The Soil Moisture and Ocean Salinity Mission

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Presented by

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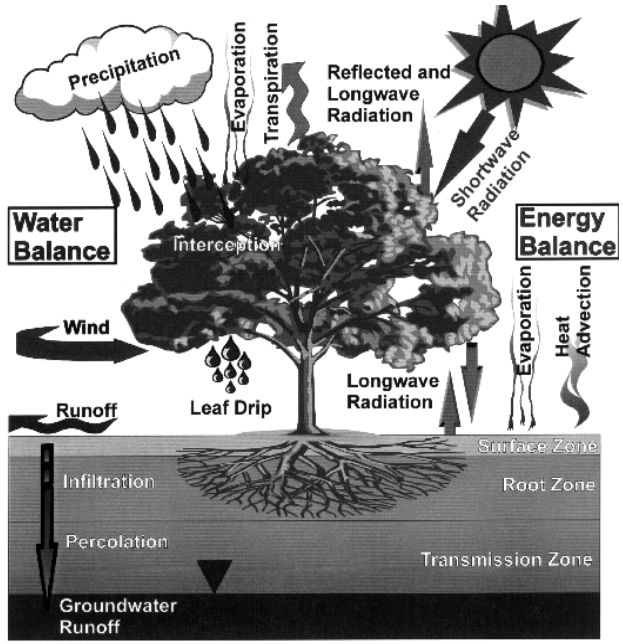
SM Rationale

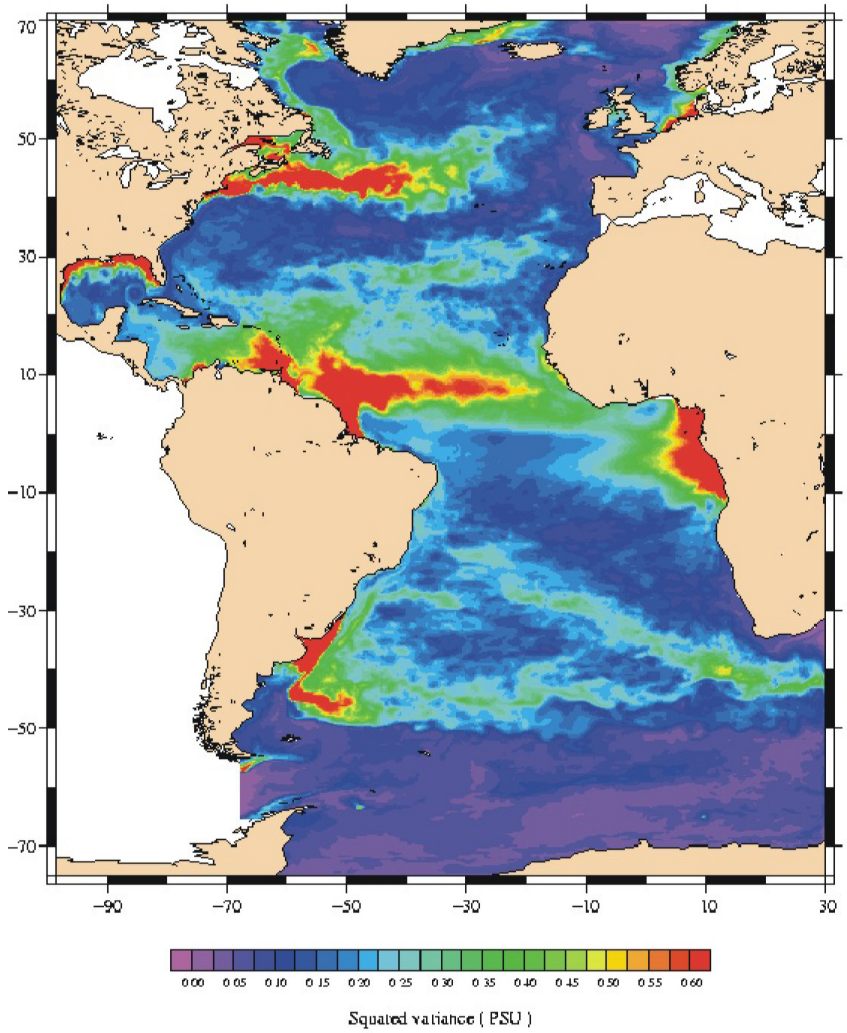
- Role of Soil moisture in surface atmosphere interactions:
  storage of water (surface and root zone), water uptake by vegetation (root zone), fluxes at the interface (evaporation), influence on run-off
- Implies relevance for
  Weather and climate forecasts
  Water resources
  Crop management
  Forecast of extreme events
- Climate change predictions and rain event forecasts requires SST and SM



multi-angular
dual pol
4 % vol 3 day revisit
(Vegetation 7 day)
better than 50 km

Need For SSS data

Modelled SSS **temporal variability** in the Atlantic Ocean: up to more than 0.6 psu (Le Traon et al., 2002)



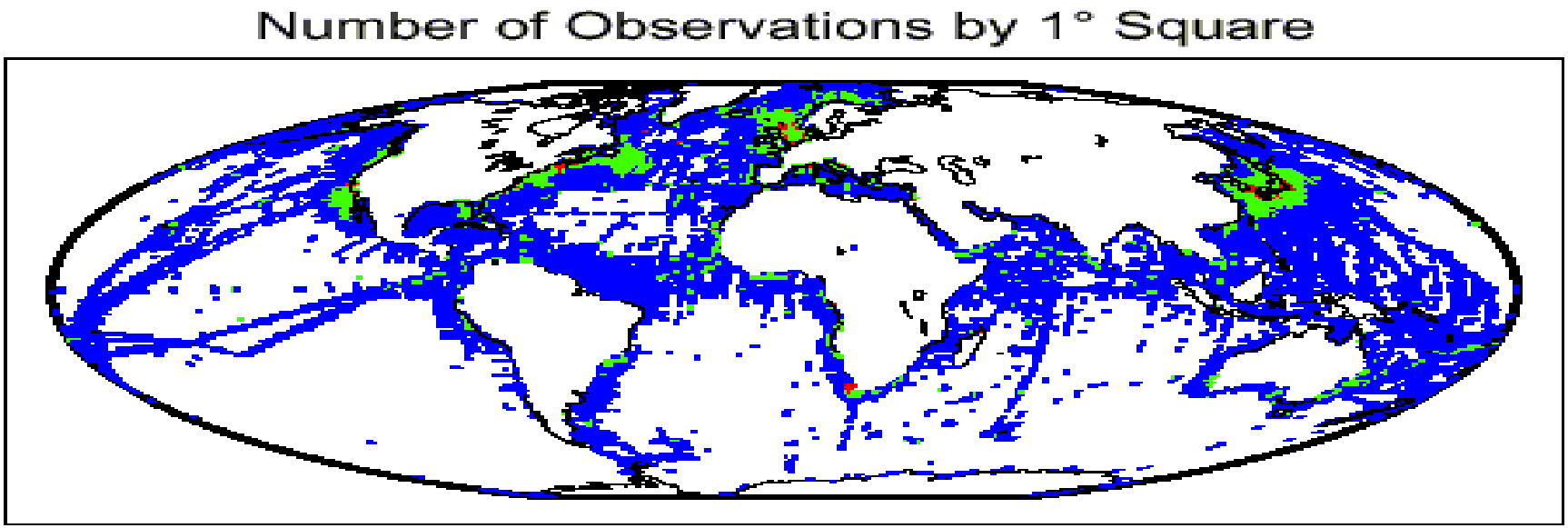
There is an urgent need of obtaining global SSS maps with a space mission as recognised by the GOOS (Global Ocean Observing System) Scientific Plan

SMOS is responding to this need

Ocean Salinity Rationale

- **Thermohaline overturning circulation.**
  How can climate variations induce changes in the global ocean circulation?
- **Air-sea freshwater budget.**
  How are global precipitation, evaporation, and the cycling of water changing?
- **Tropical ocean and climate feedback**

Lagerloef et al., 2001



The *SMOS* Mission

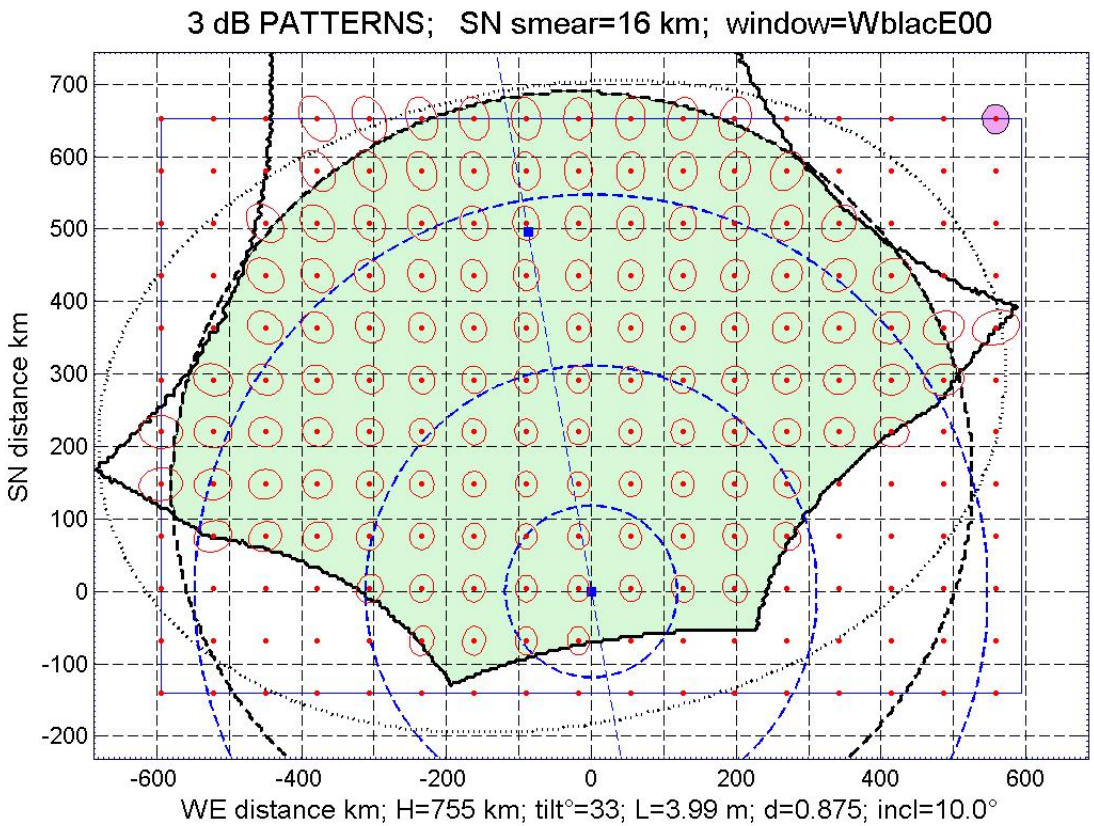
- *SMOS* is the second Earth Explorer opportunity mission (1st round)
- An ESA/CNES/CDTI project
- Selected in 1999, initiated in 2000
- Phase B finished, C/D Started in January 2004 for a launch in 2007
- A **new technique** (2D interferometry) to provide **global measurements** from space of **key variables** (SSS and SM) for the **first time**.

•Need for soil moisture and sea surface salinity fields
•Only passive L band suitable
•Real aperture systems currently not adequate (antenna size) ==>Synthetic antenna

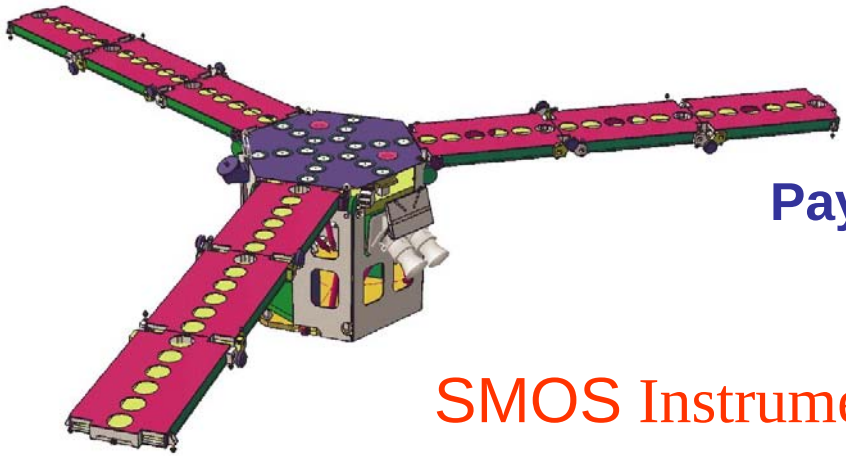
Principle of operations

SMOS FOV; 755 km, 3x6, 33° , 0.875λ,

- Each integration time, (2.4 s) a full scene is acquired (dual or full pol)
- Average resolution 43 km, global coverage
- A given point of the surface is thus seen with several angles
- Maximum time (equator) between two acquisitions 3 days



P. Waldteufel, 2003



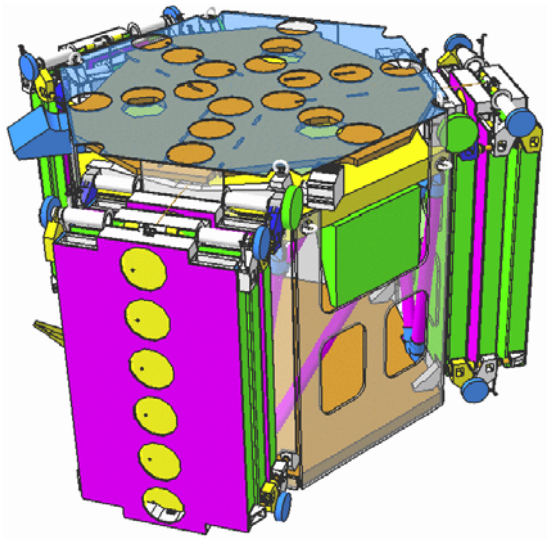
Payload Module (deployed)

SMOS Instrument: MIRAS derived concept
CASA EADS (Spain)

BUS: PROTEUS
Alcatel SPace Industry

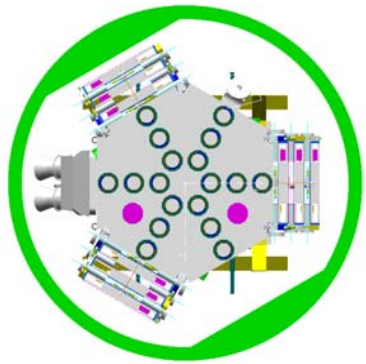
Launcher: ROCKOT

Ground segment: Level 0-2 Villafranca
Level 3-4 Toulouse



Payload Module (stowed)

SMOS in Rockot



CASA EADS, 2003

Data products

Level 1: brightness temperature at H and V polarisation (or full pol) at antenna level and ground level on a fixed grid

Level 2: daily soil moisture and ocean salinity (swath) maps at basic temporal and spatial resolutions

Level 3: daily global soil moisture maps global salinity maps

Level 4: special products

Services

All data products are produced (with quality statement) and distributed to registered users.

- All data products are archived for the duration of the mission plus 10 years.
- All data products are in a catalogue with a browse facility.

Calibration

- Calibration of a SMOS like system is not trivial
- Need to “calibrate” both the interferometer and the radiometer
- Use of different approaches
  - on ground characterisation and modelling of instrument
  - on board in orbit calibration and instrument monitoring
  - use of extended well known sources (gal background)
  - use of point sources ? (sun but manœuvres, thermal)
  - Other sensors (HYDROS Aquarius) and vicarious calibration schemes?

Other activities

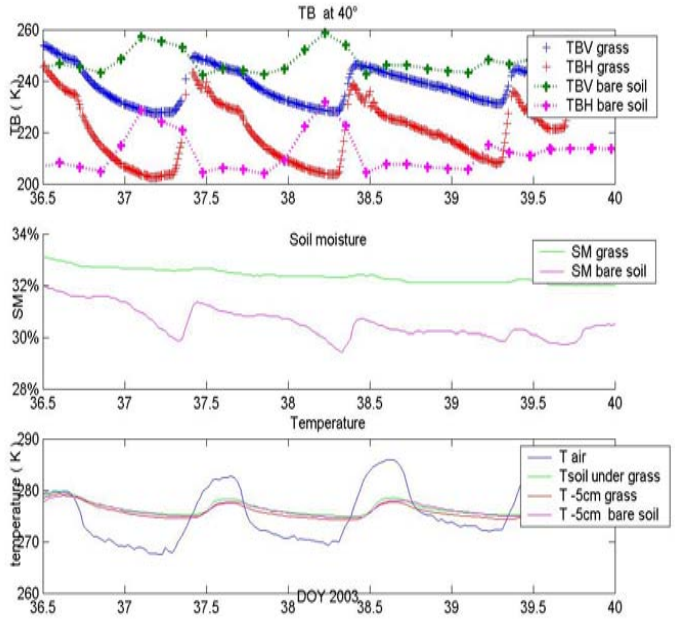
- Work on reconstruction algorithm & retrieval algorithm improvements initiated at ESA
  - Level 1 processor
  - Level 2 processors just initiated
- Cal Val AO open (15/4/2005)
- Mission simulator (SEPS) has been released
- Soil moisture retrieval algorithm breadboard released
- Field campaigns, field measurements, dielectric constant measurements
- Synergisms with other sensors including future potential L band systems (**Aquarius, Hydros**)
- Work on “exotic” targets (mountains, frozen soils , arid soils, ….

LEWIS

L band for
Estimating
Water
In
Soils

23 January 2003

High Quality
Ground based radiometer
1.4 GHz, H & V
sensitivity 0.1 K
main lobe 12.5 @3db,
22° beam efficiency 0.986
No « visible » back lobes
ONERA/CESBIO
Operational since 23/1/2003



LOSAC Campaign

L-band Ocean Salinity Airborne Campaign

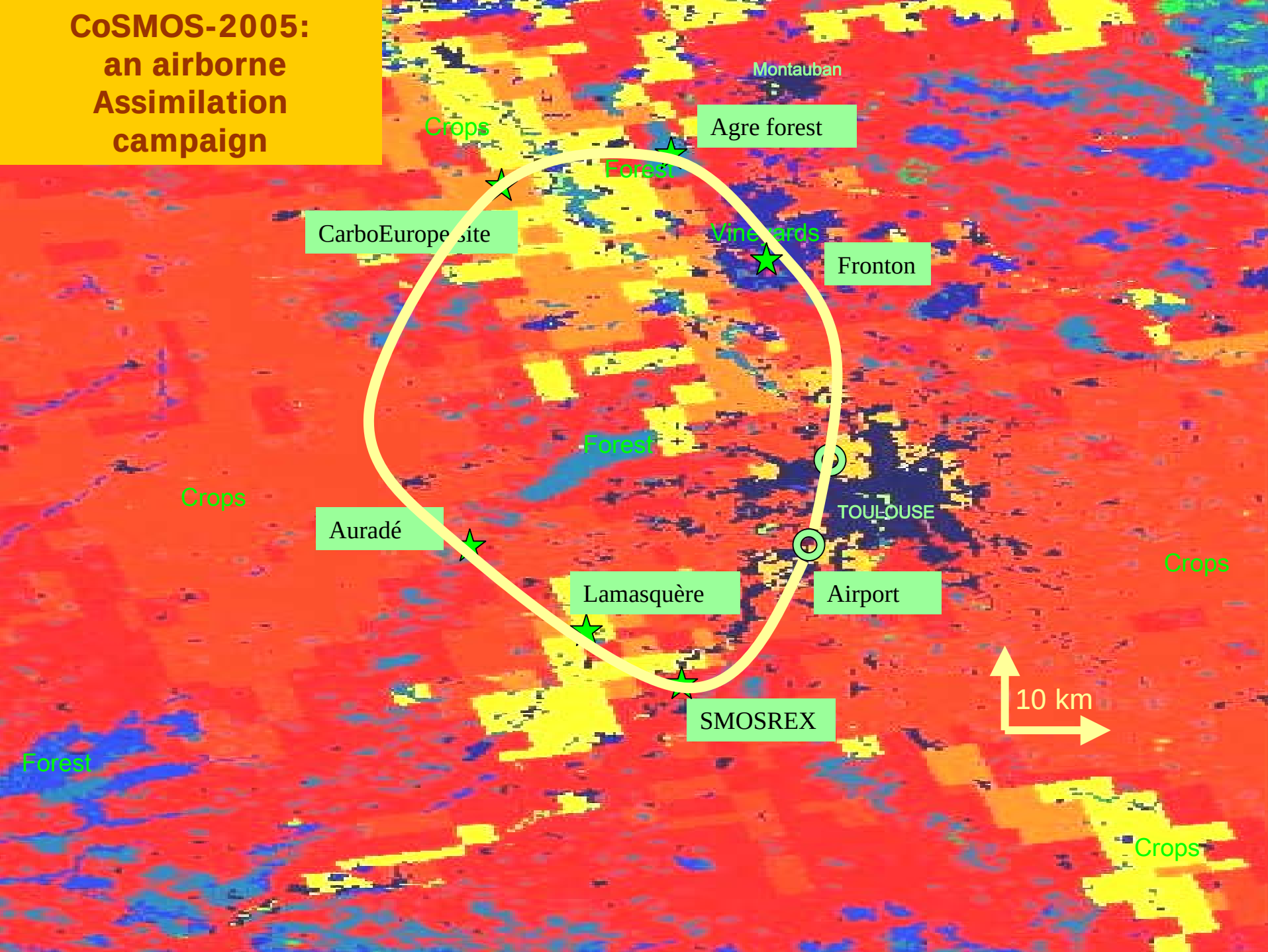
Technical University of Denmark (Niels Skou)
EMIRAD L-band radiometer
full polarisation

Danish Air Force C-130 aircraft
23° depression angle
circular flights 25°-62° incidence
1000, 2000, 3000 m

16 Jan 2001 (test)
15 Mar 2001 North Sea
23 Mar 2001 Kattegat
25 Oct 2001 North Sea
6 Mar 2003 Norwegian Sea

coSMOS-2005 Toulouse

- Objectives
  - Extend current field campaigns dedicated to data assimilation (e.g. SMOSREX) to a variety of surfaces
  - Validate the data assimilation algorithms for SMOS in near-operational conditions
  - Assess the use of SMOS data at the regional scale
- Data Users
  - Meteorology – ***Météo-France, ECMWF***
  - Remote sensing – ***INRA, CESBIO***


CoSMOS-2005:
an airborne
Assimilation
campaign
Montauban
Crops
Agre forest
Forest
CarboEurope site
Vineyards
Fronton
Forest
Crops
TOULOUSE
Auradé
Crops
Lamasquère
Airport
SMOSREX
10 km
Forest
Crops

Conclusion

- *SMOS* will be the first mission to deliver global fields of soil moisture and sea surface salinity
- Currently in phase C/D
- Accepted at PB-EO, IPC for ESA and General Council of CNES during Fall 2003.
- A lot of activities allowed a successful end of phase B and a seamless transition to Phase C/D
- Preparation of ground segment, cal/val initialised
- Fruitful Collaboration with US Colleagues, excellent complementarity between Aquarius and HYDROS missions
- http//www.cesbio.ups-tlse.fr/us/indexsmos.html