SEGMA/EMMA report 2015

M. Vellante, **A. Del Corpo**, E. Pietropaolo, M. Piersanti, U. Villante,

M. De Lauretis, P. Francia, M. Regi, A. Piancatelli

Department of Physical and Chemical Sciences, University of L'Aquila, Italy

B. Heilig

Geological and Geophysical Institute of Hungary, Hungary

J. Reda

Institute of Geophysics-PAS, Poland

M. Chamati
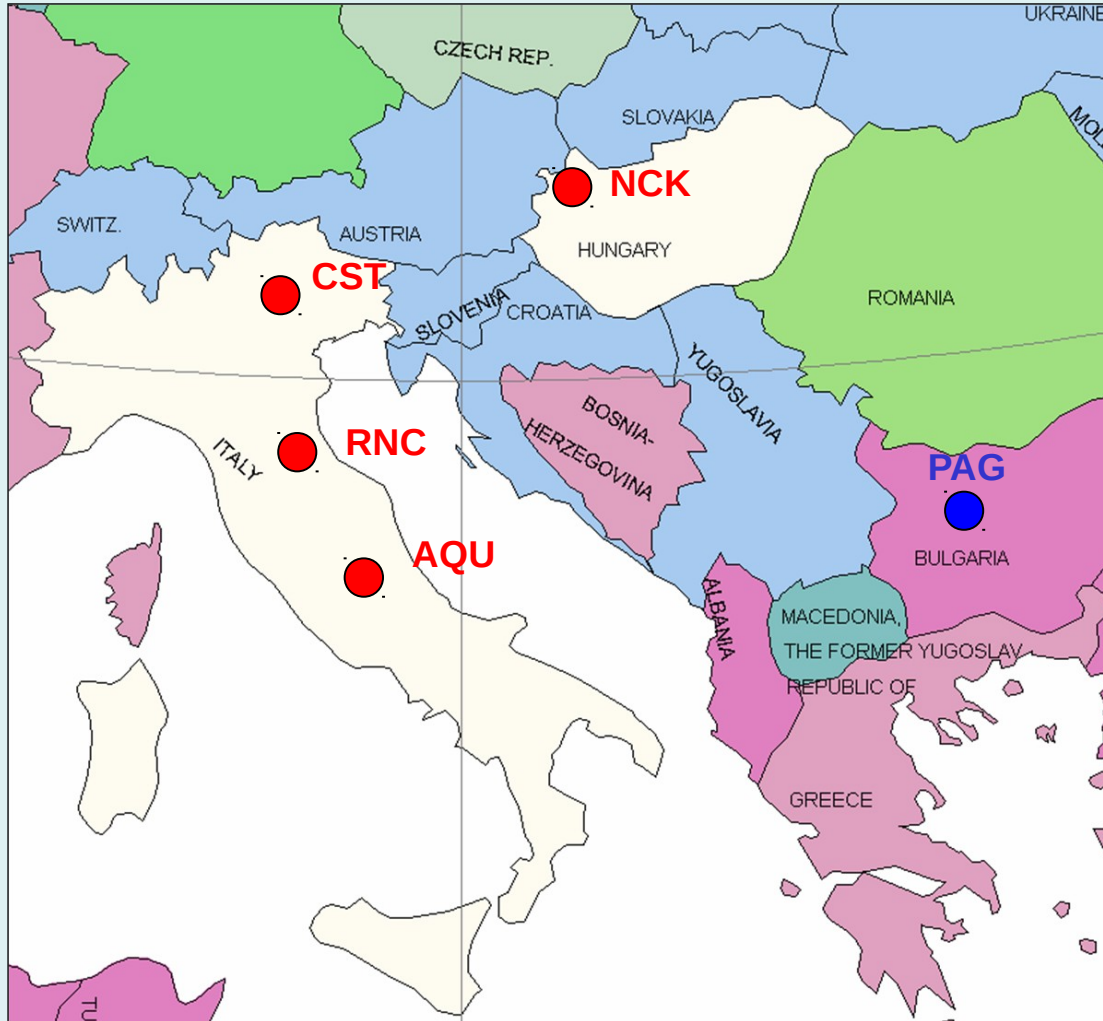
Institute of Geophysics-BAS, Bulgaria

W. Magnes

Space Research Institute (IWF), Austria

ULTIMA Meeting

13 December 2015 - San Francisco, USA

# SEGMA (South European GeoMagnetic Array)   (1.56 < L < 1.88)

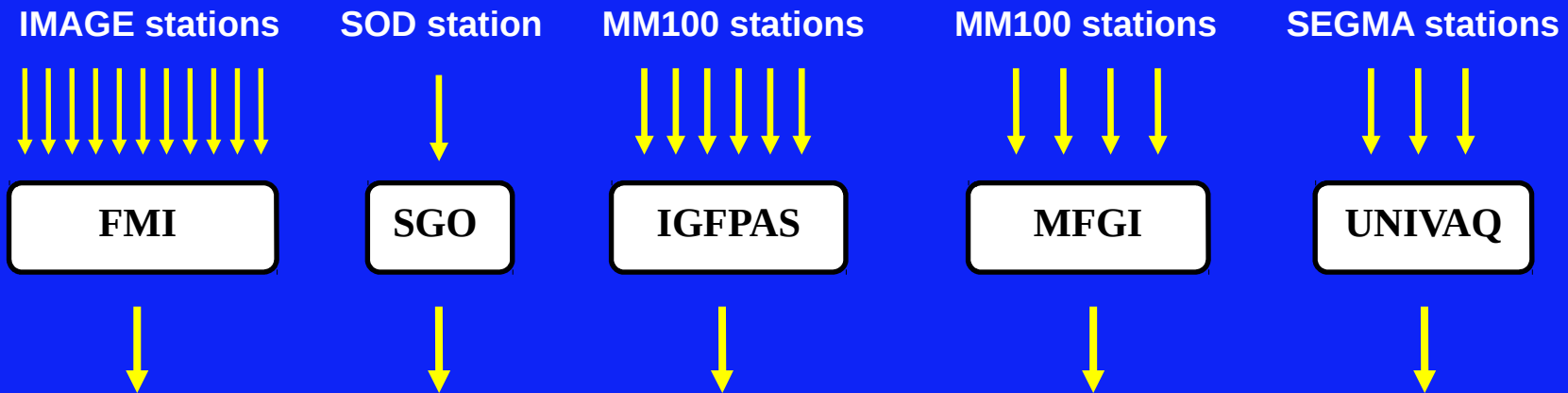| Stations	Latitud. separ.	L
3 gradient installations		
NCK - CST	1.9^o	1.83
CST - RNC	2.5^o	1.71
RNC - AQU	1.9^o	1.61

Cooperating institutions:

- *University of L'Aquila, Italy*
- *Space Research Institute (IWF), Graz, Austria*
- *Geodetic and Geophysical Research Institute, Sopron, Hungary*
- *Geophysical Institute, Sofia, Bulgaria*

EMMA (1.5 < L < 6.5)

EMMA points in Europe

www.hist-geo.com
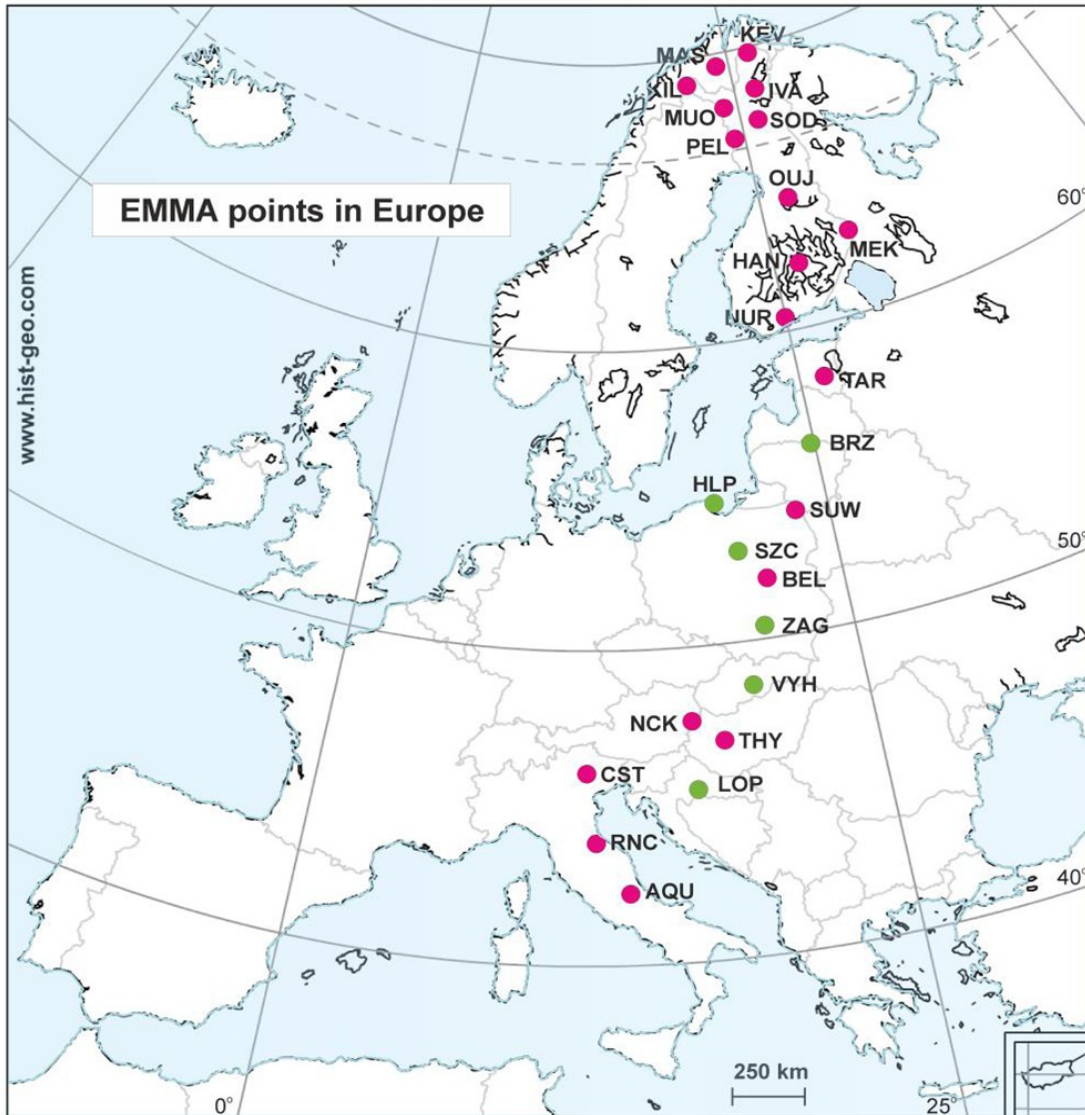
- 25 stations, all equipped with high sensitivity fluxgate magnetometers and GPS antenna for precise time recording.

- All stations are remotely connected and transmit data to local servers every 1-15 min.

- Data are collected at two main servers (one in Hungary and the other at University of L'Aquila) which continuously monitor the operational status of the whole network.

- They cyclically (every 15 min) run a procedure to detect FLR frequencies from several station pairs and deduce in near real time the equatorial plasma mass density in the L-range 1.6-6.1.

EMMA-Net Data Flow

IMAGE stations   **SOD station**   **MM100 stations**   **MM100 stations**   **SEGMA stations**

FMI   **SGO**   **IGFPAS**   **MFGI**   **UNIVAQ**

PLASMON EMMA Servers (L'Aquila; Tihany)

- **Conversion to EMMA Data Format (FMI stations)**
- **Transformation: XYZ --> HDZ (if necessary)**
- **Removal of spikes,   check of timing – correction**

Tihany Server

- **Implementation of FLRID**

- **Web-based monitor (http://geofizika.canet.hu/plasmon/):**

   near real time magnetograms/power spectra/FLRID results
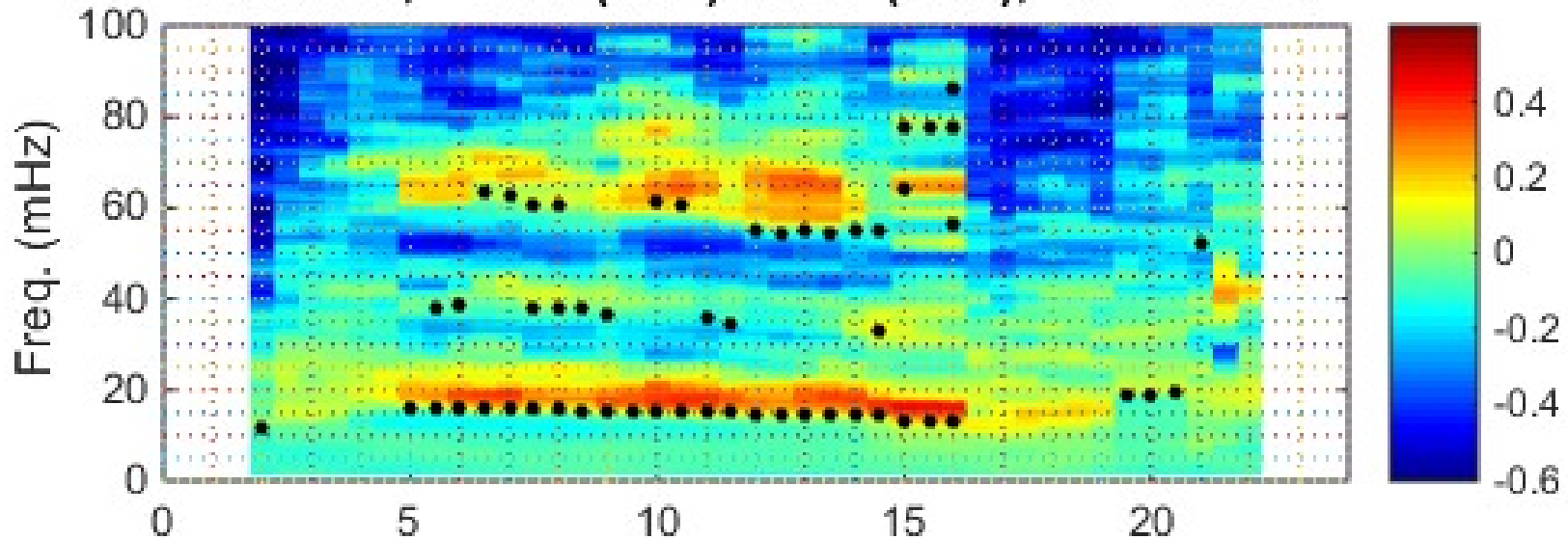
L'Aquila Server

- **Implementation of FLRID**

- **Implementation of FLRINV:**

   results are stored in daily text files

   updated every 15 min and available

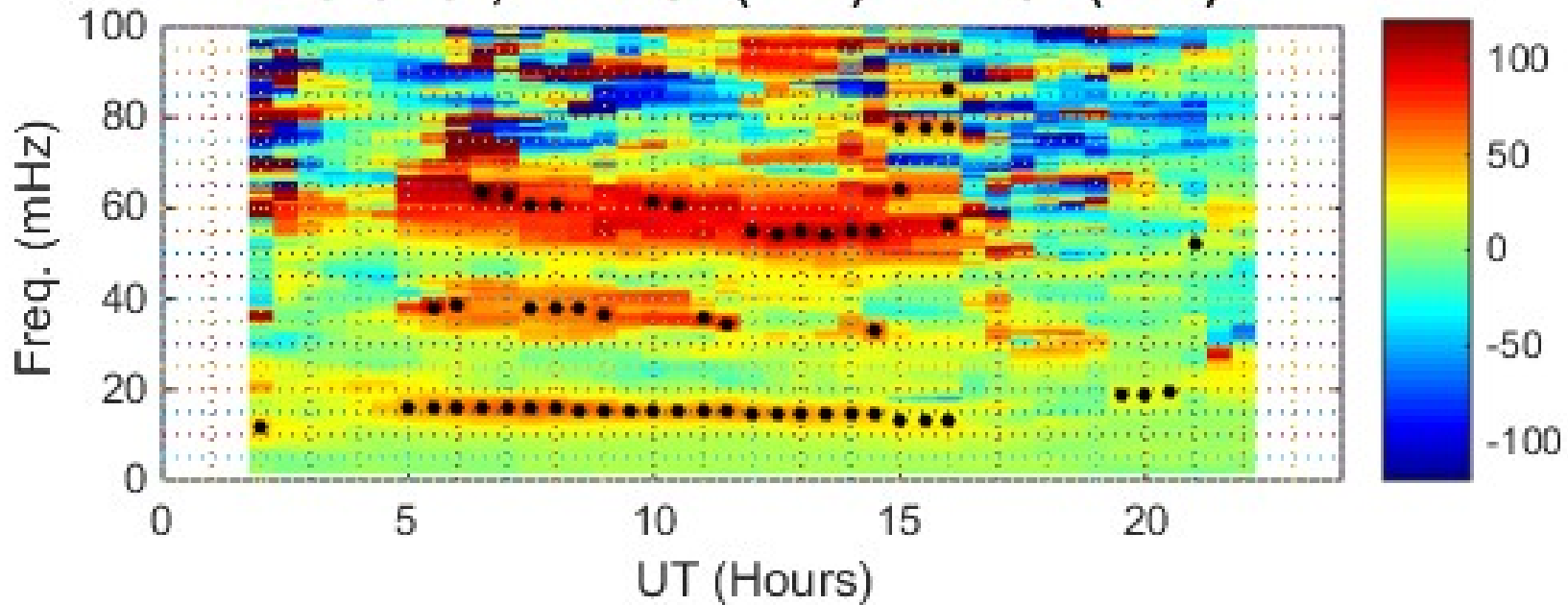   **for downloading**

   http://plasmonserver.aquila.infn.it/EMMA_FLR_DENSITY

DYNAMIC CROSS-SPECTRA

2013 157,   AMP (BRZ) / AMP (TAR),   M = 1.1533

2013 157,   PHASE (BRZ) - PHASE (TAR)

FLR inversion (FLRINV)

The inversion algorithm converts FLR frequencies into estimates of the equatorial plasma mass density ρ_{eq} (1.6 < L < 6.3).

It solves numerically the MHD wave equation for the toroidale mode in an arbitrary field geometry (dipole, IGRF, **T01** models) and for a given density distribution along the field line:

$\rho(s) = \rho_{eq} (r / r_{eq})^{-m}$, and infers ρ_{eq}.

T01 model (Tsyganenko, 2002).   Input parameters:

- Universal Time: to determine the proper coefficients of the internal field (IGRF) and the tilt angle;

- Solar wind dynamic pressure;

- Dst index;

- IMF By and Bz components;

- G1, G2: take into account the prehistory state of the magnetosphere (determined by By, Bz, Vsw of the previous hour).

Near Real-time FLRINV process

Run every 15 min using:

- quasi real-time values of field line eigenfrequencies of all available station pairs (as computed by FLRID);
- solar wind and Dst parameters.

Real time solar wind data taken from the NOAA Space Weather Prediction Center which provides the latest 2 hours of magnetic and plasma data of the ACE satellite located at the L1 libration point:

http://services-swpc.noaa.gov/text/ace-magnetometer.txt;

http://services.swpc.noaa.gov/text/ace-swepam.txt

- Data are time-shifted to take into account the propagation time of the solar wind from the satellite position to the Earth (typically about 1 hour).
- Propagated data are resampled at fixed times and hourly running averages (time step 1 min) are produced.

Real-time Dst data are taken from the Dcx server of the University of Oulu, Finland:

http://dcx.oulu.fi/DstDcxDxtData/RealTime/Dxt/DxtRT.txt

Extract of an online output file

PAIR	L	YEAR	DOY	HOUR-UT	LT	Req	mHz	amu/cc	HOUR(SW)	BY	BZ	P	HOUR(G)	G1	G2	HOUR(DST)	DST
masmuo	6.012	2014	185	10.72	12.89	6.207	23.1	1.01e+00	10.72	-2.6	2.1	0.9	10.22	0.81	0.52	10.72	-2.9
kilpel	5.691	2014	185	10.95	13.02	5.845	14.8	3.97e+00	10.95	-2.2	2.2	1.0	10.45	0.36	0.01	10.95	-2.9
muopel	5.450	2014	185	10.80	12.91	5.622	15.0	5.28e+00	10.80	-2.4	2.1	0.9	10.30	0.69	0.47	10.80	-2.9
oujhan	4.093	2014	185	10.95	13.09	4.161	5.7	4.19e+02	10.95	-2.2	2.2	1.0	10.45	0.36	0.01	10.95	-2.9
hannu2	3.627	2014	185	11.34	13.36	3.670	6.0	1.06e+03	11.33	-1.8	2.3	1.0	10.83	0.17	0.00	11.33	-3.0
nu2tar	3.240	2014	185	10.87	12.83	3.268	10.6	8.82e+02	10.87	-2.3	2.1	1.0	10.37	0.52	0.20	10.87	-2.9
tarbrz	2.893	2014	185	10.87	12.79	2.911	13.2	1.50e+03	10.87	-2.3	2.1	1.0	10.37	0.52	0.20	10.87	-2.9
brzsuw	2.607	2014	185	10.81	12.60	2.620	15.2	2.71e+03	10.82	-2.4	2.1	0.9	10.32	0.66	0.43	10.82	-2.9
belzag	2.173	2014	185	11.39	12.92	2.178	21.2	6.63e+03	11.38	-1.7	2.3	1.0	10.88	0.15	0.00	11.38	-3.0
kilpel	5.691	2014	185	11.04	13.11	5.844	14.8	3.98e+00	11.03	-2.1	2.2	1.0	10.53	0.29	0.00	11.03	-2.9
muopel	5.450	2014	185	11.05	13.17	5.596	14.8	5.64e+00	11.05	-2.1	2.2	1.0	10.55	0.28	0.00	11.05	-2.9
oujhan	4.093	2014	185	11.20	13.34	4.161	4.9	5.68e+02	11.20	-1.9	2.3	1.0	10.70	0.21	0.00	11.20	-3.0
hannu2	3.627	2014	185	11.51	13.53	3.667	6.0	1.06e+03	11.50	-1.5	2.4	1.0	11.02	0.11	0.00	11.52	-1.2
nu2tar	3.240	2014	185	11.12	13.08	3.267	9.1	1.20e+03	11.12	-2.0	2.2	1.0	10.62	0.24	0.00	11.12	-2.9
tarbrz	2.893	2014	185	11.12	13.04	2.910	12.4	1.70e+03	11.12	-2.0	2.2	1.0	10.62	0.24	0.00	11.12	-2.9
brzsuw	2.607	2014	185	11.08	12.87	2.619	15.2	2.72e+03	11.08	-2.0	2.2	1.0	10.58	0.26	0.00	11.08	-2.9
kilpel	5.691	2014	185	11.29	13.36	5.844	14.6	4.09e+00	11.28	-1.8	2.3	1.0	10.78	0.18	0.00	11.28	-3.0
muopel	5.450	2014	185	11.15	13.27	5.595	14.6	5.80e+00	11.15	-2.0	2.2	1.0	10.65	0.23	0.00	11.15	-2.9
oujhan	4.093	2014	185	11.45	13.59	4.160	4.8	5.93e+02	11.45	-1.6	2.3	1.0	10.95	0.13	0.00	11.45	-3.0
nu2tar	3.240	2014	185	11.21	13.17	3.267	9.1	1.20e+03	11.22	-1.9	2.3	1.0	10.72	0.21	0.00	11.22	-3.0
tarbrz	2.893	2014	185	11.37	13.29	2.910	11.7	1.91e+03	11.37	-1.7	2.3	1.0	10.87	0.16	0.00	11.37	-3.0
belzag	2.173	2014	185	11.45	12.98	2.178	21.2	6.63e+03	11.45	-1.6	2.3	1.0	10.95	0.13	0.00	11.45	-3.0

Thank you for your attention