

# SATELLITE DETECTED (TERRA-MODIS) AND MODELLED (SAFRAN-CROCUS) SNOW COVER COMPARISON IN THE PYRENEES

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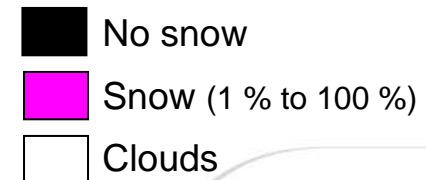
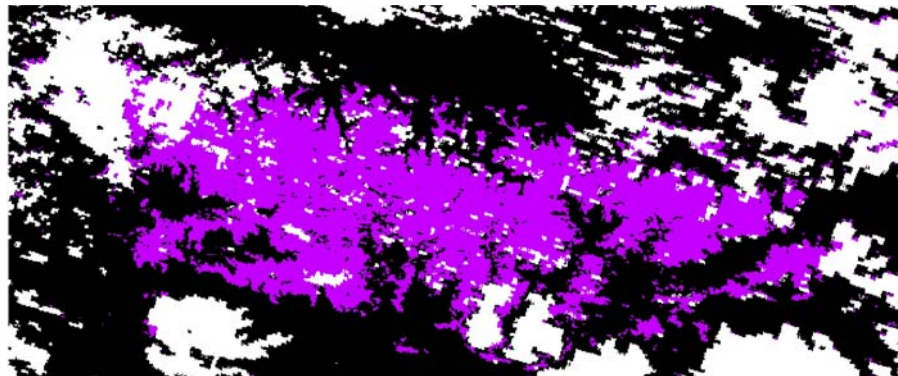
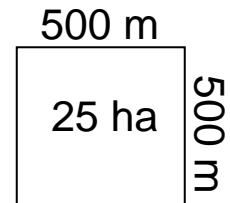
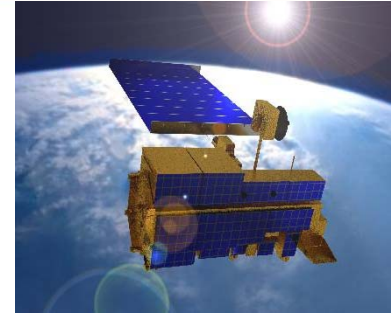
FLUXPYR-OPCC meeting - 5-8 June 2012 - Barcelona (Spain)

# OUTLINE

- ✓ **MODIS-Terra data**  
satellite snow cover data
  
- ✓ **SAFRAN-Crocus** modelled data  
modelled snow data in mountainous regions
  
- ✓ **Snow cover comparison**
  - a) between satellite and modelled data
  - b) between satellite and observed data

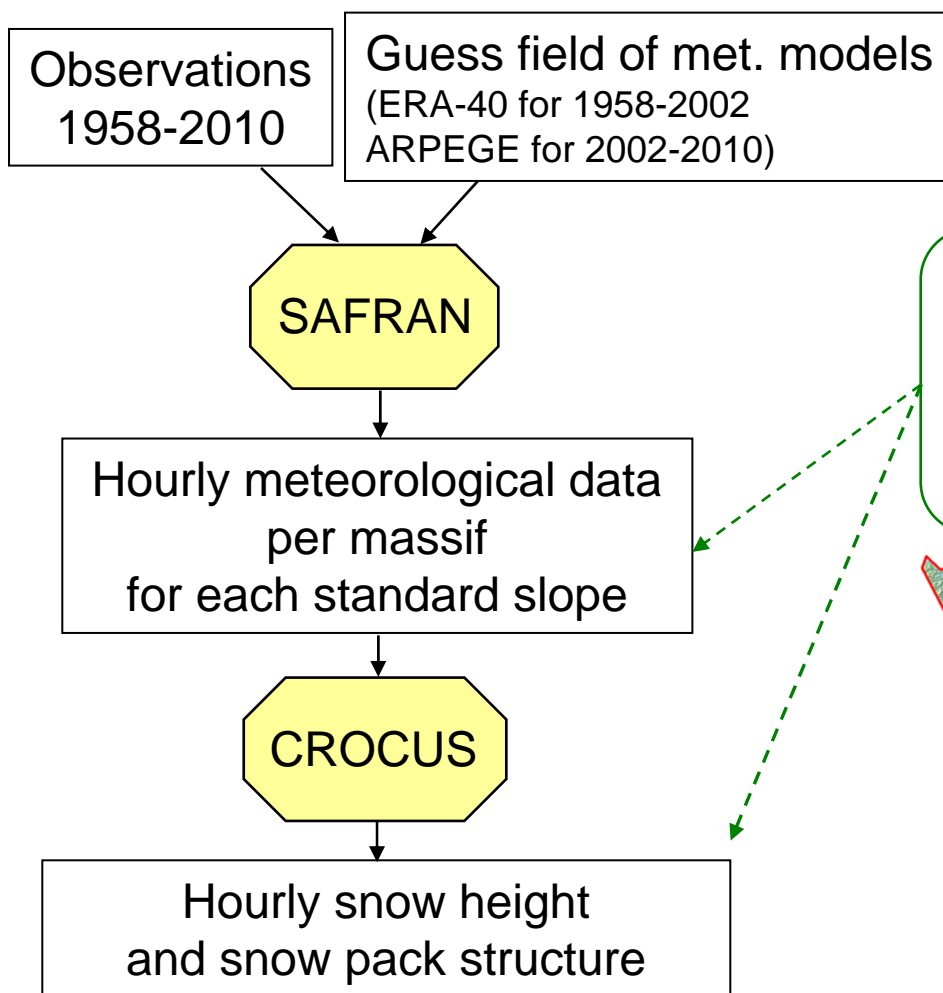
# MODIS-Terra data

- ✓ Terra Satellite launched 18/12/1999
- ✓ Daily flying over Pyrenees around at 10h30 p.m.
- ✓ Data are available since 24/02/2000
- ✓ MODIS tools : MODERate resolution Imaging Spectroradiometer :
  - 36 wavelengths
  - 250 m to 1 km resolution ; 500 m for snow measurements
- ✓ Snow data validated by Simon GASCOIN (CESBIO) :
  - 96% conformity with LANDSAT satellite data
  - differences near the snow line



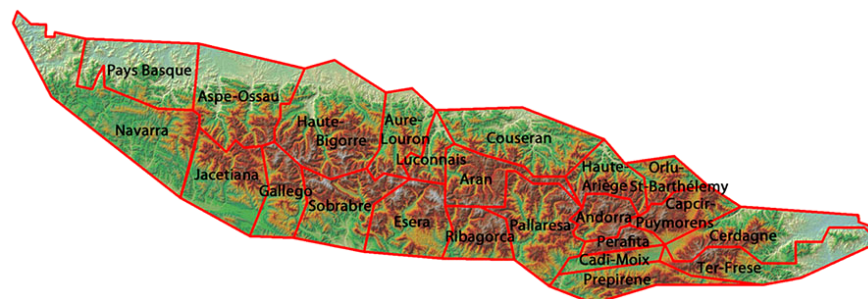
# SAFRAN-Crocus modelled data

## SAFRAN-Crocus “chain”

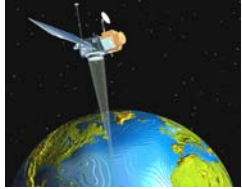


for:

- various elevations (by 300 m step)
- various aspects (6)
- several slope angles (3)
- for each of the 23 Pyrenean massifs



# Snow cover comparison between satellite and modelled data



**MODIS**

(processed by CESBIO)

- Fractional snow cover for measured land divided into 25 Ha areas
- 100 000 measured data every days (at 10:30 am)
- Cloud measures and missing data



**SAFRAN-CROCUS**

- Snow depth for points defined as a function of massif, elevation, aspect and slope
- 3 000 calculated data every day (at 06:00 h UTC)
- Forest and local topography not taken in account

Interpolation on DTM and extraction of fractional snow cover for 25 ha areas

Exclusion of clouds and missing data

Period of comparison :  
24/02/2000 - 31/07/2010

# Snow cover comparison

## a) between satellite and model data

The comparison results are divided in 4 quality classes :



Very low differences : lower than 10 %



Low differences : between 10 and 50 %



High differences : between 50 and 75 %

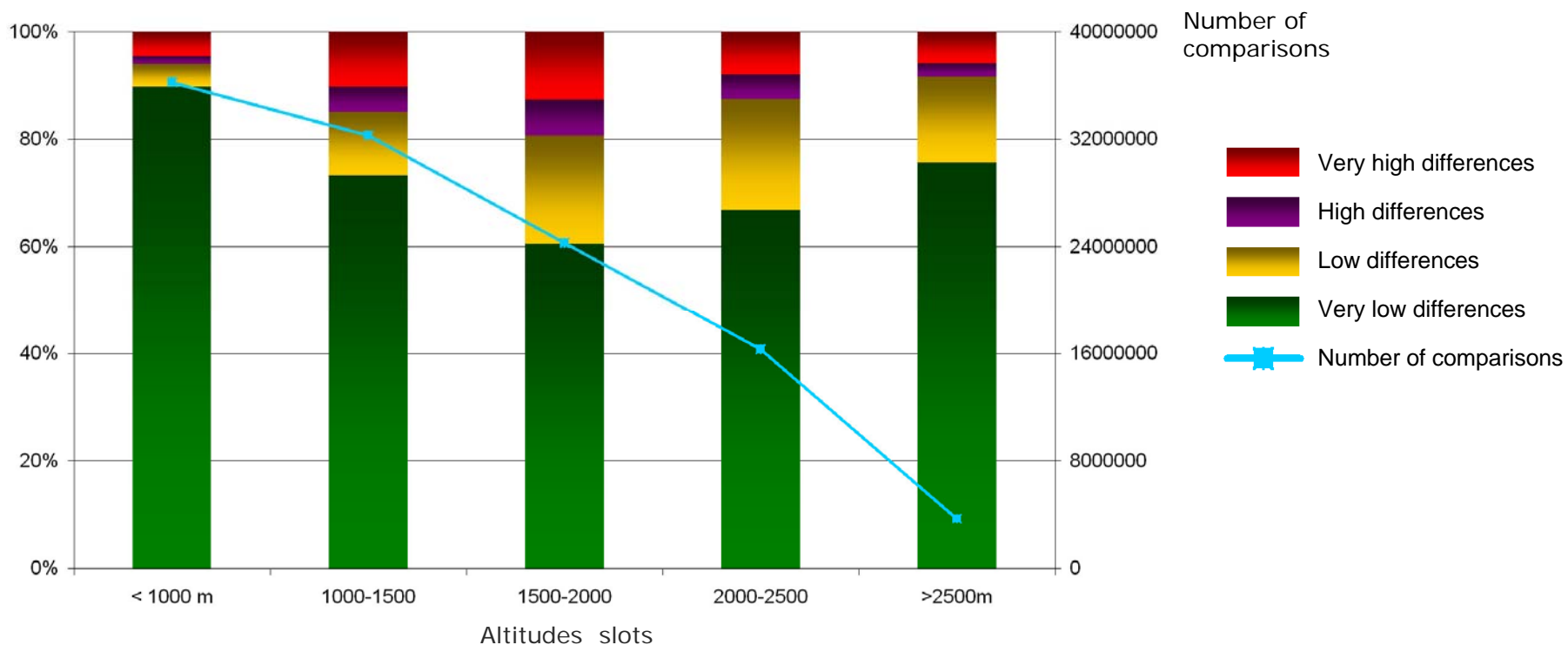


Very high differences : higher than 75 %

# Snow cover comparison

## a) between satellite and model data

**Number of comparisons between modelled and observed snow occurrence divided into four quality classes (November to May months from 2000 to 2010)**



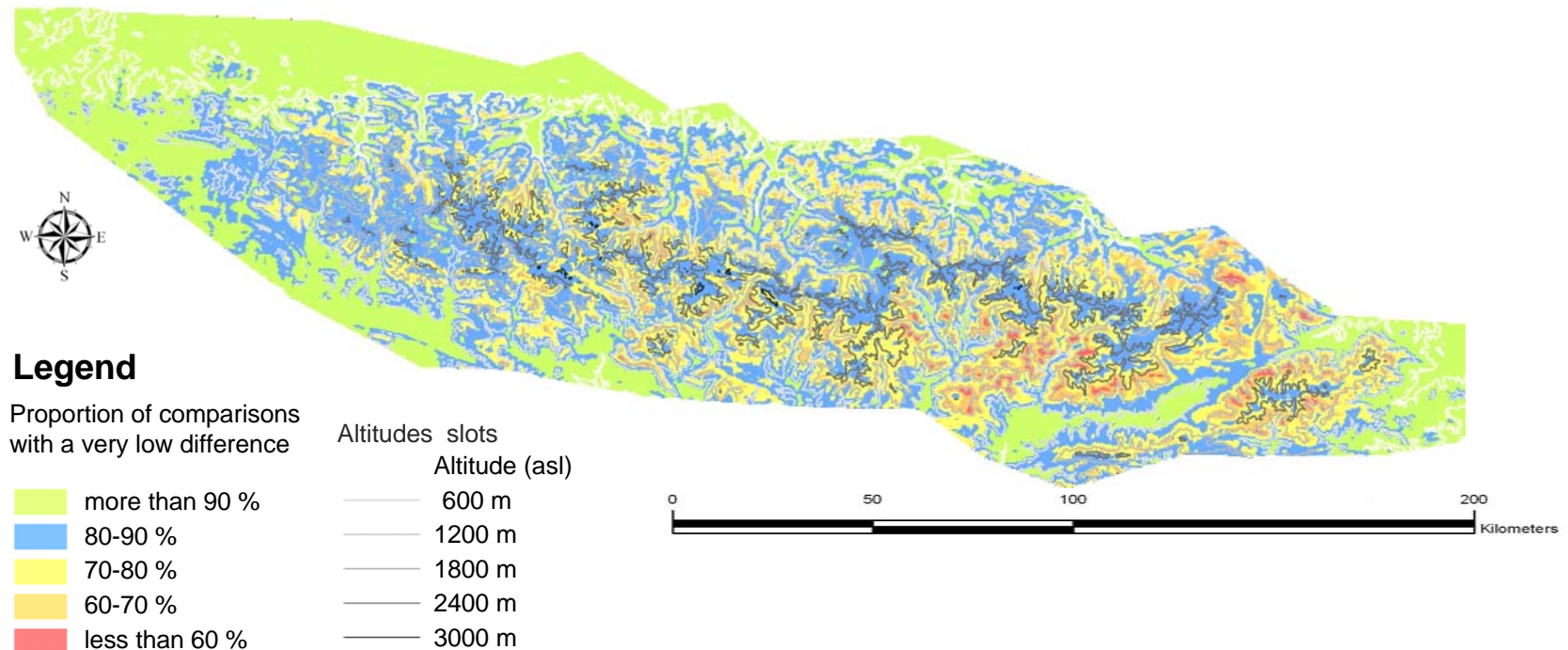
*Low differences between the two data sets on the entire Pyrenees, except for elevations between 1500 and 2000 m where there are more significant differences*

# Snow cover comparison

## a) between satellite and model data

### Proportion of data that presents a very low difference between MODIS satellite and SAFRAN-CROCUS chain

(green bar in previous graph, distributed as a function of massif, elevation, aspect and slope)



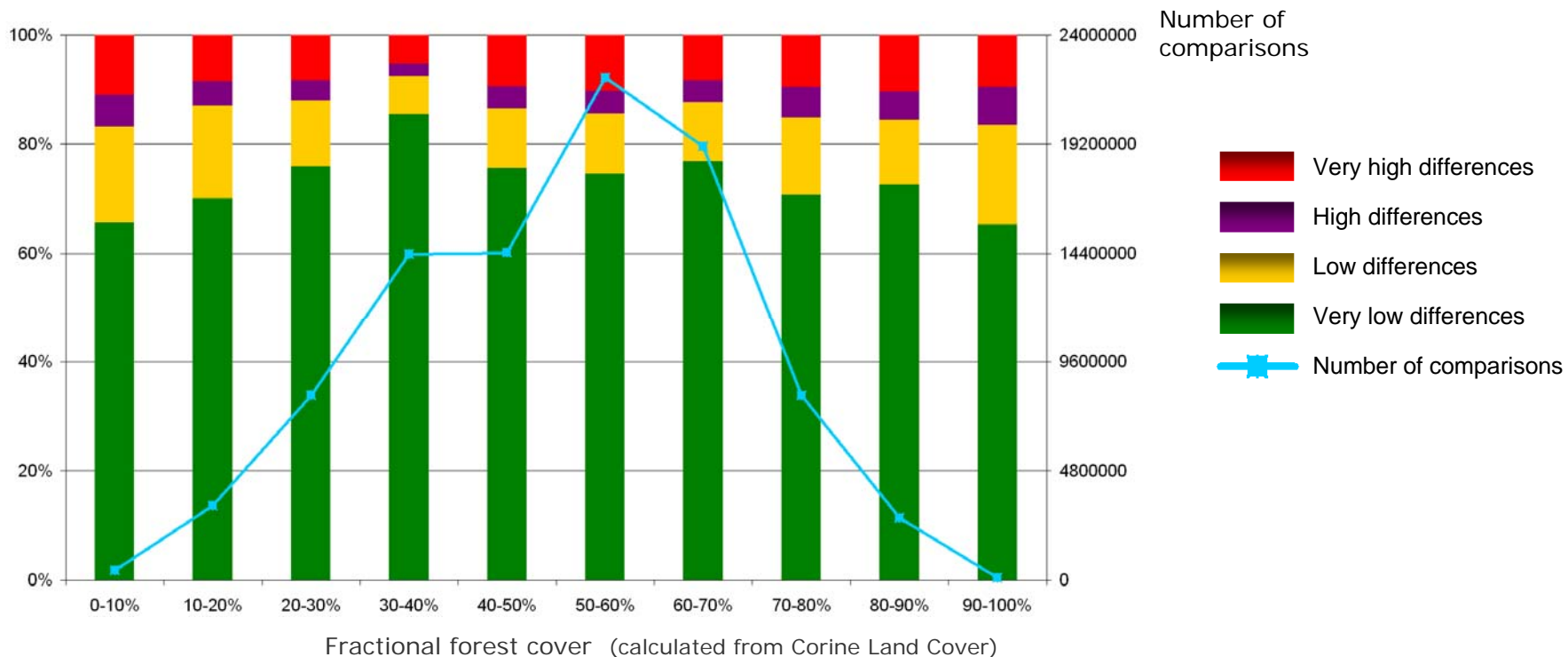
*Low differences are not so frequent in the East part of Pyrenees, and at middle elevations.*



# Snow cover comparison

## a) between satellite and model data

### Representation of the four differences classes as a function of the fractional forest cover

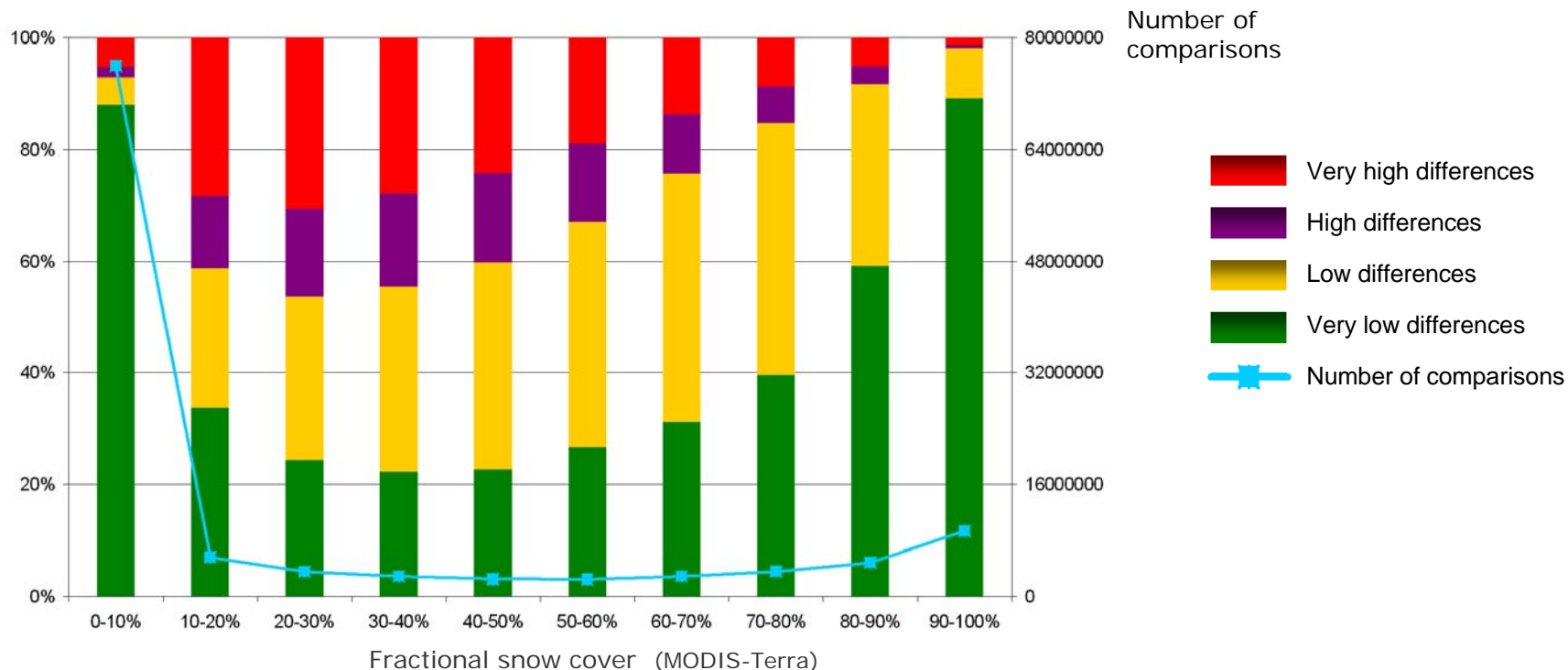


*Forest areas are not taken into account by SAFRAN-CROCUS and are expected to influence MODIS satellite measurements. However, forest effects do not seem to be a source of difference.*

# Snow cover comparison

## a) between satellite and model data

Representation of the four differences classes as a function of the fractional snow cover

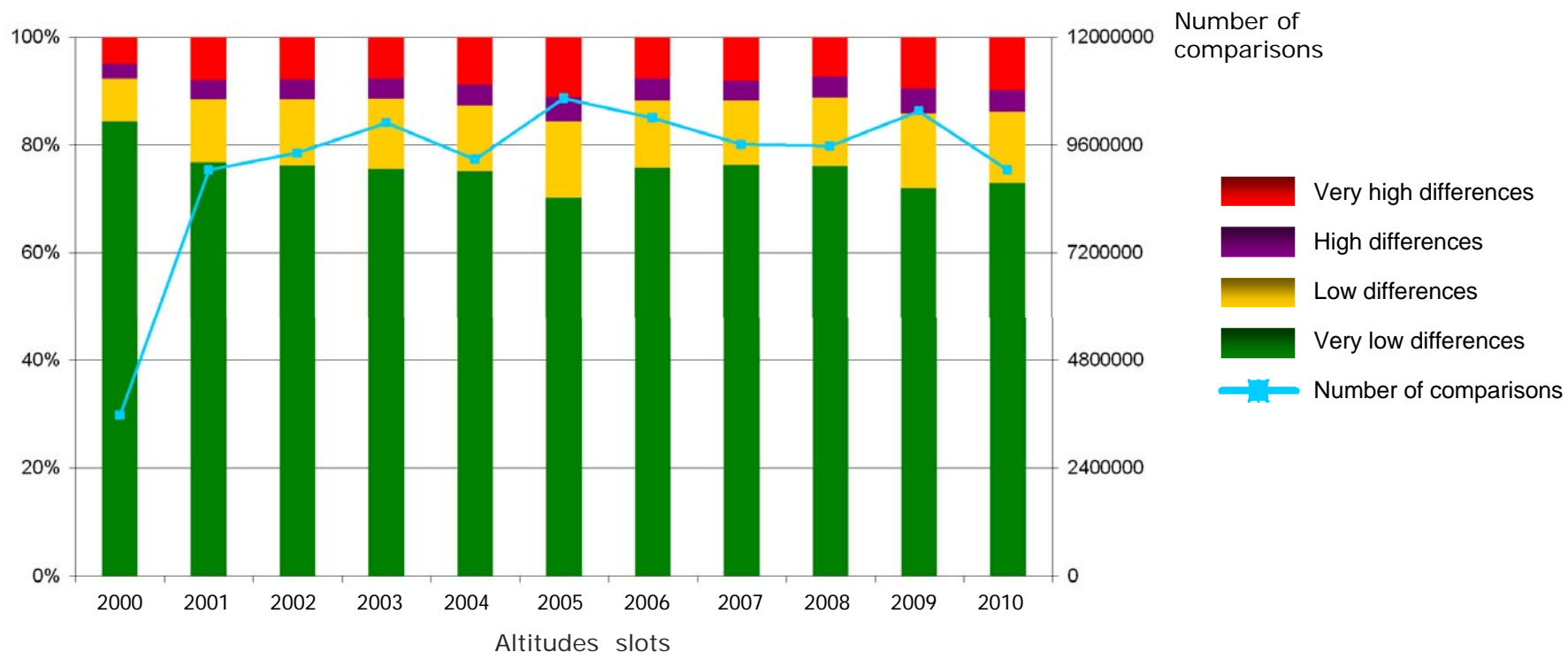


*The fraction of the snow coverage has an influence on the differences between the two data sets: very low differences are more frequent when the fraction of snow is null (no snow) or very high (continuous and thick snow cover). On the opposite, high differences are frequent when the snow cover is discontinuous (snow line neighbourhood).*

# Snow cover comparison

## a) between satellite and model data

**Representation of the four differences classes as a function of the winter season** (November to May months from 2000 to 2010)

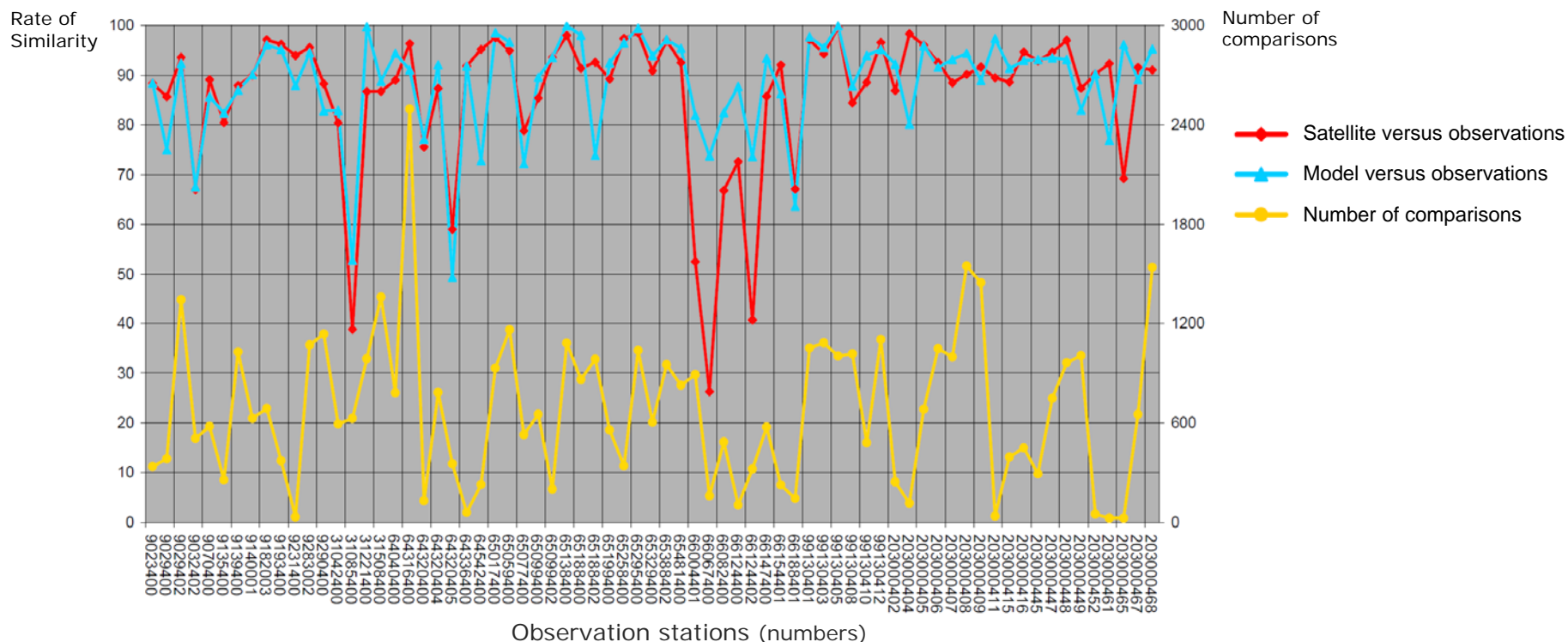


*The comparison results are similar for each of the 11 winter.*

# Snow cover comparison

## b) between satellite and observed data


**Conformity between satellite and observation data  
and between modelled and observation data**  
(attendance / absence of snow)



*The global rate of similarity is 89 %, but depends on the observation station. Among the 71 observation stations, the rate is lower than 80 % for 13 stations and lower than 60 % for 5 stations.*

# CONCLUSION

- ✓ **Global good conformity**  
between MODIS-Terra satellite  
and SAFRAN-Crocus modelled snow cover data
  
- ✓ **More differences :**
  - around the snow line
  - in the East part of the Pyrenees
  
- ✓ **Comparison with terrestrial observations :**
  - high conformity rate with both satellite data  
and modelled data
  - some local bad conformity rates  
(both satellite and modelled data)



Thank you for your attention !