

TEA-IS - Exchange Grant - 4061

Program: SHORT and EXCHANGE VISITS

Title: Comparing RHESSI and AGILE TGF search algorithms and measurements

Visitor: Dr. Thomas Gjesteland, University of Bergen, Bergen, Norway

HOST INSTITUTE(s)

Dr. Martino Marisaldi , INAF-IASF, Bologna, Italy

Dr. Enrico Arnone, CNR-ISAC, Bologna, Italy

1. Purpose of the visit;

AGILE and RHESSI have the two largest database of TGF events so far.

The motivation of this visit is to compare search algorithms to optimize the TGF detection methods in both datasets. Such study will increase the number of identified TGFs and also put constrains on the true fluence distribution of TGFs, which again can give indication of how common TGFs are.

We will also look for TGFs measured from AGILE and RHESSI which are coming from the same thunderstorm. If this search is successful, the thunderstorm system will be analyzed during its whole evolution time through meteosat images and global lightning activity from the WWLLN network to understand at what phase TGF production is active.

2. Description of the work carried out during the visit;

1) Dr. Thomas Gjesteland had a seminar at the CNR-ISAC about TGF research in general and the researched carried out by his group in University of Bergen. The seminar was open to everyone at CNR and led to a good discussion and suggestions for further collaboration.

2) We had discussion about trigger algorithms for RHESSI and AGILE. Also, we discussed TGF properties such as global distribution, energy spectra and duration.

3) We have identified TGFs from the same region measured by both AGILE and RHESSI within two hours.

4) We had a colloquium about the latest simulation paper in TGF research “The relativistic feedback discharge model of terrestrial gamma ray flashes” by J. Dwyer 2012.

5) We have done a global correlation study between MIPAS NO2 and thunderstorms producing terrestrial gamma-ray flashes (TGFs) observed by the RHESSI.

6) We have found three TGFs in the Mediterranean sea, which Dr. Sante Laviola from CNR-ISAC have meteorological data from.

3. Description of the main results obtained;

We have found six cases where AGILE and RHESSI both detects TGFs in the same region within two hours. In three of the cases AGILE and RHESSI passes over the same region within one hour. For these cases we have also looked at data from geostationary orbit to try to point out the thunderstorms in these regions. So far we have not been able to identify which storm the TGFs are

coming from.

In the MIPAS RHESSI correlation study no individual measurement of NO₂ in coincidence with TGFs could be associated to a robust NO₂ enhancement, therefore pointing to a lack of major regional impact of TGFs on the chemistry of the stratosphere above thunderstorms. The results are clearly limited by the uncertainties of the analysis we performed, which includes a sensitivity to NO₂ changes of the order of 0.5 to 2 ppbv depending on altitude, and shortages in the capability of confirming the coincidence of the measurements by the two satellites.

Together with Dr. Sante Laviola from CNR-ISAC we have identified three TGFs from the new RHESSI TGFs which occur over the Mediterranean sea. For these events Dr. Sante Laviola has data from multiple satellites which clearly confines the TGF producing thunderstorm. One of the RHESSI events has also a match with WWLLN spheric data. The cloud top of these TGF producing storms are 8-10 km for two of the TGFs which occur during late autumn, and the last one which occur in May comes from a remarkably low convection cloud with cloud top 6-8 km. This is lower than what the suggested production altitude of TGFs detected so far. The TGF occurring over the Mediterranean in November is among the 1% brightest RHESSI TGFs ever measured. With this event it is possible to do spectral analysis.

4. Future collaboration with host institution (if applicable);

We will continue to collaborate on TGF research in general. We will continue on the Mediterranean TGF study and hopefully prepare it for publication.

Dr. Martino Marisaldi and Dr. Thomas Gjesteland will, together with Dr. Sebastien Celestin, host a session at the EGU general assembly in April 2012. This session is titled «High Energy Radiation from Thunderstorms and Lightning.»

Dr. Martino Marisaldi will visit the Bergen group in spring.

5. Projected publications / articles resulting or to result from the grant (ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant);

The three RHESSI TGFs which are detected over the Mediterranean sea will be further analyzed and prepared for publications. This will be a collaboration between Dr. Thomas Gjesteland, Dr. Sante Laviola, Dr. Martino Marisaldi, Dr. Fabio Fuschino and Dr. Enrico Arnone.

6. Other comments (if any).