

GEWEX Hydroclimate Panel – GHP

**Co-Chairs: Jan Polcher
Jason Evans**



The role of GHP within GEWEX

The GHP aims to address the GEWEX Science Questions from a regional and integrated perspective.

- Only at the regional scale can the water cycle be addressed from its physical to human and socioeconomic dimensions
- The Regional Hydroclimate Projects (RHPs) are an essential tool in this endeavour as they bring together various disciplines on water issues.
- The cross-cut projects allow GHP to propagate knowledge from one region to another and synthesize results at the global scale. They are science not region focused. They also allow development and testing of applications developed with the new knowledge.
(actionable science)

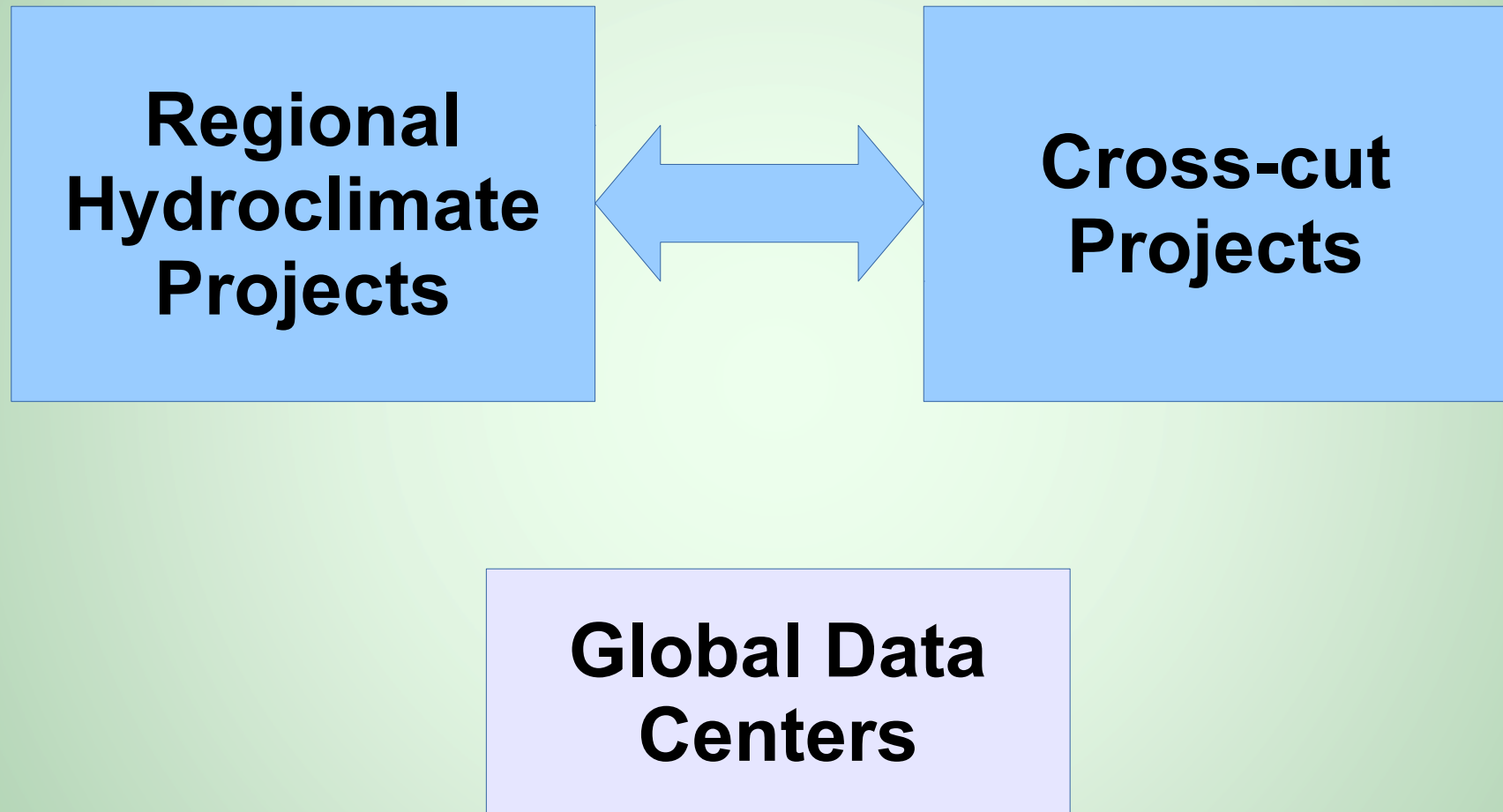
GHP Structure

**Regional
Hydroclimate
Projects**

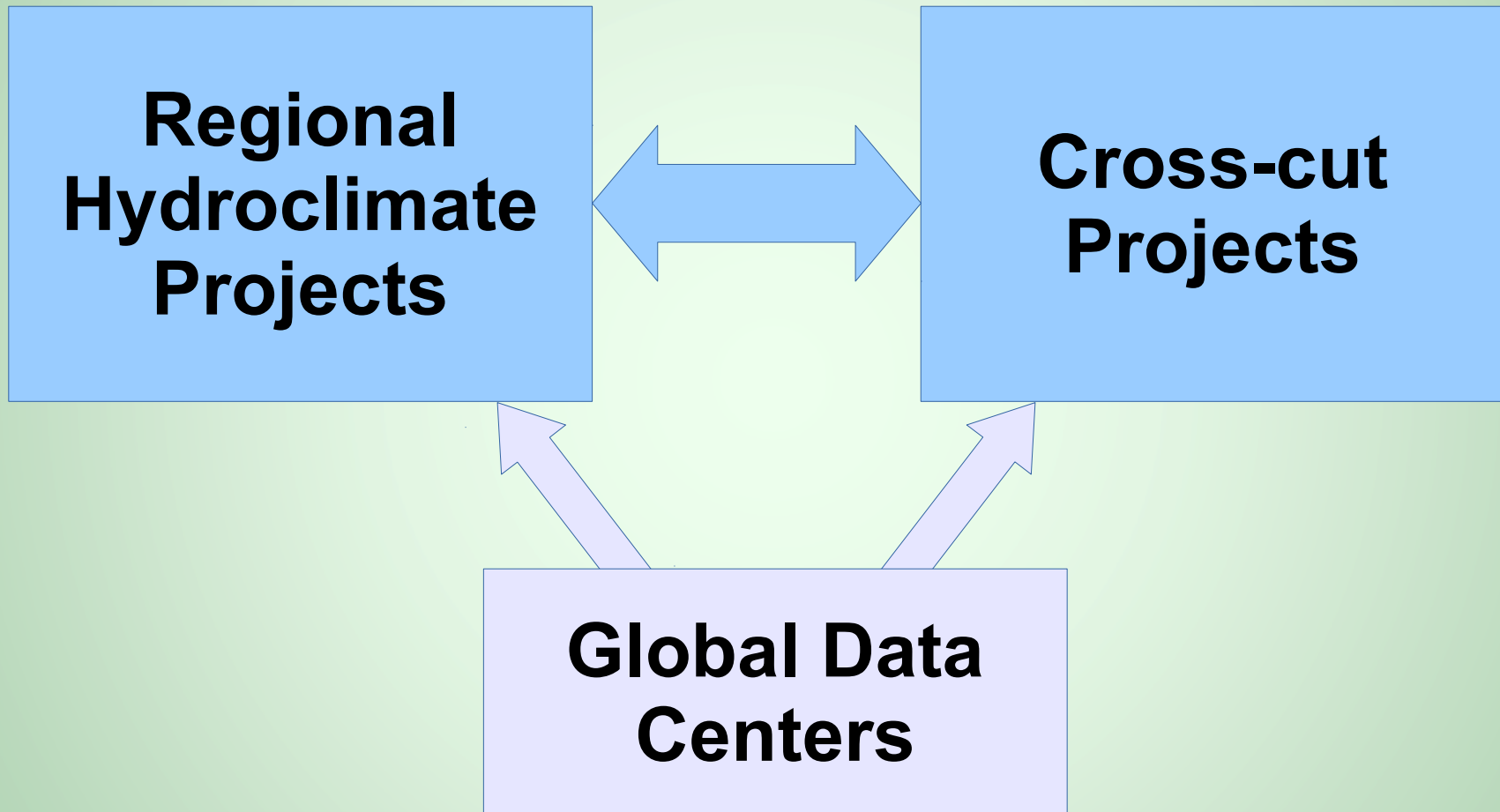
**Cross-cut
Projects**

**Global Data
Centers**

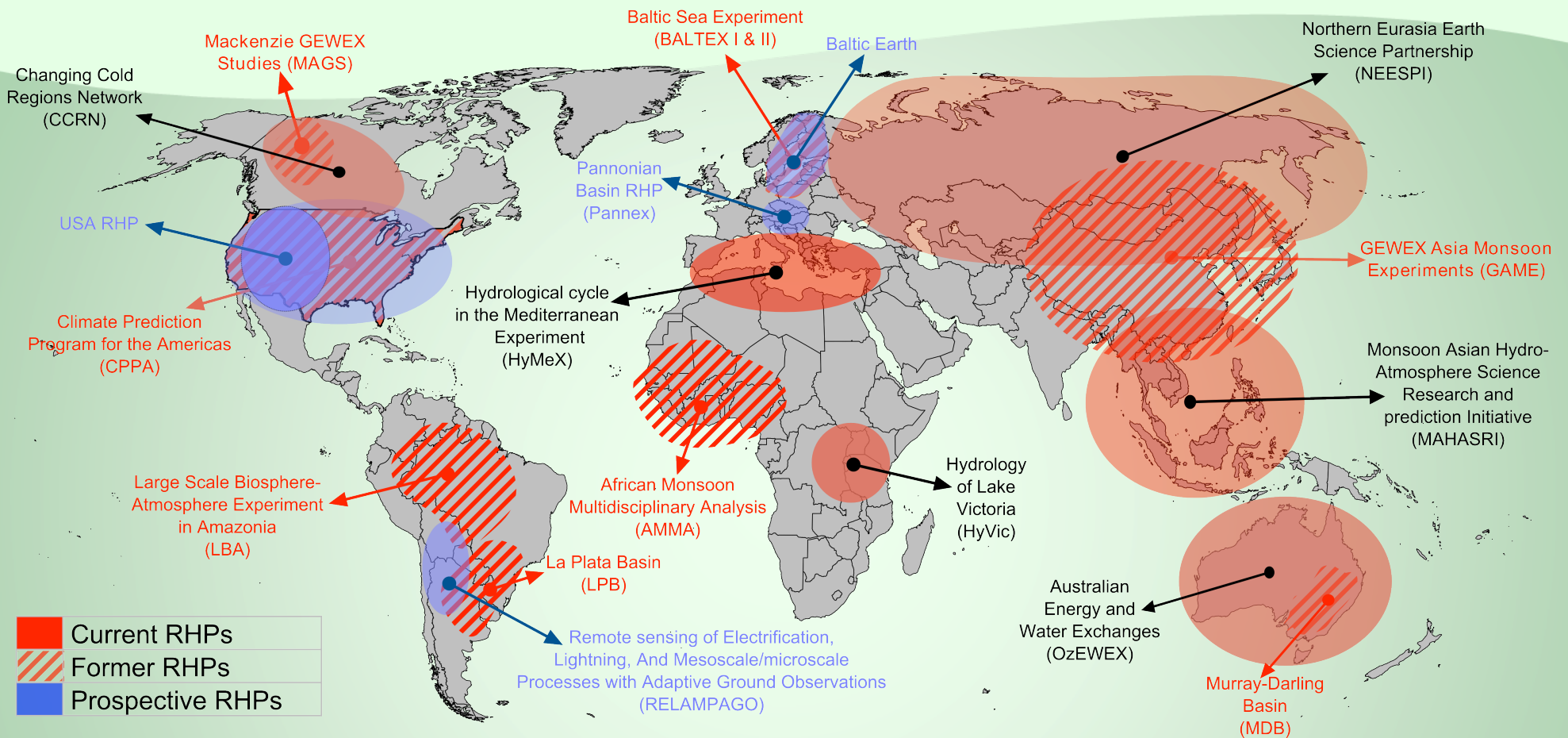
GHP Structure



GHP Structure



GEWEX REGIONAL HYDROCLIMATE PROJECTS



Completed

MAGS, CPPA, GAME, LBA, LPB, MDB, AMMA, BALTEX

Active

NEESPI, MAHASRI, HyMeX, CCRN, HyVic, OzEWEX

Proposed

Baltic-Earth, USA RHP, PannEx, RELAMPAGO

Cross-cut Projects

Cross-cut Projects - Objectives

- Target GEWEX science questions
- Tackle issues best addressed through large collaborative projects
- Should test and evaluate applications of the knowledge produced in RHPs.
- Generate interactions between RHPs and keep completed RHPs involved
- CC projects are also a tool for collaboration with other GEWEX panels and WCRP projects.
- A way for the broader Community to get involved in GEWEX/GHP.

Cross-cut Projects List

Currently active

- INTENSE (Sub-daily precipitation) (H. Fowler)
- Cold/Shoulder Season Precipitation Near 0°C, (R. Stewart / P. Groisman) **new**
- INARCH (Mountain Hydrology) (J. Pomeroy) **new**

Proposed

- MOUNTerrain (Mountainous Terrain rainfall) (J. Renwick)
- Including water management in large scale models (R. Harding / H. Wheeler / A. Nazemi)

Potential

- Seasonal hydrologic prediction (A. Wood/HEPEX)
- GDAP integrated product regional evaluation

Cross-cut Projects Ongoing

Cold/Shoulder Season Precipitation Near 0°C

Ron Stewart (Uni. Manitoba, Canada) & Pavel Groisman (NCDC, USA; P.P. Shirshov Institute for Oceanography, Russia)

To improve our understanding of future changes in hazardous cold/shoulder season precipitation and storms, especially occurring near 0°C

Near 0°C – Motivation

It is difficult to predict the phase of near 0°C precipitation events and when in frozen phase, this precipitation may become one of dangerous weather phenomena that can cause:

Interruptions in human activity affecting

- traffic
- communication
- housing and other man-made infrastructure
- high seas fleet operation
- impact on off-shore oil and gas production

including life threatening events

These are relatively rare events but there are good reasons to expect that their frequency and strength may change with global warming

Near 0°C – Phenomena of interest

- Heavy snowfall/rainfall transition
- Large fraction of blizzards
- Rain-on-snow events
- Freezing rain and freezing drizzle
- Ice load on infrastructure

Near 0°C – Planned tasks

- Prepare a review article for BAMS
- **Compile the relevant metadata and data worldwide**
- Study the physics of atmospheric processes associated with near 0°C precipitation events and establish their relationships with these events (in particular, the hazardous events)
- Create contemporary climatology of each type of near 0°C precipitation phenomena
- Improve the model representation of near 0°C precipitation phenomena and perform projections of their changes

INARCH

International Network for Alpine Research Catchment Hydrology

John Pomeroy (Uni. Saskatchewan, Canada)

To better understand alpine cold regions hydrological processes, improve their prediction and find consistent measurement strategies



INARCH - Motivation

- to IPCC (2014) WG II report – “In many regions, changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality”
- Alpine catchments receive and produce a disproportionately large fraction of global precipitation and runoff including contributions to floods and water supply for vast downstream areas.
- Snowfall *does not equal accumulation on the ground!*
- Snow, ice, and phase change domination of alpine hydrology means that it is especially sensitive to temperature change.

INARCH – Science questions

- **How different are the measurement standards and the standards for field sampling and do we expect distinctive differences in model results and hydrological predictability because of the sampling schemes, data quality and data quantity?**
- How do the predictability, uncertainty and sensitivity of catchment energy and water exchange vary with changing atmospheric dynamics in various high mountain regions of the Earth?
- What improvements to high mountain energy and water exchange predictability are possible through improved physics in land surface hydrological models, improved downscaling of atmospheric models in complex terrain, and improved approaches to data collection and assimilation of both in-situ and remotely sensed data?
- Do the existent model routines have a global validity, are they transferable and are they meaningful in different mountain environments?
- How do transient changes in perennial snowpacks, glaciers, ground frost, soil stability, and vegetation impact models of water and energy cycling in high mountain catchments?

INARCH – Planned activities

- GEWEX Newsletter article
- Initialisation of workshops to promote scientific integration
- Joint field and modelling experiments through scientific exchanges, resulting in multi-authored papers
- Joint development of an open-access Alpine Hydrological Modelling Toolbox.
- Joint development of an open-access Alpine Downscaling Toolbox.
- Promote the development of other catchments so that they can match the data availability requirements into the INACH initiative through scientific exchanges.
- Snow hydrology model climate change sensitivity experiments with the Toolbox: Spain, USA, Germany, Canada (so far)
- Model snow process evaluation and algorithm intercomparison exercises using archived datasets to evaluate the prevalence and operation of various snow accumulation, redistribution and ablation processes in differing global alpine environments.

Cross-cut Projects Proposed



MOUNTerrain

Mountainous Terrain Rainfall

James Renwick (Victoria Uni., New Zealand)

Address the mismatch between the strong need for, but poor availability of, high-quality observational data sets of precipitation in mountain regions

MOUNTerrain – Science questions

- How useful are (and how best do we utilize) remotely-sensed and gridded data sets such as TRMM, GPCP, and reanalyses for characterizing high-elevation precipitation?
- How well are we measuring solid precipitation in mountain areas and how representative are the available datasets?
- What are the statistics of high-elevation precipitation around the globe – means, extremes, seasonal cycle, spatial distribution, trends at different space and time scales?
- What are the key processes involved in features of high-elevation precipitation – spillover, orographic lifting, slope effects, spatial gradients, location of the pluviometric optimum, phase and amplitude of the diurnal cycles?
- How well is high-elevation precipitation modelled, and what advances are needed to improve model performance (e.g., orographic enhancement, convective initiation, ...)?
- What are the effects of climate variability and climate change on the characteristics and features discussed in the previous questions?

MOUNTerrain – Proposed activities

- GEWEX Newsletter article
- **Collation of available digitized observational data for high-elevation precipitation along orographic gradients.**
- **Data rescue of high-elevation precipitation records, such as un-digitized meteorological station records, non-conventional written records from ski fields, alpine clubs, etc.**
- *Intercomparison studies*: Comparing gridded precipitation data sets (and reanalyses) both with station records and through cross-comparison. Development of best-estimate integrated, gridded data sets of mountain precipitation for all major high-elevation terrain regions of the globe.
- *Model validation and model experiments*: Validating global and regional climate model output against gridded data sets developed under (1). Development of coordinated model experiments to guide process studies and model development – “MtnPrecMIP”?
- Development of proposals for Integrated Observing Periods/Programmes in identified areas, on the basis of (1) and (2).

Including water management in large-scale models

Richard Harding (Centre for Ecology and Hydrology, UK), Ali Nazemi (Uni. Saskatchewan, Canada)

Aims to improve the scientific basis of the description of water management in global and regional freshwater models, suitable for coupling to climate models

Water management - motivation

- Flow in many rivers is reduced by 30% (or more) by man's activities
- Impoundments fundamentally change the seasonality and extremes in the flow
- Most irrigation water is lost to the freshwater system through evaporation and this may have important impacts on regional climate
- Historically models of the global water and energy cycles have not included the impact of river management and extractions

Water management – Proposed activities

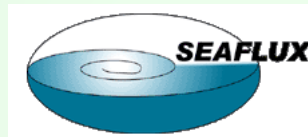
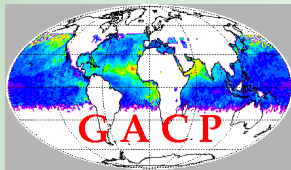
- **Identify global and regional data needs for large scale water resource models, such as on water demand, operating rules etc**
- Review and co-ordinate the parameterisations of water management in global hydrology models, focussing initially on reservoirs and irrigation
- Provide a forum between climate scientists, hydrologists and water resource scientists to provide improved analyses of current and future freshwater supply and demand

GDAP reference products



Validation

BSRN



Validation

Buoys/Ships



Validation

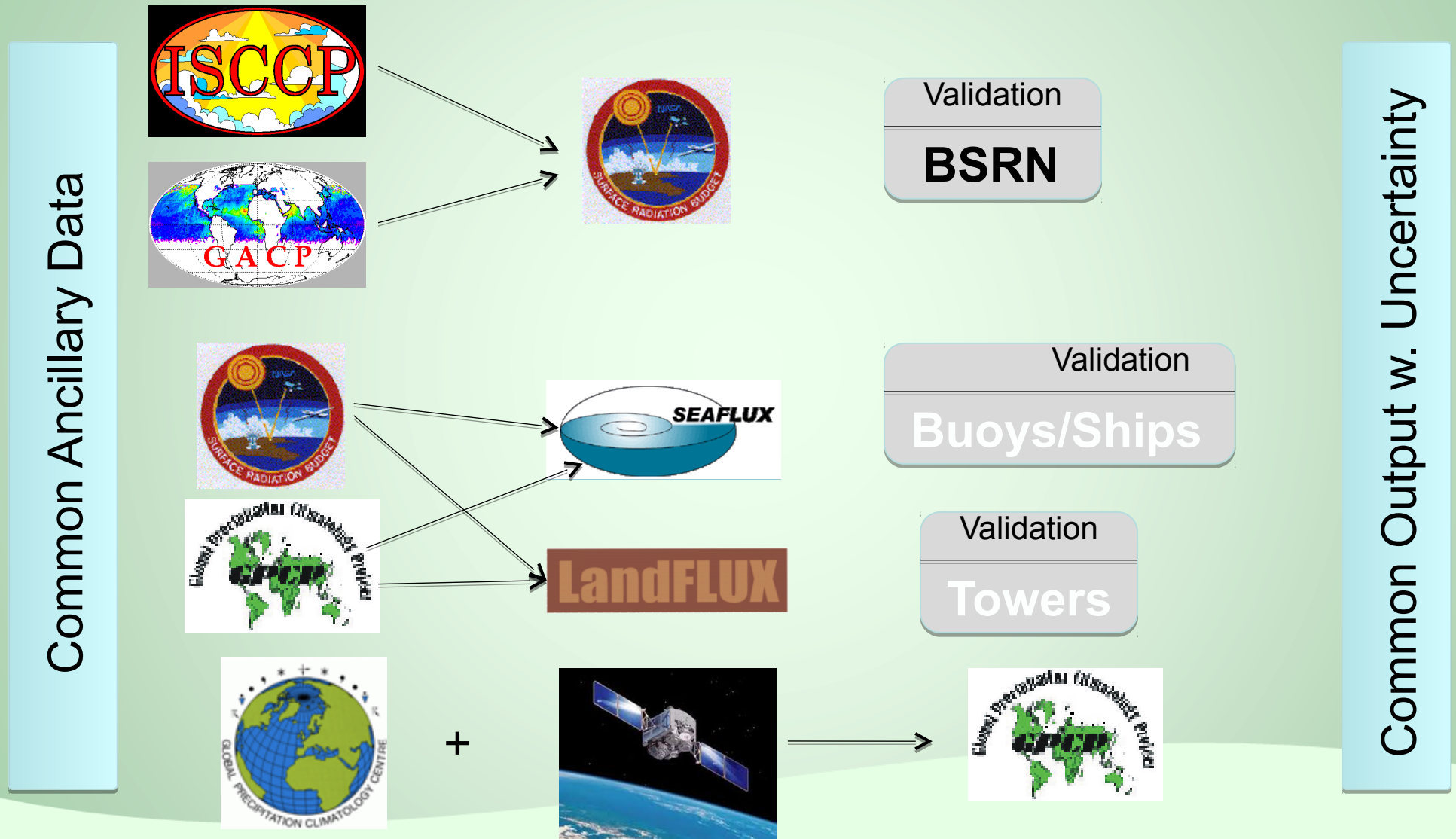
Towers



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GDAP integrated (1°, 3hr) products



GDAP integrated (1°, 3hr) products

- ISCCP currently being reprocessed (March?)
- Other products to follow
- Should be with beta testers by mid-year