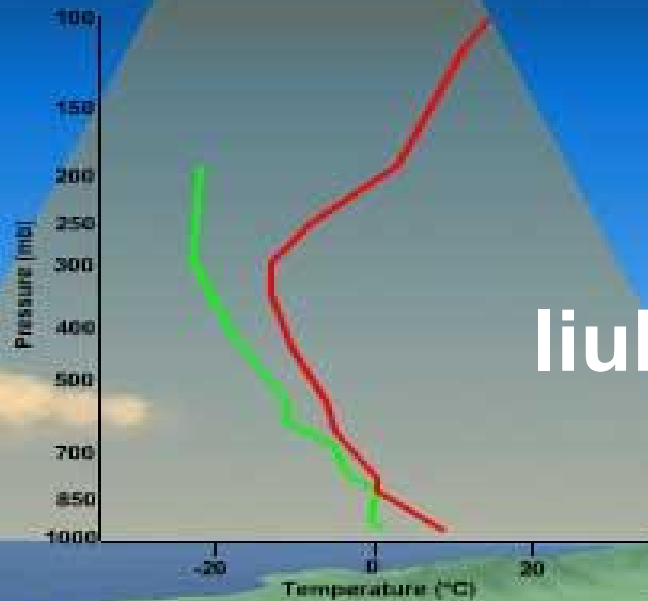


风云四号大气温湿廓线产品介绍



刘辉

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68409409

提 纲

- 产品组介绍
- 算法原理简介
- 产品示例
- 产品应用计划

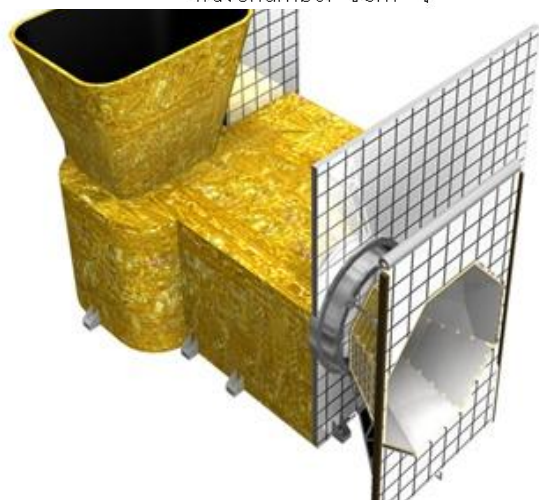
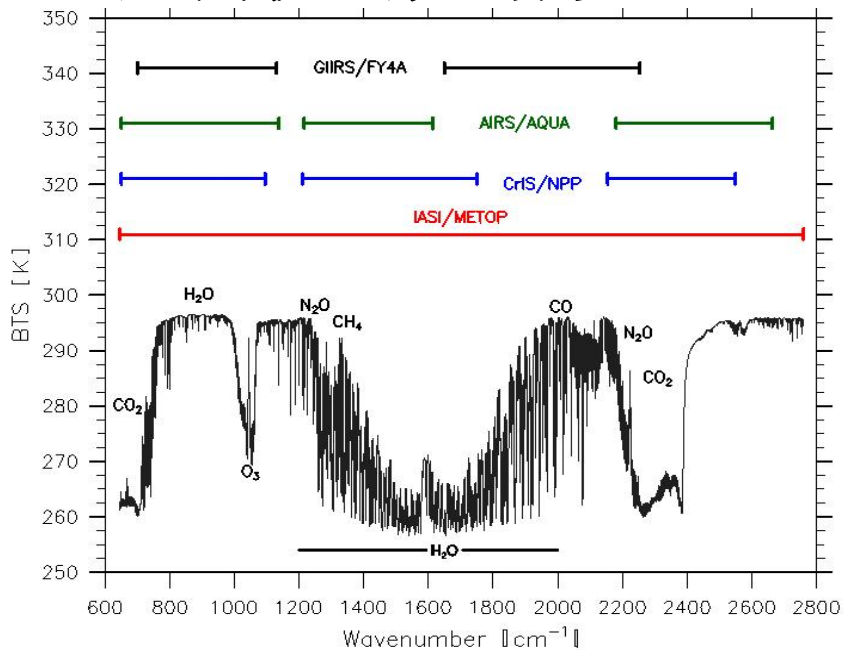
探测仪晴空大气参数（吴春强）：大气温度、湿度和臭氧廓线，臭氧总量，地面温度，探测仪总、低层、中层、高层水汽含量

探测仪云天大气参数（刘辉）：云天大气温度、湿度廓线

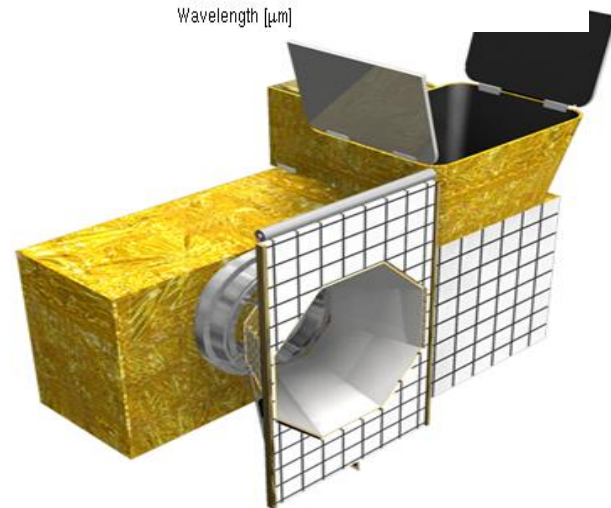
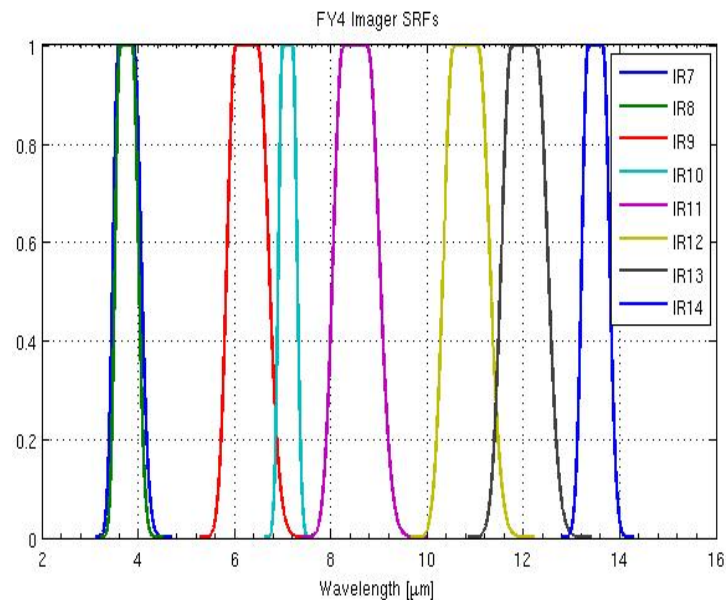
不稳定指数产品（刘辉）：KI，LI，SI，CAPE（晴空和云天）

成像仪分层水汽含量（张勇）：总、低层、中层、高层水汽含量

探测仪的光谱设置



成像仪的红外光谱设置



探测仪晴空大气参数（吴春强）：大气**温度、湿度和臭氧廓线**，臭氧总量，地面温度，探测仪总、低层、中层、高层水汽含量

探测仪云天大气参数（刘辉）：云天大气温度、湿度廓线

不稳定指数产品（刘辉）：KI，LI，SI，CAPE（晴空和云天）

成像仪分层水汽含量（张勇）：总、低层、中层、高层水汽含量

算法原理简介

正演: 已知地球表层**温度**，大气温度分布和**气体成分的垂直分布**的大气状态，随高度变化的卫星通道**透射率**函数也已知，即可计算到达卫星感应器的地气系统**辐射量**。

正演

$$\hat{I}(\nu^*, \theta) = B(\nu^*, T_s) \tau_s(\nu^*, p_s, \theta) + \int_{\ln p_s}^{\ln p_\infty} B(\nu^*, T(p)) \frac{\partial \tau(\nu^*, p, \theta)}{\partial \ln p} d \ln p$$

反演

反演: 知道了卫星仪器在不同光谱频带上的观测辐射量，而去推求大气温度及吸收气体的分布。

方法：统计回归和物理反演(1DVAR)相结合

Cost Function or Penalty Function:

$$\mathbf{J}(\mathbf{x}) = (\mathbf{x} - \mathbf{x}^b)^T \mathbf{V} \mathbf{B}^{-1} (\mathbf{x} - \mathbf{x}^b) + (\mathbf{y}^o - \mathbf{y}(\mathbf{x}))^T \mathbf{O}^{-1} (\mathbf{y}^o - \mathbf{y}(\mathbf{x}))$$

牛顿非线性迭代

$$\delta X_{n+1} = (K_n'^T \cdot E^{-1} \cdot K_n' + \gamma B^{-1})^{-1} \cdot K_n'^T \cdot E^{-1} \cdot (\delta Y_n + K_n' \cdot \delta X_n)$$

$$\delta X_{n+1} = X_{n+1} - X^b$$

2) : 将待反演变量和权重函数等投影到EV空间，但

亮温和权重函数还是需要按波数计算

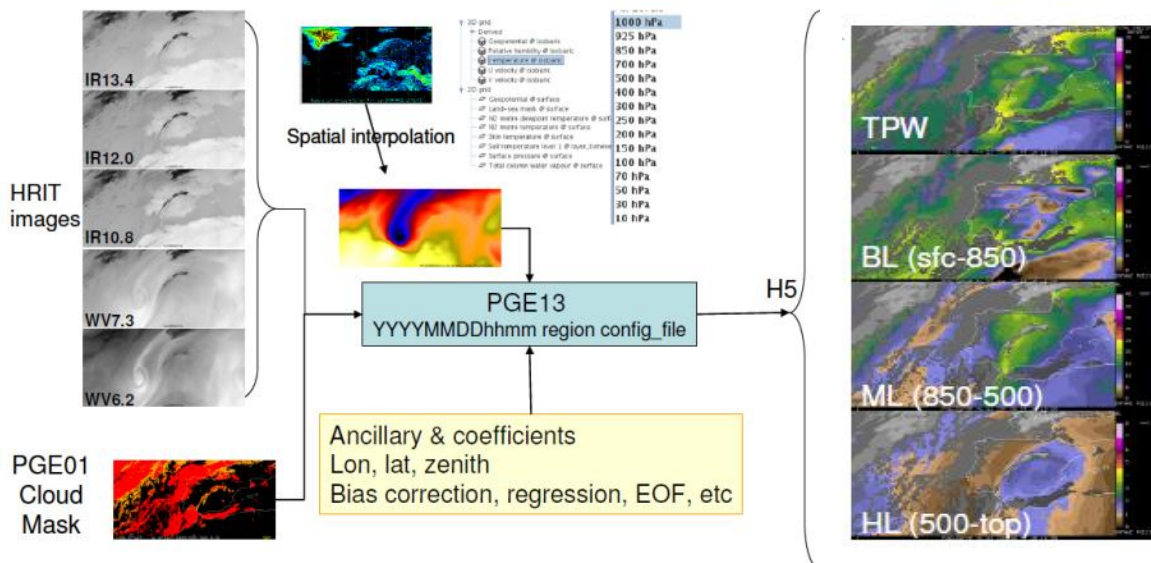
• 探测仪：

使用全波通道，得到大气温湿度等参数的垂直分布

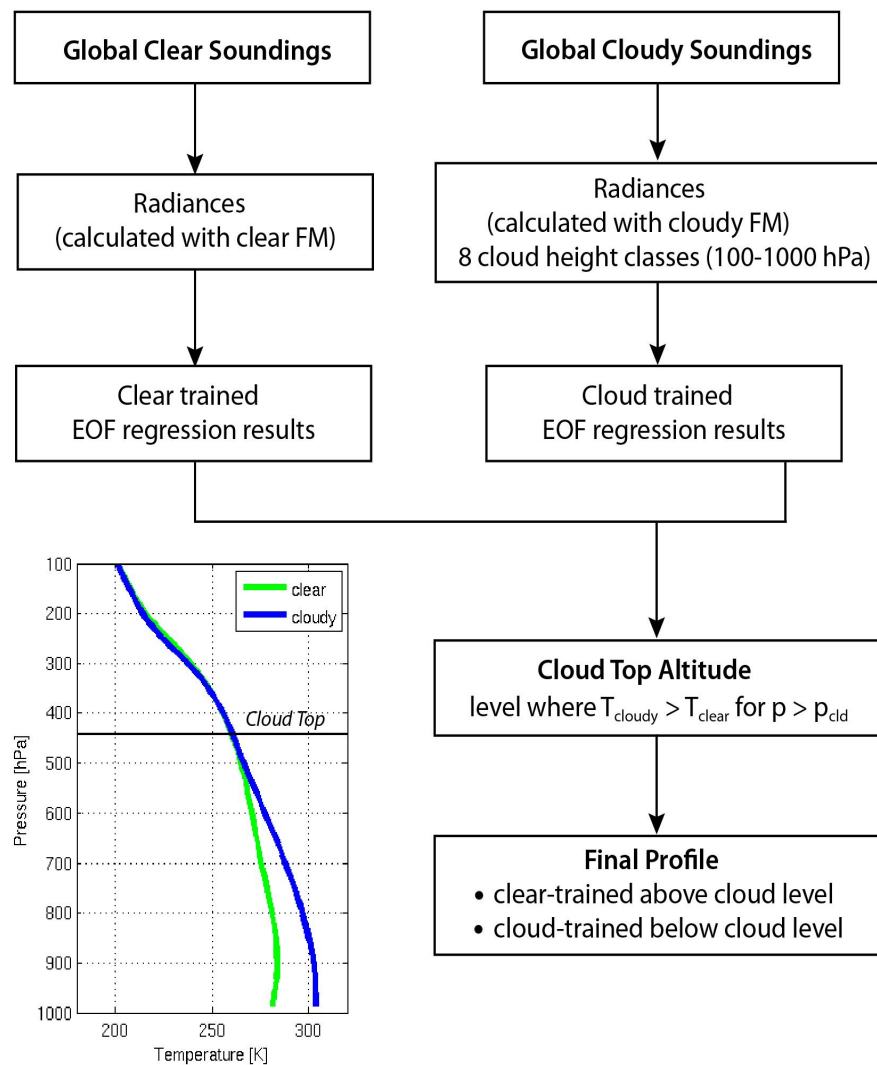
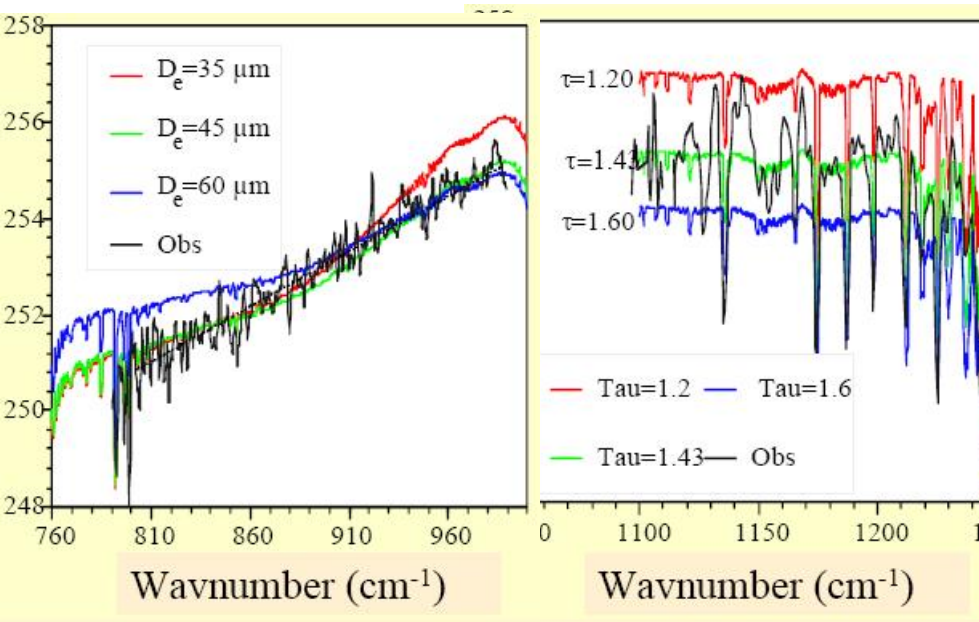
• 成像仪

使用**6个**红外通道+NWP预报场，在大气湿度廓线的基础上积分得到分层水汽含量（总水汽、低层水汽、中层水汽、高层水汽）

5.8~6.7 μm ,
6.9~7.3 μm ,
8~9 μm ,
10.3~11.3 μm ,
11.5~12.5 μm
13.2~13.8 μm



云天反演基础



- 得到晴空和最优云天反演廓线
- 确定云顶高度
- 根据云顶高度，选择不同的反演结果

气候廓线模拟：

与AIRS比较

高层CO₂吸收通道对上层温

湿度反演具有重要意义

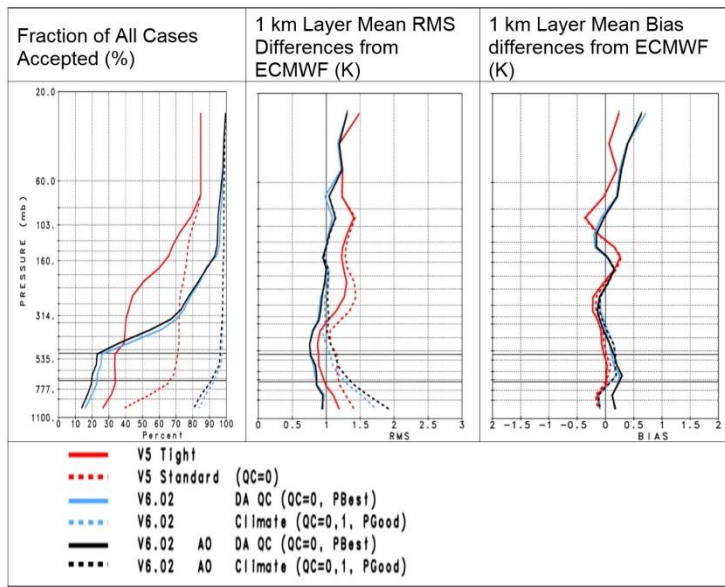
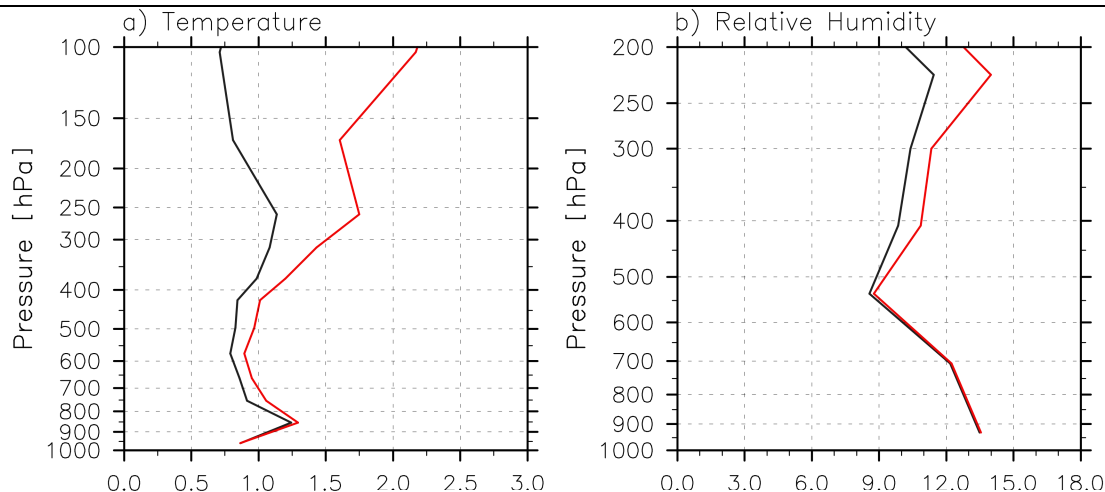


Figure 4: Global temperature statistics of AIRS retrievals compared to collocated ECMWF for seven study days.

Left panel shows % of QC'd retrievals accepted as a function of altitude; Central panel shows the RMS differences of 1 km mean temperatures wrt ECMWF; Right panel shows the biases of 1 km mean temperatures wrt ECMWF
Study Days: 20020906, 20030125, 20040929, 20050805, 20070224, 20070810, 20100530

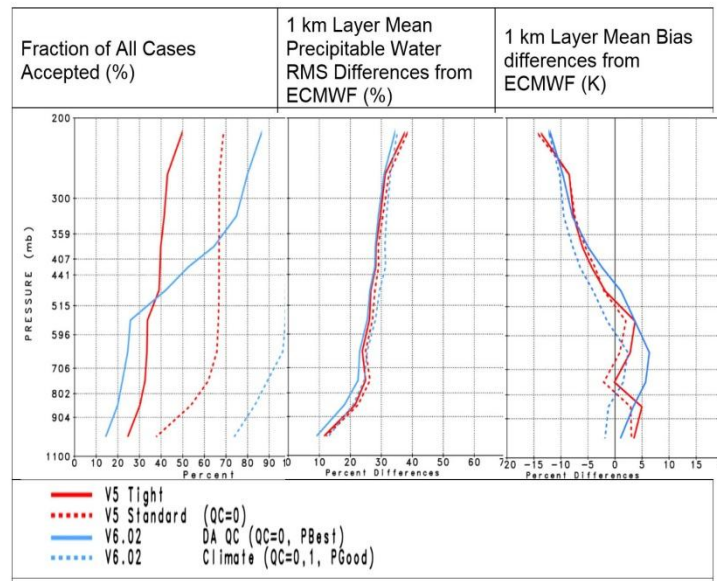
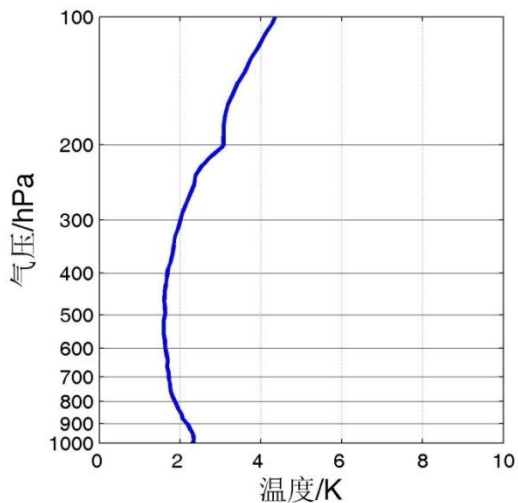


Figure 7: Global water vapor statistics of AIRS retrievals compared to collocated ECMWF for seven study days.

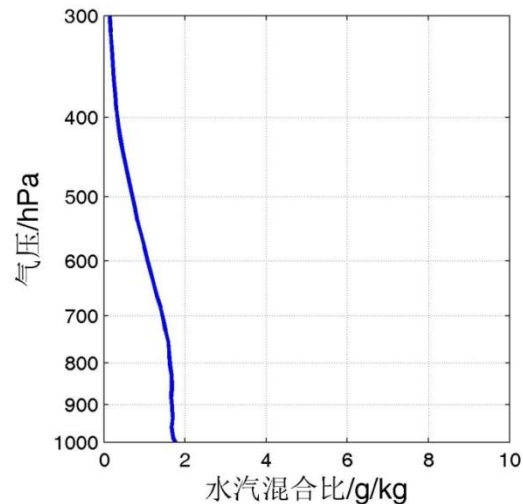
Left panel shows % of QC'd retrievals accepted as a function of altitude; Central panel shows the % RMS difference of 1 km mean precipitable water wrt ECMWF; Right panel shows the % bias of 1 km mean precipitable water wrt ECMWF
Study Days: 20020906, 20030125, 20040929, 20050805, 20070224, 20070810, 20100530

气候廓线模拟

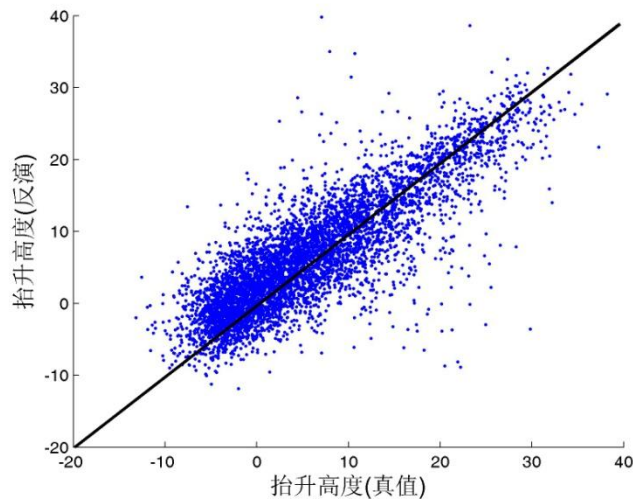
温度



湿度

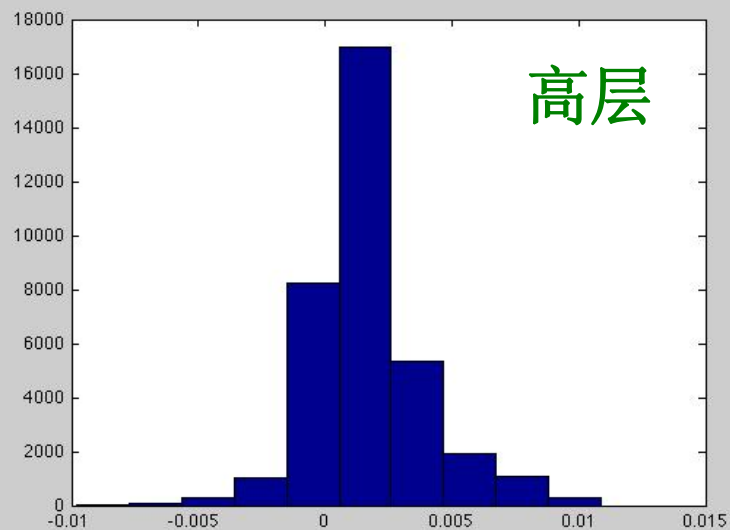
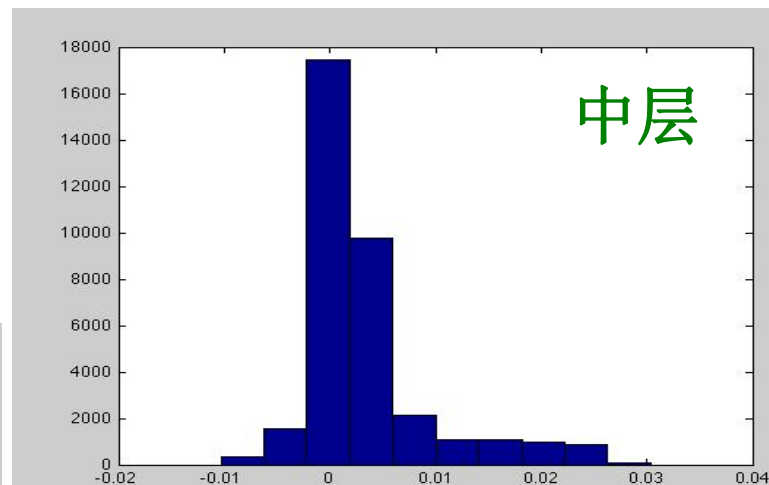
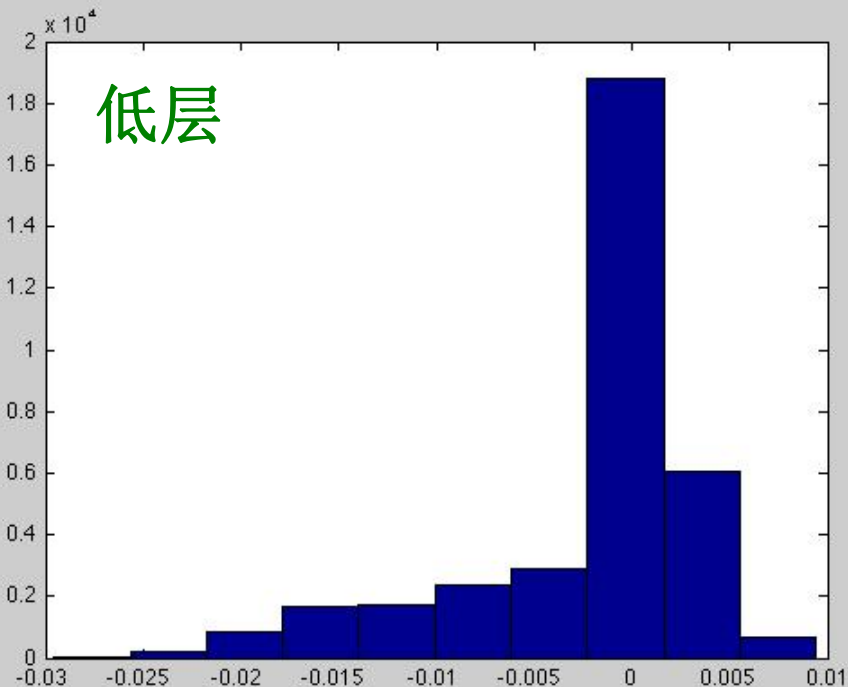


抬升高度



GOES观测个例

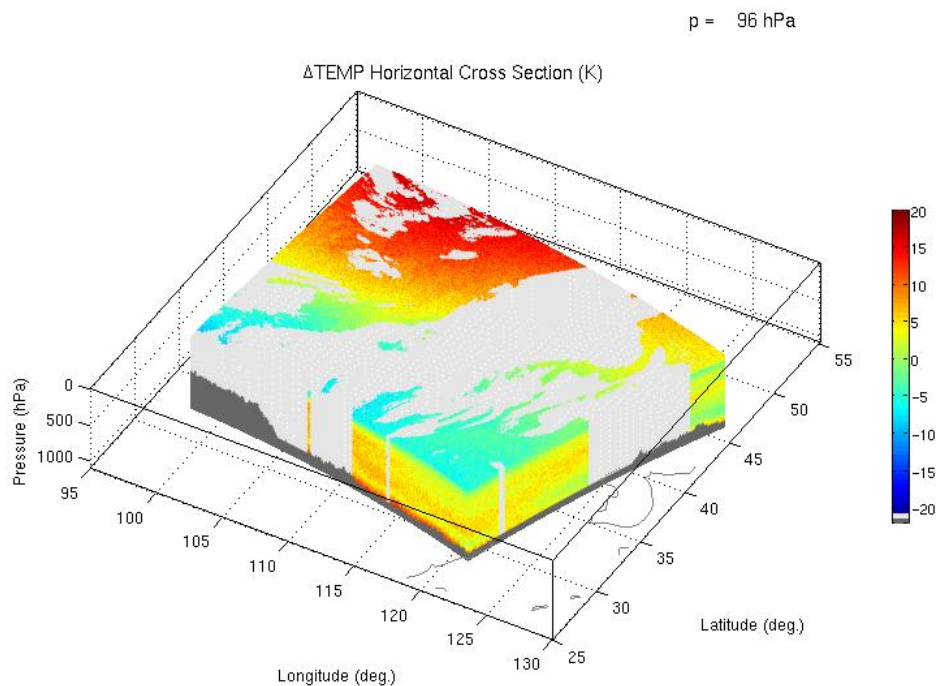
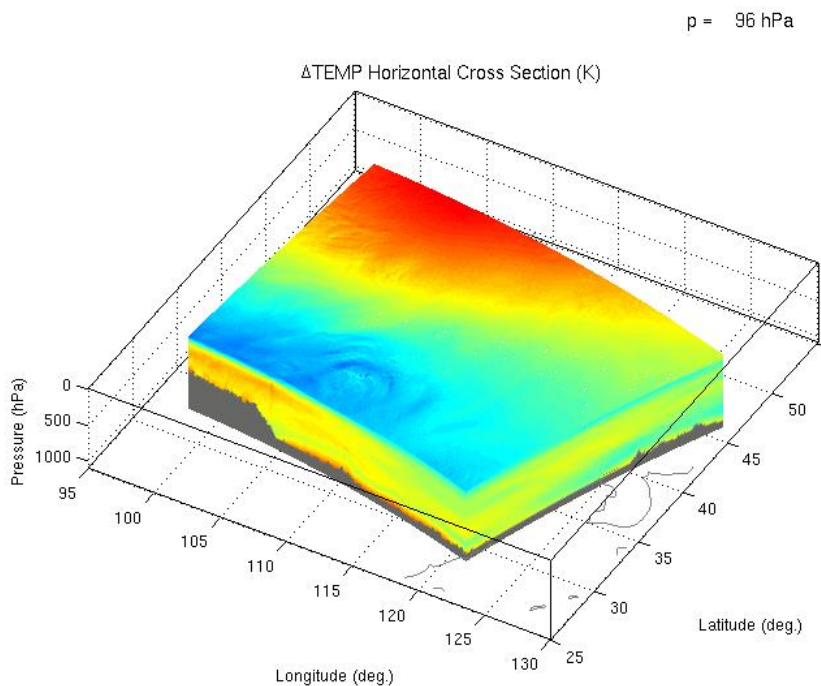
分别为低层、中层和高层水汽差值的直方图，均值分别为：-0.0021，0.0034和0.0018 g/kg



数值模拟个例：北京721暴雨 <温度>

“真”值

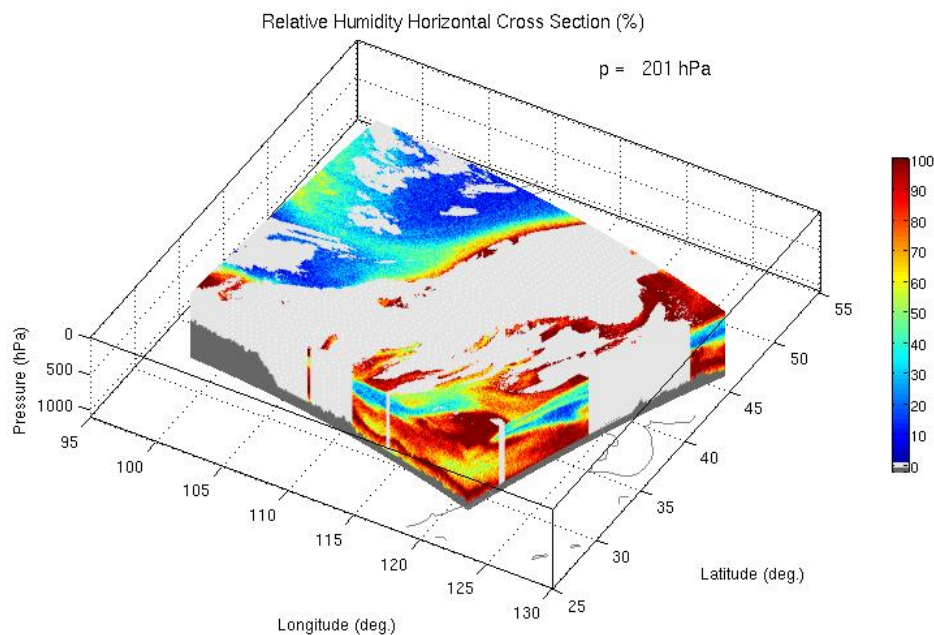
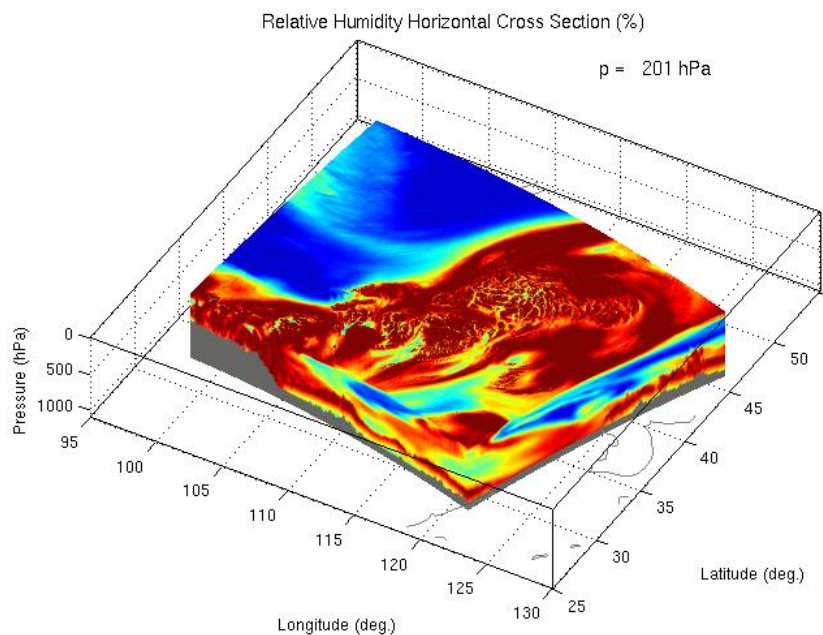
反演值



数值模拟个例：北京721暴雨 <相对湿度>

“真”值

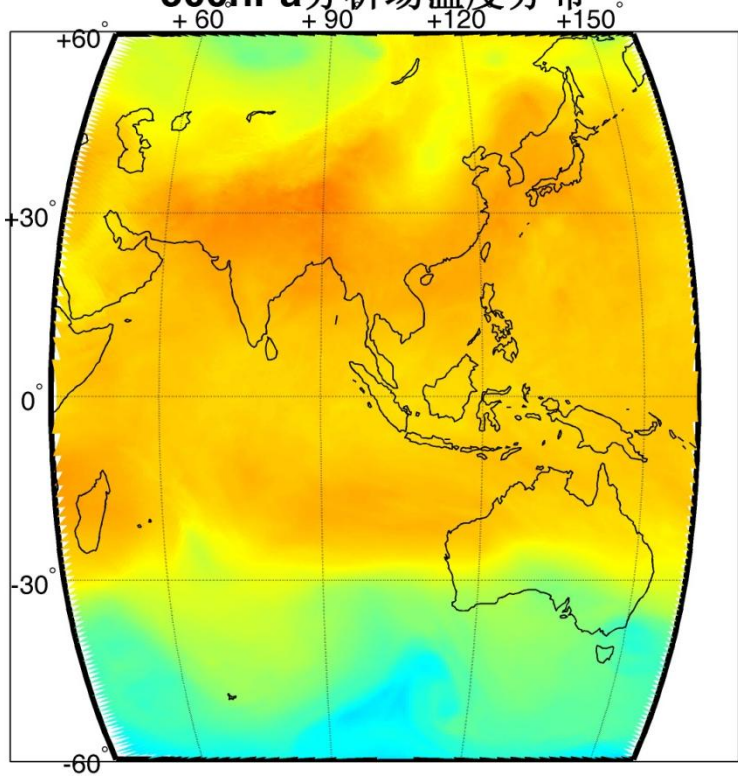
反演值



数值模拟个例——欧洲中心预报场

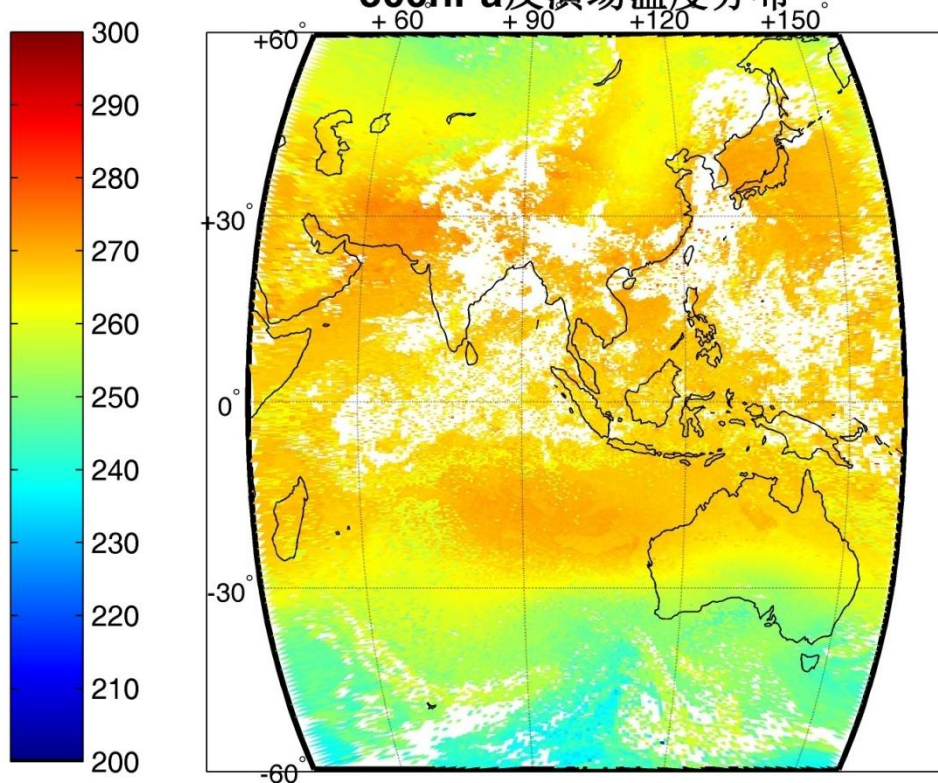
“真”值

500hPa分析场温度分布



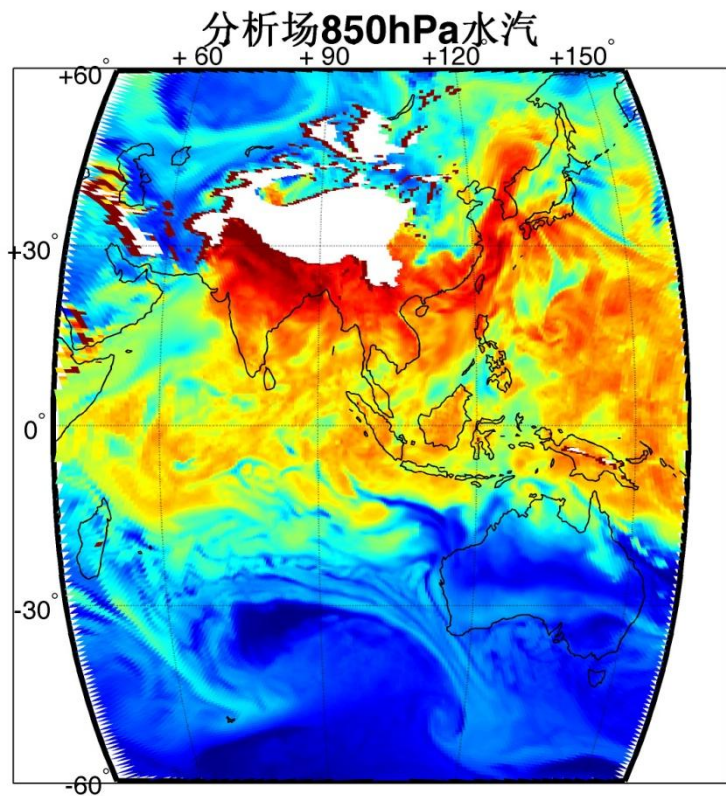
反演值

500hPa反演场温度分布

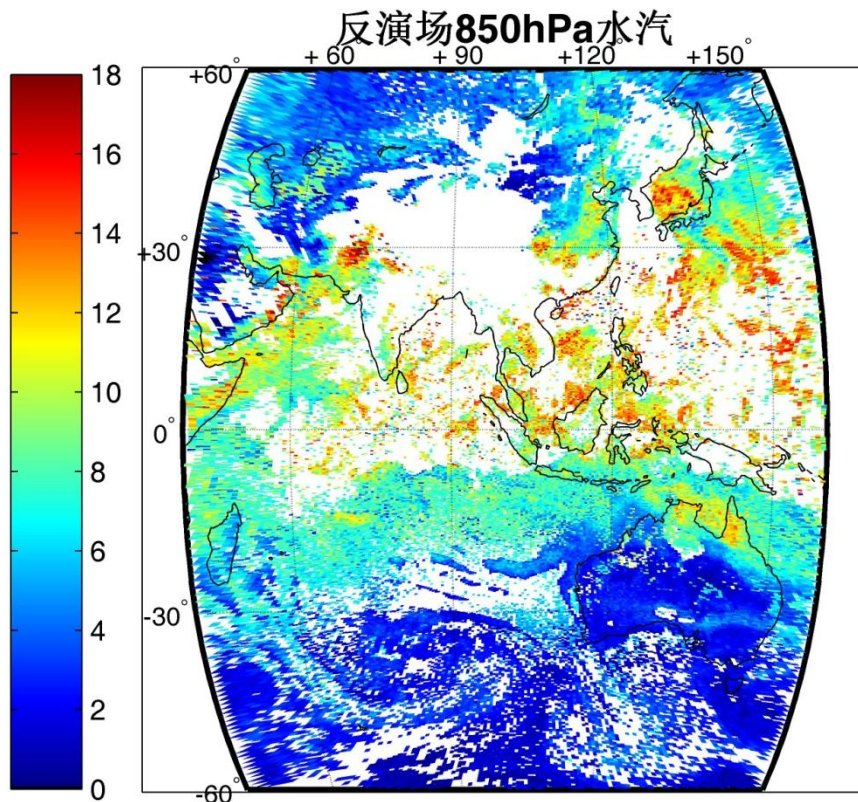


数值模拟个例——欧洲中心预报场

“真”值

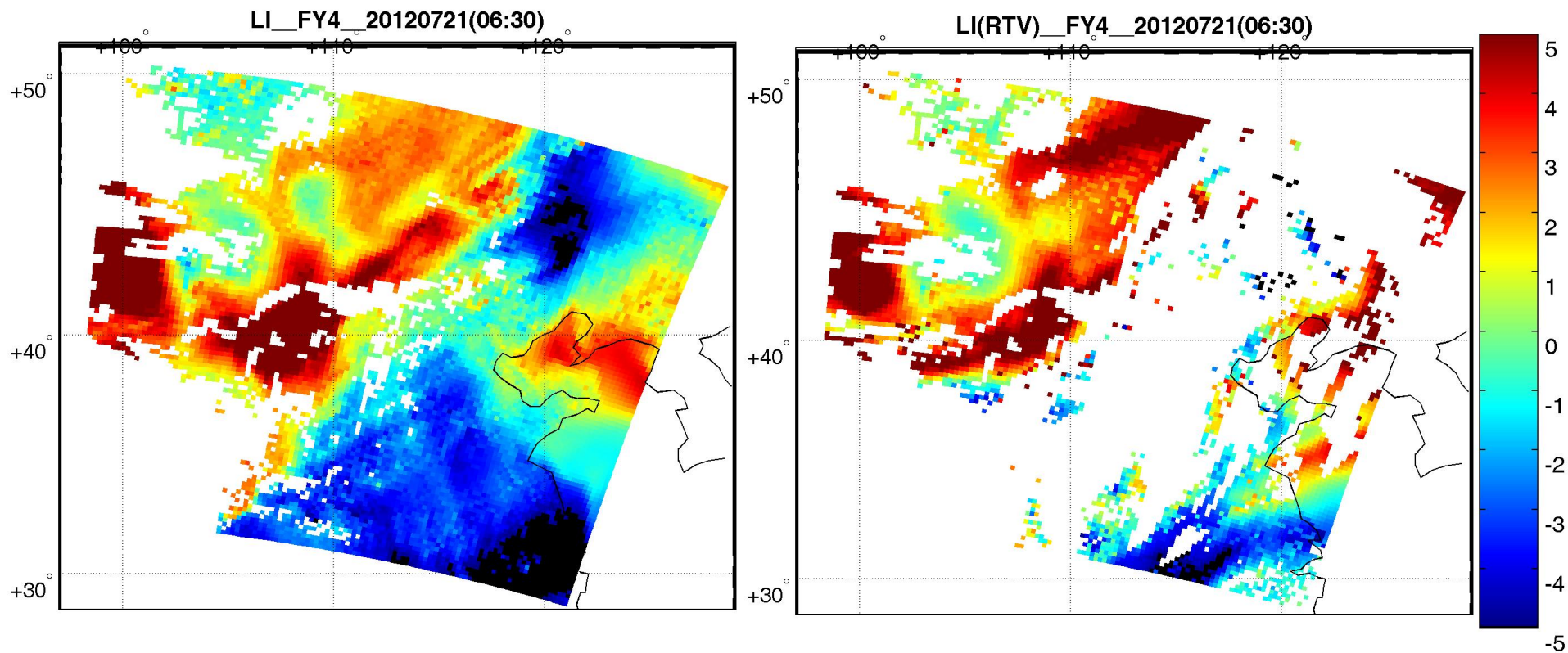


反演值



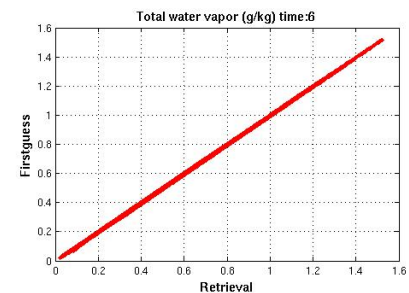
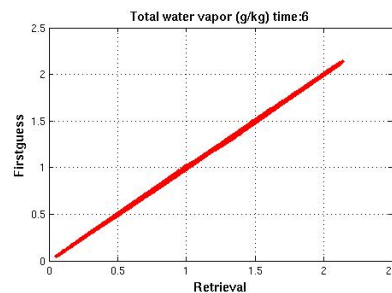
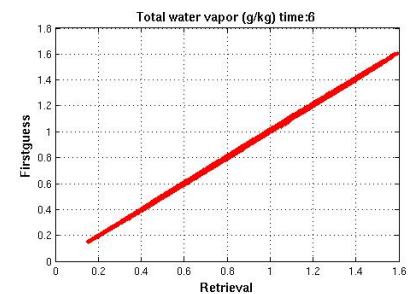
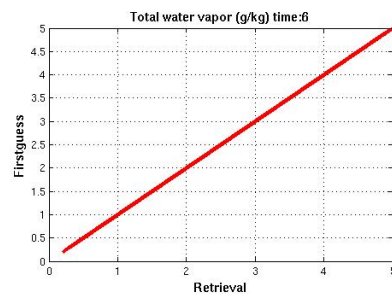
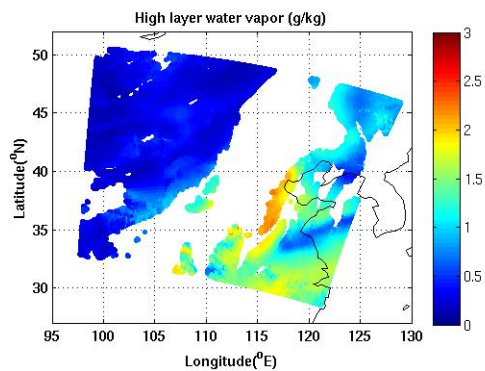
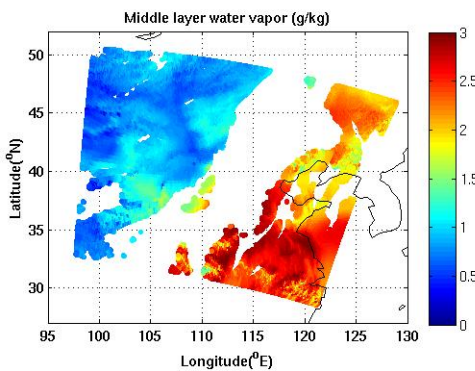
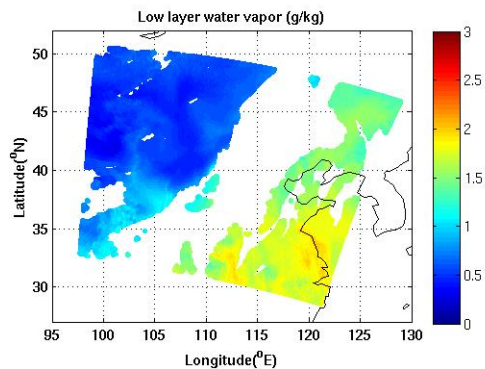
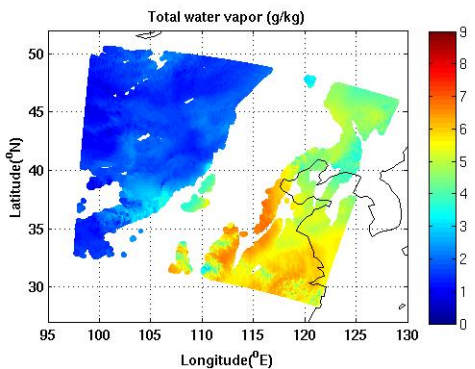
“真”值

反演值



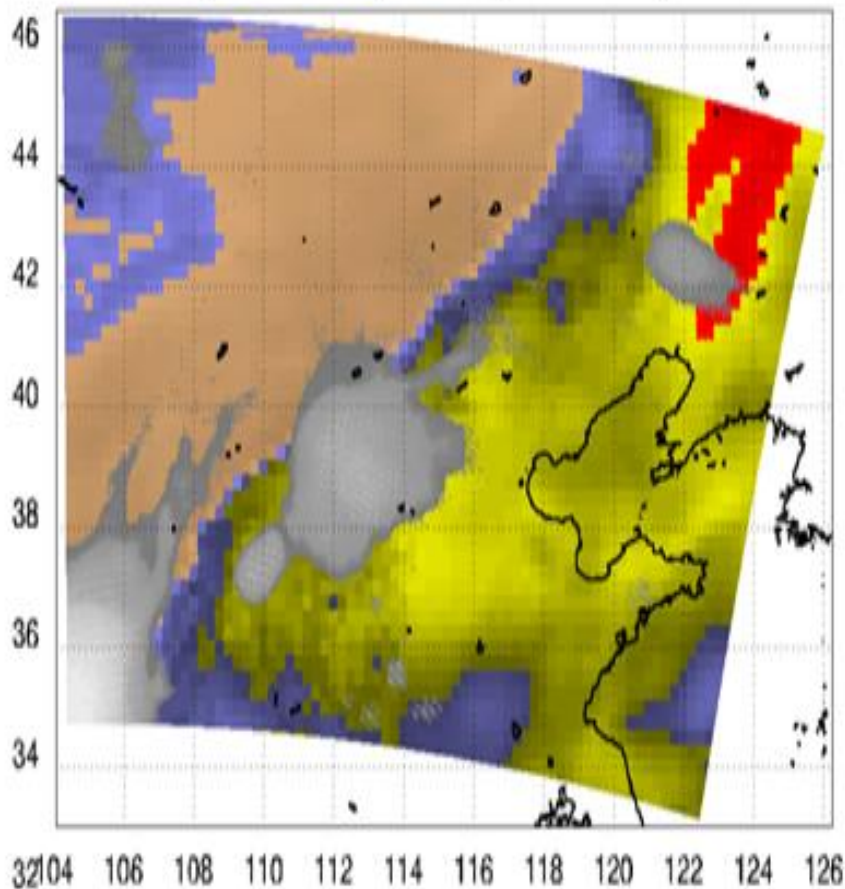
抬升指数

数值模拟个例：北京721暴雨

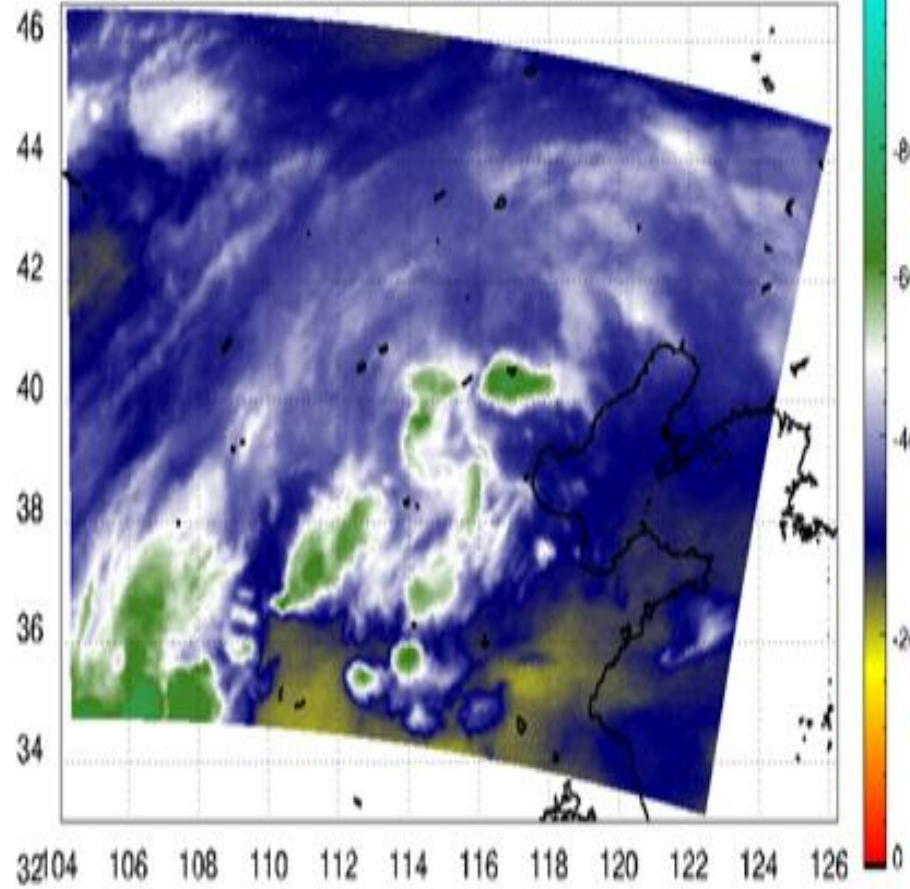


1、在短临预报中的应用

(12:00 UTC, 06 August 2013)

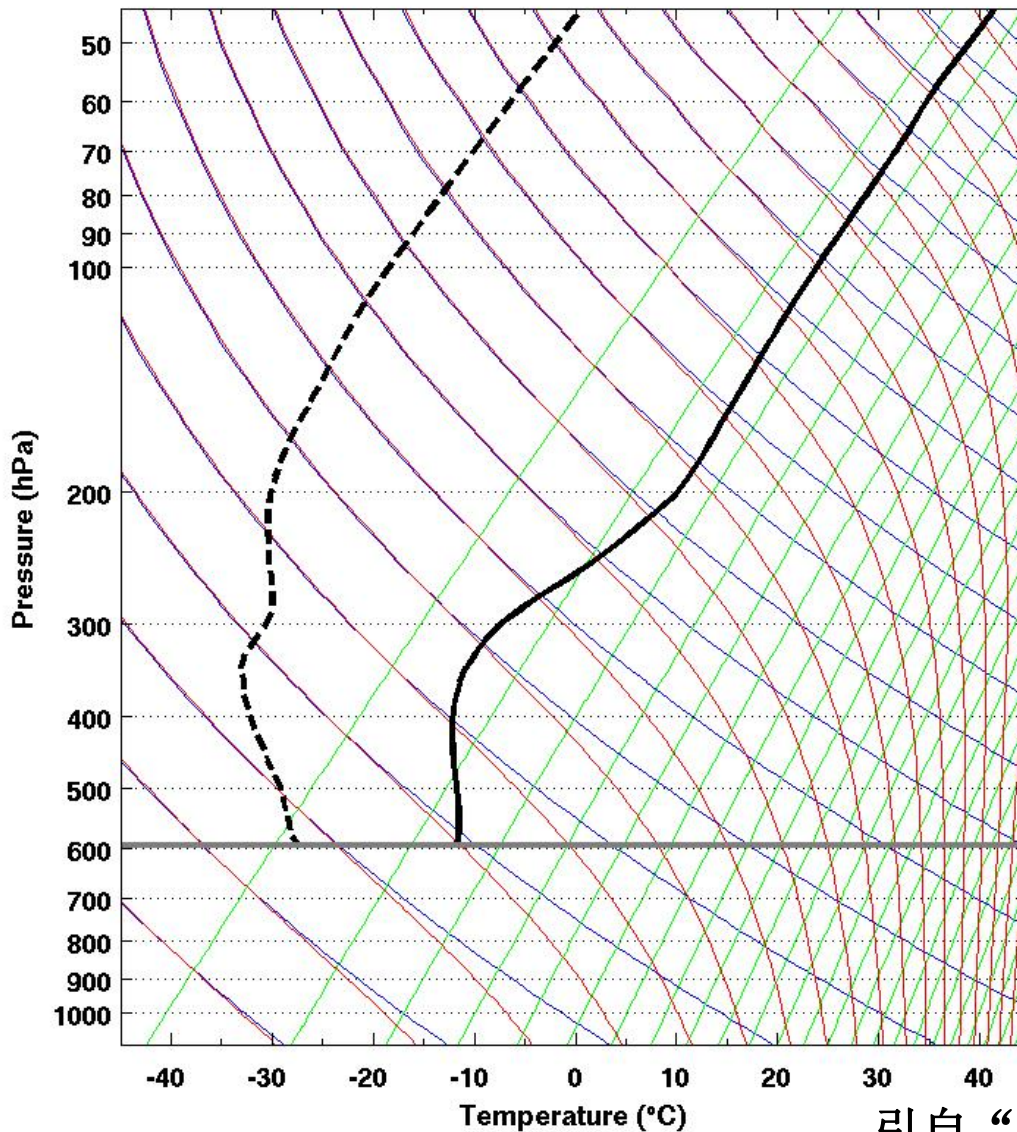


(15:02 UTC, 06 August 2013)



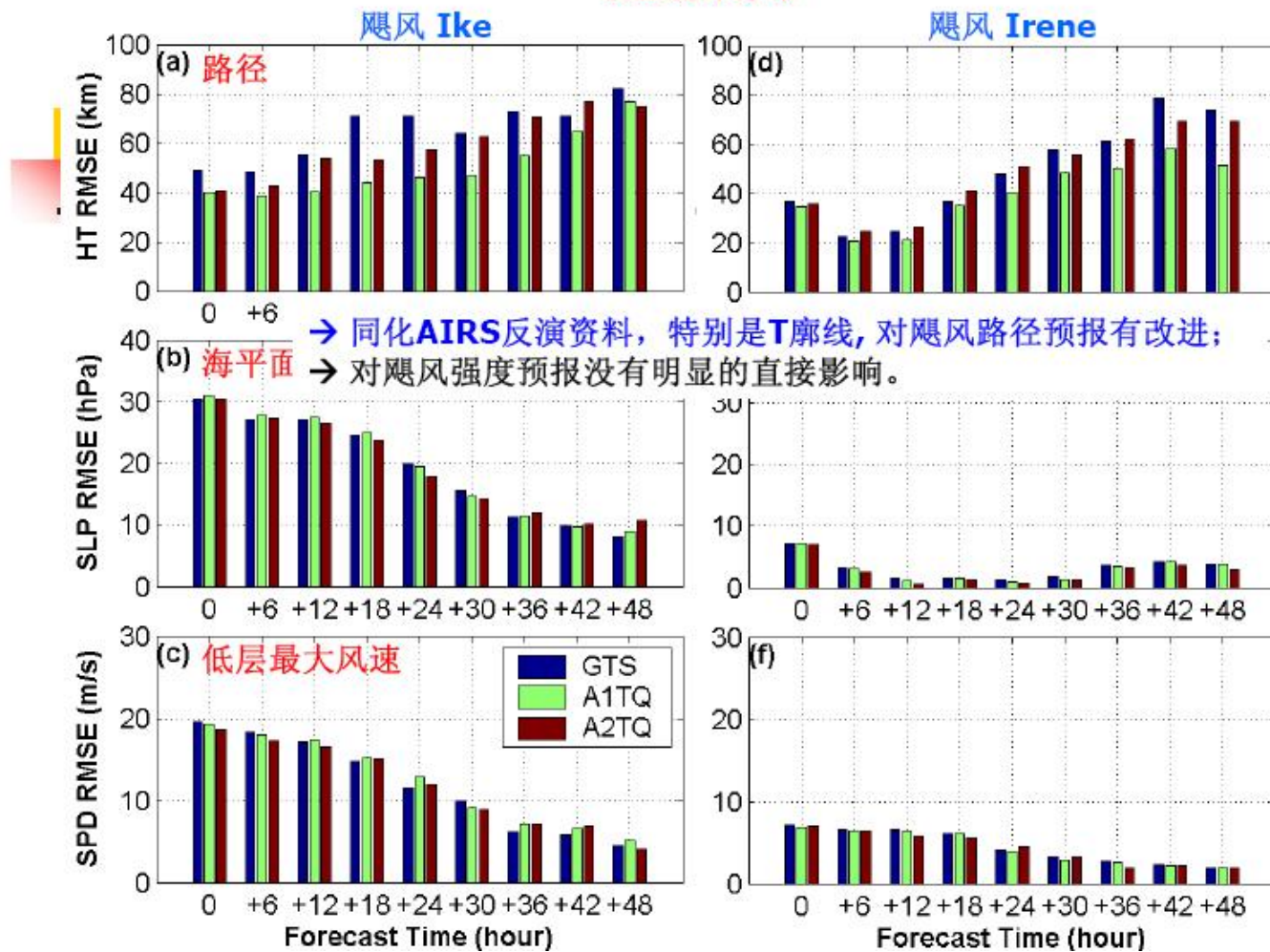


IASI 06:05 UTC 2013-01-27



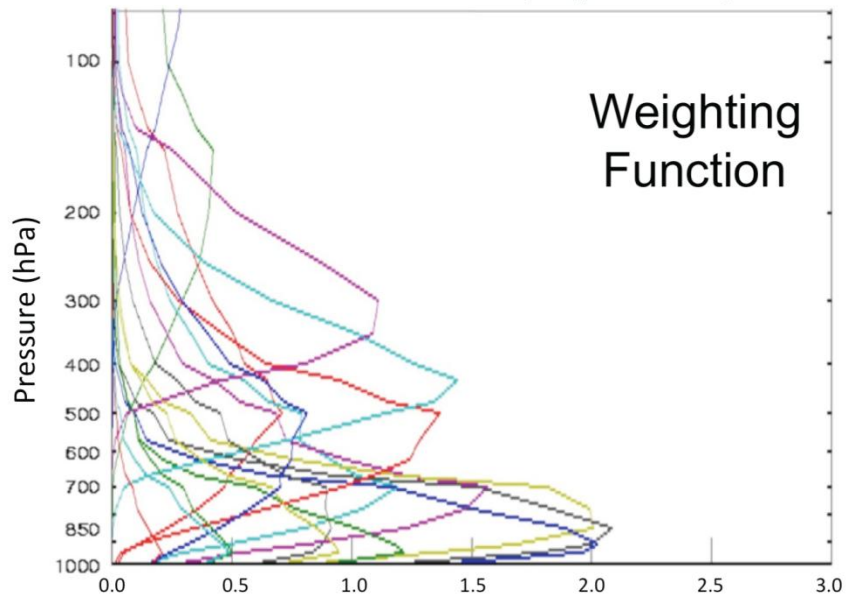
2、在数值预报中的应用

误差统计分布

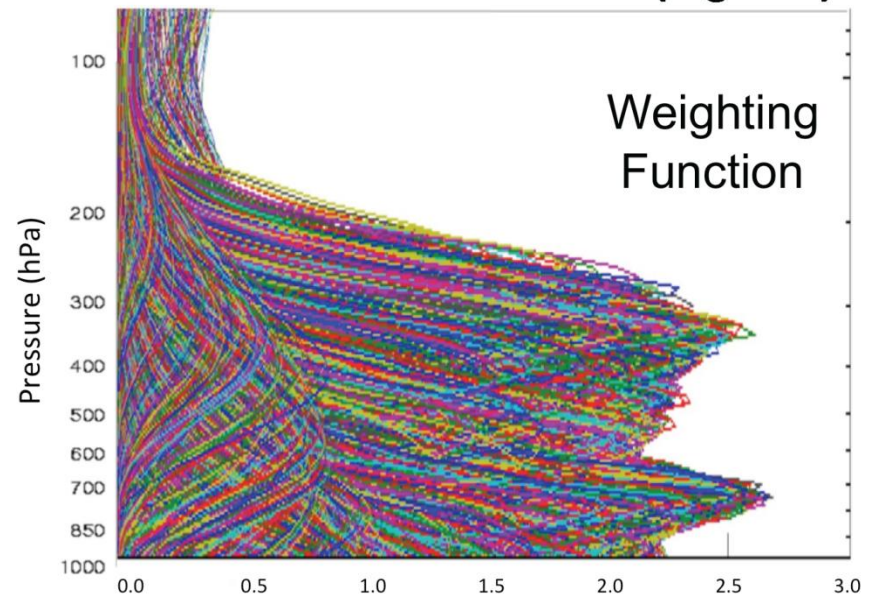


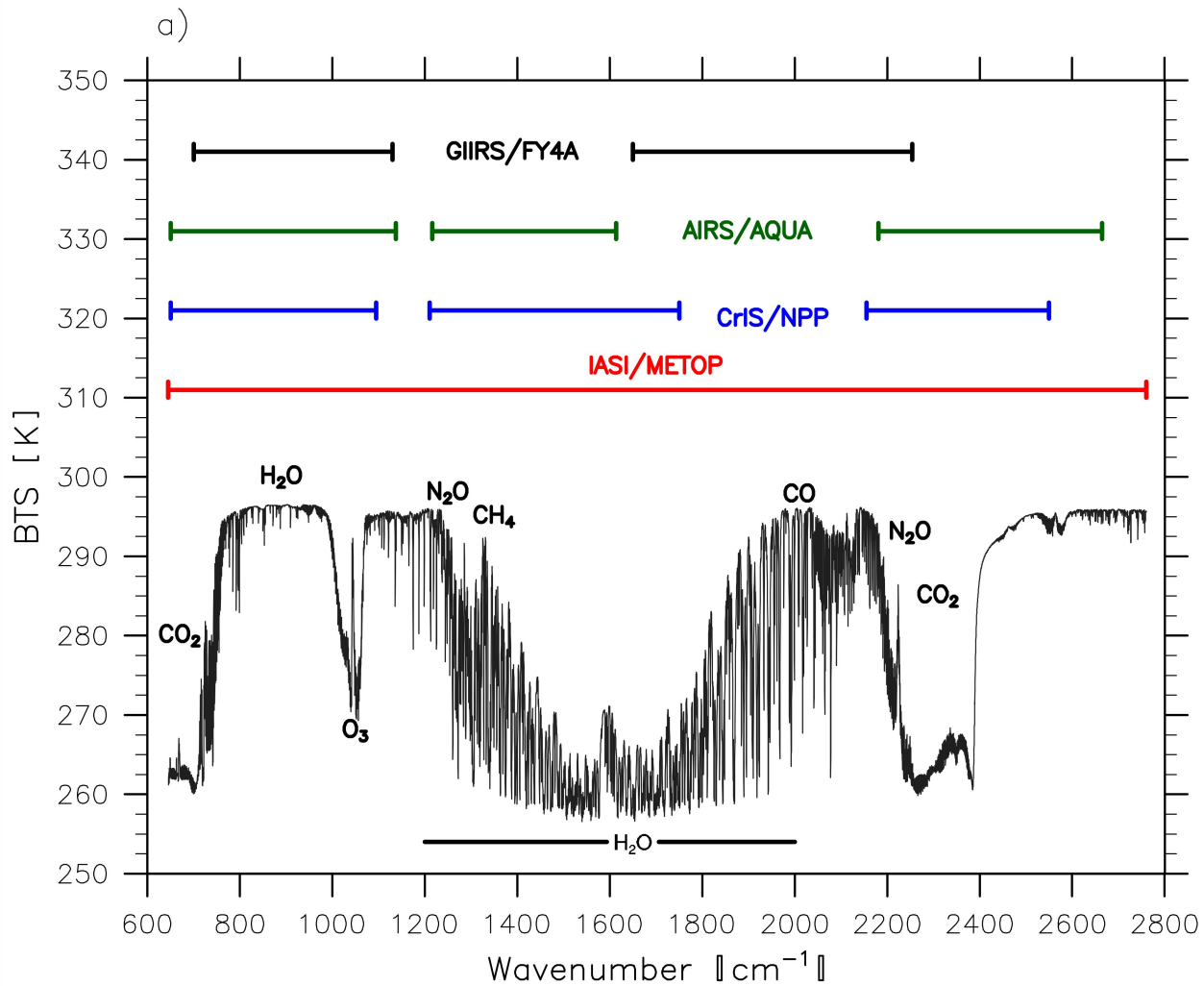
谢谢!

Filter Sounders (e.g., HIRS)

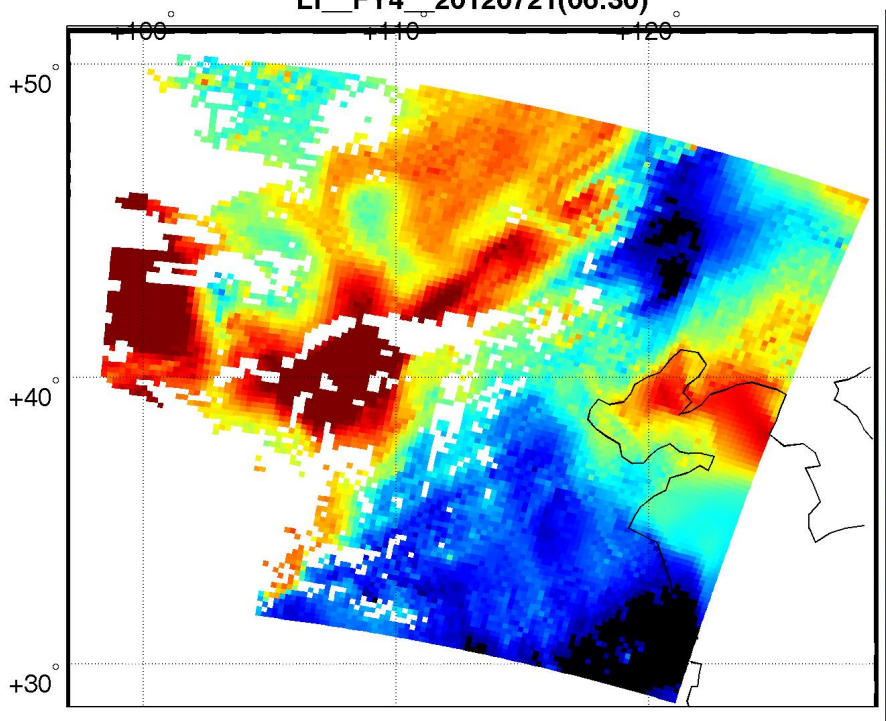


Interferometer Sounders (e.g., CrIS)

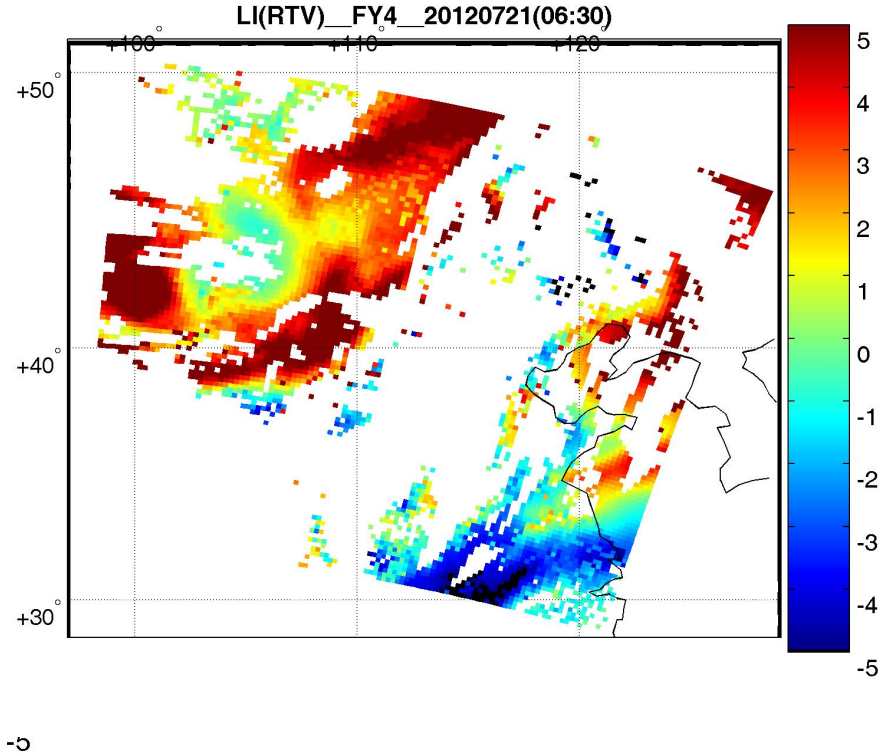


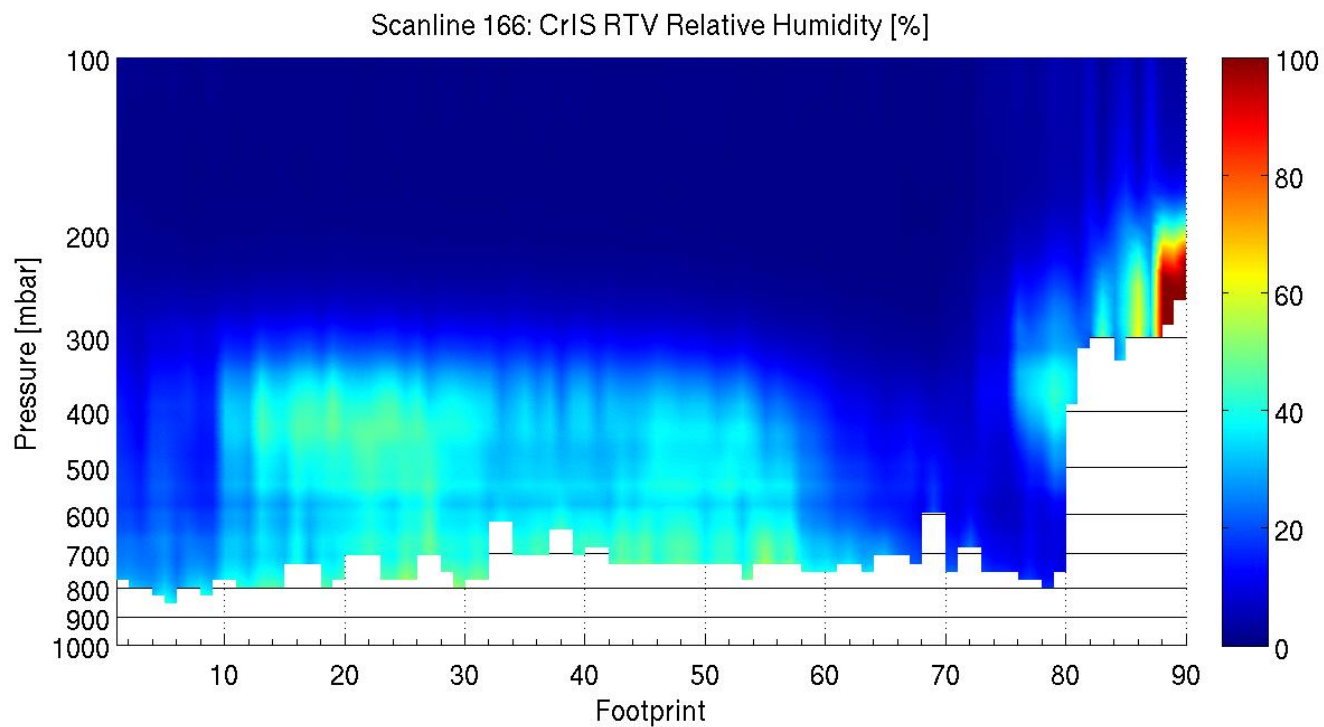
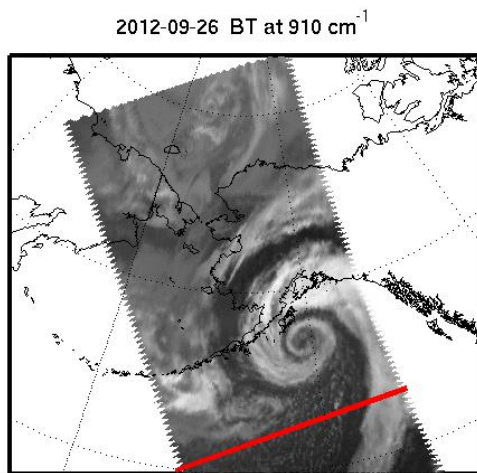


LI_FY4_20120721(06:30)



LI(RTV)_FY4_20120721(06:30)







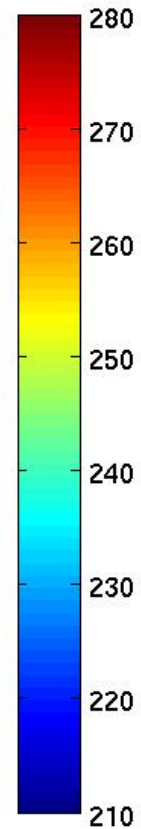
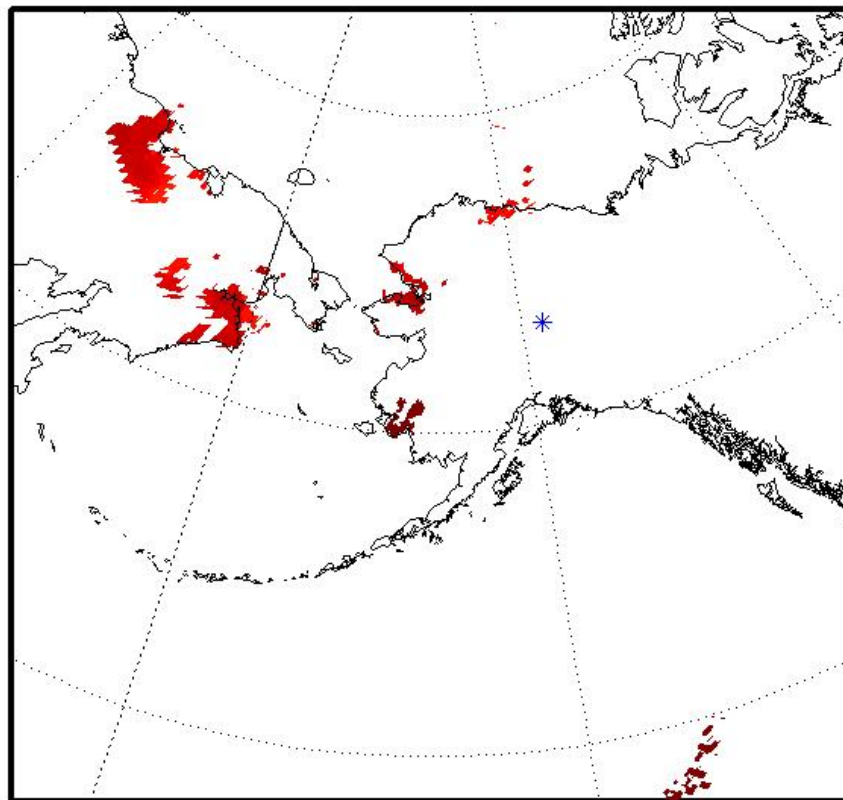
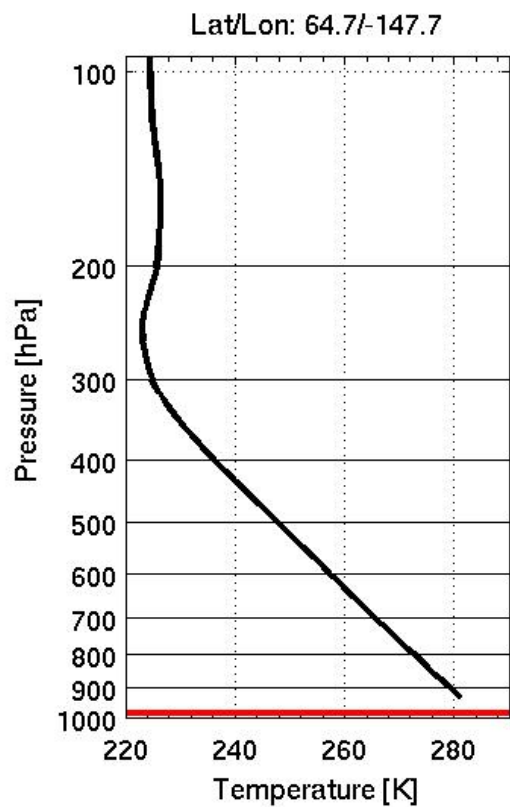
Temperature Surface to 100 hPa Movie (26 Sept 2012)

www.cma.gov.cn

国家卫星气象中心



CrIS RTV Temperature [K] at 986.1 hPa





IASI 2013-01-27 06:05 UTC

