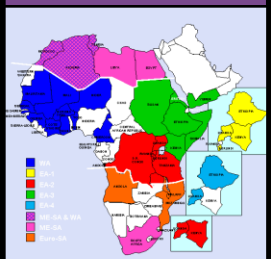
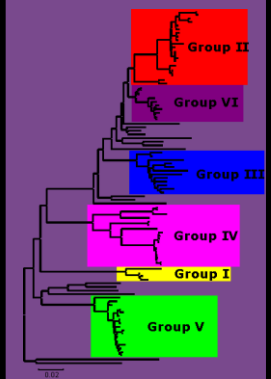




Global Diversity of Foot-and-Mouth Disease Virus

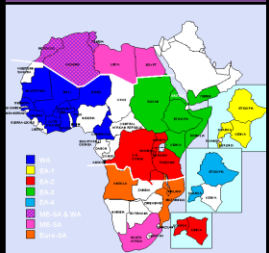
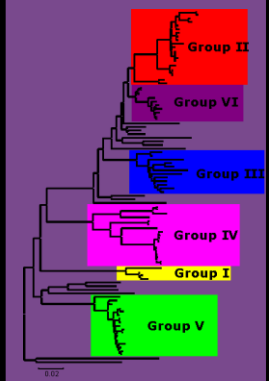
Nick Knowles

*FAO World Reference Laboratory for FMD and
Molecular Characterisation and Diagnostics group,
Institute for Animal Health,
Pirbright Laboratory.*



FMDV Classification

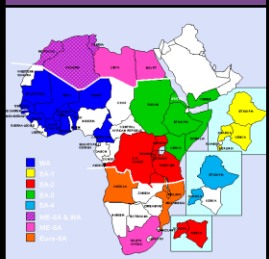
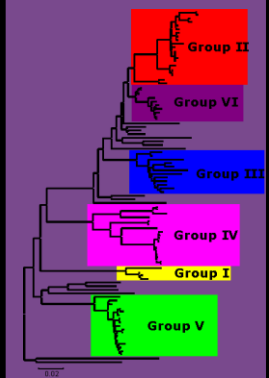
- Order: *Picornavirales*
 - Family: *Picornaviridae*
 - Genus: *Aphthovirus*
 - Species: *Foot-and-mouth disease virus*
 - Species: *Equine rhinitis A virus*
 - Proposed species: *Bovine rhinitis A virus*
 - Proposed species: *Bovine rhinitis B virus*



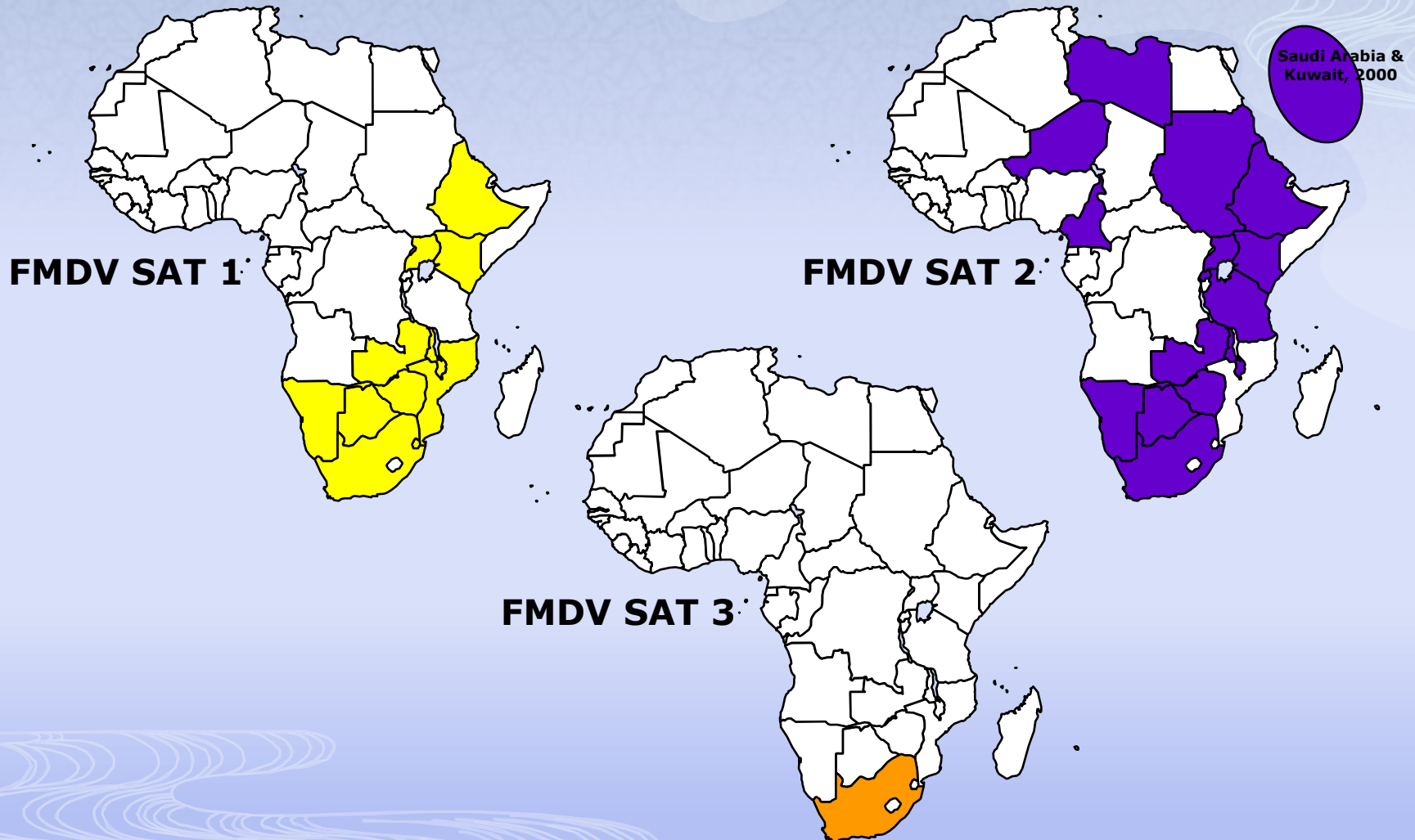


FMDV Serotypes

- Vallée O (Dept. of Oise)
- Vallée A (Allemagne)
(Vallée and Carré, 1922)
- Waldmann A
- Waldmann B
- Waldmann C
(Waldmann and Trautwein, 1926)
- Southern African Territories (SAT) 1
- SAT 2
Brooksby, 1958
- SAT 3
- Asia 1
India in 1951 (Dhanda et al., 1957)
Pakistan in 1954 (Brooksby and Rogers, 1957)



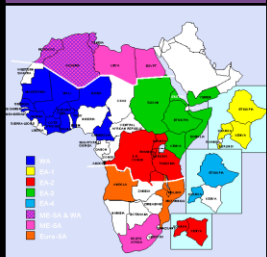
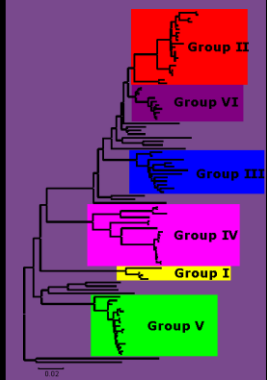
FMDV SAT Serotypes: 2000-2008



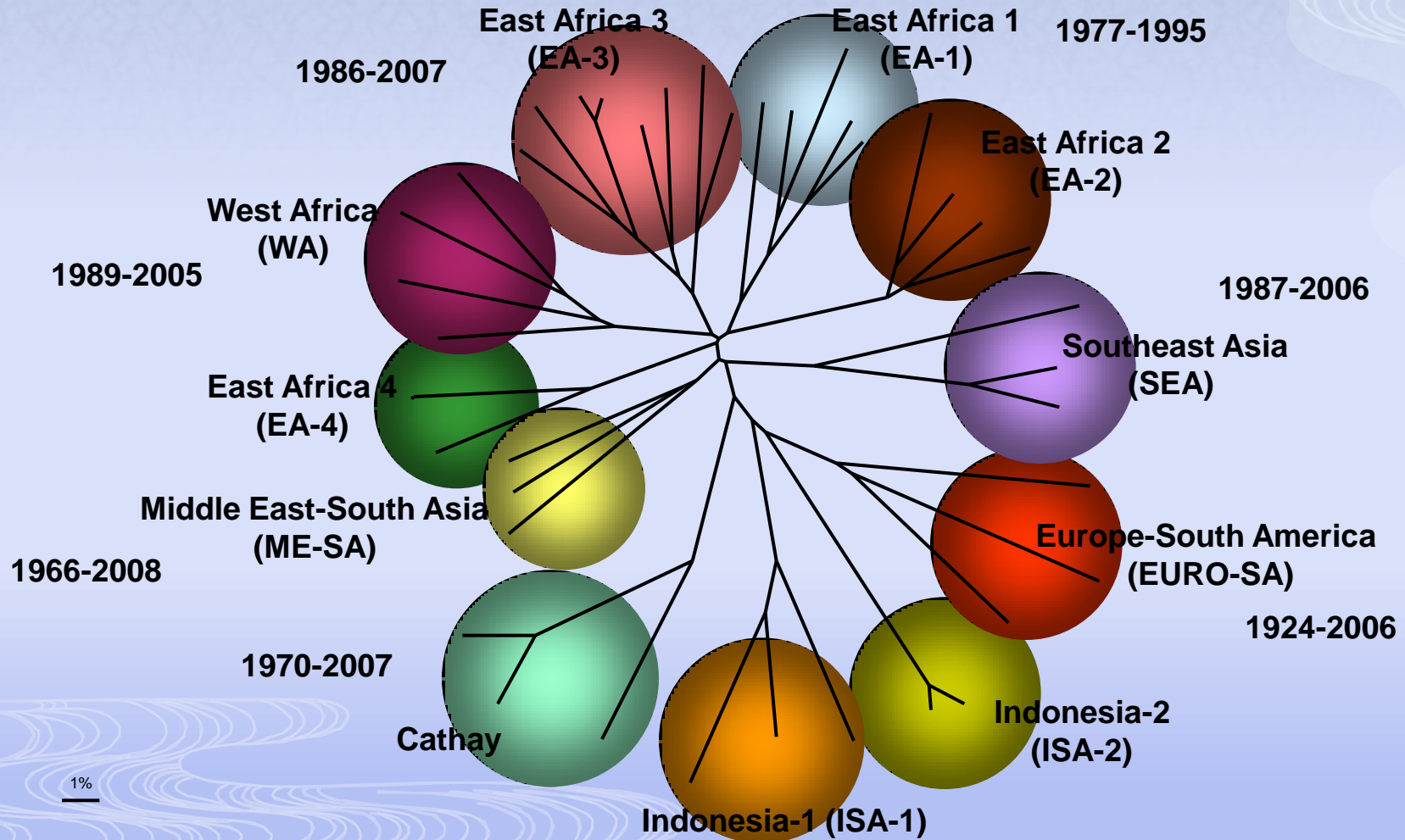
Summary of known FMD outbreaks; this may not represent the true disease situation

Measuring FMDV Variation

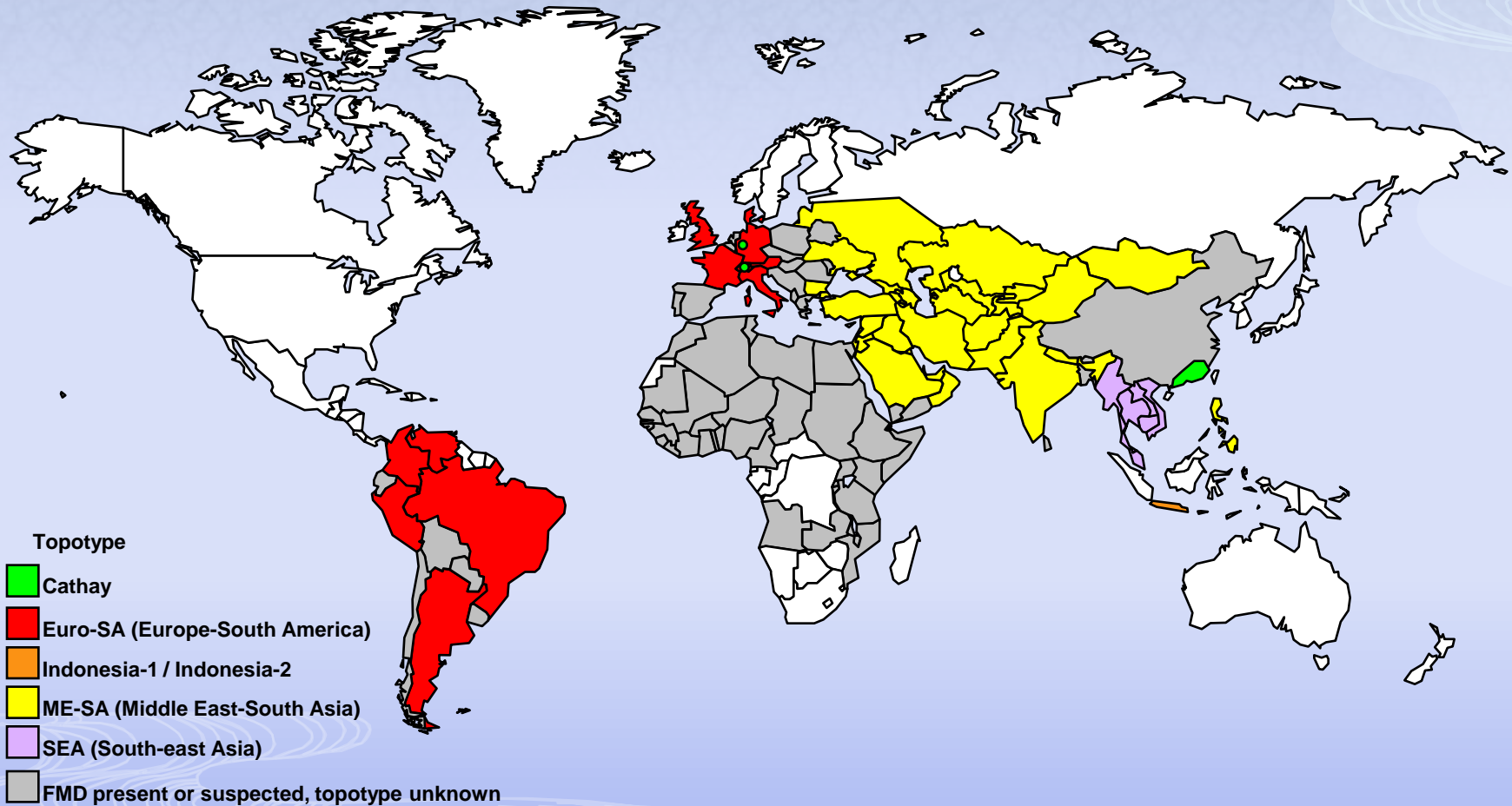
- Antigenic subtypes (1940-1976)
- Antigenic variants (1976-present)
- Biochemical assays
 - PAGE (1979-1986)
 - Electrofocusing
 - RNase T1 oligonucleotide mapping
- DNA sequencing (1987-present)



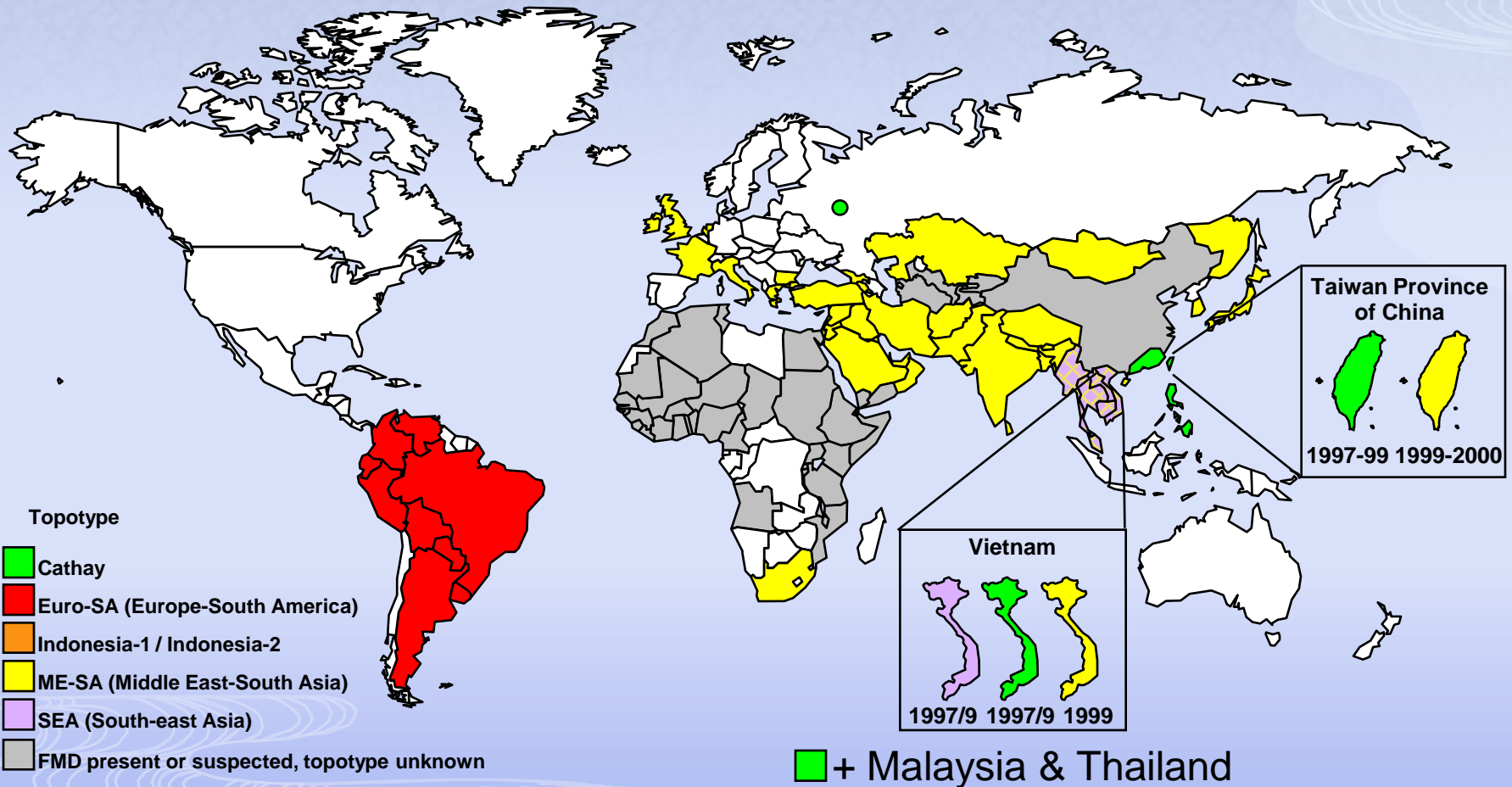
FMDV O Topotypes



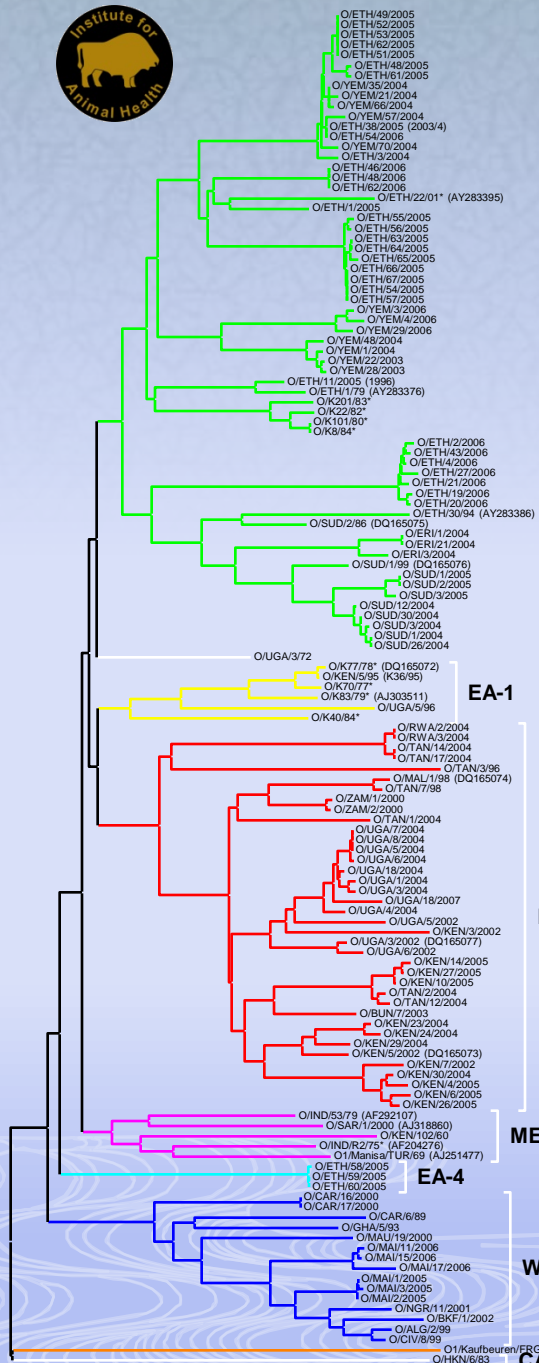
FMDV O Topotypes: 1924-1993



FMDV O Topotypes: 1993-2006



FMDV O in Africa 1960-2007



EA-3

EA-1

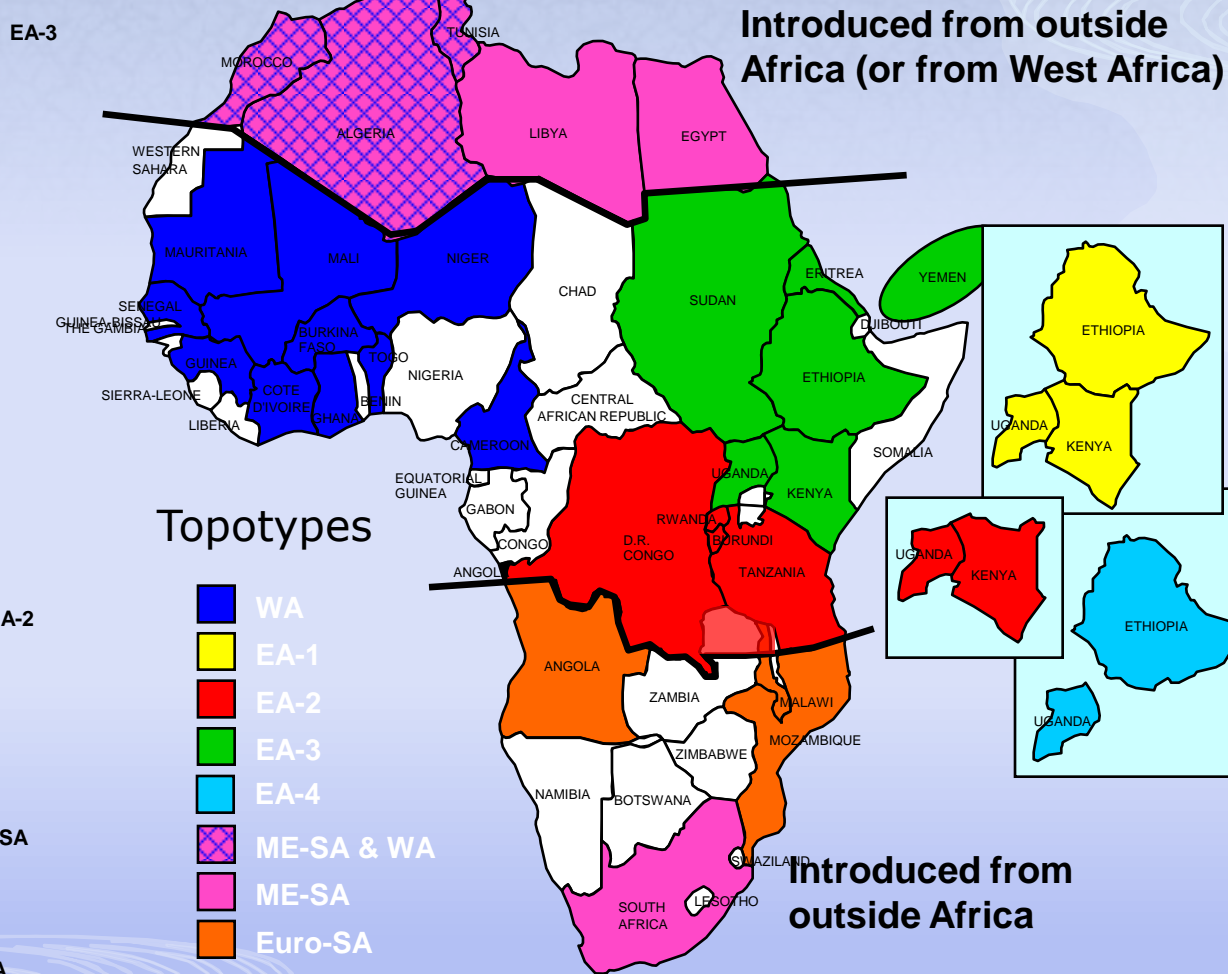
EA-2

ME-SA

EA-4

WA

CATHAY EURO-SA



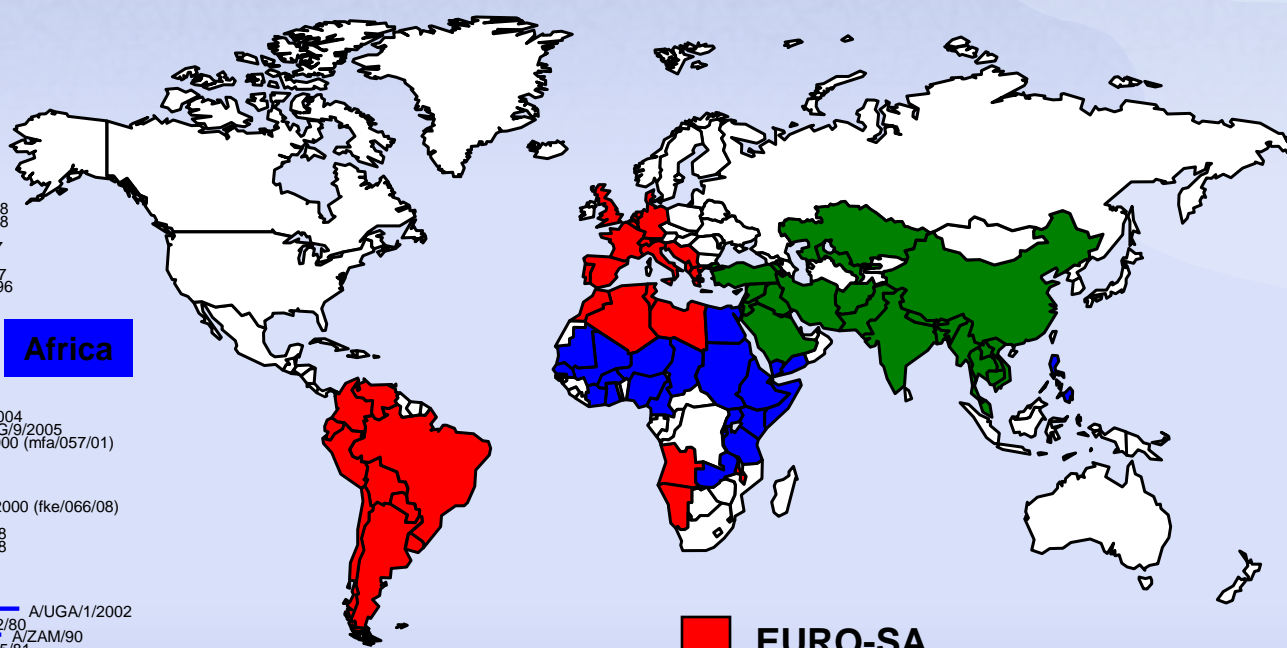
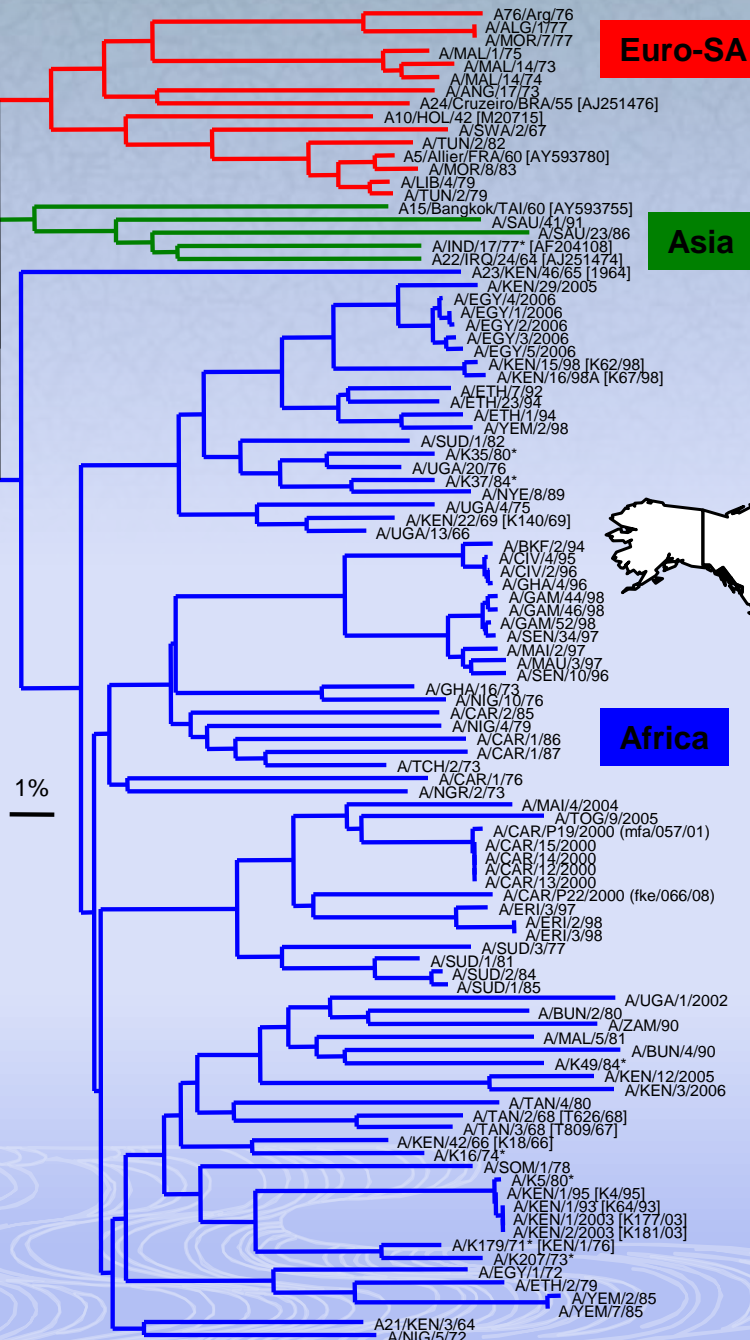


Euro-SA

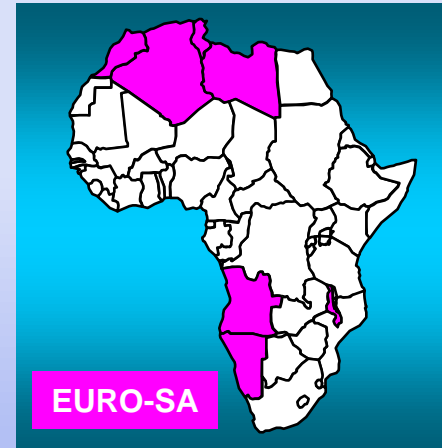
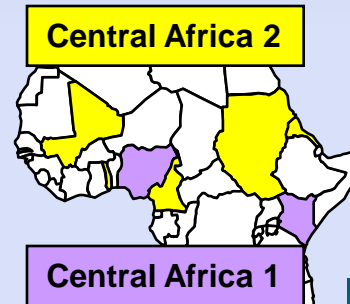
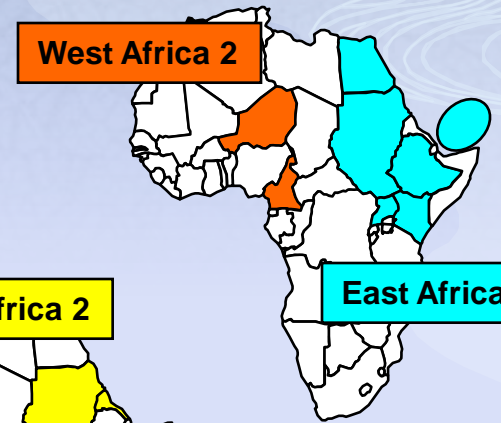
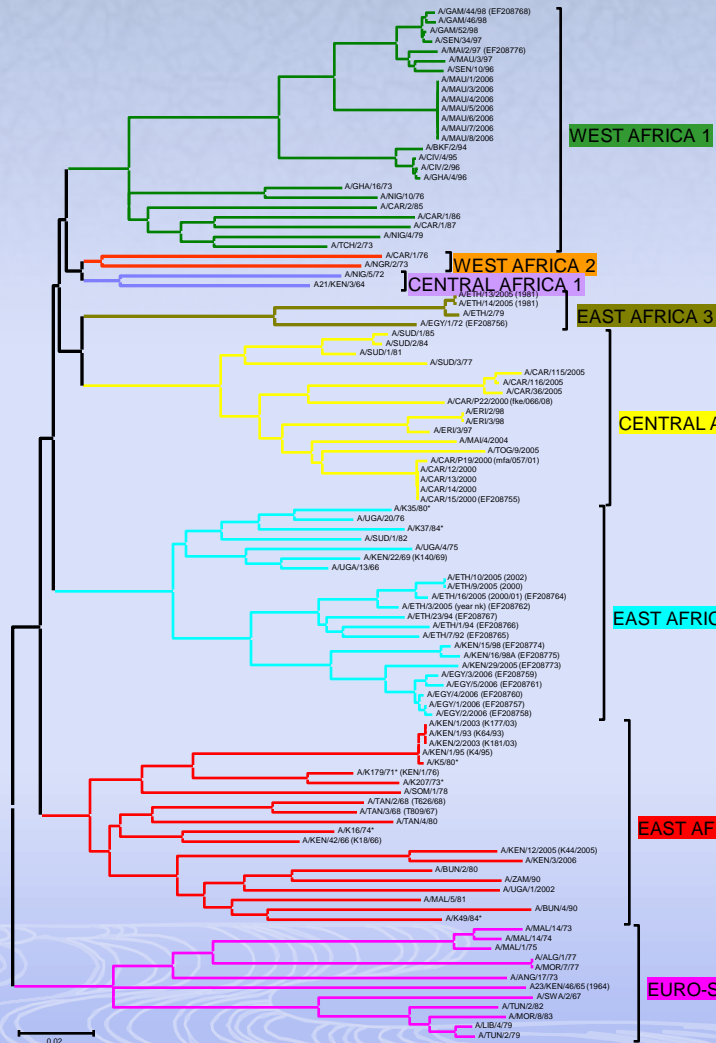
Asia

Africa

FMDV A Topotypes 1929-2008

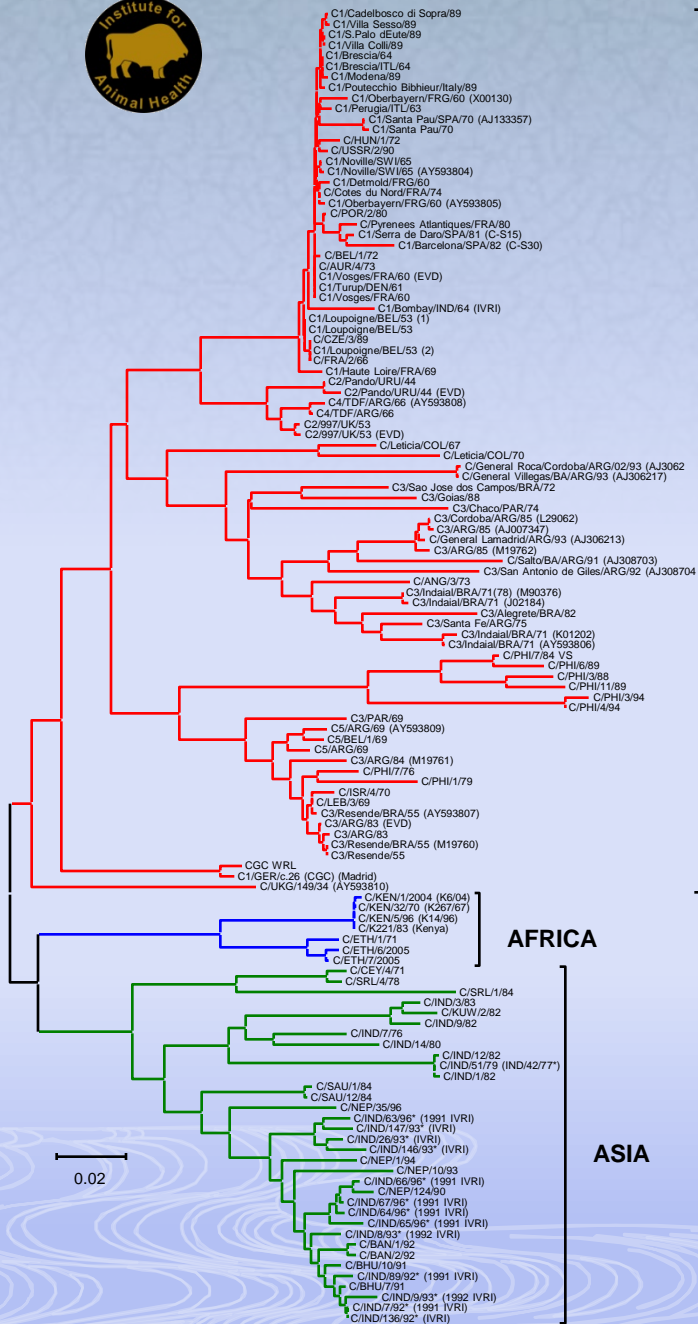


FMDV A Lineages in Africa

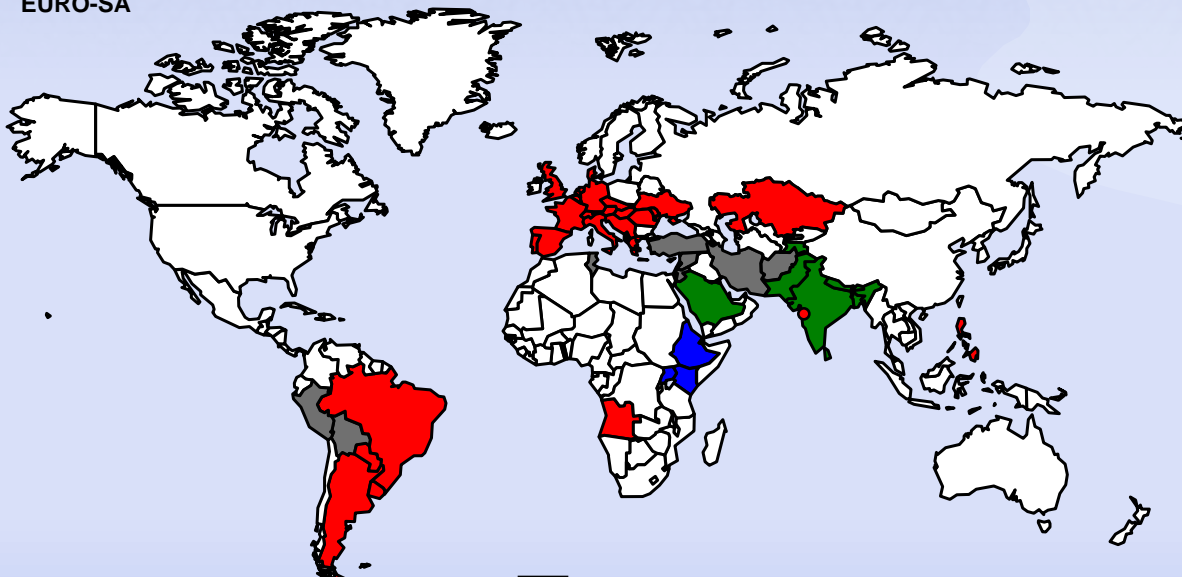




FMDV C Topotypes 1926-2004

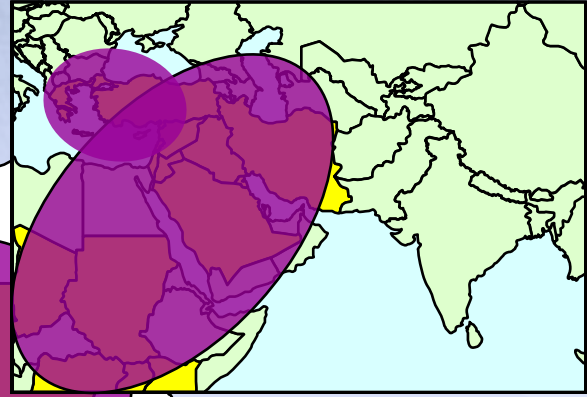
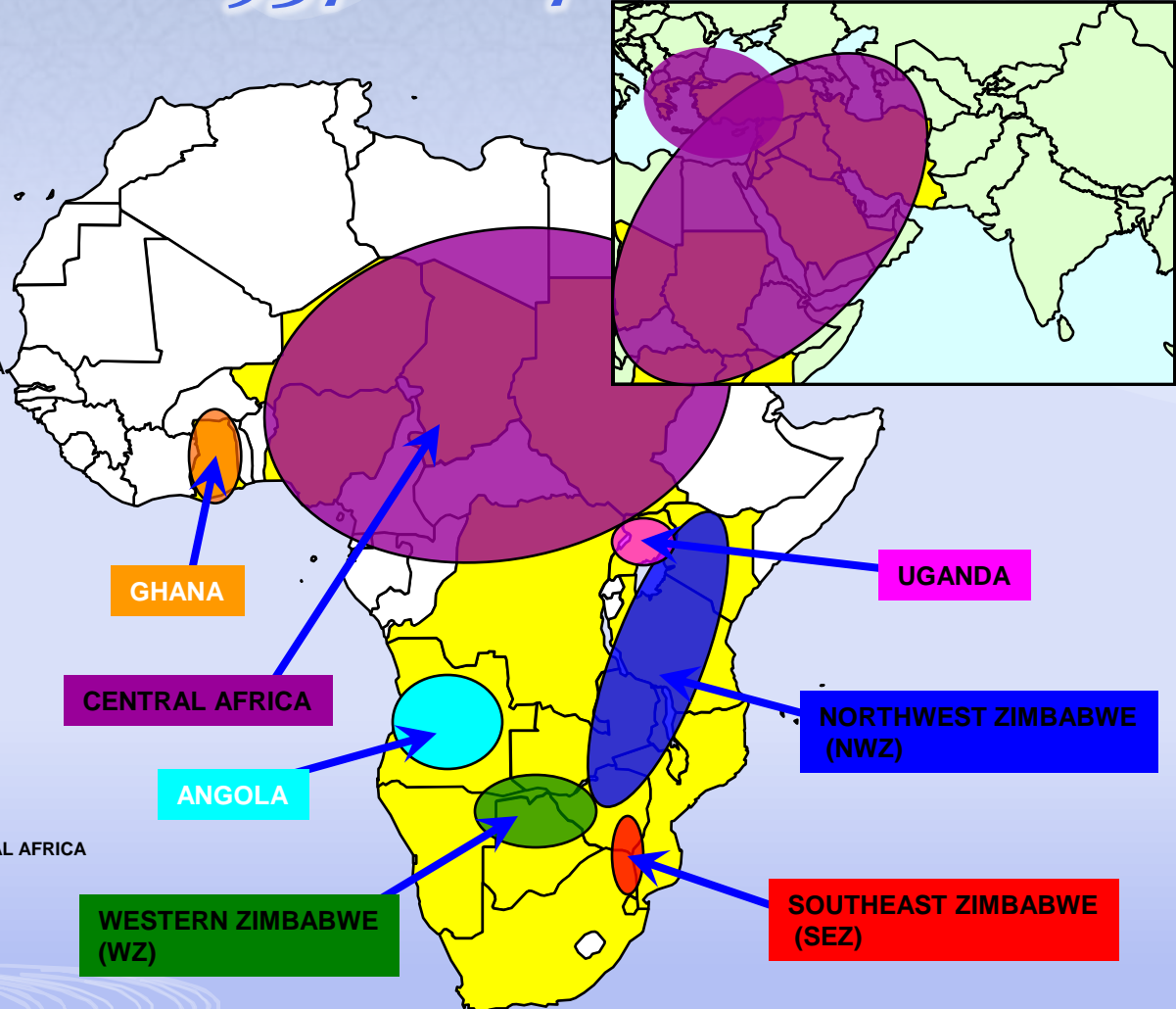
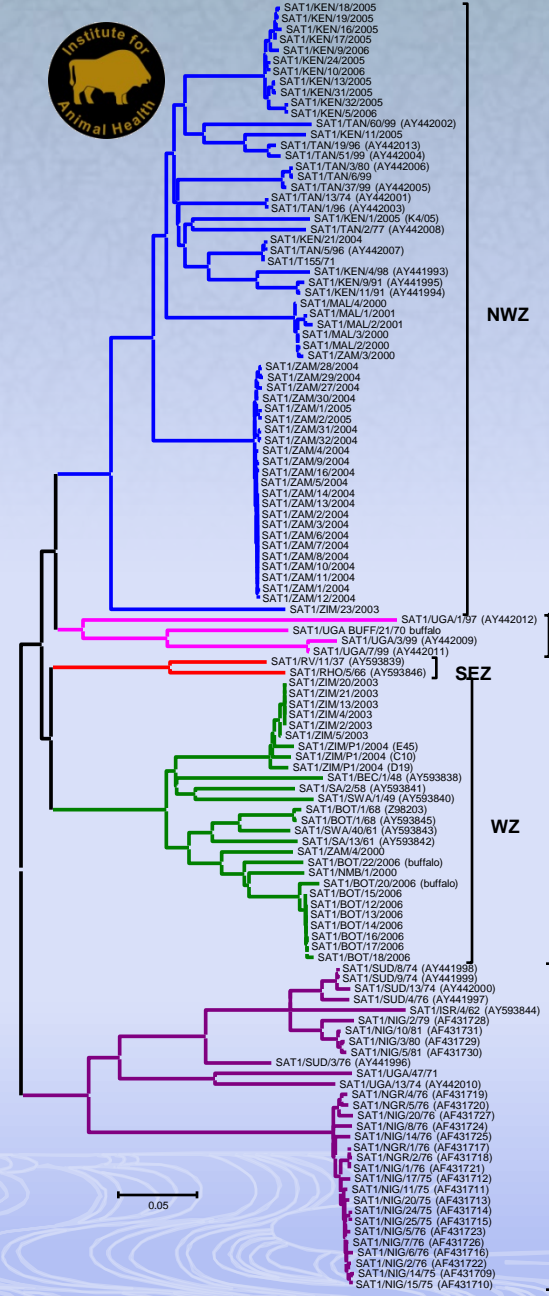



EURO-SA





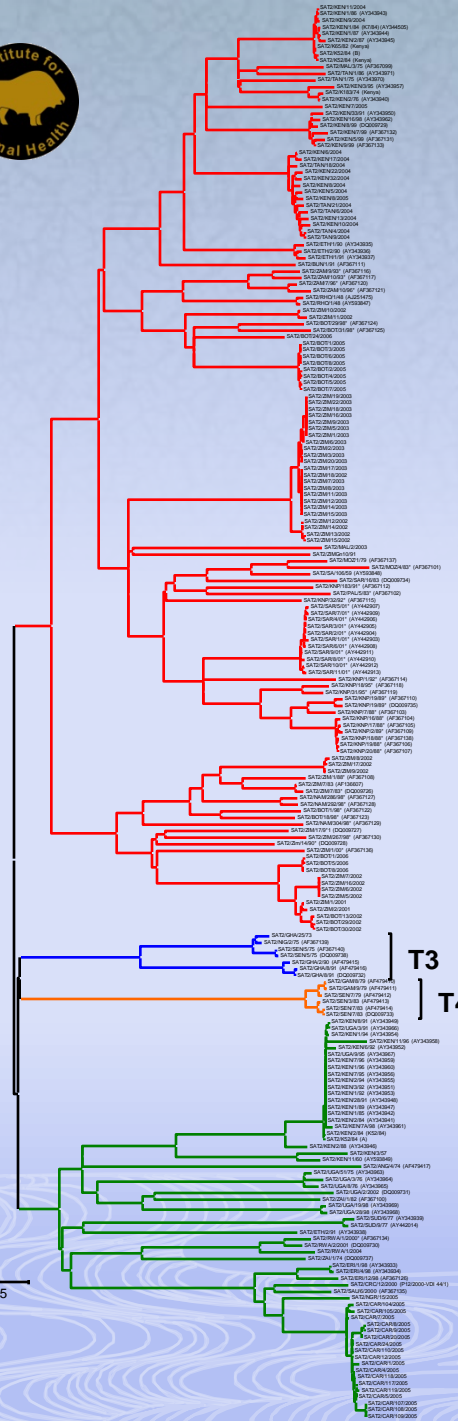
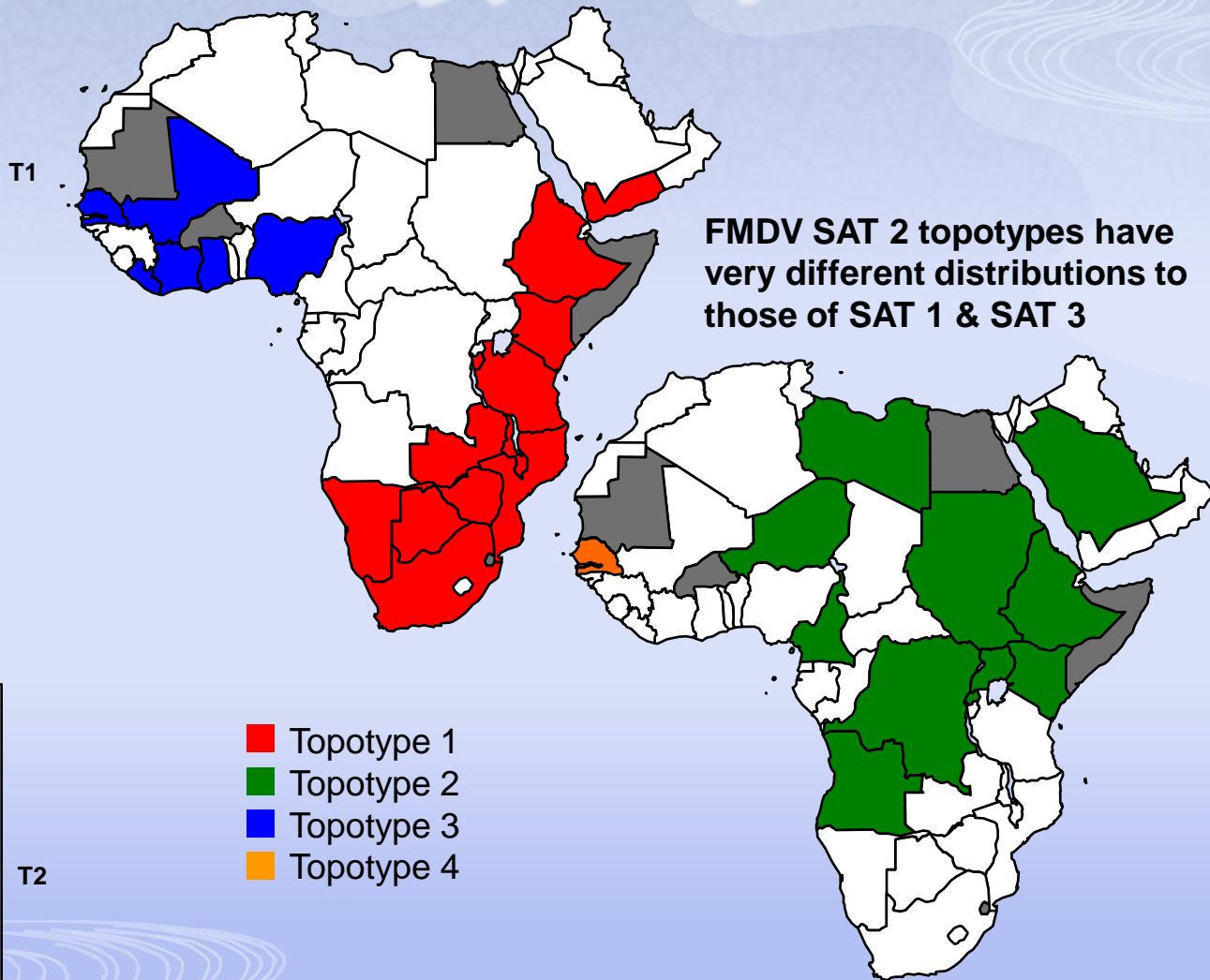
SAT 1 Topotypes 1937-2007



 Countries in which FMDV SAT 1 has been found

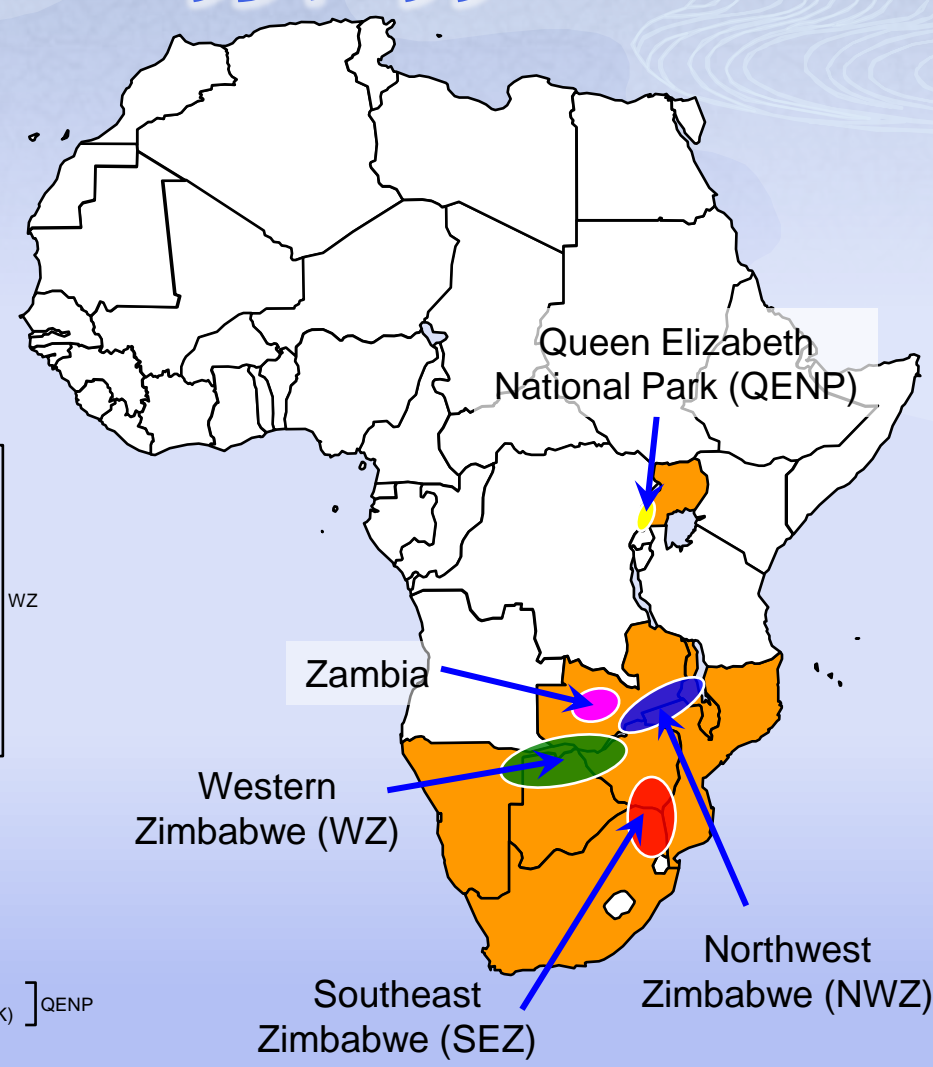
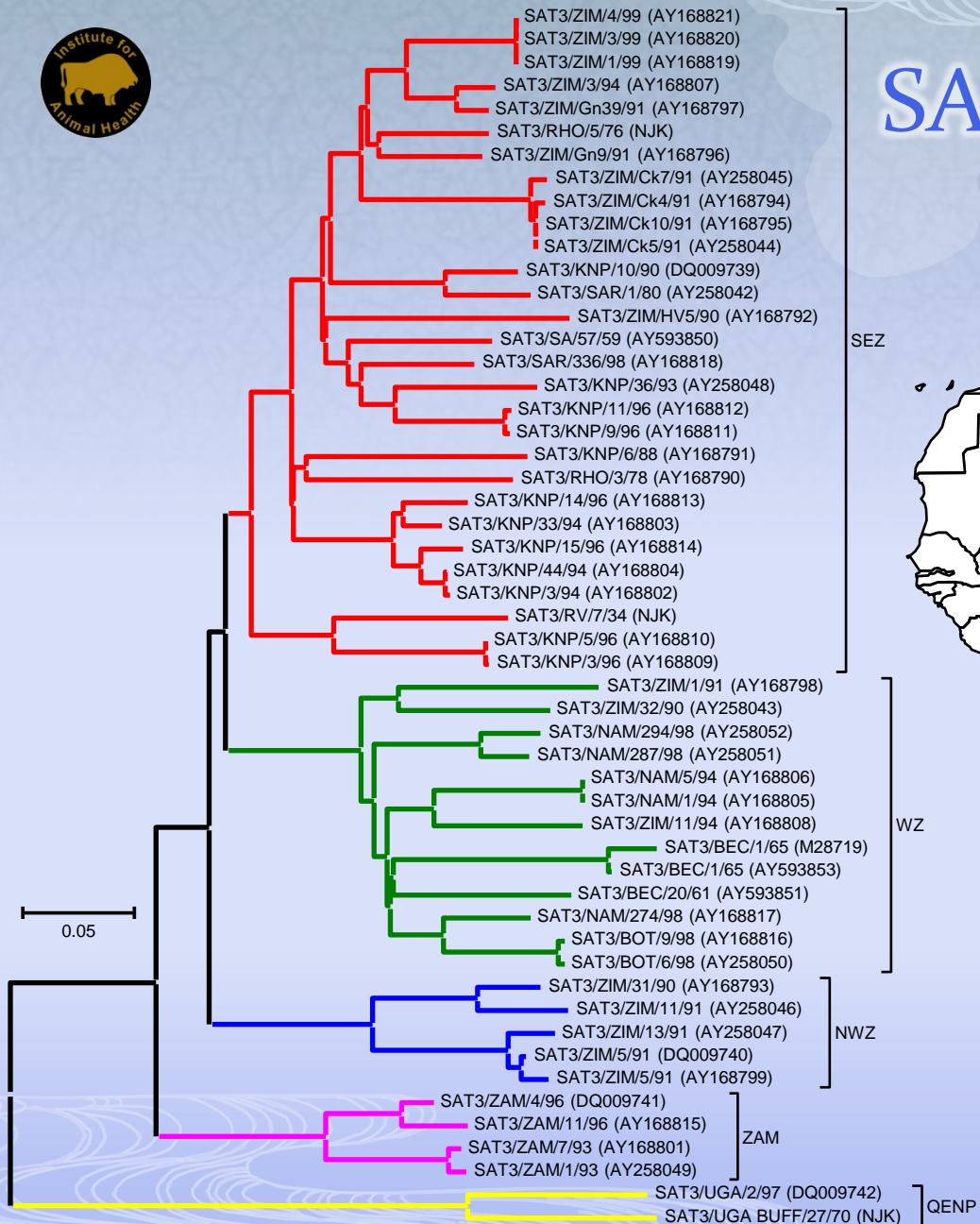
SAT 2 Topotypes 1948-2007

FMDV SAT 2 topotypes have very different distributions to those of SAT 1 & SAT 3





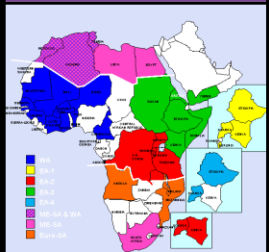
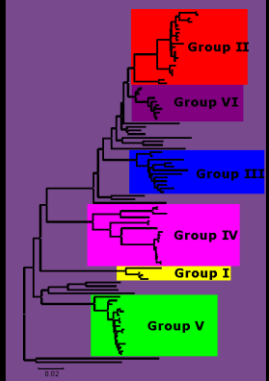
SAT 3 Topotypes 1934-1998



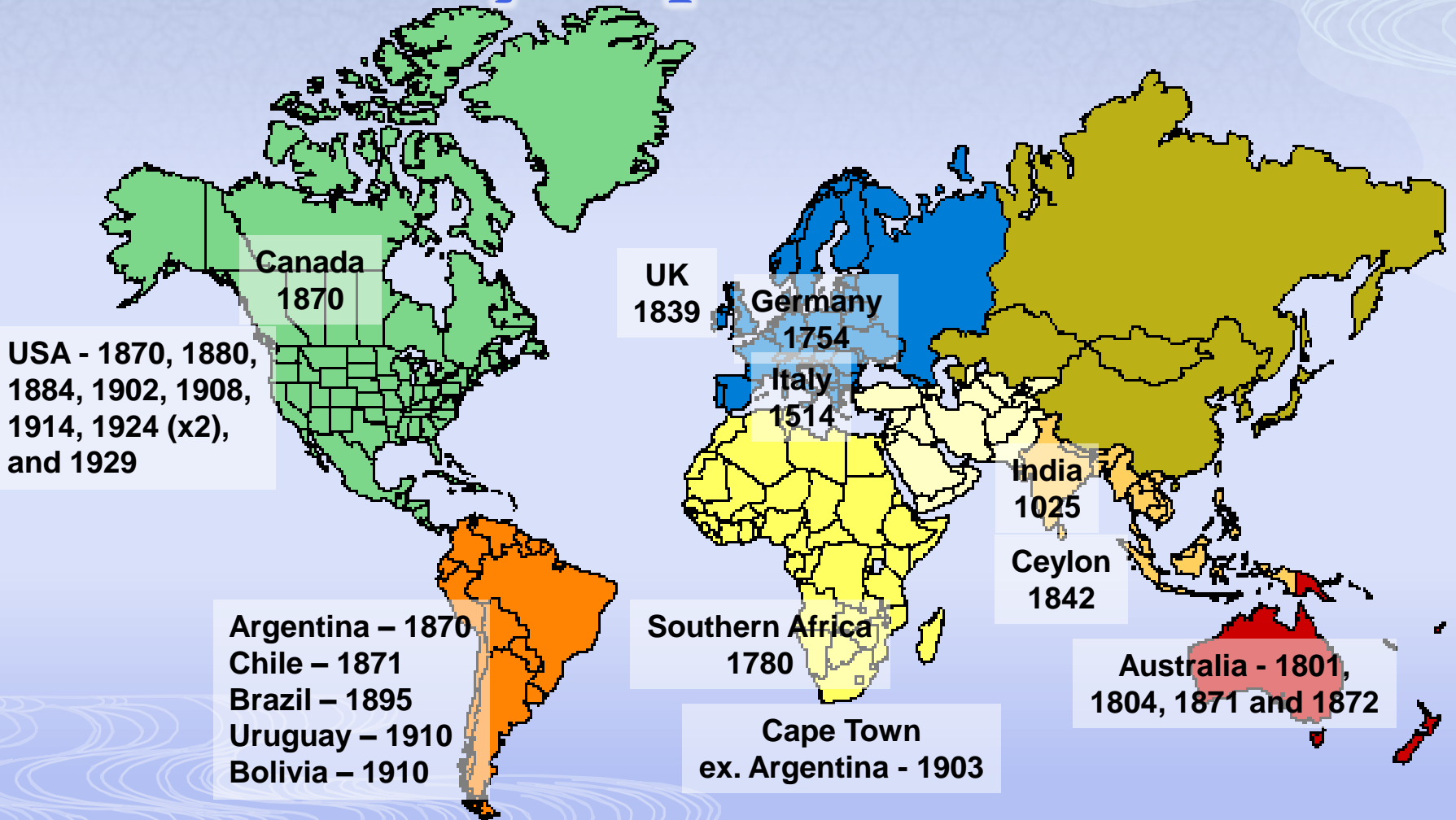
 Countries in which FMDV SAT 1 has been found

The Origins of FMDV

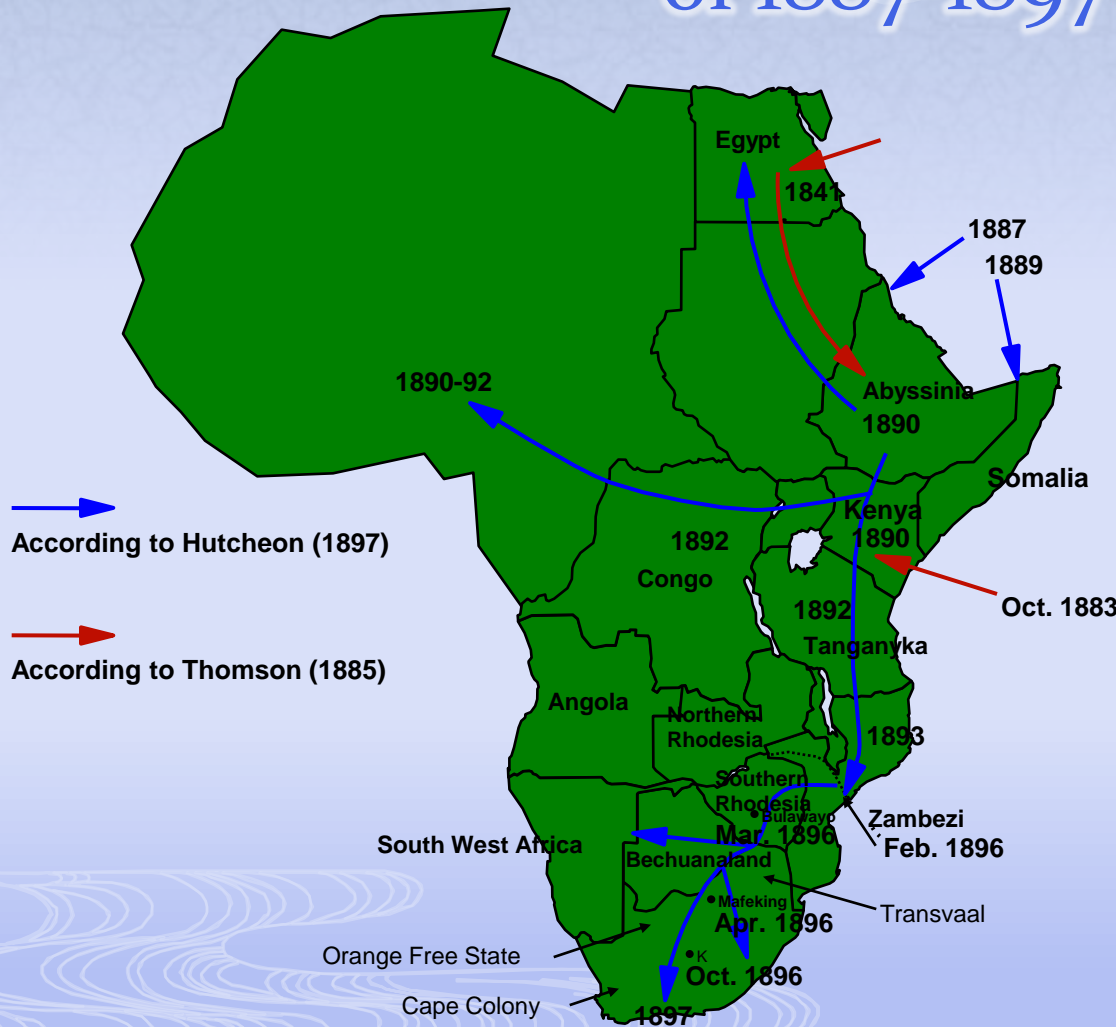
- It is thought that the natural host of FMDV is the African buffalo (*Syncerus caffer*) since:
 - it is principally a persistent infection
 - disease is rarely observed
 - greatest genetic diversity is seen within and between the SAT serotypes



Early Reports of FMD



The African Rinderpest Pandemic of 1887-1897

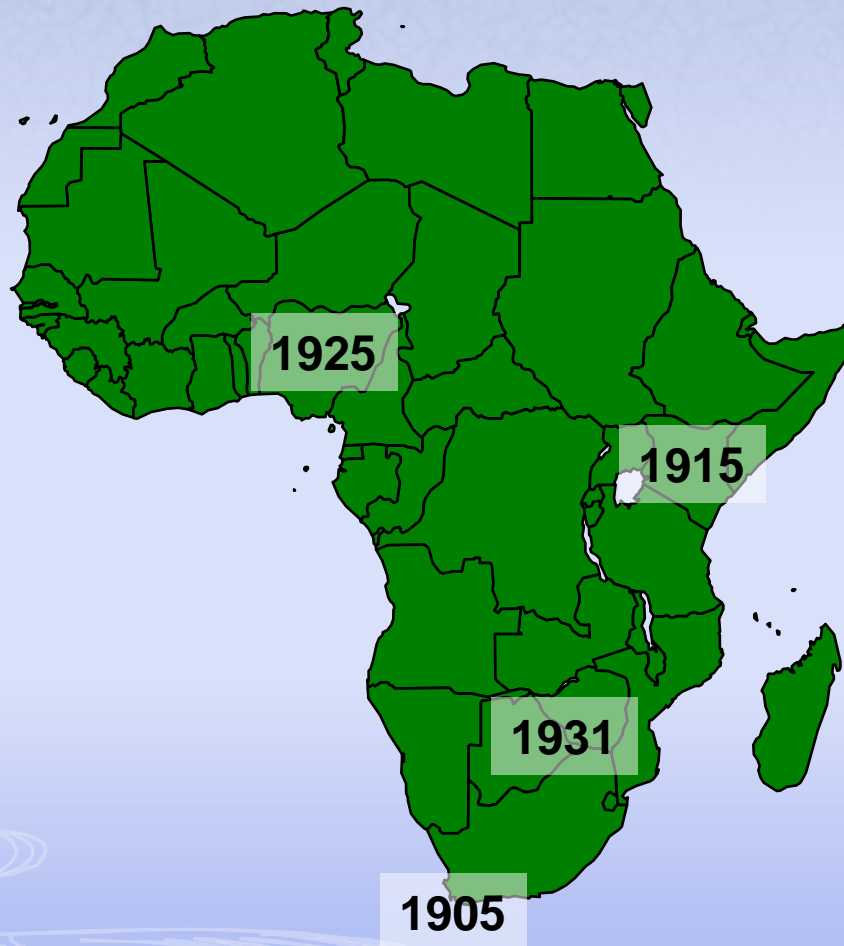


Affected FMDV diversity in Africa by severe reduction in numbers of susceptible hosts (possibly by 90-95%)

Prior to the pandemic African buffalo ranged almost continuously from southern Sudan to the Cape

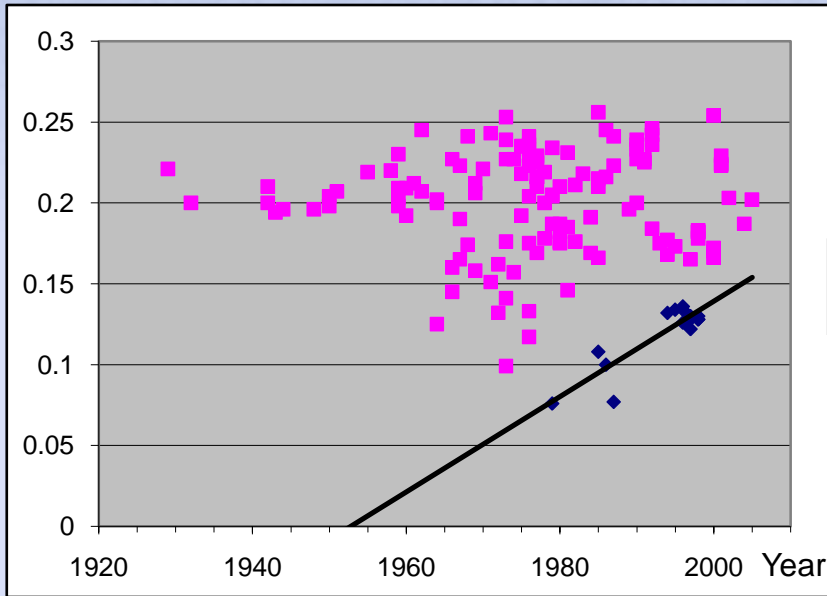
Afterwards only isolated herds were left, some of which harboured the SAT serotypes of FMDV

Reappearance of FMD in Africa



Kenya
1915 – A
1954 – O
1957 – C
1957 – SAT 2
1971 – SAT 1

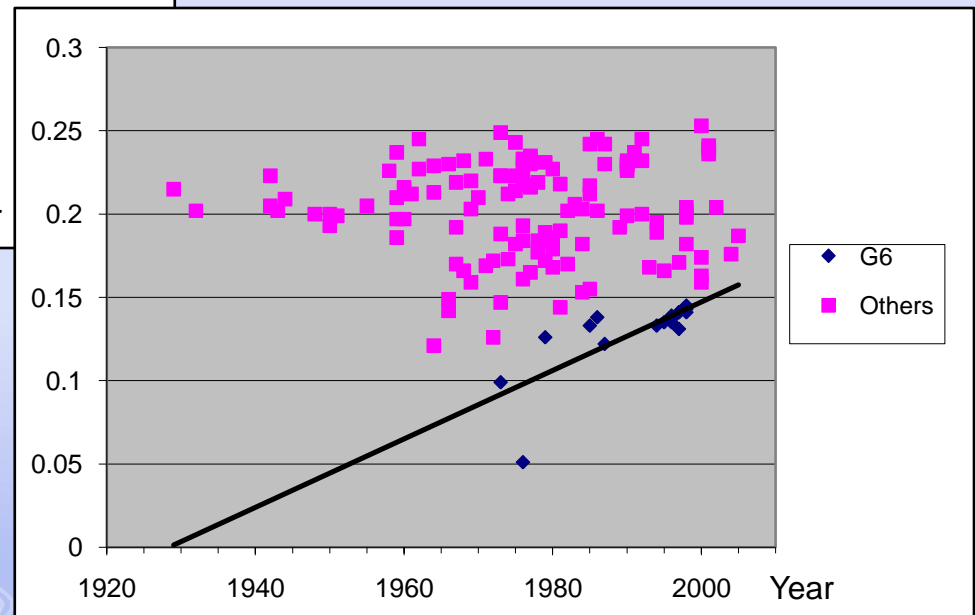
Dating by Regression Analysis



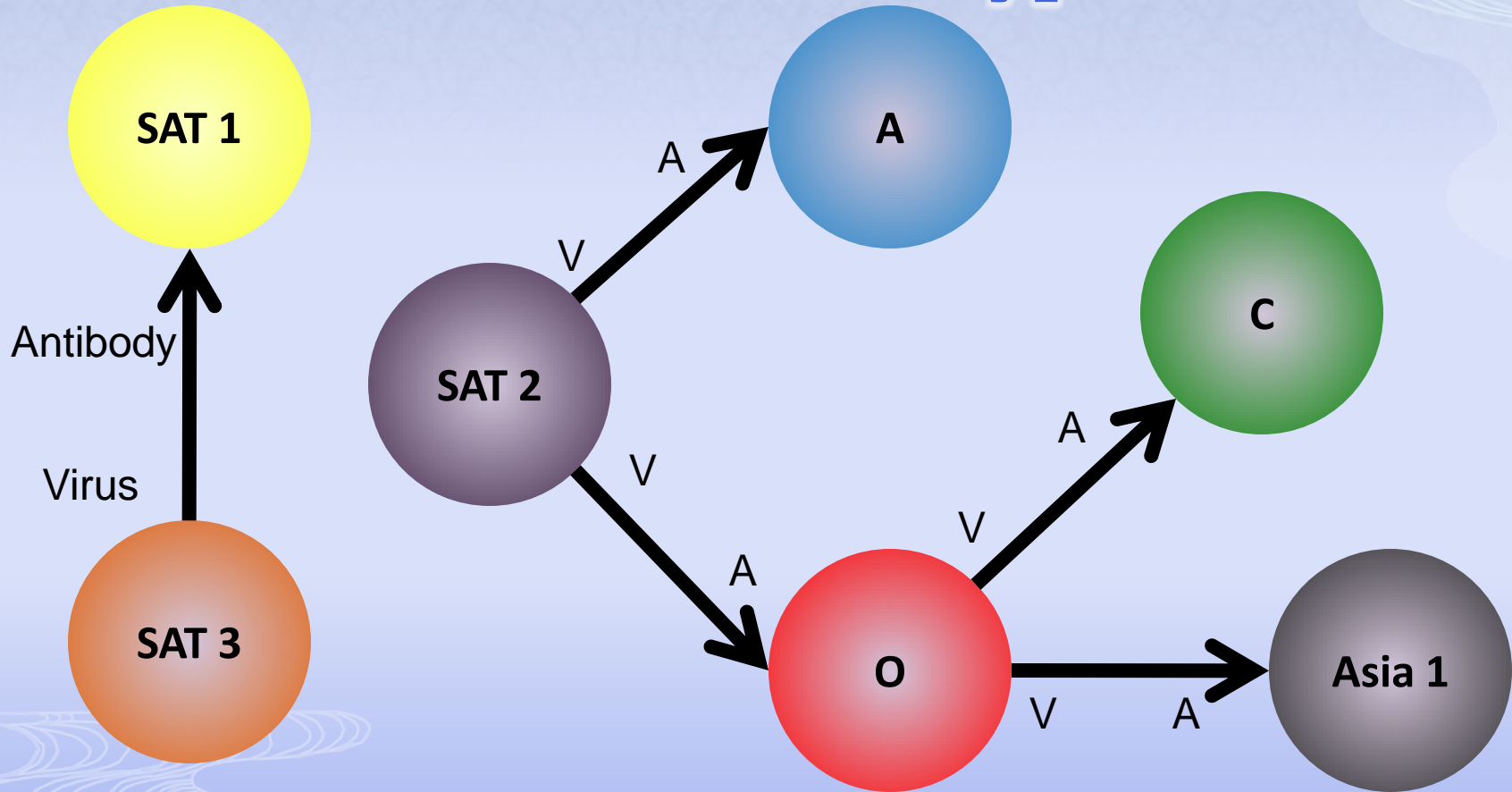
A/TCH/2/73



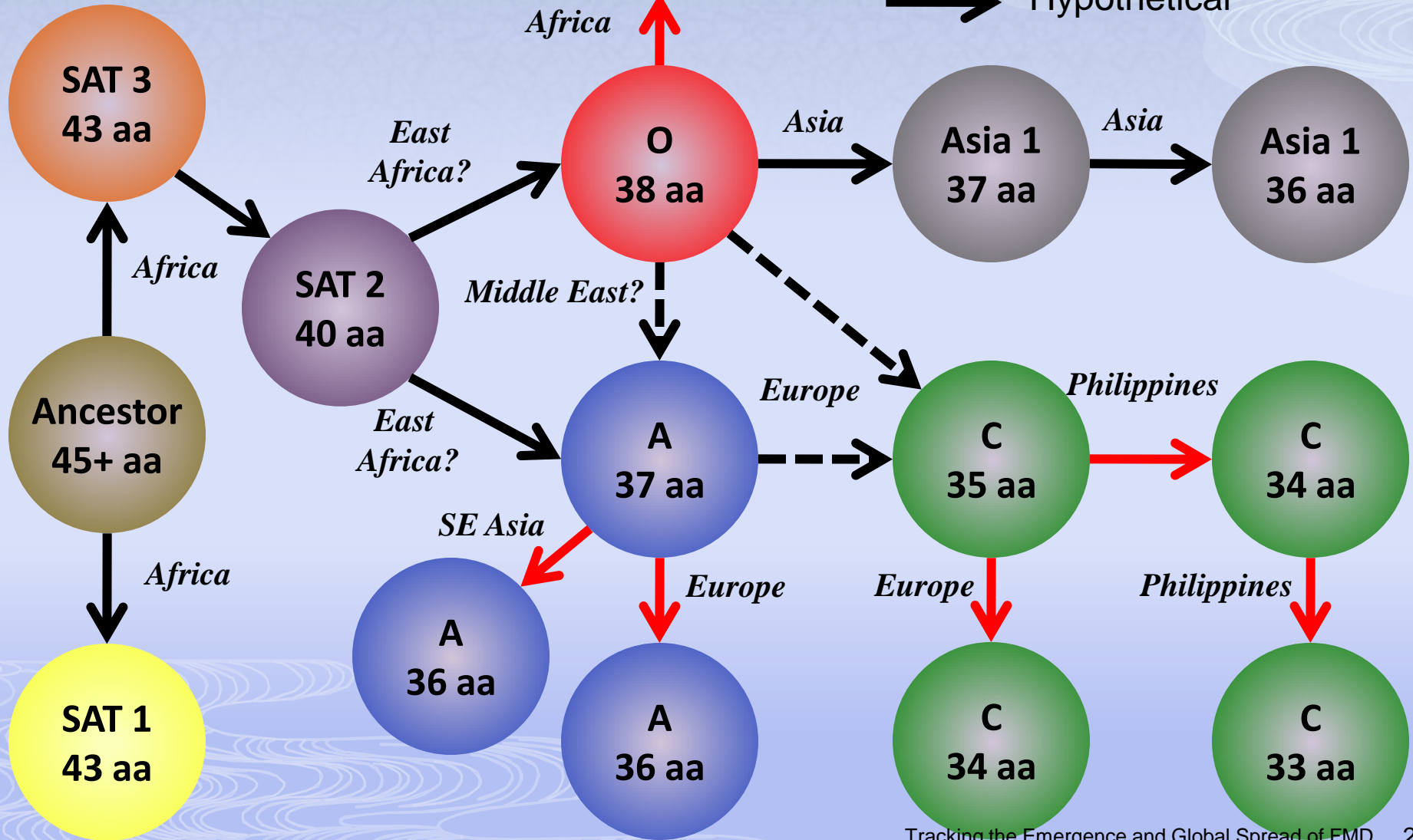
A/GHA/16/73



Antigenic Cross-Reactions Between Serotypes

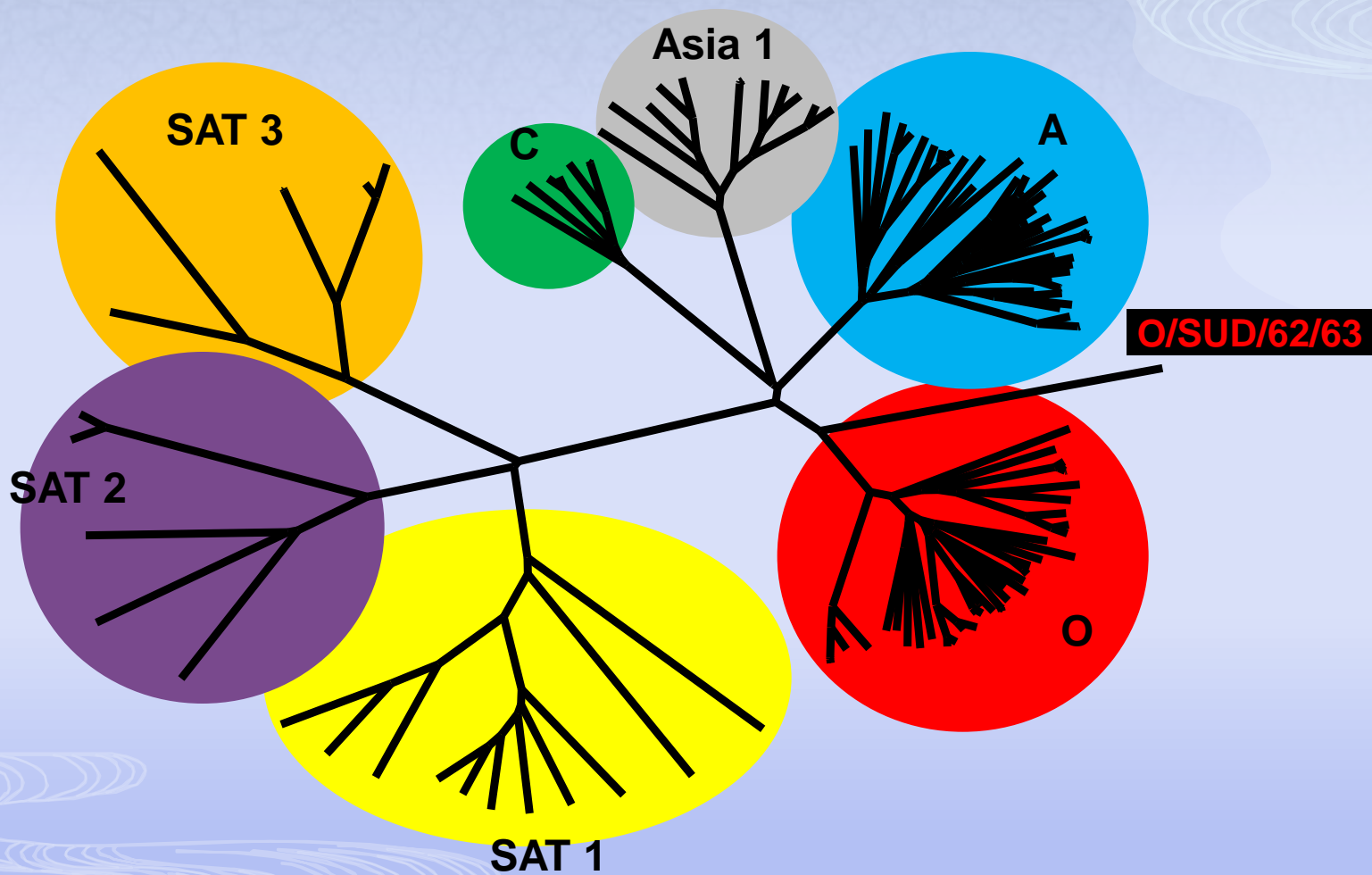
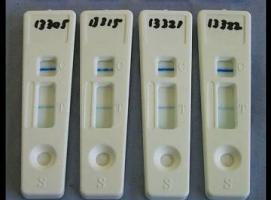
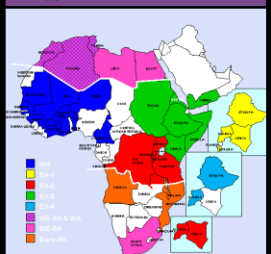
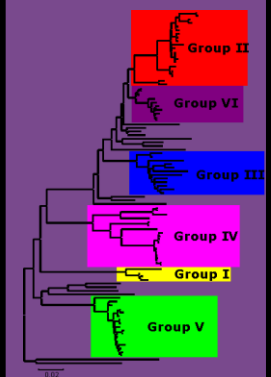


Serotype Evolution & VP1 G-H loop length





An Early African O Lineage



Conclusions

- ❑ FMDV is most diverse in Africa where it probably originated
- ❑ The different serotypes exhibit distinct epidemiological patterns
- ❑ Most serotypes have members which have evolved independently in different geographical regions to give rise to “topotypes”



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- Jemma Wadsworth
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- Paul Kitching
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- Nigel Ferris
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- Defra
- Onderstepoort Vet. Inst., South Africa
- Lanzhou Vet. Res. Inst., China
- PDFMD-Mukteswar, India
- Indian Immunologicals, India
- FMD Ref. Lab., Pakchong, Thailand
- FMD Ref. Lab., Botswana
- PIADC, USA
- FGI-ARRIAH, Russia
- AAHL, Geelong, Australia
- Panaftosa, Brazil
- INTA, Argentina

