ccast intro and overview

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introduction

CCAST takes level zero data from the Cross-track Infrared Sounder (CrIS), a Fourier transform spectrometer on the Suomi NPP and JPSS weather satellites, and produce high-quality calibrated radiances. It is written primarily in Matlab, allowing for easy interaction, modification, and data visualization. We give a brief overview of the design, implementation, and use.

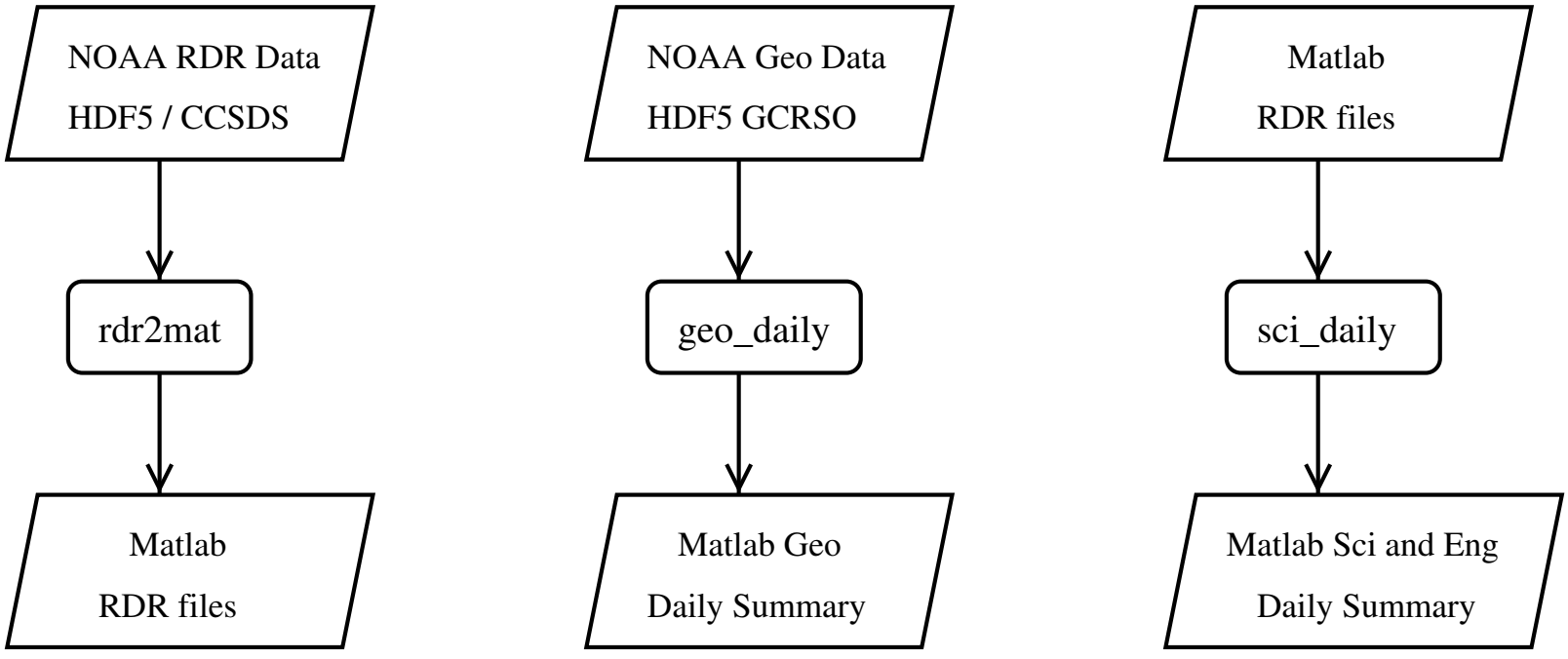
The authors of the UMBC CCAST are Howard E. Motteler, David Tobin, L. Larrabee Strow, and Dan Mooney, with interferometric parameters in spreadsheet form from Joe Predina.

CCAST is available as a GitHub public repository and is distributed under the terms of the GNU GPL v3.

history

- CCAST started as a collaboration between UMBC and UW in fall 2010, with major components from the 2007-2008 FM1 bench and TVAC tests.
- H. Motteler wrote the L1a processing, starting with Dan Mooney's RDR reader, and L. Strow, Dave Tobin, and H. Motteler all collaborated on the L1b
- this forked into a UW version with Fred Nagel's geo that got first light, and a UMBC version with NOAA geo that got the first high res obs a month later.
- in the summer of 2012 H. Motteler updated the UW code to run in the UMBC environment, and for some time maintained both versions while continuing to develop the UMBC branch.
- major portions of the UW branch, including ICT modeling and the non-linearity correction, were updated and merged into the UMBC branch.

preprocessing



main ccast processing

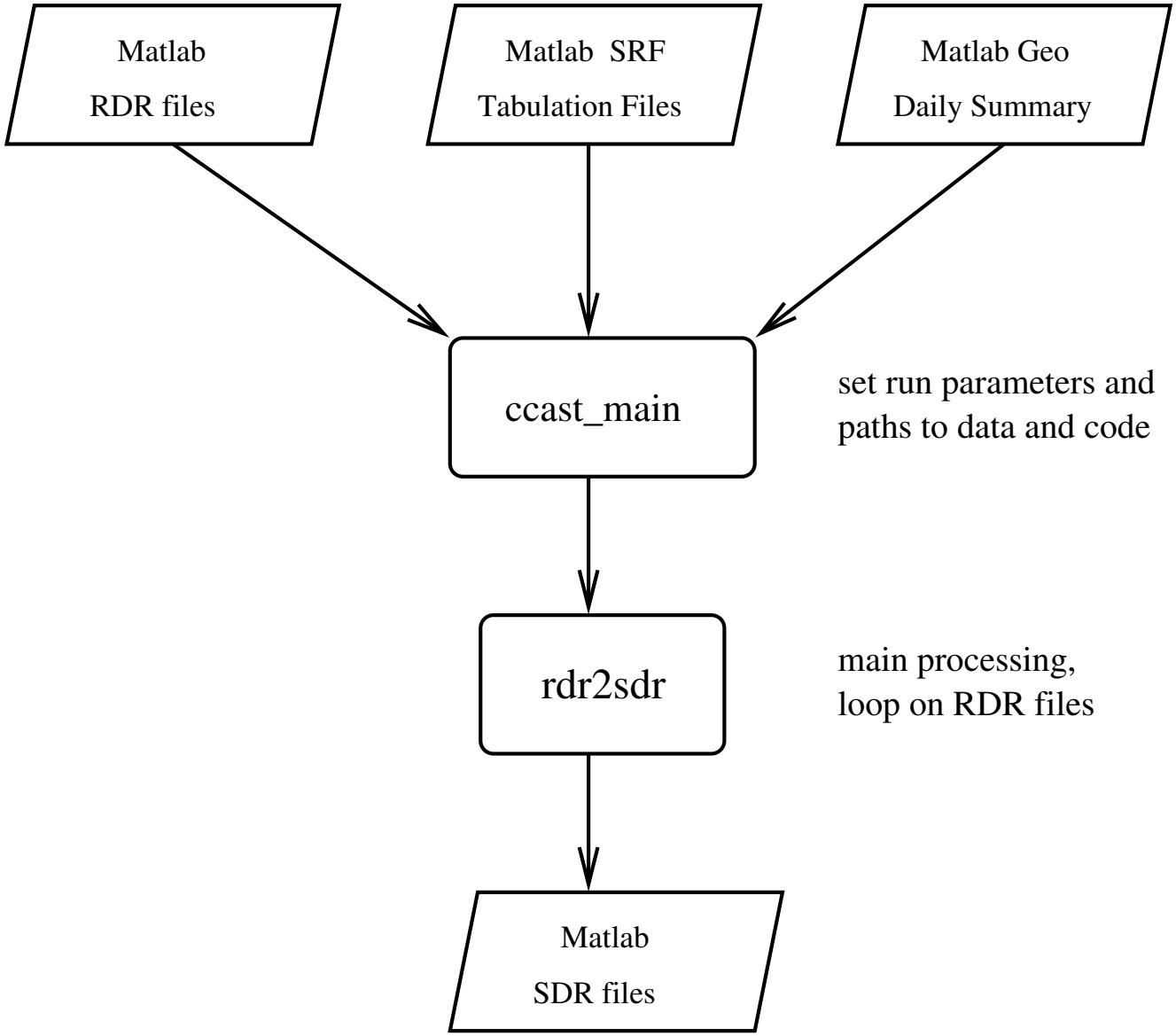
support

preprocessing

CCAST processing is done in two passes—the first takes HDF and CCSDS data to Matlab files, and the second takes the Matlab files to calibrated radiances. The preprocessing is done by ccast_prepro. The main steps are

- rdr2mat – read NOAA RDR files (CCSDS level 0 data with an HDF-5 wrapper) and produce Matlab RDR files, our working level 0 format.
- geo_daily – read NOAA GCRSO HDF-5 geo files and produce a daily abstract of CrIS geo data, as matlab files.
- sci_daily – read Matlab RDR files and produce a daily abstract of "science" (8 second) and "engineering" (4 minute) support data, as matlab files.

main processing



main processing

ccast_main sets parameters and paths and calls rdr2sdr, which loops on Matlab RDR files, typically one day per call. The main processing steps in rdr2sdr are

- checkRDR – validate and order the RDR data
- scipack – process sci and eng packet data
- inst_params – user and sensor grid parameters
- igm2spec – take interferograms to count spectra
- scanorder – group data into scans
- geo_match – match GCRSO and RDR scans
- movavg_app – calculate moving averages
- calmain – radiometric and spectral calibration

design notes

Some high-level design choices reflect past expedience and incremental development.

- there is no granule structure, data is organized as sets of scans
- the NOAA RDR files can start and stop at any field of regard (FOR), and the output SDR files follow this organization.
- the translation to count spectra should be done later, right before taking moving averages
- there is no explicit quality control for the final calibrated product. There is extensive low-level data QC, and most output and working arrays are initialized with NaNs as a sanity check on processing
- the use of the geo summary files was originally meant to be temporary; the geo_match procedure could read the GCRSO files directly

performance

- CCAST produces high-quality calibrated radiances. Although it borrows significantly from the NOAA ATBD, key features such as the ILS, SA interpolation, and the form of the calibration equation were developed independently and in some cases have been adopted by other groups.
- runtime performance is very good. Running as a single task rdr2sdr processes 60-scan files at a rate of slightly less than one file per minute
- reliability is very good. We have repeatedly reprocessed all data from mission start with no problems.

to-do list

- continue to improve the documentation.
- regularize the output and expand the draft matlab_sdr.txt into more user-friendly data definitions
- vectorize the non-linearity correction and set non-linearity parameters in inst_params.
- add file spanning moving averages. This was on hold pending possible lower level regularization or the addition of a granule structure.
- add some QC for the final calibrated product, including the residual complex component from the calibrated radiances
- consider switching to a faster RDR reader. Dan Mooney's reader (with some local mods) has been very reliable, but is idiosyncratic and slow relative to the rest of the processing.

getting started

- to download the ccast repo
  git clone https://github.com/strow/ccast.git
- to update a local copy of the ccast repo
  git pull origin master
- see ccast/README for info on installation and testing, and for URLS to test data and sample SRF tabulations
- see ccast/doc for
  - ccast_intro.pdf – this document
  - ccast_eqns.pdf – ILS and main calibration equations
  - matlab_sdr.txt – output data format and fields
  - finterp.pdf – notes on Fourier interpolation