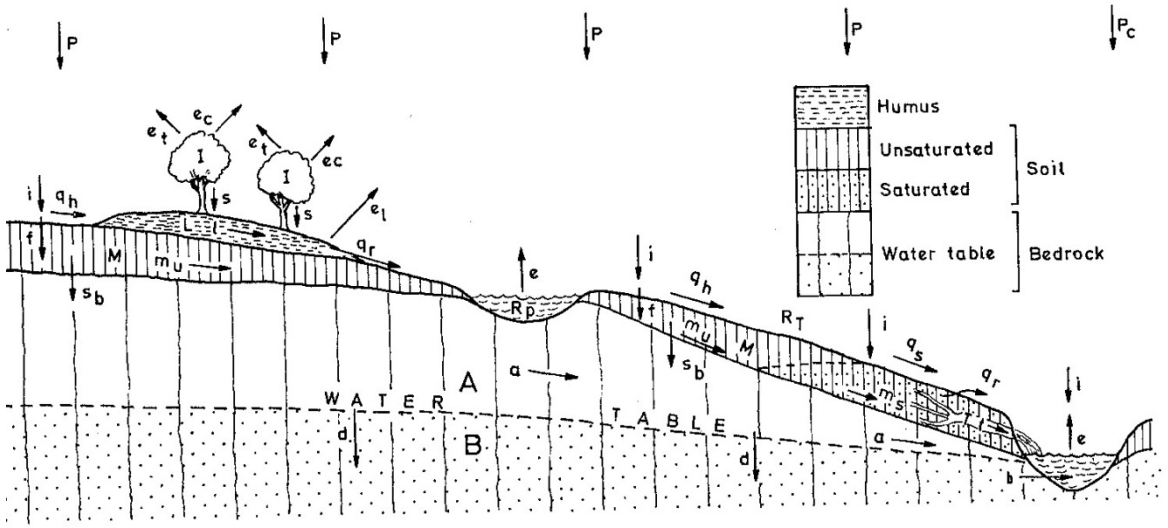
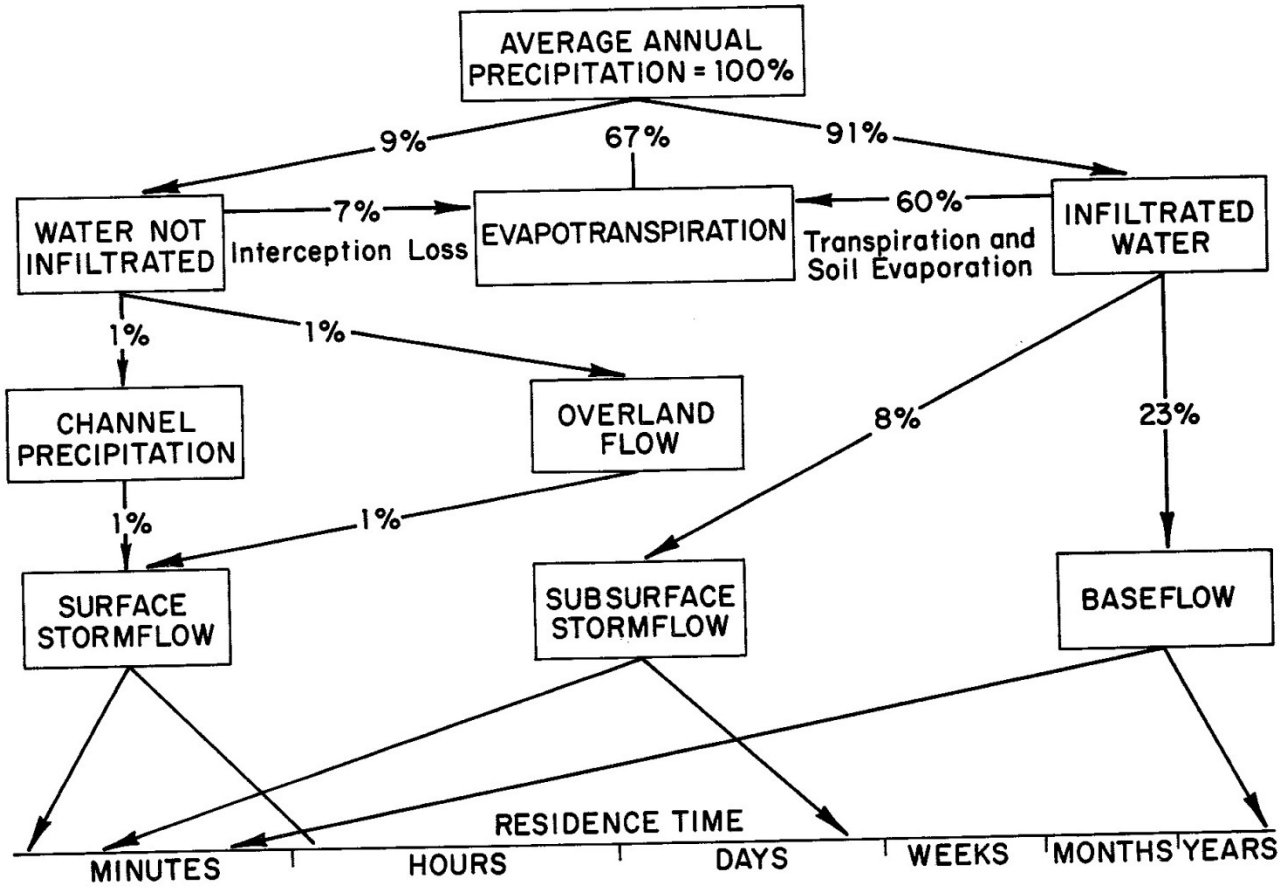
The Complex Hillslope Hydrological Cycle



Precipitation (gross rainfall)	P	Horton overland flow	q_h
Channel precipitation	P_c	Saturated overland flow	q_s
Precipitation intensity	i	Return flow	q_r
Evapotranspiration	e_t	Pipe flow	t
Canopy interception loss	e_c	Pipe storage	T
Interception and canopy storage	I	Unsaturated throughflow	m_u
Stemflow and drip	s	Saturated throughflow	m_s
Litter flow	l	Soil-moisture storage	M
Litter interception loss	e_l	Seepage into bedrock	s_b
Litter storage	L	Interflow in bedrock	a
Evaporation	e	Aeration zone storage	A
Depression storage	R_P	Deep seepage	d
Detention storage	R_T	Baseflow	b
Infiltration	f	Groundwater storage	B

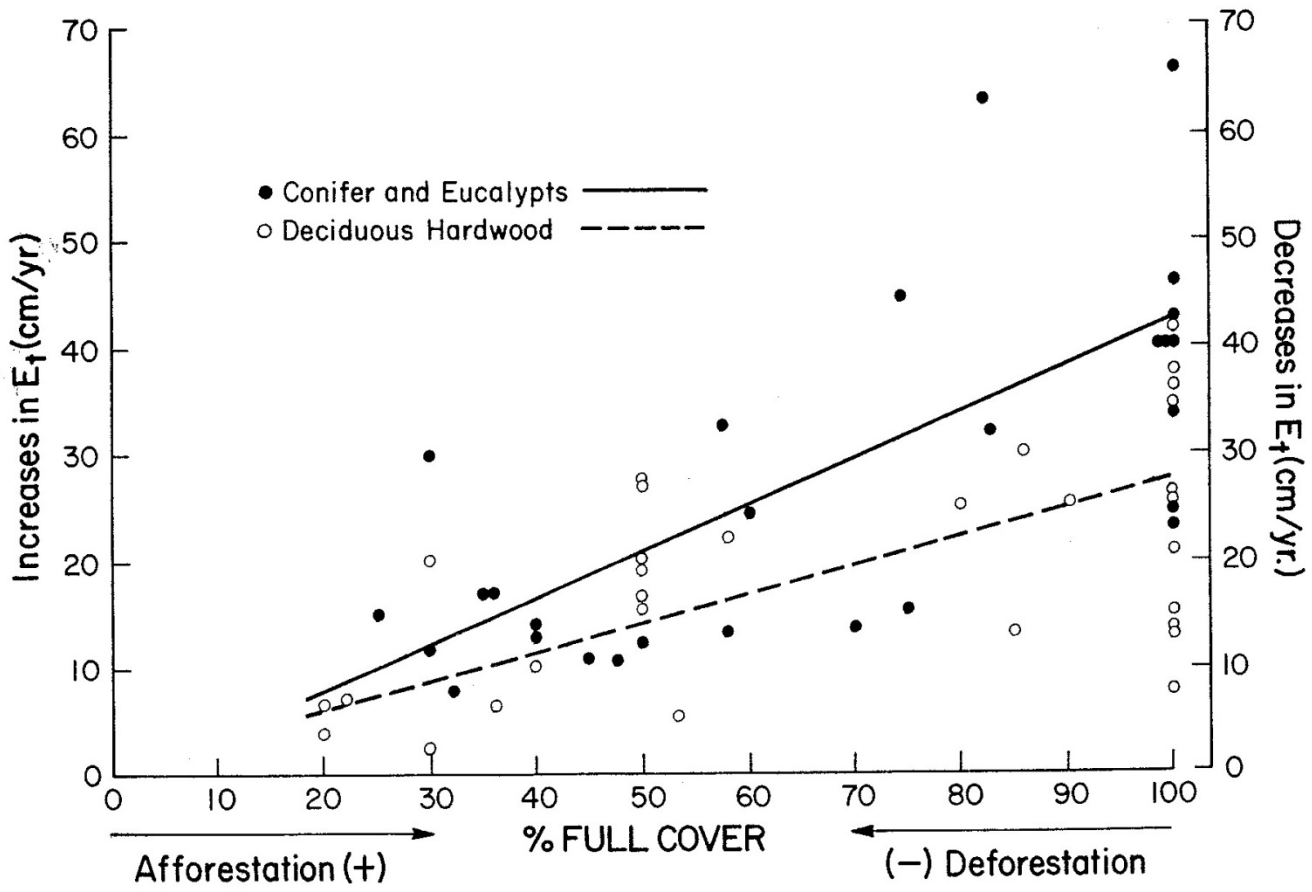
Figure 1.2 Components of the hillslope hydrological cycle

Water flow type and residence time in the watershed



Forest cover and water quantity form experimental evidence

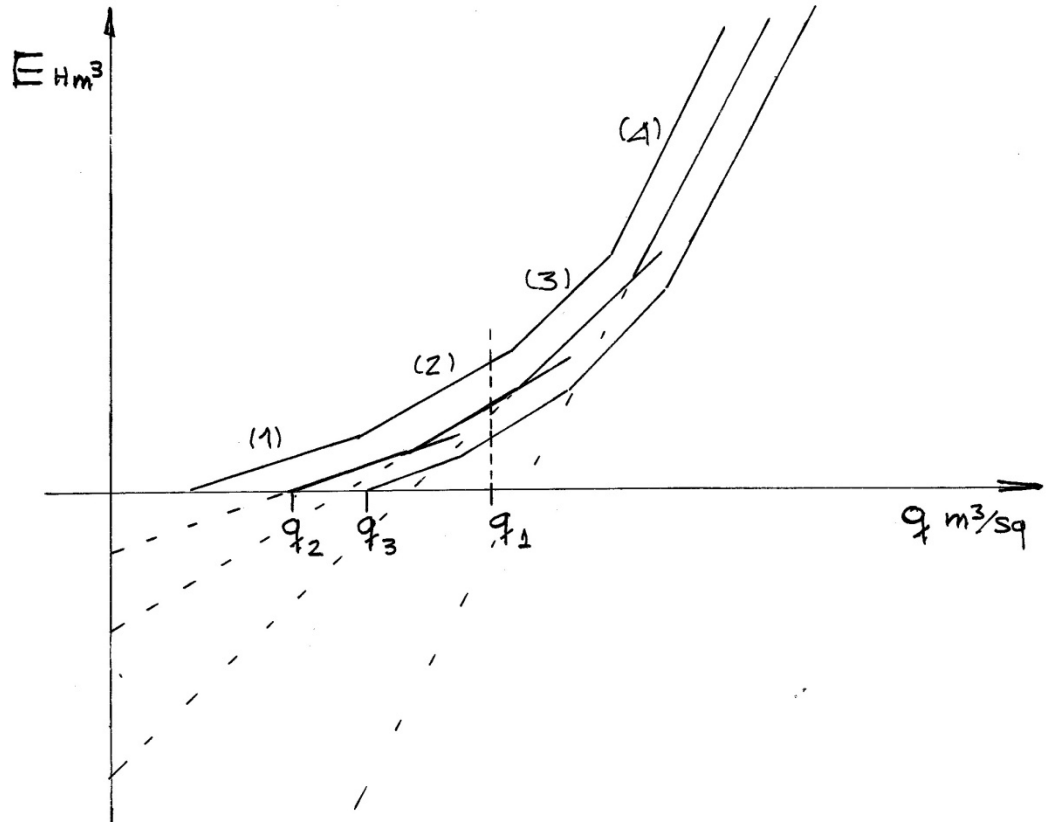
U.S.



Integration of water production into the forest management. Multi-functionality and prerequisites

- When speaking of forest influence on water is essential to clarify which attribute of water: **quantity, quality and regime,** under consideration
- Eureka!!!! After those experimental evidences we have found out the solution: Spread and cover of concrete the basins, as I saw in Kitt Peak Nat Observatory Az USA, and will get water to meet worst prospects
- **Forests are Multi-functional entities which have to meet diverse demands**, such as, ecological, (hydrological),economical, cultural, productive, protective, recreational, scientific, landscape, game, wildlife,…. **Which have to be harmonized**
- Forests are essential to protect **water quality and soil**. **Riparian zones** are key to protect water.

$$E_{(Hm3)} = N_i\ q_{(m3/sg)} - a\ k_i\ (Hm3)$$

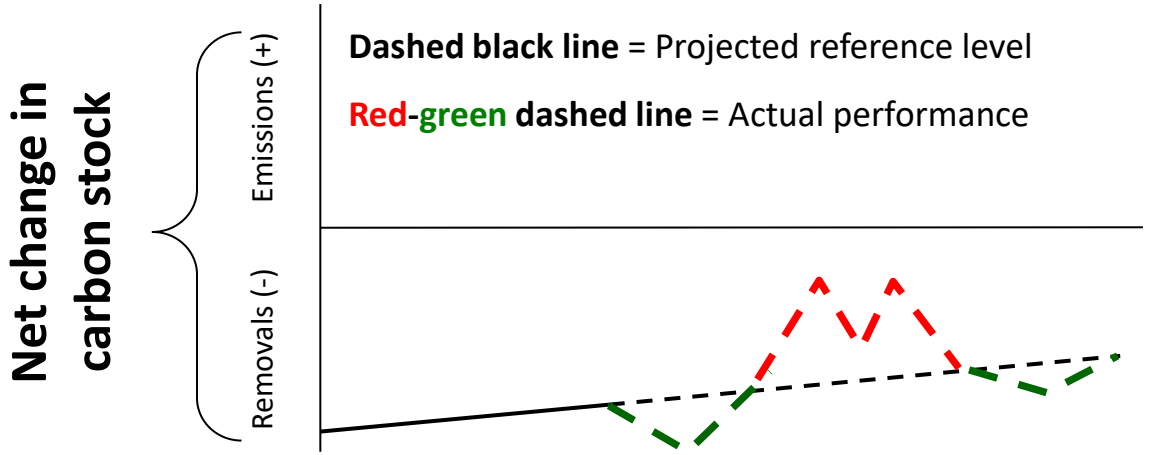


Forest management oriented to water production. Some orientations to consider (from USFS ¨NED¨¨)

- Minimal management unit 20 ha. All the stands adyacent to water, wetlands or riparian buffer should meet:
  - Evergreen species should comprise less than 70% of basal area
  - Relative density of overstory should be less than 70%
  - If stand is in the seedling size class, relative density should be less than 30% and sprouts should comprise less than 30% stand
- Treatments may include:
  - Reducing stand stocking to below 70% relative density
  - Using short rotations
  - Encouraging hardwood species
  - Encouraging regeneration from seedlings

Art 8: Accounting for managed forest land

- Accounting will continue to be based on a national "**Forest Reference Level" (FRL)** → *value of projected emissions/removals, against which the future emissions/removals will be compared for accounting purposes*



Less removals than reference level = **Debits**

More removals than reference level = Credits

- Maintains 3.5% cap of Member State's base year emissions from 2/CMP.7
- Maintains the practice of "technical corrections" to ensure methodological consistency between FRLs and GHG inventories

Art 8: rationale, principles and criteria of the new FRL

Options for mitigating climate change through forest management

Option	current offset of total EU emissions (%)	Impact of > harvest (short term)	Reported/accounted in:
Increase in C stock	**in existing forests (CO_2 sink or "removal")** 	≈ 10% (only 1% accounted under KP in 2008-2012)	<<	*LULUCF*
	in wood products 	≈ 1%	>	*LULUCF*
Substitution effects by wood (approximate figures)	**Material** 	≈ 1-2%	>	*Other GHG sectors*
	Energy 	≈ 4-5%	>	*Other GHG sectors*

Forest !

Trade-offs exist between options, each with its **temporal dynamics** of emissions. E.g. *more harvest usually means less forest sink in the short term but more substitution effects*

The most effective forest mitigation strategy is the one that optimizes the sum of the above options in a given time frame, while being consistent with long term objectives.

What science says on the best forest mitigation strategy?

short answer is:

IT DEPENDS

The optimal mix of mitigation options is very much country-specific (e.g. forest and market characteristics, policy priorities…)

Forest management policies are responsibility of MS

An EU LULUCF legislation does not identify the best mitigation strategy (harvesting more or less), but **promotes an accurate accounting**, including that *bioenergy is properly accounted for,* consistently with the goal of achieving a balance between emissions and sinks in the 2nd half of this century

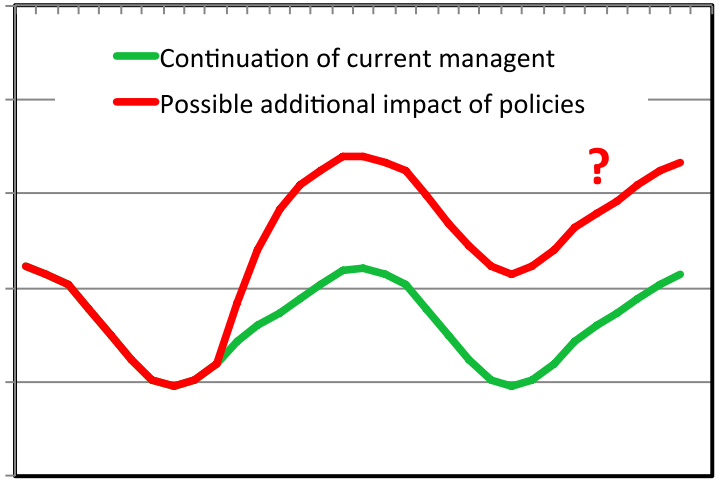
Impact of forest aging and policies on the forest sink

Impact of forests getting older

Even keeping current management, in *some* MS the forest sink *may* decline due a age-related need of extra harvest → temporary effect

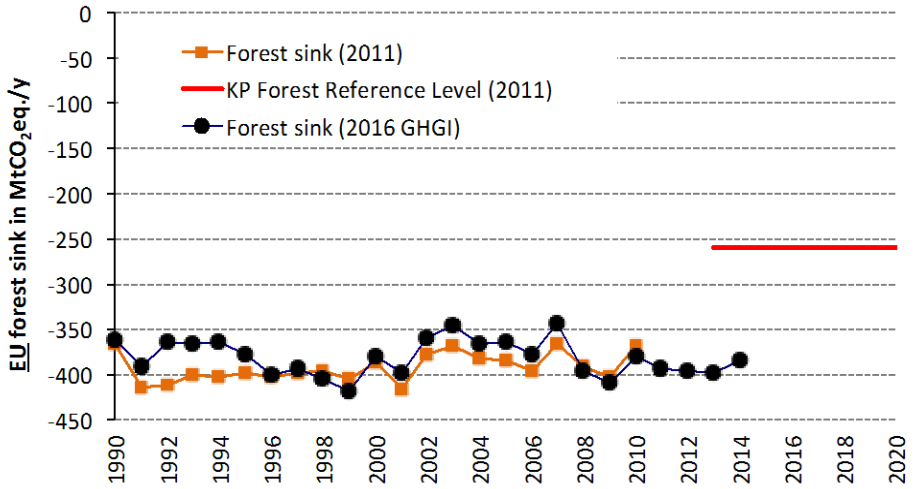
Impact of additional policies stimulating harvest

E.g. shortened rotation cycles → greater *decline of the sink in short term*, but *greater substitution effects* → extra harvest is not *necessarily* bad for reaching a GHG reduction target



Past Forest Reference Levels (under Kyoto) allowed policy assumptions

(see Figure 5.12 from COM(2016)249, LULUCF IA)



The new FRLs will be based on the **continuation of current forest management practice and intensity** (documented for 1990-2009).