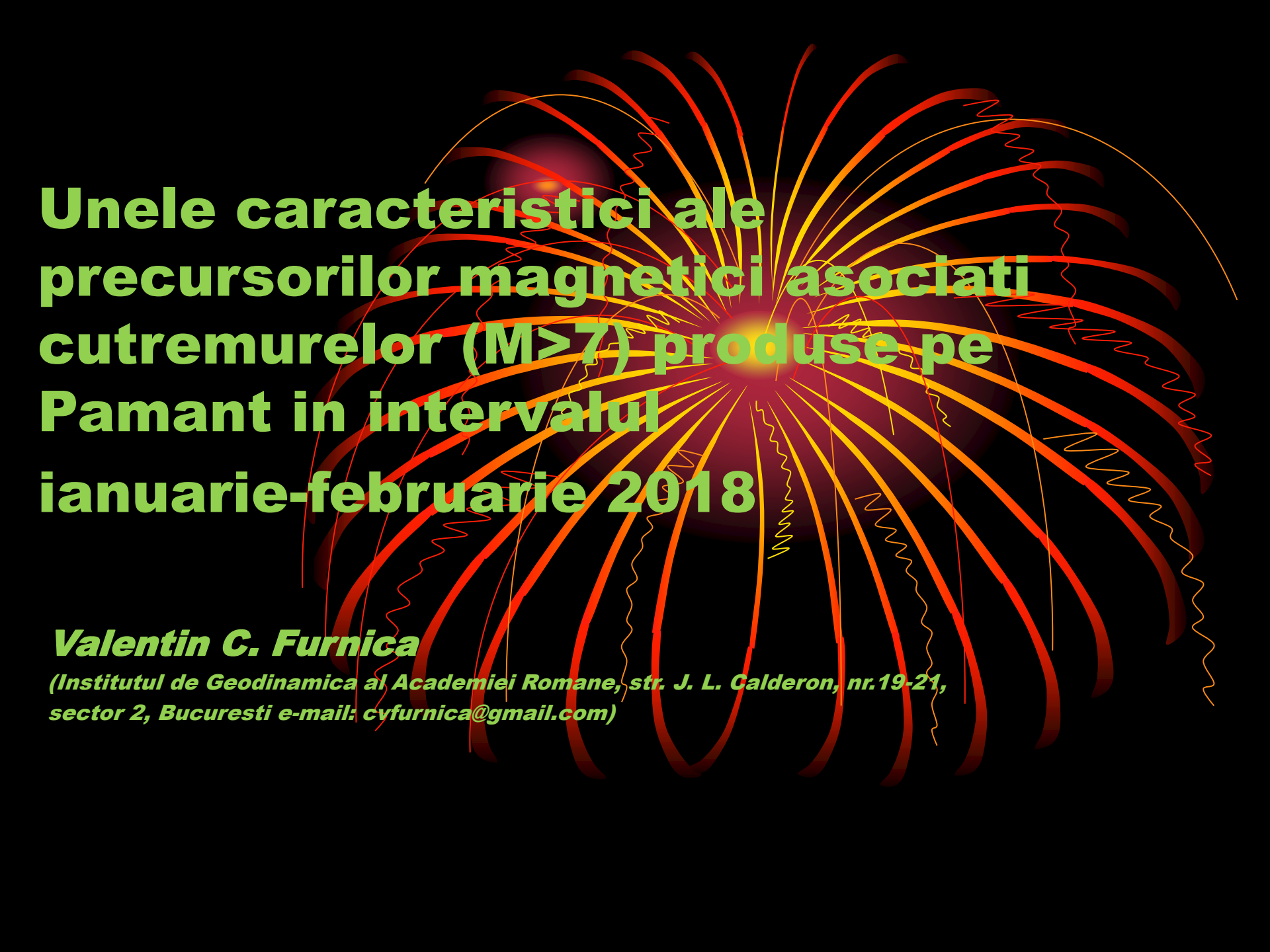

Unele caracteristici ale precursorilor magnetici asociati cutremurelor (M>7) produse pe Pamant in intervalul ianuarie-februarie 2018

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Forma de unda "treapta" (stepwise, offset, jump, tranzient) este o anomalie in variatia campului electric, magnetic, sau electromagnetic, cu valoare de precursor seismic, avand un timp de crestere in amplitudine de cateva minute (1-10 minute), sfarsitul fiind reprezentat de o descrestere gradata sau abrupta (Fig.1)

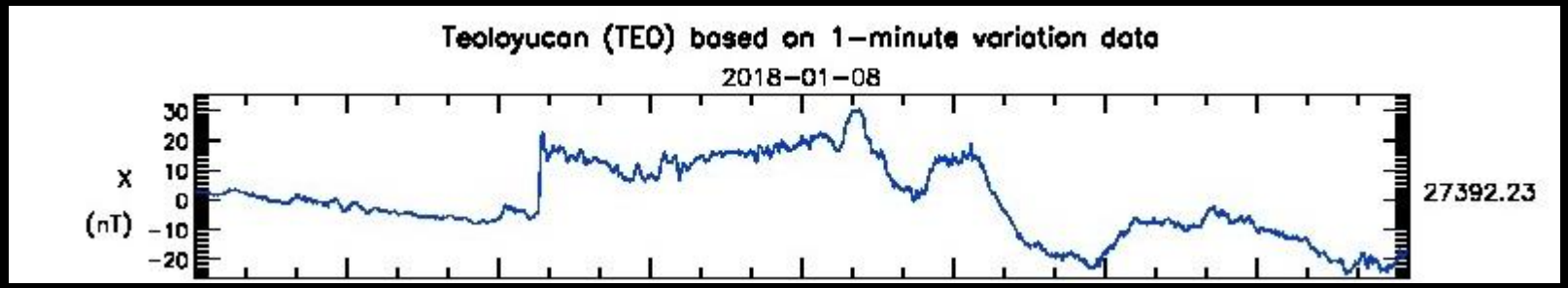


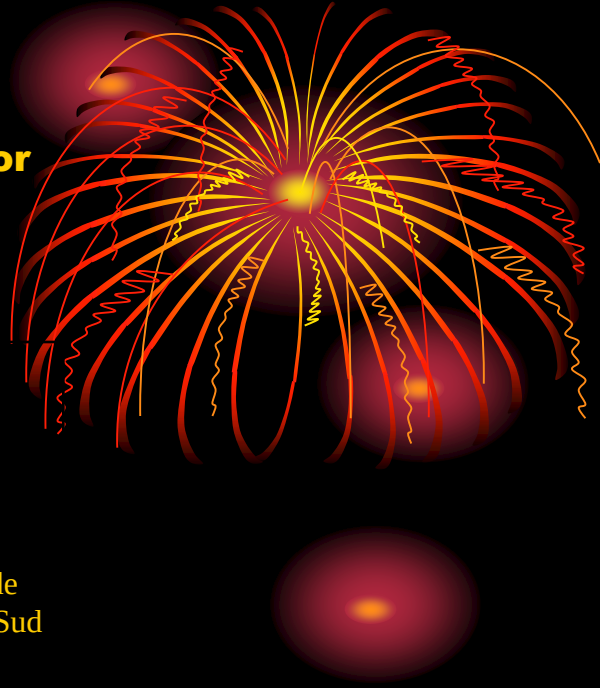
Fig.1 Semnal-treapta inregistrat la observatorul geomagnetic TEO din Mexic.

Daca perturbatia campului geomagnetic este inregistrata in jurul epicentrului pe distante mici (90-300 km, in cazul frecventelor ULF), se considera ca ea reflecta o activitate tectonica si seismica ce contribuie substantial la campul total (Aperovich et al., 2002). Piezomagnetismul, dependenta de stres a rezistentei electrice, efectele electrokinetice, procesele de generare a sarcinilor electrice, sau efectele magnetohidrodinamice sunt presupuse drept cauze (Masci et al.,2009).

In cazul in care semnalul-treapta este intalnit pe arii extinse, la scara regionala sau globala, se considera ca fenomene perturbatoare la nivelul magnetosferei si ionosferei, cum sunt cele care genereaza Sudden Impulses (SI), sau Sudden Storm Commencements (SSC) pot fi implicate in procesele de pregatire ale cutremurelor pe Pamant.

Prezentam aici situatia existenta inaintea a trei cutremure majore, care s-au produs in intervalul ianuarie – februarie 2018, semnalele-treapta identificate in reteaua Intermagnet (2018), in componenta orizontala X (cu directia N-S), fiind presupuse precursori seismici (Tabelul nr.1)

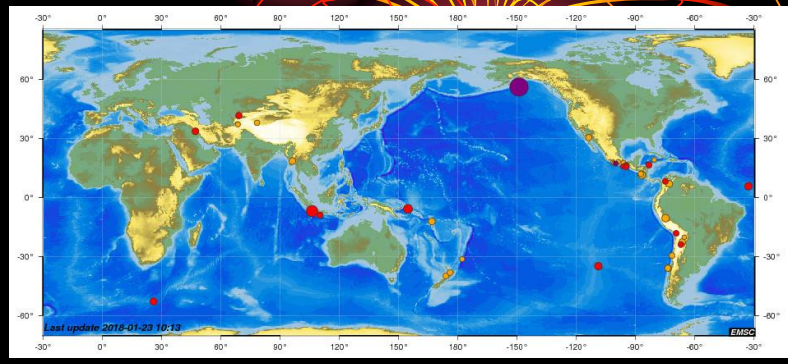
Tabel nr.1 Evenimentele seismice si distributia precursorilor seismici de tip treapta in reteaua Intermagnet



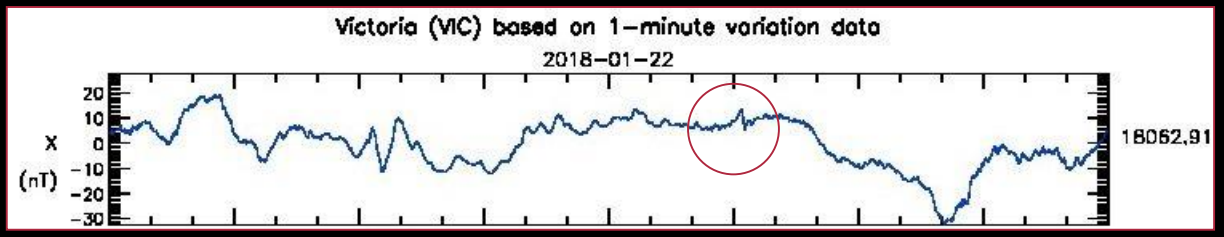
Evenimentul seismic	Precursor (data/ ora UT)	Timp precursor (ore)	Numarul observa-toarelor testate	Numarul observa-toarelor cu semnal precursor	Zona de aparitie
Alaska, 7.9M h 30 km 23.01.2018 09:31 UTC	22.01.2018 15:10	18	126	17	Americile de Nord si de Sud
	22.01.2018 02:40	33	126	20	Europa
	23.01.2018 05:40	4	119	23	Europa, Asia, Oc. Indian, Antarctica
Mexic, 7.2M h 10 km 16.02.2018 23:39 UTC	15.02.2018 08:45	39	93	89	Pe intregul Glob
Papua-Noua Guinee, 7.5M h 30 km 25.02.2018 17:44 UTC	23.02.2018 16:00	50	70	17	Coasta de vest a Pacificului (E-Asia + E-Australia)

Seismul 7.9M - Gulf of Alaska/20180123_0931 UTC

are un precusor specific in data de 22.01.2018, ora 15:10 UT, pe cand in Europa se inregistreaza doi precursori, unul in 22.01.2018, ora 02:40 UT si altul in 23.01.2018, ora 05:40. Este interesant faptul ca cel din urma cuprinde si Asia, Oceanul Indian si Antarctica. Pe de alta parte, pentru coasta de vest a Oceanului Pacific si pentru Africa, nu s-a pus in evidenta nicio anomalie magnetica din cele trei (Fig.2). Fata de acest eveniment seismic, Europa a prezentat un "efect de excludere" privind precursorii magnetici: observatoarele care au inregistrat semnalul in data de 22.01.2018, ora 02:40 UT, nu au inregistrat precursorul din 23.01.2018, ora 05:40 UT.

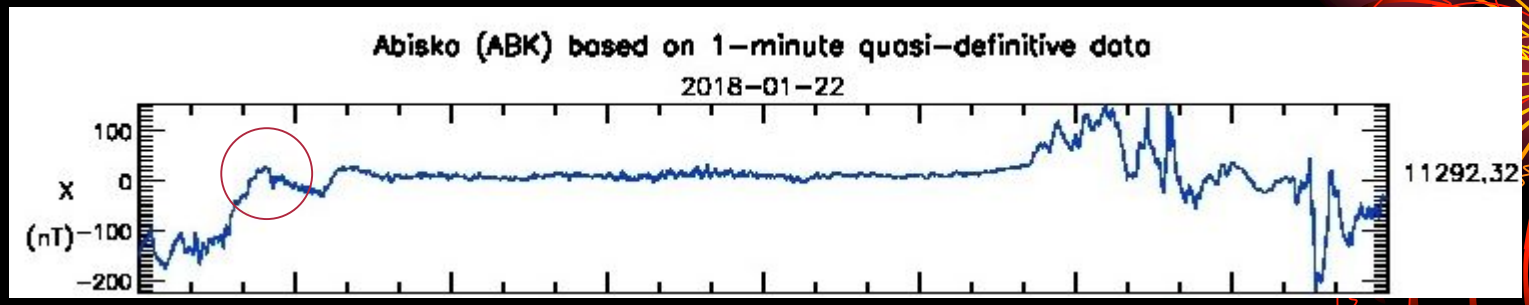


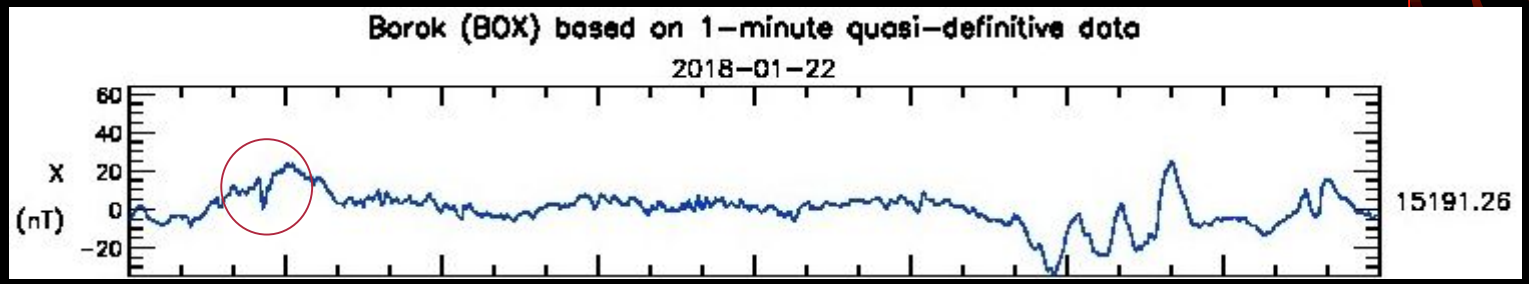
Semnal-treapta inregistrat cu circa 30 de minute inainte de cutremur (23.01.2018/09:00 UT) numai la observatorul geomagnetic DED-Alaska, relativ apropiat epicentrului.



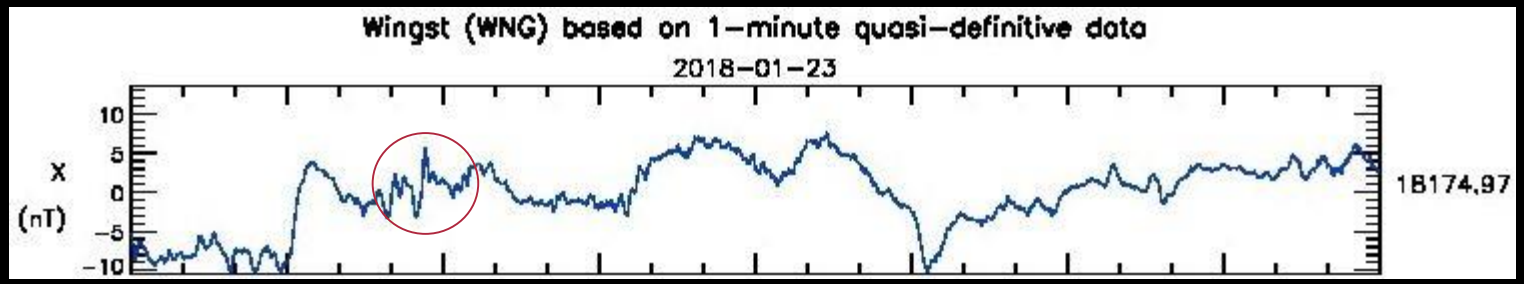
Semnal-treapta (22.01.2018/15:10 UT), identificat in statii mai indepartate de epicentrul din Alaska, specific doar continentelor americane si considerat precursor pentru aceasta zona (Fig. 2).

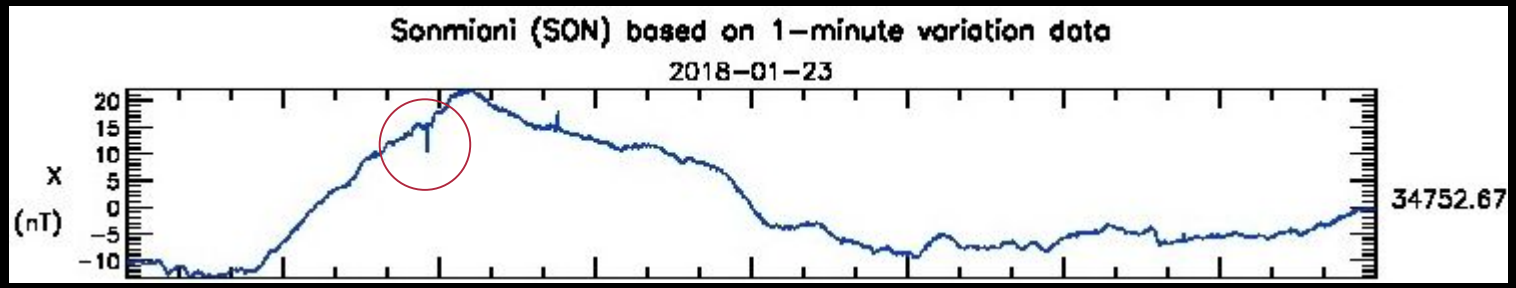
Precursor 22.01.2018/ 02:40 UT



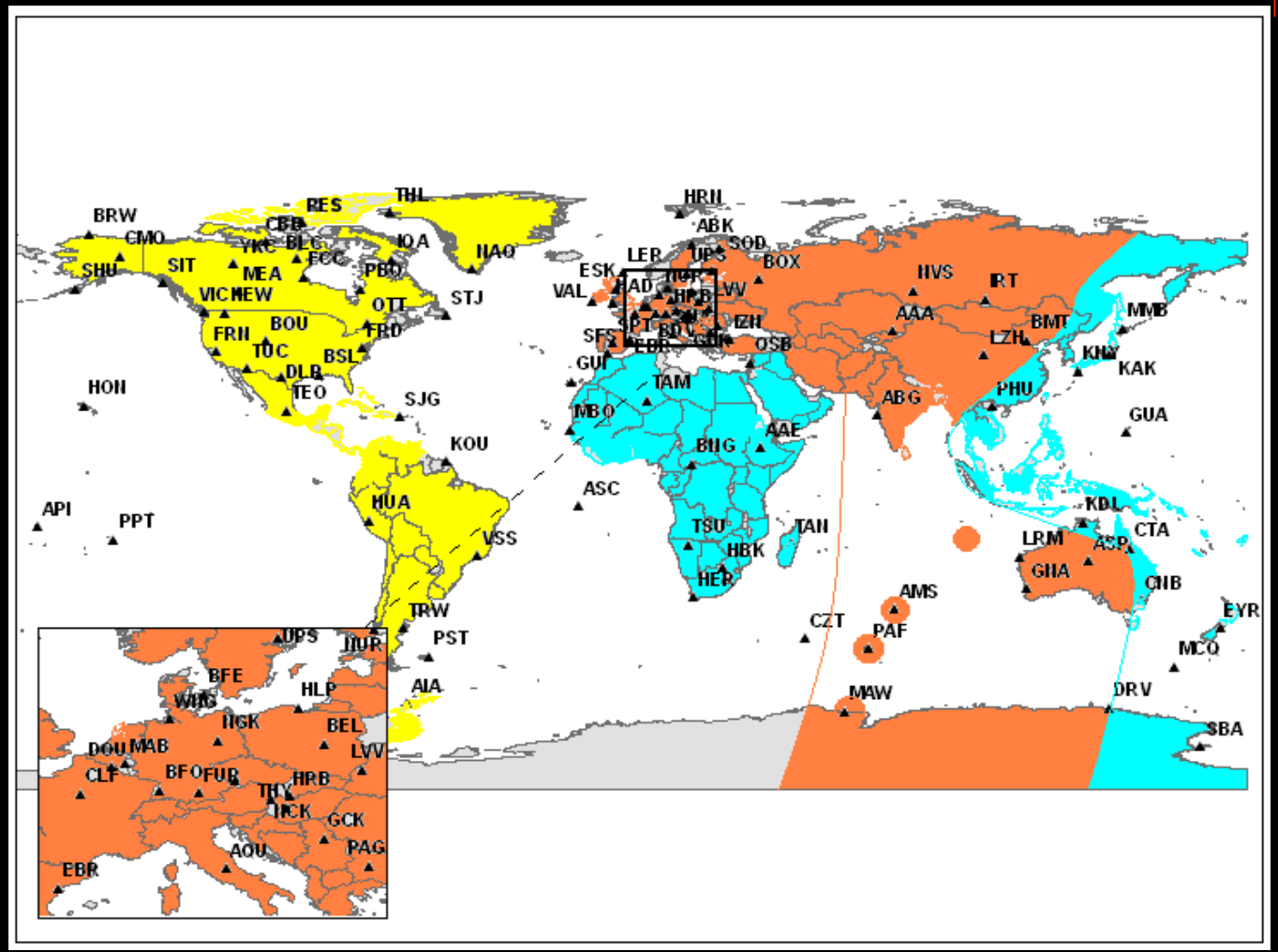


Precursor 23.01.2018/ 05:40 UT



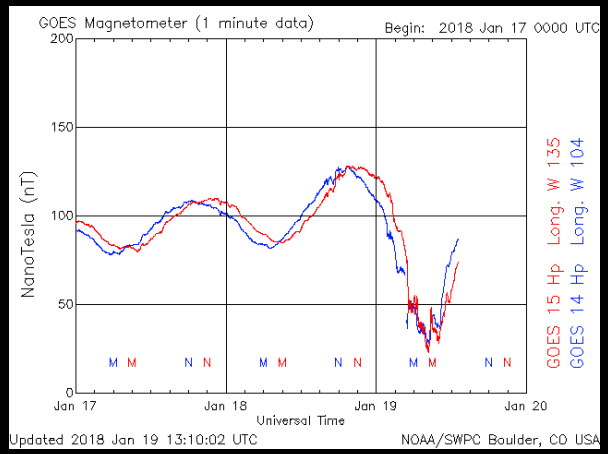


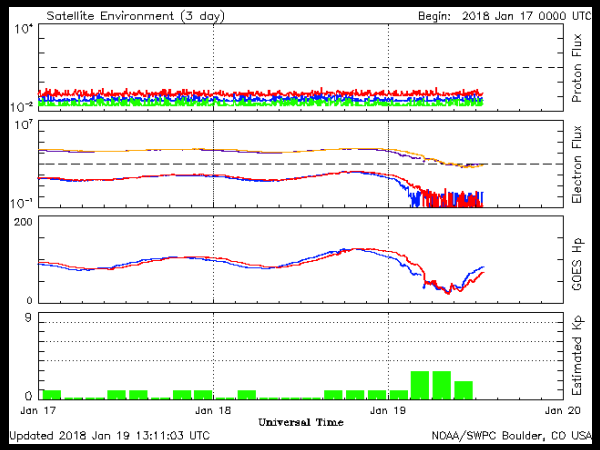
Distributia pe Glob a precursorilor posibil asociati seismului 7.9M-Alaska, 23.01.2018/09:31 UTC

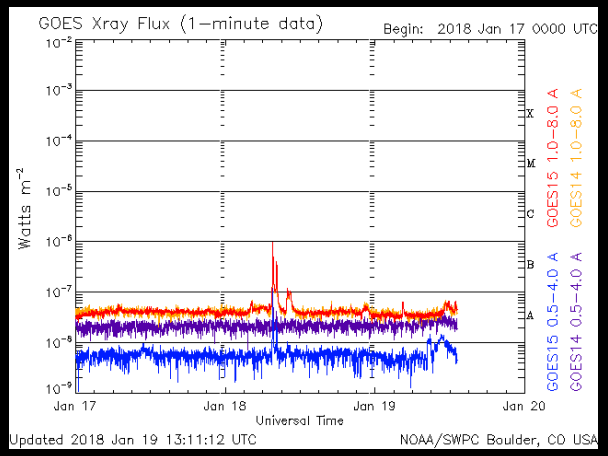


- s. prec. 22.01.2018/15:10 UT
- s. prec. 22.01.2018/02:40 UT; 23.01.2019/0540 UT
- fara precursori magnetici

Fig. 2







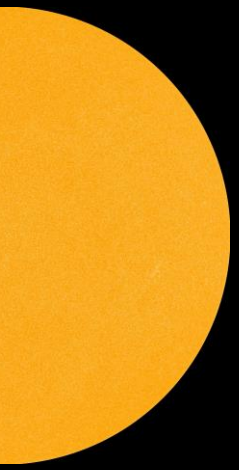
Din punctul de vedere al cauzelor externe care ar fi putut favoriza eventualele SSC descrise aici ca semnale-treapta cu caracter precursor, mentionam:

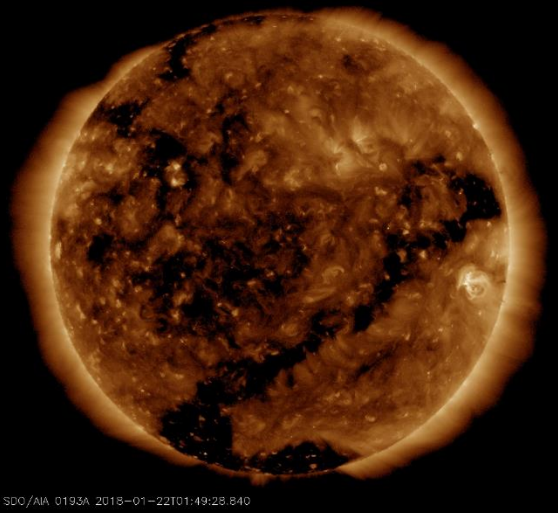
- eruptia solara din 22.01.2018, ora 02:41 UT,

- furtuna magnetica intre 18 si 23.01.2018,

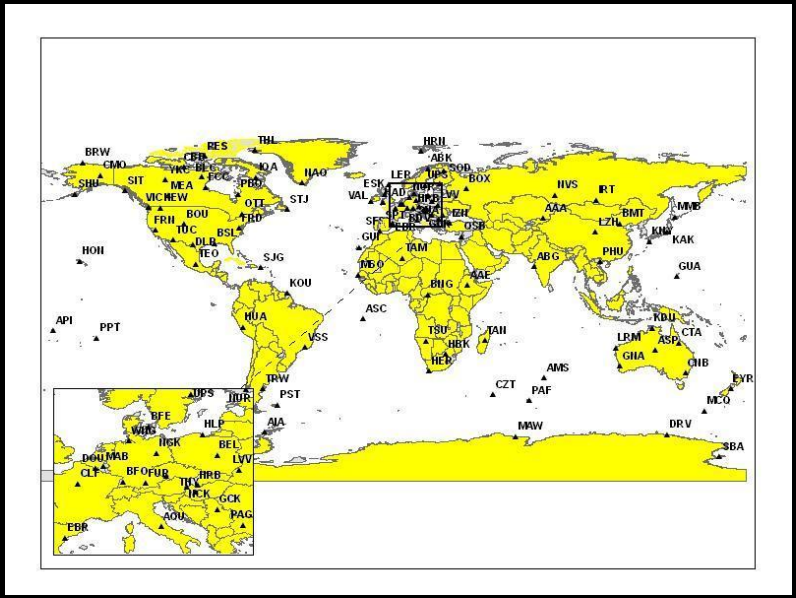
- anomalie in fluxul RX intre 18 si 22.01.2018

- anomalie in fluxul de electroni in intervalul 19-22.01.2018.



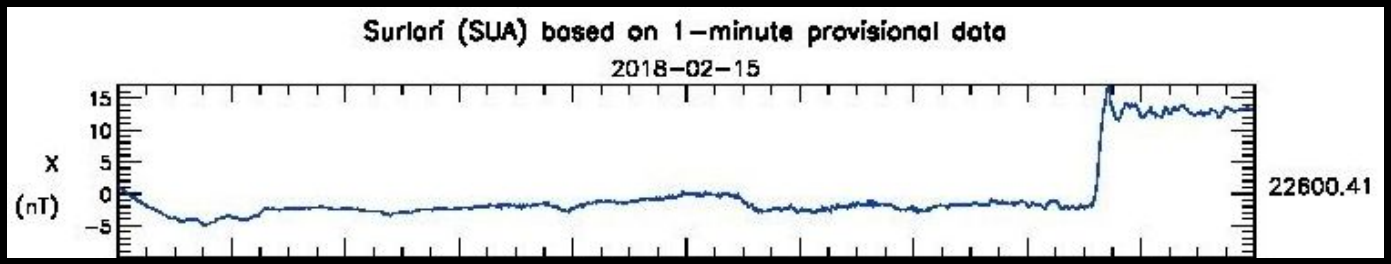


Seismul 7.2M-Oaxaca, Mexico/20180216_2339 UTC

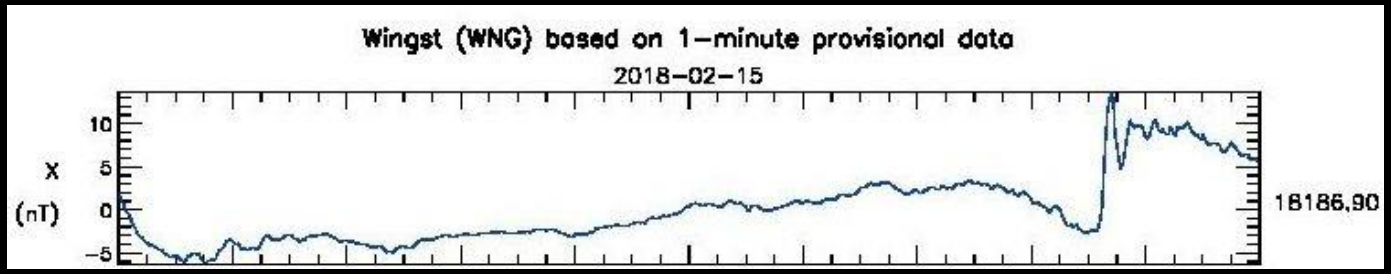


a avut semnal precursor pe intregul Glob (15.02.2018/08:45 UT), fiind identificat la 83 din 93 de observatoare testate. S-a constatat o tranzitie de la forma de unda "treapta" la pulsatie, atat in nordul Americii de Nord cat si in sudul coastei vestice a Pacificului (Fig.3).

Fig.3

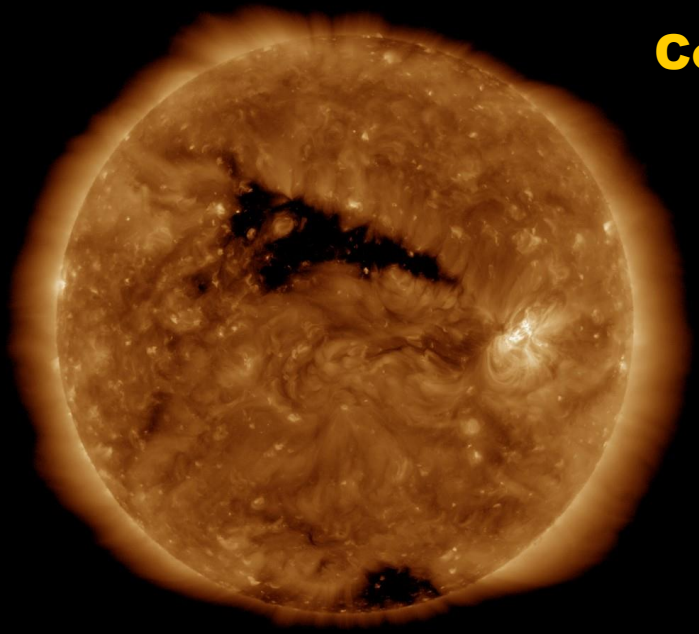


Semnal-treapta tipic, cu valoare de precursor seismic, inregistrat la observatorul SUA-Romania (intervalul de timp din reprezentare: 00 – 10 UT)

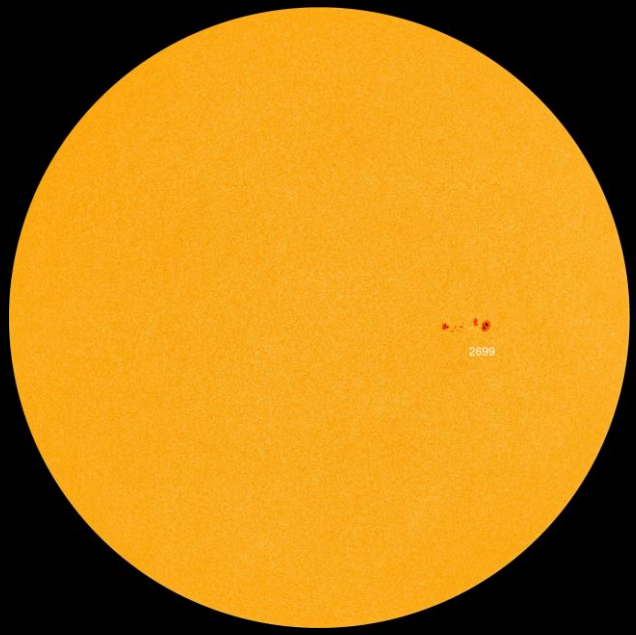


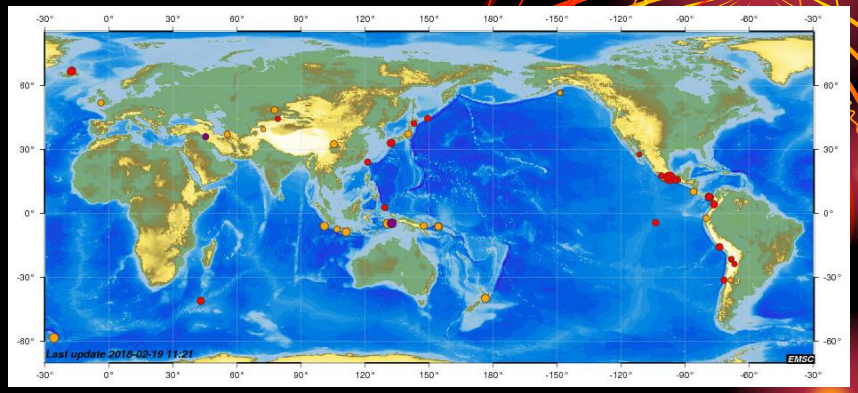
Acelas semnal-treapta, inregistrat la observatorul WNG-Germania, tinde sa dezvolte o pulsatie pe durata timpului de crestere.

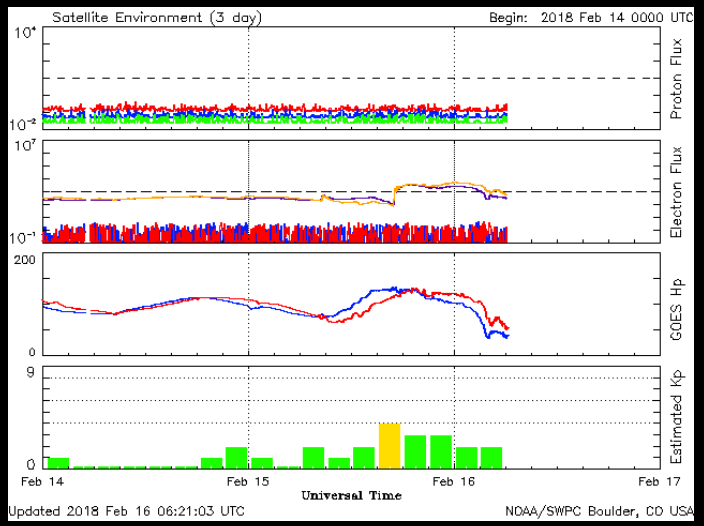
Contextul geofizic se afla sub influenta petei solare AR2699

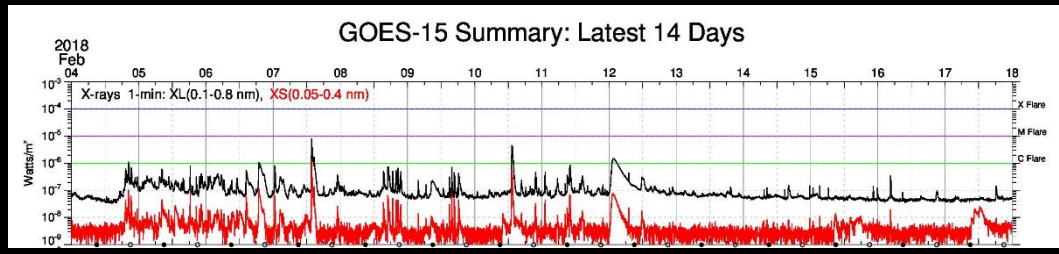


SDO/AIA 193 2018-02-13 19:41:05 UT

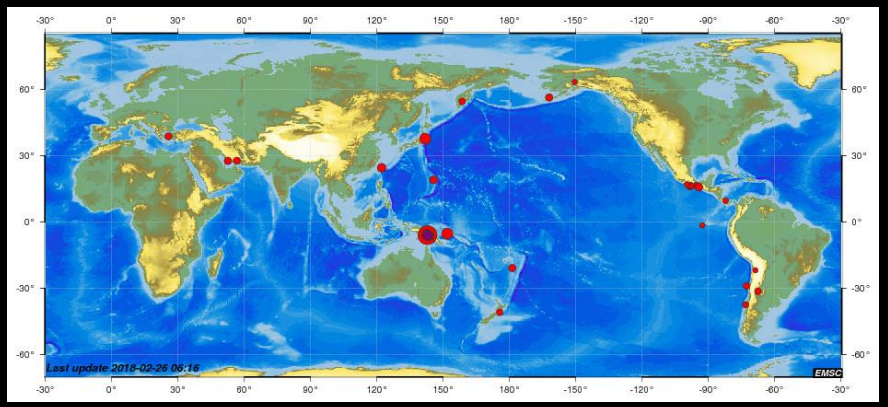








Seismul 7.5M-Papua, Noua Guinee/20180225_1744 UTC



a avut precursor magnetic in data de 23.02.2018, aproximativ la ora 16:00 UT,

dar numai in Pacificul de Vest (din 70 de statii testate, doar 17 au prezentat semnalul – Fig. 4).

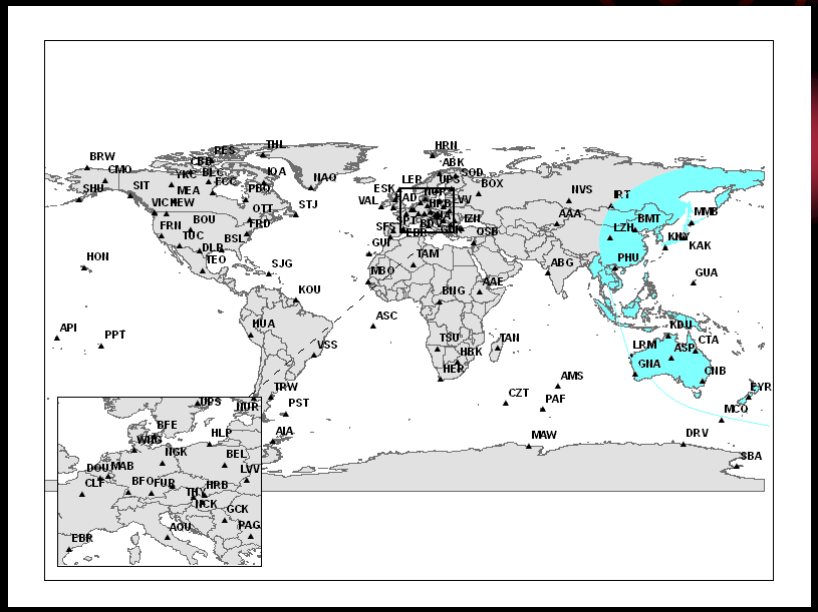
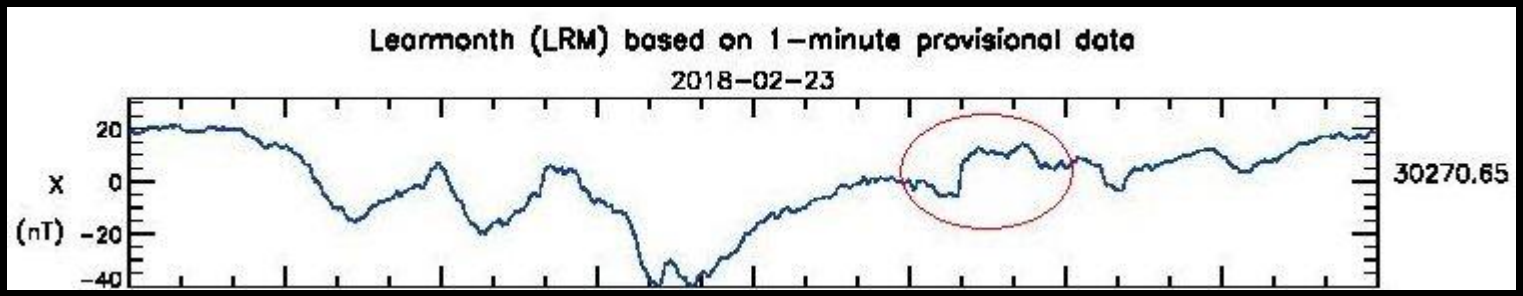
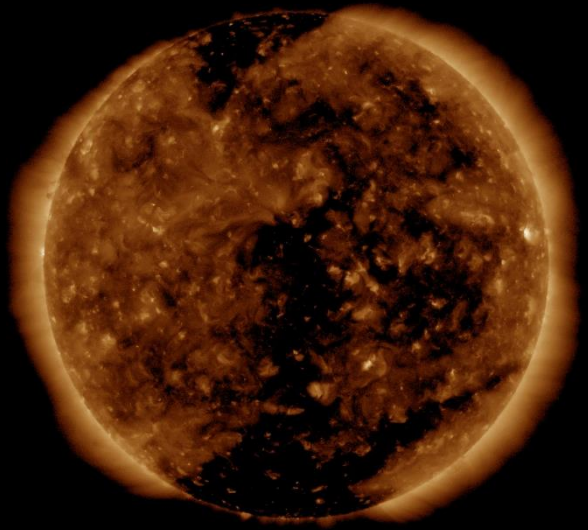


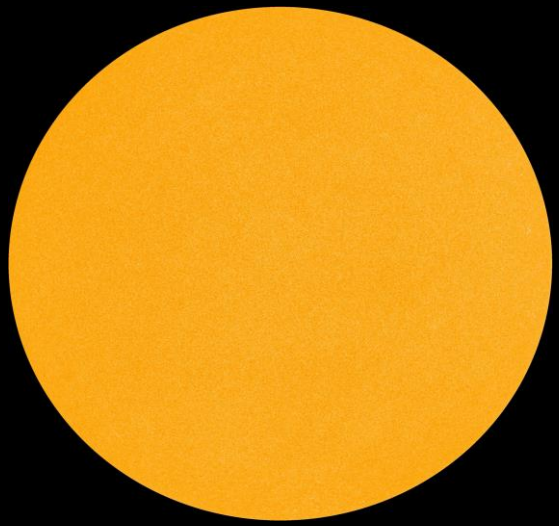
Fig.4

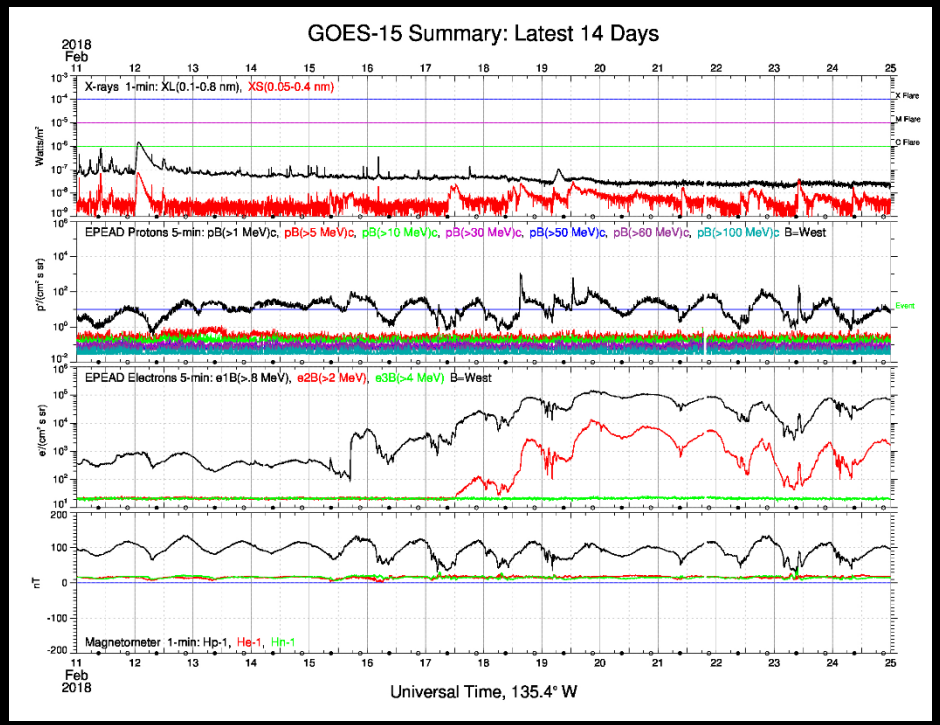


Semnal inregistrat la observatorul LRM-Australia (intervalul de timp din reprezentare: 11 – 19 UT)

Conditiile spatiului solar-terestrial in jurul datei precursorului magnetic (23.02.2018/16 UT)



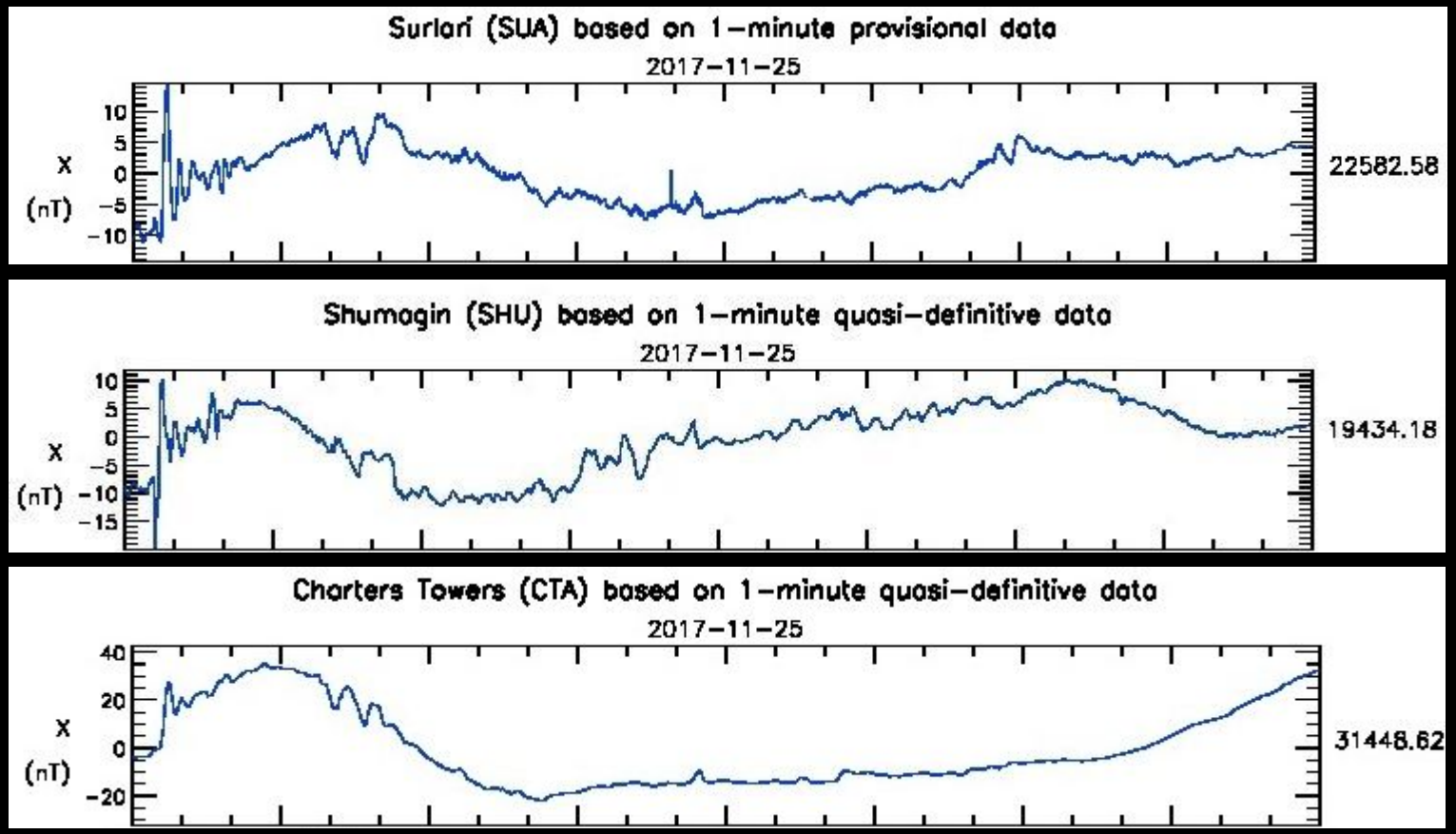




O comparatie a semnalelor considerate precursori seismici in cazurile prezentate a fost facuta cu alte trei fluctuatii in componenta orizontala X, care insa nu au fost urmate de cutremure mai mari sau egale cu 7,0M: o pulsatie si doua anomalii de tip treapta.

1. Pulsatia din 25.11.2017, ora 00:30 UT

Din 92 observatoare geomagnetice ale retelei Intermagnet testate, variatia a fost identificata in 58 acestea fiind raspandite pe intregul Glob (Fig.5).



Se poate observa cum fluctuatia isi modifica forma de la aceea de pulsatie la SUA-Romania, la dipolara in SHU-Alaska, sau aproximativ treapta la CTA-Australia. Intervalul de timp in baza graficelor este 00 – 24 UT.

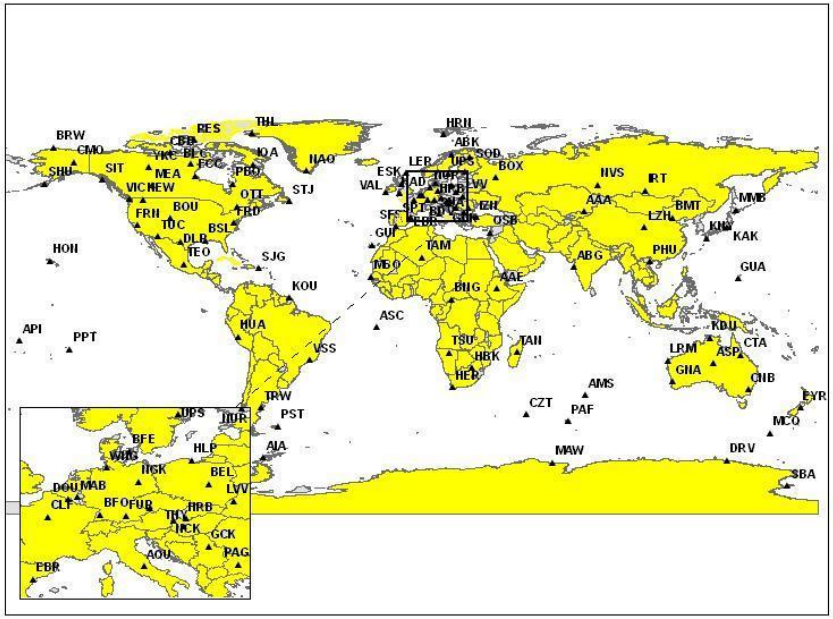
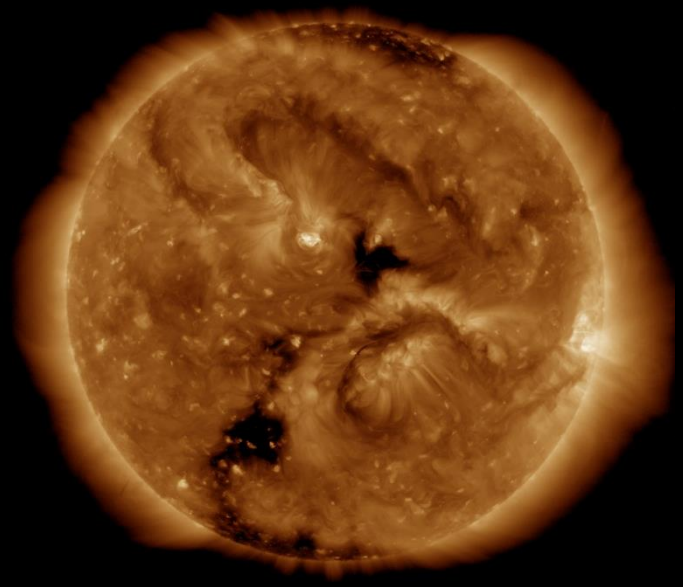
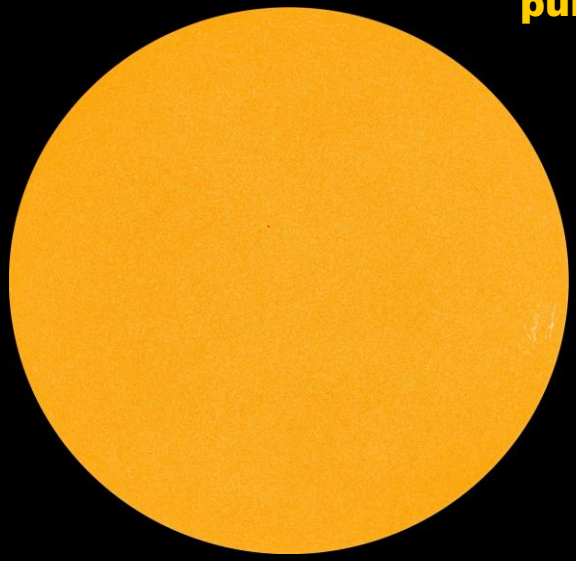


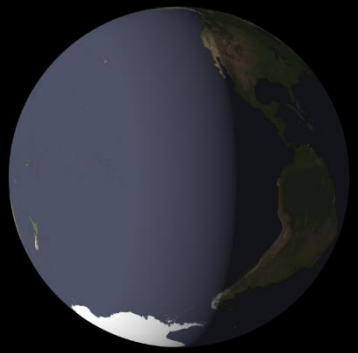
Fig. 5

Distributia pe intregul Glob a pulsatiei identificata pe componenta N-S a campului geomagnetic.

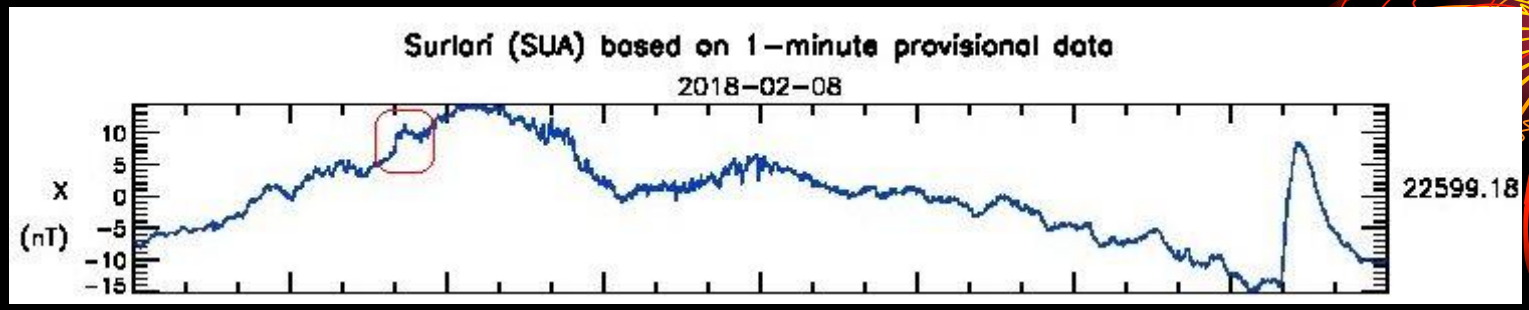
Activitatea Soarelui si pozitita Lunii fata de Pamant in ziua de 25.11.2017 in care s-a produs pulsatia.



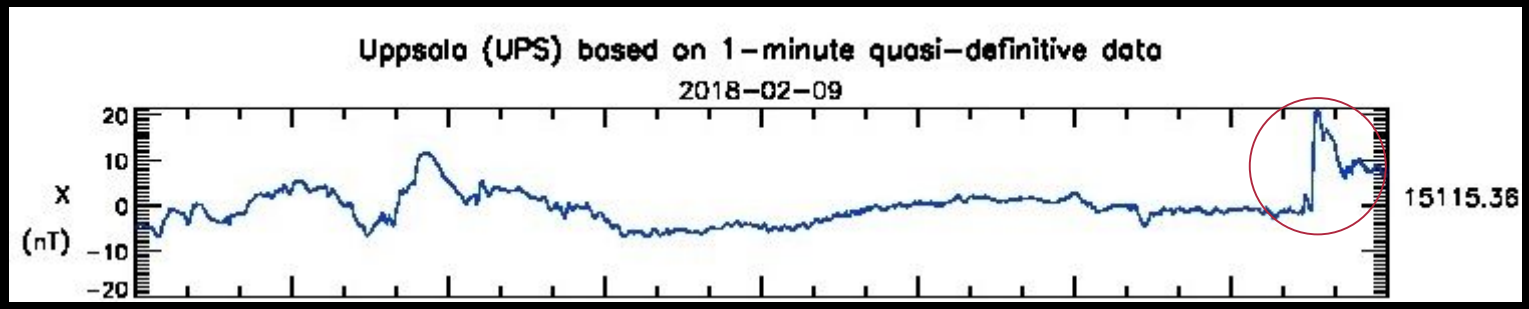




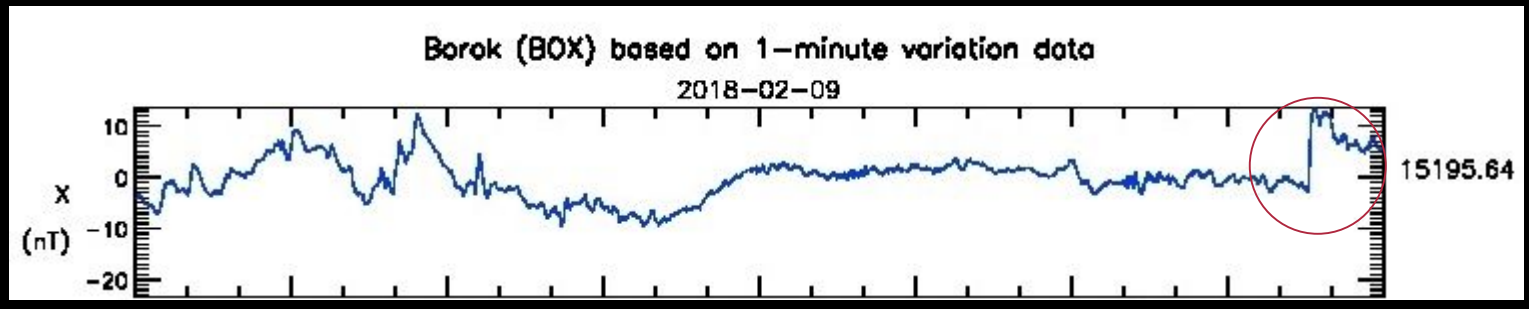
2. Variatiile "in treapta" din 8.02.2018, ora 05:00 UT si din 9.02.2018, ora 22:30 UT



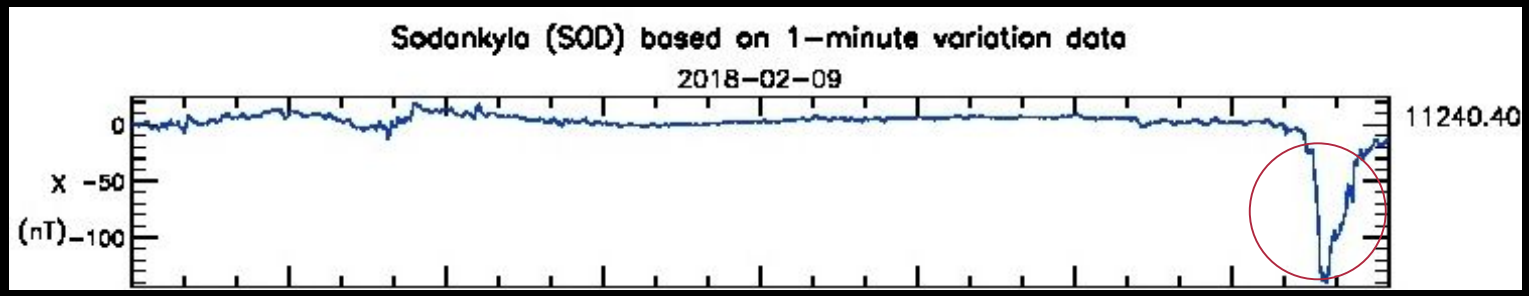
SUA – Surlari-Romania



UPS – Upsala-Suedia

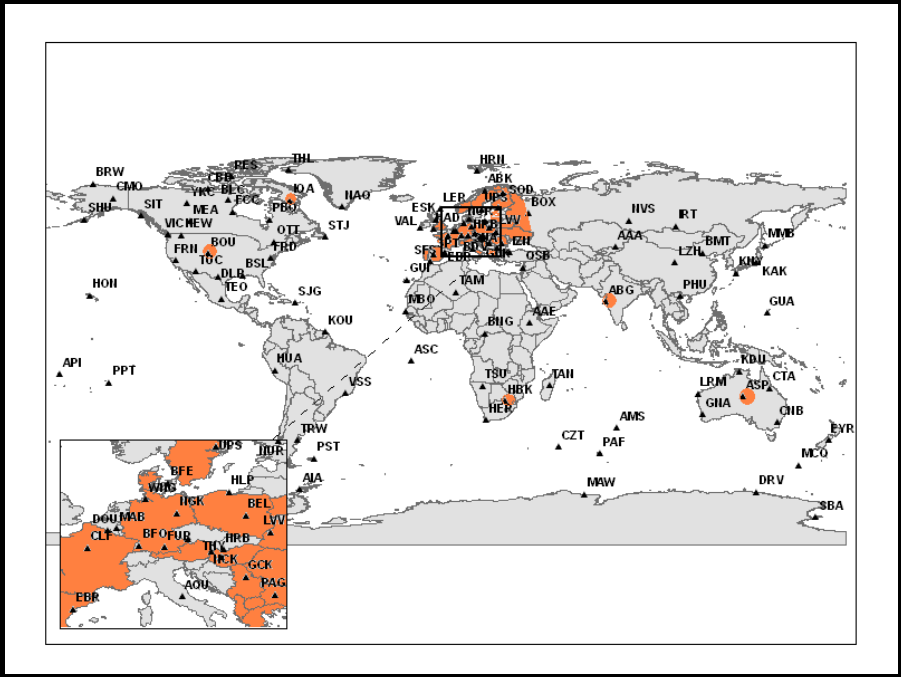


BOX – Borok-Rusia

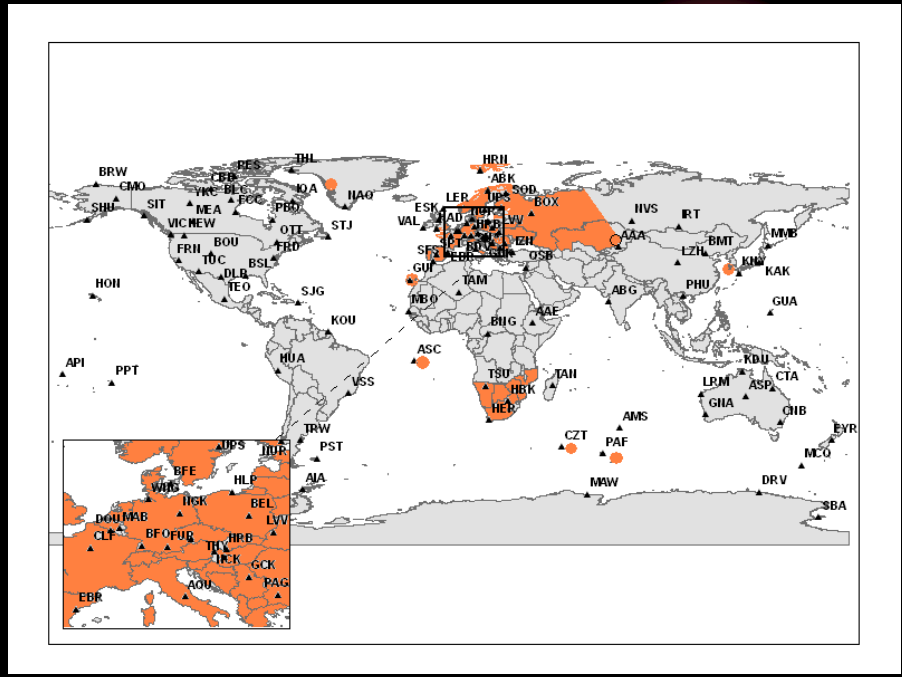


SOD – Sodankyla-Finlanda

Semnalul-treapta din 8.02.2018 a fost inregistrat in doar 22 observatoare din 107 disponibile, iar din acestea 16 apartin Europei. In ziua urmatoare, al doilea semnal-treapta a fost pus in evidenta de 35 observatoare din 111 active, iar 26 au apartinut Europei. Prin urmare, Europa este in mod deosebit sensibila la acest tip de semnal, sau cel putin in perioada ianuarie-februarie 2018.

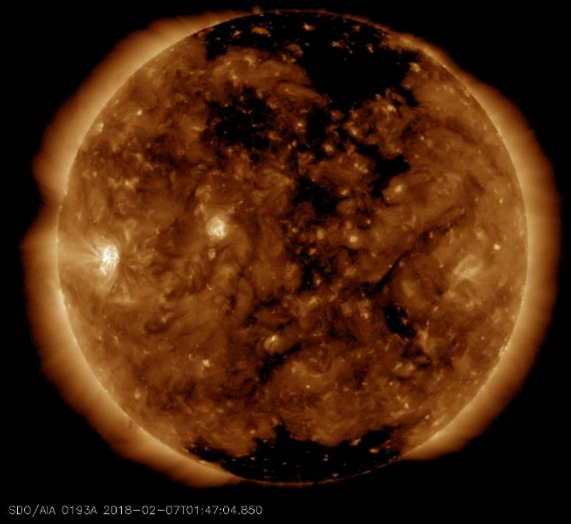


Distributia semnalului-treapta din 8.02.2018

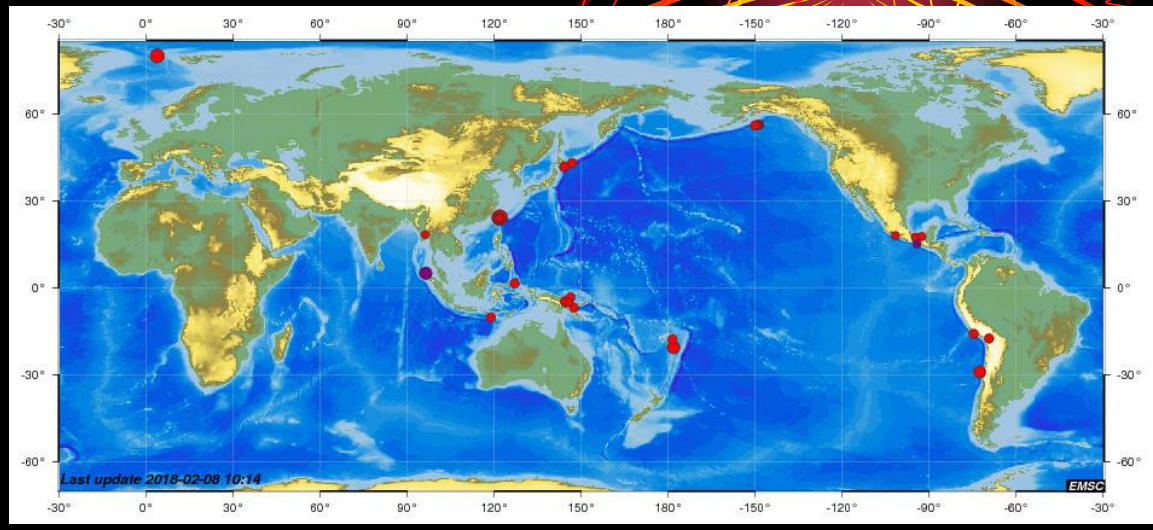


Distributia semnalului-treapta din 9.02.2018

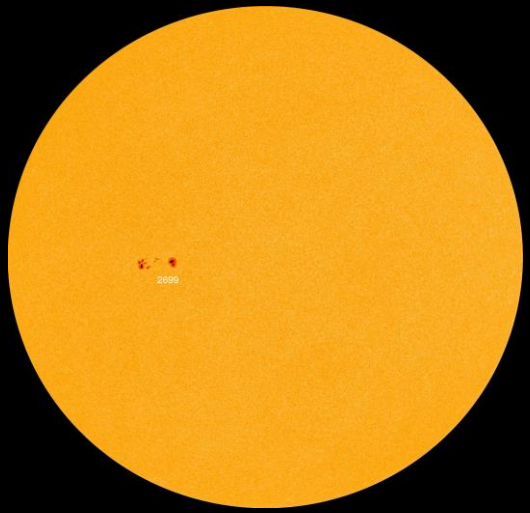
Activitatea solara, seismica si pozitia relativa Soare-Pamant-Luna in intervalul de timp 07 - 09.02.2018



7.02.2018

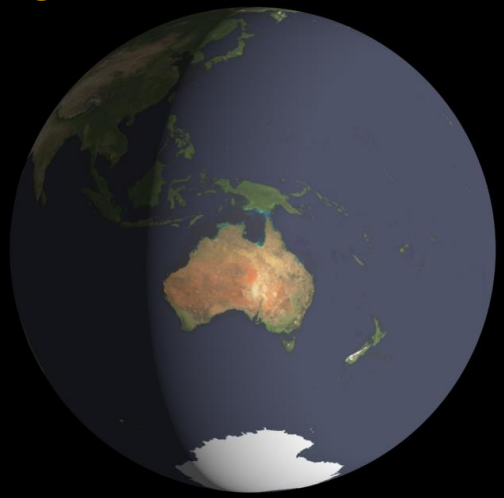


8.02.2018

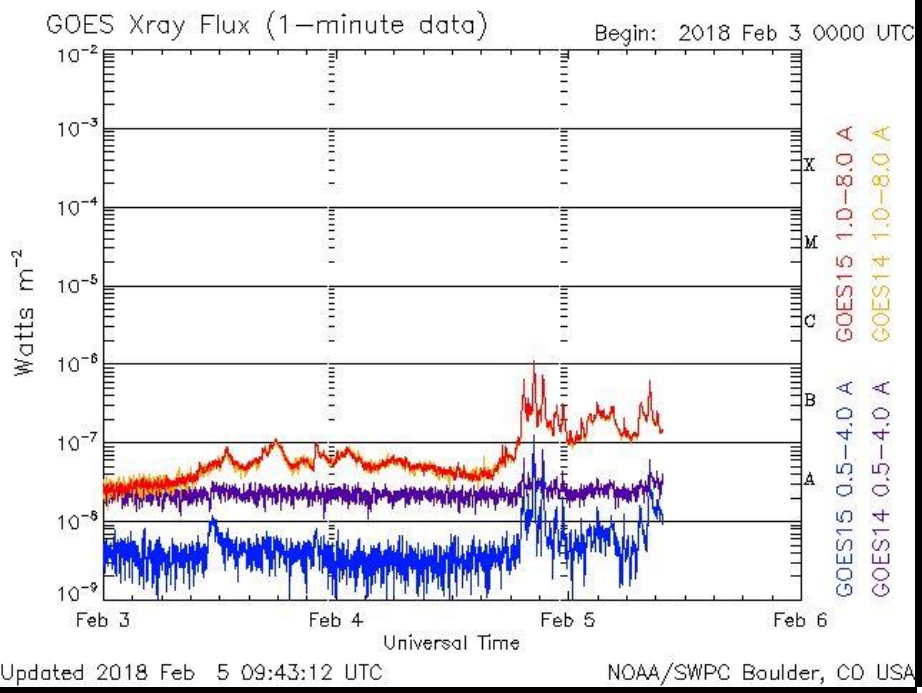


9.02.2018

8.02.2018_05:00 UT

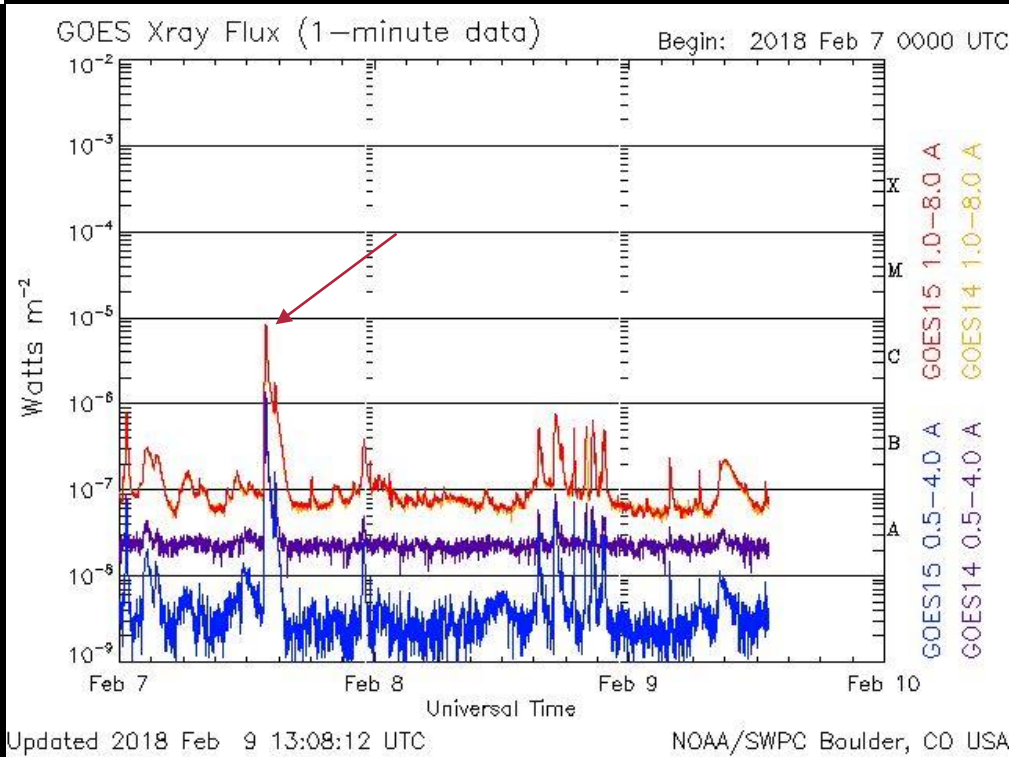


9.02.2018_22:30 UT



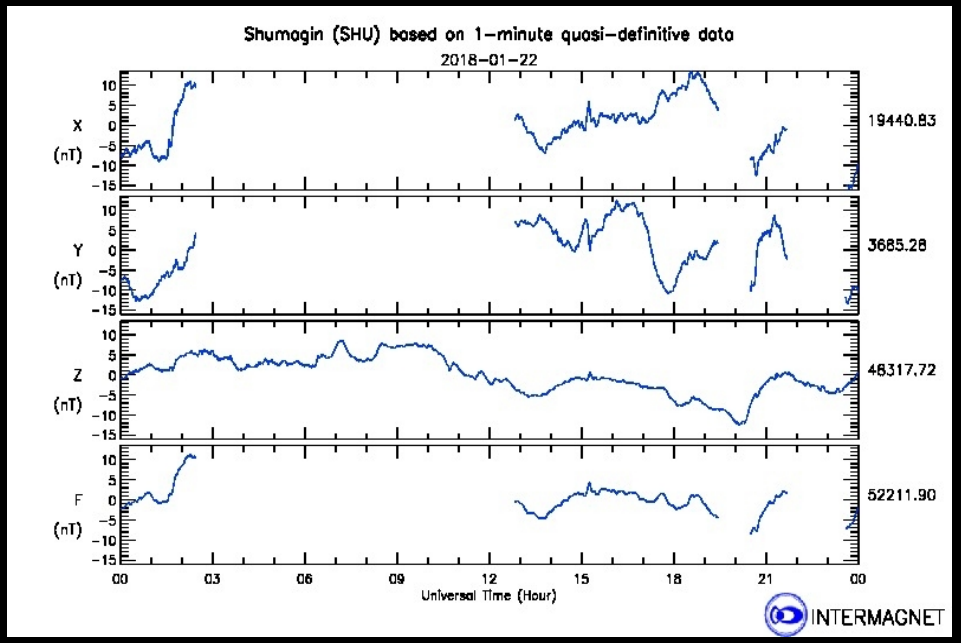
Anomalie in fluxul RX in perioada 04 - 12.02.2018 ca urmare a prezentei petei solare AR2699.

In 07.02.2018 la 13:47 UT aceasta a produs o explozie semnificativa pentru perioada de minim a activitatii solare, dar neinsotita de CME care sa produca furtuni geomagnetice.



CONCLUZIE

Avand in vedere rezultatele obtinute, consideram oportuna infiintarea in cadrul Institutului de Geodinamica al Academiei Romane a unei directii de cercetare pentru urmarirea precursorilor magnetici de tip treapta, observatorul geomagnetic SUA (Surlari-Romania) punand in evidenta majoritatea semnalelor SSC (treapta) urmate de cutremure mai mari de 7M, oriunde pe Pamant.



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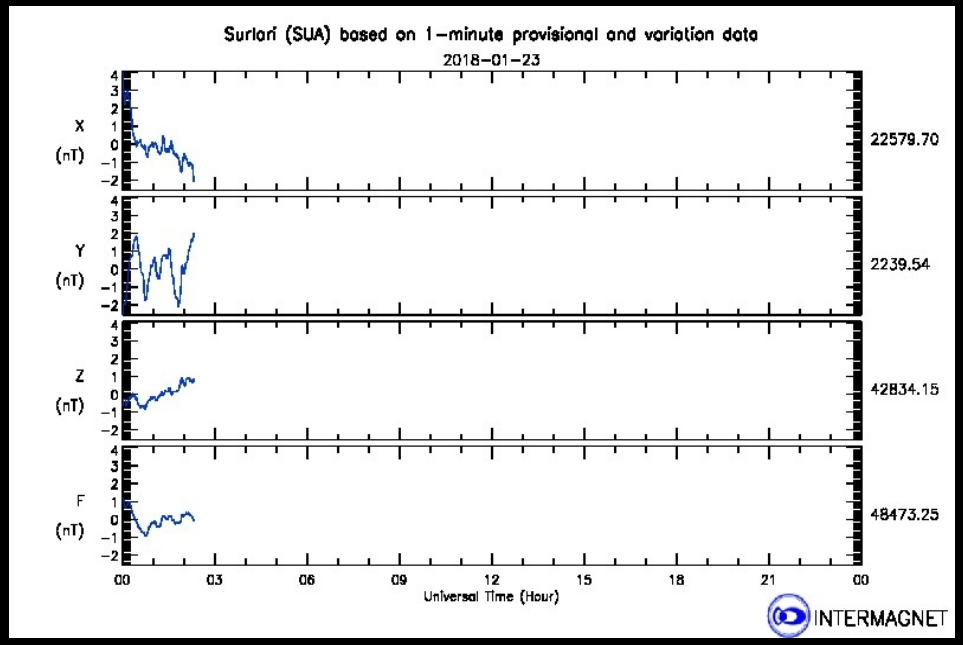
Inregistrari ale observatorului magnetic SHU-Alaska, cel mai apropiat de epicentrul seismului 7.9 M Alaska/20180123_0931 UTC



Inregistrari ale observatorului magnetic SUA-Romania, in ziua seismului 7.9 M Alaska/20180123_0931 UTC

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IG-AR, 28 martie 2018