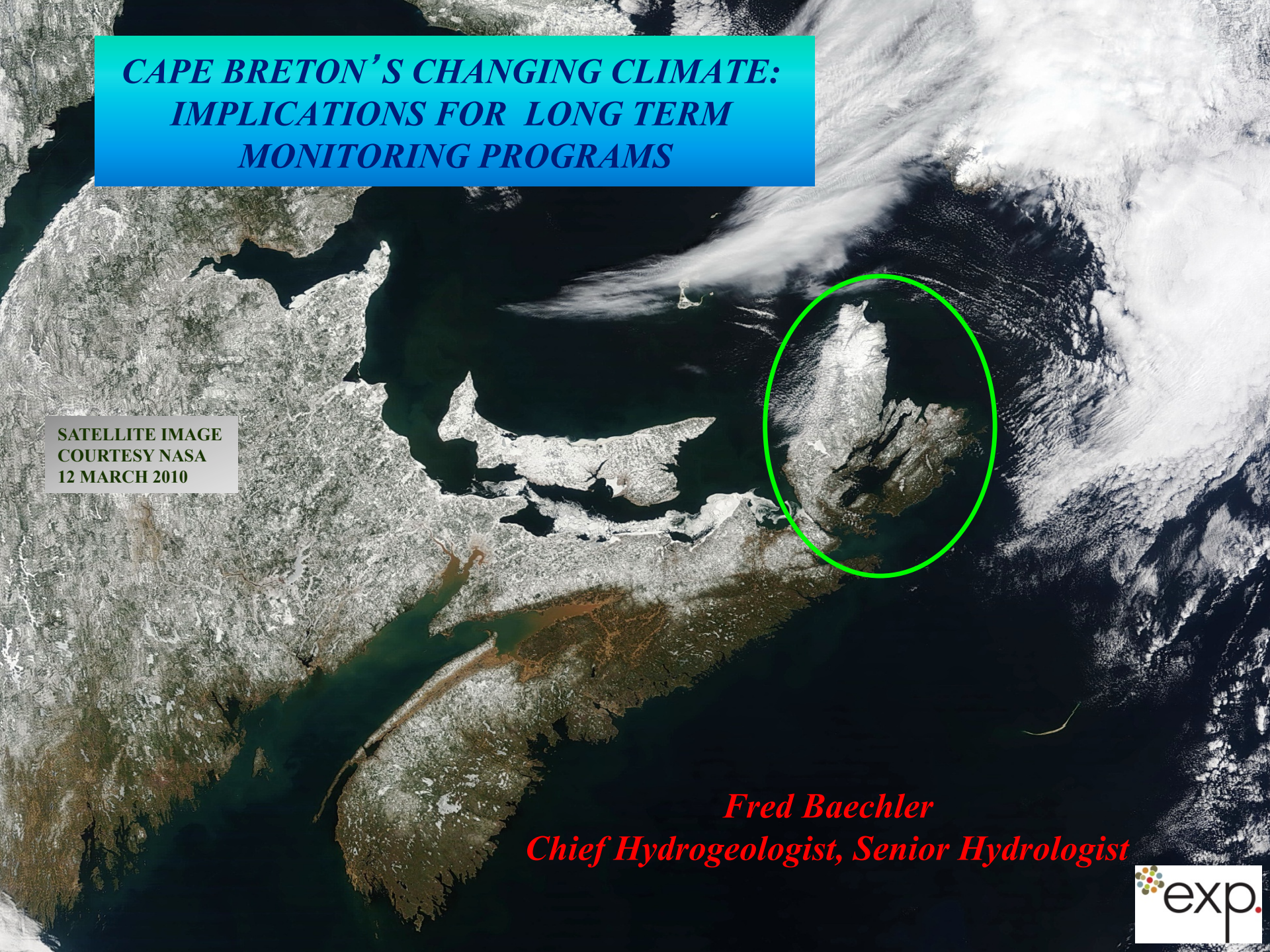
CAPE BRETON'S CHANGING CLIMATE: IMPLICATIONS FOR LONG TERM MONITORING PROGRAMS



SATELLITE IMAGE COURTESY NASA 12 MARCH 2010

Fred Baechler

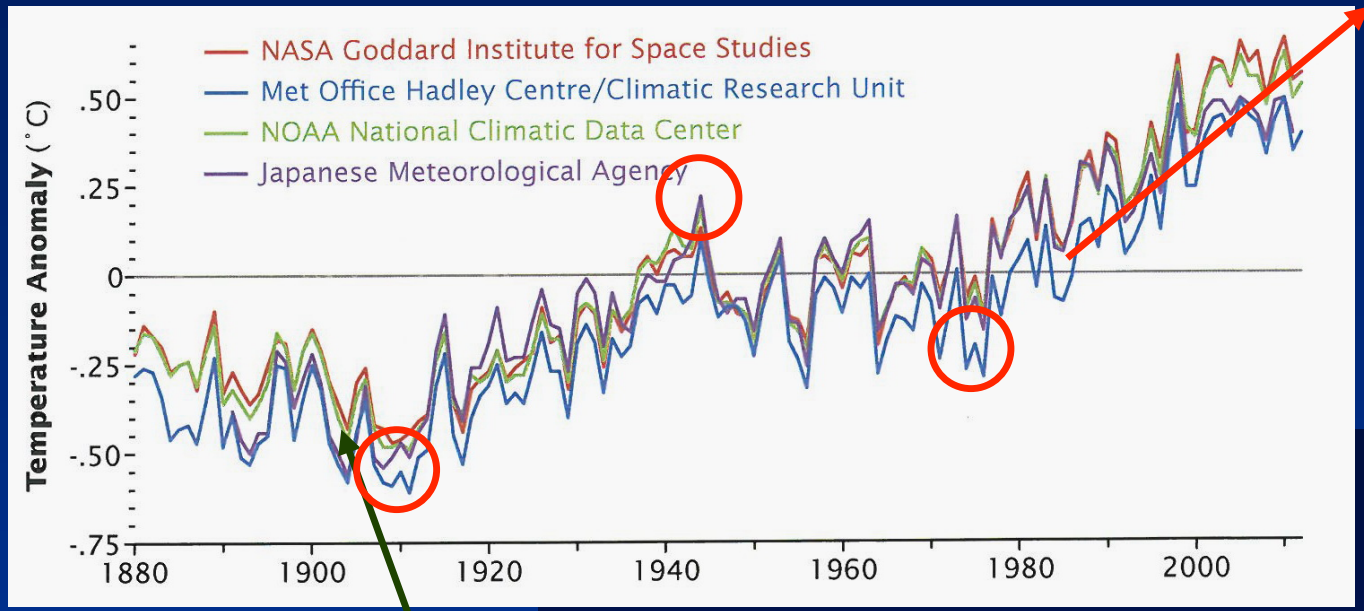
Chief Hydrogeologist, Senior Hydrologist


Complex terrain
How is our Climate Changing?
Impact on Long Term Monitoring Program Design?
exp.

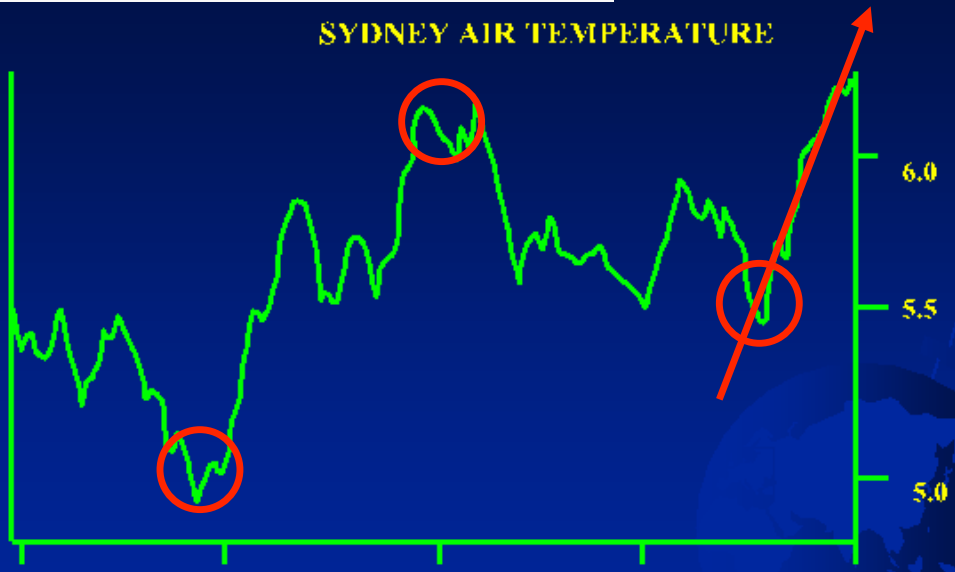

COMPLEX TERRRAIN
LOW LEVEL OF MONITORING
CONCEPT: Difficult to extrapolate background conditions from other areas – will need baseline and background monitoring built into program design.


Complex Terrain
How is our Climate Changing?
Impact on Long Term Monitoring Program Design?
exp.

AIR TEMPERATURE

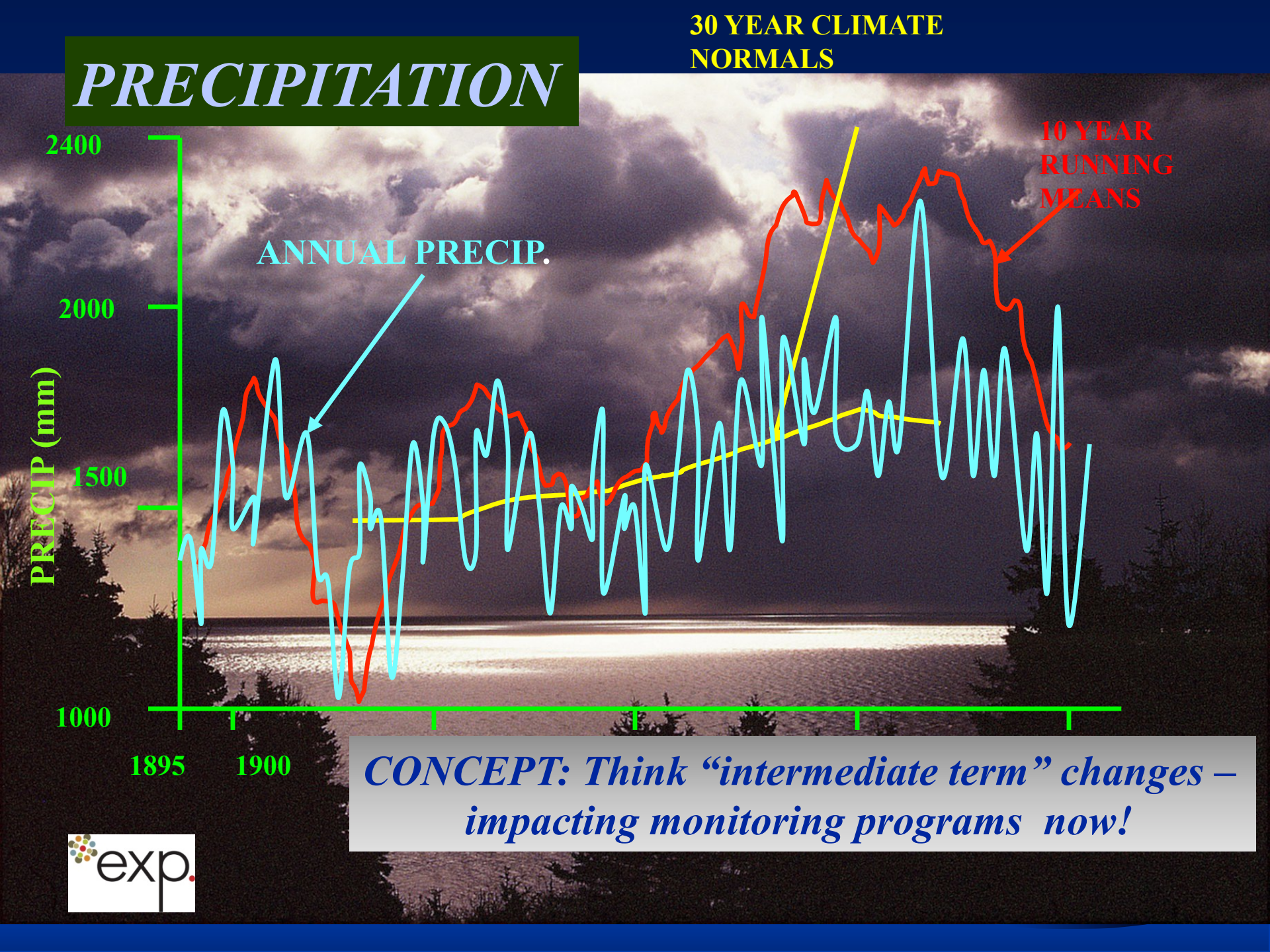


LITTLE ICE AGE



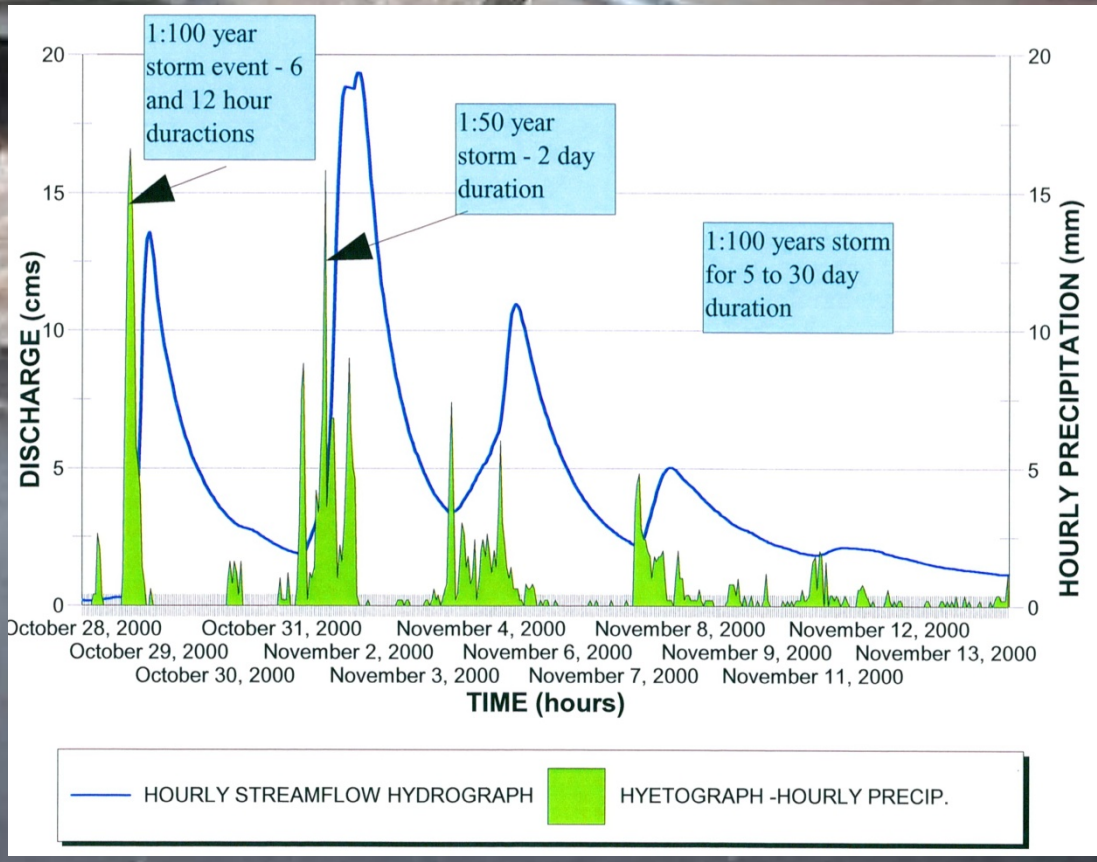
PRECIPITATION

30 YEAR CLIMATE NORMALS



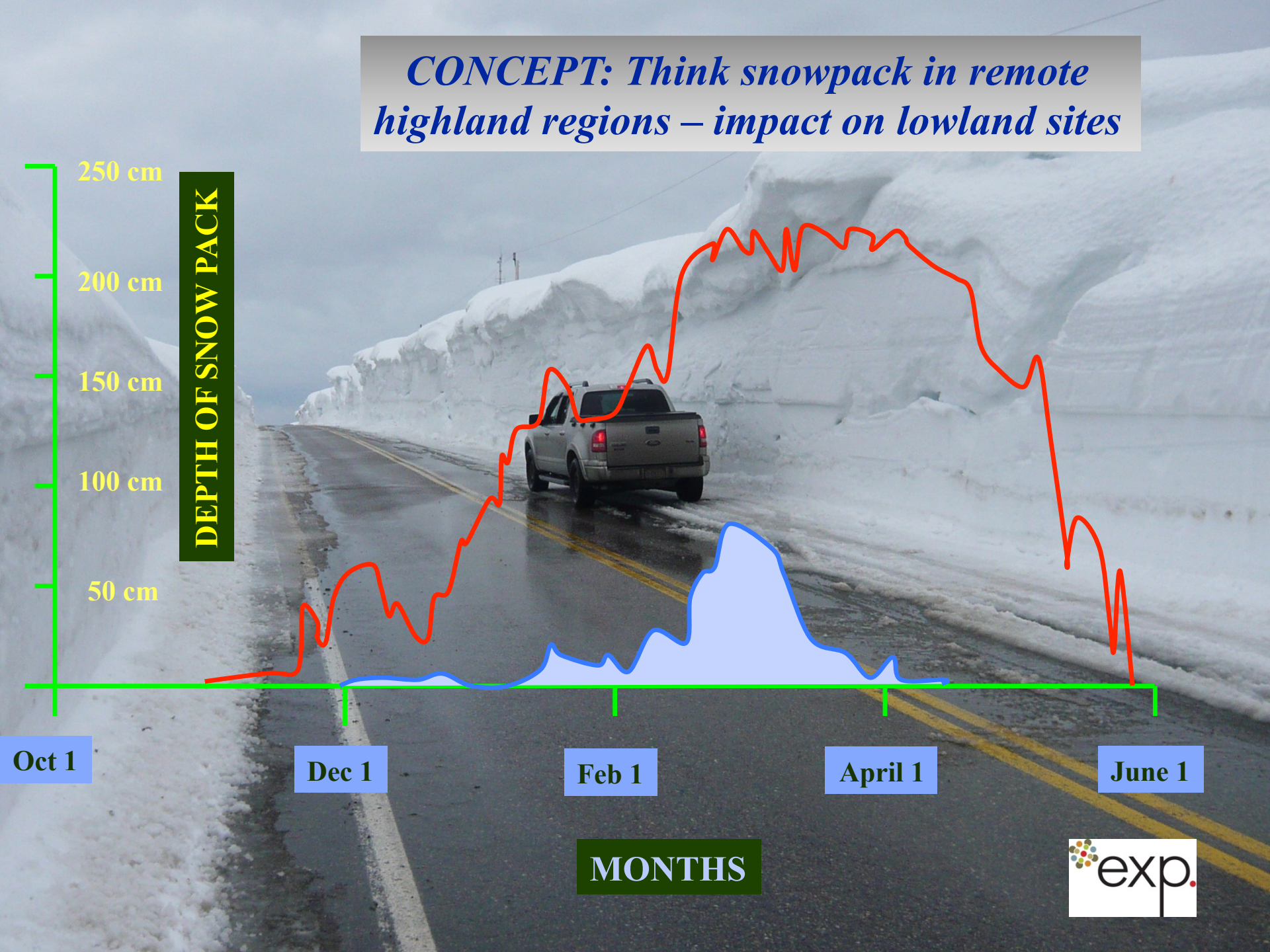
CONCEPT: Think "intermediate term" changes – impacting monitoring programs now!

CONCEPT: Think longer duration storms

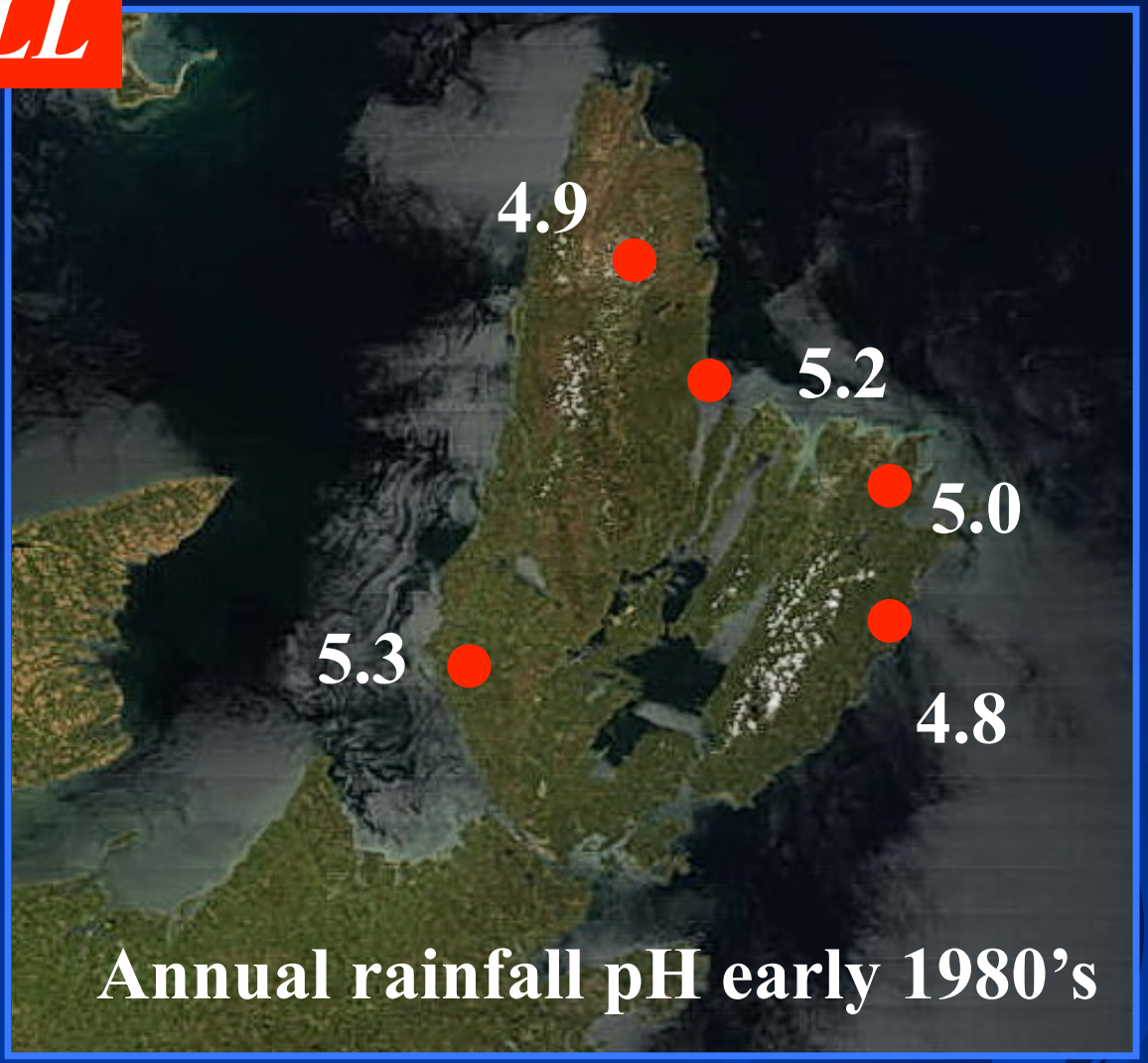


SNOWFALL


10 YEAR RUNNING MEAN OF MEAN ANNUAL
SNOWFALL - SYDNEY
600
cm
500
400
300
cm
1900
1920
1940
1960
1980
2000
2010


CONCEPT: Think snowpack in remote highland regions – impact on lowland sites
250 cm
200 cm
150 cm
100 cm
50 cm
DEPTH OF SNOW PACK
Oct 1
Dec 1
Feb 1
April 1
June 1
MONTHS
exp.

ACID RAINFALL

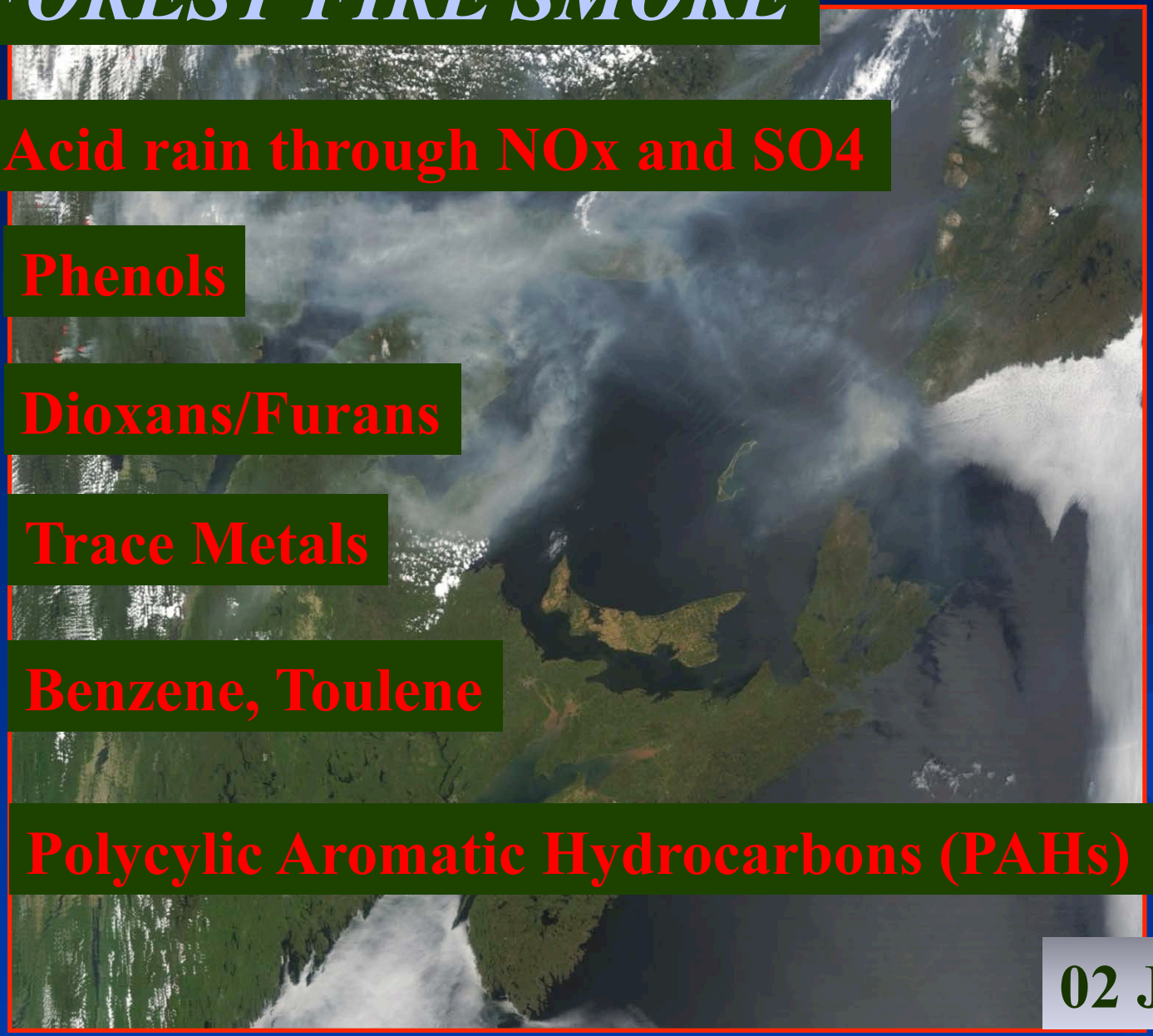


Normal rain 5.7

Acid rain 4 - 5

Fog 3-3.5

FOREST FIRE SMOKE



Acid rain through NOx and SO4

Phenols

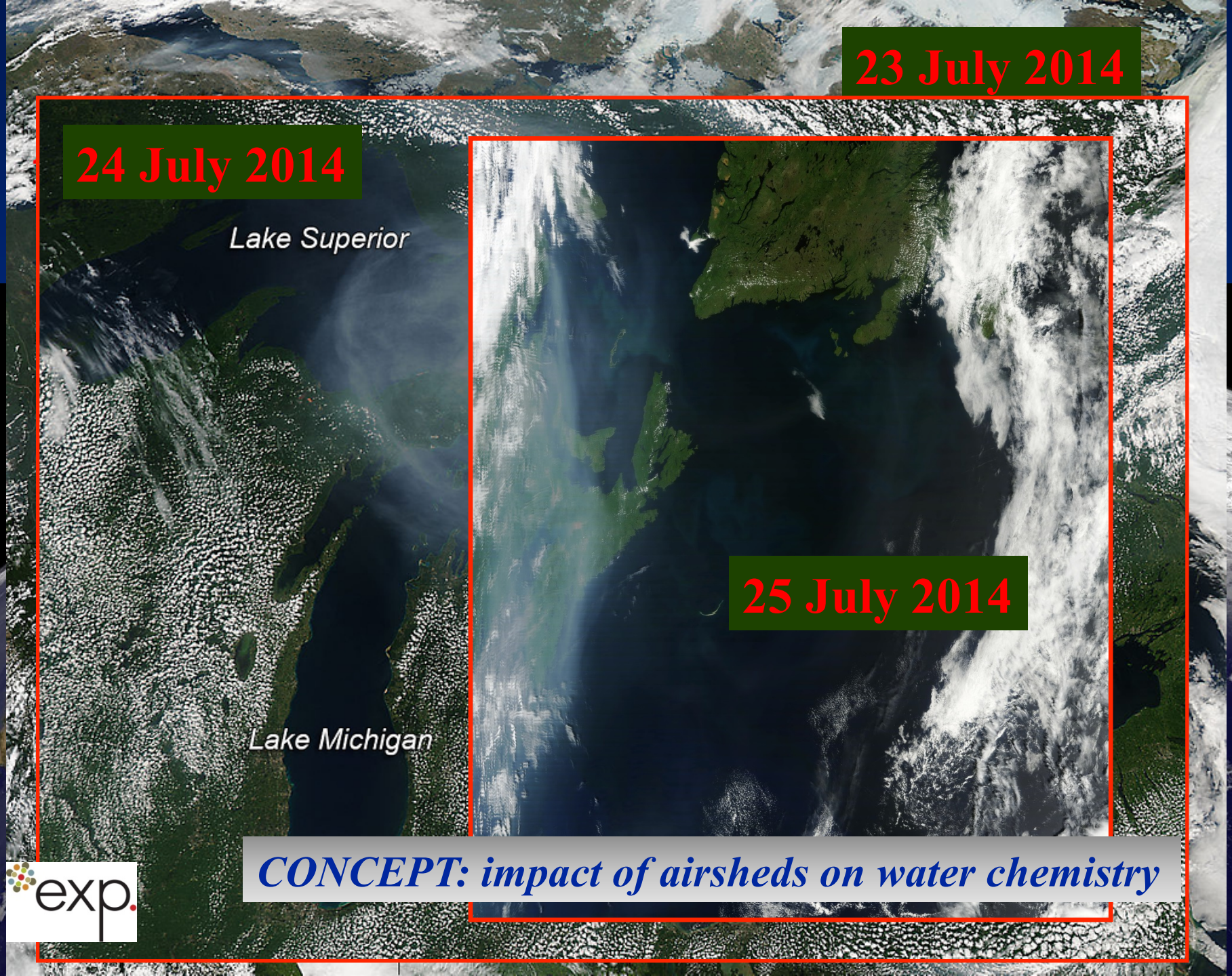
Dioxans/Furans

Trace Metals

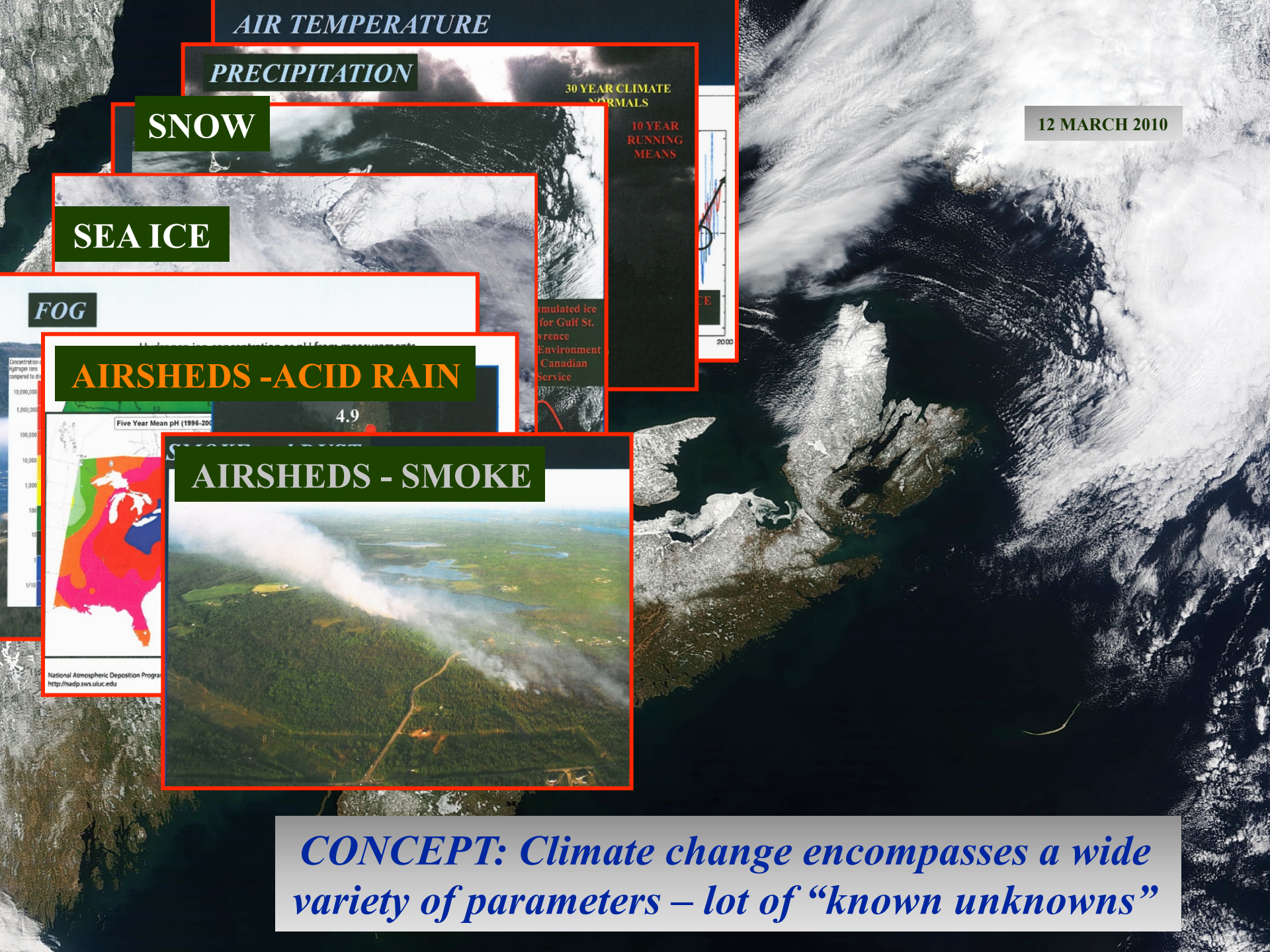
Benzene, Toulene

Polycylic Aromatic Hydrocarbons (PAHs)

02 June 2005



CONCEPT: impact of airsheds on water chemistry



CONCEPT: Climate change encompasses a wide variety of parameters – lot of "known unknowns"

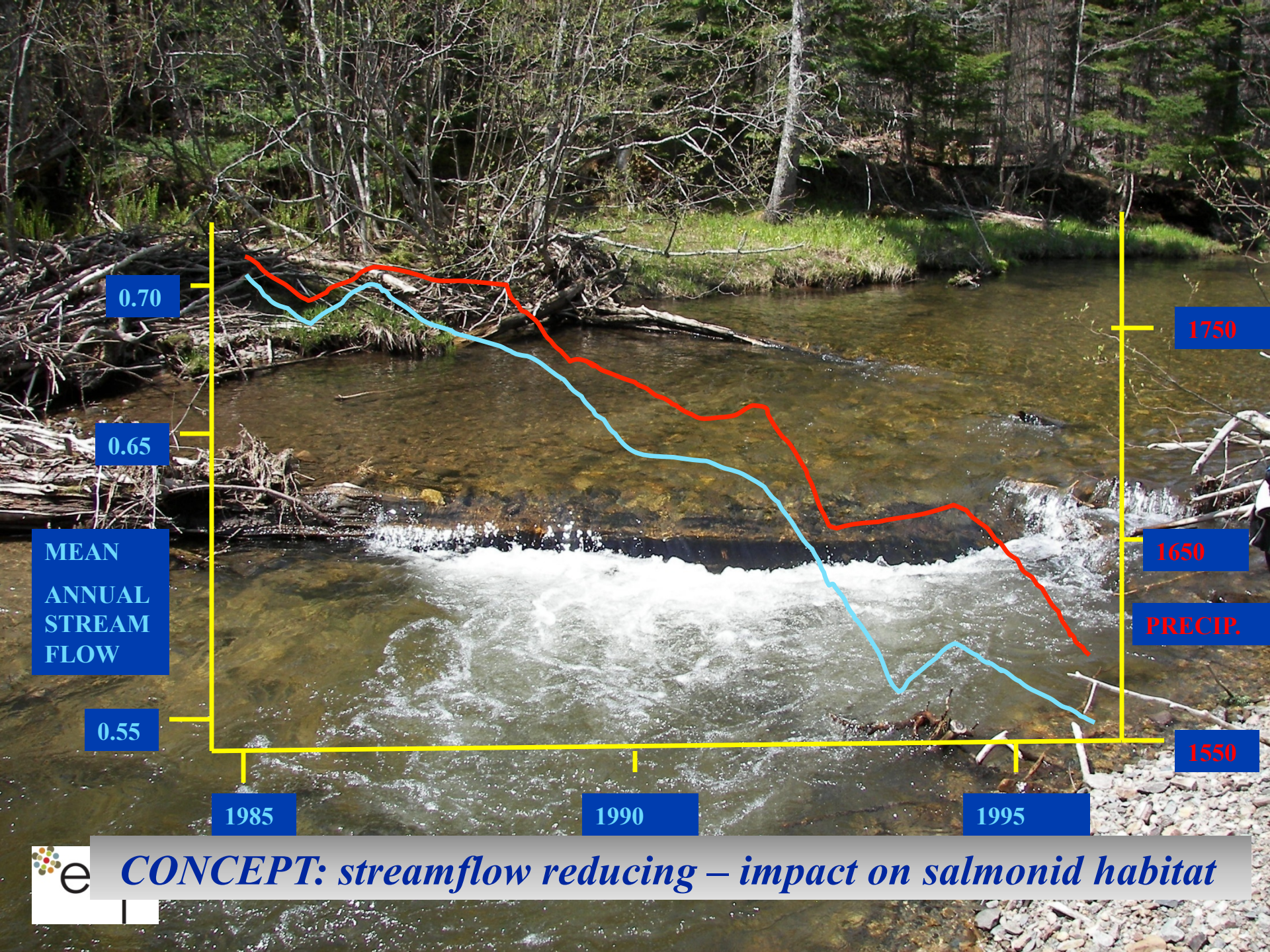

Complex Terrain
How is our Climate Changing?
Impact on Long Term Monitoring Program Design?
exp.

CONCEPT: "Long Term" – starting on 25 years Coke Ovens/Tar Ponds; 50 years CBDC mine sites; results here are from on-going 15 to 20+ years

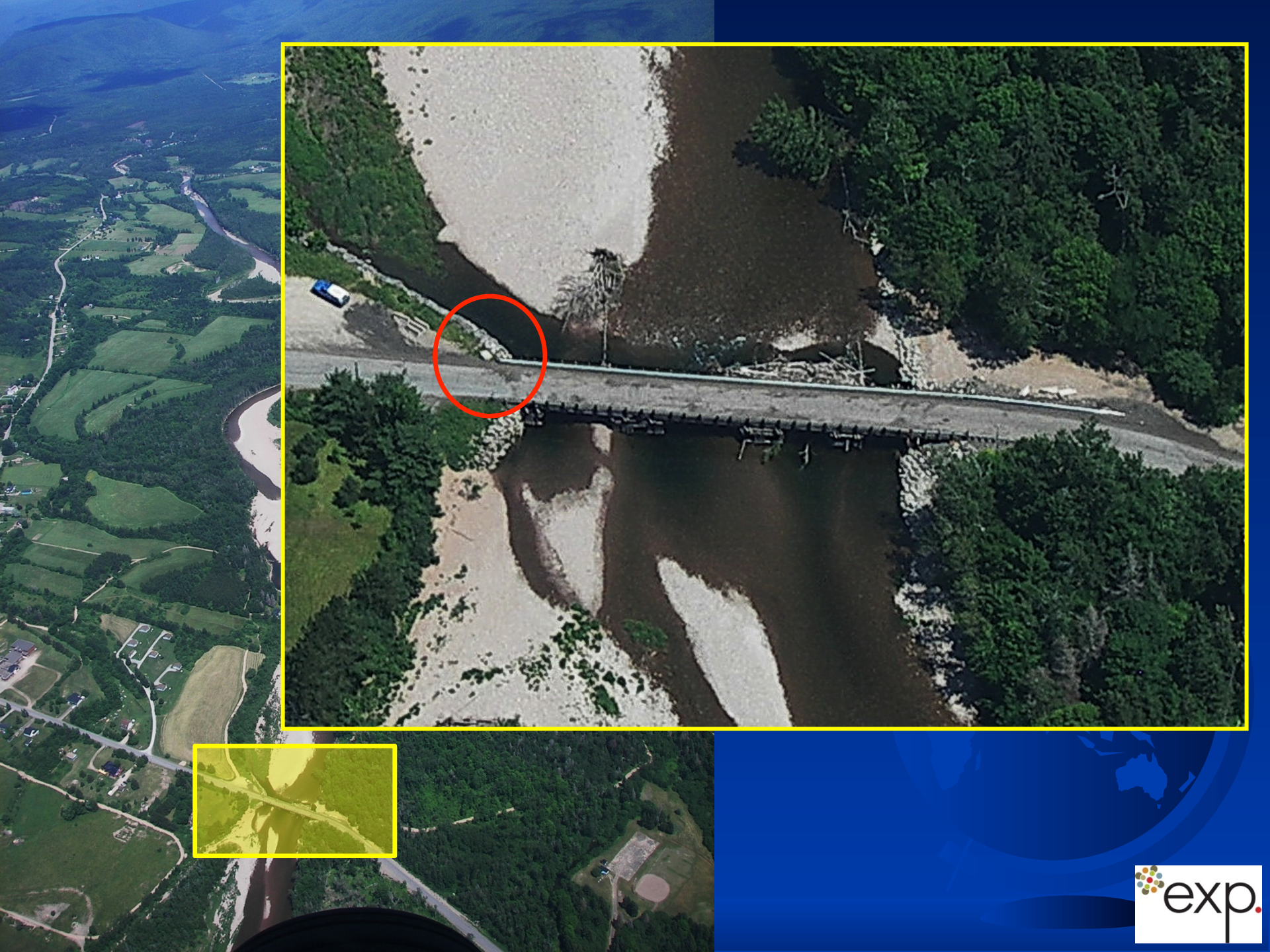
CONCEPT: BASELINE before as well as BACKGROUND during/after operations

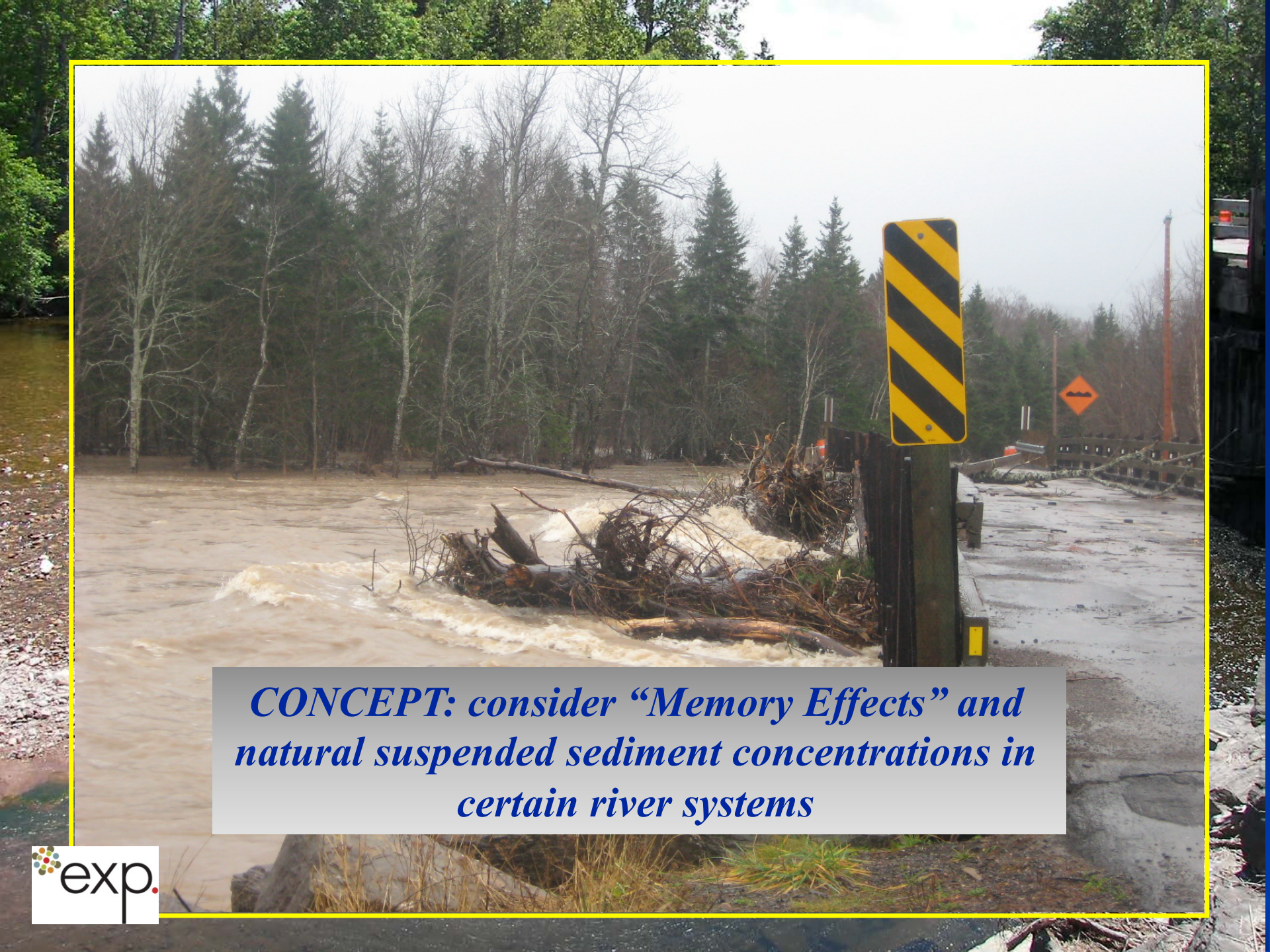
CONCEPT: separate out impacts due to changing climate, Legal-Due Diligence, another Quality guideline for comparison, aid regulatory research on climate change impacts/adaptation

exp.

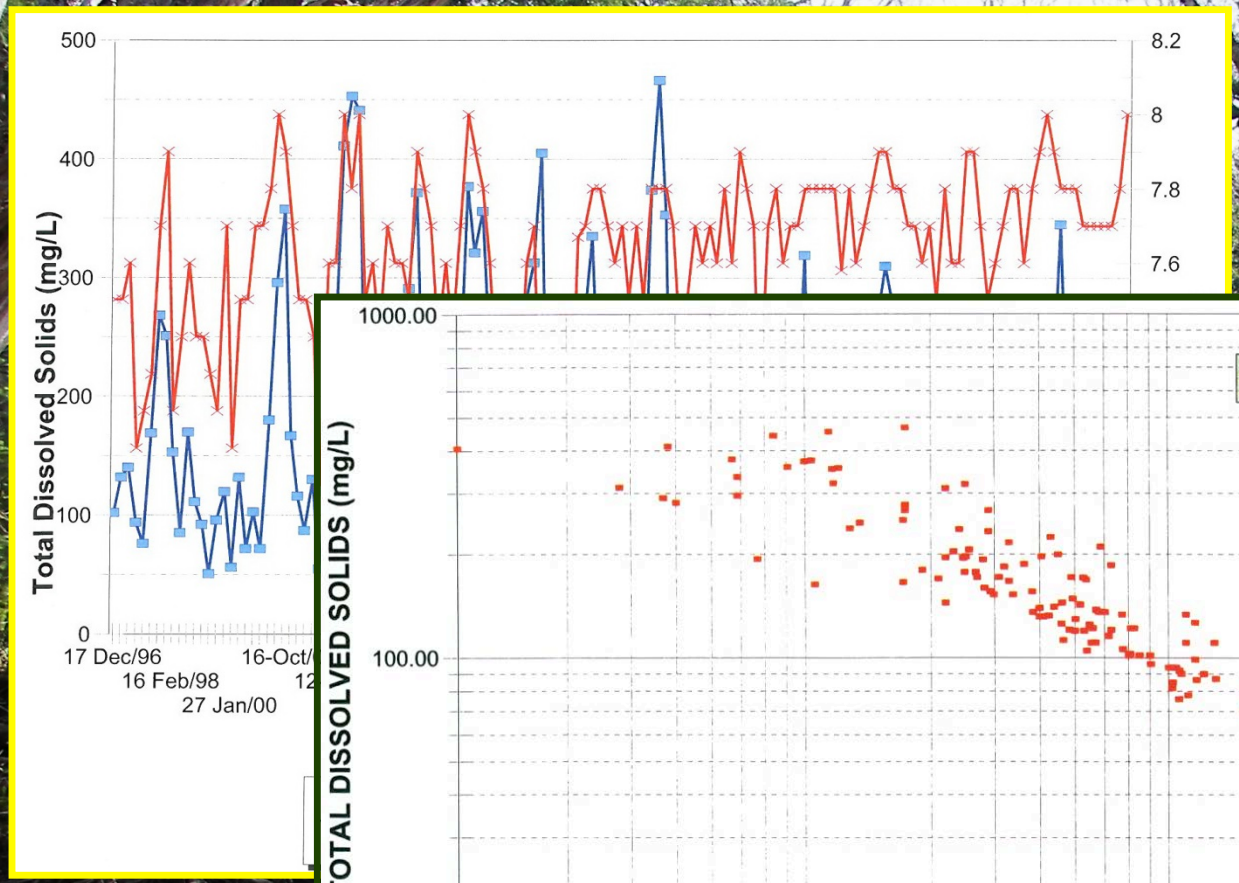


CONCEPT: streamflow reducing – impact on salmonid habitat

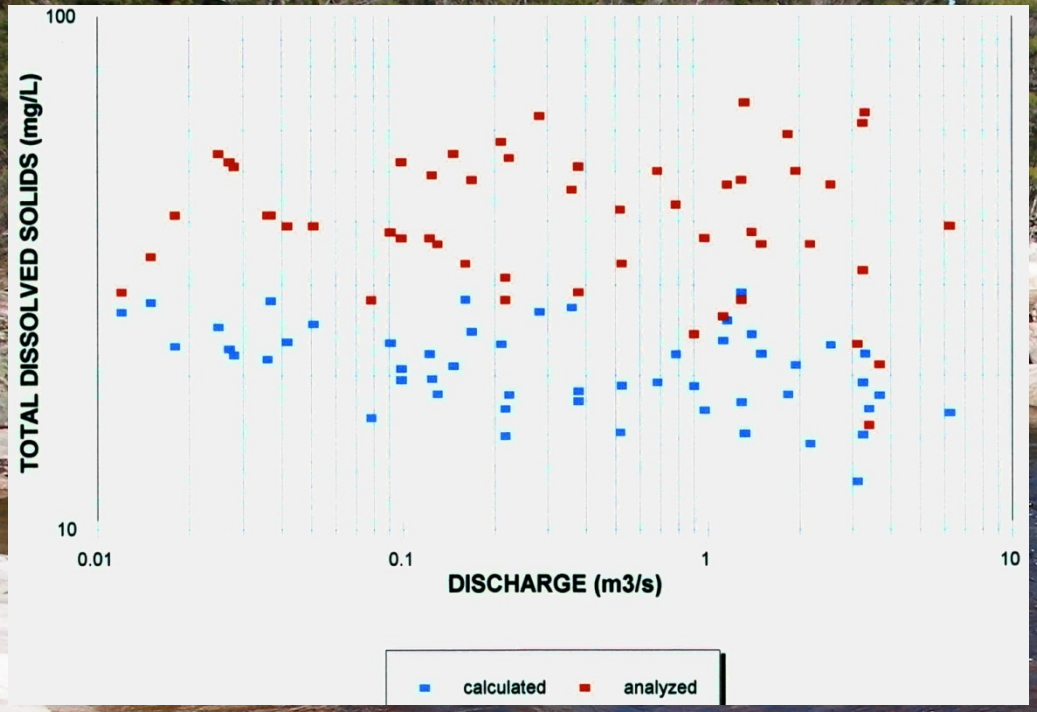




CONCEPT: consider "Memory Effects" and natural suspended sediment concentrations in certain river systems

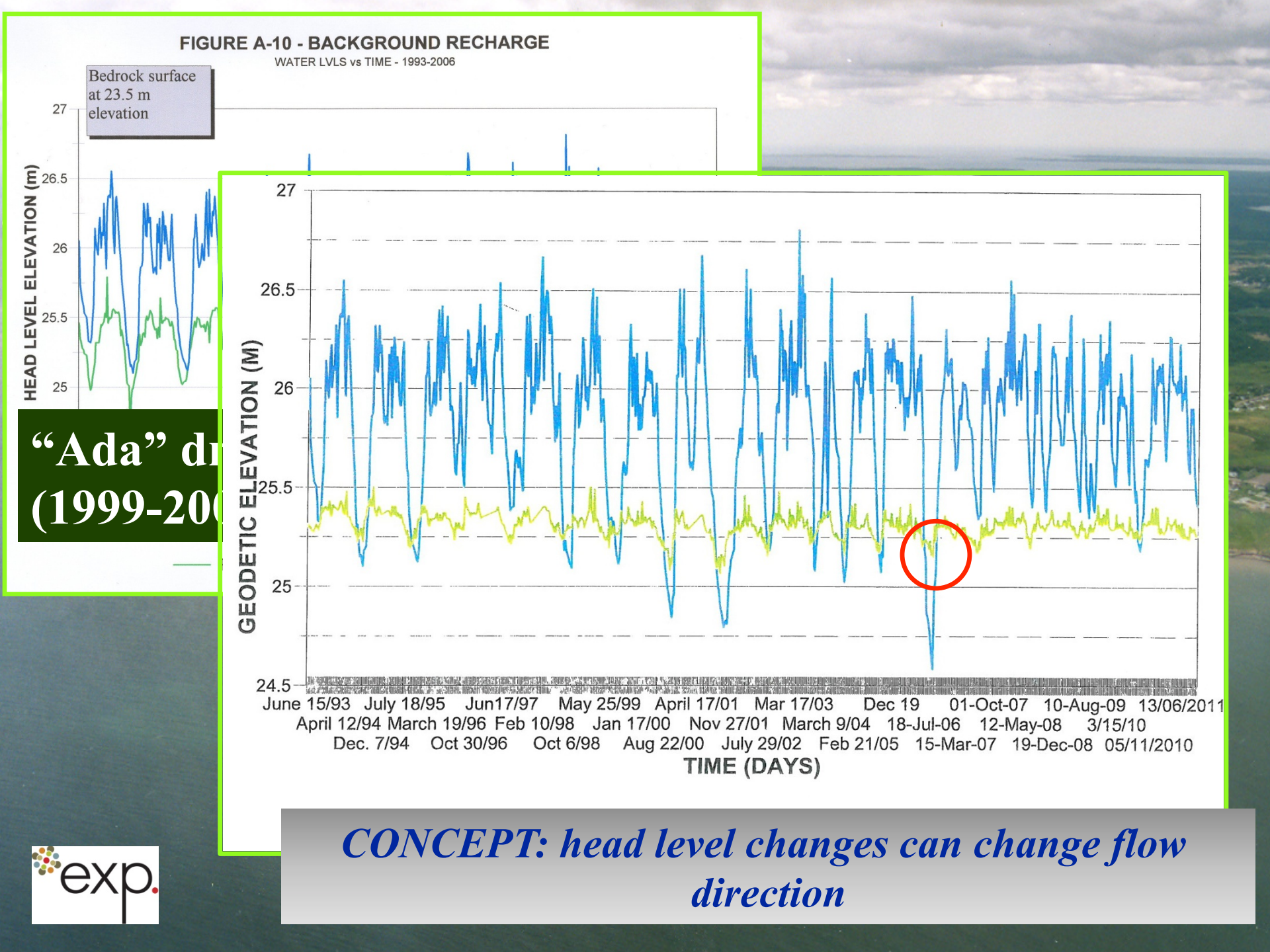

500
400
300
200
100
0
Total Dissolved Solids (mg/L)
8.2
8
7.8
7.6
17 Dec/96
16 Feb/98
27 Jan/00

1000.00
100.00
10.00
TOTAL DISSOLVED SOLIDS (mg/L)
1996 -2010
0.01
0.1
1
10
DISCHARGE (m3/sec)



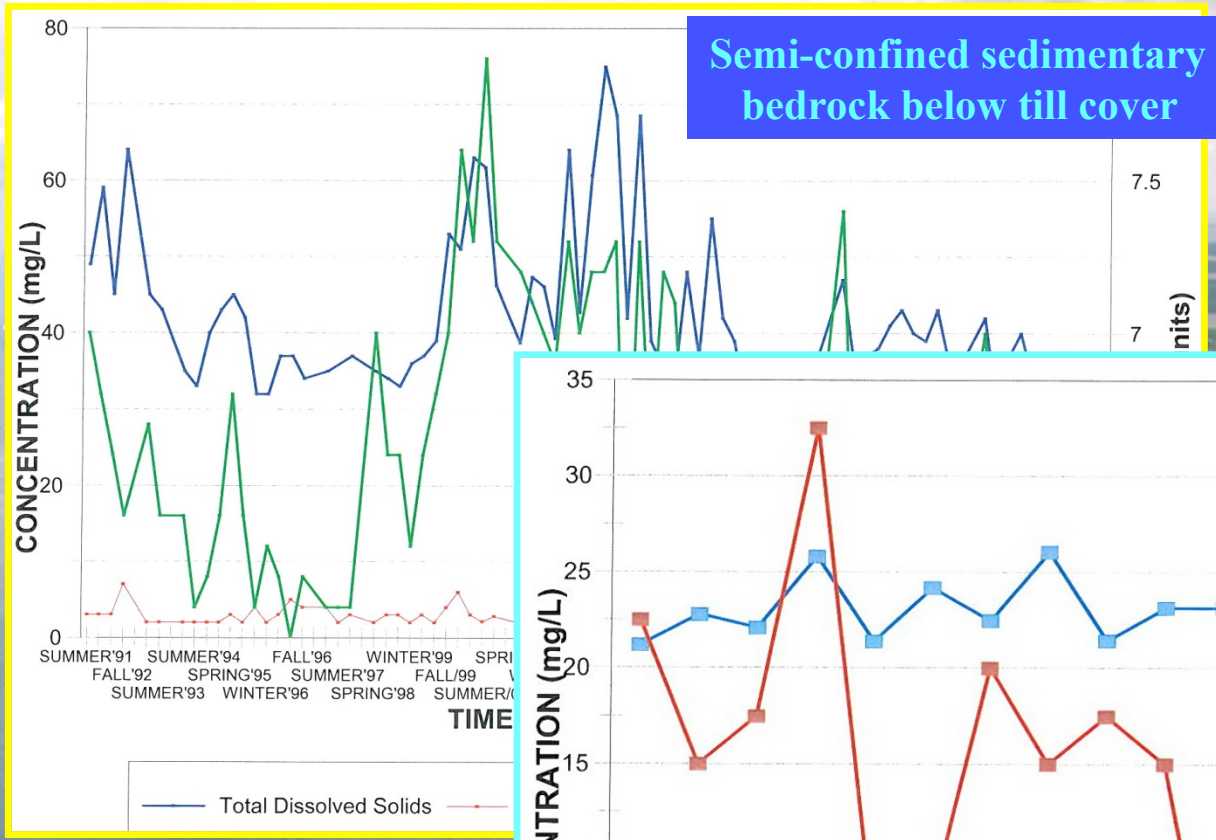
Naturally low pH-
below 6.5 guidelines

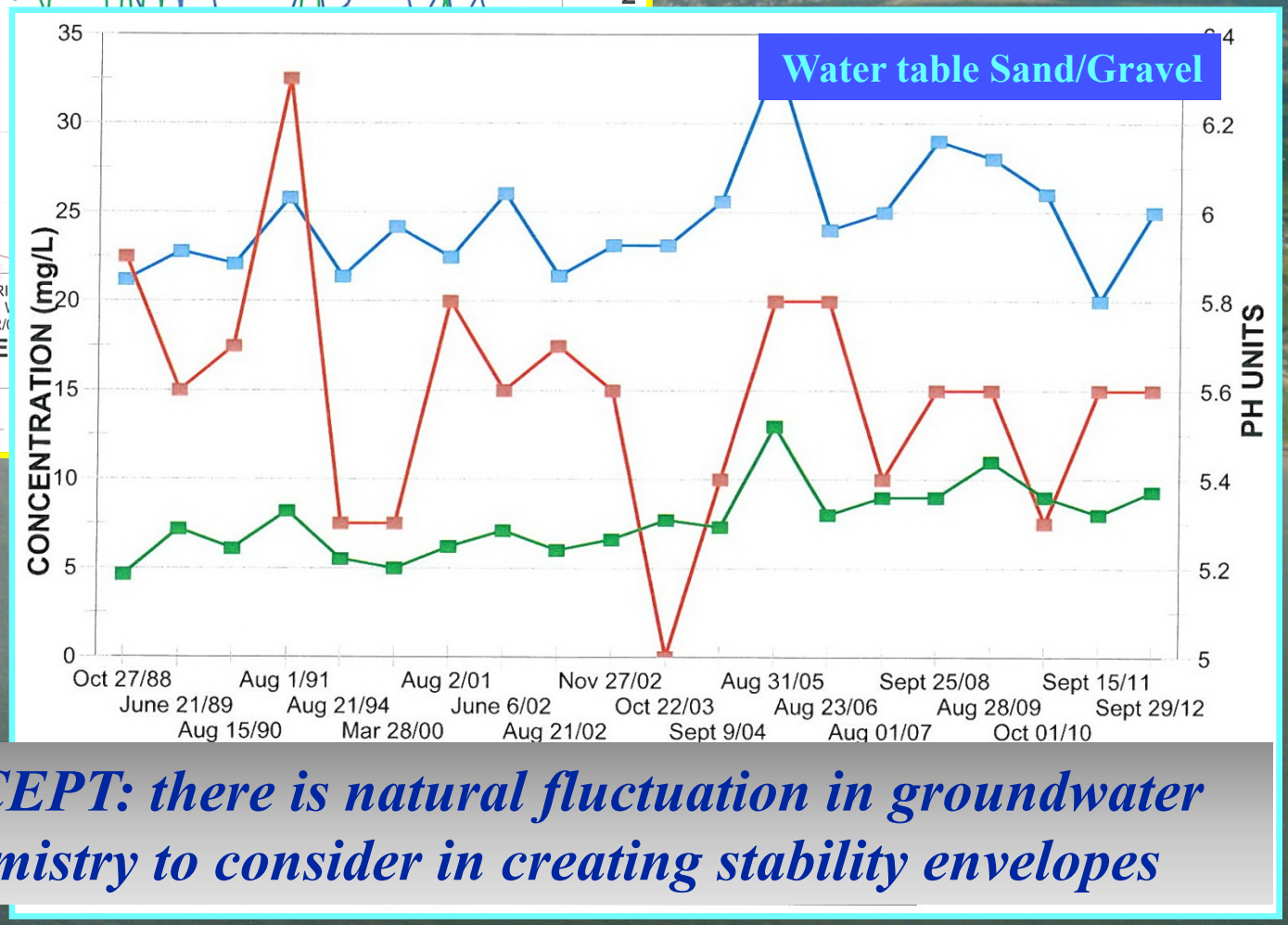
CONCEPT: consider natural changes in the evolution of water chemistry – don't just compare with some guideline – expand the analysis



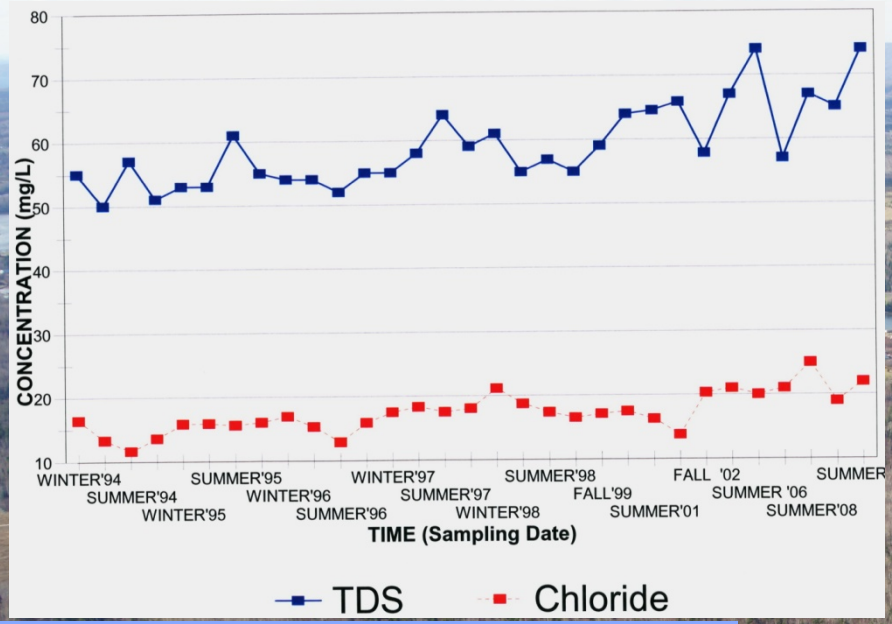
"Ada" d
(1999-20

CONCEPT: head level changes can change flow direction



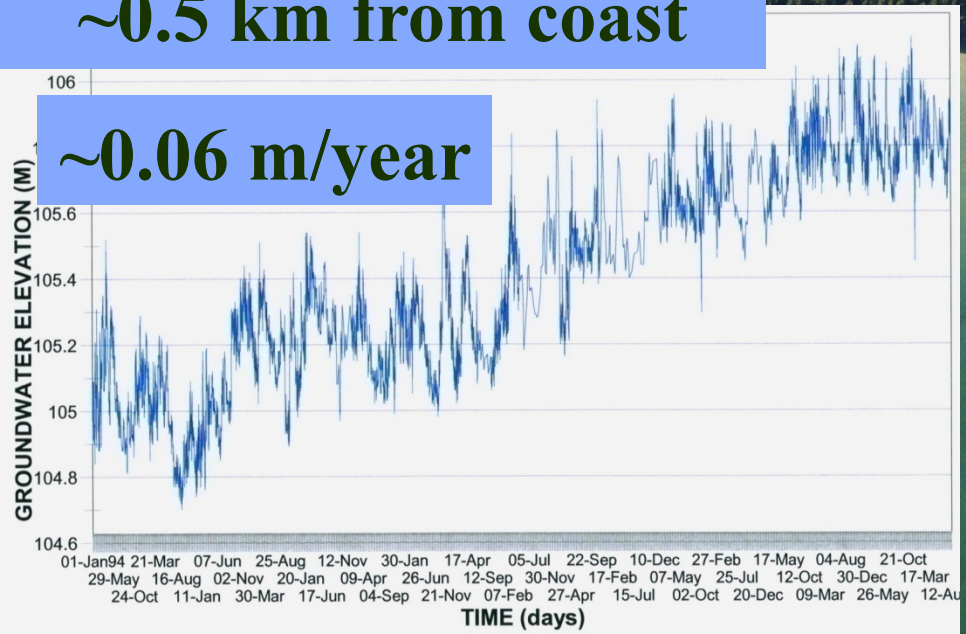


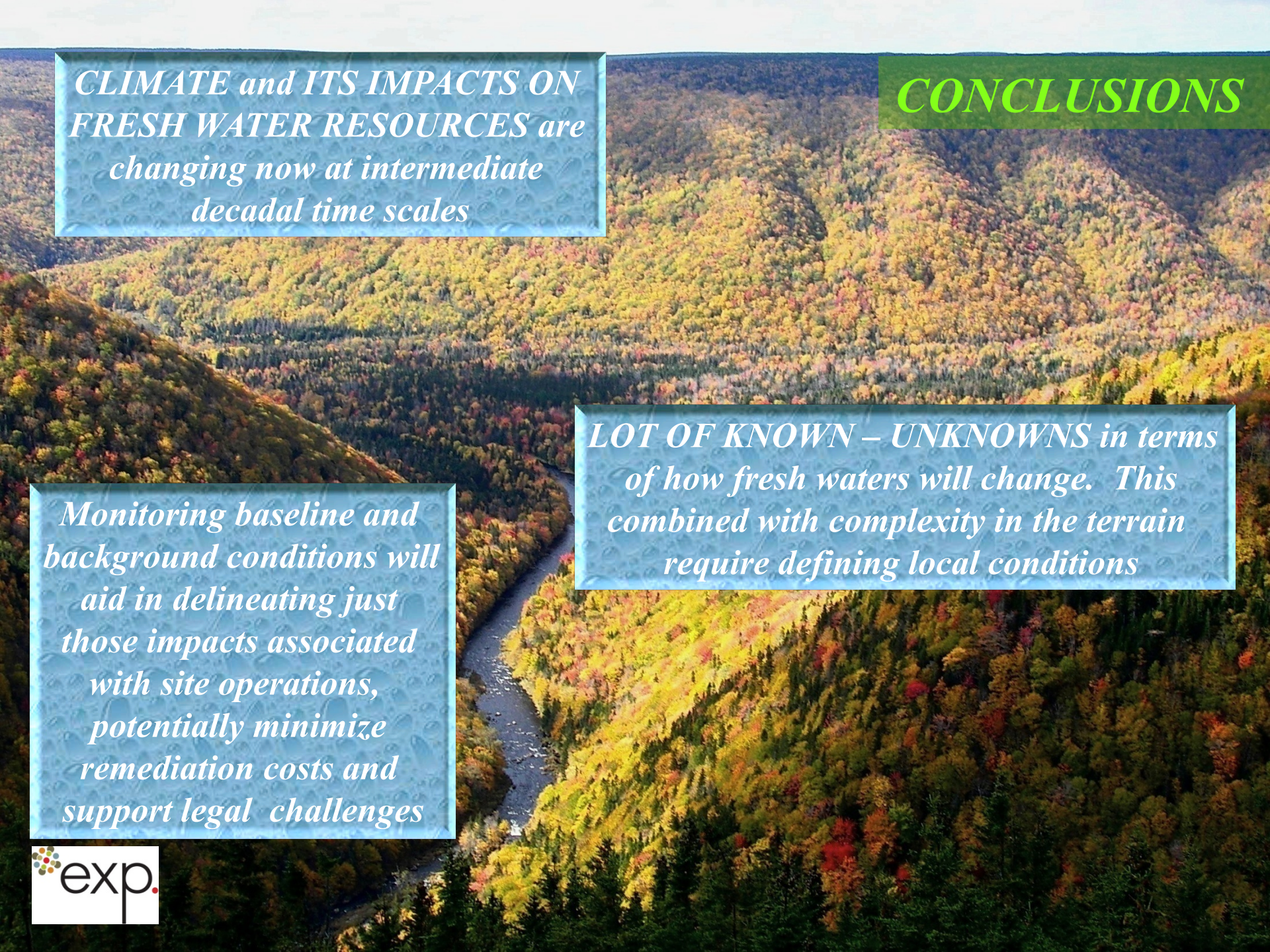
CONCEPT: there is natural fluctuation in groundwater chemistry to consider in creating stability envelopes



Upper Morien Aquifer ~0.5 km from coast

~0.06 m/year





CONCLUSIONS

CLIMATE and ITS IMPACTS ON FRESH WATER RESOURCES are changing now at intermediate decadal time scales

LOT OF KNOWN – UNKNOWNS in terms of how fresh waters will change. This combined with complexity in the terrain require defining local conditions

Monitoring baseline and background conditions will aid in delineating just those impacts associated with site operations, potentially minimize remediation costs and support legal challenges

exp.