WATFLOOD® / CHARM™

Canadian Hydrological And Routing Model

Programmers Manual

SINCE 1972

Developed for

Surveys and Information Branch
Ecosystem Science and Evaluation Directorate
ENVIRONMENT CANADA

by

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WATFLOOD®/CHARM™ Programmers Manual

WATFLOOD is a registered trademark

CHARM is the acronym for Canadian Hydrological And Routing Model – registered trademark pending

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Surveys and Information Branch
Ecosystem Science and Evaluation Directorate
ENVIRONMENT CANADA

Contributors:

Tricia Stadnyk	wetland routing, tracers and isotope model
Tegan Holmes	tracers and isotope model
Todd Neff	evapo-transpiration model
John Donald	snow model
Frank Seglinieks	snow model
Ric Soulis	advisor to Todd Neff, John Donald & Frank Seglenieks

WATFLOOD overview

WATFLOOD has three distinct components:

CHARM*.exe – the hydrological and routing model

SNW*.exe, MOIST*.exe, RAGMET*.exe and TMP*.exe – point data to gridded data conversion

And then a host of data processing and conversion programs to ingest meteorological and hydrometric data.

The next page shows the complete list with links to the executables.

Following the list of executables are screenshots of the Solution Explorer in Microsoft Visual Studio showing the subroutines (s/r's) in each program

Downloading WATFLOOD code

The watflood code is released as open source with the GNU Lesser General Public License http://www.gnu.org/licenses/

The code may be downloaded by installing TortoiseSVN with the following folders on your computer:

Watflood\model

Watflood\utilities

Watflood\common

The setting the repository browser for each folder:

svn://watflood.uwaterloo.ca/watflood/model

svn://watflood.uwaterloo.ca/watflood/utilities

svn://watflood.uwaterloo.ca/watflood/common

You should then be able to checkout the code

Login is ‘anonymous’

Conditions

As a condition to accessing, modifying, using and distributing the WATFLOOD code you agree NOT to remove any license information and/or disclaimers in the WATFLOOD code – e.g.:

```
!**********************************************************************
!    Copyright (C) 1987-2018 by Nicholas Kouwen

!    This file is part of WATFLOOD (R)

!    WATFLOOD(R) is free software: you can redistribute it and/or modify
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!    any later version.

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!    You should have received a copy of the GNU Lesser General Public License
!    along with WATFLOOD.  If not, see <http://www.gnu.org/licenses/>.
!**********************************************************************
```
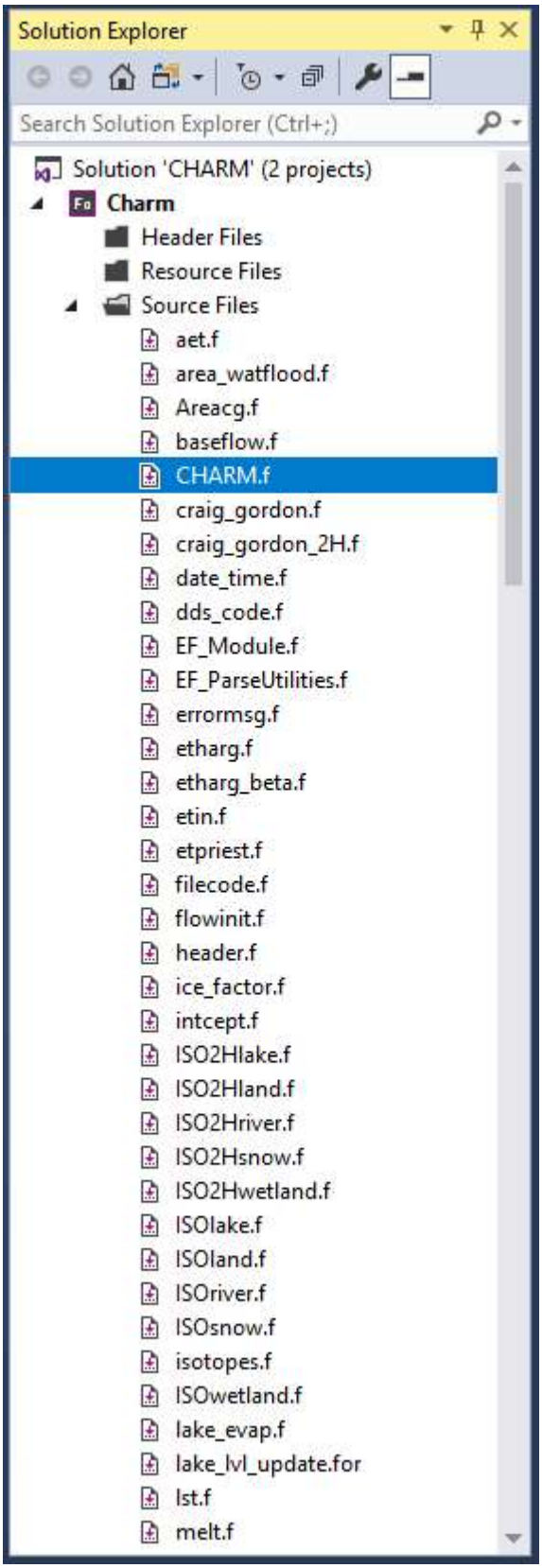

```
      print*,'DISCLAIMER'
       print*,'The WATFLOOD software and other material supplied'
       print*,'in connection herewith is furnished by N. Kouwen and the'
       print*,'University of Waterloo and is accepted by the'
       print*,'user upon the express understanding that N. Kouwen'
       print*,'or the University of Waterloo make no warranties, either'
       print*,'express or implied, concerning the accuracy, completeness,'
       print*,'reliability, usability, performance, or fitness for any'
       print*,'particular purpose.'
       print*
       print*,'The material is provided "as is". The entire risk as to'
       print*,'its quality and performance is with the user.'
      print*
       print*,'The forecasts produced by the WATFLOOD software are for'
       print*,'information and discussion purposes only and are not to'
       print*,'be relied upon in any particular situation without the'
       print*,'express written consent of N. Kouwen or the'
       print*,'University of Waterloo.'
      print*
```

WATFLOOD Components

Function	Executable
Watershed model	
CHARM64x & CHARM64d Download the model executables by agreeing to accept the Disclaimers in the WATFLOOD manual and those stated in the code.	To get CHARM x & d respectively: I accept & I accept the disclaimer
Utilities (WATFLOOD Manual)	manual
.map to _shd.r2c converter	BSN64X.ZIP BSN64D.ZIP
Snow course distribution	SNW64.ZIP
Soil Moisture distribution	moist64.zip
Precipitation distribution	ragmet64x.zip ragmet64d.zip
Temperature distribution	tmp64x.zip tmp64d.zip
Daily Temperature Differences	diff.zip
Event file generator	make_evt.zip
Dynamically Dimensioned Search - DDS http://www.civil.uwaterloo.ca/btolson/papers.htm	DDS_p.zip
WATFLOOD-DDS coupler	dds_wfld_rev5.zip
Statistical analysis	stats64.zip
Model setup & Env. Can. data conversion	Utilities_Manual.pdf
Selecting CCC climate stations	select
Convert CCC climate data to tb0 format	ECmet
Convert WSC HYDAT flow data to tb0 format	ECflw
Convert WSC HYDAT flow data to tb0 format	ECrel
Convert WSC HYDAT level data to tb0 format	EClvl
Disaggredation of Gridded Precipitation NEW	blend64x.zip blend64d.zip
Forecasting	Flow_Forecasting_Manual.pdf
Create bat files for downloading CaPA, Regl & Glb forecasts & WSC provisional flows	run_daily
Convert CMC Regl. forecast to watershed r2c format	regl_conv.zip
Convert CMC glb. forecast to watershed r2c format	glb_conv.zip
Convert WSC downloaded provisional flows to tb0 format	wsc_rt.zip
File conversion - old to new formats	TRNS.ZIP FLI.ZIP (not supported) RTE.ZIP (not supported)



CHARM program components

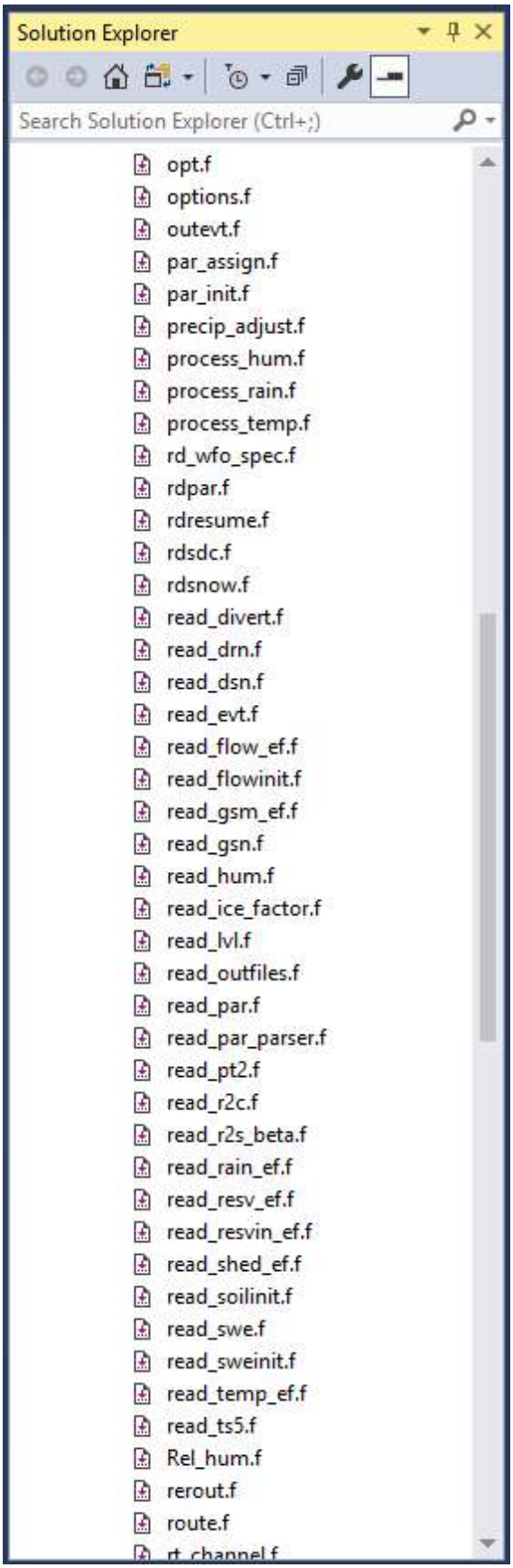
CHARM is the hydrological model.

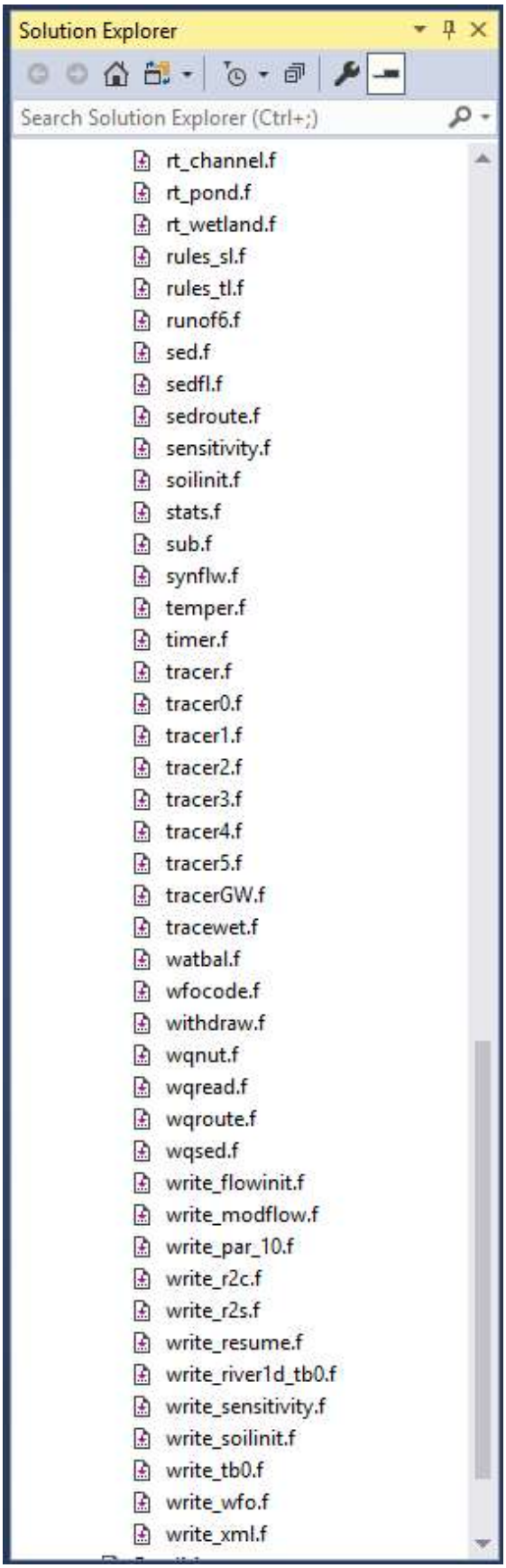
Three charts show the subroutines making up CHARM

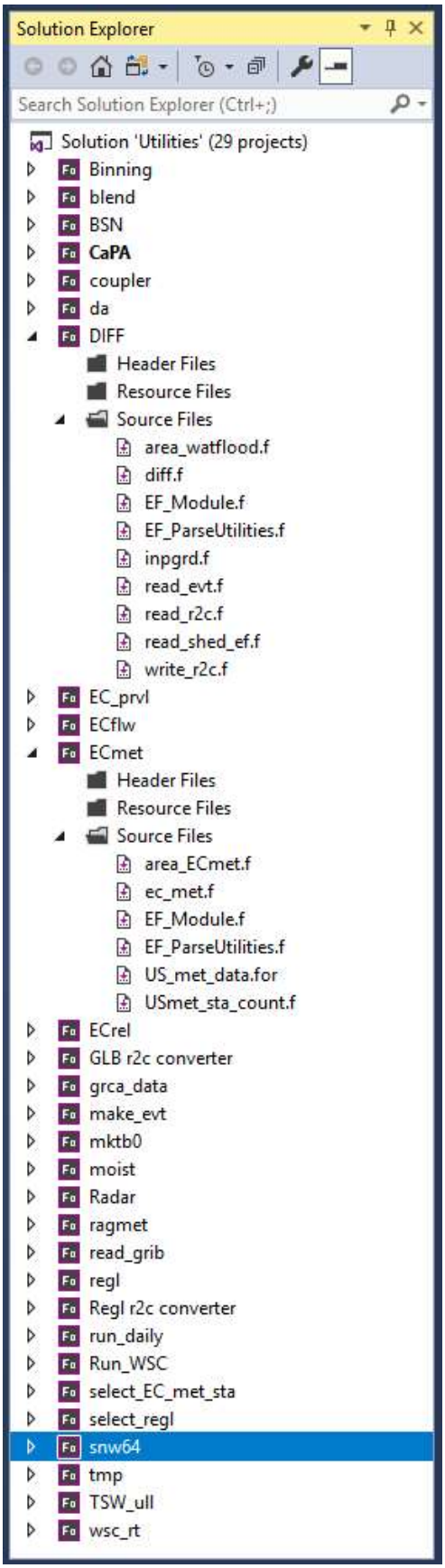
Two s/r's EF_Module.f and EF_Parse_utilities.f were written by Dave Watson at NRC as part of the effort to make all (or nearly all) WATFLOOD data files adhere to the Green Kenue formats. Some files were just not amenable to this – e.g. the event files and parameter files so these were left as text and Csv files. These modules are used by most WAFLOOD programs.

The module area_watflood.f is used by most WATFLOOD programs. Many of the utility programs are composed of the s/r's in the "common" folder.

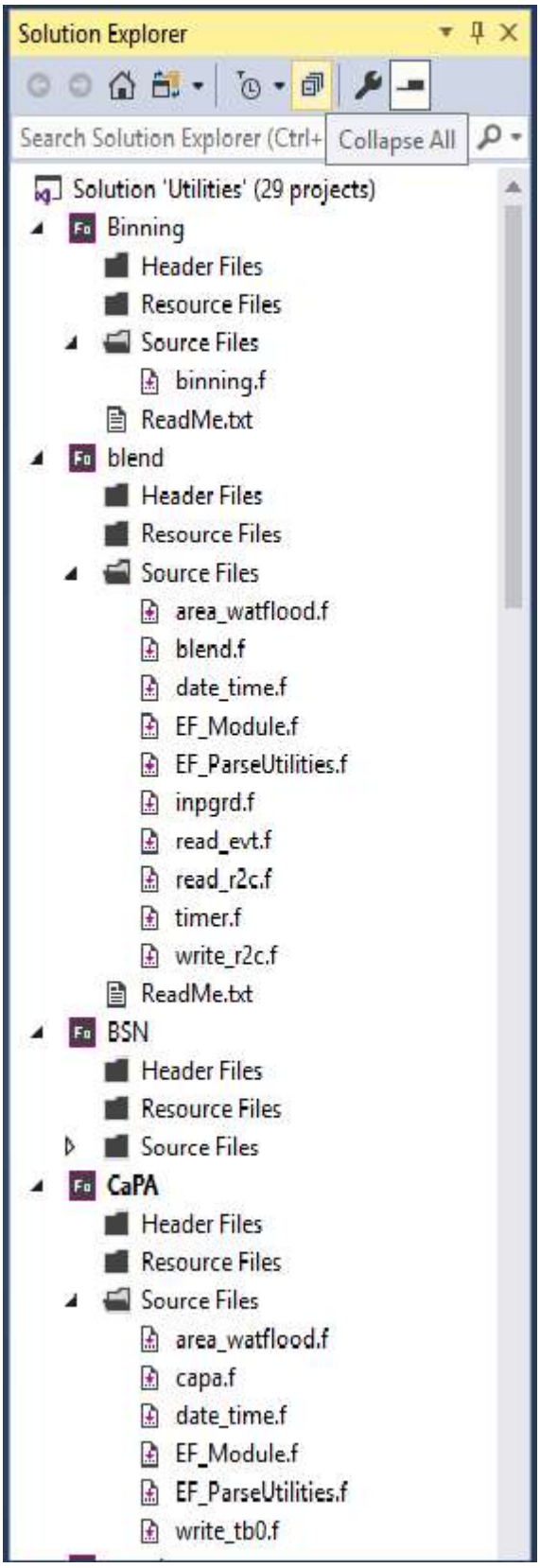
The craig_gordon.f and iso*.f s/r's are for the isotope models

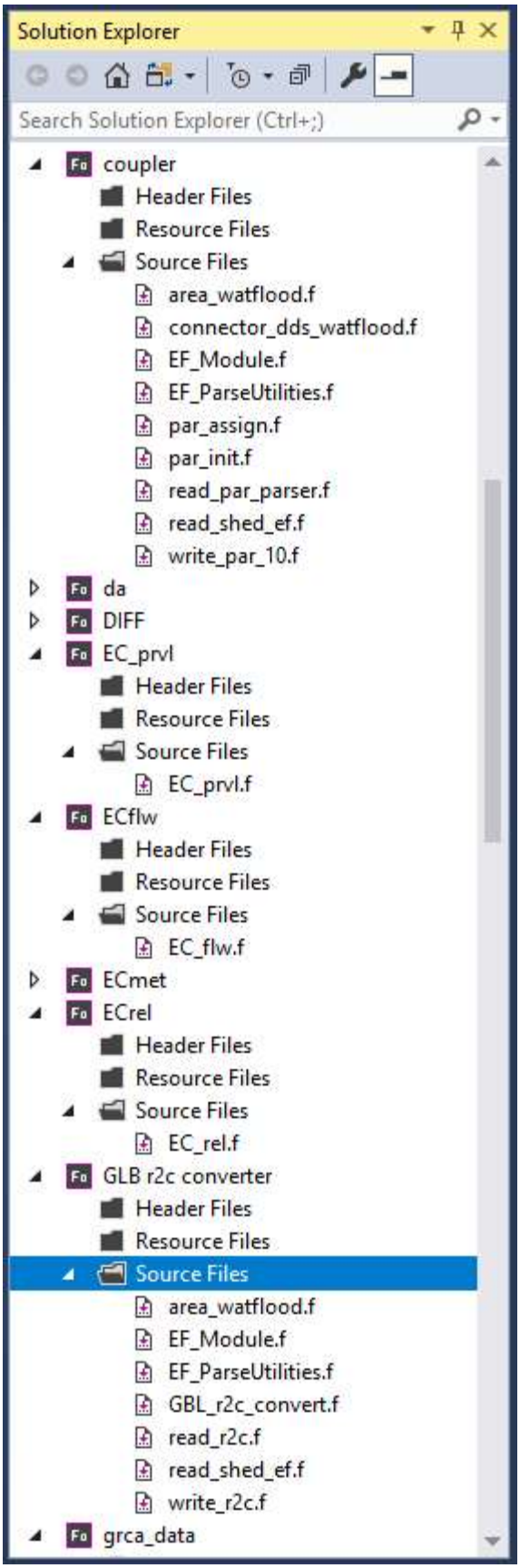

Solution Explorer
Search Solution Explorer (Ctrl+;)
opt.f
options.f
outevt.f
par_assign.f
par_init.f
precip_adjust.f
process_hum.f
process_rain.f
process_temp.f
rd_wfo_spec.f
rdpar.f
rdresume.f
rdsdc.f
rdsnow.f
read_divert.f
read_drn.f
read_dsn.f
read_evt.f
read_flow_ef.f
read_flowinit.f
read_gsm_ef.f
read_gsn.f
read_hum.f
read_ice_factor.f
read_lvl.f
read_outfiles.f
read_par.f
read_par_parser.f
read_pt2.f
read_r2c.f
read_r2s_beta.f
read_rain_ef.f
read_resv_ef.f
read_resvin_ef.f
read_shed_ef.f
read_soilinit.f
read_swe.f
read_sweinit.f
read_temp_ef.f
read_ts5.f
Rel_hum.f
rerout.f
route.f
rt_channel.f


Solution Explorer
Search Solution Explorer (Ctrl+;)
rt_channel.f
rt_pond.f
rt_wetland.f
rules_sl.f
rules_tl.f
runof6.f
sed.f
sedfl.f
sedroute.f
sensitivity.f
soilinit.f
stats.f
sub.f
synflw.f
temper.f
timer.f
tracer.f
tracer0.f
tracer1.f
tracer2.f
tracer3.f
tracer4.f
tracer5.f
tracerGW.f
tracewet.f
watbal.f
wfocode.f
withdraw.f
wqnut.f
wqread.f
wqroute.f
wqsed.f
write_flowinit.f
write_modflow.f
write_par_10.f
write_r2c.f
write_r2s.f
write_resume.f
write_river1d_tb0.f
write_sensitivity.f
write_soilinit.f
write_tb0.f
write_wfo.f
write_xml.f



Left: All utility programs





The descriptions and users manuals for each of the programs are in the WAFLOOD, Utilities and Flow Forecasting anuals

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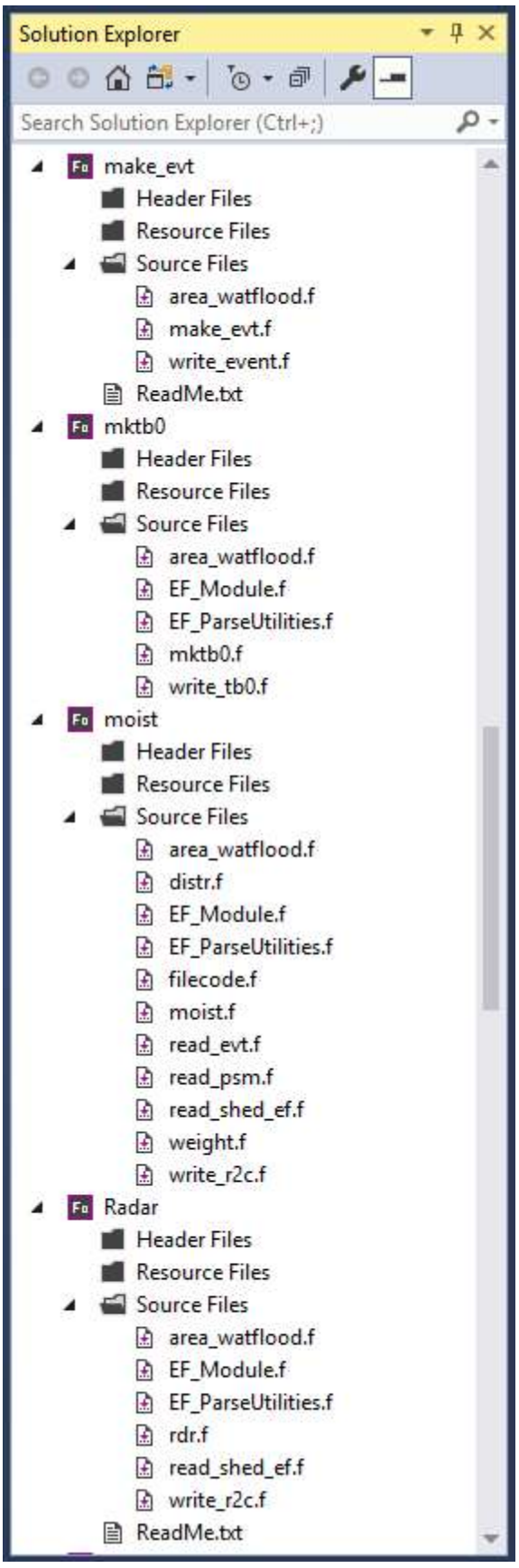
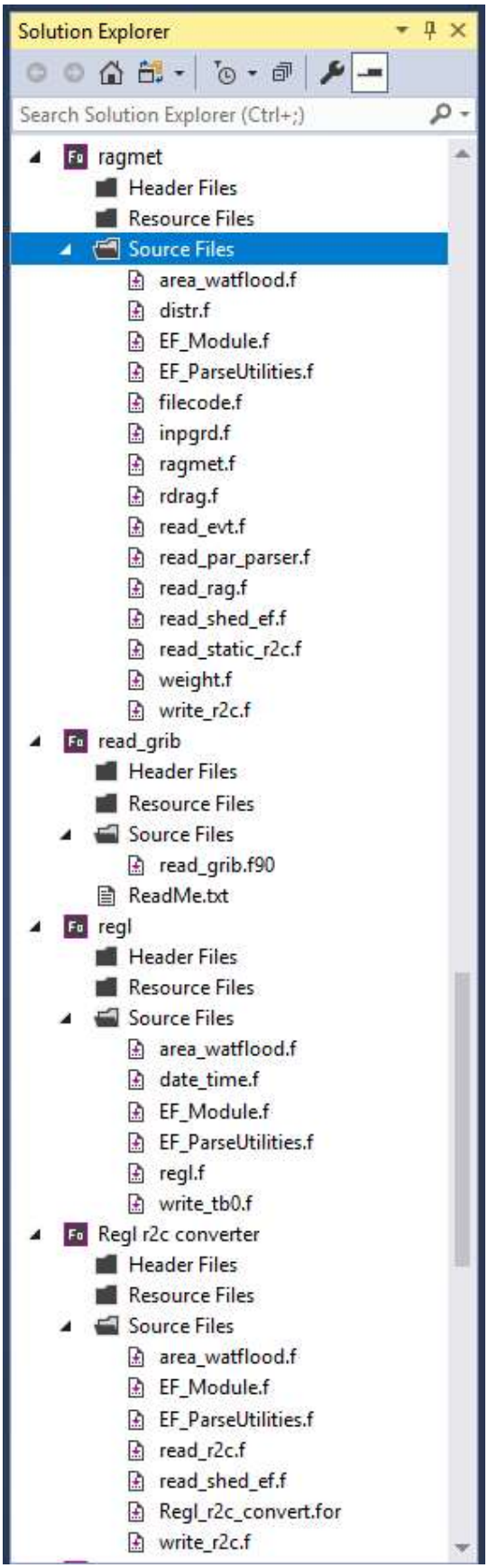
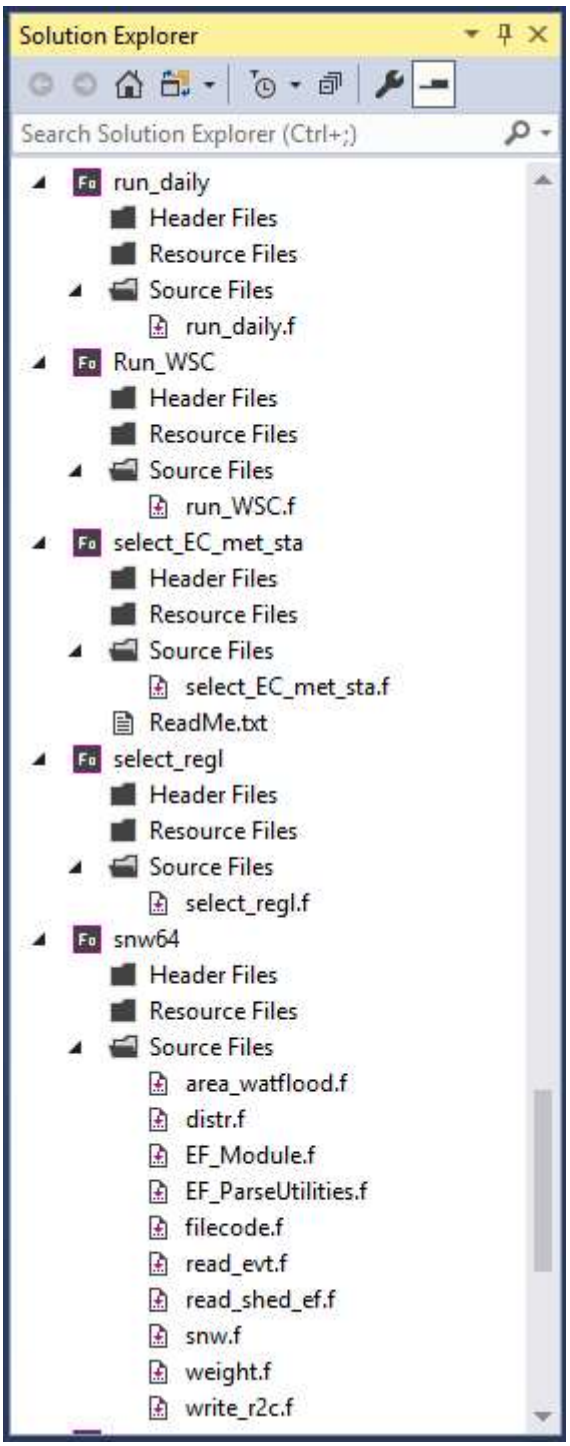
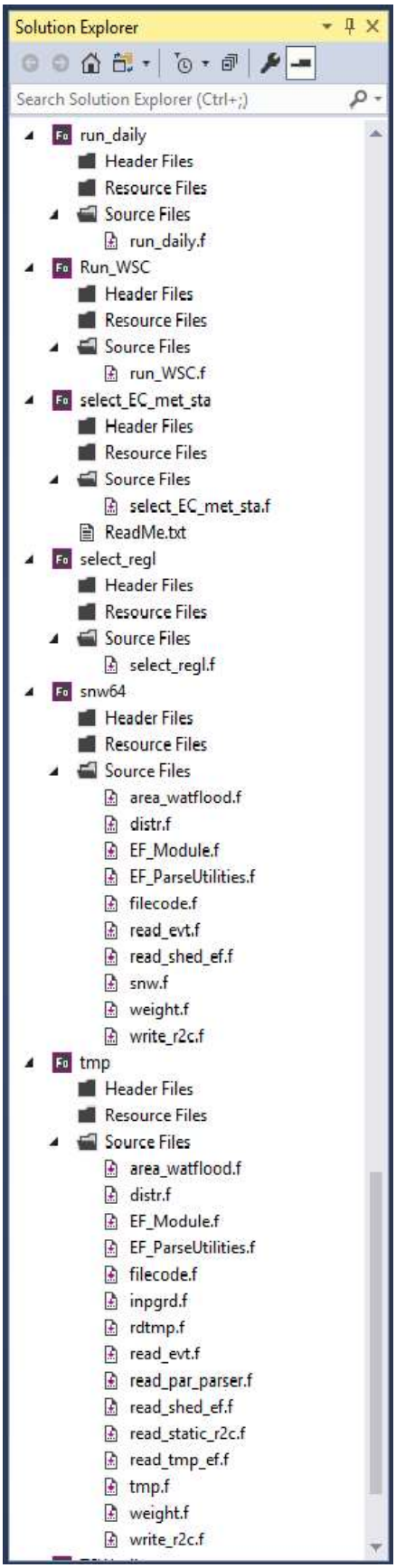

Solution Explorer
Search Solution Explorer (Ctrl+;)
make_evt
Header Files
Resource Files
Source Files
area_watflood.f
make_evt.f
write_event.f
ReadMe.txt
mktb0
Header Files
Resource Files
Source Files
area_watflood.f
EF_Module.f
EF_ParseUtilities.f
mktb0.f
write_tb0.f
moist
Header Files
Resource Files
Source Files
area_watflood.f
distr.f
EF_Module.f
EF_ParseUtilities.f
filecode.f
moist.f
read_evt.f
read_psm.f
read_shed_ef.f
weight.f
write_r2c.f
Radar
Header Files
Resource Files
Source Files
area_watflood.f
EF_Module.f
EF_ParseUtilities.f
rdr.f
read_shed_ef.f
write_r2c.f
ReadMe.txt


Solution Explorer
Search Solution Explorer (Ctrl+;)
ragmet
Header Files
Resource Files
Source Files
area_watflood.f
distr.f
EF_Module.f
EF_ParseUtilities.f
filecode.f
inpgrd.f
ragmet.f
rdrag.f
read_evt.f
read_par_parser.f
read_rag.f
read_shed_ef.f
read_static_r2c.f
weight.f
write_r2c.f
read_grib
Header Files
Resource Files
Source Files
read_grib.f90
ReadMe.txt
regl
Header Files
Resource Files
Source Files
area_watflood.f
date_time.f
EF_Module.f
EF_ParseUtilities.f
regl.f
write_tb0.f
Regl r2c converter
Header Files
Resource Files
Source Files
area_watflood.f
EF_Module.f
EF_ParseUtilities.f
read_r2c.f
read_shed_ef.f
Regl_r2c_convert.for
write_r2c.f


Solution Explorer
Search Solution Explorer (Ctrl+;)
run_daily
Header Files
Resource Files
Source Files
run_daily.f
Run_WSC
Header Files
Resource Files
Source Files
run_WSC.f
select_EC_met_sta
Header Files
Resource Files
Source Files
select_EC_met_sta.f
ReadMe.txt
select_regl
Header Files
Resource Files
Source Files
select_regl.f
snw64
Header Files
Resource Files
Source Files
area_watflood.f
distr.f
EF_Module.f
EF_ParseUtilities.f
filecode.f
read_evt.f
read_shed_ef.f
snw.f
weight.f
write_r2c.f


Solution Explorer
Search Solution Explorer (Ctrl+;)
run_daily
Header Files
Resource Files
Source Files
run_daily.f
Run_WSC
Header Files
Resource Files
Source Files
run_WSC.f
select_EC_met_sta
Header Files
Resource Files
Source Files
select_EC_met_sta.f
ReadMe.txt
select_regl
Header Files
Resource Files
Source Files
select_regl.f
snw64
Header Files
Resource Files
Source Files
area_watflood.f
distr.f
EF_Module.f
EF_ParseUtilities.f
filecode.f
read_evt.f
read_shed_ef.f
snw.f
weight.f
write_r2c.f
tmp
Header Files
Resource Files
Source Files
area_watflood.f
distr.f
EF_Module.f
EF_ParseUtilities.f
filecode.f
inpgrd.f
rdtmp.f
read_evt.f
read_par_parser.f
read_shed_ef.f
read_static_r2c.f
read_tmp_ef.f
tmp.f
weight.f
write_r2c.f