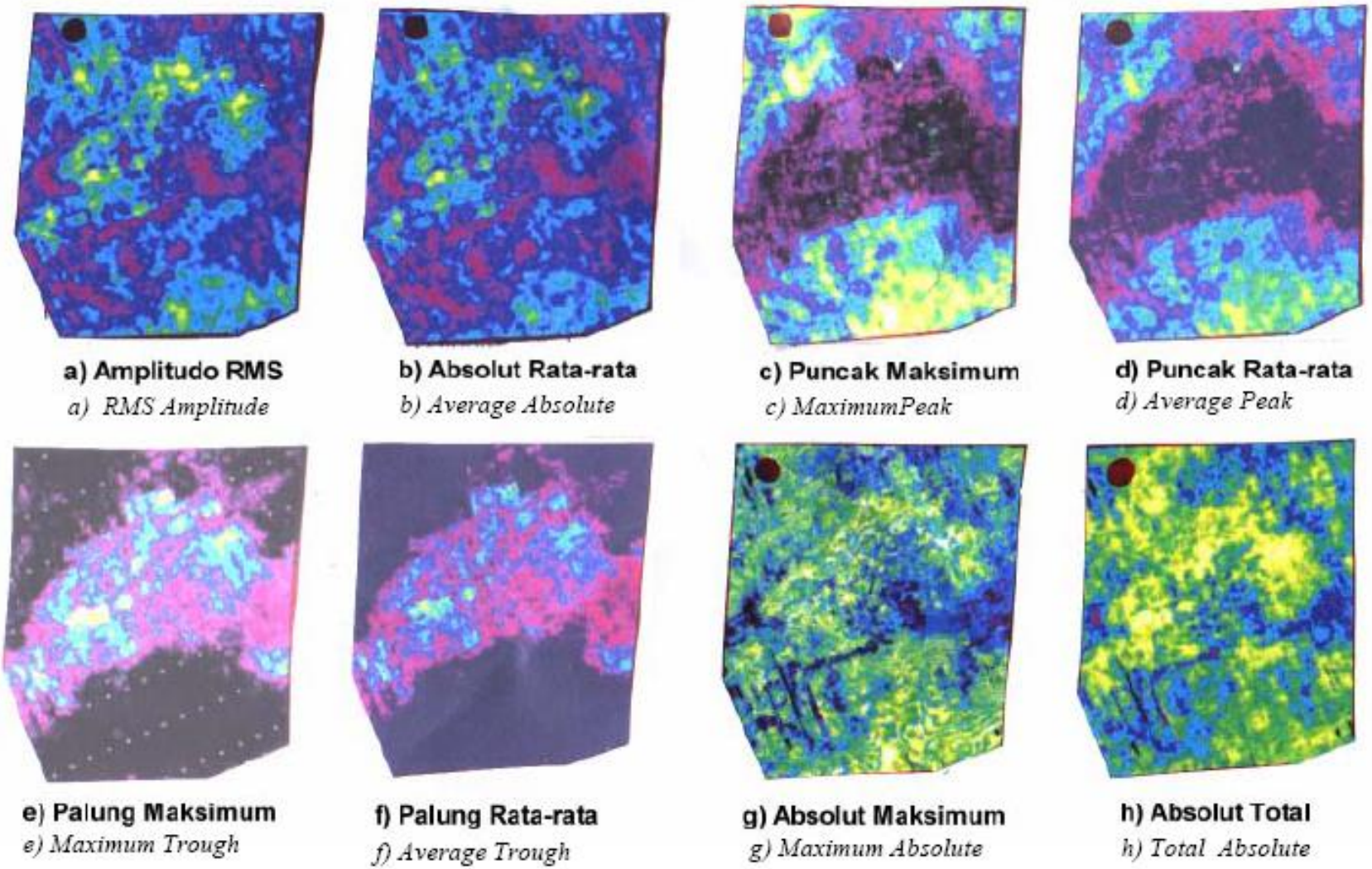
-Pilih Map attribut yang paling dapat menunjukkan lingkungan pengendapan tsb.

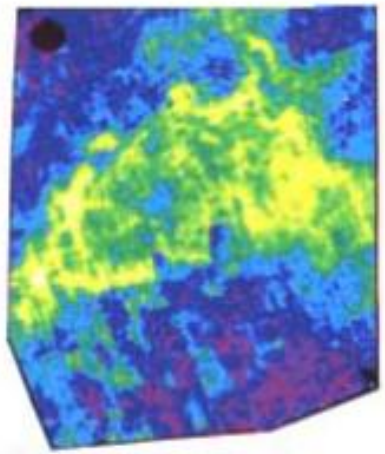
-Tentukan sumur pengembangan berikutnya.

Sintetik seismogram menggunakan fasa nol dan reverse polarity

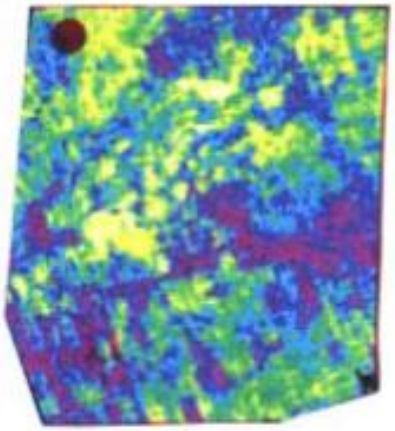


Nilai tinggi ditunjukkan oleh warna cerah dan sebalikknya

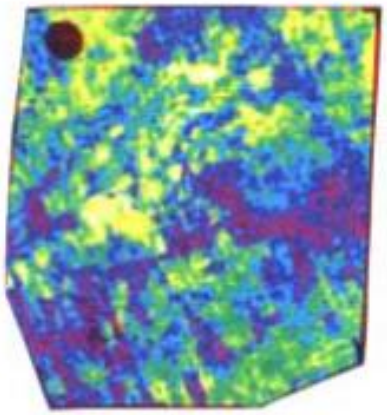




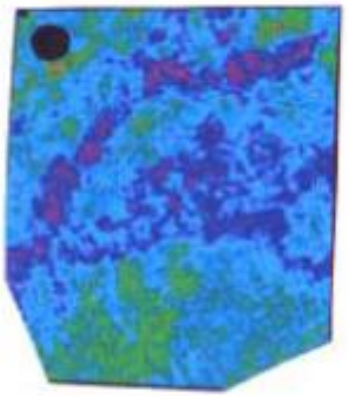
**i) Amplitudo Total**
*I) Total Amplitude*



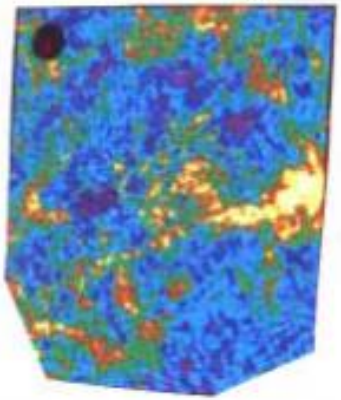
**j) Energi Rata-rata**
*j) Average Energy*



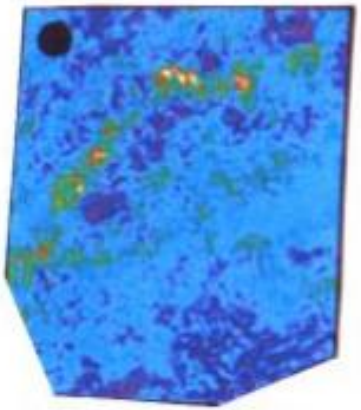
**k) Energi Total**
*k) Total Energy*



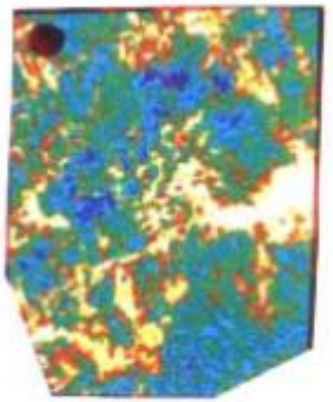
**l) Amplitudo Rata-rata**
*l) Average Amplitude*



**m) Variansi Amplitudo**
*m) Amplitude Variance*

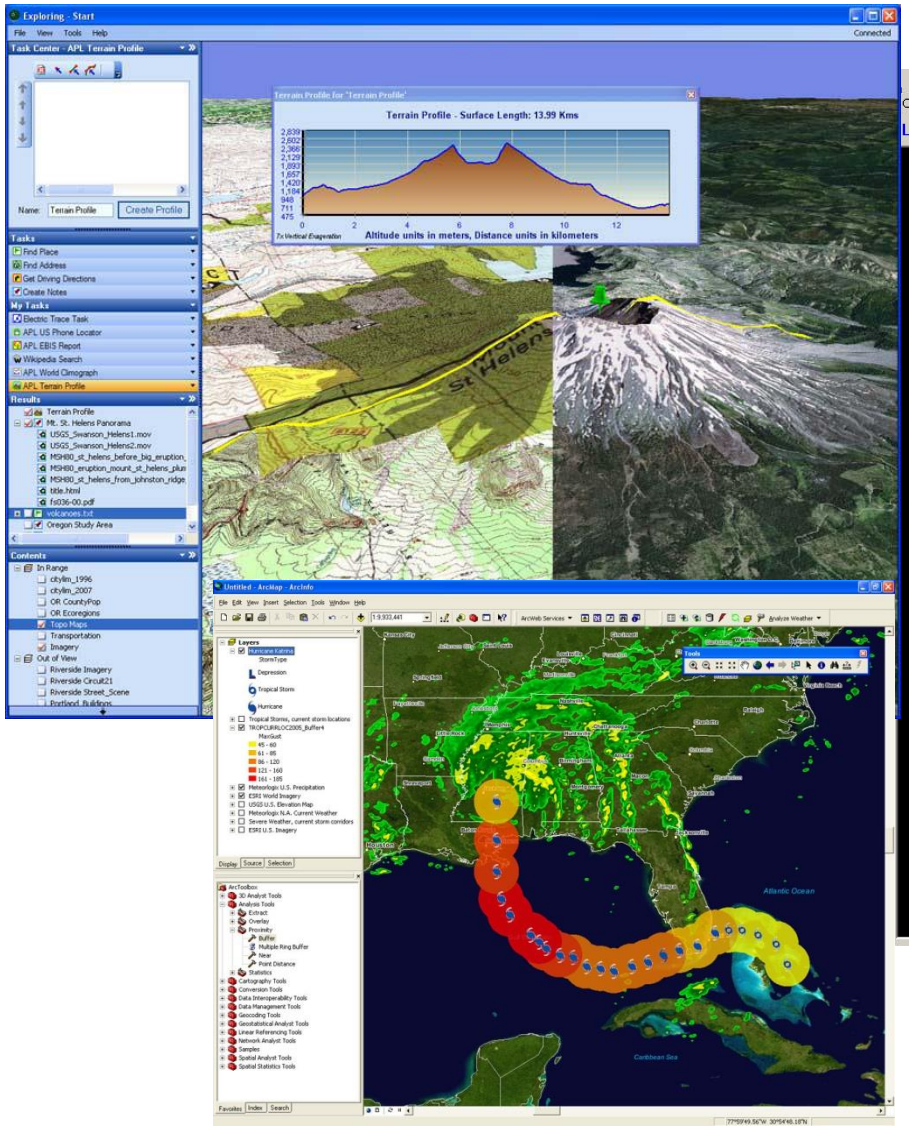


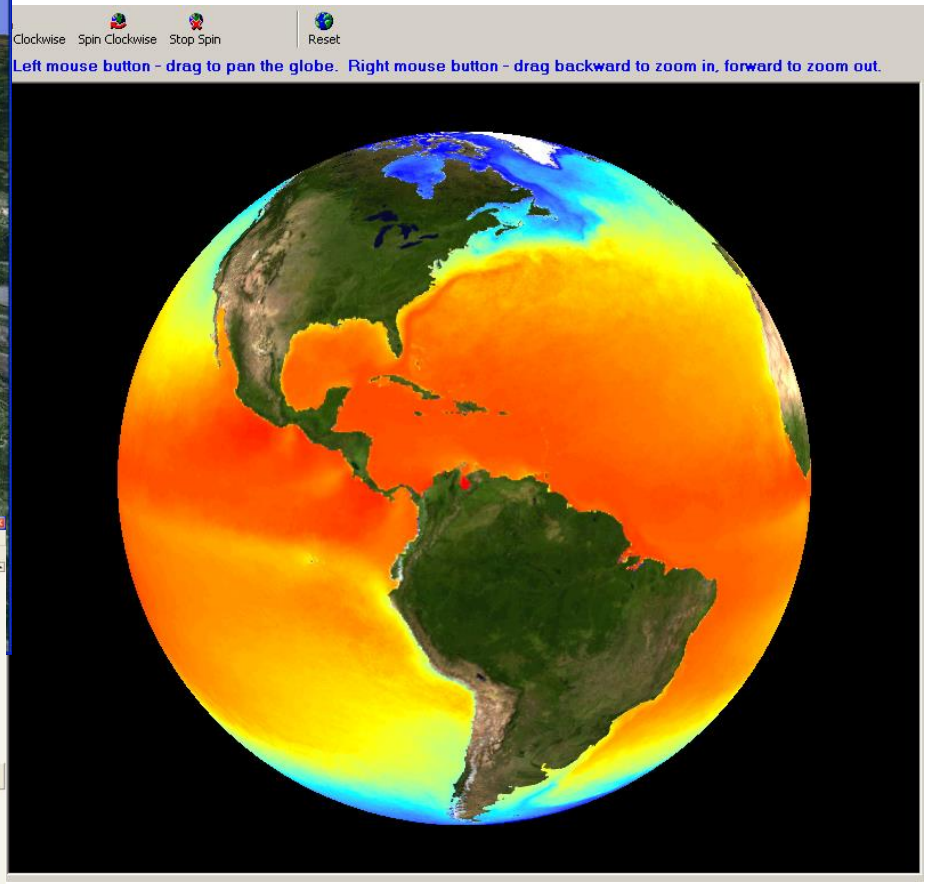
**n) Skew Amplitudo**
*n) Skew Amplitude*



**o) Kurtosis Amplitudo**
*o) Kurtosis Amplitude*

# What is GIS?


Exploring - Start
Task Center - APL Terrain Profile
Terrain Profile - Surface Length: 13.99 Kms
Altitude units in meters, Distance units in kilometers
Untitled - ArcMap - ArcInfo


Clockwise
Spin Clockwise
Stop Spin
Reset
Left mouse button - drag to pan the globe. Right mouse button - drag backward to zoom in, forward to zoom out.

# What is GIS?

- GIS = Geographic Information System
  - Links databases and maps
  - Manages information about places
  - Helps answer questions such as:
    - Where is it?
    - What else is nearby?
    - Where is the highest concentration of ‘X’?
    - Where can I find things with characteristic ‘Y’?
    - Where is the closest ‘Z’ to my location?

# Pengertian Informasi Geografis dan Informasi Keruangan (1)

Informasi Geografis merupakan informasi kenampakan permukaan bumi. Jadi informasi tersebut mengandung unsur posisi geografis, hubungan keruangan, atribut dan waktu .

Informasi Keruangan menyatakan lokasi yang berkaitan dengan informasi geo-grafis.

# Pengertian Informasi Geografis dan Informasi Keruangan (2)

Posisi geografis: sebagai standar digunakan sistem koordinat lintang dan bujur, yaitu sitem UTM (Universal Transverse Mercator)

Atribut (non-spatial atribut) menjelaskan informasi apa yang dikandung, misal: hutan dengan spesiesnya.

Hubungan keruangan: misalnya suatu area sekolah, disebelah Utaranya misal ada jalan, disebelah Timur ada gedung olah raga, disebelah Barat ada toko, dan disebelah selatan ada lapangan terbuka.

Waktu: mengandung informasi temporal, karena obyek permukaan bumi bersifat dinamis.

# Data Spasial dan
# Data Deskriptif / Non-Spasial (1)

Data Spasial berupa titik, garis, poligon (2-D), permukaan (3-D), terdiri dari informasi posisi geografis

Data Deskriptif merupakan uraian atau atribut data spasial (anotasi, tabel, hasil pengukuran, kategori obyek, penjelasan hasil analisis / prediksi dll.)

# Data Spasial dan
# Data Deskriptif / Non-Spasial (2)

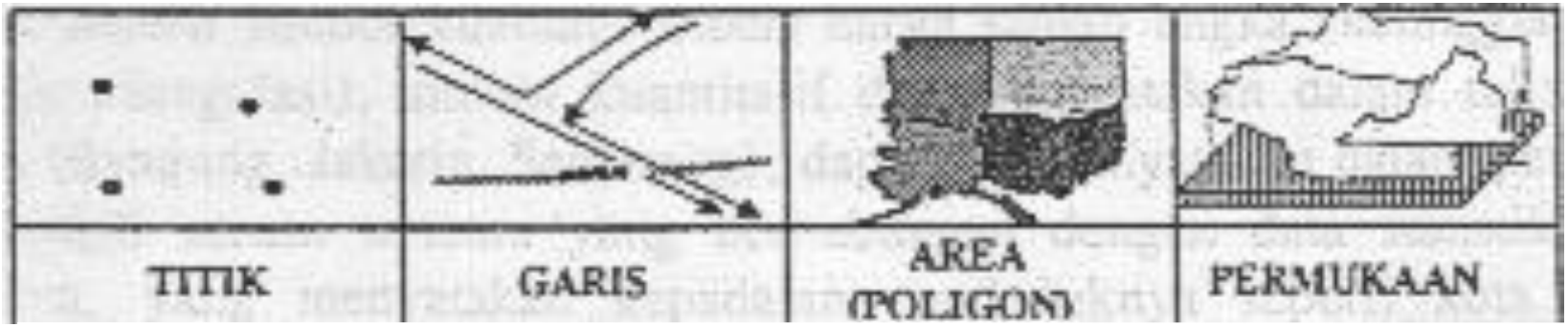
Contoh: Data Obyek Permukiman di Depok

Data Spasial: merupakan data grafik berbentuk poligon yang merupakan closed area yang menghubungkan posisi-posisi geografis di lokasi Depok

Data Non-Spasial: Luas Permukiman, Jumlah Penduduknya, Jumlah Rumah, Jumlah Kepala Keluarga, Pendapatan Rata-Rata Kepala Keluarga, dll.

# Data Spasial

(Sumber: Purwadhi, 1997)



# Data Deskriptif

(Sumber: Purwadhi, 1997)

# GIS in Education

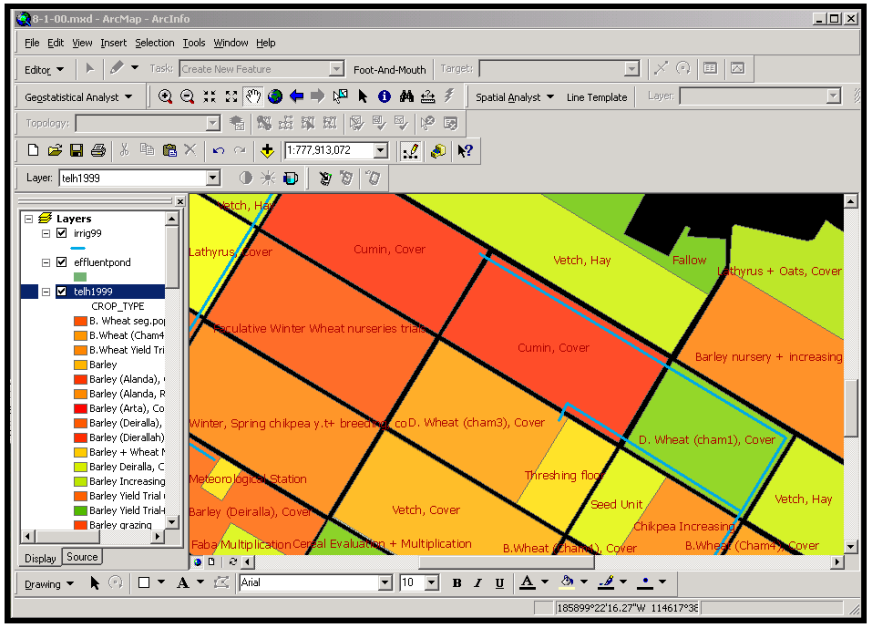
- Over 7,000 universities worldwide teach GIS
- GIS used in multiple disciplines:

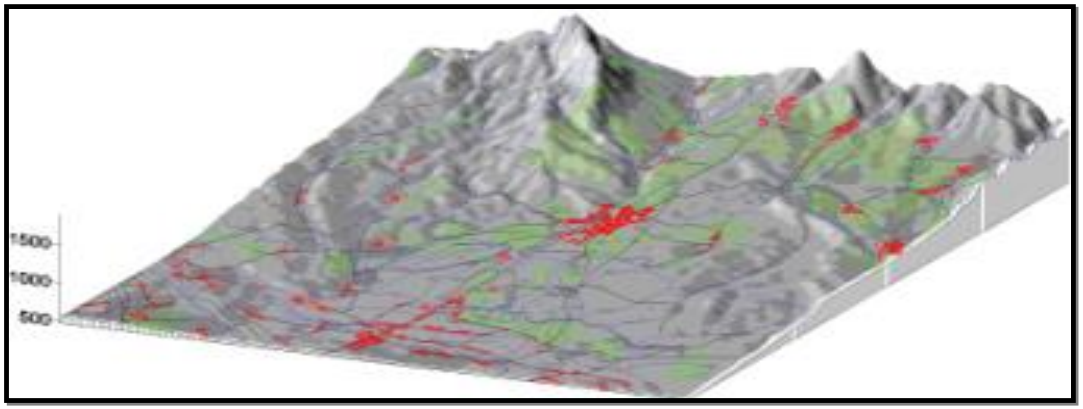
Agriculture
Archaeology
Architecture/Lanscape Arch.
Business
Computer Science
Environmental Science
Engineering
Journalism
Military Science
Natural Resource Management

**Geography**
**Geology**
**Meteorology**
**Oceanography**
**Law Enforcement**
**Public Health**
**History**
**Sociology**
**Urban/Regional Planning**

# Agriculture

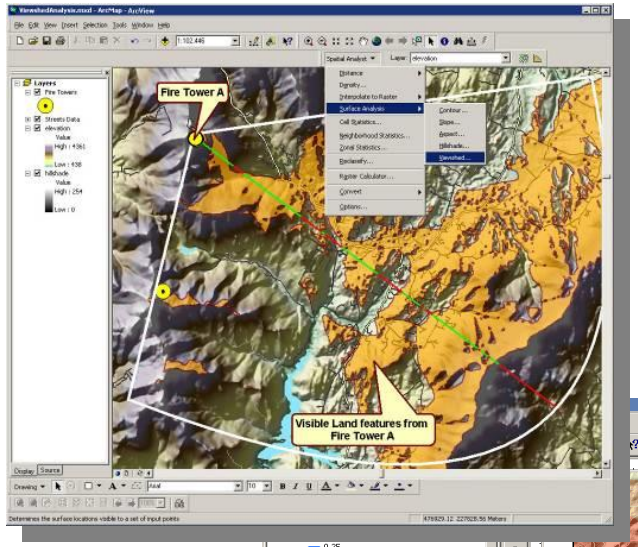
- Farm management
- Pest/Disease tracking
- Crop monitoring
- Yield prediction
- Soil analysis

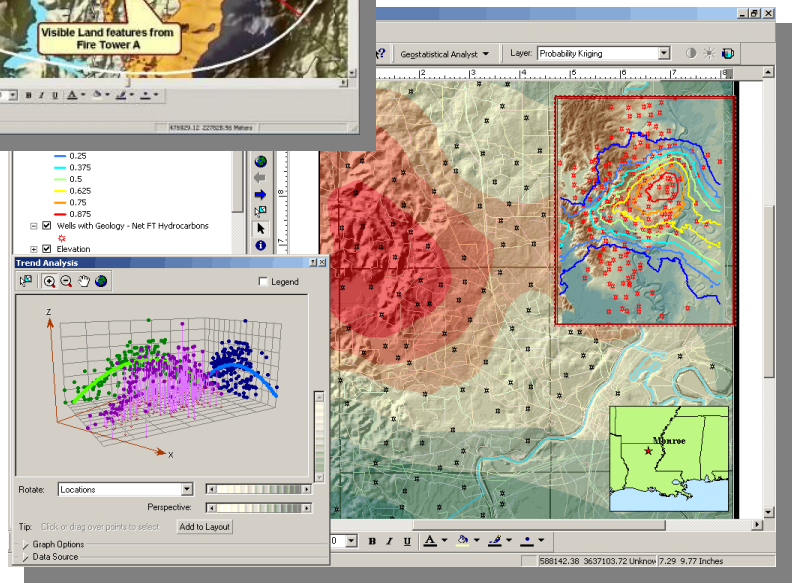


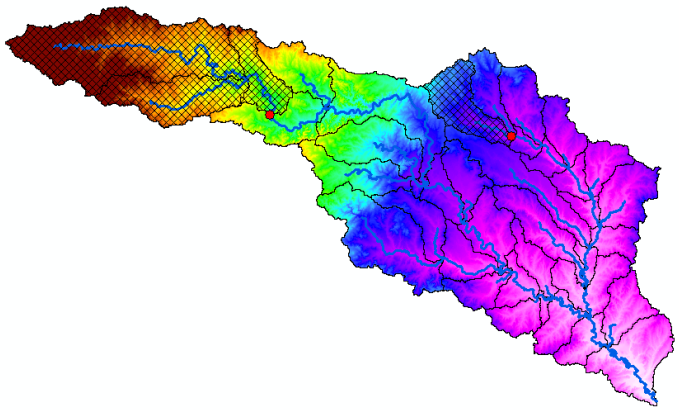



# Natural Resource Management

- Forestry
- Ecology
- Mining
- Petroleum
- Water Resources

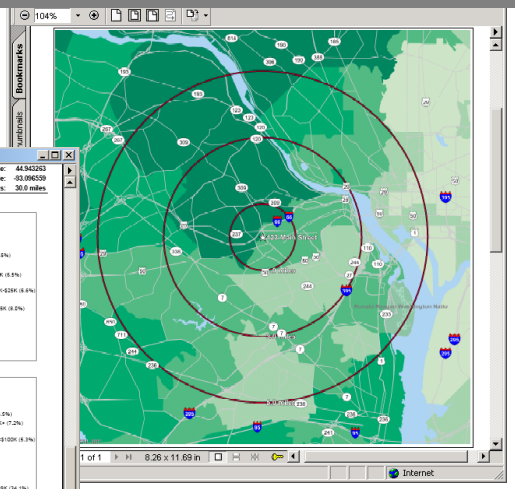


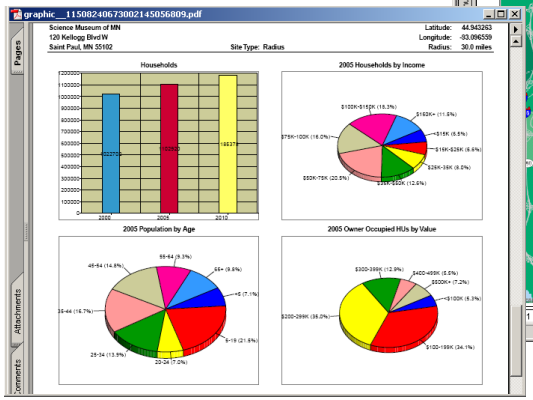



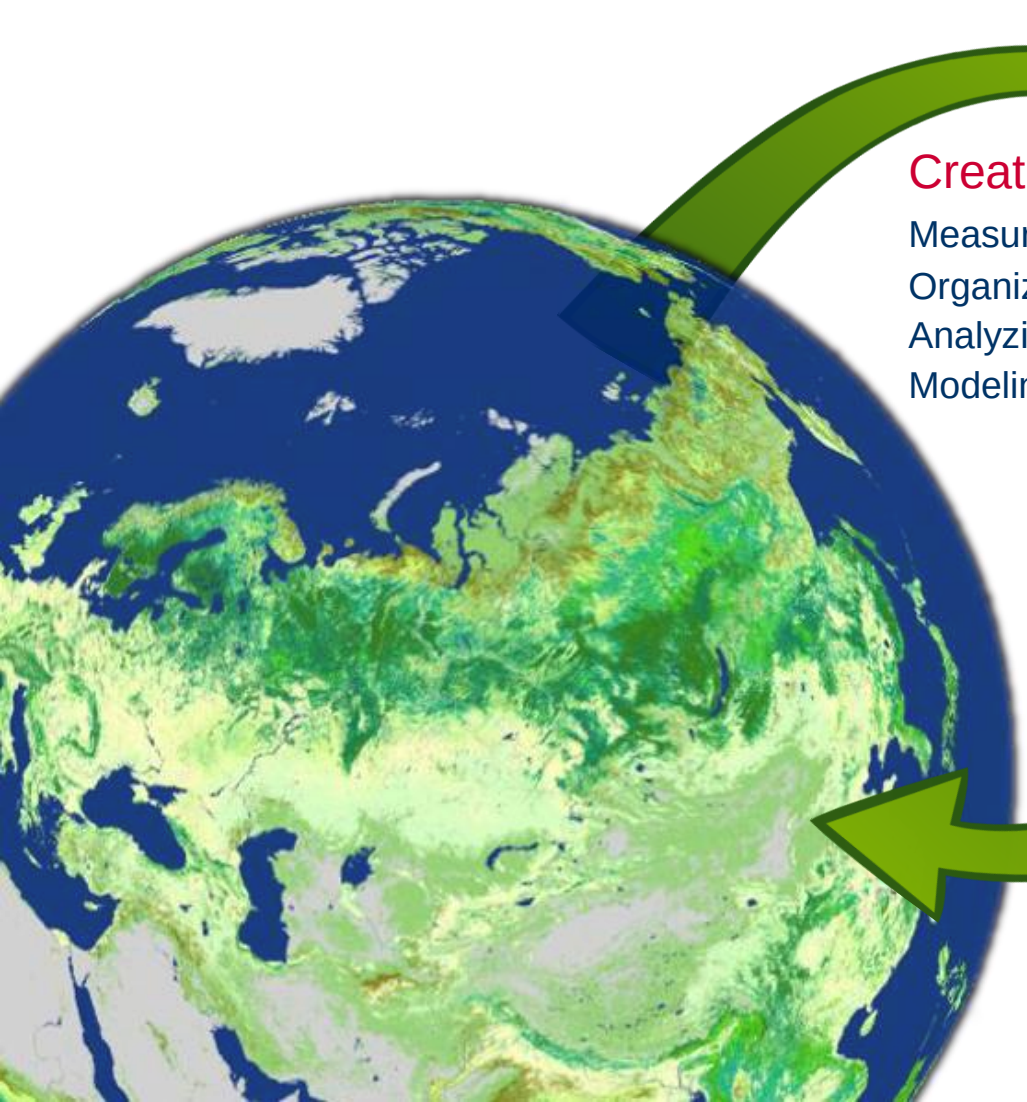
# Planning and Economic Development

- Land Use/Zoning
- Emergency Preparedness
- Population Forecast
- Market Analysis
- Property Tax Assessment
- Transportation



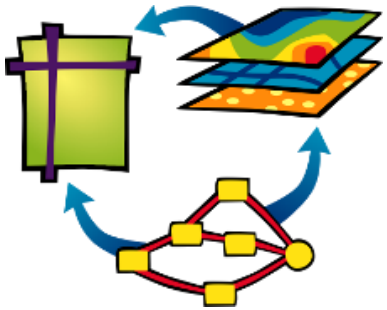
# GIS: A Framework for Understanding and Managing Our Earth



Geographic Knowledge

Creating

Measuring
Organizing
Analyzing
Modeling



*Holistic*

*Comprehensive*

*Systematic*

*Analytic*

*Visual*

Applying

Planning
Managing
Acting

# GIS enhances education because it is:

- Multi-disciplinary
- A real-world technology using real data
- Involves authentic tasks / assessments
- Promotes holistic / systematic approach
- Engages multiple ways of learning
- Encourages community connections
- Used at scales from local to global

# Geography matters

Today's challenges require geographic approach

- Climate Change
- Urban Growth
- Sustainable Agriculture
- Water Quality and Availability
- International and National Security
- Energy
- Epidemiology/Disease Tracking
- Natural Hazards: Seismicity, Weather Events

# GIS skills needed in workforce

- 2004:  US Secretary of Labor identifies geospatial technology as one of the 3 most important evolving fields.

- GIS part of US Department of Labor High Growth Job Training Initiative

- Emily DeRocco, US Dept of Labor Employment and Training Administration:  2005 budget includes $1.6 billion for secondary, technical, and adult education programs.

# GIS and Distance Education

- Current workforce needs GIS training, distance education meets their needs
- Examples of online GIS programs:
  - University of California Riverside
  - Emporia State University
  - University of Montana
  - University of Denver
  - Louisiana Tech University
  - Pennsylvania State University
  - Northwest Missouri State University

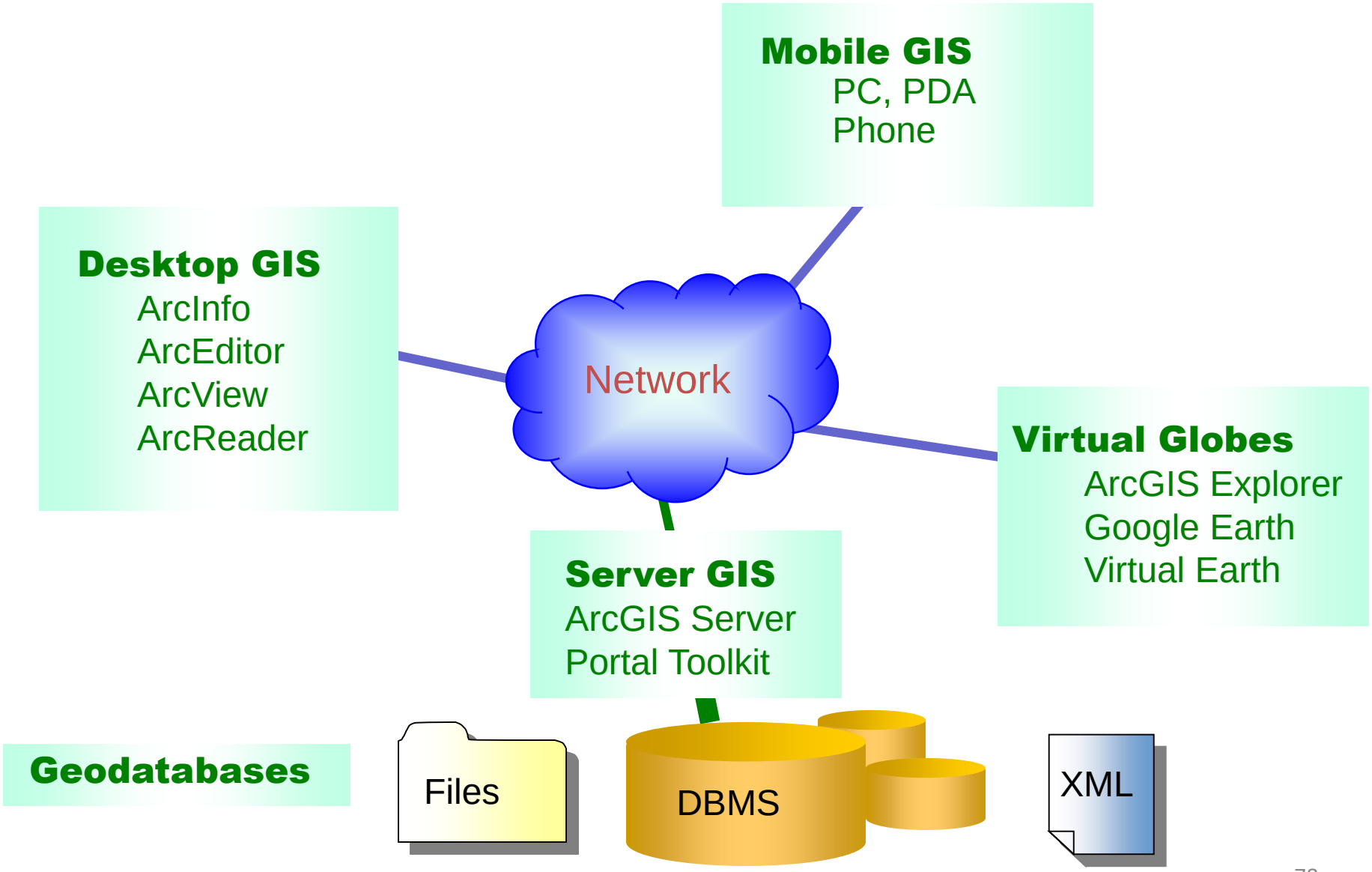
# GIS as Infrastructure

- Because GIS is used in many departments, coordination is needed
  - Software licensing
  - Instruction
  - Data

# GIS as infrastructure

- Data is greatest expense
  - Previously: Data scattered in multiple departments, not coordinated
  - Future: Data accessible anywhere, GIS portal and Web services facilitate sharing
- Libraries / Data Centers key
  - GIS data has unique characteristics

# GIS as infrastructure



# PENGERTIAN GPS

**GPS : Global Positioning System**

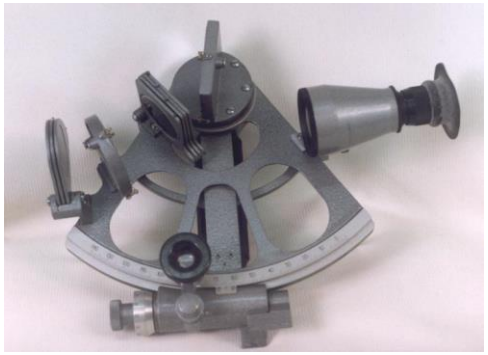
**Sebuah system yang dapat menunjukkan posisi benda di permukaan bumi secara cepat, di semua tempat, pada semua kondisi dan pada setiap waktu.**

**GPS : merupakan perkembangan paling modern sistem navigasi kuno**

- **GPS dikontrol oleh U. S. Department of Defense (DOD).**


# SISTEM NAVIGASI

Sistem yang menandai dimana posisi mereka, dan yang menunjukkan kemana mereka pergi, serta bagaimana jalan mereka pulang.



**Sextant**

**Navigasi kuno :**

Penghuni gua memberikan tanda pada dinding gua pelaut berpegangan pada posisi bintang

**Navigasi Kompas** : memberikan arah utara

**Navigasi Sextant** : memperkirakan sudut tinggi bintang, bulan dan matahari di atas Horison

Kombinasi Kompas dan sextant banyak dipakai untuk pelayaran, kelemahannya adalah bahwa dengan alat tersebut masih kesulitan dalam menentukan posisi garis bujur

**Chronometer**

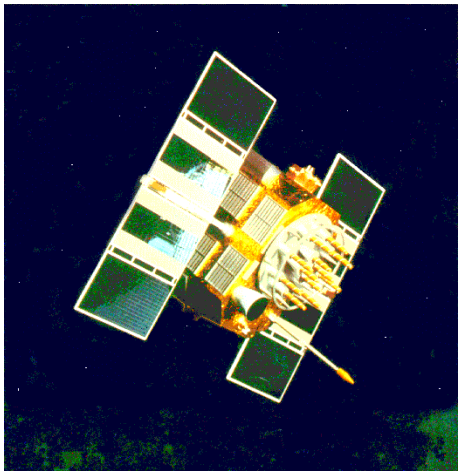
- **Chronometer** :

  Mampu memberikan informasi posisi garis lintang (lintang utara/ lintang selatan)

  **Ground-based radio-navigation systems** :

  Akurat namun cakupan areal sempit

  Sistem ini banyak dipakai pada waktu PD II



**Satelit GPS**

- **GPS** :

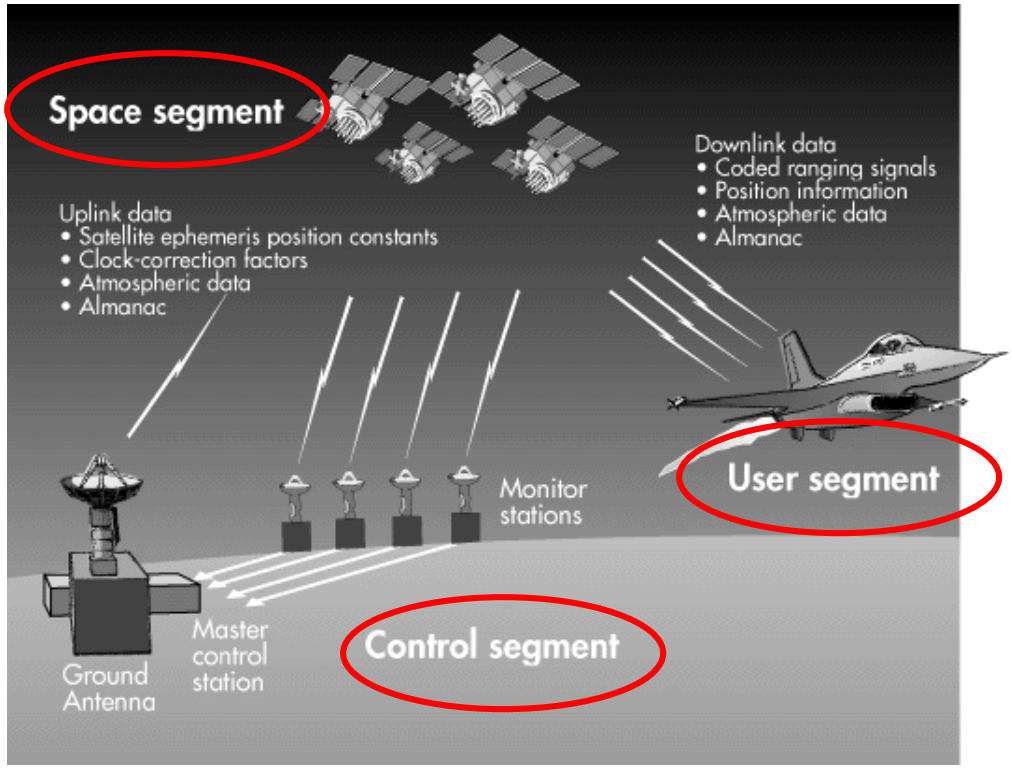
Satellite-based radio-navigation system (high-frequency radio wave with a special coded signal)

: cakupan area sangat luas

GPS banyak dipakai dalam operasi Dessert Storm

(9000 buah)

# KOMPONEN GPS




- **Space segment,**

  **(24 Satelit)**

- **User segment**

  **(Pesawat, kapal, mobil,**

- **Monitor segment**

  **(Hawai, Diego Garcia,**

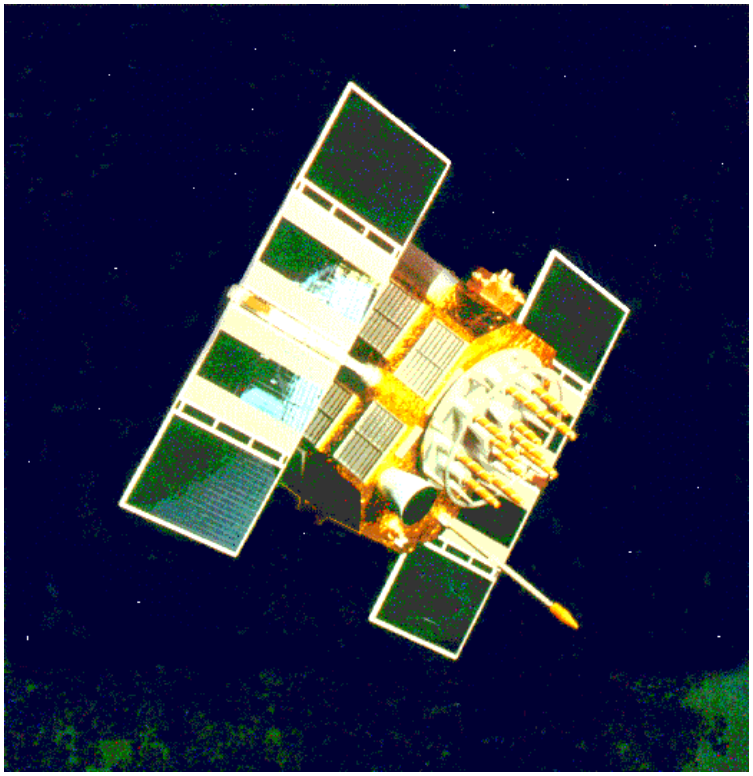
  **dan Colorado)**

- **Ground Control System**

  **(Falcon Air Force Base in**

  **Colorado Springs,**

  **Colorado)**



# SATELIT GPS

**GPS didukung oleh 27 satellite (data tahun 1998)**

**Pada ketinggian 20200 km di atas permukaan bumi**

**Setiap Satelit membutuhkan 12 jam untuk memutari bumi.**

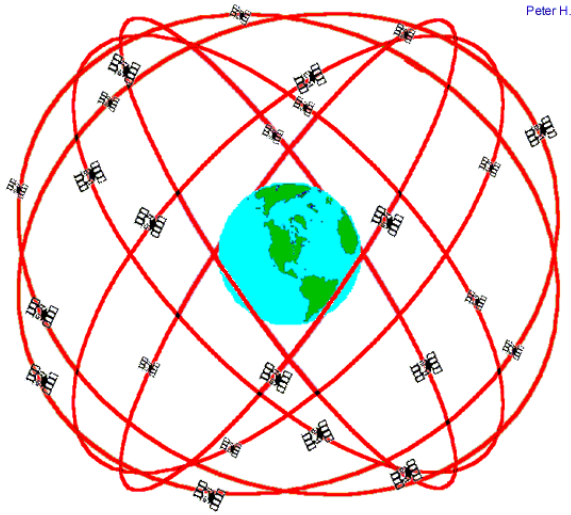
**Masing-masing dilengkapi dengan jam dengan akurasi yg sangat tinggi (0.000000003 detik)/ 2 cesium + 2 rubidium clocks**

**Berat satelit : 930 kg,**

**Panjang : 5.1 meter**

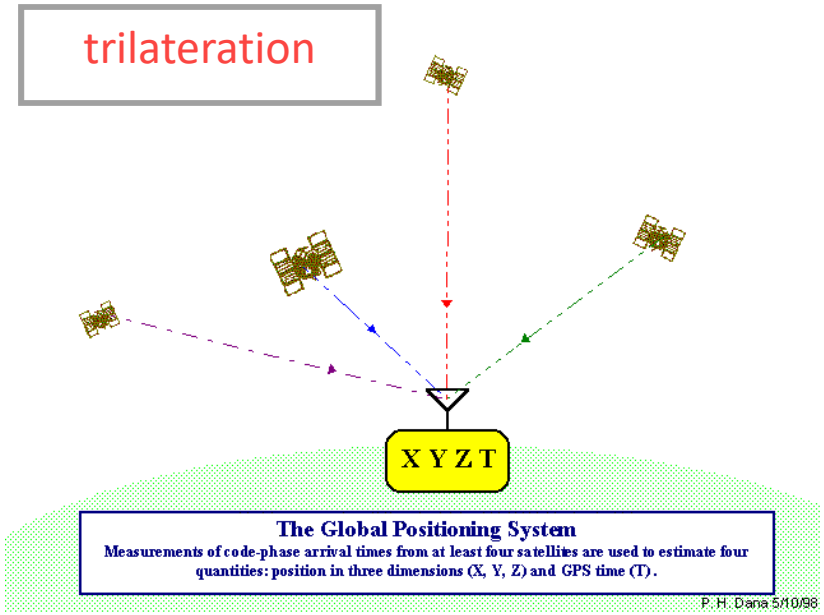
**Kecepatan : 4 km/detik**

**Umur satelit : 7.5 tahun**




GPS Nominal Constellation
24 Satellites in 6 Orbital Planes
4 Satellites in each Plane
20,200 km Altitudes, 55 Degree Inclination

# How GPS Works




Prinsipnya adalah :

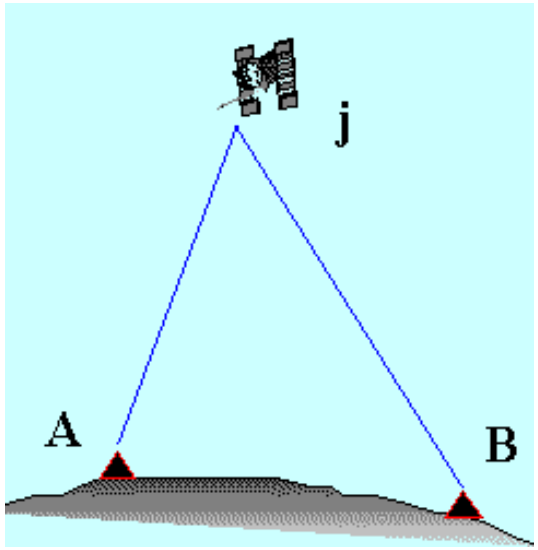
Satelit GPS memberikan informasi kepada receiver GPS mengenai jarak/ posisi satelit.

Sehingga kita tahu bahwa kita berada pada suatu radius tertentu dari satelit.

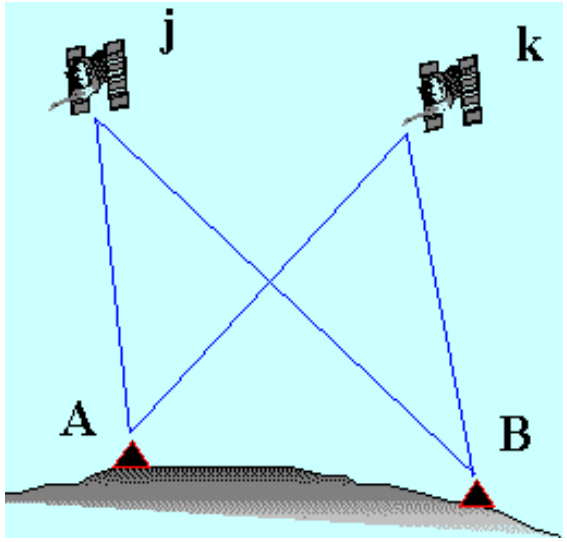
Bila ada dua satelit maka kita tahu posisi kita, berada pada 2 lokasi, yaitu perpotongan dua radius tadi. GPS receiver mampu menghitung tempat yg paling mungkin.

Semakin banyak sinyal satelit ditangkap semakin teliti satelit menghitung posisi ----→ metoda Trilateration

# Phase Differencing Techniques




Single Differences



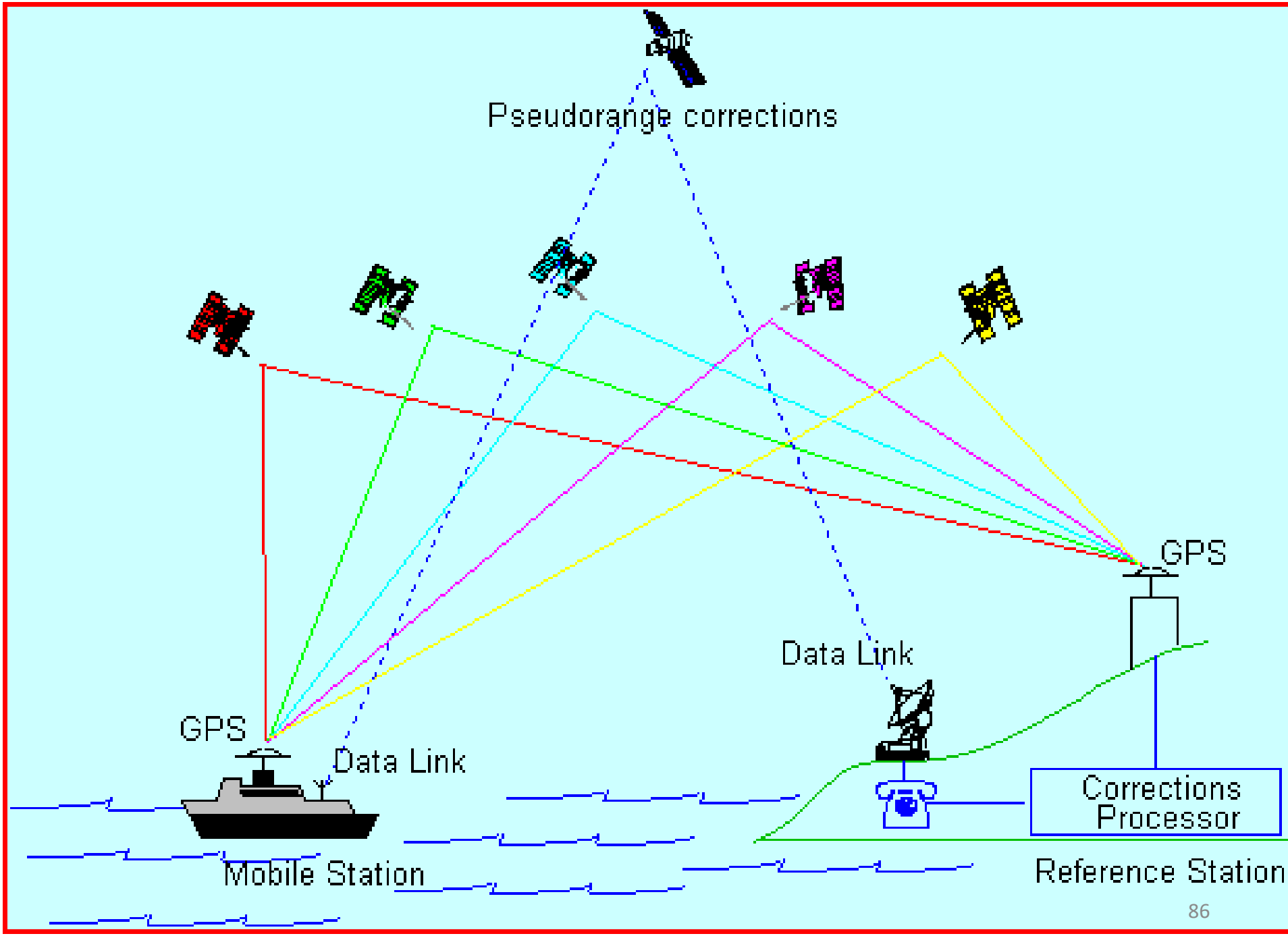

Double Difference

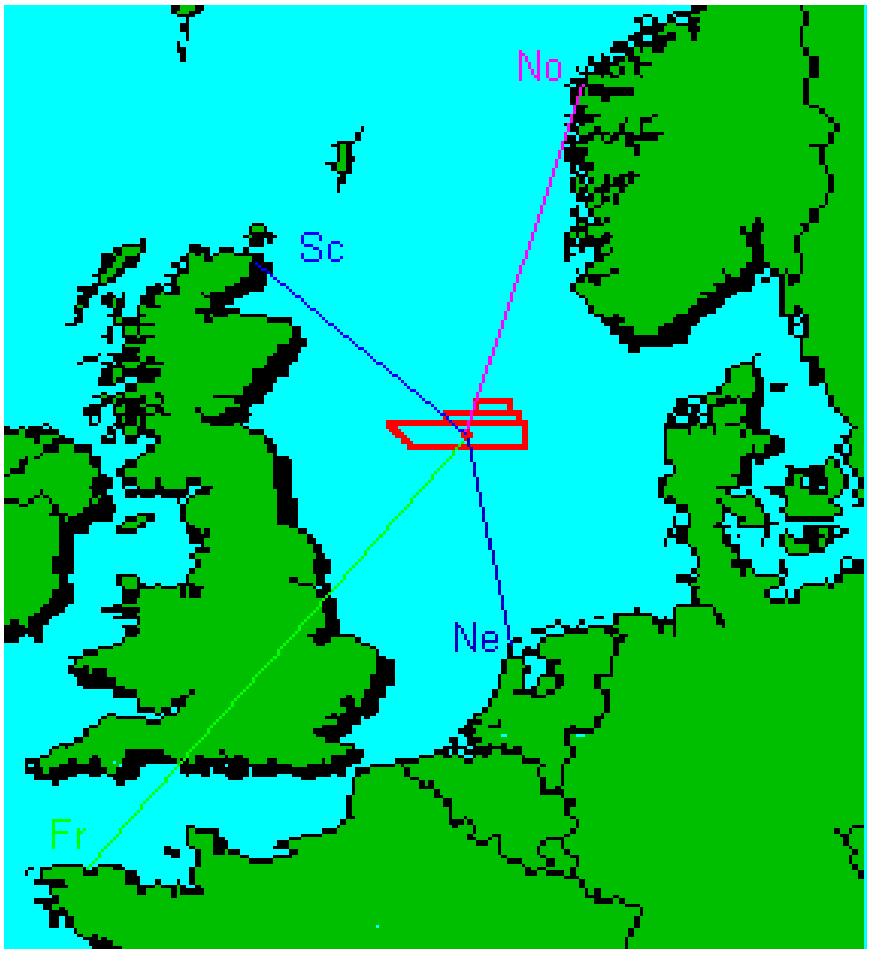
Teknik ini digunakan untuk menambah ketelitian pengukuran.

Diperlukan Reference Station GPS yang sudah diketahui posisinya, dengan merefer data tersebut GPS yang mobile, dapat memperkirakan posisinya dengan lebih tepat.

Posisi Reference Station GPS dapat satu tempat atau lebih

Teknik pengukuran seperti ini disebut DGPS : Differential GPS

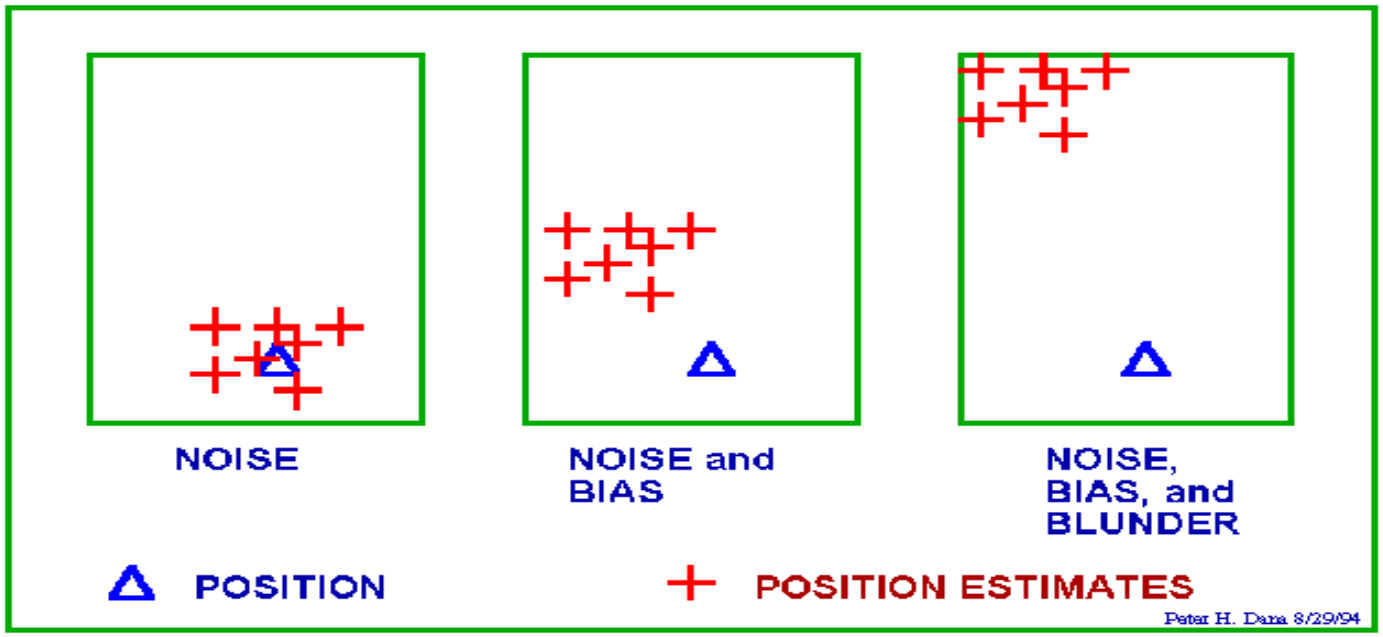

Pseudorange corrections
GPS
Data Link
GPS
Data Link
Corrections Processor
Mobile Station
Reference Station

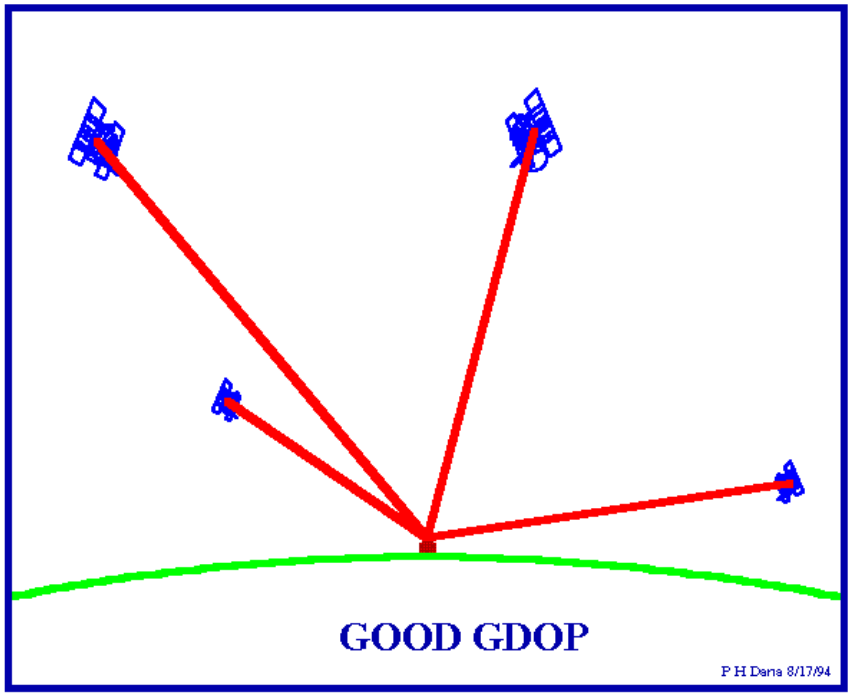



Navigasi Kapal dengan menggunakan 4 Reference Station GPS

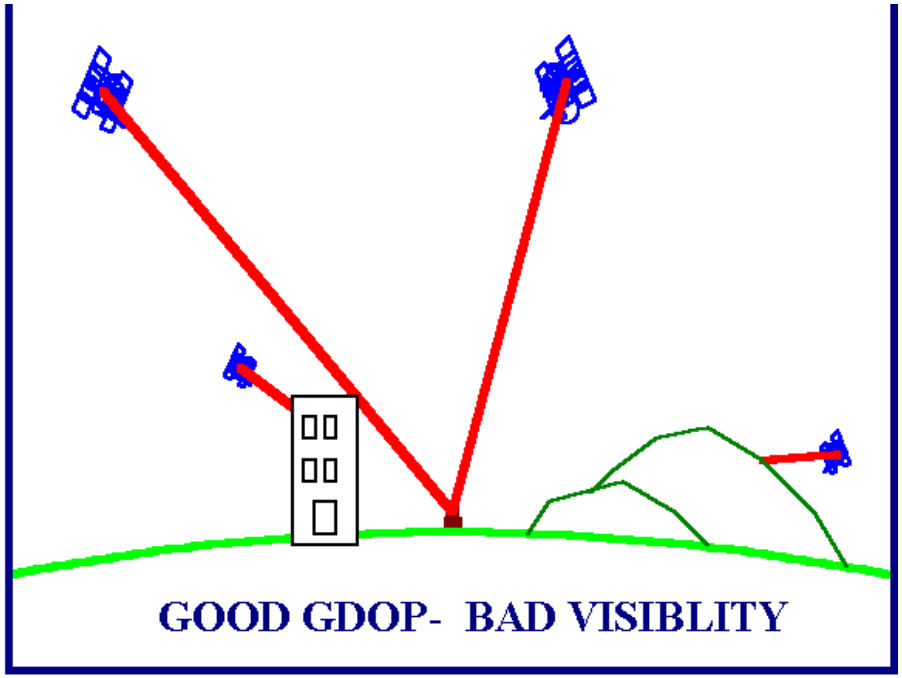
# GPS Error Sources

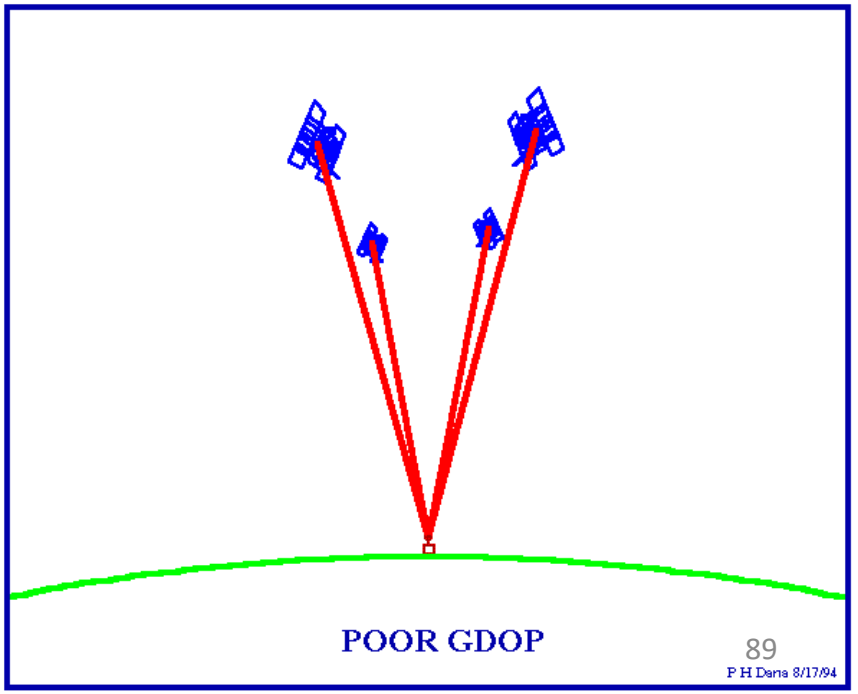
- **Noise : Gangguan pada signals**
- **Bias : Selective Availability (SA), Multipath, Delay oleh Ionosphere dan Troposphere**
- **Blunder : Kesalahan user (kesalahan datum, kesalahan komputer pada segment kontrol)**



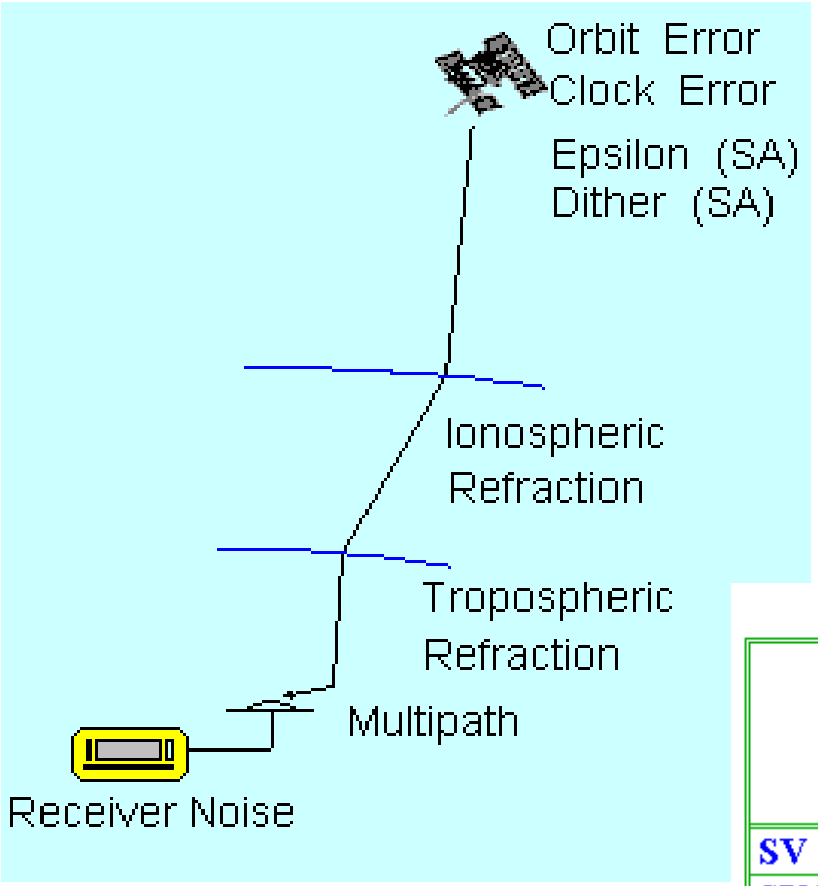



- **Geometric Dilution of Precision (GDOP) and Visibility**



# GPS Error Sources




## GPS ERROR SOURCES

| ERROR SOURCE | TYPICAL RANGE ERROR | DGPS (CODE) RANGE ERROR <100 KM REF-REMOTE |
|---|---|---|
| SV CLOCK | 1 M | |
| SV EPHEMERIS | 1 M | |
| SELECTIVE AVAILABILITY | 10 M | |
| TROPOSPHERE | 1 M | |
| IONOSPHERE | 10 M | |
| PSEUDO-RANGE NOISE | 1 M | 1 M |
| RECEIVER NOISE | 1 M | 1 M |
| MULTIPATH | 0.5 M | 0.5 M |
| RMS ERROR | 15 M | 1.6 M |
| ERROR * PDOP=4 | 60 M | 6 M |

PDOP=Position Dilution of Precision (3-D) 4.0 is typical

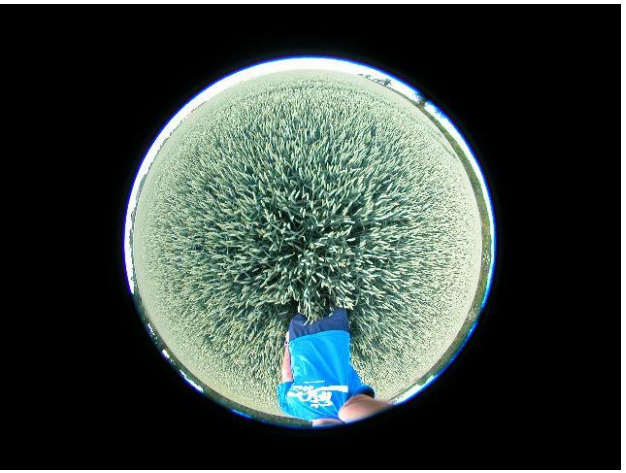
# GPS FOR?

General Purpose Handheld
Attitude Determination
Aviation
Automobile Navigation,
Mapping & Data Collection
Marine
OEM (Original Equipment Manufacturer)
Space
Surveying
Timing

# Fundamentals of Remote Sensing

- Remote sensing is the acquisition of data, "remotely"
- Earth Observation / Remote Sensing (EO/RS)
- For EO, "remotely" means using *instruments (sensors)* carried by *platforms*
- Usually we will think in terms of satellites, but this doesn't have to be the case
  - aircraft, helicopters, ...

# Remote Sensing: examples



- Not always big/expensive equipment
  - Photography (kite, aerial, helicopter…)
  - Field-based

# Remote Sensing: examples

upscale

upscale

upscale

- Platform depends on application
  - What information do we want?
  - How much detail?
  - What type of detail?

http://www-imk.fzk.de:8080/imk2/mipas-b/mipas-b.htm

# Why use satellite RS ?

- Source of spatial and temporal information
  - land surface, oceans, atmosphere, ice
- monitor and develop understanding of environment
- information can be **accurate**, **timely**, **consistent** and **large** (spatial) scale
- some historical data (60s/70s+)
- move to quantitative applications
  - data for climate (temperature, atmospheric gases, land surface, aerosols….)
- some 'commercial' applications
  - Weather, agricultural monitoring, resource management

# Why use satellite RS ?

- Sumber informasi spasial dan temporal

  - permukaan tanah, lautan, atmosfer, es

- memantau dan mengembangkan pemahaman tentang lingkungan
- informasi dapat skala yang akurat, tepat waktu, konsisten dan besar (spasial)
- beberapa data historis (60an / 70an +)
- pindah ke aplikasi kuantitatif

  - data untuk iklim (suhu, gas atmosfer, permukaan tanah, aerosol ....)

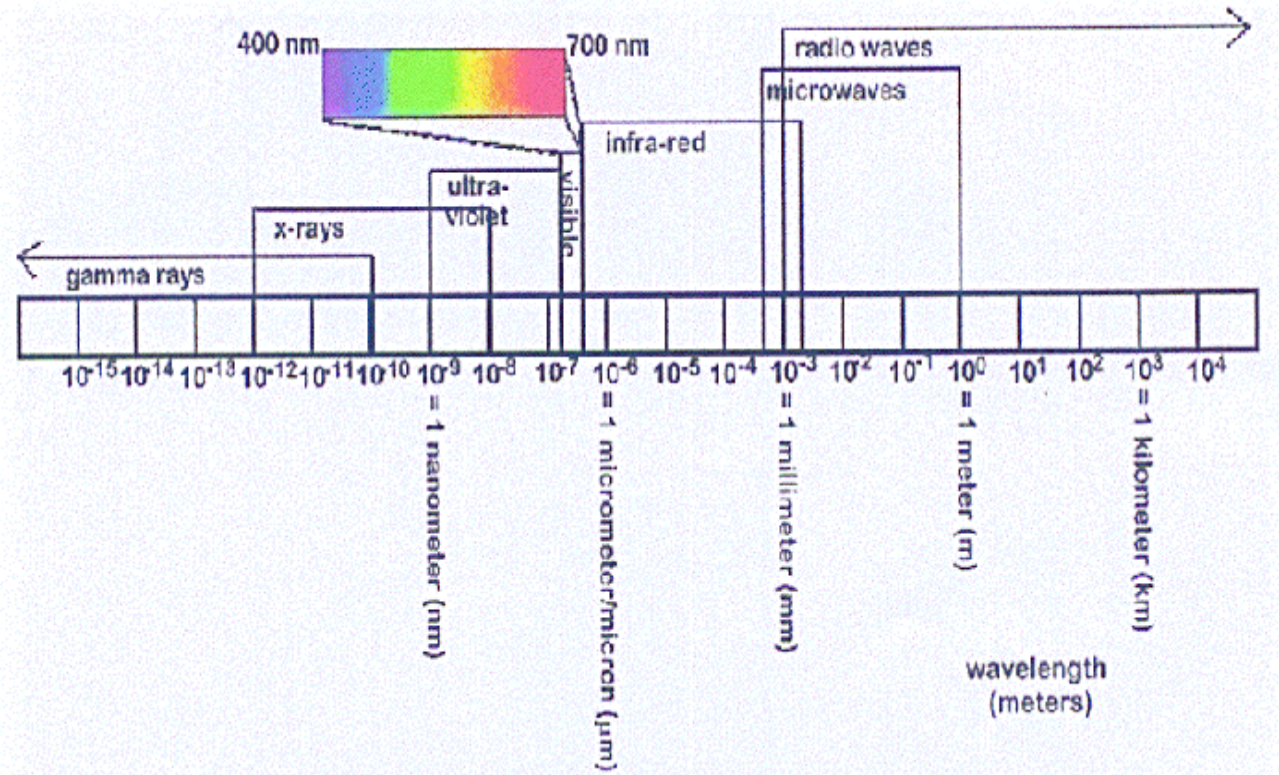
- beberapa aplikasi 'komersial’

  - Cuaca, pemantauan pertanian, manajemen sumber daya

# But….

- Remote sensing has various issues
  - Can be expensive
  - Can be technically difficult
  - NOT direct
    - measure surrogate variables
    - e.g. reflectance (%), brightness temperature ($Wm^{-2}$ $\Rightarrow$ $^{o}K$), backscatter (dB)
    - RELATE to other, more direct properties.

# Basic Concepts: EM Spectrum




Sometime use frequency, $f=c/\lambda$,

where $c=3\text{x}10^8$ m/s (speed of light)

$\lambda$ 1 nm, 1mm, 1m

$f$ $3\text{x}10^{17}$ Hz, $3\text{x}10^{11}$ Hz, $3\text{x}10^{8}$ Hz,

# A Remote Sensing System

- Energy source
- platform
- sensor
- data recording / transmission
- ground receiving station
- data processing
- expert interpretation / data users

# Physical Basis

- measurement of EM radiation
  - scattered, reflected
- energy sources
  - Sun, Earth
  - artificial
- source properties
  - vary in intensity AND across wavelengths

# EM radiation

- emitted, scattered or absorbed
- intrinsic properties (emission, scattering, absorption)
  - vary with wavelength
  - vary with physical / chemical properties
  - can vary with viewing angle

# Data Acquisition

- RS instrument measures energy received
  - 3 useful areas of the spectrum:-

*1) Visible / near / mid infrared*

  - **passive**
    - solar energy reflected by the surface
    - determine surface (spectral) reflectance
  - **active**
    - LIDAR - active laser pulse
    - time delay (height)
    - induce florescence (chlorophyll)

*2) Thermal infrared*

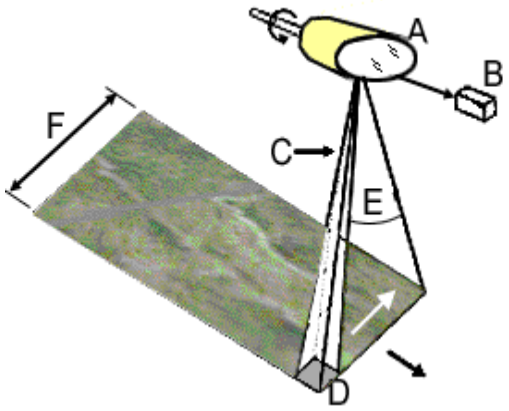
  - energy measured - temperature of surface and emissivity

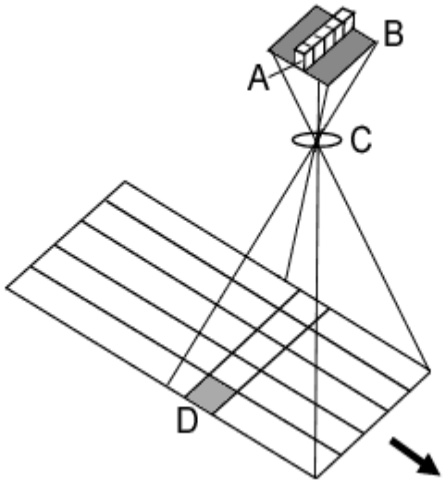
*3) Microwave*

  - **active**
    - microwave pulse transmitted
    - measure amount scattered back
    - infer scattering
  - **passive**
    - emitted energy at shorter end of microwave spectrum

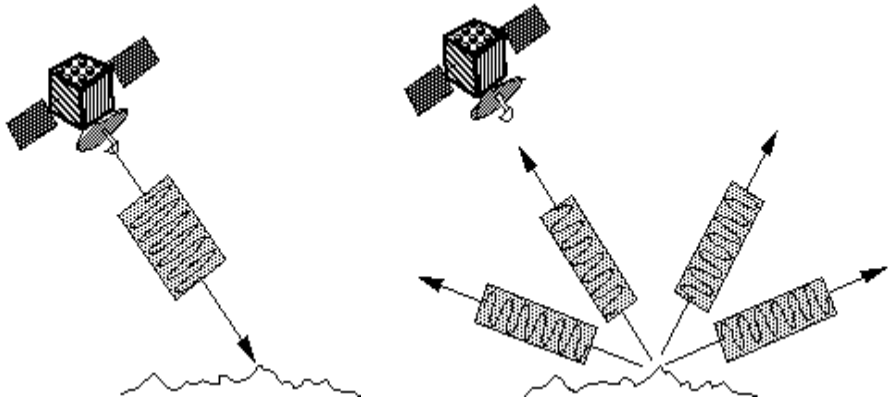
# Image Formation

- Photographic (visible / NIR, recorded on film, (near) instantaneous)
- *whiskbroom scanner*
  - visible / NIR / MIR / TIR
  - point sensor using rotating mirror, build up image as mirror scans
  - Landsat MSS, TM
- *Pushbroom scanner*
  - mainly visible / NIR
  - array of sensing elements (line) simultaneously, build up lin
  - SPOT

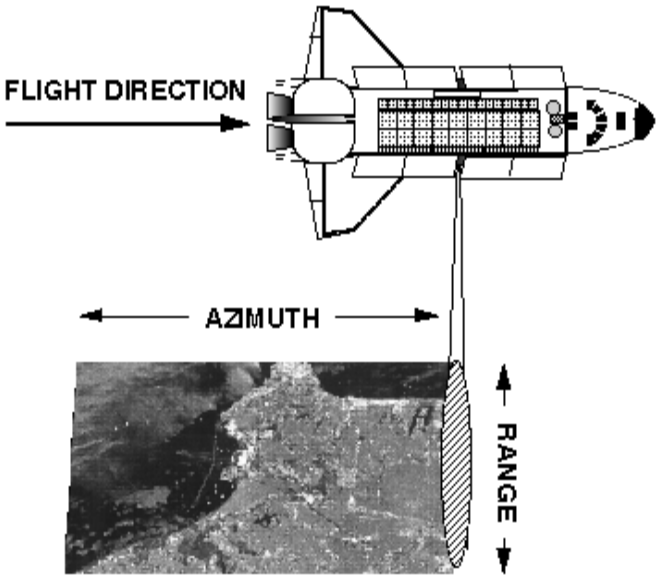


# Image Formation: RADAR



- real aperture radar
  - microwave
  - energy emitted across-track
  - return time measured (slant range)
  - amount of energy (scattering)
- synthetic aperture radar
  - microwave
  - higher resolution - extended antenna simulated by forward motion of platform
  - ERS-1, -2 SAR (AMI), Radarsat SAR, JERS SAR



# Quantization: digital data

- received energy is a continuous signal (analogue)
- quantise (split) into discrete levels (digital)
- Recorded levels called digital number (DN)
- downloaded to receiving station when in view
- 'bits'...
  - 0-1 (1 bit), 0-255 (8 bits), 0-1023 (10 bits), 0-4095 (12 bit)
- quantization between upper and lower limits (dynamic range)
  - not necessarily linear
- DN in image converted back to meaningful energy measure through *calibration*
  - account for atmosphere, geometry, ...
- relate energy measure to intrinsic property (reflectance)

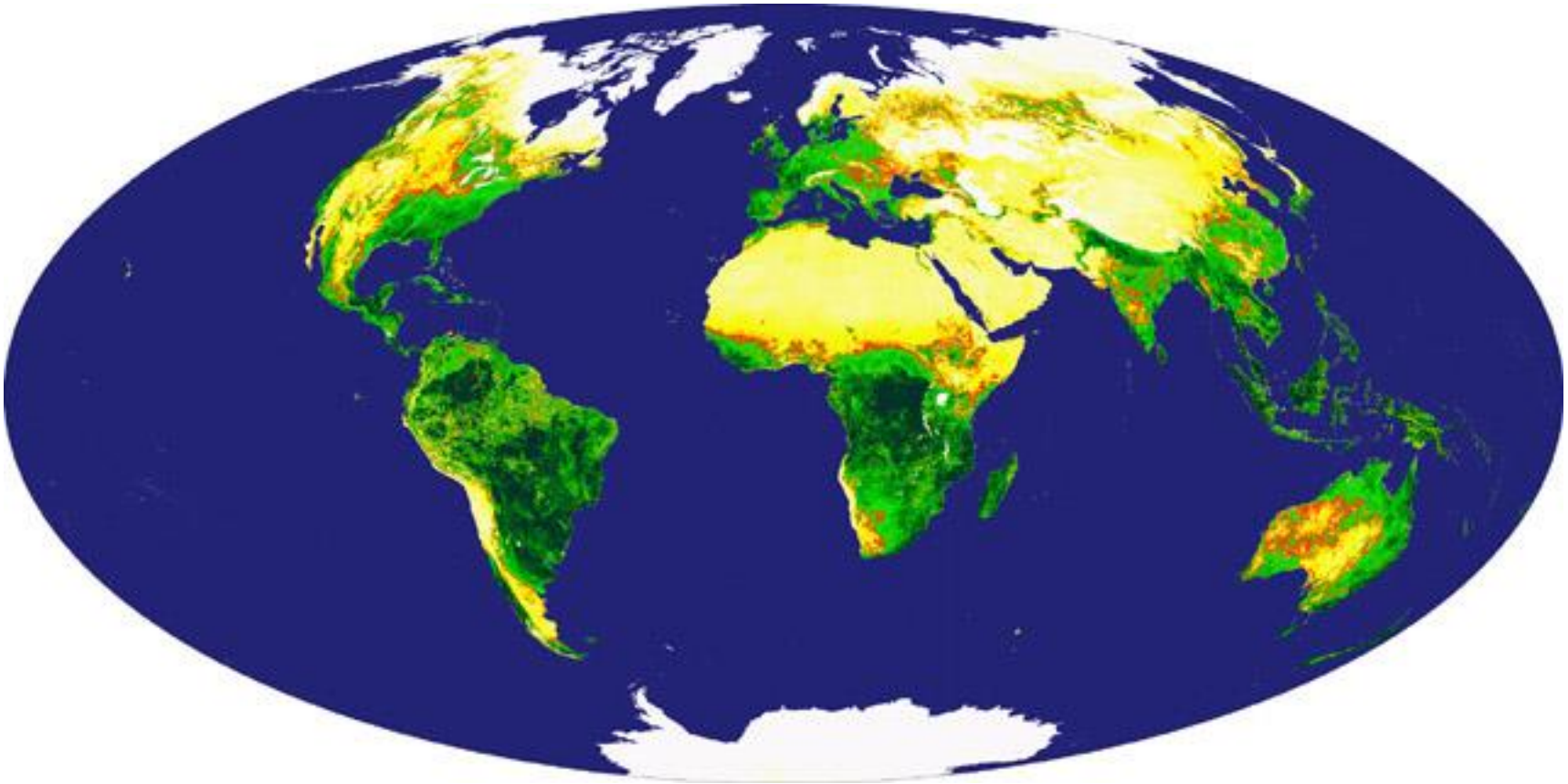
# Image characteristics

- pixel - DN
- pixels - 2D grid (array)
- rows / columns (or lines / samples)
- 3D (cube) if we have more than 1 channel
- dynamic range
  - difference between lowest / highest DN

# Example Applications

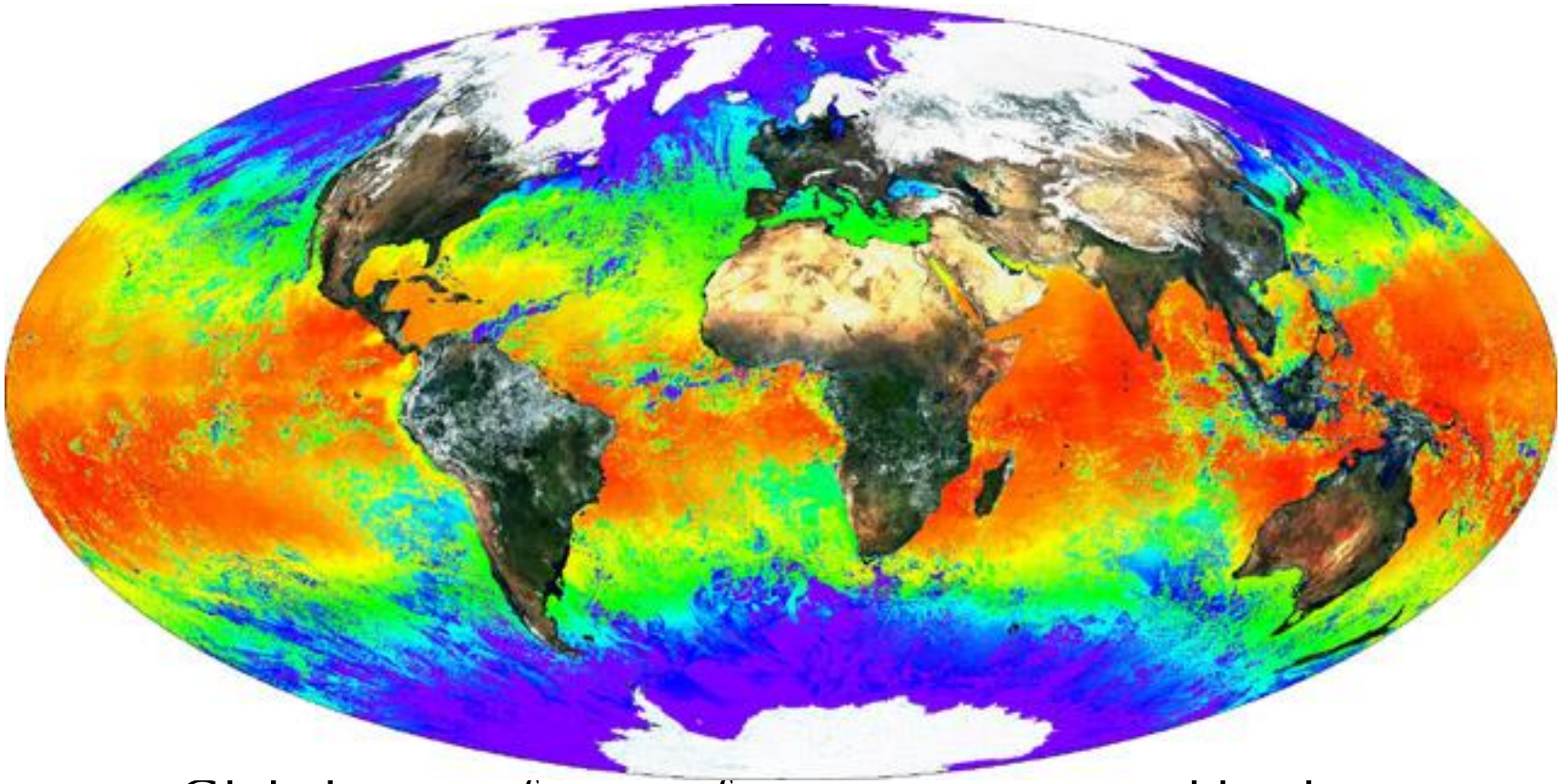
- visible / NIR / MIR - day only, no cloud cover
  - vegetation amount/dynamics
  - geological mapping (structure, mineral / petroleum exploration)
  - urban and land use (agric., forestry etc.)
  - Ocean temperature, phytoplankton blooms
  - meteorology (clouds, atmospheric scattering)
  - Ice sheet dynamics

# Remote Sensing Examples



- Global maps of vegetation from MODIS (moderate resolution imaging spectroradiometr) instrument
- modis.gasfc.nasa.gov

# Remote Sensing Examples



•Global maps of sea surface temperature and land surface reflectance from MODIS instrument

# Example Applications

- Thermal infrared - day / night, rate of heating / cooling
  - heat loss (urban)
  - thermal plumes (pollution)
  - mapping temperature
  - geology
  - forest fires
  - meteorology (cloud temp, height)

# Example Applications

- Active microwave - little affected by atmospheric conditions, day / night

– surface roughness (erosion)

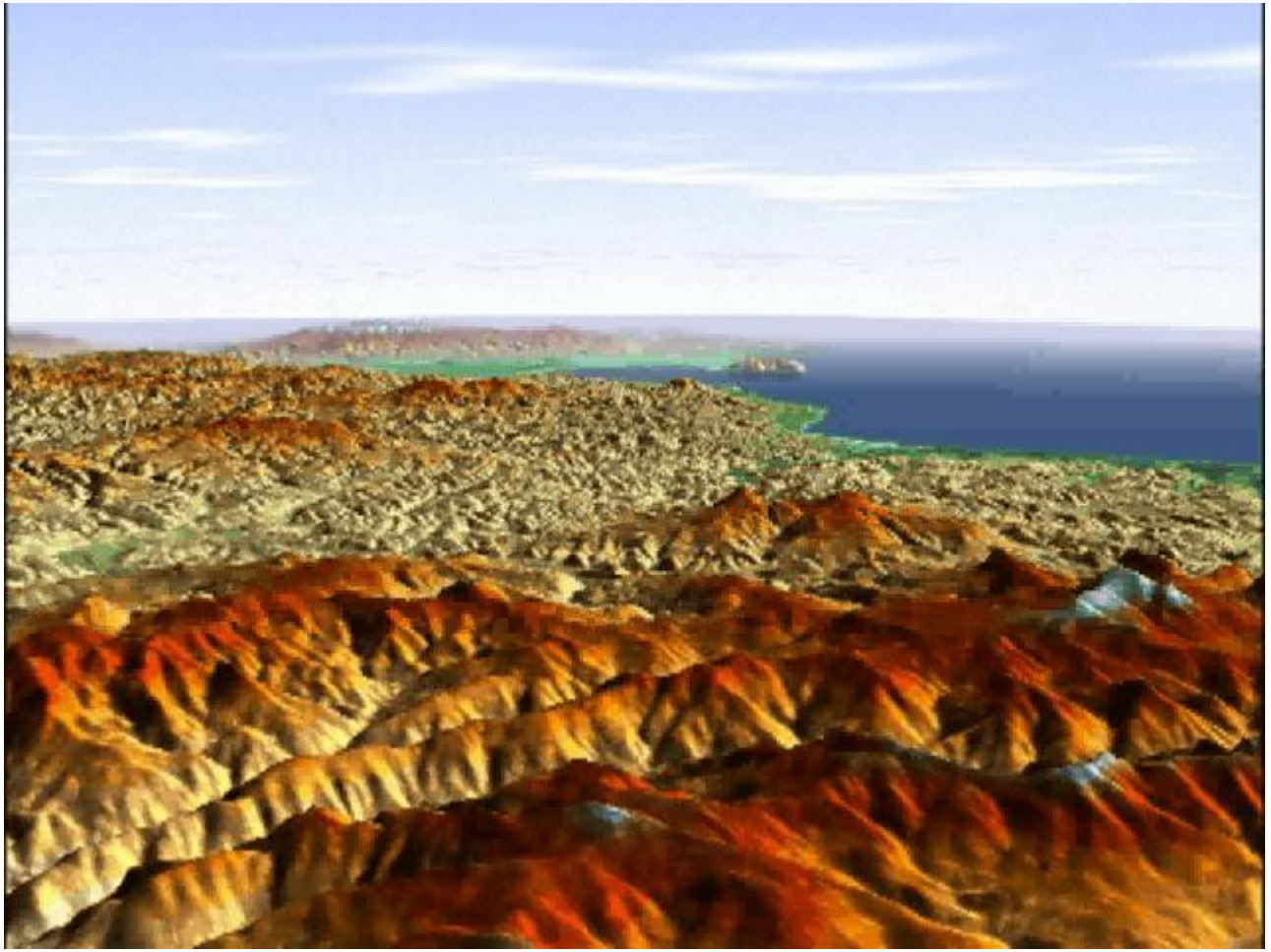
– water content (hydrology) - top few cms

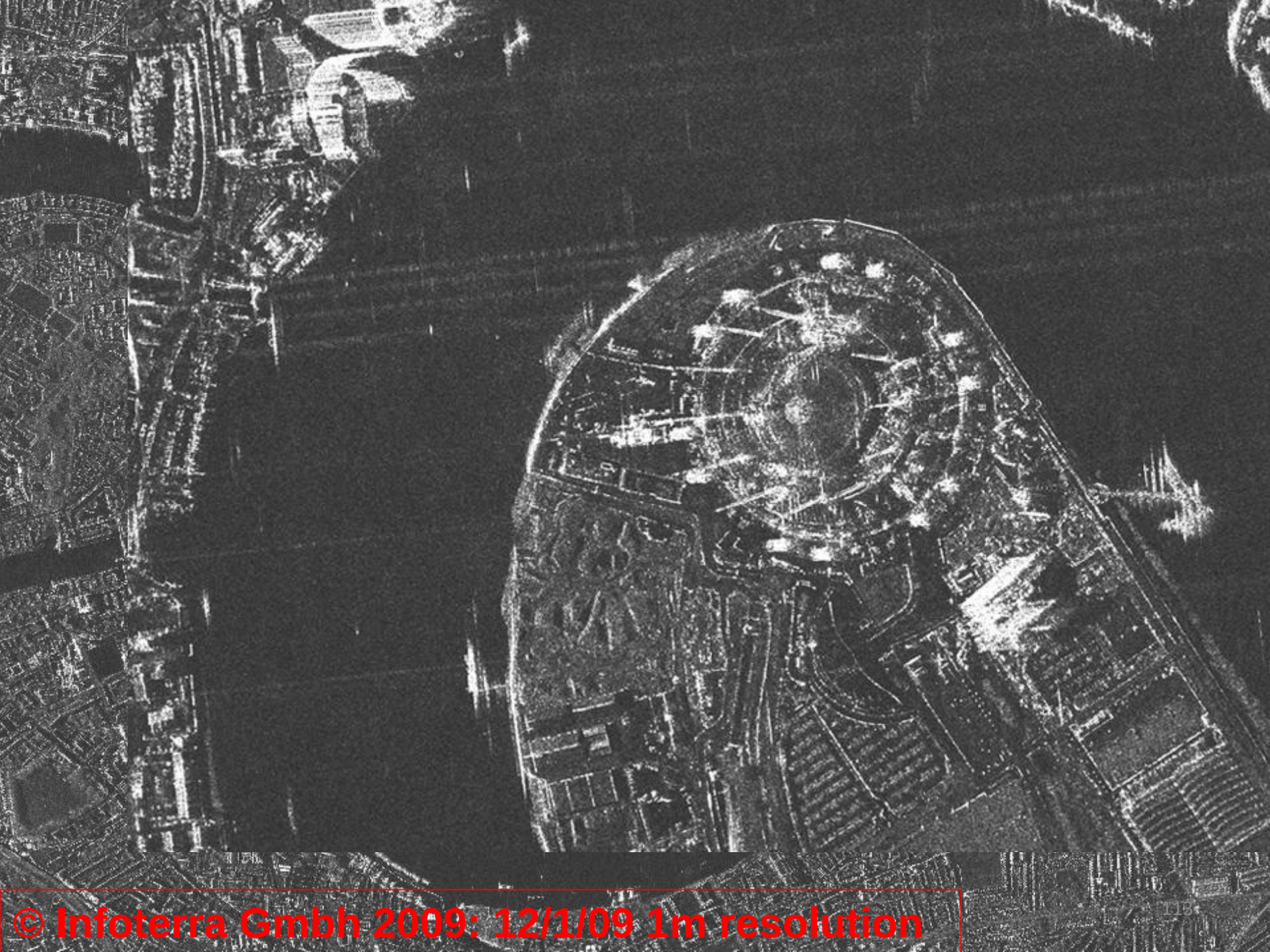
– vegetation - structure (leaf, branch, trunk properties)

– Digital Elevation Models, deformation, volcanoes, earthquakes etc. (SAR interferometry)

# Example Applications

Fly-through of Mt Hokaido generated from SRTM (Shuttle RADAR Topographic Mapping data)




© Infoterra Gmbh 2009: 12/1/09 1m resolution

© Digital globe 12/1/10 0.5m resolution

© Digital globe 12/1/10 0.5m resolution

© Digital globe 12/1/10 0.5m resolution