# Precipitation Estimation from NOAA/AMSU Data


**Izabela Dyras, Danuta Serafin-Rek**

**Satellite Research Department, Institute of Meteorology and Water Management, Poland.**

Izabela.Dyras@imgw.pl

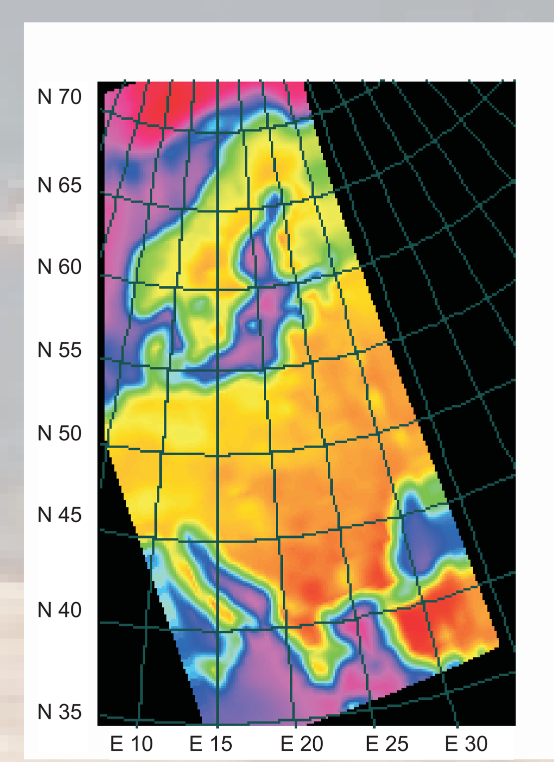

## INTRODUCTION

The data available from an Advanced Microwave Sounding Unit (AMSU) on board of NOAA-16 and NOAA-15 satellites have enhanced the possibilities of the new meteorological products derivation.

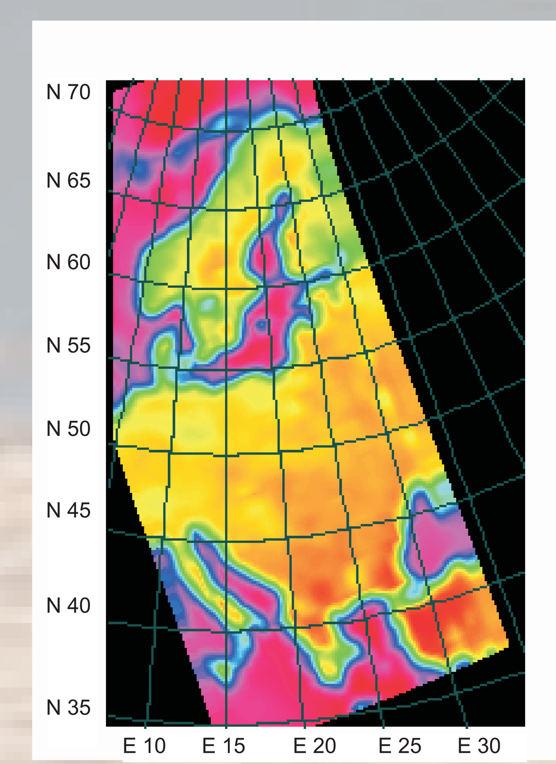
The presented algorithms are the modification of the regression algorithms developed by Grody and Crosby to infer cloud liquid water path (LWP) and rain detection over the land surfaces from passive microwave measurements of AMSU.

The methods were developed using satellite observations of July 2001 with the ground-based precipitation measurements and radiosonde observations from Central Europe region.

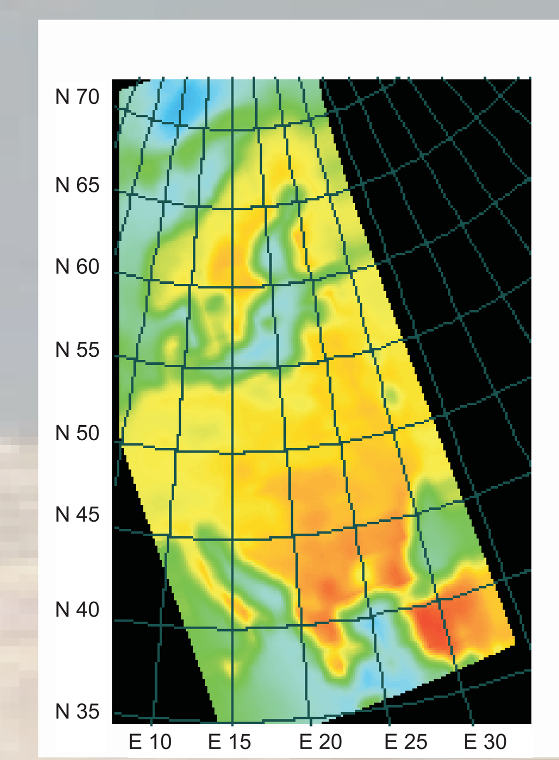
The AMSU data have been processed using the Advanced ATOVS Processing Package (AAPP ver.3.0) and visualised using ER Mapper 6.2 software. Presented examples are calculated for 9 July 2001.



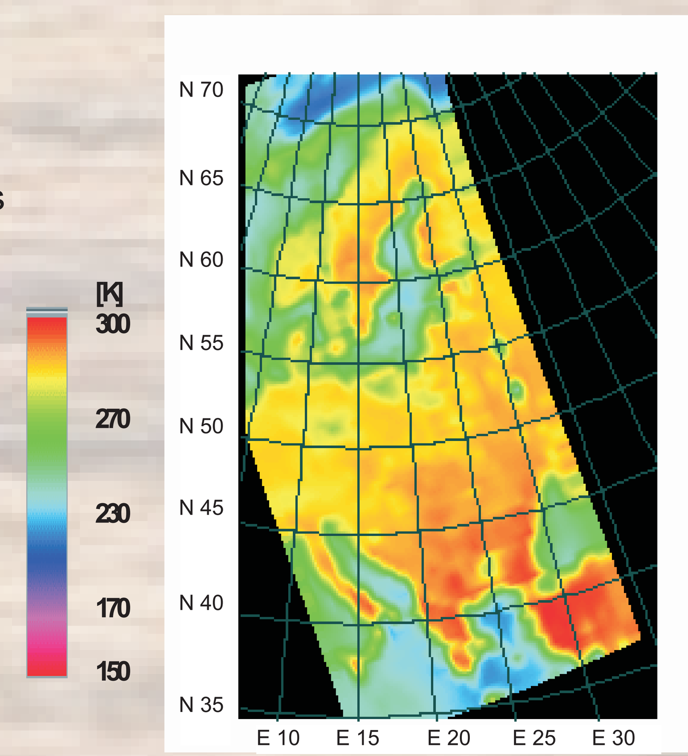

AMSU-A 23.8 GHz



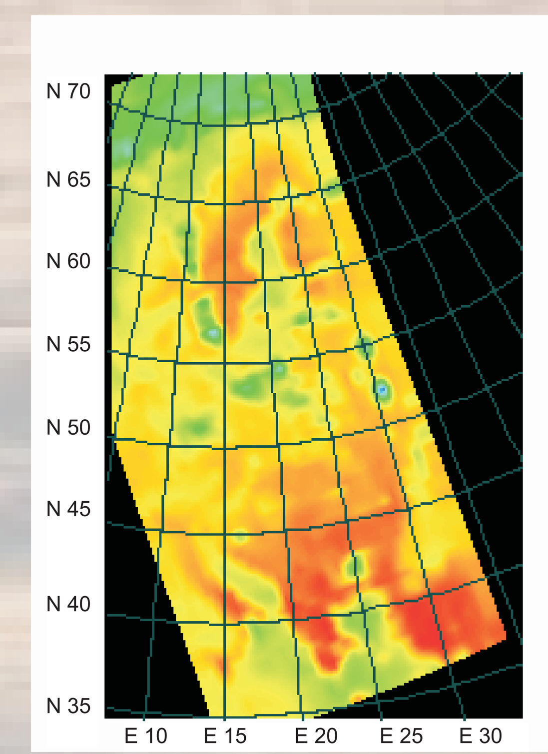
AMSU-A 31.4 Ghz



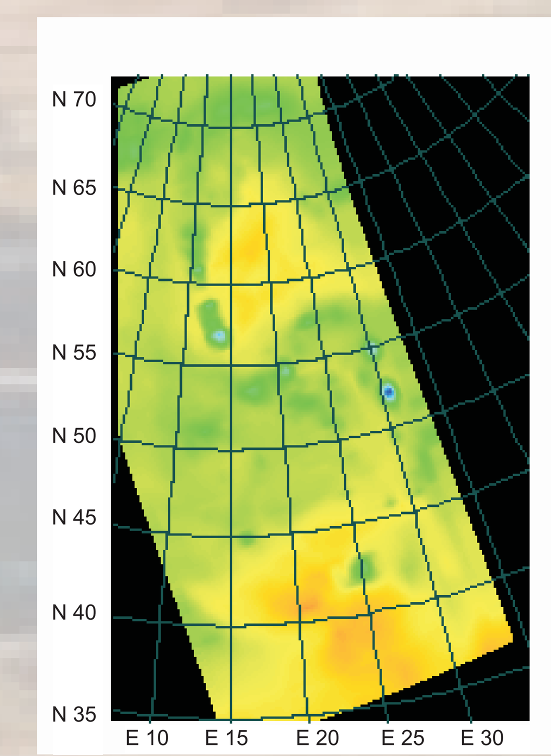
AMSU-A 50.3 GHz




AMSU-B 89.0 GHz



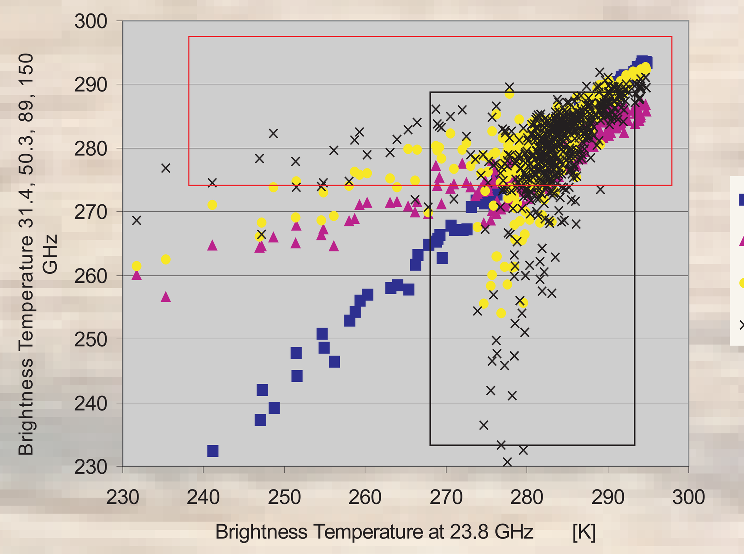
AMSU-B 150.0 GHz



AMSU-B 183.3+7 GHz

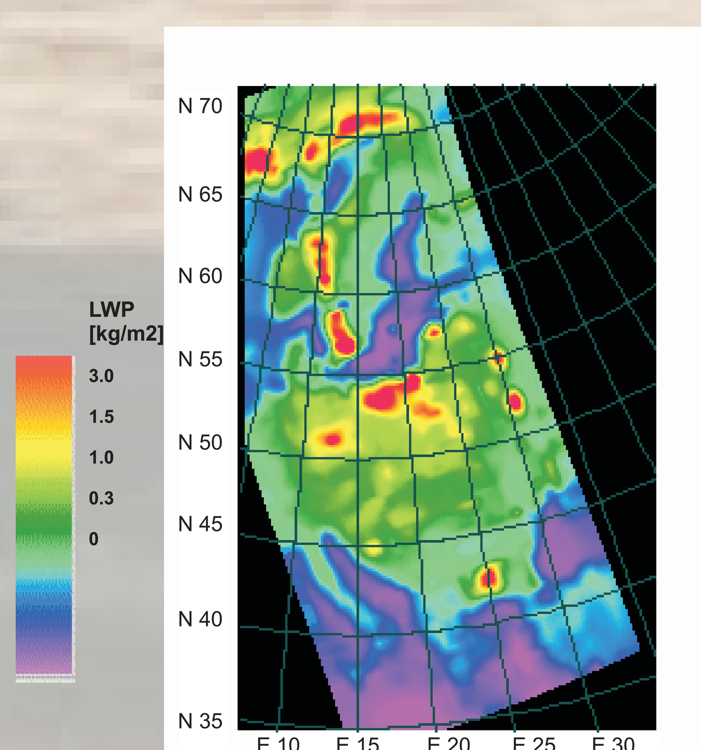
## ALGORITHMS:

### REGRESSION ANALYSIS OF AMSU

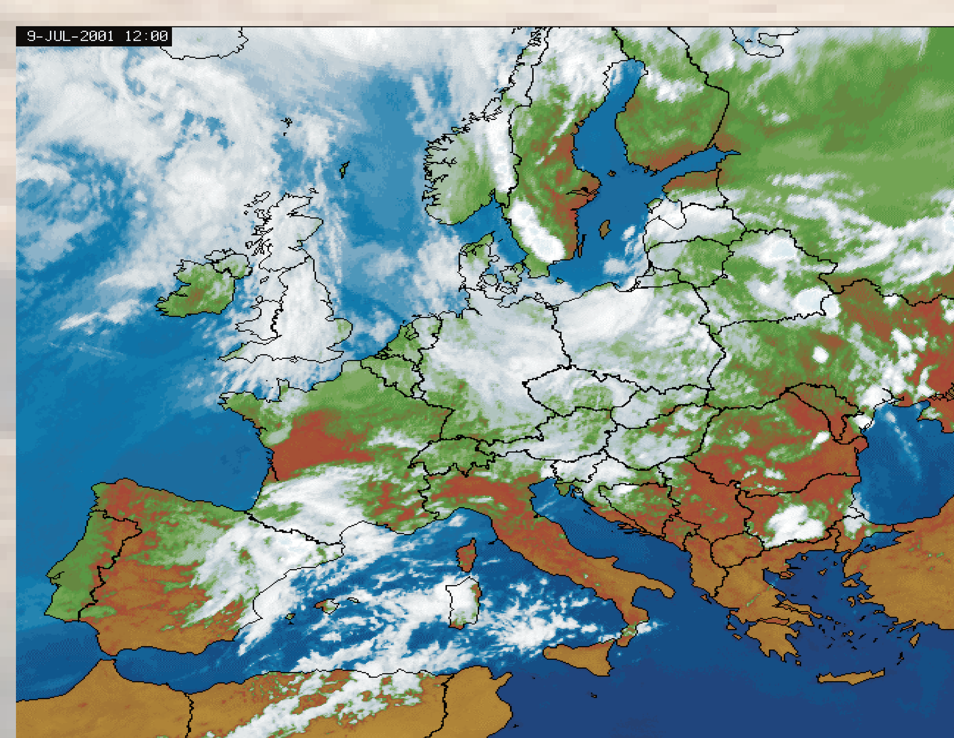



The influence of the water vapour, cloud water and precipitation on brightness temperature was investigated using channels at: 23.8, 31.4, 50.3, 89.0, 150.0,183.3 GHz as their weighting functions' maxima are in the lower and middle troposphere. The plot shows the brightness temperature from 31.4, 50.3, 89.0 and 150.0 GHz channels as a function of temperature at 23.8 GHz for all analyzed cases. Very high correlation - 0.97 was found between temperatures at 31.4 and 23.8 GHz.

### CLOUD LIQUID WATER




09.07.2001, 12.00 GMT




METEOSAT - IR 09.07.2001, 12.00 GMT

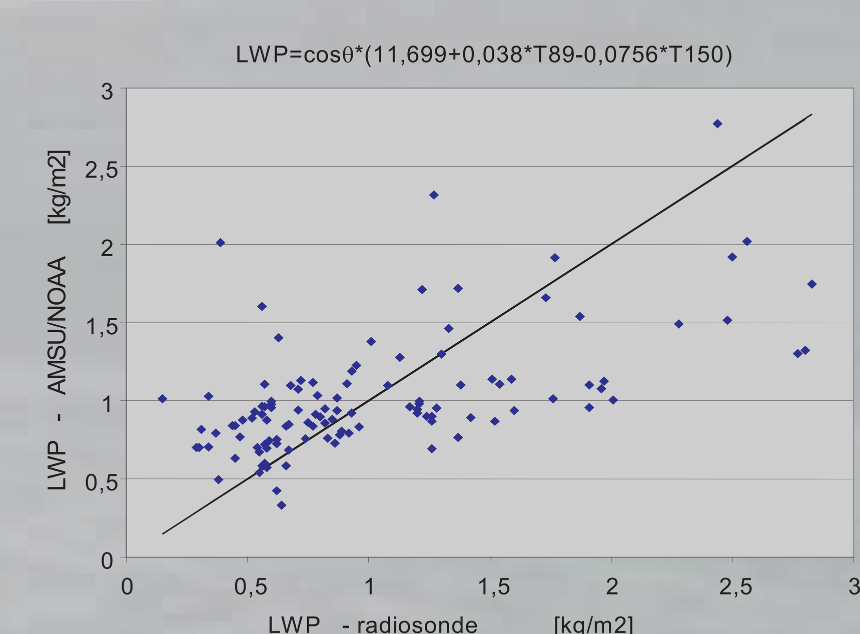
#### Liquid Water Path

LWP_sat = cosθ(11.699 + 0.038* TB(89) - 0.0756* TB(150))

Θ- satellite zenith angle,
TB(89) and TB(150) brightness temperature at 89.0 and 150.0 GHz respectively.

**On the left:** the areas of high LWP derived from AMSU correspond to the regions covered by thick clouds observed on METEOSAT image.

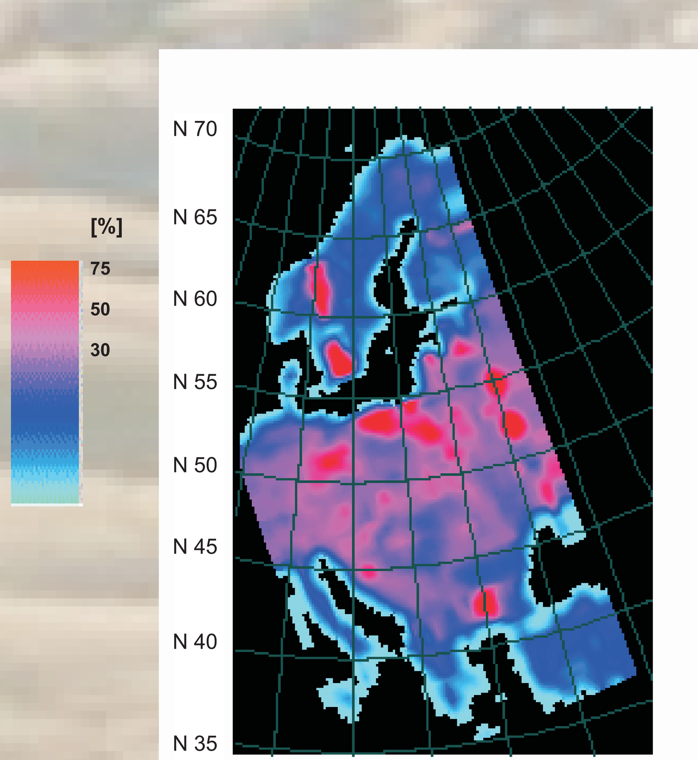
**On the right:** the scatter plot of the LWP derived from satellite microwave data against the values calculated from radiosonde measured data. Bias for LWP_sat is equal 0.6 kg/m$^2$ and $R^2$=0.33.




### PRECIPITATION

#### Precipitation Probability - Crosby test

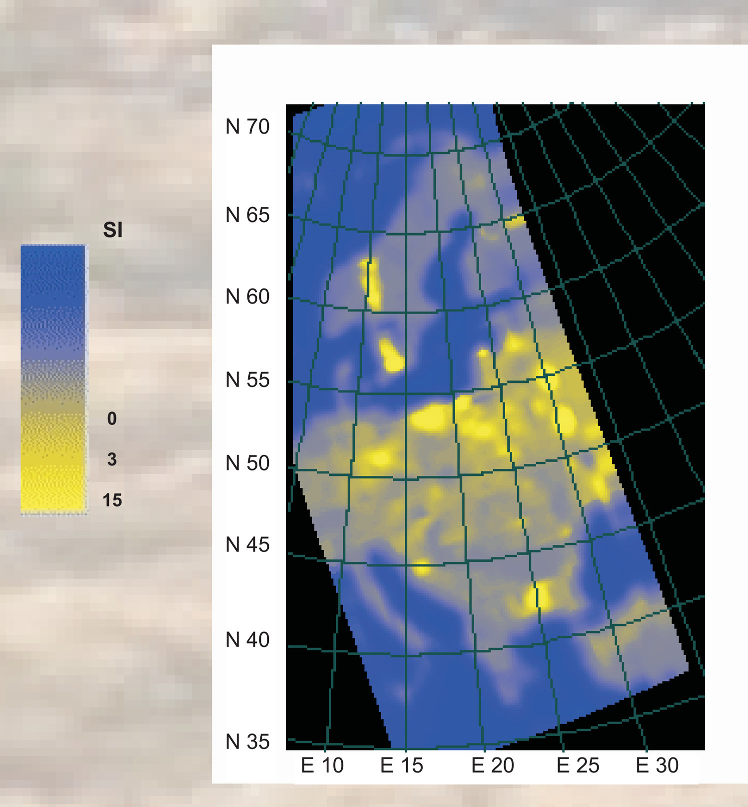
**P = 1/(1+exp(-f)) [%]**
**f = 10.5 + 0.184*TB(23.8)- 0.221* TB(89)**




09.07.2001, 12.00 GMT

#### Rain Detection

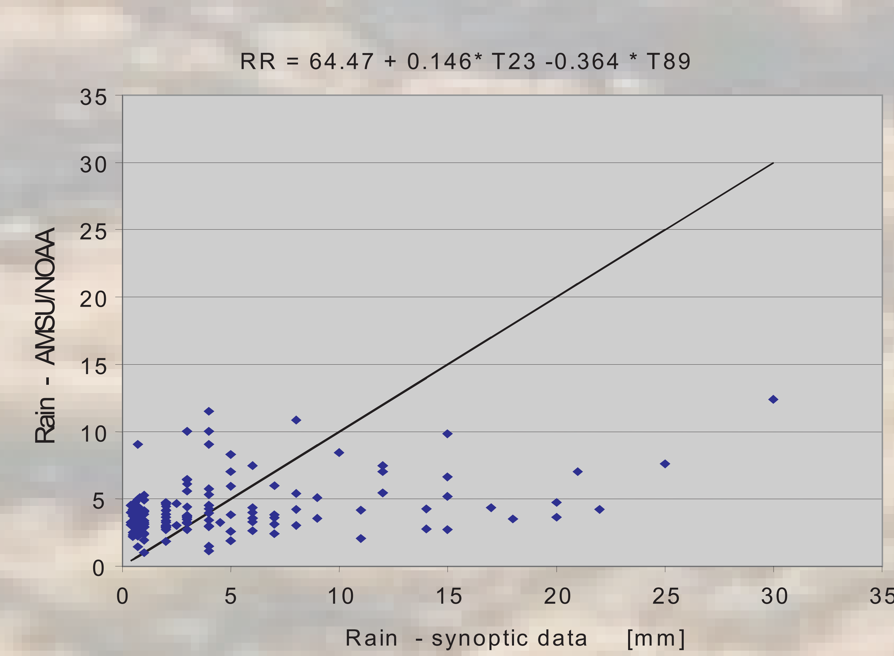
**SI_land = 42.72+TB(89)-TB(150)**




09.07.2001, 12.00 GMT

#### Rain Rate

**RR = 64.47 + 0.146 * TB(23.8) 0.364 * TB(89)**




## CONCLUSIONS

- While developing regression algorithms for atmospheric moisture and cloud water content from satellite data only the data from aerological measurements at the same time should be considered, also the weather type should be taken into account.
- Due to AMSU/NOAA radiometers' low spatial resolution it is very important to pay attention to the geographical rectification of the data.
- Rain rate algorithms should be developed based on the network of hydro- meteorological or radar stations.
- Algorithms have to be tested for different seasons.
- Another problem concerns the microwave data analysis in wintertime, the impact of snow and ice needs the detailed investigation.

## RESULTS

- The presented analysis was performed on 23 satellite images chosen from July 2001, when the extremely high rain rates were noted in Poland.
- The best results were obtained in retrieving cloud liquid water path and convective clouds identification.
- The algorithms for rain intensity evaluation are not satisfactory and need further research.

## FUTURE WORKS

- It is difficult to develop correct algorithm for rain rate estimation, as the precipitation is highly variable in time and space. Further investigation is planned.
- The temporal resolution of the polar orbiting satellites is not sufficient for precipitation monitoring, however, coupled with METEOSAT/MSG data wil provide valuable information concerning rain, moisture distribution for hydrological models, numerical weather prediction or in climatology.

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CIRA AMSU Website http://amsu.cira.colostate.edu/

NOAA KLM User's Guide http://www2.ncdc.noaa.gov/docs/klm/html