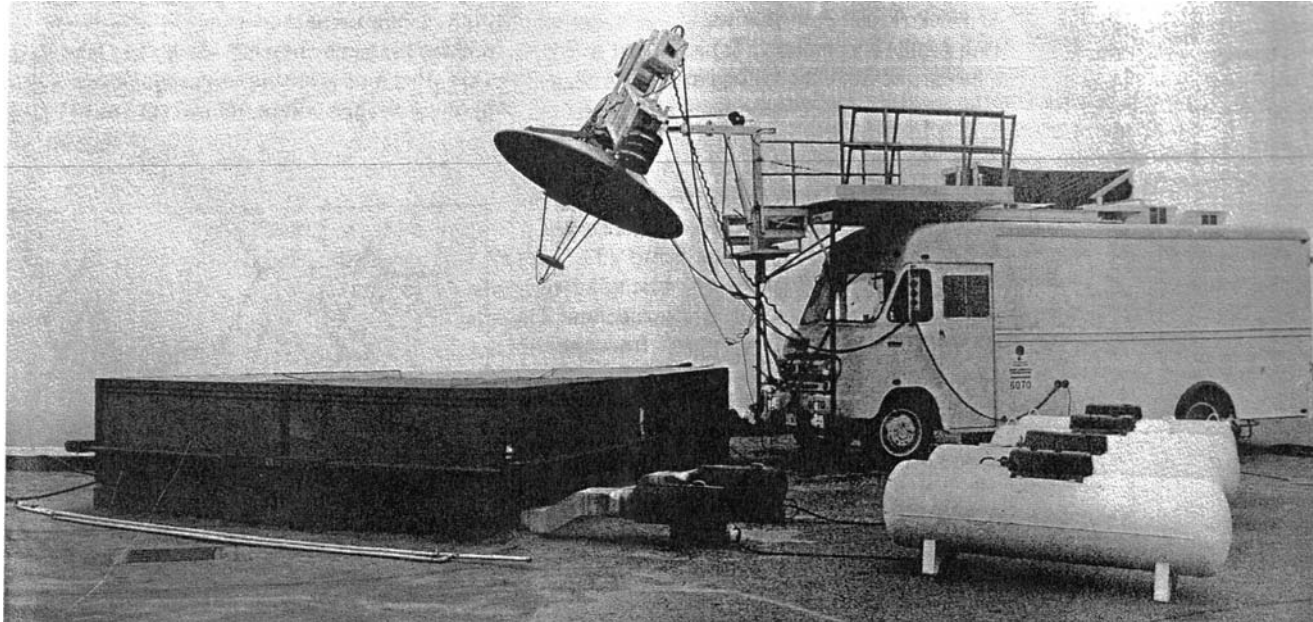


# A Brief Overview of Passive Microwave Experiments over Land



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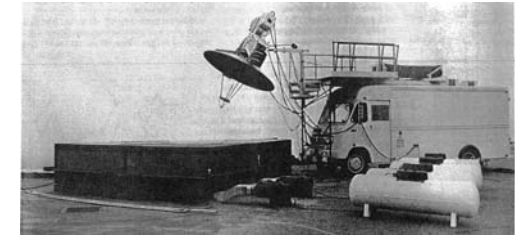
# Outline

- **Overview**
- **Discussion**
- **Future**



# Overview

First experiments in Laboratory > Validation of Theory  
 Bare soil experiments > Sand/Gravel



BARC experiment > different crops and bare soil  
 > valuable database (data available at [hydrolab.arsusda.gov](http://hydrolab.arsusda.gov))

PERIOD	GROUP/ PROJECT	LOC.	RADIOM.	FREQ. (Ghz)	SURFACE	REF
1968					Snow	Edgerton et al. 1968
1970	NASA-JPL	Lab.		L,X,Ka	Bare	Blinn et al, 1972
1975	NASA-JPL	Lab.		0.25-25	Bare	Njoku and Kong, 1977
1977	Tex.Uni	Texas		L	Bare	Newton, 1977
1979-1985	BARC	Beltsville(US)	TruckRad	L,C,X, Ka	Agri.C	Wang et al., 1983



# Overview

More Groups get involved:

- The Italians: > Multi freq. measurements above crops > vegetation study  
The Swiss: > Bare soil emissivity catalogue  
> Transmissivity measurements of a forest

PERIOD	GROUP/ PROJECT	LOC.	RADIOM.	FREQ. (Ghz)	SURFACE	REF
1980	Microrad	Florence (IT)	IROE	L,C,X,Ku,Ka	Agri.C.	Paloscia et al., 1993
1986-1992	U.Bern	Var.	PAMIR/ RASAM	1-100 Ghz	Var.	Matzler (1994), Wegmuller et al, 1994

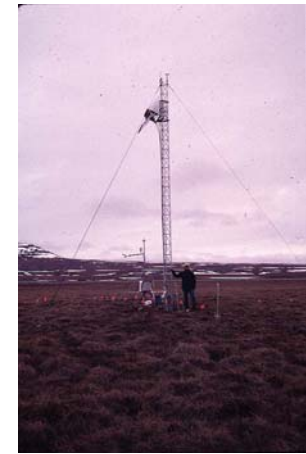


# Overview

**Microwave experiments at NOPEX and EFEDA**

> Extensive  $\omega$ - $\tau$  study

**Cal-Val experiments for SSM/I (REBEX)**



**TMRS in Alaska**

PERIOD	GROUP/ PROJECT	LOC.	RADIOM.	FREQ. (Ghz)	SURFACE	REF
1991	BARC	Beltsville (US)	RusRad	L,C	Agri.C.	Owe (Pers Comm)
1991-1993	PORTOS	Avignon (F)	PORTOS	L,C, 20-90	Agri, bare	Wigneron et al 96
1992-2000	REBEX	Var.	TMRS	Ku,Ka	Var.	<a href="http://www.eecs.umich.edu/grs/">http://www.eecs.umich.edu/grs/</a>
1994	NOPEX	Uppsala (SW)	RusRad	L,C	Agri.C.	Owe (Pers Comm)
1994	EFEDA	Tomelloso (SP)	RusRad	L,C	Vineyards	Gouweleeuw, 2000



# Overview

**Big S.Great Planes exp. (ground/air)  
Development of new Sensors**



**DSD**



**SWaMP-L**

PERIOD	GROUP/ PROJECT	LOC.	RADIOM.	FREQ. (Ghz)	SURFACE	REF
1997/99	SGP97/99	Washita (US)	SLMR	L,S	Agri.C.	<a href="http://hydrolab.ar.susda.gov/sgp997/">http://hydrolab.ar.susda.gov/sgp997/</a>
1999	ESSC	Reading (UK)	SWaMP-L	L	Bare	Pearson et al., 2000
2000	UMICH	Michigan (US)	DSD	L	?	<a href="http://www.eecs.umich.edu/grs/">http://www.eecs.umich.edu/grs/</a>



# Overview

**More Groups,.....More Sensors**

- > Long term measurements
- > High temporal resolution



**LEWIS at Fauga**

PERIOD	GROUP/ PROJECT	LOC.	RADIOM.	FREQ. (Ghz)	SURFACE	REF
2001	INRA	Avignon (F)	EMIRAD	L	Corn, Bare	Parde, 2003
2002	ETH	Eschikon (CH)	ELBARA/ MIRA	L,X	Bare	Schneeberger, 2003
2002	MASMEX	Alps (IT)		L,C,Ka,Ku	snow	Macelloni et al., 2003
2003-2005	SMOSREX	Fauga (F)	LEWIS	L	Bare,Fallow	De Rosnay et al



# Overview

- > Simultaneous measurements of different sites
- > Important forest studies



**ELBARA**

PERIOD	GROUP/ PROJECT	LOC.	RADIOM.	FREQ. (Ghz)	SURFACE	REF
2003	VUA	Wageningen (NL)	ELBARA	L	Bare,grass	De Jeu et al
2003	REFLEX	Valencia (SP)	LAURA	L	Vineyards	Vall-Ilossera et al 2005
2004	ETH	Eschikon (CH)	ELBARA	L	Grass	Schwank et al
2004	BRAY	Les Landes (F)	EMIRAD	L	Forest	Wigneron et al
2005	ETH	Julich (G)	ELBARA	L	Forest	Schwank et al



# Discussion

- Impressive list of field observations
- Many groups are involved nowadays
- Improvement radiometers
- At least 7 field radiometers operational (or ready to use):
  1. LEWIS (CNES-CESBIO-ONERA, France)
  2. ELBARA (ETH, Swiss)
  3. LAURA (Univ. Catalunya, Spain)
  4. DSD (Univ.Mich., USA)
  5. SLMR (NASA/GSFC, USA)
  6. SWaMP-L (ESSC, UK)
  7. Multifreq. Rad (CNR-IFAC, Italy)
  8. EMIRAD (Tech. Univ. Denmark)
  9. Radiometer of Ontario group (Duke et al.) ?
  10. Radiometer of group from India (Singh et al.) ?



# Discussion

**At least a dozen airborne missions over a variety of land surfaces, for example:**

- **PBMR during FIFE, HAPEX MOBILHY**
- **PORTOS during PORTOS93, HAPEX SAHEL**
- **EMIRAD during NOPEX**
- **ESTAR during SGP97 SGP99**
- **PALS during SGP99 SMEX02**
- **2DSTAR during SMEX03 SMEX04**



**EMIRAD in Airplane**



# Discussion

**Development of new airborne instruments and experiments:**

- **PLMR<sup>+</sup>, NAFE (C. Rudiger/J. Walker)**
- **STAR-LIGHT (U.Mich)**
- **MIRAMAP (private company at ESA)**
- **French ATR42 for SMOS cal-val ?**



# Discussion

**However;**

**We have to be careful not to do similar experiments**

- **Keep an open discussion**
- **Start comparison studies**
- **Use historical information**
- **Look for more collaboration**



# Future

**Do we need future experiments ?**

- **Comparison studies between different sensors**
- **Measurements of urban areas > RFI problem**
- **Transmissivity studies**
- **Comparison of flux measurements with microwave**
- **??**

