

[BoldFont=STHeiti, ItalicFont=STKaiti]STSong [Scale=0.9]Monaco
song[BoldFont=STSong]STSong sf[BoldFont=STSong]STSong "zh" = 0pt
plus 1pt

FSO çŤíæŁŭæŁ'ŇăĚŇ/è;rážúæŁ'ŇăĚŇ

Release 1.0.0-dev

**ăŇŮăžňæĲŮæúęçšăđ'l'çğŚæŁĂæĲL'éŽŘăĚňăŘÿ
FSO æĲŮæúęçšăđ'l'**

Dec 12, 2018

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- èőÿăŔŕă■Ŕèőő

- æñcéŁŮ
- FSOçőĂăžŇ
- äĭİèŦŮèįřăžŮ
- FSOèŁŔèqŇ
- æŦĚéŽIJăd'ĎçŘĚ

1.1 æŋćè£Ó

1.1.1 1.1.1

FSOijLFforecast sensitivity to observationijjL'ā■écĎæŁęáržèĖĈætŊćŽĎæŤŖæĎšæĀġiijŊæIJāāLīĈŤsM
/NCARaijĀāRŚiijŊæŸřäŸĀġġ■āšžāžŌāijt'ēŽŖĈŖĖēōžĈĎĈŤlāžŌērĎāijrēĖĈætŊāržāŖŊāŊŮĉszĉzšāŊŊæŤ

æIɲæL'ŃâEŃăzŃçz■çŽDæYřăyžăy■ăŽ; ærTèsqāsĀærTèsqæŌcætŃăy■ăfČæŘ■ăzzçŽDăyĀăĕŮécDæLĕ
 DockeraōžăŽlæLĀăIJrărzFSOè; řăžűefZëaŃăžEărAèçEiijŃăžăă; řăžŌçşçzçşçgžæd'■ăyŌçoaçREăĀČăRŃăŮ
 AirflowætAçlŃçoaçREè; řăžűărzæTt'ăylăyŽăLaq; IJăyŽëfZëaŃăRřègEăŃŮçoaçREăĀČèřëçşçzçşëČ; ăodăŮŮ

1.1.2 ælJ■åŁąåŻíèęAæśĆ

PHP version 7.0.15 or newer is required, with the *intl* extension installed.

A database is required for most web application programming. Currently supported databases are:

- MySQL (5.1+) via the *MySQLi* driver
- PostgreSQL via the *Postgre* driver
- Python3 external packages: pendulum

Not all of the drivers have been converted/rewritten for FSO. The list below shows the outstanding ones.

- MySQL (5.1+) via the *pdo* driver

- Oracle via the *oci8* and *pdo* drivers
- PostgreSQL via the *pdo* driver
- MS SQL via the *mssql*, *sqlsrv* (version 2005 and above only) and *pdo* drivers
- SQLite via the *sqlite* (version 2), *sqlite3* (version 3) and *pdo* drivers
- CUBRID via the *cubrid* and *pdo* drivers
- Interbase/Firebird via the *ibase* and *pdo* drivers
- ODBC via the *odbc* and *pdo* drivers (you should know that ODBC is actually an abstraction layer)

1.1.3 āŘřăĚążę

èřěFSOæIJăĹĭçŦś MMM/NCAR āĭjĂăŔŚăĂĆèřěæąEæđúæŸřăŷžăőđéŽĚăŷŹăŁăèŁŔèąŇèĂŇçĭjŮăEZç
WRF Data Assimilation System çŽĎăžččăAăžŞăŷ■ăĂşéL't'èĂŇæĭēcŽĎăĂĆăđ'Žăžt' æĭěĭjŇăőČăŷĂçŽt' çŦśă

CHAPTER 3

āĳlètŮèįřăžŮ

3.1 āŮL'èċĚ

āŃĚæŃăžěäŷŃăĜăăŷlėĆlăĽĖ:

- āŮL'èċĚAirflows, äžŃċž■AirflowċŽĎăŮL'èċĚ
- āŮL'èċĚSingularity, äžŃċž■SingularityċŽĎăŮL'èċĚ
- āĜĖăđ'ĜèĽŘèqŃċŽŮăĴ, äžŃċž■èĽŘèqŃċŮřăċĈċŽĎăĜĖăđ'ĜăĂĆ

@startuml Alice -> Bob: Authentication Request Bob -> Alice: Authentication Response

Alice -> Bob: Another authentication Request Alice <- Bob: another authentication Response

@enduml

3.1.1 AirflowăŮL'èċĚ

AirflowæŸřăŷĂċğ■ċŤlċijŮċlŃæŮžăijŘċijŮăĖŽăžèăŮL'æŮŠăŃŃċŽŚæŮğăüëăĴIJăĵĂċlŃċŽĎăžşăŘăĂĆ

ăŮL'èċĚ

```
>export AIRFLOW_HOME=/æŃĜăăžèûřăĴĎ/airflow  
→#èŮĳċ;ŮċŮřăċĈăŘŸéĜŘairflowăŷžèûřăĴĎ  
>pip install airflow #ăŮL'èċĚ
```

ăŮL'èċĚăŮŃăĽŘăŮŮ

```
cd $AIRFLOW_HOME
>vim airflow.cfg
```

äy z è ç Ä ä ł ó æ Ĥ ź ä z ě ä y Ñ ã Ĥ Ć æ Ĥ ř

```
airflow_home = /æŃĜăôžèùrá;Ď/airflow #airflowäÿžèùrá;Ď
dags_folder = /æŃĜăôžèùrá;Ď/airflow/dags #dag pythonæŮĜăžúçŽôâ;Ŧ
executor = LocalExecutor #ăĚĹă;ĕçŦílocalăíăăijŔ
base_log_folder = /æŃĜăôžèùrá;Ď/airflow/logs #ăÿžæŮěăĤŮçŽôâ;Ŧ
sql_alchemy_conn = postgresql+psycopg2://airflow:fso2018@localhost
→ #æŃĜăôžăĚčăŦŕă■ôă■ŸăĆíăŮžăăijŔiijŃçŽôăĹ'■éĜĜçŦíPostgresql

[webserver]
authenticate = True
filter_by_owner = true
base_url = http://localhost:8080
web_server_host = XXX.XXX.XXX.XXX #web server æIJžăžíIP
base_url = http://XXX.XXX.XXX.XXX:8080 #web server æIJžăžíIP:PORT
```

ǎĹiǎġNǎŃŮǎTřǎ■óǎž\$

```
>airflow initdb
```

Airflow

DAG (Directed Acyclic Graph)

ãĎČãŠŤčď'žčŽĐãĎŤřãžžãŁãçŽĐÉŽĚãŘĹĩĩŇãžũãŘŘěřãžĚãžžãŁãžžŇéŮŤčŽĐã;ĩĕťŮãĚšçšzĩĩŇãžěãŘĹ

task äzzåŁa

ǎǎĈārsæYřDAGæŨĜäzúäy■čZDäyÄäyľäyİOperatoriijNæRRèřřäzEäĚüä;ŞçZDæŞ■ä;IJæ■ěéld'āĀĆ

Operator æL'gèaÑaZÍ

airflowáoŽázL'ážEąŁąd'ŻçŽĐ OperatoriiŃéĂžăyyäyĂäylæŞ■ăIJăřsæYřäyĂäylçL'záóŽçŽĐOperatori
OperatorăĂĆ

ds æŮěæljš

aL■élcčŽDēDŽæIJnéGŇčTíĀLřāzE{ { ds } }āRŸēGŘíijŇærRāyĭDAGāIJĀL'gèqNæŮüēČĭaijZāijāāĚēäy
 render āŚ;āzd' æŮüēčnāŽŁæ■cāĹŘāřzāžTčŽDæŮüēŮt'āĀĆ

Important: è£ŽéGÑèeAçL'záL'náijžërČäyÄäyNriižNärzäžŎâSÍæIJšäzzâLäiijNairflowäijääĚčŽDæUúéUť æV

Macros

èDŽæIJñéGÑæČædIJéIJĚeAäy■āRŇčŽDæUúéUť æäijäijRæLŮèĀĚäy■āRŇčŽDæUúéUť æōtæĀŎäzL
çŽDæUúéUť æäijäijRiijNèĀNäyTè£YäijŽæIJL'äyĀäzŽçZyāĚšçŽDāG;æTřāRřäzēcŽt æŎèërČçTliijNæfTæČ

āRČèĀČç;Séat

<<https://airflow.incubator.apache.org/tutorial.html>>

3.1.2 SingularityāóL'èčĚ

āōdāEťāLEædRçşçzçšéGčTÍSingularityāōzāZlæLĀæIJfè£ŽèaŇāřAèčĚriijNāRřäzææIJL'æTlÉŽTççzä;I

āóL'èčĚ

äyŽāLāuüëä;IJçñŽæŎlé■RLinuxæS■ä;IJçşçzçšriijNUbuntu/centosāRŚèaŇçL'ŁæIJñ,äžęcentosäyžä;NriijŽ

```
#āóL'èčĚæLŮæŽt'æŮřä;ĪèťŮ

sudo yum update && \
sudo yum groupinstall 'Development Tools' && \
sudo yum install libarchive-devel

#äyNè; ;āžúāóL'èčĚæIJĀŮřçL'ŁæIJñ

git clone https://github.com/singularityware/singularity.git
cd singularity
./autogen.sh
./configure --prefix=/usr/local --sysconfdir=/etc
make
sudo make install
```

ārijaĚééTlJaČRæŮGäzú

āuëä;IJçñŽäy■āžTā■YāIJFSO SingularityéTlJaČRæŮGäzúfso3.simgāČ

```
>ls -al fso3.simg
```

ăŦĈèĂĈçĭŚéąŦ

<<http://singularity.lbl.gov/docs-installation>>

3.1.3 èĚŘèąŇçŽóăĭŦ

FSOçŽóăĭŦçžŚæďĎ

```
/home/zwtđ/FSO
ăŦĪăŦĂăŦĂ china_FSO #FSOăŷžçŽóăĭŦ
ăŦĈăŦĪăŦĂăŦĂ be
ăŦĈăŦĪăŦĂăŦĂ fc
ăŦĈăŦĪăŦĂăŦĂ fsoplot
ăŦĈăŦĪăŦĂăŦĂ ob
ăŦĈăŦĪăŦĂăŦĂ plot
ăŦĈăŦĪăŦĂăŦĂ rc
ăŦĈăŦĪăŦĂăŦĂ run
ăŦĪăŦĂăŦĂ china_static
ăŦĪăŦĂăŦĂ china_working
ăŦĪăŦĂăŦĂ scripts
```

èĎŽæĭŇăŦŦçĭŦ

```
cd /home/zwtđ/FSO/china_FSO/be
> be.d01.dat
```

```
cd /home/zwtđ/FSO/china_FSO/fsoplot
> data2pg.py
drawfso.py
drawlev.py
drawmap.py
drawvar.py
drawvarlev.py
sql.py
timepath.py
chn.ncl
fso.ncl
map.ncl
var.ncl
varmap.ncl
```

```
cd /home/zwttd/FSO/china_FSO/run
>wrapper_run_fso_v3.4.ksh\
```

```
cd /home/zwttd/FSO/china_static
> namelist.input
   namelist.wps
   namelist.obsproc
   geo_em.d01.nc
   Vtable.GFS
   Vtable.GFS_0p5
   QNWFA_QNIFA_Monthly_GFS
   obserr.txt
```

```
cd /home/zwttd/FSO/scripts
> fso_2pg.py
   fso_adj.py
   fso_check_ana.py
   fso_check_icbc.py
   fso_check_obs.py
   fso_da.py
   fso_err.py
   fso_forcing.py
   fso_impact.py
   fso_nl.py
   fso_plot.py
   china_common.py
   wrf_check_gfs.py
   wrf_obsproc.py
   wrf_prod.py
   wrf_real_ana.py
   wrf_real_icbc.py
   wrf_wps.py
```


- $FSO\acute{e}L\check{A}\acute{e}IJ\check{a}eT\check{r}a\check{e}\check{O}$, äzŃçz■eŁŖëąŃFSOéIJĄeĀĄĜĖĀd' ĜçŻDæŤŤræ■ăăĂĈ
- $\acute{a}L\check{a}\grave{e}_{ij}DAGs$, äzŃçz■DAGçŻDĀŁăë_{ij}äyŌăĥăeŤzăĂĈ
- $\acute{a}\check{R}\acute{r}\acute{a}L\acute{I}Airflow$, äzŃçz■AirflowăŖŖăŁĹăĂĈ
- $FSO\acute{e}ŁŖëąŃ\acute{a}tA\grave{c}I\acute{N}$, äzŃçz■FSOçşçzçşşëŁŖëąŃ\acute{a}tA\grave{c}IŃăĂĈ
- $FSO\grave{a}y\check{Z}\acute{a}Ł\grave{a}çşçzçşçŻS\acute{a}\check{O}\check{g}$, äzŃçz■FSOăyŻăŁ\grave{a}çşçzçşççŞéatçŻSăŌğăĂĈ
- $\acute{a}\check{z}\grave{g}\acute{a}S\acute{A}ç\check{Z}D\acute{a}\check{Z}_{\acute{a}}\grave{c}\grave{e}_{\acute{a}}S\grave{a}G\check{z}$, äzŃçz■FSOăżğăS\acute{A}çŻDëŁŞăĜăăŃçŻăăŤăĂĈ

èGşârŚeIJÀèèA₄ærĤæŮêUTC00æŮûåŠŇUTC12æŮûçŽĐGFSæŤræ■ōiijNäyŤærĤäyłæŮûåŁzèGşârŚå■Ů
GFSå■ŮYæŤĤ;èûrâ;ĤĤiijŽ/data1/raw/gfs/gfs.yyyymmddhh

```
cd GFS_PATH

> gfs.2018080112    gfs.2018080200    gfs.2018080212    gfs.2018080300

cd gfs.2018080112

> gfs.t00Z.pgrb2.0p25.f000    gfs.t00Z.pgrb2.0p25.f012    gfs.t00Z.
↪pgrb2.0p25.f024
    gfs.t00Z.pgrb2.0p25.f036    gfs.t00Z.pgrb2.0p25.f048    gfs.t00Z.
↪pgrb2.0p25.f060
```

èġĊætŊæTŕæ■ó

çŽóâL'■åšæIJL'çŽĎèġĆætNètĎæŮŽăŇĚæNñiiž

观测类型	数量	观测变量
全国地面气象自动站 (METAR)	约56000站	气温 (T)、气压(Ps)、 湿度(Q)、风 (U、V)
全国探空站 (SOUND)	共120站	气温 (T)、湿度(Q)、 风 (U、V)
全国风廓线雷达 (PROFILER)	共93站	风 (U、V)

1.эгЦæтНетДæУЗèÕàRÛ

èġĈætŊètĎæŮžéČ;éĜĜçŤlcrontabǎǒŽæŮűëŎűǎŔŮãǺĆ

1.1 ĀĲřēĲċĕġĊætĲNĕĲDæŮŽ

```
> */15 * * * * bash -c "python3.6 get-metar.py --root-dir /home/
↳data/raw/cimiss --time $(date -u +%Y%m%d%H%M --date '-30_
↳minute')" 1> /dev/null
```

ètDæÚZäzəxmlæŨĜäzúa■ŸäĆíiijÑærR15áŁEeŠşäyÄäyłæŨĜäzúuijŽ

```
> cd SURF_CHN_MAIN_MIN
> 201810282030.xml 201810282045.xml 201810282100.xml
```

(continues on next page)

4.1.2 DAGăŁăèj:

DAGÅLÆJ

```
cd $AIRFLOW_HOME/dags
```

ãĖDAG pythonĖĎŽæIJniiĴLfso-prod-v2.0.py,wrf-prod-v2.0.py)ãĤ;ãĖĖĕrĕçZõã;TăyN

```
ls -all
```

```
> fso-prod-v2.0.py      wrf-prod-v2.0.py
```

DAGǫſǵǣlJǵǣdǾǣdǔ

äžewrf-prod-v2.0.pyäyžä;ÑiijŃDAGåšžæIJñæEæđüäyžiiž

```
vim wrf-prod-v2.0.py
```

```
>default_args = {
'owner': 'airflow',
'depends_on_past': False,
'start_date': datetime(2018,8,01),      #äzzâŁąđijĂăĝNæL'ġèaŃçŽĎăŮěæIJS#
'end_date': datetime(2030, 12, 31),    #äzzâŁąđijĂăĝNçzŁă■ćçŽĎăŮěæIJS#
}
```

```
> dag = DAG(
'wrf-prod-v2.0', #dag_id
default_args=default_args,
user_defined_macros={ 'npe': 12 }, #èℓRëàÑèrěDAGæL'Ăă■ăèŁĆçĆzæTř
schedule_interval='00 06,18 * * *')
↪#äzžâŁaaŘrâĹáŮűéŰt'ii jŽærĴad'l'ăŇŮăžžăŮűéŰt'06ăŮűiii jŇ18ăŮű
```

```
> check_gfs_command = """
    ulimit -s unlimited \
    && cd /home/FSO \      #FSOäÿžçŽŒă;Ț
    && SINGULARITYENV_CURR_DATE={{ ts_nodash }} \
    singularity exec -e -B china_FSO:/FSO3.4 -B china_working:/gjx_
    ↪working -B china_static:/gjx_static -B /data1/raw/gfs:/gfs fso3.
    ↪simg ./scripts/wrf_check_gfs.py""" #
    ↪ăŖĖäÿžæIJžèŭă;ĎăÿŒăŒăžĺèŭă;ĎçžŖăŒžiiŷŇăĖŖăŖăL'■æŸŕăÿžæIJžçŽŒă;Țeŭă;ĎiiŷŇă
    ↪check_gfs.py
```

ǎŔĆèĂĈç;Śéąţ

<http://airflow.incubator.apache.org/tutorial.html>

4.1.3 AirflowâRrâLí

âRrâLí

AirflowâRrâLíèçRèaÑçlNâžRâNĖæNñ

```
>airflow webserver #âRrâLíèçRèaÑçlNâžRâNĖæNñ
>airflow scheduler #âRrâLíèçRèaÑçlNâžRâNĖæNñ
```

èçRèaÑçlNâžRâNĖæNñ scheduleriijL'ijNĖt' šet' çâIJlæNĖGâžæUúéU' èçRèaÑçlNâžRâNĖæNñ

çðaçRĖéatĕlçâRrâLíèçRèaÑçlNâžRâNĖæNñ webserveriijL'ijNĖt' šet' çâRrâLíèçRèaÑçlNâžRâNĖæNñ

AirflowâšžçâĀâš;äzd'

airflowçŽDæL'ĀæIJL'æL'gèaÑæš■ä;IJĖç;éIJĀèçAâIJlâš;äzd'èaÑäyNâóNæL'RiijNçTñéIçâRlĖç;IJNâž
airflowçŽDâš;äzd'æĀžçŽDæIĖçt'â;LçñçâRlçŽt'èçL'ijNâžçTlçŽDæIJL'æçCâyNâGâäyñijŽ

- testijŽ çTlâžŌætNĖrTçL'žâžçŽDæšRäytaskiijNäy■éIJĀèçAâ;IĖt'Uæžæúš
- run: çTlâžŌæL'gèaÑçL'žâžçŽDæšRäytaskiijNĖIJĀèçAâ;IĖt'Uæžæúš
- backfill: æL'gèaÑæšRäyIDAGiijNâijŽèçLâLĖççædRâ;IĖt'UæšçžijNæNL'â;IĖt'UæžæúšRæL'gèaÑ
- unpause: âRĖäyĀäyIDAGâRrâLíäyžâ;NĖaÑâžžâLâijNĖžYĖð'æYrâĖšçŽDijNæL'ĀäžçijŪâĖŽâóNDæ
- scheduler: èçŽæYræT'äy airflow çŽDĖçRèaÑçlNâžRiijNäyĀèLñæYrâIJlâRrâLíèçRèaÑçlNâžRâNĖæNñ
- clear: äyĖĖŽd'äyĀäžŽâžžâLççŽDçLúæĀâijNĖçŽæüäijŽèçl scheduleræIĖæL'gèaÑæš■èúš

äžŌäyLĖlççŽDâš;äzd'èažâžRâžšâRrâžçIJNâGžijNĖĀžäyçŽDæL'gèaÑæžâžRæYrĖçŽæüüijŽçijŪâĖ
scheduler æYrâIJlâRrâLíèçRèaÑçlNâžRiijNäyĀèLñæYrâIJlâRrâLíèçRèaÑçlNâžRâNĖæNñ

äyçäçN

1.

```
>airflow test dag_id task_id execution_date
```

çTlâžŌætNĖrTĖrēdag_idäy■çŽDtask_idèçŽäyĀäžžâLâijNâžççŽâžçæTĖrTæUúéU'
â;NâççijŽ

```
>airflow test fso-prod-00Z-v2.0 2-3-adj-backward 2018-08-16T08:00:00
```

2.

```
>airflow backfill dag_id -s start_date -e end_date
```

çTlâžŌâR■çŌUâšNĖæäĖĖæšRäyæUúâLzæL'ŪæšRæŏæUúéU' çŽDdagætAçlN,æšlæDRçŽDæYrstart

- real-icbc-prod

årEĠFS-36årRæŮüécĎæLěâIJž(gfs.*.f036)çŦlă;IJâRŇNâŇŮčşşçşçşçŹĎĎČŇæŽřâIJžwrfinput_d01,â■ŸæŦ

- wrf-prod

äžereal-icbc-prodă;ŮâĹřçŽĎwrfinput_d01ă;IJăyžâĹlăğNâIJžii;NâRŠâL'■écĎæLě24årRæŮüii;NéŦæŦ

fso-prod-v2.0

- check-obs, check-icbc, check-ana

æčĂæšëëĠCætĠNob.asciiăĂAâRŇNâŇŮĎČŇæŽřâIJžwrfinput_d01ăĂAçIJšâôĎâIJžwrfinput_d01.anaæŸřâĹ

- 1-data-assimialtion

äyL'çžŦ'ârŸâĹEâRŇNâŇŮii;Nâ;ŮâĹřâĹEæĎRâIJžwrfvar_output,ăĹIâ■Ÿăyž/china_FSO/fc/wrfinput_d01

- 2-1-nl-forecast

âĹEâĹNâzŮXaiijŇXbâijĂâğNèĤŽeâNéİđçžĤæĂğçğřâĹEĹ2årRæŮüă;ŮâĹřécĎæLěâIJžXfa,Xfb

- 2-2-comp-forcing

ëôaçŮŮécĎæLëèřřâũôäzëâRĹécĎæLëèřřâũôâržécĎæLěâRŸéĠRçŽĎæçřâžę

- 2-3-adj-backward

årEġécĎæLëèřřâũôâržécĎæLěâRŸéĠRçŽĎæçřâžęă;IJăyžâi;Ŧ' éŽRæĹâi;RçŽĎâĹlăĹAi;ii;NâR■âRŠçğřâĹE

- 3-fcst-err

æăžæ■ôăyď' æŇăi;Ŧ' éŽRçžŞæĎIJii;NëôaçŮŮécĎæLëèřřâũôâržâĹEæĎRâRŸéĠRçŽĎæŦRæĎŞæĂğăĂĈ

- 4-fso-impact

æĹĹécĎæLëèřřâũôâržâĹEæĎRâRŸéĠRçŽĎæŦRæĎŞæĂğă;IJăyžë;ŞâĤëii;NâĹĹ' çŦĹWRFDAăi;Ŧ' éŽRæš

- 5-fso-plot

éĠĠçŦlæŦřæ■ôăžŞæŮžâi;Râ■ŸâĈlăŠŇâĹEçşşçşşëôaçĠCætĠNèŦ' açŇôçŮŮii;NâžúçŦlăžŮçžŸâŽ;ăĂĈ

4.1.5 FSOçşşçşçşç;ŠéatçŽŠæŮğ

éĠĠçŦlăşžăžŮPythonèr■ĹĂçŽĎAirflowætAçĹŇçŮaçRĤè;řäzúii;NâržâôĎæŮüèĤRëâŇçŽĎFSOă;IJăyŽe
prod-00Z-v2.0ii;NçČžâĠřäžëèĤŽâĤëă;IJăyŽeřæČĤéatĹĈii;NŹScheduleâĹŮæŸçď' žçŽĎæŸřă;IJăyŽeĤRë
06 * * *
“ealçď' žæřRâďĹ'06æŮüçŽĎ00âĹEâRřâĹlă;IJăyŽeĤRëâŇii;NRecent

TasksâĹŮæŸçď' žă;IJăyŽeĤRëâŇçĹŮæĂAi;ii;Näžëăy■âRŇécIJèĹ'şëalçď' žăy■âRŇèĤRëâŇçĹŮæĂAi;ii;NâçCæŮ
RunâĹŮâRřäžæşëçIJNæIJĂèĤŞëĤRëâŇæŮüèŮŦ' ii;NĹlinksâĹŮæRĹă;ŽăyĂăžŽâĤŇæ■üçŽĎæŞ■ă;IJæŇĹ' éŠŮ

âIJăyĹăyĂéatĹĈcäy■éĂŽèĤĠçČžâĠžDAGâĹŮăy■çŽĎæŞRăyĂă;IJăyŽâR■çğrii;NâRřäžëèĤŽâĤëèëă;IJ
Viewii;Nâüëă;ğæŸřâšŦăi;NĂçŽĎ■RăzzâĹai;ii;NâRşă;ğæřRâĹŮârRæŮžâĹŮæŸřăy■âRŇæŮüèŮŦ' èĤRëâŇçŽĎ

çČžâĠžăyĹăŽ;ăy■çŽĎGraph ViewèğEâŽ;ii;NâRřäžëæŸçď' žă;IJăyŽăy■âRĎăyĹăžžâĹæŮŦ' çŽĎă;ĹèŦŮ
LogæŇĹ' éŠŮâRřäžæşëçIJNèřëăžžâĹAçŽĎèĤRëâŇæŮüèŮŮâĂĈă;ŞâĠçžŮŮèŦŽëřræŮüâRřäžëæşëçIJNéŦŽëř

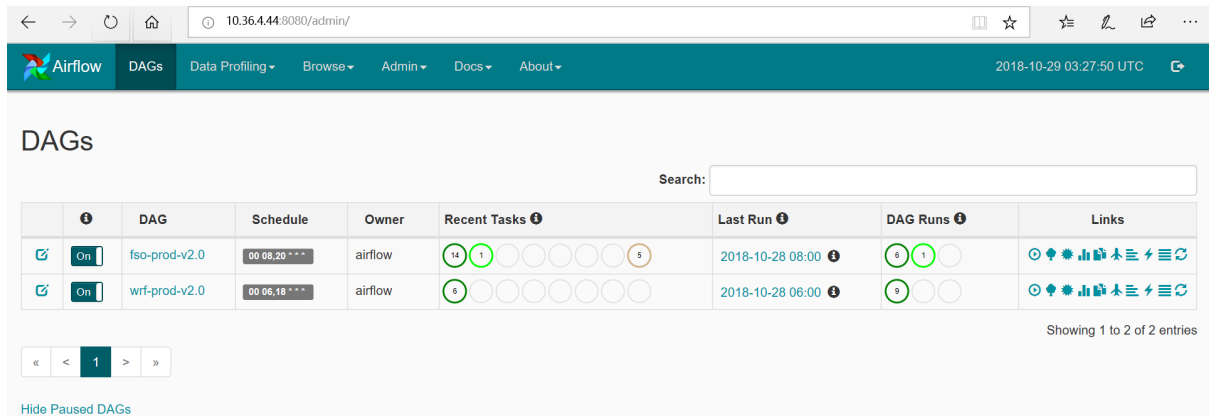


Fig. 1: FSOçşzçzşä;IJäyŽçóaçŘĚéąłÉł

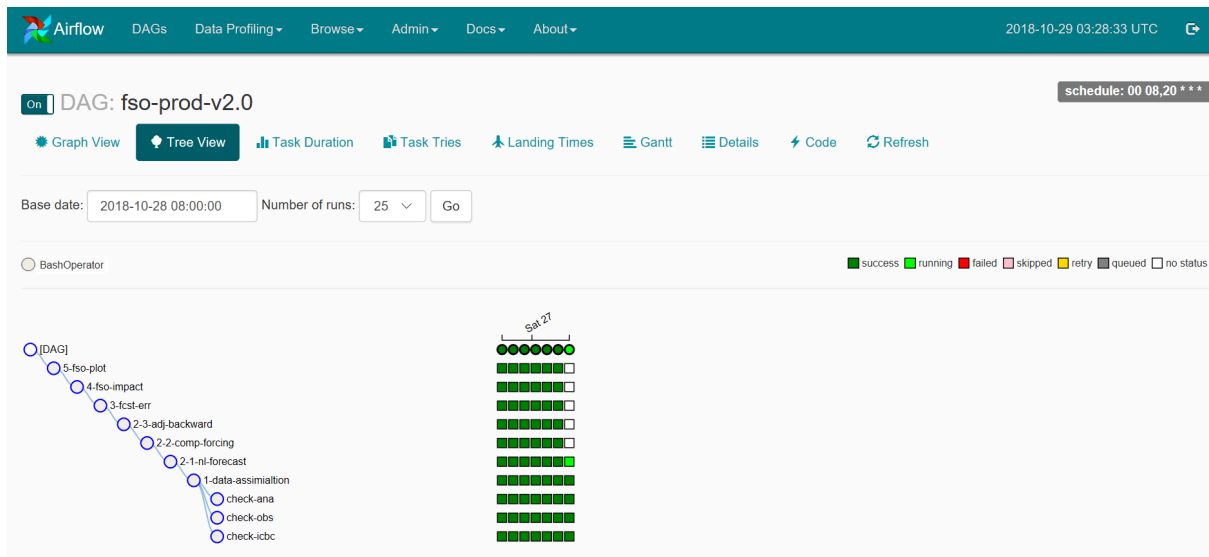


Fig. 2: äıIäÿŽæıAçıNçŽDæăȘçŁúçzȘæđDăŽı

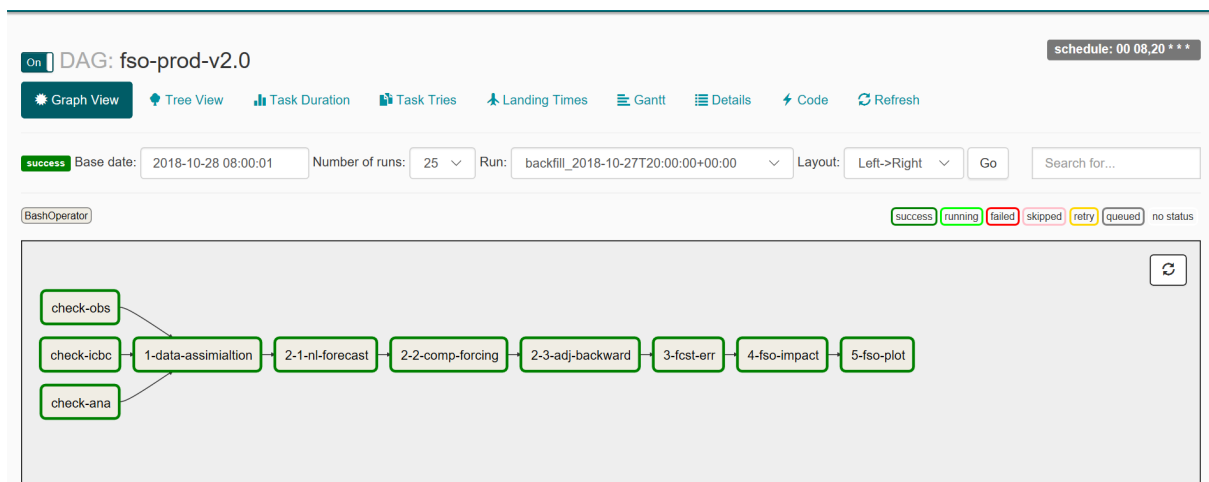


Fig. 3: äꞤIJäyŽæɫAçĺNăꞤİèɫŪăĖșçșzăZꞤ

FSOçşzçzşèöaçöŮa; ŮaŁřcŽĎécĎæŁèerrâuôaržèġCætNæTRæĎšæĂğçzŞæđIä;■āžŎ/home/zwtđ/FSO/

[illegible]

çnnäYÄäYlçñZçCzæRŘäꞤZçŽDæTṛæ■ōäYlæTṛ # 1
 ↳äIJṛéÍcèĜlāLÍçñŽäZĚæŎcætŃāIJṛéÍcāsCæTṛæ■ōiijNæL'ÄäžæærRäYlæŮūāLzéĈ;ærRäYlçñZçC

æTṛæ■ōāžRāRū çszādNāăĜerĚ çžnāžę çzRāžę æṛTāŎN
 ↳èğCætŃāRŸéĜRucŽDèğCætŃāĀij uæŮṛæArācđéĜRiijŁO-BiijL'
 ↳èt'ĺăŏğçăĀiijĴqc) uèğCætŃèrrāũŏ uçŽDèt'açŃŏçŎĜ
 ↳èğCætŃāRŸéĜRvçŽDèğCætŃāĀij væŮṛæArācđéĜRiijŁO-BiijL'
 ↳èt'ĺăŏğçăĀiijĴqc) vèğCætŃèrrāũŏ vçŽDèt'açŃŏçŎĜ
 ↳èğCætŃāRŸéĜRtçŽDèğCætŃāĀij tæŮṛæArācđéĜRiijŁO-BiijL'
 ↳èt'ĺăŏğçăĀiijĴqc) tèğCætŃèrrāũŏ tçŽDèt'açŃŏçŎĜ
 ↳èğCætŃāRŸéĜRpçŽDèğCætŃāĀij pæŮṛæArācđéĜRiijŁO-BiijL'
 ↳èt'ĺăŏğçăĀiijĴqc) pèğCætŃèrrāũŏ pçŽDèt'açŃŏçŎĜ
 ↳èğCætŃāRŸéĜRqçŽDèğCætŃāĀij qæŮṛæArācđéĜRiijŁO-BiijL'
 ↳èt'ĺăŏğçăĀiijĴqc) qèğCætŃèrrāũŏ qçŽDèt'açŃŏçŎĜ \#
 ↳äYÄäYlçñZçCzçŽDäYÄäYlénYāžęāsCæTṛæ■ōäYžäYĀeāN

1	1SURF_	22.47	111.36	-888888.0000000	-1.0840874	
→	0.0000000	-88	1.1000000	0.0000000	0.	
→	1864257	0.0000000	-88	1.1000000	0.	
→	0000000	299.2500000	0.0000000	-88	2.	
→	0000000	0.0000000	-888888.0000000	0.0000000	-	
→	88	100.0000000	0.0000000	-888888.0000000	0.	
→	0000000	-88	-888888.0000000	0.0000000		

cñňäžŇäÿłčńŻćĆżæŘŘä;ŻćŽĎæŤřæ■őäÿłæŤř # 1

• • • •

æslüjŽsynopāĀships āĀbuoy āĀsurfaceiijLāÑĖāNñmetar) āĀ-
sonde_sfcāĀatamdar_sfc æŦræ■ōæäijâijRçŽyâRÑ

sound

```
sound çñŽçÇzäyĭæŦř # 1äyĭ

çññäyĀäyĭçñŽçÇzæRŘäçŽçŽDæŦræ■ōäyĭæŦř #5äyĭ
→æŦçætŦNāLř5äyĭäyĭ■āRÑēñŸāžæāśĆäyĭçŽDæŦræ■ō

çñŽçÇzāžRāRū āRÑäyĀçñŽçÇzæŦræ■ōāžRāRū çśzādNæāĠērĖ çžñāžę çžRāžę
→uçŽDëğÇætŦNāĀij uçŽDèt' açNōçŦŦ èt' lāŦğçāA(qc) uèğÇætŦNērāũō
→āLĖæđRāćđéĠR vçŽDëğÇætŦNāĀij vçŽDèt' açNōçŦŦ èt' lāŦğçāA(qc)
→vèğÇætŦNērāũō āLĖæđRāćđéĠR tçŽDëğÇætŦNāĀij tçŽDèt' açNōçŦŦ
→èt' lāŦğçāA(qc) tèğÇætŦNērāũō āLĖæđRāćđéĠR qçŽDëğÇætŦNāĀij
→qçŽDèt' açNōçŦŦ èt' lāŦğçāA(qc) qèğÇætŦNērāũō āLĖæđRāćđéĠR #
→äyĀäyĭçñŽçÇzçŽDäyĀäyĭēñŸāžæāśĆæŦræ■ōäyĭžäyĀèaÑ
→æŦççl' žæŦræ■ōèğÇætŦNāRŸéĠRäyĭzuāĀvāĀtāĀq

1      1      UPA      36.73      101.75      77100.0000000      -1.6704050
→      0.0000000      -88      1.2200000      0.0000000      -
→1.0998851      0.0000000      -88      1.2200000      0.
→0000000      287.3500000      0.0000000      -88      1.
→0000000      0.0000000      0.0071498      0.0000000      -
→88      0.0018132      0.0000000
```

æslüjŽsoundāĀatamdarāĀairepæŦræ■ōæäijâijRçŽyâRÑ

profiler

```
profiler çñŽçÇzäyĭæŦř # 1äyĭ

çññäyĀäyĭçñŽçÇzæRŘäçŽçŽDæŦræ■ōäyĭæŦř #2äyĭ
→æŦçætŦNāLř2äyĭäyĭ■āRÑēñŸāžæāśĆäyĭçŽDæŦræ■ō

çñŽçÇzāžRāRū āRÑäyĀçñŽçÇzæŦræ■ōāžRāRū çśzādNæāĠērĖ çžñāžę çžRāžę
→uçŽDëğÇætŦNāĀij uçŽDèt' açNōçŦŦ èt' lāŦğçāA(qc) uèğÇætŦNērāũō
→āLĖæđRāćđéĠR vçŽDëğÇætŦNāĀij vçŽDèt' açNōçŦŦ èt' lāŦğçāA(qc)
→vèğÇætŦNērāũō āLĖæđRāćđéĠR \
→#éçŦāžŦçççæŦçætŦNāžĖĀIJL' uāĀvāyĭd' çğ■èğÇætŦNāRŸéĠR

1      1      WND      20.00      110.15      1415.0000000      -9.0069802
→      -708.2427394      0      2.2000000      -6.3706098
→10.1899120      -1873.6202283      0      2.2000000      9.
→7260098
```

NoteiijŽpilotāĀaprofilerāĀageoamvāĀaqscatāĀapolaramvæŦræ■ōæäijâijRüyĀèĠr


```
#!/usr/bin/python
import psycopg2
conn = psycopg2.connect(database="fso", user="fso", password="fSO@2018
↵", host="10.36.4.44", port="5432")
```

```
fso-> \d tb_surface
```

Table "public.tb_surface"		
Column	Type	Modifiers
id	bigint	not null default nextval('tb_surface_id_seq'::regclass)
time	bigint	not null
stnid	character(8)	not null
lon	real	not null
lat	real	not null

Indexes:

"tb_surface_pkey" PRIMARY KEY, btree (id)

```
fso-> \d+ tb_surfacedata
Table "public.tb_surfacedata"
Column |          Type          | Modifiers | Storage | Stats target | Description
-----+-----+-----+-----+-----+-----
id      | bigint                 | not null  | plain   |               |
var     | character varying     | not null  | extended|               |
lev     | integer                | not null  | plain   |               |
pres    | real                   |           | plain   |               |
obs     | real                   |           | plain   |               |
inv     | real                   |           | plain   |               |
qc      | integer                |           | plain   |               |
error   | real                   |           | plain   |               |
inc     | real                   |           | plain   |               |
Indexes:
    "tb_surfacedata_pkey" PRIMARY KEY, btree (id, var, lev)
```

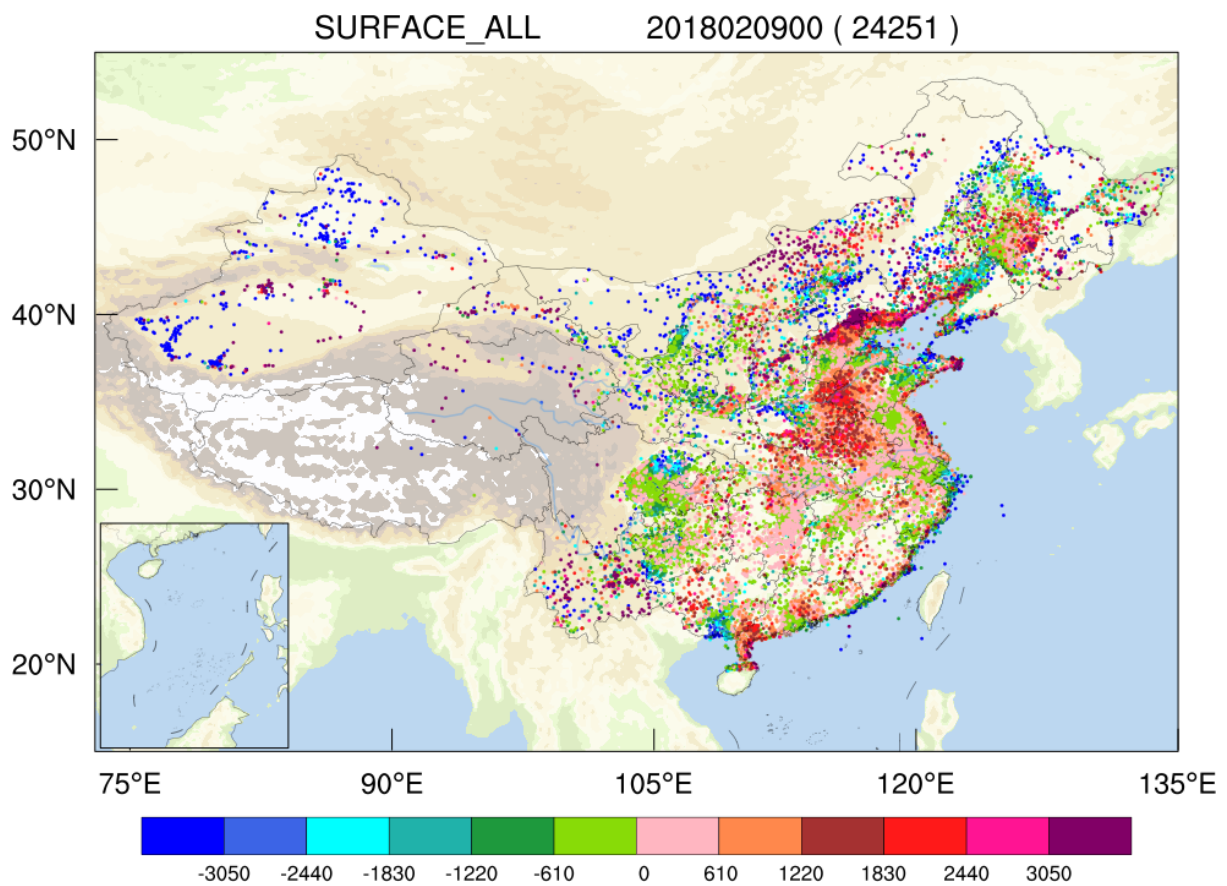



Fig. 7: âĬĤřéĬcèġĆæŦŇâřž12âřŔæŮůécĎæŁčèřřâůôçŽĎèŦ æçŇô

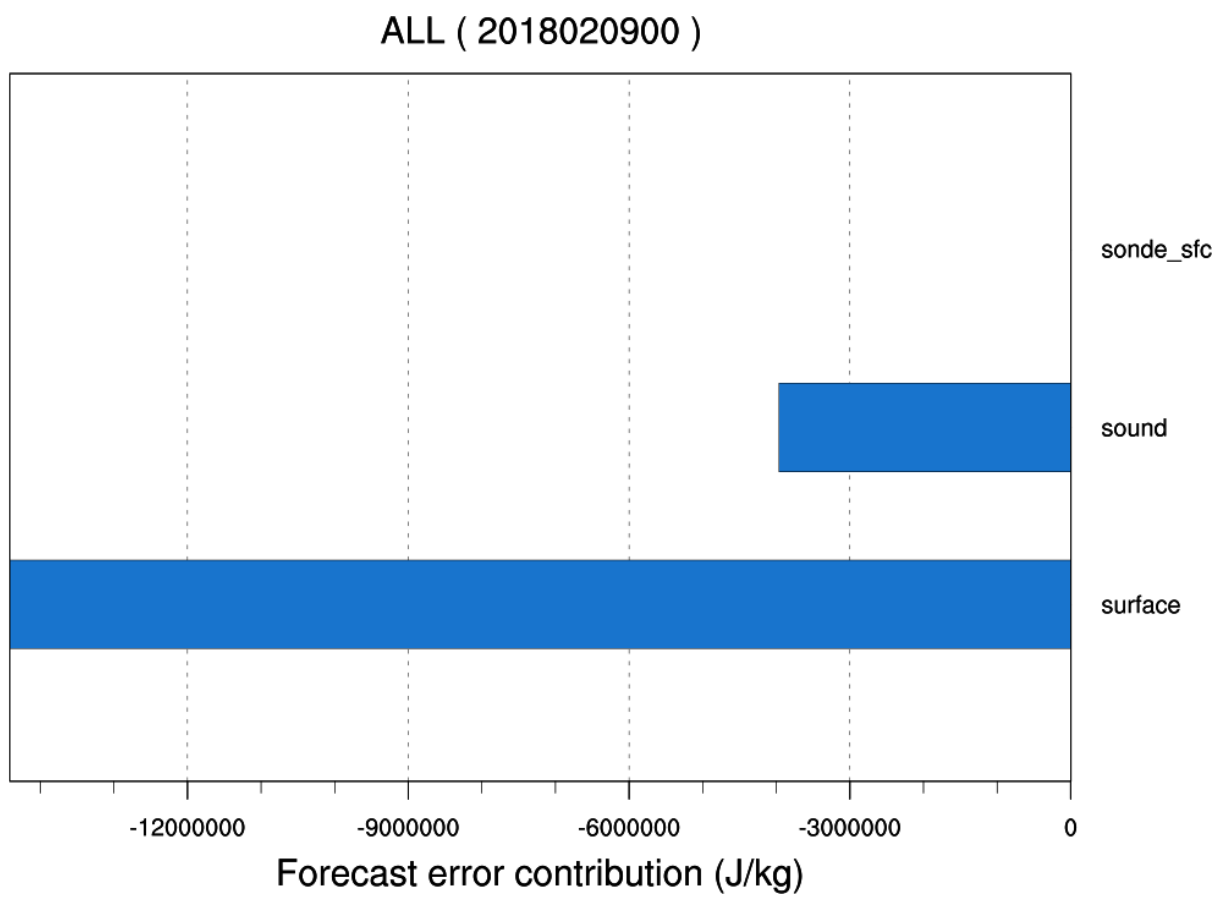


Fig. 8: èġĆæŦŃçśăđŅăřž12ăřRæŰűécĎæŁěèřăŰőçŽĎèt'ăçŃő

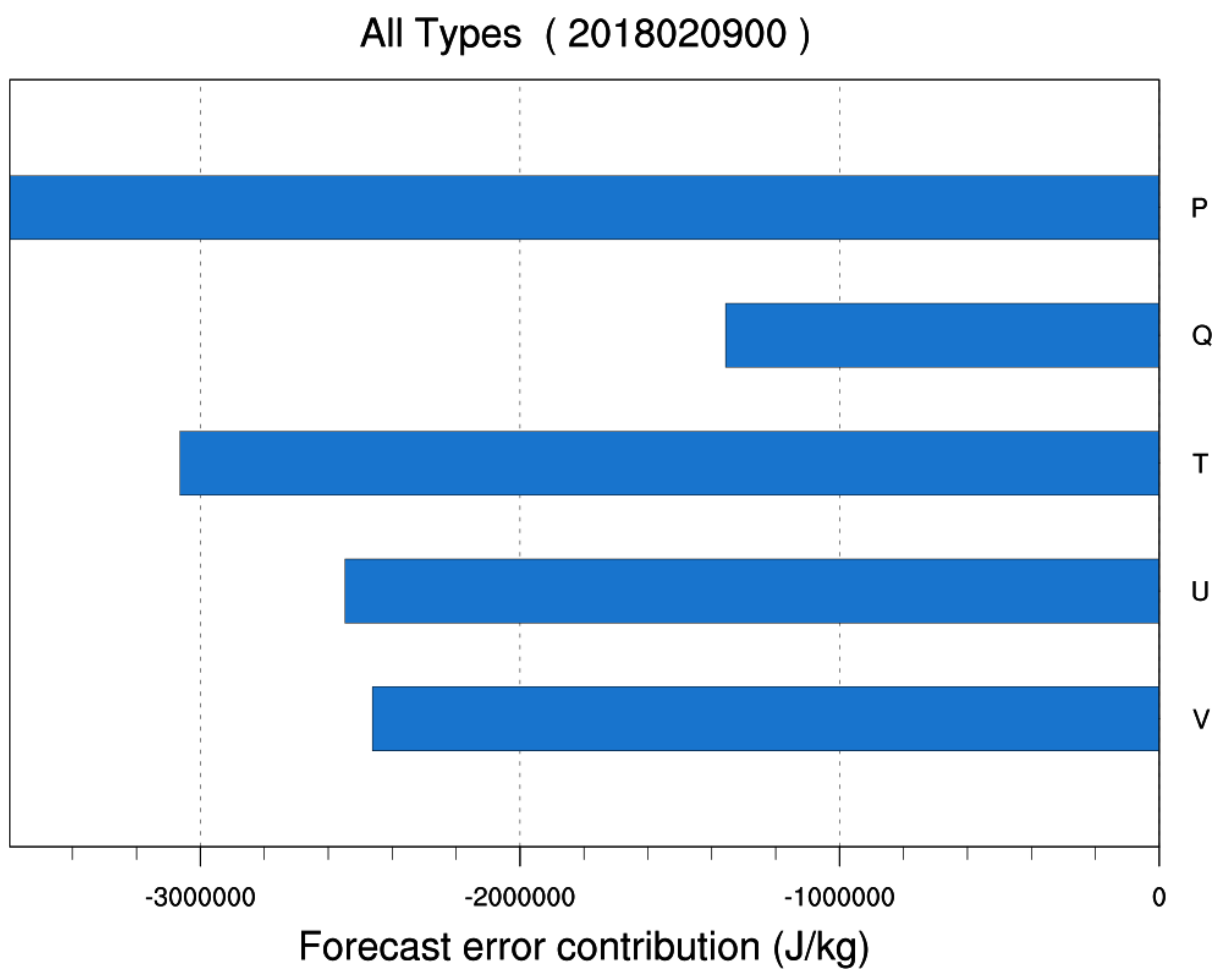


Fig. 9: řŘěĞŘčsžďŇărž12řŘæŮűćĎæŁěėřăũőčŽĎèt' ačŇó

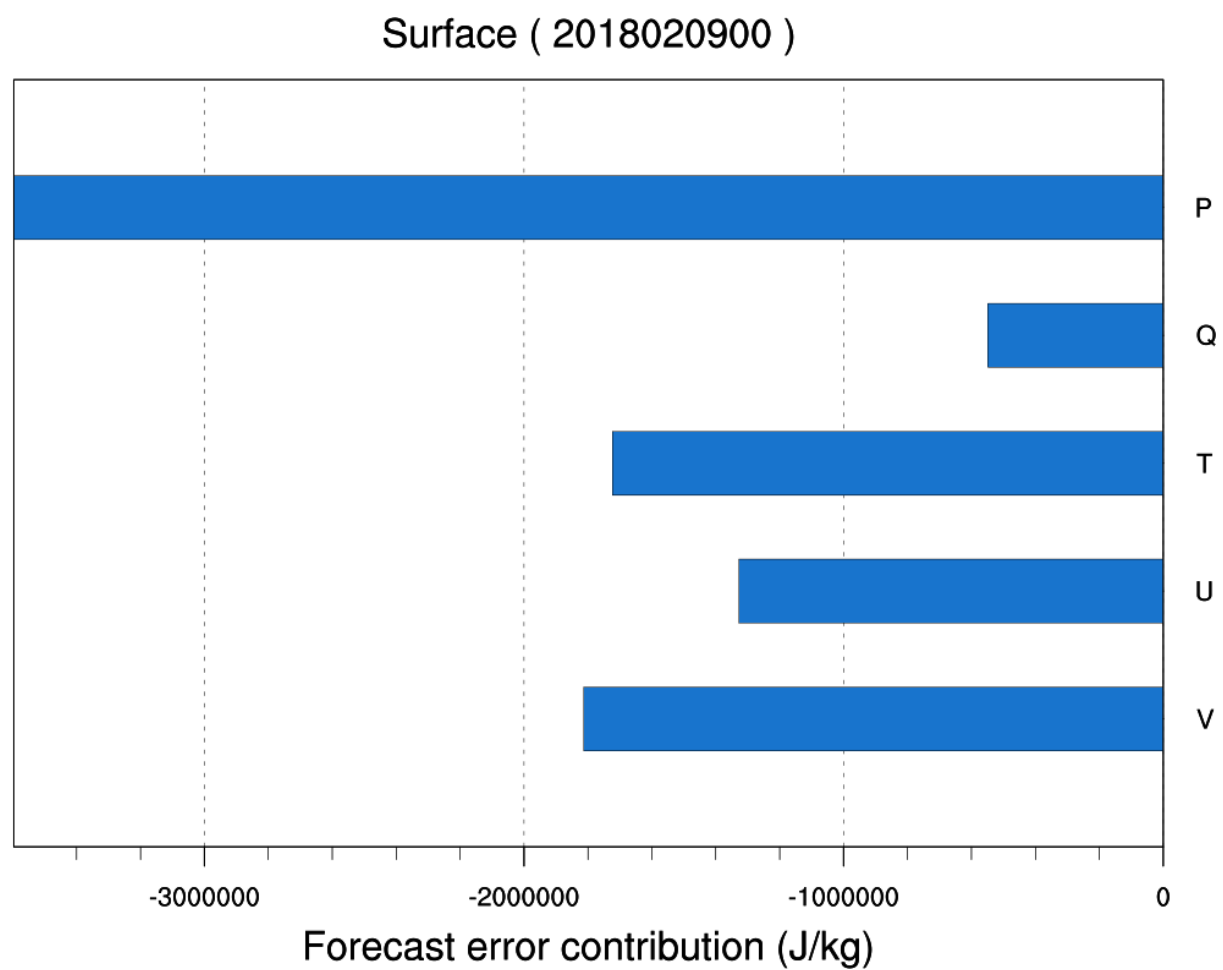


Fig. 12: ŕĲřéĲčĕğĲætŇčŽĎăŷ■ăŔŇĕğĲætŇăŔŸéĜŔărž12ăŕŔæŰűécĎæŁèėřăŭőçŽĎèŕ'ăçŇő

CHAPTER 5

æṬĚéŽIJad'DčŘĚ

5.1 åÿÿèġAæṬĚéŽIJad'DčŘĚ

å;ŞéAĞåŁřéŮóécŸæŮüüijNéçŮåĚŁæčĀæŞëäzzåŁaçŽĎlogüijNéĀŽèŁĠçČzåĠzåĠzèŤŽäzzåŁaüijŁtree
viewäÿNçŽĎçžcèL'såIŮüijL'ãĀČazëäÿNæŸřåRřèČ;åĠžçŮřçŽĎéŮóécŸüijŽ

5.1.1 èġCæṭNæṬřæ■óäÿŌæIaüijRèČNæŽřåIJæṬřæ■óçŽĎåóðæŮúèŮåRŮ

åIJřéIcåRřçñZæṬřæ■óåRŮèĠCIMISSäÿ■çŽĎSURF_CHN_MAIN_MINüijNçŽóåL'■äžŮFTPäÿLèŮåR
åŽ,1üijŽä;IJäÿŽåĠžçŮřéŮóécŸüijNæČäÿŁåŽ,äÿ■çŽĎçžcèL'såIŮüijNæĚüä;ŽézĎèL'såIŮæŸřçŤsäžŮçž
åçČæđIJèçAéĠ■æŮřèŁRřèaNæŞRäÿŁäzzåŁaüijNåRřäzèçČzåĠzåřzåžŤçŽĎèL'såIŮüijNçĎúåRŮóĀL'æŤ'Clean
åŽ,2üijŽéĀŽèŁĠçČzåĠzçžcèL'såIŮüijNçĎúåRŮóČzåĠzåijzæaEäÿ■çŽĎView
LogæŤL'éŞŮüijNæŞèçIJNæŮèåŁŮäžèåŁd'æŮ■åĚüä;ŞéŤŽèřřāĀČ

5.1.2 çčAçŽŸçŁ'zéŮt'äÿ■èŮşéŮóécŸ

AirflowäÿŽåŁaætAçÍNäÿ■åüšçzRæûzåŁääžEçclean-dataäzzåŁaüijNäijŽåóŽæIJşæÿĚçŘĚäÿ■éŮt'åŮĚåRş.