# Groundwater Data Analysis

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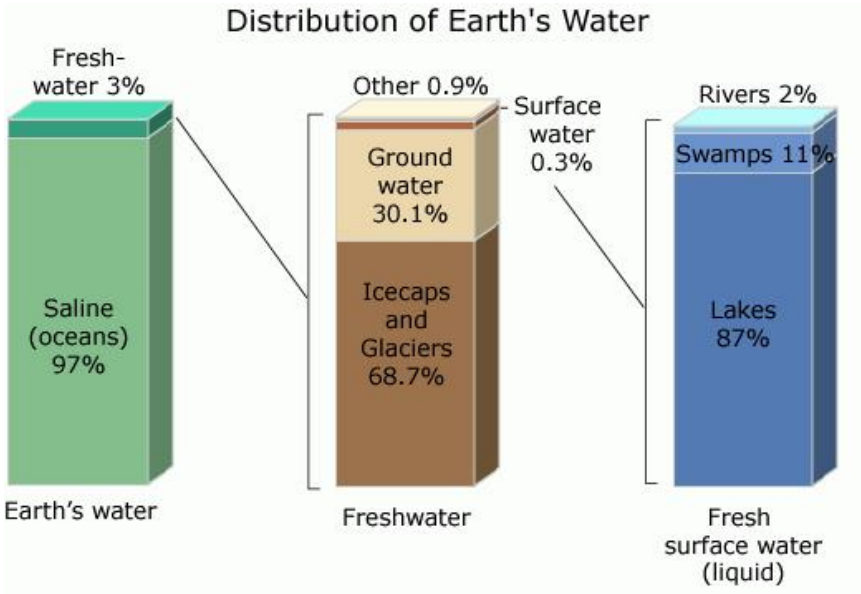
# Outline

- Motivation
- Objective
- Terminology
- Case Studies
- GSDA Data Set
- Discrepancy
- Single Well Year Long Model

# Motivation

- Water, second most important thing for survival.




Source:http://ga.water.usgs.gov/edu/waterdistribution.html

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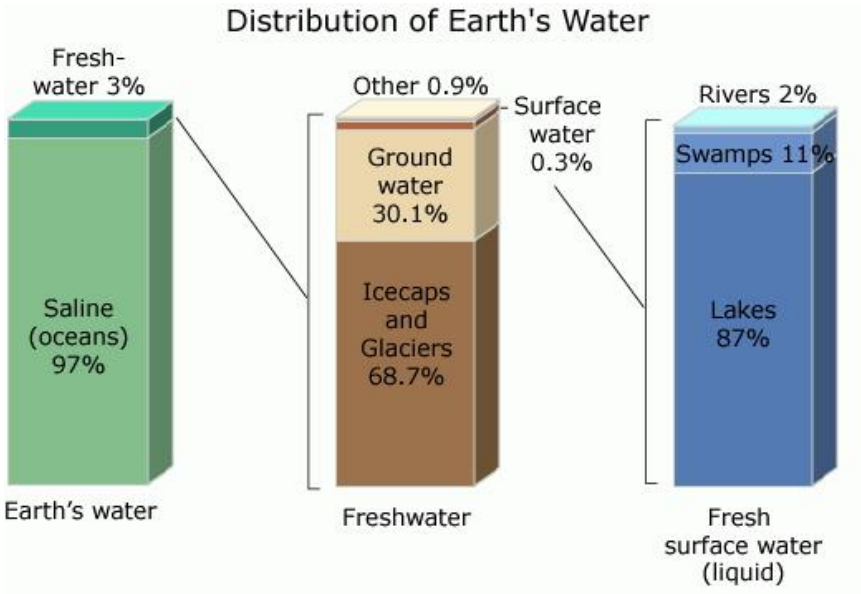


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- So, groundwater is important.

# Motivation

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- Groundwater feeling the pressure.
- Wells in India: 1960($<$100,000), 2006(12 million)
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- Increasing population,industries : more demands
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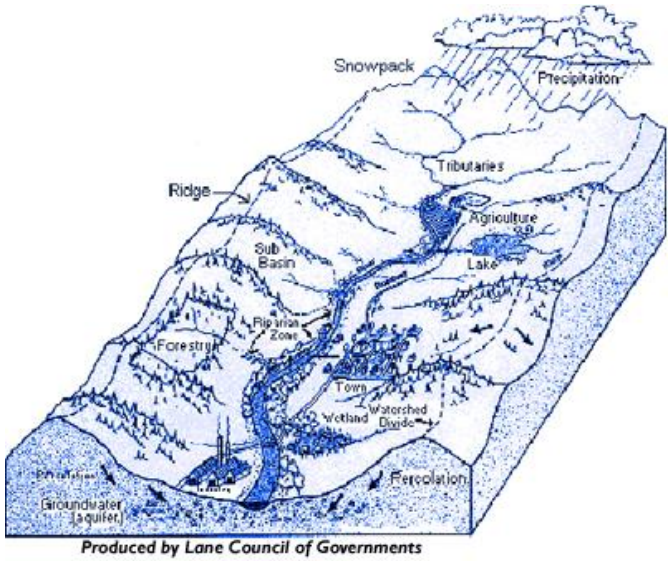
- Wells in India: 1960($<$100,000), 2006(12 million)
- Water table going down.
- Need to monitor,plan and regulate its use.
- Future needs can be handled.

# Some Terms

- Watershed : Water flows to same point.
- Aquifer : Layer underneath the ground which allows storage and movement of water through it.
- Hydraulic conductivity: Ease with which water can move in soil.




Watershed

# Objective

- Study groundwater behavior for Thane district.

1. Build mathematical models.
2. Understanding water budget.
3. Feedback for 163 wadis.

# Objective:Mathematical models

- Start with simple single well model.
- To show groundwater variation in a year.
- Help in predicting the water level.
- Could be used as input in planning for drinking water schemes .
- Extend them to district and regional level.
- Make the model more inclusive.

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  - Higher elevation (hills): Water not reaching.

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- Need to investiagte what's wrong ?
  - Groundwater is an important factor.
  - Tribal people : Social factor may have been involved.
  - Higher elevation (hills): Water not reaching.
- Study groundwater for these wadis
- Provide the feedback

# Objective:Water budget

- Water bugdet : Yearly document for each district.
- Describes water requirement and the resources to meet them.
- Objective is to this document.
  - What all input are needed for its preparation?
  - What are the output of this document.
  - How is the output used in planning.

# Case Study: NHDM

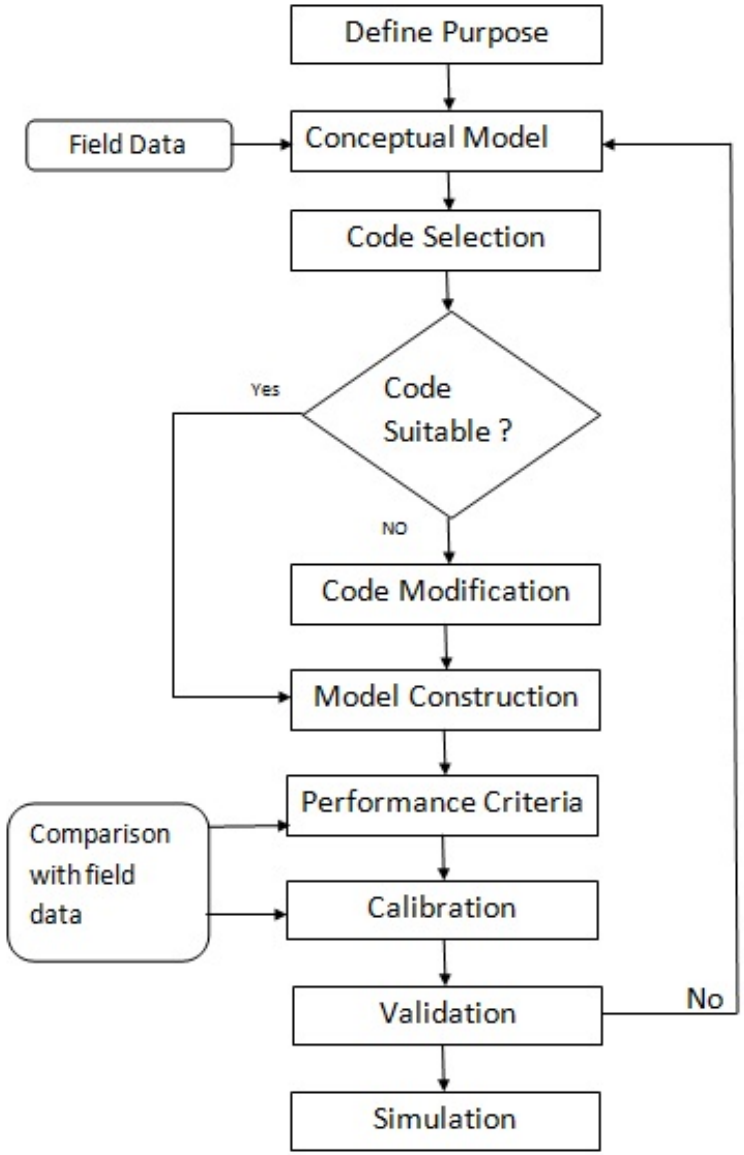
- Denmark: 99% water supply based on groundwater.
- Problems: Pressure on groundwater, its pollution.
- Review present status and future needs of groundwater resources.
- Geological Survey of Denmark(GEUS): Nationl Hydrological Model(NHM).
- Covers 43000 $Km^2$
- NHM Goal : Accurate assesment of groundwater.

# Case Study: NHDM

- Prior:Surface or ground water modelling.
- Done for areas $\geq 50000\text{Km}^2$
- Intergrated models :area $\leq 4000\text{Km}^2$
- Problems with integrated model
  - Would require large data
  - Aggregate behaviour same.
  - But underlying process may be not be same.
- Describes input,peformance criteria and validation and not the details of modelling.

# Case Study

- Conceptual Model.
  - Geology: Area and topography
  - Hydrology process included
- Performance Criteria
  - Observed data used as targets.
  - Deviation of simulated from observed
  - Run-off for river gauging station.
  - Variation in dischharge.
- Validation
  - split-sample
  - proxy-basin



# GSDA

- Groundwater Survey and Development Agency.
- Water Supply  Sanitation Department.
- Established in 1972.
- 3 Tier hierarchical Organization
  - Head office: Pune
  - 6 Regional offices
  - District offices

# GSDA some functions

- Periodic groundwater monitoring.
- Drinking water supply to rural areas
- Drilling of borewells/tubewells.
- Artificial groundwater recharge.
- Provide assistance to NGO's and other organization
- Communicate the environmental and economic value of groundwater .

# GSDA Data Set

- Observation wells data.
- Tahsil level rainfall data.
- Watershed maps.
- Aquifer boundary maps.
- Soil properties.
- Available : Observation well data for Thane

# Thane District

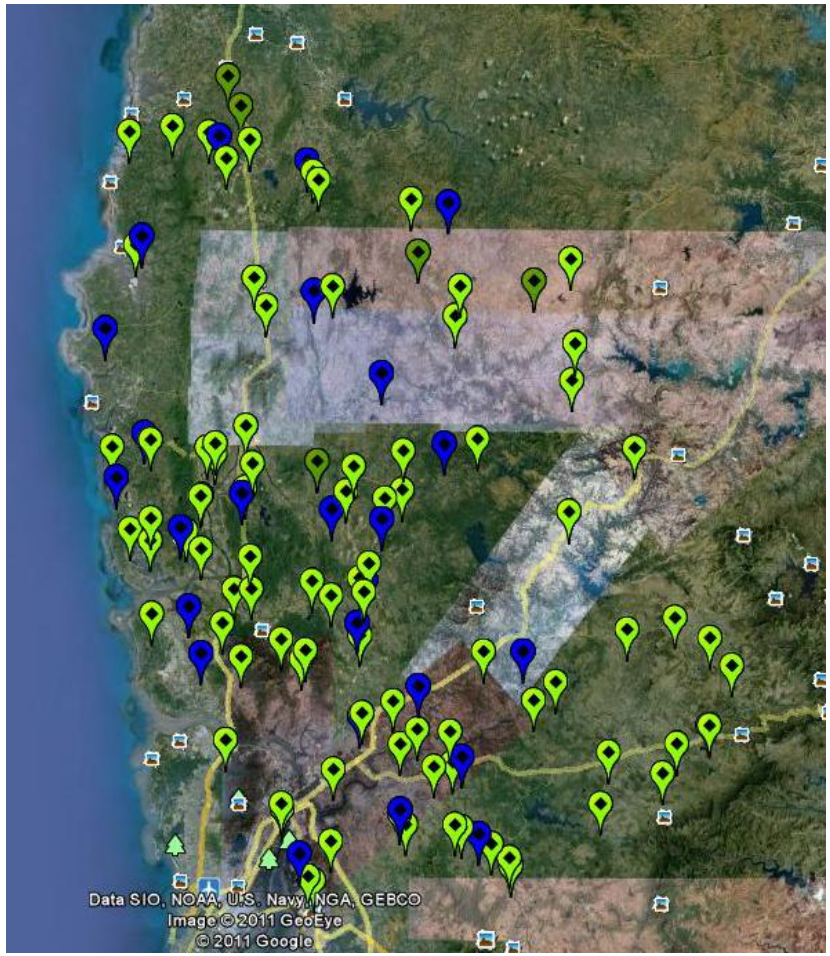
- Geographical area : 9337 sq. Km
- Population(2001): 81 Lakhs, Rural(23 Lakhs)
- Tahsils : 15
- Villages : 1728
- Average Rainfall : 2600mm

# Observation Wells

- Observation Wells : Dedicated wells for groundwater monitoring
- Choice of observation well ?
- Watersheds :
  - Runoff(10-20%)
  - Recharge(20-40%)
  - Storage (>50%)
- Thane: 34 Watersheds, but no storage part
- Hardrock area

# Observation Wells in Thane

- Thane: 120.
- Spread in 115 villages.
- Dug Wells
  - Count : 92
  - Sampling started from 1975.
  - Jan, Mar, May , Oct.
  - Usually 7m -10m deep.
- Bore Wells
  - Count : 28
  - Sampling started from 2000.
  - Sampled throughout the year.
  - Depth is about 15m-30m.



# Observation Wells Data : Thane

- Received data for 120 observation wells in excel sheet format.
- 11682 tuples, 476 indicated dry wells.
- Indicated the water level over the sampled period.

| Tahsil | Village | Watershed | Site_Type | wls_date | wls | depth | Site_id |
|---|---|---|---|---|---|---|---|
| Bhiwandi | Akoli | WF-27 | Dugwell | 1991-01-31 | 3.5 | 5.5 | W192915073024001 |
| Bhiwandi | Akoli | WF-27 | Dugwell | 1991-03-31 | 3.7 | 5.5 | W192915073024001 |
| Murbad | Inde | WF-35 | Dugwell | 2004-05-30 | 3.3 | 7.8 | W191700073333001 |
| Murbad | Inde | WF-35 | Dugwell | 2004-09-30 | 1.7 | 7.8 | W191700073333001 |
| Bhiwandi | Padgha | WF-31 | Borewell | 2002-10-08 | 3.46 | 30 | W192143073103001 |

# Observation Wells Data:Thane

- Basic Cleanup
  - Duplicate entries: 366
  - Negative entries: 12
  - Water depth more than well depth : 2
  - Remaining tuples: 11302
- Other Variations: Geological, rainfall, noise, human interference
- Flagging Done: Unexpected Varaition, gap in observations.

| Village | Site_Type | Wls_Date | Wls | Depth | Flag |
|---|---|---|---|---|---|
| Khodala | Dug Well | 2000-04-06 | 5 | 5.8 | 0 |
| Khodala | Dug Well | 2000-05-25 | 2.6 | 5.8 | 1 |

# Observation Wells Data:Flagging

- Previous approach of flagging was not good.
  - Hard deadline of monsoon.
  - Gap between observation was not taken into consideration.
  - Flagging in monsoon without rainfall consideration.
- New Approach for flagging
  - Flag bewteen Oct-May.
  - Water depth should striclty increase(water goes down) as no rain in this period.
  - Flag where it increases. 471 entries.
- Check against rainfall .
- Got daily rainfall data for period 1986-2007 from GISE lab, IIT Bombay.

# Observation Wells data: Discrepancy Checking

- Rainfall data for points show in red.
- Checked 373 discrepancy out of 471 against rainfall(conservative).
- 102 had non-zero rain and 271 had zero rain.
- Out of 271 neglect those with increase $\leq 0.2m$.
- Still 189 discrepancies remain.

# Year Long Single Well Model