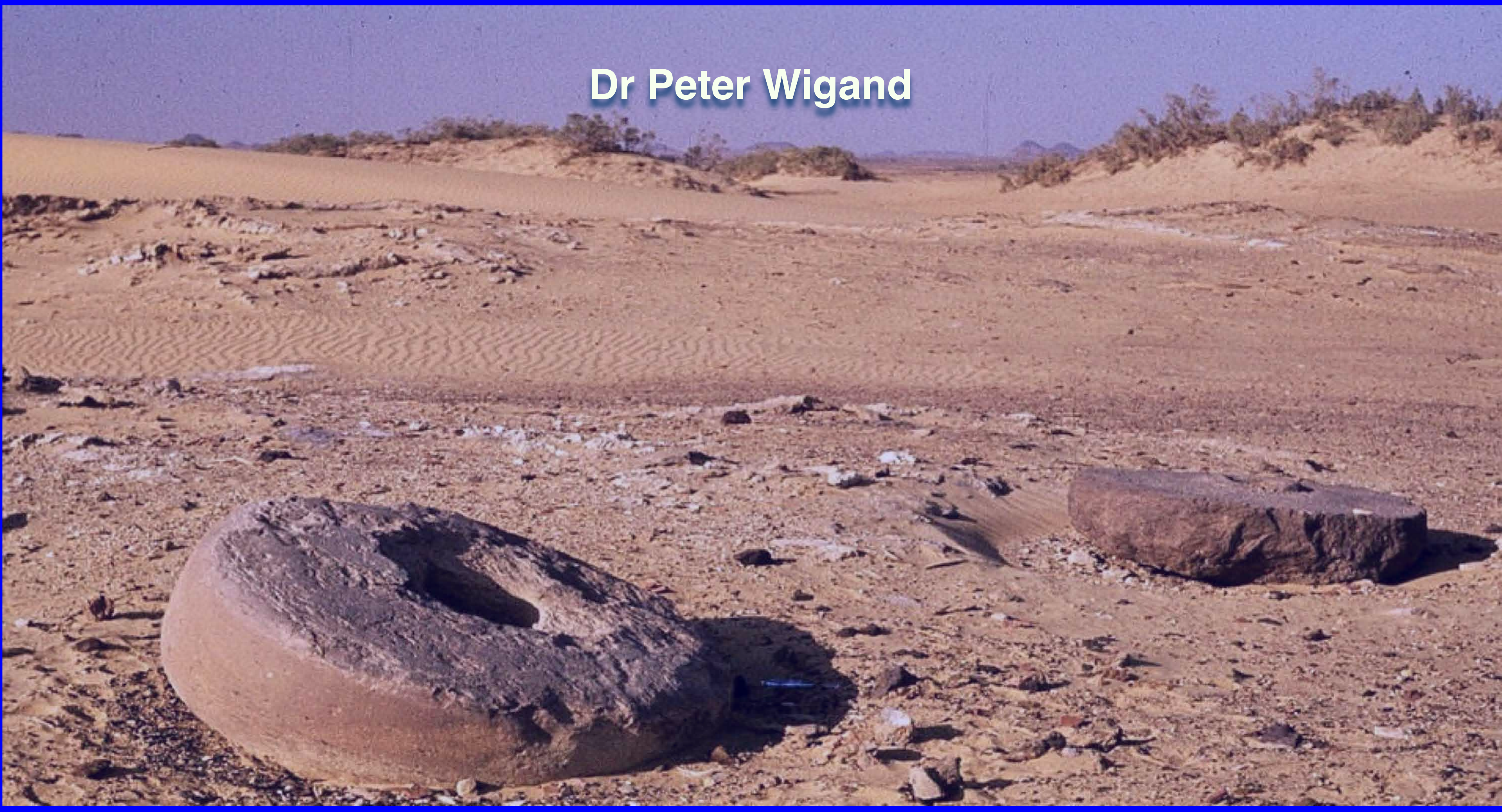
Holocene Landscape Dynamics in the Southern Italian Interior: Analogues for Modelling Future Trends Under Global Warming, & Implementing Mitigation & Restoration -

Sustainable Ecosystems/Carbon Sequestration/Food

Can we act fast enough to save the planet and humanity?

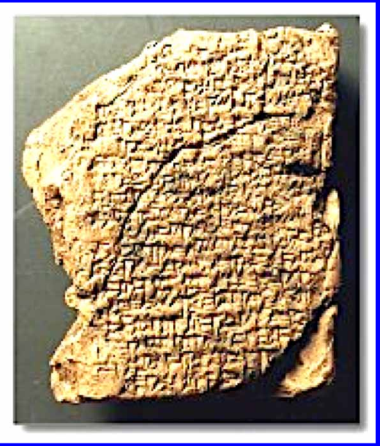


Dr Peter Wigand

Climate Change, a HOAX?

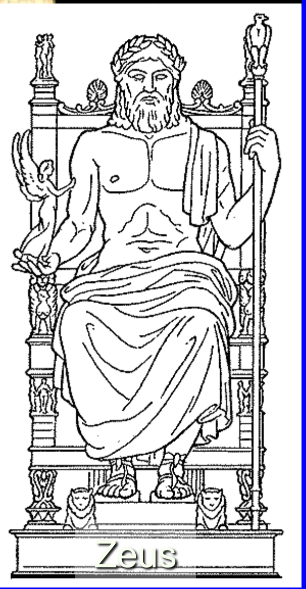
Pre-Modern Climate Explanations

- Supernatural
  - Ancient gods - seen as source and controllers of weather - a way to punish and reward people
    - Egypt - Amun Ra - dung beetle rolling the sun across the sky
    - Middle East - Gilgamesh Epic – Utnapishtim's tale = the flood of Noah
    - Greek and Roman mythology is full of gods that control the weather and use it to reward and punish people
      - » Zeus (Jupiter) storm and thunder
      - » Helios rode a fiery chariot across the sky and caused droughts when he got too close to the earth
    - Norse Mythology
      - » Thor the god of thunder (hammer)
      - » Balder the sun god
      - » Frost giants -cold and evil
    - Middle America
      - » Tlaloc the rain god



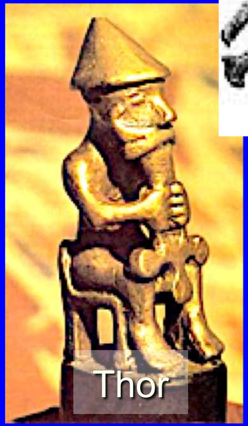
The Epic tale of Gilgamesh (tablet above) is an ancient poem written in Mesopotamia more than four thousand years ago.

Amun Ra



Zeus

Helios



Thor

Balder

Tlaloc

Pre-Modern Climate Explanations

- Aristotle - volcanos
  - Fires inside the earth (volanos) caused climates to warm or cool by giving off heat (today we know that volcanic ash changes the climate)
- Meteorology, Aristotle (Written 350 B.C.E) Book I, Part 14 - global climate system
  - *The same parts of the earth are not always moist or dry, but they change according as rivers come into existence and dry up. And so the relation of land to sea changes too and a place does not always remain land or sea throughout all time, but where there was dry land there comes to be sea, and where there is now sea, there one day comes to be dry land. But we must suppose these changes to follow some order and cycle....Here the causes are cold and heat, which increase and diminish on account of the sun and its course.*

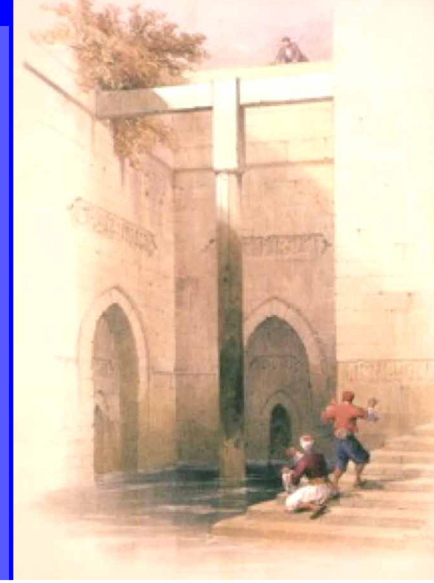
Recognition of environmental change by agricultural peoples

- Importance of floods to human populations
  - Hydraulic Civilizations Karl Wittfogel
    - Early agriculture (fertile crescent and adjacent areas)
      - Anatolian Peninsula (Catal Huyuk) and Iranian plateau rainfall agriculture...alluvial fan agriculture
      - Jericho...irrigation tethered to a spring by 10 ka
      - Southeastern Jordanian movement from valley slope rainfall agriculture to valley bottom flood irrigation sites
      - Movement from Anatolian Plateau rainfall dependent irrigation to lower Tigris and Euphrates river flood irrigation
    - Egypt – Nile canal systems
    - Iran qanat systems >4200 years ago
    - Petra - rainfall collection and cistern storage irrigation
    - Yellow River China – flood irrigation
    - New World -
      - Rainfall and alluvial fan irrigation systems
      - Hohokam river flood and canal irrigation systems
  - Religion ----> Catastrophism
  - Greek travelers and scientists (Herodotus, Aristotle)

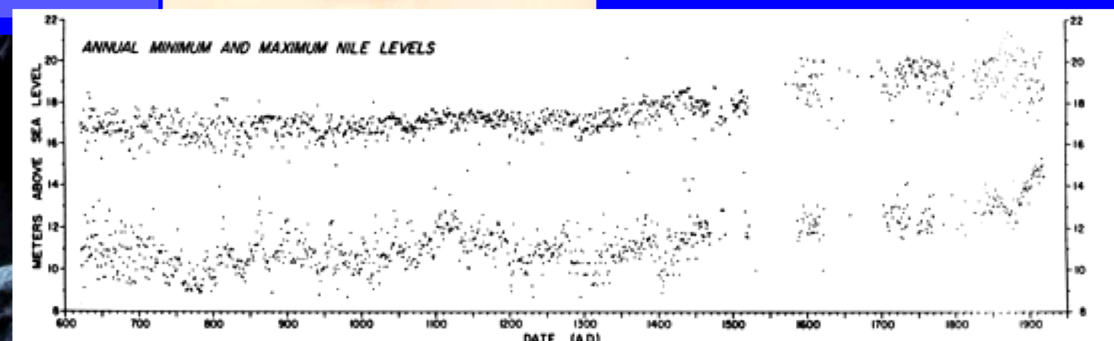
Nile River, NE Africa

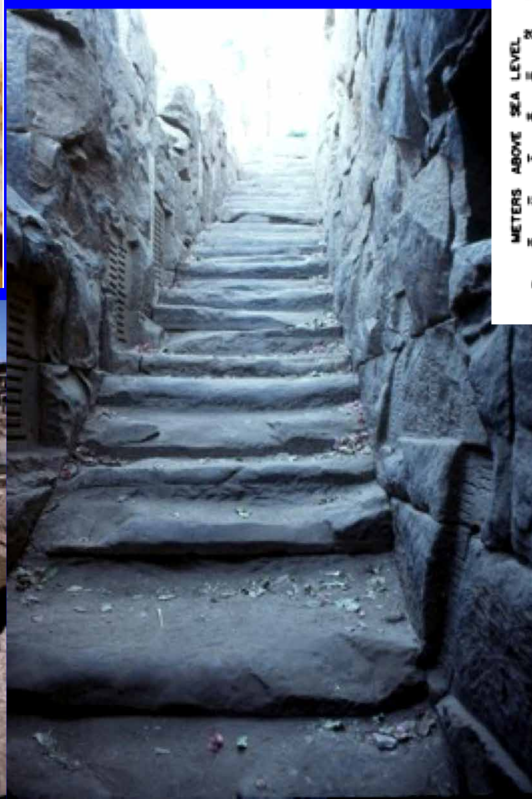
Nilometers, such as the ones at Aswan and Cairo, were used to track the magnitude and progress of the annual Nile floods. Information garnered from the Nilometers were used to assess the flood, and then even to predict crop yields and potential tax assessments. Elaborate procedures and engineering were used to take advantage of the annual floods.

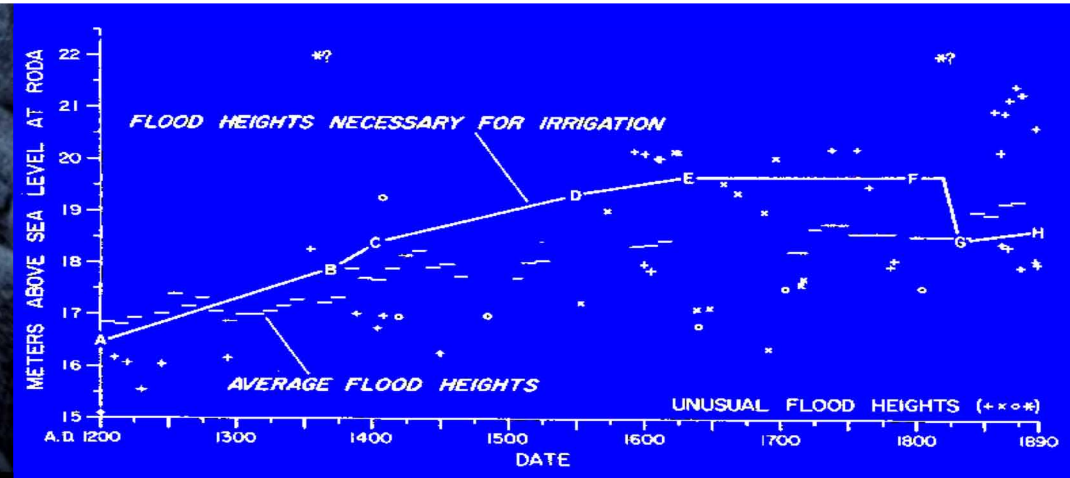
The Nilometer at Rhoda in Cairo



Nile River levels recorded at the Island of Rhoda since the Muslim Conquest (A.D. 641)







Let us look at an area you are familiar with. Global Warming in the Mezzogiorno of southern Italy, a land on the verge of disaster:
Using evidence of past and modern climate change from Geomorphic and Archaeological studies as tools to mitigate its Impacts

Study Area: Regional Geology & Early Imperial Setting

The Basilicata and Puglia region is part of the Bradanic Foredeep, an area that was a shallow sea until the early Pleistocene or later. Geologically the region is marine marls overlain by Pleistocene coastal sands and conglomerates. Subsequent regional tectonics lifted the NW by 300 to 500 m, but plunges in the SE beneath the Gulf of Taranto at Metaponto. This area lay on the boundary between Italic and Messapian language speakers and Magna Graecia 2,000 B.P., and was the boundary between Byzantines and Lombardi 900 B.P. when Normans began their domination.

Study Area: Basentello/Bradano River Valley

The flat-lying country side of the Bradanic Foredeep is incised by small streams that have cut through the weakly cemented coastal sands and conglomerates and exposed the easily erodible marine marls. In this view to the northeast and east from Irsina, the 200 m fault scarp east of Spinazzolla is evident. The immediate plateau is about 300 m above sea level.

Proxy Data Collection for Study of Past Climate & Erosion History

- **Geomorphology**
  - Sedimentary Structures and Grain Size Analysis for Determining Stream Velocity
  - Landforms for Sequencing Erosion and Deposition Events
- **Soils**
  - Radiocarbon Ages on Soil Formation Episodes
  - Strength of Soil Development for Duration Soil Formation Events
- **Springs**
  - Radiocarbon Ages of Timing, Magnitude and Duration of Discharge Events
- **Vegetation**
  - Pollen of Local Vegetation to Document Changes in Community Structure

Sites

PRE-HOLOCENE

Spinazzola Quarry Exposure - 563 m

Brandano River Exposure – 259 to 276 m

Bosco Exposure - 439 m

Irsina Exposure - 539 m

San Felice Exposure 481 m

Castello de Monteserico Vista Exposure - 363 m

Vagnari 3 Exposure 336 m

HOLOCENE

Vagnari 1 & 2 Exposure 336 m

Arroyo Italiano 1 Exposure - 259 m

Arroyo Italiano 2 Exposure - 252 m

Baron Spring - 252 m

Sedimentary Units in the San Felice Area

The regional geology is summarized on the left. Plateau tops are characterized by lower Pleistocene coastal deposits overlying Lower Pleistocene & Pliocene marine deposits. Sediments in stream valleys are comprised of Middle Pleistocene through recent alluvium and slope colluvium. To the right is the base of an alluvial channel cut into the Pliocene marine marls and filled with carbonate cemented gravels. A second cut into this contains the last Interglacial rubified alluvium. The direction of this channel is at a right angle to the Holocene channel. Since the last Interglacial there has been about 80 m of regional uplift.

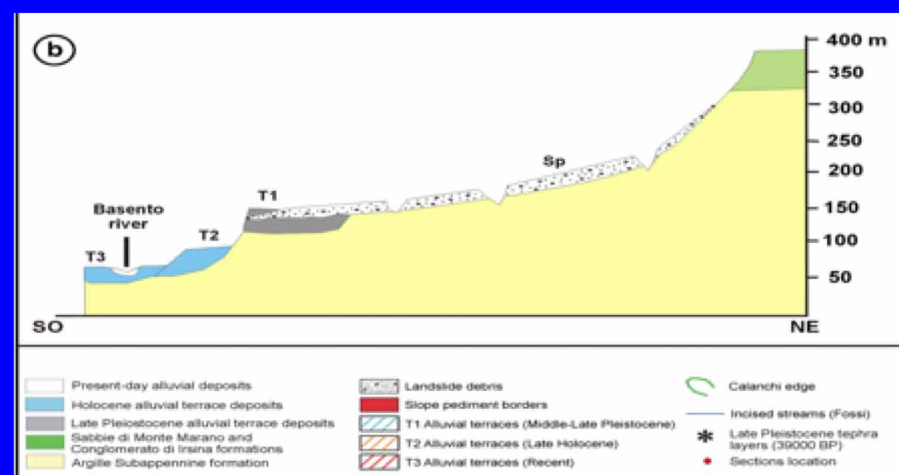


Diagram from F. Boenzi et al. / Geomorphology 102 (2008) 297–306 Fig. 2b. Schematic geomorphological profile (b).

Vagnari 1 & 2 Exposures

Vagnari 2

This exposure reveals >8,500 years of alluvium. Depositional units are evident as well as occasional weathering profiles related to soil formation. The shovel highlights a 2,100 cal. B.P. soil that can be traced regionally in all stream banks and archaeological sites in the area. At the base of the exposure is a gleyed unit containing snail shells indicating ponding in this stream more than 8,500 years ago.

Vagnari 1 ~1,400 years exposed with soil at the top

Cleaning & Sampling the Exposures

The cleaned exposure at Arroyo Italiano 1 reveals the two major Holocene soils. The upper at the top 1/3 of the meter stick is 2,100 cal yr B.P. and the lower soil (the dark unit in the lower 1/3 of the meter stick) is 8,400 cal yr B.P.

We have collected over 400 sediment samples to be used for grain size and other analysis. We are also interested in lead content of the sediment as an indicator of when people in this region began to fabricate lead artifacts.

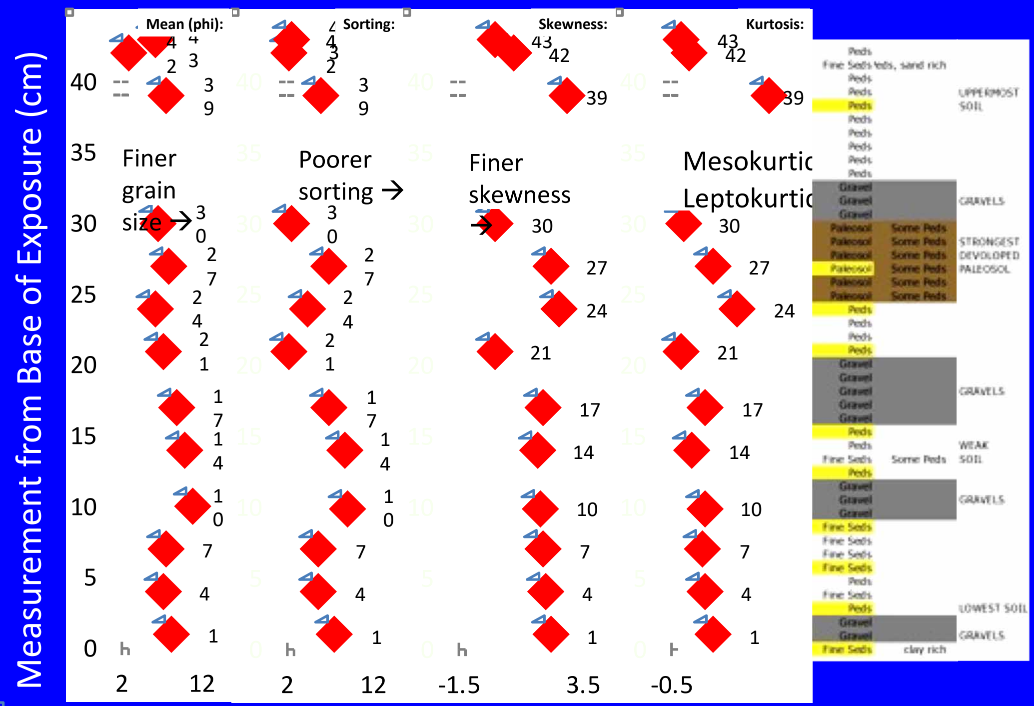
Arroyo Italiano 1 Stratigraphy

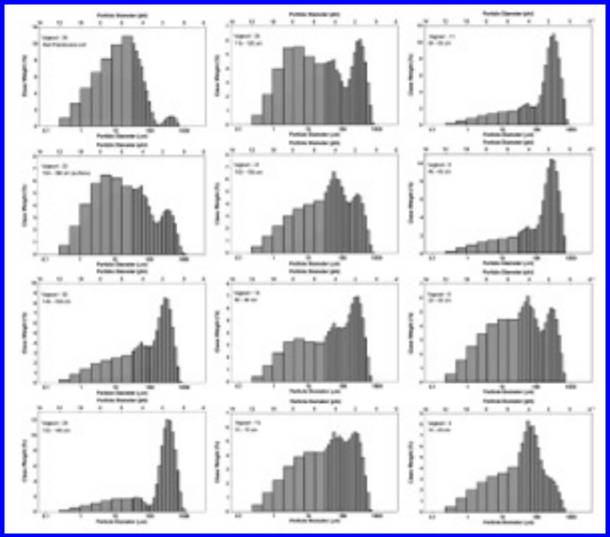
Peds		6-1 cm	50%		
Fine Seds	'eds, sand rich	3-1 cm	5%		
Peds		4-1 cm	50%		
Peds		9-1 cm	80%		UPPERMOST
Peds		2-1 cm	80%		SOIL
Peds		3-1 cm	60%		
Peds		4-1 cm	70%		
Peds		3-1 cm	60%		
Peds		2-1 cm	40%		
Peds		4-1 cm	60%		
Gravel		3-1 cm	10%		
Gravel		5-1 cm	10%		GRAVELS
Gravel		4-1 cm	50%		
Paleosol	Some Peds	3-1 cm	25%		
Paleosol	Some Peds	3-1 cm	50%		STRONGEST
Paleosol	Some Peds	2-1 cm	60%		DEVOLOPED
Paleosol	Some Peds	3-1 cm	50%	C14	PALEOSOL
Paleosol	Some Peds	3-1 cm	50%		
Paleosol	Some Peds	6-1 cm	80%		
Peds		5-1 cm	70%		
Peds		4-1 cm	60%		
Peds		3-1 cm	60%		
Peds		5-1 cm	50%		
Gravel		3-2 cm	40%	20b	
Gravel		6-1 cm	80%	20a	
Gravel		6-4 cm	30%	19b	GRAVELS
Gravel		3-4 cm	30%	19a	
Gravel		8-4 cm	30%		
Peds		4-1 cm	30%		
Peds		3-1 cm			WEAK
Fine Seds	Some Peds	3-1 cm	15%		SOIL
Peds		2-1 cm	35%		
Gravel		5-3 cm	50%		
Gravel		5-3 cm	30%		GRAVELS
Gravel		6-3 cm	50%		
Fine Seds					
Fine Seds					
Fine Seds					
Fine Seds					
Peds		3-1 cm	95%		
Fine Seds					
Peds		1-0 cm	90%		LOWEST SOIL
Gravel		12-5 cm	80%		
Gravel		8-5 cm	80%		GRAVELS
Fine Seds	clay rich			606715	

Stratigraphic description is aligned with the profile, AMS dates are placed in the profile where they were collected.

This exposure reveals four major flooding events during the last 8,400 years, much fewer than the number of flood units exposed upstream. Here evidence of previous flood events have been destroyed by larger flood events.

Each cycle was initiated by an erosional event followed by deposition of poorly sorted gravels and then by finer and finer sediments.

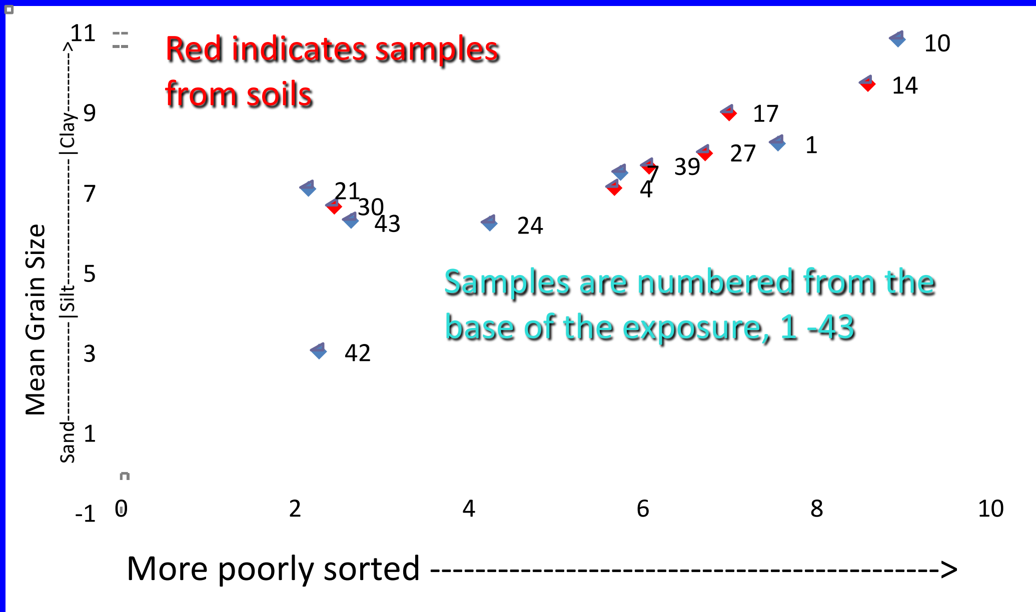




Mastersizer grain size analyses of Vagnari alluvial exposure. The upper left sample is from underlying channel fill that dates to the last interglacial (~150,000) and has been rubified. Sample 34 is near top of Holocene alluvial section, and sample 4 is near the base.

Arroyo Italiano 1: Grain Size Parameters

Arroyo Italiano 1: Mean vs. Sorting



Arroyo Italiano 2 Exposure: Evidence of Modern and Past Erosion

The summer of 2013 Arroyo Italiano 2 was sampled by my colleagues. Although there have been erosional cycles in the past, the current cycle of down cutting far exceeds any which is recorded in the any stream bank in the area during the last 20,000 years.

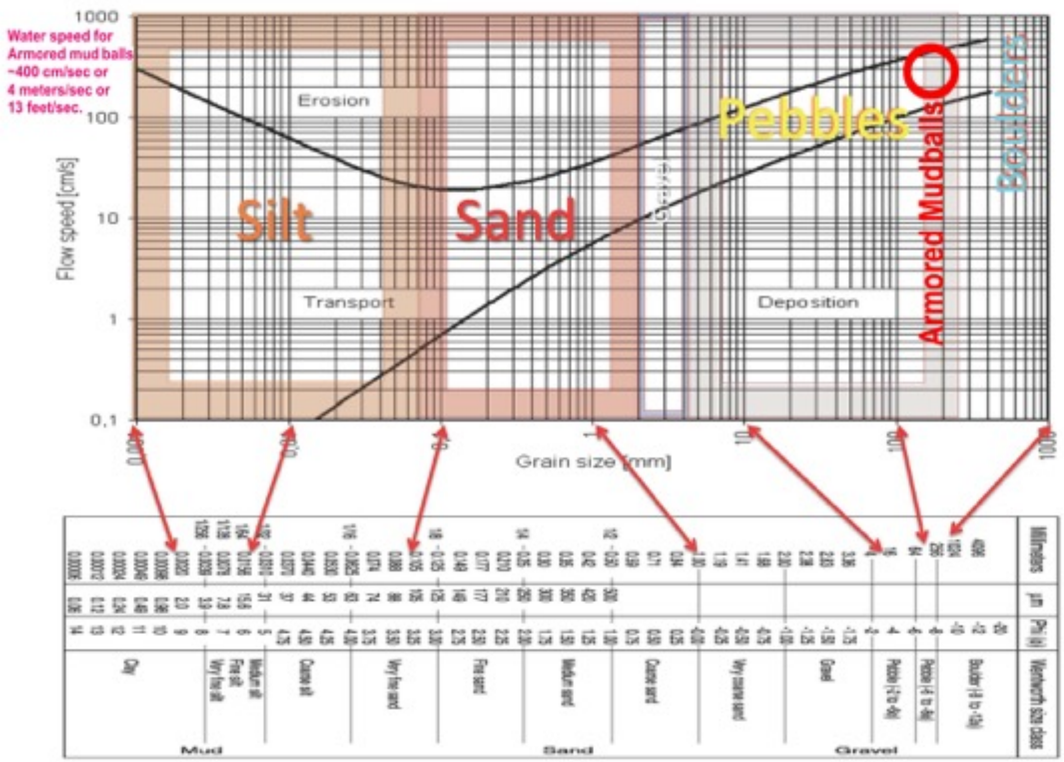
This stream bank exposure lies close to the flood plain of the Basentello River. Gravels and coarse sands have been deposited upstream. Ongoing arroyo cutting is exposing deeper and deeper deposits. In 2013 when the photo on the left was taken, about 8,400 years of sediment was exposed. This past year this channel had been deepened by over 2 meters of erosion.

In the Summer of 2014 an additional 2 meers of profile had been exposed by stream erosion, and flood related armored mud balls filled the stream bed.

Hjulstrom’s Diagram (Filip Hjulström1935) :

- The upper curve shows the critical water velocity in cm per second as a function of particle size in mm for erosion to occur. Cohesion is the dominating force preventing erosion of small particles, and friction is the dominating force preventing erosion of larger particles

- The lower curve shows water velocity as a function of particle size for deposition to occur. Deposition depends upon the settling velocity, which decreases with decreasing grain size



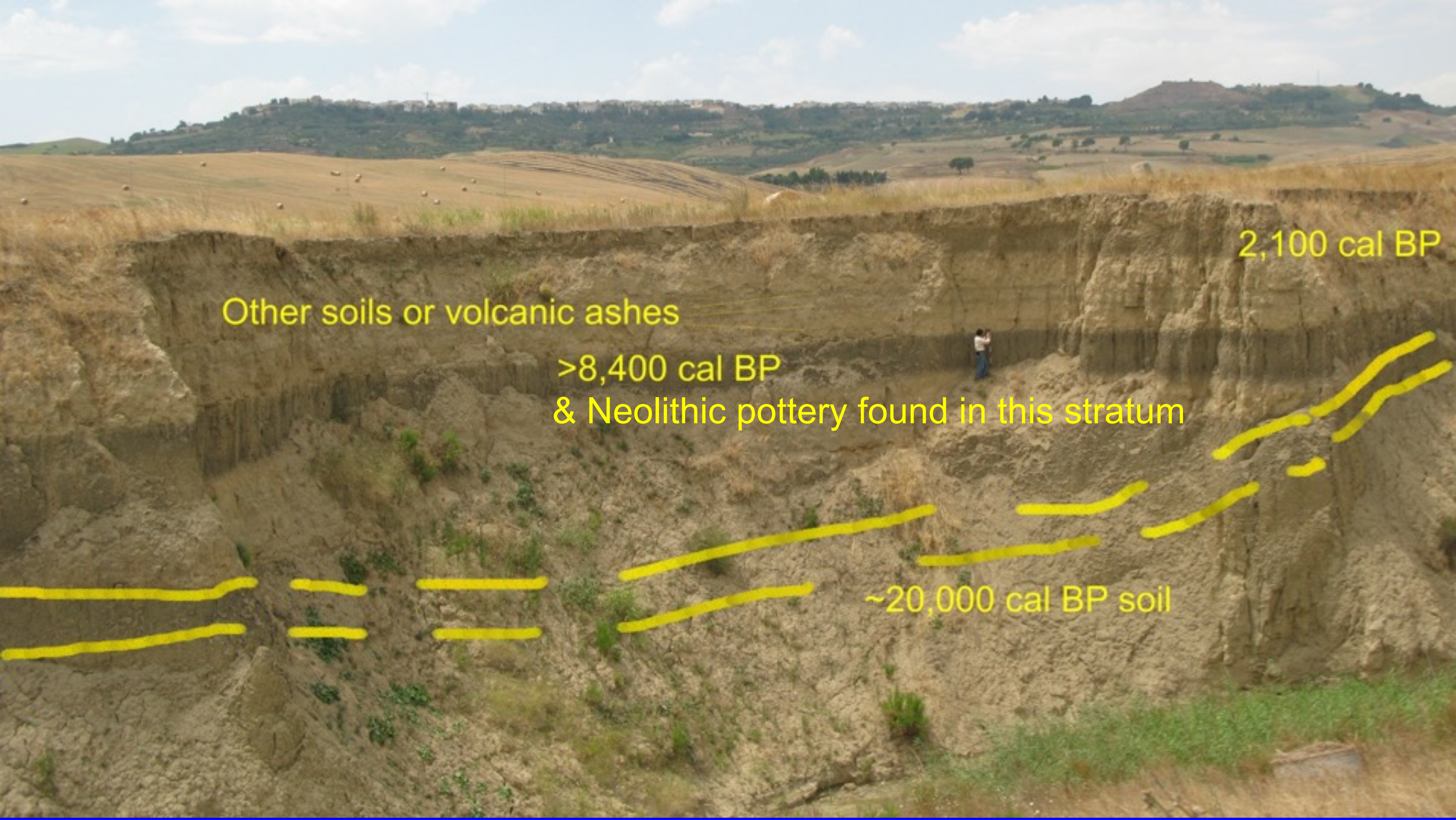
Flood Water Velocity:

- The size of the largest armored mud balls lies within the range of the red circle in the diagram. For and object of that size, the water velocity is about 4 meters/second. The other possibility is that the flow was very viscous.

The Irsina Exposure just east of Irsina

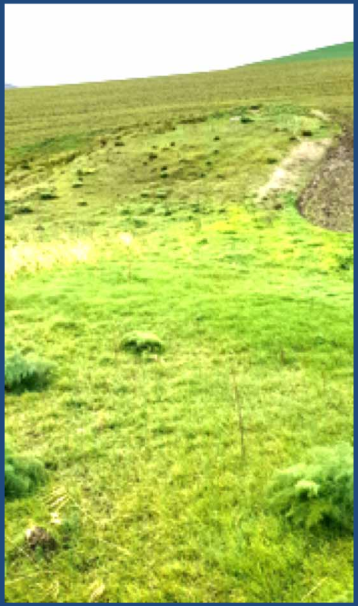
Three soils are clearly visible in this exposure. They from 1.5 to 2 m thick, and are truncated by flood events with only a few fine gravel units. The lowest one conforms to an ancient stream channel that seems to date to the maximum of the last ice age when sea level was much lower. The 9 m of erosion in this channel has occurred in less than 25 years.

Dated Strata of Irsina Exposure

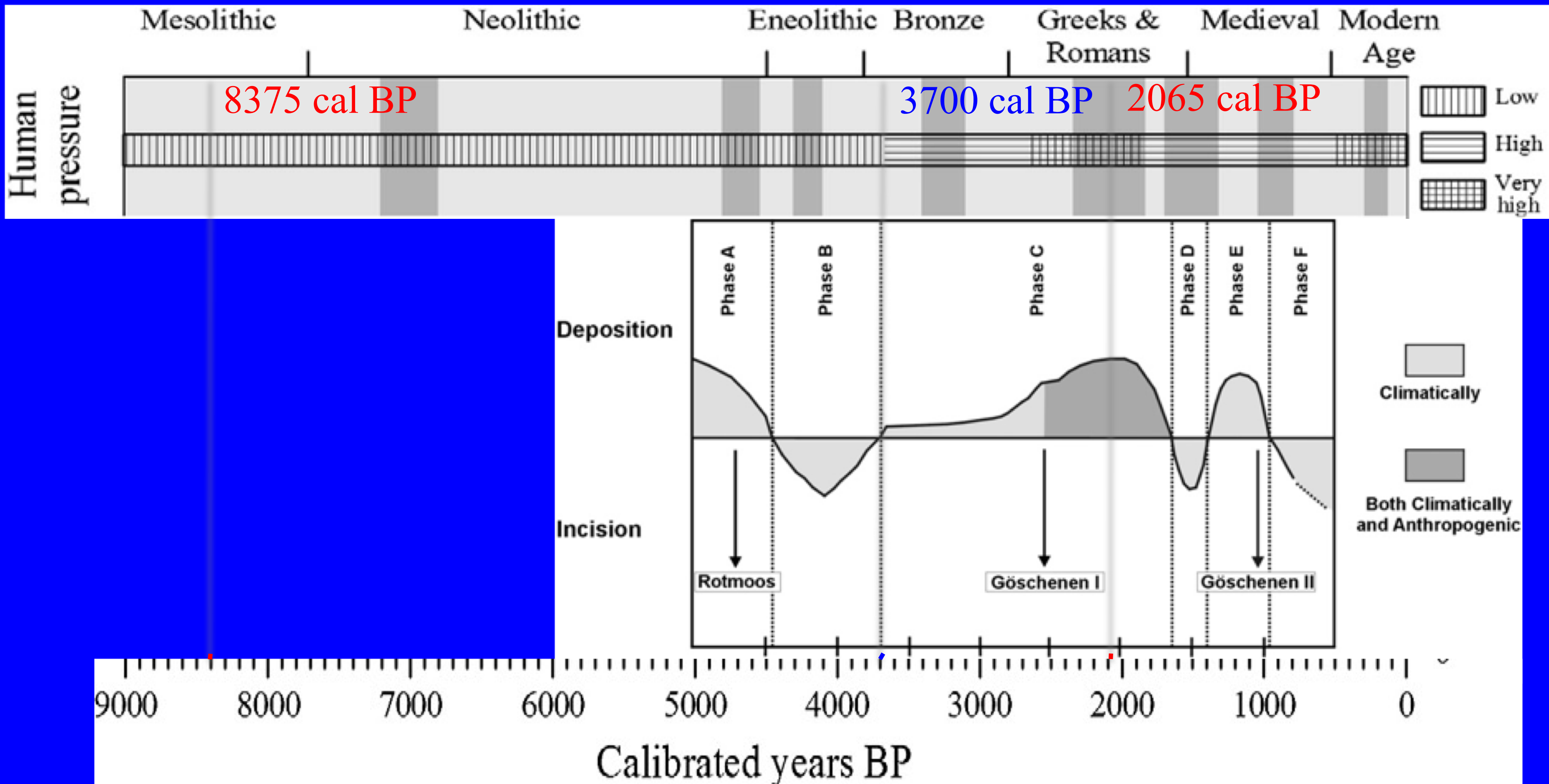


Based upon correlation with other exposures we have dated in the region there is at least 21,000 years of alluvial history exposed in this stream bank. The current 15 m-deep alluvial cutting is unequalled at any time during the last 21,000 years, and is due to current land use practices coupled with the change in precipitation timing and intensity.

Baron Spring



A 4,000-year record of Spring Discharge contains at least three major increased discharge events, that can be correlated with episodes of soil formation, and periods of increased rainfall. Today farmers are trying to destroy springs.



Composite diagram showing the relationship between:

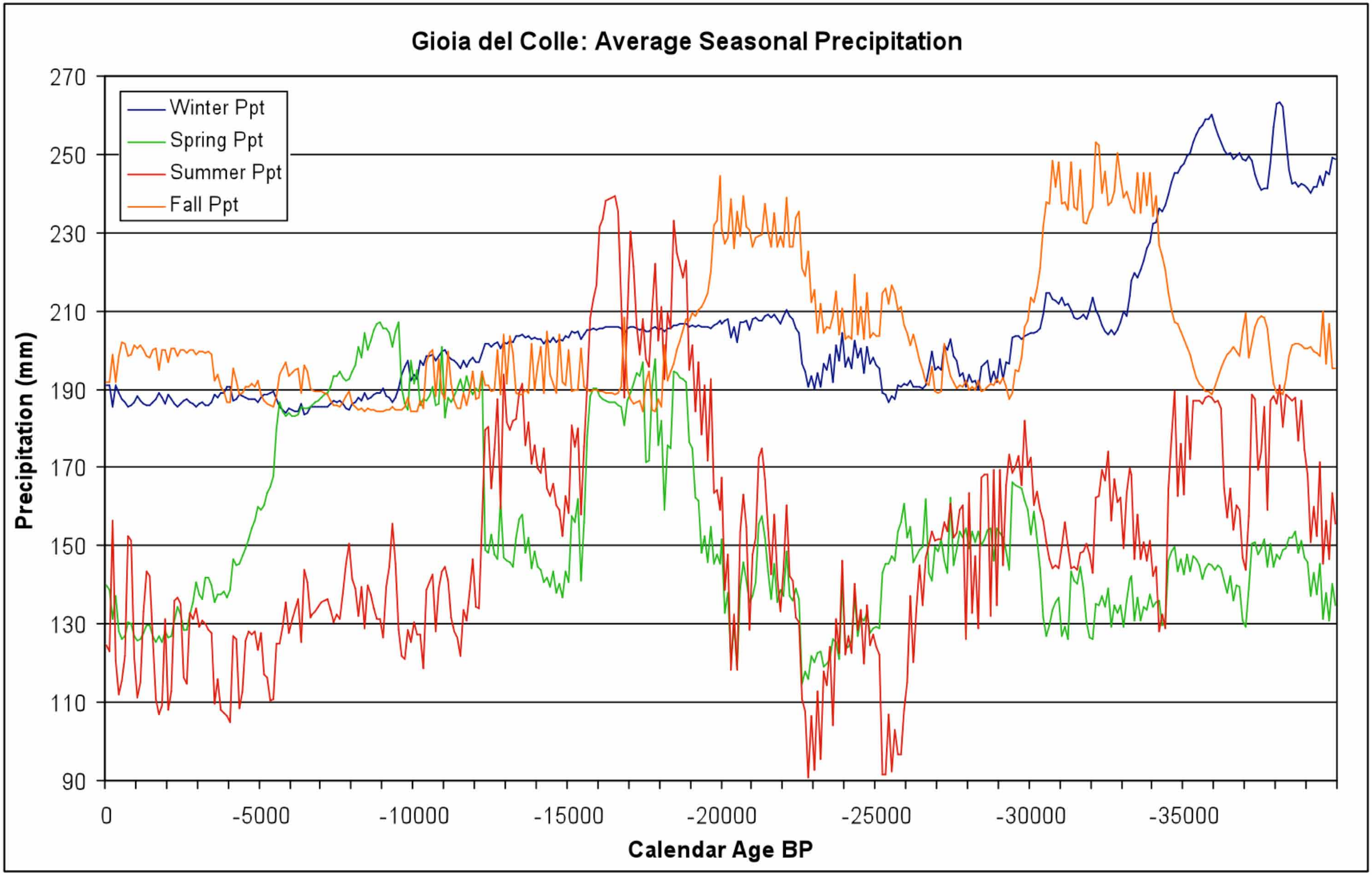
1) deposition and erosion stages in the Fossa Bradanica
2) the main European climatic epochs during the Holocene (F. Boenzi et al. (2008) 297–306)
3) related human cultural periods for southern Italy (M. Piccarreta et al. (2011) 137–147.)

*The ages associated with the red lines are dates that we have from alluvial exposures. The blue date is on the deepest spring discharge event at Baron Spring and a major regional phase of soil development when there was also no erosion.

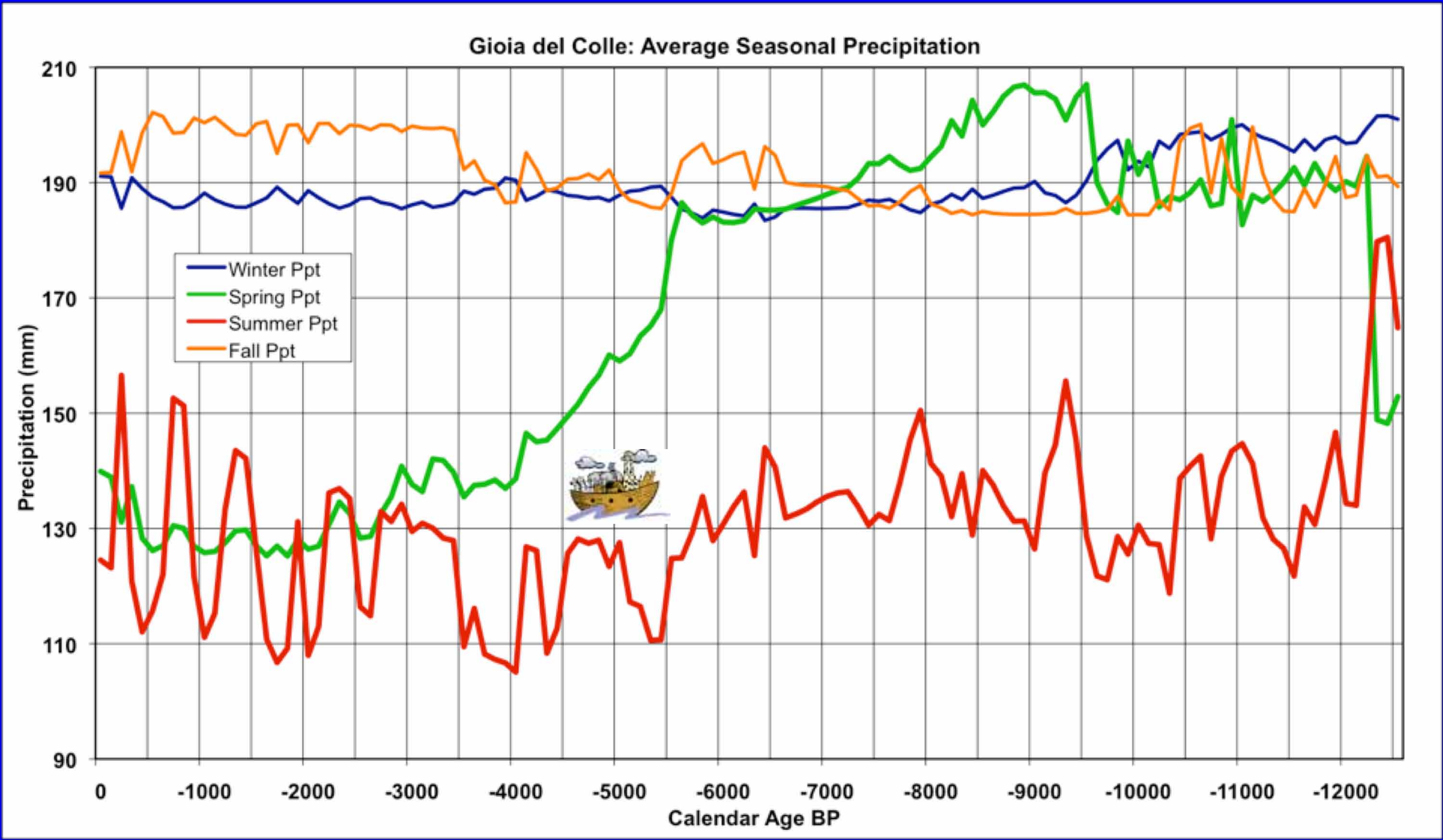
Using the Meso-scale Climate Model (MCM) to Assess the Impact of Climate Change and Landscape Dynamics

- We are assessing the impact of variations not only of annual precipitation and temperature, but also of their seasonal variation.
    - Seasonal variation may result in significant changes in the kind and density of vegetation cover. These changes impact landscape processes (erosion and deposition).
- We are investigating the evidence of human land use and its impact upon the landscape.
    - Because the surface geology is extremely sensitive to human activity, we are mapping sites on the landscape and the type of surface geology that was being impacted.

Applied Bryson and Bryson MCM Physical Climate Model:
Precipitation and Temperature for 40,000 years

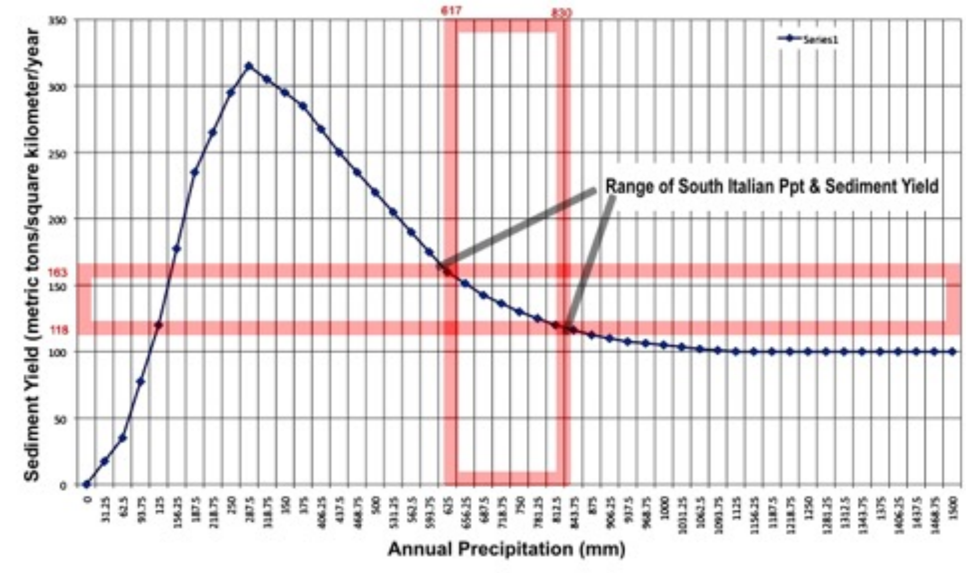


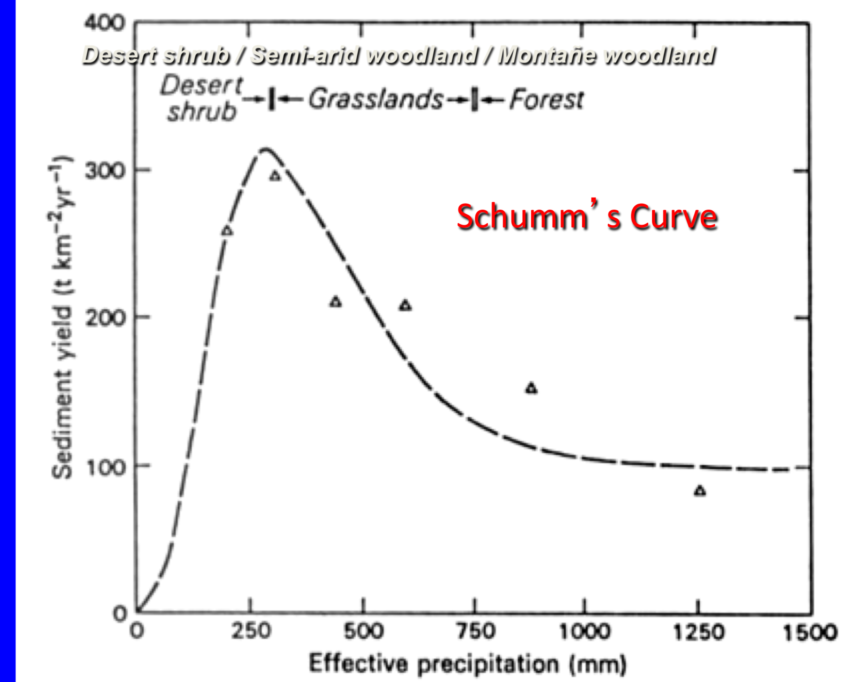
Bryson MCM Physical Climate Model: Role of Seasonal Precipitation

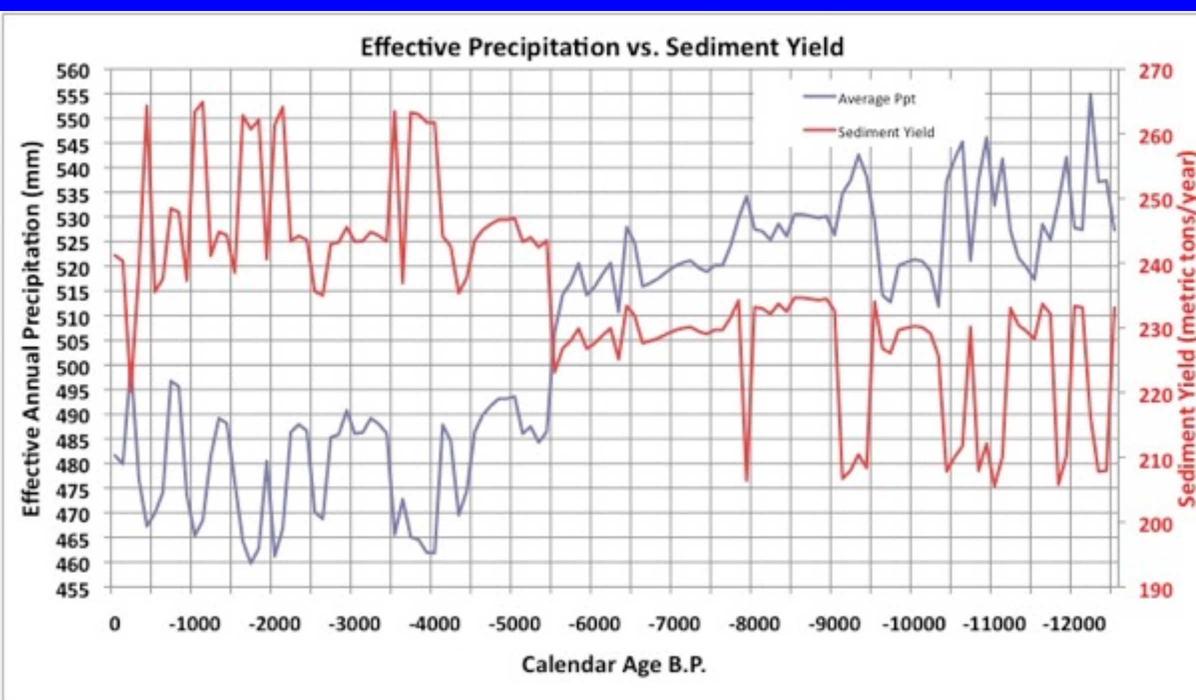


MCM modeled seasonal precipitation for the last 12,500 years. Fall and winter precipitation have not varied as much as spring and summer precipitation.

Langbein and Schumm Curve



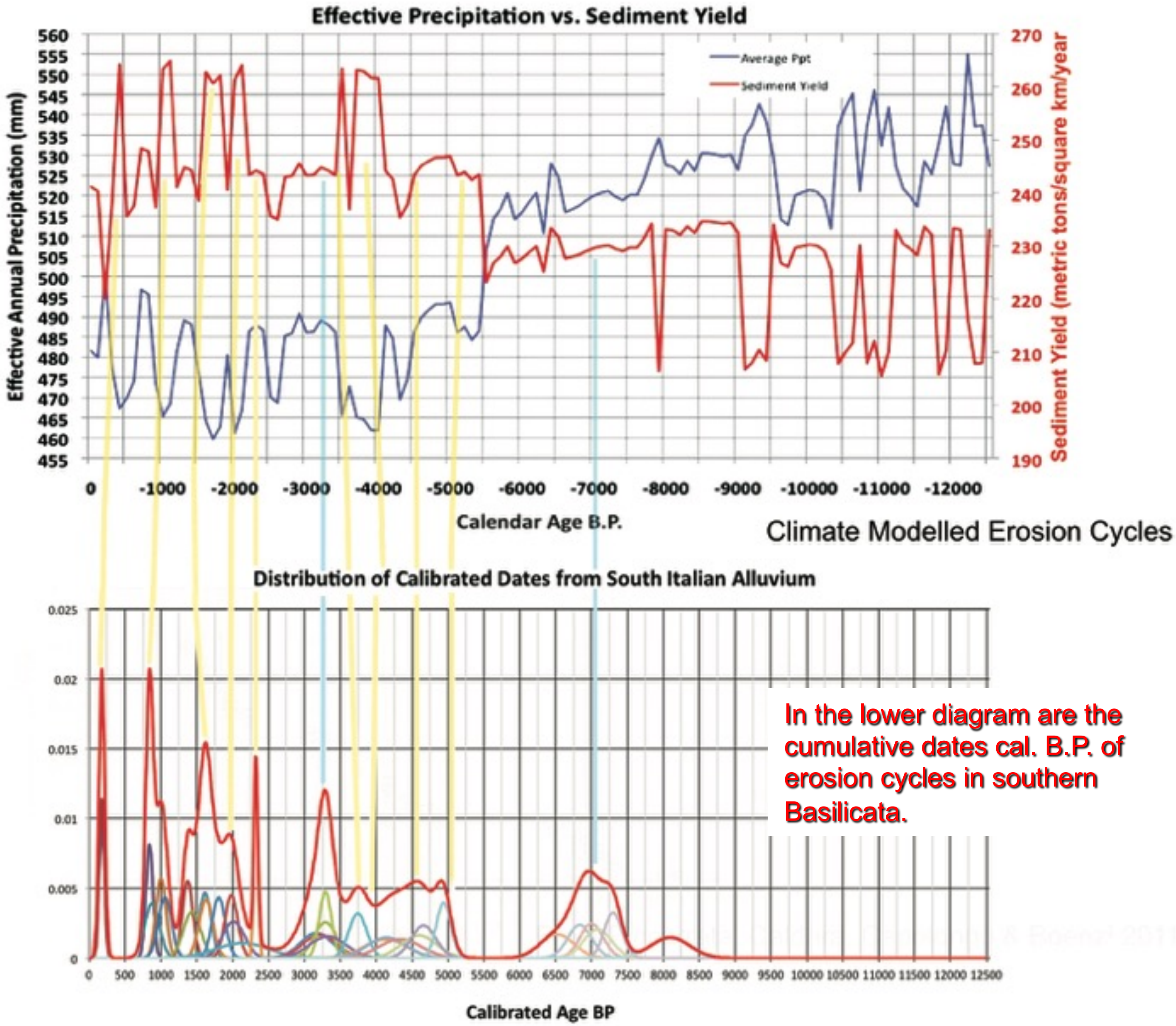




The relationship between sediment yield (erosion) and effective precipitation (adjusted for temperature variations; after Langbein and Schumm 1958).

We have converted the MCM modeled precipitation to effective precipitation, and plotted it with respect to sediment yield from the Langbein and Schumm (1958) model to show predicted correspondence between past effective precipitation and erosion cycles in southern Italy for the last 13,000 years.

Correlation of Model with Alluvial History



Climate Modelled Erosion Cycles

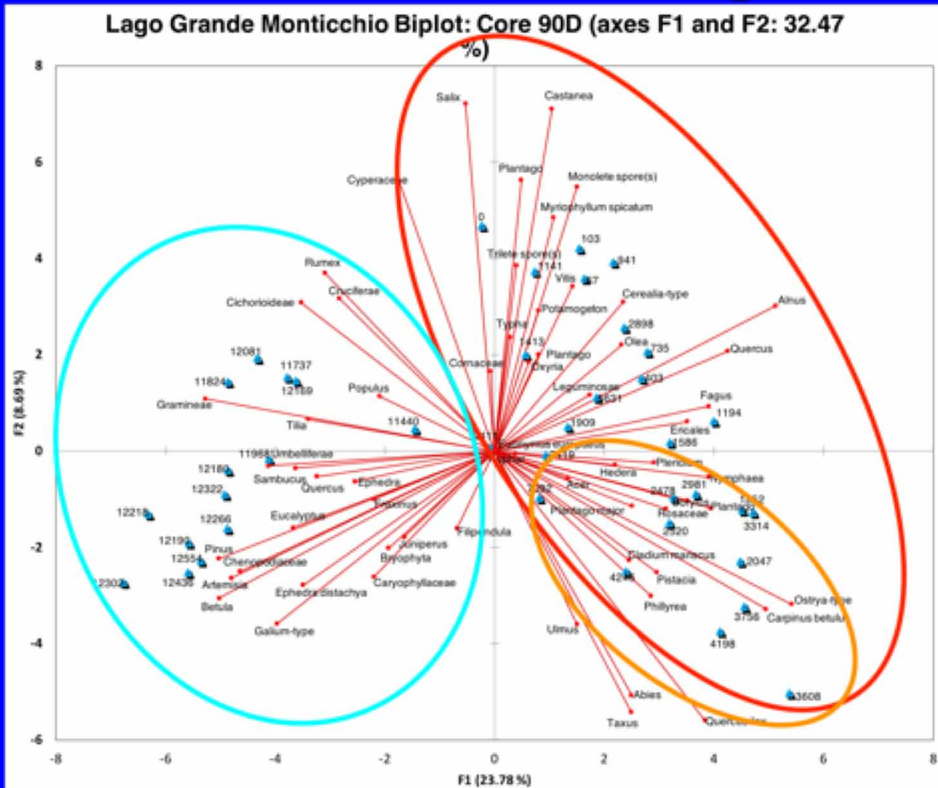
Calibrated Dates on Erosion Cycles from Picarretta *et al.* 2011

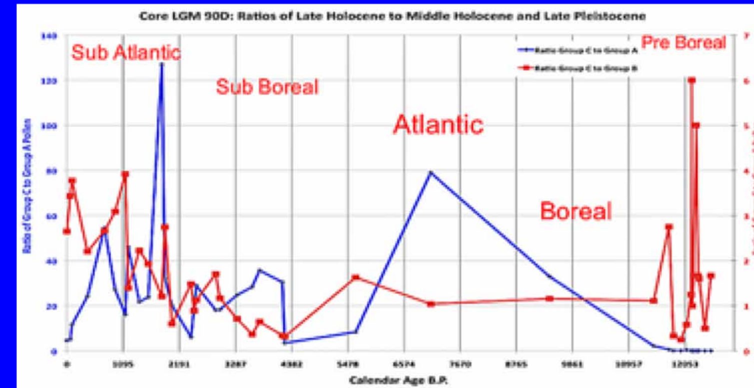
Model of predicted erosion corresponds with the sum of the record of calibrated ages B.P. of erosion cycles in the Mezzogiorno.

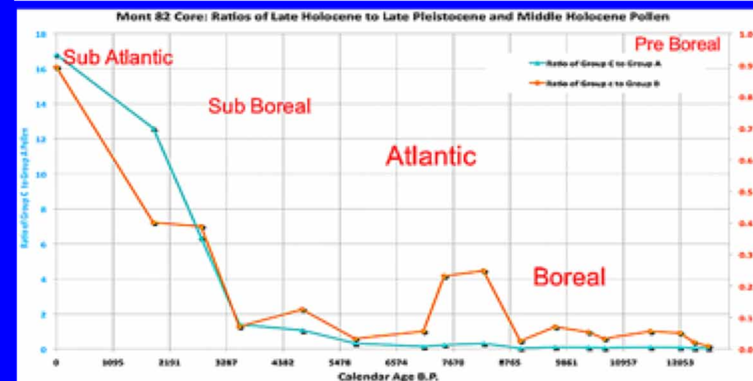
Events connected with yellow lines are climate based, whereas with blue lines are caused by intensified land use.

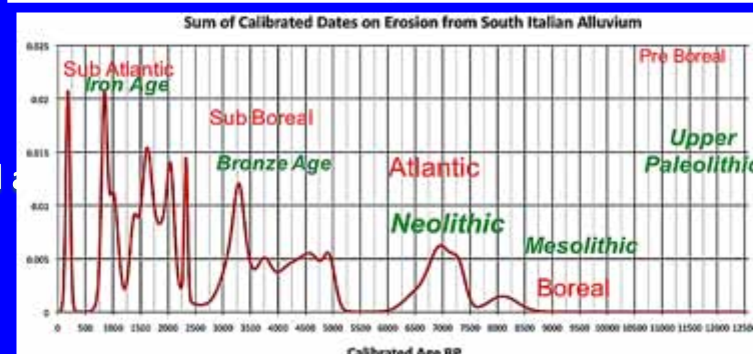
Erosion cycles began after a major decline in spring precipitation during the last 8,000 years. Episodes of erosion during the last 5,000 years generally begin after the onset of episodes of summer precipitation after a significant drought.

Holocene Pollen of Lago Grande Monticchio & Erosion









Principle component analysis of pollen from Lago Grande Monticchio core 90D from the crater of Monte Vulture. Both the primary plants for each cluster as well as the dates associated with each cluster are plotted of the diagram the species or date the stronger the correlation of that group.

Comparison of the pollen rations of the three dominant periods from Lago Grande di Monticchio. The tripartite division of the Holocene vegetation of southern Italy is clear, but there is also an underlying five-part division, which mirrors the Blytt-Sernander system of northern Europe. The lowest diagram compares the Blytt-Sernander system with the erosion cycles of southern Italy and the general cultural phases of the region. The cultural stages are general, but a significant change in land use and climate seems to occur at the end of the Bronze Age.

Torrential Summer rains following wheat harvest, chaff burning, and plowing in Italy during July of 2015 carried sediment downslope in low- scale debris flows. Sediment was carried into streams feeding the Bradano and directly into the Gulf of Taranto. The years 2013, 2014 and 2015 had several episodes of extreme flooding and erosion. These have been triggered by a shift from gentle winter to high intensity summer storms. This has caused significant erosion of hillsides and exposure of underlying 3rd interglacial (Riss-Würm/Ipswichian /Sangamonian) rubified soils, and in many places Pliocene marine marls. The resultant creation of infertile badlands threatens this important wheat growing region.

Results of a Single Storm

In summer of 2014, a week and a half after the wheat harvest, field burning, and plowing, the region was hit by numerous torrential rainstorms. This has been the pattern the last decade or more. It is a pattern that is to increase under the scenario of global warming. The summer of 2016 the mud of this storm was still evident on the road.

Resulting Deteriorating Landscape:

1) Accelerating destruction of agricultural land resulting from climate change and poor agricultural practices, and the pressure from absentee landlords to maximize production by farming extreme locations

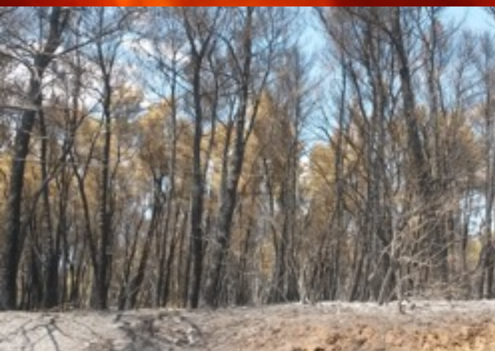
2) Destruction of local infrastructure, in particular roads, which are not being repaired because there is little money coming from the government for this repair. I have traveled damaged roads which have been untouched for five years.

Soil Erosion in the Basentello Valley:

Last interglacial rubified soils exposed above the Basentello River near the San Felice villa site (people at left and insets). The Spinazzola fault scarp is visible in the distance. The Vagnari Massaria is at the left in the valley.

FIRE!!!

Field burning after the harvest has been practiced for thousands of years in southern Italy. However, recently uncontrolled field burning has become a major problem. Spring drought dries trees, shrubs, and grasses. Wheat is harvested in June – July, and then the chaff is burned to plow under. Traditional field burning is no longer followed. Young farmers are impatient, pour gasoline on the stubble, and light it from where it spreads to the dry hillslopes and vegetation next to the fields. They intentionally burn riparian vegetation areas and also the macchia on the steeper slopes. The behavior is almost arsonist. During the summer of 2017 huge areas from Mt Vesuvius at the edge of Naples southward burned. The skies were smoke-filled for months.



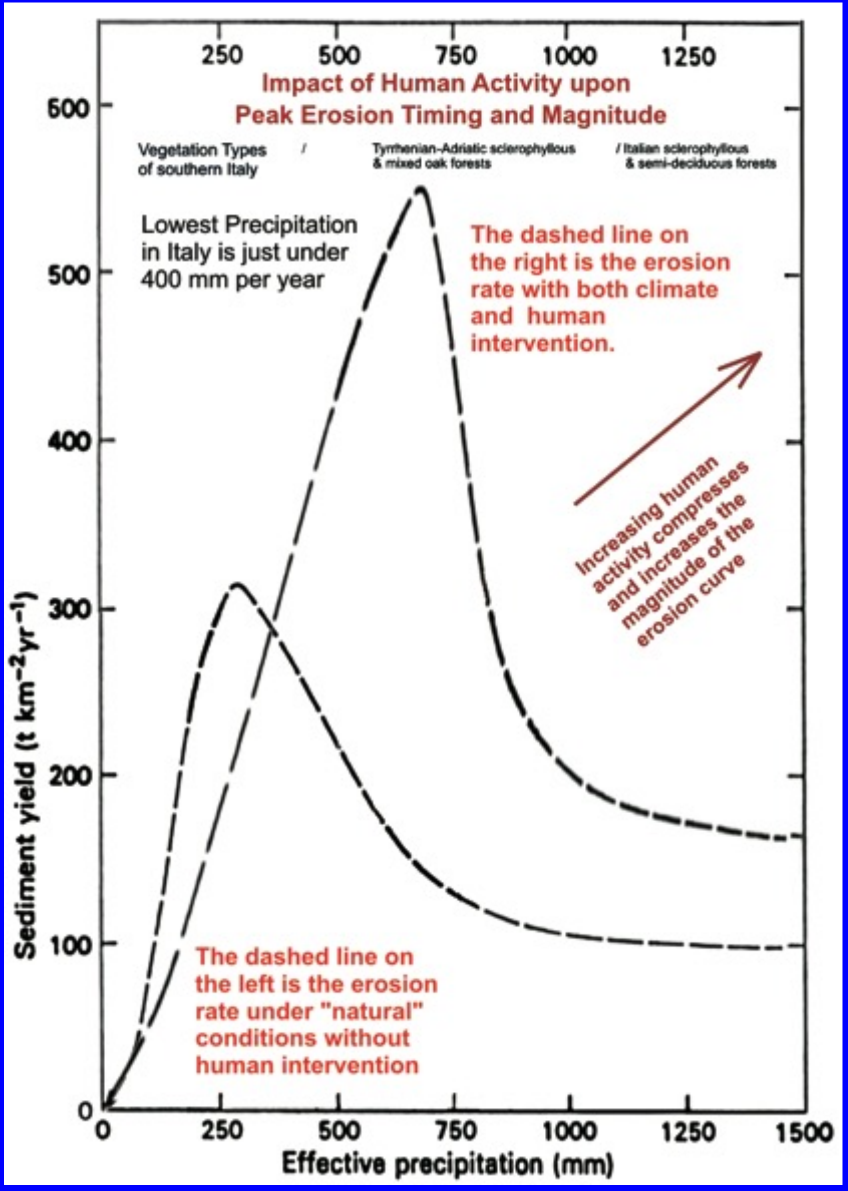
Rainy Season Erosion



- The summer rains follow closely upon the plowing and field burning.
- the fine sediments of the region are then subject to massive erosion, especially during torrential rainfall events.
- 1950's concrete lined irrigation canals built with U.S. foreign aid, intended to reduce field flooding instead keeps water velocity high and carries large volumes of sediment downstream.
- this causes up stream erosion above the ends of the concrete lined channels.
- greater than 2 m of slope erosion on the upper slopes resulted.
- the channels have filled with sediment and vegetation, which the government now wants to clean the drainage canals. Bad idea.

Langbein & Schumm Erosion Model under Increased Land use

- When human landscape clearance is taken into account the erosion curve is displaced to the right and upward, indicating that erosion rates can increase without a change in precipitation, because protective vegetation has been removed



Applied Palaeoecology:
Past Analogues for Present Applications

- At times in the past climates and human impacts have been similar to those we see today.

- Climate and human land use practices may have acted together to result in a regional economic collapse.

- Create and test a climate and land use based landscape dynamics model for southern Italy during the Holocene

  - ✓ determine of the contributions of climate and people to landscape change.

  - ✓ predict future trends in landscape change there, and in other regions of the world as well.

Atmospheric Carbon Reduction

- **The growing pace of global warming with increasing frequency of extreme temperature and rainfall events, droughts and wildfires due to increasing atmospheric carbon emission content, requires immediate and drastic action.**

- **There are the two sides of the atmospheric carbon problem**
  - **1) reduce emissions**
  - **2) remove what is already in the atmosphere**

- **Although "Green Energy" is being given the big push right now, on the flip-side of the coin, removing what is already there is being given short shrift.**

- **The problem is that the atmospheric content of carbon is already great enough to cause irreversible damage to the earth's environment.**

- **Atmospheric Carbon Goal**
  - **So we must not only reach zero emissions, but must achieve the goal of a 33% reduction in the current atmospheric carbon content of over 412.5 ppm to achieve the ~280 ppm that was the average prior to the 1850s.**

(The Caldor wildfire summer of 2021, 100 km south of my home in Reno, Nevada, at one time we had three fires like this burning south, west and east of Reno. One fire in 2020 burned up to the fence next to my house.)

How is the Environment is going to Respond?

- Previous studies indicate that we must look at the paleo-ecological record and not just at the modern ecology of vegetation to see how it will respond to global warming.

- Vegetation responds as individual species not as a community.

- Factors such as migration rates, and the ability of plant species to respond to incredibly rapid rates of climate change must be taken into account.

- Some species will respond more quickly than others to global warming.

- Many species may immediately, become extinct because they cannot respond or simply because changes in seasonality or amount of rainfall may exterminate them.

- The past record provides some of that information, but in the final analysis we cannot predict the accidents of chance as well, that is routes of escape via valleys, mountain ranges, and animal seed dispersal.

- These are just some of the factors that might influence the survival of plant species and their role in carbon sequestration in the final analysis is a luck of the draw.

The Potential Role of Forests in Carbon Sequestration

- Recent research has shown that regenerated forests could remove up to two thirds of the atmospheric carbon required to reduce global temperatures.

- As a result global governments are assuming that they can rely upon the earth's forests to do this.

- However, this is becoming an empty hope.
  - Increasing frequency and magnitudes of heat waves and drought has resulted in increasingly more common and severe wildfires.
    - This is turning many forests into carbon emitters rather than carbon sequesters, and into an ever growing source of atmospheric carbon.
    - In just the last decade many of the most important forests have now switched from being atmospheric carbon sinks into major sources of atmospheric carbon when they are burned by wildfire.
      - (This fire just north of my home in Reno, Nevada, forced the evacuation of the town of Doyle, and burned over a month.)

- Emphasis on the regeneration of shrub and grass land habitats, and even the pollarding of established broad-leafed forests would provide a more rapid means of atmospheric carbon removal.
- In particular, the regreening of agricultural lands around the Mediterranean with macchia or chaparral communities, especially with shrubs such as *Pistacia lentiscus* (Cyrus sumac)
  - Which could also serve to rejuvenate small-scale local green businesses. For example: Pistacia has important food uses ranging from Turkish delight to chewing gum, to flavorings in dishes, and important medicinal (anti-bacterial and anti-fungal) applications for digestive problems and skin disorders, and even as a furniture varnish!

Grasslands and Chaparral are more Resilient Carbon Sinks than Forests Today

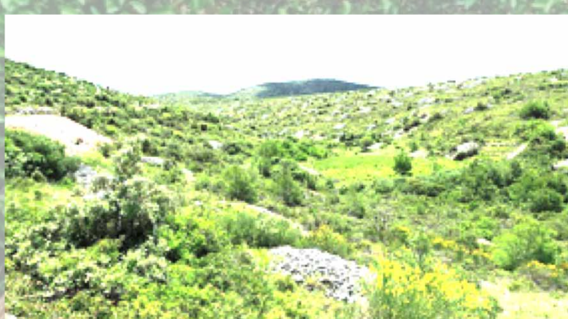
- **Modelled simulations show that grasslands can store more carbon than forests, because they are impacted less by droughts and wildfires.**

- **Whereas forests sequester carbon primarily in woody biomass and leaves, grasslands sequester most of their carbon underground.**

  - **Forest wildfires release the carbon that had been stored above ground in stems, branches and leaves into the atmosphere.**

  - **Grasslands fix the carbon underground in their roots and in the soil as compost, where wildfires have minimal effect. This leaves the carbon they sequester behind so it does not contribute even more to atmospheric carbon emissions.**

  - **Establishment of sustainable ecosystems that can be highly efficient carbon sinks as well, must be a top priority. Without it the atmospheric carbon problem will not be solved**



What Needs to be Done?

Educate the Public about Climate Change

- Public Education through:
  - ✓ Publication of global change research results on the internet
  - ✓ Linking our website to other educational resources
  - ✓ Presentations at schools, universities and other educational institutions
  - ✓ Public lectures
  - ✓ Meeting with local land owners and land users
  - ✓ Presentation of findings and results of landscape modification at workshops and scientific conferences.

PLAN OF ACTION

Determine future impacts of global change:

- ✓ Determine what action will be needed to address these impacts
- ✓ Formulation of plans of action to address climate change and landscape restoration issues
- ✓ Write a detailed mitigation proposal for obtaining funding
- ✓ Obtain public input to these plans

Organize Local Action Groups for the purpose of:

- ✓ Educating the public and organizing volunteer groups
  - ➢ Determining the roles of the various participants in the plans
- ✓ Identifying and organizing local resources
  - ➢ Determine the resources that are available and those that will be needed
- ✓ Establishing sustainable ecosystem pilot projects to test both methods of design and the plants to be used
  - ➢ These will be both natural and agricultural ecosystems – many will recover deteriorated or burned ecosystems, or will convert unsustainable environments
- ✓ Install remote ecosystem monitoring system to follow the progress of the ecosystem

Local Landscape Remediation Firms

- Determine which mitigation and restoration methods have been successful
  - ✓ Organize companies that can continue to implement these solutions regionally and extra regionally. For example:
  - ✓ Earth- & Eco- Systems Expertise for Environmental Modelling & Restoration (EESEEMR)
    - ✓ Apply what we already know
      - ✓ Eliminate biomass burning
      - ✓ institute crop rotation and diversification (olive and grape agriculture with pollinator-friendly and nitrogen fixing understory plants, e.g., clover
      - ✓ Encourage no-till plowing and eliminate plowing on slopes at risk to erosion entirely
      - ✓ maintain riparian and steep slope vegetation
      - ✓ Restore damaged landscapes through re-sculpturing slopes, terracing and replanting of stream channels and slopes replanting with native plant communities
      - ✓ Install no-waste water systems, ones employing qanat, aqueduct, cistern, drip irrigation and mulching





Problems to be Resolved in Facing Global Climate Change

- Governments need to set mid- and short-term targets that force them into action, rather than setting long term targets, which are difficult to achieve and can be ignored until some unspecified time in the future.

- Conversely, company boards need to stick to medium and long term goals and must not be distracted by short-term shareholder activism.

- Companies address sustainability issues, either to gain a competitive advantage or to maintain legitimacy, however, they lack a deeper understanding of the reasons why they should reduce their impact upon the natural environment. This should change!

- Activism in addressing climate change needs to become universal

✓ no nation can choose to avoid participating in this challenge

✓ people of all ages and social classes are becoming climate change activists, but the 30 to 40 somethings are still too pre-occupied with their own economic success. This needs to change!

✓ If this does not the words of Benjamin Franklin, at the time of the signing of the Declaration of Independence will be our fate:

"We must all hang together, or, most assuredly, we shall all hang separately."

Meaning we must all be in the fight against climate change!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