

Tropopause altitude and PMSE detection at 78°N, 16°E, 2008: first results of the refurbished SOUSY Svalbard Radar (SSR2)

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Introduction



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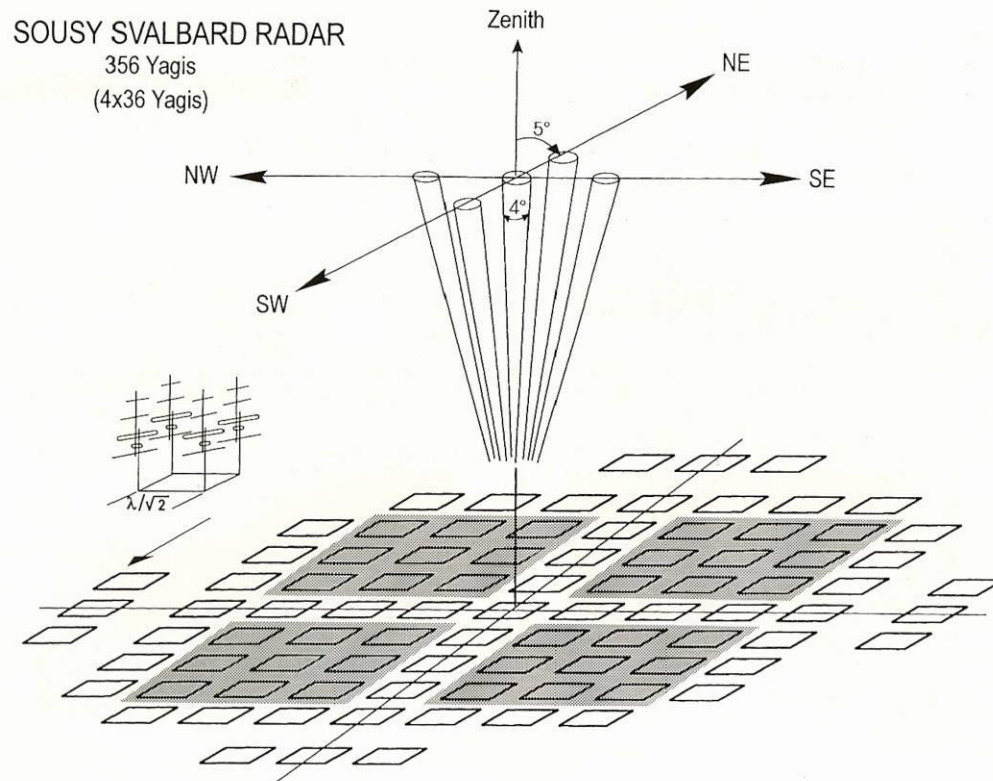
- Sousy Svalbard Radar (SSR) is an MST radar, 53.5MHz
- Location: Adventdalen (78°N, 16°E)



Introduction



Troposphere, lower stratosphere with SOUSY Svalbard Radar



- Sousy Svalbard Radar (SSR) is an MST radar, 53.5MHz
- Location: Adventdalen (78°N, 16°E)
- Antenna array (356 yagis of 4-elements)



Introduction



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- Svalbard Radar (SSR) is an MST radar, 53.5MHz
- Location: Adventdalen (78°N, 16°E)
- Antenna array (356 yagis of 4-elements)
- Close proximity to two field stations operated by The University Centre in Svalbard (UNIS) providing, inter alia and meteorological data.
- Near to EISCAT Svalbard Radar (ESR) y SPEAR
- Co – located with NSMR (31MHz)

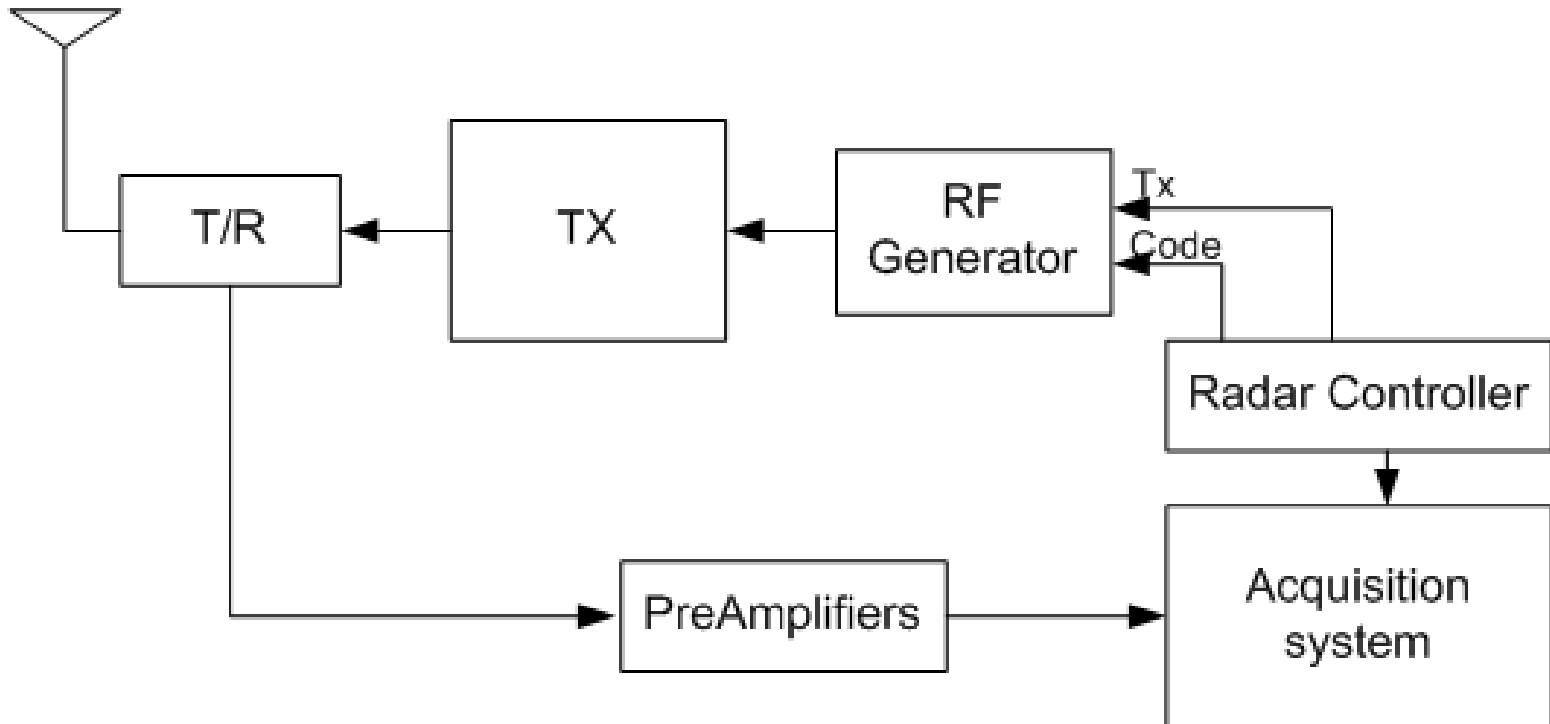
SSR vs SSR2



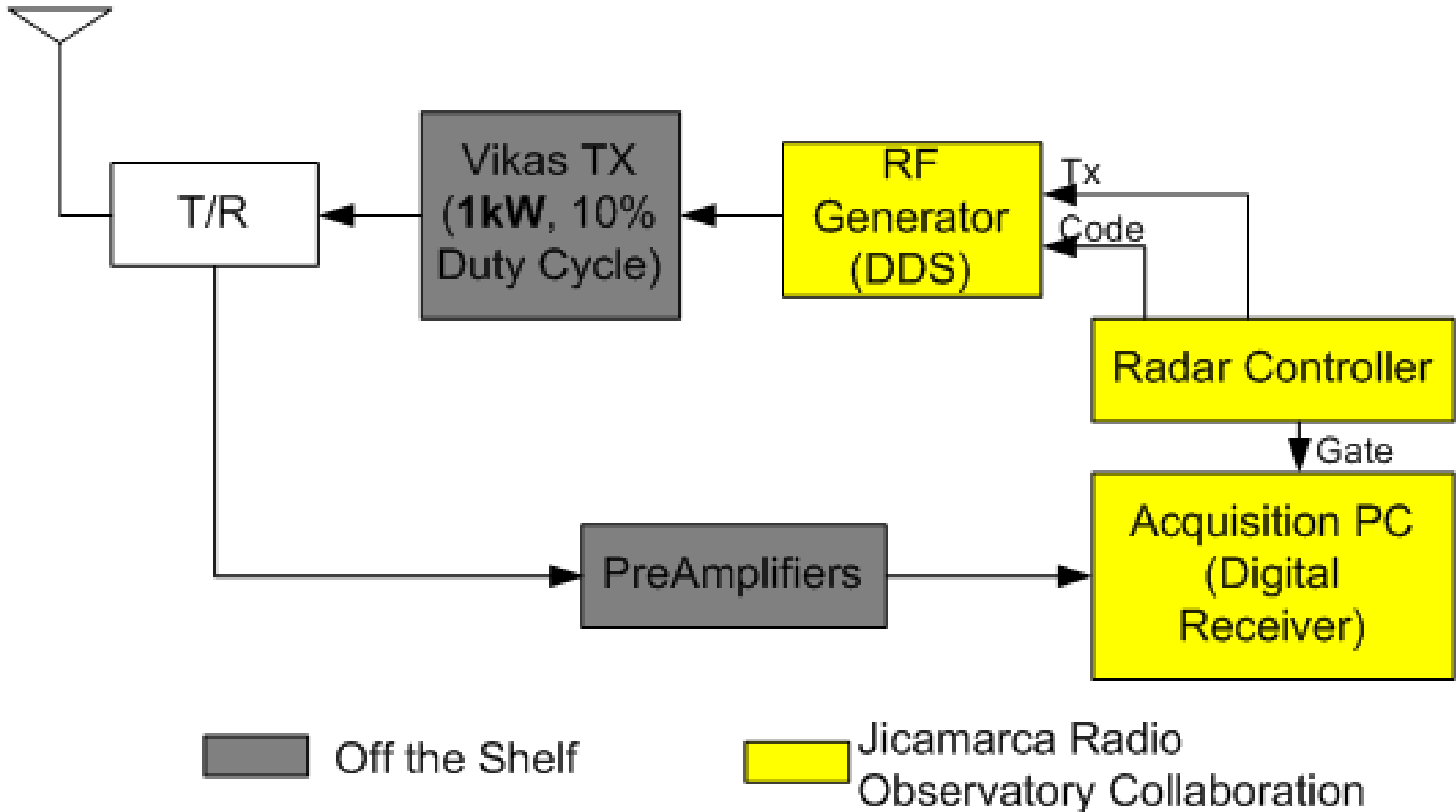
SSR	SSR2
<ul style="list-style-type: none">- Operated on campaigns.- Requires an operator because of continuous failures on the old electronics and power line breaks	<ul style="list-style-type: none">- Operates 24/7 on an unattended mode and can be controlled and/or reprogrammed over the internet
	<ul style="list-style-type: none">- Has 2 operational modes (Mesosphere, troposphere), interleaving between them every 10 min.
<ul style="list-style-type: none">- Transmitter with 60kW power peak on campaigns (4kW driver on unattended mode)	<ul style="list-style-type: none">- Solid state transmitter of 1kW power peak



SSR



SSR2



SSR2 – Radar Controller



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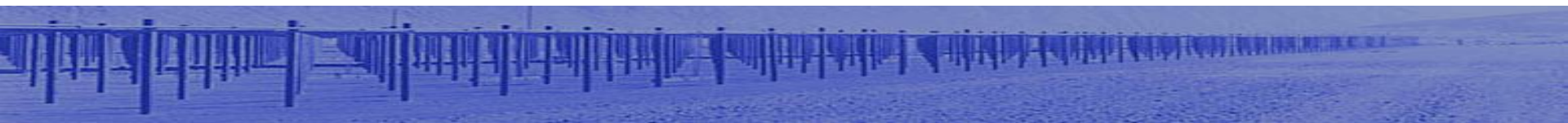
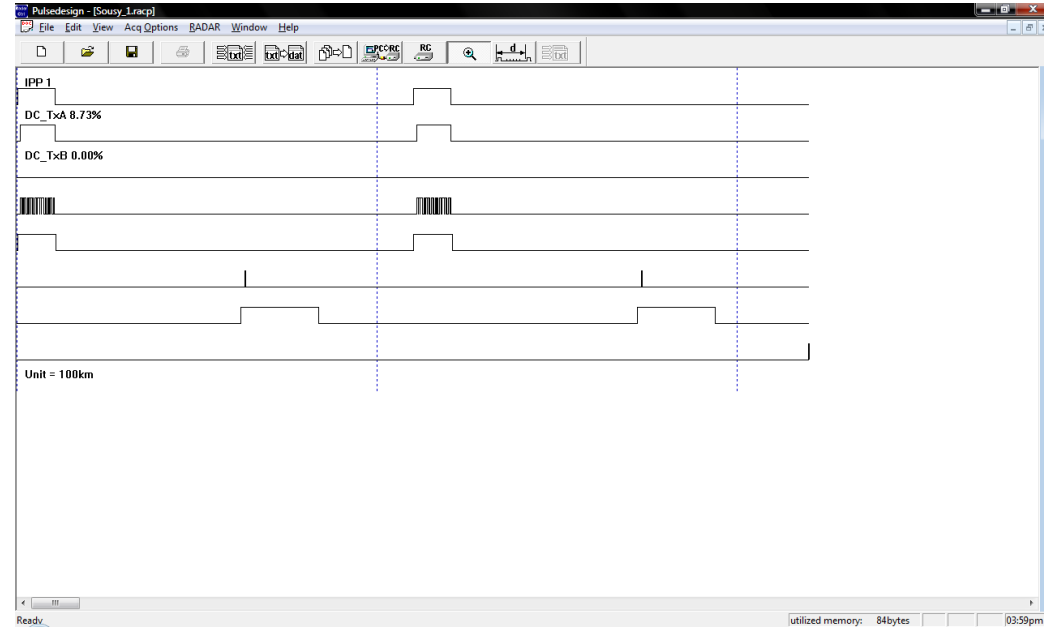
- Based on CPLD (complex programmable logic device)
- Has 8 lines for controlling the transmitting and receiving part, TTL output level



SSR2 – Radar Controller



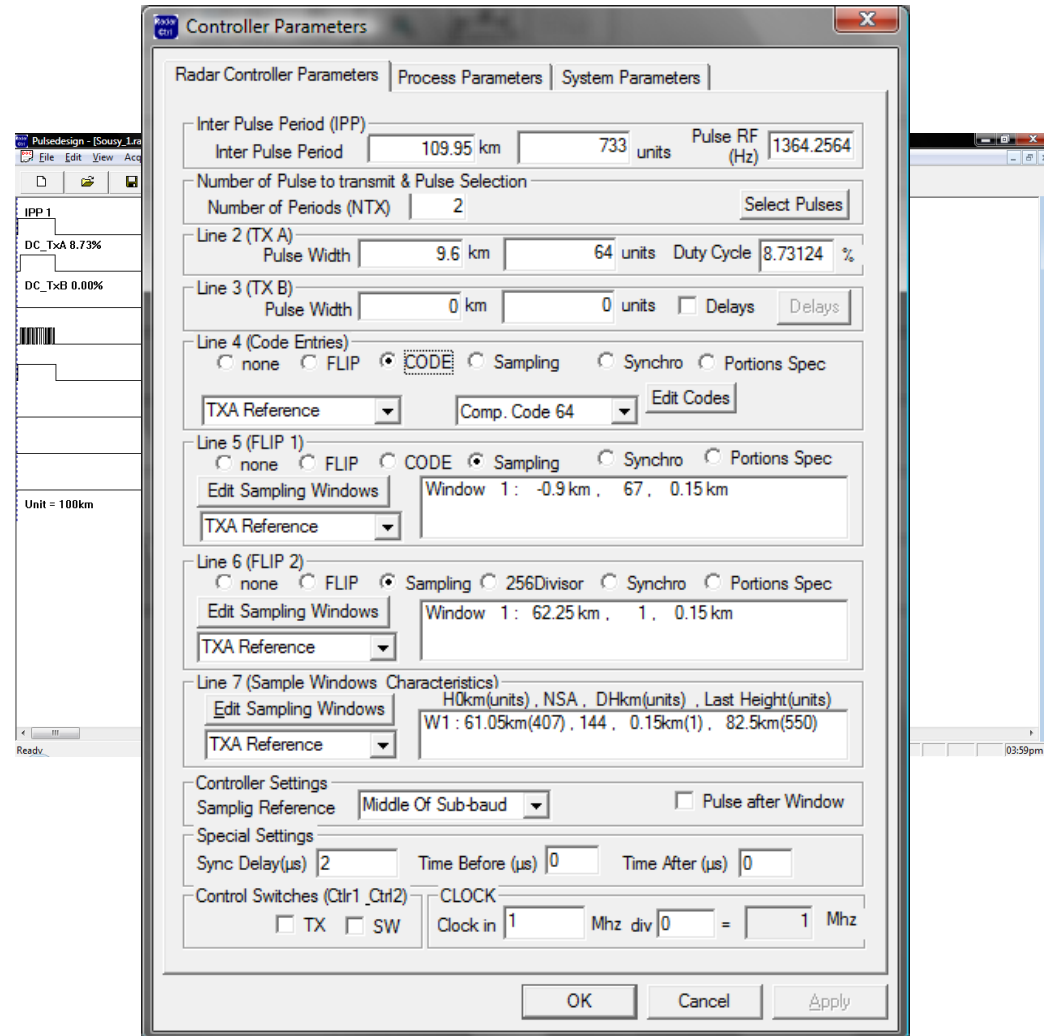
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- It is programmed with a PC through a serial cable using the program "PulseDesign".



SSR2 – Radar Controller



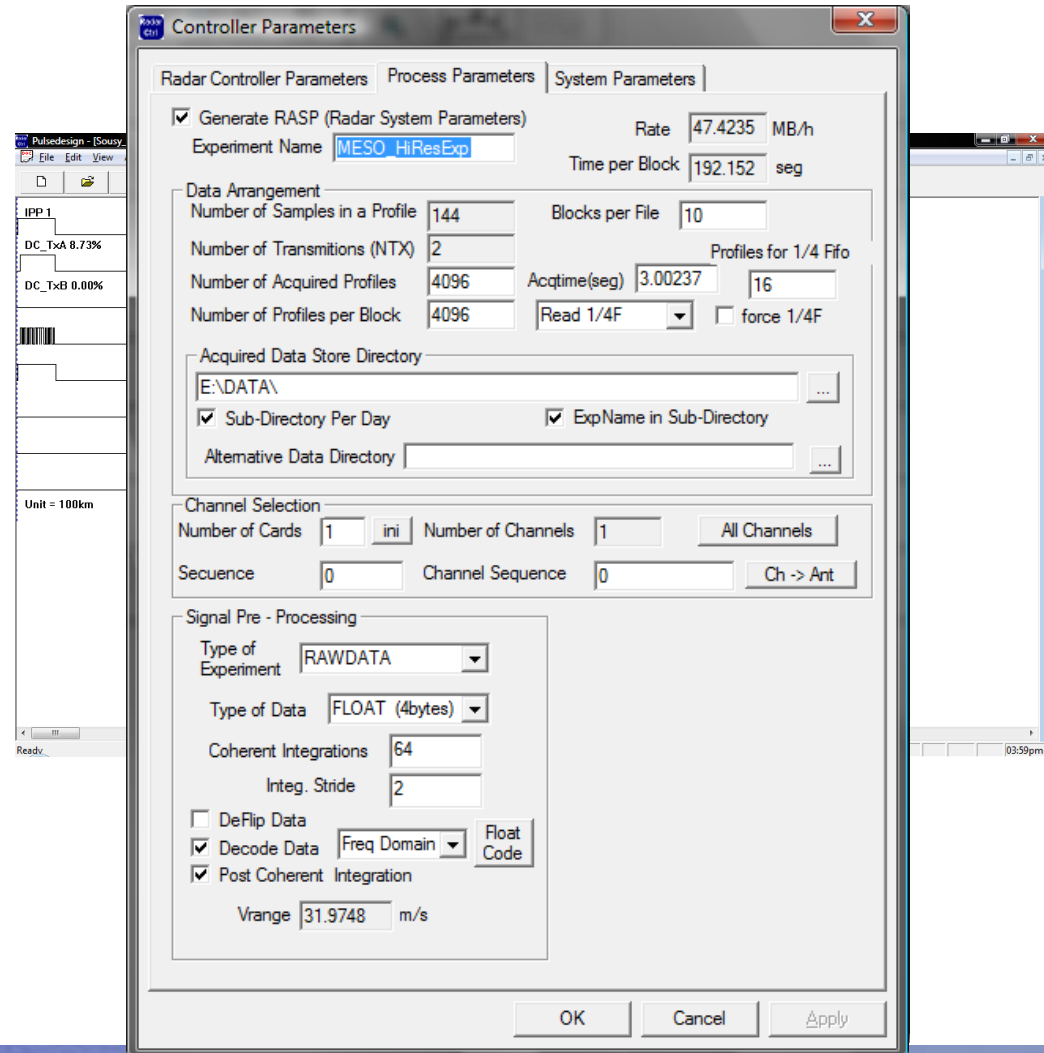
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- PulseDesign: software developed at JRO, facilitates the creation of radar experiments with its graphical user interface and also includes the parameters for acquisition system and online process.



SSR2 – Radar Controller



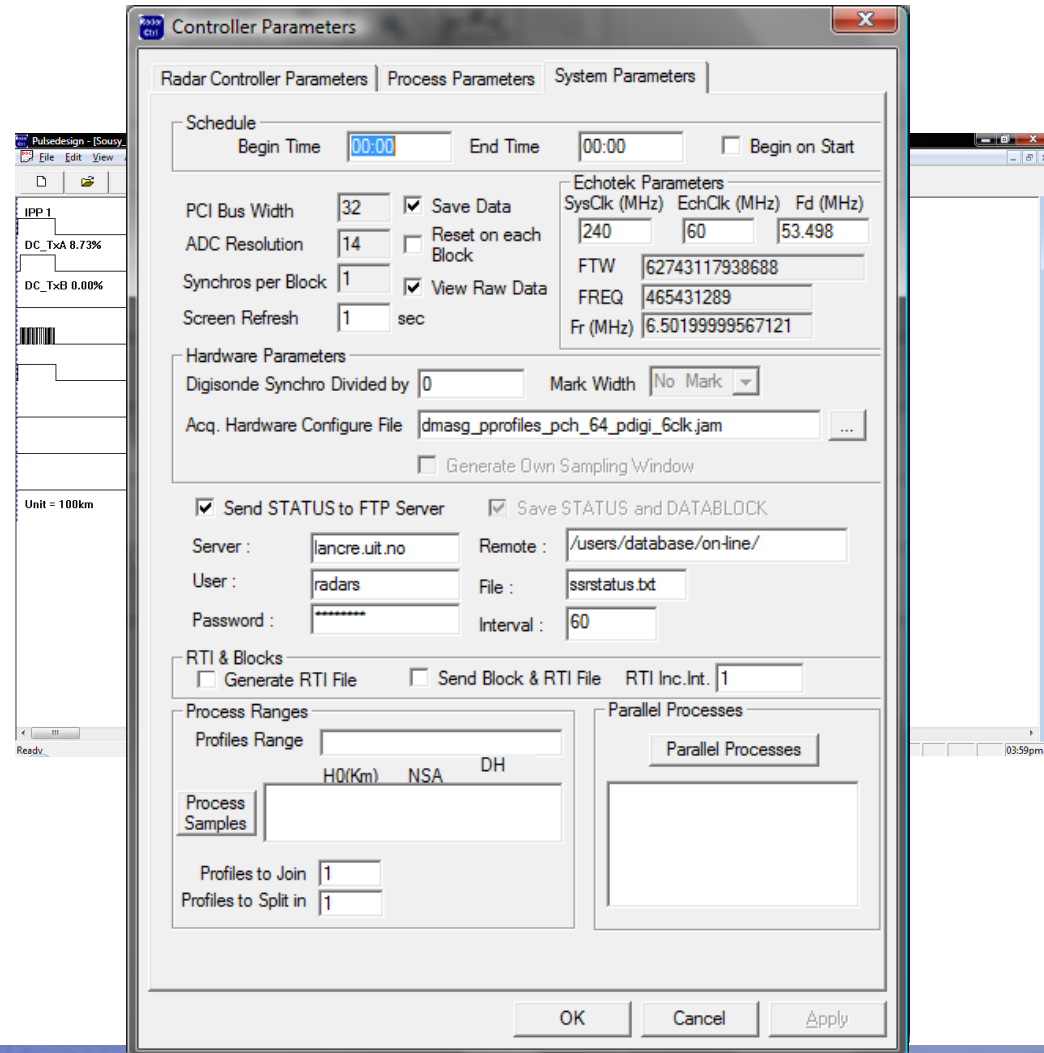
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SSR2 – Radar Controller

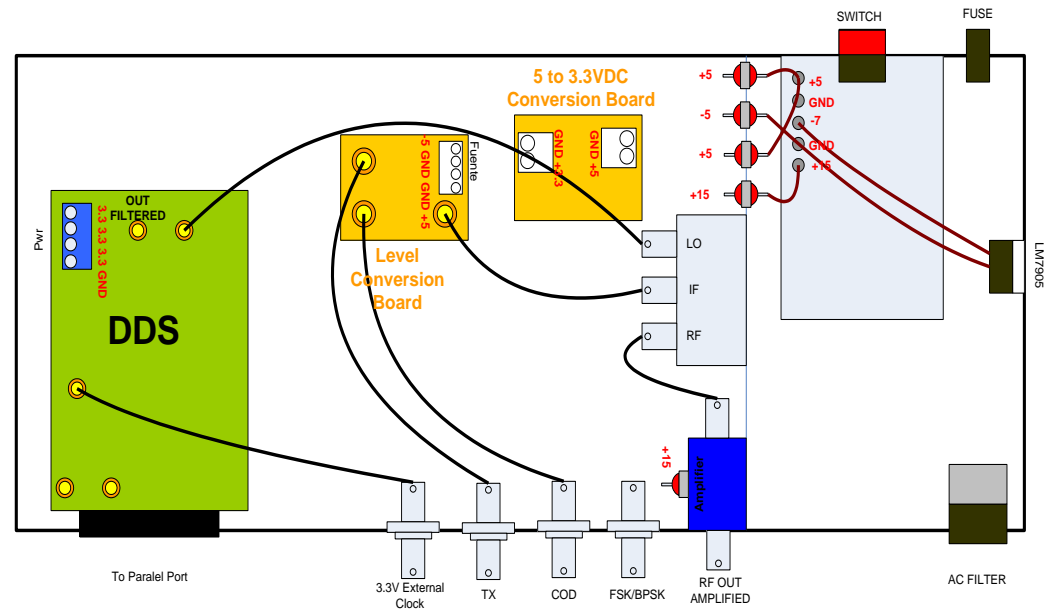


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SSR2 – RF Generator

- RF Generator is a DDS Module based on an AD9854 card (48 bit frequency resolution)
- [DC ,300MHz] frequency range generated
- Generates the pulsed/coded RF for the transmitter.



SSR2 – RF Generator

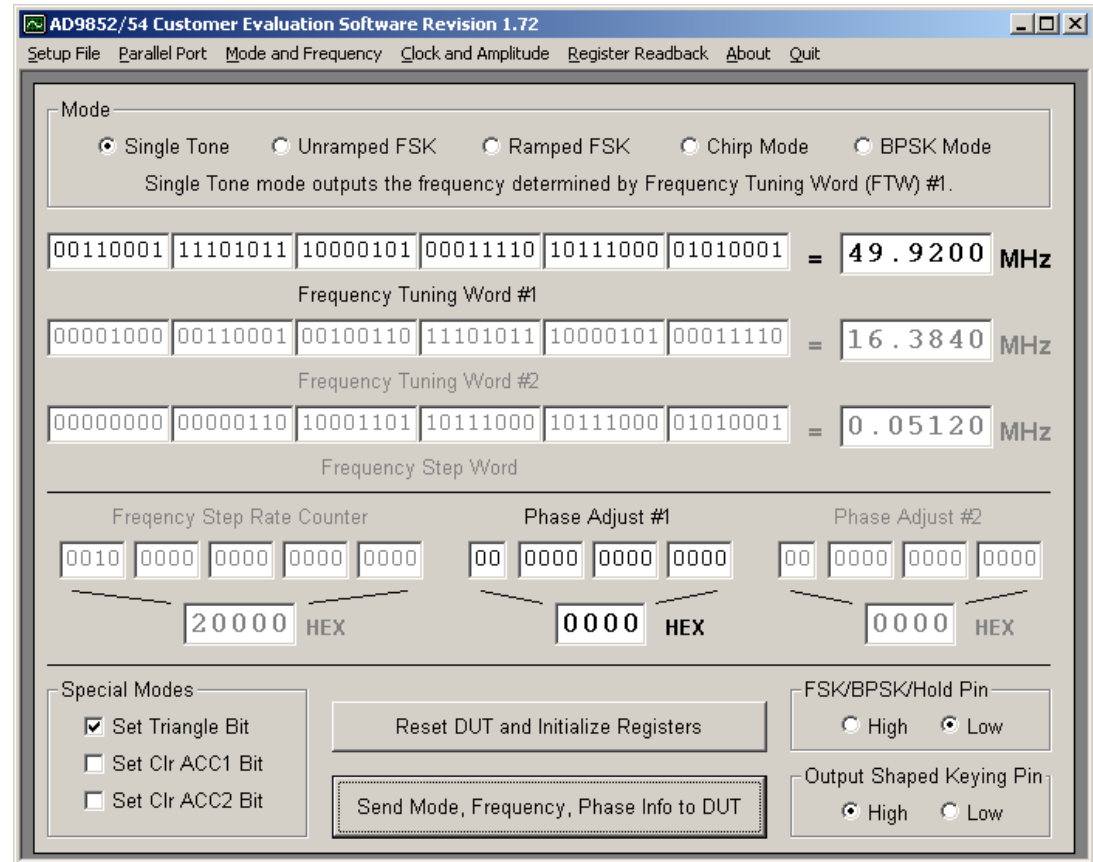


-RF Generator is a DDS Module based on an AD9854 card (48 bit frequency resolution)

-[DC ,300MHz] frequency range generated

- Generates the pulsed/coded RF for the transmitter.

- The frequency is programmed with a PC through the parallel port sending a file generated with the AD9854/52 software from the manufacturer



SSR2 – Acquisition System



-The acquisition system is based on an Echotek GC214-PCI board, digital receiver installed on the PCI port in the PC.

-The digital receiver is programmed using the software DRxDesign.

-The acquisition software has been developed at JRO that not only programs the card and acquires the data but performs online process like coherent integrations, decoding and also FFT to save spectra indicated on the PulseDesign file.

The screenshot shows the DRxDesign software interface with the following settings:

- To All Channels:** Actual Channel been Configured: A
- MIX20B
- USE SHIFT: SHIFT 5, BIG SCALE 6, SCALE 1
- COARSE GAIN 2, No Saturation Condition
- CIC DECIMATION 19, 42<=42.465547
- FINE GAIN 4705, Att(dB) 0
- Resampler Sample Rate 1
- Frequency 6.50199999567121 Mhz, FREQ 465431289
- External Clock 60 Mhz, 0x1BBDEAF9

MultiChannel mode Settings:

- Input Port Selection 0
- PHASE 0 * (DEG) 0, 0x0000
- SPLIT IQ
- QDLY CFIR, IDLY CFIR
- QDLY PFIR, IDLY PFIR
- I ONLY, Odd Even
- Q ONLY, Q I Q I
- NEG_CTL
- CHAN_MAP 0

Synchronismus:

- NCO_SYNC 2, SIA, PHASE_SYNC 7, on [alv], Delay(us) 8.41667
- FREQ_SYNC 7, on [alv]

Filter Design:

- No symmetric CFIR, Edit CFIR Filter Taps
- No symmetric PFIR, Edit PFIR Filter Taps

Static:

- FINAL SHIFT 5, ADD A To B
- Use a non symmetric Resampler Filter, Edit Resampler Filter Taps, NFILTER 1, ADD B To C
- Number of Channels 2, NMULT 7, NDELAY 32, ADD C To D
- Other Global Parameters

Buttons: Open, Gain 8.4284835391024, Decimation 60.000000, DH 0.150000 km, 0.001000 ms, SAVE, OK, Cancel

SSR2



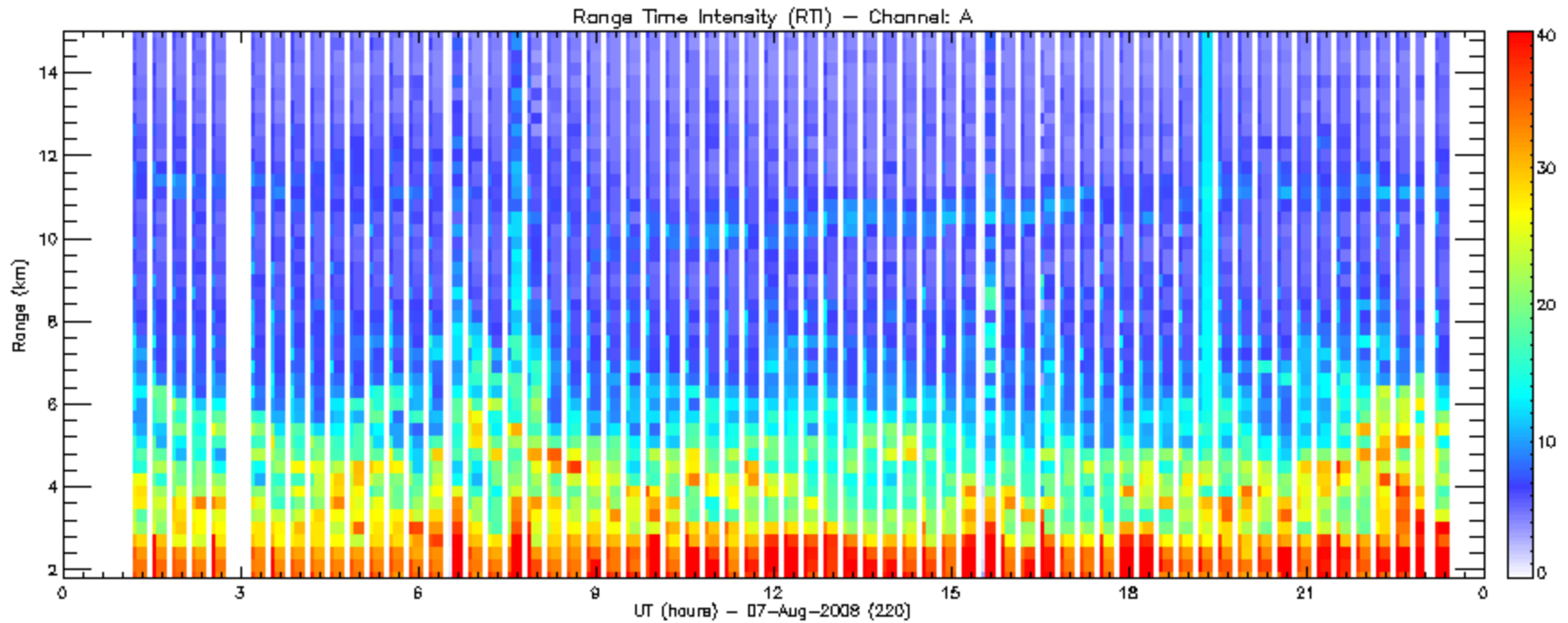
	ST experiment	MESO experiment
IPP	18km	110km
Tx pulse width	1.2km	9.6km
Code	CompCode4	CompCode64
Duty Cycle	6.6%	8.72%
Sampling window	1.8km - 16.2km	81km - 102.6km
Resolution	0.3km	0.15km



SSR2 – ST echoes



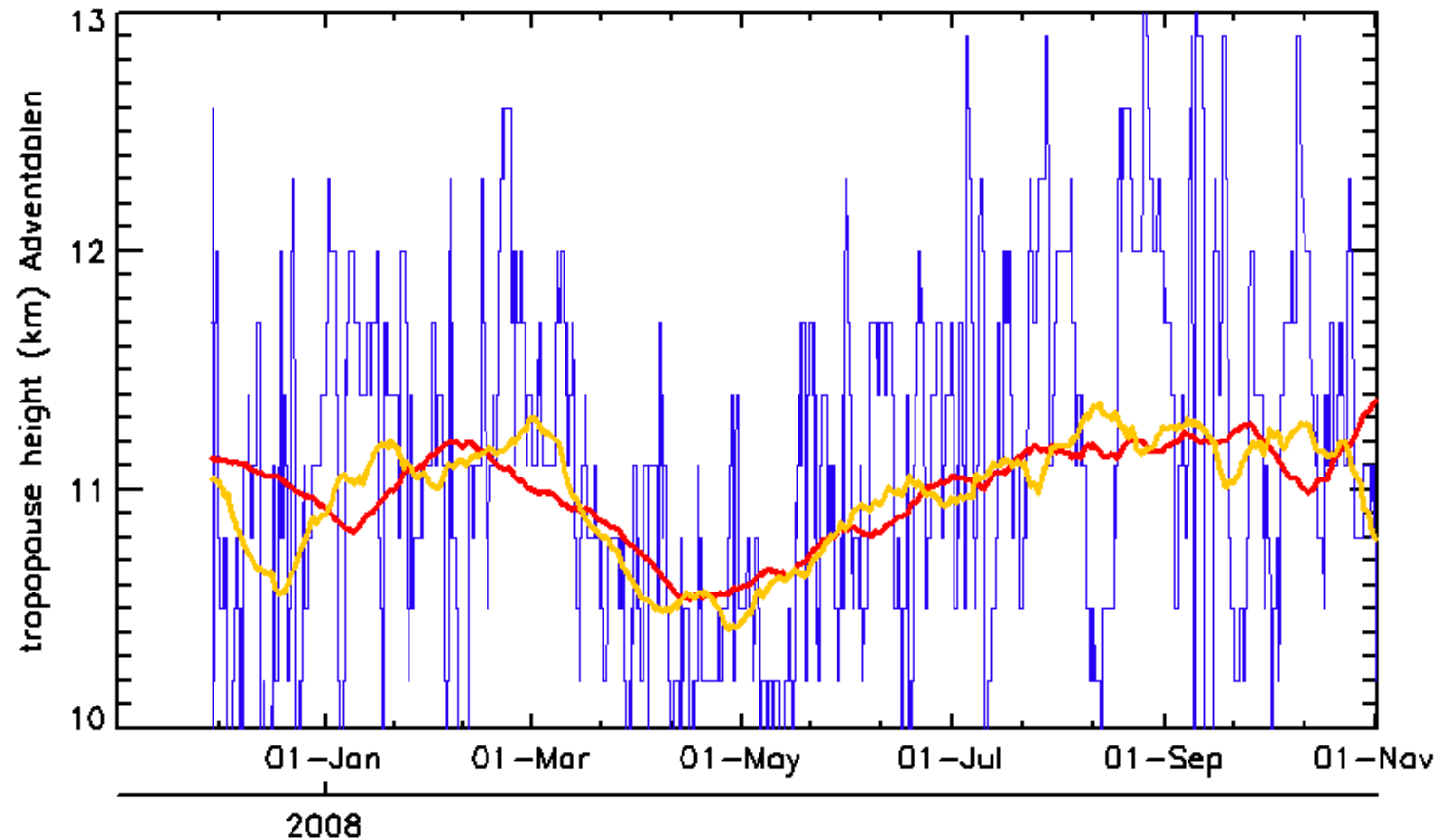
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SSR2 – ST echoes

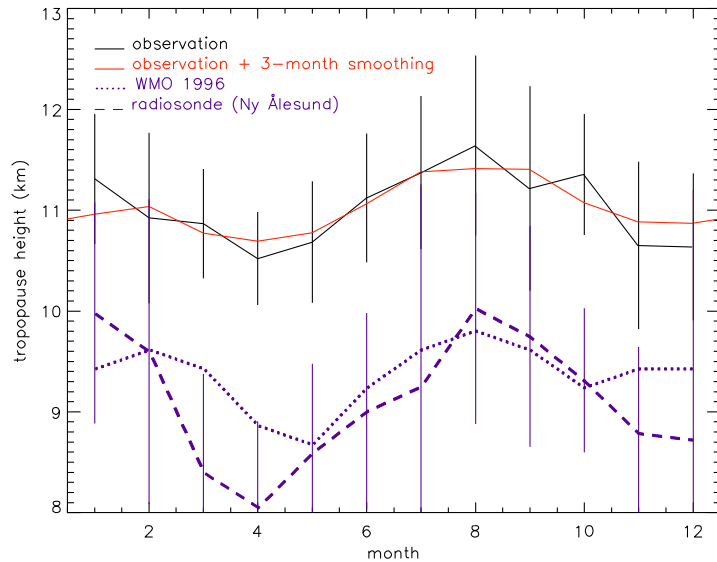


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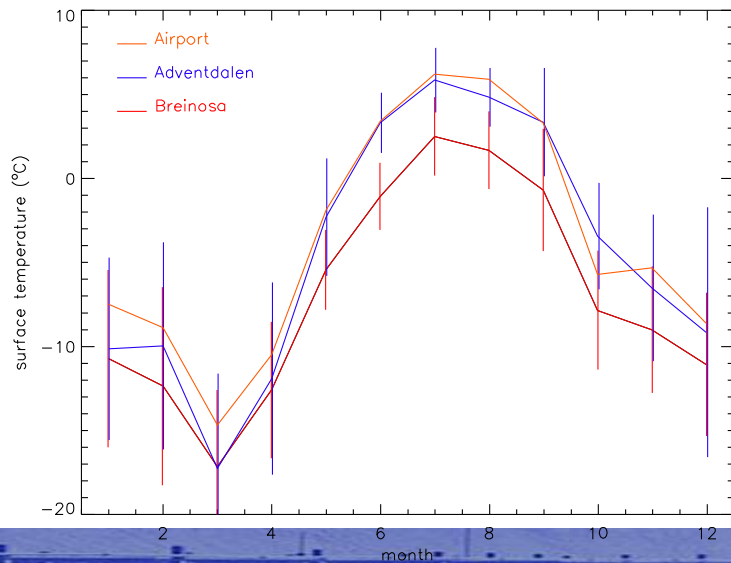
Images and conclusions from:
Tropopause altitude detection at 78°N, 16°E, 2008: first results of the refurbished SOUSY radar
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SSR2 – ST echoes



Tropopause monthly means for 2007-8 and standard deviations

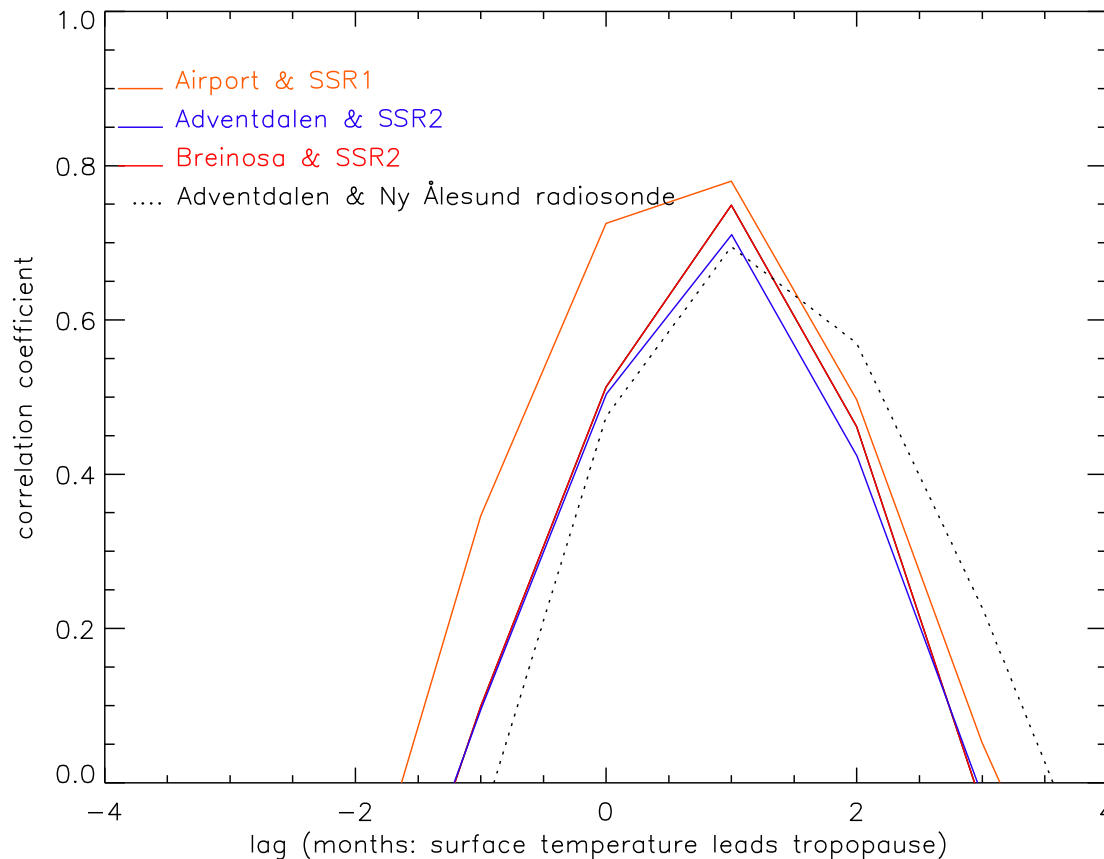
- (black): 3-month median filtered series removing edge effects
- (red): WMO [1996] prediction
- (dotted): meteorological tropopause from radiosondes from Ny Ålesund
- (dashed) (Ny-Alesund radiosonde data from Alfred Wegener Institute, courtesy of M. Maturilli.).



Monthly mean surface air temperatures from 3 sites near SSR2 for 2007-8:

- Longyearbyen airport (approximately 12 km to the NW, courtesy of the Norwegian Meteorological Institute),
- Adventdalen (approximately 5 km to the NW)
- Breinosa (approximately 1 km to the SE but at 520m above sea level).

SSR2 – ST echoes



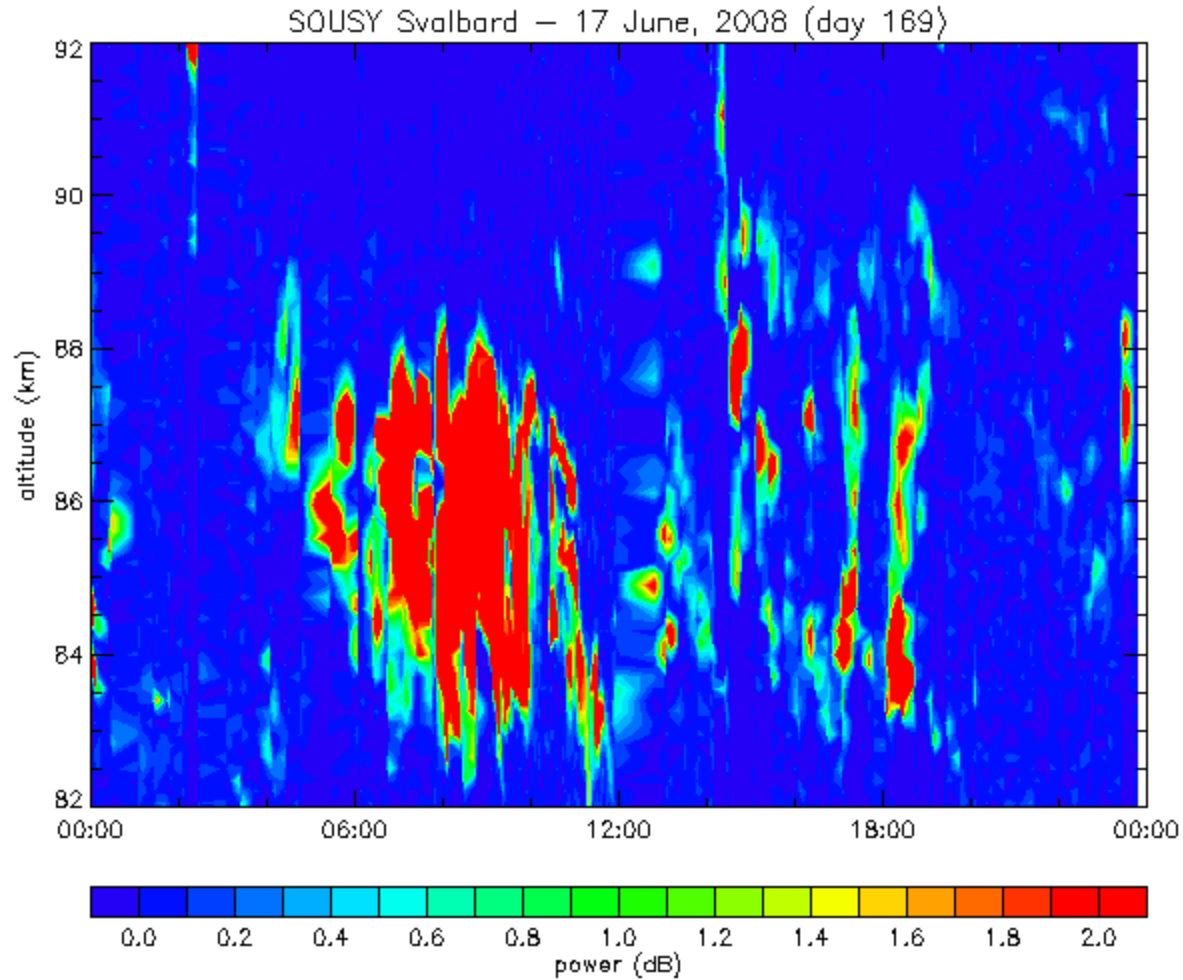
Correlation coefficient versus lag for:

- (i) temperature measured at Longyearbyen airport (widest) and "old" SOUSY system (2004-2006 data),
- (ii) Breirosa and SSR2 (2008 data) (narrowest),
- (iii) Adventdalen valley floor and SSR2 (2008 data)
- (iv) Adventdalen valley floor and meteorological tropopause above Ny Ålesund (same coverage as SSR2).

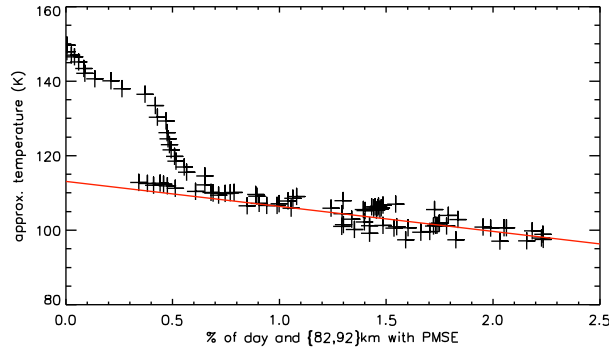
SSR2 – PMSE echoes



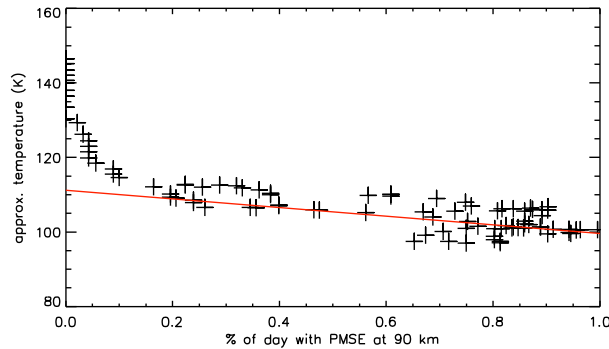
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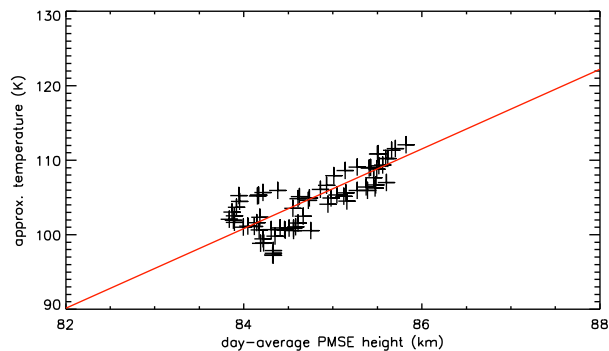
SSR2 – PMSE echoes



Scatter plot of 90km temperature versus daily PMSE occurrence in the interval 82-92 km



Scatter plot of 90km temperature versus daily PMSE occurrence at 90 km only

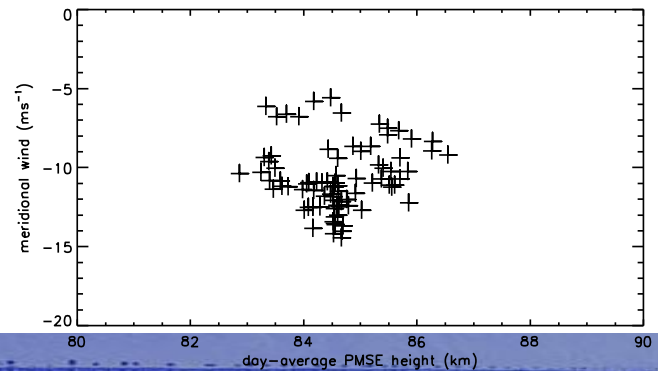
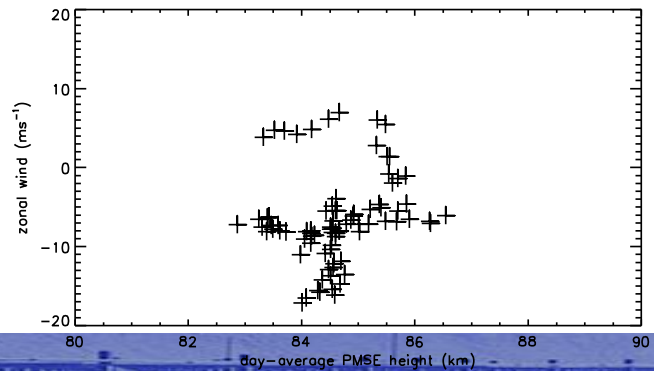
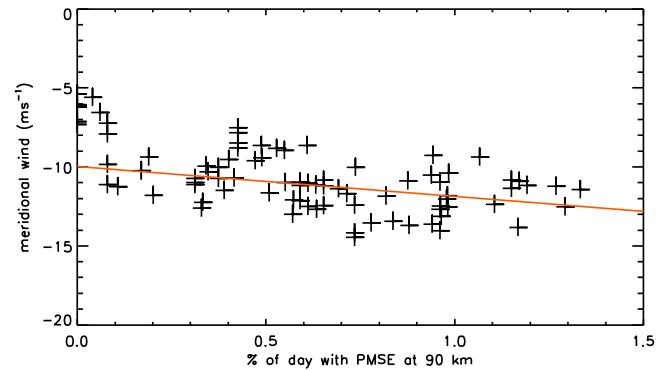
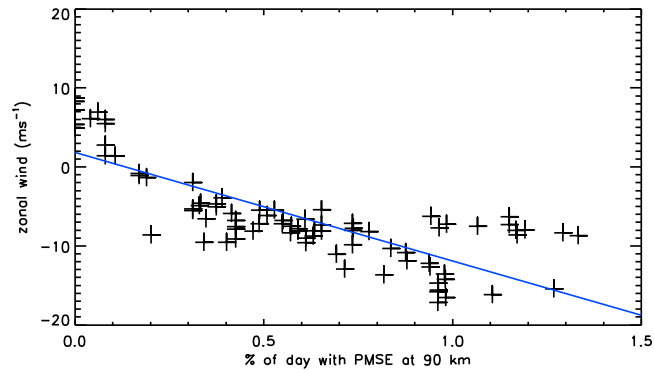
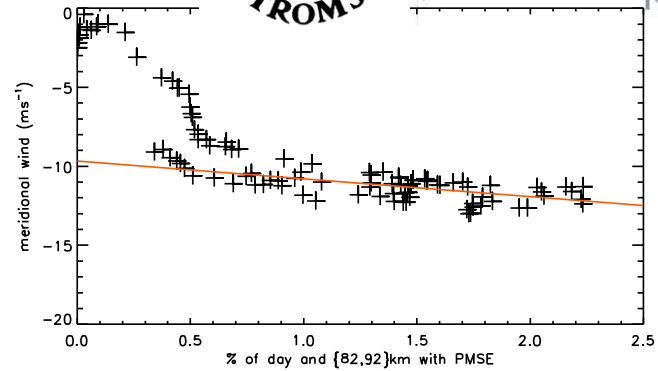
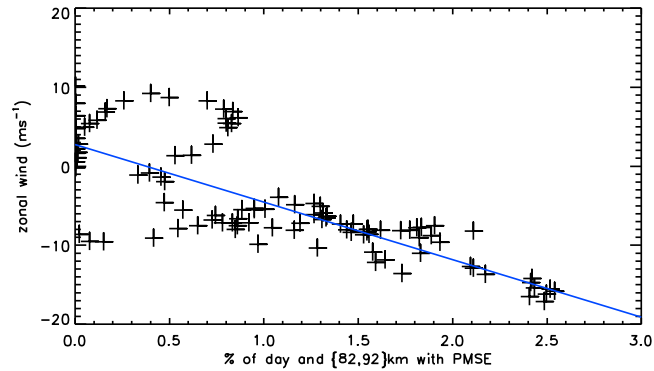


Scatter plot of 90km temperature versus daily PMSE preferred altitude

SSR2 – PMSE echoes



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Summary



- Using a transmitter of only **1kW** peak power (8% duty cycle) we have obtained MST echoes
- SSR2 is working unattended and continuously with external monitoring and can be controlled via internet.
- Having different instruments near SSR2 with its large data set obtained increases the comparisons of various parameters and their dependence if exists.



Future work



- Rising the transmitter power with the use of 2 transmitters
- Lower interleaving time between different experiment modes



References



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Polar Mesospheric Summer Echoes at 78°N, 16°E, 2008: first results of the refurbished SOUSY radar

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2009RS004144, submitted to *Radio Science*, 2009.