MWSIM 学习笔记

1. 安装方法

安装方法与旧模式相同。但是 test 之后，会发现生成的结果和预想值不同，但是两者差异在可允许范围内。因此，新模式基本可靠。

2. MWSIM 与 MWRT 差别简述

输入变量新增数组 ： CldWtr，Rain，CldIce，Snow，Graupel

原模式中：

WC	云液态水含量(g/m^3)
WI	云冰水含量(g/m^3)
RR	降水率(mm/h)，负值时使用 WR 参数
WR	雨水含量(g/m^3)
RS	降雪率(mm/h) ，负值时使用 WS 参数
WS	冰雪含量(g/m^3)
RG	降雹率(mm/h) ，负值时使用 WG 参数
WG	雹霰水含量(g/m^3)

3. 调用 Fortran 子程序运行

```
SUBROUTINE MWSTRM4(F,L,LOUT,IHV,U,PMB,TK,RH,Z,TS,IS,SLNTY,WND, &
                   CldWtr,CldIce,Rain,Snow,Graupel,&
                   MixingRule,TB, TW1,TW2,WK,SurfModel,IO,retcode)
```

输入参数

```
C ********************** INPUT ***************************
C
C F: Frequency in GHz  频率
C L: TOTAL NUMBER OF LAYERS  层数
C LOUT: Layer Number (top=1, bottom=L) at which TB will be outputted
C IHV: 1=V-POL, 2=H-POL, else=BOTH  输出的极化方式
C U: DIRECTION for OUTPUT, positive upward TB at layer top
C                          negative downward TB at layer bottom
C -------
C VERTICAL PROFILES: FIRST LAYER IS TOP, DOWNWARD
C                  DIMENSION = L / L+1
C
```

```
C    Variables with dimension of L are average in a layer
C                                          L+1 are value at the top boundary
C    For example, CldWtr is for water cloud averaged in the first (top) layer
C     while TK(1) is the Temp at TOA, TK(L+1) the air Temp at surface

C PMB: PRESSURE IN mb                      PMB(L+1)
C TK: TEMPERATURE IN K                        TK(L+1)
C RH: RELATIVE HUMIDITY IN %                  RH(L+1)
C Z: LAYER TOP ALTITUDE IN m                  Z(L+1)
C     for hydrometeors, always assume gamma psd, i.e.,
C     N(D) = N0*D**mu*exp(-lambda*D), where D is diameter in m, and
C               N(D) in 1/m^(4+mu)
C ***** CAN ONLY GIVEN TWO of the THREE: N0, lambda and water content
C CldWtr:                                  CldWtr(5,L)
C    (1,*) - cloud liquid water content (WC) in g/m^3
C    (2,*) - N0 in 1/m^4
C    (3,*) - Lambda in 1/m
C    (4,*) - mu in psd (mu=0 is exponential)
C    (5,*) - 0: no cloud water; 1: know N0 and WC;
C               2: know lambda and WC; 3: know N0 and lambda
C               4: know N and WC for monosized cloud drops, N0 will be N in 1/m^3
C               5: know D(iameter, in um) and WC for monosized, LAM will be D in um
C          6: know N and D (use N0 and LAM) for monosized cloud drops
C                    N in 1/m^3, D in um
C     ****** when giving D, please use even number (so that radius will be an integer),
C               otherwise, it will be rounded to the nearest even number internally
C               in the program.      ******************

C Rain:                                    Rain(5,L)
C    (1,*) - rain water content (WC) in g/m^3
C    (2,*) - N0 in 1/m^4
C    (3,*) - Lambda in 1/m
C    (4,*) - mu in psd (mu=0 is exponential)
C    (5,*) - 0: no rain water; 1: know N0 and WC;
C               2: know lambda and WC; 3: know N0 and lambda
C**********************************************
C CldIce:                                  CldIce(6,L)
C    (1,*) - cloud ice water content (WC) in g/m^3
C    (2,*) - N0 in 1/m^4
C    (3,*) - Lambda in 1/m (冰粒子的大小)
C    (4,*) - mu in psd (mu=0 is exponential)
C    (5,*) - 0: no cloud ice water;
C               >0: D in PSD is melted diameter; <0: D in PSD is actual diameter
C               abs()=1: know N0 and WC, lambda will be output;
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```
C                abs()=2: know lambda and WC, N0 will be output;
C                abs()=3: know N0 and lambda, WC will be output
C                4: know N and WC for monosized cloud ice particles, N0 will be N in 1/m^3
C                5: know D(iameter, in um) and WC for monosized, LAM will be D in um
C                6: know N and D (use N0 and LAM) for monosized cloud ice particles
C                    N in 1/m^3, D in um
C        Note: options 4-6, can only work for spheres
C   ****** when giving D, please use even number (so that radius will be an integer),
C              otherwise, it will be rounded to the nearest even number internally
C              in the program.      ********************
C   (6,*) - ice shape or density in g/cm^3 [Ice Shape]
C                if>=0 ice shape no in scatdb, if<0 its absolute value is density
C                for monosized cloud ice particles, must set (6,*) <0 (spheres)

C Snow:                                                          Snow(6,L)
C   (1,*) - Snow ice water content (WC) in g/m^3
C   (2,*) - N0 in 1/m^4
C   (3,*) - Lambda in 1/m
C   (4,*) - mu in psd (mu=0 is exponential)
C   (5,*) - 0: no snow ice water;
C                >0: D in PSD is melted diameter; <0: D in PSD is actual diameter
C                abs()=1: know N0 and WC, lambda will be output;
C                abs()=2: know lambda and WC, N0 will be output;
C                abs()=3: know N0 and lambda, WC will be output
C   (6,*) - snow shape or density in g/cm^3
C                if>=0 ice shape no in scatdb, if<0 its absolute value is density
C Graupel:                                                       Graupel(6,L)
C   (1,*) - Graupel ice water content (WC) in g/m^3
C   (2,*) - N0 in 1/m^4
C   (3,*) - Lambda in 1/m
C   (4,*) - mu in psd (mu=0 is exponential)
C   (5,*) - 0: no Graupel ice water;
C                >0: D in PSD is melted diameter; <0: D in PSD is actual diameter
C                abs()=1: know N0 and WC, lambda will be output;
C                abs()=2: know lambda and WC, N0 will be output;
C                abs()=3: know N0 and lambda, WC will be output
C   (6,*) - graupel density in g/cm^3
C                (either negative or positive) its absolute value is density

C -------
C TS: SURFACE TEMPERATURE IN K
C IS: SURFACE TYPE:
C          0 = OCEAN
C          1 = LAND or SPECIFIED SURFACE EMISSIVITY
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```
C            2 = SEA ICE
C            3 = SNOW
C SLNTY: (negative means using default)
C            WHEN IS=0, SALINITY IN PER THOUSAND [35]
C            WHEN IS=1, EMISSIVITY [0.9]
C            WHEN IS=2, ICE TYPE:0=NEW,1=2ND YEAR, 2=MULTIYEAR [2]
C            WHEN IS=3, SNOW TYPE: 0=WET, 1=DRY, 2=REFROZEN [1]
C WND: WIND SPEED (ONLY USED WHEN IS=0)
C MixingRule: Mixing Rule for graupel: MG,LL/DB,EV,EM/BR
C
C SurfModel: "Fresnel" [default], or "Lambertian"
C                    character*1, Valid values are "l","L","f","F"
C
C IO: set to 0 when call this program first time, and never change it
C-----------------------------------------------------------------
C
C    ******************** OUTPUT *************************
C
C TB(2): BRIGHTNESS TEMPERATURE (K)
C 1= Vertical Pol
C 2= Horizontal Pol
C If IHV Specify only one pol, The other will be blank.
C TW1: TOTAL INTEGRATED LIQUID WATER (CLOUD AND RAIN)
C TW2: TOTAL INTEGRATED ICE WATER (CLOUD ICE, GRAUPEL AND SNOW)
C
C retcode: 0=OK, else=no suitable lambda found; invalid output
```

MWRT 存在非降水云时的信号特征

——参考王雨老师博士论文

1．参数初值设置：

大气中存在着三类有代表性的非降水云：水云、冰云和双层混合云。其中，水云，或称之为暖云，指仅由液相水组成的低云（如层积云），由于此类云中不含冰相粒子，故微波信号主要来自于云水和洋面的发射辐射；冰云是指仅由固相水组成的云，完全不含液态水，即在模拟过程中，LWP 始终取 0 kg m^{-2}，这种情况大体对应了实际大气中孤立的积雨云砧或卷云；另外，双层混合云对应着垂直尺度较大的云，即在冻结层以下为水云，以上为冰云的情形。

在本节中，我们将分别对上述三类云的微波信号特征进行分析。

	海温 (K)	风速 (m/s)	水汽含量 (kg m^{-2})	水云高度 （km）	冰云高度 （km）
水云	295	4	40	2	-

表 1　洋面下水云条件下输入参数的典型值

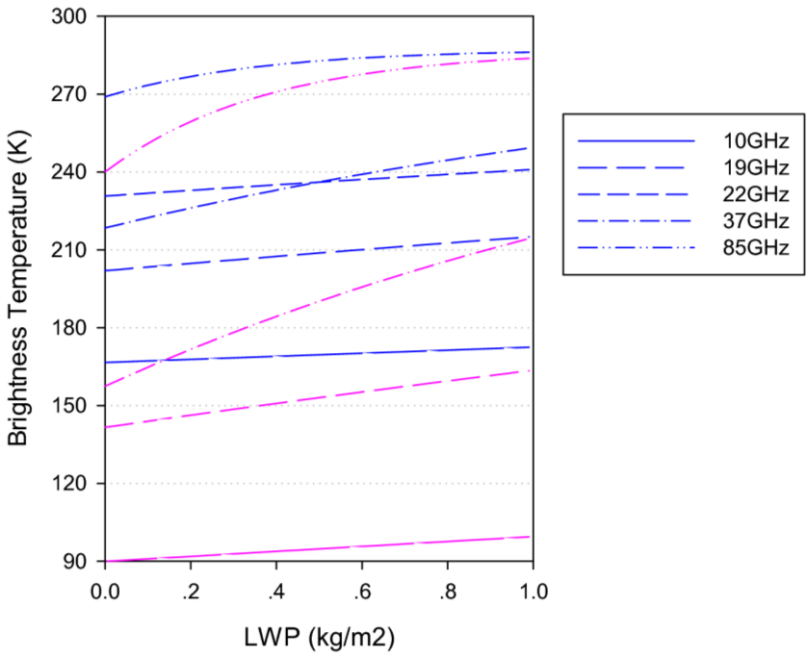
微波亮温对液态水路径的敏感性试验，程序为：

程序：

```
Parameter (Maxl=75)
REAL sff(5)
      REAL    mr(Maxl),mt(Maxl),qq(Maxl+1),ar(Maxl,10)
      DIMENSION RS(MAXL),PMB(MAXL+1),Graupel(6,MAXL),
     +     CldWtr(5,MAXL),Rain(5,MAXL),CldIce(6,MAXL),Snow(6,MAXL),
     +     TK(MAXL+1),RH(MAXL+1),Z(MAXL+1),TB(2),WK(95*MAXL)
      DIMENSION WR(Maxl),WS(Maxl),RG(Maxl),WG(Maxl)
      CHARACTER SurfModel*2, MixingRule*2
      real       SLNTY,WND,TS,TW1, TW2,F, U
      INTEGER IceShape,SnwShape,IO,IS, IHV, L, LOUT, retcode
DATA sff/10.65,19.35,21.3,37,85.5/
character*4 cmd


       CldWtr = 0.0
       Rain = 0.0
       CldIce = 0.0
       Snow =0.0
       Graupel = 0.0

      L= Maxl
      TS = 295     ！典型值
      WND = 4   ！典型值
      RH = 54   ！典型值，水汽含量
      LOUT=1
      U=cos(3.1415926*52.0/180)
      IS=0



open(25,file='C1',status='old')
```

```
      read(25,*) nn
      do i=1,Maxl+1
      read(25,*) Z(Maxl+2-i),PMB(Maxl+2-i),TK(Maxl+2-i),
     &      qq(Maxl+2-i) ! qq original relativly humidity
      enddo
      close(25)
      ! z(1) means top altitude, that is 14.9km
      ! z(75) means ground altitude, that is 0.1m

c     write(*,*)'ok'
      open(40,file='./tmp-uwnd.txt')
      open(30,file='./tmp-Water-Cloud.txt')


      do j1=1,5 ! five frequency
      F=sff(j1)

          j5 = 66
          do kwc=0,100,3
          CldWtr(1,j5) = 0.05*real(kwc)
          CldWtr(3,j5) = 1.E+5
          CldWtr(4,j5) = 2
          CldWtr(5,j5) = 2

       CALL MWSTRM4(F,L,LOUT,IHV,U,PMB,TK,RH,Z,TS,IS,SLNTY,WND,
      1       CldWtr,CldIce,Rain,Snow,Graupel,
      1       MixingRule,TB, TW1,TW2,WK,SurfModel,IO,retcode)

**********Calculate Column Water Vapor*******
          wp=0.0

          do i=1,Maxl
          mt(i)=(tk(i)+tk(i+1))/2.0 ! 大气廓线中的温度
          mr(i)=(rh(i)+rh(i+1))/2.0  ! 我自己设定的相对湿度
          tm=7.5*(mt(i)-273.15)/(237.3+mt(i)-273.15)
          es=6.11*(10**tm)
          aa=es*mr(i)*217.0*200*0.01*0.001/mt(i)
          wp=wp+aa                              ! kg/m2
          enddo

      cht=(TK(j5)+TK(j5+1))/2.0

      write(30,*)TB(1),TB(2),TW1,TW2,wp
```

```
      write(40,*)j1,j3

      enddo
      enddo

      close(30)
      close(40)
888   stop
      end
```



洋面下 TMI 各通道亮温与云水含量的关系

（蓝色表示垂直通道，红色表示水平通道）