Spanish Climate Conditions Considering in Biosphere Modelling
(Soil-Plant system at regional scale)

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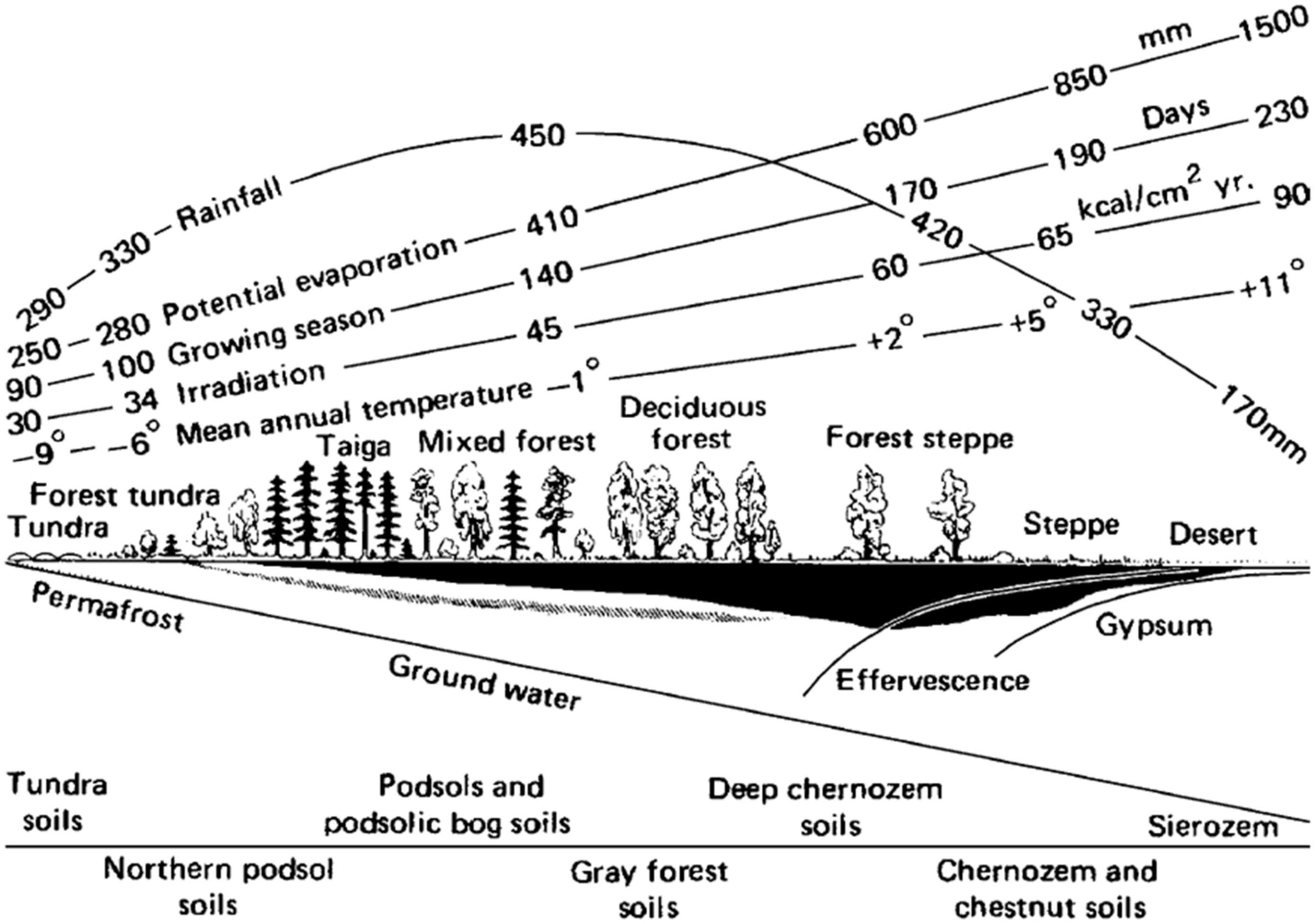
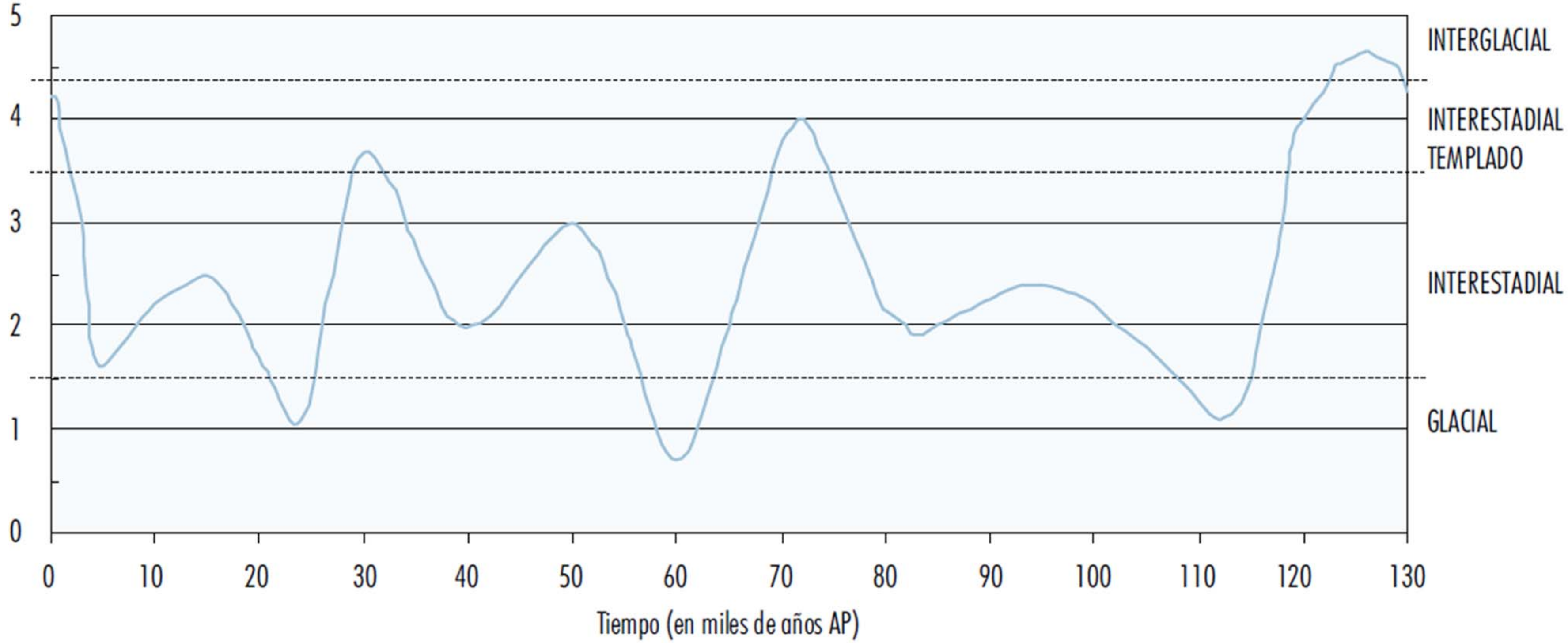
European Climate Variation (Walter at al. 1984)



Climate Sequence variation in Spain for next 130000 years



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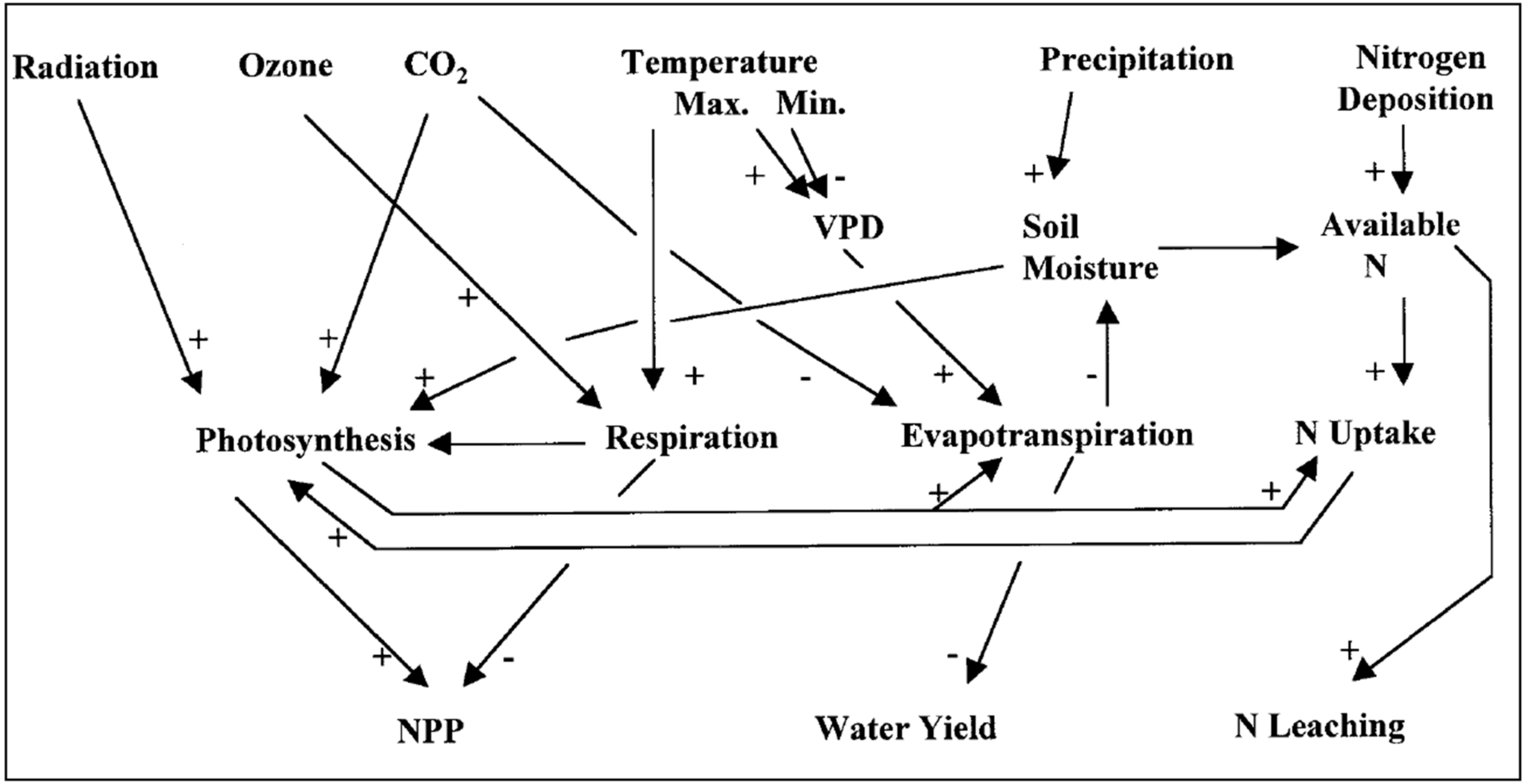
Environmental change related with soil plant system



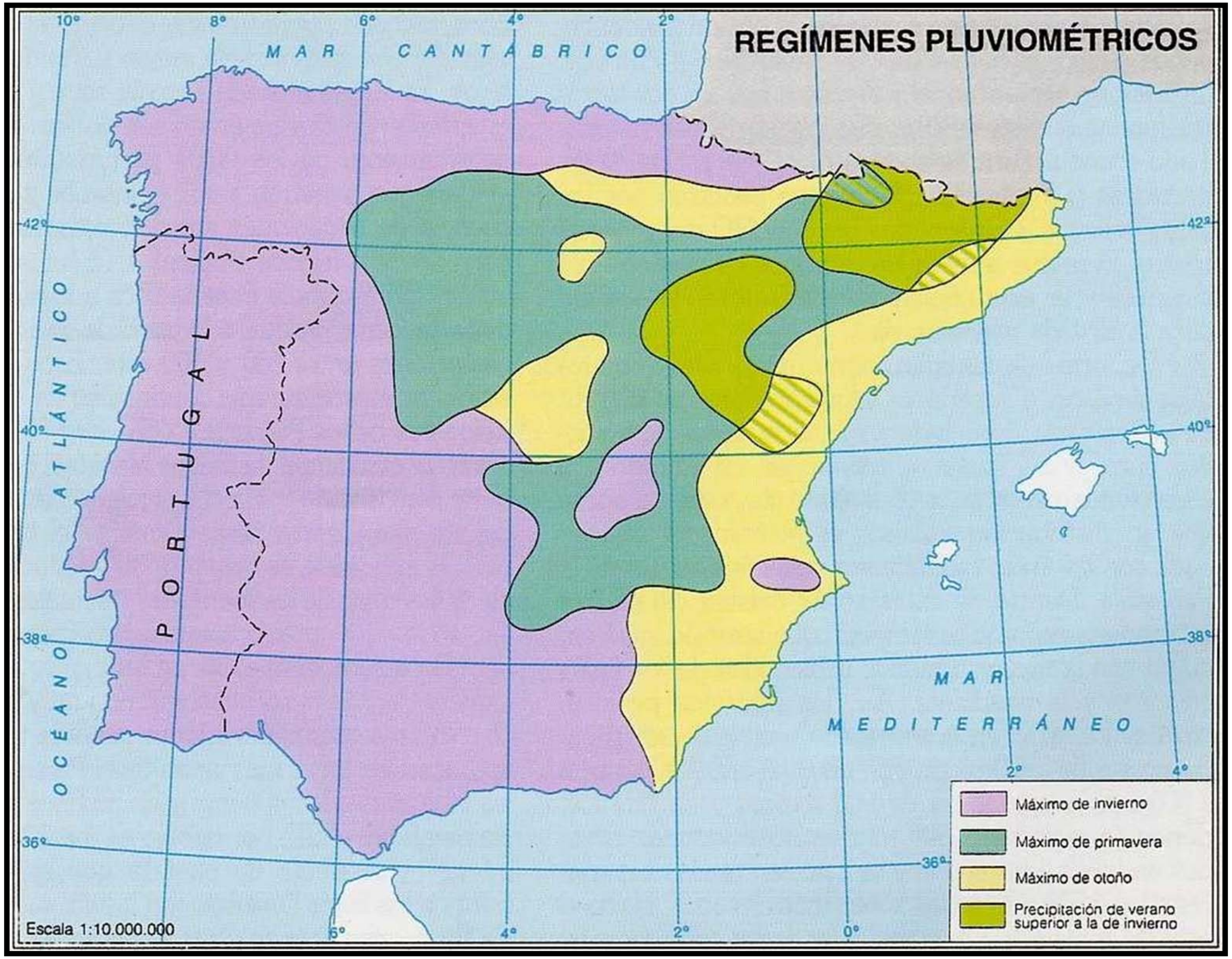
Interactions among environmental factors that are subject to change through human activities

Characteristics of Precipitation Regime

The management of the water resources in Spain has to adjust to a scarce precipitation for the most part of the territory, and several singular characteristics, most of then negatives in temporal spatial contributions.

-Modest Rainfall
-variability and disparity in rainfall
-Daily rainfall irregularities (excessive weight of a few very wet days)
-High daily and hourly rainfall intensity (rain do not know rain)
-Long dry periods
-Unlike rainfall less negative potential evapotranspiration (problem of aridity)
-Diversity of seasonal precipitation patterns (lack of a rainy and dry seasons overall)
-Seasonal distribution of precipitation
-Rainfall anomalies of different signs in Spanish regions
-Spanish rainfall complex map (exisiting numerous islets and rain shadow rain

Precipitation Regime at Iberian Peninsula



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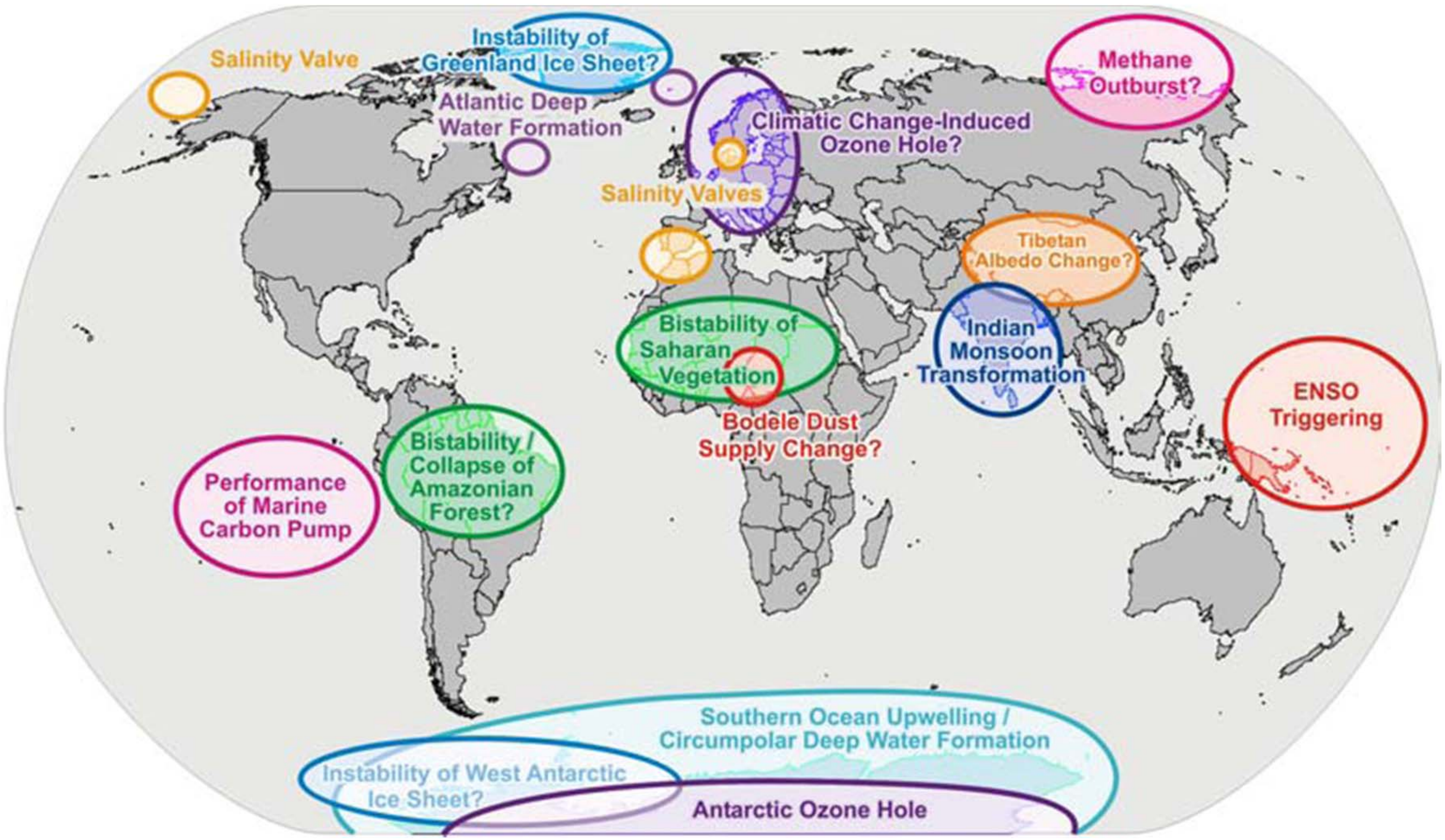
Abrupts Change



Radiological implications of temperature and precipitation changes

The potential radiological implications of changes to seasonal patterns of temperature and precipitation on a regional scale are various.

Warmer climate regimes may provide for a greater diversity of agricultural practice, as well as influencing human diet and behaviour (ex. Changes in water consumption).

Colder climate regimes will tend to restrict the range of possible agricultural practices to crops tolerant of a shorter growing season, with increased emphasis (in communities dependent on local resources) on bringing animals inside during the winter, greenhouse cultivation and reliance on food products from natural and semi-natural ecosystems. There may also be increased seasonal differences in surface hydrology (snow melt, ice dams etc.) and human behaviour (e.g. diet, time spent indoors or outdoors)

More arid climate regimes imply a greater soil moisture deficit and corresponding increased requirement for groundwater and surface water resources to be used in support of irrigation

More humid climate regimes may increase the availability of local water resources and rates of erosion, with the potential for increased dilution and dispersion of contamination

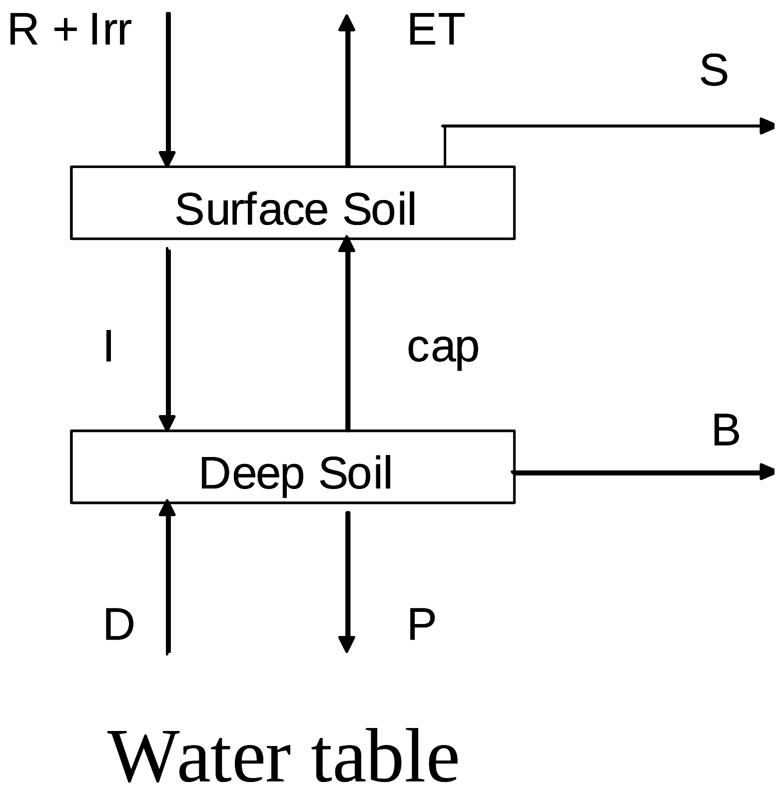
Biosphere Modelling Climate Parameters

✓Time series of potential evapotranspiration;
✓Time series of precipitation;
✓Depth to the field drains and their location;
✓Depth to the water table;
✓Saturated hydraulic conductivity for each layer;
✓Saturated and residual water content for each layer

Consider also that Climate defines productivity and distribution of the vegetation

✓Temperature is influencing the vegetation (e.g. minimum winter temperatures constrain broad-leaved deciduous trees from invading and excluding higher latitude boreal evergreen conifers at their mutual border)
✓Soil moisture is influencing the vegetation (e.g. determines whether forest or steppe occupies a region)
✓Seasonal availability influences the vegetation (e.g. determines whether forests are dominated by needle-leaved evergreens or by broad-leaved deciduous trees)

Compartments and water flows in the soil system



The modelling approach adopted for estimating transfer rates of radionuclides in the soil system has been based on the soil water balance.

In Figure the water flows are rainfall plus irrigation (R+Irr), evapotranspiration (ET), throughflow and interflow losses from surface soil (S), Infiltration (I), capillary rise (cap), baseflow from subsoil (B), discharge from deep soil (D), and recharge to deep soil or percolation (P). In the long-term, this system needs to balance, so:

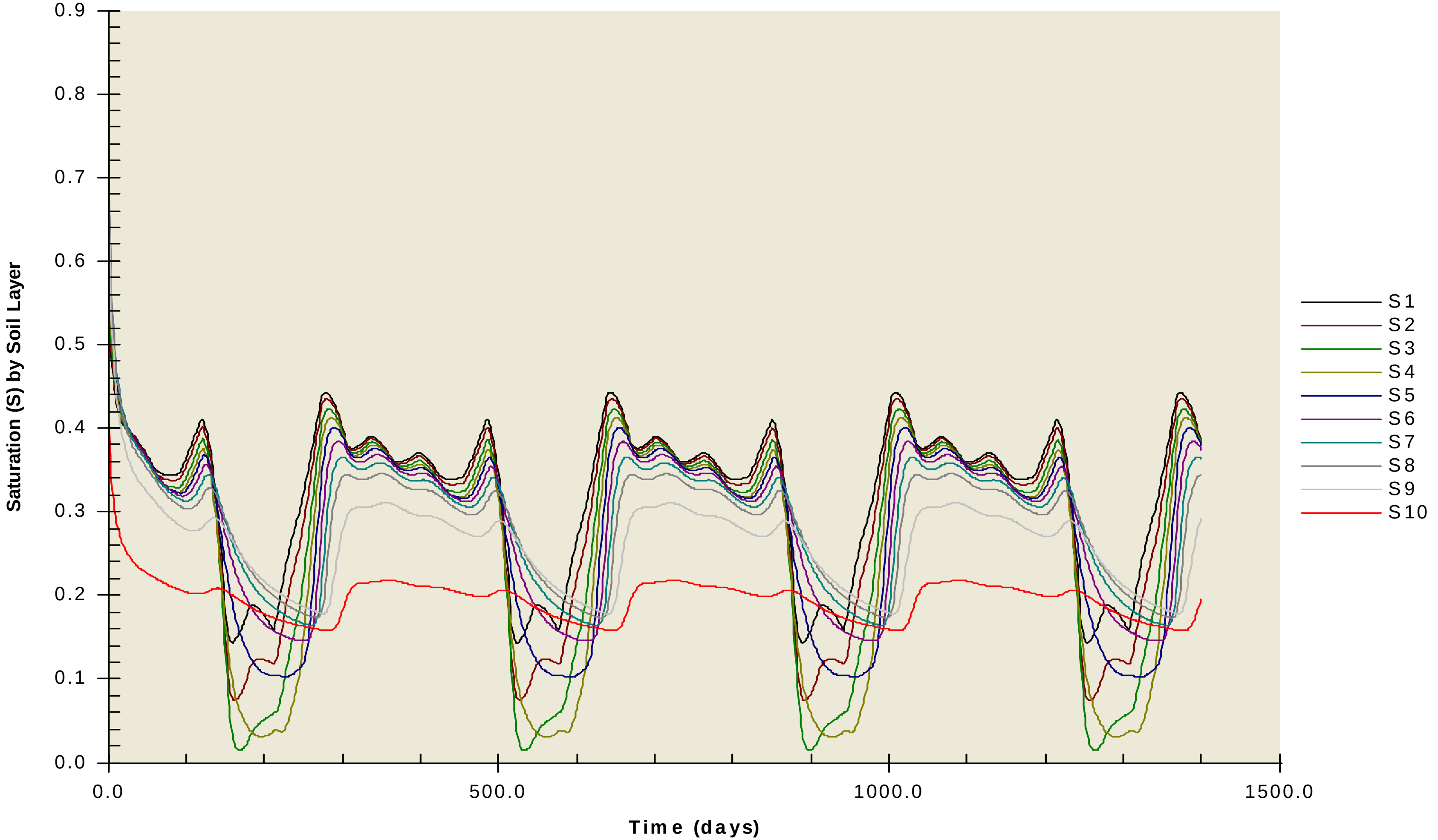
R + Irr + cap = ET + I + S

I + D = cap + P + B

Biosphere Modelling, Climate Parameter

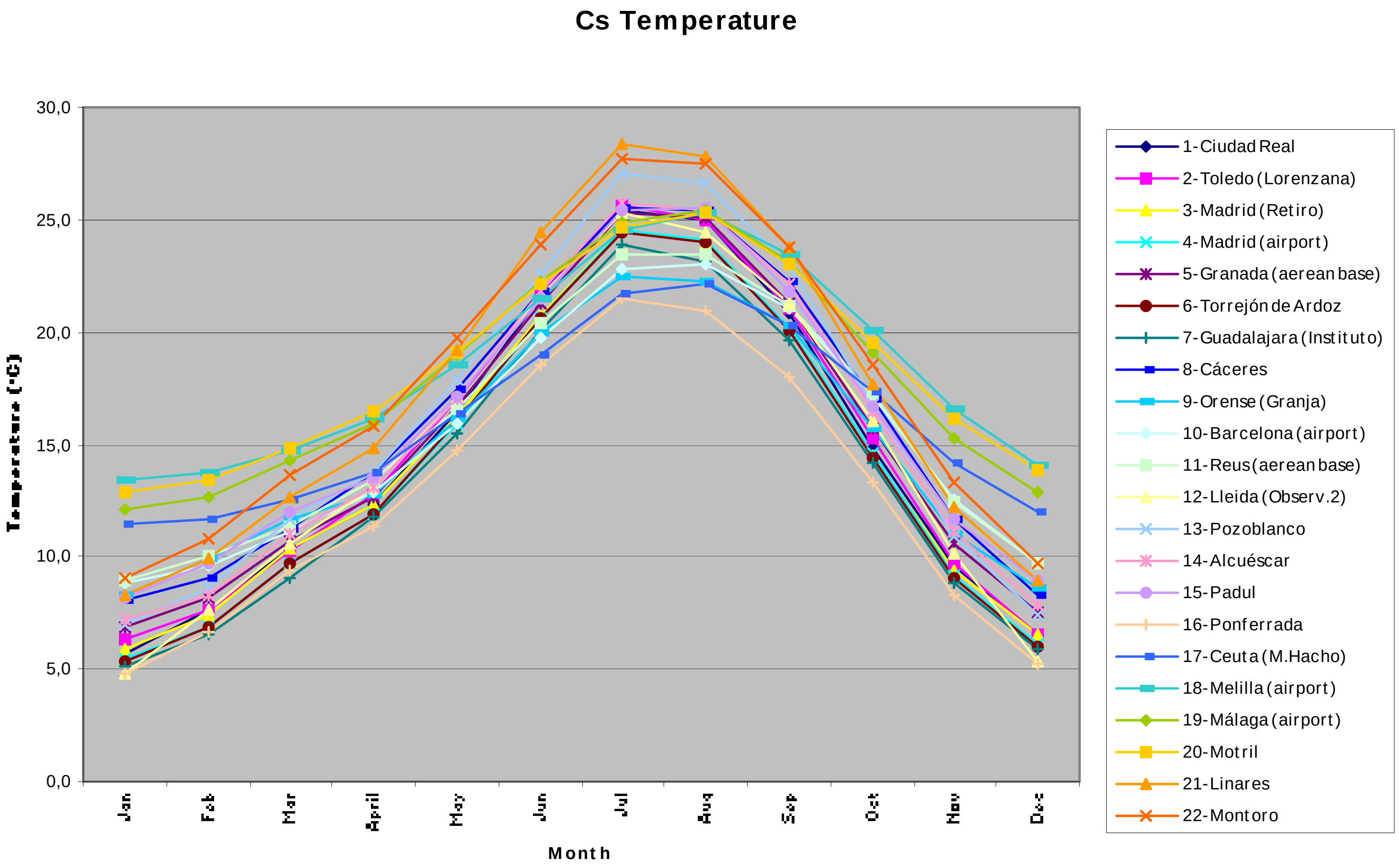
Month	Duration (d)	Period in Year (d)	Precipitation (mm)	Precipitation rate (mm d^{-1})	Potential Evapotranspiration (mm)	Potential Evapotranspiration Rate (mm d^{-1})
January	31	1-31	20.2	0.652	11.206	0.361
February	28	32-59	31.8	1.136	18.356	0.656
March	31	60-90	25.7	0.829	34.459	1.112
April	30	91-120	33.1	1.103	39.223	1.307
May	31	121-151	84.6	2.729	68.603	2.213
June	30	152-181	9.8	0.326	190.172	6.339
July	31	182-212	38.4	1.239	194.717	6.281
August	31	213-243	10.1	0.326	50.356	1.624
September	30	244-273	71.3	2.377	149.177	4.973
October	31	274-304	121.8	3.929	48.293	1.558
November	30	305-334	26.9	0.897	19.913	0.664
December	31	335-365	39.8	1.284	10.821	0.349

Hydrological Water Balance in Soil



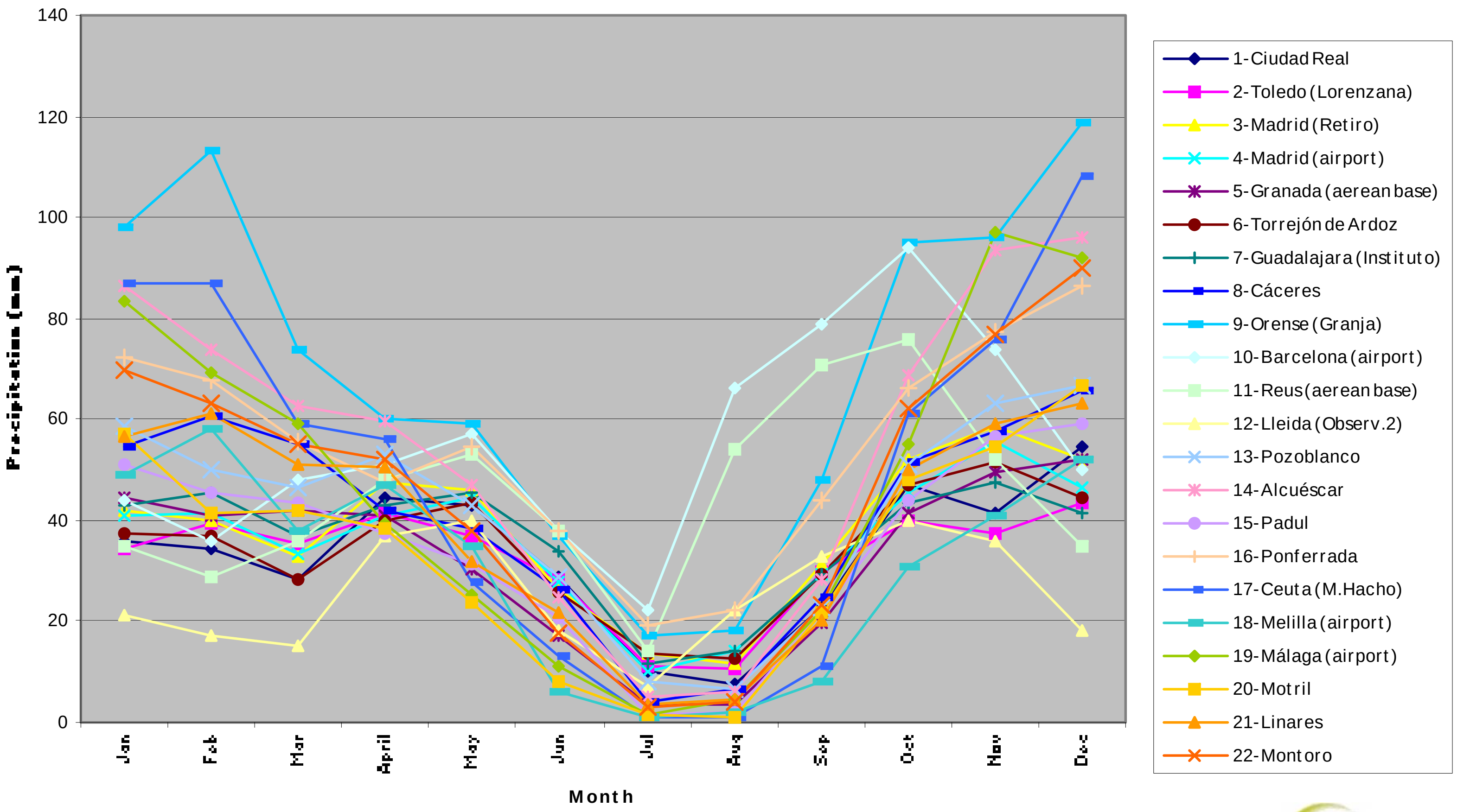
Meteorological data information available

Mean monthly temperatures of Cs type Spanish meteorological stations



Use meteorological data information available

Mean monthly precipitations of Cs type Spanish stations.



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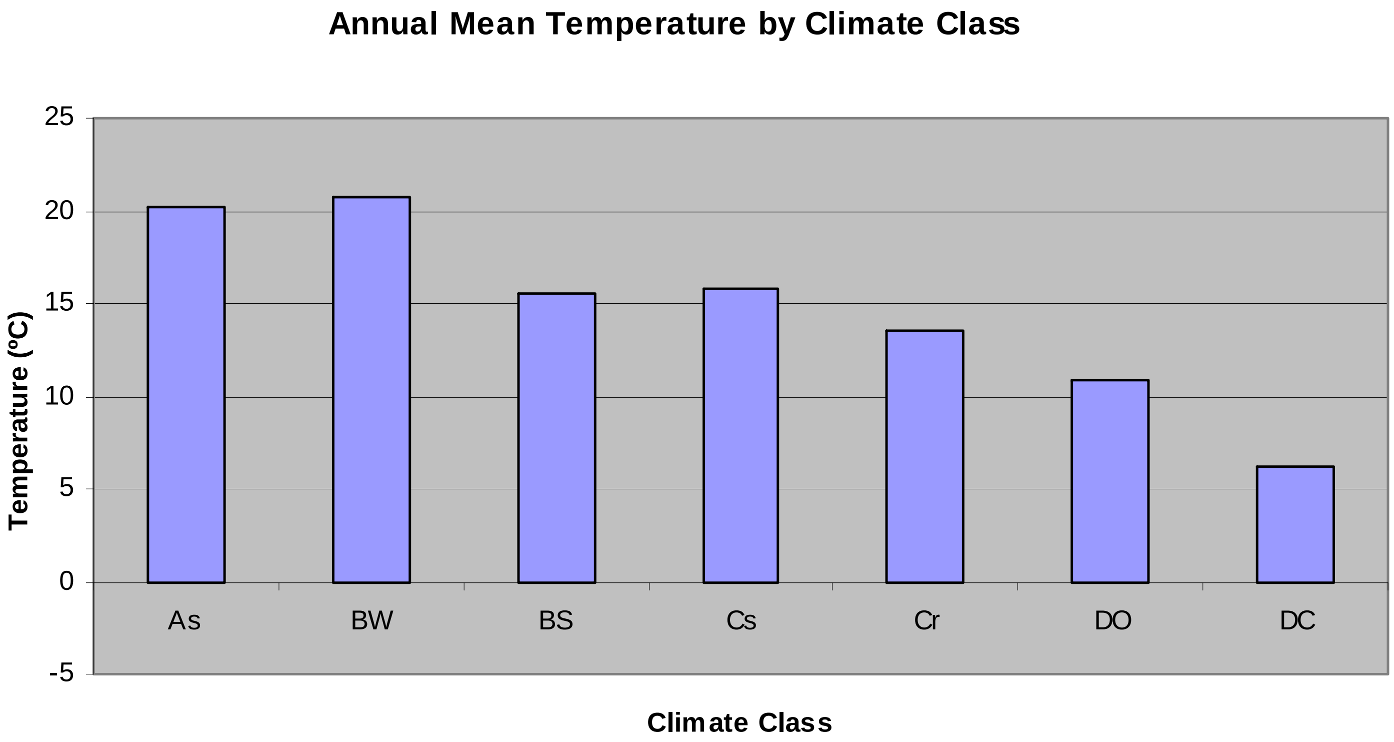
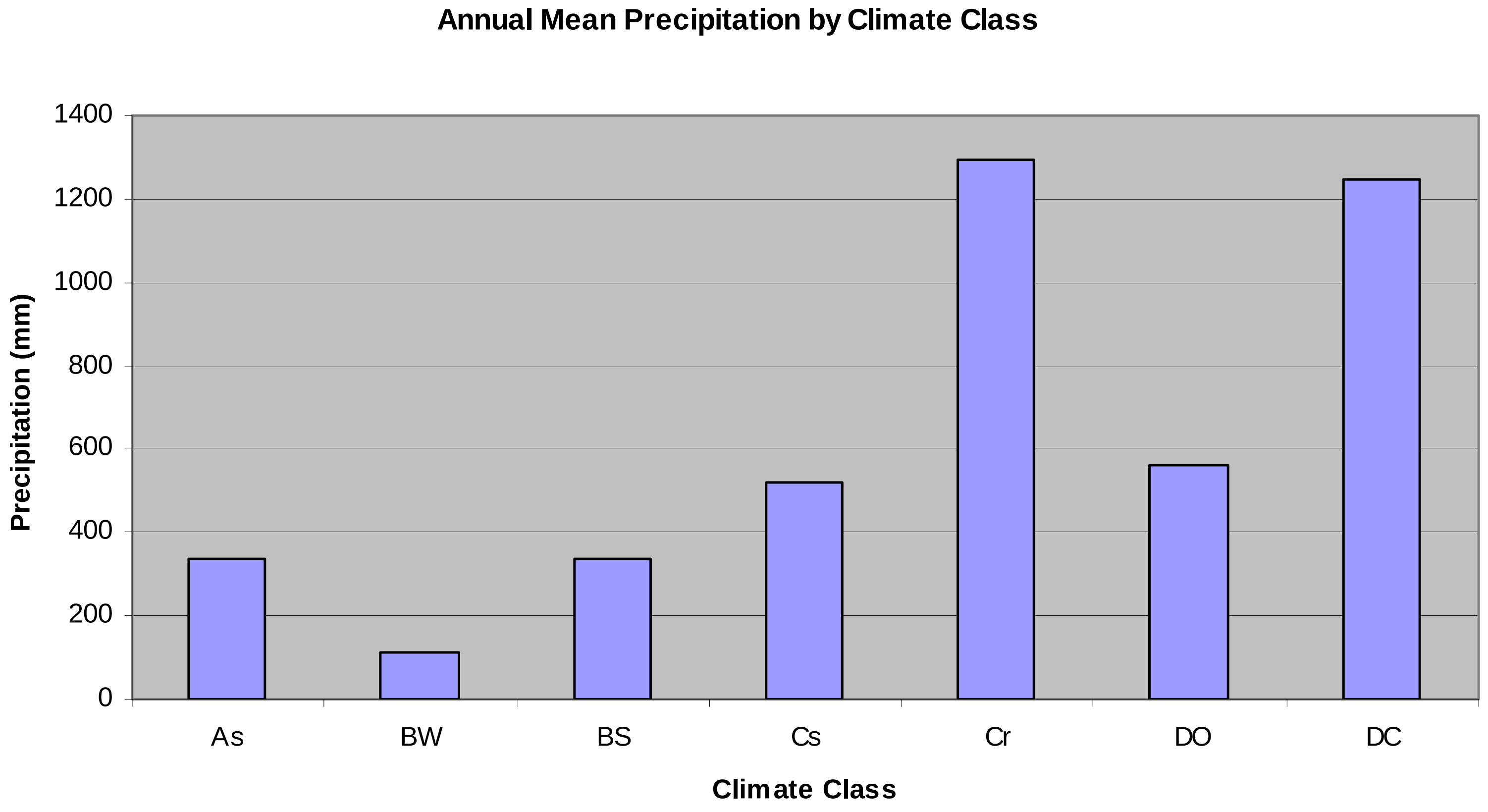
Temperature of Spanish stations by climate class

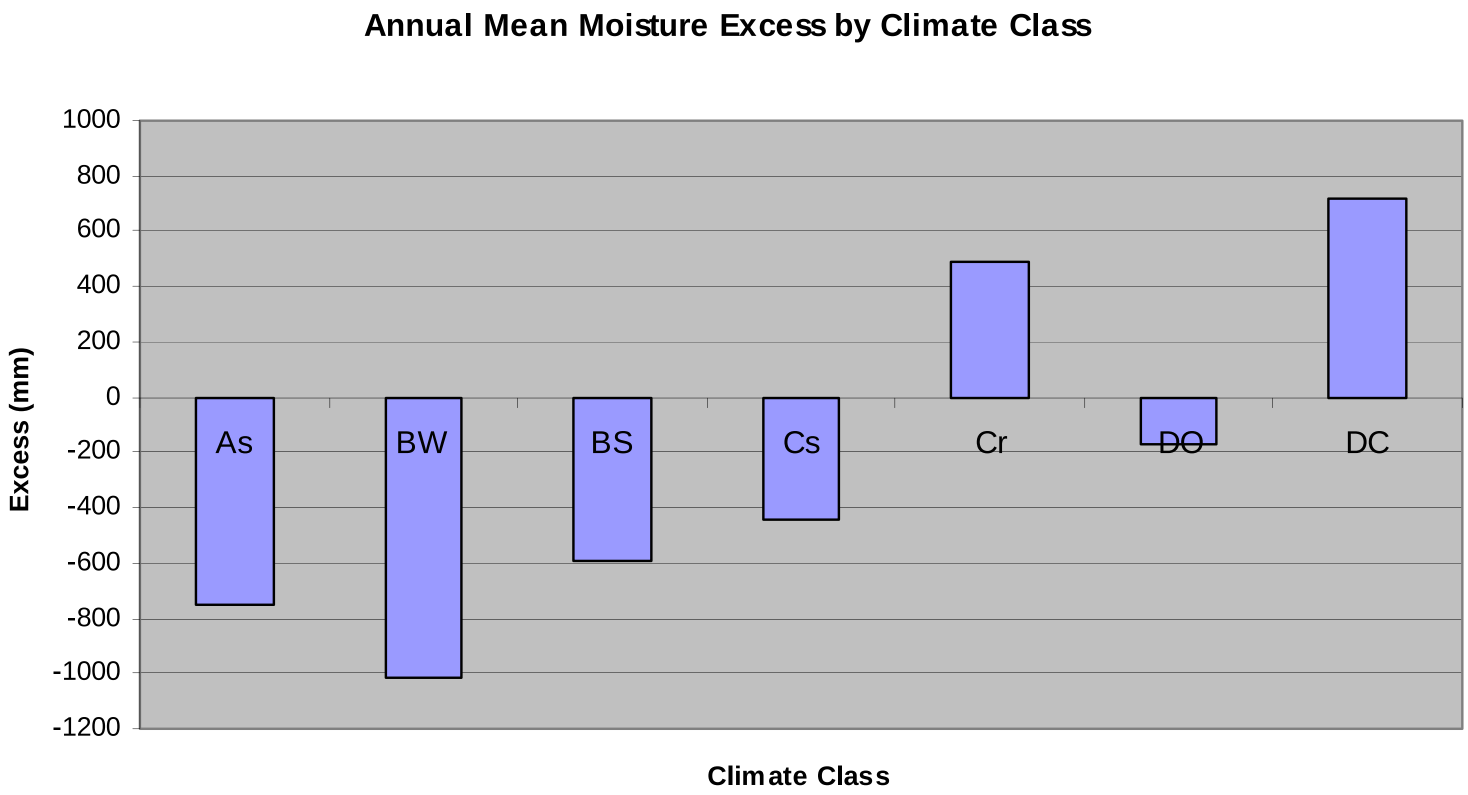
BIOCLIM was analysed and climatically classified a series of meteorological stations. These stations were classified according to the climate class of (Rudloff) and according to the Thermal Universal Scale.



Precipitation of Spanish stations by climate class.



Moisture Deficit or Excess by Climate Class.



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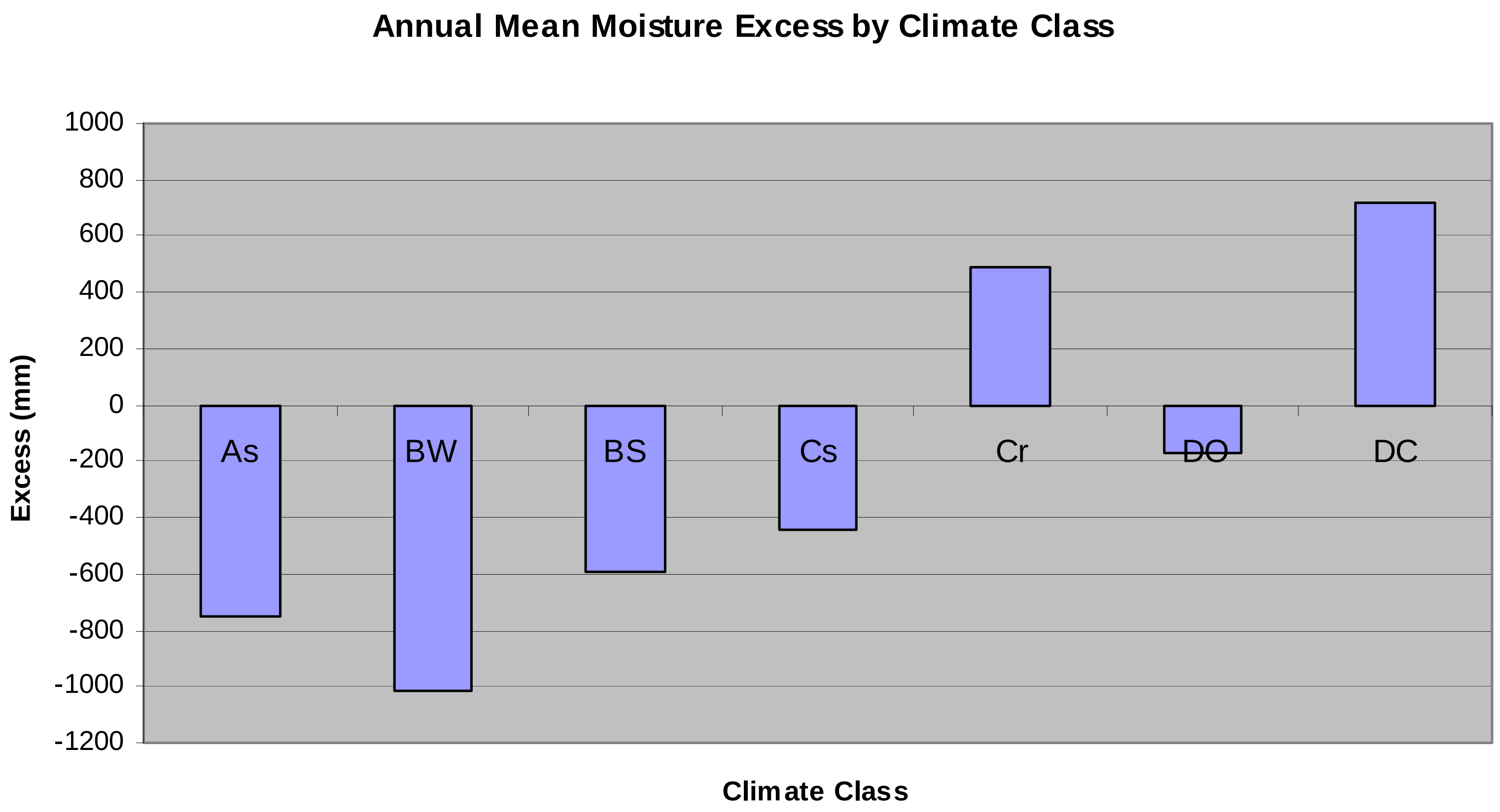

Climate change influence in Vegetation

Climate change and associated changes in vegetation are closely coupled to soil development.

Vegetation colonization of a regolith leads to the early stages of soil development, which in turn provides a changing substrate on which vegetation succession occurs.

Climate-dependent considerations include influences on rates of decay and decomposition of organic matter. For example, in some cooler climate regimes, primary productivity may be relatively high, but decomposition rates may be restricted, leading to an accumulation of organic detritus.

Link Irrigation Model with Soil-Plant Model

In the FAO methodology, the irrigation amount should aim at replacing the daily crop evapotranspiration, *ETcrop*. The irrigation water need is determined as follows:

- Determine the reference crop evapotranspiration: *ETo*
- Determine the crop coefficients: *Kc*
- Calculate the crop water need:
- Determine the effective rainfall: *Pe*
- Calculate the *Irrigation Water* = *ETcrop* – *Pe*

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Mean crop coefficients and Crop water needs for the reference evapotranspiration ET0.

Identified Crop for each climate class

Crops considered	Crop types	K_c	ET_{crop} (my^{-1})
	Human consumption crops:		
Grain cereals	Wheat, barley, oats, rye, maize and rice	0.61	**0.440**
Root vegetables	Potatoes	0.85	**0.613**
Legumes	Green bean, dry bean, lentil, chick pea, dry pea	0.70	
Green Vegetables	Cabbage, asparagus, celery, lettuce, endive, spinach, beet, thistle	0.90	**0.649**
Fruit vegetables	Water melon, melon, tomato, cucumber, aubergine, pepper, strawberry, artichoke, cauliflower, green beans, pea and beans	0.76	
Citric fruits	Orange, mandarin and lemon	0.68	
Non-citric fruits	Apple, pear, apricot, cherry, peach, plum, almond and three hazel varieties	0.70	**0.497**
	Animal consumption crops		
Fodder crops:	Cereal, maize, alfalfa, grassland	0.70	**0.505**

Conclusions

- Identified meteorological data series for different climate class in Spain for Hydrological balance regime.

- Identified the types of soils and characteristics (ph, density, OM, etc.)

- Identified of type of crop production to each climate class and crop data information (crop coefficient, TF, root density and depth, biomass) need for the model.

- Link a Irrigation model at Spanish Climate conditions with soil to plant model