FFGS Concept

HYDROLOGIC RESEARCH CENTER

2 May 2017

Research and Development History

- **1970-1988**: US NWS Produces **FFG statistically** for each River Forecast Center. Also, **research** in adaptive site specific FF prediction systems.
- **1988-1993**: IIHR/HRC develop **physically consistent FFG formulations based on GIS** and create the first operational codes for US NWS
- **1993-2005**: HRC continues **research** in various aspects of the FFG process and system (sparsely gauged basins and uncertainty issues, forcing and models). The development of **prototype regional systems** using FFG is proposed and accepted in work plan of **WMO CHy Working Group on Applications** (**2002-2003**)
- **2004**: The **Central America Flash Flood Guidance System becomes operational** (serves 7 countries in CA)
- **2008: WMO, USAID, NOAA, HRC sign a quad-part Memorandum of Understanding to collaborate in the development of a global flash flood guidance system (currently in second 5-year phase)**

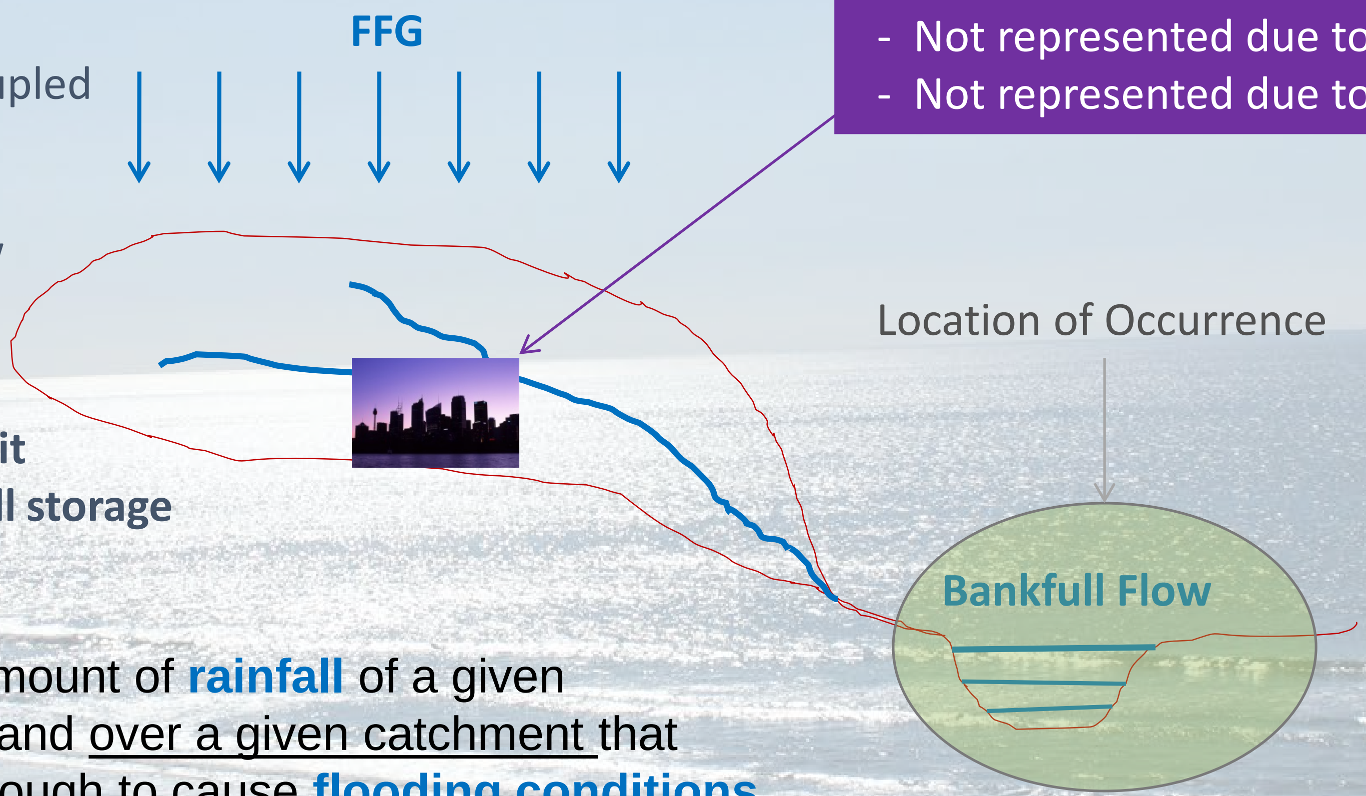
FFG Fundamental Concepts

Rainfall threshold (familiar concept)

Meteorology and hydrology decoupled for adjustments

Concerned only with bankfull flow

Urban environment
- Not represented due to scale
- Not represented due to sewers



Soil Water Deficit
Channel bankfull storage

FFG: Amount of **rainfall** of a given duration and over a given catchment that is just enough to cause **flooding conditions** at the outlet of the draining stream

Threshold exceedance concept to estimate occurrence only!

Examples of soil texture and infiltration rates

Maximum Daily Rainfall observed
187 cm/day - Reunion

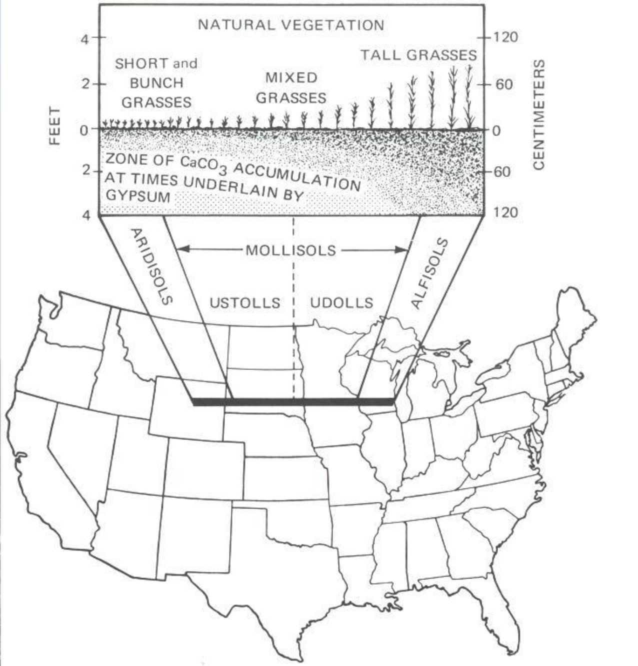


FIGURE 12:7. Correlation between natural vegetation and certain zonal soil groups is graphically shown for a strip of territory in north central United States. The control, of course, is climate. Note the greater organic content and deeper zone of calcium accumulation as one proceeds from the drier areas in the west toward the more humid region where prairie soils are found.

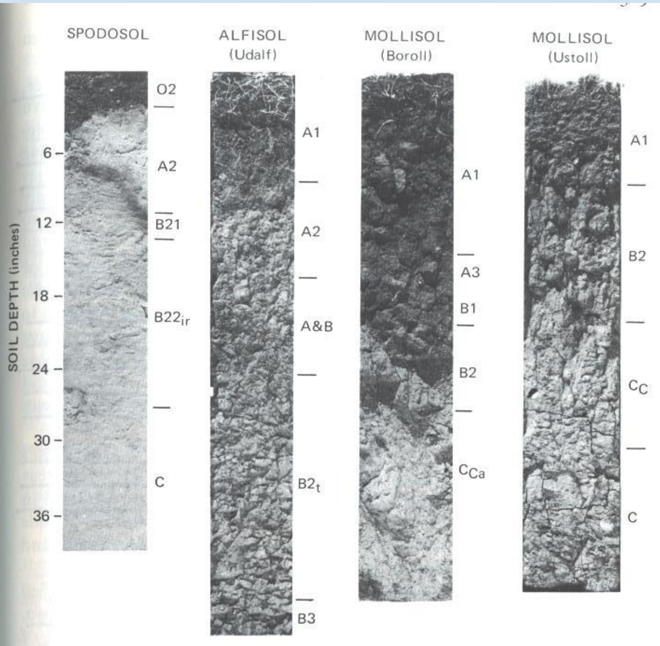


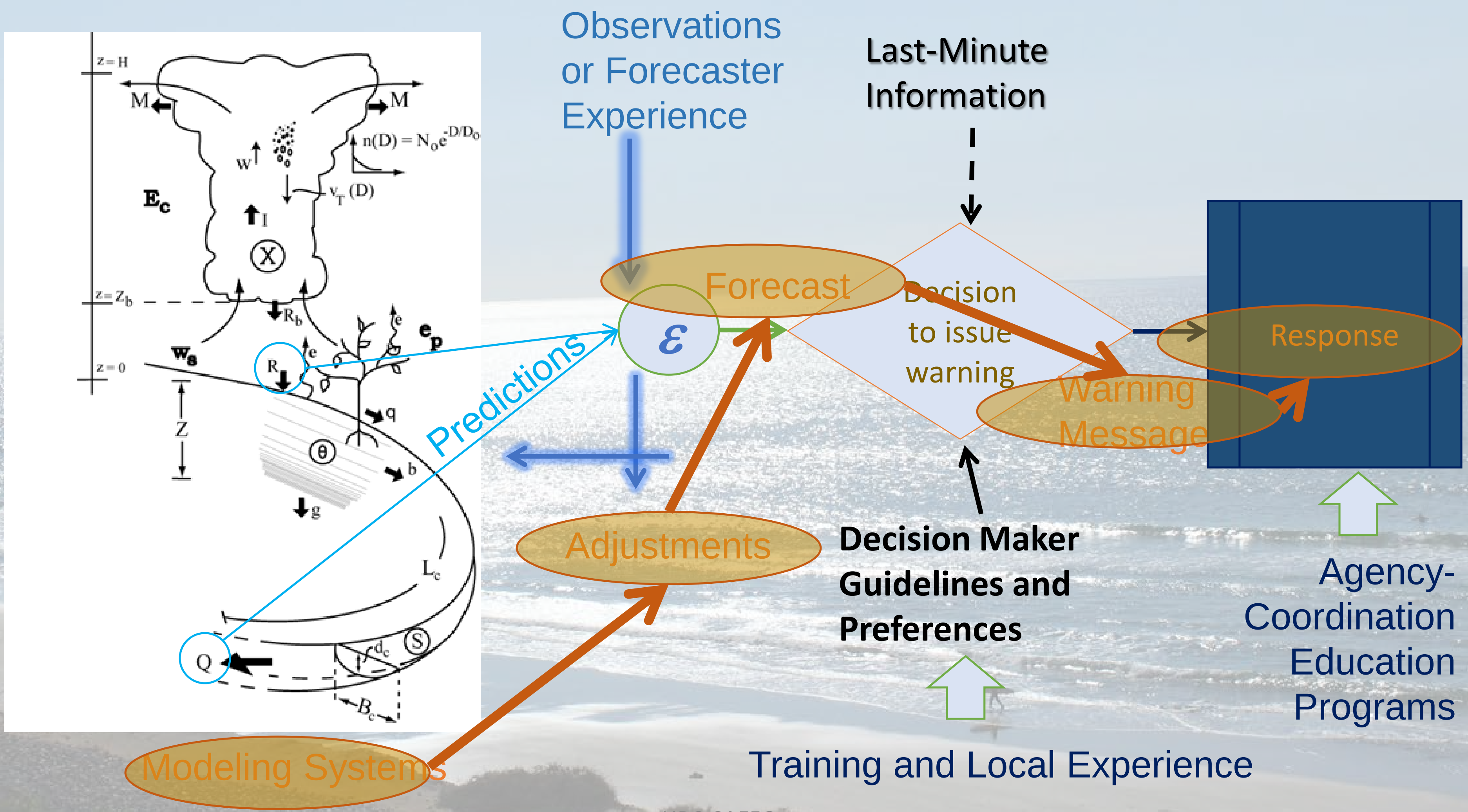
FIGURE 12:8. Monoliths of profiles representing four soil orders. The suborder names are also shown (in parentheses). Note the spodic horizons in the Spodosol characterized by humus (h) and iron (ir) accumulation. In the Alfisol is found the illuvial clay horizon $B2_t$. The thick dark surface horizon (mollic epipedon) characterizes both Mollisols. Note that the zone of calcium accumulation (C_{Ca}) is higher in the Ustoll, which has developed in a dry climate.

Brady, N.C., 1974: The nature and properties of soils. McMillan Publ. Co., NY.

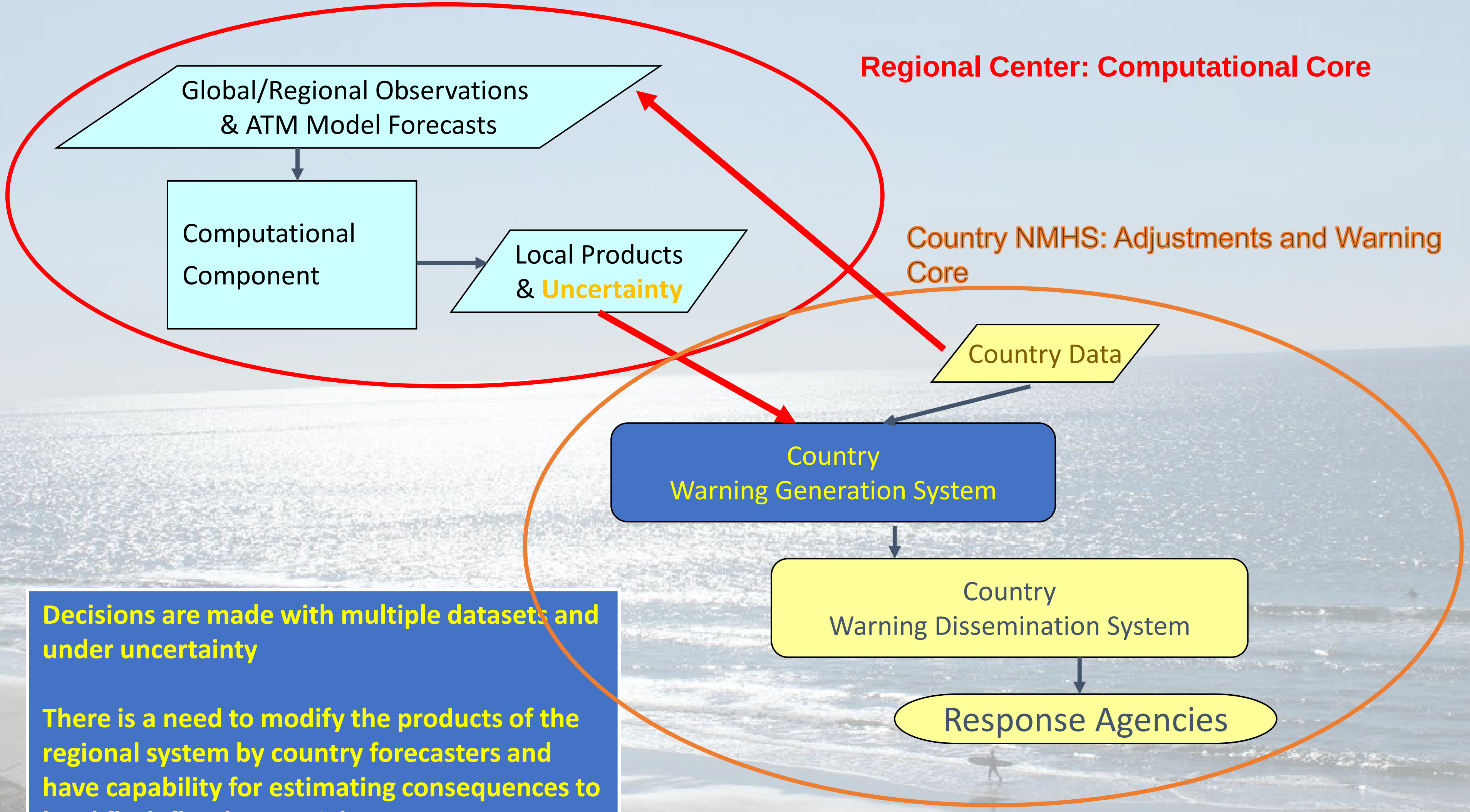
Profile	Depth (cm)	Horizon Description	Upper Limit Infiltration Rate (cm/day)
RP-1	10	A/B	5,760
	40	C/Bt Clay in fractures	26
	80	C/Bt Clay in fractures	19
RP-2	40	Bt2	9
	80	Cox/t Saprolite with clay in fractures	55
RP-3	40	Cox/t Saprolite with clay in fractures	180
	80	Cox/t Saprolite with clay in fractures	160
RP-4	10	Bw/C Disturbed horizon	14,400
C-1	10	Bt	60
	120	Saprolite	180
	300	Saprolite	85
C-2	50	Bt	85

Harmon, R.,S., (ed.) 2005: The Rio Chagres, Panama. Springer, The Netherlands.

Integrated Systems for Real-Time Warning



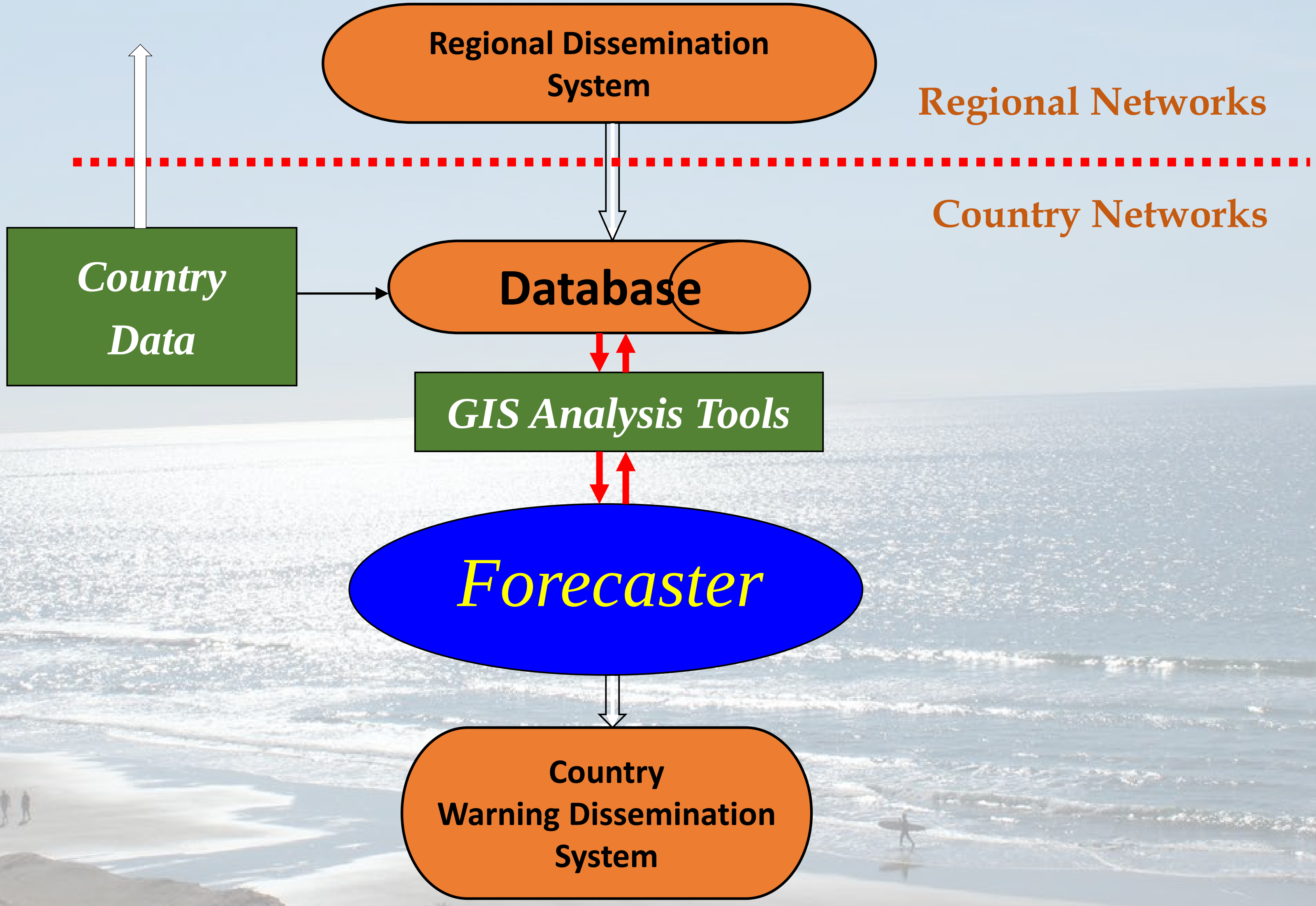
FLASH FLOOD GUIDANCE SYSTEM
From Global Data and Regional Hydrometeorology to Country Data and Warnings



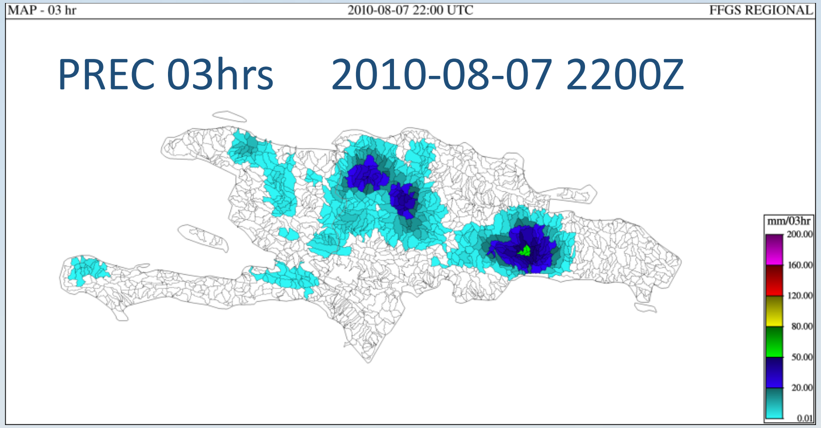
Decisions are made with multiple datasets and under uncertainty

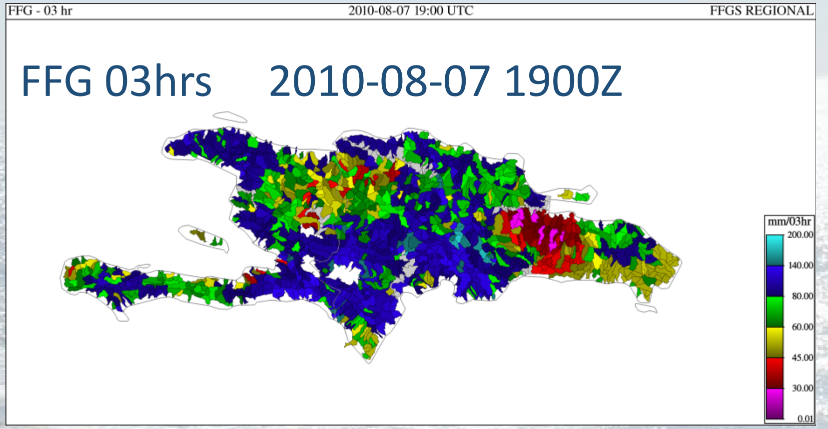
There is a need to modify the products of the regional system by country forecasters and have capability for estimating consequences to local flash flood potential

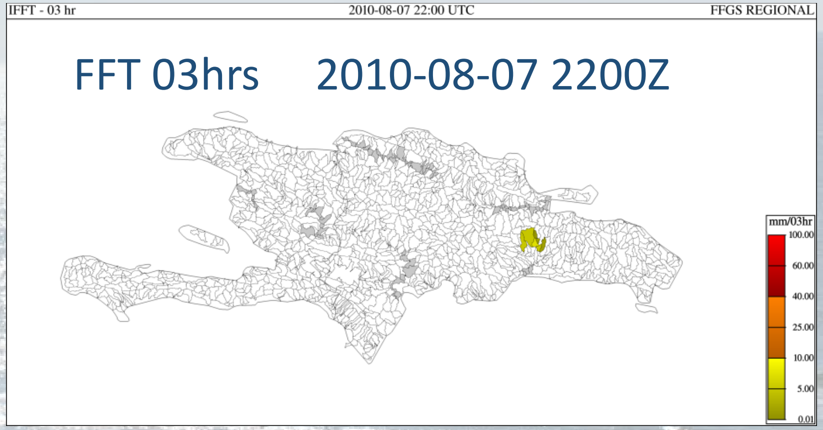
Local System for Warnings



Application of Flash Flood Guidance

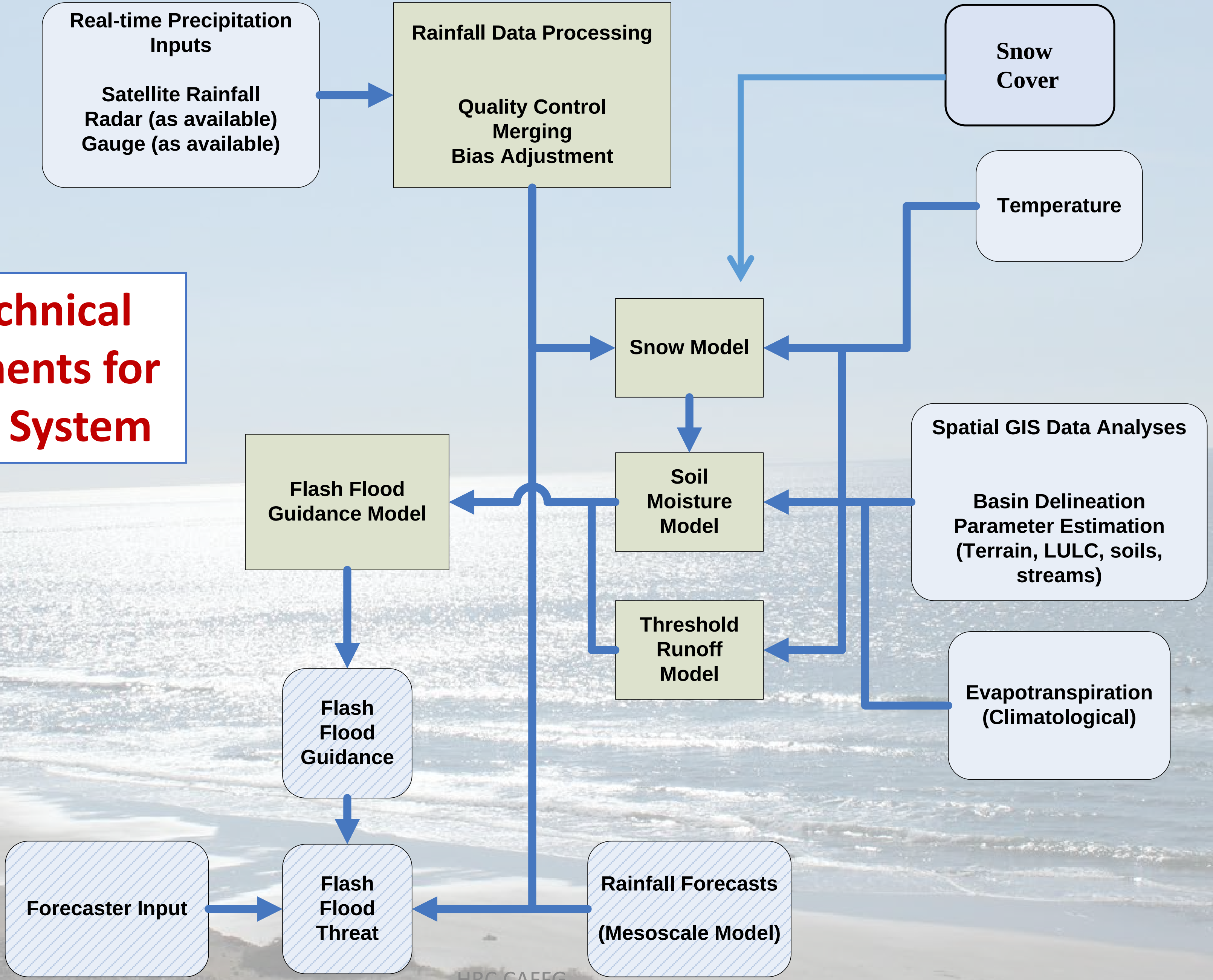






Flash Flood Guidance (FFG): **The amount of actual rainfall of a given duration over a small basin required to generate flooding flows at the outlet of the basin.**

Key Technical Components for the FFG System



Desired Prerequisites

Country data support (e.g., spatial data for soil type and texture, basin delineation verification, historical hydrometeorological data for bias adjustment and snow/soil water model calibration, etc.)

Links of regional center to national real time databases for reduction of uncertainty in precipitation input and increase of reliability

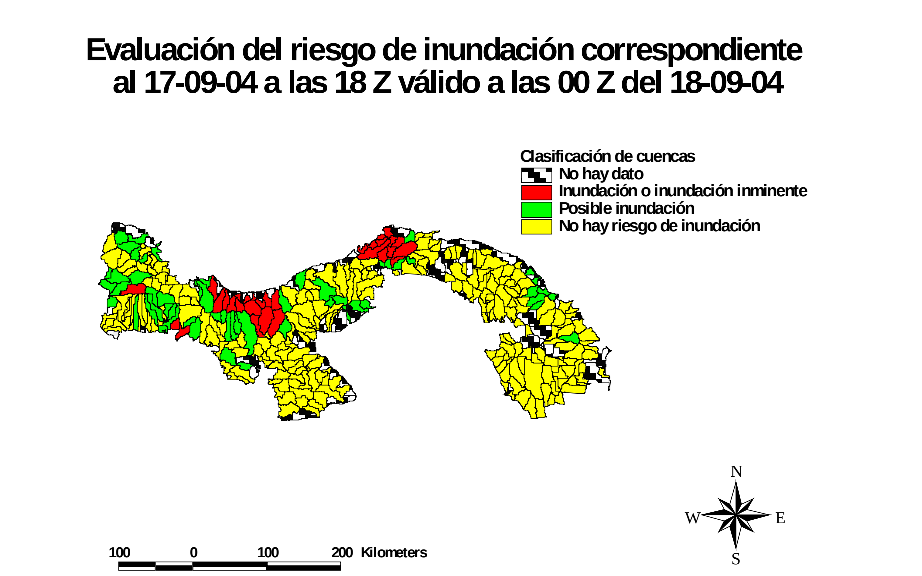
Development of databases of observed flash flood occurrence for validation

Reciprocal training of forecasters and disaster managers and development of well defined a priori plans for response

Enhance public information on flash floods, their perils and the needed response measures

Example of Warning Validation

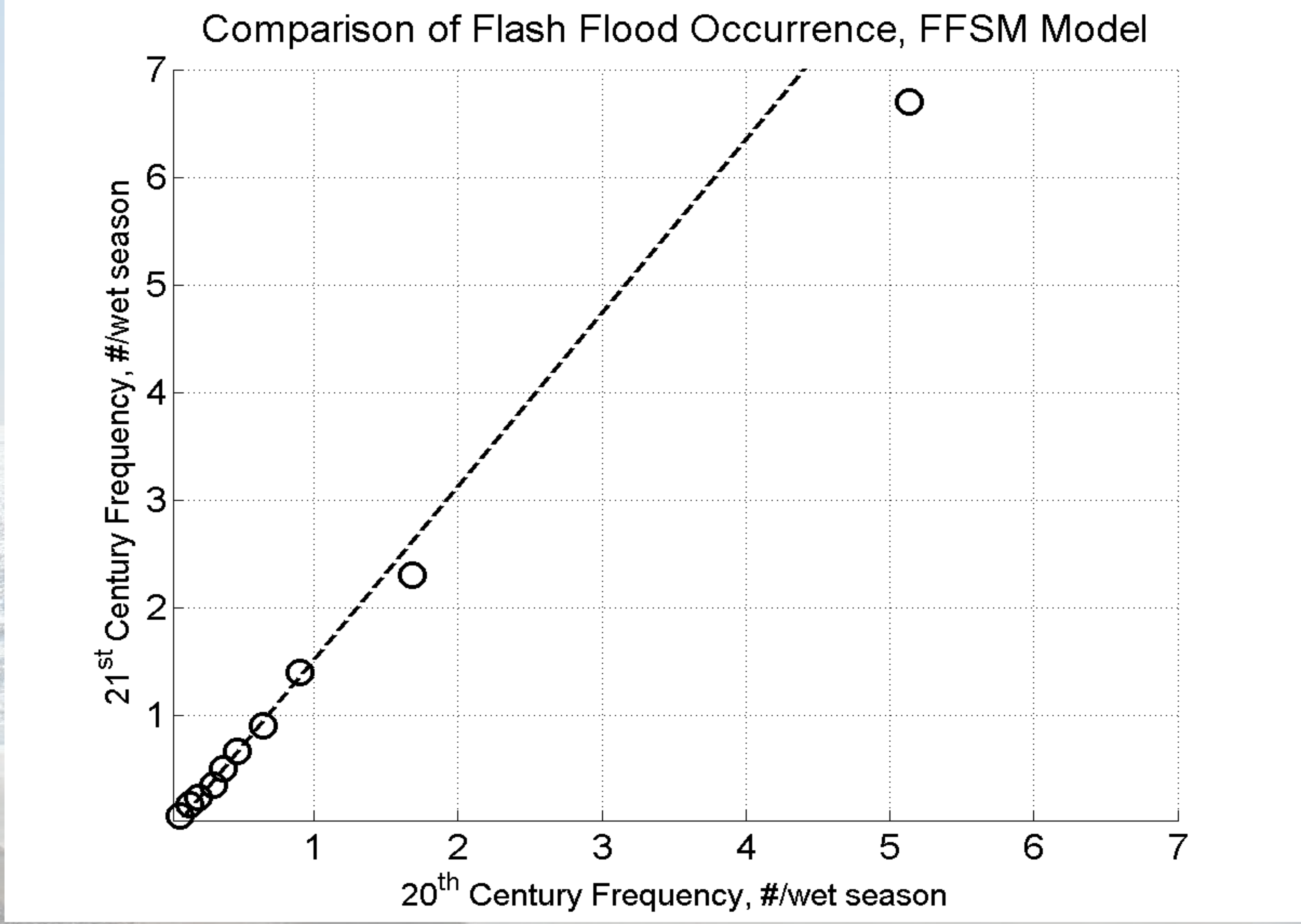
System operators from Costa Rica and El Salvador were in daily communication with Country Agencies to receive community information regarding local flooding (2.5 months in Fall 2004)



Flooding in the Panama Canal verified by local TV news. Flooding time at the airport was reported at approximately 9 p.m. local time.

3-Hourly FF Threat (*adjst*):
Hits: 57% (*63 – 100%*)
False: 30% (*0 - 21%*)
Misses: 13% (*0 - 16%*)

Climate Change Impacts (Southern California)



FFG Development Team at HRC

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Robert Jubach - Program Management/Disaster Risk Reduction

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Eylon Shamir – Soil Water and Snow Models

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Rochelle Graham – Education and Training