



**British  
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Applied geoscience for our  
changing Earth

# Technological advances – how groundwater management might take advantage

Andrew McKenzie

# Issues for groundwater management

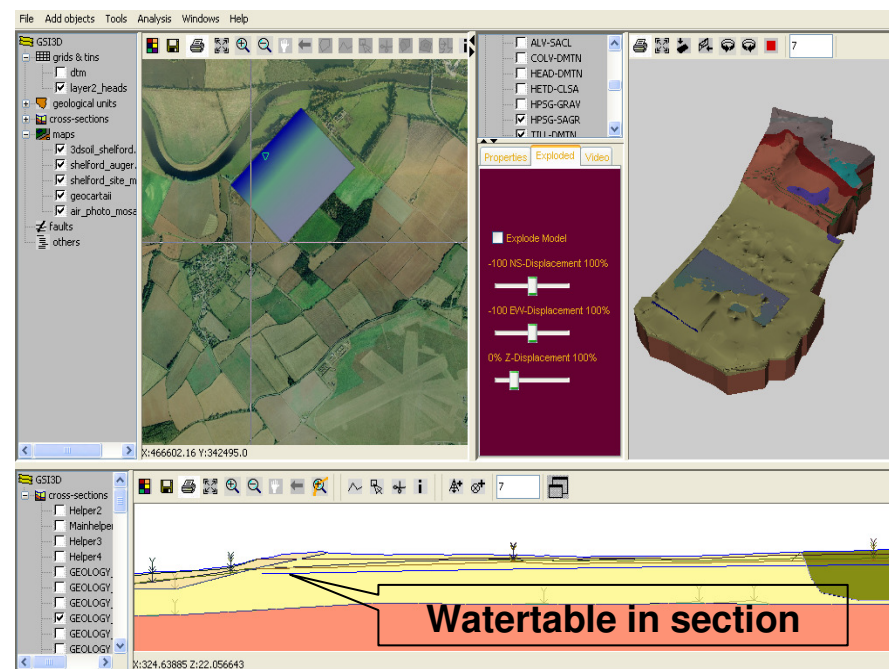
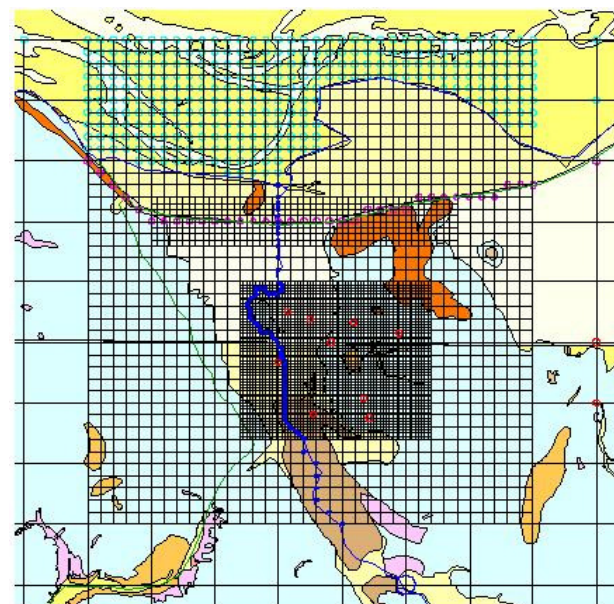
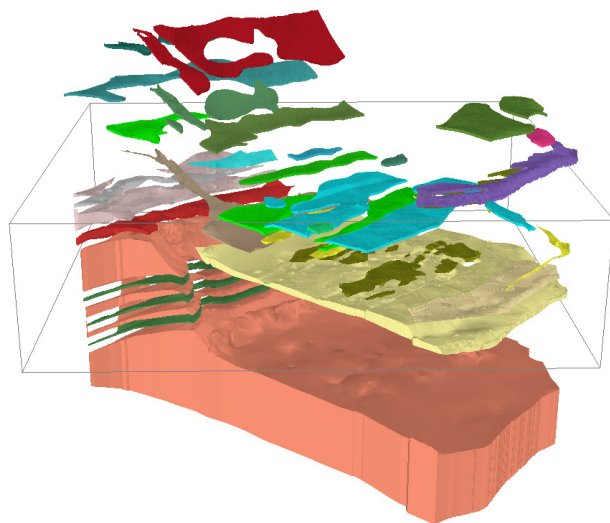
- Groundwater depletion
- Nutrient use and management
- Urban growth
- Public concern and legal requirements for ecosystem preservation or restoration
- Energy production alternatives and greenhouse gas mitigation strategies
- Groundsource heatpumps
- Biofuels
- Coal-bed and deep methane sources
- Geosequestration of CO<sub>2</sub>
- Climate change



# The questions:

1. What technology has most changed your work over the last 5 years?
2. What technological advances do you expect to change the work of a groundwater specialist in the next 10 years?
3. What technological advances do you expect to change the work of a groundwater specialist in the next 40 years?
4. What will be the major issue facing a groundwater scientist in 2050?

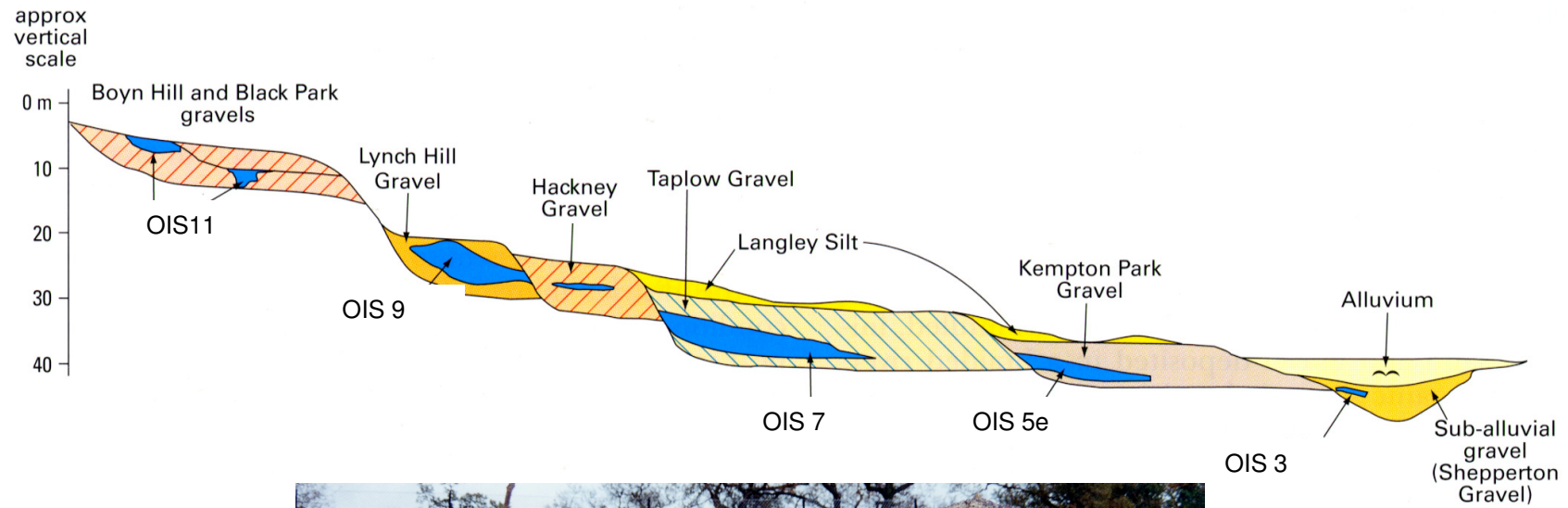












# Evolution of Computer Power/Cost

MIPS per \$1000 (1997 Dollars)

Million

1000

1

1  
1000

1

Million

1

Billion

1900

1920

1940

1960

1980

2000

2020

Year

Brain Power Equivalent per \$1000 of Computer

Human

Monkey

Mouse

Lizard

Spider

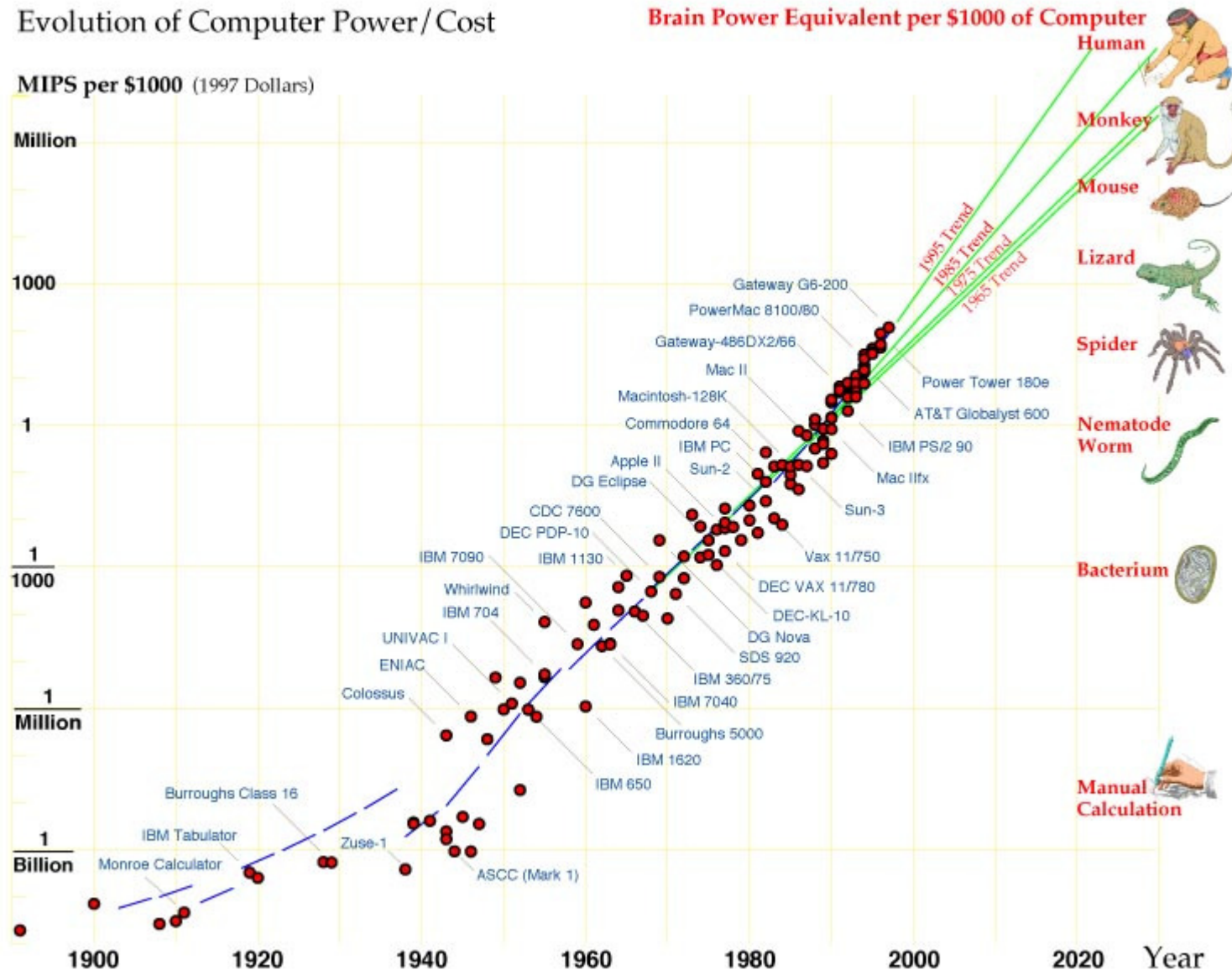
Nematode

Worm

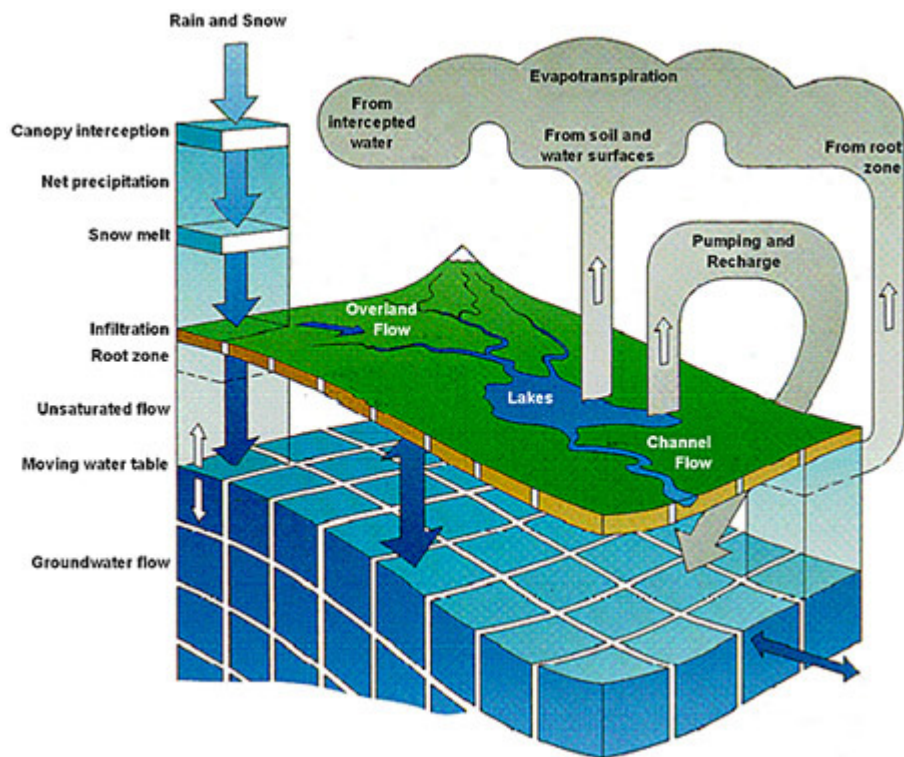
Bacterium

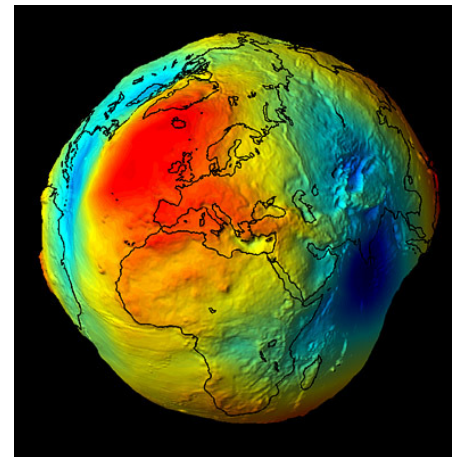
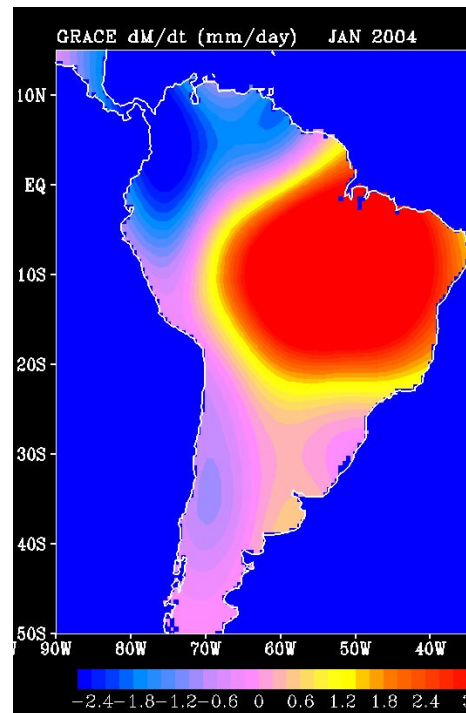
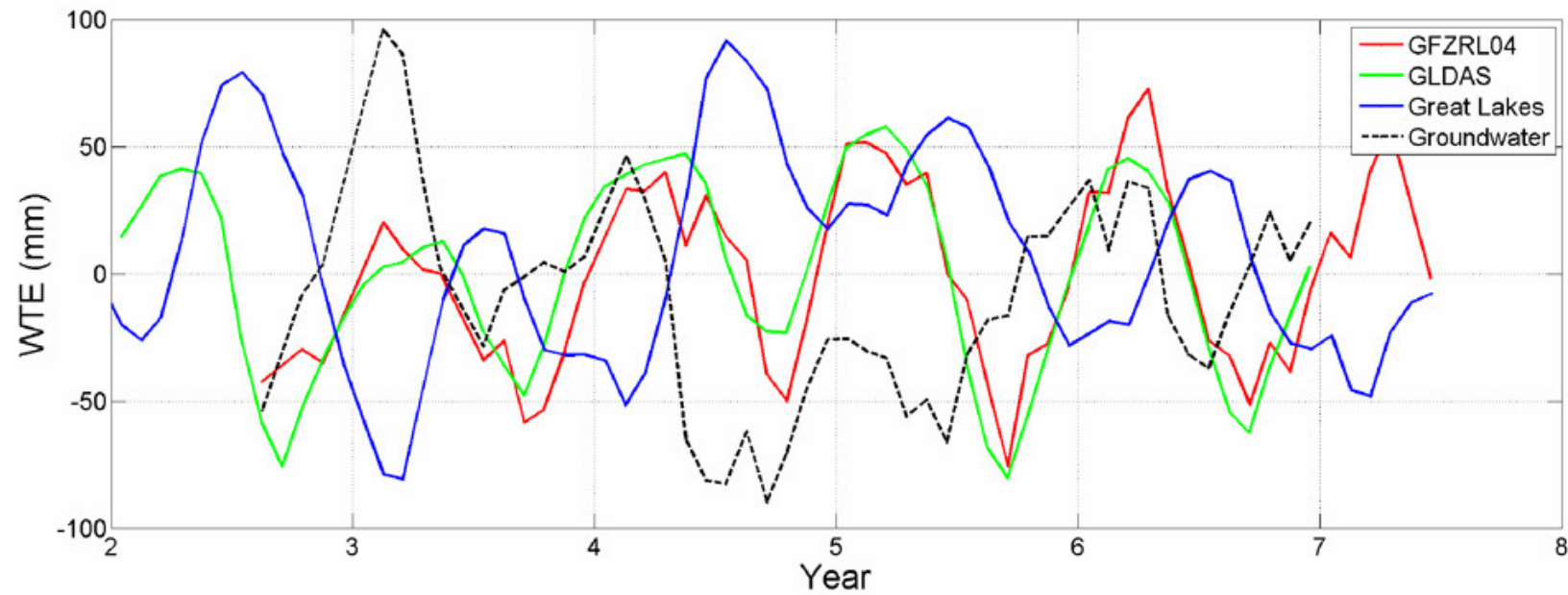
Manual

Calculation





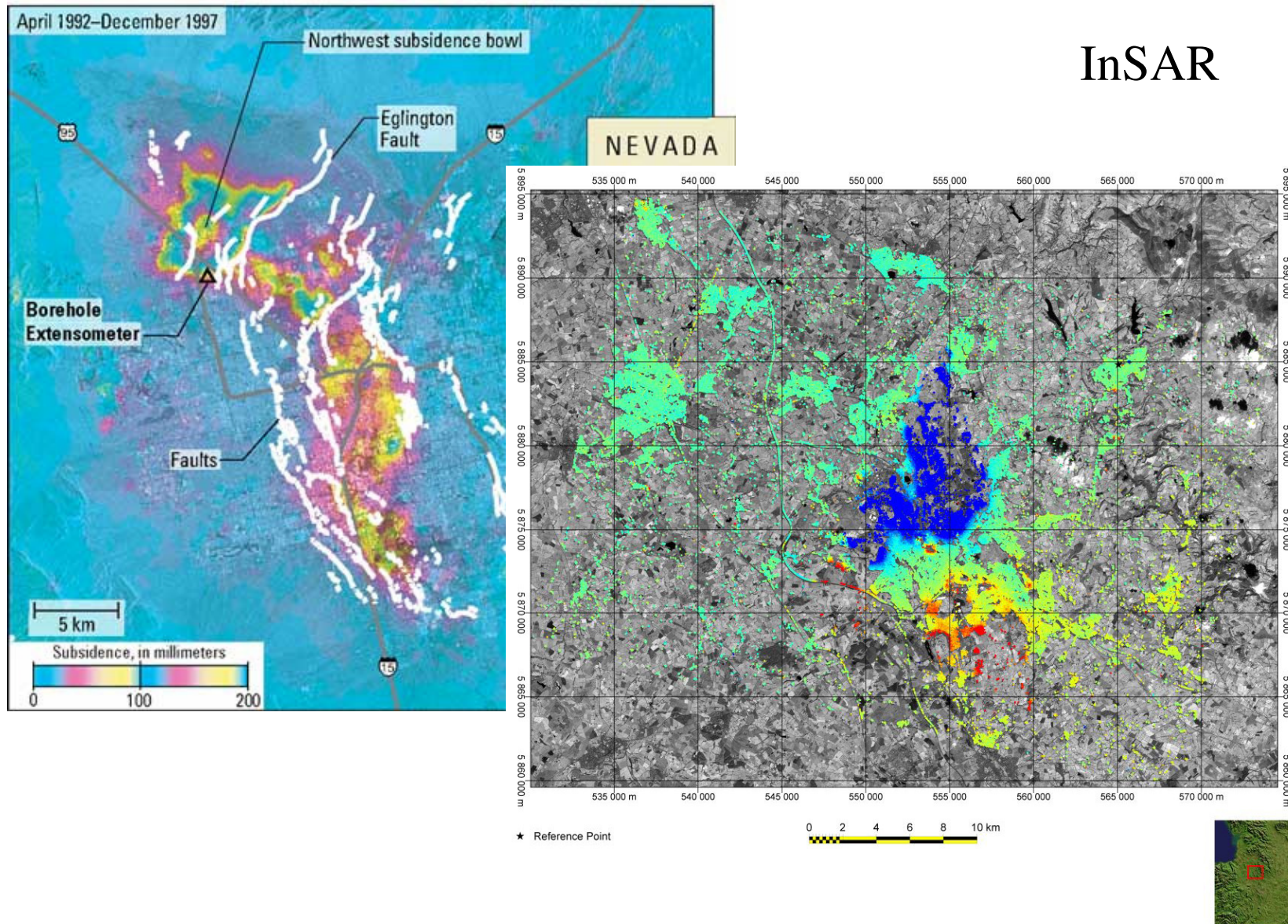




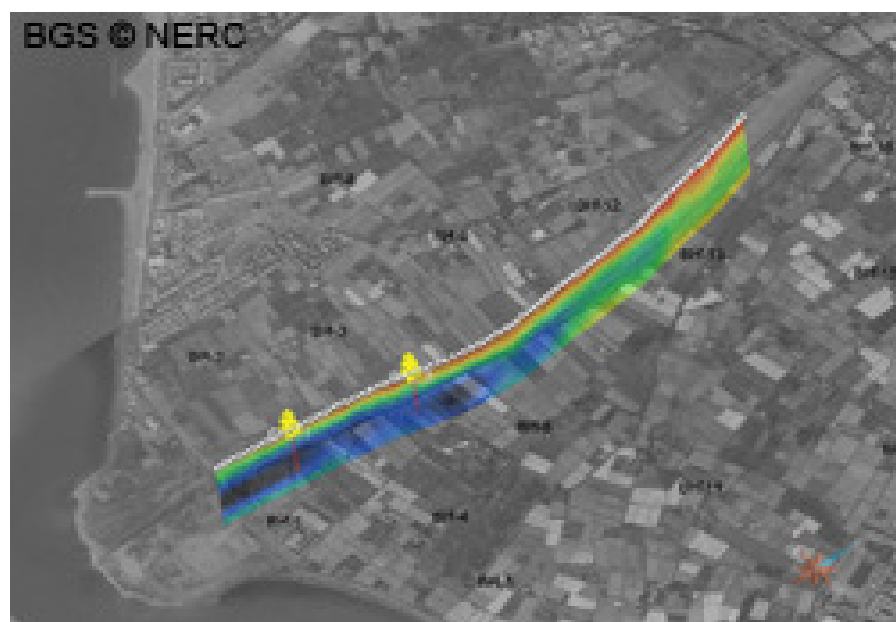
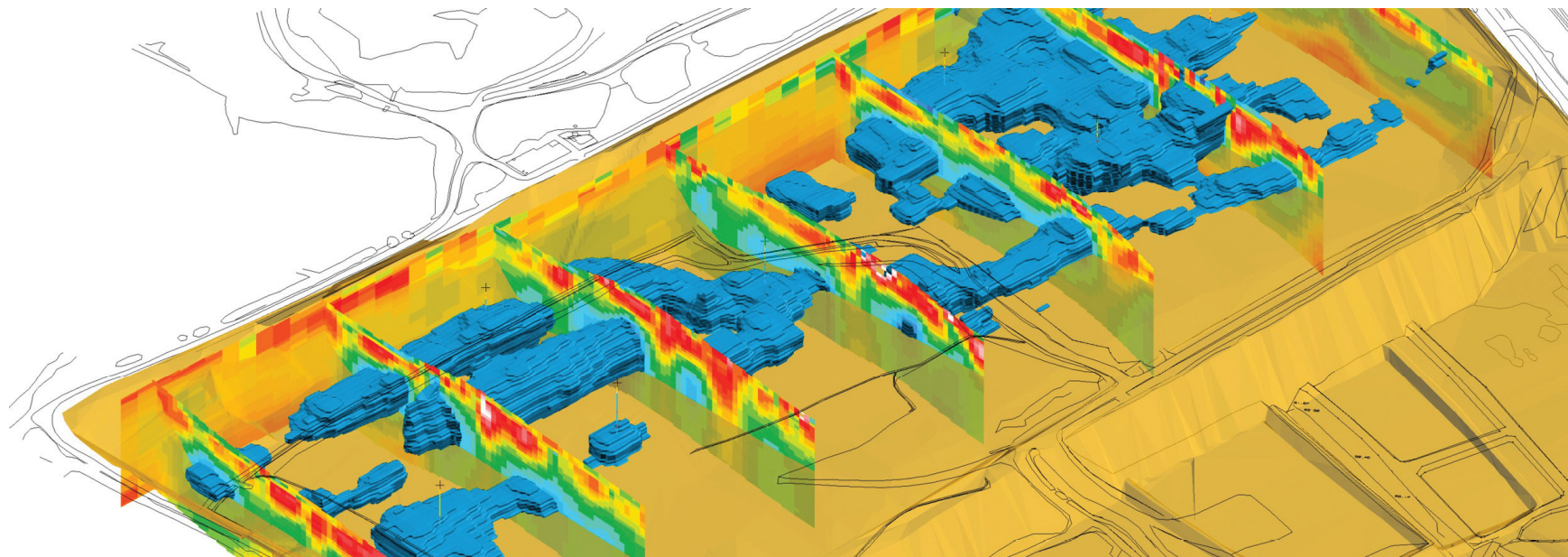
GRACE



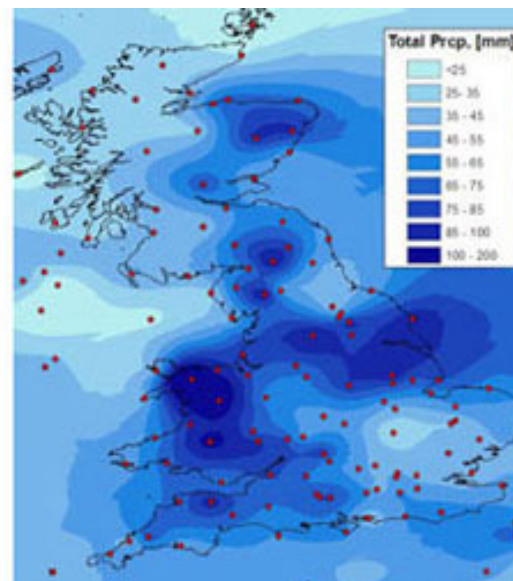
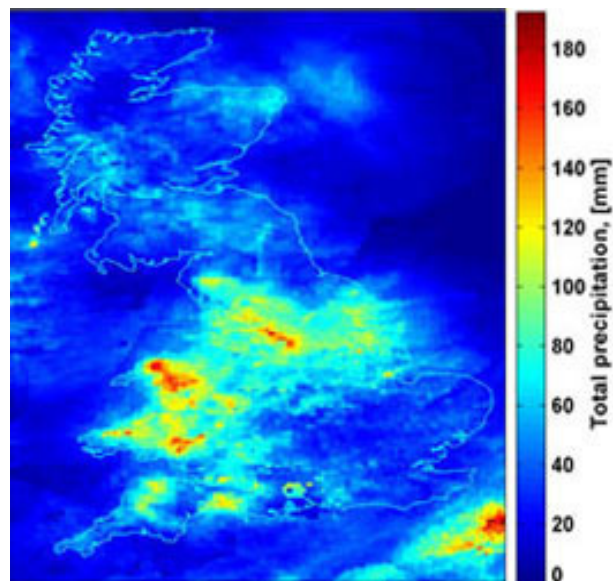
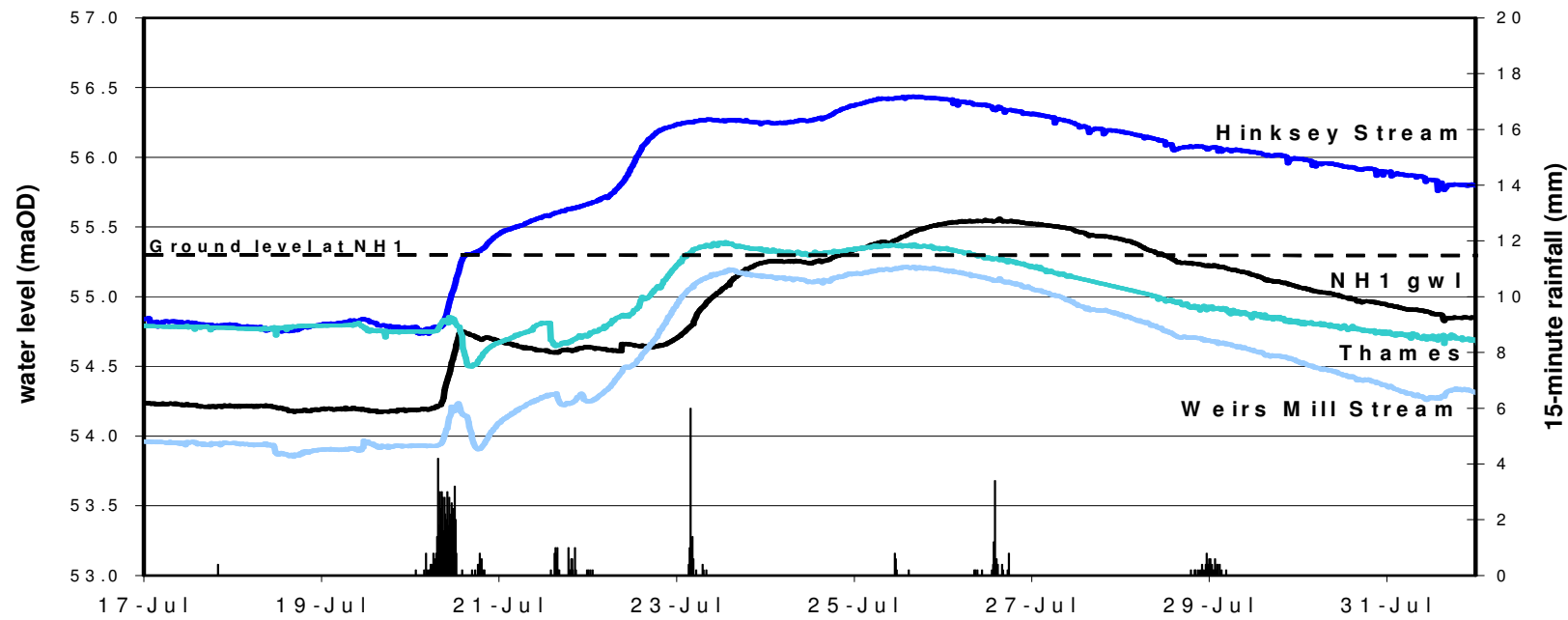
# InSAR







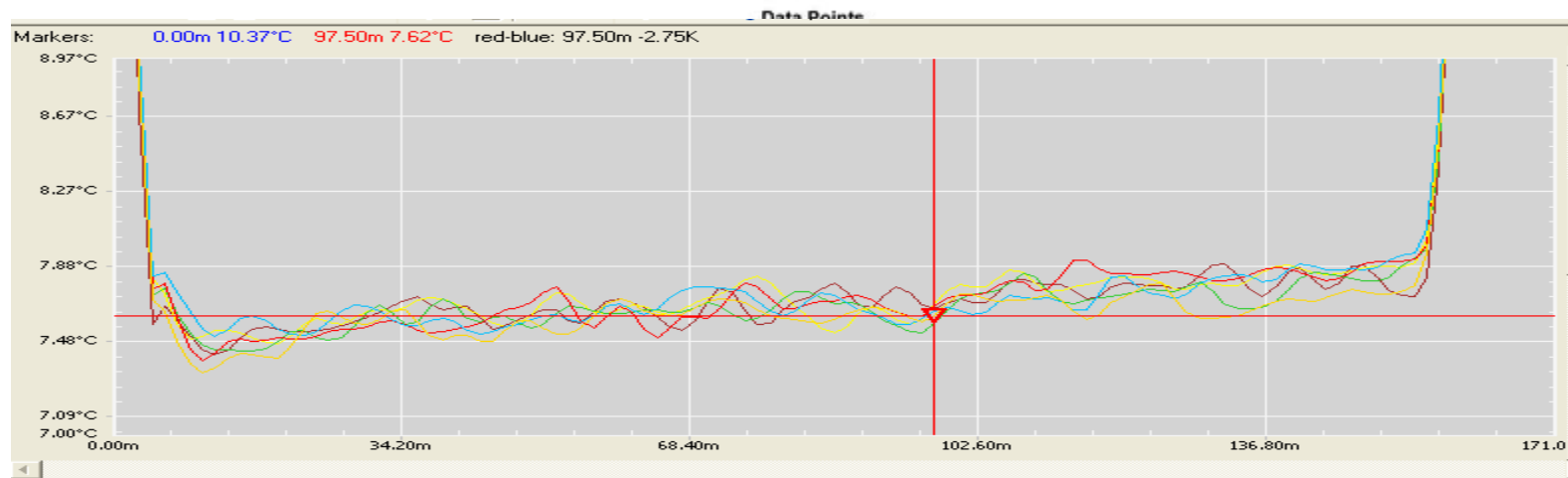
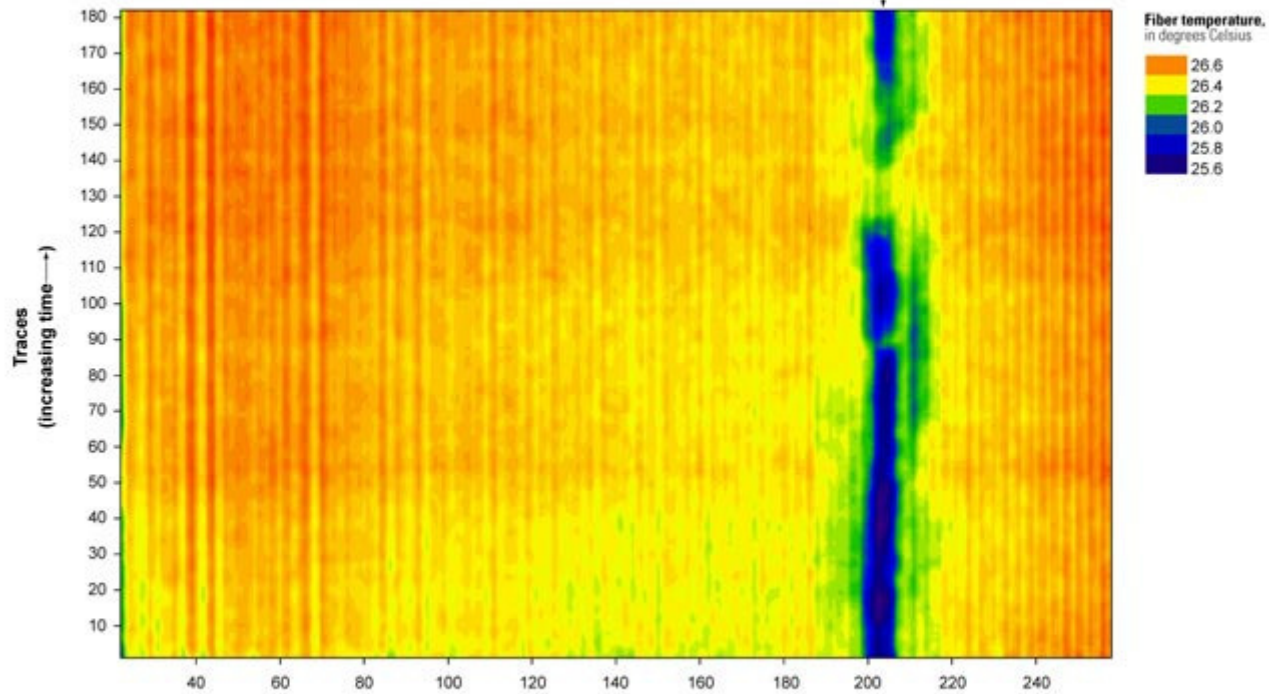
## Geophysical tomography and ALERT





Lockes Mill Study Area  
on the Shenandoah River  
Clarke County, Virginia  
300-meter Downstream fiber  
8/10/2006 12:10:28 to 8/10/2006 15:10:35

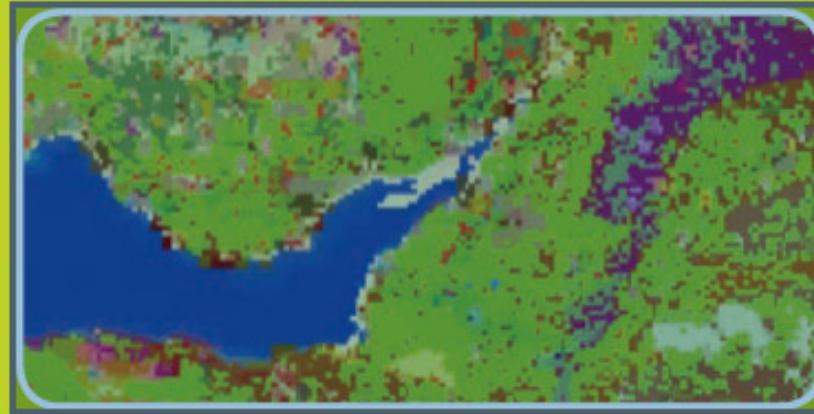
Spring discharging to river  
25m from Fiber



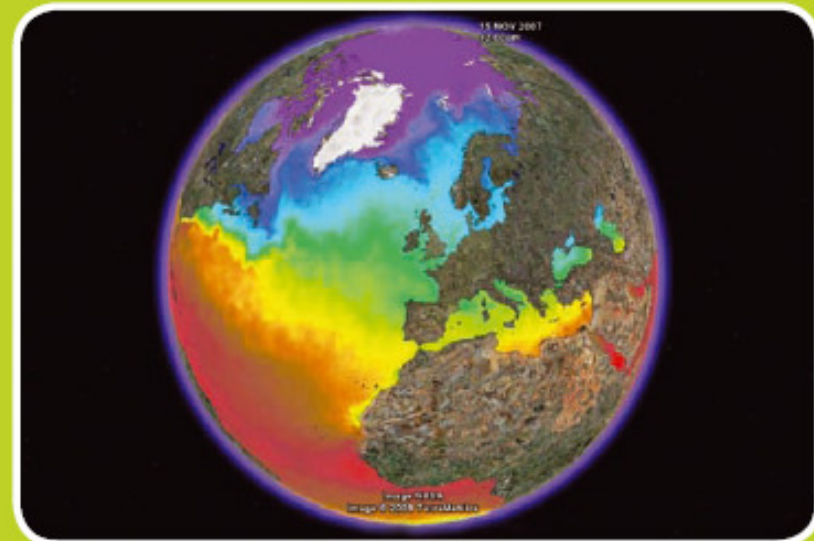
← *Flow*



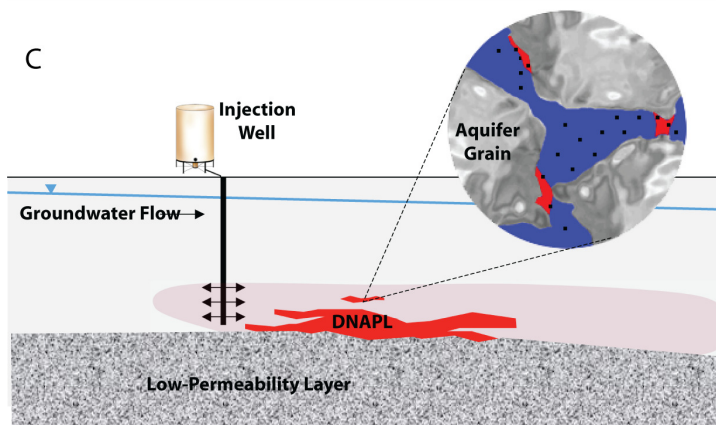
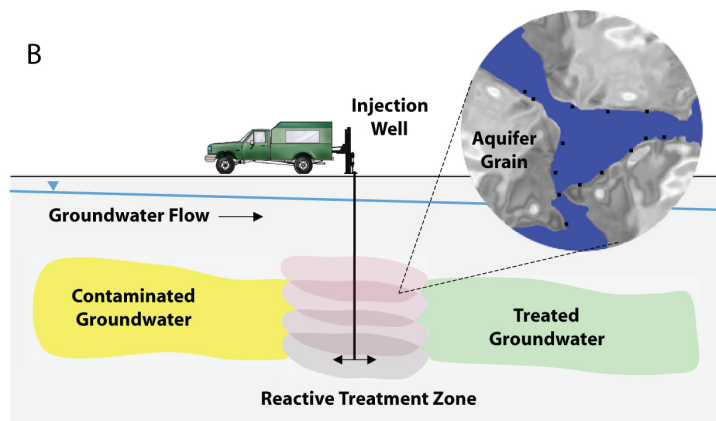
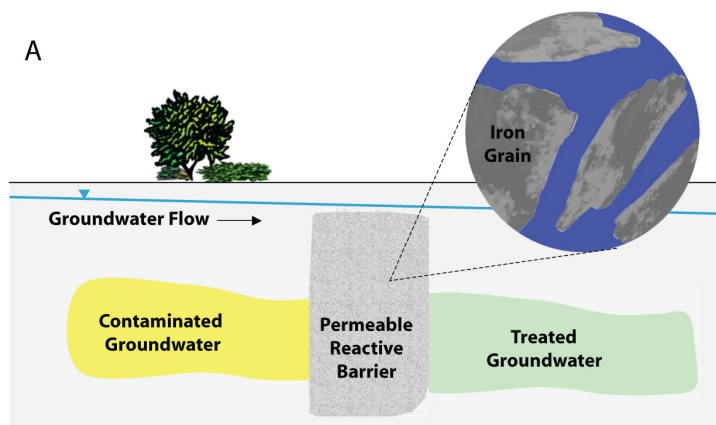
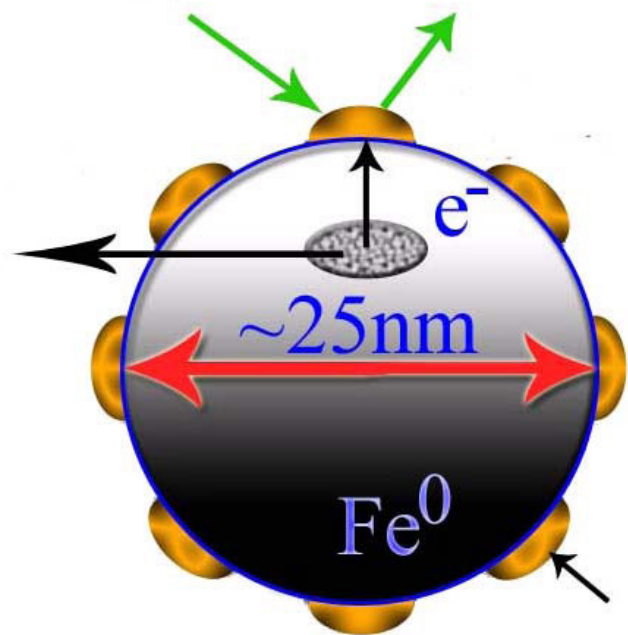
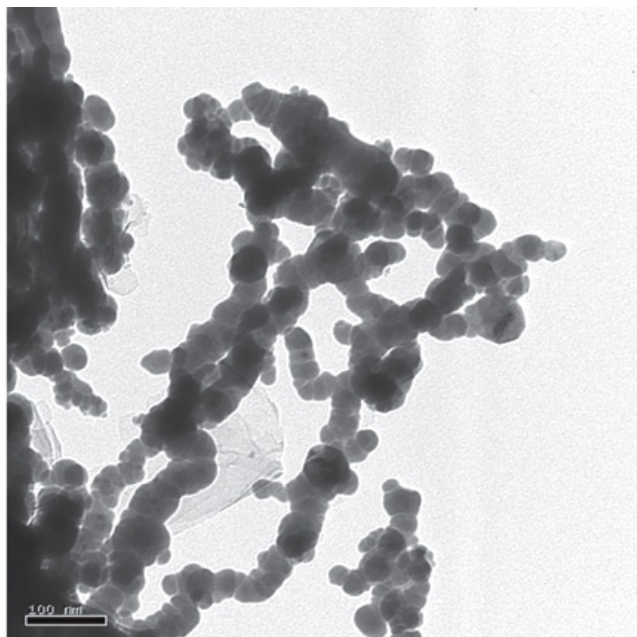


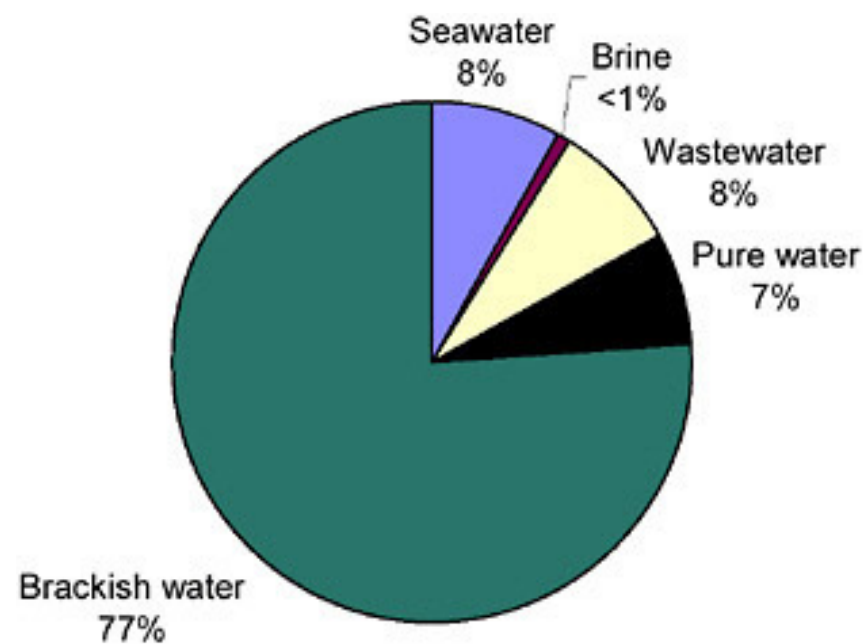
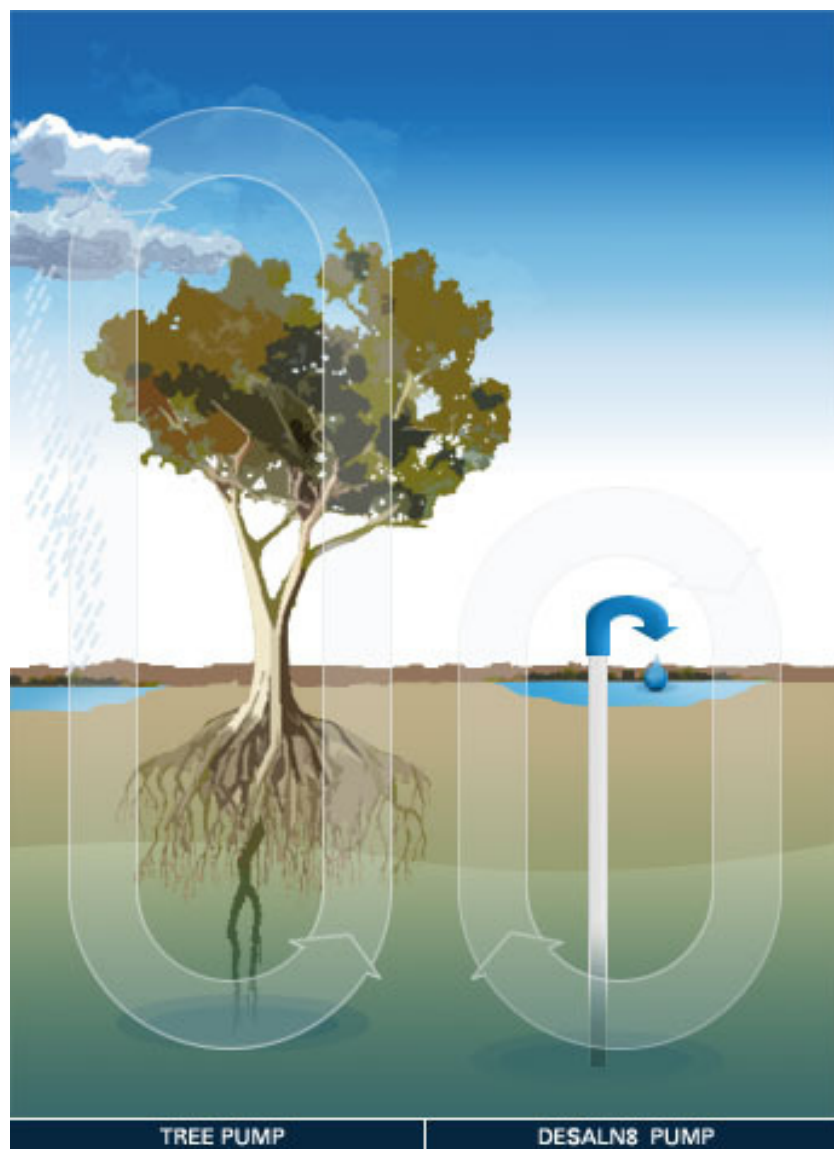


The Centre for Ecology & Hydrology's UK Land Cover map (1km square) overlaid onto the British Geological Survey's UK Geology 1:625k scale.

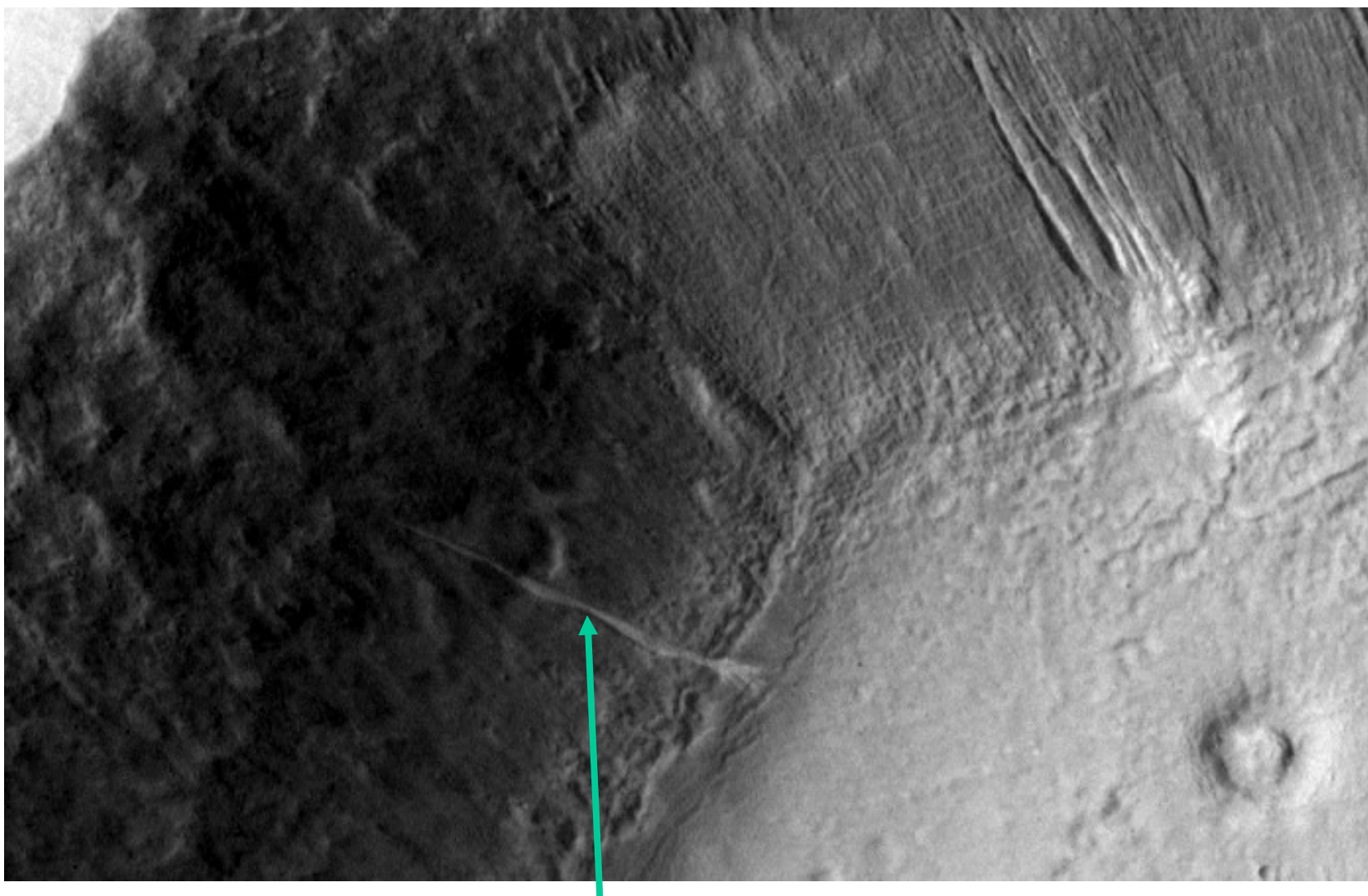


Global sea-surface temperature.



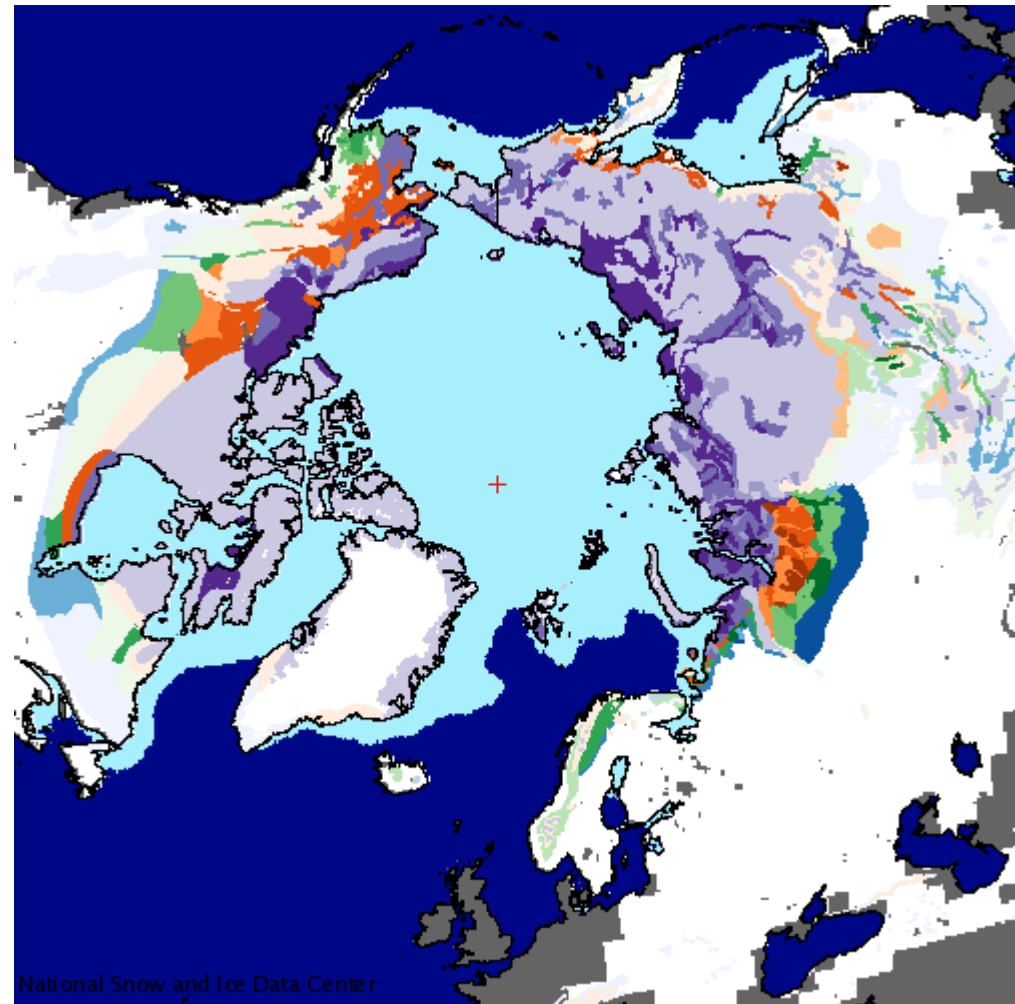






Terra Sirenum - Gully showing mobilization of deposits sometime between 2001 and 2005

The map shows areas (coloured) of permafrost in the Northern hemisphere – Melting permafrost makes a Massive contribution to global warming.



# ALMANACH

pour l'An 1565.

Composé par M. Michel Nostradamus  
docteur en Medecine, de Salon  
de Craux en Prouence.

*L'annee de grace sera à plusieurs peup'es,  
En amitié seront les paysans,  
La terre aura en soy beaucoup de meubles  
Dont en maintz lieux en seront suffisans.*



A PARIS.

Pour Thibault Bessault, demourant en la rue  
S. Iaqués, à l'enseigne de l'Elephant.

AVEC PERMISSION.

A part of our future appears to be evolutionary and unpredictable, and another part looks developmental and predictable.

Our challenge is to invent the first and discover the second."

([John Smart](#) – Acceleration Studies Foundation)

