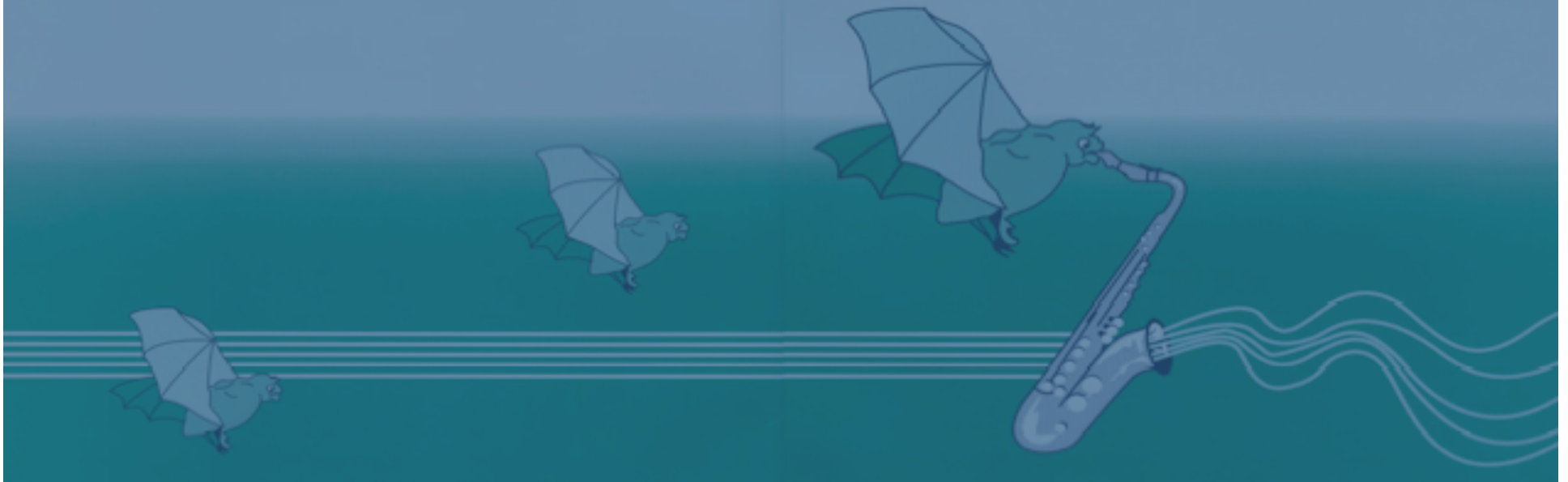


The BBOP Data Processing System: 1992 – 2009

A long-term study of oceanographic
radiometry



Philosophy

- Ocean optics data sets have huge potential for addressing oceanic biogeochemical variations.
- Calibration and validation of satellite ocean color sensors require fully processed ocean optics data.
- Must be available in a timely manner for investigators in other fields.

Philosophy (Continued)

- Goal: efficient, straight-forward processing of radiometric data.
- Addressed several characteristics, which made "final" products difficult to produce quickly:
 - many parameters are sampled at relatively high data rates (≥ 4 Hz).
 - many profiles (as many as 60) are often made in a single day.
 - recalculations are often necessary due to uncertainty of radiometric calibrations.

Philosophy (Continued)

- Final product of the BBOP processing system is a 1 m binned data set including relevant derived parameters that can be disseminated
 - upwelling or downwelling radiant fluxes extrapolated to the sea surface, $E_d(0^-, \lambda)$ or $L_u(0^-, \lambda)$
 - diffuse attenuation coefficient spectrum, $K_d(z, \lambda)$

Design

- Utilize existing methodologies
- All relevant metadata (calibration, at-sea comments, processing history, etc.) are contained within each data file
- Minimize human intervention
- Maximize the number of data quality assessment/assurance checks
- Enable the easy extendibility of the system for data sets of changing parameter diversity
- Produce all processed data sets in ASCII format
- Allow quick (and easy) looks of the data at several stages of processing
- Make each processing step self-documenting within the data file
- Work on present and future computer platforms

BBOP Format - File Creation

- At the heart of the BBOP processing system is the LCD file (least common denominator)
- An independent, self-contained unit with all pertinent headers, calibration information and processing history
- Originates from the raw data files created by the manufacturer's software (i.e. Biospherical Instruments, Satlantic)
- organized into five major sections separated by keywords in brackets (< >)
 - <cruise_info> consists of general information about the cast
 - <sampled_parameters> and <derived_parameters> contain a list of the contents of the data fields
 - <data>
 - <filters_used> a record of all BBOP programs applied to the file as well as any statistics output by the programs

- Example of LCD file

```
filename p031802aa.lcd
<cruise_info>
cruise b162
station b162.001
start_date 20020318
start_time 14:56:09
end_date 20020318
end_time 14:58:17
start_date_local_ast 20020318
start_time_local_ast 10:56:09
...
east_longitude -64.5692
west_longitude -64.5692
metadata_filename b162_metadata
calibration_files pro028.11ucsb_20020301,ref028.11ucsb_20020301
wave_height 1
cloud_percent 80
wind_speed 6.1
wind_dir 110
cloud_type stratocum
measurement_depth NA
secchi_depth NA
<sampled_parameters>
1lu324.2, 1lu339.8, ...
<derived_parameters>
solar_time_gmt, ...
<data>
0.17991001 0.39088424 ...
<filters_used>
bscalc, bbopkc, ...
```

BBOP Format - Filtering

- All processing of LCD files is performed by a suite of ANSI C++ programs (BBOP filters).
- The BBOP filters were designed to:
 - streamline record keeping
 - ease examination of data at intermediate steps
 - provide several levels of quality assessment

Filters used in the BBOP data processing system.

bbopstrip: extracts lcd data columns and writes them to a simple ascii file

bbopdespike: replaces spiked data with a mean of windowed points using forward first difference and/or slope difference

bbopdeflag: removes or keeps lines of data based on flag values in one data column

bbopangq: compares package angle data to a constant and writes a quality flag

bbopmovavg: smooths data using a moving window average

bbopbin: breaks the cast into profiles, sorts the profiles and averages data over depth intervals creating new lcd files for each profile

bbopmath: performs simple math operations

bboptrans: performs transformation operations (log, sqrt, sin, etc.) on data

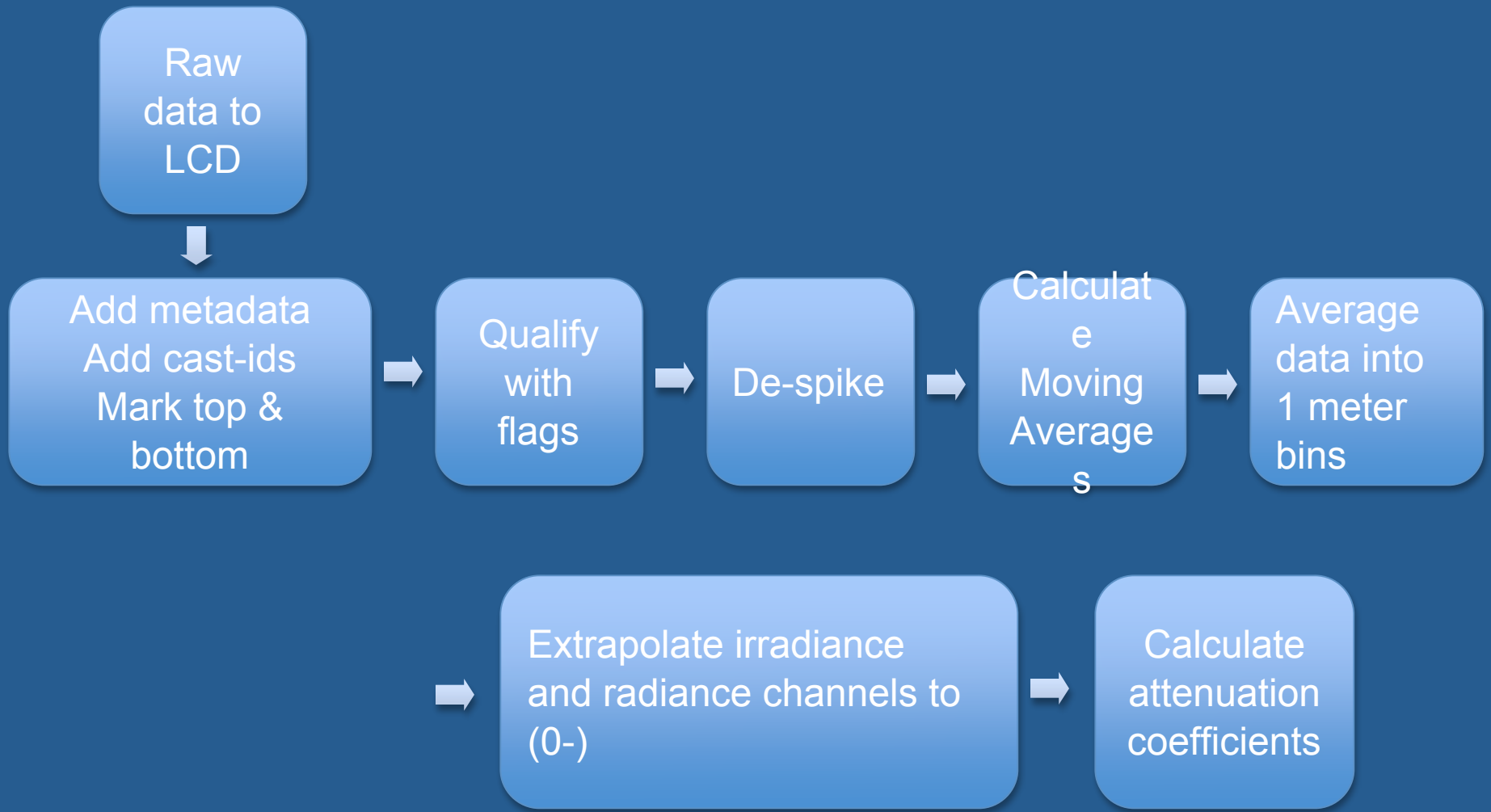
bbopradq: compares data to thresholds and replaces values below a threshold with flags

bbopkq: calculates changes in irradiance over a depth interval and writes a quality flag

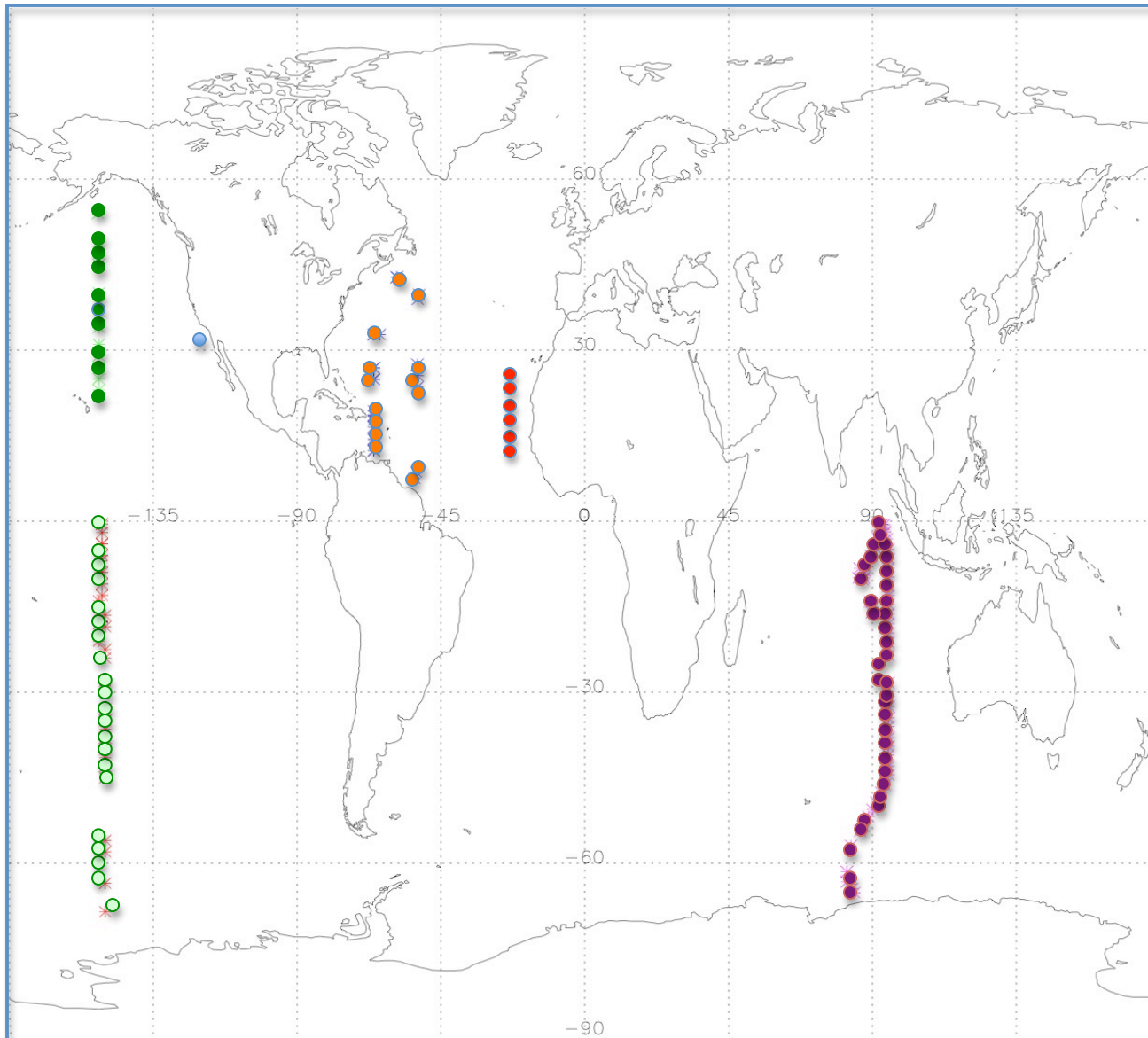
bscalc: extrapolates data to the sea surface ($z=0$ -) over a specified depth window

bbopkc: calculates diffuse attenuation coefficients from radiometric data

BBOP Processing Procedure

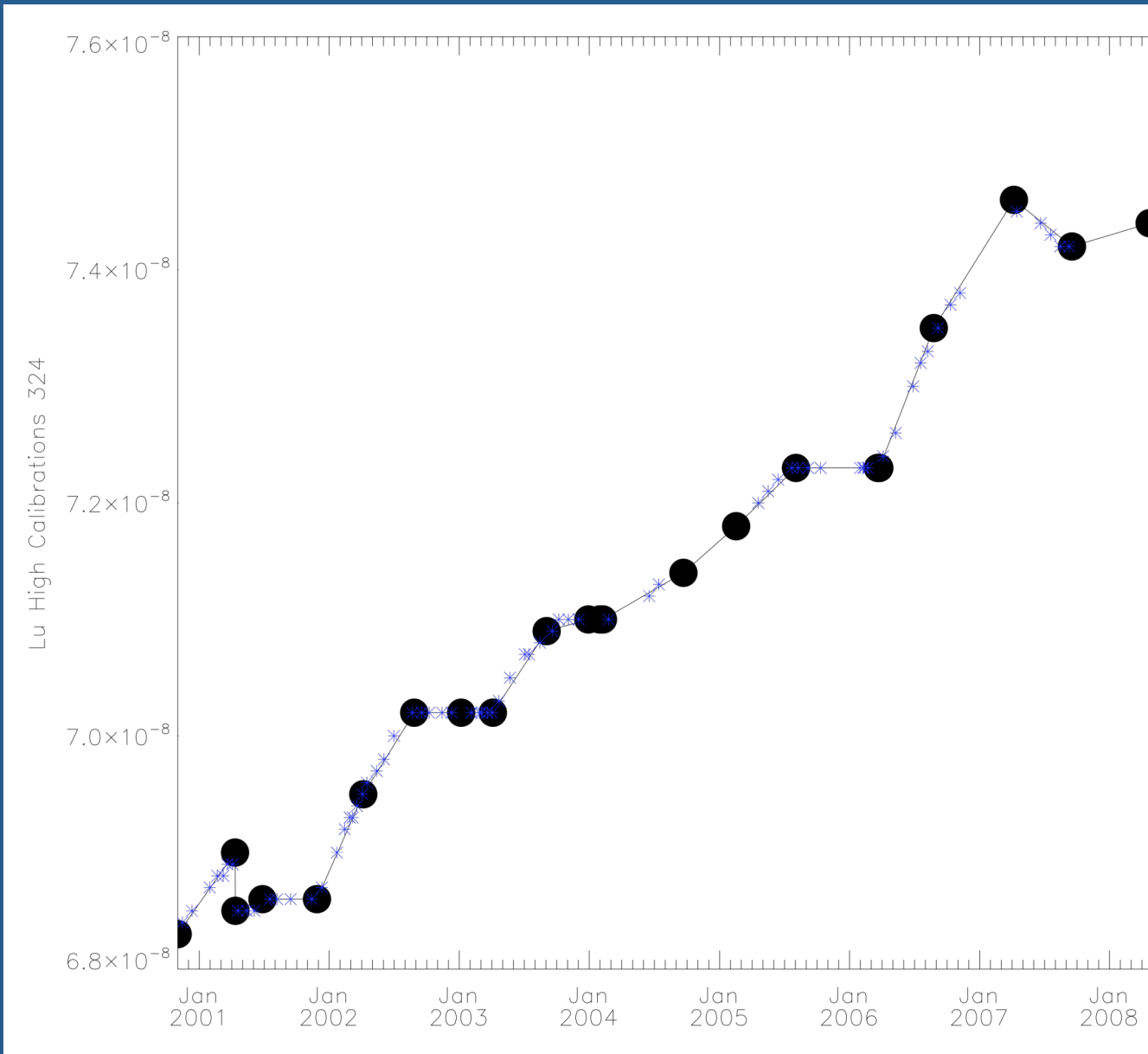


Additional Applications of BBOP Processing



- A20-A22
- AMMA
- P16 N
- P16 S
- I9N & I8S
- Plumes & Blooms

BBOP Calibration Process



- Calibration Event
- ★ Sampling Event

Coefficients for each cruise are interpolated between calibration events.

Concerns & Future Goals

- Optical calculations were decided upon > 10 years ago & need to be reassessed
- BBOP processing codes are mostly written in GNU G++ (needs to be replaced)
- Extracting the data from its raw format relies upon the manufacturer's software.
- Need for community standardization