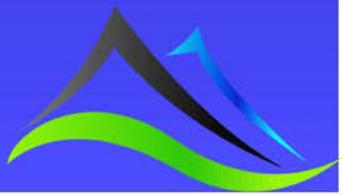
AEM Workshop

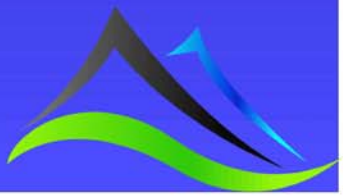
Visualisation

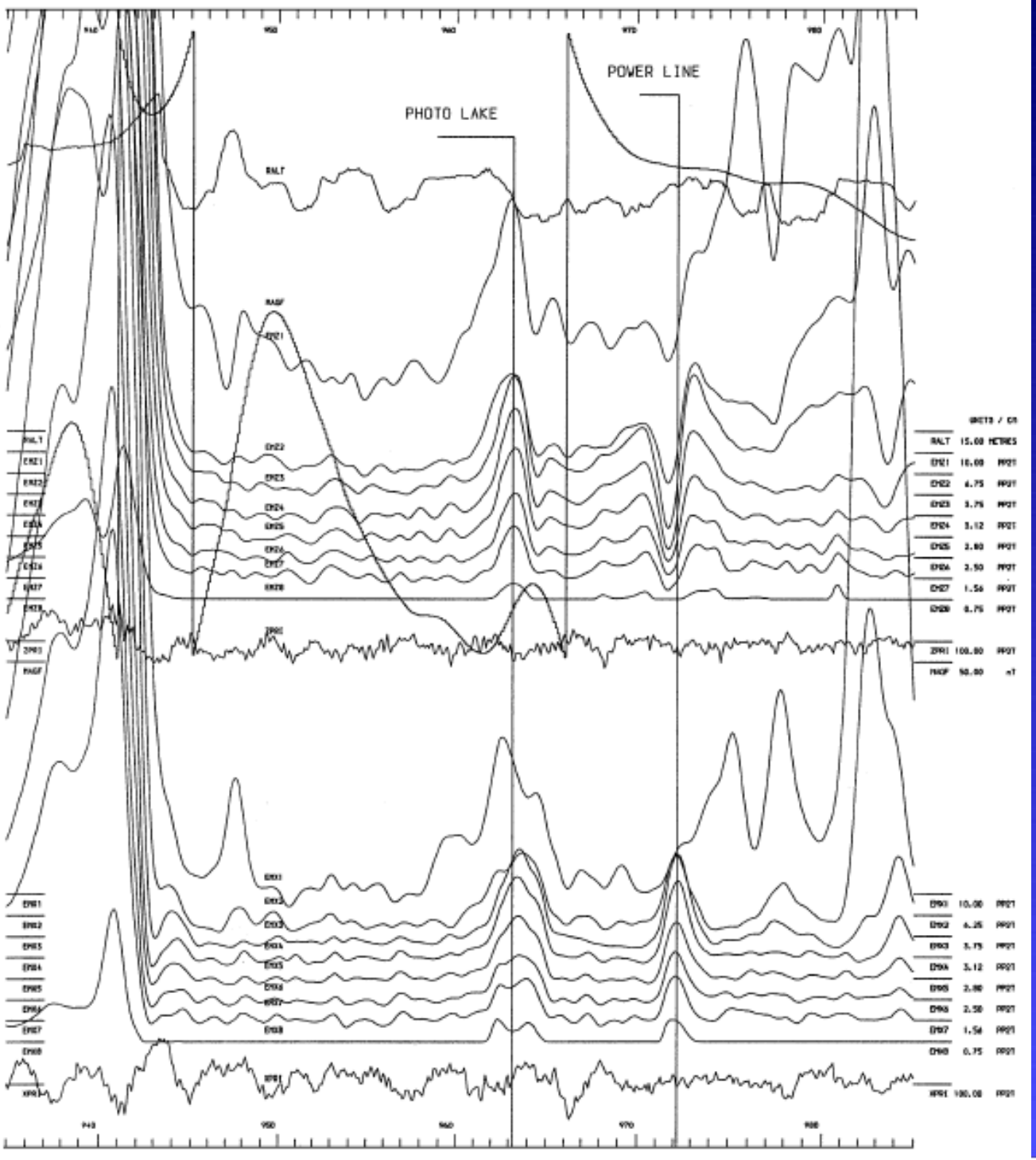
Kim Frankcombe
ExploreGeo



Visualisation

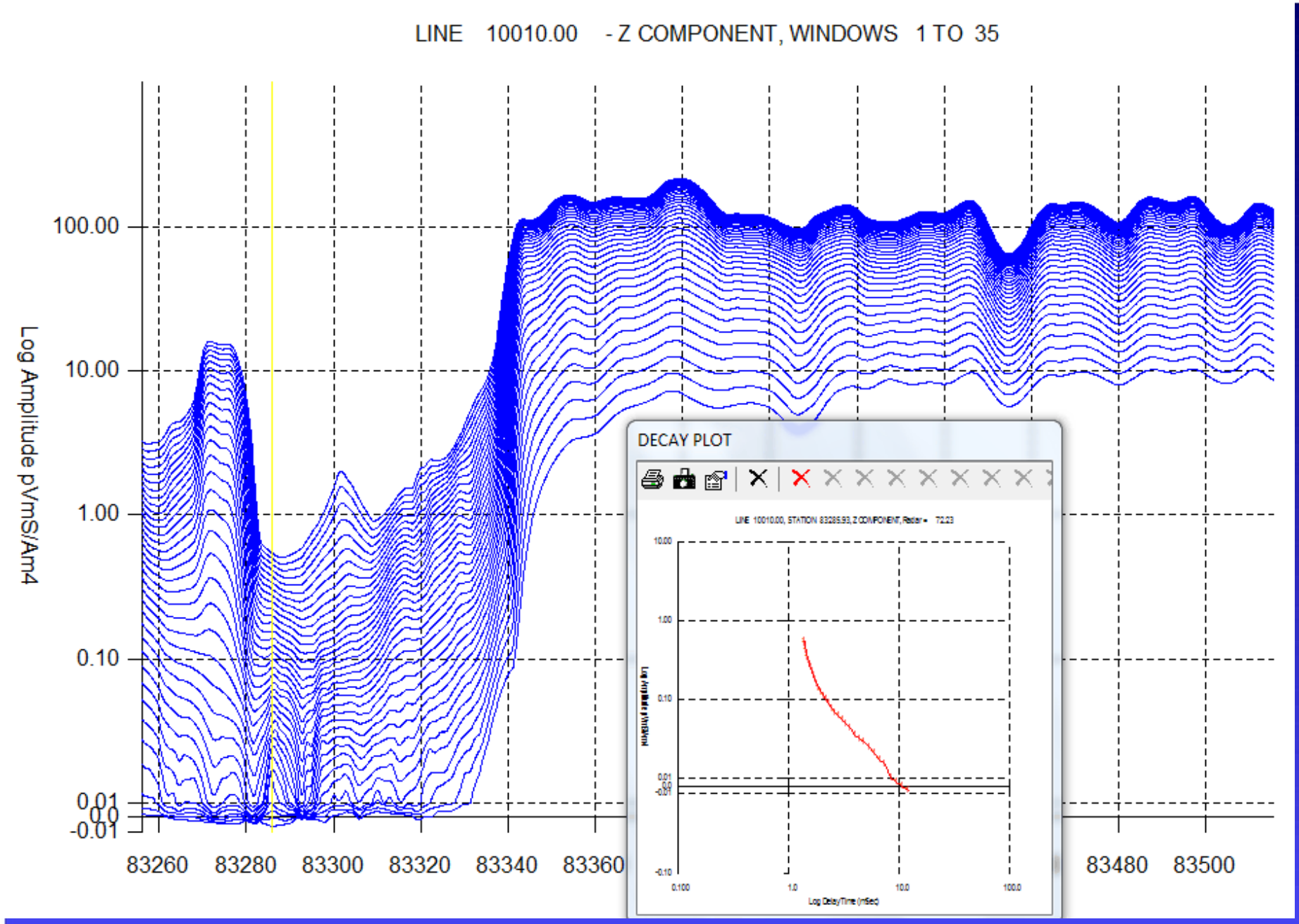
- Profiles
- Channel images
- Time constant images
- CDI/CDT - Conductivity Depth Image/Transform
- LEI - Layered Earth Inversion 1D
- 2D/3D Inversion
- Plate modelling



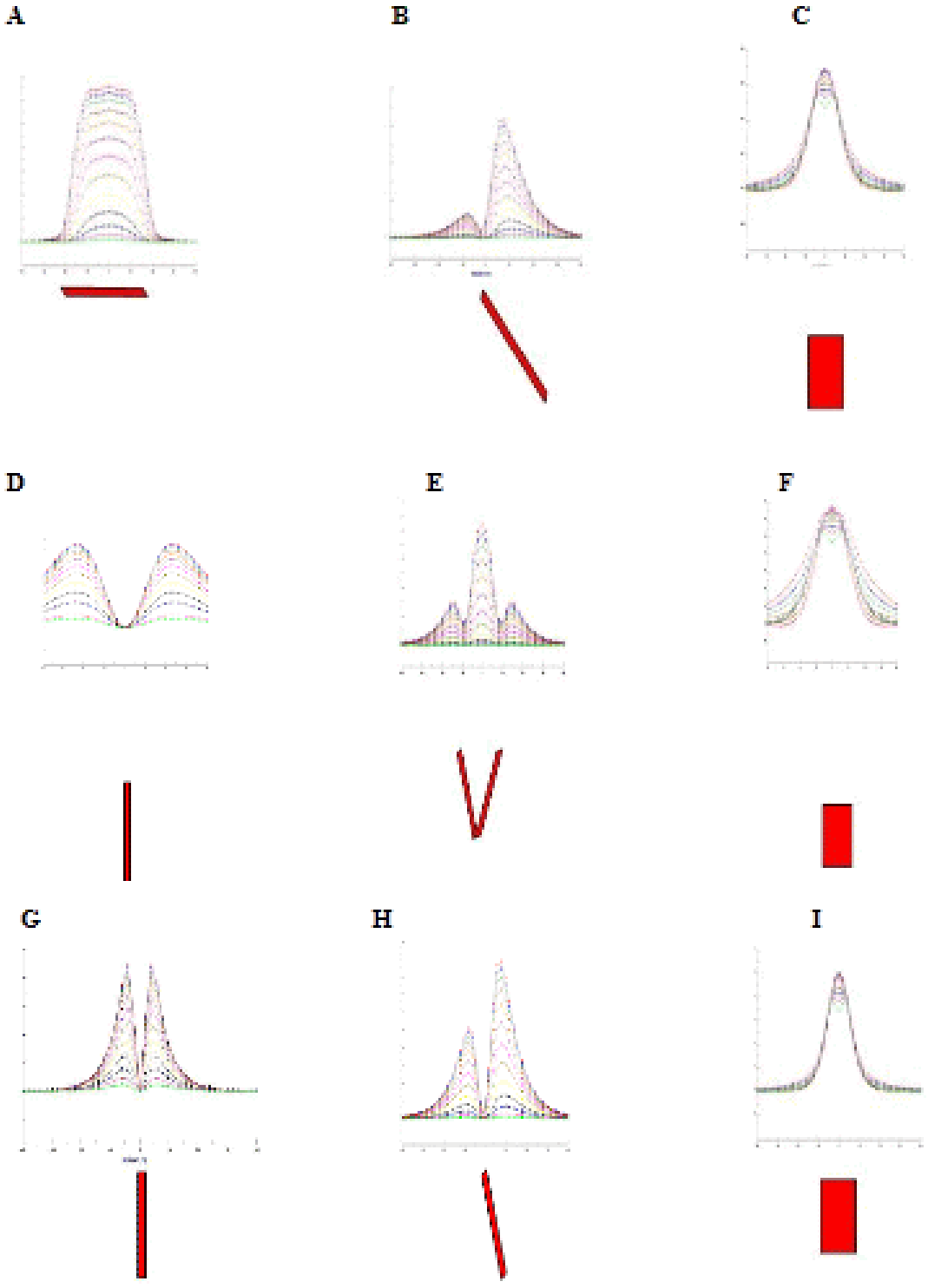


- Log
- Linear
  - Independently scaled
  - Grouped scale
  - All same

Leggatt et al 2000



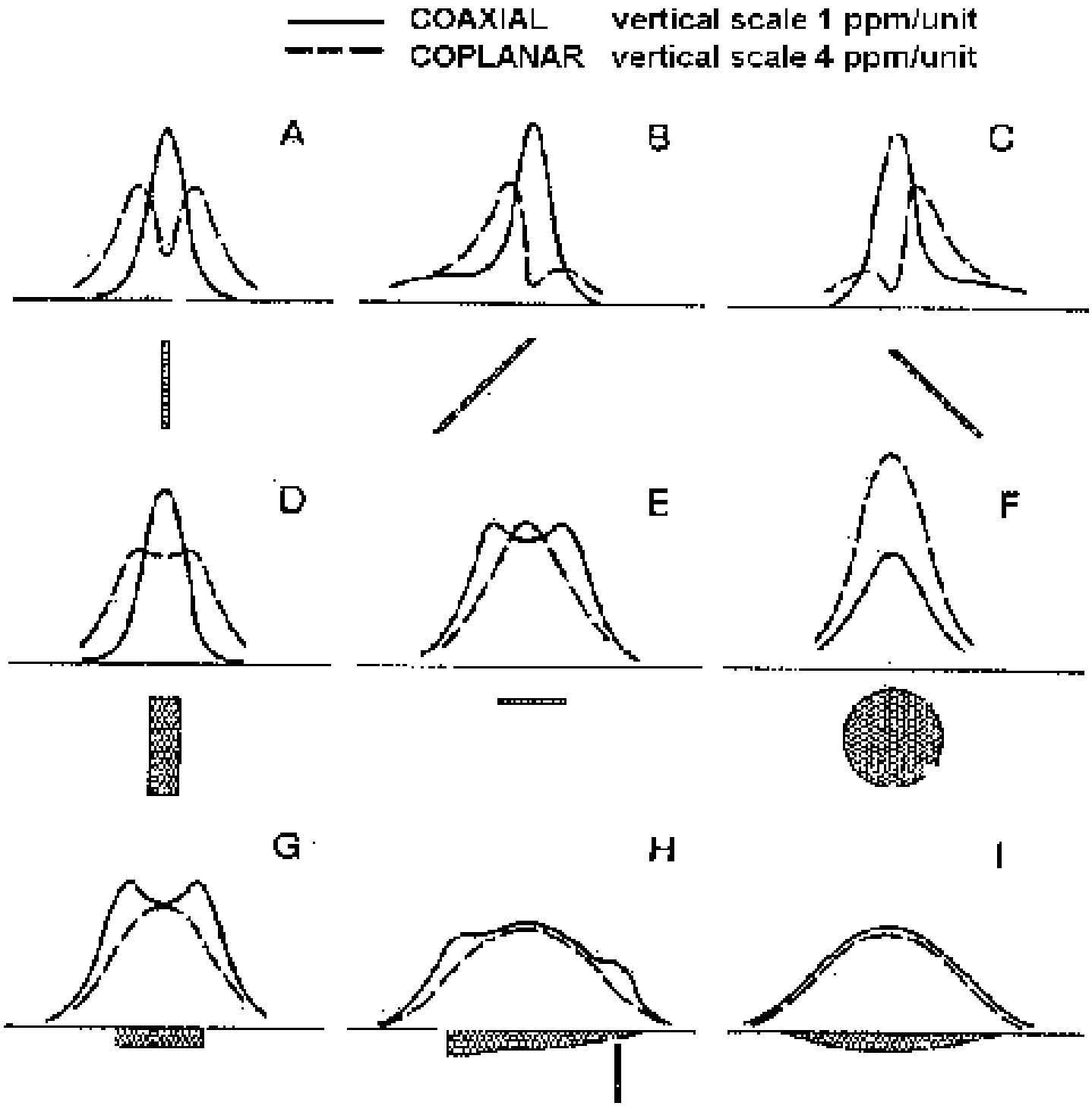
Interactive profiles with decays



Anomaly shape is a function of the system geometry and the target shape

Anomaly shape templates
-Time Domain In-Loop

From Geotech



Anomaly shape templates - Frequency Domain

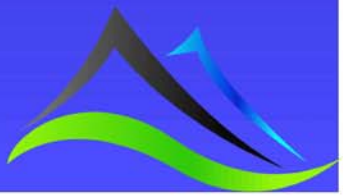
http://www.geoexplo.com/airborne_survey_workshop_EM.html

Secondary Response

Shape Dependence

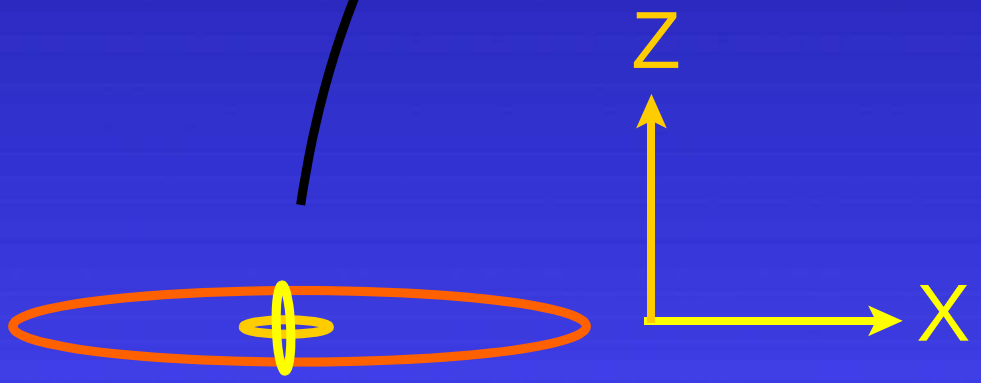
Thin Bodies - Secondary field is always in the plane of the body

Thick Bodies - Secondary field is in the plane of maximum coupling with the Primary field



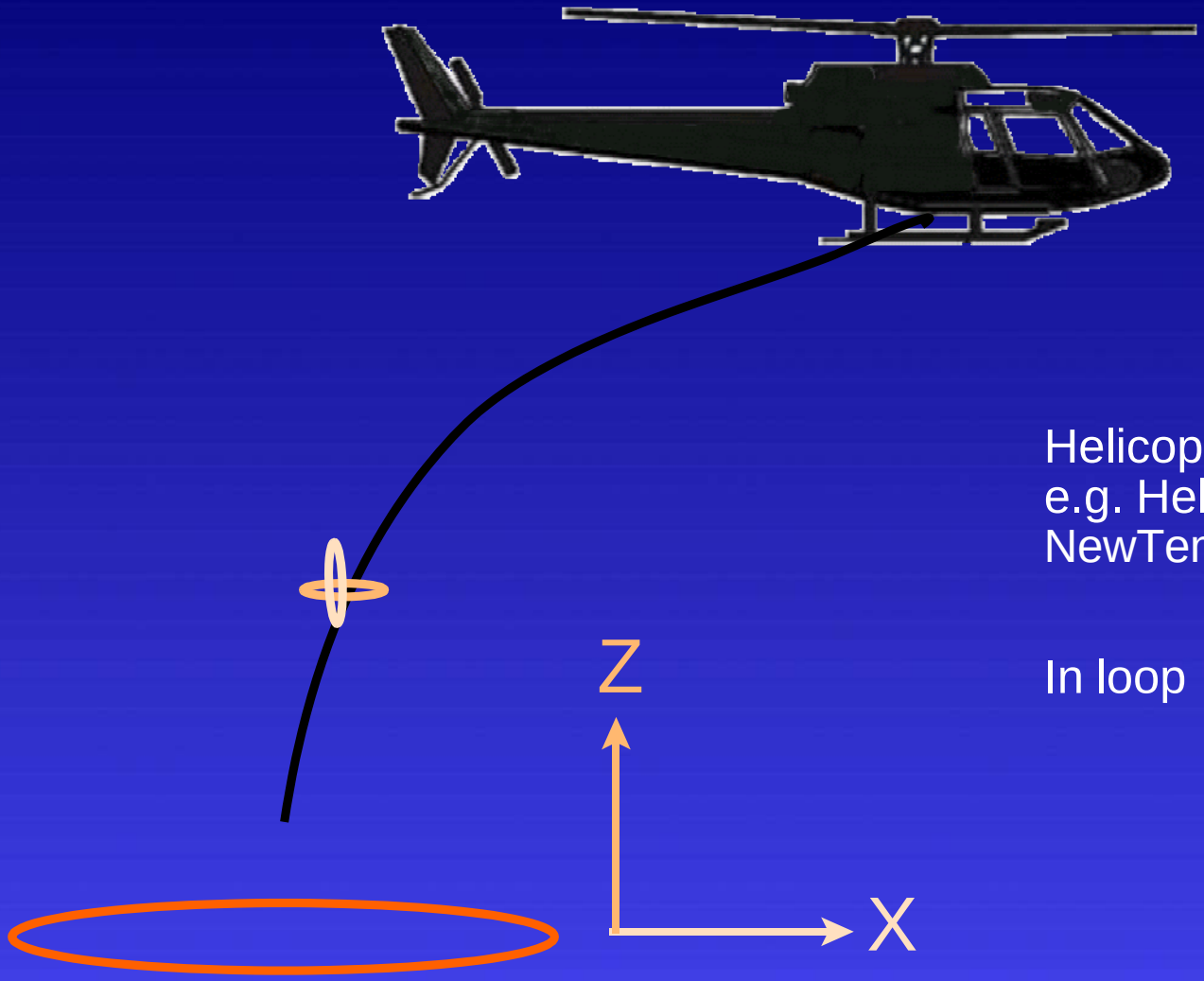
Helicopter Time Domain
e.g. VTEM, Hoistem,
Reptem, Aerotem, Xtem

In loop



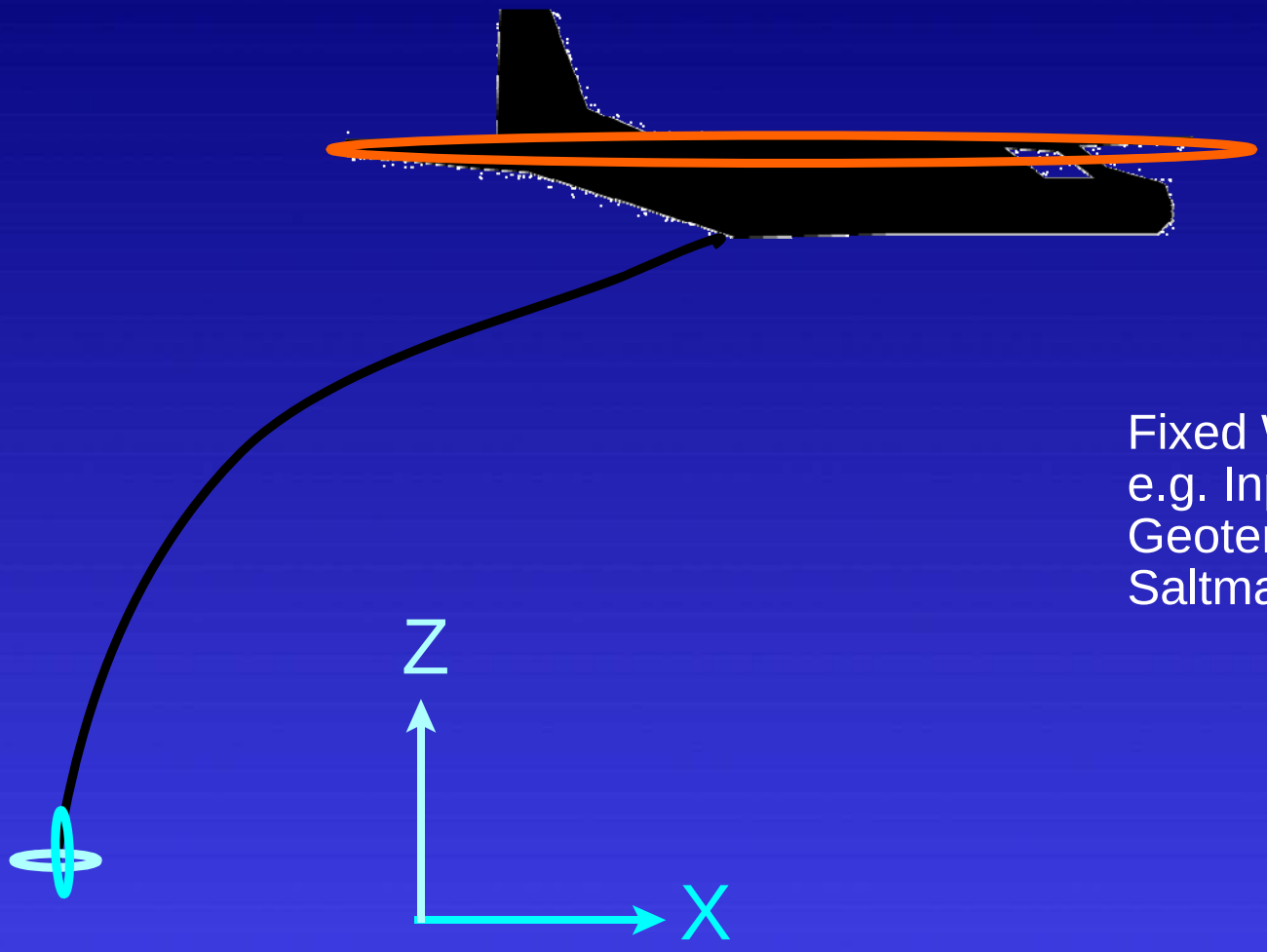
Helicopter Time Domain
e.g. Skytem

In Loop

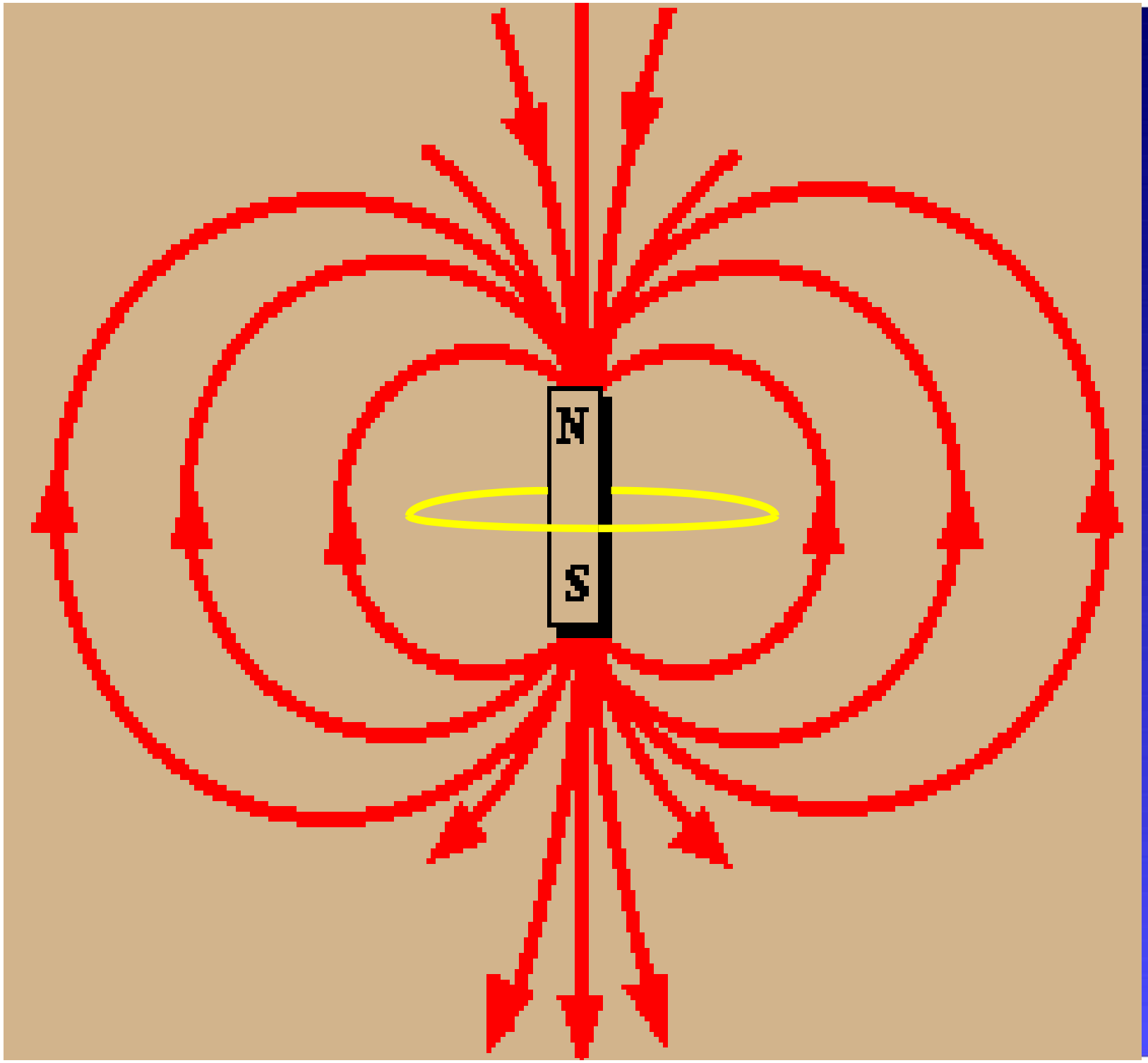


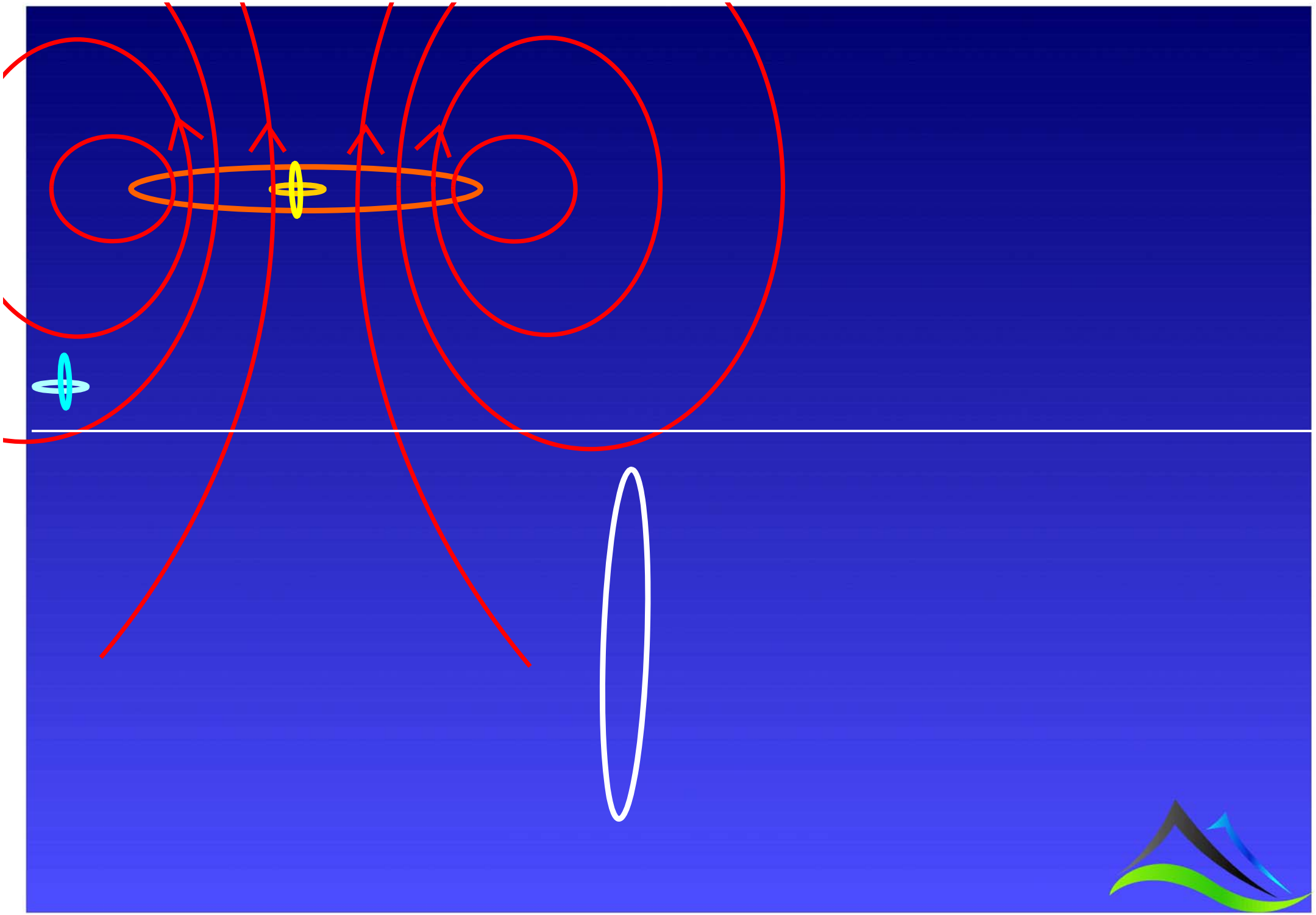
Helicopter Time Domain
e.g. HeliTem, (HeliGeotem)
NewTem

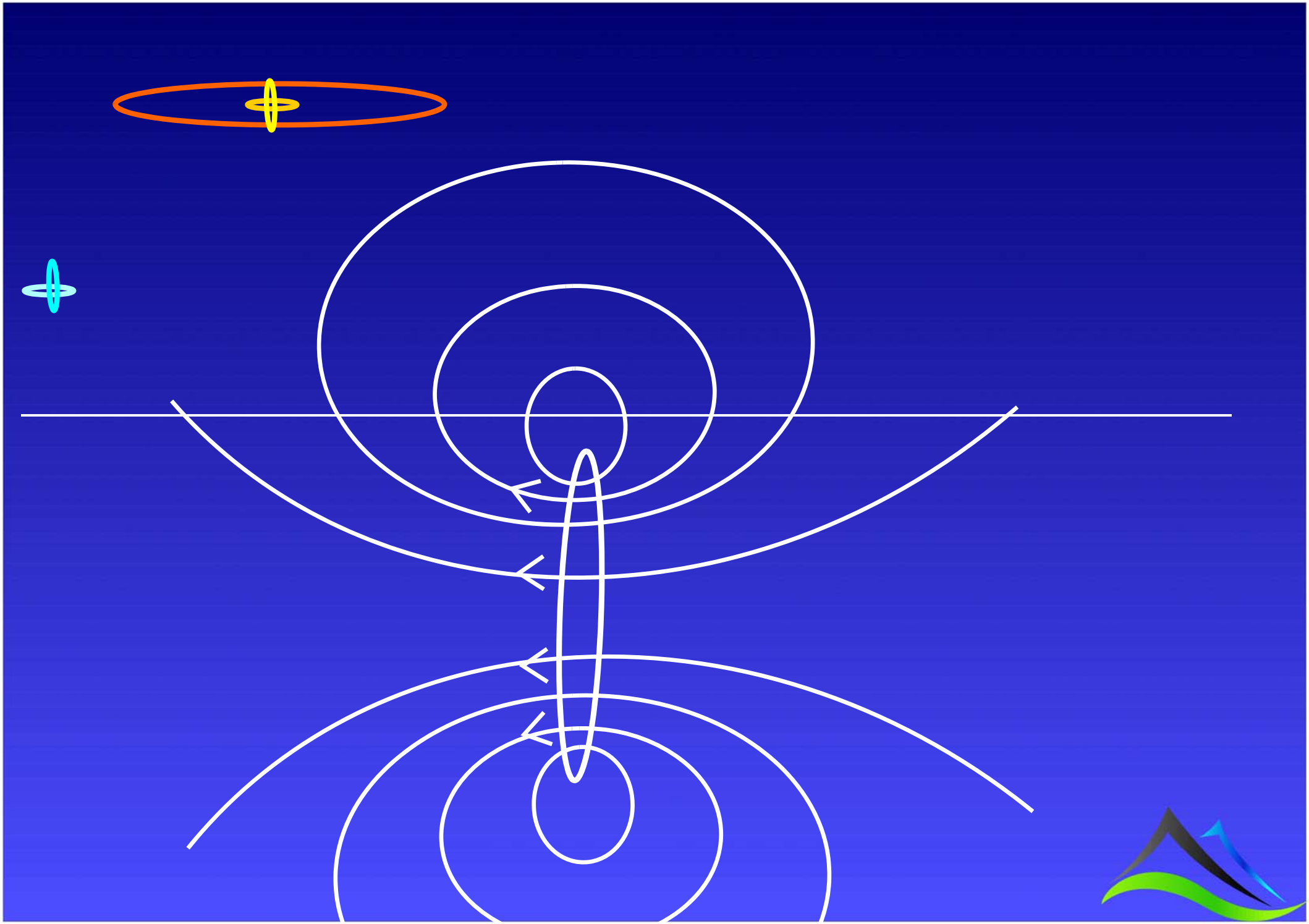
In loop

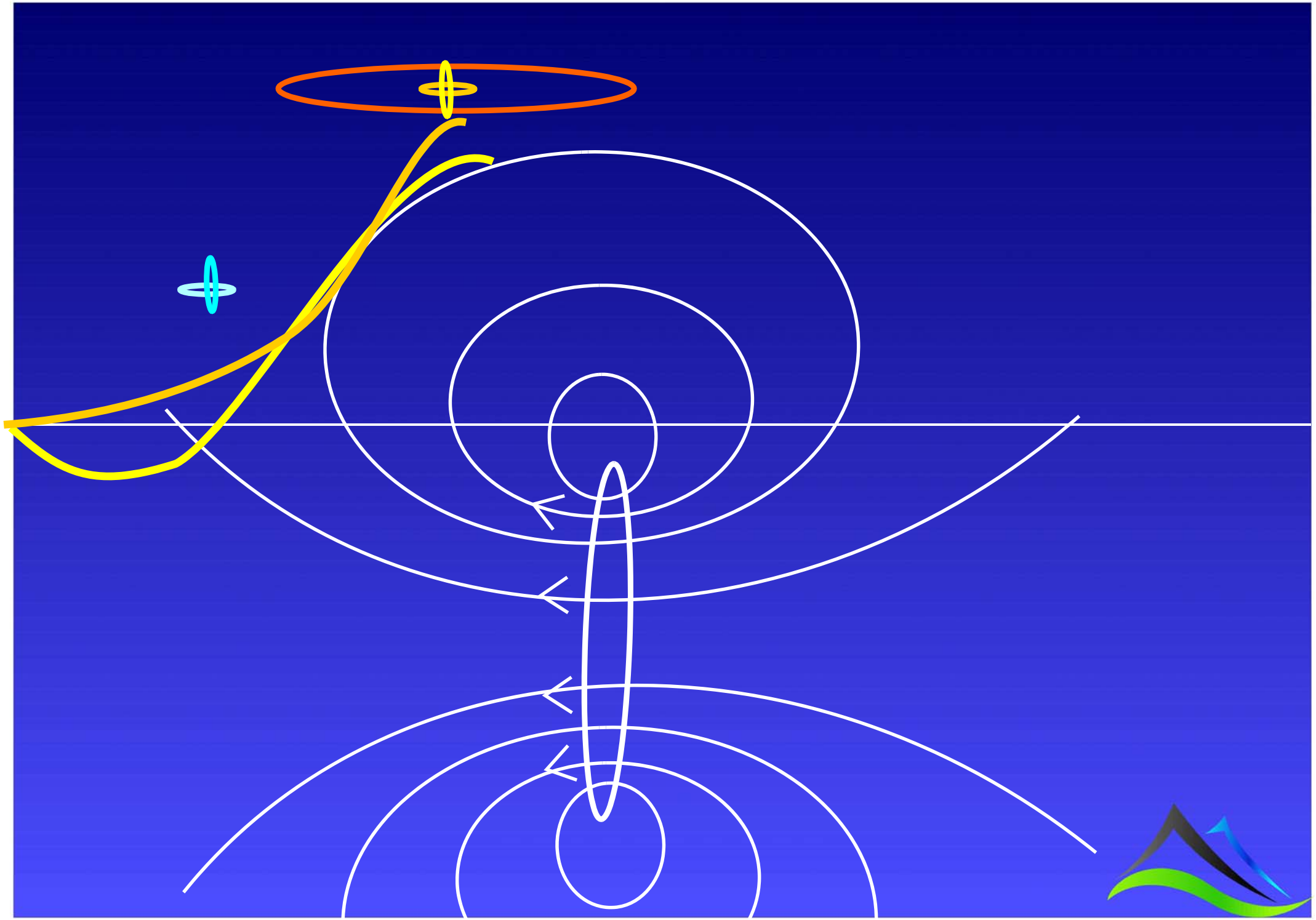


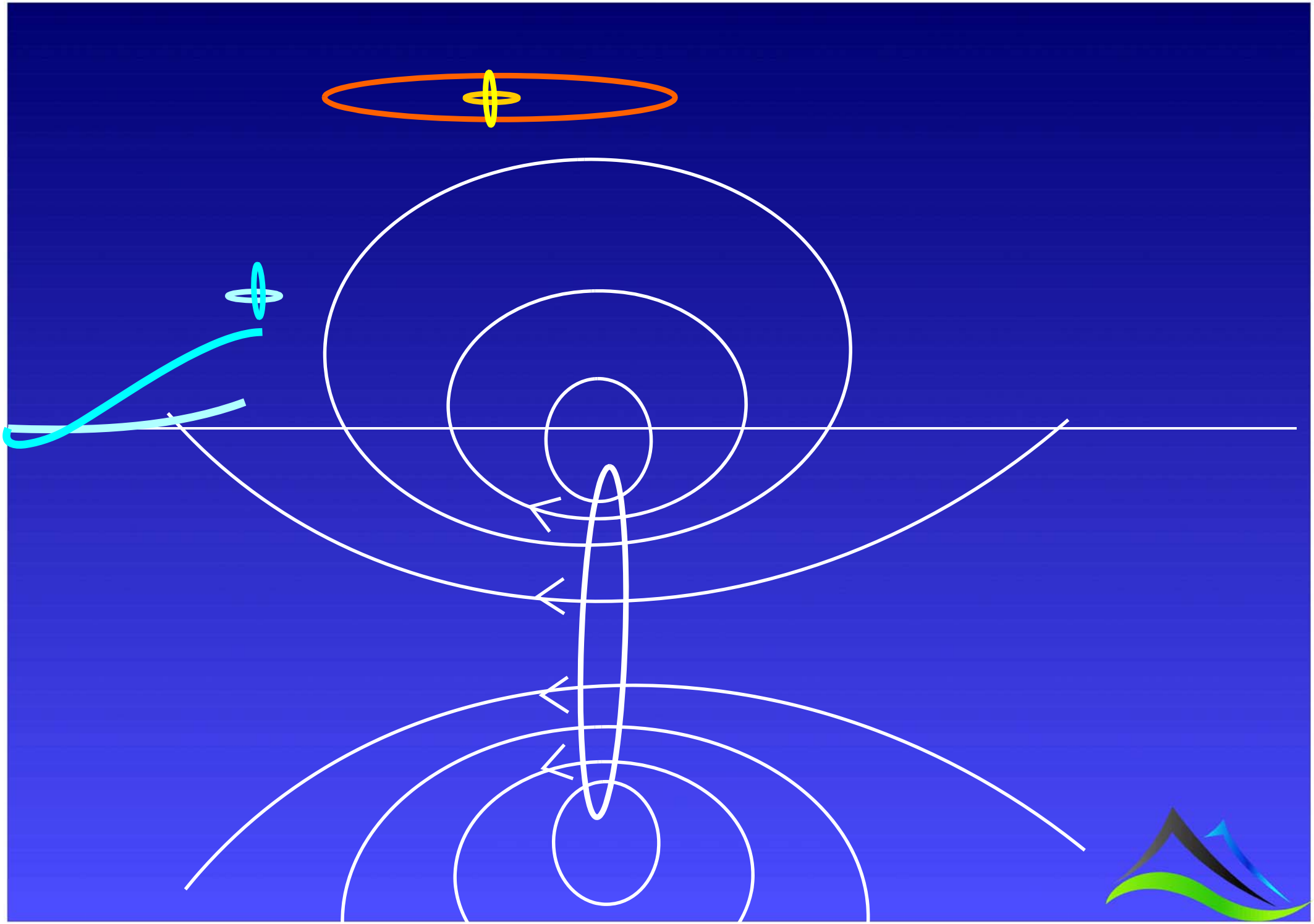
Fixed Wing Time Domain
e.g. Input, Questem,
Geotem, Megatem, Tempest,
Saltmap, Spectrem

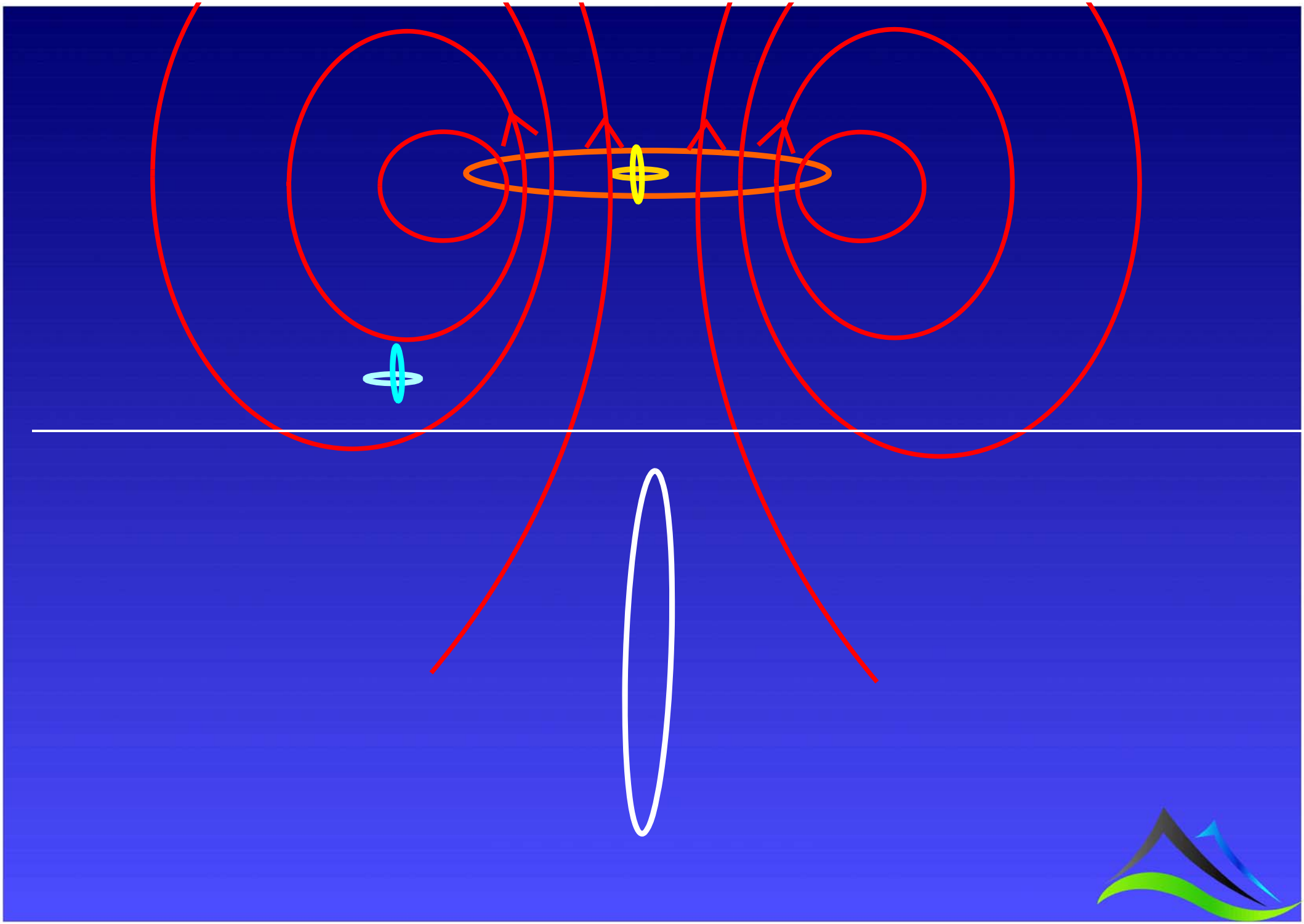

N
S

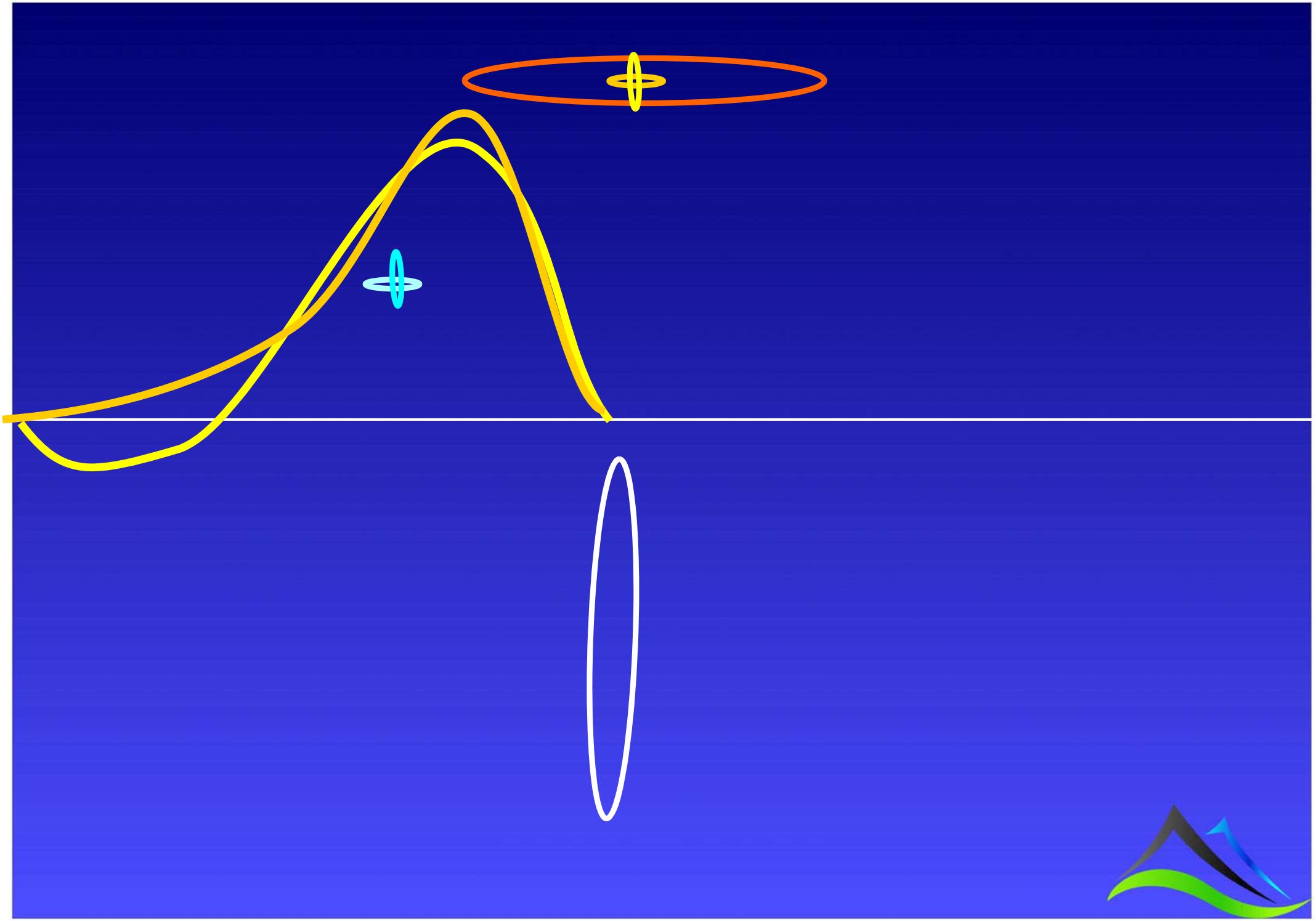


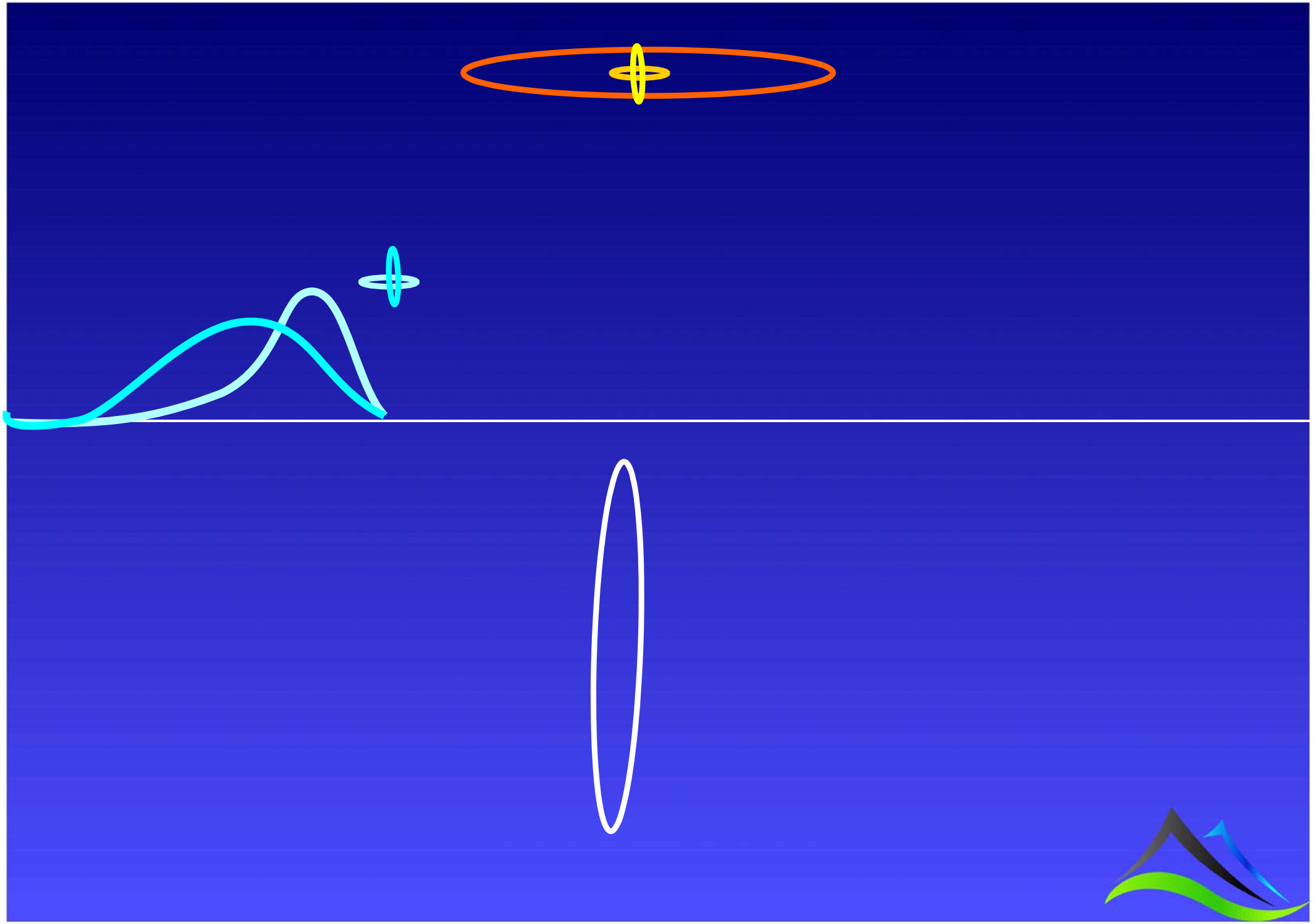


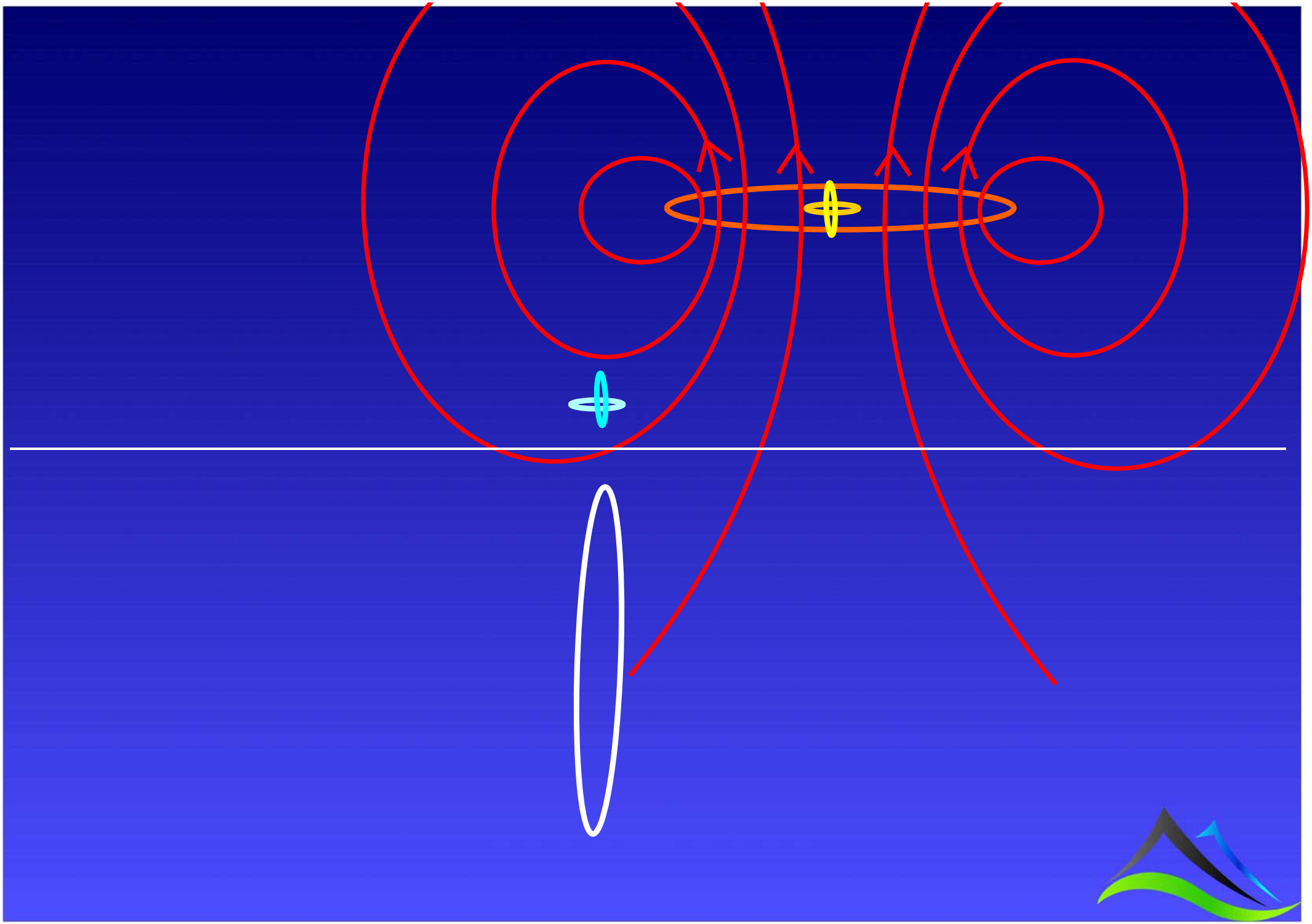


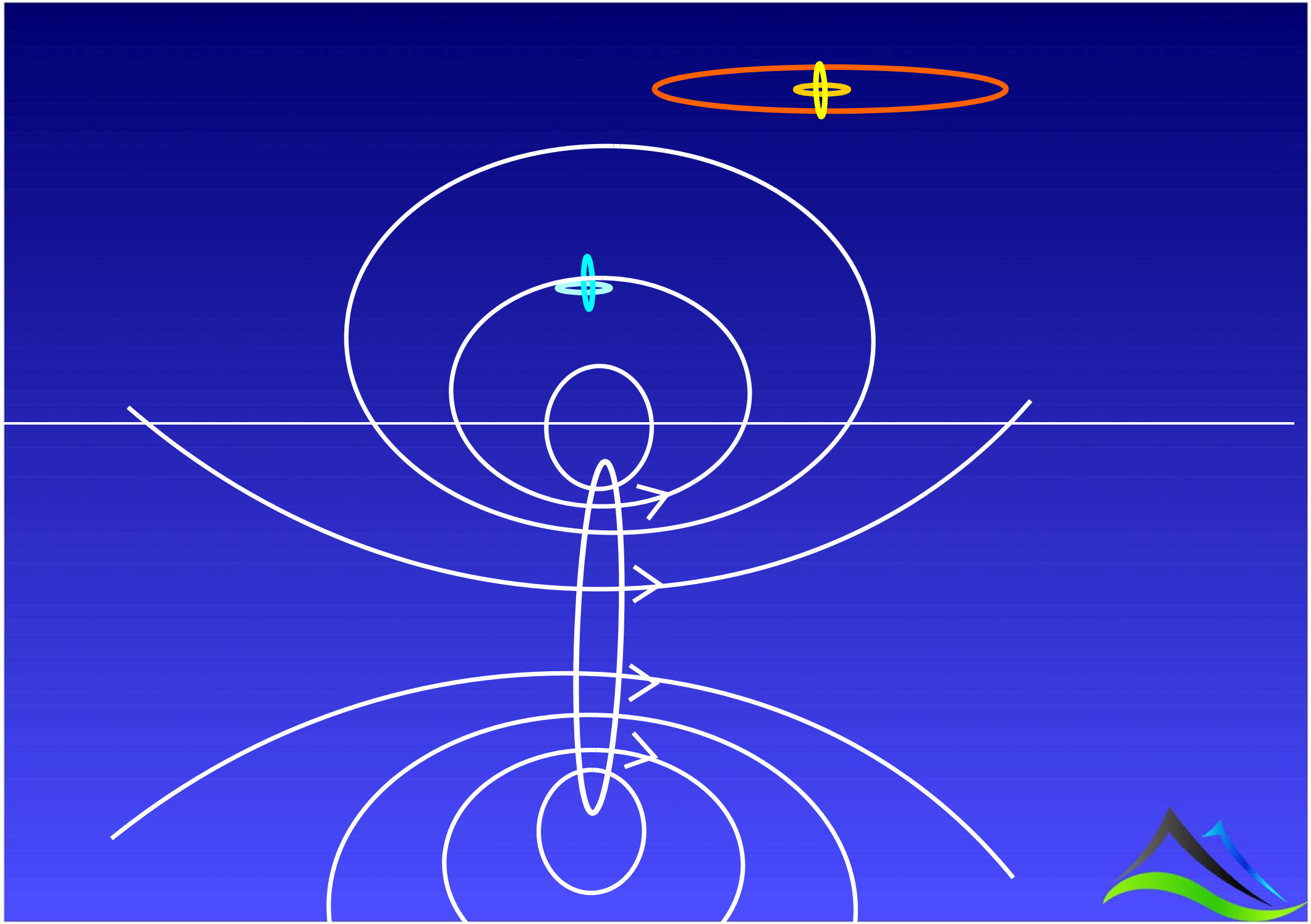


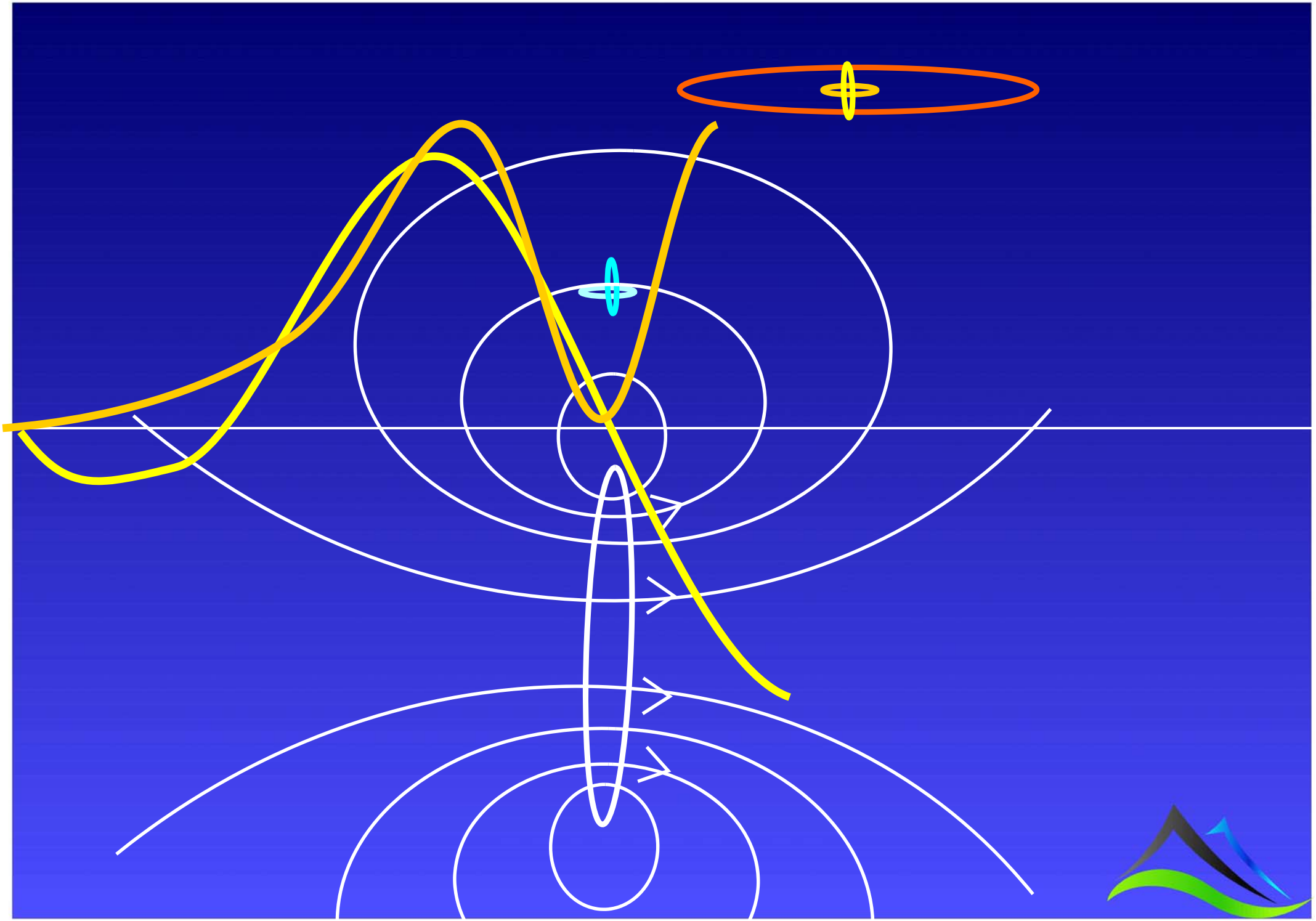


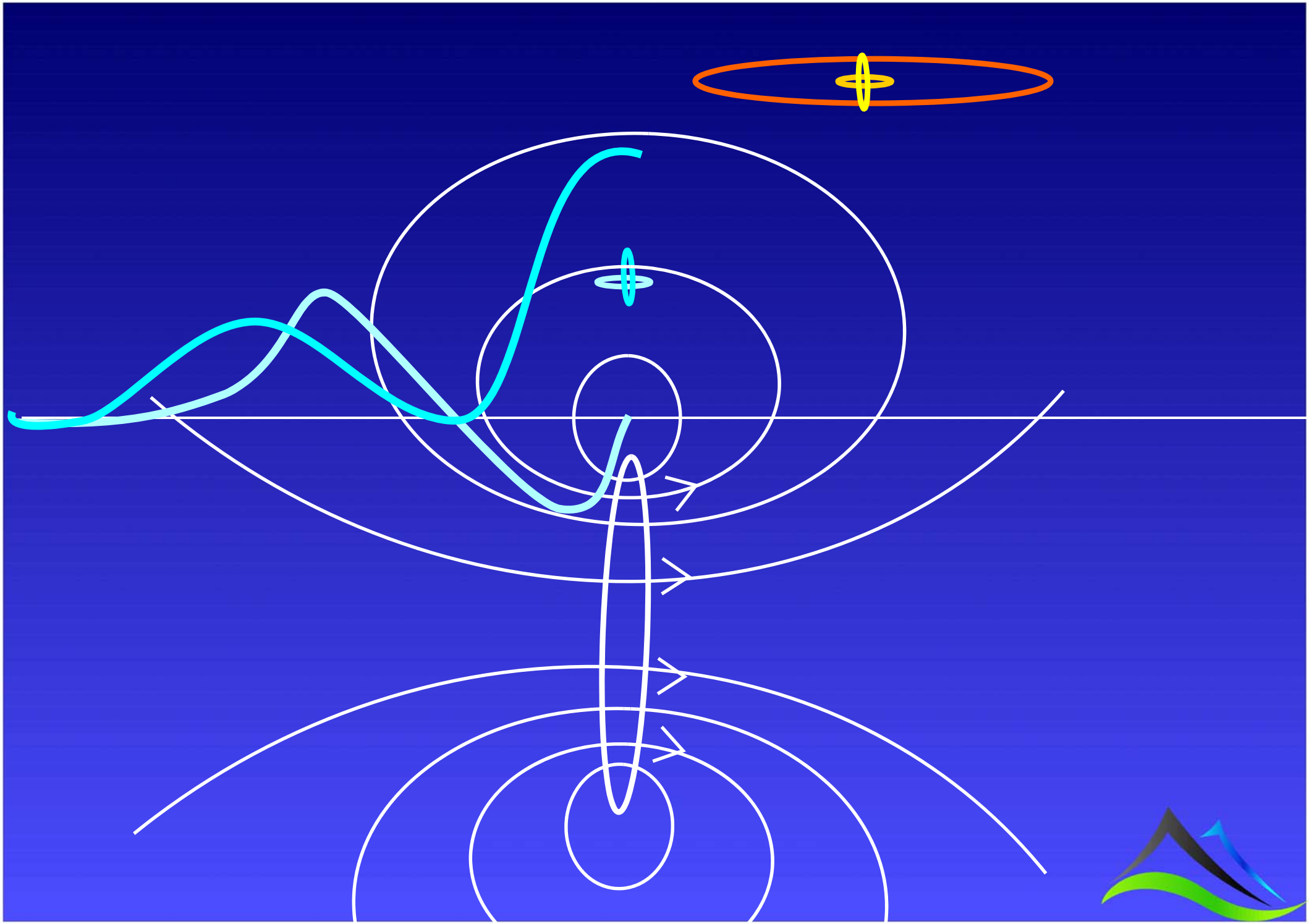


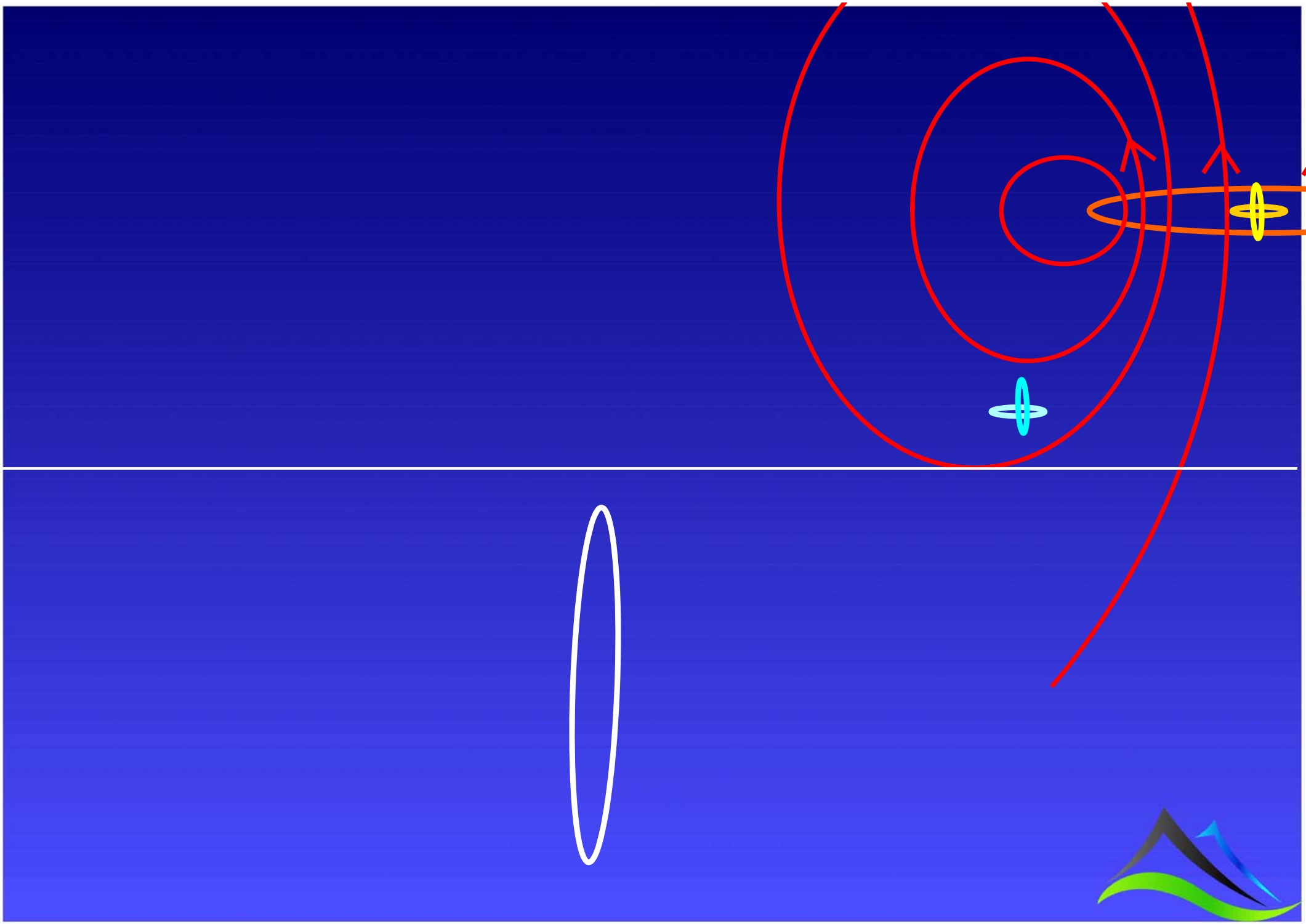


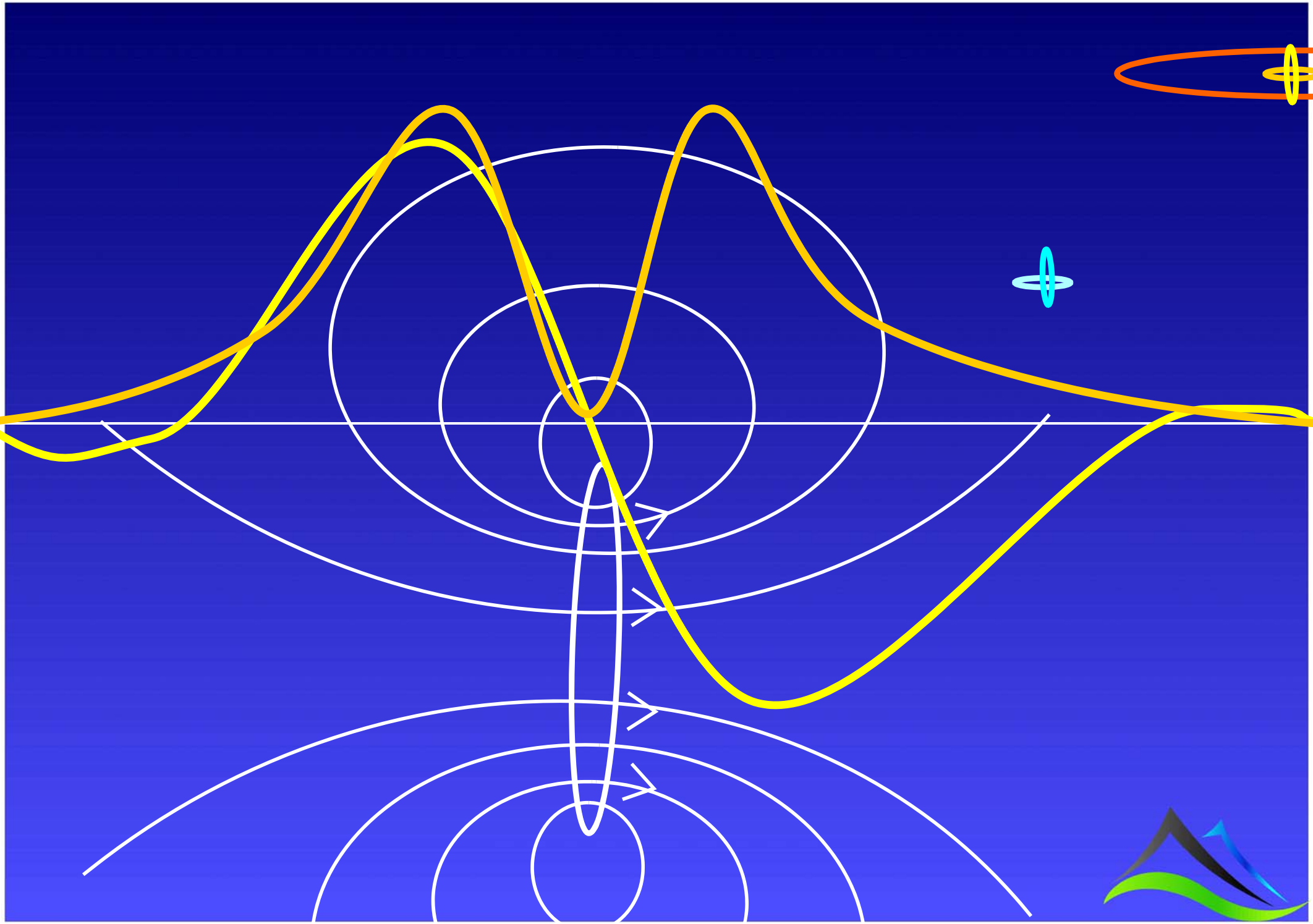


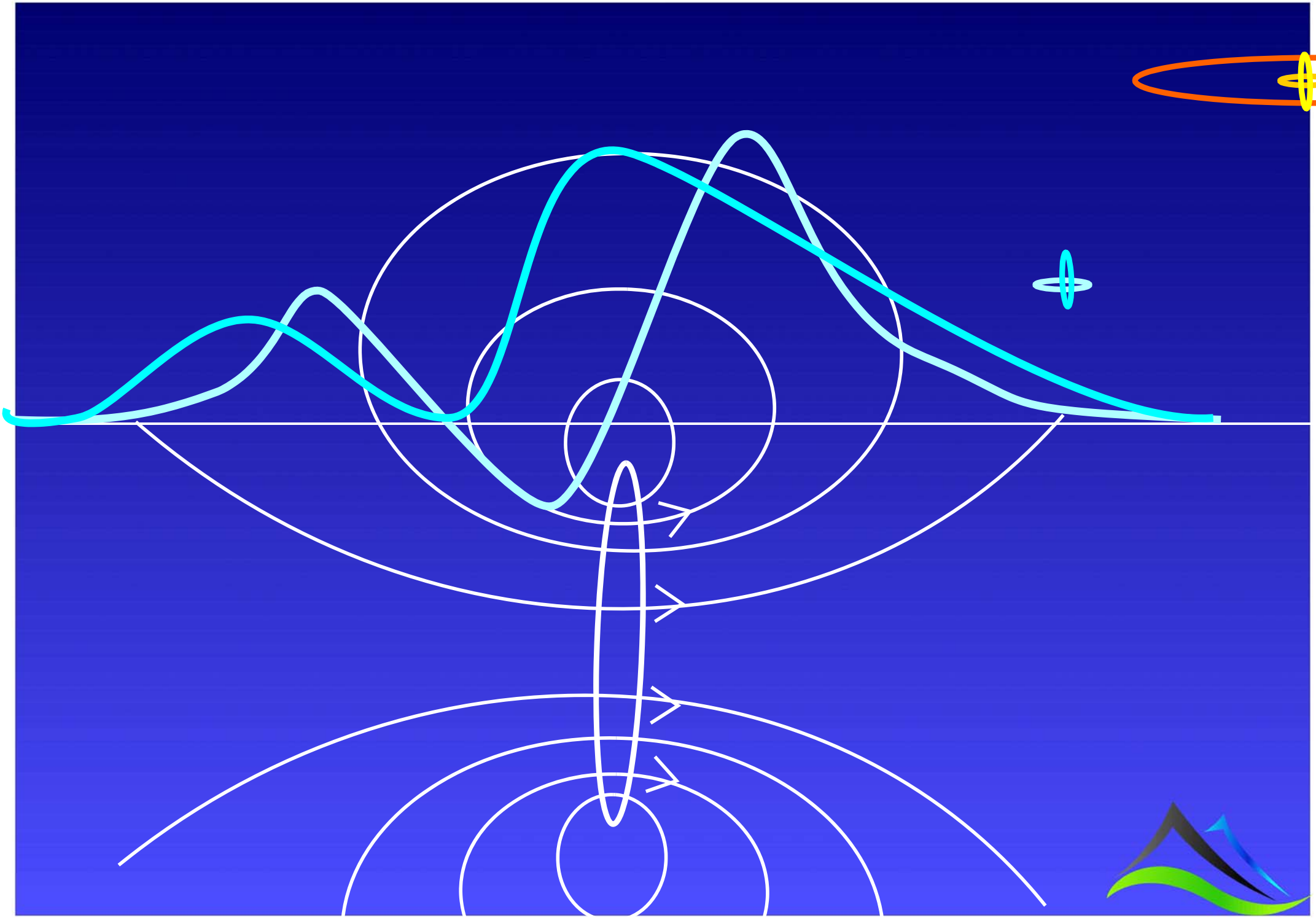




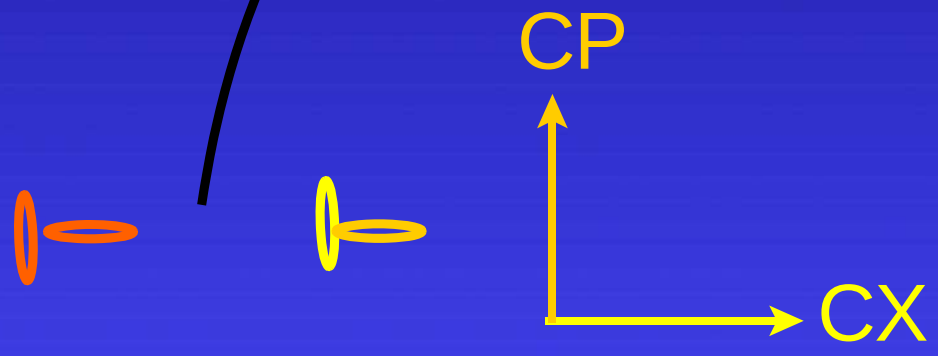


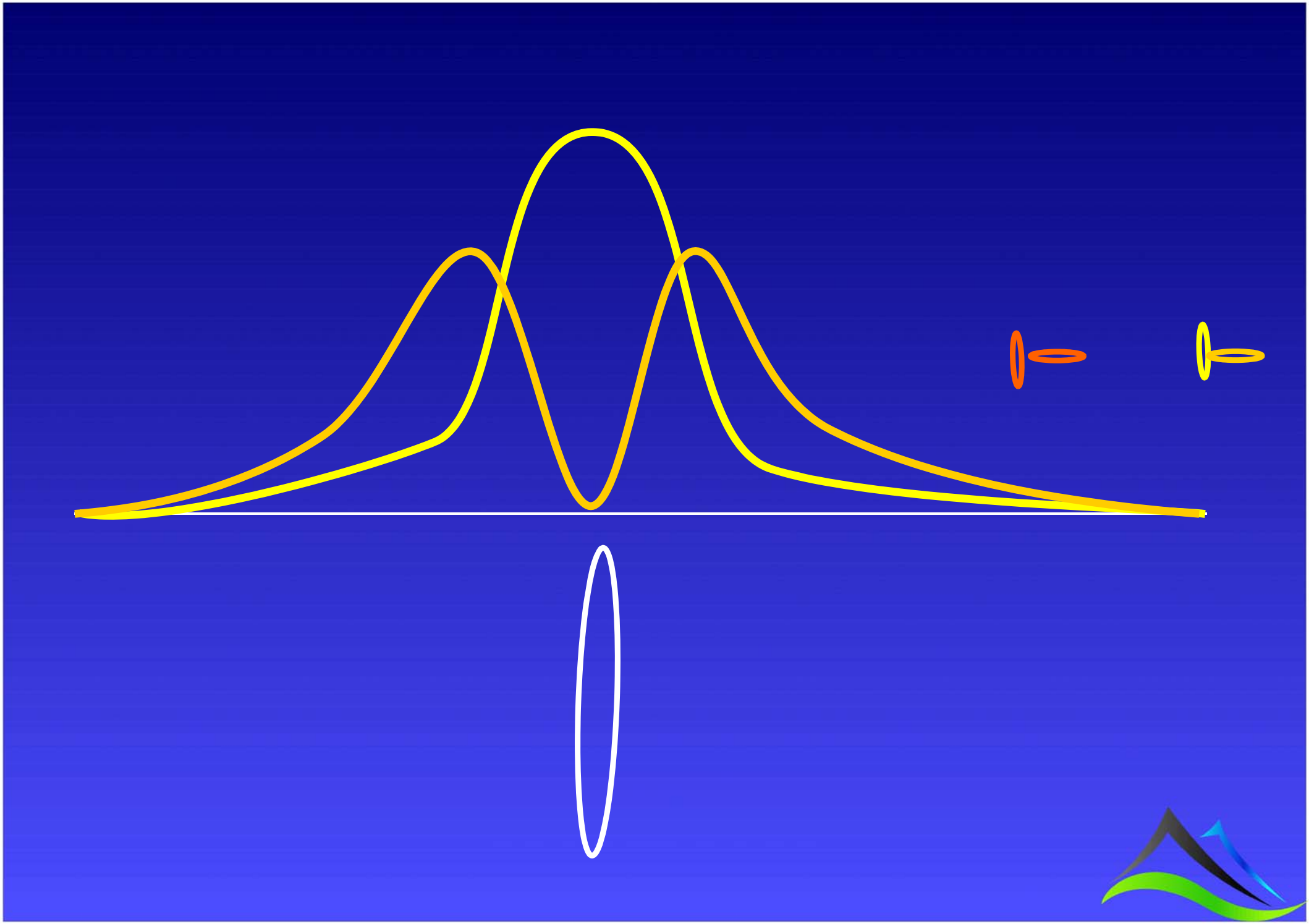




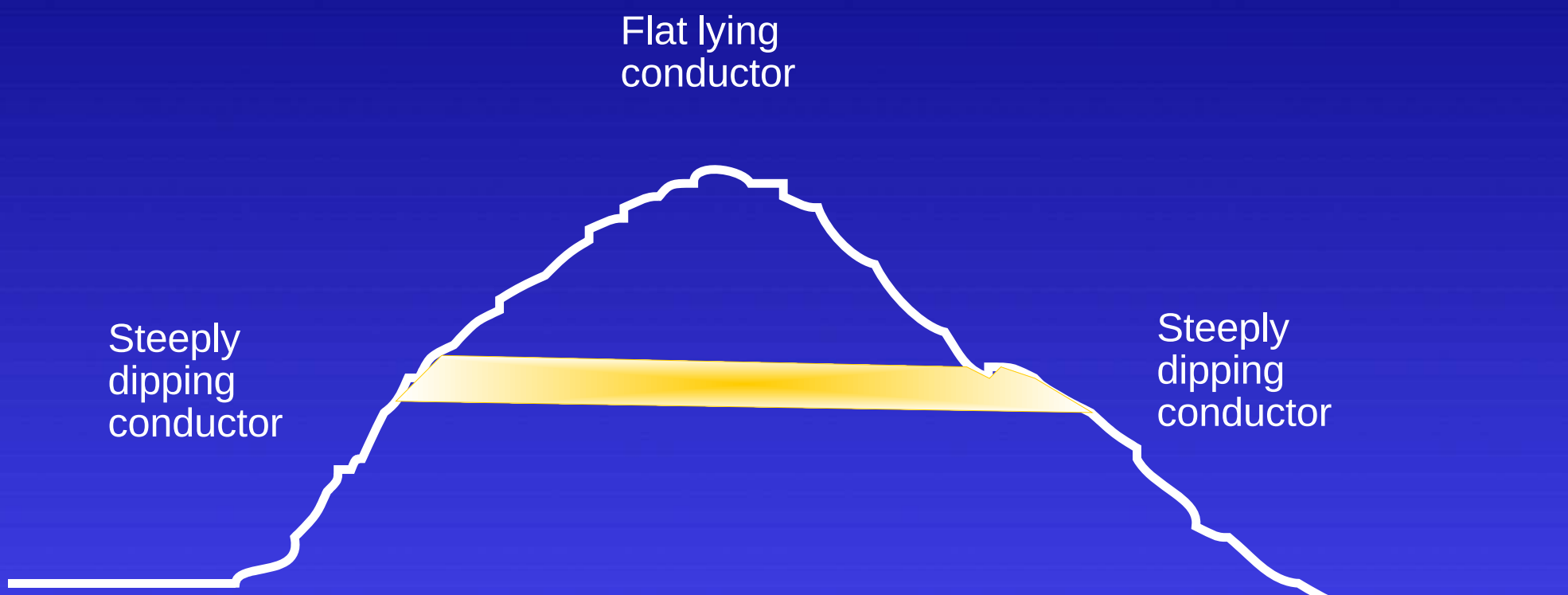


Helicopter Frequency Domain
e.g. Resolve, Dighem,
Hummingbird



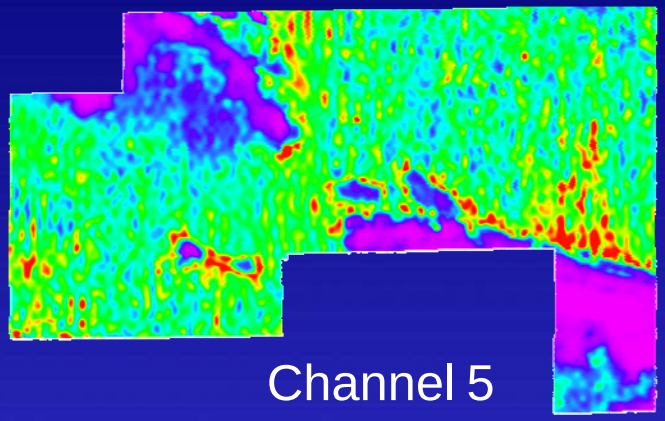


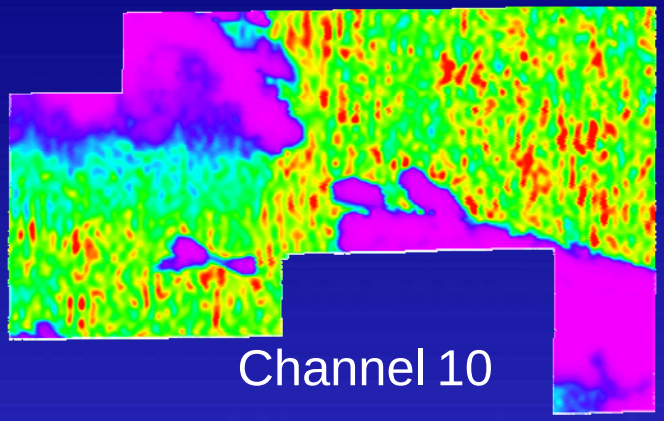
Topography needs to be taken into account!

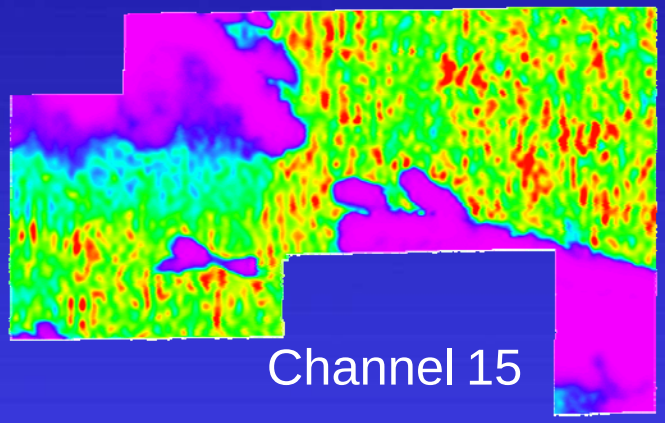


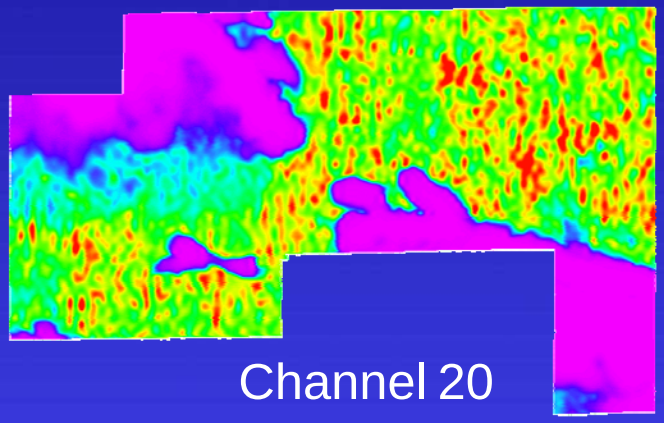
This will result in a profile which looks like the flat earth response fromvariable thickness overburden

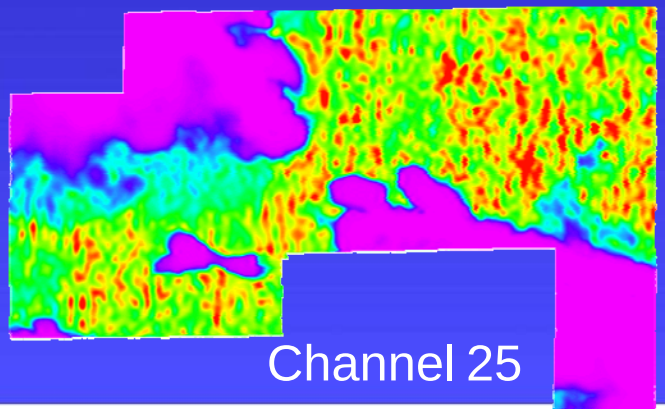
Channel Images





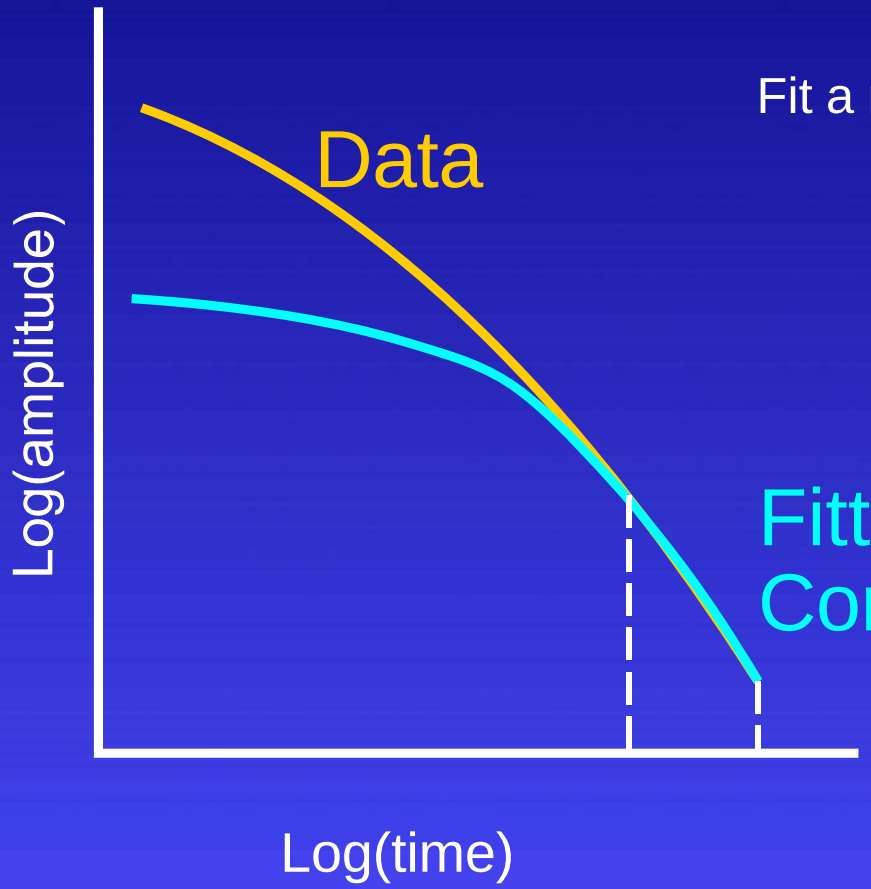






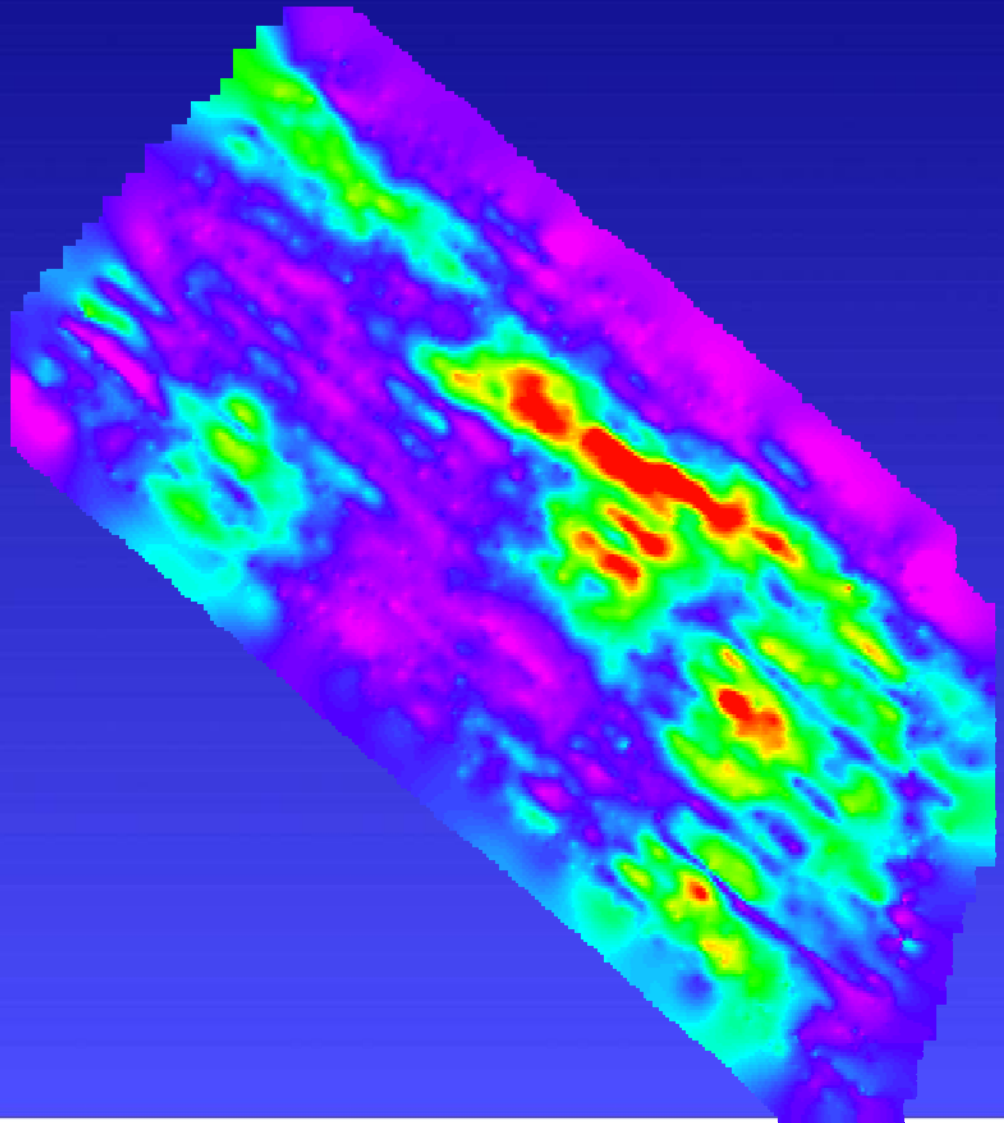
Linear colour stretch

Time Constant Images



Fit a model decay to all or part of the observed data

Time Constant Images



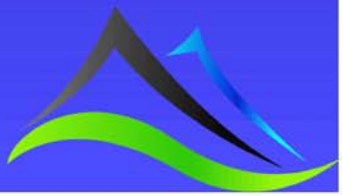
Exponential or Power Law constant?

Time range to consider fitting?

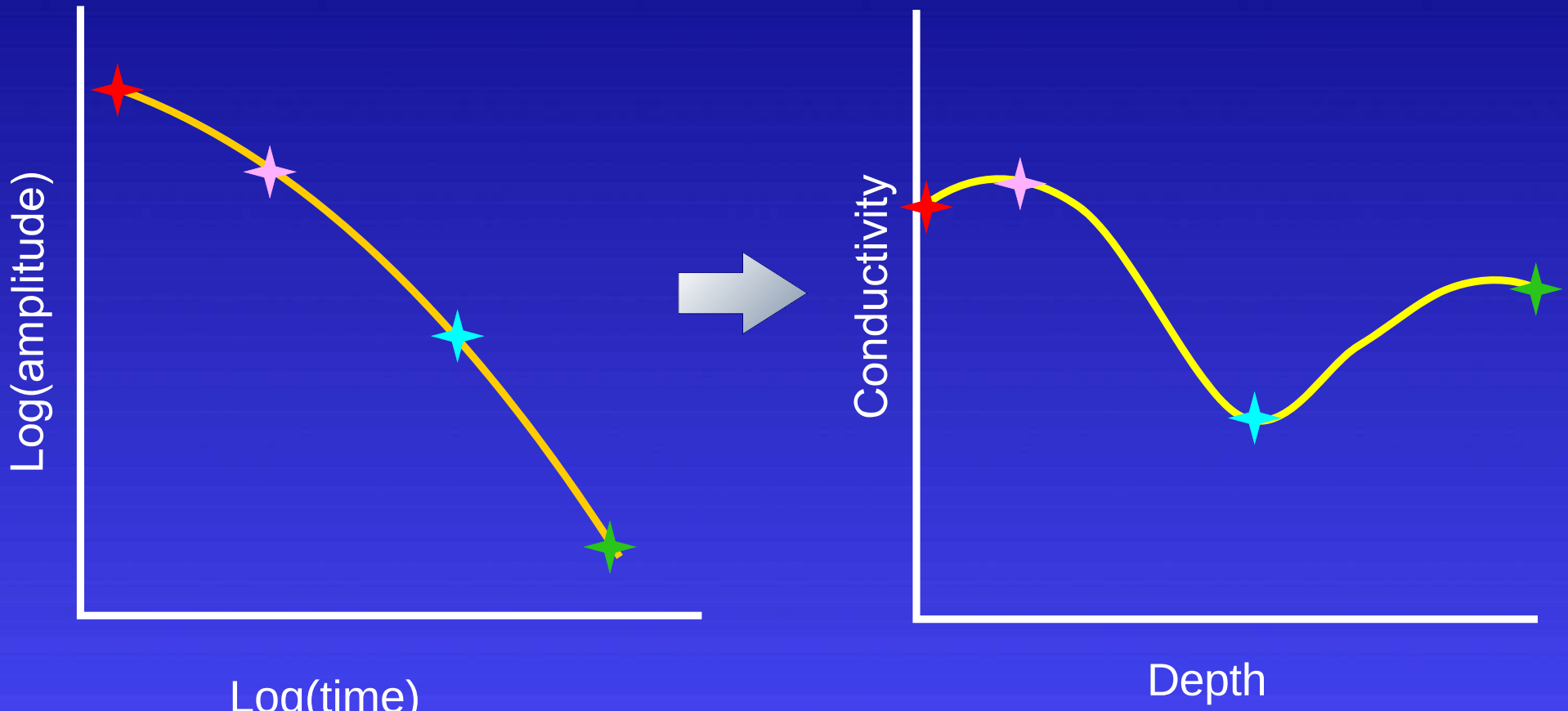
CDI/CDT

A direct transform of the data

- Spiker (Smith et al)
- Emax/Emax Air (Peter Fullagar)
- EMFlow (MacNae et al)
- Nekut (Anthony Nekut)
- Fast CDI (Davis et al)
- Sengpiel (Sengpiel)
- Input geometry (Wolfgram & Karlik)
- Pseudo-layer half space (Huang & Fraser)
- + others



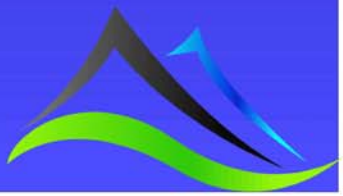
CDI\CDT



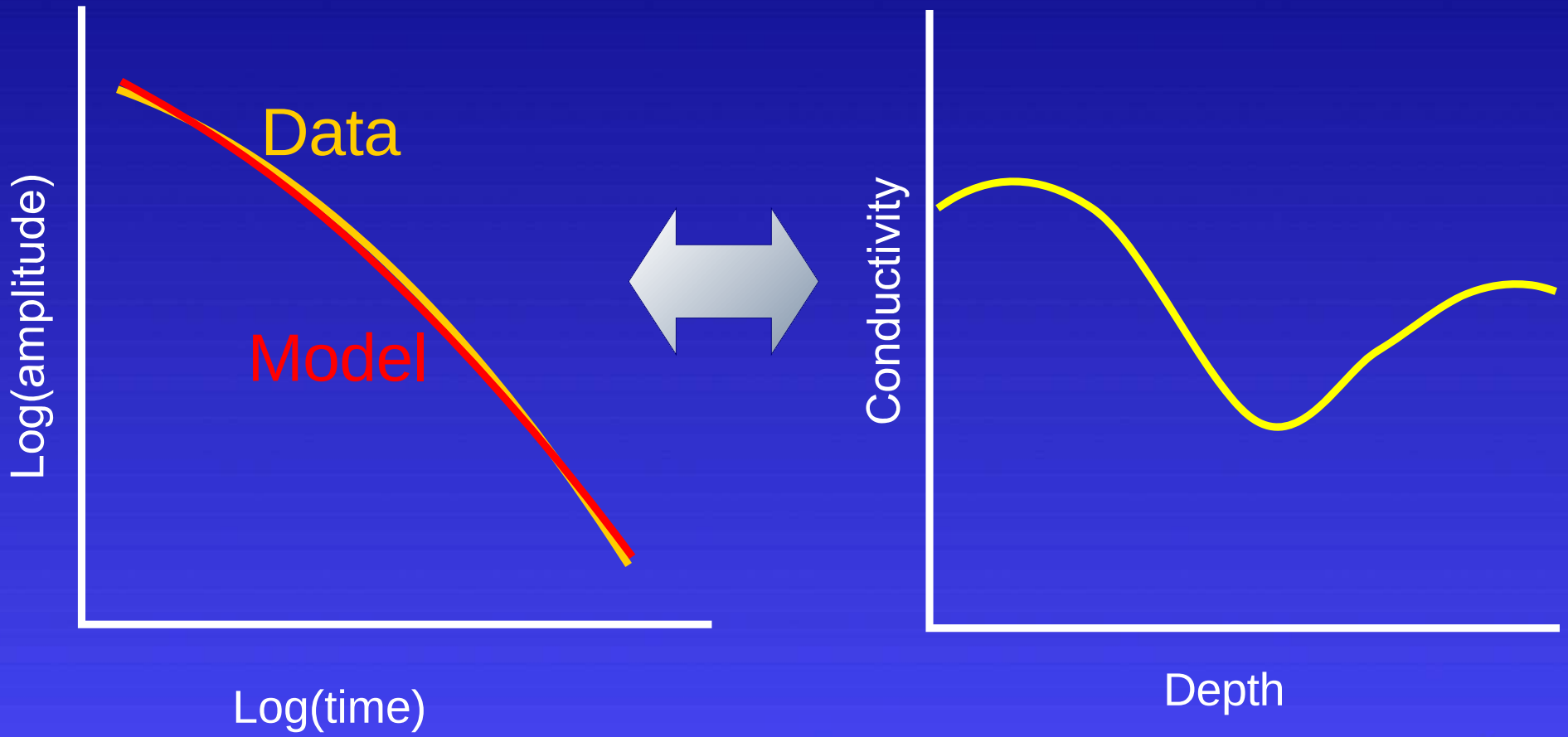
1D Inversion

Layered Earth Inversion - LEI

- Grendl (CSIRO)
- Amity (Peter Fullagar)
- LCI - Laterally constrained inversion (Aarhus)
- SCI - Spatially constrained inversion (Aarhus)
- Airbeo, Beowulf (CSIRO)
- EMIGMA - (PetRos EiKon)
- + others



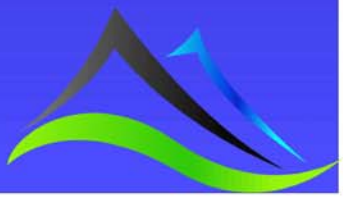
1D Inversion



2D-2.5D Inversion

Something for the history books?

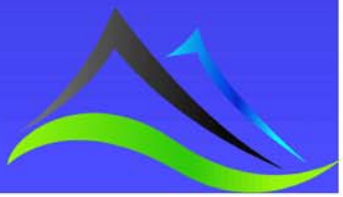
- ArjunAir (CSIRO)
- Arjuna (CSIRO)
- + others



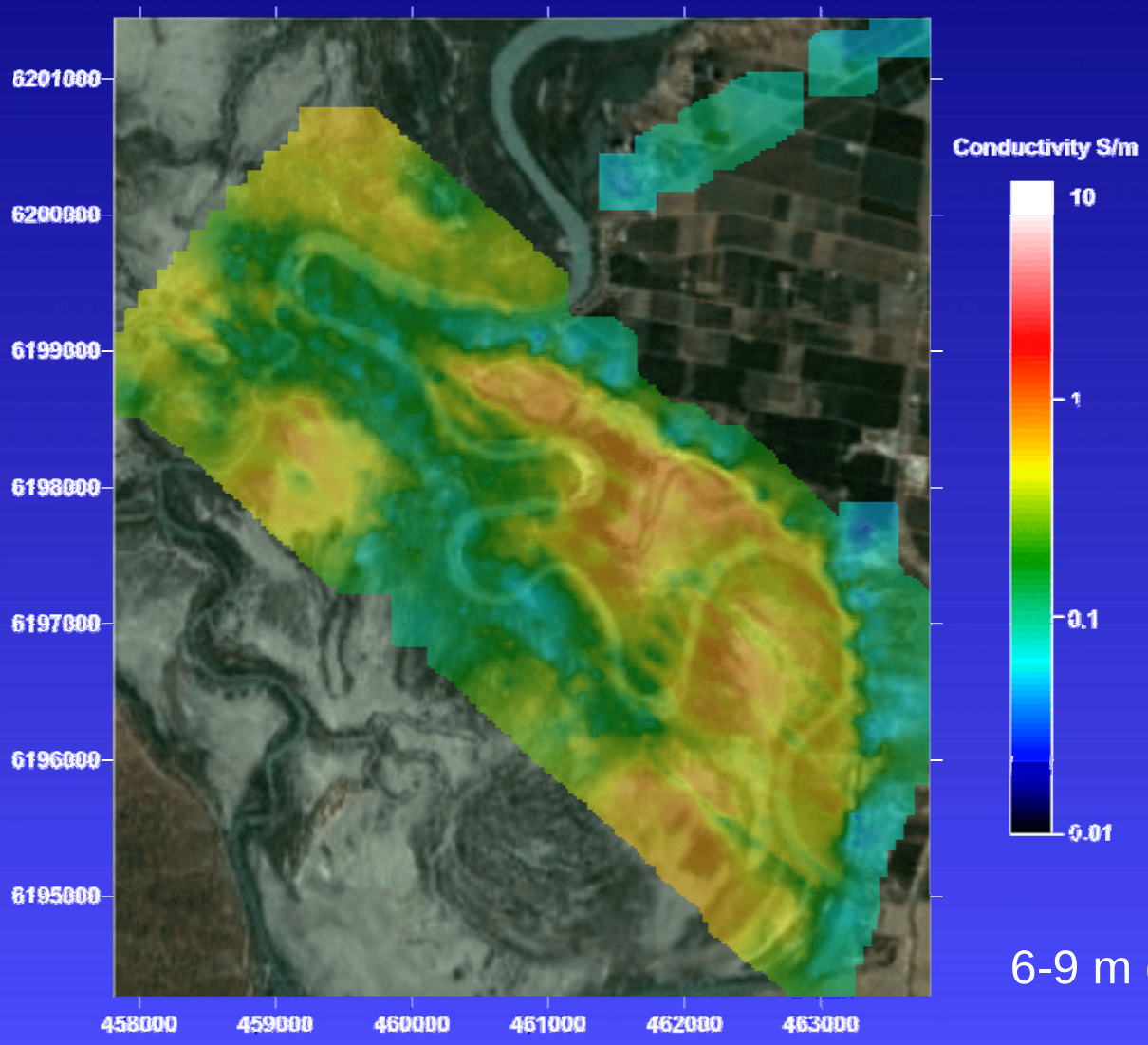
3D Inversion

Watch this space!

- EM3Dinv (UBC)
- Moving Footprint (U of Utah/TechnoImaging)
- Loki/LokiAir (CSIRO)
- EMIGMA (PetRos Eikon)
- + others



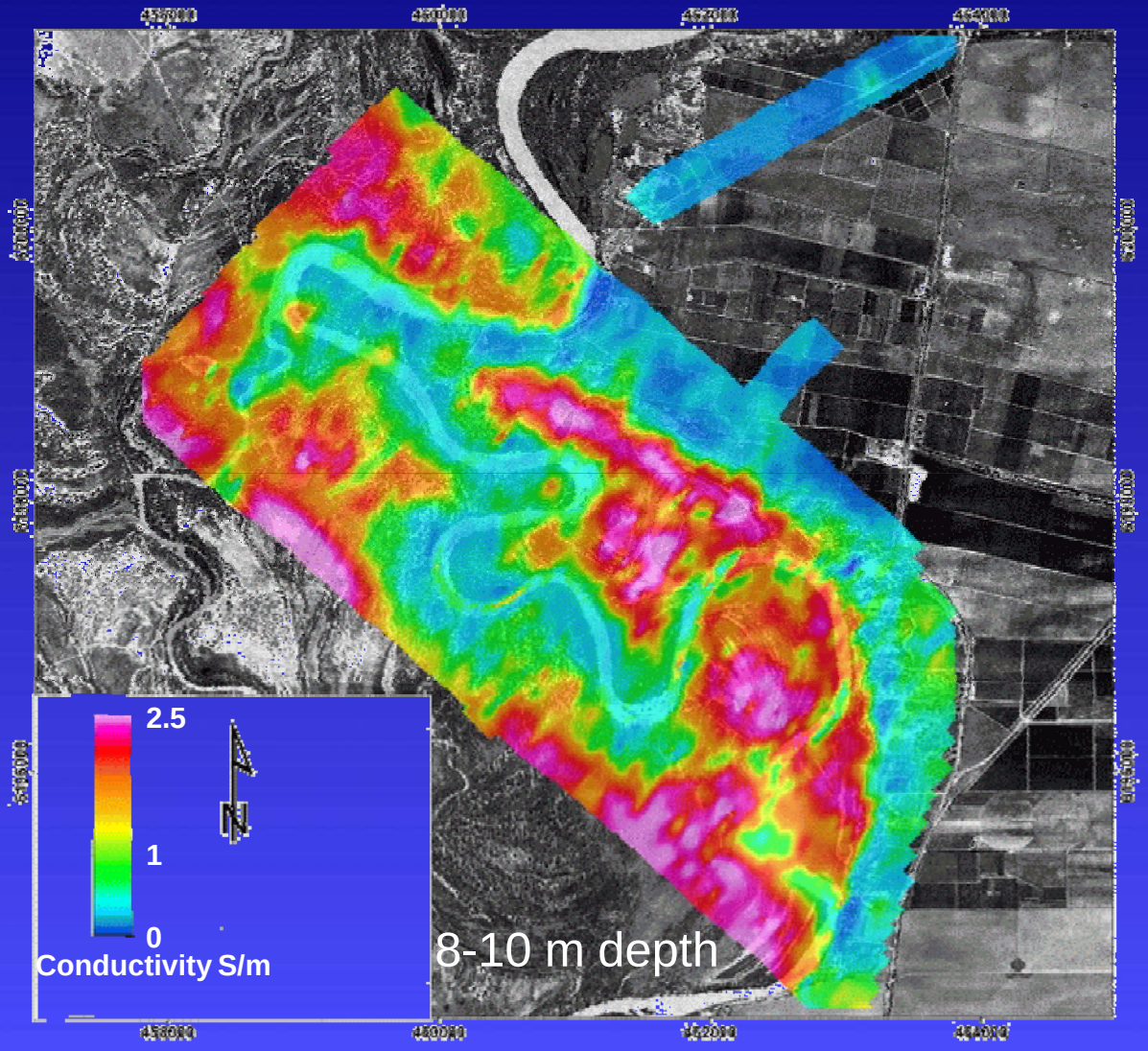
Fast CDI



1-2 seconds setup and execution

6-9 m depth

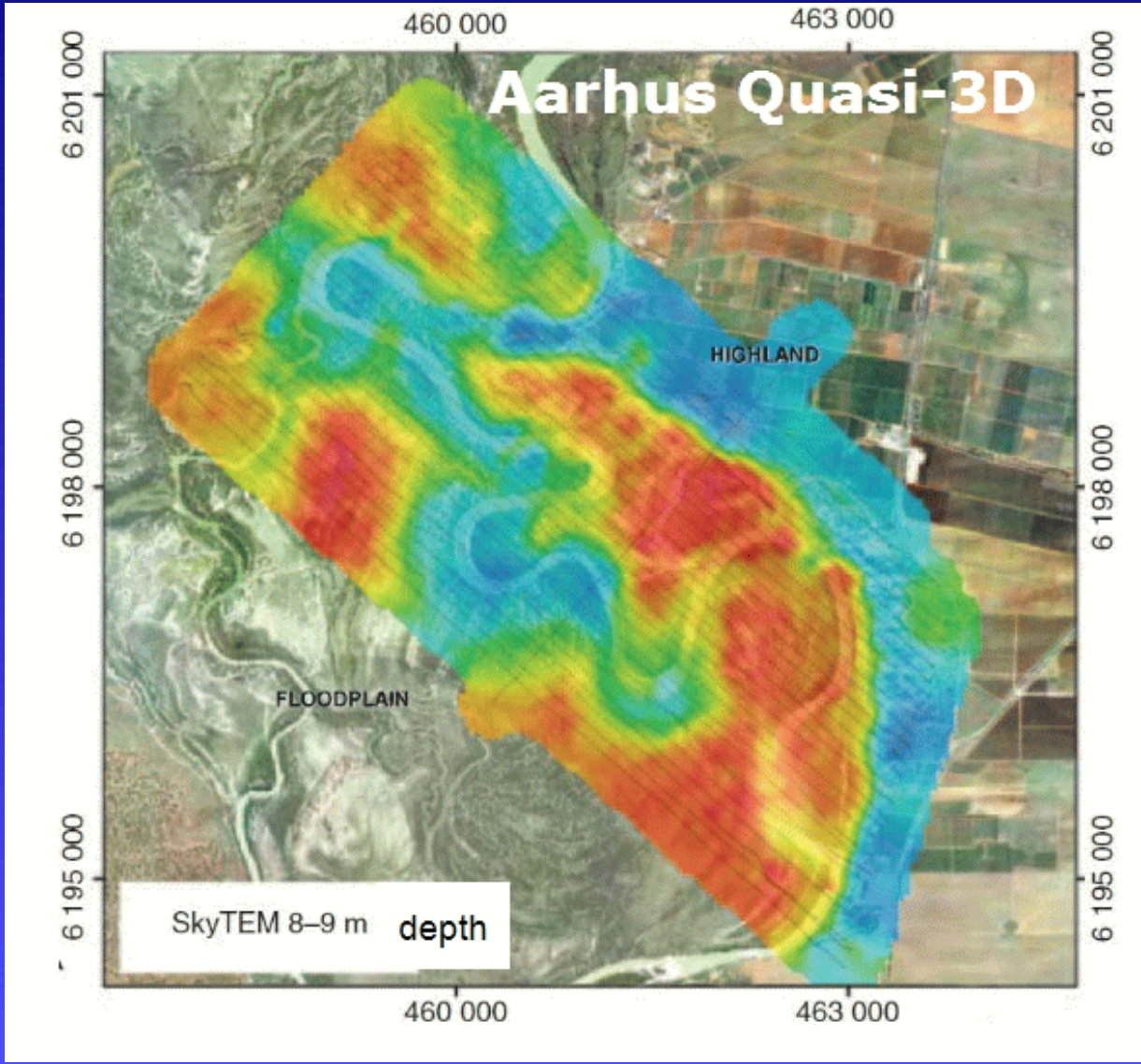
LEI - LCI



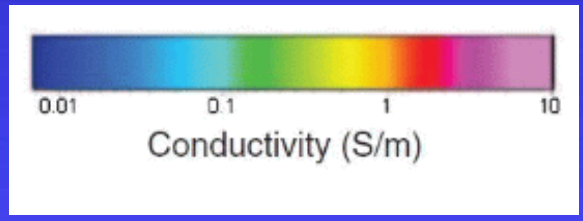
Several hours setup + execution

From CSIRO ex Aarhus

SCI - LEI Inversion

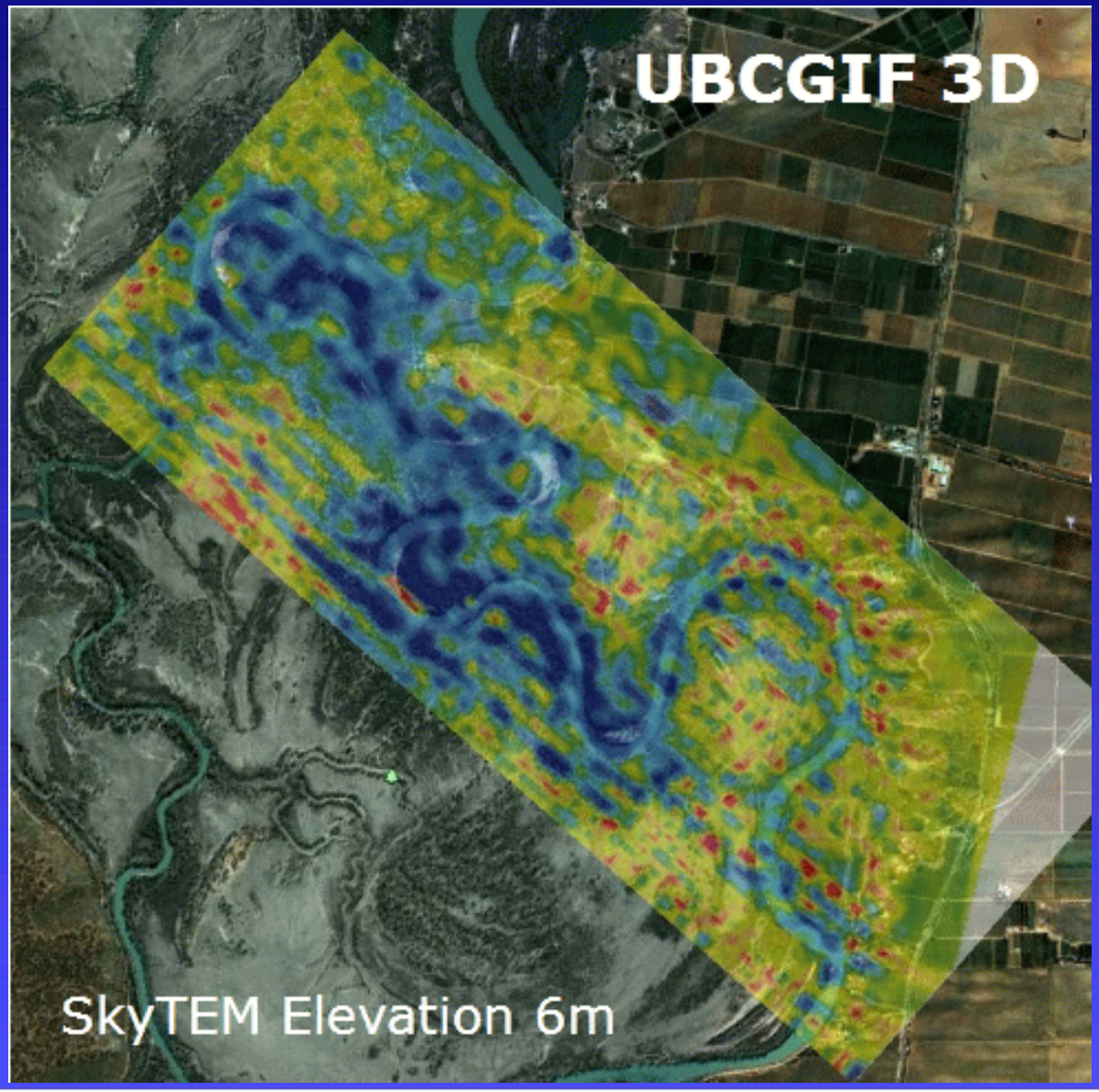


Several more hours
setup + execution

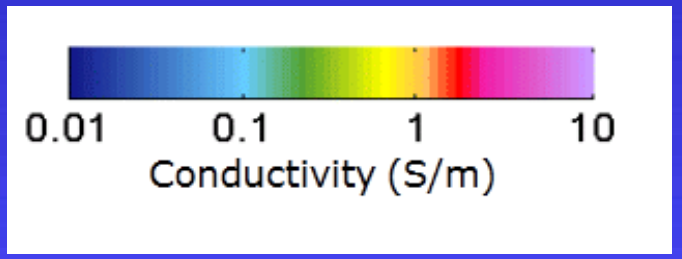


From UBC Inversion Workshop

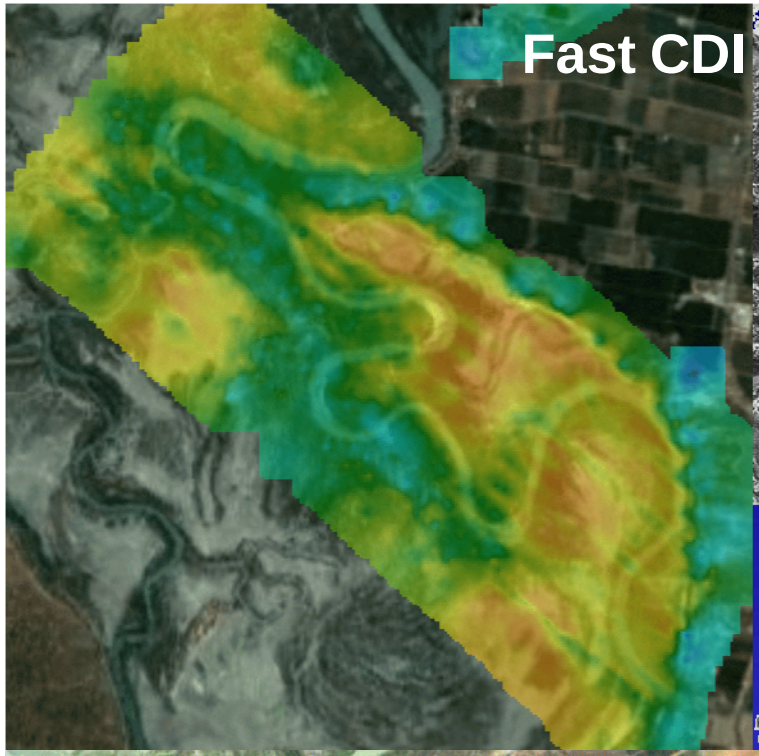
3D

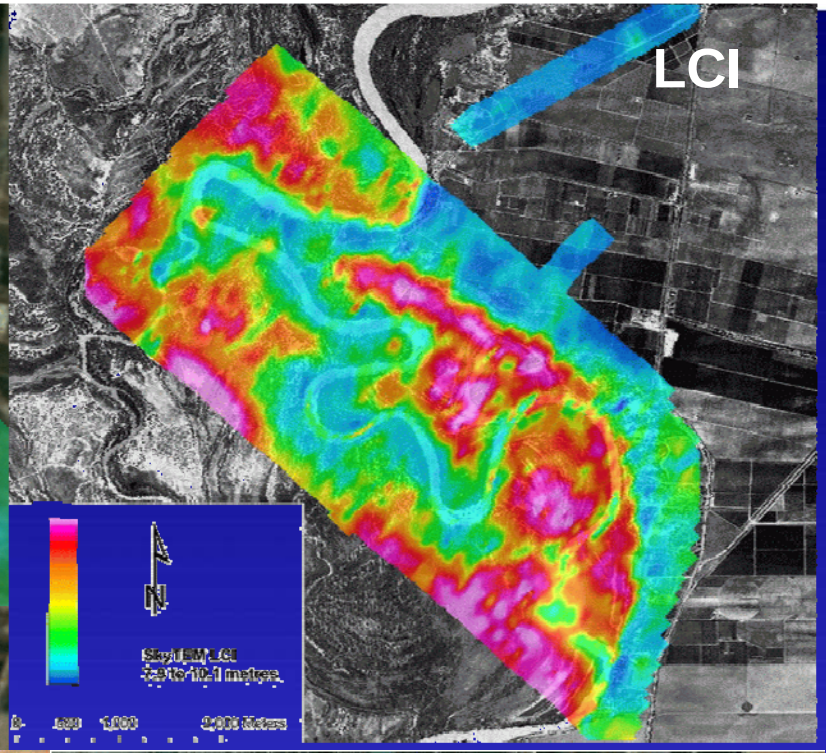


A day or two on a cluster

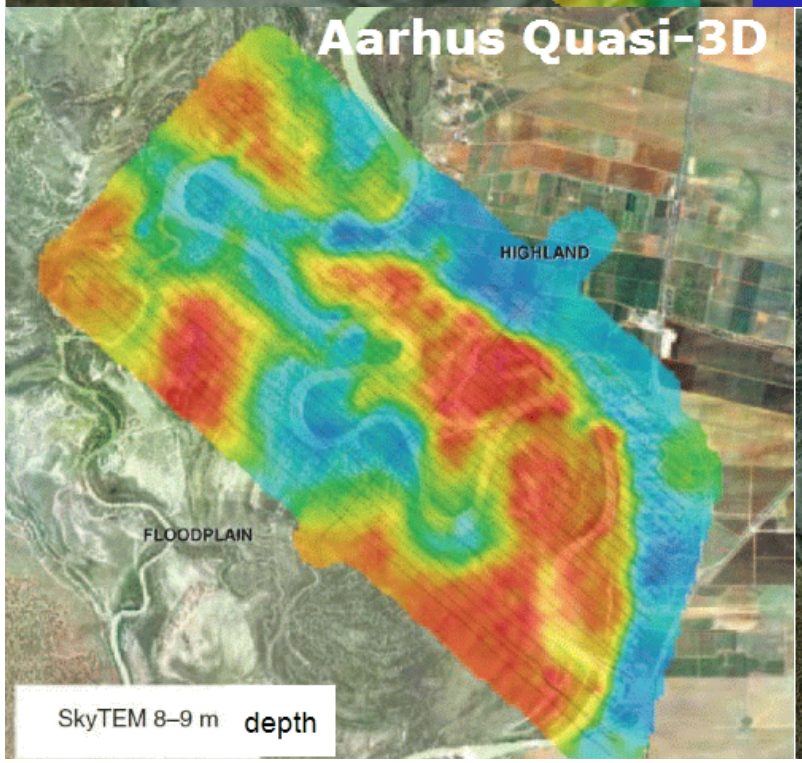


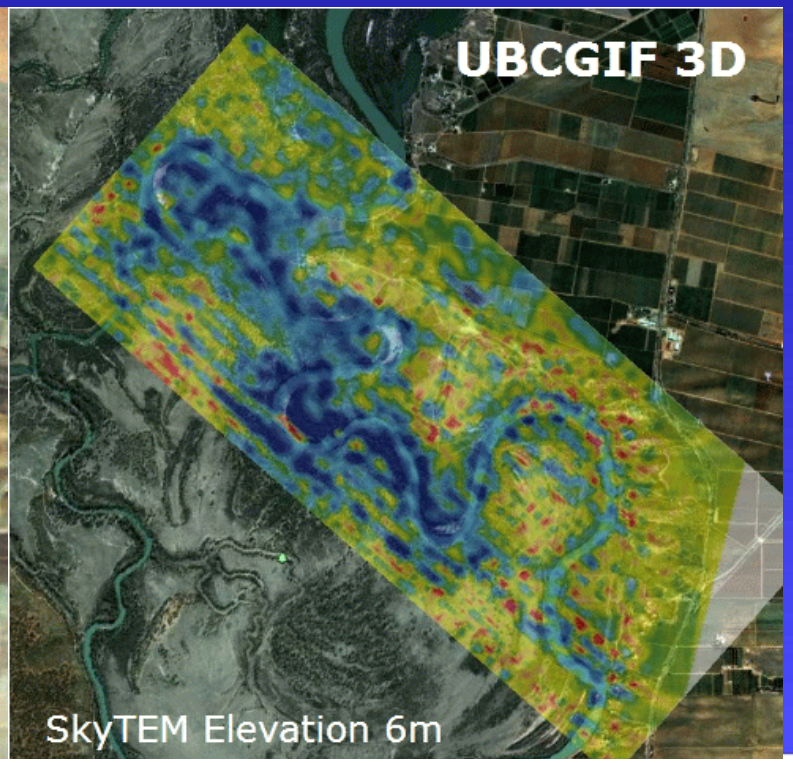
From UBC Inversion Workshop





Was it all worth it?





Fast CDI vs LEI

Bore Hole log vs SkyTem

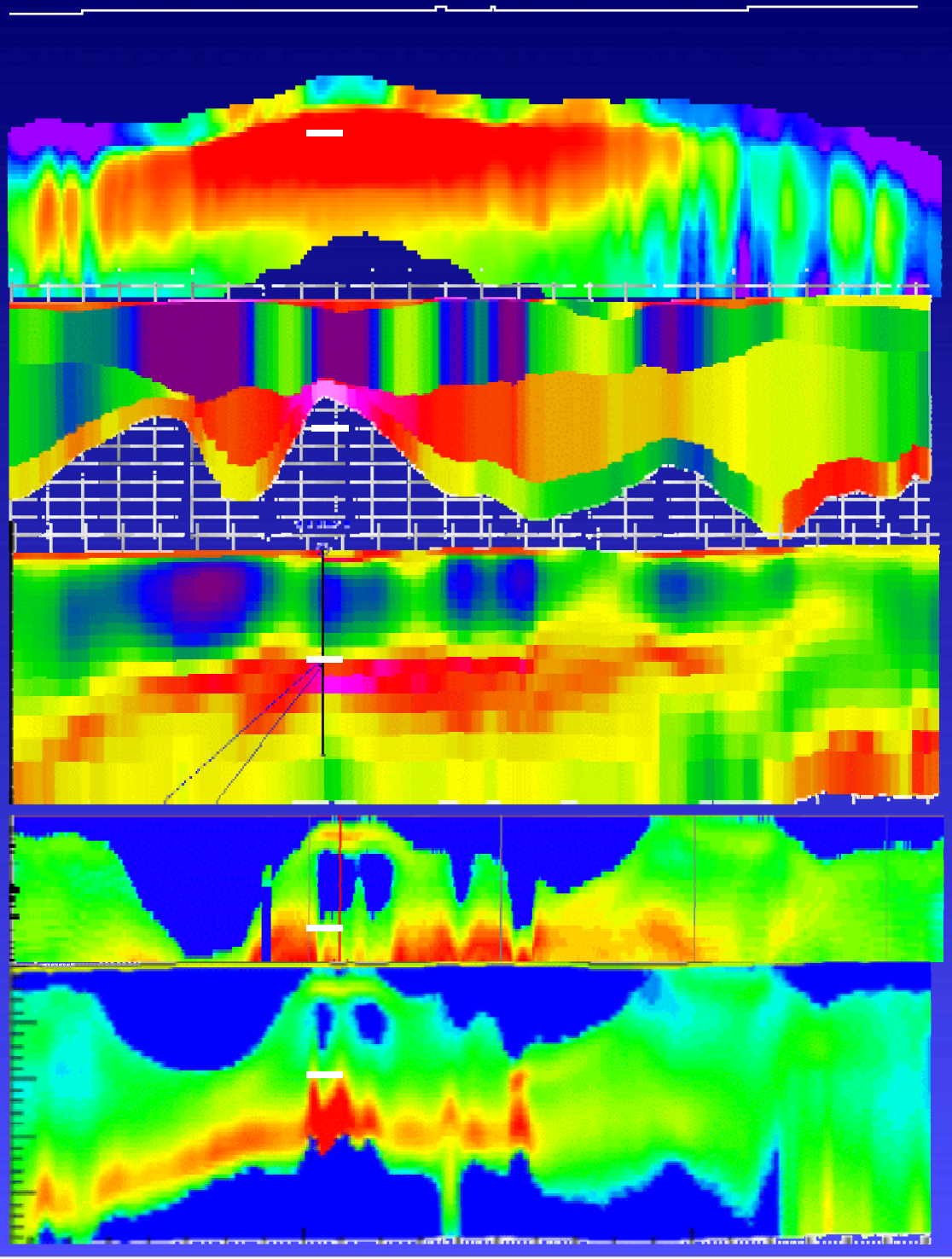
Borehole Conductivity

Fast CDI of Skytem LM

LEI of Skytem LM

From Davis et al

Comparisons -coloured independently



Fast CDI

LCI 4 layers

500m V:H = 2:1

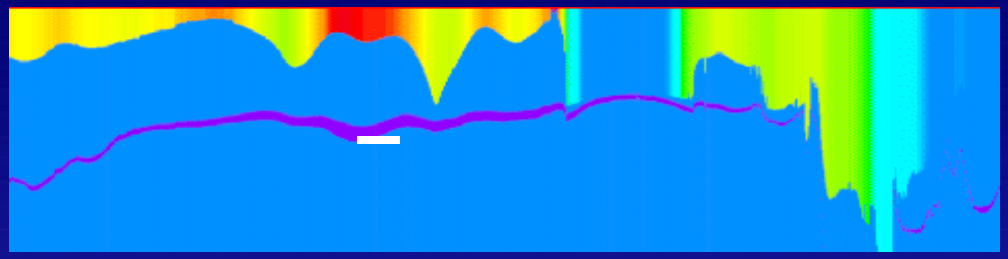
LCI 19 layers

EM Flow Operator 1

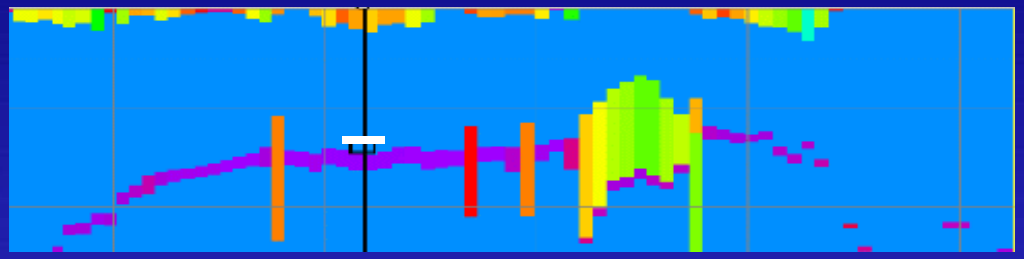
EM Flow Operator 2

Courtesy Ausquest & SGC

More Comparisons -coloured independently

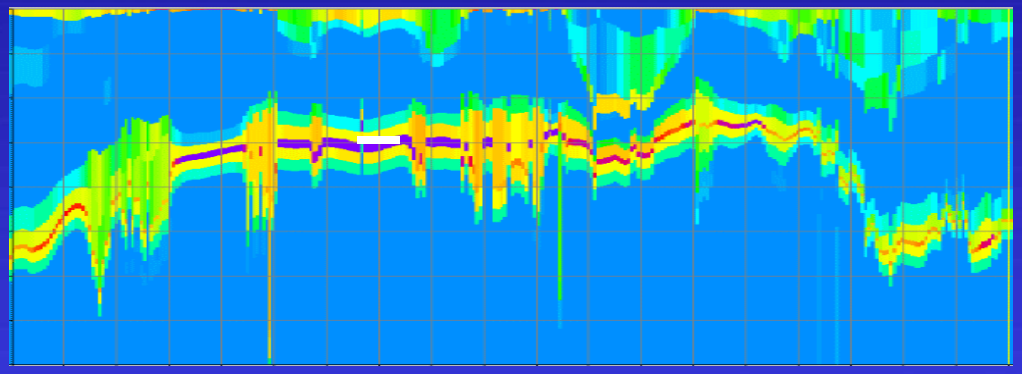


Grendl 4 layers



AirBeo 4 layers

500m V:H = 2:1

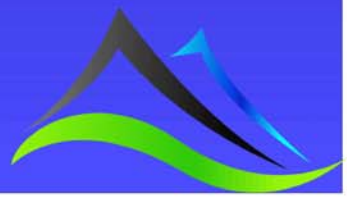


AirBeo 19 layers

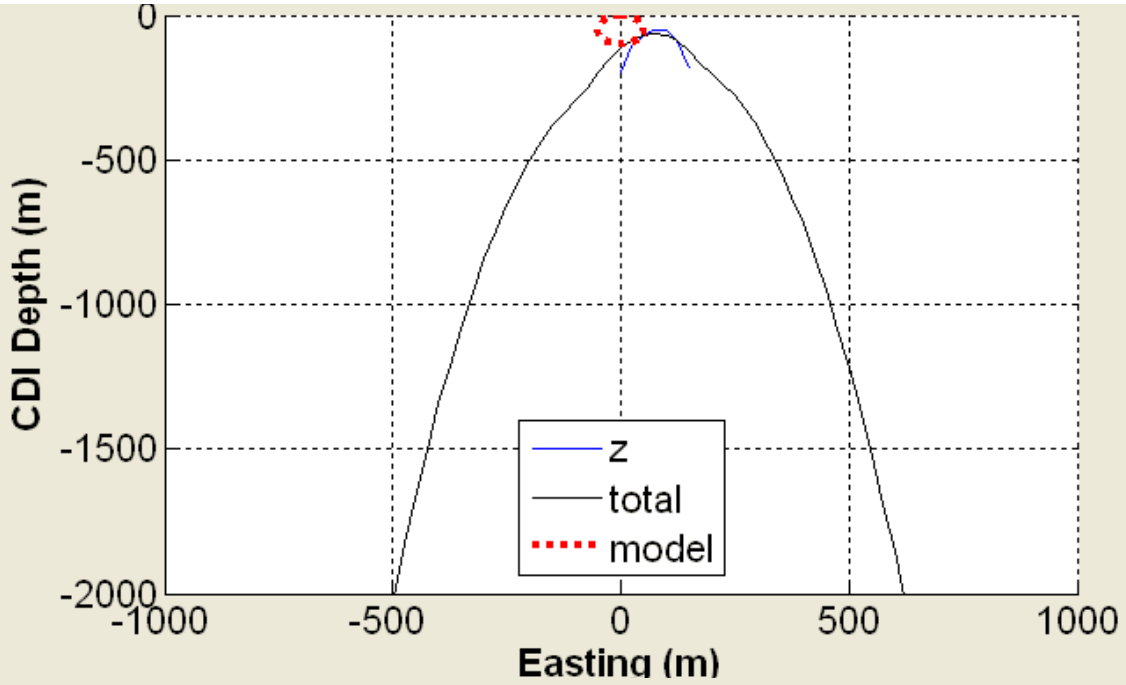
1 line, 1 drill hole, 5 algorithms, ~100 man hours

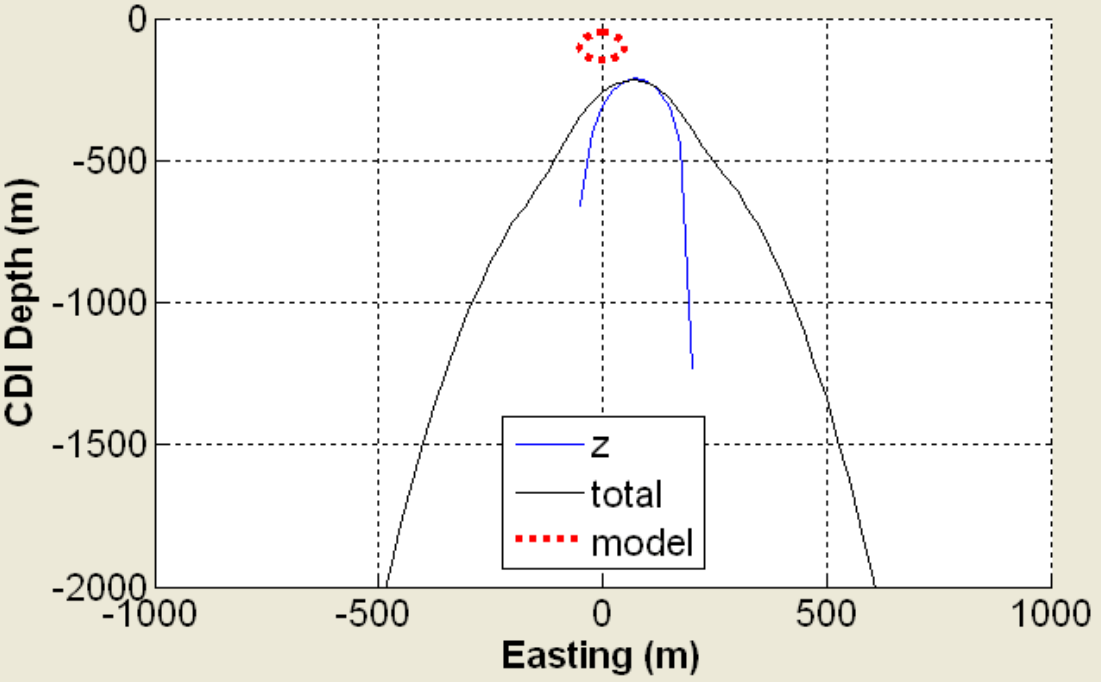
Courtesy Ausquest & SGC

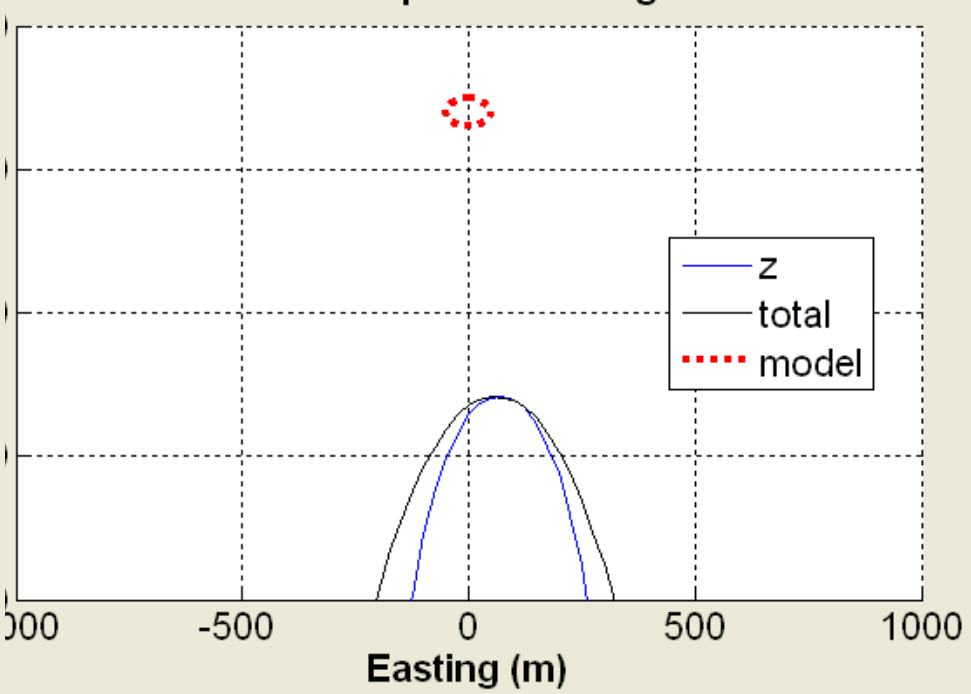
1D pitfalls



Fixed Wing response
3D target (Sphere)
Depth to top of 50m, 100m, 300m
Contour from CDI





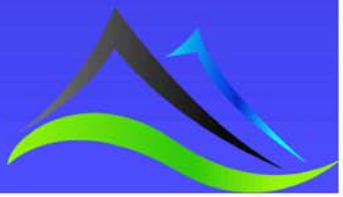


Courtesy Jim MacNea

1d fitting of 3D structure

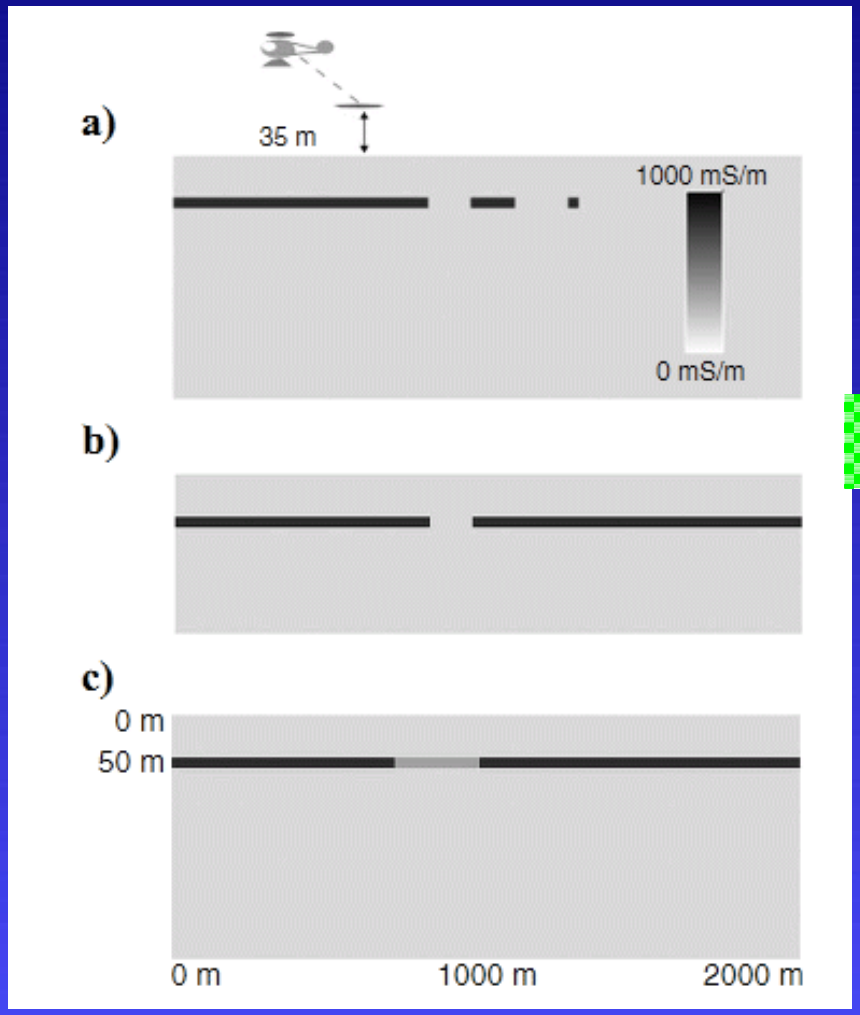
- Depths show up correctly when either
  - Host conductive
  - Horizontal dimension of target > depth of burial
- Does geometry shows up correctly?
  - Rarely unless flat-lying
  - Need to ignore horseshoe lateral effects

Courtesy Jim MacNea

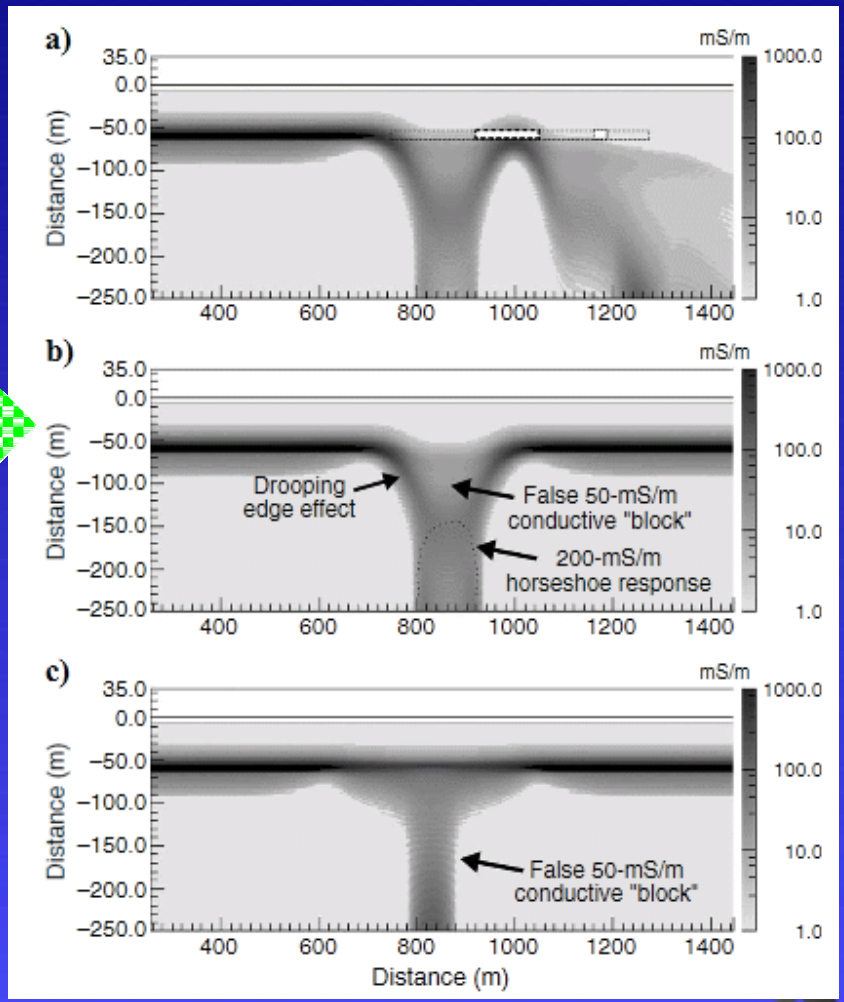


Effect of lateral discontinuities on 1D

Model



EMFlow CDI



Ley-Cooper et al

Plates

- Simple filament (Barnett)
- Multiple ribbons (Multiloop, Maxwell)
- Plate (University of Toronto)
- Leroi/Leroi Air (CSIRO)
- + others

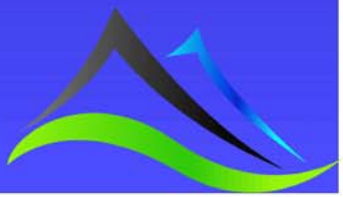
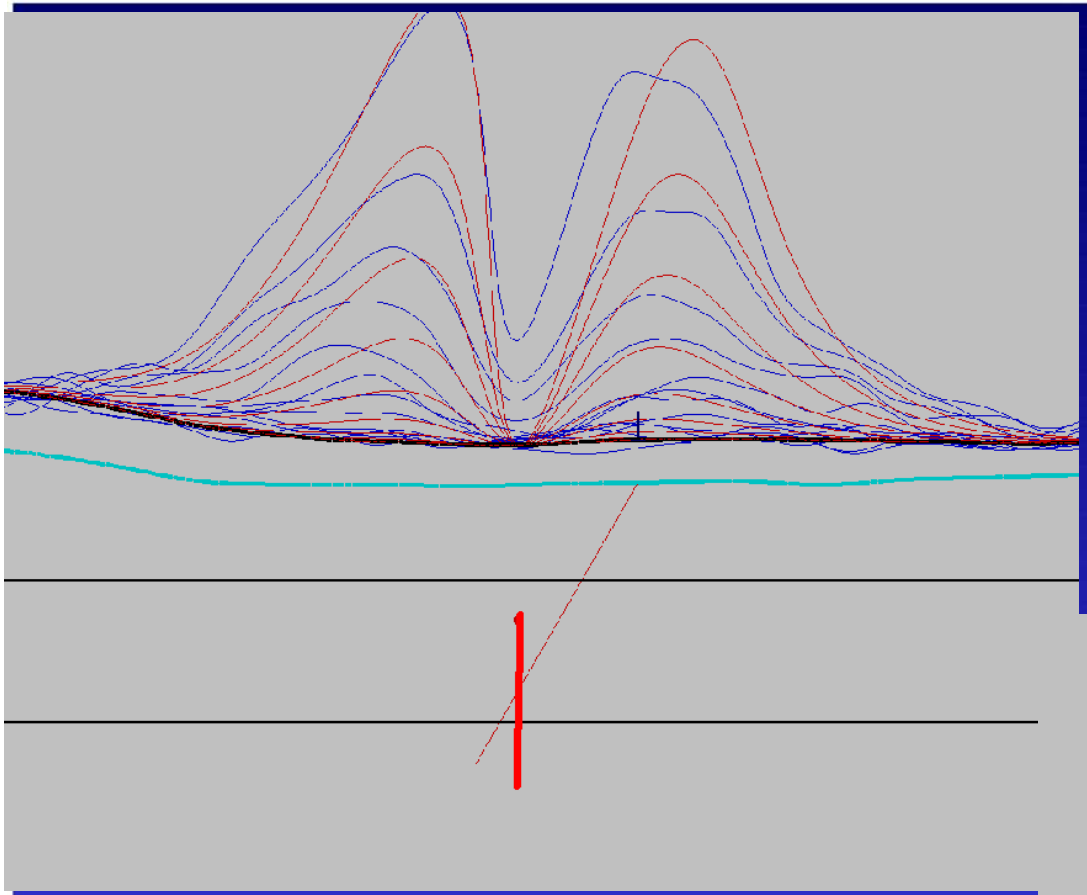
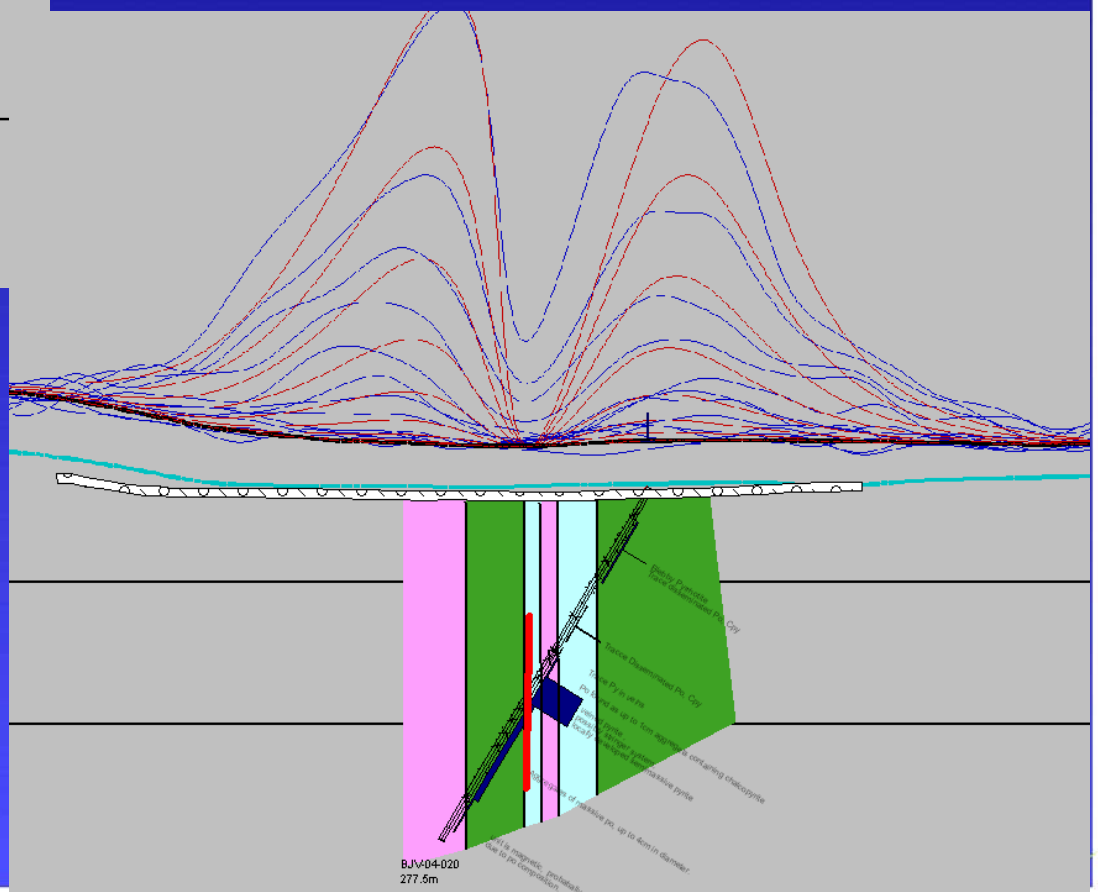


Plate Modelling discrete conductors





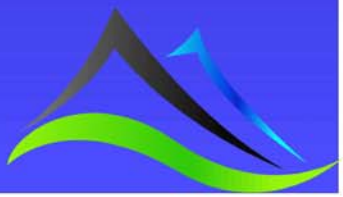
Taylor 2005, MacNea and Noranda

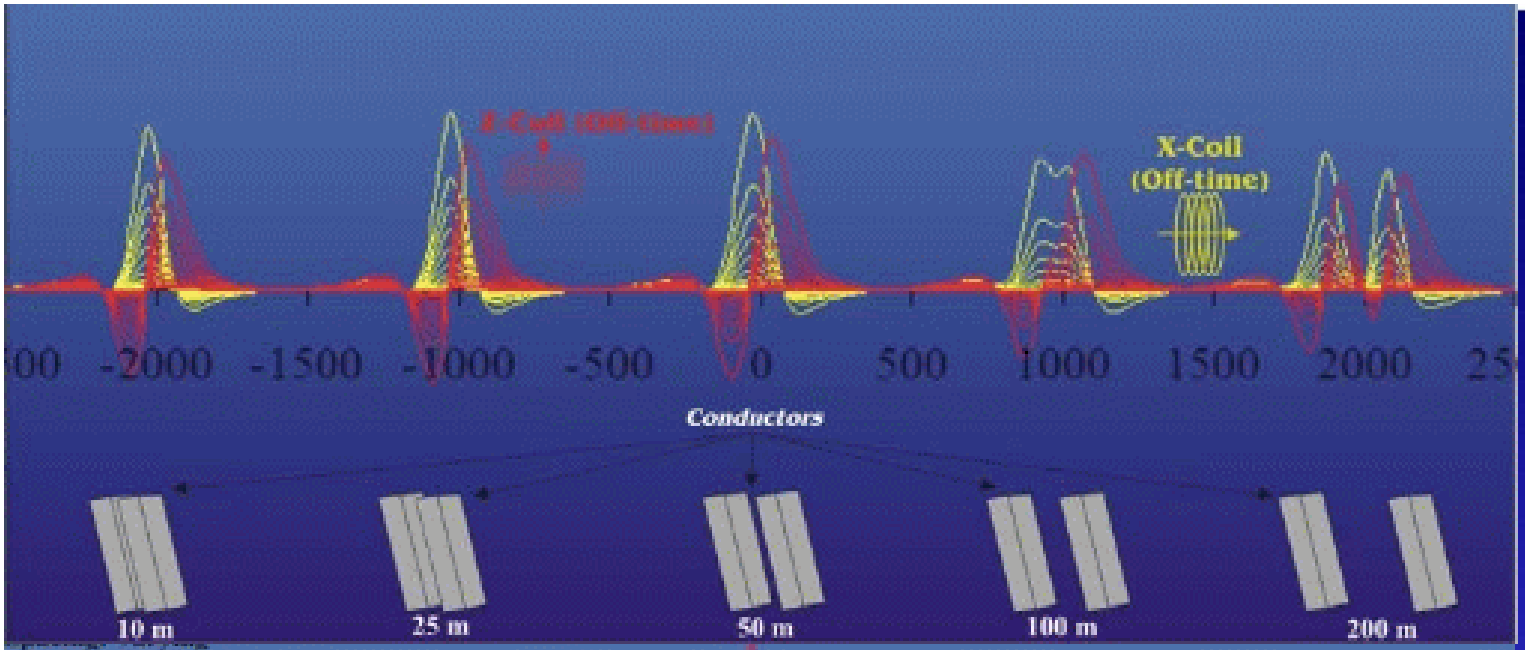
Footprints and approximate rules of thumb

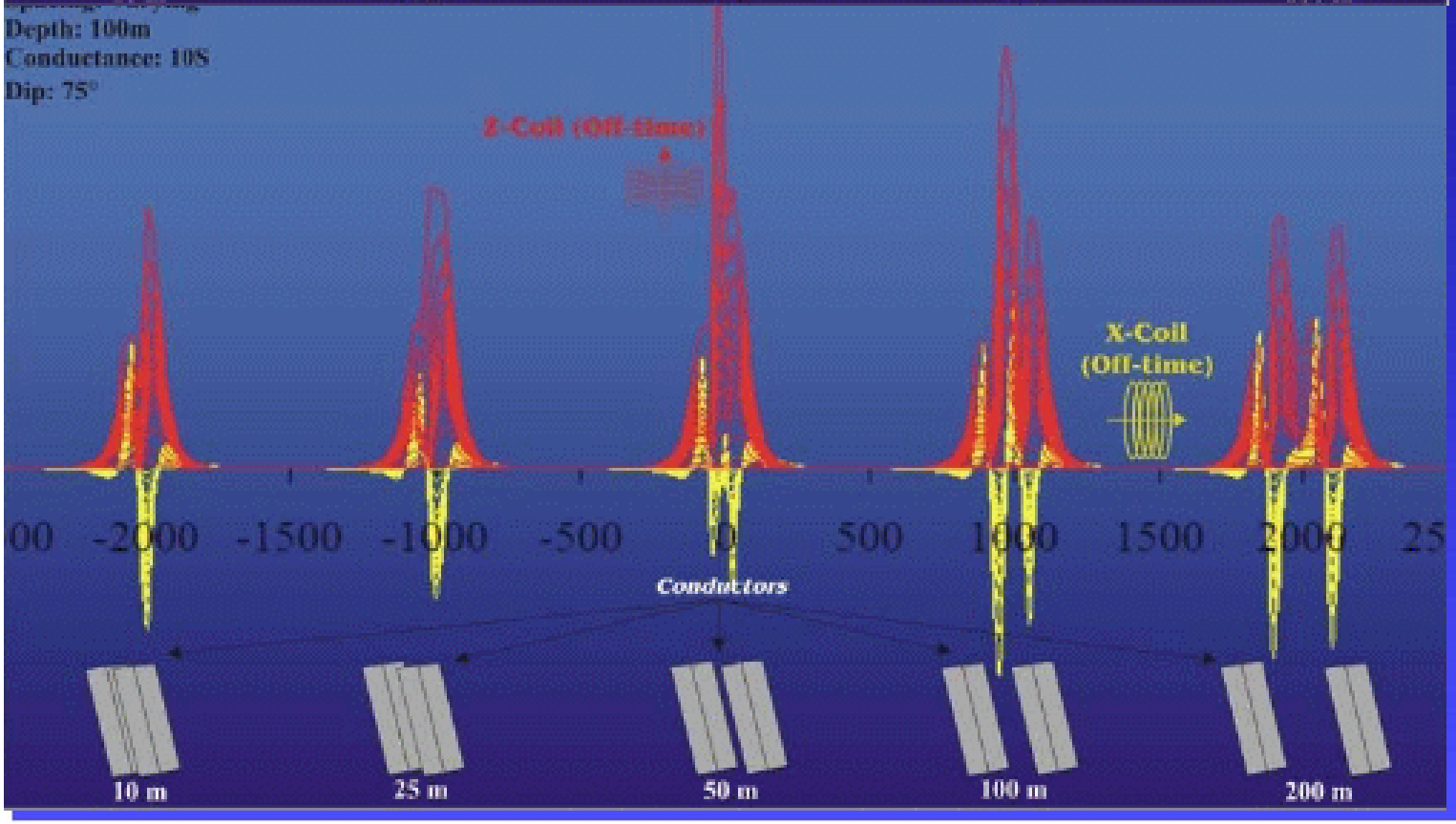
"Footprint" of current airborne time domian systems is ~3.75 x Tx flying height - 35m flying height => 130m, 120m flying height => 450m

"Footprint" of frequency domain systems is ~3.75 x bird height for coplanar coils and ~1.35 x bird height for coaxial

Liu and Becker, 1990







Resolution of Multiple conductors

Fixed Wing - Input geometry

Helicopter - In-loop geometry