



*An exercise to assess research needs
and policy choices in areas of drought*

Drought and Desertification

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Geography

Water scarcity in space: Southern Tunisia





Water scarcity in space: Senegal

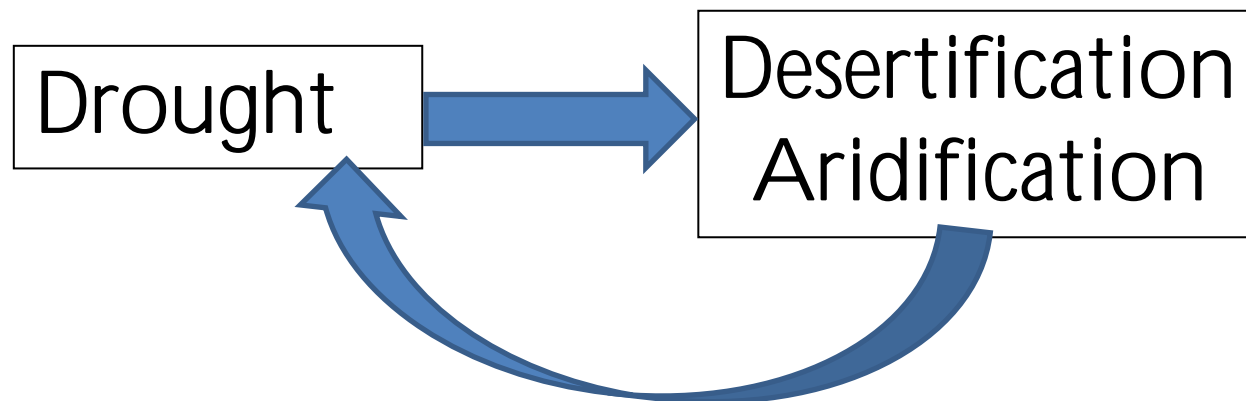
Bed of the River Ferlo (30,000 km²), N Senegal, 3 months after the rainy season



Water scarcity in time,
(here seasonal)

Water scarcity in space and time

- Scarcity in space = aridity
- Scarcity in time = drought
- Scarcity in relation to use
 - Camel herding
 - Paddy rice



What is 'Desertification' (UNCCD)

"Desertification" means land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities

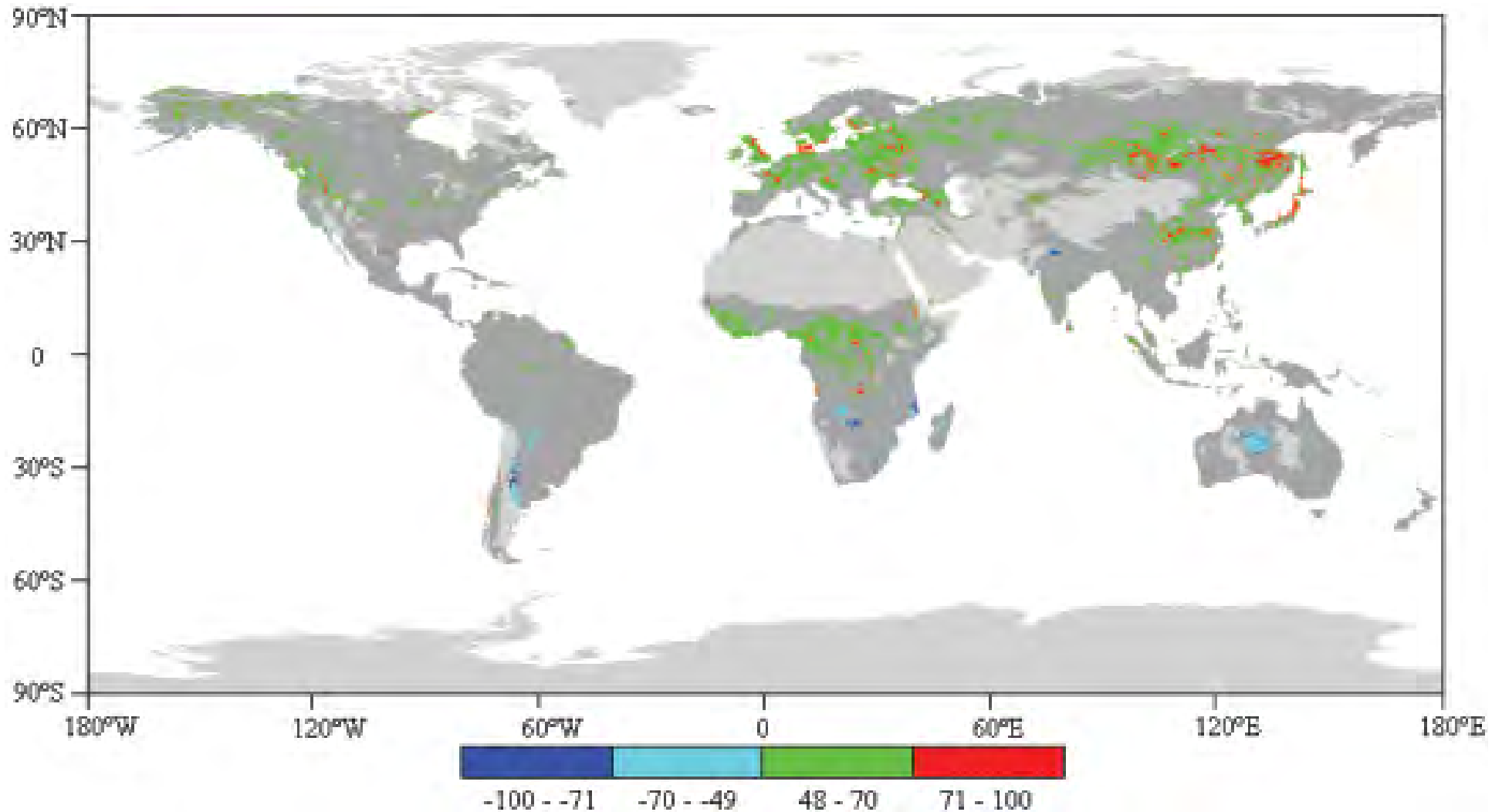
"Land Degradation" means reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as:

- (i) soil erosion caused by wind and/or water;
- (ii) deterioration of the physical, chemical and biological or economic properties of soil; and
- (iii) long-term loss of natural vegetation;

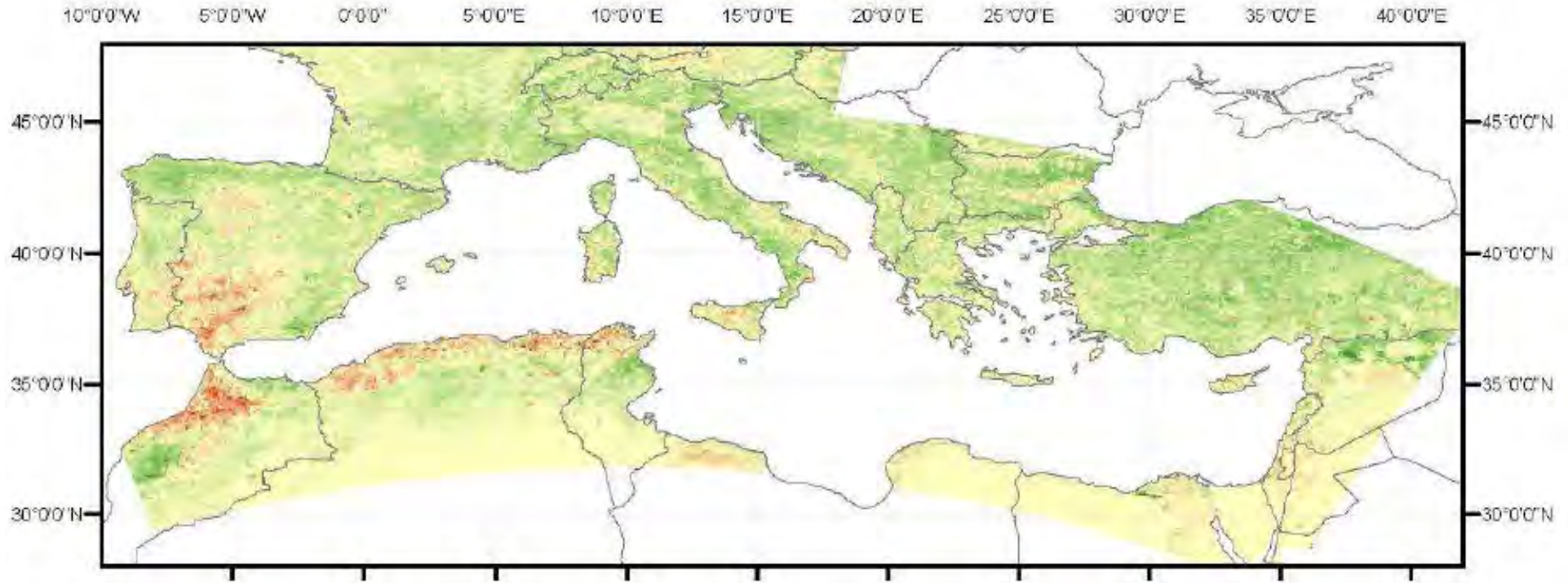
"Combating Desertification" includes activities which are part of the integrated development of land in arid, semi-arid and dry sub-humid areas for sustainable development which are aimed at:

- (i) prevention and/or reduction of land degradation;
- (ii) rehabilitation of partly degraded land; and
- (iii) reclamation of desertified land;

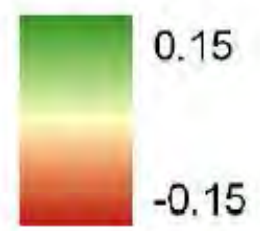
Annual greening trends 1982-1998 (from Xiao & Moody, 2005).



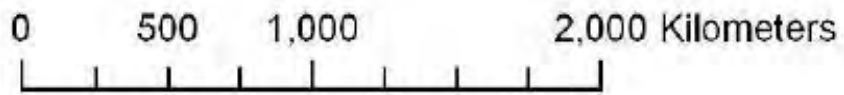
GIMMS (1989 - 1999)



Linear modelled NDVI change

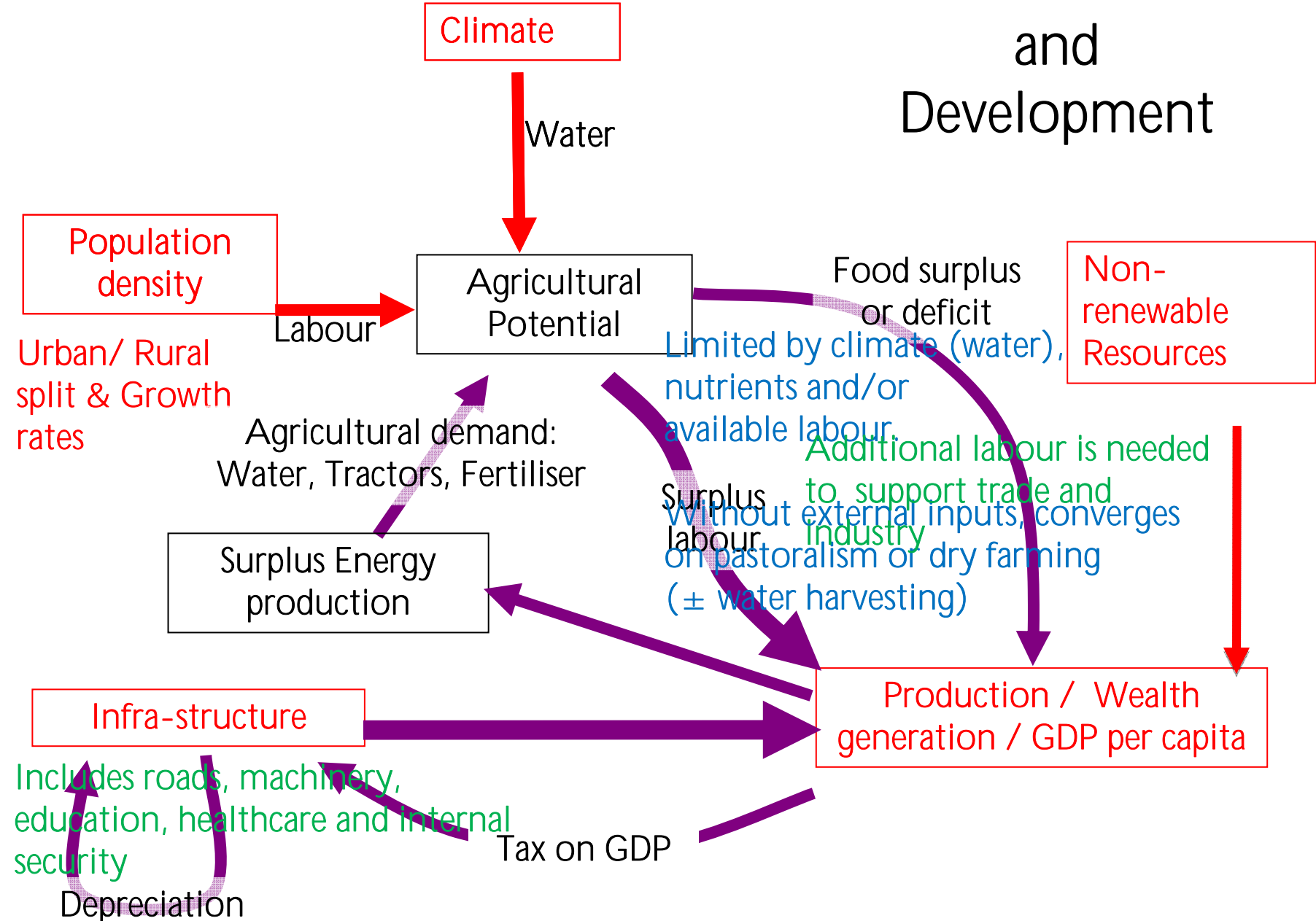


— National border

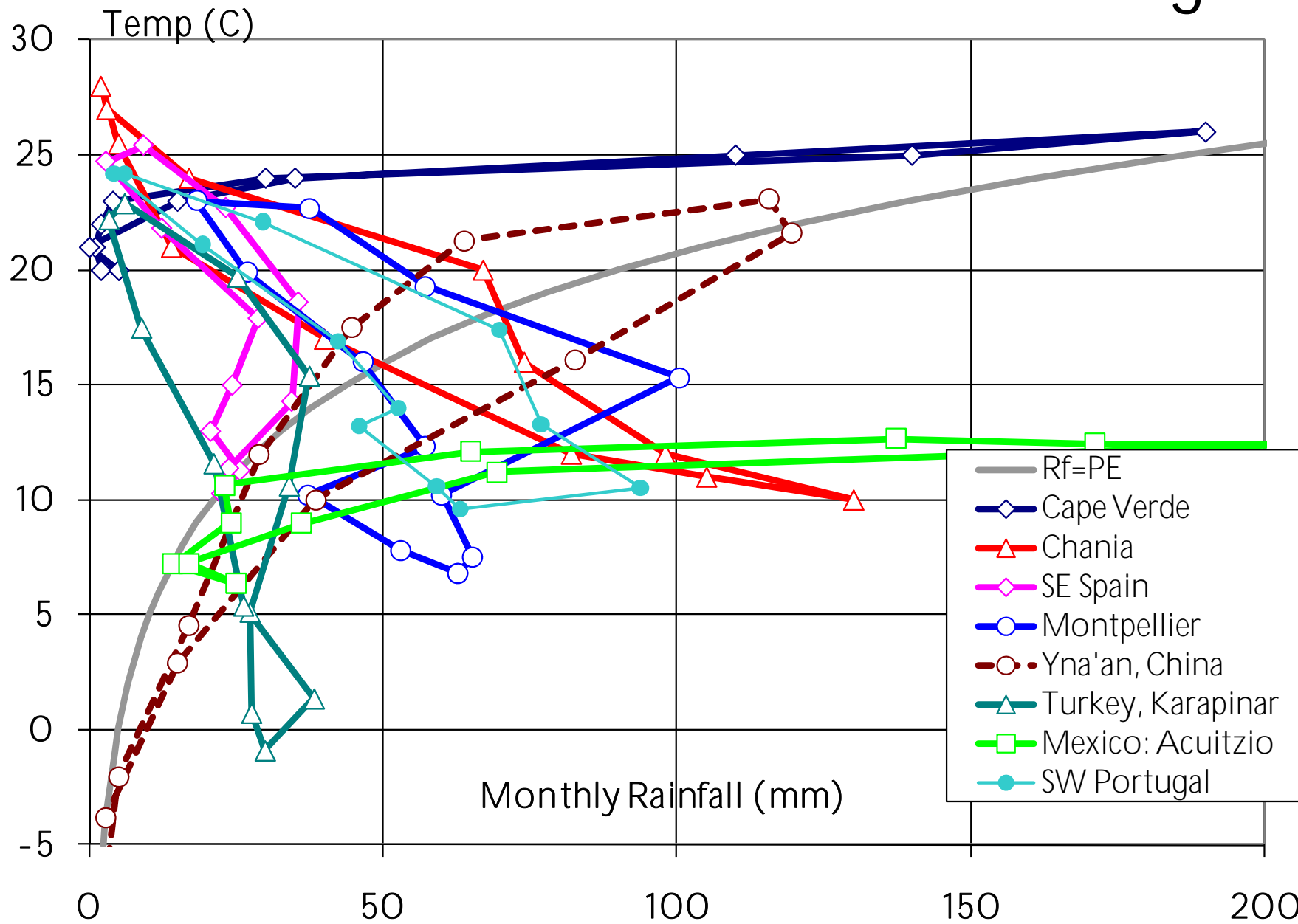


Data source:
NOAA-AVHRR - MEDOKADS archive:
D. Koslowsky (FU Berlin)
NOAA-PAL and GIMMS archives:
NASA
National borders: ESRI world map
Projection:
Geographic Lat/Long
WGS84

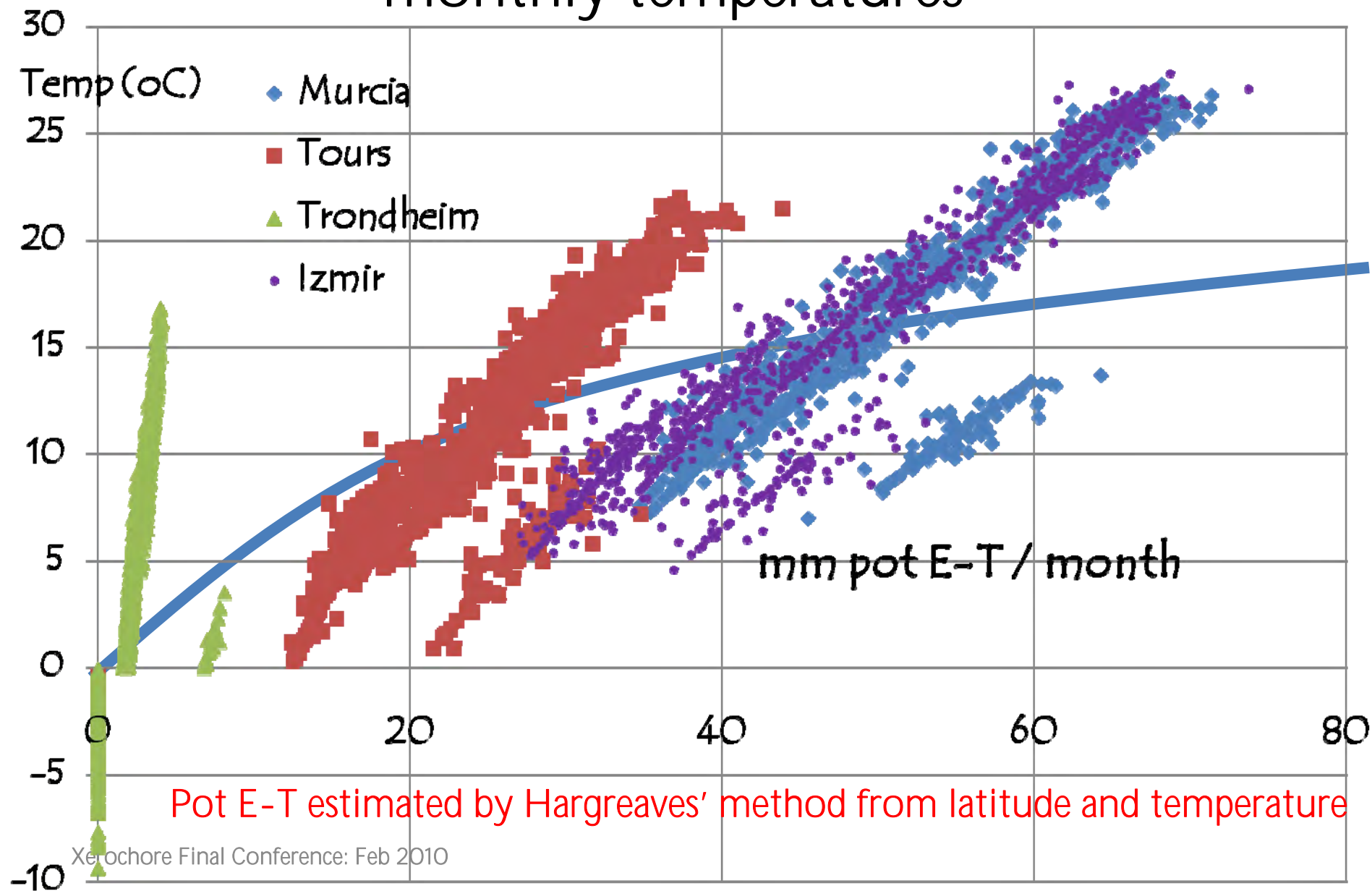
Desertification and Development

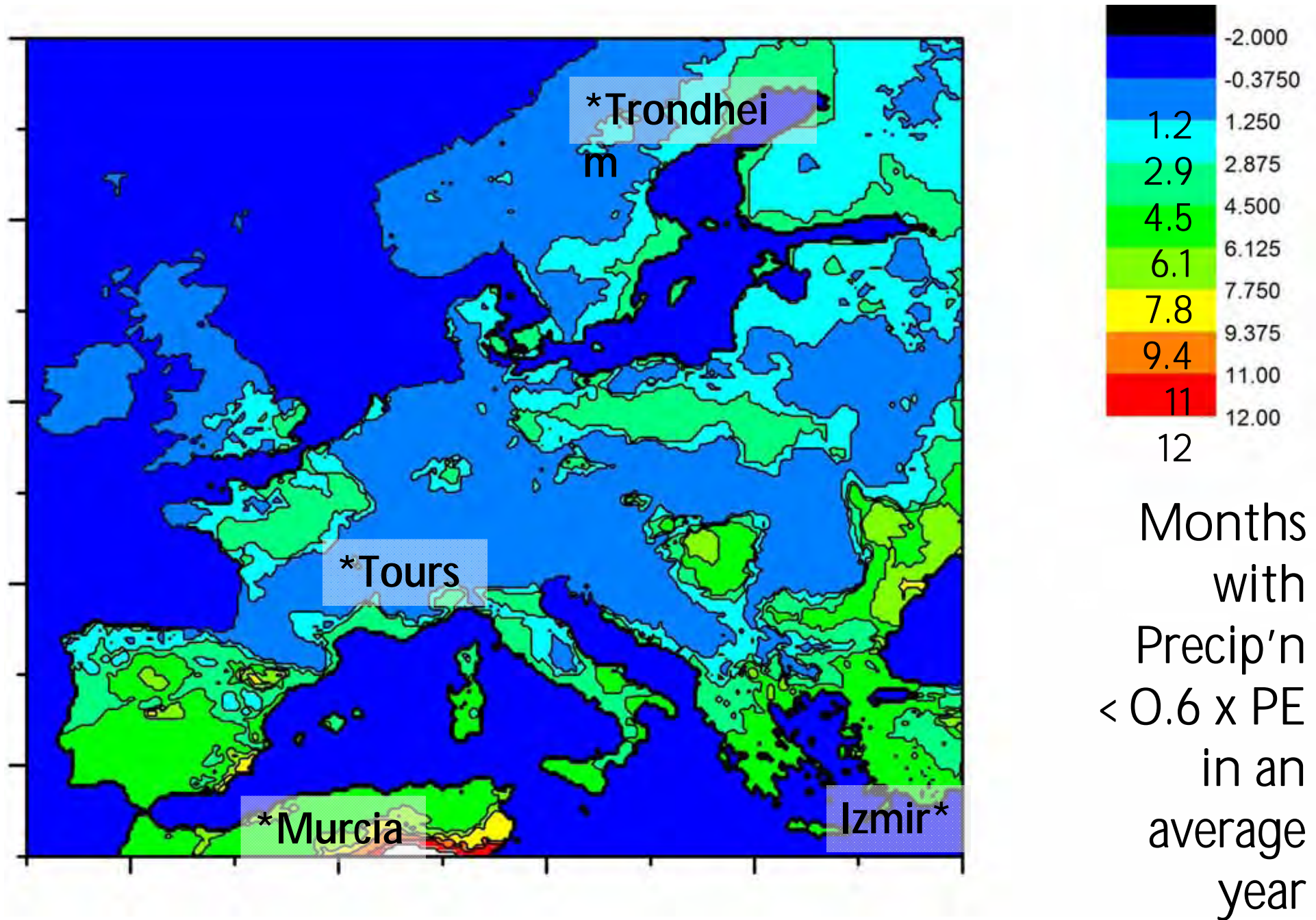


One visualisation of varied climatic regimes



Relationships between Pot E-T and mean monthly temperatures

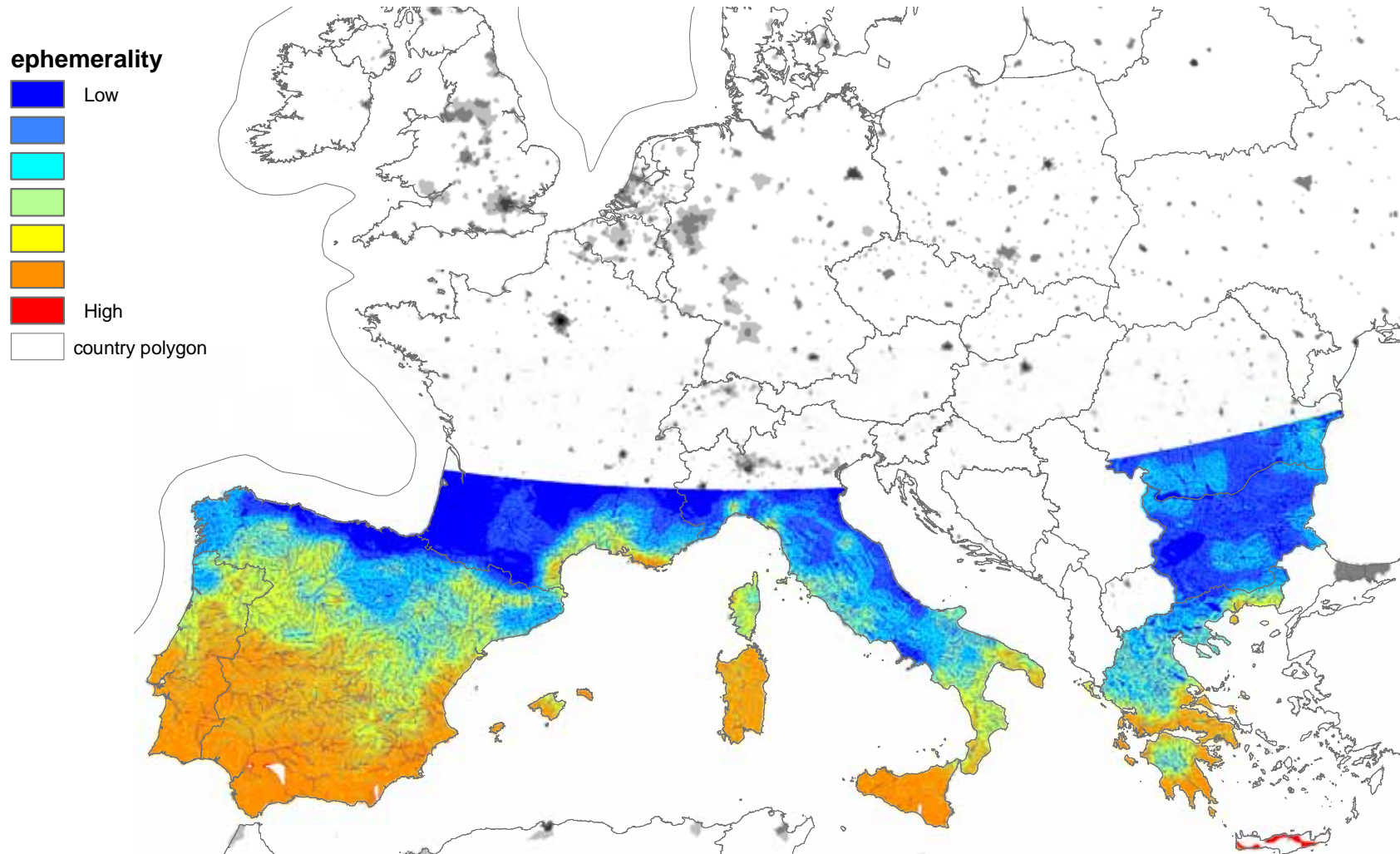




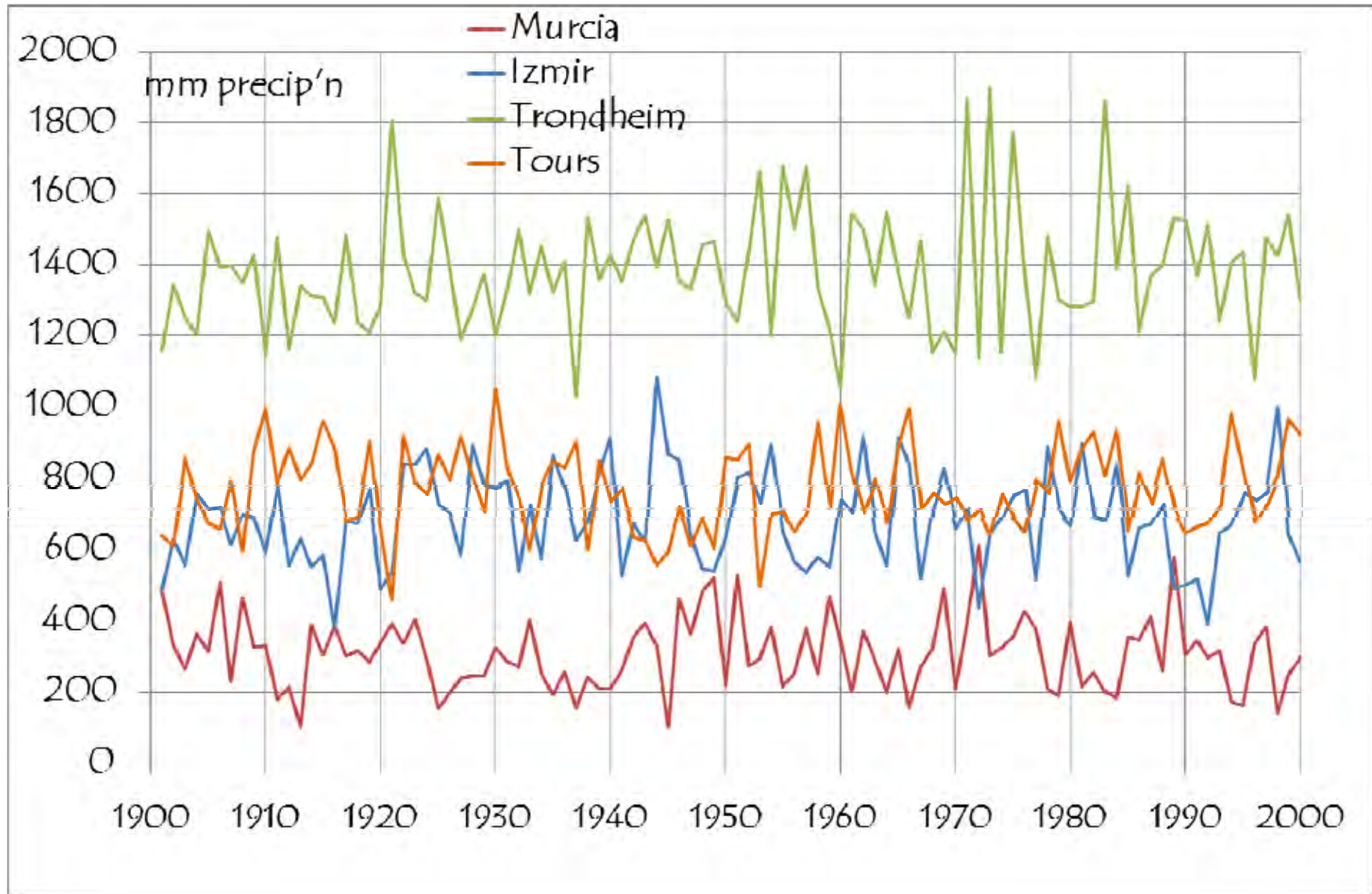
Based on CRU 10' gridded data for Europe, 1901-2000

Ephemerality:

Monthly runoff is accumulated downstream to give continuity of flow in terms of rainfall and geology, with estimated Actual E-T and Runoff.

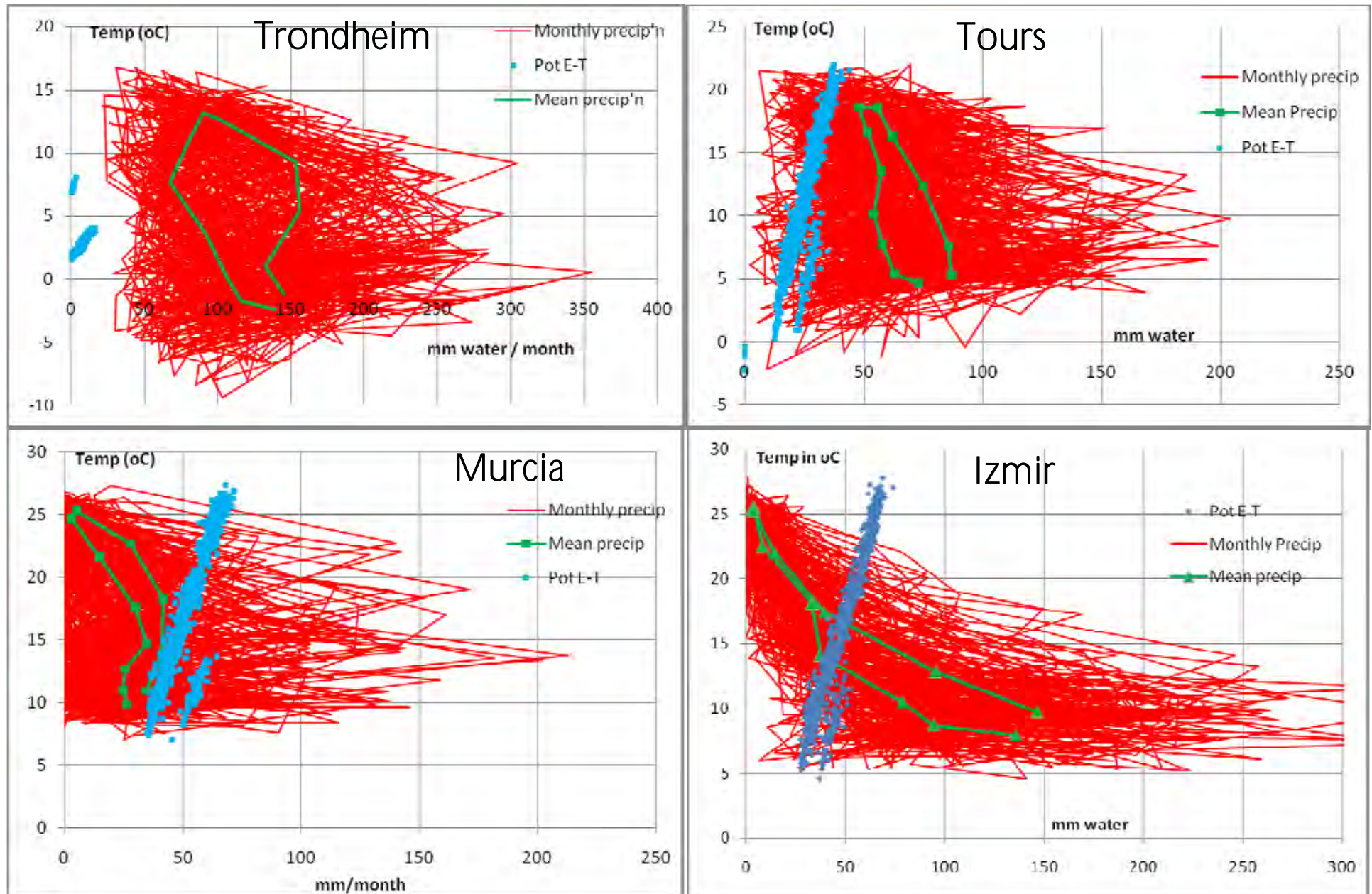


Annual precipitation 1901-2000



Rainfall & Pot-ET for 4 sites across Europe

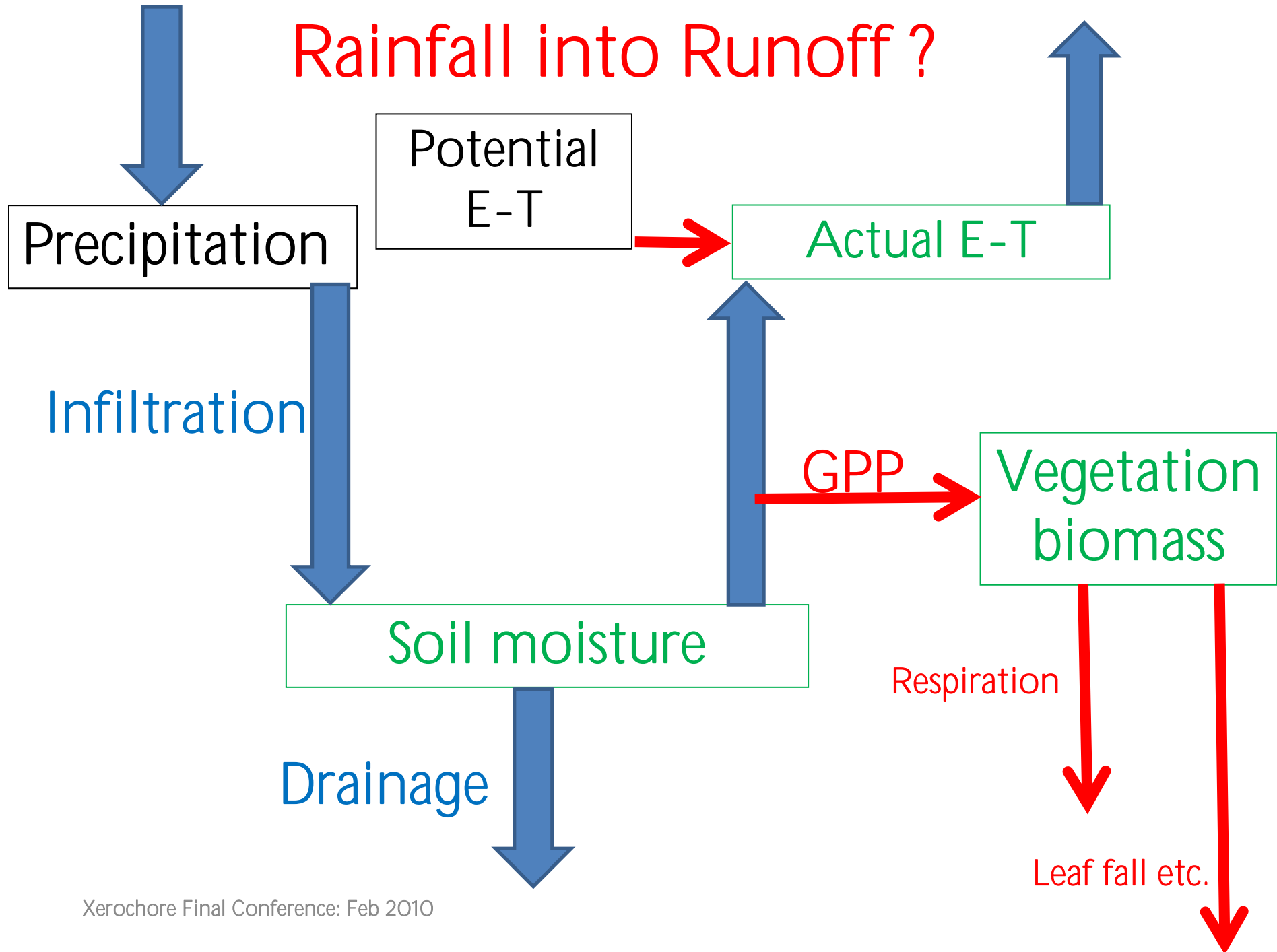
Based on CRU 10' gridded data for Europe, 1901-2000



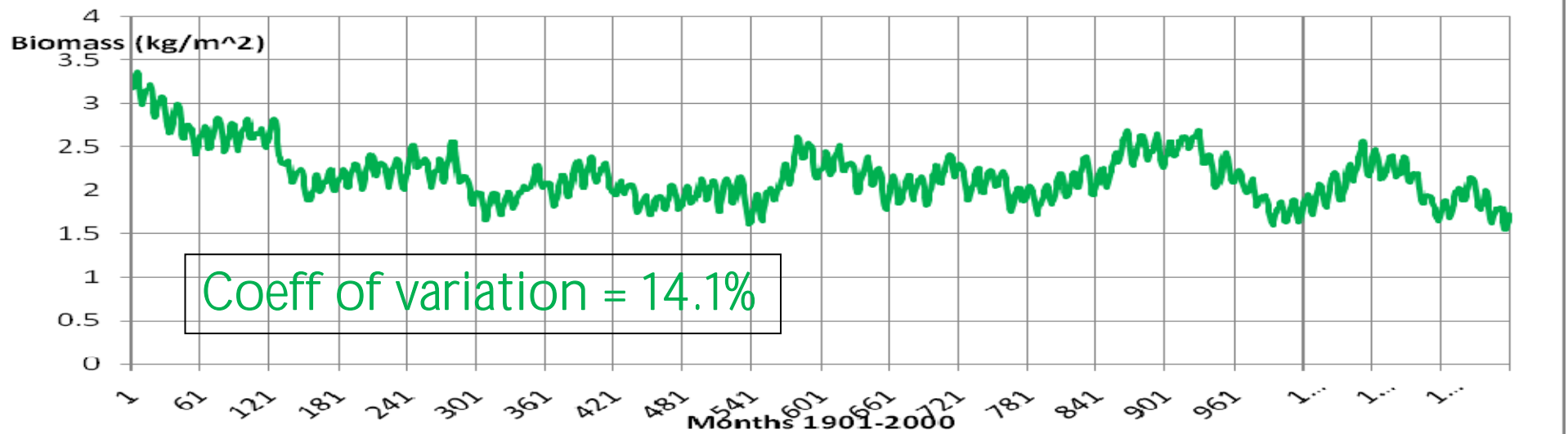
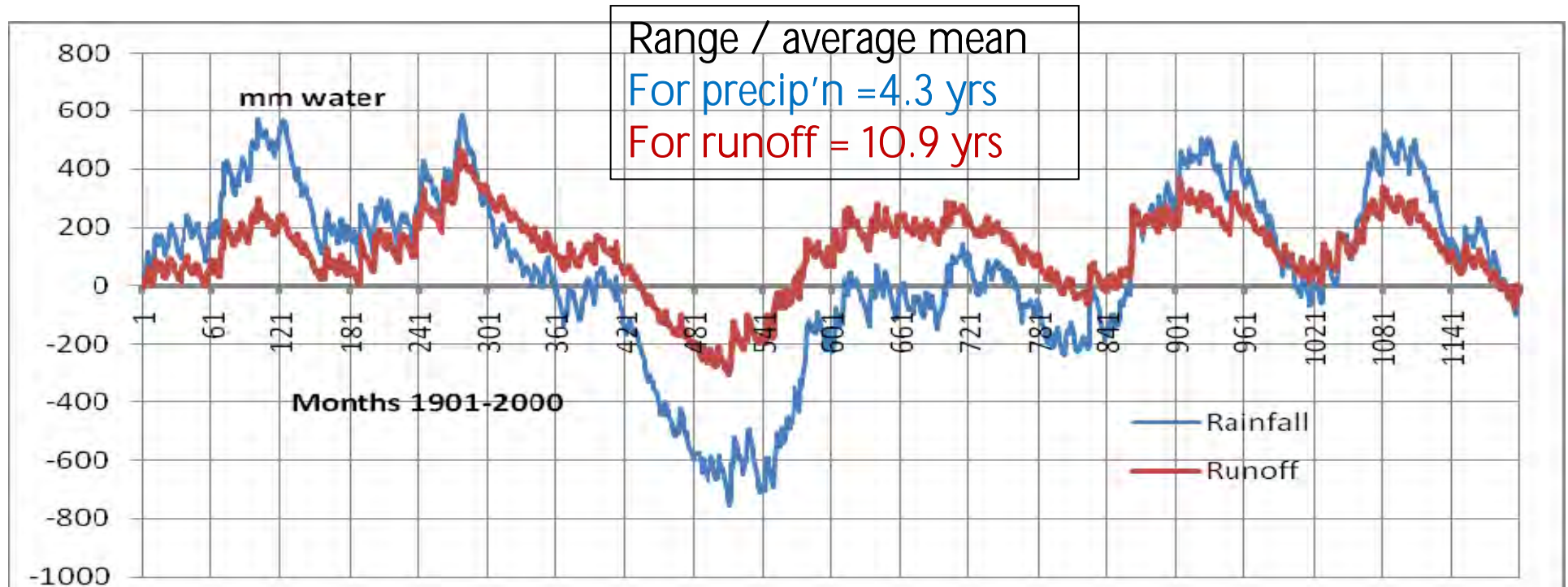
Environmental impacts of drought ?

- Rainfall or runoff ?
- Single month/year or cumulative effect ?
- Desertification impacts ?
 - Wind erosion and Fire
 - Vegetation as a key intermediary
 - Salinisation
 - Mainly produced by long term aridity
 - Water erosion
 - Mainly produced by floods rather than droughts

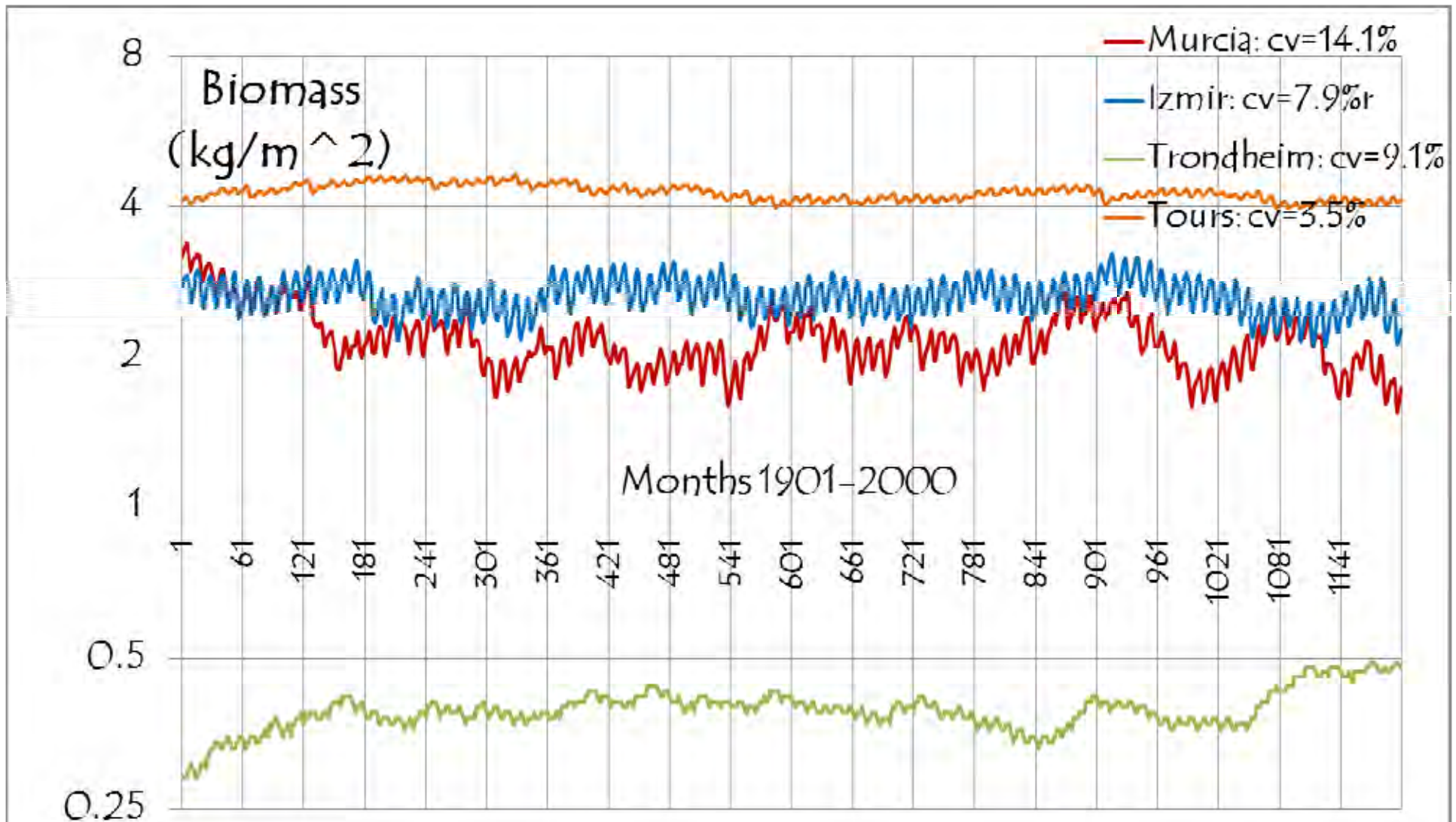
Rainfall into Runoff ?



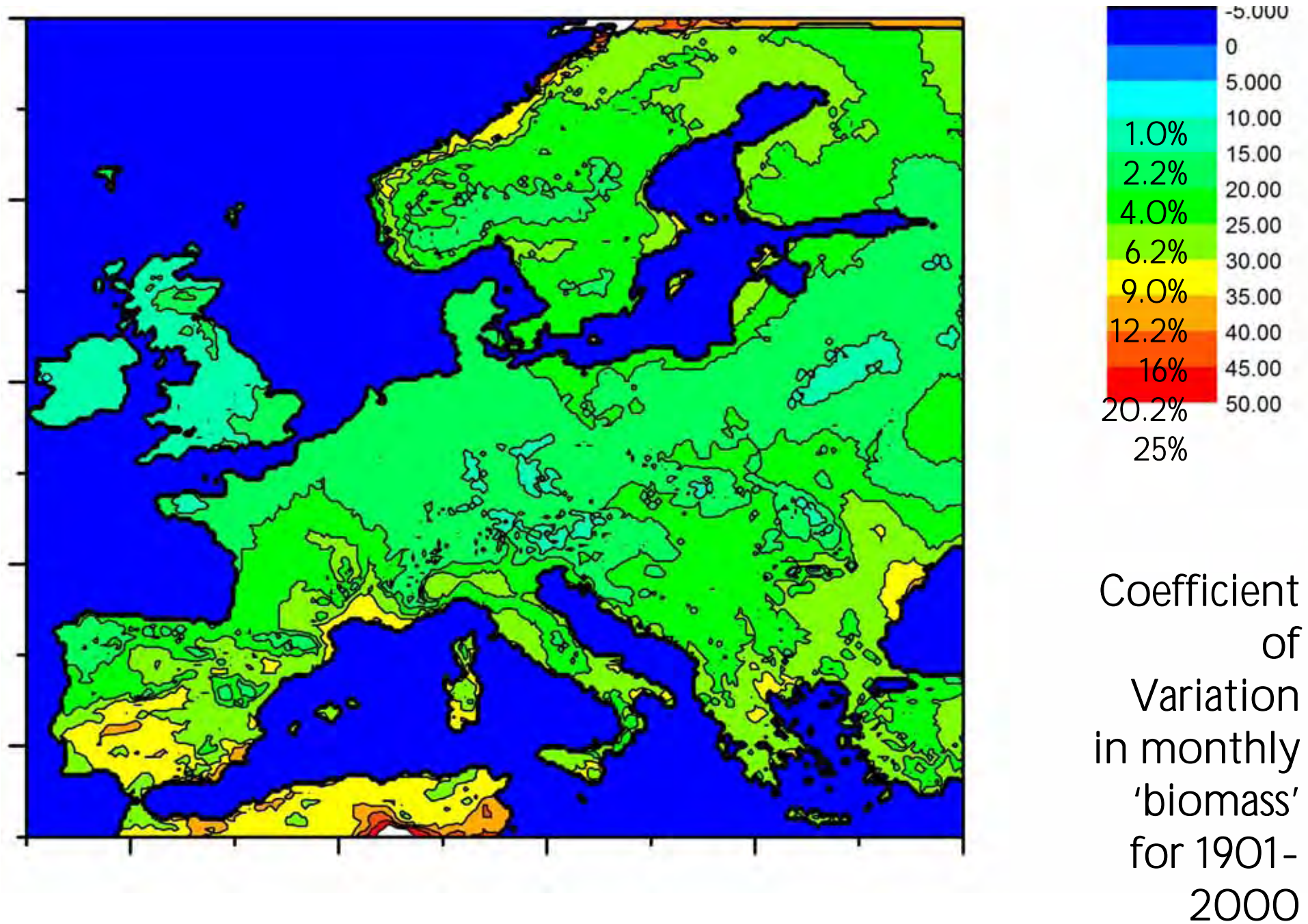
Cumulative anomalies for Precipitation and Runoff, and estimated uncultivated biomass: Murcia data



Estimated biomass and variability: 1901-2000

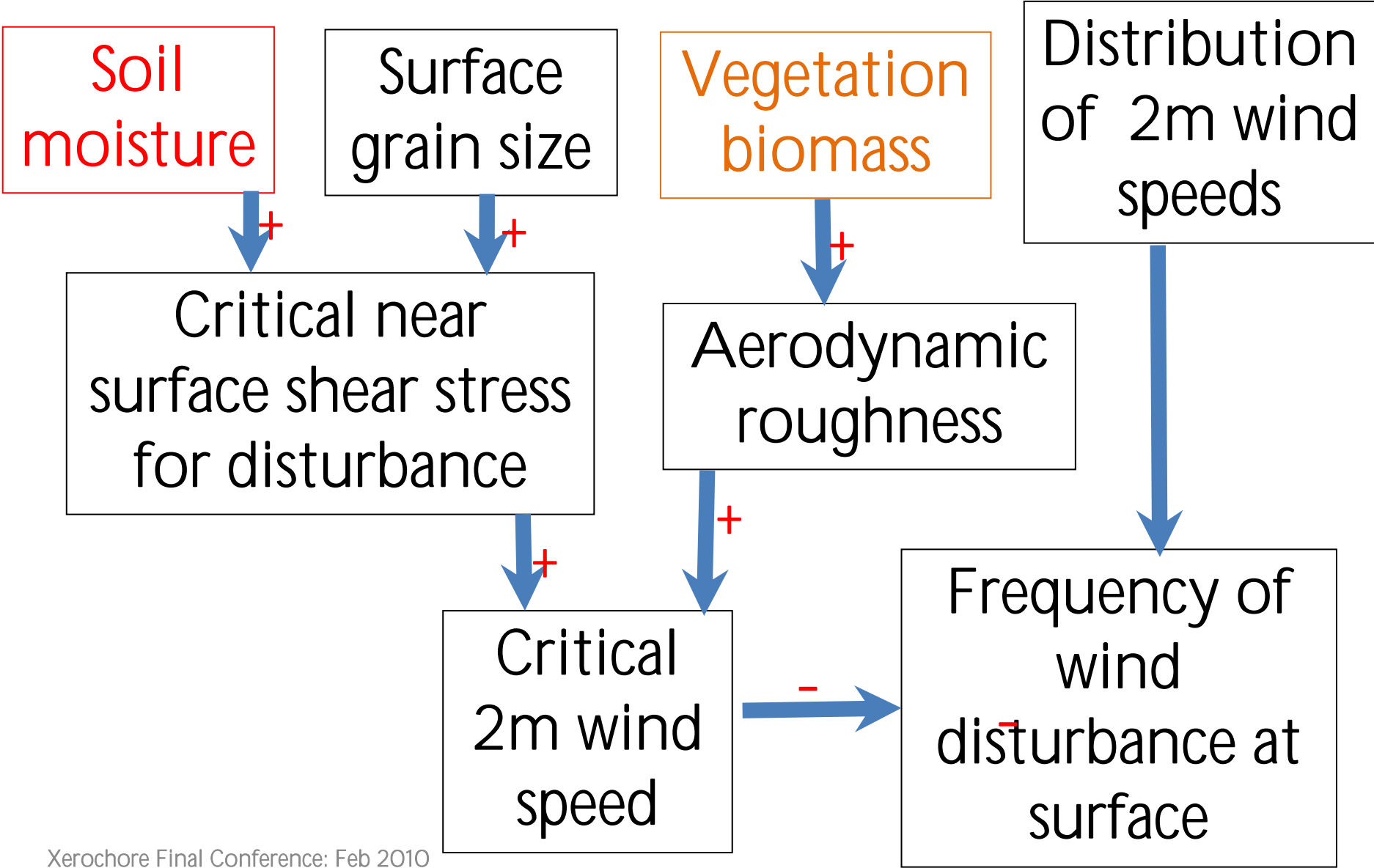


Biomass plotted on log scales: $cv = \text{coefficient of variation} = \text{SD} / \text{Mean}$

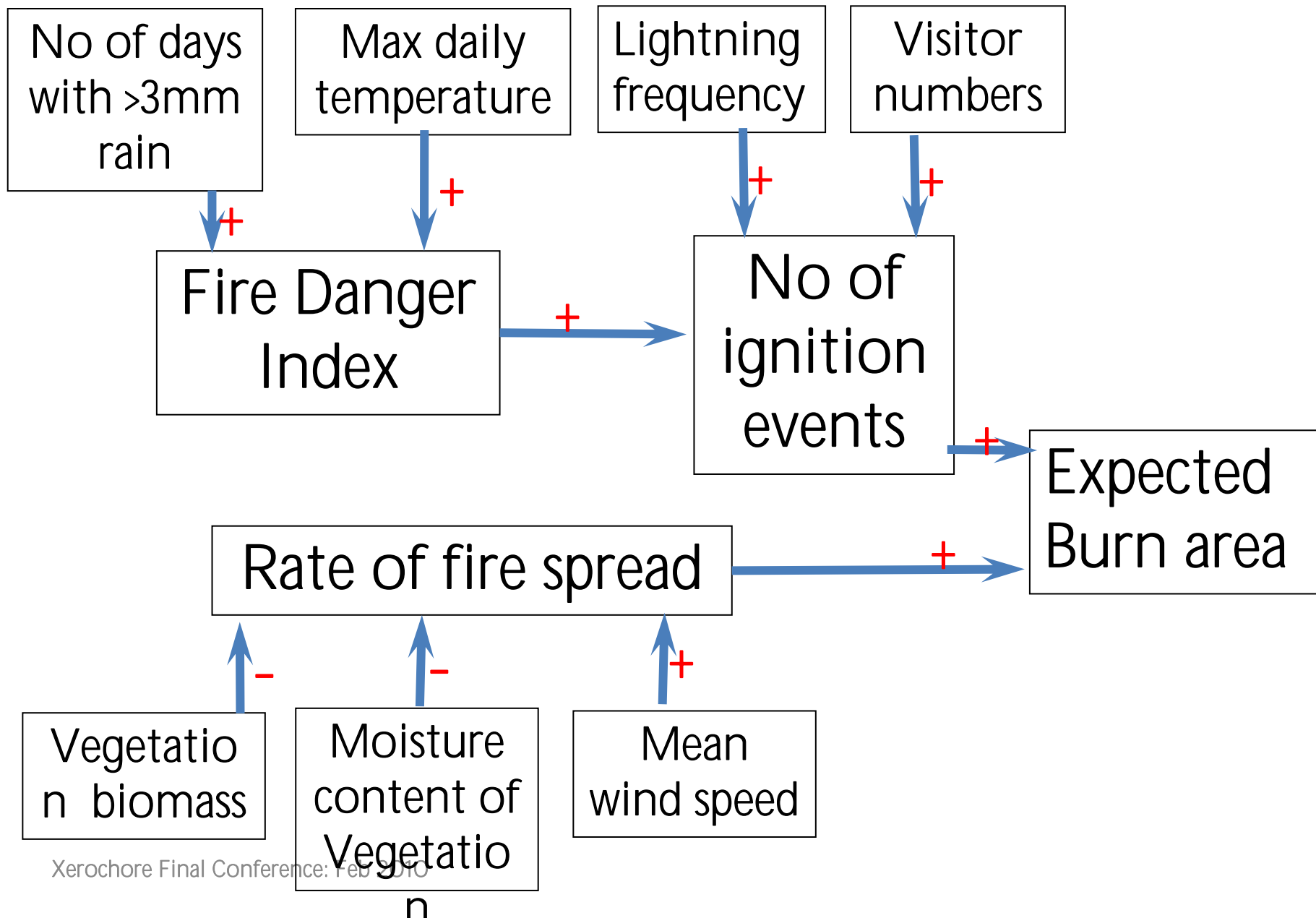


Based on CRU 10' gridded data for Europe, 1901-2000

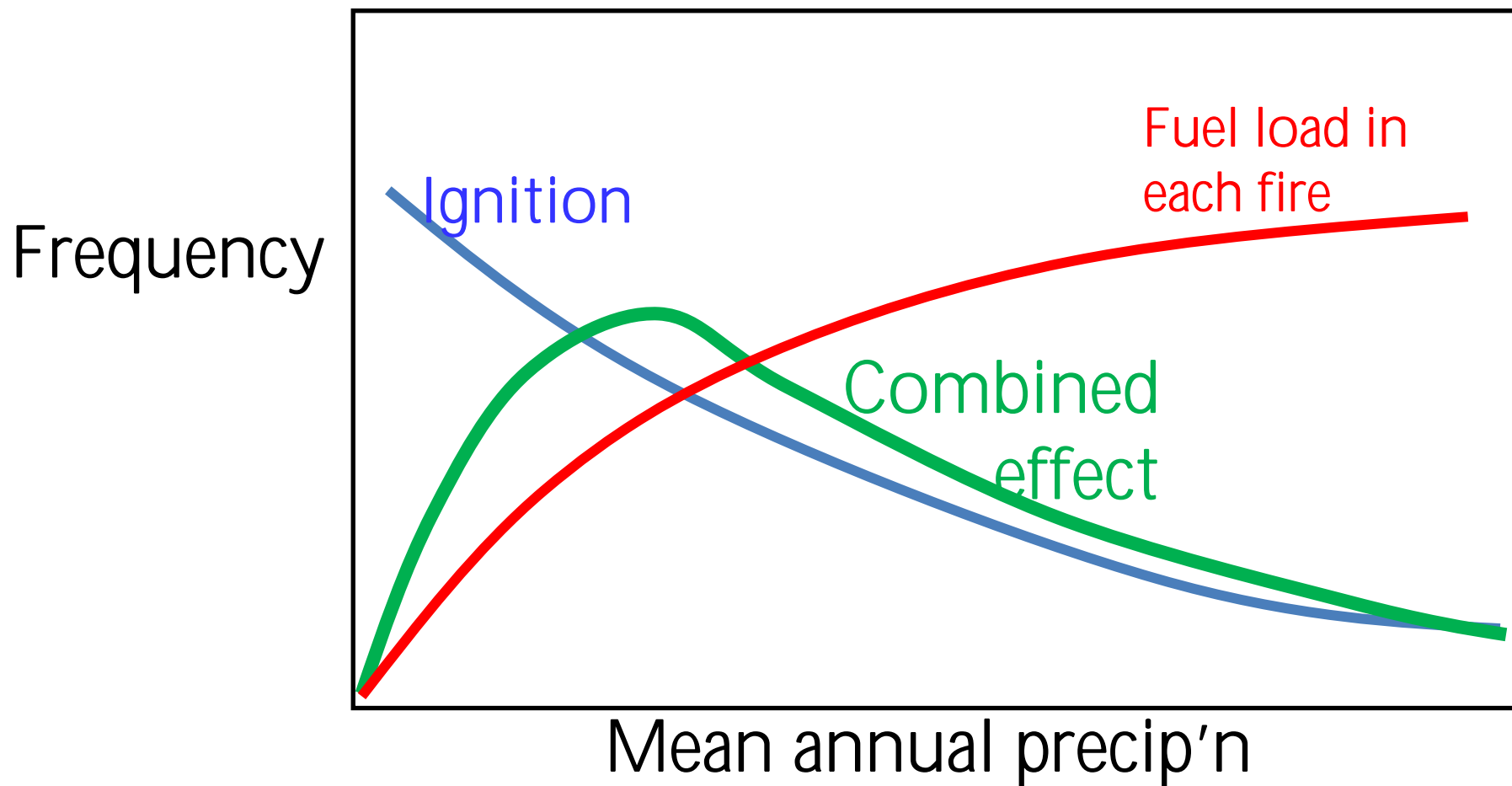
Modelling Wind Disturbance at the soil surface



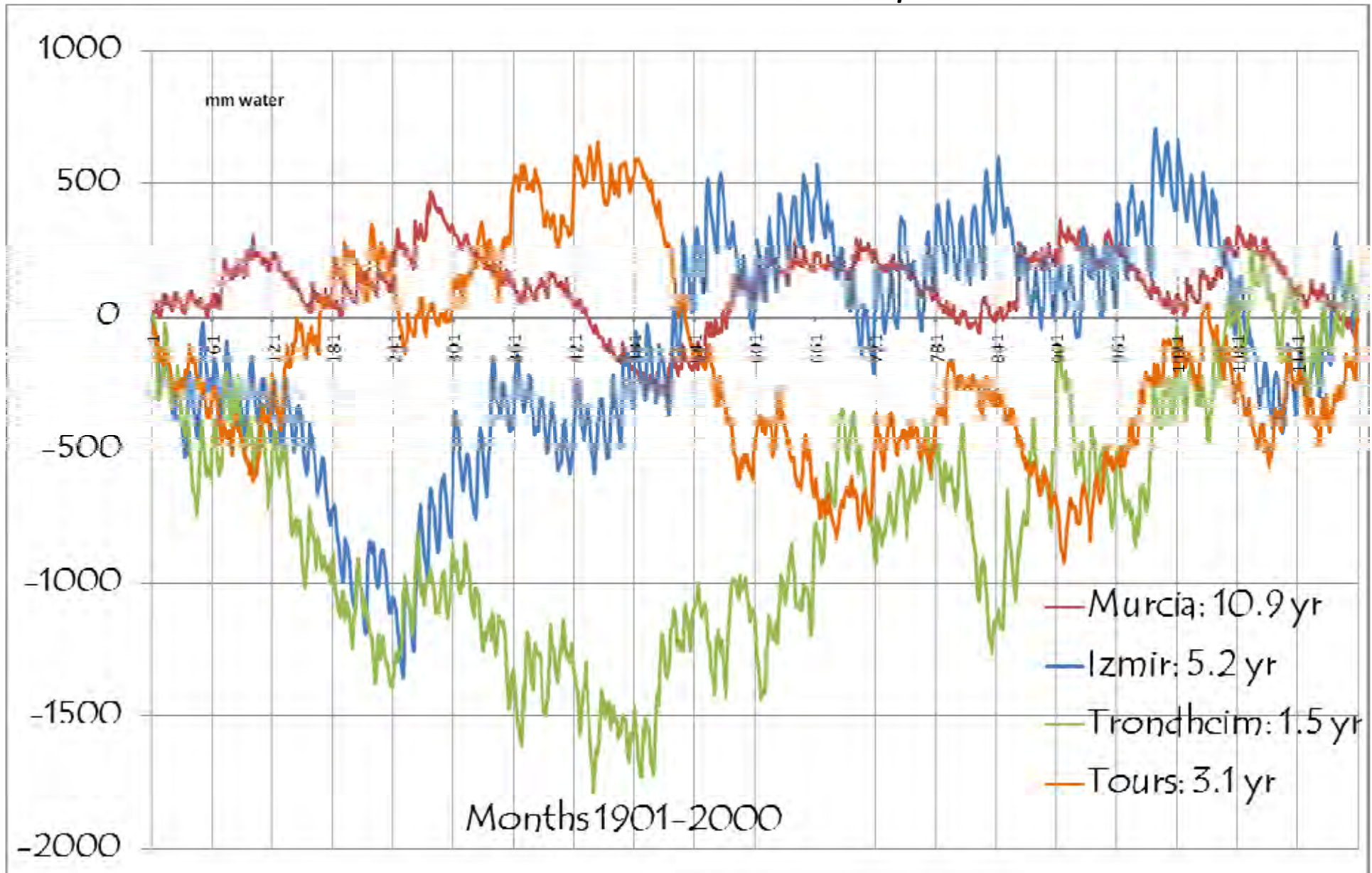
Modelling wildfires in each month



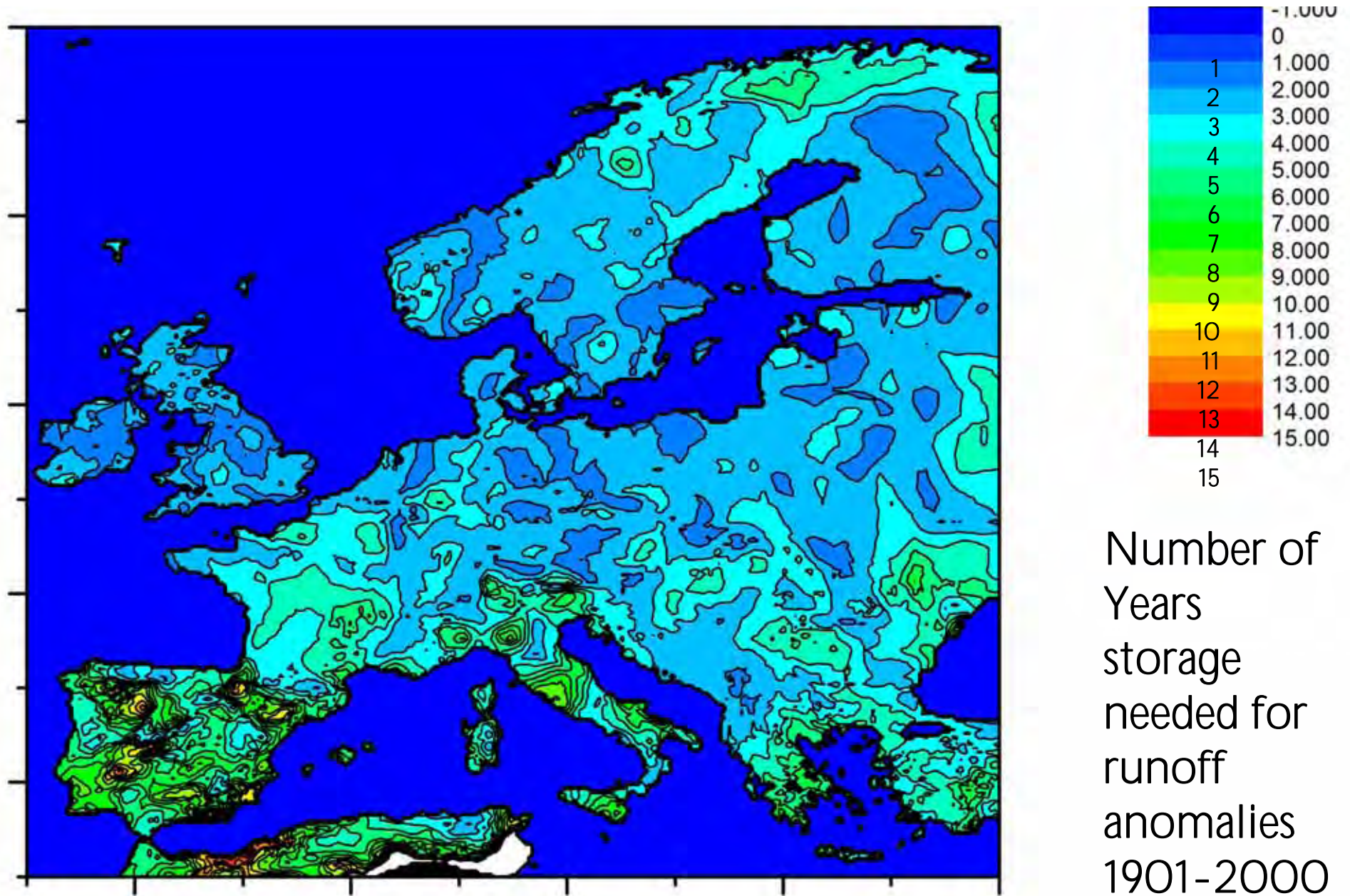
Wildfire burns and climate



Cumulative runoff anomalies, 1901-2000

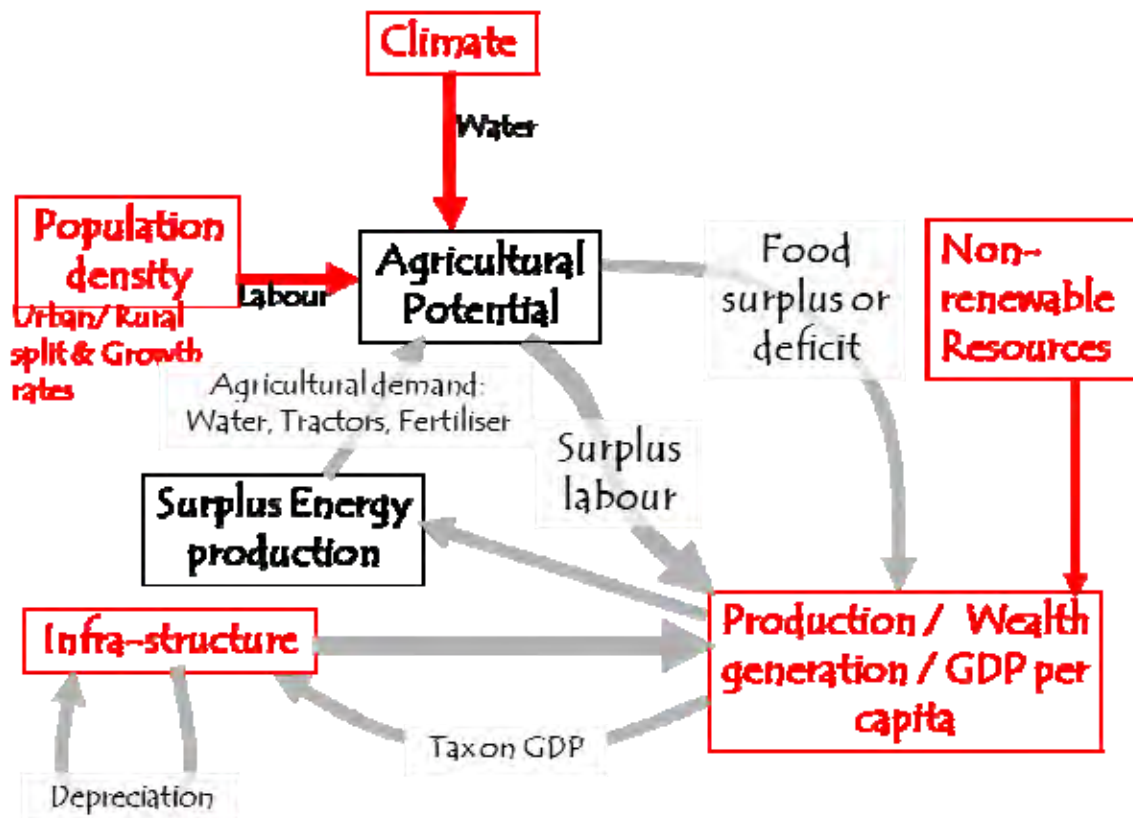


Runoff = Precip - Act ET: Time is number of years storage required to buffer observed range



Based on CRU 10' gridded data for Europe, 1901-2000



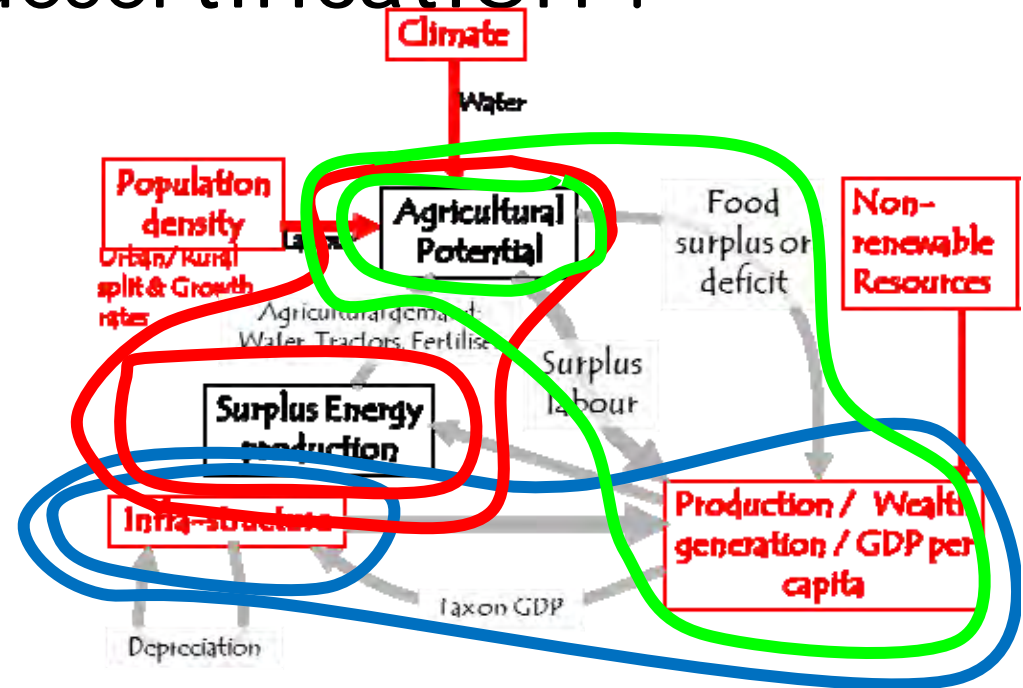


- Ideally a benign positive feedback, leading to exponential growth of GDP
- Small labour surplus supports trade, wealth supports more productive farming and so on.
- Kick-started by resource wealth or a coastal location
- Hindered by low rainfall and population, or a land-locked location

- Once started, feedback may be cut in various ways, e.g.
- Conflicts that destroy production and absorb person power.
- Diversion of GDP from useful infrastructure (the Pyramids or Foreign debt)
- Over-dependence on rigid technical infrastructure (irrigation and salinity; US auto industry) without alternative investment
- External exploitation without local investment

Mitigating desertification ?

- Physical remedies that increase productivity
 - Terracing, mulching, inter-cropping....
- Investment in infrastructure
 - Roads, wells, machinery, healthcare, education
 - Supporting trade & improving agriculture
- Providing (cheap & renewable) energy
 - Increasing productivity and releasing labour
- Others, e.g.
 - Migration, Exploit resources



Possible responses to external drivers

