



MINISTÉRIO DA CIÊNCIA E TECNOLOGIA

INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

INPE-9653-RPQ/739

**CATÁLOGO DE ESPECTROS DINÂMICOS DE EXPLOSÕES
SOLARES DECIMÉTRICAS REGISTRADAS PELO
BRAZILIAN SOLAR SPECTROSCOPE (BSS): 2000**

Francisco Carlos Rocha Fernandes

INPE
São José dos Campos
2003

EQUIPE DE COLABORADORES DO PROJETO BRAZILIAN SOLAR SPECTROSCOPE - BSS

- Prof. Hanumant Shankar Sawant (FMI-DAS/INPE)
- Dr. José Roberto Cecatto (FMI-DAS/INPE)
- Dr. José Ângelo da Costa Ferreira Neri (FMI-DAS/INPE)
- Dr. Francisco Eduardo de Carvalho Viola (FMI-DAS/INPE)
- Dr. Reinaldo Roberto Rosa (LAC/INPE)
- MSc. Maria Conceição de Andrade (FMI-DAS/INPE)
- MSc. Cláudio Faria (PUC-MINAS)
- Eng. Eduardo Mena Barreto Alonso (FMI-DAS/INPE)
- Téc. Marinaldo José Barbosa da Silva (FMI-DAS/INPE)
- Téc. Francisco de Paula Vitor Mesquita (DEA/INPE)
- André Ricardo Fazanaro Martinon (LAC-DAS/INPE)
- Kleber de Mattos Dobrowolski (LAC-DAS/INPE)
- Felipe Ramos Hald Madsen (FMI-DAS/INPE)
- José Carlos de Moraes Filho (FMI-DAS/INPE)
- Alessandro Guedes Caracini (FMI-DAS/INPE)

SUMÁRIO

	Pág.
1 - O PROJETO BRAZILIAN SOLAR SPECTROSCOPE (BSS)	1
1.1 - Breve Histórico.....	1
1.2 - Descrição Geral do Instrumento.....	1
1.3 - Visualização e Análise de Dados	1
2 - OBSERVAÇÕES SOLARES DECIMÉTRICAS: 2000	3
3 - CATÁLOGO DAS EXPLOSÕES SOLARES REGISTRADAS	7
REFERÊNCIAS BIBLIOGRÁFICAS	146

1 - O PROJETO BRAZILIAN SOLAR SPECTROSCOPE (BSS)

1.1 - Breve Histórico

Em 1990, a Linha de Pesquisa e Desenvolvimento de Física do Meio Interplanetário (FMI), da Divisão de Astrofísica, do INPE iniciou a primeira etapa do projeto de desenvolvimento do espectrógrafo solar. Inicialmente, foi instalado, em São José dos Campos, SP, um refletor parabólico de 9 metros de diâmetro, com um alimentador de banda estreita, operando no foco da antena na faixa de frequência de (1600 ± 100) MHz. A aquisição digital de dados teve início em 1992 (Sawant e Rosa, 1990; Sawant et al., 1991; Fernandes, 1992; Sawant et al., 1992; Sawant et al., 1993; Sawant et al., 1996). Este instrumento esteve em operação regular até o final de 1994, e registrou cerca de 350 grupos de explosões solares.

A partir de 1995, teve início a nova etapa do projeto, com a instalação de um alimentador de banda larga composto de duas antenas log-periódicas cruzadas e com a modificação de todo equipamento para operação na faixa de frequência de 200 a 2500 MHz, incluindo o software de aquisição. O espectrógrafo de banda larga entrou em operação em maio de 1996, com observações iniciais principalmente para testes do funcionamento do sistema, incluindo a aquisição digital dos dados e aquisição do código de tempo do GPS (“Global Position System”). Desde abril de 1998, está em operação regular, o instrumento batizado de **Brazilian Solar Spectroscope (BSS)** (Fernandes, 1997; Faria, 1999; Fernandes et al., 2000; Sawant et al., 2000; Sawant et al., 2001; Fernandes et al., 2001). O sistema de aquisição digital dos dados tem sido aprimorado, junto com o desenvolvimento dos programas para visualização e tratamento dos dados digitais (Faria, 1999; Martinon et al., 2000).

1.2 - Descrição Geral do Instrumento

O sistema receptor do BSS é constituído pela antena parabólica de 9 metros de diâmetro, do alimentador de banda larga (200 - 2500 MHz) composto por um par de antenas log-periódicas cruzadas, que permitem a recepção das componentes ortogonais (vertical e horizontal) do sinal recebido da fonte (Sol). A saída do alimentador está conectada a dois pré-amplificadores de baixo ruído, ligados a um circuito somador de banda larga. Depois de somado, o sinal é introduzido em um analisador de espectros (HP8559A), depois os sinais de variação de tensão na saída do analisador seguem para os sistemas de aquisição e monitoramento. O dados coletados pelo sistema receptor são digitalizados no microcomputador de aquisição e armazenados e visualizados num segundo microcomputador, conforme mostra a Figura 1. A Tabela 1 mostra as principais características do BSS.

O BSS é o único espectrógrafo dedicado às observações solares na faixa decimétrica, com alta resolução e alta sensibilidade em operação no hemisfério ocidental terrestre, de modo que, entre 16 e 19 UT, este é o único espectrógrafo digital a monitorar o Sol, preenchendo uma lacuna entre as observações realizadas na Europa e na América do Norte.

1.3 - Visualização e Análise de Dados

Para visualização e tratamento dos dados digitais do BSS é utilizado um programa desenvolvido na linguagem IDL (“Interactive Data Language”) batizado de BSSView (Faria, 1999). Este programa permite visualizar em tempo quase-real o espectro dinâmico das observações e obter representações gráficas dos dados digitalizados (perfis temporais de múltiplos canais de frequência, imagens 2D e 3D em escalas de cores e mapas de contorno).

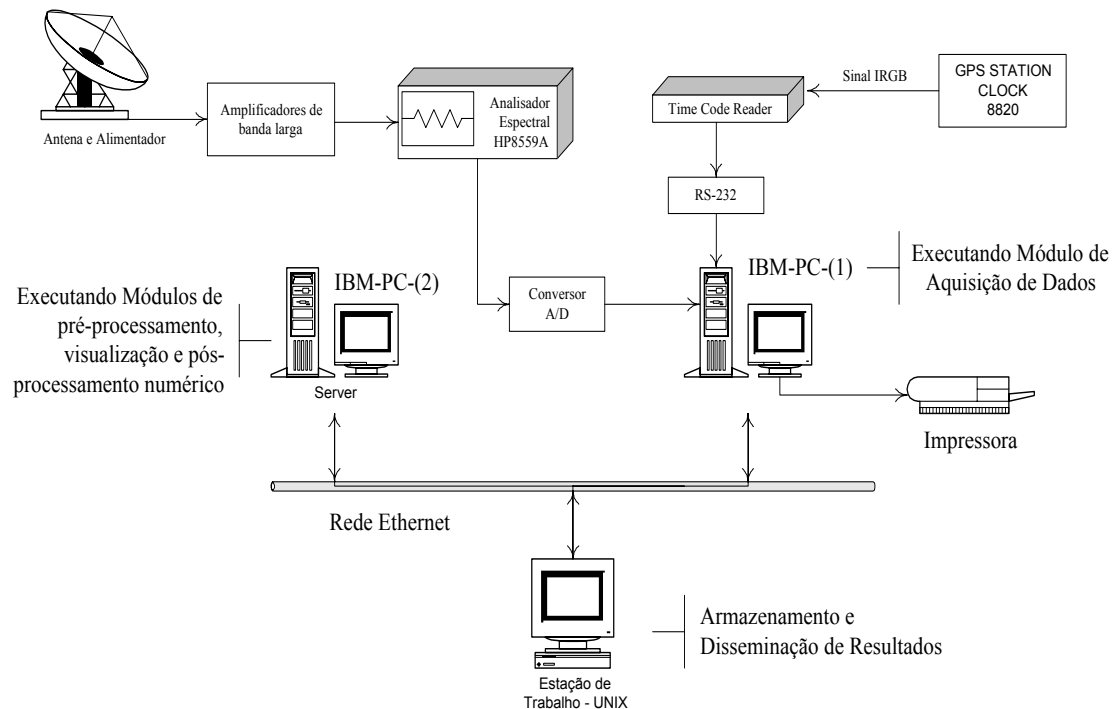


FIGURA 1 - Diagrama de blocos representando o Brazilian Solar Spectroscopy (BSS).

TABELA 1 - Principais características do BSS.

Diâmetro da Antena	9 metros
Montagem	polar
Alimentador	log-periódico cruzado
Frequência	200-2500 MHz
Resolução temporal	0,01; 0,02; 0,05; 0,10; 0,20; 1 s
Resolução espectral	1; 3 MHz
Precisão tempo absoluta	0,003 s
Sensibilidade	~2-3 sfu
Número de canais	25; 50; 100
Visualização	tempo real
Campo de visada	todo o disco solar
Observações diárias	11:00-19:00 UT

Para a determinação de parâmetros das observações, foi desenvolvido um programa base, batizado de BSSData (Martinon et al., 2000; Martinon et al., 2002), contendo ferramentas para destacar as explosões, para determinar visualmente os parâmetros das explosões, para manipular as cores do espectro dinâmico e para organizar os dados em projetos distintos.

2 - OBSERVAÇÕES SOLARES DECIMÉTRICAS: 2000

Devido à grande incidência de tempestades elétricas no verão na região de São José dos Campos, SP, que podem danificar a eletrônica do sistema do BSS, e principalmente às férias coletivas dos funcionários do INPE, os meses de janeiro e fevereiro são escolhidos para manutenção e reparos mecânicos na antena e no sistema de rastreamento, não ocorrendo observações neste período. Assim, as observações solares sistemáticas utilizando o BSS ocorrem entre os meses de março e dezembro. As observações são realizadas diariamente, de segunda a sexta, aproximadamente das 8:30 às 15:30 horas, horário local (11:30 - 18:30 UT). A Tabela 2 mostra o resumo das observações realizadas pelo BSS em 2000 e a Figura 2 a distribuição mensal dos dias de observação e eventos registrados. A lista completa das explosões solares observadas é apresentada na Tabela 3.

TABELA 2 – Observações solares com o BSS em 2000.

Dias	Horas	“Flares” solares registrados
175	980	99

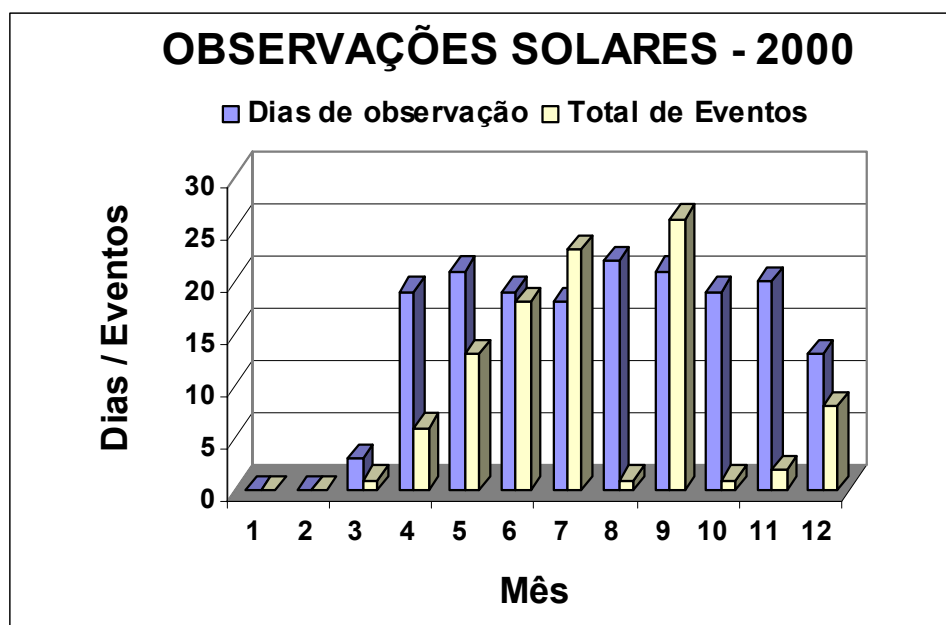


FIGURA 2 - Distribuição mensal do total de dias de observações solares realizadas pelo BSS em 2000 e do número de eventos registrados no mesmo período.

TABELA 3 - Lista de explosões registradas pelo BSS em 2000.

Dia	Hora (UT)	Tipo de atividade*	BSS Arq.	GOES	Atividade Associada**
MARÇO					
31	13:11:04-13:17:44	CNT + EF	A5	-	-
ABRIL					
03	14:52:19-14:57:48	TIII bb	D0	-	245
04	15:00:52-15:39:25	CNT	C4-D0	C9.7	DSF 145-15400
17	13:02:44-13:08:13	Rise/fall	B2	-	13:02 RBR III/1
17	14:41:33-14:47:00	Dots	D0	-	14:11-17:09 RSP CTM/1
18	14:55:11-15:00:39	Dots	A2	-	-
27	12:07:37-12:13:12	TIIIG bb	A7	-	11:36-21:58 RSP CTM/2
MAIO					
02	14:43:18-14:48:46	CNT + EF	D1	M2.8	245-15400
08	15:30:30-15:35:58	EF nb dfdt Int.var.	E3	-	SF 15:29-45 e 15:35-40 DSD
09	17:34:56-17:40:23	TIII-like	G6	C9.2	SN 17:30-50 RBR 4995
16	18:48-18:53	EF freq/temp	E7	-	-
18	15:53-15:59	EF fraca	E6	M2.7	245-15400
19	13:12-13:18	TIIIG ib-bb	A9	-	12:44-17:00 CTM/1
22	13:24-13:41	CNT	B9-C1	-	13:38-13:40 RBR 245
24	14:29-14:35	CNT + Fibra	D3	-	-
24	18:09-18:14	CNT	H3	-	14:31-14:33 RBR 1415/410
25	16:06-16:11	CNT	E8	C2.7	SF 18:00-18:09
25	16:17-16:27	CNT	F0	-	SF 16:10-16:48
25	16:49-16:55	CNT	F6	-	-
25	17:00-17:06	CNT	F8	-	-
JUNHO					
02	13:30-13:41	CNT	B2-B3	-	13:33-13:37 RBR 245
05	12:08-12:14	CNT ib + EF	A3	-	12:09-12:10 RBR 1415
05	13:54-13:59	EF Tx nb+ib fraca	C2	M1.5	1F 13:53-20 14:05 RSP III/2
05	18:34-18:39	CNT fraca	H3	C3.8	1F 18:23-19:07
06	13:27-13:33	Uinv+CNT+IIIlib-nb	A5-A6	X1.1	13:30-13:56 245-15400
06	15:01-17:17	Pre EF + CNT + Dots+zebra+Fibra	C2-E5	X2.3	320-15400 14:47 RSP IV/3
07	15:37-15:43	TIII ib-bb	D4	X1.2	15:38-31 245-15400 II IV
14	13:41-13:46	Spikes	C3	C1.8	13:44-07 III RBR 245-2695
14	18:31-18:37	CNT	H6	-	RSP III/1
15	17-12-17:18	Dots + EF	G0	C4.1	17:05 RNS 245 RBR 245
19	14:28-14:34	Spikes	D2	C1.9	14:29-14:36 245-1415
19	14:50-14:56	Dots	D6	-	-
21	14:17-14:18	EF	C8	C9.7	1N 14:18-25 RBR 410-15400
27	12:44-12:48	CNT + Fibra NS	A8	-	12:43-54 RBR 245-15400
27	12:56-13:20	Fibra NS	B0-B4	C9.3	13:03 RSP III/1 RBR 606
27	13:43-15:02	Fibra + EF NS	B9-D2	-	13:10-15:21 RSP CTM/2
30	12:15-12:59	CNT NT fraco	A0-A7	-	-
30	14:18	CNT fraco	C2	-	-

(continua)

... Continuação

JULHO

04	14:58-14:59	Dots	B7	C2.3	SF 14:58-15:16
04	15:18	EF curta duração	C1	C3.4	SF 15:11-16:22
04	15:43	Cigar patch	C5	-	15:11 RSP CTM/1
04	15:44	Patch	C5	-	15:11 RSP CTM/1
06	12:26-12:37	Fraca CNT + Puls.	A7-A8	C4.3	12:36 RBR 410-1415
06	12:54-13:00	Fraca CNT + bb	B2	-	12:36-12:55 RSP II/2
06	15:06-15:11	CNT	D6	-	SF 15:09
06	18:49	Split patches	H6	-	-
10	16:21	Dots	F1	-	16:18-16:20 RBR 245
11	12:31	Cigar patch	A0	-	SF 12:31 RSP CTM/2
11	13:13-13:24	Oscilações	A8-A9	X1.0	-
11	13:24-13:27	Spikes (pré flare)	A9-B0	-	2N 13:20-48 RBR 245-8800
11	13:30-13:57	CNT	B1-B5	-	2N 13:20-48 RBR 245-8800
11	13:46	Zebra	B3	-	2N 13:20-48 RBR 245-8800
12	18:39-18:50	Patch + Pulsações	H5-H6	M5.7	2F RBR 1415 -15400
13	14:18	Patch	C8	-	-
13	14:44-14:54	Patches + EF	D3-D4	-	SF 14:48 RBR 245-15400 RSP III
13	17:42	Patch + Puls.	G5	-	-
14	12:52	EF+Puls.+Patch + TIII+Zebra+CNT	B2-B3	-	-
14	13:48	TIII+Dots+CNT+Patch	C3-C4	-	-
20	13:26-13:34	Pulsações	A3-A4	C7.0	SF RBR 245-1415
20	14:56-15:01	Patch + TIII + Puls.	B9-C0	C5.1	SF RBR 245-15400
31	15:55	Puls. + Patch	B5	-	-

AGOSTO

18	17:15	Pulsações	F7	-	-
----	-------	-----------	----	---	---

SETEMBRO

14	14:40-14:51	CNT + Patch	A0-A1	C2.1	SF RBR 245-8000
15	13:20-13:25	EF	B7	-	RSP III/2 RBR 245-410
15	14:31-14:37	Pulsações	D0	M2.0	RSP V/3 RBR 245-15400
16	13:23-13:34	Patch	C0-C1	-	SF RBR 245-606 RSP III/2 V/3
16	14:18-14:28	Patch+TIII +CNT	D0-D1	M3.2	2N RSP III/2 V/3 RBR 245-15400
17	12:18-12:23	Patch	A9	C4.7	-
18	11:54-11:59	CNT + Puls.	A5 A7	-	-
18	13:59-14:04	DOTS	C7	-	-
19	15:24-15:30	DOTS	D0	C3.0	1F 15:17
20	12:04-12:10	DOTS Pré-flare	A5	-	-
20	14:39-14:45	Pulsações	D3	-	SF 14:42
20	15:23-16:07	Patch+Puls.+TIII+nb + DOTS	E1-E8	C3.1	DSF CTM/1 RBR 410-15400 15:51-00 RBR 410-1415
20	16:12-18:02	Puls.+TIII+Patch+ DOT ISO	F0-G0 G9	-	-
21	17:55	EF	F1	-	RBR 606
21	18:16	EF	F5	-	18:14-18:16 RBR 245-410
21	18:22	Puls. + Patch	F6	-	18:25 RBR 245-606

(continua)

... Conclusão

21	18:16	EF	F5	-	18:14-18:16 RBR 245-410
21	18:22	Puls. + Patch	F6	-	18:25 RBR 245-606
22	15:34	DOTS	E0 E3	-	RBR 245-15400 RSP III/2 V/3
23	14:54-15:00	DOTS	D6	-	-
25	15:15-15:26	DOTS	C1-C2	-	-
26	12:33	TIII	B2	C4.3	SF CTM/2
26	14:26-14:30	CNT	D3	-	-
26	18:23-18:30	CNT fraco	H6-H7	-	RSP V/1
29	16:23-16:24	DOT chain	C5	-	-
29	16:33-16:34	DOT Uchain	C7	-	-

OUTUBRO

26	16:03-16:09	CNT fraco	E2	C8.5	1N RBR 410-4995
----	-------------	-----------	----	------	-----------------

NOVEMBRO

22	16:19-16:21	CNT	F0	C7.0	1N RBR 210-15400 RSP II/1
24	14:53-15:20	CNT+ TIIIInb + Puls.	C3-C8	X2.3	2B RBR 245-15400 RSP II/3

DEZEMBRO

12	14:40-14:44	CNT NB Inv. U	C9-D0	M1.3	1F ERU RBR 1415 4995
14	15:40-15:58	CNT Grad.	E4-E7	-	-
18	16:34:57	EF nb	F5	-	-
18	16:35:26	EF fracas	F5	-	-
18	16:35:38	EF fracas	F5	-	-
18	16:35:58	EF nb	F5	-	-
18	16:38:22	EF	F6	-	-
19	13:15	CNT Int bb	B3	-	RSP III/1

* Abreviações das estruturas finas: CNT: emissão contínua; EF: Estrutura Fina; EFT: Estrutura Fina em Tempo; TIII: Tipo III; G: Grupo de < 10 estruturas; GG: Grupo de > 10 estruturas; ISO: estrutura isolada; RS: “Reverse Slope” – taxa de deriva inversa; nb: banda estreita; ib: banda intermediária; bb: banda larga; NT: curta duração; BT: longa duração; dfdt: taxa de deriva em frequência; Puls.: Pulsações; Osc.: Oscilações; U: na forma de U; U inv.: na forma de U invertido; int. var.: com variação da intensidade com a frequência; HOR: Horizontal; VER: vertical.; Bxfreq: Baixa Frequência; LBxfreq: Limite de Baixa Frequência; Atfreq: Alta Frequência; LATfreq: Limite de Alta Frequência; ABS: Absorção; Nclass: Não classificada; NS: Noise Storm.

** As siglas para a atividade associada (eventos em raios-X e rádio em diversas frequências) são as mesmas adotadas pelo “Space Environment Center” (gopher://solar.sec.noaa.gov).

3 - CATÁLOGO DAS EXPLOSÕES SOLARES REGISTRADAS

Este Catálogo é composto de uma seqüência de figuras representando os registros de todas as explosões solares observadas pelo instrumento Brazilian Solar Spectroscopie durante o ano. Os registros das explosões solares são apresentados na forma de **espectro dinâmico** (a variação da intensidade da emissão em função do tempo e da freqüência). A Figura 3 mostra um exemplo ilustrativo de um espectro dinâmico gerado a partir de dados de explosões solares apresentando estruturas finas.

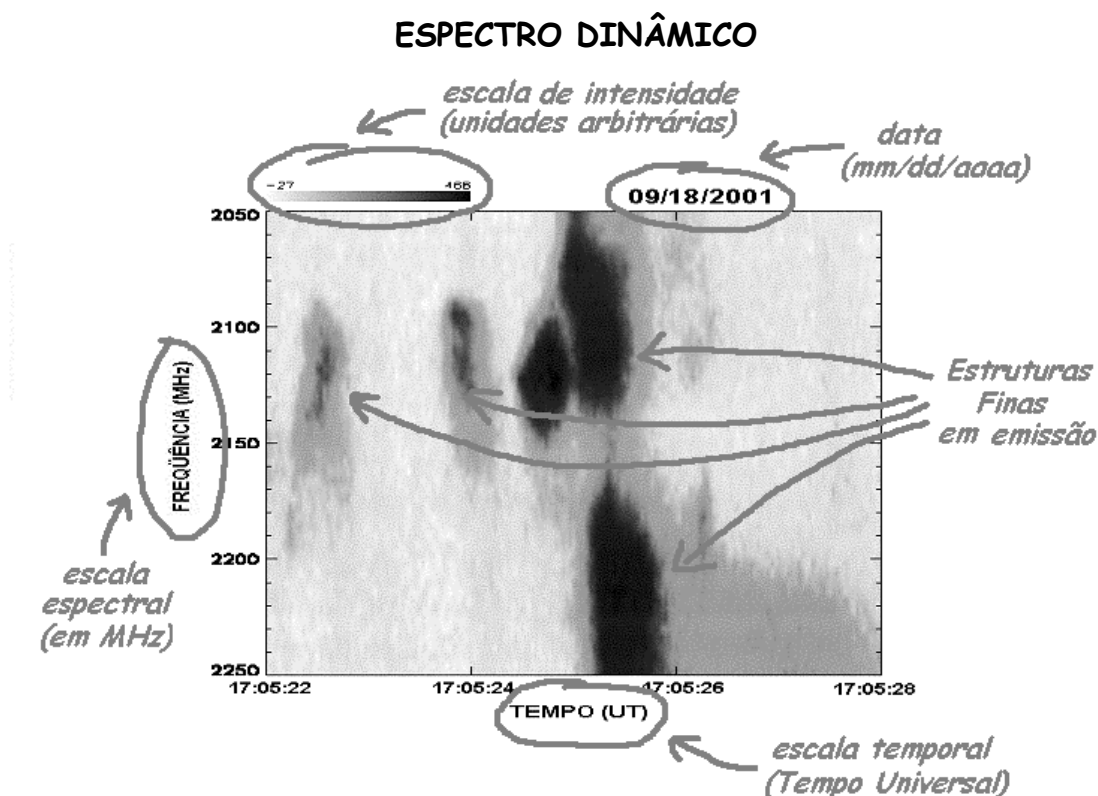
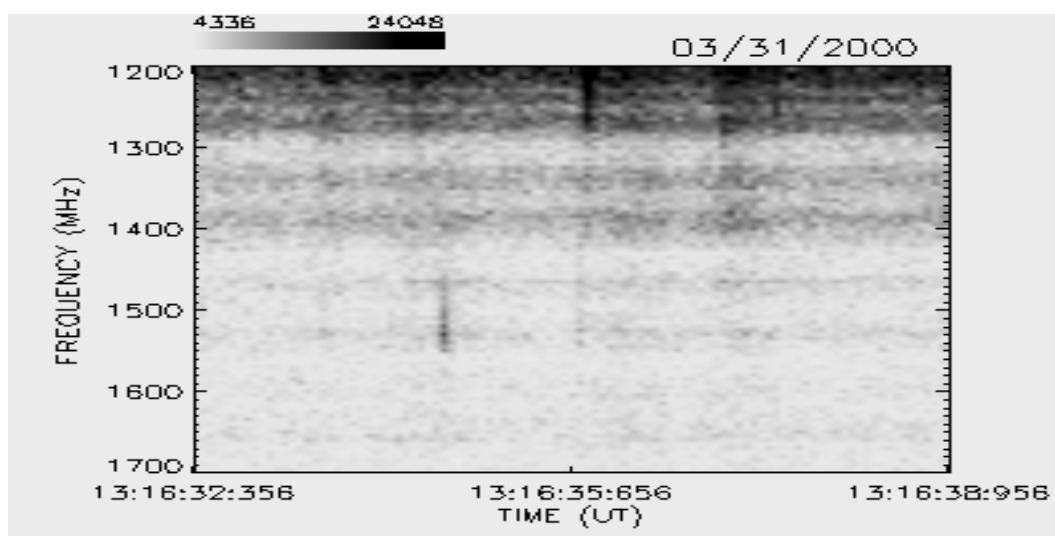
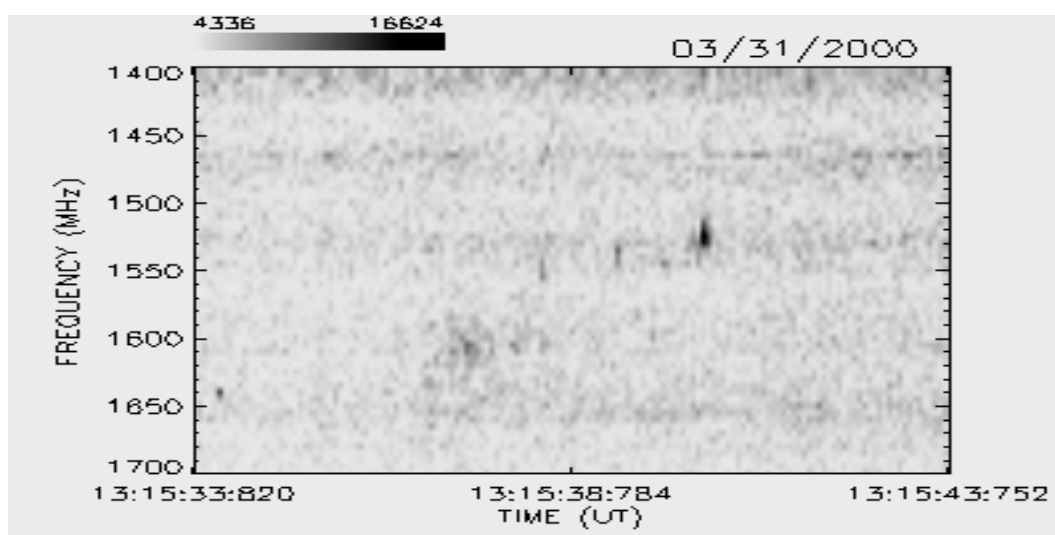
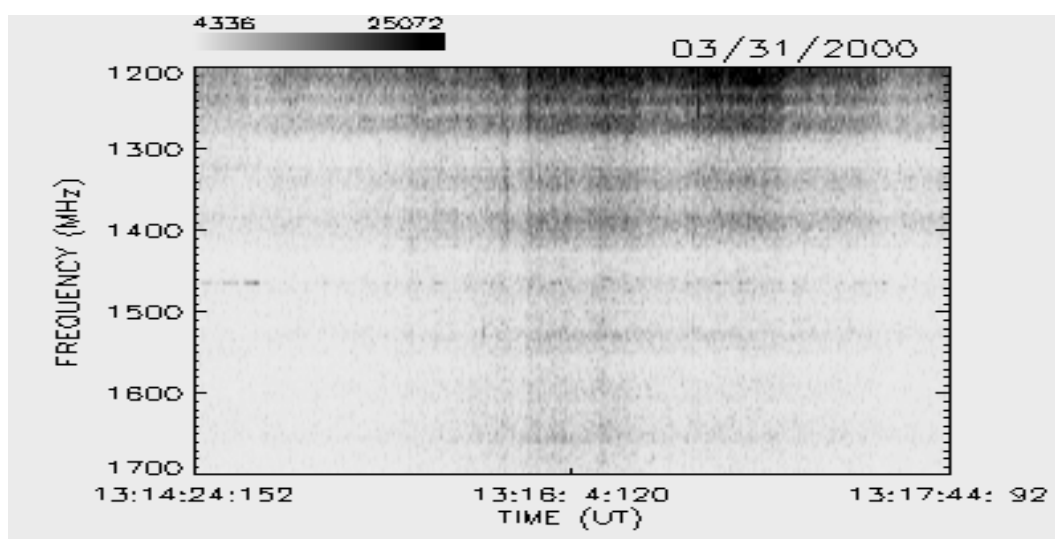


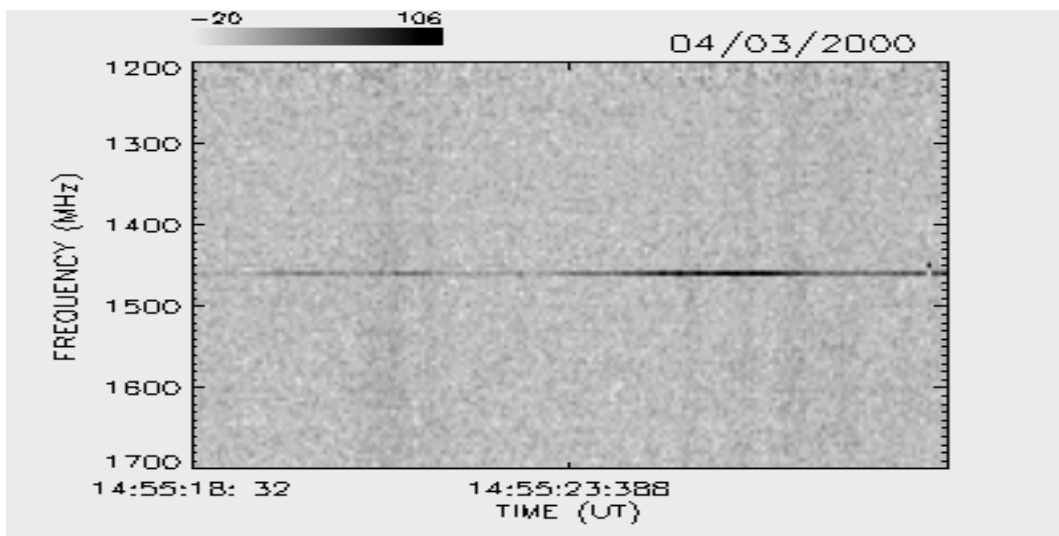
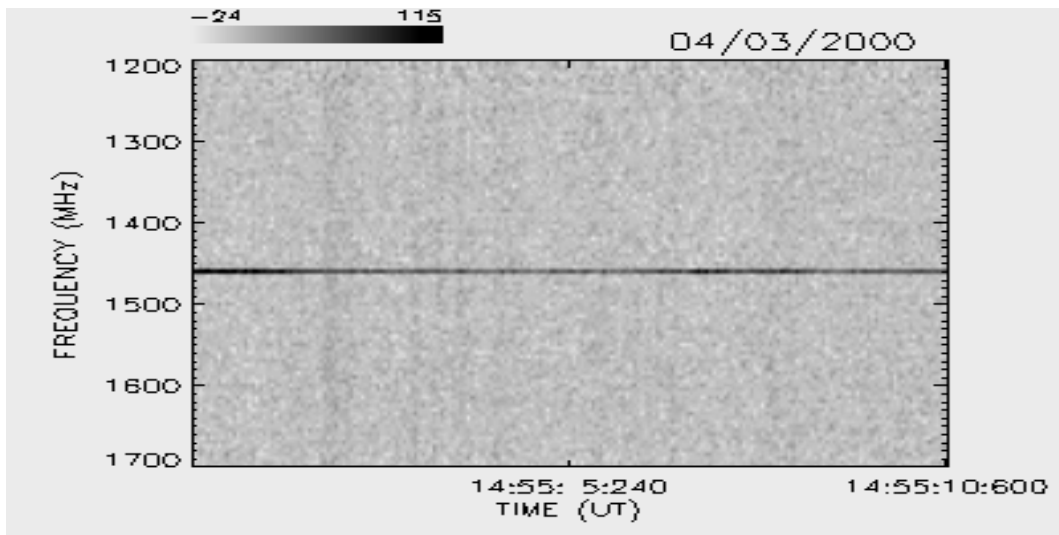
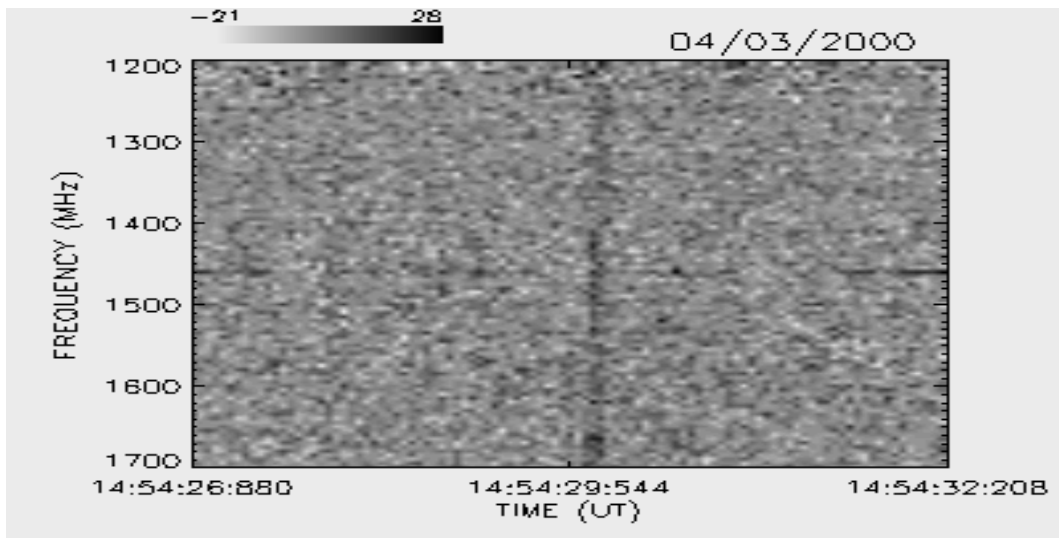
FIGURA 3 – Exemplo de espectro dinâmico gerado a partir dos dados de explosões solares observadas pelo BSS. Na parte superior da figura, são representadas uma escala de intensidade (em unidades arbitrárias) e a data da explosão na forma (mm/dd/aaaa); os eixos vertical e horizontal representam, respectivamente, os intervalos em freqüência (em MHz) e em tempo (em Tempo Universal) em que foram registradas as emissões. Nota-se que os valores da freqüência no eixo vertical crescem para baixo, conforme convenção adotada internacionalmente.

O Catálogo completo dos espectros dinâmicos das explosões registradas pelo BSS ao longo do ano de 2000 é apresentado a seguir. Cabe ressaltar que neste Catálogo não houve preocupação em apresentar as explosões de acordo com qualquer tipo de classificação morfológica ou fenomenológica. Os espectros dinâmicos estão dispostos em ordem puramente cronológica. Uma catalogação das explosões baseada em aspectos morfológicos pode ser encontrada em Fernandes et al. (2003).

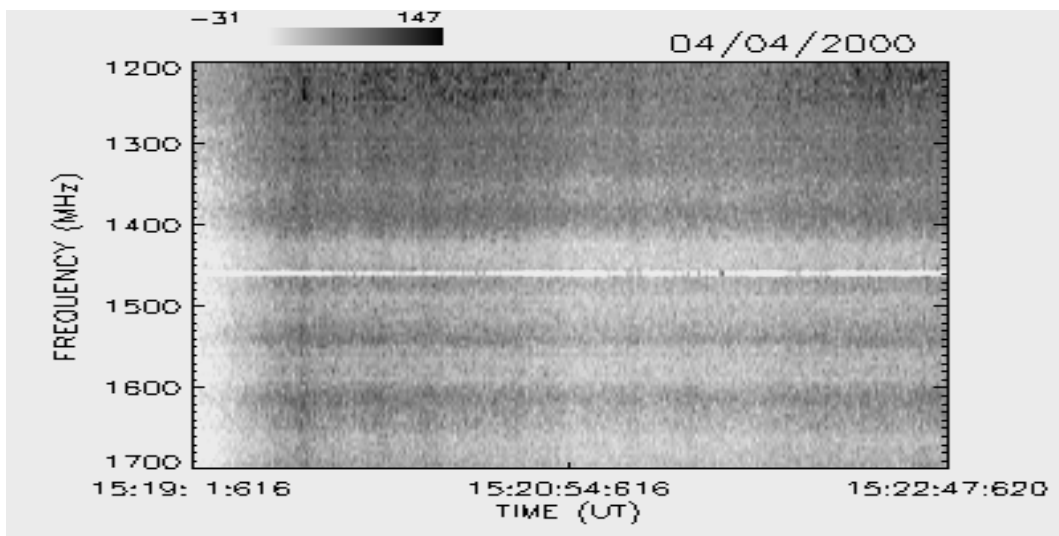
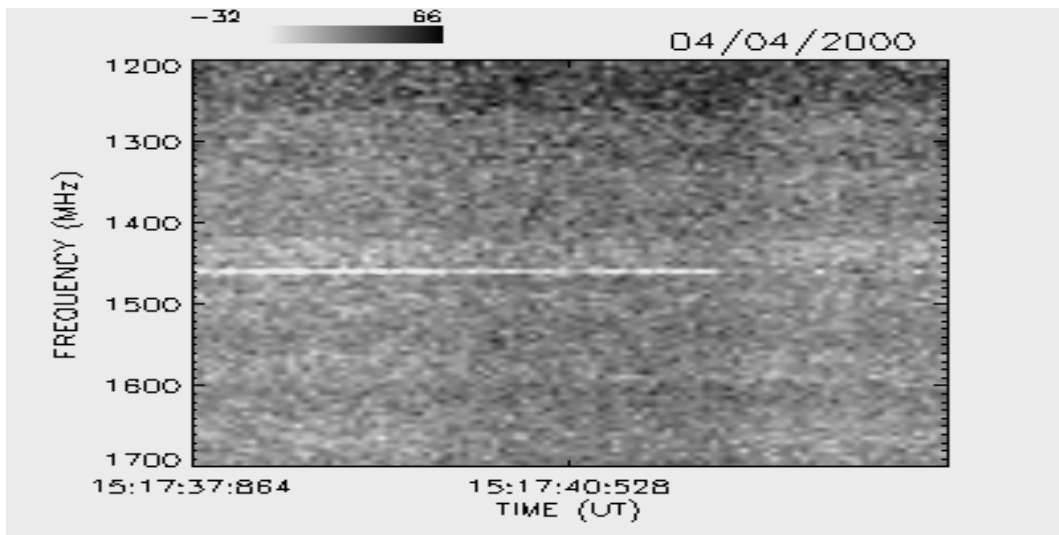
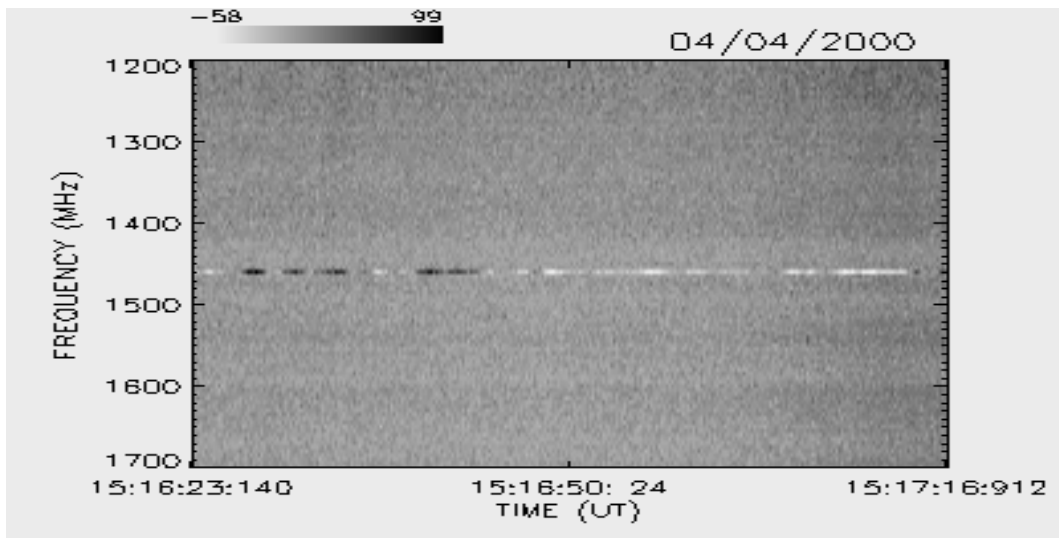
MARÇO / 2000



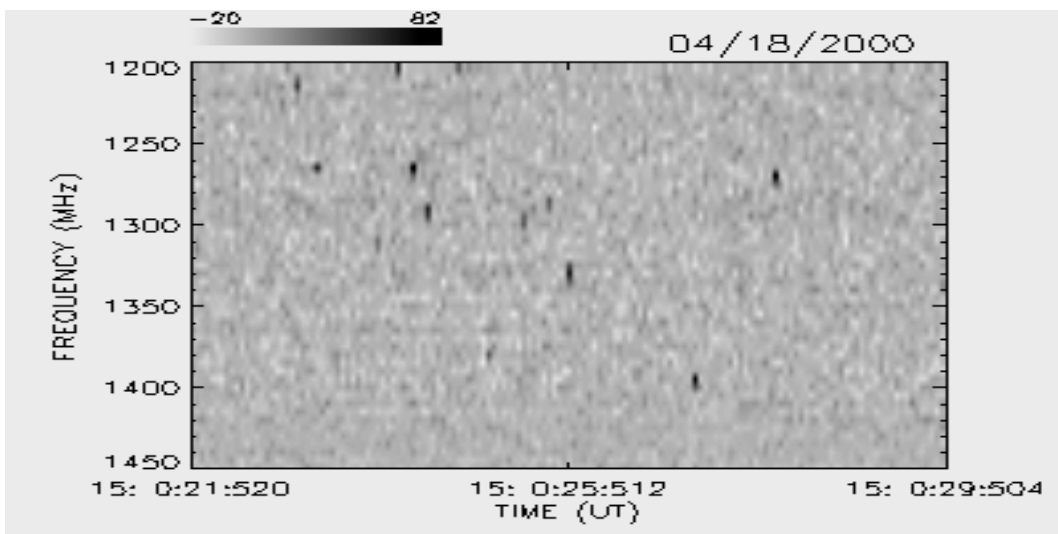
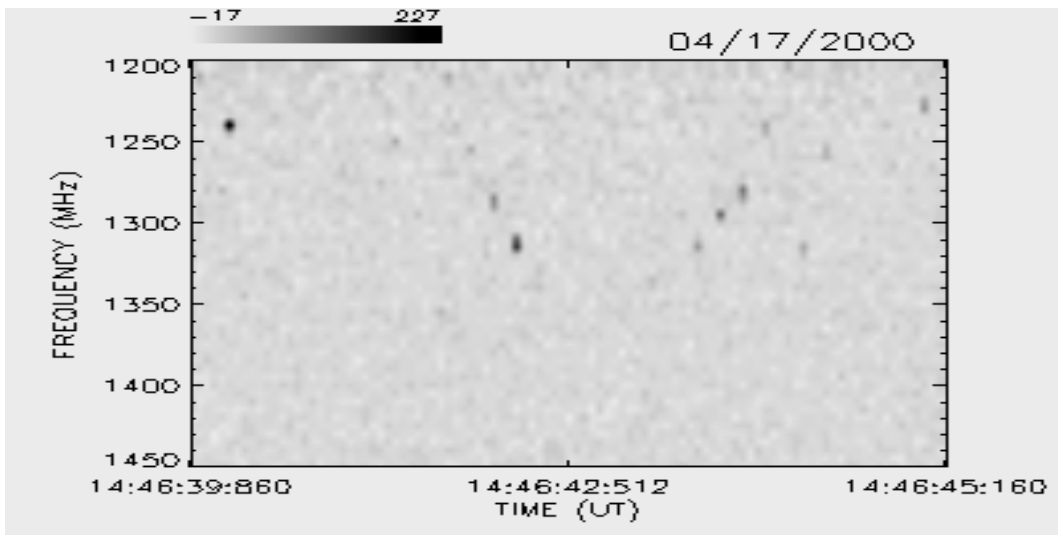
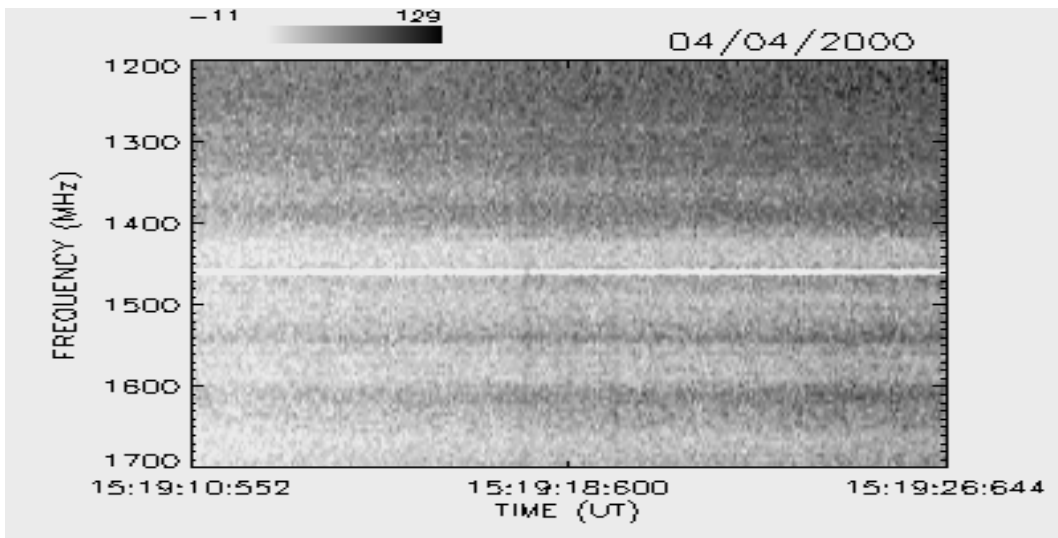
ABRIL / 2000



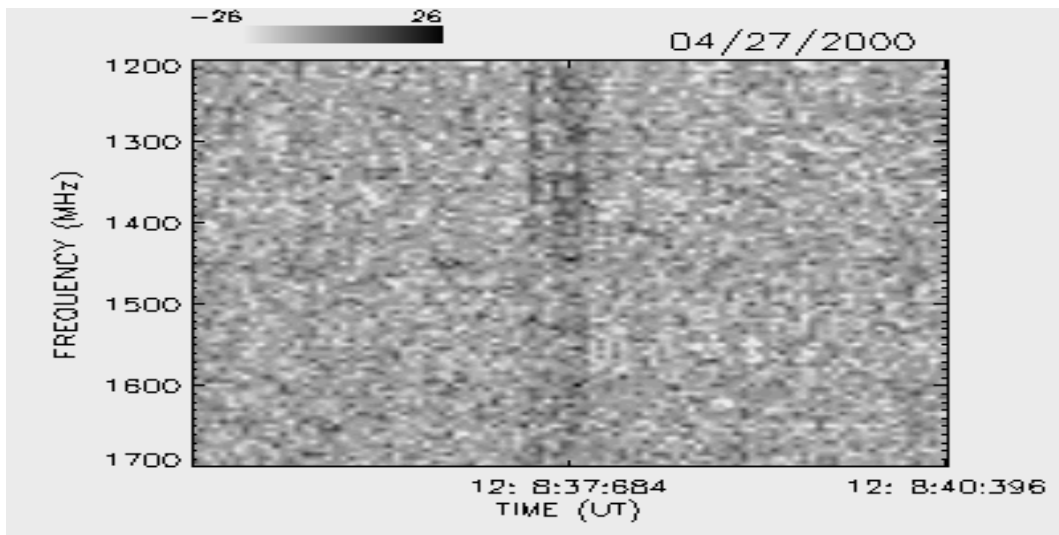
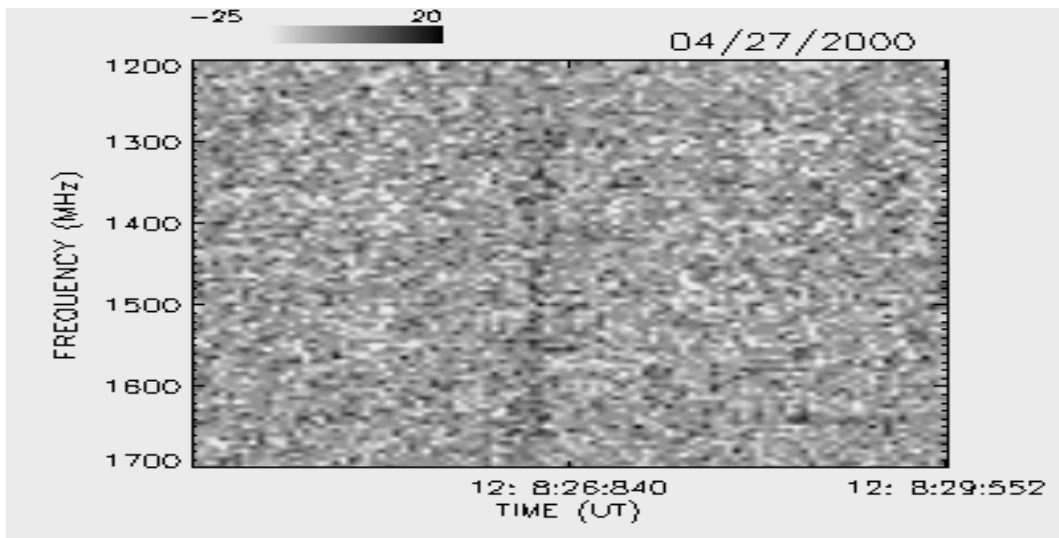
ABRIL / 2000



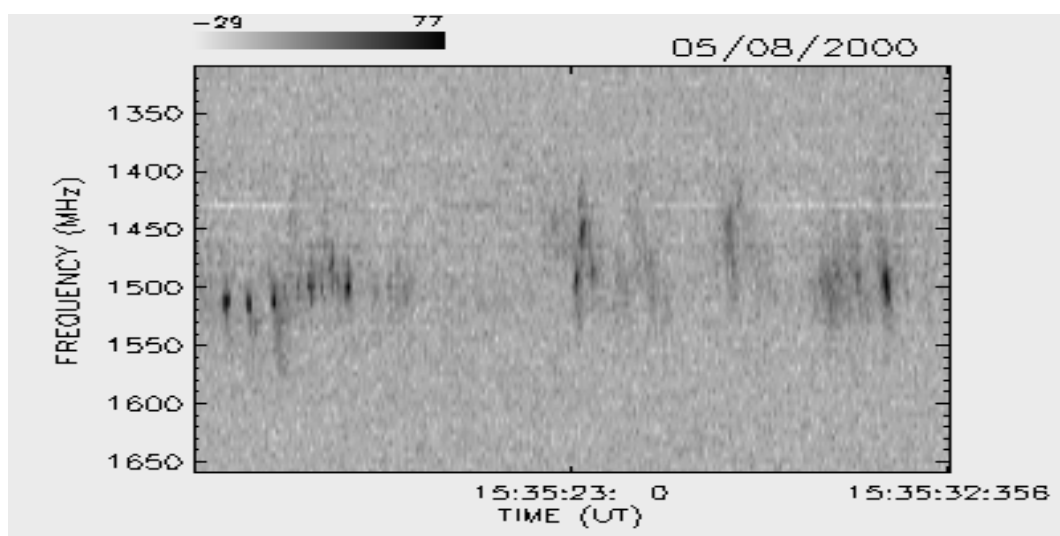
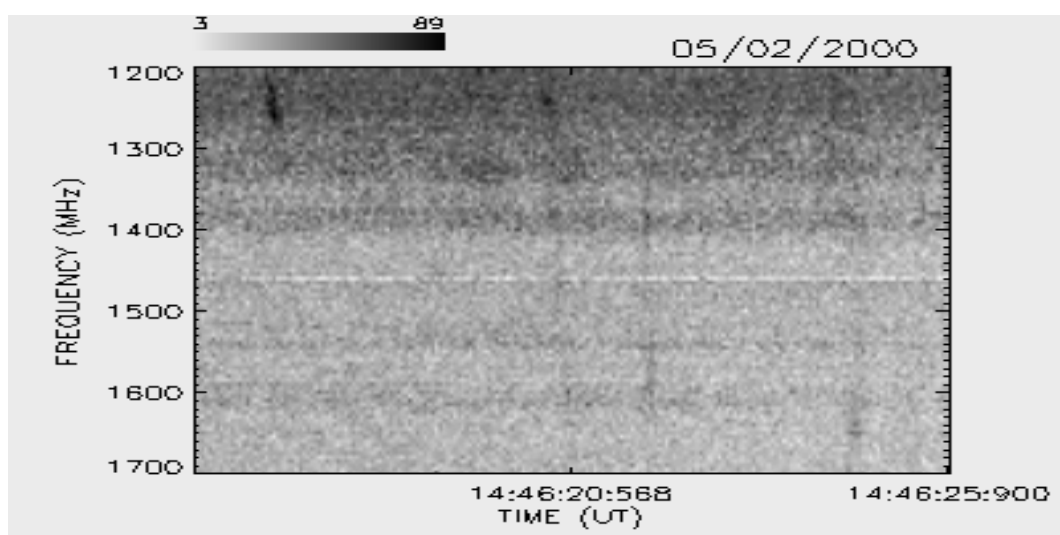
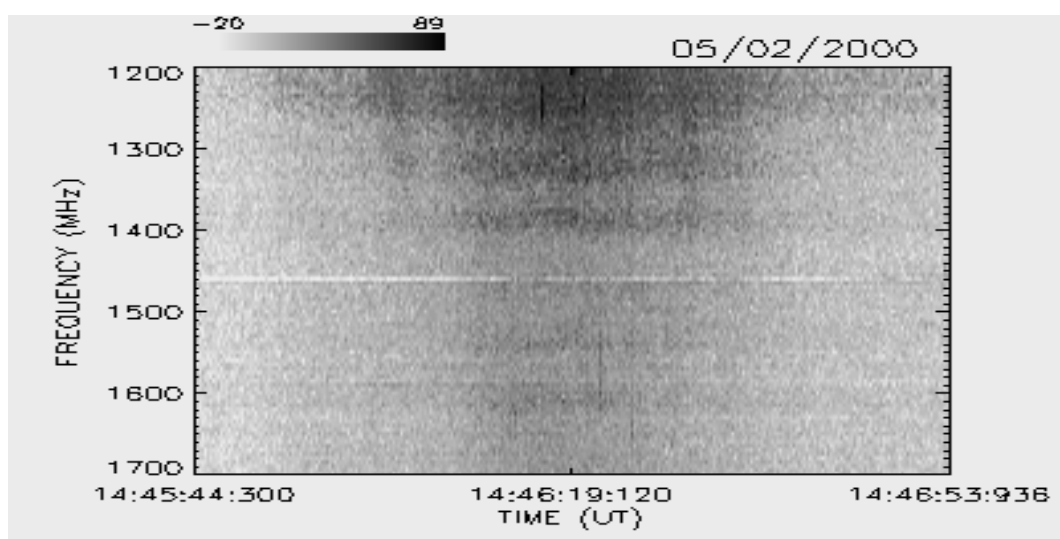
ABRIL / 2000



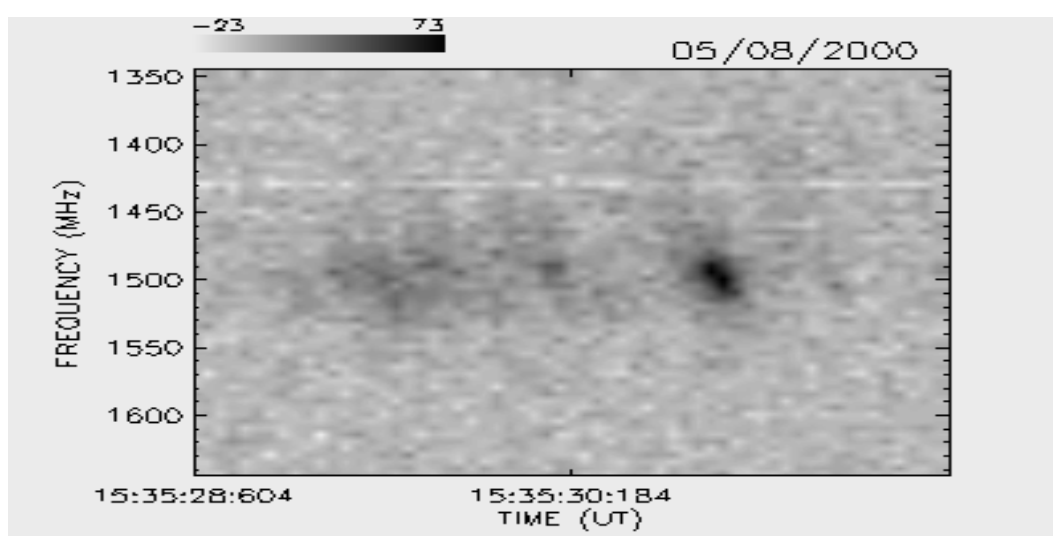
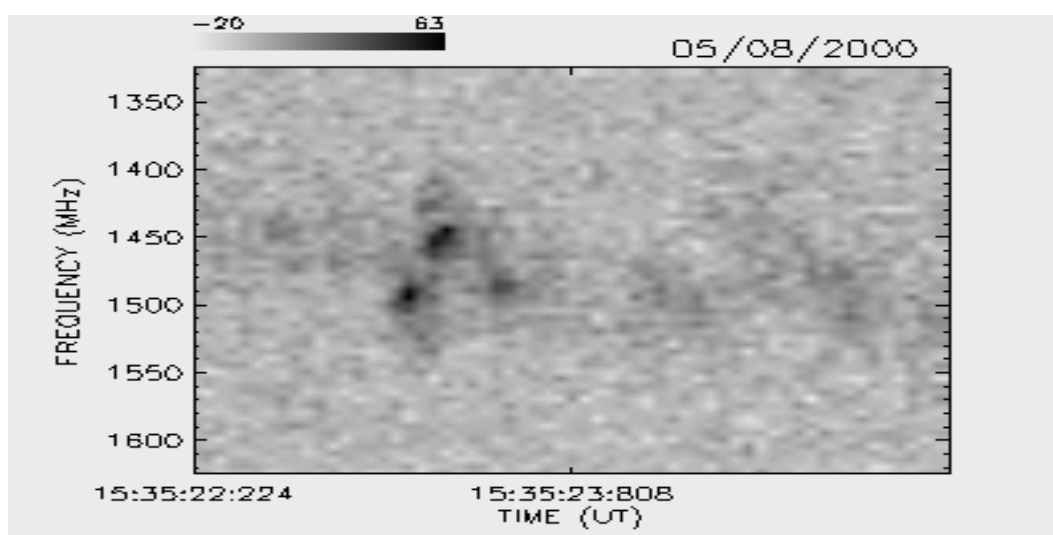
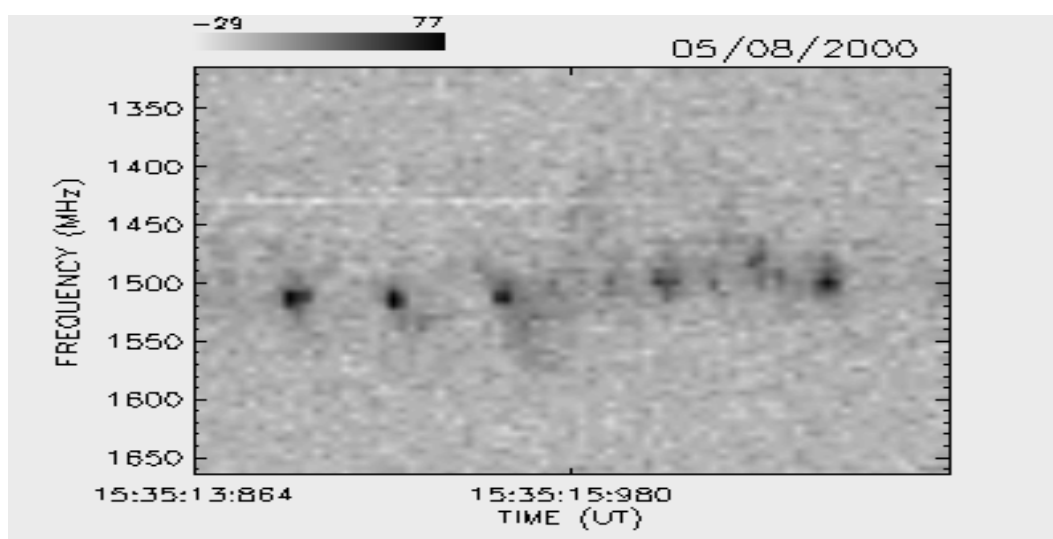
ABRIL / 2000



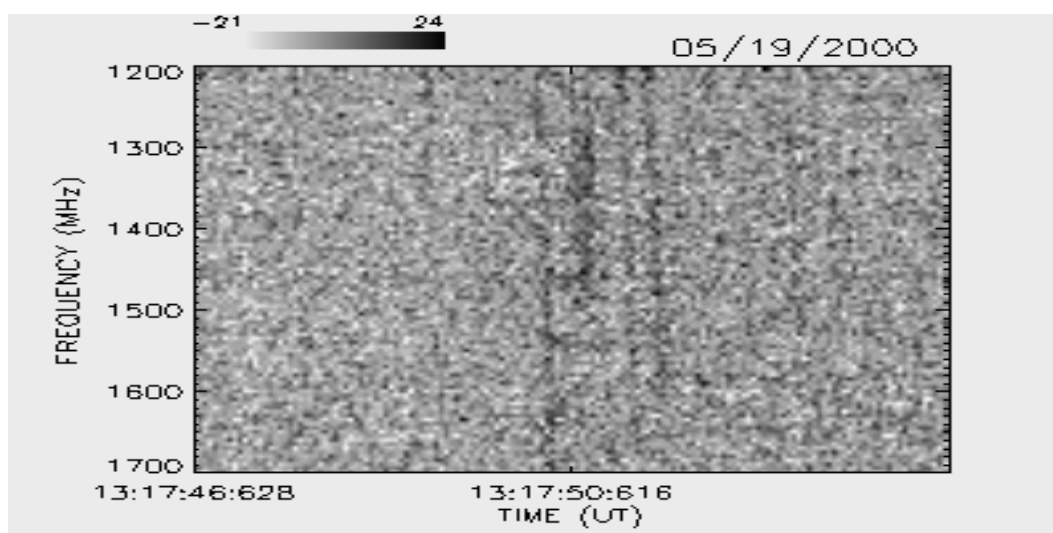
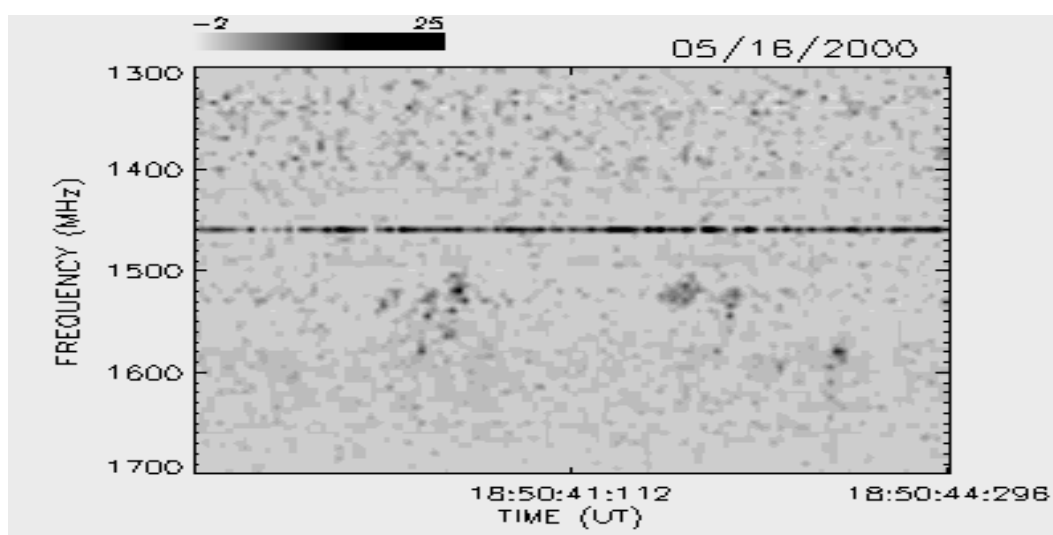
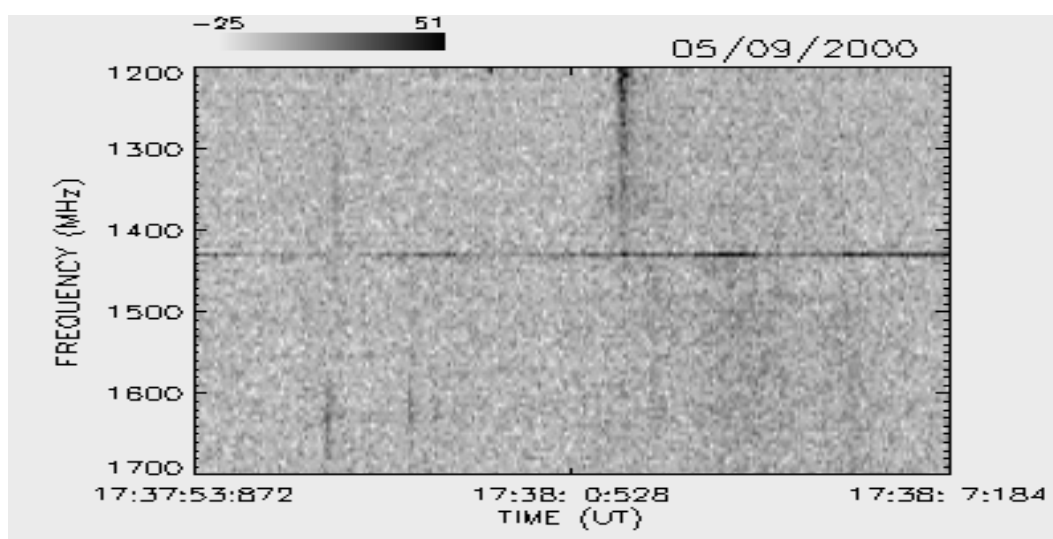
MAIO / 2000



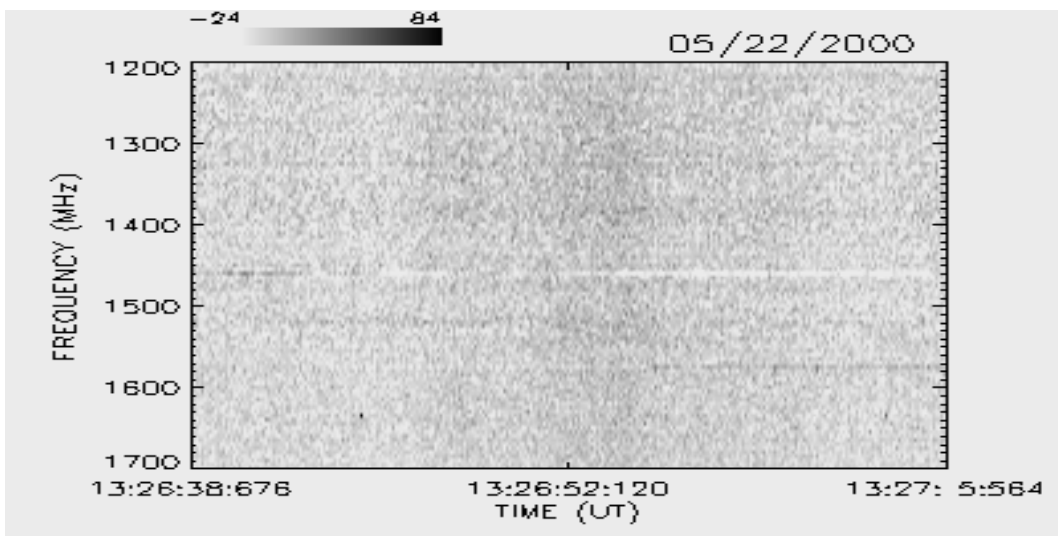
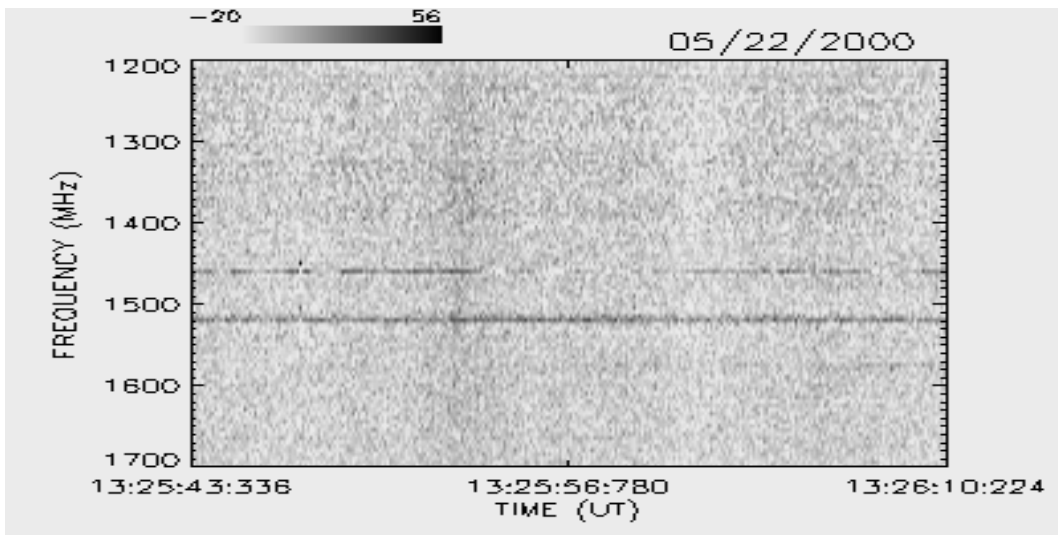
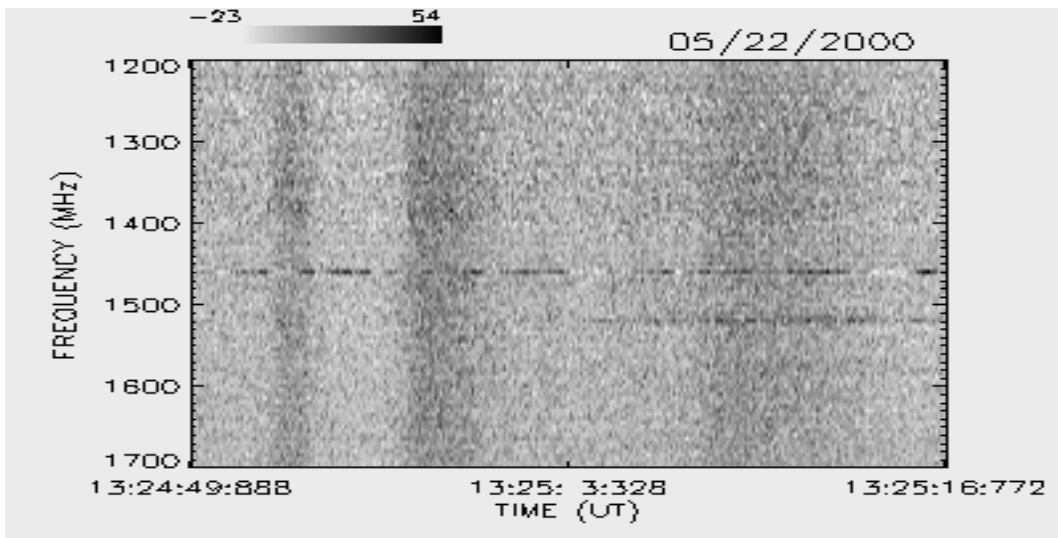
MAIO / 2000



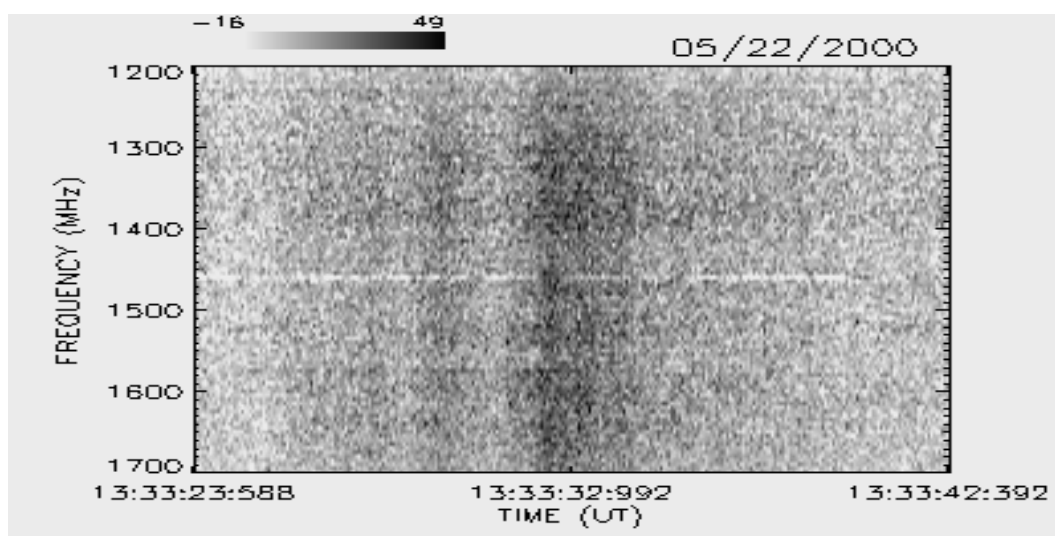
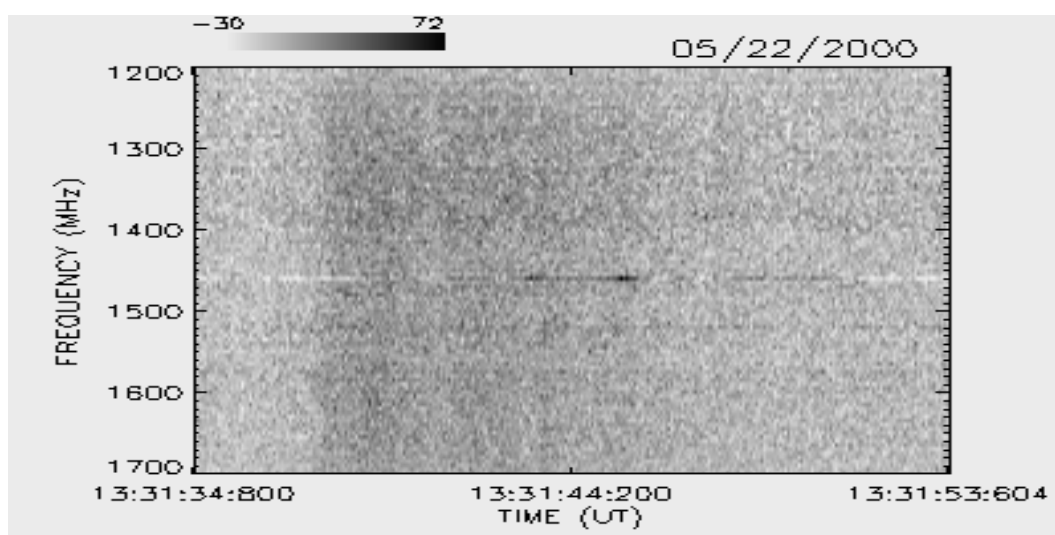
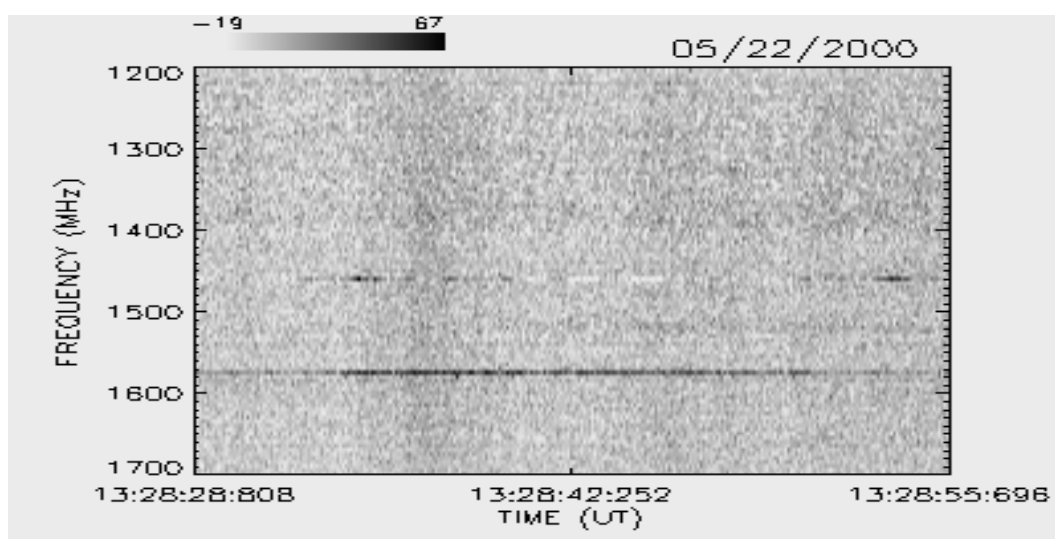
MAIO / 2000



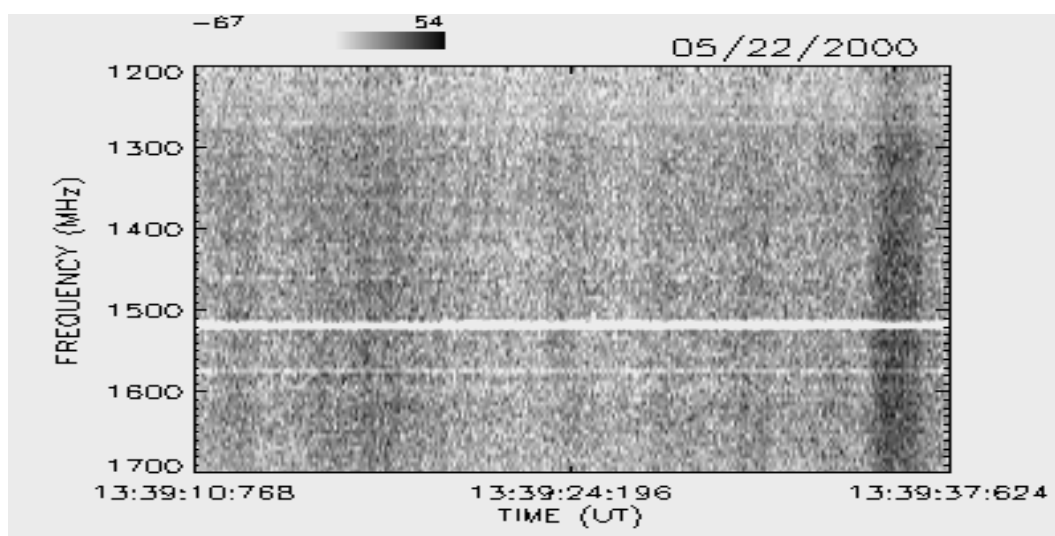
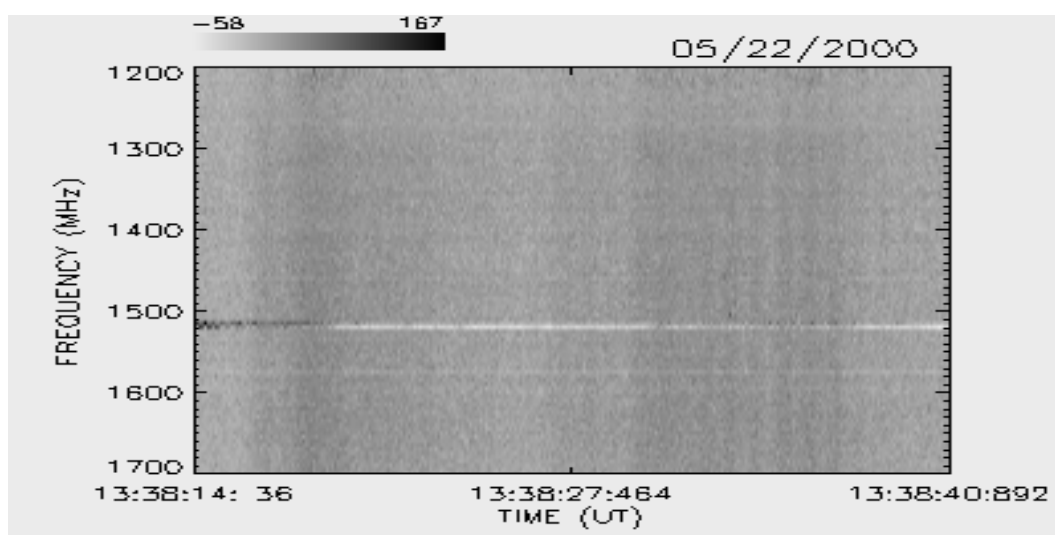
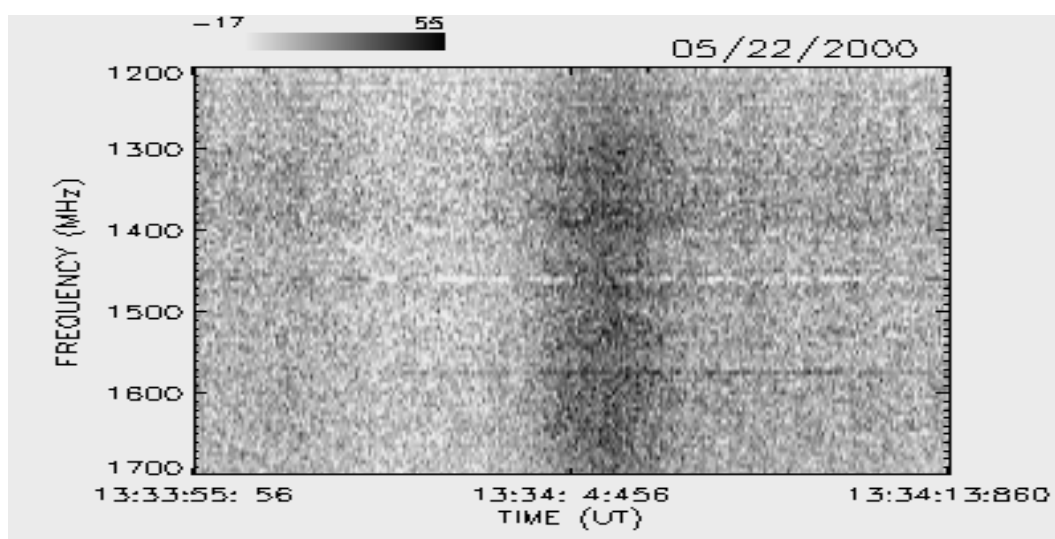
MAIO / 2000



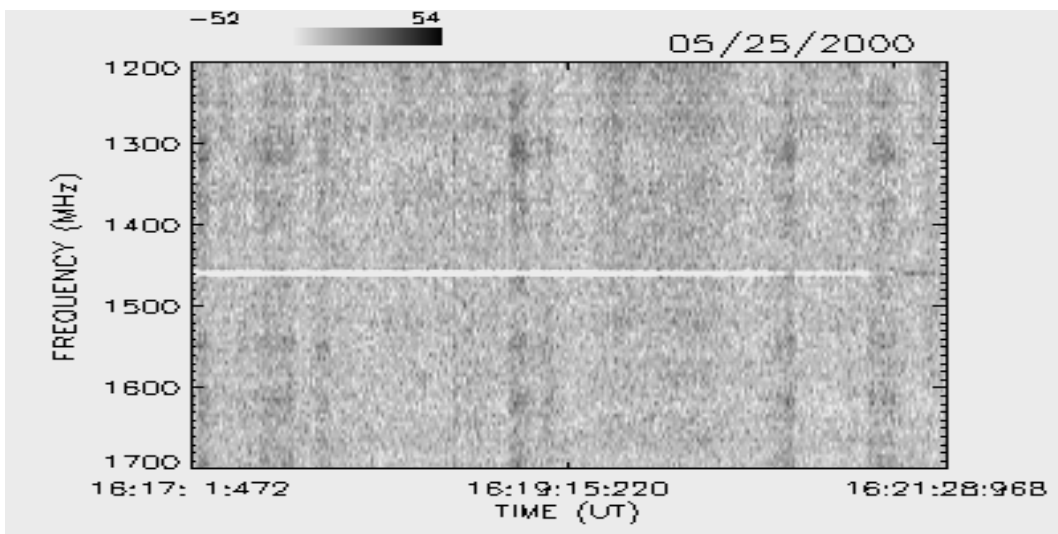
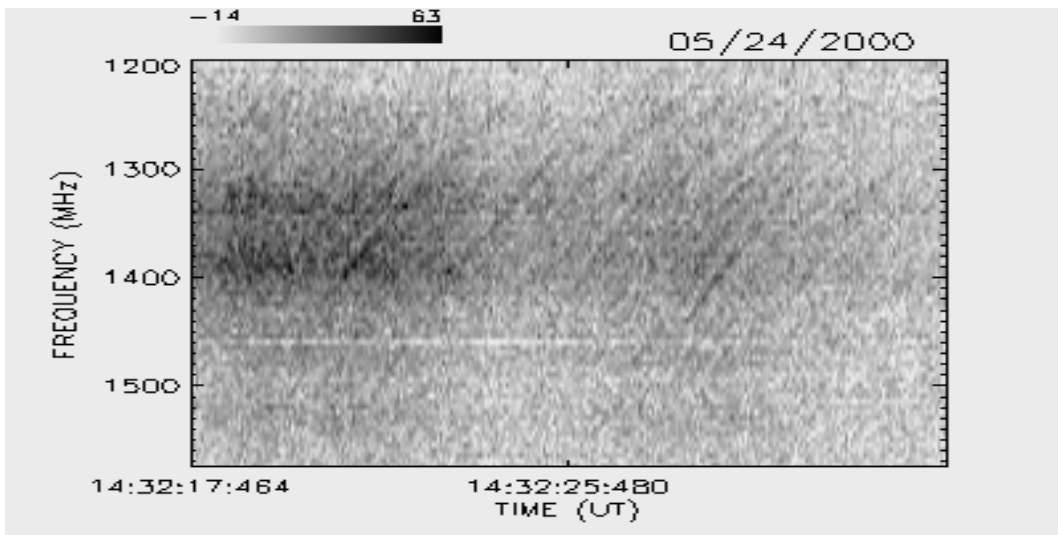
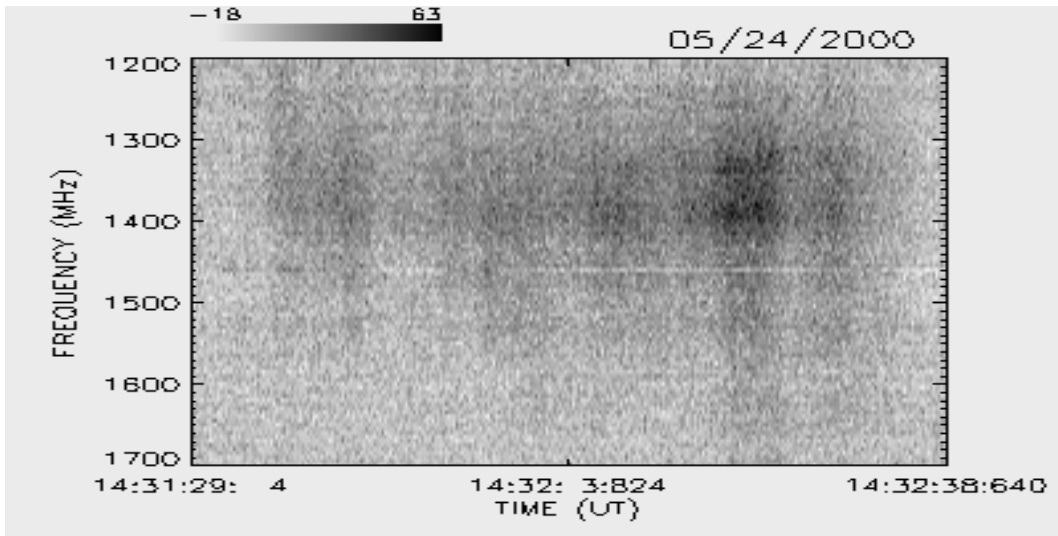
MAIO / 2000



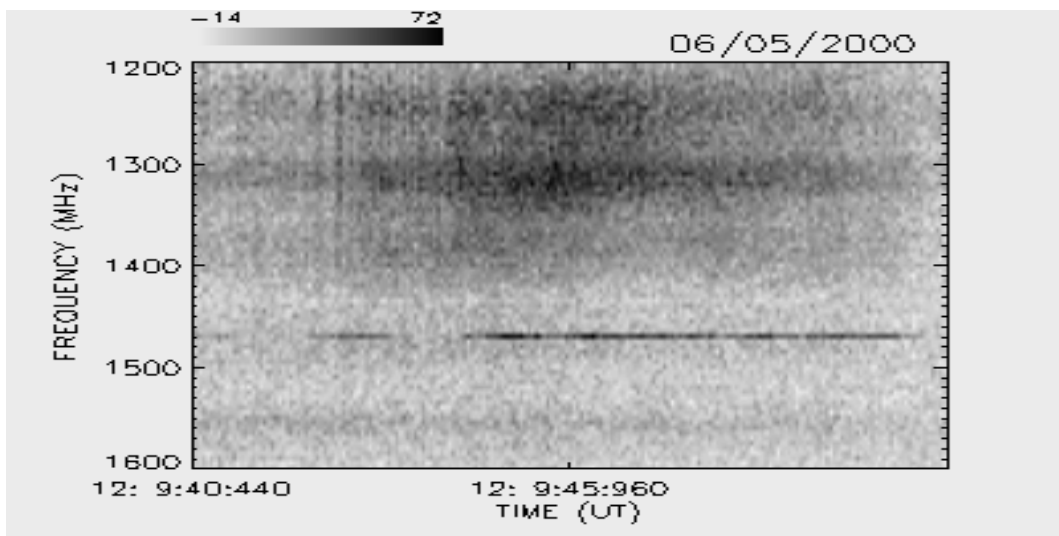
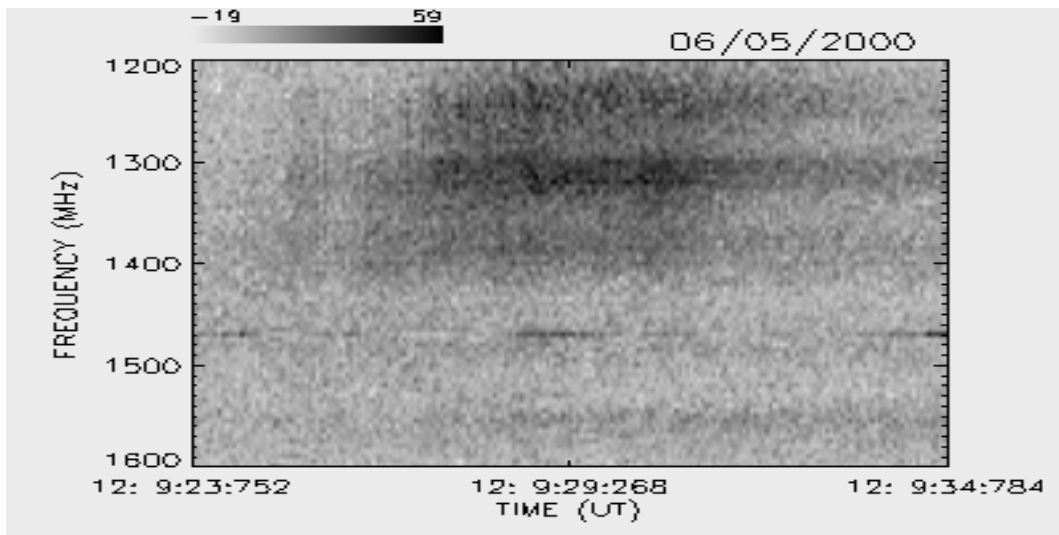
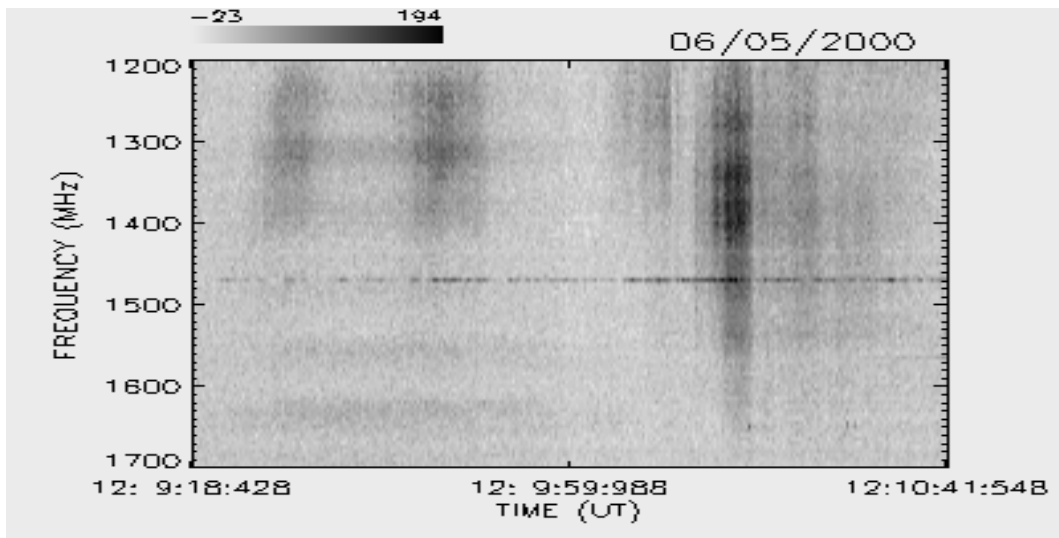
MAIO / 2000



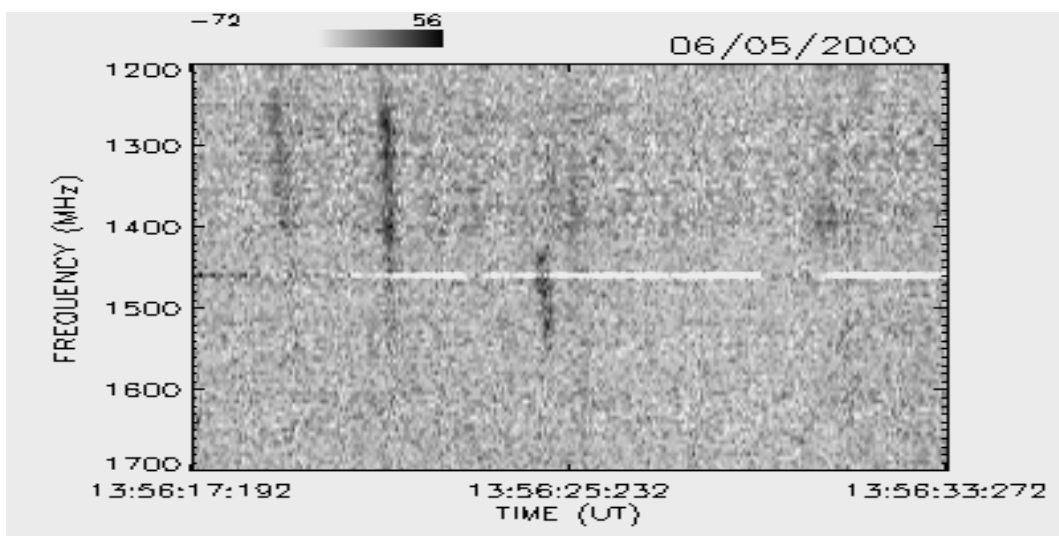
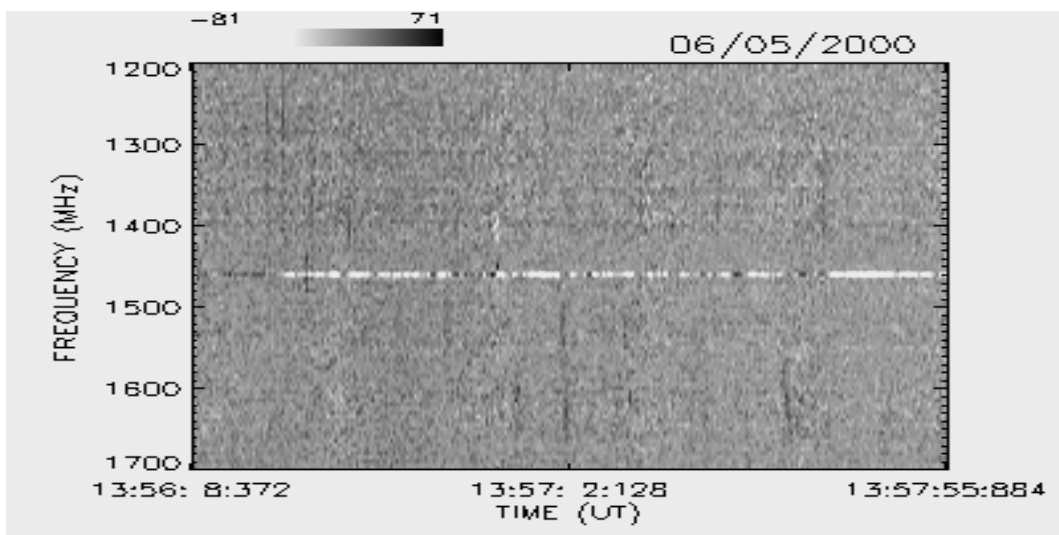
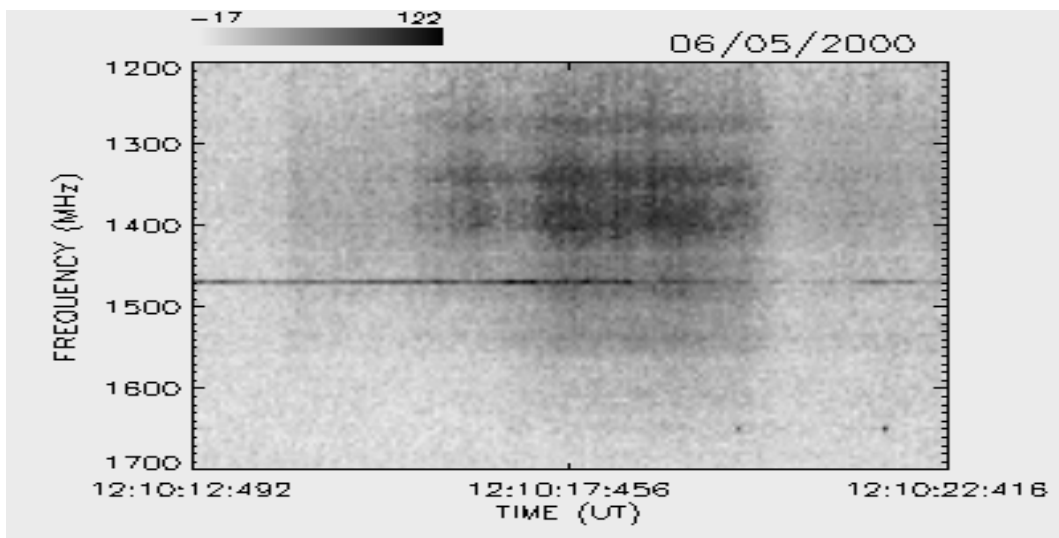
MAIO / 2000



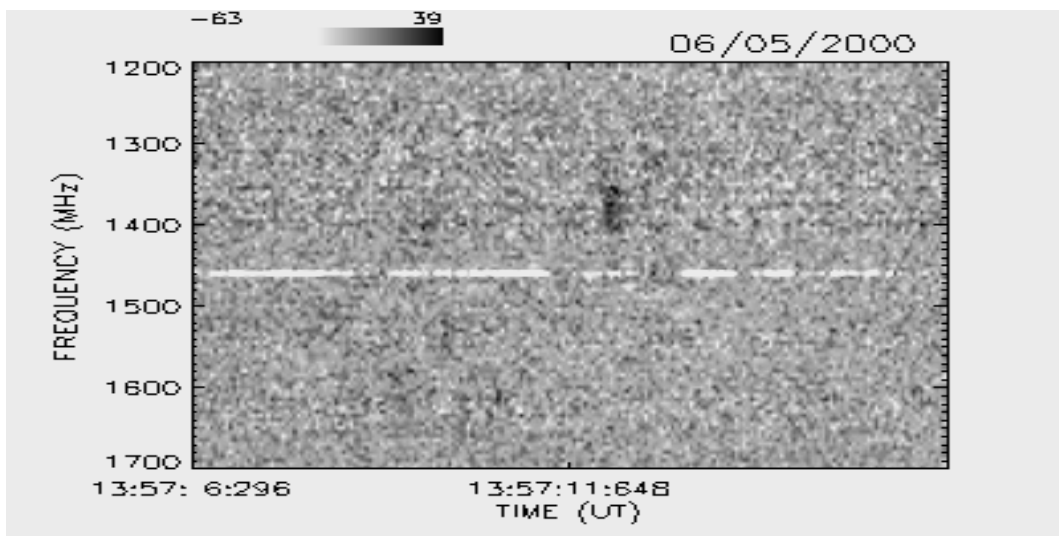
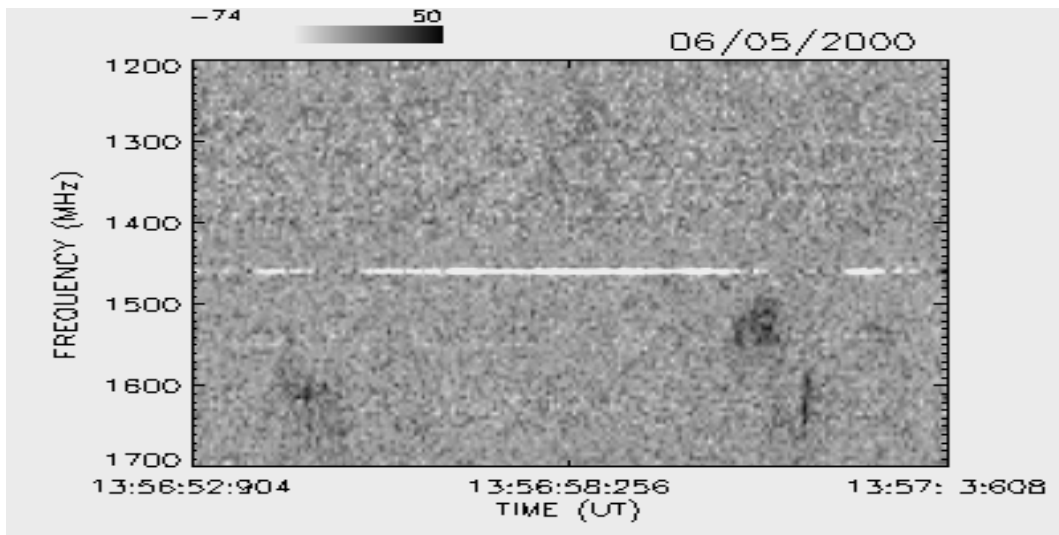
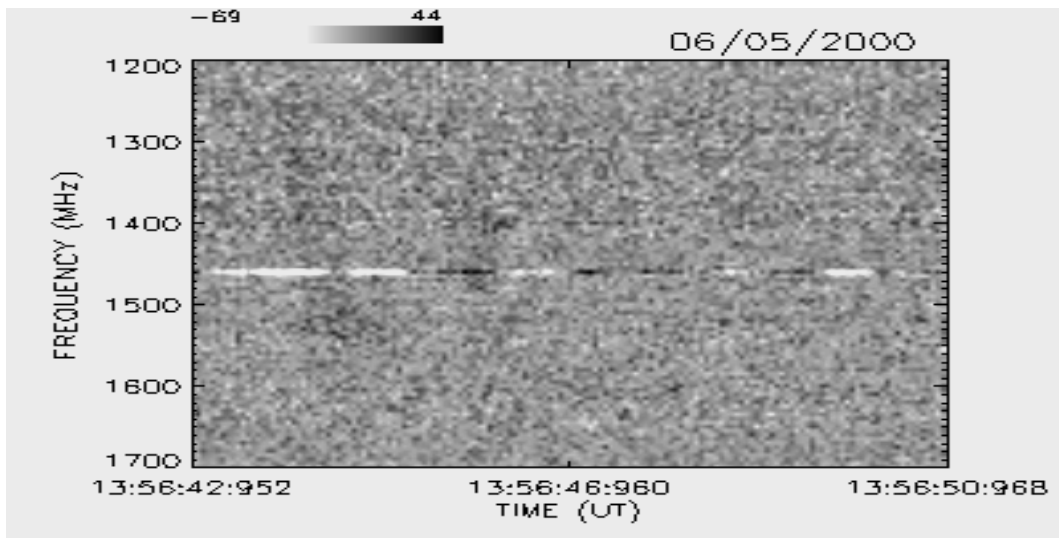
JUNHO / 2000



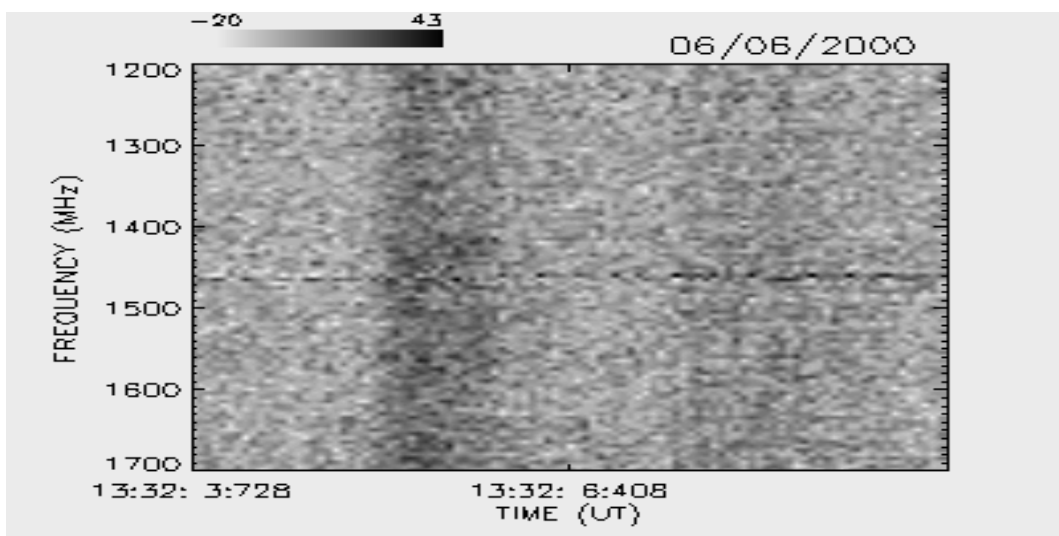
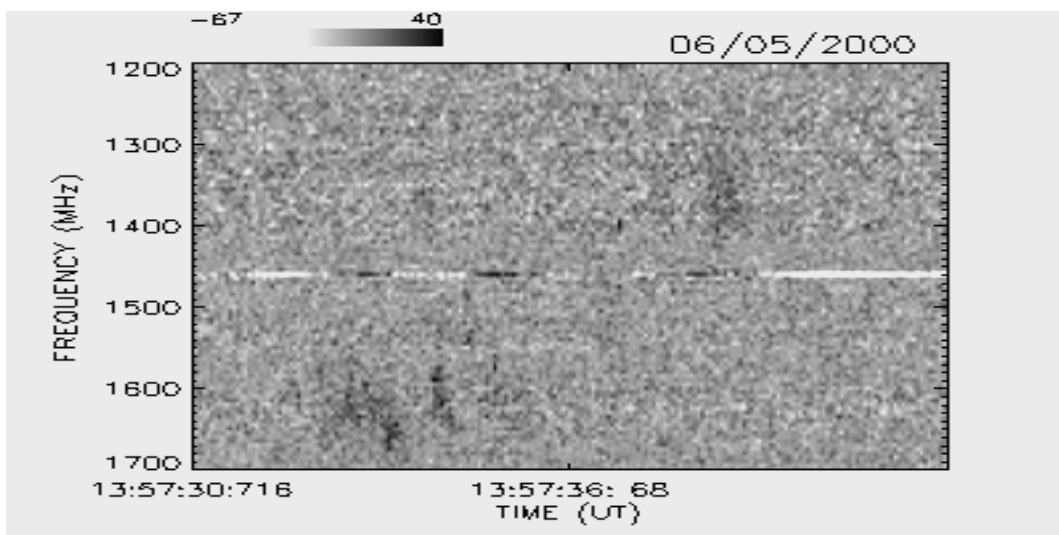
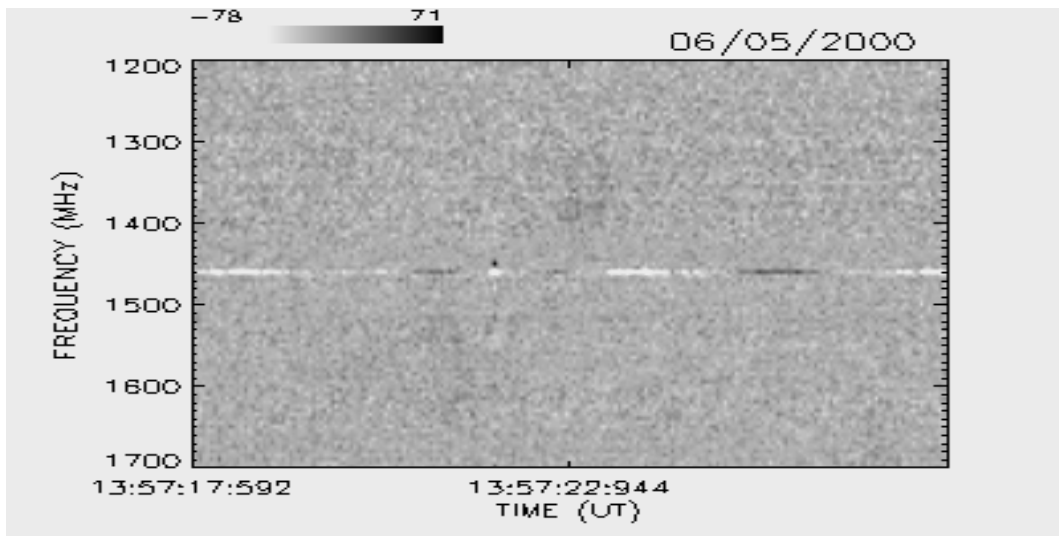
JUNHO / 2000



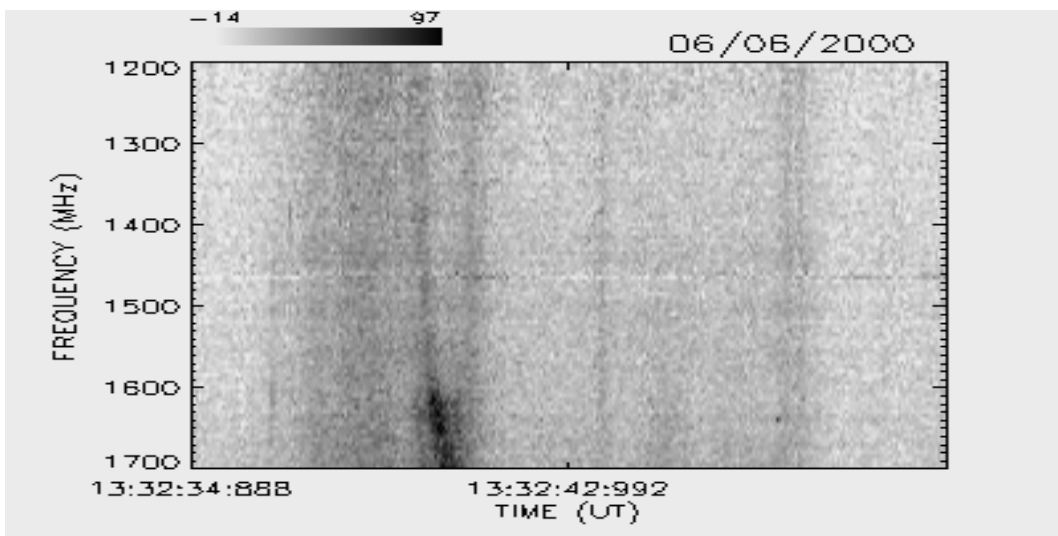
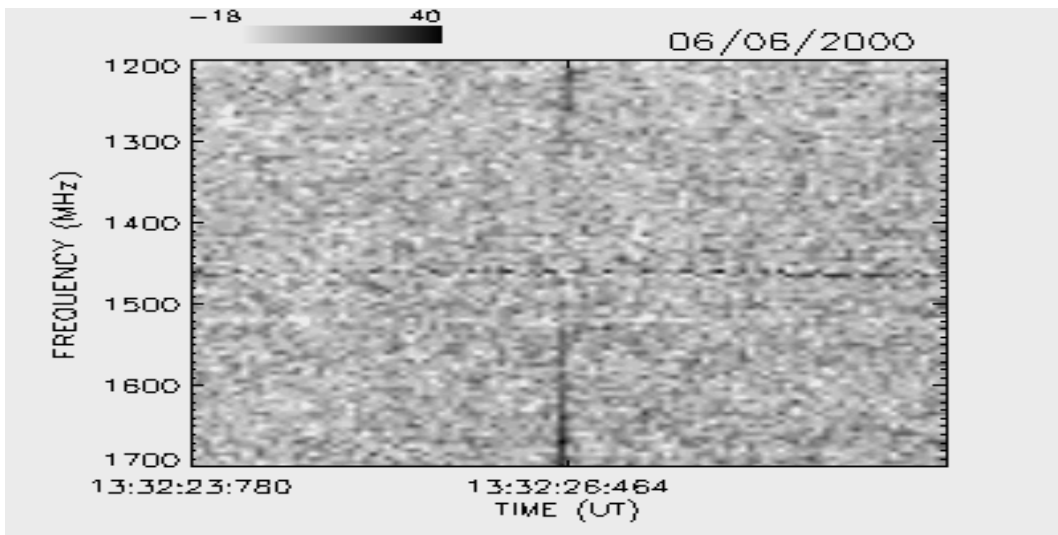
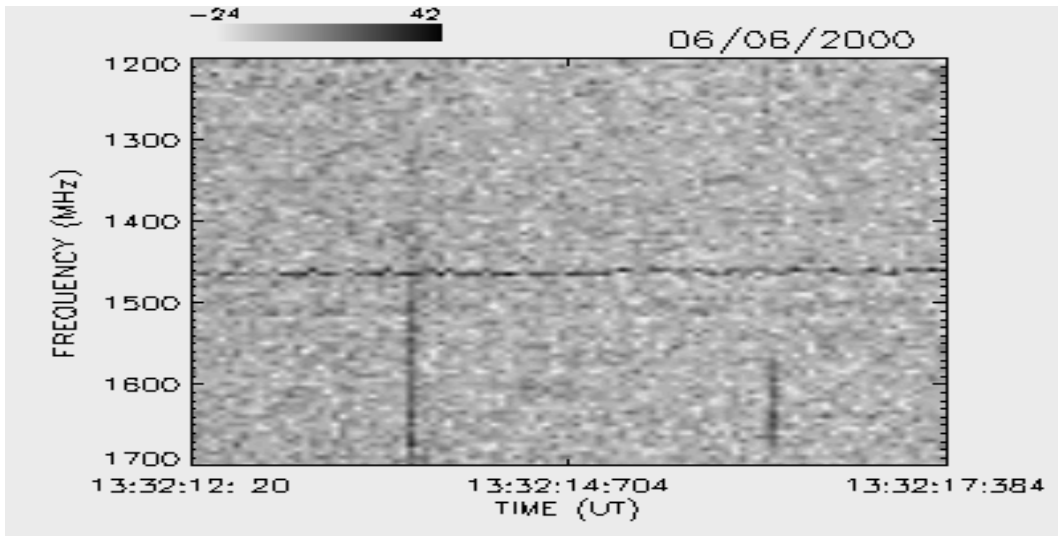
JUNHO / 2000



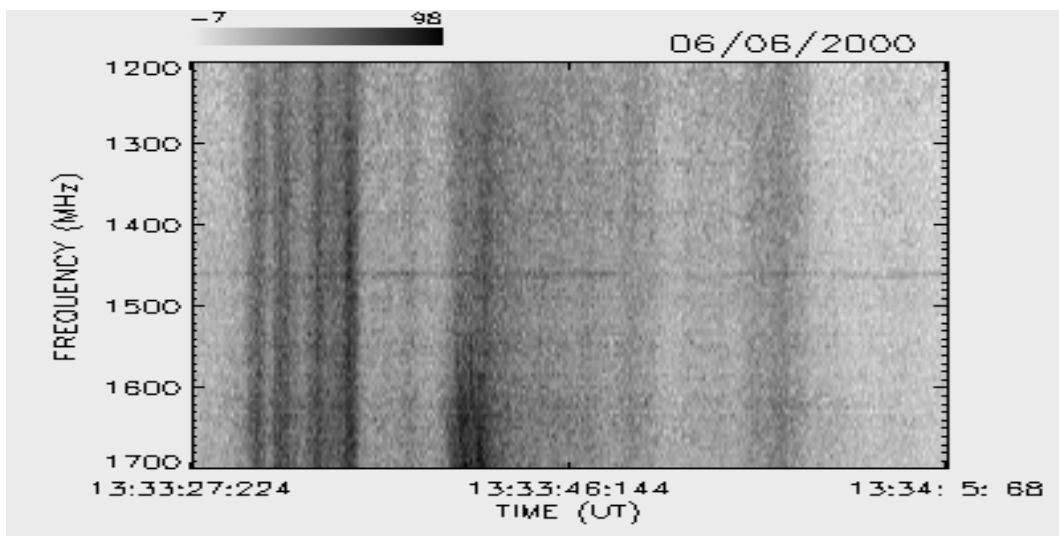
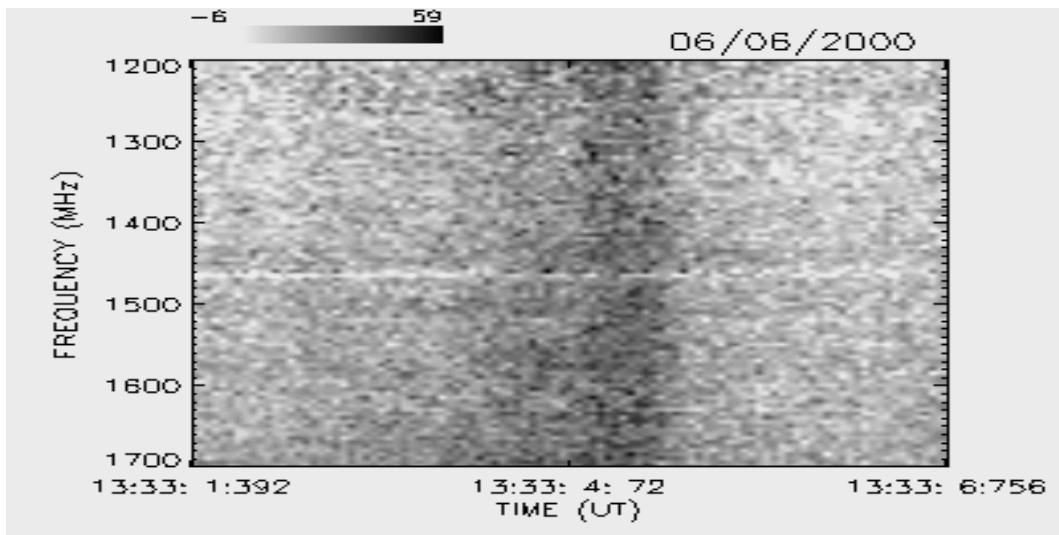
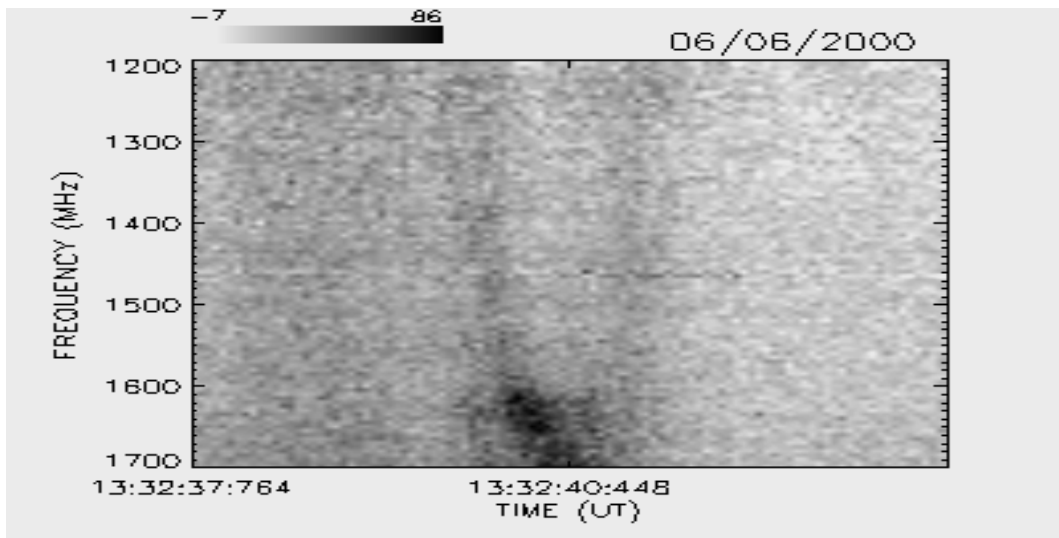
JUNHO / 2000



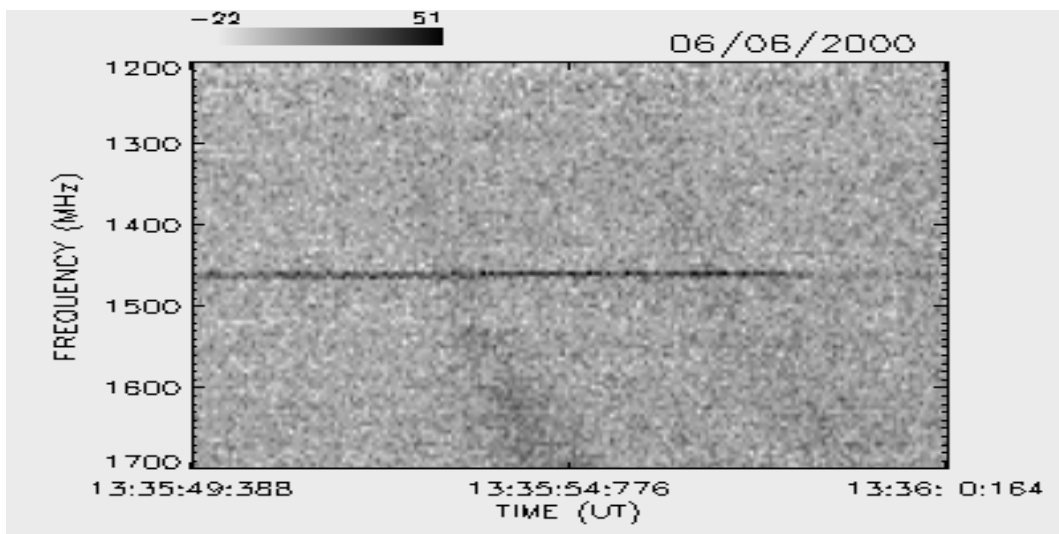
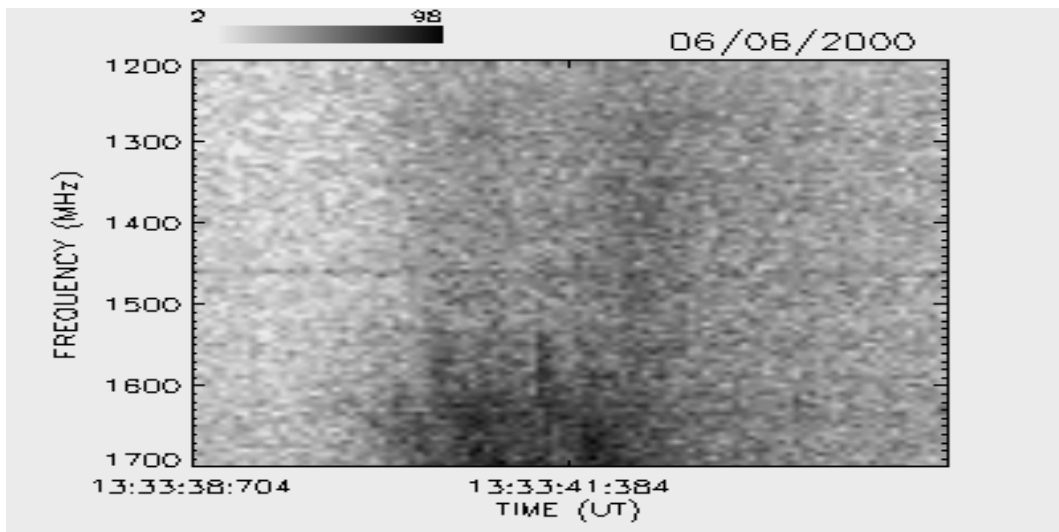
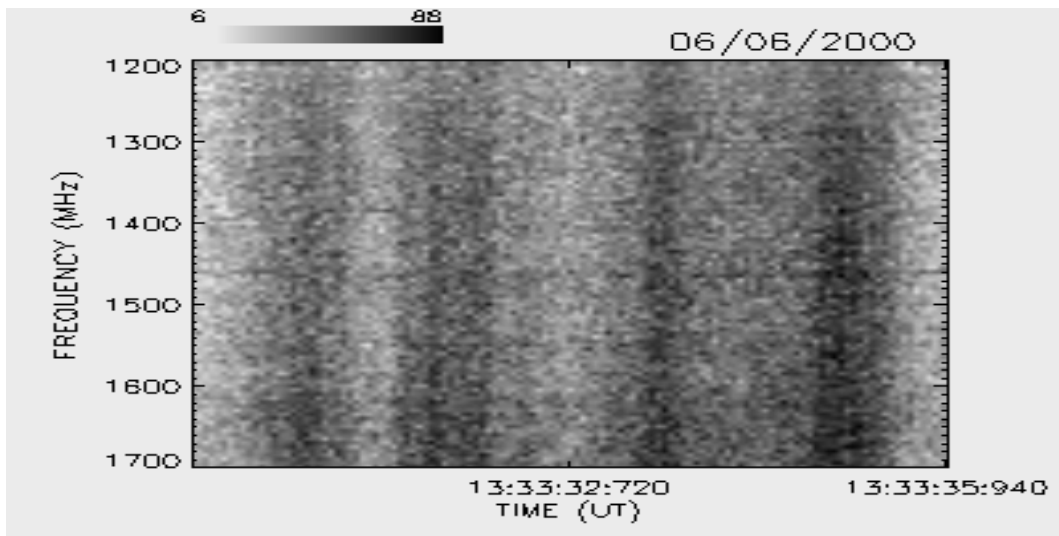
JUNHO / 2000



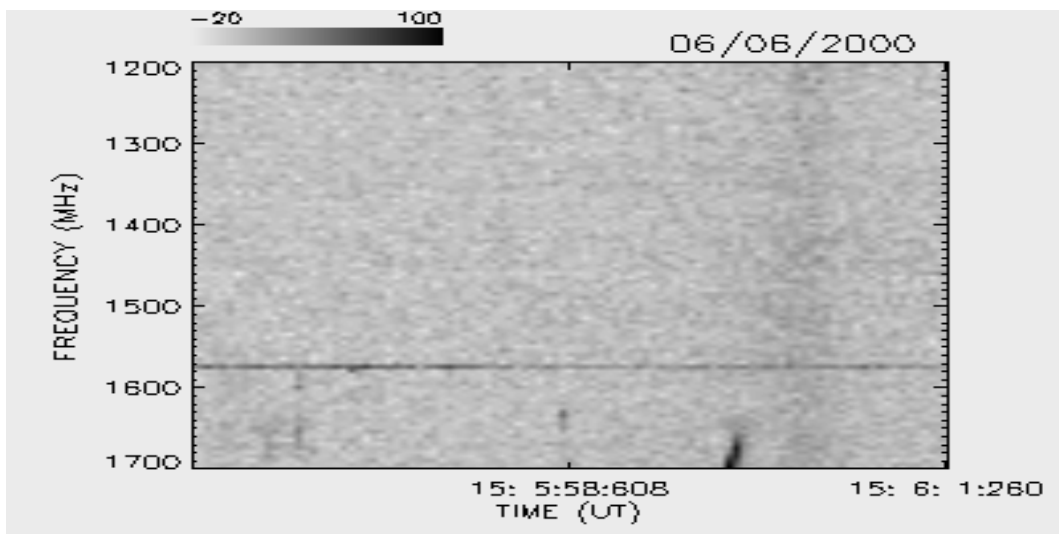
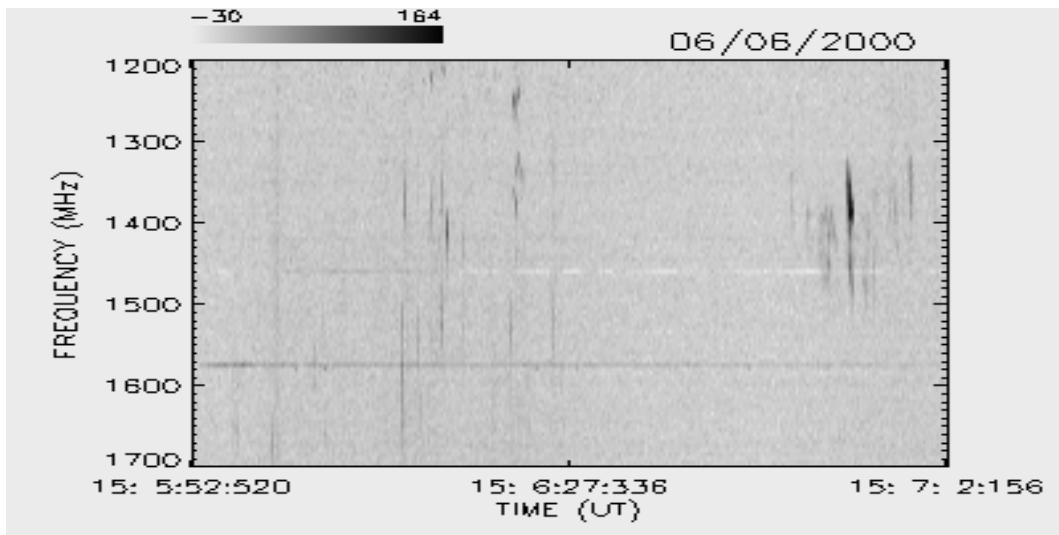
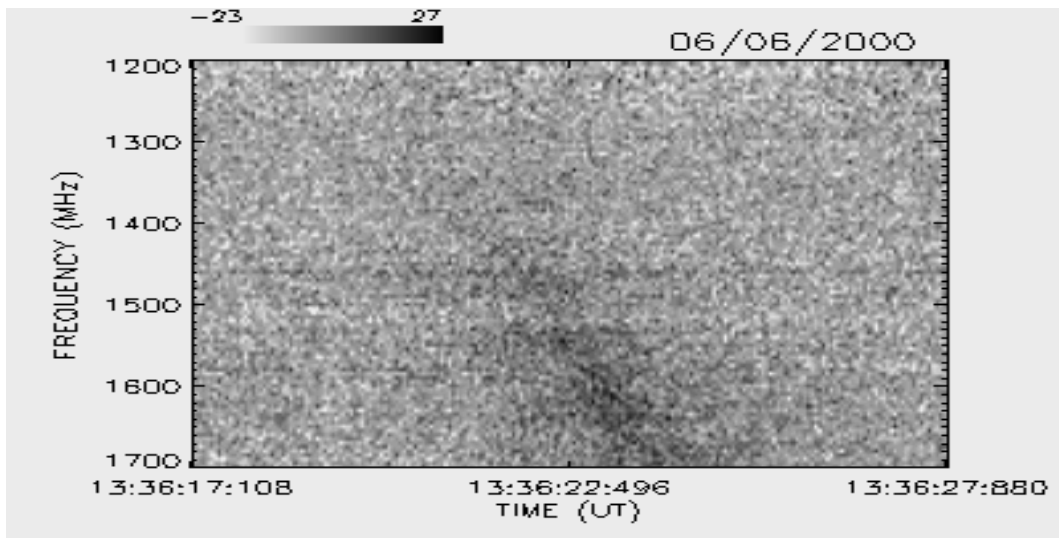
JUNHO / 2000



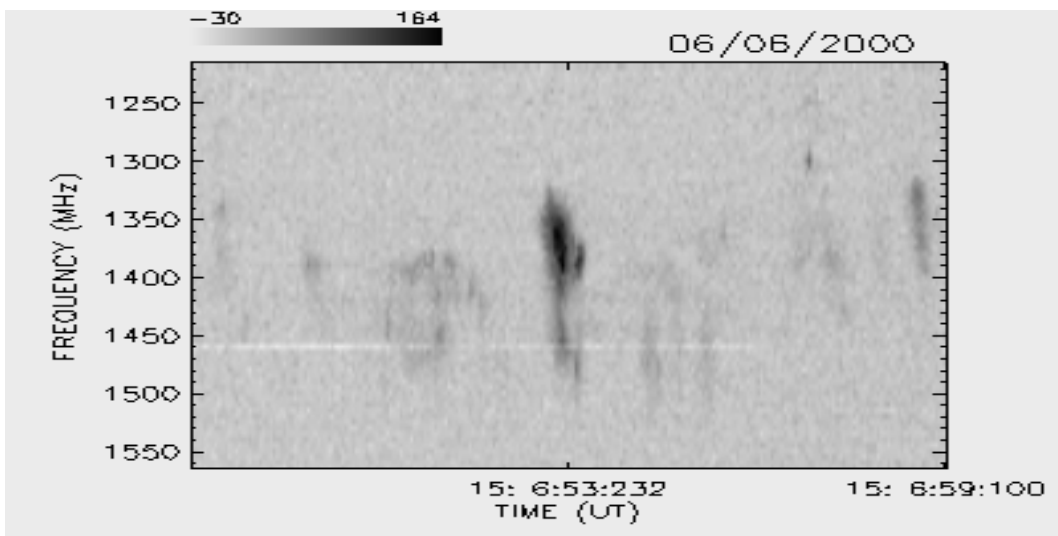
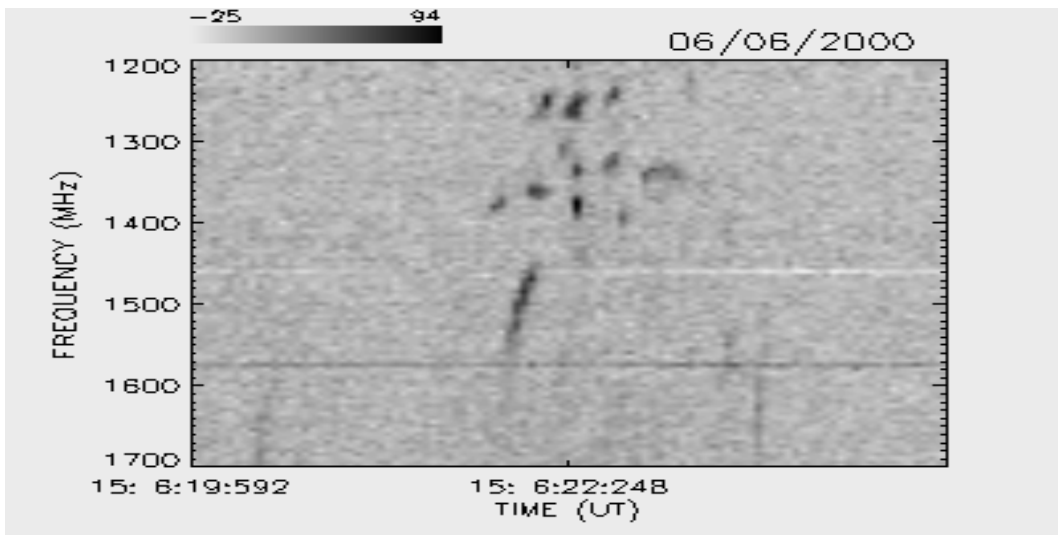
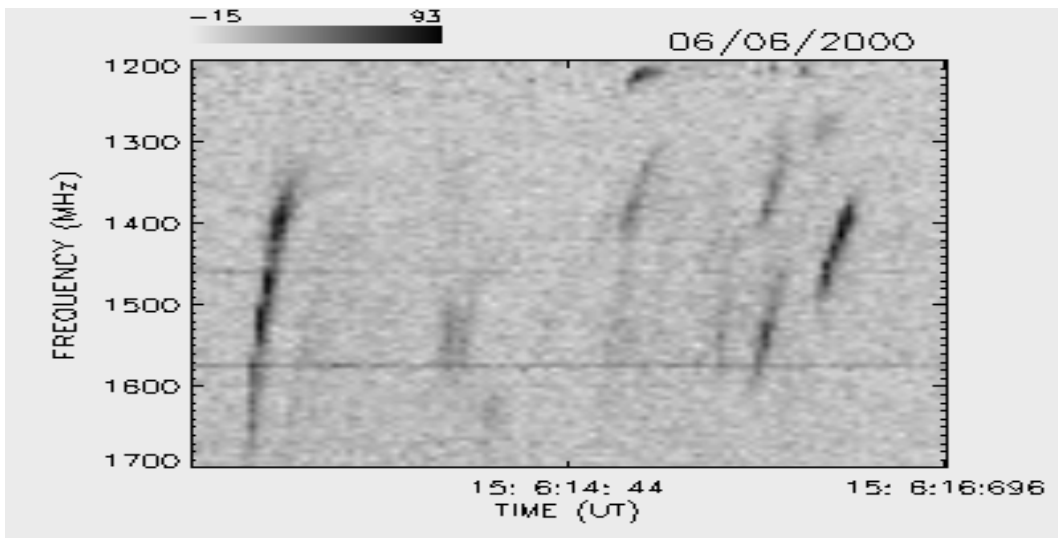
JUNHO / 2000



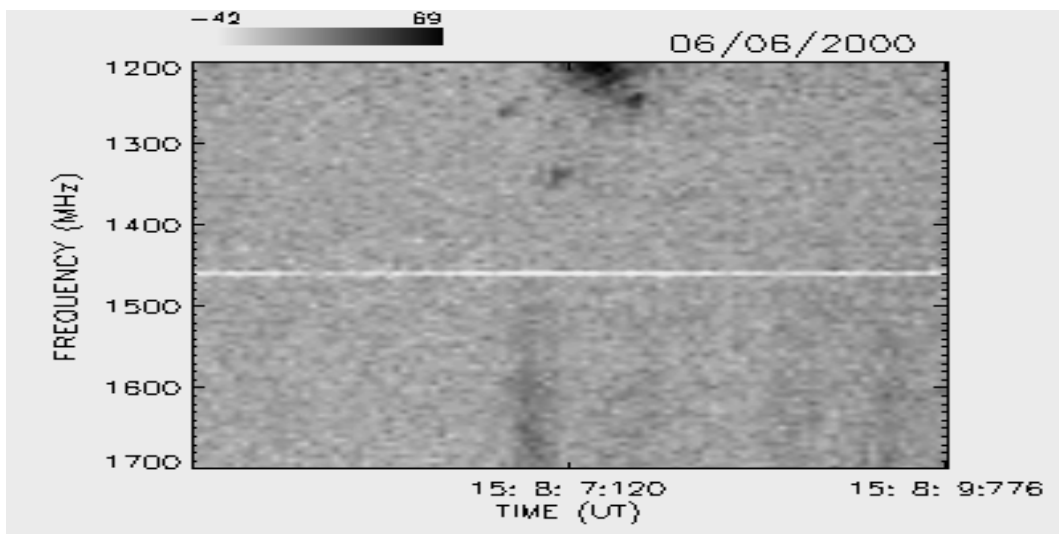
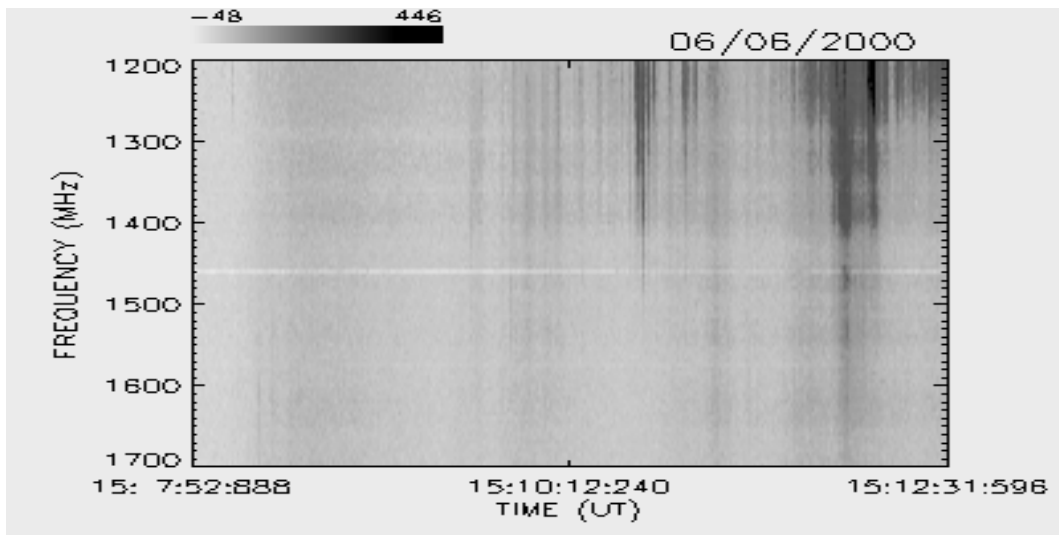
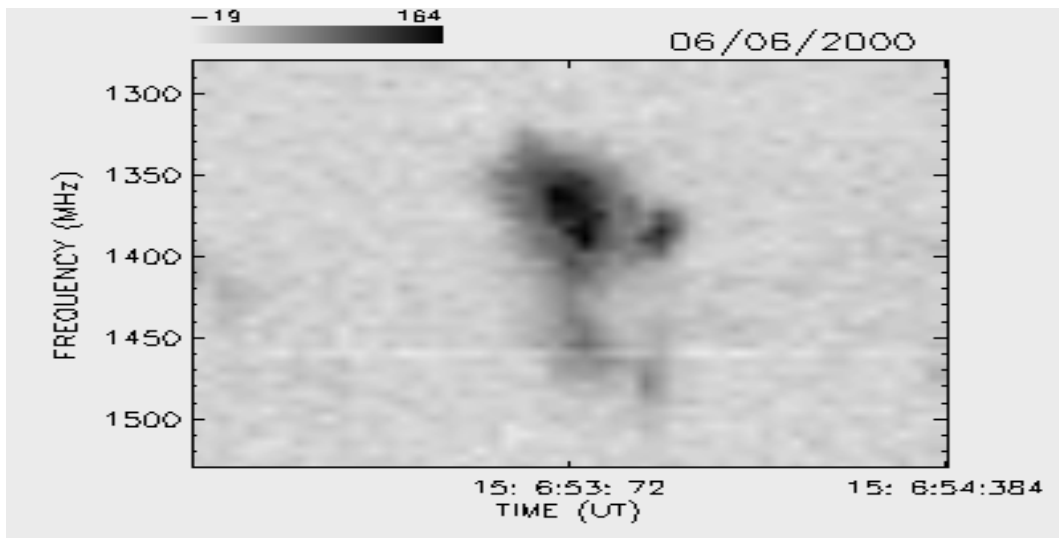
JUNHO / 2000



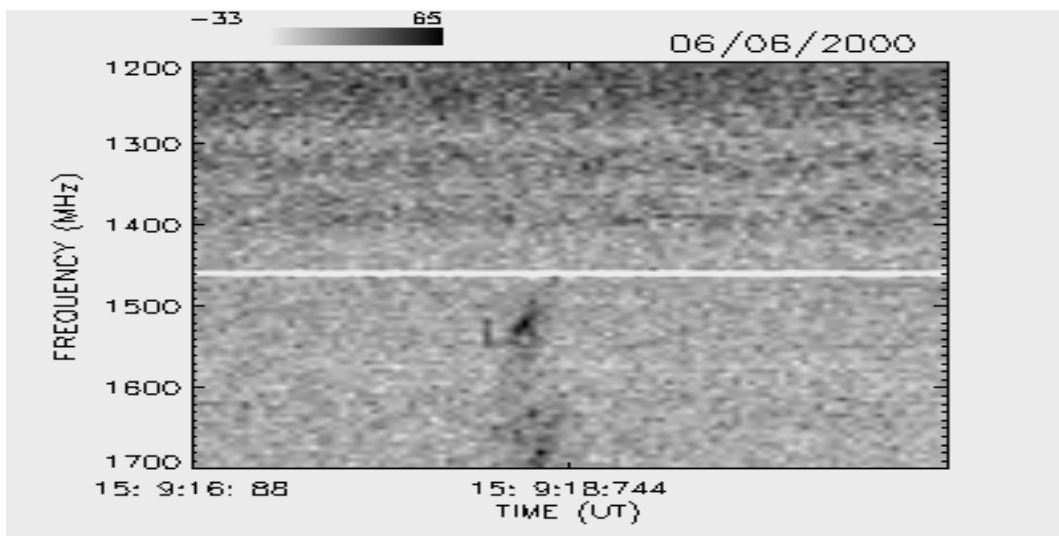
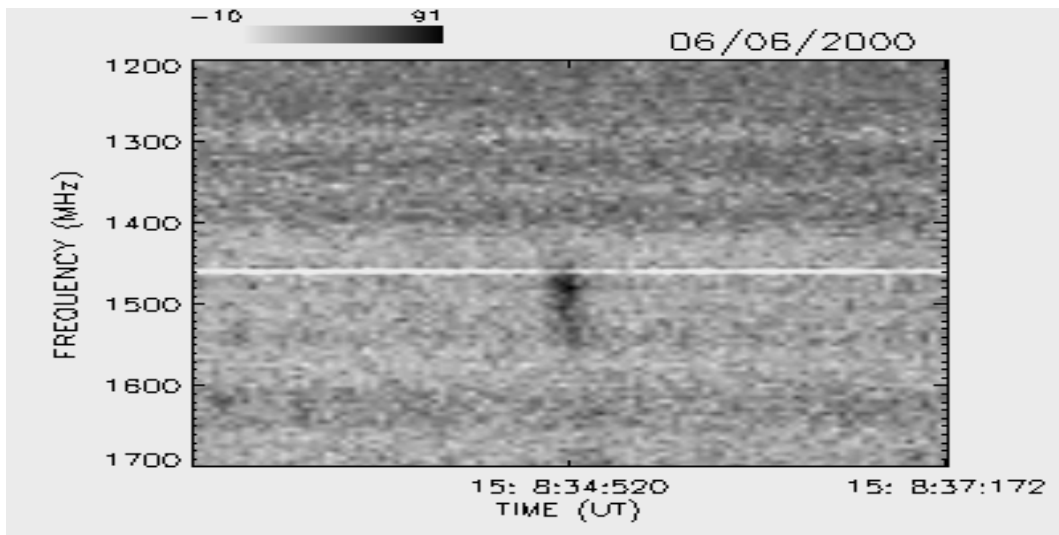
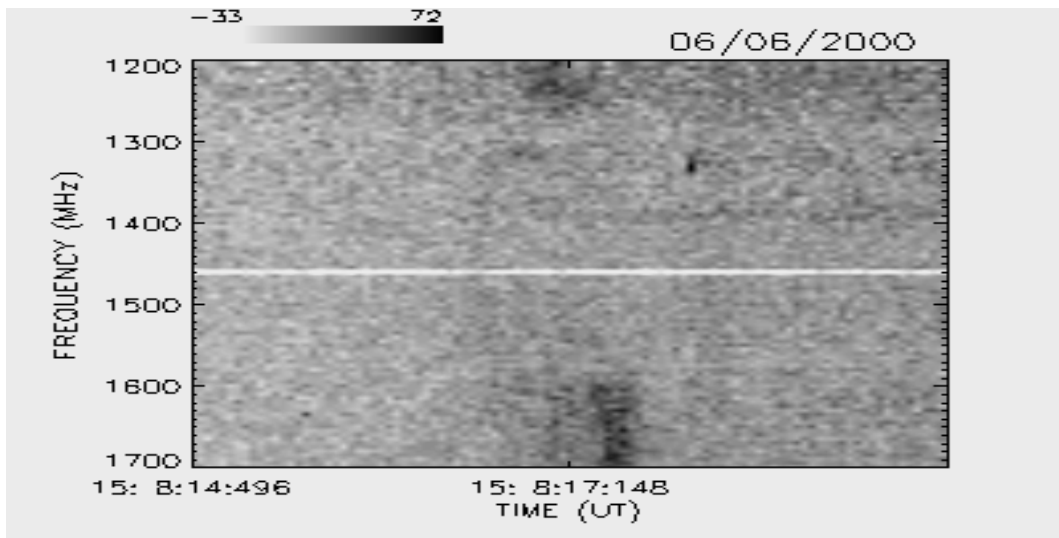
JUNHO / 2000



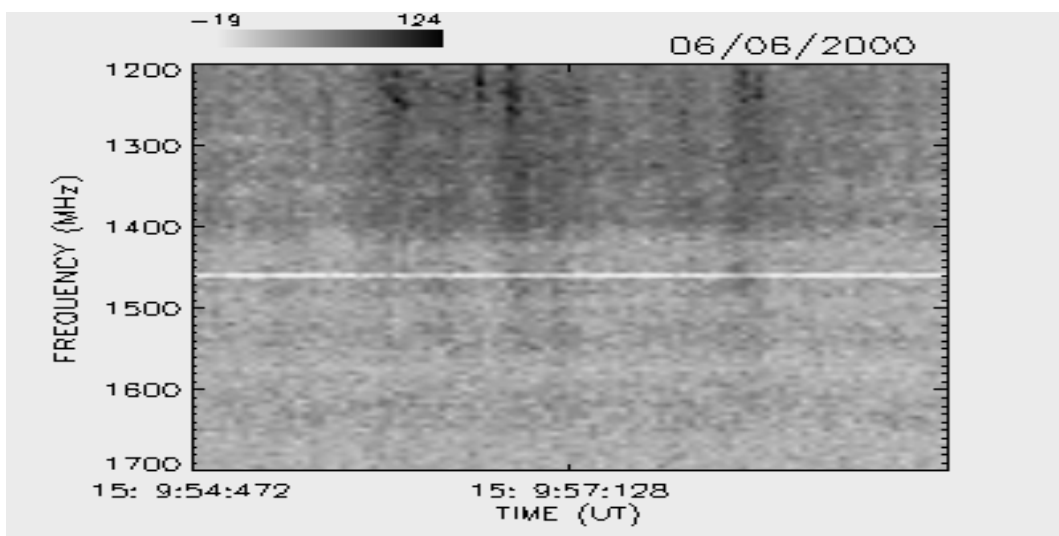
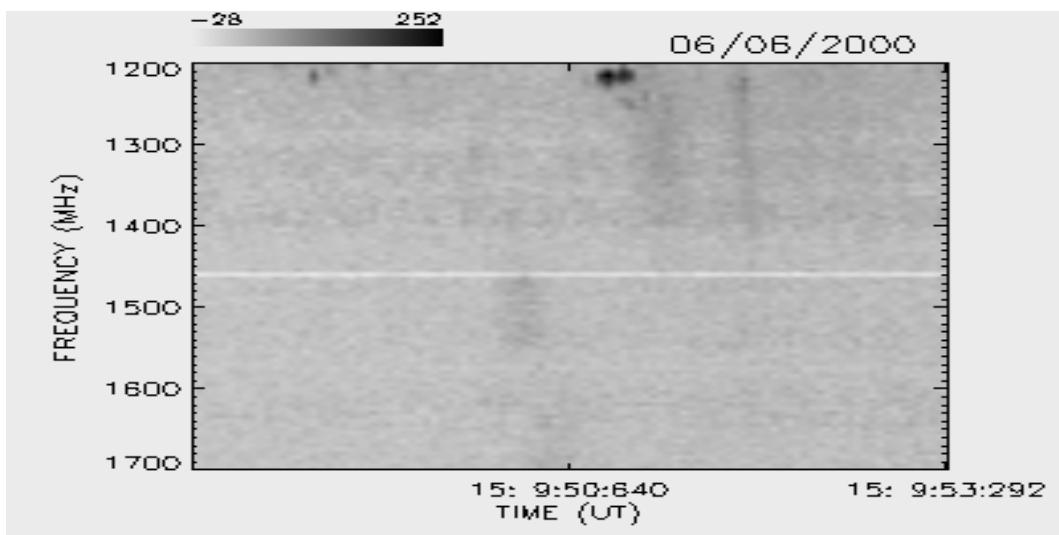
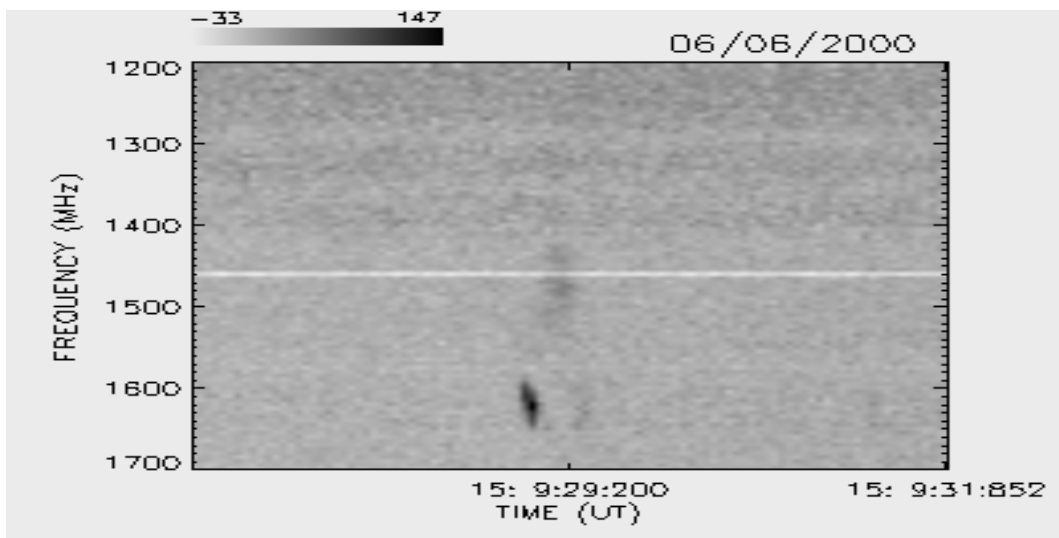
JUNHO / 2000



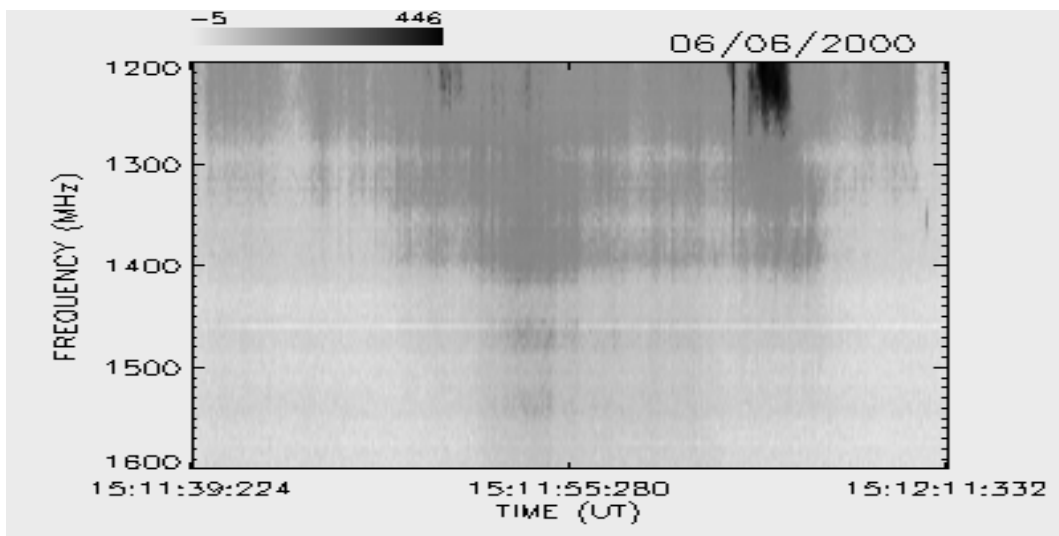
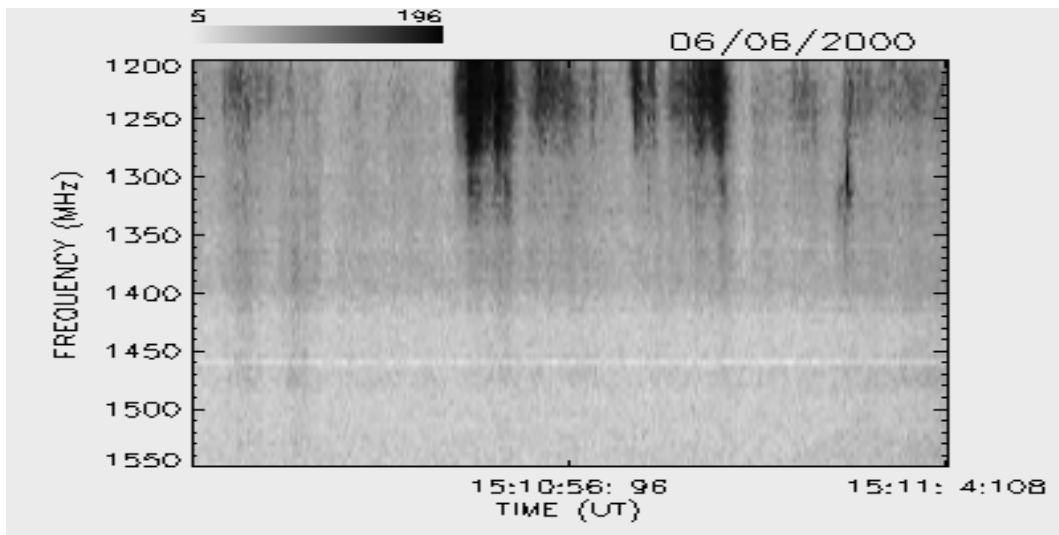
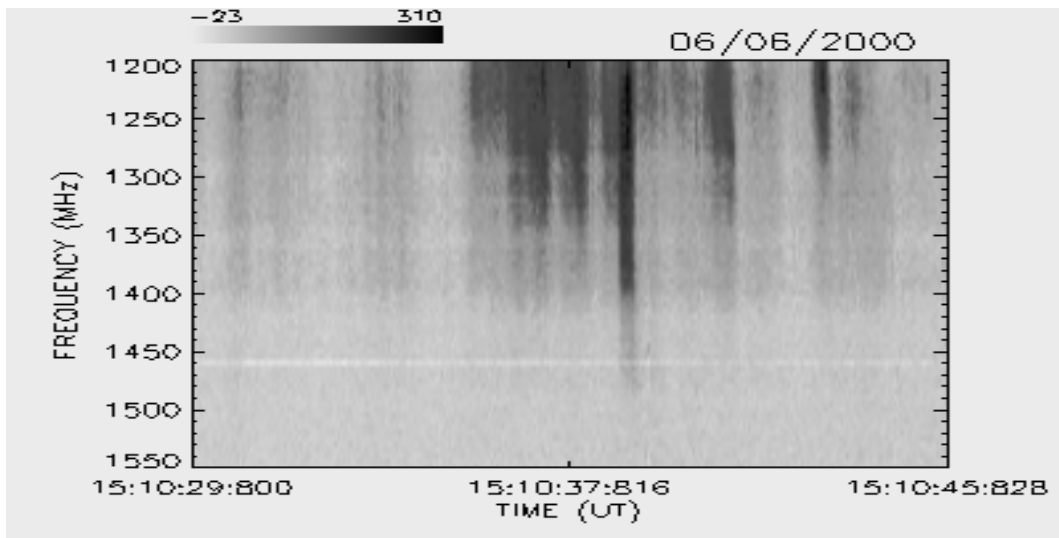
JUNHO / 2000



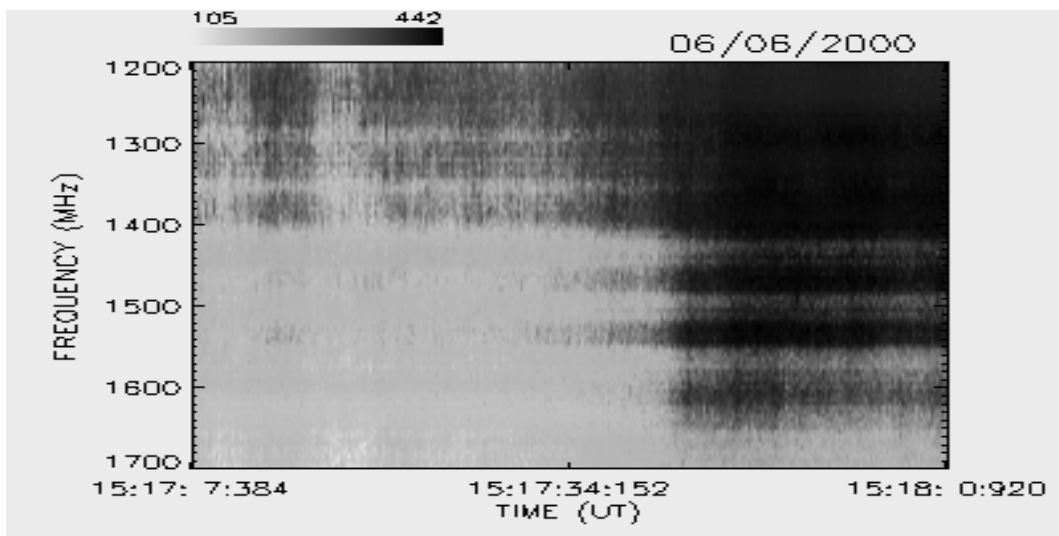
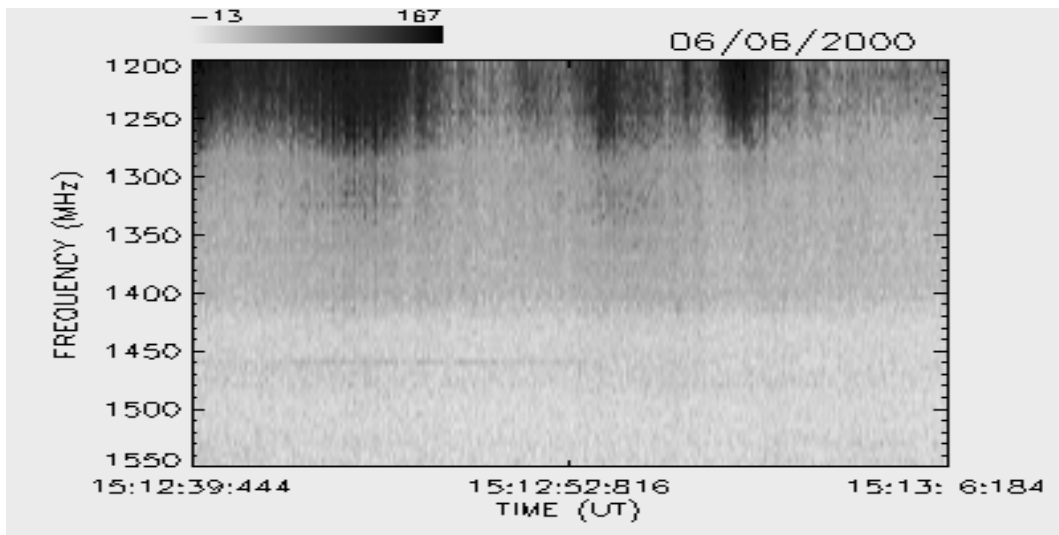
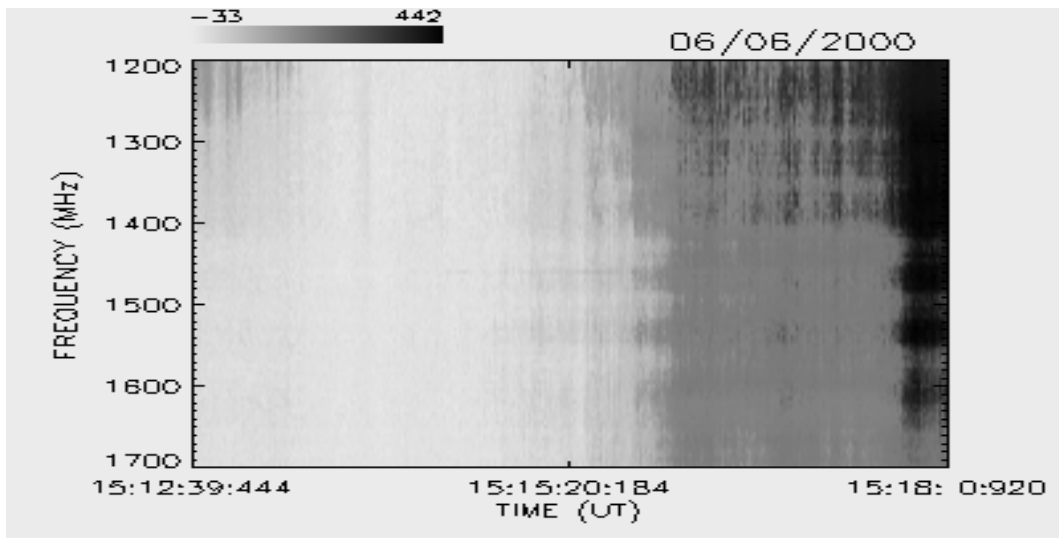
JUNHO / 2000



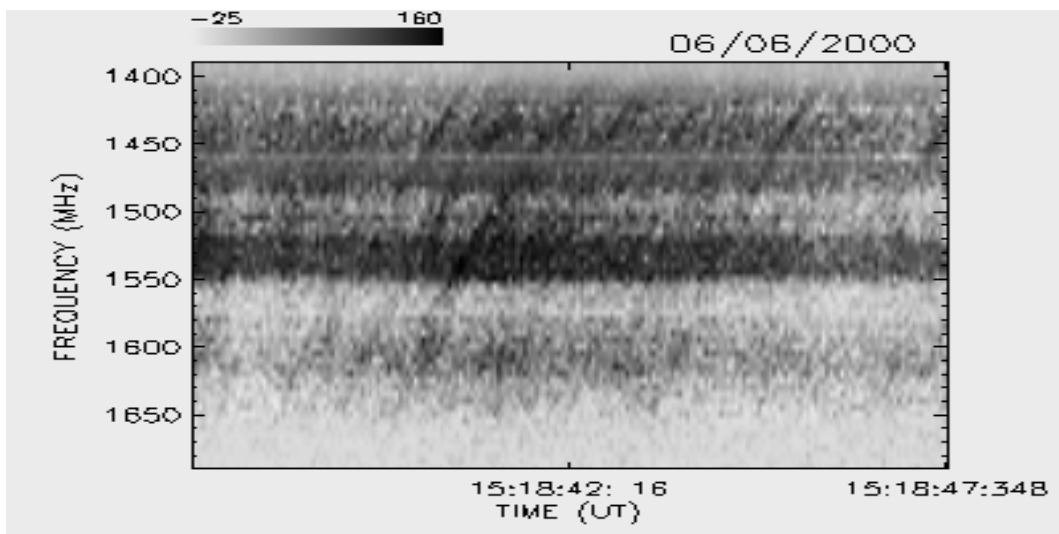
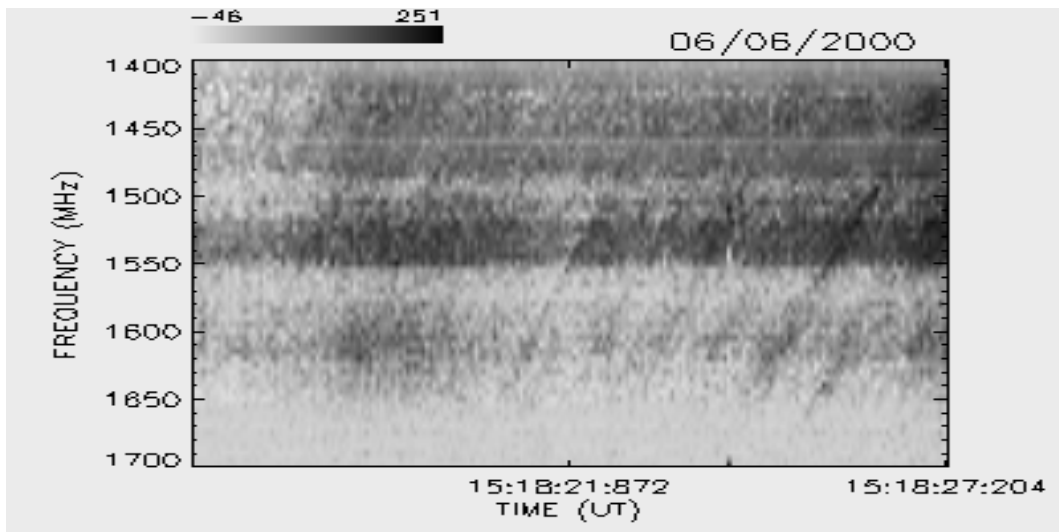
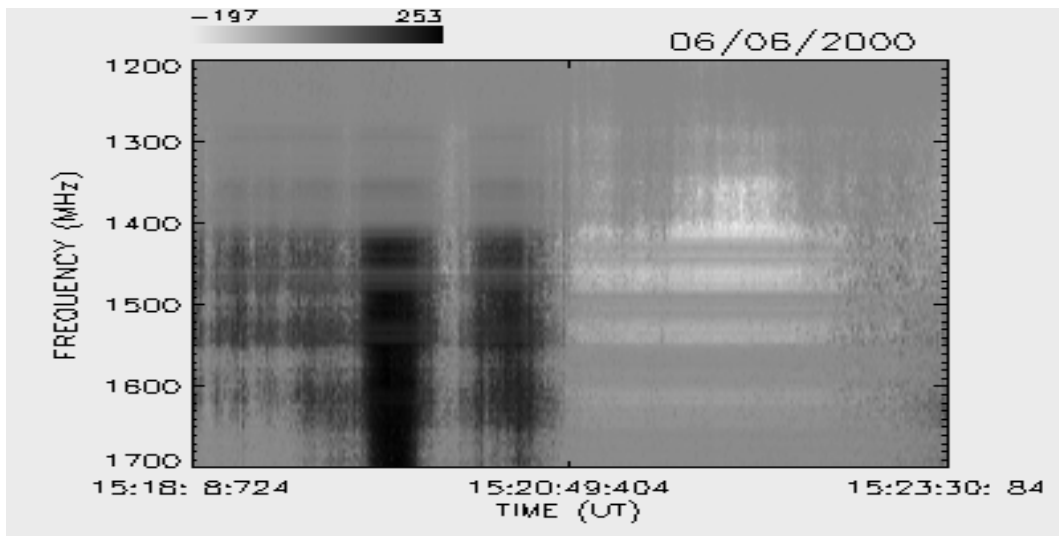
JUNHO / 2000



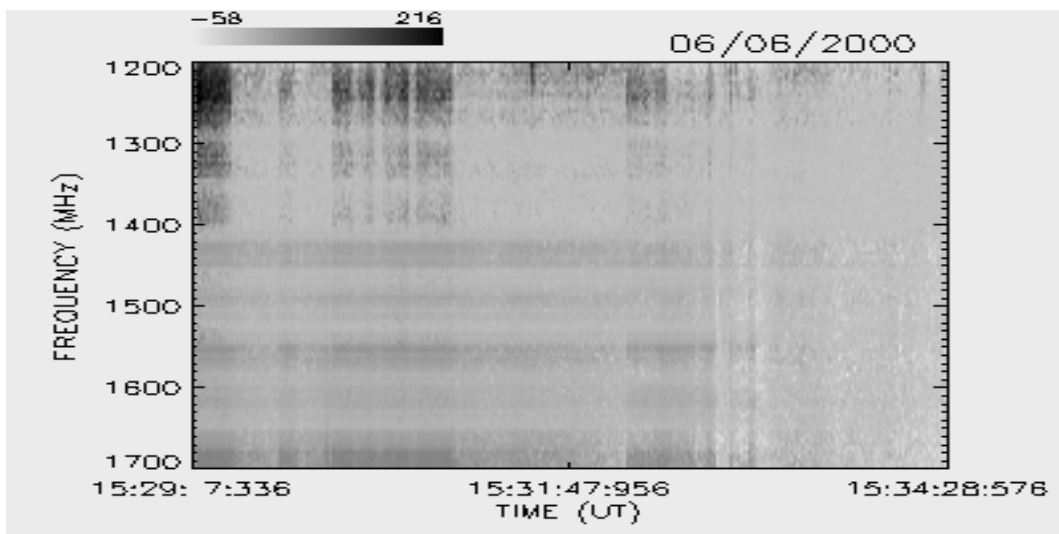
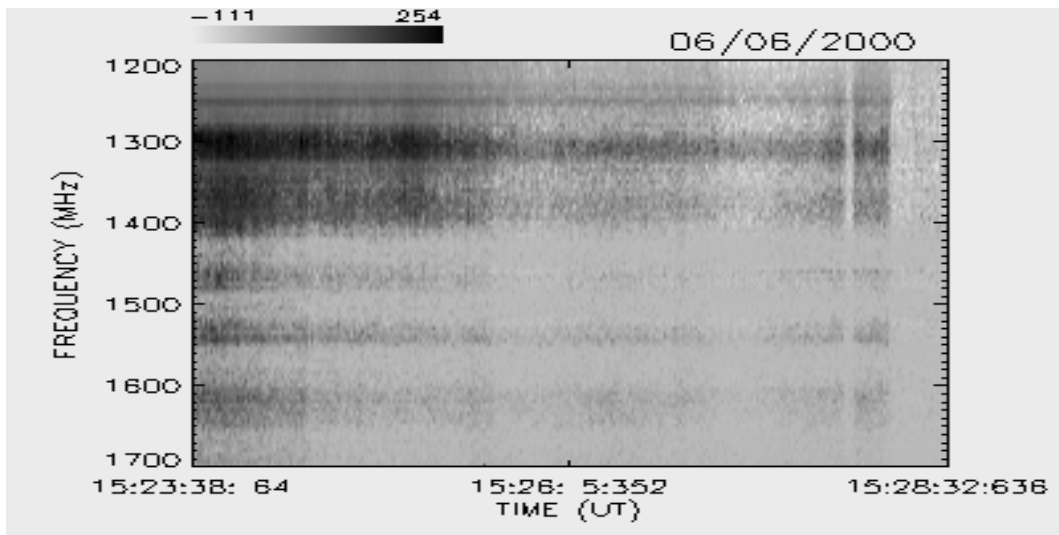
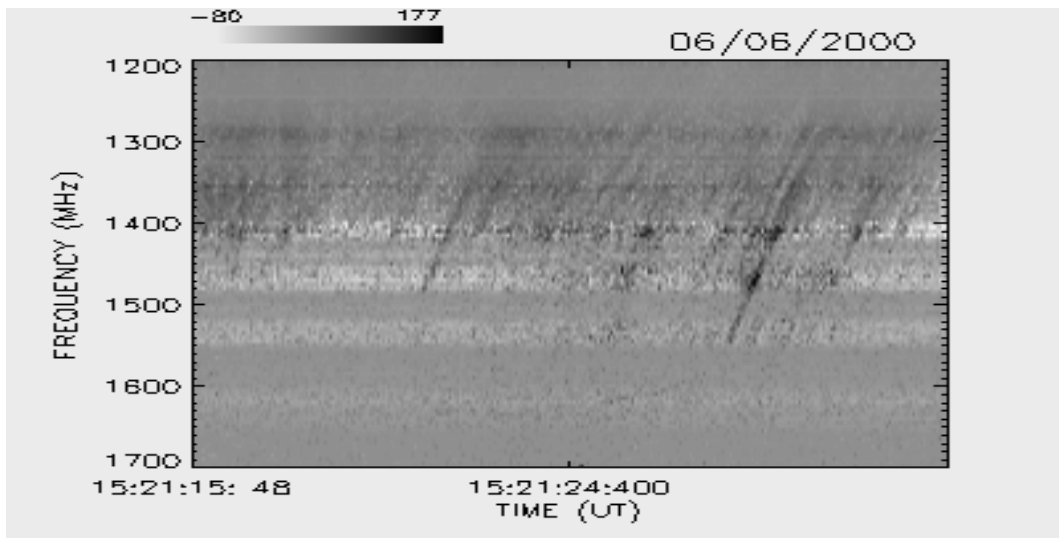
JUNHO / 2000



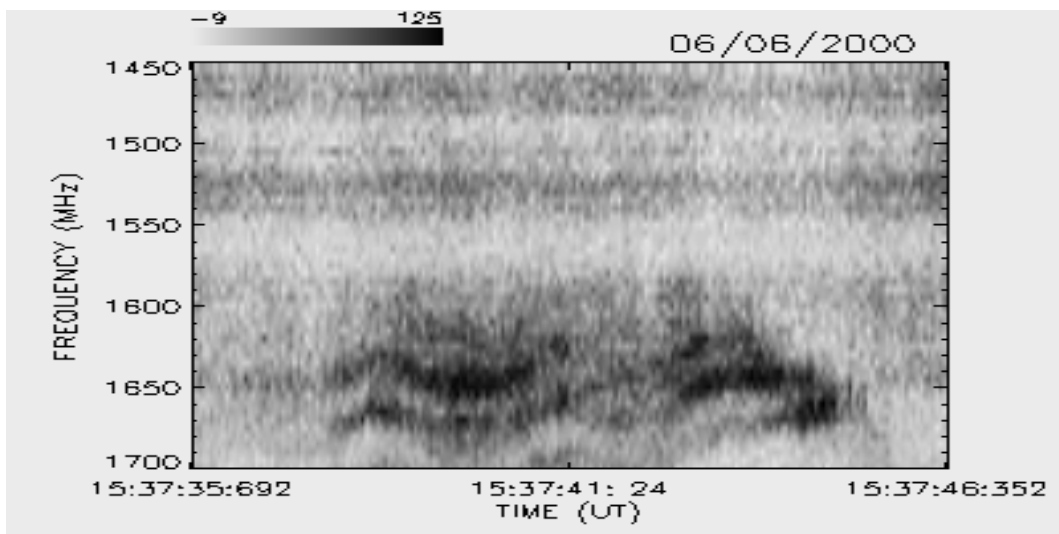
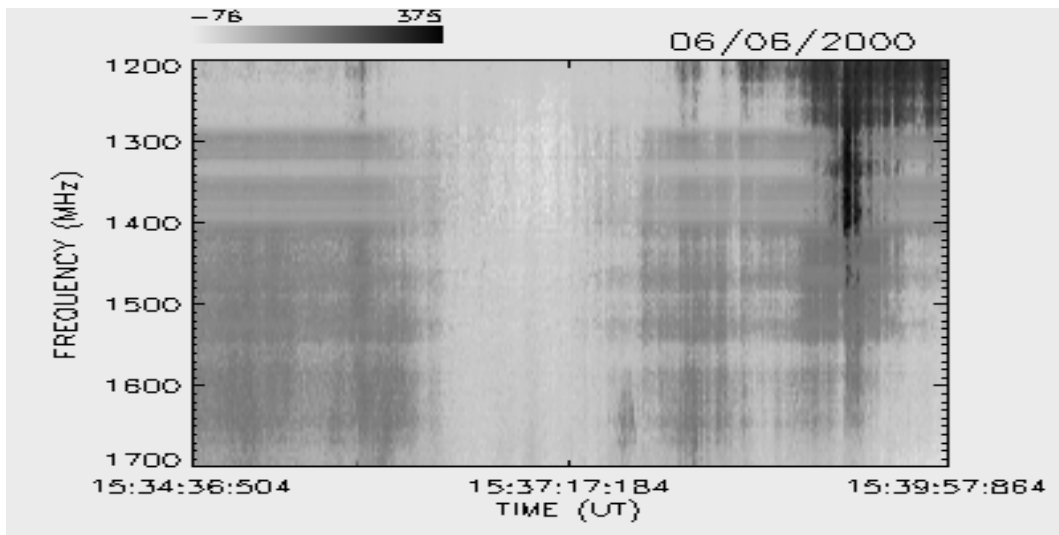
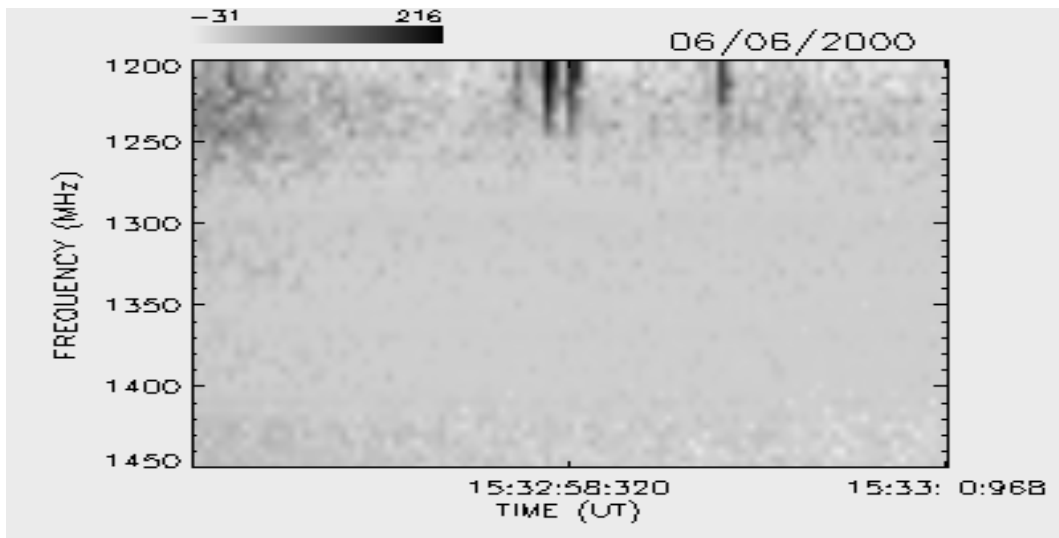
JUNHO / 2000



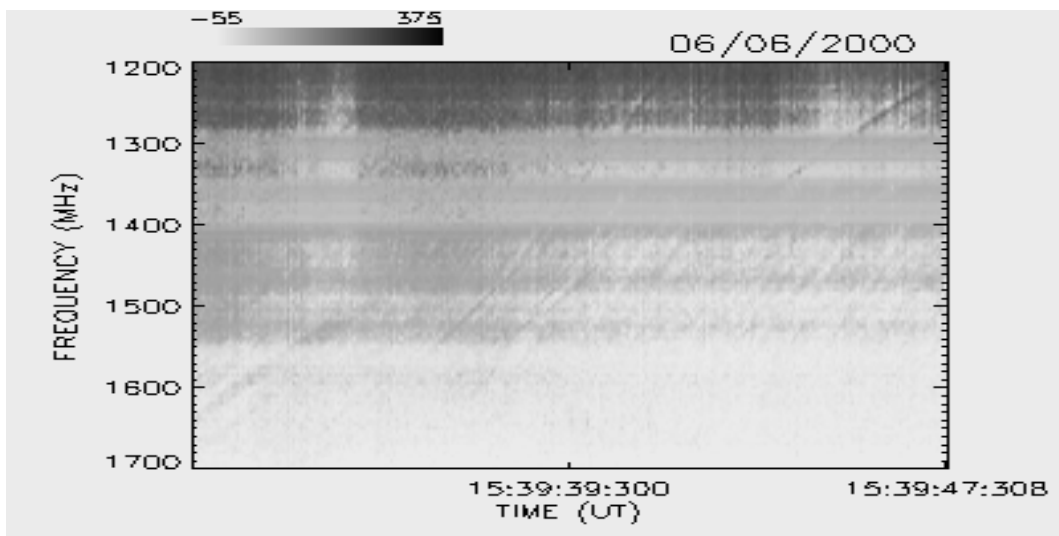
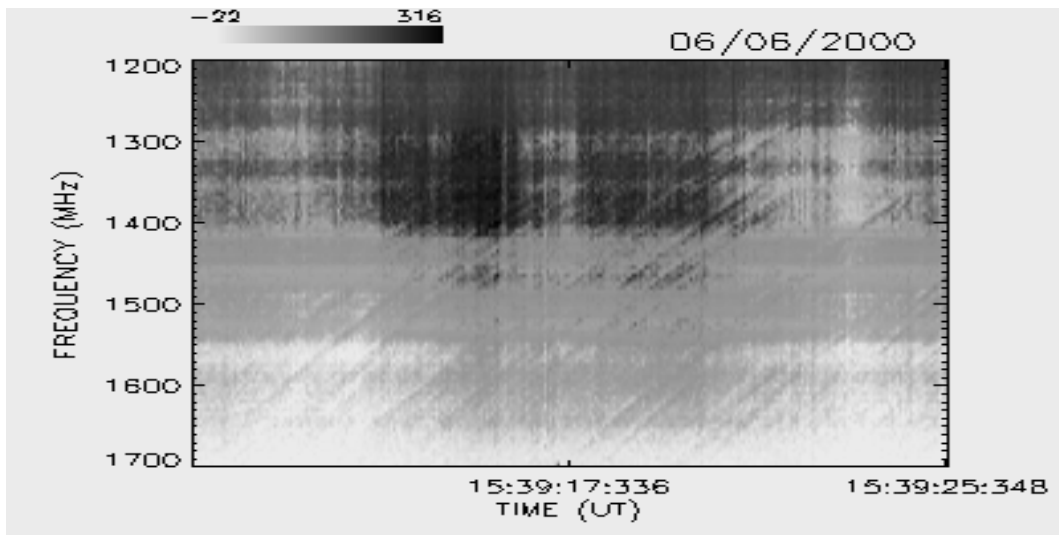
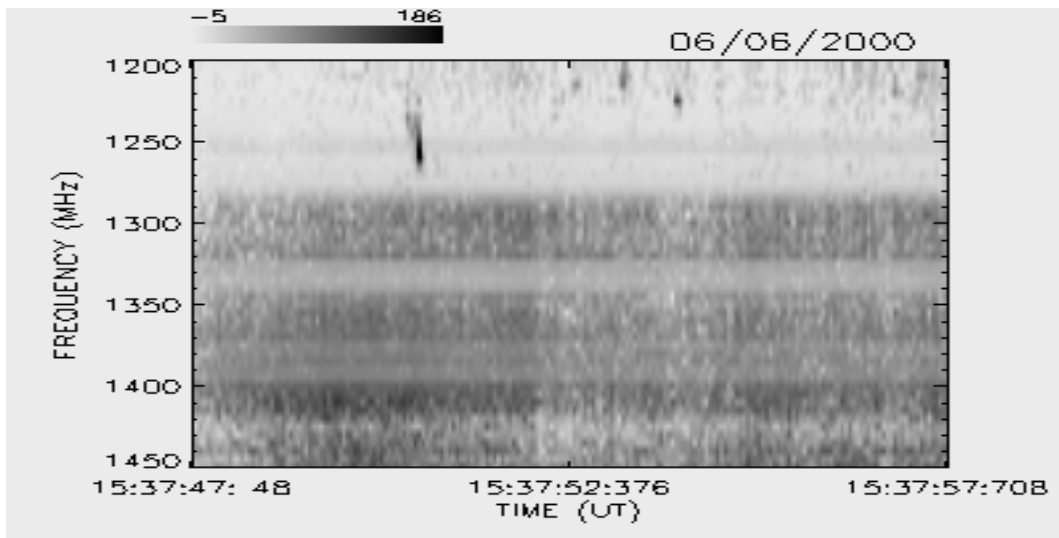
JUNHO / 2000



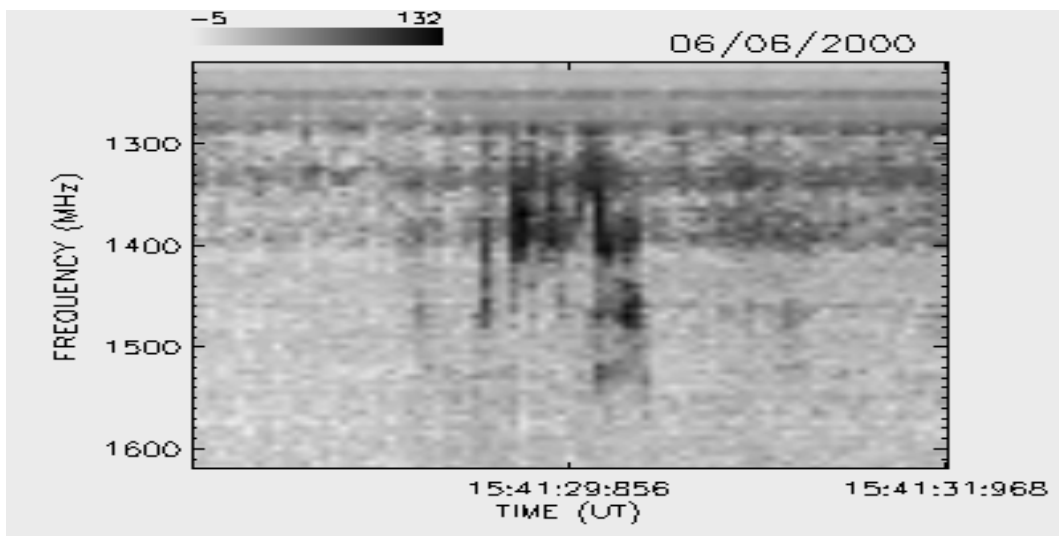
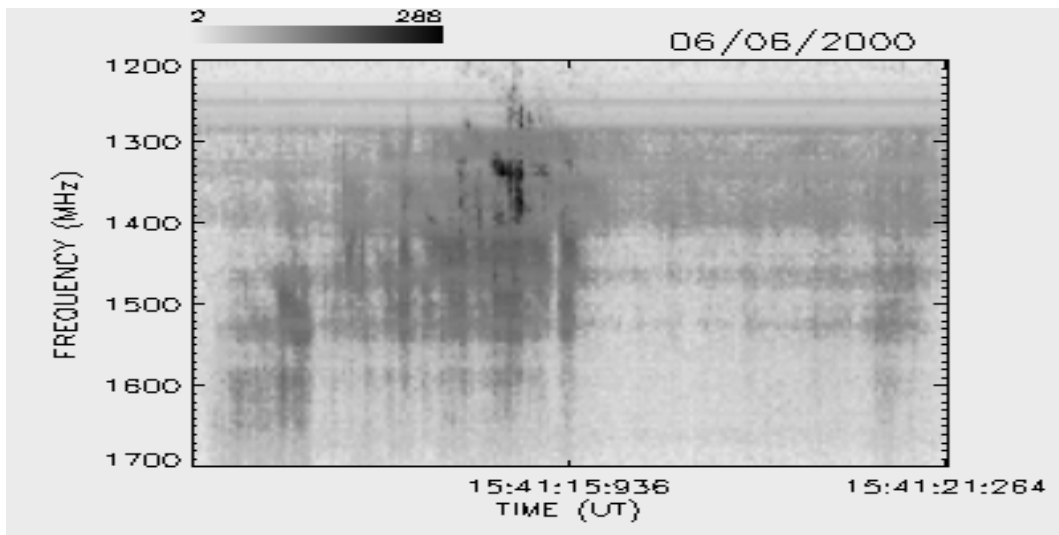
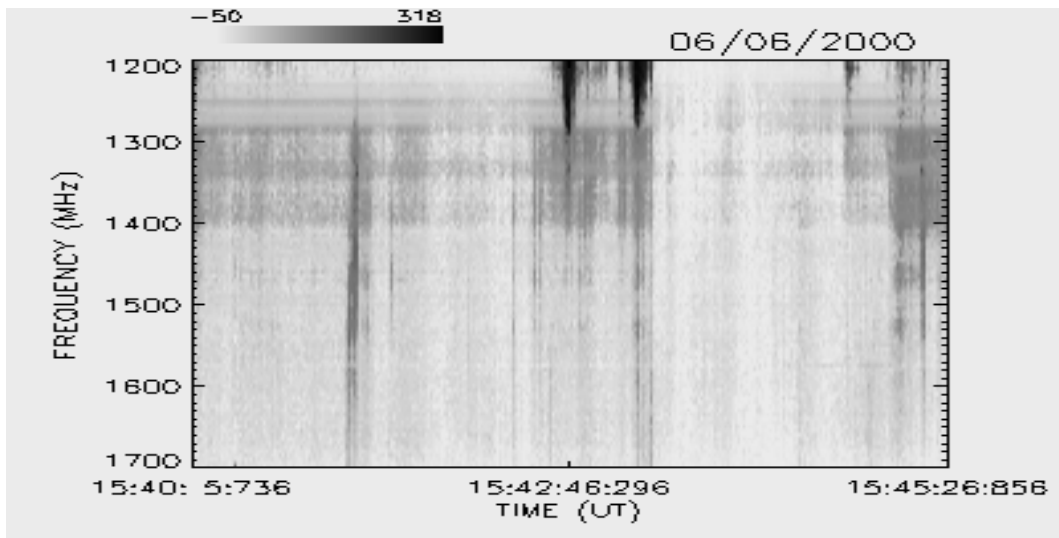
JUNHO / 2000



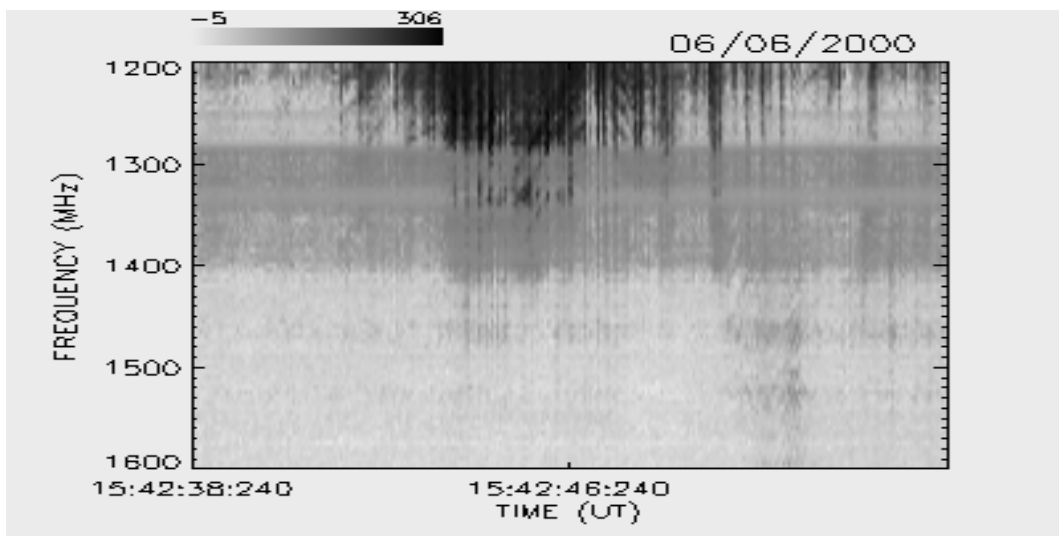
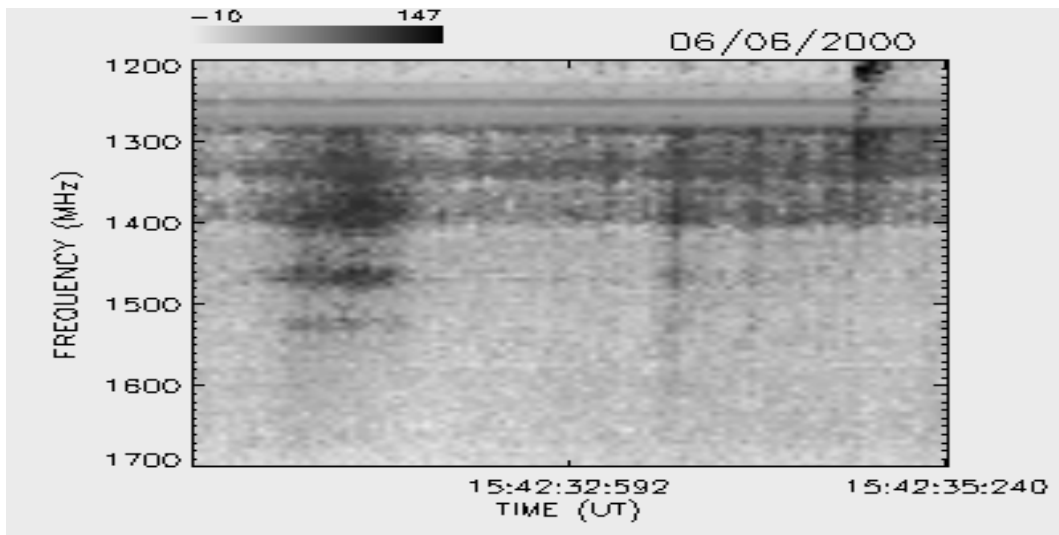
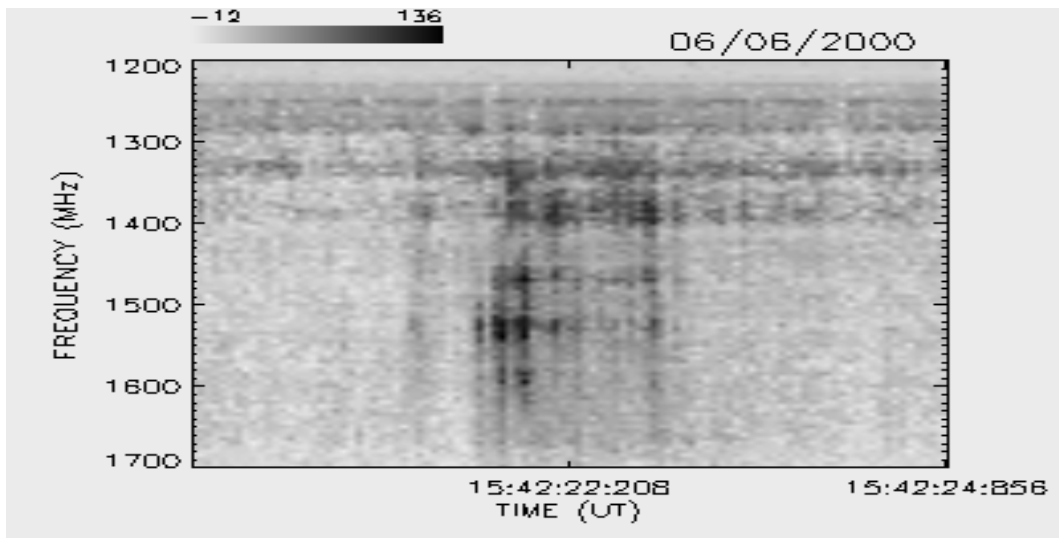
JUNHO / 2000



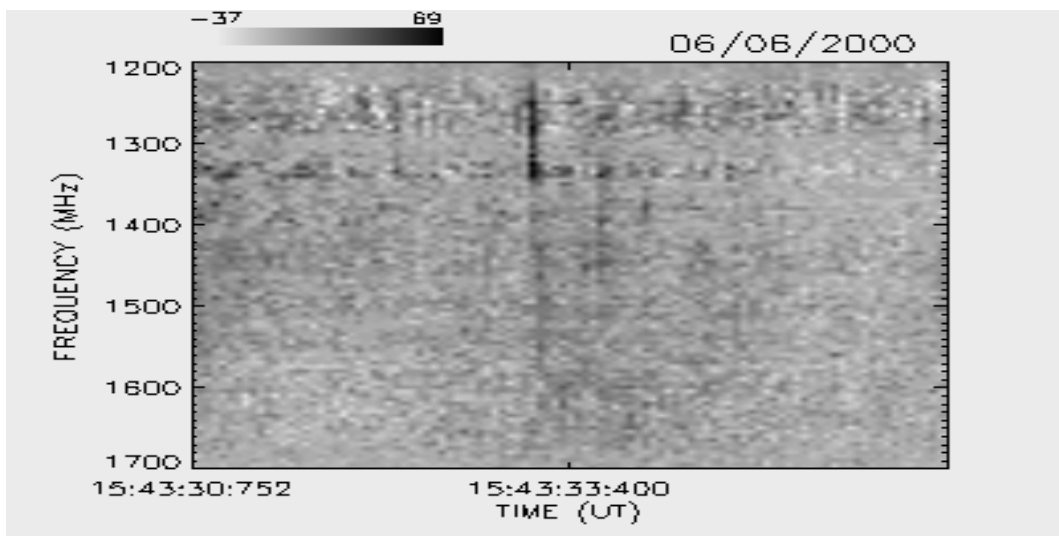
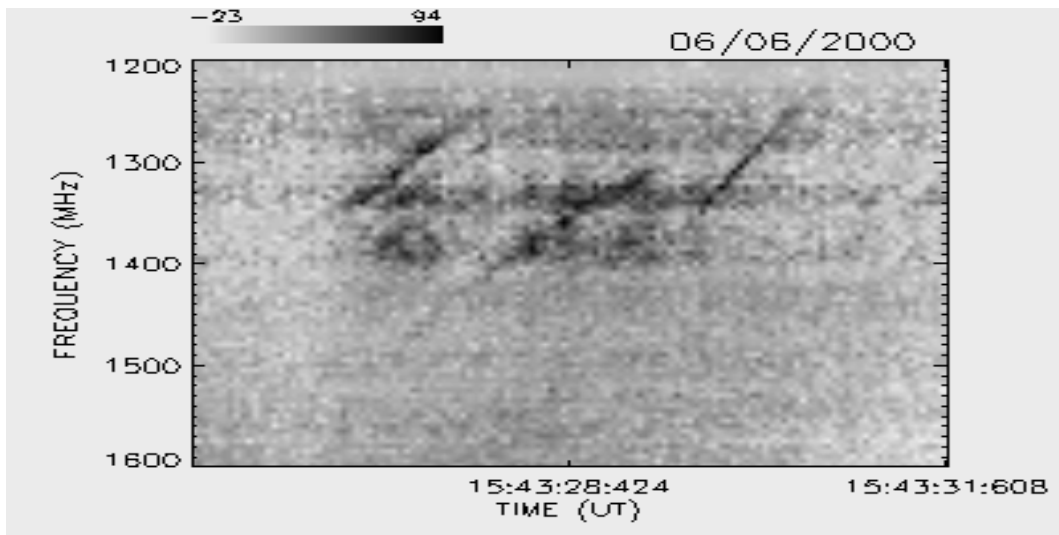
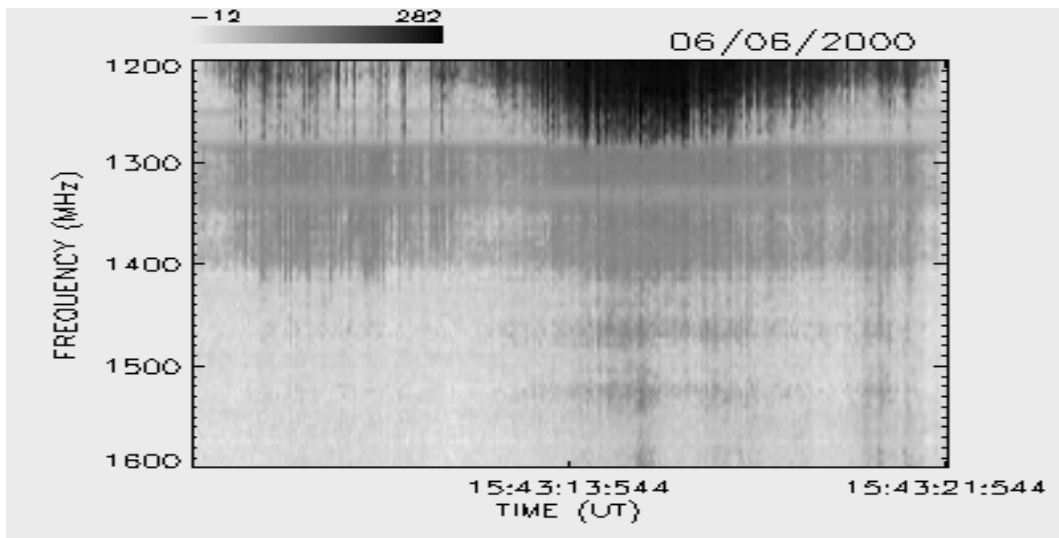
JUNHO / 2000



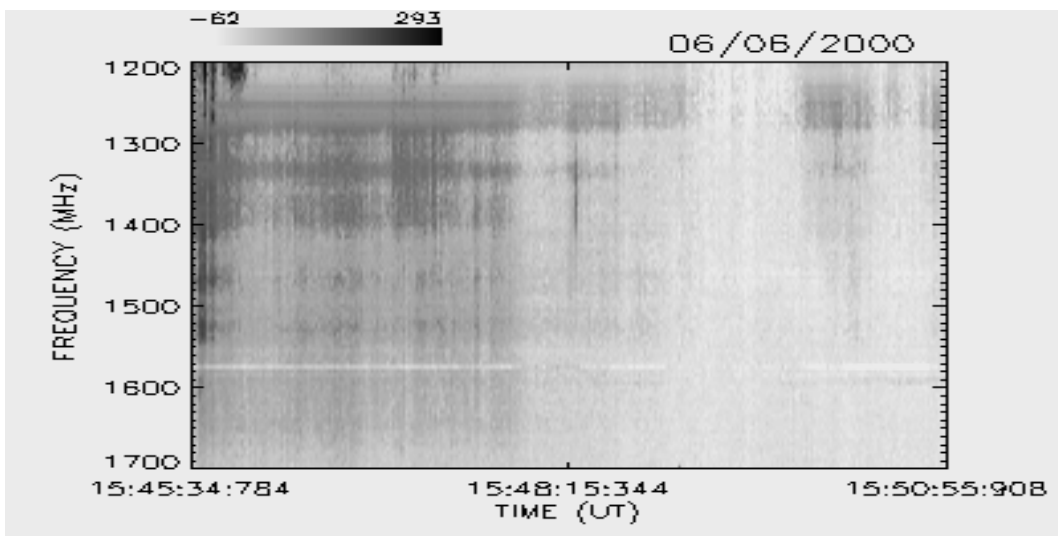
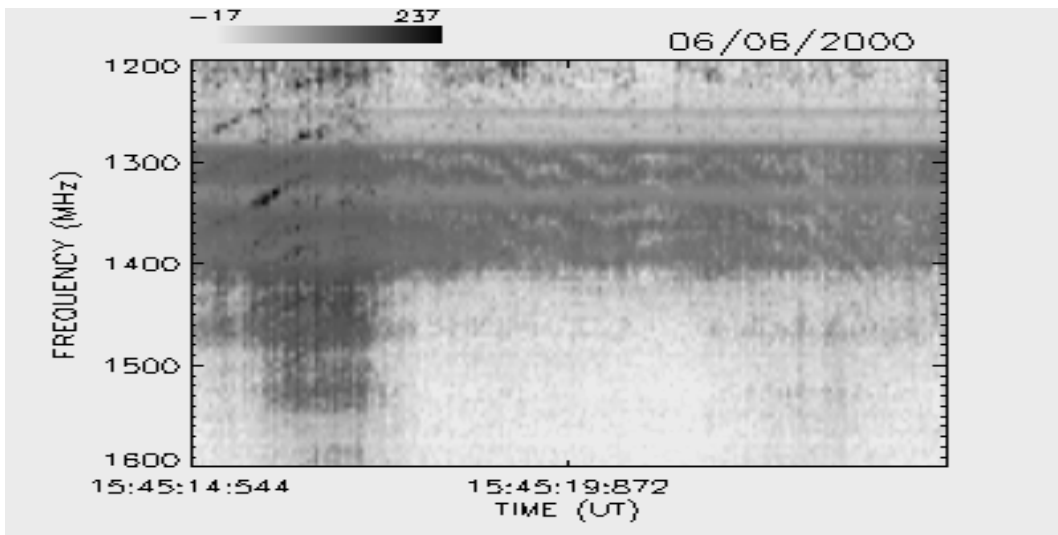
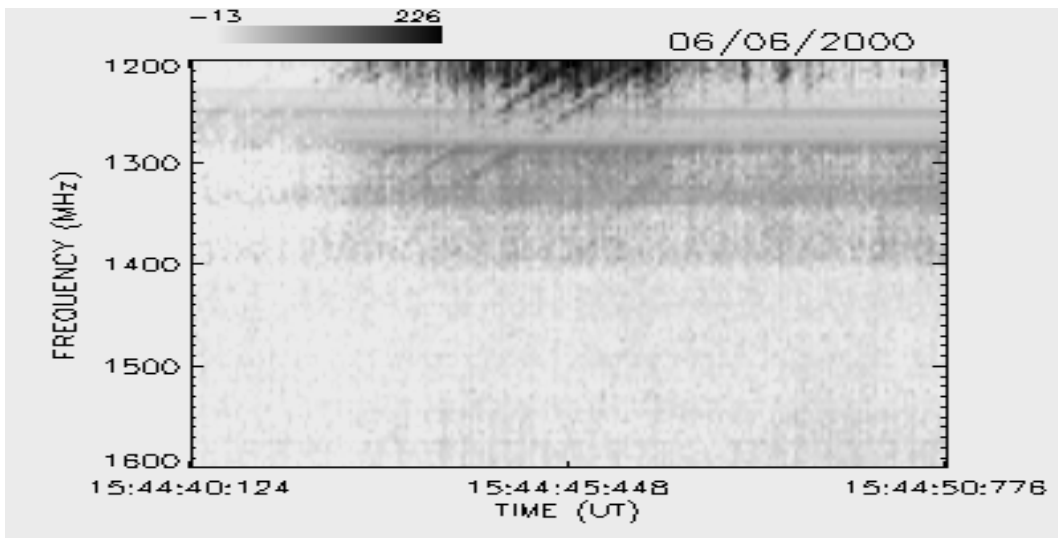
JUNHO / 2000



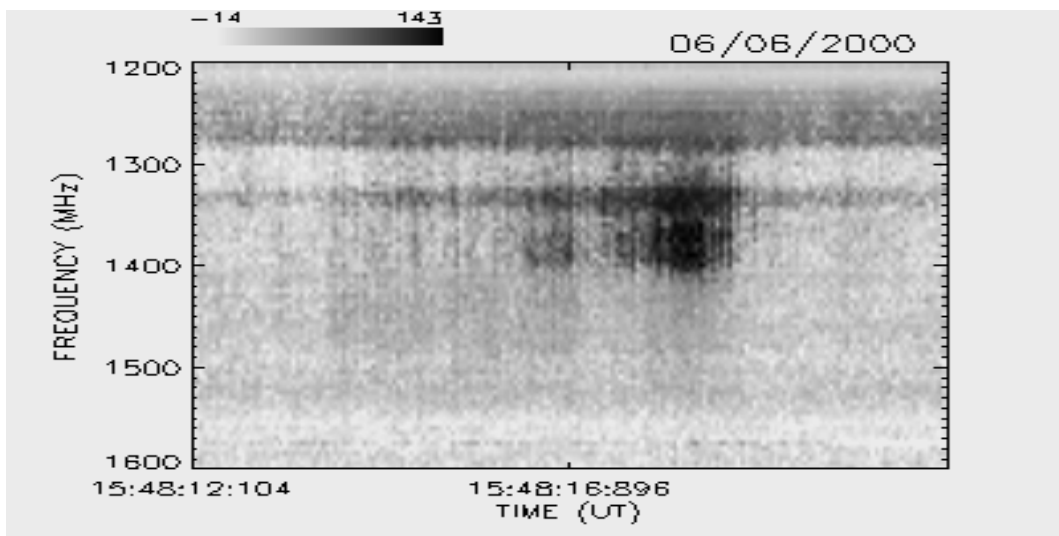
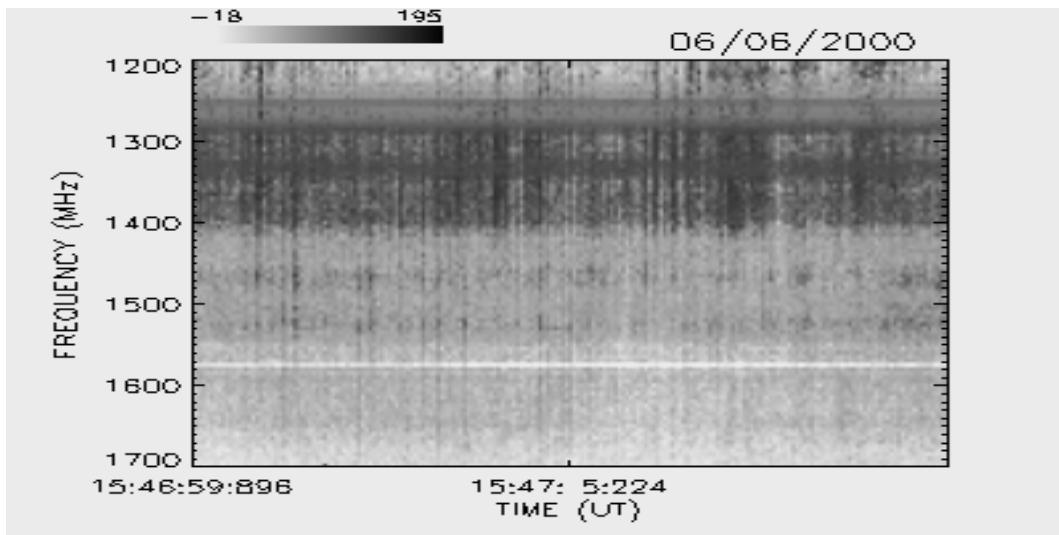
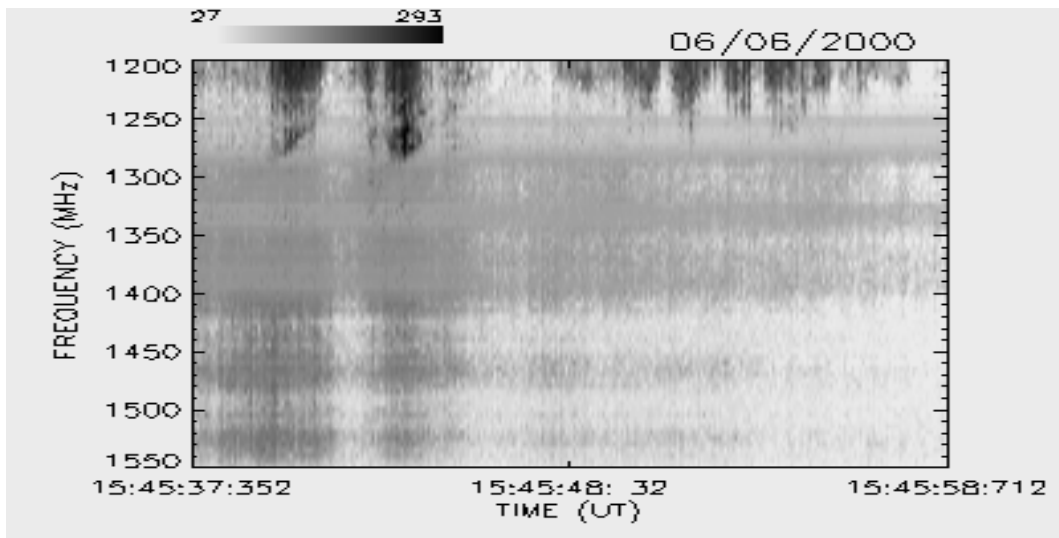
JUNHO / 2000



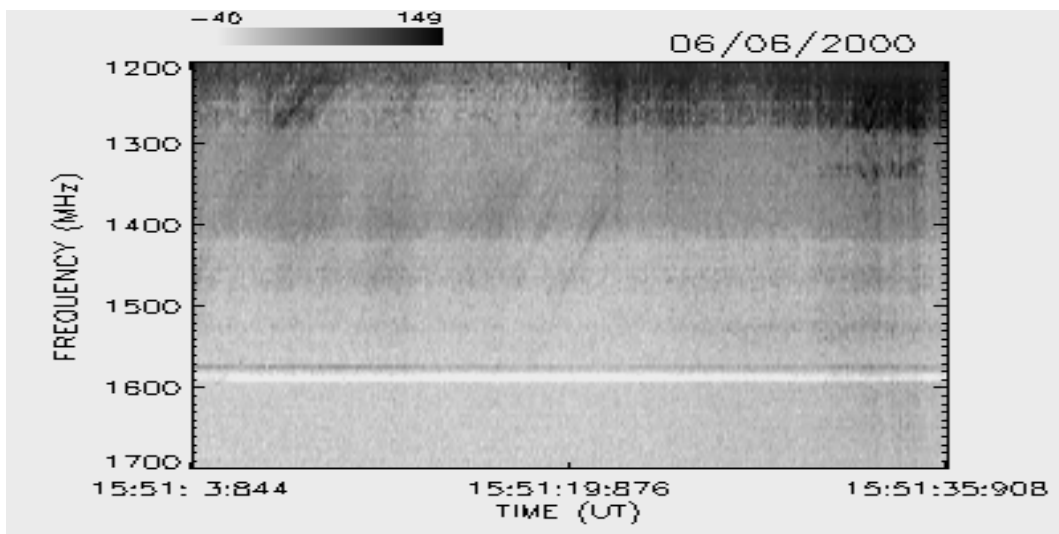
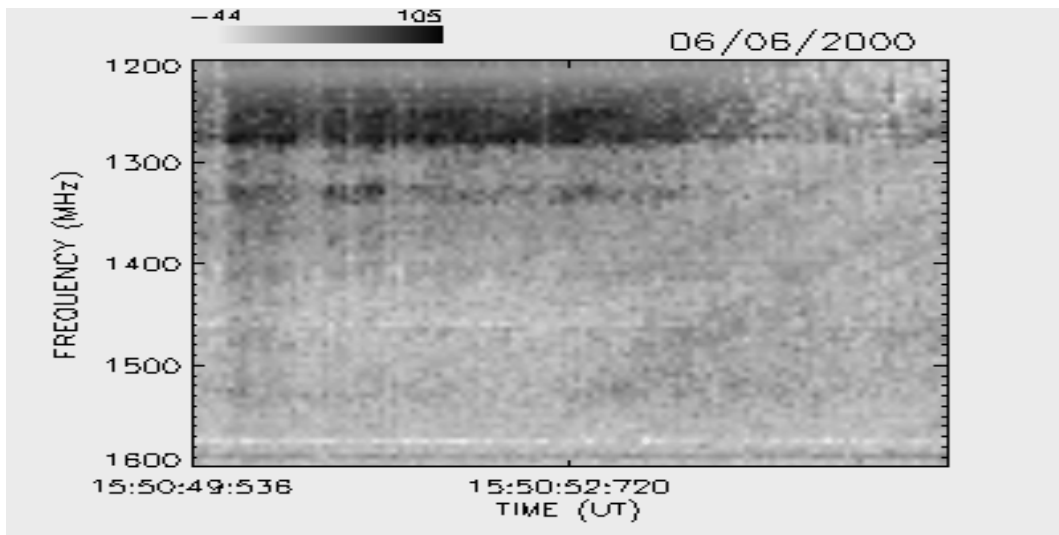
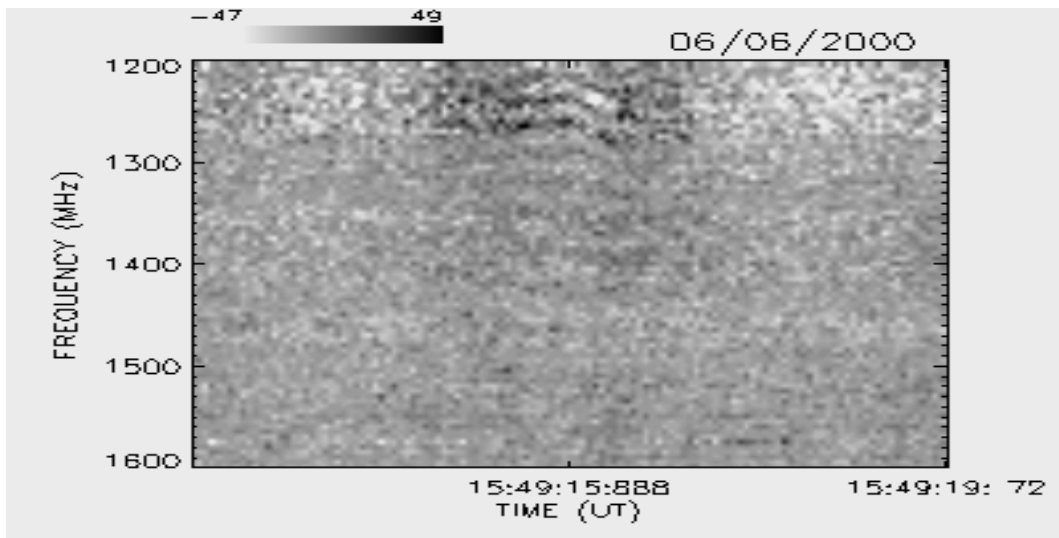
JUNHO / 2000



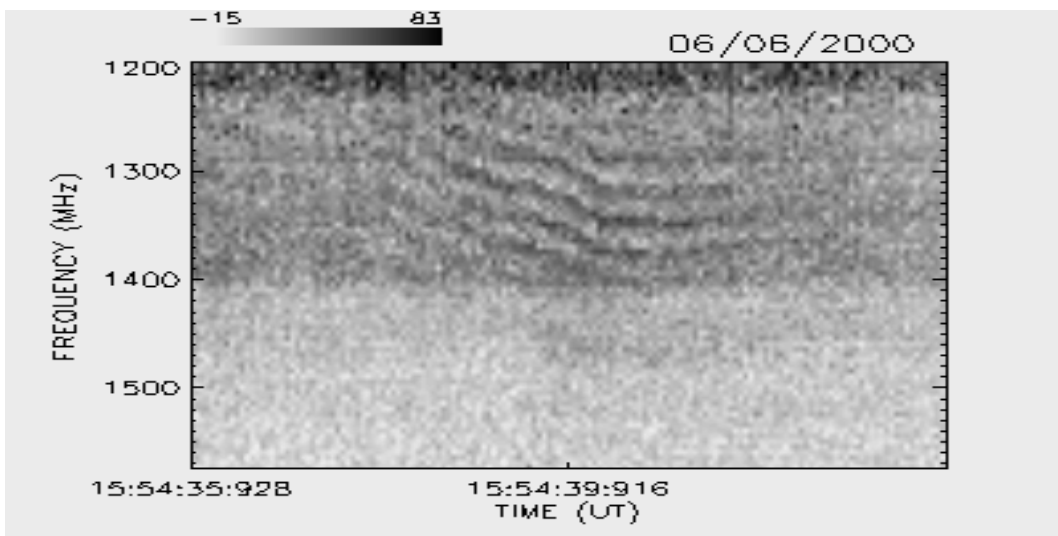
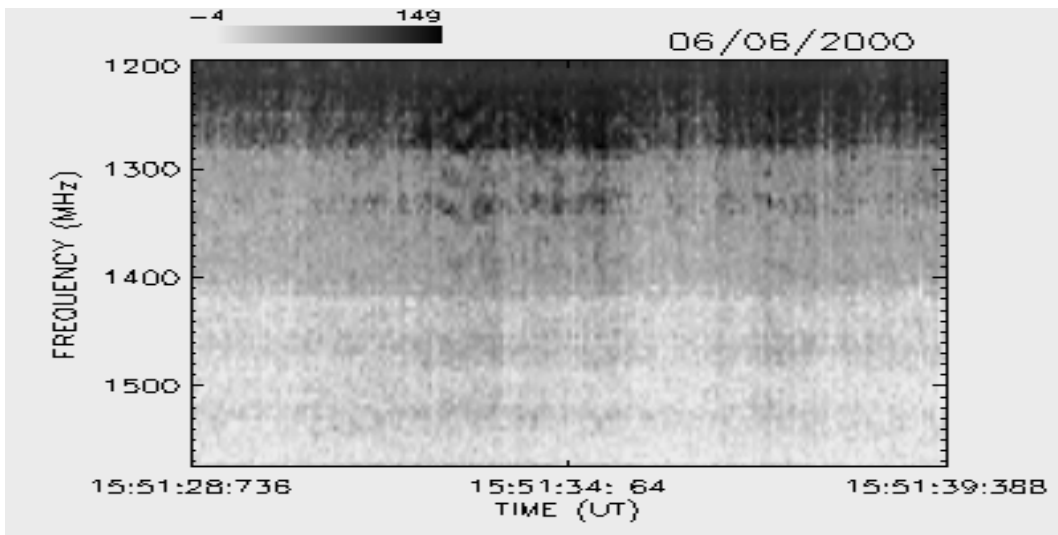
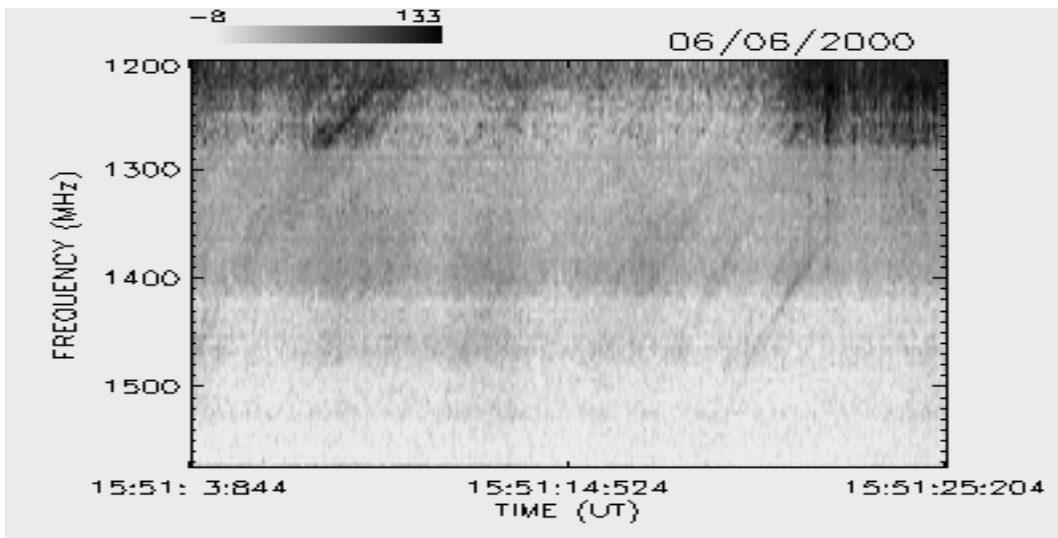
JUNHO / 2000



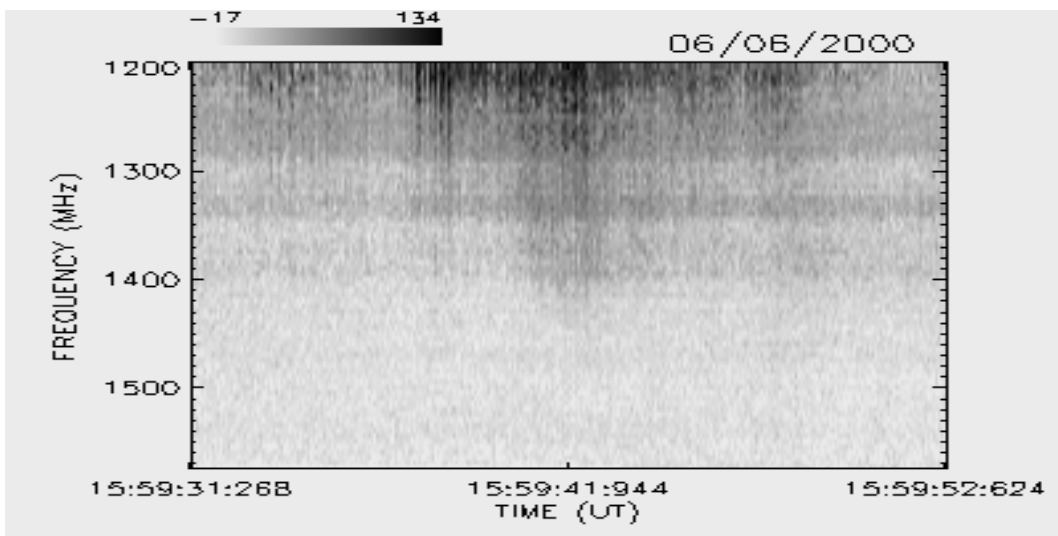
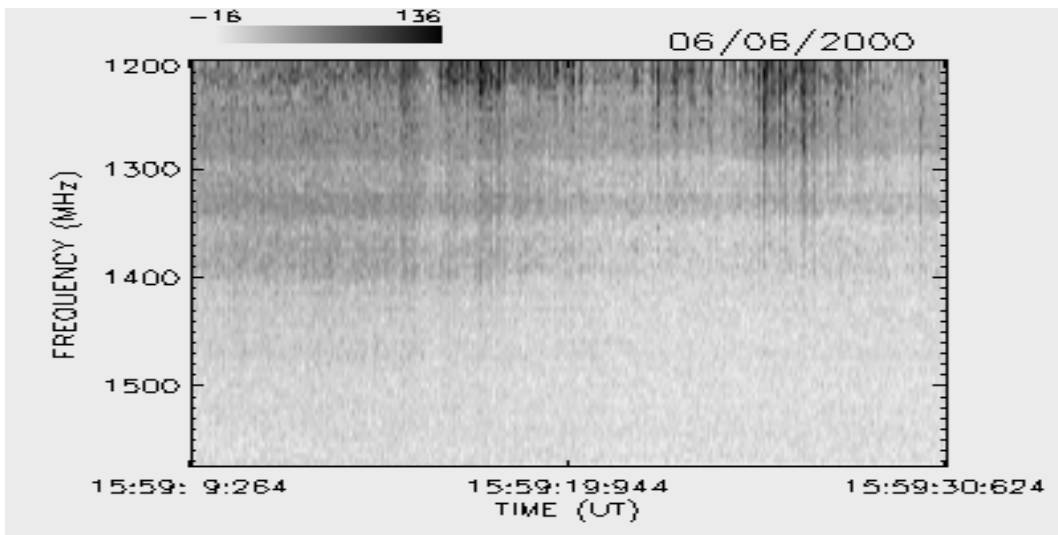
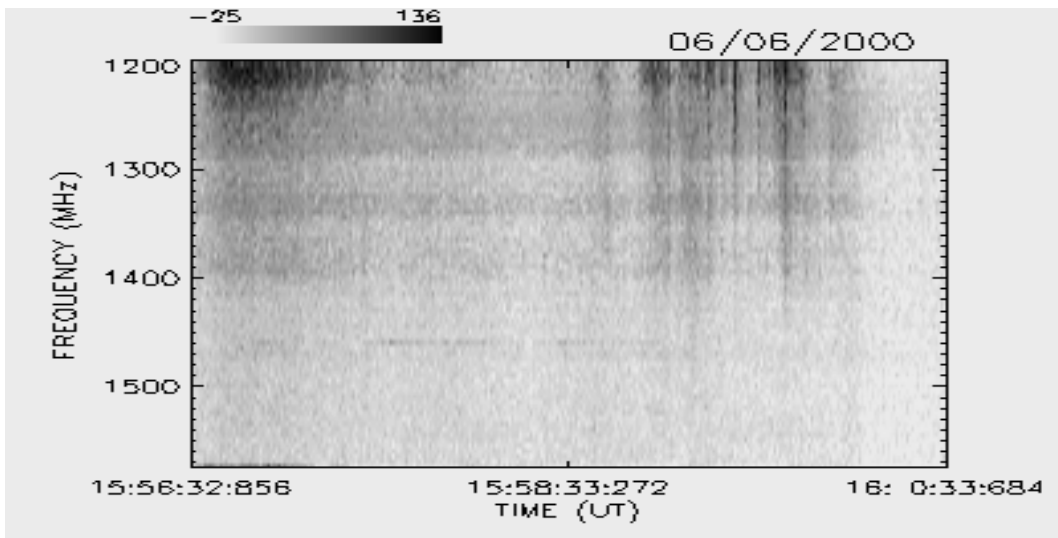
JUNHO / 2000



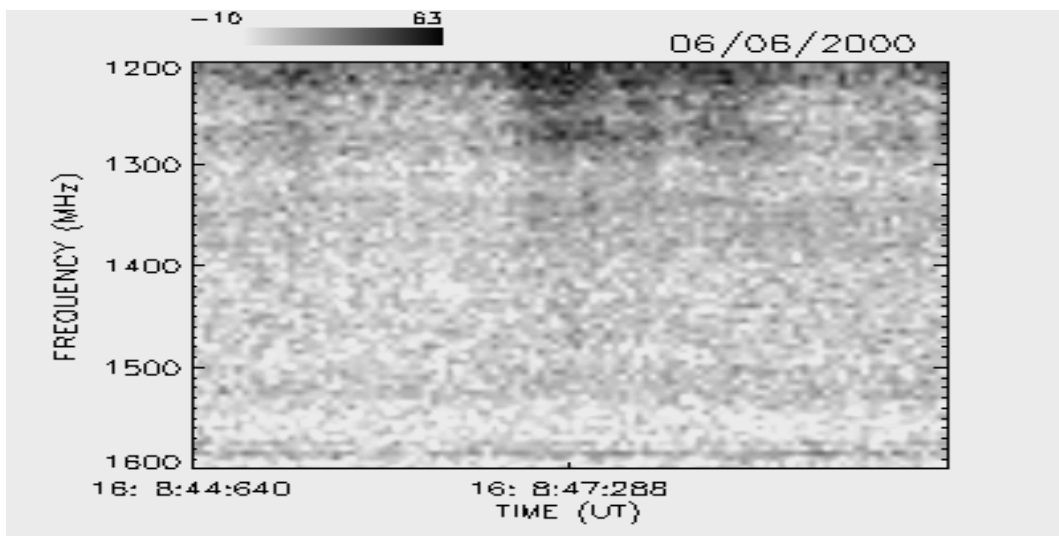
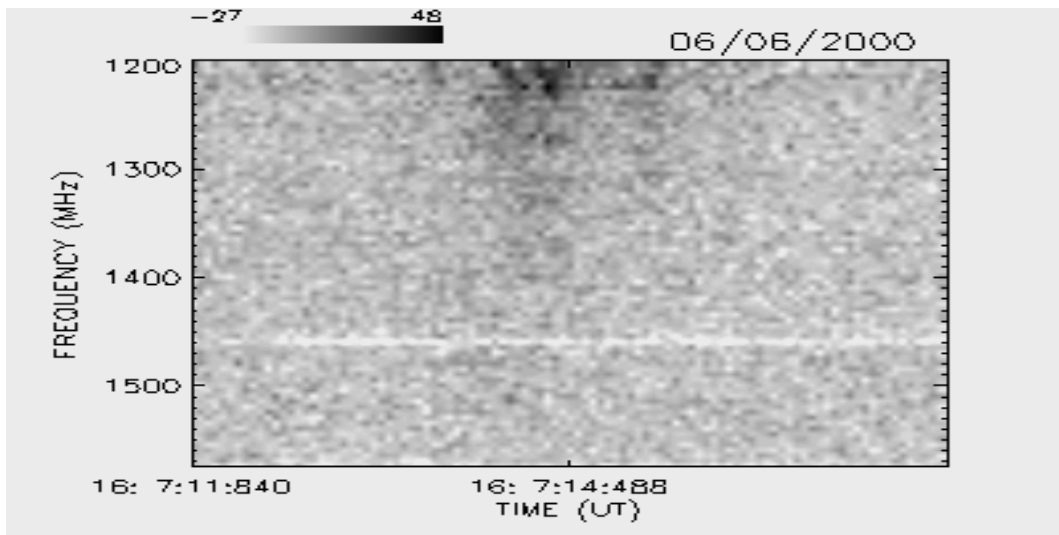
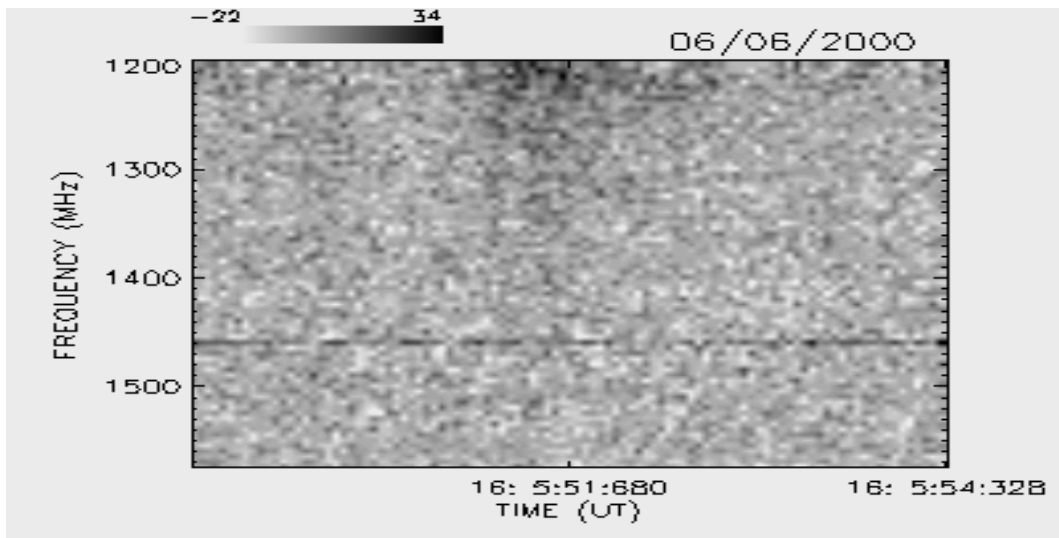
JUNHO / 2000



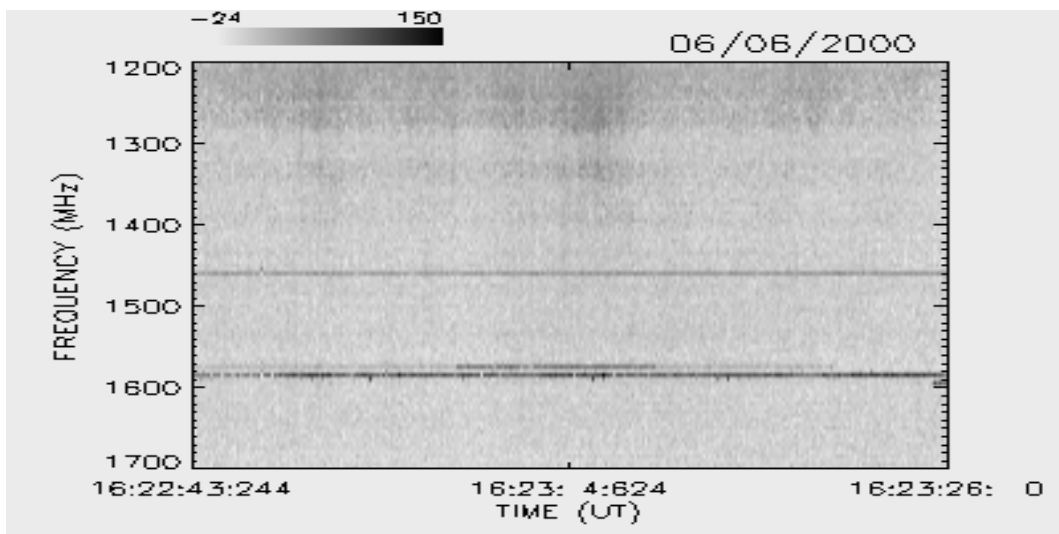
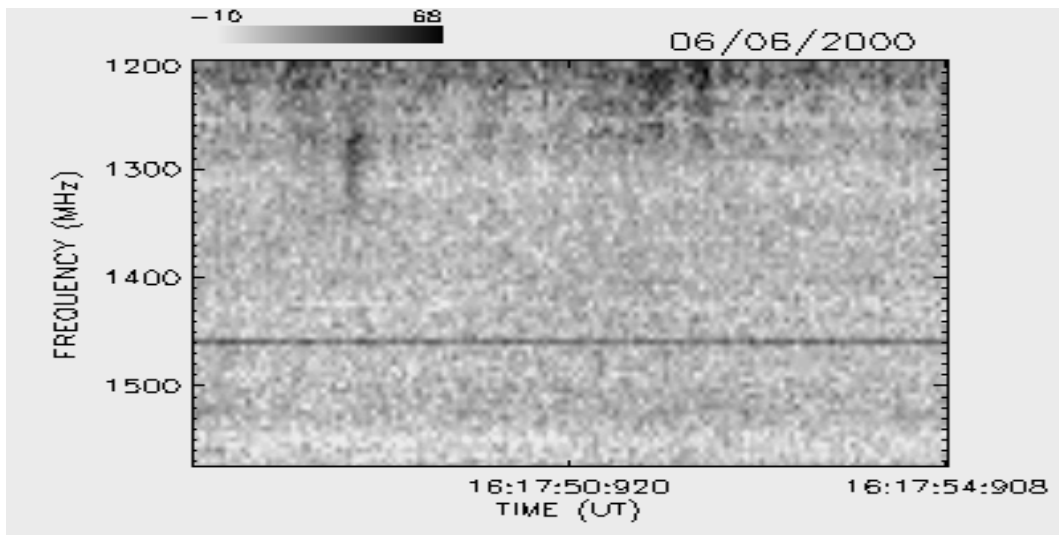
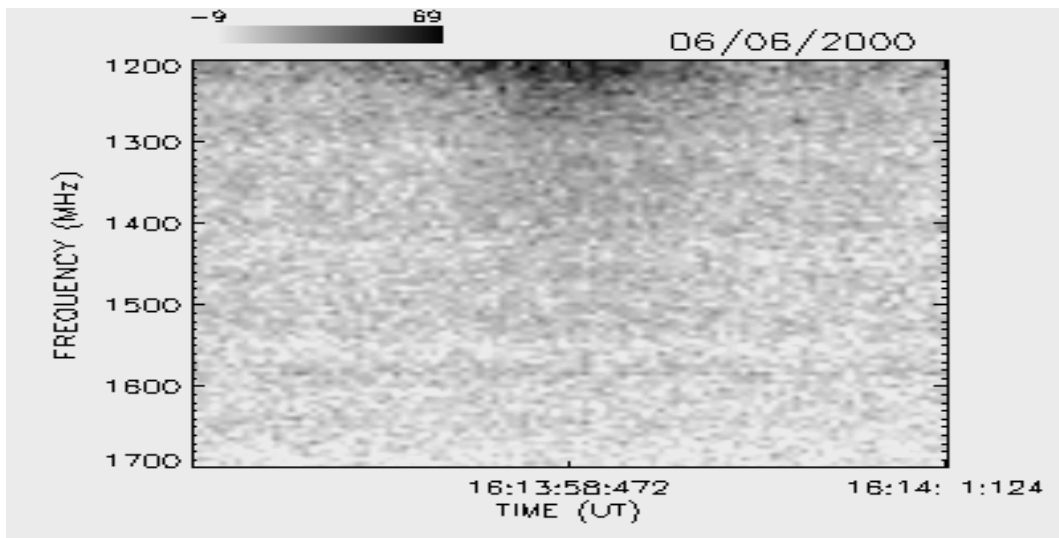
JUNHO / 2000



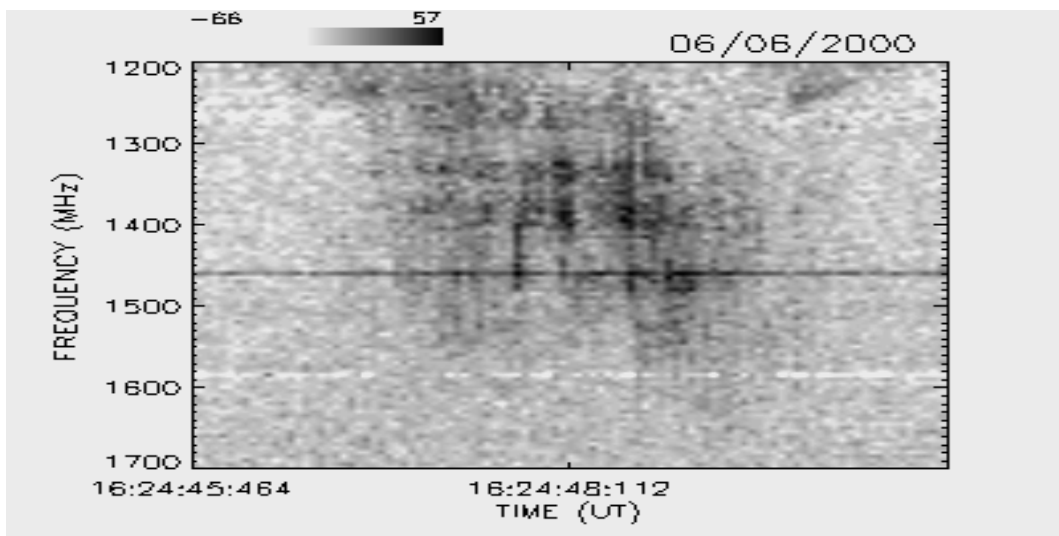
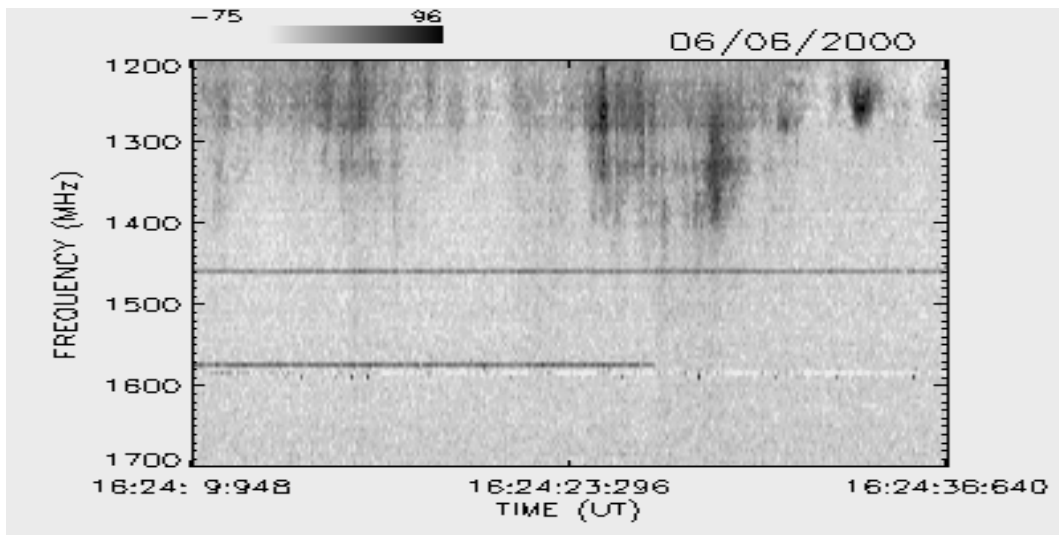
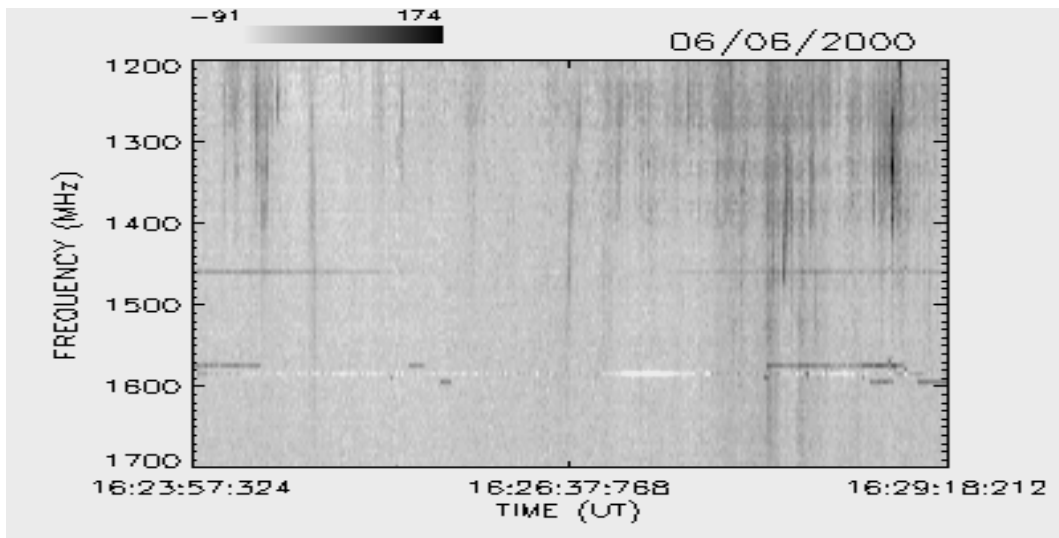
JUNHO / 2000



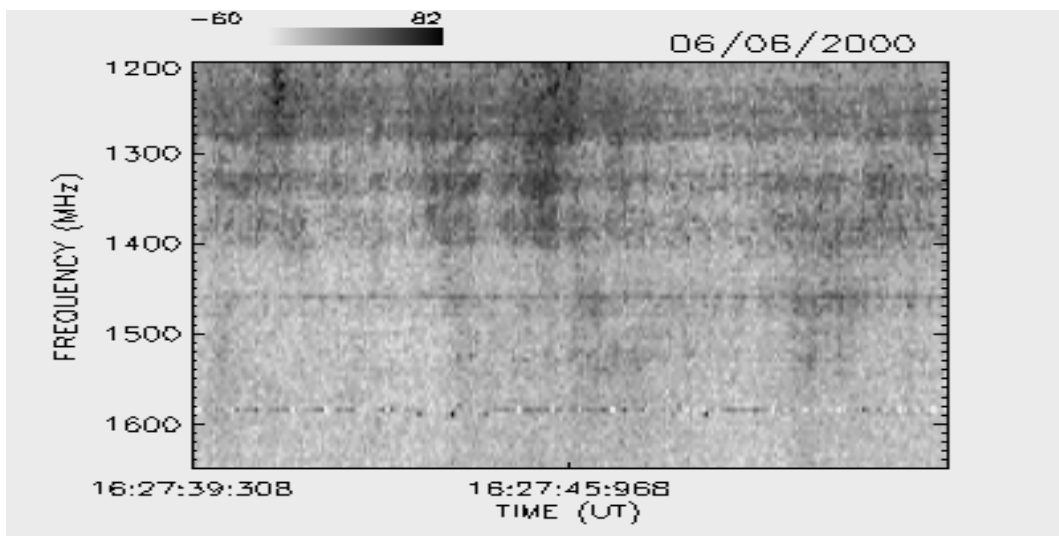
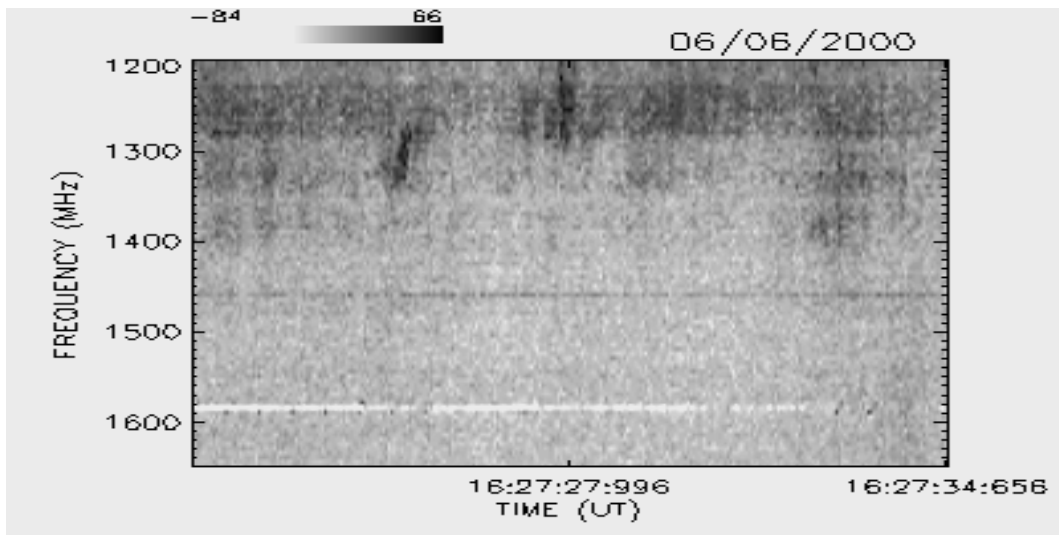
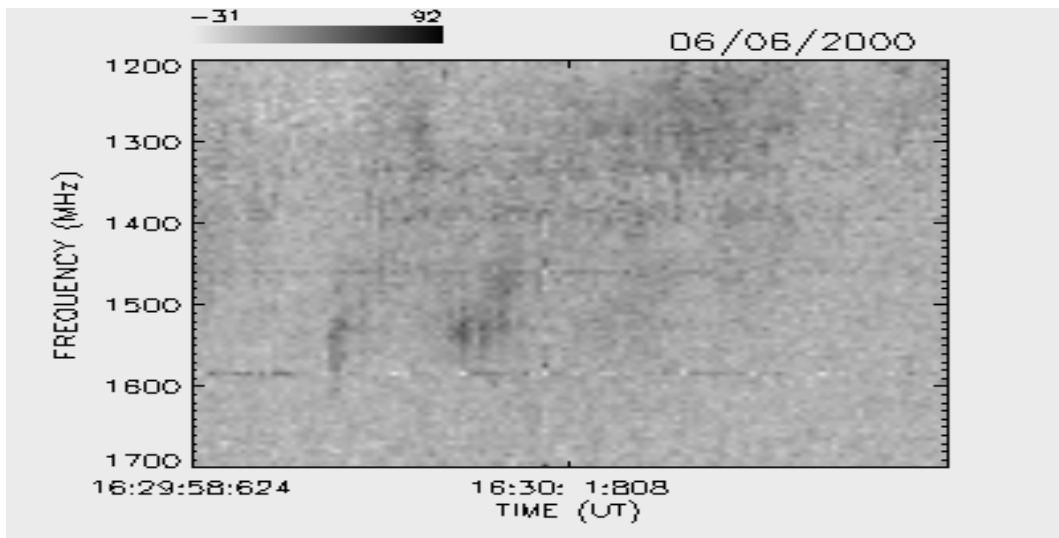
JUNHO / 2000



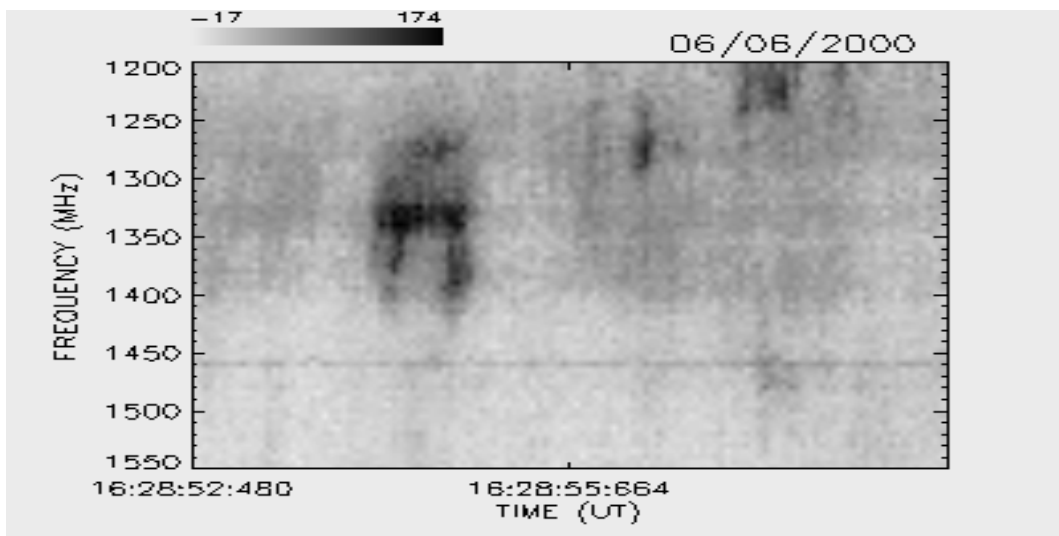
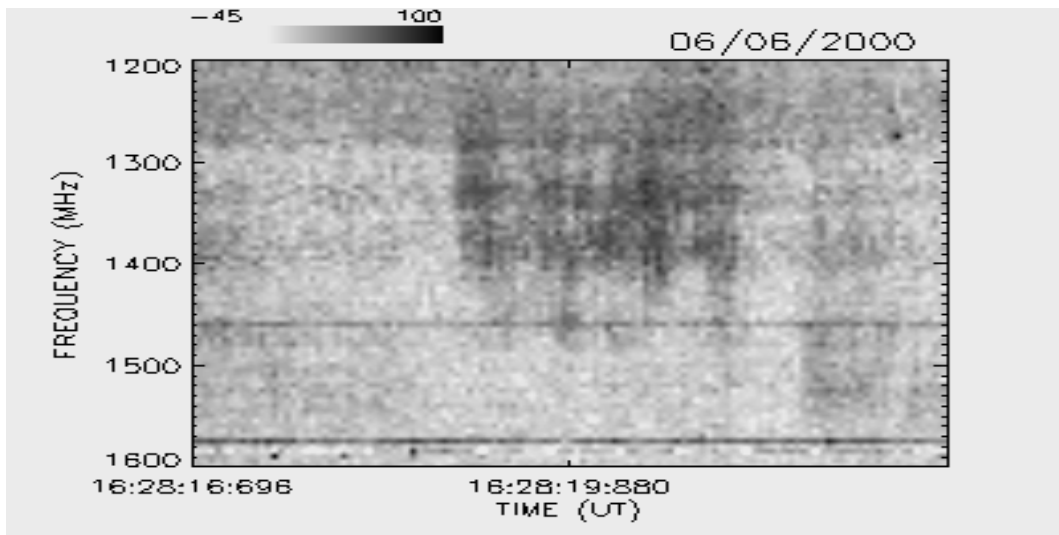
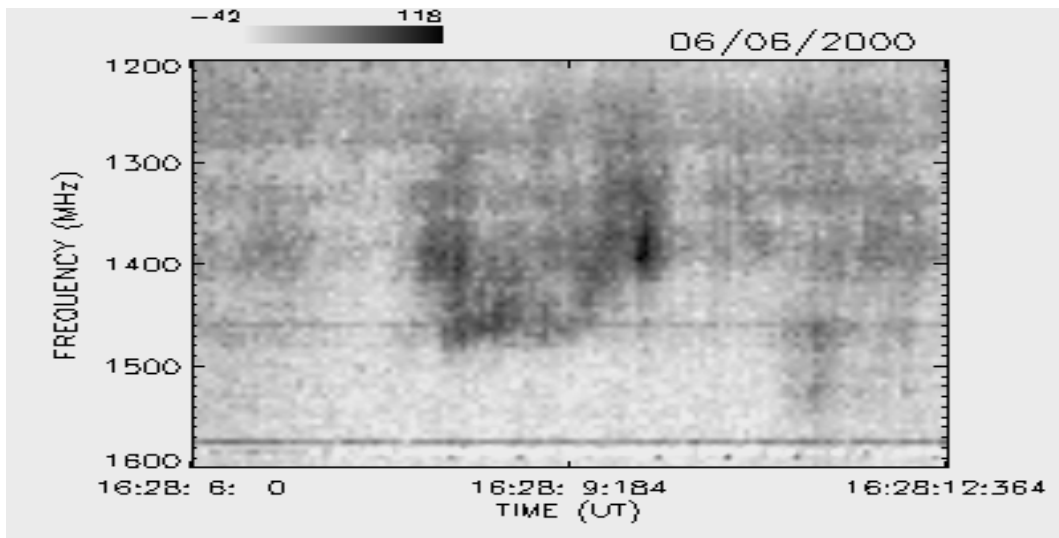
JUNHO / 2000



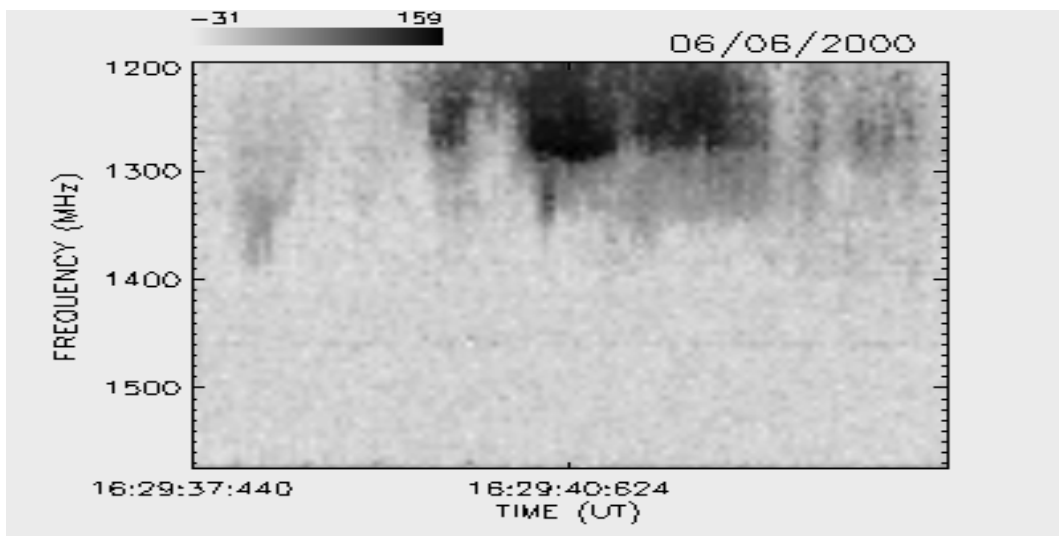
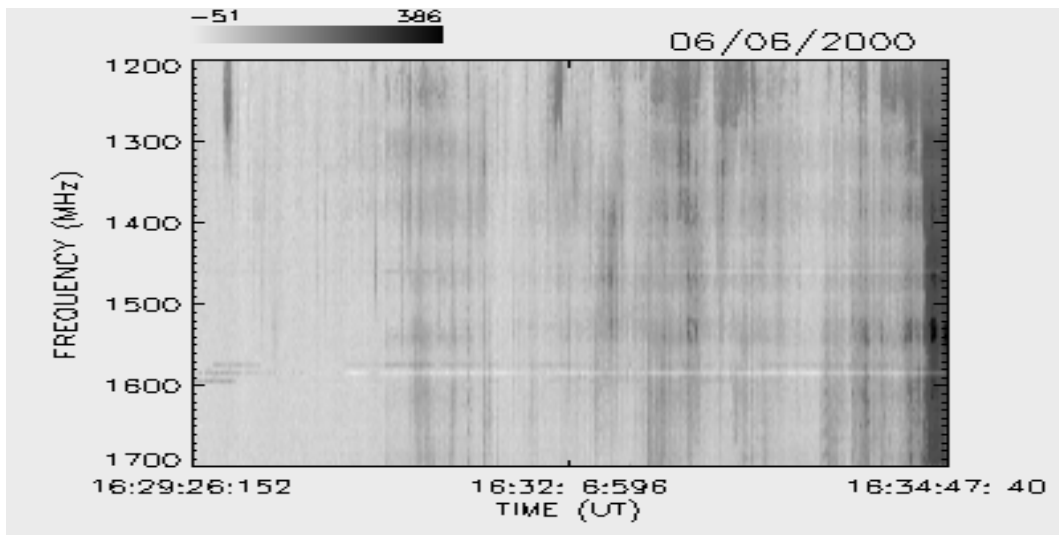
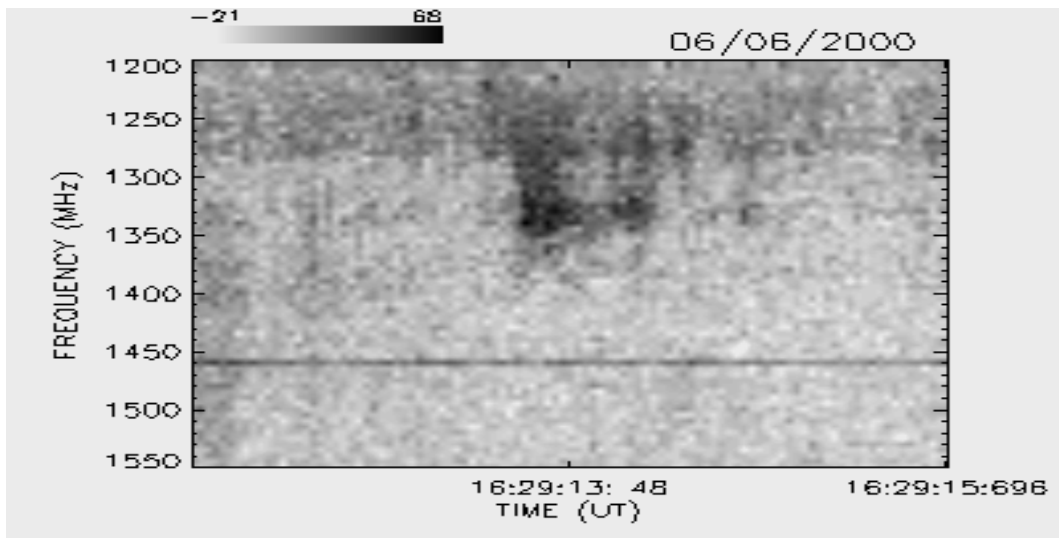
JUNHO / 2000



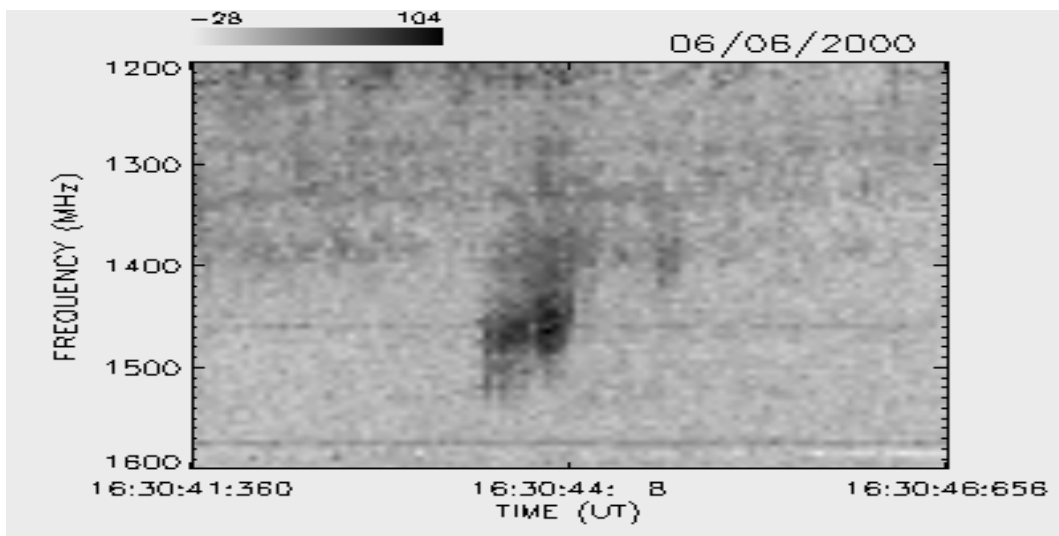
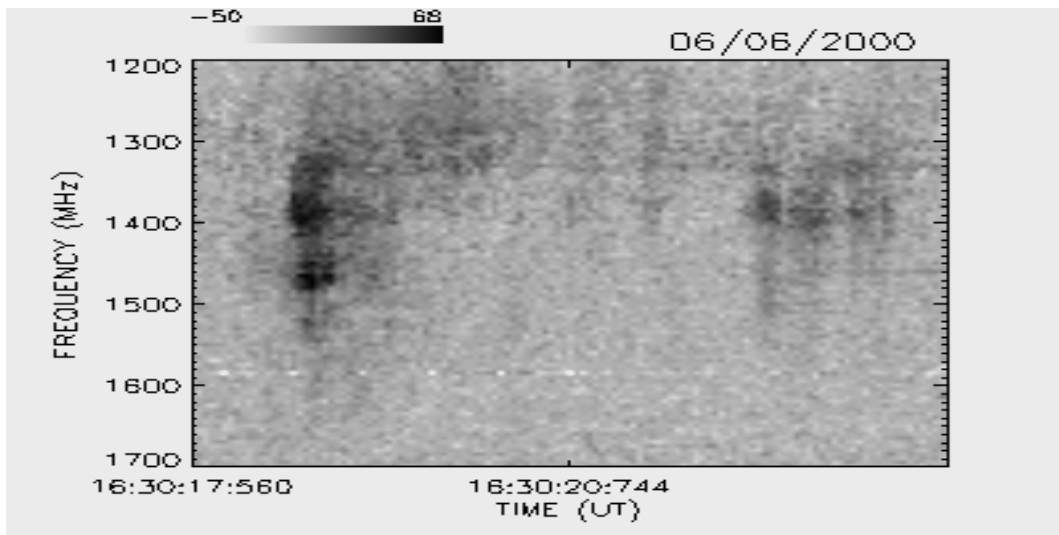
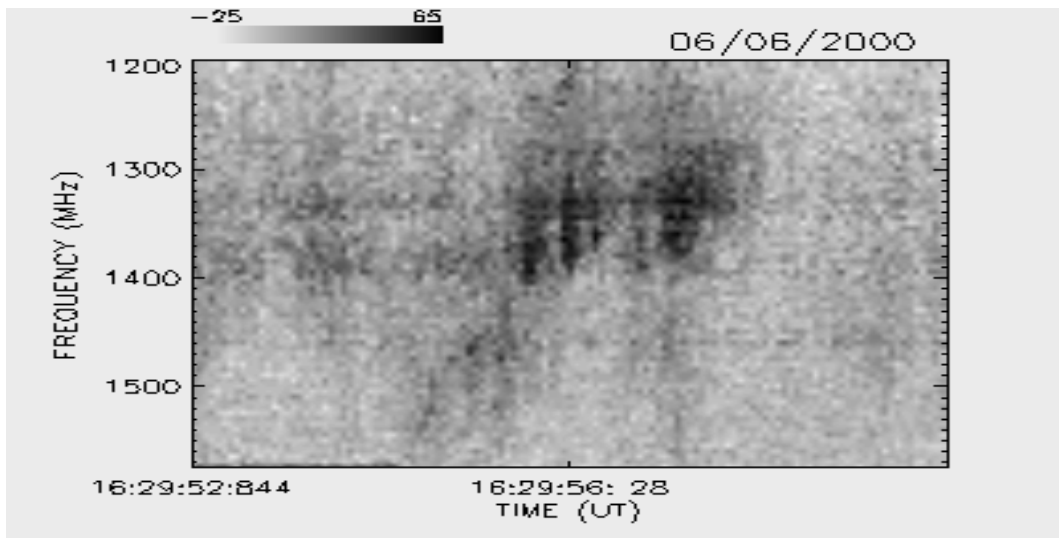
JUNHO / 2000



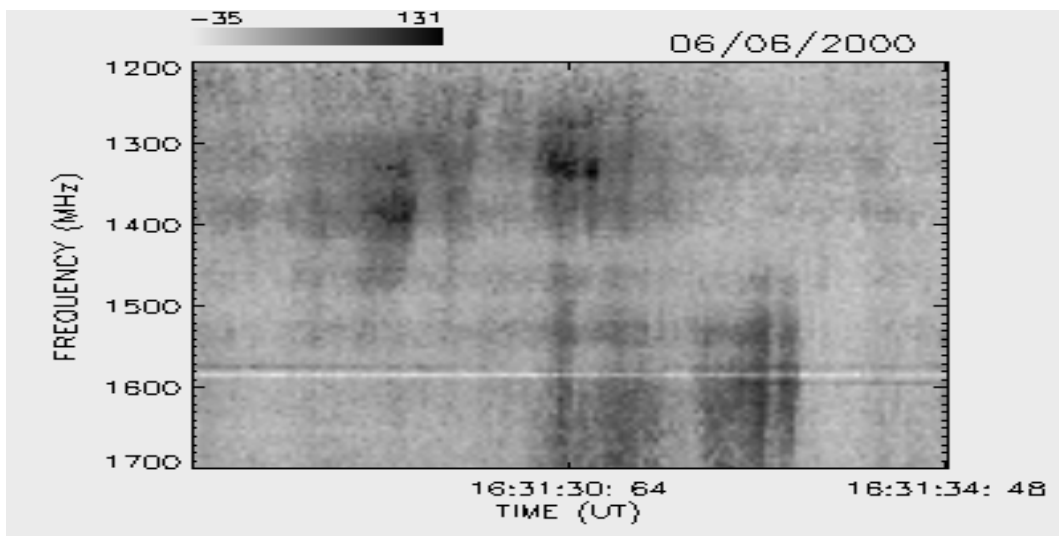
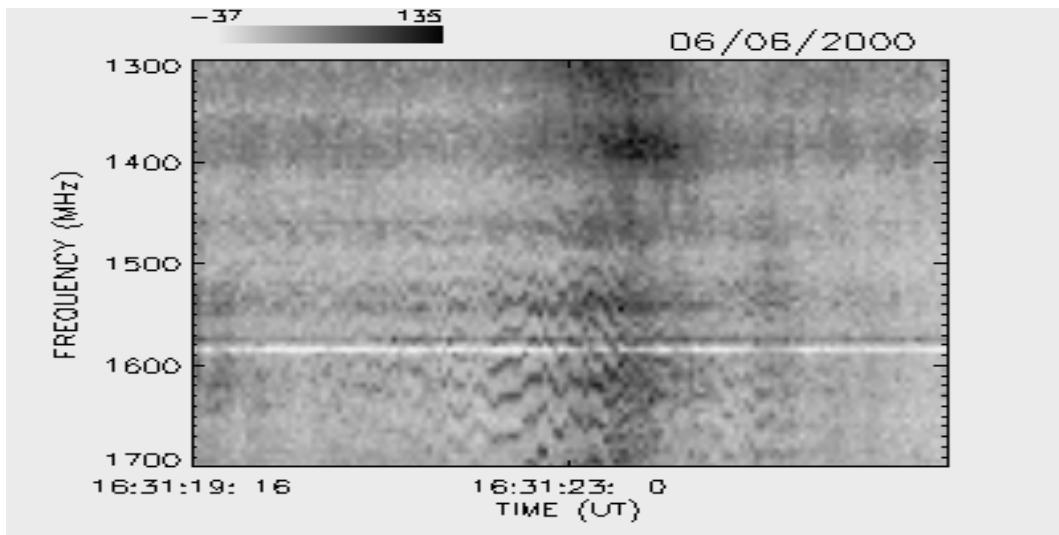
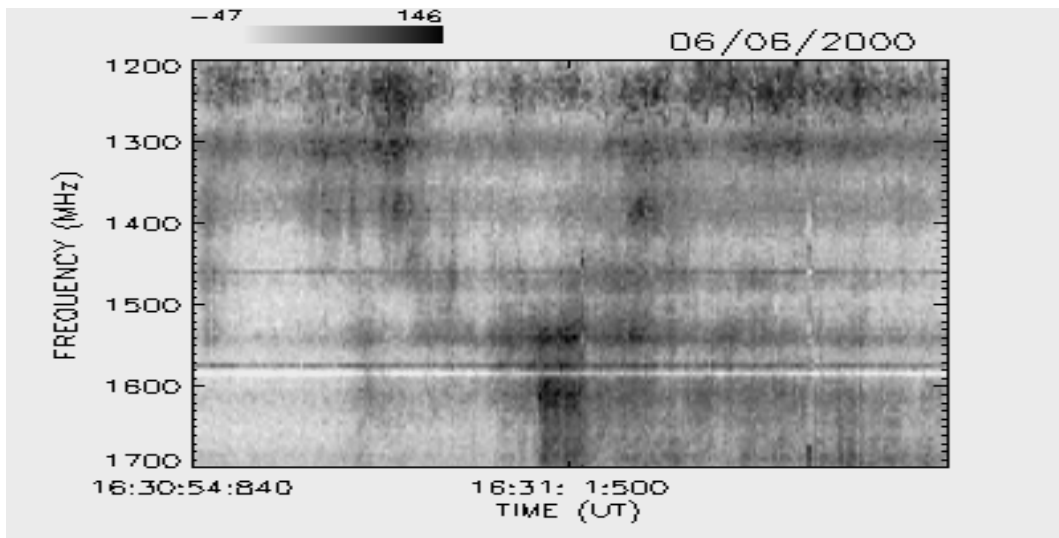
JUNHO / 2000



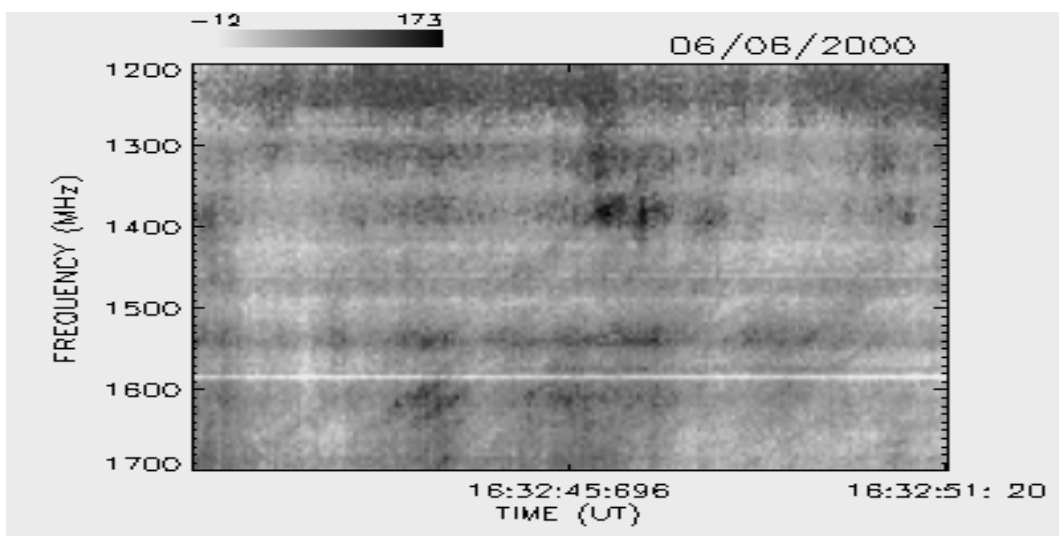
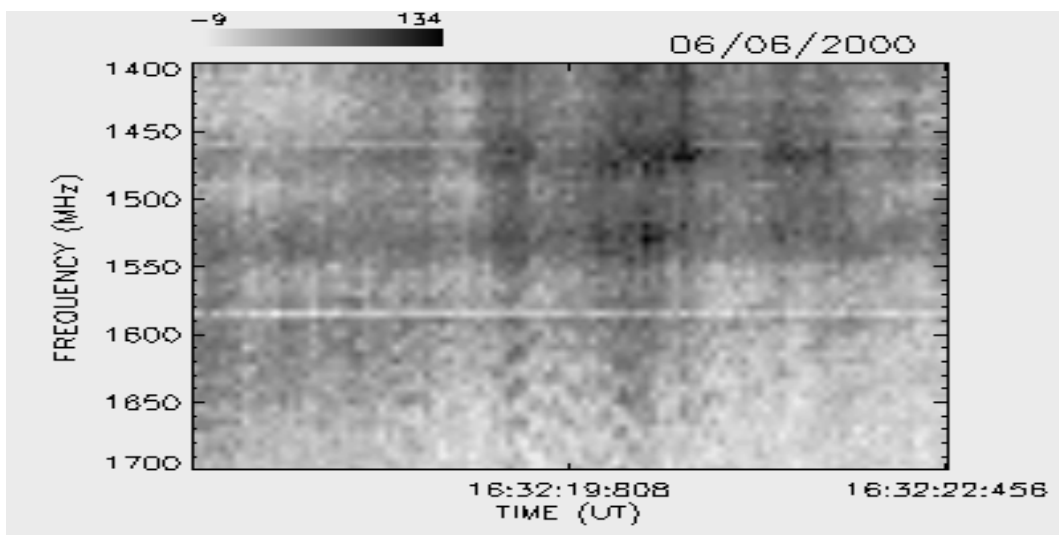
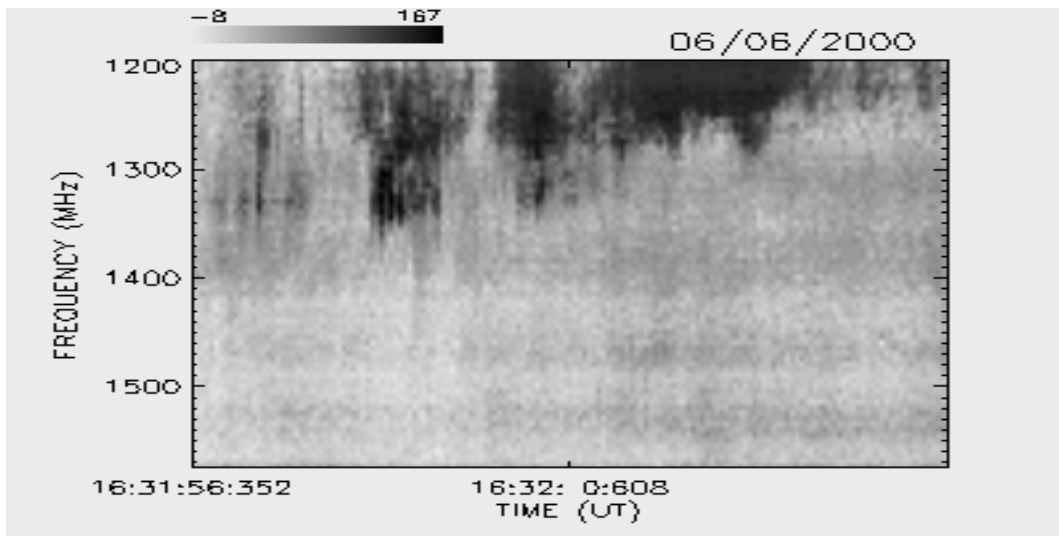
JUNHO / 2000



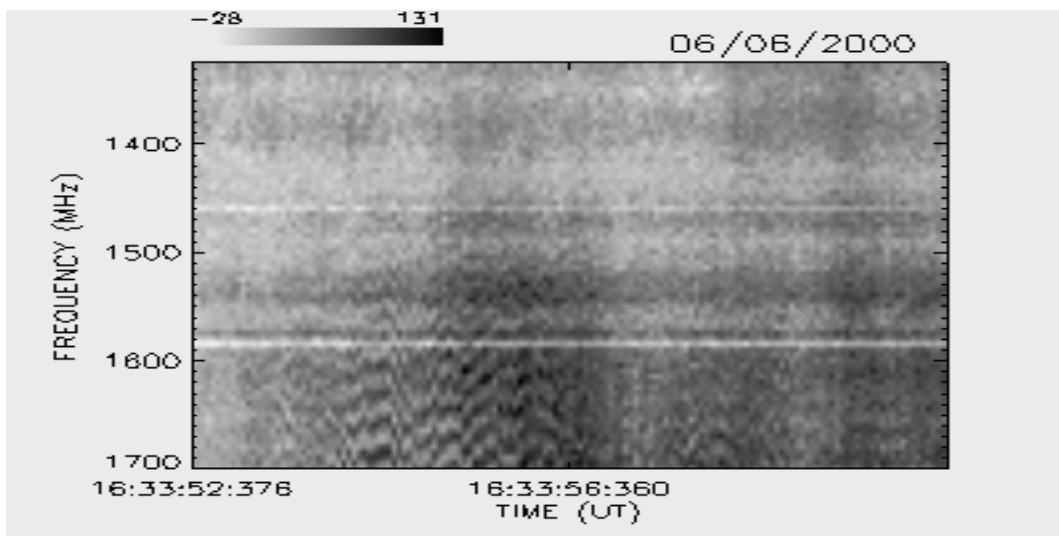
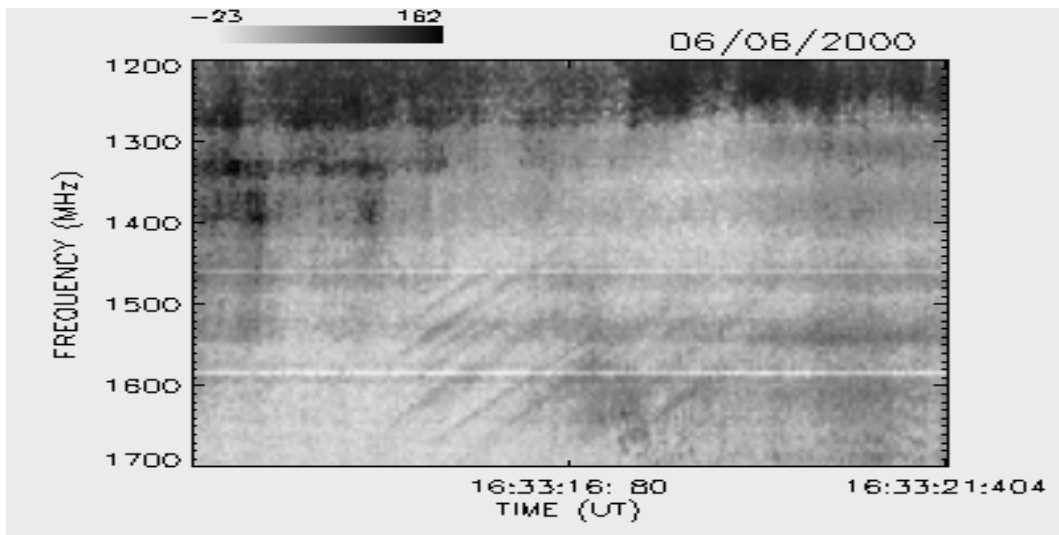
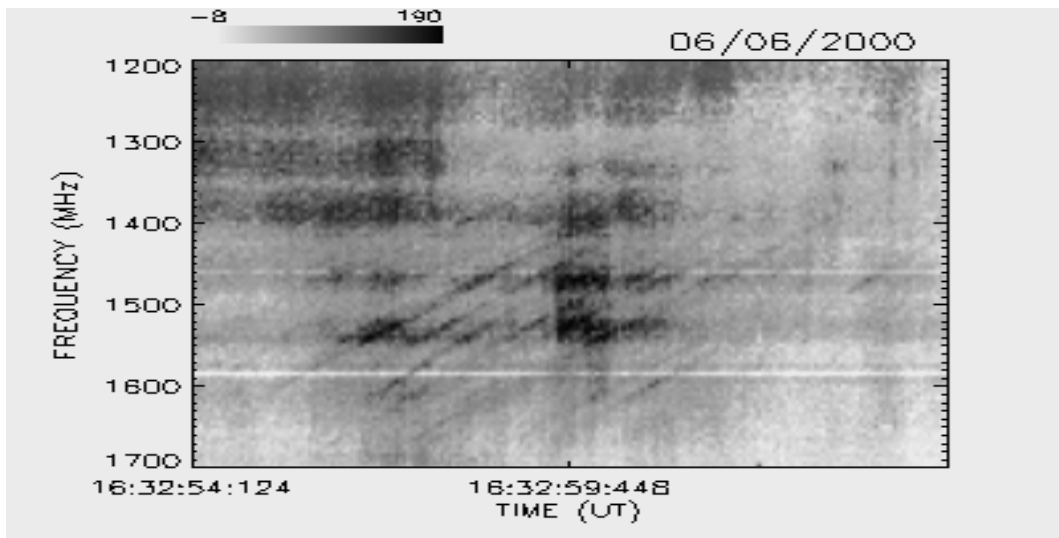
JUNHO / 2000



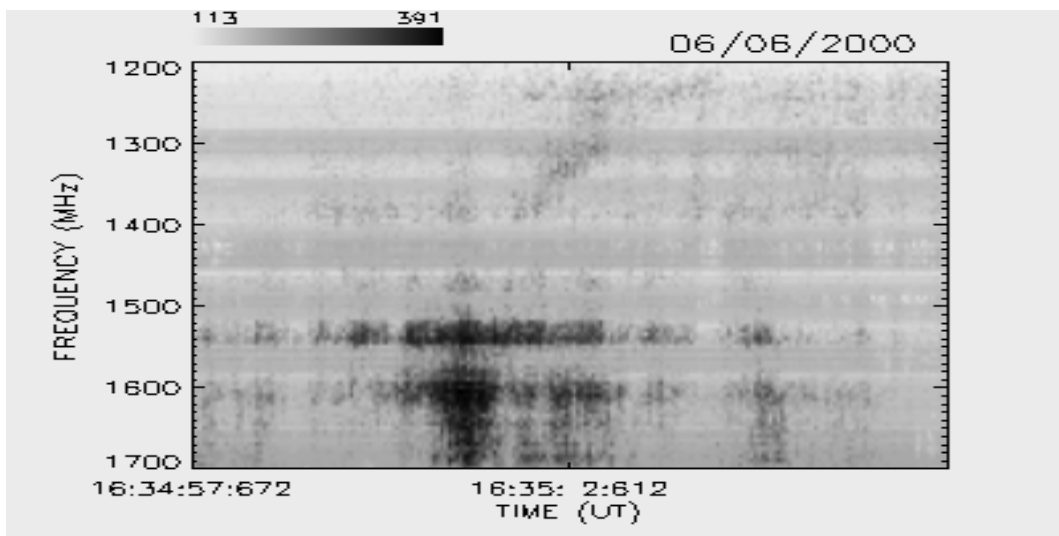
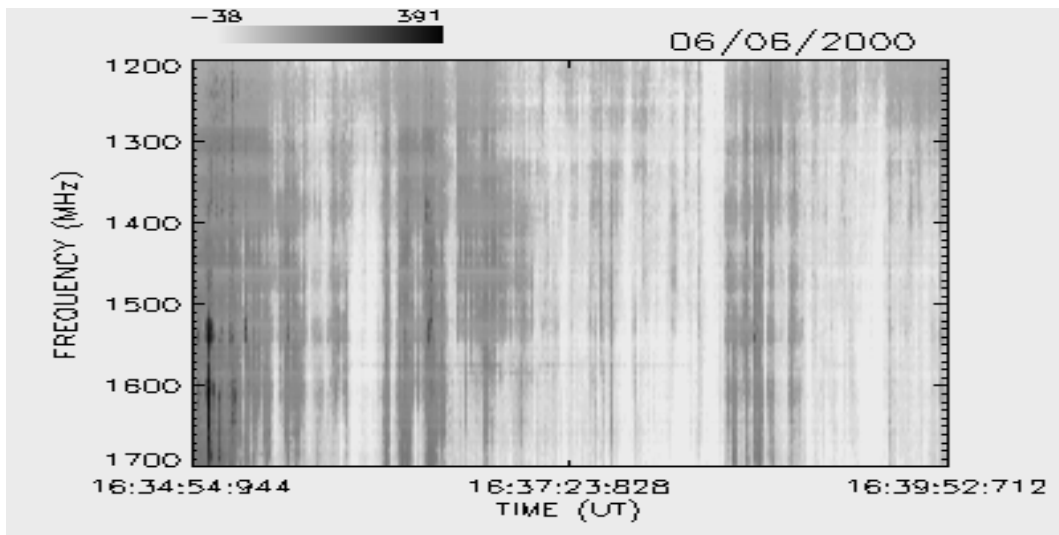
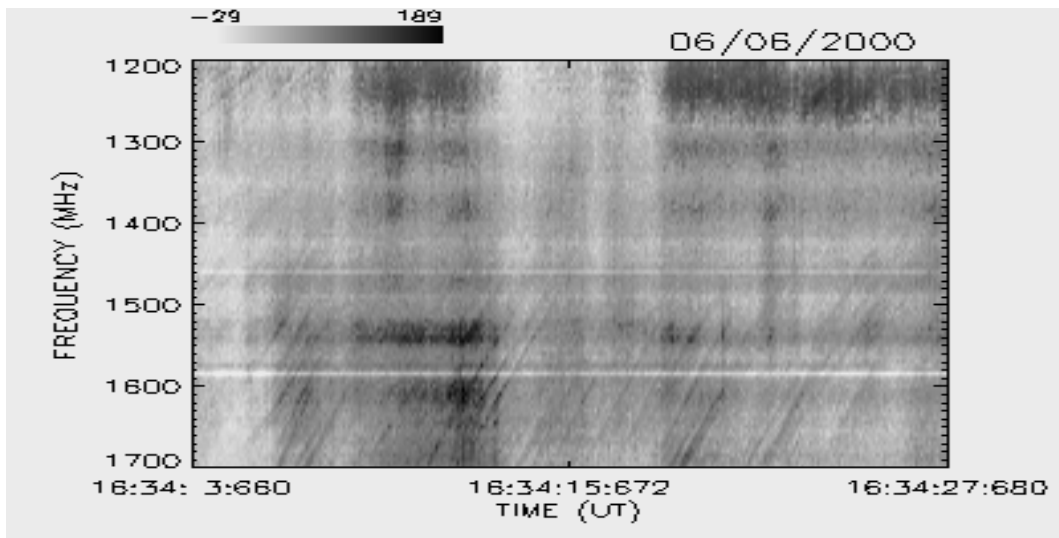
JUNHO / 2000



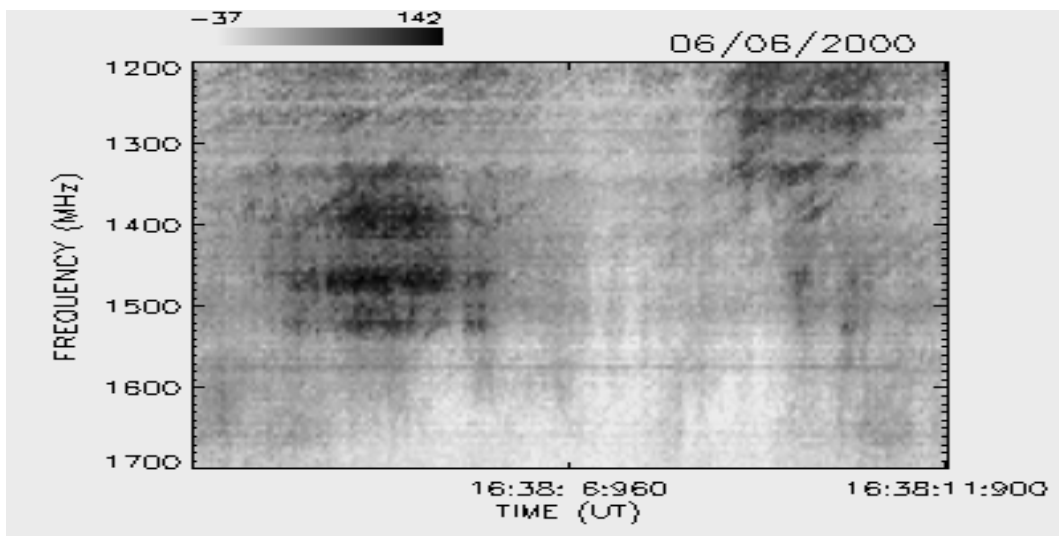
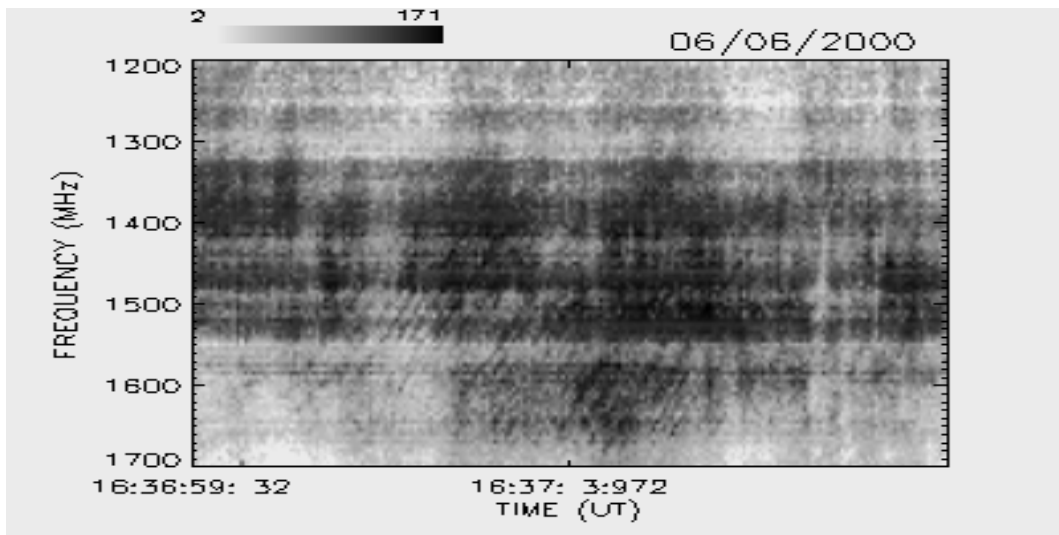
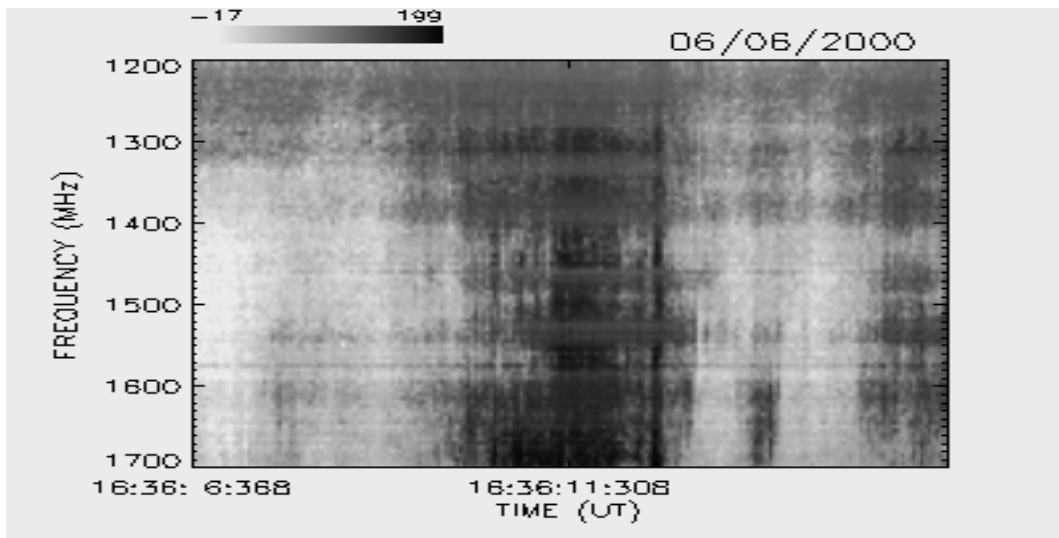
JUNHO / 2000



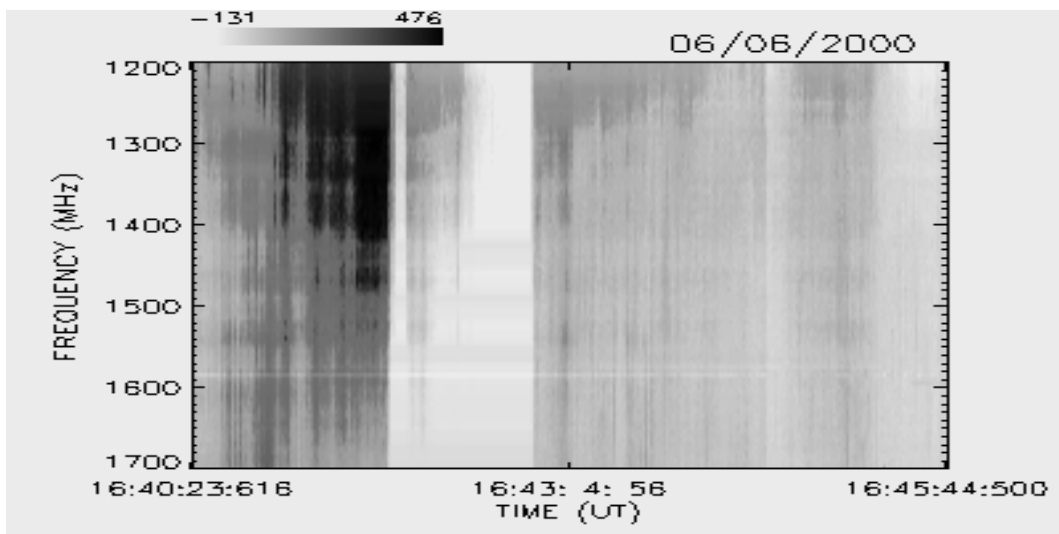
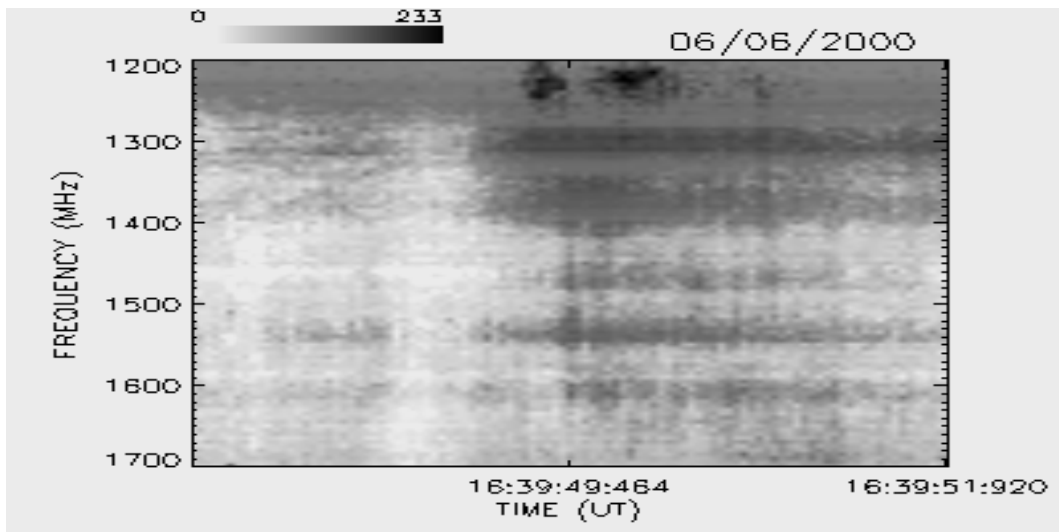
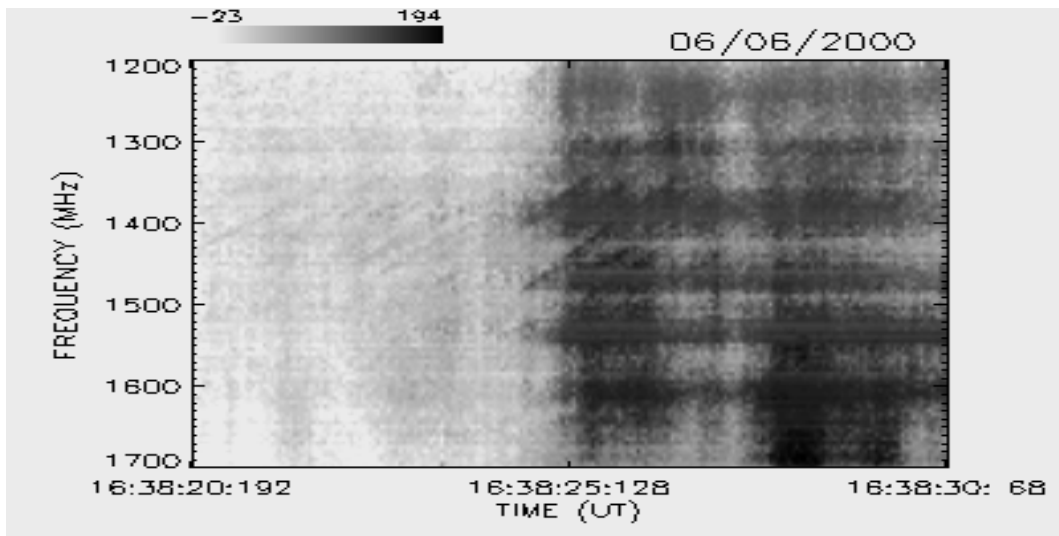
JUNHO / 2000



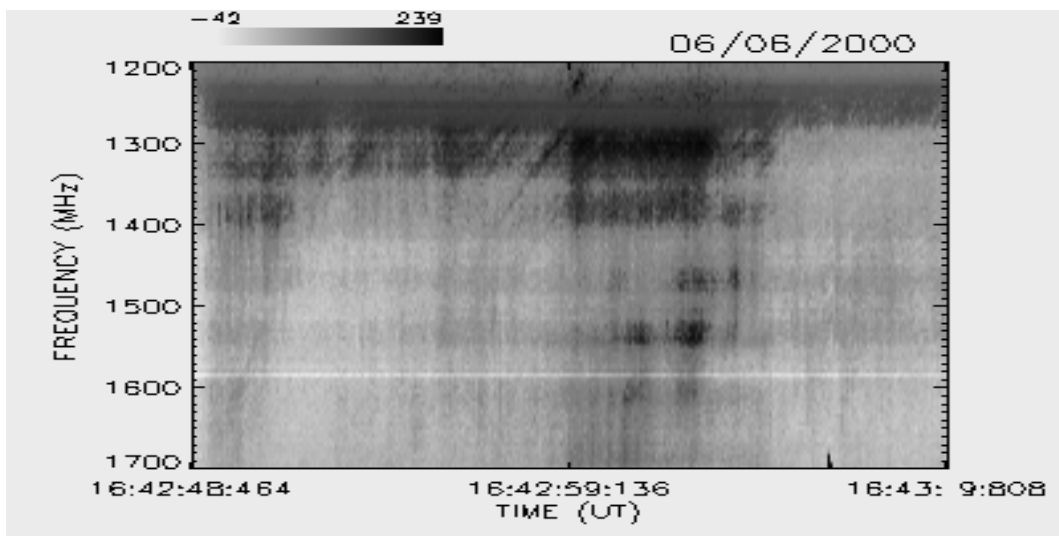
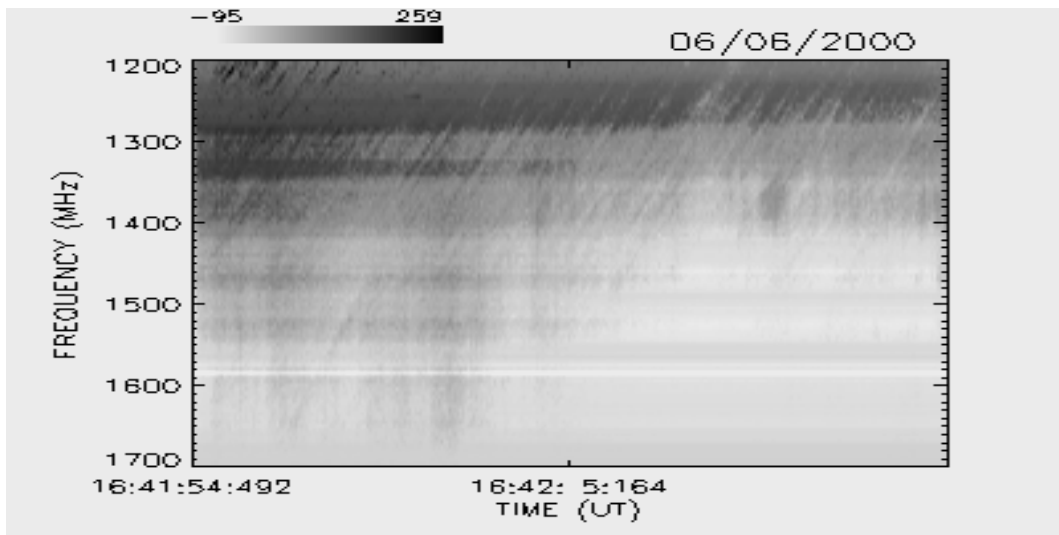
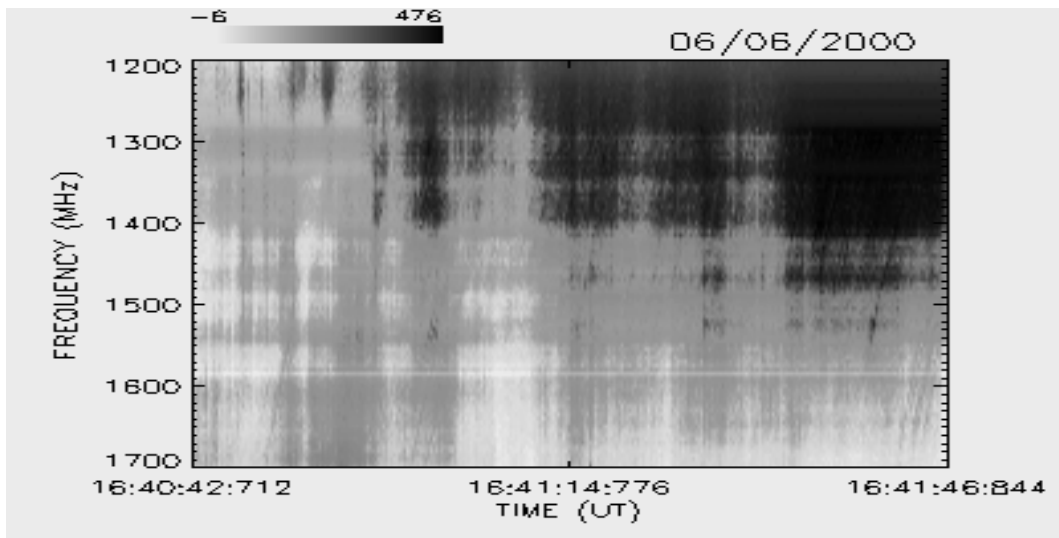
JUNHO / 2000



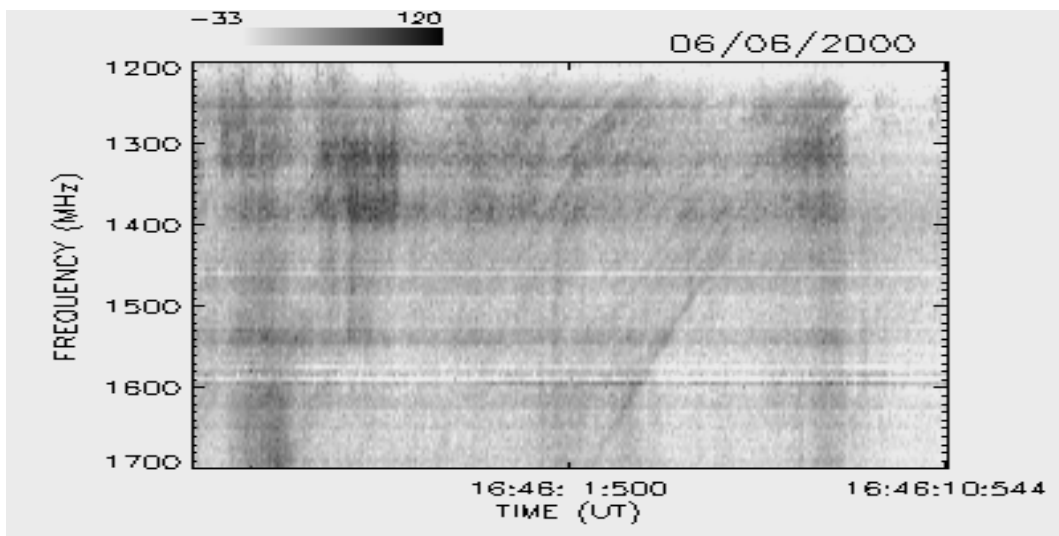
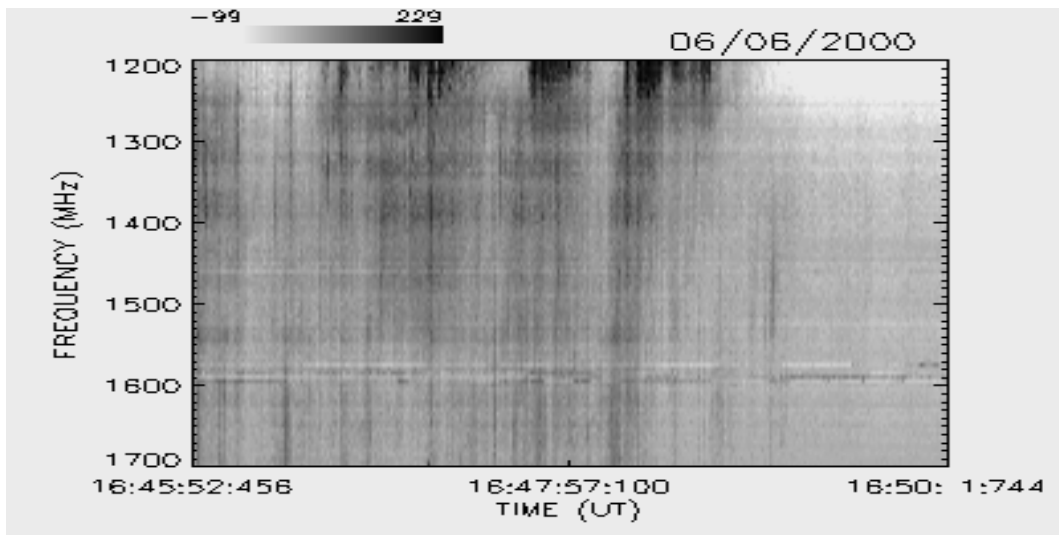
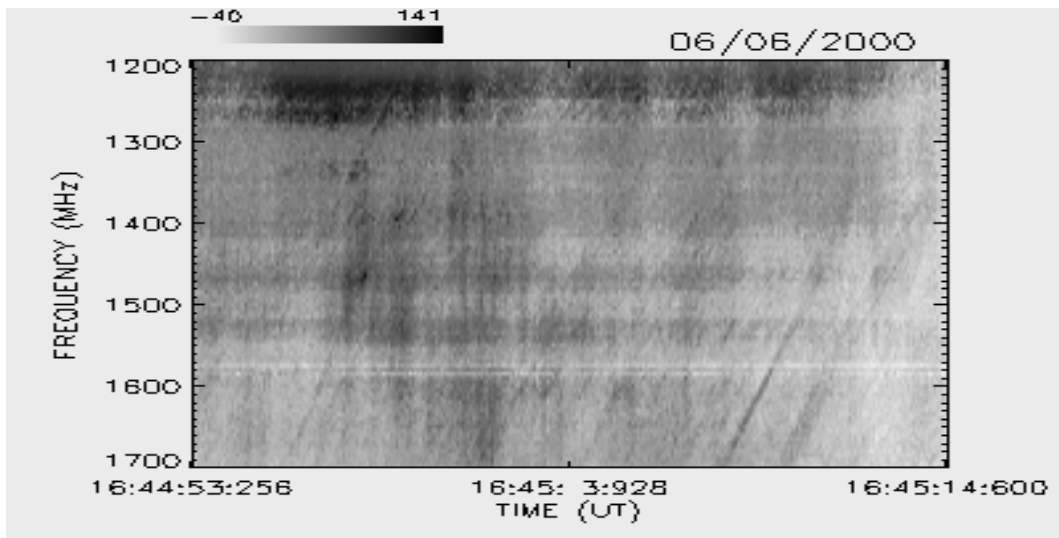
JUNHO / 2000



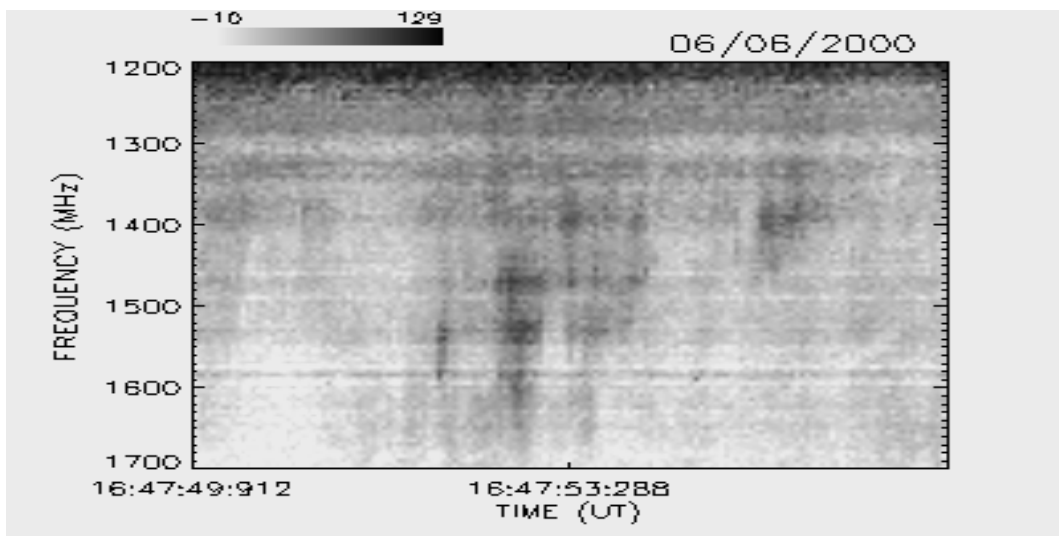
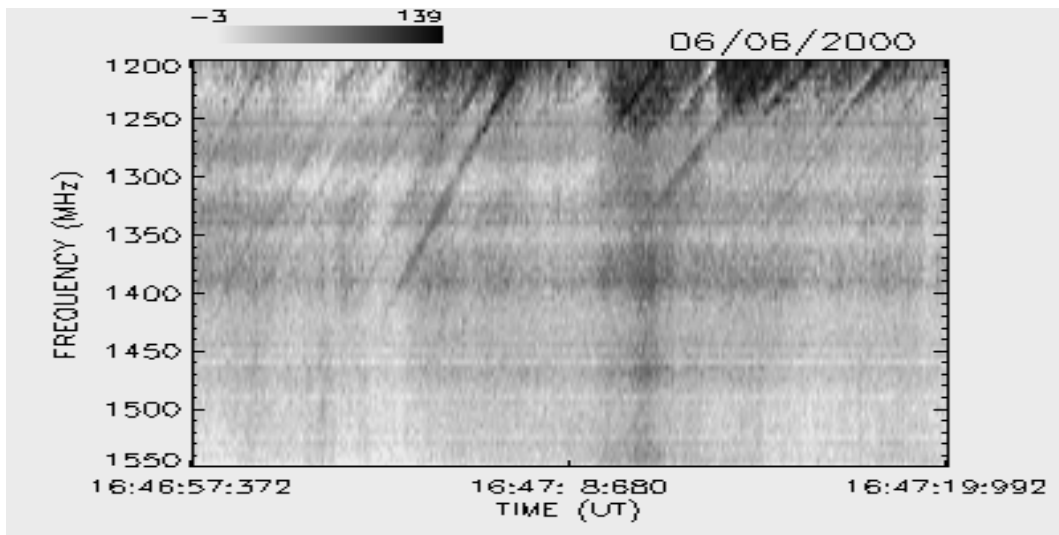
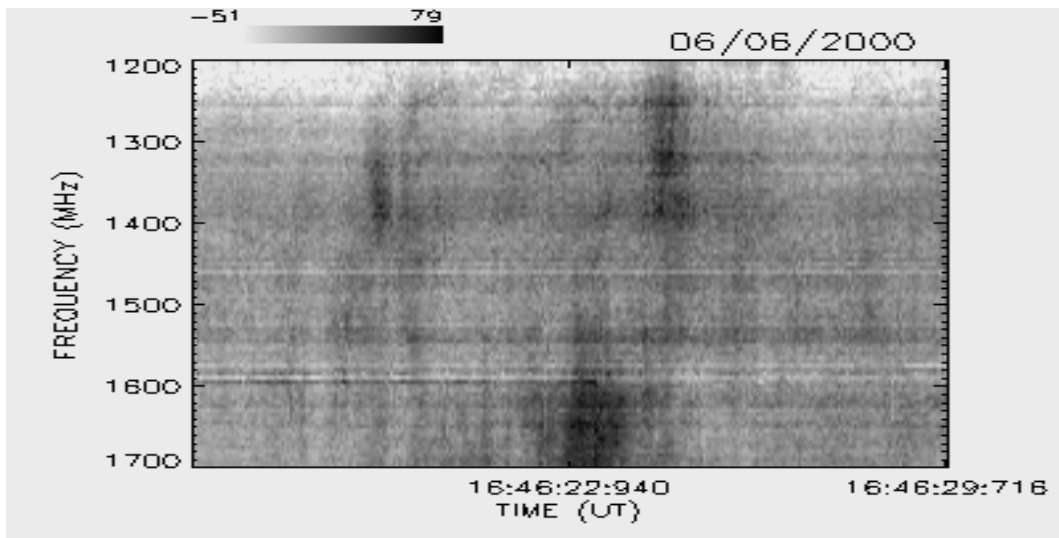
JUNHO / 2000



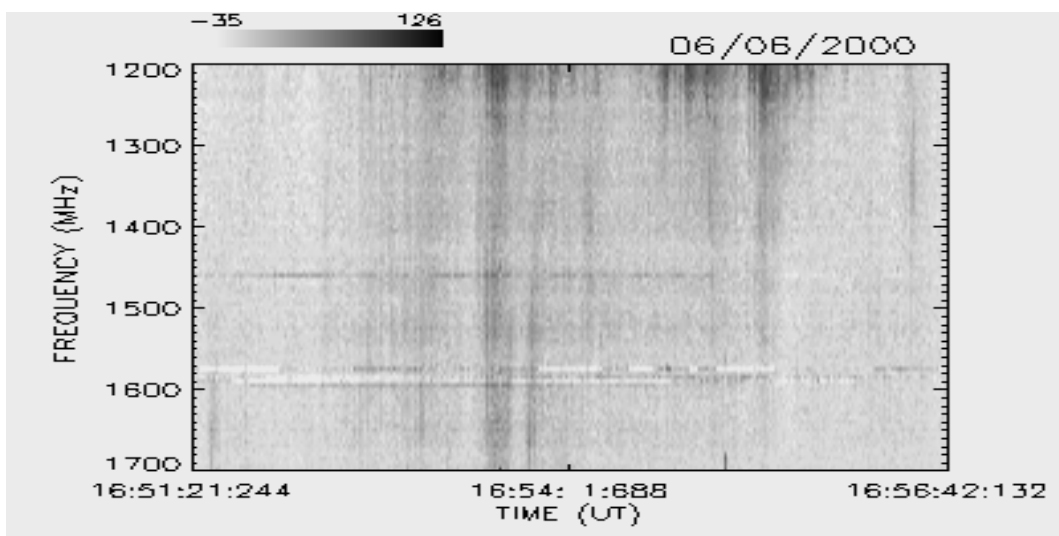
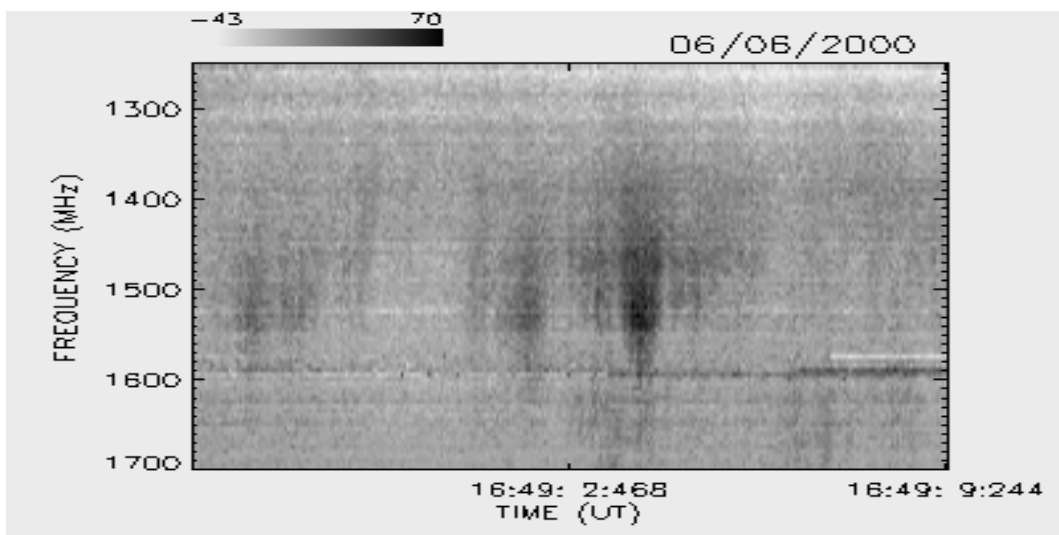
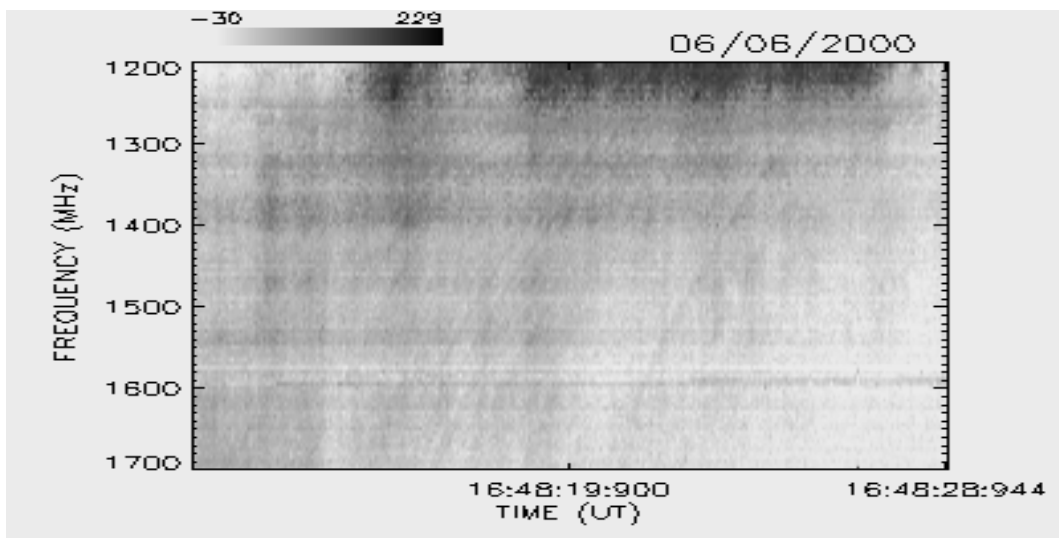
JUNHO / 2000



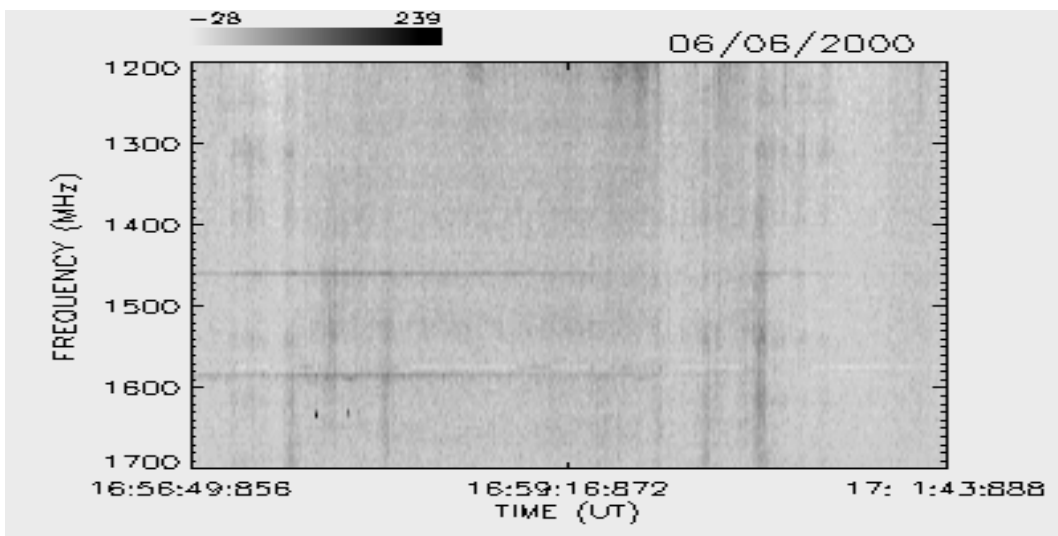
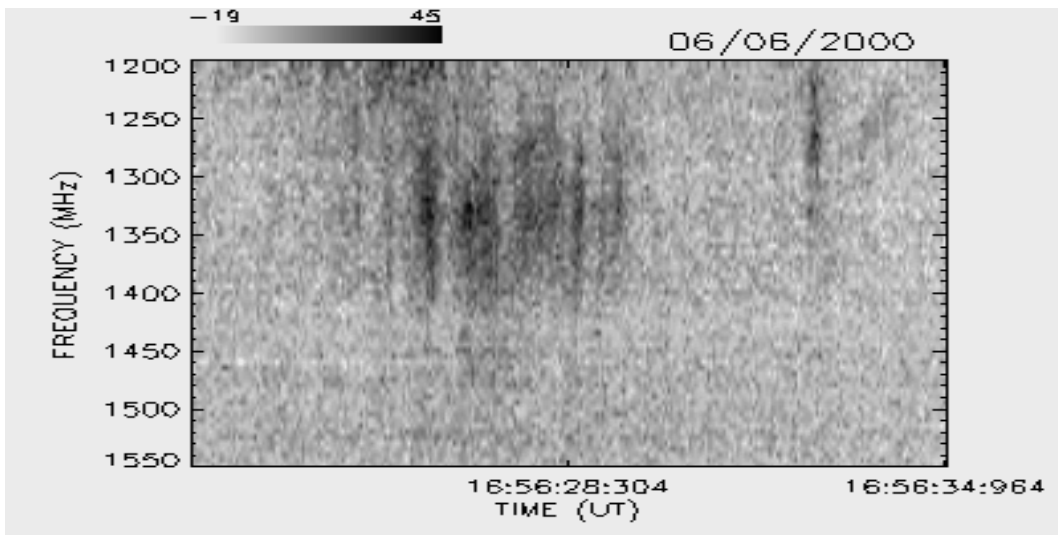
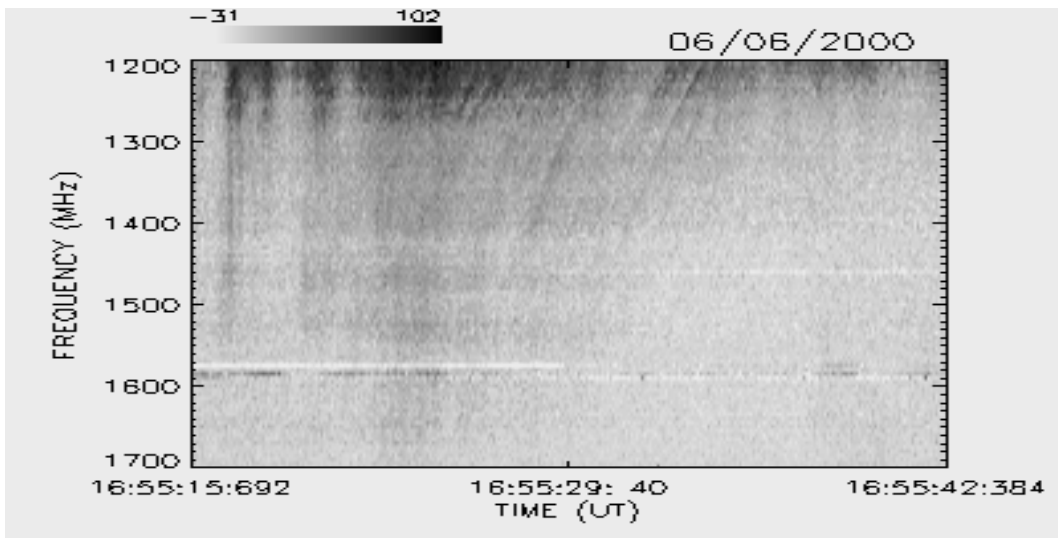
JUNHO / 2000



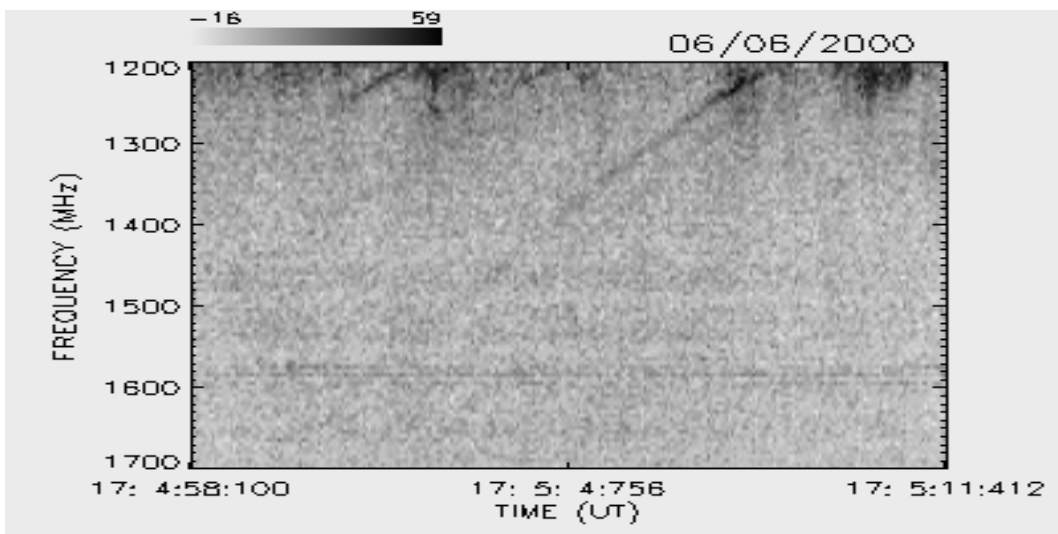
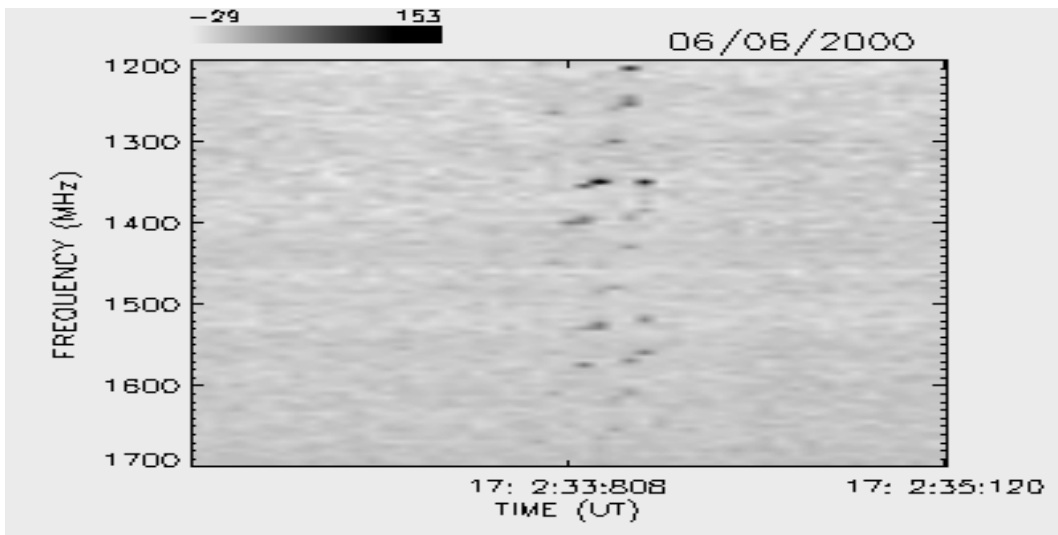
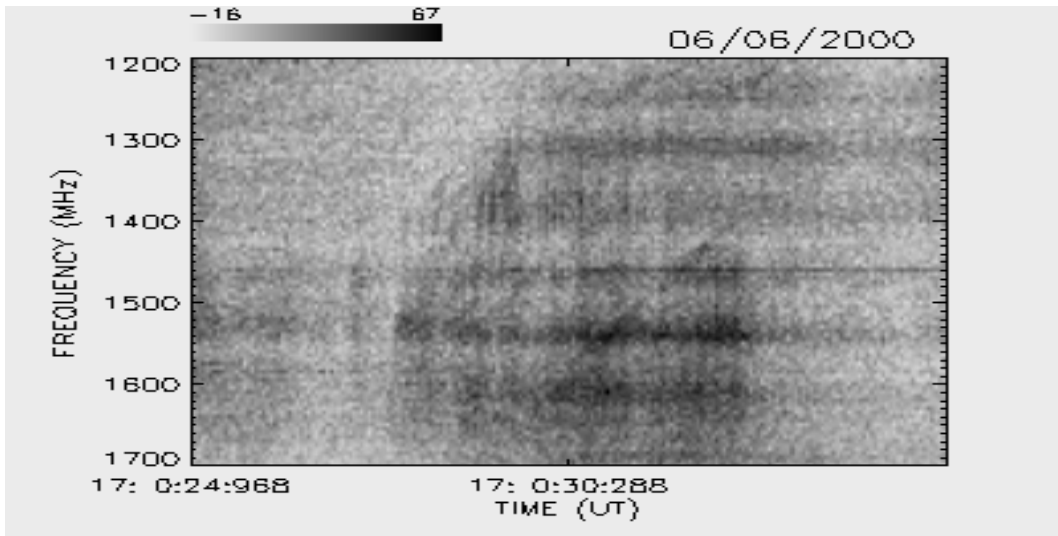
JUNHO / 2000



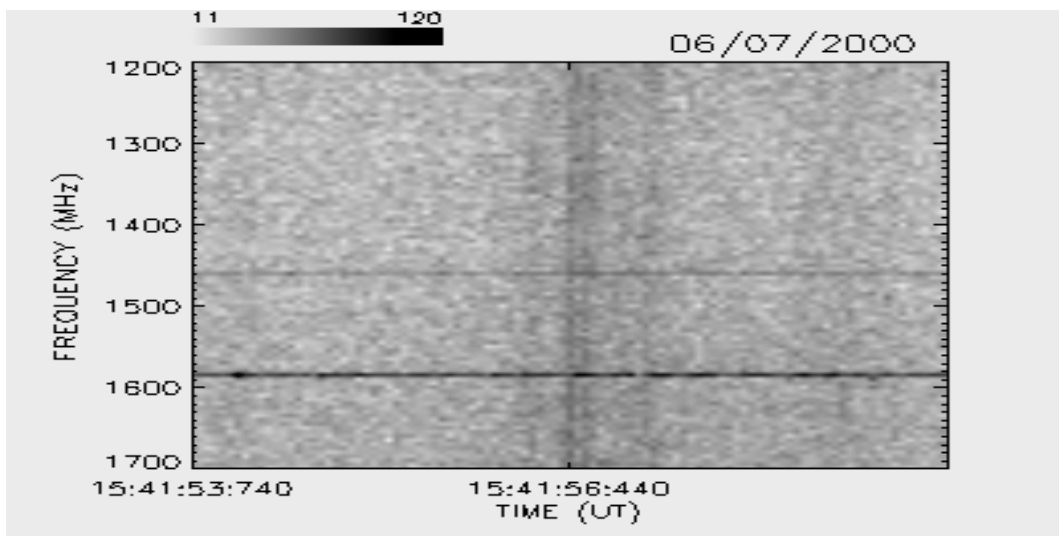
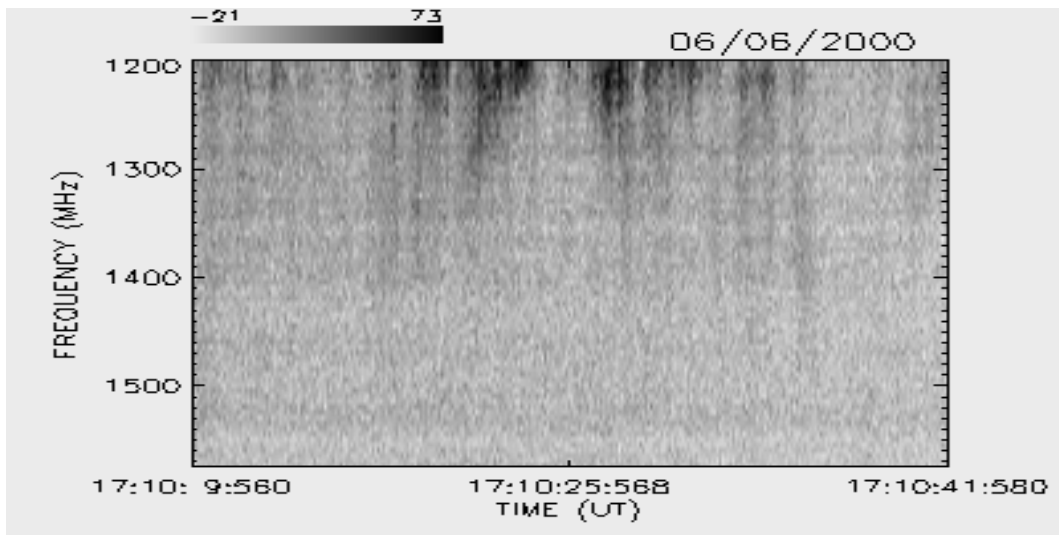
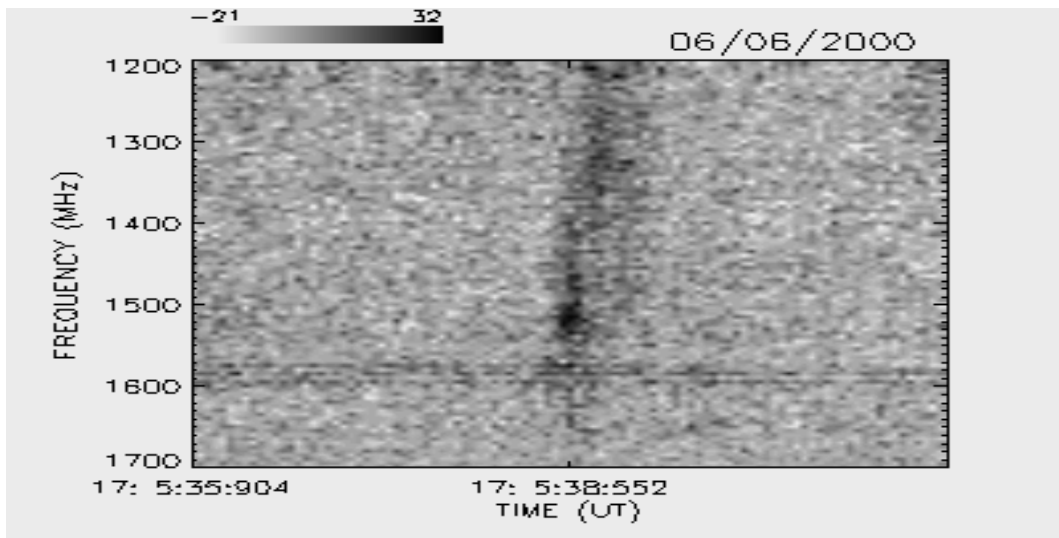
JUNHO / 2000



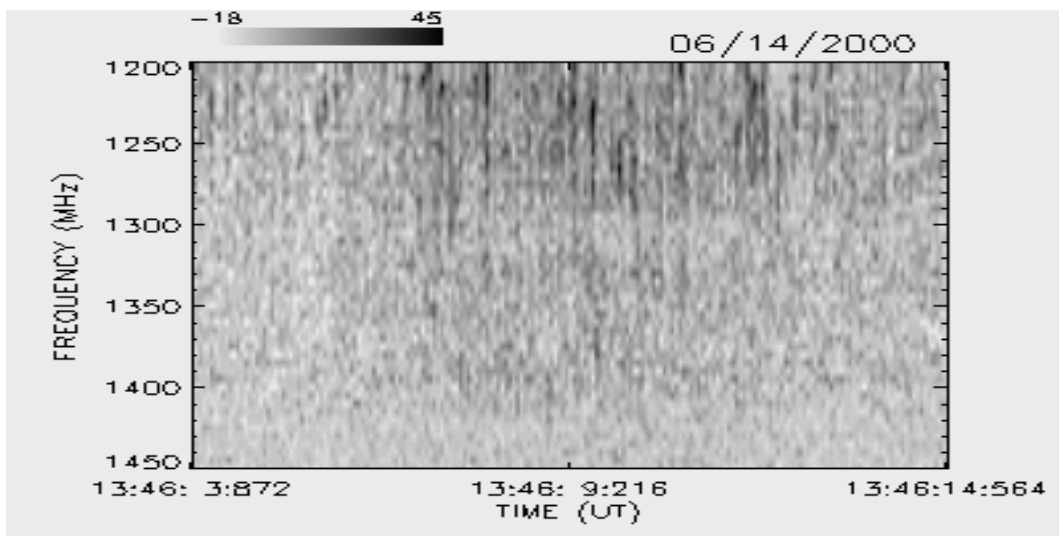
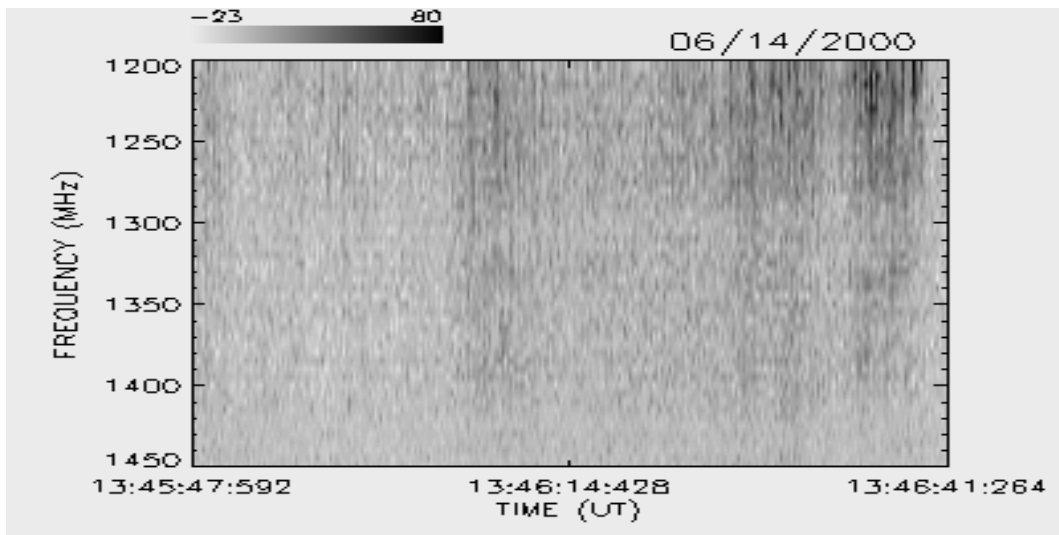
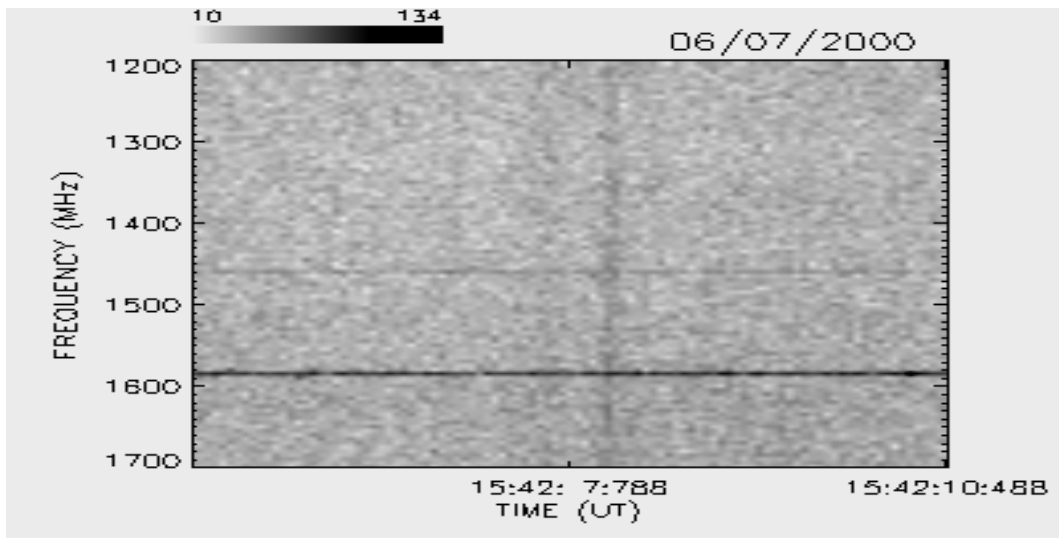
JUNHO / 2000



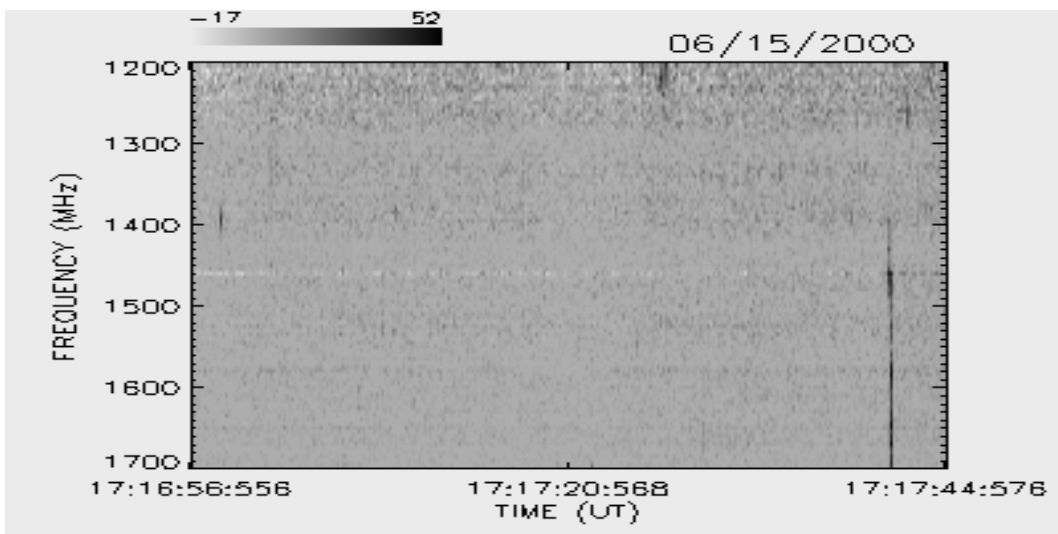
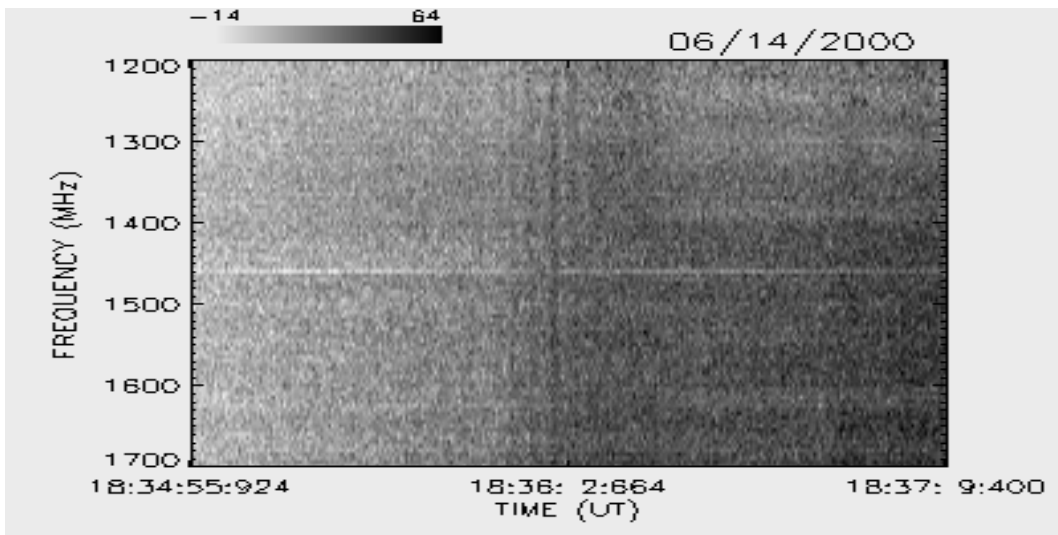
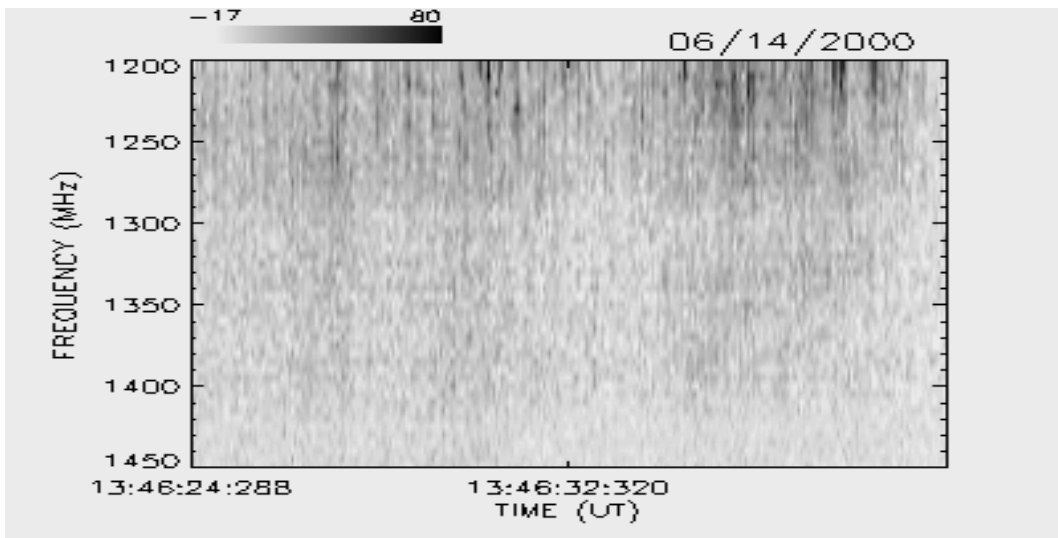
JUNHO / 2000



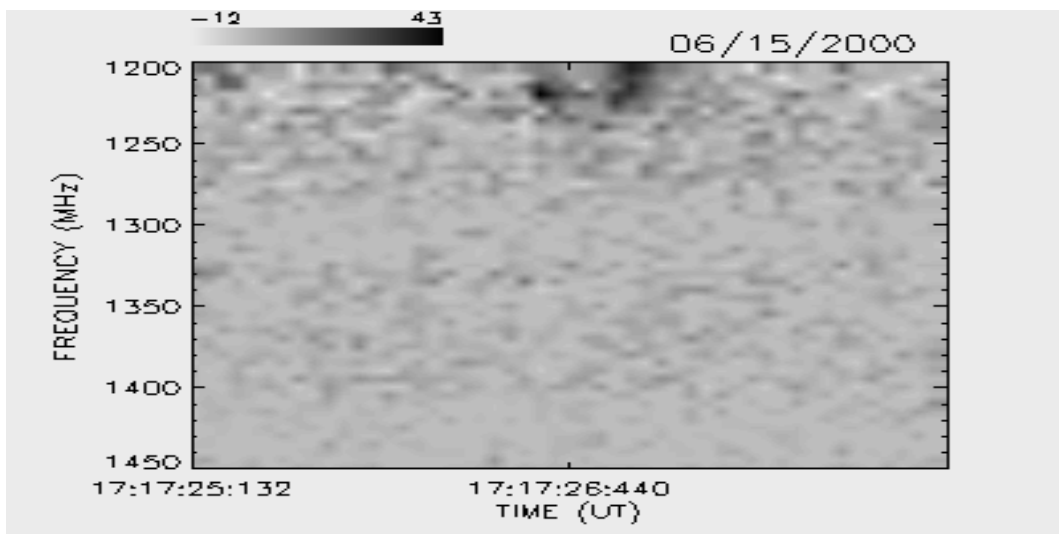
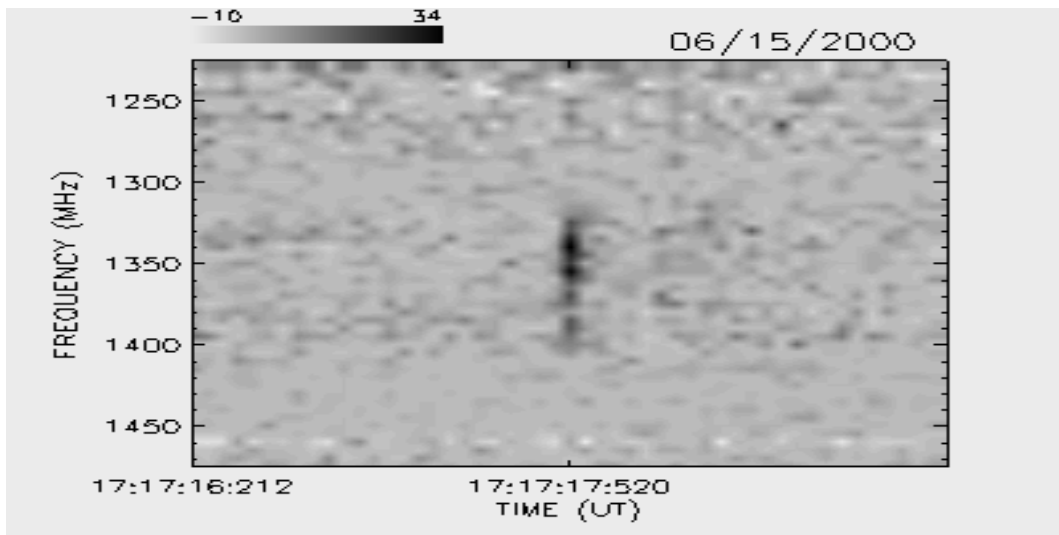
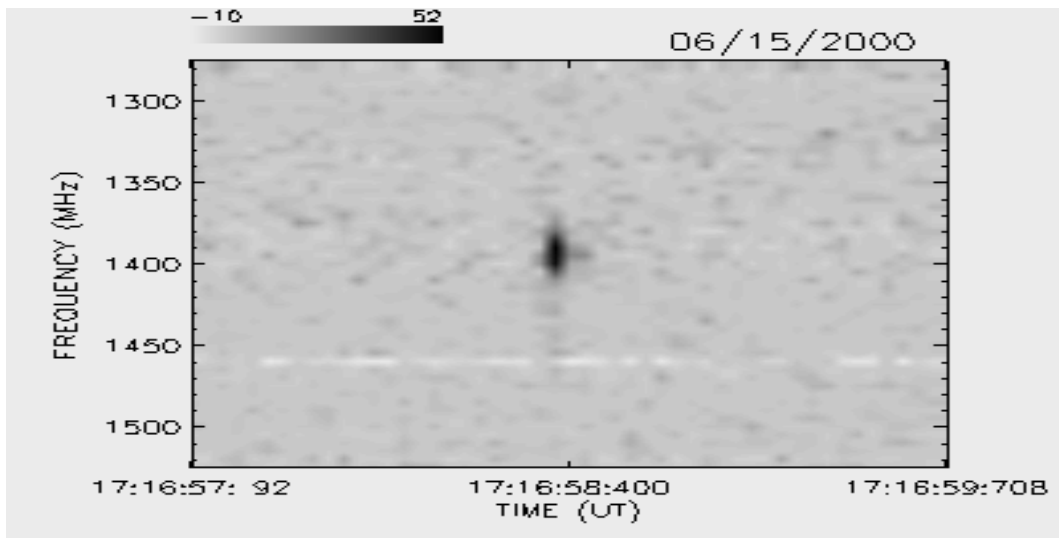
JUNHO / 2000



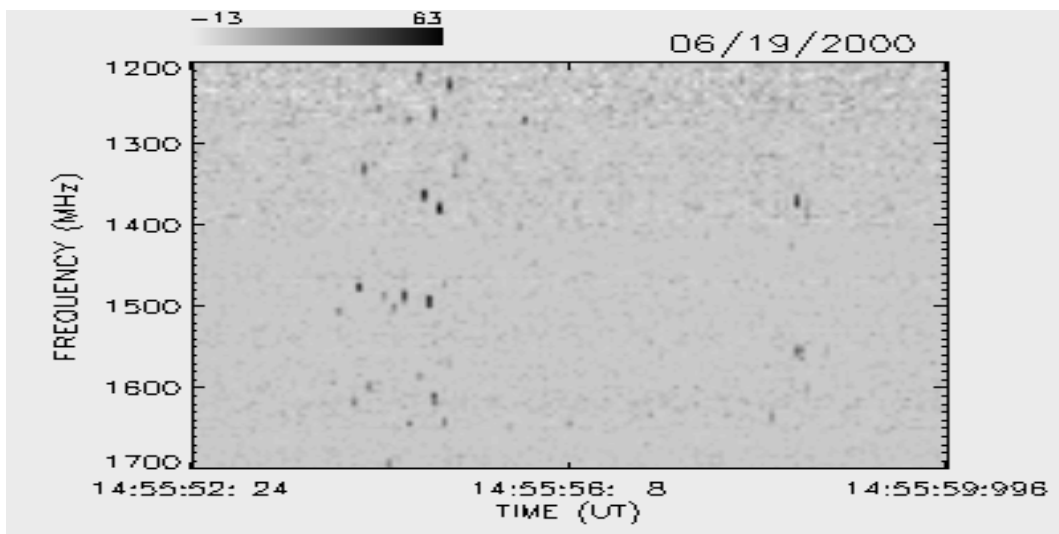
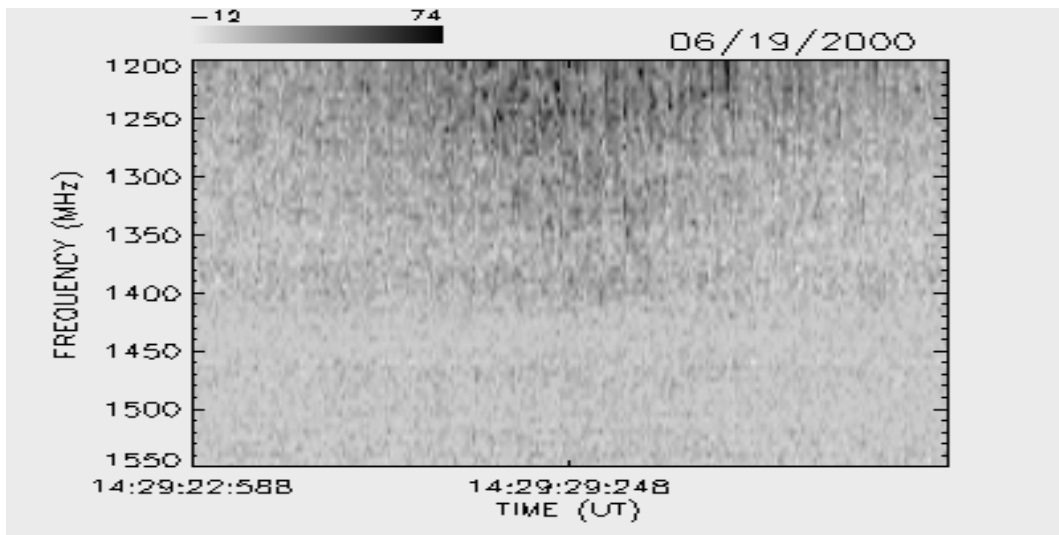
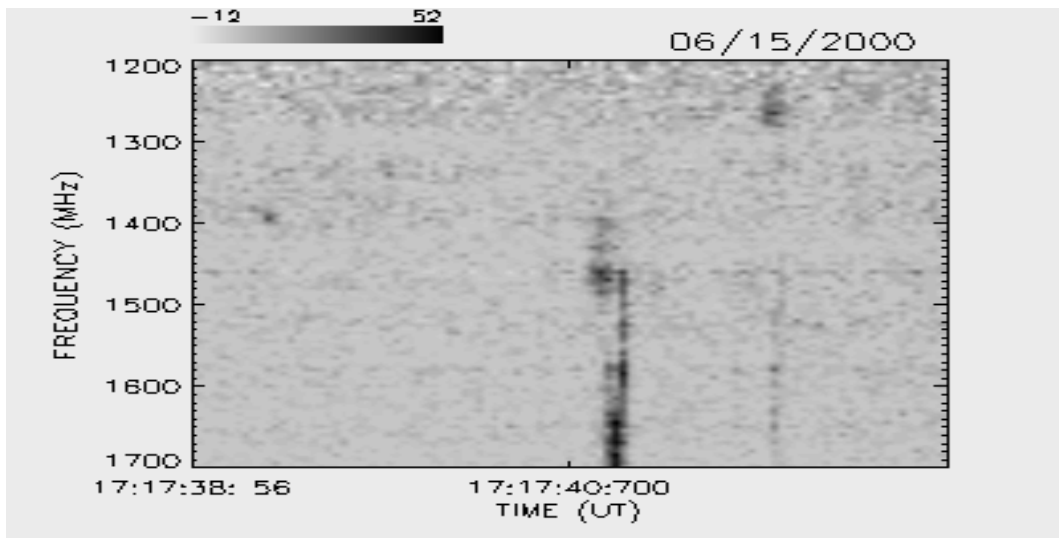
JUNHO / 2000



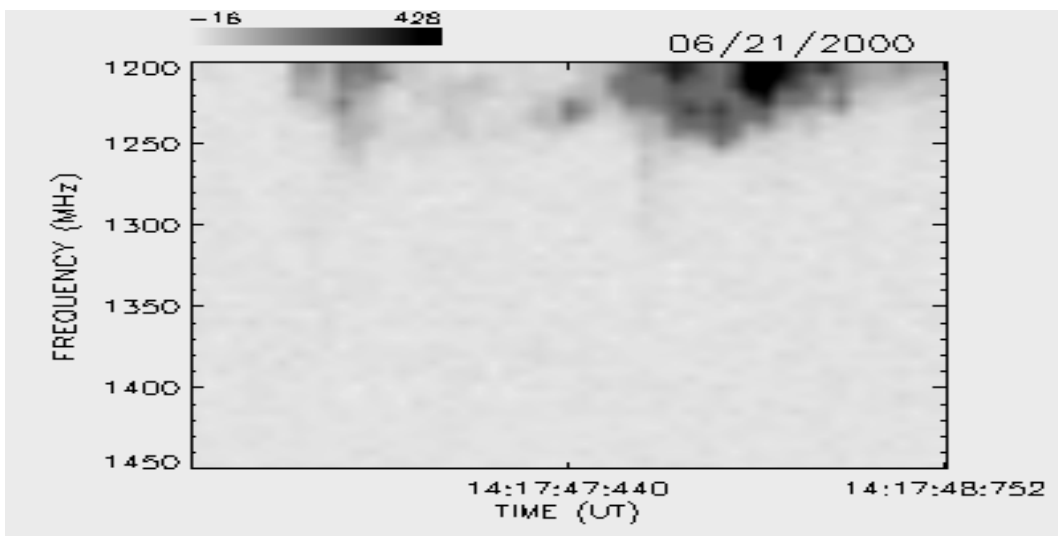
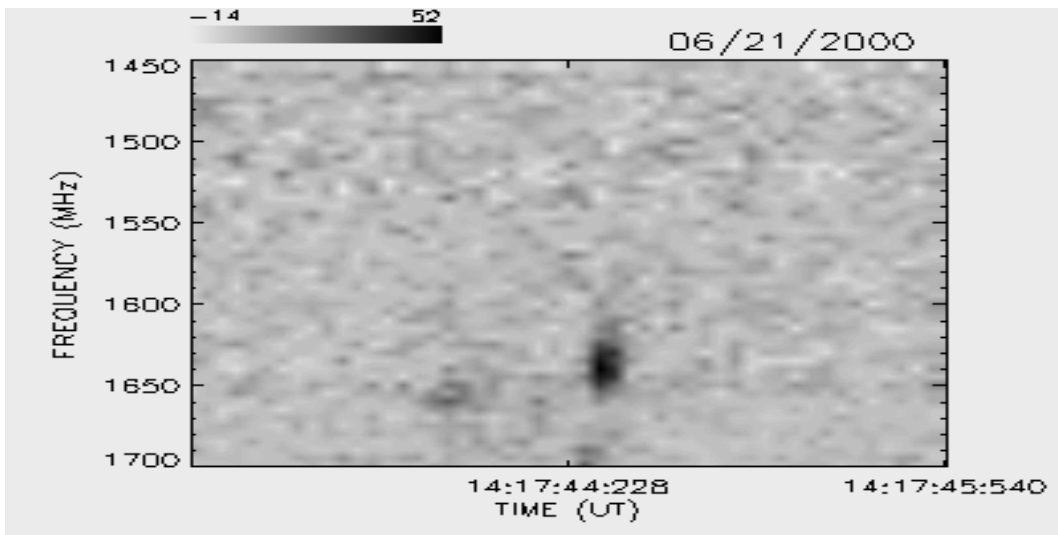
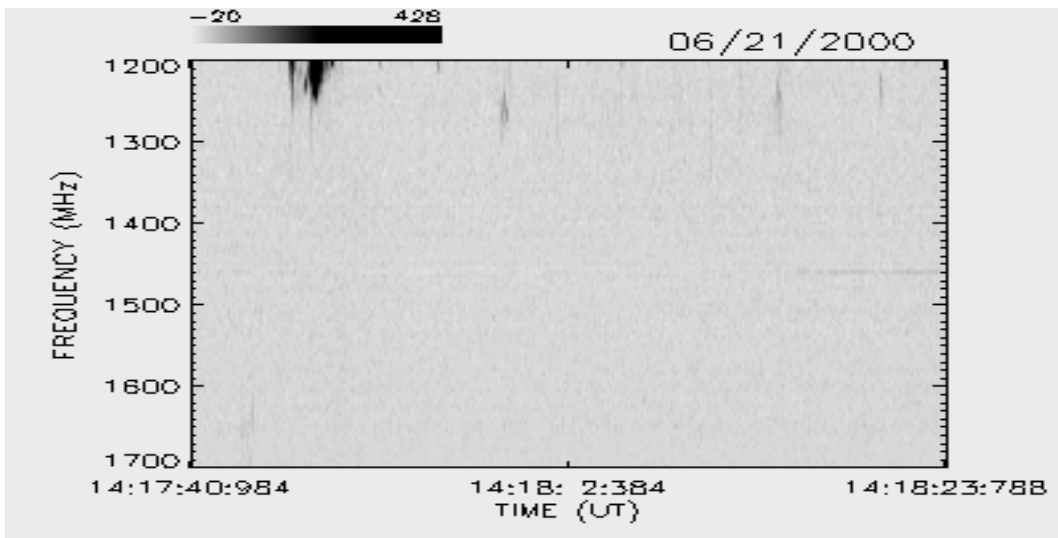
JUNHO / 2000



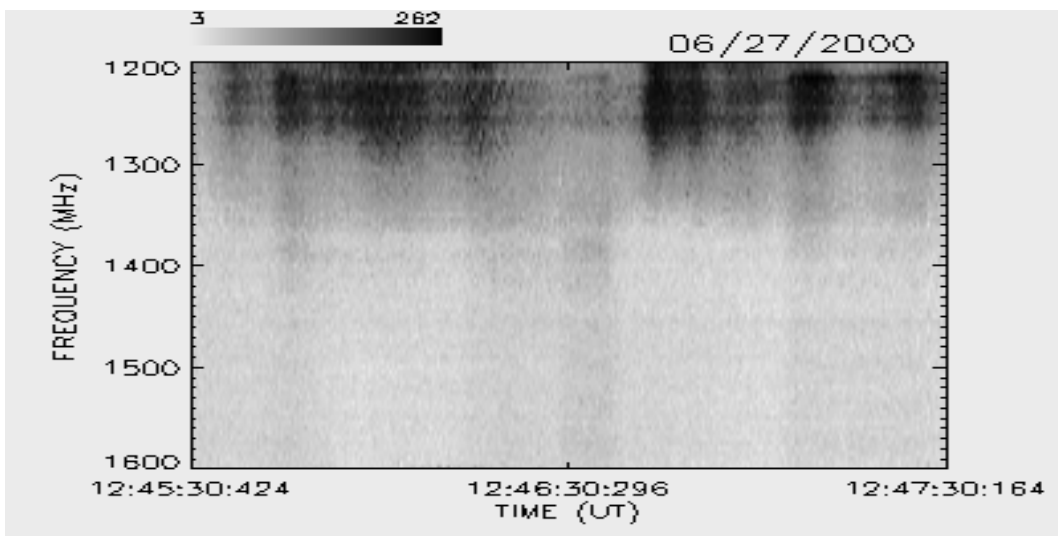
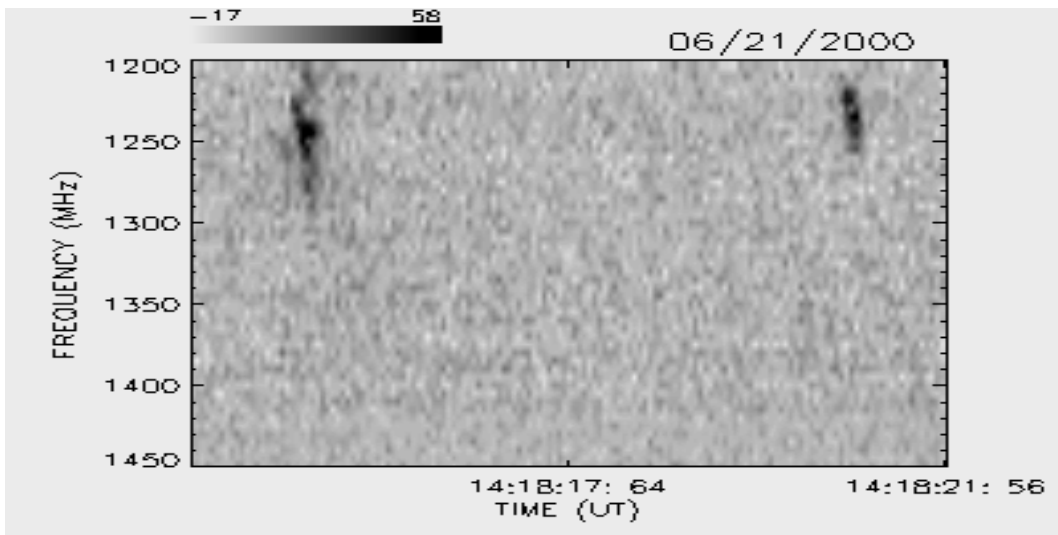
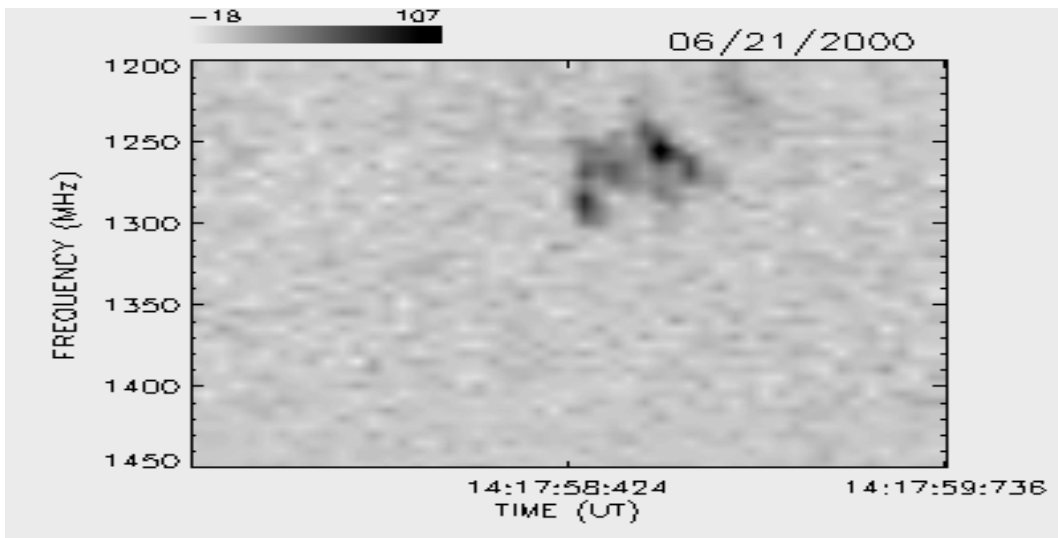
JUNHO / 2000



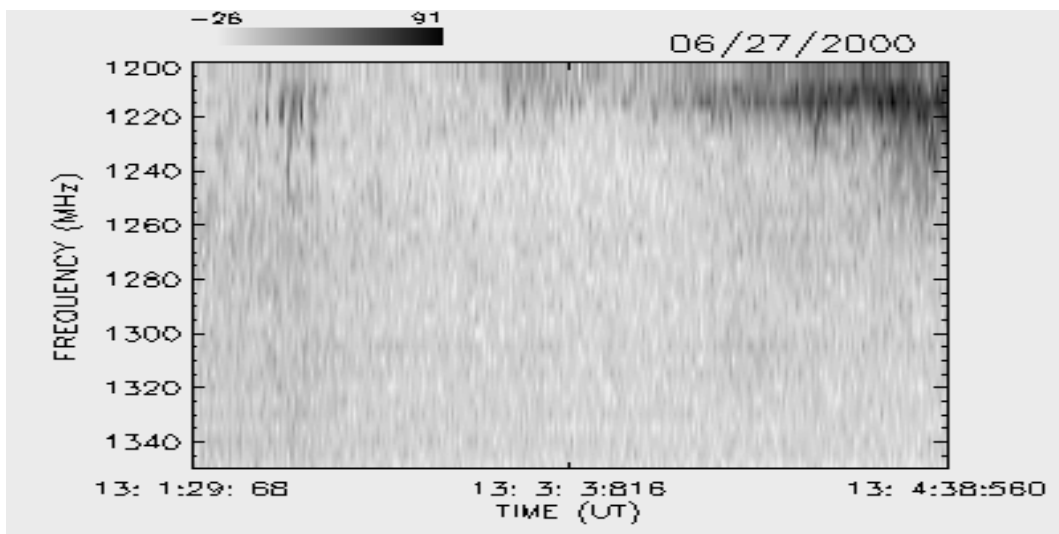
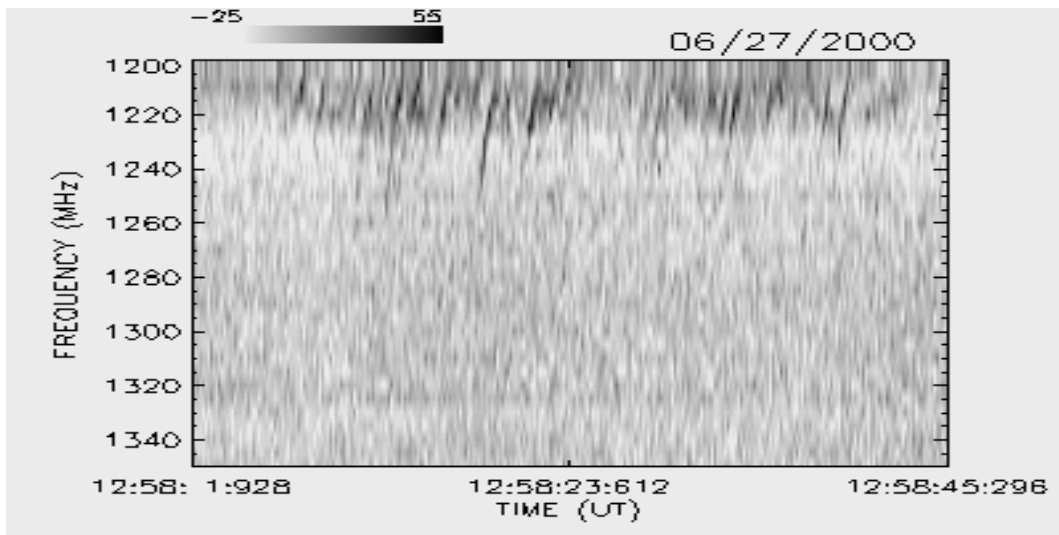
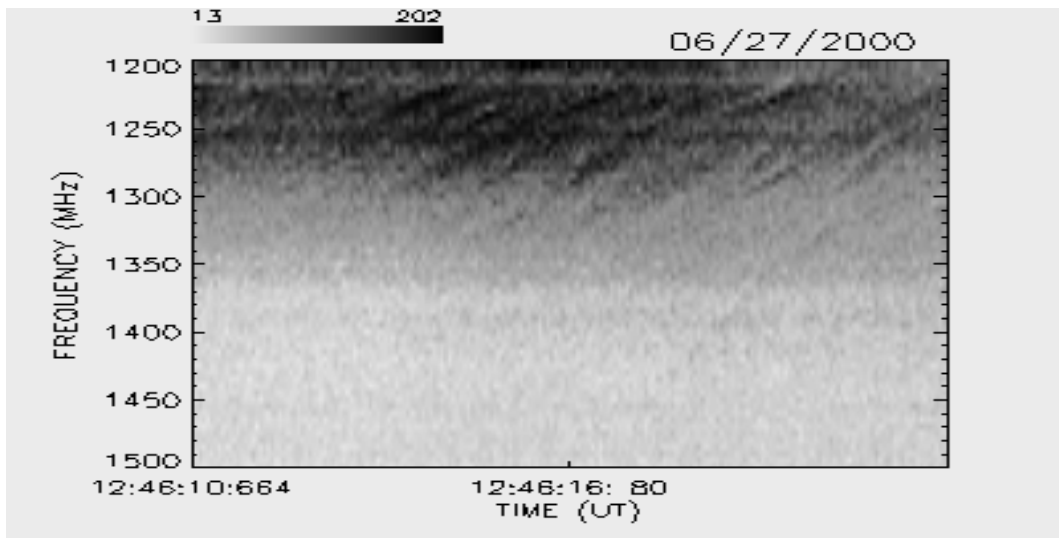
JUNHO / 2000



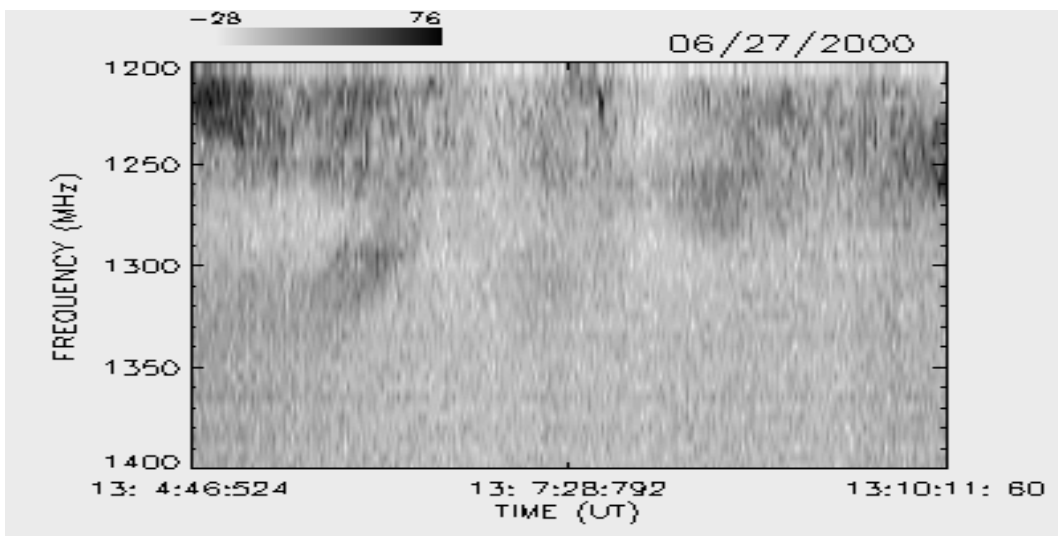
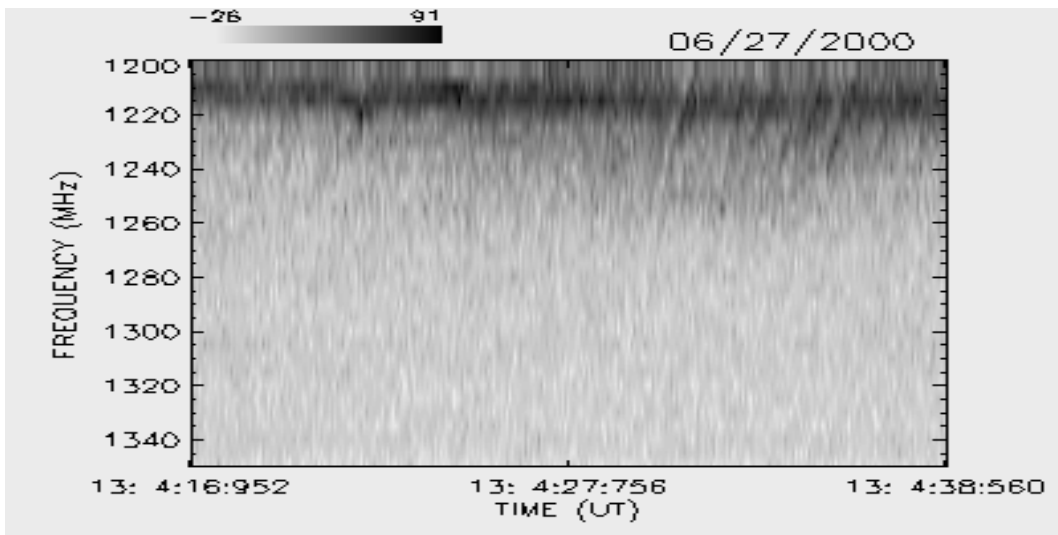
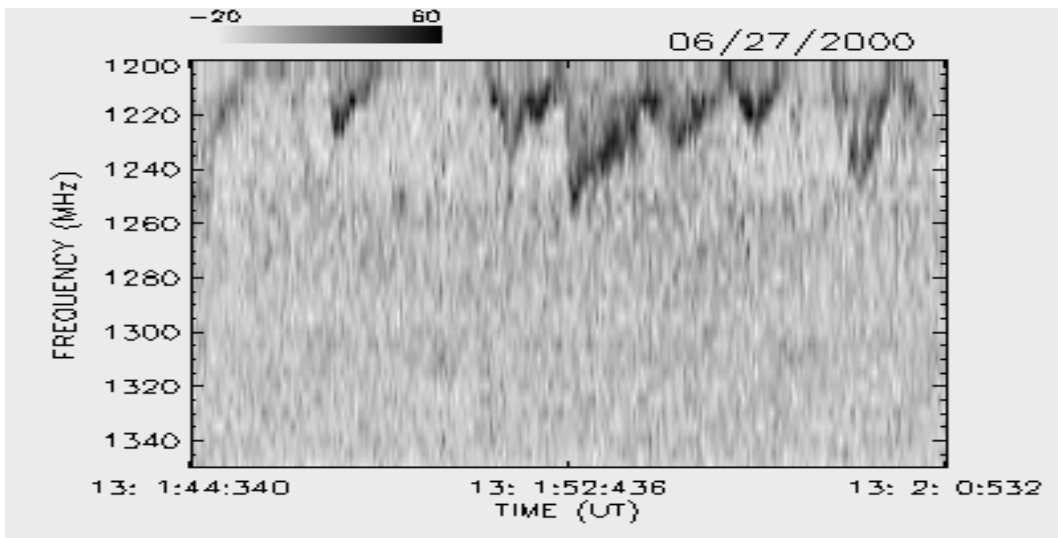
JUNHO / 2000



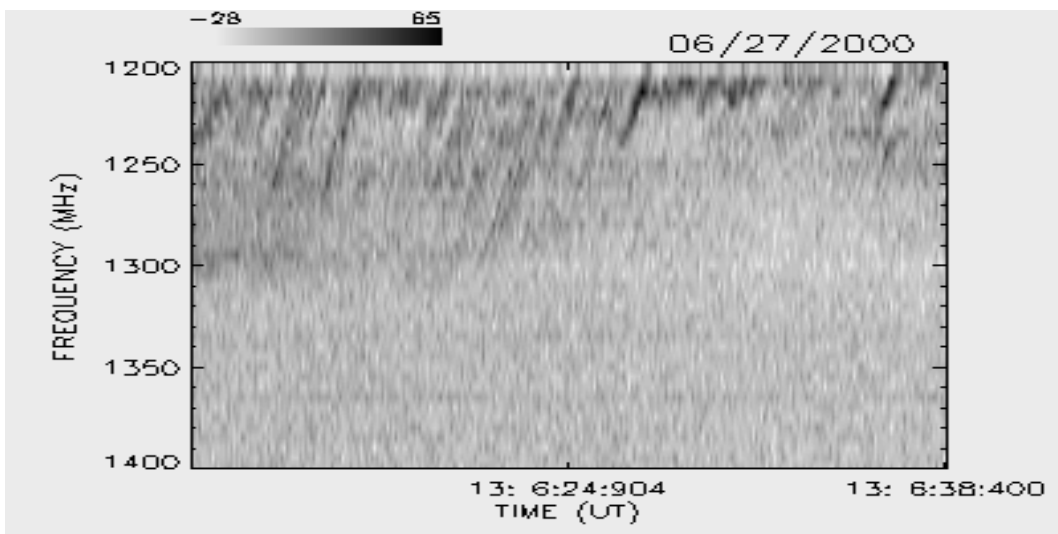
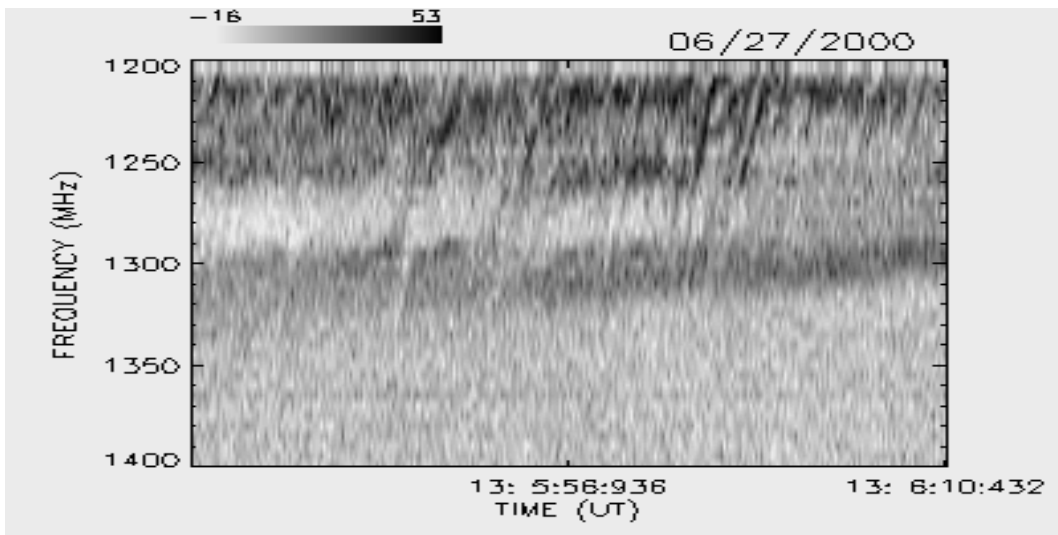
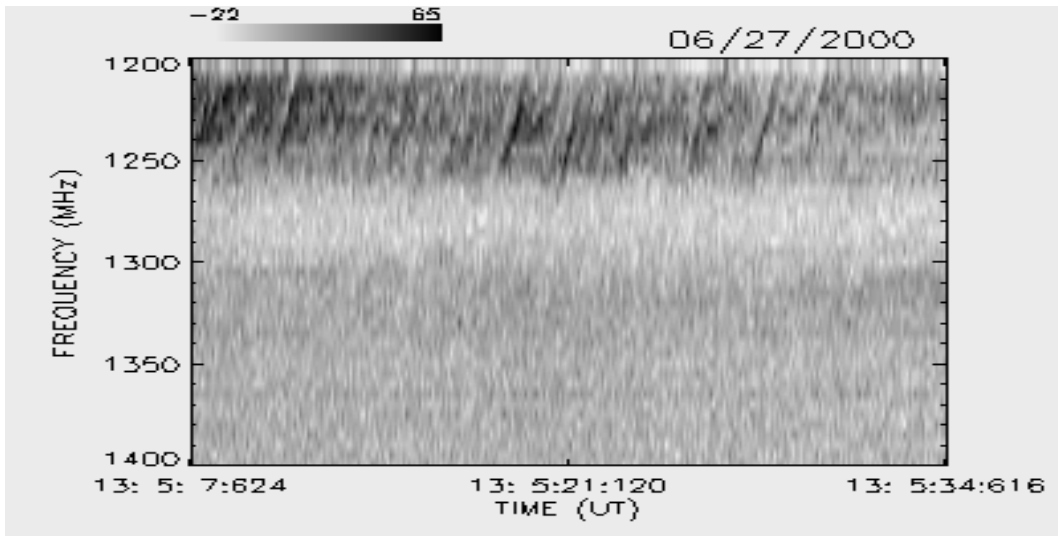
JUNHO / 2000



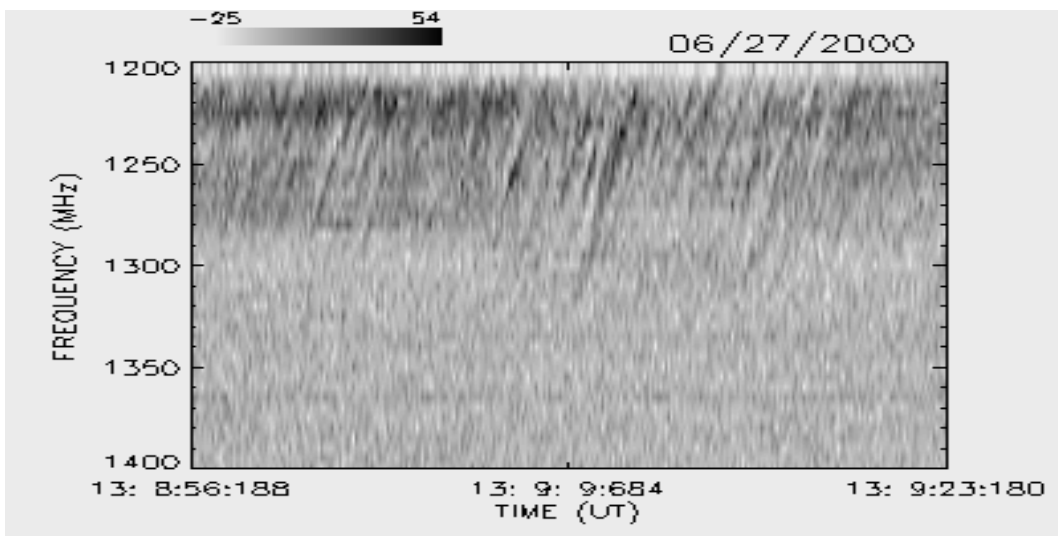
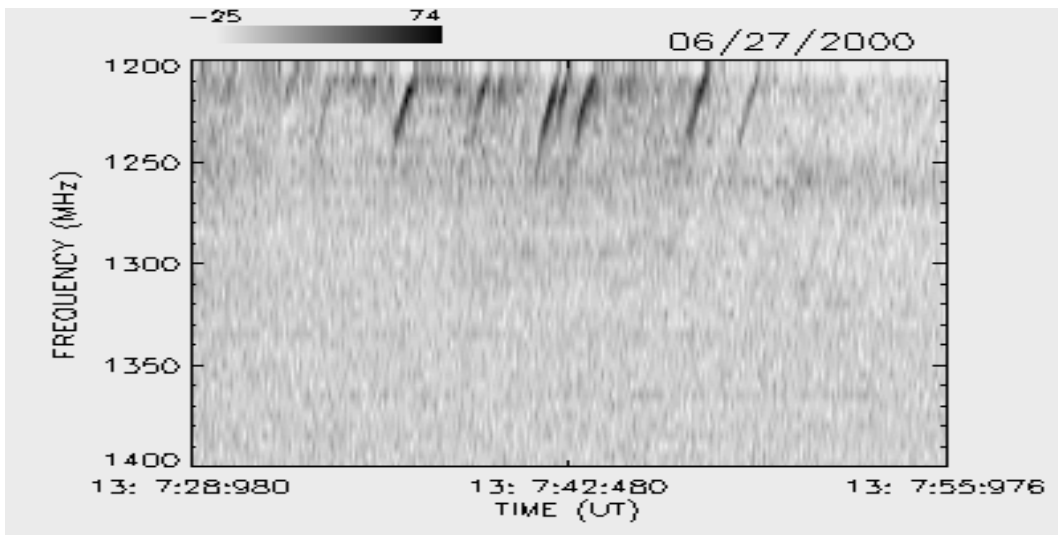
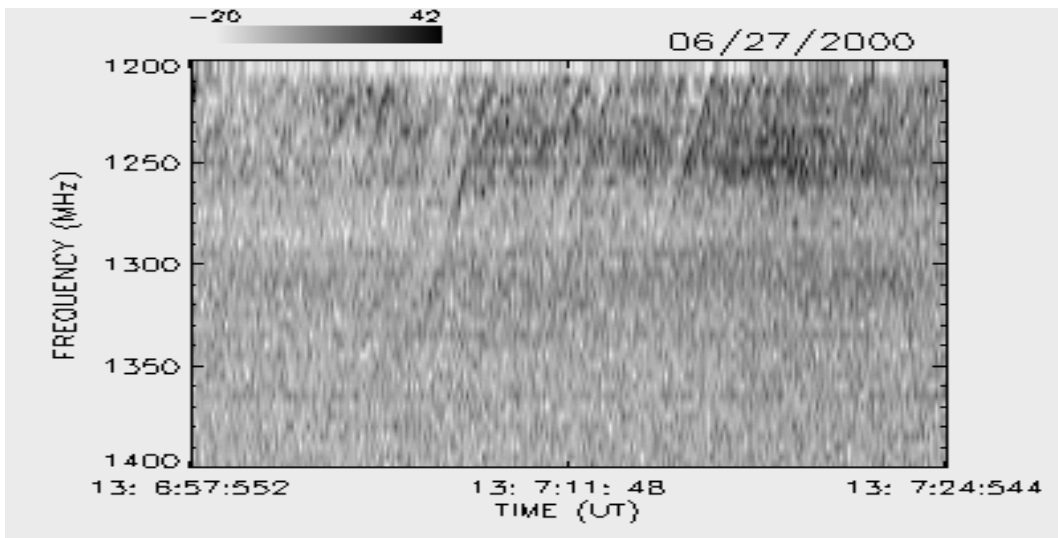
JUNHO / 2000



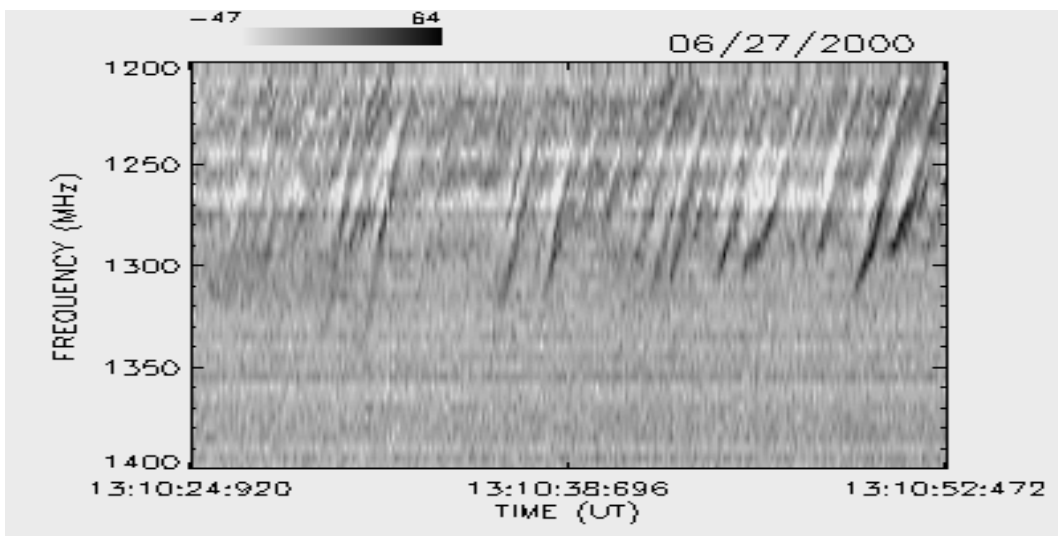
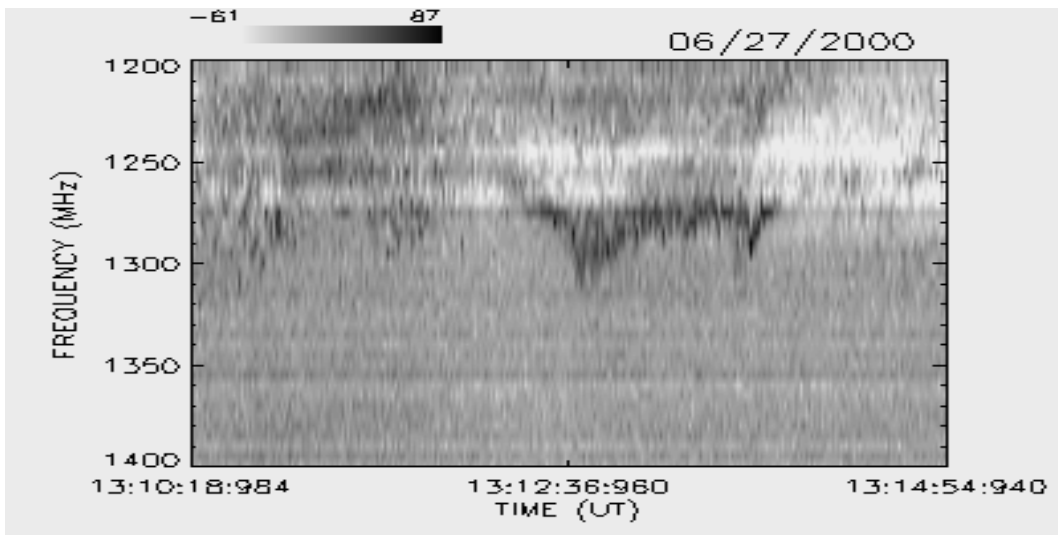
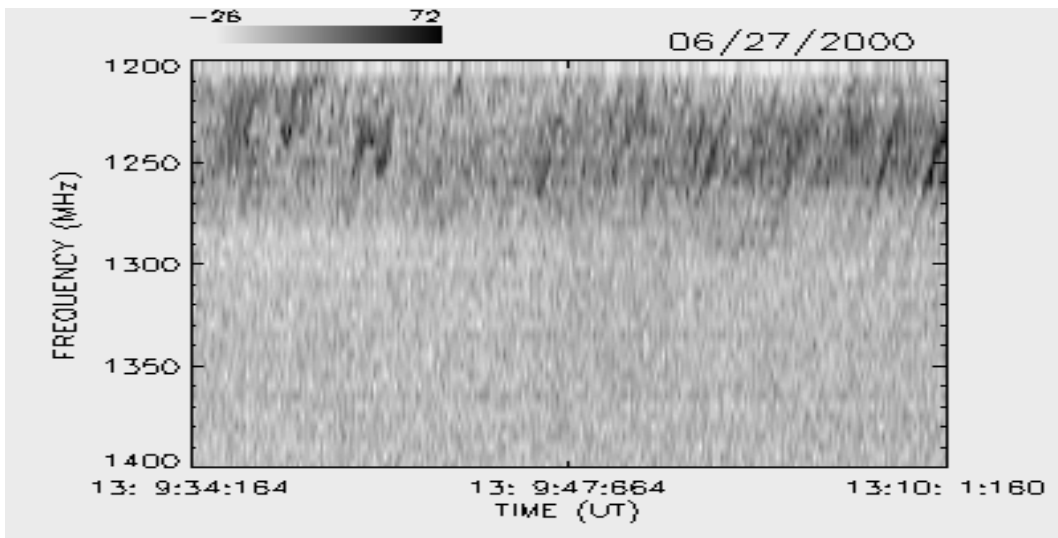
JUNHO / 2000



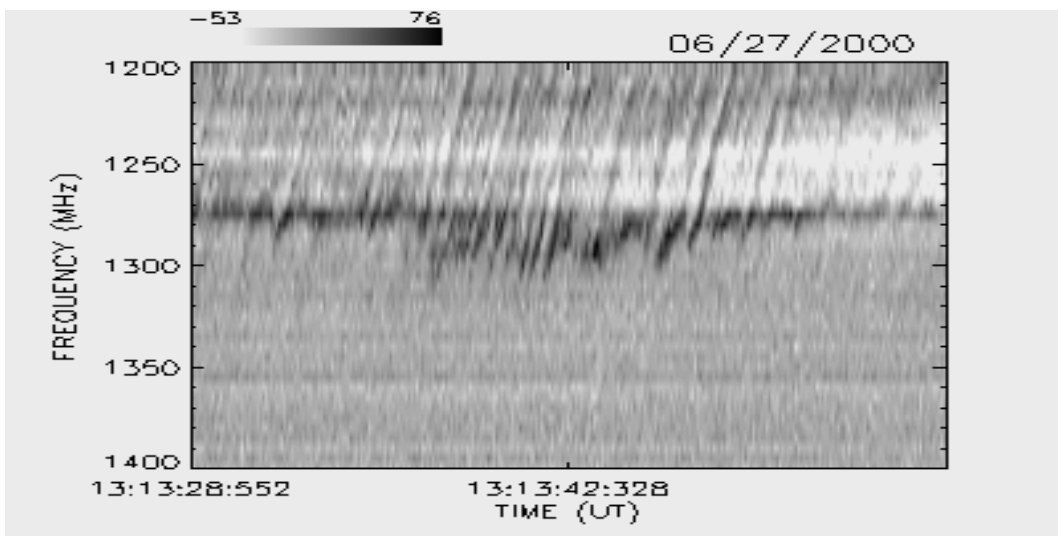
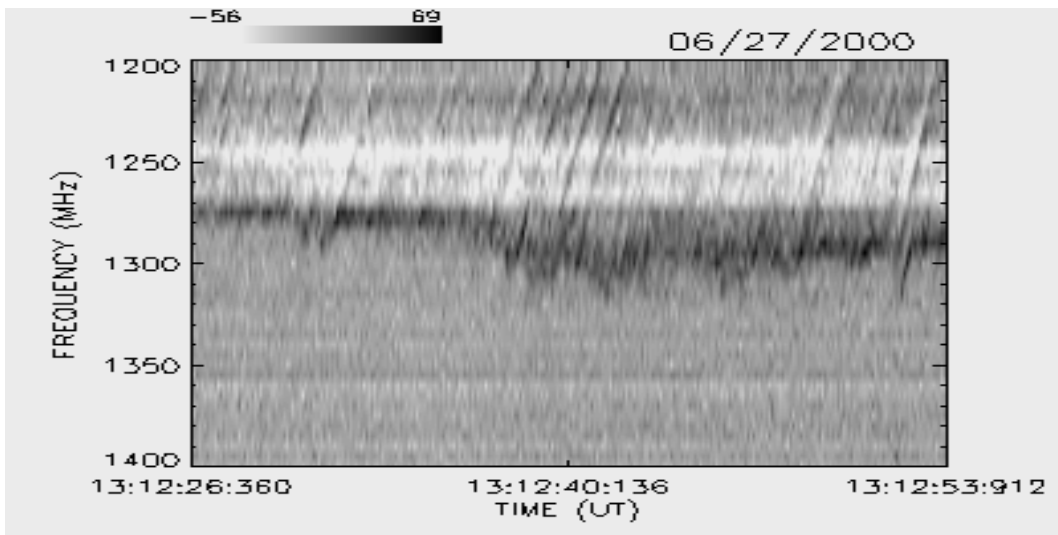
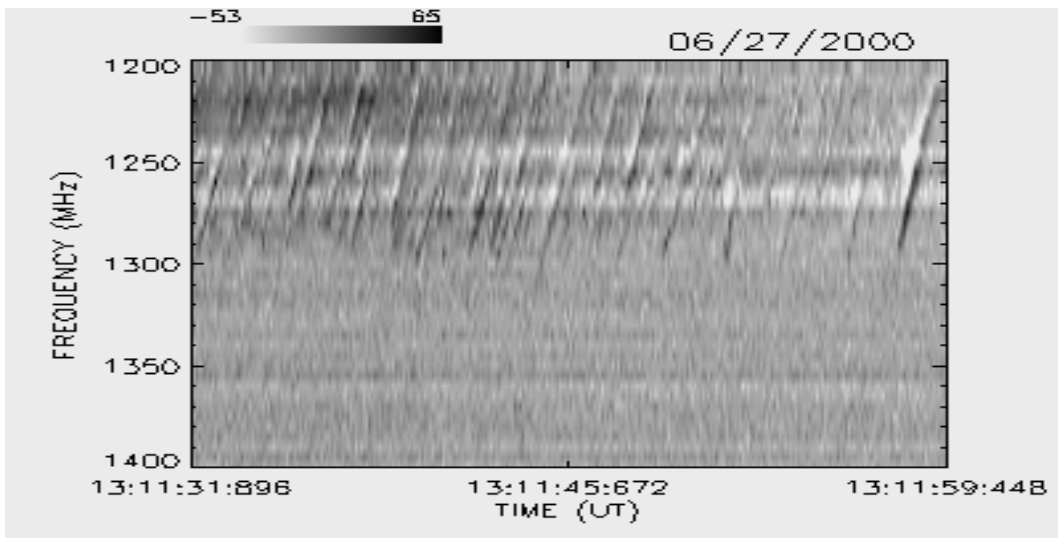
JUNHO / 2000



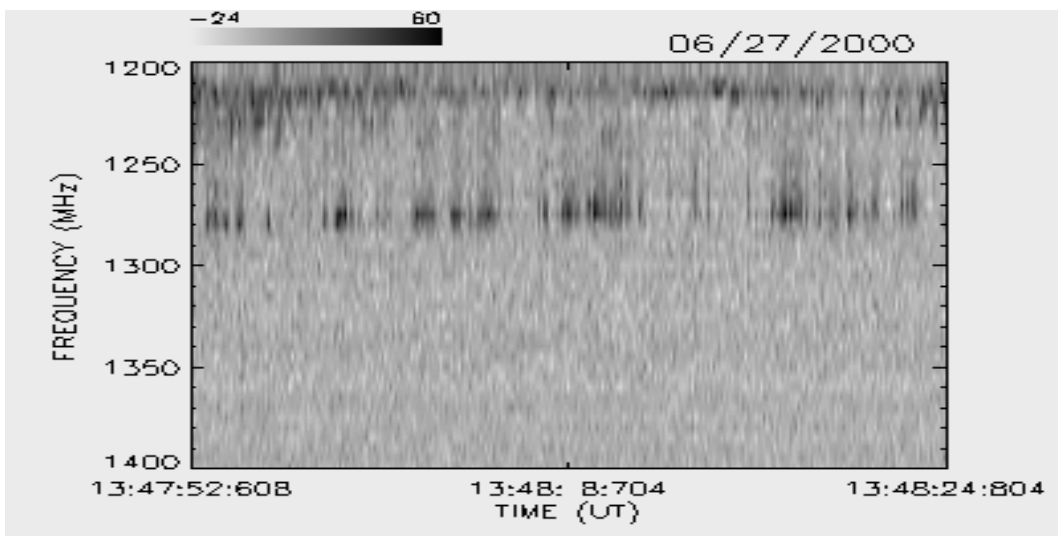
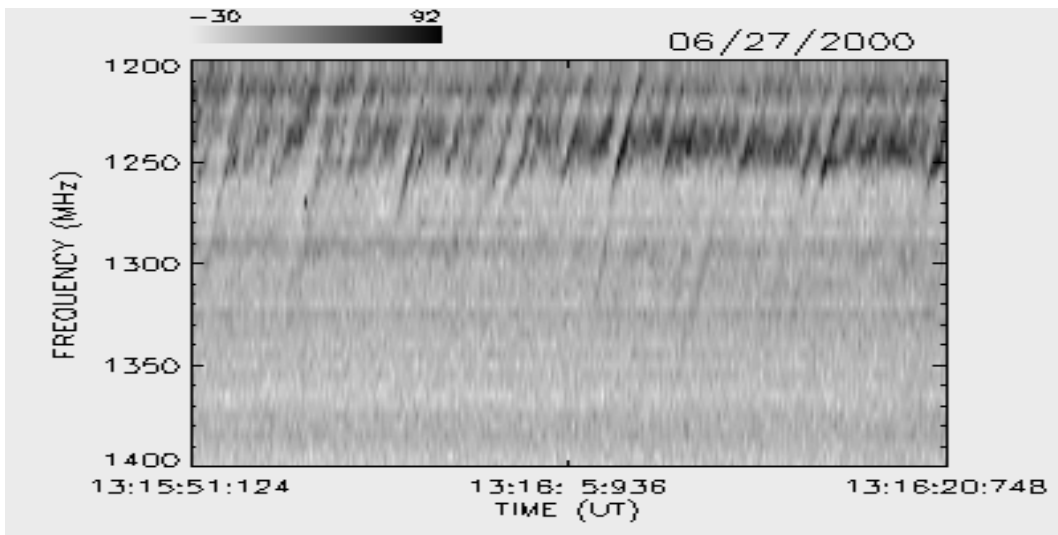
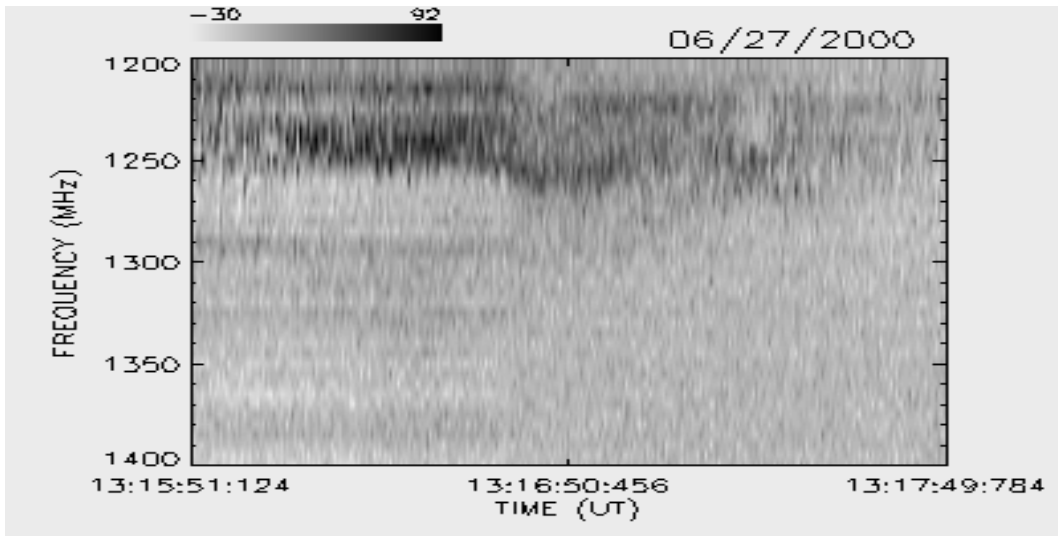
JUNHO / 2000



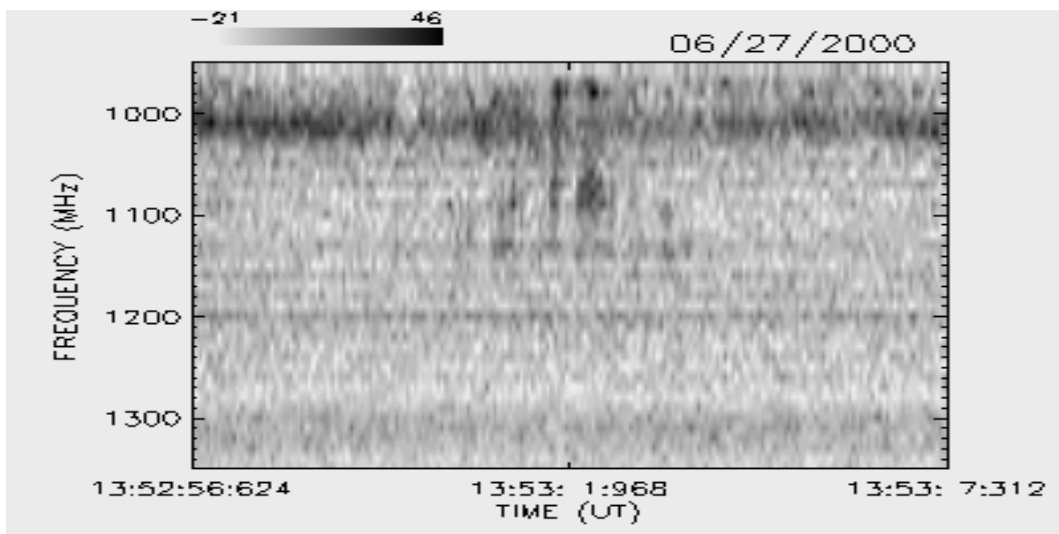
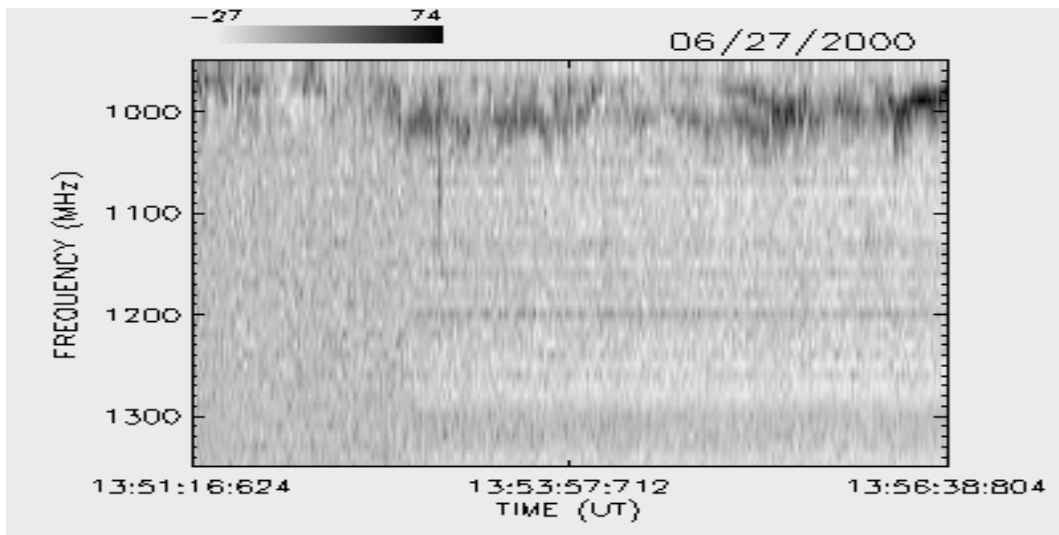
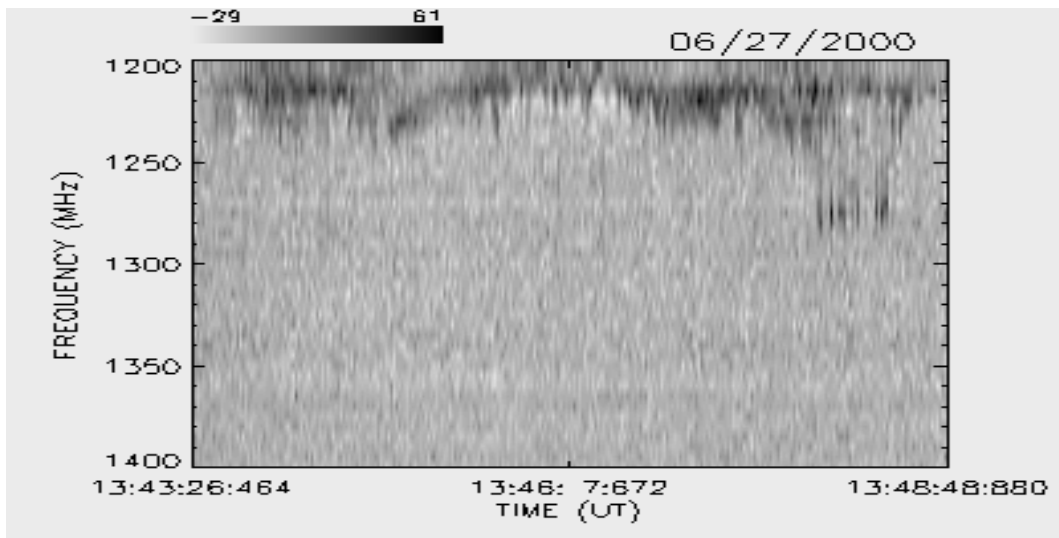
JUNHO / 2000



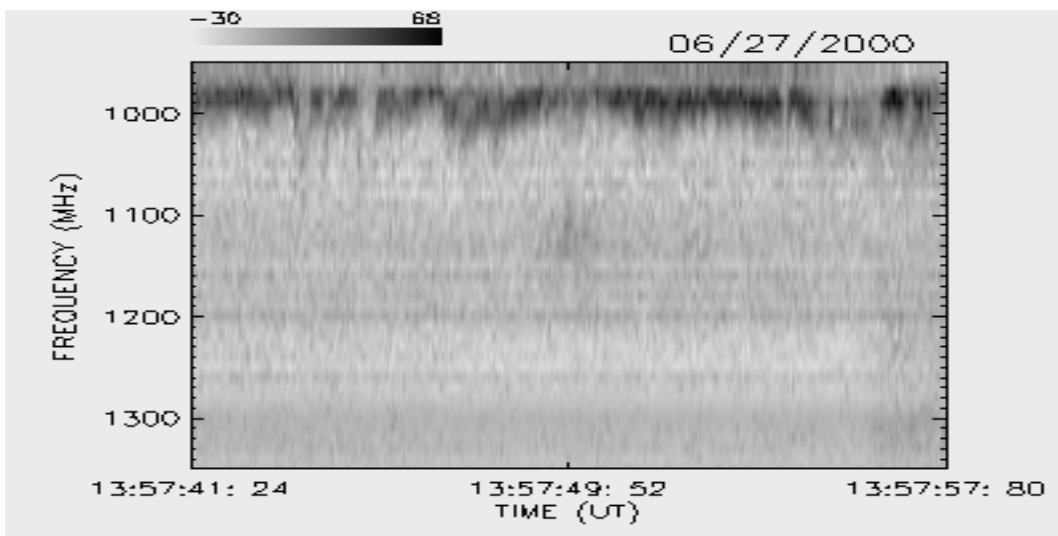
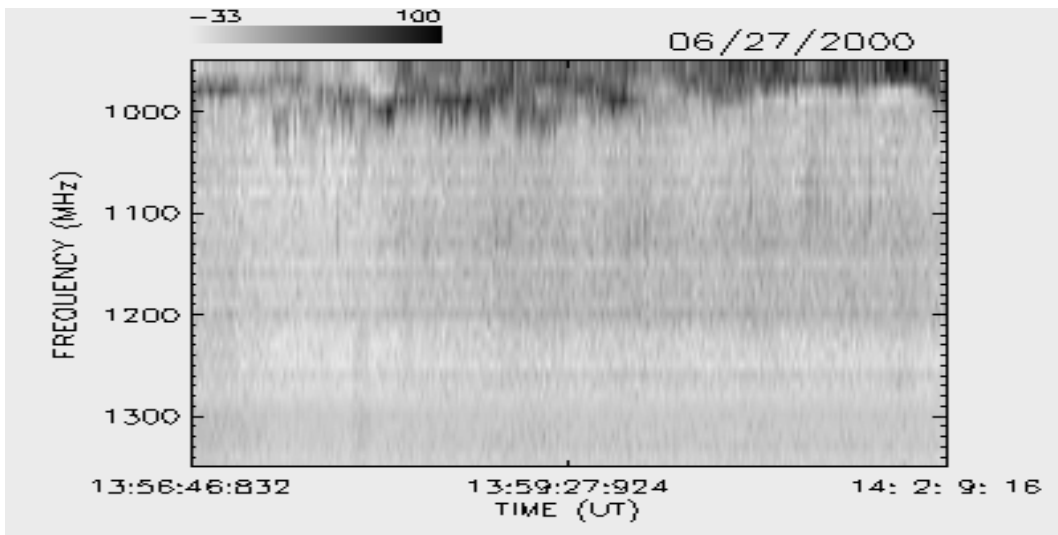
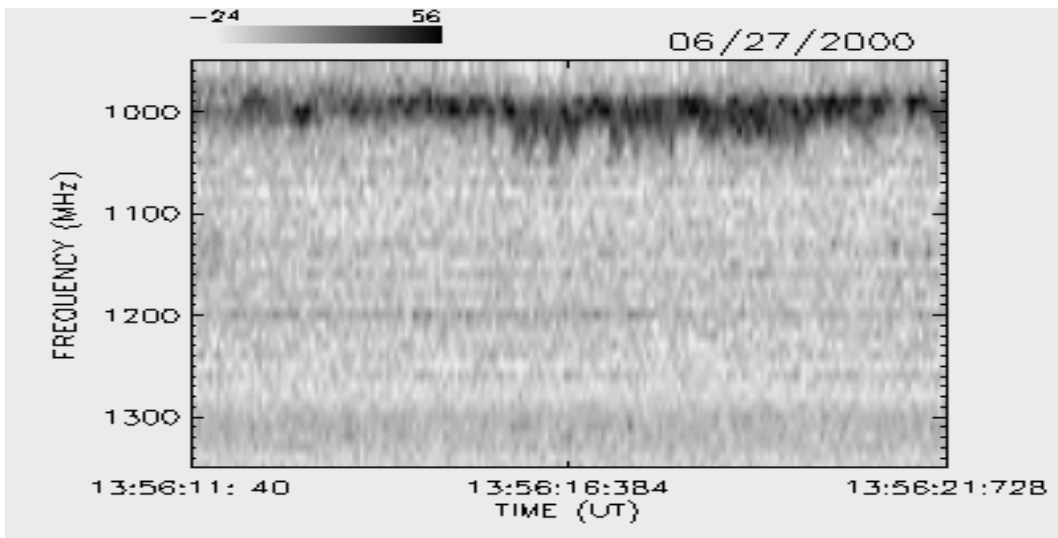
JUNHO / 2000



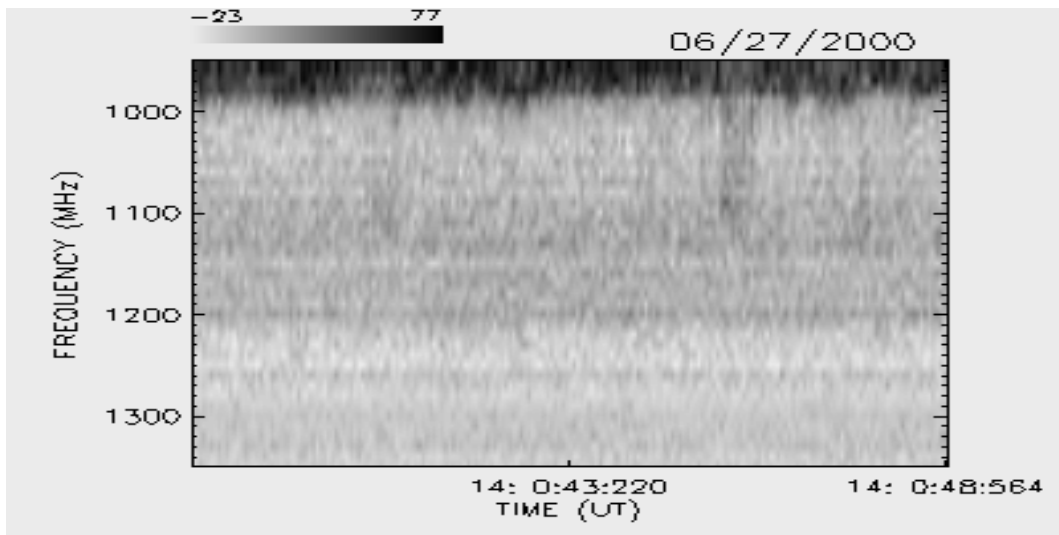
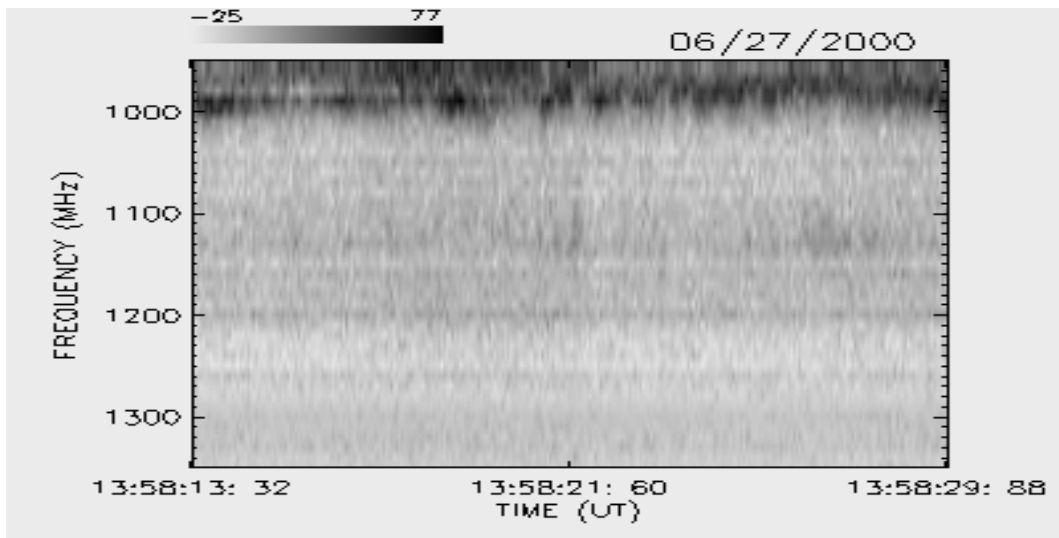
JUNHO / 2000



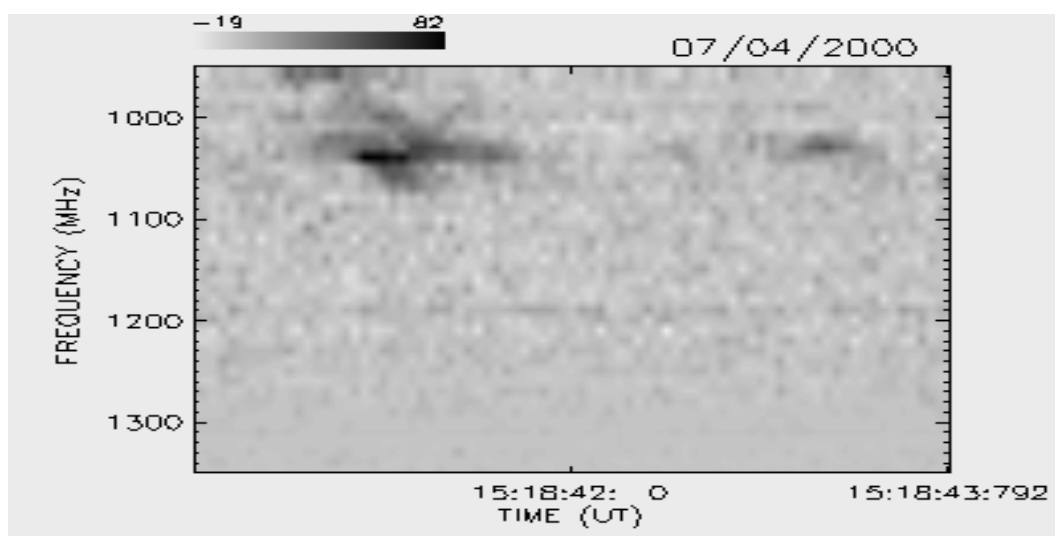
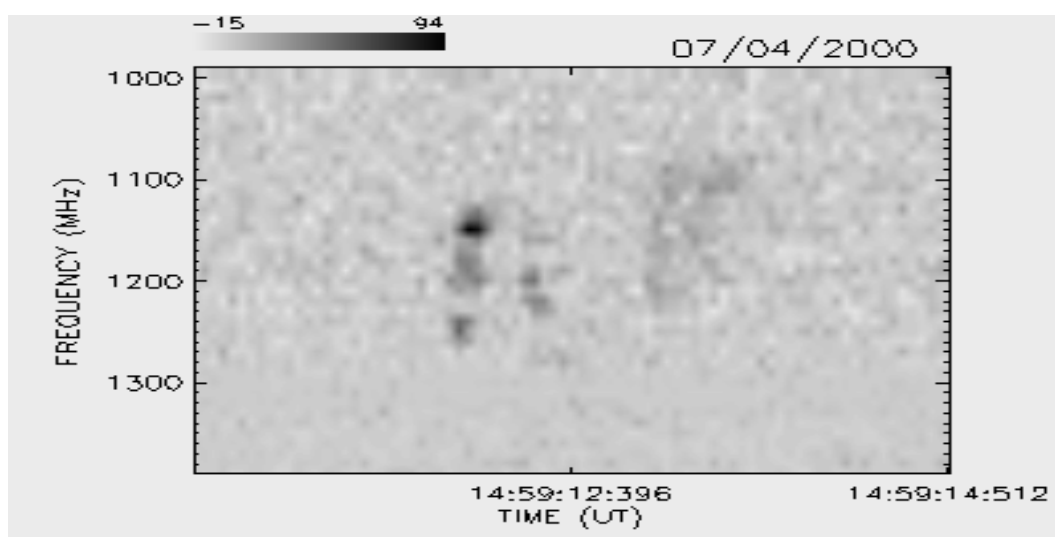
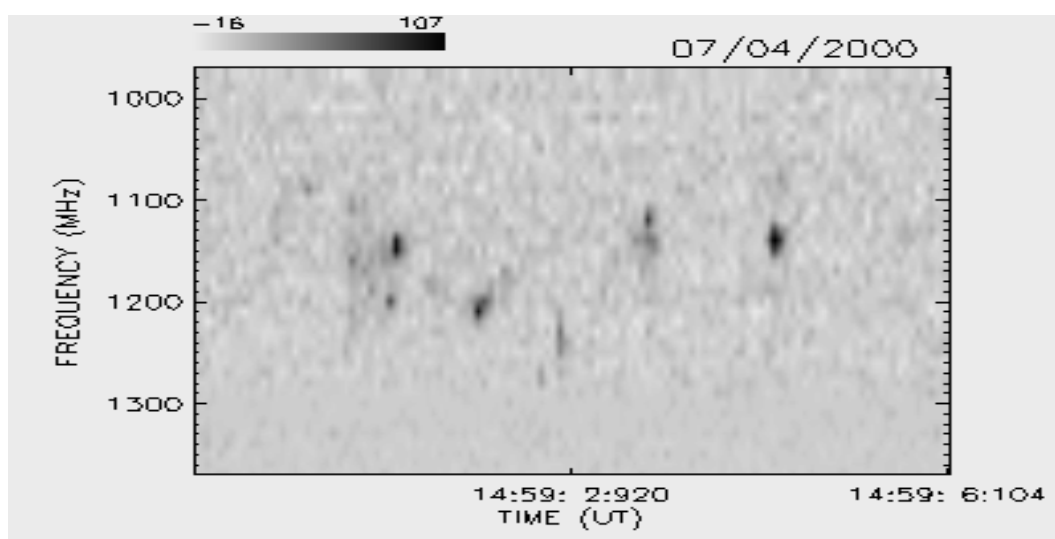
JUNHO / 2000



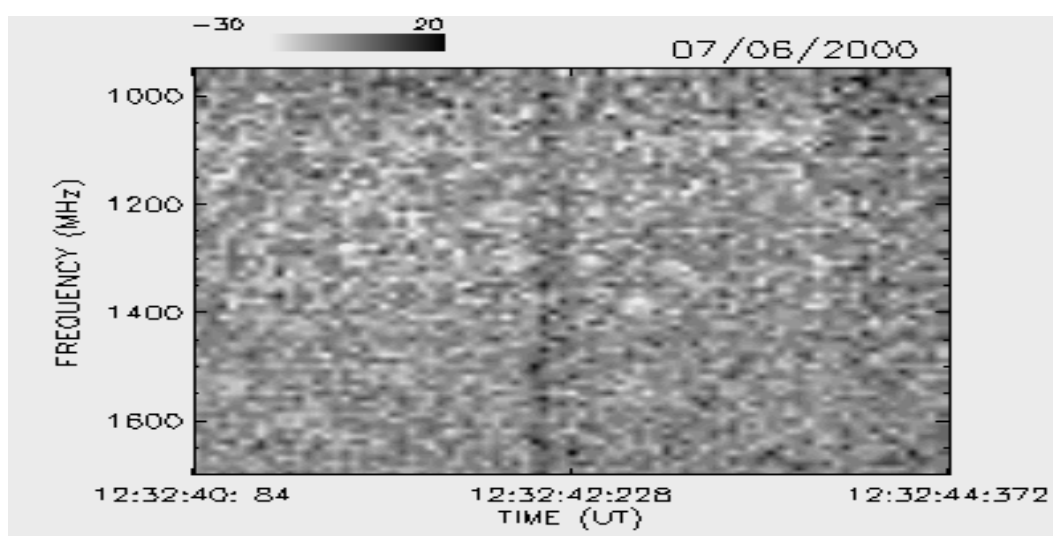
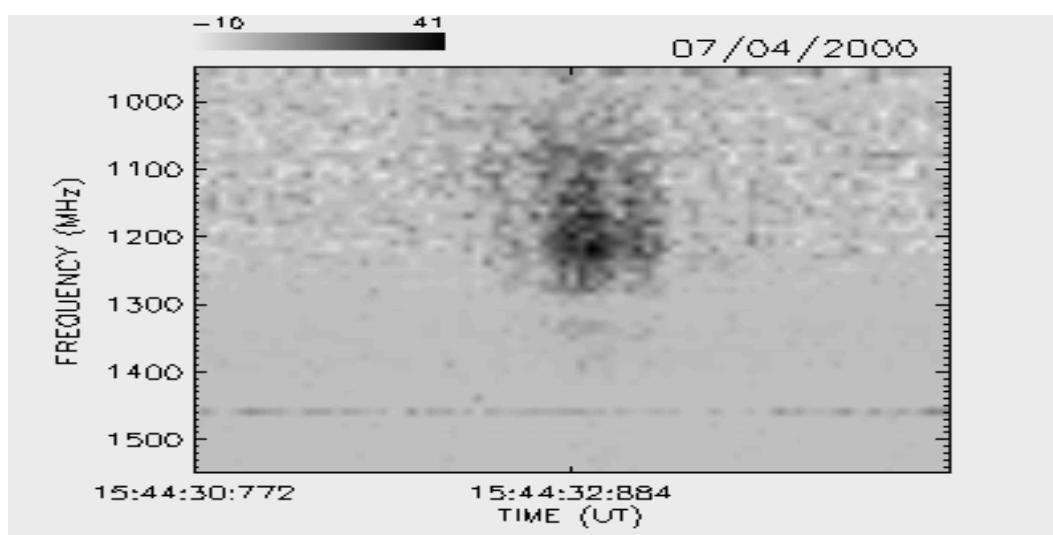
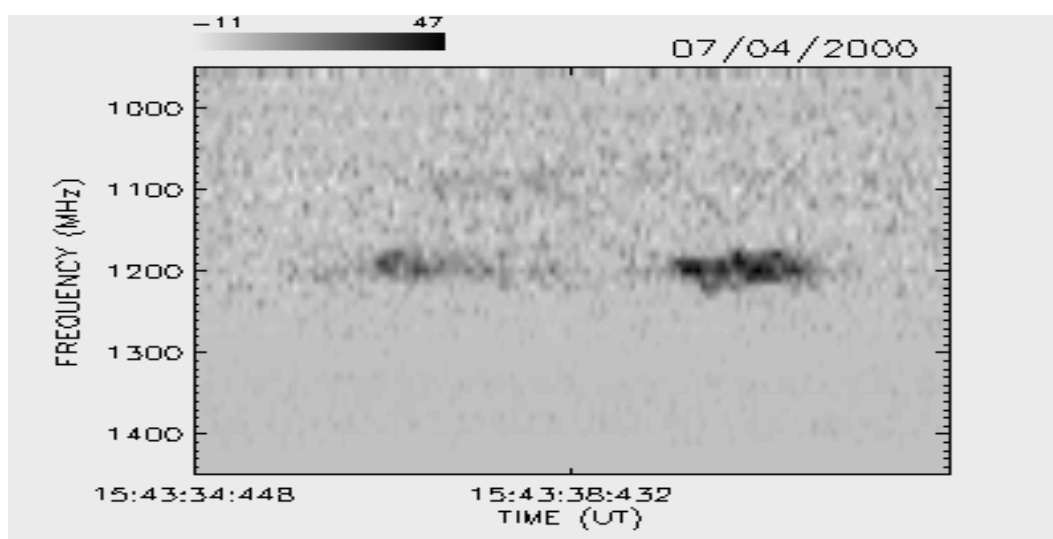
JUNHO / 2000



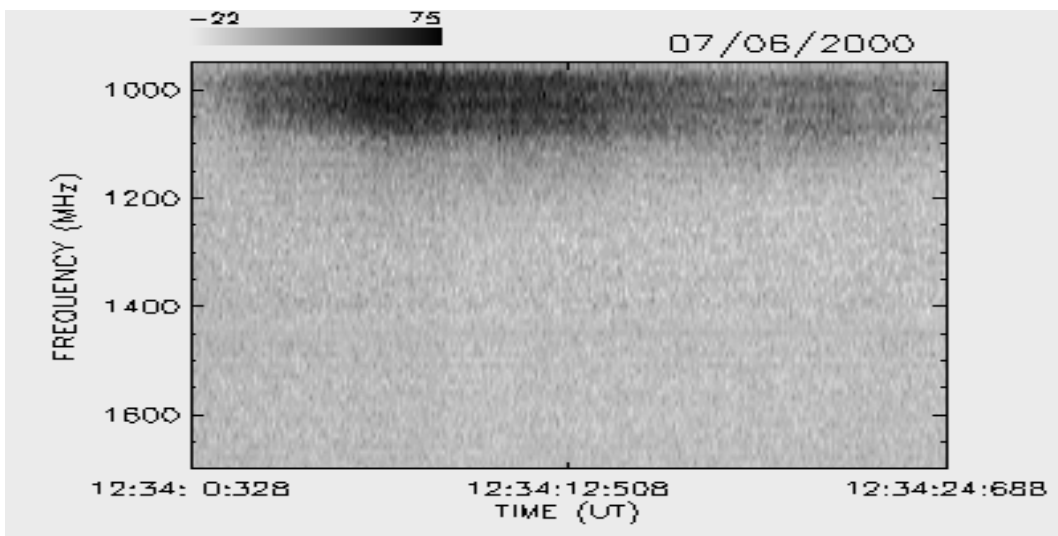
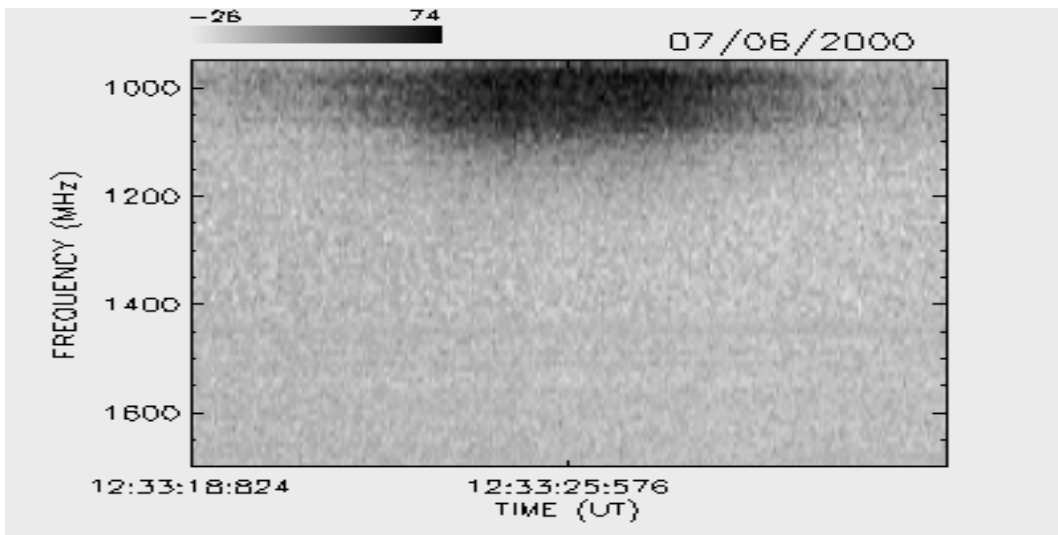
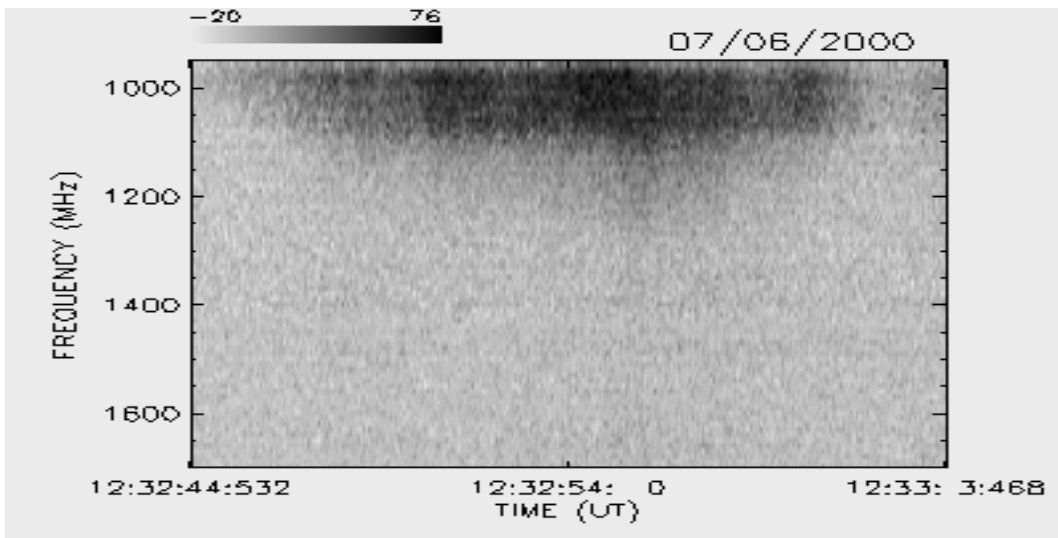
JULHO / 2000



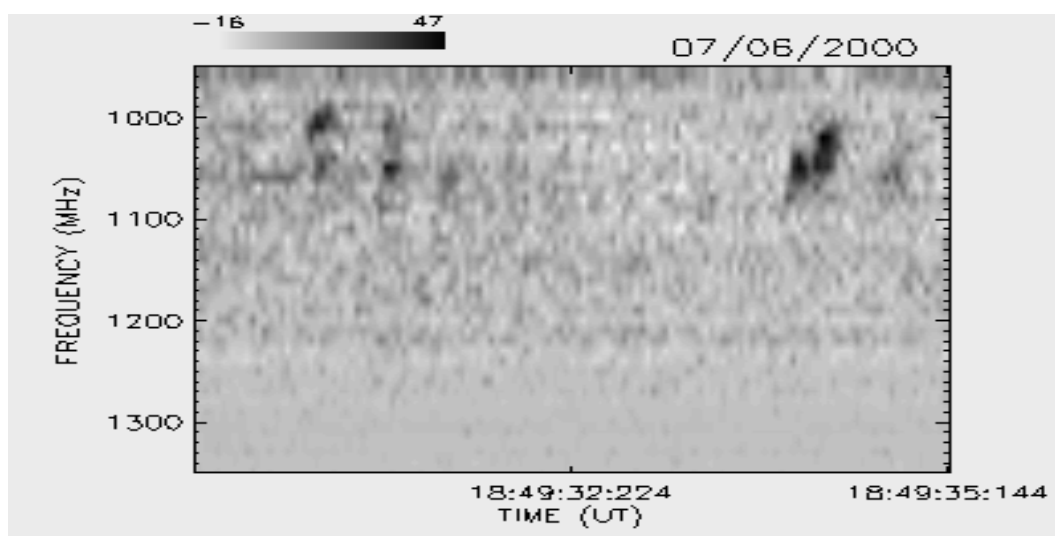
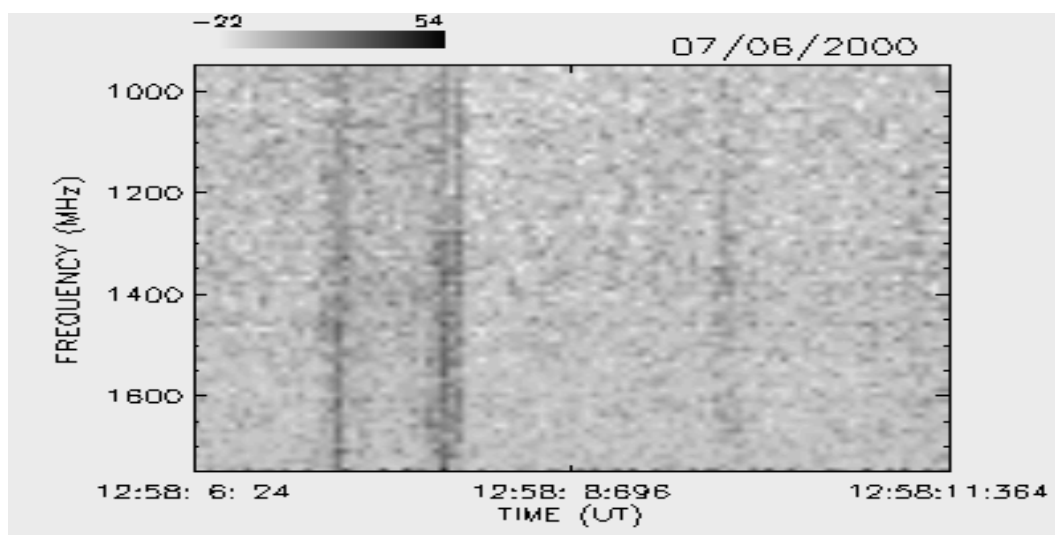
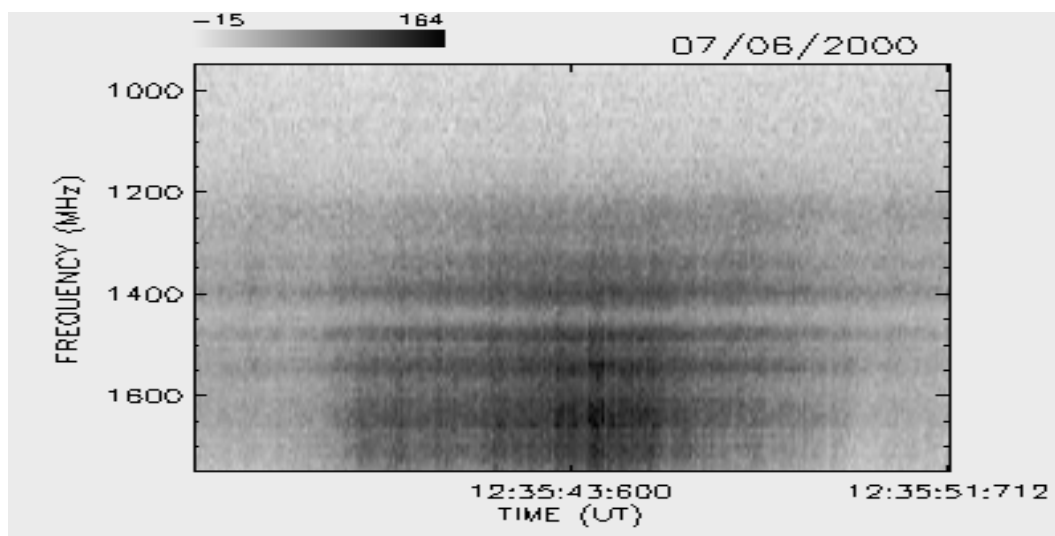
JULHO / 2000



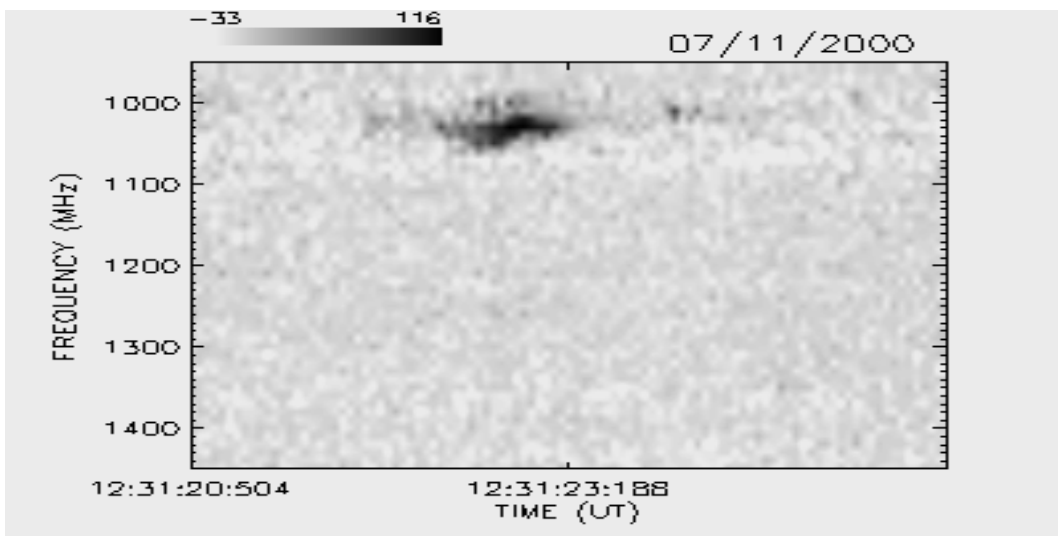
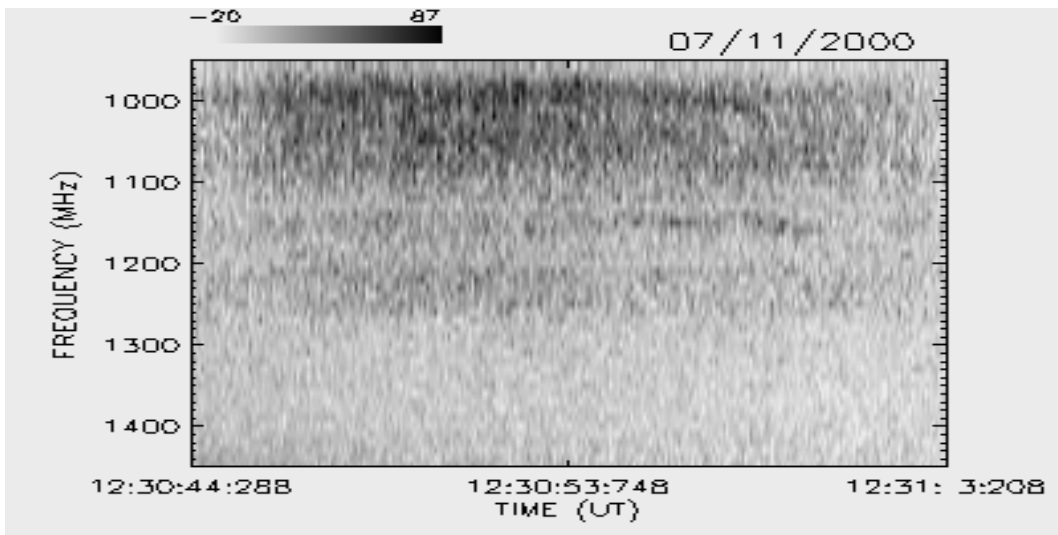
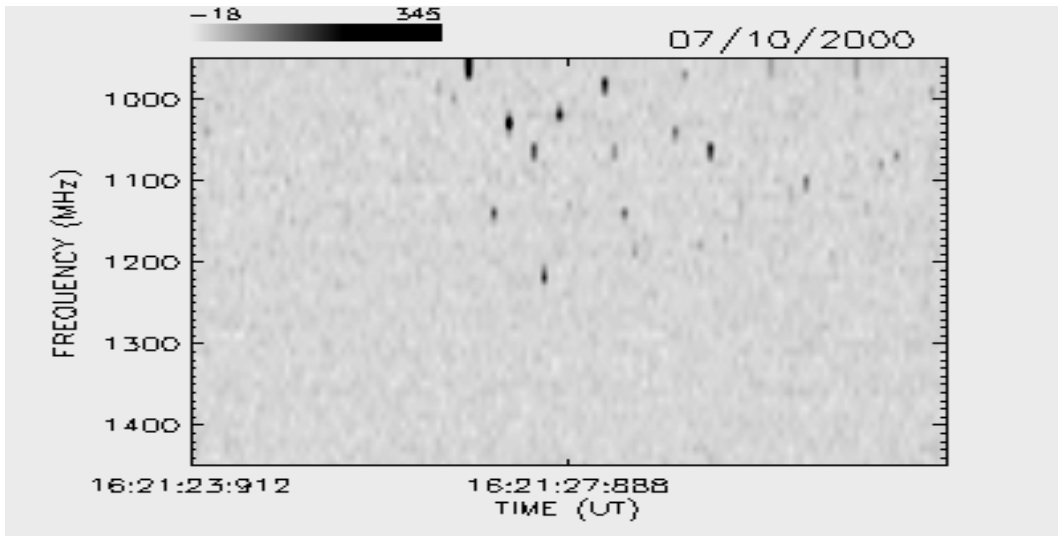
JULHO / 2000



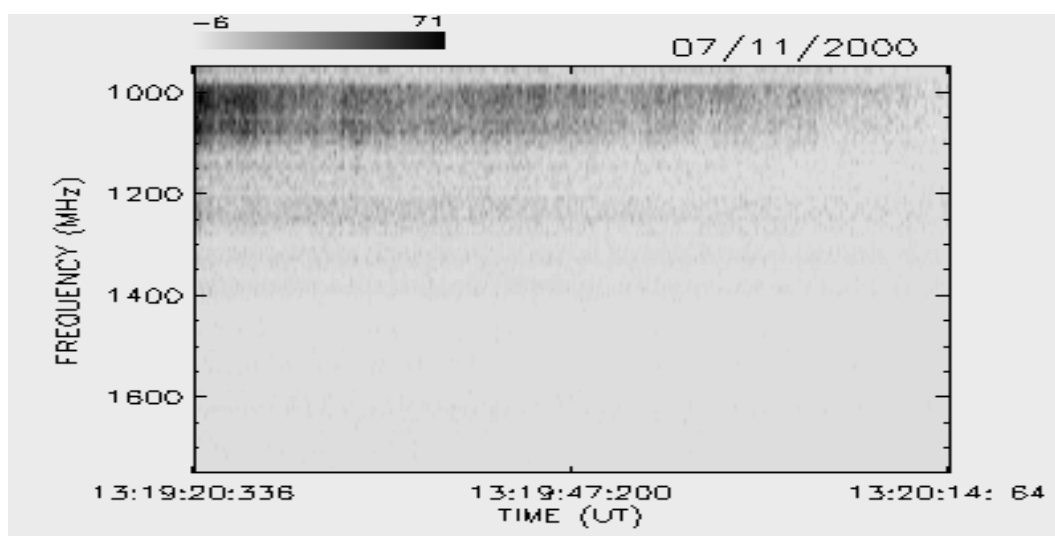
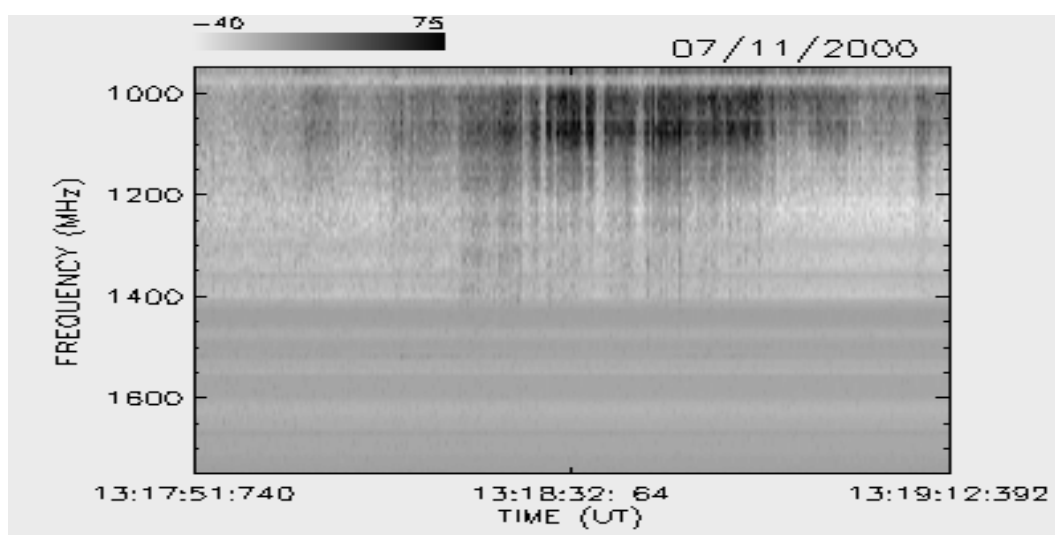
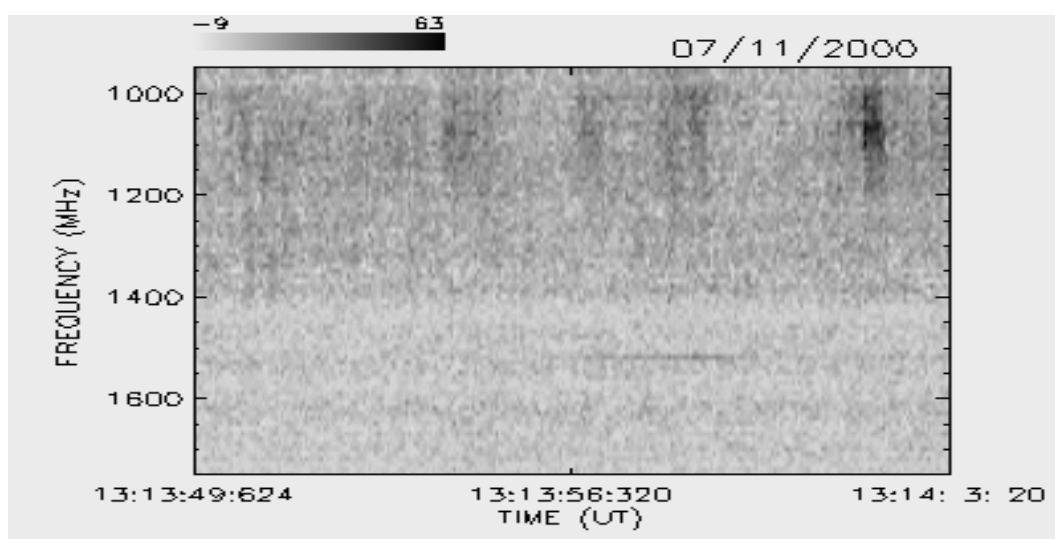
JULHO / 2000



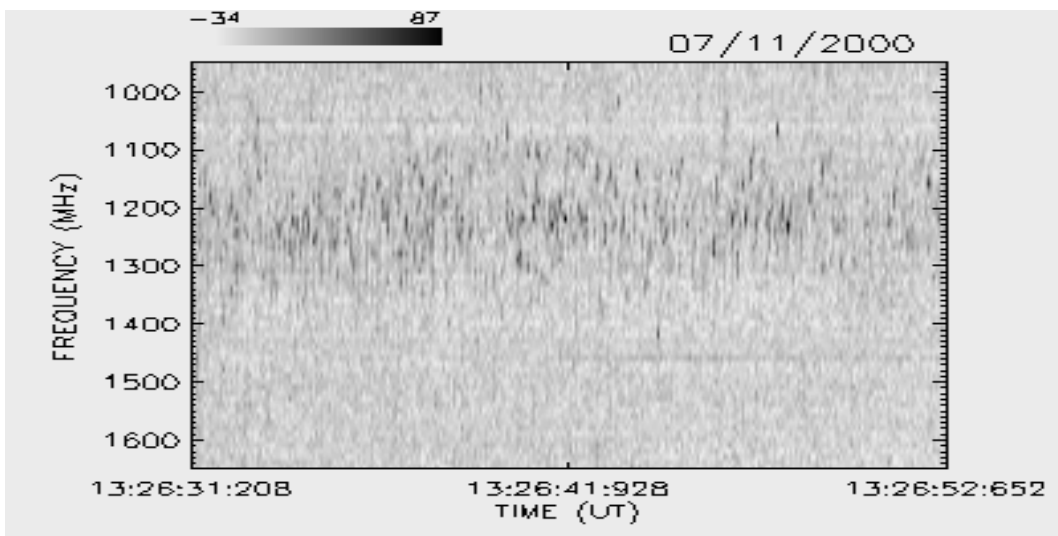
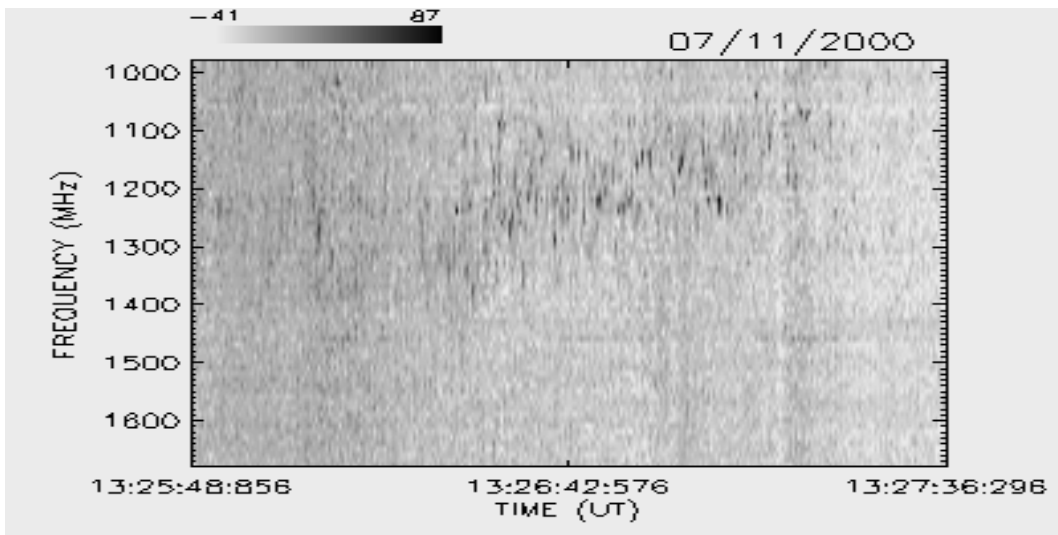
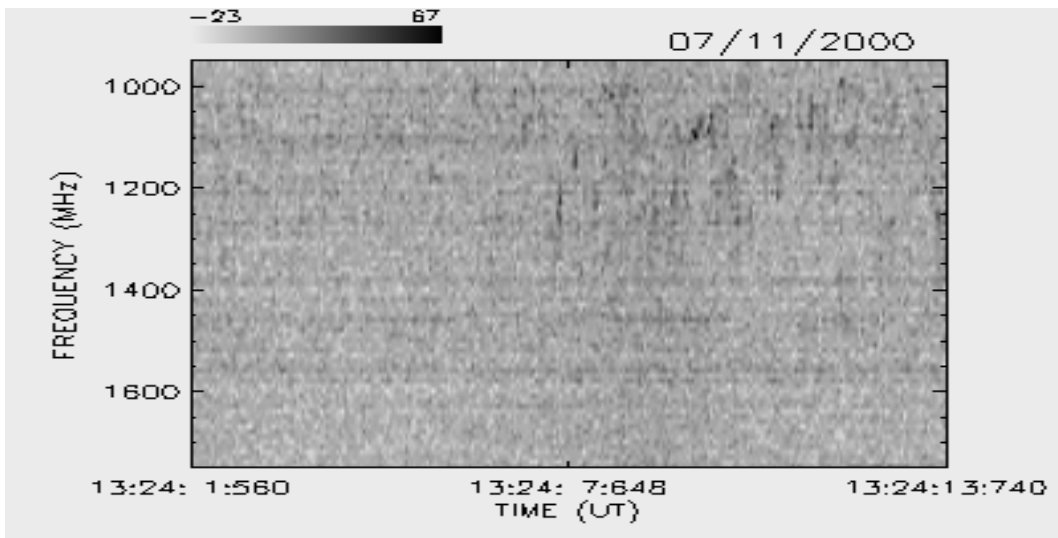
JULHO / 2000



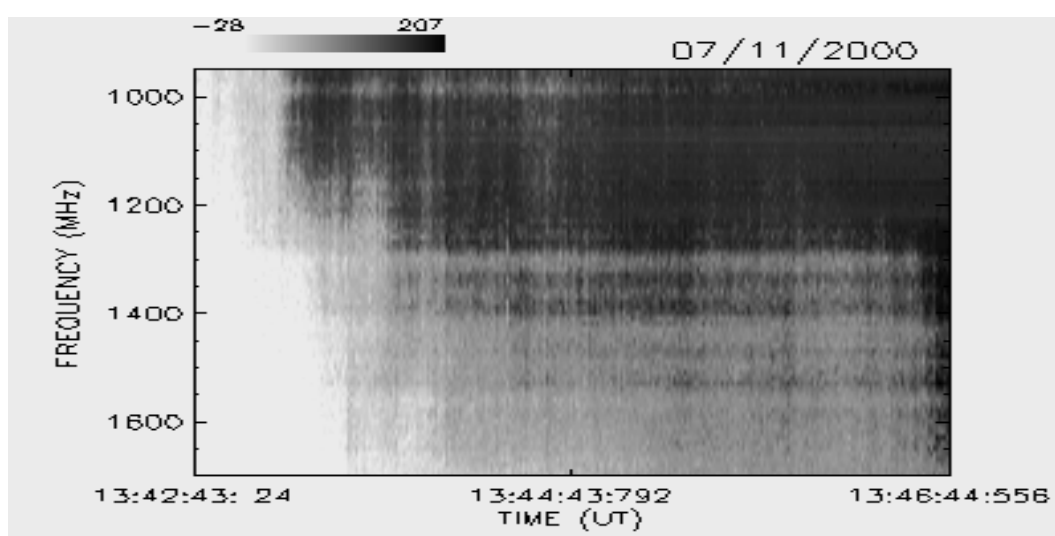
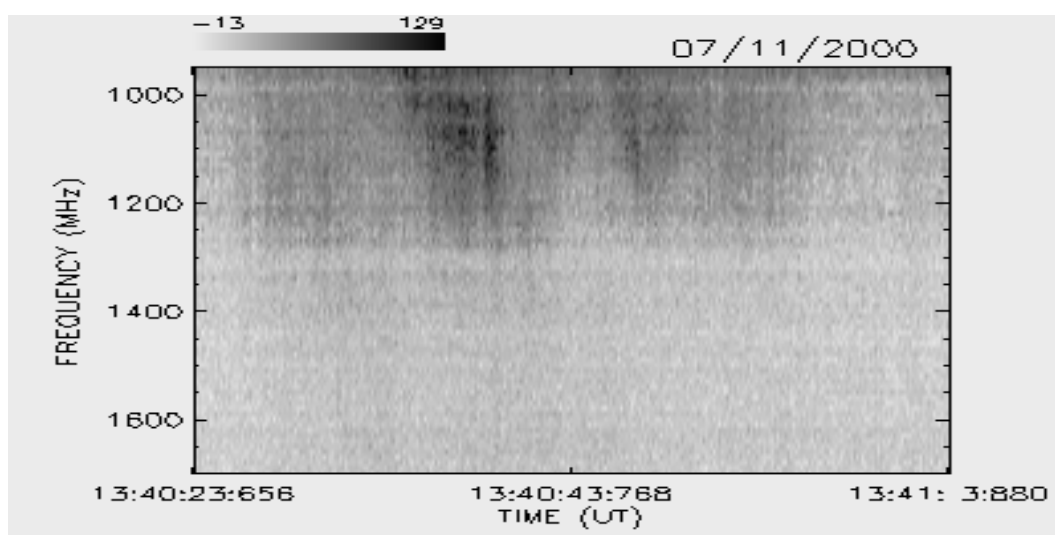
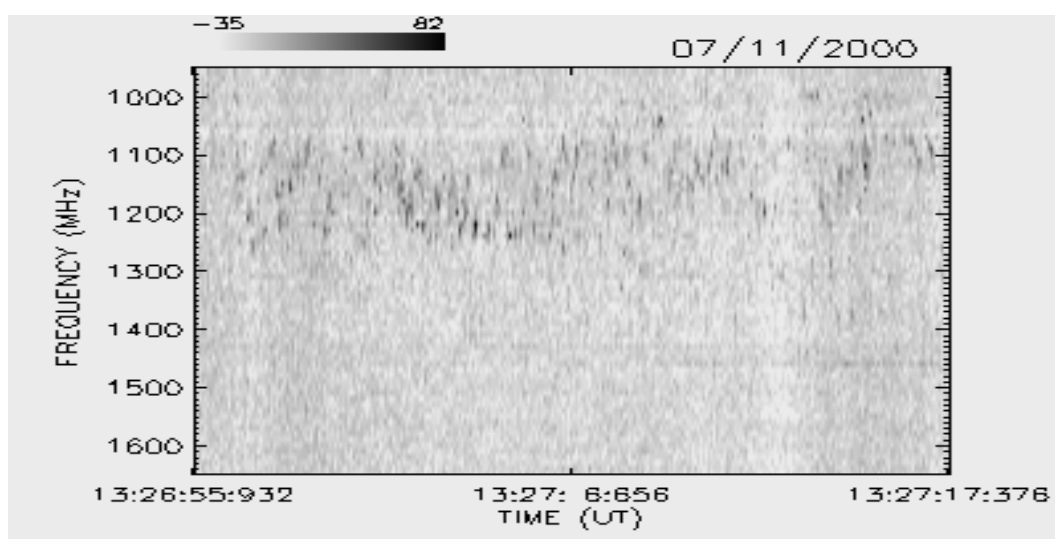
JULHO / 2000



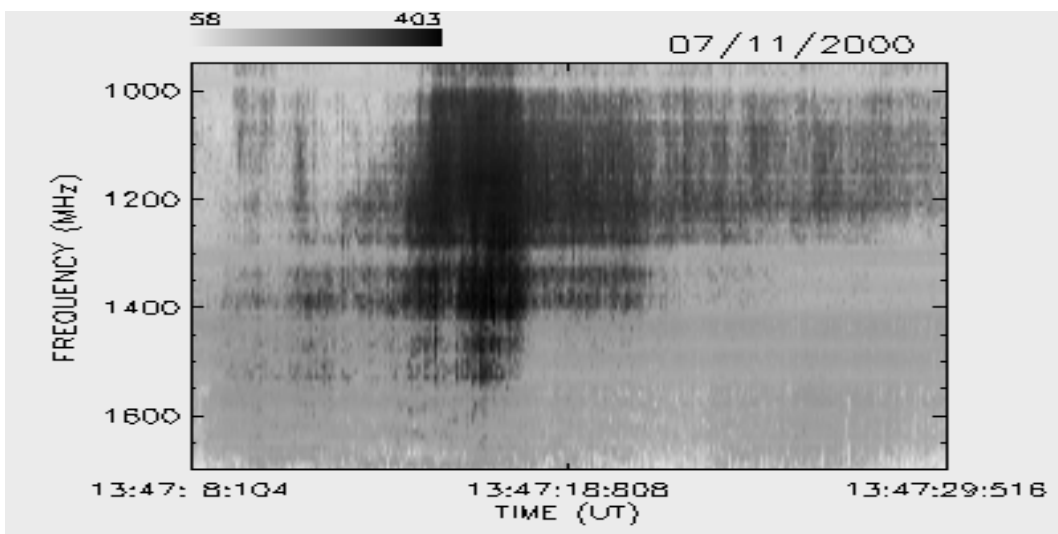
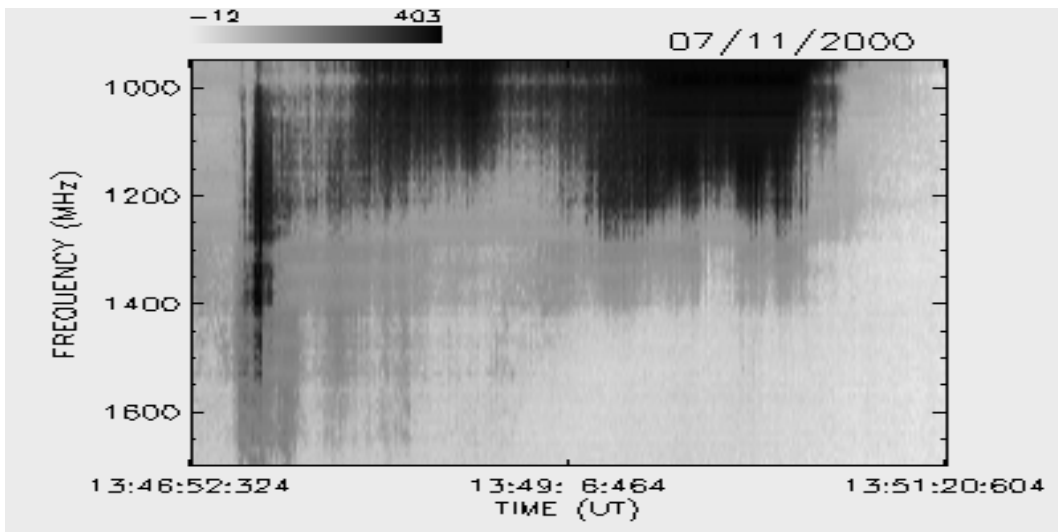
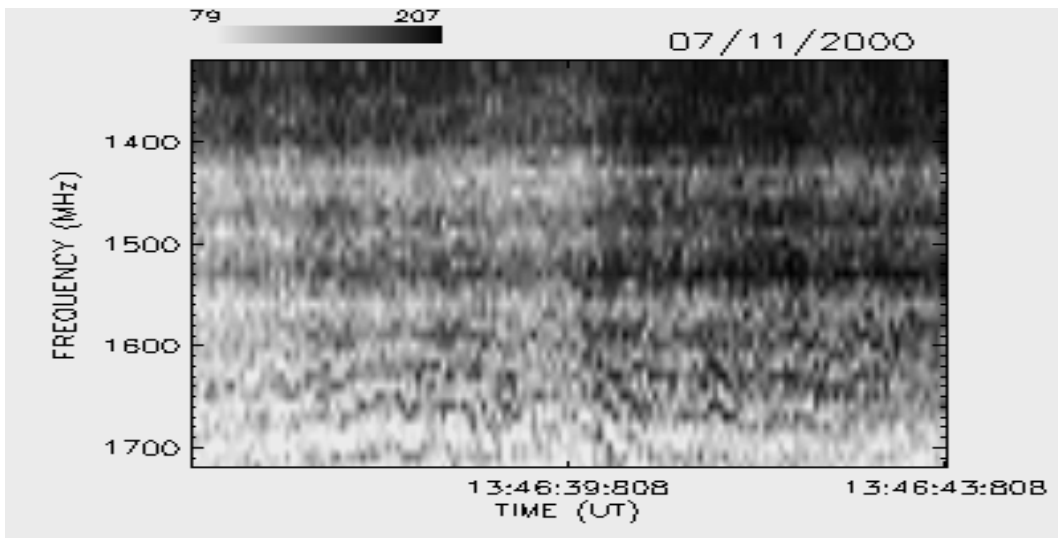
JULHO / 2000



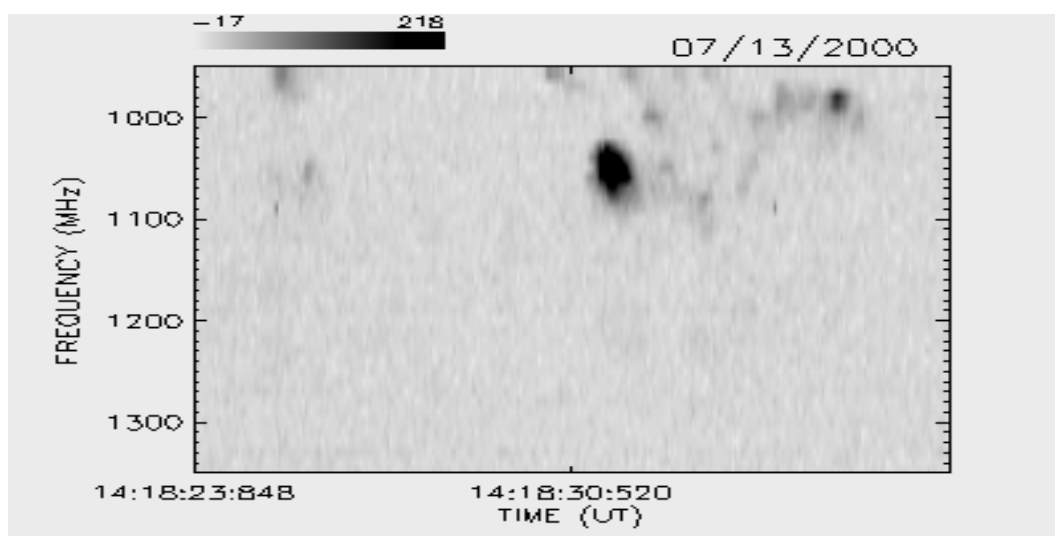
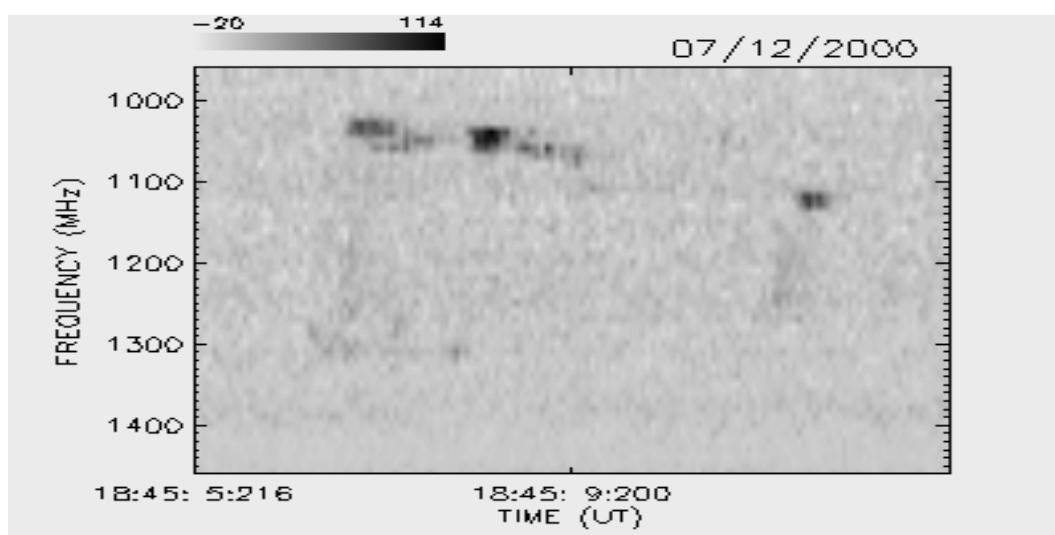
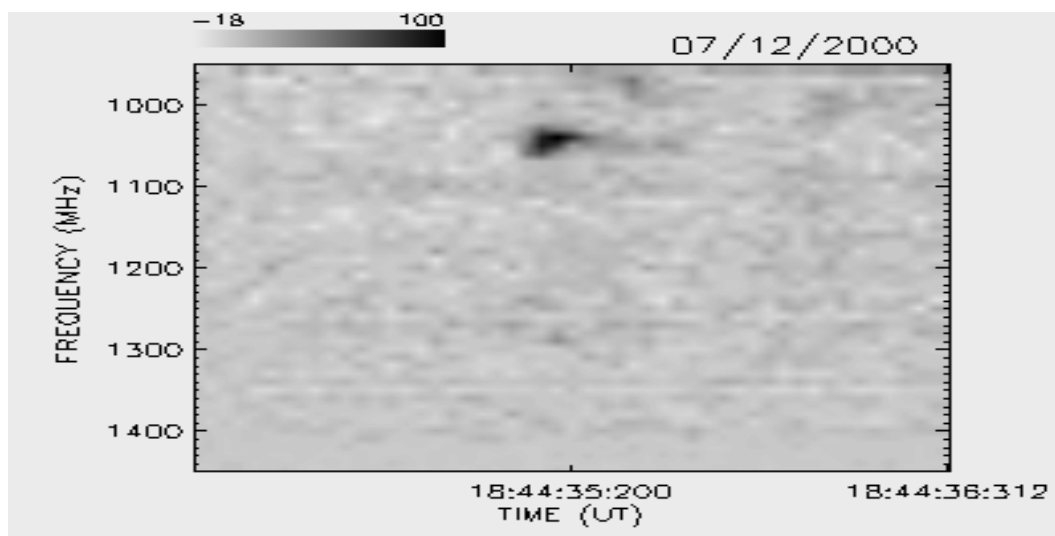
JULHO / 2000



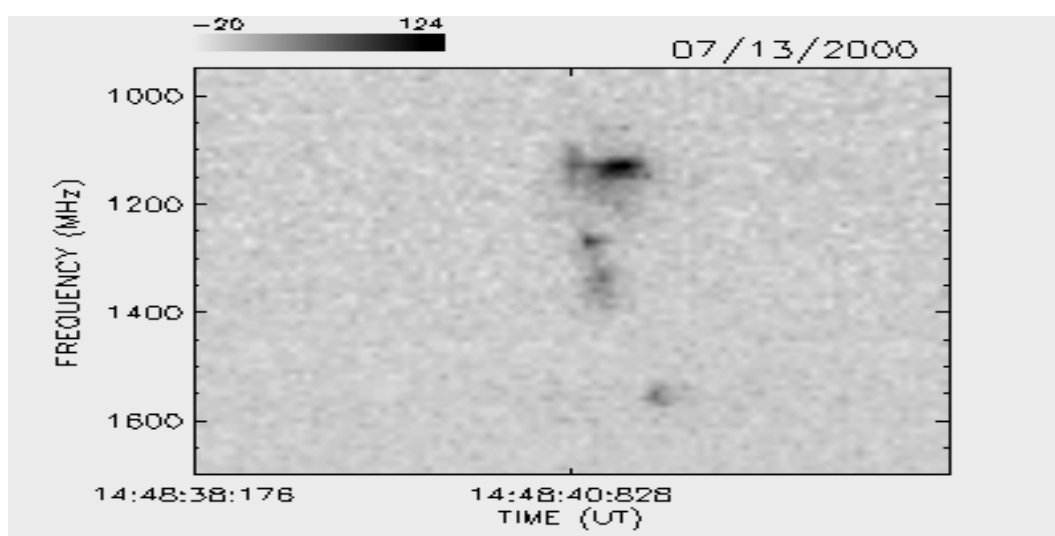
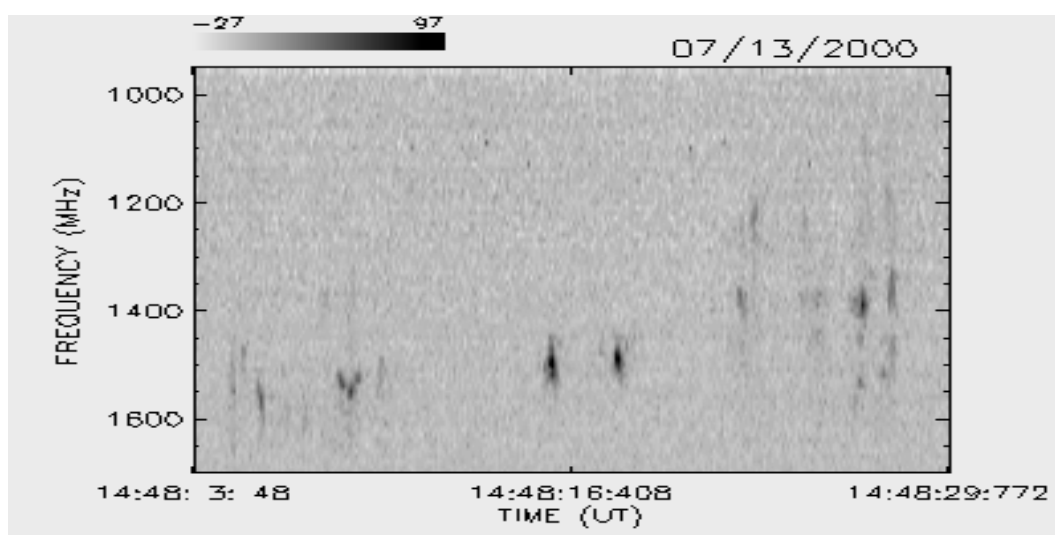
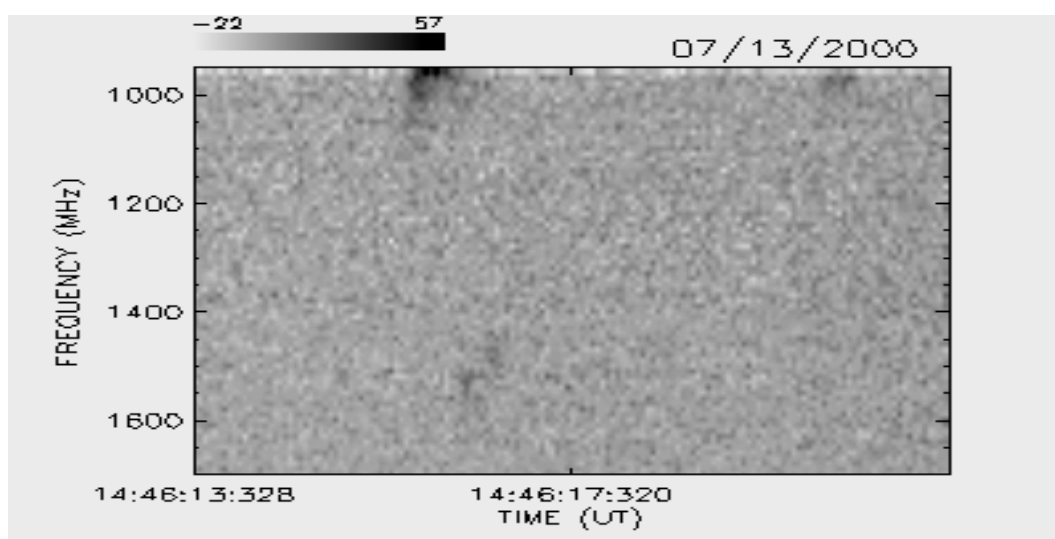
JULHO / 2000



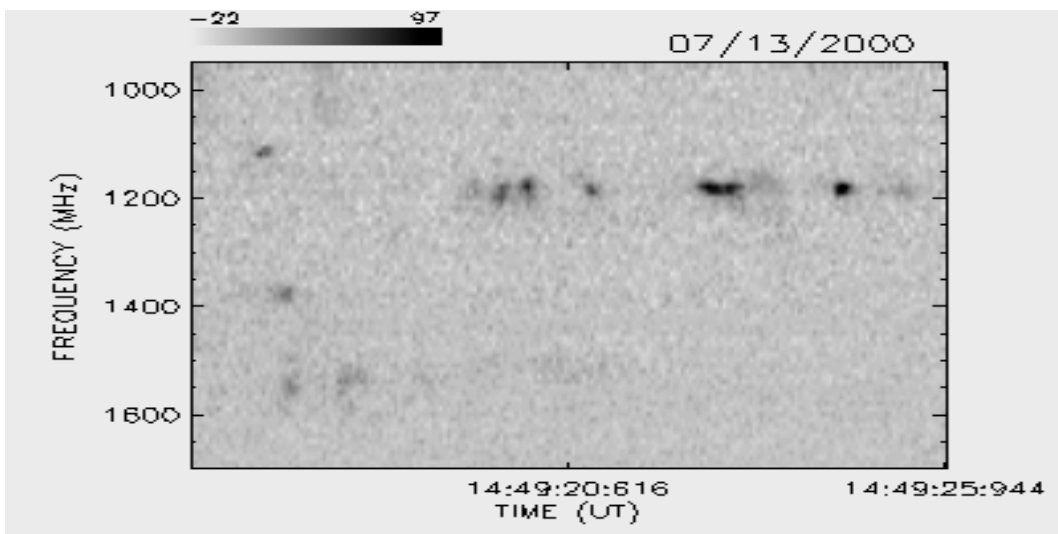
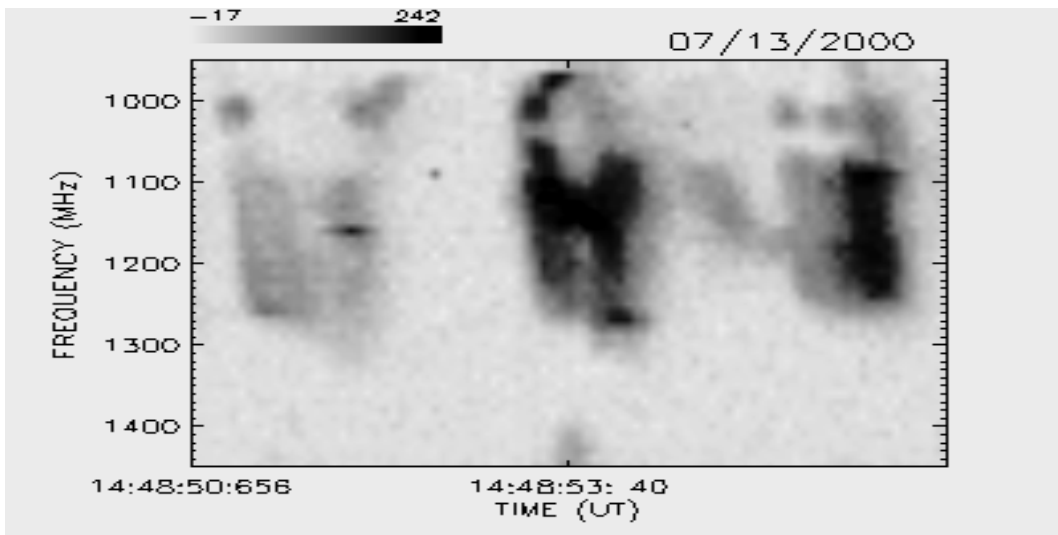
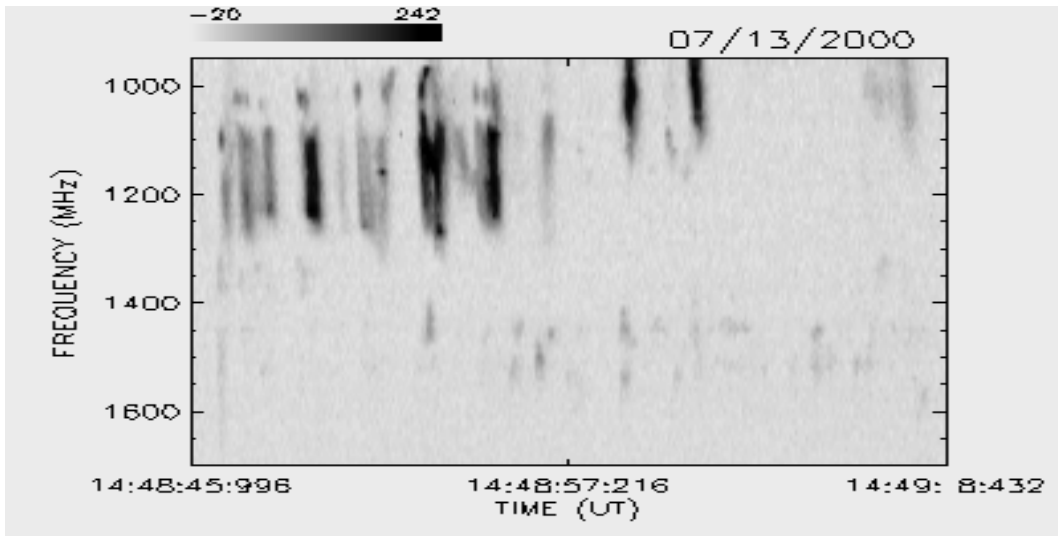
JULHO / 2000



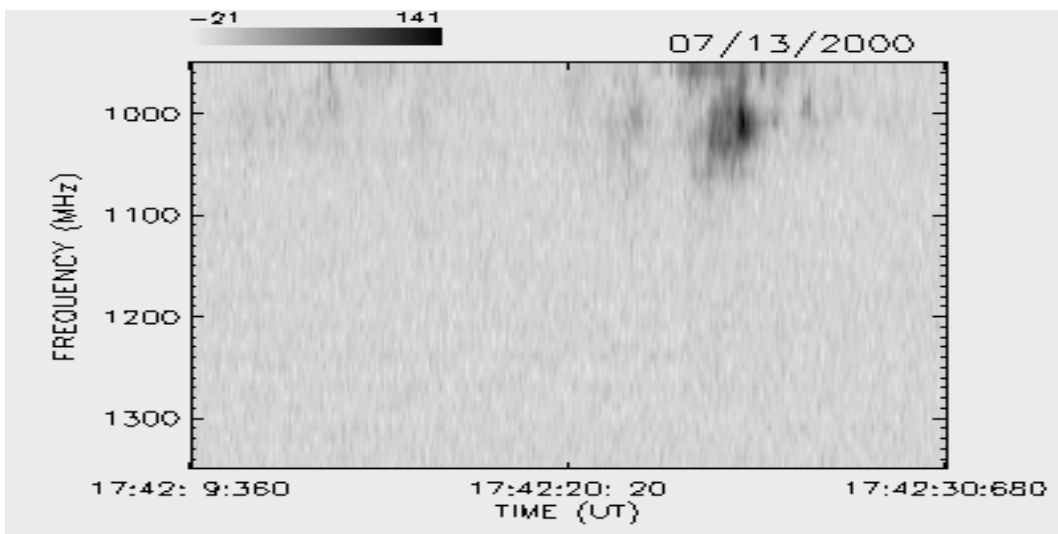
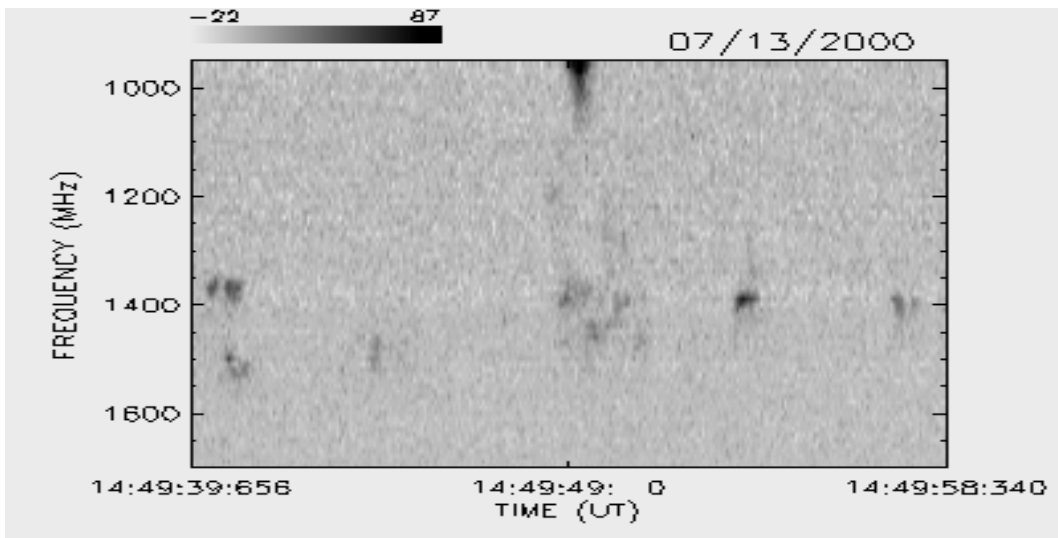
JULHO / 2000



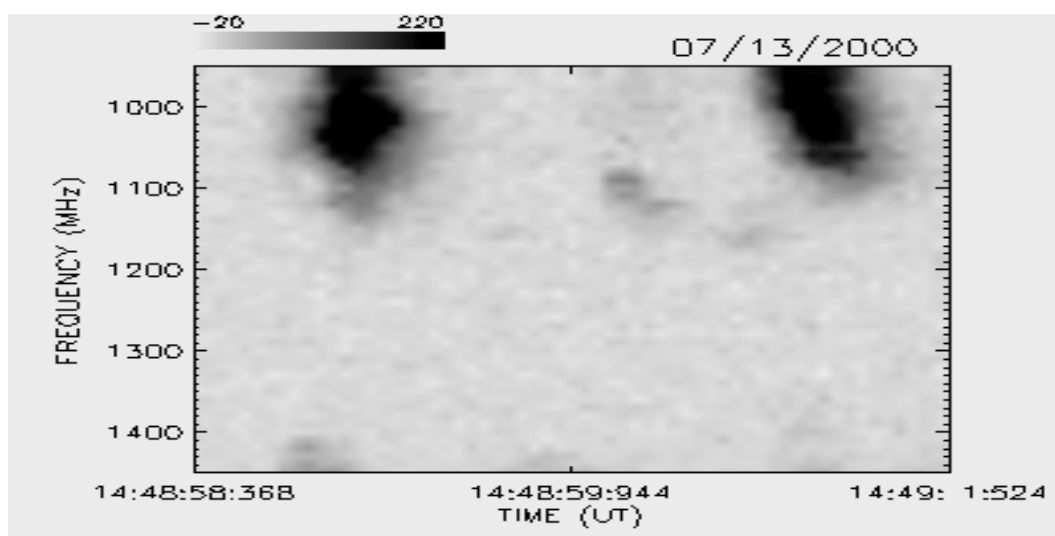
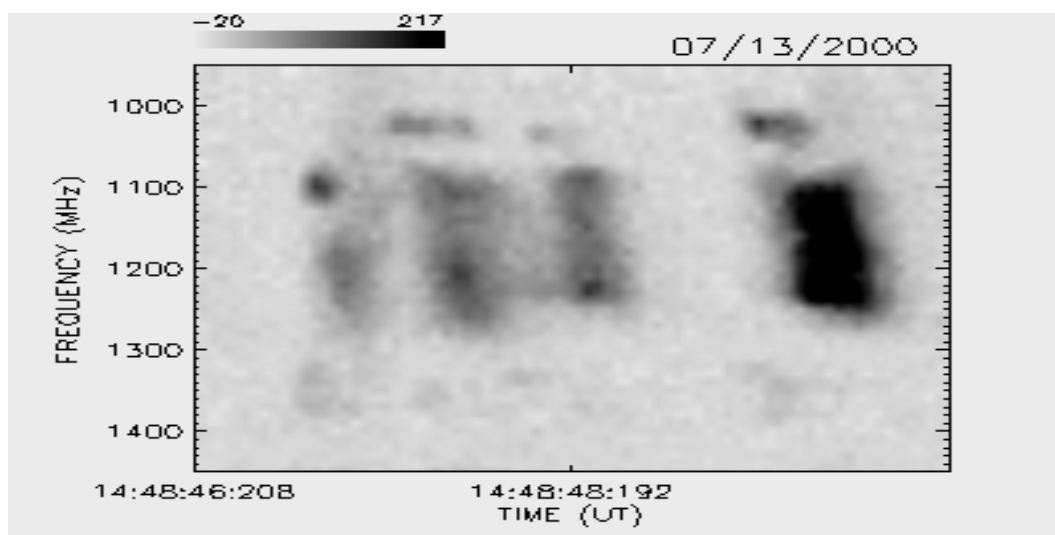
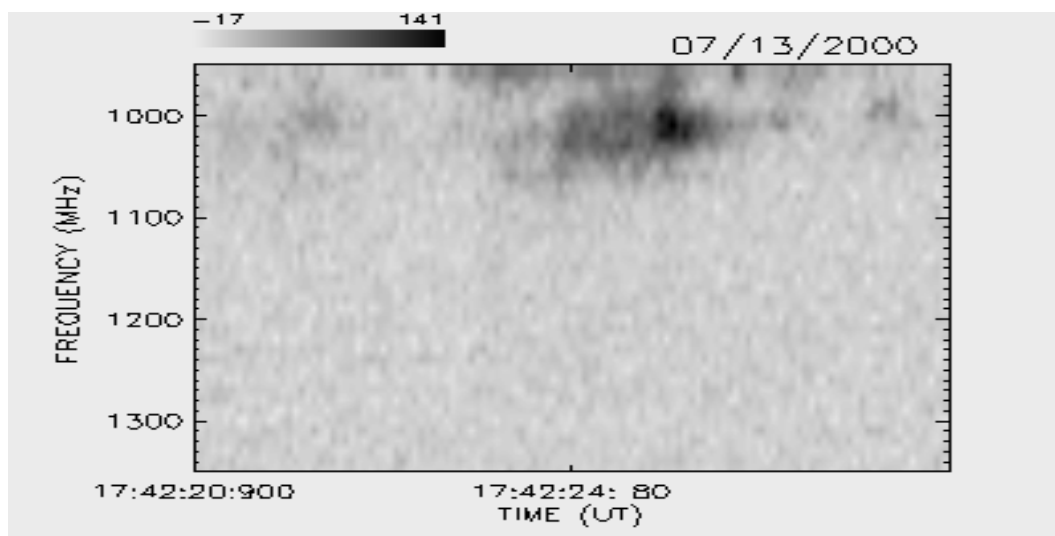
JULHO / 2000



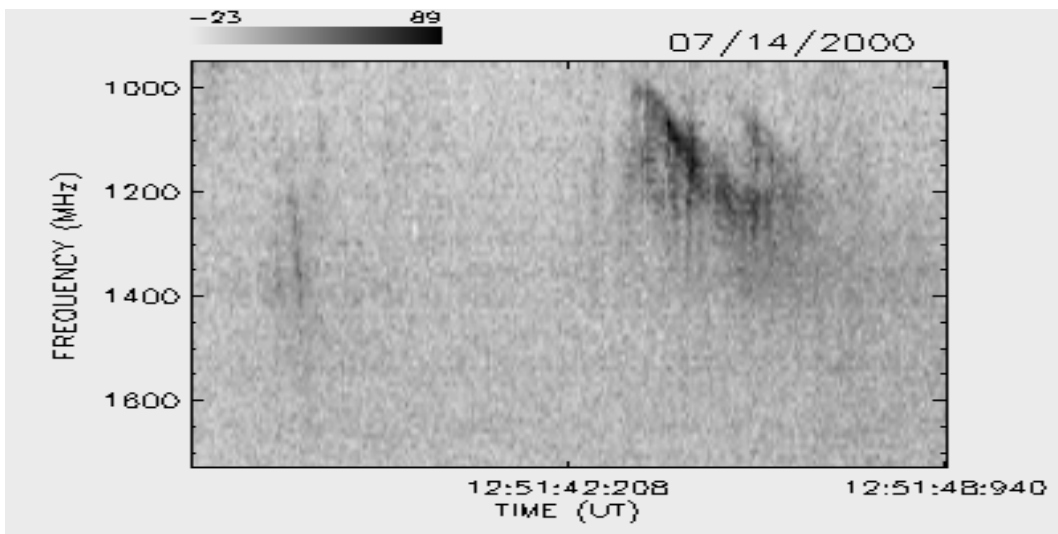
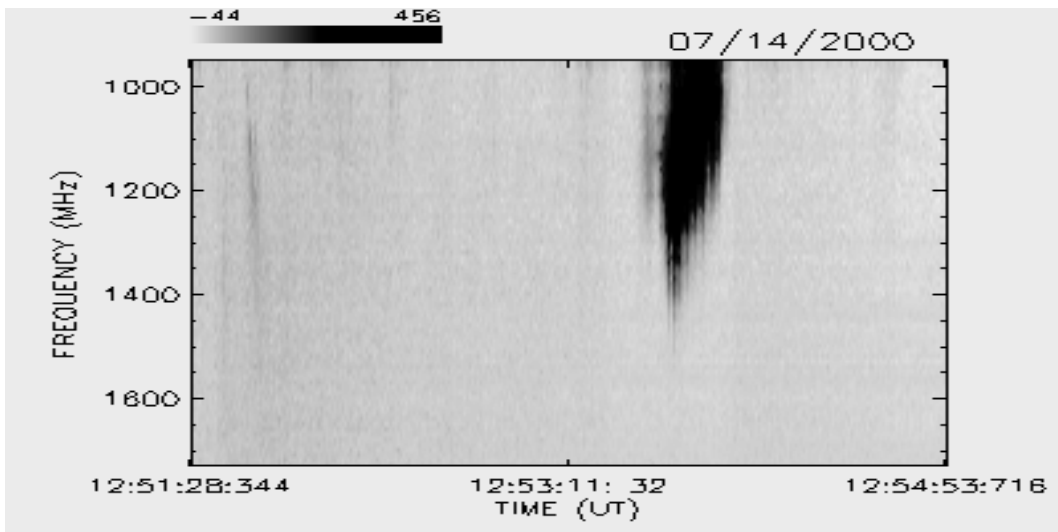
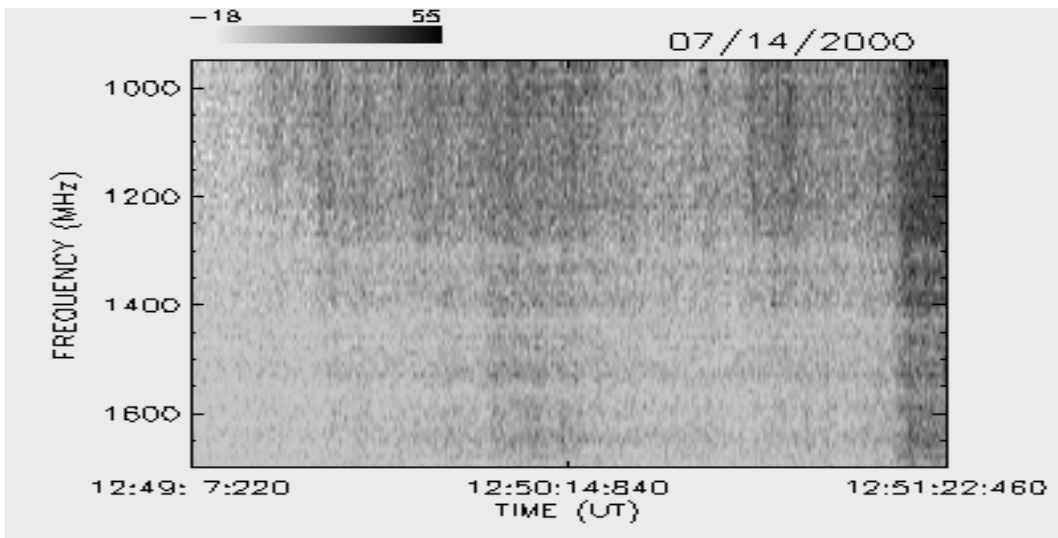
JULHO / 2000



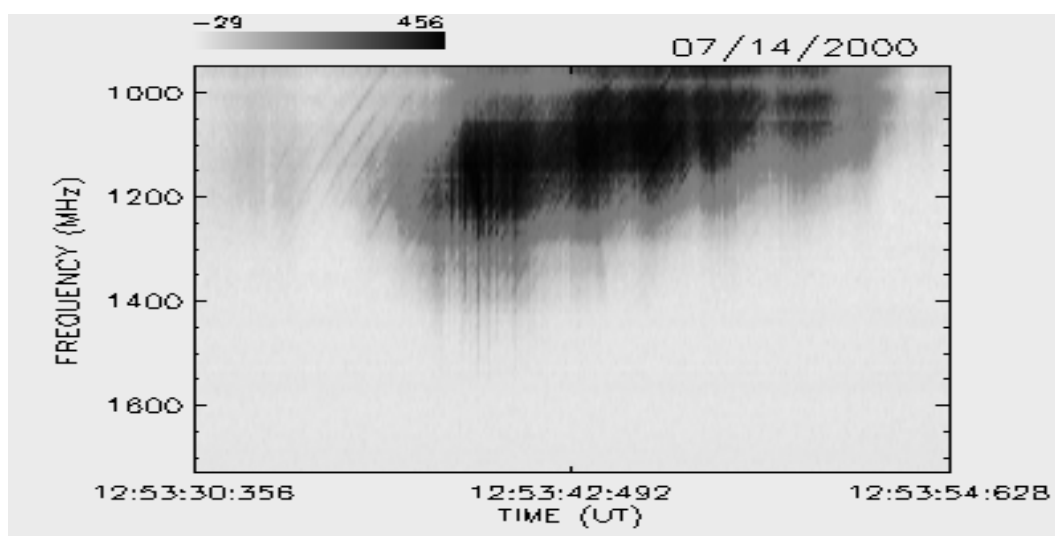
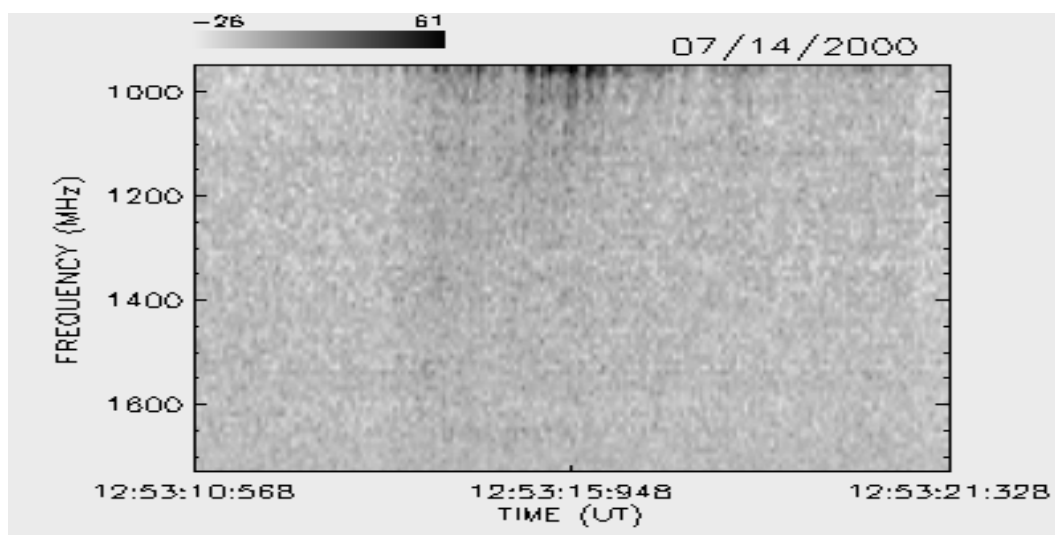
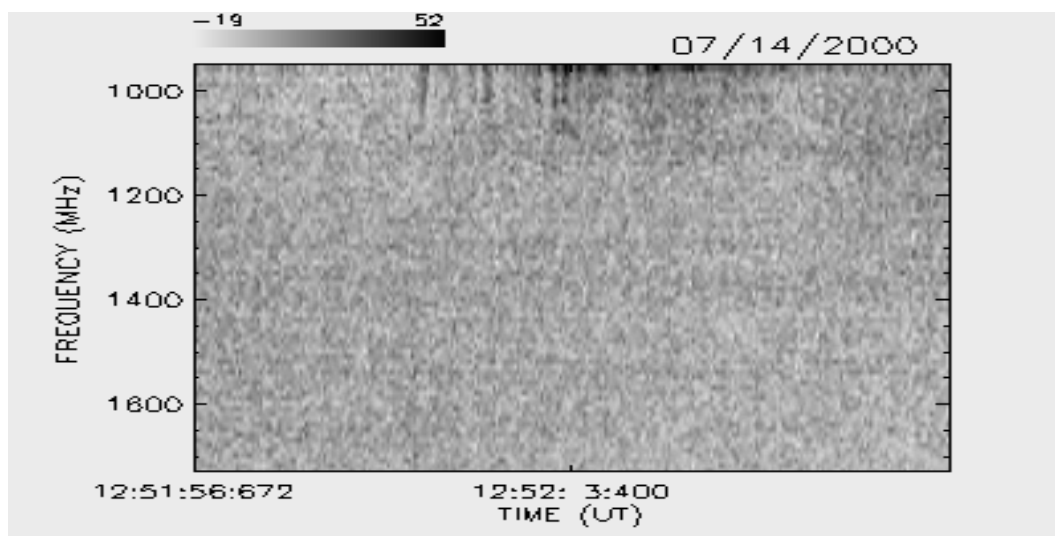
JULHO / 2000



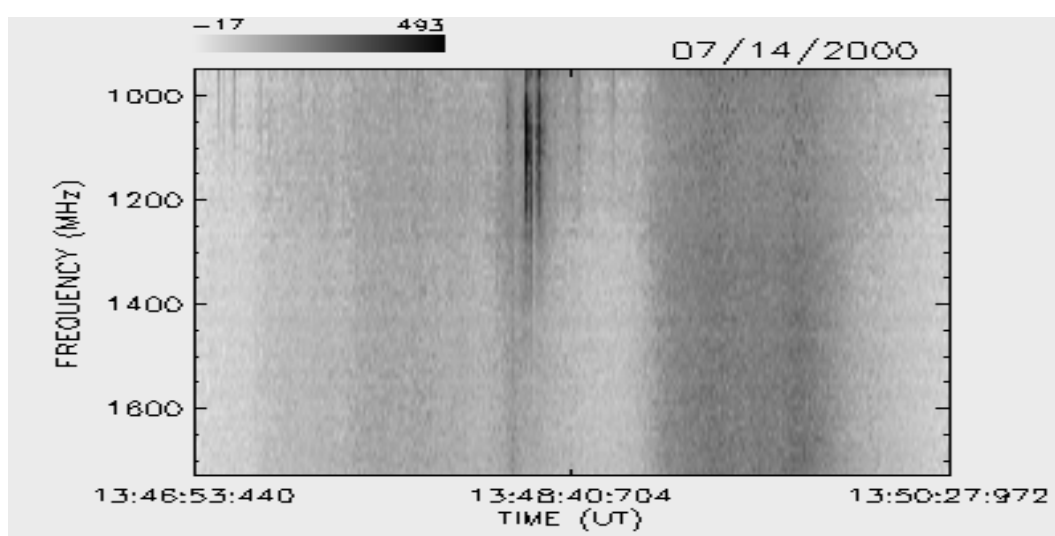
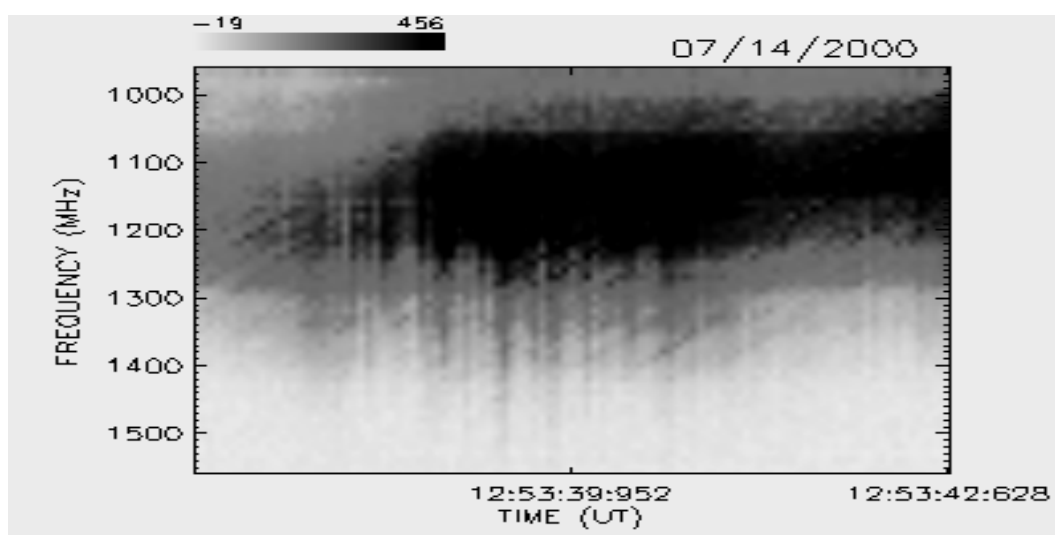
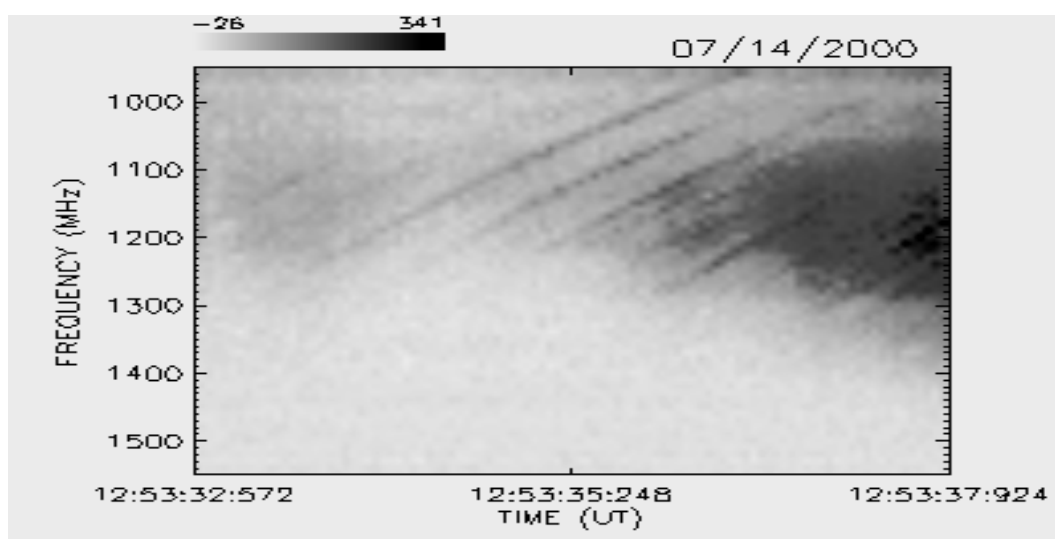
JULHO / 2000



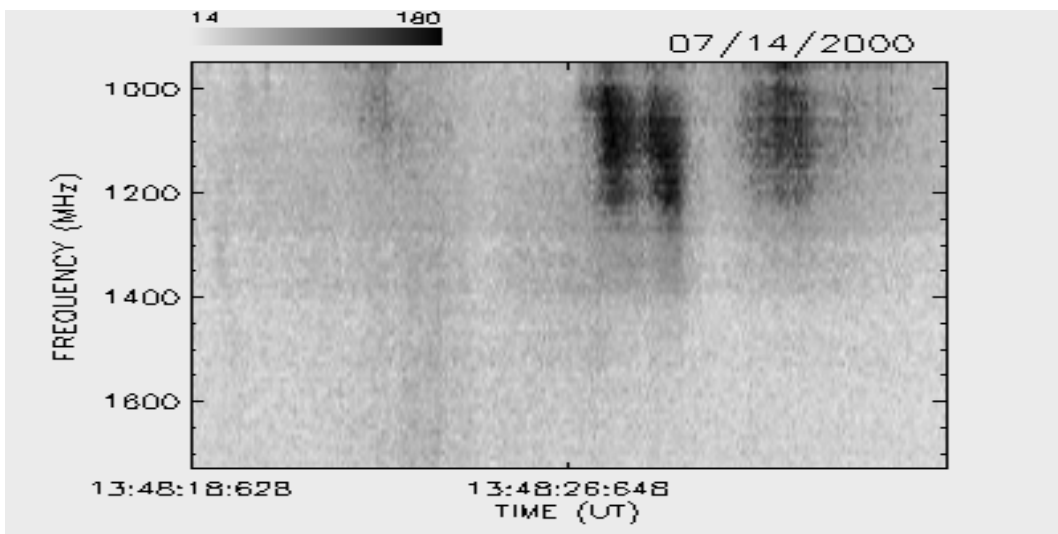
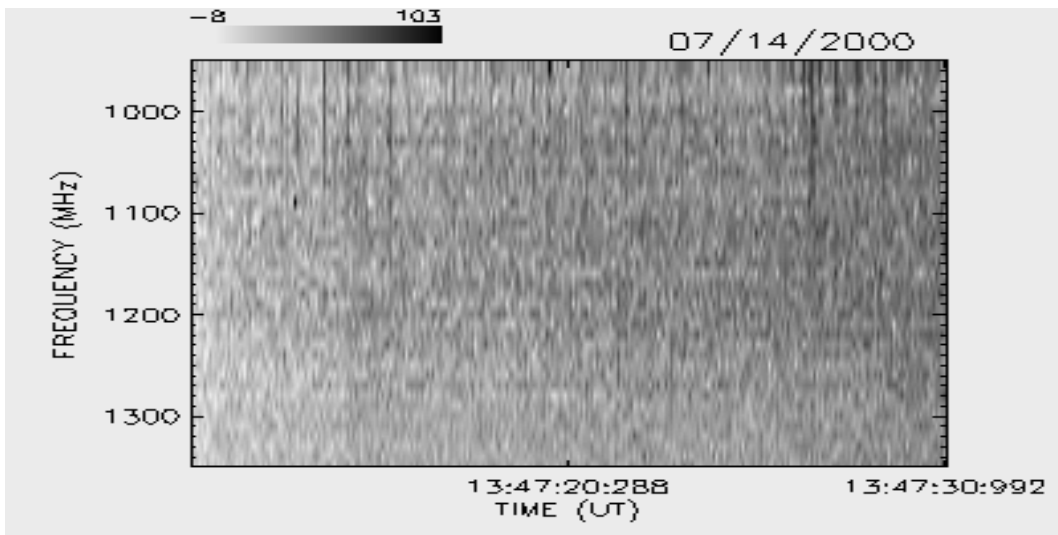
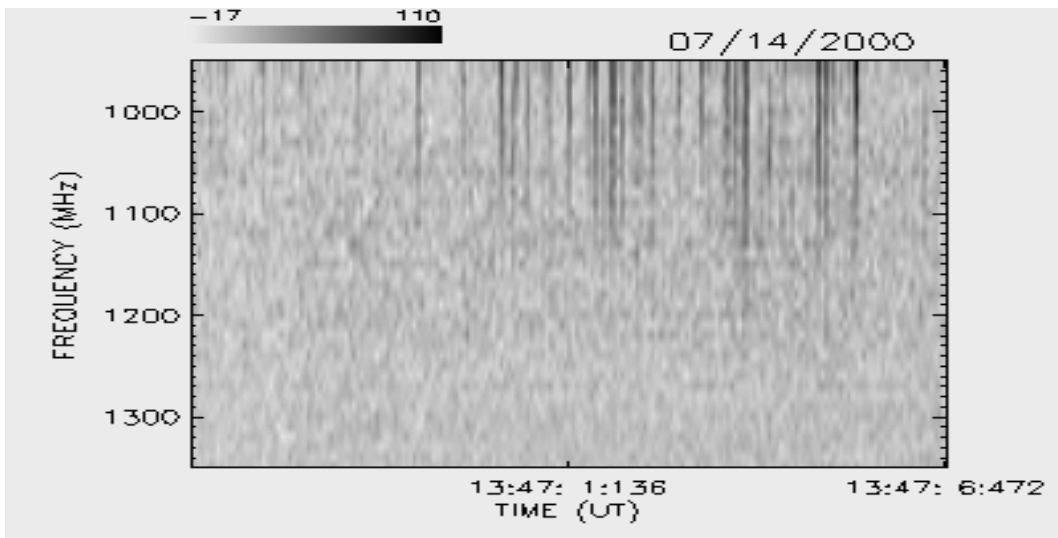
JULHO / 2000



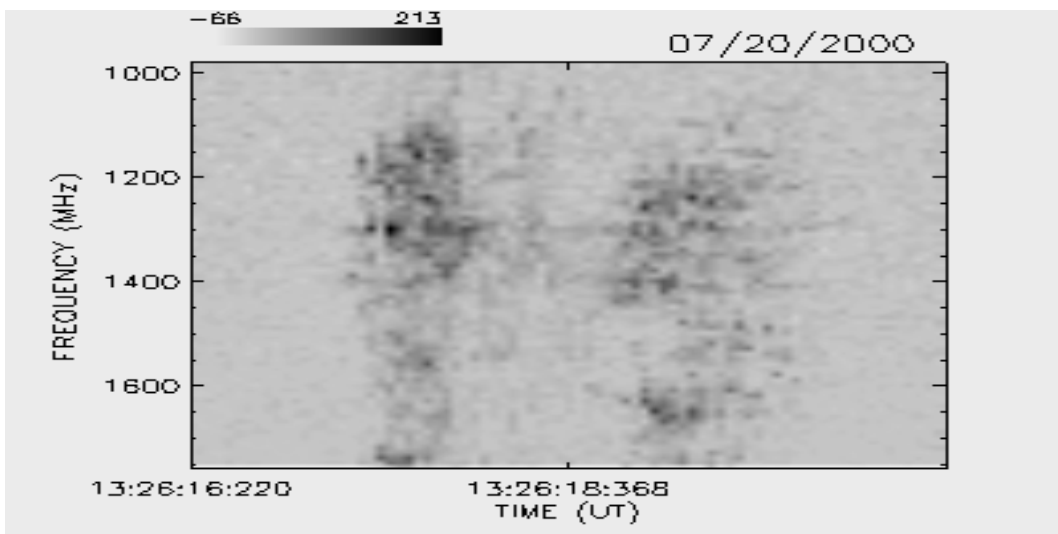
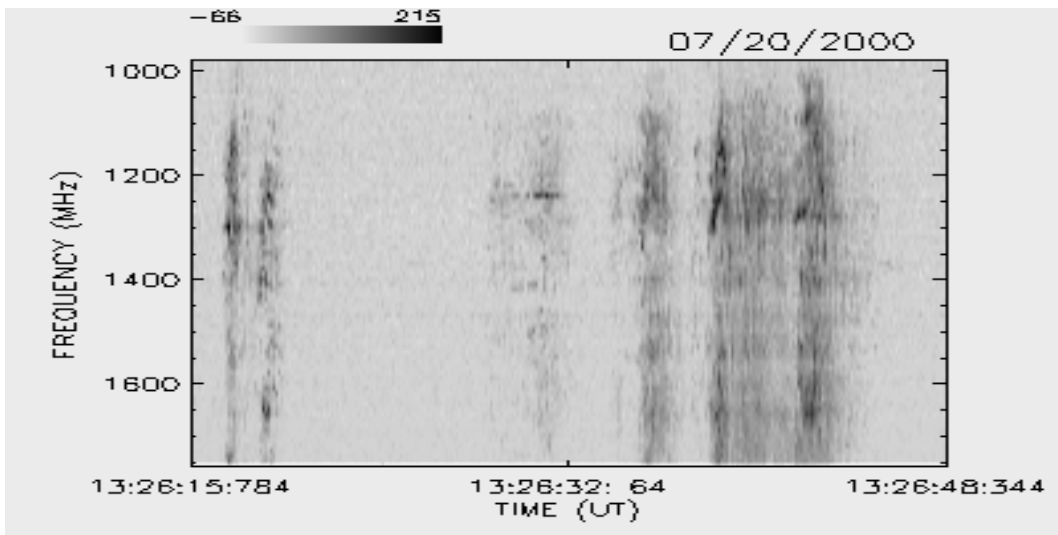
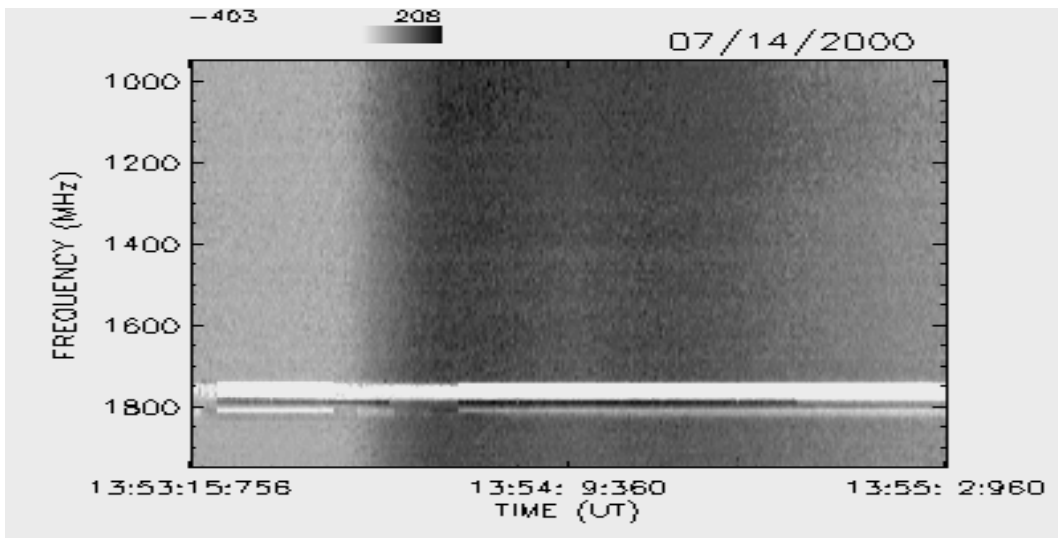
JULHO / 2000



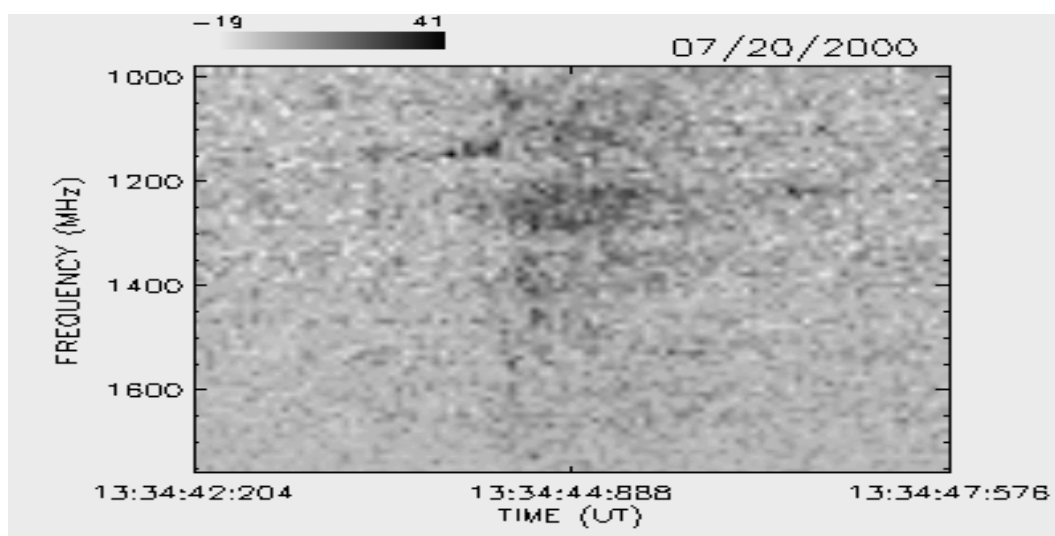
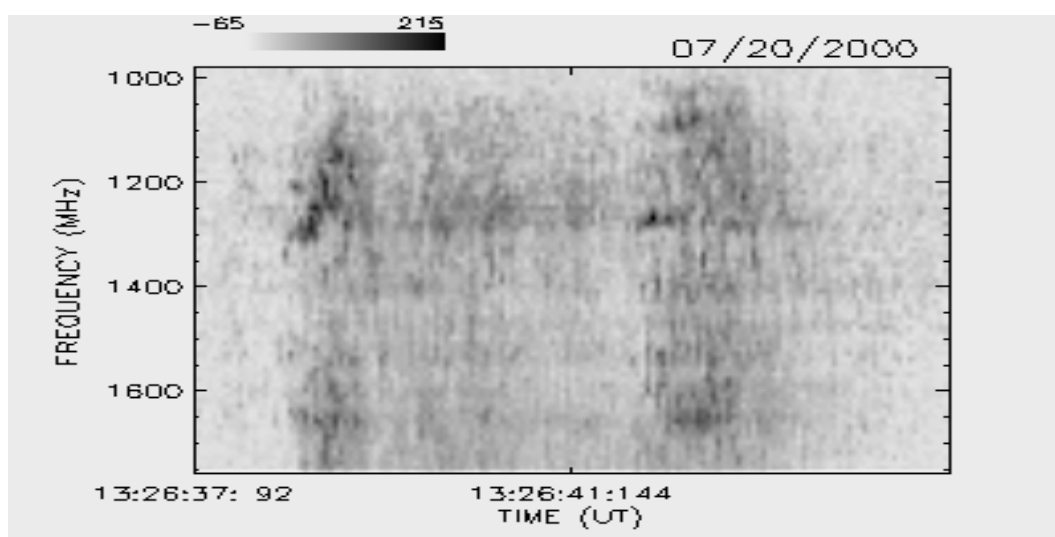
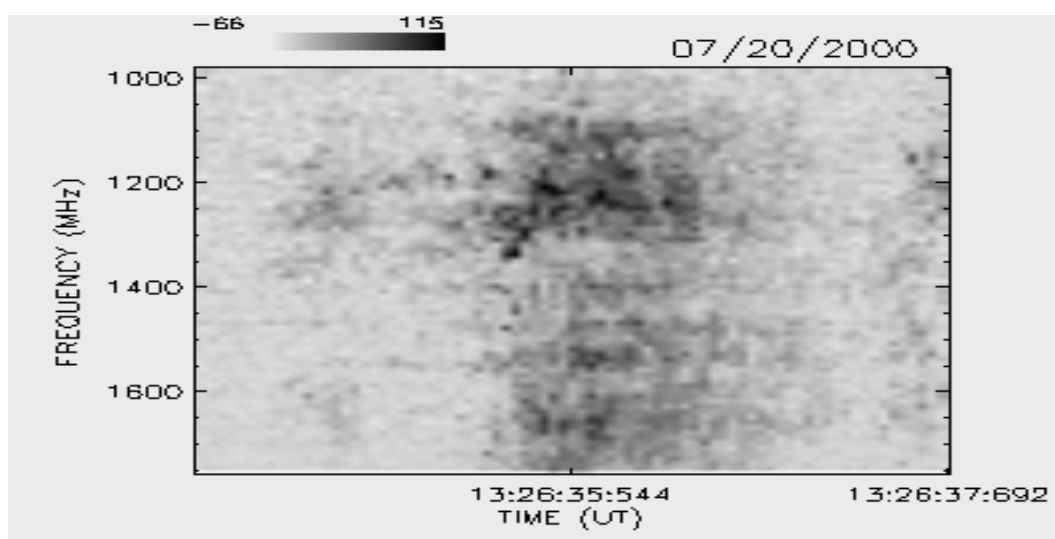
JULHO / 2000



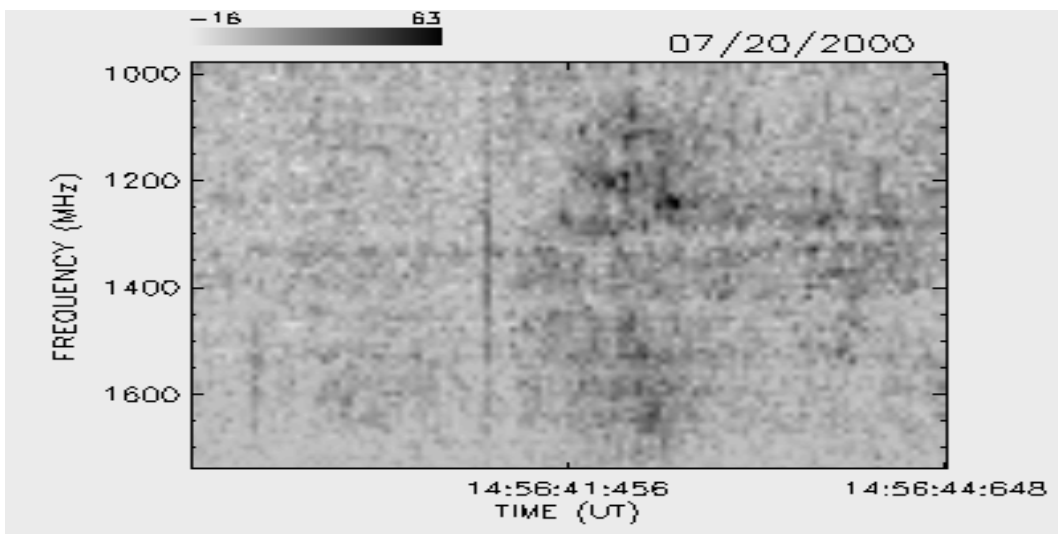
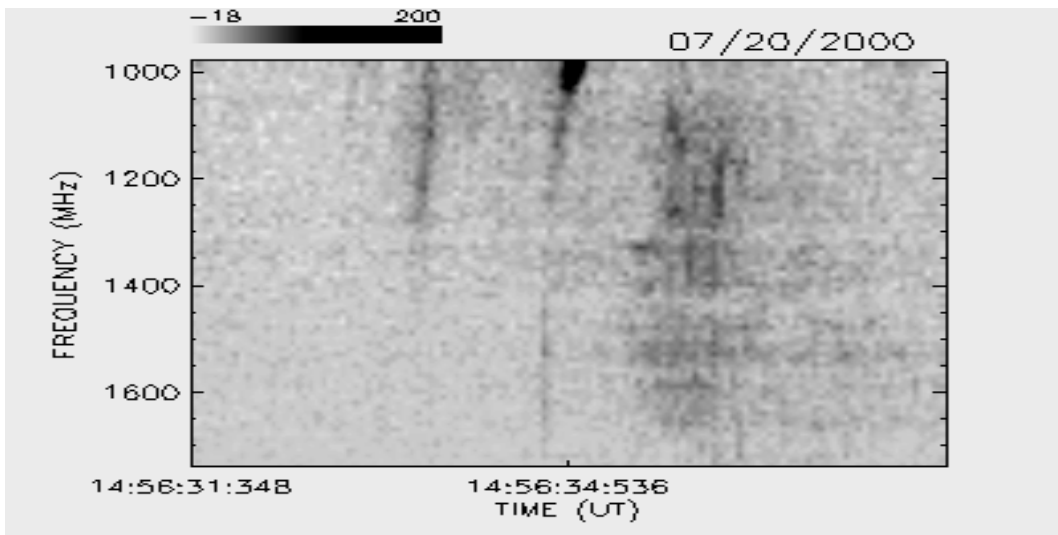
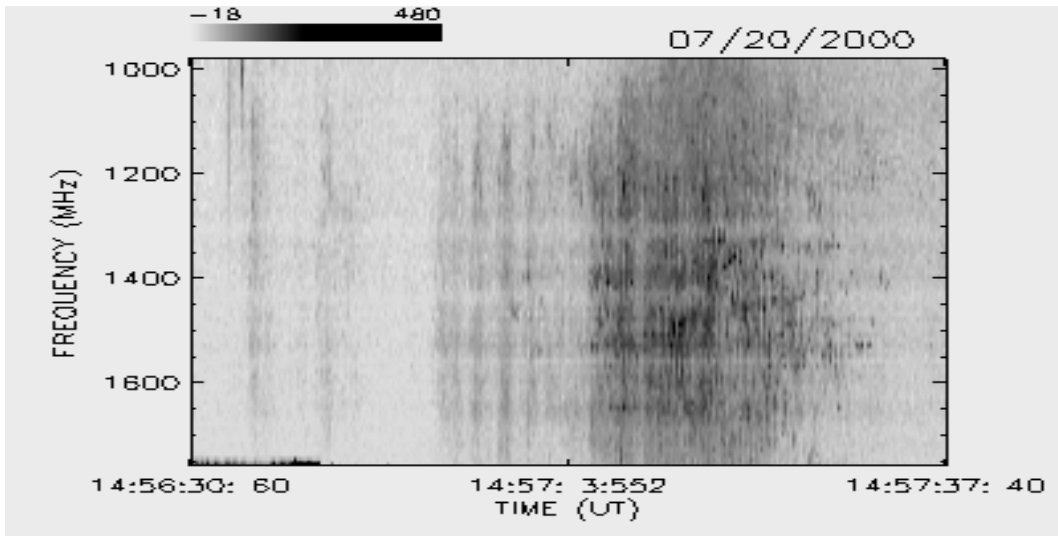
JULHO / 2000



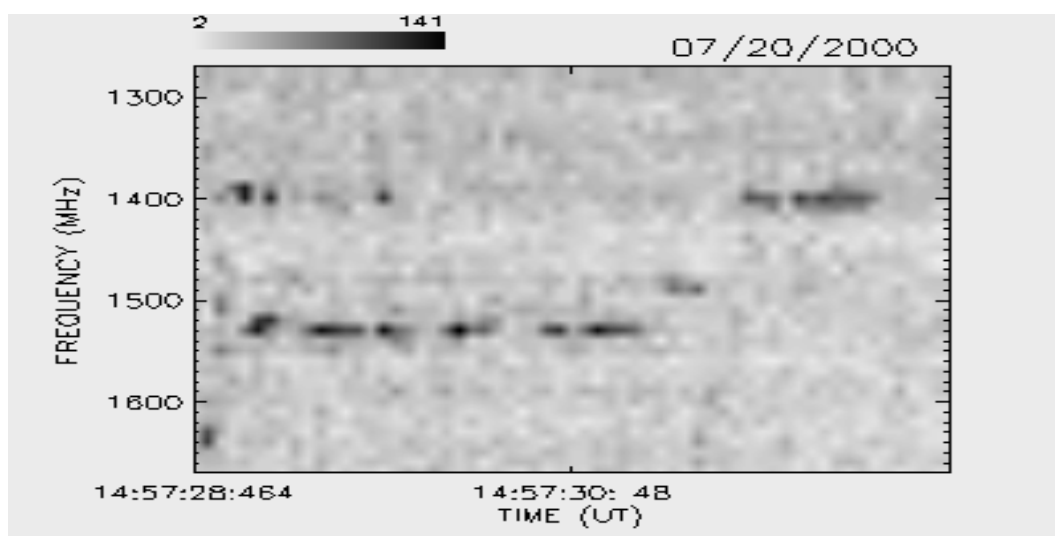
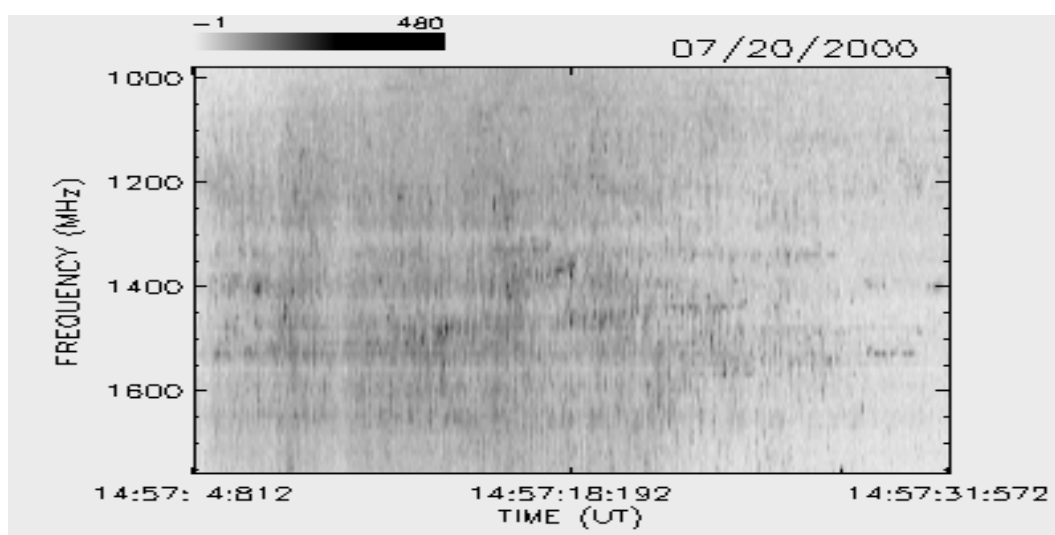
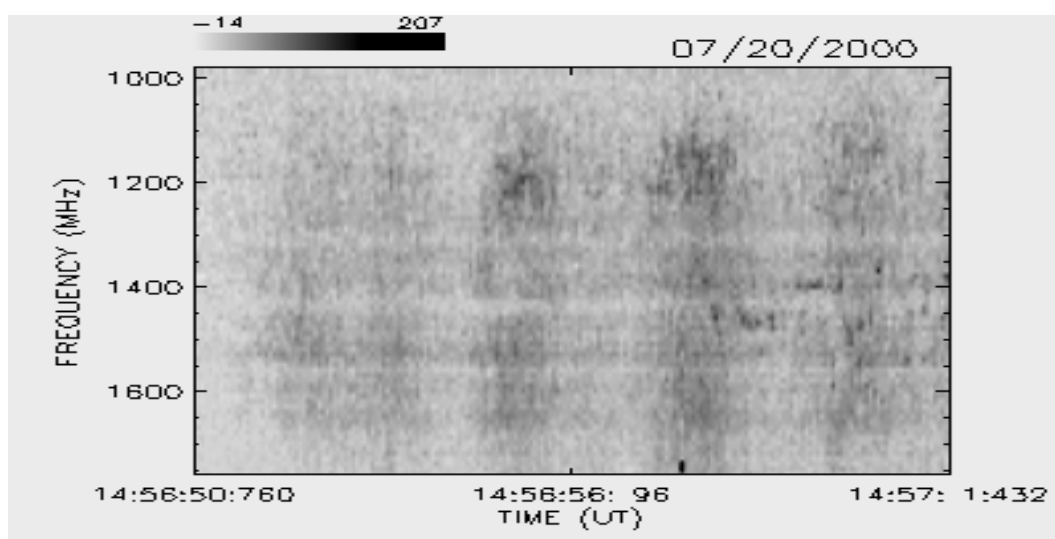
JULHO / 2000



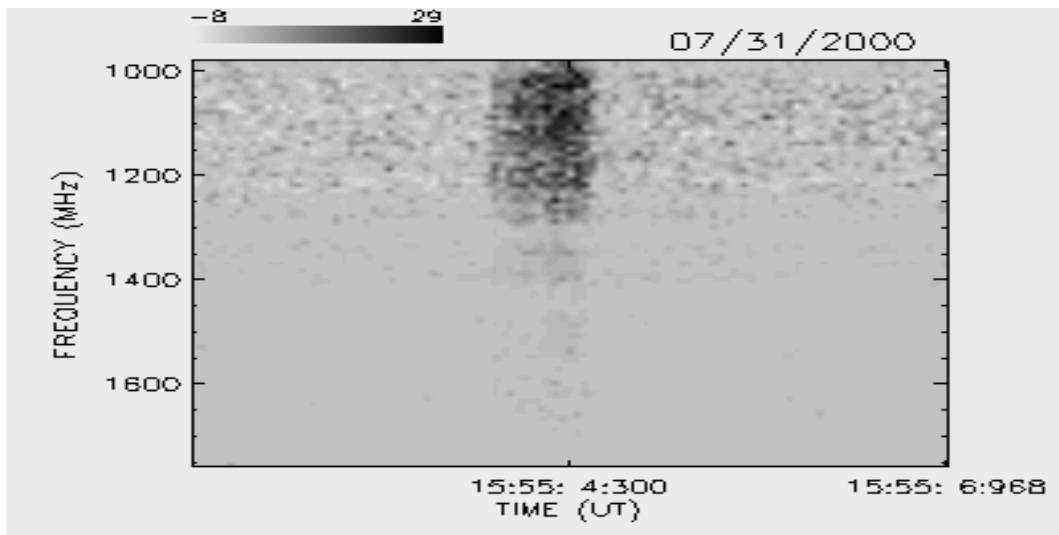
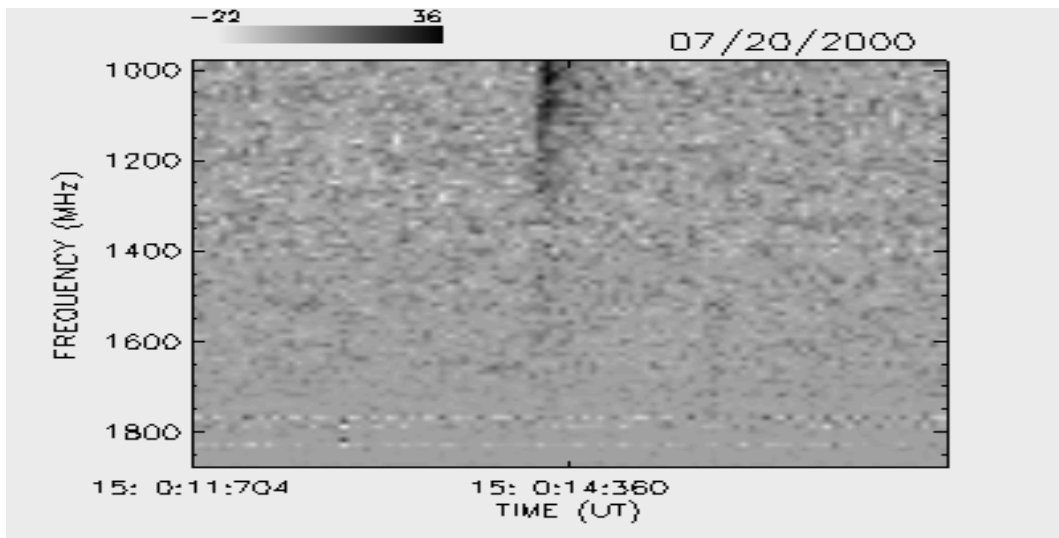
JULHO / 2000



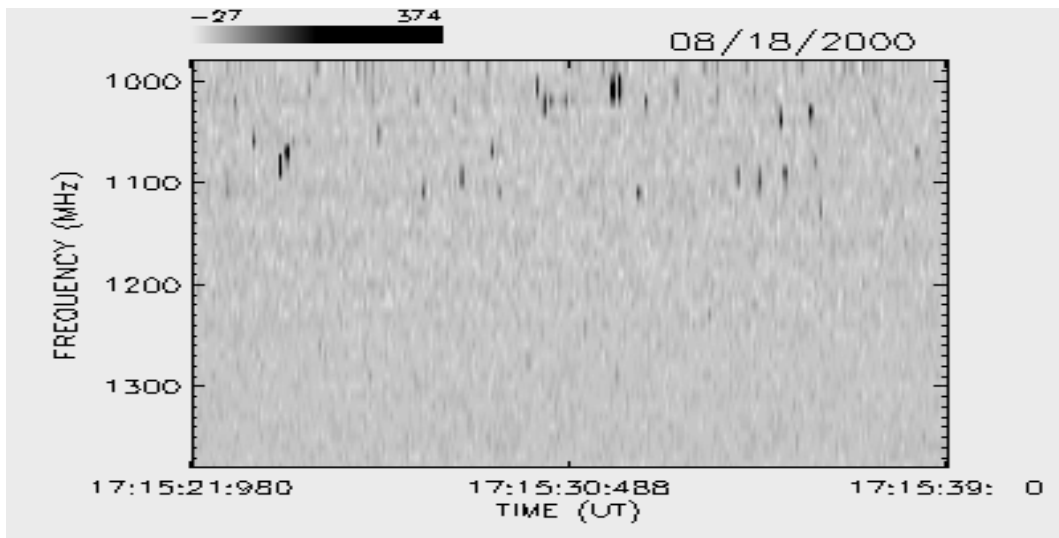
JULHO / 2000



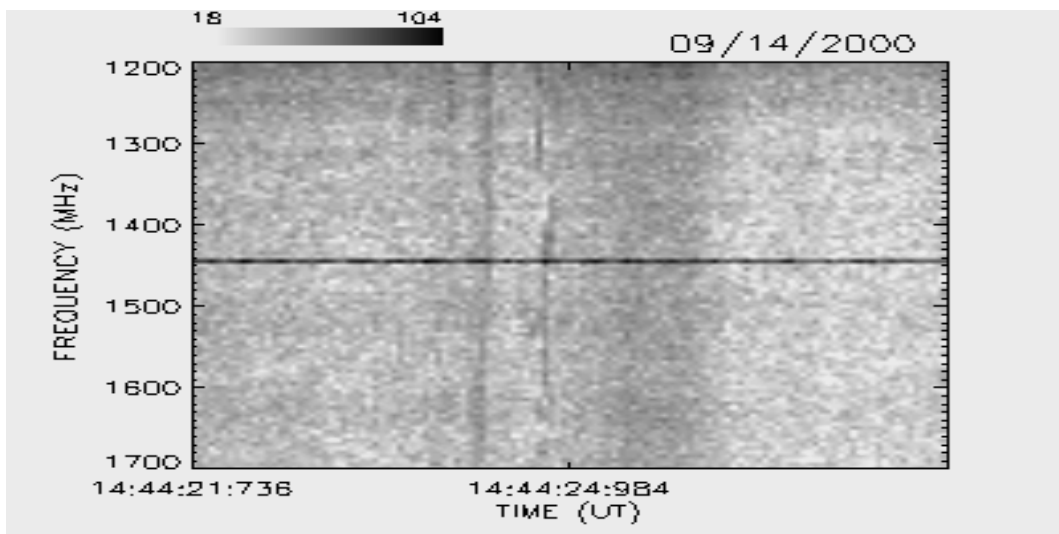
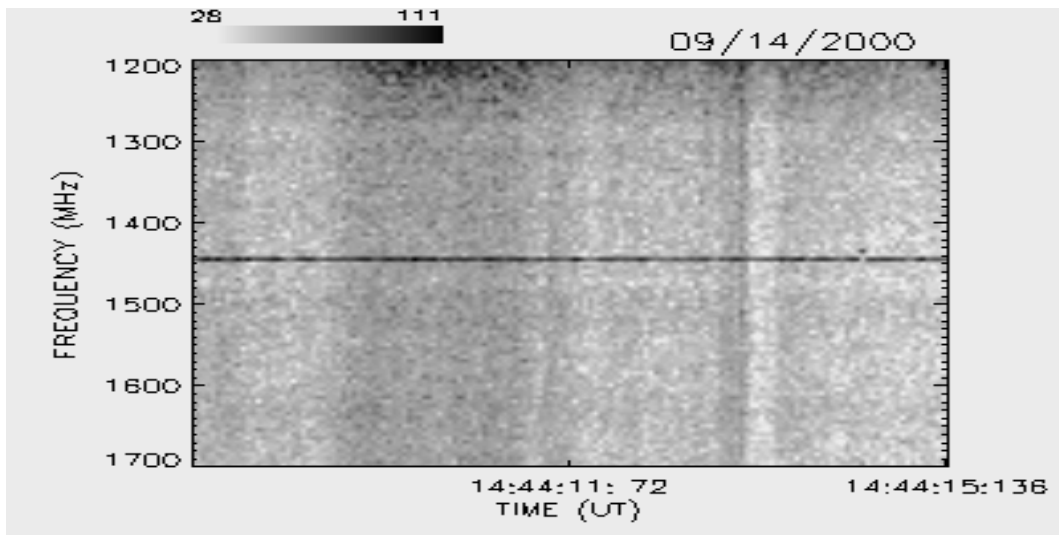
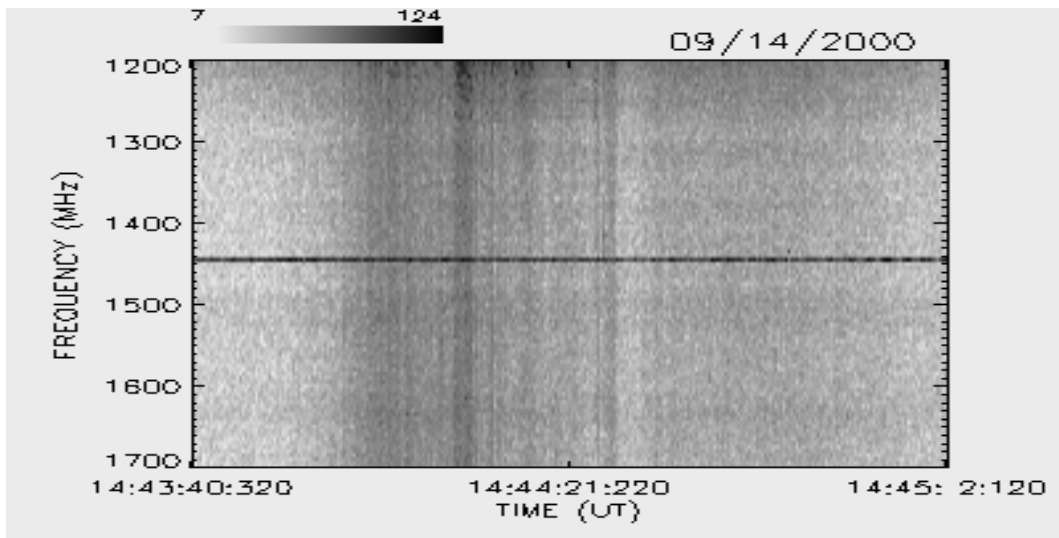
JULHO / 2000



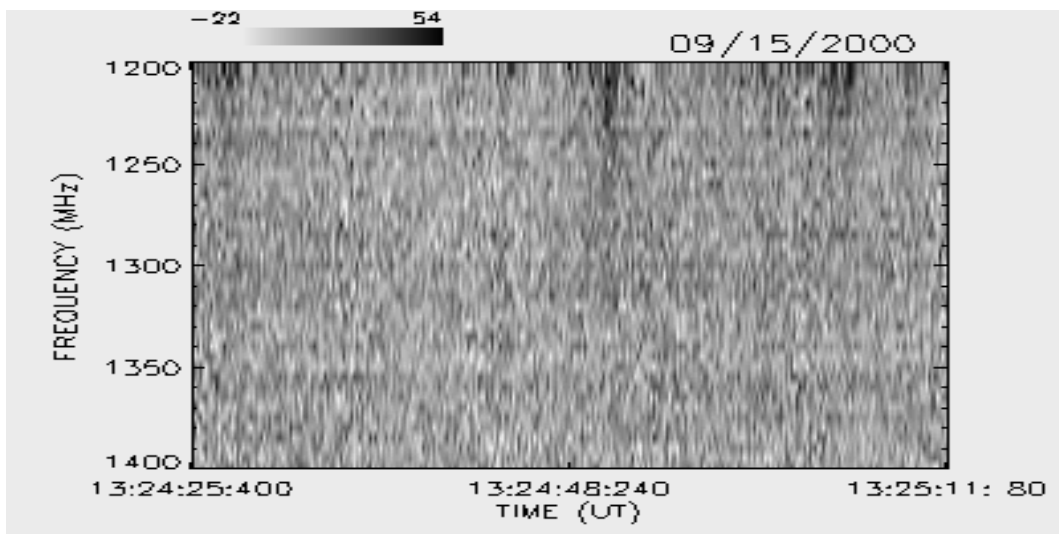
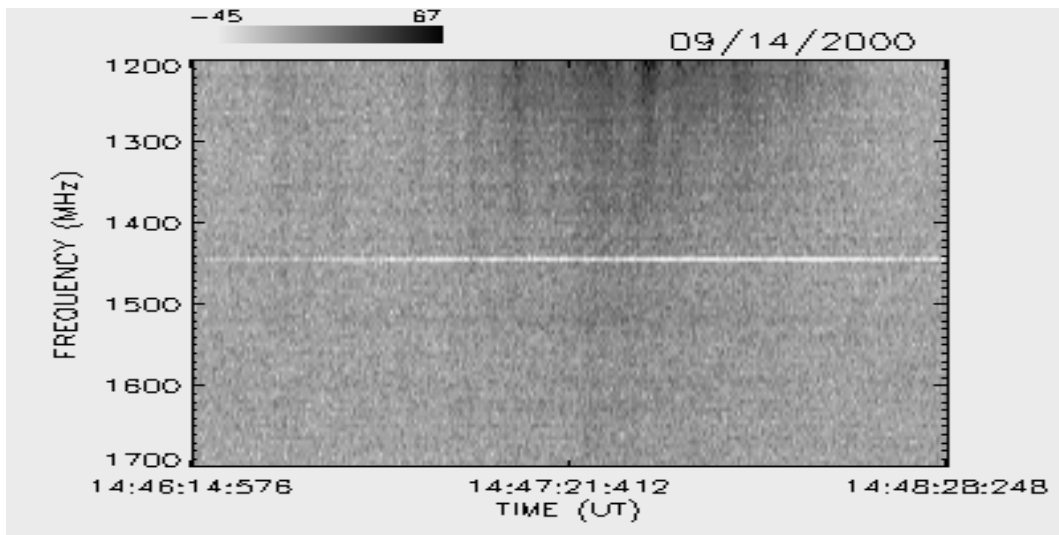
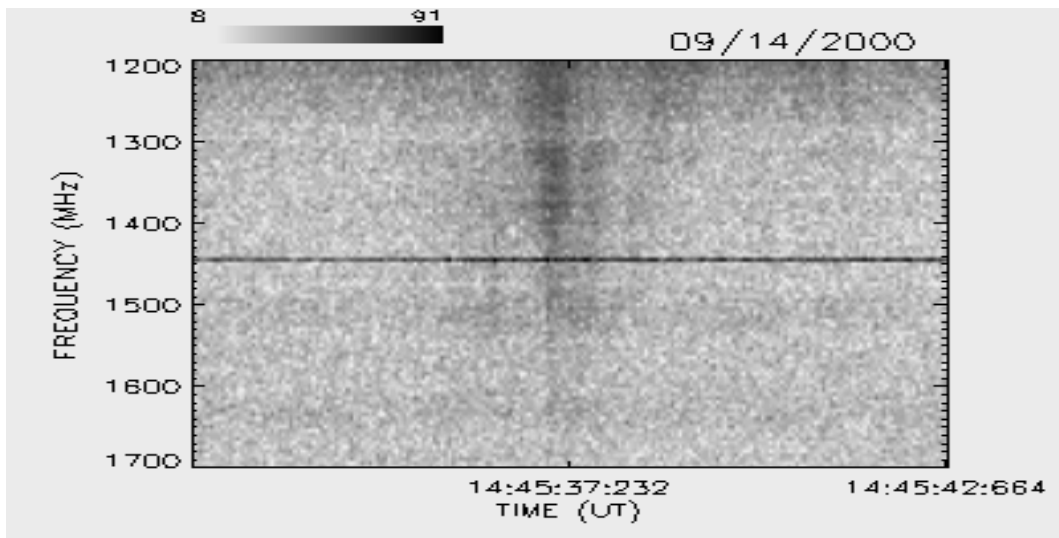
AGOSTO / 2000



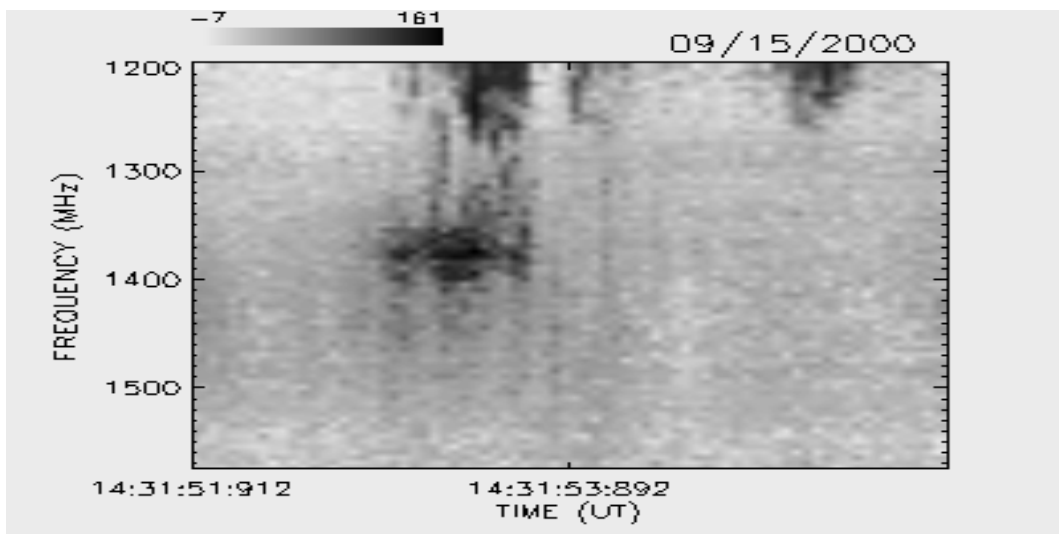
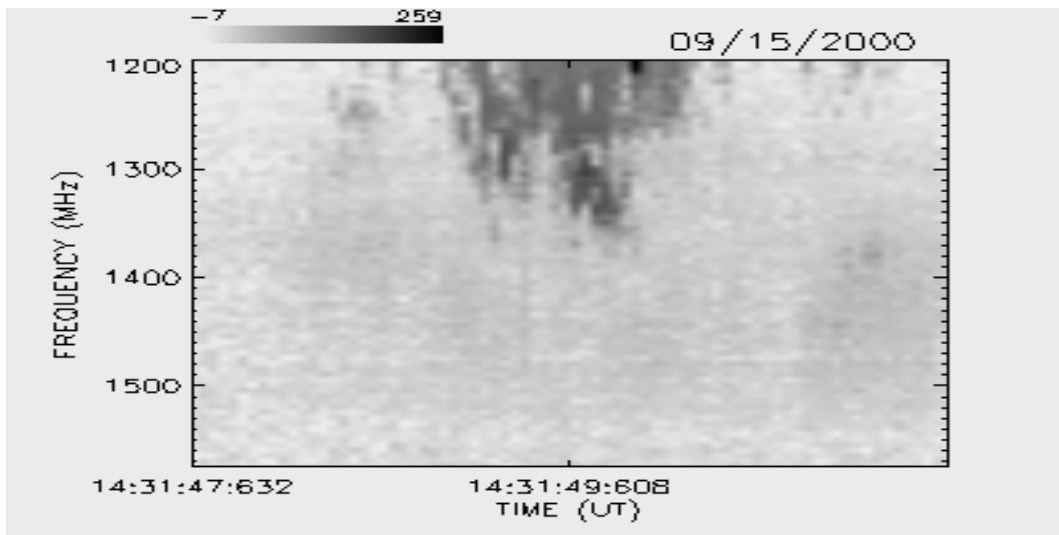
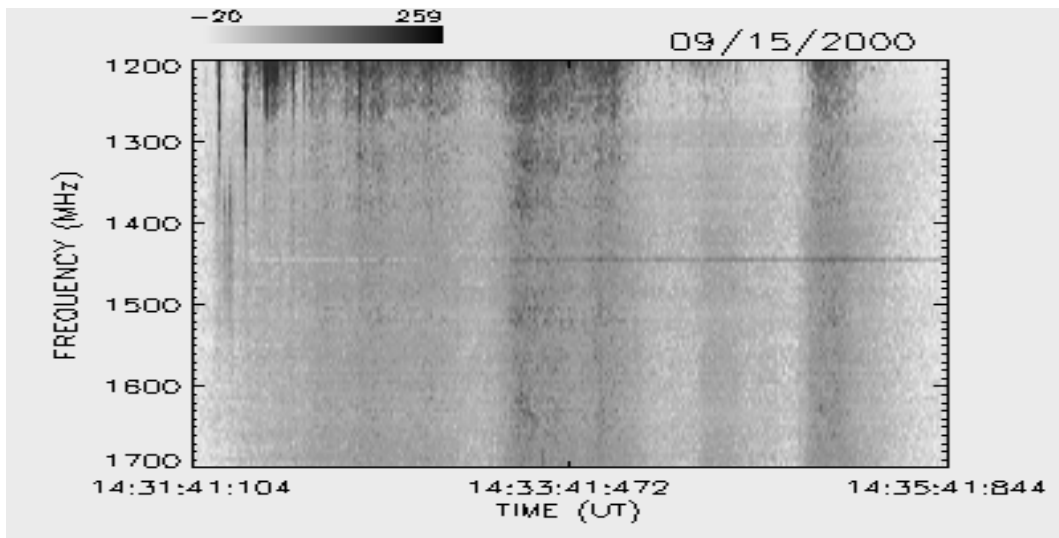
SETEMBRO / 2000



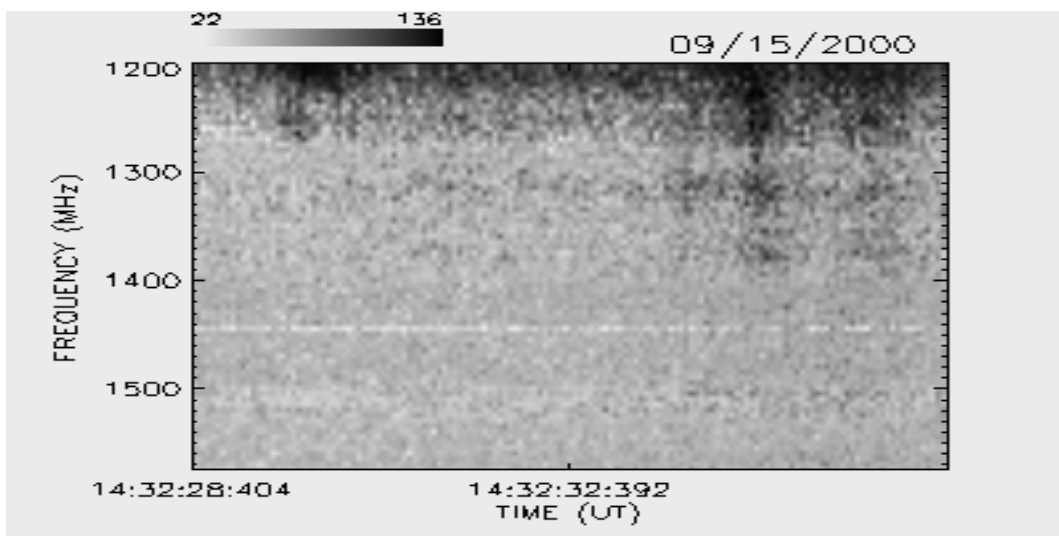
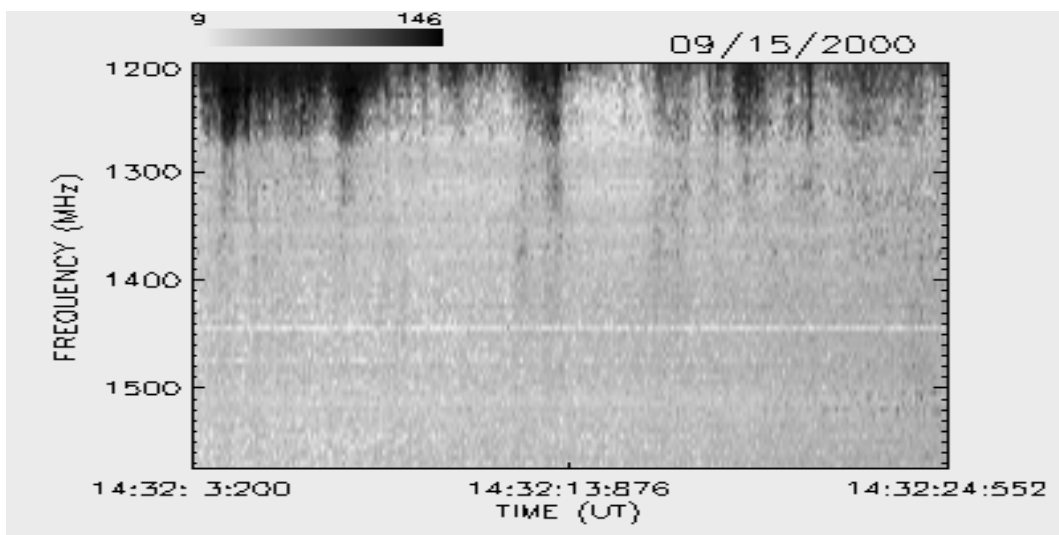
SETEMBRO / 2000



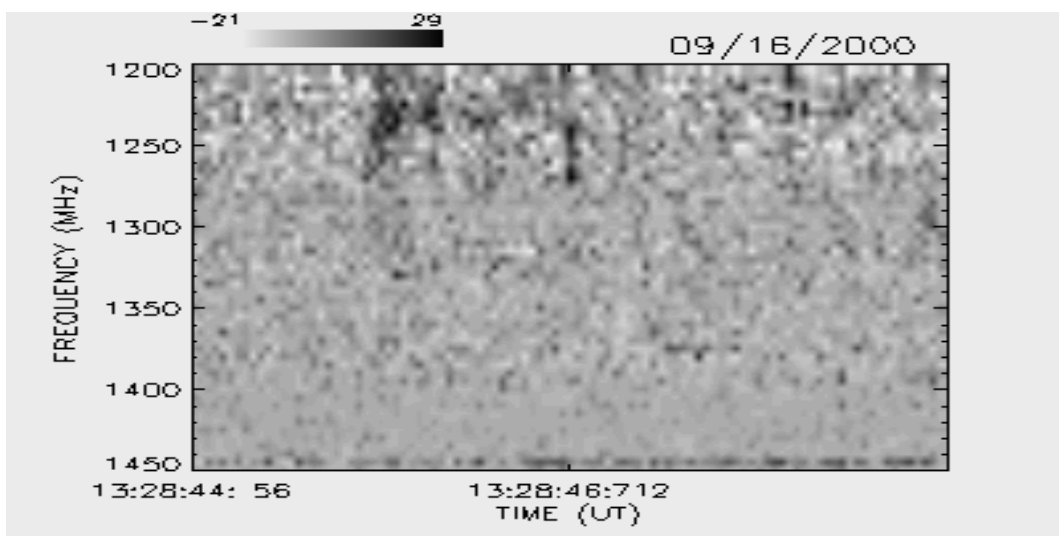
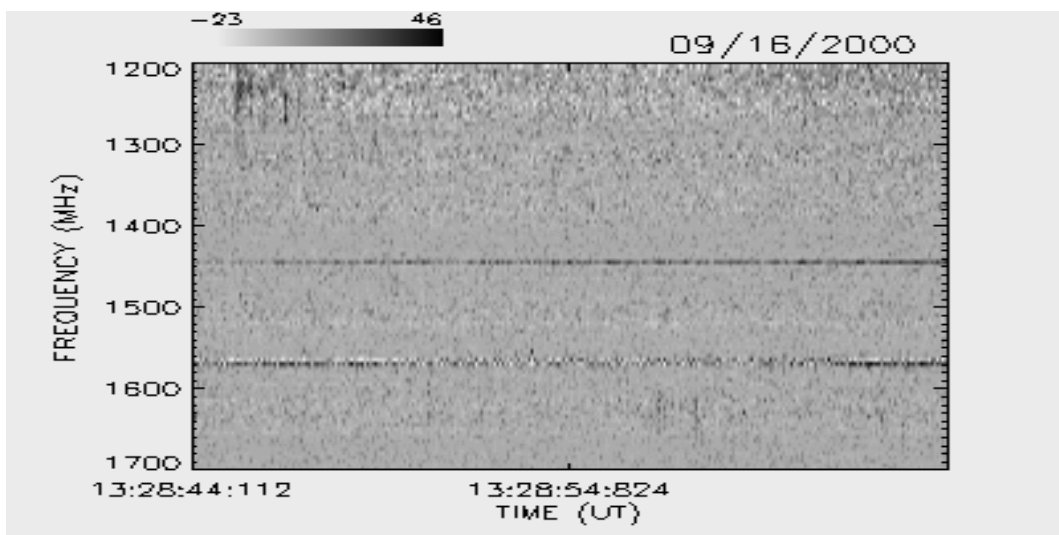
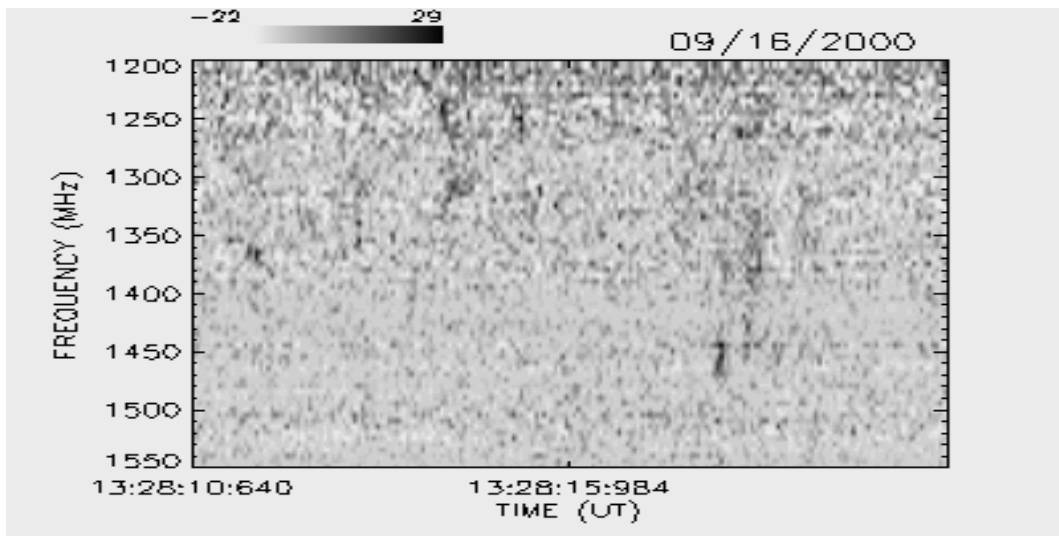
SETEMBRO / 2000



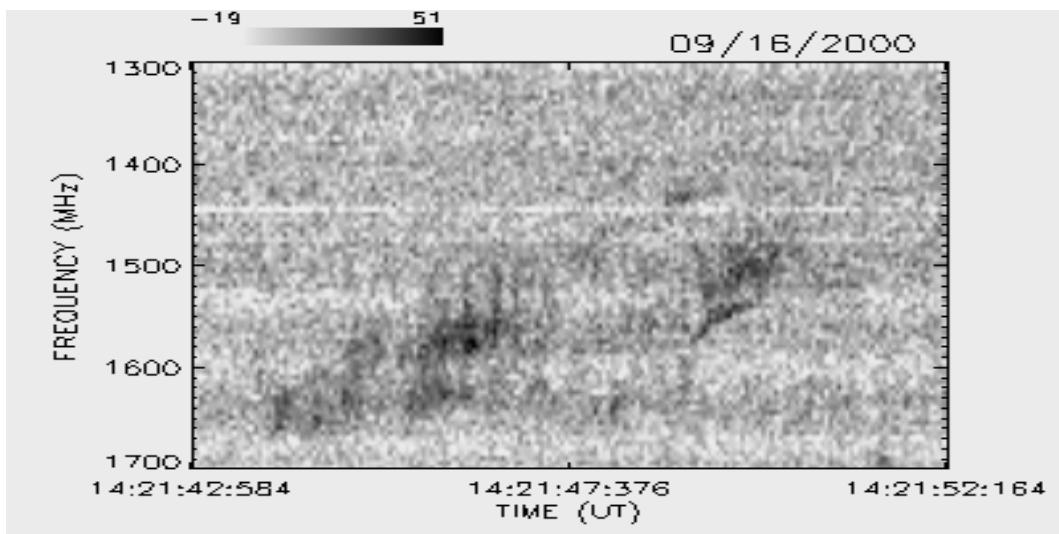
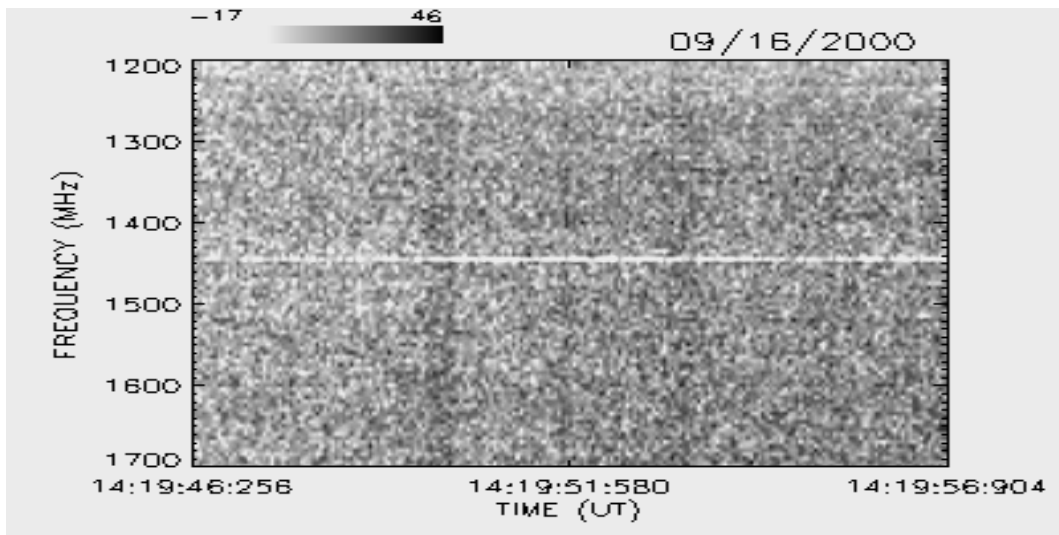
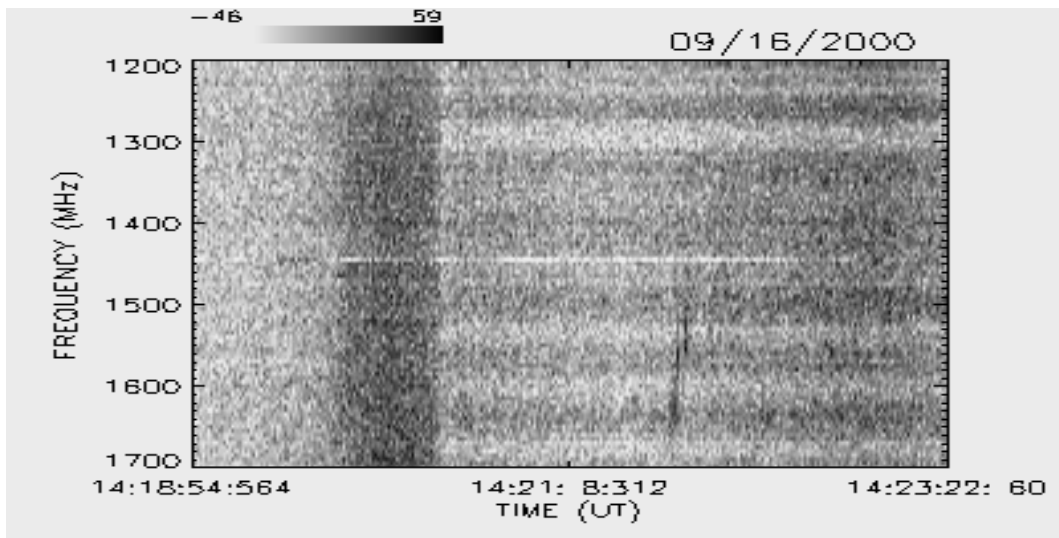
SETEMBRO / 2000



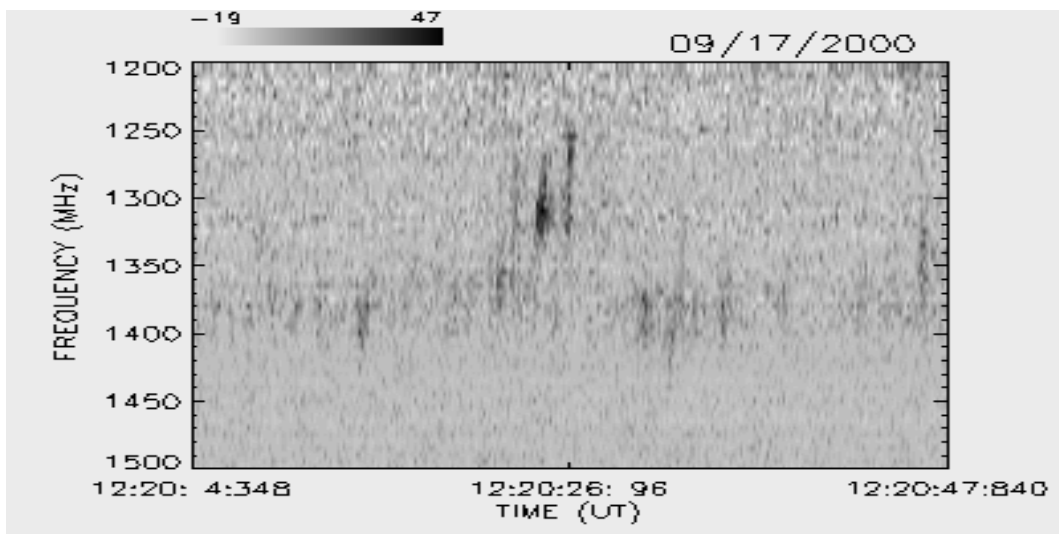
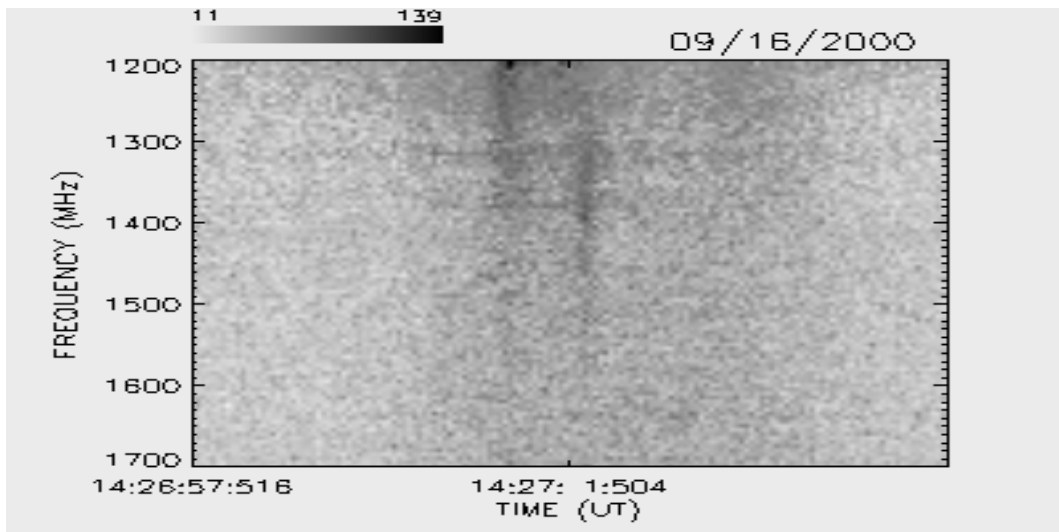
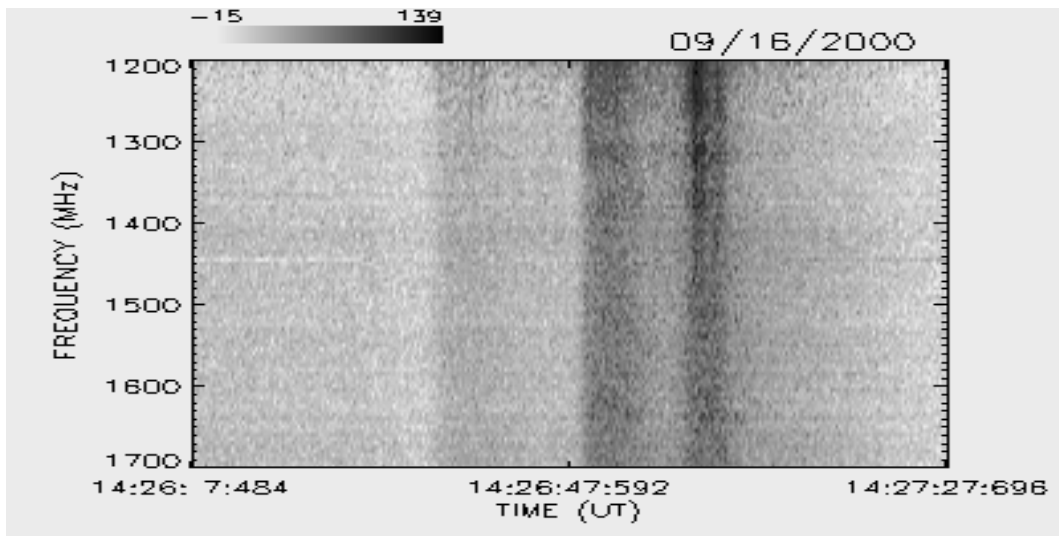
SETEMBRO / 2000



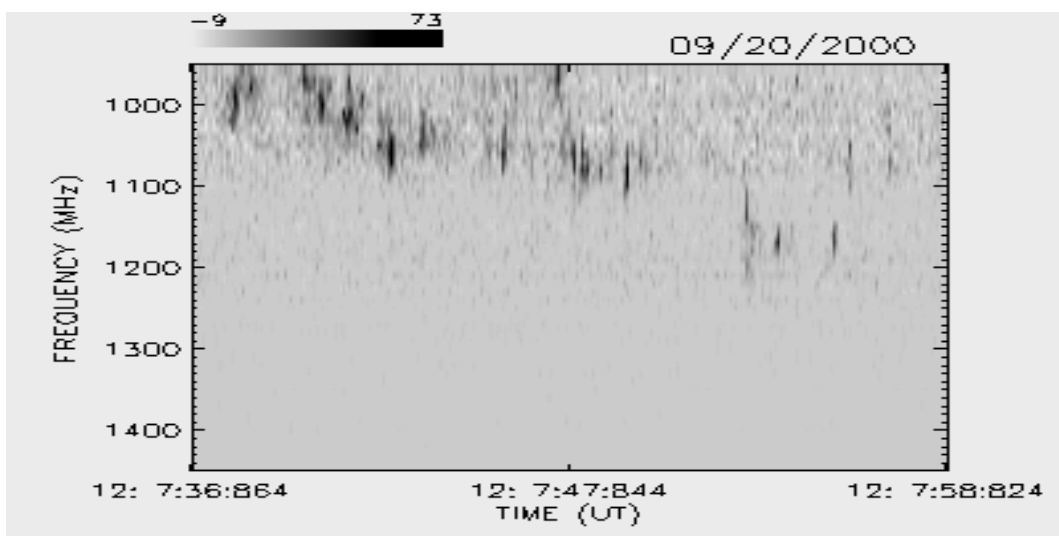
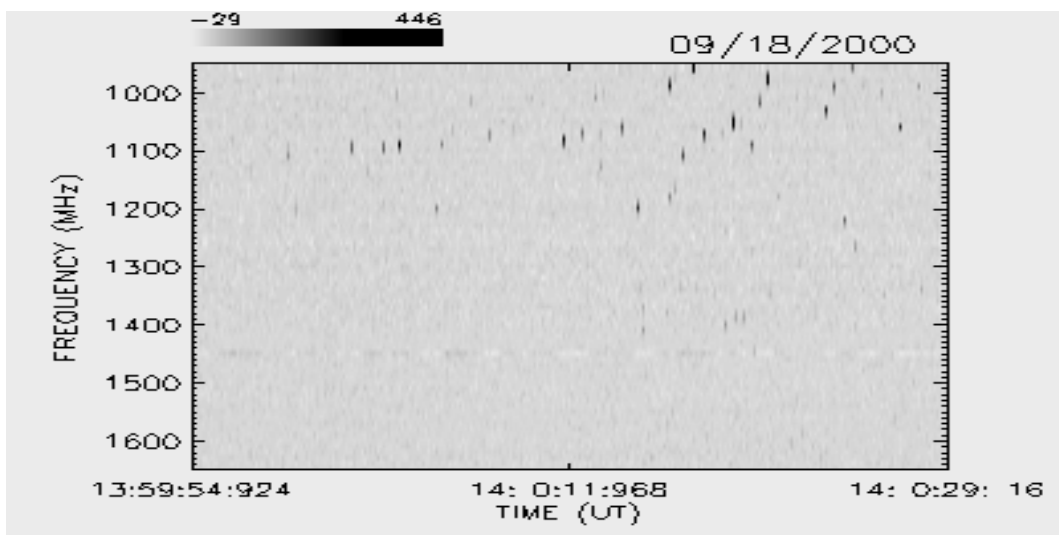
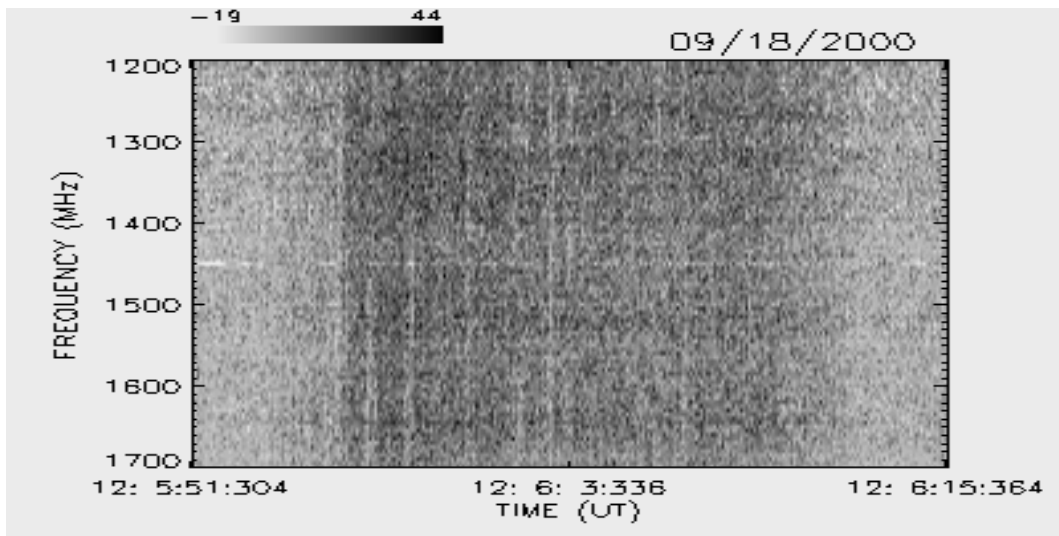
SETEMBRO / 2000



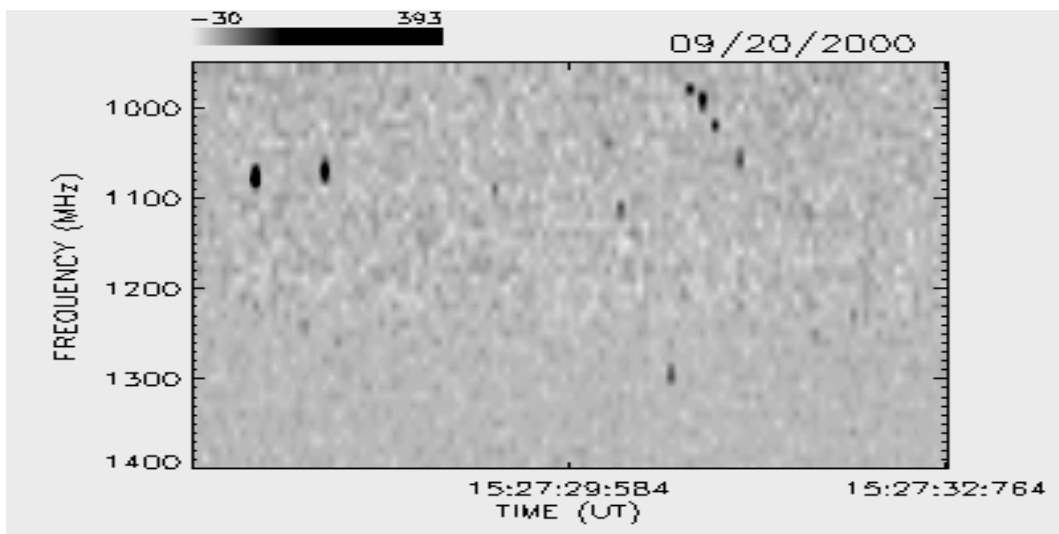
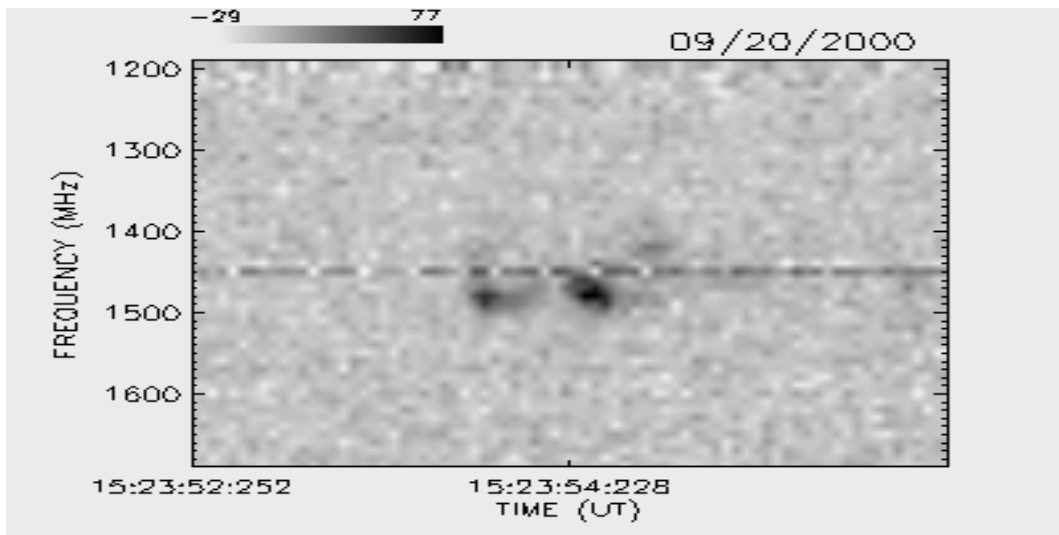
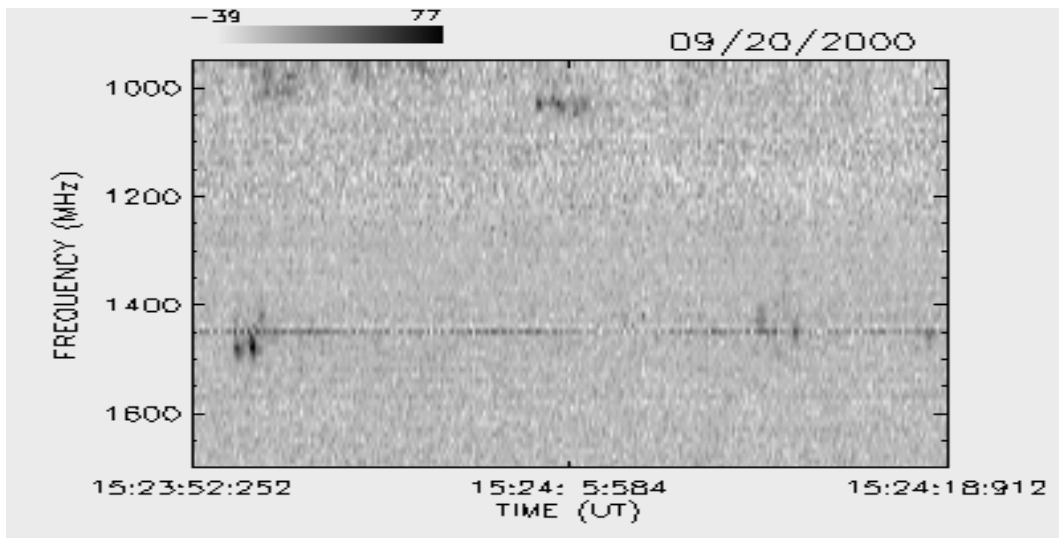
SETEMBRO / 2000



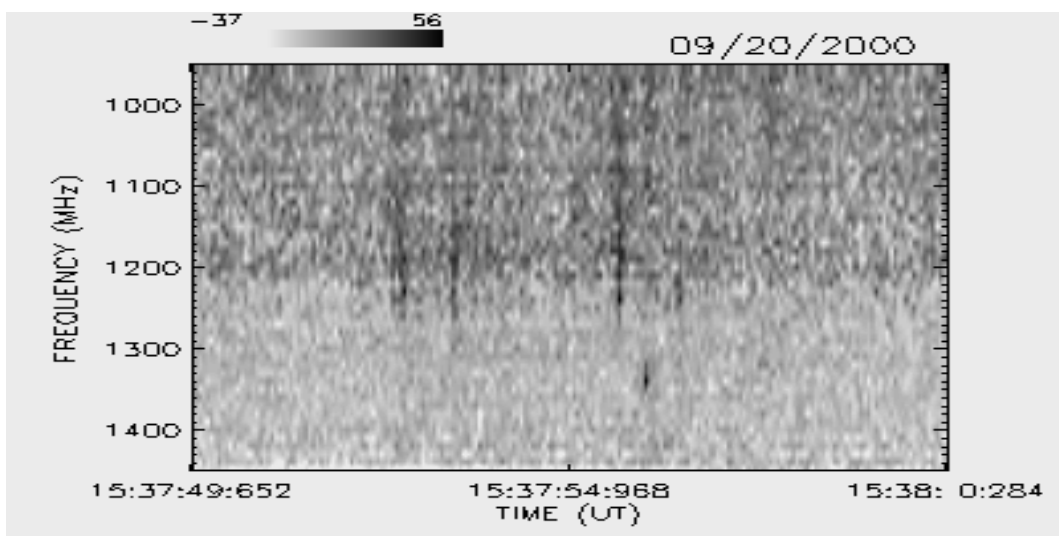
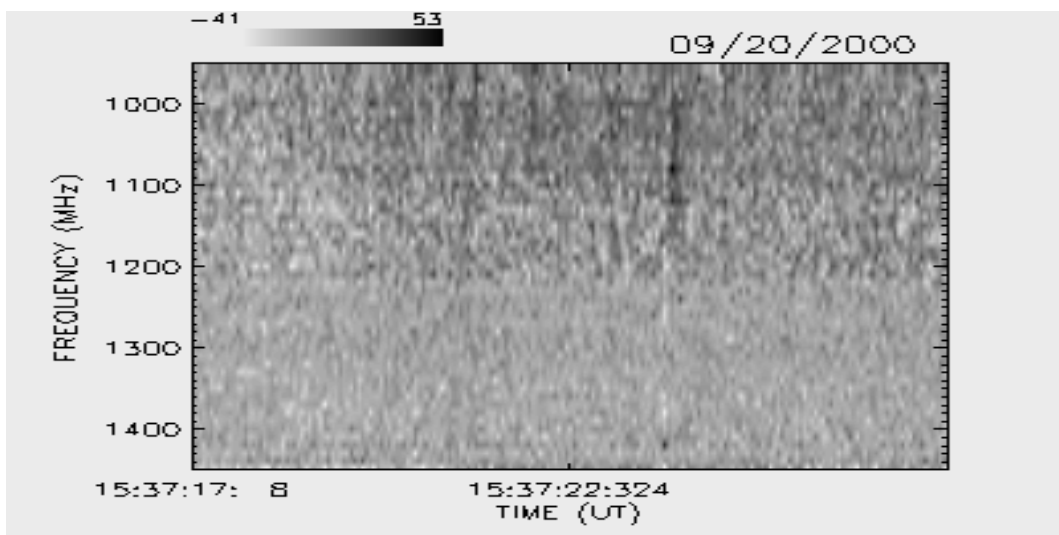
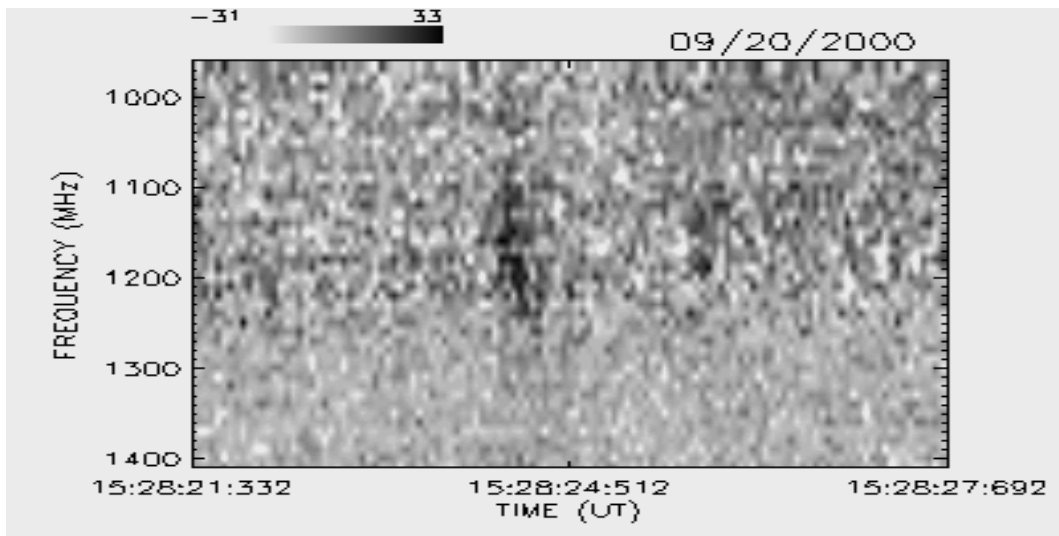
SETEMBRO / 2000



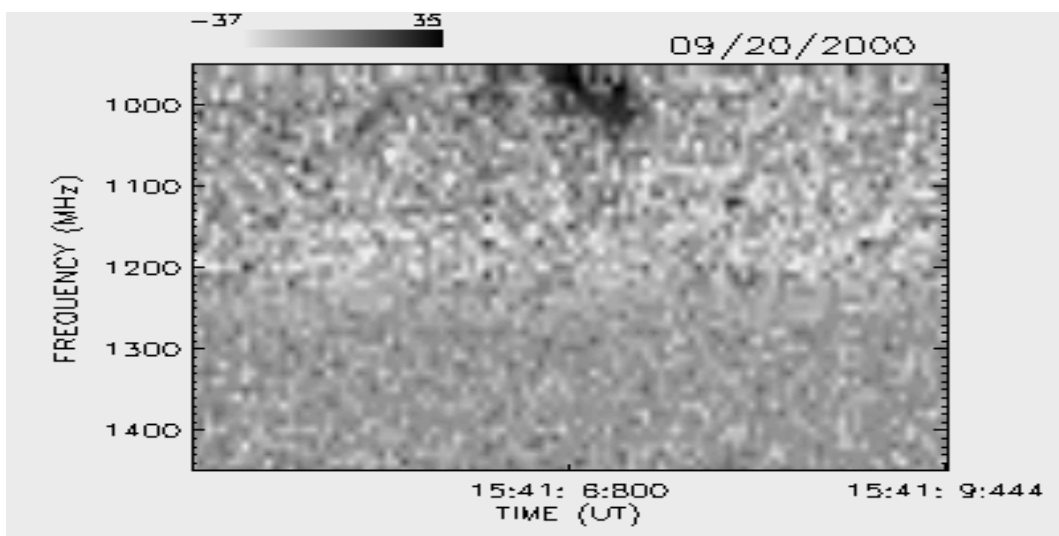
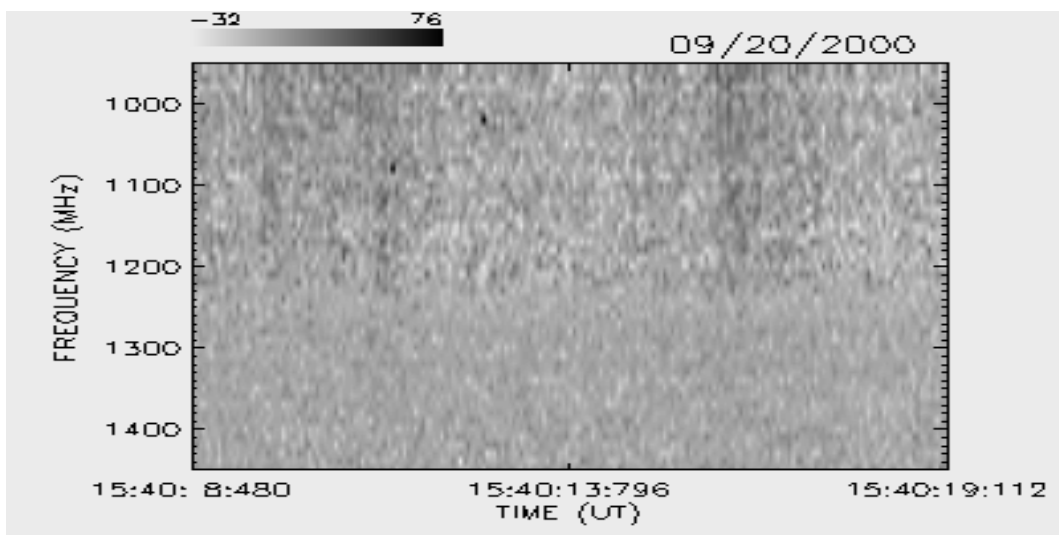
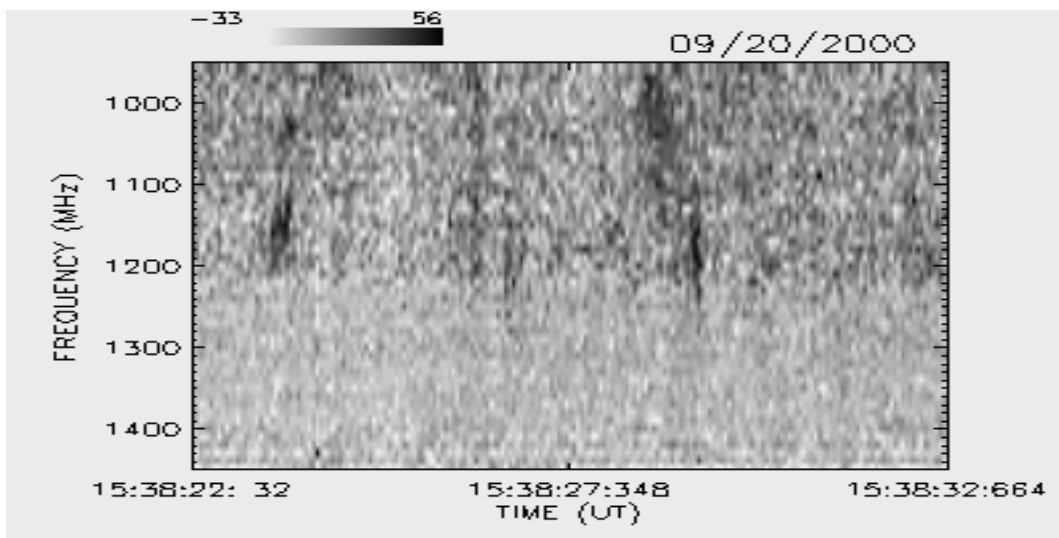
SETEMBRO / 2000



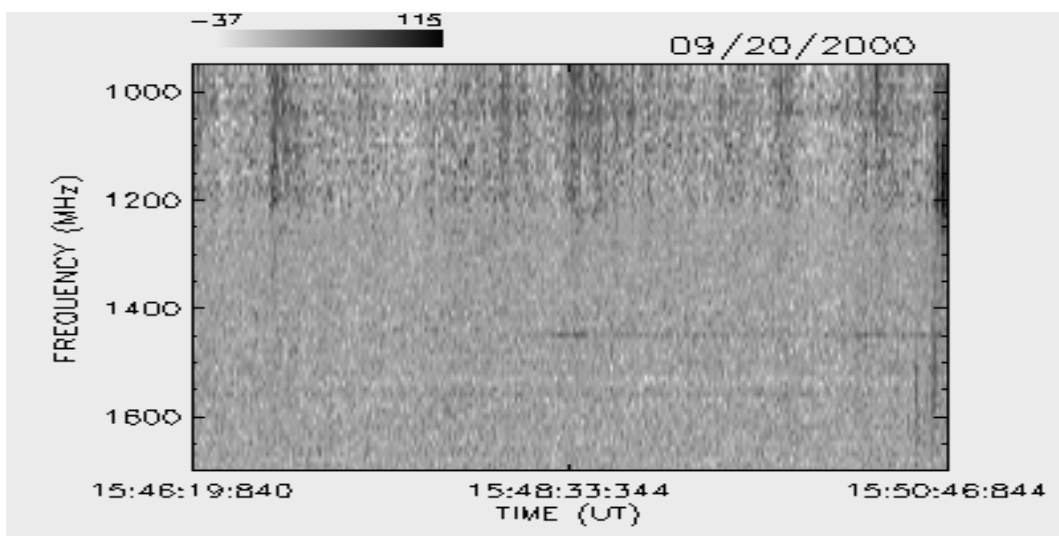
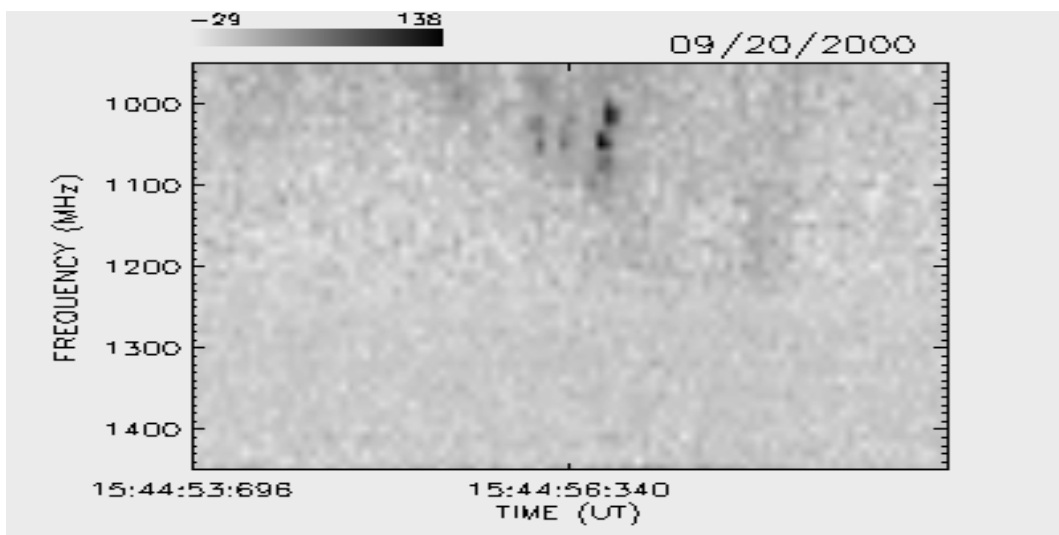
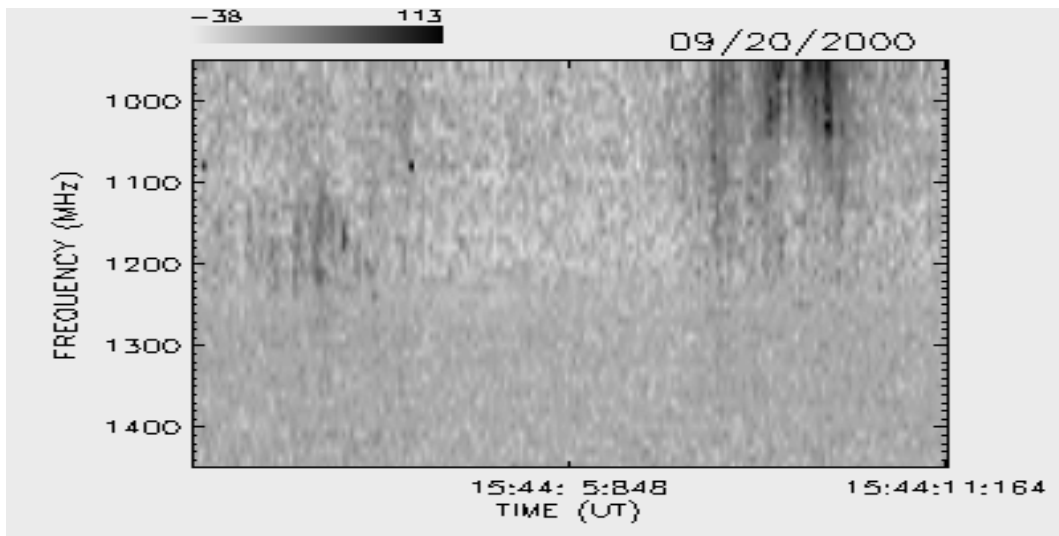
SETEMBRO / 2000



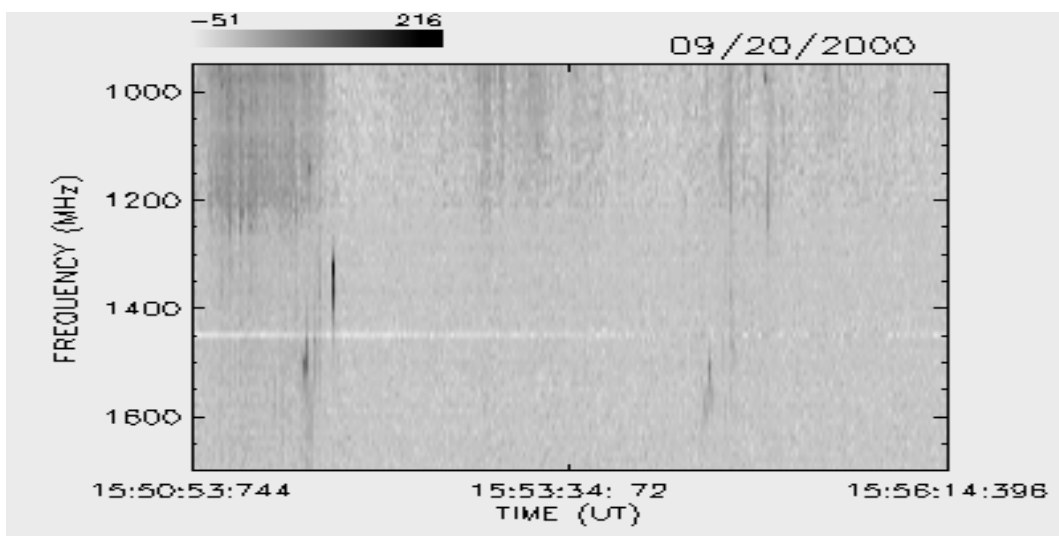
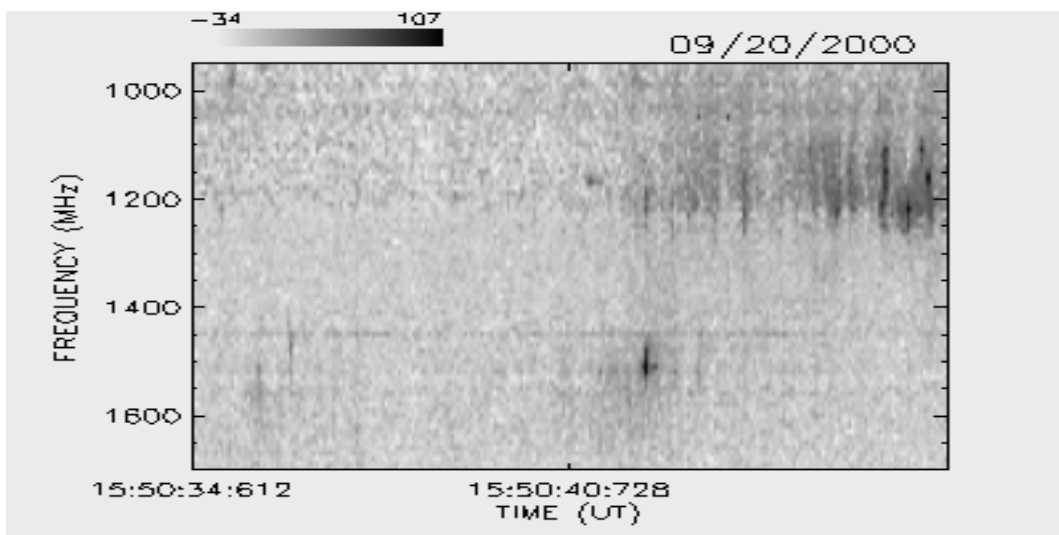
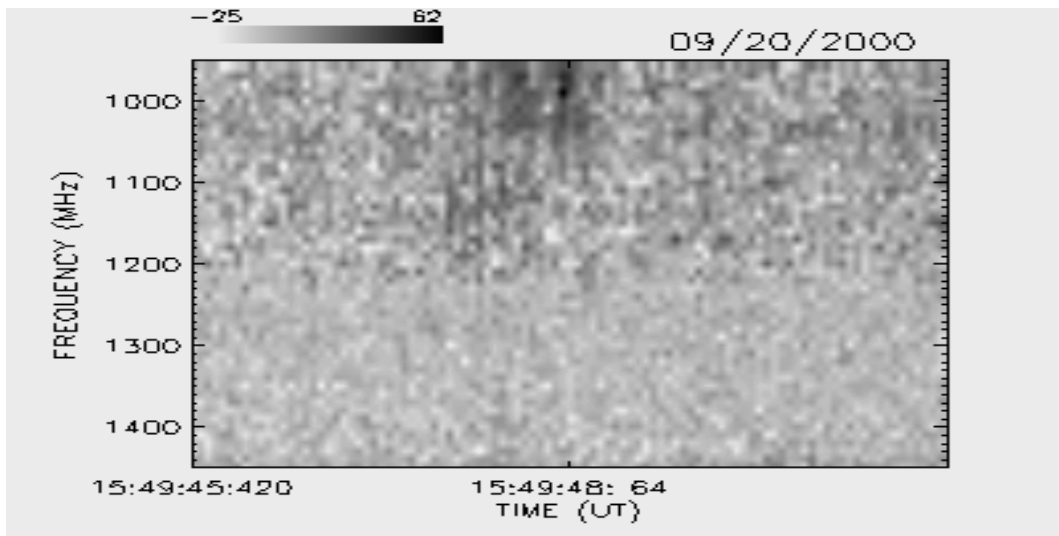
SETEMBRO / 2000



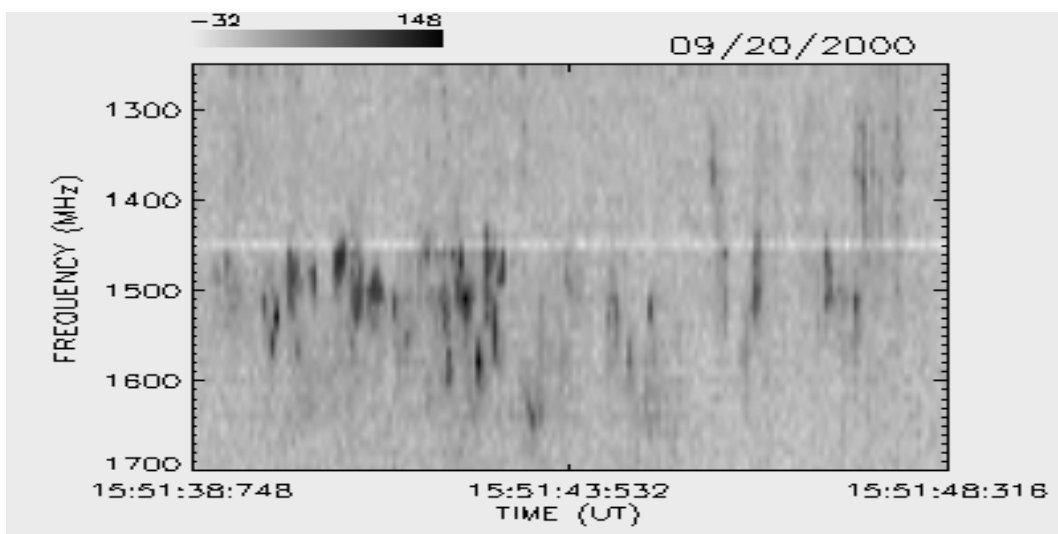
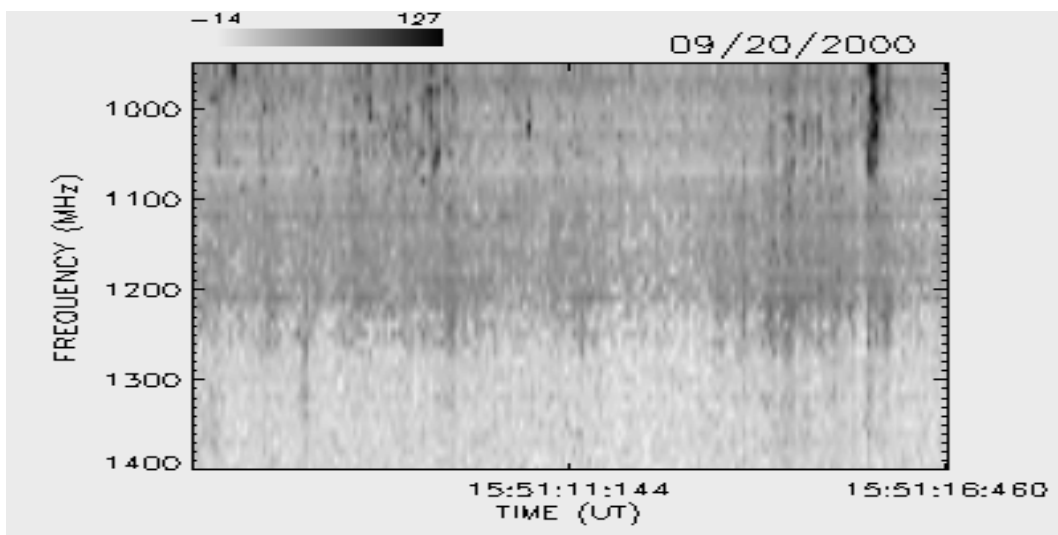
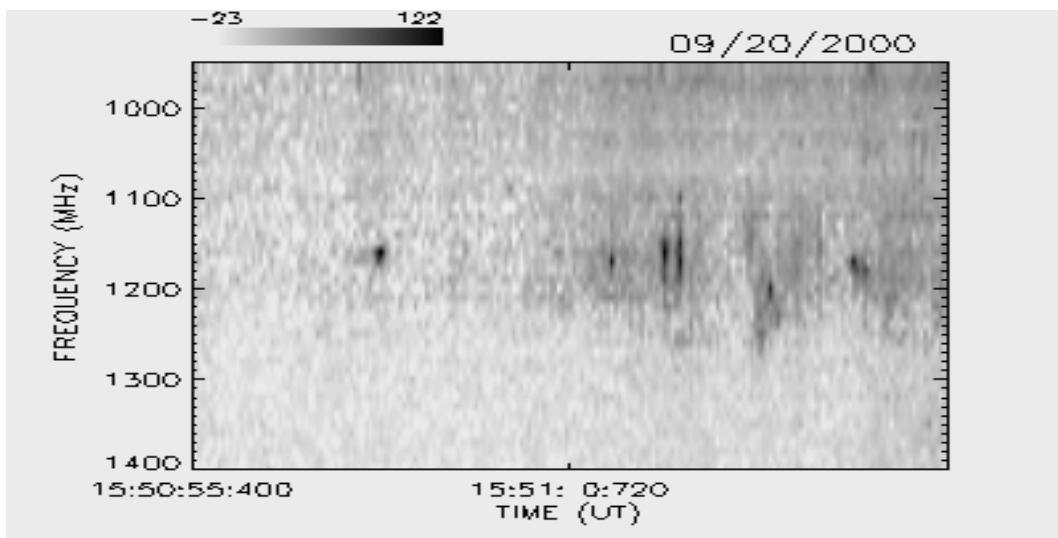
SETEMBRO / 2000



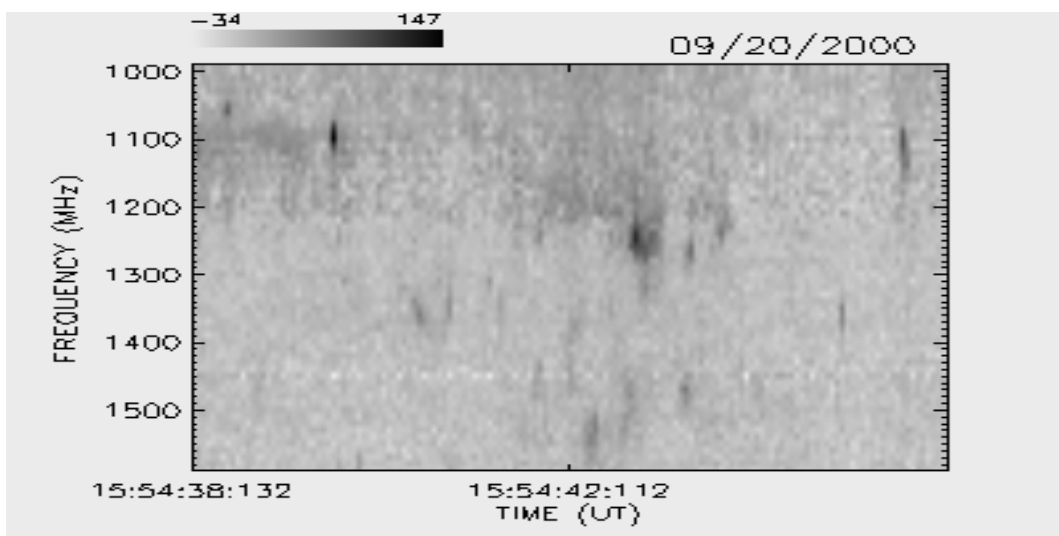
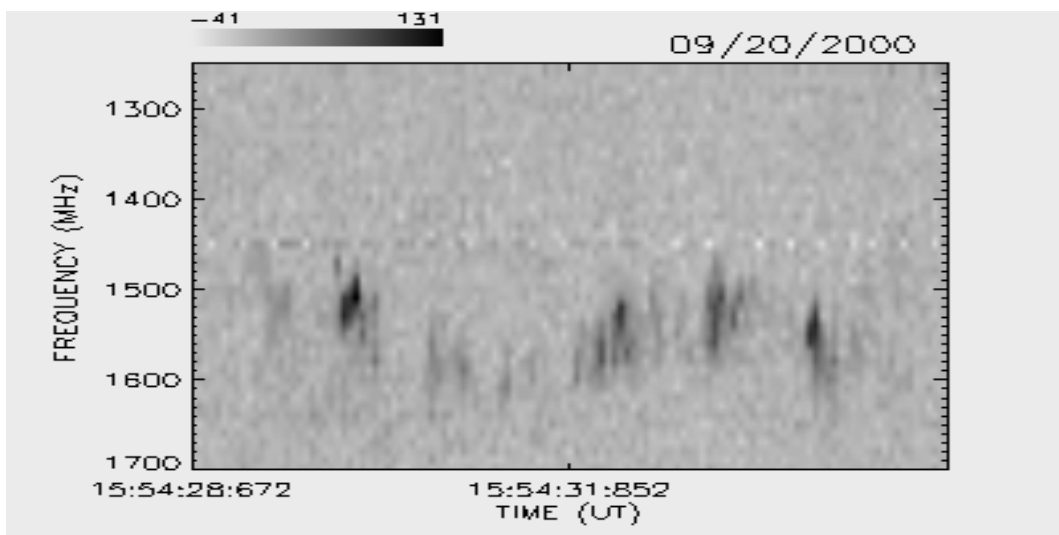
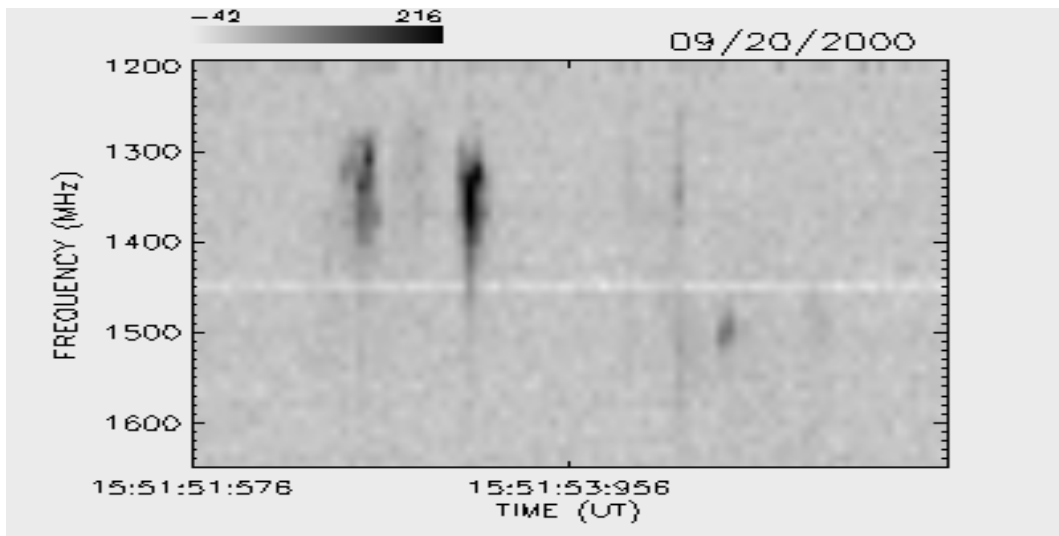
SETEMBRO / 2000



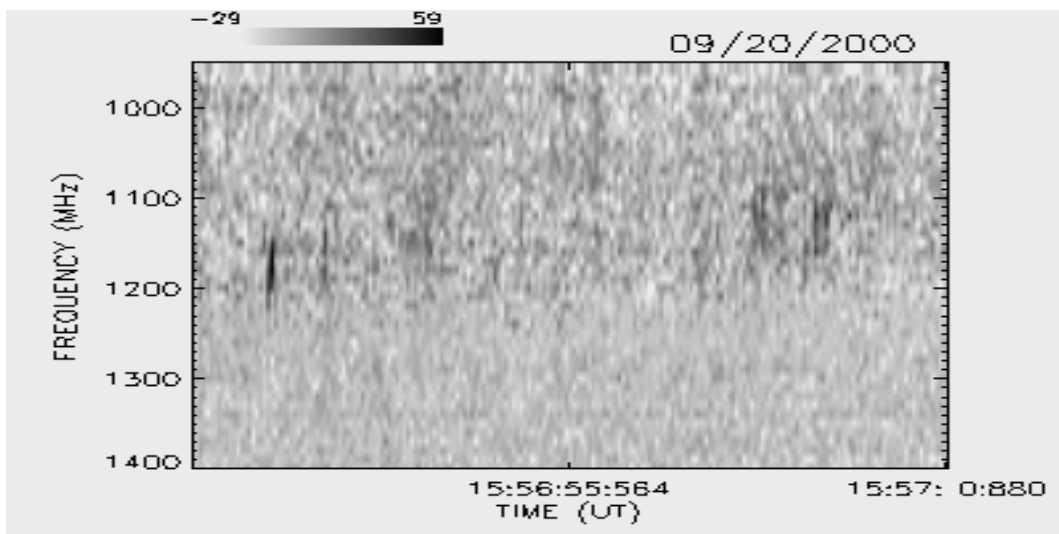
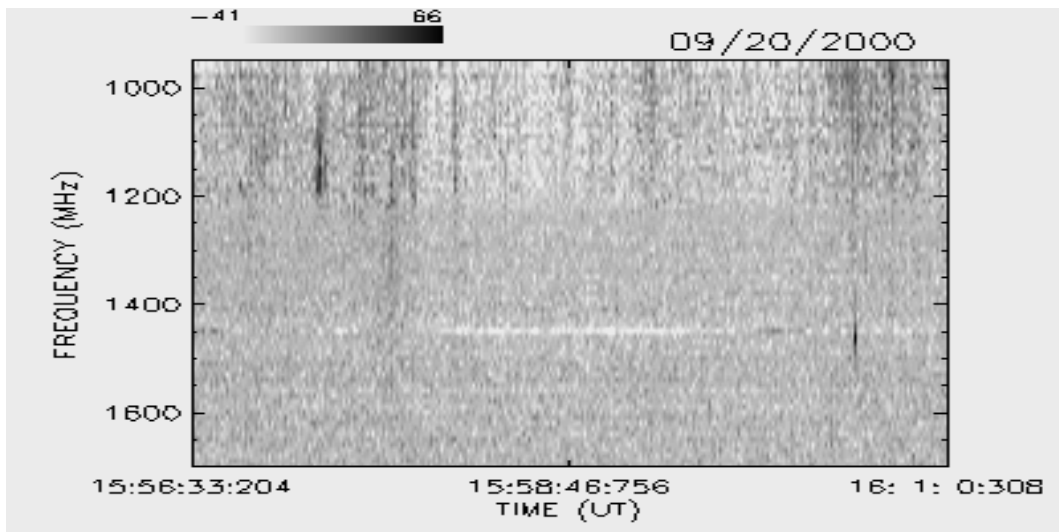
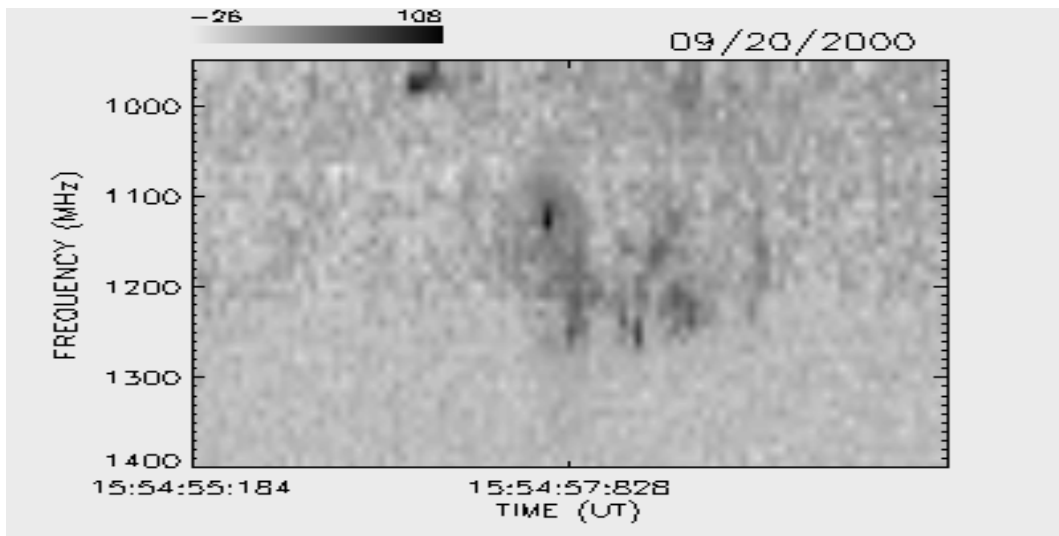
SETEMBRO / 2000



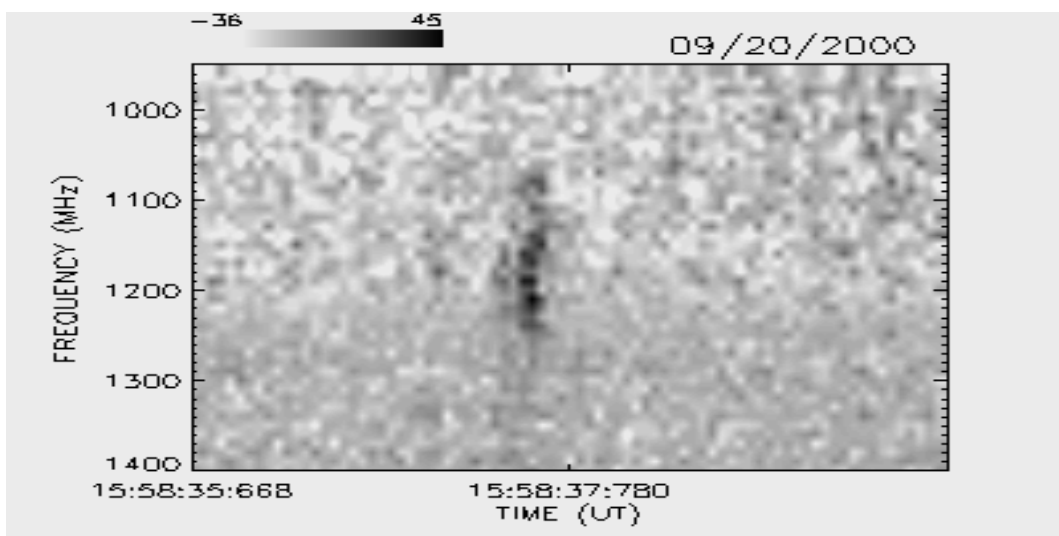
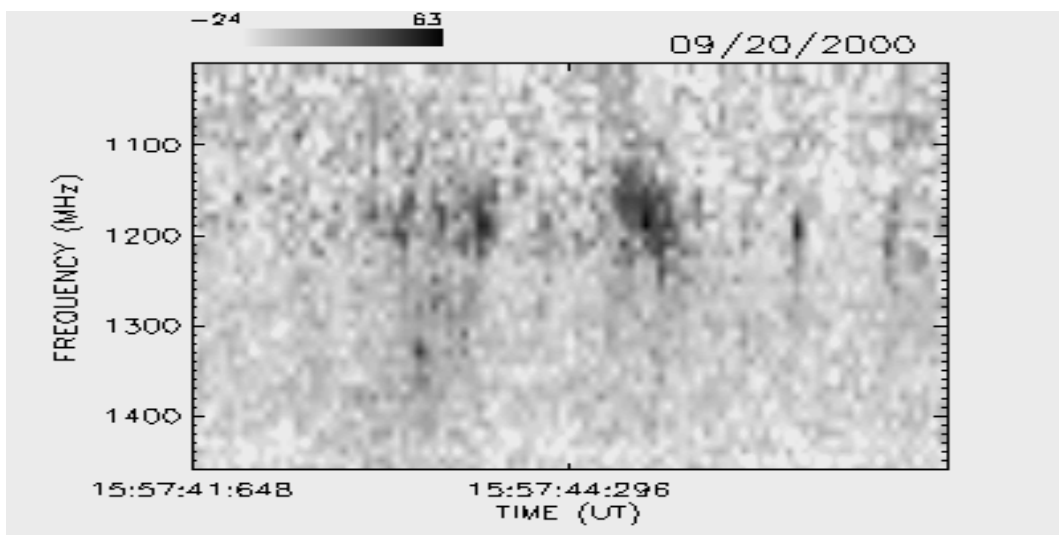
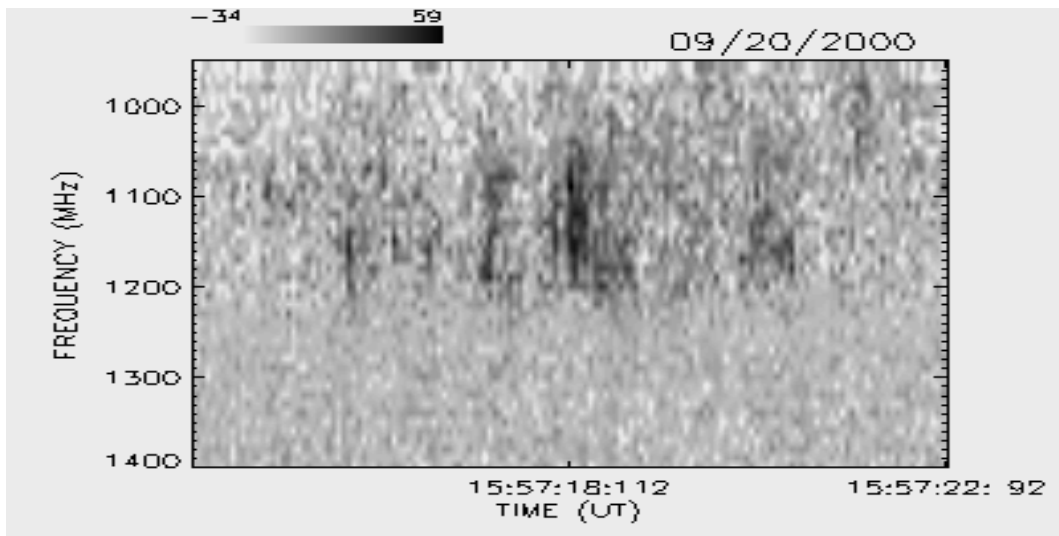
SETEMBRO / 2000



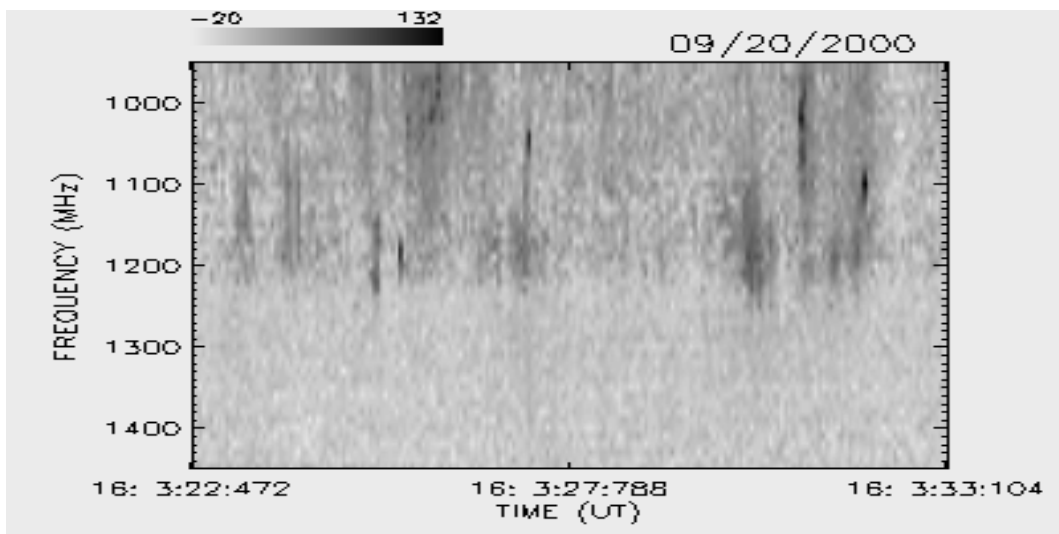
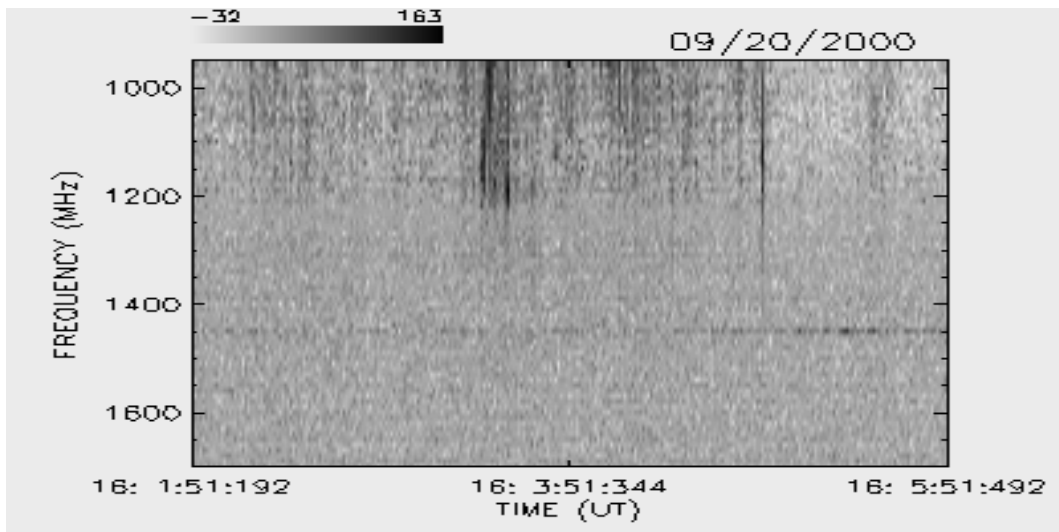
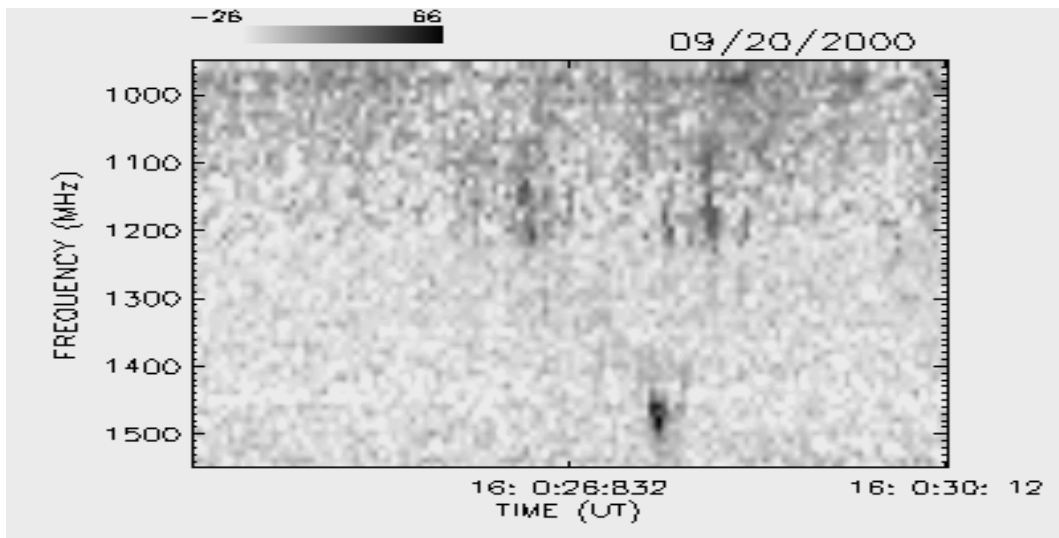
SETEMBRO / 2000



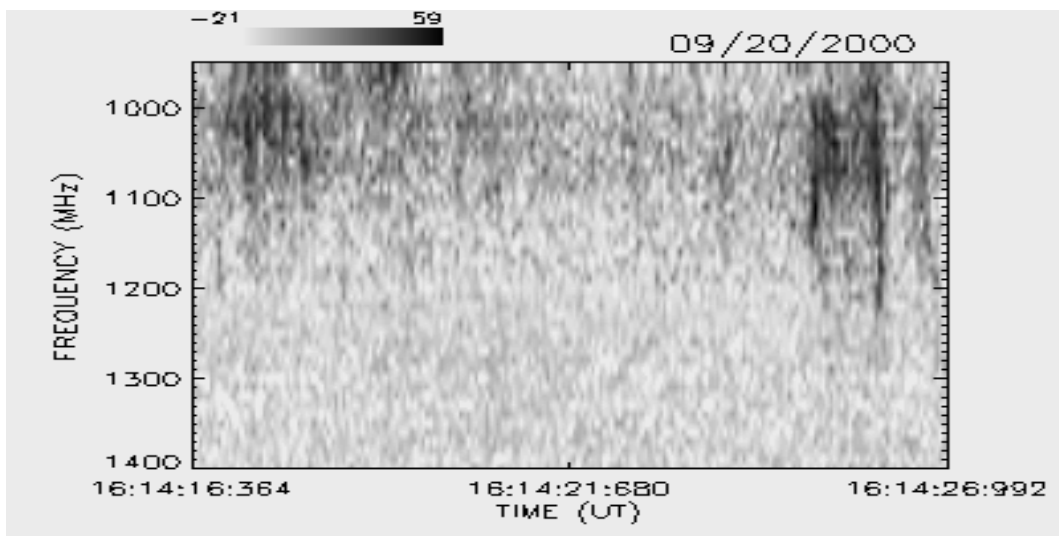
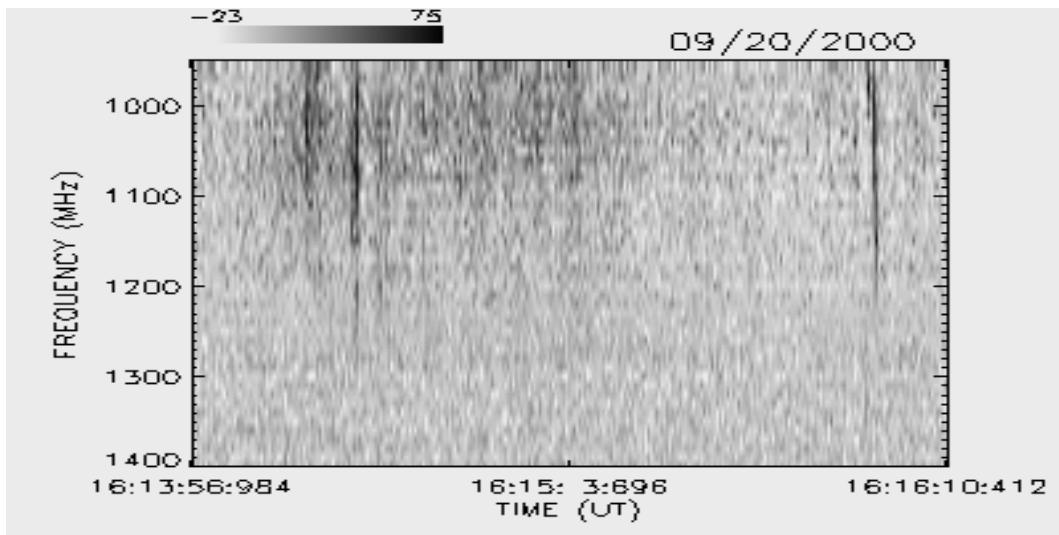
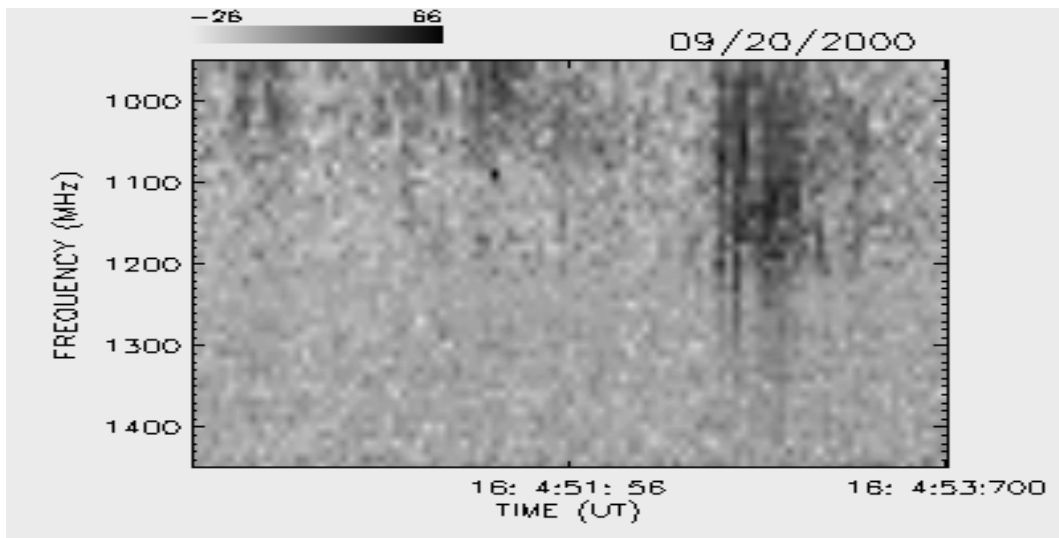
SETEMBRO / 2000



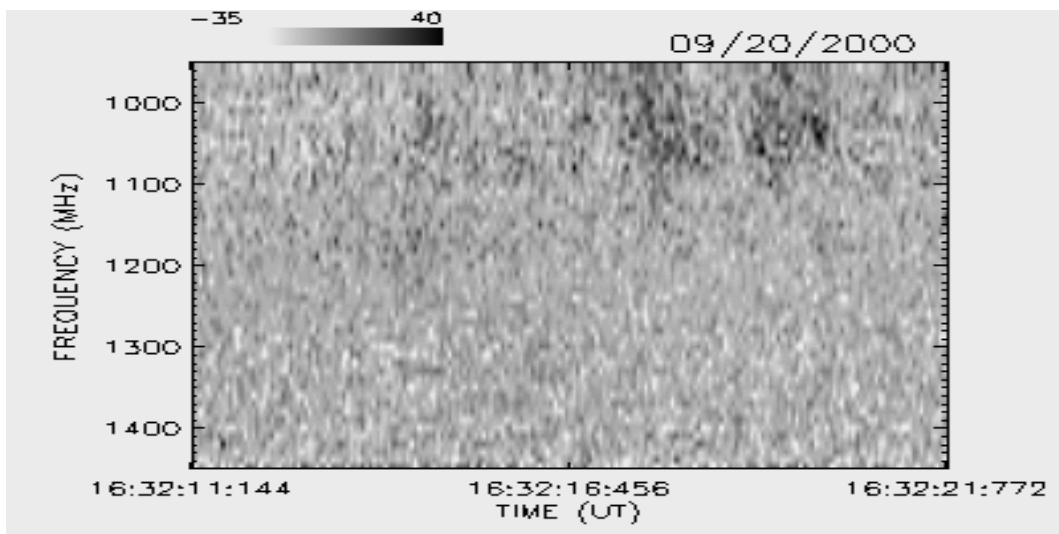
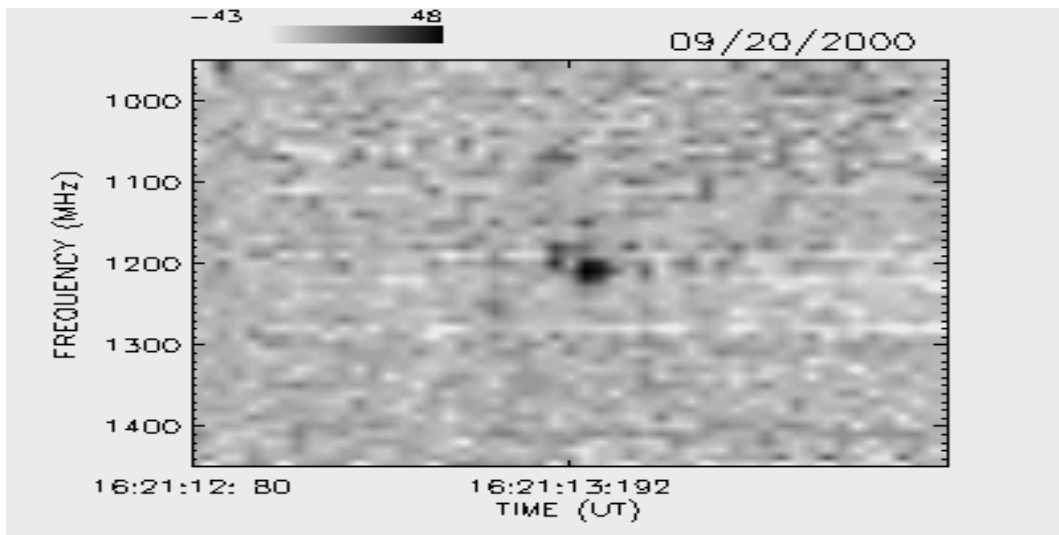
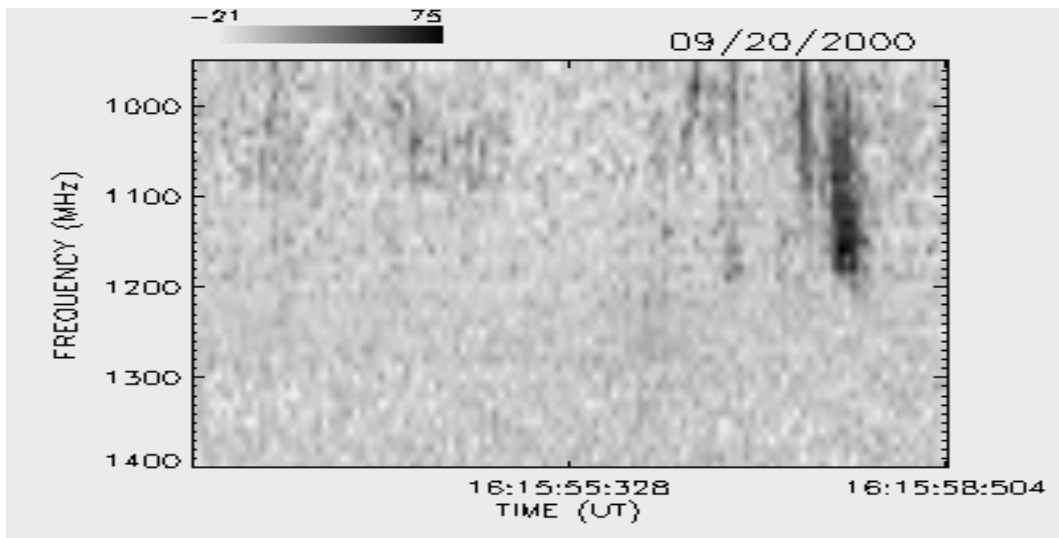
SETEMBRO / 2000



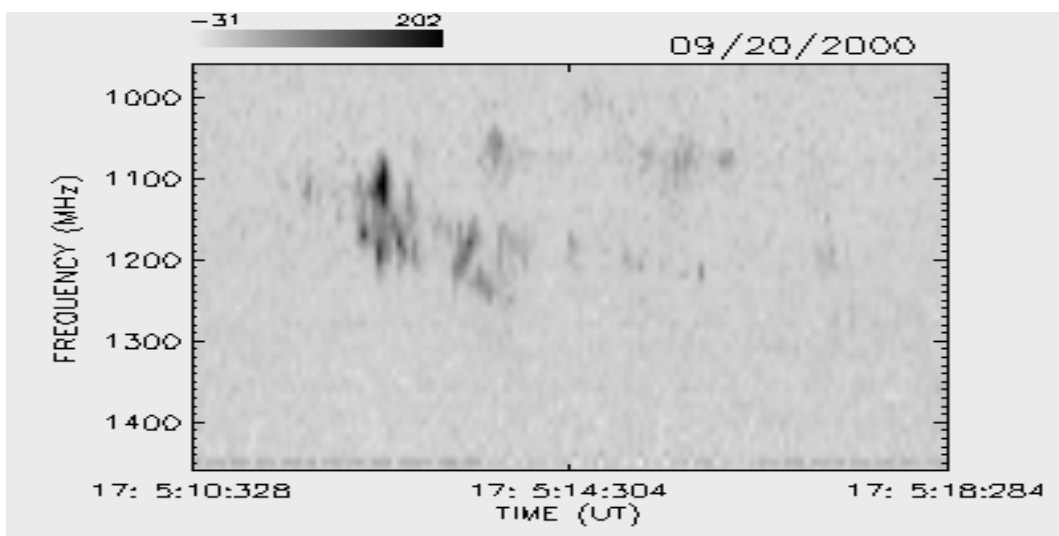
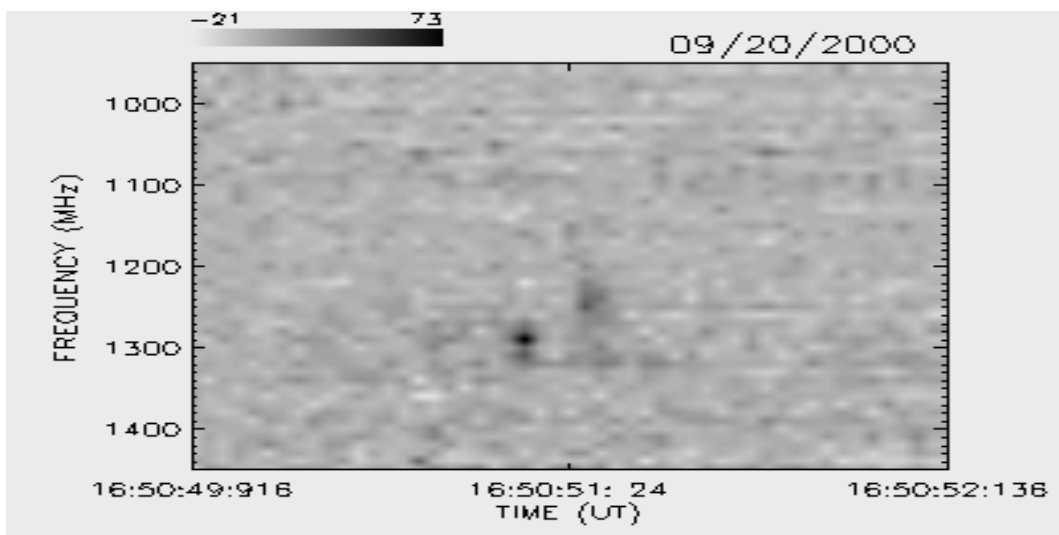
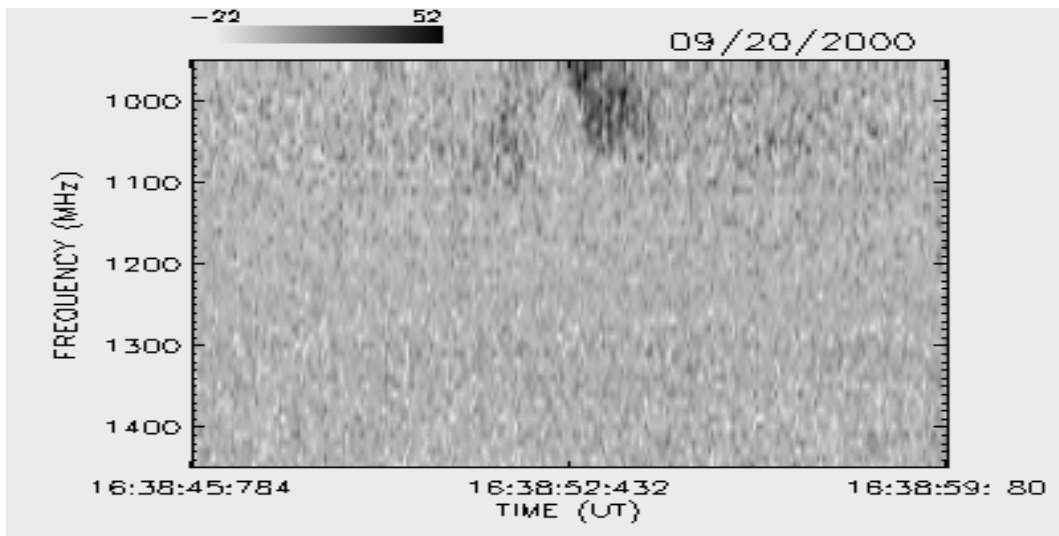
SETEMBRO / 2000



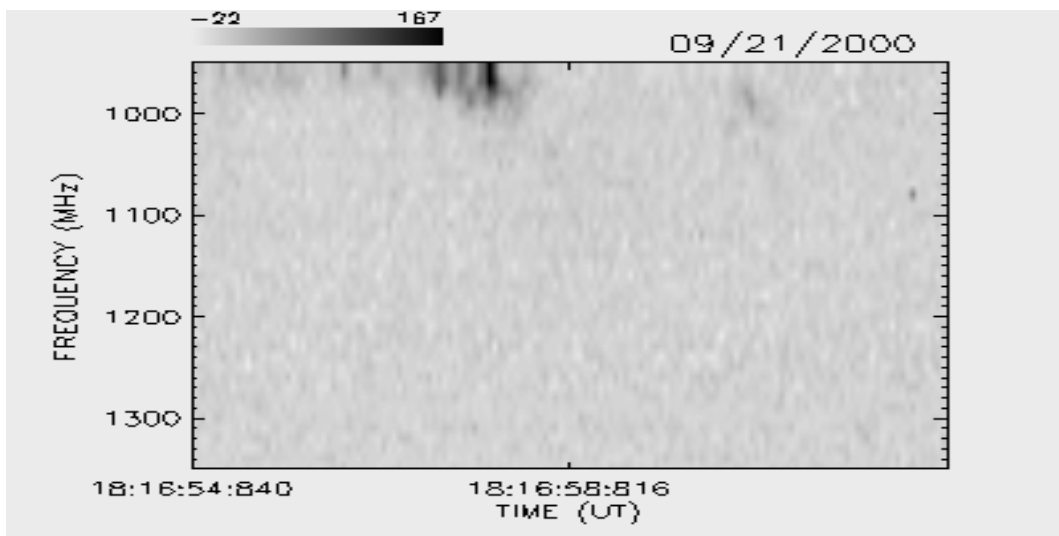
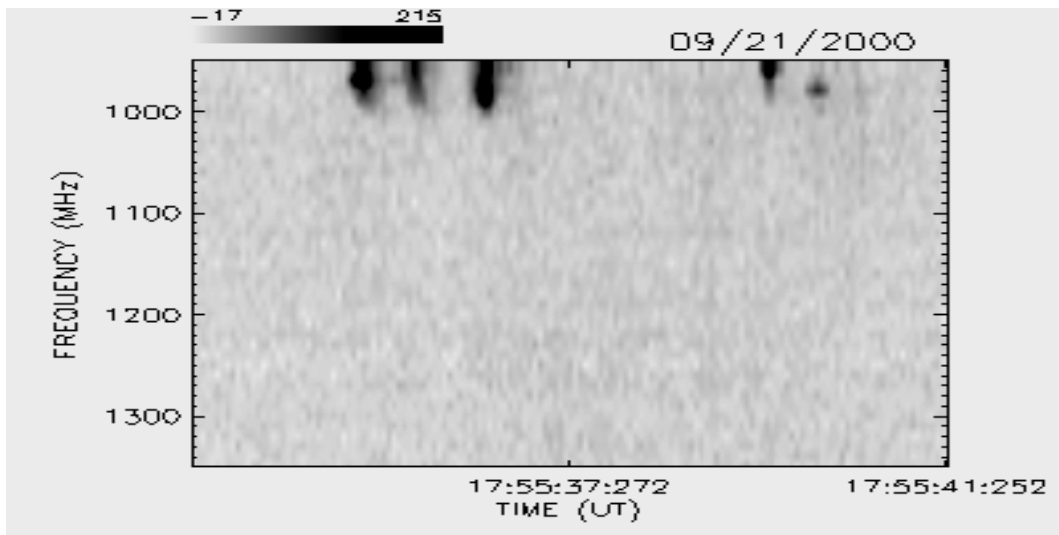
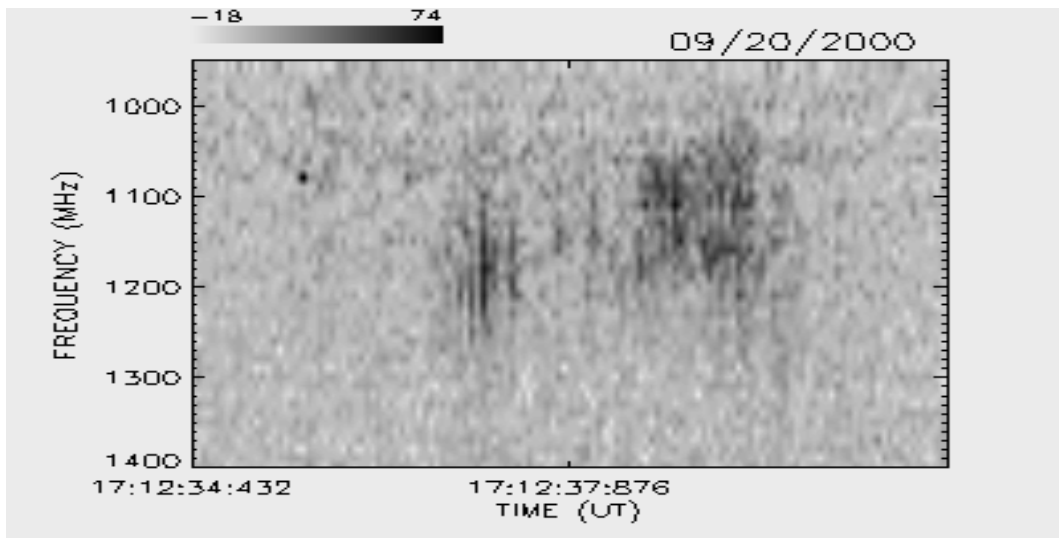
SETEMBRO / 2000



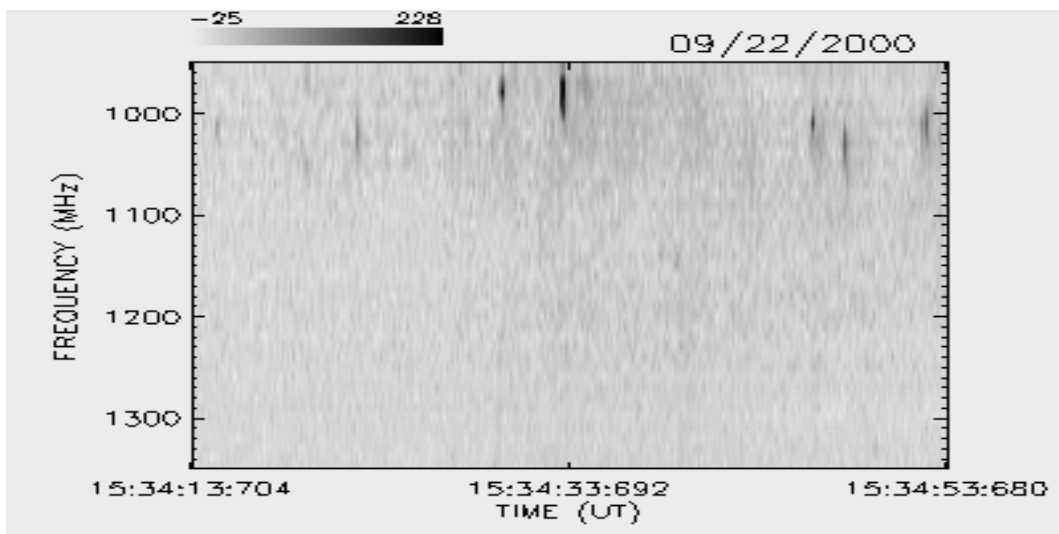
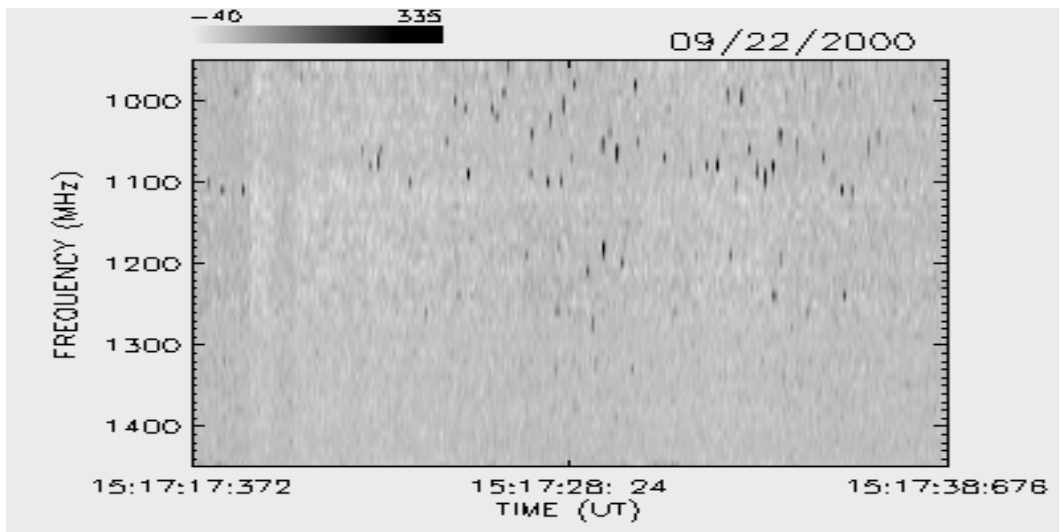
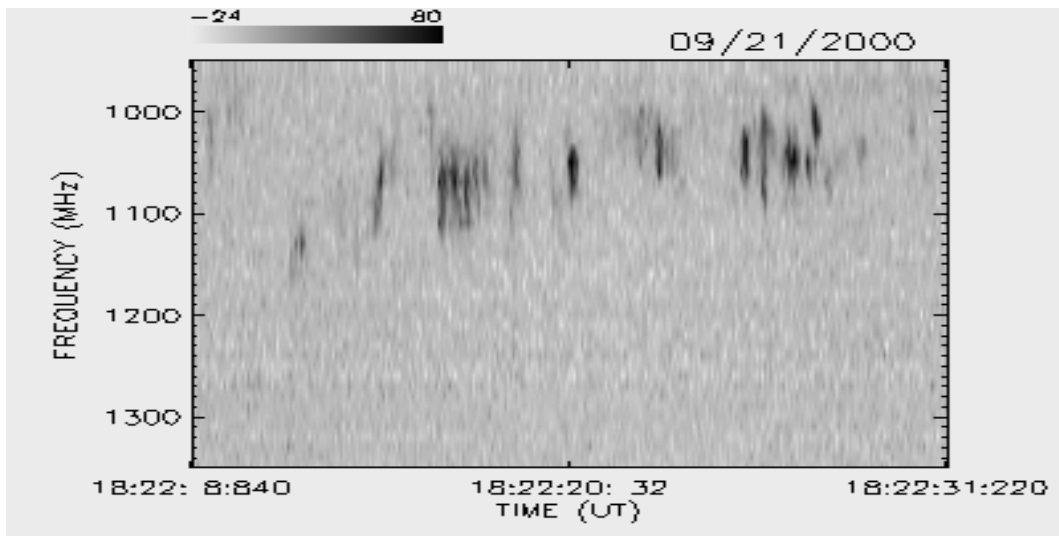
SETEMBRO / 2000



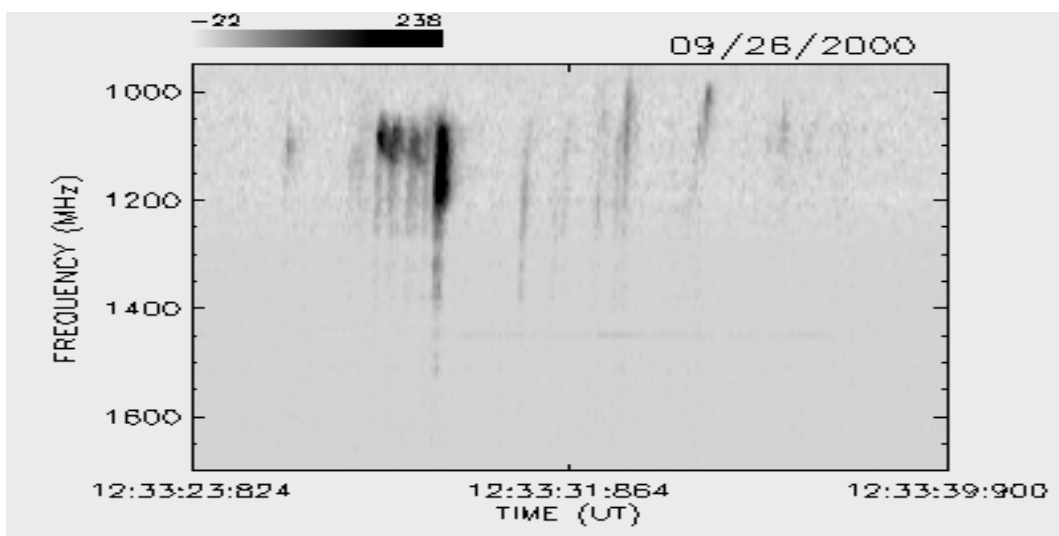
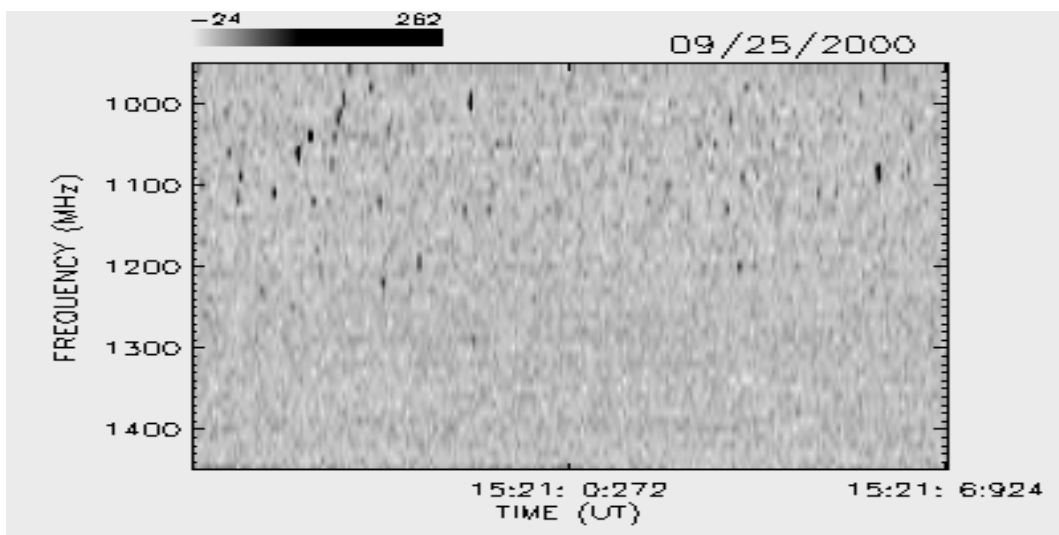
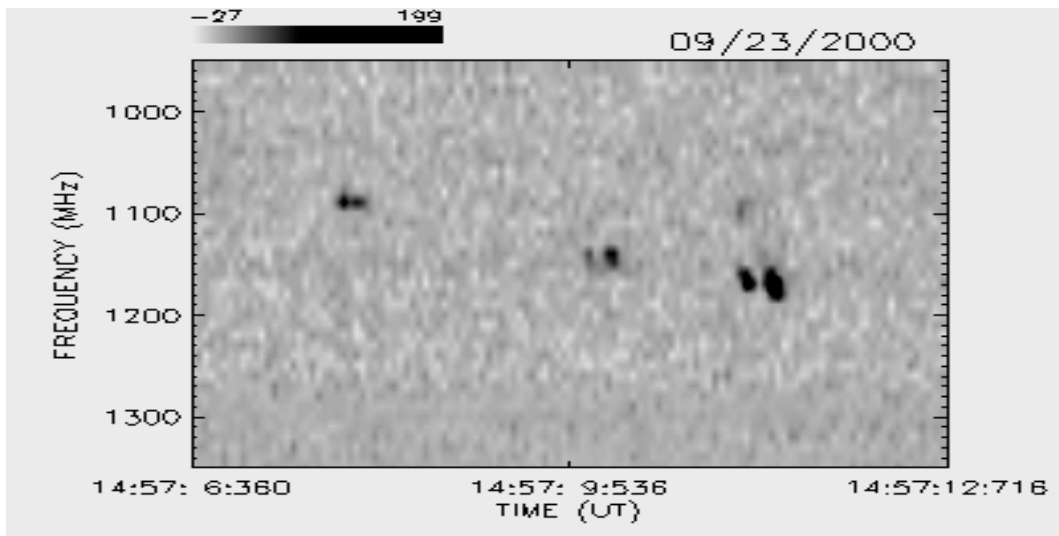
SETEMBRO / 2000



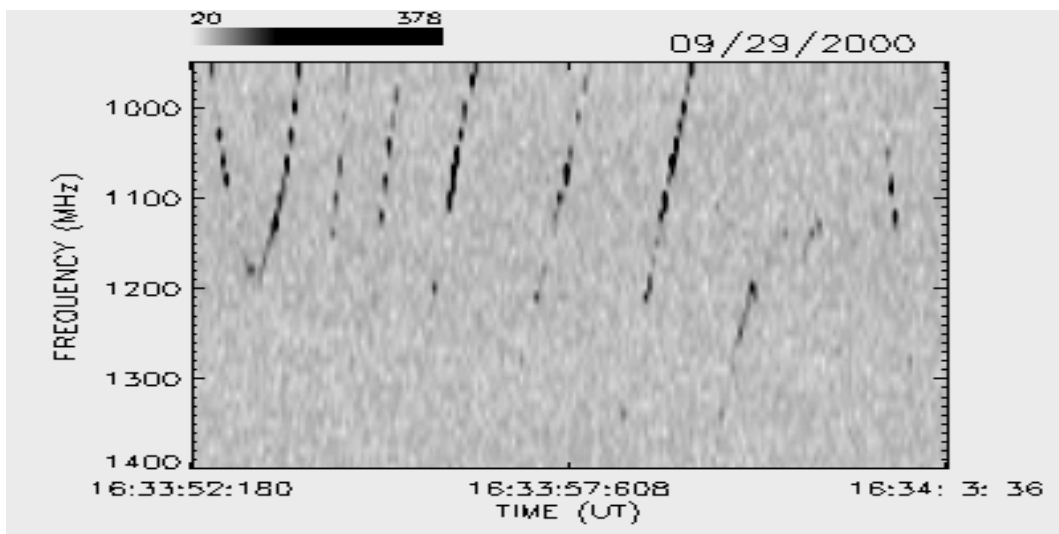
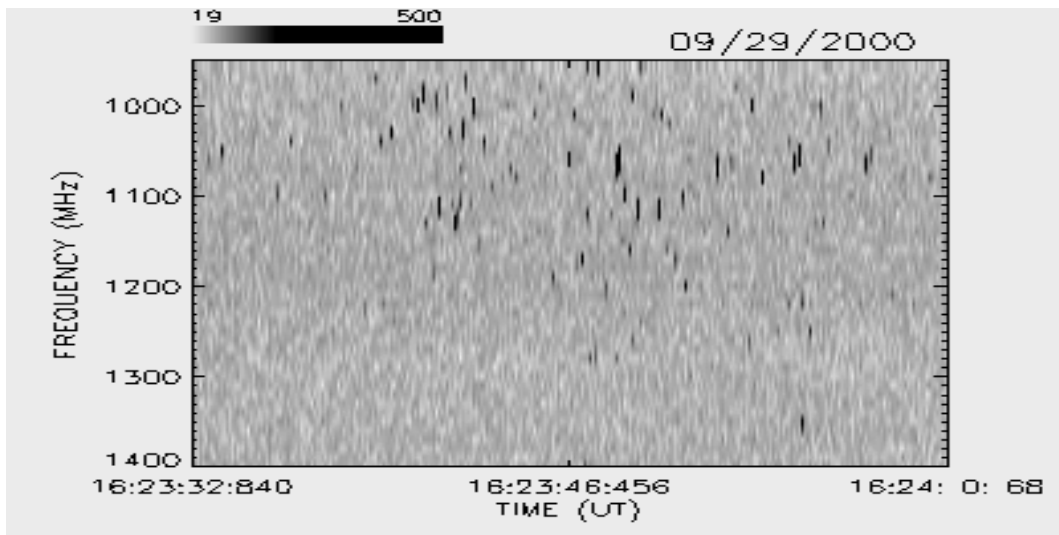
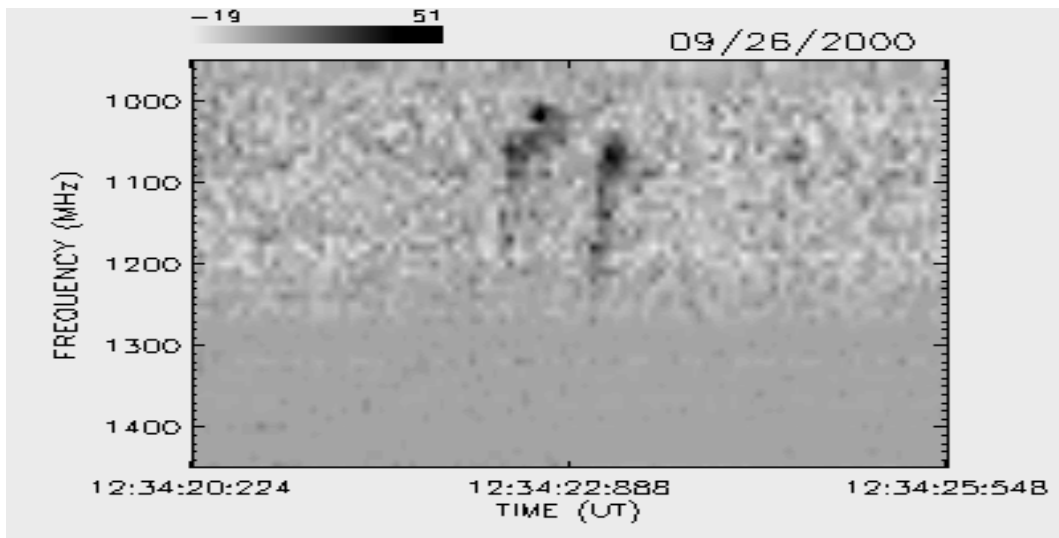
SETEMBRO / 2000



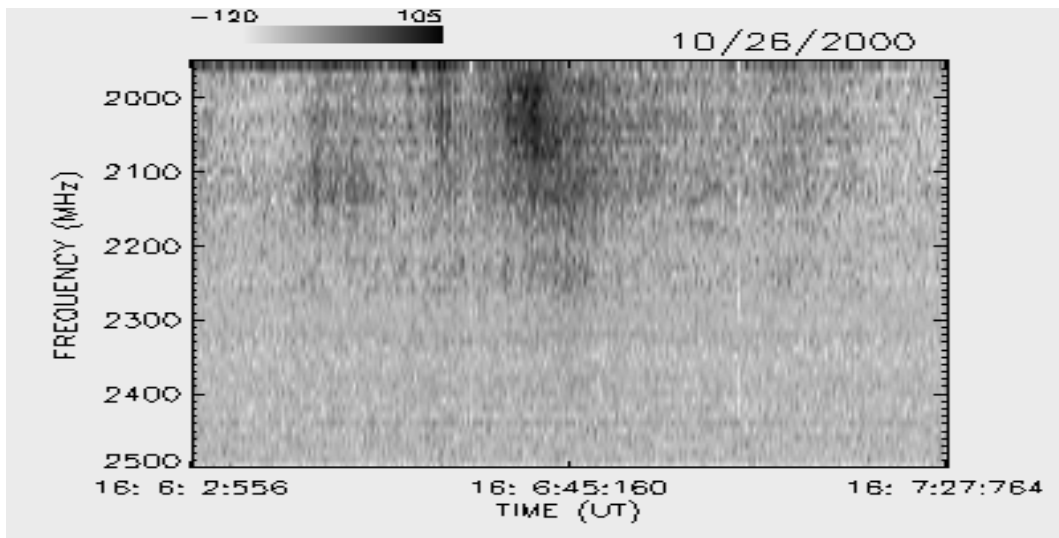
SETEMBRO / 2000



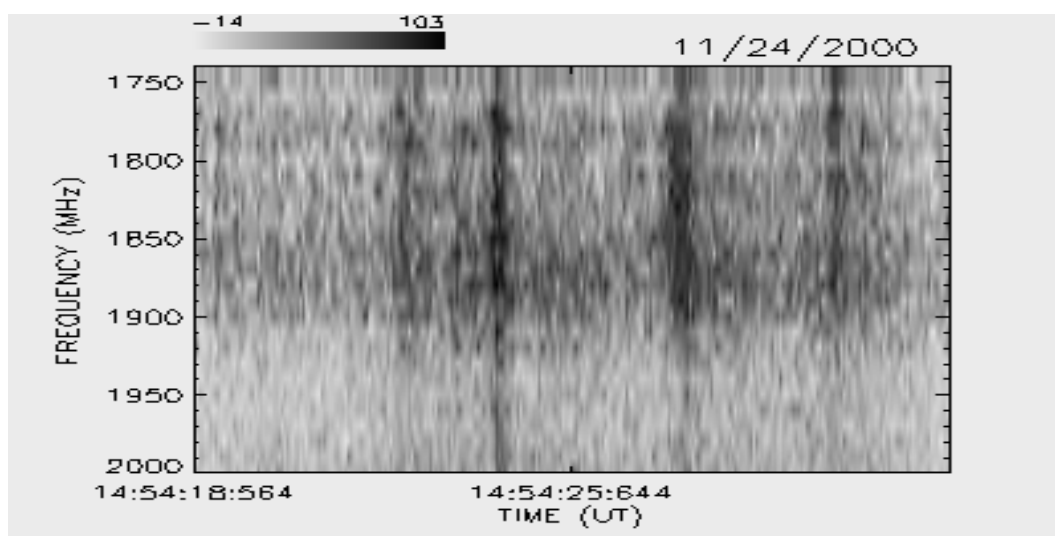
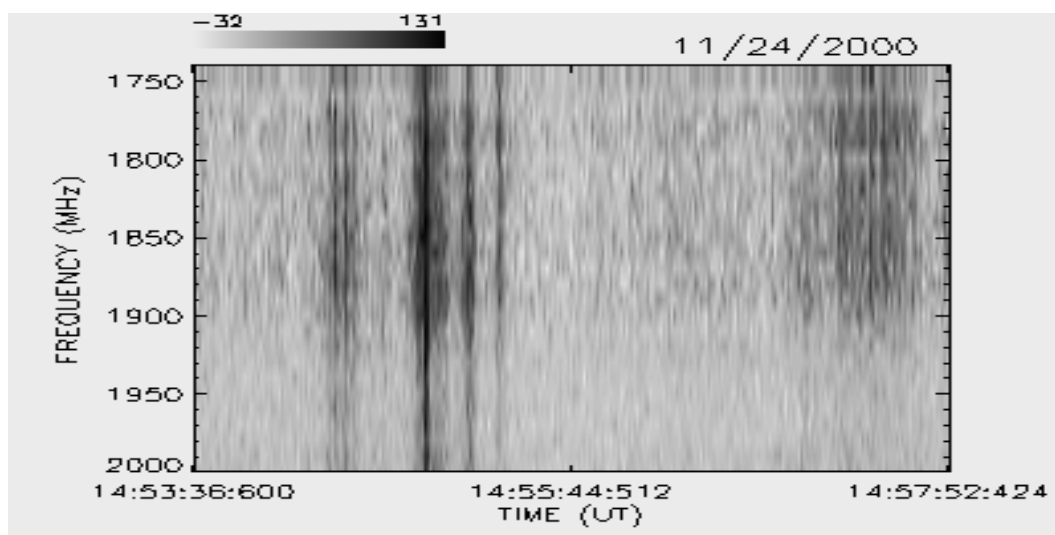
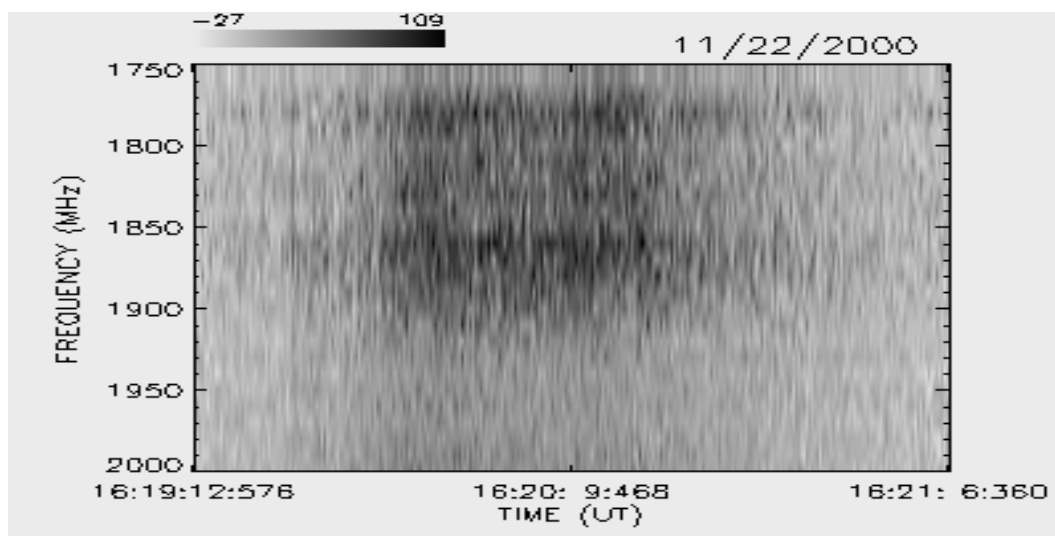
SETEMBRO / 2000



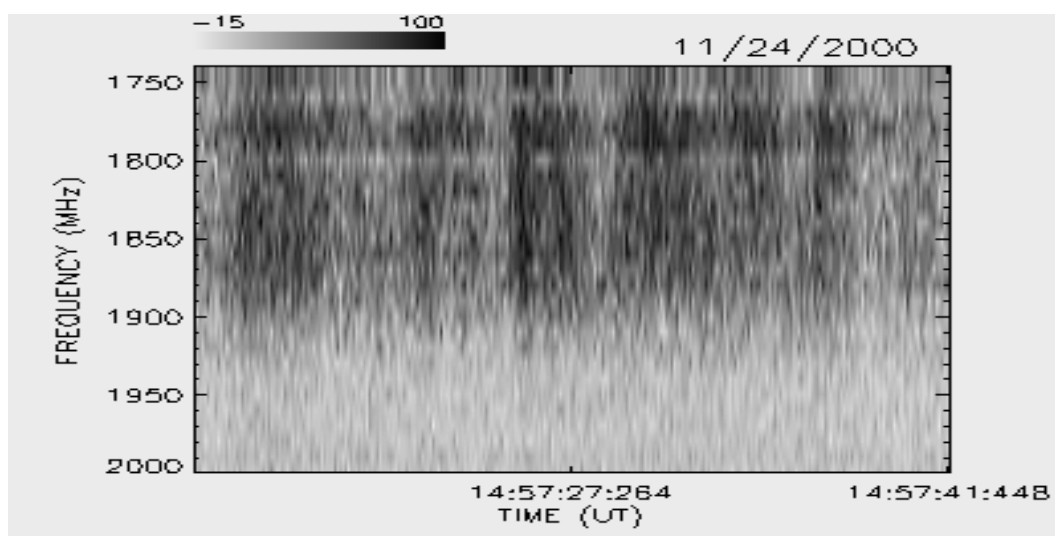
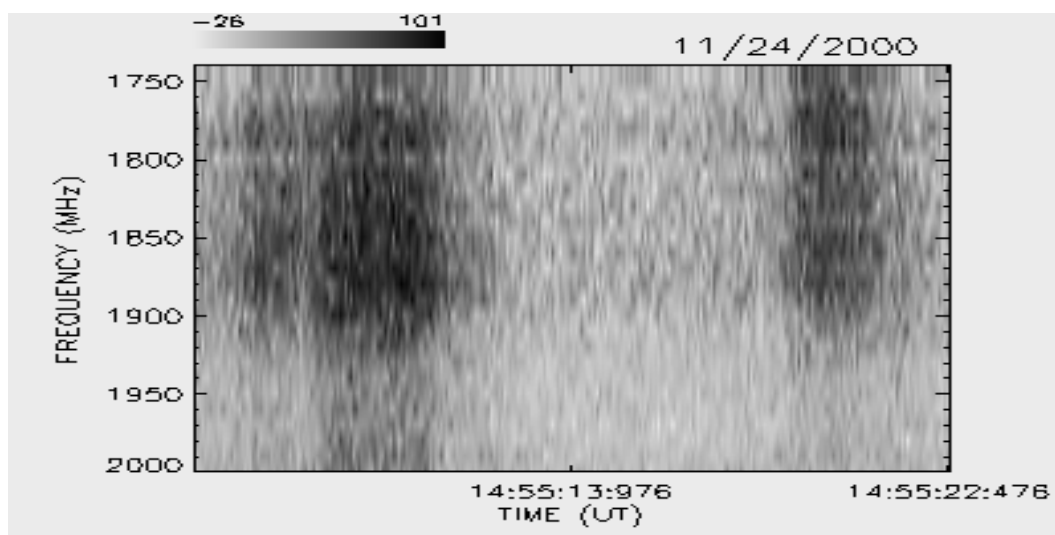
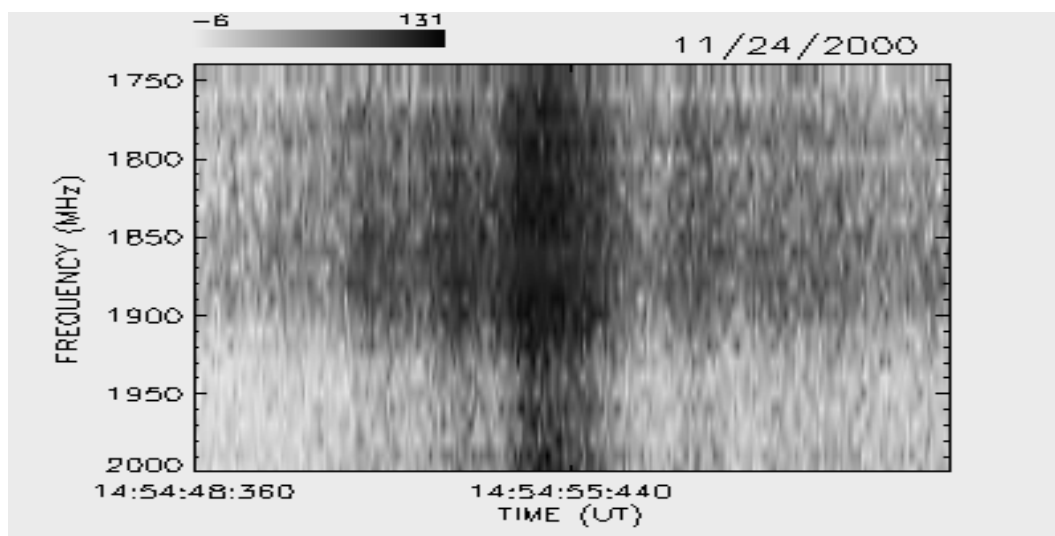
OUTUBRO / 2000



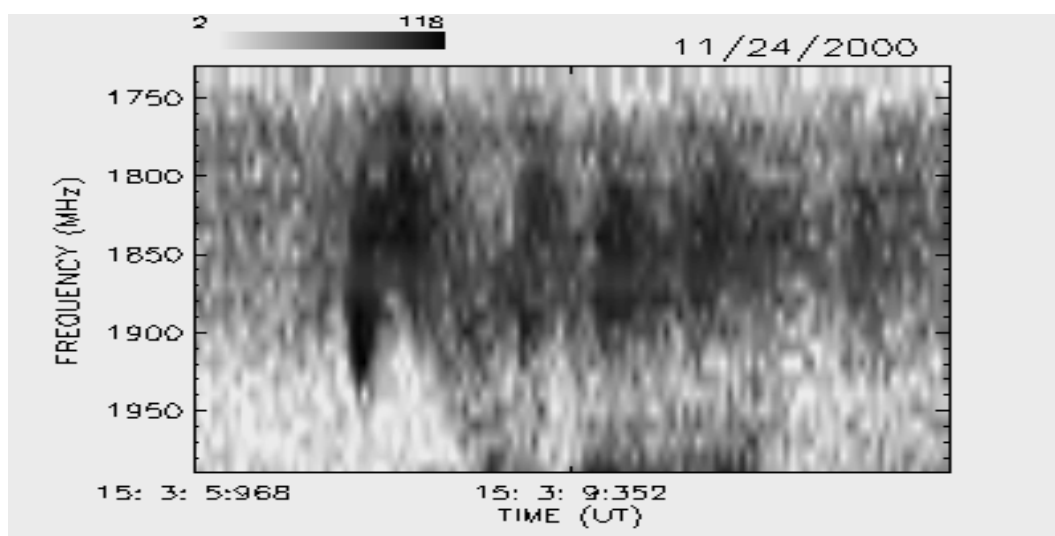
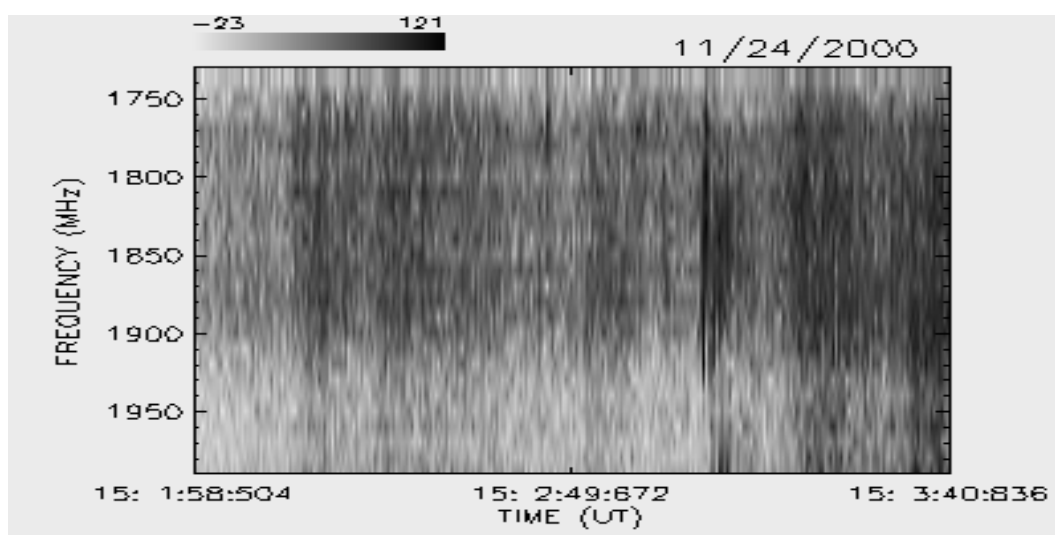
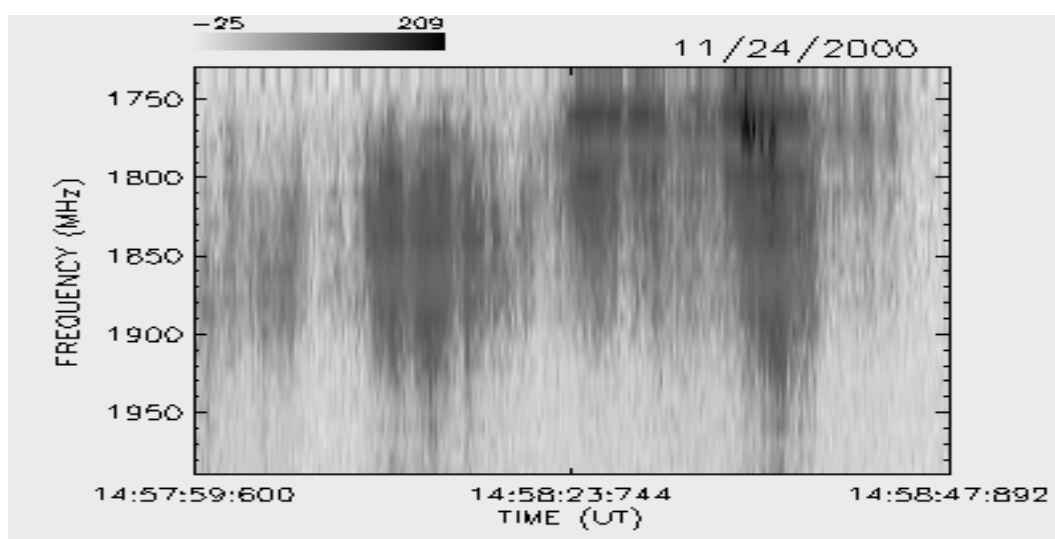
NOVEMBRO / 2000



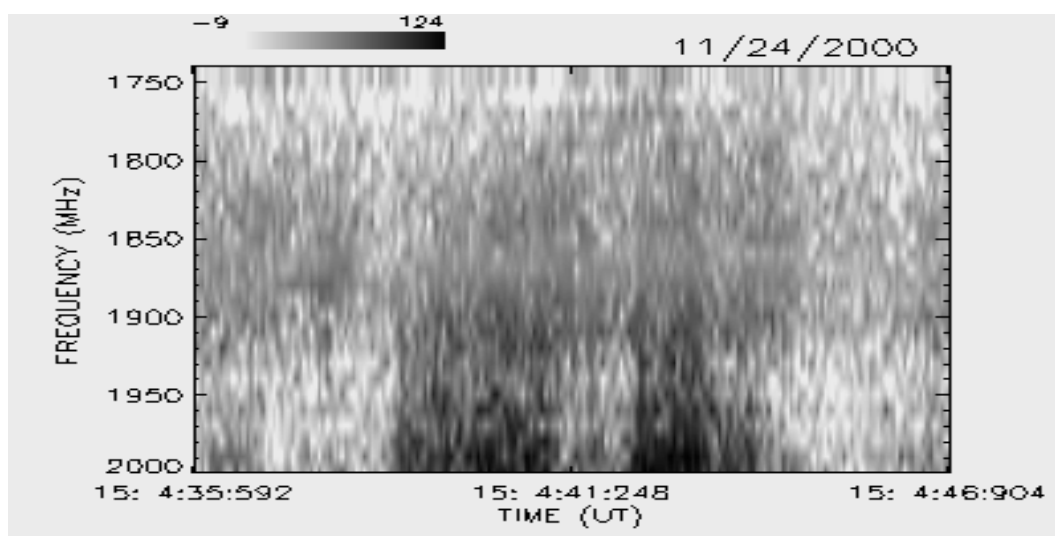
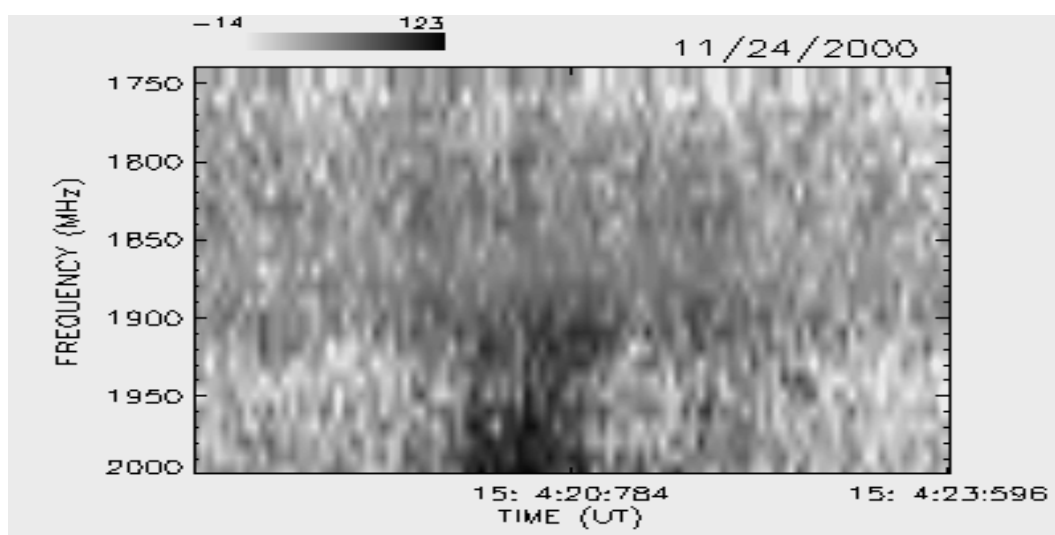
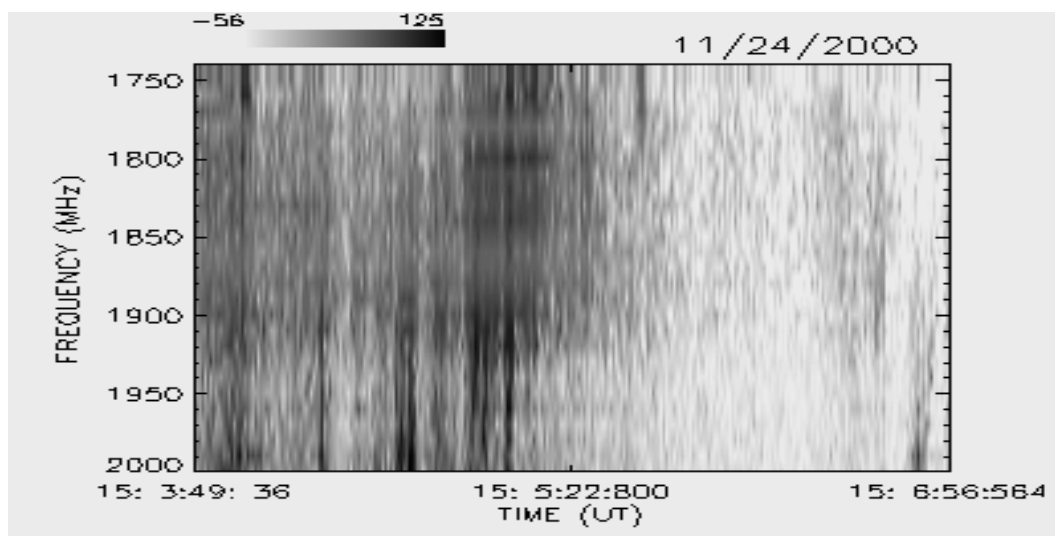
NOVEMBRO / 2000



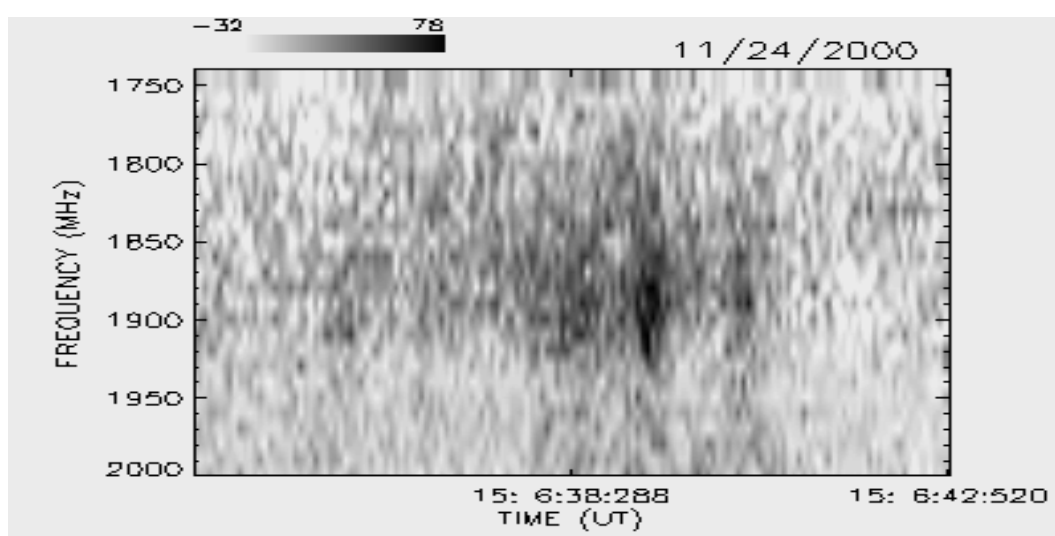
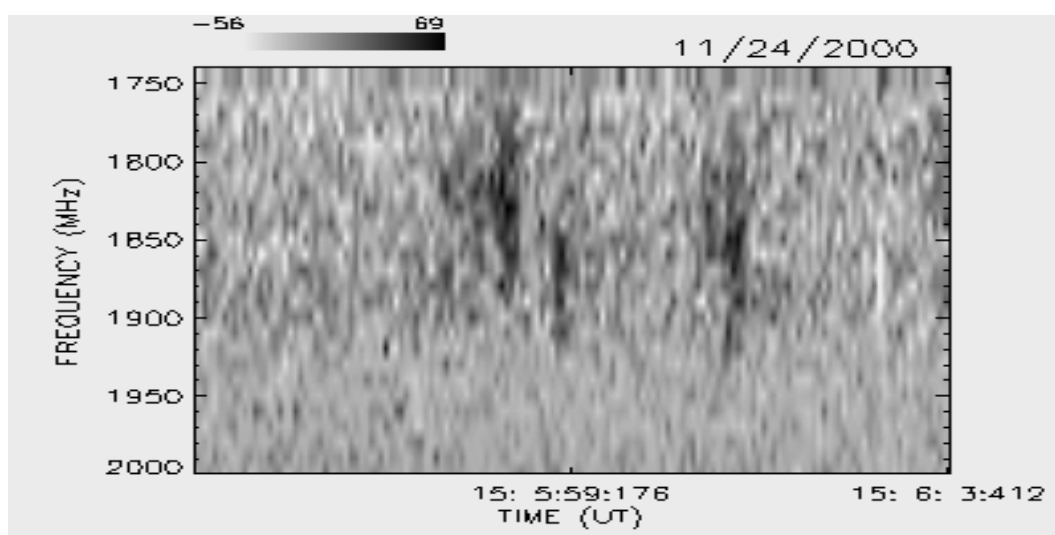
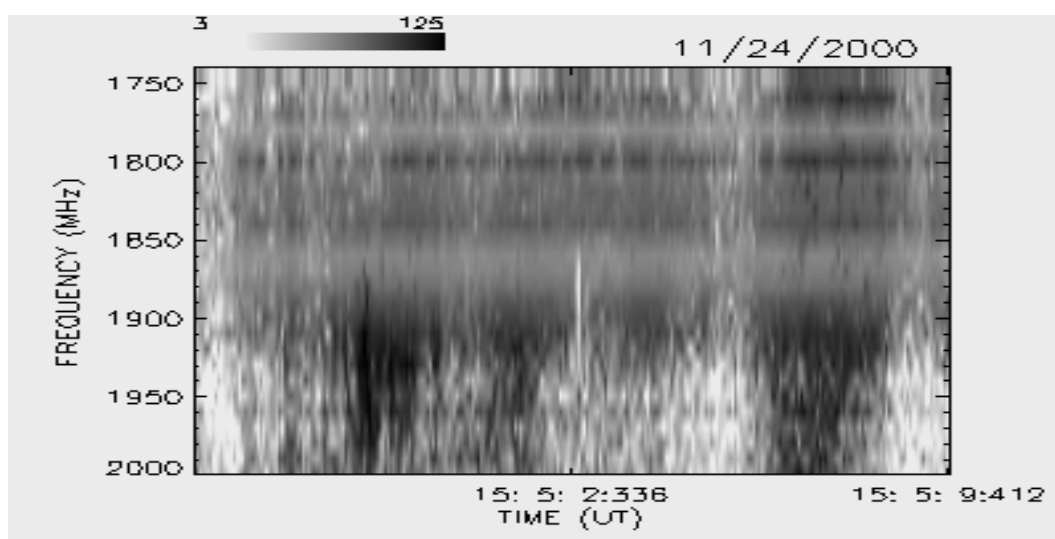
NOVEMBRO / 2000



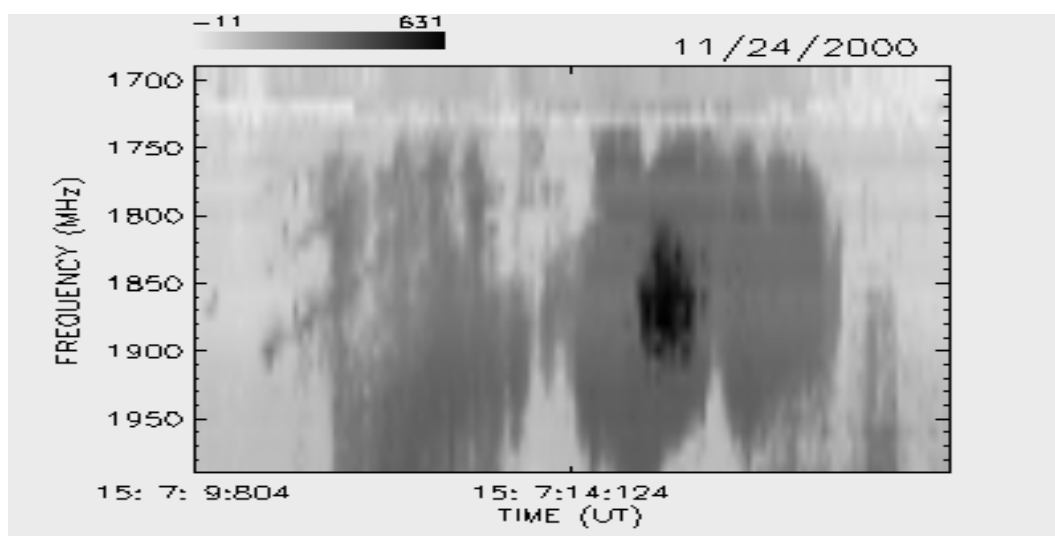
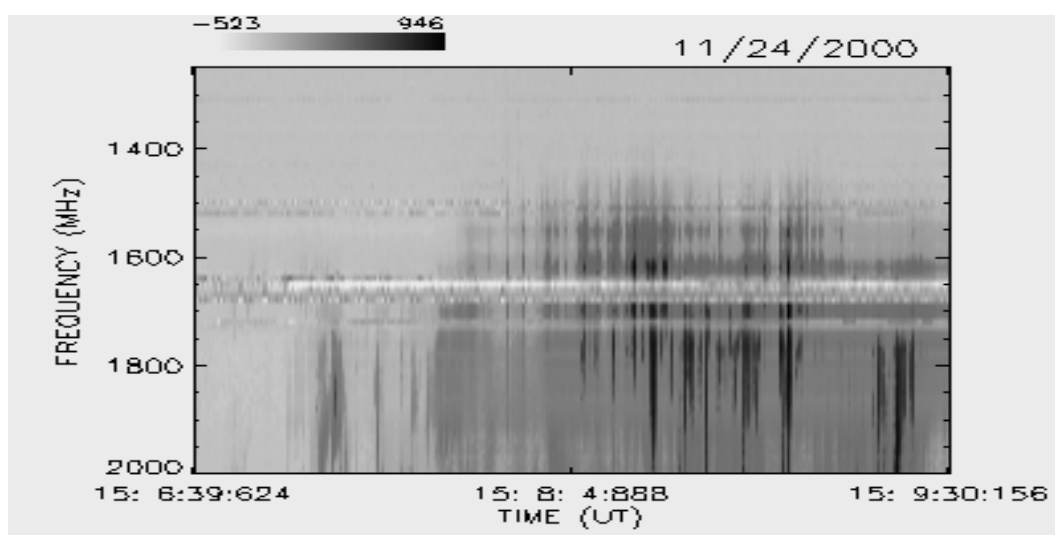
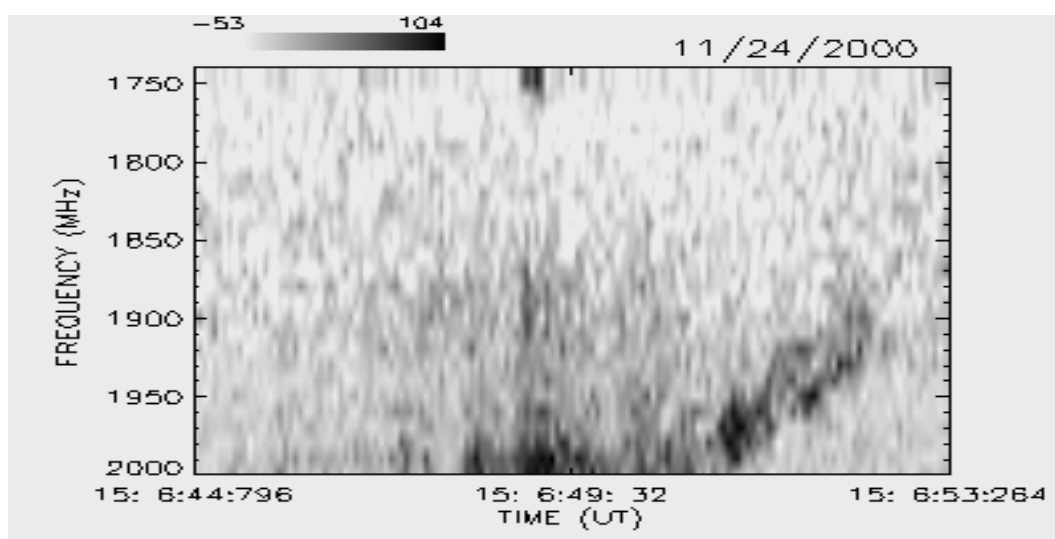
NOVEMBRO / 2000



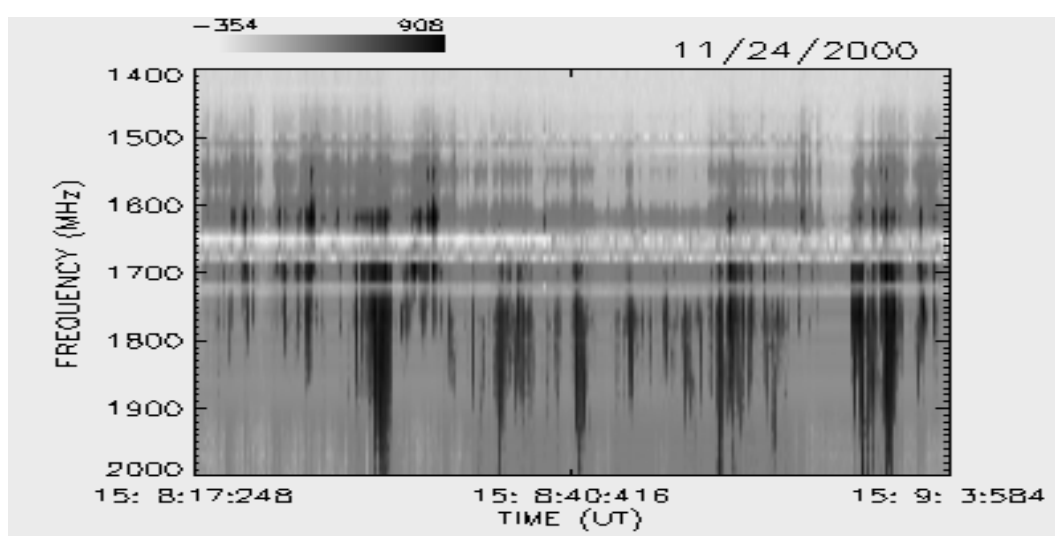
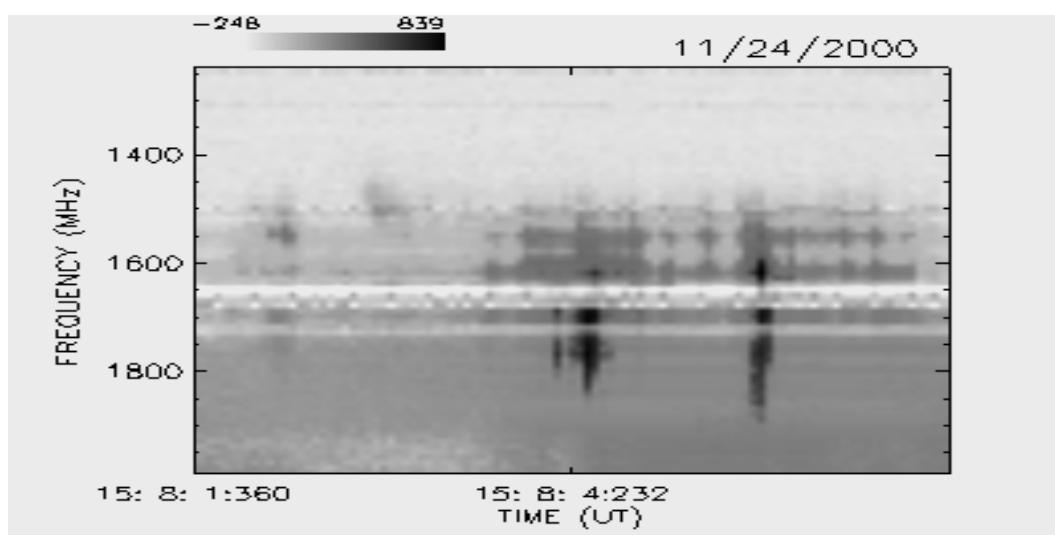
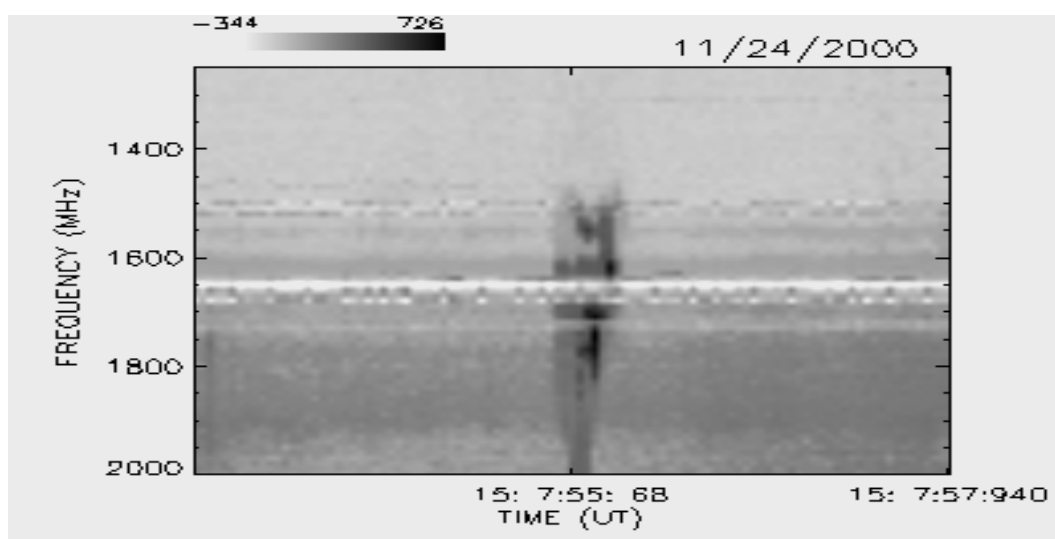
NOVEMBRO / 2000



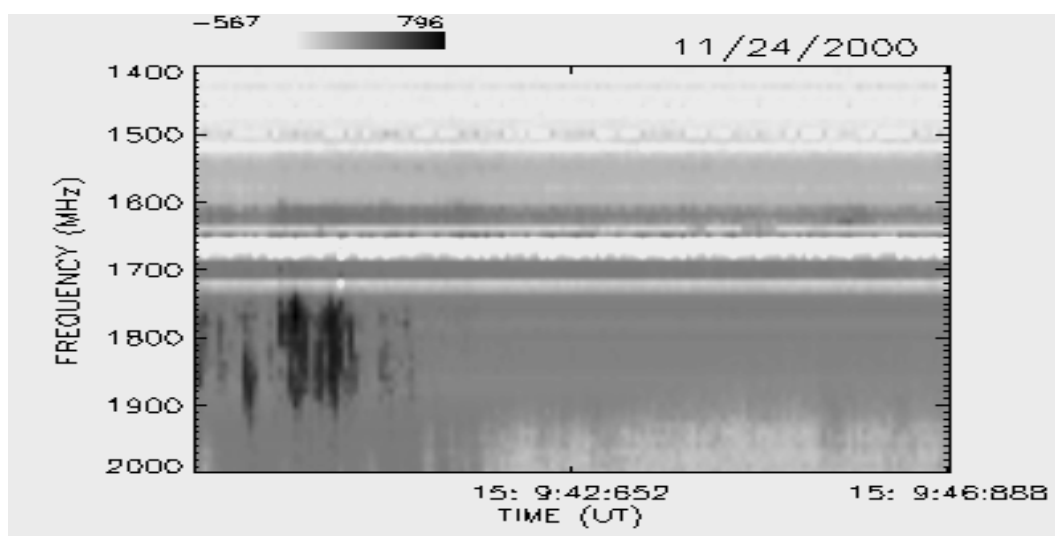
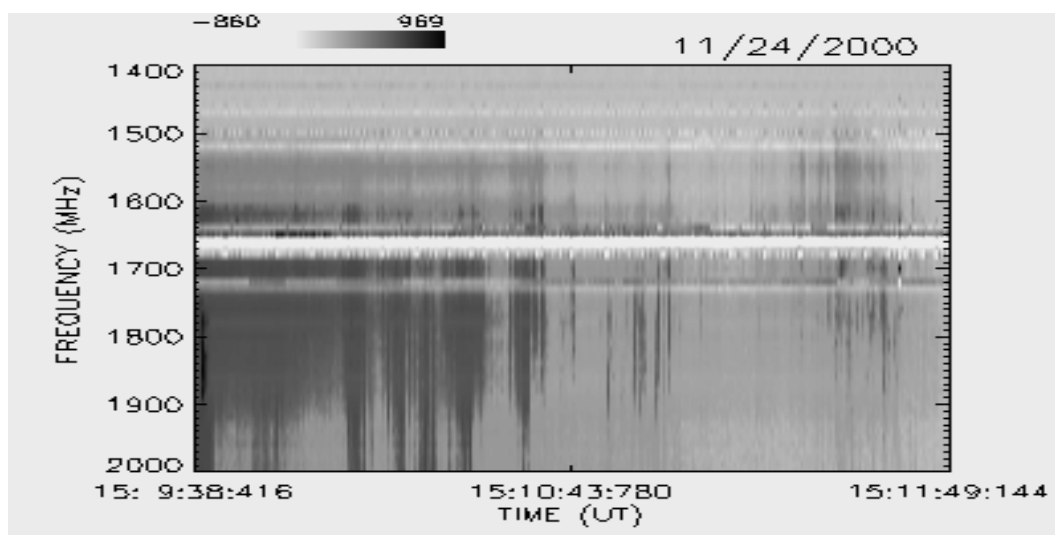
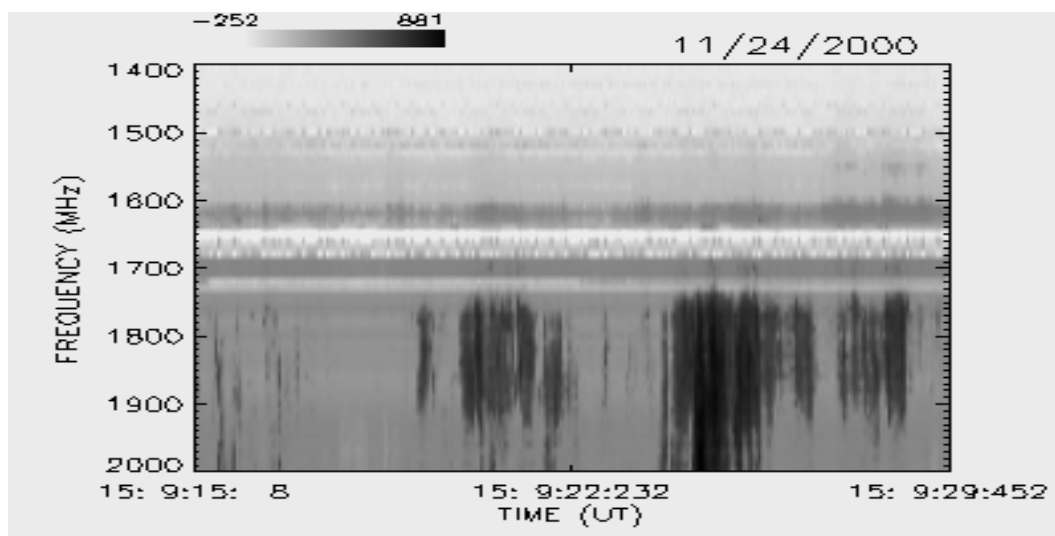
NOVEMBRO / 2000



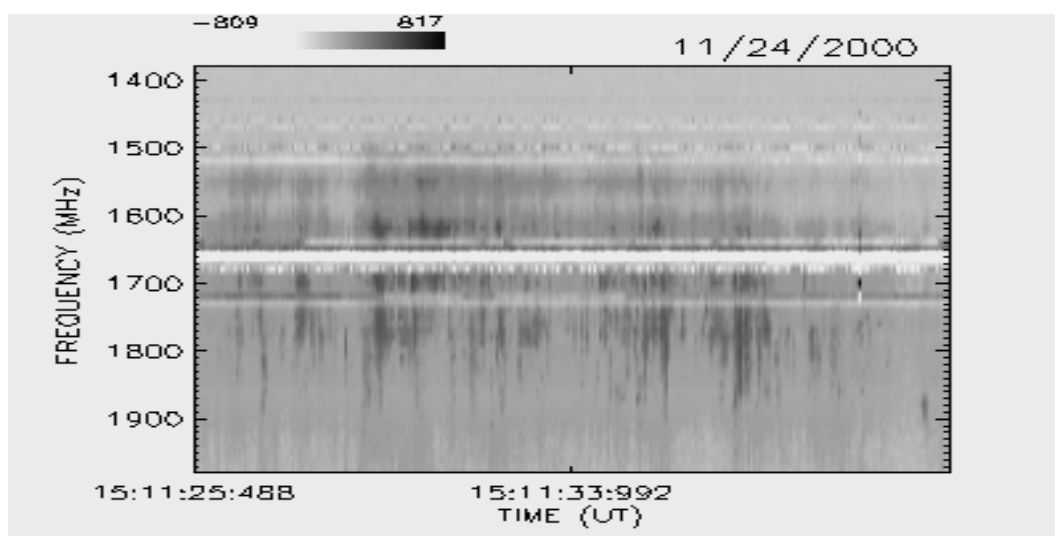
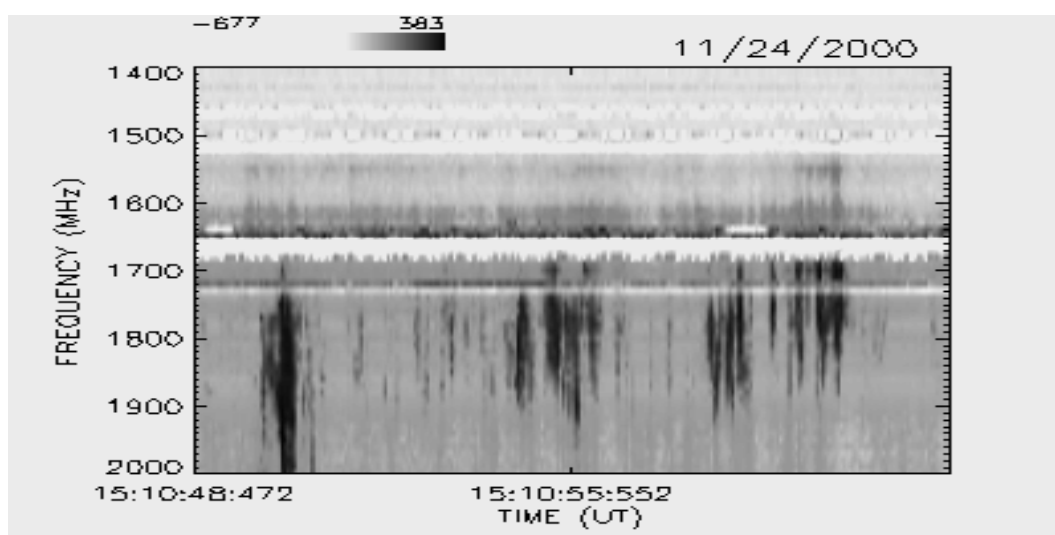
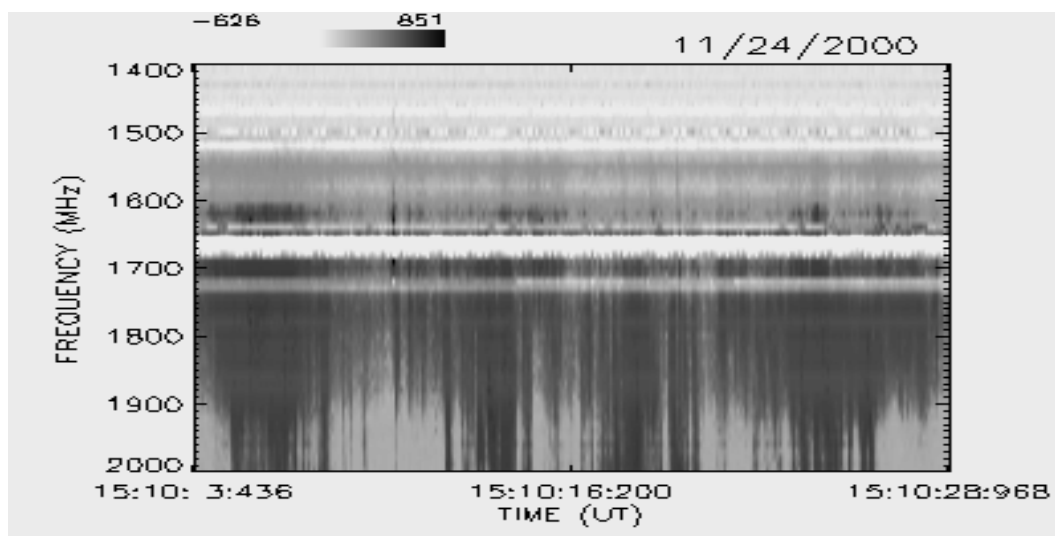
NOVEMBRO / 2000



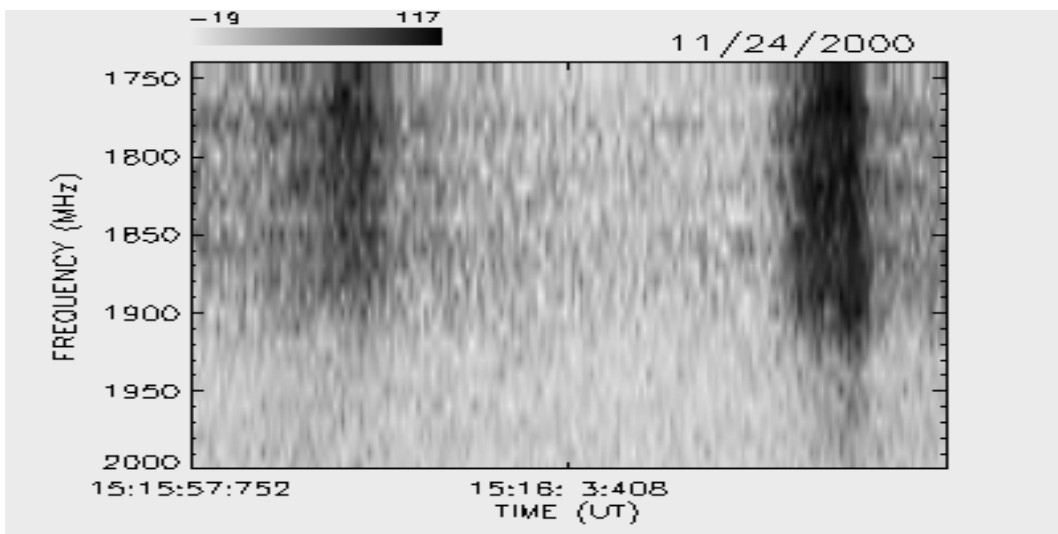
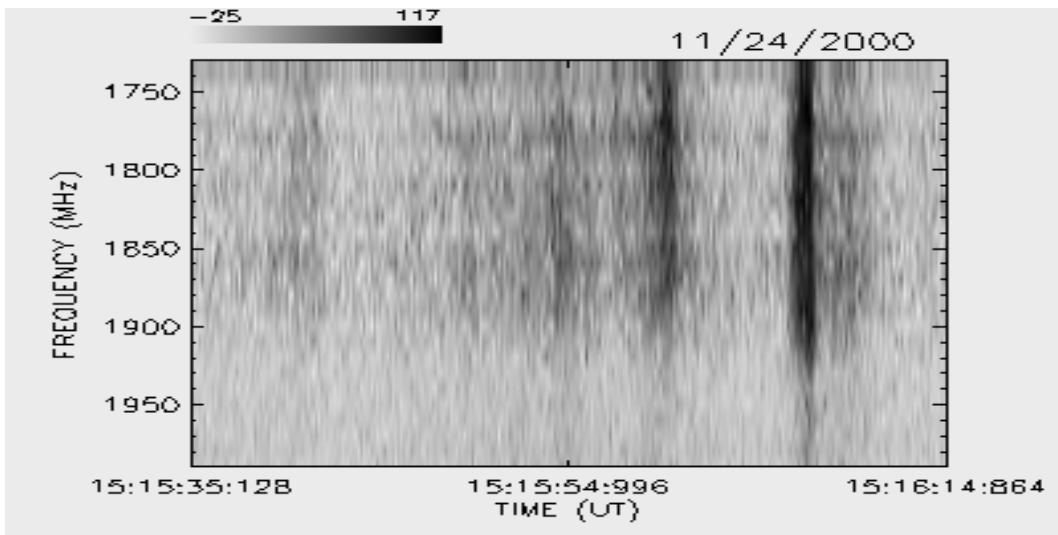
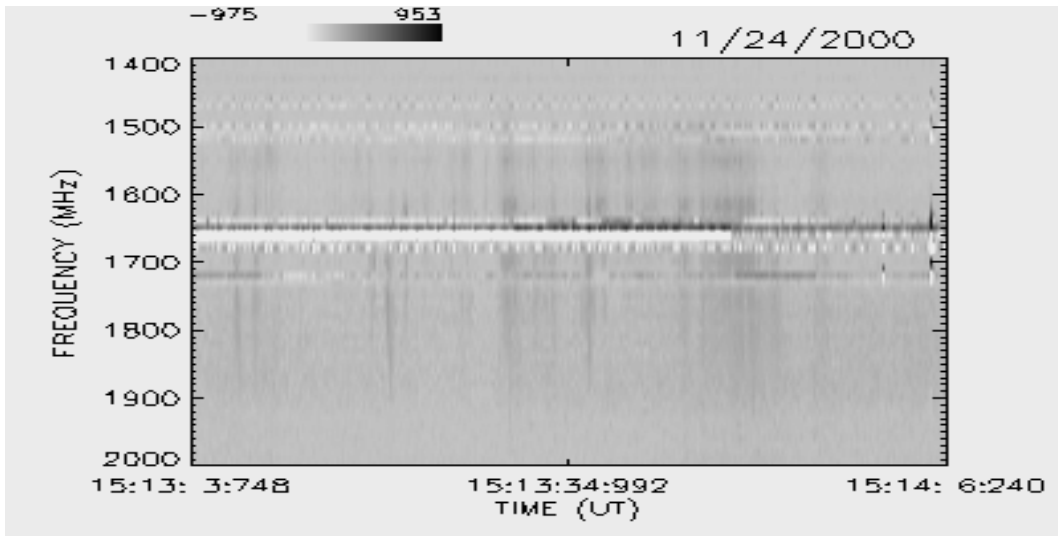
NOVEMBRO / 2000



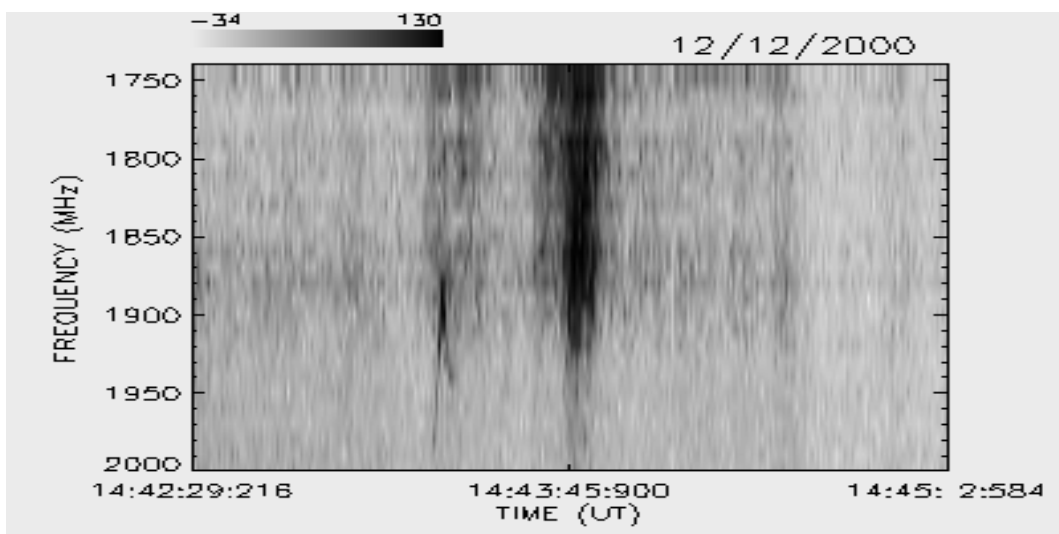
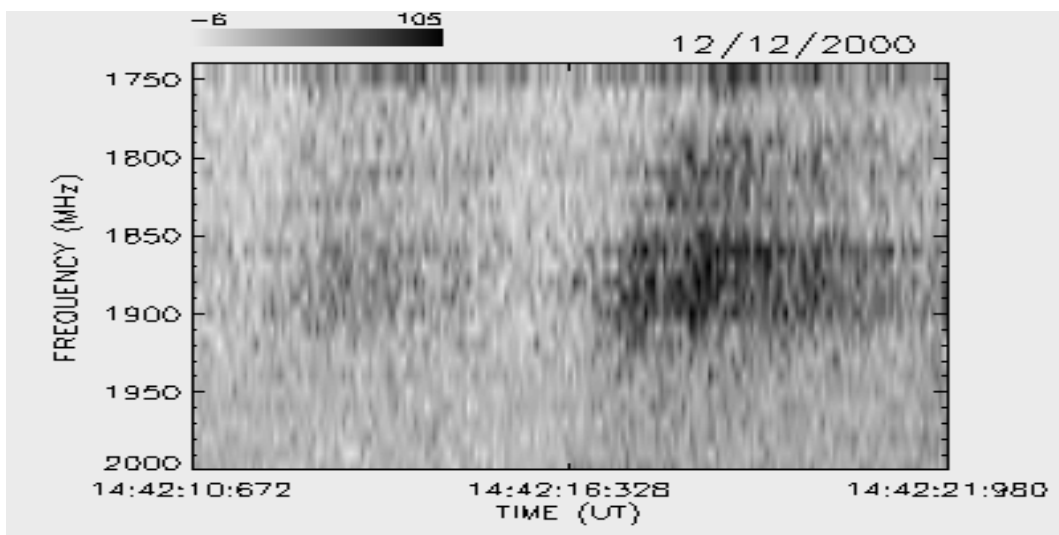
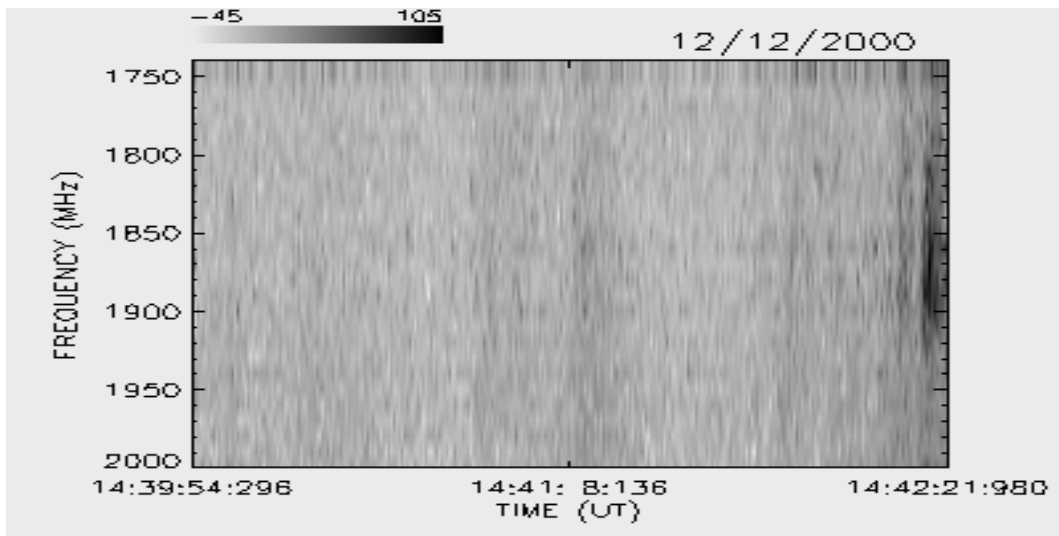
NOVEMBRO / 2000



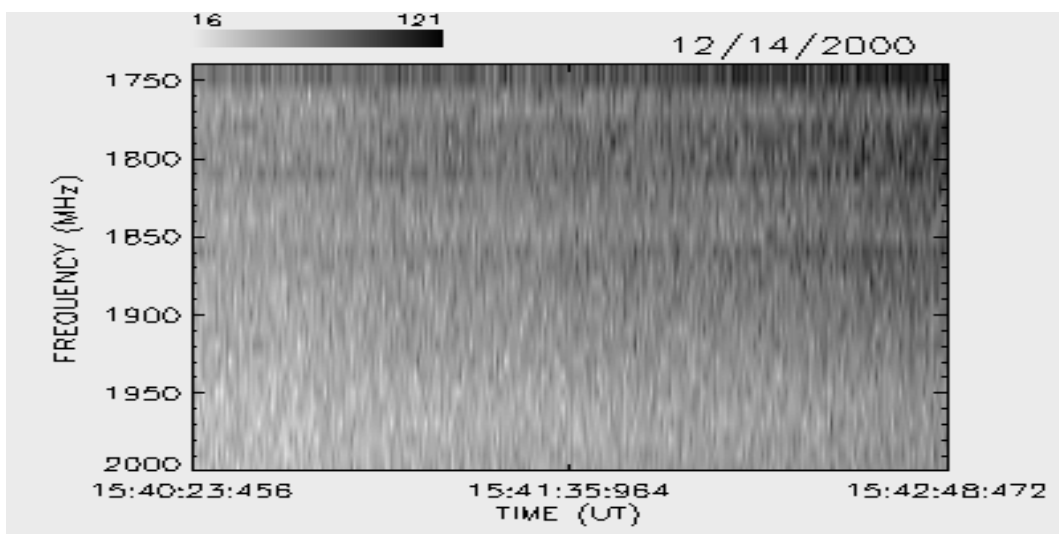
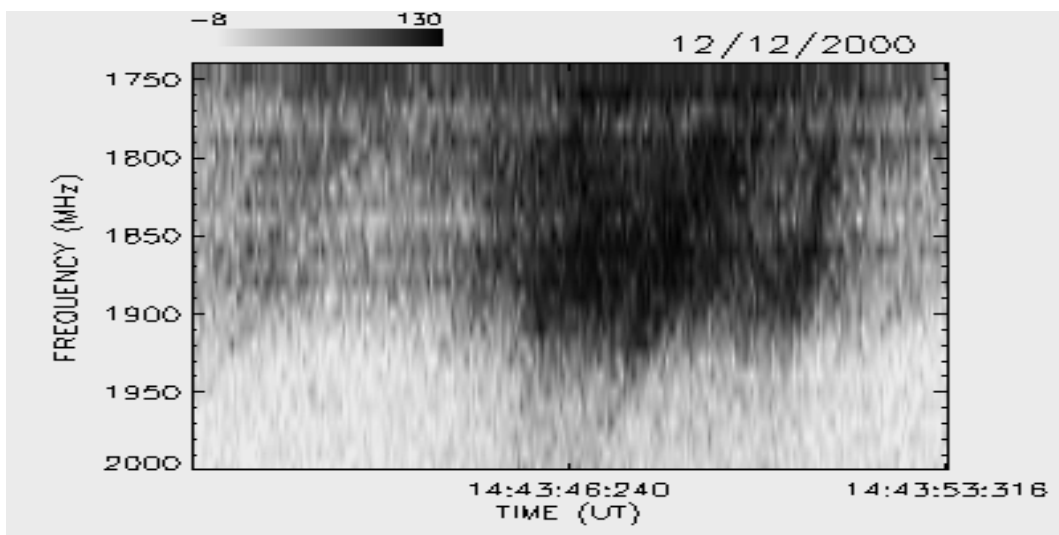
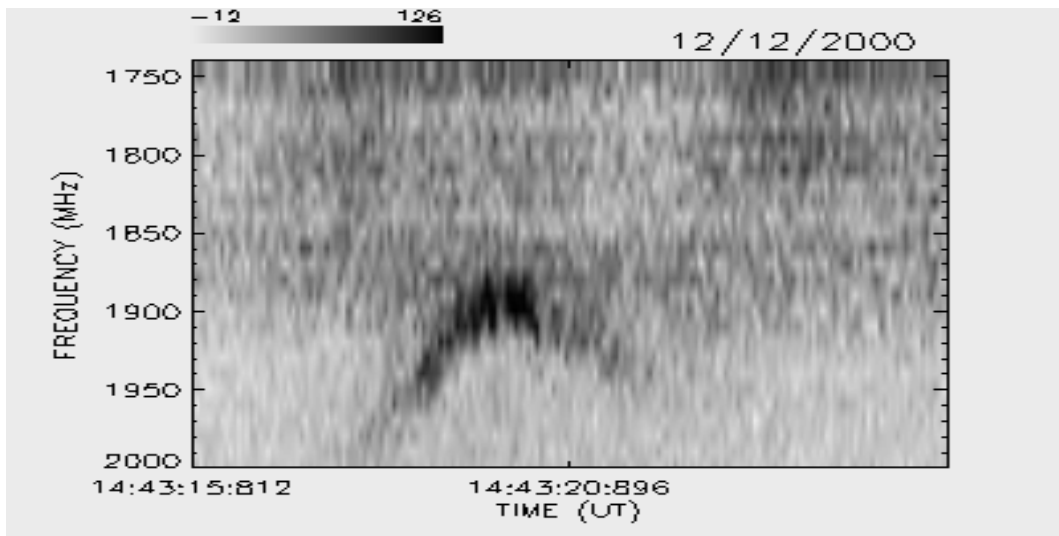
NOVEMBRO / 2000



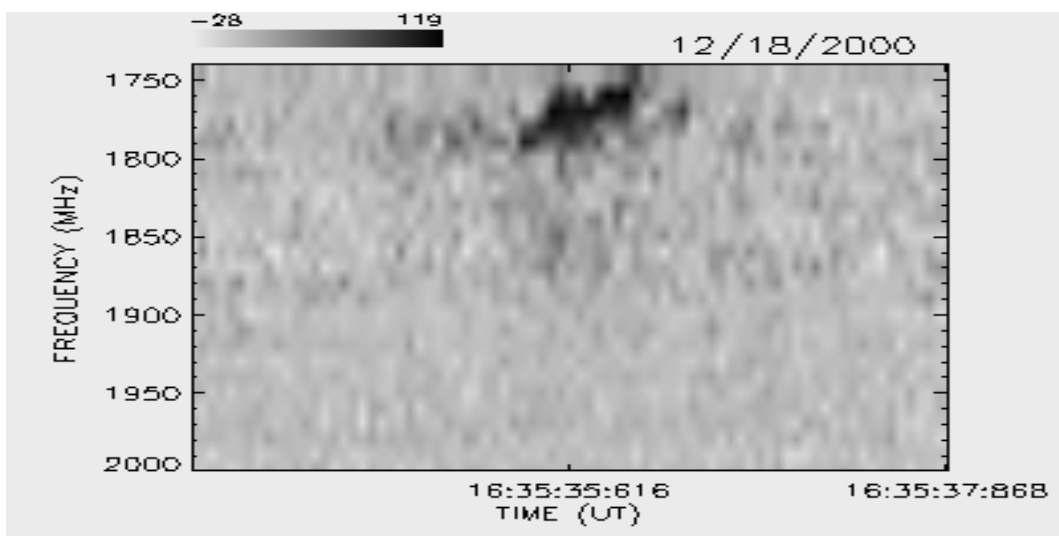
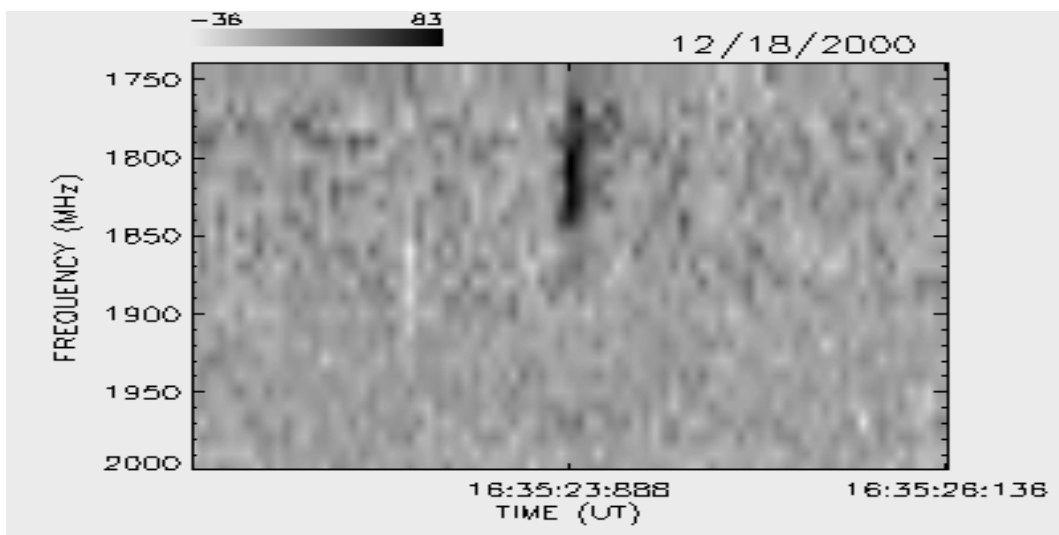
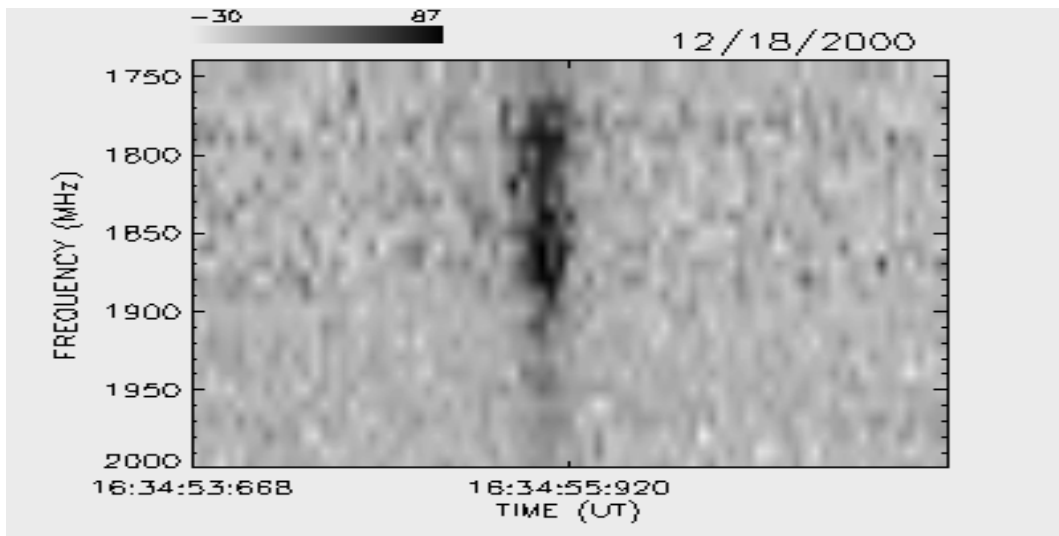
DEZEMBRO / 2000



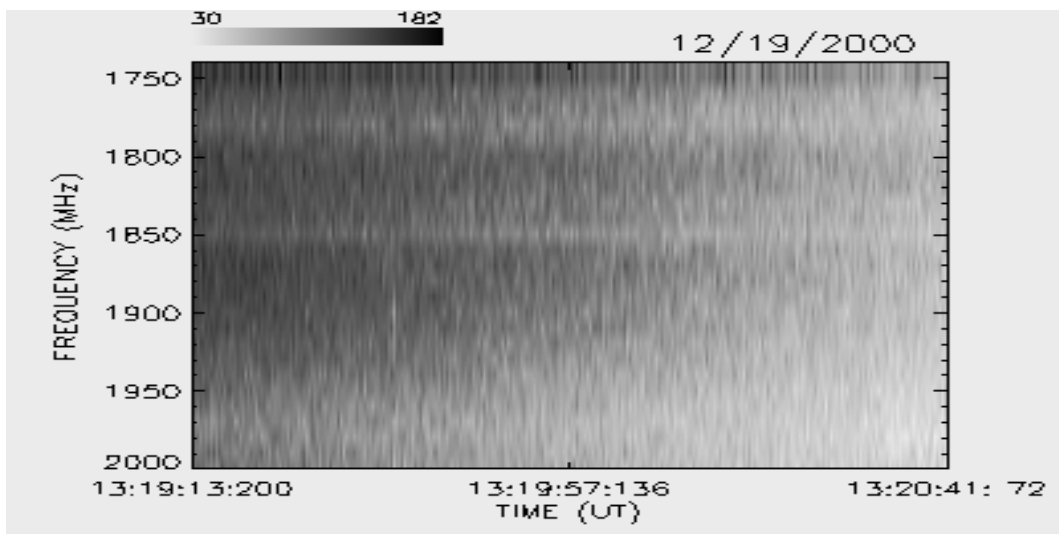
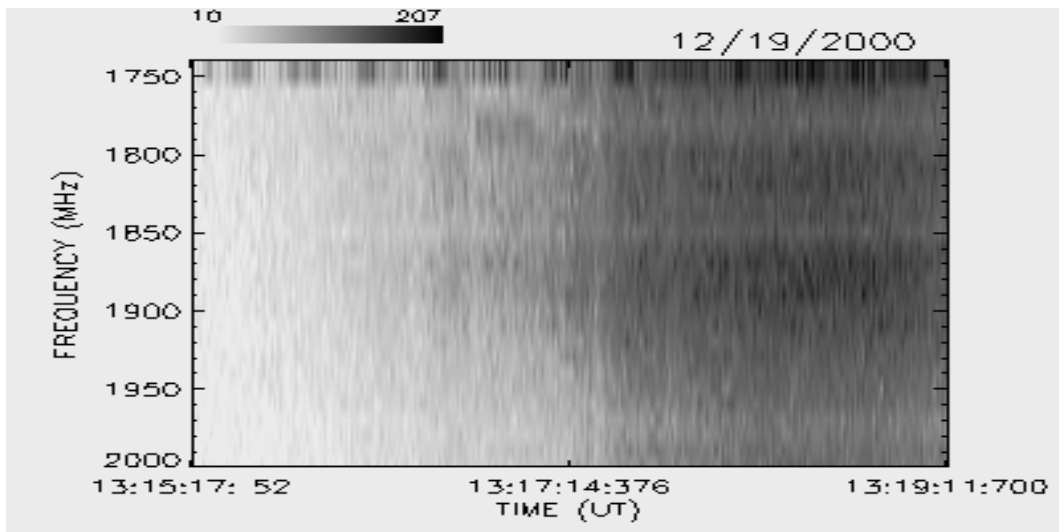
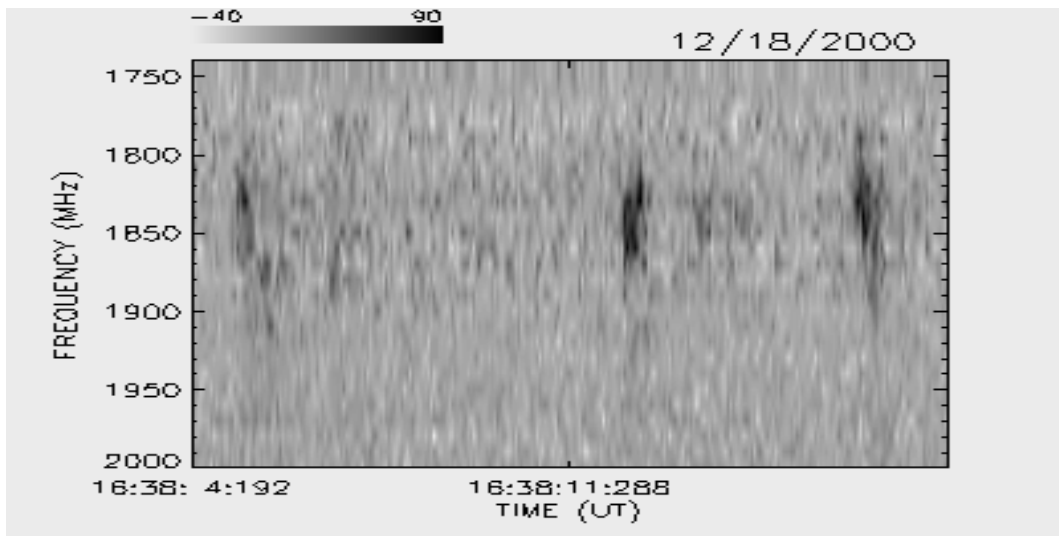
DEZEMBRO / 2000



DEZEMBRO / 2000



DEZEMBRO / 2000



REFERÊNCIAS BIBLIOGRÁFICAS

- Faria, C., **Um sistema para tratamento e visualização de dados astronômicos espectrais**. São José dos Campos. 120 p. Dissertação (Mestrado em Matemática e Computação Aplicada) - Instituto Nacional de Pesquisas Espaciais, 1999.
- Fernandes, F. C. R., **Espectrógrafo decimétrico de alta sensibilidade e resolução: análise preliminar das explosões solares**. São José dos Campos. 132 p. (INPE-5537-TDI/525) Dissertação (Mestrado em Ciência Espacial - Radioastronomia e Física Solar) - Instituto Nacional de Pesquisas Espaciais, 1992.
- Fernandes, F. C. R., **Espectrógrafo Digital Decimétrico de banda larga e investigações de flares solares em rádio e raios-X**. São José dos Campos. 178 p. (INPE-6396-TDI/612) Tese (Doutorado em Astrofísica) - Instituto Nacional de Pesquisas Espaciais, 1997.
- Fernandes, F. C. R.; Cecatto, J. R.; Neri, J. A. C. F.; Faria, C.; Martinon, A. R. F.; Rosa, R. R.; Mesquita, F. P. V.; Portezani, A.; Andrade, M. C.; Alonso, E. M. B.; Vats, H. O.; Sawant, H. S. O Brazilian Solar Spectroscop (BSS) e os Problemas Atuais da Física Solar. **Boletim da Sociedade Astronômica Brasileira**, v. 20, n. 2, p. 33-43, 2000.
- Fernandes, F. C. R., Cecatto, J. R., Neri, J. A. C. F., Silva, M. J. B., Rosa, R. R., Faria, C., Andrade, M. C., Alonso, E. M. B., Martinon, A. R. F., Dobrowolski, K. M., Barbosa, T. M., Freitas, D. C., Nascimento, V. F., Reis, A. L., Sawant, H. S. Observações espectroscópicas inéditas de explosões solares decimétricas com 20 ms. **Boletim da Sociedade Astronômica Brasileira**, v. 21, n. 2, p. 49-53, 2001.
- Fernandes, F. C. R.; Cecatto, J. R.; Andrade, M. C.; Martinon, A. R. F.; Sawant, H. S. Catalogue of solar bursts observed by the Brazilian Solar Spectroscop – BSS, **Astrophysical Journal Supplement Series**, 2003. Submetido.
- Martinon, A. R. F., Fernandes, F. C. R., Vats, H. O., Neri, J. A. C. F., Sawant, H. S. BSSView: novas rotinas para visualização e análise de dados espectrais solares In: XXVI Reunião Anual da SAB, 2000, Mangaratiba, RJ. **Boletim da Sociedade Astronômica Brasileira**, v. 20., n. 1, p. 44-44, 2000.
- Martinon, A. R. F., Dobrowolski, K. M., Preto, A. J., Sawant, H. S., Stephany, S., BSSLibrary - Uma biblioteca de rotinas vetorizadas para filtragem de dados em radioastronomia solar. In: Workshop dos Cursos de Computação Aplicada do INPE (WORCAP), 2., São José dos Campos, SP, **Anais**, p. 167-172, 2002.
- Sawant, H. S.; Rosa, R. R. High sensitivity, high frequency and high time resolution decimetric spectroscop. **Revista Mexicana de Astronomia e Astrofísica**, v. 21, p. 651-654, 1990.
- Sawant, H. S., Sobral, J. H. A., Neri, J. A. C. F., Fernandes, F. C. R., Rosa, R. R., Cecatto, J. R., Martinazzo, D. High sensitivity, high frequency and high time resolution decimeter solar radio spectroscop In: Reunião Anual da SBPC, 43., 1991, Rio de Janeiro, RJ. **Anais**. ISSN 0102-2474. Rio de Janeiro. Ed. SBPC. 1991. p. 689-690.
- Sawant, H. S., Sobral, J. H. A., Neri, J. A. C. F., Fernandes, F. C. R., Rosa, R. R., Cecatto, J. R., Martinazzo, D. Decimeter High Resolution Solar Radio Spectroscop. **Lecture Notes In Physics**, v. 399, p. 318-321, 1992.

- Sawant, H. S., Sobral, J. H. A., Neri, J. A. C. F., Fernandes, F. C. R., Cecatto, J. R., Rosa, R. R. High Sensitivity Digital Decimetric Spectroscope. **Advances In Space Research**, v. 13, n. 9, p. 199-202, 1993.
- Sawant, H. S., Sobral, J. H. A., Fernandes, F. C. R., Cecatto, J. R., Day, W. R. G., Neri, J. A. C. F., Alonso, E. M. B., Moraes, A. High Sensitivity Wide Band Digital Solar Polarimetric Spectroscope. **Advances in Space Research**, v. 17, n. 4/5, p. 385-388, 1996.
- Sawant, H. S.; Subramanian, K. R.; Faria, C.; Stephany, S.; Fernandes, F. C. R.; Cecatto, J. R.; Rosa, R. R.; Portezani, V. A.; Mesquita, F. P. V.; Alonso, E. M. B. Data Acquisition and Recent Results of the Brazilian Solar Spectroscope - BSS. **Astronomical Society of the Pacific Conference Series**, v. 206, p. 347-350, 2000.
- Sawant, H. S.; Subramanian, K. R.; Faria, C.; Fernandes, F. C. R.; Sobral, J. H. A.; Cecatto, J. R.; Rosa, R. R.; Vats, H. O.; Neri, J. A. C. F.; Alonso, E. M. B.; Mesquita, F. P. V.; Portezani, A.; Martinon, A. R. F. Brazilian Solar Spectroscope (BSS). **Solar Physics**, v. 200, n. 1-2, p. 167-176, 2001.